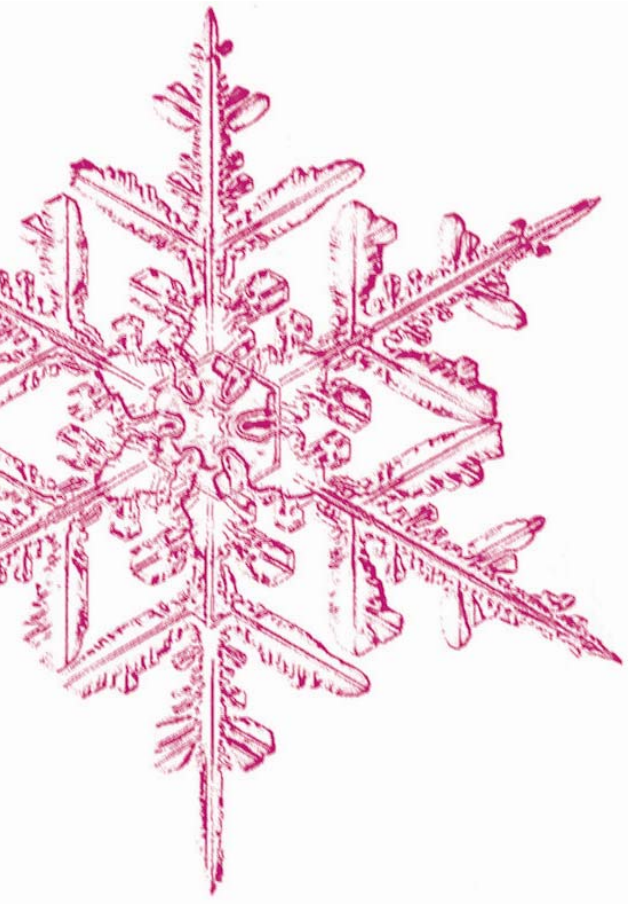
The Vienna Symposium on Polar Tourism

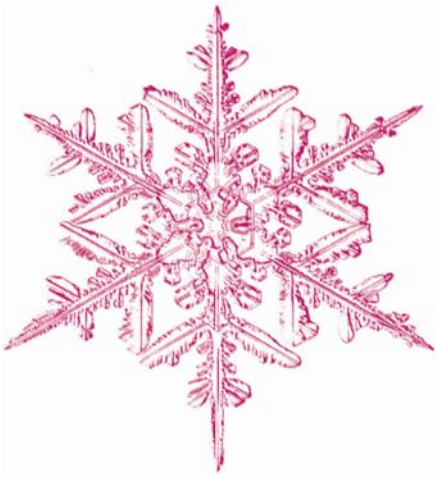


October 22nd to 25th, 2008,
A contribution of TU Wien to the International Polar Year 2007-2009

Technology.Tourism.Landscape
TU Interfaculty Cooperation Centre
In search for partnership for
International Research Co-operations

TU WIEN

TTL technology tourism landscape
technik tourismus landschaft



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Contributions to „The Vienna Symposium on Polar Tourism“

Introduction to "The Vienna Symposium on Polar Tourism"

For a long period, the Polar Regions were assumingly unattractive for tourists: cold regions, far away, expensive to reach, little or no cultural activities, lack of comfort, just to mention a few disadvantages of Polar Regions as tourist destinations.
The disadvantages to reach the Polar Regions widely changed, the Polar Regions get warmer and at a considerably faster pace than the rest of the globe and there is better access to different spots in the Polar Region, inexpensive air tickets bring the regions into reach for us within hours and prices for cruises dropped sharply with the economy of scale, any reminder of the past is now marked as a cultural attraction and under strict protection, vessels that cruise in the Polar Oceans can offer any comfort and luxury. And Polar Regions remained exclusive, prestigious resorts, where so far mass tourism is still absent. However, all signs for a further increase in polar tourism are given and Polar Tourism should receive more attention.

Tourism started in the 19th century. The purpose of travelling was not business or visiting people but pleasure, curiosity and new experience. The first tourists were aristocrats or rich people. Along with time many more people could effort tourism. New destinations became attractive all the time and today everywhere in the world we can find touristic facilities. This is also true for the most remote areas in the world namely the Polar Regions, Arctic and Antarctica. While the Arctic region is scarcely populated by humans, Antarctica has – beside the temporary presence of researchers – has no resident population.

One may ask why a symposium on polar tourism is organized in Austria, a country landlocked and far away from the actual locations. There are several good reasons for us in doing so.

- The first reason is the importance of snow and ice for tourism; here we can find a lot of analogies to the mountain regions of Austria. Several percent of Austrian economy directly depend on snow based tourism. Glaciers and temporary snow cover are shrinking in Austria; the snow experience will be reduced to fewer locations for a shorter period of time in the next decades. It could be that Polar Regions will gain tourists from mountain regions as they can offer snow based tourism considerably longer, even under very strong warming. On the other hand, some experiments and measurements can be much easier undertaken in the flat regions of Arctic and Antarctica than in the high Alpine zones of Austria. The faster pace of warming in snow rich terrain was first proven in Polar Regions, the lack of permanent stations over 3000m does not allow a similar analysis for high altitude regions. However, the only station available, the "Sonnblick" meteorological station at 3106m altitude, gave evidence that during the winter 2006/07, the warming in high altitudes during the winter half year (Nov. to April) was 5°C higher than experienced in the lowlands of Salzburg province. The average snow cover was never so low, like during this season. Studying the Polar Regions will also help to explain the development in Alpine Regions.
- The second reason is the developed competence in tourism services that could be used in the Polar Regions as well. In particular the development of high altitude tourist resorts brought a lot of experience that can be used in high latitudes as well. Questions related to the carrying capacity of fragile ecological regions and the balance of touristic income and protection of the resorts are a long studied subject in Austria and with growing numbers of tourists, these questions arise also in the Polar Regions.
- The third reason is tradition and early research on the polar region in the Austro-Hungarian Monarchy. Austrian researchers were the first ones on Franz Joseph land and were able to honor their emperor by devoting this island to him. Already during the first polar year in

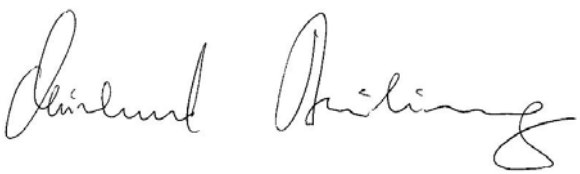
1882/83 a lot of analysis was done there and provides today an extraordinary source to original data of that time. At that time the artistic aspects and the beauty of the landscape received particular attention and created a desire for polar tourism long ago, when no one could dream about accessing these territories.

- A fourth reason is technological and scientific challenge; the polar region is better suited to test new measurement devices or technical equipment than the Alps or other mountain regions. New devices of snow cover measurement equipment can be named. Or the existence of cryophil bacteria and their role in changing climates and snow cover is another point to explore. The knowledge on how and to what degree humans can make an impact on an artificial snow cover can be generated.
- A fifth reason was to cooperate within the framework of the current International Polar Year and to give a small and hopefully essential contribution. While researchers seem to be well integrated, one can educate tourists as diplomats and amateur researchers of Polar Regions, saving a lot of costs in limited research budgets of relevant institutions.
- A sixth reason is a political one. Polar tourism is not yet sufficiently recognized as an important factor for public participation and public interest. The local population alone is too scarce in the Arctic or not existing in the Antarctic. Usually highly educated tourists participate in polar tourism. They help to popularize the subject, to give the appropriate attention to these areas. It just depends on how to prepare track for the expected further growth of polar tourism and to set high environmental standards.
- A seventh reason is joint tourism research. It was recognized that many research networks are lacking appropriate contacts to Russian institutions. Despite political difficulties, e.g. the absence of Russia in the PolarClimate ERA (European Research Area) Network, four key institutions of the Russian Federation declared an interest in working together with us. It is our declared aim to unite with other networks in Polar Regions having similar aims and to assist in making research of polar tourism a real global one.

The following 18 articles, extended abstracts or abstracts or descriptions provided were given for the purpose to stimulate cooperation between participating parties. They originate from natural and social scientists and artists and are diverse in their orientation. It is the expressed aim of the symposium to stimulate future research and projects on polar tourism and the proceedings of the symposium are a mean to achieve this. To

In addition “The Vienna Symposium on Polar Tourism” is a special university course, 2.5 ECT units, for both, graduate and undergraduate students, in TU Wien course unit 261.058 Contemporary Aspects of Landscape Planning of 2008/09.

Sincerely,



Meinhard Breiling

(TU Wien, Coordinator TTL, convener of the symposium)

HOTLINE during symposium: +43-676-928-58-54

Program of "THE VIENNA SYMPOSIUM ON POLAR TOURISM"

Program: Oct. 22nd 2008, Operngasse 11/4, A-1040 Wien

During day arrival of participants

18:00 THE ICE BREAKER (Location 1, Operngasse 11/4)

Starting with Welcome Reception & Small buffet! at Operngasse 11/4 Room 32

19:00 Films by Thomas Macho about Antarctica

Film 1: "Antarctic from a tourism perspective"

Film 2: "Antarctic from a natural hazard perspective"

Slides about Arctic and Antarctic! Bring your treasures with you; there will be a beamer to watch slides and films.

20:30 or later, end of the day!

==========

Program: Oct. 23rd 2008, 9:00 to 12:00,
Location 2: Thomas Schopper Meeting Room, Kesselhaus, Getreidemarkt 6,

Welcome note, Prof. Richard Stiles, speaker TTL, TU Wien

Block I: The polar experience

1. "Exploration of Franz Josef Land." S. Sokratov, Moscow State University & Aleksander N. Krenke, Russian Academy of Sciences, Dep. Of Geography.

2. Polar tourism: An overview of the 'state of research' during the International Polar Year. Patrik Maher, University of Northern British Columbia,Canada.

3. "The history of discovery of Antarctic oases" Irina Sokratova, Arctic and Antarctic Research Institute, St. Petersburg

4. "Climate in sensitive regions: the high latitude Arctic and the high altitude European Alps – some comparisons between Svalbard and the Hoher Sonnblick". Inge Auer, Austrian Central Meteorological Agency (ZAMG) Vienna

Coffeebreak

5. "Tourism in Polar Oceans - advantages and disadvantages of co-operations with marine investigations. View of professional oceanographer". Sergey Pisarev, Shirshov Institute of Oceanology, Russian Academy of Sciences.

6. "Creation of the Russian Arctic National Park: Challenges for Nature Conservation and Polar Tourism"
   Maria Gavrilo, Arctic and Antarctic Research Institute, St. Petersburg

7. "Customized High Resolution Weather Forecasts to Support Polar Tourism" Gerald Spreizhofer, Vienna University, Institute of Meteorology

All presentations are scheduled for 20min presentation and 2min questions, directly after the presentation.

12:10 to 13:30 Lunch, at Vietnamese restaurant!

8. Poster Session & Student Presentations on Polar Tourism "Golf in the Arctic region" Katalin Andre, Korvinius University Budapest

Program: Oct. 23rd 2008, 14:00 to 17:30 (Location 2: Kesselhaus, Getreidemarkt 6)

Block II: The touristic polar products

9. "Snow and Ice as a resource for innovative tourist experiences in Northern Sweden, the case of Ice Theatre and Ice Music Hall" Hans Gelter, Lulea Technical University, Dep. of Music and Media, Sweden.

10. "Microbial Life in Polar Region". Florin Aonofrisei, Ovidius University, Constanza, Romania.

11. "Future perspectives on tourism in Antarctica" Machiel Lahmers, ICIS, Maastricht University, Netherlands

12. "The usage and tourist potential of the Northern and Southern Poles". Maria Tsekina, Moscow State University,

Coffeebreak

13. "Snow and ice as touristic attraction". Sergey Sokratov, Moscow State University, Faculty of Geography Glaciology department

14. "Spring snowmelt variability in polar Eurasia" by Anett Bartsch, TU Wien, Remote sensing and photogrammetrie.

15. ""Climate change and Alpine tourism: some assumptions with regard to the development of Polar tourism" Meinhard Breiling, TU Wien, Landscape Planning

All presentations are scheduled for 20min presentation and 2min questions, directly after the presentation.

Resume of the day!

Evening: Common dinner with speakers of symposium

For the very active ones with finalization of application to PolarCLIMATE Call, deadline for submission is Oct. 24th, 12.00!!!

http://www.esf.org/research-areas/european-polar-board-epb/polarclimate.html

Program: Oct. 24th 2008, 9:00 to 12:00 (Location 3: Albertina Art Museum, meeting punctual 8:50 in front of lower entrance, next to the "Portier")

Block III: The cultural and historic dimension of Polar Tourism.

16. "Infinite Ice" Maren Gröning, Albertina Museum, Vienna. Exhibition at Albertina with photographic analysis of arctic and alpine regions since 1860.

17. "The desire for infinite white: motives for polar and mountain tourism originating in the 19th century from landscape paintings and photography." Herbert Justnik, Austrian Museum of Folk Life and Folk Art

Guided tour and contributions made in Albertina Art Museum.

http://www.albertina.at/jart/prj3/albertina/main.jart?rel=de&reserve-mode=active&content-id=1202307119260&ausstellungen_id=1212669381455

13:00 to 14:00 Lunchbuffet at location 2, Kesselhaus, Getreidemarkt 6

Program: Oct. 24th 2008, 14:00 to 15:30 (Location 2: T

Resume of "The Vienna Symposium on Polar Tourism". All group!

Location 2: Thomas Schopper Meeting Room, Kesselhaus, Getreidemarkt 6,

Upon request: Individual tourist programs for foreign guests can be arranged on Friday afternoon and during Saturday morning by our students and in small groups!

Or continued work program with European project proposals.

Program: Saturday, Oct. 25th 2008, 14:00 (to appr. 16:00) Meeting at Vienna Zoo entrance Hietzing at 13.50!

18. Get to see the Penguins and Ice bears in the "Polarium" of Schönbrunn Tierpark with guided tour by Dr. Gaby Schwammer. How close is Vienna with regard to polar conditions? How much warming the animals can tolerate? We will see backstage views on how to keep the environment for animals comfortable.

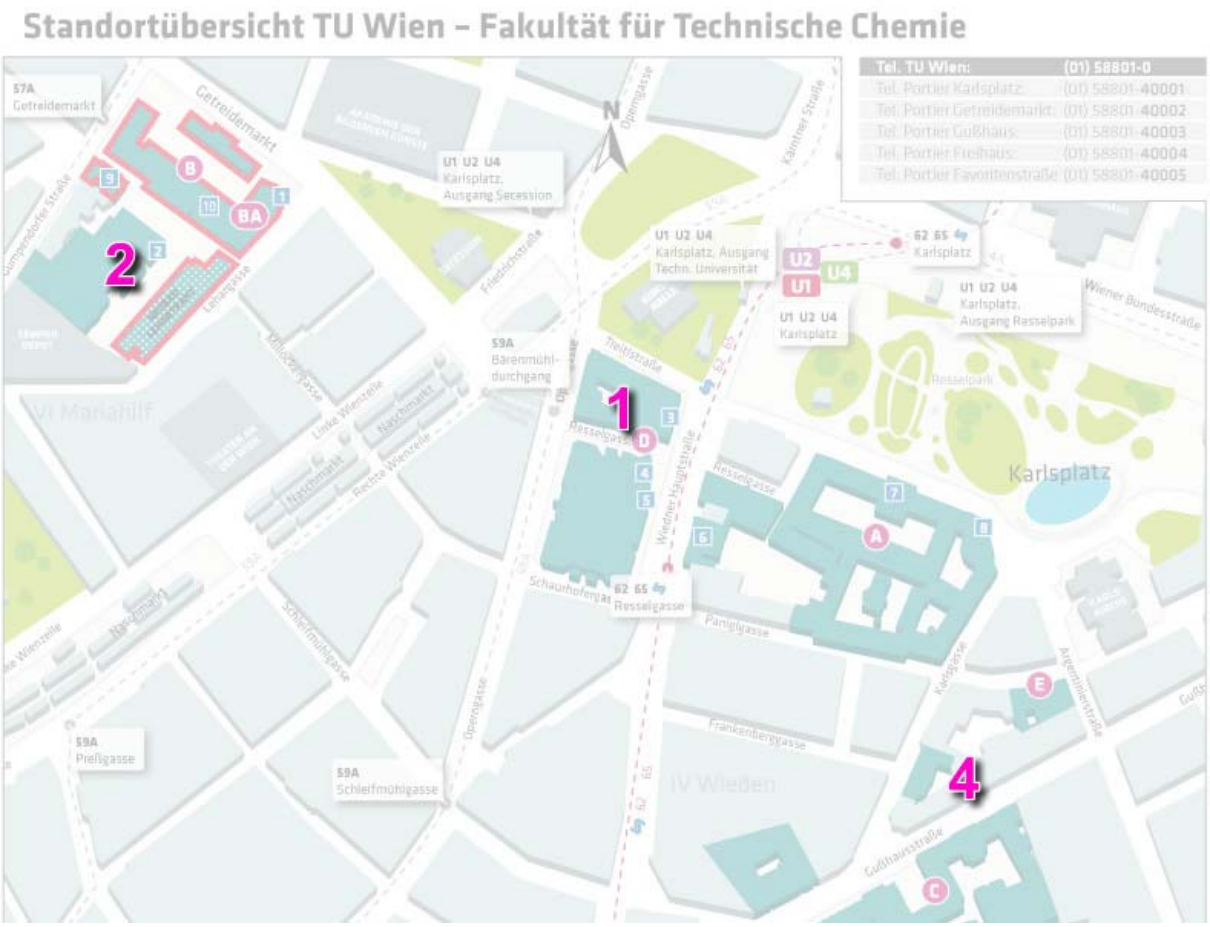
Locations 1 -3 “The Vienna Symposium on Polar Tourism”:

Location 1, Seminarroom 32 in fourth floor, entrance Resselgasse 4-6 (is the same house like Operngasse 11/4), A-1040 Wien
During Wednesday, Oct. 22nd, all day/night long!

Location 2, Thomas Schopper Meeting room, Kesselhaus also called Bauteil BL, Getreidemarkt
During Thursday, Oct. 23rd, all day long!
During Friday, Oct. 24th, 1 p.m. to 3.30 p.m.

Location 3, Albertina Artmuseum, Albertinaplatz 1, A-1010 Wien
During Friday, Oct. 24th, 9 a.m. to 12 a.m.

3 (Albertina)



Location 4, Ausseninstitut TU Wien, Gußhausstraße 28, A-1040 Wien (only for participants interested in FP709 “AFTERSOGWAS”)
During Friday, Oct. 24th, 15:30 p.m. to 19:00 and During Saturday, Oct. 25th, 8:30 to 13:00

Program Wednesday, October 22nd, 2008,

Location1: Operngasse 11/4, A-1040 Wien, 18:00

ICE-BREAKER with Films and Slides

Film 1: Antarctic from a Tourist Perspective
By Thomas Macho

Film 2: Antarctic from a Risk Perspective
By Thomas Macho

Hope you have your slides with you! Otherwise only 400 tonight.

All slides presented on this page originate from an Antarctic tourist,
Willibald Loiskandl, and were taken in February 2007!

1. Sokratov S.A., Krenke A.N.

Exploration of Franz Josef Land

Franz Josef Land is the most polar territory of Eurasia situated just 900 km from the North Pole. Though at present time interest to such remote places can sometimes be surprising, not too long ago finding of a passage from Europe to Asia and to the north coast of North America, especially in case of presence of a solid ground and fresh water on such passage, was considered as an important step in development of commerce and protecting of national interests in the Arctic region. The latter issue once again became hot topic in recent years, with consideration of the Polar Ocean floor as a rich source of minerals.

What was the national identity of first people to see the Franz Josef Land is unclear. It is possible that coast-dwellers from the presently Russian territories did use the Franz Josef Land waters and beaches. Same can be true for the Vikings. That time lands and routes were kept in secret—not to attract others to newly found resources. It can be most likely true that the "North-East Spitsbergen" found by N.F. Rønnbeck and J.P.Aidijärvi in 1865 was part of the Franz Josef Land (Barr, 1995). However, unquestionably the first introduction of the archipelago to public was made by the Austro-Hungarian Tegetthoff expedition 1872–1874.

The expedition funded in large part by Count Hans Wilczek and officially supported by the Russian Tsar Alexander II consisted from two part: First was the reconnaissance sail on yacht Jsbjörn (Isbjørn) from Tromsø in summer 1872. The map presented in the resulting publication has no Franz Josef Land on it (Daublebsky, 1874). The second expedition on schooner Tegetthoff brought first map of the Franz Josef Land (Payer, 1876), which was considerably edited in future, but, more importantly, it brought world-wide interest to the heroic adventures of the Polar explorers and exploration of the Arctic region in general. It is believed that soon expressed idea of C. Weyprecht on the necessity of the international cooperation in the Polar research and on the organization of the International Polar Year was the result of suffering, which accompanied the discoveries of this expedition (Schröder & Wiederkehr, 2001).

The discovery of new lands stimulated various kinds of activities in the regions. More than 100 hunting expeditions visited the Franz Josef Land before the Soviet Union closed access of foreigners to this area (Barr, 1995). Considerable number of scientific expeditions also took place, not always able to reach the land, but related to such famous names as Willem Barents, Leigh Smith, Fridtjof Nansen, Frederick George Jackson, Georgiy Sedov, Umberto Nobile, etc.

Annexing of the Franz Josef Land by Soviet Union in 1926 practically closed access of foreigners to the regions. On the other hand, it resulted in very high activity of Soviet Union in there. In 1929 a permanent station was settled under the leadership of O.Yu. Shmidt. Even the German expedition of the Graf Zeppelin airship was with participation of Russian

researchers, together with scientists from other countries including Lincoln Ellsworth. The Graf Zeppelin exchanged mail with Soviet icebreaker Malygin in Tikhaya Buchta, and among the passengers of Malygin was Umberto Nobile.

Soviet expeditions repeated year by year, up to 300 people were wintering on the Franz Josef Land and the weather stations in there were securing Arctic exploration by planes and the intercontinental flights of V.Chkalov, widely advertized around the World. The activity was highly reduced during WWII, when there were only two weather stations in there-Soviet and German ones, but came back after the war, when the Franz Josef Land started to be considered in USSR as the unsinkable aerocarrier. Scientific expeditions had in the list of duties the study of the possibility of construction and use of airfields. This changed after appearance of intercontinental missiles, to 1956, but the participation of the Soviet Union in the International Geophysical Year (IGY) allowed once again truly detailed and large scale study of the Franz Josef Land in 1957–1959 (Grosswald et al., 1973; Markin, 1963). The Soviet exploration of the Franz Josef Land after the IGY up to the period of "Glasnost'" was mainly related to the military presence in the regions. Several scientific expeditions also took place, but the scale on not-secret investigations was well below the previous activity.

The next period of exploration was marked by decline in financing of scientific research in Russia with easier organization of the participation of Western institution. Soviet–Norwegian expedition with participation of Poland took place at the archipelago in 1990, when several historic cites of the Franz Josef Land exploration were rediscovered. As a participant of the second such expedition Karl Habsburg–Lothringen could visit the land named in honor of his forefather. 4 expeditions of Austrian Broadcasting System (ORF) in 1992–1994, resulting in documentaries to become part of "1000 years Austria" celebration, took place. Institute of Geography of the Russian Academy of Sciences together with Scott Polar Research Institute and Ohio State University succeed in airborne radio-echo sounding of the Franz Josef Land glaciers and in drilling of several icecaps in 1994. The latter collaboration is still continuing, in large part shifted to study of icebergs formation and distribution in Arctic Seas, for which the Franz Josef Land plays important role. More recently, the archipelago is included into at least two of the International Polar Year 2007–2008 programs: investigation of the radiation-climatic factors of meteorological conditions in the Arctic region and rehabilitation of the polluted territories of the Franz Josef Land.

Since 1994 the Franz Josef Land and surrounding waters became a nature reserve. At the same time large interest in developing of tourism to the area was expressed by various authorities not only as the intermediate stop on the tourists passage to the North Pole but also as the sites of historic interests as itself. For example, the full-size model of the Tegetthoff ship was installed at the Ziegler Island by ORF.

There seems to be one more change in the relation to the archipelago by Russian authorities more recently. President Medvedev visited the archipelago in 2008 and once again expressed the Russian predominance in the region. Not long before that an Austrian expedition to the Franz Josef Land related to the IPY activities was not permitted by the Russian government. Evidently, the political developments around the Arctic region are the outcome of the unresolved territorial claims accumulated over the previous century. No other ocean and very few seas have such small ratio of total area to be unclaimed by anyone (IBRU, 2008). Making difficult direct international scientific collaboration, such situation is unavoidably increasing the touristic interest. An interplay between the financial dividends from the Polar tourism and managing the scientific research as a part of such

touristic activity can soon become the leading way to carry out scientific research in such politically tense area as the Arctic region in general and the Franz Josef Land in particular.

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2. Patrick Maher

Outdoor Recreation and Tourism Management program
University of Northern British Columbia - Prince George, BC, Canada

Polar tourism: An overview of the 'state of research' in the International Polar Year

Polar Tourism and the IPY

To begin, when we discuss polar tourism, what is it? Evolving from many discussions the author has been involved in recently perhaps it can be simply defined as tourism in and about the Polar Regions. The Polar Regions being geographically defined as per the Antarctic Treaty System area (60°S) ("Antarctic Treaty", 2007) and the Arctic Human Development Report (2004) boundaries, but also being inclusive of sociological items such as visits to museums that focus on polar topics (i.e. the International Antarctic Centre in Christchurch, NZ), or activities primarily attributed to the Polar Regions (i.e. kayaking where focus is placed on the Inuit's links to this activity not just the activity as it takes place in certain places, such as the South Pacific).

The Polar Regions have received intense attention over the past two years due to the International Polar Year (IPY), yet surprisingly little has been examined regarding tourism. This gap is surprising given the tremendous growth of tourism in the Polar Regions, particularly the Antarctic, and given the focus in previous IPYs on geographical exploration, which has to some degree become a precursor to tourism (Maher, 2007a).

Much research across both hemispheres has also concentrated on the poles for the last two years, but again despite the increased research attention tourism research has largely been left out of officially linked IPY projects (see www.ipy.org). Again this is surprising given that there are so many issues to which tourism is linked and thus tourism research could prove useful, i.e. tourism is seen as a key economic diversification tool for small communities throughout the Arctic, and access for/impacts from tourist vessels often enters the climate change debate surrounding both poles.

In whatever the circumstances, two of the most significant aspects to track the state of polar tourism research, both before and during the IPY, are via publications and meetings/networks. Both these aspects have important bases since the early 1990s, but have seen recent expansion.

Publications

Despite a lack of tourism research links to the IPY, many important texts have been published since 1990 that help to provide a base for the growing interest in polar tourism research today. Three initial texts resulted from conferences (see Kempf & Girard, 1992; Johnston & Haider, 1993; Martin & Tyler 1995), while a fourth is the 1994 special issue on Antarctic tourism in the *Annals of Tourism Research* (21(2)). Hall and Johnston's (1995) *Polar Tourism: Tourism in the Arctic and Antarctic Regions*., although now out of print, was the first comprehensive overview of tourism issues across both Polar Regions, addressing issues such as monitoring tourism impacts, the regulation of tourism, patterns of tourism, the impact on aboriginal peoples, issues of access, and the search for sustainable management regimes (Maher & Stewart, 2007).

Other contributions followed, including: Johnston, Twynam and Haider's (1998) *Shaping tomorrow's North*; Bauer's (2001), *Tourism in the Antarctic: Opportunities, constraints and future prospects*; Sahlberg's (2001), *Going north: Peripheral tourism in Canada and Sweden* and Watson, Alessa and Sproull's (2002) *Wilderness in the circumpolar North: Searching for compatibility in ecological,*

traditional and ecotourism values. There have also been numerous book chapters on the subject including Stonehouse's (2001) chapter in the *Encyclopedia of ecotourism - Polar environments* and Marsh's (2000) chapter in *Tourism and national parks - Tourism and national parks in Polar Regions*. Since 2000 there have been many significant changes in polar tourism (*i.e.* diversification amongst products available, increasing tourist numbers, increasing local involvement and recognition of the importance of local involvement, changes in policy and governance) (see Maher & Stewart, 2007). These changes are in addition to ongoing issues such as cumulative environmental and social impacts, provision of education and awareness for tourists (creating ambassadors), increasing vessel sizes and numbers within the cruise sector, and changing climate patterns that affect actual travel as well as the industry (ibid, 2007).

Such issues have been addressed sporadically in individual book chapters (see Bauer & Dowling, 2006; Maher, 2007b), but also in three edited books published either just before or during the IPY: Baldacchino's (2006) *Extreme tourism: Lessons from the world's cold water islands*; Müller and Jannson' s (2006) *Tourism in peripheries*; and Snyder and Stonehouse's (2007) *Prospects for polar tourism*. Each text had some useful coverage from a research perspective, but was not without their flaws. Baldacchino's (2006) text offers mainly descriptive case study material to share the situation of tourism in cold water locations (from both the northern and southern Polar Regions) with very little empirical research reported upon. Müller and Jannson's (2006) book addresses Polar and sub-Polar regions in some chapters, but the majority of chapters are not directly dealing with polar tourism rather tourism in periphery locations (polar or not). The Snyder and Stonehouse's (2007) text is heavily focused on tourism in Antarctica, and in general is much more descriptive than empirical. While reporting to provide multiple perspectives through multiple authors (as should be the case with all three of these edited texts), most chapters in the Snyder and Stonehouse book (14 of 17) have one of the editors as a sole or listed author.

Rising from a gap in the lack of publications showcasing empirical work, two more additions to the polar tourism literature base are the recently published special journal issues of *Polar Geography* 30(1-2) and *Tourism in Marine in Environments* 4(2-3). These have provided a depth of empirical work that otherwise has not been published together in comprehensive volumes. The *Polar Geography* special issue is Arctic specific and arouse from the 2006 Canadian Association of Geographers (CAG) annual meeting in Thunder Bay, Ontario, Canada. The *Tourism in Marine Environments* special issue began in response to the distinct lack of tourism-related projects officially linked to the IPY, and then moved towards a means to share the work of empirical authors (generally younger academics) versus descriptive authors (generally those more established in the field). The issue sought to bridge the gap having younger academics publish together and older academics review such works – creating a bridge between the foundations of the field and the wave moving it forward today. The overwhelming response to the call for this issue then led the editors to successfully solicit for an empirically based text (Maher, Stewart & Lück, in press)

Meetings and Networks

Perhaps one of the most useful developments for polar tourism research during the IPY has been the chance for groups to meet and network. Once again with conferences held in the early 1990s (see Kempf & Girard, 1992; Johnston & Haider, 1993; Martin & Tyler 1995) one of the few tourism projects officially linked to the IPY was the *Tourism and Global Change in Polar Regions* conference held in 2007 in Oulu, Finland. This conference provided an excellent opportunity for polar tourism researchers to network and share. Outcomes of that conference include: the proceedings (Saarinen & Tervo, 2008) and a book in press (Hall & Saarinen, in press).

Other newly developed groups also held meetings in 2008, including the University of the Arctic Thematic Network on Northern Tourism and the International Polar Tourism Research Network. The University of the Arctic Thematic Network on Northern Tourism (UATNNT; see http://www.uarctic.org) was established by a working group of researchers from tertiary institutions

across the circumpolar north. Sletvold and Maher (2008) presented the group's declaration from a working group meeting in Nordkapp, Norway and a proposal for a joint-master's program to the University of the Arctic's Council meeting. The network was approved and has funds to operate for the next two years, continuing Master's program discussions amongst other topics. Under the umbrella of the University of the Arctic, members in this network represent their own expertise, but must be connected to a University of the Arctic member institution. Additionally, through the University of the Arctic's structure this network is equally split between functions of teaching and research or teaching informed by research as presented in the Master's program.

The International Polar Tourism Research Network (IPTRN) was initiated as a 2nd outcome to the 2006 CAG conference in Thunder Bay, and following two years of initial set up, held its first meeting in Kangiqsujuaq, Nunavik in August (see www.polartourismnetwork.uqam.ca). As a result of this initial meeting, the IPTRN has been founded as a group with a shared interest in research that advances the understanding of tourism in and about the Polar Regions. The IPTRN strives to generate, share and disseminate knowledge, resources and perspectives on polar tourism, and strongly supports the development of international collaboration and cooperative relationships between members. Membership in the network could include individuals such as university researchers, consultants, tourism operators, government organizations, community members, and graduate students. The polar versus northern delineation, member status and specific research focus are what differentiate IPTRN from the UATNNT.

Wider than simply a focus on tourism, four other networks saw increased activity amongst tourism researchers during the IPY as locations to share their work. The Social Sciences & Humanities Antarctic Research Exchange (SHARE; see www.share-antarctica.org) hopes to build a collaborative platform similar to the Scientific Committee on Antarctic Research (SCAR), but first the community must with mobilize social science and humanities research knowledge with a focus on the Antarctic and thus allow for its use to be seen by governments and policy-makers (*Tourism in Marine Environments*, 2007, p. 245). A similar northern initiative is the Northern Research Network (see http://northernresearchnetwork.electrified.ca). Additionally, given the IPY focus on promoting the emergence of young researchers, the Association of Polar Early Career Scientists (APECS; see http://arcticportal.org/apecs), is playing an important role for a number of researchers, and through topic-specific working groups so to is the Ocean Management Research Network (OMRN; see http://www.omrn-rrgo.ca). Even well established organizations such as the International Arctic Social Science Association (IASSA; see www.iassa.gl) have seen an increased discussion of tourism as witnessed by sessions at their latest meeting in Nuuk, Greenland.

Conclusions

While publications and meetings/networks are important, what they have lacked so far is a concrete agenda of where the state of polar tourism research is and then how it should proceed. Such and agenda would seem to be an important legacy for the 2007-2008 International Polar Year whether through officially linked projects or not; 'legacy' was a key tenet upon which the IPY was predicated. A research agenda would create a comprehensive action plan, provided it where able to receive appropriate funding. If such an agenda were a larger overarching puzzle to solve, with many smaller pieces, then individual researchers or nations could pursue or fund facets. Research agendas have not been a lost item as they have been discussed at both the UATNNT and IPTRN meetings, specific research questions were asked at the 2006 CAG (see Maher, 2007a), and prior to the IPY additional research agendas have also been published (see Mason & Legg, 1999; Stewart, Draper & Johnston, 2005). With the IPY focusing attention on the Polar Regions, an increase in global attention to polar tourism and polar tourism research has indeed already begun. A recent report commissioned by the United Nations Environment Program (UNEP) and the International Ecotourism Society (TIES) (see Snyder, 2007) presented a largely descriptive understanding of the topic and as a result produced a somewhat disjointed agenda for research. Polar tourism researchers need to embark upon a clear,

singular agenda – comprehensive enough to cover the large-scale topics of the day, but open enough to be broken down into manageable pieces by individual researchers/research consortiums. Researchers need to immerse themselves in the wide-range of empirical work available and build from there; if this cannot occur then the field is doomed to continue describing 'what' is happening, 'when', and by 'whom', without furthering knowledge of 'why' or using such knowledge to appropriately detail 'how' to manage or shape the changing industry into the future. To what degree tourism research is included in a future IPY will largely depend on taking up such a call.

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3. Sokratova I.N.

The history of discovery of the Antarctic oases

The Antarctic oases are small free of ice areas mainly on the Antarctic coast but some in mountains hundreds kilometers inland. The origin of these areas is still not quite clear. Some data is interpreted as if at least some of the areas were previously covered by ice, which retreated due to climate change. The timing of such retreat was estimated from hundreds to hundreds thousand years ago. Other data indicate that some of the oases (including some of those mentioned above) could be ice free for millions of years, up to the time the Gondwana continent was still in existence. On one hand this can be evidence of the scientific data obtained so far to be too sparse and not accurate enough. On the other hand, similar uncertainty does exist in relation to either the East Siberia was or was not covered by ice in the last glacier maximum, despite more than 250 years of investigations in there (*Kuzin, 2005*). Thus, it is more likely that the present scientific understanding of the climatic and geological processes responsible for glaciations to be far from definitive one. In this frame, the scientific investigation of the Antarctic oases and their comparison with the Arctic ice free landscapes are of great importance.

The name "oasis" in relation to the ice free areas in Antarctic can be found in publications of 100 years old, as the contrast to the "ice desert" naturally associated with the endless frozen landscapes of the Antarctic (*Cook, 1900, Mawson, 1915*). In present time, the term "Antarctic oases" corresponds to ice free areas where water is present at least in Antarctic summer season and, as the result of that, there is some life and some soil, though the local climate is still regulated by the surrounding ice fields (*Sokratova, 2007*).

Discovery of the Antarctic oases accompanied the process of exploration of the newly found lands of the Southern continent in the beginning of the XXth century related to the sea fishery and national commercial interests of different countries in the Antarctic. The presently known geographical names of these small free of ice areas were not always given at the first sign of the new lands. Moreover, several expeditions from different countries could simultaneously explore same Antarctic region (for example the Enderby Land), each naming same spots on their maps differently. That is why, it is not always possible to name date and first discoverer of many of the Antarctic oases with 100 % reliability. The date of discovery as listed in the gazetteer of the Scientific Committee of Antarctic Research (SCAR) is often the date of appearance of the name on a map presently accepted by SCAR (*SCAR, 2008*). That is why "official" discovery can be tens years after the actual sign of a place by members of early expeditions.

The first Antarctic oasis, Taylor Dry Valley (77°37´ S 163°00´ E), was discovered near McMurdo by the British R.Scott expedition 1901–04 (*Taylor, 1927*). The Australian expedition of D.Mawson discovered another oases-Cape Danison (67°00´ S 142°40´ E) in 1912. Many oases were discovered by whalers in 20th–30th. Most active were Norwegian whaling expeditions in 1929–1937 funded by L.Christensen (*Christensen, 1939*). They used airborne techniques and discovered oases Vestfold Hills (68°35´ S 78°10´ E), Larsemann Hills (69°24´ S 76°13´ E), Lutzow-Holm (69°20´ S 39°30´ E). German expedition leaded by A.Ritsher discovered the Schirmacher oasis in 1939 (*Kottas & Ritscher, 1942*). The political situation detained World-wide attention to these discoveries and the most famous one

became the discovery of the ice-free areas with lakes and simple vegetation by the US expedition "Highjump" in 1947-Bunger Hills (66°10′ S 101°00′ E) and Thala Hills (67°40′ S 45°51′ E) (*Byrd, 1947*). The existence of such areas in Antarctic was considered as the proof of the possibility to explore supposingly rich mining resources, including oil, coal and uranium (*NYT, 1947a–d*). This also became the turning point for many other countries to enter the Antarctic exploration. In Soviet Union the exploration of the Antarctic oases became one of the reasons to enter the Antarctic program of the International Geophysical Year 1957–1958 (IGY) (*Berg, 1949*).

The IGY was the beginning of the massive international Antarctic exploration. All other known Antarctic oases were discovered by the systematic airborne mapping of the Antarctic started in IGY.

The remoteness of the Antarctic and the presently acting international agreements did not allow to the Antarctic region to gain high industrial importance. However, the Antarctic oases are indeed the main spots for positioning of research stations and of tourist attractions. Despite relatively low anthropogenic pressure on Antarctic in general, most of it acts in these small and very vulnerable areas. In would not be far from truth to state that the ice sheet is much more sustainable in terms of travels over and stepping on. It is already difficult for scientists to find places for drilling with the purpose of study the bacterial life preserved in permafrost for several millions years (with link to possibility of such life preservation on Mars) in vicinity of scientific station because of station's waste products. Thus, the scientists, being the main population of the Antarctic in the last 50 years, impair the image of the Antarctic as the least human-affected region in the World. The tourists, on the other hand, picking up the souvenirs and bringing foreign for Antarctic spores and bacteria change yet not well studied environment in there.

The programs of the International Polar Year 2007–2008 include investigation of the effects of human impact of the Antarctic oases and search for ways to decrease them. First nature preserved territories appeared in Antarctic. However, the human impact is unavoidable and one can only expect increase in the quantity of visitors to there. Therefore, it is very important to combine the touristic and the scientific plans of the future Antarctic exploration not to interfere or better to help each other. The on-going scientific research can also become tourist attraction as it happened with some of the Antarctic oases being the historic cites representing the traces of the first heroic Antarctic expeditions.

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Climate in sensitive Regions: The high latitude Arctic and the high altitude European Alps – some comparisons between Svalbard and the Hoher Sonnblick (Austria)

Introduction

Triggered climate change debates have focused on the arctic region. The Arctic Climate Impact Assessment (ACIA) reported that the Arctic is warming at almost twice the rate of the rest of the world (ACIA, 2005); analogous findings have been published for the Alpine Region (e.g. Auer et al., 2007). For both regions climate measurements have been made available, however special attention has to be drawn on data quality; in respect to time series analyses the homogeneity aspects have to be borne in mind.

Figure 1. Examples for problems of data quality in Svalbard (left) and on Sonnblick (right). photo credits: Å.H. Botnen (left) and L. Rasser (right)

The presented Svalbard series is a composite of several series of measurements carried out at different sites near Isfjorden, all values had to be adjusted to be valid for the current observations of Svalbard Airport located at 78°15'N and 15°28E, station height 28 m a.s.l., with continuously measurements since 1975 (Nordli, 2005). Sonnblick series (12°57'N, 47°03', 3106 m a.s.l.) have been derived from the permanently maintained Observatory (since 1886). Nevertheless changes in observation rules, instrumentation and improvements in the infrastructure of the observatory and the nearby Zittelhaus afforded some adjustments.

20th Century Climate Variability

Longyearbyen' s climate has been described as an Arctic tundra climate with cold winters, cool summers with low precipitation amounts the whole year through. Due to high latitude in summer sun doesn't sink below the horizon for 123 days, whereas in winter sun stays below the horizon for 110 days straight.

Air temperature

The average temperature in Longyearbyen in January is -15.8 °C, and in July 6.1 °C., the mean annual temperature -6.7°C. In comparison, Sonnblick's annual mean temperature has been calculated with -5.7°C. Between June and September summers in Longyearbyen tend to be warmer than on Sonnblick. Sonnblick's highest temperatures exceed those of Spitzbergen the whole year round, whilest Sonnblick presents the lower minima.

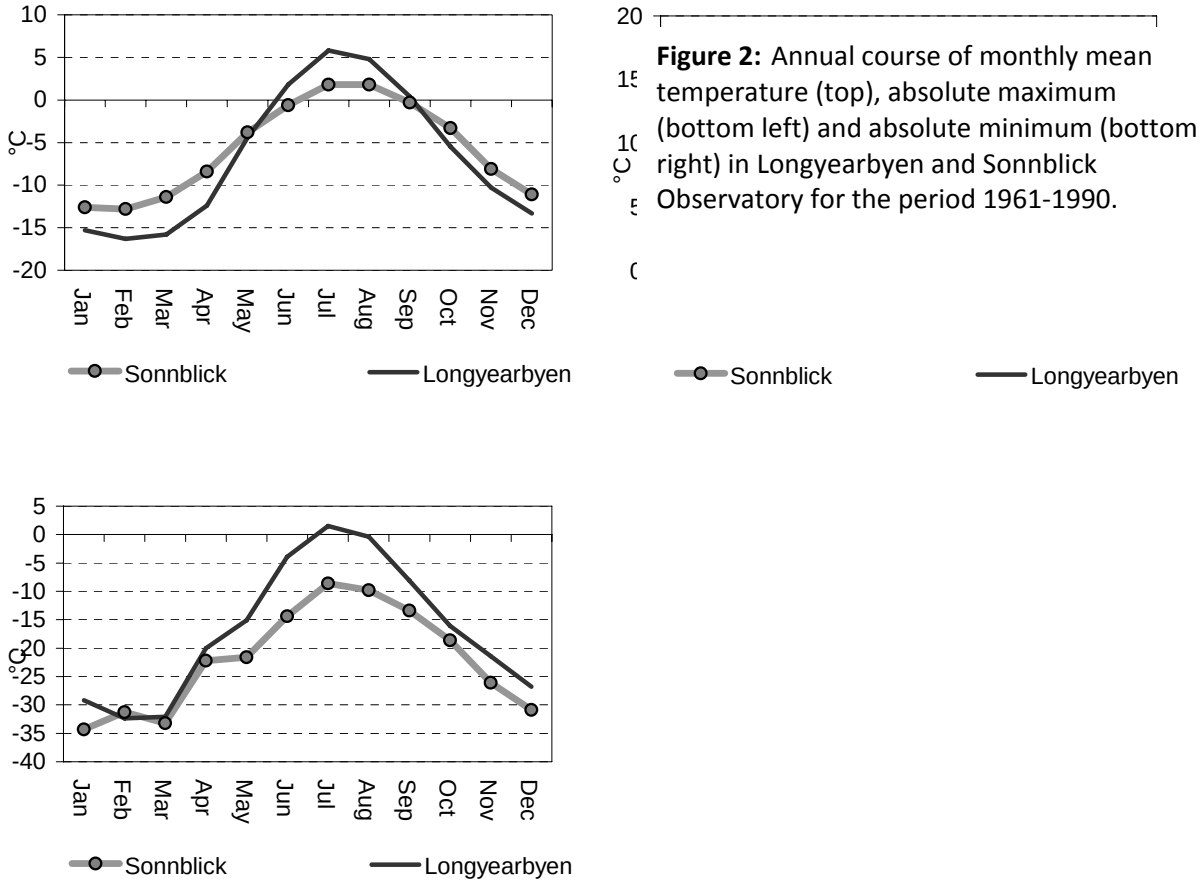

Figure 2: Annual course of monthly mean temperature (top), absolute maximum (bottom left) and absolute minimum (bottom right) in Longyearbyen and Sonnblick Observatory for the period 1961-1990.

During the 20th century Longyearbyen experienced a remarkable warming of 0.22°C per decade. The presented series of Longyearbyen starts in 1911 with a cold phase up to 1920, characterised by clear sky and pronounced inversions (Nordli, 2005). The follow up warm phase between 1920 and 1930 was characterised by overcast sky and weaker and rarer inversions. According to Nordli and Kohler (2004) cloud cover accounts for about 2/3 of the temperature increase. Further explanations refer to circulation changes (Hanssen-Bauer & Foerland 1998) and to decreased areas of ice cover (Benestad et al., 2002). Continuously warming has been observed since the 1970ies. Compared to Sonnblick the annual time series of Longyearbyen shows a greater year to year variability, and a higher trend. For comparison, the time series of Sonnblick (since 1886) was cut and a trend of 0.14°C per decade was calculated for the period 1911 – 2005. Except summer, all seasons have experienced a higher warming in Spitzbergen since 1911. The recent Arctic warming was associated with changes in atmospheric circulation (positive NAO Index) and partly triggered by anthropogenic forcing of the climate system (Hanssen-Bauer, 2007) .

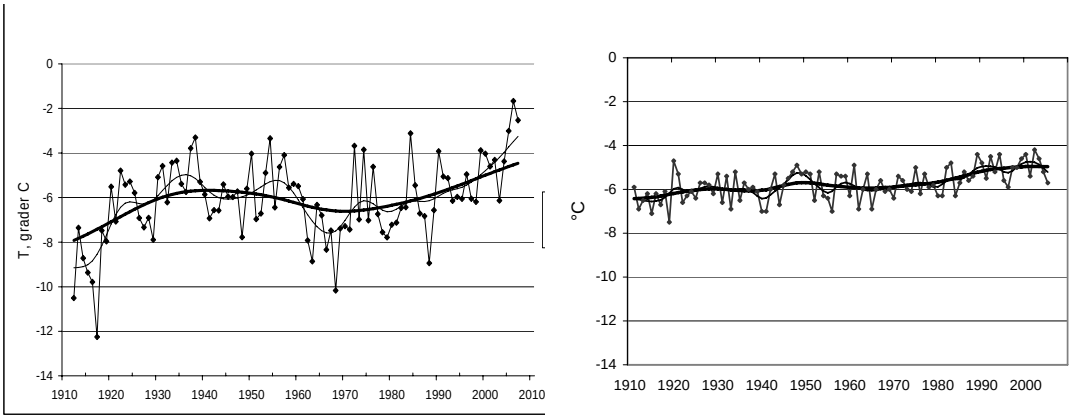

Figure3. Time series of annual mean temperature in Longyearbyen (left) and Sonnblick (right). The graph of Longyearbyen kindly was provided by Inger Hanssen-Bauer.

Precipitation

Precipitation measurements in the Artic as well as in high Alpine regions are biased due to problems of wind and cold temperatures (blowing and drifting snow), and some others too. Foerland et al., 2000 showed that the calculated precipitation increase of 2,9 % per decade between 1964 and 1997 was biased due to the "systematic error of precipitation measurements", Foerland et al., 1996. After correction the real precipitation increase was calculated with 1.7% per decade. In the same way, precipitation measurements at our Sonnblick Observatory provide only poor results (Auer, 1992).

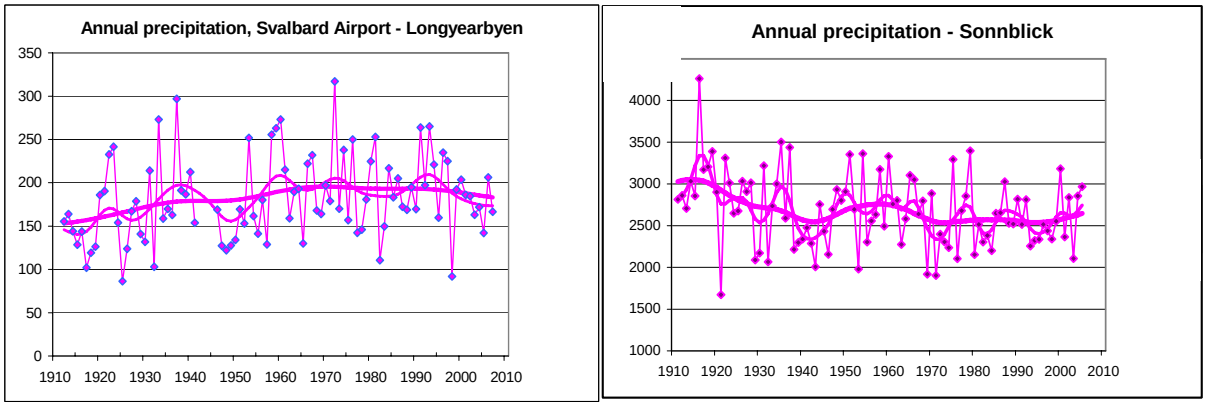

Figure 4. Time series of annual precipitation in Longyearbyen (left) and Sonnblick (right) (note the different scaling of y-axis). The graph of Longyearbyen kindly was provided by Inger Hanssen-Bauer.

Longyearbyen's precipitation climate can be characterised as dry with annual precipitation amounts between 100 and 350 mm. Precipitation has increased with 2% per decade whereas Sonnblick experienced only a slight precipitation increase. Concerning seasons an increase in spring (+1.5% per decade), in summer (+4% per decade) and autumn (+3% per decade) stands against a slight decrease in winter of 0.7% per decade.

Some future aspects

Recent and future temperature rise is expected to be particularly intense in the Arctic. On the other hand Arctic changes will affect the rest of the world. Therefore the Arctic Council called for an "Arctic Climate Impact Assessment (ACIA)" integrating the knowledge and experience of over 300 scientists

within a five years period. The projections herein are based on the best available knowledge, but with further research surprises and new results have to be taken into account. This especially concerns new findings of IPPC 2007 not included into ACIA 2005 and the fact that we cannot completely explain what has happened in the past.
The prospected future Arctic climate**s** have been described by Atmosphere-ocean general circulation models (AOGCMs) producing scenarios for future climate changes consistent with increased atmospheric concentrations of "greenhouse-gases". The spatial resolution of the AOGCMs is, however, still too coarse for many climate impact studies. In the Norwegian project RegClim, regional modelling and empirical (statistical) downscaling have been applied in order to make local climate scenarios for Norway and adjacent areas (Hanssen-Bauer I, Haugen J, Benestad R E, &. Førland E J). For Longyearbyen empirical downscaling was applied to downscale a temperature scenario from the AOGCM ECHAM4/OPYC3 with emission scenario IS92a (Hanssen-Bauer, 2002). The projected increase in annual mean temperature was 0.6 °C per decade (1.0 °C per decade in winter, 0.3 °C per decade in summer), while the annual precipitation was projected to increase by 1.4% per decade up to 2050. The increase of winter precipitation (snow) will contribute to increased winter accumulation on glaciers in the area. A longer extent of snow cover could produce negative impact on the sparse vegetation in the Svalbard area.
Temperature increase has been also prospected for the Alpine Region, around Sonnblick a temperature increase of 2°C has been estimated until 2050 (Böhm et al, 2008). Only extremely uncertain results have been published for future precipitation and especially for extreme events. Nevertheless the glaciers around Sonnblick (mainly reacting on summer temperatures) will experience a remarkable decrease of 40-50% until 2050. Until 2100 glaciers of the Goldberggruppe (Hohe Tauern) are expected to have retreated to 15-20% compared to 1980 (Böhm et al., 2007). With increasing temperature a decrease of solid precipitation (snow) will occur depending on altitude and season. Regions making their income to a great part from winter tourism will be forced to develop new touristic concepts. However, not all observed changes in Sonnblick region are caused by climate change. Proske et al., showed that the increased timberline is related to changes in land-use and will do so in the near future.

Conclusions
Both the Arctic and high Alpine mountains turned out to be high sensitive regions. This has to be understood in two different ways:

1) a high sensitivity of climate itself to natural as well as to anthropogenic forcing
2) a high sensitivity and vulnerability of nature, life and man to climate impacts in those regions

The increased sensitivity of regional climate to external forcings is caused in both regions due to the fact that they are situated near to the freezing/melting point of water – the arctic more in horizontal, the Alps in vertical terms. This stabilizes climate in a certain sense due to the large amounts of energy necessary to pass the freezing/melting point. But, as soon as this barrier has been surmounted, a sudden destabilization may take place compared to the hitherto circumstances. This effect is stronger in Arctic regions with their larger snow- or ice covered areas, especially in respect to the so far existing sea ice which is supposed to continue to decrease. This further activates in both regions the so called "albedo feedback mechanism" which is based on the much stronger reflection of snow and ice compared to bare ground or water. In the arctic it also reduces the isolating effect of the ice cover against the huge amounts of warmth transported by southerly ocean currents (global thermo-haline oceanic conveyor belt). The European Alps however are affected more by their special situation near the northern border of the subtropic high pressure belt in summer which tended to move northwards in recent decades.

The mentioned "second order sensitivity" is easy to understand. It is clear that all kinds of living beings from tundra plants to specialized animals but also human societies are under great pressure from the harsh environmental conditions in arctic and high mountain regions. They have adapted over long periods and found their "niches" to get on with them. Although warmer conditions certainly bear a number of advantages, those specialized forms of life will also receive pressure from not so well adapted competing species which then will find (and already have found) better chances to invade those hostile regions. Human societies will of course also be influenced but should be regarded to have better chances to adapt than specialized arctic or high alpine plants – having much more flexible ways and means to do so.

Notwithstanding the existing uncertainties and different possibilities to react on climate change in arctic and high alpine regions one thing should be clear: Further independent and not interest-driven research is necessary to further reduce the still existing scientific uncertainties. The recent respective efforts under the frame of the International Polar Year (IPY) 2007/08 show that we are on a good way.

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5. *Pisarev Sergey V.*

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Tourism in Polar Oceans - advantages and disadvantages of cooperations with marine investigations

Participation of Shirshov Institute of Oceanology in Polar Oceans tourism

Among the founders of Shirshov Institute of Oceanology of Russian Academy of Sciences (SIO) 60 years ago was Petr Shirshov. He is well known as a member of the multi seasonal expedition called "North Pole -1" in 1937-38. The expedition used drifting ice floe (not the frozen ship) as a scientific platform firstly in the history of polar ocean exploration. The heritage of Shirshov determined the traditional interest of SIO to polar ocean investigations. Not every year, but frequently, the scientific ships of SIO worked in Russian Arctic Seas or within the Southern Ocean. Scientists of SIO participated in the cruises on a board of others expeditionary and research vessels, for example the Russian Antarctic Expedition's vessels or fishing ones, as well. Not crew member and professional oceanographers only were on the boards of these ships. Journalists, writers, photographer and painters participated under different pretexts in some expeditions into seldom visited, harsh, but beautiful polar oceans.

The situation with organization of ocean scientific expeditions in SIO was dramatically changes shortly after the Russian economic crisis in first part of 1990s. The basic research marine expeditions were practically stopped, industrial oceanology related expeditions were very scarce, and state financial support of the research vessels became extremely insufficient. These circumstances resulted, among other things, in rapid degradation of the research vessels and their crews. Using the research vessels as a passenger' ships and for touristic purposes particular to keep their good technical state, became the common practice of Russian marine institutes and SIO as well. Passengers and tourists became common and most important guests on a board of these scientific ships.

Many multi-purpose research vessels, in contrast, for example, to drilling ones, have good potential to be transformed into passenger marine class. Many research vessels have a great deal of comparatively comfortable cabins in addition to the cabins of crew. The kitchens and dinner rooms of the research vessels are ready to serve not only the crew members. The wide working decks of the research vessel are appropriate for exercises of passengers as well. Laboratory rooms can easy to be transformed into cinema or meeting rooms or to the bars even. The market of touristic cruises in temperate and warm oceans was occupied by original, very comfortable passenger liners. Russian research vessels commonly have ice-resistance class. Therefore, formerly scientific ships became work actively with tourist companies within the Arctic Seas and near the Antarctic coasts.

Because of numerous of reasons the majority of Russian formerly scientific ships have changed their owners, and even the name sometimes, while worked under the freight with the tourist companies. It is enough to look in Internet on the schedule of Antarctic tourist cruises between South America and Antarctica to recognize this fact. These 5-6 ships have practically lost their vessel mounted permanent scientific equipment such as scientific echosounders, recorders of the characteristics of the upper ocean layer, oceanographic winches and etc. The probability of returning of these ships into the serious scientific ocean investigations is negligible.

Two ships of SIO which worked as touristic ships as long as 8-9 months per year during last 10-12 years are in absolutely another state. These two ships – "Academic Ioffe" and "Academic Sergey Vavilov" not only keep the biggest part of their permanent scientific equipment, but have modernized even these equipment periodically. Moreover, these ships continue to carry out investigations of the World Ocean under the umbrella of SIO scientific projects during 2-3 months per year. Thus, two biggest research vessels of SIO represent unique marine platforms which are used jointly by tourist firm and scientific projects.
It's necessary to point out that two others not great marine platforms of SIO – bathyscaphes "MIR-1" and "MIR-2", represent now the same type of joint (exclusive tourism and science) marine platforms. However, with the exception of one well known demonstration dive in 2007 within the North Pole region, these submersibles not use for polar tourism purposes.

Experience of SIO to use the research vessels to carry out the scientific expeditions and tourist polar cruises as well

Last ten years two great research vessels "Academic Ioffe" (Technical specification: US NODC Code: 90KD Russian Academy of Sciences Length (M): 117.10 Range (n. mi.): 20000 Crew: 70 Beam (M): 18.20 Endurance (days): 60 Officers: Draft (M): 5.90 Cruise speed (kt): 13.5 Scientists: 55 Gross Tons: 6600 Max. speed (kt): 15.0 Air Cond.: yes Power (HP): 7000 Aux. Power (HP): 2400) and "Academic Sergey Vavilov" (Technical specification : US NODC Code: 90SG Russian Academy of Sciences Length (M): 117.10 Range (n. mi.): 20000 Crew: 37 Beam (M): 18.20 Endurance (days): 60 Officers: 38 Draft (M): 5.90 Cruise speed (kt): 13.5 Scientists:51 Gross Tons: 6231 Max. speed (kt): 15.0 Air Cond.: yes Power (HP): 7000 Aux. Power (HP): 2400) obtained 75-80% of material resources required to support "their marine status" owing to freight with tourist companies. The companies changed from time to time ("Quark Expeditions" under the TUI umbrella freight the SIO vessels at the moment), but every company agreed to collaborate with sciences as far as possible.
Such collaboration involve, first of all, the simple participation of little scientific group (2-5 scientists) into tourist polar cruise. The Antarctic cruises through the Drake Passage, between the southern point of South America - Cape Horn and Antarctic Peninsula, are one of the scientifically interesting routes. The Passage is the narrowest part of the Southern Ocean where powerful Antarctic Circumpolar Current is shrunk to push water through 800 km wide passage. Huge energy of winds and currents interact there, and regular international oceanographic section established in this region. Certainly, it's impossible to use complicated and precision oceanographic devices while cross the Drake Passage during tourist cruise because vessel can't maneuver or stop even for any purposes except the tourist ones. But vessel mounted devices, such as Acoustic Doppler Current Profiler and Multi parametric echo sounder, used of SIO here as often as scientific funding available. Much more interesting results were reached when XBT (expendable bathythermograph) or XCTD (expendable temperature – conductivity – depth) devices were used by author of this text in autumn 2002. Expendable oceanographic devices not need of the vessel stopping while can measure the vertical profiles of temperature and others characteristics "on the run". Good scientific results concerning the changes of the positions of frontal zones during 1-2 weeks were obtained. The results were interesting especially, because the SIO XBT sections were carried out during that several months when analogues multiyear program of the sections of Scripps Institute of Oceanography (USA), which use the Antarctic Supply icebreaker as a ship of opportunity, was temporally interrupted. The results and progress of scientific investigations of opportunity during tourist cruises of the SIO vessels across the Drake Passage depends fully from mobilization by scientists the appropriate devices and founding.
Science-tourist collaboration in joint research vessels using involve also the driving of the ships between home port and port, where tourist cruises start. Tourist companies have to pay for this crossing in accordance with the freight regulations. Scientific projects have to find the resources for

maneuver or additional nautical miles only while plan marine expedition close to direct way between two ports. It is realistic task. Hopefully for SIO, our vessels cross annually the North Atlantic Ocean between the Europe and Canada to work with tourist groups within the Canada Archipelago during July-September. North Atlantic is extremely interesting oceanographic region and for Europe particular. Such lucky combination of tourist and scientific interest is probably the main reason why Russia have carried out during 1997 – 2008 8 sterling oceanographic Trans-Atlantic sections along the 60 deg latitude within the framework of international Climate Variability project – CLIVAR. Another very interesting driving of our ships is longitude section between the Europe and southern most region of South America. Due to this route and additional funding availability, the Deep Antarctic Water penetration through the Vima Channel depression was investigated in 5 expeditions, 5 sections through the Drake Passage and 4 sections between the Capetown and Antarctic ice margin were carried out with using the heavy and high-precision oceanographic devices. These sections through the Atlantic sector of the Southern Ocean are the part of the international IPY project CASO (Climate of Antarctica and the Southern Ocean – Ocean Circulation Cluster), therefore scientists from Germany, France, Spain, Argentina and South Africa also participated in SIO cruises under the common scientific program.

Initially tourist drifting ice camp "Barneo" as a platform for the oceanographic investigations

Well known private drifting ice camp "Barneo" established every spring from 1993 and up to 2008 in Central Artic Basin to support logistically the various tourist programs of "subjugations" of the North Pole. All technical aspects of camp's organization were firstly the direct copies of the Russian seasonal scientific drifting ice camp establishing. It is necessary to point out, that during the 1980s, at least three Soviet organizations – NAVY, Acoustic Institute, and Arctic and Antarctic Research Institute used their own seasonal drifting ice camps for investigations of the Arctic Basin. One of the main professionals to organize the drifting ice camp - aircraft and helicopter pilots and ice runway specialists became almost job less while scientific drifting expeditions finished in Russia at the start of 1990s. Therefore, they have incorporated into tourist business when an opportunity offered. The "Barneo" ice camp has changed the owners and management in 2002-2003. However, the main persons of tourist activity – Russian aviation's stuff and international group of famous polar adventurers as a guides of tourist groups, remained the same practically.

Scientific groups started to use "Barneo" as a platform for investigations in 2000. The first was the USA team of NPEO (North Pole Environmental Observatory) project. Some Japan scientists and agencies associate to NPEO activity later. Two Norwegian oceanographers with their own project and multidisciplinary expedition of SIO under IPY project PAICEX (Pan-Arctic Ice Expedition) worked on "Barneo" in 2007-2008. Extremely interesting results concerning the current state of the surface and intermediate water masses within the North Pole region were obtained by expedition of SIO. Redirection of a lot of logistic related tasks from scientists to "Barneo" staff during two PAICEX expeditions was, comparing with drifting expeditions in 1982 – 1994, new experience for the author of this text. But questions remain. Is it really necessary for professional polar oceanographer to have the same living and safety conditions as unprepared tourists have? Is it the costs to prepare the comparatively good living conditions for scientists reasonable?

Some aspects of marine legislation for tourist business and scientific investigations

Both activities – marine tourism and scientific expedition practically not need huge official endorsements and permissions while take place in so called neutral waters. Absolutely another situation is when ship visit EEZ (Exclusive Economic Zone) of practically any countries. It is not need permission for passenger ship with tourists on a board to come up closely to Cape Horn, for example, to make unforgettable photos. In the same time, the owner of the ship has to ask the special permission of Chilean officials 3-6 months before the cruise to observe simple profile of temperature 0-250 m on the distance not closest as 12 miles from the shore. All countries use their own laws for

marine tourism and practically the same international regulation exists for marine investigations. Passenger or tourist ships much more free comparing with scientific ones to visit near shore regions, internal basins and ports even.

It is interesting example of the obvious difference of official attitudes towards scientific marine investigations and tourism within the basic Russian document, which regulated the tourist and investigation activity within the Russian EEZ, including Arctic, during 1990-2003. The title of this document is - “Decree of Council of Ministries #400“. It is special additional remark in this document stating that it is impossible to carry out scientific measurements on a board of the ship while she working under tourist freight. Remark was added after German oceanographer Quatfasel has carried out in 1990 the XBT section through the Barents Sea and continental slope of the Kara Sea during the tourist cruise of nuclear icebreaker “Rossia”.

The indisputable fact is that all countries are very sensitive to scientific investigations within their EEZ.

Conclusions

There are good examples, during recent 10-15 years, of mutually beneficial collaboration between the marine tourism business and the ocean sciences interests. Such collaboration for SIO, for example, may be only the way to keep their big research vessels. But the circumstances which stimulate the collaboration are unique and temporal. Ships which are used, partially or fully, as tourist ones, will disappear due to the age or will returned to previous specialization before the technical end. Theoretically good idea to use jointly, for tourism and science, the expensive ocean observational platforms have as advantages – cost reduction and public education, but disadvantages as well – modern marine investigations look, sometimes, extremely monotonic and very often abhor unqualified participation. The current international marine legalization contents for marine tourism business the disadvantages only while collaboration with scientific programs are under the consideration. The neutral waters of the Central Arctic Basin outside the EEZs, and neutral or having internationally indeterminate status waters around the Antarctica are, quite possible, only the places were realistic perspective of shared using of the same platforms, for tourism and ocean investigations, exists.

6. Gavrilo Maria

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Creation of the Russian Arctic National Park: Challenges for Nature Conservation and Polar Tourism.

Introduction

Nature conservation in the Russian European North has the longest traditions as compare to the most other regions of Russia. It is the Barents Sea Region where the first nature reserves have been organized to protect marine wildlife as early as in the beginning of XX century. Modern state of the biodiversity in the Russian Arctic can be considered relatively undisturbed as a whole. At the same time, spatial patterns of the industrial development in the North starts to change from patchy distribution to frontal or continuous development in many regions (i.e. in West Siberia). These changes pose new threats to the Arctic ecosystems and tend to complete destruction of wilderness over large areas. Spatial analysis of the distribution of biodiversity hotspots and highly vulnerable biological zones on the one hand, and existing and planned areas of petroleum activity including its transportation network on the other hand, allows to conclude that existing network of Spatially Protected Areas (SPAs) by far does not include ecologically valuable and vulnerable areas in the Barents Sea Region. It should be stressed, that sensitive and valuable marine areas virtually are not covered at all. Taking into account that the northernmost portion of the Barents Sea Region still remains pristine and undeveloped, thus being an etalons of virgin High Arctic ecosystems, it is worth to preserve it undisturbed for future generations. Creation of the *Russian Arctic* National Park (NPRA) should become a step towards this goal.

Background information on the *Russian Arctic* National Park

The idea of establishment of the national park in the northern Barents Sea Region has long history. Finally, the National Park *Russian Arctic* has been included in the perspective plan of the enlargement of Federal NPAs network in the Russia for the period until 2010 as it is stated in the Governmental Decree of Russian Federation from 23.05.2001. NPRA is largely based on the existing SPA – Federal Refuge *Franz Josef Land* established in 1994. New SPA will have cluster structure and will include three major areas as the following (figure 1):

- Western cluster – Victoria Island, 135,000 ha.
- Northern cluster - Franz Josef Land Archipelago, 6,370,000 ha .
- Southern cluster – northern portion of the Northern Island, Novaya Zemlya Archipelago, 1,300,000 ha.

The entire area of the planned national park will sum up at approximately 780 sq km.

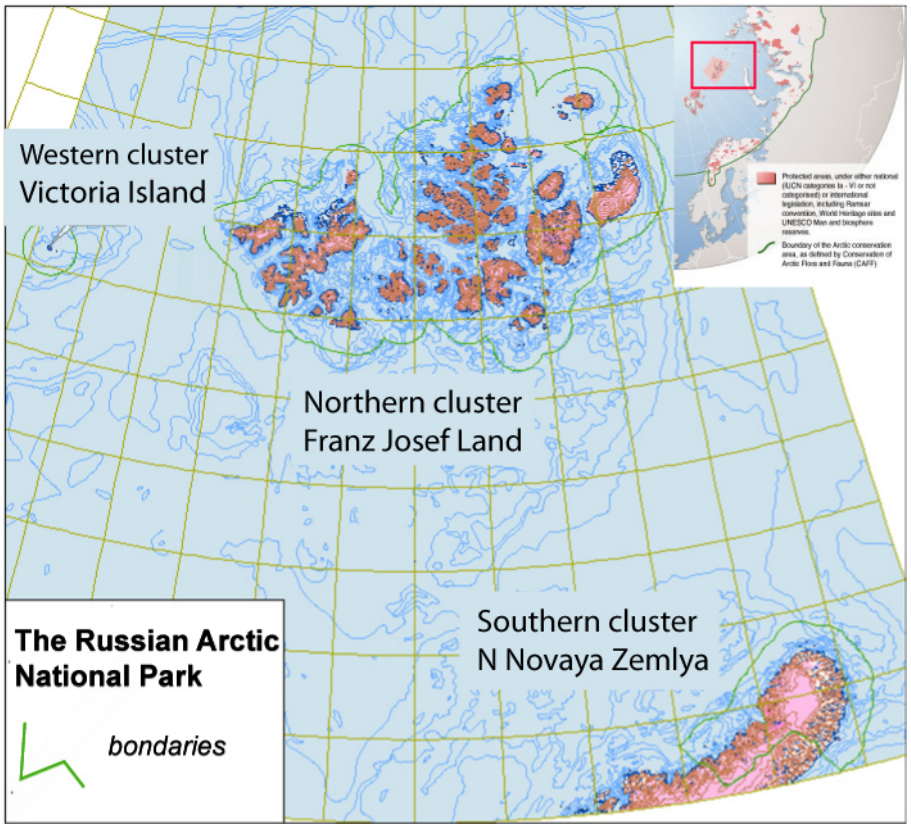


Figure 1. Area of the *Russian Arctic* National Park

In the year 2006, an ecological-economic background for the NPRA design project has been completed. Arctic and Antarctic Research Institute led the scientific parts of the projects in the fields related to environmental conditions, flora and fauna, GIS mapping and databases. Experts from other leading institutions including Zoological and Komarov Botanical Institutes of the Russian Academy of Science, VNIIPriroda, VNII Okeangeologiya, Polar Marine Geosurvey Expedition (Ministry of Natural Resources), and Polar Research of Fishery and Oceanography have been involved. The project has successfully passed State Ecological Expertise, and at the moment is waiting for approval of the relevant Federal Ministries.

Sustainable development approach to new Arctic SPA creation

The main goals of the NPRA establishment are the following:

- Conservation of the valuable natural and historical-cultural heritage of the Russian Arctic.
- Involvement of the area into the international network of research, cognitive, ecological and extreme tourism.
- Ensure Russian presence in High Arctic areas.

The two first goals lead to unavoidable dialectic collision of conservation and tourist interests which is accentuated by some subjective factors as it will be shown below. To balance these, to a certain extent, antagonistic interests and to ensure further sustainable development of the new SPA contemporary theoretical approaches and information technologies were used already at the stage of the NPRA design project. Some institutional mechanisms as a possible tool for successful realization of the project were suggested.

Theoretical approaches. The best available practices in terms of polar SPA creation and polar tourist management were considered while preparing scientific background for the NPRA design project. A need to work out a *Sustainable development working plan* was stated. Such *Sustainable development working*

plan should take into account specific features of the climatic and environmental conditions of the area as well as peculiarities of regional development and exploration as listed below:

- Harsh climatic conditions shaping landscapes and ecosystems and affecting any human activity.
- Specific features of High Arctic ecosystems functioning like simplified food webs, relatively low biological diversity, prevalence of K-strategy species etc.
- Low natural recovery capabilities of the ecosystems.
- Current climate warming which is mostly pronounced in the polar regions and related cascading processes in the ecosystems.
- Overall wilderness of the area.
- High compartmentalization of the area (for example, only Franz Josef land Archipelago consists of more than 190 islands).
- Scarce background information on the environment and absence of reliable and modern scientific data.
- Absence of indigenous people and corresponding practice of traditional nature use.
- Presence of impact hotspots (including highly toxic polluted sites) as a result of former intense but focal exploration of selected sites for scientific, logistic and military purposes.
- Absence of permanent local human population and transport infrastructure and corresponding limited possibility to control protection regime of the SPA.

New challenges raised recently should be emphasized. Rapid climate changes observed during last decades in the polar regions act as new environmental stressors to the populations and ecosystems. On the other hand warming climate provides better access to the high latitudes both for industrial and tourist exploration. Moreover, recent climate change related processes make new attraction to the tourists. All these may result in cumulative impact on the polar ecosystems and populations (Gavrilo 2008).

The *Sustainable development working plan* aims at balancing of interests of new touristic activities as a new form of indirect nature use and nature conservation purposes by mitigation of impacts related to tourism and recreation taking into account originally very fragile character of local ecosystems and largely lack of the knowledge.

Figure 2. Tourist activities pose additional threats to the wildlife with one of the most widespread being disturbance. Here: helicopter operations from the icebreaker charted for the tourist cruise in the Franz Josef Land Archipelago, 2004. Photo Maria Gavrilo.

This *Sustainable development working plan* should be based on the following principles:

- precautions and use of ecological analogues;
- reservation of intact (pristine) areas and prevention of new anthropogenic activities to spread on these areas;
- concentration of extensive exploration including development of new infrastructure elements within already developed / impacted areas;
- development of sustainable Arctic tourism (using principle suggested by WWF (2008) and SATA (2008);
- differential (spatially, temporarily, and by objects) protection regime for different areas of SPA and implement license system for tour operators.

Taking into account above mentioned principles marine border of the new SPA and functional structure of its area were established, baseline for future monitoring and priorities for scientific projects were proposed.

Rational for marine boundaries of the NPRA as an example

One of the major peculiarities of the High Arctic ecosystems is dominance of marine communities in terms of biological productivity and biodiversity, strong dependence of top predators on marine resources. That's why one should ensure inclusion of sufficient marine areas into the SPA to cover the area sufficient for self-maintenance of the local communities. It was stated earlier that for the Arctic minimum area of SPA should exceed 50 – 100 sq km (Schtilmark 1979). Scientific background for the evaluation of marine areas to be protected within the NPRA include the following principles:

- Most vulnerable areas and communities as well as key areas for maintenance of marine biodiversity and conservation of marine biological resources should be protected
- There is a mutual relationships between terrestrial and marine communities and ecosystems with the leading role of the marine food web in formation of biological production
- Extreme environmental conditions of High Arctic accounts for greater areas needed for supporting sustainable communities and populations as compare to the temporal zones.

Taking into account above mentioned principles marine part of the NPRA should include the following areas:

- Coastal shallow zones within 20-50 m depth (highly productive kelp communities, diverse and productive zoobenthos). This area is mostly within 10 km offshore;
- Marginal ice zone with recurring polynyas and drifting ice edge (enhanced biological productivity and high biological diversity during entire annual cycle, wintering and staging areas for seabirds, Atlantic Walruses, Bowhead Whales and possibly White Whales). Position of outer edge of polynyas is highly variable and situated within 20 – 80 km offshore;
- Major foraging areas of breeding seabirds (range within ca. 40 km around seabird colonies taking into account species composition of the major colonies (Johnston et al. 2000, BirdLife 2003);
- Key seasonal habitats of the Polar Bear and marine mammals (fast ice – pupping areas of seals; marginal ice zone – see above). Fast ice zone lies within 20 m depth, i.e. closer than 10 km offshore.

In terms of protection of marine biological resources and ensuring sustainable maintenance of marine inshore ecosystems it would be needed to protect water area within 40 km from the islands' coastline. At the same time, there is a legal restriction which does not allow extend areas of some SPA categories (i.e. strict nature reserves and national parks) beyond state territorial waters. Final

compromised decision was to include maximum legal area, i.e. 12 nm (22.2 km) from the coastline. NPRA area in this case will be as large as 780 sq km and each cluster will be big enough to ensure protection of the self-maintaining ecosystems (see above). The area within 12 nm will also cover the entire coastal shallows, land-fast ice zone, most of the recurring polynyas, and most of the key habitats of the marine mammals and seabirds.

Spatial – functional structuring of the national park area

The following differential functional zones are defined within the NPRA:

- strict nature reserve zone;
- specially protected zone;
- zone of marine biological resources protection;
- zone of historical-cultural heritage protection;
- zone of cognitive tourism;
- visitor service zone;
- administrative zone;
- zone of special regime.

The following objective and subjective difficulties affected designation and mapping of these zones: high compartmentalization of the area, lack of basic environmental knowledge (for example, some of the island shave never been visited and their environment are not described), highly patchy distribution of current human activity against the overall background wilderness, high sensitivity of the local ecosystems to both anthropogenic and climatic impacts. Taking into account these peculiarities, the following principles were taken into account during zoning of the NPRA area:

- To ensure protection of local ecosystems and its components as much as possible of currently intact (wilderness) areas should be allocated to the *strict nature reserve zone*.
- The *zone of cognitive tourism* should include a network of sites and routes established during recent decades of tourist operations in the area.
- The v*isitor service zone* and *administrative zone* should not be spread beyond existing impact areas, most of the existing buildings and infrastructure elements should be used instead of creation the new ones.
- Existing objects of other than NPRA land users should be allocated to the *zone of special regime*.

While designating of the *strict nature reserve zone* the principles of landscape representativeness and securing of most valuable ecosystem components protection were used. Landscape representativeness means that the *strict nature reserve zone* should include examples of all habitat and biological diversity. As a background information, a landscape chart developed by Leonid Govorukha (1960) for the Franz Josef Land was used as well as original field data of the recent AARI expeditions. At the same time, tourist interests were taken into account as well. Allocating natural objects and areas valuable for tourists to the *zone of cognitive tourism* we controlled that similar habitats and communities were allocated to the *strict nature reserve zone* to ensure that etalon ecosystems are properly preserved and animals have safe seasonal habitats to escape increased anthropogenic load if needed. Examples of functional zones in Franz Josef Land are discussed in the presentation.

Institutional mechanisms

Taking into account remoteness and relative inaccessibility of the study area, its low and scarce non-resident human population as well as presence of other than SPA administration land users and current activities in the area (touristic and scientific) it is worth to establish and legally formalize collaboration and relationships between different institutions of Ministry of Natural Resources including its Hydrometeorological Service, Border Guard Service of FBI, Administration of the Northern Sea Route and operators including transport and tourist operators, research expeditions. Mutual cooperation between

all these desirable partners would ensure effective logistics and control over protection regime, conducting of comprehensive researches and monitoring, minimizing cumulative impact, and fixing problems with permissions to enter the area.

GIS-technologies and databases

Modern information technologies were used from the very beginning of the NPRA design project. A GIS *The Russian Arctic* was created. GIS includes thematic layers describing nature use regulations, value of the areas in terms of biodiversity, historical and cultural heritage, esthetics, cognitively, and recreation. A set of databases includes geolocated lists of geological monuments, seabird colonies, marine mammal records, Red-listed species records, large lakes, spectacular glacier fronts, rich plant communities, historical and cultural monuments and sites, impact sites. Besides standard options like *search, map scaling, distance measurement tools, navigation tool etc.,* the GIS provides extended options like interactive regime and export regime. Two GIS-based maps were created at a scale 1:500,000: *The complex environmental and historical-cultural evaluation of the Russian Arctic National Park* and *Functional zones of the Russian Arctic National Park*. Demo version of the GIS includes complete information for different thematic layers for 7 prioritized localities in Franz Josef Land and Victoria Island. A chart of Hayes Island locality is shown as an example in figure 3.

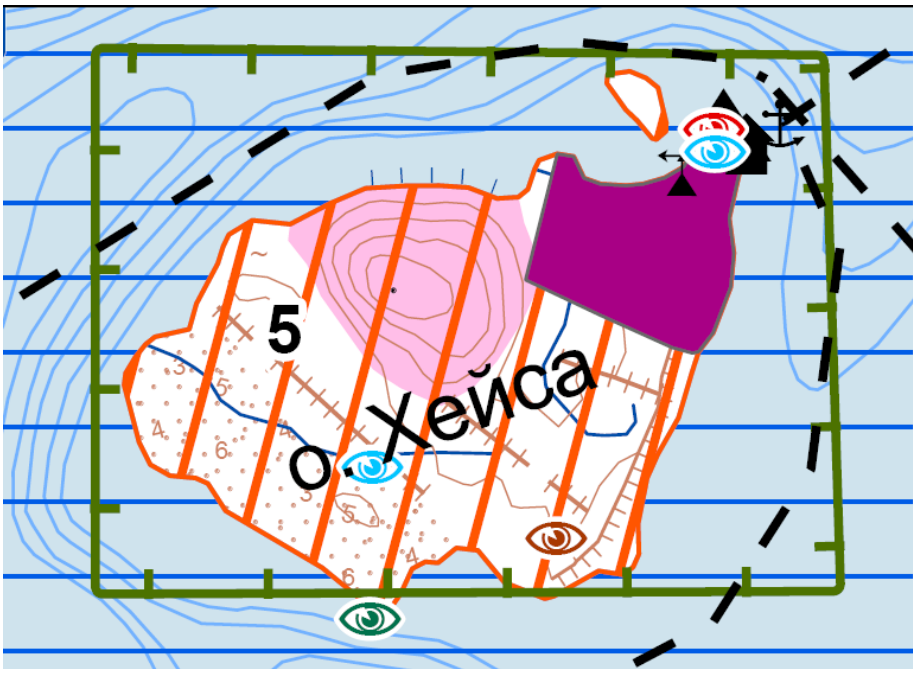
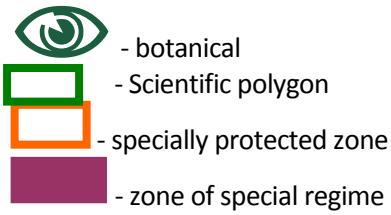


Figure 3. Fragment of the GIS-based map *Functional zones of the Russian Arctic National Park* with valuable ecosystem and historical-cultural components in Hayes Island area, Franz Josef Land.

; planned administrative zone
Å – polar (weather) station
Î – recommended anchoring site
Objects valuable for tourists
- geological
- hydrological
- zoological



Conclusions

- Creation of the new SPA belonging to the category of national park will tend to development of regulated and sustainable tourism in the High Russian Arctic
- Developing of tourist activity will be followed by increased anthropegenic load on the local ecosystem, and at the same time legal regime of the national park will provide better opportunity to protect the most vulnerable areas and communities and to control reserve regime
- Best available practices along with modern technologies (GIS, remote censing etc.) should be used to ensure sustainable development of the new SPA
- Mutual collaboration between all relevant operators in the area is essential to achieve most effective logistics and mitigate unavoidable impacts

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Customized High-Resolution Weather Forecasts to Support Polar Tourism

Abstract

MetGIS is a new, international, Java-based, combined Meteorological and Geographic **I**nformation System, with a specific emphasis on snow, mountain weather and cold climates. A principal focus of the system is the automated operational production and update of high resolution meteorological area forecasts. The predictions can be accessed via Internet by a user-friendly, multilingual Graphical Web Interface. Among the forecast parameters are temperature, wind, precipitation, fresh snow and mode of precipitation (rain, sleet or snow). After minor adaptations, the system could serve as a valuble help for polar region tourist service providers, and it could also support the organization of polar expeditions and scientific field trips.

Introduction

Concerning polar regions, the meteorological community has recently spent a considerable amount of research efforts in topics of global relevance, such as climate change issues, but little attention has been paid to the development and improvement of operational weather forecasts over the Arctic and Antarctic regions, mainly due to the lack of major settlements and customer demand. Useful forecast systems would obviously need to put a special focus on snowfall, wind and cold climates. At present operational meteorological forecasts for the polar regions frequently have a rather poor spatial and time resolution, and in many cases they are restricted to specific points (e.g. the location of research stations). Moreover, the output of polar-related weather prediction systems is rarely customized to the needs of specific user groups; normally it can just be interpreted by professional meteorologists. This is certainly a drawback for polar tourism, not only for the crews of tourist vessels planning a safe route and ideal times for land excursions, but also for the occasional individual tourist on a sailing or moutaineering expedition. An answer to many of the above listed problems is offered by the system MetGIS (Spreitzhofer 2006, 2007; Spreitzhofer & Steinacker 2007). This is a new, high-resolution **M**eteorological and **G**eographic **I**nformation **S**ystem, specialized on snow and cold regions forecasting. It provides the predictions via a user-friendly Graphical User Interface (GUI) which can easily be interpreted by non-meteorologists, from tour operators to individual tourists interested in weather conditions on the trip.

MetGIS

2.1 System Development Process

MetGIS was developed having the latest techniques of software engineering (Dumke 2003, Endres & Rombach 2003) and basics of geographic information systems (Burrough et al., 2000; Jones 1997) in mind. It uses Java-based, object-oriented approaches (Naughton & Schildt 1999) and some graphics libraries employed in the construction of the successful snow cover visualization software SN_GUI (Spreitzhofer et al., 2004). Some basic ideas of MetGIS were inspired from the now outdated, but

methodically interesting PC-based WeatherPro (formerly WELS) weather prediction scheme (Teixeira & Reiter, 1995; Spreitzhofer, 1997, 2000; Steinacker & Spreitzhofer, 1998).

Research Institution	Country/City	Contribution/Achievement
Alden/WELS (Alden Electronics, Inc./WELS Research Corp.)	**USA** (Boulder, Colorado)	Some basic ideas about the combination between geographic information systems and meteorological forecasts
WSL/SLF (Swiss Federal Inst. for Forest, Snow and Landscape Res., Swiss Federal Inst. for Snow and Avalanche Research)	**Switzer-land** (Davos)	Java technology for GUI programming. Visualization of the output of snowpack models.
SENAMHI (Servicio Nacional de Meteorología e Hidrología)	**Peru** (Lima)	Start programming Java-based GIS. Tests of the prototype with a complete set of country-wide geographic vector data.
NIED/NISIS (National Research Institute for Earth Science and Disaster Prevention, Nagaoka Inst. for Snow and Ice Studies)	**Japan** (Nagaoka)	Continue GIS programming. Start programming interface for meteorological forecast models, using the NHM model.
CRICYT/IANIGLA (Centro Regional de Invest. Científicas y Tecnológicas, Inst. Argentino de Nivelogía y Glaciología)	**Argentinia** (Mendoza)	Inclusion of high resolution terrain data (SRTM, Shuttle Radar Topographic Mission).
DGF (Departamento de Geofísica, Universidad de Chile)	**Chile** (Santiago)	Integrate visualization of the output of the MM5 model for two domains covering the Andes range.
IMG (Institute of Meteorology and Geophysics, University of Vienna)	**Austria** (Vienna)	Construction of an operational forecast system. Inclusion of European forecast and terrain data.

Table 1: Contributions of international research institutions in the development of MetGIS.

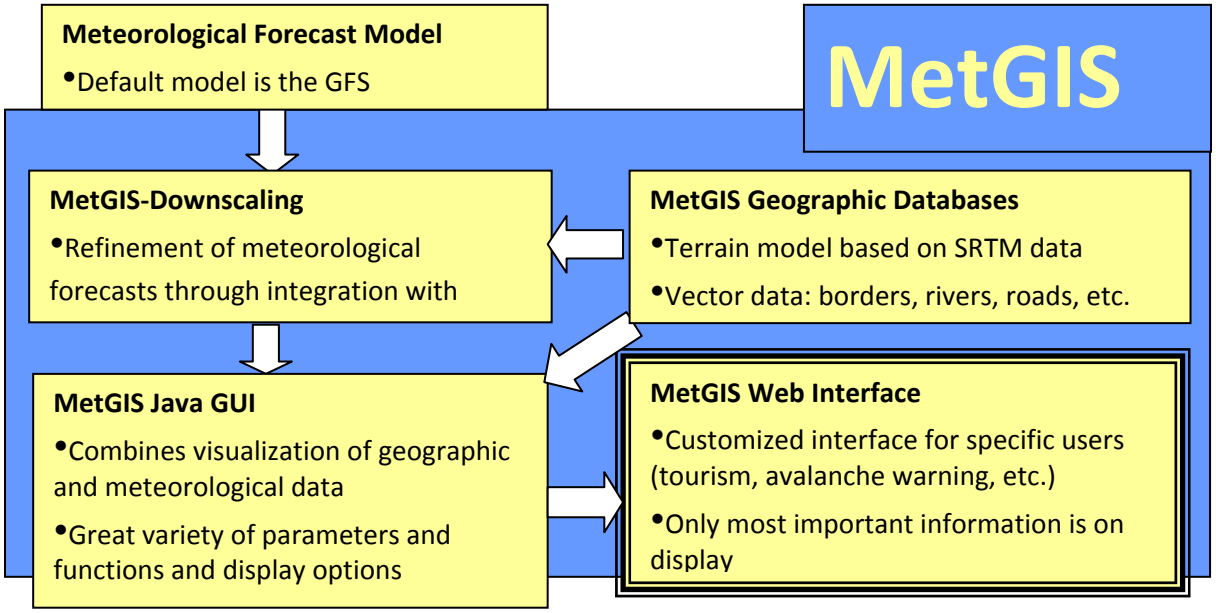

Fig. 1. Structure of MetGIS.

From the start of the system development process, collaboration with international meteorological organizations and snow research institutes has been established (see Table 1). This was to take advantage of the specific expertise of these institutions, to tune the emerging system with different sorts of geographic and meteorological data, and to facilitate an international, wide-spread application of the system, from mid-latitude mountain areas to polar regions. Prototypes of MetGIS have been successfully operated with test data sets for specifically interesting cases over Japan and South America (Spreitzhofer & Norte, 2006, 2008).

2.2 Structure of MetGIS

The basic structure of MetGIS is depicted in Fig. 1. The system is fed by the gridpoint output of meteorological mesoscale forecast models. Operating these models is not part of the proper MetGIS system. Currently the GFS (Global Forecast System) of the US National Weather Service is used, but any other numerical forecast model delivering forecasts for polar areas might be utilized to drive MetGIS. The external forecast model data are "downscaled" by MetGIS to the high (around 100m) resolution of system-internal topographic data bases and subsequently further manipulated through the MetGIS Java GUI (see Fig. 2). Since the start of 2007, the MetGIS Java GUI can be operated in an automated mode to operationally produce forecast graphics that feed the MetGIS Web Interface.

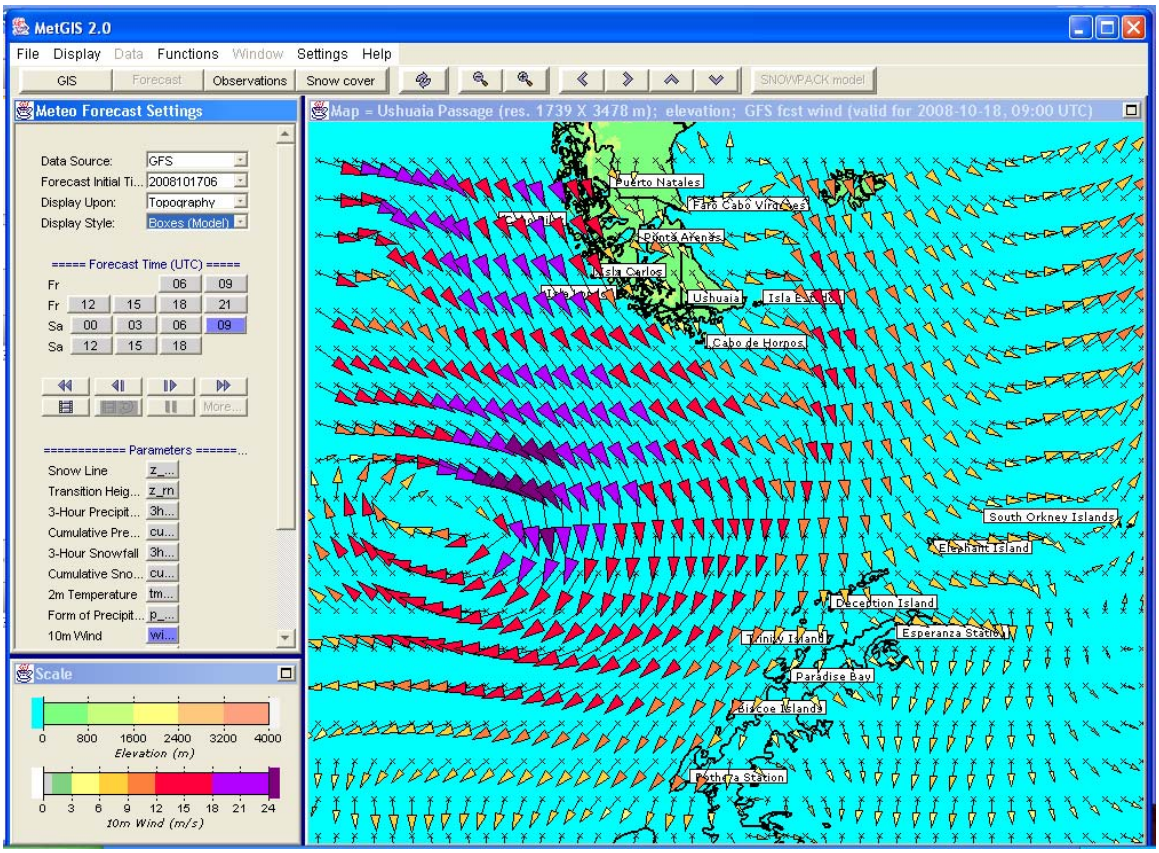

Fig. 2: Example of a MetGIS wind forecast for the Drake Passage between South America and the Antarctic Peninsula. The displayed framework is the MetGIS Java GUI, but the same kind of graphics are also accessible via the more user-friendly MetGIS Web Interface. Purple arrows stand for wind velocities exceeding 18 m/s.

2.3 Practical Application of MetGIS

For applied users (tourism industry, avalanche warning, traffic operation centers, etc.), the partly password-protected MetGIS Web Interface (http://univie.ac.at/amk/metgis/) is the main point of access to the system. This user-friendly web site offers information, forecast examples and real-time forecasts for a number of geographic sections, parameters and display styles in 4 languages (English, German, Spanish and Russian). Currently graphical forecasts for a number of defined regions over the Alps, Pyrenees and Andes, all with a forecast range of 36 or 48 hours and a forecast interval of 3 hours, are computed 4 times a day. User response has been quite encouraging so far. Forecast parameters are wind (Fig. 2), fresh snow amount (Fig. 3), precipitation amount, snow limit (Fig. 4), mode of precipitation (Fig. 5) and air temperature (Fig. 6). Display styles available are numbers on a regular grid (Fig. 3) or color areas (Fig. 4, 5, 6).

Another feature which will be added to the MetGIS Web Interface by the beginning of 2009 is the possibility to display forecast histograms (time evolution of selected parameters), valid for specific locations that are clicked in the forecast maps.

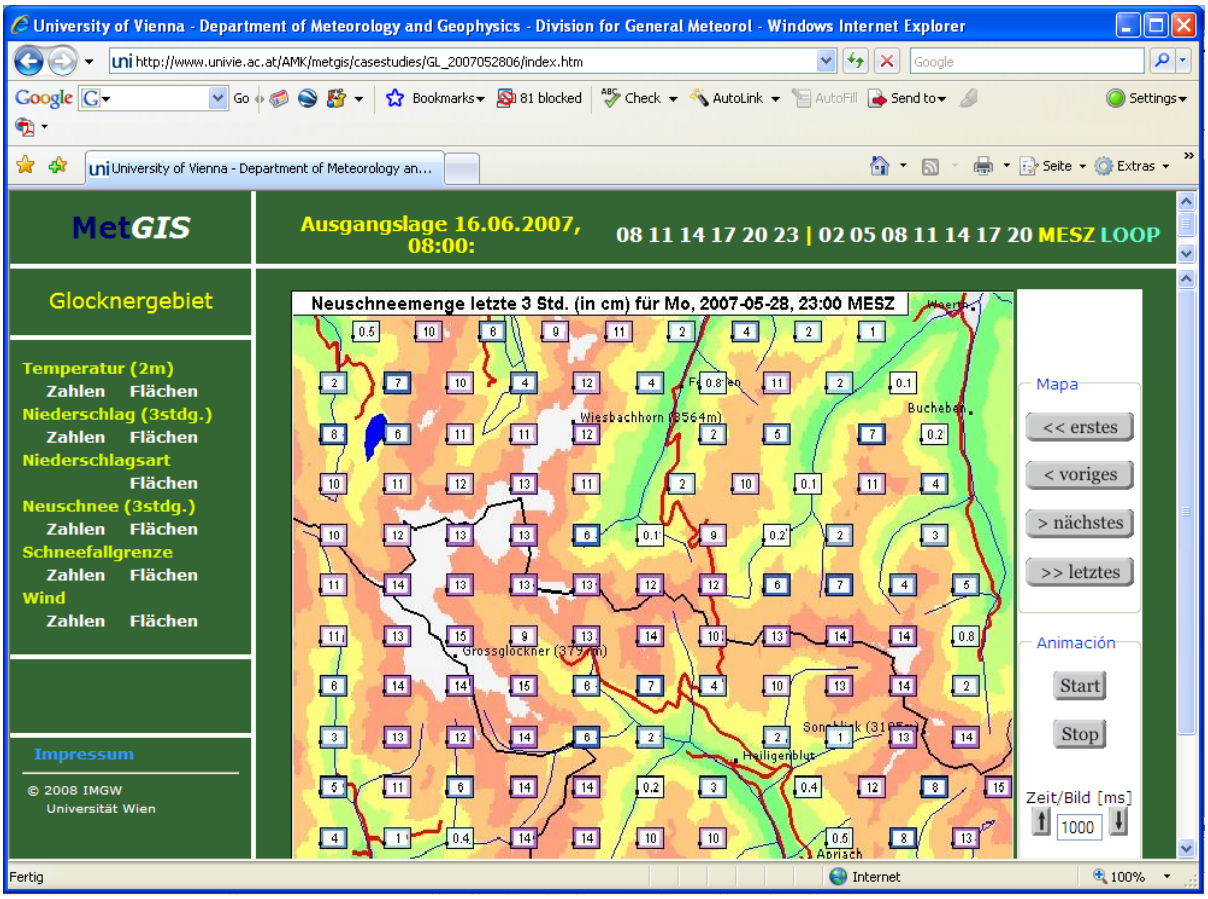

Fig. 3: Example of a high-resolution forecast of three hourly fresh snow amounts over the Glockner range (Austria), using the operational MetGIS Web Interface.

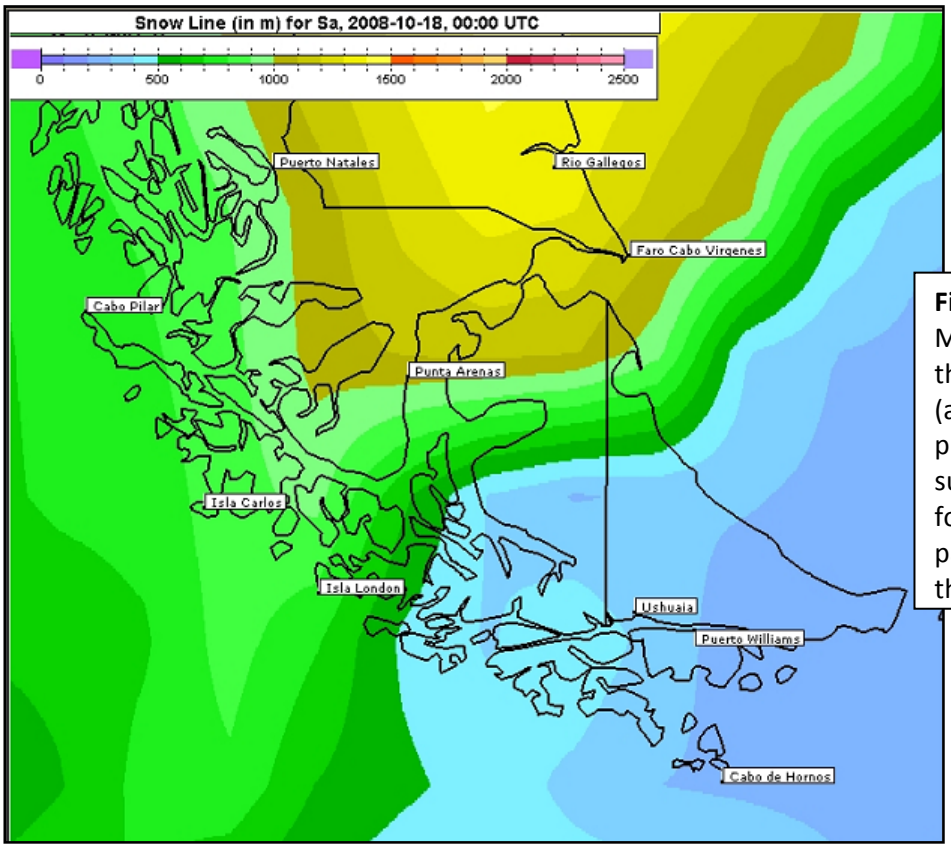

Fig. 4: Example of a MetGIS forecast of the snow line (altitude till which precipitation is supposed to fall in form of snow at a particular time) for the region of Tierra

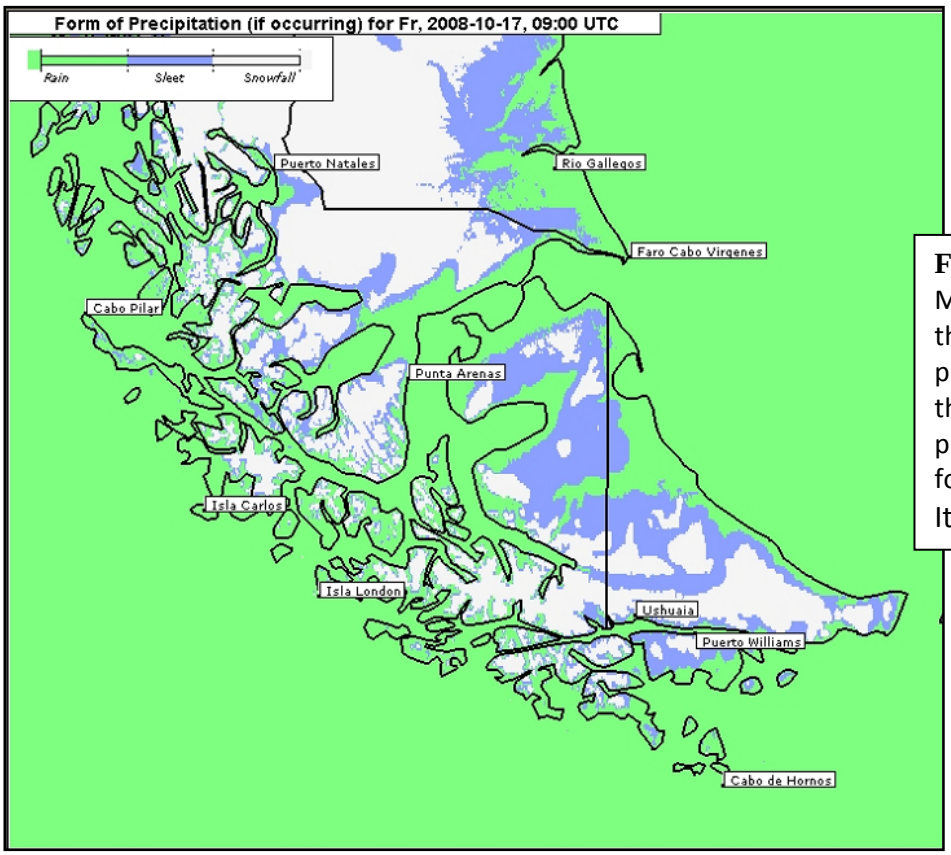

Fig. 5: Example of a MetGIS forecast of the mode of precipitation (for the case that precipitation occurs) for Tierra del Fuego. It is distinguished

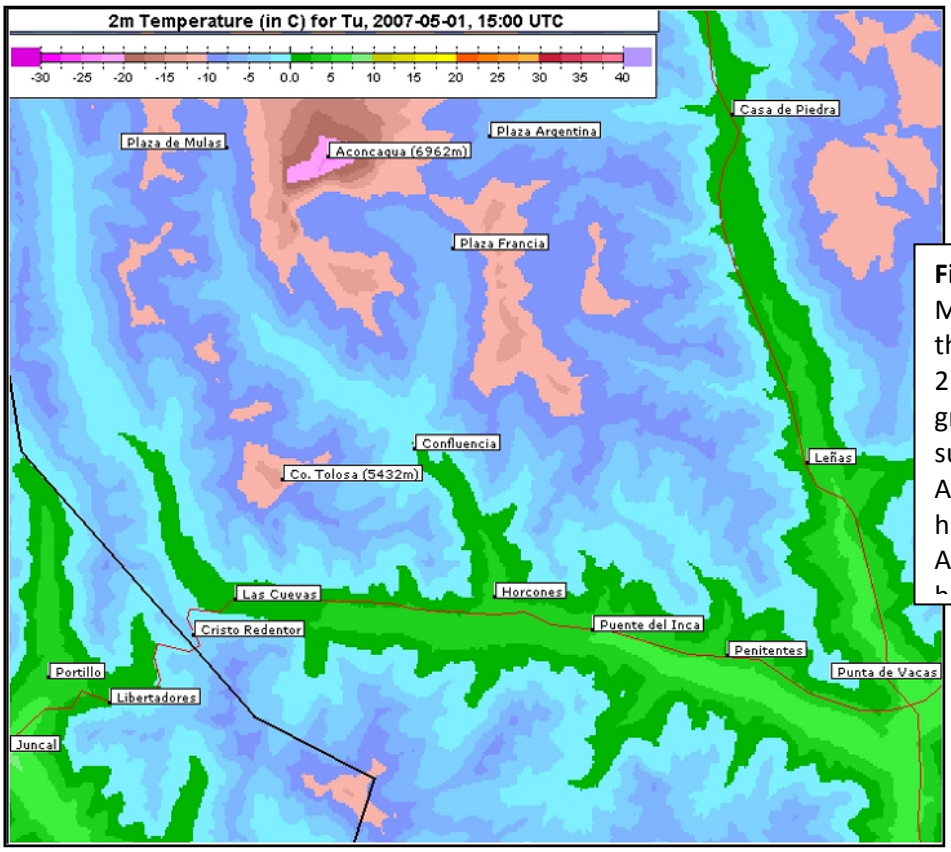

Fig. 6: Example of a MetGIS forecast of the air temperature 2m above the ground for the surroundings of Aconcagua, the highest mountain of America. The used horizontal

3. Conclusions and Final Remarks

After minor adaptations, the MetGIS system may be ready to support tourism in the southern and northern polar regions. First of all, high-resolution topographic data of the Arctic and Antarctic would have to be included into MetGIS. Setting up specific forecast areas such as the Antarctic Peninsula or the Drake Passage, that can be accessed by an interested community via the MetGIS Web Interface, would be a next step. Concerning the meteorological base model feeding MetGIS with raw data, the GFS model could still be used, since it delivers global forecast data. However, it might also be useful to experiment with running other, more specific polar region forecast models in combination with MetGIS. The currently offered forecast parameters will probably be sufficient for the needs of many people travelling or working in the polar regions. However, the introduction of additional parameters could be useful, such as ocean wave height and wind chill temperature (temperature sensation of the human skin, including the wind factor). The power of MetGIS could also be further increased (especially over polar regions) if it would be combined with external snow cover models such as SNOWPACK (Bartelt & Lehning, 2002; Lehning at al., 2002a,b). By this, a high resolution prediction of drifting snow would be feasible.

Finally it should be noted that, due to the simplicity of its graphical web interface, the potential use of MetGIS forecasts is not restricted to polar tourist service providers. The animated predictions could also be offered as a special service to individual tourists, e.g. on info screens of cruise liners.

Acknowledgements

Thanks goes to all institutions and persons that contributed with financial or logistical support to the success of MetGIS. Special thanks goes to WELS/Alden (USA) under the leadership of Prof. E.R. Reiter, to WSL/SLF (Switzerland – see Tab. 1 for all used abbreviations), SENAMHI (Peru), NIED/NISIS (Japan), CRICYT/IANIGLA (Argentina), to DGF (Chile) and to Markus Ristic and Michael Blaschek (both Institute of Meteorology and Geophysics, University of Vienna). We are also grateful to ASFINAG (Autobahnen- und Schnellstraßenfinanzierungs-AG, Austria) and BMVIT (Austrian Ministry for Traffic, Innovation and Technology) for sponsoring a recent MetGIS-related research project.

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8. André Katalin

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Golf in the Artic Region

Motivation of my topic

The tourism has a lot of branch in the artic region, as well. Of course, golf tourism belongs to the luxury vacations because it is a very important status symbol. Not everybody can be addicted to golf as it is quiet expensive.

Even in this region there are more and more golf clubs which shows that there are biger and biger interests in golf.The main reason of that is the Midnightsun which causes that these countries are so irresistible for the lovers of golf. The most golf players are looking for something unique when they coose a new course. In this region all of the terms has been given even the 'unique factor'. So why don't they play there, as well? I suppose it is completely normal. Additionally this branch can develope also the tourism which couses more proceeds to the countries.

Although what my interests intrigues is an other modulus. Namely it is the landscape of these courses. I'm keen on gardens and landscape and it is the reason why I like these golf courses in spite of that I can't play golf. My favourite golf courses situeted in Iceland as there are not olny a wonderful seacoast and green course but also lava which is an other unique factor. So it couse a geological experiences, as well.

Short history of golf

Some sources mention a similar game already existed in the Roman times. According to other records, especially pictures, there are also similar games in China, which remind to modern golf and it would have been brought to the old continent by seamen. For sure, today's golf is most like the old Dutch game, named Kolf. Probably the game did arise with herdsmen, who were spending their time by hitting stones with a stick while watching the sheep.

The first balls were made of wood, as well as the sticks. The wooden balls have been replaced by fragile leather balls, filled with boiled goose feathers. In the year 1848 the era of the feather balls ended. They were replaced by balls made of rubber like material and dried milk-juice of Asian tropical wood. The sticks were originally made of wood.

The cradle of golf, as we know it today, is Scotland. The game was already popular in the 15th century over there. Back then, the Scottish king Jacob II had prohibited it because he thought it endangered archery. When Jacob VI became the king of Great Britain, the first playground outside of Scotland opened in south London (only 7 holes). After this the game spread over some English colonies around the world and at the end of the 19th century to other parts of Europe.

The first club has been established in 1744 in Edinburgh by the Brits. The first manufacturer of sticks and balls, licensed by the authorities were the Scots; the still valid rules on golf were written at the golf club St. Andrews in Scotland. The rules were formed and written down in the year 1764.

Why people play golf near to the nordic polar, as well….

Golf is an exclusive sport and it is always very important that the golf court are sorroundig by a beautiful landscape. That's why people play it all over the world from California to Iceland. Golf is more than a sport. It offers visual pleasure for the players, as weel.But how can these nordic

countries, as Finland, Norway, Iceland, Greenland attract the rich people to spend there a week? The answer is very simple:
Namely these counties have excellent givens. The landscape is beautiful, the environment is very peaceful and there is one advantage yet…
The location of these countries allows that the players play golf also during the night, because during the summer time the sun never goes down. Maybe it is the most important advantage which attracts the people all over the word as it offers a really new experience. So nowadays more and more people want to try it near to the nordic polar and that's whay more and more golfcourt get place there. In Scandinavia, the golf boom of the 90's was handled more formally than it was in the United States.

Golf in Norway

Norway has quite an amount of golf courses spread around the country. It is very popular to play golf in Norway during the summer time in the northern region
while enjoying the midnight sun. In Norway there is 23 Golf Clubs in contient and some more in the islands. These golf clubs which located in the islands are in the north part of Norway and that's why these courses are very popular among tourists.
The most beautiful is maybe **Lofoten** Golf links'68-degree latitude (the Artic Circle is at 66 degrees). There are a handful of other places to golf in the midnight sun, but only a select few are farther north than Lofoten. Namely, there are fine 18-hole courses at **Tromso** (69 degrees), and **Narvik** (68 degrees), and a good 9-hole course at **Harstad** (68 degrees), and at **North Cape**, the most northerly point in Europe and an inconceivable 280 miles above the Arctic Circle, there is a muddy six-hole course (71 degrees), which in late May still had some snow on it. The most tourist visit these places Late May to early August because it is the season of "midnattgolf". From May 23 through July 24, the sun doesn't set at all. Golfing in the midnight offers a ineffably beautiful experience. Everybody who has already tried it wants to go back and play there once more.

Midnightgolfing – Norway

Golf in Finland

Finland has nearly 50,000 golfers and an ever increasing number of golf courses, about 60 at this time. Given that Finland is one of Europe's most northerly countries, the seasons are typically long periods of darkness in the winter and long periods of sunlight in the summer. Indeed in the very far north, the sun does not set at all for a period of months - every played golf at midnight. The golfing season is between may and September. The majority of courses are 18 holes and quite spacious. Facilities are typically to a high standard with green fees very affordable. As a tourist destination, Finland offers the unique opportunity of sampling West and East culture. There is more to see than golf and visitors should consider visiting neighbouring countries to sample their rich cultures. Fishing

is another popular pastime as are the famous saunas. There are companies which organise recreational activities which include golf for anyone spending a few days in Finland.

A golf course – Finland

Golf in Sweden

Perheps golf belongs to the most popular sport sin Sweden. It has enjoyed a 72% increase in the number of golf courses built during the 1990s. In fact, demand for golf club places outstripts supply and we can therefore expect a substantial number of new courses to be built over the next few years. Sweden has also come onto the golfing world stage with some world class golfers, such as Annika sorenstam and Jesper Parnevik. Nowadays there are about 235 golf clubs in the country which means that the golf is in Sweden is the most popular among the skandinavian countries. Although in the north part of the country there are just a few courses. For example in Lappland there is neighter one and in Norrbotten ther are only 5, but there you can enjoy the midnight golf. One of them, namely **Haparanda** golf course is very special as it situated on the borders of Sweden and Finland. 11 of the holes are played in Sweden, while the other 9 are played over the border in Finland. This course offers the elements from the trio-combination of forest, parkland and seaside courses. The membership costs in general about 956 SEK (swedish krone) per person which means about 100 Euro and it is just the membership which doesn't include the games as well.

Nice landscape with midnightsun and green course – Sweden

Golf in Iceland

There are 15 golf clubs in Iceland. This number seems very much. Altought Iceland is in all 102.928 km^2, the biggest part of the island is covered by ice or by lava.
You can find a golf club anywhere round the island as in the east part a sin the south part. The most clubs is near to Rejkjavik. But it is not a suprise, as the biggest circulation is there. These courses located in general next to the seacoast so that you can enjoy the beautiful views of the North Atlantic

Ocean from several points along this courses. These places give a handle to feel the mystery of Iceland becouse you can see not only the Ocean but also the natural beauties for examples lavas and rocks.
The size of these courts is beetwen about 4800-6200 yardage and including 9 or 18 holes, so the tourists can choose, which is the best for them. These golf clubs are equipped very well. Facilities of the club include changing and shower rooms, other services include a pro shop, club and trolley hire, restaurant and bar refreshments.
Iceland is beautiful of oneself, as well and a lot of tourist travel there to see the sights of the iceland but perheps there will be more and more tourist who will visit Iceland because of the golf clubs.

Golf course surrounding by lava – Iceland

Golf in Greenland

The one of the the biggest island which is more than 2 million km^2. Almost the whole part of the island is covered by ice. But the ice actually is not object if you want to play golf. Even it is not so easy to create an average golf court. It is possible only if the terms and equipments are changed. Namely temperatures reach minus 40 degrees, the greens are white, the balls are red and players need to watch out for seal-holes on the course and because the court is covered by ice you cannot control the ball so easily.
The most popular ice golf court takes place near the town of Uummannaq on a small island in Northern Greenland. During January and February the climate, the sea and the ice create the natural settings for the year's 9-hole course. As a result, the appearance of the course changes dramatically from one year to the next. The real architect of the course every year is the ocean, which interacts with the weather and the formation of icebergs in January and February to create an external framework for the course.
The course itself is laid out in March on the fjord ice, close to the town a week prior to the actual championship. Its shape is determined largely by the positions of icebergs in the fjord. With it´s dry high arctic and stabile climate, icebergs, pure environment north of the Polar Circle, only a few millimeter of snowfall during the winter Uummannaq, Greenland offers perhaps the best, most extreme and spectacular golf course.

Golf course beetwen the icebergs –Greenland

Events near to the Artic polar

World Ice Golf Championship in Greenland: The World Ice Golf Championship was the brainchild of Arne Neimann, a local resident and hotel proprietor on a small island called Uummannaq, off Greenland's North West coast. In 1997 Neimann challenged architect Rolf-Henning Jensen to design Greenland's first golf course, which proved remarkably easy to do. The World Ice Golf Championship (TWIGC) is one of the world's most unique sporting events. The event attracts a selection of 36 international golfers – both professional and amateur players as well as a selection of media and personalities invited to play by the title sponsor.The 2002 event attracted great media interest from around the world including 144 pieces of international television coverage, 200 print stories and 15 radio coverage. The next event is on 19 - 24 March 2009.

Arctic Open International Golf Tournament Jun 2009: First held in 1986, this four-day championship event, open to international professional and amateur golfers, takes place at the Akureyri Golf Club, the most northerly 18-hole golf course in the world, beneath snow-capped mountains in the far north of Iceland, and the midnight sun. Participants need not worry about playing too slowly, since competitors can tee off at 3am and still be certain of seeing where their ball has landed - it is light all night at midsummer on the Arctic Circle.

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Snow and Ice as a resource for innovative tourist experiences in Northern Sweden, the case of IceTheatre and Ice Music Hall.

Background

Tourism in high altitude or high latitude is traditionally based on nature based experiences in an environment of snow and ice. The snow and ice covered landscape constitutes a background and substrate for "winter" outdoor activities such as downhill and cross country skiing, snow shoes hiking, dog sledge and snow mobile driving[1] and on ice covered waters cross-country skating, ice-sailing and ice fishing. Recently other motorised snow activities such as driving quads and car racing on frozen lakes have been added to winter activities in Northern Scandinavia.

Parallel to such nature based outdoor winter activities artic and high altitude areas have a long history of cultural winter activities of the form of winter sports, events and cultural constructions in snow and ice. Cultural winter attractions includes traditional winter markets such as "Jokkmokks marknad"[2] in Northern Sweden which started already in 1705 and has developed from a traditional trading market into a Sami tourism event[3]. Also indigenous culture events and traditions[4] such as aspects of the Sami culture traditions have transformed into tourism and tourist activities such as reindeer races or visiting Sami living places etc.[5] Winter and snow festivals have a long tradition in artic and sub arctic countries and have in many cities and communities become a significant cultural event. Famous are events such as the Sapporo Snow Festival[6] since 1949 which is Japans largest and most distinctive winter event with over two million visitors, the Saint Paul Winter Carnival Minnesota[7] which in 1886 started after a New York journalist described the town as "another Siberia, unfit for humans habitation." and features everything from the famous ice palace to bobsledding and ice horse racing.. Other examples of winter festivals are Kiruna Snowfestival[8] since 1986, Alta Borealis festival[9], Nuuk Snow festival[10] on Greenland, the Anchorage Fur Rondy Rendezvous[11] in

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[7] Extracted from www.winter-carnival.com
[8] Extracted from www.snofestival.se
[9] Extracted from www.borealis.alta.no
[10] Extracted from www.snow.gl
[11] Extracted from www.furrondy.net

Alaska since 1935 with dog sledge world championships, and the Quebec Winter Carnival[12] since 1894 which is the world largest winter carnival.

Associated with most winter festivals is the construction of snow and ice sculptures[13] and snow buildings in the form of igloos and snow castles. The igloo is an Inuit shelter and living construction in the artic environment[14]. In some areas such as in Thule, the northeastern shore of Greenland, igloos where extended to large ice domes as singing, dancing and wrestling competition halls for the community during the long dark winter days[15]. Such Inuit igloos have been transformed into tourism attractions in the form of igloo hotels such as the Igloo Village in Saariselka, Finnland, part of Hotel Kakslauttanen[16], where the visitor can stay in on of 20 snow igloos or one of the 20 warm glass igloos where to watch the northern lights from the bed. Here the World´s largest snow restaurant offers sitting for 150 guests inside a single snow igloo. The Igloo Village has also an Ice Bar, Ice Chapel and Ice Gallery of ice sculptures. One of the most famous tourist igloo construction is the worlds first Icehotel in Jukkasjärvi[17] which will be described in detail below. The concept of the Icehotel has since its opening in 1989 in Jukkasjärvi been copied in Scandinavia and elsewhere. The Alta Igloo Hotel[18] that opened in 2000 consists of a 2000 square meter ice hotel with 80 beds in 30 snow rooms, icebar, ice gallery and ice chapel. The Bjorli Ice Lodge at hotel Bjorli ski Centre in Romsdal[19] consists if a icehotel building with individually designed guest rooms and a icebar. The Laino Snow Village Hotel in Finland[20], opened in 2000 has a large ice hotel with 20 igloo bedrooms and seven fancy ice suites. It has an ice restaurant and Europe's largest icebar. Outside the Icehotel there is an illuminated ice sculpture park with snow slides and an ice chapel. The Kirkenes Snow Hotel[21] opened in 2006/2007 has 20 rooms individually decorated by ice artists from Finland and Japan. It has the largest snow dome in Norway eight meters high and twelve meters in diameter which host a large snow bar. The Mammut SnowHotel at the Lumilinna Snow Castle in Kemi, Finland[22] has 18 regular rooms for up to five persons and a honeymoon suite. At the snow castle there is a theatre, Ice gallery, SnowRestaurant and SnowChapel

Igloos appear to be popular and pooping up around the world. The German Iglu-Dorf concept[23] consists of a 50 bed hotel that in 2005 has been established in six European mountain ski areas (Davos-Klosters, Engelberg-Tiltis, Gasaad and Zermatt in Switzerland, Zugspitze in Germany and Andorra) which all offer an Iglu-bar besides the Iglu-hotel with standard iglu-rooms for up to six persons, double rooms and romantic-iglu rooms. The Iglu-Dorf can also be rented for Iglu-Events such as conferences etc. In 2006 the first ice hotel in East Europe was build at Bâlea Lake in the Fâgâras Transylvanian Mountains, Romania[24]. The Ice hotel was built at an altitude of 2034meters and can offers 8 double rooms

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[17] Extracted from www.icehotel.com
[18] Extracted from www.alta.friluftspark.no
[19] Extracted from www.ice-lodge.co.uk
[20] Extracted from www.snowvillage.fi
[21] Extracted from www.kirkenessnowhotel.com
[22] Extracted from www.snowcastle.net
[23] Extracted from www.iglu-dorf.com
[24] The Finest Hotels of the World www.finesthotels.net/hotels/hdescription.php?pid=3073

The first Icehotel in North America was the Hôtel de Glace, the Ice hotel in Quebec, Canada[25] which opened in 2001 and now has 85 beds. The Icehotel is build with 5000 tons of sculpture ice and 15000 tons of snow, forming arches over rooms with 5 meters high over an art gallery, an Ice Café, a N´Íce Club and a 60 feet slide. The hotel also has an ice chapel. Another ice hotel is the Ice and Snow hotel in Harbin, northeast China opened in 2005 in association to the Harbin Ice and Snow World[26]. This Ice festival was first organized in 1963 and is now the world largest snow and ice exhibition attracting with over one million visitors from all over the world. Attractions are the International Snow Sculpture Art Expo, the "ice lanterns" of illuminated frozen water end the extensive ice and snow buildings of the festival.

The most common form of snow construction, however, is the snow castle and ice palace. The Worlds first Ice palace was constructed in St Petersburg, Russia, build for the Russian empress Anna Ivanovna[27]. This Anna Ivanovna´s Palace was built in the cold winter of 1739-1740 by order of Anna to celebrate Russia's victory over Turkey. The Palace was 24 meters tall and 7 meters wide. Ice blocks where glued together with water and ice statues of birds and elephants were constructed in the ice garden while artillery pieces of ice protected the palace. In this first ice palace also the first ice wedding took place by the order from Empress Anna and the new married couple had to stay over night - looked into the ice palace. Since 2005 a replica of this ice palace is build in St Petersburg.

The first Ice Palace in North America was build in Montreal, Canada in 1883-1995 using 16 000 ice blocks three feet four inches square and fifteen inches thick[28]. Due to an outbreak of smallpox in Montreal 1885 St Paul quickly in 1886 build a ice palace to take over the tourist from Montreal[29]. Here the ice palace was build of 35 000 blocks of ice. The city has now build 36 ice palaces and in 2004 the ice palace hosted the NHL All Star Game and was build of 18 000 blocks of ice. Even more famous is the ice palace at the Quebec Winter Carnival in Quebec City[30] which was build for the first time in 1955. This ice castle is unique by being build by 9 000 tons of small ice bricks into a traditional shaped castle up to 20 meters high.

In Scandinavia snow castles are rare and the only one is the Snow Castle of Kemi, Finland[31] which is the biggest snow castle in the world with 20 000 square meters and includes the Mammut Snow Hotel, the Snow Restaurant and a chapel with 50-100 seats. At the theatre many opera singers and dancers have preformed. The highest towers have been over 20 meters high and the longest wall was 1000 meters long and the castle had up to three stories. A more unusual place to find an ice palace is Florida where the Gaylord Palms Resort in Orlando near Disney World each December builds a palace in ice, the ICE! walk-through attraction of carved ice winter wonder land.

From this overview we can conclude that snow and ice in a cultural context is commonly used as either a constructed attraction in the form of castles, palaces or igloos or as an art form in snow or ice sculpturing. Such snow and ice constructions are either an attraction per se or occur in combination with winter festivals and carnivals. Other cultural expressions such as snow or ice painting, ice cinema, ice theatre or ice music are more uncommon. The term Ice Theatre (or theatre on ice) is commonly associated to figure skating such as the Ice Theatre of New York[32] or American Ice Theatre[33] while traditional theatre performance in a constructed snow theatre is uncommon. Outdoor winter cinemas are uncommon but we can find one of the few a cinema made of snow and ice mad as a drive in cinema for snowmobiles in Kaotokeino in Norway[34]. Thus the border-crossing of

[25] Extracted from www.ice-hotel-canada.com
[26] Extracted from: www.beijing-visitor.com/index.php?cID=433&pID=1213
[27] Extracted from www.nationmaster.com/encyclopedia/Ice-Palace
[28] Extracted from www.victoriana.comWinterResort/wintercarnival.htm
[29] Extracted from www.winter-carnival.com
[30] Extracted from www.carnaval.qc.ca
[31] Extracted from www.snowcastle.net
[32] Extracted from www.icetheatre.org
[33] Extracted from www.americanicetheatre.org
[34] Extracted from http://news.bbc.co.uk/2/hi/entertainment/3603665.stm

traditional cultural art expressions with snow and ice are still uncommon and undeveloped. The aim of this paper is therefore to present the background of two innovative cases of snow constructions within tourism used in an unusual cultural context, the Ice Theatre at Jukkasjärvi and the Ice Dome Concert Hall in Piteå.

Method

Material for this study has been collected since 2004 both from newspaper articles, Internet search and communications with participants and stakeholders to the Ice Theatre at Jukkasjärvi and the Ice Dome Concert Hall in Piteå. By being direct involved in the Ice Music project at the Ice hotel in Jukkasjärvi and in the Ice Dome project in Piteå the author kept a project diary over meetings for project planning and meetings with stakeholders. From this extensive material the following reconstruction and description of the projects have been extracted.

The Ice Hotel

With the exception of empress Anna Ivanovna´s Ice Palace in 1739, the worlds first Icehotel was build on the bank of Torne River in the village of Jukkasjärvi located 200 km north of the Arctic Circle in Swedish Lapland[35]. The story of the Icehotel started in 1989 when some Japanese ice artists visited Jukkasjärvi resulting in a much talked-about and written-about exhibition of ice art[36]. One of the local tourist entrepreneurs Yngve Bergqvist saw the touristic potential. In the next year of 1990 he built a cylinder-shaped igloo direct on the ice of the Torne Rive, in witch an art exhibition by the French artist Jannot Derid opened. The Igloo of 60 square meters was named ARTic Hall and hundreds of visitors were amazed at the icy art gallery. During the national ski championships held in Kiruna 17 km north of Jukkasjärvi all hotels were full booked. A friend of Bergqvist, Lars Bylund at the international satellite company in Kiruna had 14 guests from USA, Mexico and Holland who had no where to stay and Bergqvist suggested the Artic Hall. Sleeping bags and reindeer furs were organized and the guests spend the night in the exhibition igloo. In the morning every one was ecstatic over the experience and the idea of an Icehotel was born. In the season 1992/1993 Yngve Bergqvist and others built the first real Icehotel and then created the company Icehotel AB.

The concept of the Icehotel developed each year and has now become known as one of Sweden's most famous attraction and a brand as famous as Volvo and Ikea. The break-trough came in 1994 when Yngve Bergqvist wanted to cooperate with an established company that could be associated to ice. He phoned Absolute Vodka but did not get any response. He therefore arranged some Absolute Vodka bottles at the icebar and let a professional photographer take some pictures and send a press release to 1000 receivers in the USA and the same number in Germany which created a success news story. Absolute reacted by sending some people to Jukkasjärvi to sponsor the icebar. The same year Absolute Vodka started a promotion program in partnership with the Icehotel. In 1997 it got international attention with the Absolute Versace campaign photographed on location in Jukkasjärvi with photos by Herb Ritts of top models Naomi Campbell, Kate Moss and Marcus Schenkenberg light dressed in Versace designs inspired by the Absolute bottle at minus 27 degrees Celsius. After that the Icehotel was also used for other promotions such as Volvos TV-commercial for the USA and a James Bond movie. Today each year 600-700 media companies visit Icehotel.

[35] Jansson, L.M. and Petterson, L. 2002.Icehotel, mat och upplevelser I Jukkasjärvi. [Icehotel – food andas experiences in Jukkasjärvi] Arena, Stockholm.
[36] Extracted from www.icehotel.com

Figure 1. The Icehotel in 2004. Photo: Hans Gelter

From the original 60 square meters the Icehotel has grown over 80 times and is now the world largest Icehotel with is planed for the season 2008/2009[37] to cosiest of 5500 square meters and build of 21 500 m^3 of snow and 900 tons of ice. In the season 2008/2009 the hotel will have 74 cold rooms. These consists of one Deluxe suite designed by especially chosen artists, 30 specially designed Art suites with special design and sculpture, 13 Ice rooms with furniture's of ice and decorating artwork of ice and 29 snow rooms which are simple but spacious snow rooms with a snowbed.

Figure 2. Designed suites in the Icehotel in 2004. Photo: Hans Gelter

In addition the Icehotel had 184 warm beds in 30 fully modern cabins, double rooms at the "Kaamos" hotel with double rooms furnished in a modern Scandinavian style, a chalet with two bedrooms and an aurora house with two separate bedrooms for 3 persons with ceiling skylight for a view of Midnight Sun or Aurora borealis. The Icehotel also contains a reception lobby, a pillar hall, film auditorium and the Absolute Icebar. The temperature in the Icehotel varies between -4 and -9 degrees centigrade, depending on the temperature outside. The Icehotel exists between December and April. Each year the design of the building and rooms change. In 2004 also140 igloos were erased on Torne River with the help of balloons and "snis" which shortened the igloo construction time by a fifth. Over 4000 ice blocks 1x2 meter weighting 2 tons are harvested in February-Mars from the Torne Rive by hydraulic equipment and special ice saws which were developed in Jukkasjärvi. Torne

[37] Icehotel Press Kit 2008

River flows 510 km from the mountains down to the Baltic Sea and is one of the few intact and unexploited rivers of Sweden. Its clear and flowing water is said to give the unique crystal clear ice as the river freezes in strong cold and fast-flowing current of 370 m^3 per second preventing air bubbles in the ice. Analyses from Umeå University confirm the ice quality where the ice contains less salts and minerals then the water of the river as well as some lower pH-value. The ice starts to form in October-November and grows to 60-70 cm thickness in Mars-April. To let the ice grow even thicker the Icehotel clears it of snow which let the ice grow up to 1m thick. The ice blocks are stored in a 1500 square meter freezing house – the Icehall Art Centre for the next years building of the Icehotel and for export of ice blocks. The Art Centre is a cool room of minus five degrees Celsius where an ice art snow exhibition is presented for summer tourists to give visitors a taste of the Icehotel. Also five igloos allow guests cold sleeping in the summer. Of the harvested ice blocks 65% are exported around the world as ice blocks to Icebars or as ice glasses "in the rocks" for the Icebars. Over 2 000 glasses can be made from one block. In the season 2007/2008 over 800 000 ice glasses were sold at the different Icebars. In the coming season over 1.4 million ice glasses need to be produces, thus an "ice plant" will be built. 1500 ton ice is used only for ice sculptures in the Icehotel. Each ice block is therefore valued to 40 000 SEK according to Yngve Bergqvist.

The construction of the Icehotel consists of ix stages and starts in end of October where around thirty local artists and builders start working using 80 million litres of water for the construction. The ice hotel opens is in the beginning of December but each week a new section is opened until the whole Icehotel is constructed to the beginning of January. It all then melts back to the Torne River in end of April. The construction technique is patent protected and developed by the concrete founder Kauko Notström. In the beginning the walls of the Icehotel were built of natural snow. As the size of the hotel grows, it became too expensive to scrape the snow from the surrounding. Instead front loaders, snow canons, **snowblower** and **snowthrower were used to create a snow material called "snis" (or** "snice"**) a snow-ice mixture that then is transported to the construction site. The snow canons can also blow the snow directly on the construction.** The construction is build so the roofs will not collapse but rather melt away along the walls in spring. The patented methods is based on arched steel mould forms some are as big as 5 metres in height and 6 metres across. The Mould forms are shaped as tunnels that are covered by the "snis" which freezes to the snow walls and roofs. After two days the mould is then moved to form a new section. The huge cupola over the icebar is reinforced by iron armouring – the only building material in the Icehotel that is not snow and ice. The 30 000 $m^3$of snis is used to build the walls and roof while the 3 000 ton ice is used to create gables, inner walls and sculptures. The ice pillars give extra strength to the self-supporting snow arches.

By the beginning of December, the main building is almost finished and the interior work begins. This continues until the end of January. With an indoor temperature of around five below zero, working conditions are relatively comfortable compared to the outdoor temperature, which can drop lower than forty below zero. Working to late in the evening, the sculptors cut and work the ice to create things like interior decorations, windows, doors, pillars, furniture, lamps and naturally - sculptures. About 25 specially invited Swedish and international guest artists from 14 countries come every year to design the décor certain rooms which all have unique design and ice installations. The varied styles of the many artists, together with the properties of the ice, create a unique atmosphere filled with mystique and surprises for the visitors as they wander from room to room.

Figure 3. Ice sculpture and the IceChapel at the Icehotel in 2004. Photo: Hans Gelter

The Icehotel was in 2007/220 visited by 24 100 day guests of which 70% are foreigners[38]. Ca 30 222 stay over night. The rooms were booked 97,5% during December to April in 2007 and 40% of the cabins during May to November. One night in double room Deluxe suite costs[39] 3500 SEK per person per night, and a single room 6900 SEK per person per night. A night in a double room Art suite cost from 1700 per person and night to 3200 SEK depending on season and weekday. A double room in the Ice room costs from 1250 to 2700 SEK per person and night and in the Snow room from 1250 SEK to 2050 SEK per person and night. Each guest spend between 1000-5000 SEK and spend on average 2,5 days at the Icehotel staying one night in a ice room and two night in warm rooms. The turnover of the Icehotel was 195 million SEK in 2007 and the Icehotel company employing 141 persons. The 28th Mars 1992 a first ceremony was held in an IceChapel at the Icehotel and since then the IceChapel opens every year the 25th December when it is taken over by the Swedish church for ceremonial use. About 150 weddings and 20 christenings take place every year and in 2006 the 1000ed wedding took place at the IceChapel. In winter 2000, a new chapter in the story of Icehotel AB began when operations were extended across the Atlantic - and co-operation began with Icehotel Québec un the area of Duchesnay outside Québec, Canada.

In 1994 the Icehotel opened an icebar that has grown as a concept and become the famous Abosult Icebar that enjoys more international fame than the trendiest bars in Stockholm. In June 2002 the icebar concept was exported as a pilot project to Stockholm where the worlds first permanent year round Icebar – the Stockholm Absolute Icebar was established in the lobby of the Nordic Sea Hotel near the Central Station in Stockholm. The 60 m^2 glass walled icebar and holds a temperature of minus 5 degrees Celsius. Twice each year the ice is substituted with new clear ice from Torne River. The pilot project expected to last three years has now developed into Stockholm's most profitable bar per square meter in 2007 where over 100 000 people have played 125 SEK to put on a silver poncho and step into the cold to get a vodka drink from ice glasses made of ice from Torne River. All ice in the bar disc, walls and sculptures are from Torne River. Each year 10-20 international articles are published and 5-10 TV-companies film in the Stockholm Absolute Icebar each month. The success

[38] Icehotel Press Kit 2008
[39] The Icehotel hompage www.icehotel.com

of the Stockholm Absolute Icebar pilot project lead to an Icebar franchise concept with the opening of the "Below Zero" Icebar in London in 2004 and Icebars in Tokyo and Milano. In 2007 Icebars opened in Copenhagen and Shanghai and the goal is to open 25 Absolute Icebars around the world, all with the same concept of an 80 m^2 icebar from Torne River. Until today about 50 unique or experimental Icebars have been constructed and over one million people have visited an Absolute Icebar. The concept has generated copy-cats such as the Icebar in Henningsvog at Noth Cape, Norway and elsewhere.

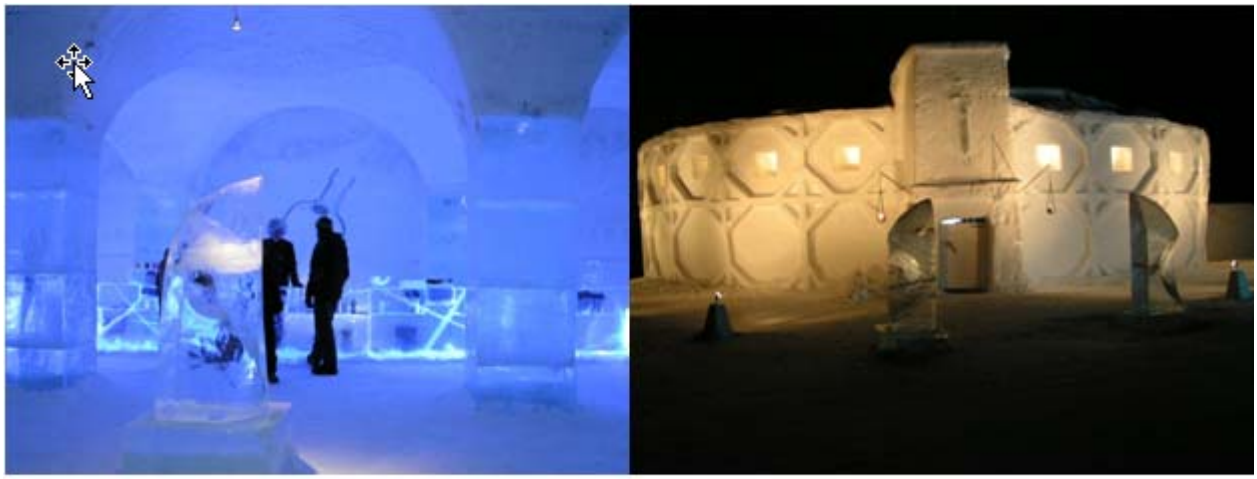

Figure 4.The Absolute IceBar and the Ice Dome Theatre at the Icehotel in 2004. Photo: Hans Gelter

The Ice Globe Theatre

Another new chapter in the history of the Icehotel began in winter 2003 with the construction of "**Ice Globe Theatre"** - a replica of Shakespeare's "Globe Theatre" on the Thames in London. As in the Shakespeare's original Globe Theatre, the performance was beneath the open sky with the guests sitting either on the ground or seated under the roof in a box. The Story of the Ice Theatre begun when the professional actor and theatre chief Rolf Degerlund in 1997 painted an aquarelle painting of an ice theatre and had a dream of being a ice theatre chief. At a lecture for the experience industry the 20th November 2001 he showed his painting and ended with *"I have a dream – to become a ice theatre chief".* The owner of the Icehotel Yngve Bergqvist hear the presentation and presented himself afterward and said "*I buy the theatre for you*". Two weeks later they met in Jukkasjärvi where Rolf told about the Globe Theatre in London where after the ice architect Åke Larsson made the blue print and the 18 December the construction began together with the selling of tickets. The Icehotel opened 13 December 2002. The cost of the construction was12 million SEK. The building was a highly interesting challenge in its own right, and the goal was to unite that bastion of the Thespian arts, The Globe, with the beauty and magic of Icehotel. The Theatre was build completely in snow in two floors 7 meter high and 31 meters in diameter. It had eight boxes for 12 persons and 424 standing places on the floor, thus slightly smaller then the original in London with 37 meters diameter and three floors.

The first performance opened the 23th January 2003 with a play of Shake spears Hamlet preformed in the Samic language. The performance was one hour and fifteen minutes with a pause where the guests could take a drink in the Icebar. The theatre group was the National Sami Theatre in Norway the "Beaivváš Sámi Teáhter" from Kautokeino and consisted of Sami actors and musicians. On the second day was a premiere for Jasat (meaning snow spots in Sami language). Jasat was a Joik and dance performance under the northern lights and a co production between Beaivvas Sami Teatre and Swedish Sami Theatre in Kiruna. A total of 74 performances were given in the IceTheatre during the first winter with 30 performances of Hamlet, 24 of Jasat and in addition 20 guest performances by

music and dance groups. All performances were given in the cold under the open sky often -35 degrees Celsius and under a clear sky with northern lights The price was 875 SEK for sitting place and 495 SEK for standing place. The performance started at 10 pm each night and the last performance was given the 6th April where after the sun melted the theatre. In 2004 the performances continued with Shake spears Macbeth in the Sami language, The Laponia IceGlobe cinema, The Opera Falstaff by Giuseppe Verdi, Northern Light Rock Concert with Yana Mangi & Enyojk and others. The IceTheatre could, however, not carry the construction costs and the concept was given up with huge economical loss.

Ice Music

Another way of using ice and snow in a cultural context beside the artistry and ice and snow sculpturing and igloo and castles constructions is to use the material for music. There are only a few musicians in the world that use snow and ice for their music, one of the most famous is the Norwegian percussionist Terje Isungset who plays on instrument made of ice[40] The worlds first public concert combining instruments of ice with traditional instrument was Terje Isungsets performance at the Lillehammer Winter Festival in 2000[41]. In cooperation with Bengt Carling, Isungset created a set of ice percussion instruments that where played for the whole world at the televised New Years Day Millennium Celebration in 2000. Fascinated by this ice music Isungset constructed string instruments and recorded the first ever all ice music CD "Iceman Is" at the Icehotel in Jukkasjärvi in February 2001[42]. A special recording studio was built at the Icehotel using 1 meter thick hard packed snow blocks which proved to be 100% sound proof. For this recording ice instruments such as ice harp. ice horn, ice trumpet, ice bass drum and other percussion were constructed. Since then several ice miusic performances have been given by Isungset in Quebec City, in IceGlobe Theatre at Jukkasjärvi, at the Sapporo Snow Festival, in Helsinki , Narvik, Geilo and others places.

This ice music tradition was picked up in 2006 at the Ice Music festival at Geilo, Norway and has since then held yearly at the first full moon of the new year. The festival consists of music and performance concerts outside and inside an igloo where all instruments are mad of ice and snow[43]. The festival is held at the frozen waterfall at the 1930 meter mountain Hallingskarvet. The festival is dedicated to nature as the moon decides the datum of the festival and the frozen water and the temperature the quality of the sounds of the ice instruments.

Ice Music at Icehotel in Jukkasjärvi

In 2003 the Swedish Polar Research Secretariat hosted the SSW 2003 Arctic Science Summit Week 30 mars – 2 April in Kiruna[44]: As a conference program and as an experiment and empirical research on ice music and concerts based on ice music a cooperation between the ice sculptor Tim Linhart[45] from New Mexico, USA, the Royal Music School in Stockholm and Swedish Polar secretary produced an six person assemble "*Voices of Ice*" which preformed at the Ice Globe Theatre at Jukkasjärvi[46]. The assemble consisted of Gunilla von Bahr, flute, Ulrika Bodén, vocal, Olle Hagson, contrabass, Jonny Axelsson, percussion, Åsa Åkerberg, cello and Susan Barett, cello.

The first performance given the 16th Mars was part of the programs "Science as Art" 16-20 Mars held at Abisko. It was the world premiere for two new written music pieces by Swedish composers, the *Ice Music Fantasy for soprano, speaker, ice instruments and an audience with warm mittens* by Karin Rehnqvist and *Of Ice and Frozen Circles* by Bill Brunson. Other preformed pieces where from Haydn,

[40] Isungset, T. homepage: http://home.online.no/~isungz/
[41] Extracted from http://home.online.no/~isungz/news_2002.html
[42] Extracted from http://home.online.no/~isungz/is.htm
[43] Extracted from www.icefestival.no
[44] Extracted from www.polar.se/assw/
[45] Extracted from www.icemusic.de/mainTim.html
[46] Extracted from www.polar.se/assw/infofiles/Pressmeddelande%201.pdf

Bach and Vivaldi. The music was written for classic instruments made of ice. The Ice orchestra consisted of two cellos, one base, ice flutes and percussions. This first performance was a struggle against the weather as the instruments where near to melt in the warm weather Two additional concerts where given 1-2 April in association to the Polar conference held in Kiruna. The Ice artist Linhart worked in Jukkasjärvi since beginning of February to build the instruments in ice by using a unique technique of blending fresh powder snow with water.

At the Queen of Sweden´s 60th birthday the 23 December 2003 The queen got a family gift to spend a night at the Icehotel. Before returning to her night in the ice suite a music performance was given in the Icebar with the queens favourite flute player Gunilla van Bahr [47]. To this performance Linhart again build his ice orchestra. However, the night before the performance for the queen, Linhart shattered the ice cello while moving it. He spent all the night patching it together and it turned out to be the best sounding cello he ever heard.

Tim Linhart builds his first ice instrument 1997 in the form of a 3 m high bas. Working for over ten years as a ice sculpture in the alpine environment of the Rocky Mountains, in places such as Taos and Vail, Linhart had been pushing the outer limits of Ice's potential as a sculpting material and discovered certain flexibility in the ice. He started sculpturing ice at age 24 hoping to score a free season ski pass in Taos while looking for a place to ski bum. He thus became a self-taught ice carver and had during his years worked for places such as Two Elk Lodge, Cascade Village and Vail Hyatt in the Vail Valley.

While out backpacking in 1997 with his friend Luthier Tony Sutherland, a guitar maker who one night played guitar music at the campfire Tim said he was thinking of building a sculpture of a violin in ice. Tony wondered if it would be able to make any sounds[48] and from that moment the idea of ice instruments became a life passion for Linhart. He constructed an 8-foot violin, known as octabass with grand piano strings and waited for the first tone of ice. The first not of the instrument sounded as music to his ears but after tightening the string the next sound was a loud pop and the instrument shattered. But Linhart was hooked, coined the word "*Ice Lutherie*" for building music instruments out of ice and decided to build the world first ice orchestra. In winter of 2000 he build an igloo near the Beaver creek ski area summit and at 3500 meters he constructed five instruments, two octabasses, a churchbasss and two cellos. In March Tim hired the Colorado Symphony Orchestra to perform an ice music concert in a dug-out snow amphitheatre claimed to be the first of its kind. In 2001 at the "Fiddling While Rome Burns" Ice Music Festival held in Taos Ski Valley, Tim Linhart recorded the 25-track "*Kiss my Ice Music*" with 6-, 10, and 12-string guitars, octabass, two ice cellos and a 10-string Irish bouzouki constructed with Sutherlands help. The concert featured music from Mozart to Hawaii-style and "Ice Cello Blues"[49].

While learning the art of ice sculpturing Tim learned to mix ice and snow to produce a slush by hand – similar to the technique used in clay sculpture[50]. A considerable skill is needed to construct the hollow instruments sometimes only 1/8 inch (0,3 cm) thick that not explode while playing on them. These instrument have to be played with extreme care and the adjustment of the proper tensions of the strings constitute a critical face of the construction and handling of the instruments. Another critical issue is temperature change which quickly can throw an instrument out of tune. Temperature can be changed both from the musician but also the heat from the audience Two years later in 2003 Tim was invited by the Swedish Polar Research Secretariat to the Artic Conference and visited the Stockholm Royal Academy of Music to study with Gunilla von Bahr, the renowned flute player, to develop flutes and percussions to his string ensemble. The concerts at the Icehotel at Jukkasjärvi

[47] Extracted from www.theroyalforums.c om/forums/f185/queen-silvias-60th-birthday-celebrations-december-2003-a-1506.html
[48] Extracted from www.vaildaily.com/article/20050219/NEWS/102190011
[49] Extracted from www.vaildaily.com/article/20050219/NEWS/102190011
[50] Extracted from http://adviceinice.com/main3.cfm?id=EDC716B9-1372-5A65-_3B4DC8A9089F4988

ended with the recording of "*Voice of Ice*" that integrated Sami joyking and the yodel of reindeer herders with the ice music.

Figure 5.Ice instruments constructed by Linhart at the Icehotel in 2004. Photo: Hans Gelter

After these ice music performances at the Icehotel Linhart developed the idea of building an ice pipe organ. During his time at the Icehotel Linhart met the ice sculpture artist at Birgitta Johansson which he later married. To learn about the construction of pipe organ Tim spent two weeks at Grönlunds Organ Co in Bigitta´s hometown Luleå. Here he builds a fleet of different sized copper pipes. He then packed snow and water onto them icing the pipes and blow warm air through the copper pipes to slip off the ice pipes. The workers at the organ factory where sceptic but when blowing wind through the ice pipes they got enthusiastic. Tim spend then thee month at the Icehotel building a 54-pipe ice organ in an extension area to the Icebar. The construction process attracted much interest among visitors to the Icebar. The construction work was sponsored by the Icehotel and the performance event sponsored by voluntary work by teachers and students from the School of Music in Piteå Under one evening of the 4th April the organ was unveiled before an audience of 450 during two concerts. After that the whole construction melted away back to Torne River.
The concert was produced by Roger Norén at the School of Music in Piteå. The performance on the ice organ was conducted by professor Hans-Ola Ericsson. The program consisted of a mixture of chorus preformed by 26 students from the School of Music in Piteå and ice music where two compositions where special written by Anders Ferm from the Music School in Piteå. The concert theme was produced by an experience production student, Jennie Lindström which consisted of the interaction between the artic mythology, the artic light and the sounds of ice and music.

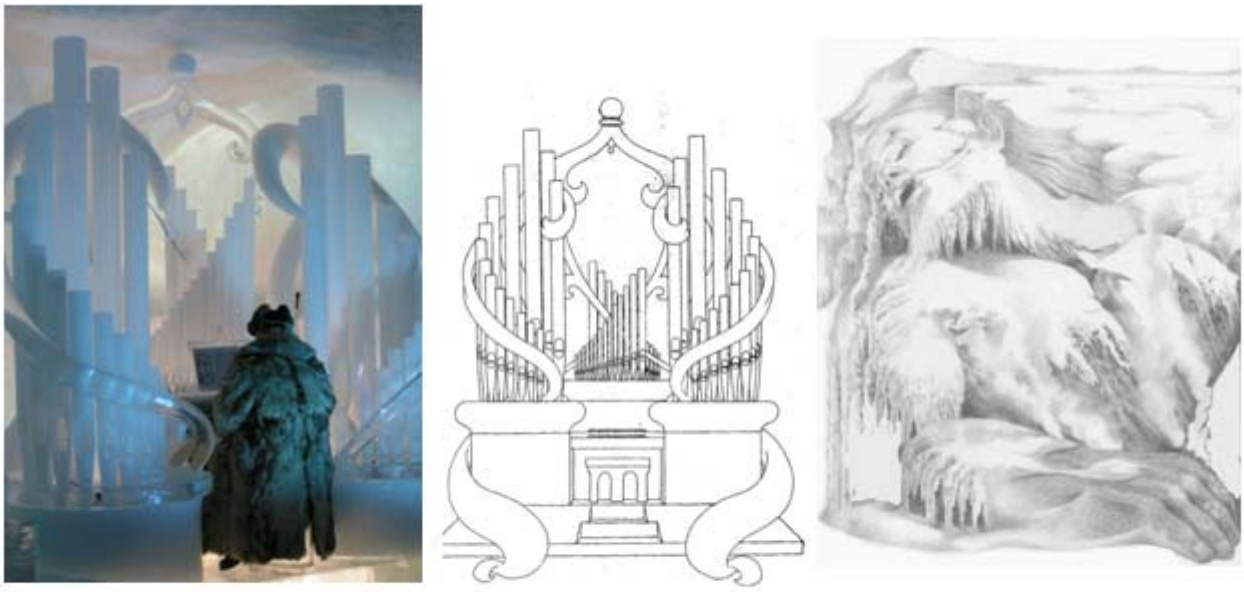

Figure 6. Ice organ constructed by Linhart at the Icehotel in 2004 and the emergence of Ymer as the concert theme. Drawing Tim Linhart (organ) and Jennie Lindström (Ymer). Photo: Hans Gelter

The theme aimed to highlight the cold of the north, the northern light, snow and ice in a mythological perspective. The concert production was based on the thematic story "*The Emergence of Ymer as the ice organ"* and the short story: *The frost giant, Ymer, creator of the Nordic world, once emerged from snow and ice. Tonight, once again – in this northern home of the Aurora Borealis and the north wind, Bore – Ymer re-emerges from the snow and ice in the form of mystical music.* This thematic story determined the dressing of the musicians such as the wolf-clad of the organist, the marketing layout, music composition and lightning of the concert. The special written ice music by Ferm was "*Improvisation on Ymer*", "*Awaiting Ymer´s re-emergence*", "*The dance of the Aurora borealis*", "*Ymer´s re-emergence*" and "*Bore´s dance*". In addition Hans-Ola Ericsson Played two organ solo "*Improvisation on snow and ice*" and "*Improvisation on the cold*". This world unique concert was much appreciated by the audiences as well as by all stakeholders and musicians.

Figure 7. Construction of the ice pipes and musicians at the concert at the Icehotel 2004. Photo: Hans Gelter

During his work with the ice instruments Linhart discovered new possibilities of instruments. When pulling out his arm of a tight ice cylinder he discovered a new sound, and created new instruments he calls the piston drum, bubble drum and unbeating drum. Thus in addition to the ice organ ice instruments consisted of a cello, guitar, flute and percussion. Although the concert was a success the instruments got problems with the temperature change in the Icebar due to the number of people which made the instruments go out of tune. This heat problem made Linhart to design the Ice Dome Concert Hall for performances that would maintain a steady temperature for acoustics reasons. It consisted of a central onion shaped dome with an opening to let the heart out anf thre ice-igloos for the audience, see figure 8.

This Ice Concert concept was presented at an evaluation meeting between all stakeholders after the concert. After the economic losses with the Ice Globe Theatre Yngve Bergqvist at the Icehotel was not interested of a new expensive "project" at the Icehotel. Therefore Gelter suggested building of an "IceLab" in the form of a larger igloo at the Music School in Piteå to develop and test ice music, ice instruments and train music students for future development of the ice music concept resulting in an Ice Dome Concert Hall as an association to the world's most northern Music school in Piteå. Gelter presented a vision developed together with Linhart to construct a three igloo dome concert hall on the sea ice outside Pite Havsbad resort which was in the process of developing a "Winter wonderland concept". The Ice Dome concert Hall could become a world class attraction and Piteå a unique destination based on the border-cross if ice/snow and music with ice music events, and snow and ice decorations on the music theme. This could complement the attractions of the Icehotel in Jukkasjärvi and Snow Castle in Kemi which all three together could attract long distance tourist for an exciting winter experience in the region.

Figure 8. The Ice Dome Concert Hall drawing by Tim Linhart.

Ice Music Ice Dome Concert Hall in Piteå

This suggestion by Gelter[51] was well received and created interest in local stakeholders in Piteå and a lobbing started both within Luleå University of Technology and the municipality of Piteå. During a meeting in spring of 2004 with the manager of Acusticum the idea of an IceLab as a first step towards an Ice Concert Hall was discussed. The Ice Lab – in the form of a snow igloo filled with instruments created by Tim Linhart would be a perfect experiment setting to learn to play ice instrument, develop new instrument, compose music for ice instruments etc. The enthusiasm among music teachers and music students was however generally low as "ice music" was probably a too strange concept to

[51] Gelter 2004. Projekt: Gestaltning av Piteå vinterstad i snö och is. Projekt Piteå Tillväxtråd Handel, Turism & Arrangemang 2004-10-18

adapt. Also Linhart´s expressed his experience with musicians as "*Musicians are some of the toughest to sell on the concept of ice music".*

This lobbing resulted in a cooperation project[52] between the school of Music in Piteå and the department of leisure and culture in Piteå Municipality where Per Lenndin coordinated the project. A found of total 105 000 SEK were raised by the stakeholders to hire Linhart to train students and staff at the municipality in ice sculpturing and producing ice instruments and present a first concert at the V.I.P. "Vinter I Piteå" festival 23-27 February 2005. Linhart also gave lectures at the school of Music and contributed in a courses of Experience production where students were o learn ice constructing and ice music experiences. A freezer room was organized to preserve the ice instruments for coming seasons. Together with staff from Piteå Havsbad ice blocks were taken from Piteå River for the ice instruments and 60m^3 snow was planed to be used for the igloo construction.

Linhart accepted this offer and negotiated with the Icehotel to hire a balloon to build a snow igloo in the same manner as Icehotel has built their Igloo-village. The Icehotel however, offered Linhart to buy a balloon that was to big for the Igloo-village. Linhart quickly bought this larger balloon of 6 meter diameter and 4.5 meter high and started to build his Ice Concert Hall in the shape of a double igloo in stead if the planed ice-lab igloo. Linhart planed to give full concerts already in 2005 instead of the planed gradual learning and development process. This came to everyone's surprise and the project had quickly to adapt to this new development. Linhart planed also to bring the balloon to Vail or Beaver Creek after Piteå and return with the Ice Dome Hall to where it all once begun.

The course Linhart was assigned to had quickly to adapt to this new situation and the 12 students at the experience production program started in January of 2005 together with Linhart to built ice instruments and the double igloo of the Ice Dome Concert Hall outside the school of music in Piteå. The double igloo was constructed for 100 persons with the ice instrument in a centre lover ditch and the audience elevated to keep the instruments cold during the concert. Linhart also educated local parks and recreation department staff in snow sculpturing and constructed a large G-clave at Piteå Centrum and a ice mermaid at Piteå Havsbad as a return for the help in harvesting ice blocks from Piteå River.

Figure 8. The igloo-baloon and the double-igloo Ice Dome Concert Hall at the School of Music in Piteå. Photo: Hans Gelter

However, the head of the Music school as well as music teachers and music students never got involved in the preparation for an ice music concert as there was a lack in resources, time, organisation and probably understanding of the innovative qualities of the project. In fact there was no formal organisation of the Ice Dome Concert Hall project. The person from the development

[52] Lenndin, P. 2004 . PM: Projekt: Gestaltning av Piteå vinterstad i snö och is. PM 2004-12-21 Piteå Kommun, Kultur Fritid

office was supportive but had no resources to lead the project. The department of culture and leisure could contribute with manpower and machinery to the project and the teachers from the study program of experience production could due to lack of time and resources only inspire students to take part in the project. As the date for the concert come closer Linhart got more and more and more upset about the slow response of the Music School to supply music students and treated to bring up music students from the Royal Music Academy in Stockholm who where engaged in the first concert for the Queens 60 celebration at the Icehotel. Some day before the concert some students volunteered to play on the instruments and a program for two days with different music styles was planed. Also media students were engaged to record and film the concert on the second day.
At the V.I.P: festival two ice music concerts were planed as part of the Music School Midvinter Festival held yearly at the V.I.P. festival. Both concerts were sold out for 250 persons. The first concert given at Saturday midnight the 26th February 2005 was according to the local press a magic experience with an exited audience. The concerts were kept to 40 minutes not to create too much heat in the igloos. The concert was given by students of the Music school including guest student Carmen Chan, a percussion student from Australia.
At the second concert on Sunday noon Linhart unexpectedly and surprisingly to the audience interrupted the concert which was to be recorded and filmed by students at the music school. His motivation was that the musical quality was to low as the music students had not rehearsed enough on the instruments. This became great news around the world and resulted in a strong reaction from the project owner Per Landin at Piteå municipality which directly fired Linhart and withdraw its resources from the project. Also the dean of the Music School Christer Wiklund broke all formal cooperation with Linhart as he defended the students as just being students and not professional musicians. This was a catastrophe for the promising ice music project. At a crisis meeting with all stakeholders Gelter suggested that in order to rescue all the work and resources that has been put into the project that the experience production student association should take over the Ice Dome Concert Hall and continue to produce ice music concerts. This solution was accepted by both the dean of the School of Music and Piteå Municipality
The students together with Linhart continued by planning six concerts at a mini snow festival called “Snöyran” given at Easter 25-27 March 2005. Professional musicians were invited to play together with music students from the School of Music in Piteå which were still interested in ice music. The concerts were preformed on an ice xylophone, bubble drums, ice cello, the world first ice violin played by Sofia Csakany from Romania, ice guitar, ice trumpets and the experimental organ pipes played by Christina Rödder from Germany. On Good Friday two blues concerts were planed, on Easter evening two concerts with contemporary music blended with folk music and on Easter Day the festival ended with two classical concerts. On Easter Day also a church service was planed and during the days children family activities were planed outside the igloos organised by the students. However, warm weather before the concerts gave troubles with the instruments and during the Easter weekend the outside temperature rose to +10 degrees Celsius. This wet snow condition together with fine weather didn’t attract the expected families for outdoor activities at the igloos and also the concerts did not fill the igloo. The first concert attracted only 50 persons and the following concerts were in the same order. This caused an economical disaster for Student association which got bankrupt as the costs for travel and salary of the professional musicians widely preceded the income from the concerts.

Ice Dome Concert Hall at Piteå Havsbad

After this double disaster the IceDome Concert Hall idea should have been dead, but the business development office at Piteå municipality found the concept so unique that the knowledge gained should not be wasted. Instead they contacted Piteå Havsbad where its MD Robert Sjölund saw a great potential to attract international guests to Piteå Havsbad during the winter season as nowhere else in the world such number of ice instruments could be experiences. The Ice Dome Concert Hall

could also be a complement to their main winter attraction the Ice breaker that attract over 2000 tourist each year, most international guests from Italy, Spain, Germany and France. Piteå Havsbad also had plans of building a "Winter Wonder Land" at the beach of the Baltic Sea where ice music would fit fine. Sjölund agreed to invest in the project together with destination development resources from Piteå Municipal.
The plan was to start a pilot project to develop the full Ice Dome Concert Hall according to Linhart´s original blueprint with a central high onion shaped dome of 15 meters for the instruments where the onion shape will allow the warm air to leave the dome at the top. Around this onion dome three igloos should give sitting places for the audience. Linhart started to prepare for this project by buying a used warm air balloon and re-sew it as an onion-shape balloon At a preparing meeting between the Piteå municipality, Piteå Havsbad and researchers in snow construction at Luleå University of Technology it was, however, decided that for safety reasons only the three igloos would be constructed in the 2006 project. The three igloos could take 200 guests but at each concert the number was limited to 150 to reduce the heat production as the heat-outlet was not included in this construction. Also each concert was limited to 45 minutes to reduce temperature shift influencing the instruments.
Piteå Havsbad coordinated the pilot project and invested 500 000 SEK and Piteå municipality contributed with 100 000 SEK for the construction of the ice concert hall. The production was not intended to give any revenue this first year but was planed as a test year to learn the building process. By freezing the instruments in freeze room in Öjebyn more instruments could be recovered from the preceding year and be saved for the coming years. Pite Havsbad hired a project leader for the concert production and the construction work began on the beach of the Baltic Sea outside the Piteå Havsbad resort. The construction on the sea ice as the original suggestion by Gelter was decided to be too complicated at this stage.
Eleven professional musicians from Sweden and Switzerland and music students from the school of Music in Piteå were hired to play on the ice instruments. The music program was compiled by Joacim Casagrande. Seven string instruments of guitar, cello, contrabass, violin, and altviolin together with ten flutes, ice xylophone and seven ice drums were used. The instruments were lightened in blue and red led lights to create an exotic experience.

Figure 9 Ice Dome Concert Hall at Piteå Havsbad 2006. Picture by Piteå Havsbad

Six concerts were conducted at an "Ice music festival" at Piteå Havsbad during the 16-19 mars 2006. For the opening concert the 16 mars 2006 120 guests were specially invited and a total of 850 persons visited the ice music concerts in 2006.[53] The Ice Dome Concert Hall attracted much interest and the Munich symphony orchestra had announced their interest to give a concert in 2006 but had to cancel in a late stage and Linhart had plans to engage *Kraftwerk* who also were interested of the concept.

[53] Robert Sjölund, MD Piteå Havsbad– pers. com.

Figure 10. Inside the Ice Dome Concert Hall at Piteå Havsbad 2006. Picture by Piteå Havsbad

The high construction costs together with uncertain climatic conditions in the future lead to the decision by Piteå Havsbad that they could not by themselves take the full cost of the Ice Dome Concert Hall. During the discussions in the summer of 2006 of the future of the project Linhart went of and looked for sponsors in central Europe for the winter 2006/2007 season. His idea was to build the Ice Dome Concert Hall on a glacier as a year round construction. He managed to get foundlings and financial help from USA for such a project on the top of a glacier in Schalstal in Italy[54]. Here a 2000 meter cableway takes the guests up to the hotel Grawand at 3000 meters elevation. About 500 meters from the cableway station Linhart has build a double-igloo Ice Concert Hall at 3200m elevation on the Val Senales glacier.

Figure 11. Ice Dome Concert Hall at Schnalstal in 2008. Picture extracted from Open PR[58] and Schalstal.com.[59]

The concert hall is built with a central domed camber 20 meters high and with side chambers for 160 visitors.[55]. Linhart transported with the help of a freezer trucks the ice instruments constructed in 2005 and 2006 from Piteå to Italy. The Ice Dome Concert Hall opened the 18th February 2007 and has since then regularly given ice music concerts every Sunday and at special Ice Music Festivals[56]. This

[54] Extracted from www.schnalstal.com/
[55] Extracted from www.meranerland.com/en/culture/highlights/icemusic/
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move by Linhart to Italy left the Piteå ice music project to a halt and uncertain future but there are initiatives by Gelter[57] and others to continue the project.

Conclusions

This report of two innovative snow construction projects that border-cross the traditional cultural context of theatre and music with snow and ice shows the great experiential and touristic potential of such projects. At the same time several problems are associated with such projects. The most obvious that resulted in financial problems both with the Ice Dome Theatre at Jukkasjärvi and the Ice Music Concert Hall in Piteå are the high construction and production costs compared with the relative limited income during a short period available for performances. This problem is accentuated by climate change problems where the winter season even in northern Sweden appear to become more unstable affecting the time available for the return of cost. This has Linhart solved by constructing the Ice Dome Concert Hall at 3200 meters elevation, which however result in other problems such as access and material transport costs as well as high altitude fatigue among workers, musicians and audience. The projects have however taught us that high quality experiences can be produced based on traditional cultural art in combination with snow and ice. Further research on methods to reduce both construction and production costs and as well as the economical calculations and project management for such projects should be initiated.

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Microbial Life in Polar Region

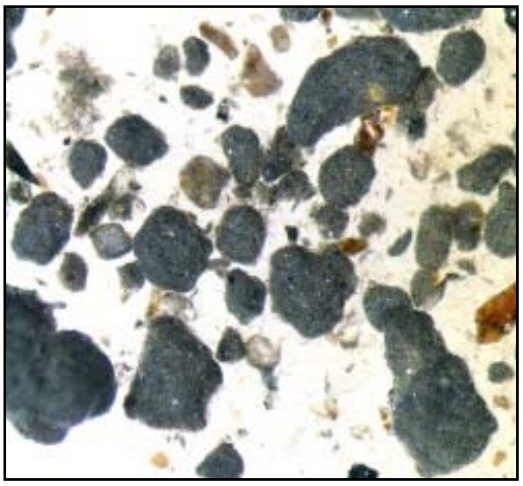
Introduction

Snow and ice as habitat: The snow and ice are dynamic systems as the balance between frozen and liquid states due to periodic uptake and loss of the heat and are subjected to large physical and chemical changes. The snow and ice have low thermal conductivity and they play the role of an energy bank which stores and releases energy that enters the ecosystem. Snow and ice mediates light between the atmosphere and the ground due to their radiation reflective properties, largely influenced by biota especially by snow and ice algae. Snow and ice can be regarded as a reservoir of water that provides habitat and food for microbes and small invertebrates. Frozen environments are extremes as temperature, radiation levels, low level of nutrients, and desiccation. In spite of such rash conditions, snow and ice frequently support relatively abundant populations of microorganisms and some invertebrates. Ice, snow and organisms form particular ecosystems with very characteristic food webs and nutrient recycling dynamics. As a result of their activity, microbes may affect physical properties of the environment reducing the wave reflectance. (Pomeroy et Brun, 2001). Since the activity of microorganisms depends on the presence of liquid water these food webs are often active for only a limited period of time (Thomas, 1995; Hoham et Duval, 2001).

Microbial Ecosystems in Polar Regions

Cryoconite holes: Cryoconite holes are vertical cylindrical basins in the glacier surface. They contain liquid water and deposits of dark granules called cryoconite. The granules include microorganisms, organic matter and mineral particles. Size of the granules is usually from 0.5 - 2.5 mm in diameter and a cross section shows that each granule consists of mineral particles and spherical algal mats. Annual growth of the cyanobacteria forms a layered structure of the granule. Filamentous cyanobacteria grow at the surface of cryoconite granules where they form a dense layer by entangling each other, thus maintaining the spherical shape of the granules. Living cyanobacteria colonize only the surface since they need light for photosynthesis. As cyanobacteria grow, the size of the granules increases and decaying cells, organic matter and mineral particles are trapped inside the granules. Heterotrophic bacteria are also an important component of this miniatural ecosystem and they usually are growing attached on the cyanobacterial filaments. They decompose senescent and dead cynobacteria cells releasing the mineral nutrients needed for the photoautotrophic component. In temperate regions and in some polar habitats, cryoconite holes may harbor a more complex living community such as algae, rotifers, tardigrada, and ice worms (Takeuchi et al., 2001). Since they exhibit specific dynamics of energy flow and nutrient cycling it has been suggested that these systems would be microecosystems with distinct boundaries. Following the observation that inactivation of the microorganisms resulted in holes 10% less deep than those with living and active biota (McIntyre, 1984) it has also been suggested that living organisms might play significant roles in the glacier dynamics. In the McMurdo Dry Valleys, Antarctica, due to the air temperatures below freezing and strong winds cryoconite holes have an ice cover. Beneath the ice lid, sediments continue to melt due to local greenhouse effect where solar heating is sufficient to raise the tmeperature to the melting point. The sediments provide a mechanism of increased absorbtion of

solar radiation and the holes will deepen to a depth where solar radiation is reduced and cannot provide sufficient energy for melting (Fountain et al, 2004). This mechanism is supported by most data field experiments showing that formation of holes enhances during clear whether with strong solar radiation. In the Taylor Valley, Antarctica, Fountain et al (2004) showed that area of cryoconite holes represented about 4-6% of the total ice surface. In this region, size of holes commonly ranged from 5 to 145 cm in diameter while their depth varied from 5 to 145 cm, but exceptionally some holes can have larger dimensions, of 5 m depth and 30 m diameter. The cryoconite holes in the Mc Murdo Dry Valleys is a complex subsurface hydrologic system with interconnected passages between holes that can generate in some cases about 10% of the observed runoff (Fountain et al., 2004). Little is known on the contribution of living community to the melt water runoff and mass balance of the glaciers not only in polar regions but also in more temperate regions. Based on the data collected in Himalaya glaciers, Takeuchi et al (2001) support the idea that living organisms inhabiting the cryoconite holes might be responsible for a significant proportion of melt water runoff. Most probable, the direct heat released during the metabolic activity of the whole community is too low and therefore its contribution could be insignificant to the melting of ice.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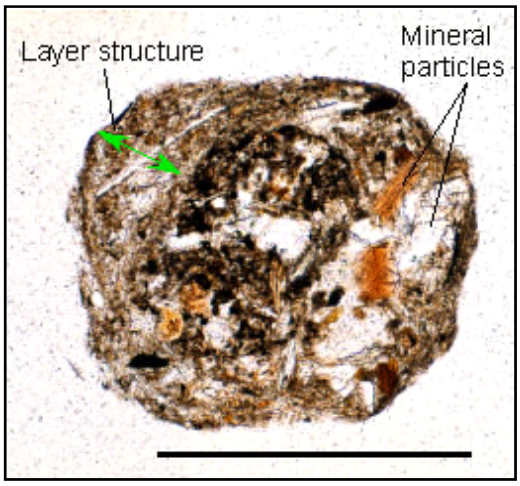

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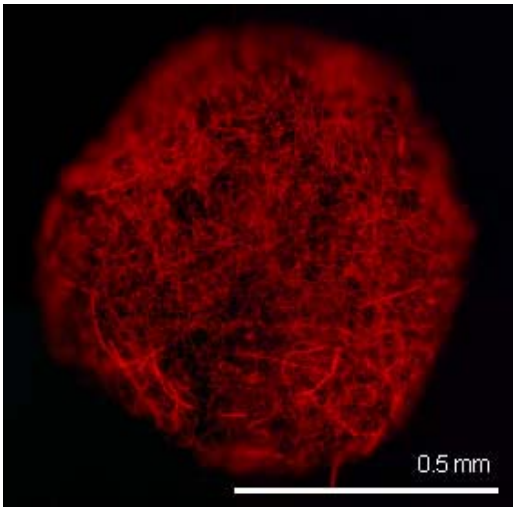

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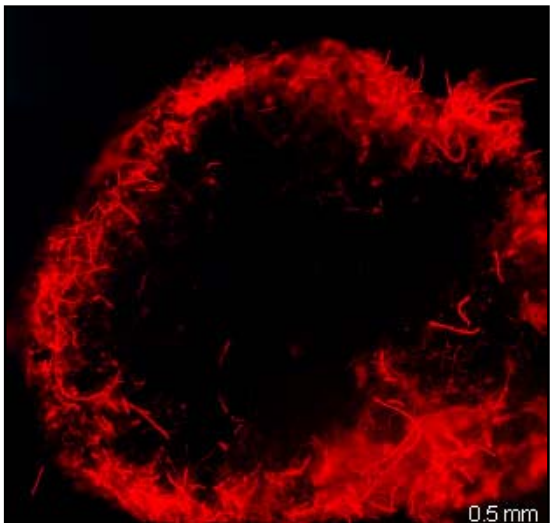

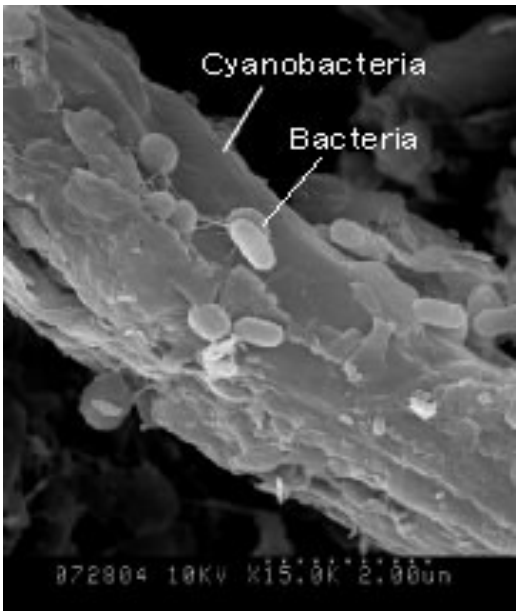

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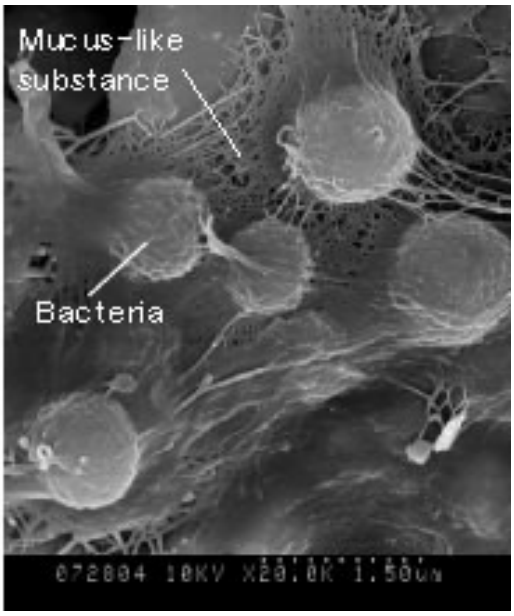

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Figure 1. Cryoconite granules and microorganisms. a – cyroconite granules; b –cross section of a cryoconite granule; c, d – filamentous cyanobacteria on the cryoconite surface; e, f – scanning microscopic images of cryoconite showing filaments heavily colonized by bacteria (Courtesy of Nozomu Takeuchi, Chiba University, Japan)

On the other hand, as a result of the organisms growth, a significant amount of material acumulates and increases the absorbtion of solar energy. We can speculate that the living community thriving in the cryoconite holes promotes indirectly the melting and mass loss of the glaciers.

Microbial endolithic life

An efficient microbial strategy to cope with harsh conditions such as high light intensity, high UV radiation, freezing and dessication etc is the retreat inside rocks. Colonization of hard substrata is an ancient mechanism to conquest and survive in new inhospitalier habitats. Microorganisms can grow at the surface of rocks (epilithic growth), within macroscopic cracks (chasmoendolithic growth) or in the subsurface pore space (cryptoendolithic growth). In Antarctica, epilithic growth is generally scarce and restricted to zones more clement and protected from strong dry winds and with sufficient humidity. In the Mc Murdo Dry Valleys, strong winds and dessication are extreme conditions which strongly inhibit the microbial growth on exposed rock surfaces. In such environments, endolithic growth seems to be a useful survival strategy. The endolithic region may provide a relatively constant microenvironment where microorganisms are protected against freezing, high UV radiation, and rapid freeze-thaw events. In Antarctica, cryptoendolithic microbial growth is characterized by a layered pattern as a result of the shift from active growth during summer to dormant state in winter. In the endolithic pore space microorganisms are protected against freezing due to the thermal inertia of rocks. Mc Kay and Friedmann (1985) have observed that freezing in the enolithic zone rarely occurred even if the air temperature was -15 - -20^{o}C. The thermal inertia of the rocks is also important in maintaining a constant microenvironment where microorganisms are also protected against rapid freeze-thaw changes. This characteristics have a great importance in extreme environments like Mc Murdo Dry Valleys where temperature fluctuations are large and frequent at the surface of the rocks.

Structure of the rocks as well as their characteristics can largely influence the growth of microorganisms and colonization of the endolithic space. It is expected that lower porosity (small pore dimension) should hinder the growth of larger microorgansims such as filamentous

cyanobacteria. Relative air humidity has a strong effect on the microbial activity in the endolithic space. In arid zones of Antarctica, far from littoral region, the main factor restricting the endolithic life is dessication that along with extreme low temperature mark the limits for life. It is well known that under 70% relative air humidity the photosynthesis stops and whole microbial community cannot survive. This can explain the lack of epilithic life in arid regions of Antarctica, like Mc Murdo Dry Valleys. In Antarctica, living organisms need also to cope with elevated UV radiations, especially during spring as a result of the depletion of ozone column. Data field experiments show that in the endolitic zone living microorgnisms are well protected from UV damage.
Cockell et al, (2003) explored the the microbial diversity of gneissic endolith in Arctic and they found a lower diversity in comparison with Antarctic despite much more clement conditions as air temperature and humidity. They explain the lower diversity as a result of water flow through the rocks and the irregularity of the porespace distribution. The presence of abundant liquid water in the Arctic might hinder the establishment of well-defined microzones. The more homogenous pore space distribution of the Antarctic sandstones allows microorganisms to colonize specific depth with well-defined vertical gradients of nutrients and light providing the microenvironments for different microorganisms. In contrast, the Arctic gneisses are irregular with important consequences on colonization and diversity of microorganisms. These authors speculate that with the increasing global warming, Antarctica will experience a reduction of endolithic communities diversity as a result of increasing water flow through the rock that could alter the subsurface colonization.

Microbial ecosystems of polar oceans

Sea ice microbial communities: Sea ice provides a support matrix for a variety of microorganisms, including microalgae and prokaryotes. Sea ice microbial community is a diverse and dynamic assemblage of organisms found at both poles with unique adaptations to cold environments. During the freezing process salts are excluded and sea-ice brines form within the ice matrix. These salted pockets are often enriched in dissolved organic and inorganic nutrients and provide a specific habitat for microorganisms. Sea ice organisms include both free-living and attached microorganisms, capable of rapid growth. They are usually larger than pelagic bacteria, belonging to true psychrophiles (Brinkmeyer et al, 2003; Junge et al, 2002). The phylogenetic composition of the sea-ice assemblage is an important topic of research. Data of 16S rRNA gene sequencing show that most of psychrophilic species are characteristic to the sea-ice habitat. Majority of sea-ice bacteria belongs to the Bacteriodetes, Actinobacteria and Proteobacteria phyla. In polar oceans, widespread species fall into genera: *Glaciecola, Psychrobacter, Psychroserpens, Flavobacterium, Octadecabacter* (Junge et al, 2002).
Bacterioplankton: In Antarctic and Arctic waters bacterioplankton exhibits strong seasonal fluctuations as abundance and species composition. Its activity follows algal blooms and is similar as intensity to that in warmer waters. In winter, bacterial production is much lower due to reduced photosynthesis and carbon limitation, but not to colder water temperatures. There are reports indicating that the shift from winter to summer is also accompanied by changes of community composition (Murray et Grzymsky, 2007). Heterotrophic microorganisms recycle the organic matter released by phytoplankton while chemolitoautotrophic ones mediate transformations of inorganic nutrients (nitrogen, sulfur) (Hollibaugh, 2002). Majority of species inhabiting polar oceans belongs to the Proteobacteria, Actinobacteria and Bacteriodetes groups (Bano et Hollibaugh, 2000) with compostion more or less similar to warmer waters. Diversity of microorganisms is high and most of species are common to both poles. Widespread groups such as SAR86, SAR11, *Flavobacterium*, *Roseobacter* can be detected in polar waters. Unlike other oceanic systems, cyanobacteria seem to be absent in polar oceans or at least they are scarce as species and abundance. Most bacteria inhabiting cold waters are psychrophilic and their genome contains sequences that code for molecules providing increased cold tolerance such as nucleic-acid binding proteins, modification of aminoacid composition as well as molecules involved in specific molecular interactions (Grzymsky et

al, 2006). As regard Archaea from polar waters, it seems that its members follow a different spatio-temporal dynamics than those from lower latitudes oceanic waters. Crenarchaeota is a major group found in surface waters while deeper regions are the characteristic habitat for Euryarchaeota (DeLong et al, 1994).

Polynyas – "windows into polar oceans"

Polynyas are limited areas of open water that can be detected by remote sensing as zones of reduced to absent ice cover throughout the year. They exhibit high productivity due to the particular dynamics of light, temperature, and nutrients that support short-term and dramatic blooms (Lovejoy, 2002). These areas are usually more active as microbial communities (Hollibaugh et al, 2007) than those found under adjacent ice cover.

Most studied polynyas are the Ross Sea Polynya (RSP) in the Antarctic, the Northeast Water Polynya (NEW) and the North Water Polynya (NOW) both in the Arctic. There are several mechanisms involved in genesis of polynyas: a) activity of winds blowing off the ice shelf and advecting the sea ice; b) ice exported from the region by an surface current; c) reduction of new ice formation during spring with the increase of solar radiation. Open water areas reduce the albedo of the surface water, allowing greater absorbtion of solar radiation that stimulate the ice melt and surface water warming. Light can penetrates deeper in the water column allowing the appearance of phytoplankton and ice-algae blooms. The most important characteristics in the Ross Sea Polynya (RSP) – the largest in the Antarctic – is the dominance of *Phaeocystis antarctica* which influence indirectly the bacterial communities dynamics by release of dissolved organic matter (DOM). During a bloom of *Phaeocystis*, bacterial abundance has increased from October ($1x10^8$ cells L^{-1}) to February ($2x10^9$ cells L^{-1}) (Ducklow et al. 2001). Within the same period bacterial production rates have also increased from October to February (Ducklow et al., 2001) and growth efficiencies had a mean value of 25% over the same period (Carlson, 1999). All dissolved organic carbon – about 20% of the total primary production - produced over this period was consumed by bacteria (Ducklow, 2003). Most data show that bacteria are capable of rapid growth even at annual minimum of temperature. Their growth was not affected by substrate addition indicating that bacteria were growing at almost maximum rates.

The Northeast Water Ploynya (NEW) is situated in the permanent ice of the continetal shelf of Northeastern Greenland. It is a seasonally active polynya, a summer polynya, that opens in May and closes by September-October. It was the topic of a intense, multi-disciplinary, international research project during 1992-1993. These studies revealed that bacteria were always promptly and able to respond to small increases in their nutrient supply even at subzero temperature (Yager et Deming, 1999). In the NEW bacterial production value ranged from 0.08 to 23.3 mg C m^{-3} d^{-1}, comparable to rates observed in the Ross Sea Polynia. The efficiency of incorporation of substrata decreased during short-term warming experiments, but it was higher at low *in situ* temperature (Yager et Deming, 1999). Another interesting observation is that bacteria used DOC (dissolved organic carbon) with minimal respiration. The general emerging picture is that heterotrophic potential in the polynyas is similar to other temperate an polar seas.

The North Water Polynya (NOW) is generated by winds and ice advection southward from Nares Strait. It is the largest and most productive polynya in the Arctic (Deming et al. 2002). Diatoms are the main primary producers (Lovejoy et al. 2002) and blooms starts usually first in the southeast region (April) followed by the second in the northern region (May). The bacterial abundance was generally higher than in the NEW and ranged from $0.4\text{-}1.6x10^9$ cells L^{-1} (Middelboe et al. 2002) while bacterial production presented a mean value between 17-123 mg C m^{-2} d^{-1}. The system was net hetrotrophic and bacteria metabolized 44-46% of the primary production while the bacterial growth efficiency was 25-30%. Bacterial growth in the NOW seemed to be carbon limited since addition of glucose enhanced the growth. Bacterial hydrolytic activity was high similar to that found in temperate environments and correlated with the seasonal changes in food quality (Middelboe et al. 2002). In the polynyas, bacteria are adapted to respond quikly to organic matter enrichment

resulting from algal blooms. Bacterial growth, bacterial production and the efficiency to take up substrata are similar to temperate regions. Most data field support the idea that activities of bacteria are not limited by low temperatures of polar regions. Polynyas are regarded as climate sensitive environments that could largely change with future warming (Ducklow et Yager 2006). Along with their spatial changes, the polynyas may experience changes in bacterial communities, their activities as well as the pattern of biogeochemical cycles. Ducklow et Yager (2006) speculate that increased terrestrial DOC input and warming could lead to increased bacterial respiration in the Arctic and could alter the CO_2 balance as a result of the increased gas release.

Adaptation to cold environment

Microorganisms characteristic for ice and snow include both psychrophilic and psychrotrophic organisms. They have in common the ability to grow at or below 15°C, but differ as temperature of the maximum growth rate. To successfully colonize frozen environments, microorganisms have adopted specific strategies, ranging from cellular to molecular level.

A fundamental mechanism of microorganisms to cope with freezing is to maintain the fluidity of cell membrane. This has been achieved through the accumulation of polyunsaturated fatty acids within membrane by incorporation of short-chain, branched, or cyclic fatty acids and thus cells avoid the rigidification of the membrane normally occuring at low temperature (Los et Murata, 2004; Morgan-Kiss et al, 2006). Microorganisms growing on ice surfaces are also exposed to high light intensity and intense UV radiation (Gorton et Vogelmann, 2003). The optimal function of the photosynthetic electron transport system chain is based on the correct folding of its proteins process that largely depends on the fluidity of membranes. At low temperatures the chemical reaction rates are more reduced in comparison to microorganisms living in warmer environments. A potential mechanism of microorganisms to compensate the reduced metabolic rate at low temperature is to increase the concentration of enzymes. However, this strategy is used by a few organisms because it seems that it is not energetically efficient (Nichols et al, 2000). Most of cold adapted microrganisms have instead specific enzymes with higher catalytic efficiency (*k*cat/*Km*) that compensate the reduction reaction rates at low temperatures (Gerday et al, 1997). It also seems that cold adapted organisms contain an elevated concentration of ATP as a supplementary mechanism to avoid the reduction of the metabolic reactions at low temperatures (Napolitano et Shain, 2005). The energy absorbed by organisms living in permanently cold environments is higher than that consumed by metabolic processes. These organisms need to have mechanisms in order to maintain the energy balance either by reducing the effective absorbtion of light or by dissipating the energy as heat (Falkowski et Chen, 2003). Algae and other microorganisms occurring at the snow and ice surfaces are frequently exposed to high levels of radiation. For example, *Chlamydomonas nivalis* receives high light level due to the radiation reflected off the snow (Williams et al, 2003). Its cells are capable to synthesize high levels of the secondary carotenoid astaxanthin responsible for red snow. Astaxanthin accumulates around the chloroplast and absorbs wavelength of around 474 nm protecting the cell from the shorter wavelengths. At the same time, algal populations can be exposed to high level of UV radiation with inhibitory effects on the growth and photosynthesis. UV radiation have detrimental effects on the nucleotides, proteines, and other cellular components (Tyrell, 1985), prolonged exposure can cause even the cell death. Astaxanthin is screening UV wavelengths and provide an efficient photoprotective mechanism for the chloroplast in *C. nivalis.* (Hagen et al, 1993). Another mechanism to avoid the UV damages by snow algae is the accumulation of phenolics (Duval et al, 2000) and amino acids (Gorton et al, 2003).

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Future perspectives on tourism in Antarctica

Abstract

Tourism in Antarctica has grown rapidly over the last two decades and diversified into different modes of transport and activities. Faced with these trends, stakeholders have started to express concern about the increasing accessibility of the Antarctic, issues of safety, the implications of regulation and potential impacts of tourism growth. In the last 10 years the tourism debate has become one of the central debates at Antarctic Treaty Consultative Meetings, however not many comprehensive regulations have followed. In view of the developments in the Antarctic tourism industry, a number of academic authors and organisations argue that a more strategic and long term perspective on Antarctic tourism development and governance is needed, in order to safeguard sustainable development. Reconciling some of the main differences between stakeholder perspectives is an important process in the development of such a long term Antarctic tourism policy.

This paper aims to analyse the main differences between stakeholder perspectives in the Antarctic tourism debate, with a focus on the future. The Antarctic Tourism Opportunity Spectrum (ATOS) (Lamers, et al. 2008) will be used as a conceptual tool to elicit key future questions related to Antarctic tourism development. The well-established Cultural Theory (CT) (Thompson, et al. 1990) will be applied to understand the differences in stakeholder perspectives regarding these future questions. The material used in this study was derived from a range of interviews with key stakeholders in Europe, North America, and Latin America, complemented by literature review. Stakeholder perspectives are analysed on a number of potential future pathways, including the increasing scale of ships based operations, the diversification of tourism activities, the development of a land based tourism infrastructure, forms of government supported tourism, and the changing intensity of industry self-organisation. Based on our analysis a number of recommendations will be formulated towards the development of a broadly supported longer term policy for tourism in Antarctica.

Introduction

The last two decades have seen a rapid development of tourism in Antarctica with increasing visitor numbers, from a few hundred to almost 45.000 (IAATO 2008), and a diversifying supply of transport modes and activities (see Figure 1). It has been argued that in recent years operational strategies in Antarctic tourism have been increasingly dominated by economies of scale, in addition to the traditional niche tourism products (Lamers, Haase et al. 2008). Antarctica is a special tourism destination for a number of reasons, i.e. the extreme climatic and weather conditions, the short four to five month season, the unique ecosystems and wildlife populations, the inexistence of an indigenous population, the sparse human (infra)structures, the relatively limited human activities,

and the successful tailor-made international governance system. These characteristics are often considered intrinsically connected to the Antarctic continent, unchangeable, and independent from external globalization processes. If these inherent Antarctic conditions remain untouched remains to be seen and cannot be guaranteed.

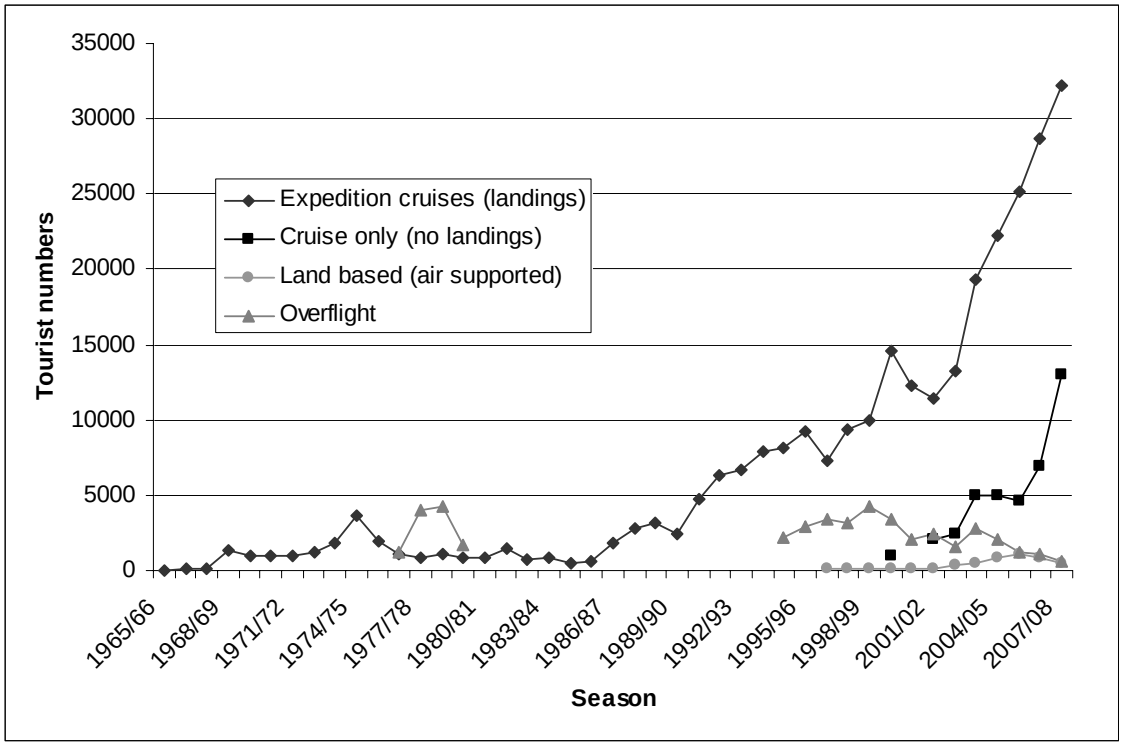

Figure 1: Tourists visiting Antarctica in different industry segments 1965-2008 (Enzenbacher 1993; Headland 1994; IAATO 2005; IAATO 2006; IAATO 2007; IAATO 2008; Headland Forthcoming)

In view of these developments, many stakeholders and academic authors are becoming concerned about Antarctic tourism. Recent policy discussions at Antarctic Treaty Consultative Meetings (ATCMs) reflect these concerns and focus on the need for additional legal instruments and measures, such as site-specific guidelines and shipping standards, to mitigate some of the negative effects of tourism. A range of authors (Bastmeijer and Roura 2004; Molenaar 2005; Amelung and Lamers 2006; ASOC 2006) argue that, in addition to these rather reactive measures, a more proactive long term tourism policy is needed, based on a strategic vision on Antarctic tourism. Recently, the tourism industry and a number of Antarctic Treaty Parties have taken up this idea of a strategic tourism policy vision (Antarctic Treaty System 2008; Scully and IAATO 2008; United Kingdom 2008). At the same time, discussions clearly indicate that different parties and stakeholder groups have different views on a number of strategic issues, such as the use of large cruise ships and the development of land based tourism infrastructure (Bastmeijer, et al. 2008).
Understanding and reconciling these different stakeholder perspectives is the key to the development of a long term strategic vision. Some recent work has been done before on this issue (Stewart, et al. 2006; Haase, et al. 2007) but never specifically focused on future issues in a theoretically based manner with a wide range of stakeholder input. In this paper the main points for the future will be identified and analysed using stakeholder interviews and the Cultural Theory (Thompson, et al. 1990). The discussion of this paper will focus on the consequences of these different perspectives for policy making.

Methodology

Data

To obtain insights from key-stakeholders interviews were conducted with fifteen international stakeholders and experts in Europe, North America and South America. During these interviews a semi-structured interview guideline was used reflecting the issues discussed during the workshops. Interviews were audio-recorded, transcribed, and sent back to the interviewees for revisions and consent. To maintain the confidentiality of the data interviewees remain anonymous and a coding system will be used to refer to interviews (for details see Table 1).

Coding	Category	Profile	Date
O1	Organiser	Sales and marketing director of expedition cruise company (< 200 passengers) in the USA.	16-6-2007
O2	Organiser	Executive director of industry association	7-6-2007
O3	Organiser	Expedition leader of expedition cruise company (< 200 passengers) in the Netherlands.	27-11-2006
O4	Organiser	Expedition leader of expedition cruise company (> 500 passengers) in the USA.	22-6-2007
O5	Organiser	Director of expedition cruise company (< 200 passengers) in Canada.	12-6-2007
O6	Organiser	Director of Antarctica cruise agent company in Argentina.	19-2-2008
M1	Monitor	Antarctic tourism researcher and lecturer on board Antarctic tourist ships in the UK.	6-6-2007
M2	Monitor	Antarctic tourism researcher and university lecturer in the UK	8-6-2007
M3	Monitor	Environmental officer for national Antarctic programme in the USA	14-6-2007
M4	Monitor	Logistical director for national Antarctic programme in the USA.	14-6-2007
M5	Monitor	Environmental officer for national Antarctic programme in Argentina	18-2-2008
R1	Regulator	Antarctic policy maker in USA	13-6-2007
R2	Regulator	Antarctic policy maker in Chile	15-1-2008
R3	Regulator	Policy maker at Antarctic Treaty System secretariat in Argentina	19-2-2008
R4	Regulator	Policy maker at Antarctic Treaty System secretariat in Argentina	19-2-2008

Table 1: Categorisation and coding of interviewees

Interview questions were based on the results of three stakeholder workshops, organised in the Netherlands and New Zealand and the factor analysis resulting from these workshops. The conceptualization and integration of these development are factors resulted in the Antarctic tourism opportunity spectrum (see Figure 2), published in an earlier article (Lamers, et al. 2008). The model provides and integrated view on the factors that determine the opportunities for Antarctic tourism development, i.e. accessibility, other resource users, existence of tourist infrastructures, facilities and attractions, operational factors, acceptability of impacts, and regulation and management. The

model also illustrates that development factors are susceptible for change both inside and outside the Antarctic tourism system (e.g. climate change, global economic developments, etc.).

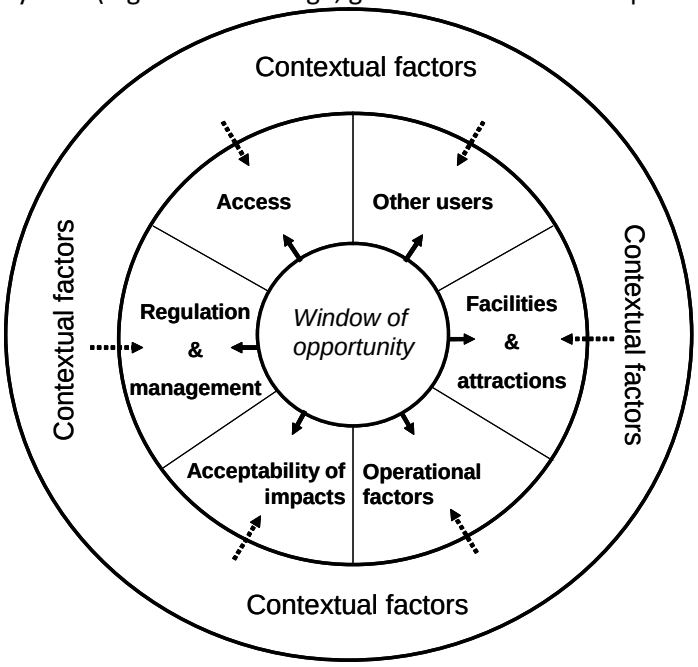

Figure 2: Overview of factors influencing future Antarctic tourism development opportunities (Lamers, et al. 2008)

Analysis

An iterative and modified constructivist grounded-theory approach as suggested by Pidgeon & Henwood (2004) guided the analysis of the interviews with themes and categories both prescribed by the topic guide used during the interviews and emerging from the data. This way the most pressing future issues related to Antarctic tourism development were derived.

Second, a comparative analysis of the different perspectives was performed using the Cultural Theory, a well-known theoretical framework in analyzing risk perceptions and perspectives in environmental studies (Thompson, et al. 1990). Cultural theory postulates that there is consistency between people's evaluation of uncertainties in various fields and on different issues. It provides a set of five highly stylised perspectives, labelled "individualist", "hierarchist", "egalitarian", "fatalist", and "hermit". The last two perspectives are passive and will not be discussed here. All perspectives consist of both a world view and a management style. According to the individualist worldview, nature and society are robust; the preferred management style is one of "laissez-faire" and markets. The egalitarian worldview holds that nature and society are fragile and can be easily disrupted; the preferred management style is one of consensus building. According to the hierarchist worldview, nature and society can be used an exploited to a certain limit; the preferred management style is one of regulation. This theoretical framework was applied and resulted in a perspectives map in which these stylised perspectives were defined for the Antarctic tourism case (see Table 2). This perspectives map was used to analyse the main differences between the views coming from the interview material.

Category	Aspect:	Hierarchist	Egalitarian	Individualist
Worldview	Value of Antarctica	Continent with several functions	Pristine wilderness	Attractive destination
	Perception of problem	Serious problem but manageable	Large problem and unmanageable	No problem and manageable
	Ecosystem	Not vulnerable when kept with limits	Very vulnerable for external shocks	Not vulnerable to external shocks
	Trust in technology	Reserved attitude: careful assessment needed	No trust: only when focused on sustainability with minimal risk	Great trust: unbridled and opportunist
Management style	Priority of functions	Science: existing human function and high societal value	Ecology: all human functions are equal	Business: self-realisation and innovation
	Responsibility	The Antarctic Treaty System	Everybody	Individuals and companies
	Process structure	Norm setting by expert knowledge	Open, deliberative planning	Free market
	Use-management approach	Sectoral approach	Integral approach	Competition between users
	Priority issue	Safety	Integrity of the wilderness	Freedom of operation
Future tourism issues	Managing scale of tourism	Restriction: setting limits	Collective choices	Not necessary
	Managing impact of tourism	Regulation when proven impacts	Precautionary approach	Self-regulation
	Managing tourism safety	Minimising risk through regulation	Avoiding risky areas and activities	Insurance, contingency planning
	Managing compatibility of tourism	Restriction when not compatible with regulation	Cooperation between users	Not necessary
	Control of tourism	Formal control remains ATS	Collective control	Self-control No formal control needed

Results

Future issues in Antarctica tourism can be summarised as three overarching and interlinking questions.

- What form of tourism industry would we like to see in Antarctica?
- What scale of the tourism activity would we like to see in Antarctica?
- What level of control over the tourism industry would we like to see in Antarctica?

Each of these questions covers a range of other issues and is linked in multiple ways.
An overview of issues related to these main future questions is provided in Table 3.

Form of tourism

The question of the future form or shape of the Antarctica tourism activity relates to the diversification trend mentioned in the introduction. With a few exceptions, tourism activity has been predominantly ship based in the Antarctic. Many stakeholders think that more air connections for tourism in the future is likely, but acknowledge at the same time that the development of this mode of transport would be difficult due to lack of infrastructure. The continued trend of large cruise liners in Antarctic waters is almost generally seen as a likely future perspective. Related to this issue is the discussion about the likelihood and desirability of the development of land based tourism infrastructure. In this discussion the perspectives largely diverge between regulators, operators and monitors. The regulators consider land based tourism not desirable mostly for judicial reasons. For some of the operators it would be an acceptable option, whereas others do not. Most of the monitors principally reject the idea of land based tourism, whereas other state that it depends on how it would be done. The question of whether certain activities would be unacceptable in the Antarctic is answered by most of the interviewees by the criteria of preventing environmental damage, damage to scientific activities and safeguarding human safety. Some of the monitors are more critical and claim that certain activities are not acceptable for their incompatibility with intrinsic Antarctic wilderness values.

Scale of tourism

The question of scale is perceived in different way among different types of stakeholders. The regulators indicated that this question was difficult to answer because of lack of knowledge and comparable cases. They did agree however that the growth rate of tourism is rapid. For the operators scale is not an issue at the moment and that activities can still grow multifold in the future without major problems. Scale of the activity cannot be equated to impact of the activity, because of management. For the monitors this is very different. For some the scale of the current tourism activity is already too much, and the potential for further growth is enormous. For all of the interviewees it is not clear if the scale of the businesses involved in Antarctic tourism will become a problem in the future; they all share concern about this issue. The increasing scale of operation (e.g. the use of larger ships) is recognized across the interview. However, there are differences in perspective if this will lead to problems in the future. For the operators this would not lead to major environmental and safety problems. The regulators and monitors do foresee major problems in these two criteria. For example, in case a large ship would find itself in an emergency situation there is no capacity in the Antarctic to recover all the passengers. Overall concern goes out to the scale of activity on particular landing sites, which is generally seen as the most important area of impact.

Main question:	Sub-question:	Development paths:	Associated future risks:	Suggested policy options
Form of tourism (diversification)	Mode of transport	Remains ship based	Cumulative impacts Catastrophic impact Safety - SAR	Shipping standards
		Towards more aircraft	Safety Intrinsic values	Aviation standards Limit use of runways
	Mode of operation	Remains expedition cruising	Cumulative impacts	Site guidelines Accreditation Observers
		Towards cruise-only	Catastrophic impacts Safety	Shipping standards Zoning
		Towards land based tourism	Intrinsic values Cumulative impacts Jurisdiction	Prohibition of facilities Zoning
	Type of activity	Towards more adventure and yachts	Safety - SAR Intrinsic values	Measure 4 (2004) Operation guidelines
Scale of tourism	Scale of industry	Larger scale	Amplification all risks	Cap number ships Cap number visitors
		Development levels off	No additional risks	No policy needed
	Scale of business	Larger companies	Erosion of values and operational practices	Accreditation
	Scale of operational unit	Towards larger ships	Cumulative impacts Catastrophic impact Safety - SAR	Operational restrictions Zoning Accreditation
		Towards smaller niches	Safety - SAR Intrinsic values	Operational restrictions
	Scale per region	More in southern Peninsula	Safety – SAR	Zoning
		Other regions than Peninsula	Intrinsic values Safety - SAR	Limit use of runways
	Scale of activity per site	Concentration on few sites	Cumulative impacts	Site guidelines
		Spread out over more sites	Intrinsic values Biological invasions	Zoning
Control of tourism	ATS	Remains current level	Non-compliance issues Hopping and shopping Lack of enforcement	Codifying ATS rules IMO Competent authorities Observers
		Towards comprehensive regime	Funding Lack of enforcement Non-compliance	User-pays principle
	Self-regulation	More diverse membership	Non-compliance Erosion of standards	Codifying IAATO rules

Table 3: Overview of main future questions in Antarctic tourism

Control of tourism

Perspectives on the level of control that is needed on tourism activity largely diverge between and among the stakeholder groups. The regulators of different countries have different perspectives on how much control the ATS has over tourism in the Antarctic, whether this is enough for the future, and whether agreeing on comprehensive regulations is feasible. For the operators this is no different. Some focus on the lack of regulation and the need for backing up self-regulations by the tourism industry. Others qualify the ATS regulation as already comprehensive. The monitors largely agree that more control is needed and consider the lack of knowledge of policy makers as the main reason for this. The regulators and monitors are largely aligned about the role of self-regulation in Antarctic tourism. They consider self-regulation of great importance, but point at the same time to the vulnerability of self-regulatory systems and stress the responsibility of the ATS. Many operators share this view on the importance and vulnerability of self-regulatory systems, but they do not agree that the responsibility lies ultimately with the ATS. In general both regulators and monitors agree that monitoring is a vital issue in the future, but how this should be funded remains uncertain.

Discussion

Future perspectives on Antarctic tourism diverge considerably among stakeholders.
Analysing these differences with the Cultural Theory highlights a number of interesting observations:

- Tour operators can be originally seen as representing the individualistic worldview. However, since the number of operators has grown they were forced to adopt an egalitarian management style.
- Originally the ATS member states have adopted an egalitarian worldview and management style allowing cooperation for scientific research. Now that tourism is developing the regulators would like to adopt a more hierarchical management style. Given the unique governance situation of the Antarctic Treaty System the question arises whether this is possible. Is the ATS locked-in?
- The independent monitors (representatives of NGOs and researchers) are originally associated with egalitarian views. However, in the current tourism debate they are the most outspoken stakeholder group calling for hierarchical regulations.

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The usage of the tourist potential of the Northern and the Southern Poles

The tourist potential of geographical poles is basically determined by three reasons: the unicity, the historical dramatic nature of its discoveries, the geopolitical intention.
The unicity of geographical poles is evident. The poles are intersections of the axis of the Earth and earth's surface.
The historical dramatic nature of pole's discovery is the most important component of their potential. The history of discovery of the North Pole is related to sledge expedition, which was organized by British Admiralty in 1827. The starting point was the northern coast of West Svalbard. Participants of the expedition arrived to the island by "Hecla" ship. William Parry and James Ross went to the North on 21 of June 1827. 82°45' N - the northernmost point which was reached by Parry. It was the record has been kept for almost fifty years. The British pioneers turned to the South on the 21 of August having overcome only 320 km and they reached the ship "Hecla".
About a half of a century Albert Markham approached the pole even more 65 km from the Canadian Archipelago. In 1875 in England it was organized a great polar expedition on two ships "Alert" and "Discovery". George Strong Nares was the leader of the expedition. But his expedition on the 12 of May 1876 reached only 83°20' N. Nares wrote to the England "The North Pole is inaccessible!"
In 1881during the preparation to the first International Polar Year the American expedition went by the ship to Ellesmere Island and it was organized a meteorological station on the northeast coast. The leader of the expedition was Adolph Washington Greely. From this station the lieutenant James Lokcwood got ahead to the North by sledges. According to different recourses he achieved 83 24 or 83 30 N.
In August-September 1881 Fridtjof Nansen and Otto Sverdrup with four companions crossed the southern Greenland by the parallel of 64° for the first time (the length of the route was 560 km, the route duration – 40 days). After this trip F. Nansen suggested the daring plan of the North Pole's exploration. The ship "Fram" was frozen in near the 78°50 N. The expedition has been drifted about one year and three months and it reached just 83°43 N by the end of 1894. By this time Norwegians got evidence that ice didn't drift to the North. Then Nansen took Fredric Johansen and they left the "Fram" on the 14 of March 1985. They moved to the Pole by three sledges. On the 7 of April they reached 86°14 N but they had to turn to the South. In august they came up to Franz Josef Land and passed the winter on Jackson Island. In 1986 they were transported from the Nordbrook Island to Verde (Norway).
Naval officer of USA Robert Peary, whose the most important aim was reaching of the North Pole, demonstrated excellent pertinence and did several geographical discoveries in Eastern Arctic. During the preparation to the exploration of the North Pole R.Peary has been traveled by sledges in Greenland for several times.
At the beginning of twenty century R.Peary attempted to reach the North Pole for three times. In 1908 Peary with little crew went to the Pole. They moved by 5 dog-sledges. On the 6 of April Peary according to him reached the North Pole. The crew returned to Ellesmere Island on the 23 of April

and the telegram about its reaching became well known in all cities in USA. But five days before this date Fredric Cook informed the World that he reached the North Pole on 21 of the April 1908.
Fredric Albert Cook was the doctor and arctic traveler. He had 15 years experience in the Arctic and Antarctic and he like Peary had a goal to conquer the North Pole. On the august 1907 he arrived by sea to the Greenland to the eastern seaside of the Smith Strait. According to him he stepped to the northernmost point of the Earth on 21 of the April 1908. He reported news from Shetland Islands only on 1 of the September 1908. Fredric Cook like Fridtjof Nansen had been using primitive devises to find their location. It will be correctly speak that they both reached circumpolar region. But the priority of the North Pole discovery was gave to Fridtjof Nansen by USA National Congress because F.Cook gave up the struggle.
One of the greatest stories in Antarctic Exploration is that of the race to the Geographic South Pole.
The Antarctic continent was discovered on the 28 of January 1820 during Russian Antarctic Expedition. The Expedition consisted of two boats: "Vostok" under the command of F.F.Bellingshausen and "Mirniy» under the command of M.P.Lazarev. There is the South Geographical Pole of the Earth.
The history of the discovery of the South Pole probably began with the first winter stay in the Antarctica. In 1899 the group of Norwegian scientists, which was headed by Karsten Borchgrevink, wintered for the first time in the Antarctica near Ader Cape. During this wintering one man died. After the wintering the group on the boat "Southern Cross" headed for Ross Ice Shelf. K.Borchgrevink managed to rise up the barrier and moved forward along the glacier by dog-sledge to 78°50 S.
The experiment of K. Borchgrevink was kept in mind when English expedition was planning and organizing in 1902. Robert Falcon Scott headed this expedition. R.Scott and small team investigated high-mountain coastal fringe of the Victoria Land till 82°17 S.
For carrying out of the expedition to conquest the South Pole Ernest Shakleton arrived from the Ross Sea on the catcher boat "Nimrod" on the January 1908 and organized wintering in Mac Murdo Gulf. On the end of October Shakleton with three companions started by sledges to the South Pole. They achieved 88°23 S with supreme efforts but being less than 180 km from the Pole had to double-back on the 9 of November 1909.
In 1911 Roald Amundsen arrived on the boat "Fram" to the eastern edge of Ross Ice Shelf. Norwegians landed in Walfish Bay and organized the camp on the 14 of January. Roald Amundsen used his great polar experience (Arctic and Antarctic) for choice of camp sitting and planning of the South Pole achievement. His route to the South Pole was more than 100 km shorter and more difficult than Shakleton's and Scott's routes. Amundsen and four companions took the field by the dog-sledges on the 20 of October 1911. The group has been achieved the South Pole on the 15 of December 1911. In the point of the Pole tent was set out and Norwegian flag was hoist up. The Expedition went back to the North on the 17 of December. In each three days they killed a dog – in such a way they ate fresh meat till they reached the provision store next to the Pole. They went around 2800 km and returned to the Walfish Bay on the 26 of January 1912.
The boat «Terra Nova» took the expedition of Robert Scott to the place of wintering in Mac Murdo Gulf on the 3 of January 1911. Scott suddenly found out news about Norwegians plan to conquest the South Pole. They set out to the Pole on the 2 of November 1911. Finally 5 persons went to the Pole. The last 250 km of the way required to supreme efforts. They had to lug the sledge by unstable snow and sometimes they went less than 10 km per a day. On the 18 of January Englishmen found a tent and a letter in the name of Scott therein. Amundsen asked the Scott to deliver letters to Norwegian King. Englishmen took a photograph of the tent and draw it, stood the Britain flag and returned. By the way from the camp and the Pole Englishmen organized ten way provision stores. They came closer to the camp, but more exhausted they were. One man died. Other participants of the expedition went astray often, temperature became fall, disappoint grew up. But nevertheless they were pulling to the death the valuable geological collection (around 15 kg) of rock samples that were picked up on the way to the South Pole. Than another man died. He just took leave and went to

snowstorm. On the 12 of November 1912 the search element founded the tent that were partially snowed in, three dead bodies inside and a letter with a request to take care of their families.
Geographical Poles of the Earth are filled of geopolitical content, which is fulfilled the actions that demonstrate technical opportunities of the country, which is interested in Polar Regions. Russian interests in the Arctic have long traditions are connected both history of Discovery in this region and history of exploration of the Arctic. In fact, the large part of the Arctic is a Russian territory. The evidence of the Russian state interest in the North Pole is the organization of the expedition on the boat "Svyatoi Foca" to the North Pole in 1912; transarctic flight of V.P.Chkalov on the aeroplane "AHT-25"; the organization of polar stations; the emersion of Soviet submarine K-181 ("Leninskiy komsomol") in 1962 near the North Pole; the trek of icebreaker "Arctica" to the North Pole in 1977; the dive of bathyscaphes "Mir" in the point of the pole in 2007; an initiative of the implemention of the fired International Polar Year 2007-2009. The international Polar interest is fulfilled by reaching of the North Pole by American pilot R. Bird in 1925 and American submarine SSN-678 ("Nautilus") in 1959; an organization of American polar stations ("T") since 1946. In 1926 it was successful conducting of the transarctic flight by the dirigible "Norway" (R.Amundsen). The second attempt of such flight by dirigible "Italy" (U.Nobile) was tragically completed.
Well-known ski expeditions to the North Pole of D.Shparo, M.Malakhov, V.Chukov and others reflect the geopolitical interest of Russia. Actually the continue of it - is tourist activity on the North Pole which is realized the tourist potential of the Pole. Nowadays the Russian company «Expeditionary Centre Polus» which is a travel department of the Association of Polar Explorers, supervised by Arthur Chilingarov, successfully realizes the tourist potential. Today tour operators can offer a wide range of expeditions to the North Pole in April (Express Tour, Tourist program, Last Degree program, Sky Diver program). The organizer selects a time and a place for the expedition when the danger of the ice melting is almost nil. This is why all expeditions to the North Pole take place in April. In April the center "Polus" is planning: to build an ice strip and a camp, to make aircraft freight deliveries to the place of Barneo by the means of a Ilyushin-76 airplane, cargo and passenger airlines flights to the ice; to make helicopter Mi-8 to the North pole region to support scientific and sport programs. The trip officially begins at Longyearbien, Spitzbergen. From there, travelers will take a special flight to "Barneo" field camp, 150 kilometers away from the North Pole. Depending on the program traveler's choice they will either fly the Pole itself by helicopter, or ski there with guides. Thereby are organized about 50 journeys per a season.
In the summer season (July-August) the "VICAAR" Company organizes cruises from Murmansk to the North Pole. Thereby the business in the North Pole is based on its tour potential and geopolitical interests of Russia in the Arctic.
Canadian Company Adventure Network International (ANI) realizes the tourist potential of the Geographic South Pole more than twenty years. During the Antarctic season (October through January) it offers a lot of journeys both Antarctica and the South Pole. Adventure Network International provides the logistics, the guides, the equipment and the transport. In 1987, ANI flew the first tourists to the South Pole and to date remains the only company in the world offering airborne travel to the interior of Antarctica and the southernmost point on earth. A journey is significant today as it was for those early explorers so many years ago.
The trip begins in city of Punta Arenas, Chile. As the best and largest port for thousands of miles, Punta Arenas attracts ships from the burgeoning South Atlantic fish industry as well as Antarctic research and tourist vessels. Than tourists fly via private aircraft over tabular icebergs and ice shelves into the heart of Antarctica; fly across the polar plateau enroute to the South Pole; become one of the few to stand at the southernmost point on earth – the Geographical South Pole; explore Patriot Hills, ANI's base in the foothills of the Ellsworth Mountains. Nestled within the heartland of Antarctica, Patriot Hills is the home of Adventure Network International's base camp. Established in 1987, it is the only private camp in Antarctica and will serve as tourist primary accommodation for the duration of the stay. In average the camp visits from 300 to 500 tourists per a year.

During the Period of International Polar Year (2007-2009) it is expected the activation of scientific work and the growth of the tourist interest in Geographic Poles of the earth. In addition it is expected the growth of tourist potential of this regions in the near future in view of scientific and social resonance on the occasion of the centenary of its conquest.

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Snow and ice as tourist attraction

According to the World Tourism Organization, tourists are people who "travel to and stay in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes not related to the exercise of an activity remunerated from within the place visited". Leaving aside the time limitation, many or most of early expeditions, often even funded by the explorers themselves, could be labeled as tourism.

For majority of tourists the main attraction to go somewhere is pleasure, with the price to be the main concern. The next level corresponds to the wishes to see new landscapes or to visit a historical cite which "everyone should visit". The next level is "to be the first". Very few remote places can offer this nowadays.

The tourism to high mountains started in Alps first from "to be the first" approach (mountaineering and alpine skiing in 18th century) and than, after success in selling the photos of the peaks and glaciers around the Europe, coming "down" to "everyone should see". Today, the skiing made the Alps comparable in popularity with see beaches, and at that stage not only tourist agencies but also the local communities consider the tourism as an important and sometimes the main source of income.

Following the early routes is the combination of history and new landscapes for modern time tourists, though "to be the first" is more and more difficult. A new hiding route in remote mountains and heliskiing are ones of few such possibilities, though not quite. Snow and ice landscapes are still unusual and thus interesting cites for tourists. This can be proved by the touristic success of peculiar natural features provided by Zao mountains in Japan (unusual rime on trees), skidoo trips in Alaska, ice hotel in Jukkasjärvi, snow festivals in Sapporo, ice sculpture festival in Kemi, and ship trips in Arctic and Antarctic seas.

The Polar regions are probably the least explored for now, connected to stories of heroic expeditions in past, and more captious tourists are choosing North or South Pole "by feet" and alike adventures. Such are, of course, singular trips, still important for the tourist industry through continuously brought attention to the Polar Regions and to snow and ice in general.

Considering the history of high mountains tourism, the Polar regions are now reaching the stage "everyone should see". The next stage would be the common access, and this is unlikely that it can be stopped regardless considerations of vulnerability of Polar nature or political decisions on closing access to one or another cite. Thus, this is the time to develop a strategy for the tourism development in these regions, with balancing the possibilities for people to visit the places and at the same time to keep Polar regions' attraction by preserving closeness to their original environmental state. The latter is scientific problem. But the recipients of the short and long-term advantages of such strategy would be the tourist companies. If some local communities still exist in Arctic, the Antarctic has no local habitants yet. Investments into joint work of the tourist companies with natural scientists should be considered.

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Spring snowmelt variability in polar Eurasia

Introduction

Snowmelt dynamics play an essential role in the hydrological cycle of northern latitudes. Entire northern Eurasia is seasonally covered by snow. It instantaneously impacts not only surface hydrology and the energy budget but also terrestrial biota and thus the carbon cycle. An evolution towards earlier snowmelt in the northern hemisphere has been determined from different satellite date records starting in the 1980s ([58], [59]).

Diurnal differences are investigated in a range of studies since they indicate exactly when snowmelt is taking place. These single days of thaw and refreeze are usually summed up to obtain the number of melt days. Such a method has been specifically used with passive microwave systems over large ice caps like the Greenland ice sheet ([60], [61]) and for mass balance studies over smaller ice caps ([62]). The actual number of dates of snow thaw is of most interest for glacier mass balance studies but the final disappearance of snow together with the length of spring thaw is required in regions with seasonal snow cover. Clusters of consecutive days of diurnal cycling of freeze/thaw are characteristic for the final snowmelt period in boreal and tundra environments ([63]). The start, end and duration of such periods give inside into spring CO_2 emissions and river runoff behaviour ([64]). Results of the clustering of diurnal thaw and refreeze days as detected from active microwave satellite data over polar Eurasia is presented in this paper. The aim is the monitoring of spring snowmelt variability not only for assessment of impact of climate change on hydrology and energy budget, but also economy.

Method

SeaWinds Quikscat (Ku-band) measurements are available since 1999. The first entire snowmelt period on the northern hemisphere is covered in 2000. Large changes in backscatter between morning and evening acquisitions are characteristic for the snowmelt period, when freezing takes place over night and thawing of the surface during the day. A change from volume to surface

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scattering occurs in case of melting. This may cause changes up to 6 dB ([65]). When significant changes due to freeze/thaw cycling cease, closed snow cover also disappears (63). For the identification of melt days over permanently snow or ice covered ground, only evening measurements are considered. Diurnal differences (63) on the other hand are calculated for the delimitation of the final spring snowmelt period. The exact day of year of beginning and end of freeze/thaw cycling can be clearly determined with consideration of long-term noise (63) in order to exclude unnatural effects and changes in soil moisture and snow pack characteristics. Therefore a location specific noise estimate s_s is determined from analyses of long-term backscatter time series. Only then can significant diurnal differences be identified over a variety of environments.

Backscatter at each location in the northern latitudes is measured several times with spatially and temporarily varying footprints during a single day by QuikScat. As this occurs in irregular intervals, the exact number of measurements in the morning and in the late afternoon/evening needs to be taken into account. The diurnal difference Ds^0 is calculated by averaging all measurements acquired during morning and evening passes respectively and then calculating the difference . Since the estimated noise of Ds^0, s_s is known, the standard deviation of Ds^0, s_D, can be directly estimated. To identify diurnal changes which are significant at the 99 % confidence interval, Ds^0 needs to exceed 3 times s_D. A simple three-step approach is pursued to determine the most significant period of freeze/thaw indicators within a time series:

[1] For calculations on the northern hemisphere only periods between 1st of January and 1st of July are considered.

[2] Indicators that are found within initially 10 days of each other are grouped into periods using temporal filtering.

[3] The onset of the major and, usually final, snowmelt period is determined as the indicator period containing the greatest number of indicators. The onset of snowmelt is determined as the first day of this period.

Thus the duration of the snowmelt as detected from QuikScat corresponds to periods of significant diurnal change of surface conditions due to thaw and refreeze.

Results

The end of snowmelt timing varied by less than a month in most regions during the eight years of data availability (2000-2007). There has been only a difference of up to two weeks in eastern Siberia. Central and western Siberia, especially the European part experienced more variability. This impedes an assessment whether there is a trend of earlier spring or not. However, monitoring of these regions is of importance for global change and thus also economic issues.

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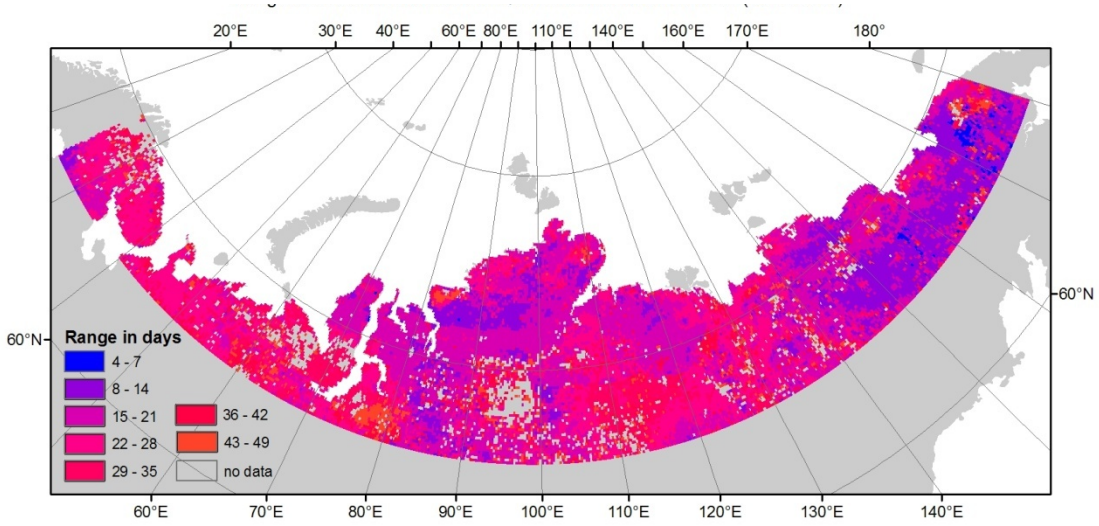

Figure 1: Range of end of snowmelt in days from QuikScat Diurnal Difference (2000-2007) over polar Eurasia (12.5km grid).

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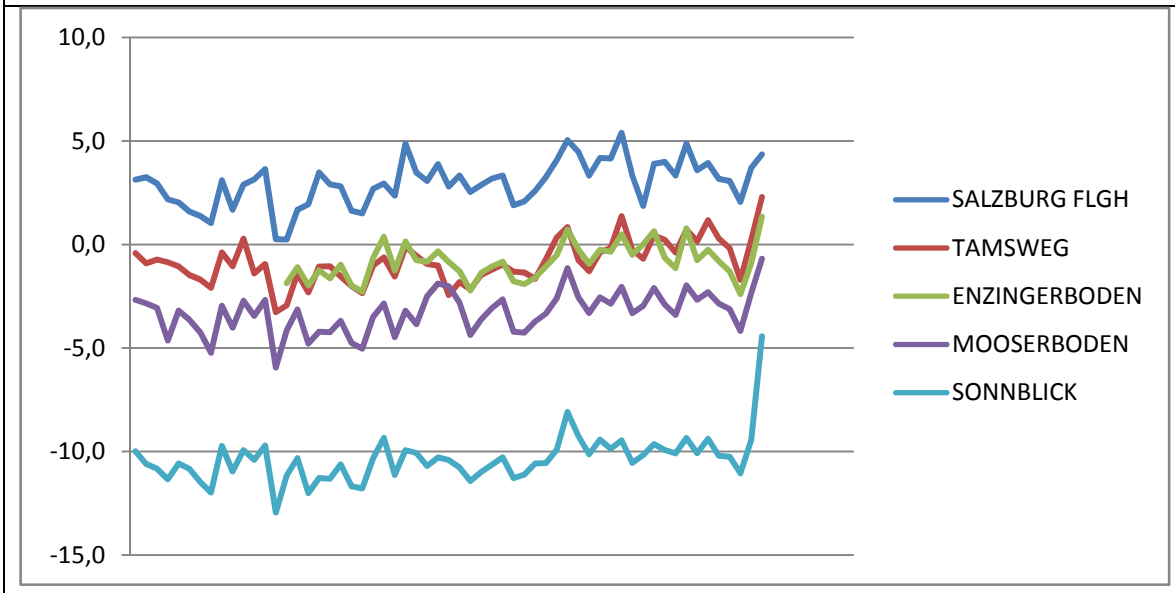
Climate change and Alpine tourism: some assumptions with regard to the development of Polar tourism.

The origin of Alpine and Polar Tourism are founded in a similar desire for experiencing snow and ice in wilderness. In the beginning of 19th century, high Alpine areas were as little known as the Polar Regions. During the 19th century the Alps were investigated by mountaineers, mainly during summer and in low numbers. With the start of the winter Olympic Games in Chamonix in 1924, Alpine areas became increasingly popular during winter. The real start of mass winter tourism happened after WWII and primarily from 1970 onwards, when increasingly more families could effort also a second vacation in winter. Today, in countries like Austria and Switzerland, winter tourism is economically more important than summer tourism. Currently, some 4% of Austrian GDP is directly earned in winter tourism. In the Alpine areas this share can be much higher and provinces like Salzburg and Tirol earn 10% and more directly from snow based winter tourism. Single resorts are completely dependent on this income during winter. The indirect value of winter tourism is much higher.

Figure 1 Trends of winter temperature 1948-2007 in different altitudes of Salzburg county



Source: Data of ZAMG, own calculations, extracted from Climate sensibility of winter tourism in Salzburg; Breiling et al. 2008

The evidence of success has recently been challenged by climate change and global warming. During the last 50 years the temperature has risen by more than 1°C or more and this change required for adaptations, ski slopes were widened to allow a better management with preparation machines; ski lifts became much more powerful and efficient in transporting tourists from down to up; and the shrinking amount of natural snow was increasingly more substituted by artificial snow. The costs of adaptations were high, but the additional income gains were even higher and no one seriously put into question adaptations to climate change. Today, we have the most profitable winter tourism in the Alps and if climate would stagnate the coincidence of favorable environment conditions with technical support means could sustain winter tourism as most important rural economy of Austria. Unfortunately, this situation is likely to be discontinued in the next few decades. One reason for this is raising energy and resource prices that make adaptation even more difficult and another one is that the warming is likely to continue. A trend – originally discovered in high latitudes of the Arctic region – is that high altitudes showed much more warming than lower altitudes. This fact is perhaps responsible, that high altitudes are not so save with regard to snow than previously considered. A continued adaptation to climate change is finally only possible for the richest, the highest and most innovative resorts.

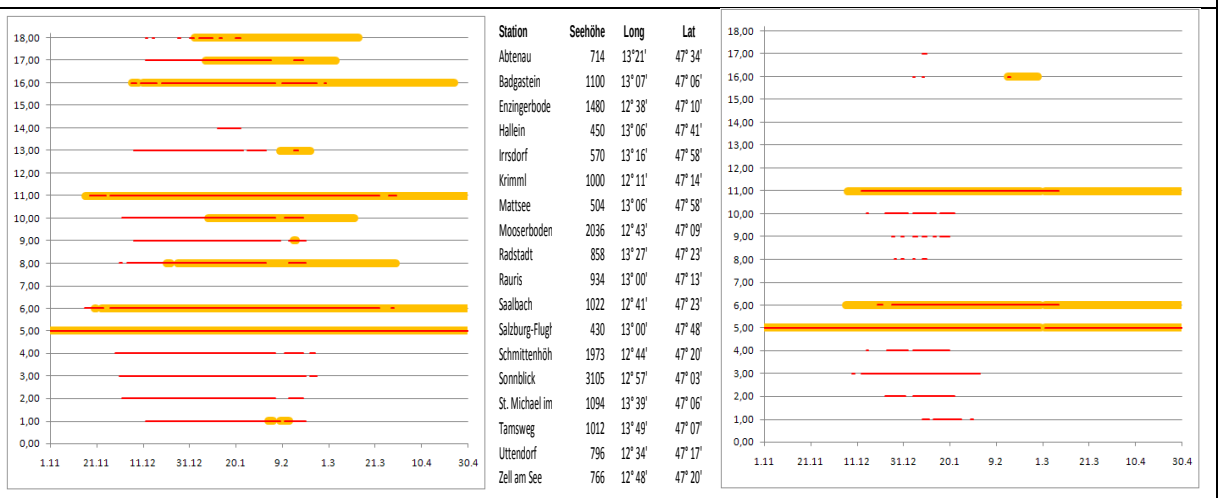
In contrary to the Alps, the Polar Regions did not yet experience a similar intensity of use. They were too remote and environment conditions considered being too harsh. Snow rich mountains with glaciers were near and the attractiveness of Polar Regions remained limited until recently, primarily due to high costs. Since the 1980s and onwards, Polar Tourism received increased consideration. Currently, estimated 100,000 tourists visit the Polar Regions (35,000 in Antarctic and the reminder in the Arctic) and spend perhaps a little more than one million guest nights in the area. A very small number if one considers that in Austria alone 16.7 million winter guests, spending almost 61 million guest nights during winter. However, this low number of Polar tourism is compare able to the situation in the Alps 100 years ago. The initial to use previously untouched could also stimulate touristic exploitation that we cannot imagine today. The global climate works for a change in the proportion of future snow based tourism in disfavor of Alpine tourism and in favor of Polar Regions. Considering the global tourist market and the value of snow and ice for tourism Polar tourism will sharply increase if promoted.

For the time being the traditional Alpine resorts try to keep their high share in snow based tourism and continuously prepare to cope with a warmer climate and less snow. Recently, everywhere in the Alps artificial snow making became popular. Many small resorts have closed or will close in the next decade as the means to buy appropriate snow making technologies are lacking. Thereby winter tourism in the Alps gets concentrated. Tourism as a safeguard for maintaining the local population in place will lose its importance. The remaining resorts become more exclusive and more dependent on continued and increased economic income to further finance their adaptations. But with every increment of warming and consequently less snow, the economic ratio or natural conditions to offer winter tourism gets worse and increasingly more companies and tourist resorts will give up winter tourism. The areas in which skiing is still possible will get limited, the frequency of use will become much higher to compensate for the loss in area.

In Fig.2 the decrease of winter tourism season due to climatic factors is depicted. Red line stands for temperature value of -2°C, orange line stands for snow depth larger or equal 30cm. It is considered that a temperature below -2°C is necessary for artificial snowmaking in case the natural snow cover is

not sufficient. The combination of the red and orange line is the season length of snow based winter tourism. The price for 1 m³ snow costs between 2 and 5 Euro and the tendency is going up. For one ha of ski track some 3000 m³ of artificial snow or 1000 m³ of water are necessary. Sufficiently long cold periods are needed to keep the snow in place, otherwise the amounts needed become much higher.

Figure 2: The likely decrease of winter tourist season length in Salzburg based on data of the period 1970 – 2000 (left side) at 18 climate stations and a 2°C warming (right side)



Station	Seehöhe	Long	Lat
Abtenau	714	13°21'	47° 34'
Badgastein	1100	13° 07'	47° 06'
Enzingerbode	1480	12° 38'	47° 10'
Hallein	450	13° 06'	47° 41'
Irrsdorf	570	13° 16'	47° 58'
Krimml	1000	12° 11'	47° 14'
Mattsee	504	13° 06'	47° 58'
Mooserboden	2036	12° 43'	47° 09'
Radstadt	858	13° 27'	47° 23'
Rauris	934	13° 00'	47° 13'
Saalbach	1022	12° 41'	47° 23'
Salzburg-Flugf	430	13° 00'	47° 48'
Schmittenhöh	1973	12° 44'	47° 20'
Sonnblick	3105	12° 57'	47° 03'
St. Michael im	1094	13° 39'	47° 06'
Tamsweg	1012	13° 49'	47° 07'
Uttendorf	796	12° 34'	47° 17'
Zell am See	766	12° 48'	47° 20'

Source: Data of ZAMG, own calculations, extracted from Climate sensibility of winter tourism in Salzburg, Breiling et al. 2008

Even the tourists are changing. The pioneers of Alpine tourists of the first days where soon outnumbered from the common people that demanded for a different infrastructure to cope with mass tourism in the Alps. Today winter tourism is again becoming more exclusive due to the rising prices and permanently necessary new investments.

The difference in price of Alpine winter tourism and Polar tourism was never before so close and it is conceivable that Polar tourism might at a certain time become cheaper than Alpine winter tourism. In particular the Arctic region might become more attractive and the local population – similar to the poorest mountain farmers in Austria at the highest locations – could generate considerable wealth, if Arctic tourism gets developed. It is not impossible that with ongoing warming touristic settlement projects in Antarctica would receive some attention. While adaptation options will increasingly fade away in the Alps, the touristic development in the Polar Regions could just be on an initial state if global warming continues.

Reference:

Breiling M., P.Charamza, W. Feilmayer (2008). Klimasensibilität des Salzburger Wintertourismus nach Bezirken. Die Bedeutung eines Klimawandels und Strategien der Anpassung.

16. Gröning Maren

Albertina Museum Vienna, Exhibition Albertina Museum 20 August – 23 November 2008

Infinite Ice: Traversing the Arctic and the Alps from 1860 to the Present

Throughout history largely inaccessible tracts of land have always exerted a great fascination on people – as did the Eternal Ice. From the middle of the 19th century onwards, photography made it possible to capture a single instant of nature and to reproduce it. What proved to be of particular attraction to photographers were glaciers and Arctic landscapes. The Albertina devotes its annual photographic exhibition this year to this very special type of landscape photography, contrasting early works of the 19th century with positions of today.

In glacier photography the aspects of spatial expansion and temporal change were being combined as early as the 1860s. These components also played a significant role in the two Austrian exhibitions to the Arctic region, of 1872 and 1882. On both occasions, the photographer, Wilhelm Burger, succeeded in capturing images which, with the aid of complementary panoramic views from afar and detailed views from close by, were able to convey atmospheric impressions of the depth and width of the polar landscapes, and which also allowed for an assessable documentation of the geographical conditions in this unexplored region, once the expedition had returned home. In contrast, Friedrich Simony, in his photographs from the Alps, concentrated on the temporal aspect, which he attempted to bring clearly into focus with a camera firmly fixed in a certain position over the course of several years.

Apart from the documentations on the two Austrian polar expeditions of the photographer Wilhelm Burger and the alpine series of Friedrich Simony, the Albertina also presents photographs by Gustav Jägermayer and works from the publishing house of Würthle. Particularly impressive are Würthle's stereoscopic images, which created an amazing 3D-effect through a double set of pictures taken simultaneously but at a slightly different angle. These were able to delight and fill audiences at the time with extraordinary enthusiasm.

This photographic technique, rarely explored nowadays, catered to a desire to experience the immense expanse of those icy landscapes from a safe distance and yet from an almost physically tangible proximity. Contemporary positions of today react, not least, to this desire, as may be seen in the exploration of the arctic night by Darren Almond or the aerial shots by Olafur Eliasson. Walter Niedermayr's overlapping sequential images of alpine landscapes, in turn, reveal an extended view of the world of the Alps.

Friedrich Simony: Eastern View of the High and Lower Dachstein, 1885

17. Justnik Herbert

Scientific Landscape Photography. The Photographs of the Austrian Polar Expedition to the Island of Jan Mayen (1882/83)

(Abstract of diploma thesis 2007)

A portfolio of forty photographs of the island of Jan Mayen. Created during a one-year expedition in the so-called „First International Polar Year“. At first sight landscape shots, whose peculiar esthetics may seem strange, but are nonetheless fascinating. On closer examination, it becomes clear, however, that they do not owe their existence to an artistic ambition. Rather, they were created for a primarily scientific purpose, since the expedition was meant as a scientific enterprise.
The sponsor of these pictures, Count Hans Wilczek, was an Austrian aristocrat interested in furthering science, who examined geographic problems and was an important member of the k. k. Geographische Gesellschaft (the Imperial and Royal Geographic Society). It is due to his passion for science and his interest in photography that this expedition was provided with photographic equipment. He was also a photographer himself.

This way, Richard Basso, one of the officers of the expedition who was also active as a scientist, was able to put together a documentation of the island and the expedition, consisting of 250 photographs. Unfortunately only a few representative portfolios remain today. Even from these few remaining pictures, the scientific character of this documentation can be gathered quite clearly. On the one hand, it can be deduced from a visual analysis of the photographs, that their composition was directed by an interest in the geo-morphological documentation of the island. On the other hand, it becomes clear, when reading the scientific reports of the expedition, that the photographs were used as support for the island’s cartography. During his 13 months on the island, the scientific officer in charge of geographic examinations, Adolf Bóbrik von Boldva, had the opportunity to chart the island and to collect the necessary data to draw up a special map of Jan Mayen.

18. Schwammer Gaby

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Guided tour to the Zoo Vienna Polarium

In 2004, the Polarium was renovated and modernized to include state-of-the-art technology. The old building was gutted, dividing walls removed, the pools combined and deepened. This renovation has major advantages for the visitors as well. They can now peek underwater – eye to eye with the southern sea lions and penguins.

The POLARIUM of the Vienna zoo was completely rennovated in 2004 for 3.4 million Euro. Details with regard to the construction of the polarium can be found at the homepage of the architects (http://www.zottlbuda.at/polarium.htm)

Energy saving technology was used to keep maintenance costs low. Some 900 m³ with water have to be cooled to pleasant conditions under 6°C. The air temperature should be under 12°C to make the animals feel comfortable.

Following polar animals habitate the Polarium:

Southern sea lions
King Penguin
Rockhopper Penguins
Humboldt Penguins

During the guided tour on Saturday, Oct. 25th, 2 p.m. to 4 p.m., details of interest will be discussed!

Photo: Larsemann Hills, Antarctica by A. Ekaikin, 2005

The Vienna Symposium on Polar Tourism

October 22nd - 25th 2008, Vienna University of Technology

TU WIEN

Intention

The Vienna Symposium on Polar Tourism will provide an opportunity to combine knowledge of research specialists and institutions related to the Arctic and Antarctic with interests related to polar tourism opportunities. The intention is that participants can jointly apply for available funding programs to increase the level of the research in the field of polar tourism. At the same time the general level of awareness will be altered. Countries like Austria, not situated in the polar region, can provide many analogies and broad experience from mountain tourism. Therefore we welcome the participation of interested parties from non polar countries.
The symposium, to be held as part of the International Polar Year 2007-2009 (IPY), will become an opportunity to develop research topics and to discuss trends and industry requirements in the field of polar tourism, that roughly exists since a quarter of a century.

Polar tourism - a growing industry

Polar tourism is continuously rising. The expected climate changes are not supposed to act adversely in this context and even opening new opportunities or changing the price ratio to the cheaper. So far, the Polar tourism was mainly connected to expedition cruises to the High Arctic and Antarctic, but increasingly stretches further down from 90° to approximately 65° or the level of the polar circle.
The upper core zone of polar tourism still remains restricted for exclusive guests due to lacking resources, like water, or because of restriction in access. A joint Russian- Austrian program during the IPY in Franz Josef Land failed as the access even for researchers was not granted. This is in line with new international conflicts in expectation of exploitable resources. Polar tourism with educated tourists could contribute by resolving such conflicts and creating a critical mass of a concerned public.
The lower extended zone became more diversified offering a wide range of products, from land-based safaris in the backcountry to cultural experiences in urban and semi-urban environments. In this way, polar tourism increasingly gets a mean of regional development of economically disfavored, periphery cold regions. An example for success is the ice-hotel in Jukkasjärvi, allowing a whole village with 300 employees to prosper.

Partners

Vienna University of Technology (AT)
Albertina Museum (AT)
Free University of Bozen-Bolzano (IT)
Luleå University of Technology (SE)
Maastricht University (NL)
Ovidius University Constanza (RO)
Institute of Geography, Russian Academy of Sciences (RU)
Lomonosov Moscow State University (RU)
Shirshov Institute of Oceanology, Russian Academy of Sciences (RU)
others to be confirmed

Contact

Meinhard Breiling: meinhard.breiling@tuwien.ac.at
Participation is free of charge and only upon invitation!

TTL technology tourism landscape
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