# *PPS Arctic Norway* – the Norwegian contribution to the internationally endorsed IPY project #151; *PPS Arctic*

**Responsible institution** Norwegian Institute for Nature Research (NINA)

The here proposed *PPS Arctic Norway* project is the Norwegian contribution to the IPY core project ***PPS Arctic*** (***P***resent day processes, ***P***ast changes, and ***S***patiotemporal variability of biotic, abiotic and socio-environmental conditions and resource components along and across the ***Arctic*** delimitation zone; see www.ipy.org project #151, or Attachment 1) coordinated by Dr. Annika Hofgaard, NINA, and Dr. Gareth Rees, Scott Polar Research Institute, UK. *PPS Arctic* is a multidisciplinary research cluster focusing on the southern border of the Arctic with its transition zone into shrub and tree dominated regions. This zone is internationally recognised due to its exceptional importance in terms of climate feedbacks, global vegetation, and settlements by indigenous people. Large scale changes in the structure and position of this zone (as predicted) will affect the total arctic environment. The core project, endorsed by IPY JC in November 2005 (cf. Attachment 2), had its first international meeting in Quebec City, 16-18 February 2006 where all included projects (EOIs) were presented and discussed in terms of their role and contribution to the interdisciplinary and circumpolar approach of *PPS Arctic*. The core project, that will be presented during the Arctic Science Summit Week (ASSW) in Potsdam March 2006, has established links to a network of terrestrial endorsed IPY core projects: e.g. GOA, COMAAR, ENVISNAR, ITEX, TARANTELLA, BTF, CARMA, ELOKA (cf. www.ipy.org for descriptions). A project description of *PPS Arctic* including project organisation, logistics, and financial status and plans is attached to this proposal (cf. Attachment 3). The Norwegian contribution, *PPS Arctic Norway*, does not cover the entire scientific width of the core project but has principal responsibilities within two main scientific domains of the core project: *i)* vegetation structure and present tree regeneration capacity, and spatiotemporal dynamics of the tundra-taiga transition zone in the southern Arctic; and *ii)* definition and spatiotemporal characterisation of the zone.

## OVERALL AIM:

***To give comprehensive information on status, and spatiotemporal changes and relocation, of the circumpolar Arctic delimitation zone, and possible consequences for regional to global climate***

## SUB-OBJECTIVES AND THEMES IN FOCUS FOR *PPS ARCTIC NORWAY*:

***to*** characterise the roles of environmental conditions and disturbances in shaping the structure and position of the arctic-boreal transition

***to*** establish accurate ways of relating spectral, textural, and spatial information in aerial and satellite images to structural properties of the boundary and the transition zone

To fulfil these aims we focus on two thematic areas addressed through two work packages (WPs) that mutually will form our herewith proposed integrated ecological-remote sensing-climate forcing project. In addition a “coordination and communication” package constitutes a fundamental third component for the fulfilment of the project.

| | |
|---|---|
| WP I | Structure, dynamics, and regeneration capacity of the arctic-boreal transition zone |
| WP II | Spatiotemporal characterisation and monitoring of the arctic-boreal transition zone |
| WP III | Coordination and communication of progress and results |

## GENERAL RATIONALE FOR *PPS ARCTIC* AND FOCAL THEMES INTEGRATED IN *PPS ARCTIC NORWAY*:

The position and dynamics of the arctic-boreal boundary are major determinants for land atmosphere interactions at the circumpolar scale and for ecological and socioeconomic conditions at the local to regional scale (Beach 1997, Callaghan et al. 2002, Vlassova 2002, Hofgaard 2004, ACIA 2005). This zone, the 'tundra-taiga ecotone' varies dramatically in width (up to hundreds of kilometres) throughout the circum-arctic North and has thus a recognized exceptional importance, in terms of global vegetation, climate, biodiversity and human settlement. Further, the particular vulnerability of the zone to changes in climate and land use is recognized, along with concern for subsequent alterations and shifts of its position with consequences for the entire arctic region and the global climate through feedback mechanisms. Despite this recognition, comprehensive and large scale multidisciplinary scientific focus incorporating cause, effect, and importance of its past and present transformation to the biota and human societies, has been lacking.

The contrast in surface characteristics, including albedo (reflectance), across and along the arctic-boreal transition zone is probably the greatest found on land anywhere (Harding et al. 2002). This variation causes massive changes in energy fluxes and temperature conditions. The dynamics, including feedback mechanisms and sensitivity to environmental change of this boundary, is of crucial importance to the scientific and political community. Even small changes can be expected to cause profound alteration of the land-atmosphere interactions with radical consequences for large-scale climatic systems (Harding et al. 2002) and consequently to broad-scale conditions in the Arctic as a whole (ACIA 2005). Increased forest volume and density is normally considered to reduce the radiative forcing because of the sequestration of atmospheric $CO_2$. However, changes in forest cover will also change the reflective properties of the surface (albedo), especially in areas which are snow covered part of the year[1]. This may offset the benefits of negative radiative forcing from carbon sequestration (Betts, 2000). Nevertheless, a comprehensive framework for climate assessment of land-cover transitions is not included in the Kyoto Protocol and in policy strategies due to limited data and lack of accounting frameworks. Furthermore, the understanding of the location, dynamics and environmental drivers (natural and human factors) at regional and circumpolar level is poor. To be able to predict the effect of future climate changes and feedbacks from the system profound knowledge on how the position is changing in response to a range of abiotic and biotic forces (e.g. climate, edaphic conditions, herbivory), together with refined techniques for detection of spatial displacement of the boundary over large spatial scales is needed. A rewarding way to gain this knowledge is to analyse and use past and present changes of the boundary in regions with contrasting major environmental drivers that occur within fairly short distances and that can have major effects on global climate. Northern Norway, Northwest Russia, and Northeast and Northwest Canada are ideal areas in this respect.

High latitudinal ecosystems are adapted to cold conditions, and face many natural stresses. However, they may be particular vulnerable to changes in the environment due to slow ecosystem processes in cold environments, including highly variable (in space and time) regeneration and reqruitment capacity, and long recovery times following imposed disturbances (Chapin & Körner 1995, Hofgaard 2004). Further, future changes of climate-related factors are predicted to outrange until present experienced changes in both intensity and variability (IPCC 2001). This could result in unprecedented changes of established systems at scales from species to biomes (Scheffer et al. 2001). These changes will be most apparent and significant in ecotonal areas, i.e. transition zones between for example different biomes. The transition zone between the two major biomes the treeless tundra and boreal forest is such a boundary, which has been predicted to be particularly sensitive to changes in the climate and human activities (Houghton et al 1996, ACIA 2005). This ecotone is especially abrupt due to the relatively distinct and apparent change in life-form from dominating upright growth to procumbent growth (Sveinbjörnsson et al. 2002). This abrupt transition creates dramatic contrasts in surface characteristics and can thus at the large scale be analysed and monitored by the use of satellite images. However, up to present these studies have generally produced fairly coarse pictures that do not capture

[1] Any dominance shift between present tree species and/or a range shift would strongly influence land cover albedo, energy exchange between the biosphere and the atmosphere, and fluxes of emissions to the atmosphere.

the actual boundary position or its structure, partly due to lack of reliable transfer functions based on detailed ground data (Rees et al. 2002). Additionally, model predictions of changes in the location of the boundary contrast recently observed changes (Callaghan et al 2002). Because the position of various components of the boundary (e.g. position of forest line, treeline, species line) are used as measures of effects of environmental change (e.g. climate, pollution, land use) there is a need for both detailed ground data and refined models (e.g. for analyses of satellite images) in order to monitor structural changes of the ecotone over larger areas (regional to circumpolar), and to predict the effect of changed land cover on radiative forcing and feedbacks to the climate system. Conclusively, as much of the forest-tundra boundary is remote with low accessibility, remote sensing from space-borne platforms will have a significant role in determination and monitoring of future changes. Therefore a comprehensive and large scale study of its present position, its relation to historic positions using older remote sensing data, regeneration and growth conditions, in regions dominated by continental and oceanic climates, respectively, is needed. In this way can reliable scenarios for future development of the transition zone and consequences for land-atmosphere interactions and its effect on global climate be constructed, information that with confidence can be used by policy makers/stakeholders at national and international level.

Herewith we propose a comprehensive cross-disciplinary based study using ecological process studies and remote sensing, to approximate effects of environmental pressures on the transition zone, and conclude on feedbacks to the global climate. The main study regions are northern Norway and north-western Russia, and north-eastern and north-western Canada. The Canadian study regions are not part of this proposal but are used as reference regions and will be studied in detail by collaborators in the here presented project, using the same protocol, within the frames of *PPS Arctic Canada* which is the Canadian contribution to the *PPS Arctic* core project.

***A section with study design, available data and models is given in Attachment 4.***

## WORK PACKAGES[2]:

### Work package I

STRUCTURE, DYNAMICS, AND REGENERATION CAPACITY OF THE ARCTIC-BOREAL BOUNDARY

WP coordinators: Senior Scientist Annika Hofgaard, NINA

Collaboration: Prof. David Cairns, Prof. Karen Harper, Prof. Greg Henry, Prof. Håkan Hytteborn, Dr. Natalia Lukina, Dr. Ludmila Isaeva, Prof. Jon Moen

One PhD student and one post doc (expectantly Russian and to be shared with WP II) will be allied to the theme (to be appointed).

WP I corresponds to *Modules* 1&2, and to *Theme*s "Location", "History of shifts", "Interface processes", "Effects of shifts", and "Detection of shifts", within *PPS Arctic* (cf. Attachment 3), and it

**Principal objective:**

*To* characterise the spatiotemporal roles of environmental conditions and disturbances in shaping the structure and position of the arctic-boreal transition, including changes in tree recruitment capacity

**Sub-objectives:**

1. to analyse how the structure of the boundary change along spatial and temporal scales
2. to analyse if there are significant differences in structure and positions present between oceanic and continental fractions of the landscape, and if so elucidate main environmental predictors
3. to explore evidence for correlation between regeneration and climate along and across the boundary and through time
4. to analyse if the pronounced natural environmental variability of the regions induce structural stability to the boundary through time, or if it destabilise the system

[2] Only main collaborators are given for each work package. The *PPS Arctic* cluster comprises both broad-scoped and subproject-specific tight collaborations across the cluster involving PIs, post docs, and PhD students.

5. to explore how the present position of different structural components of the boundary relate to historic positions of the boundary

Considerable attention has recently been given to the detection of movements of treelines as a possible confirmation of the reality of climatic warming (Crawford 2000, Callaghan 2002, Holtmeier 2003, ACIA 2005, Dalen & Hofgaard 2005). However, the lack of systematic and comprehensive regional studies of the interface between Arctic and Boreal regions currently makes conclusive interpretations impossible. Biotic and abiotic factors have structured the ecotone through time (Hofgaard 1997, Payette et al. 2001) and thus have an impact on the position of the present forest-tundra boundary (Sveinbjörnsson et al. 2002). The main abiotic factor climate has both direct impacts through for example temperature deficiency and wind and snow abrasion (Scott et al. 1987), and indirect impacts through effects on other abiotic factors e.g. edafic conditions for regeneration (Seastedt & Adams 2001) and on biotic factors e.g. growth, vitality, herbivory, pest outbreaks (Hofgaard et al. 1991, Stöcklin & Körner 1999, Neuvonen et al. 1999, Cairns & Moen 2004). The importance of all these factors will vary in a spatiotemporal manner along and across the forest-tundra boundary, in response to differences in prevailing environmental conditions. In a future predicted climate characterised by increased winter temperatures and general precipitation increases at high latitudes (IPCC 2001) the relative importance of the factors are likely to change (Skre et al. 2002). Additionally, human activities that have and are impacting the structure of the transition zone has to be taken into account when analysing responses to other changes in the environment (Hofgaard 1999, Vlassova 2002, Holtmeier 2003).

**Products:** WP I will give a “fingerprint” or snapshot, of the position, structure and the recruitment profile for the IPY 2007-2008 period, and give details for the dynamics of these variables in a broader time window. This includes: recent history of the present transition zone; species and age specific recruitment profiles; spatiotemporal trends; and modelled predictions of future development given different climate scenarios.
***These products constitute main input and validation variables to WP II.***
(For detailed scientific background and Methods see Attachment 4)

**Work package II**

CHARACTERISATION AND MONITORING OF THE ARCTIC-BOREAL BOUNDARY BY REMOTE SENSING
WP coordinators: Dr. Hans Tømmervik, NINA & Dr. Gareth Rees, Scott Polar Research Institute
Collaboration: Prof. Erik Næsset, Dr. Ryan Danby, Dr. Olga Tutubalina, Dr. Frank Berninger
Post doc worker: one post doc to be appointed (cf. WP I)
WP II corresponds to *Modules* 3 and 4, and to *Themes* “Terminology”, “Location”, and “Detecting shifts” within *PPS Arctic* (cf. Attachment 3), and it emphasizes the IPY priorities 1, 2 and 4.

**Principal objective:**
*To* establish accurate ways of relating spectral, textural, and spatial information in aerial and satellite images to structural properties of the boundary and the transition zone
**Sub-objectives:**
1. to detect and monitor the forest-tundra boundary including its different structural components using the best airborne and satellite remote sensing platforms and sensors available
2. to assess and apply high, medium and low resolution sensors in order to map and monitor spatiotemporal growth-climate relations including albedo in the forest-tundra border zone
3. to assess older remote sensed data in order to reveal changes related to climate change

The tremendous advances in remote sensing and computing technologies allow scientists to measure and model environmental patterns and processes at an increasing level of detail and with increasing confidence. Satellite-borne passive instruments operating in the visible and near infrared regions (e.g. imaging spectrometers) of the electromagnetic spectrum, and active microwave imaging radars (Synthetic Aperture Radars), can provide observations of the Earth’s surface at different spatial resolutions from sub-metre (high resolution) up to several kilometres (low resolution). Use of low resolution data such as NOAA-AVHRR and TERRA-MODIS have been proved to be useful for global monitoring of forests with emphasis on phenology, biomass and NPP (Myneni et al. 1997, Zhou et al. 2001) and more regional (Pettorelli et al. 2005, Beck et al. 2006). LIDAR measurements from aircraft enable us to detect the tree height and other tree parameters (Næsset & Økland 2002, Næsset & Gobakken 2005) and this will be essential for definition of the forest-tundra border in both deciduous and conifer dominated regions.

Airborne Imaging Spectrometers (IS) provides large numbers of spectral bands within a broad spectral region of the electromagnetic spectrum (ultraviolet, blue, green, red and near-infrared up to mid-infrared wavelengths). This technique allows the user to make more specific analyses, e.g. separation of different vegetation cover types (Goetz et al. 1985). The usefulness and potential of airborne imaging spectrometers in vegetation monitoring and mapping have been demonstrated through a number of studies or projects (Rock et al. 1988, Franklin et al. 1992, Radeloff et al. 1999, Tømmervik et al. 1997, 2000, Zarcotejada 2004, Schlerf & Atzberger 2006). Also the use of satellite remote sensing has revealed changes in the forest-tundra transition zone (Rees et al.2002, Colpaert et al. 2003, Tømmervik et al 2001, Tømmervik et al 2003, Tømmervik et al 2004). This, together with recent achievements in image processing and pattern recognition techniques (Harsanyi & Chang 1994, Vapnik 1995, Szu & Kopriva 2002, Bruzzone 2000,) provides the potential to study and monitor changes and displacements of the forest-tundra transition zone in detail. However, the exploitation of these opportunities calls for an integrated research effort, combining knowledge of the physical interaction between electromagnetic waves and vegetation, modern statistical signal processing and pattern recognition, with expert knowledge in spatiotemporal growth-climate relations including analysis of change in albedo as well as statistical analyses of large-scale biological data. Up-scaling of the point measurement data (field analysis) as well as high resolution remote sensing data up to lower resolution will be high-lighted (Wu 1999).

**Products:** WP II will give efficient tools for detection and analyses of the boundaries and structure of the forest-tundra border zone, and important input information and data (e.g. maps) for WP I and WP II concerning the spatio-temporal growth-climate relations including albedo in the forest-tundra border zone.
(For Methods see Attachment 4)

**Work package III**

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| COORDINATION AND COMMUNICATION OF PROJECT PROGRESS AND RESULTS | |
| WP coordinator: | Senior Scientist Annika Hofgaard, NINA |
| Collaboration: | Grafic designer Kari Sivertsen, NINA & the entire project consortium with principal responsibilities for Theme and WP coordinators |

**Principal objective:** To ensure efficient coordination within the entire *PPS Arctic* and *PPS Arctic Norway*, and communicate information from the project to user groups (including publication of results directed to the scientific community, the general public, and policy makers, by the use of e.g. web-site, scientific publications, public media, and IPY book series).

**Principal tasks:**
1. Coordination of *PPS Arctic* (including harmonisation between national project groups and scientific fields; promotion of exchange of knowledge and resources at PI, post doctoral and graduate levels; and communication of progress and results)
2. Coordination of *PPS Arctic Norway* (including harmonisation between work packages, and their interactions with other *PPS Arctic* project components)
3. Communication and outreach of *PPS Arctic Norway* progress and results

**Education and outreach activities:**

1. To develop and run the *PPS Arctic* web site, hosted by NINA, with up-dated project information on scientific background, organisation, study regions, status for ongoing activities, results, data availability, contacts, related links, personnel, and literature. The web-site will be linked to official international and national IPY websites, other IPY- project websites where appropriate, and to IASC.
2. To emphasise popularisation of results in addition to products for the scientific community.
3. Synthesize new and existing thematic information for broad groups of interest.
4. Use and encourage the joint knowledge capacity of *PPS Arctic* and the evolving data sets for education in various contexts: universities, schools, environmental programmes, workshops.

The project with its results has both scientific and human-environmental importance and is hence expected to generate political and public interest at a local, national, and international level. Consequently, ongoing activities and results will be presented to suit the interest of a broad variety of user groups within the relevant communities. The information section at NINA has the necessary infrastructure and broad experience in developing suited communication tools for large projects, e.g. web-based and printed information material for a broad range of target groups

**Scientific communication:**

The new scientific results from the project will in addition to information designed for the general public, students, and policy makers, be compiled in approximately 3-4 scientific publications per work package including one PhD theses, covering all sub-objectives and the main objective of the project, and also strongly contribute to the integration of the scientific fields which is desired for future predictions of environmental effects and feedback mechanisms at regional to global scales. The papers will be published in journals of the highest possible reputation. Furthermore, we expect that the project will generate an additional number of publications during and after the IPY project period as a result of collaboration within the *PPS Arctic* core project and related other IPY core projects. This network of projects represents a unique opportunity to interlink and evaluate results and interpretations from a range of viewpoints and scientific fields and at a range of spatial and temporal scales.

**Products:** Efficient project management, and outreach activities to communicate results through diversified information channels (including peer reviewed scientific literature, articles directing the general public, web site, public media, seminars, workshops, university courses).

## PROJECT MANAGEMENT STRUCTURE AND COMPETENCE OF PROJECT WORKERS

The project will be administrated through the Unit of Terrestrial Ecology, NINA, Trondheim, and led by Senior Research Ecologist A. Hofgaard in close co-operation with all project workers. One PhD student and the postdoc will work full time within the project. The research team together with associated project members and experts within the *PPS Arctic* network will form an active research group around these younger scientists (to be appointed[3]). All together this group warrant for a successful and highly productive project. Further a number of master-degree students will be connected to the project. The PhD student and the postdoc will be based in Trondheim, but spend part of the project time in Tromsø and at the University of Laval, Québec and/or Dalhousie University, Canada[4], Scott Polar Research Institute, Cambridge, UK, and at the University of Life Science, Ås, Norway. The affiliation of

Further, the proposed project generally fits into the outlines and overall aim of the International Arctic Science Committee (IASC) project "Tundra- Taiga Initiative" (TTI) and ICARP WG8. The main aim of this initiative is to identify and stimulate relevant tundra-taiga interface research activities at the regional to circumpolar scale; and to provide a communicative platform for researchers and stakeholders with interest in the field (cf. IASC Project Catalogue at www.iasc.no ).

[3] The project team has been contacted by a number of candidates for the PhD and postdoc positions. These could presumably enter the positions and fulfill the requirements in an excellent way. However, the positions are kept open to have candidates go through an application procedure and herewith ensure that the best suited candidates get the positions.

[4] From 2007 the affiliation of Dr. K. Harper, the coordinator of PPS Arctic Canada, will be Dalhousie University.

***Senior Scientist Annika Hofgaard,*** Unit of Terrestrial Ecology, NINA. Coordinator of *PPS Arctic* and leader of TTI. Vegetation ecologist with expertise on structural changes and population dynamics in northern forests and the forest-tundra transition with focus on climate effects. (cf. CV).

***Senior Lecturer Gareth Rees***, Remote Sensing Group, Scott Polar Res. Inst. Cambridge, UK. Co-coordinator of *PPS Arctic*, member of TTI. Physicist & remote sensing scientist with expertise on techniques for detection of environmental impacts on forest & tundra vegetation. (cf. CV).

***Senior Scientist Hans Tømmervik,*** Unit of Arctic Ecology, NINA. Vegetation ecologist with expertise on remote sensing methods in mapping and monitoring of boreal and arctic-alpine vegetation with focus on impact variables such as pollution, logging and herbivores. (cf. CV).

***Dr. Frank Berninger***, Université du Québec à Montréal (UQAM), Canada. Forest ecologist with expertise on albedo changes and climate feedbacks (cf. CV).

***Prof. David Cairns***, Texas A&M Univ. Ecosystem ecologist with expertise on ecosystem modelling and herbivory influences on treeline under climate change. (cf. CV).

***Dr. Ryan Danby***, Univ. of Alberta, Canada. Remote sensing ecologist with special expertise on northern boreal transition zones. Collaboration discussions in progress.

***Prof. Karen Harper***, Univ. of Laval, Quebec/ Dalhousie University, Canada. Forest ecologist with special expertise in transition zone processes. Coordinator of the Canadian part of *PPS Arctic* and main contact for the eastern study region within *PPS Arctic Canada* (cf. CV).

***Prof. Greg Henry***. Univ. of British Columbia, Canada. Arctic tundra ecologist with expertise on global change impacts and species interactions. Coordinator of ITEX (IPY core project #188) and together with Hofgaard main responsible for harmonisation and cooperation between ITEX and *PPS Arctic*. Main contact for the western study region within *PPS Arctic Canada* (cf. CV).

***Prof*. *Håkan Hytteborn***. Dept. of Biology, NTNU, Norway. Vegetation ecologist with expertise in species distribution, population dynamics, ecotonal processes, and climate-growth relations.

***Senior Researcher Ludmila Isaeva***, Institute of the Industrial Ecology of the North, Kola Science Centre, Russian Academy of Sciences, Apatity. Expertise on disturbances and forest system health (cf. CV+letter).

***Senior Researcher Natalia Lukina,*** Centre of Problems of Forest Ecology and Productivity, Russian Academy of Sciences, Moscow. Expertise in environmental impact on status of northern forest communities (cf. CV+letter).

***Prof. Jon Moen***, Univ. of Umeå, Sweden. Boreal vegetation ecologist with expertise on herbivory-treeline interactions. (cf. CV).

***Prof. Erik Næsset,*** Dept. of Ecology and Natural Resource Management, UMB. Remote sensing ecologist with special expertise on forest stand inventories and use of LIDAR. (cf. CV).

***Graphic designer Kari Sivertsen***, NINA. Expertise in printed and web based information techniques.

***Dr. Olga Tutubalina***, Faculty of Geography, Moscow State University, Moscow, Russia. Expertise in remote sensing and environmental conditions in northern systems (cf. CV+letter).

## TIME SCHEDULE

Funding is requested for a four-year program i.e. January 2007 – December 2010 including visiting scholarship abroad for the PhD student and the post doc. The main fieldwork will be carried out in Norway in 2007 and in Russia in 2008. Analyses of collected data will be carried out during all years. Publication of obtained results will take place in 2008-2010 and onwards (cf. WP III), with the final report to NFR in 2010. Project and core project meetings will be held annually.

| **Principal project activities** | *<2007* | **2007** | **2008** | **2009** | **2010** |
|---|---|---|---|---|---|
| Project coordination | *X* | X | X | X | X |
| Establishment of sampling areas | *X* | X | | | |
| Airborne data collection | *X* | | | | |
| Satellite image retrieval | *X* | X | | | |
| Ground data collection, Norway | *X* | X | (X) | | |
| Ground data collection, Russia | | (X) | X | (X) | |
| Data analysis | | X | X | X | |
| PhD courses and literature exams | | X | X | X | |
| Dataset construction albedo, NDVI | | X | (X) | (X) | |
| Annual project workshops (January) | | X | X | X | X |
| Annual core project workshops (February) | | X | X | X | X |
| Reports to NFR | | X | X | X | X |
| Visiting scholarships abroad | | | X | X | |
| Presentations at international meetings | | X | X | X | X |
| Publication | | | X | X | X |
| PhD thesis submission | | | | | X |
| Final core project workshop | | | | | X |

## DATA MANAGEMENT

The *PPS Arctic* cluster and *PPS Arctic Norway* will, following the IPY Data Policy, and to the benefit of effective management and future accessibility, implement the following procedures and principles for data management. Metadata: All sub-projects linked to individual projects and the cluster will register descriptive information characterizing measurements and sites in a data base developed for *PPS Arctic* at the NINA Database, Trondheim, Norway, with automatic links to international polar databases in accordance with the IPY data policy development. The metadata base and updates will be announced at the *PPS Arctic* web site (to be developed for the IPY period and onwards). Primary data and processed data: Individual projects and sub-projects will be responsible for their own data storage, security routines, data validation, and quality control. The data collected within individual projects will be made available after quality control, full documentation, and publication at the same web site as the metadata. If not published within three years after completed collection primary unpublished data will be made available (after compulsory quality control), stored and safeguarded for future analysis. *PPS Arctic* will use common protocols that will be published in a *PPS Arctic* manual. Work has begun on devising this framework and it will be approved during the next annual core project meeting, to be held in Tromsø February 2007 (see Attachment 3)

## BUDGET FOR ALL THREE WPS TAKEN TOGETHER

Details at WP level are given in Attachment 7.

**Total Project costs (WP I-III)**

costs are given in kNOK

| | 2007 | 2008 | 2009 | 2010 | 2007-2010 |
|---|---|---|---|---|---|
| ***1) Salaries and benefits*** | | | | | |
| Post-doctoral fellow | | 696 | 696 | | 1392 |
| PhD student | 296 | 592 | 592 | 296 | 1776 |
| Researcher NINA | 912 | 920 | 930 | 960 | 3722 |
| Research assistant | 0 | 75 | 0 | 0 | 75 |
| *Sum* | *1208* | *2283* | *2218* | *1256* | *6965* |
| | | | | | |
| ***2) Equipment and Materials*** | | | | | |
| Fieldwork equipment | 30 | 10 | 0 | 0 | 40 |
| Laboratory analysis | 20 | 30 | 0 | 0 | 50 |
| Consumables | 30 | 30 | 30 | 20 | 110 |
| *Sum* | *80* | *70* | *30* | *20* | *200* |
| | | | | | |
| ***3) Travel*** | | | | | |
| Fieldwork Norway | 60 | 40 | 0 | 0 | 100 |
| Fieldwork Russia | 0 | 90 | 40 | 0 | 130 |
| Allowances fieldwork Norway | 132 | 61 | 0 | 0 | 193 |
| Allowances fieldwork Russia | 0 | 132 | 61 | 0 | 193 |
| Research fee Russia | 0 | 20 | 20 | 0 | 40 |
| Travel costs team & collaborators | 90 | 90 | 90 | 90 | 360 |
| *Sum* | *282* | *433* | *211* | *90* | *1016* |
| | | | | | |
| ***4) Dissemination and communication*** | | | | | |
| Data management | 20 | 40 | 50 | 50 | 160 |
| Publication costs | 10 | 35 | 45 | 50 | 140 |
| Conference costs | 80 | 75 | 75 | 80 | 310 |
| Outreach and communication | 10 | 30 | 10 | 30 | 80 |
| *Sum* | *120* | *180* | *180* | *210* | *690* |
| | | | | | |
| ***5) Other*** | | | | | |
| Visiting scholar post-doctoral fellow | 0 | 32,25 | 32,25 | 0 | 64,5 |
| Visiting scholar PhD student | 0 | 32,25 | 32,25 | 0 | 64,5 |
| *Sum* | *0* | *64,5* | *64,5* | *0* | *129* |
| | | | | | |
| **Applied to NFR** | **1690** | **3030,5** | **2703,5** | **1576** | **9000** |
| | | | | | |
| Own funding | 385 | 385 | 385 | 385 | 1540 |
| **Total project budget** | 2075 | 3415,5 | 3088,5 | 1961 | 10540 |

## ATTACHMENTS

1) *PPS Arctic*: IPY full proposal #151
2) Endorsment from IPY JC November 2005
3) Project description for *PPS Arctic*
4) Details: Study design and WP I-II
5) Curriculum Vitae (short) for all WP coordinators and collaborators; and letters of confirmation for Isaeva, Lukina, and Tutubalina.
6) References
7) Budget details at Project and WP level