

# Full Proposals for International Polar Year 2007-2008 Activities

## Proposed IPY Activity Details

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### 1.0 PROPOSER INFORMATION

(Activity ID No: 16)

#### 1.1 Title of Activity

Hydro-sensor-FLOWS Arctic and antarctic glacier hydrosystems as natural sensors for recent climatic variations

#### 1.2 Short Form Title of Proposed Activity

Hydro-sensor-FLOWS

#### 1.3 Activity Leader Details

Madeleine GRISELIN  
CNRS  
France

#### 1.4 Lead International Organisation(s) (if applicable)

CNRS , France  
Group of Cryokarst and glacier caves in polar region and high mountain (USI)  
Group Remote sensing of polar environment  
NULL

#### 1.5 Other Countries involved in the activity

France  
Spain  
Russia  
Germany  
Uruguay  
Korea  
Italia  
NULL  
NULL  
NULL  
NULL  
NULL  
NULL  
NULL  
NULL  
NULL  
NULL

#### 1.6 Expression of Intent ID #'s brought together in this proposed activity

535

#### 1.7 Location of Field Activities

Bipolar

## 1.8 Which IPY themes are addressed

1. Current state of the environment

## 1.9 What is the main IPY target addressed by this activity

2. Data Management

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## 2.0 SUMMARY OF THE ACTIVITY

This activity joins EoI n° 535 (LovenFLOWS presented by M. Griselin, France and EoI n° 233 (SUGLANET, presented by A. Eraso, Spain). The two teams worked together for a long time concerning Svalbard Hydrology and are linked by a convention between CNRS (French Scientific Research Center) and IPEV (French Polar Institute). The objective of this clustering project is to investigate the hydrology of polar and subpolar glacier basins. It is known that discharge of temperate glaciers ( $1-1.2 \text{ m}^3 \cdot \text{s}^{-1} \text{ km}^{-2}$ ) is bigger than that coming from subpolar glaciers ( $0.2-0.3 \text{ m}^3 \cdot \text{s}^{-1} \text{ km}^{-2}$ ), but also it is true that extension of subpolar glaciers (ca.  $750,000 \text{ km}^2$ ) is 10 times bigger than that of temperate glaciers (ca.  $70,000 \text{ km}^2$ ). By considering these data, the discharge of subpolar glaciers due to the global warming may be as important as those coming from temperate glaciers. However, the hydrological response of subpolar glaciers to atmospheric inputs is not well-known and may be precised by continuous monitoring of some parameters at key-locations on basins. New technologies in the fields of information and communication drastically increased the observation capacity of scientists. In very reactive environments such as polar regions, it is now possible to enhance qualitative and quantitative observations using automatic data collection sensor webs. The development of such networks is bringing new tools to answer hypothesis that were so far lacking a continuous database to be studied. Such is the situation of arctic hydro-systems for which the most data available over the last forty years are discontinuous, usually summer measurements. The originality of this program is to investigate the hydrology of glacier basins through continuous survey, over a period of several years, that is necessary to quantify the hydrosystems reactivity to climatic variations (hourly, daily, seasonally even yearly). Through this cluster, the dynamics of polar hydrology will be approached continuously at two different scales on 5 representative polar basins of Arctic (3) and Antarctic (2).

1. At a local scale, a sensor-web will be developed on the Loven East glacier (Svalbard): this glacier is representative of the alpine type glaciers of Svalbard and is hydrologically studied by the French and by the Spanish scientists since 40 years. The goal is to analyze liquid and solid fluxes from this hydro-system with a sensor web (both remote and in situ sensing). An environmental watch will be conducted in this area over a three years period through a network of photographic stations, hydrological sensors and meteorological stations. All the ground data will be transmitted automatically thus contributing to set up a true "sensor web". The database will allow a global approach of spatial and temporal dynamics of the Loven East hydrosystem. Field surveys will also be conducted regarding the different inputs to the system. Remote sensing data, aerial photographs, meteorological data and hydrological information will allow the quantification of the system reactivity to contemporary climatic fluctuations. Experimental pilot catchment areas will be implemented to register glacier discharge continuously, recording time series with hourly cycle-time of different hydrological parameters (water level, conductivity, water temperature, pH, solid contents). In laboratory, using correlative and spectral analysis between input time series (meteorological parameters as air temperature, relative humidity, atmospheric pressure, solar radiation, precipitation amounts) and output time series (hydrological parameters), we will establish their characteristics in the time and frequency domains. The use of cross-correlogram for temperature and discharge, for example, will define the influence of air temperature to the glacier discharge, as well as its law of time distribution, that means the glacier response to weather changes and global warming. Chemical and isotopic analyses will be performed on water for completing the model of water circulation within the system (surface water, subglacial water and groundwater).

2. At a global scale, the Spanish group started to develop the GLACE Project in 2001: "GLACiers, Cryokarst and Environment" (Proyecto GLACKMA, in Spanish). At the moment, 4 experimental pilot catchment have been implemented to assess the latitude effect on the

hydrology of glaciers: 2 for temperate glaciers (Iceland at 64°N and Patagonia at 51°S) and two for polar glaciers (Svalbard at 79°N and Insular Antarctica at 62°S in subpolar glaciers). For all them, the discharge glacier is registering continuously. For the IPY, those stations will be maintained for generating time series in hourly frequencies like for the Loven East sensor-web. Additional new stations will be set up (at least one in the Antarctic Peninsula at S63°24' near ECARE, another in the Eastern Antarctica at 71°S near Novolazarevskaya and another one around 70°N latitude) for studying the variability of the global warming impact.

### 2.1 What is the evidence of inter-disciplinarity in this activity?

- The French team for the Loven East investigations: geographers climatologist, hydrologist, geomaticians, statisticians, hydrogeochemist, micro-technic engineers
- Spanish team for hydrology measurements:hydrologist + mathematician + physicist
- German team for permafrost and sediment: geomorphologist (permafrost) and sedimentologist
- Russian team : for deltas investigations : ocenaografers, sedimentologists.

### 2.2 What will be the significant advances/developments from this activity? What will be the major deliverables? What are the outputs for your peers?

Using very new technology, this program will allow comparisons for similar basins: Arctic/Antarctic polar/subpolar. For the best known of them (Loven East) the program will allow to follow the spatial and temporal hydrological dynamics for the last 40 years in relation with the meteorological data recorded in Ny-Alesund since the 1960s. This continuous survey will help us in apprehending processes differently and to display hydrologic and climatic data spatially in a context of accelerating glacial receding.

The sensor-web developed on the Loven East will be a very significant technological advance which could be develop after this program for other basins at different latitudes

Establishment of a network of pilot stations measuring glacier discharge in different latitudes in both hemispheres. This network will be enlarged successively -Define on time the exponential function that described the increase of specific glacier discharge in every station -Find the correlation between glacier discharge with solar radiation, air temperature and another meteorological parameters using correlative and spectral analysis -Compare specific discharge glacier for several latitudes in both hemispheres and its time evolution applied to prediction models of sea rise level -Estimation of physico-chemical characteristics of subpolar waters (Eh, pH, T, EC) and identification of water-rocks interactions (dissolution, hydrolysis, sorption, redox reaction)

Papers will be submitted to different journals (Journal of Hydrology, Journal of Glaciology, Arctic and Alpine Reserach), and will be presented to various symposiums: (10th Remote sensing of polar environment, 8th Cryokarst in polar environment). A paper will be submitted to Cybergéo the @media journal of Geographers

### 2.3 Outline the geographical location(s) for the proposed field work (approximate coordinates will be helpful if possible)

Locations	Coordindates
Loven East glacier basin, Svalbard	79°N
Kiviarjökull, in Iceland	64°N
Collins glacier in King George Island	62°S
Patagonia	51°S
Antarctic Peninsula near ENCARE	S 63° 24' E
Eastern Antarctica near Novolazarevskaya	71°S

### 2.4 Define the approximate timeframe(s) for proposed field activities?

Arctic Fieldwork time frame(s)	Antarctic Fieldwork time frame(s)
04/07 – 11/07	11/07 – 02/08
04/08 – 11/08	11/08 – 02/09

## 2.5 What major logistic support/facilities will be required for this project?

Existing field stations

**Further details** – Logistic equipment provided by IPEV and AWIPEV or by ourself like : skiddo, rubberboat, skis, high technical and scientific equipment Further details – - for the Loven East investigations - use of logistic equipment existing in Ny Aalesund with the French-german AWIPEV Platform (Base Rabot) and Jean Corbel (rubber boat, skidoo, etc.) - scientific equipment provided by each laboratory and/or specially bought for this project - for the other basin: logistic support and facilities required for this project are coordinated with the agreements that we have with the Polar Institutions -Uruguayan Antarctic Institute -Russian Academy of Natural Sciences -Moscow Geographical Institute -Korea Antarctic Research Program -Water Division, XII Region of Chile -Norks Polar Institutt, Ny-Alesund -Laboratoire Souterrain Moulis, -CNRS-, France

## 2.6 How will the required logistics be supplied? Have operators been approached?

Source of logistic support	Likely potential sources	Support agreed
Consortium of national polar operators		
Own national polar operator	Y	
Another national polar operator	Y	
National agency	Y	
Military support	Y	
Commercial operator		
Own support	Y	
Other	Y	

## 2.7 If working in the Arctic regions, has there been contact with local indigenous groups or relevant authorities regarding access?

## 3.0 STRUCTURE OF THE ACTIVITY

### 3.1 Origin of the activity

This is a pulse of activity during 2007-2009 within an existing programme

**If part of an existing programme please name the programme** – Sensor-FLOWS (France); GLACE (Spain)

### 3.2 How will the activity be organised and managed? Describe the proposed management structure and means for coordinating across the cluster

– The leader teams are those which presented the EoI 535 and 233. The leadership of the cluster is insured by the French (M. Griselin and C. Marlin) together with the Spanish (A. Eraso and C. Dominguez).

–To finalize the project, the different teams have to meet. They will be together on the field in Svalbard each year.

Since 2005, a convention has been signed between the French lab ThéMA-CNRS and the Universidad Politecnica of Madrid to put in common their polar data.

- For the Loven East investigation: through a 3 years program the French team will lead the fieldworks. The French base (Jean Corbel) will be our base camp (logistic management of IPEV and AWIPEV), as we did since 40 years.

- directed by Dr Madeleine Griselin, senior scientist CNRS Besançon

- co-directed by Pr Christelle Marlin, Professor of the University Paris-Sud Orsay.

The two scientists will organise all the logistical and scientific issues.

This will be undertaken under the management of CNRS France and of the French Polar Institute (IPEV) in relation with the universities of Madrid, Postdam, Kiel and Moscow

- The missions in Iceland, Patagonia and Antarctica will be conducted by A. Eraso.

The project will be organised and managed as we have made during the first phase of GLACE Project above mentioned. It is based on coordination between the scientists of the Institutions enumerated above and research developed for different groups. Logistic required is also always coordinated with those Polar Institutions including it in their own program of activities and seeing the possibility of increasing the scientific groups and works developed. In this way we have been working during the first phase of GLACE Project and now we have research coordinated with Uruguayan, Russian, French, Korean, Chilean, Germany and Icelandic.

### **3.3 Will the activity leave a legacy of infrastructure and if so in what form?**

- For Svalbard, the infrastructure used already exists: Corbel French Camp. The project would certainly leg new equipment to this existing camp
- The sensor-web system implemented on the Loven East is supposed to run several years after the IPY as well as for the other monitoring stations

### **3.4 Will the activity involve nations other than traditional polar nations? How will this be addressed?**

no

### **3.5 Will this activity be linked with other IPY core activities? If yes please specify**

- Hydrological cycle and freshwater budget

### **3.6 How will the activity manage its data? Is there a viable plan and which data management organisations/structures will be involved?**

- data will be processed by the different laboratories involved.
- published as soon as possible through international papers and congress
- part of them will be available directly on the web site (photos, meteo, hydrological data)
- a link to our data web site will exist on the IPEV web site to increase the visibility of thois project
- if the IPY organised a central data bank, our data will be made available through this structure

### **3.7 Data Policy Agreement**

**Will this activity sign up to the IPY draft Data Policy (see website)**

Yes

### **3.8 How will the activity contribute to developing the next generation of polar scientists, logisticians, etc.?**

With the sensor-web we will develop for the polar year, we propose a really new way to collect information on the field. The concept of sensor-web adapted to polar hydrology will be a real advance for next generation of scientist tool. Young scientists (pHD Student and post-doc fellow) will be involved in this project.

### **3.9 How will this activity address education, outreach and communication issues outlined in the Framework document?**

This program will be well covered by the communication service of CNRS. Photo and film will be done. During the polar year a real time website will be operating, on which data of the sensor-web will be available.

- Develop of doctoral thesis, postgraduate projects and student workshops
- Elaboration of book chapters, monographic publications, videos, conferences and media
- Web-site during the develop of expeditions with photos and daily reports scientific and outreach-education
- Update lectures of the official teaching programmes in Universities according to the results of expeditions

### **3.10 What are the proposed sources of funding for this activity?**

A lot of applications have been already submitted: the results will be positively influenced if the

program receives the IPY Label

- Svalbard field works
  - 450,000 euros requested to the ANR (French National Research Agency) in June 2005 for 2006-2008 (decision: September 2005)
  - 100,000 euros requested to the IPEV (French Polar Institute) in September 2005 for 2006-2009 (decision: January 2006)
  - German people applied to the AWI foundation.
  - Russian people applied to the Oceanographic Institute of Moscow
- Other field works

As this project will be part of the second phase of GLACE Project, that starts in 2005, it is proposed to fund through the Spanish Meteorological Institute included in the Ministry of Environment and through the National Program of Ministry of Education and Science in Spain.

### 3.11 Additional Comments

2.7 If working in the Arctic regions, has there been contact with local indigenous groups or relevant authorities regarding access? - We work in Svalbard since the 1980s, always with official agreement of the Governor (Syssleman).

This cooperating program will represent a good presence of the French and Spanish scientists in the Arctic, especially in Svalbard where both nations conducted programs since several decades but where not present in Svalbard for the last IPY, because the French camp was built after it in the 1960s.

Some French organisations are involved in this program and already provided funds (50 000 euros) to develop the scientific equipment (sensor web) and to fund the preliminary fieldwork in Svalbard (2005) in order to test the automatic stations and to prepare the following investigations of 2006-2008. As our project already started to be supported by our respective countries (France and Spain), the IPY label would be helpful to highlight our project and to find additional funds, it is why we do prefer to applied on 30June, the earlier we will know if we receive the IPY label, the better it will be in our funds requests. This program will concretised a French-Spanish cooperation started some 20 years ago, together with those cooperation developed through the Cryokarst International group. The Circumpolar of Environment Remote Sensing group is also represented here through our French-Russian cooperation. Even if it did not find a place in the proposed clusters, this program Hydro-sensor-FLOWS is a real international, interdisciplinary project, which would well represent the polar hydrology during the IPY.

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## 4.0 CONSORTIUM INFORMATION

### 4.1 Contact Details

#### Lead Contact

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#### 4.2 Other significant consortium members and their affiliation

<b>Name</b>	<b>Organisation</b>	<b>Country</b>
Pr Christelle MARLIN	université de Paris Sud et IDES CNRS, Orsay,	France
Dr Thierry BROSSARD	ThéMA CNRS, Besançon	France
Dr Daniel JOLY	ThéMA CNRS, Besançon,	France
Dr Dominique LAFFLY	CNRS IRSAM-SET, universite de Pau	France
Sébastien NAGELEISEN	ThéMA CNRS, Besançon,	France
Dr Alain MANGIN	CNRS, Laboratoire souterrain de Moulis	France
Dr Igor ZEMLIANOV	Information System Lab. (ISysLab)	Russia
Olga V. GORELITS	Information System Lab. (ISysLab)	Russia
Dr DETHLEFF Dirk	IPÖ - Universität de Kiel	Germany
Dr Georg SCHWAMBORN	Dr Georg SCHWAMBORN	Germany
Pr Carmen DOMINGUEZ	Dpt Applied Mathematics, Univ. Salamanca	Spain
Pr Albert LLUBERAS	Urugayan Antarctic Institut	Uruguay
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