

## **Remote and In-Situ Sensing to Survey a Glacier Basin: Protocole of setting up and First Results of an IPY project (Loven East Glacier, Svalbard, Norway (79°N))**

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This paper will present the Sensor-FLOWS program which has been endorsed by the IPY (International Polar Year)

### **1. Scientific background and objectives**

In the frame of the International Polar Year, several projects focus on the study of glacier geosystems based on the mass balance (glaciological approach). Very few projects are approaching such systems by studying the hydrological balance, because the hydrological survey of polar glacier basins is very difficult due to the divagation of the streams. Near the French Base Jean Corbel, the Loven East glacier is a true real scale “laboratory” for hydrological observations which are conducted since the sixties.

The objectives of this program is summed up in its acronym: Sensor-Flows (Flux Of Water and Sediments). The goal is to analyze liquid and solid fluxes from a typical polar hydrosystem with a sensor web (both remote and in situ sensing) and with water samplings. Space and time dynamics over a four years period will also be monitored to improve our understanding of the system’s reactivity to contemporary climatic fluctuations (40 years). This project consists in offering engineering sciences development to naturalists and geographers in order to set up an environmental watch. This survey will help us in apprehending processes differently and in displaying hydrologic and climatic data spatially in a context of accelerating glacial receding in Spitsbergen.

### **2. Description of project, methodology**

The present cross-institutional, interdisciplinary and international project – hosted by the Arctic Network in collaboration with the FEMTO laboratory – will be taking place in the King’s Bay (Spitsbergen) where France is managing its only scientific base in the Arctic.

The study site where the sensor web will be established is the Loven East glacier basin (10 km<sup>2</sup>). In addition to water samplings, an environmental watch will be conducted in this area over a four 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”. This data will be used in conjunction with large scale information offered by remote sensing.

The database (in collaboration with Spain for hydrology) will allow a global approach of spatial and temporal dynamics of the Loven East’s hydro-system. Field surveys will also be conducted regarding the different entries to the system. They will be necessary to complete and verify the water circulation model proposed. In collaboration with scientists of the Alfred Wegener Institute, a mapping of the permafrost will take place as well as an approach of the littoral progradation (Oceanographic Institute of Moscow) and of the marine sedimentology (Polar Ekologie Institute of Kiel). Remote sensing data, aerial photographs, meteorological data and hydrological information will allow the quantification of the hydro-systems’ reactivity to climatic variations over the last forty years.

### **3. Expected results**

New technologies in the fields of information and communication drastically increased the scientists’ observation capacity. 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 only data available over the last forty years is discontinuous. The absence of population in extreme polar environments allows the display of high-technology equipment that wouldn’t be possible in inhabited or visited regions. That’s why western Spitsberg constitutes a favourable ground for the survey of sites.

Adding to the spatial modelling proposed at first by our group, the data obtained through this system of observation concerning environment and processes will allow (in the long term) a modelling of the processes (in future collaboration with the glaciologists of LGGE Grenoble).

Comparisons with other polar basins (studied by the Spanish in the frame of this project), will allow a real contribution to the knowledge of polar hydrosystems, and will allow France to take part in the very promising fields of “in situ sensing” and “sensor web”, all in the context of the International Polar Year (IPY).

In April-May 2006 will take place the setting up of the whole protocole on the Loven East and the test of the automatic equipment. So for the congress we expect to present the first pictures of this sensor-web.