

Workshop on European Satellite Snow Monitoring Perspectives

**Eumetsat, Darmstadt, Germany.
4-5 December 2012**

Meeting Summary and Recommendations

Authors: S. Pinnock, L. Schüller, F. Appel, T. Nagler, K. Luojus, J. Pulliainen, N. Foppa

Introduction & Objectives

Satellite based snow monitoring capabilities have been developed in Europe over the last decade in projects such as EUMETSAT's Hydrology SAF, ESA's GMES PolarView and DUE GlobSnow, and the EC's FP7 CryoLand. Each of these has worked closely with their user communities and performed the necessary R&D to successfully implement information services addressing a broad spectrum of user needs including flood forecasting, climate research, meteorology, hydrology, water management, public risk, tourism, etc.

The aim of this workshop was to bring the major European satellite snow monitoring initiatives together with their key users, to:

- Review the current state of development of European snow monitoring capabilities,
- Identify gaps and opportunities in meeting the users' needs and securing sustainable funding for the services,
- Define priorities for developments over the next 5-10 years which build on European expertise and satellite infrastructure to achieve sustainable information services which maximize benefits to users.
- Understand how these activities fit within GMES and the EC, ESA and Eumetsat priorities over the next decade.

The outcome of the workshop will be a "white paper" providing a consensus perspective on the future development of European satellite snow monitoring capabilities. The aim is to circulate a draft white paper for comment to all participants by the end of February 2013, and to finalise the document by the end of March 2013.

All presentations from the workshop are available from the following URL:
http://www.globsnow.info/snow_workshop_2012

Meeting Agenda

Programmatics: European Long Term Evolution of Snow Services

Eumetsat's Network of Satellite Applications Facilities - *Lothar Schüller, Eumetsat*

ESA and Snow - *Simon Pinnock, European Space Agency*

Global Cryosphere Watch - *Barry Goodison, World Meteorological Organization*

GEO Involvement in Cold Regions - *Yubao Qiu, GEO Secretariat*

Science Outlook

Summary of CliC/EGU/ESA "EO and Cryosphere Science Conference" - *Jouni Pulliainen, Finnish Meteorological Institute*

Status and Perspectives of Existing European Snow Monitoring Initiatives

ESA GlobSnow - *Kari Luojus, Finnish Meteorological Institute*

Eumetsat H-SAF - *Jouni Pulliainen, Finnish Meteorological Institute*

ESA GMES PolarView - *Florian Appel, VISTA GmbH, Germany*

EC GMES Cryoland - *Thomas Nagler, ENVEO GmbH, Austria*

Discussion Session

Introduction to the Snow White Paper concept - *Fabio Fontana and Nando Foppa, MeteoSwiss*

Summary of Day 1 and Introduction to Day 2 - *Florian Appel, VISTA GmbH, Germany*

User/Provider Dialogue on Experiences, Expectations and Perspectives for Snow Monitoring Services

Inclusion of Space-Based Snow Products into the Canadian Land Data Assimilation System - *Bernard Bilodeau, Environment Canada*

Hydrometeorological and Hydrological Validation of Satellite derived Snow data - *Peter Krahe, Federal Institute of Hydrology, Germany*

Use of Snow Information by Flood Forecasting Centre, State Institute for Environment, Baden-Wuerttemberg - *Werner Schulz*

Cryoland User Requirements on Snow Monitoring - *David Gustafsson, Swedish Meteorological and Hydrological Institute*

Discussion Session

Continued discussion according seed questions from Users / Provider Dialogue - *Kari Luojus, Finnish Meteorological Institute*

Identification of Recommendations on European Snow Monitoring Perspectives - *Barry Goodison, World Meteorological Organization*

Wrap-up and Conclusions - *Lothar Schüller, Eumetsat*

Recommendations identified during the workshop

	Products
1	The satellite snow community should perform regular product intercomparison, validation and product assessment exercises, to help improve user acceptance of satellite snow products.
2	Product accuracies need to be better communicated to users. Large and unexplained differences between snow products are detrimental to product credibility.
3	<p>Intercomparisons between snow models and satellite snow products need to be performed to understand differences such as the production of too much Spring-time snow in CMIP5 models.</p> <p>Intercomparisons for dedicated areas (super-sites) should be targeted. These super-sites should cover <i>e.g.</i> large scale watersheds in order to allow hydrological validation, and consist of a network of reference sites based on existing network stations with co-located measurements for the validation of satellite- and model-based data sets and products.</p> <p>It is, however, important to distinguish between (1) purely remote sensing/observational data, (2) purely modelled data, and (3) model-assimilated analyses, so that users can understand the capabilities of each approach.</p>
4	<p>A common definition of snow parameters should be adopted by the satellite snow community. For example, sometimes it is not clear whether "Fractional Snow Coverage" products are defined at canopy or ground level.</p> <p>Definitions and accuracy measures should meet user's requirements and operational needs.</p> <p>Users should be provided with updated information about the product developments.</p>
	Services
5	<p>A synthesis of the status of precursor snow services developed under various existing projects should be documented, as for example requested by the EC GMES Bureau to help in planning for future GMES service development.</p> <ul style="list-style-type: none"> • This should highlight any gaps in snow services to users that will result from completion of the current precursor projects, and provide business cases to show what needs funding publicly as a core service, and what has commercial potential as a downstream service. Business cases need to show how investment in the development of services will result in a commercial return and "jobs" later on (which is an area of major European concern at the moment). • Need to demonstrate the added value of each service - <i>i.e.</i> what is the difference in the user's application performance if you do or do not have the satellite services. (<i>e.g.</i> benefits in security) • Need to identify alternative information sources after the termination of precursor projects (<i>e.g.</i> similar products from projects such as the H-SAF) fulfilling the users requirements. • Need to know the costs for the snow services, <i>e.g.</i>, to understand if they can fit

	within the available EC GMES budget lines.
6	<p>The operational use, the experiences of users and their acceptance of EO snow information should be collected and promoted to other users.</p> <p>There is a long process from initial user interest to final integration of the information in users' operations. Users need support to successfully integrate satellite snow information into their applications.</p> <p>Some types of snow information that can be retrieved from EO data are not widely employed by users mainly because they are unaware of its existence, or its value has not been demonstrated. An example is the use of satellite-retrieved snow albedo for snow-pack modelling. Demonstration and assessment activities are therefore required to convince users of the value of these types of information.</p>
7	Existing reviews of user requirements for snow services should be collected, synthesised and published. Priorities should be highlighted.
	Development
8	Ground based snow observations are crucial, but uncertainties in the record of these measurements need to be fully characterised; such as effects due to changing from manual to automated snow depth measurements, and quantifying the representativity of the station for the surrounding area. This is particularly important for the development of snow climate data records which meet GCOS requirements for long term stability (see GCOS Climate Monitoring Principles).
9	The model-assimilation of satellite snow products needs further development to understand best approaches, such as how to avoid inconsistencies between model and retrieval physics.
10	<p>R&D is required to ensure advanced capabilities of the new GMES Sentinel satellites are fully exploited for the retrieval of snow information.</p> <p>Snow service requirements should be taken into account by ESA in the Sentinel-1 acquisition planning (HLOP: High Level Operations Plan). Availability of continuous <i>Interferometric Wide Swath Mode</i> (IW) for land areas should be secured.</p>
	Coordination
11	<p>The necessary interaction and interface between the existing European satellite snow monitoring initiatives should be improved. Identified mechanisms are:</p> <ul style="list-style-type: none"> • Funding agencies (ESA, EUMETSAT, EC) to consider cross involvement in project processes (reviews, workshops, etc.) • Snow projects to present their products and services in the context of the overall European (International) snow initiatives. • Snow projects and funding agencies to consider direct interfaces and dependencies between projects (<i>e.g.</i> more efficiently capitalise on existing capabilities, direct data use in downstream services instead of own developments, Research to Operation scenarios: implementation of algorithms from one project in the operational chain of another). • Snow projects to timely address the continuation of mature developments in operational services taking adequately into account the decision and planning processes.

12	<p>Future satellite infrastructure: The community (developers and users) need to exploit in full the opportunities to influence the decisions on new satellite sensors relevant for snow monitoring. Identified mechanisms include:</p> <ul style="list-style-type: none"> • Document and promote snow user requirements in relation to sensor capabilities together with a convincing articulation of the benefits, <i>e.g.</i> through user cases and impact demonstrations • Actively participate to user consultation meetings, <i>e.g.</i> for CoReH2O • Contact national delegates in ESA/EUMETSAT decision bodies ensuring that the needs and benefits of the snow communities are heard and understood.
	Outlook
13	<p>It was proposed to consider this workshop as the inauguration of a new "Group on European Satellite Snow Monitoring Perspectives", and that another meeting in one year's time to review progress on the recommendations.</p> <p>ESA offered to host the next meeting of "GESSMP" jointly with the next GlobSnow User Consultation towards end 2013.</p> <p>It was recommended that someone think up a better acronym.</p>
14	<p>A "Snow White Paper" should be compiled and provided as a document of the status and the recommendations disclosed within the workshop. This paper should provide in particular the strategy of sustainable services for European users. Science, operational applications (<i>e.g.</i> early warning) and commercial aspects should be covered in the recommendations.</p>

List of Meeting Participants

Organising Committee

- Lothar Schüller (Eumetsat)
- Simon Pinnock & Ola Grabak (ESA)
- Florian Appel (VISTA GmbH)
- Kari Luojus (FMI)
- Thomas Nagler (ENVEO GmbH)

Participants

Accadia	Christophe	EUMETSAT	Darmstadt	Germany
Akyurek	Zuhal	Middle East Technical University (METU)	Ankara	Turkey
Appel	Florian	Vista Remote Sensing in Geosciences GmbH	Munich	Germany
Bach	Heike	Vista Remote Sensing in Geosciences GmbH	Munich	Germany
Bilodeau	Bernard	Environment Canada	Montreal	Canada
Demuth	Norbert	Landesamt für Umwelt, Wasserwirtschaft und	Mainz	Germany

		Gewerbeaufsicht Rheinland-Pfalz		
Fontana	Fabio	Federal Office of Meteorology and Climatology MeteoSwiss / Swiss GCOS Office	Zurich	Switzerland
Foppa	Nando	Federal Office of Meteorology and Climatology MeteoSwiss/ Swiss GCOS Office	Zurich	Switzerland
Gattari	Flavio	Telespazio	Rome	Italy
Geist	Thomas	FFG - Austrian Research Promotion Agency	Vienna	Austria
Goodison	Barry	World Meteorological Organization	Geneva	Switzerland
Grabak	Ola	European Space Agency	Frascati	Italy
Gustafsson	David	Swedish Meteorological and Hydrological Institute	Norrköping	Sweden
Krahe	Peter	Federal Institute of Hydrology	Koblenz	Germany
Kuppusamy	Balaji	Telespazio VEGA Deutschland GmbH	Darmstadt	Germany
Luojus	Kari	Finnish Meteorological Institute	Helsinki	Finland
Massart	Michel	GMES Bureau, European Commission	Brussels	Belgium
Metsämäki	Sari	Finnish Environment Institute	Helsinki	Finland
Moreno	Laura	Starlab	Barcelona	Spain
Morin	Samuel	Meteo-France - CNRS	Grenoble	France
Nagler	Thomas	ENVEO	Innsbruck	Austria
Pinnock	Simon	European Space Agency	Frascati	Italy
Pulliainen	Jouni	Finnish Meteorological Institute	Helsinki	Finland
Puzzolo	Virginia	EC Research Executive Agency	Brussels	Belgium
Qiu	Yubao	Group on Earth Observations	Geneva	Switzerland
Rosci	Paolo	ITAF USAM	Rome	Italy
Schiller	Christian	EOX IT Services GmbH	Vienna	Austria
Schüller	Lothar	EUMETSAT	Darmstadt	Germany
Schulz	Werner	Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg	Karlsruhe	Germany
Sorman	Ali Unal	Middle East Technical University (METU)	Ankara	Turkey
Sucksdorff	Yrjö	Finnish Environment Institute	Helsinki	Finland
Surer	Serdar	Middle East Technical University (METU)	Ankara	Turkey
Ticconi	Francesca	School of Earth and Environment-University of Leeds	Leeds	United Kindom
Triebnig	Gerhard	EOX IT GmbH	Vienna	Austria
Wunderle	Stefan	University of Bern	Bern	Switzerland