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Arctic HYCOS – 1st Workshop on Improved Monitoring, Accuracy and Data Availability in the Arctic Drainage Basin: Meeting Summary Report and Implementation Plan

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Recommended Citation

Lammers, R.B. L. O'Brien-Latham, A. Pietroniro (2013) Arctic HYCOS – 1st Workshop on Improved Monitoring, Accuracy and Data Availability in the Arctic Drainage Basin: Meeting Summary Report and Implementation Plan, Arctic-HYCOS Summary, World Meteorological Organization, EC-PORS-4/INF.16, https://www.wmo.int/pages/prog/www/WIGOS_6_EC_PORS/EC_PORS_4/INF16_Arctic_HYCOS.doc

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**Arctic HYCOS – 1st Workshop on
Improved Monitoring, Accuracy and Data Availability in the Arctic
Drainage Basin:**

Meeting Summary Report and Implementation Plan



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**Alain Pietroniro,
Director – Water Survey of Canada, Environment Canada**

Meeting held at :

**The Prince George Hotel
1725 Market Street
Halifax, Nova Scotia
March 6-8, 2012**

Arctic-HYCOS Workshop Summary:

Background: The World Hydrological Cycle Observing System (WHYCOS) is a global programme, developed in response to the scarcity or absence of accurate, timely and accessible data and information in real or near real time on freshwater resources in many parts of the world. The programme is implemented through various components (HYCOSs) at the regional and/or basin scale. It is guided by the WHYCOS International Advisory Group (WIAG). The Arctic-HYCOS program is being promoted through this Workshop. For more information on the WHYCOS, please see <http://www.whycos.org/cms/>.

The main goal of the Arctic-HYCOS program is to improve monitoring, data accuracy, availability and dissemination of information in the pan-arctic drainage basin. This project is science-driven and is aimed at monitoring freshwater fluxes and pollutants into the Arctic Ocean with the objective of improving climate predictions in the Northern Hemisphere and assessing the pollution of the Arctic coastal areas and the open Arctic Ocean. Arctic-HYCOS is currently organized along three main activities.

1. Develop an optimal design for hydro-meteorological monitoring networks to capture the essential variability of the Arctic hydrological system and to enable accurate and efficient assessment of change
2. Estimate uncertainty of available in situ and possible remote sensing data including analysis of accuracy and systematic errors of new observation technology
3. Develop an integrated pan-arctic data consolidation and analysis system for the water cycle uniting data from various in-situ and other sources.

Summary: A planning meeting was held in Halifax, Nova Scotia, Canada, 6-8 March 2012 to begin the formal process of developing a strategic plan to implement the Arctic-HYCOS project and to establish a commitment from Arctic Council (AC) Member States to develop this project under the WHYCOS umbrella. Strong linkages were encouraged to other WMO efforts, notably Arctic HYDRA, EC-PORS (inc. GIPPS, GCW, WWRP, WCRP) and GFCS. The nations of Canada, Iceland, Norway, Sweden, United States, and Russia were represented. Finland and Denmark/Greenland were unable to attend the meeting.

The meeting began with an overview of the [Arctic HYDRA Science and Implementation Plan \(2010\)](#), which was proposed as the research model and foundation for a pan-arctic hydrological modeling system. Arctic-HYCOS was positioned as an opportunity to enable cooperation amongst Arctic Nations for the free and open sharing of hydrological observations essential to realize the vision of providing pan-arctic products and services.

Technical and scientific presentations on key areas of research informed the discussions around the potential for the development of an Arctic-HYCOS, and the broader linkages with other WMO efforts. These presentations informed representatives of strategic opportunities that could be built upon, as well as gaps that could be addressed under

Arctic-HYCOS. For instance, Canada presented its latest advancements in developing a coupled ocean-atmosphere-ice prediction system under its METAREAs initiative, and Sweden presented a hydrometric modeling effort for Sweden and Europe with intent to upscale to the pan-arctic. Presentations also included research from pan-arctic land surface hydrometeorology, Arctic Ocean process modeling and efforts to develop aggregated pan-arctic information resources.

Representatives from AC Member States presented overviews of the state of their existing Arctic hydrometric gauge networks, an assessment of their gauged and ungauged networks, and information on existing hydrological forecasting systems and models, highlighting strategic opportunities and limitations. A wide variety of approaches to river discharge data management and access were described from fully open and unconstrained access with real-time availability to a lack of any access to such information. Nations consistently pointed to the lack of sustained observational capacity in the Arctic as a challenge, therefore demonstrating the benefit of greater sharing of the data that is available.

Support: Support for the workshop provided by Environment Canada, Meteorological Service of Canada, Weather and Environmental Monitoring.

Workshop Participants:

[[To be added from list collected at meeting]]

Arctic-HYCOS Work Plan:

Arctic-HYCOS mission statement:

Representatives agreed to establish a formal commitment between Arctic Council (AC) Member States to freely and openly deliver monthly estimates of daily gauged (and un-gauged) Arctic drainage basin river flow data in support of WHYCOS and PORS to establish a better understanding of the pan-arctic hydrological system.

Justification: The Arctic-HYCOS mission directly supports numerous efforts in the Arctic countries to stimulate more efficient international cooperation in studying and assessment of hydrometeorological processes in the Arctic drainage basins in relation to climate change, particularly with Arctic Council and its entities such as AMAP.

The monitoring activities will improve pan-arctic cooperation in hydrometric monitoring, enhance estimates of river flow trend and the climate record and increase understanding of lake-level changes. These activities will also supplement global observations, improve coastal zone ecology (e.g. fish spawning and migration and the coastal environment) and contribute to transportation issues related to river ice and sea ice.

Arctic-HYCOS will improve Arctic region meteorological prediction, enhance ocean and climate models and contribute to the development of methodologies for ungauged flow estimation in high latitude rivers. These lead to the improved understanding of the contribution of hydrological processes within the global climate system.

Expected outcomes: The workshop participants agreed on a set of short and mid-term outcomes to advance the Arctic-HYCOS project. Due to the complexity of international efforts, the workshop participants recognized the requirement to make these outcomes acceptable to all nations and achievable within a relatively short time frame. The following eleven items represented the foci of plenary discussion over the final two days of the workshop.

1. Larger framework of Arctic-HYCOS

Arctic-HYCOS has a strong role to play in support of existing International efforts. These include the observation component of the Executive Council Panel of Experts on Polar Observations, Research and Services (EC-PORS), Global Integrated Polar Prediction System (GIPPS), Arctic Monitoring and Assessment Programme (AMAP), and the Global Cryosphere Watch (GCW).

2. Formal Arrangements

Formal arrangement with representative national governments shall be arranged with a Memorandum of Understanding (MoU), and a lead agency in each nation shall be nominated to represent the effort. Annex I of the [WHYCOS Guidelines](#) (page 32-33, WMO/TD-No. 1282, October 2005) contains an example of an agreement between participating countries and the project regional office. It was stressed the MoU should make a clear and strong statement of the overall aims of the Arctic-HYCOS project.

Participants recommended and agreed that this voluntary commitment would be secured from Arctic Council Member States through a two step process:

- 1) Issue a letter from Canada's WMO PR/EC PORS co-chair, David Grimes, to all AC Member States and their WMO Hydrological Advisors to encourage commitment from the proposed Arctic-HYCOS members and to make the connection with EC-PORS.
- 2) Initiate the request stage through a letter of intent to the WMO, developed according to the [WHYCOS Guidelines](#), for the signature of the proposed members (i.e. all AC Member States).

3. Partners: Roles and Responsibilities

The expected partners in the Arctic-HYCOS project are the Arctic countries of Canada, Denmark/Greenland/Faroe Islands, Finland, Iceland, Norway, Russia, Sweden, and the United States of America, as well as the World Meteorological Organization, the Global Runoff Data Centre and other *ad hoc* partners (e.g. from the scientific research community). The primary responsibilities of the member nations are the timely delivery of river flow data within the Arctic Basins, as well additional supporting data such as river ice regime, lake level, and meteorological data.

4. Governance

Membership will include all Arctic Council Member States, each with a designated representative on the Steering Committee. Representation from EC-PORS and the research community was also recommended. Árni Snorrason (Iceland) has volunteered to represent EC-PORS.

There was a recognized need for an entity overseen by the Steering Committee to coordinate the Arctic-HYCOS Project. The coordination role includes leadership, project administration, and connections to other agencies, country representatives, and ad-hoc associates. Canada tentatively accepted the role as the lead regional National Meteorological and Hydrological Service (NMHS), involving the coordination function for Arctic-HYCOS. Based on other HYCOS initiatives, it was recommended that this coordinating support would involve at minimum the dedicated support of a coordinating officer, plus a level of technical/data management support (estimated at \$50K CAD). However, it was recognized that Canada would require support from other members and/or research institutions for the technical coordination of the data.

Representation in the Global Integrated Polar Prediction System (GIPPS; part of EC-PORS) is necessary to ensure the integration of Arctic-HYCOS into a broader international effort. Selected for this *ad hoc* group were: Berit Arheimer (Sweden), Alain Pietroniro (Canada), Árni Snorrason (Iceland) and a USA representative, possibly from NOAA, to be named.

5. Geographic Scope

The domain of primary interest for the project are the Arctic Drainage Basins comprising the Arctic Ocean and northern Seas and the hydrologically connected land areas (Figure 1).

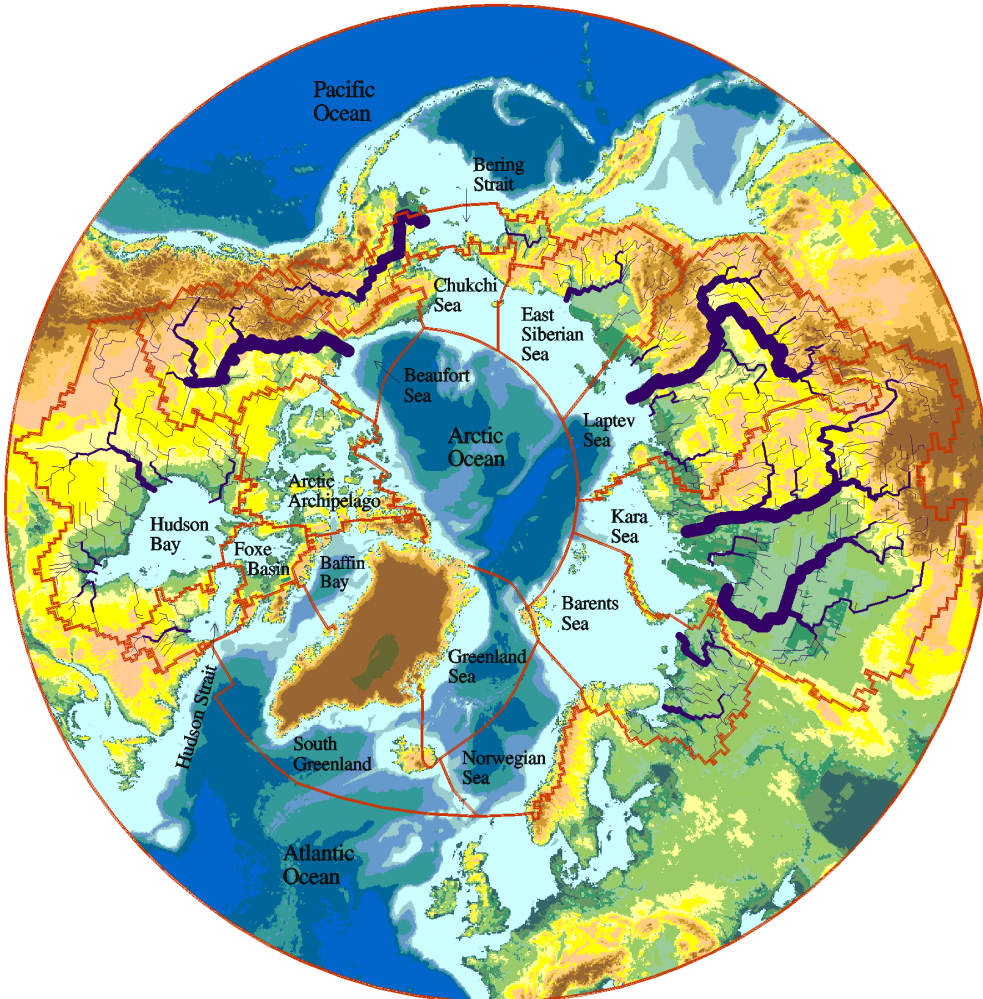


Figure 1: Major Pan-Arctic Drainage Basins. Source: Richard Lammers, University of New Hampshire.

6. Networks/Tiers of Observations

Users of Arctic-HYCOS data will have a variety of information needs depending on the demands of their research or service requirements. Several networks are considered primary sources for hydrological data and these would support estimates of:

1. Hydrological flow to the ocean (requiring down stream sites)
2. Variability of land surface runoff (requiring a spatially extensive network)

Where available, gauges with long-term records are preferred and additional local measurements for different variables (e.g. river temperature) and remotely sensed data are desirable and support the Arctic-HYCOS aims.

7. Sharing of data and information

The near-real time river discharge estimates, which form the primary Arctic-HYCOS product, shall be shared among the Project members. Members agreed to deliver monthly estimates of daily gauged Arctic drainage basin river flow data. Data will be provided by the following month in provisional form and later in approved (archival) form.

It is important for efficient and timely data access to maintain a central repository to deliver the data to the community in a consistent format and Environment Canada has pledged to seek a viable solution. Any provider of cross-national Arctic-HYCOS information should ensure acknowledgement of (and direct links to) the national hydrometric data providers and a clear indication the data is provisional. Participants recommended a 'pull' technology to minimize effort on the part of each NMHS and to use acceptable interoperability standards for hydrometric information exchange. Representatives discussed the possibility of turning to an academic institution for the management and delivery of provisional data, with the Global Runoff Data Centre (GRDC) to manage the archive quality data. These options will be explored further.

8. Update of Arctic-HYDRA

It was recognized that Arctic-HYDRA represents the scientific goals for Arctic hydrometeorological research and these goals have been subsumed by EC-PORS. As a result, Arctic-Hydra as an individual effort has been dissolved. An *ad hoc* group is necessary to ensure the integration of Arctic-HYCOS into GIPPS. See section 4 above.

9. Resource Issues

Representatives agreed that this effort would be undertaken within existing resources and additional funding would not be sought at this time. However, it was recognized that eventually the initiative could require funding to ensure sustained telecommunication support, and to expand the objectives of the program which could include the collection and sharing of additional parameters (which not all members may be positioned to undertake), as well as the development of models to support delivery of products and services through related WMO efforts, namely EC-PORS.

10. Docking points with other programmes:

Important connections to EC-PORS (GIPPS, GCW), WCRP, WWRP, GFCS, AMAP were recommend. An identified gap was the lack of a hydrological equivalent to the World Climate Research Programme under the WMO. Connections with the Remote Sensing community need to be strengthened. It was suggested the Committee on Earth Observation Satellites (CEOS) could coordinate a position paper of remote sensing of river flow in the cryosphere.

11. Action Plan

Arctic-HYCOS Action Plan		
Action	Lead	Completion Date
Short Term		
Seek internal approvals to formally accept the Arctic-HYCOS coordination role	Alain Pietroniro, Environment Canada	April 2012
Send out letters to the Member states (PR) and the WMO Hydrological Advisors containing the Memorandum of Understanding	David Grimes, Environment Canada	End of April 2012
Create letter of intent to formalize commitment from proposed members (see WHYCOS Guidelines , p. 32 for example)	David Grimes, Environment Canada	End of April 2012
Deliver Arctic-HYCOS Workshop Report and Implementation Plan	Arctic-HYCOS Member Nations	End of April 2012
Send letter of intent to WMO Commission of Hydrology informing Commission of the intent to proceed with establishing Arctic-HYCOS	Environment Canada	May 2012
Seek engagement of NOAA in Arctic-HYCOS Steering Committee	Harry Lins, USGS	May 2012
Medium Term		
Establish Core Coordination Committee to continue activities	Arctic-HYCOS Member Nations	May 2012
Identify Networks and hydrometric stations within those networks	Arctic-HYCOS Member Nations	September 2012
Prototype Arctic-HYCOS web site and data repository	TBD	TBD 2012

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3. Develop an integrated pan-arctic data consolidation and analysis system for the water cycle uniting data from various in-situ and other sources.

A preliminary planning meeting will be held in Halifax, Nova Scotia, Canada to begin the formal process of developing strategic plan to implement the Arctic –HYCOS programme. Arctic Nations are invited to present and contribute to the discussions and development of the implementation plan.

Material Arrangements

A block of 15 rooms is being held at the following Halifax Hotel:

**The Prince George Hotel
1725 Market Street
Halifax, Nova Scotia
B3J 3N9**

Phone: 902-425-1986

Fax: 902-492-7834

In North America Toll Free: 1-800-565-1567

The rooms have been booked for the evenings of March 5, 6, 7, and 8th depending on travel plans. The room rate is \$129.00 for single occupancy and \$149.00 for double occupancy. The

block of rooms will be held until Wednesday February 22, 2012 and is under the event name "Environment Canada".

Agenda

The meeting will consist of presentations and discussion by member nations in order to arrive at consensus around the issues of timely and accurate discharge information in near-real time. In order to achieve this workshop will focus on the issues of:

- Data Availability: quantify a list existing hydrometric information of all circumpolar countries that could be use to estimate monthly average flows for all gauged rivers.
- Ungauged Flows: Examine and review existing techniques to extrapolate ungauged flow estimates from existing records (geo-statistical, deterministic modeling) and make recommendations and develop a pan-arctic strategy. This will include discussion around forecasting systems.
- Stakeholder Requirements: Understand an articulate the importance of this information to local stakeholder as well as the scientific community include the oceanographic, climate and water resources community.

The proposed outcomes and deliverables will be to set realistic timeline to implement the Arctic HYCOS observing in order to deliver systematic estimates of freshwater flux into the Arctic.

The organizing committee is proposing that Arctic Council Nations should be prepared to send representatives and also be prepared to present information on

- Existing hydrometric gauge network,
- Assessment of gauged and ungauged contributions
- Current hydrological forecasting systems
- User needs and Stakeholder engagement

March 6, 2012

Purpose of the session on Day 1 is to provide background and overview of the Arctic HYCOS program and to also provide the state-of-the art overview of science and technology framework surrounding the initiative.

13:00 – 13:20	Introduction and Welcome	Jim Abraham Director General, Weather and Environmental Monitoring, Meteorological Service of Canada
13:20 – 13:45	Meeting objective, HYDRA and plan	Alain Pietroniro/ Árni Snorrason
13:45 – 14:30	Plenary Speaker - Global Runoff	Richard Lammers
14:30-15:00	Plenary – IAHS PUB	Berit Arheimer – Sweden
15:00- 15:30	Health Break	
15:30-16:00	Plenary – Arctic Freshwater Flux – importance to ocean circulation	Will Perry – Department of Fisheries and Oceans, Canada
16:00-16:20	Overview of Arctic Hydrology Research	Daqing Yang – National Water Research Institute, Environment Canada
16:20-16:40	Advancement in NWP and THORPEX	Hal Ritchie – Atmospheric Science - Environment Canada
16:40 – 17:00	Advancement in NWP/Hydrology Modelling Approaches	Alain Pietroniro –Environment Canada

March 7, 2012

Purpose of the session on Day 2 is to provide and overview of existing networks and updates on science, technology and research initiative being undertaken by the individual country NHSs. Topic to include

- *State of existing hydrometric network*
- *Real-time Flow estimation*
- *Current standards and operating procedures*

09:00 – 9:30	Overview of Workshop Objective	Alain Pietroniro/ Árni Snorrason
9:30 - 10:00	Overview :Global Runoff data Centre	Global Runoff Data Centre - Ulrich Looser
10:00 - 10:30	Health Break	
10:30 – 11:00	Canada : Update on the Water Survey of Canada in the Arctic	Alain Pietroniro,EC,
11:00 – 11:30	USA : Update on the USGS efforts for monitoring in he Arctic	Harry Lins, USGS
11:30-12:00	Russian Federation: Update	Valery Vuglinski,
12:00-13:00	Lunch	
13:30-13:30	Sweden	Berit Arheimer
13:30-14:00	Finland	Markku Puupponen
14:00 – 14:30	Iceland	Árni Snorrason
14:30 – 15:00	Overview discussion	
15:00 – 15:30	Health Break	
15:00 – 16:30	Workshop Break Out Session - Hydrometric Networks and Uncertainty o Moderator - o Rappotuer - Ungauged Basins and Forecasting o Moderator - o Reporter	All

March 8, 2012

Purpose of the session on Day 3 is the Development and agreements of implementation and science plan and to discuss next steps.

08:30 – 10:00	Workshop Break Out Session - continued - Hydrometric Networks and Uncertainty o Moderator - o Reporter -	All
10:00 - 10:30	Health Break	
10:30 – 11:30	Plenary Workshop Report on Hydrometric Networks and Uncertainty Report on Ungauged Estimation and Forecasting	All
11:30- 12:00	Review of proposed Implementation Plan	All
12:00 - 12:30	Summary and closing Remarks	Jim Abraham//Alain Pietronrio /

Confirmed Attendance

Canada

- Jim Abraham, EC
- Alain Pietroniro, EC
- Daqing Yang, EC
- Will Perry, Fisheries and Oceans
- Hal Ritchie, Science and Technology, Environment Canada

USA

- Harry Lins, USGS
- Richards Lammers, UNH

Russian Federation

- Valery Vuglinski

Norway

- Morten Johnsrud, NVE

Sweden

- Berit Arheimer

Iceland

- Árni Snorrason

Germany

- Ulrich Looser – GRDC

WMO

- Wolfgang Grabs

Participants

