

WMO-Solid Precipitation Measurement Intercomparison (WMO SPICE): a Global Cryosphere Watch priority activity

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SPICE Mission

- To develop a reference using automatic gauges and to provide guidance on the performance of modern automated sensors, for measuring: (i) total precipitation amount measurement in cold climates for all seasons, especially when the precipitation is solid, (ii) snowfall measurement, and (iii) snow depth measurement (height of new fallen snow).
- To understand and document the differences between automatic and manual measurements of solid precipitation of equally sheltered gauges, including their siting and configuration.

SPICE Plan

Project stage	Objective	Participation (tentative: to be confirmed formally)*
Pre-SPICE (2011/2012)	<ol style="list-style-type: none">1. Define field reference configuration2. Validate data management and analysis concepts	Canada, USA, Finland, Norway, Switzerland
2012-2014	Formal intercomparison organized as a coordinated, concurrent multiple site experiment; Start date: Nov 15, 2012.	Northern Hemisphere: Canada, USA, China, Russia, Finland, Norway, Switzerland, Italy; Southern Hemisphere: New Zealand, Australia, Chile, Argentina.

* The list of host countries will be finalised in April 2012, based on the formal invitation from each interested participant;

WMO-SPICE Objectives (1)

- Define and validate one or more **field references** using automatic instruments for each parameter being investigated, over a range of temporal resolutions (daily to minutes).
- **Assess/characterize automatic systems** used in operational applications for the measurement of Solid Precipitation (i.e. gauges as “black boxes”):
 - Assess the ability of automatic systems to perform over a range of operating conditions;
 - Derive adjustments to be applied to measurements from operational automatic systems, as a function of variables available at an operational site: e.g., wind, temp, RH;
 - Recommend the required ancillary data to enable the derivation of adjustments;
 - Assess operational data processing and data quality management techniques;
 - Assess the minimum practicable temporal resolution for reporting a valid solid precipitation measurement (amount, snowfall, and snow depth on the ground);
 - Evaluate the ability to detect and measure trace to light precipitation.
- **Evaluate new and emerging technology** for the measurement of solid precipitation and their potential for use in operational applications.

WMO-SPICE Objectives (2)

- **Provide recommendations on best practices and configurations** for measurement systems in operational environments:
 - exposure and siting specific to various types of instruments;
 - optimal gauge and shield combination for different collection conditions/climates;
 - instrument specific operational aspects, specific to cold conditions;
 - Consideration will be given to the needs of remote locations, in particular those with power and/or communications limitations.
- **Assess the achievable uncertainty** of the measurement systems included in WMO-SPICE and the ability to effectively accurately report solid precipitation.
 - sensitivity, uncertainty, bias, repeatability, and response time of automatic systems;
 - sources and magnitude of errors;
- **Configure and collect a comprehensive data set** for further data mining or for specific applications (e.g., radar- and/or satellite-based snowfall estimation). Enable additional studies on the homogenization of automatic/manual observations and the traceability of automated measurements to manual measurements.

SPICE Deliverables

- Recommendations of automatic field references systems;
- Characterization of the performance of existing, new, and emerging technologies measuring solid precipitation;
- A comprehensive data set for legacy use, for further data mining.
- Guidance to WMO Members on transition to automation from manual observations of solid precipitation measurements;
- Recommendations to manufacturers on instrument improvements.
- Update of relevant chapters of the CIMO Guide (WMO No 8) and potential publications of WMO/ISO standards (under the WMO-ISO agreement, 2009).
- Timing:
 - Pre-SPICE results: summer 2012
 - SPICE report: 2015

Instruments and Configurations

The experiment will include:

- Instrument types, models and configurations identified as currently operational;
(*WMO CIMO IOM 102, Survey on National Summaries of Methods and Instruments for Solid Precipitation Measurement at Automatic Weather Stations*,
<http://www.wmo.int/pages/prog/www/IMOP/publications-IOM-series.html>).
- Emerging technologies, as recommended by the WMO Members and the Industry (HMEI).
- Specifically:
 - Weighing Gauges, Tipping Buckets, other storage gauges;
 - Instruments employing emerging technologies e.g. laser, particle disdrometers, hot plate, spinning arm, vertically pointing radar, optical gauges, acoustic, precipitation video imaging, video camera.
 - Wind shields: (type: e.g. Alter, Nipher, Tretyakov, Wyoming, Belfort, wood), and configurations (single, double, small DFIR);
 - Gauges equipped with heating in various configurations;
 - Emerging trends: low-cost sensors with (potential for) wide use.

Intercomparison References

- Function of the participating sites conditions, the possible field reference configurations, are:
 - R1: DFIR + Tretyakov gauge (manual measurements): secondary field reference, defined by the 1989-1993 intercomparison;
 - R2: DFIR + automatic weighing gauge (AWG) + Alter shield; the AWG determined during 11/12 pre-SPICE.
 - R3: An AWG in a windshield with characterization and history.
 - characterization done in relation to R1 and R2
 - a pragmatic approach for sites where the installation of a DFIR is not feasible, but key to meeting the SPICE objectives (e.g. complex terrain with heavy wet snow)
- Given the three field reference configurations, the following SPICE site configurations are possible:
 - S1: Sites with R1, R2 and R3;
 - S2: Sites with R2 and R3
 - S3: Sites with R3.
- Reference for snow on Ground: manual measurements using snow boards;



CARE (Egbert) - Canada

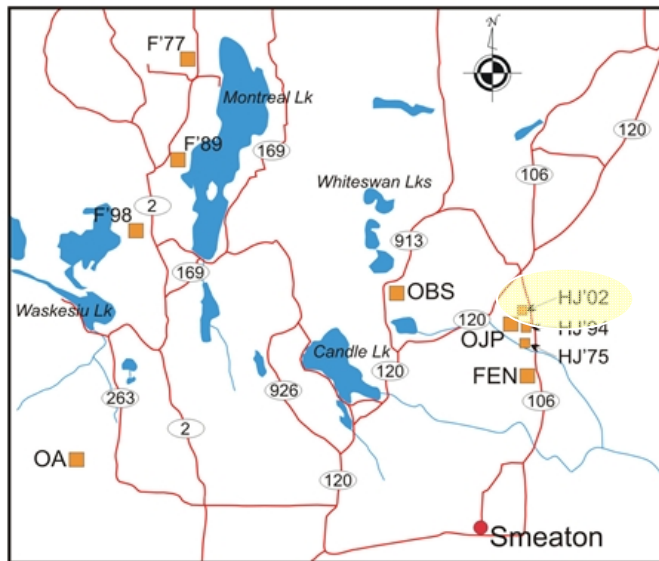
DFIR: Double Fence Intercomparison Reference
- Outer fence: 12 m diameter;
- Inner fence: 4 m diameter;
- Height of measuring gauge 3 m;

Planned Canadian contribution to SPICE: C-SPICE

- Southern Ontario (near Toronto):
 - Participate in pre-SPICE (11/12);
 - Host of SPICE Experiment 2012-14: to host up to 20 instruments under test;
 - Extensive ancillary measurement set, available on site;
- Saskatchewan:
 - has two DFIRs, has been operating for 8 years.
 - Pre-SPICE: definition of experiment references.
- Bush Gauge Intercomparison (primary standard) Prince Albert, SK.
 - intercompare gauge / wind shield configurations to observations made using natural “bush” shielding;
 - Opportunity: modified natural landscape and pre-existing infrastructure:
- Wind tunnel test of gauges (NRC);

Assessment of the primary reference (bush gauge)

- Proposed site: BERMS HJPo2
- Jack pine stand harvested in 2002
- Natural re-growth of vegetation
- 1.5 hours north of Prince Albert via Hwy 106
- Site infrastructure, available;
- Could be made available: 2012

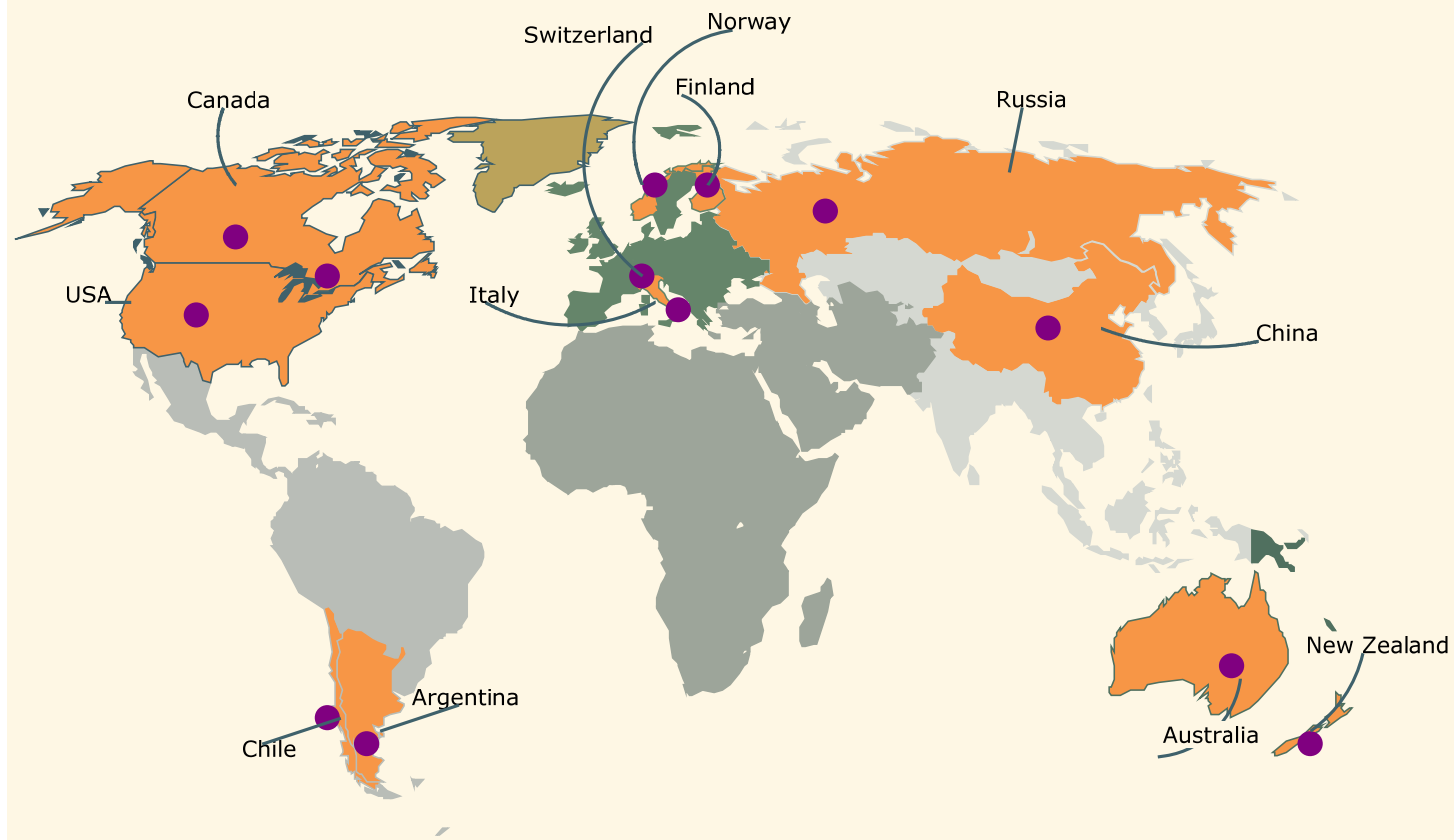


Status (November, 2011)

- Intercomparison Organizing Committee (IOC) approved by WMO
 - includes representatives from Canada, China, Germany, Italy, New Zealand, Russia, Switzerland, USA.
- IOC co-Chairs: Rodica Nitu (Canada), Roy Rasmussen (USA);
- Oct 5-7, 2011: IOC face to face planning meeting in Geneva; defined objectives and plan;
- Formal engagement of WMO Members and HMEI:
 - Nov 2011: 1st letter of invitation to inform about the initiative and solicit interest in participating;
 - Jan 2012: 2nd letter of invitation: requesting details on the planned participation (sites hosting the experiment, instruments for evaluation, other forms of contribution);
 - April 2012: IOC will communicate the selection of participating sites and instruments;
 - Hosting of the experiment coordinated through the WMO Members;
 - No willing host will be turned away: use SPICE for capacity building.

WMO SPICE: Proposed engagement

WMO SPICE: Proposed host countries (Nov 2011)



GCW role (discussion)

- Ensure CIMO recognition of GCW as an important stakeholder
- Promote appropriate participation in SPICE by cryospheric community
- Ensure recommended improvements in solid precipitation measurement are implemented
- *Suggested as a GCW Demonstration Project*