Second International Workshop on Space-based Snowfall Measurement

31 March – 4 April 2008

AGENDA

Monday, 31 March 2008

16:00 – 19:00 Registration
19:00 Reception

Tuesday, 1 April 2008

08:00 – 08:30 Continental Breakfast

08:30 – 08:45 **Welcome/Workshop Organization**

08:45 - 10:15 **Invited Presentations (Programmatic)**

1. **Storm Peak Lab – G. Hallar**
2. **UW Welcome – G. Tripoli**
3. **Snowfall in the Western US – N. Doeskin**
4. **GPM/ CEOS PC – A. Hou**
5. **CloudSat – G. Stephens**
6. **Japan – T. Iguchi**
7. **CSA/ESA – P. Joe**
8. **IPWG and Charge for Workshop – R. Ferraro**

10:15 – 10:45 Break

10:45 – 11:00 **Working Group Meeting Organization (how breakout groups are formed)**

11:00 – 12:00 **WG I: Applications**

A) Invited Scientific Presentations

a. **D. Lettenmaier**
b. **M. Brodzik**
c. **N. Doeskin**

12:00 – 13:30 Lunch

13:30 – 14:45 **B) Breakout WG I (see Application Questions)**

14:45 – 15:00 Break

15:00 – 16:00 **WG II: Global and Regional Detection and Estimation**

- **A) Invited Scientific Presentations**
  - **a. H. Meng (NOAA) – Operational Products (15 min)**
  - **b. Y-J Noa (CIRA) - Current Research (15 min)**
  - **c. C. Kummmerow (CSU) – Summary of Other Efforts (30 min)**

16:00 – 17:15 **B) Breakout WG II (see Global Estimation Questions)**

Wednesday, 2 April 2008

08:00 – 08:30 Continental Breakfast

08:30 – 09:30 **WG III: Modeling of Snow and its Radiative Properties**

- **A) Invited Scientific Presentations**
  - **a. G. Petty (UW)**
  - **b. W-K Tao (NASA)**
  - **c. R. Bennartz (UW)**

09:30 – 10:45 **B) Breakout WG III (see Modeling Questions)**

10:45 – 11:00 Break

11:00 – 11:30 **Discussion on Measurement Demonstrations**

- **A) Procedure for getting to Storm Peak Lab**
- **B) Short presentation on instrumentation at Lab**
- **C) J. Hallet to describe nearby instruments**

11:30 – 13:00 Lunch, preparation for Storm Peak visit (ski rentals), etc

Afternoon **Storm Peak Lab Visit**

13:00 – 15:30 Skiers and snowboards can access the lab via lifts
16:00 – 18:30 Non-skiers will be taken up via Snowcat transport

Thursday, 3 April 2008

07:30 – 08:00 Continental Breakfast

08:00 – 09:00 **WG IV: New Technologies**

A) Invited Scientific Presentations

a. **G. Stephens (CSU) – Integrated CloudSat/ATrain, etc) (20 min)**
b. **G. Skofronick-Jackson (NASA) – (Radiometers, TRMM/GPM etc) (20 min)**
c. **S. Durden (Radar, TRMM to EarthCare and ACE) (20 min)**

09:00 – 10:15 **B) Breakout WG IV (see New Technology Questions)**

10:15 – 10:30 Break

10:30 – 11:30 **WG V: Validation**

A) Invited Scientific Presentations

a. **D. Hudak (CSA) - Summary of GPM GV Workshop in Brazil ; GV in Canada (20 min)**
b. **S Knuth (UW) – GV in Antarctica (10 min)**
c. **E. Eloranta (UW) GV in Arctic (10 min)**
d. **J. Koistinen GV in Finland and Germany; Introduction of questions for discussion groups (20 min)**

11:30 – 12:45 **B) Breakout WG V (see Validation Questions)**

12:45 – 14:30 Lunch

14:30 – 15:45 **Summary: 15 min summaries from each WG**

15:45 – 16:00 Break

16:00 – 17:00 **Final Plenary Session**

Friday, 3 April 2008

Storm Peak Lab Day Instruments and Measurements

07:00 – 16:00 Non-skiers will be transported to the lab via Snowcat
09:00 – 16:00 Skiers can access lab all day via chair lifts and skis

Second International Workshop on Space-based Snowfall Measurement

Questions for Working Group Breakout Sessions

Breakout WG I: Applications Questions

(Session chair: Dennis Lettenmaier)

Q1) Under what conditions is snowfall rate, as contrasted with accumulated depth and/or water equivalent of snow, the controlling variable for hydrologic prediction? For hydrologic applications that require snowfall, rather than accumulated snow depth or water equivalent on the ground, what are the required spatial coverage, spatial resolution, and precision and accuracy?

Q2) What other uses of snow information require snowfall rate as opposed to accumulated depth and/or water equivalent of snow (e.g., prediction of soil thermal processes)

Q3) What are the critical spatial scales at which the variability of falling snow and/or accumulated snow must be measured for hydrologic prediction purposes, and how do those spatial scales relate to the catchment scale at which hydrologic predictions are to be performed?

Q4) What other applications require snowfall data that are not adequately provided by existing observing networks?

Q5) What are the spatial and temporal characteristics of observing errors of both falling and accumulated snow, and how are those error characteristics affected by vegetation cover and topography?

Breakout WG II: Global Estimation Questions

(Session chair: Chris Kummerow)

The most common value for snowfall rates and accumulations in today's global products is "-999". This is particularly true over snow- and ice covered surfaces. While there are some experimental products, these have not matured to produce routine products on global scales.

Q1) What short term goals (< 3 yrs) can we reasonably set to produce a routine global snowfall product over all surfaces (ocean, sea ice, land, snow-covered land).

Q2) Given the projects that were recently launched or are currently proceeding towards launch (SSMIS, CloudSat, GPM, EarthCare, other?), what research is likely to produce the biggest return in terms of an operational snow products in the 3-10 year timeframe?

Q3) What global observations do we need to be advocating in order to improve products beyond the 10 year time frame?

Q4) Global snowfall rates are currently available from ECMWF, NCEP and JMA. For an observationally based snowfall product to be useful, it needs to improve upon what is currently available. What metrics should be used to evaluate this for

- (a) weather
- (b) hydrology
- (c) climate monitoring.

Q5) Short of operational data assimilation, are there methods that combine models and observations that show promise for improving snowfall estimates?

Breakout WG III: Modeling Questions

(Session chairs: Grant Petty, Wei-Kuo Tao)

Q1) How accurately do we believe we are modeling or parameterizing the microwave properties (attenuation, absorption, scattering, radar backscatter, and their spectral dependence) of frozen and melting precipitation, and what is the evidence for that belief?

Q2) To the extent that uncertainties in the above models remain unacceptably large, what measurements or new modeling efforts are required in order to reduce the uncertainties?

Q3) How accurately do we believe we are modeling or parameterizing cloud dynamical and microphysical processes relevant to the remote sensing of snowfall, and what is the evidence for that belief? In particular, how sensitive are CRM snowfall simulations to the choice of microphysical scheme? Which microphysical scheme(s), if any, yield demonstrably superior results?

Q4) To the extent that uncertainties in the above cloud models remain unacceptably large, for which processes can targeted measurement or modeling efforts yield the greatest benefit at reasonable cost?

Q5) What is the current state of the art in the modeling of the microwave properties of the lower boundary (land, sea, ice, snow), and what fundamental limits does this state of the art impose on our ability to measure snowfall using passive microwave radiometry?

Q6) How well do we believe that we are able to account for the dynamical and microphysical diversity of snowing cloud systems in various seasons and regions of the world, and what is the evidence for that belief? In particular,

a) How sensitive are ice processes to variations in IN concentrations and types?

b) What is currently known about variations in precipitation properties (e.g., particle density, DSD, shape, etc.) associated with snow events in different environments?

Q7) All things considered, what appear to be the fundamental upper and lower limits of detectability of frozen precipitation under various conditions and using various combinations of current and planned remote sensing technologies?

Q8) What do the above limits tell us, if anything, about the prospects for unbiased physical snowfall retrievals in any given region?

Breakout WG IV: New Technology Questions

(Session chairs: Simone Tanelli, Eastwood Im, Toshio Iguchi)

Questions for WG I: Regarding snowfall retrieval from space, what can be done with what we have?

Q1a) Have we tapped into all of the currently available resources (e.g., A-Train combination of instruments, other?)? If not, which instruments, or combinations show the highest potential?

Q1b) In which areas are any of the upcoming missions (e.g., GPM, EarthCARE, other?) going to help?

Questions for WG II: In regards to defining the need for new missions, what can NOT be done with what we have?

Q2a) What are the major limitations of the currently available instruments, and combinations of instruments?

Q2b) What will still be lacking after the upcoming missions have been launched? If we don't know: what research should be done to articulate this point? If we do: can we prioritize items in that list?

Questions for WG III: In regards to setting scientific requirements for new missions, can we generate a prioritized list of scientific goals and requirements that could be used to steer the design of missions in course of definition (e.g., ACE)?

Q3a) What kind of snow do we want to measure?

Altitude: Snow near surface? Snow at a high altitude? Snow above rain?

Region: Snow in the polar regions? Snow in the tropics?

Q3b) What parameters of snow do we want to measure? Snowfall rate, ice water content, snow depth, habits, DSD, density, etc.

Q3c) For each parameter we want to measure, what is the accuracy requirement? What are the required resolutions in space and time?

Q3d) If there is an instrument that can measure snow only above a certain height (say for example 8km), can it still help?

Questions for WG IV: In dreaming of unlimited funding, is there a dream set of instruments that "would do it?"

Q4a) Are there any technologies available on the ground that should be brought to space? (crucial ones)

Q4b) Which requirements should this dream instrument have? (See WG III)

Breakout WG V: Validation Questions

(Session chairs: Dave Hudak, Jarmo Koistinen)

Q1) Ground validation can be classified into three components. Network validation involves taking independent measurements and comparing it in a statistical sense with the products derived from the satellite measurements. Physical validation involves process studies in which detailed measurements of cloud and precipitation properties, presumably of a higher quality than the satellite can make, are used to investigate the basis of the algorithms. Integrated validation involves the use of satellite derived products as input to a meteorological or hydrological simulation. The implications of these measurements on the simulation can then be explored. What are the specific scientific objectives of each type of GV? When should each activity be done in relation to the other?

Q2) What role does modeling have play in GV activities? What role does a simulator/synthetic data have? How much GV is enough?

Q3) Scaling, both in time and space, plays a fundamental role in the comparison of GV and space-based measurements. On what scales can we trust GV? What scales would be useful? What are some techniques could be employed to upscale/downscale GV measurements and satellite data and data products? Is there an optimal scale? What are some types of metrics that could be used to characterize the errors?

Q4) From the technical side, which observational facilities are needed to carry out measurements that address the physical assumptions of the algorithms (optimum and minimum)? Which instruments or systems are necessary/desirable? What standards should be imposed on GV measurements, if any?

Q5) In carrying out GV experiments, which kind of institutes/consortia could perform the specific tasks in the best way? Which organizations and scientists are responsible for planning, accepting and updating the GV work plan? How can the work be shared and prioritized to minimize overlapping work and maximize cooperation?