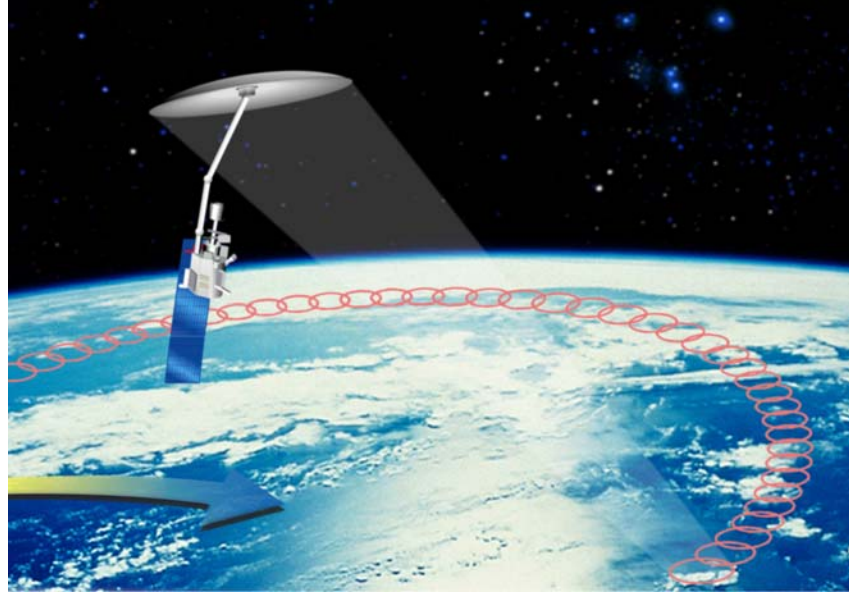
Hydros Overview and Status



Dara Entekhabi (MIT) – Principal Investigator

Yunjin Kim (NASA JPL) – Project Manager

Eni Njoku (NASA JPL) – JPL Project Scientist

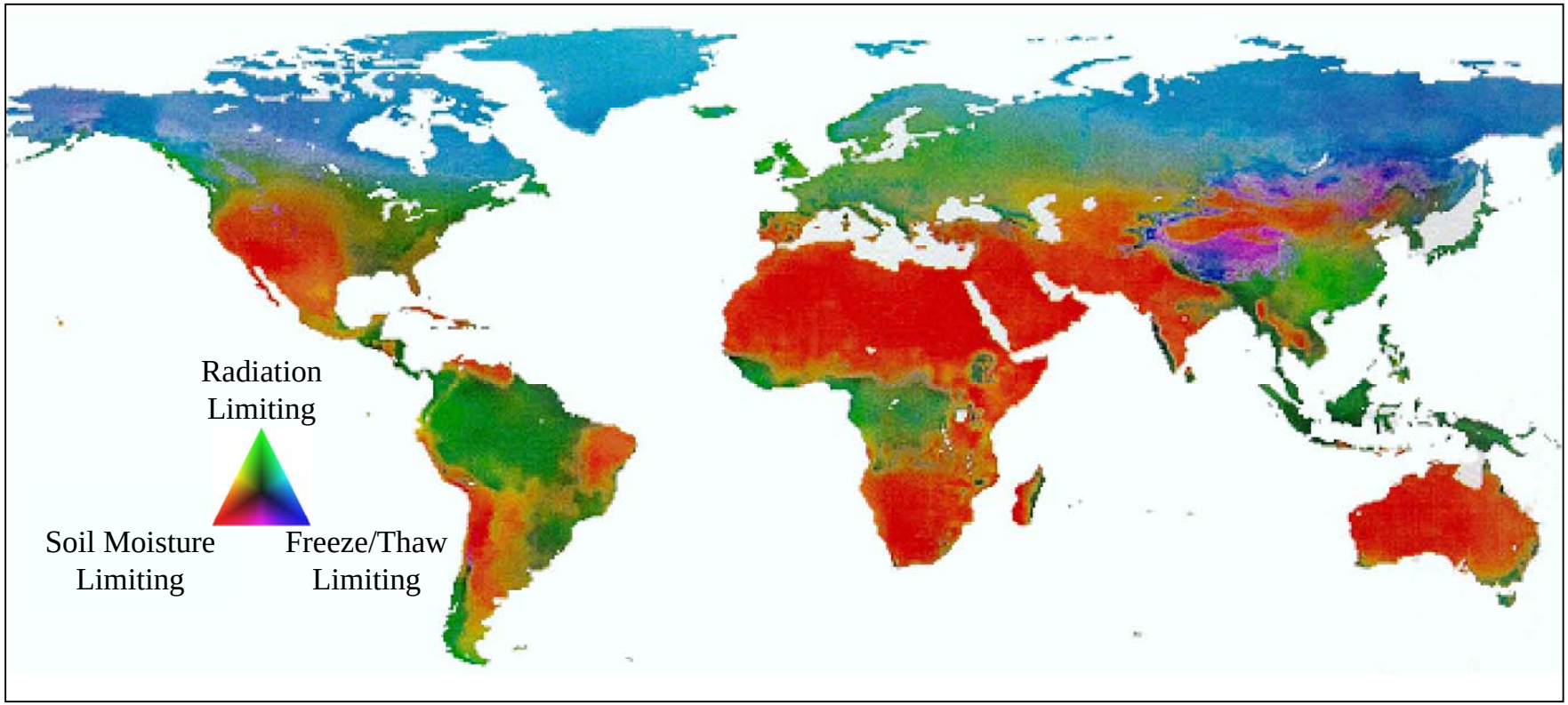
Peggy O'Neill (NASA GSFC) – GSFC Project Scientist

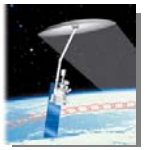
CEOP-IGWCO Joint Workshop

March 2005

Tokyo

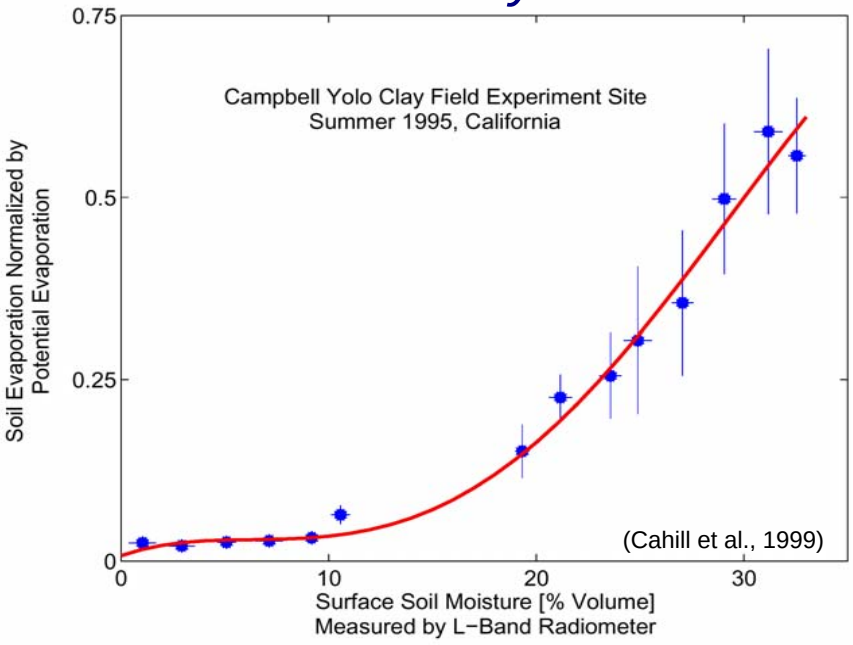
What Limits the Water and Energy Exchange Between Land and Atmosphere?



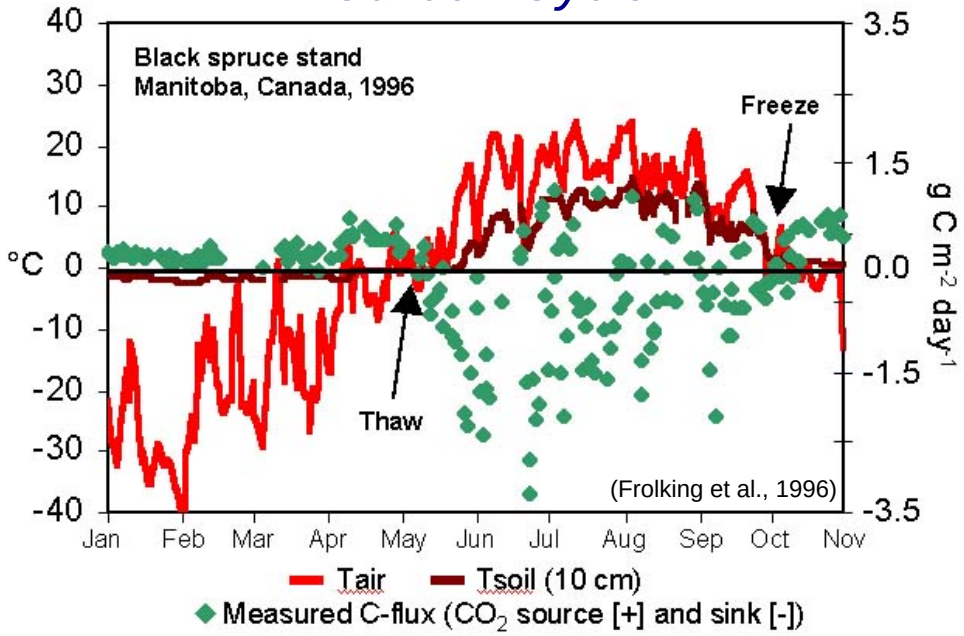


Water, Energy, and Carbon Cycle Science

Water Cycle



Carbon Cycle



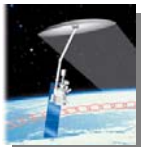
Soil Moisture Controls the Rate of Continental Water and Energy Cycles

Are climate model simulations of regional water cycle correct?

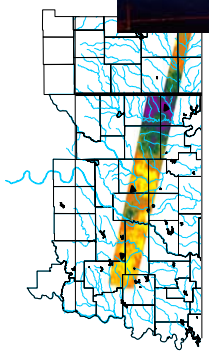
What is the new atmospheric predictability envelope with incorporation of land memory?

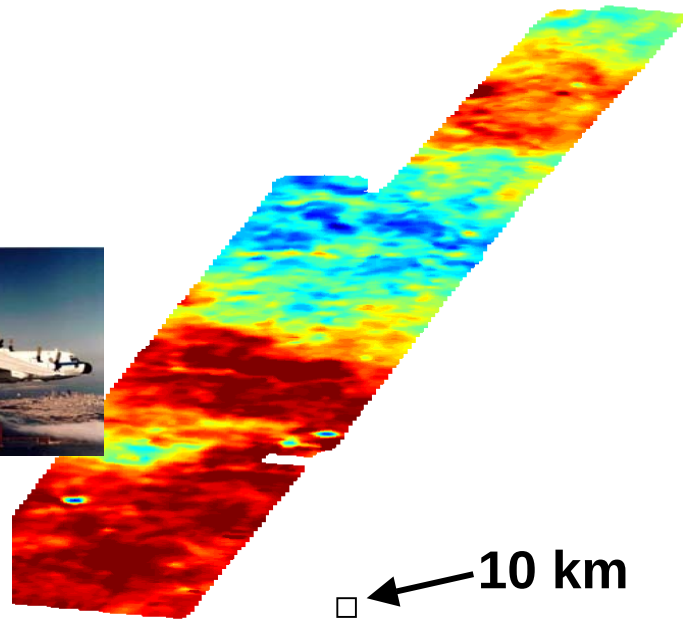
Landscape Freeze/Thaw Dynamics Drive Boreal Carbon Balance.

Are Northern Land Masses Sources or Sinks for Atmospheric Carbon?



Where Are We Going to Get the Measurements?





10 km

Measurement Requirements

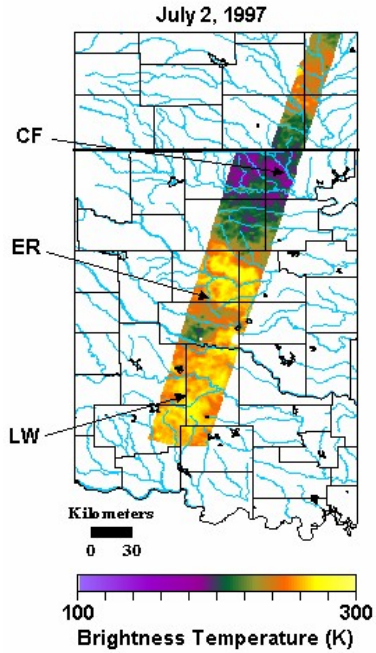
Spatial Resolution:

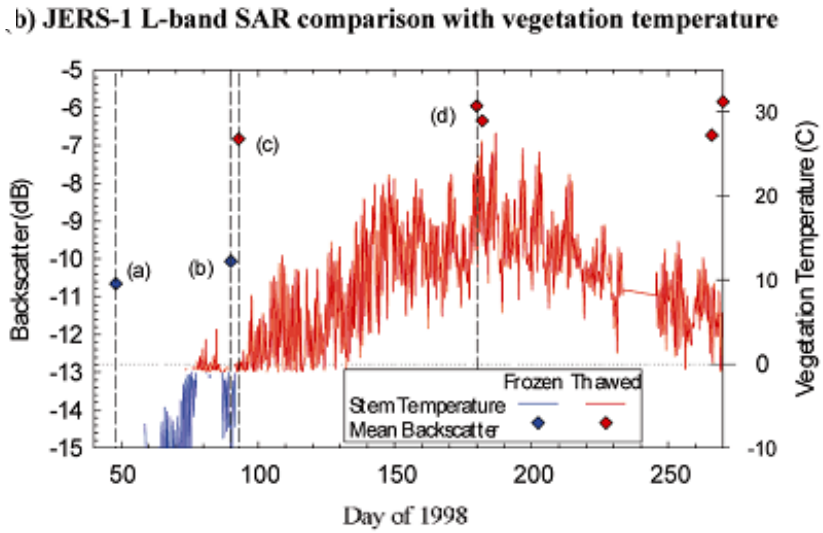
Soil moisture: 40 km (Hydroclimatology)
Soil moisture: 10 km (Hydrometeorology)
Freeze-thaw: 3 km (Heterogeneity)

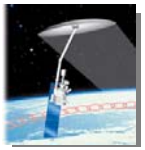
Temporal Sampling (Global revisit):

2-3 days globally (soil moisture)
1 to 2 days above 45°N (freeze-thaw)

Integrated Active and Passive L-band Sensors







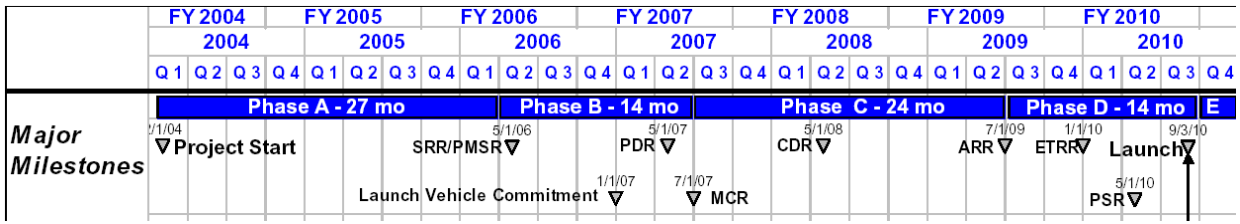
Hydros Mission Status

A hydrology mission to address water and carbon cycle science and natural hazards application requirements

Earth System Science Pathfinder (ESSP)

1. Science-driven
2. Low technological risk
3. Cost-capped

2000-2002	Phase A (Two-Step Proposal)
October 2002	ESSP-3 Selection
November 2002	Risk Mitigation Phase
December 2003	Selection
Since Feb 2004	**Formulation Phase**



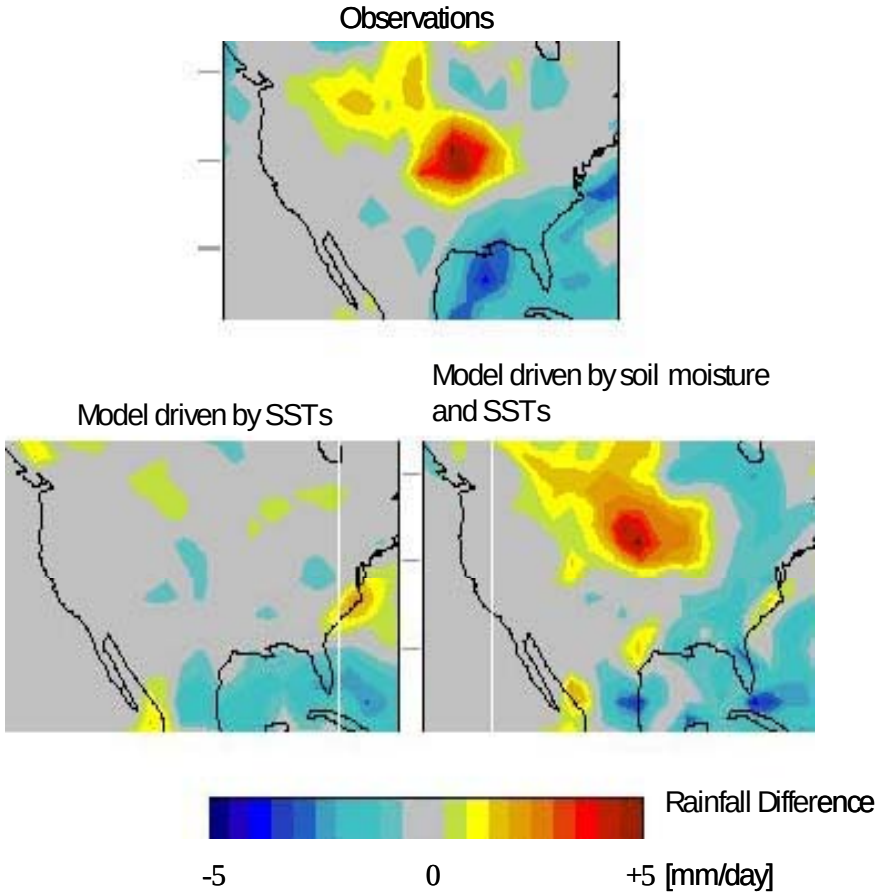
L 2010

Goddard Space Flight Center

GENERAL DYNAMICS
C4 Systems

Predictability Impacts

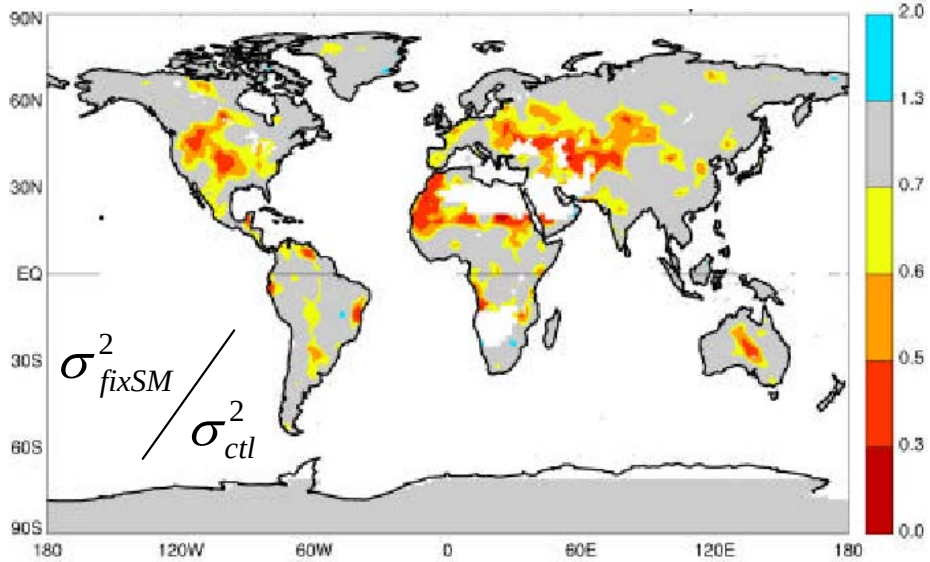
Summer 1993 Rainfall Minus Summer 1988 Rainfall



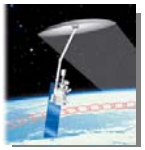
Schubert et al. (2002)

Hydros data will be used to extend seasonal climate predictability by incorporating land memory and land-atmosphere interaction processes in atmospheric models

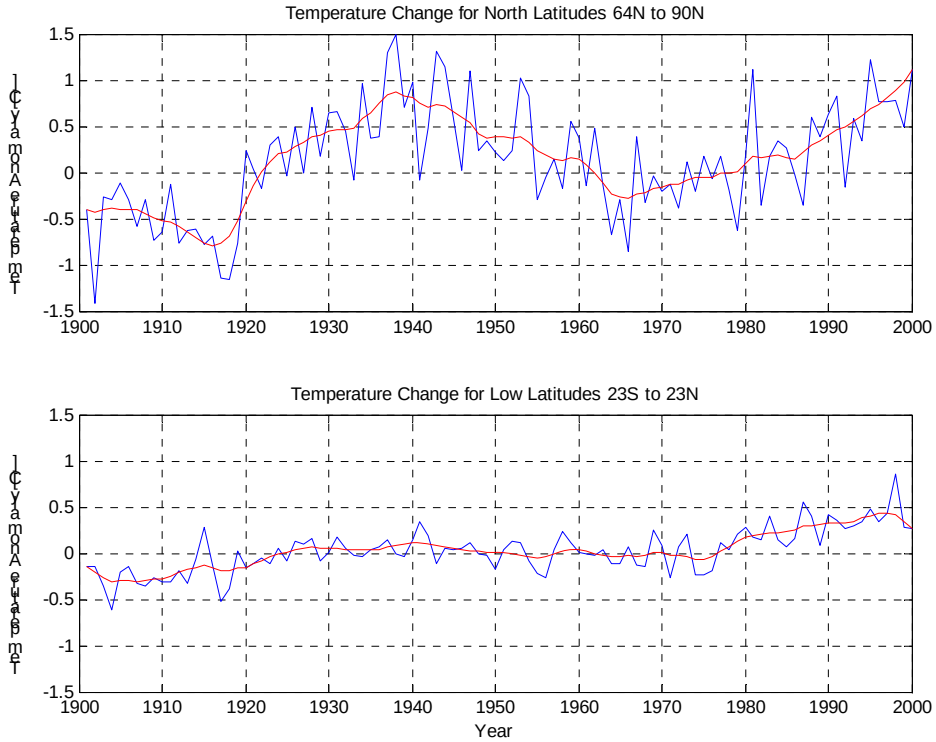
Multi-Model Consensus of Regions Where Soil Moisture Impacts Precipitation



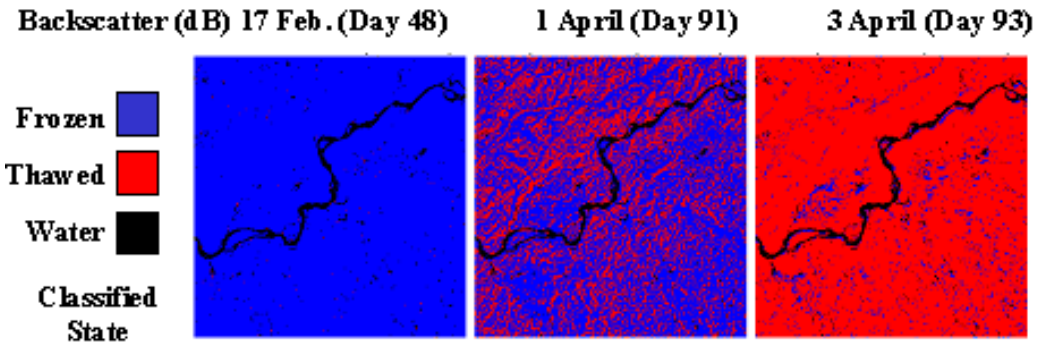
Koster et al. (2004), *Science*, 305, 1138-1140.



Magnifying Lens of Global Change



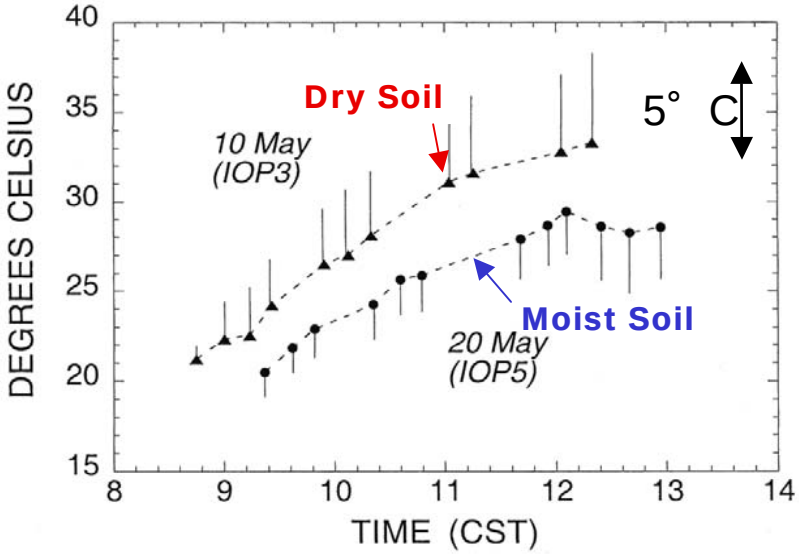
Polar amplification of global change

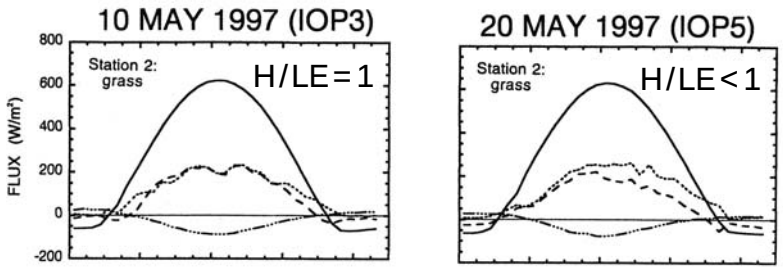


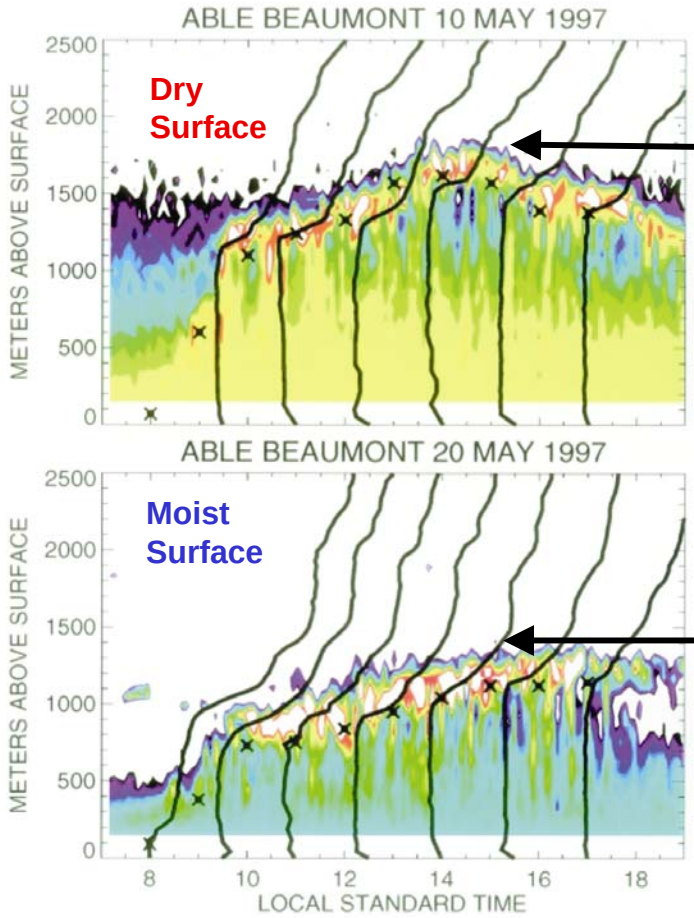
Weather Impacts

May 10 (IOP3) Clear with scattered to broken cirrus
May 20 (IOP3) PBL Winds 5-7 m/s

May 18-19 90 mm Rain





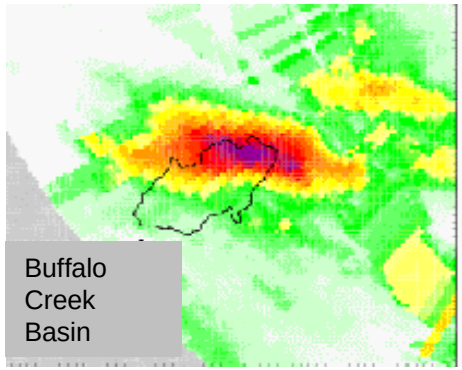


CASES'97, *BAMS*, 81(4), 2000.

Operational Center Partners

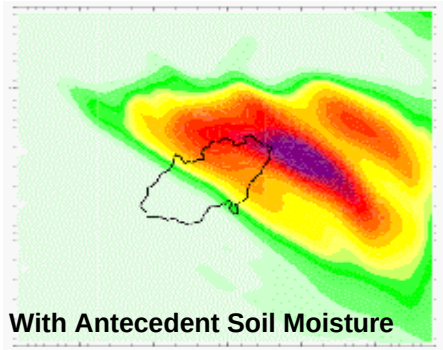
Flash flood event near Fort Collins
July 13, 1996

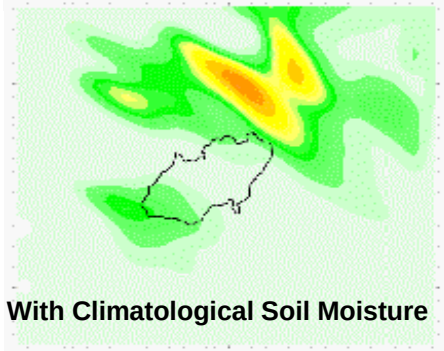
Chen et al. (2001), *JAS*, 58, 3204-3223.



NEXRAD Observed Rainfall
0000Z to 0400Z 13/7/96

24-Hours ahead atmospheric model forecasts





Hydros partnerships:

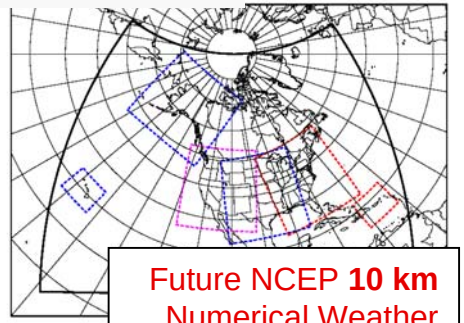
NCEP

ECMWF

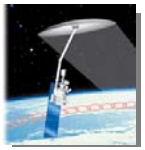
Environment Canada - MSC

NOAA CPC

Hydros <u>combined radiometer and radar</u> data will be used to develop global 10 km soil moisture mapping



Future NCEP **10 km** Numerical Weather Prediction Model Domain



Measurement Approach

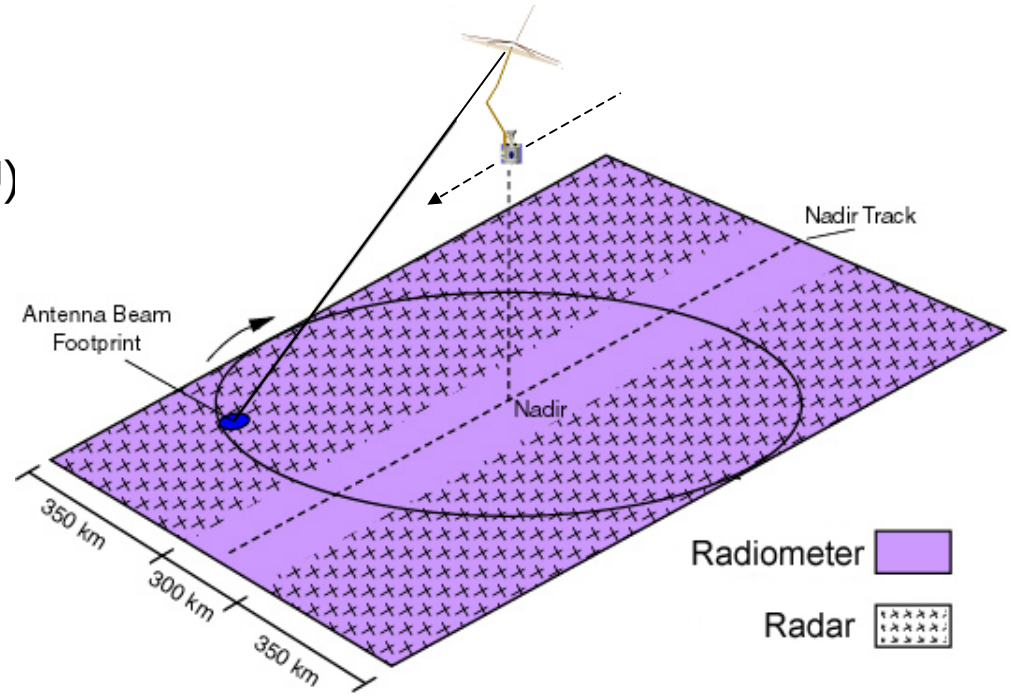
Spacecraft: Same as Coriolis

Light-Weight Mesh Deployable Reflector (6m)

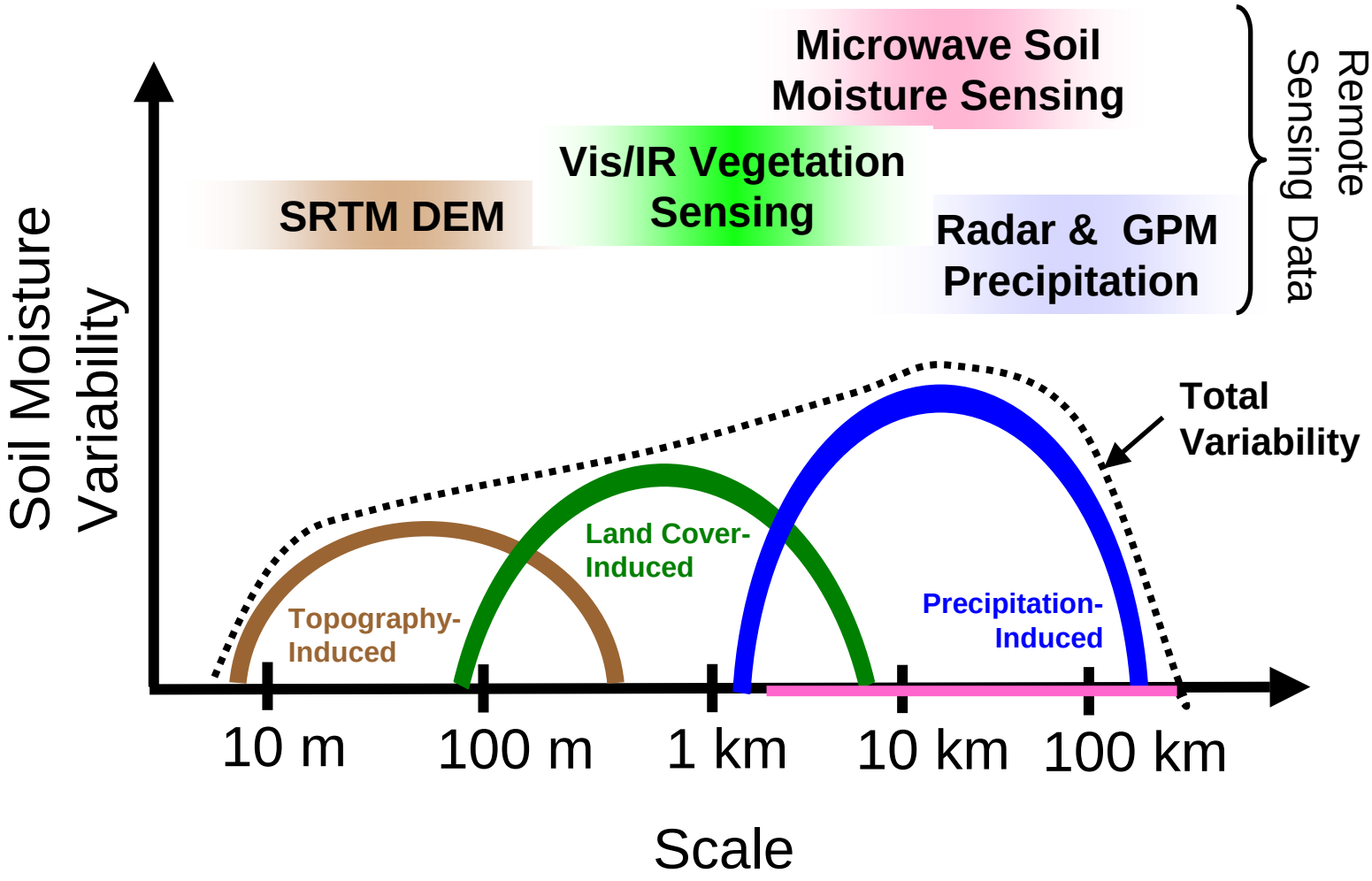
1.26 GHz Radar at 3 km (VV, HH, HV)
1.41 GHz Radiometer at 40 km (V, H, U)
at Constant 40^{o} Incidence

Wide 1000 km Swath for Global Mapping and Good Revisit
- 1-2 Day Polar;
- 2-3 Days Equatorial

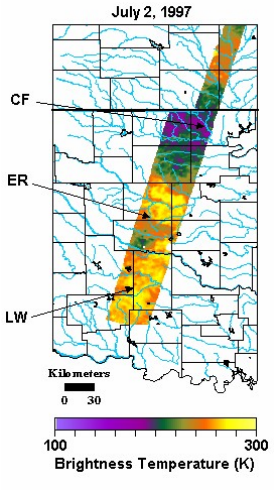
6 am Nodal Crossing

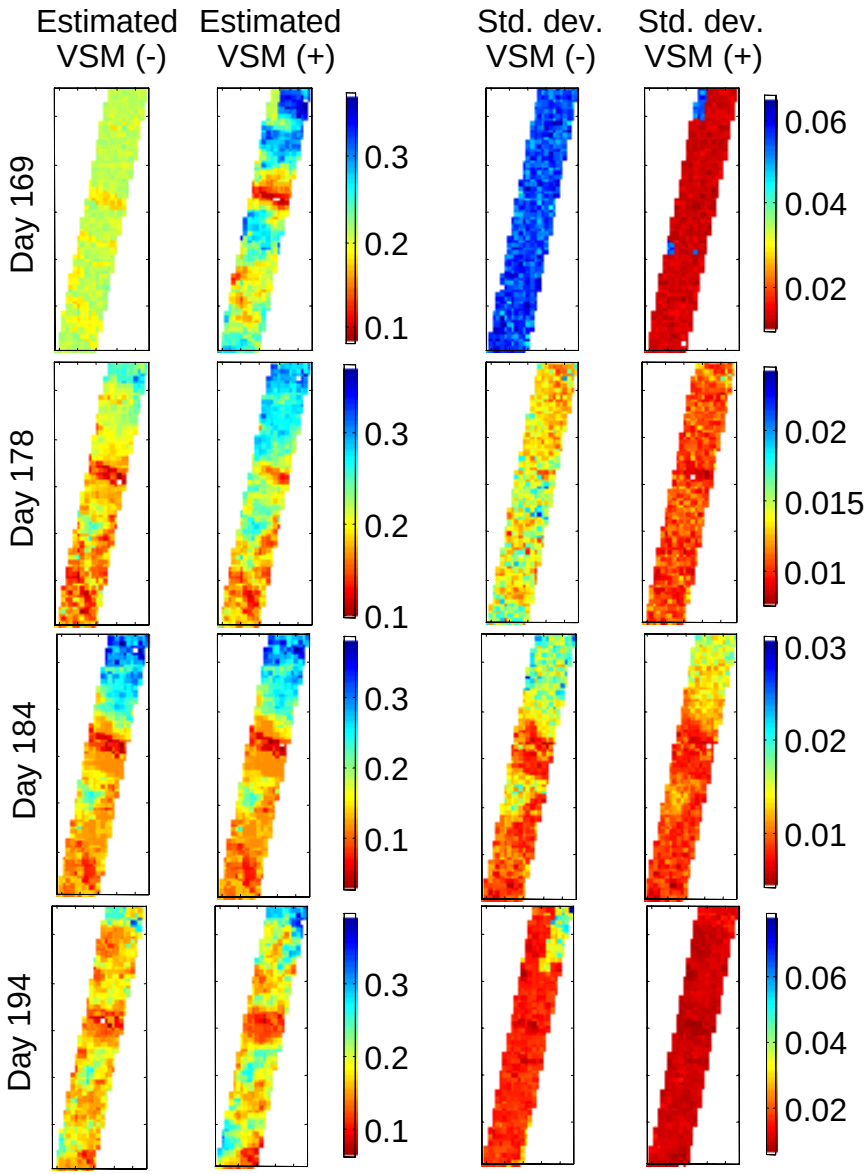


Merged Data Products



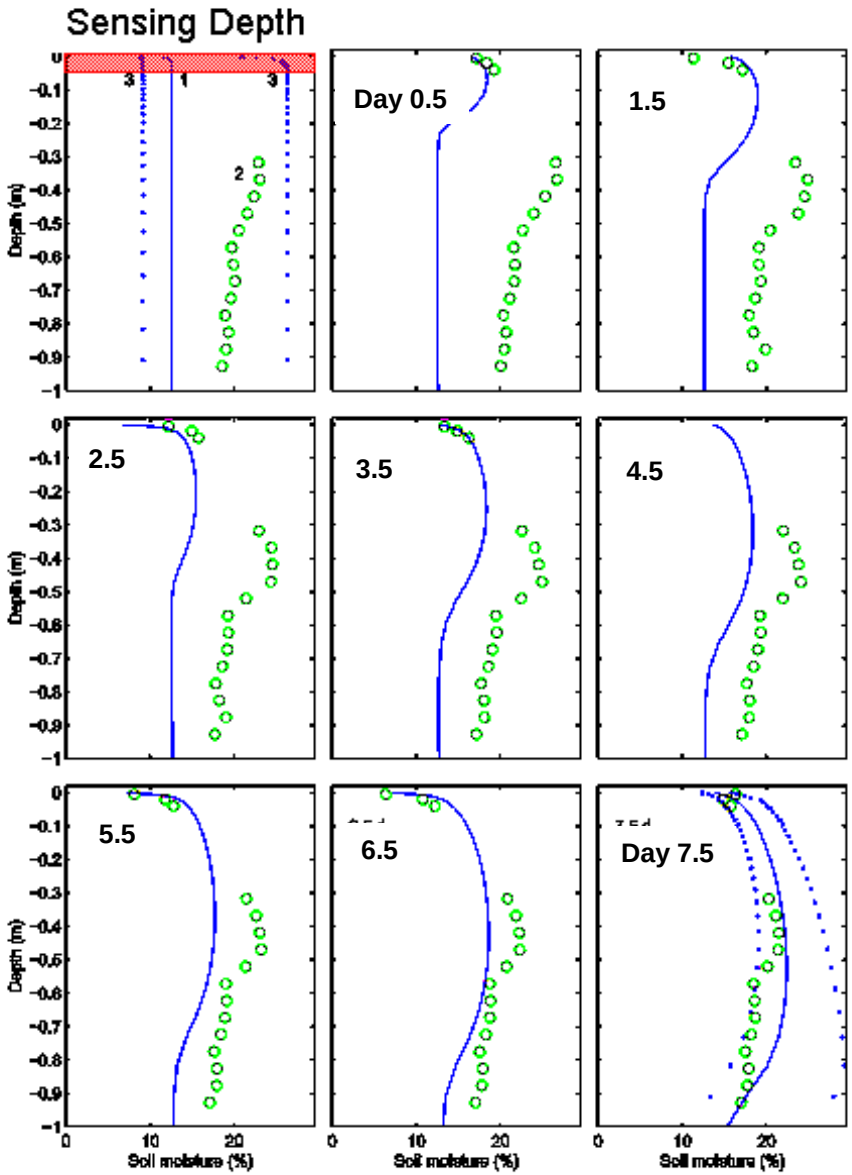
Data Assimilation





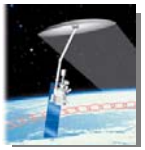
Root-Zone Retrievals

Data Assimilation of Hydros measurements allows profile estimation through model-propagation of the joint probability density between the surface state and subsurface profile.



Example:

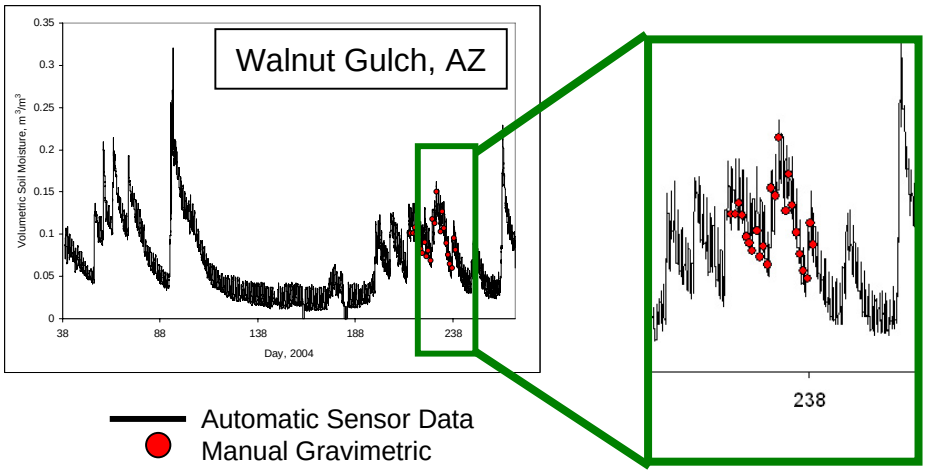
- Data assimilation (—)
- Truck-boom L-Band measurements
- in-situ ground-truth (o)



- **Water and Energy Cycle Science**
- **Weather and Climate Predictability**

Long-Term Soil Moisture *in situ* Measurements

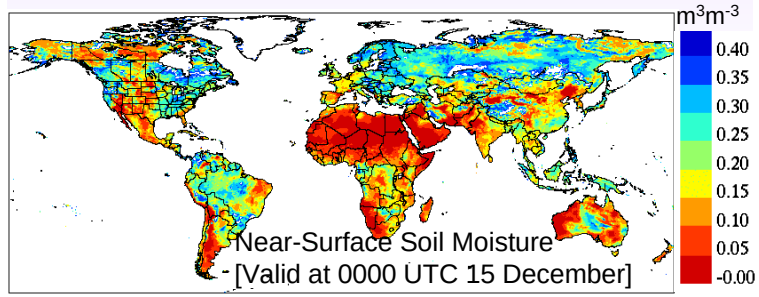
Soil Moisture Networks Can Provide Information on the Temporal Behavior

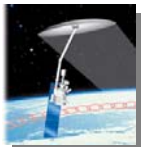


Space-Borne Soil Moisture Measurements

- AMSR-E ***2002***-*2008*
- SMOS *2007-2011*
- Hydros *2010-**2012***

Decadal Continuity of Global Mapping





Summary

Hydros as an End-to-End Pathfinder With High Returns:

1. Use Combined Active and Passive Data to Map the State Variable of Terrestrial Hydrology (Soil Moisture and Its Freeze/Thaw Condition)

2. Address Fundamental Science Questions in all Major Earth Cycles (Water, Energy, and Carbon)

3. Establish Close Linkages Between Mission and Applications Community (NWP Centers and Seasonal Prediction)

http://hydros.gsfc.nasa.gov/

You Are Invited to:
May 2-4 Hydros
Workshop
Phoenix, Arizona