SMAP

SMAP Project and Science Definition Team

Earth Science and Applications from Space

Description

Primary Science Objectives:
Estimate land-atmosphere water, energy & carbon fluxes
Enhance weather & climate forecasts
Improve flood prediction & drought monitoring

Measurements:
Surface soil moisture and freeze/thaw state

Instrument:
Radiometer (L-band, 1.41 GHz; V, H, U)
Radar (L-band, 1.26 GHz; VV, HH, HV)
Conical scanning 6-m mesh antenna reflector
Constant 40-deg incidence angle

Applications

Weather and Climate

Initialization of numerical weather prediction (NWP) models

Boundary and initial conditions for climate models

Testing land surface models in GCMs

Agriculture and Drought Monitoring

Agricultural productivity prediction

Famine early warning

Regional drought monitoring

Flood Forecast

River forecast model initialization

Flash flood guidance

Improved landslide hazards assessment

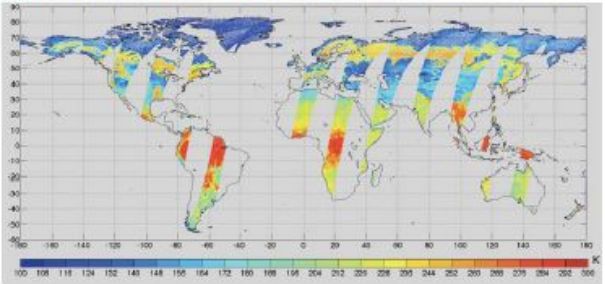
Human Health

Predictions of heat stress and virus spreading rates

Prediction of vector-borne and water-borne infectious disease

Observations

SMAP Radiometer H-pol Descending Pass, One-Day Coverage



8-day Exact Repeat

Global Revisit:
2-3 days

Swath Width:
1000 km

Soil Moisture:
Volumetric accuracy of 0.04 cm^3/cm^3 at 10 km resolution, in top 5 cm of soil, for vegetation water content < 5 kg m^{-2}.

Freeze/Thaw State:
Classification accuracy of 80% at 3 km spatial resolution, in boreal region north of 45N latitude

Data Products

Level	Description	Grid Resolution	Latency*
Level 1C	High Resolution Radar Backscatter	1–3 km	12 hours
Level 1C	Radiometer Brightness Temperature	36 km	12 hours
Level 2	Radiometer-based Soil Moisture	36 km	24 hours
Level 2	Active-Passive Soil Moisture	9 km	24 hours
Level 3	Daily Global Composite Freeze/Thaw State	3 km	36 hours
Level 3	Daily Global Composite Radiometer-based Soil Moisture	36 km	36 hours
Level 3	Daily Global Composite Active-Passive Soil Moisture	9 km	36 hours
Level 4	Carbon Net Ecosystem Exchange	1 km	14 days
Level 4	Surface & Root Zone Soil Moisture	9 km	7 days

*The SMAP project will make a best effort to reduce these latencies

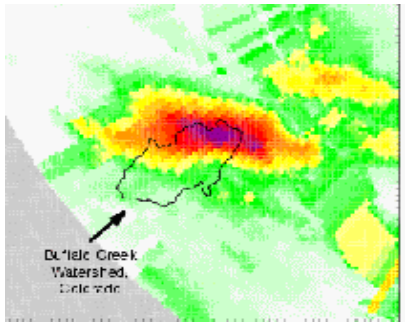
Data Product Format: HDF5 **Access**: NASA-designated archive (DAAC)

© 2010. All rights reserved.

NOAA Satellites and Information
National Environmental Satellite, Data, and Information Service

SMAP Applications in NOAA

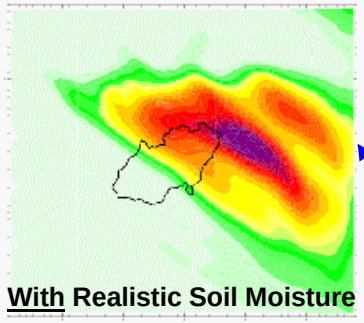
- Numerical Weather & Seasonal Climate Forecasting



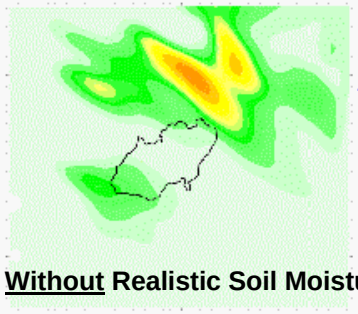
Buffalo Creek Basin

Observed Rainfall
0000Z to 0400Z 13/7/96
(Chen et al., NCAR)

24-Hours Ahead Atmospheric Model Forecasts



With Realistic Soil Moisture



Without Realistic Soil Moisture

Actual storm event is forecasted accurately only if soil moisture information is available.

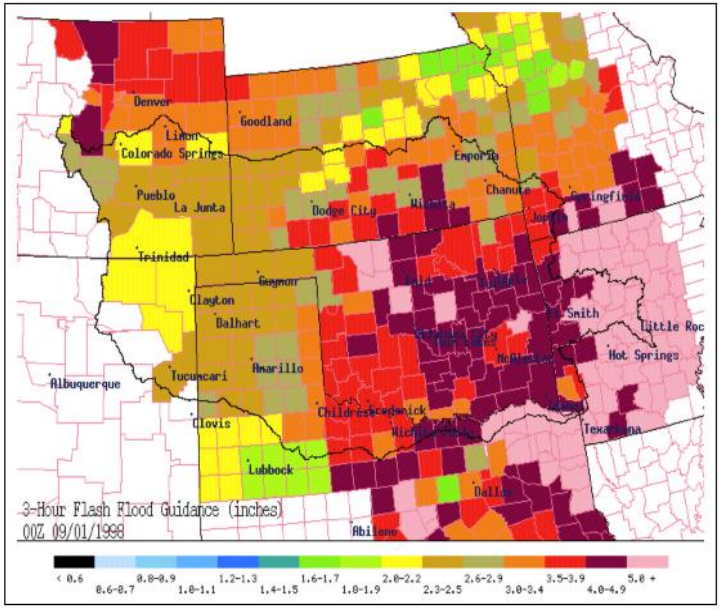
Using realistic soil moisture in numerical weather prediction model improves the rainfall forecast significantly

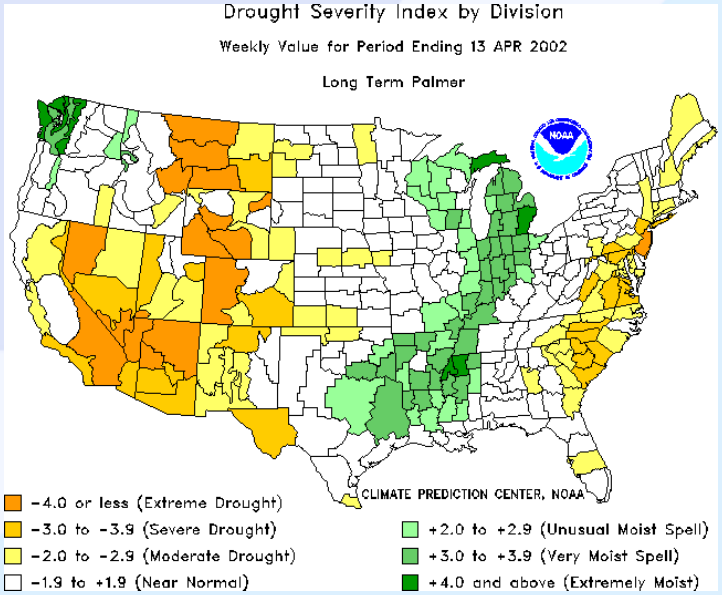
NOAA Satellites and Information
National Environmental Satellite, Data, and Information Service

SMAP Applications in NOAA

- Drought and Flood Monitoring and Forecasting

Current NWS Operational 30 km Flash Flood Guidance (FFG) is Based on *Model* Surface Soil Moisture Deficit





Current NOAA and National Drought Mitigation Center (NDMC) Operational Drought Index is also based on *Modeled* Soil Moisture Data.

Soil moisture data from SMAP will replace proxy or model estimates

SMAP R2O Transition Survey

Background - SMAP mission science justification:

1. With reliable soil moisture data, a numerical weather prediction model could improve severe rainfall forecasts more than 40% in the Rocky Mountain and Great Plains regions. The timing and intensity could be greatly affected by lack of good soil moisture estimates in the forecast models.
2. Accurate soil moisture measurements could largely improve flash flood and river flow forecasts.
3. More frequent, accurate and spatially complete soil moisture measurements are critical to drought monitoring and early warning
4. Accurate observations of freeze/thaw states and soil moisture could reduce the uncertainty in the global atmospheric trace gas budget and improve global change monitoring.
5. Soil moisture levels are also related to wild fire potential estimate, military mobility assessment, infectious disease breakouts (e.g, dengue fever, malaria, etc)

In summary, soil moisture and freeze/thaw data from SMAP are critical for forecasts of severe rainfall, flooding, droughts, landslides, atmospheric CO_2 budget, and human health.

SMAP R2O Transition Survey

SMAP Benefits to NOAA:

1. Greatly improve NWS-NCEP Global Forecast System (**GFS**) and North America Mesocale (**NAM**) model forecasts.
2. Considerably improve NWS-OHD Sacramentao (**SAC**) model for river forecast models and flash flood guidance.
3. Make the **Noah** land surface model more root-zone soil moisture more reliable and thus improve NWS-NCEP-CPC Weekly US Drought Monitor.
4. Reduce uncertainties in climate forecasts by replacing point observations of **freeze/thaw state** in Boreal and wetland regions used by NOAA-OAR climate researchers with SMAP continuous observations.
5. Augment satellite-based fire observations in NESDIS Satellite Analysis Branch (**SAB**) that provides value-added fire potential estimates to NWS.

In summary, soil moisture and freeze/thaw data products support several NOAA Mission Goals: Weather & Water, Climate, Commerce & Transportation.