Flood Monitoring and Prediction

Potential Applications of SMAP data to NOAA Operations and Research

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Outline

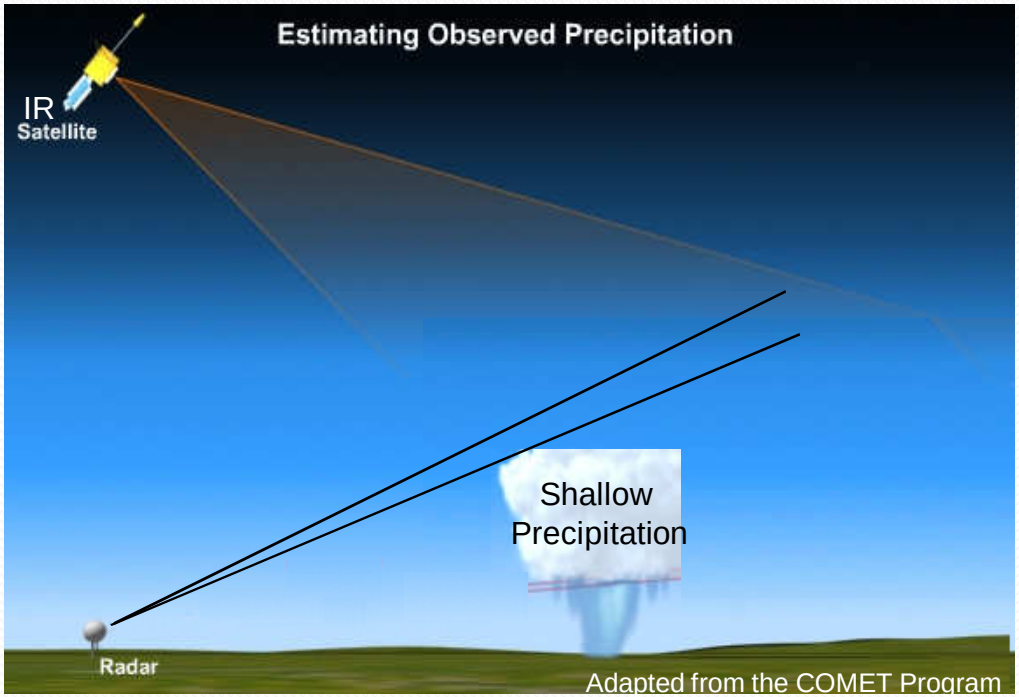
- Introduction
- Potential SMAP Applications
  - Soil wetting detection
  - Irrigation detection and assessment
  - Freeze/Thaw information
  - Flash flood prediction and monitoring
  - Stream flow prediction and monitoring
  - SMAP OSSE
- Challenges

Introduction

- National Weather Service Mission Statement: "provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy."
- Hydrologic monitoring and forecasting depend in large part on accurate assessments of soil moisture conditions
- Increases in the accuracy of these assessments would impact flood and flash flood monitoring and prediction, as well as improve management of water resources
- SMAP may serve as a key source soil moisture data

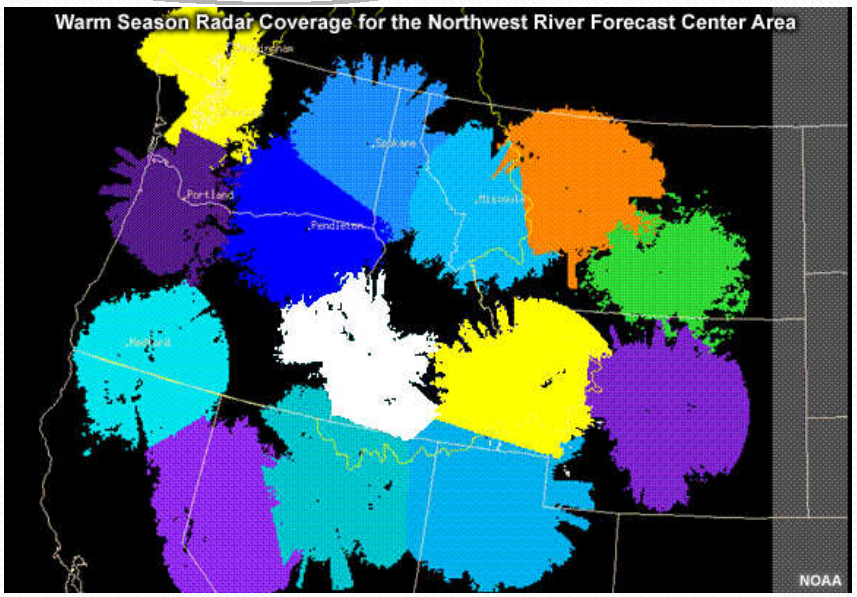
Soil Wetness: Shallow Precipitation

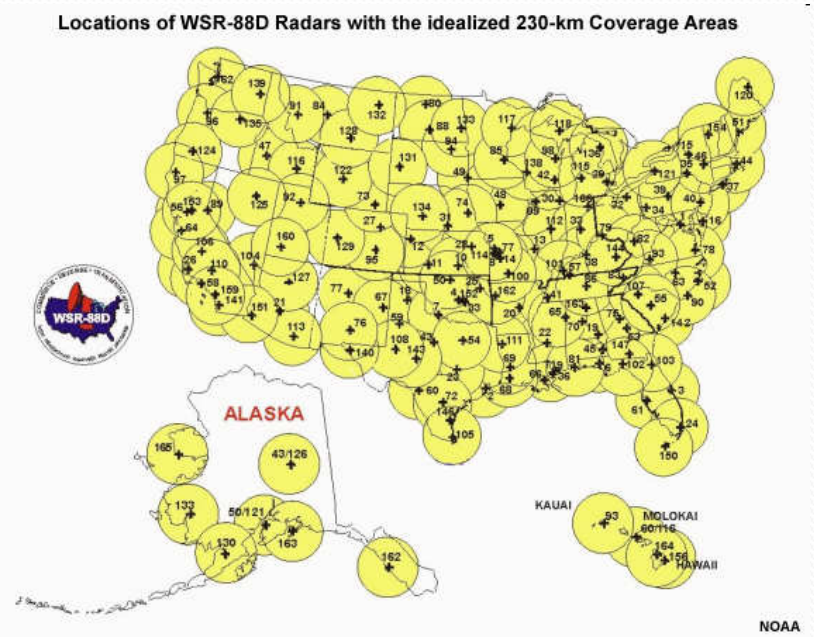
- Soil wetness impacts surface runoff, often modeled by radar/satellite-driven hydrologic model
- Radar can overshoot shallow precipitation
- IR Satellites perform poorly as well
- SMAP is a potential source of soil wetness data in these cases

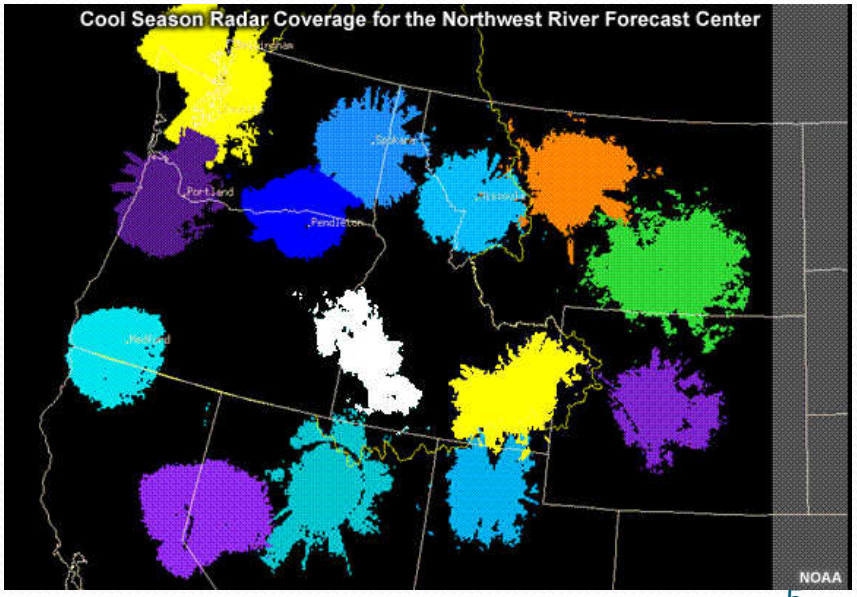


Soil Wetness: Doppler Radar Gaps

- Sizable, seasonal gaps in radar coverage (and thus accurate modeled soil moisture) exist
- SMAP can fill in soil moisture fields in these areas

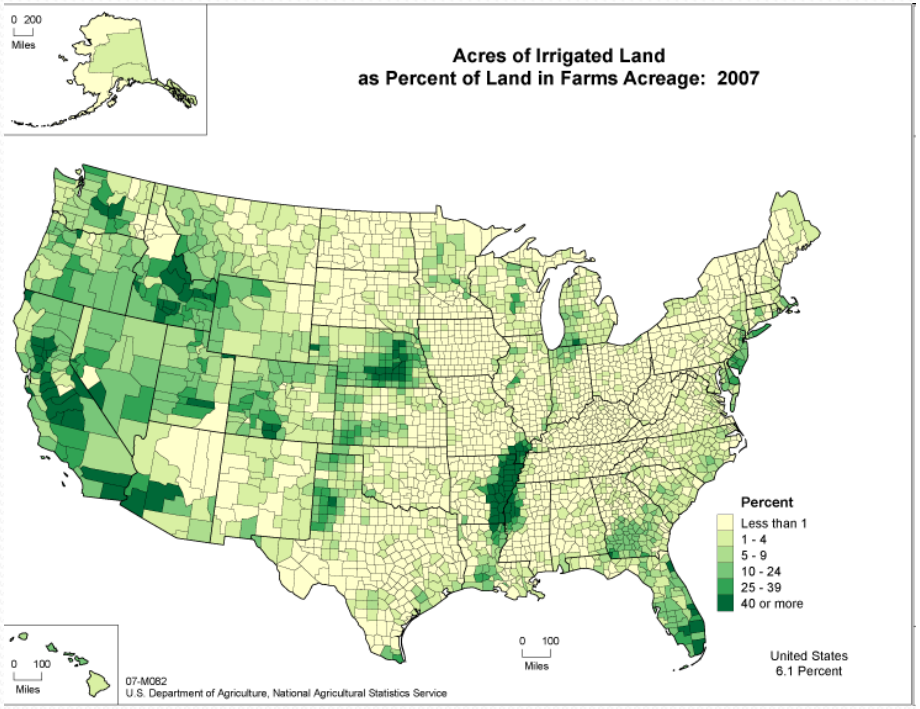






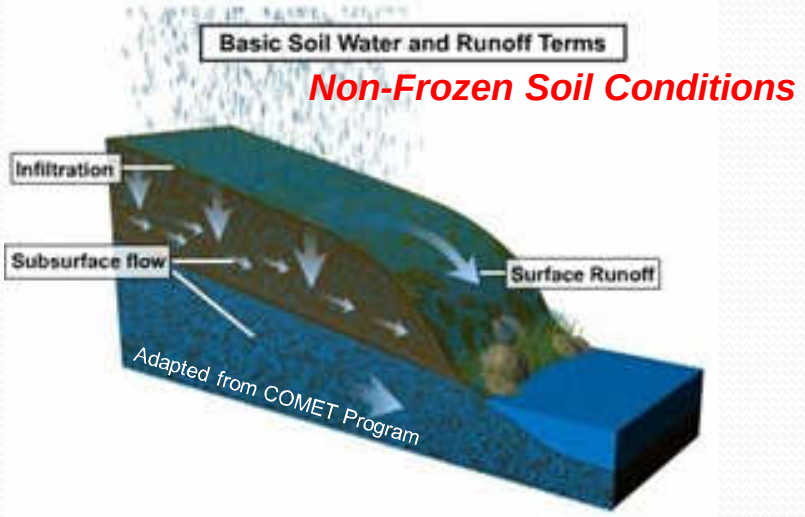
Soil Wetness: Impacts of Irrigation

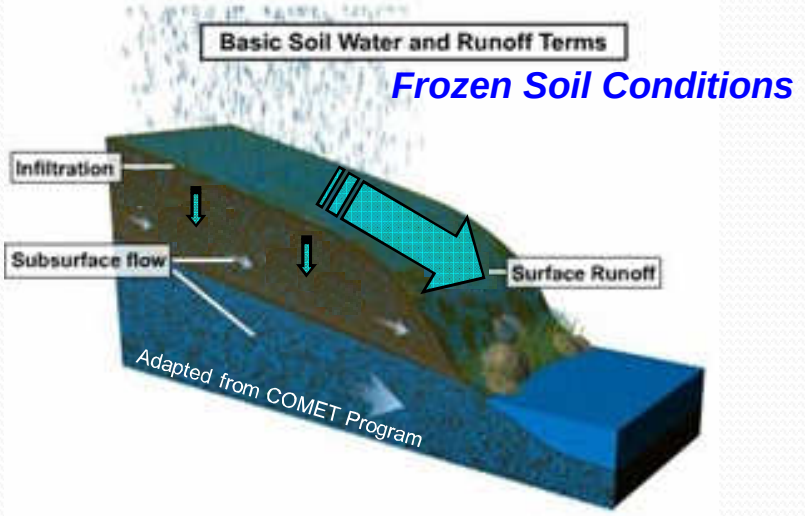
- Soil wetness affected by irrigation, can impact runoff
- No representation of irrigation or assimilation of soil moisture data in current NWS operational hydrologic models.
- SMAP could be used to adjust model fields for irrigated areas within forecast domain



Soil Freeze/Thaw Information

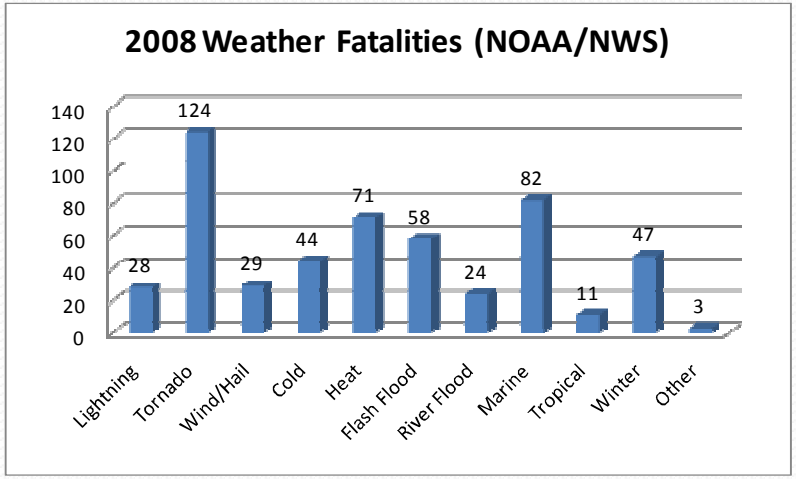
- Runoff processes directly impacted by ice content of soil
- Frozen soils lock moisture in place and increase runoff ratio
- Sacramento Heat Transfer model simulates frozen soil processes
- SMAP freeze/thaw data could be assimilated into model to improve representation of surface soil characteristics





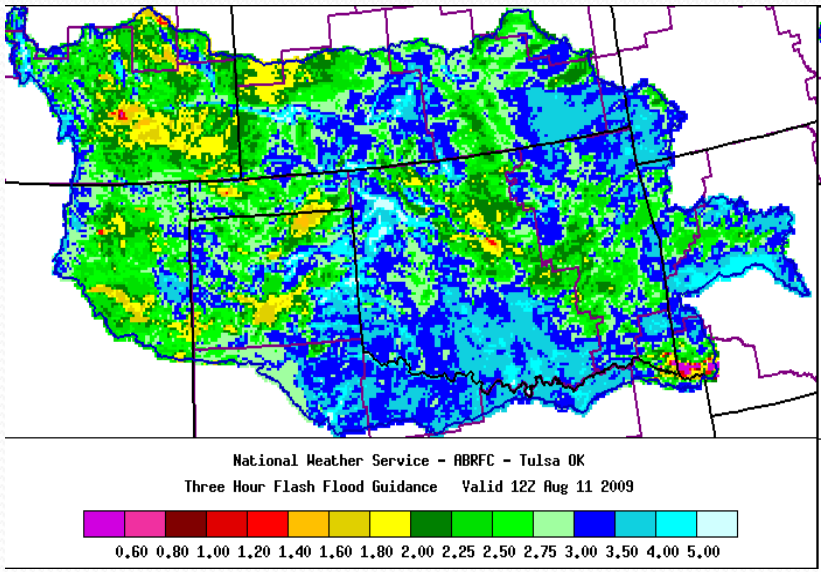
Flash Floods

- Flash floods are a devastating natural disaster
- Effective monitoring and prediction depends on accurate assessment of soil moisture conditions
- SMAP is a potential source of such data
- Several projects underway within the NWS which could leverage this data



Gridded Flash Flood Guidance

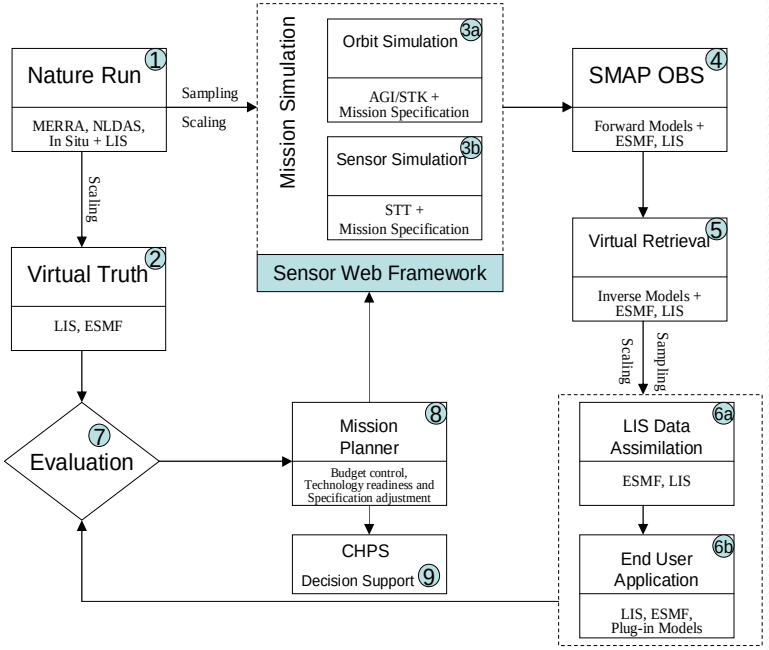
- Gridded flash flood guidance shows the amount of precipitation needed to cause local flash flooding
- Depends on surface soil moisture
- Current soil moisture source is NWS/OHD Sacramento Model



- Sacramento soil moisture states could be improved through assimilation of SMAP soil moisture values
- Pathfinder joint project (OHD/NASA/CREW/ABRFC) submitted supporting SMAP OSSE and assimilation of AMSR-E data into Community Hydrologic Prediction System (CHPS)

NWS/OHD Modeling: SMAP OSSE

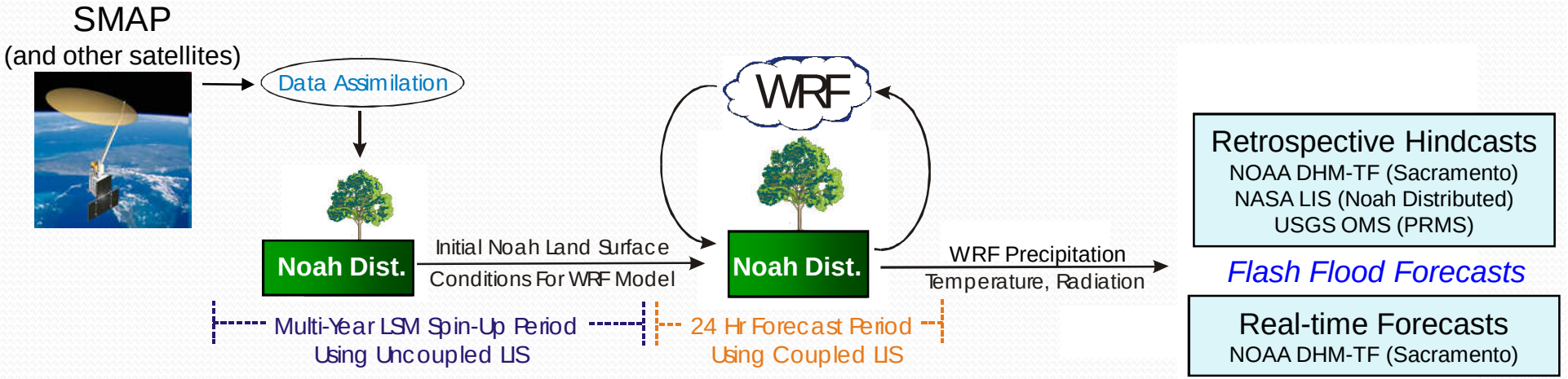
- Joint OHD/NASA/CREW/ABRFC project includes OSSE sub-study
- Simulated SMAP data assimilated into Sacramento model
- Stream flow and soil moisture results with/without SMAP assimilation compared



- Research will support soil moisture forecasts and address future objectives including the capability to predict water quality and related ecosystem variables
- Research conducted within LIS at NASA/GSFC but transferable to next generation CHPS upon completion

Flash Floods: NWS/OHD Modeling

- Joint NOAA/NASA/USGS/NCAR NASA-funded project
- Seeks to combine data assimilation with high resolution NWP and hydrologic modeling to improve flash flood forecasts at 1km to 4km scale
- Soil moisture estimates important for NWP initialization
- SMAP important source of data for this purpose



Evolving Debris Flow Warning Mission

- Joint scientific development by USGS and NOAA/NWS
- Testing underway in burn scar areas in western U.S.
- Soil moisture initial conditions in non-burned areas are critical in development of debris flows. Expansion of warning system to non-burned areas nationwide will require soil moisture monitoring

Challenges

- Data latency, repeat time, and resolution
  - Ideally, 1km resolution, 1 hr repeat time, < 1 hr latency
  - Challenge will be to extract useful information from real-world SMAP data with sub-optimal characteristics
  - Low latency data from NOAA NESDIS promising
- Performance in heavily vegetated areas
- Performance in mountainous areas
  - Critical water resource areas often mountainous
  - Ability to improve upon poor radar coverage
- Extracting useful information from shallow observations
- Operational availability, potential for follow-on missions
- Funding for SMAP data assimilation and integration work within NOAA/NWS