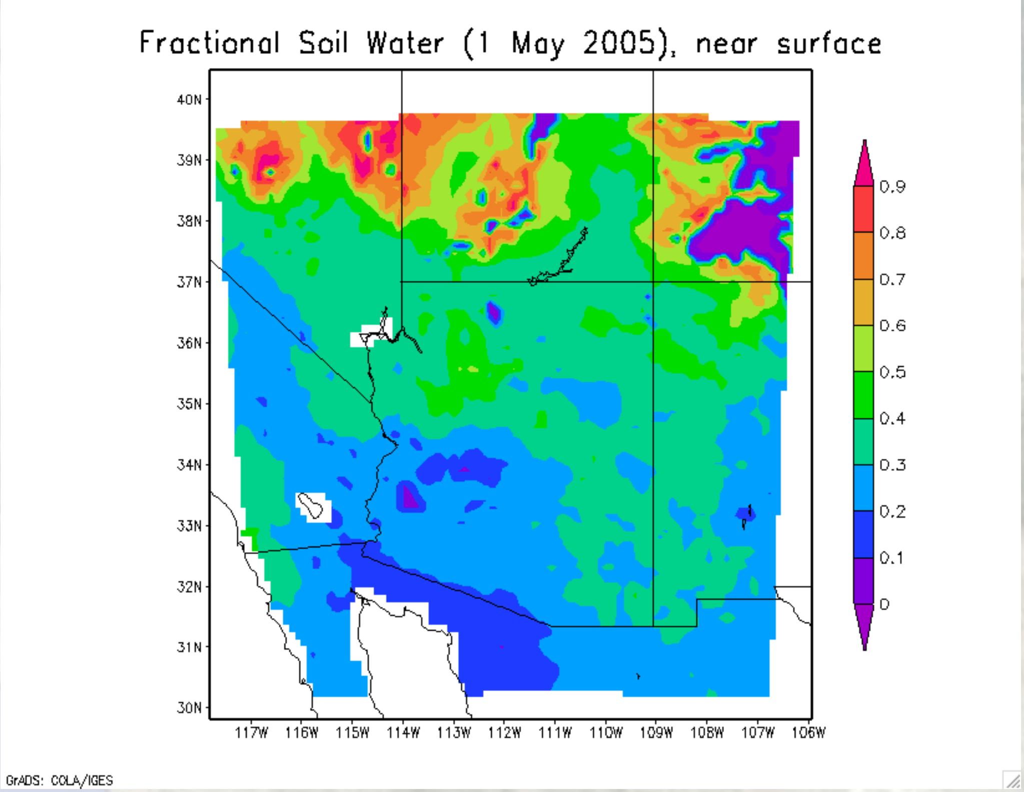
# Use of Remote Sensing Data in Hydrologic Modeling





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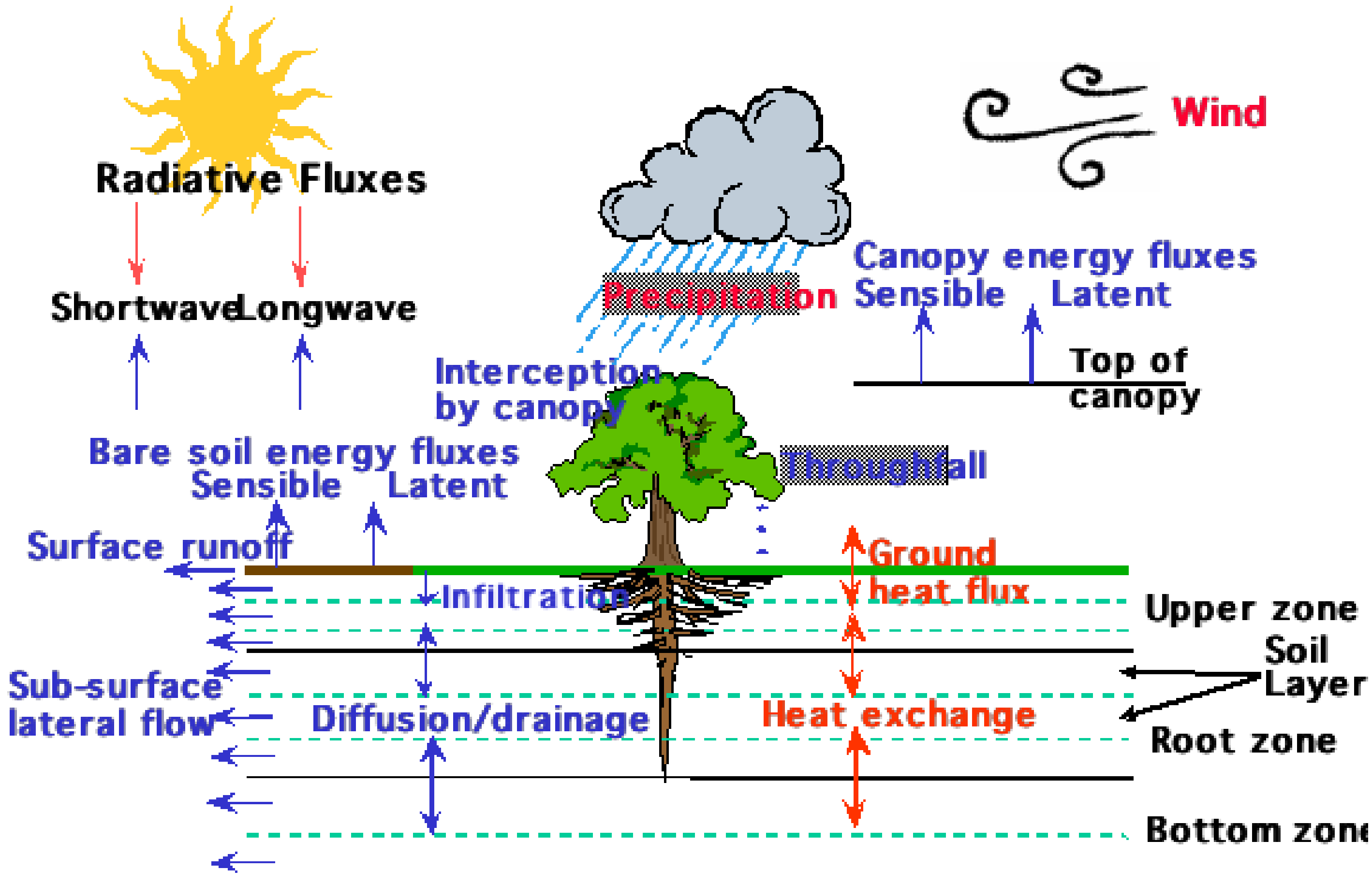
# SHEELS – Simulator for Hydrology and Energy Exchange at the Land Surface

- Distributed land surface hydrology model
- Heritage: 1980’s Biosphere-Atmosphere Transfer Scheme (BATS)
- Can run off-line or coupled with meteorological model
- Flexible vertical layer configuration designed to facilitate microwave data assimilation
- Described in Martinez et al. (2001), Crosson et al. (2002)



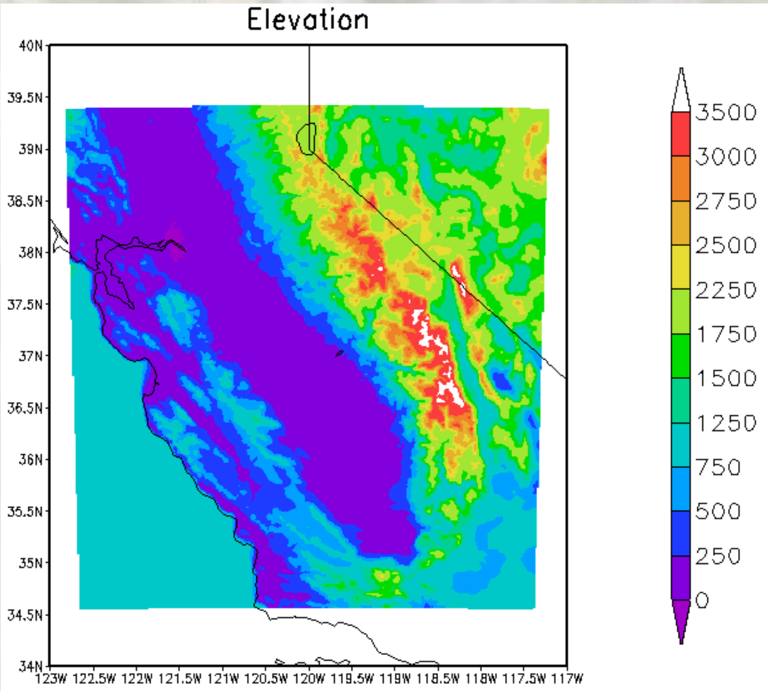
# SHEELS Input

## Required static variables:

**Soil type (STATSGO):**
Saturated hydraulic conductivity
Saturated matric potential
Soil wilting point
Rooting depth
Soil porosity

**Landcover (U of Md):**
canopy height
fractional vegetation cover
minimum stomatal resistance
leaf area index
reflectance properties

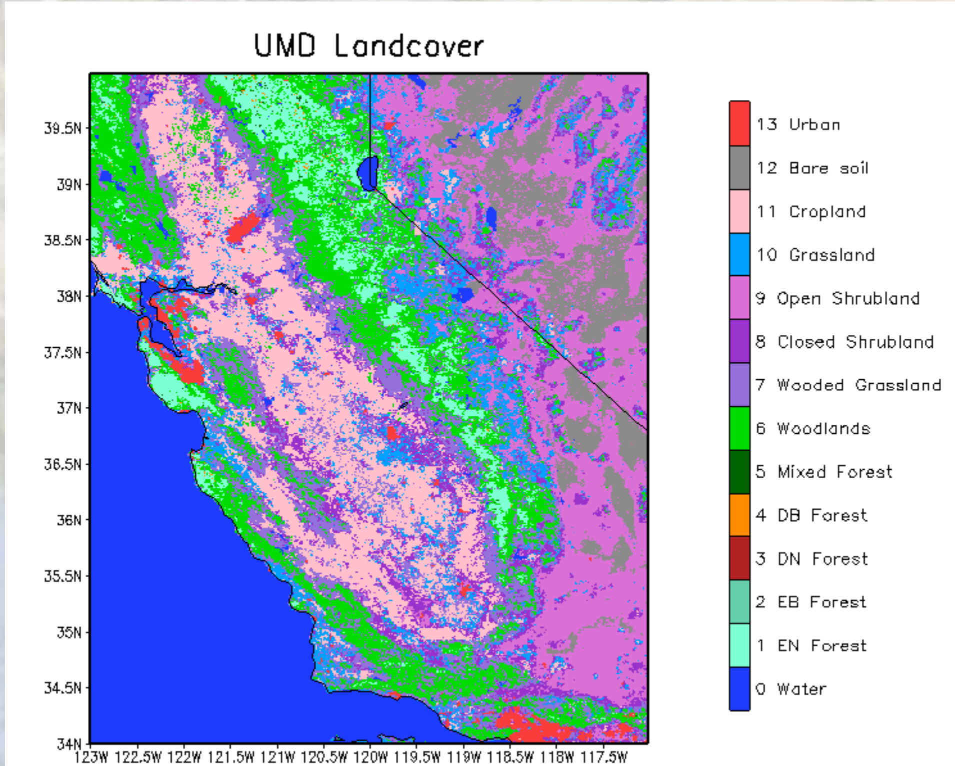
**Topography (GTOPO30):**
Surface elevation and slope

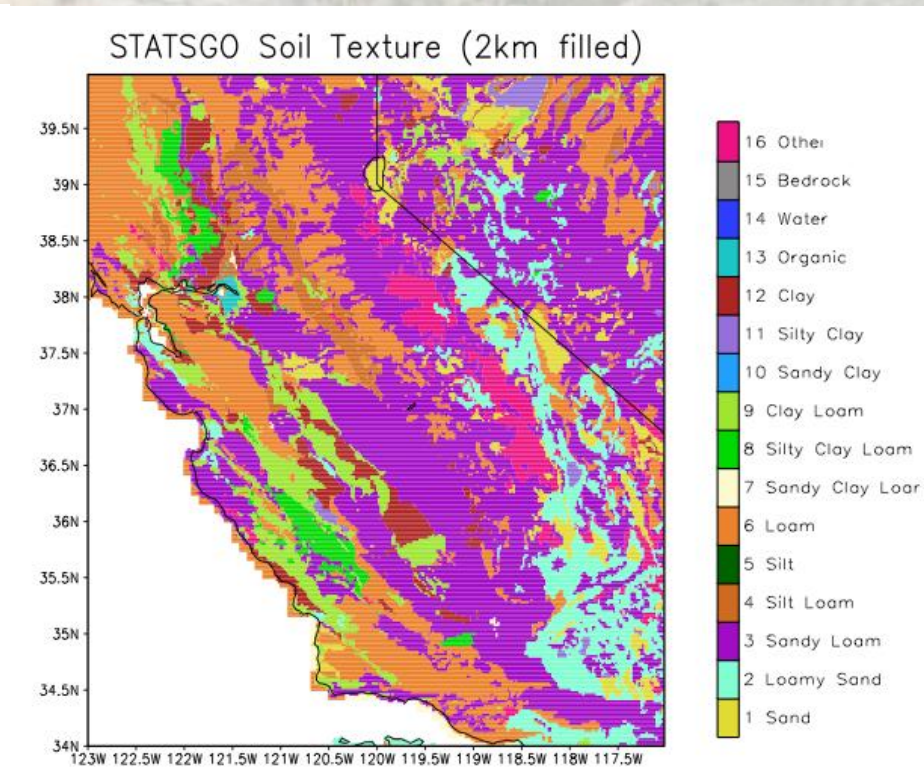



## Time-dependent input (forcing):

- Rainfall (NREPS)
- Wind speed (NLDAS)
- Air temperature
- Relative humidity
- Atmospheric pressure
- Downwelling solar radiation
- Downwelling longwave radiation

# Model Parameters



# Greenness Vegetation Fraction

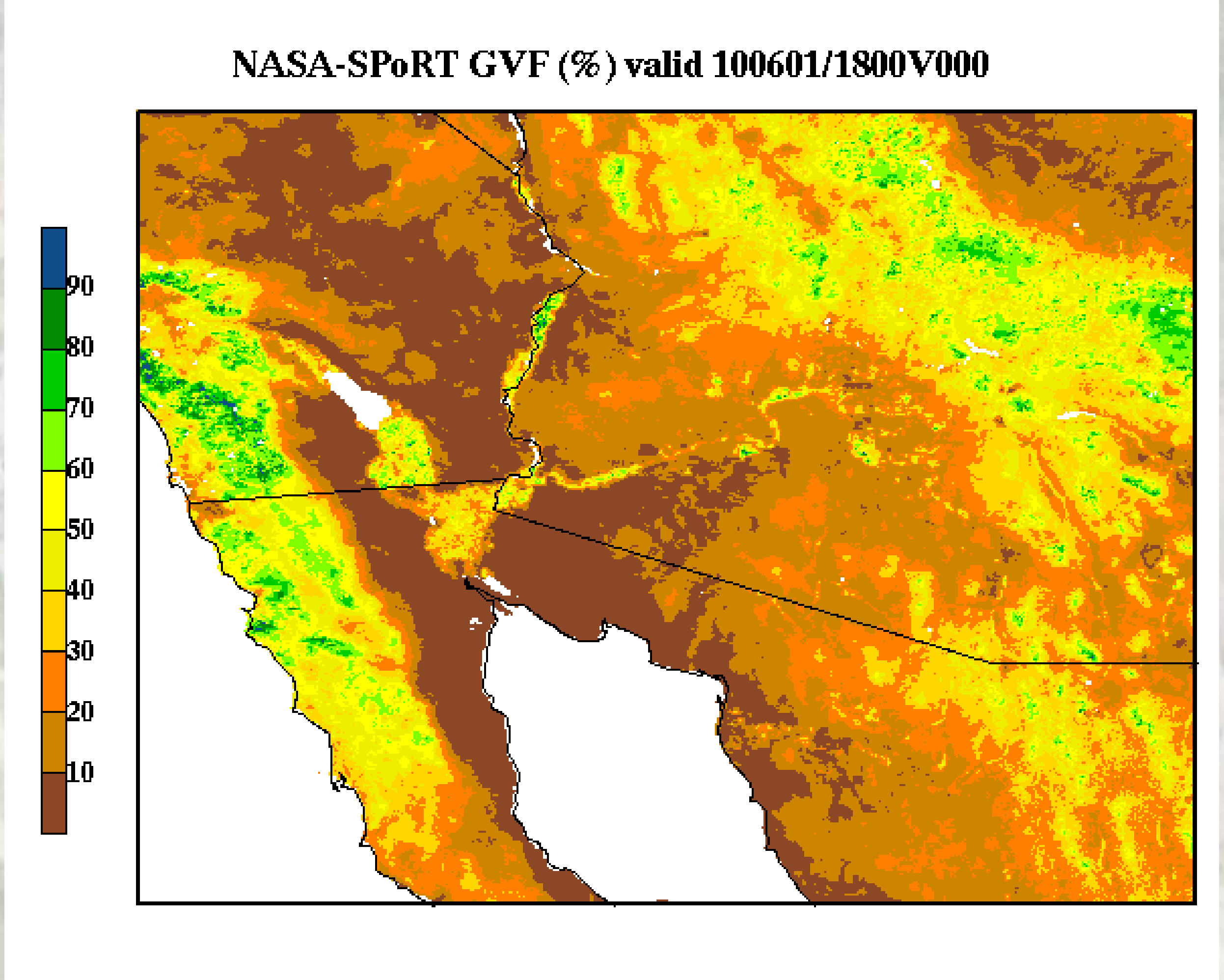



Image courtesy of Jonathan Case,
NASA Short-term Prediction Research and Transition Center (SPORT)

# SHEELS Output

**STATES**

**Soil surface and canopy temperatures**
**Soil temperature** at each layer
**Soil moisture and ice** at each layer
**Depth of water on canopy**
**Ponded water**
**Snow temperature, depth, and density**

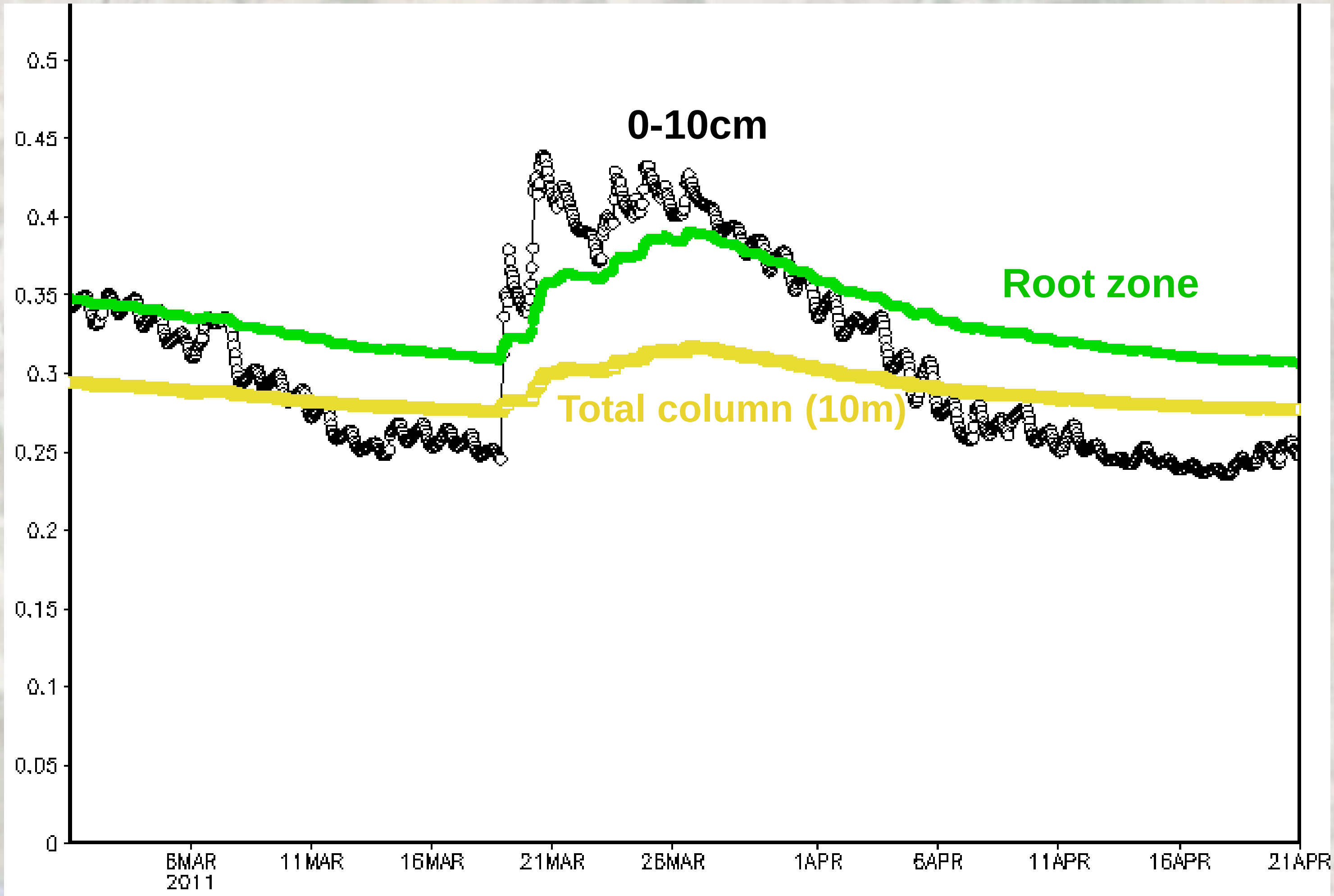
**FLUXES**

**Surface latent and sensible heat fluxes**
**Ground heat flux**
**Net radiation flux**

**Evapotranspiration**
**Infiltration**
**Runoff**

# SHEELS output time series

## Volumetric soil moisture, 1 Mar 2011 - 21 Apr 2011

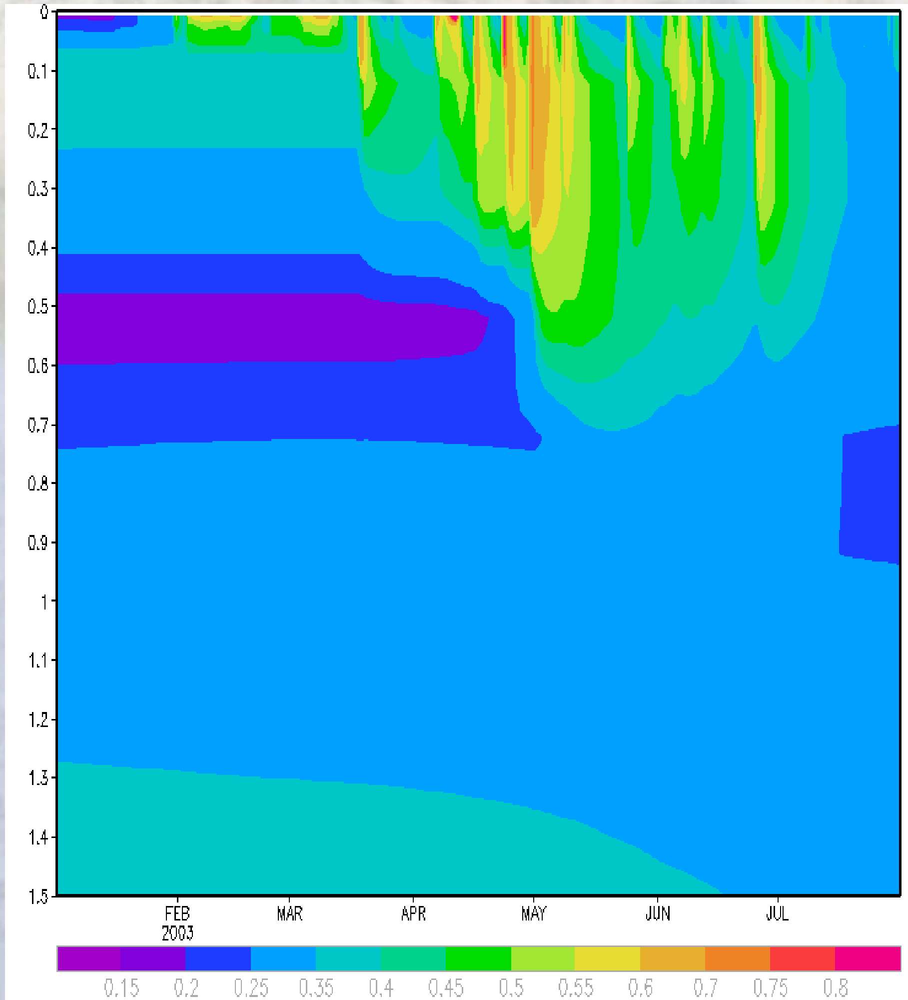



## Salinas, California

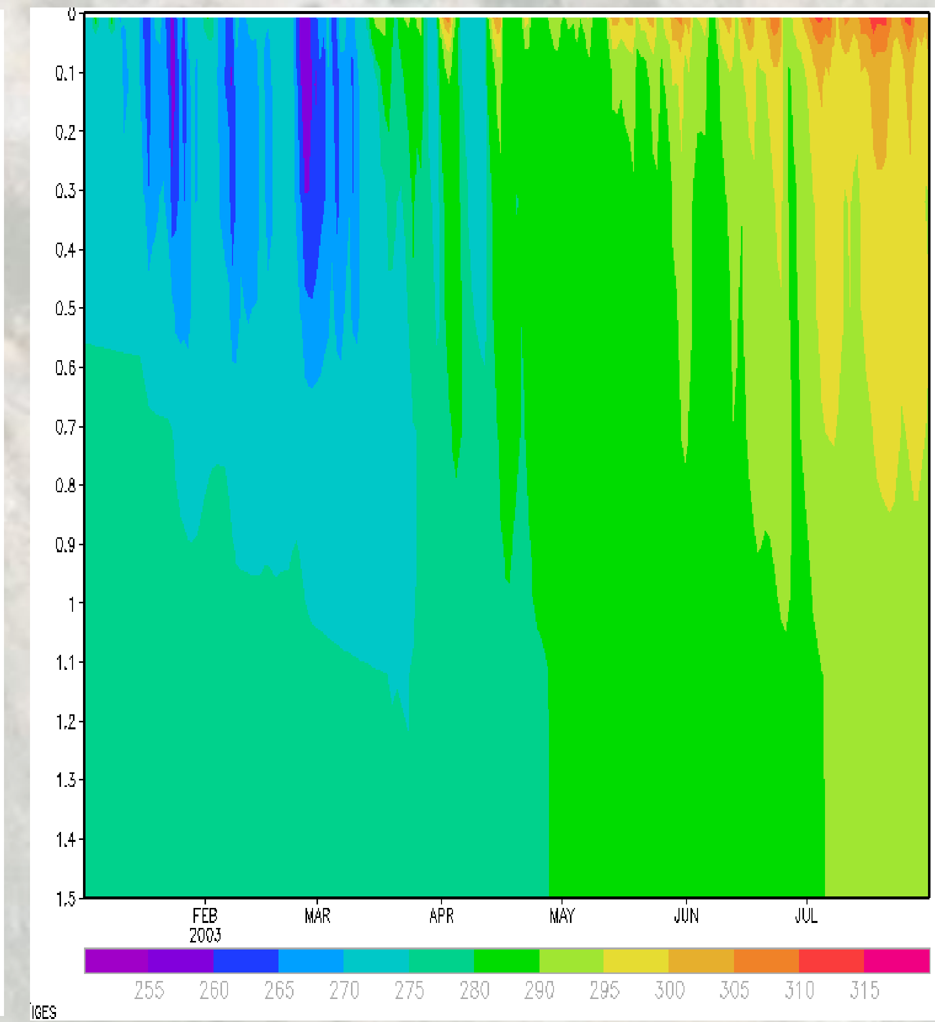
# Example Depth-Time Sections

Nebraska
JAN-JUL 2003

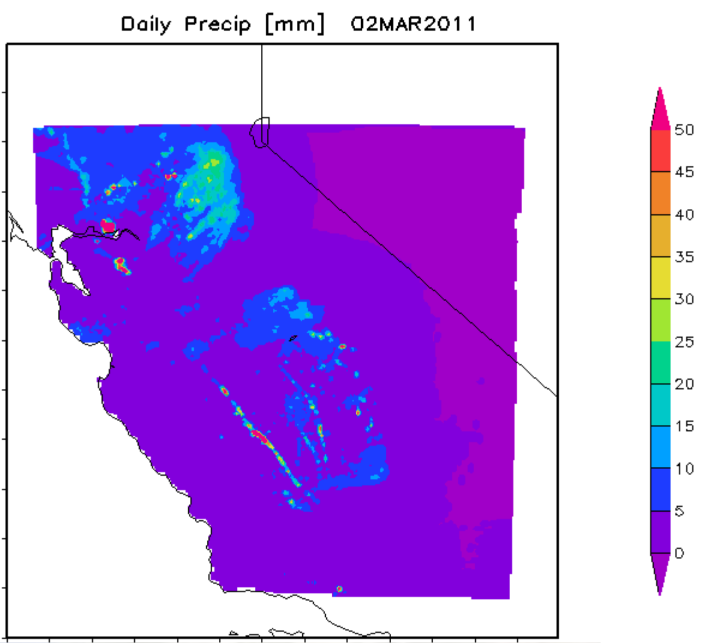
**Fractional soil moisture (water+ice)**

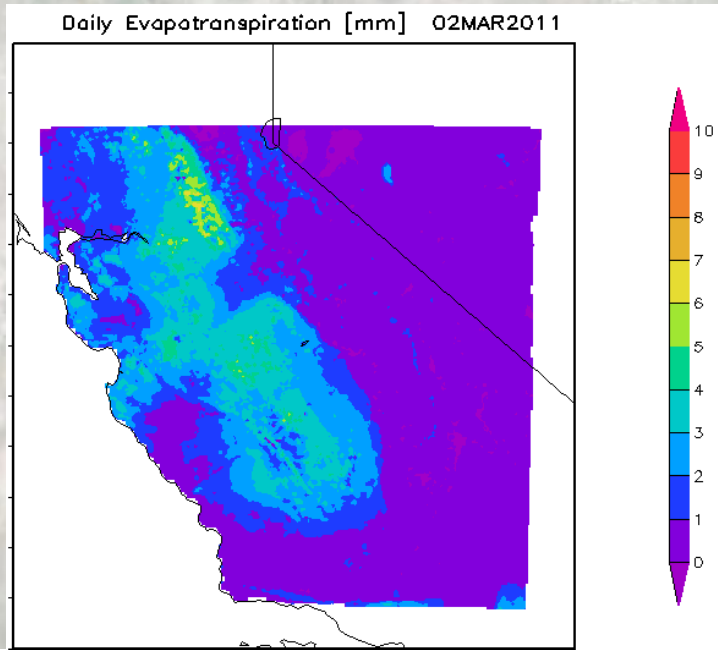


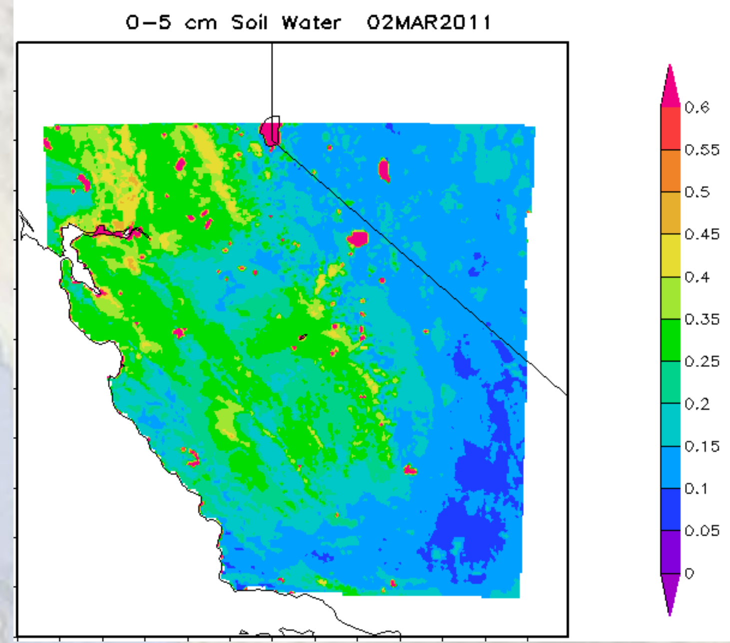

**Soil Temperature**



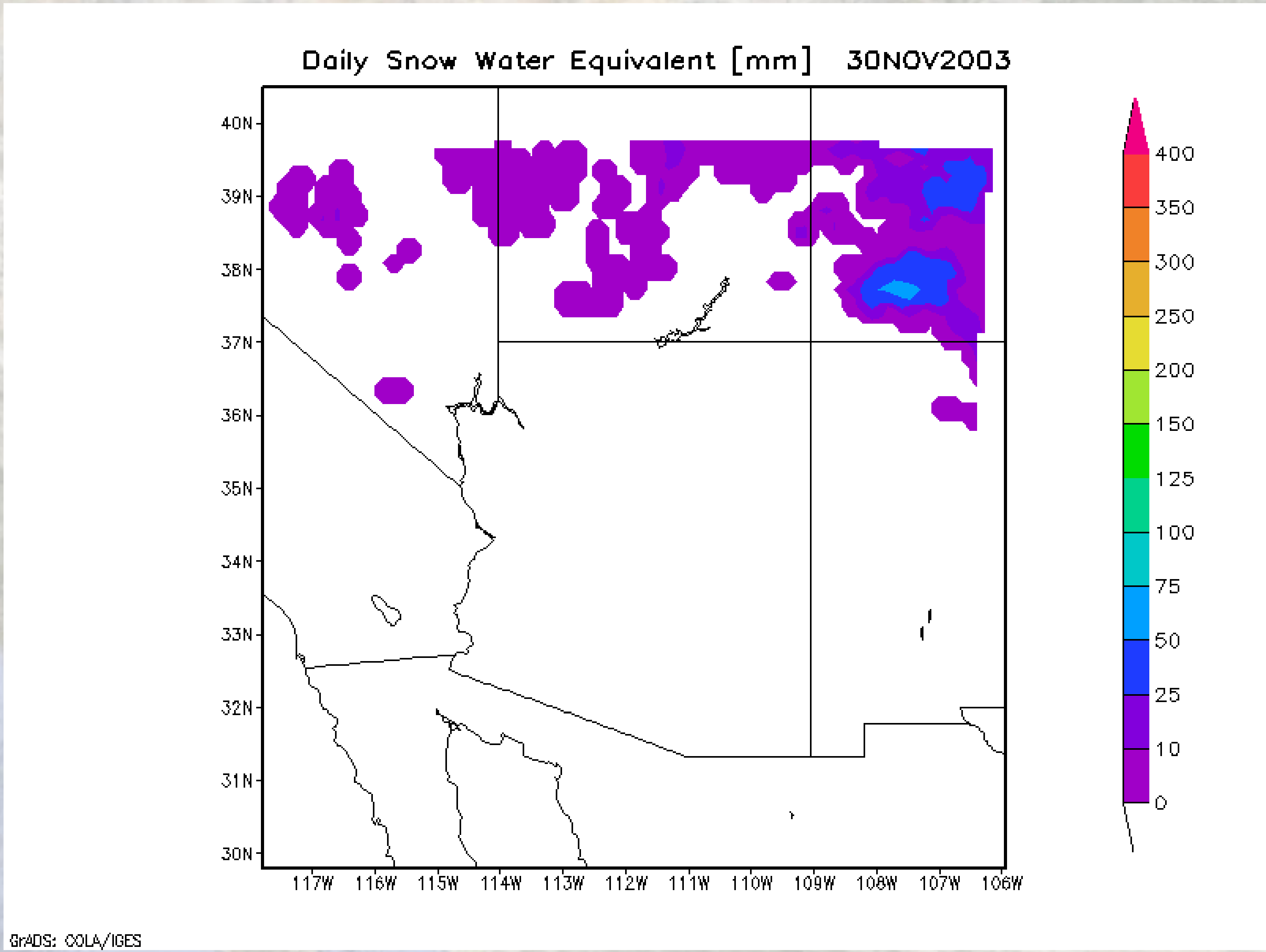
# Precip, Soil Water, ET



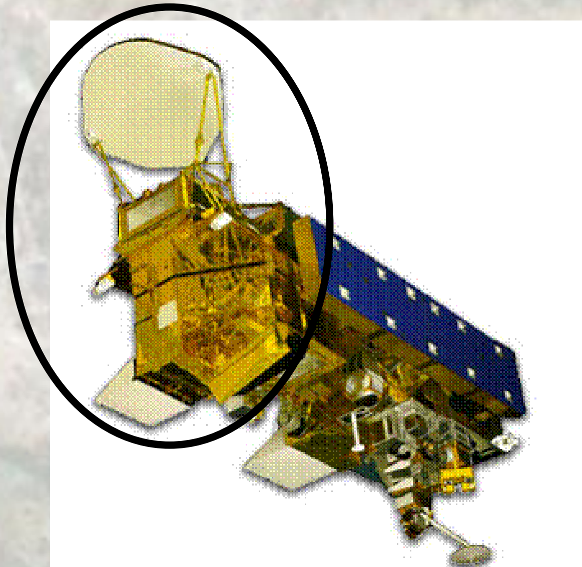



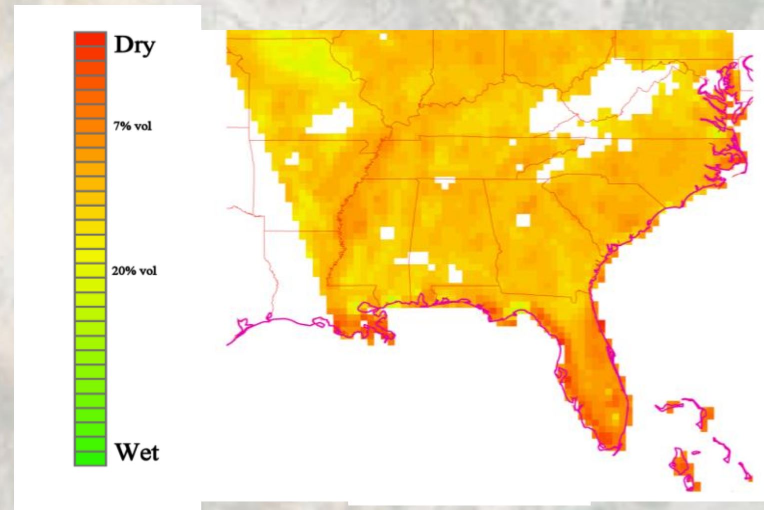
# Snow Water Equivalent



# Soil Moisture Data Assimilation



NASA Aqua satellite with AMSR-E instrument




*AMSR-E retrieved soil moisture for August 2, 2008 over the SE US*

•Satellite sensors such as AMSR-E and SMOS provide daily global estimates of near-surface soil moisture

- •~25 km resolution
- •~4% absolute accuracy
- •Works best in sparsely-vegetated regions

•**Data assimilation** is a technique to combine model variables with observations

- • Used to improve model estimates of surface hydrology (soil moisture, evapotranspiration, streamflow)

# Potential Applications

- Agriculture (irrigation demand)
- Characterizing fluxes of energy and water
- Improved weather forecasting (coupled with weather model)
- Climate change studies (coupled with climate model)
- Flood/drought impact assessment
  - Forecast or Simulation