Advancing the Effectiveness and Efficiency of GLDAS Assimilation of JPSS Land Data Products for NCEP NWP and Drought Monitoring Operations

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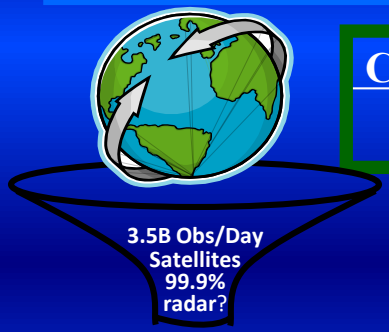
OUTLINE

- GLDAS & SMOPS
- Conventional vs Alternative EnKF DA
- Dual-pass DA Preliminary Test
- Project Plan

Noah(-MP) Land Model Connections in NOAA's NWS Model Production Suite



Climate Forecast System (CFS)
MOM4/GFS/GLDAS/Sea-Ice

Global Data Assimilation

Regional Data Assimilation

GFS/ FV3GFS

Global Ensemble Forecast System (GEFS)

North American Ensemble Forecast System
GFS, Canadian Global Model

Hurricane
HWRF, HMON

2-way coupled

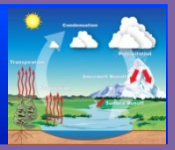
Regional NAM
NMMB

Short-Range Ensemble Forecast
WRF-ARW, NMMB

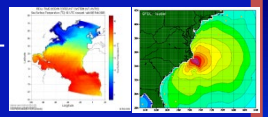
RCDAS/NARR
Eta

NLDAS (Uncoupled) (drought/flooding)

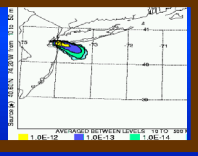
Nat. Water Model



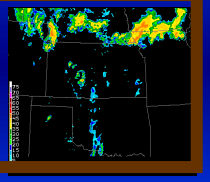
Oceans
HYCOM
WaveWatch III



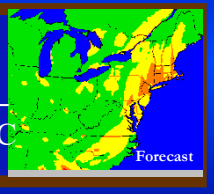
Dispersion
ARL/HYSPLIT



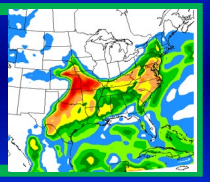
Severe Weather
HREF/HIRESW
(ARW & NMMB)



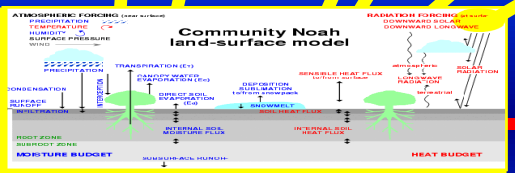
Atmospheric Composition
NMMB/CMAQ/NGAC



RAP/HRRR
(ARW-based)
/RUC LSM



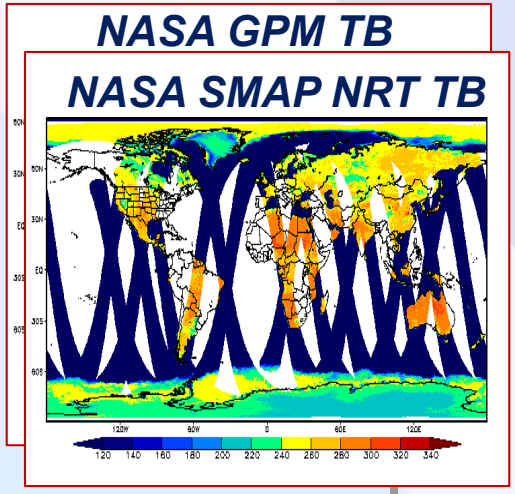
NCEP
NCAR
UT-Austin
U. Ariz.
& others

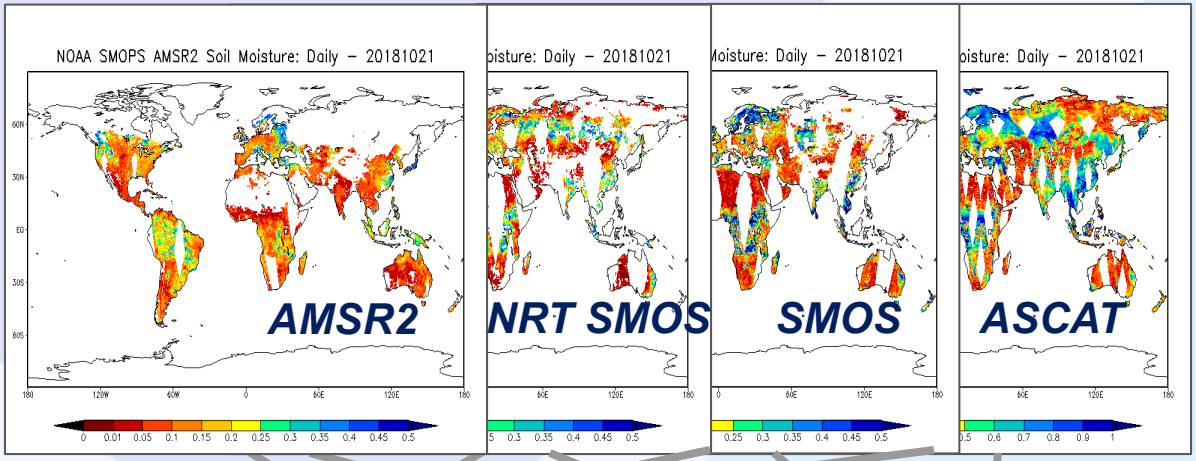


NOAH(-MP) Land Surface Model

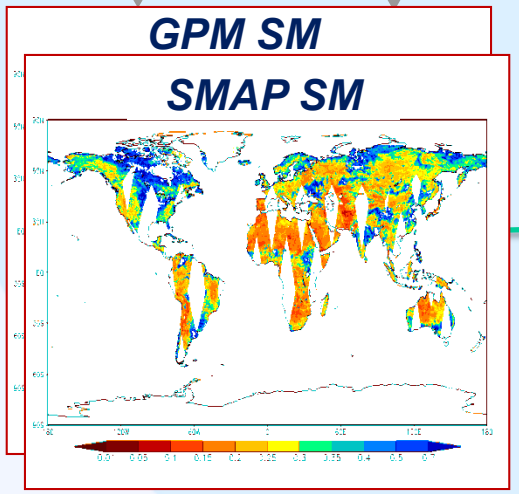
Soil Moisture Operational Product System

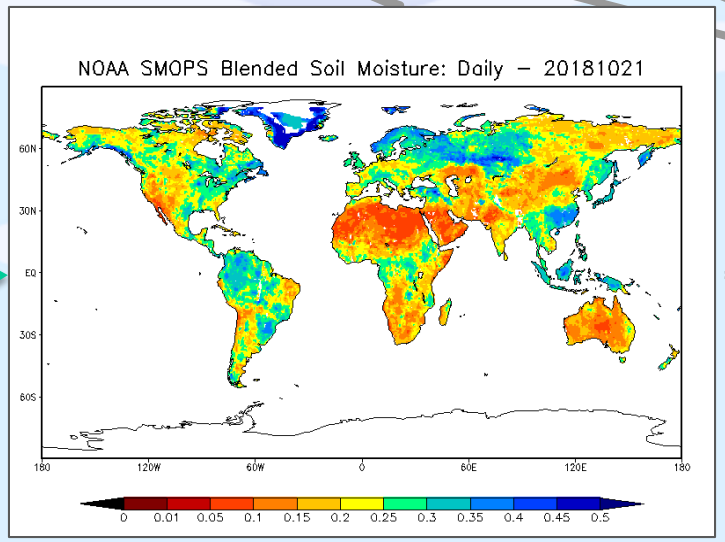
SMOPS 3.0





NOAA Ancillary Data



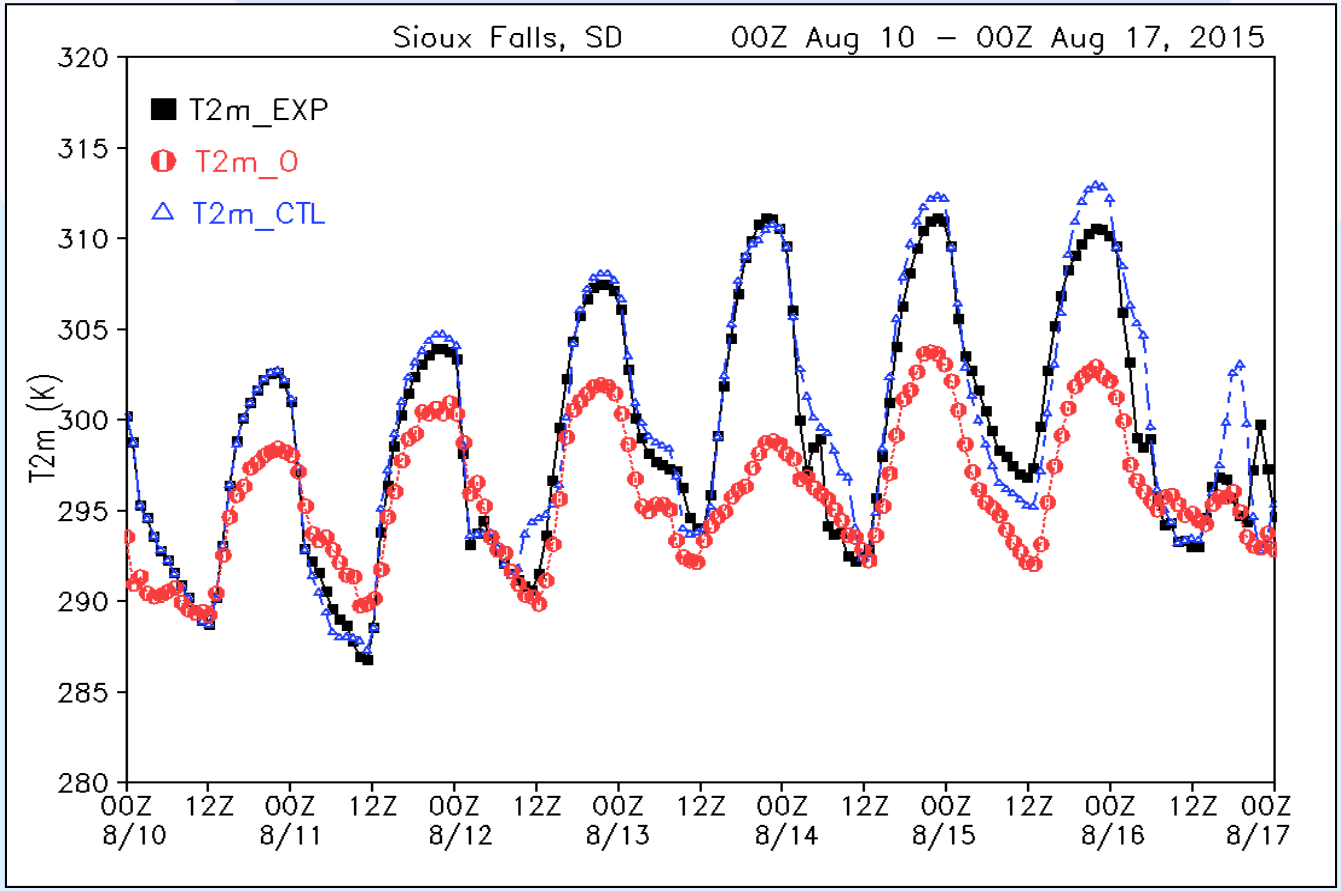


NWP models
NCEP
GFS/NAM
NLDAS/GLDAS
AFWA, etc

SMOPS products have been or will be used in numerical weather predictions at NCEP and AFWA, world crop productivity forecasts at USDA/FAS, and in water predictions at NWC

Assimilation of SMOPS SM in NCEP GFS

From W. Zheng



Assimilating SMOPS SM from 8/1 – 8/10/2015 Reduces the daytime warm biases of NCEP GFS four (4) day forecasts of 2 meter air temperature

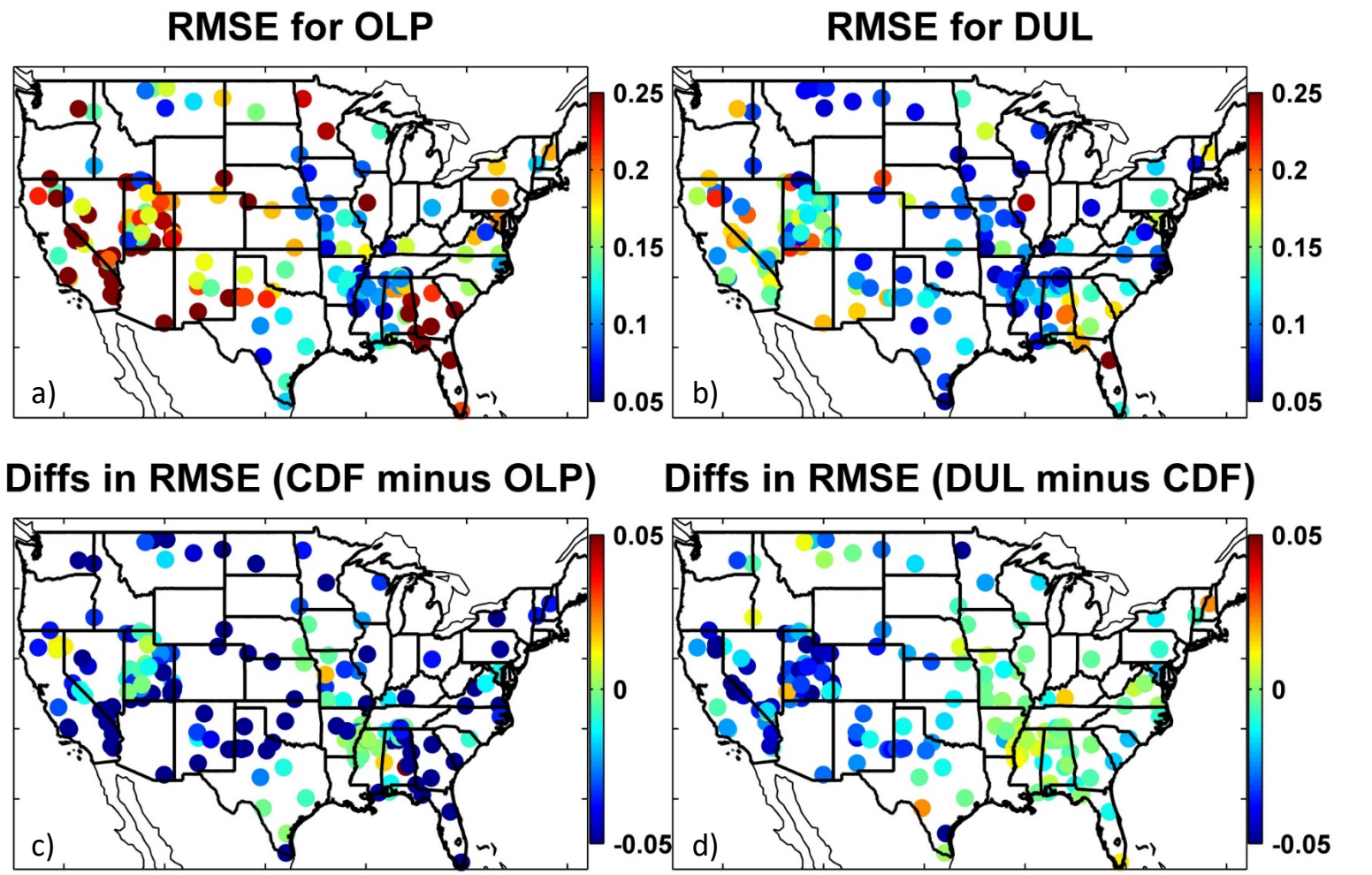
"Conventional" Soil Moisture DA Approach

- Ensemble Kalman Filter (EnKF) mostly implemented with fixed observation variance
- CDF-Matching for observation bias correction required by most EnKF DA practice
- The CDF-Matching observation bias correction process may cause significant observation Information loss (Nearing et al, 2013, 2015, 2018)

Alternative Soil Moisture DA Approach

- Dual-Pass Soil Moisture Data Assimilation (Yang et al, 2007; Tian et al, 2009):
  - Use observation climatology to calibrate model parameters so that model climatology matches observation climatology
  - Apply EnKF to assimilate NRT observations directly to the model without the need of observation bias correction so that the information loss may be avoided

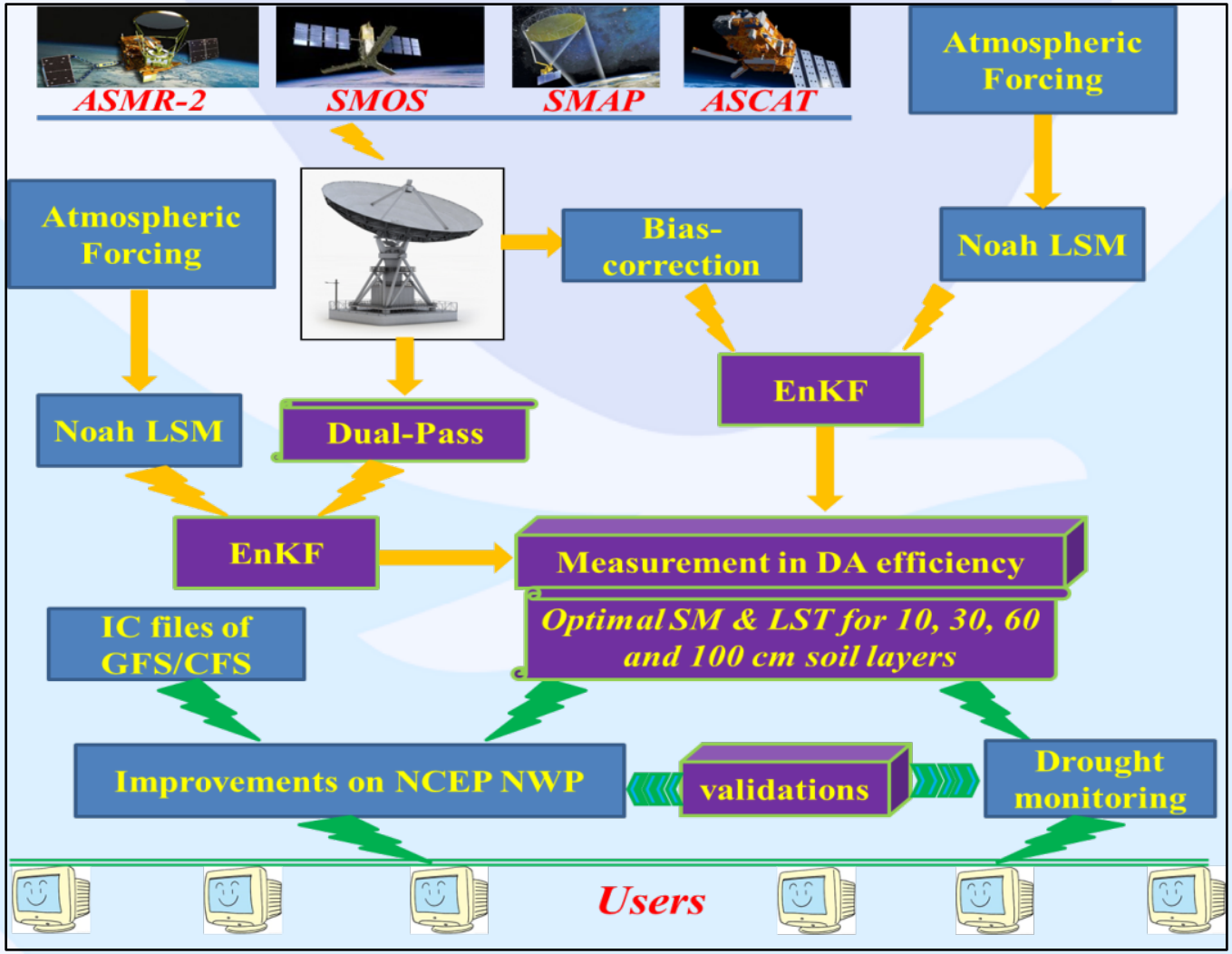
Prelim Result: “Conventional” vs “Dual-Pass”



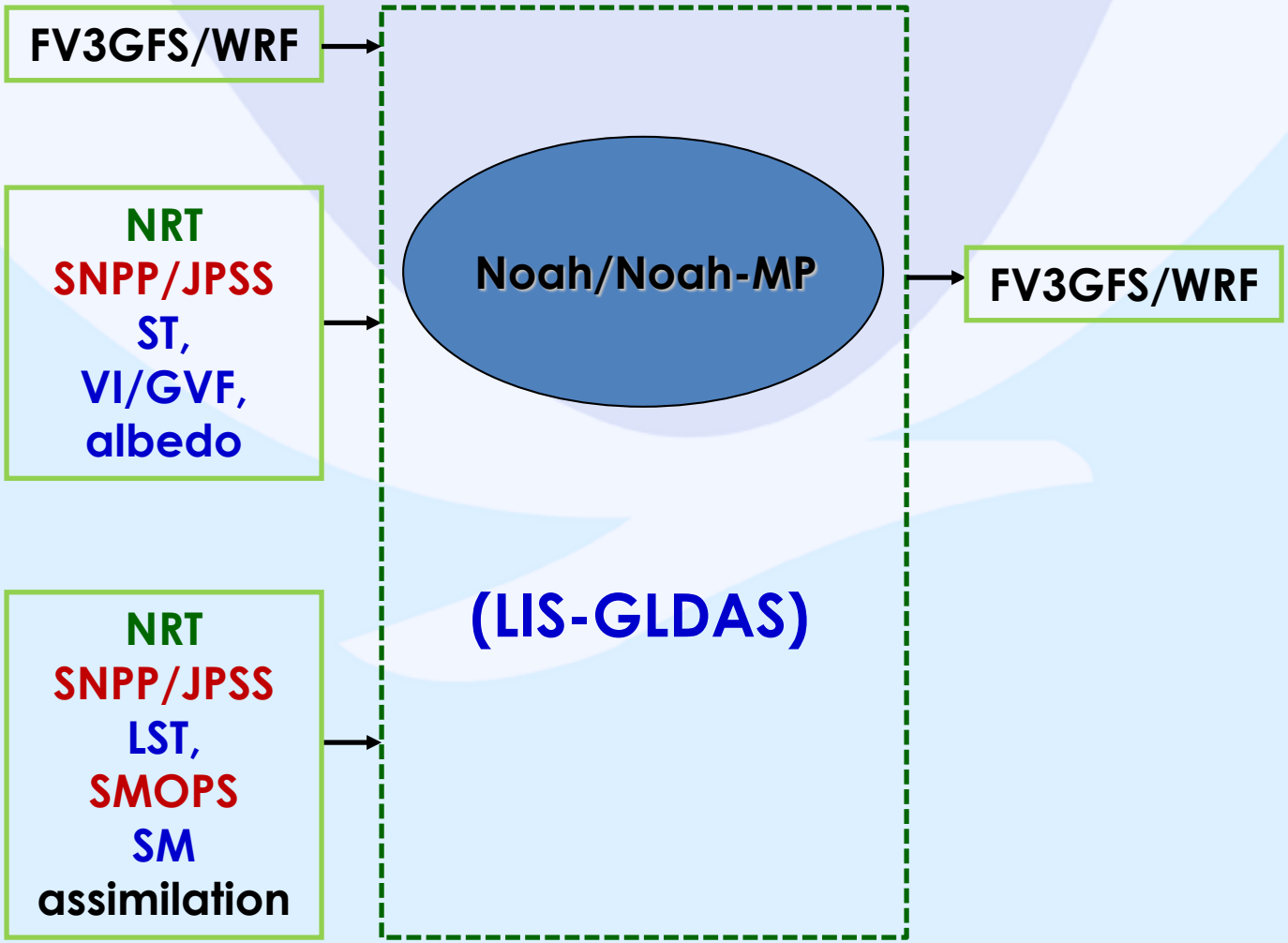
RMSEs of Noah LSM top-layer simulations or assimilations against SCAN measurements:
a) Open-loop; b) Dual-Pass Assimilation; c) Conventional vs Open-loop; d) Dual-Pass vs Conventional.
SMOPS data from April 1, 2015 to March 31, 2018

In c) & d), blue color means improvement and red color indicates degradation

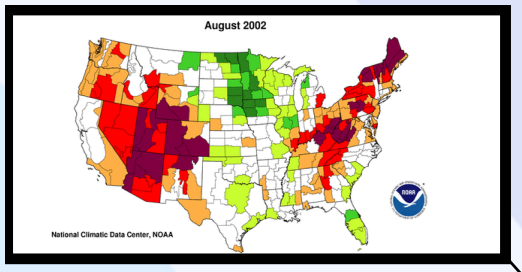
Project Plan: “Conventional” vs “Dual-Pass”



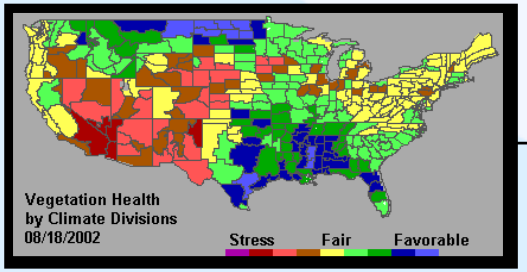
Project Plan: JPSS and Other Sat Data for NWP



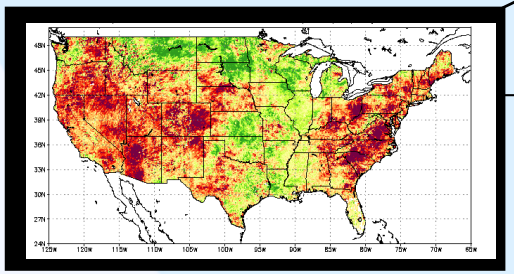
Project Plan: JPSS and Other Sat Data for DM



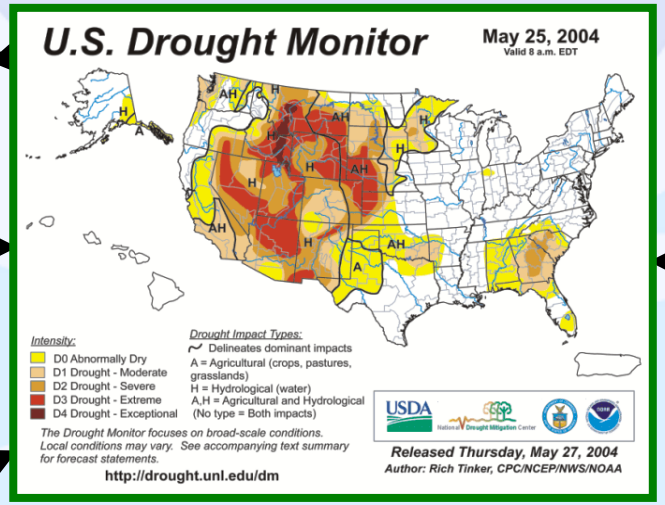
Palmer Drought Index

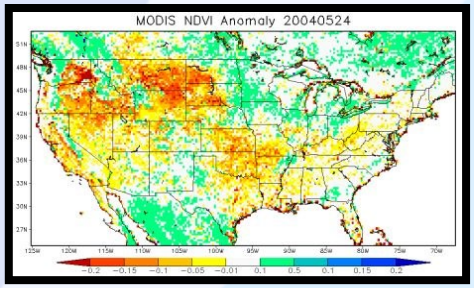


Vegetation Health Index

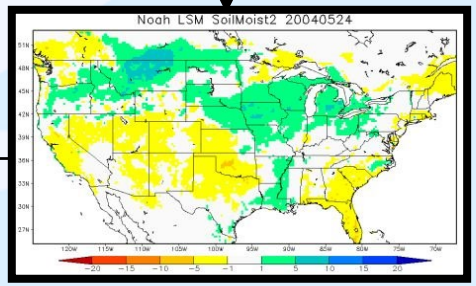


GOES ESI

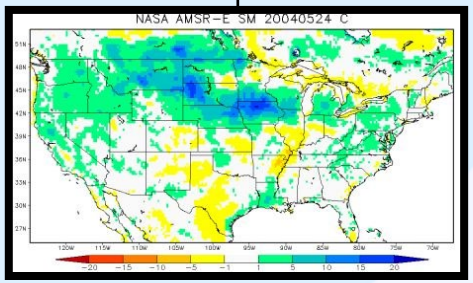




VIIRS ST, Alb, GVF/VI

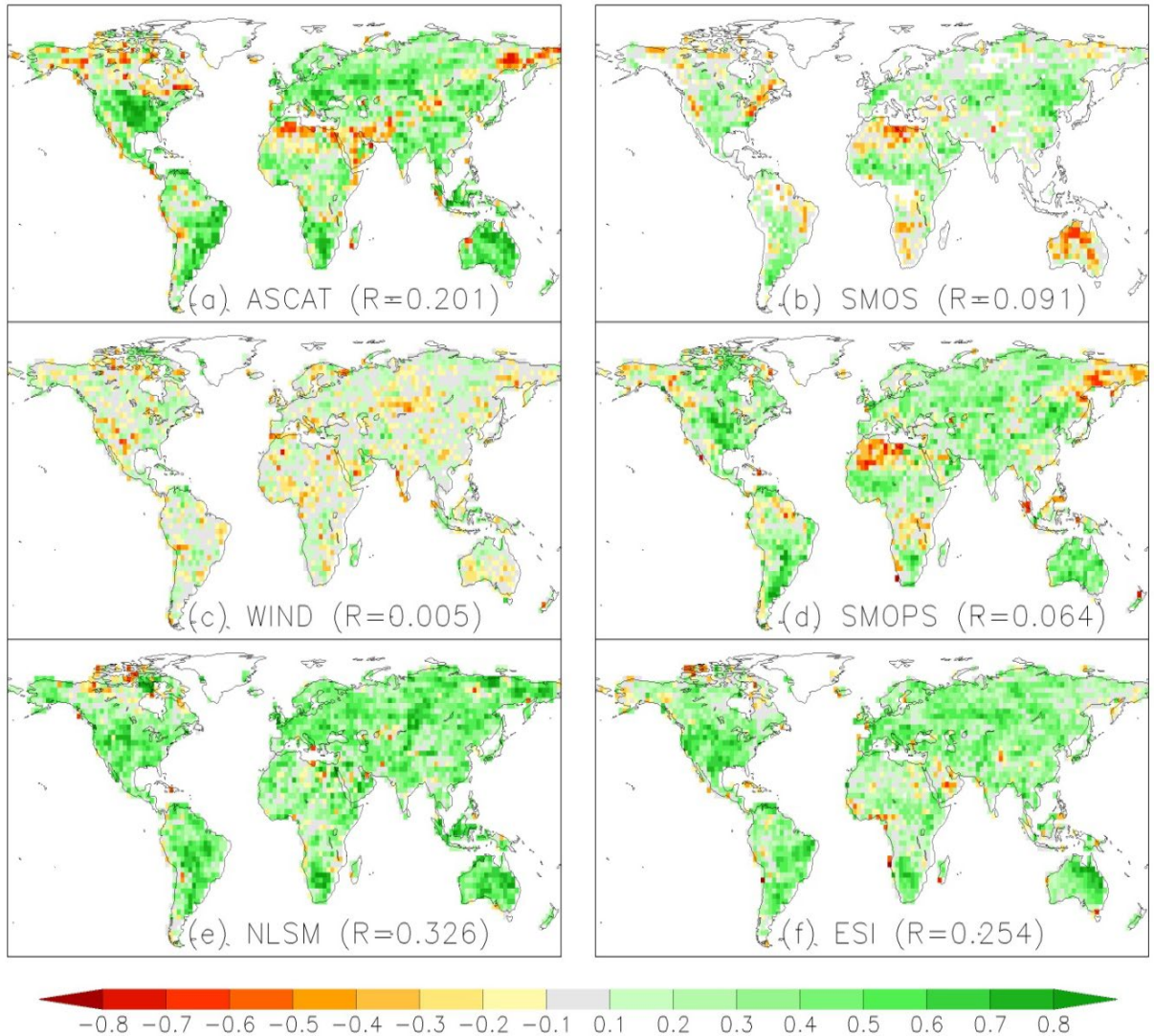


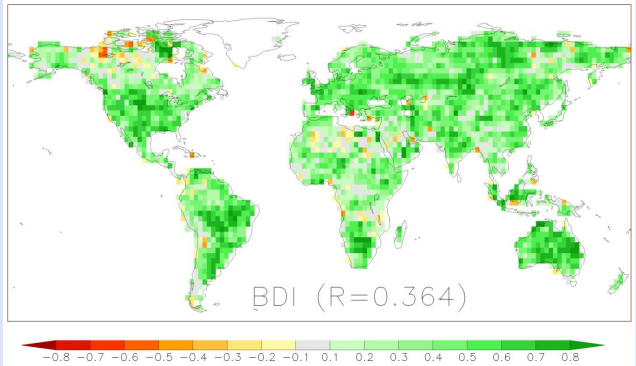
GLDAS SM Output



SMOPS SM

Project Plan: Blended Drought Index (BDI)





Correlation coefficients (R) between PDSI standard anomalies (against 1985-2014 averages) and drought estimations for (a) ASCAT, (b) SMOS, (c) WindSat, (d) SMOPS, (e) NLSM and (f) ESI cases. Grey color indicates insignificant correlation. The Blended Drought Index (BDI) has better correlation than all other data sources

Yin, J., Zhan, X., Hain, C. R., Liu, J., Anderson, M. C. (2018). A method for objectively integrating soil moisture satellite observations and model simulations toward a blended drought index. Water Resources Research, 54. https://doi.org/10.1029/2017WR021959

SUMMARY

- *The MAPP project explores a new strategy (dual-pass approach) of soil moisture data assimilation in LIS version of the Global Land Data Assimilation System*
- *The Dual-Pass DA approach does not require CDF-matching for observation bias correction in order to avoid observation information loss*
- *Preliminary result indicate some advantage of Dual-Pass DA approach*
- *GLDAS soil moisture will be used to initialize NCEP NWP models for NWP impact of SMDA*
- *GLDAS soil moisture will be directly used or blended for drought monitoring*

MAPP
Modeling, Analysis, Predictions, and Projections

JPSS NOAA NASA

Thanks for your listening!

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