

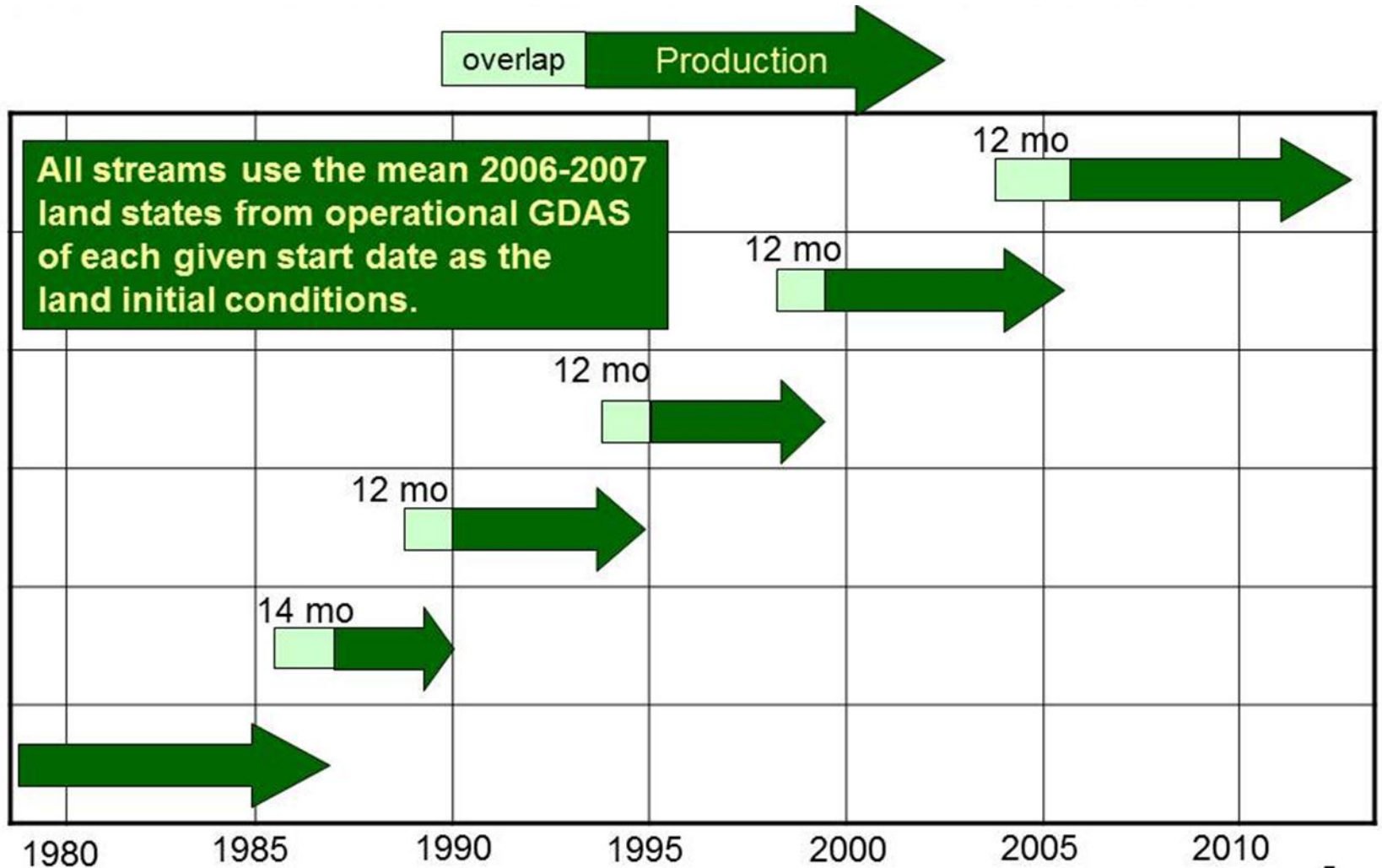


A Retrospective GLDAS for Improved Global Land Surface Climatology

Jesse Meng, **Michael Ek***, Youlong Xia,
Jiarui Dong, Helin Wei, and Rongqian Yang
NOAA/NCEP/EMC

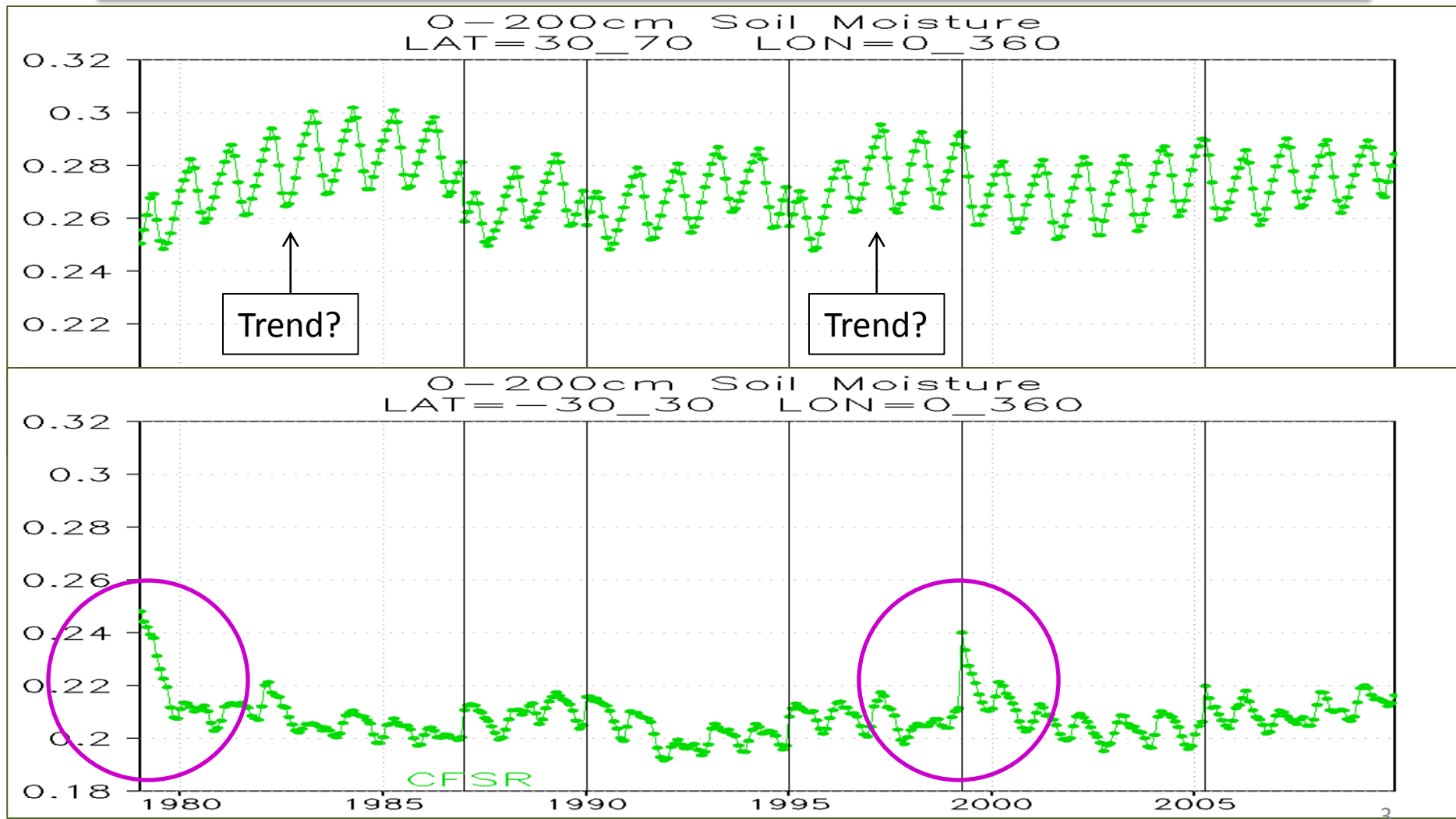
Background

CFSR runs 6 simultaneous streams and the land surface may not have sufficient spin-up.



Background

Over the northern hemisphere (top) and the tropics (bottom), the CFSR soil moisture time series may have trends and discontinuity.



Proposed Solution

Retrospective one-stream GLDAS

- Configuration: Same as CFSR (LIS, T382, 38km, 1979-realtime).
- Forcing: CFSR surface forcing and blended precip forcing.
- Initial condition: Spin up land states for 1 January, 1979.
- Spin up: 1978 went from weak warm ENSO to neutral, with a similar condition, 2003 was selected for spin up. Start with CFSR land states of 1 January, 2003, execute 5-year recursive spin up with 2003 forcing, then another 5-year recursive spin up with 1979 forcing.

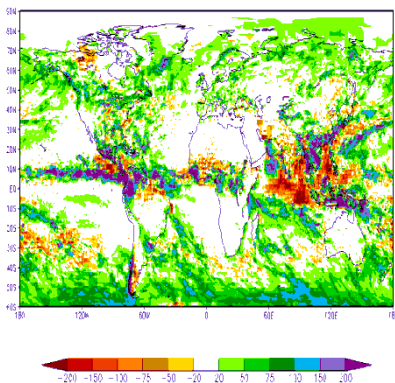


The NCEP GLDAS/LIS

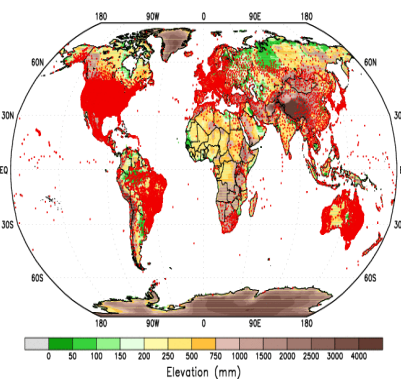
GLDAS (running Noah LSM under NASA/Land Information System) forced with CFSv2/*GDAS* atmospheric data assimilation output and blended precipitation in a semi-coupled mode, versus no GLDAS in CFSv1, where CFSv2/**GLDAS** ingested into CFSv2/*GDAS* once every 24-hours.

In CFSv2/**GLDAS**, blended precipitation a function of satellite (CMAP; heaviest weight in tropics where gauges are sparse and satellite observation is more accurate), surface gauge (heaviest in middle latitudes where most of the gauges locate) and *GDAS* (modeled; high latitude where gauges are sparse and satellite observation lacks of accuracy), vs in CFSv1 use of model precipitation comparison with CMAP product and corresponding adjustment to soil moisture.

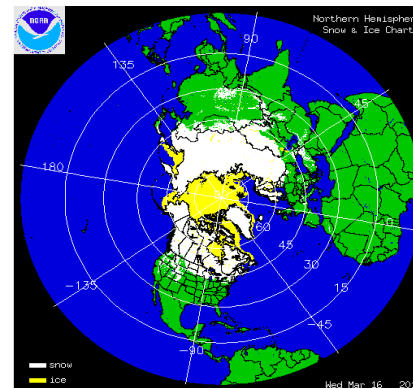
Snow cycled in CFSv2/**GLDAS** if model within 0.5x to 2.0x of the observed value (IMS snow cover, and AFWA snow depth products), else adjusted to 0.5 or 2.0 of observed value.



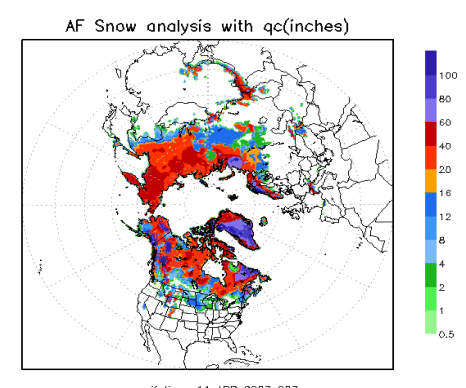
GDAS-CMAP precip



Gauge locations



IMS snow cover



*AFWA snow depth*⁵

Land Information System

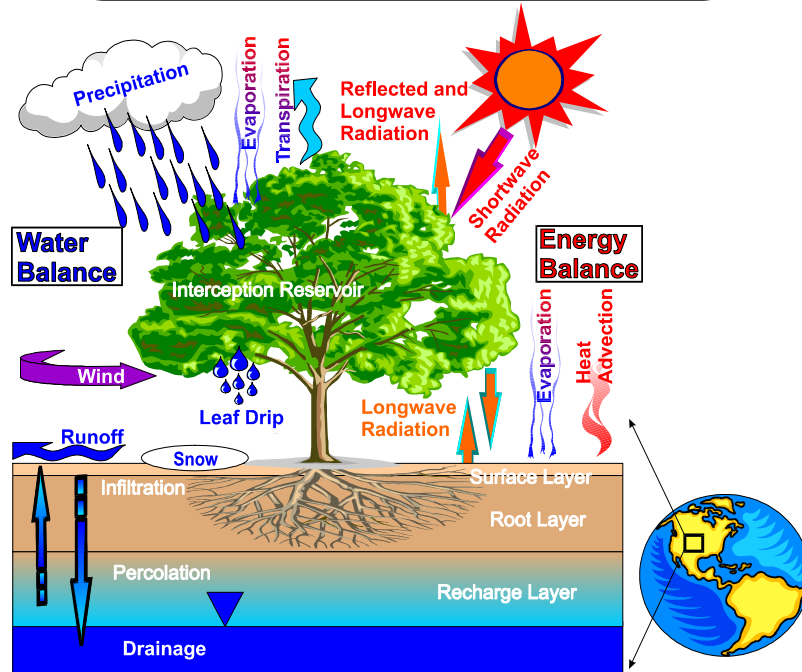
Land Surface Characteristics
 Topography
 Land Cover
 Soil

Precipitation Forcing

Non-precip Meteorological Forcing

Land Variables
 Soil Moisture
 Soil Temperature
 Snow

Noah LSM



Output

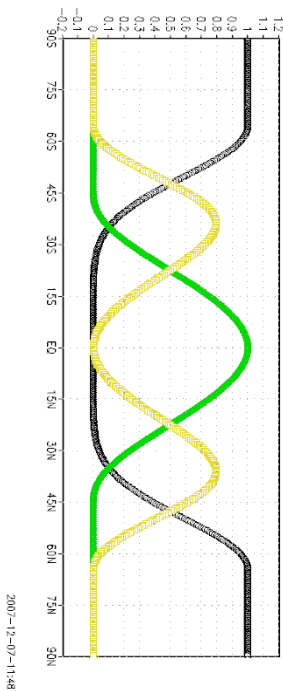
Soil Moisture
Soil Temperature
Snow
Precip
ET
Runoff

Applications

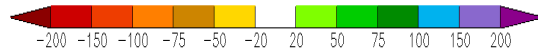
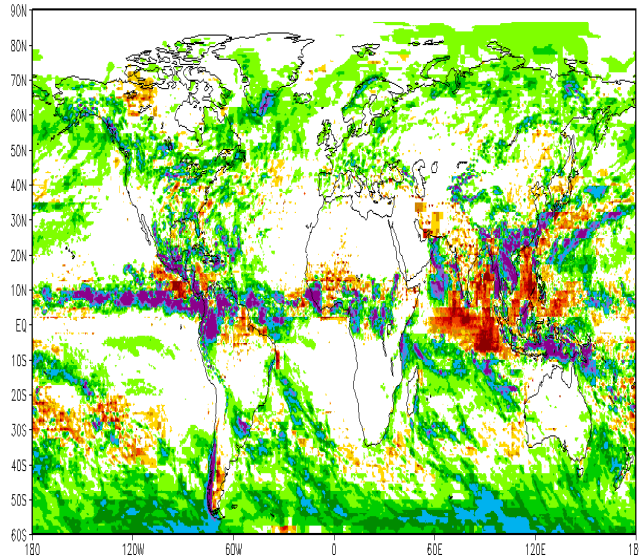
Weather
Climate
Drought
Agriculture
Water Resource

GLDAS/LIS Precip Forcing

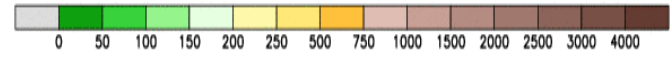
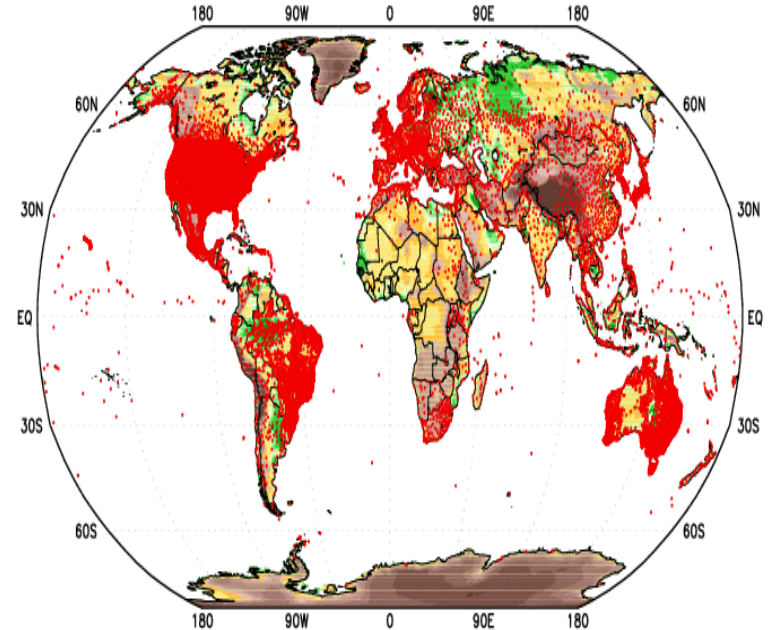
GDAS GAUGE CMAP



Precip Diff CFS-CMAP



Precip Gauge locations



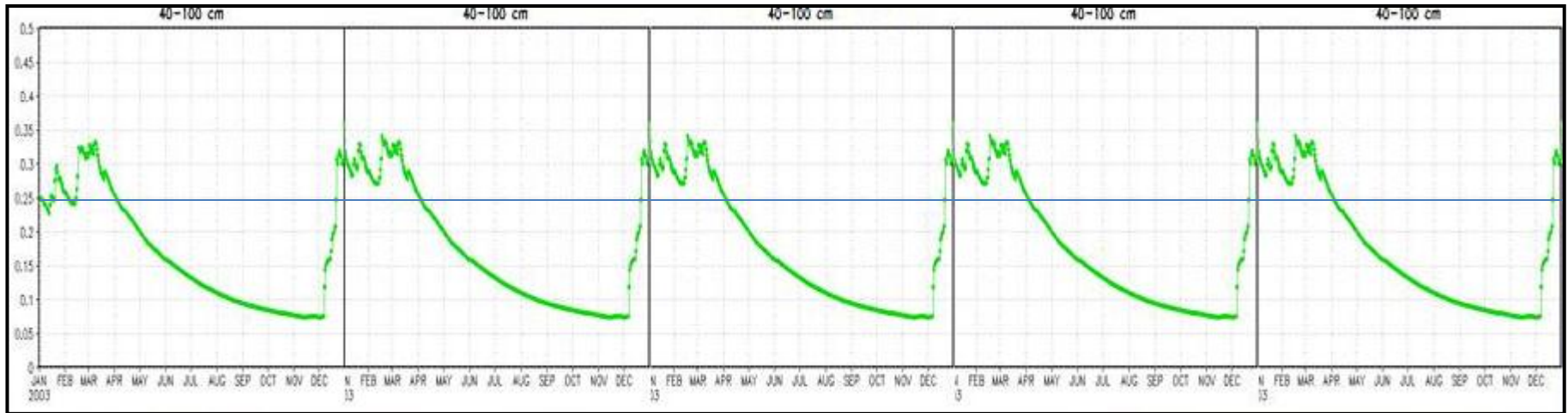
A blended precip forcing is used in GLDAS with the heavier weights of CFS/GDAS – high latitudes
 Gauge – mid latitudes
 CMAP – tropics.

CMAP and gauge precip products supported by Pingping Xie, NOAA/NCEP/CPC.

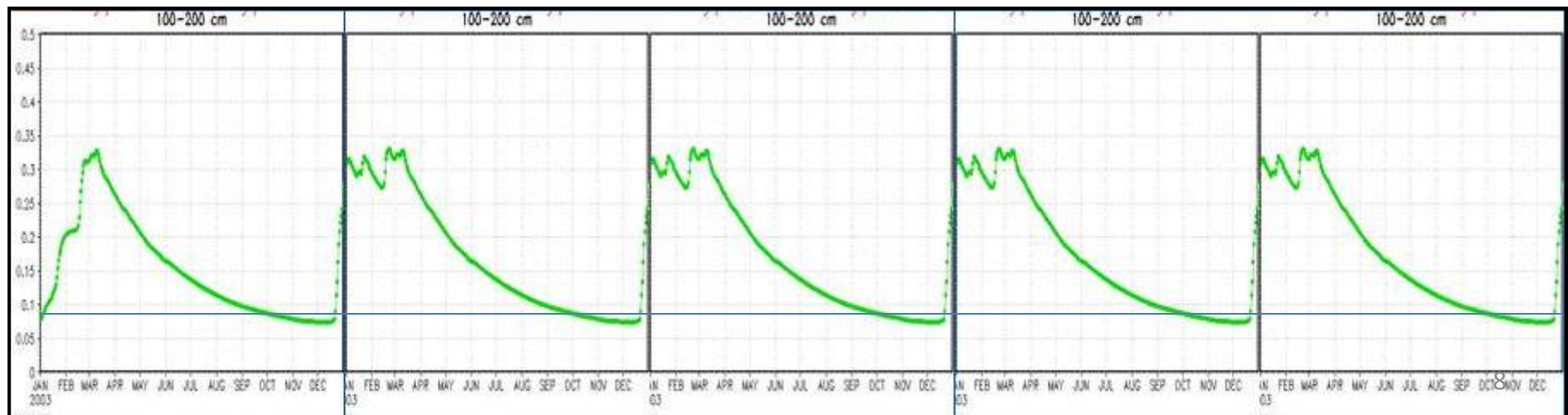
Soil Moisture Spin up Darwin savanna



40-100cm



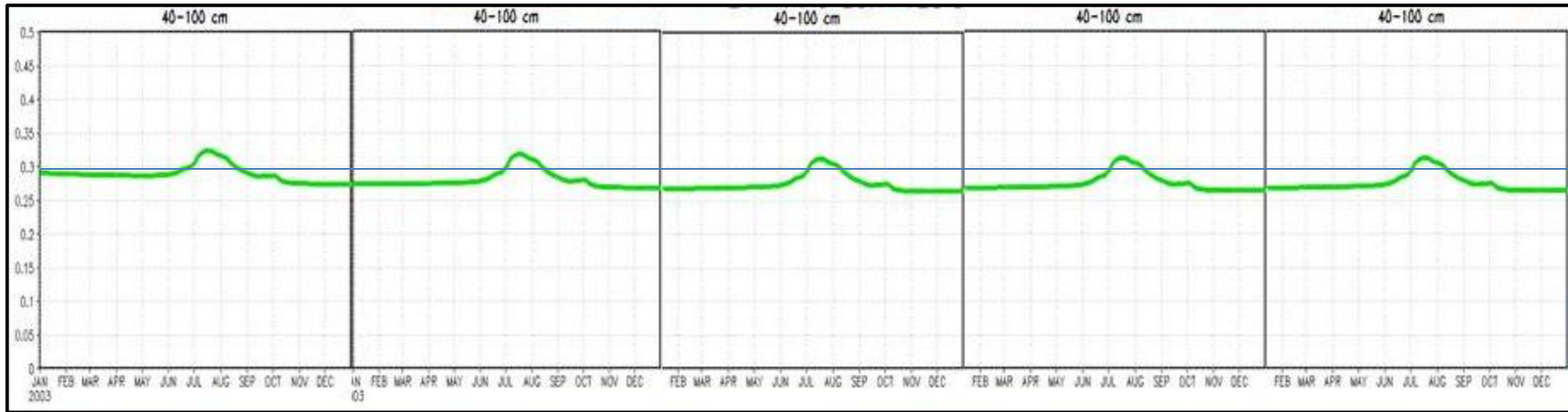
100-200cm



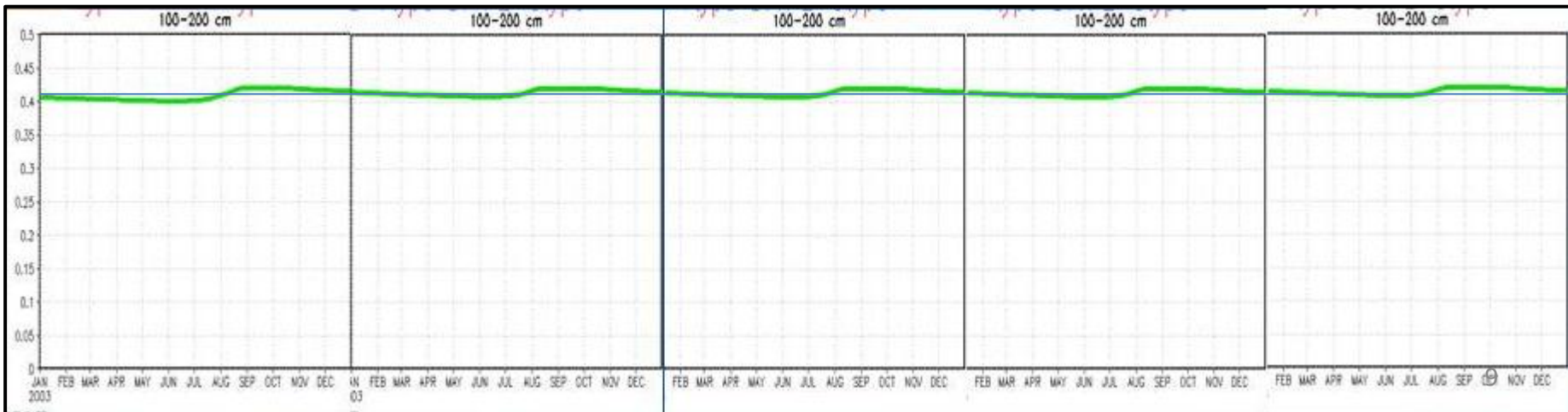
Soil Moisture Spin up Eastern Siberia tundra



40-100cm



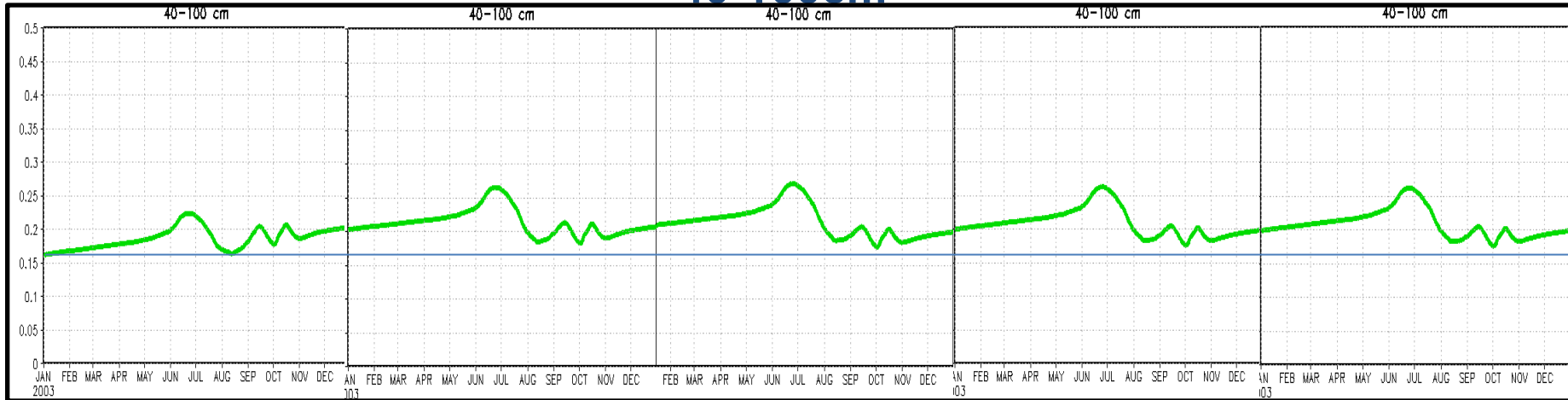
100-200cm



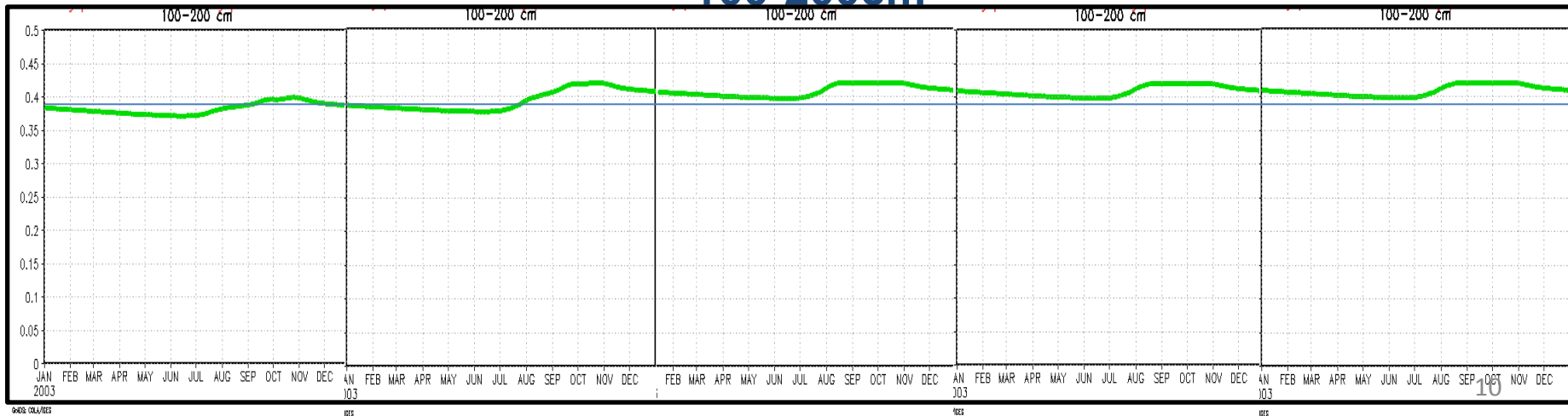
Soil Moisture Spin up Alaska needleleaf



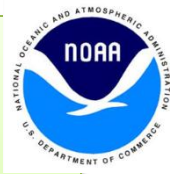
40-100cm



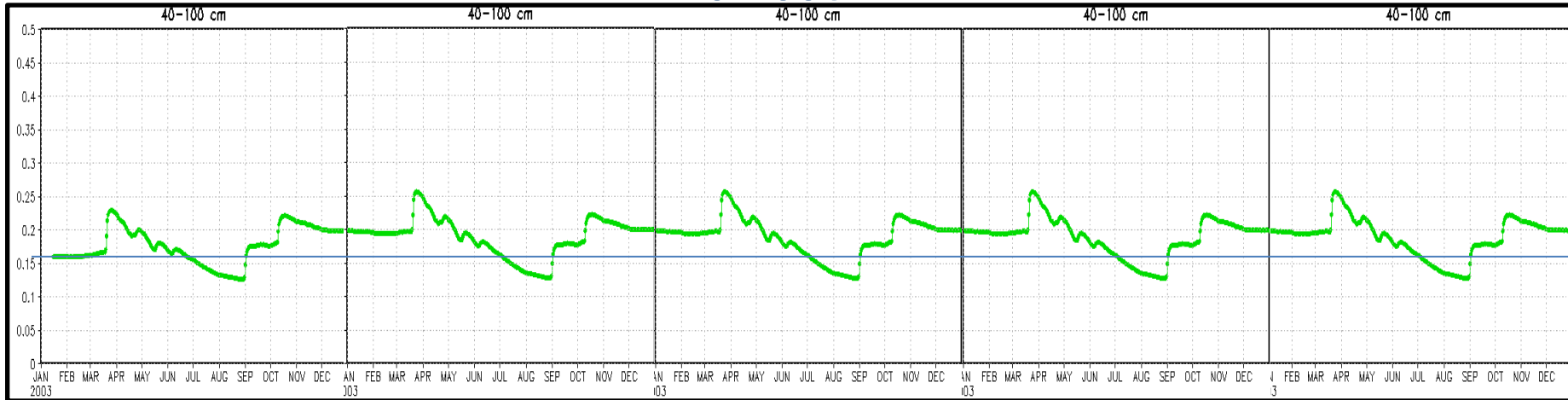
100-200cm



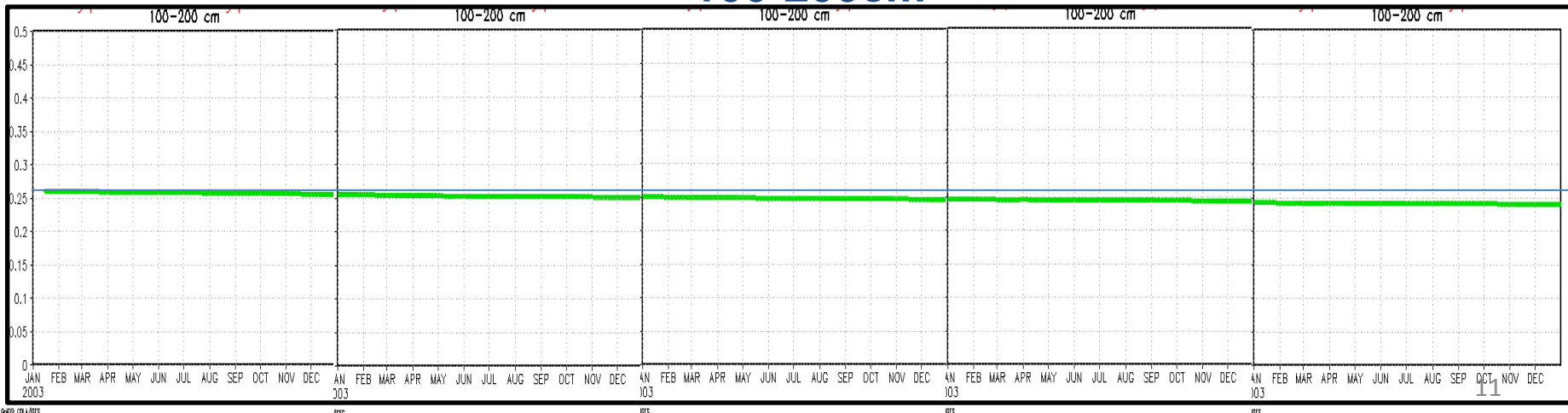
Soil Moisture Spin up Oklahoma grass



40-100cm

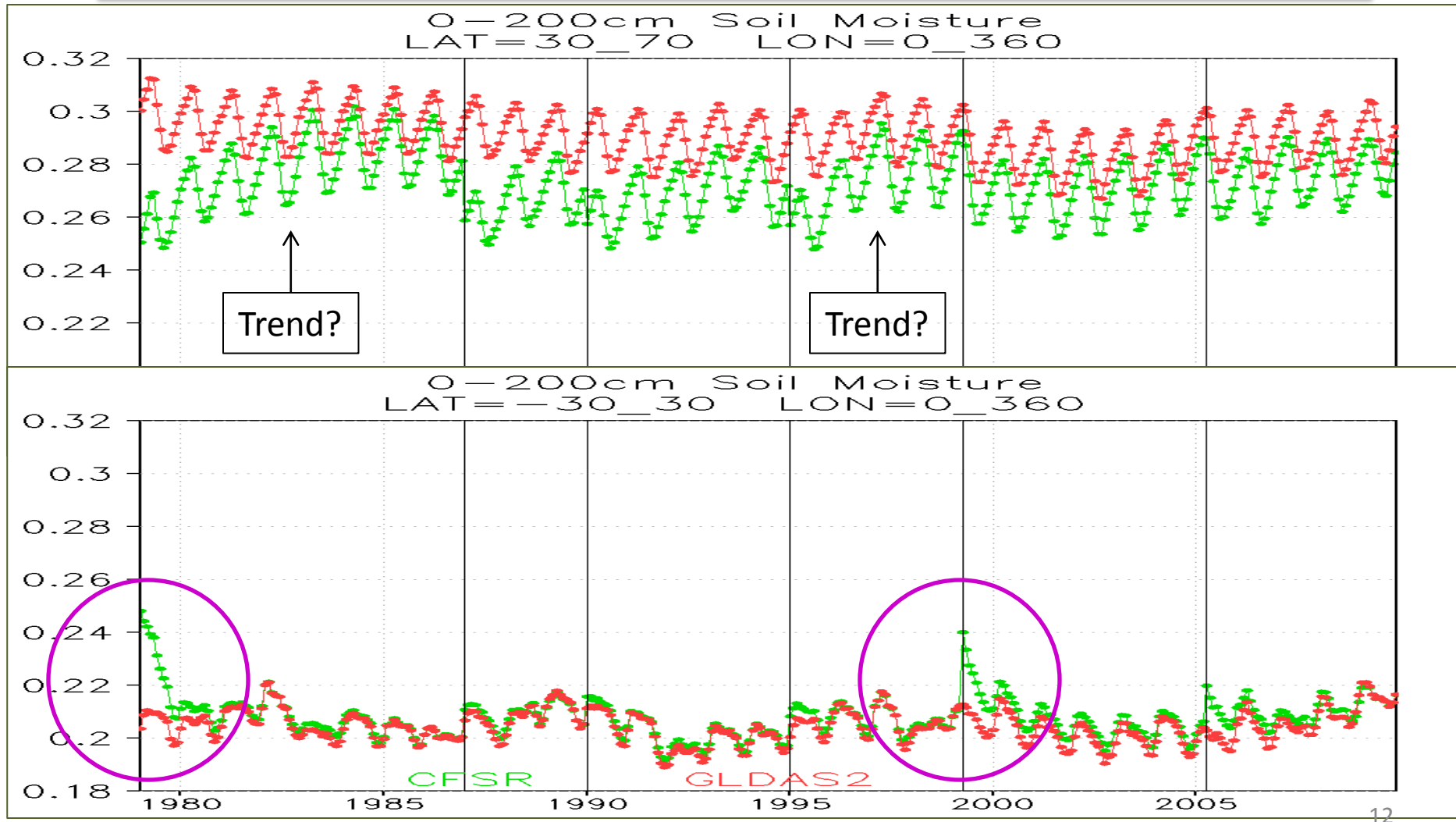


100-200cm



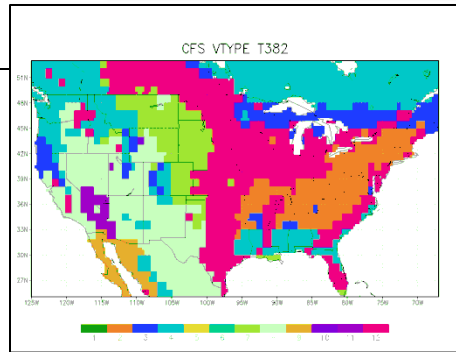
Results

The questionable trends and discontinuity in the CFSR (green) soil moisture are improved in GLDAS2 (red).

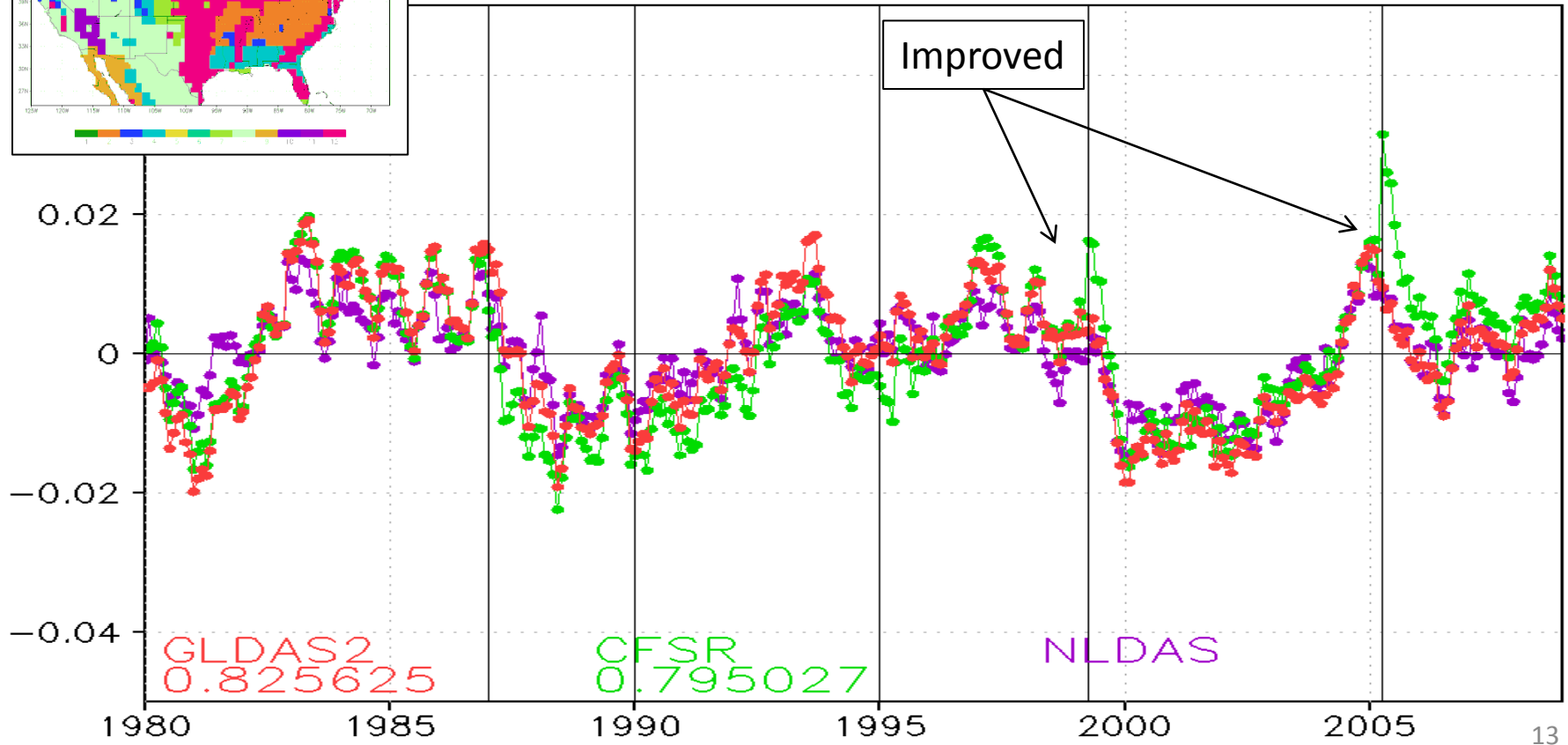


Results

Averaged over CONUS, the soil moisture anomaly correlation between GLDAS2 and NLDAS shows an improvement over CFSR, increased from 0.795 to 0.825.

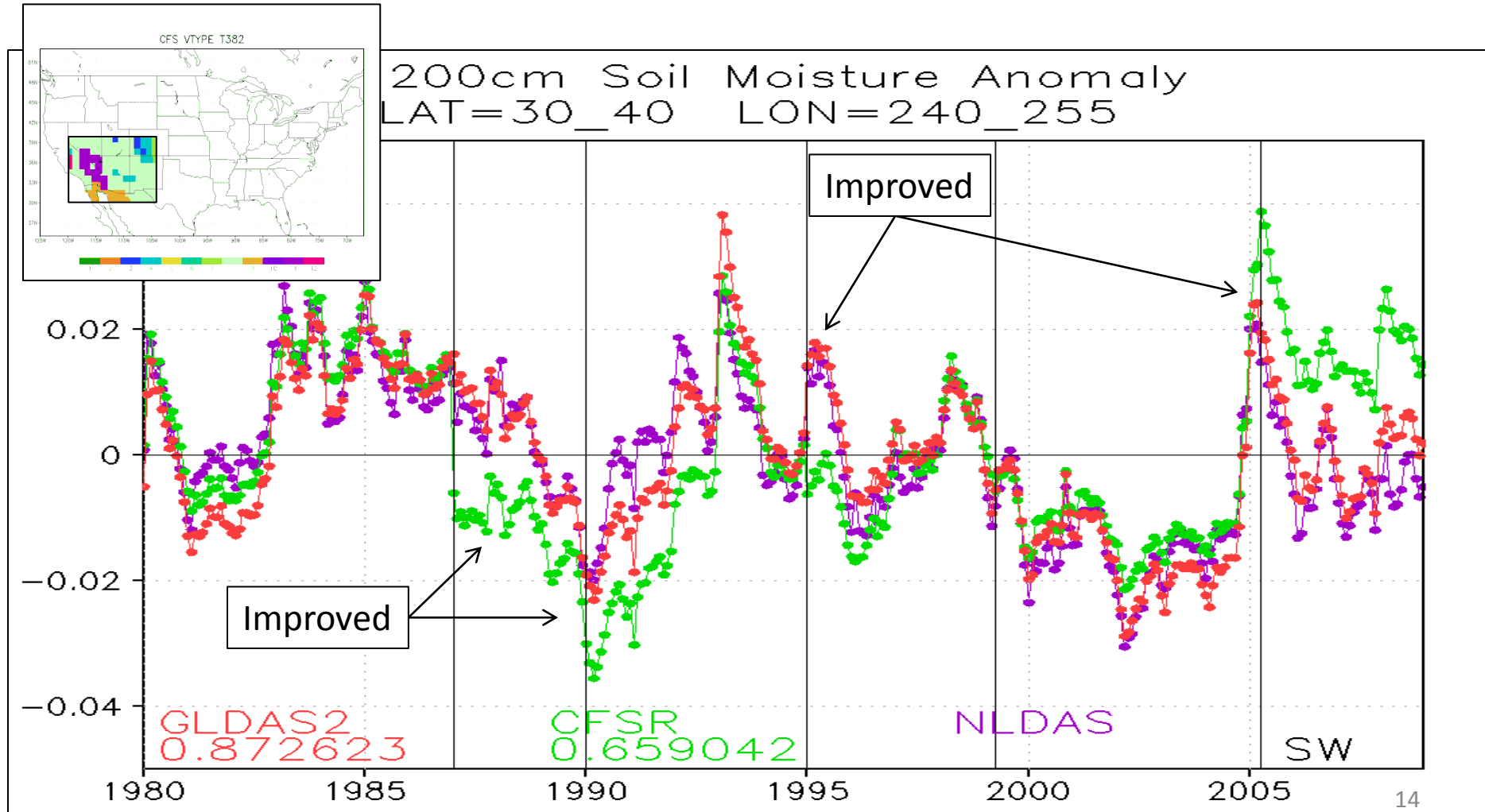


200cm Soil Moisture Anomaly
LAT=25_53 LON=235_293



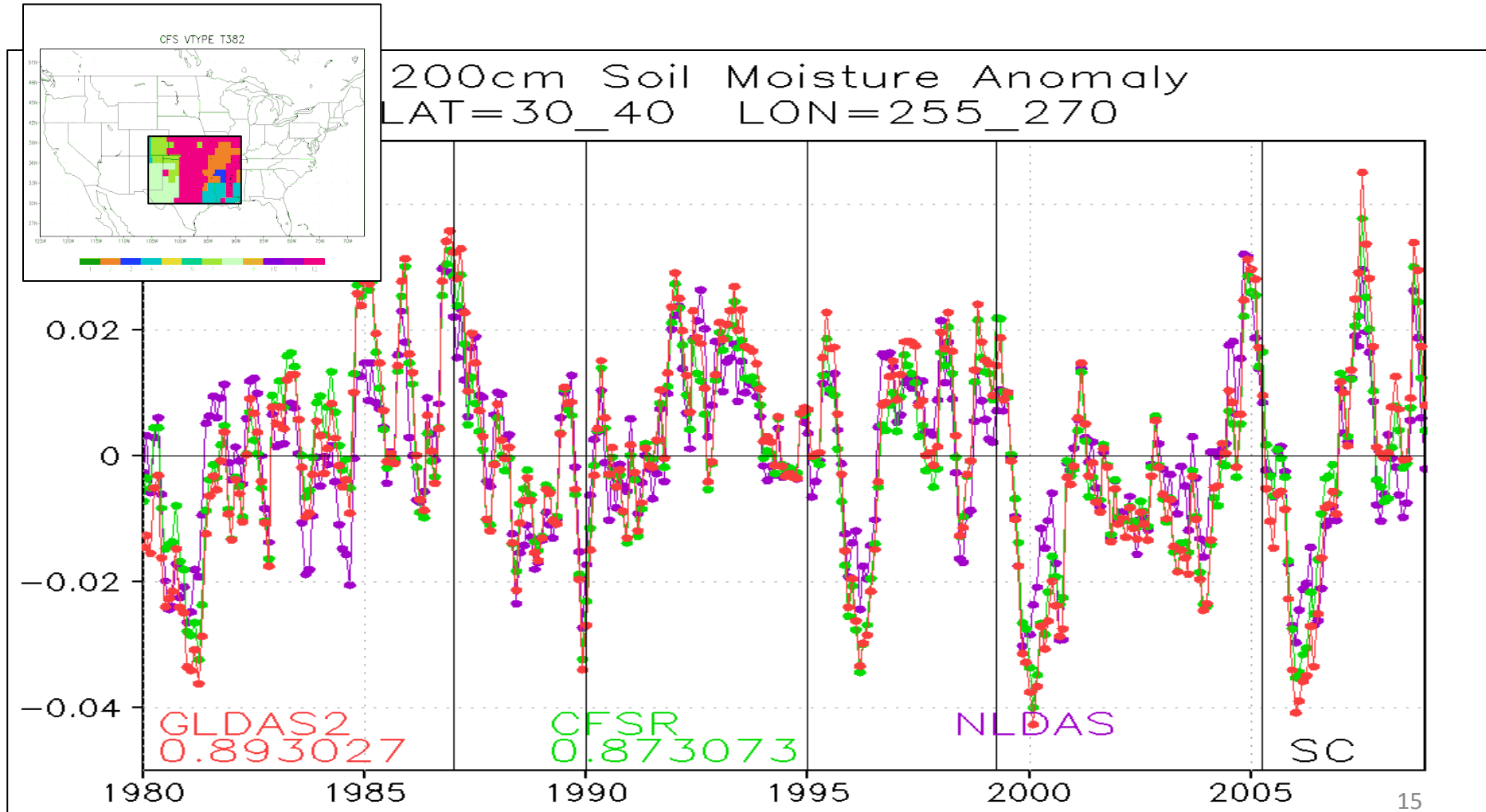
Results

The more pronounced improvement falls in SW CONUS (sparse vegetation cover, longer spin-up required), the soil moisture anomaly correlation increased from 0.659 to 0.872.



Results

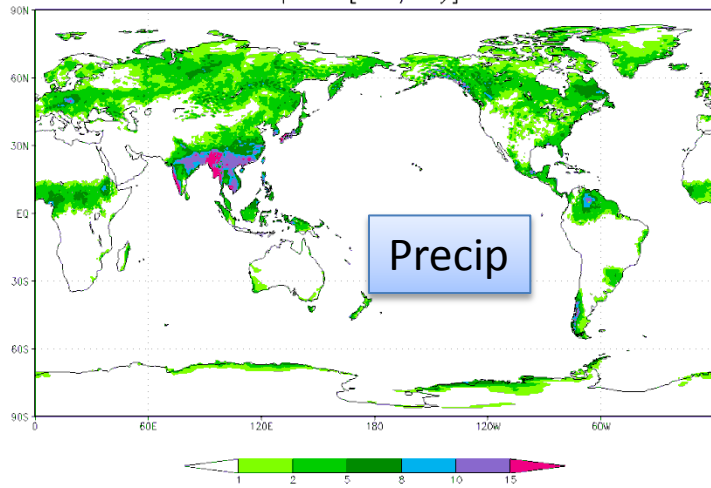
In the vegetated region where spin-up can be reached faster, CFSR already performs well and GLDAS2 still shows a slight improvement (from 0.873 to 0.893).



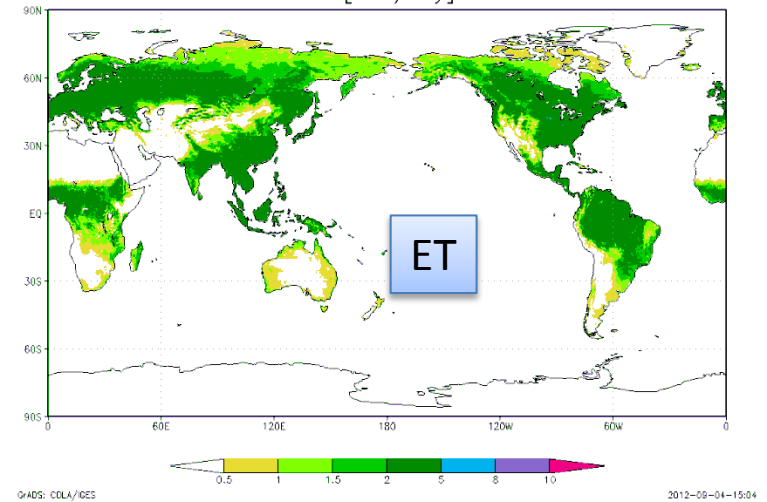
Results

GLDAS2 land surface water budget July 1997

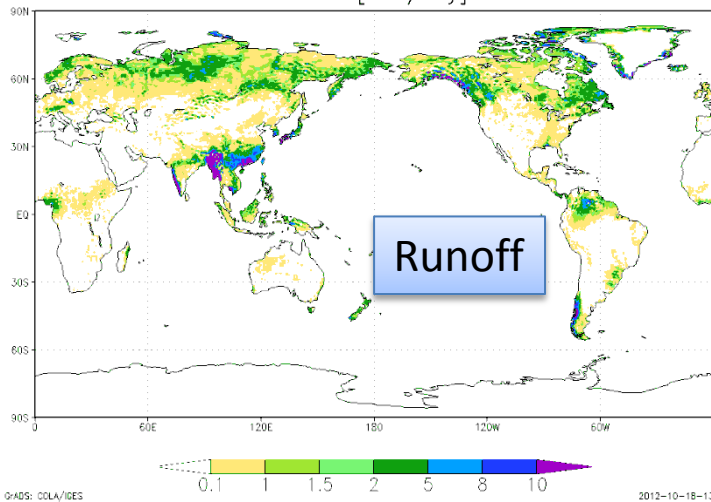
GLDAS2.prate [mm/day] 199707



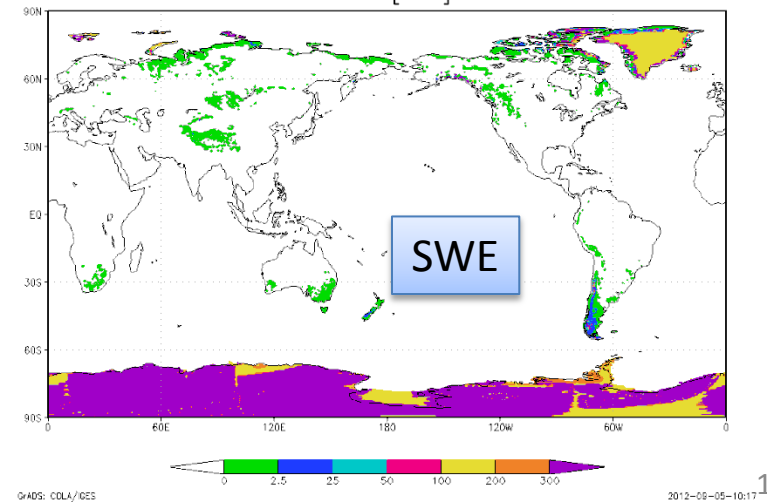
GLDAS2.et [mm/day] 199707



GLDAS2 Runoff [mm/day] Jul1997



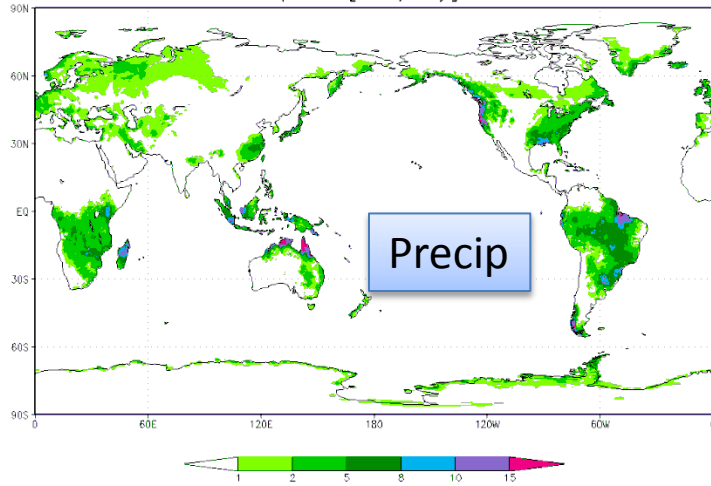
GLDAS2.weasd [mm] 199707



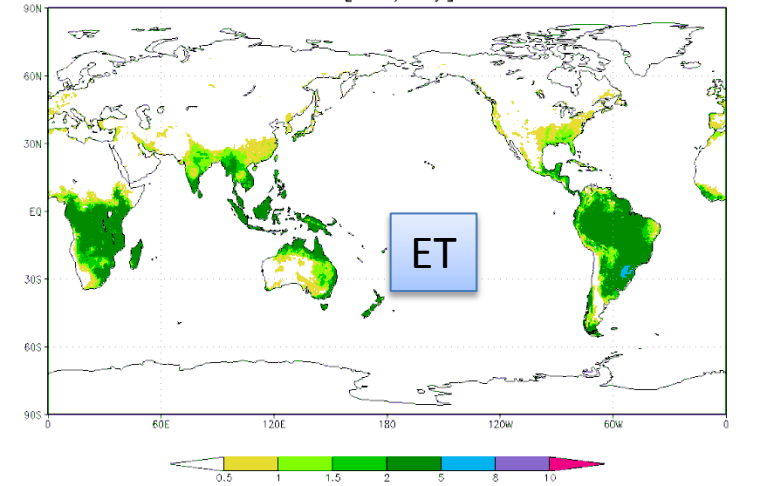
Results

GLDAS2 land surface water budget January 1998

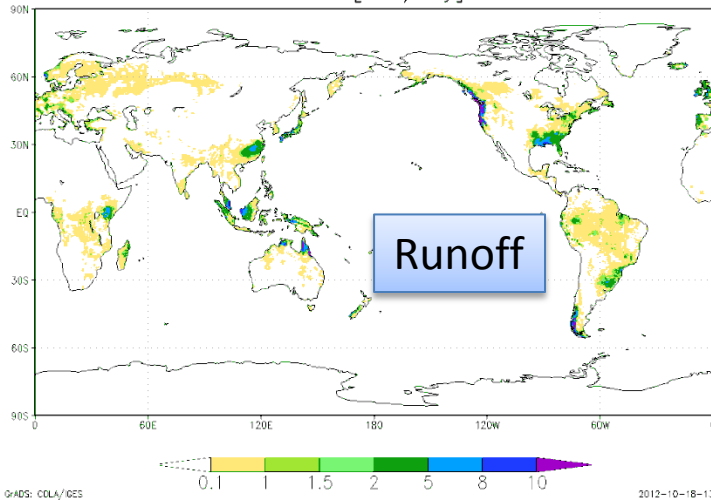
GLDAS2.prate [mm/day] 199801



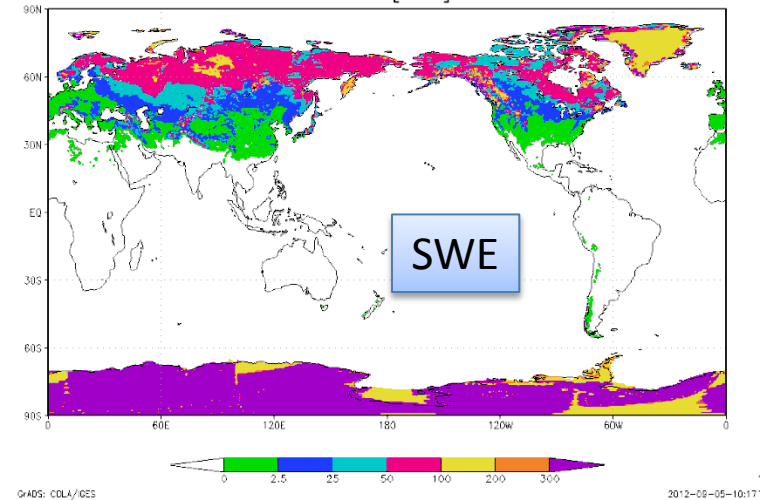
GLDAS2.et [mm/day] 199801



GLDAS2 Runoff [mm/day] Jan1998



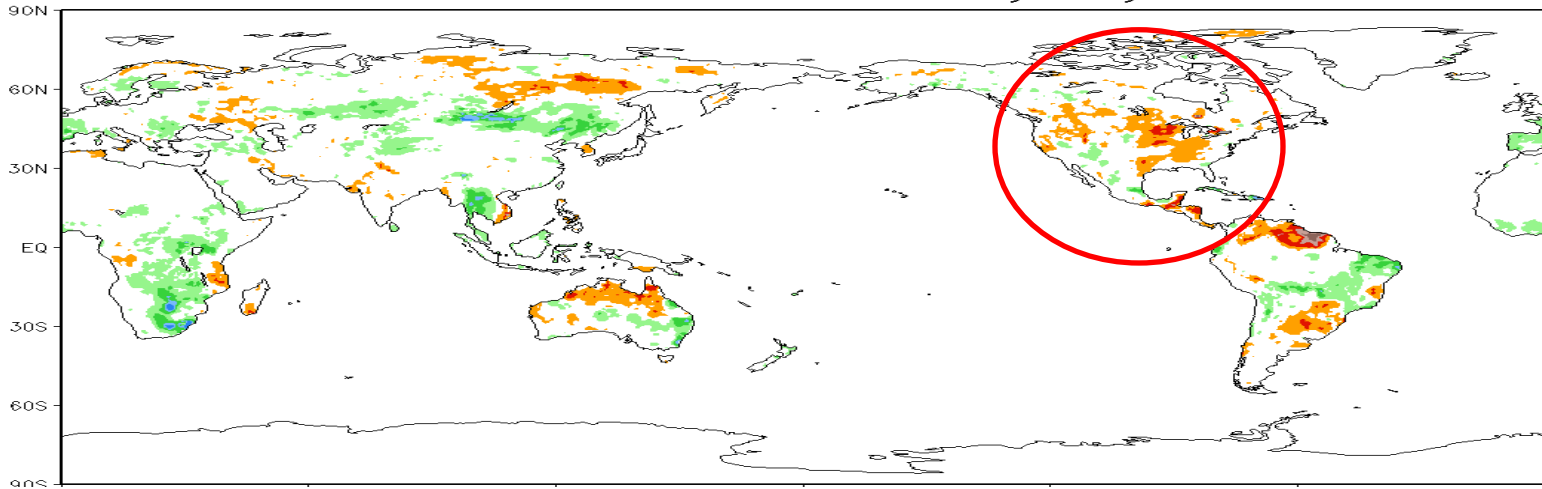
GLDAS2.weasd [mm] 199801



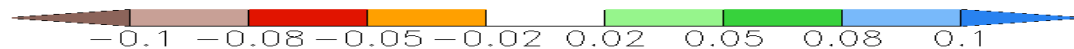
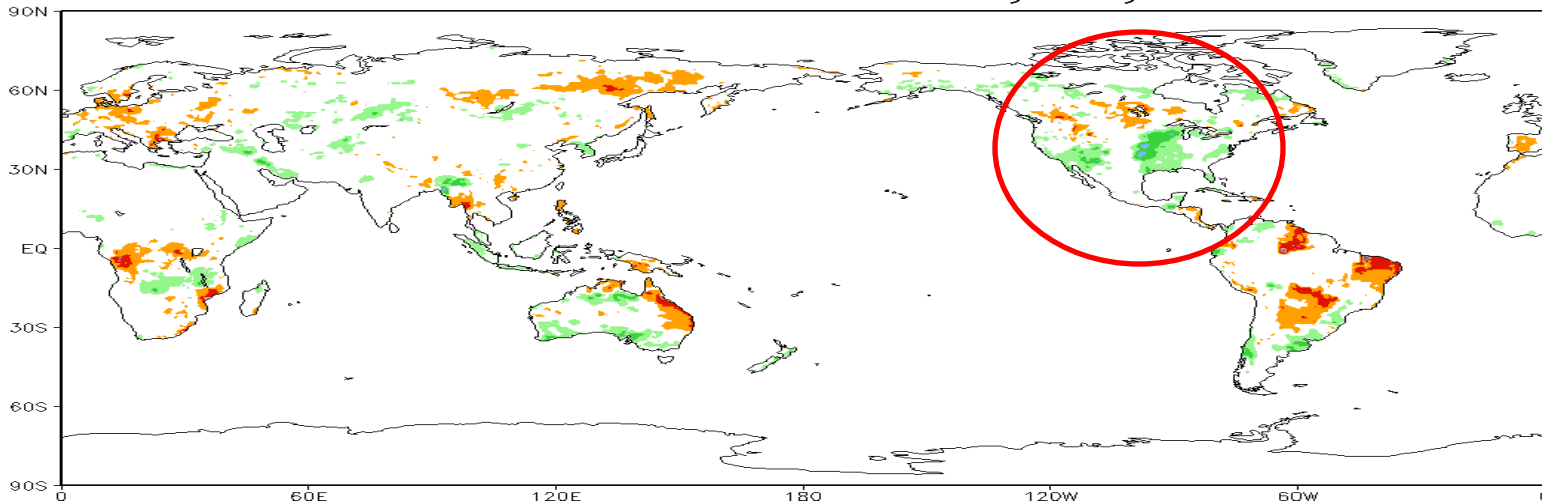
GLDAS Drought Monitor

CFSR/GLDAS can identify historical land surface variability.

GLDAS2 Soil Moisture Anomaly May 1988



GLDAS2 Soil Moisture Anomaly May 1993

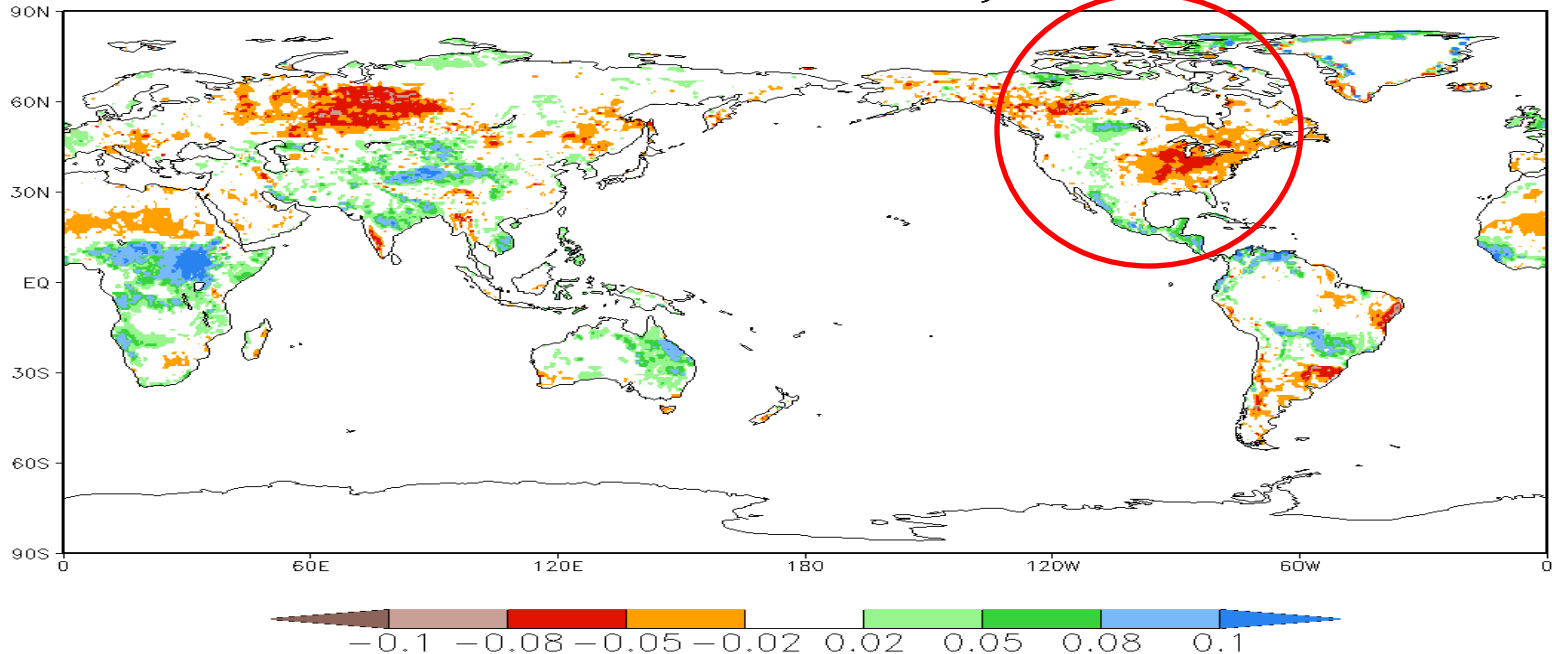


GLDAS Drought Monitor

CFSR/GLDAS and the realtime CFSv2 can monitor current land surface conditions and potentially perform land surface prediction.



CFS Soil Moisture Anomaly Jul 2012



NLDAS Drought Monitor

GLDAS2 has the potential to expand the current system to global.

Climate Prediction Center - Windows Internet Explorer
 http://www.cpc.ncep.noaa.gov/products/Drought/Drought_index/Drought_index.shtml

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Drought Indices

Move cursor over product parameter name to display the graphic. Click to enlarge.

Standardized Precipitation Index (SPI)		Total Soil Moisture Percentiles		Standardized Runoff Index (SRI)		
US	Forecast	US	Regional Time Series	SRI3	SRI6	SRI12

Drought Briefing

3-month SPI 6-month SPI

12-month SPI 24-month SPI

USA.gov
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Climate Prediction Center - Expert Assessments: United States Seasonal Drought Outlook - Windows Internet Explorer
 http://www.cpc.ncep.noaa.gov/products/expert_assessment/seasonal_drought.html

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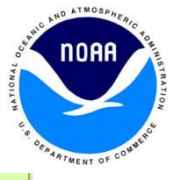
U.S. Seasonal Drought Outlook

U.S. Seasonal Drought Outlook
 Drought Tendency During the Valid Period
 Valid September 15 - December 31, 2011
 Released September 15, 2011

KEY:
 Drought to persist or

USA.gov
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Summary



- The NCEP CFSR runs 6 simultaneous streams and the soil moisture time series may have trends and discontinuity due to insufficient land surface spin up.
- A retrospective one-stream GLDAS2 with 10-year spin up has been executed to resolve the issues of spin up and stream discontinuity.
- On regional scale of CONUS, the anomaly correlation of (GLDAS2 vs NLDAS) soil moisture time series is higher than (CFSR vs NLDAS).
- Significant improvement is found in the semi-arid southwestern CONUS where longer spin up period is required.
- GLDAS2 provides a better understanding of global land surface water budget climatology and climatological variation.
- GLDAS2 has the potential to expand the current NLDAS Drought Monitor to support the proposed Global Drought Information System.