

Drought Monitoring based on the multi-model ensemble North American Land Data Assimilation System (NLDAS)

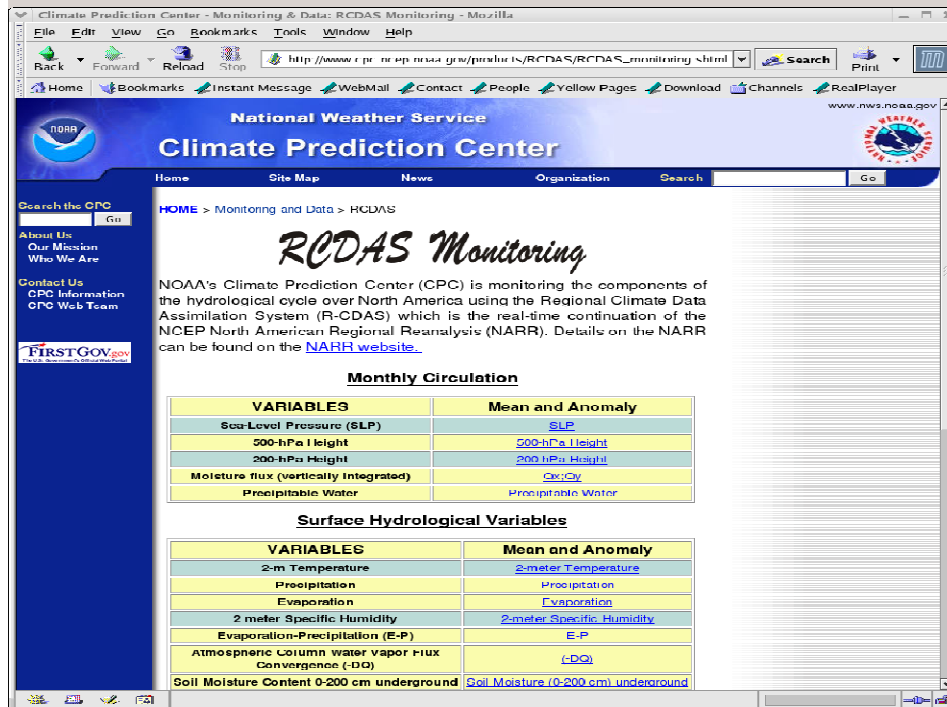
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NCEP/NWS/NOAA

Drought monitoring at the CPC

Based on your suggestions during the last CPAS meeting, we developed:

Current: Monitoring based on the Regional Reanalysis (RR)

<http://www.cpc.noaa.gov/products/RCDAS>



The screenshot shows the NOAA Climate Prediction Center website. The main heading is "RCDAS Monitoring". Below it, a paragraph states: "NOAA's Climate Prediction Center (CPC) is monitoring the components of the hydrological cycle over North America using the Regional Climate Data Assimilation System (R-CDAS) which is the real-time continuation of the NCEP North American Regional Reanalysis (NARR). Details on the NARR can be found on the [NARR website](#)."

There are two tables of variables:

VARIABLES	Mean and Anomaly
Sea-Level Pressure (SLP)	SLP
500-hPa Height	500-hPa Height
200-hPa Height	200-hPa Height
Moisture flux (vertically integrated)	Qx-Qy
Precipitable Water	Precipitable Water

VARIABLES	Mean and Anomaly
2-m Temperature	2-meter Temperature
Precipitation	Precipitation
Evaporation	Evaporation
2 meter Specific Humidity	2-meter Specific Humidity
Evaporation-Precipitation (E-P)	E-P
Atmospheric Column water vapor flux	(CDQ)
Convergence (-DQ)	
Soil Moisture Content 0-200 cm underground	Soil Moisture (0-200 cm) underground

Advantages:

Dynamical model based product and totally objective.

Disadvantages:

Products differ in climatology and variability

Possible solution:

Ensemble multi model NLDAS

Knowledge is more useful if users help to design

Ensemble Multi-model ensemble NLDAS for drought monitoring

10-yr 4 model ensemble (with the same forcing) for now.

27-yr 4 model ensemble by the end of this year.

Propose to do 56+ yr ensemble NLDAS later

This is the time to give us your input

- Products are useful to you
- How do you want them?
- Fields will be made available to the community.
- Please give us your feedback and your evaluation

Questionnaire for the Drought/Hydrology Community

Your Input/Suggestions are solicited for the webpage

“Drought Monitoring Products at PC/NCEP”

Based on your suggestions during last year’s CPASW meeting, we developed the Monitoring webpage based on the RCDAS <http://www.cpc.noaa.gov/products/RCDAS>. It has the latest weekly, monthly and seasonal values of selected atmospheric, radiation and hydrological conditions over the continental United States,

There is an elaborate plan underway to develop monitoring page based on ensemble Multi Model NLDAS products with 28 year climatology from 1979-2006. Considering NLDAS products are model and forcing dependent, ensemble mean and spread are needed to generate more realistic quantities and estimate uncertainties.

Besides using these products for our own drought/hydrology products monitoring and forecast applications, we also plan to distribute the various NLDAS data sets in GIS format. As we rebuild our existing website to include the new datasets we are seeking your suggestions and needs.

It will greatly help us evaluate your needs and input if you fill out this Questionnaire. Thank you.

Current variables

Atmospheric conditions:
 850 hPa, 200 hPa and 10 m winds
 2m Temperature q and Rh
 SLP Qu, Qv
 Precipitable water

Radiation budget terms

Hydrological variables
 P and E, E-P and PE
 runoff

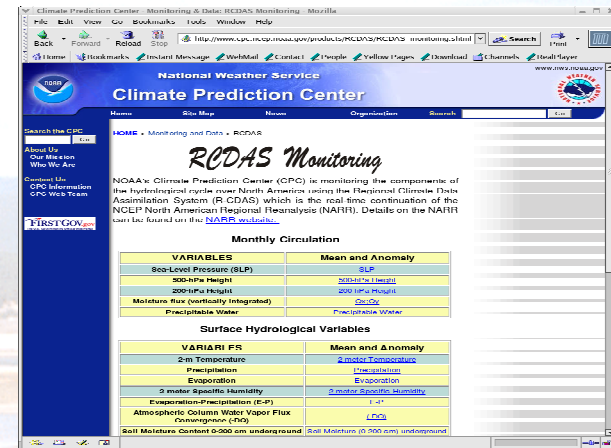
Soil moisture from all levels
 Soil temperature at all levels

Variables to be added in the next version:

Cloud coverage fractions -- RR
 Snow water equivalent (WEASD)
 Snow depth -- RR
 Surface snow melt : Ensemble
 Snow cover (%) – Ensemble
 Min daily temperature
 Runoff –ensemble
 E, PE , surface vegetation, E from bare soil and from canopy (not all NLDASes have it)

Week1 and week1 Forecast : mean and spread

Total soil water storage,
 Soil moisture from top 1 meter
 E and PE
 snow water equivalent,
 P and Tsfc



Ensemble multi model Land Data Assimilation products

- Four land models: VIC, MOSAIC, Noah and SAC with the same forcing and the atmosphere-land coupled RR
- Examples show that they differ in climatology , anomalies and variability
- Ensemble mean will decrease model biases and spread will indicate uncertainties.

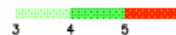
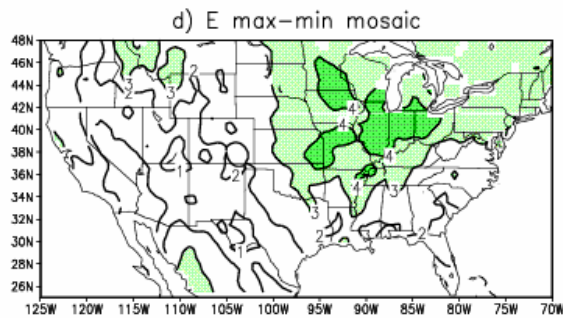
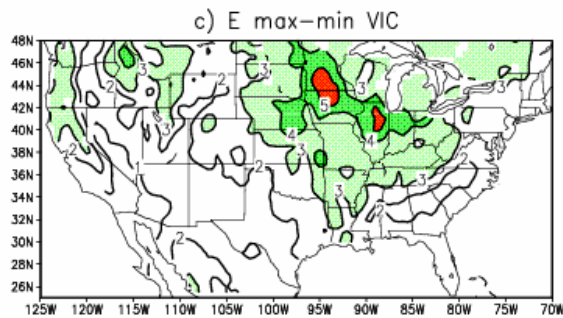
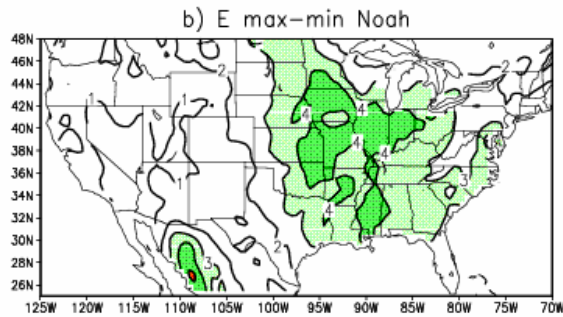
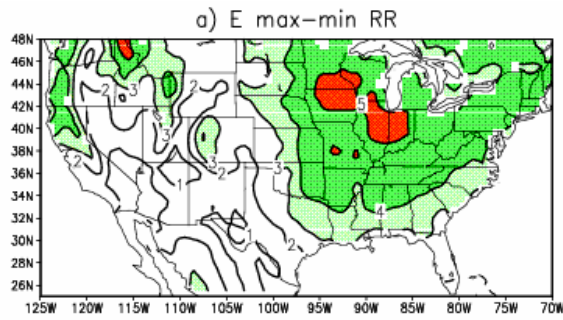
Models

RR

Noah

VIC

Mosaic



Monthly mean Climatology of E

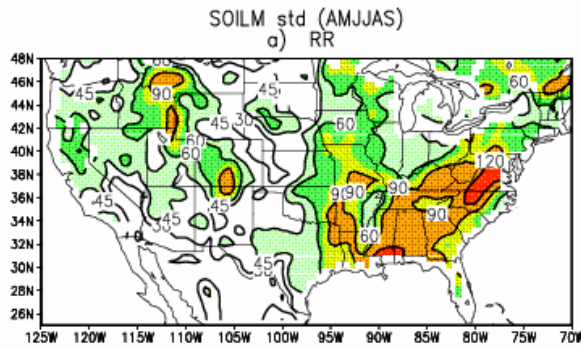
Amplitude of annual cycle: Emax-Emin

They differ 2mm/day

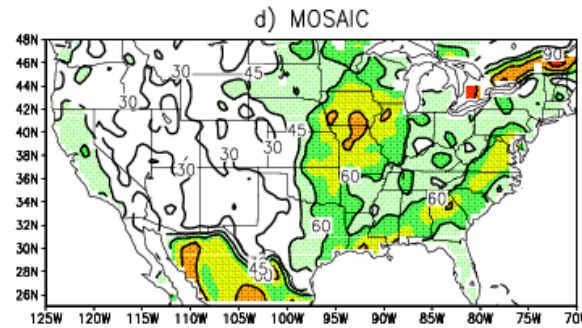
Q: Do you want the total fields or
anomalies with climatology in a
separate page?

Difference in variability: monthly mean standard deviation of total soil water storage in mm

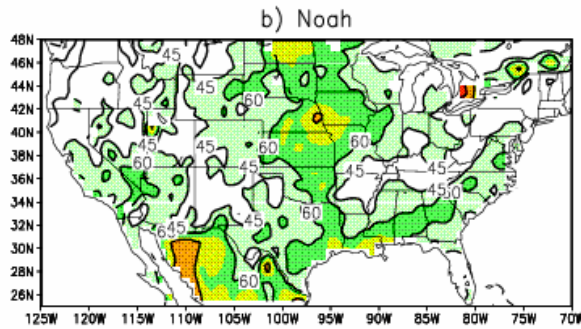
RR



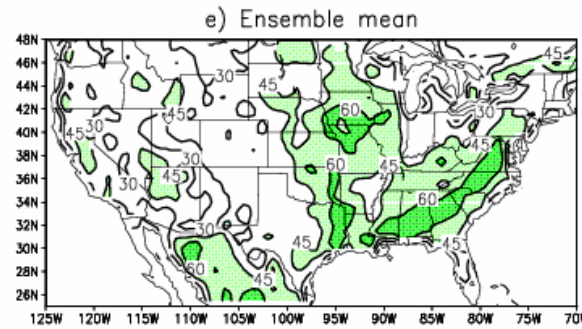
MOSAIC



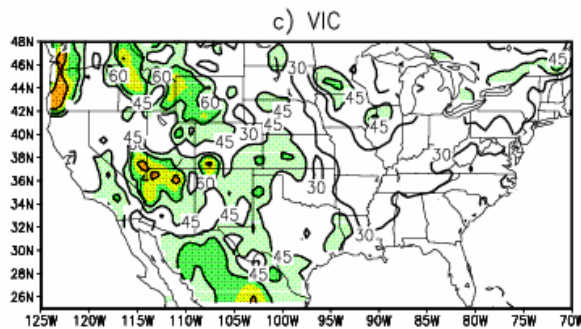
Noah



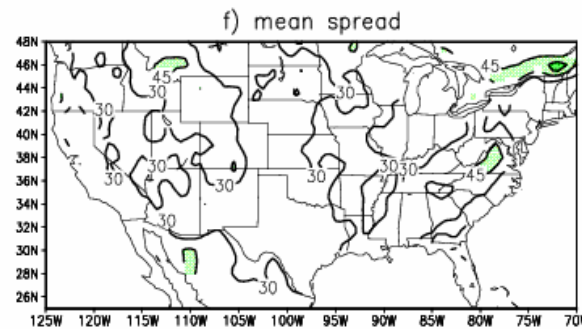
ENS



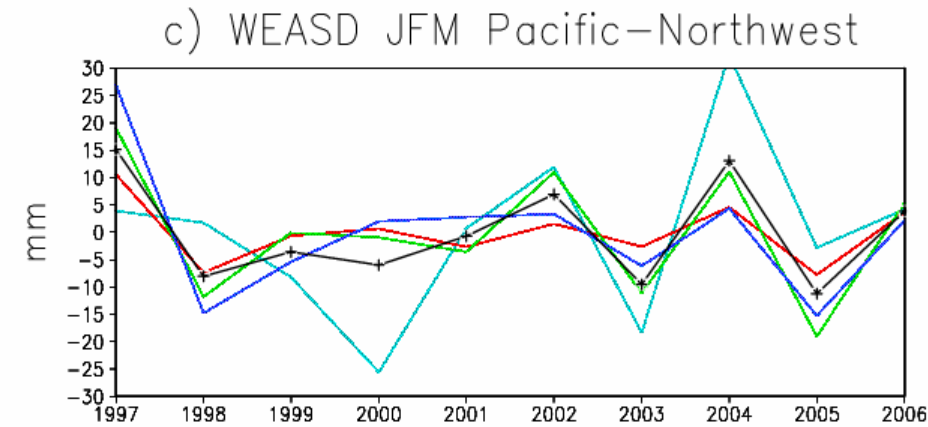
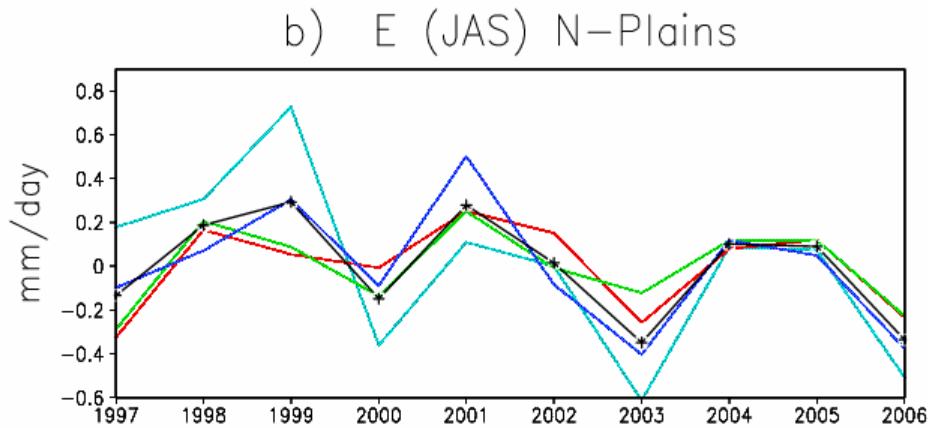
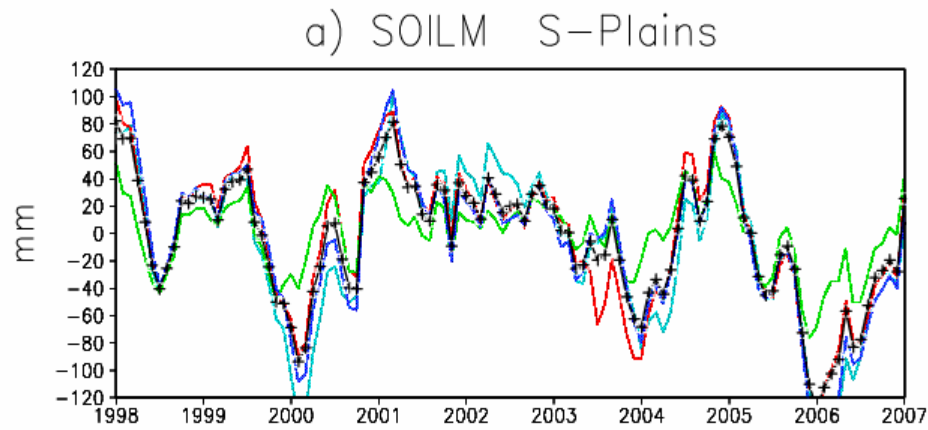
VIC



Spread



Ensemble and individual NLDAS



Light blue-RR

Red-NLDAS2

Blue-Mosaic

Green- Vic

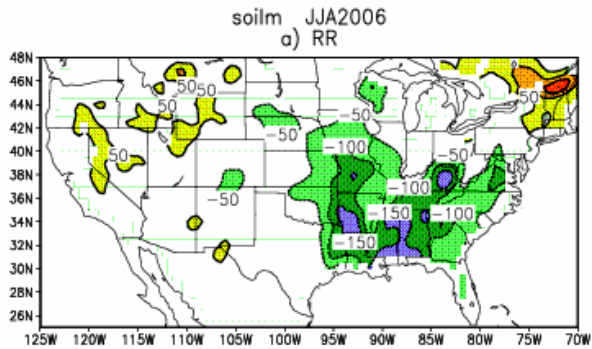
Black crosses-

Ensemble

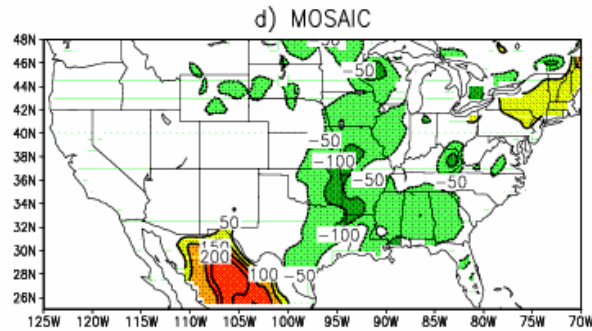
Q: Do you need each individual member or only ensemble mean and spread?

SOILM total anomaly JJA 2006

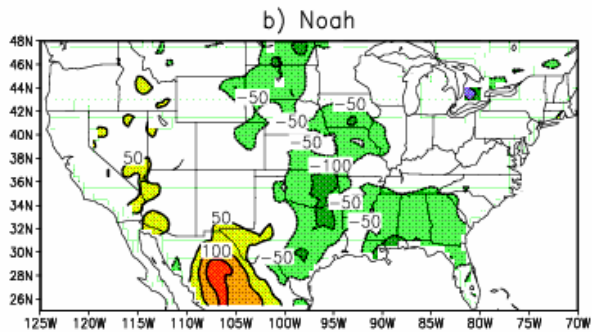
RR



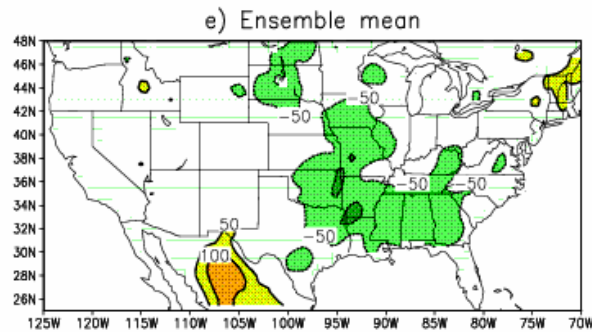
MOSAIC



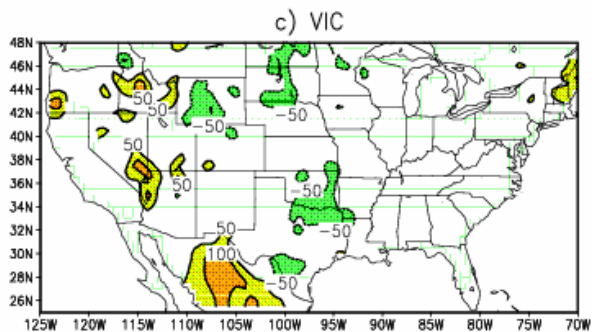
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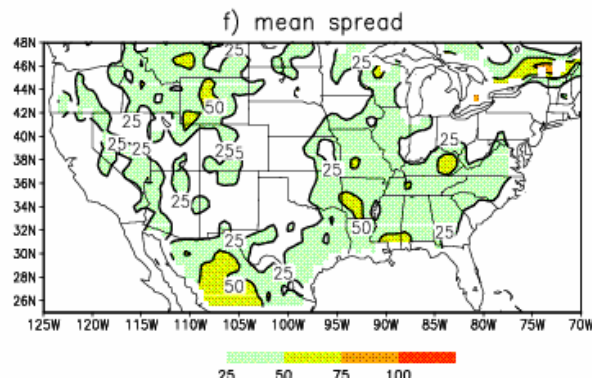
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VIC



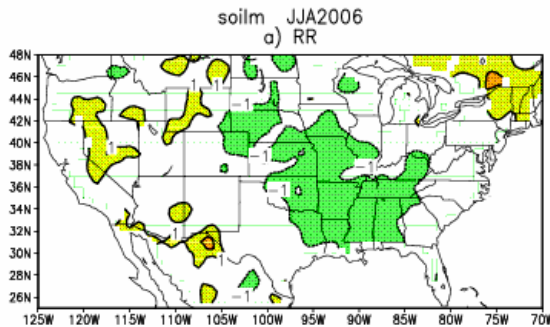
Spread



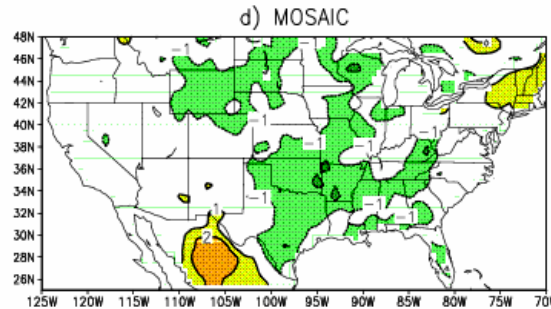
Q: Do you need normalized fields or actual number is important to you? Or you prefer PDF %?

SOILM normalized anom 2006 JJA

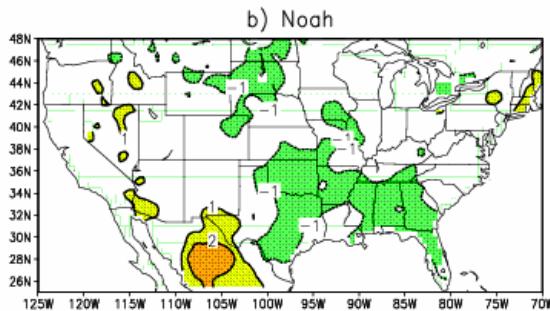
RR



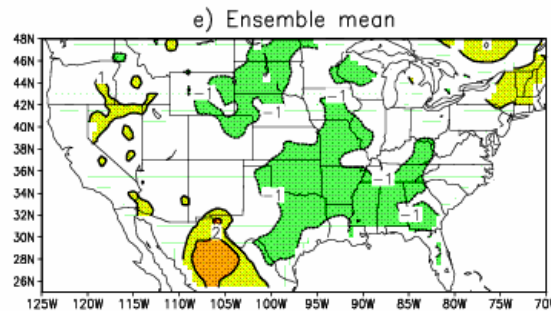
MOSAIC



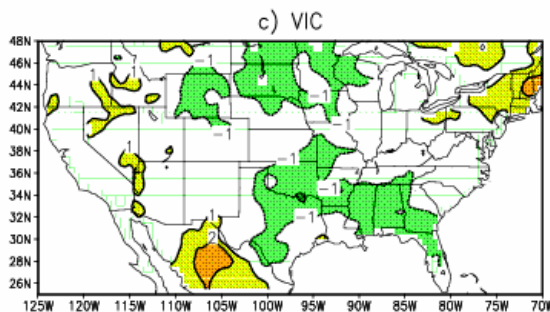
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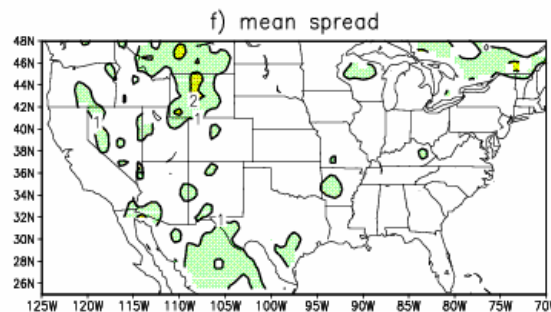
ENS



VIC



Spread



Time and temporal scales

- Currently we have weekly, monthly and seasonal means. Is this good enough for you?
- What spatial resolution do you want. The NLDAS is $1/8$ degrees, but the RR is 32-km. If we have 32-km resolution, will that be enough?

Long term monitoring of drought and drought indicators

Currently:

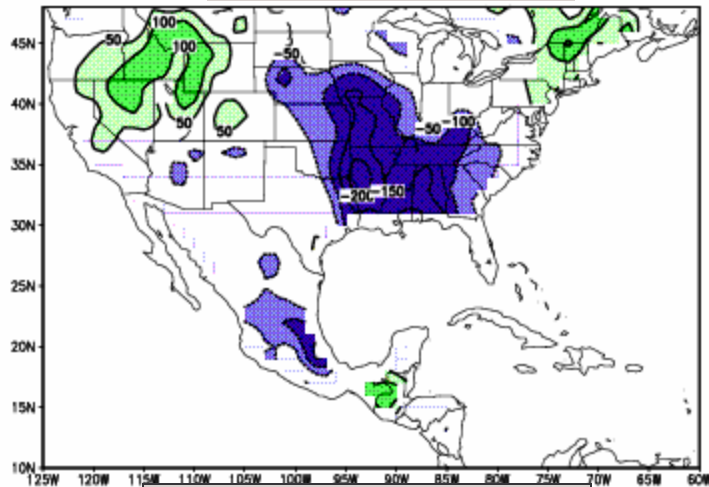
- SPI from 1950-present
- PDSI : climate division data (1900-present)
:Modified PDSI based on RR (1979-present)

Proposed

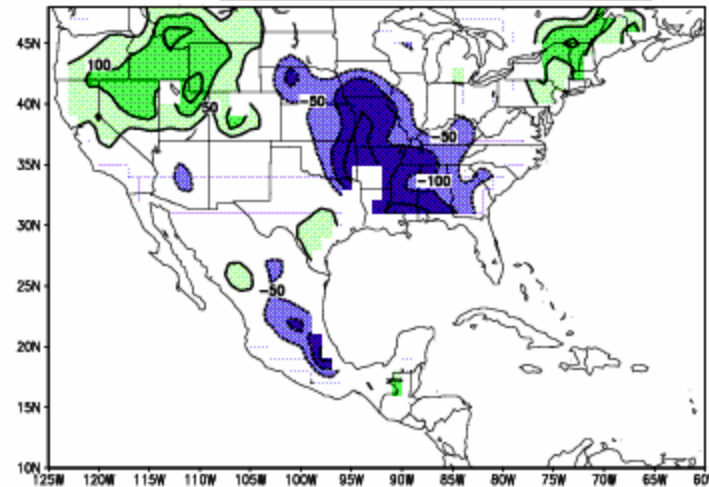
- To perform 50yr+ multi-NLDAS ensemble with same bias corrected forcing
- **add your NLDAS to the ensemble**
- Percentiles of 3, 6, 12 and 24 month mean ensemble total soil water storage as indicators for drought/floods
- Others (Suggest one?)

Week1 Forecast errors

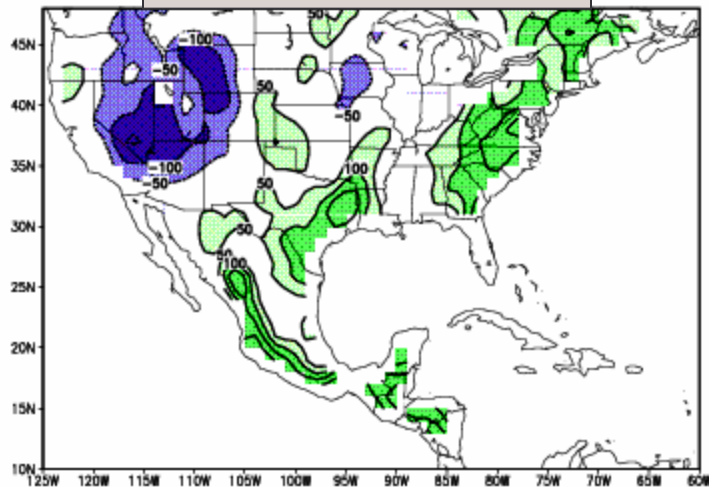
Verification



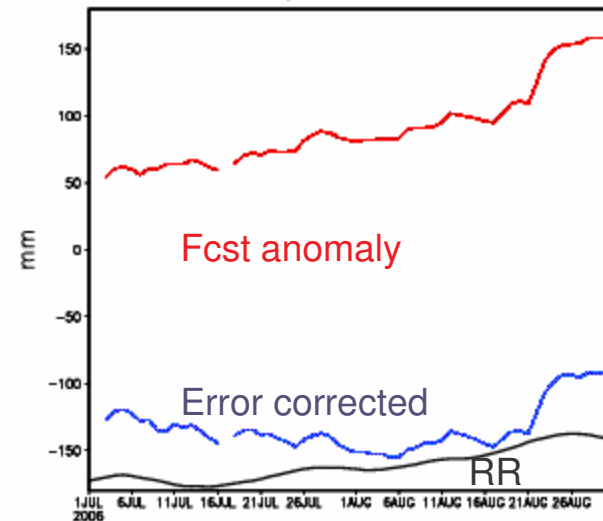
Corrected Fcst



Week1 Fcst IC
July 4, 2006



d) S-Plains



Corrected forecasts are close to the RR, but the systematic errors are HUGE. Will these forecast be useful to you?

conclusions

Our Plan:

Late summer:

- Drought monitoring page will be ready near real time based on 4 -model ensemble with 10-yr climatology.
- Forecast: Error corrected week1 and week2 products

When the 27-yr 4-model runs are ready

- Drought monitoring will be near real time based on 4-model ensemble based on the 27-yr climatology

Propose to do:

- 56+ ensemble multi model NLDAS with bias corrected forcing
- We love to add your NLDAS

Please contact us

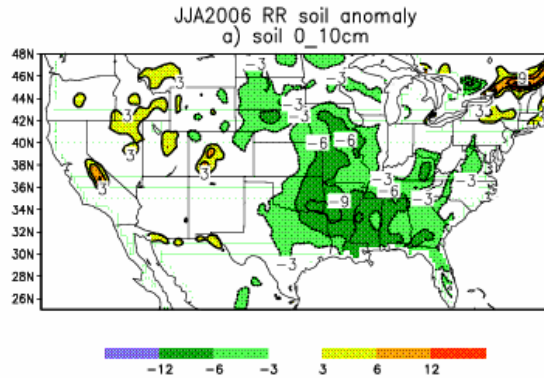
Kingtse.mo@noaa.gov

Muthuvel.Chelliah@noaa.gov

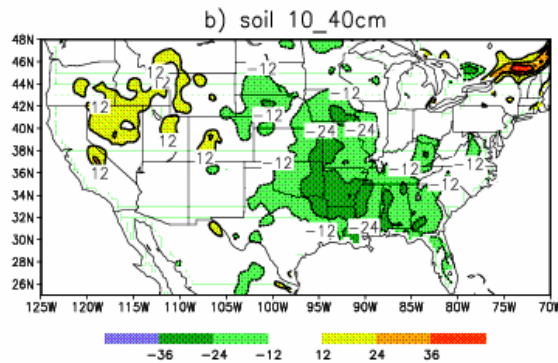
Wanru.wu@noaa.gov

Q: Do you want soil moisture at different levels? Or only soil moisture at top layer 10cm, 1m and total will be sufficient

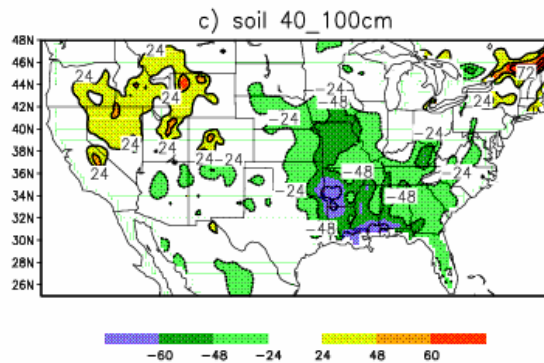
0-10cm



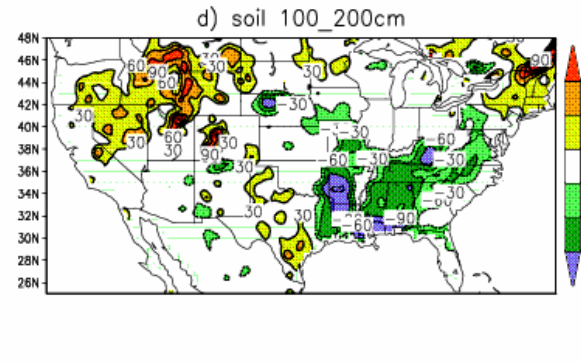
10-40cm



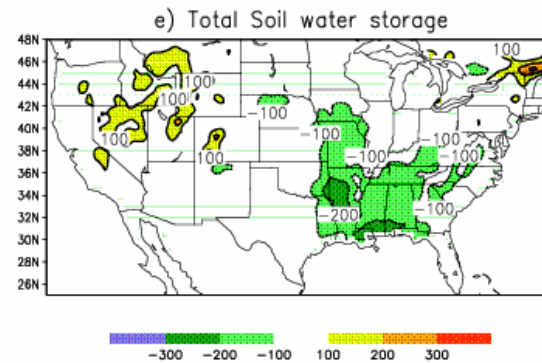
40-100cm



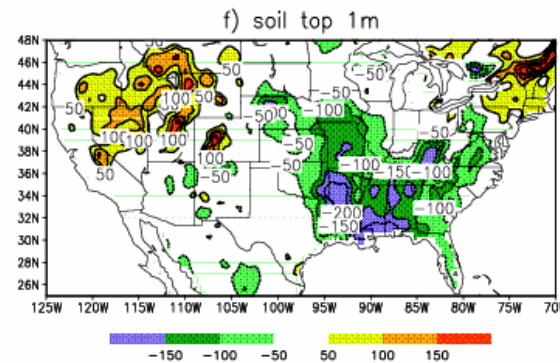
100-200cm



Total



Top 1 m



Based on RR 2006 JJA anomaly

NLDASes have different outputs

Q: If there are only one or two NLDAS have certain variables, do you still want them?

e. g. Moisture availability :

soil moisture/soil moisture at saturation

Potential evaporation (PE)

Beta: evaporation efficiency E/PE

Pro: You have more information

Con: Fields may not be consistent