



Application of NCEP Land Data Assimilation Systems (LDAS) for Global and Regional Drought Analysis, Monitoring and Seasonal Prediction: Focus on Texas

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National Weather Service (NWS)

National Oceanic and Atmospheric Administration (NOAA)

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NOAA Center for Weather and Climate Prediction

College Park, Maryland

Texas Drought Forum, Austin, Texas, 22-23 October 2012



LDAS Partners: Who we are

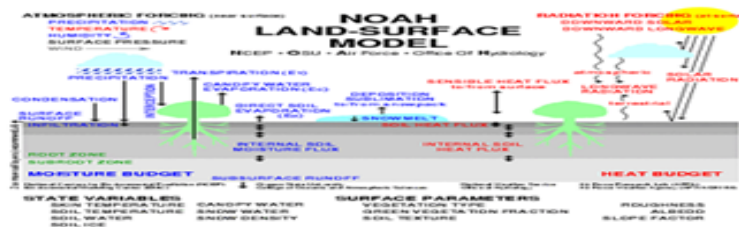


- **LDAS: Land Data Assimilation System**
- **NLDAS: North American LDAS, GLDAS: Global LDAS**
- **LDAS, Data Sets, Land Model Development:**
 - NCEP/EMC: M. Ek, Y. Xia (NLDAS), J. Meng (GLDAS), J. Dong
 - Princeton U.: J. Sheffield, M. Pan, E. Wood
 - NASA/GSFC: D. Mocko, C. Peters-Lidard
 - NWS/OHD: V. Koren, B. Cosgrove
 - U. Washington: D. Lettenmaier et al, B. Livneh (now at Univ. Colo.)
 - U. Michigan: L. Luo (formerly Princeton)
 - UT-Austin: Z-L Yang et al; NCAR: F. Chen et al; U Ariz: X. Zeng et al
- **LDAS Maintenance and Operational Transition:**
 - NCEP/EMC: Youlong Xia (NLDAS), Jesse Meng (GLDAS)
- **LDAS Products Application:**
 - NCEP/CPC: Kingtse Mo, Li-Chuan Chen
 - USDA: Eric Luebhusen, U.S. Drought Monitor Author Group

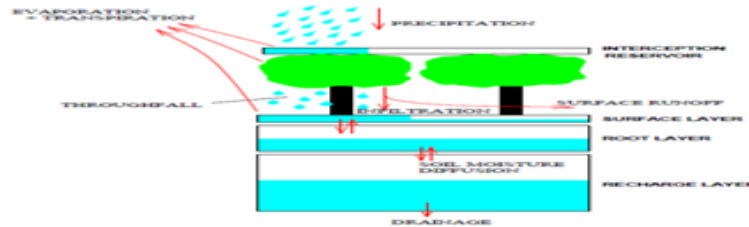
- NLDAS is a multi-model land modeling & data assimil. system...
 - ...run in uncoupled mode driven by atmospheric forcing (using surface meteorology data sets)...
 - ...with "long-term" retrospective and near real-time output of land-surface **water** and **energy** budgets.

NLDAS Configuration: Land models

Atmospheric Community

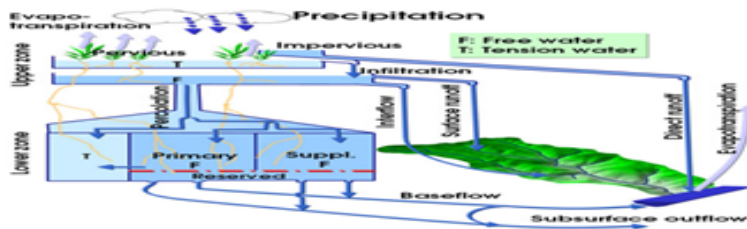


Noah
NCEP operational
land model

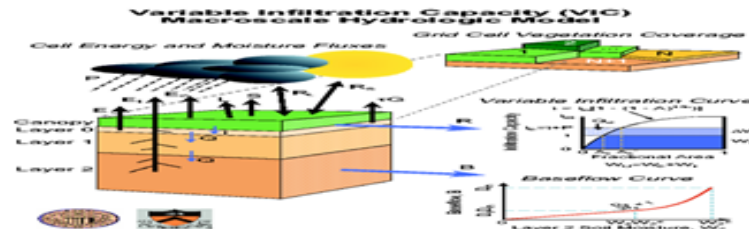


Mosaic
NASA GSFC

Hydrology Community



SAC
NWS operational
hydrological model



VIC
Princeton &
U. Washington

NLDAS Data Sets and Setup

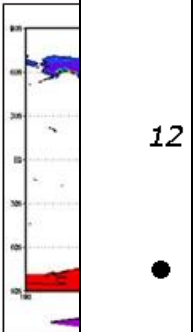
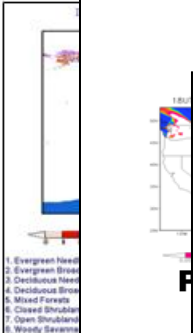


NLDAS Configuration: Land data sets

NLDAS Configuration: Forcing data

NLDAS Configuration: Simulations

- Retrospective mode (*to provide climatologies*)
 - 30-year runs: Oct 1979-Sep 2008
 - 15-year spin-up
 - 30-year climatology for each land model (1979-2008)
- Near real-time mode (*quasi-operational*)
 - depict conditions as anomalies and percentiles from climatology



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NLDAS website

www.emc.ncep.noaa.gov/mmb/nldas
ldas.gsfc.nasa.gov/nldas

NLDAS Homepage - Windows Internet Explorer


http://www.emc.ncep.noaa.gov/mmb/nldas/

File Edit View Favorites Tools Help

NLDAS Homepage

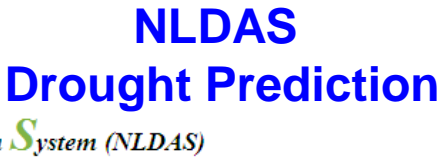
NLDAS Forcing Data Model Output **NLDAS Monitor** NLDAS Forecast Quick Links

NLDAS Drought Monitor



Soil Moisture
Snow Water
Total Runoff
Streamflow
Evaporation
Precipitation

NLDAS Drought Prediction



North American (NLDAS) is being developed that... forecast simulations by numerical weather prediction (NWP) models. Specifically, this system will reduce the errors... which are often present in NWP models and which degrade the accuracy of forecasts. NLDAS is currently running retrospectively and in... 1/8th-degree grid resolution. The system is currently forced by terrestrial (NLDAS) precipitation data, space-based radiation data and... output. In order to create an optimal scheme, the projects involve several LSMs, many sources of data, and several institutions. Data from the project can be accessed on the NLDAS forcing pages, the NLDAS model output pages, as well as on the [NLDAS Realtime Image Generator](#) page.

This is an official NLDAS website which includes NLDAS overview, land surface characteristics parameters, forcing data, land models, model output, publications, useful links, and NLDAS drought monitor.

This webpage originally developed and constructed by Brian Cosgrove, Matthew Rodell, and Charles Alonge for NASA GSFC. It was transitioned to NOAA NCEP/EMC in June 2008. Now this web is maintained and updated by Kenneth Mitchell and Youlong Xia for NLDAS Project.

Anomaly and percentile for six variables and three time scales:

- Soil moisture, snow water, runoff, streamflow, evaporation, precipitation
- Current, Weekly, Monthly

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

NASA NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NCEP NATIONAL CENTER FOR ENVIRONMENTAL PREDICTION

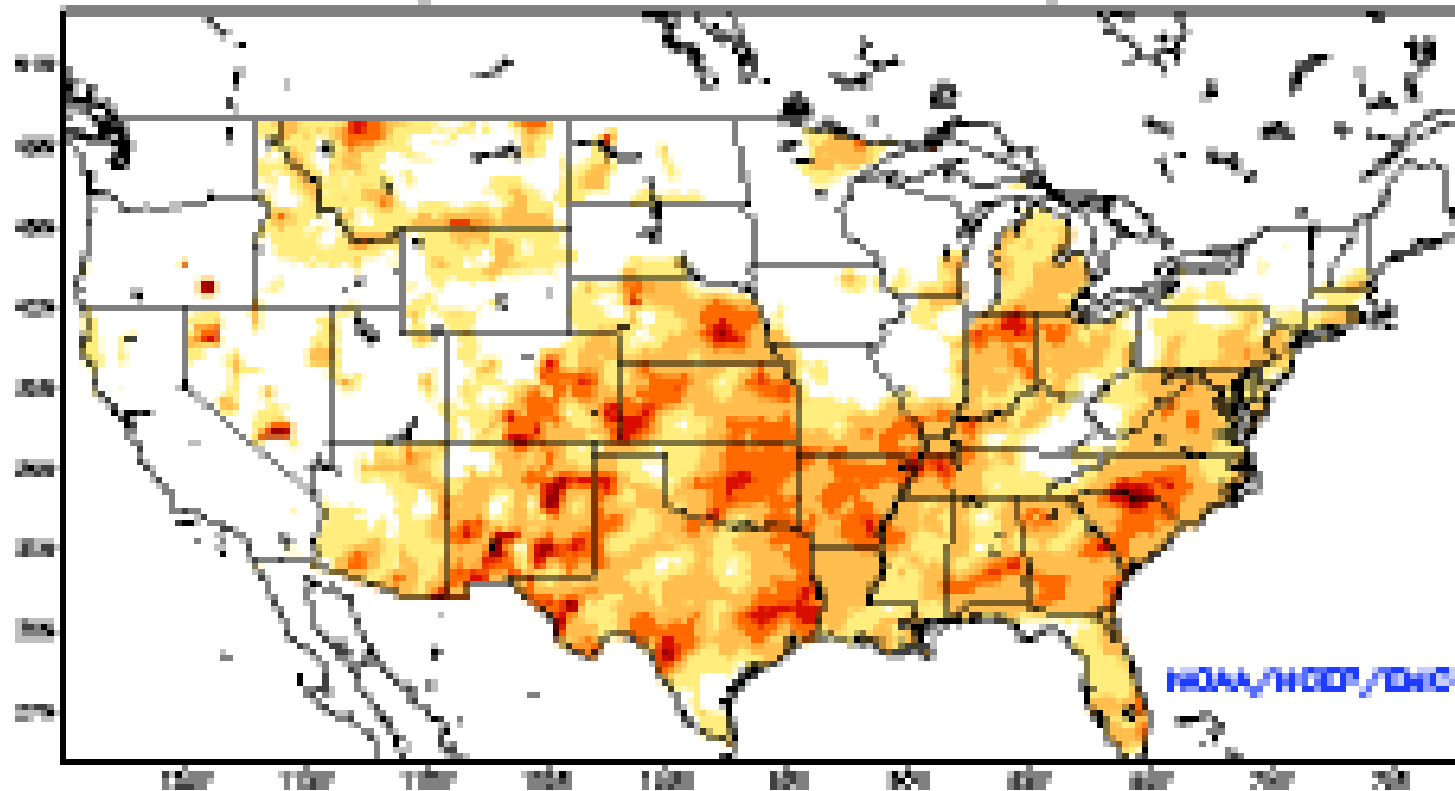
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2011-2012 Drought Variation: Monthly Animation



USDM-Based Optimal Blended NLDAS Drought Index: 201101

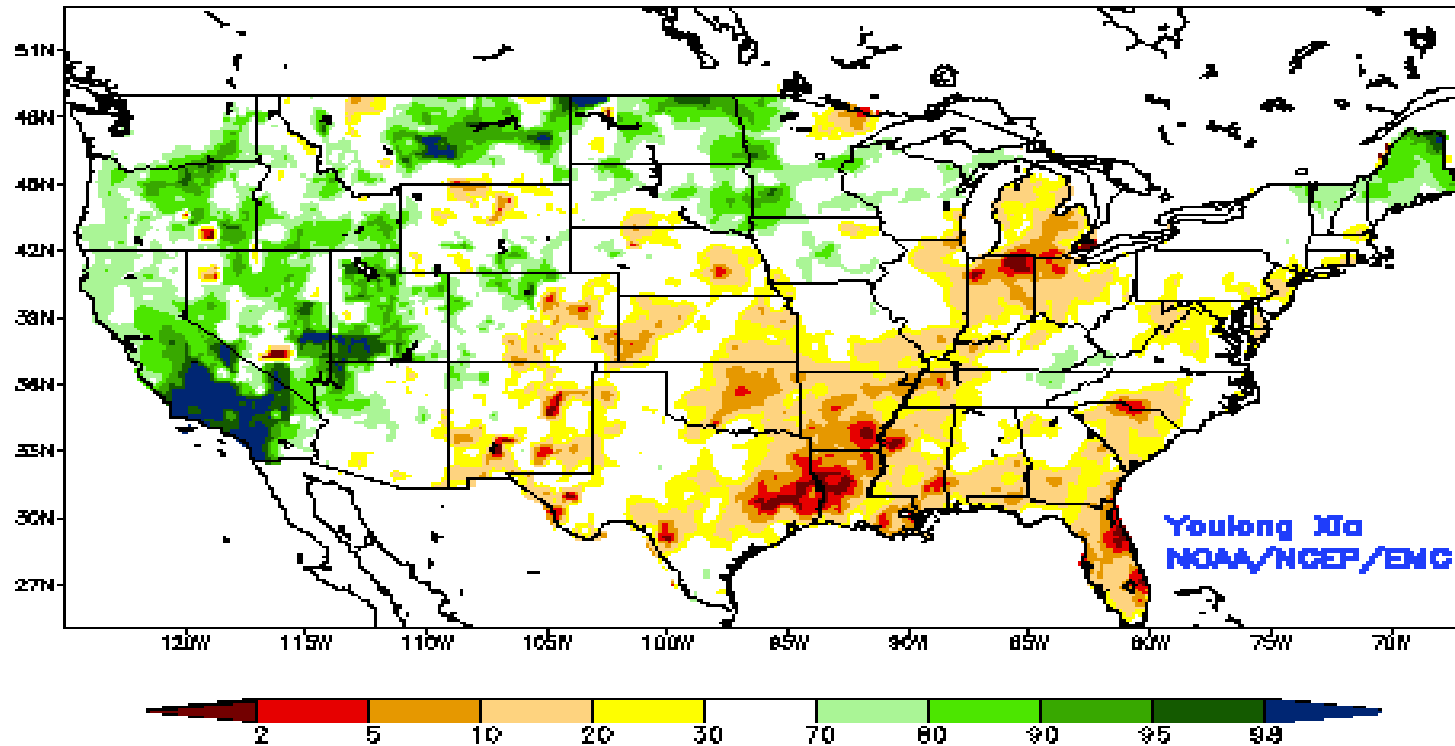




Texas Drought 2011

Near Real-time Quasi-weekly Drought Monitoring (D0 yellow, D4 red)

Ensemble-Mean — Past Week Total Column Soil Moisture Percentile
NCEP NLDAS Products Valid: JAN 05, 2011



Four land model ensemble mean total column soil moisture percentile
(5 January -14 September 2011)

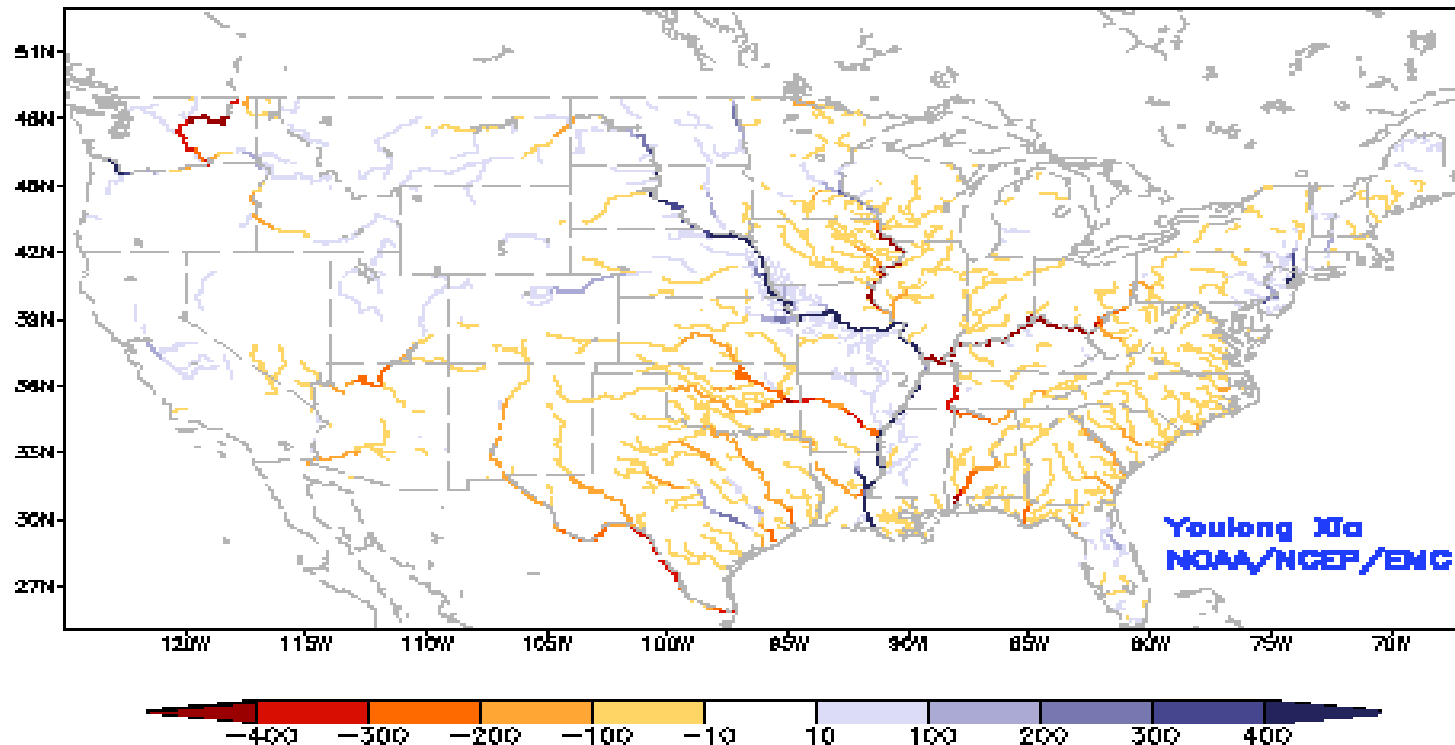


Northeast Flood 2011 Monitoring

Impact of Hurricane Irene and Tropical Storm Lee

Ensemble mean daily streamflow anomaly (m^3/s)
20 August – 17 September 2011

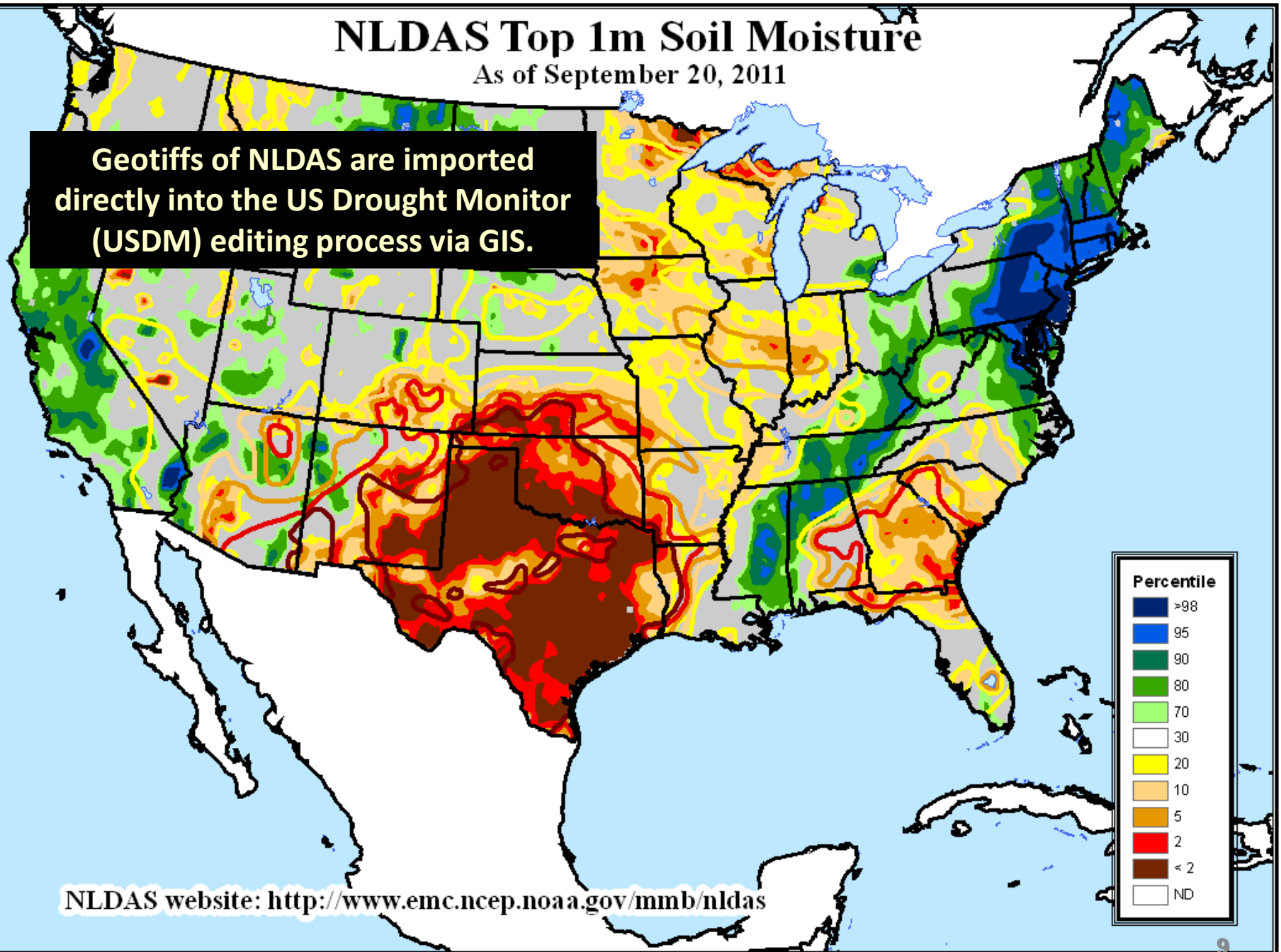
Ensemble-Mean: Current Streamflow Anomaly (m^3/s)
NCEP NLDAS Products__Valid: AUG 20, 2011



NLDAS Top 1m Soil Moisture

As of September 20, 2011

Geotiffs of NLDAS are imported directly into the US Drought Monitor (USDM) editing process via GIS.

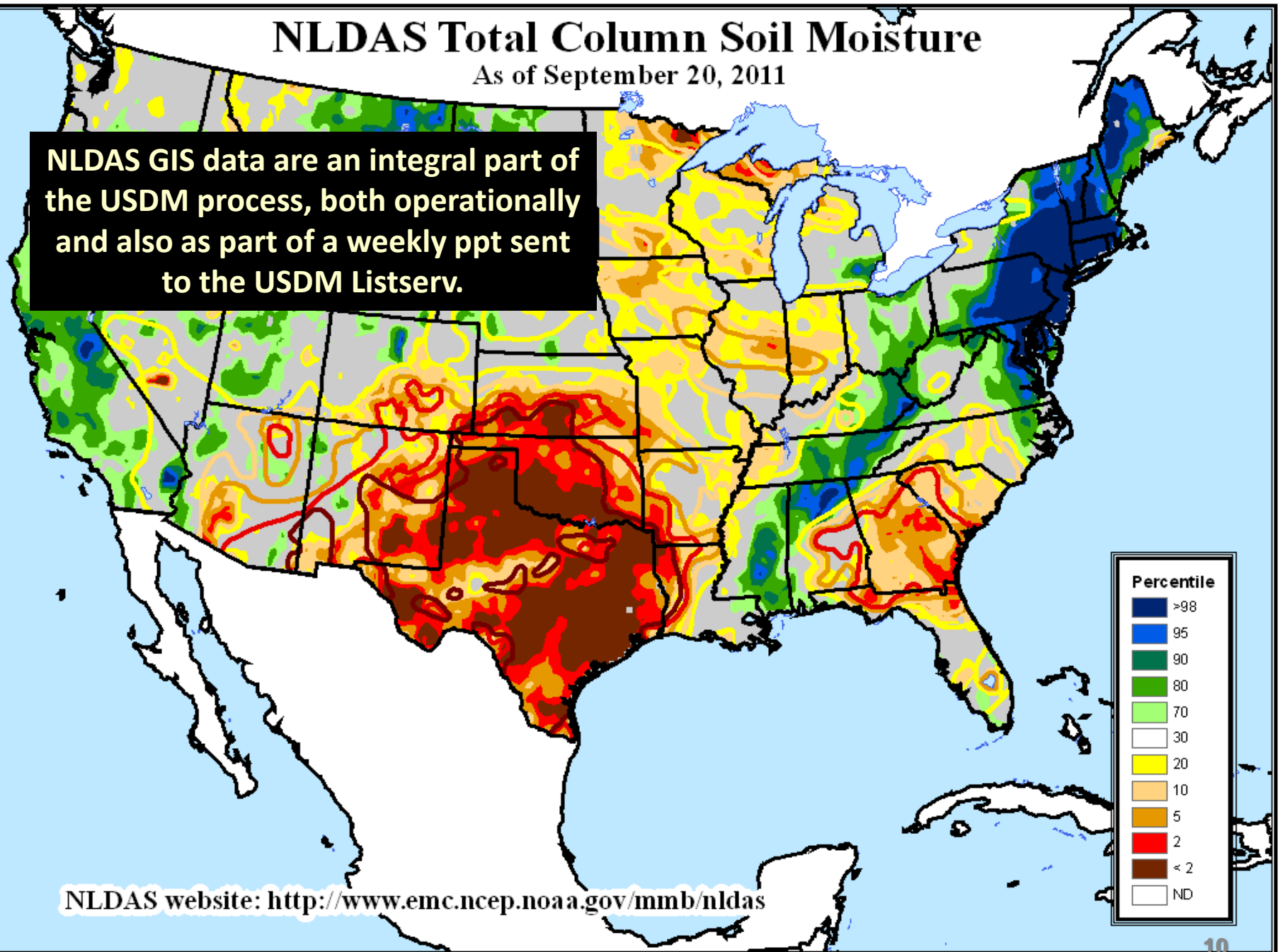


NLDAS website: <http://www.emc.ncep.noaa.gov/mmb/nldas>

NLDAS Total Column Soil Moisture

As of September 20, 2011

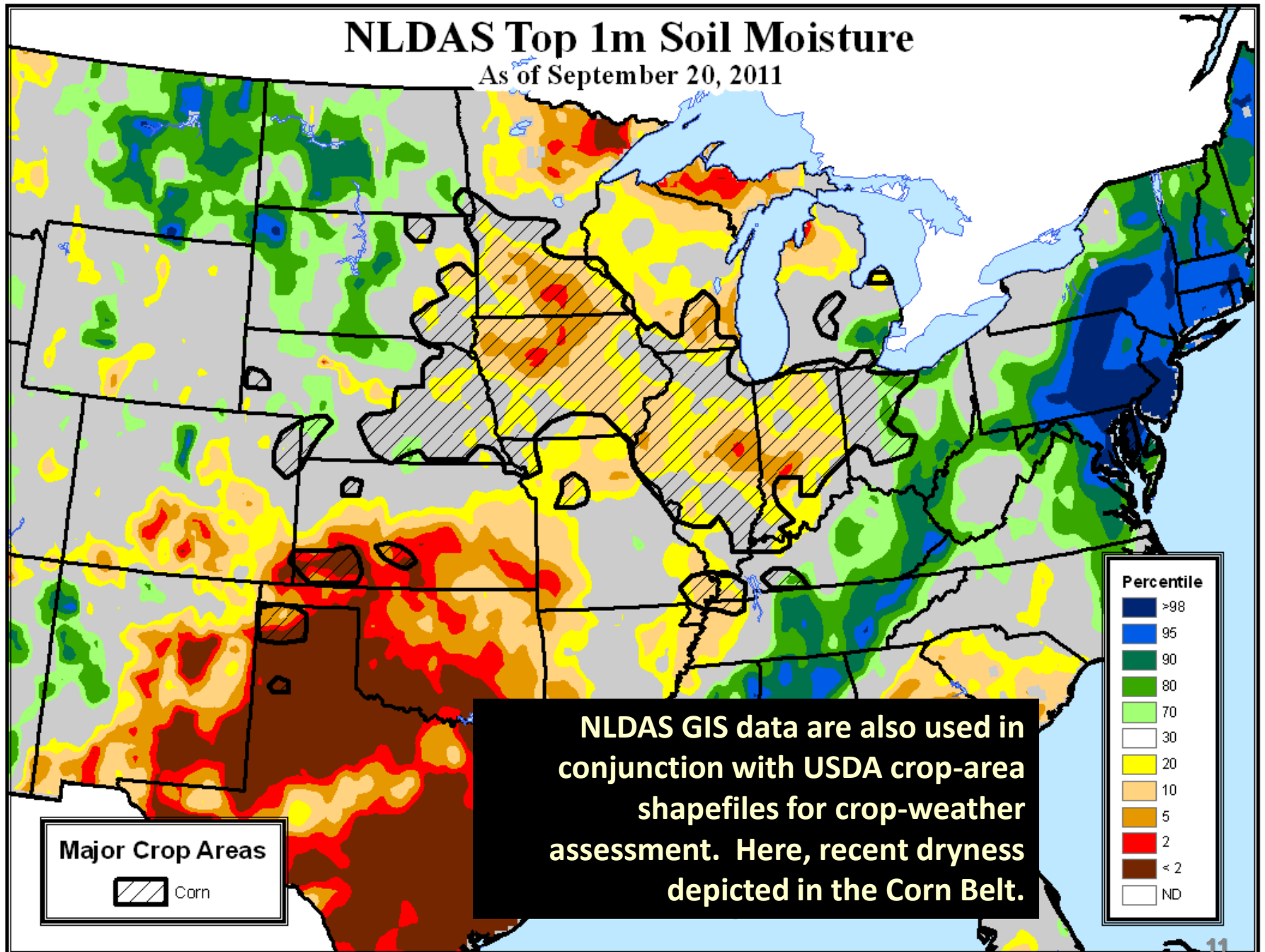
NLDAS GIS data are an integral part of the USDM process, both operationally and also as part of a weekly ppt sent to the USDM Listserv.



NLDAS website: <http://www.emc.ncep.noaa.gov/mmb/nldas>

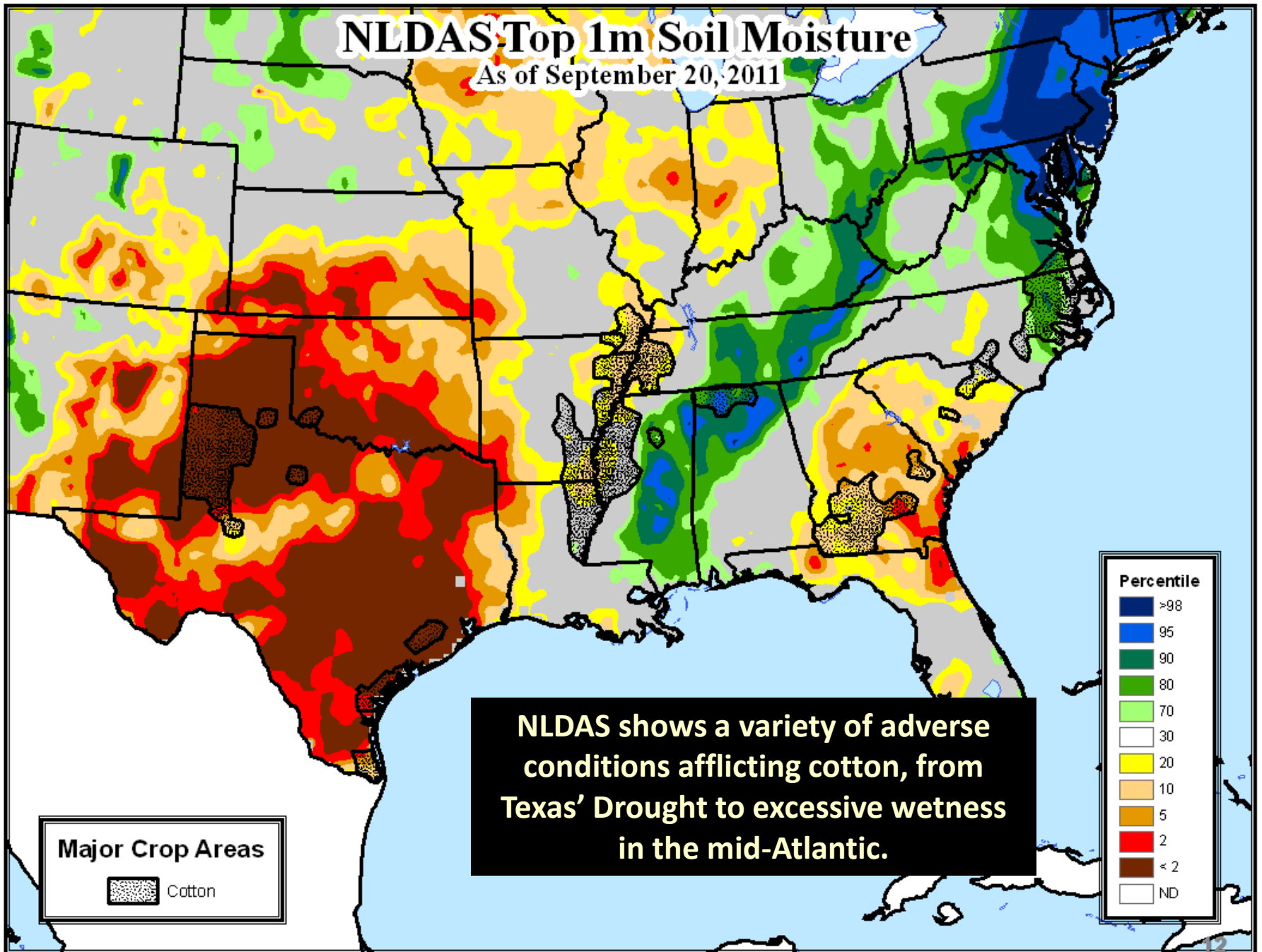
NLDAS Top 1m Soil Moisture

As of September 20, 2011



NLDAS Top 1m Soil Moisture

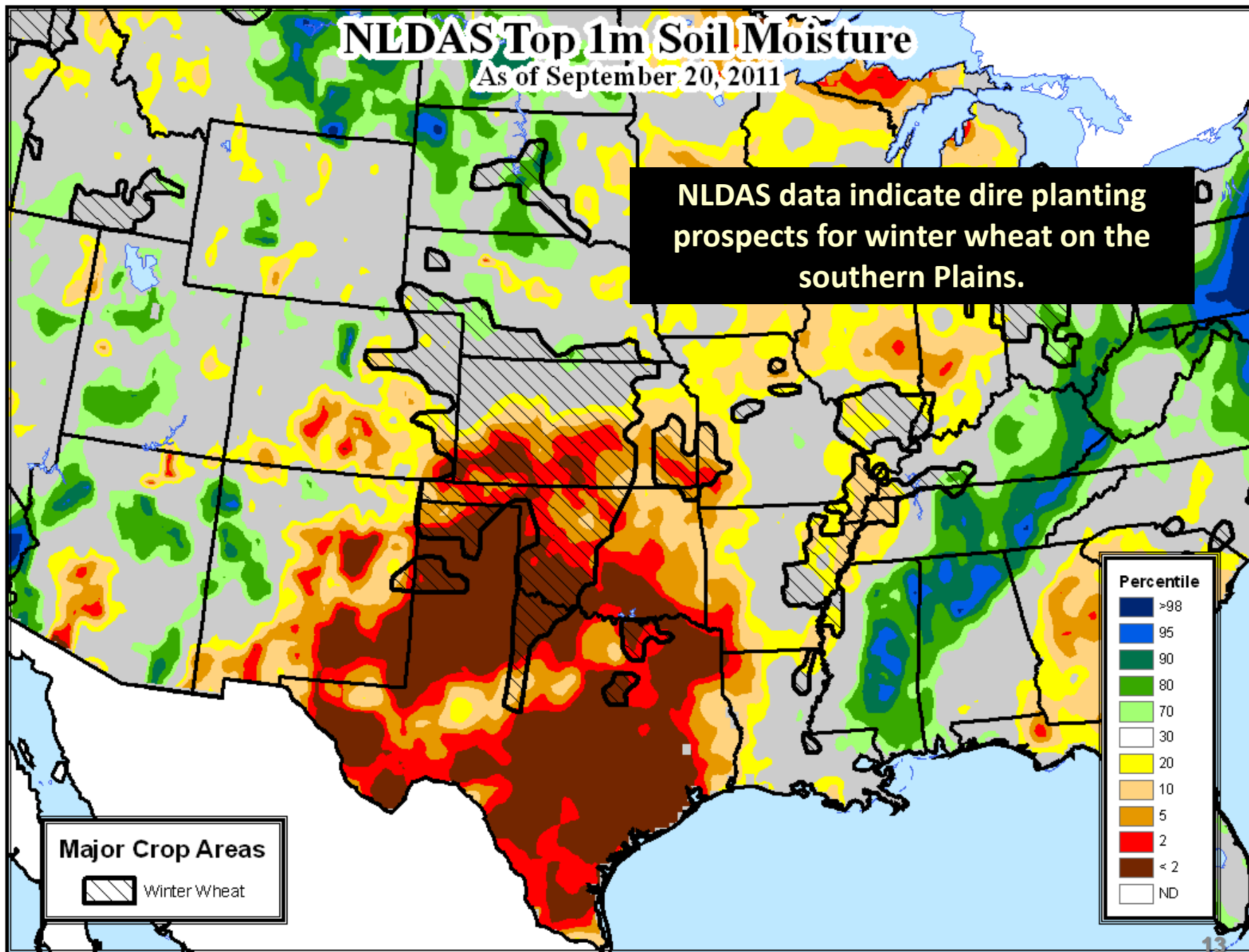
As of September 20, 2011



NLDAS Top 1m Soil Moisture

As of September 20, 2011

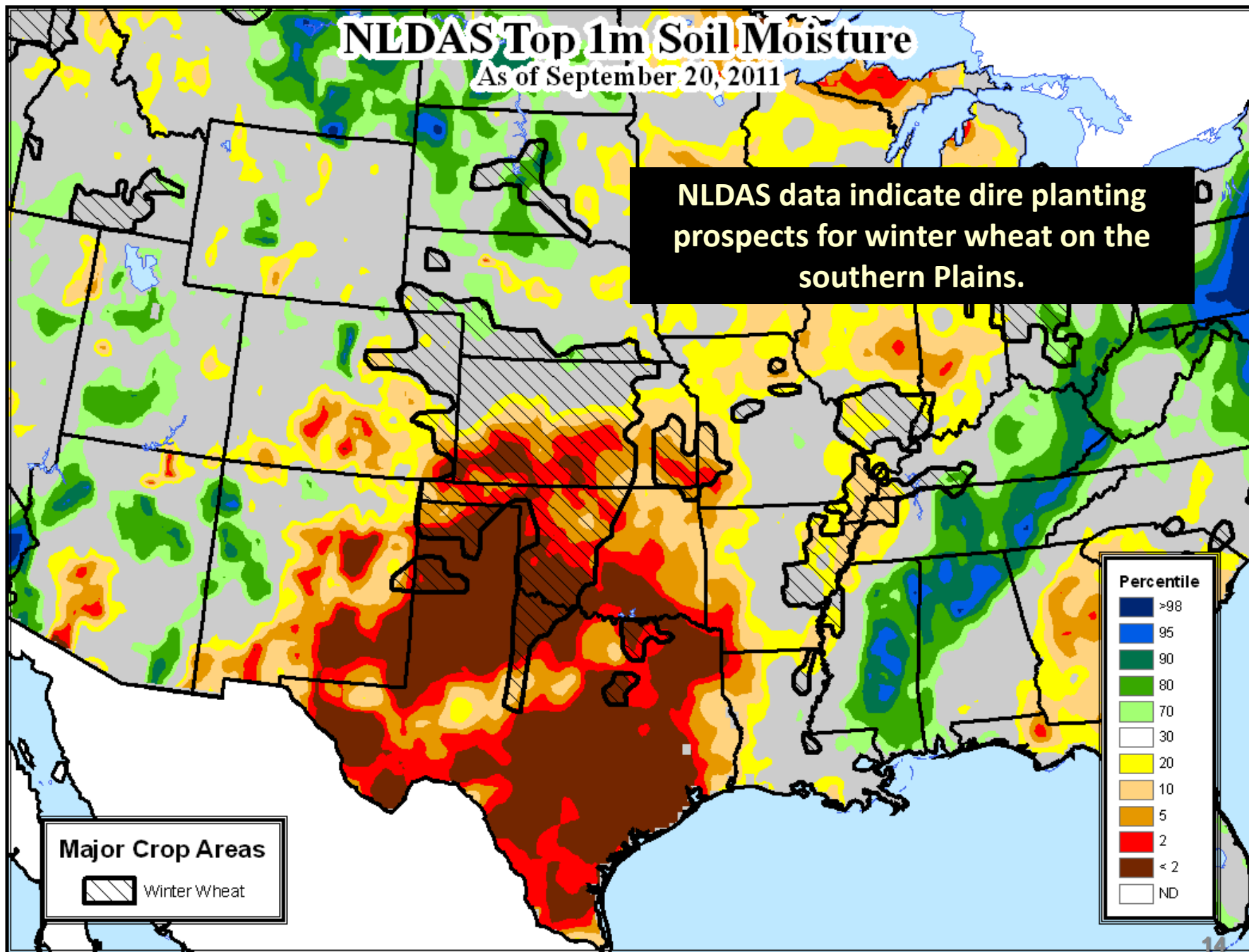
NLDAS data indicate dire planting prospects for winter wheat on the southern Plains.



NLDAS Top 1m Soil Moisture

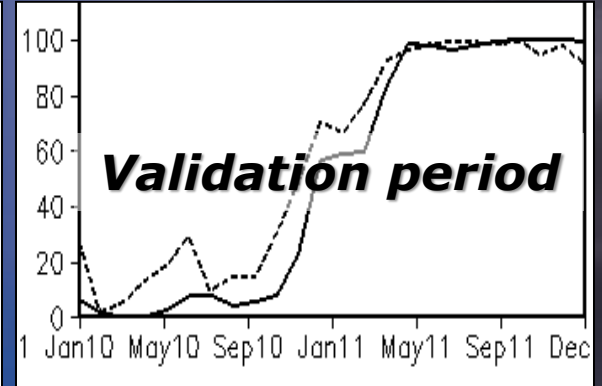
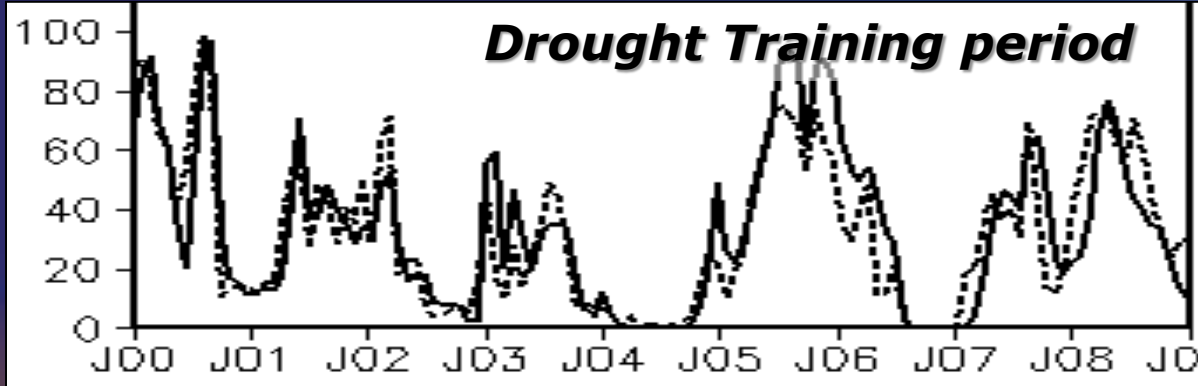
As of September 20, 2011

NLDAS data indicate dire planting prospects for winter wheat on the southern Plains.

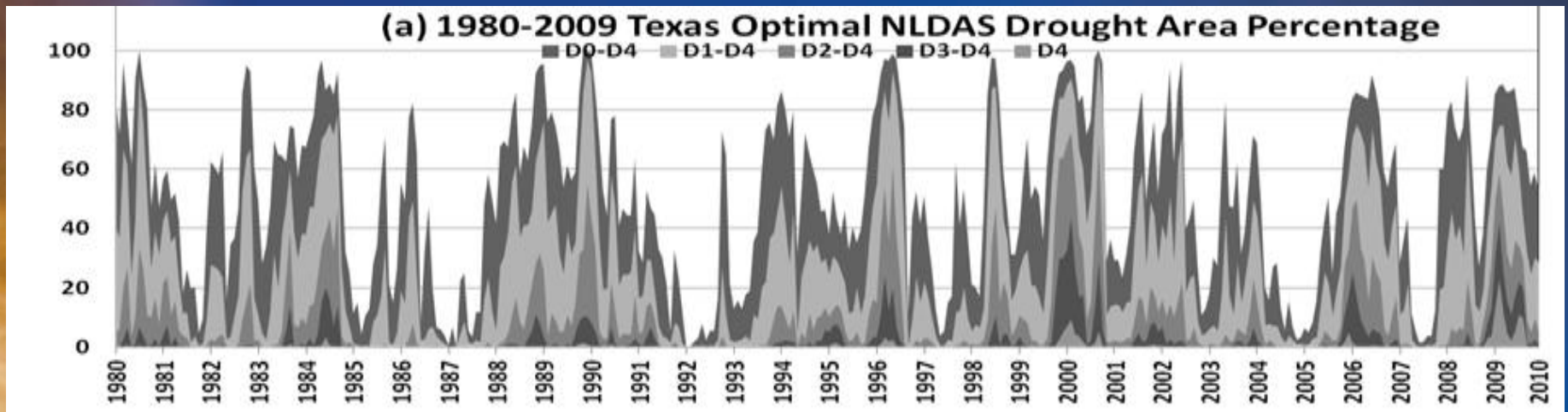




Monthly Drought Area Percentage Reconstruction: D1-D4 in Texas



Solid USDM, dashed NLDAS optimal blend (soil moisture, runoff, ET)...

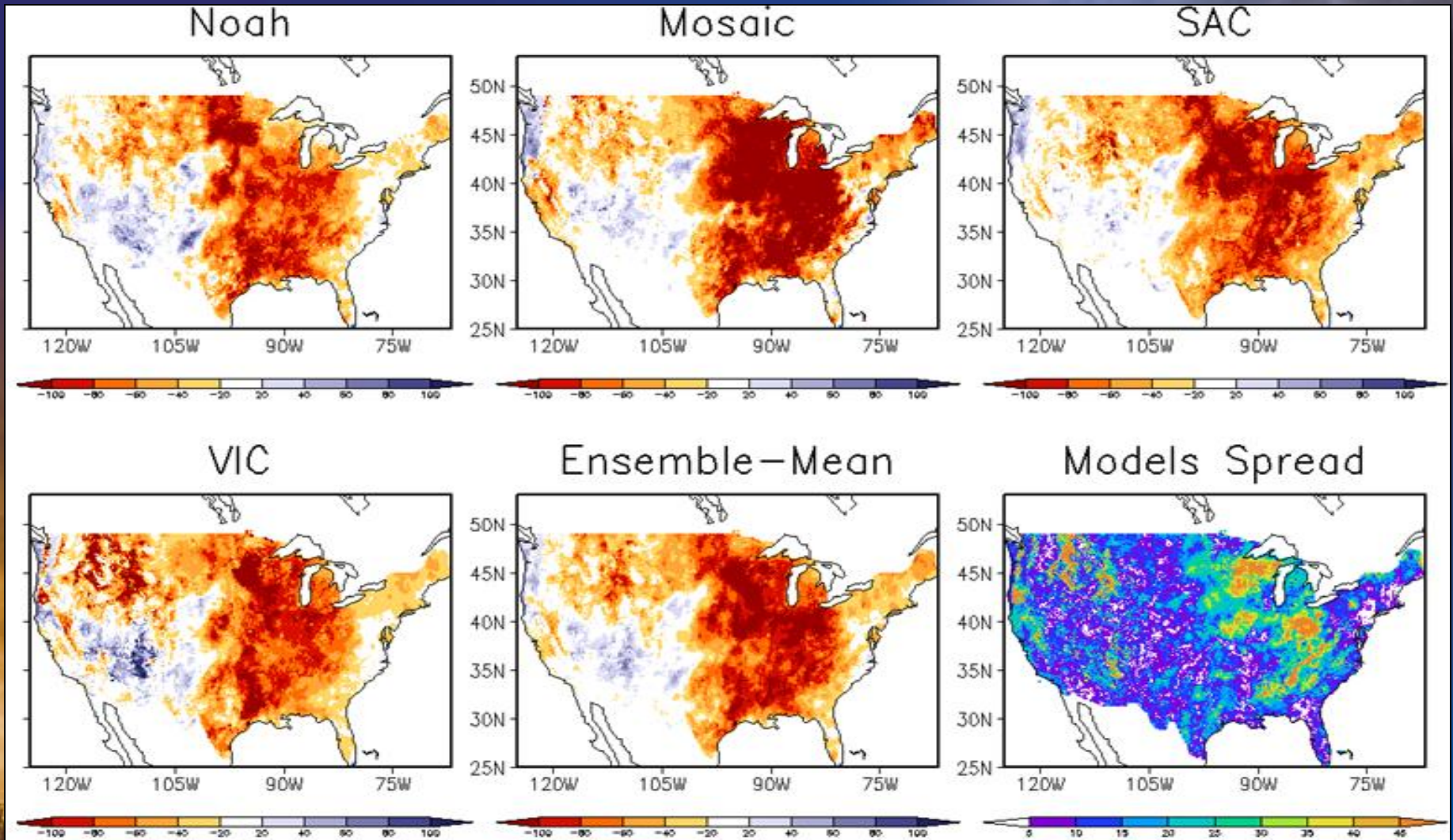


...yields a 30-year NLDAS DAP Reconstruction



June 1988: Drought Year

Monthly total soil moisture anomalies for
NLDAS land models and ensemble mean



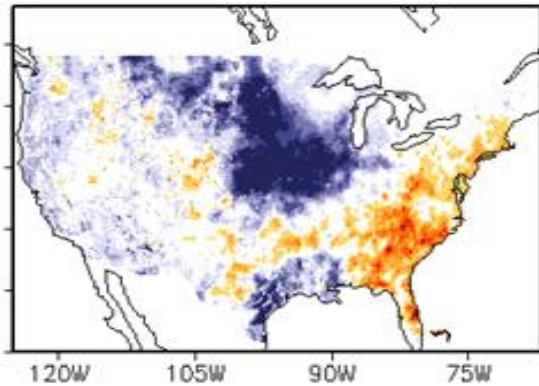


June 1993: Flood Year

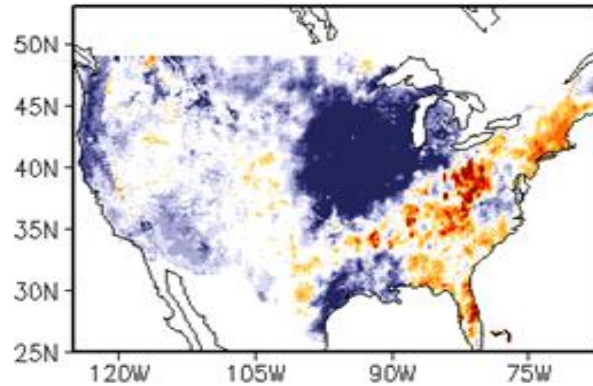
Monthly total soil moisture anomalies for NLDAS land models and ensemble mean



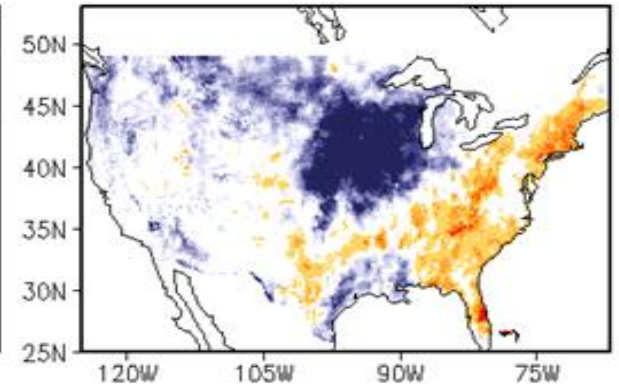
Noah



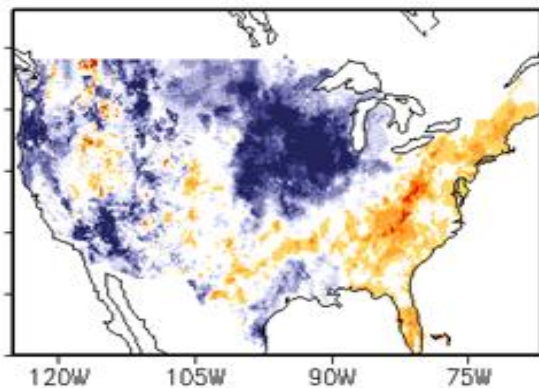
Mosaic



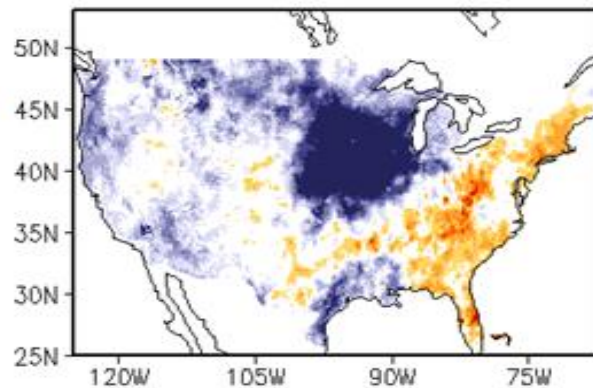
SAC



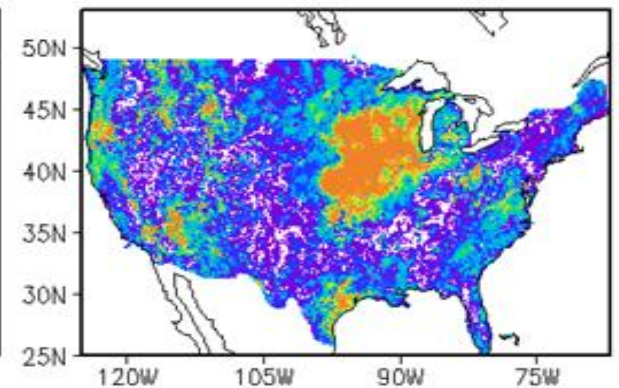
VIC



Ensemble-Mean



Models Spread





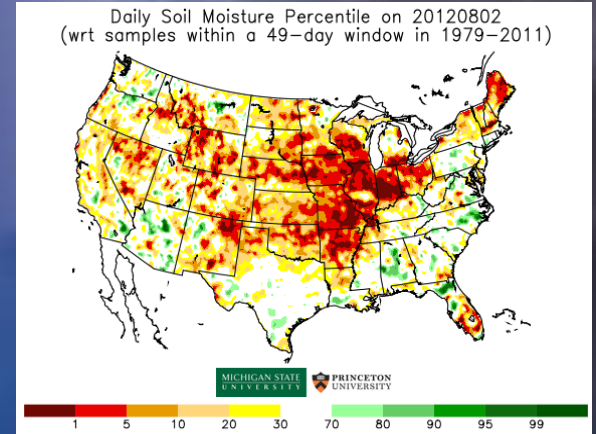
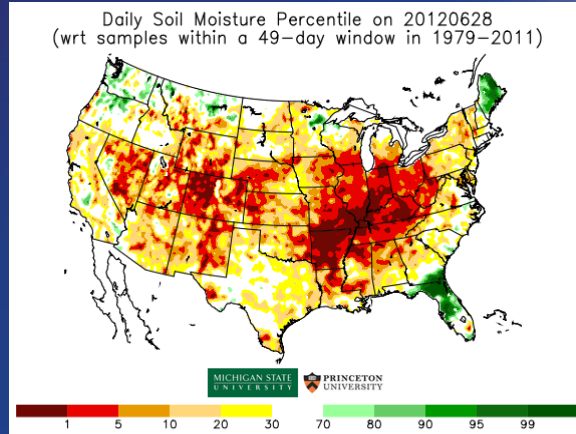
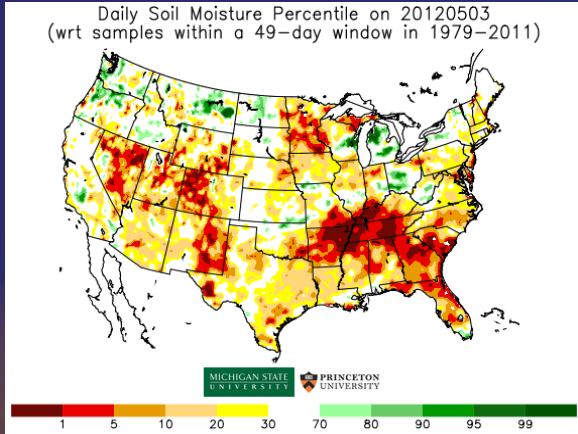
NLDAS Seasonal Hydrological Forecast System



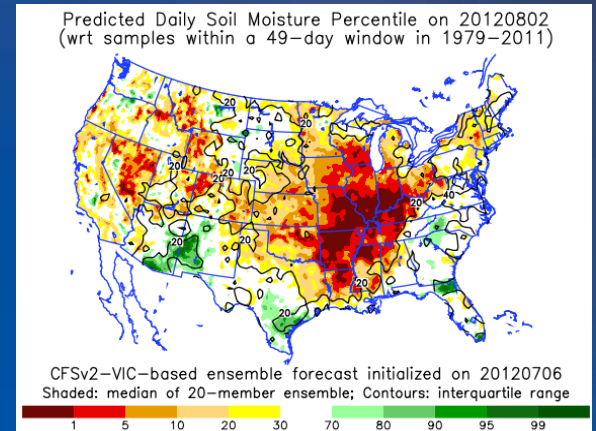
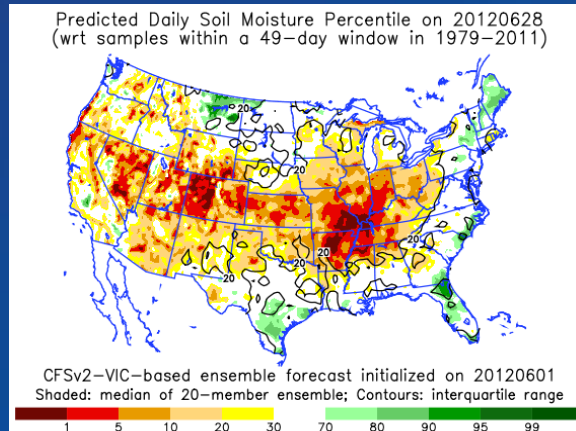
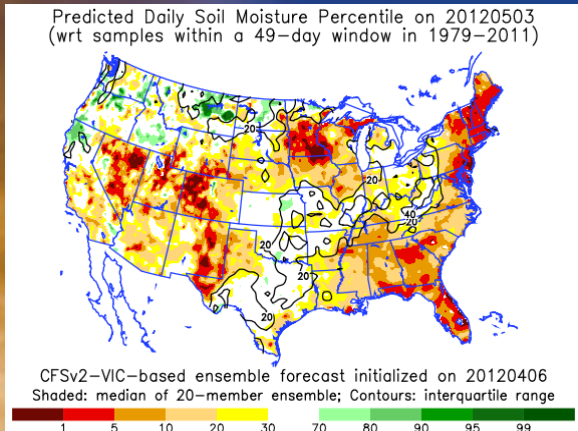
- System uses VIC land model and includes three forecasting approaches for necessary downscaled/ensemble temperature and precipitation forcing data sets: (1) NCEP Climate Forecast System (CFS), (2) traditional ESP, and (3) CPC.
- System jointly developed by Princeton University and University of Washington.
- Transitioned to NCEP/EMC local system in November 2009 as an experimental seasonal forecast system.
- Run at the beginning of each month with forecast products staged on NLDAS website by mid-month.
- For CFS forcing, transitioning from use of CFSv1 to now-operational CFSv2.



Weekly Drought Forecast System Using CFS forcing



Drought Monitoring (top) & Corresponding Monthly Fcst (bottom)



03 May 2012

28 June 2012

02 August 2012



High-Resolution NLDAS

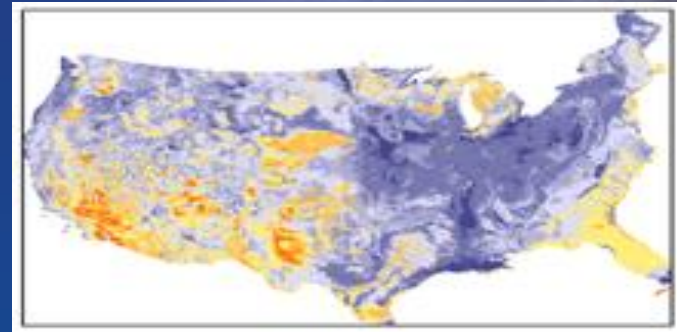
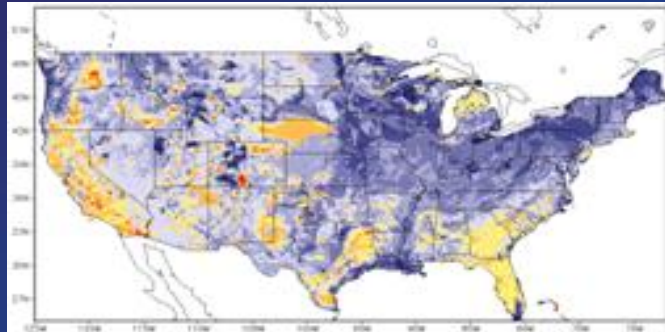
14-km (NLDAS) vs 4-km (HRAP) grid

OHD SAC land model total soil moisture anomalies

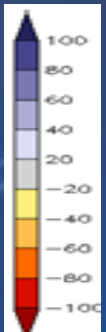
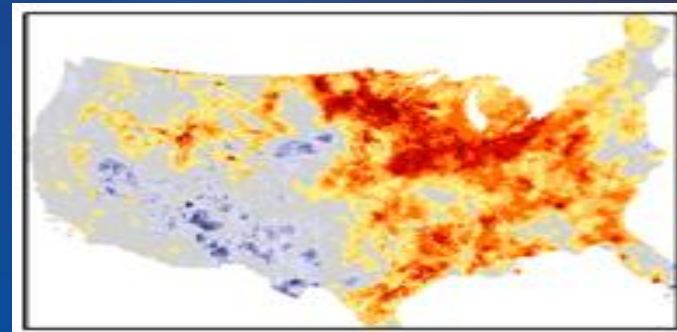
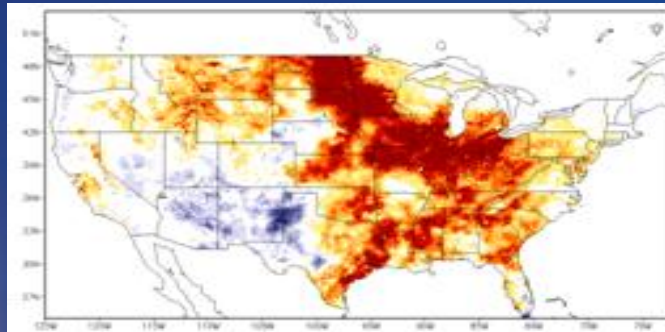
Current NLDAS

HRAP-NLDAS

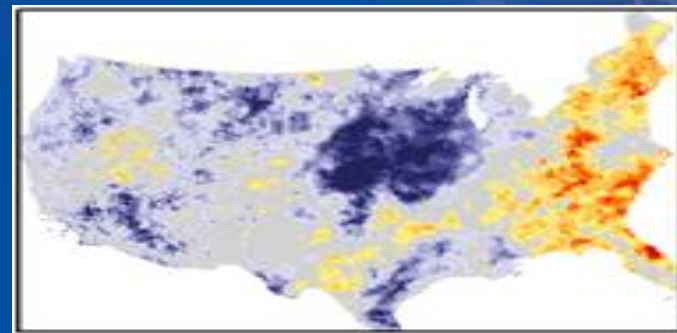
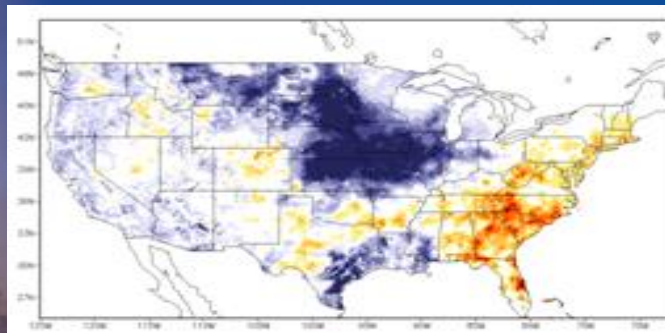
July
climate



July
1988



July
1993

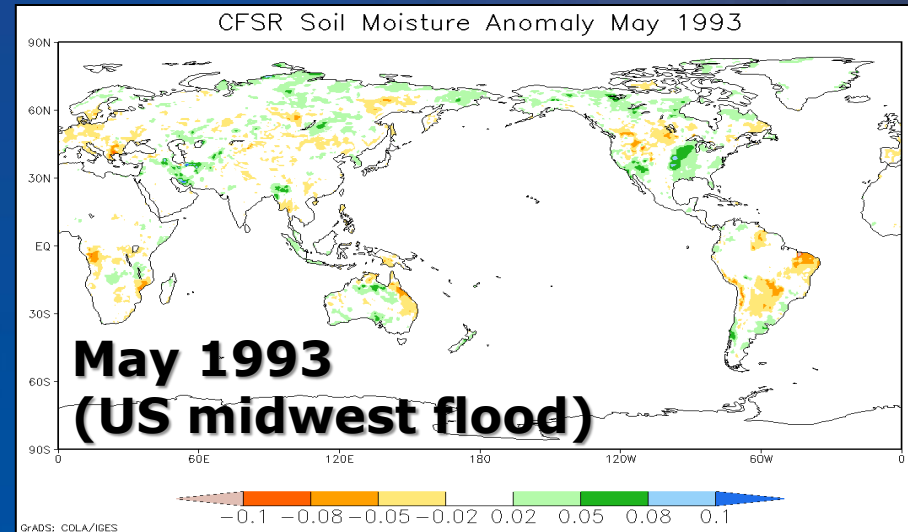
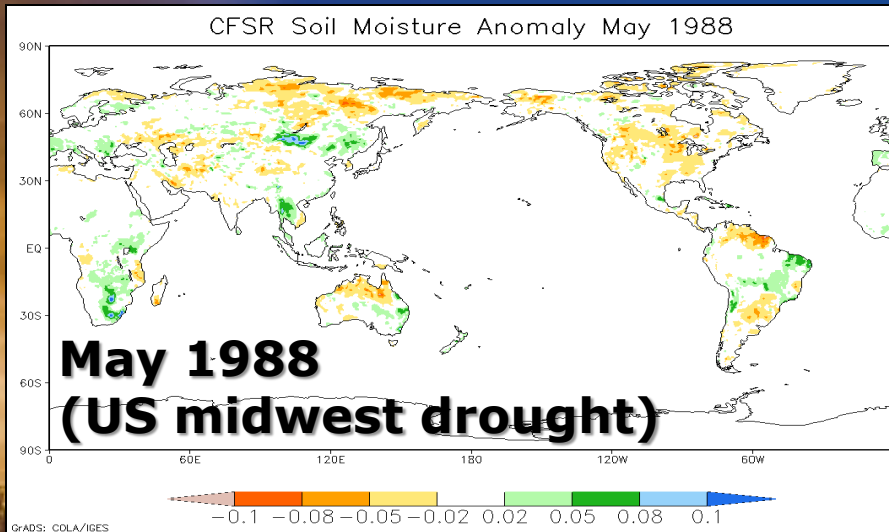
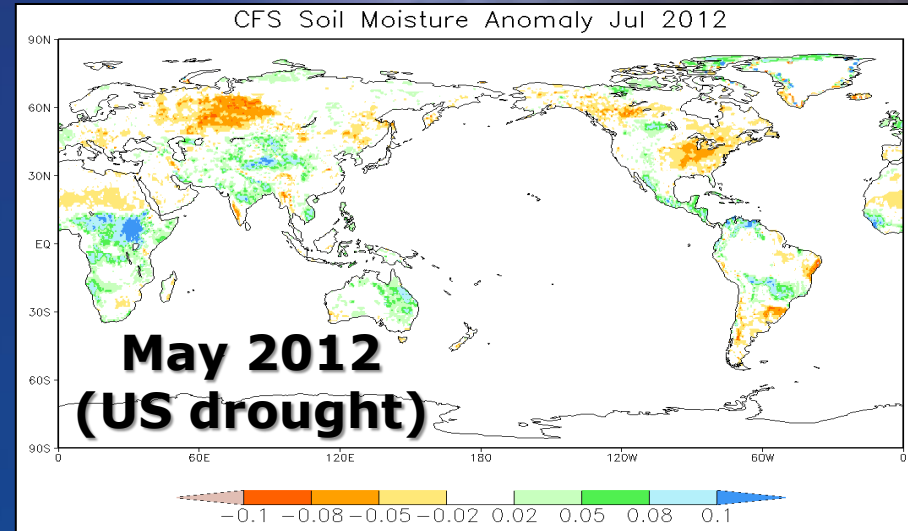




NCEP "Global" Land Data Assimilation System (GLDAS)



- GLDAS part of NCEP Climate Forecast System (CFS); similar to NLDAS; uses CFS atmos forcing and observed precip.
- Part of Global Drought Info. System (GDIS).





Summary and LDAS Future



- NLDAS system for Drought Monitoring over the Continental US –many Partners!
- Transition NLDAS to NCEP Operations “24/7”.
- NLDAS seasonal hydrological/drought prediction; include add’l NLDAS land models.
- Improved land model forcing (e.g. transition to CFS for NLDAS), data sets (e.g. land use, soils), land data assimilation (e.g. snow, veg).
- Higher resolution/downscaling, land “spin up”
- GLDAS for Global Drought Info. Syst. (GDIS).
- Better model physics (e.g. ET in Noah).



Thank You!

We welcome use of NLDAS and GLDAS products

NOAA NLDAS Website:

www.emc.ncep.noaa.gov/mmb/nldas

NASA NLDAS Website:

ldas.gsfc.nasa.gov/nldas

Comments and Suggestions to:

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***HRAP-NLDAS:* jiarui.dong@noaa.gov**

***GLDAS:* jesse.meng@noaa.gov**