NLDAS Contributions to the Operational U.S. Drought Monitor and Prediction

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NLDAS Background

- Monitoring and seasonal prediction mode
- Uncoupled multi-model system
- Long-term project (2000-present and beyond)
- Multi-institution collaboration (NOAA, NASA, PU, UW, UMD, Rutgers U.)
- Multi-grant support (i.e., GAPP, CPPA, MAPP, NASA Terrestrial Hydrology Program)
- R2O task: from research to operation

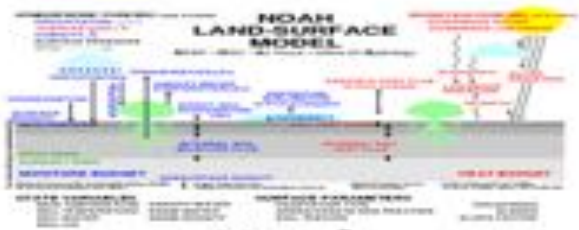
NLDAS
Monitoring Mode

• NLDAS is a multi-model land modeling and data assimilation 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.

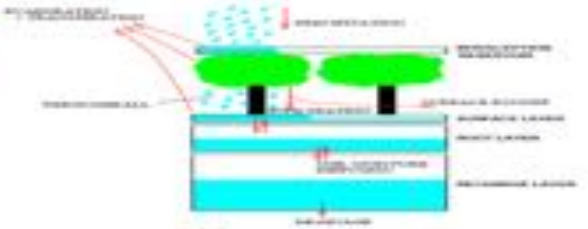
NLDAS Configuration: Land models

- Uncoupled ("offline") simulations.
- Input: atmospheric forcing.
- Output: water/energy budgets (surface fluxes, land states)

Atmospheric Community



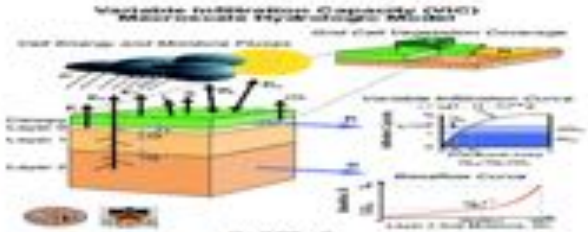
Noah
NCEP operational land model



Mosaic
NASA GSFC

Hydrology Community

SAC
NWS operational hydrological model



VIC
Princeton & U. Washington

NLDAS Data Sets and Setup

NLDAS Configuration: Land data sets

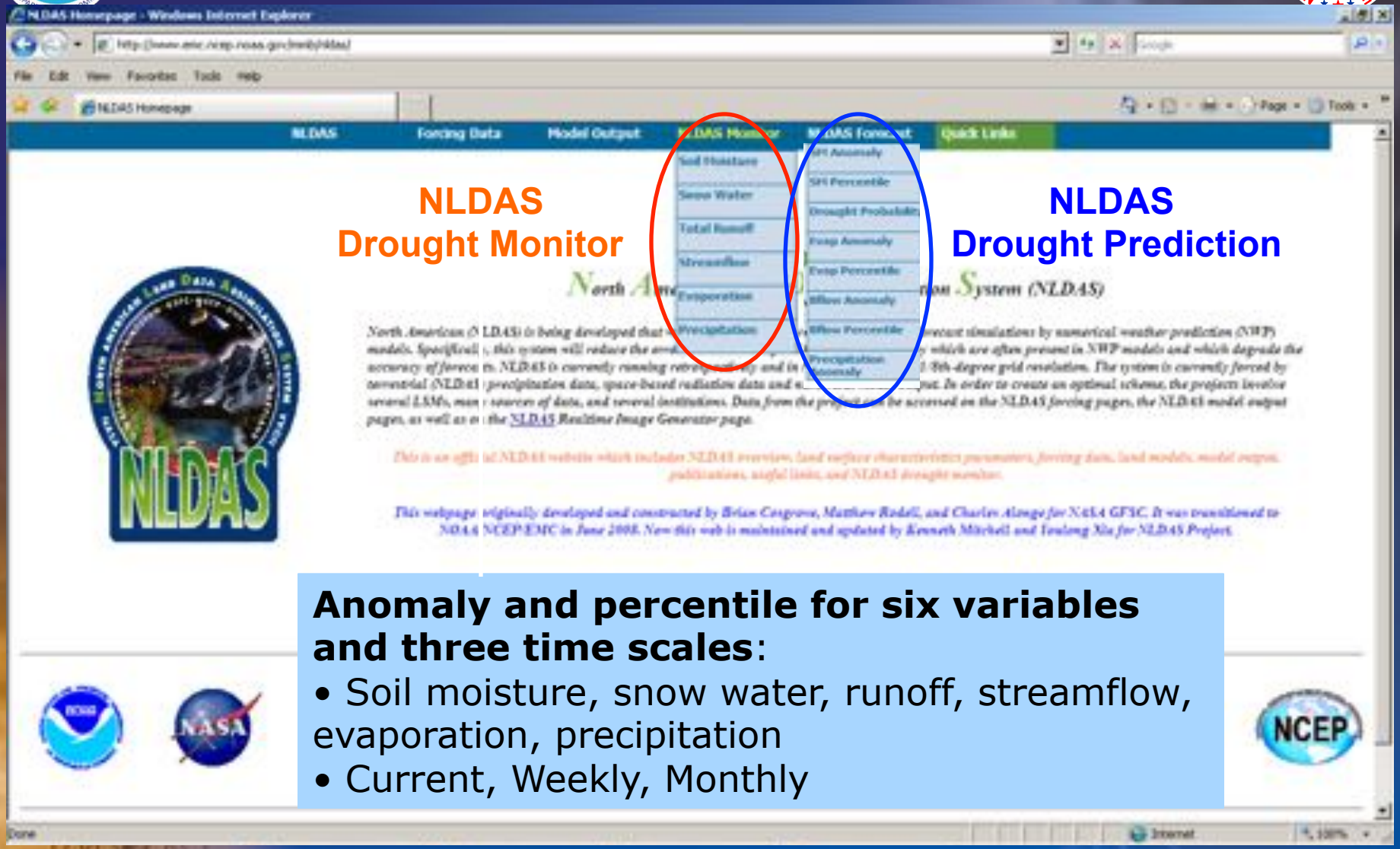
NLDAS Configuration: Forcing data

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

NLDAS website

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

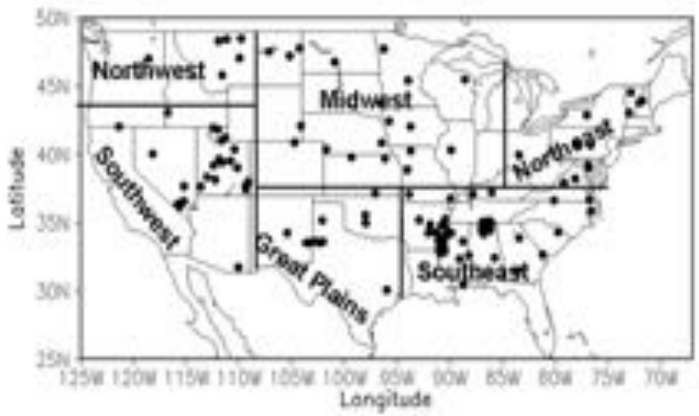


Anomaly and percentile for six variables and three time scales:

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

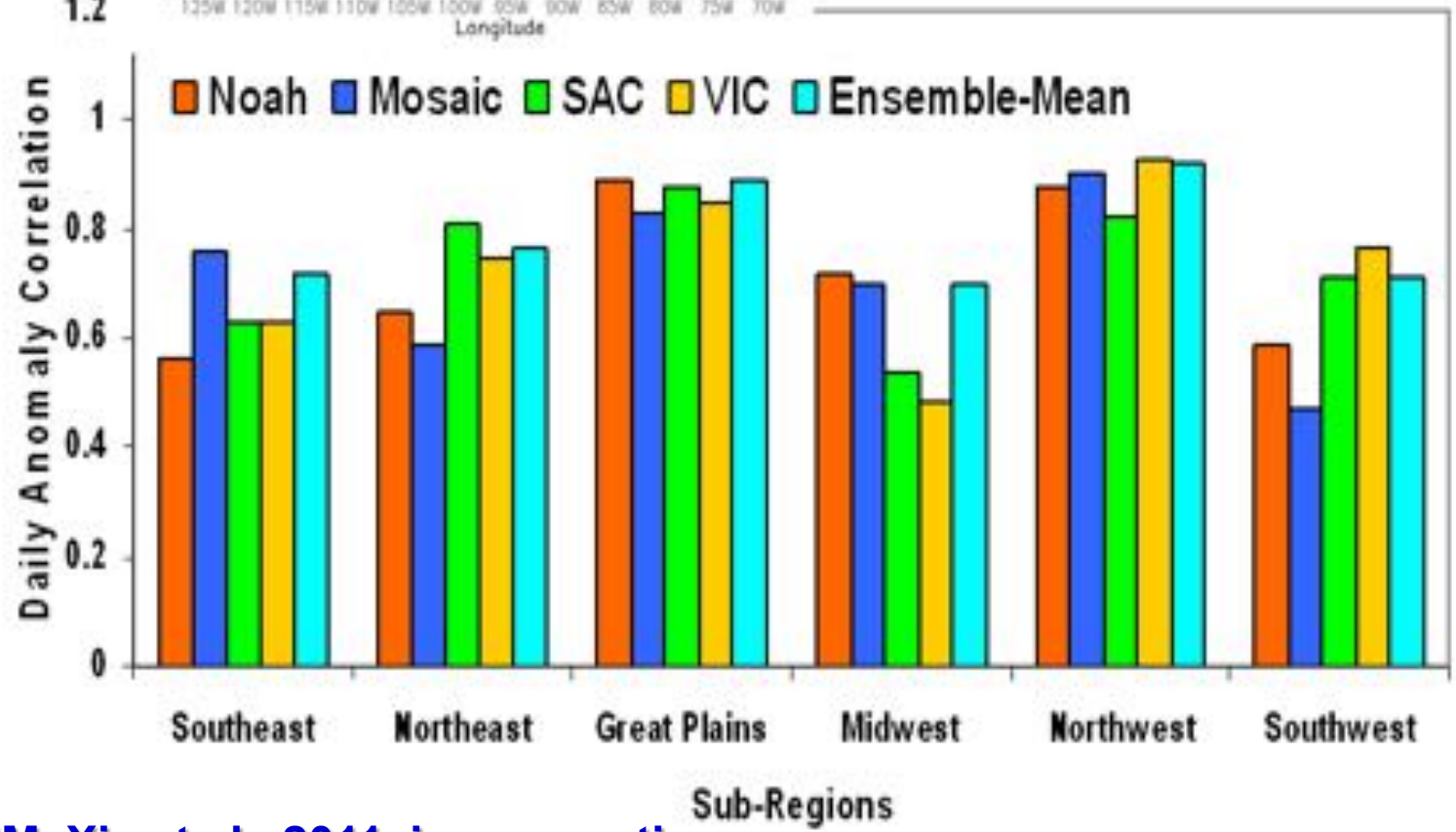
NLDAS Evaluation and Validation

J



Spatial averaged daily top 1m soil moisture anomaly correlation over continental United States

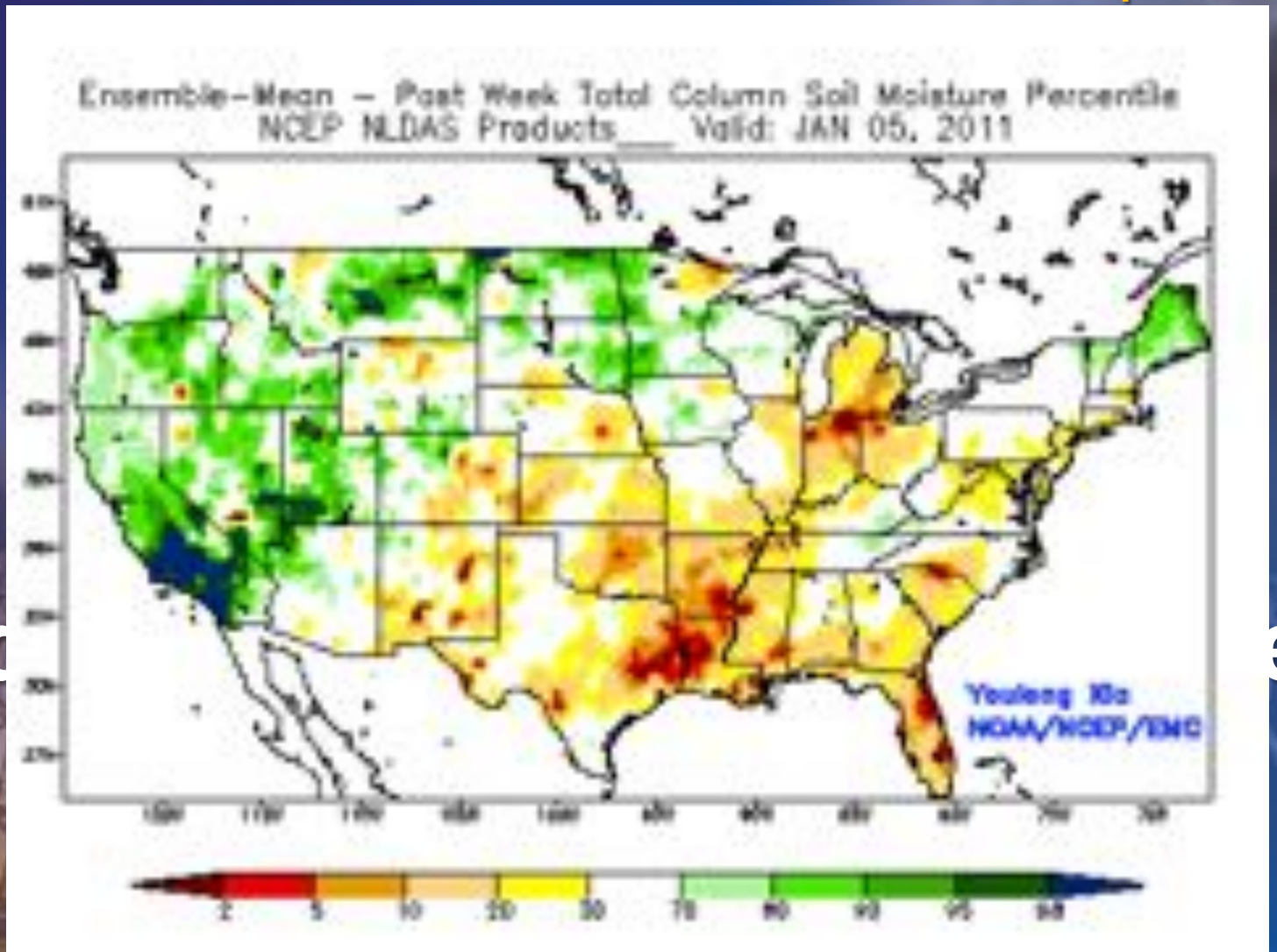
U.S. Soil Climate Analysis Network (SCAN), 1 January 2002 - 31 December 2009



JHM, Xia et al., 2011, in preparation

Texas Drought 2011
Near Real-time Quasi-weekly
Texas Drought Monitoring (D0 yellow – D4 red)

Four-model ensemble mean total column soil moisture percentile

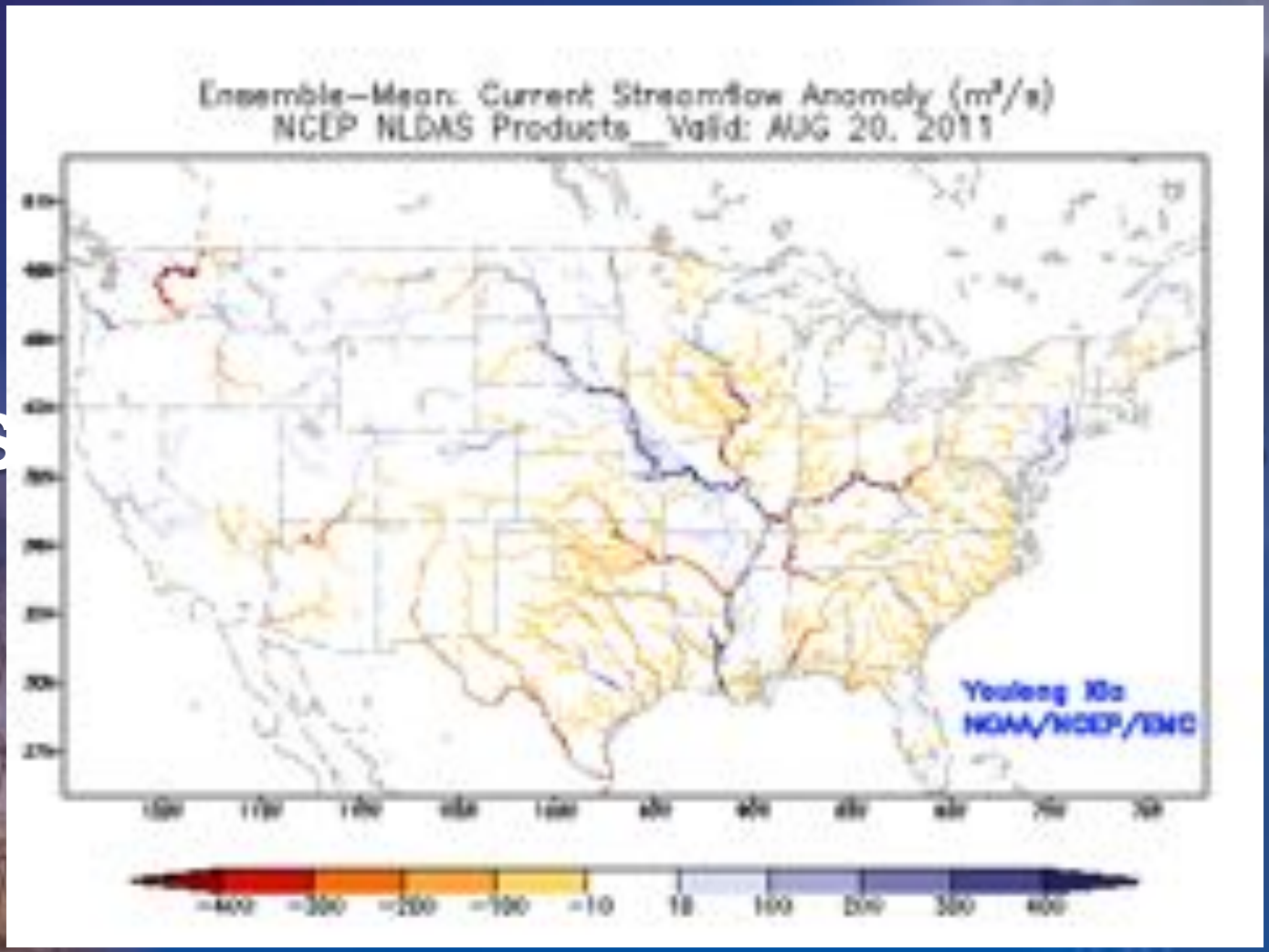


Northeast Flood 2011 Monitoring

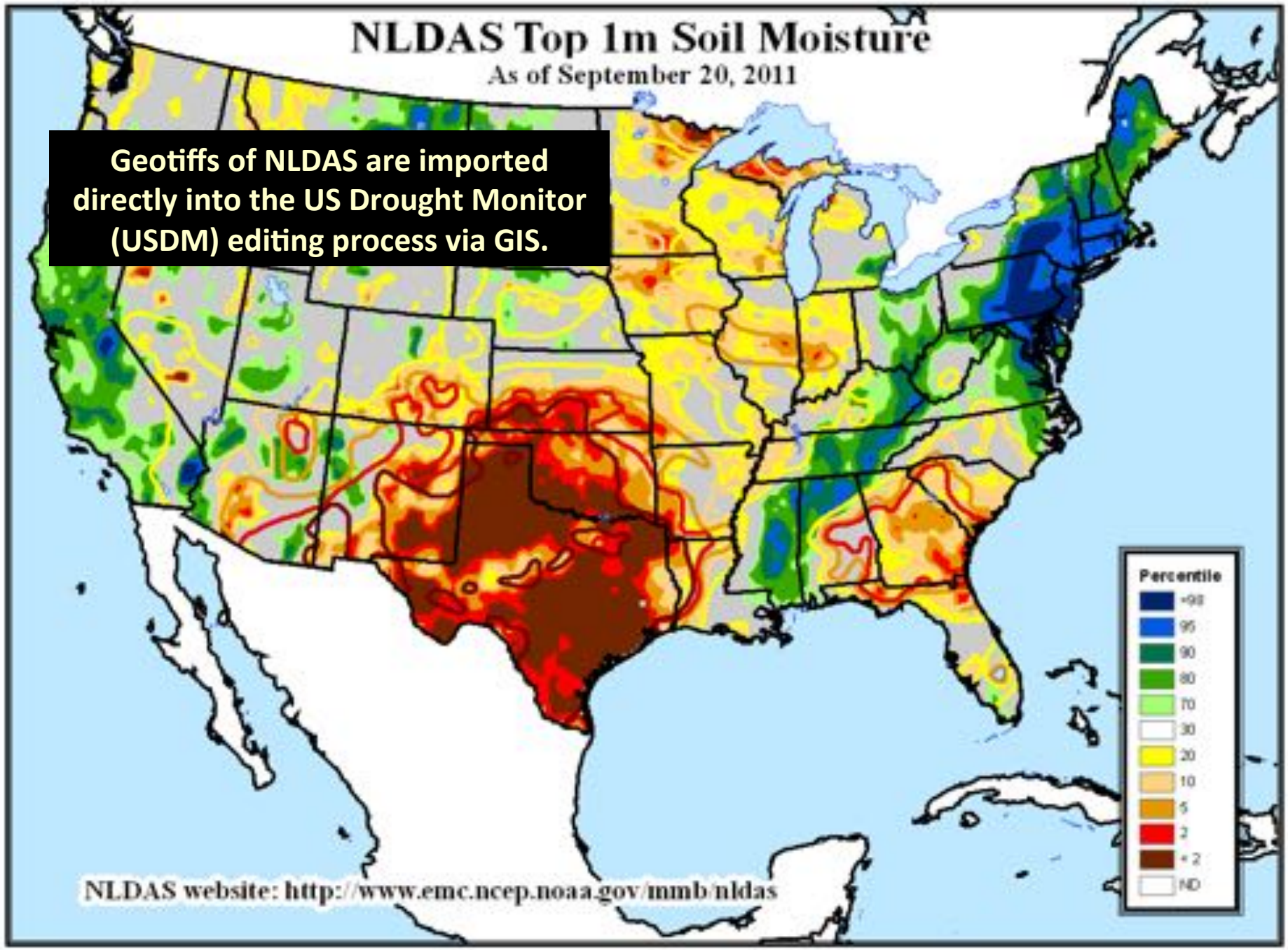
Impact of hurricane Irene and tropical storm Lee

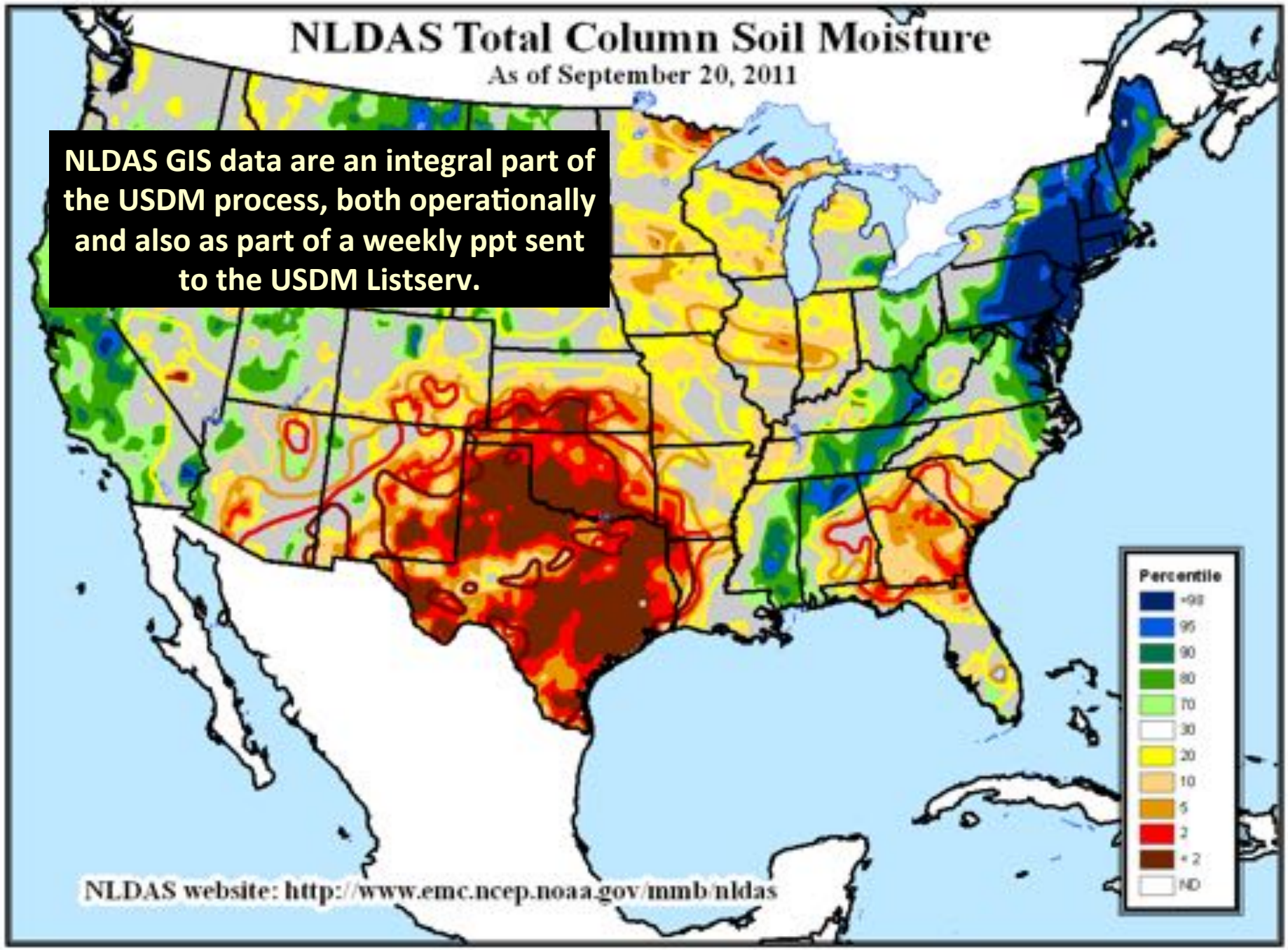
Ensemble mean daily streamflow anomaly (m^3/s)

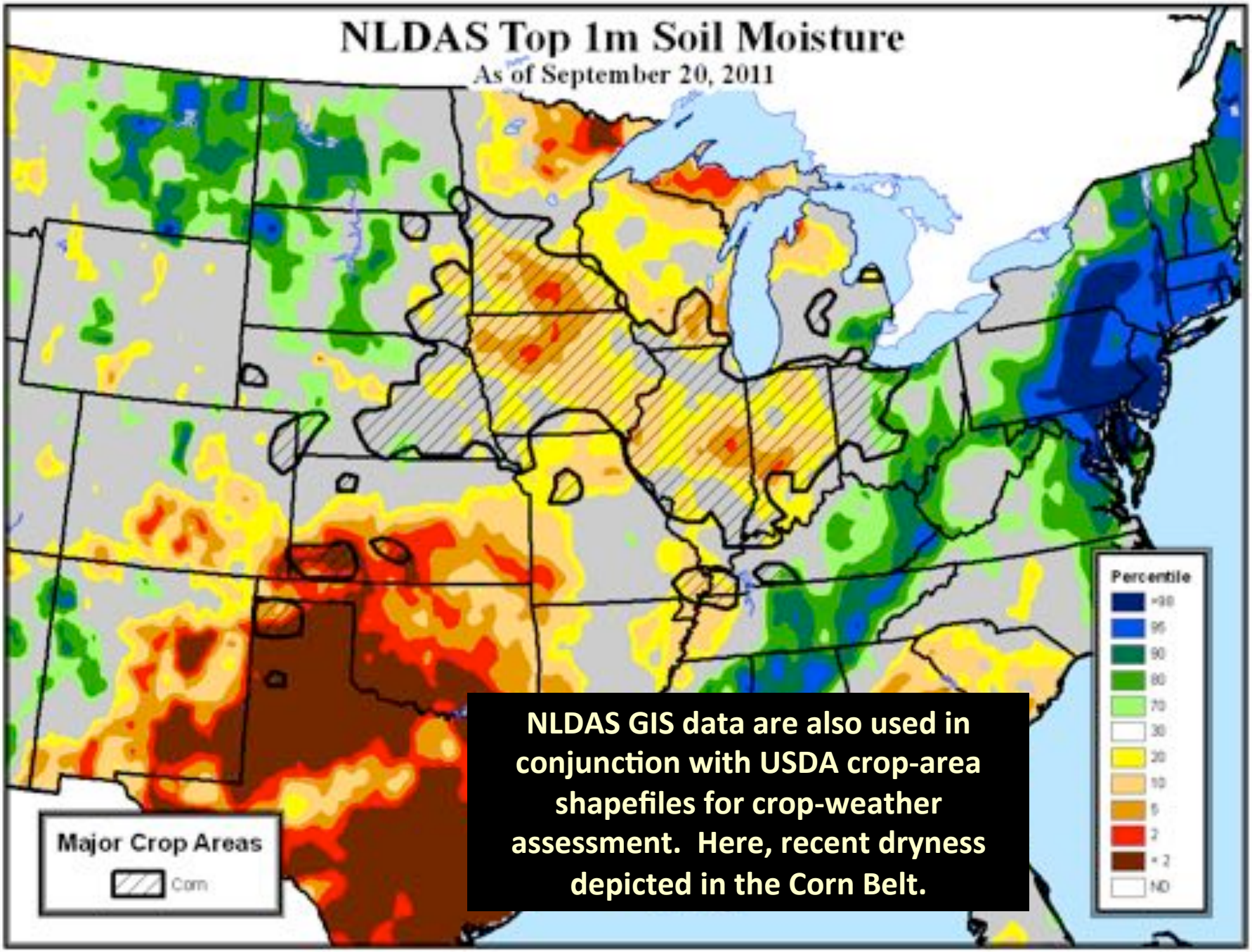
20 August – 17 September

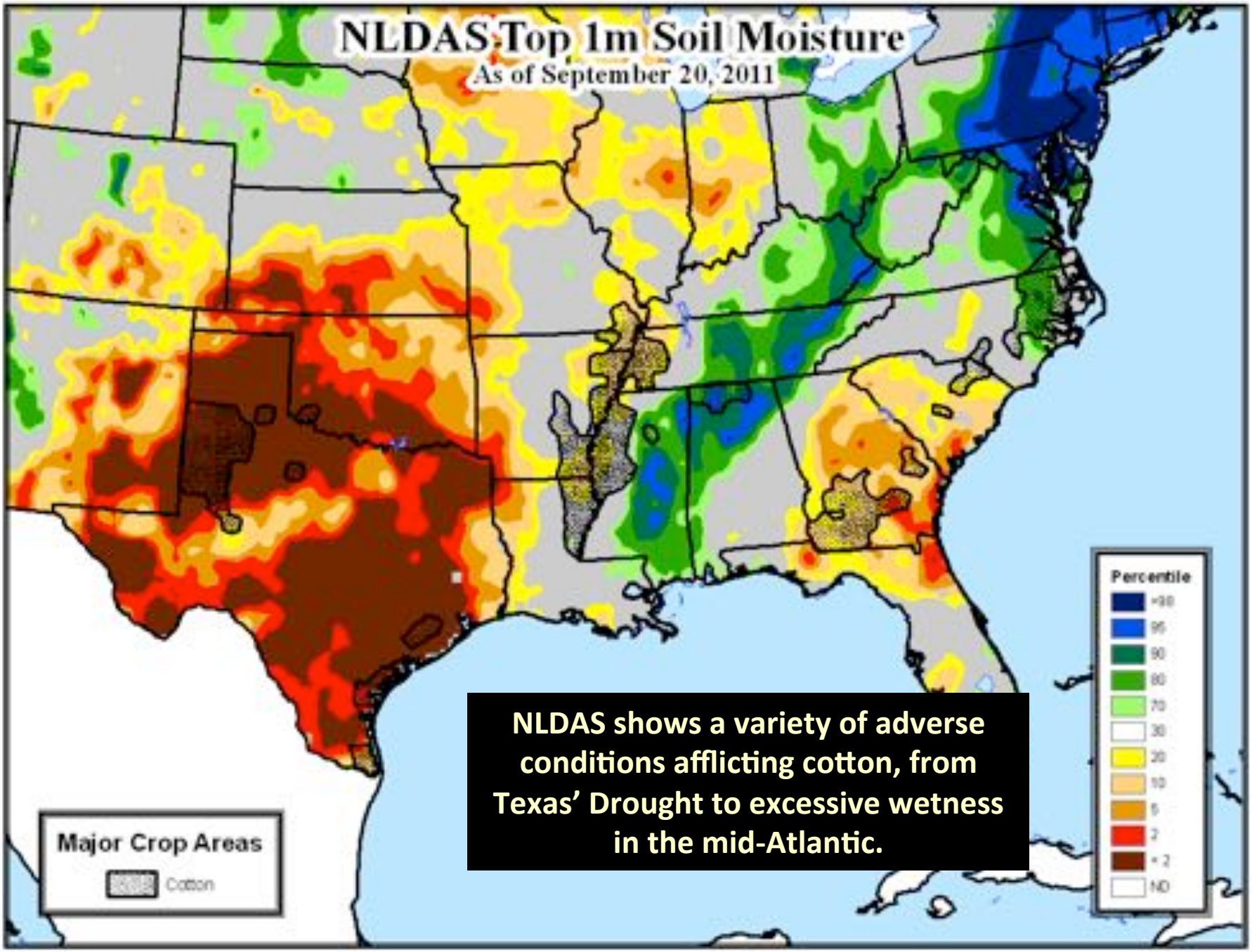


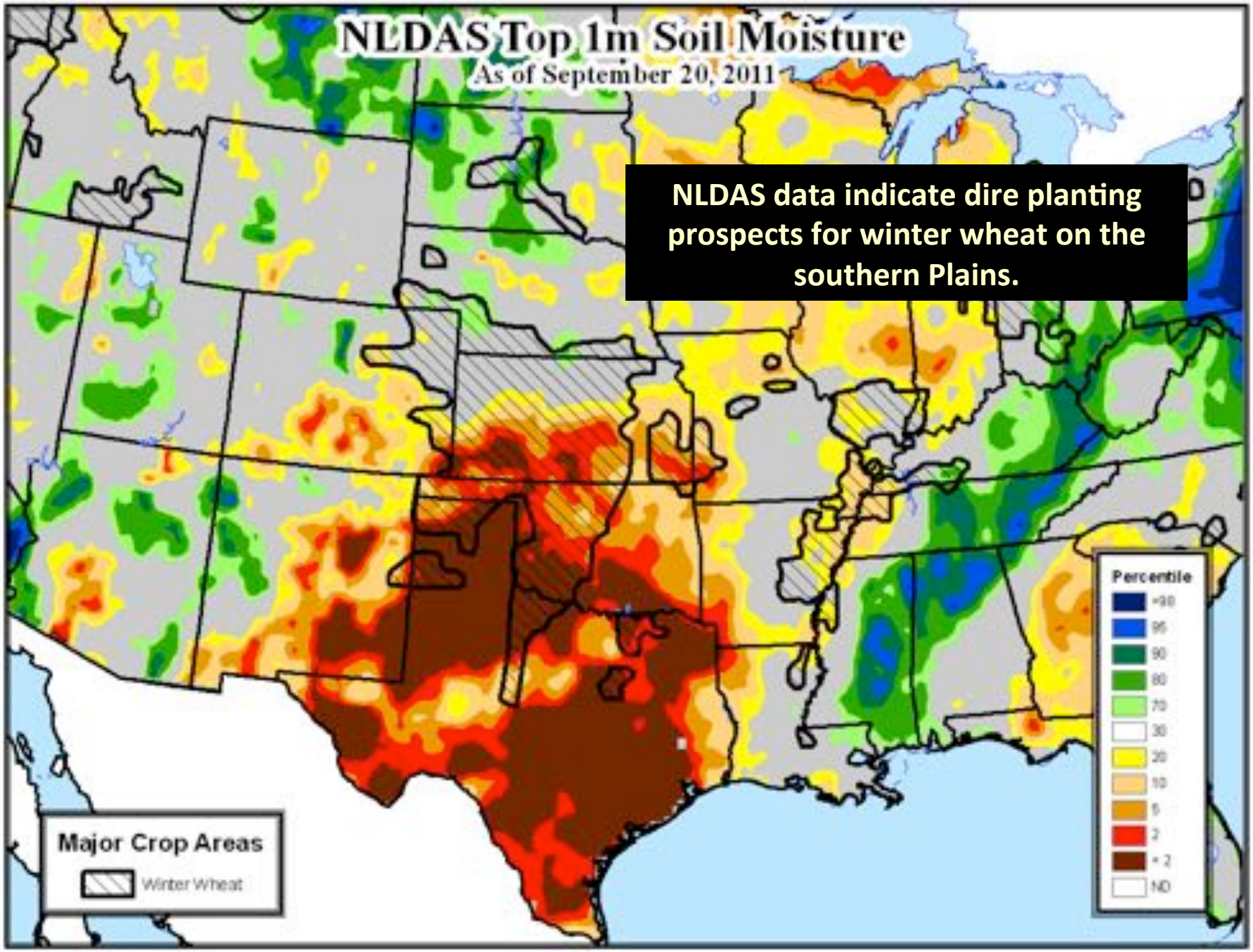
U.S DA


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.
Percentile
>98
95
90
80
70
30
20
10
5
2
< 2
ND
NLDAS website: http://www.emc.ncep.noaa.gov/mmb/nldas

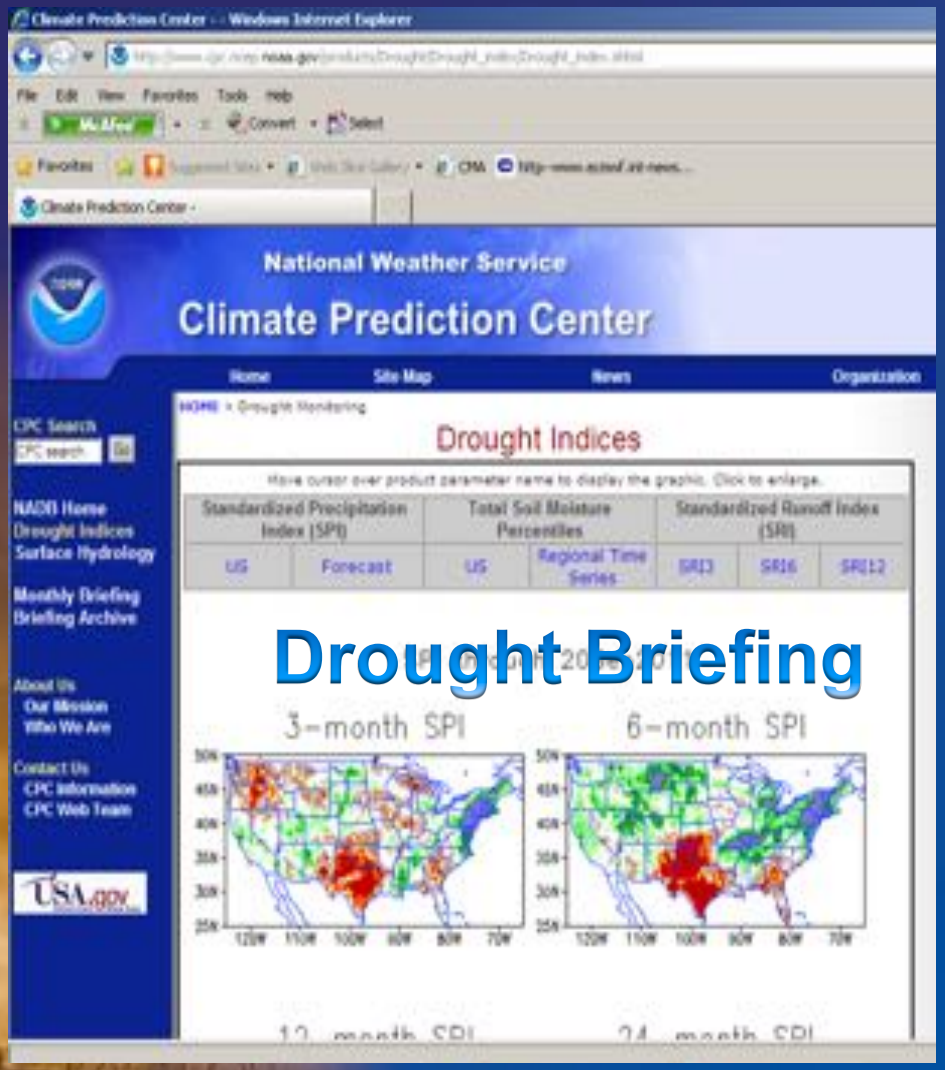

NLDAS Total Column Soil Moisture
As of September 20, 2011
NLDAS GIS data are an integral part of the USDM process, both operationally and also as part of a weekly ppt sent to the USDM Listserv.
Percentile
95
90
80
70
30
20
10
5
2
ND
NLDAS website: http://www.emc.ncep.noaa.gov/mmb/nldas

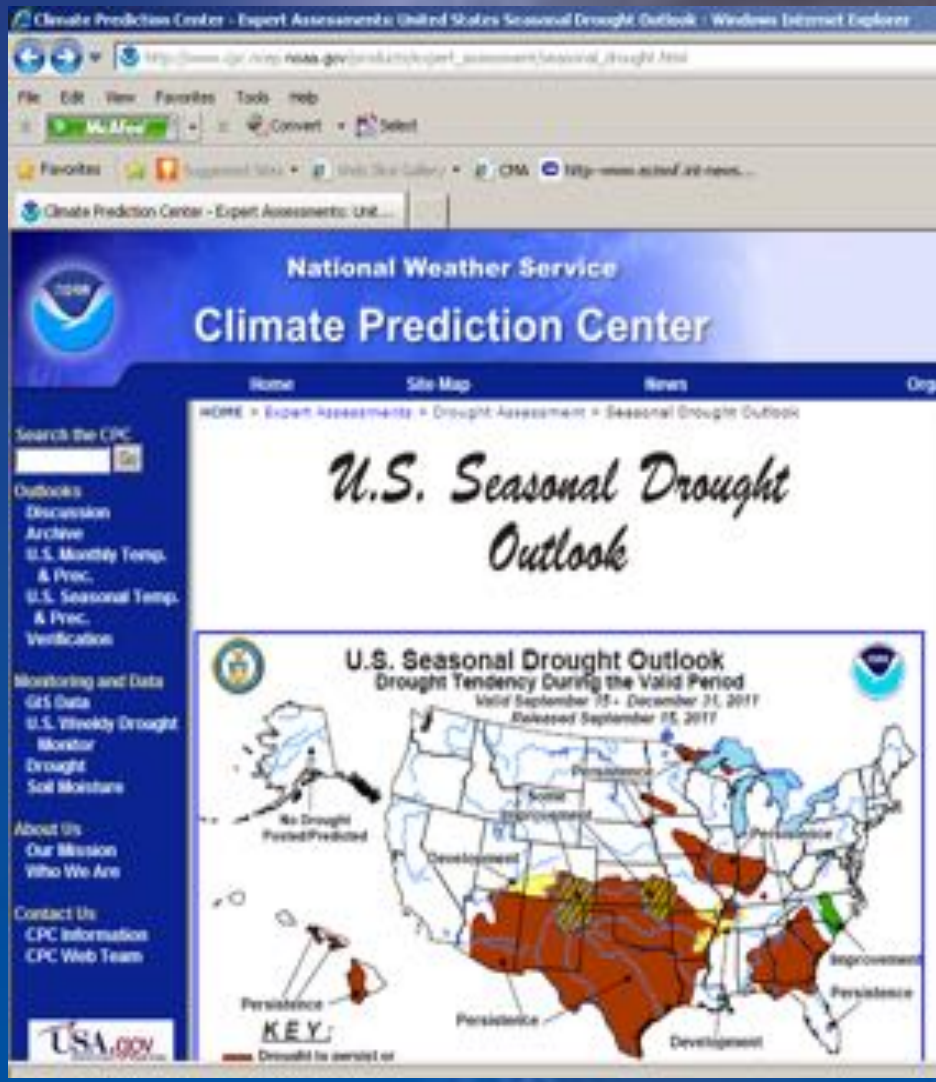

NLDAS Top 1m Soil Moisture
As of September 20, 2011
Major Crop Areas
Corn
Percentile
>98
95
90
80
70
30
20
10
5
2
< 2
ND
NLDAS GIS data are also used in conjunction with USDA crop-area shapefiles for crop-weather assessment. Here, recent dryness depicted in the Corn Belt.


NLDAS Top 1m Soil Moisture
As of September 20, 2011
Percentile
>98
95
90
80
70
30
20
10
5
2
< 2
ND
Major Crop Areas
Cotton
NLDAS shows a variety of adverse conditions afflicting cotton, from Texas' Drought to excessive wetness in the mid-Atlantic.


NLDAS Top 1m Soil Moisture
As of September 20, 2011
NLDAS data indicate dire planting prospects for winter wheat on the southern Plains.
Percentile
>98
95
90
80
70
30
20
10
5
2
< 2
ND
Major Crop Areas
Winter Wheat

NLDAS Support for NCEP/CPC Drought Monitoring and Assessment Activity





NLDAS Past, Present , and Future

Monitoring Mode

Past:

Phase 1 (2000-2005) – to establish NLDAS configuration, model evaluation framework, and collaboration partners.

Phase 2 (2006-2010) – to make long-term (30 years) retrospective NLDAS run using the improved forcing and models, to establish a quasi-operational NLDAS system to support NIDIS activities, and to assess NLDAS products using observations.

Present:

Phase 3 (2011-2014) – to maintain a quasi-operational NLDAS system, to transition all codes and scripts to NCEP central computer system, and to implement NLDAS system into NCEP operation.

NLDAS Past, Present , and Future

Monitoring Mode

Future:

EMC will maintain two NLDAS systems: operational version (current) and research version. Any upgrades from both forcing and models from research community will be quickly implemented to the research version to make an internal test on EMC local server and/or NCEP CCS computer.

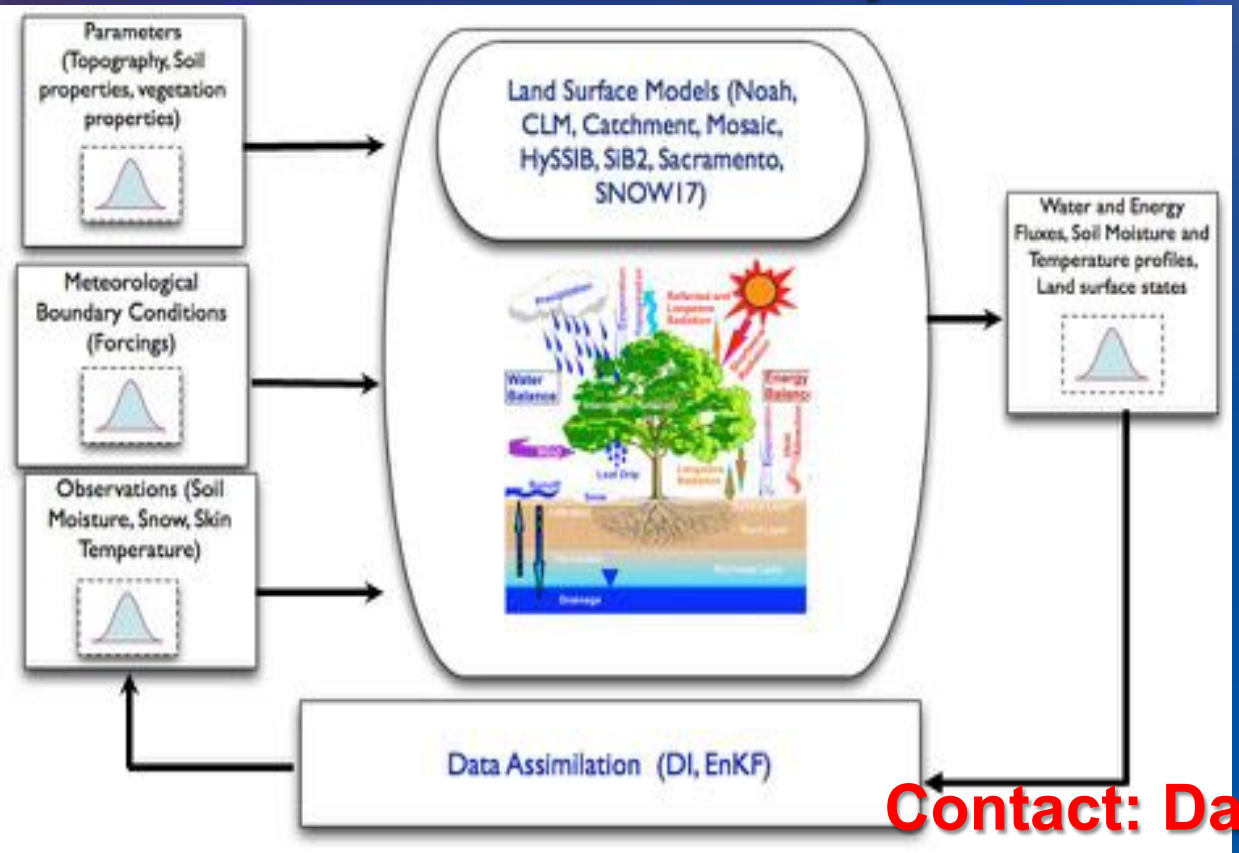
EMC will collaborate NASA/GSFC to install LIS to NLDAS system to construct a real data assimilation system to assimilate observed data from both in-situ and remote sensing.

EMC will collaborate with NWS/OHD to extend a fine scale (~4 km) NLDAS system.

NLDAS development & evaluation using the Land Information System (LIS)

NLDAS LSMs will be upgraded to the latest model versions (Noah3.2/3.3, Noah-MP, GMAO's Catchment, etc.) within the Land Information System (LIS) framework, which will allow data assimilation of soil moisture and snow products to help improve drought diagnosis in NLDAS. NLDAS products and drought monitoring skill will be evaluated using numerous observations.

The Land Information System



Using NLDAS-2 forcing in LIS with Noah3.2, Peters-Lidard et al. (2011, *Hydrological Processes*, submitted) showed an improvement of the RMSE of latent heat flux when using data assimilation of remotely-sensed soil moisture as compared to gridded FLUXNET ET data (Jung et al., 2010).

Contact: David.Mocko@nasa.gov

Enhancement of high resolution hydrological modeling on the CONUS HRAP grid using operational NOAA NCEP and NOAA OHD models

The study has three main components which together provide a comprehensive suite of modeling-related improvements enabling both improved NOAA/NWS/OHD and NCEP hydrological and land surface forecasts and analyses, as well as investigations into land-atmosphere interactions:

I. Model Support-Related Improvements
   - Improved downscaling of 1/8th degree NLDAS forcing to 4km HRAP grid
   - Enhanced spin-up strategies for retrospective and real-time simulations

II. Model Component Improvements
   - Improved snow assimilation modules for Noah and SAC-HT/Snow17
   - High-resolution routing capability for Noah and SAC-HT in LIS
   - Testing of NOAA ET physics in SAC-HT
   - Testing of improved sub-surface runoff modeling in SAC-HT
   - Integration of dynamic parameter calculation module into Snow17
   - Enhanced Noah bundle upgrades including snow albedo, ground water treatment.

III. Model Output
   - Production of 31-year 4km retrospective SAC-HT/Noah simulations
   - Validation of model output
   - Operational application of retrospective simulations

Contact: Jiarui.Dong@noaa.gov

NLDAS Past, Present , and Future

Monitoring Mode

Prospective:

EMC will extend the NLDAS system from NLDAS domain to whole north America. The purpose is to support for North American Drought Monitor.

EMC will collaborate NCEP/CPC and the other NLDAS partners to further extend NLDAS system from whole north America to the globe to support Global Drought Monitor being initiated by multi-countries as EMC has developed its own CFS-GLDAS system.

EMC will collaborate with its partners to improve land surface models (physics) and test the role of NLDAS initial conditions in coupled models.

NLDAS
Prediction Mode

A Briefing
Eric Wood's two oral talks will give more details

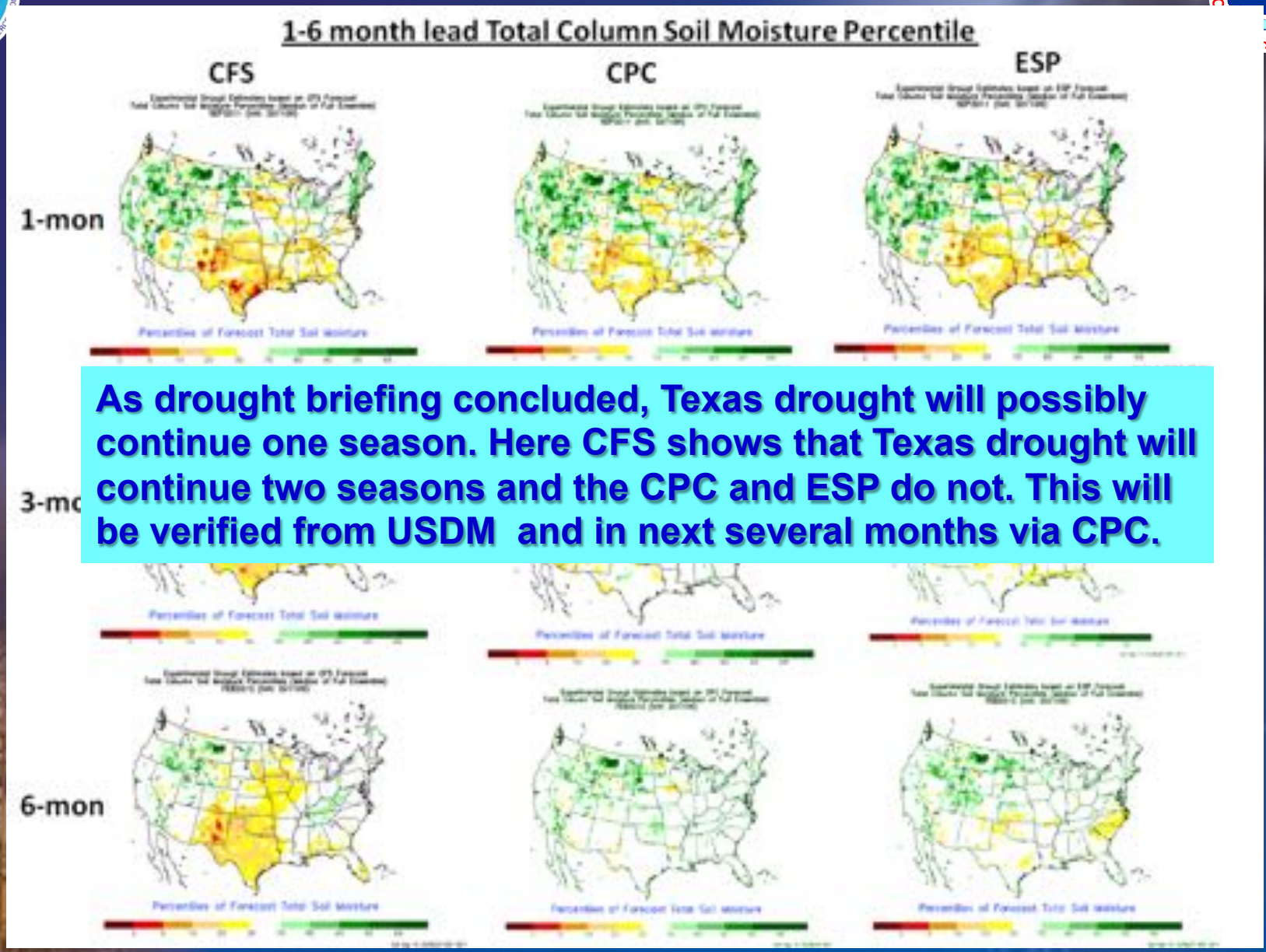
NLDAS Seasonal Hydrological Forecast System

This system was jointly developed by Princeton University and U. Washington. It has been transitioned to EMC local server as an experimental seasonal forecast system in November 2009. The system includes three approaches: (1) CFS forecast, (2) traditional ESP forecast, and (3) CPC forecast.

The system is run at the beginning of each month and forecast products are staged on NLDAS website by 15th of each month.

Current system uses CFSv1, and will be upgraded to CFSv2.

One example based 1 September 2011 IC



As drought briefing concluded, Texas drought will possibly continue one season. Here CFS shows that Texas drought will continue two seasons and the CPC and ESP do not. This will be verified from USDM and in next several months via CPC.

EMC and CPC's participation in NLDAS Prediction Mode

Seasonal hydrological system will be extended and assessed by a CTB project (PI: Eric Wood). As its collaborators,

(1) EMC (Mike Ek, Youlong Xia) will continue to run transitioned system (CFSv1) in quasi-operational mode to support CPC's drought briefing and seasonal drought outlook and will prepare to run its upgrade version (CFSv2).

(2) EMC will collaborate with CTB PIs to move the system to CTB computer. EMC will make internal test and evaluation for this system.

(3) EMC will collaborate with Lifeng Luo via CTB to add SAC-HT and Noah to this system.

(4) CPC (Kingtse Mo) will perform its verification and assessment studies

Thank You!

Welcome to use NLDAS products

NOAA NLDAS Website

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

NASA NLDAS Website

http://ldas.gsfc.nasa.gov/nldas/

Comments and Suggestions to:

NLDAS: Youlong.Xia@noaa.gov, Michael.Ek@noaa.gov