# Drought Monitoring CPC and NWS

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NOAA/NWS/NCEP/CPC

# Current Work at CPC and NWS

- Objective drought characterization
- Data download/display
- New Products

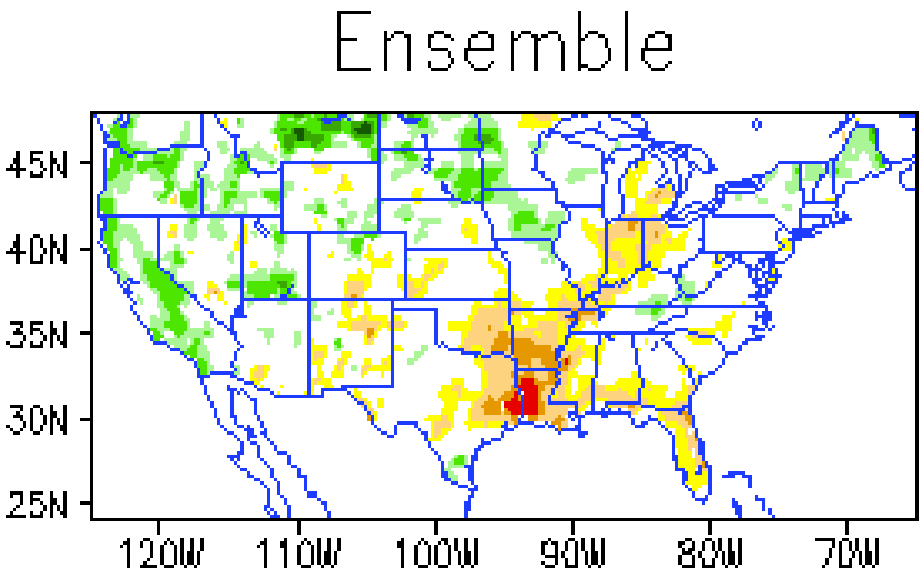
# Objective Drought Monitoring

- NCEP/EMC:
  - Four models: Noah, VIC, Mosaic and SAC
  - Climatology: 1979-2008
  - On 0.125 degrees grid
  - P forcing: CPC analysis - gauges with the PRISM correction.
  - Other atmospheric forcing: From the NARR
- University of Washington
  - Four models: Noah, VIC, SAC and CLM (different versions)
  - Climatology: 1915-2008
  - On 0.5 degrees grid
  - P, Tsurf and low level winds – from NOAA/NCDC co-op stations
  - P from index stations

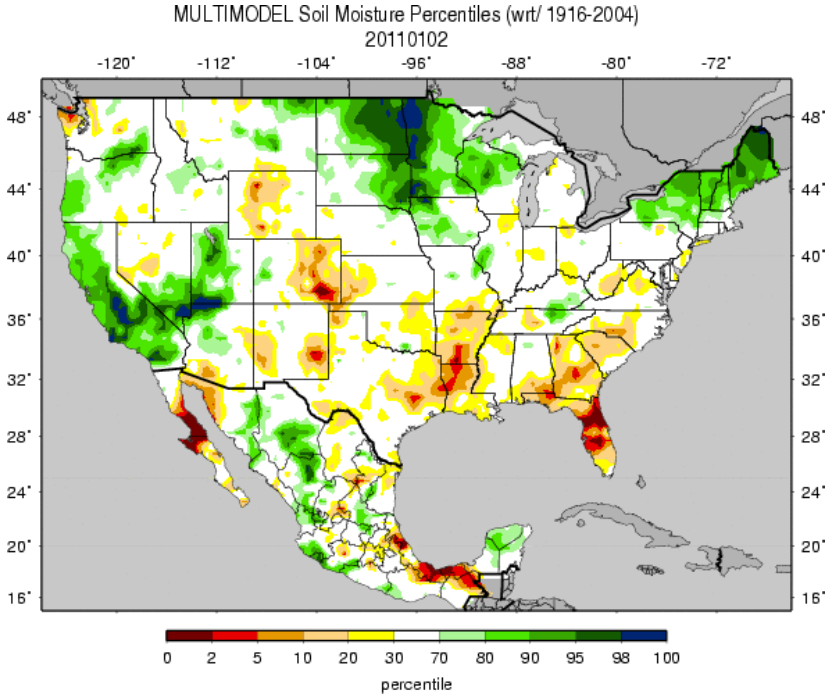
# Systems capture the same event. Same category?

## Multi model ensemble SM %

EMC




U Washington




1. Similar Pattern, different magnitudes.
2. Over Dakotas and Minnesota, percentiles are higher on the UW map,
3. Over the Southeast, UW percentiles are also higher

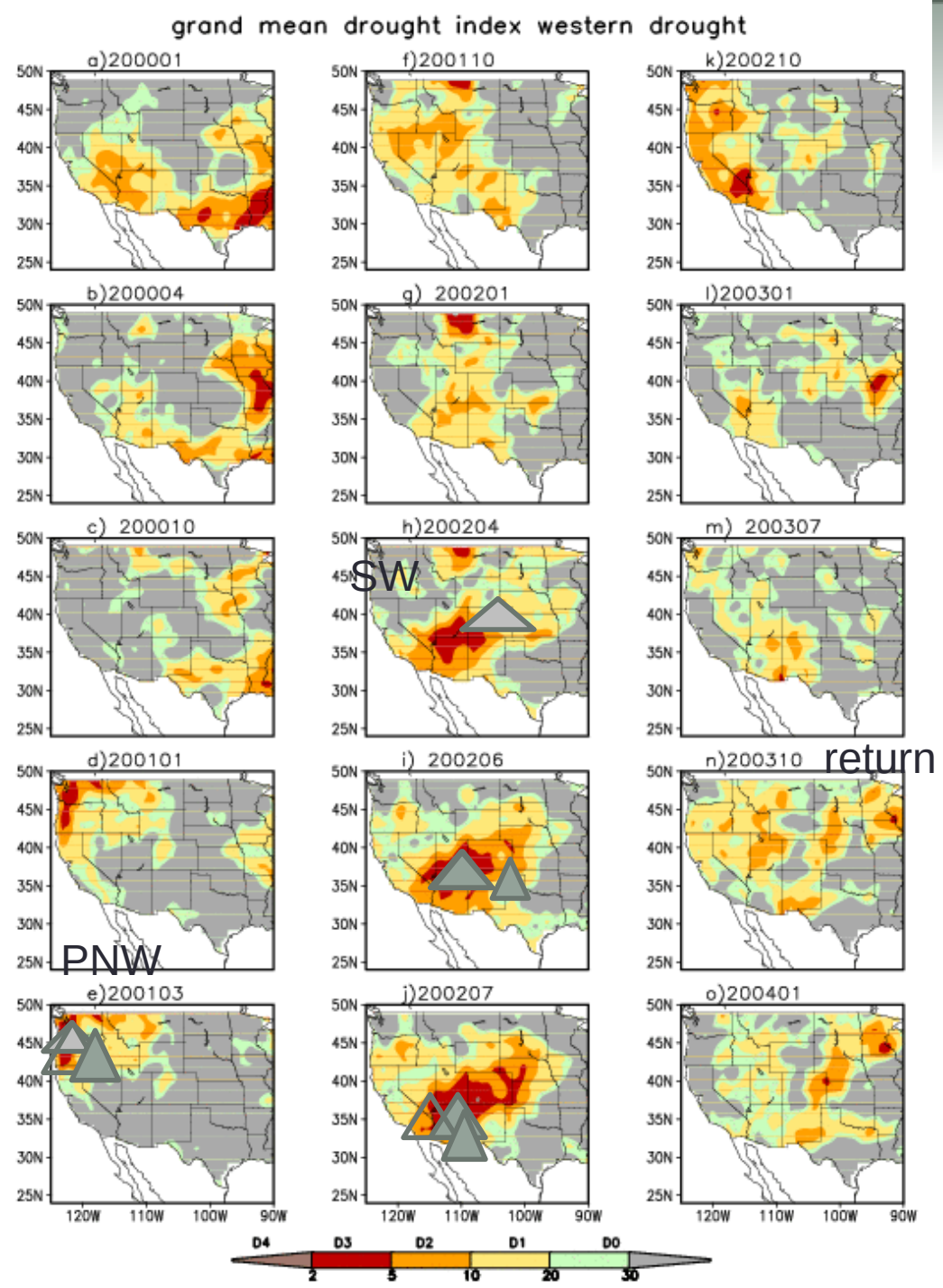
# Challenges

- Large uncertainties in the drought indices
  - Always a question of how to depict the final map when indices/measurements disagree.
- Uncertainties come from
  - Different NLDAS systems, land models, input data
  - Different time-scales of indices
    - e. g. SM may lag the SPI6 at the onset / demise stage of drought
- Proposed solution - Probabilistic

# Procedure

## Grand mean index

- Form ensemble mean for P, SM and runoff
- Calculate the drought index (SPI6, SMP and SRI3) from the corresponding mean time series
- Put indices in percentiles
- grand mean index=> Equally weighted mean of 18 indices
- Calibrate the grand mean so the mean=0 and std=1



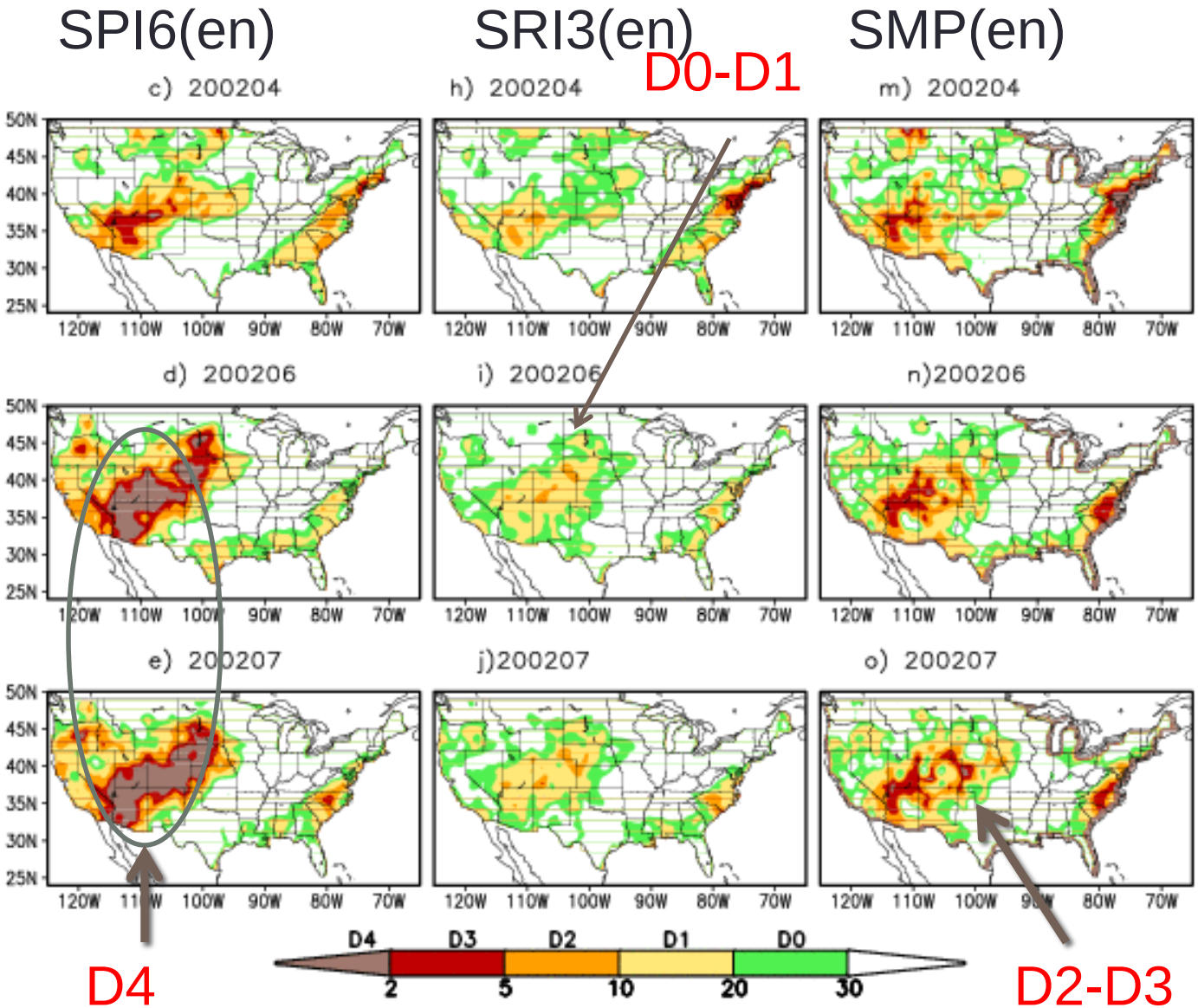

# Grand mean index

1. It captures the evolution of drought well;
2. Three episodes

- 2001 winter PNW
- 2002 summer: Southwest
- 2003 return of drought

△ The month that the state declared drought emergency

# Uncertainties of indices

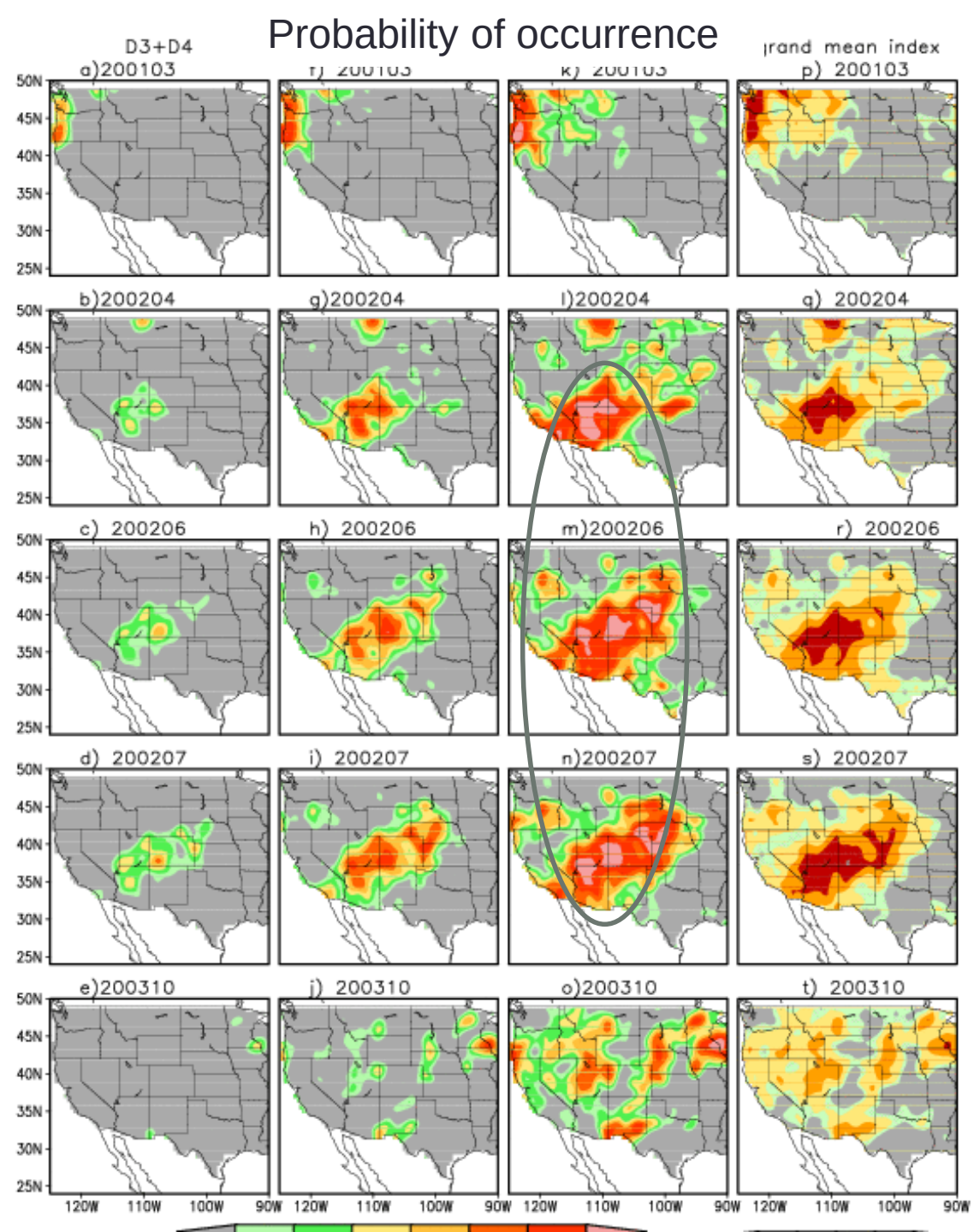


# Probability of drought occurrence in each drought category D0-D4

- Original time series :18 variables=> 18 indices in percentiles
- The drought category is assigned according to percentiles:

- For a given month and each grid point, we pool 8 nearest neighbor points together to take care of the spatial coherence.
- Count the number of indices in each category for each grid cell. e.g.
  - N (D1) - indices in D1 category. Prob of D1 occurrence is

P(D1)= N(D1) *100/total number of indices,




## Most possible scenario

### PNW episode

1. D3 or D4 for winter 2001 over the coastal areas of the PNW
2. Drought over the inland Missouri basin was weaker
   - It was not in D3 or D4
   - It is likely in D1

### SW episode

1. Intensified from spring to summer
2. In the Four Corners, the drought was in or above D2 : a 40-50% prob for D3 or D4 drought to occur
3. Outside of the core region, only D1 **(more regional details)**

### Return of drought

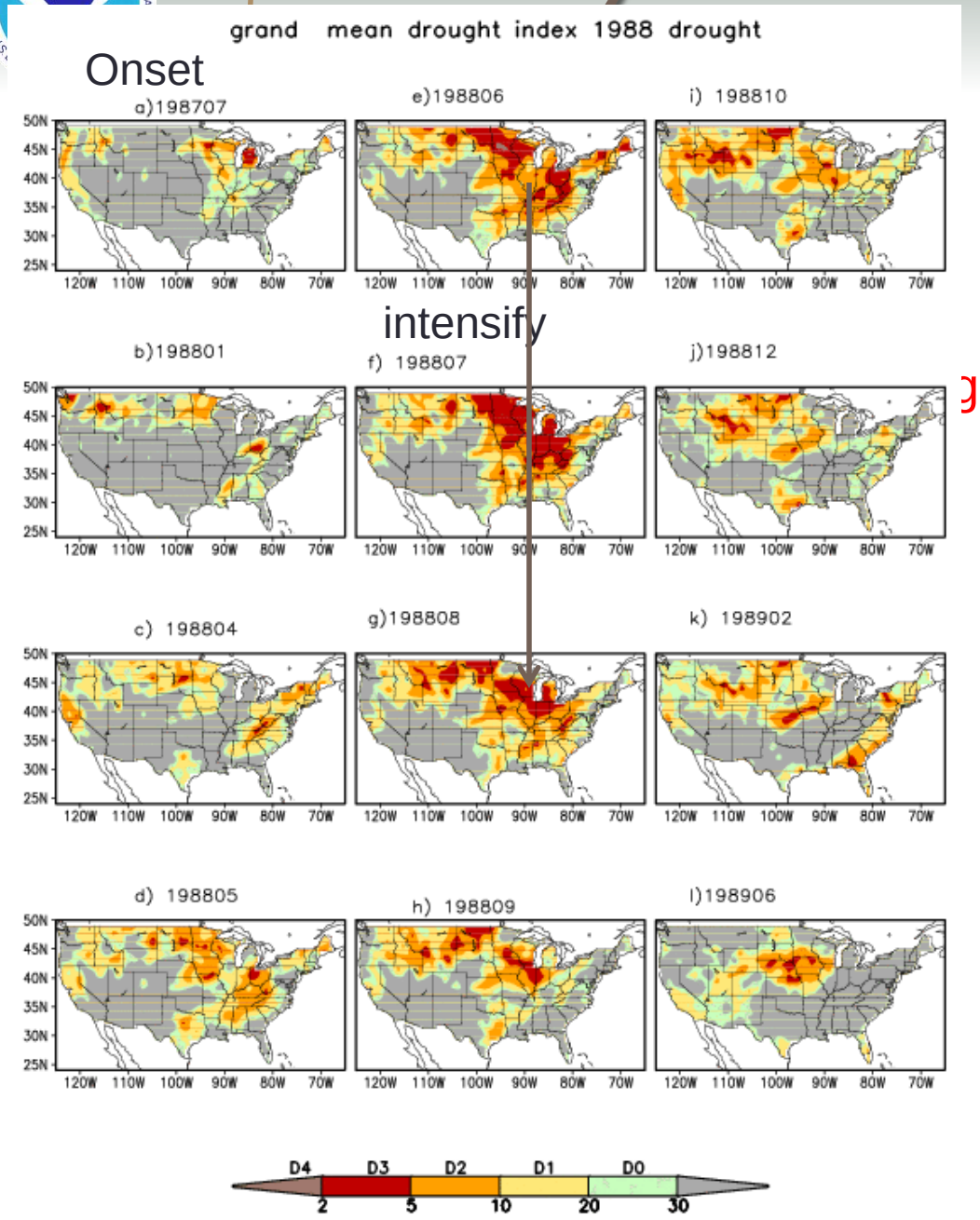
Mostly in D1

# What did we learn?

- The grand mean index captures the drought evolution and the prob is a good approach to assess the uncertainties in the grand mean index
- At the extremes, grand mean index in D3 or D4, more than 60% of prob in D3 and D4
- If the grand mean index is in D1, then a 20-30% prob in D2. The grand mean index has a tendency to underestimate drought intensity.
- The prob can also discriminate : give the scenario that is unlikely to happen
- It shows more detailed regional features.

# The 1987-1989 drought

## Grand mean index




1988-1989 drought

1. Drought did not shift from one place to another;
2. There were two centers:

North central and the Midwest from Montana to Minn.

3. The North Central had the D3-D4 drought, but the Midwest drought was less intense.

# Advantages of the probability approach

- The grand mean index should be analyzed together with the probability of drought occurrence in each category.
- Detailed regional Information
- Take into consideration of the uncertainties in the NLDAS and different drought indices.

- A way to analyze a drought event: area coverage. Duration and drought evolution
- To give risk managers the best/worse situation with the probability for it to occur

# Shortcoming ------

- All drought indices **are not** really independent .e.g. They are driven by the same forcing for a given system and the land surface models tend to have similar physics (but they do not have systematic relationships)

- At this point, we use the probability only to assess the uncertainties of the grand mean index

- We need to add more fields so it will not entirely depend on the NLDAS e. g. ESI or satellite derived fields

- We should add the Snow water equivalent (SWE) to SM so it had better representation of SM in winter.

# Data from CPC

- USDM Data Download Package
  - Downloads many of the data sources used by the authors
  - Formats, translates, clips….

- ftp://ftp.cpc.ncep.noaa.gov/mrosencrans

- Two versions
  - Full DM package – includes ArcMap Map documents, Layerfiles
- Just the scripts
  - Setup script to build directory structure
  - Grab and replace old scripts from full download package when updates are published (I will email drought@unl.edu)

# Hi-Resolution VHI

- Eric Leubehusen and I co-sponsored the transition to operations.
- 4km vs 16km, global Vegetation Health Index
- Weekly (day varies according to calendar)
- ftp://ftp.cpc.ncep.noaa.gov/GIS/USDM_Products/VegData/

usdm-130312.mxd - ArcMap - ArcInfo

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Editor

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ArcToolbox

Catalog

-110.954 43.774 Decimal Degrees

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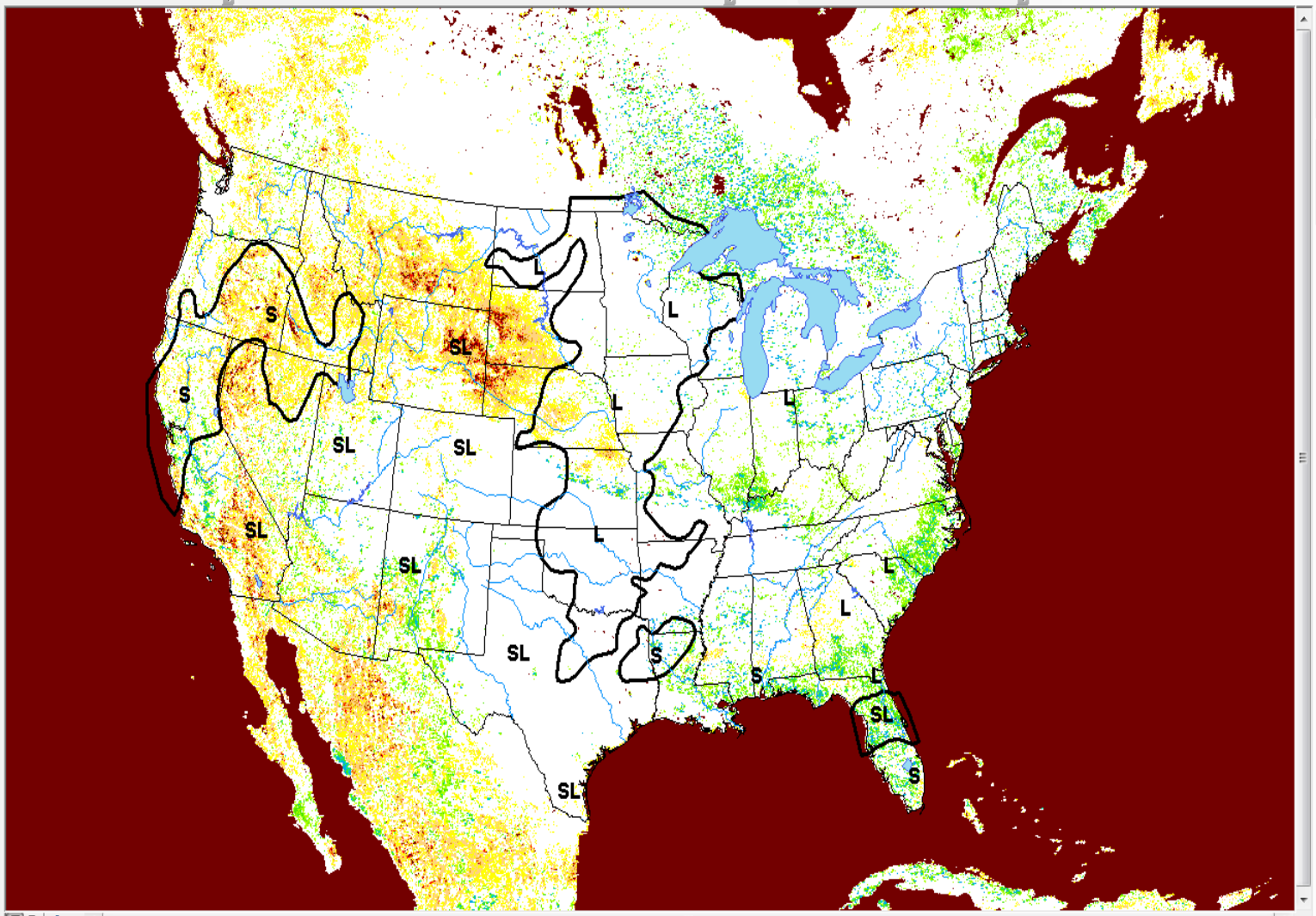


ArcToolbox

Catalog

-109.449 47.643 Decimal Degrees

# Operationalize NESDIS product

- Sponsor
  - Outside of NOAA – can involve payment to cover “care and feeding”
  - Inside of NOAA – Usually removes hurdles |$$| (pair up if possible)
- Requirements
  - Specify requirements (file type, frequency, delivery method)
- Reason to do this
  - Hard(er) to turn off
  - R2O gives things a life beyond a research proposal
  - Allows for robust extensions from the data.

# What else is going on?

- Weather Ready Nation
- 6 Pilots around the country (Tampa Ecological IDSS)
  - Drought has recognized ecological impacts

- CFSR and Retrospective LDAS runs
  - Climate Forecast System Reanalysis used to seed Land Data Assimilation Systems (NOAH)
    - Climate Division Data back to 1932 — Multi County/State
    - CFSR back to 1979 — ~40km (25mile) resolution

- Saltwater intrusion
  - Sea level rise is a big piece of NOAA/CPC upcoming work.
- Health Impacts
  - WHO / CPC joint project

# Thanks/Comments

- Objective Drought Monitoring Research
  - Drs. Kingtse Mo and Michael Ek
- What questions can we help you answer?
- What might NOAA/NWS be able to do better?