# Summer 2017 SWOP Conference Call

Matt Barnes
Scott Baker
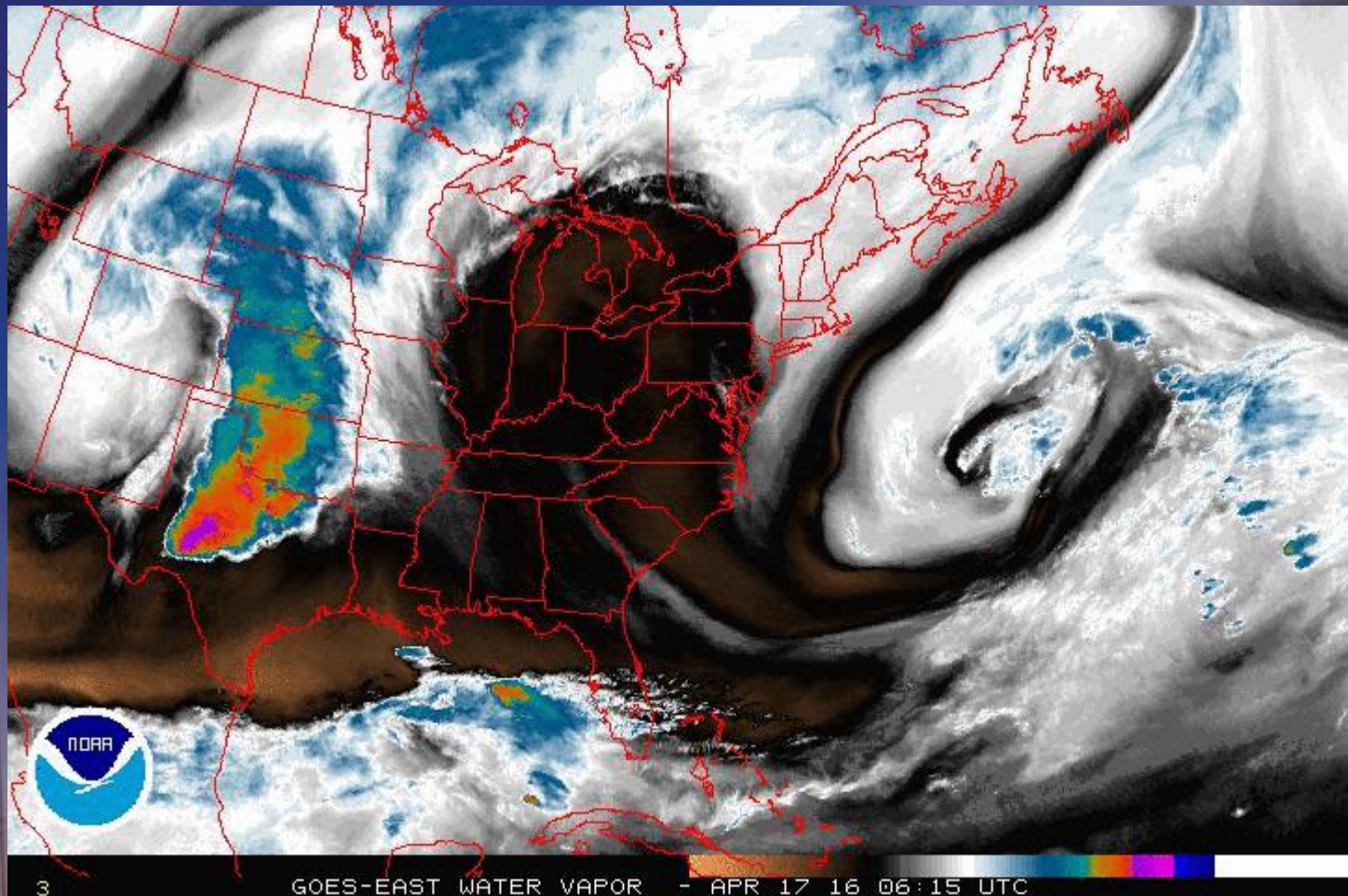
# Numerical Weather Prediction

- Using math to forecast the state of the atmosphere

- Started in the 1950s

- Skill has increased exponentially as computer power has increased

- Accuracy has improved as more datasets are added (surface obs, upper air, satellite, radar)

# Numerical Weather Prediction

The atmosphere is a fluid



GOES-EAST WATER VAPOR - APR 17 16 06:15 UTC

# Numerical Weather Prediction

- Key is to accurately sample the state of the fluid (initialize the model)

- Then use equations of fluid dynamics to predict the state of the fluid in the future (run the model)

- Use output to make forecast (analyze the results)

# Model Input



Surface observations
Upper air data
Satellite
Radar

# Running the Model

- NOAA has two supercomputers to handle all the calculations

- Operating at a total capacity of **5.78 petaflops**

- A 1 petaflop computer is capable of performing one quadrillion operations per second

- To match that, you'd have to do one calculation every second for **31,688,765 years!**

# Model Output

- Mean sea-level pressure (highs/lows/fronts)
- Winds
- Temperatures
- Dewpoints
- Precipitation
- Variables at the surface and throughout the depth of the atmosphere

- And much, much more

# Operational Models

**Global Models** (GFS, ECMWF, GEM)
"Big Picture"

**Mesoscale Models** (NAM, WRF, HRRR)
"Smaller Details"

# GFS

- **G**lobal **F**orecast **S**ystem (GFS)

- The "American Model" run by National Centers for Environmental Prediction (NCEP) in College Park, Maryland

- Produces forecasts out to 16 days (3-hourly output)

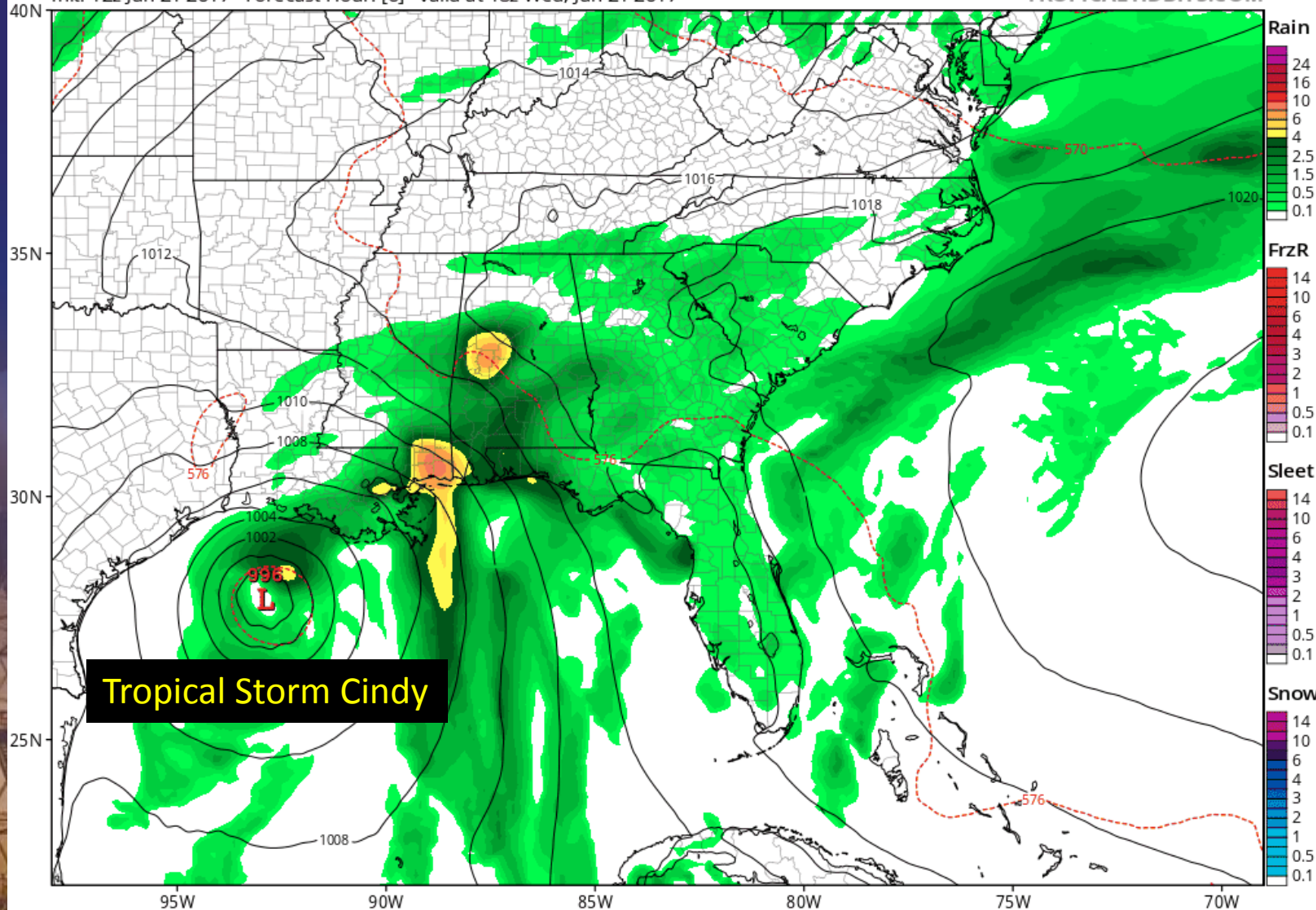- Good with the big picture, but may struggle with smaller-scale features (convection)

# GFS

GFS 6-hour Averaged Precip Rate (mm/hr), MSLP (hPa), & 1000-500mb Thick (dam)
Init: 12z Jun 21 2017   Forecast Hour: [6]   valid at 18z Wed, Jun 21 2017

TROPICALTIDBITS.COM

Tropical Storm Cindy

# ECMWF

- **E**uropean **C**enter for **M**edium **R**ange **W**eather **F**orecasts (ECMWF)

- The "European Model" run by ECMWF based in Reading, England

- The model itself is actually called the Integrated Forecast System (IFS)

- Produces forecasts out to 15 days...however not all data is available to the public
(6-hourly output)

# GEM

- **G**lobal **E**nvironmental **M**ultiscale Model (GEM)

- The "Canadian Model" run by the Canadian Meteorological Centre in Dorval, Quebec

- Produces forecasts out to 10 days (6-hourly output)

- Not particularly good with tropical weather

# NAM

- **N**orth **A**merican **M**esoscale Forecast System (NAM)

- Run by National Centers for Environmental Prediction (NCEP)

- Produces forecasts out to 84 hours (3-hourly output)

- Higher resolution than global models...better with convection

# WRF

- **W**eather **R**esearch and **F**orecasting Model (WRF)

- Two variants: ARW (Advanced Research WRF) and the NMM (Nonhydrostatic Mesoscale)

- Very high spatial and temporal resolution (hourly output)

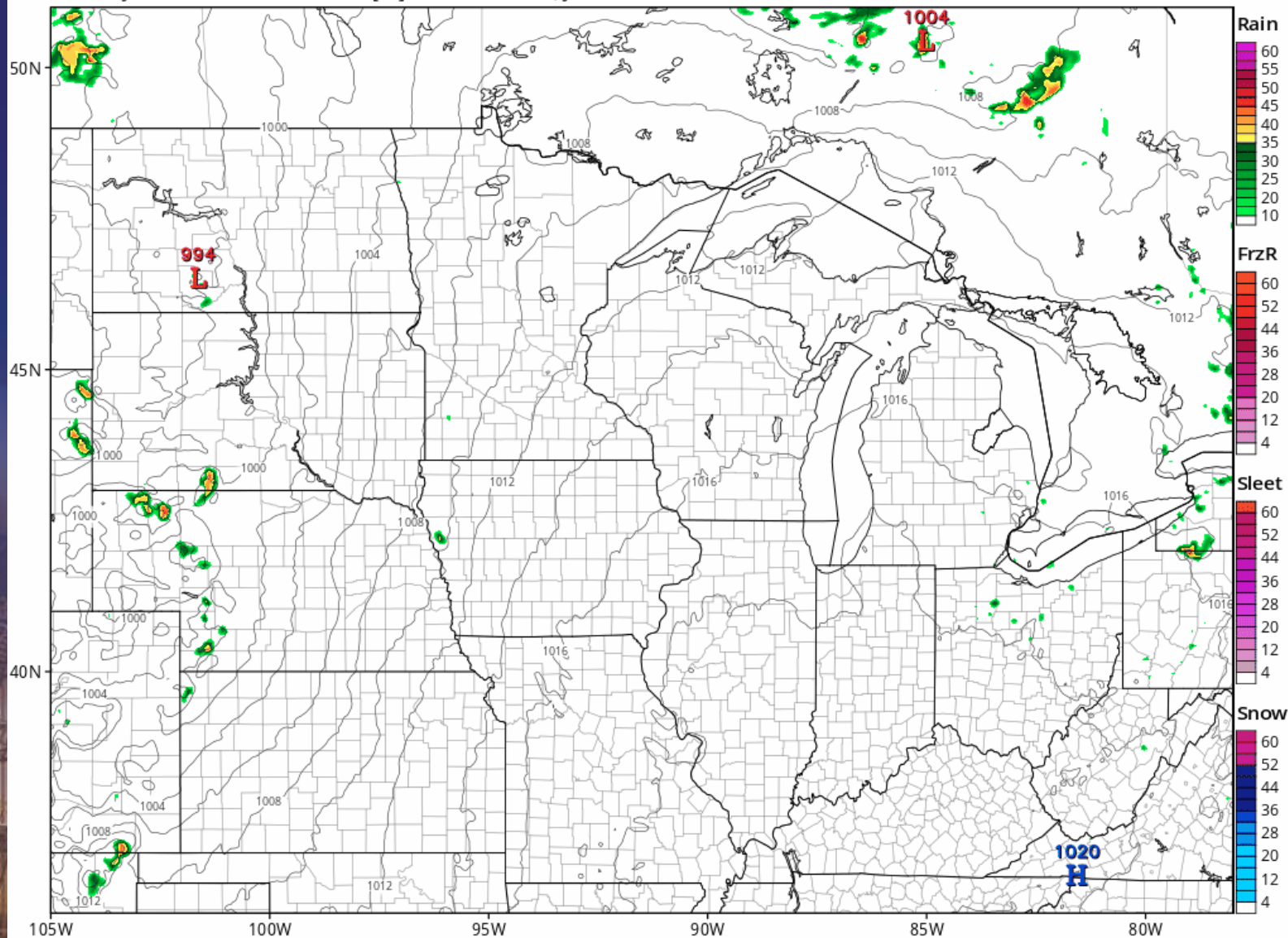- Great at showing small-scale details (wind shifts, outflow boundaries, thunderstorms)
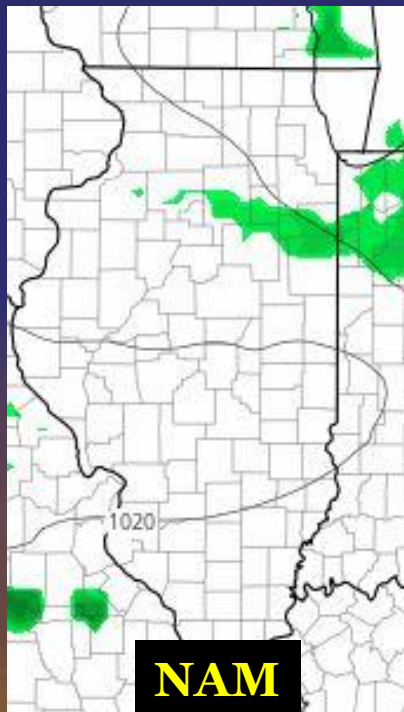
# WRF

# HRRR

- **H**igh **R**esolution **R**apid **R**efresh (HRRR)

- 3km resolution, updated hourly, with hourly output out to 18 hours

- Convection-allowing model (CAM)

- Ingests radar data

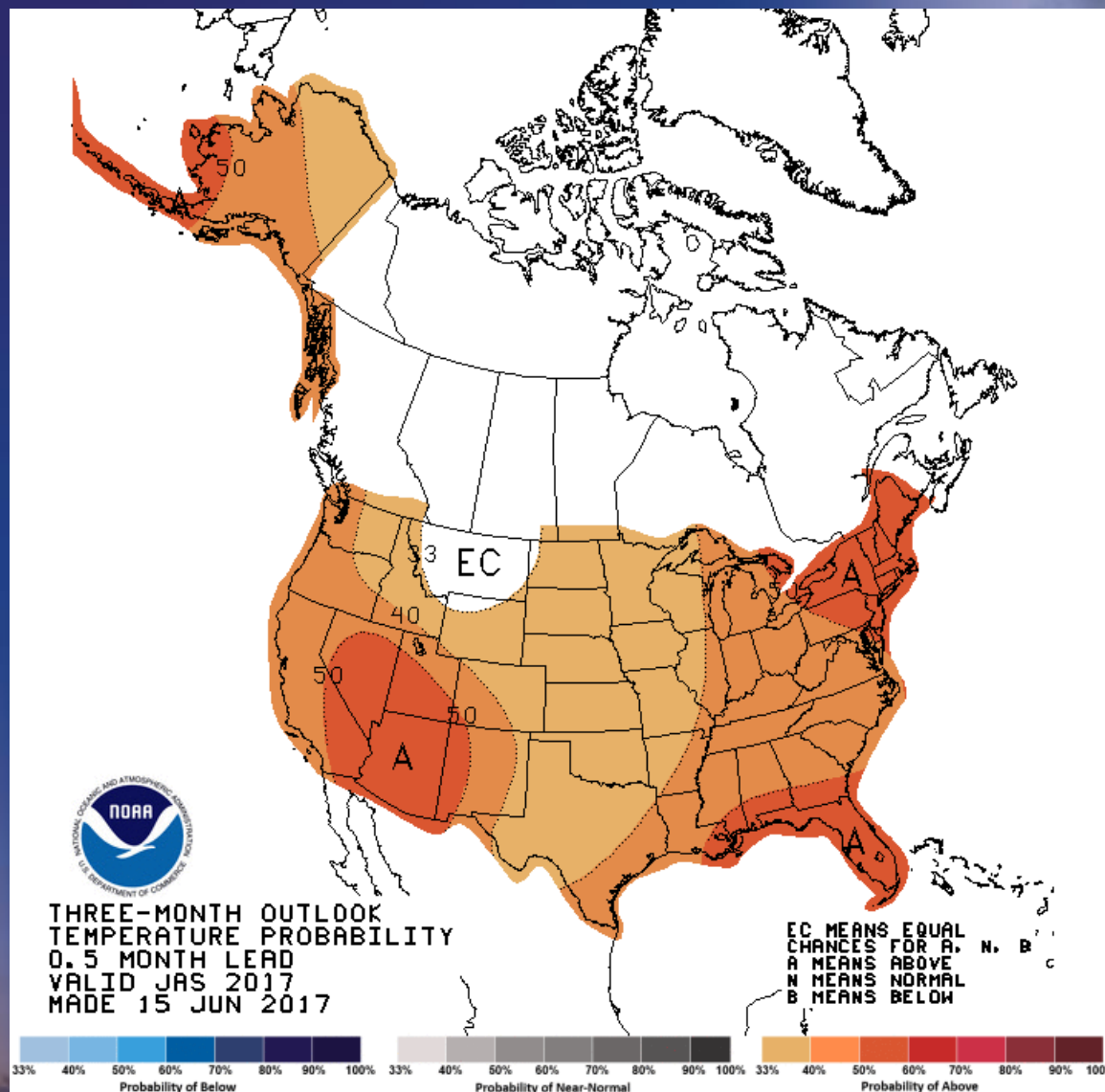# Model Comparison



NAM    WRF-NMM    WRF-ARW    HRRR

All are 9-hour forecasts valid at 21z/4pm Jun 26

Note the finer detail with the WRF and HRRR
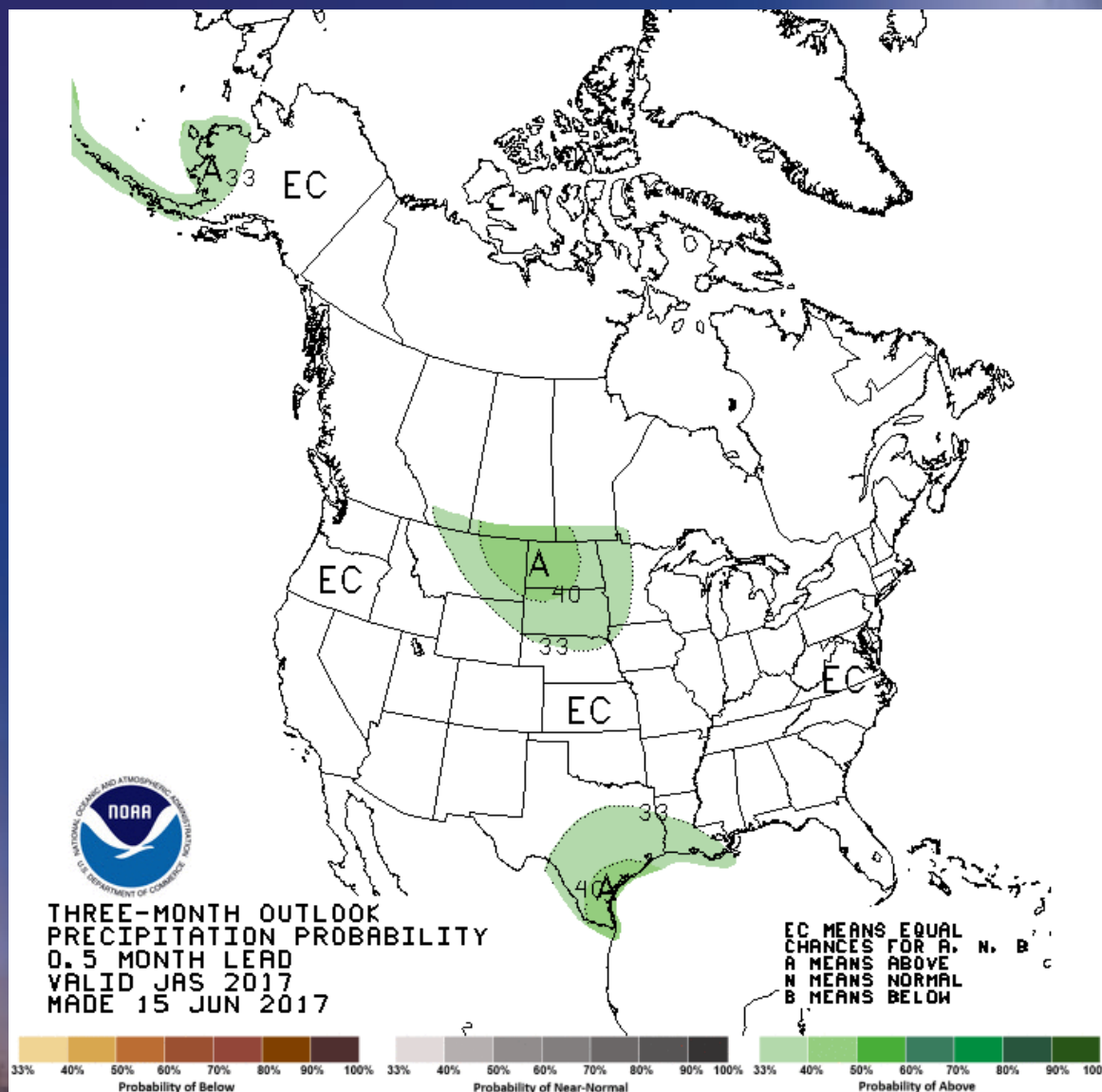
Also note the differences just 9 hours in the future
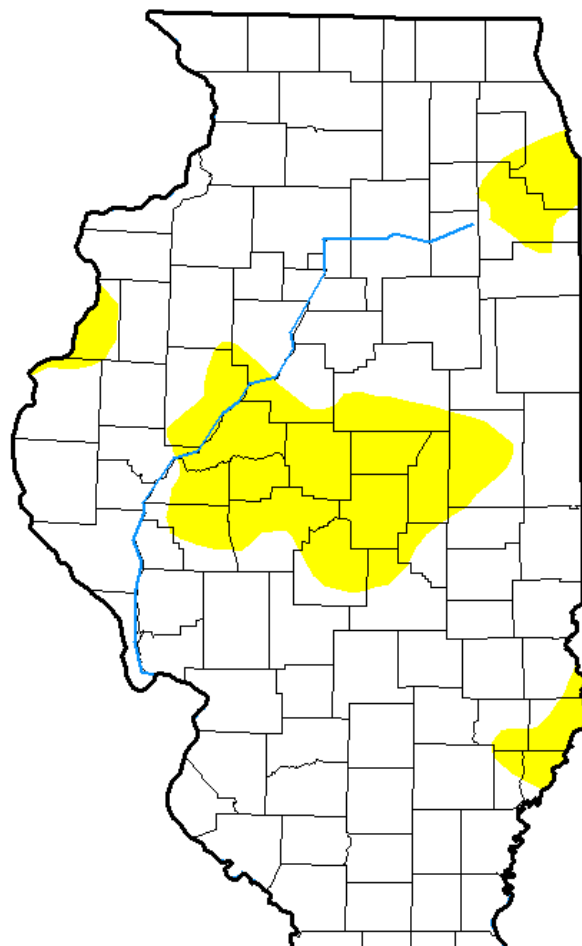
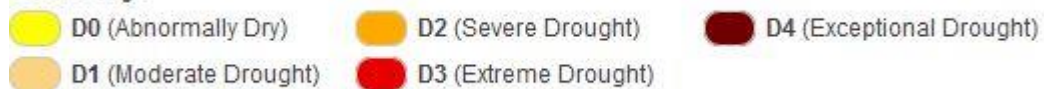# Summer Outlook



Above normal temps

# Summer Outlook



No precip trend

# Drought Monitor



Intensity:
- D0 (Abnormally Dry)
- D1 (Moderate Drought)
- D2 (Severe Drought)
- D3 (Extreme Drought)
- D4 (Exceptional Drought)

Thanks for Attending!

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Paul Hadfield
Near Forsyth
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