

# Understanding and predicting extreme precipitation

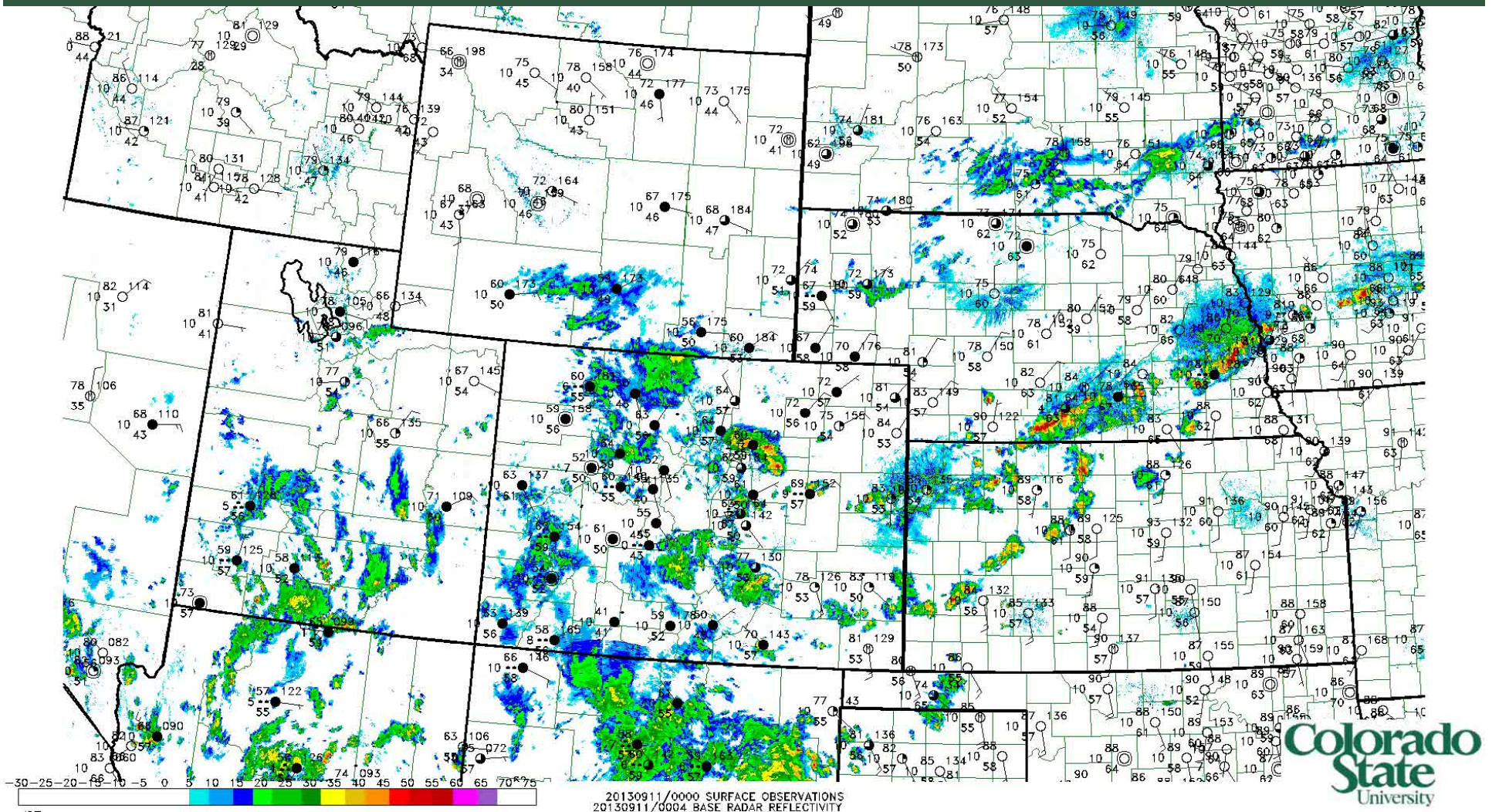
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**Colorado  
State**  
University



# The variety of spatial and temporal scales in a week of extreme rainfall...



Radar reflectivity and surface observations, every ~30 mins, 11-16 September 2013

**“Warm-season quantitative precipitation forecasts are, certifiably, the poorest performance area of forecast systems worldwide”**

**– Fritsch and Carbone (2004, BAMS)**

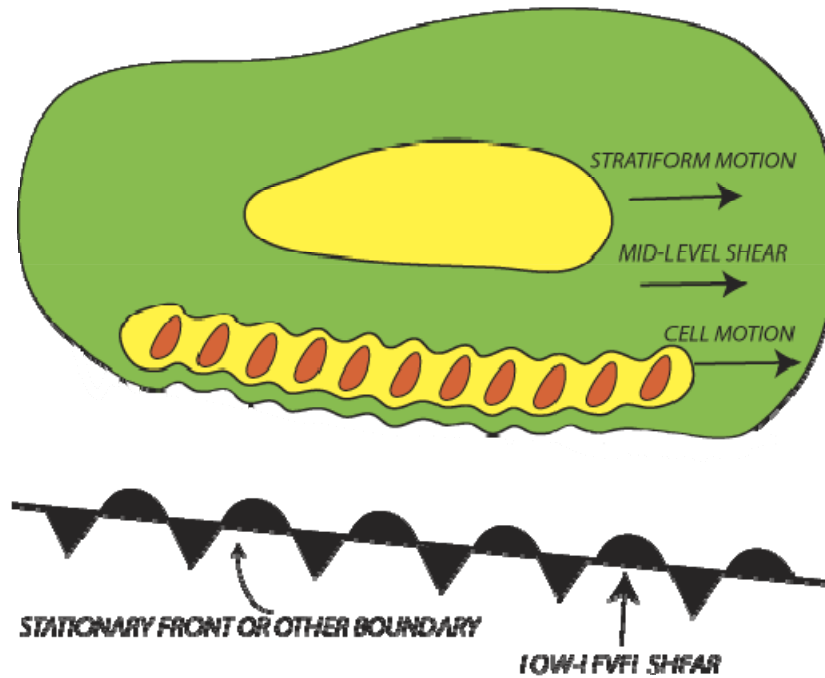
# How do we make heavy rainfall?

$$P = \bar{R}D$$

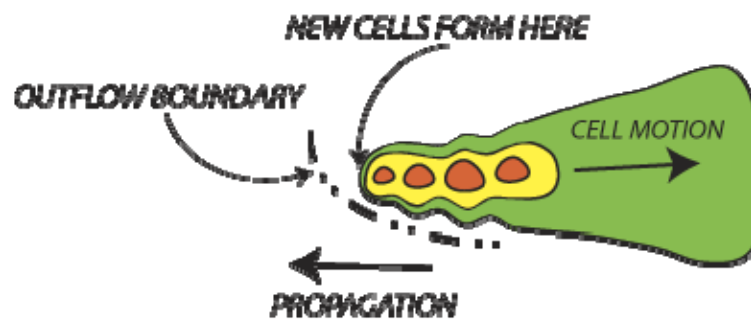
(precipitation equals average rainfall rate times duration)

Or, in other words: the most rain falls where it rains the hardest for the longest!

**A) TRAINING LINE -- ADJOINING STRATIFORM (TL/AS)**



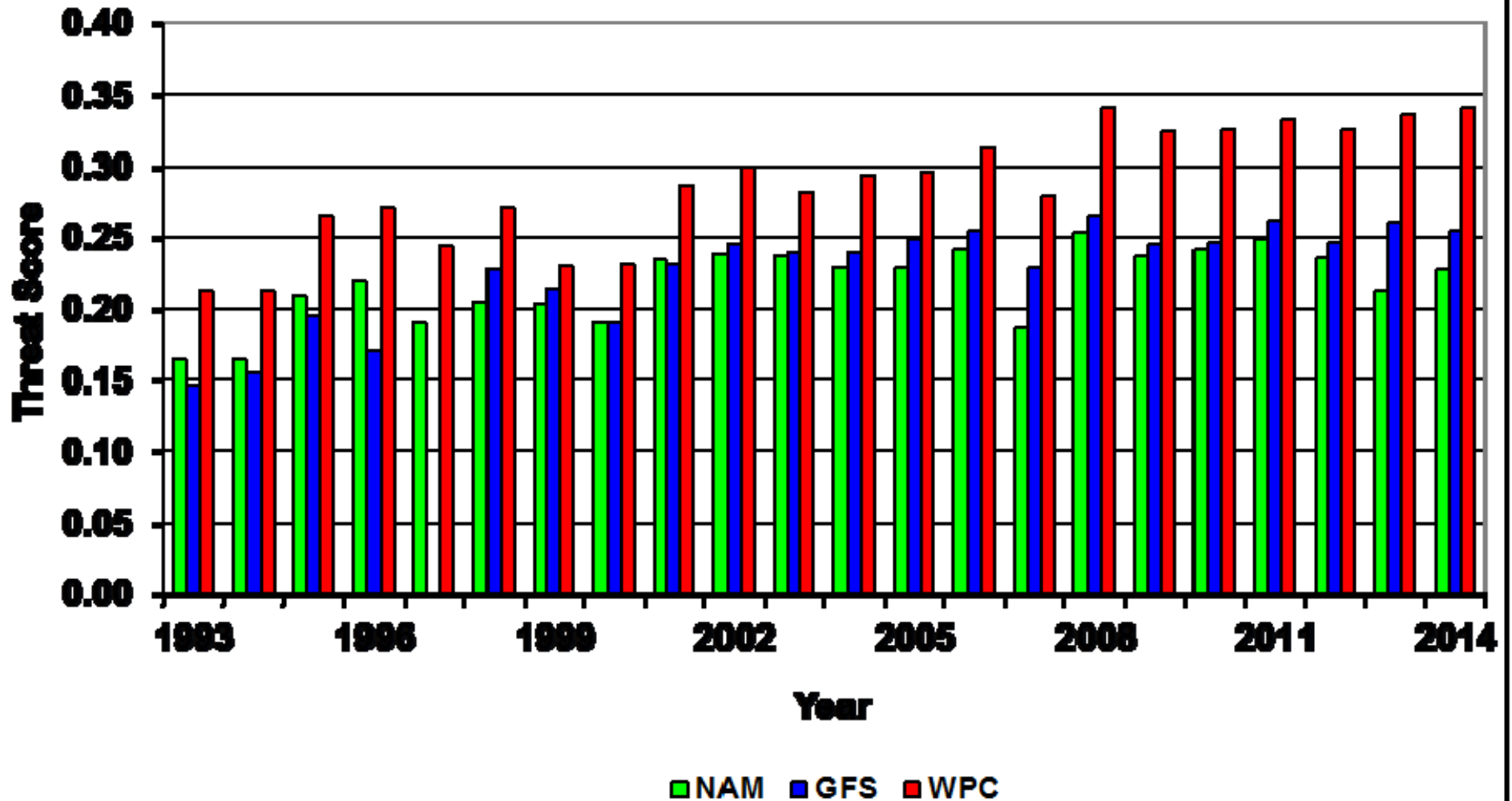
**B) BACKBUILDING / QUASI-STATIONARY (BB)**



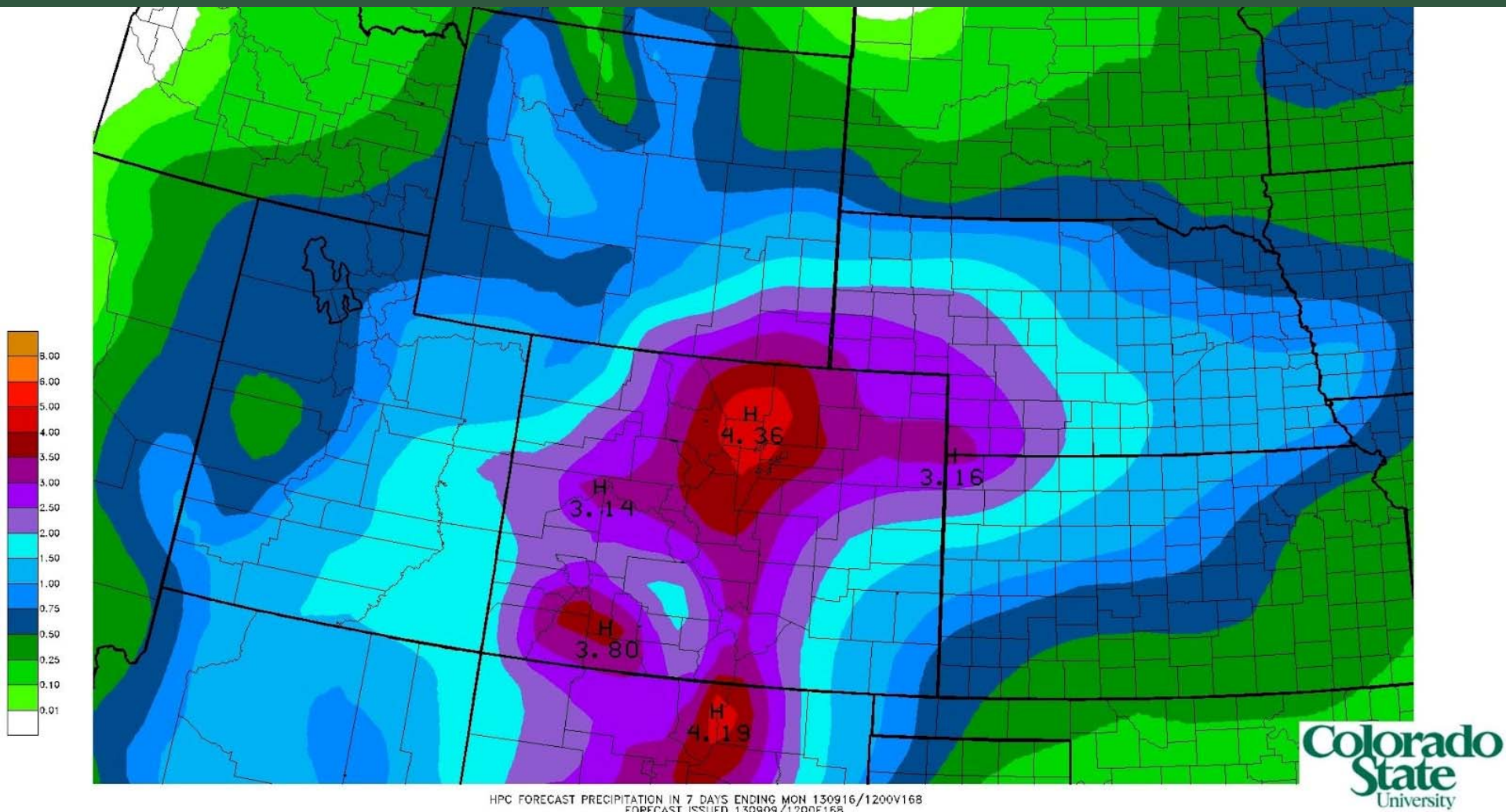
| ~ 150 KM |

Schumacher and Johnson (2005)

## 24-Hour 1-Inch Day 1 QPF Verification Annual Threat Scores

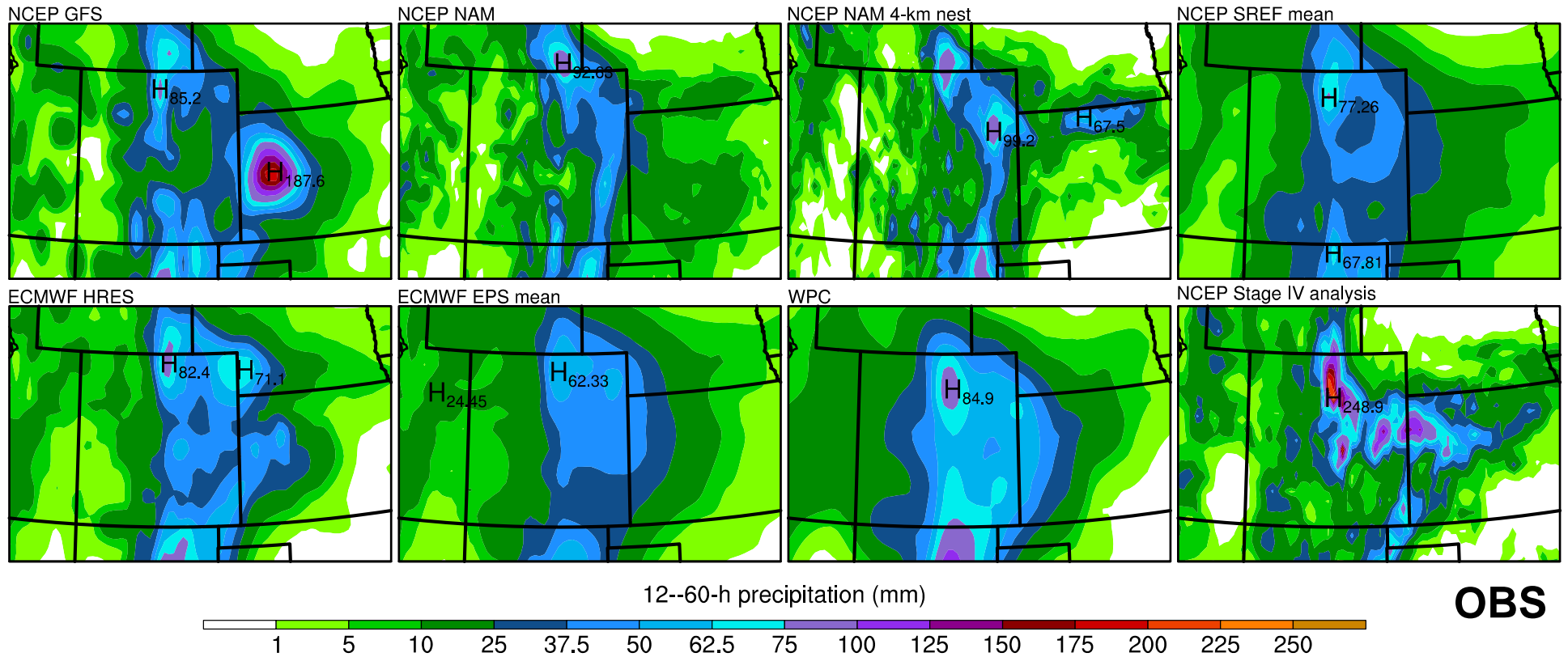


<http://www.wpc.ncep.noaa.gov/images/hpcvrf/WPCmdl10yrly.gif>



7-day precipitation forecast (inches) from the NOAA Weather Prediction Center, issued on Monday morning, Sept. 9 2013

# Precipitation forecasts from several numerical models for 11-12 September issued on Tuesday evening, Sept. 10 2013





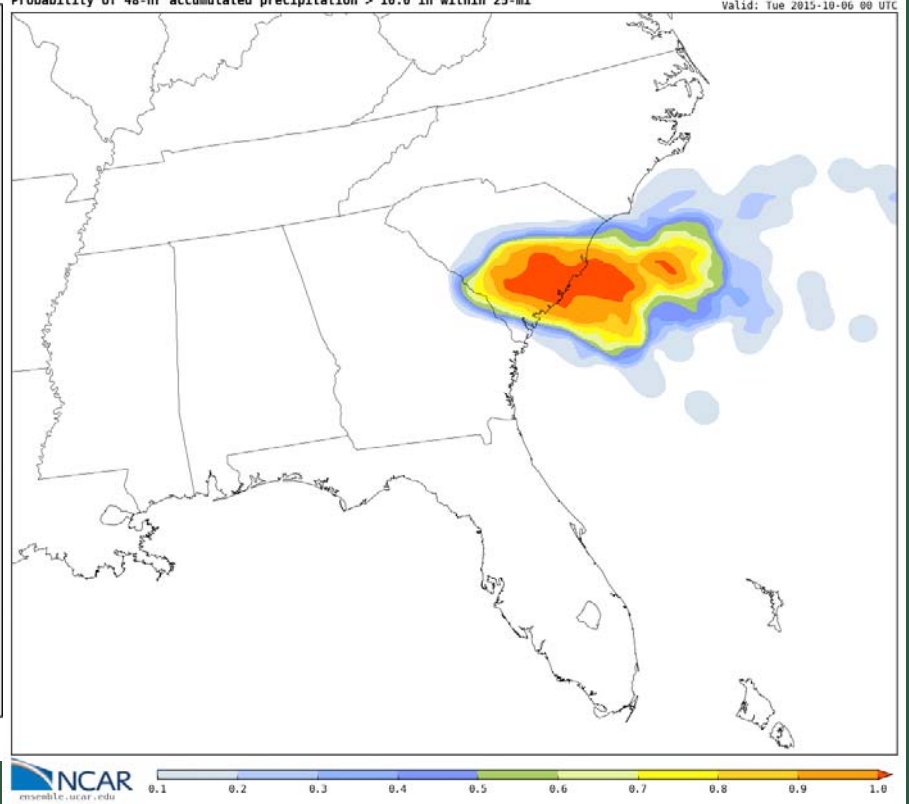
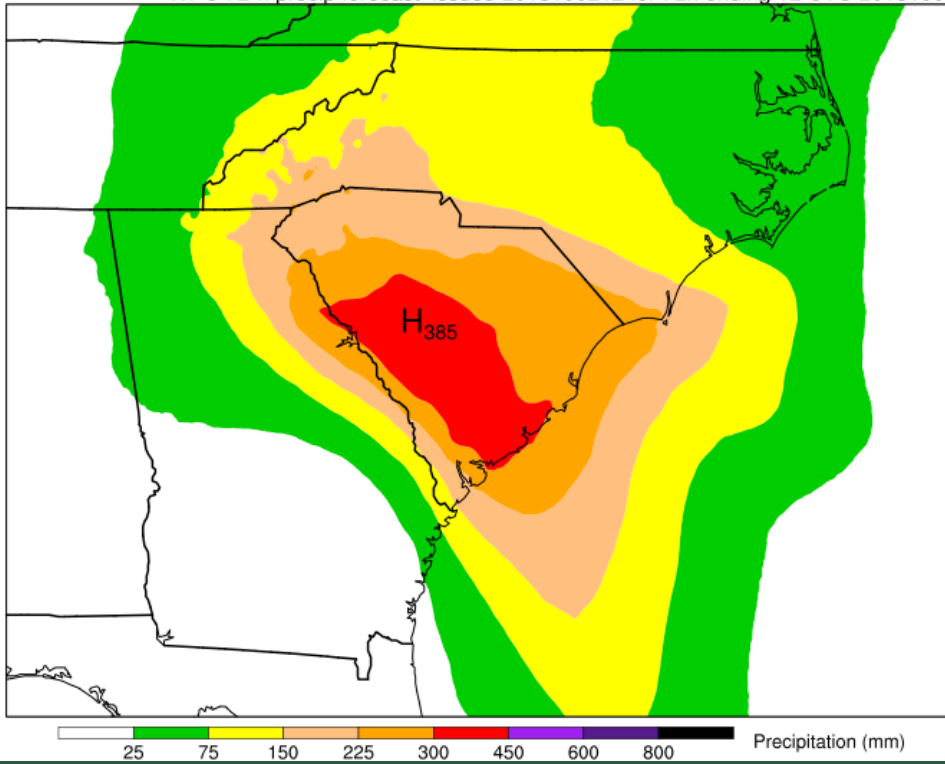
# Weather Prediction Center human forecast: deterministic

# Probability of > 10" of rain in 48 hrs

WPC 72-h precip forecast issued 2015100212 for 72h ending 12 UTC 20151005

Probability of 48-hr accumulated precipitation > 10.0 in within 25-mi

Init: Sun 2015-10-04 00 UTC  
Valid: Tue 2015-10-06 00 UTC



72-hour forecast issued 8am October 2

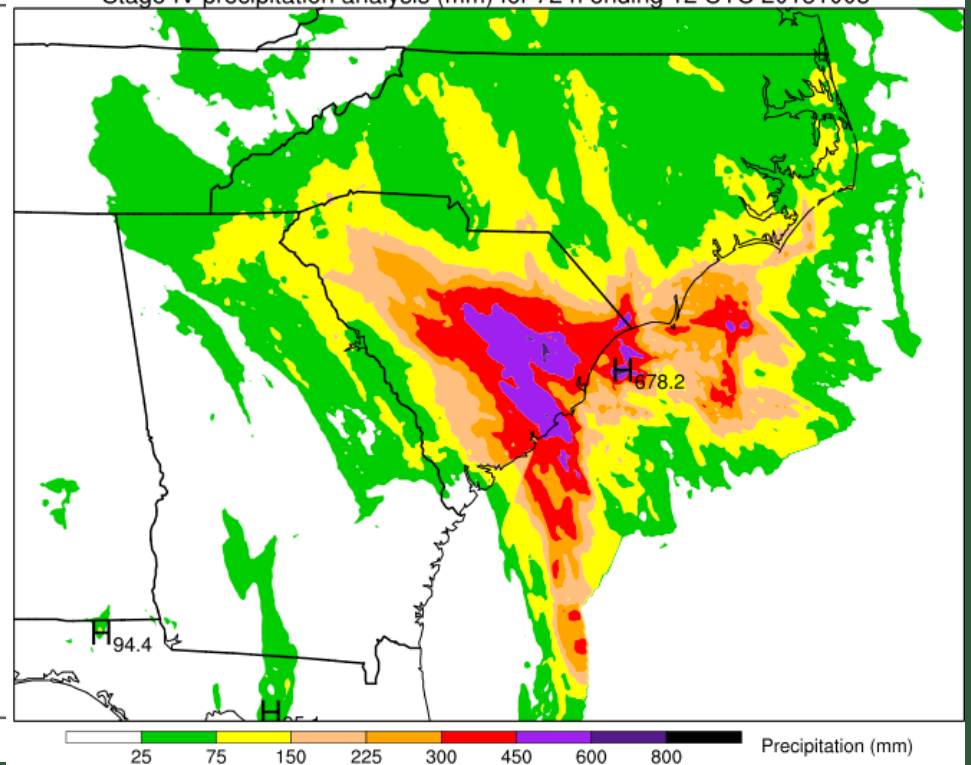
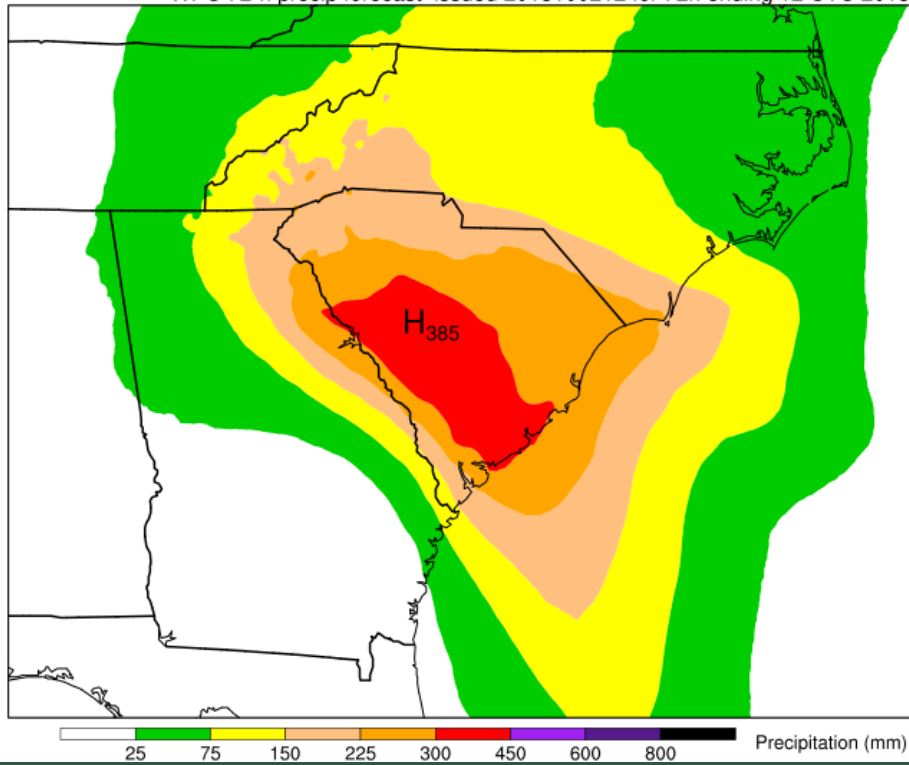
[ensemble.ucar.edu](http://ensemble.ucar.edu)  
(Red = 100%)

# Weather Prediction Center human forecast: deterministic

# Observed

WPC 72-h precip forecast issued 2015100212 for 72h ending 12 UTC 2015

Stage IV precipitation analysis (mm) for 72 h ending 12 UTC 20151005

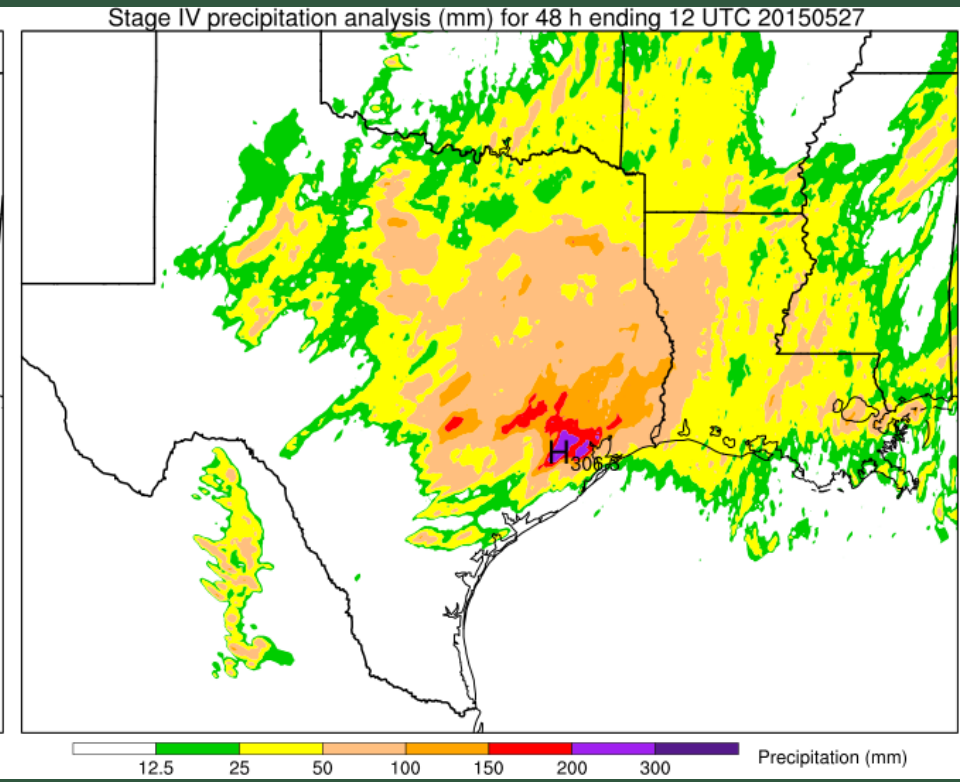
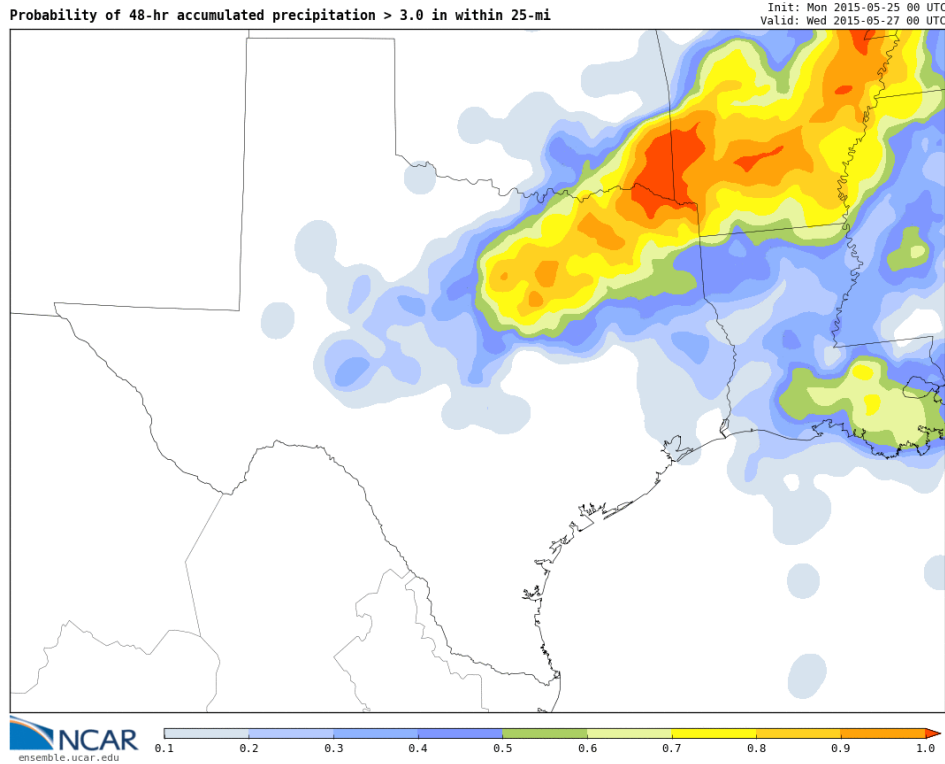


72-hour forecast issued 8am October 2

Forecasts have improved immensely – but there are still “busts” (and always will be) – we’re working to make them less frequent and not as serious

Forecast probability of >3” of rain in 48 hrs

Observed



May 25-27, 2015

ensemble.ucar.edu  
(Red = 100%)