



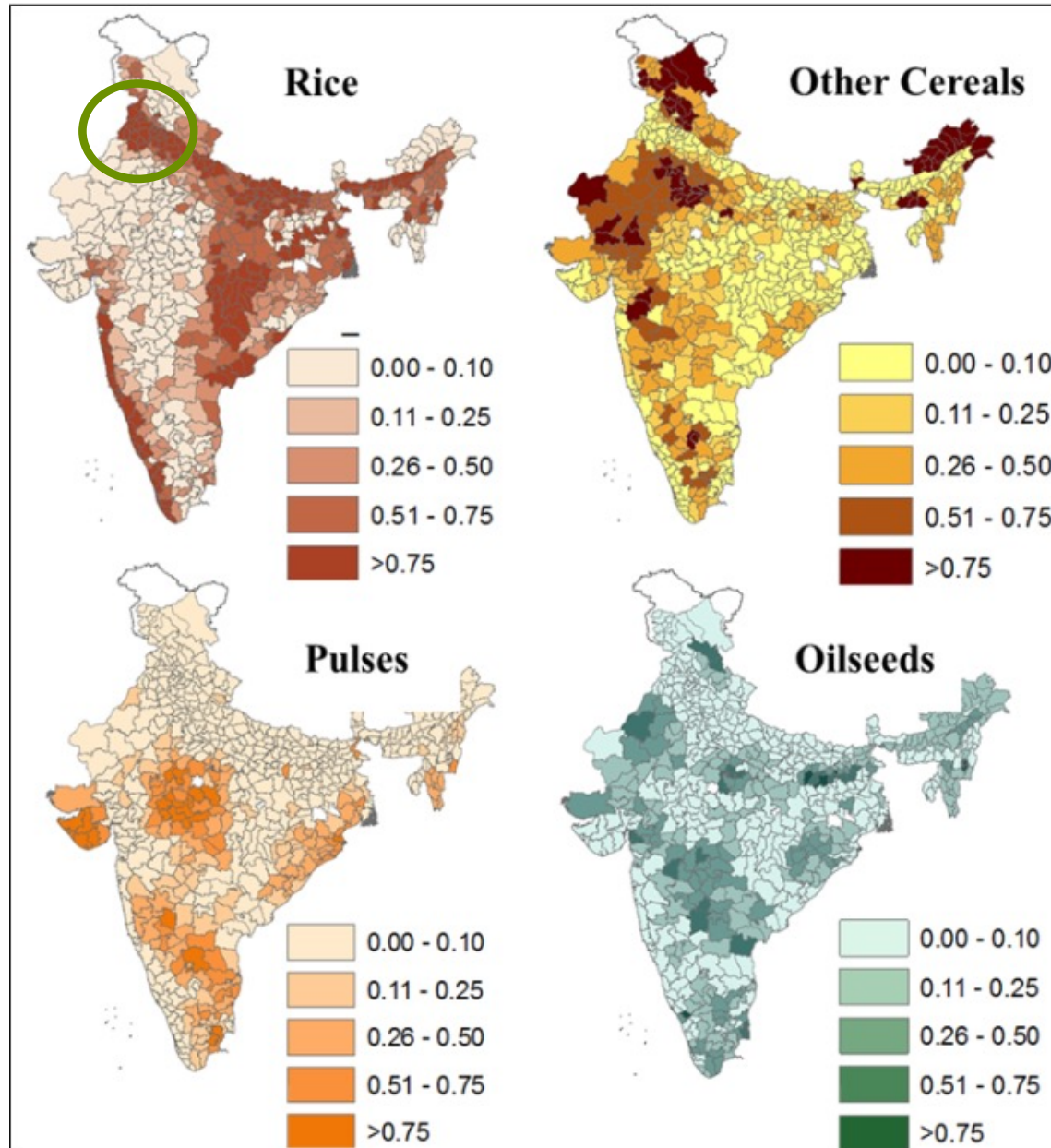
Irrigation Improvement for the Punjab Region

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Petra Kandus
Katrina Prutzman
Susana Ruge

Background: Punjab

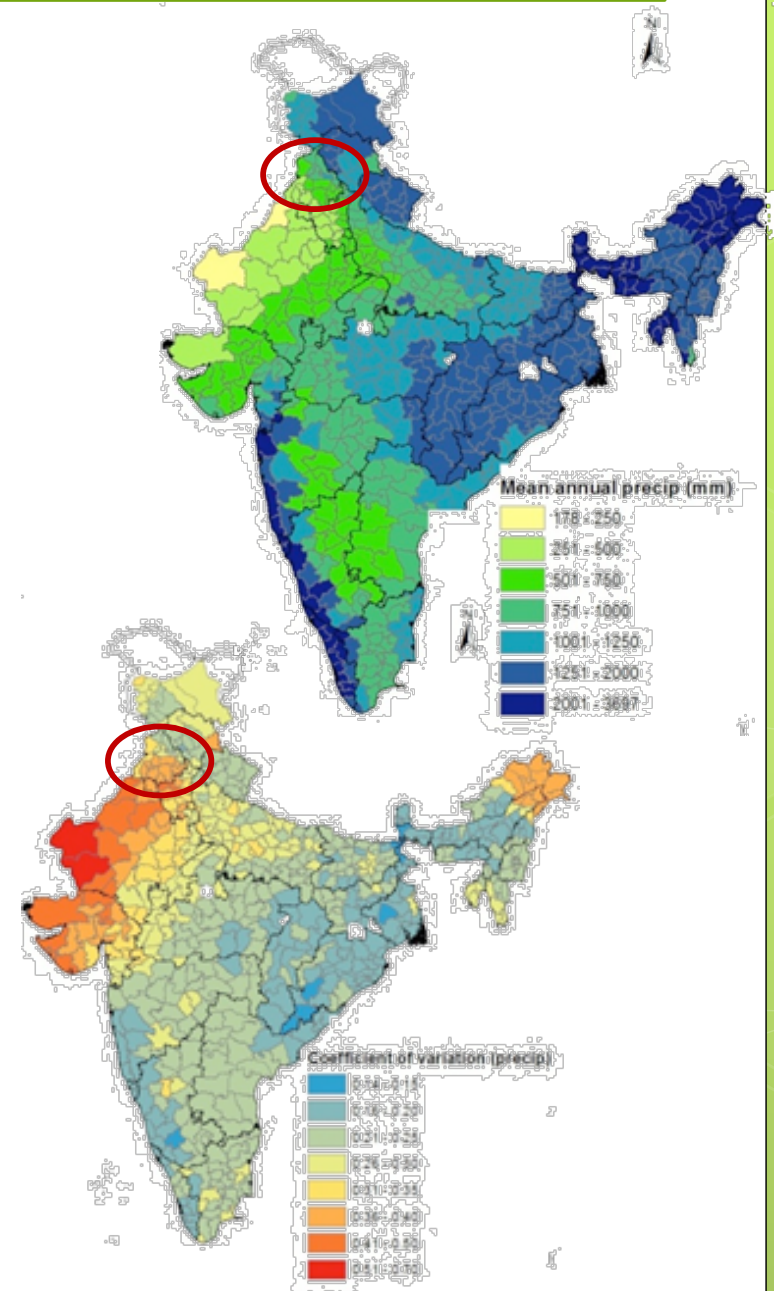
- “India’s Bread Basket”
- 1.7% of land area, 21% of wheat, 8% of rice
- Primary crops:
 - Wheat
 - Rice
 - Cotton
 - Pulses



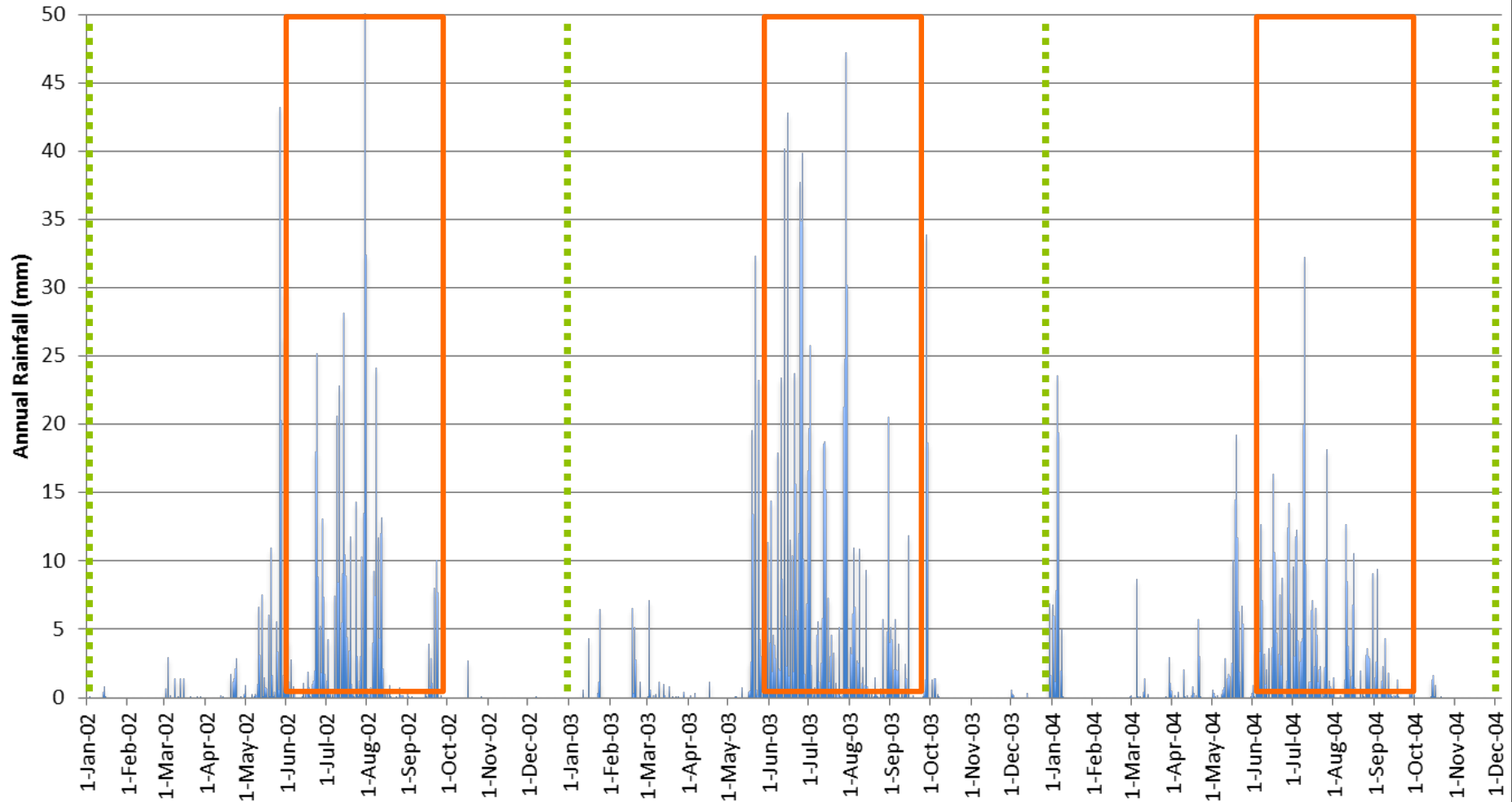


Problem: Water

- Rainfall
 - Seasonal (monsoons)
 - Highly variable
- Pervasive water shortages
- Irrigation required
- Groundwater depletion

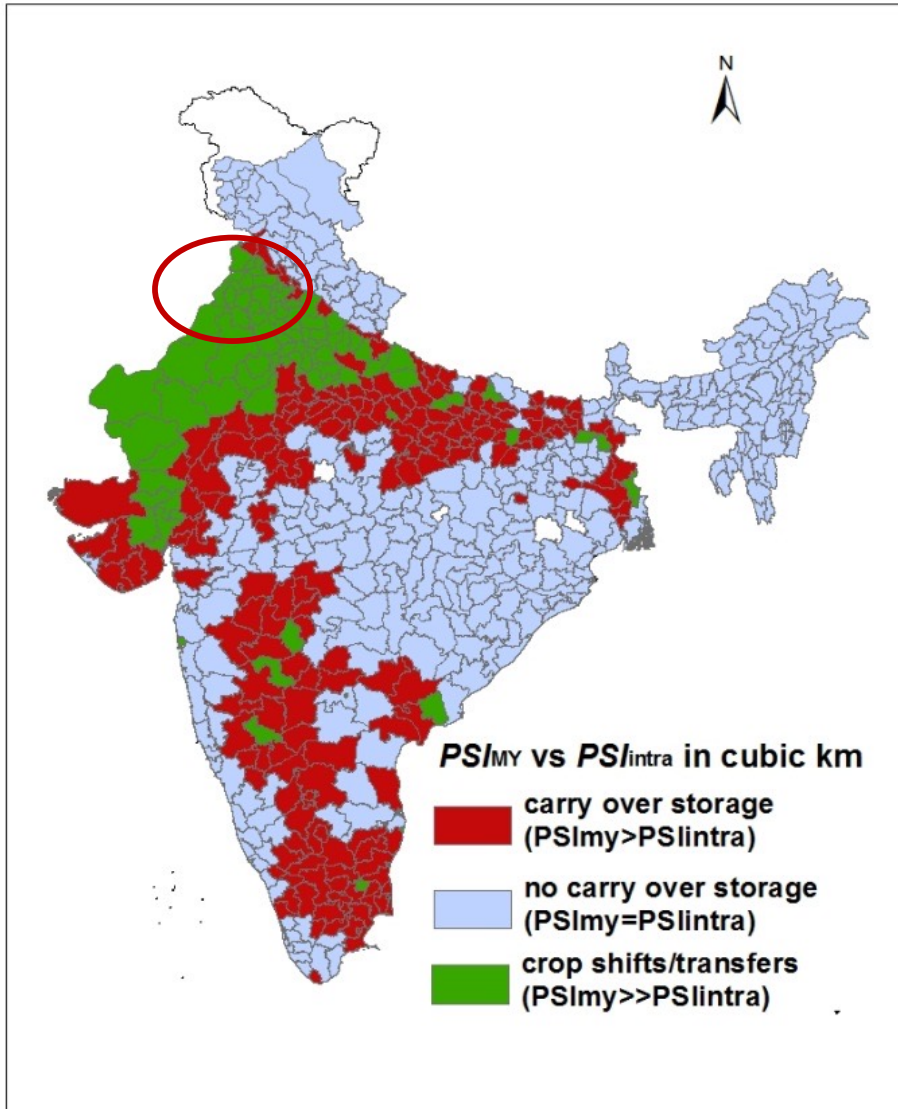


Problem: Water



Rainfall: Andhra Pradesh

Problem: Water



! CAUTION

Green =
Worst water stress

Possible Solutions: Water



- Stress can be reduced by
 - Investing in Storage Infrastructure
 - **Improve Irrigation Efficiency**
 - Shift Crop Acreage
 - Correct Pricing of Electricity

Current State/Objective

Current State

- Cell phone notification
- Rainfall predictions
- Irrigation recommendation
- Wide forecast variability

Project

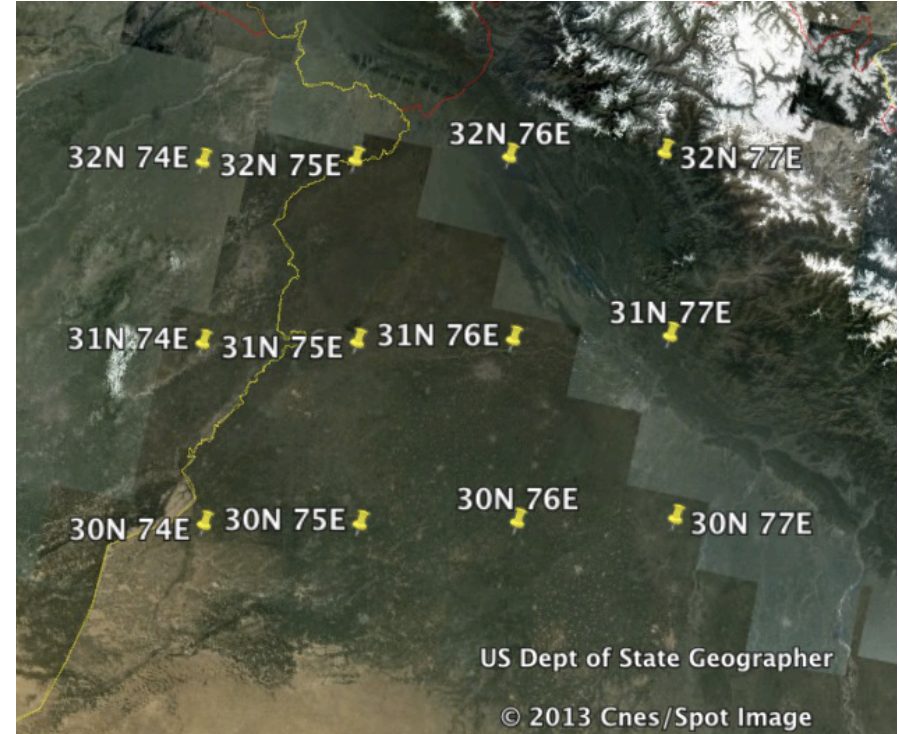
- Improve Irrigation Efficiency
- Utilize rainfall
- Limit GW depletion
- Evaluate forecast accuracy for each coordinate
- Determine best model for each coordinate



Data Sources

- Historical observed rainfall data (1901 – 2012)
 - India meteorological department gridded rainfall product
- Historical predicted rainfall data (2007 – 2012)
 - ECMWF – European Centre for Medium–Range Weather Forecasts
 - NCEP – National Centers for Environmental Predictions
 - UKMO – United Kingdom Meteorological Office

**Five day foreword forecast for each model



Evaluation Procedure

- Excel
- Focus data (2007 – 2012)
 - Growing season (Jun – Sep)
- Compare predicted to observed rainfall
 - Each model
 - Each coordinate
- Identify best model for each coordinate

Evaluation Procedure

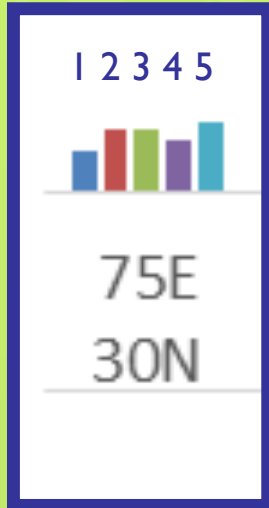
- Calculate mean/deviation of predicted vs observed rainfall
- 2x2 Contingency Table
 - Without threshold
 - With threshold
- Threshold of 15mm rainfall/day to support rice cultivation

		Observed	
		Rain	No Rain
Predicted	Rain	Hit Rate	False Alarm
	No Rain	Miss Rate	Correct Rejection

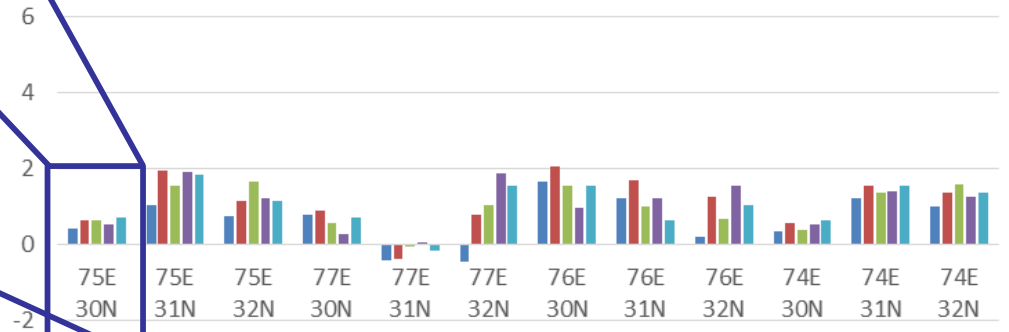
Forecast Days



Coordinates

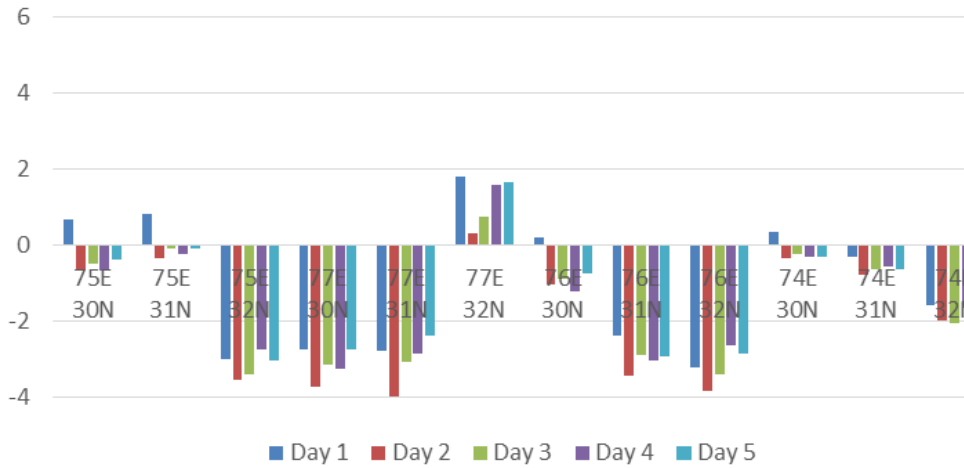


ECMWF



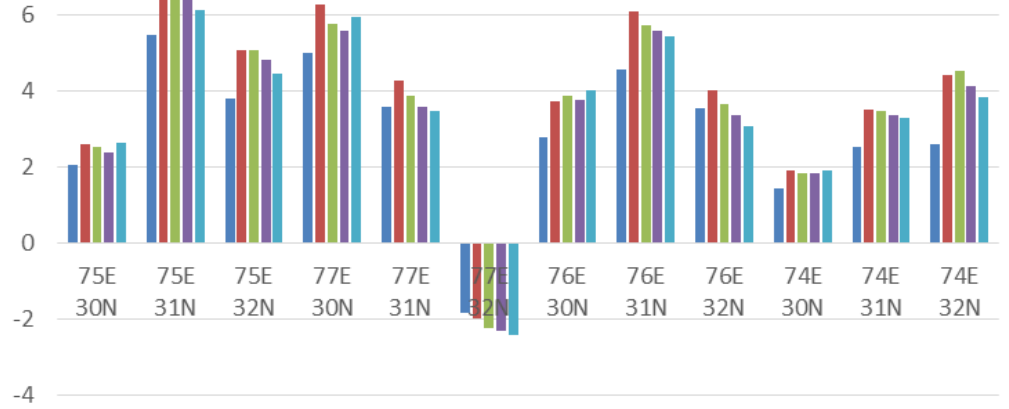
Day 1 Day 2 Day 3 Day 4 Day 5

NCEP



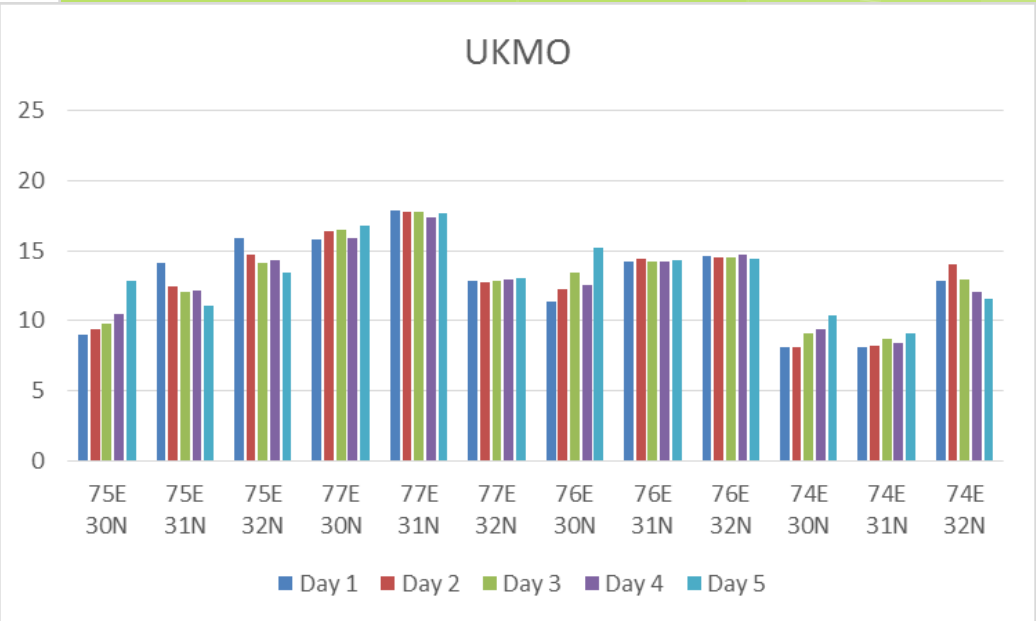
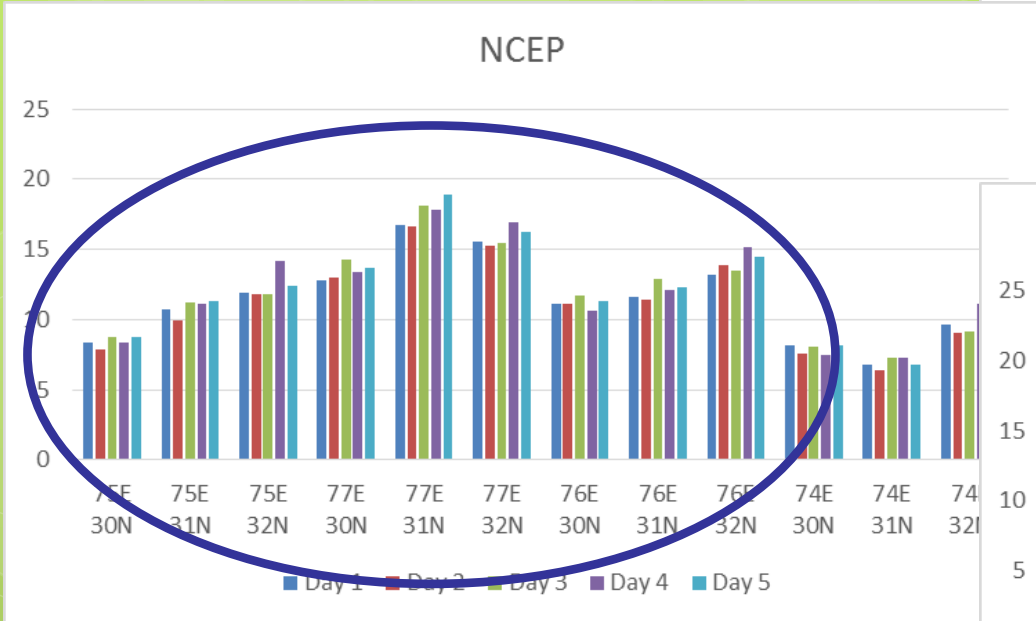
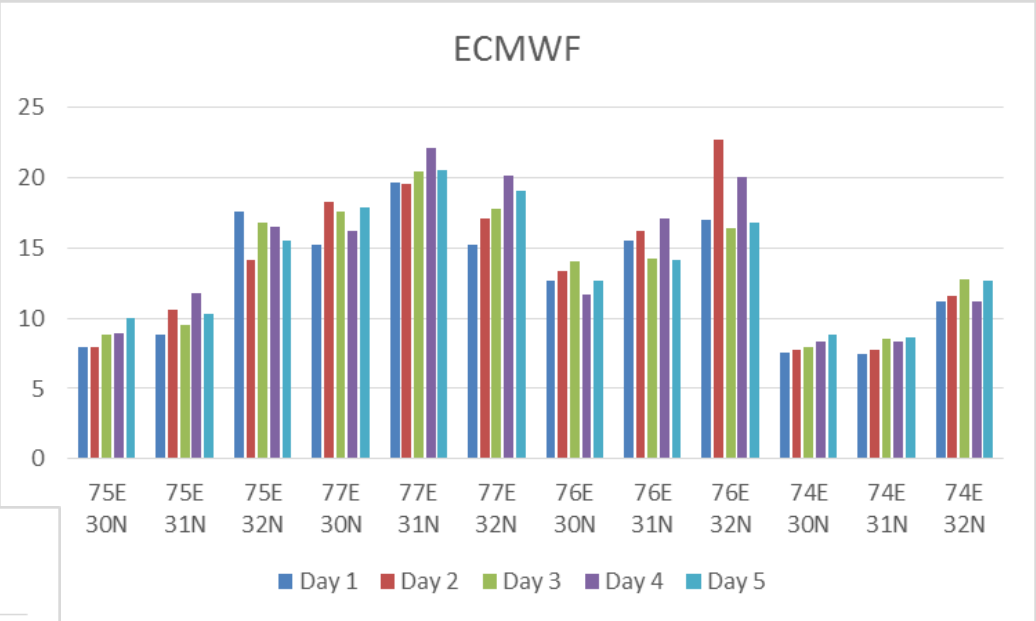
Day 1 Day 2 Day 3 Day 4 Day 5

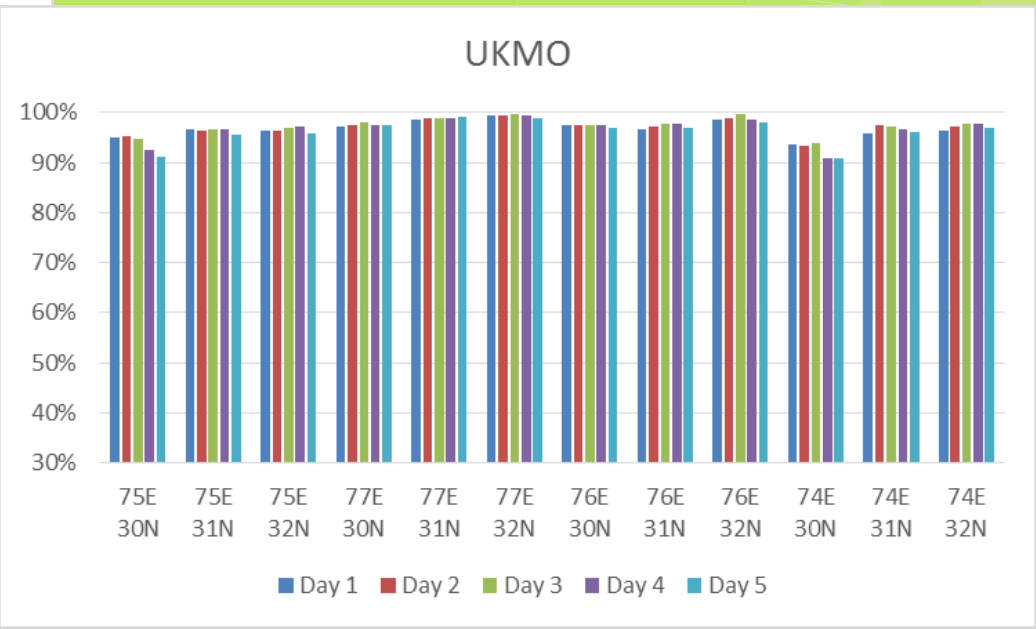
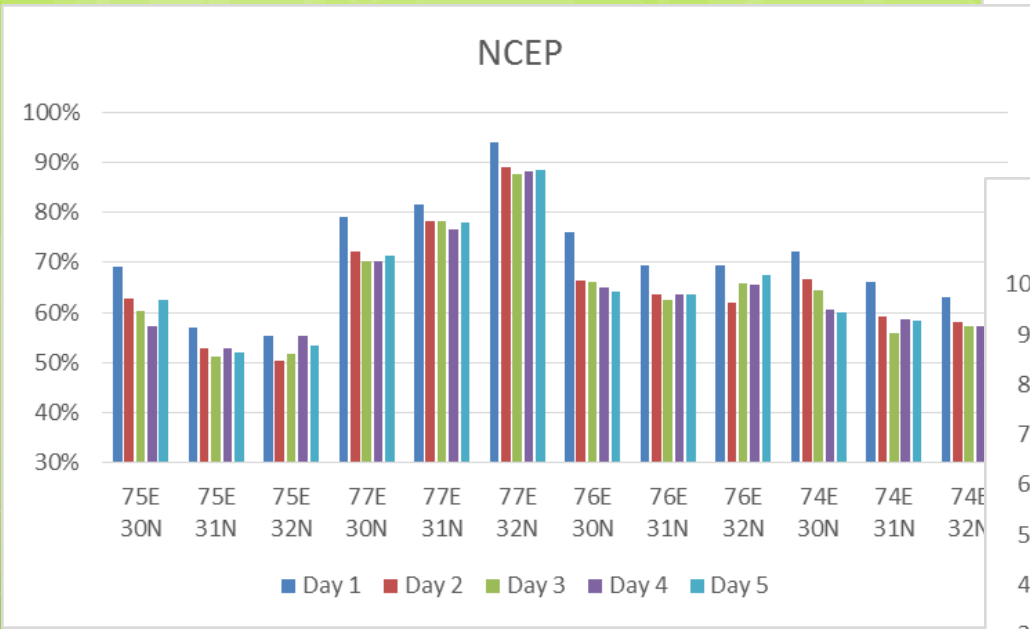
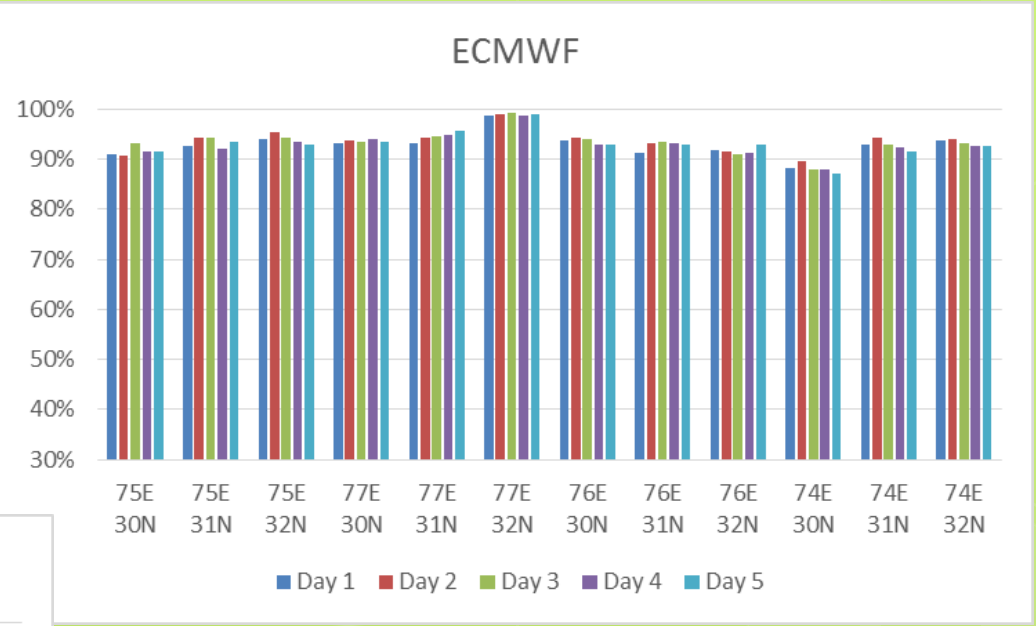
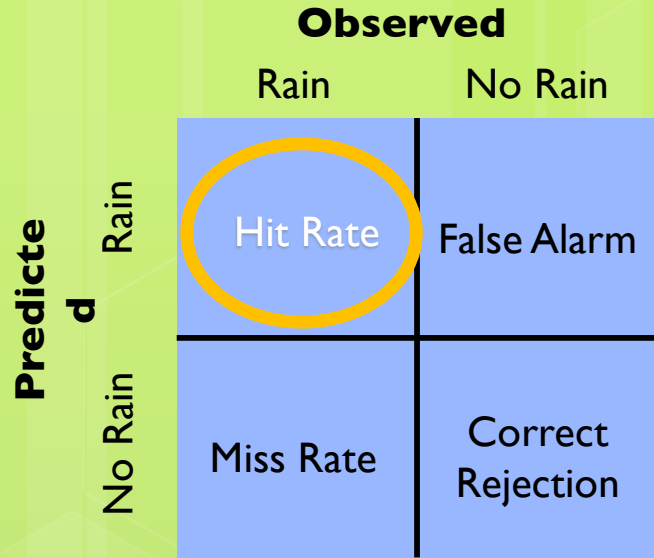
UKMO



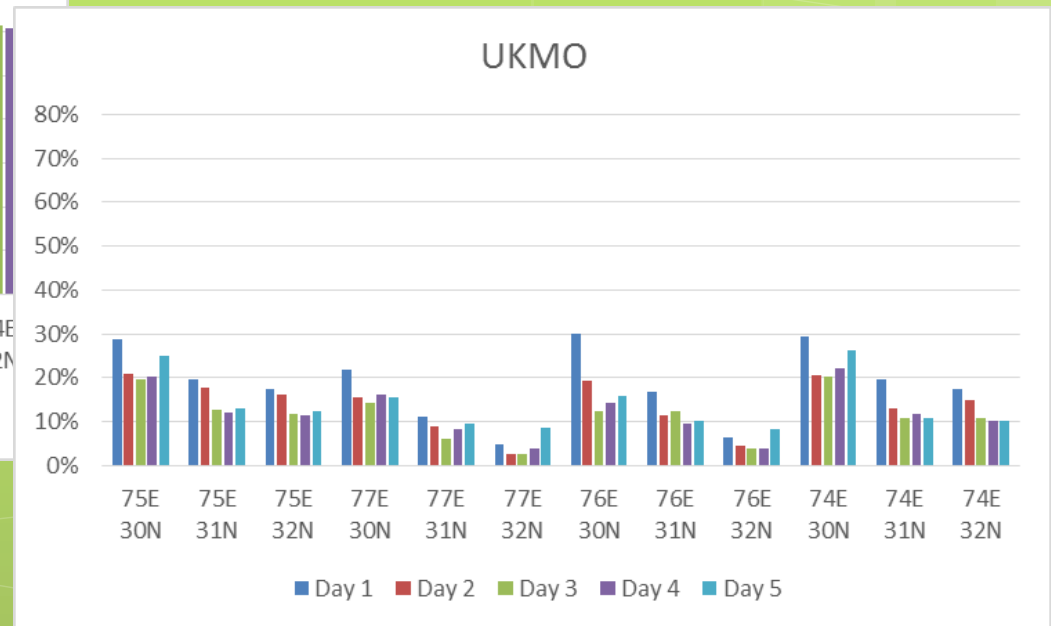
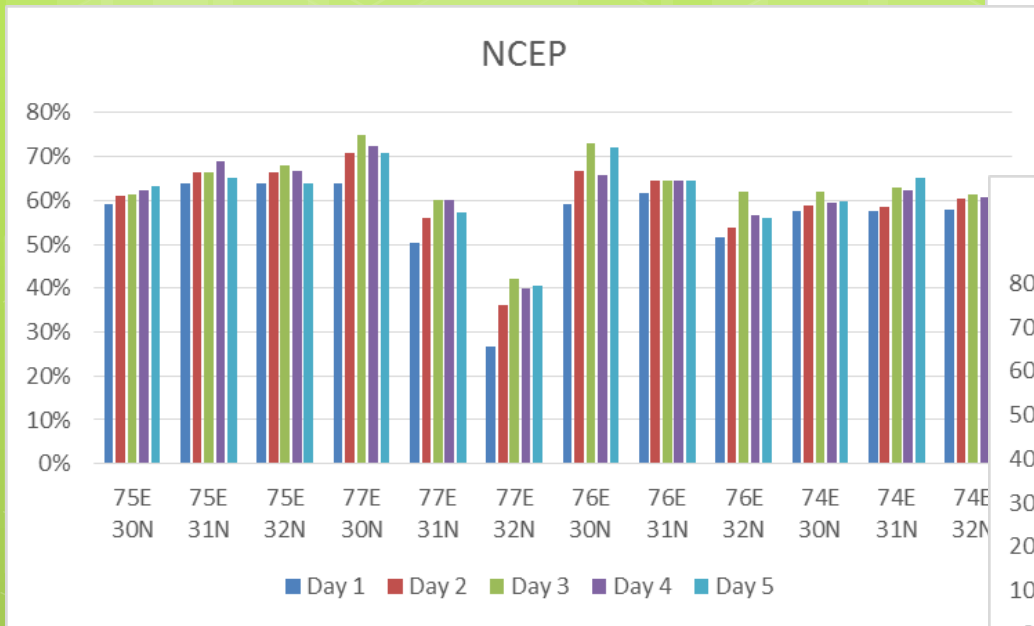
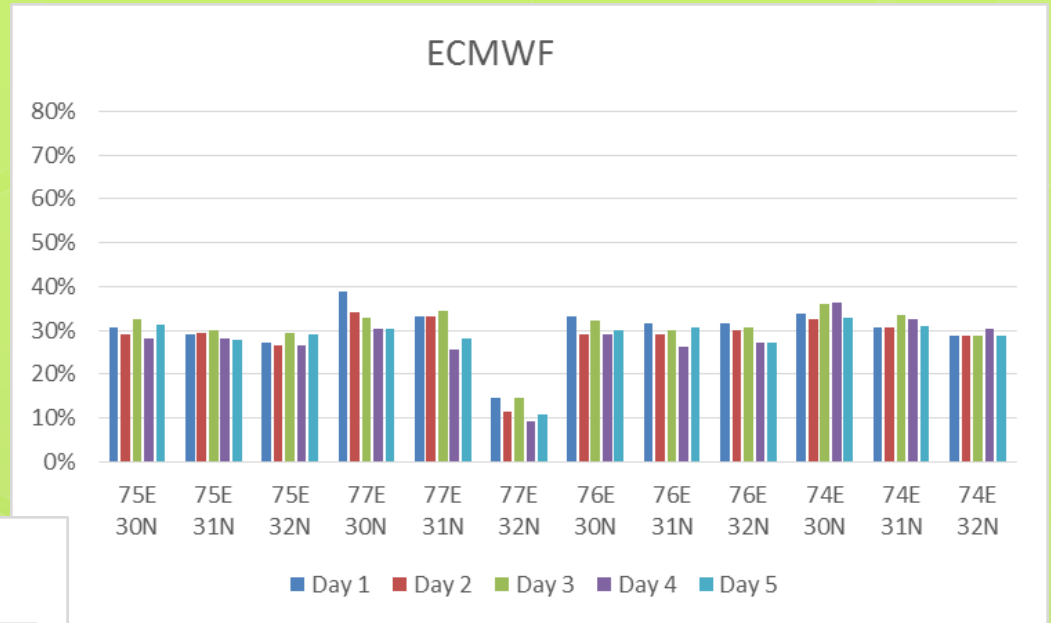
Day 1 Day 2 Day 3 Day 4 Day 5

13 Results - St Dev

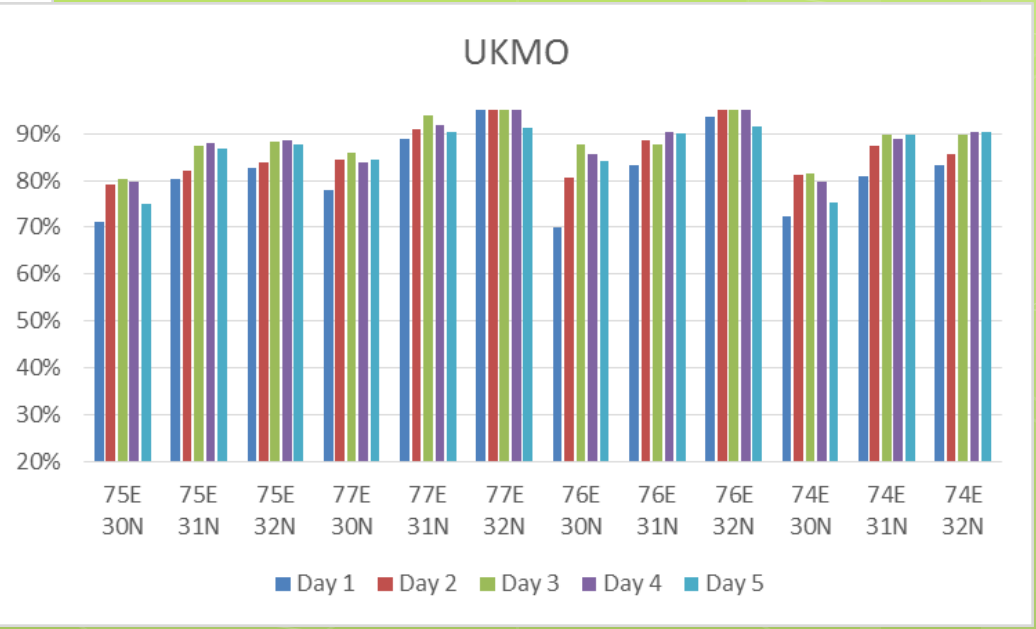
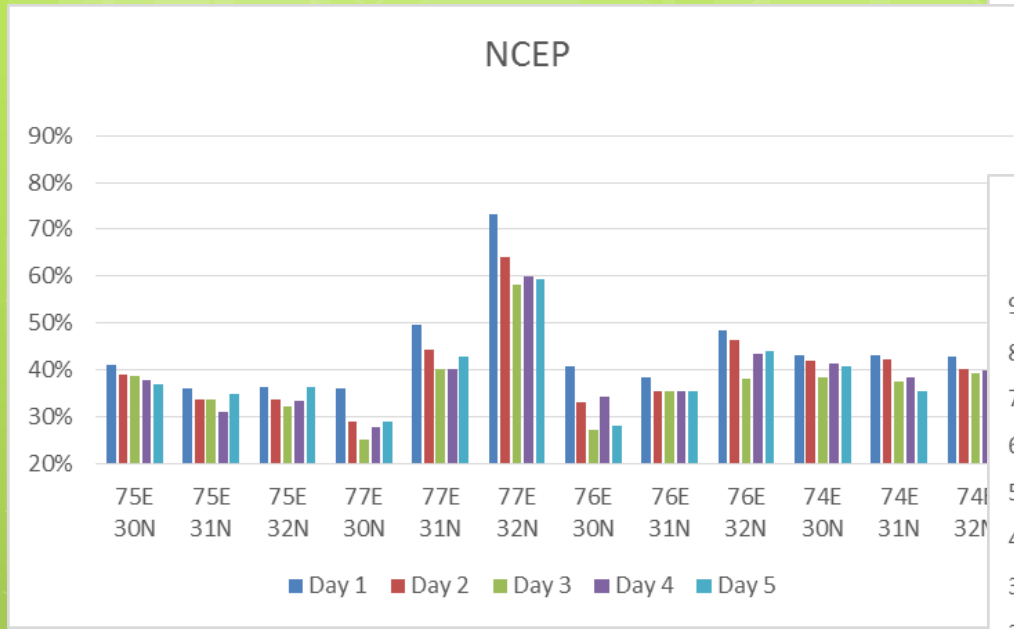
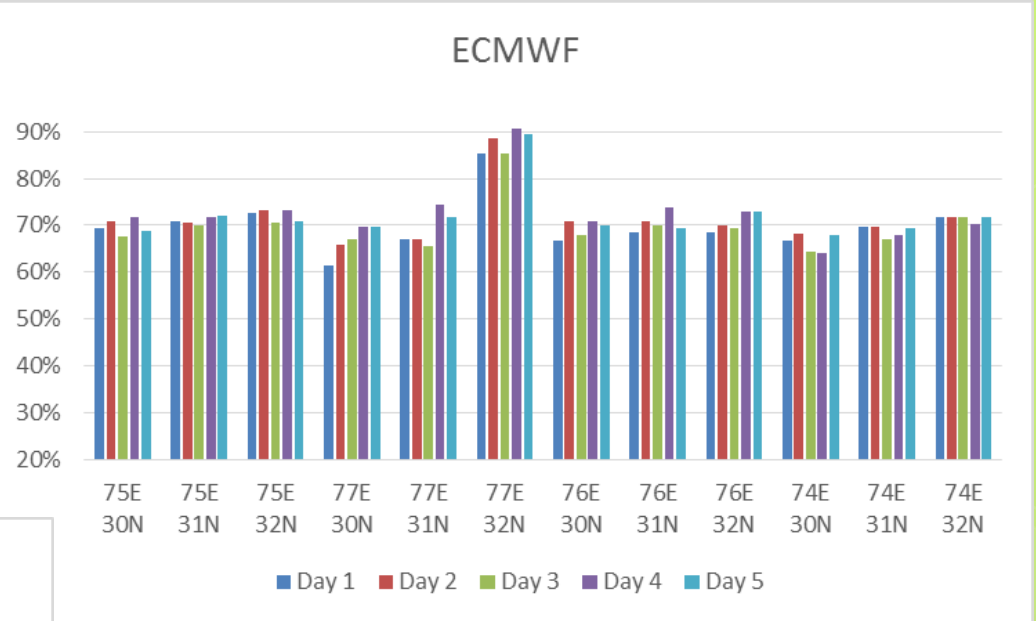


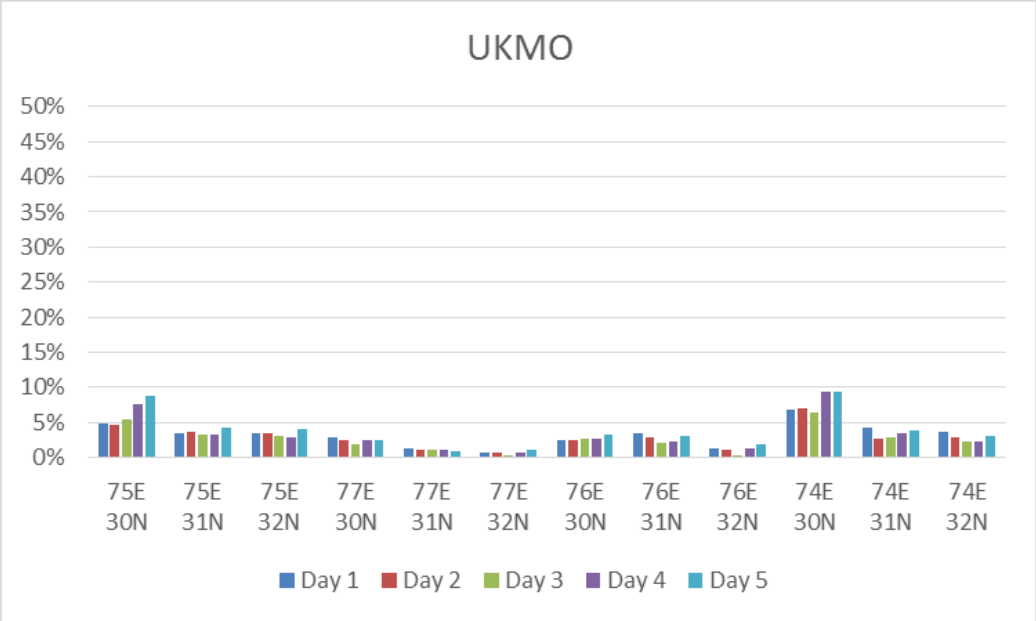
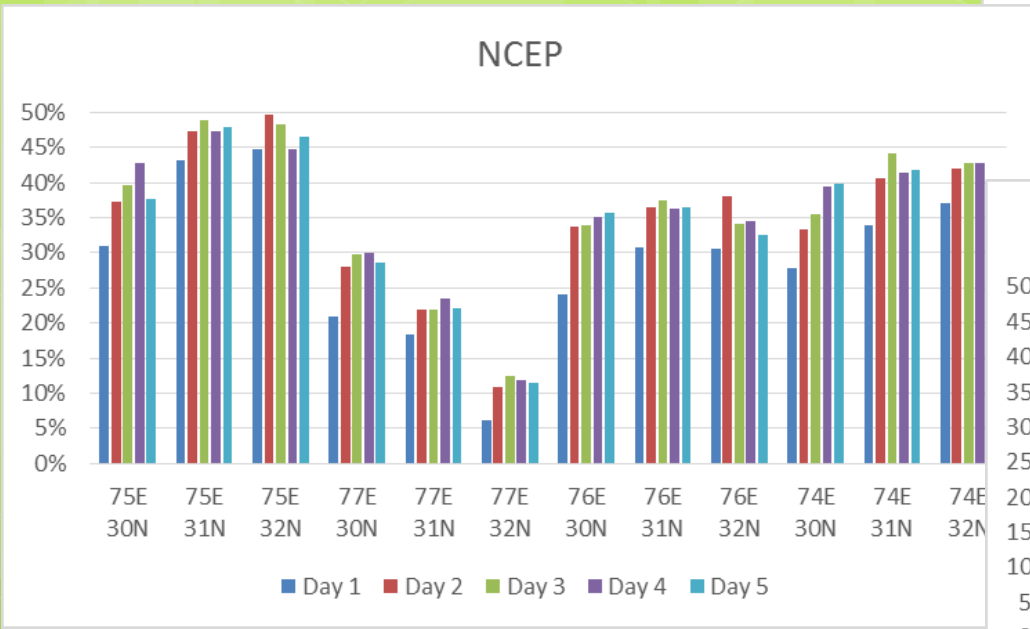
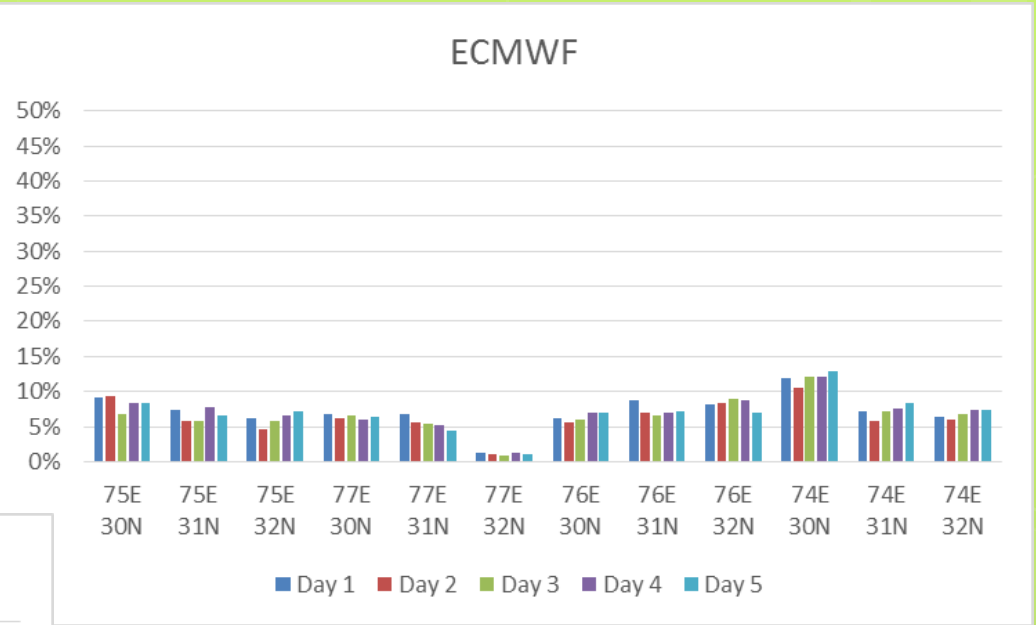
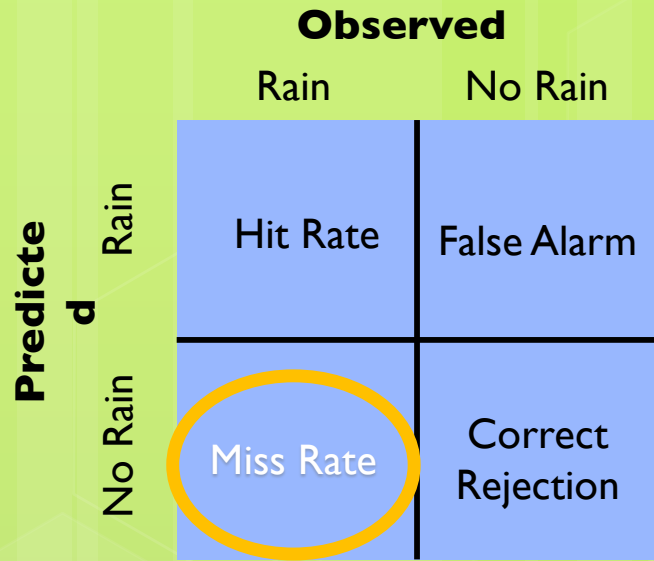


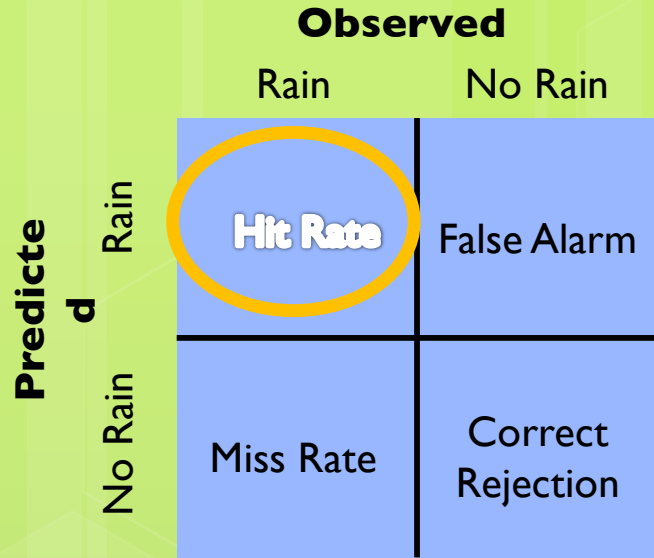
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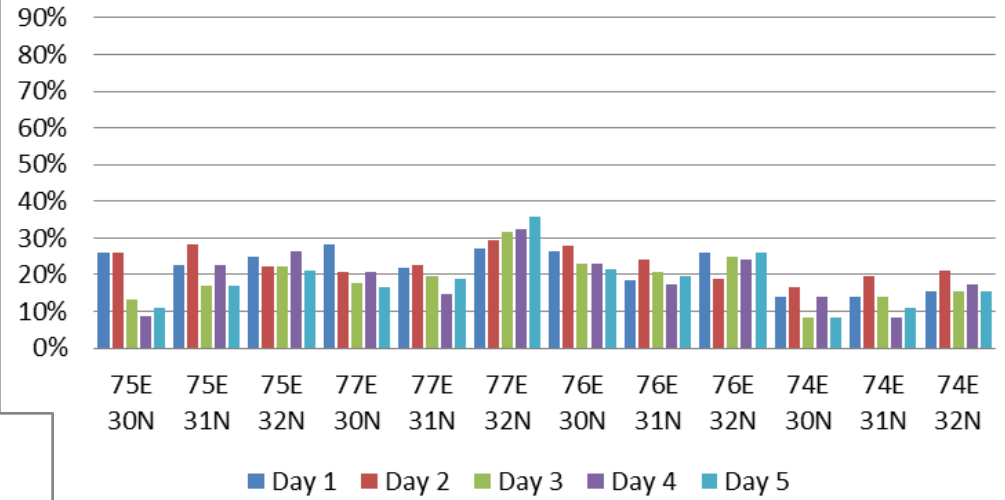
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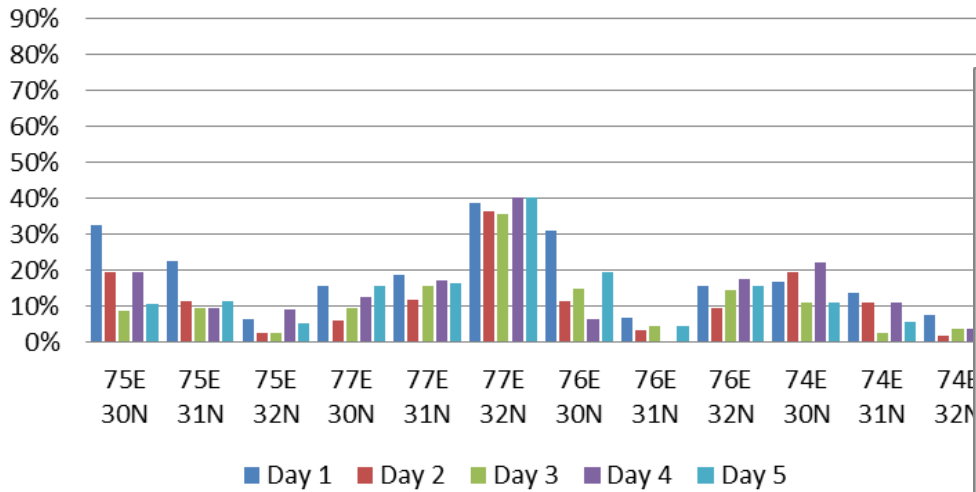




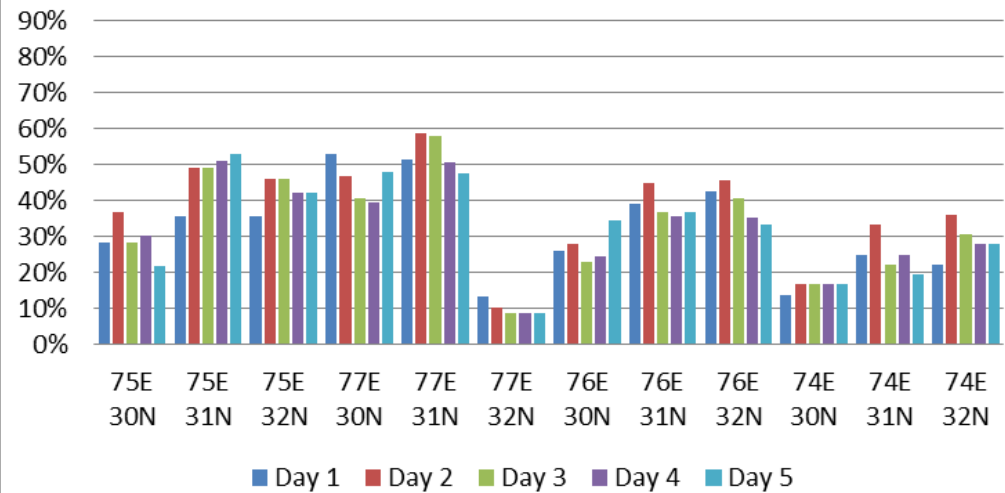
ECMWF

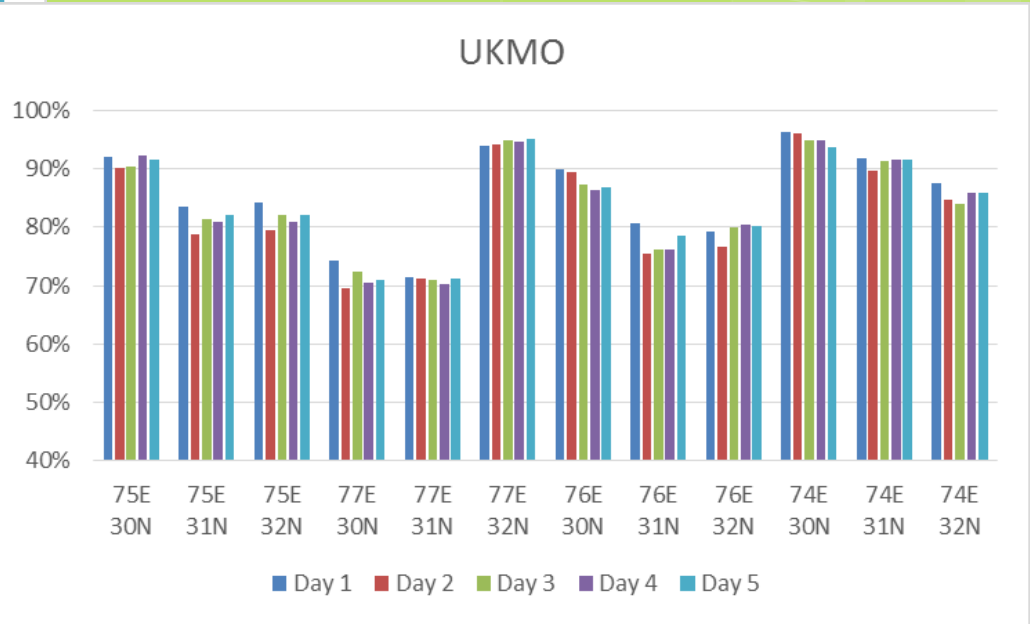
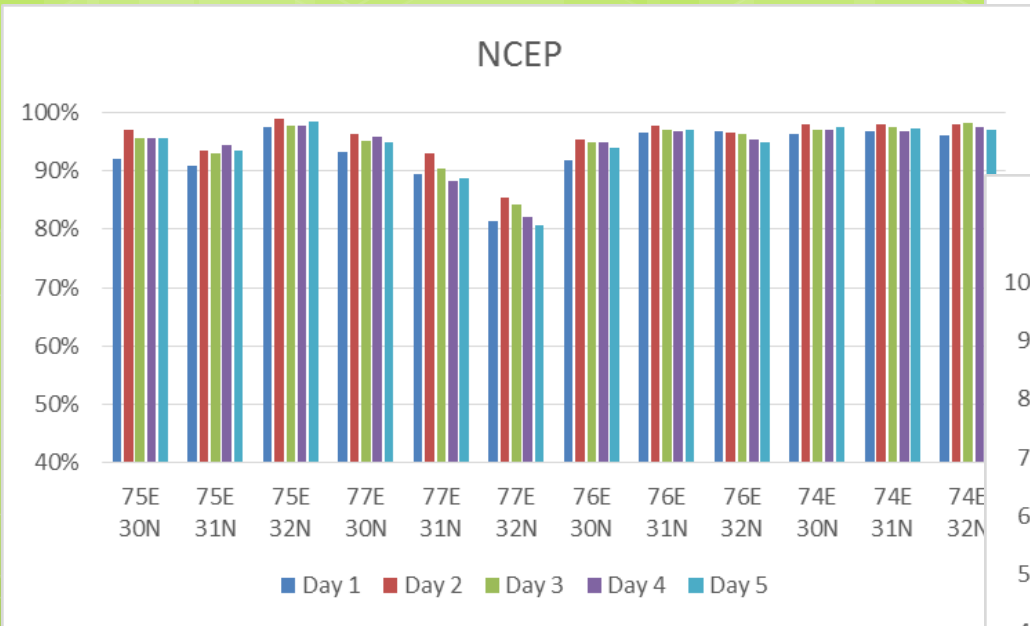
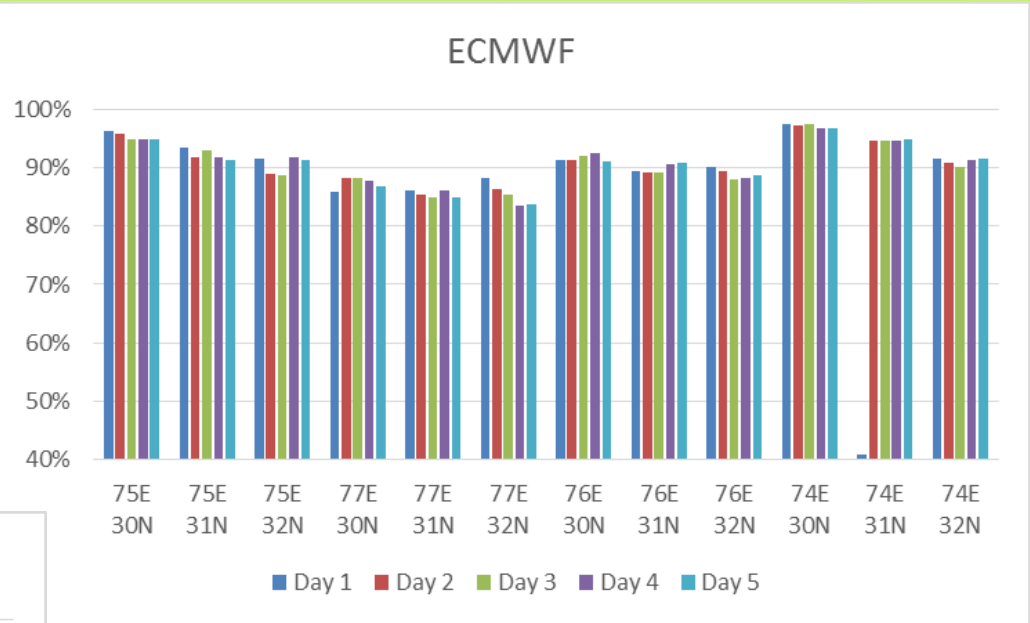
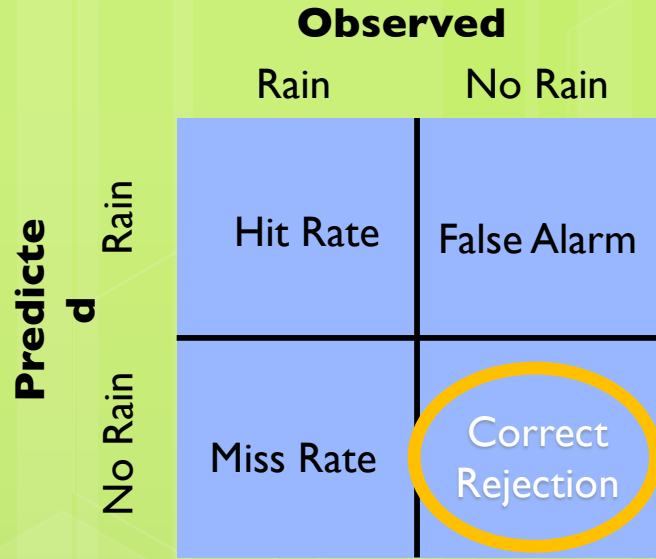


NCEP



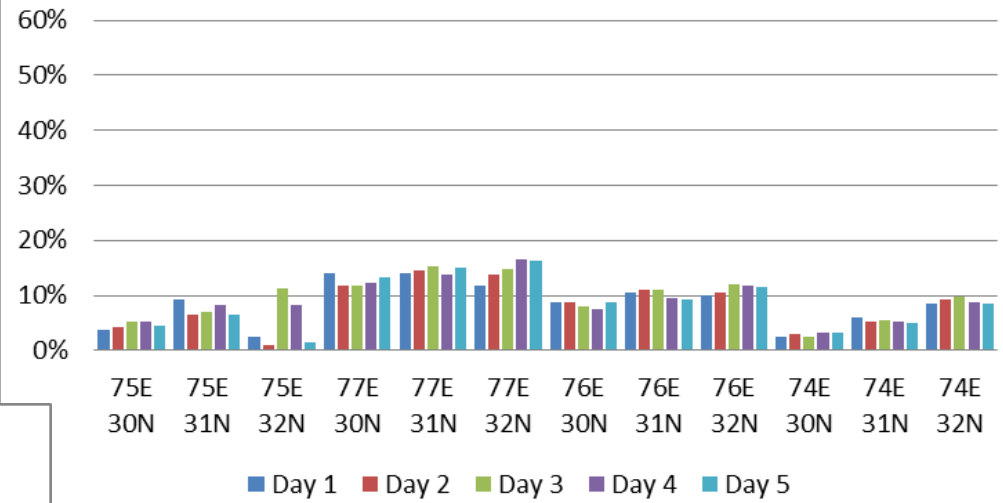
UKMO



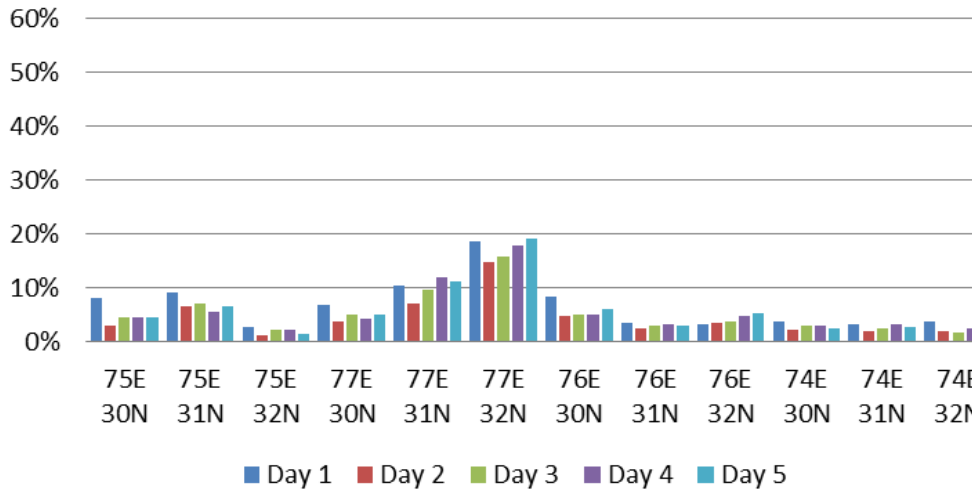


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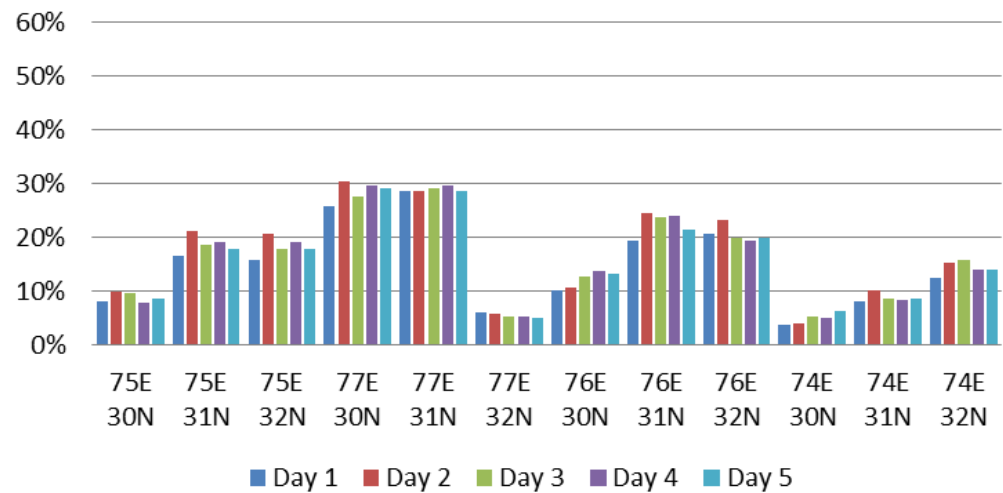
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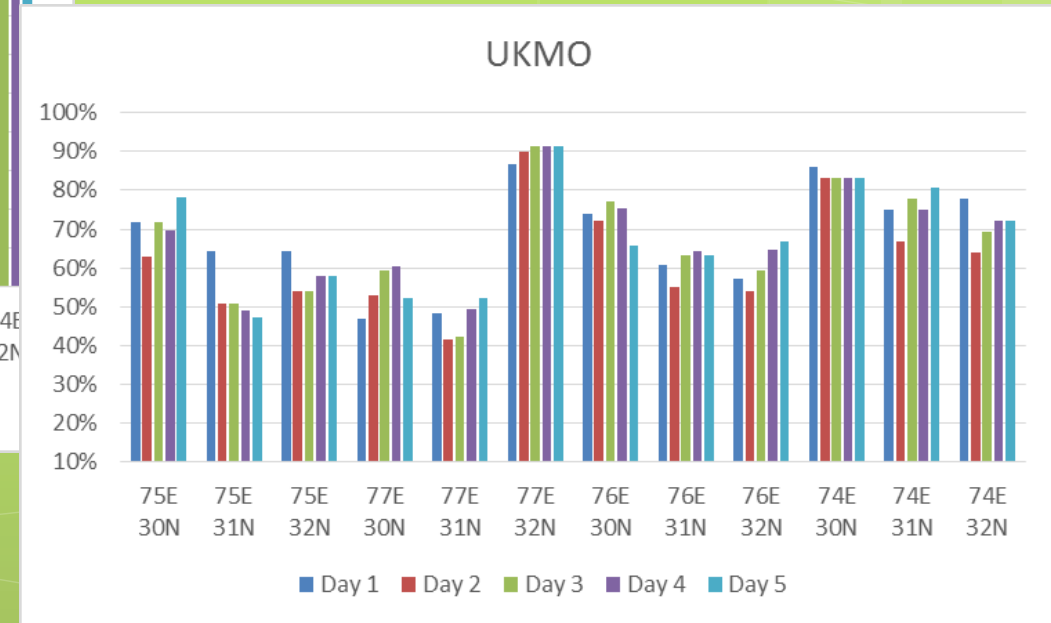
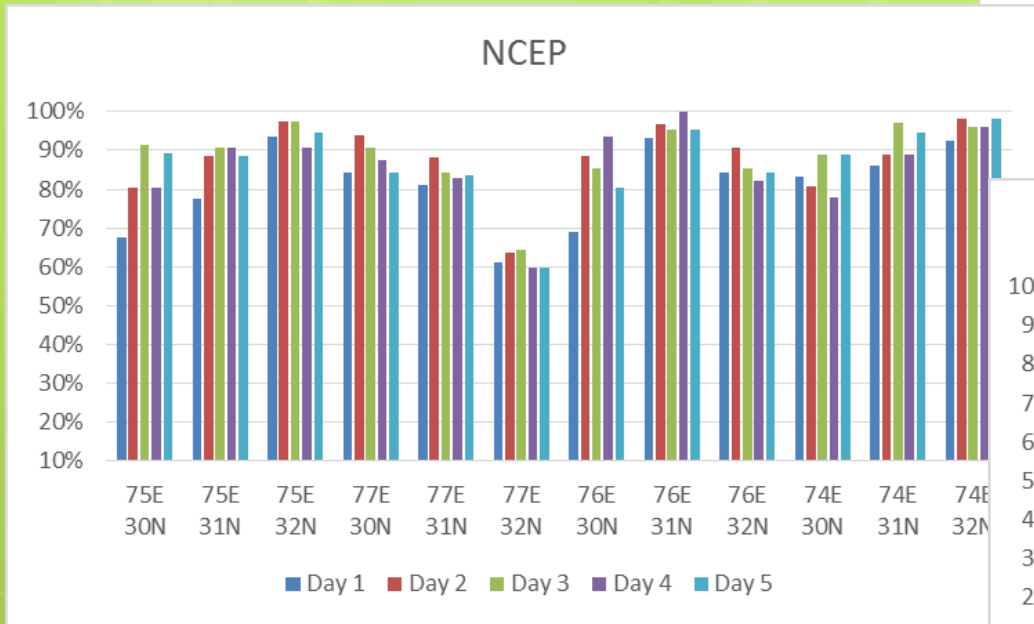
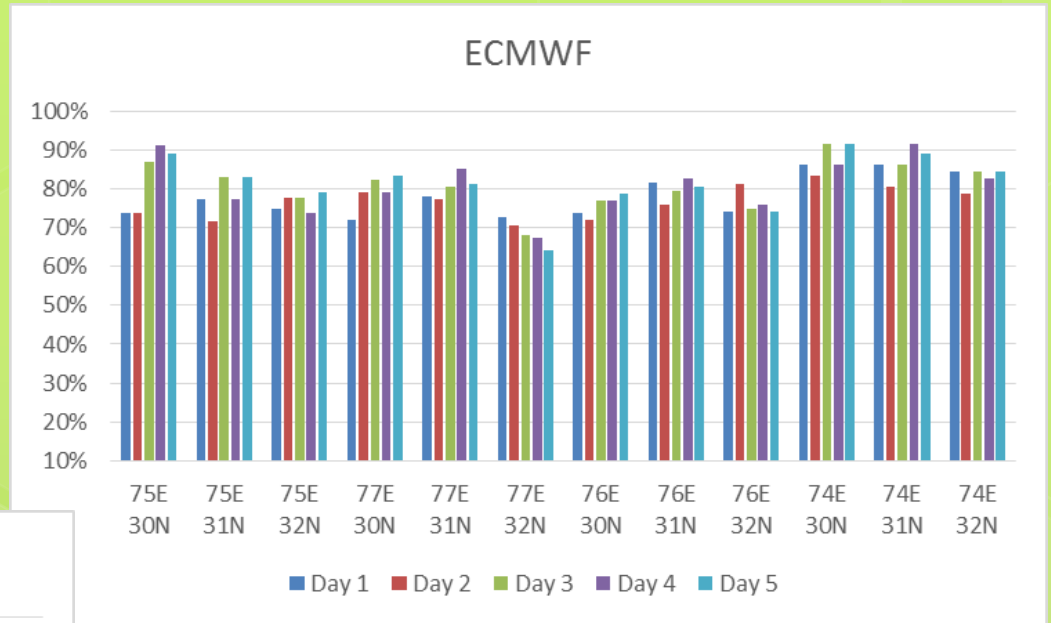
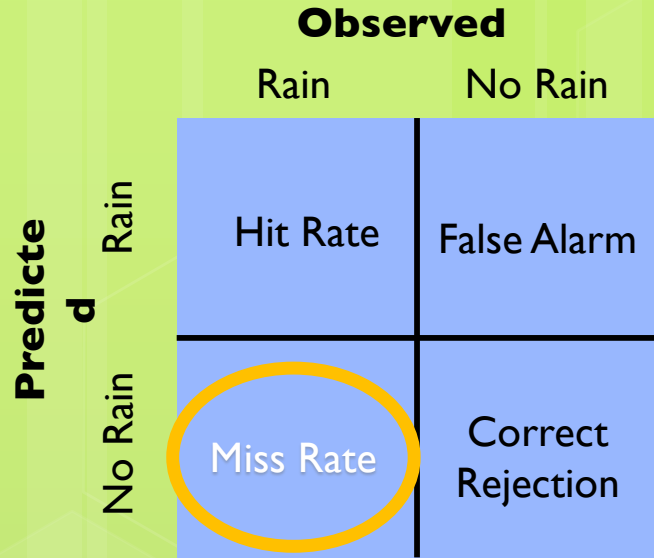


NCEP



UKMO





Summary

- NCEP model under predicts rainfall
- Standard deviation increases with prediction days
- Threshold value has a significant impact on accuracy of predicting rain
- UKMO is good at predicting hits (rain)
- NCEP is good at predicting correct rejection (irrigation)

Next Steps

- Decide on regional evaluation
- Recommend model for each region



Questions?

