Use of Synoptic Weather Pattern Identification in Operational Weather Forecasting in the Antarctic

John Cassano and Mark Seefeldt

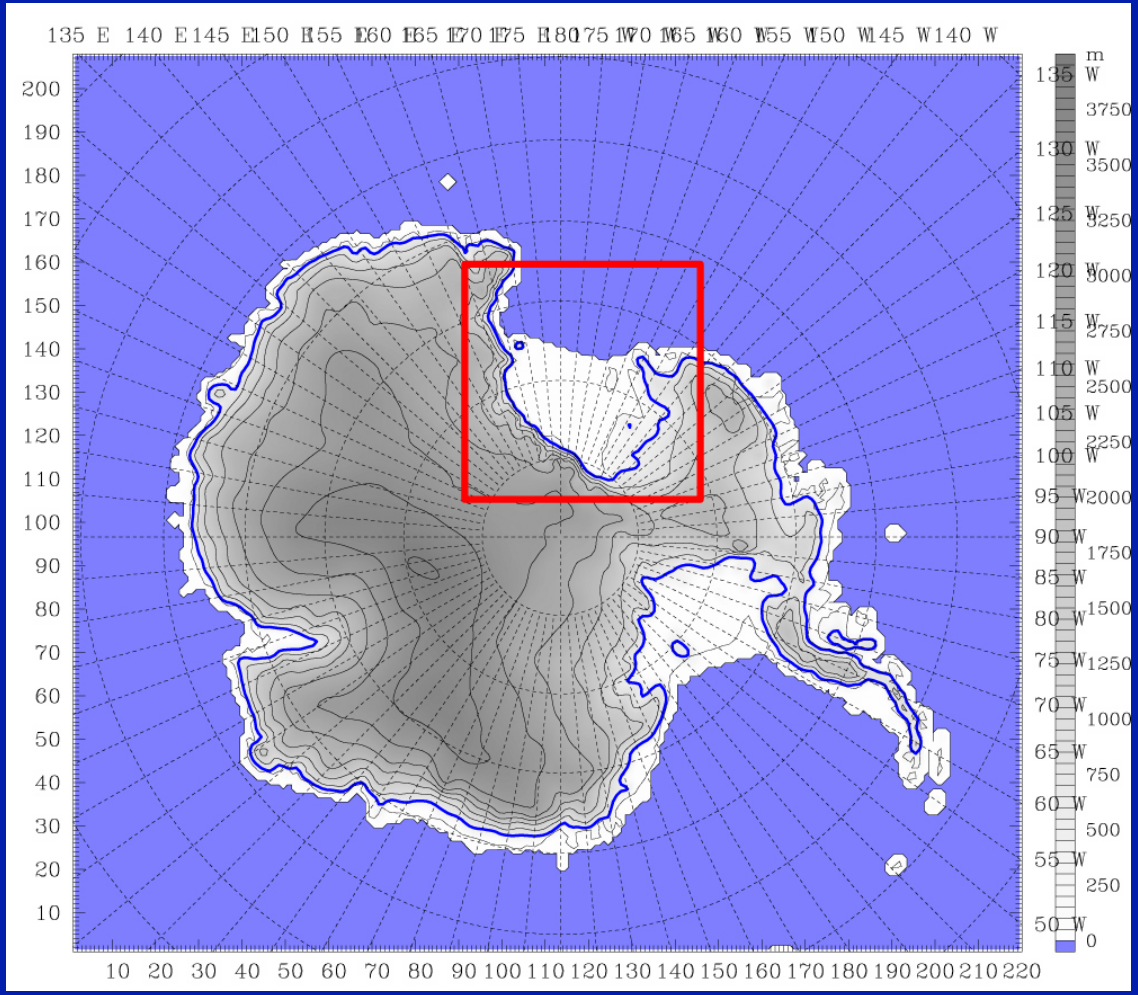
Department of Atmospheric and Oceanic Sciences
Cooperative Institute for Research in Environmental Sciences
University of Colorado

Project Goals

- Develop SLP synoptic climatology
- Evaluate AMPS forecasts from a “synoptic” perspective
  - Identify misprediction of synoptic patterns in AMPS forecasts
  - Quantify model errors under varied synoptic forcing
- Compare results with forecaster identified model errors

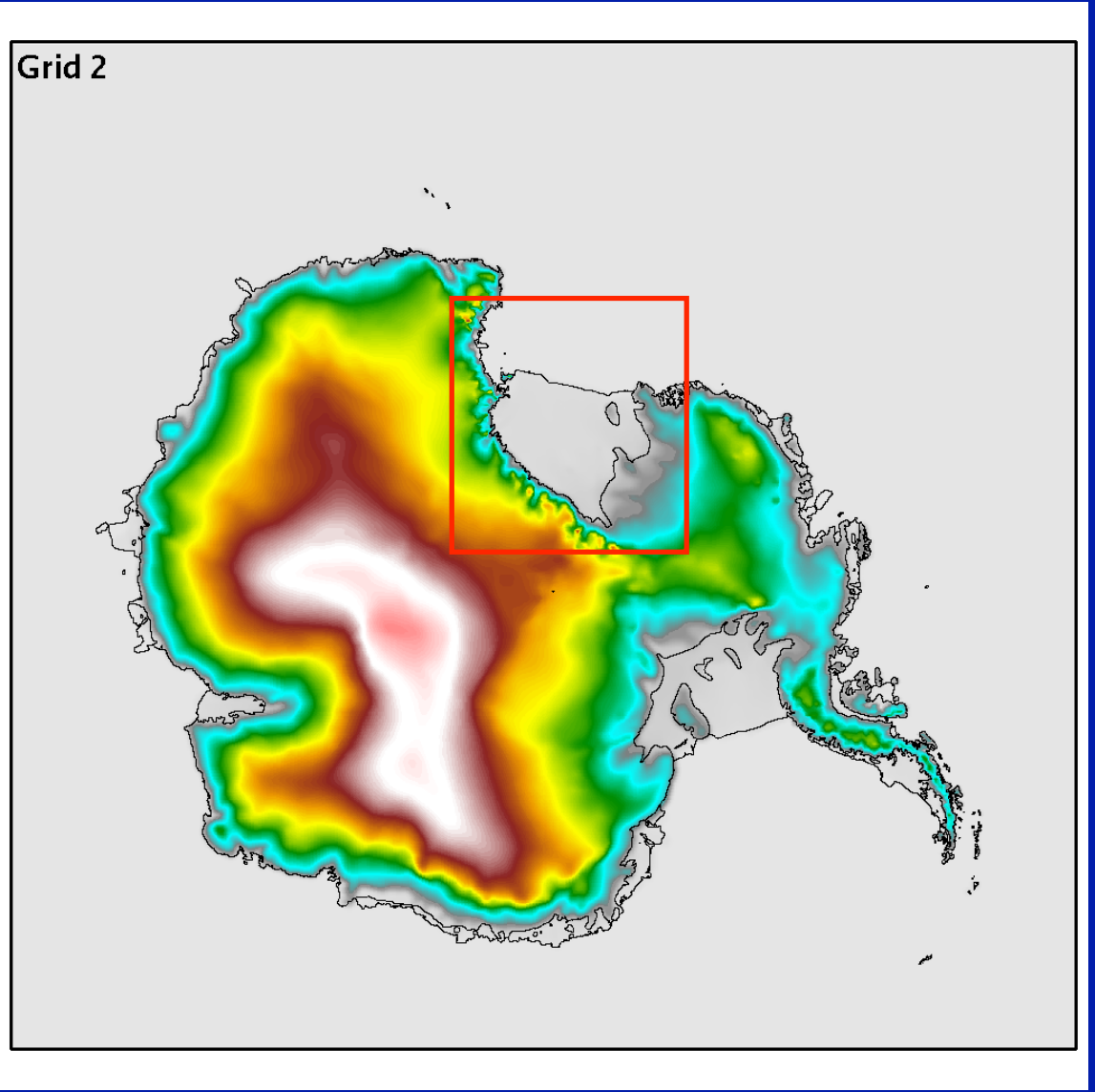
Data for Current SOM Analysis

- SLP over Ross Sea sector of AMPS 30 km model domain
- AMPS MM5 simulations from Nov 2001 through Dec 2005
  - 9823 forecast times
- Evaluate forecasts at 12h intervals
  - 000: 0, 3, 6, 9 h
  - 012: 12, 15, 18, 21 h
  - 024: 24, 27, 30, 33 h
  - 036: 36, 39, 42, 45 h
  - 048: 48, 51, 54, 57 h
  - 060: 60, 63, 66, 69 h



Data for Proposed SOM Analysis

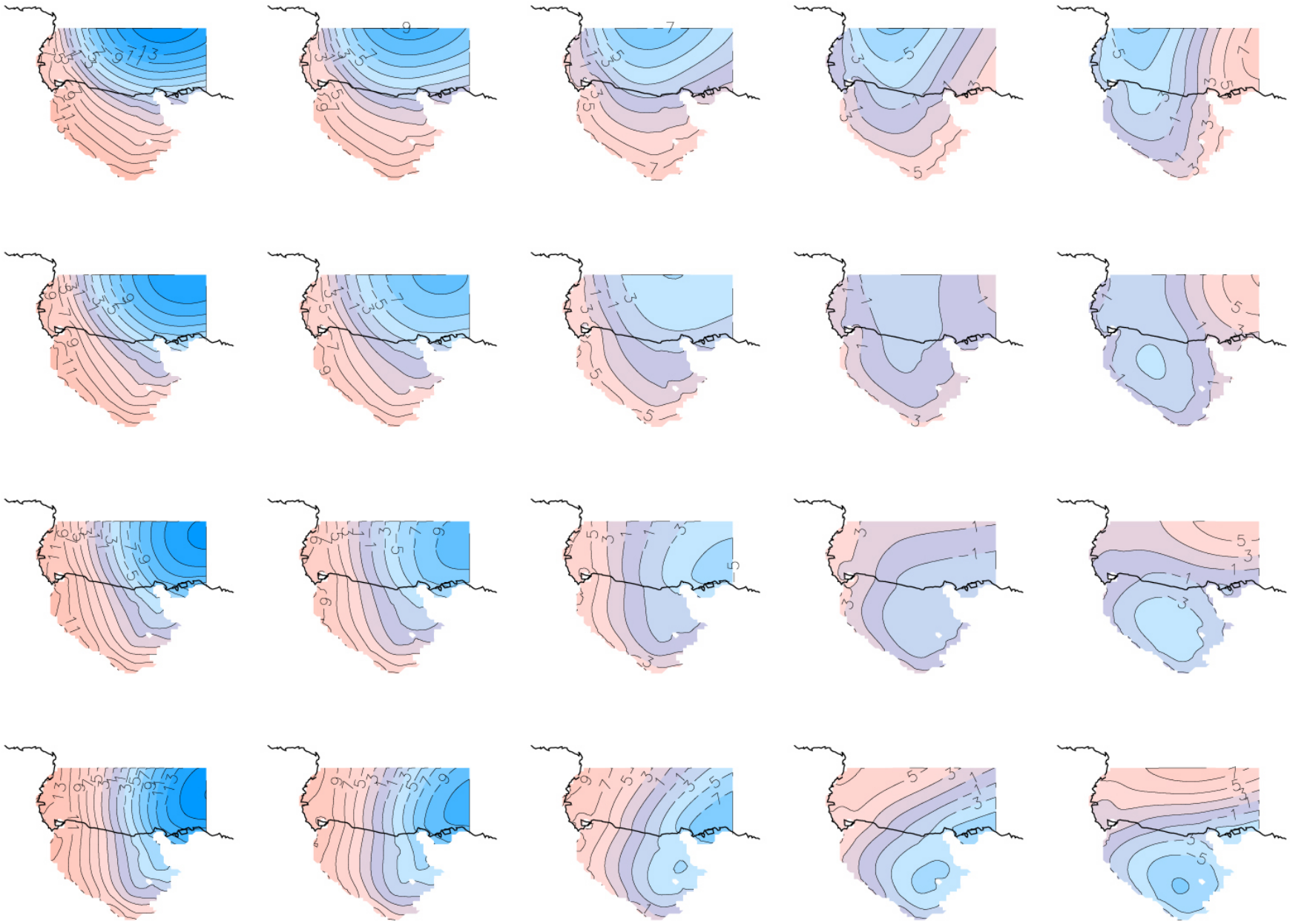
- SLP over Ross Sea sector of AMPS 20 km model domain
- Data from both MM5 and WRF AMPS simulations
- Evaluate forecasts at 12h intervals
  - 000: 0, 3, 6, 9 h
  - 012: 12, 15, 18, 21 h
  - 024: 24, 27, 30, 33 h
  - 036: 36, 39, 42, 45 h
  - 048: 48, 51, 54, 57 h
  - 060: 60, 63, 66, 69 h



SLP Synoptic Climatology

- Use self-organizing maps to develop SLP synoptic climatology
- SOM - Self-Organizing Map
- Clusters data into a user selected number of nodes using an unsupervised learning algorithm
- SOMs are in use across a wide range of disciplines
  - Climate applications of SOMs
    - Hewitson and Crane (2002) *Climate Research*
    - Cassano et al. (2006) *Climate Dynamics*
    - Cassano et al. (2006) *International Journal of Climatology*
    - Lynch et al. (2006) *International Journal of Climatology*
    - Lynch et al. (2007) *J. Geophys Res.*
    - Cassano et al. (2007) *J. Geophys. Res.* (in press)

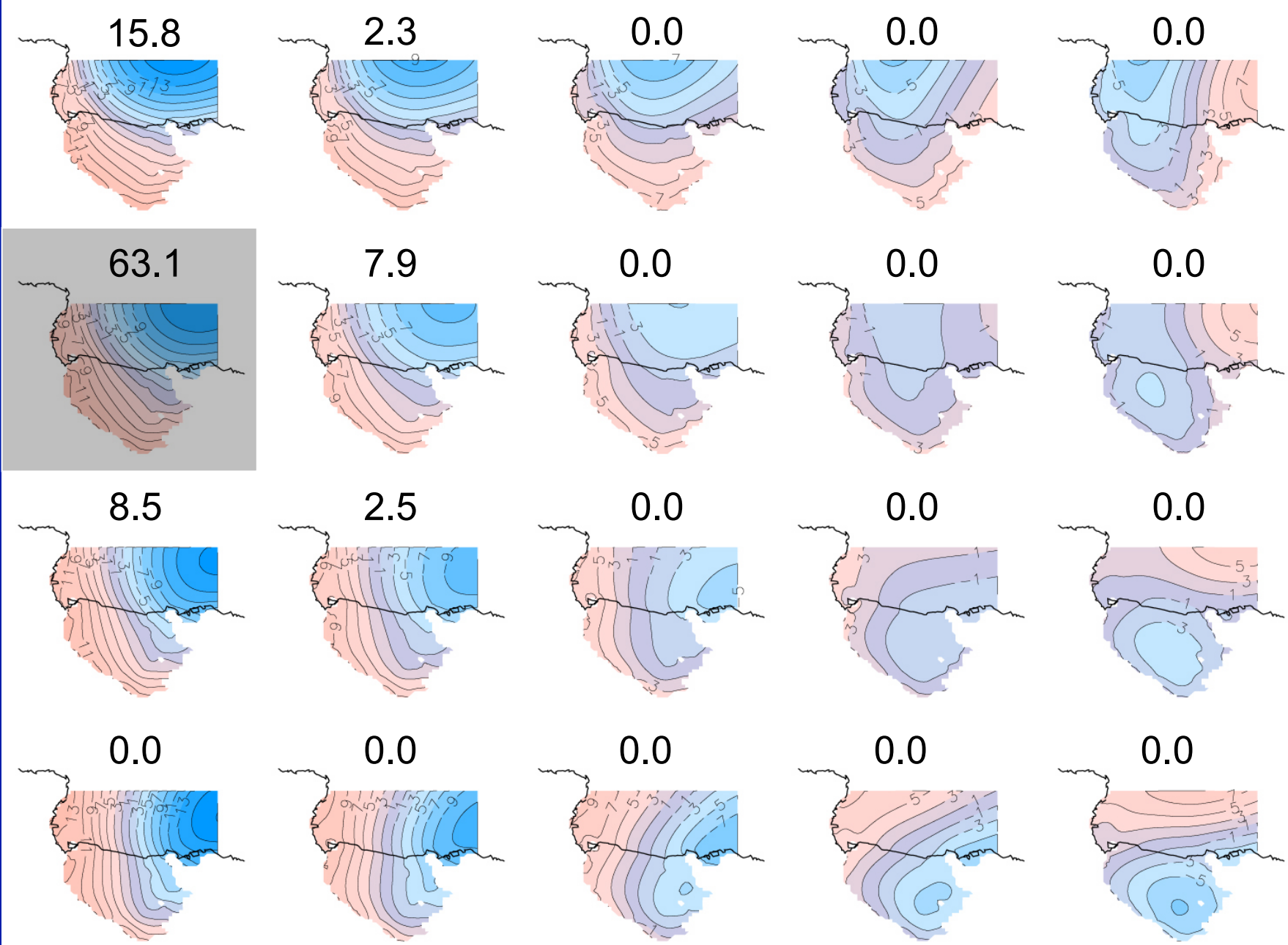
Ross Ice Shelf SLP Synoptic Climatology



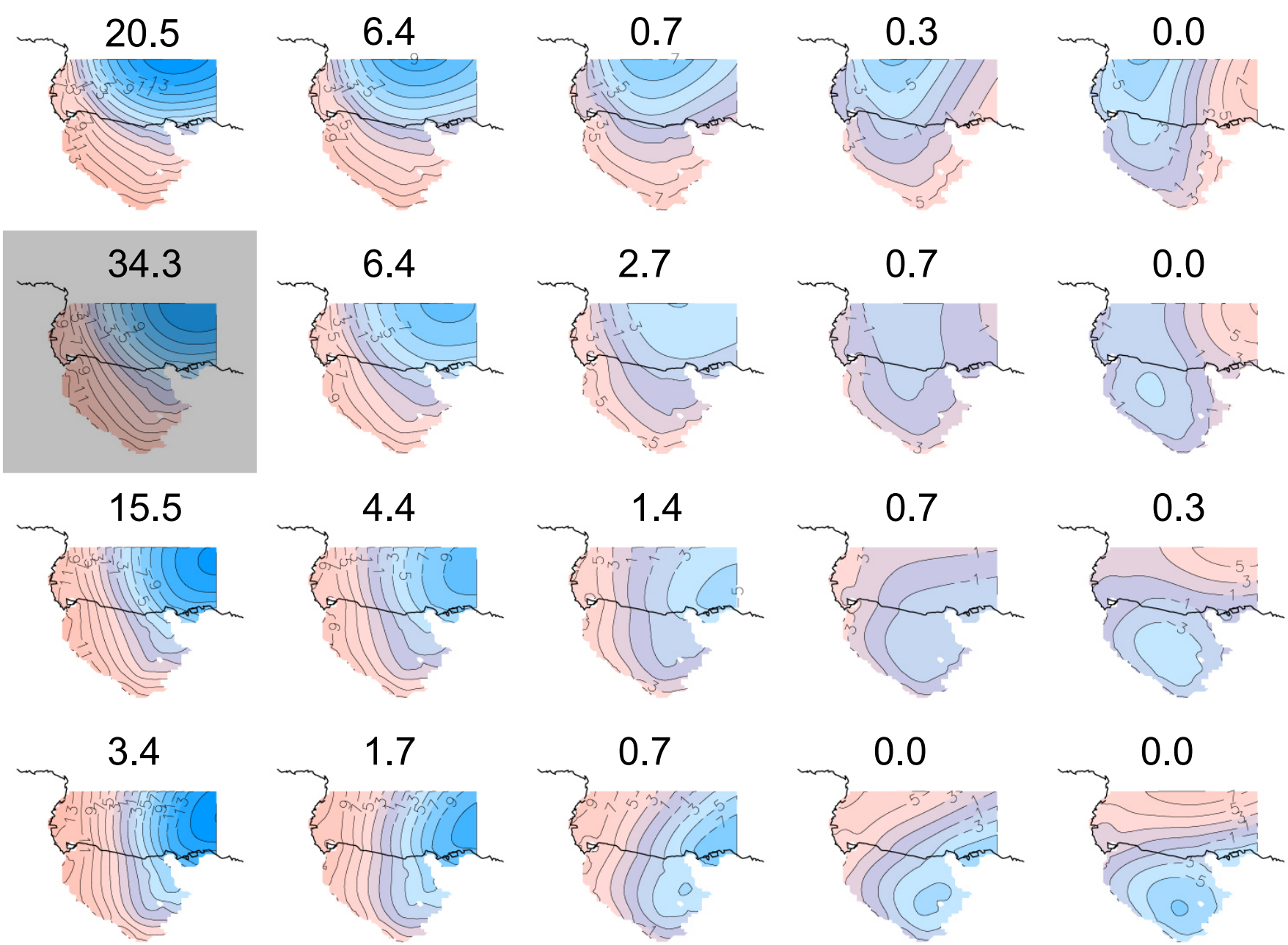
SOM Evaluation of AMPS Forecasts: SLP Pattern Misprediction

- Consider all of the time periods for which a certain forecast hour maps to a particular pattern
  - For these time periods determine which patterns the model analyses (verification) map to
- Calculate:
  - Percent of forecasts that map to the same pattern as the analyses
  - Determine mis-mapping of model predicted patterns

AMPS 012 Forecasts: Node (1,2)



AMPS 060 Forecasts: Node (1,2)

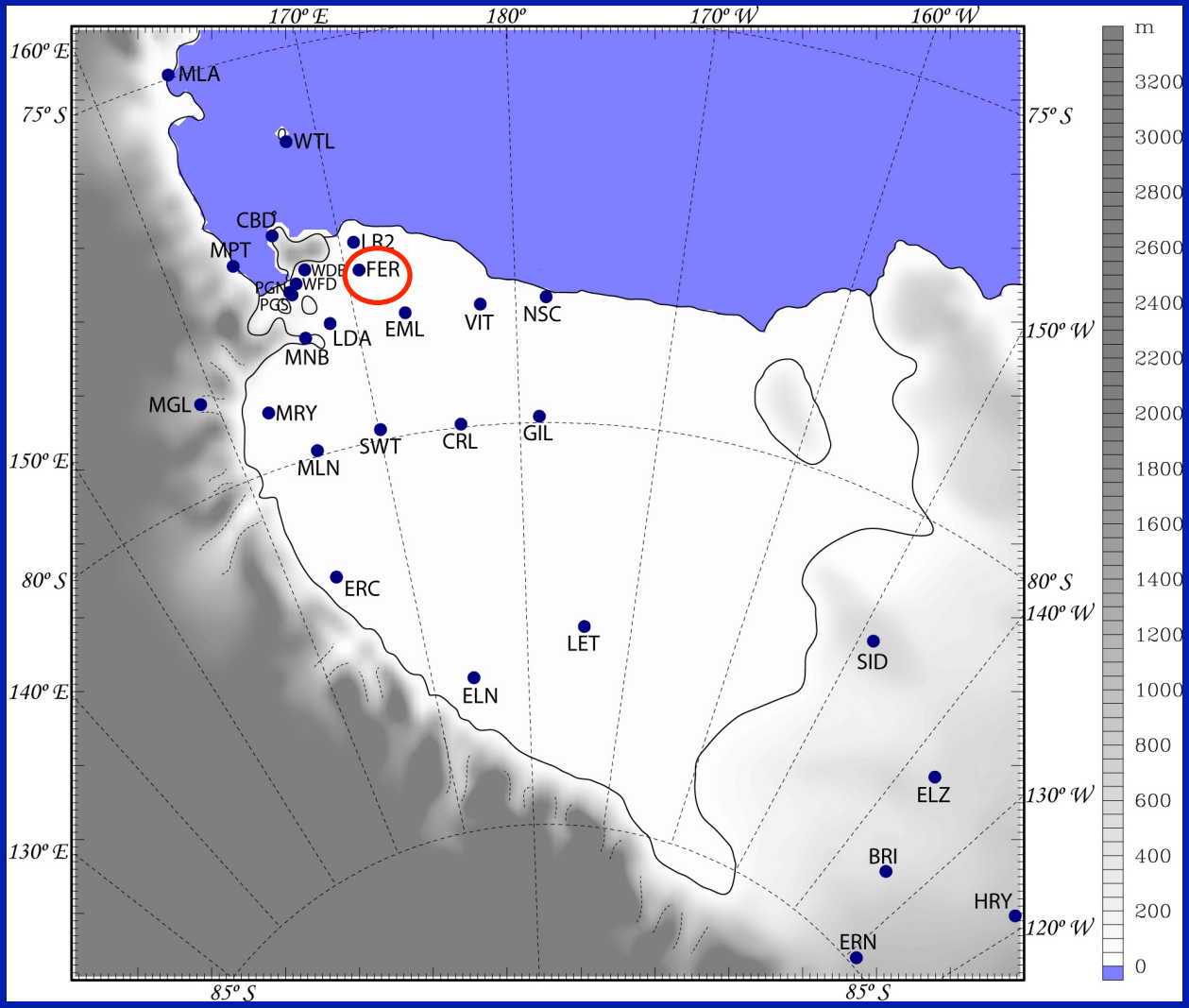


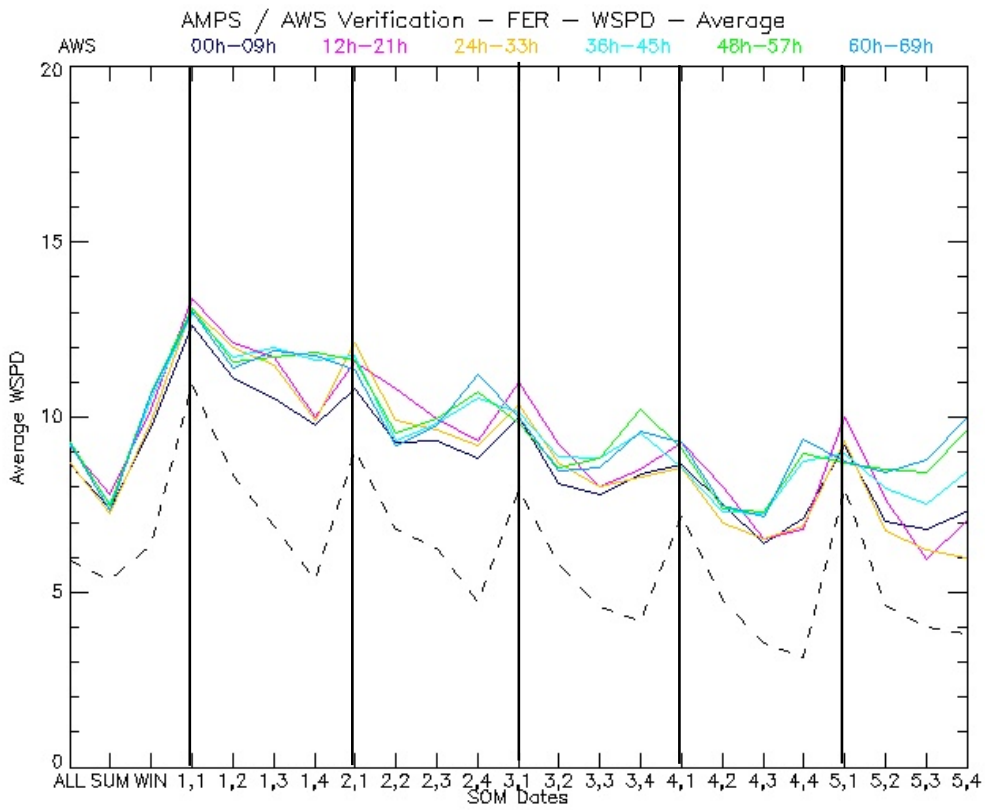
SOM Evaluation of AMPS Forecasts: Model Errors for Synoptic Patterns

- Determine how model predictions (or observations) at selected locations vary as a function of SOM identified SLP patterns
- Calculate model validation statistics (model vs obs) for all time periods that map to each SLP pattern
- Identify model errors that vary from pattern to pattern

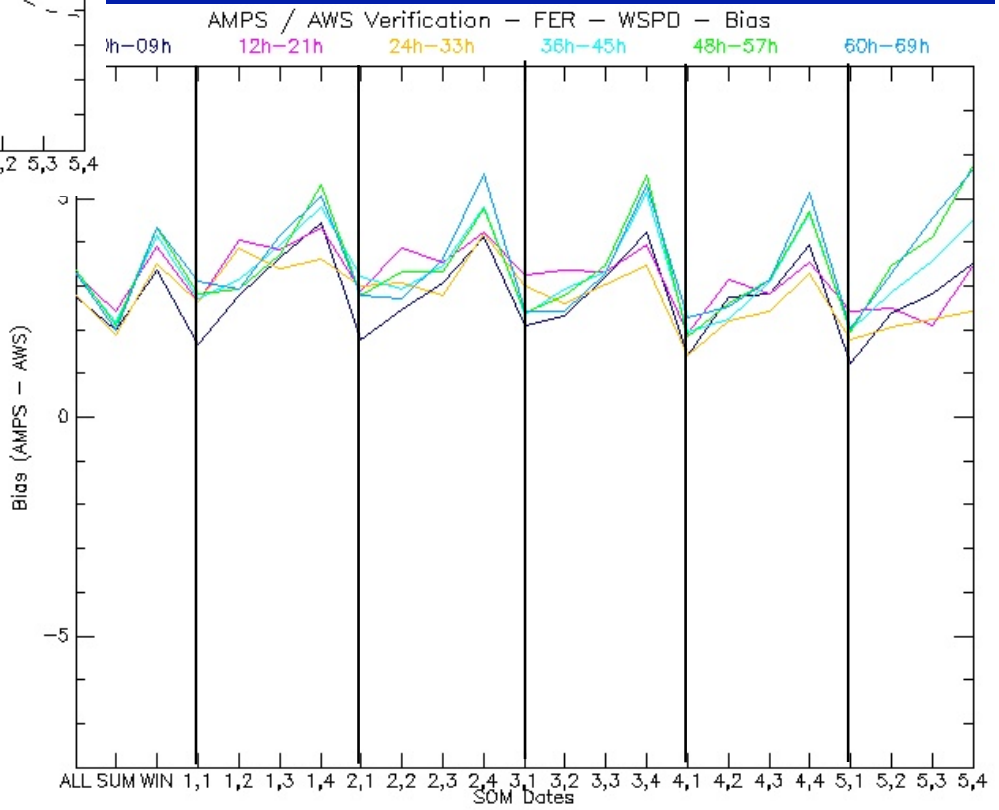
Observational Data

- Currently using Univ. Wisconsin AWS data
- Plan to use operational observations as well (Willie Field, etc.)





Ferrell: Wind Speed



Future Work

- Implement real-time SOM analysis:
  - SLP pattern identification
  - Misprediction of SLP patterns
- Develop “forecaster guide” to model errors
  - Based on error statistics for SLP patterns
- Relate SOM model analysis to forecaster identified model errors