CONCORDIASI

Concordiasi Dropsondes: Improved Characterisation of Errors in the Antarctic Mesoscale Prediction System

James Russell

Dr. David Parsons
Dr. Steven Cavallo

Image courtesy: Kelly Speelman

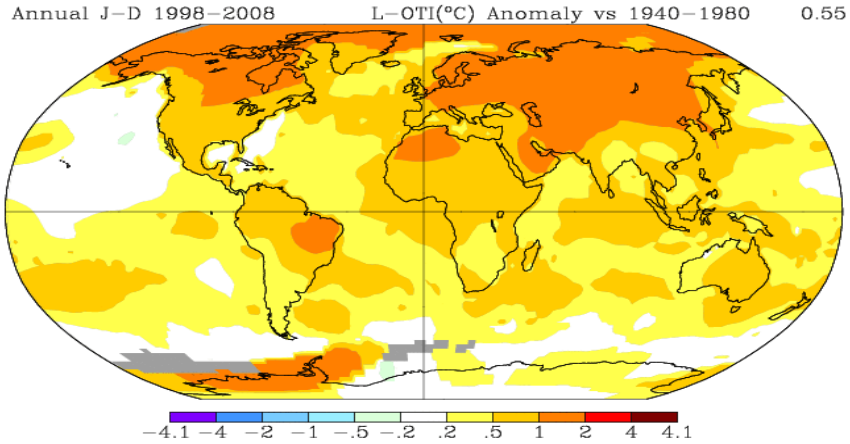
Outline

1. **Motivations, Introduction & Methodology**
2. Results: Systematic biases in AMPS
3. Discussion & Summary

Motivations

Why are we interested in Antarctica?

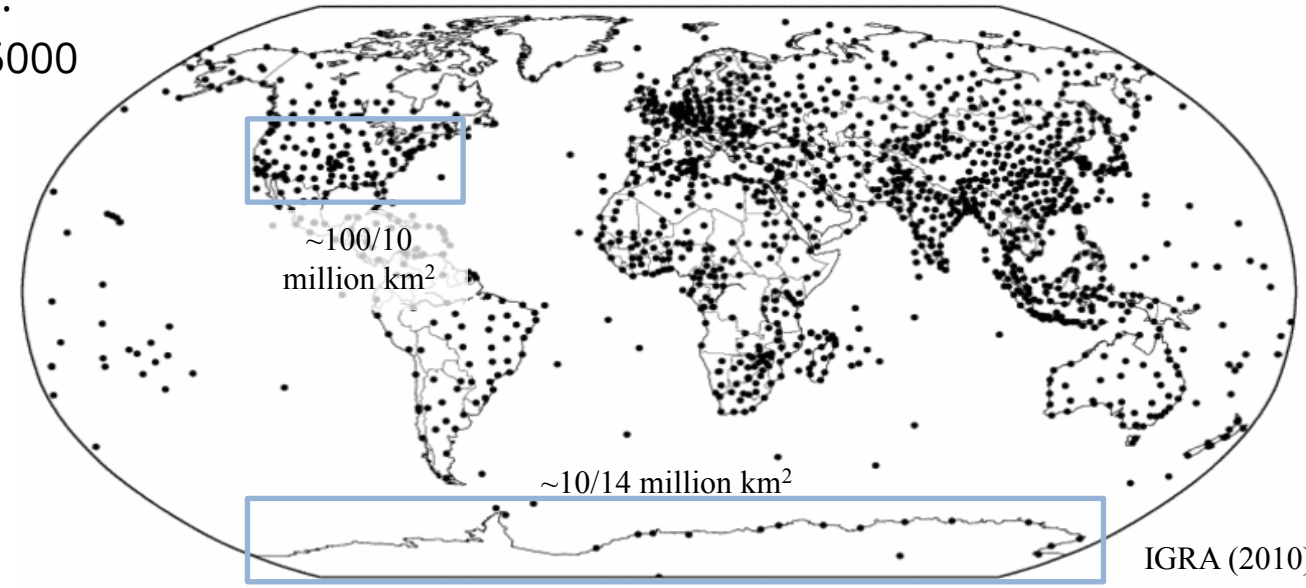
- Antarctic ice sheet holds 90% of the global fresh water – implications for global sea level and climate change.
- Stratospheric ozone
- Pristine ecological environment



NASA GISS (2014): 1998-2008 temperature anomalies relative to 1940-1980

Why AMPS?

- Premier model for research and forecasting in Antarctica.
- ~5000 scientists and ~35000 tourists annually.
- In an area with few observations the importance of NWP is greater.
- Lack of observations leads to poor NWP products.



IGRA (2010)

Concordiasi

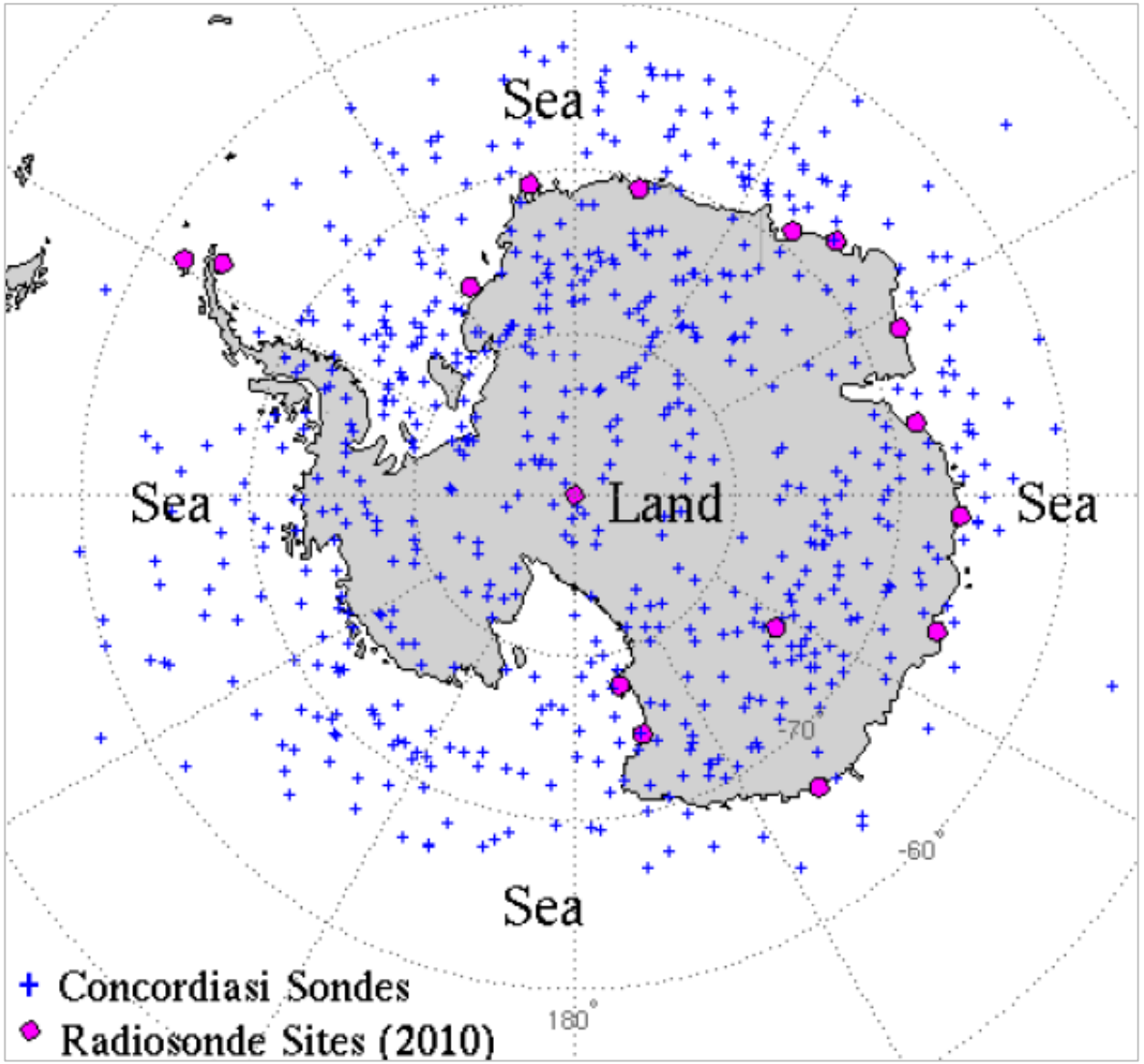
3 year international Antarctic field project (2008-2010)

Focus

- Innovative stratospheric balloon & tethered gondola system
- 639 dropsonde soundings
- Austral Spring 2010
- Rabier et al. (2013)

Current Project Goals

'To compare real-time AMPS forecast profiles to Concordiasi dropsonde profiles in order to confirm and expand on the results produced in previous evaluations (Bromwich, 2013) by utilizing the benefit of improved spacial resolution of observations.'

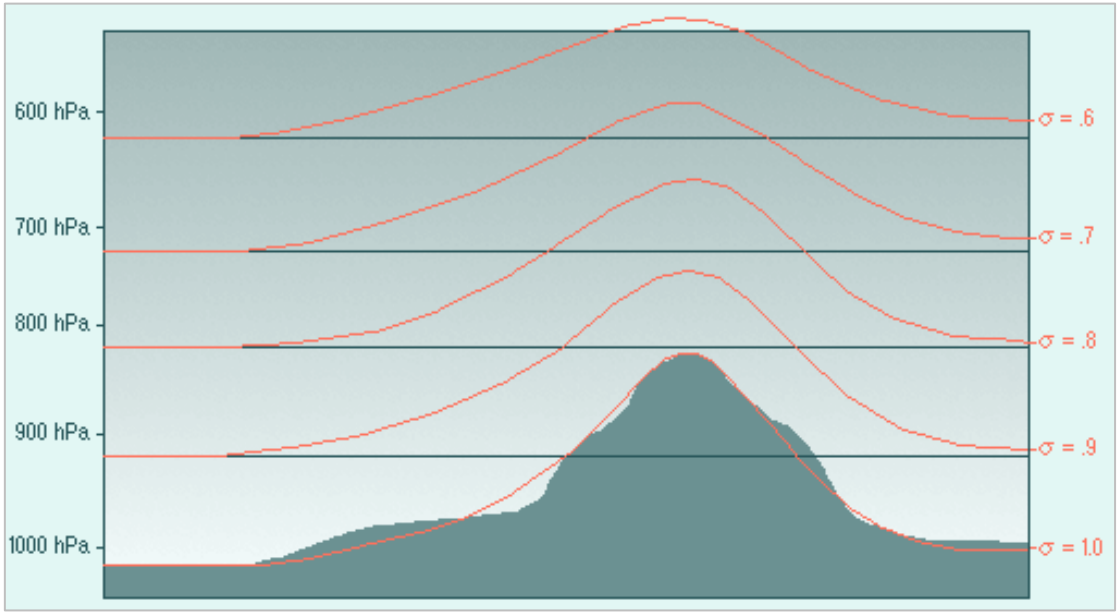


Methodology

Implement **NCAR Radiation Bias Correction** Scheme (Wang et al. 2013) for dropsondes humidity at all levels and times

Model gridded data interpolated to Concordiasi locations

Statistics
Focus: Bias
Model – Observation
Is model systematically over/under-forecasting?



Subset Size		Day	Night	Total
Land	Analysis	72	38	110
	Forecast	269	89	358
Sea	Analysis	45	24	69
	Forecast	157	108	265
Total	Analysis	117	62	179
	Forecast	426	197	623

Outline

1. Motivations, Introduction & Methodology

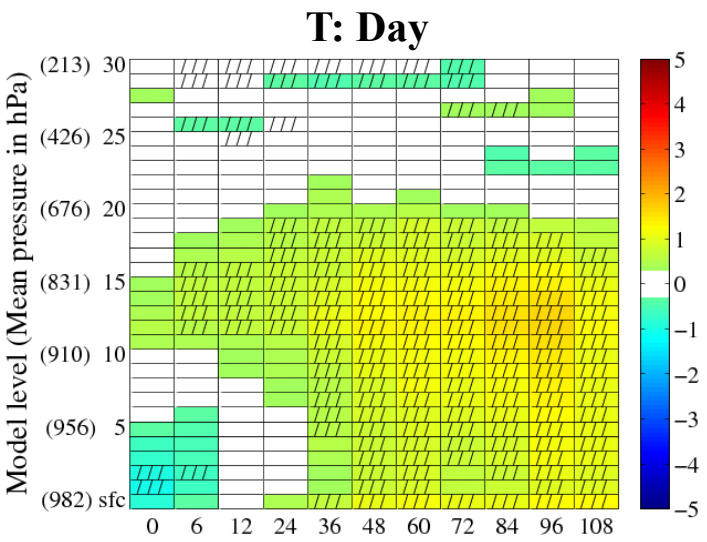
2. **Results: Systematic biases in AMPS**
   - Results presented for land & sea separately
   - Biases presented
   - Some further analysis

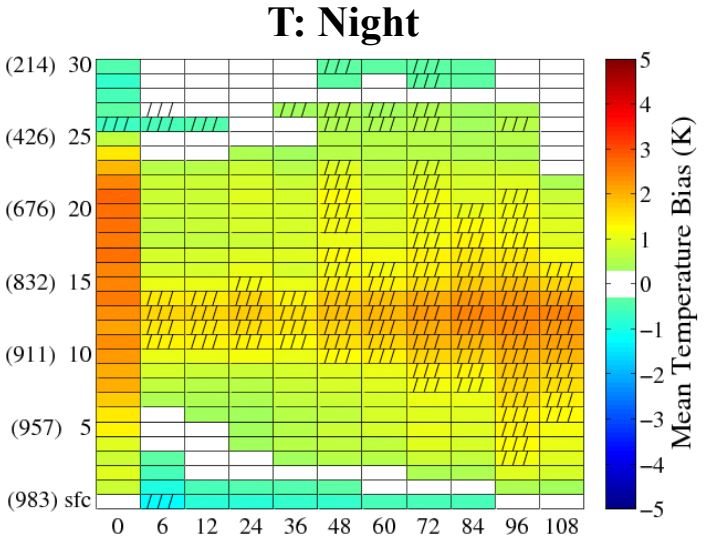
3. Discussion & Summary

Model Biases: T/RH over Sea

Temperature:

- 1-2-K bias centered on model level 12/13
- Bias is stronger and more localized during night time

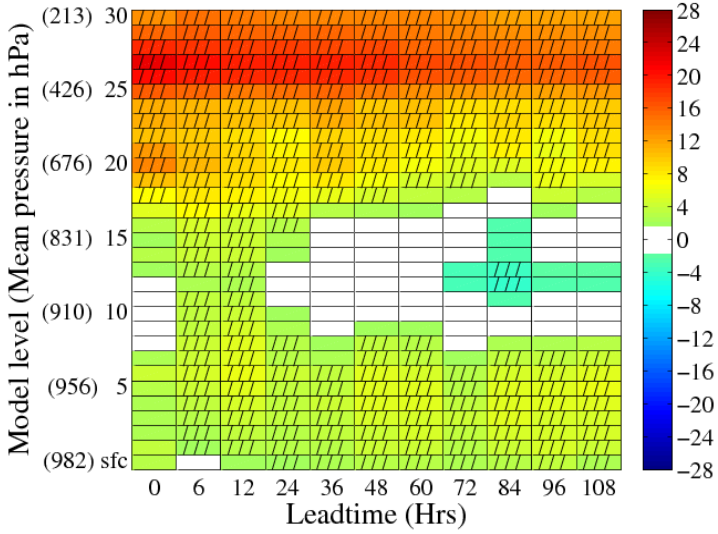


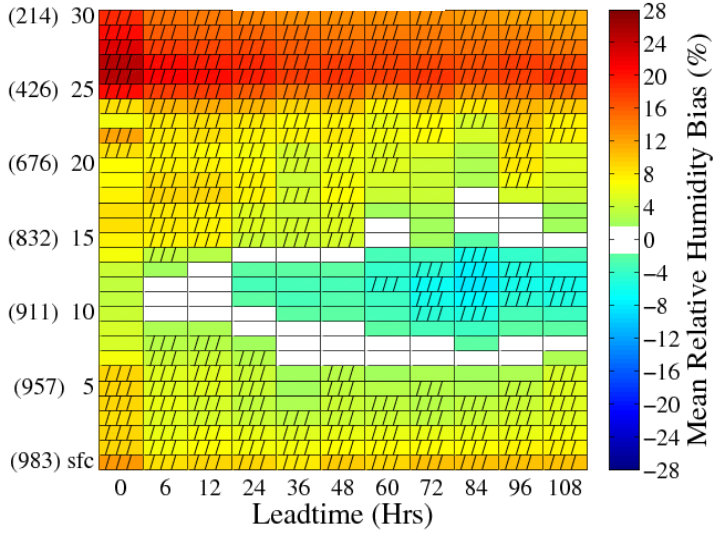


Relative Humidity

- Radiosonde humidity data above 500 hPa is unreliable
- 2-10% low-level biases (strongest at night)
- -7% bias centered on model level 12

$$\frac{\sum(AMPS - Concordiasi)}{n}$$

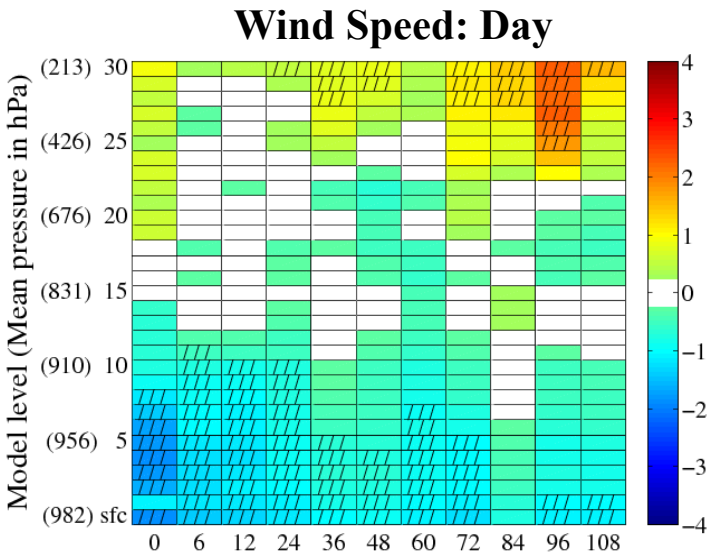


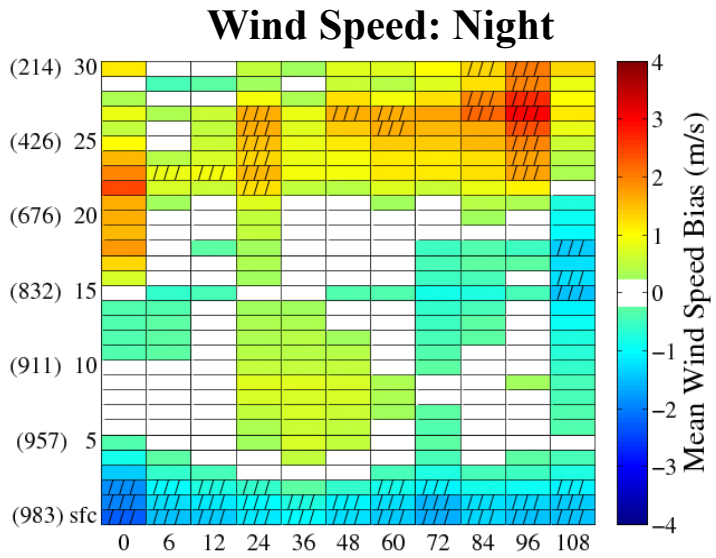


Model Biases: Winds over Sea

Wind Speed:

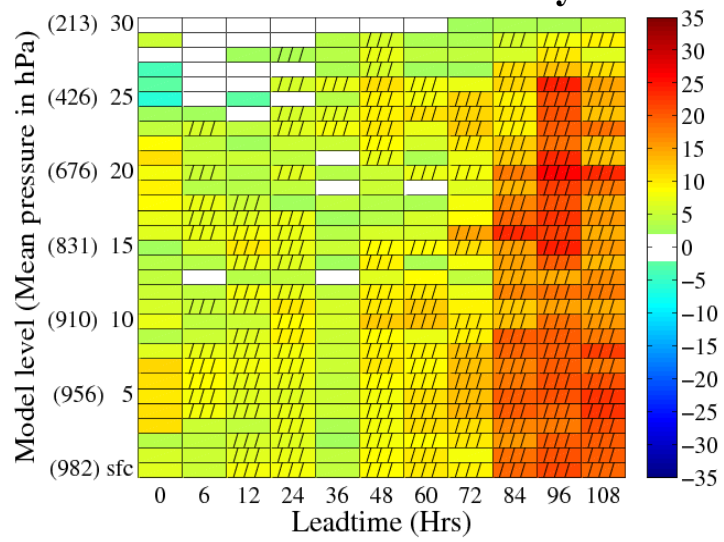
- Weak slow low-level bias
- Some positive biases aloft
- Up to 3 m/s fast bias aloft at later leadtimes

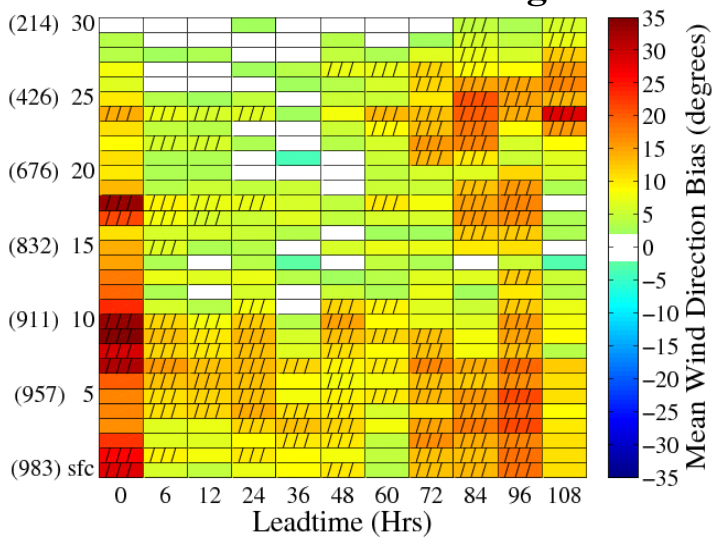




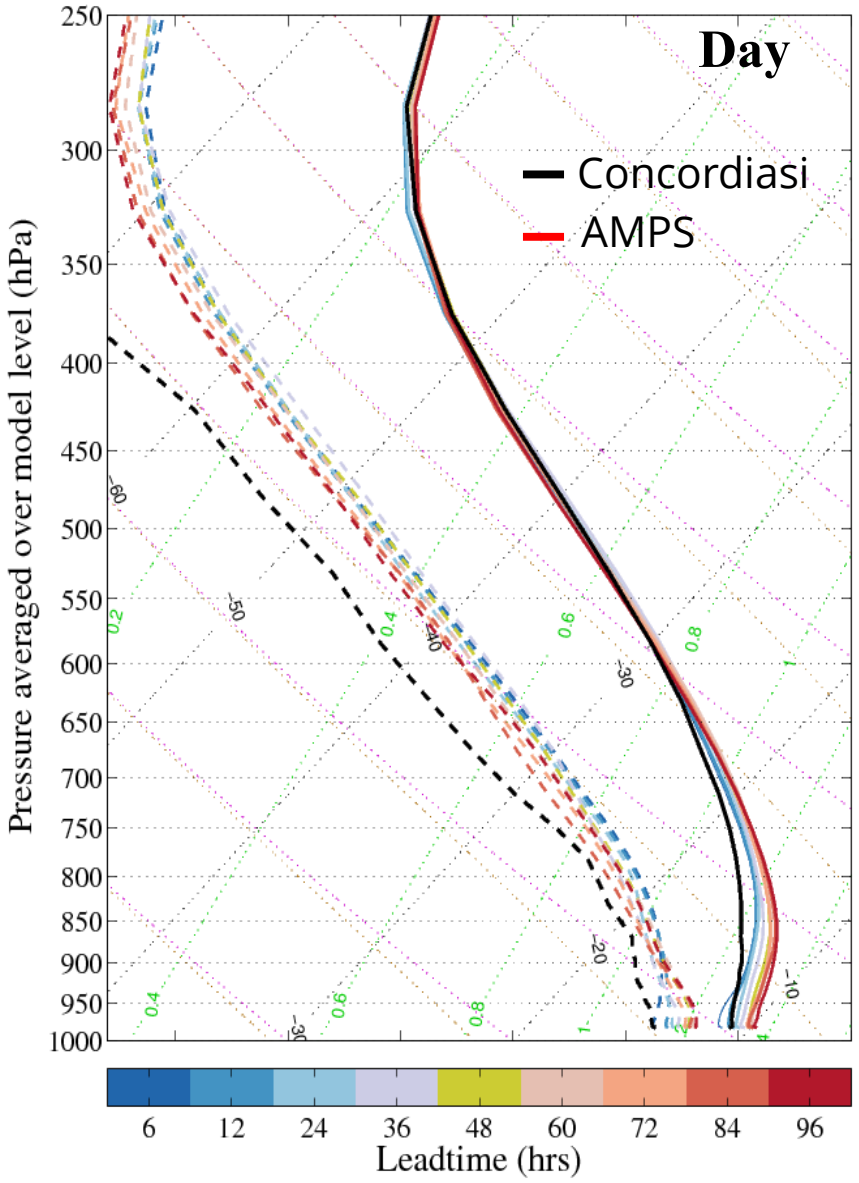
Wind Direction:

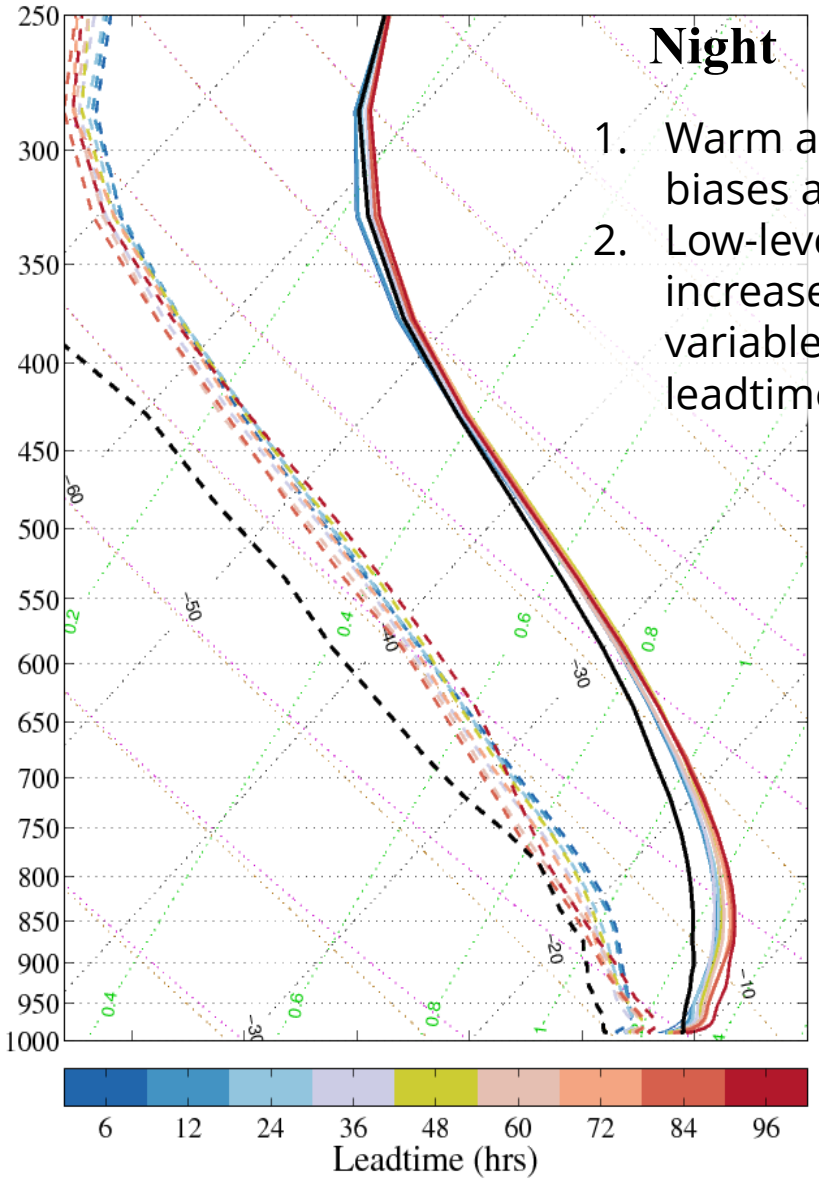
- Broad positive bias
- Turning of the wind clockwise at later leadtimes





Average Skew-T's over Sea



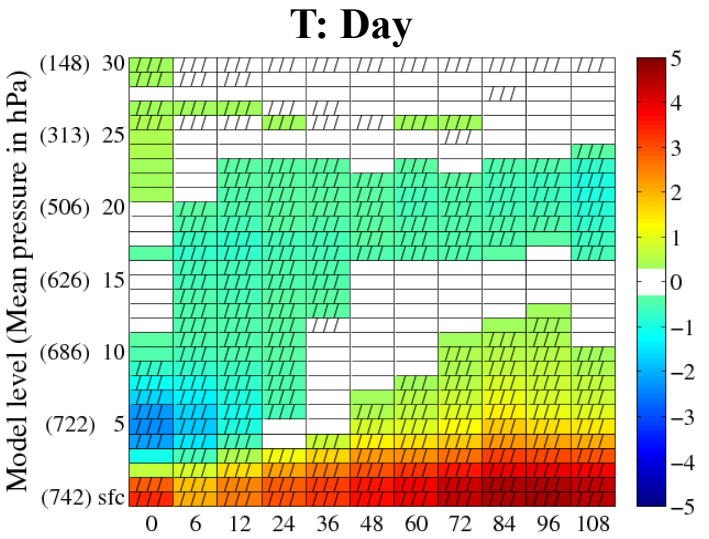


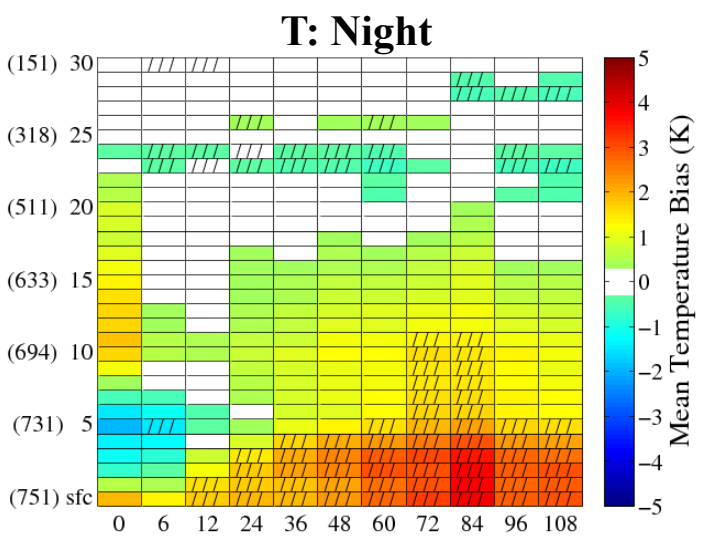
1. Warm and dry biases atop BL
2. Low-level increase in variables with leadtimes

Model Biases: T/RH over Land

Temperature

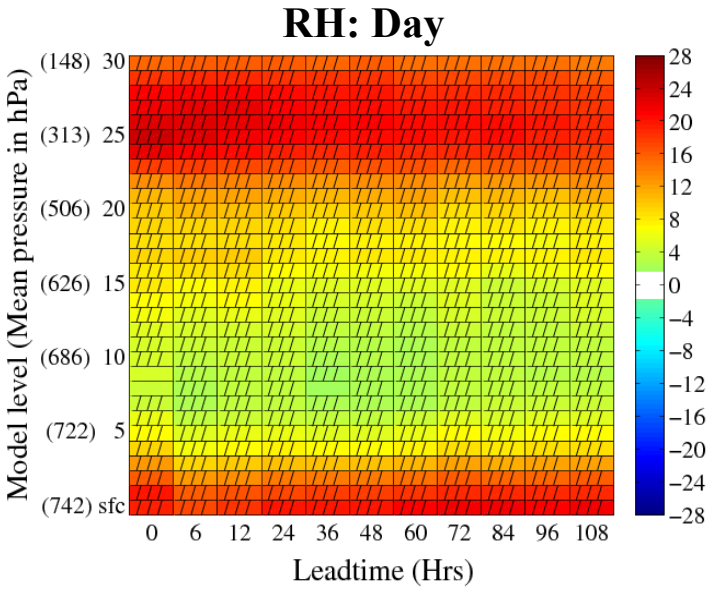
- 2-5-K low-level biases (stronger during the day)
- -1--2-K analysis bias during the day (model level 4-8)

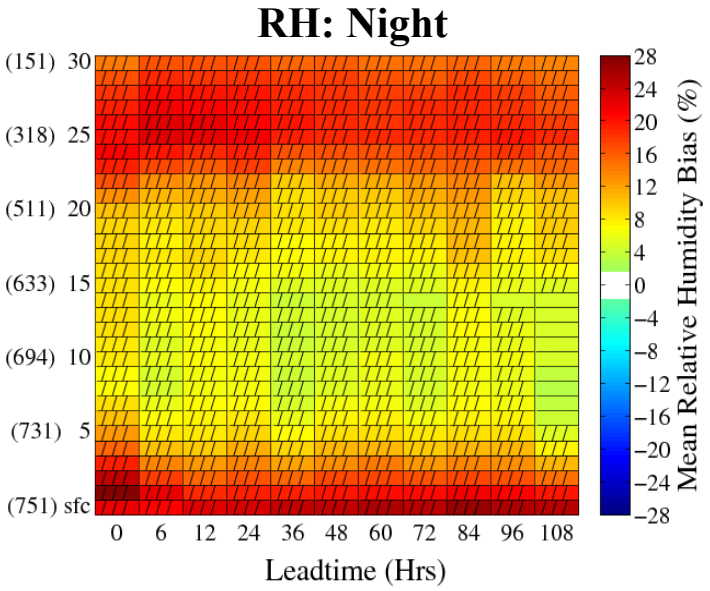




Relative Humidity

- ~15% low-level biases
- ~4% biases through mid-levels
- Little change with day/night and leadtime

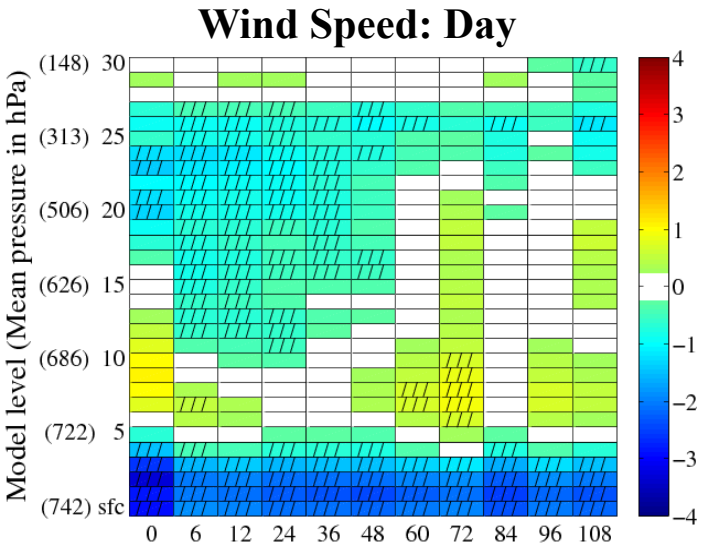


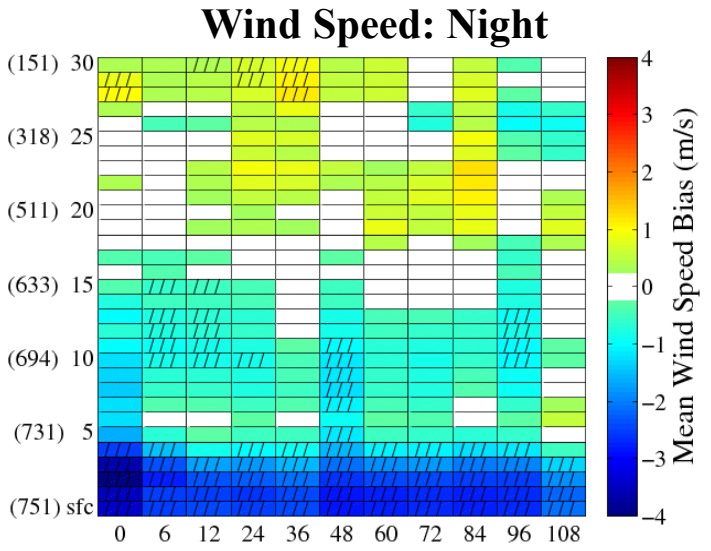


Model Biases: Winds over Land

Wind Speed

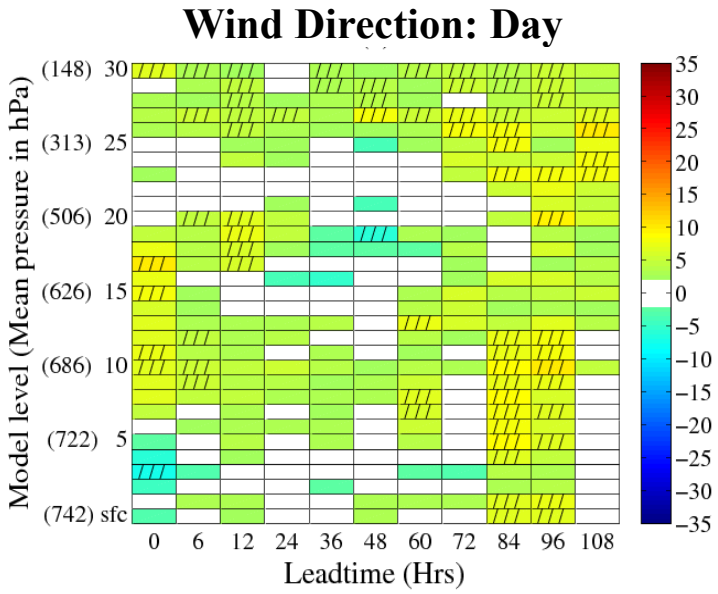
- 2-3 m/s slow low-level biases (surface to model level 3)
- Other small biases present aloft

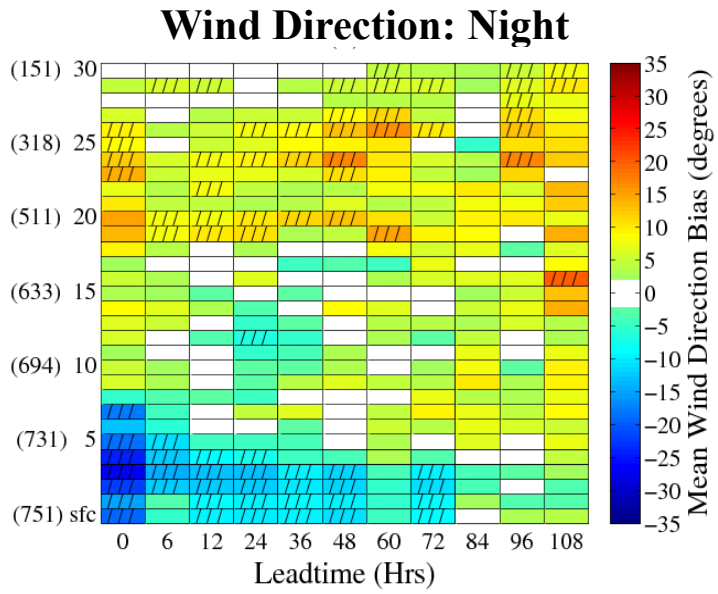




Wind Direction

- Scattered small significant biases during day
- At night, during early leadtimes, too little turning of wind with height





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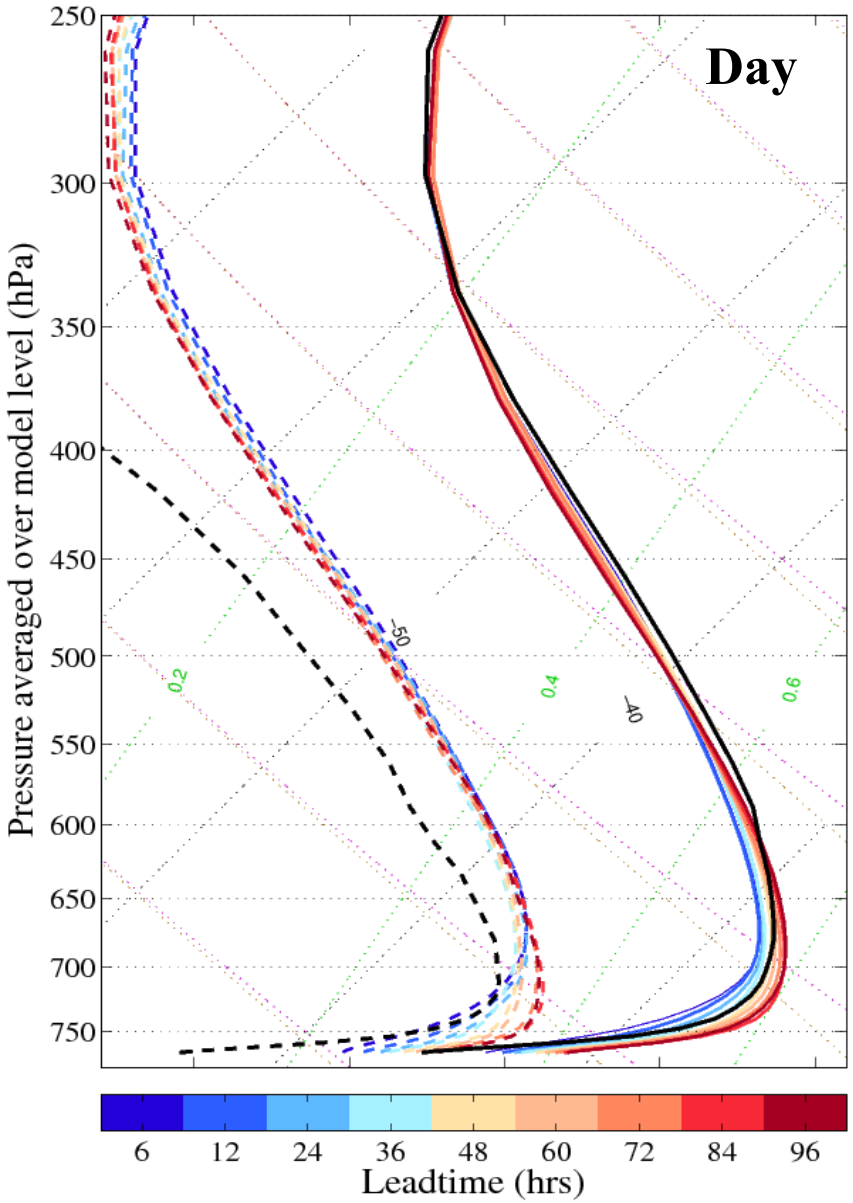
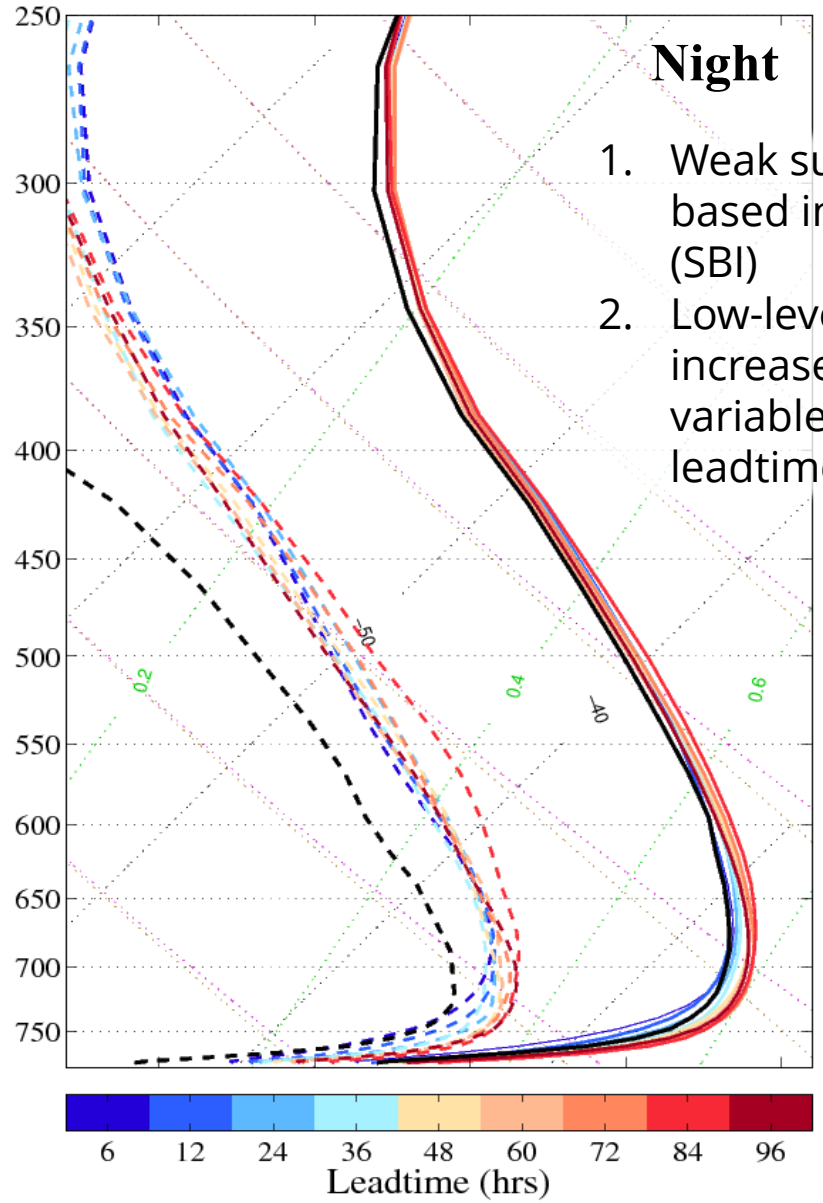




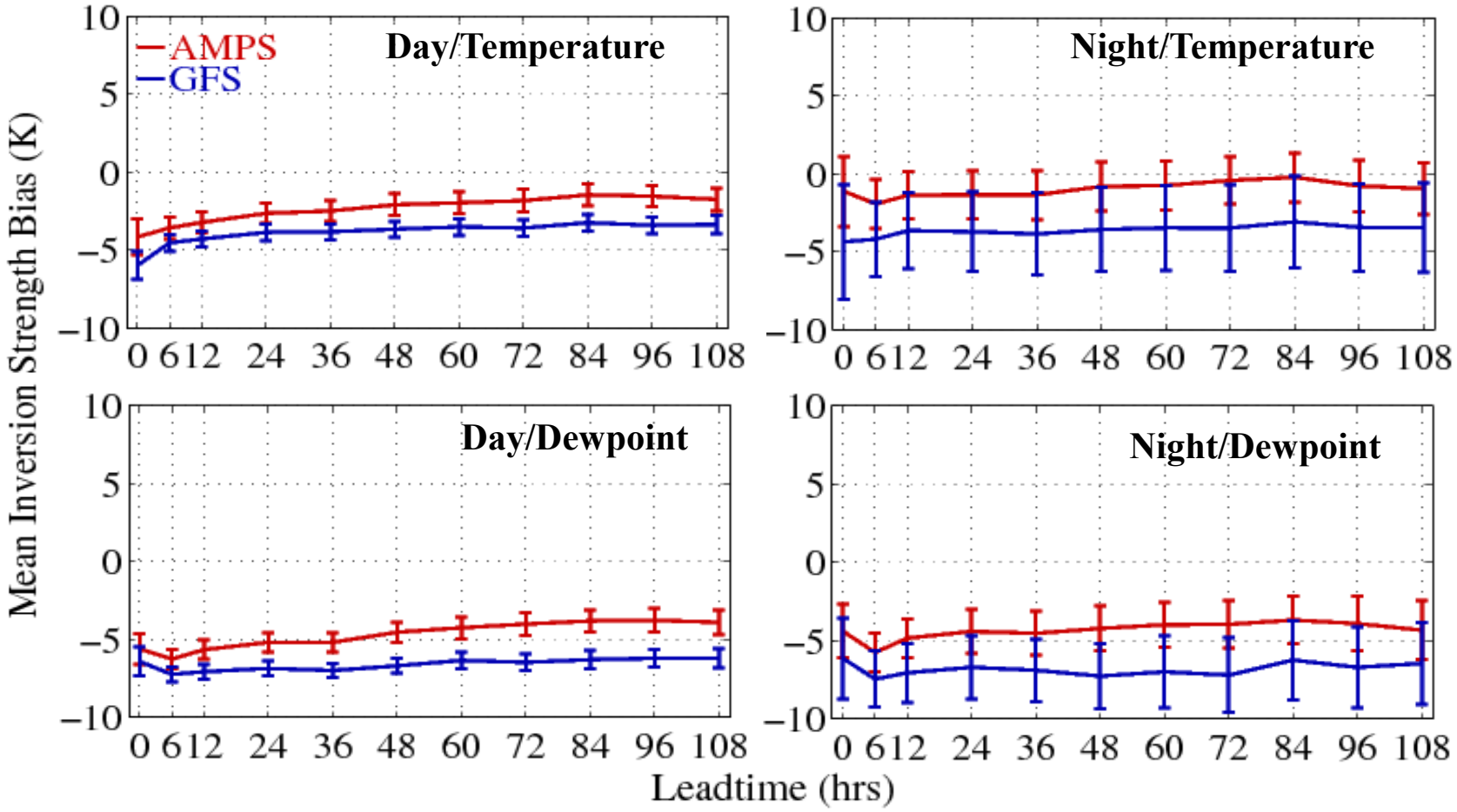
1. Weak surface based inversion (SBI)
2. Low-level increase in variables with leadtimes

Model Biases: SBI Strength over Land

$$\bar{S} = \frac{\sum_{i=1}^{n}(T_{max}(i) - T_{sfc}(i))}{n}$$

95% confidence intervals from standard normal distribution

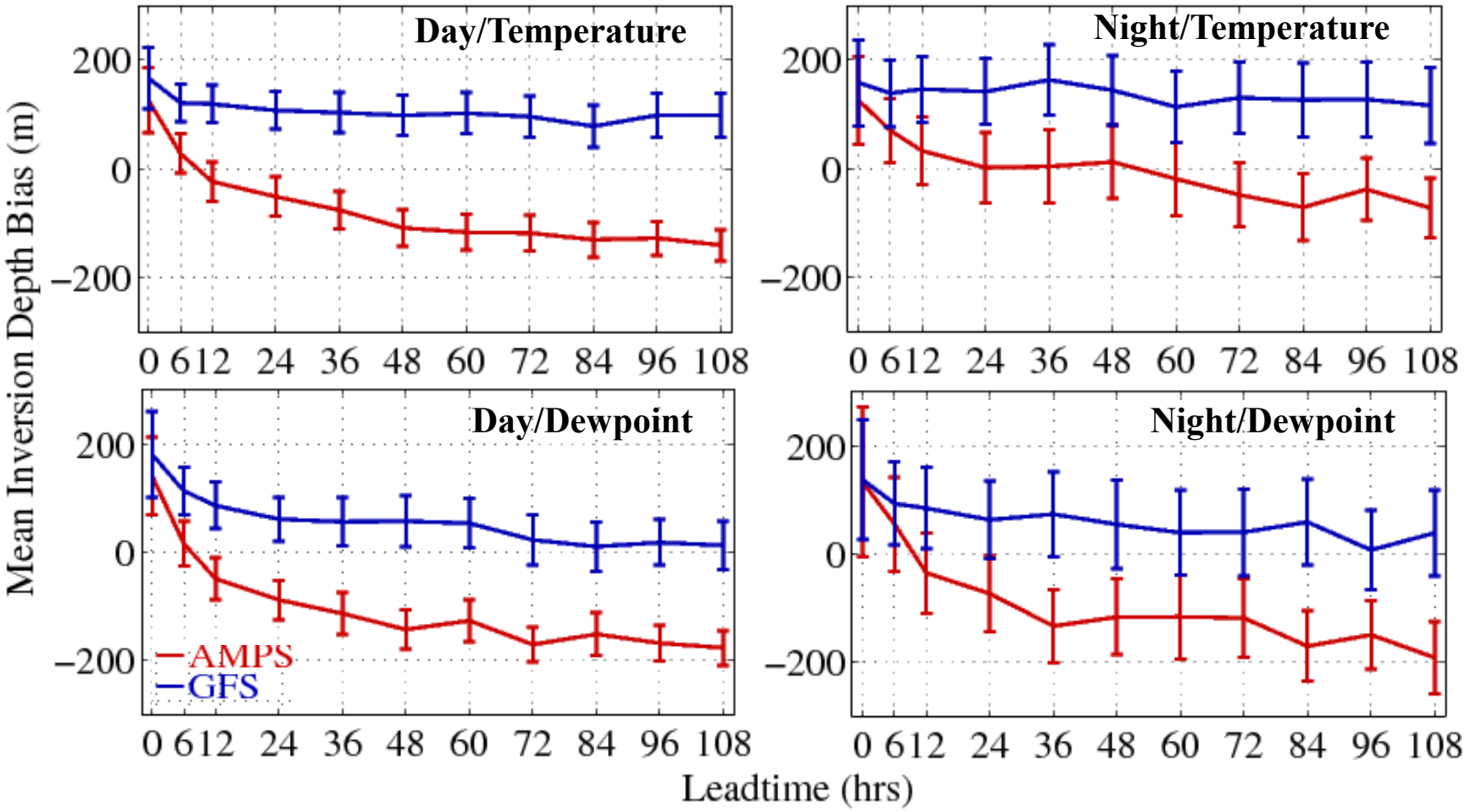
1. Weak SBI's throughout
2. AMPS biases < GFS biases
3. Little change with leadtime



Model Biases: SBI Depth over Land

$$\overline{D} = \frac{\sum_{i=1}^{n}(z(T_{max}(i)) - z(T_{sfc}(i)))}{n}$$

1. Deep SBI's at early leadtimes
2. AMPS overcorrects producing shallow SBI's
3. GFS corrects little



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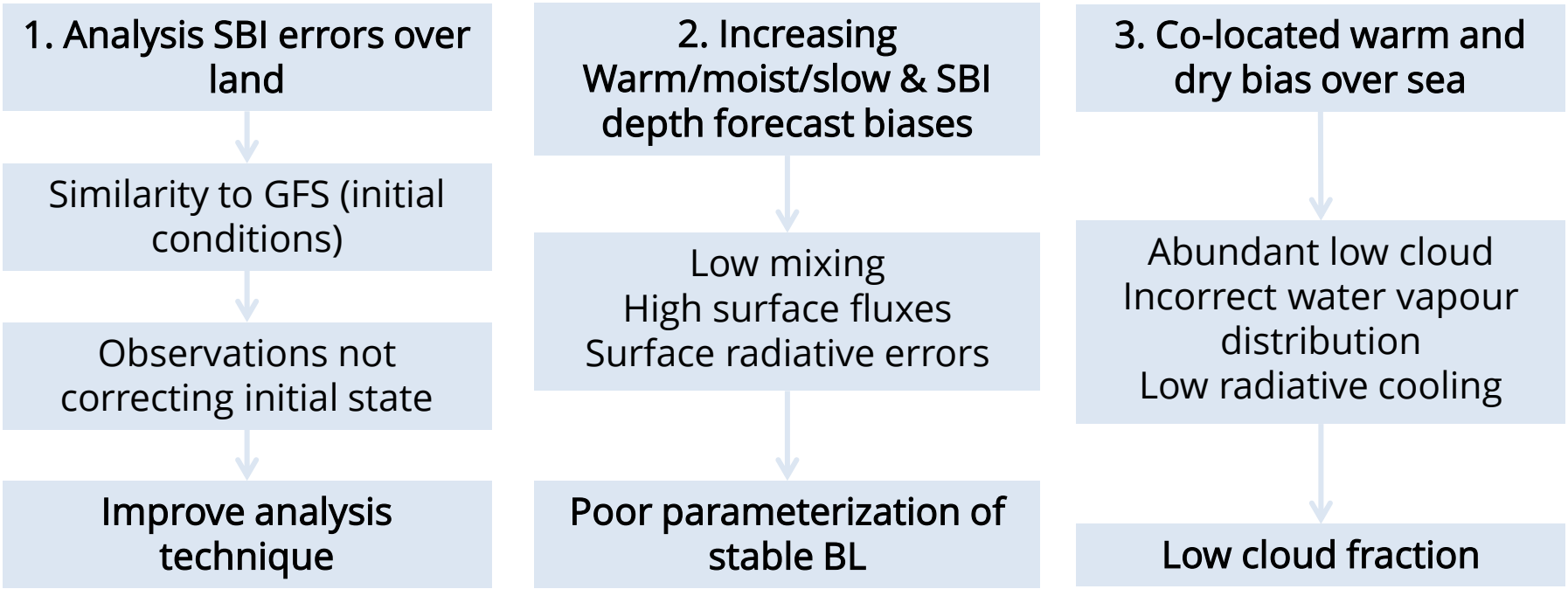

Many results consistent with Rabier (2013), Bromwich (2013) and Tastula (2012).

Future

- Using Rapid Radiative Transfer Model (RRTM) to investigate possible radiative flux errors.
- Comparison to GFS, ECMWF and various reannalysis products (ERA-Interim, NCEP-NCAR).