An Evaluation of the Antarctic Mesoscale Prediction System using Unique New Data from the CONCORDIASI Field Program

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1. Background

Antarctic Mesoscale Prediction System (AMPS)

- Experimental, real time polar WRF (Powers, et. al., 2012).
- Only mesoscale model supporting USAP and multiple other international operations in Antarctica

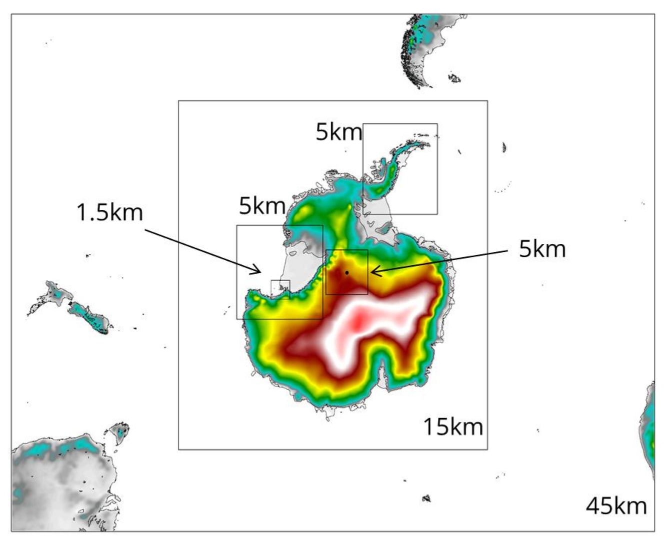

Figure 1: AMPS grids *during Sep-Dec 2010. Credit: UCAR MMM, 2014.*

CONCORDIASI Field Program (Sep-Dec 2010)

- Dropsonde and driftsonde technology
- 640 upper air observations
- Unprecedented spacial coverage

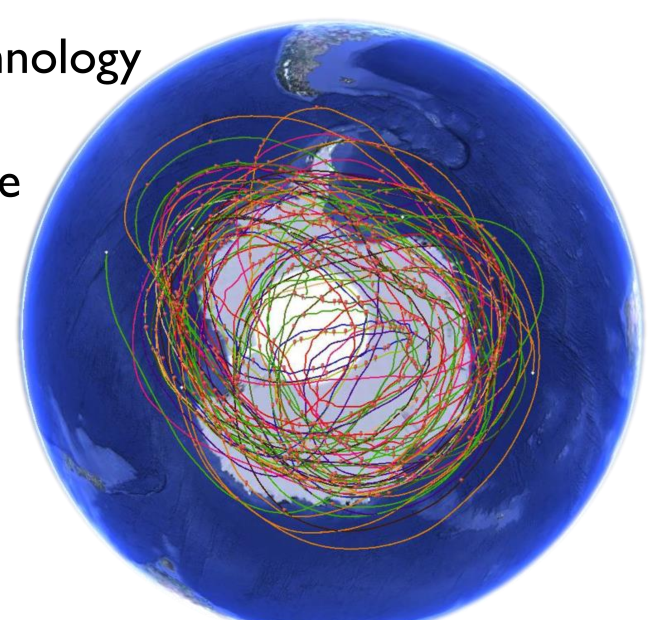

Figure 2: Track of driftsonde *with individual dropsondes displayed as markers. Credit: UCAR EOL, 2014.*

Aims & Goals

- Do systematic biases exist?
- Where and why are these biases occurring?
- What is the skill of the model and can it be improved?

2. Methods

Interpolate to create comparable vertical profiles. → **Wang et. al., 2013 correction:** RS92 radiosonde solar radiation dry bias → **Statistical analysis:** Biases, RMSE, Correlations

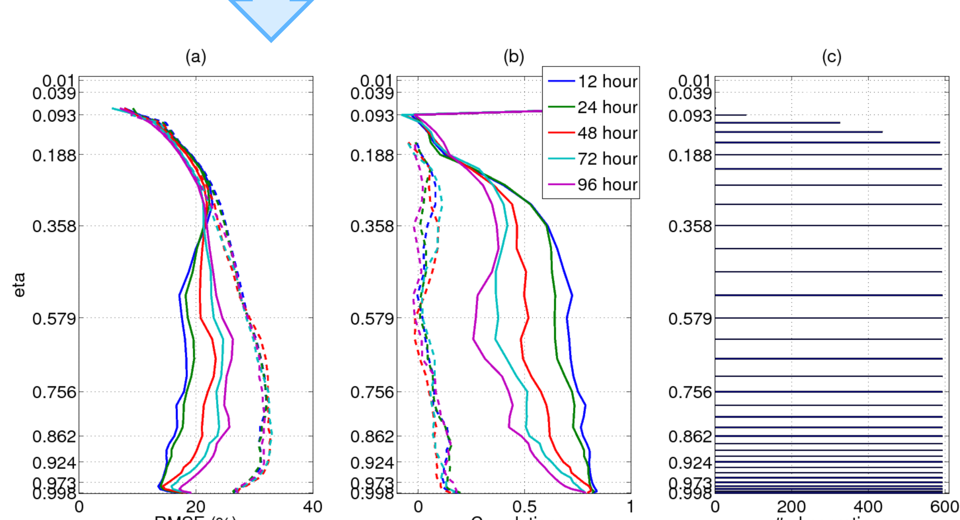

Figure 3: Wang et. al., 2013: Corrections *for Relative Humidity a) RMSE and b) Correlation. Solid = corrected Dashed = uncorrected.*

Horizontal Space	Vertical Space	Time
Bilinear to observation location	Linear to model eta level	Linear to observation time between 3 hourly model outputs

3. Initial Surface Biases

Distinct warm, moist and slow biases observed over land area, especially with relative humidity and wind speed.

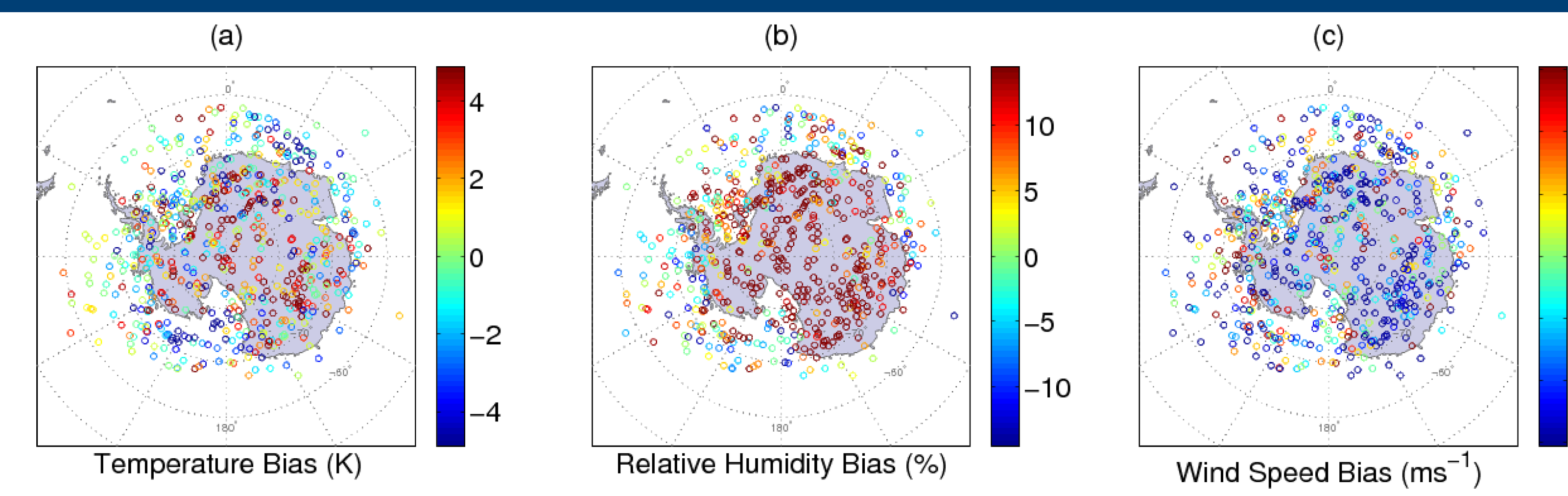

Figure 4: 6-hour AMPS forecast surface biases of *a) temperature, b) relative humidity and c) wind speed.*

4. Biases and RMSE by Land/Sea Area

Temperature:
- ~3K cold analysis bias at inversion over land area.
- ~3-4K warm bias in boundary layer, over land area, and ~2K in mid-troposphere in later leadtimes over sea area.

Relative Humidity
- Poor estimation of upper tropospheric moisture caused by radiosonde dry bias above model level 20.
- 20%+ moist bias at land surface (smaller over sea area).
- ~5% mid-tropospheric dry bias over sea area.

Wind Speed
- 2-3ms^{-1} slow bias of at the land surface (smaller over sea area).

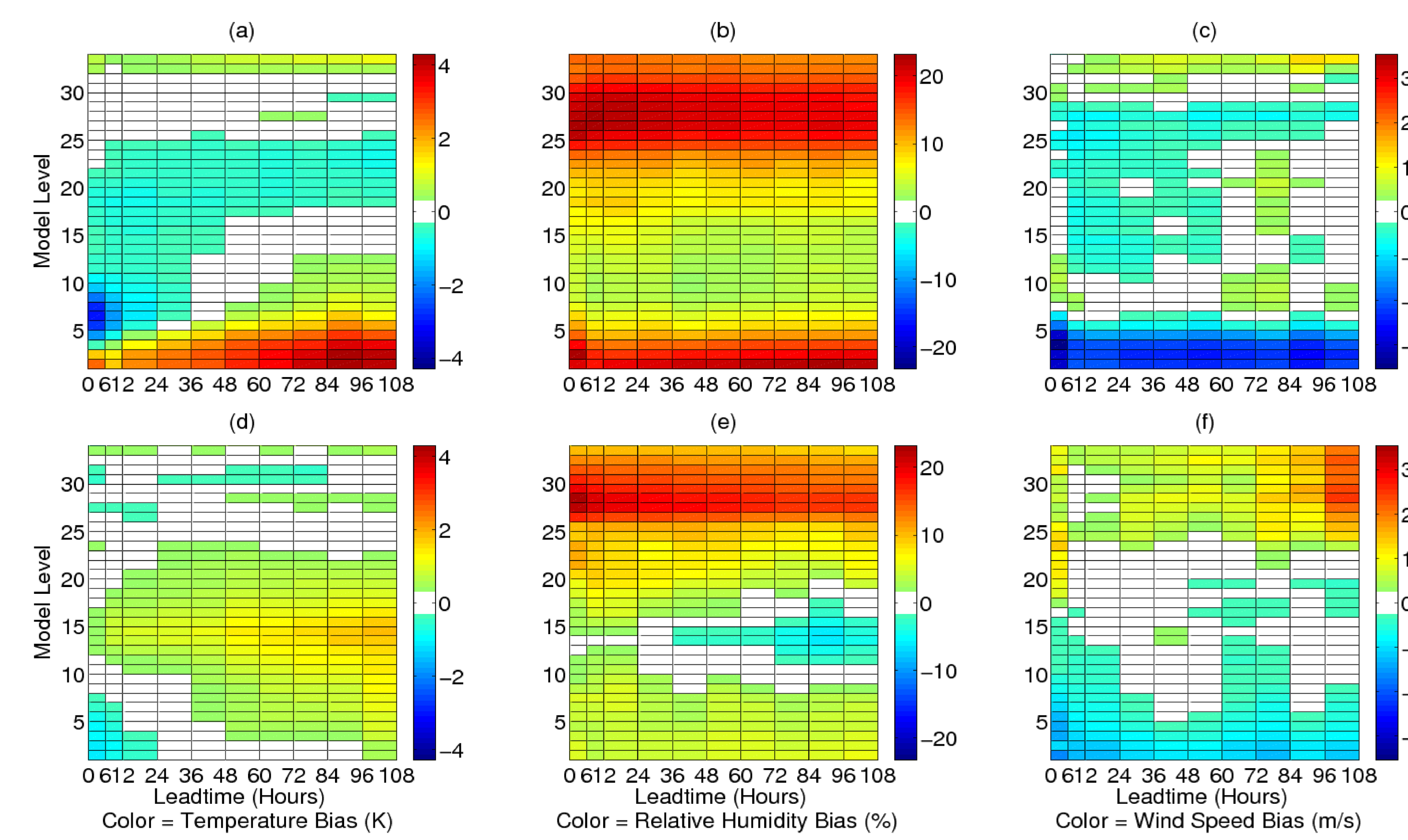

Figure 5: Mean Vertical Profiles of Bias *for temperature (a & d), relative humidity (b & e) and wind speed (c & f) by leadtime. Biases from soundings that were dropped over the land area are on the top row (a, b & c) and over the sea area are on the bottom row (d, e & f).*

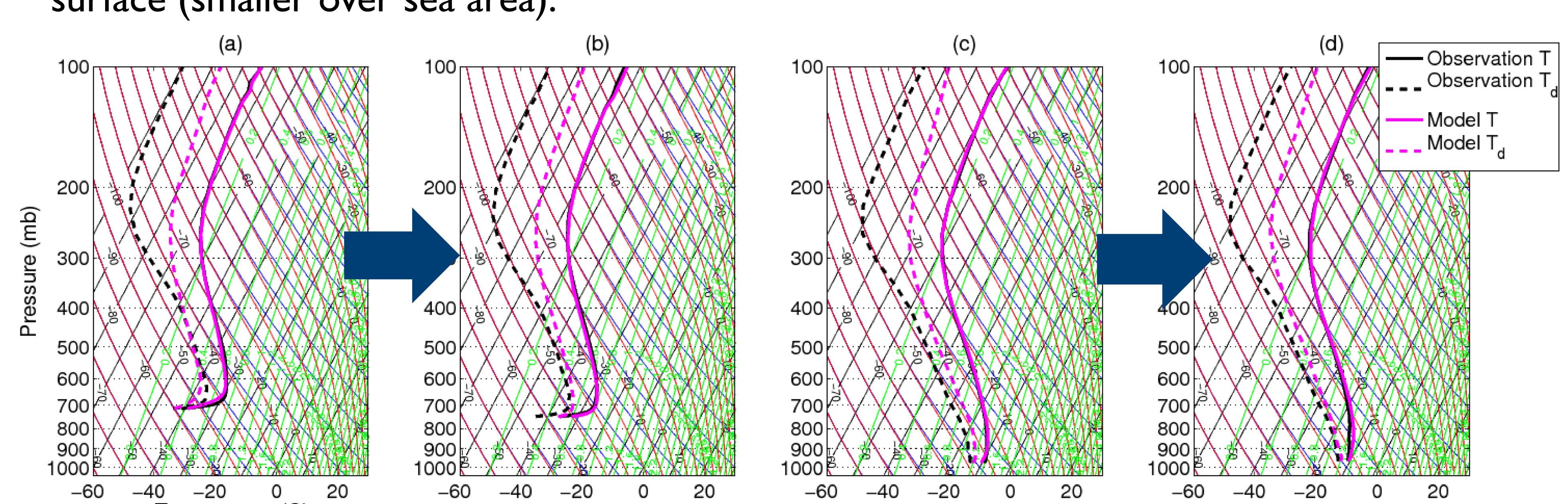

Figure 6: Mean Skew-T plots *of land area (a & b) and sea area (c & d) for the analysis (a & c) and 72-hour AMPS forecast (b & d)*

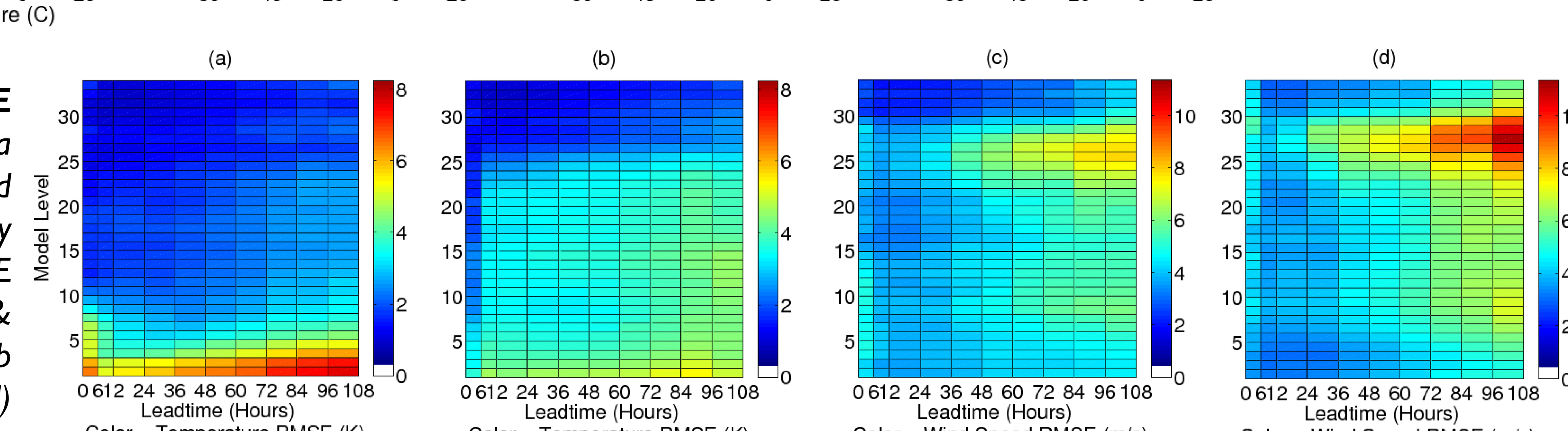

Figure 7: RMSE *for temperature (a & b) and wind speed (c & d) by leadtime. RMSE for land area (a & c) and sea area (b & d)*

5. Notable Correlations

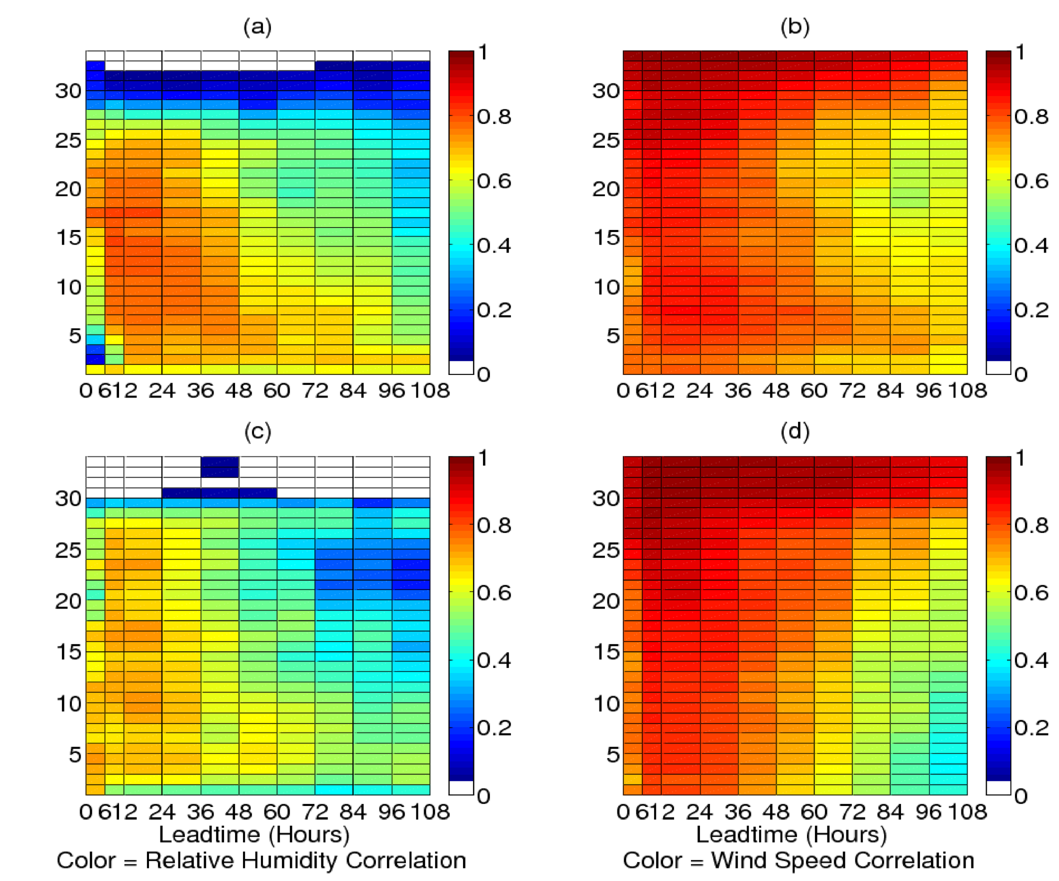

Figure 8: Correlations *for Relative Humidity (a & c) and Wind Speed (b & d). Sondes over land (a & b) and over sea (c & d).*

6. Conclusions

Systematic Biases by Land/Sea

A statistical analysis found that systematic biases could be associated with the surface type of land or sea:
- Cold analysis bias at the inversion over the land area.
- Warm, moist and slow biases occur over the land area, in the boundary layer.
- Wind speeds are overestimated in the jet over the ocean at later leadtimes.
- Warm and dry mid troposphere over sea area.

Skill: RMSEs and Correlations

Best skill occurs in the free troposphere with wind speeds poor at the jet and temperature poor at the surface. Notable low correlations occur at the analysis in boundary layer relative humidity above surface.

Attributing the Errors (Future Work)

Many of the above errors point tentatively to PBL, microphysics and radiative parameterization errors so the Rapid Radiative Transport Model (RRTM) will be used as a tool to investigate these:
- ➢ Run all model and CONCORDIASI soundings
- ➢ Obtain and calculate radiative flux profile biases

7. Acknowledgements & References

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