Thermodynamic profiles of the lower troposphere from synthesized observations

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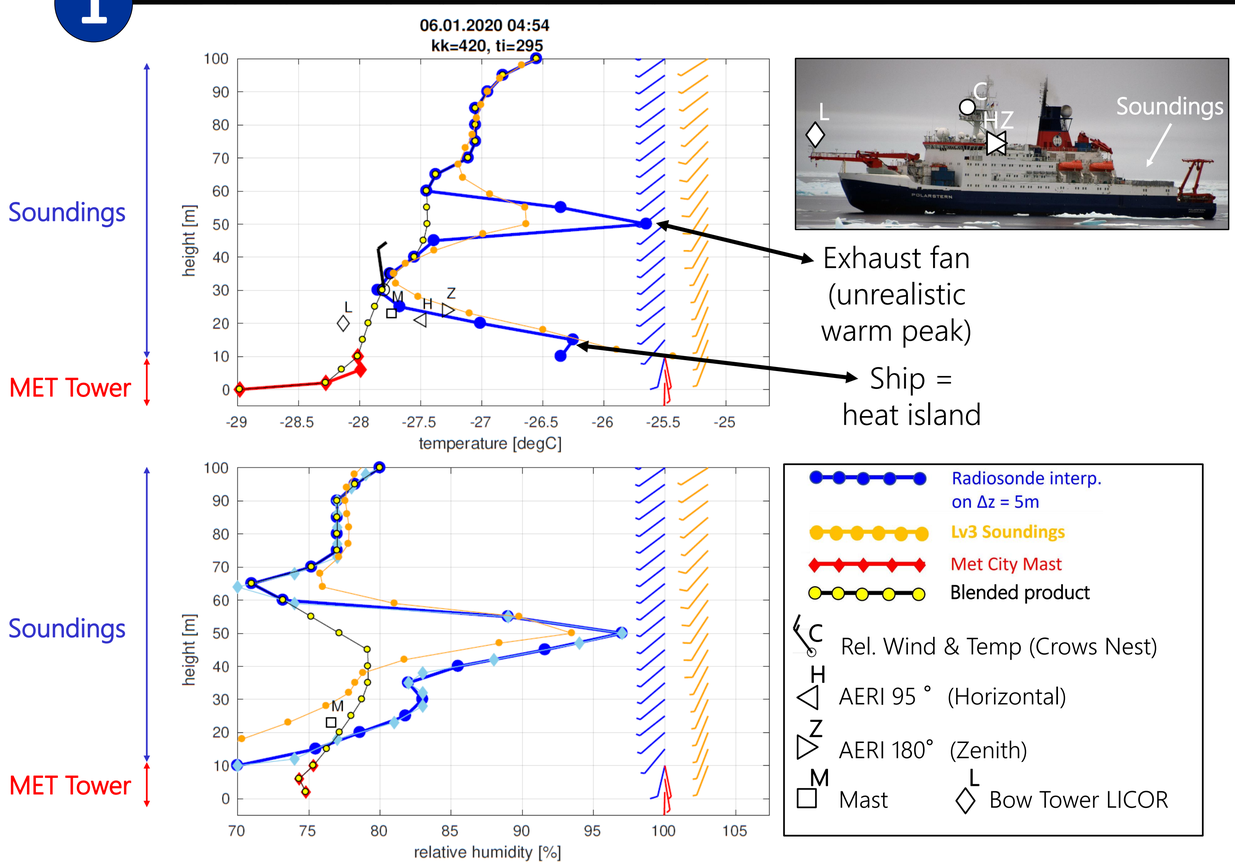
1



WHAT

- Comprehensive dataset of 1000+ atmospheric profiles of T,RH,u,v
- Covering the skin layer up to 30+km height
- Synthesizing data from soundings and MET Tower

WHY

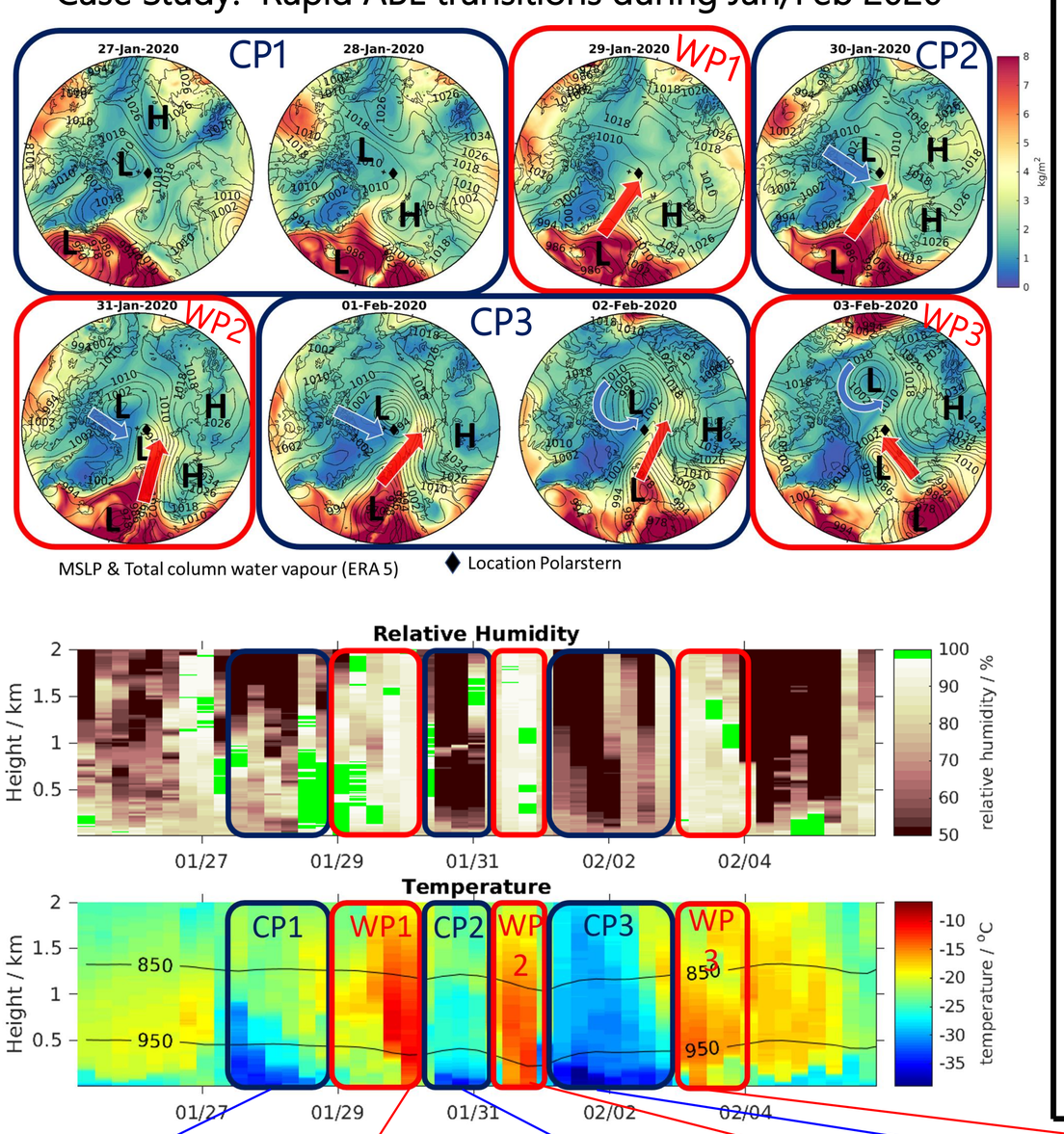
- Soundings lack the lowermost meters, Tower fills the gap
- Detecting and removing unrealistic data caused by ship influence
- Desired full-column profiles including lowest level stability, inversions

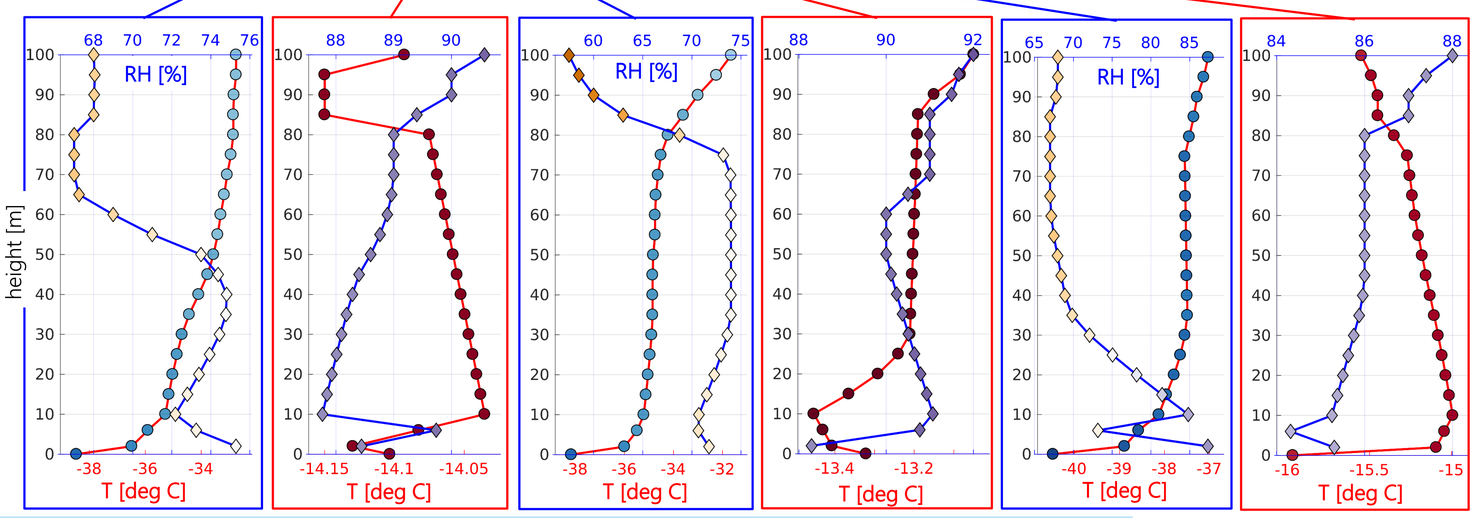
HOW

- Compare and blend tower- and sounding profiles at the minute of launch
- Dependent on the relative wind direction, the 10-50 m range is often polluted by the ship's presence and exhaust fan
- Detect and remove polluted segments, and estimate a realistic profile by synthesizing available observations

2

Case Study: Rapid ABL transitions during Jan/Feb 2020





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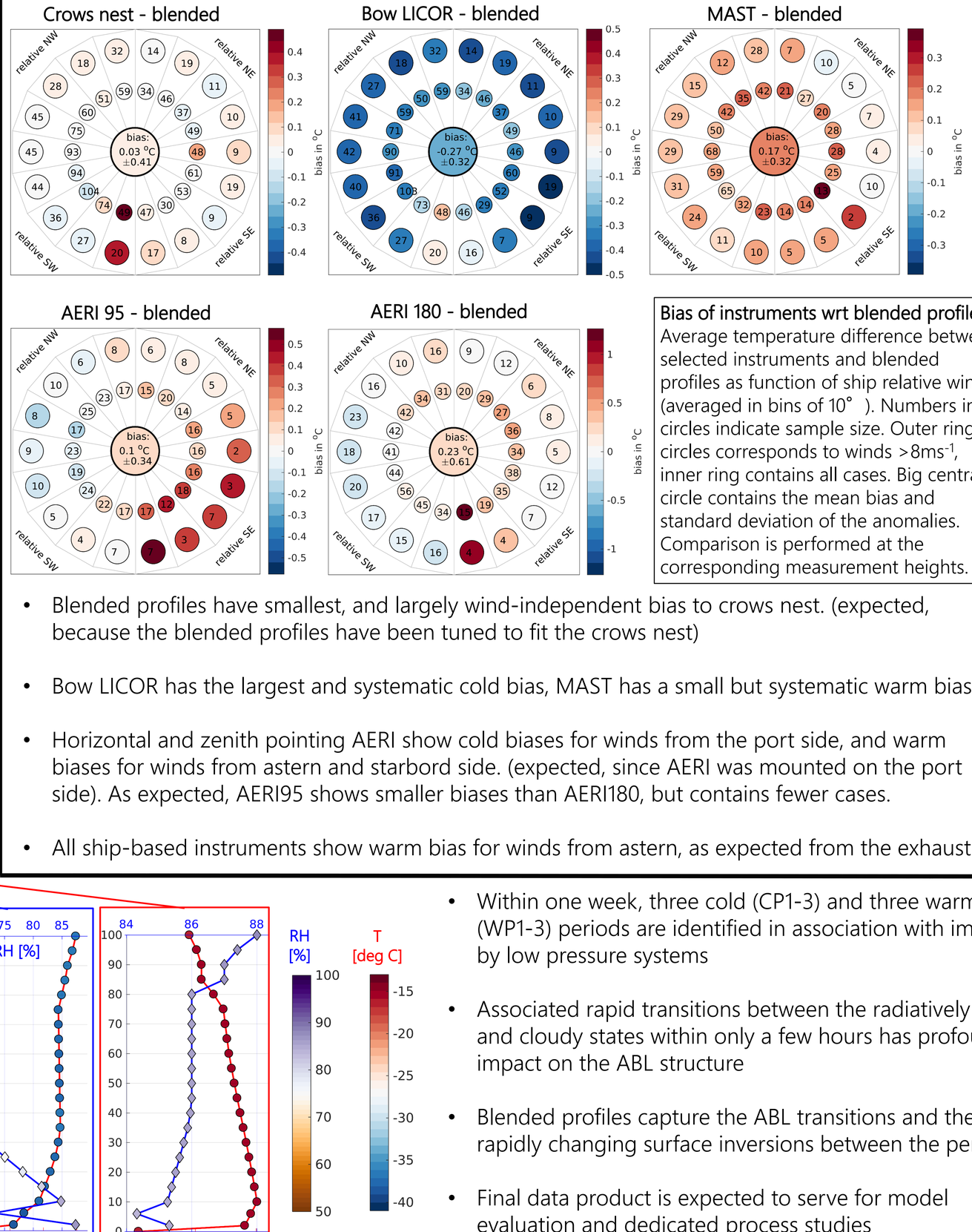
Evaluation with further instruments



Bias of instruments wrt blended profiles. Average temperature difference between selected instruments and blended profiles as function of ship relative wind (averaged in bins of 10°). Numbers in circles indicate sample size. Outer ring of circles corresponds to winds >8ms^{-1}, inner ring contains all cases. Big central circle contains the mean bias and standard deviation of the anomalies. Comparison is performed at the corresponding measurement heights.

- Blended profiles have smallest, and largely wind-independent bias to crows nest. (expected, because the blended profiles have been tuned to fit the crows nest)
- Bow LICOR has the largest and systematic cold bias, MAST has a small but systematic warm bias
- Horizontal and zenith pointing AERI show cold biases for winds from the port side, and warm biases for winds from astern and starbord side. (expected, since AERI was mounted on the port side). As expected, AERI95 shows smaller biases than AERI180, but contains fewer cases.
- All ship-based instruments show warm bias for winds from astern, as expected from the exhaust fan

- Within one week, three cold (CP1-3) and three warm (WP1-3) periods are identified in association with impact by low pressure systems
- Associated rapid transitions between the radiatively clear and cloudy states within only a few hours has profound impact on the ABL structure
- Blended profiles capture the ABL transitions and the rapidly changing surface inversions between the periods
- Final data product is expected to serve for model evaluation and dedicated process studies

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