EVALUATION OF DUAL-MODE METOP CMVs

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Objectives

The goal of the study was to perform a preliminary validation of EUMETSAT's dual-mode Metop CMV product. This novel retrieval technique takes advantage of the swath overlap between the Metop-A/Metop-B tandem, extracting CMVs from a pair of 10.8-µm images obtained ~50 minutes apart. The global coverage of dual-mode Metop winds helps filling the 50°-70° CMV data gap between the coverage areas of geostationary and polar sensors.

We evaluated 2 months (June and August 2015) of dual-mode Metop CMVs against GOES-15/13, METEOSAT-10/7, MTSAT-2, and HIMAWARI-8 geostationary CMVs, MODIS-Terra polar and MISR stereo CMVs as well as IGRA radiosonde winds and ERA Interim reanalysis. For three geostationary imagers winds were available from two independent producers: CIMSS and EUMETSAT CMVs for METEOSAT-10/7, and CIMSS and JMA CMVs for MTSAT-2, which enabled analysis of height assignment algorithm differences.

Dual-mode METOP winds were generated with v2.5 of the EUMETSAT CMV algorithm, which became operational in December 2014. The updated algorithm uses v2.6 of the IASI CO_2-slicing heights and has eliminated the speed bias between the complementary global METOP wind products that existed in v2.4 data.

Winds were collocated within 150 km, 25 mb, and 90 minutes and results were stratified according to Metop height assignment technique: equivalent blackbody temperature (EBBT) or IASI CO_2-slicing. Below we present a few typical comparison plots for CMVs with QI ≥ 80.

Conclusions

- Height agreement between METOP and METEOSAT-10/7 CMVs was significantly better when the latter were extracted by the EUMETSAT rather than the CIMSS algorithm. The different corrections applied to low-level heights by different producers can be a significant source of inconsistency.
- METOP high-level winds had a strong fast bias in the tropics and a slow bias at mid latitudes.
- Frequency of spurious METOP ground retrievals over snow/ice-covered polar surfaces has been reduced by a factor of 10 between v2.4 and v2.5.
- Comparison statistics showed larger absolute bias and rmsd for METOP CMVs with IASI heights than for those with EBBT heights, which was partially due to CO_2-slicing used for high-level, thus on average faster, winds.
- About 1-3% of IASI mid- to high-level METOP CMVs were collocated with low-level validation CMVs. The good agreement between the wind vectors and the magnitude of wind speed in this cluster, however, suggested a low bias in validation heights as opposed to a high bias in METOP IASI heights.
- Validation statistics against RAOB data were overall comparable to those against satellite and model winds; however, at low and mid levels speed rmsd was the largest and correlation was the smallest with radiosonde observations, perhaps indicating scaling differences between point measurements and large area averages.

Mean statistics and vertical variation

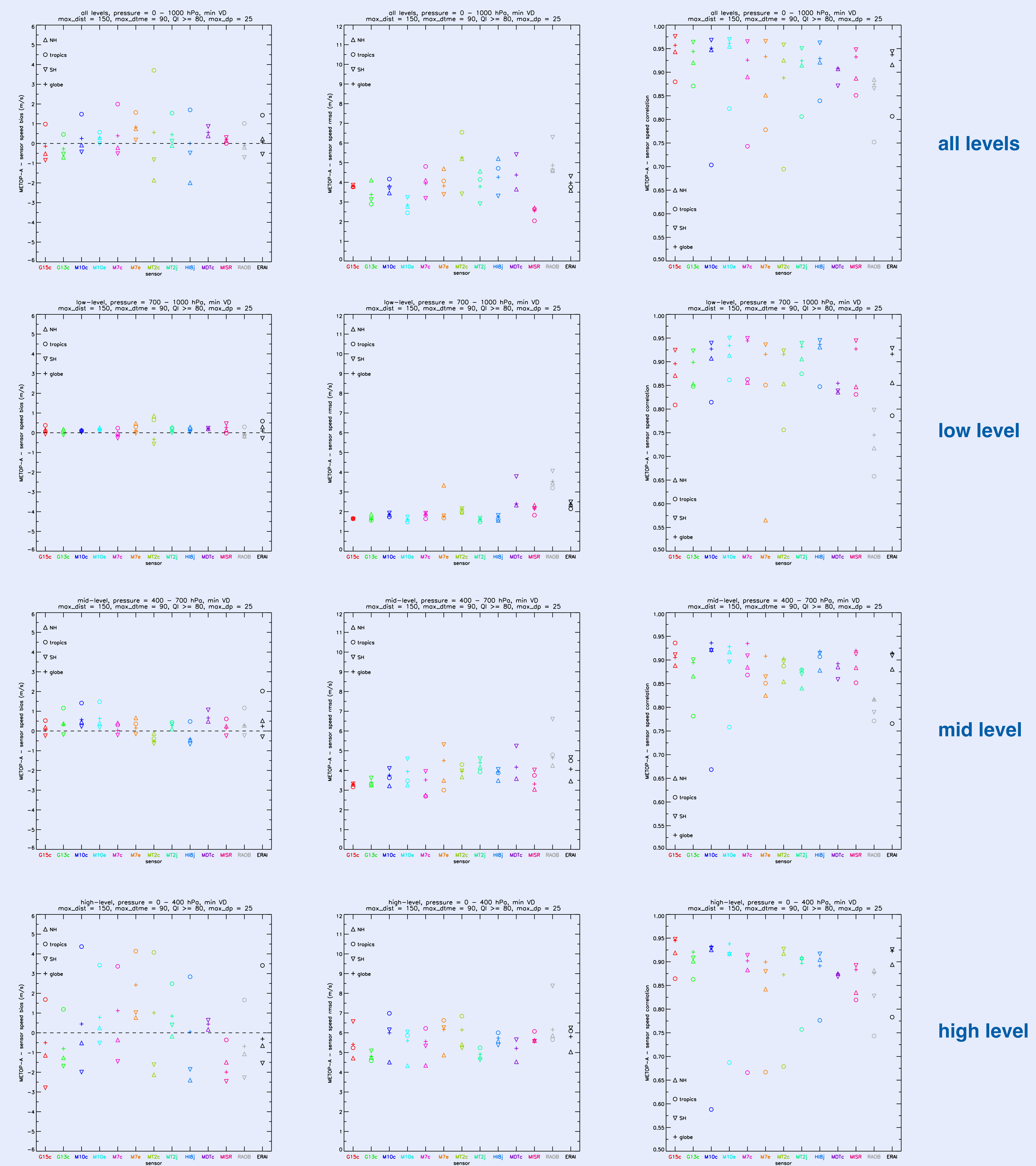

Fig. 1. Mean METOP validation statistics for the globe, northern hemisphere (25°N-90°N), southern hemisphere (25°S-90°S), and tropics (25°S-25°N), separately for all, low-level (>700 mb), mid-level (400-700 mb), and high-level (<400 mb) winds. In this and all subsequent figures each METOP wind is matched with a comparison wind within 150 km, 25 mb, and 90 minutes that minimizes the vector difference.

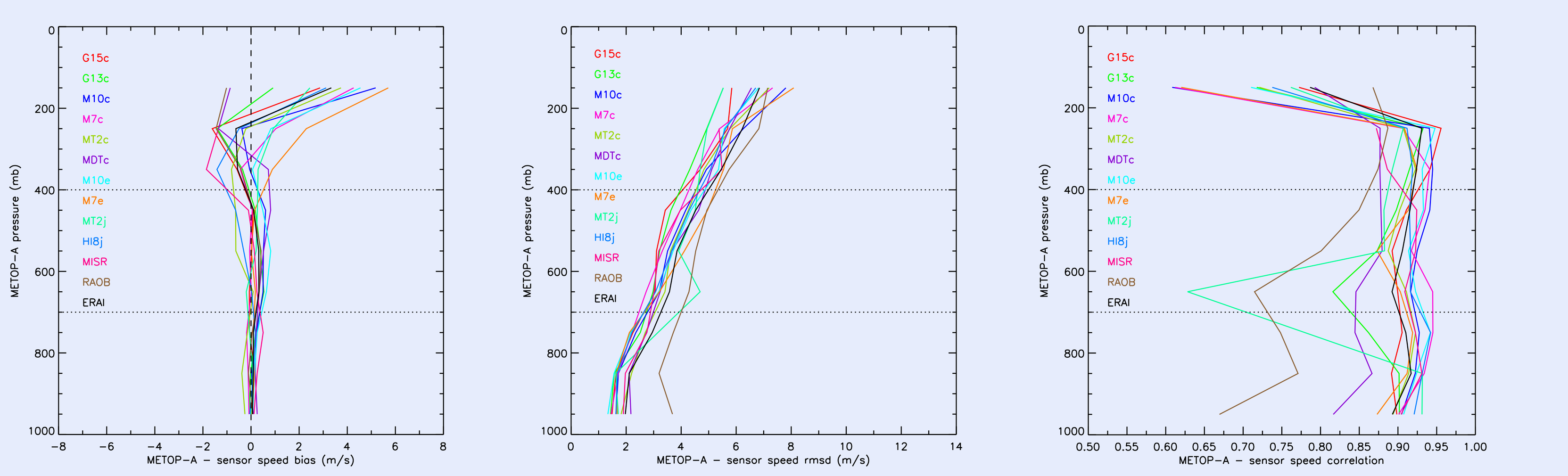

Fig. 2. Vertical variation of global-mean wind comparison statistics binned according to METOP height.

Scatter plots and geographic variation

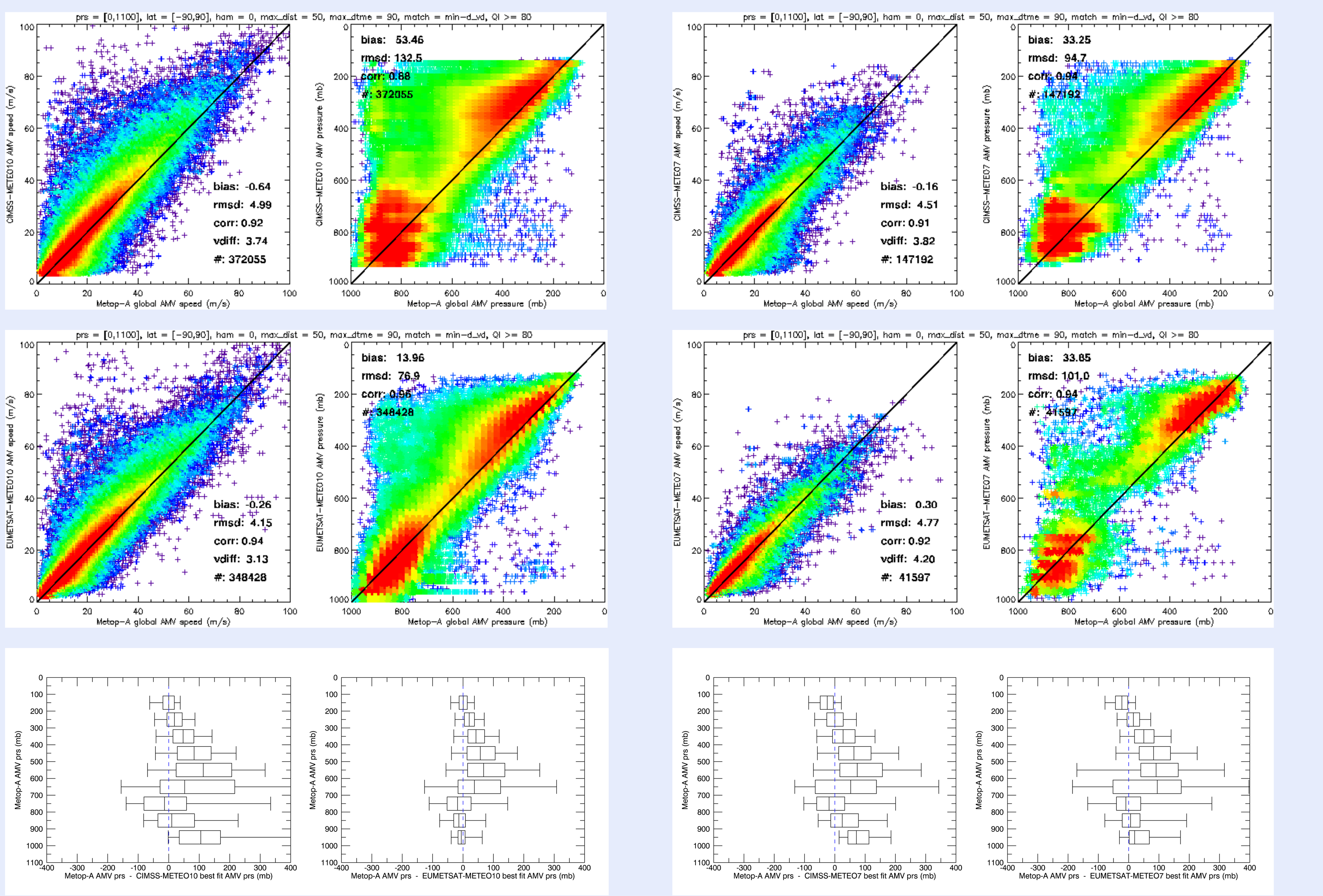

Fig. 3. METOP vs. best-fit METEOSAT-10 (left) and METEOSAT-7 (right) CMV speeds and heights. METEOSAT CMVs are from CIMMS (top) or EUMETSAT (middle). The logarithmic color scale indicates number frequency. Also shown are box-whisker plots of best-fit pressure statistics (bottom). Height agreement at low levels is significantly better with EUMETSAT CMVs.

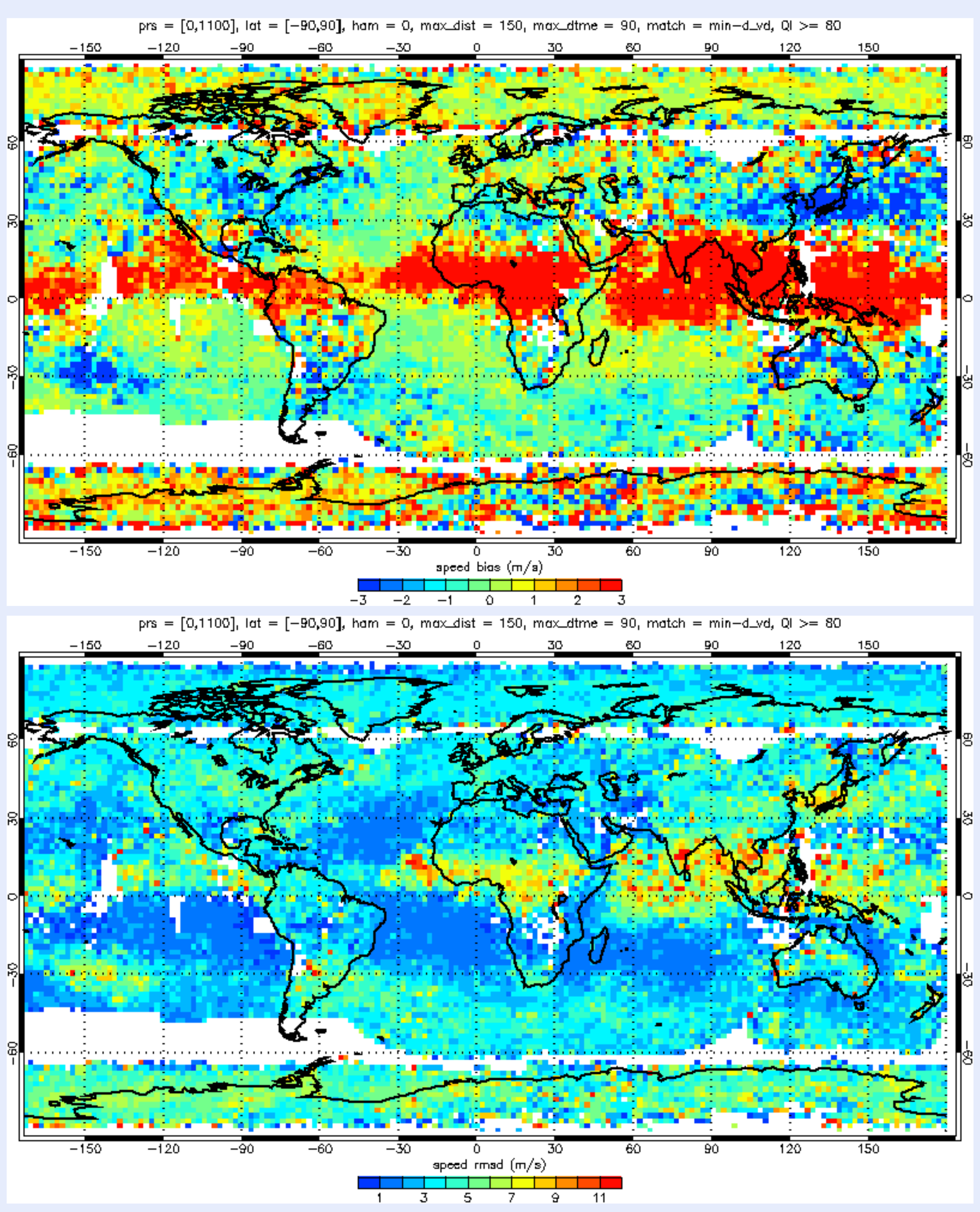

Fig. 4. Geographic distribution of METOP wind speed bias and rmsd averaged over all levels. All comparison CMVs are from CIMSS. Geostationary: GOES-15/13, METEOSAT-10/7, MTSAT-2 and polar: MODIS-Terra.