Comparison of AMSU-B Brightness Temperature with Simulated Brightness Temperature using Global Radiosonde Data

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Introduction
Upper tropospheric humidity (UTH) is a crucial parameter for meteorology and climate research. There are two global and continuous data sets for this parameter, one from polar orbiting meteorological sensors, the other from synoptic meteorological radiosondes. The basic idea of the study is to compare satellite and radiosonde data. A radiative transfer (RT) model is used to generate simulated AMSU measurements from the radiosonde data. The aims of the study are to develop a robust methodology for such a comparison and to pave the way for a systematic comparison of all stations in the global radiosonde network to satellite data. This will allow an intercomparison and quality control of the different radiosonde stations, assuming that the satellite instrument’s properties are stable during a few orbits.

Lindenberg Radiosonde Data

The Meteorological Observatory Lindenberg (MOL) [52° 27′ 22.5″ N, 12° 12′ E] has the following simulator setup:

- High Resolution Not Corrected (HRNC)
- High Resolution Corrected (HRC)
- Low Resolution Corrected (LRC)

Corrections for HRC / LRC:
- Dry bias correction
- Elimination of data affected by sensor icing
- Time lag correction

LRC - only standard and significant levels of HRC

ARTS - Atmospheric Radiative Transfer Simulator [1]

ARTS is used to simulate brightness temperature for AMSU-B channels. The clear-sky version of ARTS is used in this study. A cloudy version, which can handle scattering due to cirrus clouds has been developed and is being validated.

The table below shows the effect of cutting the profiles at 100 hPa. Simulations for the ECMWF 60-level data set [2] were used to assess this. The difference in brightness temperature in mK is given in the table (50 km circle radius, nadir view). The minimum values are in MOL, the maximum values in the four selected regions.

<table>
<thead>
<tr>
<th>Type</th>
<th>Bias</th>
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<th>Offset</th>
<th>Corr</th>
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<tr>
<td>HRC</td>
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<td>0.998</td>
<td>0.953</td>
<td>0.97</td>
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<tr>
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<td>0.998</td>
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<tr>
<td>LRC</td>
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<td>0.953</td>
<td>0.97</td>
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<tr>
<td>LRC</td>
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<td>0.954</td>
<td>0.881</td>
<td>0.97</td>
</tr>
</tbody>
</table>

Sources of error for the comparison are:
- Radiometric noise of the AMSU measurement
- Sampling error, due to atmospheric inhomogeneity
- Radiosonde measurement error in humidity and temperature
- RT model error (systematic)
- AMSU calibration error

C_{bias} = 0.5 K

σ_{bias} - standard deviation of the pixel brightness temperatures in the target area of 50 km circle around the station

Results

Total Water Vapor Content [kg m^{-2}]

- Wettest: 43.08
- Driest: 16.67
- Standard deviation: 9.11

This figure can be used to translate back the bias in brightness temperature to bias in relative humidity in the Upper Troposphere.

Future plans:
- Make colocated data set for available stations in the BADC radiosonde archive
- Analyze quality of the humidity data

References