1. Introduction

Passive microwave sensors
- **Sounder**: AMSU-A/B, FY-3, SSMIS, ATMS
- **Imager**: SSMIS, TMI, AMSR-2, GMI

AMSU-A has 15 channels, 6 temperature sounding channels around the Q1 absorption band (69.7 GHz) and 3 image channels at 31.4, 35, and 89 GHz. It is cross-track sounding radiometers, which has an instantaneous field of view (IFOV) of 50 km at nadir and the swath width of 2200 km.

2. RTTOV and CRTM

### Clear
- **RTTOV (v10.2)**
- **CRTM (common interface) v2.1.1**

#### Input variables
- Layer: p, q, t, water content
- 2m: t, salinity, d/v, type, elevation
- Geometry: satellite zenith angle, sun zenith angle, latitude
- Cloud cover: Level: p, g, L:
- **Scattering solver**
  - Two-stream Eddington approximation model (Bauer et al. 2006)
  - Advanced doubling adding (ADA) model (Xu and Wang 2006)

### Cloudy
- **RTTOV _SCATT**
- **CRTM _SCATT**

3. Results for surface emissivity

- **For Ocean**
  - One day’s observations from NOAA-15, 18, and MetOp-A are used.

1) Comparing OmB for FASTEM

<table>
<thead>
<tr>
<th>Channel</th>
<th>RTTOV</th>
<th>CRTM</th>
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2) Comparing OmB for scan positions

The correction of FG departures according to the scan position is done by removing the u i(T bch) between observed and simulated TBs of mid-point of beam positions on each channel.

3) Distribution of OmB of AMSU-A Ch-03

4) Mean and STD of OmB for 15 channels

5) For Sea-ice

### For Land

1) Surface emissivity of AMSU-A Ch-02

<table>
<thead>
<tr>
<th>Channel</th>
<th>RTTOV</th>
<th>CRTM</th>
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</table>

2) Distribution of OmB of AMSU-A Ch-03

3) Mean and STD of OmB for 15 channels

4) Surface emissivity of RTTOV and CRTM

- **RTTOV-Direct** driver has been installed. (January 2013)
- **RTTOV-SCATT** driver has been installed. (July 2013)
- **CRTM** driver has been installed for comparison. (September 2014)
- **RTTOV-K** driver has been installed. (February 2015)
- **RTTOV TELESC EmisAtlas** has been used. (February 2014)

5. Plans

- RTTOV version 11 with updated Mie table will be implemented and optimal cloud and precipitation particles will be ingested.
- Pre-processing system for mHS will be developed.

6. Current status of RTTOV in KOPS (microwave)

AMSU-A FG departures using RTTOV and CRTM (a) without and (b) with cloud conditions for AMSU-A channel 3 FG departures for RTTOV and CRTM at 0000 UTC on 7 November 2012 over ocean.

- **AMSU-A channel 3 FG departures for RTTOV and CRTM (a) without and (b) with cloud conditions**
- **AMSU-A FG departures using RTTOV and CRTM (d) without and (b) with cloud conditions**

- **Additional inputs for EmisAtlas in RTTOV**
  - When cloud fractions are considered, FG departures of image channels and low tropospheric scattering channels are reduced in both models. Especially for channel 2 (31.4 GHz) and 15 (89.0 GHz), statistics of bias and standard deviation of CRTM are getting much lower than those of RTTOV.
  - Another thing to note is that FG departures from RTTOV in mid- and upper-tropospheric sounding channels are slightly decreased when cloud fields are included since the final TBs in RTTOV are combined radiance of both clear and cloud.

7. Reference


Han, W. and P. Dong, 2012: Study and comparison of simulation of satellite microwave observations in cloudy and rainy areas using RTTOV and CRTM. In. Proc. 18th International TOVS Study Conference, 94-95.
