

A Comparison of RTTOVSCATT with ARTS and AMSU Short Range Forecasts of

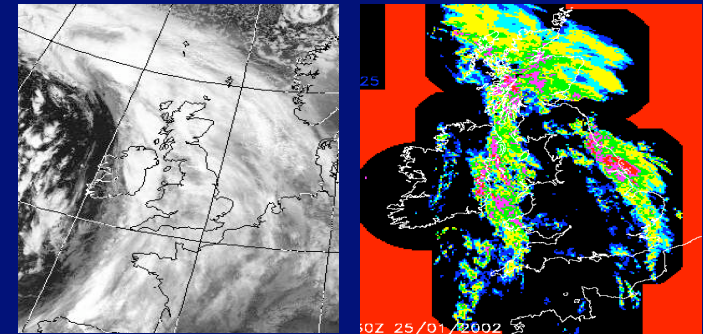
S. J. English¹, U. O’Keeffe¹,

RTTOVSCATT⁺⁺⁻

- Update of RTTOV7
- Fast
- Eddington scattering approximation
- Marshall-Palmer size distribution
- FASTEMland land surface emissivity
- FASTEM2 ocean surface emissivity

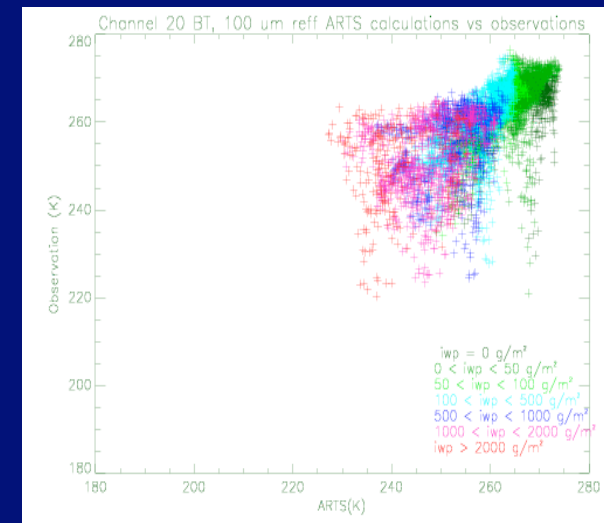
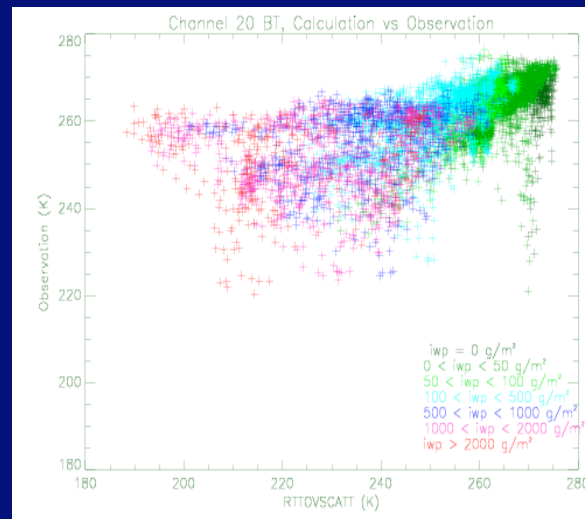
Case Study

- Frontal system over UK
- 25th January 2002



Initial comparisons between models showed significant disagreement (Figure 2) due to different assumptions about:

- Liquid Water (Figure 3)
- Surface Emissivity (Figure 4)
- Drop size distributions (Figure 5)

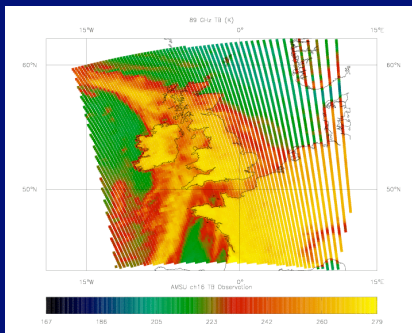


Figures 2a and 2b (above) AMSU Channel 20, RTTOVSCATT against OBS and ARTS against OBS.

Observations, Using the Met Office Mesoscale Model Cloud Ice and Liquid Water

Sreerekha T. R.² and A. Doherty¹

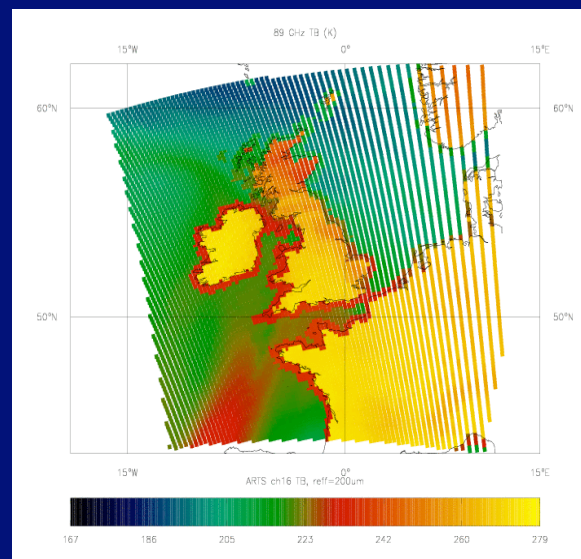
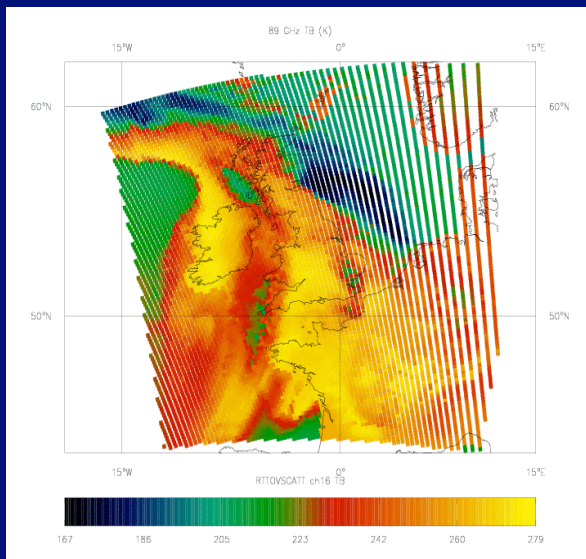
¹Satellite Applications, Met Office, Exeter, UK ²University Of Bremen



Figures 1a (far left) 1b (centre left) and 1c (near left)
 AVHRR infrared, radar and AMSU channel 16 (89 GHz) images of the case study, figures 1a, 1b and 1c respectively

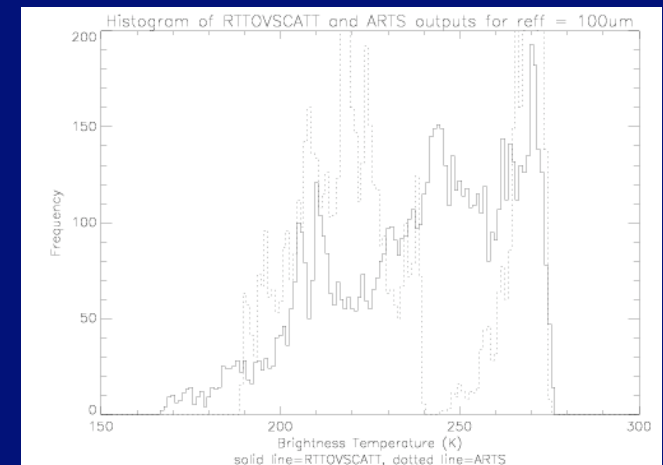
ARTS^{5%}

- Accurate
- Discrete ordinates solution
- Gamma drop size distribution
- Emissivity set for land (0.95), sea (0.6) and coast (0.7)
- No liquid water



Figures 3a and 3b (left and right above) RTTOVSCATT and ARTS AMSU channel 16 TB calculations respectively. ARTS does not include liquid water and misses the emission signal seen in the RTTOVSCATT output

Figure 4 (below) showing the clustering of land, sea and coast points in ARTS with the constant surface emissivity values compared to RTTOVSCATT with FASTEM calculated surface emissivity values.



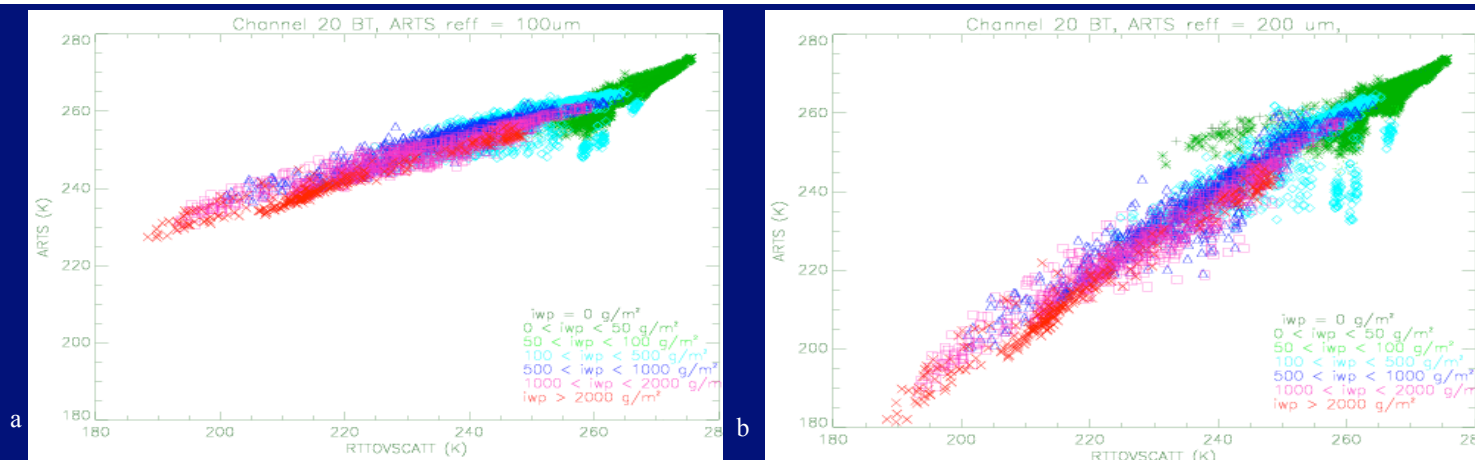
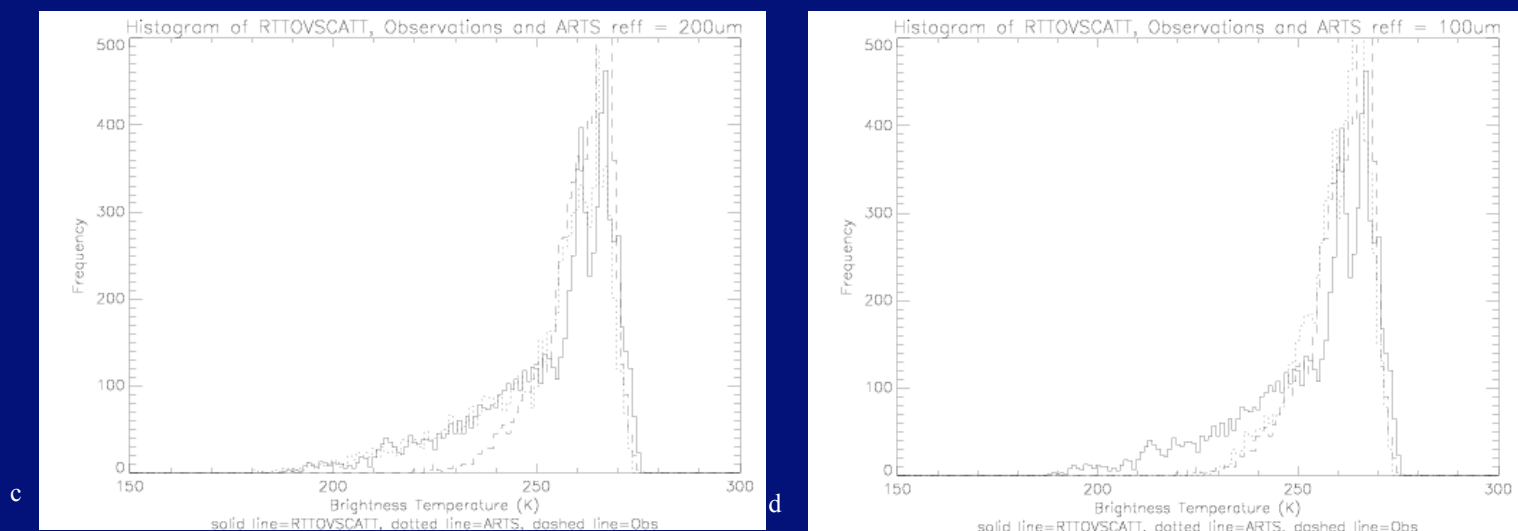


Figure 6 (right) ARTS vs RTTOVSCATT clear minus cloudy calculations. The slope of the plot is roughly a 1 in 2 gradient, probably due to the differences in drop size distribution between the models. However the overall fit is good with the spread of points tight, illustrating the good agreement between the radiative transfer calculations in the range of 1-2 K as found in previous studies⁶.

Figures 5a, 5b, 5c and 5d showing the changes in ARTS output compared to RTTOVSCATT and observations for channel 20 when the effective radius is increased from 100 μm (Figures 5a and 5b) to 200 μm (Figures 5c and 5d). Tuning ARTS effective radius gives better agreement with observation (100 μm) or with RTTOVSCATT (200 μm)



References

- †Bauer, P., 2002: Microwave radiative transfer modelling in clouds and precipitation, Part 1: Model description. *Satellite Application Facility for Numerical Weather Prediction*, NWPSAF-EC-TR-005.
- *Chevallier, F. and P. Bauer, 2003: Model Rain and Clouds over Oceans: Comparison with SSM/I observations. *Monthly Weather Review*, Vol. 131, No.7, pp.1240-1255.
- +Moreau et al., 2002: Microwave radiative transfer modelling in clouds and precipitation, Part II: Model evaluation. *Satellite Application Facility for Numerical Weather Prediction*, NWPSAF-EC-TR-006.
- Smith E.A. et al., 2002: Intercomparison of microwave radiative transfer models for precipitating clouds, *IEEE Trans. Geosci. Remote Sens.*, vol. 40, pp. 541-549.
- §T. R. Sreerekha et al., 2002: A simple New Radiative Transfer Model for Simulating the effect of cirrus clouds in the microwave spectral region, *J. Quant. Spectrosc. Radiat. Trans.*, Vol. 75, pp. 611-624.
- %<http://www.sat.uni-bremen.de/arts/>

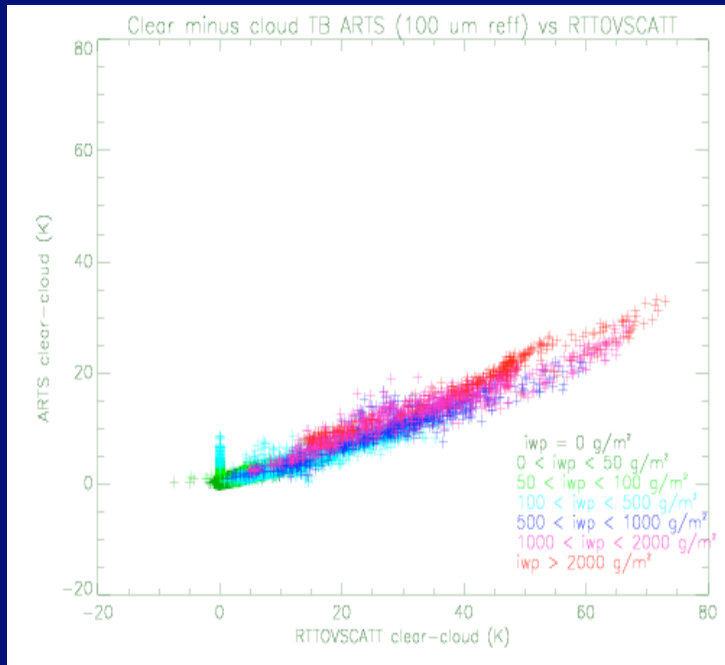
Discussion

Comparison of the two systems using the RT models in their default configurations using the NWP model input revealed large differences in calculated TB.

Comparison with observations emphasised that the level of agreement is sensitive to the choice of effective radius. Information about the effective radius is not usually available from the NWP model.

The low spread of clear minus cloudy comparisons (Figure 6) supports the idea that the methods used to solve the radiative transfer equation give similar results and the large difference arises from the interface with the NWP model. Errors in input profiles need to be characterised.

There is evidence in this preliminary study to suggest that radiative transfer models for AMSU-B are not a significant source of error in comparison to other parts of the system.



Future Work

- Characterisation of errors in NWP cloud/rain fields
- Develop a strategy for parameters required where NWP system gives little or no information
- Continue and extend intercomparisons to robustly identify sources of differences