Use Of AMSU data in the UK Mesoscale Model

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Talk Outline

- Background and Motivation
- Limited Area Models at the Met Office
- Data Usage in the Mesoscale model
  - Source of observations
  - Data screening
- Bias Correction
- Impact Assessment
  - Method
  - Some results
- Future Work

Background

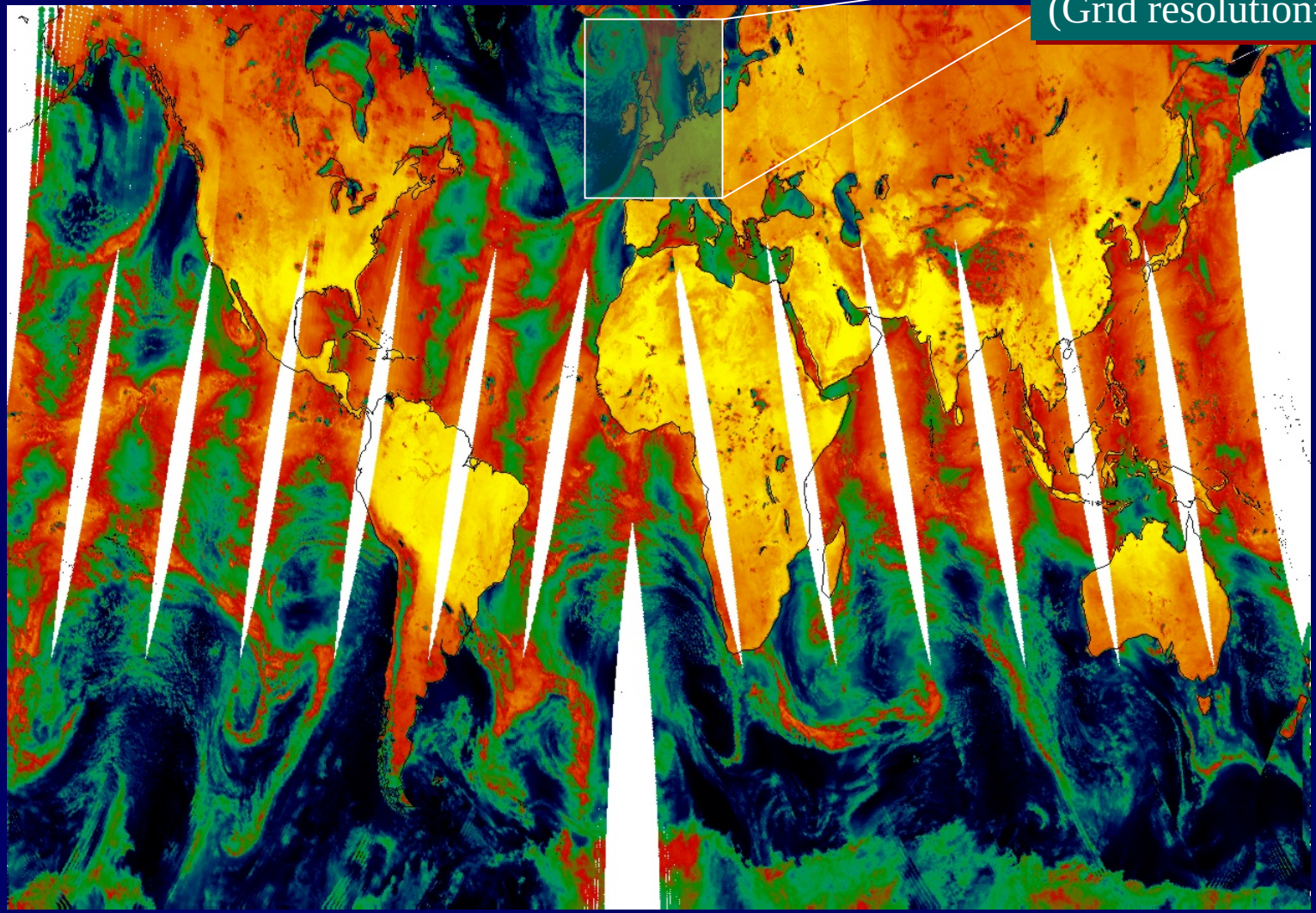
- Contribution of ATOVS in global NWP is very important

- To date effort has focused on assimilating satellite data in global NWP
  - *Some data types are currently precluded by timeliness*
- Initial tests of assimilating radiance data in the UK Mes encouraging
  - *Information retained in the short-range*
- But…..objectives are different.
  - *Key forecast parameters cloud cover, precip and surface temp*

UK Mesoscale Model 1

Model Domain

(Grid resolution=12km)



Background: Full Resolution AMSUB Imagery 89 GHz

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UK Mesoscale Model 2

- Assimilation system:
  - incremental 3D-Var
  - assimilation window ±1½ hours
  - 2 hour data cutoff
- Observations:
  - radiosondes, air reps, wind profilers
  - land station reps, including visibility
  - satellite winds from Meteosat

- Additionally cloud cover and surface rainrate information is assimilated via a different route (i.e. outside of Var)

Data Acquisition

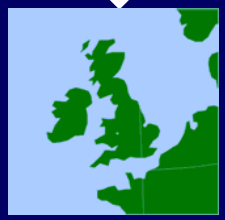
West Freugh

Local Passes

HRPT

AAPP

1d data on HIRS grid



UK Mes NWP

Washington

NESDIS

1b data

AAPP

1d data on HIRS grid

Global NWP

Comparisons for quality monitoring

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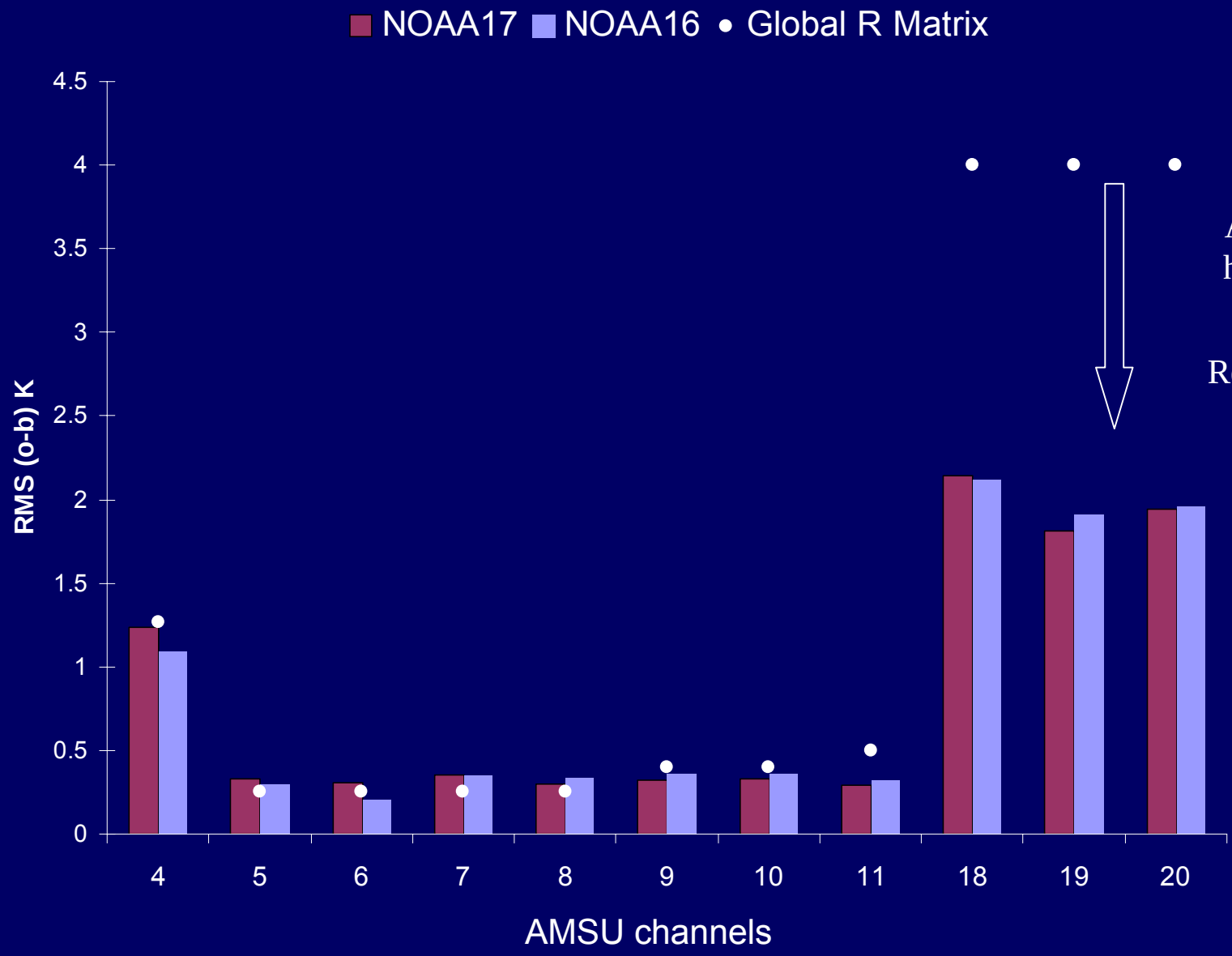
ATOVS Data Use

- HIRS data not used
  - calibration problems associated with partial super swath
- AMSU data
  - Remapped to HIRS grid (allows use of same code as global)
  - AMSUB 183 GHz channels over sea only
- AMSU data screening
  - Liquid water test in AAPP → reject channels 4,5 & 20
  - Ice test on 183 GHz channels → reject channels 19,20
  - Rain test in AAPP → reject channels 4-8 & 18-20
- Data Thinning
  - 1 observation every 40 km. More weight given to clear & microwave clear scenes.

Tuning AMSU Observation Errors



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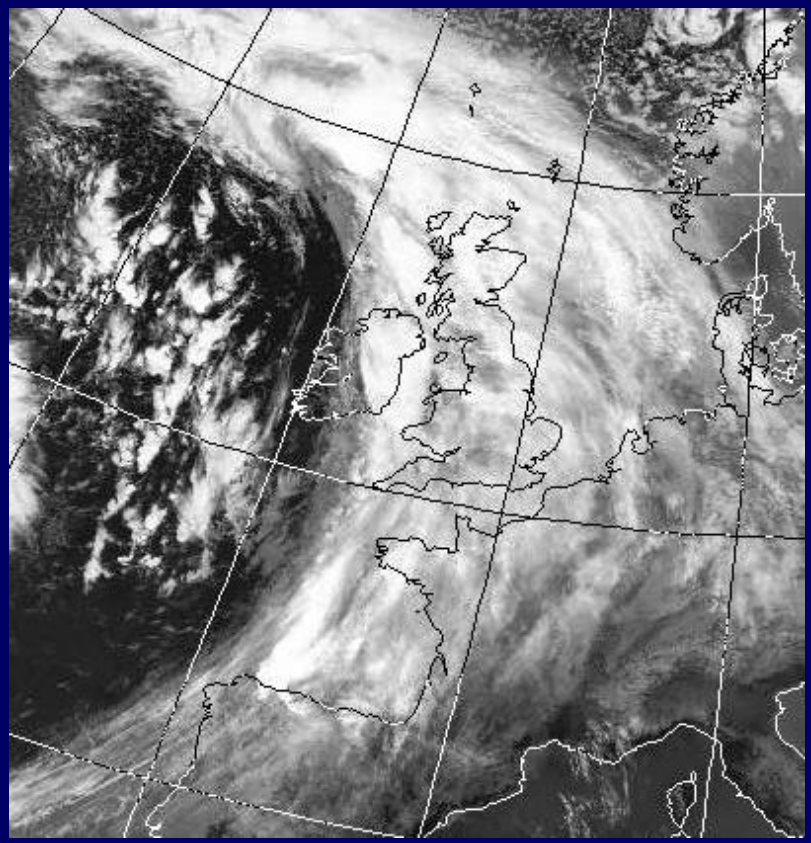
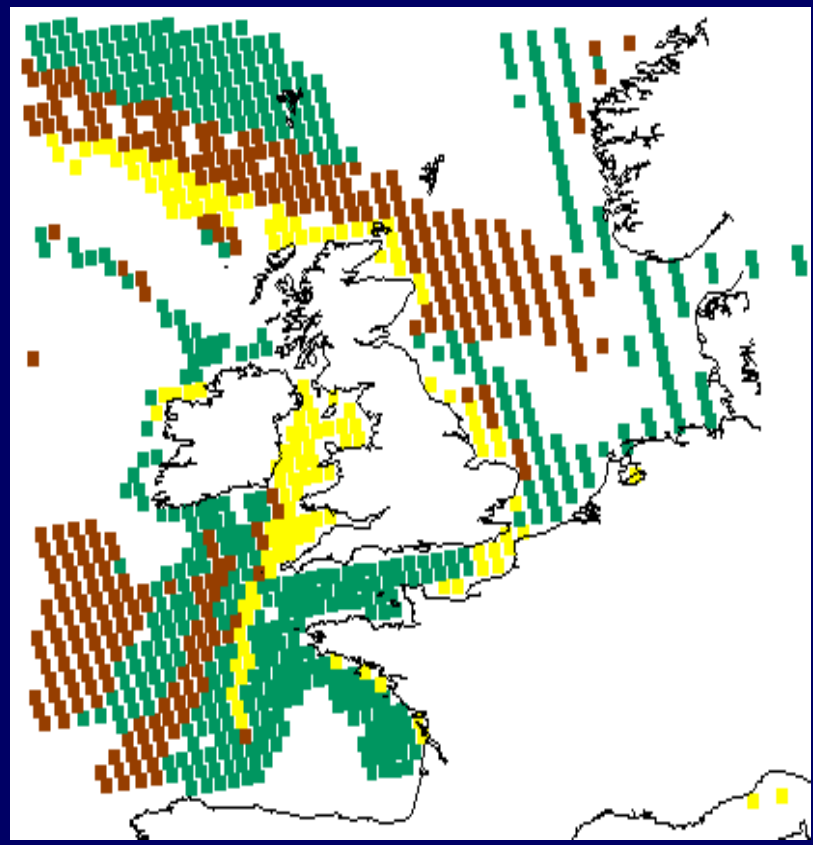
Mid-lat Cyclone Case Study

AVHRR IR image



AMSU data screening



green: lwp yellow: precip

red: AMSUB cirrus

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Bias Correction 1

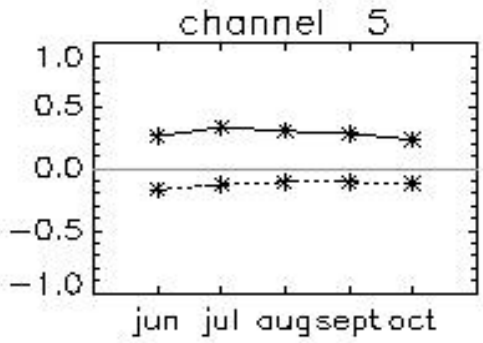
- Airmass dependent predictors (Eyre, 1992)
  - problem in a LAM is to sample enough representative synoptic systems
  - could monitor departures over a year, assuming negligible instrument drift
- Current solution is to use global bias correction coefficients
  - assumes global and LAM NWP are unbiased
  - monitoring with sondes confirms this, at least for the troposphere

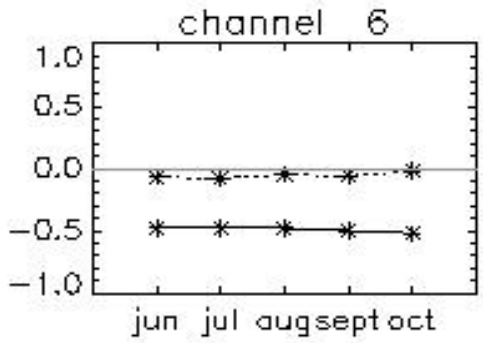
Bias Correction 2

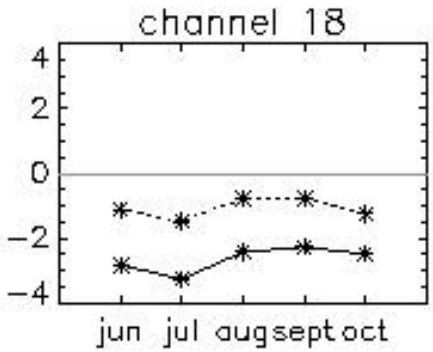
AMSU channels Mean O-B Difference (K) over Mesoscale Domain

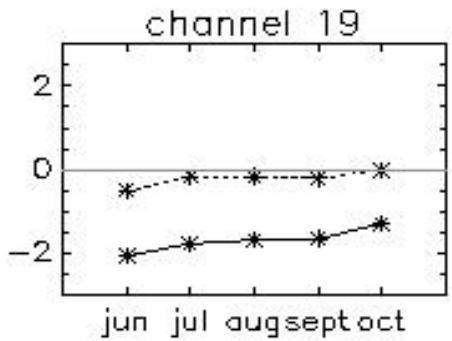
Uncorrected Radiances ——

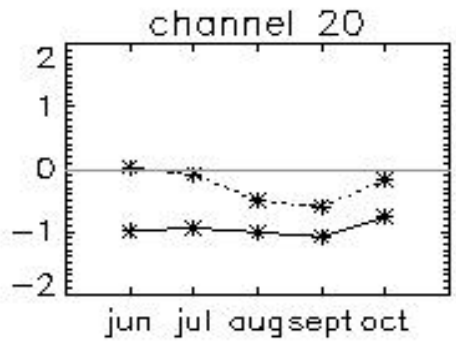
Corrected Radiances .....











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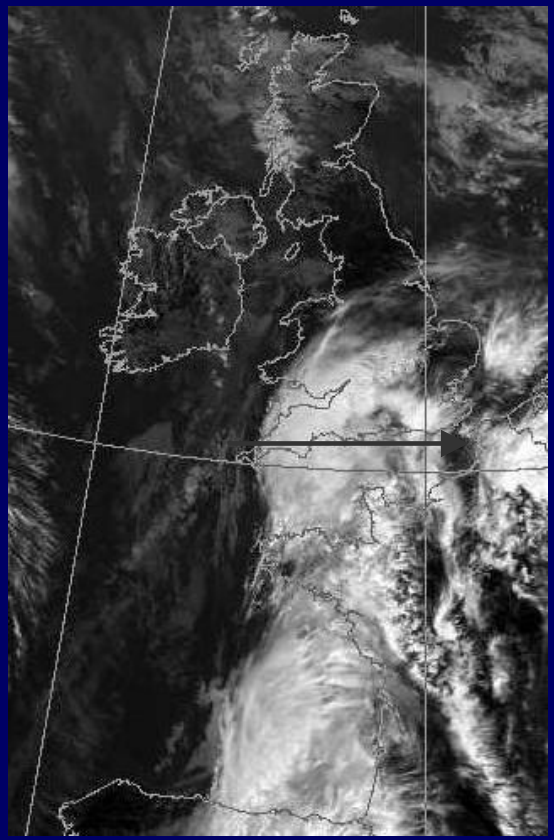
Strategy for Assessing Impact

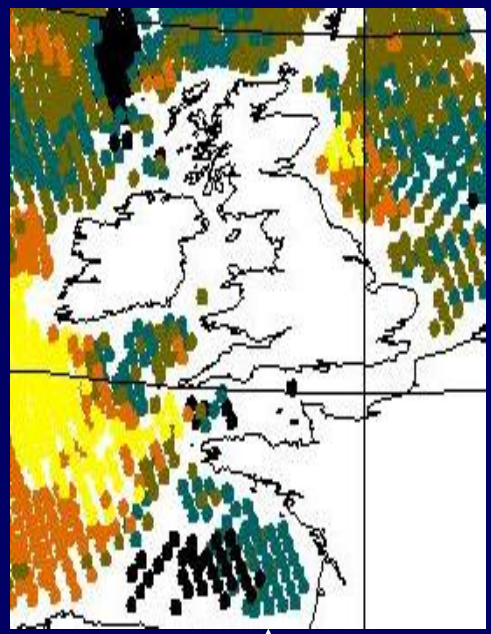
- Case study for poor operational forecast.
  - Convection over S.W. Britain
  - Rain forecasts compared to radar
- Set of cases containing range of weather situations observed over UK.
  - Chosen by forecaster
  - Subjective verification from station reports of 6 hour precip, surface temp & cloud cover
  - NOAA15 & 16 assimilated
- Extended Trial.
  - Ran for 1 month
  - Avoids spin-up problems
  - Near Real Time to get operational boundary conditions
  - Forecasts assessed by forecaster
  - NOAA16 & 17 assimilated

Convective Event 1

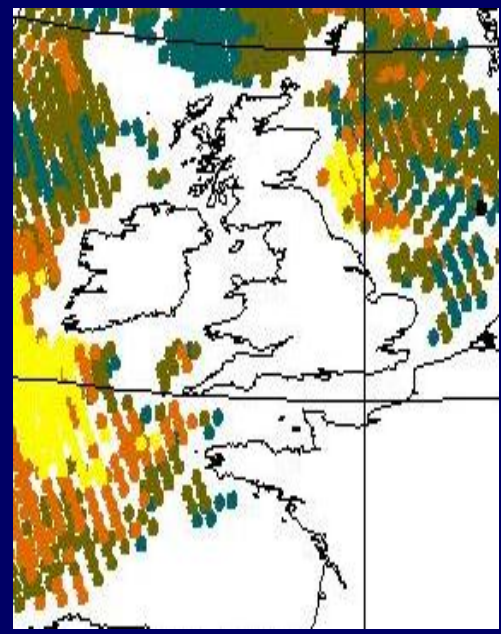


Observations Used

Channel 19



Channel 20



Situation: Warm moist air moving northwards, mixing with cooler air at higher latitudes

dark colours indicate

Negative o-b model too dry

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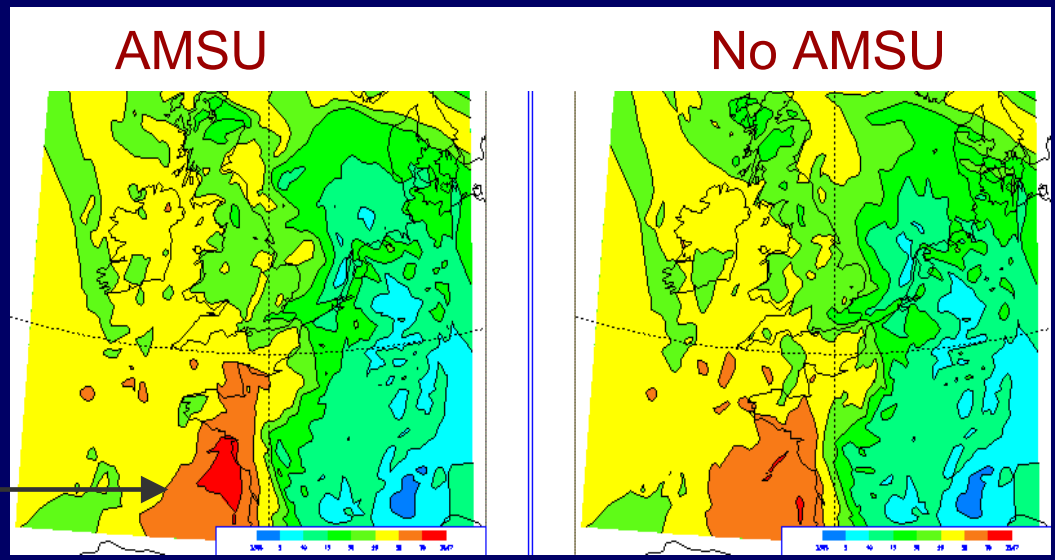
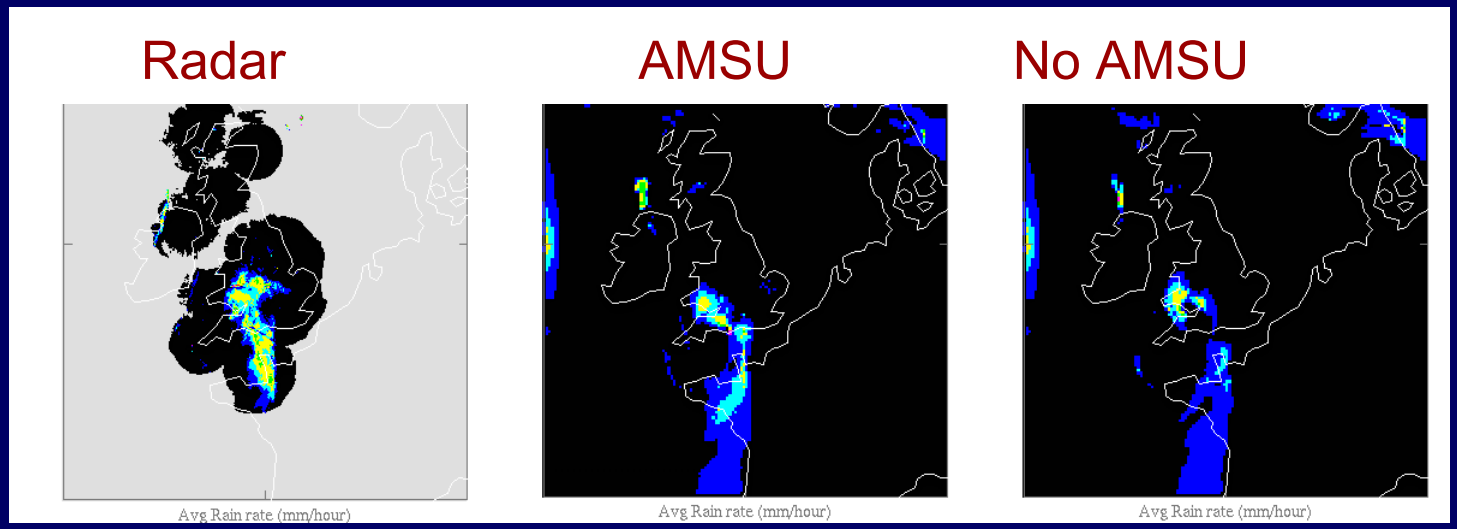
Convective Event 2

Integrated Water Vapour Analysis



region > 30kgm^{-2}

T+6 rainrate forecast



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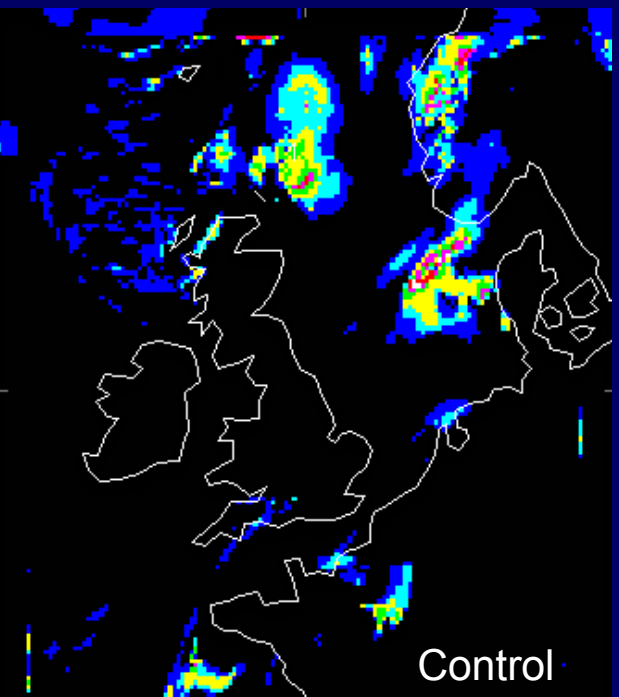
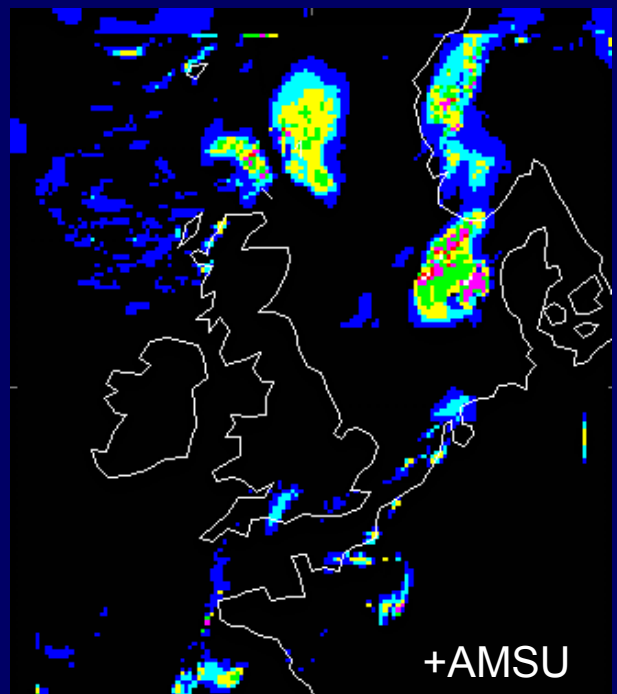
Verification of Case Studies

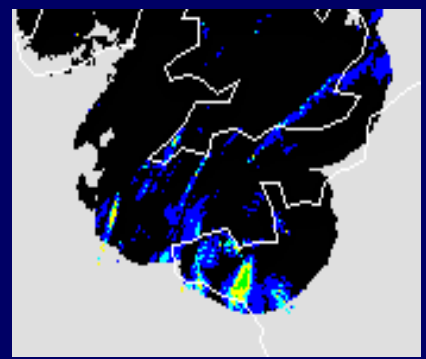
- 6 cases improved, 6 cases worsened due to inclusion of AMSU
- Worse case highlights difficulties of using sparse verification sites for reporting precipitation

Hourly Precip, 0z 26th August 2001 T+6





Verifying Radar



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AMSU Impact on Cloud

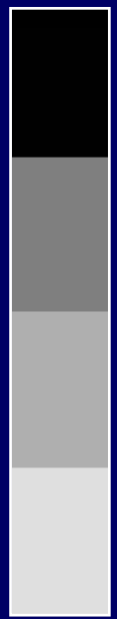
T+6 Cloud Cover

Clear

low

medium

high



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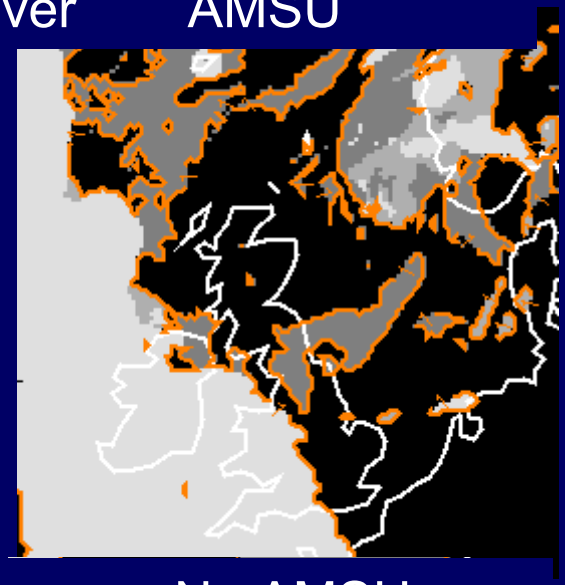
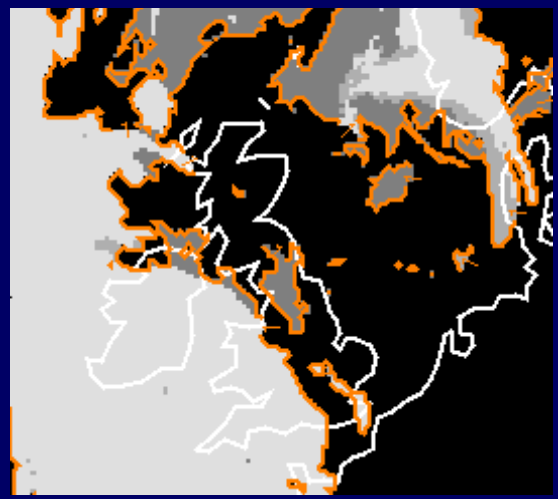
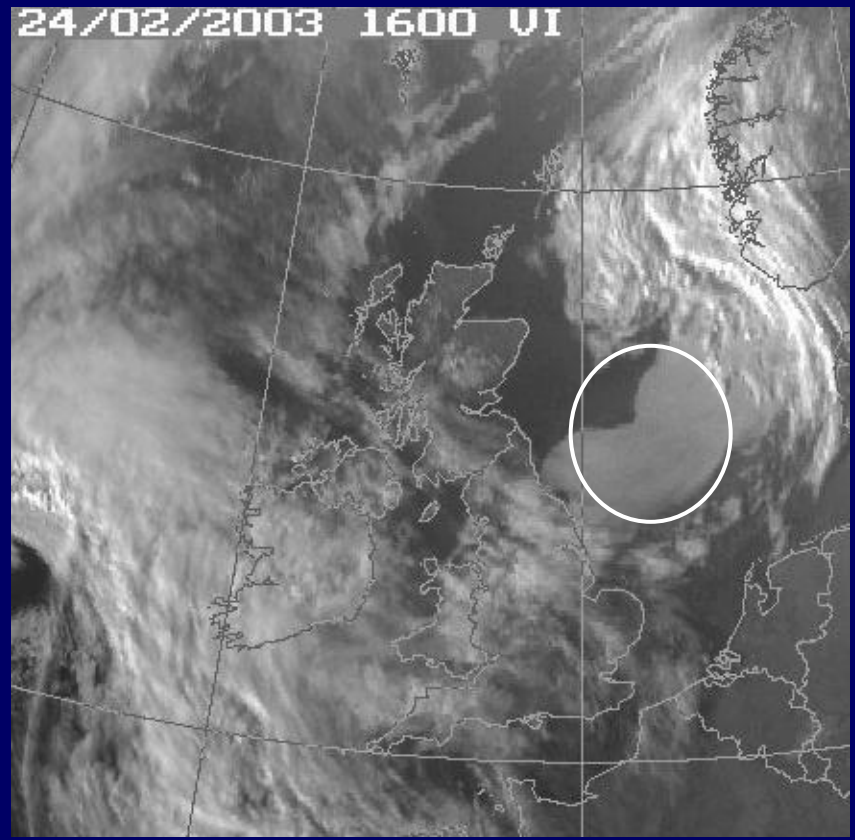


No AMSU



Validation: vis image



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Conclusions

- Operational in Mesoscale model from May 2003.
  - NRT trial positive for cloud & visibility.
  - Including a significant fog clearance case.
- Similar approach adopted for European model.
- Future Work
  - AMSUB at full resolution.
    - » Issues for qc & bias correction.
    - » Extend number of channels
  - Assimilation in regions of significant LWP.
    - » Total humidity control variable.
    - » 1D Var
    - » 3D Var

Additional Slides

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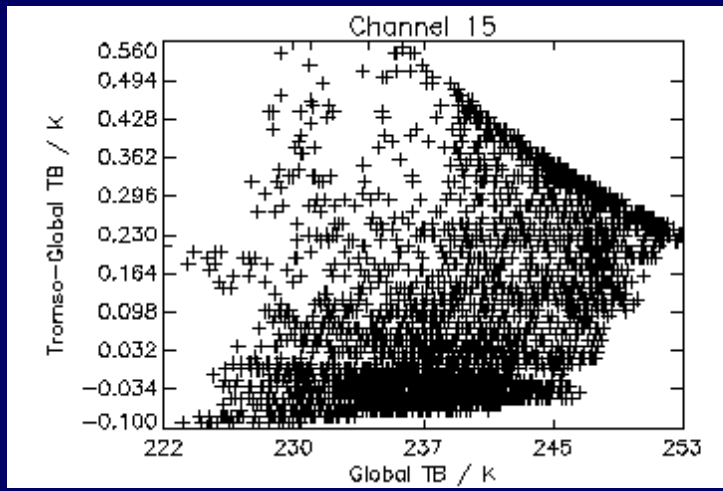
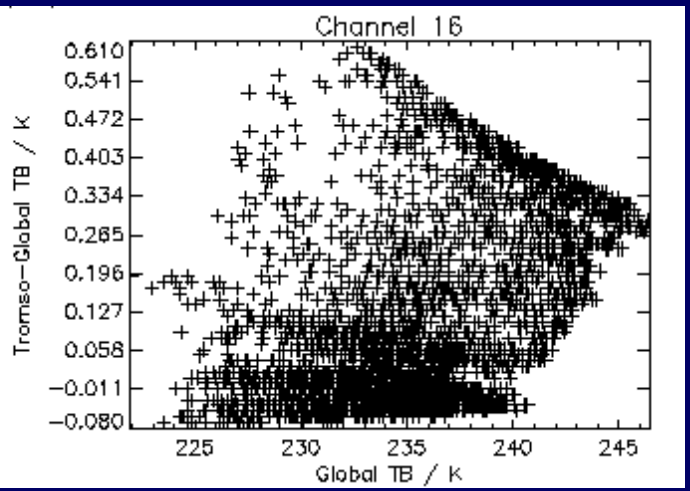
Local – Global BT Difference

HIRS

Channel 15



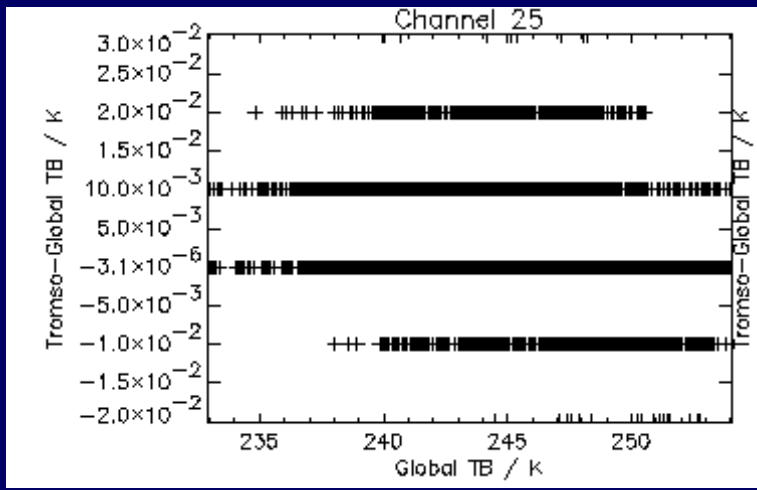
Channel 16



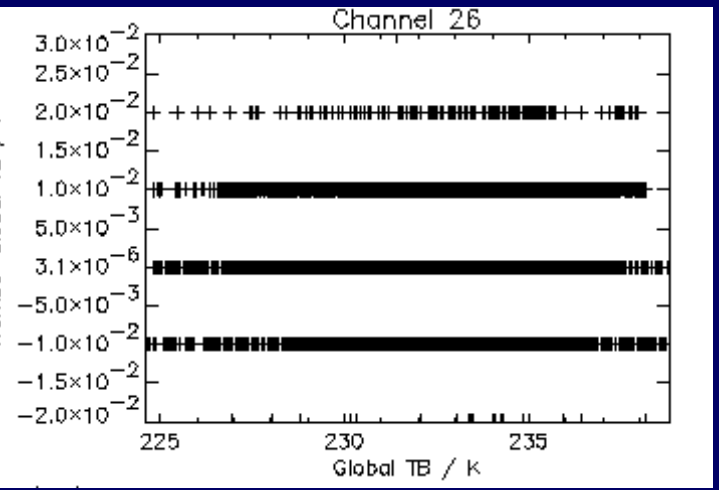
~0.5 K

AMSU

Channel 5



Channel 6



~0.02 K

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Initialisation of the Mesoscale Model: Weights given to Var & MOPs data