

# Recent developments in the use of ATOVS data at ECMWF

Niels Bormann, Shinya Kobayashi, Marco Matricardi,  
Tony McNally, Blazej Krzeminski, Jean-Noël Thépaut and Peter Bauer

# Current use of ATOVS data

## Channels used:

HIRS: channel 4-7, 11, 14, 15 over sea; 12 over sea+low orography only

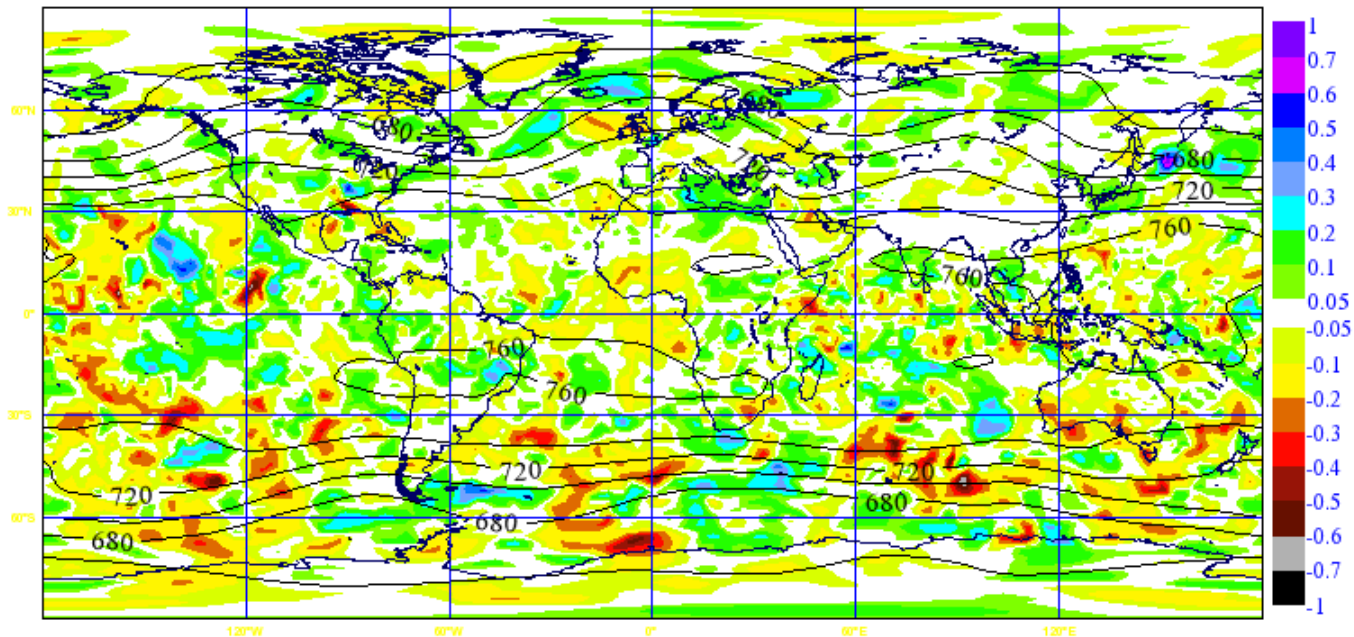
AMSU-A: channels 5,6 over sea+low orography; 7-14 land+sea

AMSU-B/MHS: channel 5 over sea only; 3,4 sea+low orography

	HIRS ( 2 used)	AMSU-A (5 used)	AMSU-B/MHS (3 used)	EARS (except HIRS)
NOAA-15	no: unstable	yes (not ch 6, 11, 14)	no: quality	yes
NOAA-16	no: unstable	yes (not ch 5-7/8)	no: quality	yes
NOAA-17	yes	Instrument failed	yes	yes
NOAA-18	no: unstable	yes	yes	yes
AQUA	n/a	yes (not ch 5-7)	n/a	n/a
METOP-A	yes	yes	yes	n/a

# Use of METOP-A AMSU-A/MHS data

Impact on 3-day forecast of 500 hPa geopotential: EXP – CTL, 19 cases  
Normalised difference in the RMS forecast error for 500 hPa geopotential.



Small positive impact over Southern Hemisphere from adding METOP data as 5<sup>th</sup> AMSU-A, and 4<sup>th</sup> AMSU-B/MHS.

METOP AMSU-A & MHS data used operationally since 11 January 2007.

# ATOVS developments

## In operations:

- Update to AMSU-A RTTOV coefficients (no Zeeman effect)
- Zero bias in AMSU-A channel 14

## Under development:

- Improved use of surface-sensitive AMSU-A/B/MHS channels over land (poster by Blazej Krzeminski)
- Revised bias correction for HIRS & AIRS short-wave channels

# ATOVS developments

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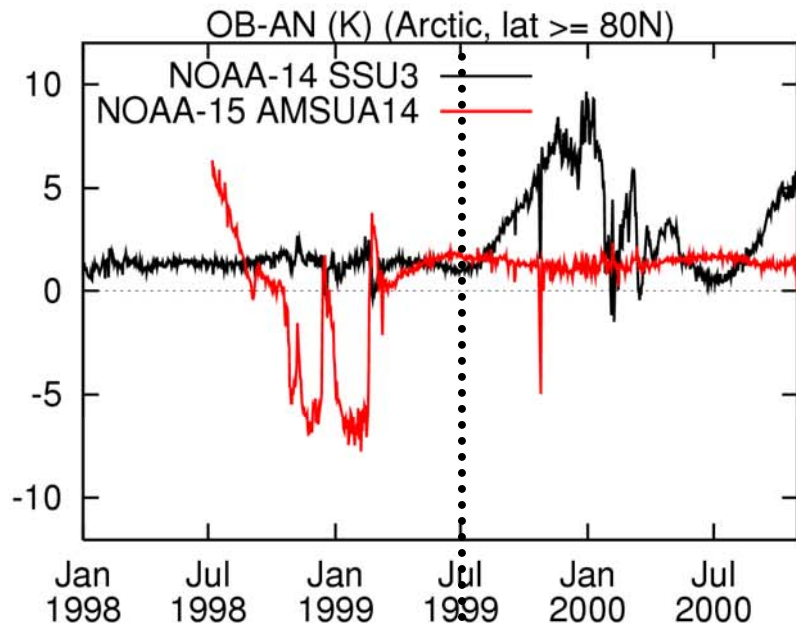
## Under development:

- Improved use of surface-sensitive AMSU-A/B/MHS channels over land (poster by Blazej Krzeminski)
3. Revised bias correction for HIRS & AIRS short-wave channels

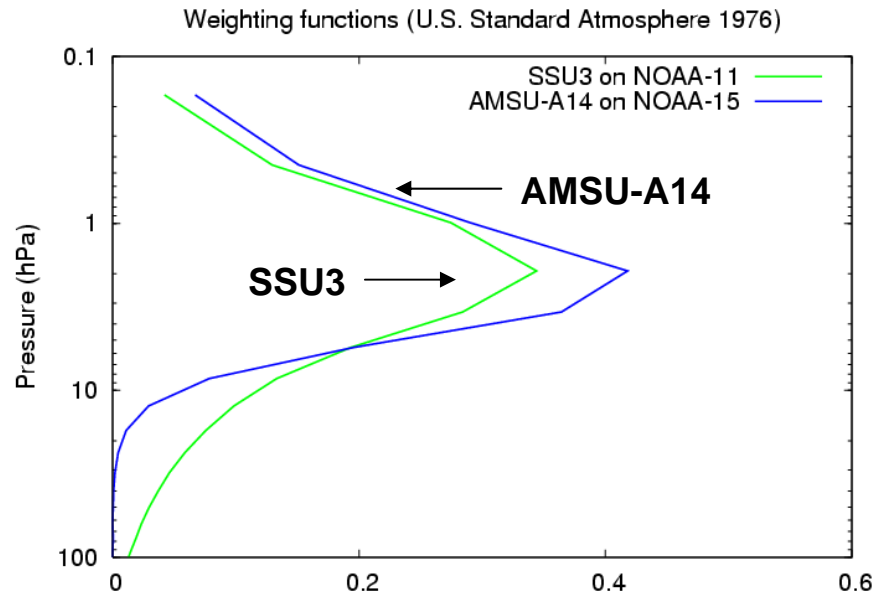
# ATOVS developments

- 1. Update to AMSU-A RTTOV coefficients (no Zeeman effect)**
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# Transition from SSU to AMSU-A in ERA-40



SSU ch 3 assimilated : blacklisted

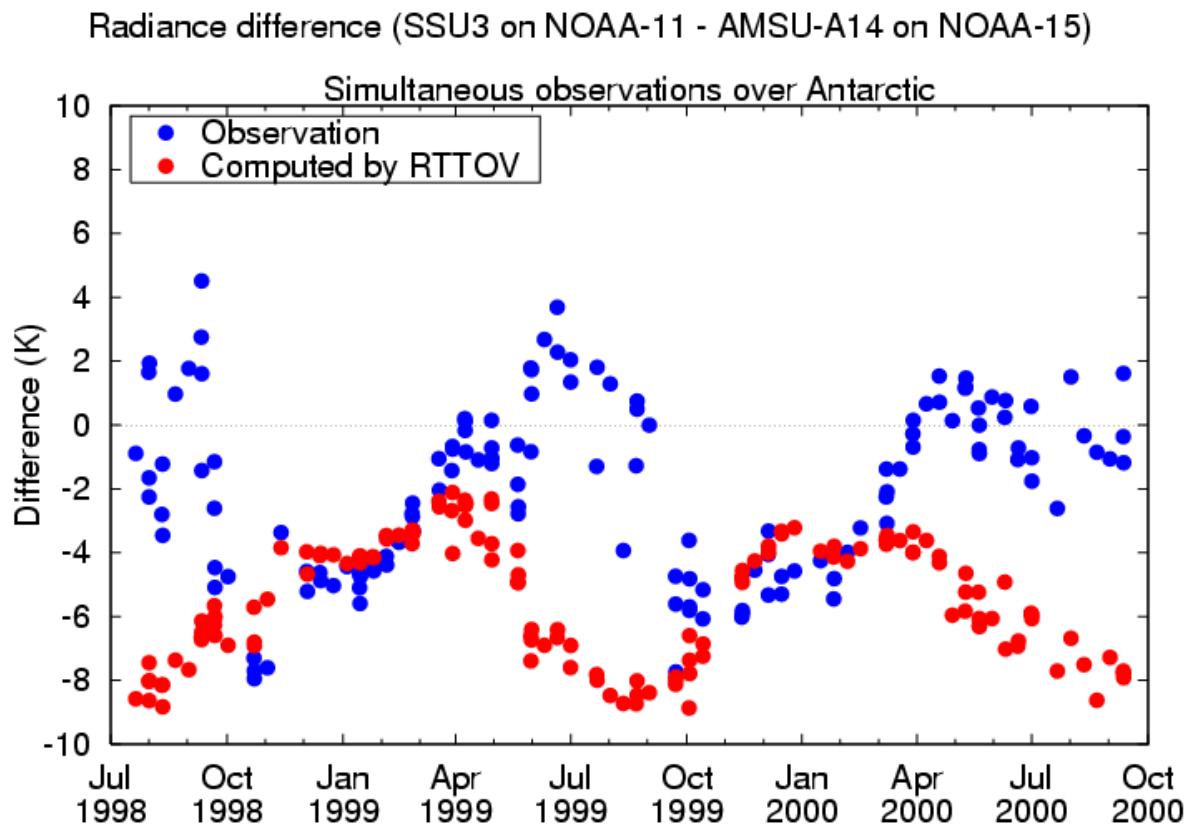


Weighting functions

Green: SSU3 on NOAA-11

Blue: AMSU-A14 on NOAA-15

# Radiance difference between collocated SSU and AMSU-A data



Radiance difference between SSU3 on NOAA-11 and AMSU-A14 on NOAA-15 at SNO over Antarctica

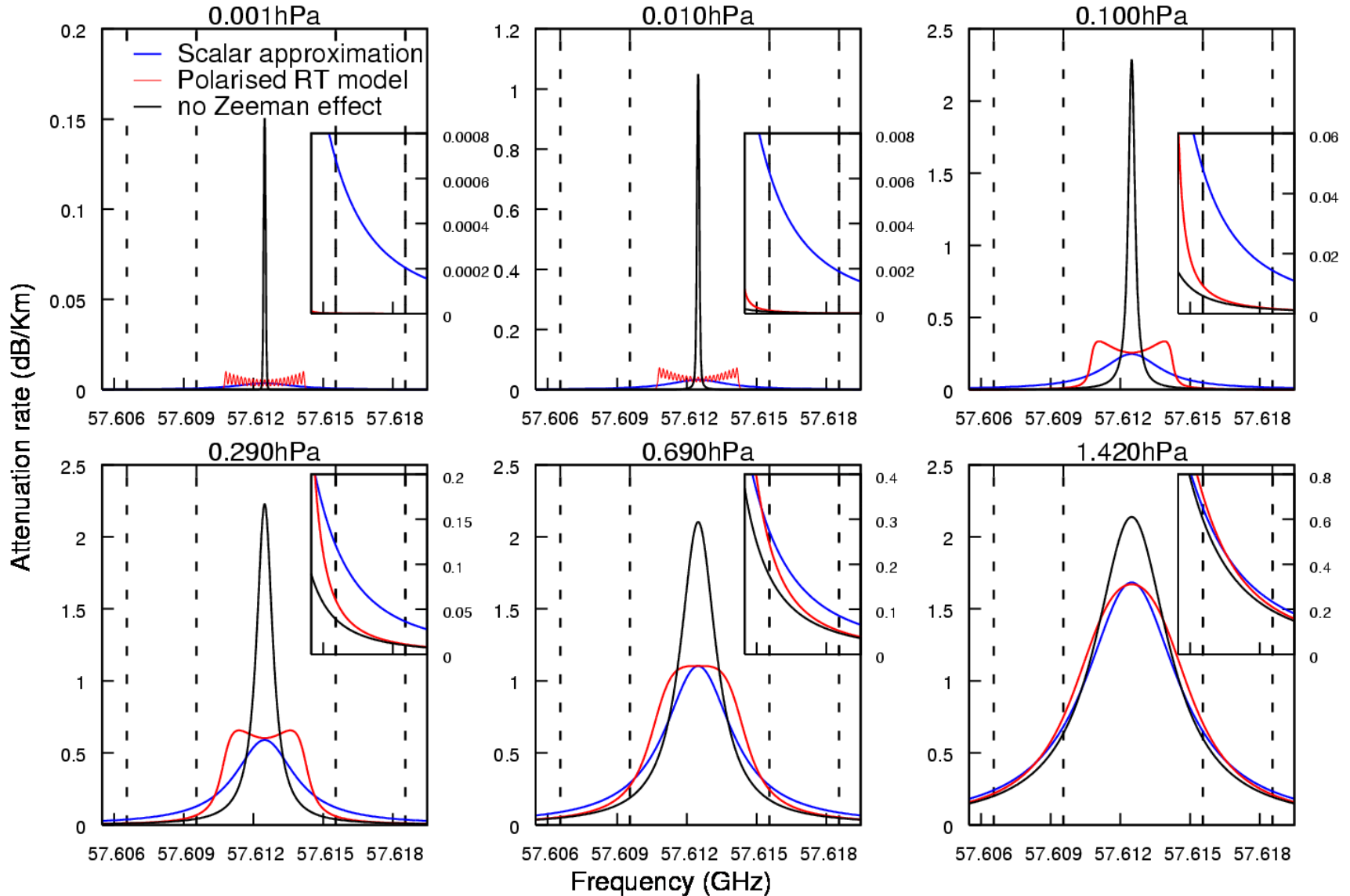
Blue: observed differences

Red: computed by RTTOV

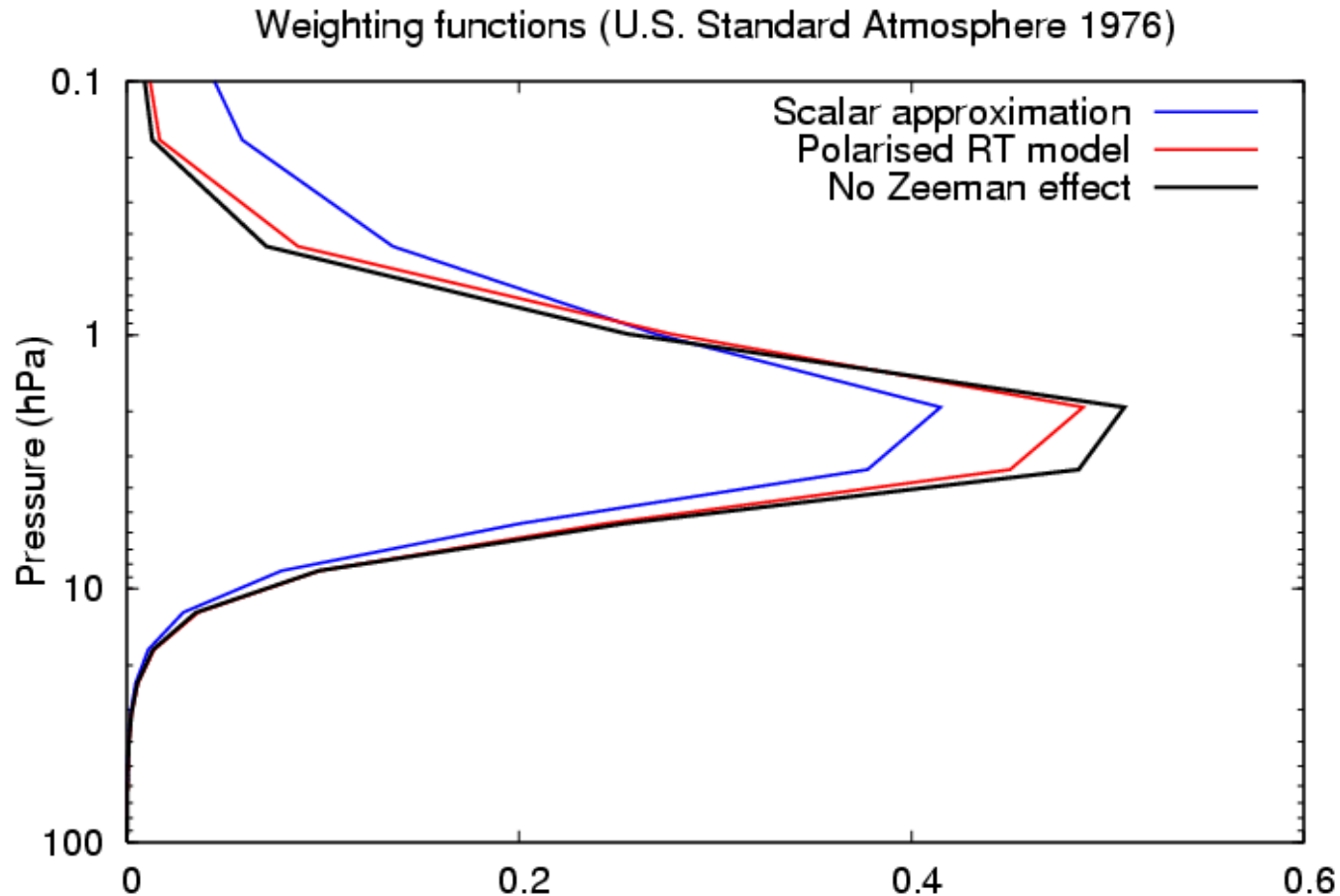


# Line shapes in the presence of a magnetic field

Attenuation rate (dB/Km) of the O<sub>2</sub> microwave line K=11- for the magnetic field strength  $B=0.6e-4(T)$



# Impact of the Zeeman splitting effect on the weighting function



Weighting functions for AMSU-A channel 14 computed by line-by-line models

# Consistency between SSU and AMSU-A

Radiance difference (SSU3 on NOAA-11 - AMSU-A14 on NOAA-15)

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Simultaneous observations over Antarctic

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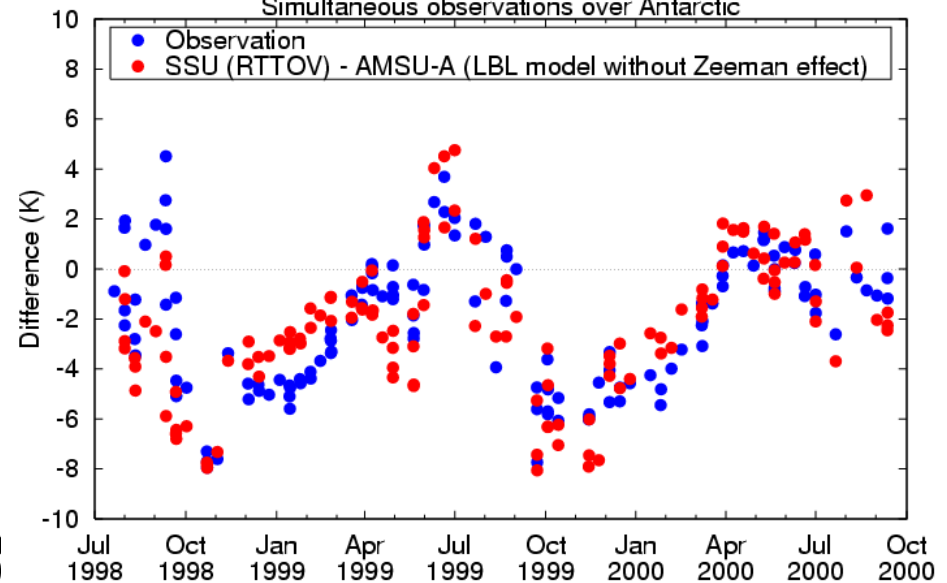
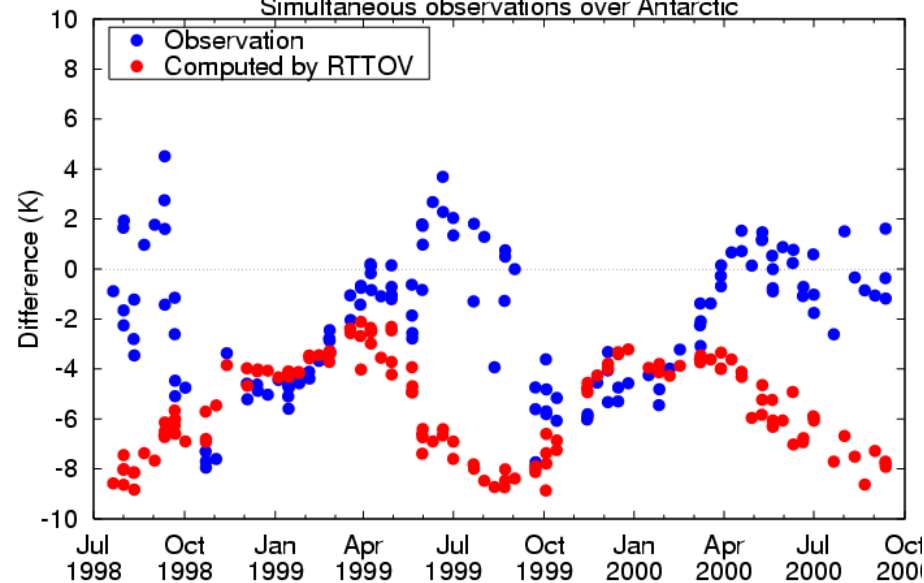


Figure: Radiance difference between SSU3 on NOAA-11 and AMSU-A14 on NOAA-15 at SNO over Antarctic

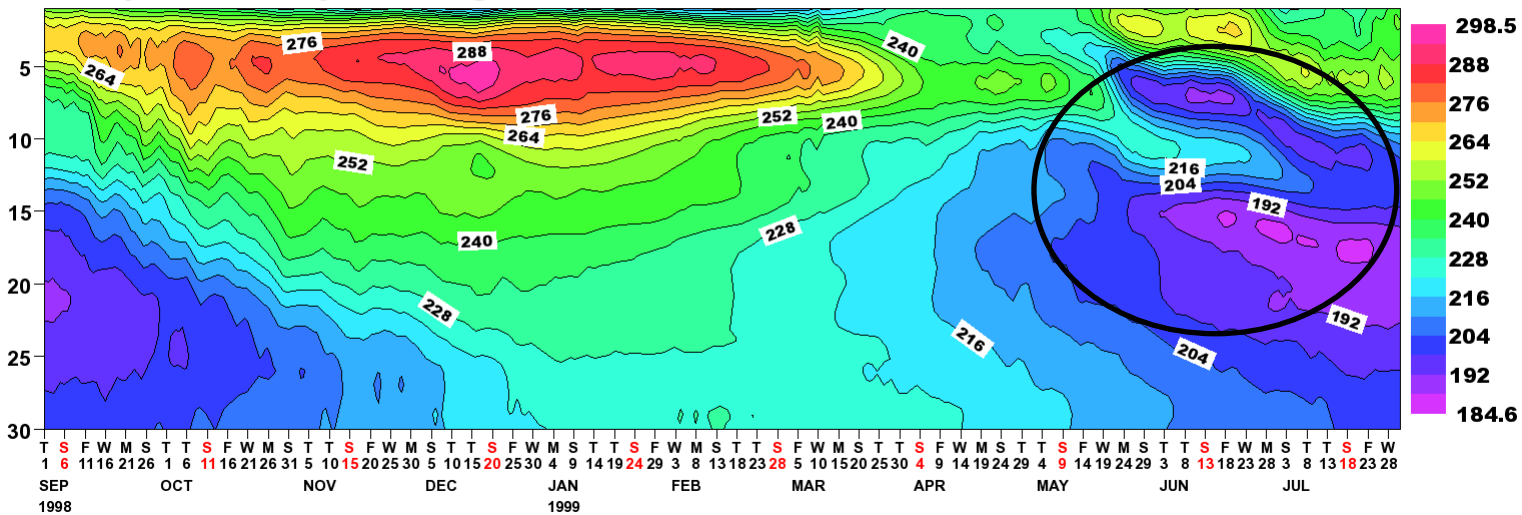
Blue: observed difference

Red (left): difference computed by old RTTOV

Red (right): difference computed by LBL model without Zeeman effect

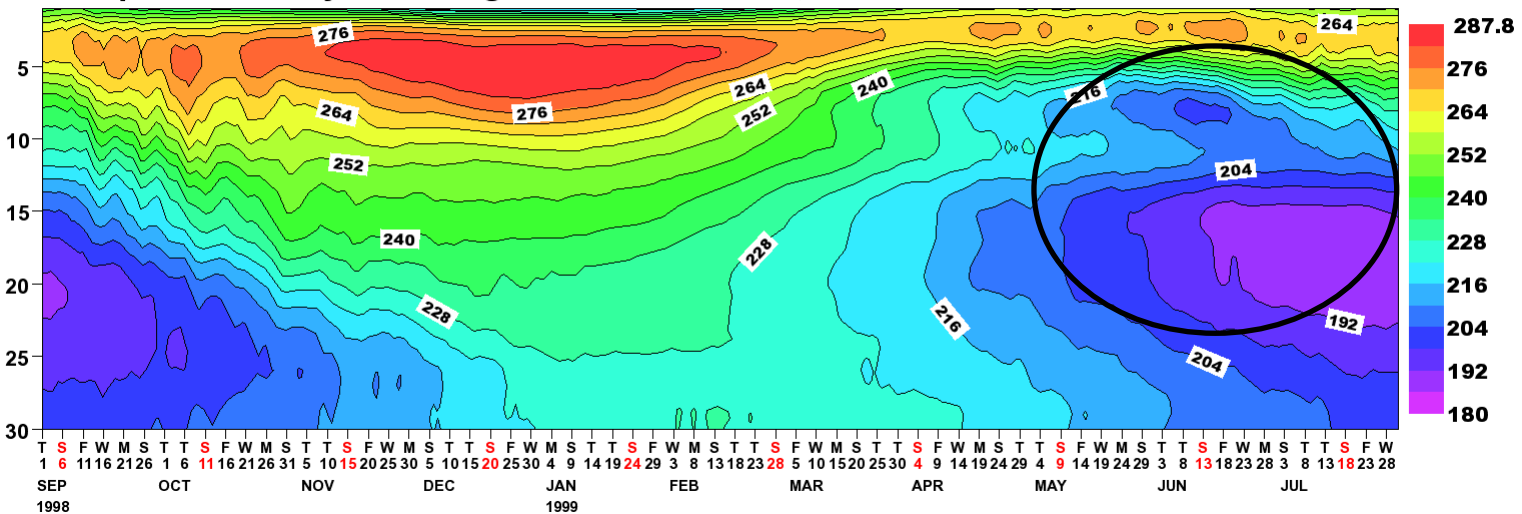
# Impact of the new RTTOV coefficients on stratospheric temperature analysis

Temperature analysis averaged from 60S to 90S, current RTTOV coefficients for AMSU-A



Old RT

Temperature analysis averaged from 60S to 90S, new RTTOV coefficients for AMSU-A



New RT

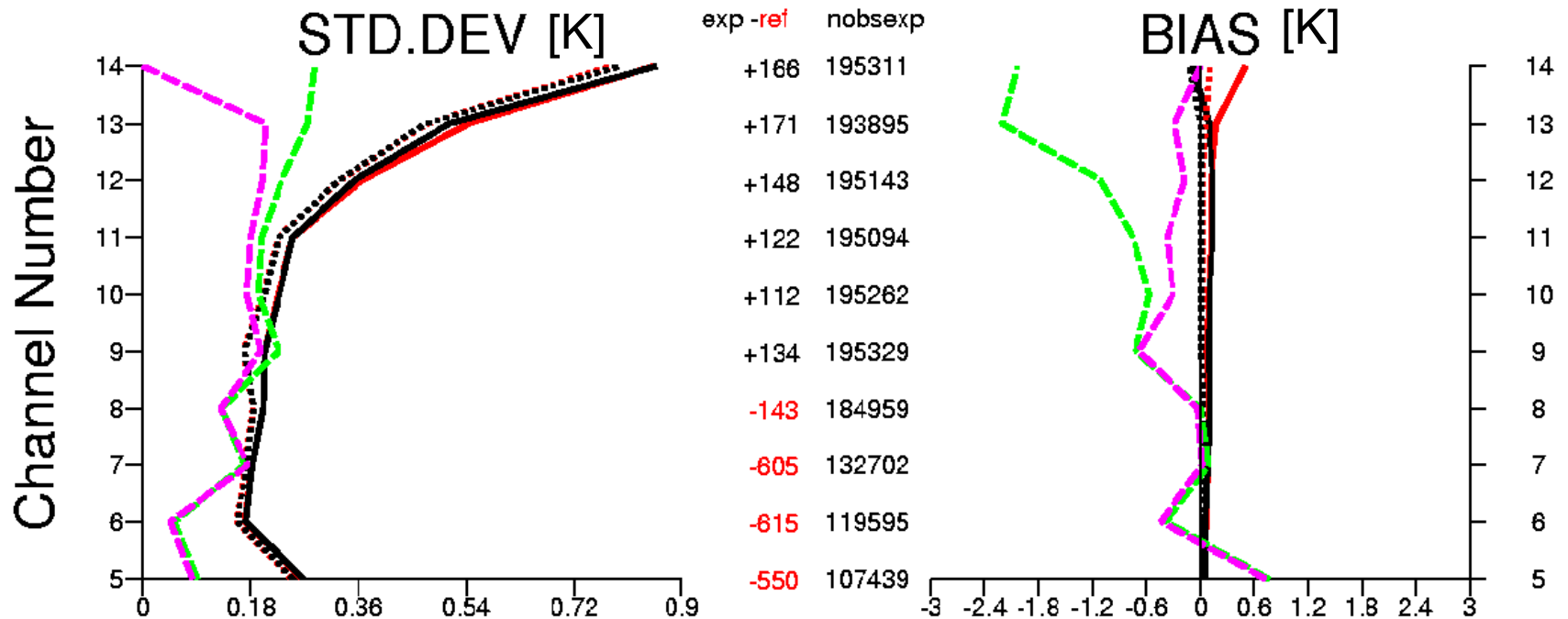
Reduced oscillations

# ATOVS developments

1. Update to AMSU-A RTTOV coefficients (no Zeeman effect)
2. **Zero bias in AMSU-A channel 14**
3. Revised bias correction for HIRS & AIRS short-wave channels

# Removal of Zeeman effect and zero bias for AMSU-A channel 14 in operations

Departure statistics for used NOAA-18 AMSU-A, NH, June 2007



Old bias correction (after ~1 year of variational bias correction)

New bias correction

Old FG (solid) or analysis (dotted) departures

New FG (solid) or analysis (dotted) departures

Operational since 6 November 2007.

# ATOVS developments

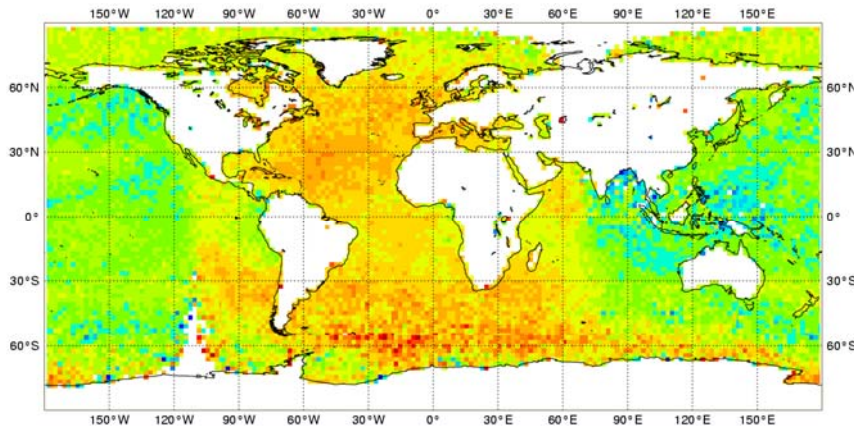
1. Update to AMSU-A RTTOV coefficients (no Zeeman effect)
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# HIRS/AIRS short-wave channels: Day/night biases

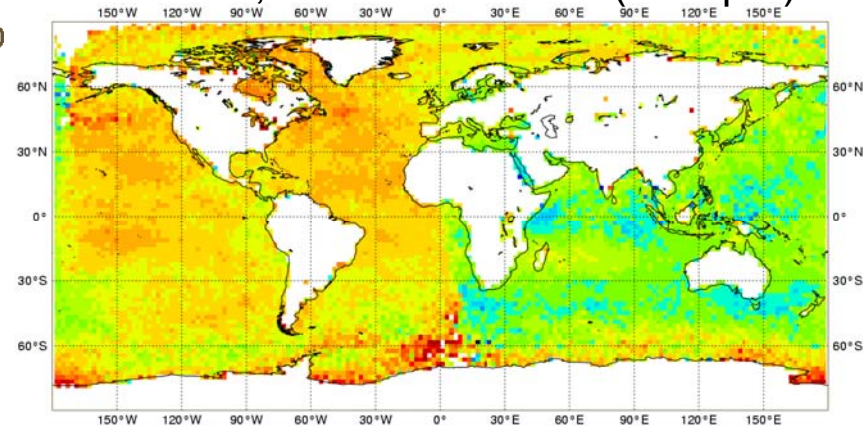
Obs-FG biases (K, after bias correction)  
for July 2007, 9-21 Z only

Day/night bias of about 0.3 K

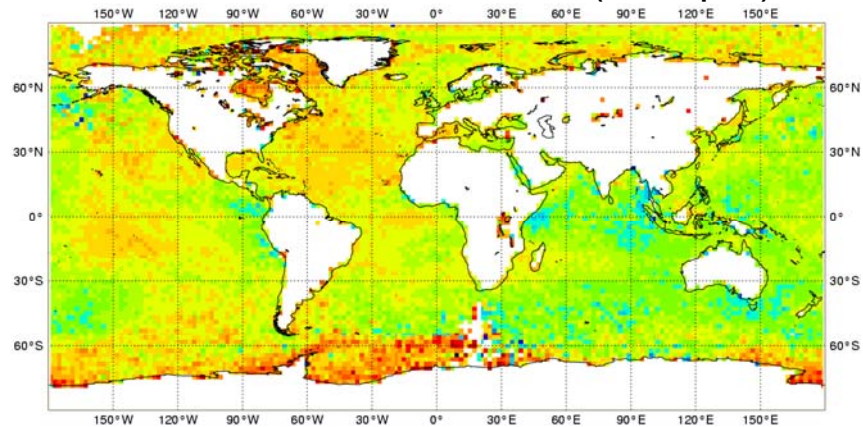
AIRS channel 1928 (4.464  $\mu\text{m}$ )



METOP-A, HIRS channel 15 (4.47  $\mu\text{m}$ )



NOAA-17, HIRS channel 15 (4.47  $\mu\text{m}$ )

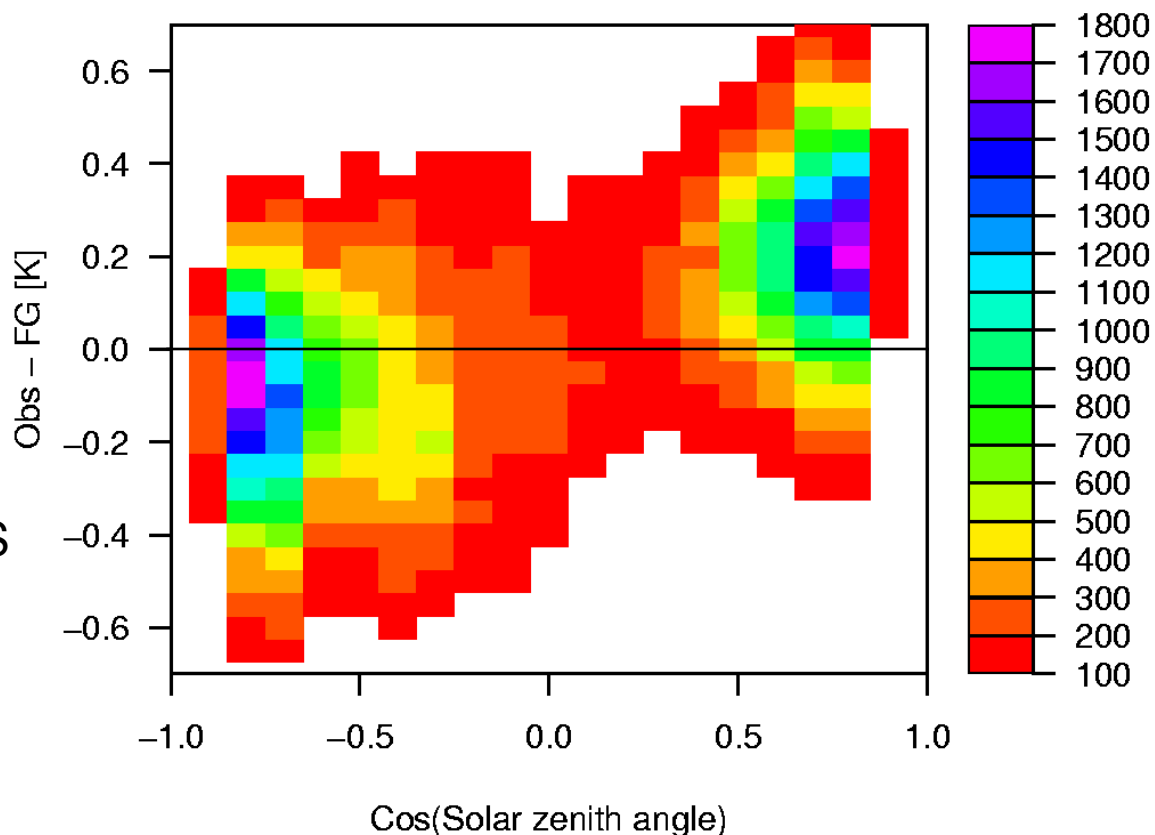




# HIRS/AIRS short-wave channels: Day/night biases

Histogram of FG departures for METOP-A HIRS channel 15 as function of  $\cos(\text{solar zenith angle})$ ;  
See also McMillin and Crosby (2000).

→ Updated bias correction for short wave channels for HIRS (ch 14 & 15) and AIRS (ch 1921-1928):  
Additional bias predictor, zero during night time, and  $\cos(\text{solar zenith angle})$  at day time.

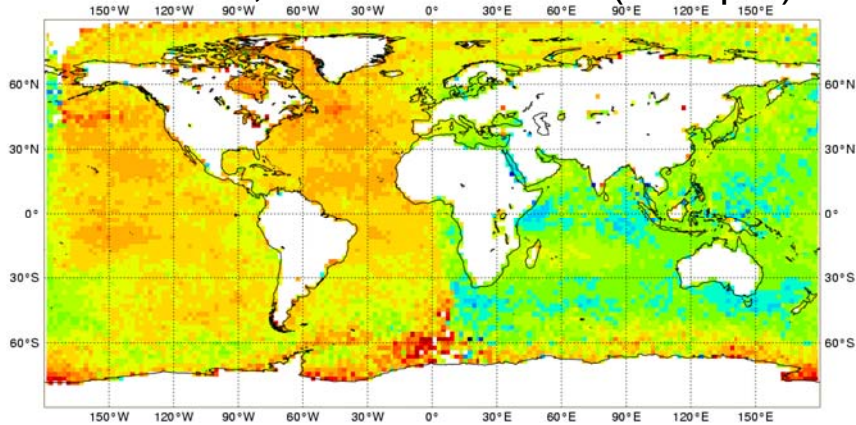


# HIRS/AIRS short-wave channels

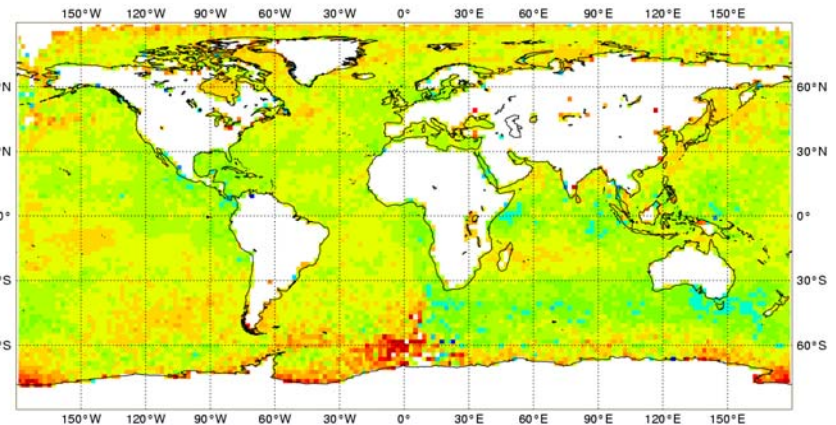
Obs-FG biases (K, after bias correction) for July 2007, 9-21 Z only

Old bias correction

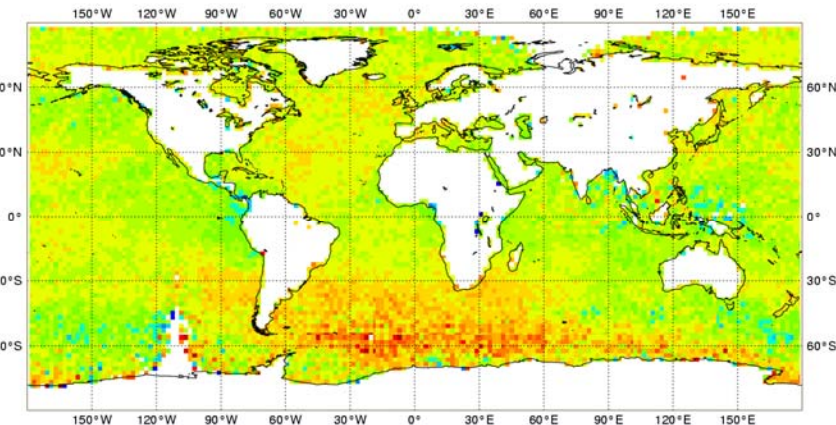
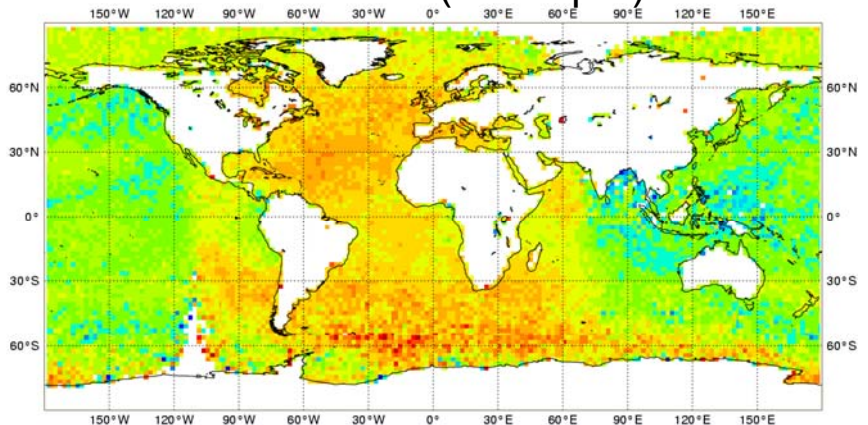
METOP-A, HIRS channel 15 (4.47  $\mu\text{m}$ )



Revised bias correction

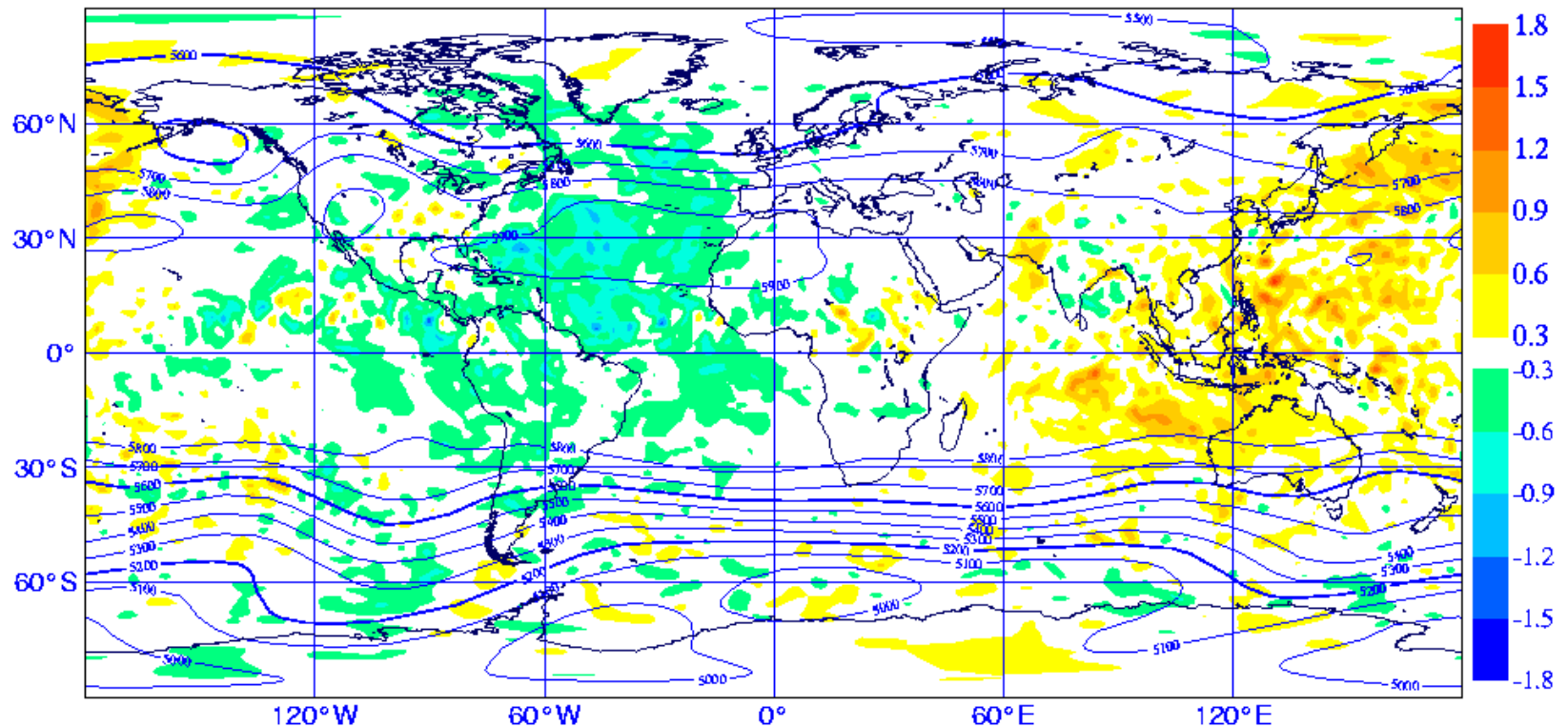


AIRS channel 1928 (4.464  $\mu\text{m}$ )



# HIRS/AIRS short-wave channels

Impact on mean analyses for 12 Z 500 hPa geopotential [gpm], July 2007:  
Revised bias predictors - old



# Summary

- Introduction of METOP ATOVS data gave a small positive forecast impact over the Southern Hemisphere.
- New AMSU-A RTTOV coefficients that exclude the Zeeman effect lead to better consistency with SSU data.
- AMSU-A channel 14 is now assimilated without bias correction to prevent variational bias correction to drift in the stratosphere.
- Revised bias correction for HIRS and AIRS short-wave channels reduces previous day/night biases.