The assimilation of IASI ozone-sensitive radiances over Antarctica

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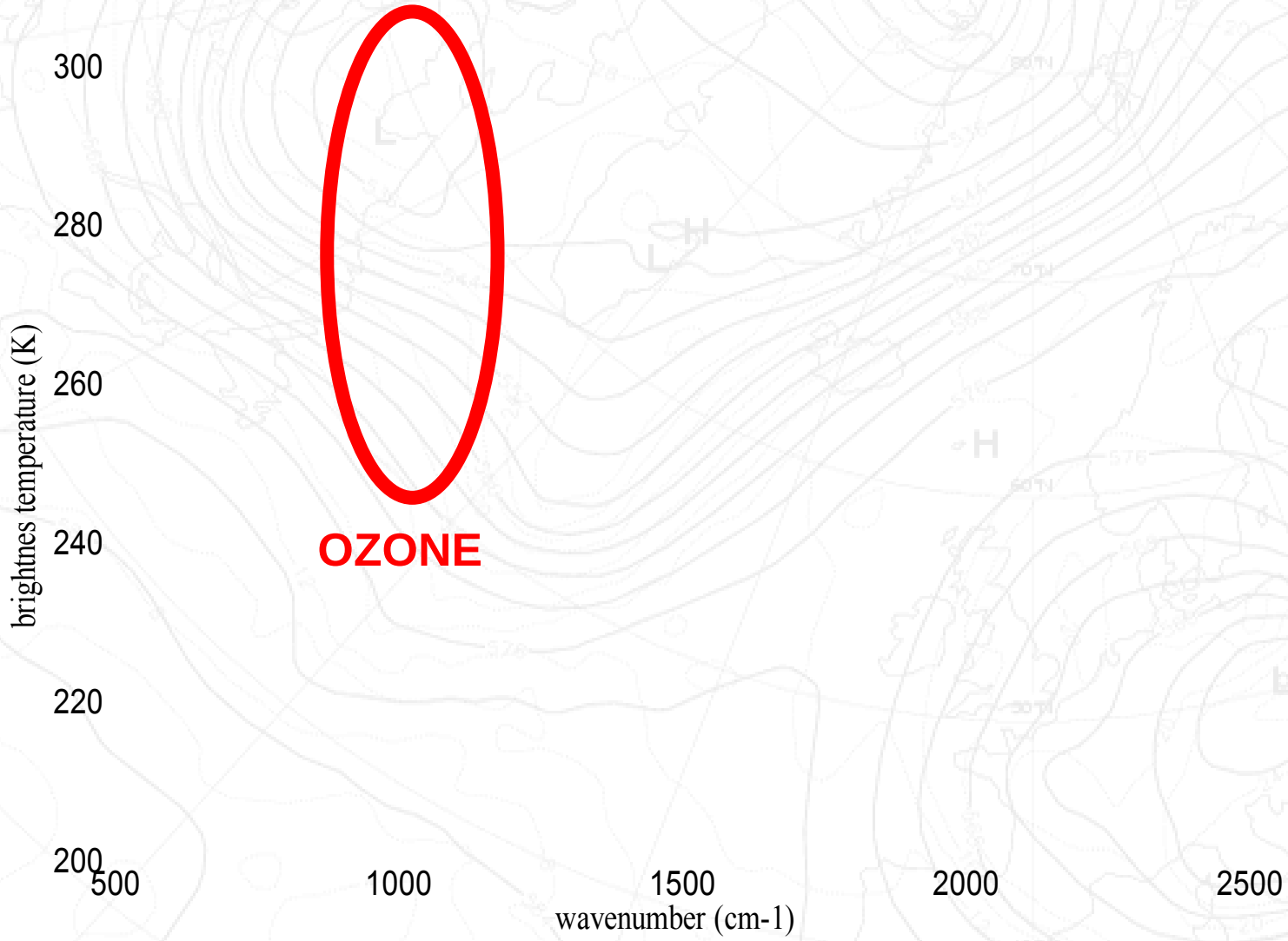
Why use infrared radiance observations ?

- With ozone estimates from UV backscatter (e.g. SBUV) we have half the globe unobserved each day and polar regions unobserved for the entire winter season
- Microwave ozone estimates (e.g. MLS) have no such sampling problems, but there is no future operational provision of these data and no historical heritage for climate and re-analysis studies
- Infrared instruments measuring ozone sensitive radiances have no such sampling problems and will be carried by a number of future operational LEO and GEO platforms. There is also a long historical record of these data.

Why use IASI radiances in particular ?

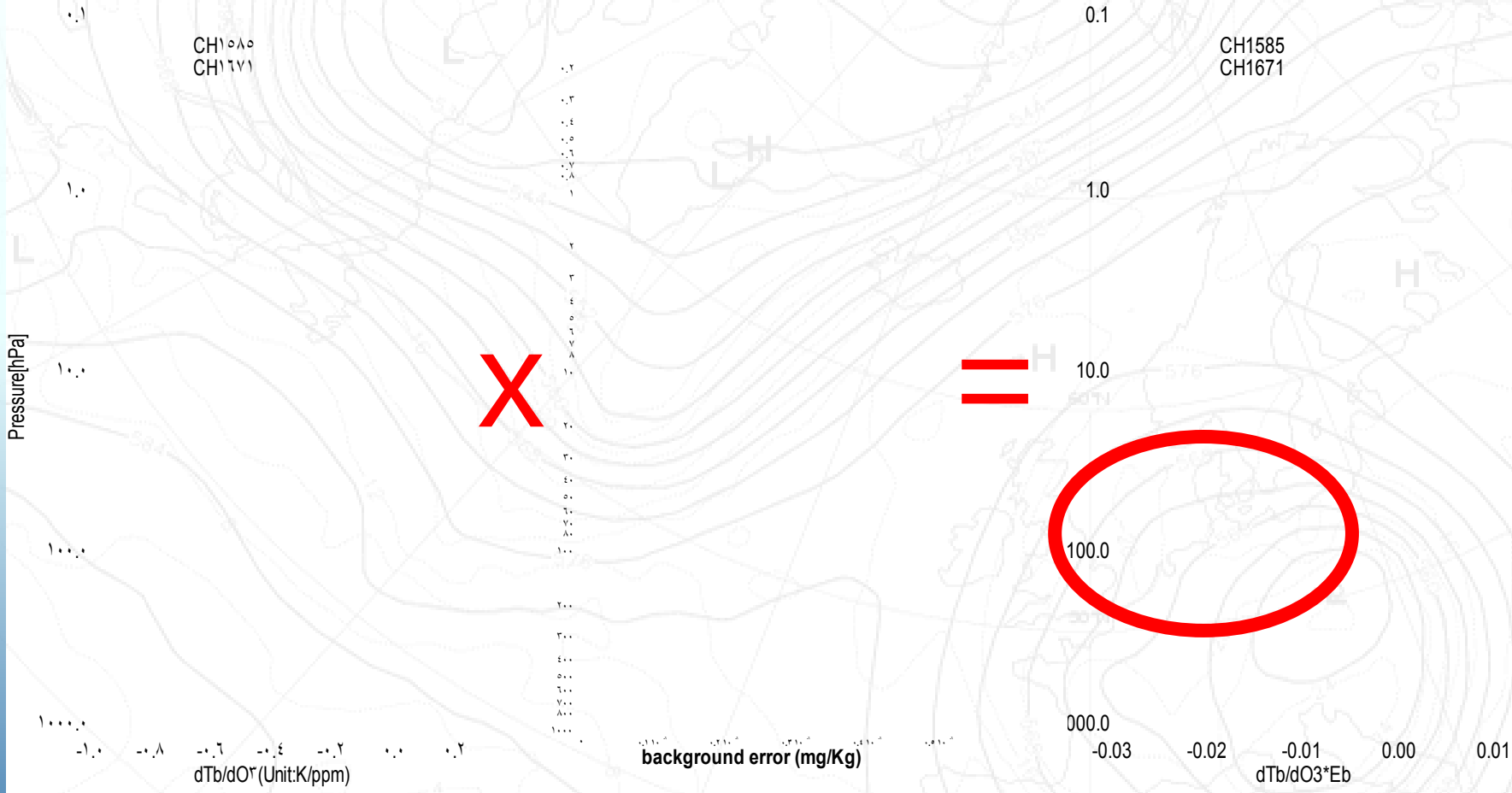
- With very high spectral resolution the radiative transfer modelling of IASI ozone channels is very accurate
- The availability of many ozone “insensitive” temperature sounding channels allows an accurate detection and handling of clouds
- Many hundreds of ozone sensitive could allow a significant reduction of random error (however, the vertical resolution is still very limited)

Ozone information from IASI



Ozone information from IASI radiances

Jacobian (dR/dO3) **Background error** **Analysis impact**



Thus we expect the impact of IASI to be in the mid-lower stratosphere and NOT near the level of maximum ozone

Key modifications for ozone channels

Bias correction:

Usually mean radiance departures are used to estimate and remove biases – assuming the NWP model background is unbiased. However, for ozone this is a weak assumption so the system is **anchored with a fixed zero bias correction** for one IASI channel with VarBC only removing residual inter-channel biases.

Cloud detection:

Usually radiance departure signatures from the background are used to identify cloud contamination. However, for ozone channels the cloud signal may be confused by ozone errors so **ozone-insensitive temperature sounding channels are used to detect clouds**

IASI Ozone Experiments

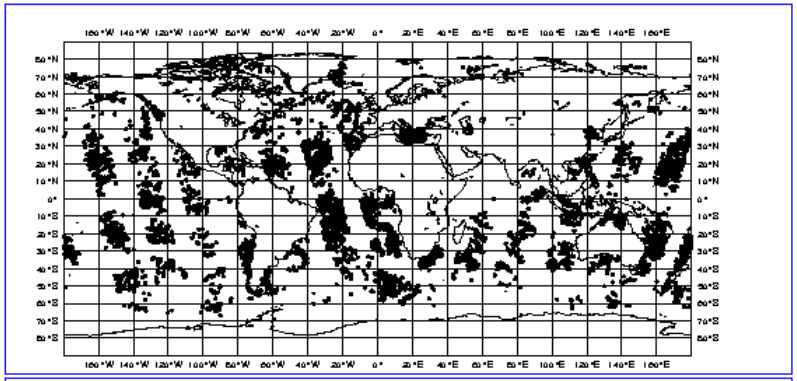
Baseline System:
T511 (40Km) full operational data (no O3 observations)

UV System:
As baseline plus UV data from SBUV and OMI

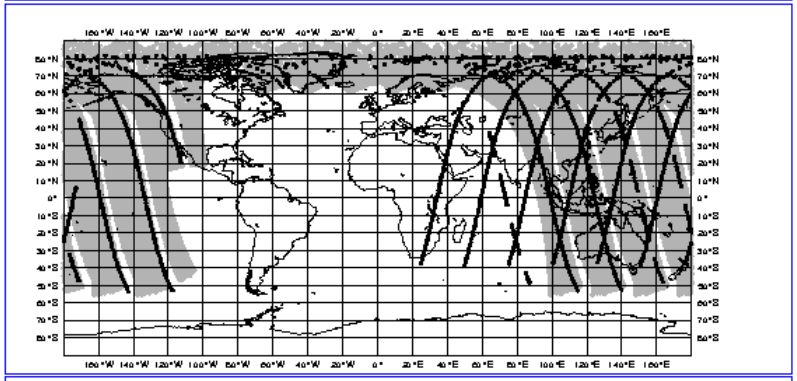
IASI System:
As baseline plus 16 IASI ozone channels
(LW cloud detection and channel 1585 anchored
to zero bias correction, other channels VarBC)

Typical data coverage

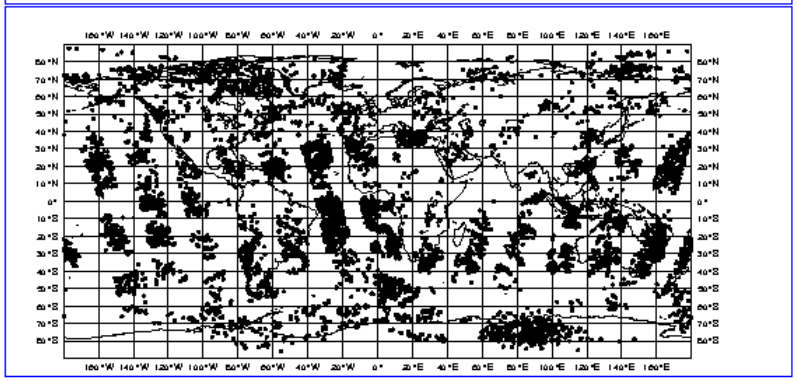
Normal IASI usage over sea in clear sky



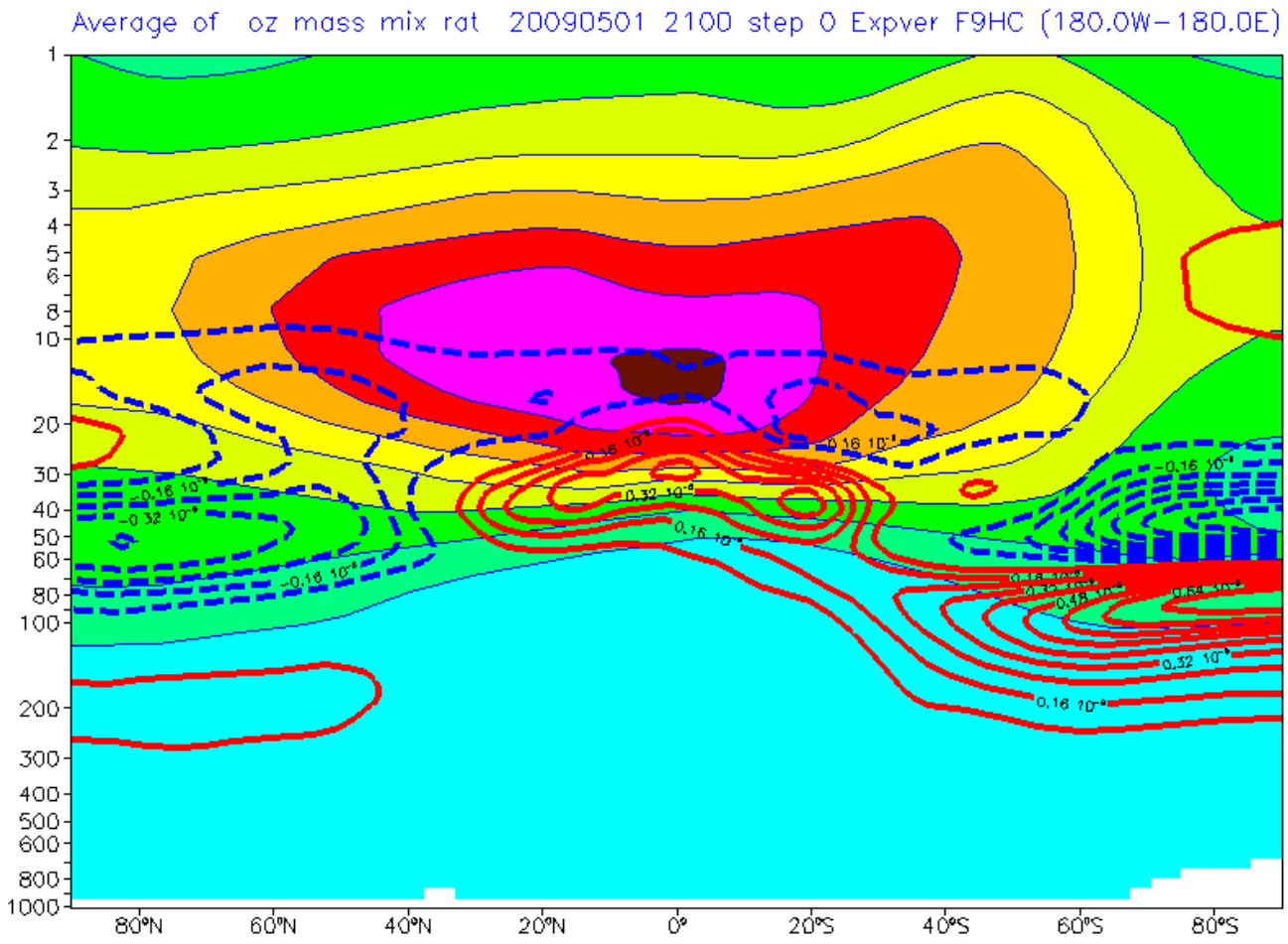
Usage of SBUV and OMI



Experimental IASI usage over sea / ice and land in clear sky



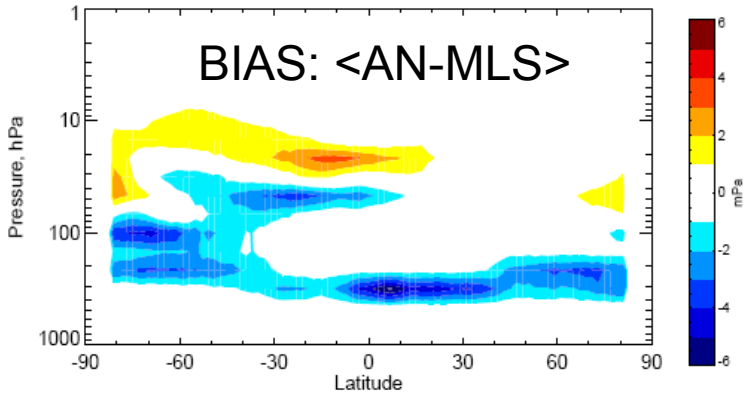
Analysis impact of IASI Ozone radiances

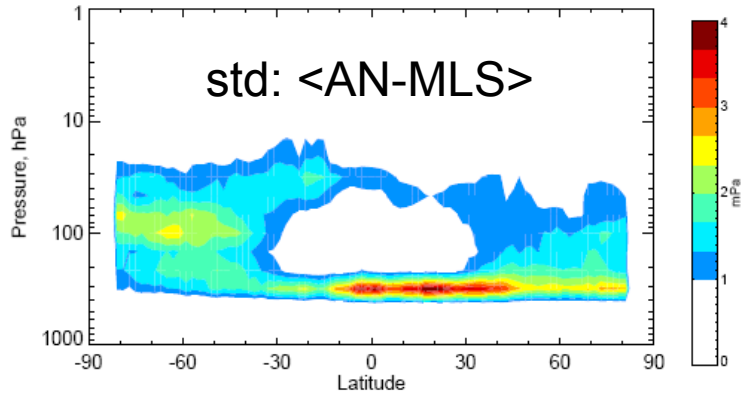


Verify against MLS (20090615-20090630)

BASELINE

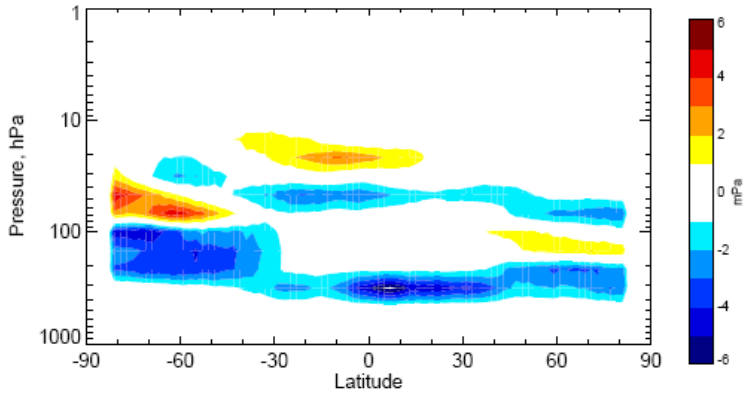
No O3 OBS

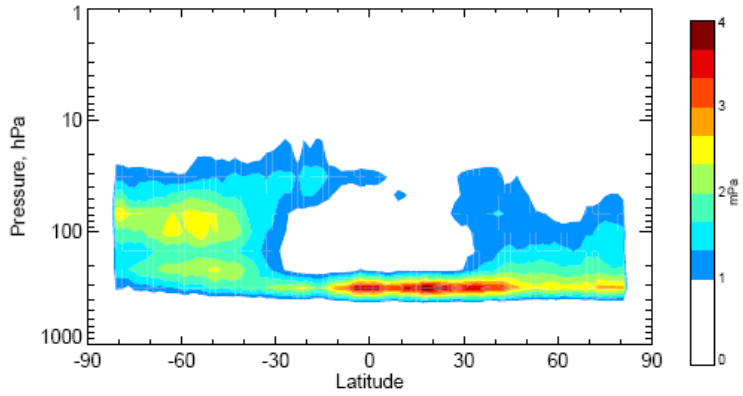




BASELINE

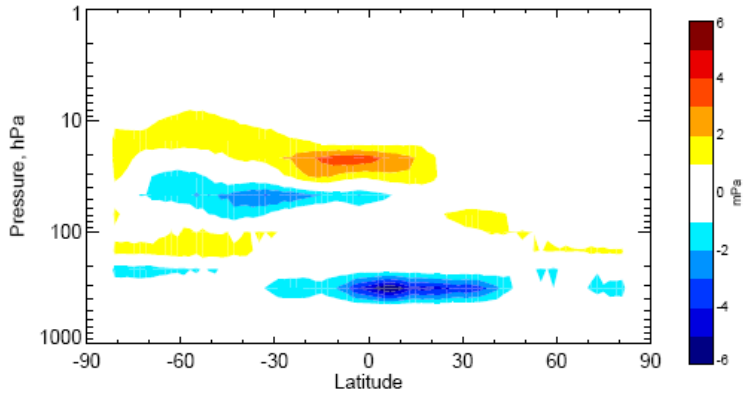
+SBUV+OMI

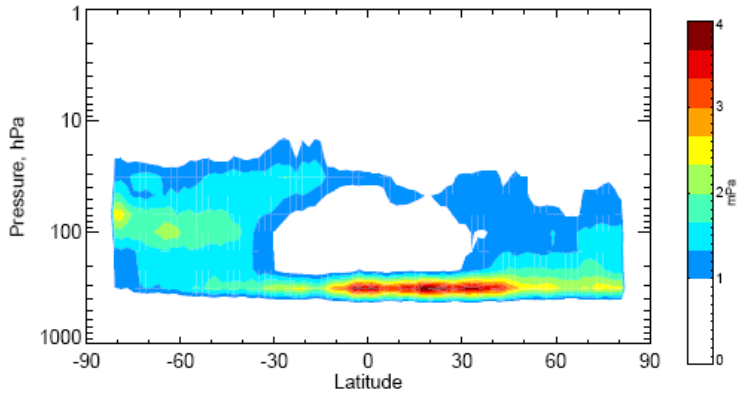




BASELINE

+IASI 16 O3 Channels



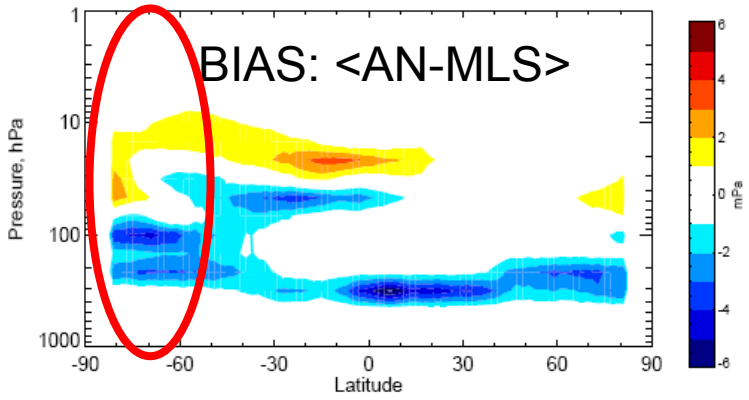


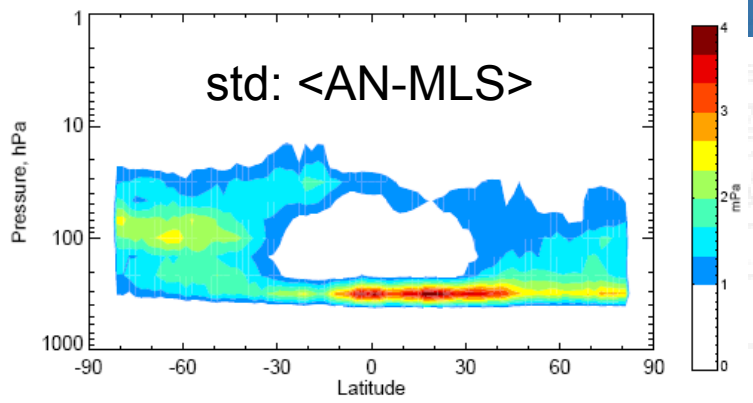
Polar night over Antarctica

Verify against MLS (20090615-20090630)

BASELINE

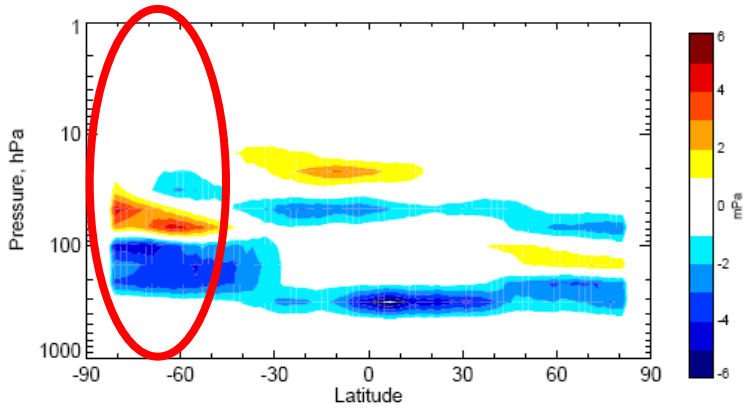
No O3 OBS

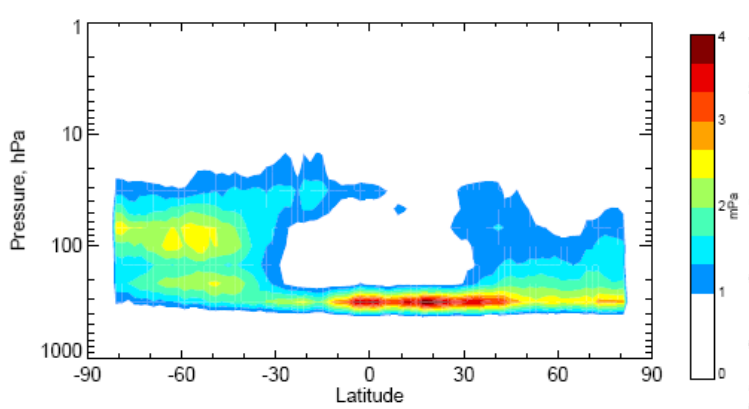




BASELINE

+SBUV+OMI





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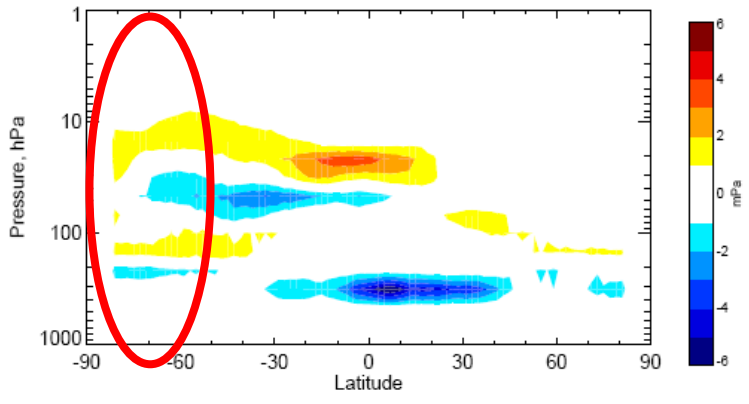
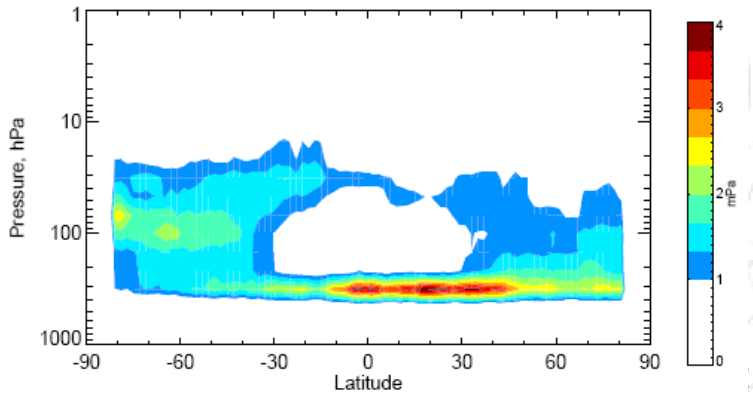
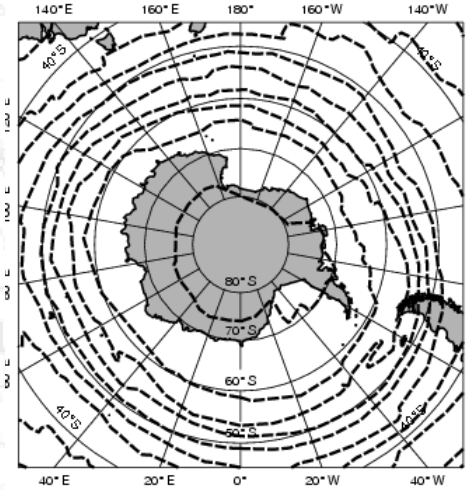


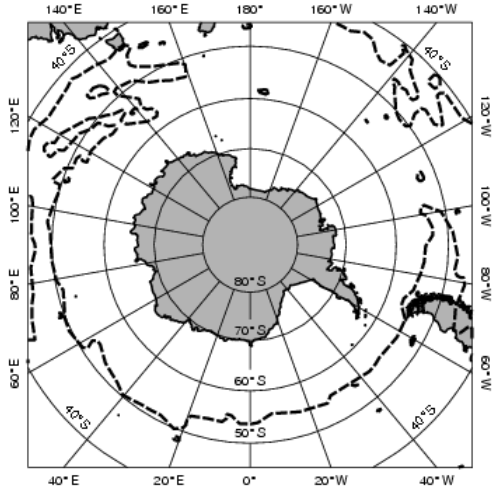


Polar night over Antarctica

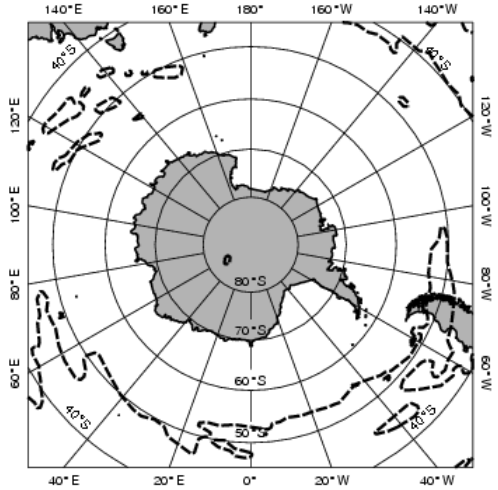
UV minus BASE



IASI minus BASE

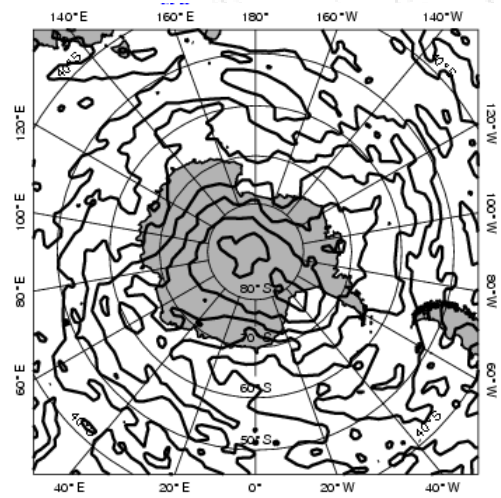


IASI* minus BASE

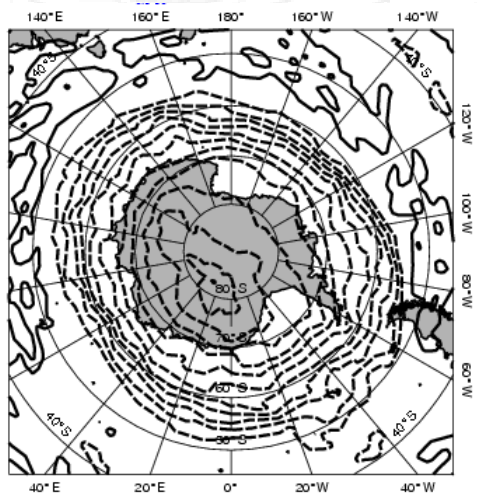


15hPa

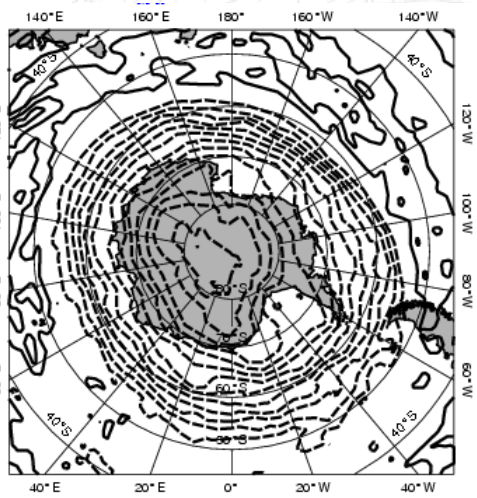
UV minus BASE



IASI minus BASE



IASI* minus BASE



50hPa

Next steps for ECMWF ozone analysis

- Blend IASI data (anchor) with UV data (vertical)
- Extend usage to AIRS radiances
- Extend usage to low-spectral-resolution instruments such as HIRS and SEVIRI
- Investigate potential for ozone feature tracing in 4D-Var to constrain the stratospheric wind analysis
- Re-couple the ozone forecast radiation