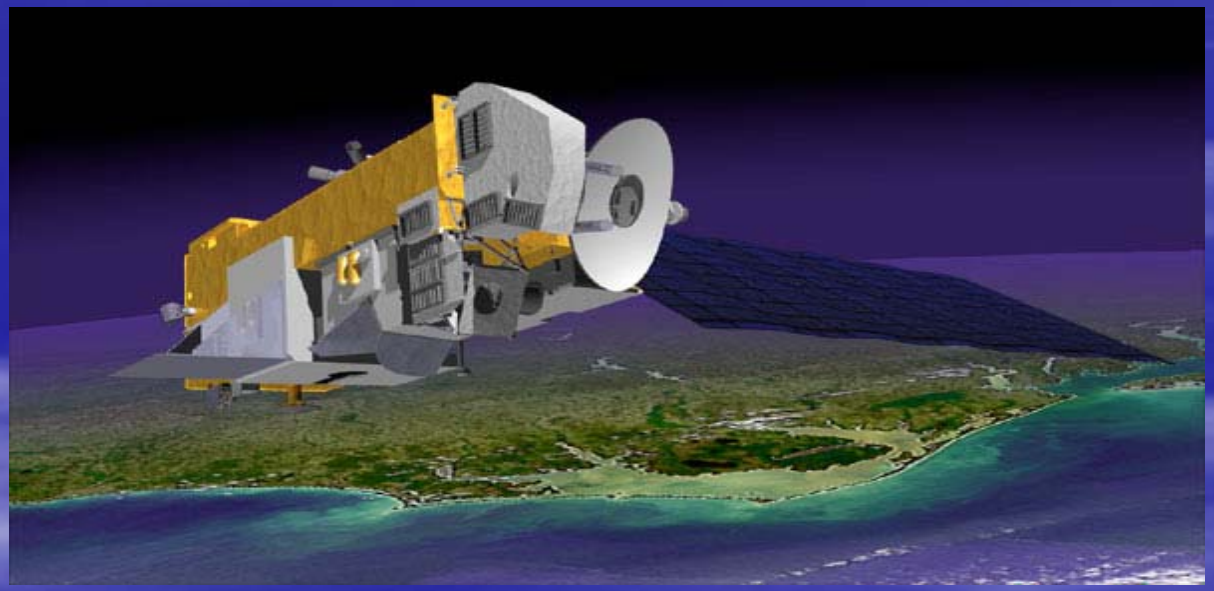
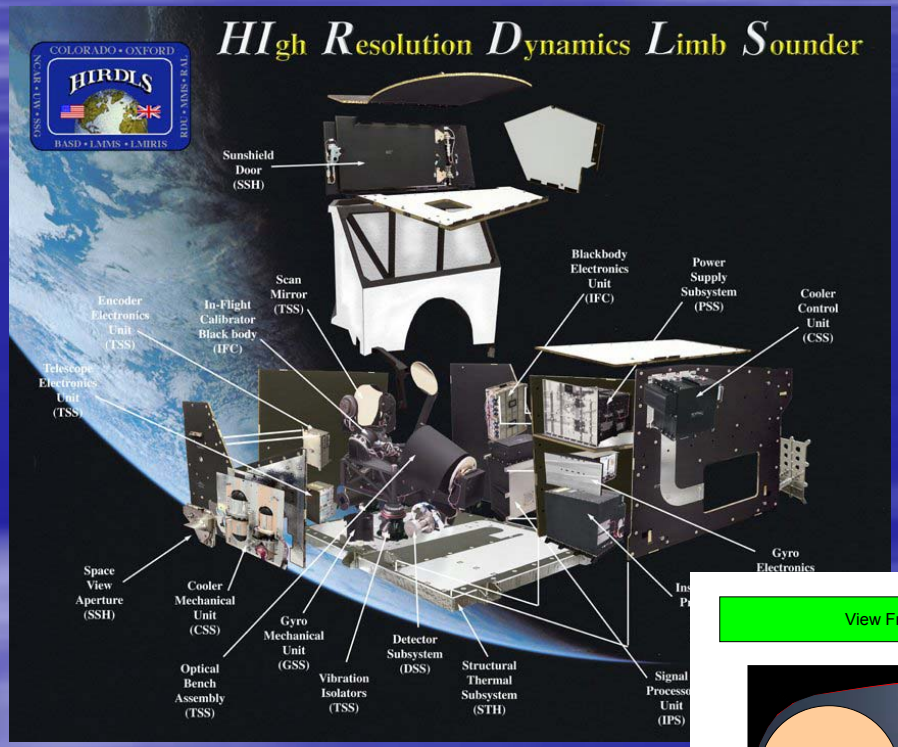
Comparison between the HIRDLS and MIPAS Instruments



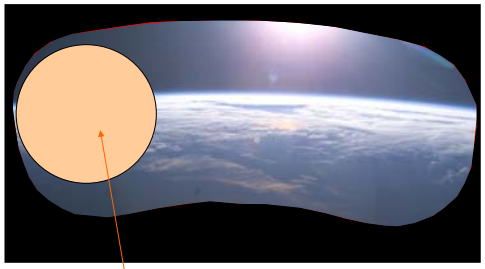
Claire Waymark
University of Oxford
Supervisors: Anu Dudhia, John Barnett and Fred Taylor

The High-Resolution Dynamic Limb Sounder (HIRDLS)

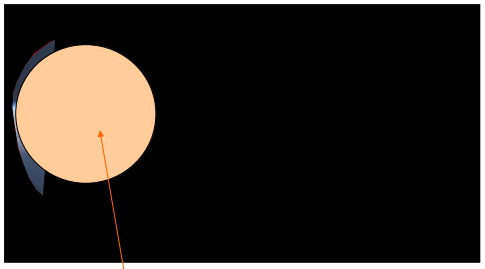


- Launched on AURA in July 2004
- Limb geometry
- Measures in the infrared
- Radiometer - fixed spectral channels
- Each channel targets a specific species
- Obstruction cover all but ~20% on one viewing angle.
- Routine products are pressure temperature, O3, H2O, HNO3, CH4, N2O, NO2, N2O5, ClONO2, F11 and F12

View From Inside HIRDLS Looking Out

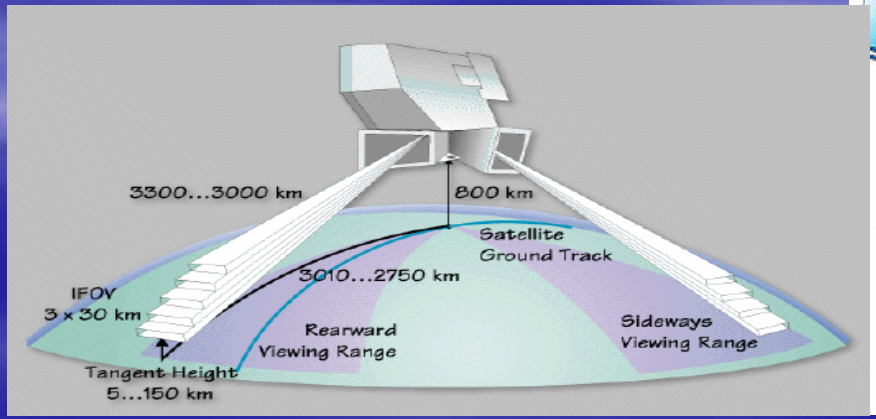


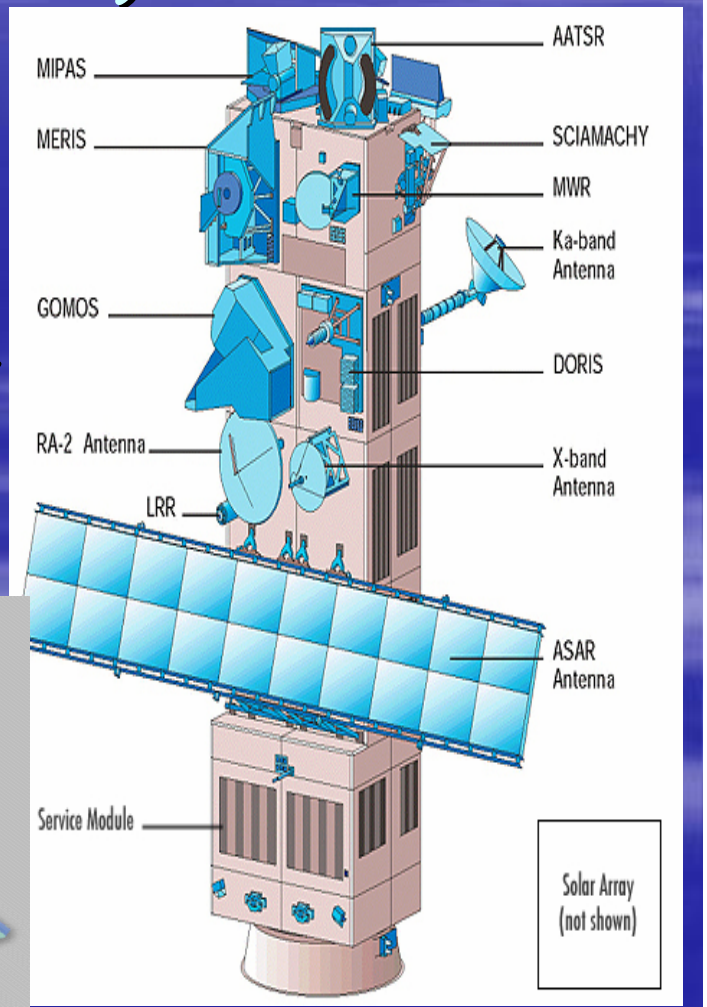
Projected Blockage Perspective From Inside Looking Out



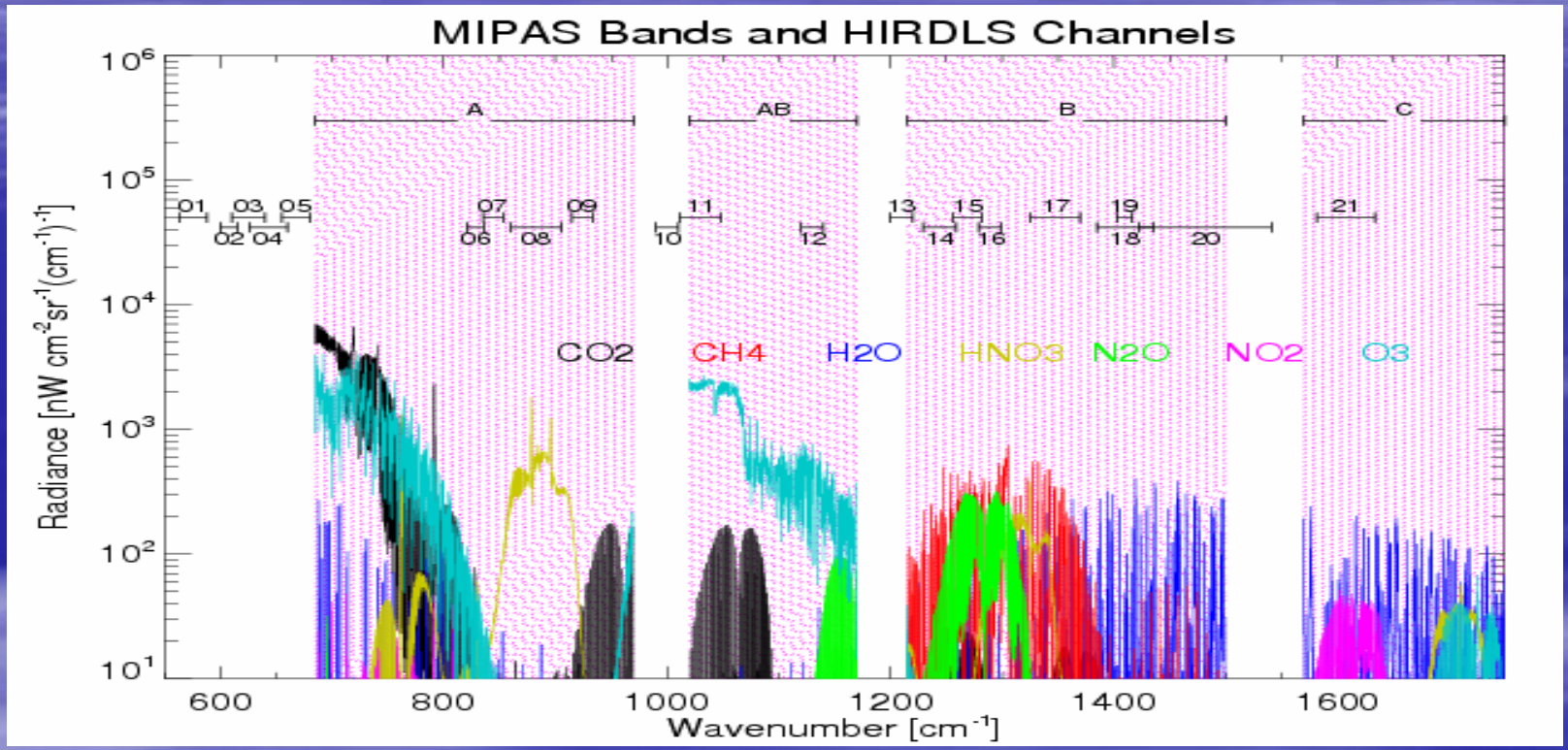
The Michelson Interferometer for Passive Atmospheric Sounding (MIPAS)

- Launched on ENVISAT in March 2002
- Fourier Transform spectrometer
- Measures in the infrared
- Uses limb geometry
- Scans sequentially through atmosphere
- Routine products are pressure temperature, O3, H2O, HNO3, CH4, N2O and NO2





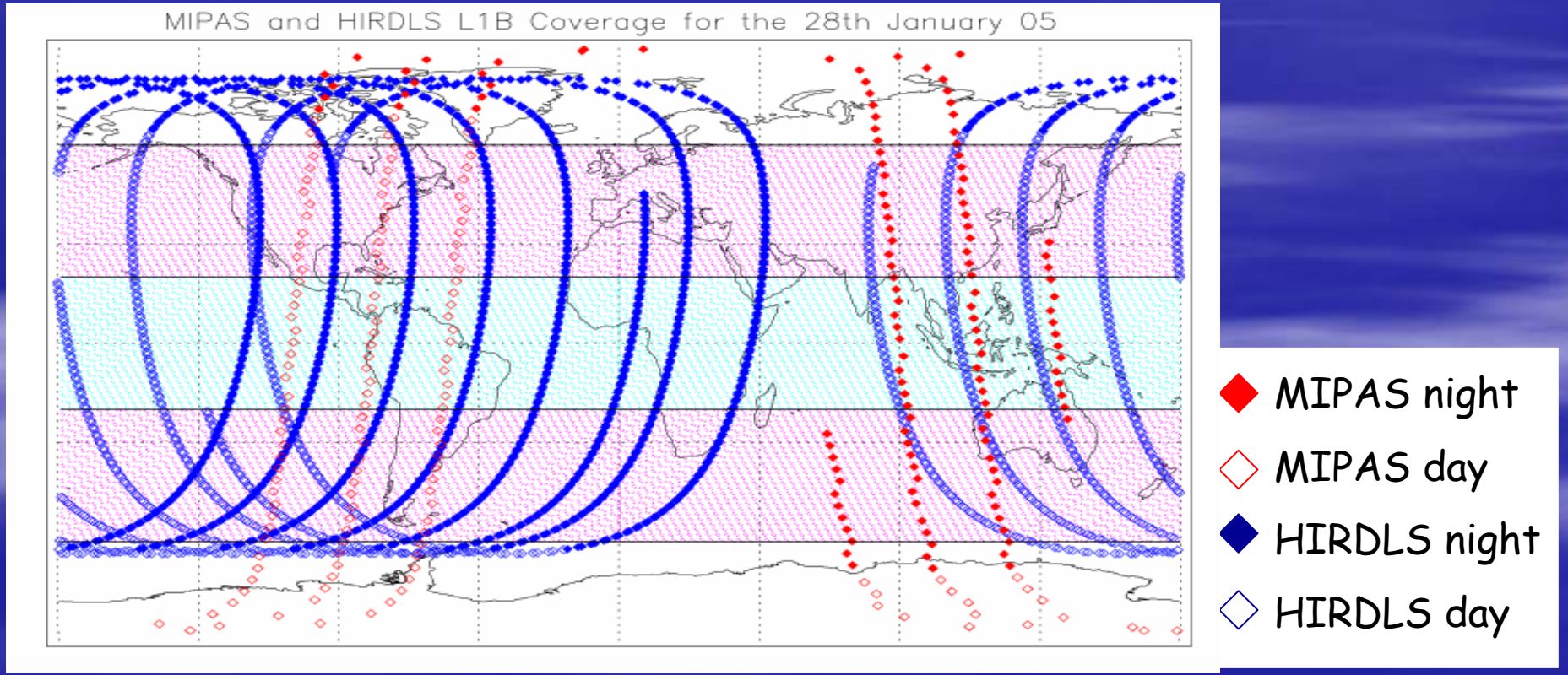
HIRDLS and MIPAS Coincidences



- 10 HIRDLS channels completely overlap the MIPAS spectrum.
- No temperature channel overlap.

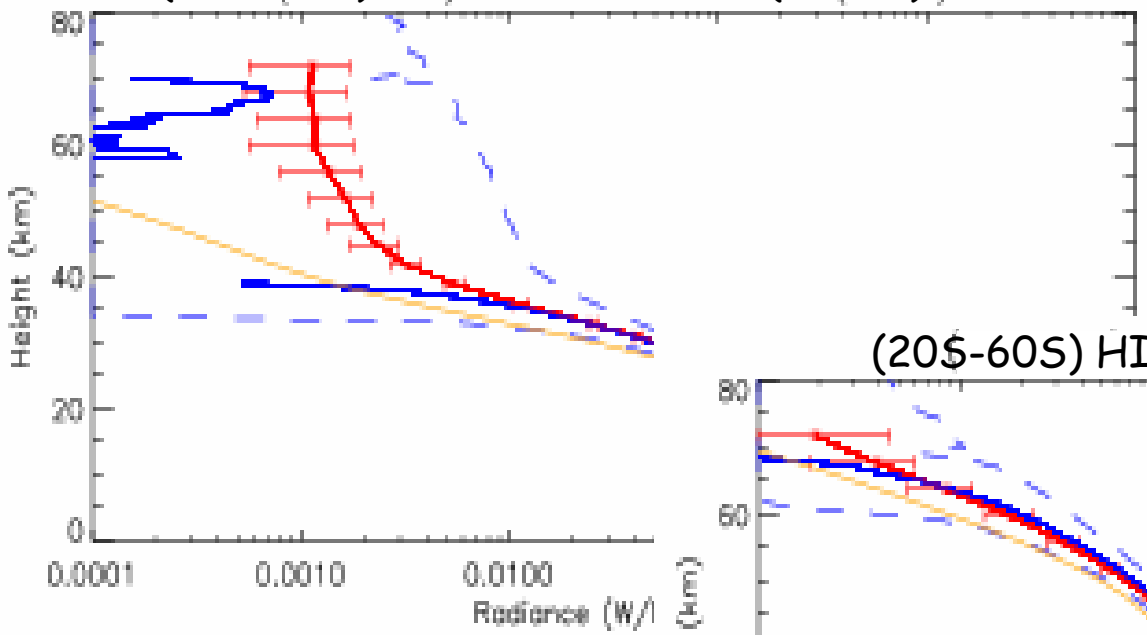
HIRDLS and MIPAS coverage

- MIPAS data only available for the 28th January 05 and 1st March 05.
- 3 orbits available for both days.



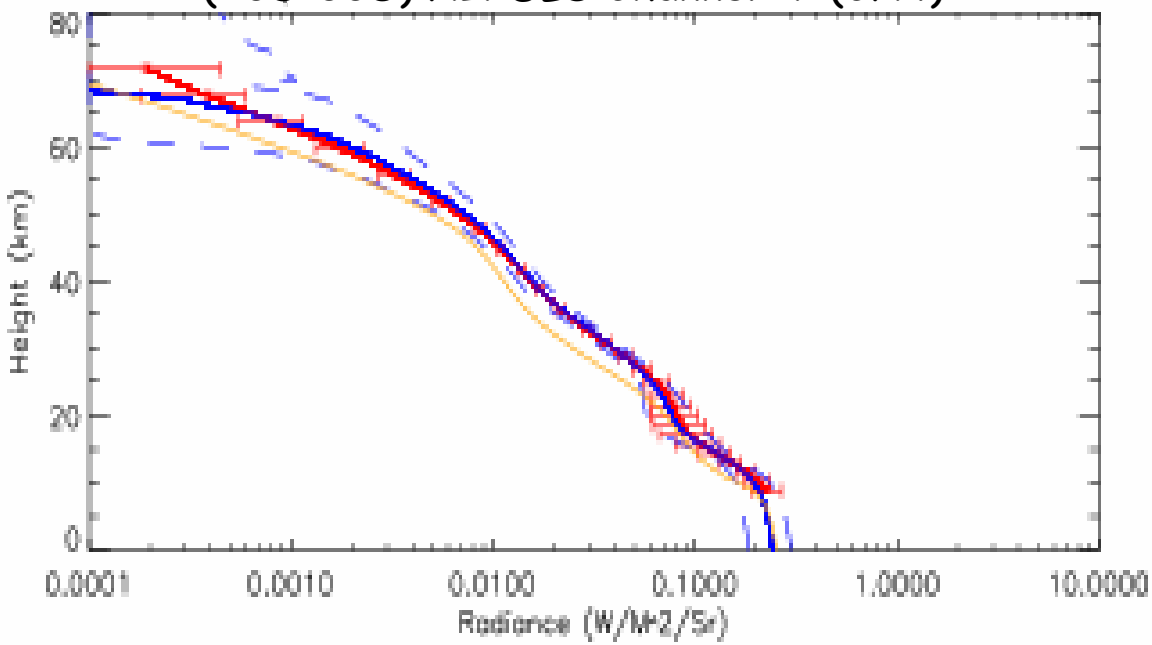
Radiance comparison

(20S-60S) HIRDLS Channel 8 (HNO3)



$$R_m = \frac{\int R(\nu)\psi(\nu)d\nu}{\int F(\nu)\psi(\nu)d\nu} * FFBW$$

(20S-60S) HIRDLS Channel 17 (CH4)



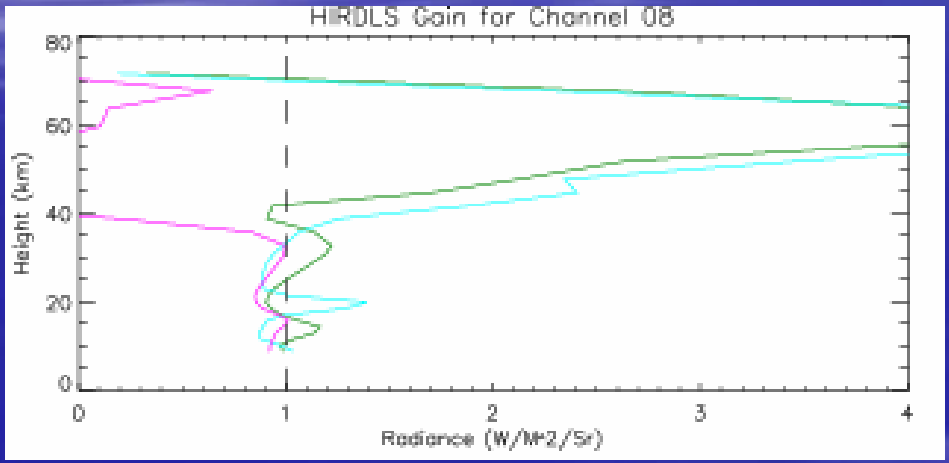
HIRDLS profile.

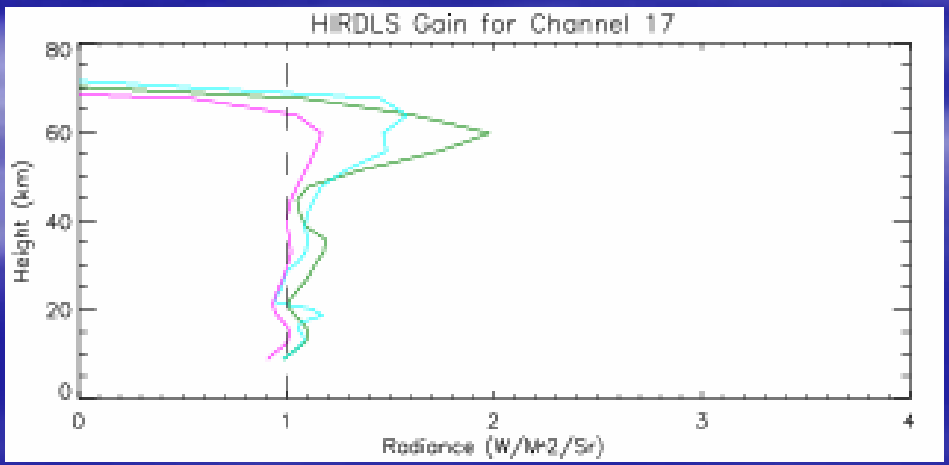
MIPAS profile

Climatology profile

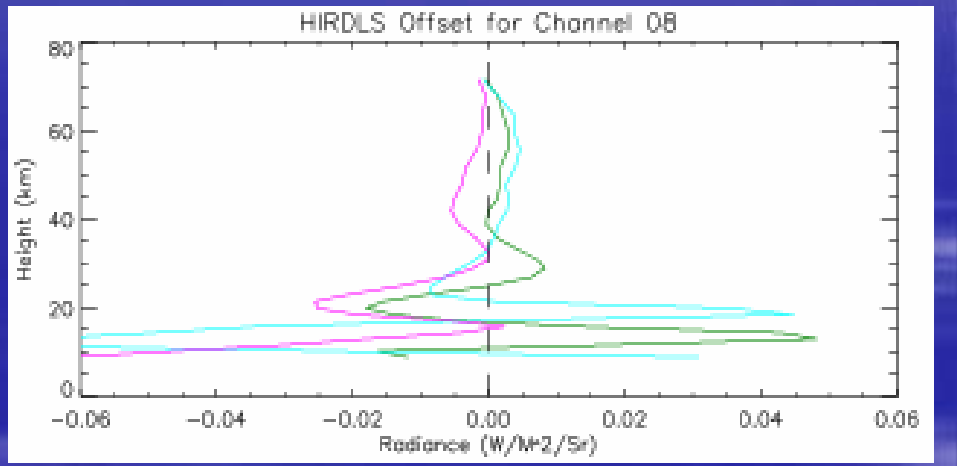
Radiance Gain and Offset

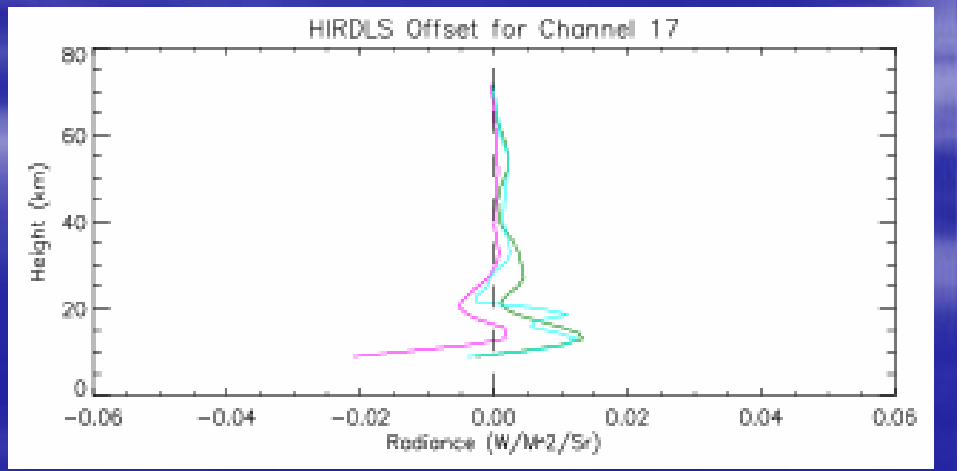
Gain = HIRDLS/MIPAS





Offset = HIRDLS-MIPAS





Radiance comparison

Date	Latitude Band	HIRDLS Channel									
		6	7	8	9	12	15	16	17	18	19
28th Jan 05	20N-60N	1.59282	1.70514	1.81616	1.76439	0.95046	1.0926	1.5312	0.88526	1.8474	1.59129
	20S-20N	1.96589	2.5643	3.04572	2.03588	1.99016	2.14251	2.61763	1.77827	3.9633	2.1211
	20S-60S	1.36909	1.70217	3.52541	1.83423	1.81043	1.16536	1.50559	0.61016	1.54114	1.93555
	Average	1.6426	1.99054	2.79576	1.87817	1.58368	1.46683	1.88481	1.09123	2.45061	1.88264
1st March 05	20N-60N	0.90807	1.25869	1.73506	1.10839	1.36252	1.61414	3.07562	3.25116	4.96052	2.44531
	20S-20N	2.62568	7.20888	4.12277	3.31034	3.61299	5.3786	3.5353	3.05216	6.23704	2.77176
	20S-60S	3.90019	9.36813	4.059	1.85806	1.9762	6.11692	10.9097	8.14139	11.0713	8.21442
	Average	2.47798	5.94523	3.30561	2.09227	2.31723	4.36989	5.84022	4.8149	7.42295	4.47716

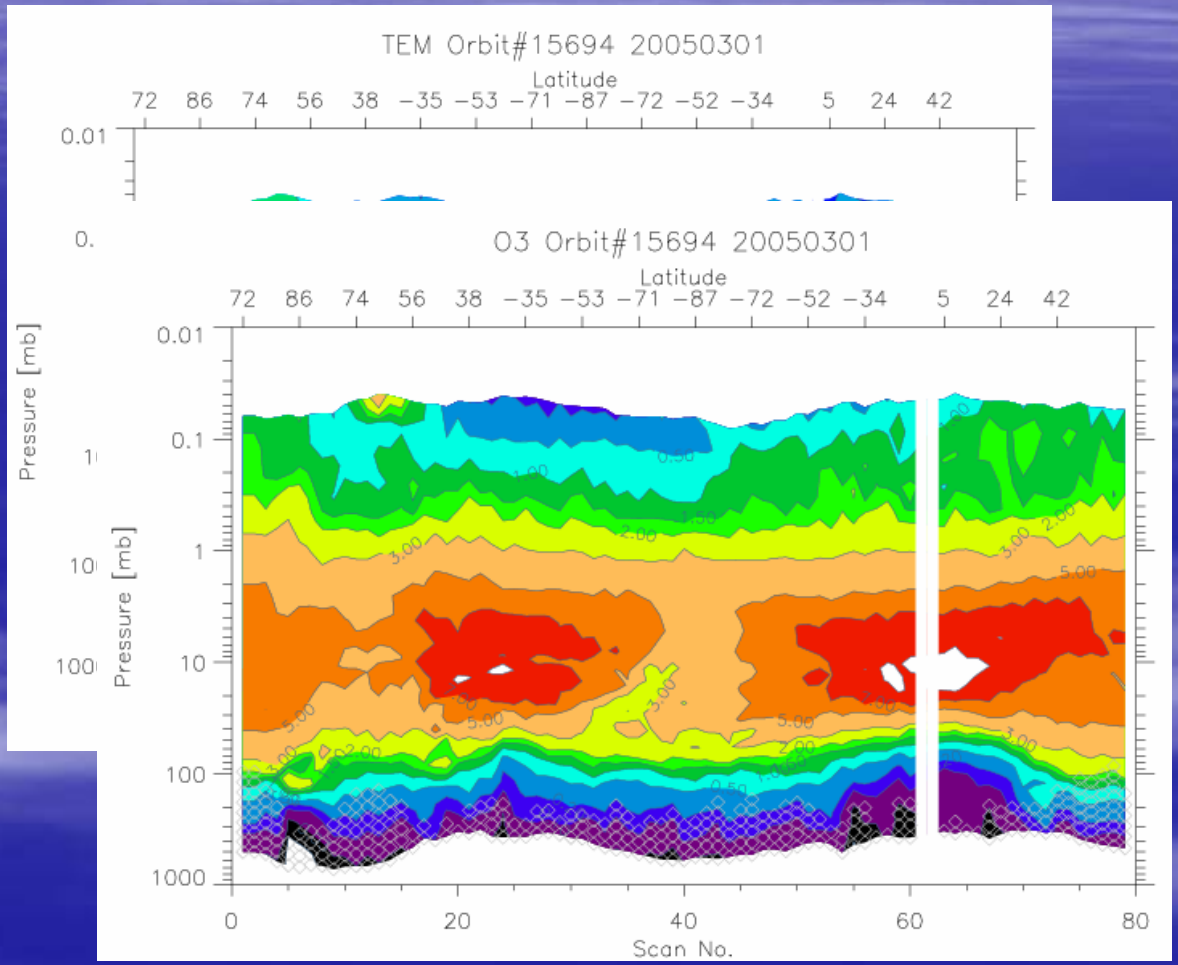
$$RMS = \sqrt{\frac{1}{N}\sum \frac{(HIRDLS - MIPAS)^2}{(Mipas\_Sd)^2}}$$

Averaged over vertically and over all profiles

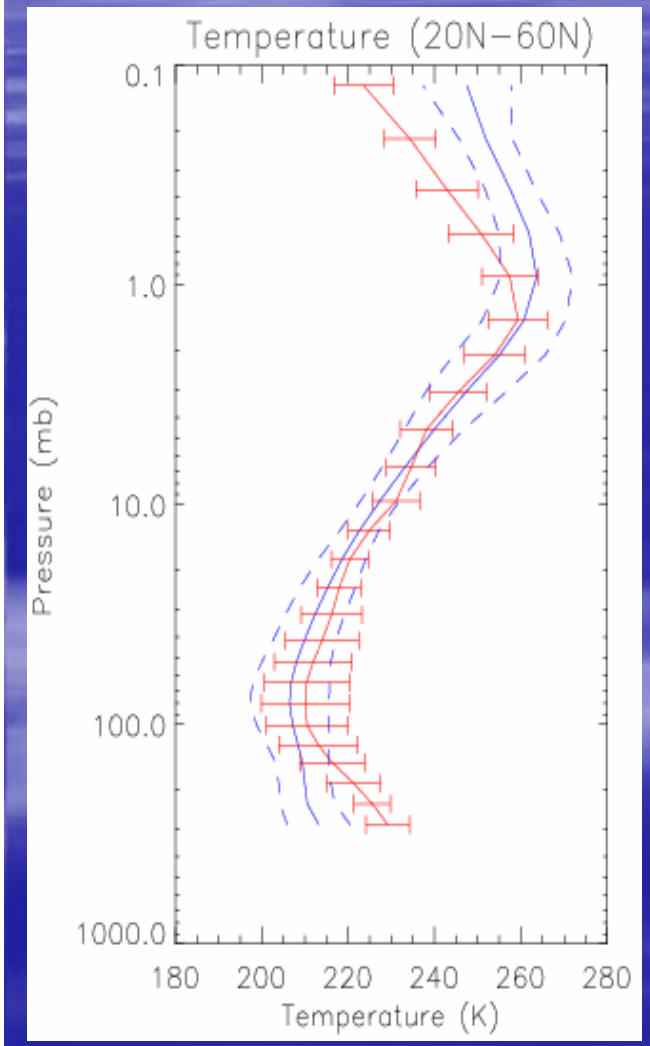
- Results mostly consistent over the latitude bands
- Better radiance agreement for the 28th January then the 1st March

MIPAS Retrievals

- MORSE was used for the retrievals
- MORSE stands for MIPAS Orbital Retrieval using Sequential Estimation
- The Micro windows used are those that will be used for the ESA retrievals
- Standard produces retrieved are PT, O3, H2O, HNO3, CH4, N2O and NO2
- N2O5,ClONO2,F11 and F12 where added to the retrievals for comparison with HIRDLS measurements.



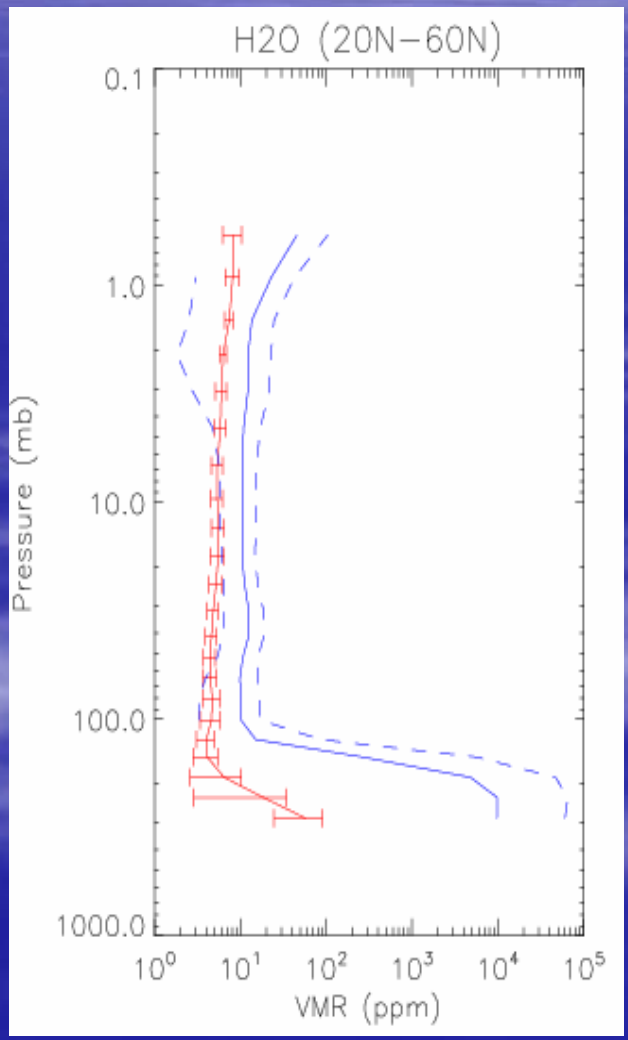
Retrieved Profile Comparison



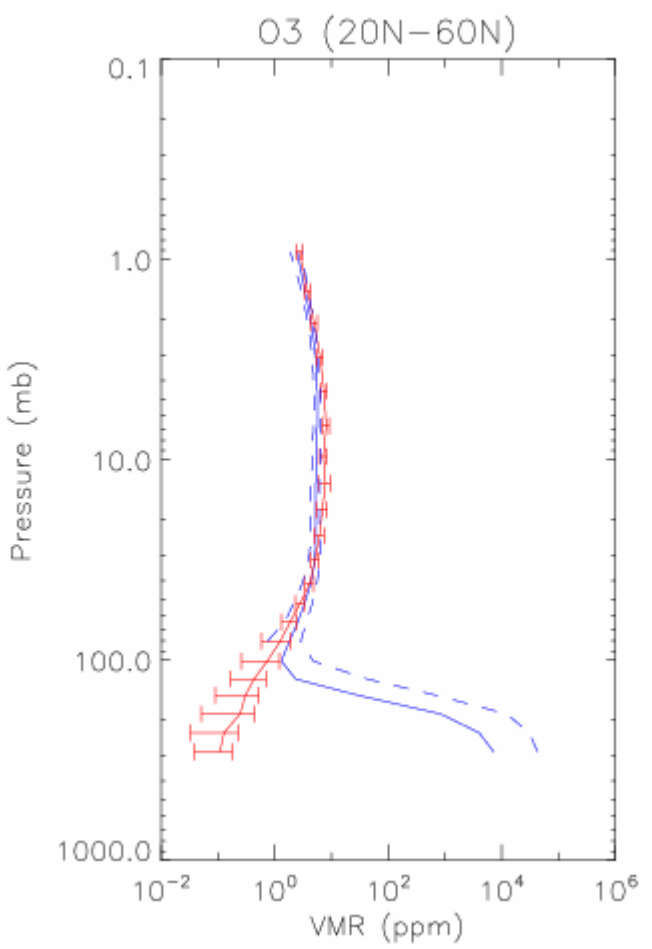
- HIRDLS retrievals from the HIRDLS team (UCB)
- MIPAS retrievals produced using (MORSE).
- Temperature:- good agreement
- H2O:- HIRDLS ~2 times higher than MIPAS

Average HIRDLS profile.

Average MIPAS profile



Retrieved Profile Comparison: Summary



- Temperature:- good agreement
- H2O:- HIRDLS ~2 times higher than MIPAS
- O3:- good agreement above 100mb
- CH4:- too high
- N2O:- good agreement above 100mb
- N2O5:- good agreement above ~40 mb
- ClONO2:- slightly higher than MIPAS above 100mb

Future Work

- Run similar comparison for other species which are measured by both instruments.
- Use the Oxford Reference Forward model (RFM) to simulate radiance using the MIPAS retrievals.

Thank you for your attention