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MIPAS_SM

‘Additional Species’

Investigations into Expanding the List of Trace Gas Retrievals.

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Introduction

- Briefly summarise work at Oxford on attempts to increase the number of MIPAS-retrievable species.
  - Some gasses we have looked at
  - 2081 – geolocation (again)
  - Oxford method
  - Results – Retrieved profiles compared with *Apriori*
  - Summary of Feasibility
  - Conclusions

Which Trace Gasses…

Priority list (Anu)

MOLECULE	ALT RANGE	INFO
CFC-12	6 – 30 KM	36.2
CFC-14	12 – 52 ? KM	33.1
ClONO2	18 – 39 KM	25.0
CFC-11	6 – 21 KM	23.7
HCFC-22	6 – 24 KM	23.6
NH3	6 – 21 KM	20.2
HCN	12 – 18 KM	19.2
COF2	15 – 33 KM	18.7
OCS	9 – 12 KM	15.2
SF6	6 – 21 KM	15.0
N2O5	15 – 33 KM	13.5
C2H6	6 – 15 KM	13.3
HOCl	18 – 30 KM	12.6

- Seek trace species within MIPAS bands, not in operational MW set.
- Those highlighted in green were tested with the latest radiometrically corrected version of the orbit 2081 file. Also, SO2.

- Assuming that we start with a priori uncertainty of 100% at 17 profile levels, define information content as 1 bit for every factor 2 improvement at one level.
- Table shows top 13 new species in terms of retrieval accuracy, and probable altitude range.
- Alternatively, have considered information gain over current climatology uncertainty (NH3 scores well)

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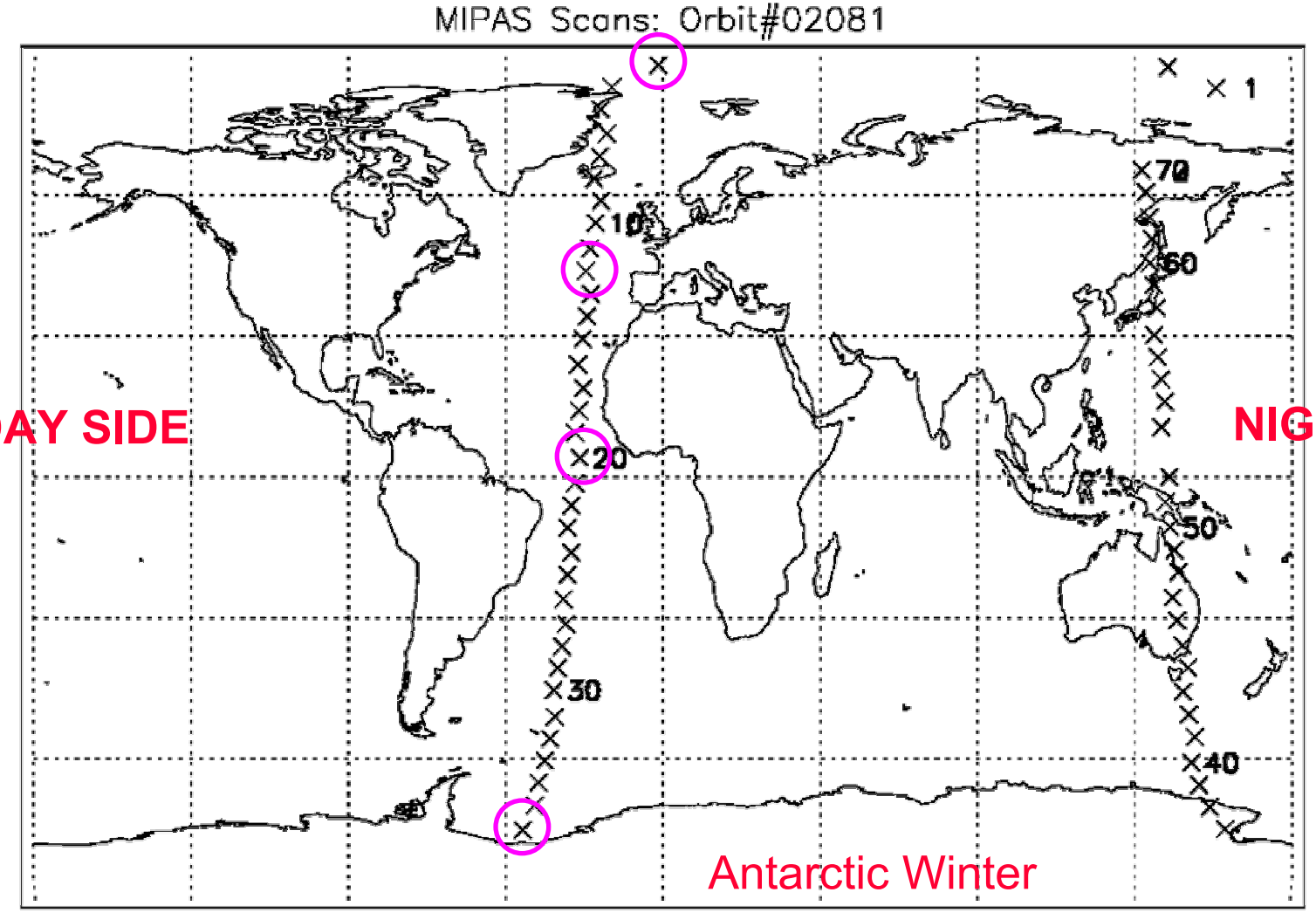
Geolocation of 2081 scans



Background on Methods

- Microwindows are selected to
  - Maximise information from target species (S/N)
  - Minimise systematic error contribution (eg other gases)
- Nominal microwindow selection algorithm (MWMAKE), but:
  - Extend to 10 microwindows or 10000 measurements (from 2-3)
  - Extend down to 6km
- Retrieve appropriate PT and H_2O profiles for the region
  - The Oxford retrieval tool, OPTIMO, uses optimal estimation method to retrieve profiles.
  - For these runs, also used other operational species, as available.
- Run OPTIMO
  - Note: Each scan in wholly independent of the previous one

Changes Since Last Time

- Large computational investment optimising MW selection. (AD)
  - Additionally, Look-up tables and irregular grids calculated
  - Large improvement in retrieval runtime
- Improvements to OPTIMO (VP)
  - Integral cloud detection and subsequent continuum adjustment.
  - Improves performance and allows retrievals to 6km
- Operationally
  - Increase correlation length from 7->50km
    - Acts as a ‘smoothing’ constraint to the retrieval
    - Helps eliminate retrieval oscillation, thought to be from radiometric calibration.
  - Make use of irregular grids and look-up tables
  - Use of a new processing cluster coming online – whole orbits faster.

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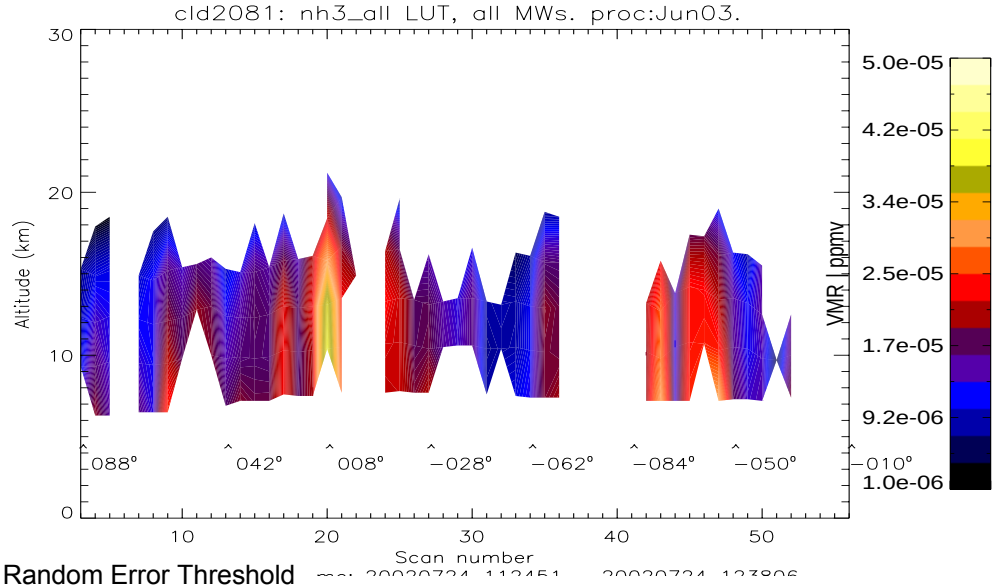
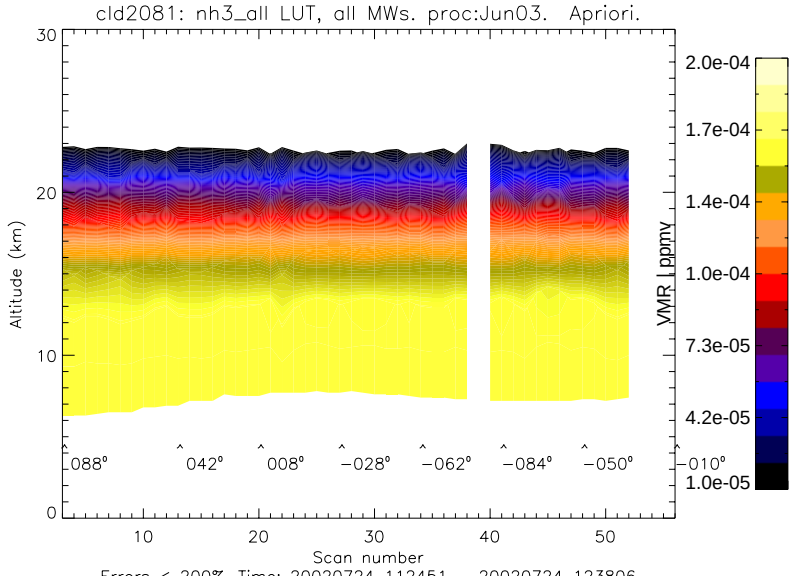
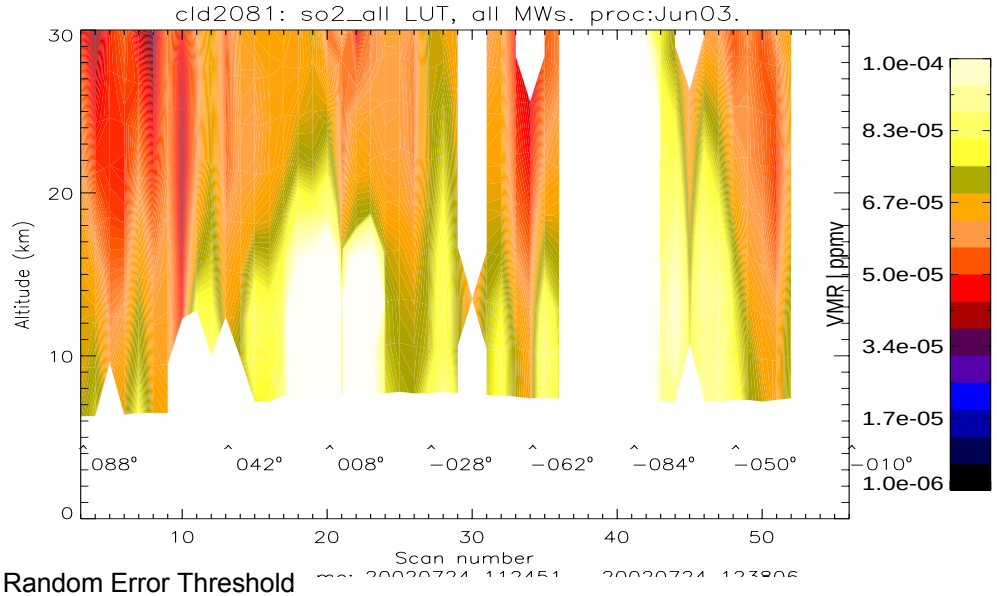
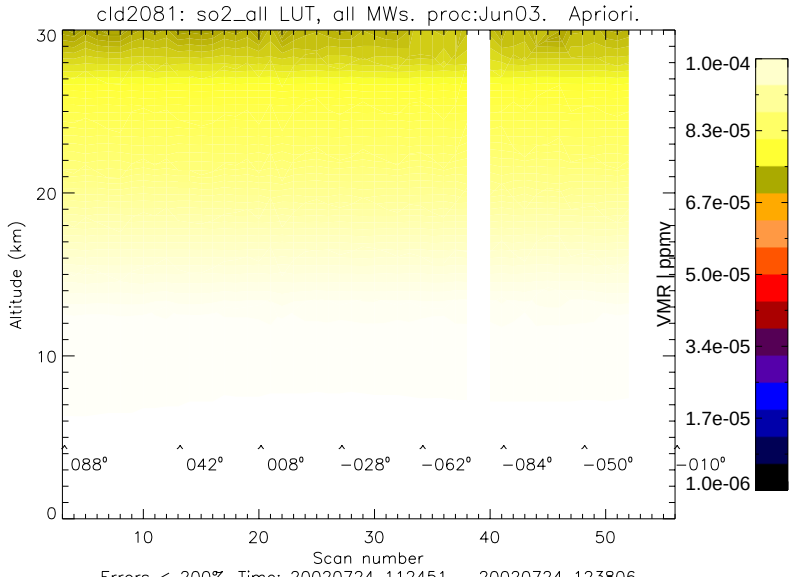
NH3 and SO2





50% Random Error Threshold





65% Random Error Threshold

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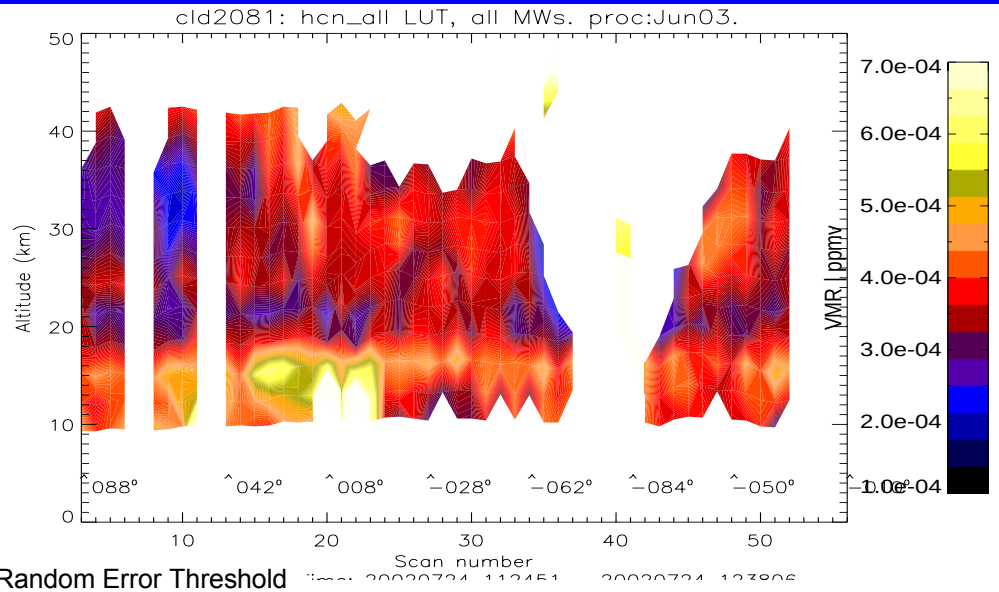
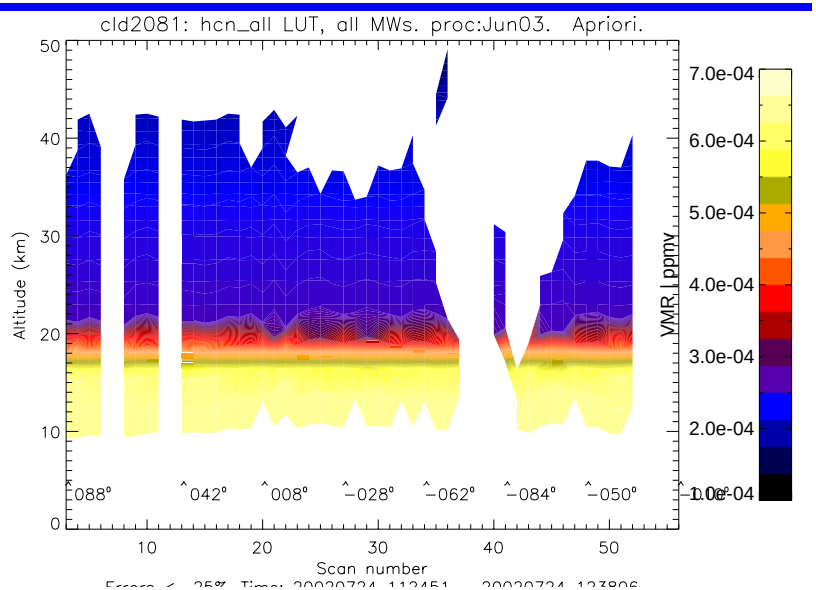
HCN and SF6





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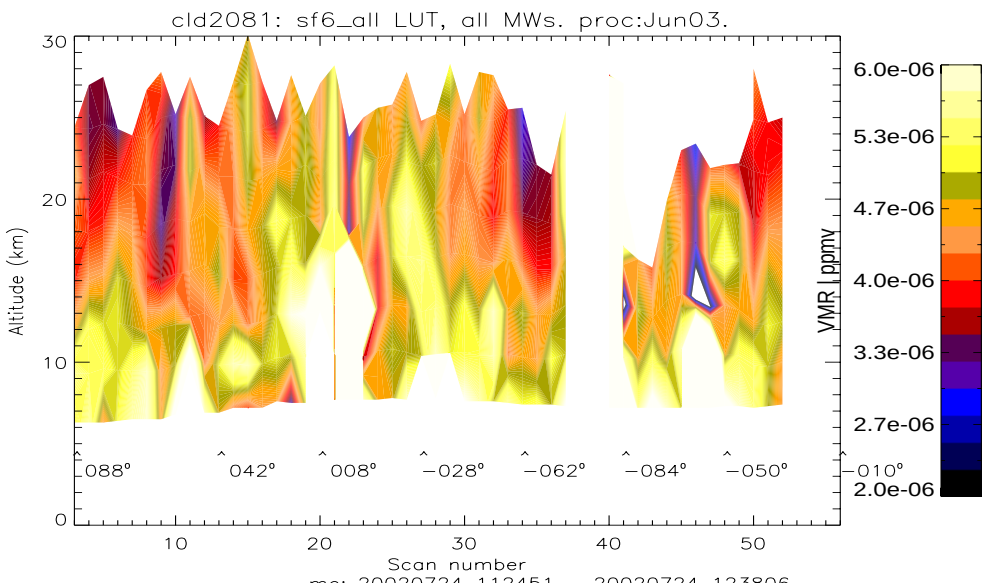

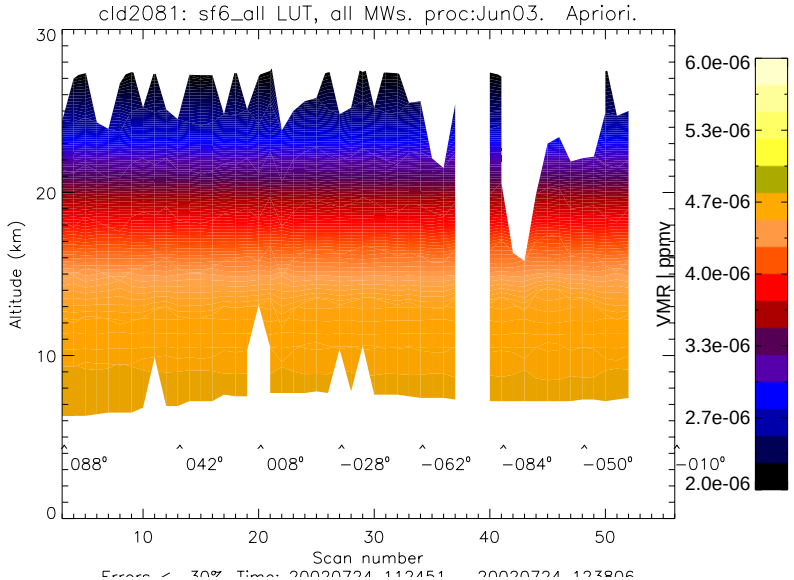

30% Random Error Threshold

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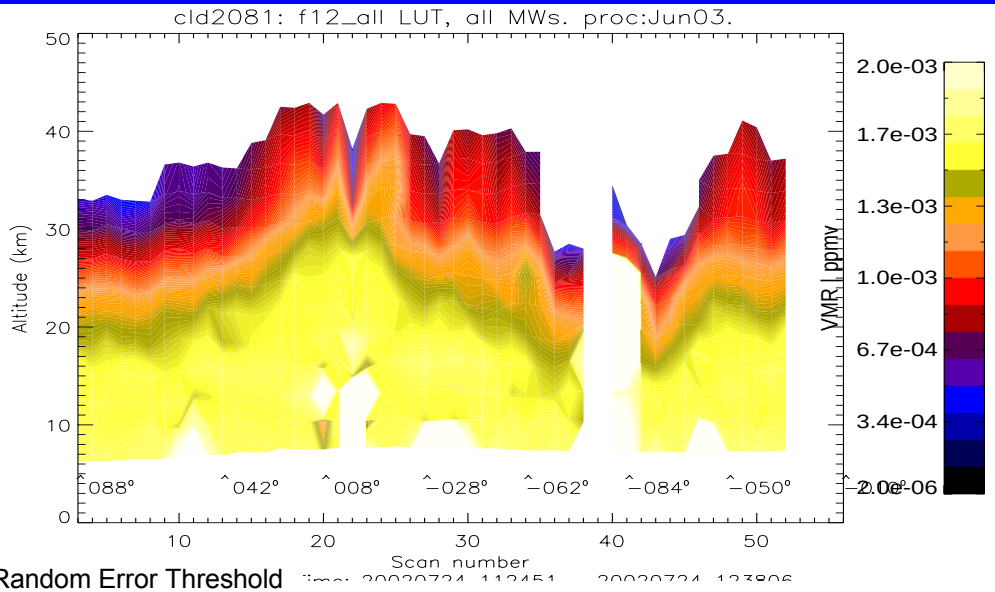
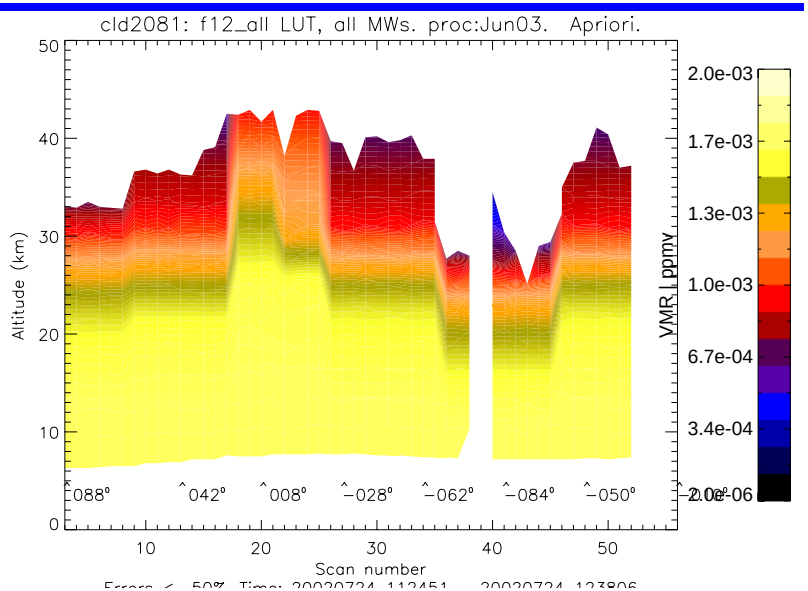
F12 and N2O5





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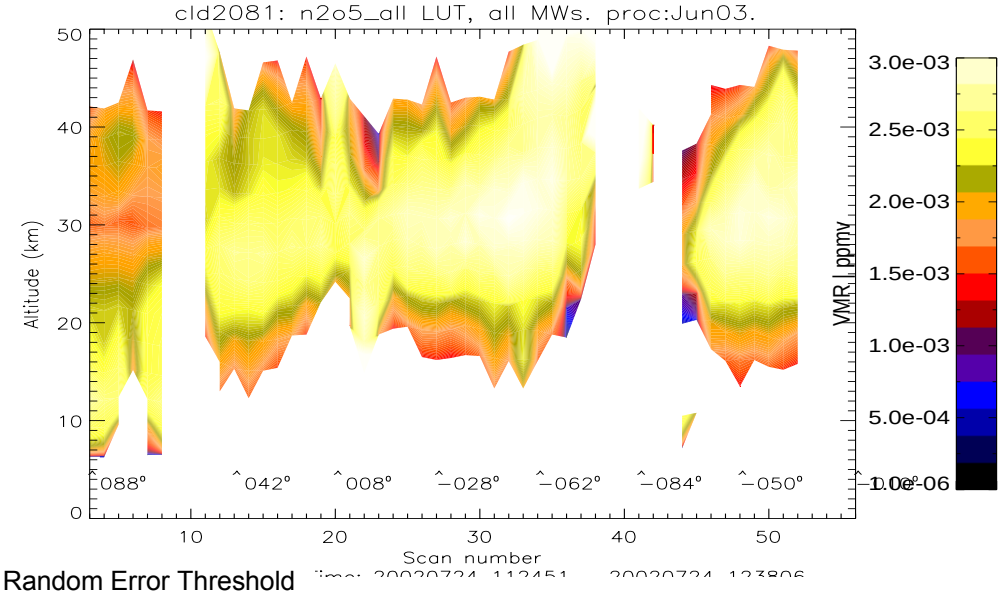

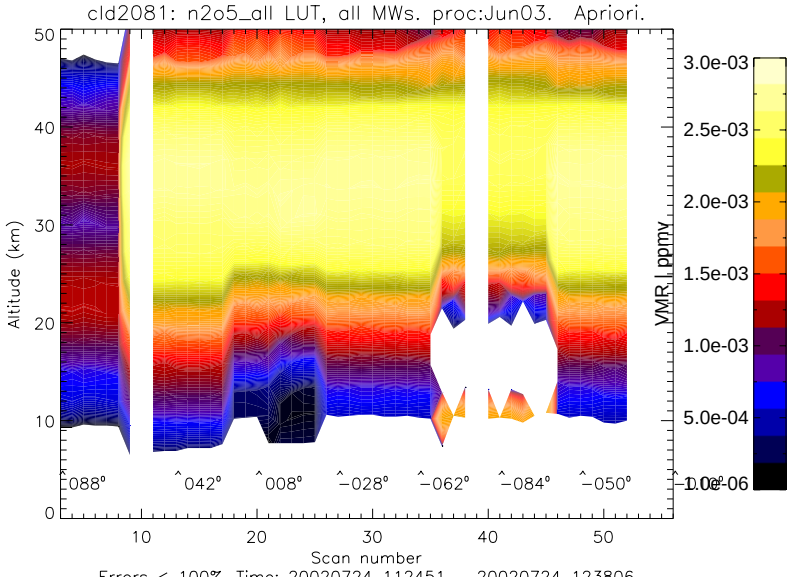

50% Random Error Threshold

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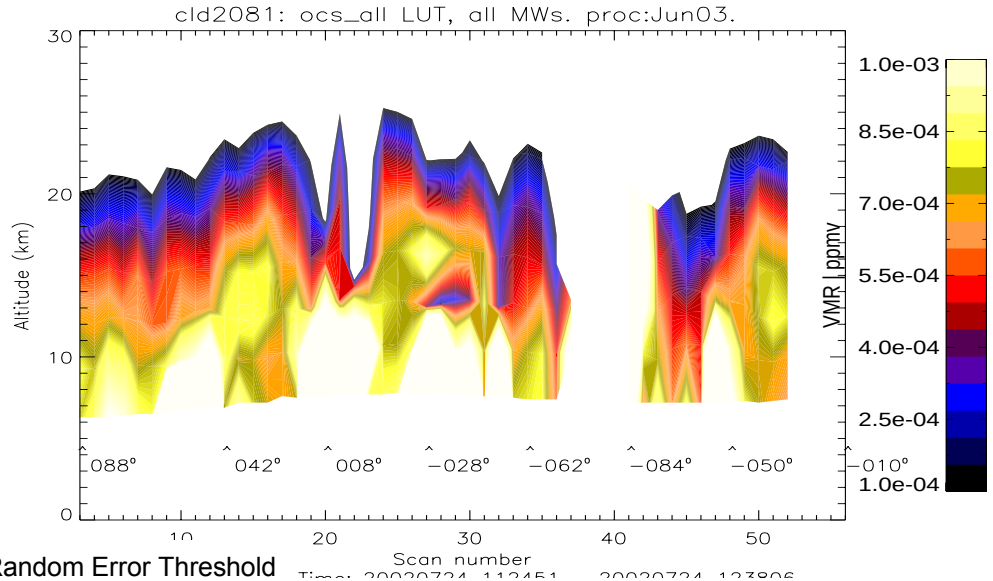
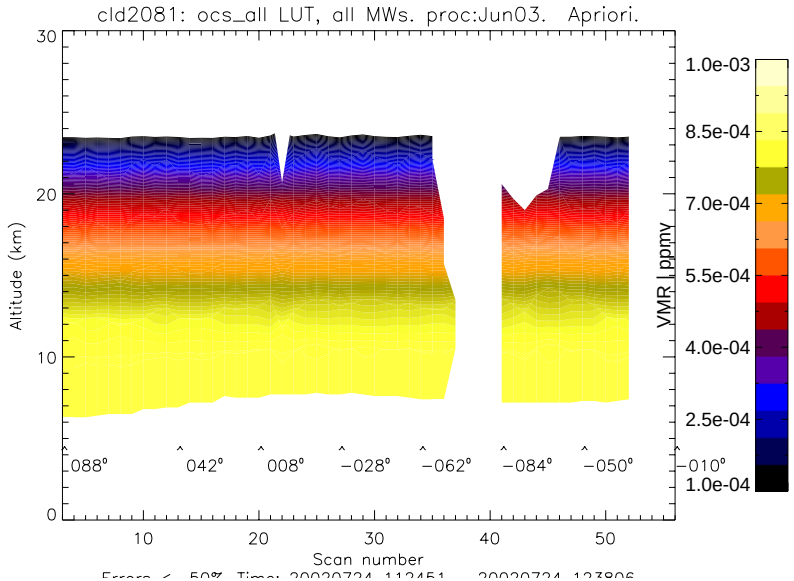
ClONO2 and OCS





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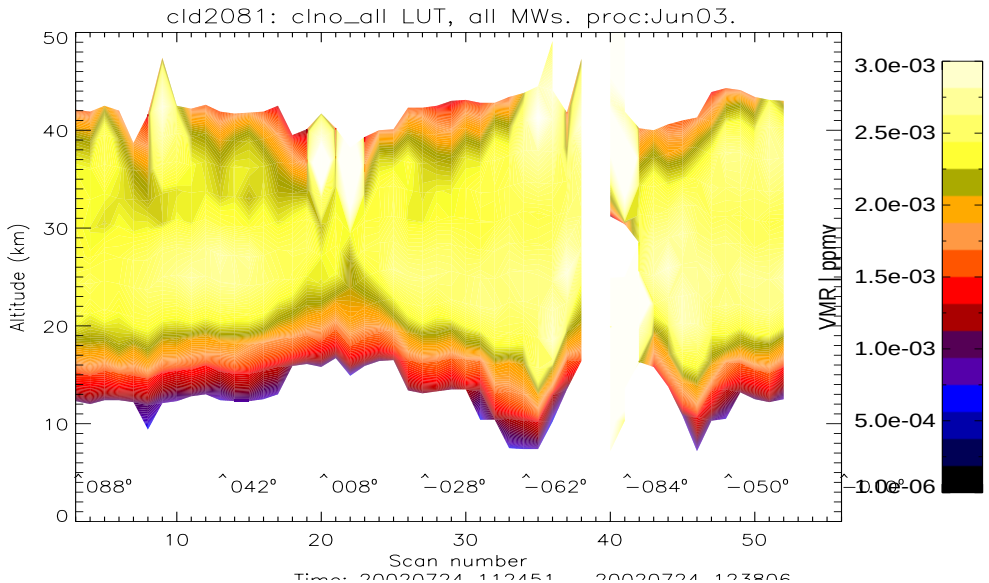

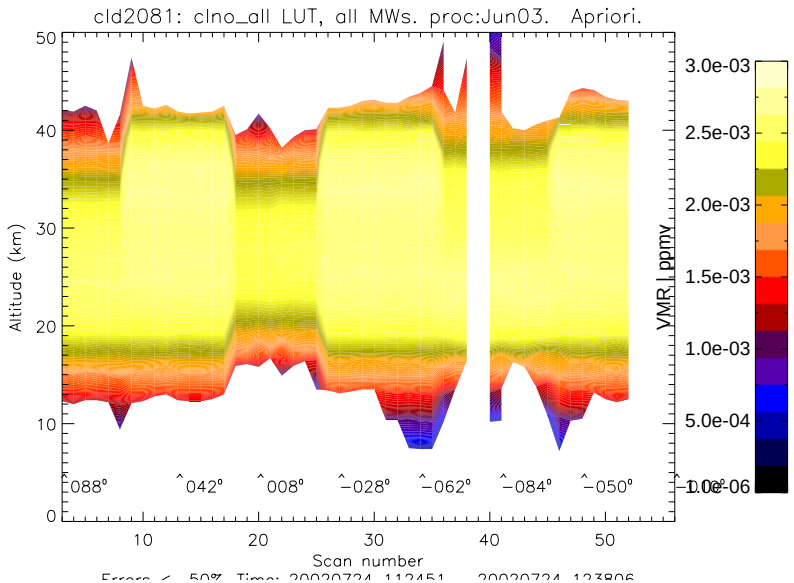

50% Random Error Threshold

Feasibility (of 1 Scan retrievals)

Species in order	Feasible profile retrieval from one scan?
$CLONO_2$	Yes. Overall nicely retrieves expected structure, but some excursions.
F12	Yes. F11(not shown) is also Feasible. F14 more difficult.
HCN	Yes. But with caution: without strong 'smoothing', answers are much poorer.
OCS	Yes. Still sensitive to cloud effects. Has developed structure not present in *apriori.*
N_2O_5	Yes. But restricted to > 25km, & has strong *apriori* correlation – investigate.
NH3	Limited. Narrow vertical range where > detection limit but reasonable values here.
SF6	Limited. High values >35km. See nothing in spectra. Not smooth between profiles.
SO2	Limited. Other work shows volcanic enhancement or co-addition useful.

Conclusions

- Operational feasibility of the MWs presented
  - Constraint is to maintain current retrieval scheme (precludes strategies such as zonal means etc.)
  - Several good candidates for possible operational inclusion at a later date.
  - Further testing, such as non-latitudinally structured *apriori* suggested.
- Comments on the new MWs themselves (Anu)
  - Potential additions to the list of operationally retrieved MIPAS species have been identified on the basis of expected accuracy
  - 'Scientific' priorities have not been considered (yet)
  - Information analysis depends on assumed profile
  - Other species may be retrievable in enhanced conditions, or with different retrieval algorithms (e.g. SO2 & vulcanism)