

First measurements of the ground-based microwave radiometer RAMAS at Summit, Greenland, during winter 2003/04



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Overview

- Motivation
- Measurement fundamentals
- Instrument details
- First measurements
- Retrieval procedure
- Summary and outlook



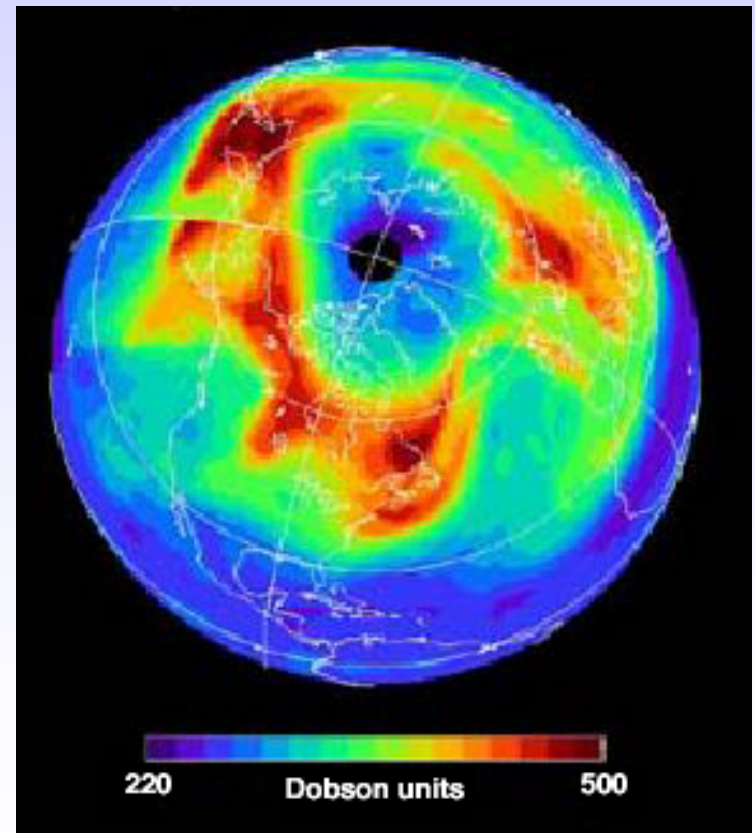
Motivation

- Northern hemisphere ozone depletion affects climate and surface UV-B, especially in Europe and North America
- Long term monitoring necessary to detect trends
- Verification and improvement of models
- Collect many profiles a day to investigate diurnal changes

Northern Hemisphere

Total Column Ozone Analysis

Total Ozone Mapping Spectrometer (TOMS) 1997/03/24



Profile Retrieval

Rodgers' Optimal Estimation
Method

Temperature/Pressure profiles:

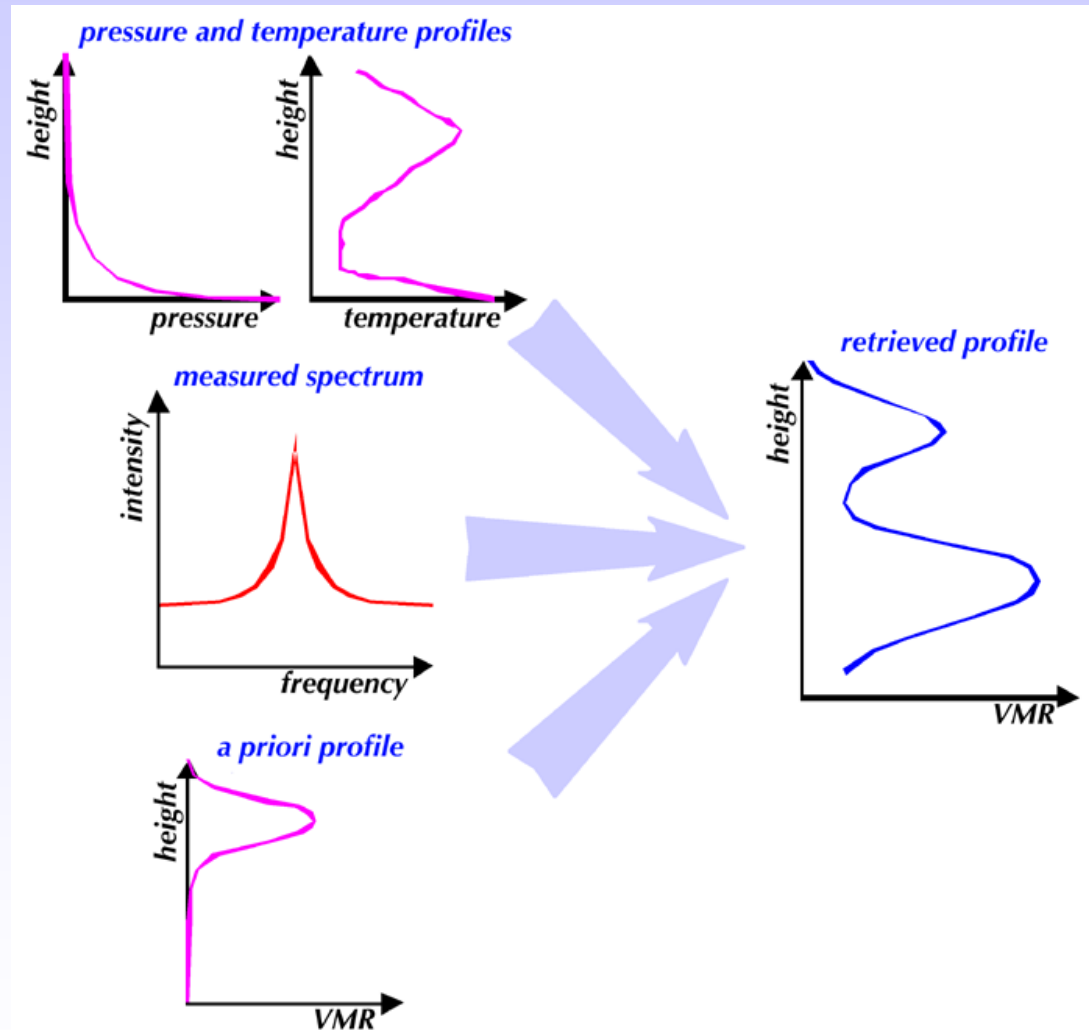
NILU, SOPRANO

A priori profiles:

MIPAS, FASCODE, SOPRANO,
SLIMCAT (depending on species)

Forward models:

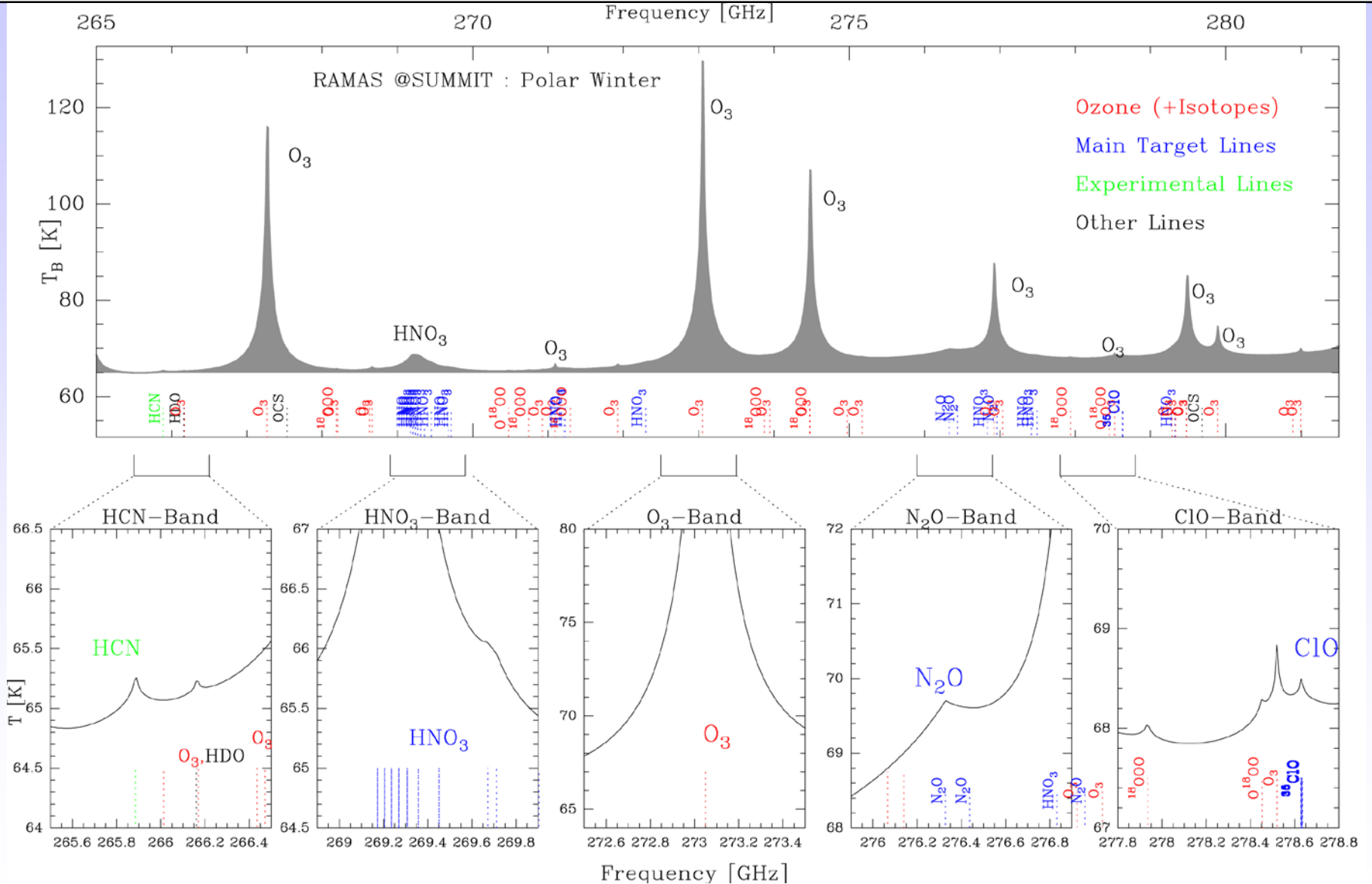
- ARTS / Qpack (Universität Bremen)
- MOLIERE (Université de Bordeaux)



Observation Targets

Several species in the
265 GHz – 280 GHz
range

Species	n [GHz]
O ₃	273.05
ClO	278.63
N ₂ O	276.33
HNO ₃	~269.4
HCN	265.89
HO ₂	~265.8
SO ₂	~267.6
NO ₂	~277.9
H ₂ O ₂	280.32

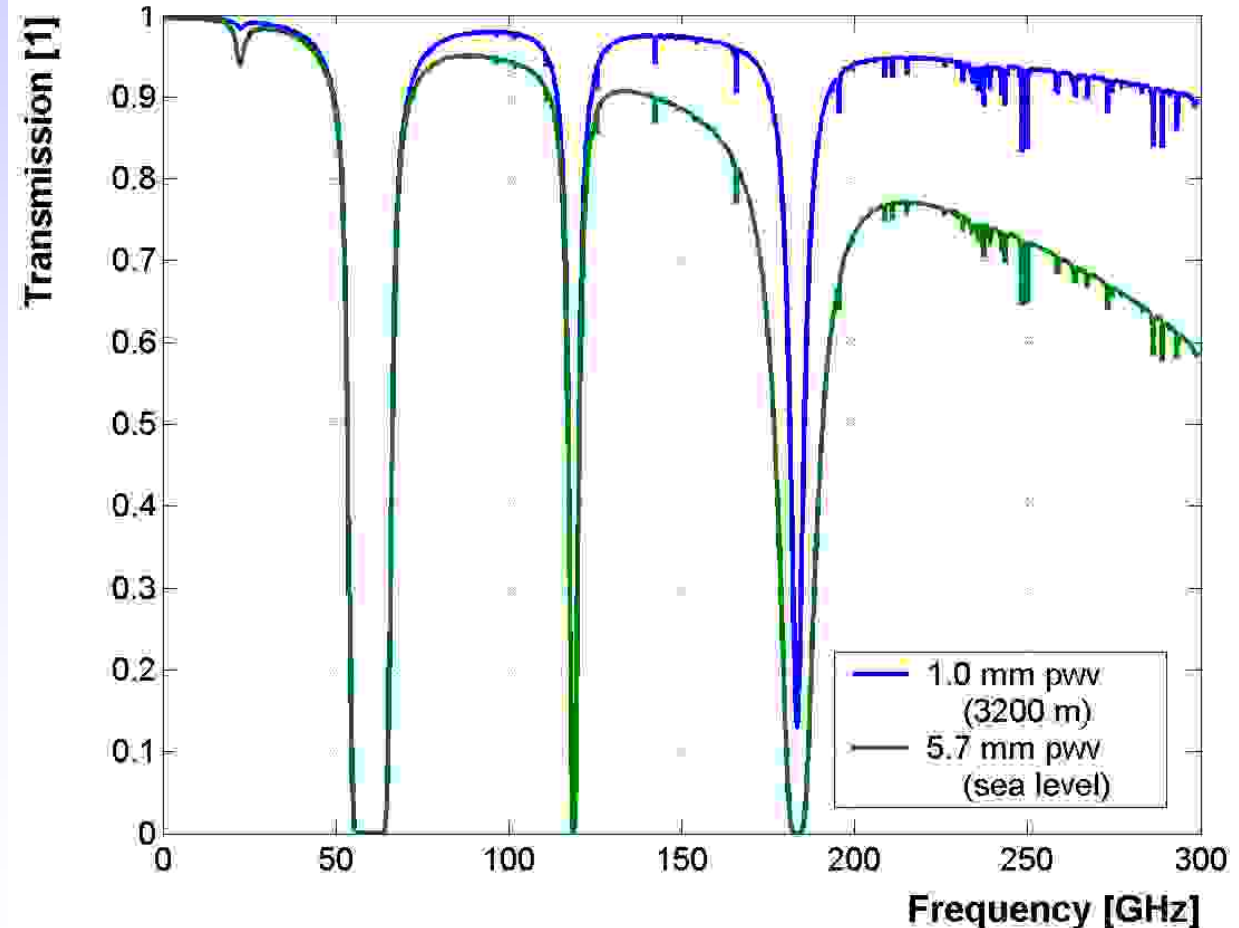


Atmospheric Opacity

Tropospheric impact
of O_2 , O_3 and H_2O :
absorption

Summit station
(3200 m a.s.l.)
offers unique
meteorological
conditions
in the Arctic

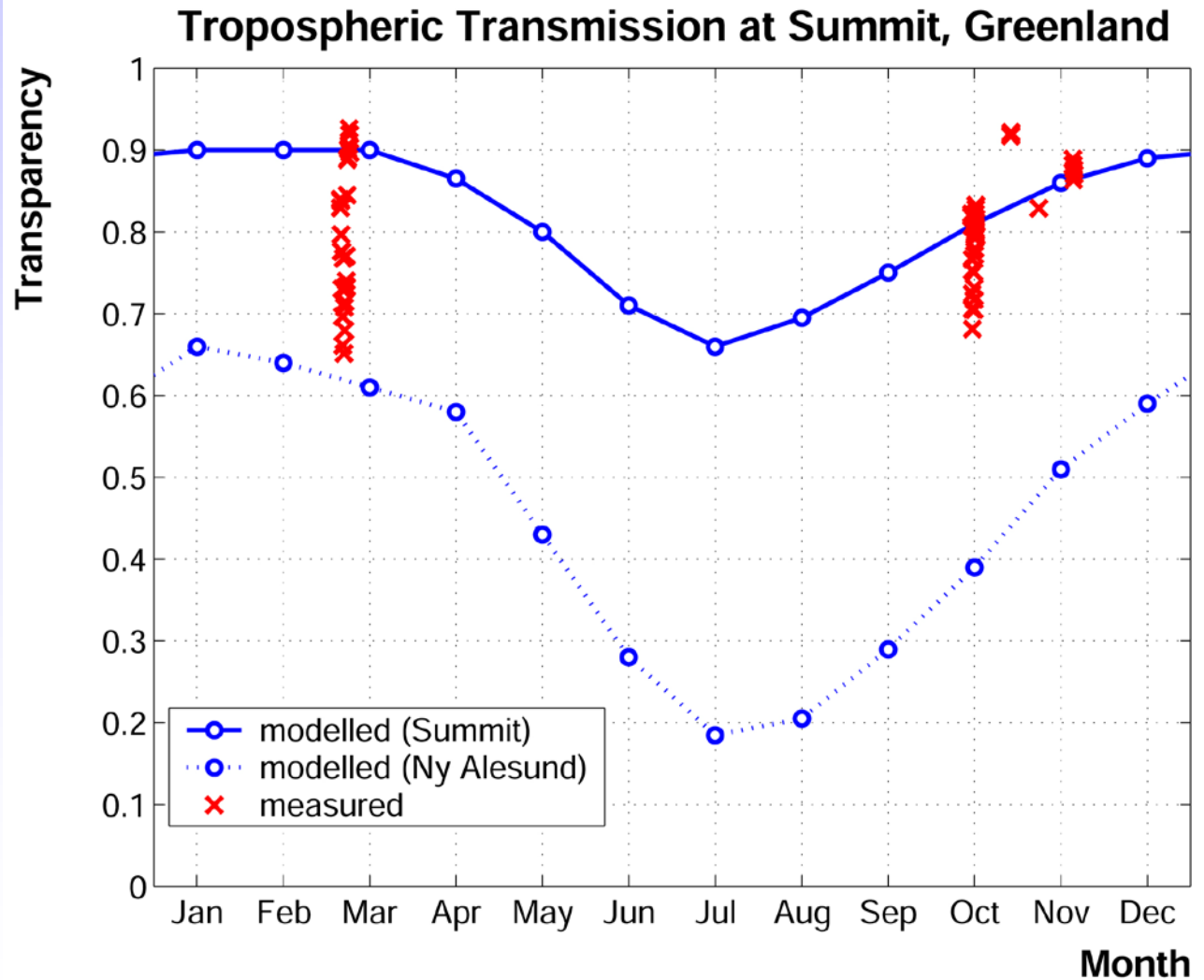
Precipitable water vapour (pwv) content and Zenith Atmospheric Transmission
in Arctic December



Tropospheric Transmission at Summit

Modelled with monthly averaged 40-year NCEP data for observations at 278 GHz.

Detection limit for ClO at a transmission of about 70%. All year round measurements of ClO expected.



Receiver Noise Temperatur

Noise-related uncertainty

$$\Delta T_N \propto \frac{T_{rec}}{\sqrt{\tau \cdot B}}$$

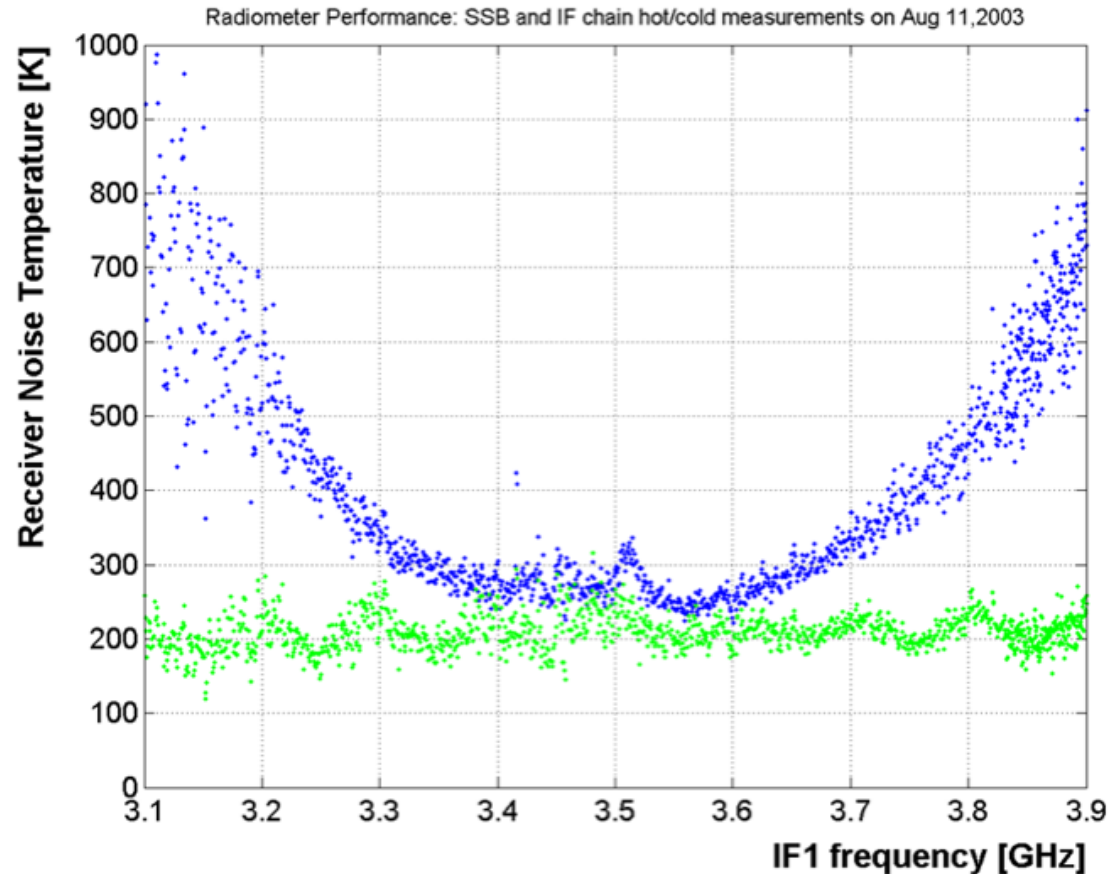
T_{rec} receiver noise temp.

τ integration time

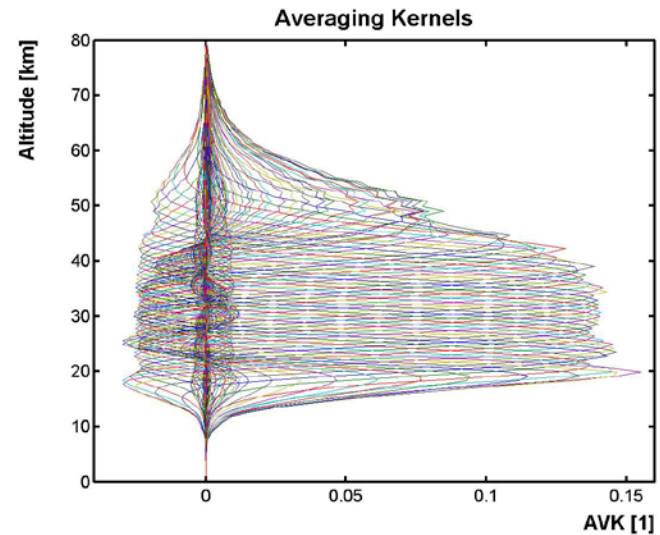
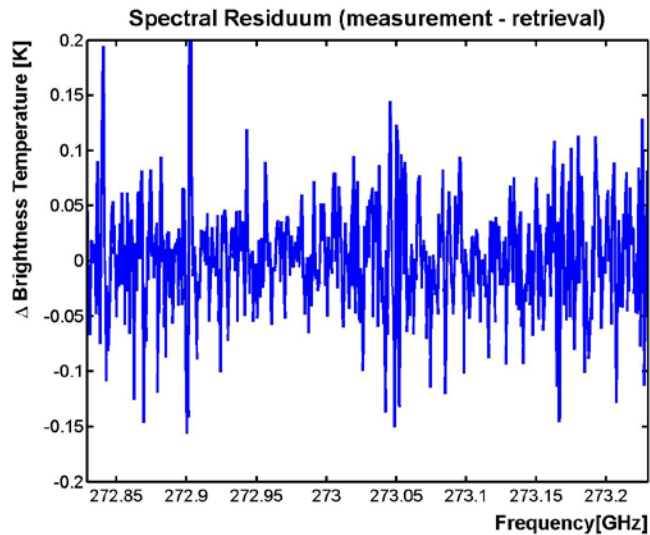
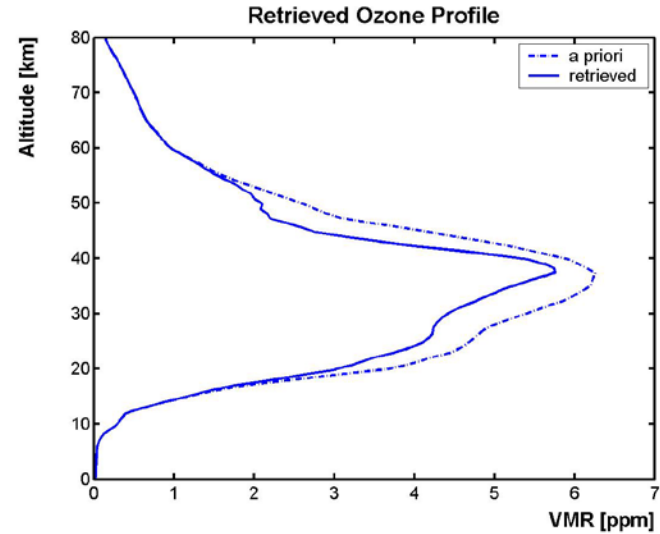
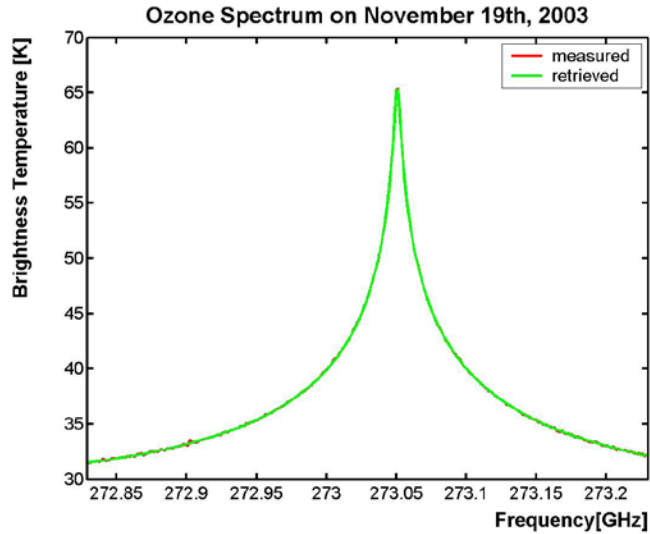
B spectr. channel width

Instantaneous bandwidth

0.8 GHz



Example: O₃ Retrieval



Summary

- Set up and test measurements have been performed
- Summit Camp offers excellent conditions for microwave measurements in the Arctic
- First retrieval runs delivered promising results

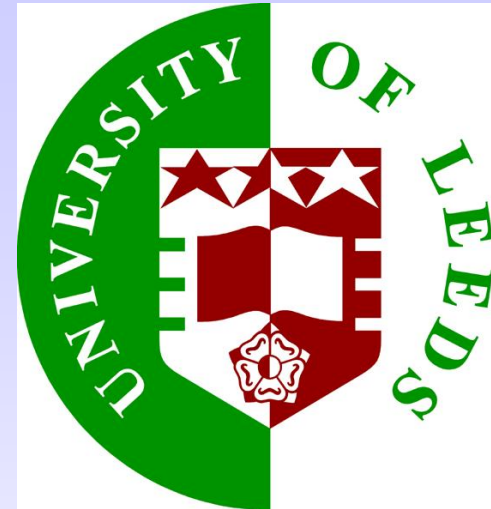
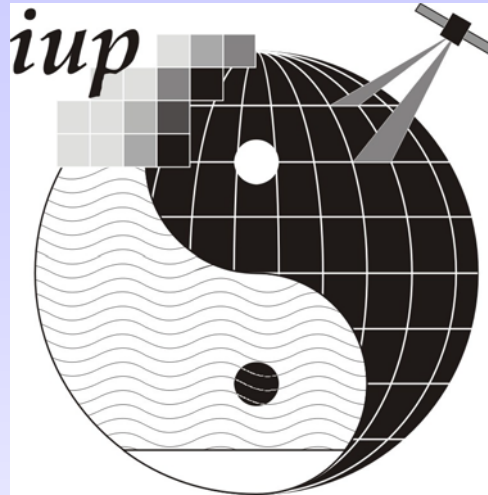
Outlook

- Fine-tune instrument
- Characterize instrument
- Establish routine measurement cycle
- Set up standard profile retrieval
- Compare data and validate RAMAS
- Integrate RAMAS in the NDSC network
- Use RAMAS data in chemical and dynamical modelling



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Partners



Acknowledgements



FIFTH FRAMEWORK PROGRAMME





Instrument Schematic

- SIS mixer and HEMT amplifier, operating at 4 K
- computer controlled local oscillator
- balanced calibration load

Receiver Noise Temperature
(Single Sideband) ~ 350 K

