



The MARSCHALS UTLS Limb-Sounder — A Status Report on the Threshold of SCOUT-O₃

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 Submillimeter Wave Earth Observation
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Introduction

- MARSCHALS**
 - Millimetre-wave **A**irborne **R**eceiver for **S**pectroscopic **C**haracterisation of **A**tmospheric **L**imb **S**ounding
 - a new airborne mm-wave limb sounder for the UTLS
 - built under ESA contract by a consortium led by Rutherford Appleton Laboratory in the UK
- Contents**
 - Scientific rationale, instrument description
 - Recent improvements: Engineering test flights, spectro-radiometric characterisation (MSF), new measurement sequence for SCOUT-O₃
 - First scientific mission in SCOUT-O₃ next week!

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Objectives

- Demonstrate the capability of the mm-wave limb-sounding technique, to be employed by MASTER, to sound H₂O, O₃ and CO in the UT/LS region
 - MASTER**: proposed spaceborne limb sounder to measure thermal emission spectra at mm and sub-mm wavelengths
 - mm-wave region**: where extinction by aerosol and polar stratospheric clouds is negligible and extinction by cirrus clouds is low
- Participate in field campaigns in its own right (strat-trop exchange, radiative forcing, UT&LS chemistry)

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Instrument Details

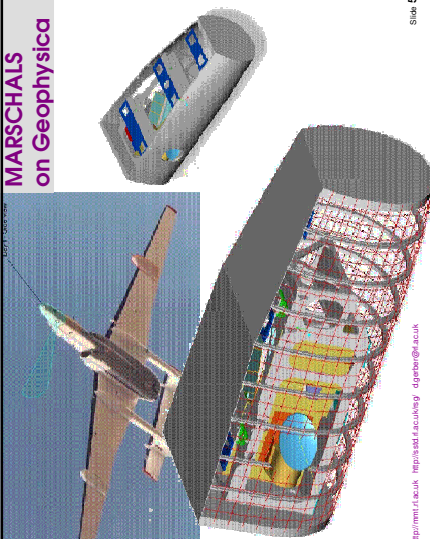
- MARSCHALS**:
 - High efficiency antenna (22 cm) to make precise elevation scans though the atmosphere
 - Heterodyne receiver concept
 - SSB receivers
 - 200 MHz spectral resolution (cf 50 MHz for MASTER)
 - Sideways viewing (cf rearwards for MASTER)

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on Geophysics



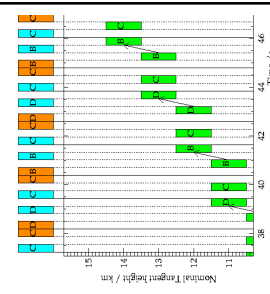
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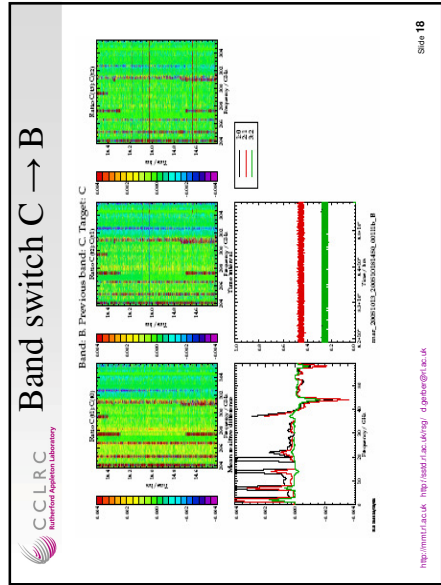
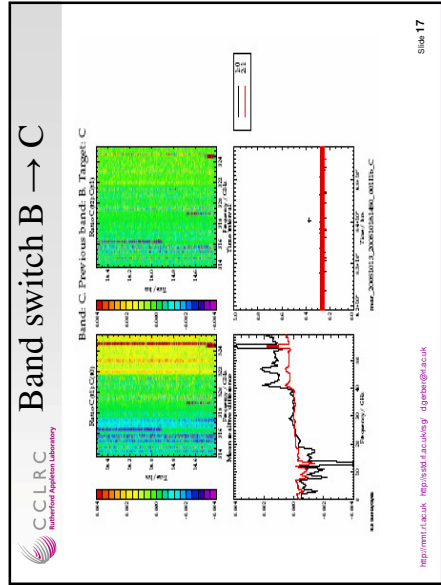
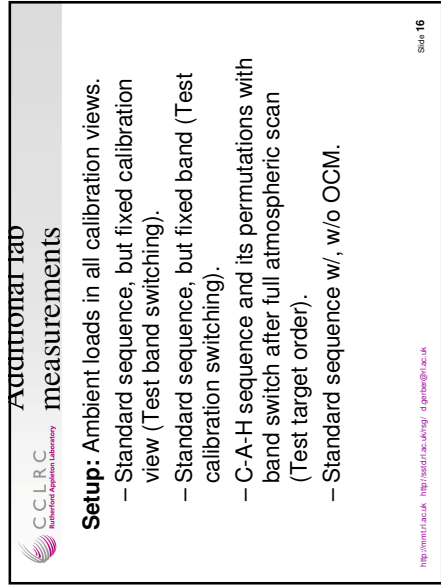
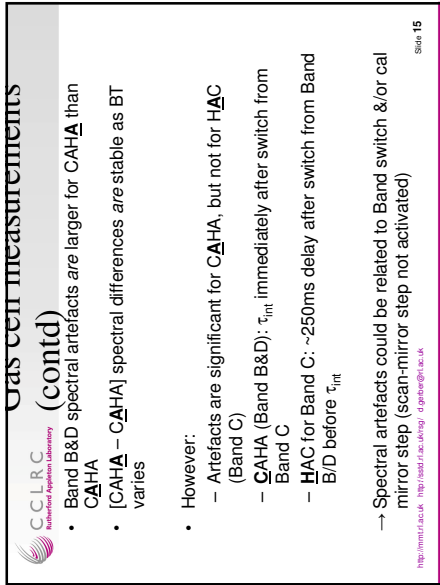
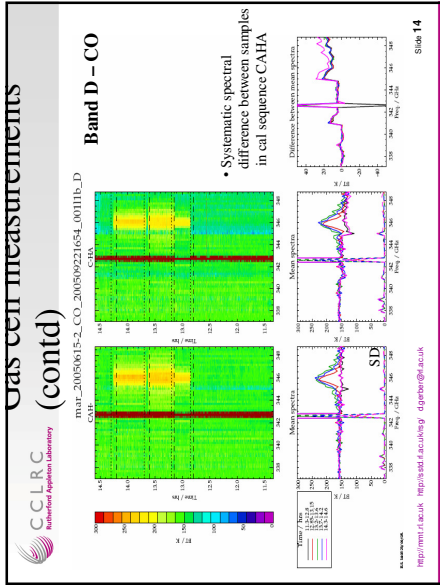
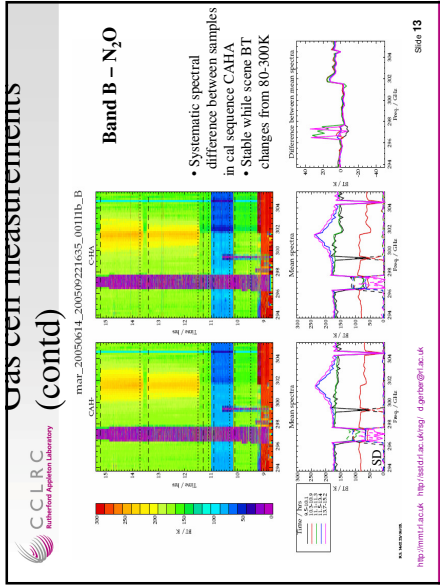
Instrument Details

- Bands**:
 - B: 294 - 305 GHz O₂ pointing
 - C: 316.5 – 325.5 GHz H₂O
 - D: 342.8 – 348.8 GHz CO
 - Modular design: more bands can be added
- Baseline scan sequence**:
 - 2 to 21 km in 1 km steps



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Improved measurement sequence for SCOUT-O₃

- Band switch only after a full atmospheric scan
- 5x C-H sequence after each band switch to allow for gain artefacts to settle
- “Conservative” cal sequence (C-A-H) for each limb view (no time delays within one calibration sequence)
- Double calibration views (CC-AA-HH). Possibility to filter measurements tainted by gain artefacts retrospectively

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The SCOUT-O₃ campaign



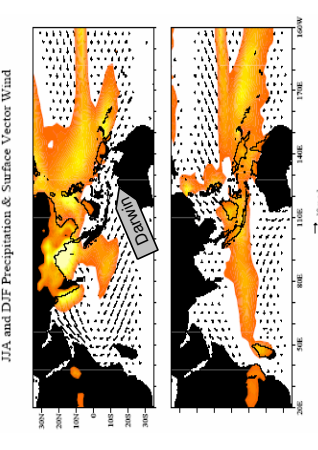
- Study Stratospheric-Climate Links with Emphasis on the Upper Troposphere and Lower Stratosphere (SCOUT-O₃)
- SCOUT-O₃ has 15 million euros of European Commission funding. There are 59 partner institutions and over 100 scientists involved from 19 countries.
- SCOUT-O₃'s aim is to provide predictions about the evolution of the coupled chemistry/climate system, with emphasis on ozone change in the lower stratosphere and the associated UV and climate impact to provide vital information for society and policy use.

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Darwin. Austral Monsoon, JJA and DJF Precipitation & Surface Vector Wind

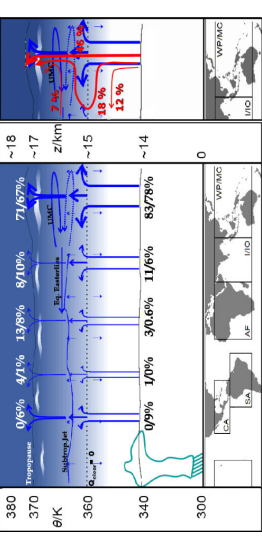


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dehydration region for



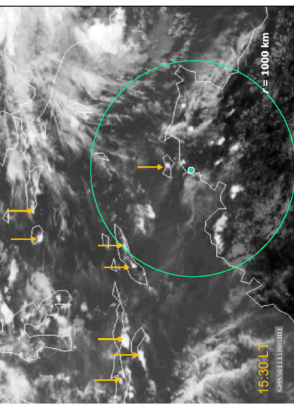
(a) Lower row: fraction of air irreversibly passing 340 K in a specified region. Upper row: fraction assuming minimum water mixing ratio in a specified region.
(b) Individual contributions over the Western Pacific / Maritime Continent (WP/MC). Based on numbers given by Fueglistaler et al. [2004].

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Hector



Strong convection over the WP/MC region. Green circle = Geophysica range

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MARSCHALS in SCOUT-O₃

- Hector**
 - Active convection events, tropopause puncturing, anvil outflow
- Cirrus properties**
 - High altitude clouds detached from deep convection
- Aged plume**
 - Chemistry and microphysics of anvil outflow
- Quiescent TTL**
 - Remote sensing

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Conclusions

- **MARSCHALS:** New submm wave limb sounder for the UTLS region (Geophysica, future space implementation MASTER)
- Some remaining teething problems successfully tackled on testflights and in the lab during the last ½ – 1 year.
- With cryogenic cold load and improved measurement sequence → MARSCHALS will be alive and kicking for its first scientific mission in **SCOUT-O₃** Nov-Dec 2005!!!