

Name of research institute or organization:

National Physical Laboratory, UK

Title of project:

Continuum Absorption in the Visible and Infrared and its Atmospheric Relevance (CAVIAR)

Project leader and team:

Mr Tom Gardiner, Dr Marc Coleman, Mr Nigel Swann, Mr Liam Tallis (University of Reading, UK)

Project description:

The aim of the CAVIAR project is to produce an improved model of the water vapour continuum that can be used by atmospheric scientists in studies of the Earth's energy balance. CAVIAR is a UK consortium project lead by Professor Keith Shine of the University of Reading and funded jointly by NERC / EPSRC. The consortium brings together expertise in atmospheric field measurements, spectroscopic laboratory measurements and spectroscopy modelling.

Water vapour is a key greenhouse gas accounting for approximately 55% of the natural greenhouse effect and approximately 55% of the solar radiation absorbed by the atmosphere. In addition to the complex ro-vibration spectral lines across the infrared region there is also an underlying continuum that pervades the infrared and microwave regions having a marked impact on the Earth's radiative balance. Since the 1980's a semi-empirical model has been used; however whilst this has served the community well, there is a lack of confidence in the performance at wavelengths and under atmospheric conditions where it has not been tested. Theory has developed that makes it now possible to produce a much improved model of the continuum absorption.

NPL's role in the project has been to provide traceable calibrations for the field instruments and also to carry out ground-based measurements in the project field campaigns. With regard to the former task, NPL have built an ambient temperature black body (now known as the CAVIAR Black Body (CBB)) that can operate at temperatures from approximately -70°C to 40°C . This black body was used to radiatively calibrate two passive FTIR systems; TAFTS employed by Imperial College and ARIES employed by the Met Office, both of which were flown on the UK facility for airborne atmospheric measurements (FAAM) aircraft. The ground-based FTIR employed by NPL is an active system and uses the sun as a light source when recording a spectrum of the atmosphere. Consequently, this instrument was radiatively calibrated against NPL's ultra high temperature black body (UHTBB) at temperatures of $\sim 3300^{\circ}\text{C}$.

Two field trials have been carried out under the project, one at Camborne (sea level), UK and another at Jungfraujoch providing a contrast in terms of 'wet' and 'dry' sites. The advantage of the latter site is that many of the stronger water lines are no longer saturated and hence it is possible to access information closer to the centre of these water absorbances. Both field trials have been successful, however, the Jungfraujoch field trial was particularly fruitful due to many days with clear sky conditions (the ground-based measurement use the sun as a light source hence without clear skies

measurements are not possible). Across the 4.5 week period at the Jungfraujoch excellent data capture was achieved on 9 days with ground-based FTIR measurements made simultaneously with airborne measurements by the instruments on the FAAM aircraft (in addition, drop sondes and radiosondes were also launched in order to obtain water vapour profile information). Analysis of the data is still ongoing and so it is not yet possible to report any conclusions. However, the data from the Jungfraujoch field trial will be key to the success of the project since it will go forward and be used to validate the new models of the water vapour continuum being calculated by the other consortium members.

Key words:

CAVIAR, water vapour continuum, radiative balance, HITRAN, FTIR, FAAM, TAFTS, ARIES, black body

Internet data bases:

CAVIAR project website : <http://www.met.reading.ac.uk/caviar/>
NPL website : www.npl.co.uk/environmental-measurement

Collaborating partners/networks:

University of Reading (consortium lead), Met Office, Imperial College, Rutherford Appleton Laboratory, UCL, University of Leicester and University of Cambridge

Scientific publications and public outreach 2009:

Peer review publications are planned, however, as the analysis is ongoing no publications have yet been made.

Results from the initial work from the project have been disseminated at a number of conferences, including:

Marc Coleman, Tom Gardiner, Eric Usadi, Liam Tallis, Stuart Newman, Alan Vance, Paul Green and Ralph Beeby, *Calibrations of Ground-Based and Airborne FTIR Systems to Ensure Comparable Radiance Measurements in UK and Switzerland CAVIAR Field Trials*, Royal Meteorology Society Conference, Jun 09, UK.

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