Geophysical Research Abstracts
Vol. 12, EGU2010-4232, 2010
EGU General Assembly 2010
© Author(s) 2010

Retrievability of atmospheric water vapour, temperature and vertical windspeed profiles from proposed sub-millimetre instrument ORTIS.

Jane Hurley (1), Patrick Irwin (1), Nicholas Teanby (1), Remco de Kok (2), Simon Calcutt (1), Ranah Irshad (1), and Brian Ellison (3)

(1) University of Oxford, Atmospheric, Oceanic and Planetary Physics, Oxford, United Kingdom (hurley@atm.ox.ac.uk), (2) SRON, Sorbonnelaan 2, 3584 CA Utrecht, Netherlands, (3) Rutherford Appleton Laboratory, Harwell Science and Innovation Campus, Didcot, United Kingdom

The sub-millimetre range of the spectrum has been exploited in the field of Earth observation by many instruments over the years and has provided a plethora of information on atmospheric chemistry and dynamics — however, this spectral range has not been fully explored in planetary science. To this end, a sub-millimetre instrument, the Orbiter Terahertz Infrared Spectrometer (ORTIS), is jointly proposed by the University of Oxford and the Rutherford Appleton Laboratory, to meet the requirements of the European Space Agency's Cosmic Visions Europa Jupiter System Mission (EJSM).

ORTIS will consist of an infrared and a sub-millimetre component; however in this study only the sub-millimetre component will be explored. The sub-millimetre component of ORTIS is projected to measure a narrow band of frequencies centred at approximately 2.2 THz, with a spectral resolution varying between approximately 1 kHz and 1 MHz, and having an expected noise magnitude of 2 nW/cm^2 sr cm^{-1}. In this spectral region, there are strong water and methane emission lines at most altitudes on Jupiter.

The sub-millimetre component of ORTIS is designed to measure the abundance of atmospheric water vapour and atmospheric temperature, as well as vertical windspeed profiles from Doppler-shifted emission lines, measured at high spectral resolution. This study will test to see if, in practice, these science objectives may be met from the planned design, as applied to Jupiter.

In order to test the retrievability of atmospheric water vapour, temperature and windspeed with the proposed ORTIS design, it is necessary to have a set of "measurements" for which the input parameters (such as species' concentrations, atmospheric temperature, pressure - and windspeed) are known. This is accomplished by generating a set of radiative transfer simulations using radiative transfer model RadTrans in the spectral range sampled by ORTIS, whereby the atmospheric data pertaining to Jupiter have provided by Cassini-CIRS. These simulations are then convolved with the ORTIS field-of-view response function, yielding "measurements" of Jupiter as would be registered by ORTIS about which all atmospheric parameters are known.

A standard optimal estimation retrieval code, the Non-Linear Optimal Estimator for Multivariate Spectral Analysis (NEMESIS), shall be used to retrieve atmospheric water vapour and temperature from such nadir "measurements" taken by ORTIS. The vertical windspeed profiles, as determined from Doppler-shifted emission lines taken at extremely high spectral resolution from limb (or near-limb, 80° emission angle) ORTIS "measurements", shall be determined using an implementation of standard optimal estimation theory. Preliminary analysis indicates that ORTIS should be able to retrieve atmospheric water vapour and temperature, as well as Doppler windspeed profiles on Jupiter to a high degree of accuracy over a large range of altitudes using single nadir or limb/near-limb measurements, respectively.