Introduction

The VAMOS Ocean Cloud Atmosphere and Land Study Regional Experiment (VOCALS-REx) took place off the coast of Northern Chile between October and November 2008. Its major aims were to reduce uncertainties in future climate projections associated with marine stratocumulus and coupled ocean-atmosphere processes. In the framework of the UK component of the campaign, two tandem hyperspectral imagers were flown onboard the NERC Airborne Research & Survey Facility (ARSF) Dornier 228 aircraft in seven high level remote sensing flights. The two hyperspectral imagers measured reflected solar radiation from marine stratocumulus clouds and cover the spectral range of 400-2500 nm in 508 spectral bands with a spatial resolution of 3-5 metres. These imagers provide a unique opportunity to retrieve high-resolution cloud microphysical and optical properties of the underlying stratocumulus cloud deck.

Lookup Tables

As an initial study the Edwards-Slingo radiation code (Edwards and Slingo. 1996) was used to construct two band radiance lookup tables for the purpose of retrieving the optical depth and droplet effective radius of the underlying cloud deck. An example lookup table is shown in figure 1. This code was initiated with a number of local observations including:

- A SHADOZ ozone sonde from the Galapagos is used to set the ozone mass mixing ratio profile which is later scaled by OMI derived total column ozone measurement.
- The FAAM BAE 146 flew several cloud profiles (Bretherton et al, 2010), using these along with LIDAR measurements of cloud top height simultaneous to hyperspectral images (figure 2).
- The ocean albedo lookup table of Jin et al (2004) was integrated into the radiation code to generate ocean albedo for varying solar zenith angle, cloud optical depth, surface wind speed and ocean chlorophyll concentration.

Radiance Comparison With MODIS Instrument

In order to verify the output from the Eagle and Hawk hyperspectral imagers a radiance comparison with collocated overpasses of the MODIS instrument has been carried out. To perform the comparison Eagle/Hawk radiances were averaged over 1 km pixels and radiances from all bands inside the MODIS bands were used to produce a weighted average according to the MODIS instrument response curve.

All flights from the VOCALS-REx campaign were searched for simultaneous overpasses of the MODIS instrument onboard the TERRA satellite. Pixels used for the comparison were limited to only those imaged within 15 minutes of each other and whose pixel centres lay within 500 metres of each other. The results of the comparisons in the four MODIS cloud retrieval bands are shown in figure 4.

Future Work

It is anticipated that this work will result in cloud products being delivered across a large spatial range for VOCALS-REx and will allow further exploration and evaluation of cloud remote sensing techniques. Several of the Domier’s flights were coordinated with both underpasses of the BAE 146 aircraft carrying out in situ cloud microphysical measurements and overpasses of the MODIS instrument. Existing cloud remote sensing techniques use homogenous plane-parallel assumptions when constructing lookup tables. The range of spatial scales available from the hyperspectral imagers along with intercomparisons with in situ and satellite measurements will allow exploration of the scales for which plane-parallel assumptions hold true and those at which they break down. In addition the large spectral range available will allow assessment of the information content of areas of the spectrum often ignored.

References