

[Investigation of cloud properties and atmospheric stability with MODIS]

Quarterly Report for July - September 1992
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NEAR TERM OBJECTIVES

Preparations for TOGA-COARE. The MAS (MODIS Airborne Simulator) is being reconfigured to improve the instrument performance in the longwave CO₂ channels so that cloud investigations can occur during TOGA-COARE. Flight configuration of the MAS channels is being selected. The PC support for investigating MAS data quality in the field is being enhanced.

Algorithm Definition. The trispectral thin cloud detection algorithm continues to be refined through further study of situations in the FIRE data which include single layer thin cloud, mixed layers of ice and water cloud, over land, over ocean. A paper on this work is being prepared. Additionally, the CO₂ algorithm is being expanded to estimate cloud height and amount for two cloud layer situations.

MODIS Instrument Review. The calibration and spectral selection of the MODIS infrared channels continues to demand attention. Simulations of the impact of spectral channel changes on the cloud parameter derivation continue in effects to guide instrument developers. The advantages of a channel in the near infrared for detection of very thin cirrus are being explored.

ACCOMPLISHMENTS

MAS Reconfiguration. Inspection of MAS data from ASTEX revealed that the expected signal to noise performance for the longwave CO₂ channels (13.0 to 14.5 microns) was unacceptable. Replacement of the lens for the longwave port is planned for November, before TOGA-COARE (beginning January 1992); this change is expected to yield a factor of 1.5 improvement. Insertion of a cold filter in this port is also planned immediately after TOGA-COARE and should yield an additional factor of 2 or 3 improvement; unavailability of the necessary parts forced the improvement to occur in two stages. Furthermore, reduction of the 400 Hz noise caused by the circuit pod heater is being worked on at NASA Ames. All of these improvements are expected to bring the MAS close to the required performance of 1.5 C single sample noise for all CO₂ channels out to 14.0 microns. Ken Brown is overseeing these modifications with assistance from Chris Moeller. The necessary resources to cover cost were secured by Mike King of GSFC, with a welcome contribution from John Arveson of NASA/Ames.

Plans for TOGA-COARE. The MAS configuration for TOGA-COARE has vis channels centered at .66, .94, 1.64, 1.78, and 2.13 microns and IR channels centered at 3.7, 8.6, 11.0, 12.0, 13.3, and 13.8 microns. It is hoped that the addition of the 1.78 micron near infrared

channel will assist the CO2 channels in finding very thin cirrus. On the ferry flight between Guam and Townsville, the ozone configuration (generated by Gary Jedlovec of MSFC) will be flown; this includes channels around the 9.6 micron ozone absorption band (.66, 1.64, 1.98, 3.75, 4.5, 4.65, 9.2, 9.6, 10.0, 11.0, 12.5 microns).

Preparations for On-site TOGA-COARE Support. The capability to view and investigate MAS data with the on-site PC McIDAS Quick View System has been enhanced. Additional software has been prepared that will enable (1) averaging the MAS data to any resolution, (2) stretching the data through different bit enhancement schemes, and (3) viewing the data from the exabyte tapes directly.

Algorithm for Thin Cirrus Detection. Three channel brightness temperature differencing of the MAS 10, 11 and 12 micron bands from the 1991 FIRE data has been providing useful information on cloud properties. More recently an automatic threshold version of the three channel brightness temperature differencing of the MAS 8, 11 and 12 micron channels (8-11 and 11-12) has been tested. The technique has been tested on single cloud scenes over land and the Gulf of Mexico from December 5 and multi-cloud scenes over the Gulf from November 24 and December 5. The simple automated technique correctly identifies the progression from water cloud to ice cloud in the images, but identification of clear regions and thick low water cloud are more sensitive to the threshold selection and must be tuned further.

CO2 Investigations. In the last quarter an initial version of an algorithm for determining cloud parameters in two layers of clouds has been coded and testing has begun. Using HIRS data in the 11.1, 13.4, and 14.0 micron CO2 channels, the lower and upper cloud layer pressures and effective cloud amounts are calculated. In a radiative transfer equation model, four unknowns (cloud amount and heights for each layer) are solved from measured radiances in the window channel and the available CO2 channels. The lower cloud layer is not assumed to be opaque. Initial results for two HIRS overpasses are showing good results; single layer CO2 heights from a non overlap region are comparing well with two layer CO2 heights in the overlap region. Best results continue to be found for thin over thick clouds, even after expansion of the algorithm to include all of the CO2 channels on HIRS. Further refinements and testing will continue; simulations with the MODIS channels is next. It is our intent to generalize the CO2 slicing algorithm to accommodate both single and double cloud layers.

Investigation of Near IR for Very Thin Cirrus Detection. In an attempt to enhance the detection of very thin cirrus, near infrared channels within the 1.4 and 1.9 micron absorption bands are being investigated. With accurate selection of wavelength, the reflected signal can be limited to just the upper half of the troposphere. Detection of very thin cirrus has been demonstrated by Gao et al. at 1.38 microns; indications are that similar

success can be realized at 1.78 microns. Reconfiguration of the MAS to include this channel is underway; the possibilities for including either on the MODIS are being explored but appear to be slim.

ANTICIPATED ACTIVITIES DURING THE NEXT QUARTER

MODIS Science Team Meeting. Paul Menzel will attend the MODIS Preliminary Design Review, the MODIS Calibration Meeting, and the MODIS Science Team Meeting (October 21-19). Steve Ackerman will join in for the Science Team Meeting.

TOGA-COARE Planning. Preparations for TOGA-COARE MAS flights will continue. Chris Moeller will be providing on-site support January 6 to February 4; Paul Menzel's dates are January 14 to February 3.

Publication of MAS Research. A manuscript has been drafted on the three channel differencing as applied to MAS, HIS, and AVHRR/HIRS data; submission to the Journal of Applied Meteorology will occur this month after some further editing. Kathy Strabala of CIMSS is leading in this effort.

PROBLEMS/CORRECTIVE ACTION

None to report