TERRA/MOPITT MEASUREMENTS OF TROPOSPHERIC CARBON MONOXIDE IN SUPPORT OF INTEX

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Interaction with the ongoing satellite measurements programs is an important goal of INTEX-A. The Terra/MOPITT instrument has now been making global measurements of the tropospheric carbon monoxide (CO) distribution for 4 years, and is in a unique position to provide valuable support during the field campaign. Remote sensing of CO will directly address the scientific questions motivating the INTEX-A strategy and deployment, and measurement of this gas is rated as being mission critical. CO is an important trace gas in tropospheric chemistry due to its role in determining the atmospheric oxidizing capacity, as an ozone precursor, and as an indicator and tracer of both natural and anthropogenic pollution arising from incomplete combustion. The satellite perspective will provide the more general temporal and spatial context to the aircraft and ground-based measurements during the subsequent scientific analysis. We will build on the experience of supplying MOPITT data to previous field campaigns, such as TRACE-P. We will provide expedited MOPITT data processing in near real-time, along with basic analysis of the measurements to indicate, where possible, the origin of the CO plumes that impact regions of flight operations and other in situ measurement activities. Temporal analysis will also be provided by comparing and contrasting the current CO measurements with data from previous years. To ensure maximum exploitation of the satellite information, we will also have a scientist in the field to present and interpret the MOPITT data for the INTEX team, and to ensure its utility in flight planning.

In support of the INTEX-A field campaign deployments in July and August, 2004, the following work will be carried out:

1. We will process the MOPITT data at NCAR in near real-time.

   Under usual operation, the raw MOPITT data, in the form of instrument counts, are transferred to NCAR from the NASA LaRC DAAC after download from the Terra satellite. These data are accompanied by supplemental files on instrument pointing and geo-location. The Level 0–1 data processing delivers geo-located calibrated instrument radiances from the instrument count data. These are then fed to the Level 2 processor. This algorithm is composed of the following principal components: the radiative transfer forward model which provides a full physical description of the measurements process, a cloud detection module to identify cloudy pixels, and the maximum-likelihood retrieval. The cloud-detection algorithm combines information from the MOPITT radiances with the MODIS operational cloud mask product to determine if the MOPITT pixel is cloud contaminated and whether a retrieval can be performed. The forward model requires supplemental NCEP (National Center Environmental Prediction) atmospheric information which is obtained from the NASA GSFC DAAC. The output of the Level 2 processor are CO total column and mixing ratio profiles reported at seven levels through the troposphere for each geo-located 22 km×22 km pixel. Validation activities show data accuracy to be about 10%. It is important to note that the mixing ratio at a given level reflects the vertical resolution of the measurement as defined by the retrieval averaging kernel and a priori profile [see *Rodgers*, 2000]. These are also reported for each pixel. The Level 0–2 processing normally takes about 4 days due to the time required to stage and transfer the MOPITT and MODIS data and for computer run-time.

In addition to this usual processing stream, we will maintain a dedicated second stream during the campaign. After identifying the Pacific, North American, and Atlantic regions of interest to INTEX-A, the corresponding MOPITT count and supplemental data will be transferred from NASA using an expedited data protocol. Once at NCAR, this will be priority-processed. Because of the time required to produce the MODIS cloud mask product, only MOPITT input will be used in the cloud detection. This tailored data processing requires considerably more data management and programmer attention than regular processing. Based on previous experience during TRACE-P and subsequent enhancements, it is anticipated that the total turn-around time between satellite measurement and availability of the Level 2 CO distribution product will be about 9 hours.

2. Maps of the CO distributions for each day for the regions of interest will be produced along with several day data-composites. MOPITT uses a cross-track scan, and in the absence of persistent cloud cover, the instrument achieves close to global coverage in 3 days. However, a single day's data are often sufficient to identify CO plumes. These maps, along with the corresponding Level 2 data, will be posted to a web-site for easy access by the INTEX team and made available for the campaign archive.

3. A scientist at NCAR will provide a daily report to accompany the MOPITT product. This will include a preliminary analysis of the data, an identification of sources such as burning events, the larger geographical and temporal context to the CO distributions observed in the region of campaign operations, and a comparison with the corresponding observations from previous years to quickly identify significant perturbations from what would normally be expected. This analysis will make use of other satellite data as and when available. For example, we have experience in comparing MOPITT CO with MODIS derived products such fire counts and aerosol optical depths, and work closely with the teams deriving these products.

4. An experienced member of the MOPITT science team will be present in the field at the flight operations center during the campaign. This scientist will be responsible for receiving the MOPITT CO maps, data, and preliminary analysis and for presenting and explaining this information to the INTEX-A team. They will also have on-hand MOPITT data processing tools to facilitate further analysis and data exploration. In conjunction with other forecast information, the MOPITT data should provide useful insight for use in flight planning. We will also help identify opportunities when Terra overpasses will coincide with flights of the DC-8, and conditions would allow for good validation comparisons. Preliminary results of these comparisons will be presented as soon as MOPITT retrievals have been performed.