20 July 1999
NASA NRA-97-MTPE-16

Integration of Long-Term Oceanic Aerosol Records
from Univ. of Miami Network Stations with NASA Satellite Products.

J. M. Prospero (PI), D. L. Savoie and H. Maring (Co-PIs)

The original work statement for this program identified the following tasks.
1) Provide a detailed survey of the types of aerosol data in the UM archive for each station and the time periods for which data are available.
2) Provide a descriptive summary of the data from the UM sites, including graphs of the times series from each station.
3) In response to specific queries from scientists involved in this NASA activity, to examine the aerosol data in detail to ascertain if they would be suitable for use in a satellite validation, algorithm development, and related activities.
4) If specific data sets are selected, to do a detailed check of data quality.
5) Provide aliquots of archived filter samples to persons interested in making additional measurements of aerosol properties.
6) Participate in the meetings and activities of the Aerosol Radiative Forcing Science Team.
7) Interact with the users of the data in the interpretation of the data in terms of our understanding of the temporal and spatial distribution of aerosols and the associated meteorological/climatological controlling situations.
8) Participate in writing summary reports or scientific papers that might derive from the above activities.
9) Participate in the planning of future aerosol/radiation/remote sensing activities.

Accomplishments during Year One:
During the past year we have carried out a first order examination of our data archive and we have developed statistical characterizations of the aerosol chemistry data sets from about 30 stations. To date, the data have only been used for model validation studies. We have been involved in two major efforts. The first was the WCRP/COSAM program. The COSAM project aims to compare the performance of the global scale chemical transport (GCTM) models in simulating atmospheric sulfate levels. As part of this project (for which we received no separate funding) we provided data from 25 of our field station measurements; these were used for the assessment of the performance of the models. (A total of eleven models participated in the study.) The only ocean data available for this test was the UM data (with the exception of the high altitude data from Mauna Loa). This assessment showed that there are serious problems with many of the GCTM's with regard to long range transport of sulfur species. A draft COSAM report is presently being circulated that highlights the result of this effort. It should be noted that the assessment of the GCTM performance would have been impossible without the UM data set.

The second model assessment activity is being carried out in the context of the current IPCC effort. The UM group is providing data from its ocean network archive for validation of the following species: sulfate (and non-sea-salt sulfate), nitrate, sea salt,

methanesulfonate, ammonium, and mineral dust. Dennis Savoie carried out the statistical characterisation of the data sets from 25 stations and conveyed the data to Joyce Penner who leads the effort. Joseph Prospero attended the IPCC Chapter 5 working group meeting which was held in Hamburg on 15-16 July. Once again, the UM archive data are the only ocean data that can be used for this assessment. The comparison of the model results for sea salt and mineral dust revealed that the models performance was extremely poor for dust and was rather bad for sea salt. (Both the GISS and the GSFC models are participating in this effort. The performance of both models was rather bad in the comparison with mineral dust data – in some cases by orders of magnitude. The sea-salt performance of the GSFC model was somewhat better.) As a result of the meeting, the modeling groups will have to reassess who the model outputs will be used in the IPCC activity. Clearly, the aerosol projections for the next century will be highly suspect if they can't even get close to replicating the current-day levels. One of the planned activities under the IPCC model validation will be to compare the model performance against the ERBE data. The UM aerosol data set will serve to guide the partitioning of the aerosol species in the models as a step in developing the model product for comparisons with ERBE.

Under the current program, Prospero also attended the Dust Workshop held in Boulder in June. Dennis Savoie also attended with support from the TOMS group. Our presentations showed the value of the global-scale archive from the standpoint of interpreting the responses of various remote sensing platforms to aerosol distributions.

We have been collaborating directly with A. Smirnov (NASA GSFC) in interpretations of sunphotometry data from the Aerosol Robotic Network (AERONET) that was established by B. Holben (NASA GSFC). A collaborative paper utilizing data obtained at Bermuda during TARFOX in July 1996 is currently under review. Work has just begun on the full 1984 to 1998 data sets from Barbados. It is expected that data from other AERONET sites will be considered in the future.

Collaboration with P. Ginoux (Georgia Institute of Technology, working at NASA GSFC) is also underway. Ginoux has been comparing our dust data with results from his dust generation and transport model that utilizes real rather than model generated meteorology. The comparisons with Barbados (1988, 1990, 1993), Izaña (1988) and Bermuda (1988) are quite promising. The model reproduces nearly all of the peaks although the amplitudes of the extreme peaks in the model are generally less pronounced than those in our data. A paper focusing on comparisons of the model results with ground station measurements (concentration and size distribution) and vertical distribution with LITE data is currently being pursued. We expect that this collaboration will also expand in the future.

II. Proposed activities in Year Two

A. Considerable time was spent to organize the aerosol chemistry data into files for the model comparisons. As a consequence, the aerosol chemistry data are genrally up-to-date in reasonably well-organized formats. Formats is plural because different modeling

efforts required different summary information. During Year 2, we propose to gather the various final data sets and their statistical summaries together into files that can be easily read by any computer platform; this will most likely be ASCII CSV (comma separated variable) files. They currently exist primarily in Excel files.

B. Another aspect of our extensive data sets are the aerosol scatter and aerosol absorption data that were (are) collected concurrently with the chemistry data. These data require a substantial amount of additional work. These data are acquired and logged at 1-minute intervals. Over the years the logging files have been updated and refined, and consequently, the data exist in files of various formats. The intent is to add this data to the already existing aerosol chemistry data files to form complete data sets. To do this requires that the scatter and absorption data be averaged over the same intervals that the aerosol chemistry samples were collected. Work on putting this information into a common format so that it can be readily analyzed has only just begun. The combined data set will permit us to more rigorously partition the total scattering and absorption among the major aerosol components. This information is important as input to models for assessing the impact of aerosols on light transmission through the atmosphere and for validation and/or refinement of algorithms used for retrieval of aerosol information from remote sensing instruments (whether space-based or ground-based).

C. During the coming year we expect to interact more directly with remote sensing groups. We have already begun planning for a specific activity with the TOMS group. This derives from the Desert Dust Workshop held in Boulder in June. At that meeting, Prospero and Torres agreed to write a joint paper which will use the TOMS absorbing aerosol index (AAI) product to identify specific dust sources around the globe. For each of these sources, we will characterize the terrain features in these source regions. This includes topography, soil characteristics and any other features that may favor the production of dust. In this way we hope to come to a better understanding of the factors that control dust emissions as observed by TOMS. A second activity will compare the temporal and spatial variability of TOMS AAI with the variability observed at our ground sites. Of particular interest will be to see if TOMS has been able to detect the variability of dust transport that we have observed at some of our sites. For example, at Barbados, we often observe a very large year-to-year variability in dust concentration. We will see if TOMS also observes these changes. This will give us an idea of TOMS “sensitivity” to dust variability. If so, then we could use TOMS to track the temporal-spatial variability of dust with some confidence.

D. We hope to establish more specific working relationships with additional remote-sensing groups during the GISS meeting in September.