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Project to Interface Climate Modeling on Global and Regional Scales with Earth Observing (EOS) Observations

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Final Technical Report

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Final Report for the NASA EOS/IDS Investigation: "Project to Interface Climate "Modeling on Global and Regional Scales with Earth Observing (EOS) Observations"

This 10-year NASA IDS project began in 1990. Its initial work plan adopted the NASA provided timeline that data would become available for new EOS platforms beginning in 1995. Over its first phase, it was based at NCAR, which had submitted the original proposal and involved activities of a substantial number of Co-Is at NCAR who engaged in research over several areas related to the observations expected to be received from the EOS platforms. Their focus was the theme of use of EOS data for improving climate models for projecting global change. From the climate system viewpoint, the IDS addressed land, clouds-hydrological cycle, radiative fluxes and especially aerosol impacts, ocean & sea-ice, and stratosphere. Other research addressed issues of data assimilation, diagnostic analyses, and data set development from current satellite systems, especially use of SAR data for climate models.

Because the PI moved to University of Arizona shortly after the investigation was approved for funding, its budget was redone to include a large subcontract to the University of Arizona. Other subcontracts and Co-Is were at the University of Colorado, Oregon State, and the University of Wyoming. Up to 50 scientists were engaged at times on these activities, and a substantial number of students and Postdocs were trained, including some who are currently highly visible in their contributions to application of EOS data. Most of the others are productively engaged in other aspects of global change research. Many journal papers published by the participants acknowledged support from the IDS funding. However, NASA's continuing slippage of the launch schedules of its new platforms kept the intended use of new data far in the future.

In 1995, this IDS investigation was subjected to a mid-life review including inputs by mail and panel. A letter from Dr. Asrar in April 1996, based on these reviews, found that the activities had been productive, but noted they had deficiencies which he summarized as: a) an overall lack of management and integration; b) a confusing science

computing facility plan, c) too broad a scope of the activities and lack of linkages between components; d) need for closer collaboration with the hydrology IDS at University of Arizona. In response to these criticisms, and a reduction of budget levels to less than half of their previous amounts, the IDS was drastically restructured in its participants and focus. In particular, the NCAR elements were phased out and it was moved to University of Arizona. The only subcontracts retained were at University of Colorado and JPL at reduced levels. The focus was, at that point, limited to land-surface processes as the activity that had moved most rapidly over the previous years and looked most promising. Indeed activities incorporating the BATS land model with the NCAR CCM had greatly improved our understanding of what would be needed to realize the core objectives of the IDS. Thus, although many components of the IDS disappeared, the activities at University of Arizona and work toward using EOS land data for improvement of climate models was strengthened and accelerated.

The particular activities planned in 1996 and carried out in subsequent years have been: a) Use of data and climate models to develop an algorithm for the diurnal cycle of land surface skin temperature. This activity was followed to completion by Dr. Menglin Jin who was supported by a NASA fellowship and used this topic for her PhD dissertation, completed in 1998. This is now a popular subject of further work include Postdoc activities by Dr. Jin at the University of Maryland. b) Activities to retrieve broadband albedo, fractional vegetation cover, roughness and LAI. A successful approach to retrieving fractional vegetation cover was lead by Dr. Xubin Zeng, published, and is now widely used. Dr. Kimberly Schaudt published several papers advancing the development of procedures to obtain roughness length. The issues of LAI and broadband albedo were addressed initially through the PhD dissertations of Dr. Jeffry Privette and Dr. Keith Oleson at the University of Colorado and more recently through initiation of collaboration with Dr. Myneni and Dr. Alan Strahlar at Boston University whose roles on the MODIS team has been to provide such data.

Simulations with global climate models were initiated to examine the use of EOS data and the improvements obtainable from use of higher resolution models. Additional work was initiated toward the use of field and pre-EOS satellite data to improve model land surface processes in semi-arid regions and the collection of data for validation and examination of the sensitivities to new EOS data.

Collaborations were initiated with the Sorooshian and Seller's IDS teams to provide a more comprehensive approach to use of land data. Substantial progress was made in the late 90's in improvement of land surface models, especially the role of vegetation, the connections between transpiration and photosynthesis, and vegetation/climate interactions and the role of snow.

In 1999 the PI moved to Gatech and this grant was transferred with him. A no cost extension moved the 2000 ending data to the end of 2001. During this period, a new activity was developed based on the previous one and in response to the new announcement for IDS proposals. This was developed with new collaborating institutions, especially Boston University and the University of Maryland. However, the underlying concept remained much the same as that of the IDS reported on here, especially after its restructuring in 1996, namely to further the application of EOS data to the representation of land in climate models.

This IDS has made major fundamental contributions to the utilization of the new data from the terra and aqua platforms. One such contribution was the development of the next generation land model referred to as the Common Land Model and especially tailored for use of such data. This was done with the help of numerous collaborators connected to NASA programs and provides the land model for the next generation NCAR/NASA/DOE climate model. However, the multiple delays from the originally scheduled 1995 launch of the first platform precluded actual application of new EOS data to climate models over the period of this investigation. Our success in competition for the

follow on activity is, however, making it possible for us to begin to achieve this long-range objective.

Selected Publications Supported by Grant

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