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THE LAND COMPONENT OF THE GLOBAL CLIMATE SYSTEM

WITH ADEQUATE SPATIAL RESOLUTION

Technical Progress Report

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R. E. Dickinson

Institute of Atmospheric Physics

The University of Arizona, Tucson, Arizona 85721

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The goals of this program over a three year period are:

- a) To upgrade the BATS1e code to current programming standards as implemented in CCM2; and to document and design the next generation of this code;
- b) To reprogram BATS1e to carry out its integration over land in efficient vector loops and interface this code to CCM2;
- c) To formulate and implement CCM2 schemes to provide statistically prescribed distributions of precipitation, radiation and sub-scale cloudiness;
- d) To perform sensitivity studies with the BATS1e scheme implemented in CCM2; and
- e) To develop graphical visualization procedures for scientific evaluation of the fine mesh output.

The overall import of this project has been to support and focus collaboration between the University of Arizona and NCAR (and when appropriate DOE staff) towards achieving a state of the art land surface model available for CHAAMP and more general community use along with NCAR's CCM2 climate model. There have been some delays due to the slow pace of the CCM2 finalization process at NCAR but these delays have been compensated for by collaborations with NCAR staff on parts of our proposed work here.

Some tasks under a) and b) have been finished or nearly so. The BATS code is being implemented in CCM2 in collaboration with research associate Patrick Kennedy of NCAR and an earlier vectorized version has been upgraded to the current BATS1e by Anji Seth, a student at NCAR working with Dickinson, and employed as consultant to the project. Her version has been implemented as vectorized longitude loops in a mesoscale climate model (a version of MM4) by programmers working for Giorgi. The same scheme has been implemented in CCM2 by CCM core group programmer Linda Bath. Documentation of the present BATS version has been completed in the form of a new NCAR Tech Note (in press).

Progress to date on c) includes the following:

- i) A. Seth has done off line sensitivity studies demonstrating the importance of doing this as part of her development work with VBATS.
- ii) M.-Y. Chen, graduate student supported by the CHAAMP project, has worked with enough hourly precipitation data to develop adequate statistics at the T-42 model resolution. She has mapped the monthly average patterns of gauge precipitation, along with intensities and frequency of occurrence. Most significantly, the resulting smooth geographic and seasonal patterns are amenable to fitting by simple physically based expressions; for example, it is possible within the CCM to convert grid-square average precipitation to fractional area of precipitation and intensity distributions of the precipitation with the grid square; similar relations

for radiation will also be found. This step is needed for the optimum implementation of the VBATS package. A hydrology graduate student, Gao, on NASA fellowship is further developing the theory of this approach.

Under task d) above – sensitivity studies with CCM2 (CPUs to be obtained elsewhere) – we have obtained 2,500 GAUs through the MECCA program at NCAR but these studies have been delayed awaiting completion of the BATS/VBATS linkages to CCM2.

Under e) above – develop graphical visualization for fine mesh output – one full-time-equivalent programmer has been devoted to this task. Much of the work to date has gone to developing needed infrastructures. This aspect of the project has supported in part salaries of J. Vaughan and B. Auvine. One result of this effort has been that our PC hardware and software support has been increased and communications with the DecStation UNIX environment enhanced. Another more intensive area of this effort has been the use of a Geographic Information System called GRASS (Geographic Resource Analysis Support System from US Army Corps of Engineers) in combination with other UNIX tools and compilers to support fine mesh data visualization. In addition, these tools are being used to develop datasets for input to the fine mesh land component of model runs. Particular attention has been given to production of a soils hydrology database for use in BATS.

Plan for Year Three

The following tasks will be the main focus of activity over the third year of this study:

1. Upgrade BATS1e to the current programming standards of CCM2. As summarized above, BATS and VBATS versions of the code have already been implemented in CCM2. The most important remaining work is to redo the structure of common blocks and subroutine argument lists to have a clearly delineated logical "plug compatible" structure. Present code consists of comment blocks that have been added as needed by Dickinson over a ten year period of development; consequently, they lack overall organization. Also a lot more cosmetic work is needed, such as getting rid of the "F -array" pointer structure that originated in the "NCAR third generation GCM", predating the CCM sequence of models. Also indenting needs to be consistent with CCM2 and comments cleaned up and made consistent with CCM2.
2. Document and design next generation code. Only minor progress has occurred to date. This work requires critical evaluation of the significant parameterization features included in more recent packages outside of BATS to see if inclusion is warranted. We should make considerable headway through participation/leadership in the PILPS international comparison project for land modules.
3. Implement the VBATS code in CCM2 as a land submesh. The primary programming task involved with moving from the longitude loop version is to prepare the required input data structures and data output structures
4. Complete the study of global precipitation intensity and fit the observed data to CCM2 via a statistical relation to some physical model parameters. Additional global data will be sought and added to the database already analyzed.
5. Create and assure the quality of the global databases of land surface initial and/or boundary condition values for subscale BATS use. To do this effectively for multiple databases, the various data input operations of subscale data into BATS will have to be integrated.

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