Statement of Work – Colorado State University

The surface roughness and fractional water coverage products being developed at JPL will be evaluated through a series of numerical experiments with a mesoscale atmospheric model (RAMS). These experiments will involve simulation of a period of 10 days in August 2001 (the Santarém Mesoscale Campaign). We will perform the following specific experiments:

1) CONTROL: This will involve specification of surface properties (land and vegetation cover, including surface water, and physical properties, including surface roughness), from AVHRR NDVI products on a 1 km grid.

2) WATER: We will specify the fractional water coverage for each 1 km grid cell from the fractional inundation data provided by Saatchi at JPL.

3) ROUGHNESS: We will replace the RAMS-specified roughness (based on a vegetation lookup table) with eh spatially-varying product derived by Saatchi at JPL.

4) BOTH: Both fractional water coverage and surface roughness will be specified from the JPL products.

RAMS is a general purpose atmospheric simulation modeling system consisting of equations of motion, heat, moisture, and continuity in a terrain-following coordinate system (Pielke *et al* . 1992). The model has flexible vertical and horizontal resolution and a large range of options that permit the selection of processes to be included (such as cloud physics, radiative transfer, subgrid diffusion, and convective parameterization). Two-way interactive grid nesting (Nicholls *et al* . 1995; Walko *et al* . 1995*a*) allows for a wide range of motion scales to be modeled simultaneously and interactively. For example, with nesting, RAMS can feasibly model mesoscale circulations in a large domain where low resolution is adequate, and at the same time resolve the eddy fluxes caused by juxtaposition of different land cover types, such as occur when forest is adjacent to pasture land (Pielke *et al.* 1992).

Several major RAMS developments were completed in the last few years which greatly enhance its ability to simulate the components of the hydrological cycle. Among these is a new bulk microphysical code (Walko *et al* . 1995*b*, 1996*b*) which represents each water category (cloud, rain, large and small pristine ice, aggregates, graupel, and hail) as a generalized gamma distribution and prognoses both the mass mixing ratio and number concentration of all categories. The model includes homogeneous and heterogeneous nucleation of pristine ice, the representation of five different ice habits, conversion of ice between the large and small pristine categories resulting from vapor deposition or sublimation, and prognosis of aerosol (cloud condensation nuclei). Very efficient solvers for the stochastic collection equation based on new analytic solutions to the collection integral and for activation of cloud droplets are implemented. Accurate prediction of cloud droplet number based on aerosol concentrations and supersaturations allows the model to properly represent cloud albedo. The sedimentation routine allows differential fall speeds based on the gamma size distribution. Another development in RAMS is the ability to nest vertically to increase vertical resolution in selected areas (Walko *et al*. 1995*a*).

The simulated meteorological fields will be compared in detail to observations collected during the Santarém Mesoscale Campaign. These include hourly surface flux data from intact forest, regrowing forest, and pasture sites operated by NASA in the Flona Tapajos; twice-daily radiosonde data collected by scientists from the Universidade de São Paulo at Belterra; and hourly boundary-layer soundings from SODAR data at the Santarém airport.

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