The OSU Mars Mesoscale and LES Models: A Status Report. J.R. Barnes and D. Tyler, 104 COAS Admin. Bldg., College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, OR 97331 (barnes@oce.orst.edu, dtyler@oce.orst.edu).

Introduction: The OSU Mars Mesoscale Model has been used for a variety of atmospheric circulation studies since its initial development from the terrestrial MM5 system. These have included investigations of the meteorology at the Mars Pathfinder and Viking Lander 1 sites [1], studies of the northern polar circulation in summer [2], and modeling of the candidate Phoenix landing sites [3]. The OSU Mars LES Model has been developed over the past several years, and has been used for Phoenix EDL studies [3] as well as fundamentally oriented studies of the Mars atmospheric boundary layer. This model was developed by adapting a terrestrial LES model which was originally developed by E.D. Skyllingstad at Oregon State University. A major advantage of this LES model is its strong suitability for running in massively parallel computing environments - in particular, the Columbia system at NASA Ames.

Recent Model Developments and Studies: More recently, the OSU Mars Mesoscale Model has been used for very extensive studies in connection with the MSL EDL engineering effort. Simulations have been performed for all of the MSL candidate landing sites, which span a very considerable range of global locations on Mars. A number of the MSL candidate landing sites are in the southern-winter hemisphere, so these simulations involved running the mesoscale model in a southern winter mode, something that had not been done in the earlier studies. In this mode the southern seasonal polar cap is essentially specified according to the MGS TES observational data (as the northern residual and seasonal caps are for spring and summer cases). The OSU LES Model is also being utilized in the MSL EDL studies, as well as in studies related to the year-long operations of the MSL rover.

Most recently, a version of the OSU Mars Mesoscale Model which is suitable for studies of the sublimation and transport of water away from the north polar residual (and the seasonal) polar cap during spring and summer has been under development. This model is in many ways a direct analogue to the terrestrial polar MM5, greatly facilitating high-resolution studies of the unique polar regions of Mars.

In connection with the MSL mesoscale modeling work a number of basic improvements in the OSU model were made. Several of these are related to the static dust loading in the model. These changes include the following: 1) the visible opacity at reference pressure was made a function of latitude; 2) the Conrath-Nu Parameter was allowed to be a function of latitude; and, 3) the reference pressure itself (the pressure at which the prescribed visible opacity is reached) was made a function of latitude. The reference pressure is a linear approximation to the zonal mean surface pressure in the NASA Ames GCM being used to provide initial and boundary conditions; we are prescribing visible opacities in relation to zonal mean total atmospheric column values (and not a 6.1 mbar surface). Thus, the altitude at which dust mass mixing ratios begin to fall rapidly towards zero (as determined by the Conrath-Nu parameter) is now keyed to geometric height above the ground. The above changes in the specification of the atmospheric dust loading have allowed the OSU Mars Mesoscale Model to show better agreement with the MGS TES atmospheric temperatures.

Other changes in the OSU Mars Mesoscale Model have included a higher model top and more vertical resolution in the boundary layer, and the use of higher resolution runs with the Ames GCM to provide initial and boundary conditions (the nominal configuration of the GCM is now 5 degrees in latitude by 6 degrees in longitude). The nominal nesting configuration being used for MSL EDL work as well as for north polar studies has a highest resolution domain with a ~ 4 km grid spacing and a semi-global mother domain with a nominal grid spacing of ~ 108 km (there are three nested domains).

In connection with the Phoenix EDL studies, considerable effort was devoted to incorporating a time and height-dependent geostrophic wind (horizontal pressure gradient) forcing in the OSU Mars LES Model. Geostrophic winds from the OSU Mars Mesoscale Model are used for the forcing of the LES model, in order to provide much more site-specific simulations of the atmospheric boundary layer [3].

References:

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