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Environment

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Especially the last year has reminded us how vulnerable the human habitat is to natural hazards. The large Sumatra earthquake from Dec. 27th 2005 and the subsequently triggered tsunami have caused one of the biggest catastrophic events in recent history. At the same time these phenomena give us an idea about the tremendous power sleeping in the interior of our planet. These forces move continents and ocean floor. Over geological time scales they let mountains grow and new ocean basins develop. On short time scales the same forces lead to earthquakes and volcanic eruptions. There is little hope that man will ever be able to gain control over these forces. Nevertheless it seems wise to understand the processes operating in the interior, in order to wisely estimate and possibly predict potential hazards. Much more accessible to -and also much more influenced by- human activity is the atmosphere of the Earth. As compared to the interior we have much more information about this part of the 'System Earth' and consequently, our expectations with respect to the predictive power of numerical models are higher. The distribution of pollutants is of significant importance and especially the distribution of fine and ultra-fine dust particles currently receives growing attention. Two projects, conducted on NIC resources have been selected to exemplify the diversity and likewise the topicality of projects carried out in the Environmental section of research at NIC.

One, by Wolke et al, aims at a better understanding of the transport of chemical species in the atmosphere, being an example of applied research, guided by practical questions. The authors have developed a multiscale approach, in which a model, simulating the transport of chemical constituents is embedded into another model, providing the various aspects of atmospheric dynamics. The coupled model is employed to study the distribution of (a) fine dust in an industrial region in Saxonia and (b) of Saharan Dust Aerosols. While the first application is of direct regional meaning the latter is of importance on even larger scale. Dust influences the amount of sunlight received by Earth. Dust scatters and absorbs sunlight and such also affects the temperature. In their contribution Wolke et al. present further steps towards a model that can be routinely employed for process analysis, as well as to interpret field data.

The study of Hansen et al. addresses fundamental aspects of planetary evolution. Plate tectonics and its relation to the internal dynamics of planets is the central topic of their efforts. At present, the phenomenon of plate tectonics seems to be a unique feature on Earth. Other planets, like Mars, may have shown plate tectonics earlier in their history. Can plate tectonics suddenly appear on a previously inactive planet, or, alternatively, can it vanish, thus leaving a stagnant lid covering the planet and keep it from further cooling? Numerical experiments are virtually the only tool, allowing to go into such matters. Exploiting the conservation laws for mass, energy and momentum leads to a set of nonlinear

partial differential equations, describing the transport properties under such extreme conditions. In their studies the authors demonstrate the important role played by the rheology of the material. Especially the dependence of the viscosity on (a) temperature, (b) pressure and (c) stress governs the style of surface tectonics. An important conclusion says that is dynamically feasible that a planet may undergo a change in its surface behaviour, i.e from an active planet to one without surface tectonics, and vice versa. The question if a planet exhibits plate tectonics has thus been extended by the dimension time.