NG-TEPHRA: A Massively Parallel, Nimrod/G-enabled Volcanic Simulation in the Grid and the Cloud

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Abstract*—Volcanoes are a principal factor of hazard across the Pacific Rim, with their focus of interest mostly divided into pyroclastic flows and ash deposition. The latter has significantly more impact due to its widespread geographical reach and prolonged effects in human activities and health. TEPHRA is a volcanic ash dispersion model based on the advection-diffusion Suzuki model, which has been revisited and modified for the Irazú volcano in Costa Rica. For the Irazú case, a full parameter exploration is required due to uncertainty of existing observations. We present in this paper the model, its assumptions and limitations as well as application lifecycle with an example of an ash distribution graphic for the Great Metropolitan Area (GMA) in Costa Rica, which holds around 60% of the population and productive activities in the country. The computational experimental settings are described, in particular the use of Nimrod/G with respect to non-homogeneous parameter sweeps and its impact on execution time. We also analyze the implementation of a new parameter discard mechanism common to e-Science experiments where sequential generation of new parameter sets has to be complemented with an early verification in order to avoid allocation of CPU time to non-valid scenarios. Finally four sample 100K-scenario runs are analyzed for both traditional HPC clustering and Cloud computing resources in the Amazon EC2 Cloud.

***Index Terms*—ash dispersion, cloud computing, computational volcanology, grid computing, nimrod, parametric sweep, suzuki advection-diffusion model, tephra**