LavaLads Work Plan

Keith has a DEM of Montserrat, and can run TITAN simulations. Currently the way he creates a flow is to consider the growing dome as the source of material. Event initiation consists of slicing this dome by a plane whose normal makes a specified angle with the vertical and azimuthal, and at a specified depth from the top of the dome. The material above this cut plane is the released material. We will reduce the dimensionality of this parameter space to two, by considering a fixed vertical angle. The azimuth angle and depth then produce, respectively, the direction of initial flow and the volume. The plan for simulation and emulation, then is:

1. Identify $O(dozen)$ locations $\mathbf{x}$ on the island at which we will monitor
$$H(T) = max_{0<t<T} h(\mathbf{x}, \mathbf{t}) \tag{1}$$
These could include, for instance, a town center and the MVO site, and locations near to these sites say points at the outskirts of the town.

2. Explore the initial parameter space by making many coarse grid runs, to determine which parameter regions might cause H to exceed some critical threshold H_c.

3. Create an emulator of H, at least for the parameter regions of interest.

4. Can use of this emulator help better outline the parameter regions?

5. Using Wolperts frequency-volume distribution, importance sampling, and a combination (to be determined) of fine grid simulations and emulations, identify the flows for which $H > H_c$ at points $\mathbf{x_s}$ a subset of selected $\mathbf{x}$s (such as the town centers).

6. Stitching together these points should provide us with a probability of damaging flow over the next N years for selected locations. If we could do this for all points, we'd have a complete hazard map.

Several issues concerning these items must be addressed. Before any real issues are discussed, an obvious one — What is a coarse grid run versus a fine grid? For working purposes, a coarse grid run will mean a run that takes 10-20 minutes of compute time on one or a few processors. A fine grid run will be one that takes 1-several hours on many processors.

Now to other issues. First, perhaps H is not the best measure to use. A smoother function might be more reliably computed and emulated - for example, a nice measure might be

$$\int_0^T \int_{cell} \frac{\partial}{\partial_{x_j}} h v_j \, dx_j \, dt \tag{2}$$

where the cell is a computational cell covering the point of interest. This integral is, then, the total flux of material into the cell of interest.

Second, how do we tie together Wolpert's distribution and importance sampling?

Next, how do we decide if emulation is accurate enough to determine the parameter values of interest?