Geocomputation in Geohazards -Tephra Fallout

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Problem 1

Suppose you are working in the volcano observatory and you observe a 10 km high eruption column that has developed during the last 2 hr. You need to make a quick calculation of the areas downwind of the volcano that will be impacted by 1 cm diameter tephra particles (settling velocity of about $2\,\mathrm{m\,s^{-1}}$). Implement the analytical solution to the tephra fallout problem (see the handout *Tephra Fallout and the Advection-Diffusion Equation*) to determine where these particles will accumulate on the ground. Assume you can calculate the total mass from the observed eruption conditions, that there are only grains 1 cm diameter in the column (very big assumption) and that all grains fall from the maximum observed column height of 10 km. Assume that the density of the 1 cm diameter grains is $1000\,\mathrm{kg\,m^{-3}}$. What is the maximum expected thickness of tephra fallout from this eruption?

Create a flowchart of your algorithm to calculate the analytical solution for the fallout of 1 cm diameter particles. The output of your algorithm should be tephra thickness from the eruption measured in *centimeters*.

Write a PERL script to implement your algorithm in code.

Execute your PERL script using reasonable initial conditions for the tephra eruption, specifying the settling velocity and release height, wind velocity ($10\,\mathrm{m\,s^{-1}}$) and particle diffusion coefficient ($300\,\mathrm{m^2\,s^{-1}}$).

Plot your results as a contour map of tephra thickness.

Explore the sensitivity of your model results to your choice of the diffusion coefficient by increasing the diffusion coefficient to $600\,\mathrm{m^2\,s^{-1}}$.

Turn in your discussion of your model assumptions, the flowchart, PERL script, output of the PERL script, and discussion of the model outputs. Be sure the PERL script is annotated to indicate the function of each element of the PERL script).

Problem 2

The handout *Tephra Fallout and the Advection-Diffusion Equation* contains a lot of information about the tephra fallout model Tephra2 and its input parameters. In this problem, you will run the Tephra2 code via the vhub.org website and compare results to the simplified problem you solved in Problem 1.

Create a user account on vhub.org

Run the Tephra2 code, specifying input parameters to mimic those in Problem 1, but use a range of grain-size distribution.

Plot the results of your Tephra2 run at the same scale as your map produced in Problem 1.

Turn in your list of input parameters, plots, and discussion. How similar or different are the maps made with your simplified analytical solution and that made with Tephra2?