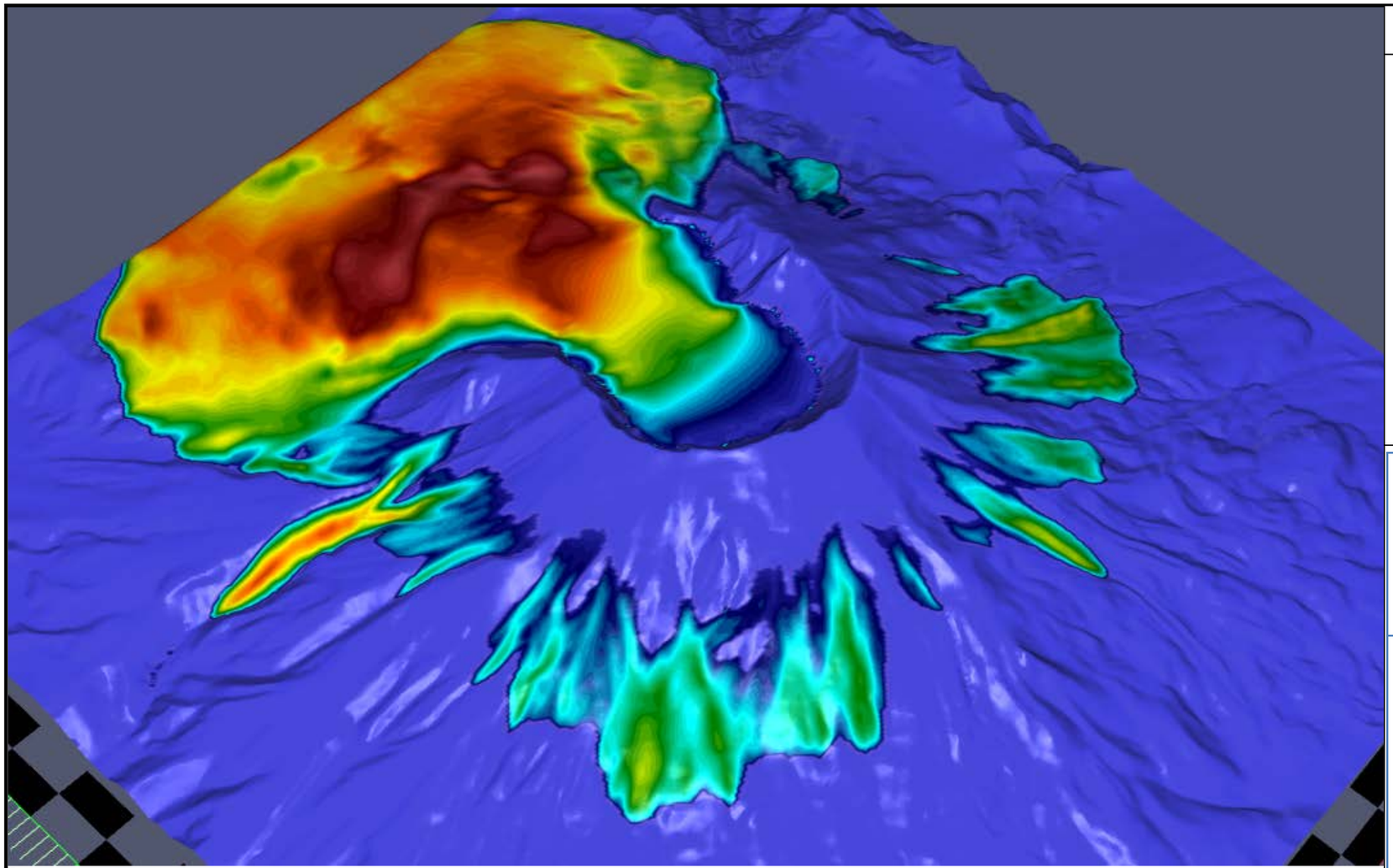
Liquefied Soil Flow Simulation of Mt. St. Helens Volcanic Eruption Debris Field in Animated 3D PDF Poster

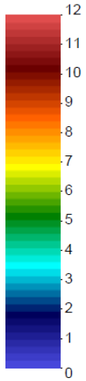
Gordon Glasgow, HR Wallingford, and Ian Curington, Visual Technology Services



80

Catastrophic Volcanic Eruption of Mt. St. Helens, May 1980

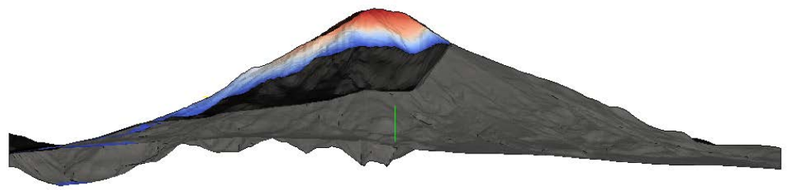
Mean Flow Velocity



Location: 46° 11′ 28″ N 122° 11′ 40″ W, in the Pacific Northwest USA, 154 km south of Seattle, Washington. The volcano is well known for ash explosions and pyroplastic flows, with the catastrophic eruption on May 18, 1980, photos by Austin Post, USGS (left) and Rocky Kolberg (right). The debris is estimated at 2.9 km^3 displaced material during this eruption.

Analysis of high resolution digital elevation model data before and after the eruption, with elevation differences, the displaced material can be estimated. In the cross-section through the crater below, the dramatic reshaping of the mountain profile is shown. During simulation, this displaced material area is treated as liquid, moving material under gravity and liquefied soil physical properties.

Cross-Section (N-S) Showing Before & After Terrain Displacement



INTRODUCTION

The joint project represents an animated 3D PDF visualisation showing the numerical simulation of the Mt. St. Helens volcanic eruption. By using publically available USGS DEM data for before and after the eruption, the total depth of fluidised material at the start of the simulation is set as a starting condition. A proportion of the material is lost into the atmosphere in the ash cloud. The 3D free surface is tracked along with mean flow velocity shown as a 50-step colour contour texture. In this simulation the whole fluidised mass is assumed to lose structure and become mobile instantaneously, with kinetic energy, flow and material friction modeled. A derived version of ParaView, PV+ is used for visualisation, with 3D PDF interactive report generation.

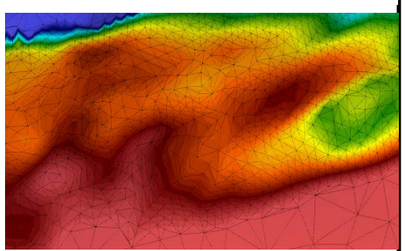
MODEL GENERATION, 3D PDF ENCODING

The DEM resolution of 40m (256x256) grid cells is used in the simulation shown, with the first 150 time steps captured for the poster animation. The 50-step banded contour colour texture represents the mean flow velocity in meters per second. The simulation generated VTK files imported by PV+. The first time step shows the state before the eruption. Details are visible due to the adaptive triangle mesh and a banded texture.

A quadric error measure weighted by both geometric shape and flow rate contours is used to create a simplified representation with a budget of 4m triangles including all 150 frames, with a 3D PDF file size of 16 MiB. The 3D PDF encoding uses PRC highly compressed tessellation (HCT) encoding, with sequence animation controls.

Contour Attribute Sensitive Simplification

At each time step, the mean flow velocity spatial gradient is used as a controlling condition for triangle mesh simplification as well as spatial geometric gradients. During the animation the triangle density varies to follow detail in the flow contours.



Date: 23/09/2014 **Revision: 1.1**

HR Wallingford
Working with water
WWW.HRWALLINGFORD.COM

PDF3D
WWW.PDF3D.COM