IMPROVE SSC on Volcano Geodesy
March 27-29, 2023
University of Bristol

Students to arrive by Sunday, March 26

Monday, Day 1: Volcano geodesy I: Observations and analytical models
Lecture 1: Satellite geodesy: InSAR basics
Practical 1: InSAR data using COMET deformation portal: https://comet.nerc.ac.uk/comet-volcano-portal/
Lunch
Lecture 2: Ground-based volcano geodesy
Practical 2: Analytical deformation models

Tuesday, Day 2: Volcano geodesy II: Numerical and laboratory models in volcano geodesy
Lecture 3: Finite Element Analysis (FEA) in volcano geodesy
Practical 3: Intro to FEA in volcano geodesy*
Lunch
Lecture 4: Laboratory models in Volcanology
Practical 4: Intro to analogue models

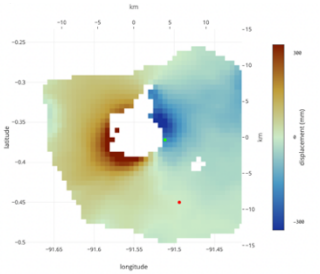
Wednesday, Day 3: Volcano geodesy III: Volcano mechanics
Lecture 5: Crustal architecture and rheology
Practical 5: Advanced FEM*
or
Practical 5: Advanced analogue modelling
or
Practical 5: Advanced InSAR analysis

Lunch
Wrap-up session/Final discussion

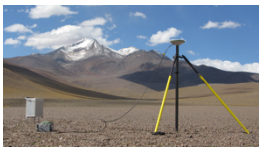
End by 15:00hrs for students to catch late afternoon flights from Bristol to Europe

* COMSOL Multiphysics trial licences for all participants

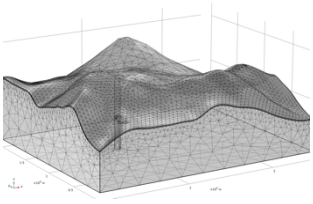
Summaries of lectures



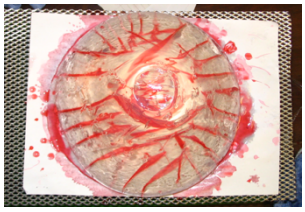
Lecture 1 -- In this lecture we will explore satellite-based observations of volcano deformation by exploring the basic concepts behind Interferometric Synthetic Aperture Radar (InSAR), advances in data processing and the use of InSAR in volcano monitoring. This lecture is followed by a practical on the use of data repositories, processing tools and data interrogation tools available from web-based platforms.



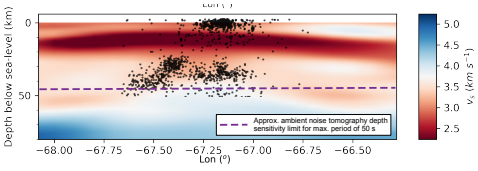
Lecture 2 --This lecture explores the basic concepts behind ground-based geodetic observations such as Global Navigation Satellite Systems (GNSS), levelling and electronic distance measurements (EDM) and their use in volcano geodesy. One focus will be on the integration of different geodetic techniques in a common geodetic reference frame to obtain consistent and comparable data sets for interrogation of causative processes behind volcano deformation. This lecture is followed by a practical on the use of analytical models to explain processes leading to volcano deformation including uncertainty analysis.



Lecture 3 -- We will focus on numerical modelling in volcano geodesy based on Finite Element Analysis (FEA) to explore opportunities such models offer with respect to analytical models. We will cover basic aspects of FEA for solving continuum mechanical problems in elastic and inelastic media in 2D and 3D space. Forward and inverse approaches to data modelling are discussed as are capabilities of FEA to solve for multi-physics problems jointly and simultaneously, such as thermomechanics, thermoporoelasticity and potential field changes. This lecture is followed by an introductory practical on the use of FEA in volcano geodesy. A follow-on practical on the next day offers training on more advanced concepts.



Lecture 4 -- This lecture will introduce the use of laboratory experiments with analogue materials to simulate volcanic processes, with an emphasis on magmatic intrusions and ground deformation. We will discuss the properties of materials, laboratory techniques, and the scaling of experiments to volcanic conditions. There will be opportunities to run relatively simply analogue experiments and consider their suitability and limitations.



Lecture 5 -- This lecture explores the role of subvolcanic and crustal architecture on the relationship between stress and strain with implications for the mathematical modelling of volcano geodetic problems. We will explore the influence of crustal mechanical heterogeneity, discontinuities and crustal rheology on surface displacements and their interpretation by drawing form examples in the published literature.