VOLCANISM AS AN ACTIVE PLANETARY PROCESS ON VENUS. M. W. Airey[1], T. A. Mather[1], D. M. Pyle[1], K. L. Aplin[2], F. W. Taylor[3], C. F. Wilson[3], R. C. Ghail[4]. [1]Dept. of Earth Sciences, University of Oxford, South Parks Road, Oxford, OX1 3AN, UK. (martin.airey@earth.ox.ac.uk), [2]Dept. of Physics, University of Oxford, The Denys Wilkinson Building, Keble Road, Oxford, OX1 3RH, UK., [3]Dept. of Atmospheric, Oceanic and Planetary Physics, University of Oxford, Parks Road, Oxford, OX1 3PU, UK., [4]Dept. of Civil and Environmental Engineering, Skempton Building, Imperial College London, South Kensington Campus, London, SW7 2AZ, UK.

Introduction: The study of the planet Venus and the dynamic interactions between its geology, atmosphere and climate provides us with a unique case study with which to examine the effects of climate warming and the evolution of extreme environments on a planetary scale [1, 2]. The role of volcanism is, or has been, intrinsic to this complex climate system and therefore a fuller understanding of Venusian volcanism, and its impacts, is crucial; more so in light of new evidence for geologically recent volcanism on Venus [3].

The ways in which Venusian volcanism physically manifests at the surface are in some ways similar to those on Earth. Edifices resembling Earth's shield volcanoes are numerous on Venus; they occur as individual volcanoes and in large volcanic fields [4]. Volcanoes resembling the more composite type volcanoes of Earth are somewhat less numerous. However, they are apparent and could possibly represent evidence of behaviour consistent with that of the volcanoes that display explosive volcanism on Earth [5]. In addition to these more familiar structural types, Venus also hosts the curious steep-sided, or 'pancake' domes of debatable origin [4].

The ultimate aim of this project is to better characterise volcanism on Venus and it's long-term effects on Venus' climate and planetary evolution. Combining morphometric analyses of radar data with mathematical modelling of plume behaviour based on existing thermodynamic models [6, 7], along with the analysis of other radar and radar derived properties, the style and nature of possible current and past volcanism can begin to be determined. With these insights, further climate modelling using these volcanological scenarios will further elucidate the manifestation and effects of volcanism on Venus.

Methods: The initial data-gathering phase involves the building of a database of morphometric and other radar derived properties from the Magellan datasets. With these, it is hoped that inferences can be drawn as to their eruptive styles and geological evolution. Using the morphometric data with the known characteristic boundary conditions at their specific locations, models of physical plume behaviour can be fitted to the observations and therefore be parameterised to reproduce the style of eruption resulting in these volcanic footprints, and hence better constrain the less well known properties such as volatile content, eruptive temperature, plume density and exit velocity. In addition to the gross topographic features of Venusian volcanoes and their related deposits, compositional and smaller scale morphological information will also be derived for the deposits from the other radar datasets including emissivity, reflectivity, and metre-scale roughness, and the relationships between them can be analysed (e.g. figures 1 & 2). By using a global systematic approach to this investigation, any other global trends will become clear from the data such as eruptive style with altitude and with location relative to other features. Ultimately, this research may offer insights into other global scale processes such as the timing and magnitude of volcanic activity (global resurfacing *vs.* gradual volcanism), possible tectonic processes and the formation of other features such as coronae and canali. Volcano-climate interactions will subsequently be explored using these findings as a stimulus for experimenting with various global volcanism scenarios by implementing a mathematical climate modelling approach to incorporate these observations with the results of previous Venus climate modelling exercises [e.g. 8].

For the morphometric comparisons, full resolution SAR data will be scrutinised; measurements made in ImageJ will be recorded and used to calculate topographic properties in conjunction with the (coarser) altimeter data and left-left stereo processing where available. Measurements of emissivity and reflectivity will be taken with which to characterise compositional properties and calculate dielectric properties. Spot checks of radar backscatter and metre-scale slope will be used to calculate roughness parameters such as R.M.S. height and correlation length. Eventually, the climate modelling phase, and any inferences drawn from it, will include comparisons with remotely sensed datasets from Venus Express, such as SO_2 and H_2O concentrations derived from the SPICAV and SOIR spectrometers; indeed, there is also the potential to utilise the derived emissivity from the Venus Express VIRTIS and VMC complementary datasets in compositional comparisons [3, 9].

A series of experimental procedures are also in the planning stage, with which to explore the potential generation of lightning via charge separation within volcanic plumes, should the plume buoyancy investigations suggest convecting plumes are possible. Electrostatic measurements will be made on ash samples following some modifications on the procedure of [10] to simulate particle charging mechanisms under Venus-like conditions, with which to predict the likelihood of, and likely characteristics of, lighting generation within Venusian volcanic plumes.

Anticipated results: With the morphometric analyses, it is proposed that volcanoes in the database can be placed into morphological groupings based on several measurements and ratios with which to characterise their eruptive styles. Global distributional trends can then also be derived from the data.

The implementation of the plume modelling phase will deliver better constrained model parameterisations with which to draw inferences as to how the erupted material may interact with the atmosphere, and how far volcanic material is transported into the overlying atmosphere. Information on plume height/behaviour will also allow us to predict the likelihood of the generation of lightning within the plumes themselves.

The climate modelling phase of the project will furnish us with more scenario-focussed predictions of how the climate system responds to a variety of model parameters derived from the previous aspects of the study. It is envisaged that, by the end of the project, the information gathered from the various aspects of the project may contribute to the formulation of a model of past and future planetary evolution for Venus in conjunction with previously suggested models [1].

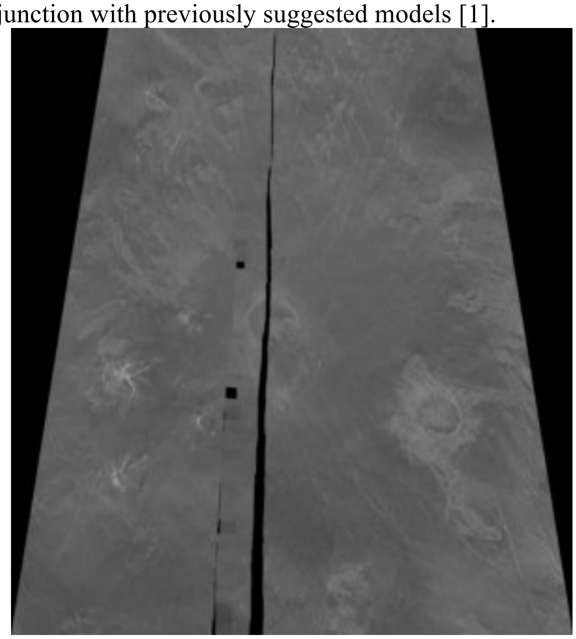
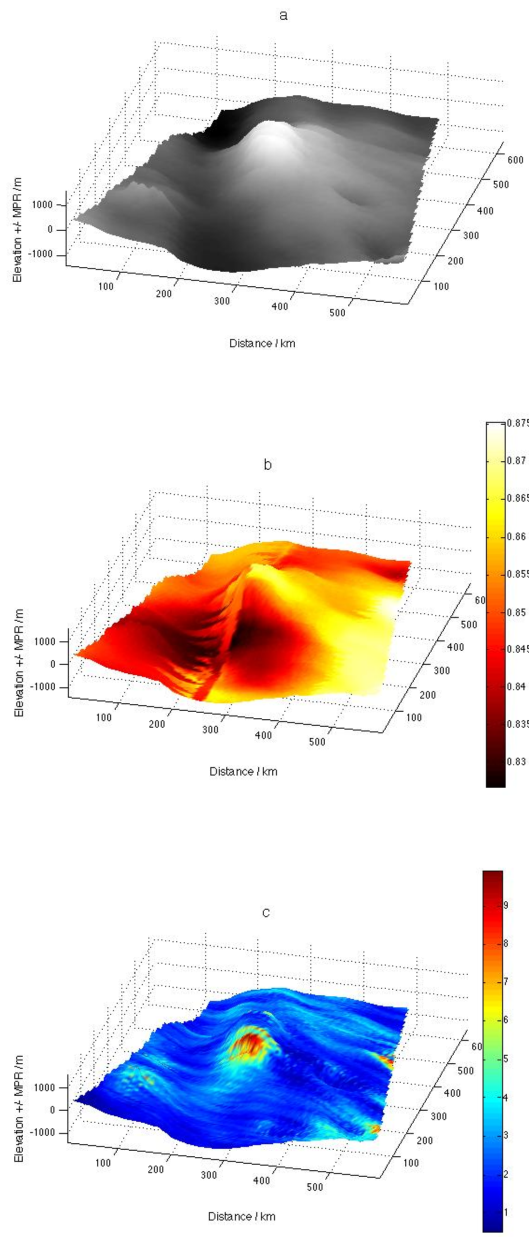


Figure 1. Renpet Mons (centre of image), situated at 76°N 236°E (image ~600 × 600 km).

Figure 2. (opposite) Topographic surfaces of the area in figure 1 with 50 × vertical exaggeration with, a) shaded elevation (m), b) shaded emissivity (dimensionless ratio) and, c) shaded metre-scale slope (degrees) as examples of how the relationships between these data can be analysed.



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