

## Monitoring the Montserrat Volcano by GPS

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Presented at Geomatics Atlantic 2009  
June 9-12

## Introduction

- Montserrat volcano
- Dome collapse in 2003
- GPS hardware & software
- Results comparison
- Results analysis
- Conclusions



## Volcanic process

- Lava is very sticky - not flowing. Sticks to ground when extruded by volcano
- A large pile, 300 m high and 1 km across, forms on top of the volcanic vent. Creates a dome
- If dome becomes unstable, collapses.
- Largest collapse occurred July 12-13 2003
- Response of volcano to this collapse is subject of presentation



## Pyroclastic flow

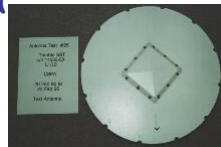


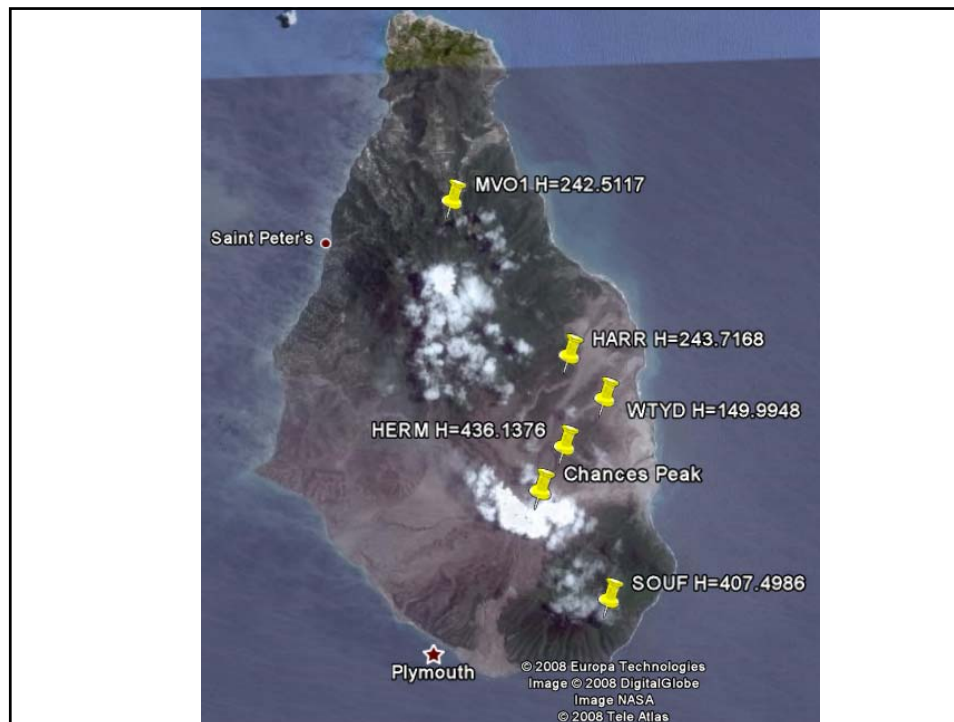
<http://news.bbc.co.uk/2/hi/science/nature/3687700.stm>

- Avalanche of hot rocks, ash and gas
- Speed: 100-150 km/h
- 210 million m<sup>3</sup> of dome material

## GPS hardware

- On volcano:
  - 2 Trimble 4000SSI receivers + 4000ST L1/L2 GEOD antenna
  - 2 Leica GPS receivers + AT504 antenna
  - 4 receivers in total
- At observatory
  - 1 Trimble 4000SSI receiver + 4000ST L1/L2 GEOD antenna



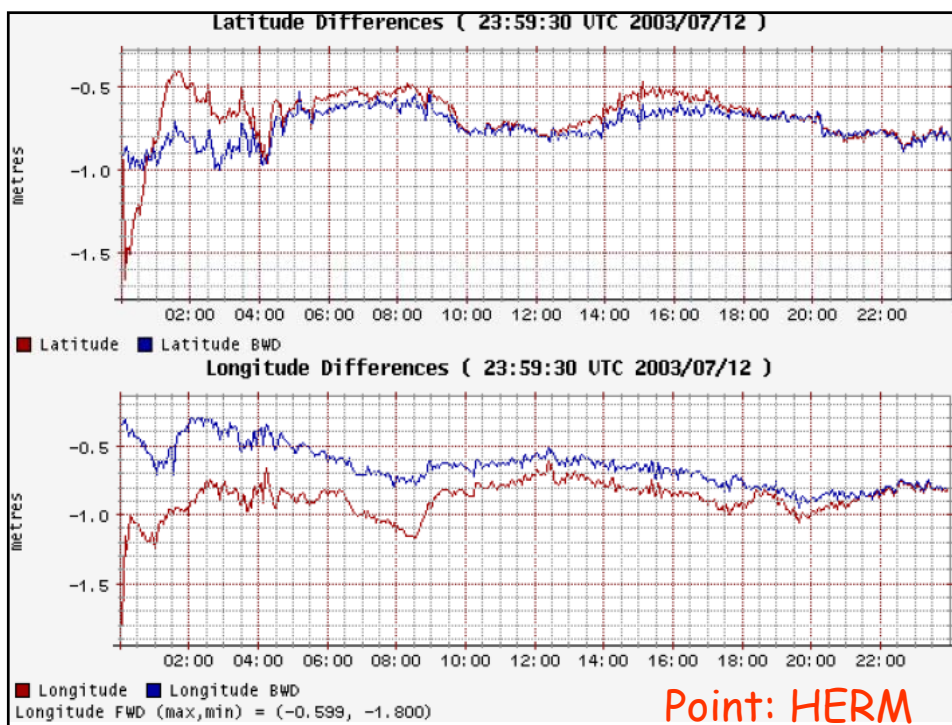


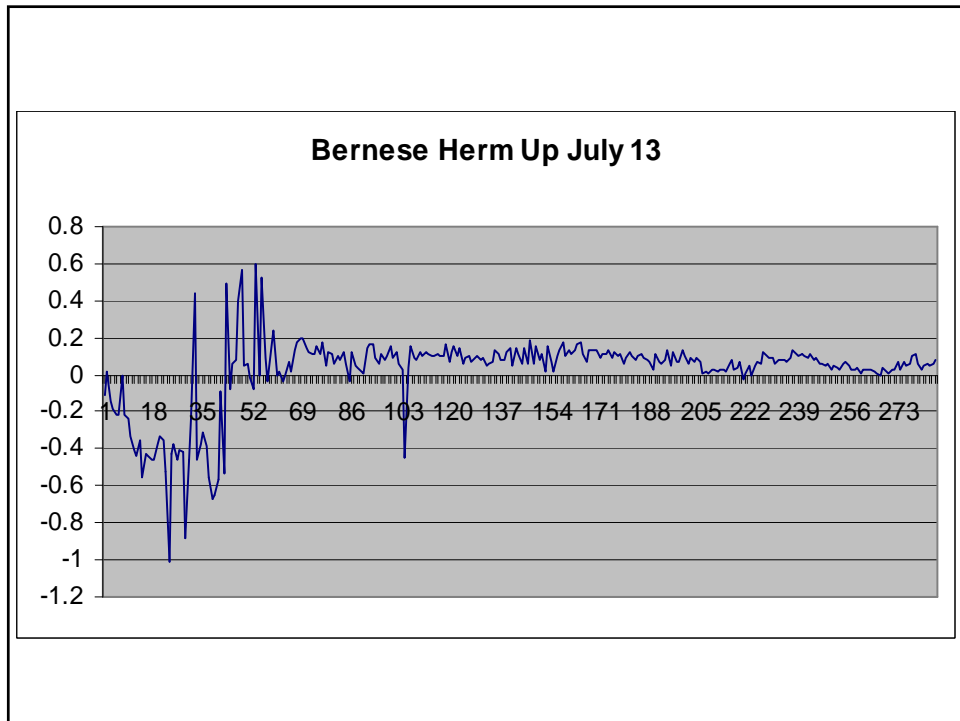
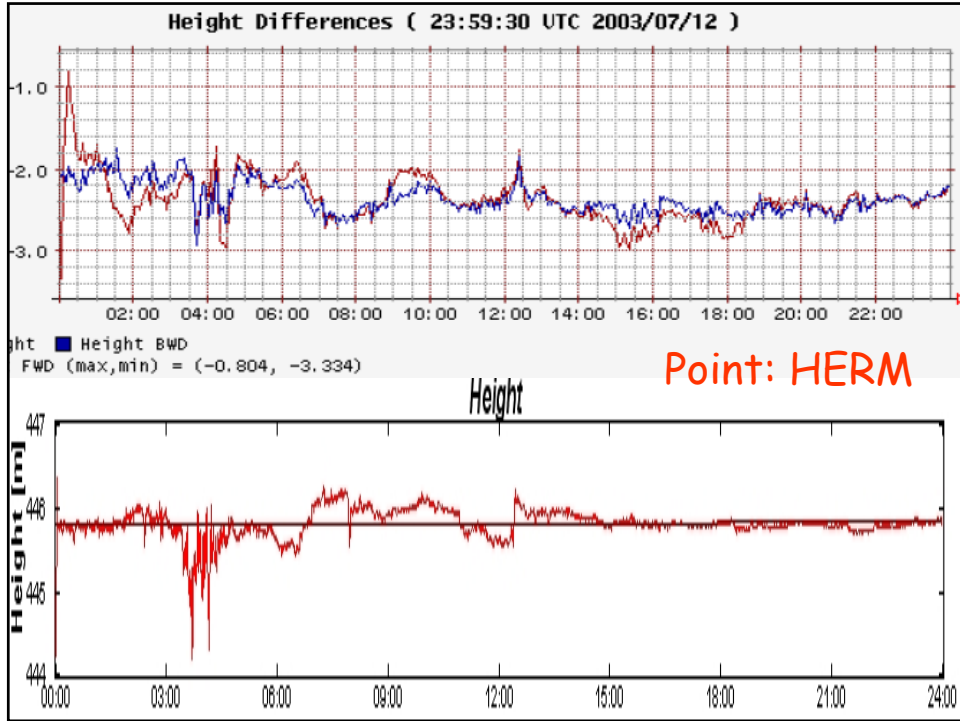
## Data collection parameters

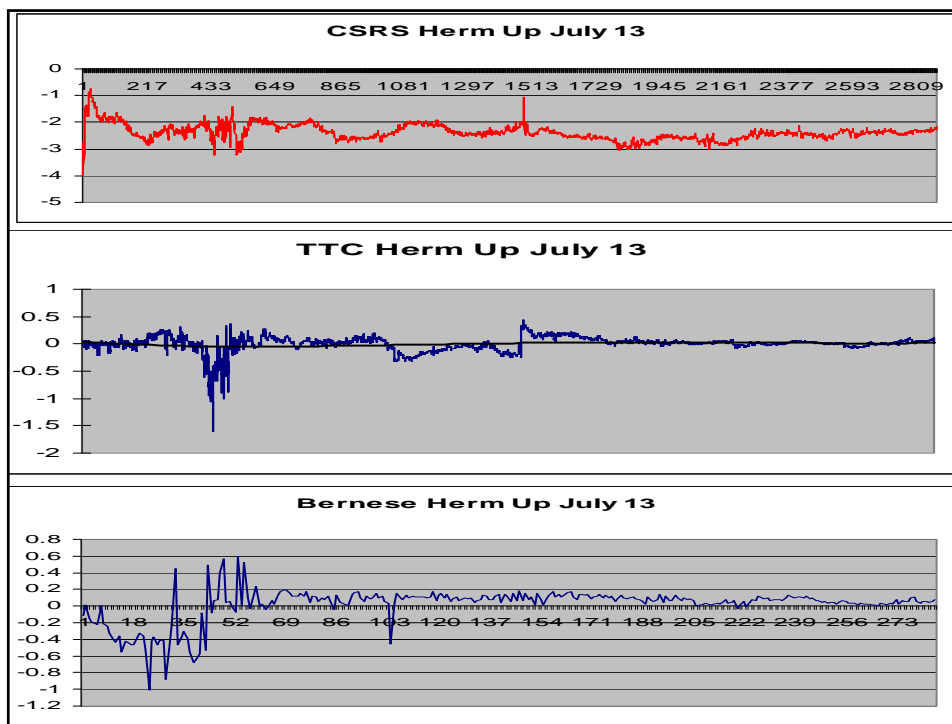
- Epoch rate: 30 seconds
- Mask angle: 0 degrees
- 24 hour datasets
- Data available from 2001
- Receivers static
  
- Results from July 13 2003 reported [here](#)
- Day of dome collapse

## Data processing

- Canadian on-line service - CSRS PPP
- Trimble Total Control
- Bernese
  
- Data processed as kinematic
- Coordinates every 30 seconds







## Why large variation in height?

- All lines < 10 km, refraction cancels?
- BUT...large height variation ( $\approx 300$  m)
- 300 m extra atmosphere
- Refraction does not cancel

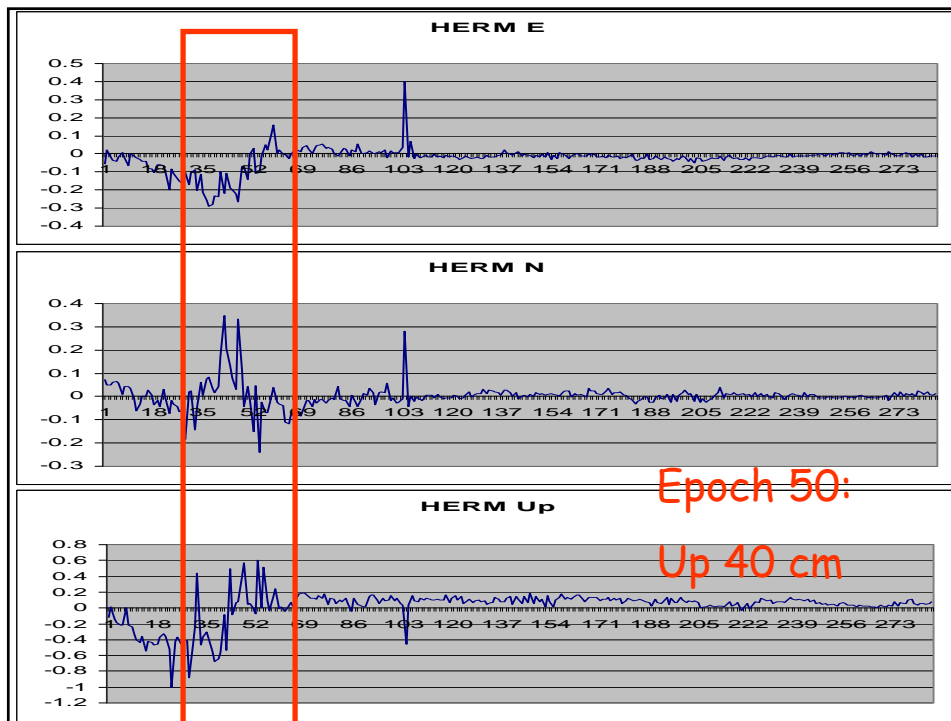


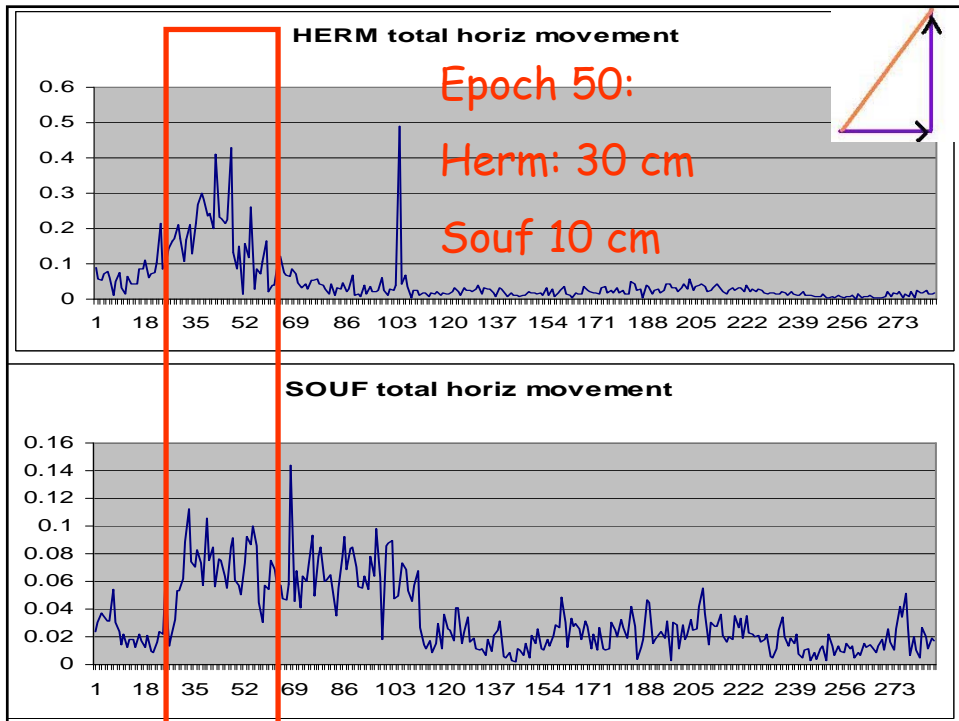
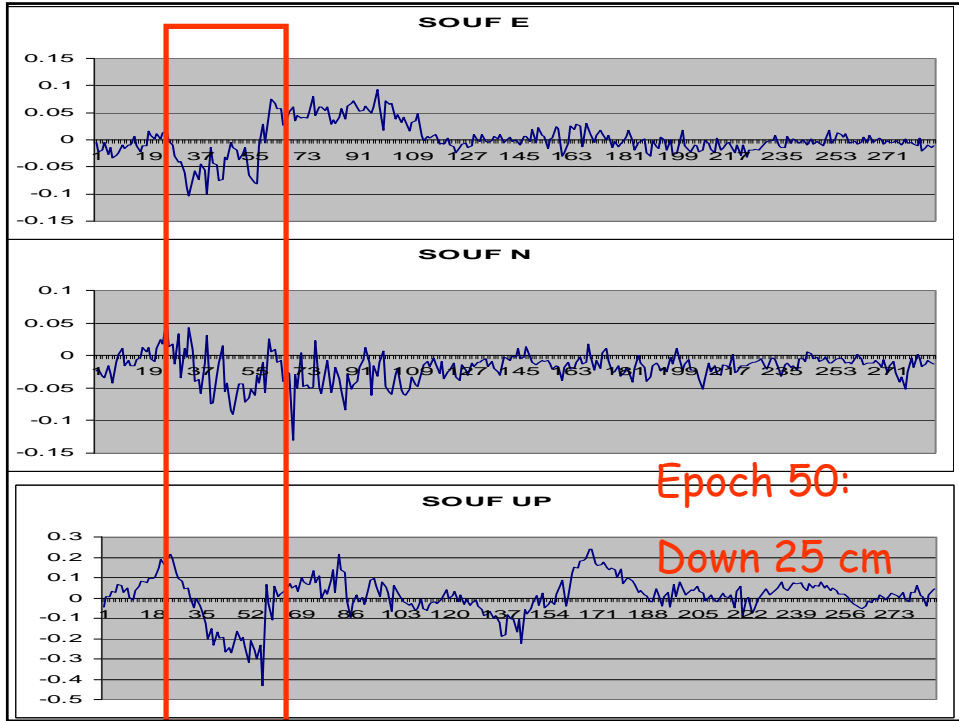
- Bernese is able to better handle this situation, and low elevation satellites
- And...changing refraction due to gas, temperature, ...and reasons unknown.



## Evidence of time of collapse

- Collapse at night so no visual observations
- Ref. 1: 2.00-4.40 a.m.
- Ref. 2: 2.30-5.30 a.m.
- Look at 2.00-5.30 a.m.
- Epochs 25-66







## Conclusions

- Different results using different processing packages - Bernese used
- Significant deformation occurred during dome collapse - some before: decimetres in horizontal at Herm
- Continued deformation at Souf
- Horizontal movement upto 40 cm
- Drop in height upto 1 m at Herm, 50 cm at Herm and Souf more likely

## Acknowledgments

- Nico Fournier, UWI Seismic Research Unit
- Reza Ghoddousi-Fard
- Surveying & Land Information
- Keith Miller, British Univ in Egypt
- Harrison McCain Foundation
- Geomatics Atlantic 2009 organisers
- And finally...

You, for your time and attention