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# ***Automatic Estimation of Volcanic Plume Height***

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# Fixed Position C-band Radars

## iskef & isegs



Keflavík SW-Iceland C-band radar.  
Photo Þórður Arason 9 August 2011



Fljótsdalsheiði E-Iceland C-band radar.  
Photo Geirfinnur S. Sigurðsson 8 October 2012

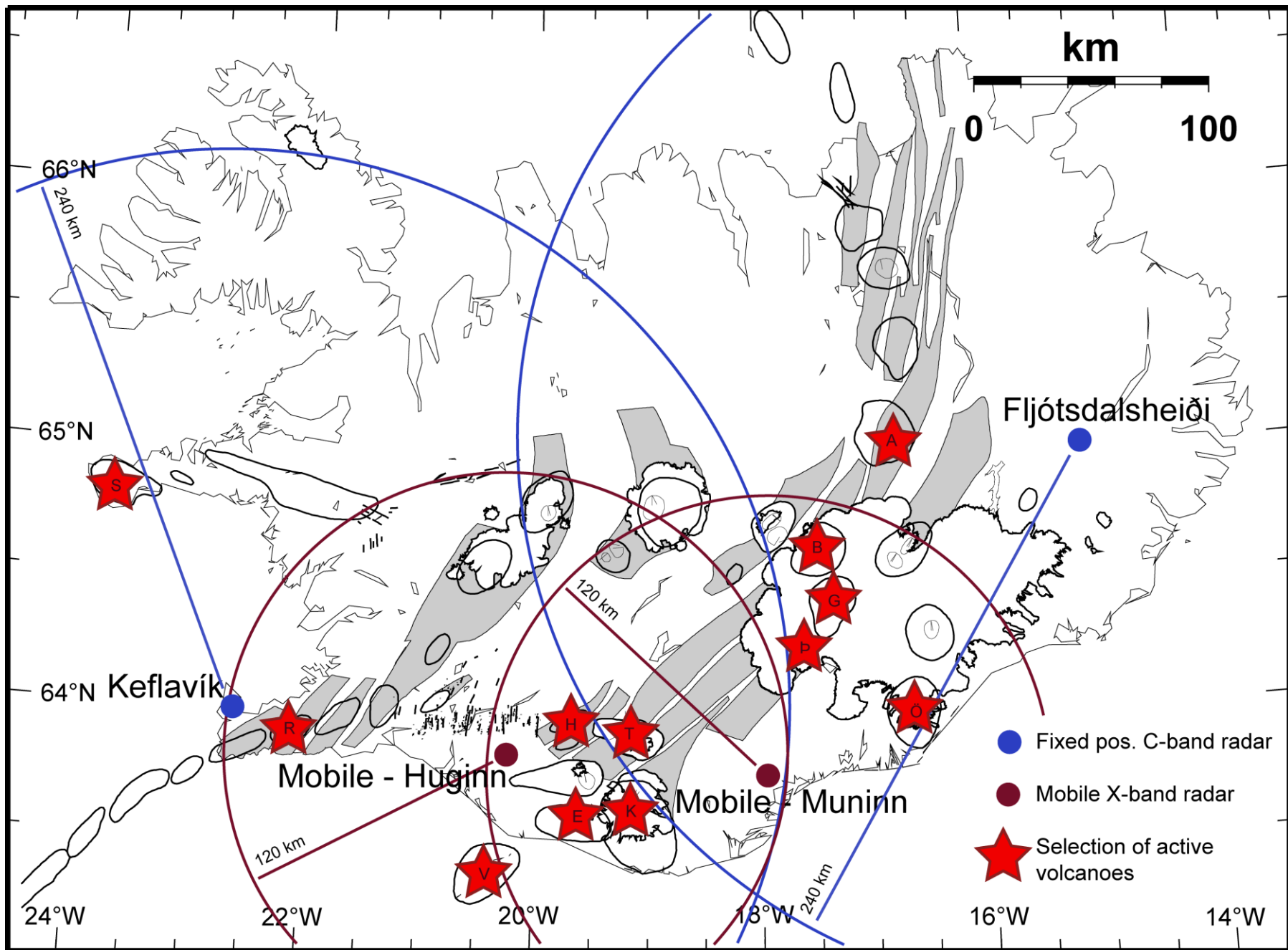
# Two Mobile X-band Radars isx1 & isx2



Specially adapted truck to take mobile radar off road.  
Photo Geirfinnur S. Sigurðsson 25 September 2012

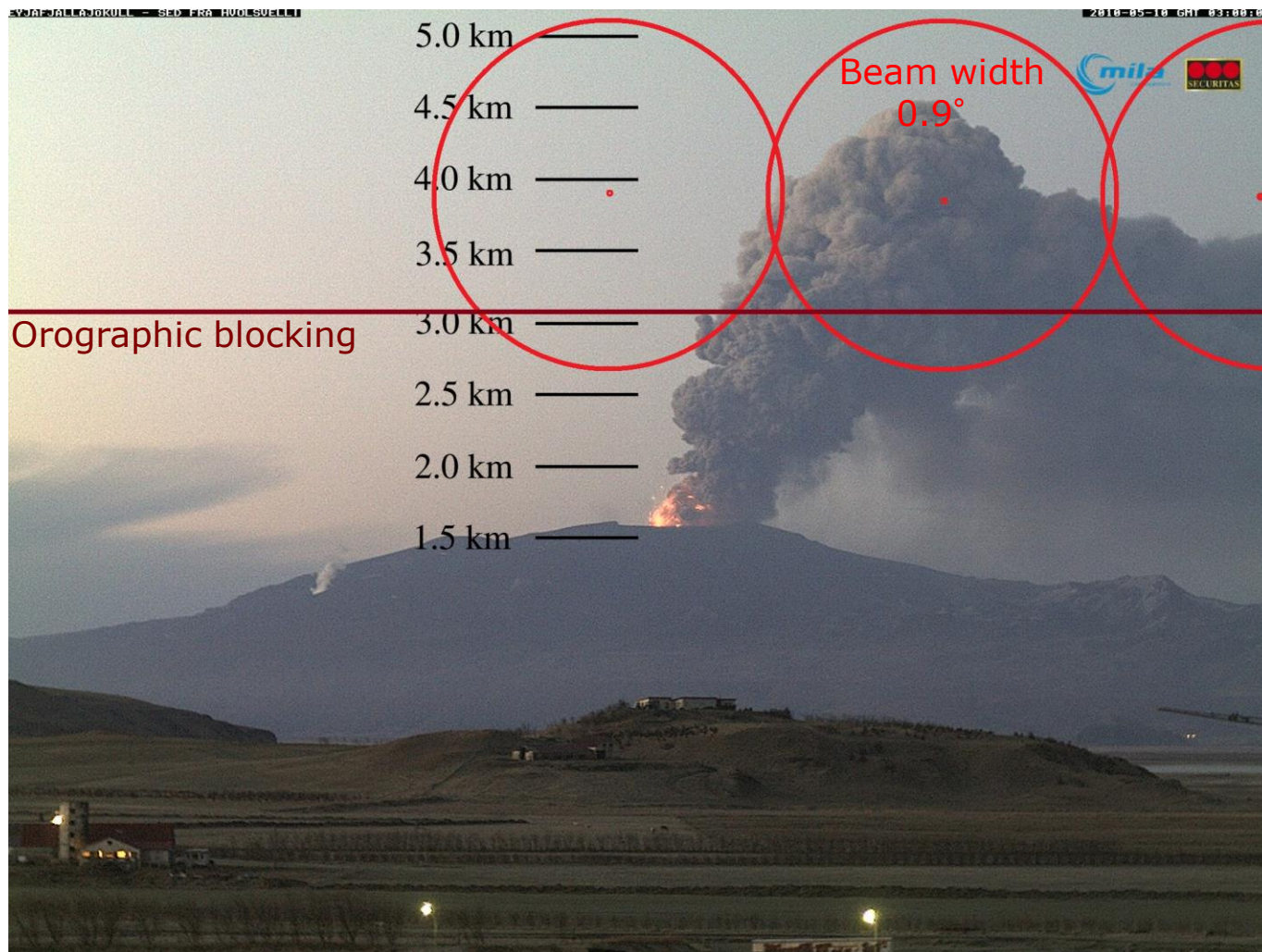


Mobile radar installed with clear view over  
Bárðarbunga before the eruption.  
Photo Þorgils Ingvarsson 22 August 2014



# Wide Radar Beam

## Keflavík radar beam at Eyjafjallajökull 2010 (155 km)



View of Eyjafjallajökull from a web camera at Hvolsvöllur, 10 May 2010 at 03:00.

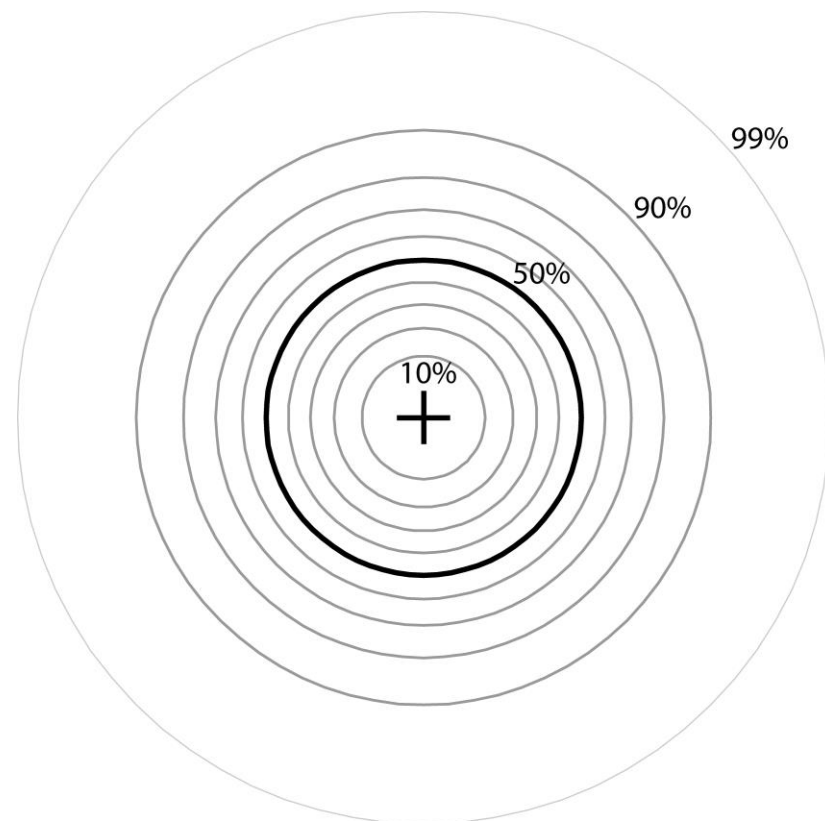
# Smooth Radar Beam

It is not as sharp as we would like

- The width of a radar beam is determined by the antenna size and radar frequency
- The beam width is measured where the center intensity has dropped by half
- Incidentally, 50% of the radar power is within the circle of the half power beam width
- IMO`s radars have:

**C-band  $w \approx 0.9^\circ$**

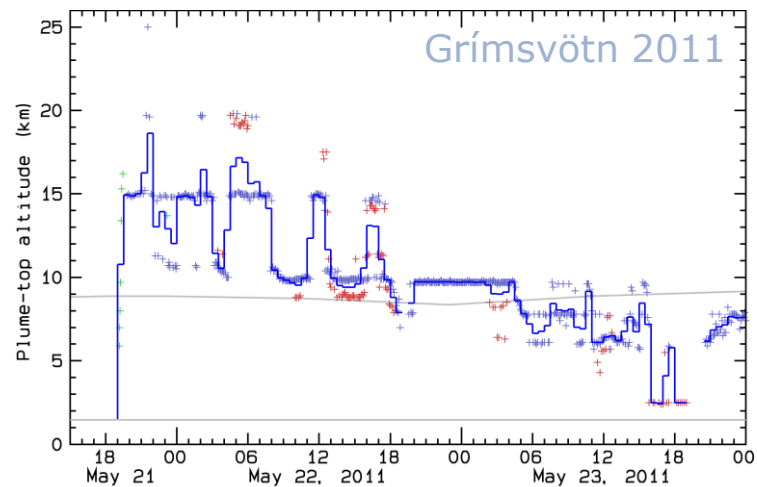
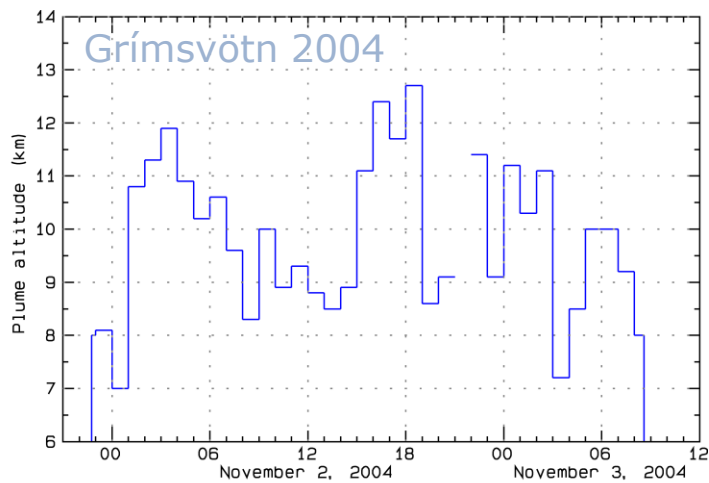
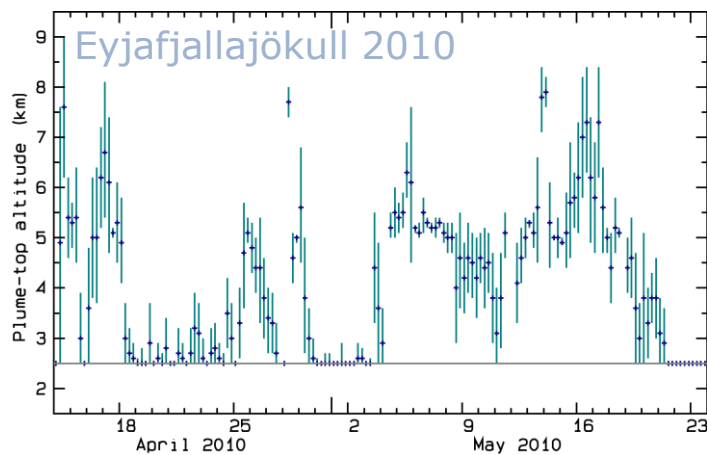
**X-band  $w \approx 1.2^\circ$**



Radar power of 10, ..., 50, ..., 90, 99% within concentric circles

# Plume Heights

## Manually estimated from radar images



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# **EHT Suite of Scripts**

## **Automatic plume height estimates**

- **A radar scan takes a few minutes and the volume-data is sent to IMO in Reykjavík**
- **When the data become available, the reflectivity of each pair of radar and predefined volcano sites are analyzed**
- **Data are transformed to a location and height of beam center above sea level. For a given radius around a volcano and observed reflectivities above a threshold, the maximum echo height is determined**
- **The height of the next radar beam above the maximum is also registered for reference**

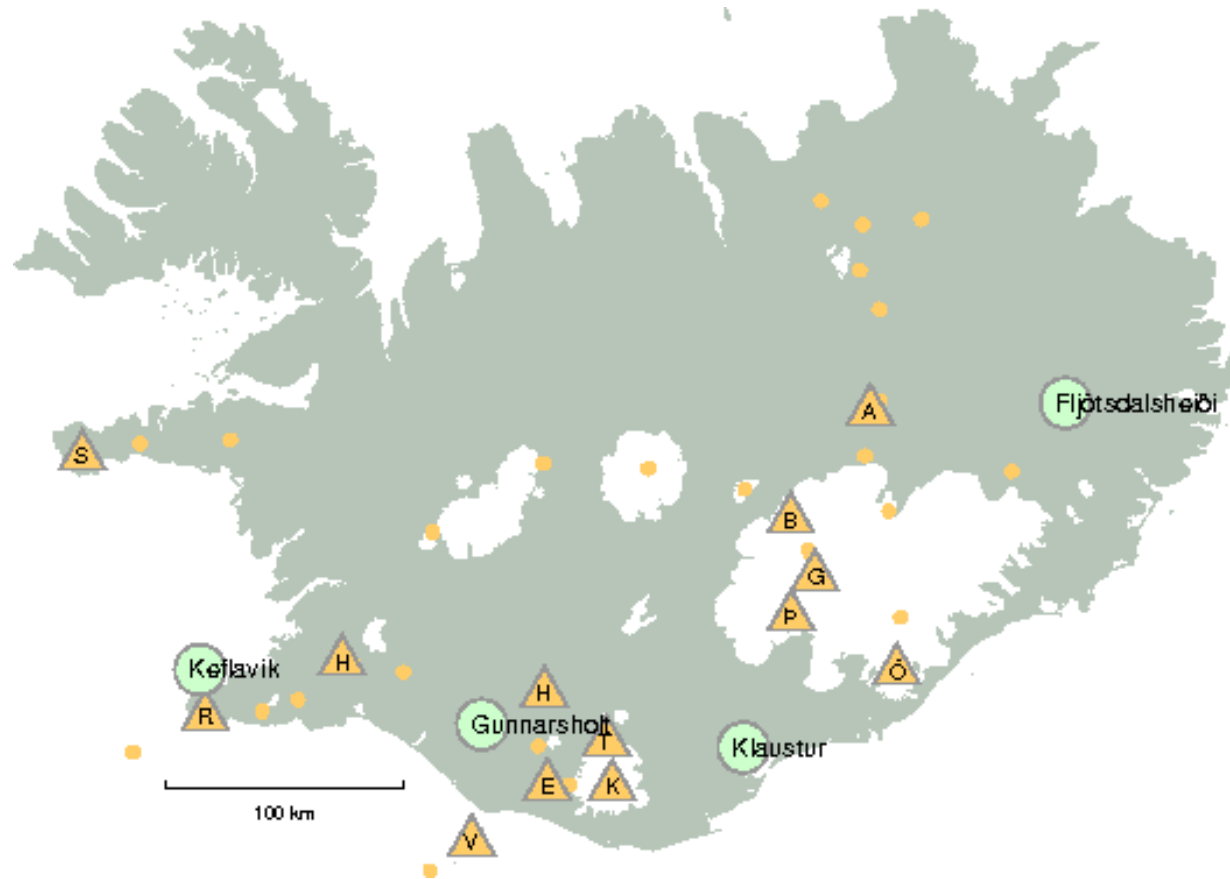
**The prototype of the automatic Unix shell-scripts were written by Þórður Arason in March-April 2016**

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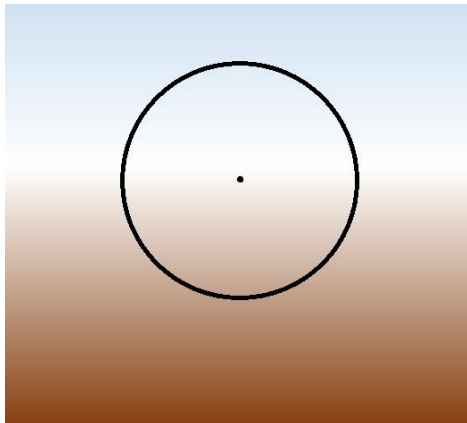
# Automatic Plume Height Estimates

<http://brunnur.vedur.is/pub/arason/radar/eldgos/>



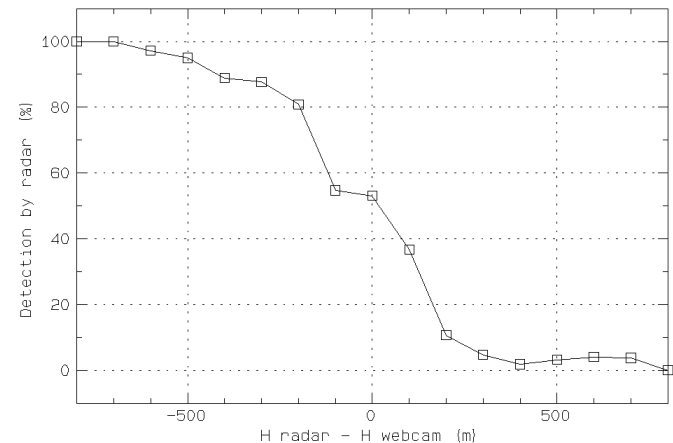
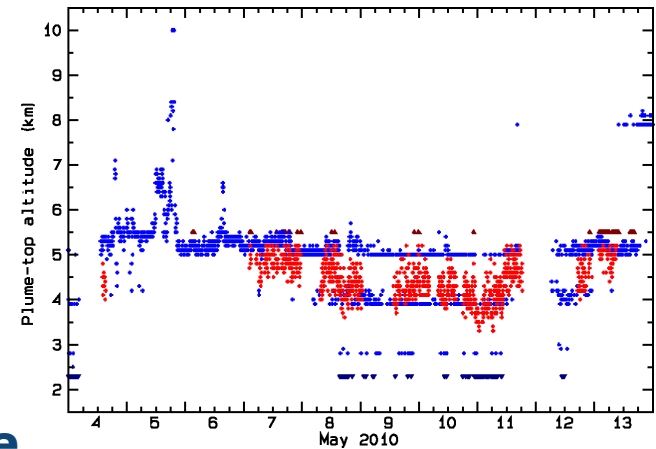
# True Top vs. Central Beam Height

- There may be a bias between the true top height and radar central beam height. Variability in this bias is not known



- Furthermore, it may be possible to estimate the average vertical reflectivity gradient near the plume top

- Comparison of radar and web camera determined heights during Eyjafjallajökull 2010 may give constraints on these problems



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- **Adjustment of the radius about volcanoes and threshold reflectivity**
  - **Analyzis of the difference between the height of the beam center and true plume top and of the vertical reflectivity gradient near plume tops**
  - **Increased speed of calculations**
  - **Automatic real-time calculations of eruptive source parameters through an inversion algorithm**
  - **Automatic estimates of mass eruption rates used to initialize the VOL-CALPUFF dispersion model**

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# ***MoU Auroral Display***

***Arnarhóll, Reykjavík  
27 September 2016, 22:30-22:46***

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# Leirvogur Magnetic Observatory

## 12 km ENE from Arnarhóll

LRV --- Leirvogur Magnetic Observatory --- 28 Sep 2016 at 08:20 UTC

