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Plume-top altitudes during the Eyjafjallajökull 2010 eruption

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We present a unique high resolution time-series of the variations in plume height during the entire 39 day eruption of the Eyjafjallajökull volcano, Iceland, 14 April - 23 May 2010. Scans were made every 5 minutes during the eruption by the weather radar of the Icelandic Meteorological Office located at Keflavik international airport, 154 km from the volcano. Due to a mountain range between the radar and the volcano and the curvature of the Earth, the plume could only be observed when over 2.9 km a.s.l. The first radar scan detecting the plume was on 14 April at 08:50 UTC, and the last on 21 May at 10:20. During the eruption, 7% of the 5 min scans are missing, 10% were intentionally short range doppler scans, 11% were masked by precipitating clouds at the volcano, 27% show clearly that the plume was below detection height, and from 45% of the scans we can estimate the plume-top altitude. Due to the discrete elevation angles of the radar and the long distance to the volcano, the plume-top altitude estimates are severly grouped in discrete steps at about 2.8, 3.9, 5.0 and 7.9 km. This obvious stepping in the raw data can be decreased by taking averages over short time periods, e.g. 1 to 6 hours. The telecommunications company Mila installed webcams to monitor the eruption. Their best webcam for observations of the plume was at Hvolsvöllur, 34 km from the volcano. These webcam-photos were saved every 5 sec, from 14 April at 09:31 UTC to 23 May at 23:59. From several known landmarks seen on the Hvolsvöllur-photos we defined a vertical height-scale above the volcano. Top of the photo-frame directly above the volcano is estimated to be at 5.2 km a.s.l. Of the photos on the hour, there are only two missing from the observation period. However, 80% of the hourly photos do not show the plume-top, due to darkness, poor visibility, low cloud cover or intermittent clouds. In 5% of the photos we are unable to determine the plume-top, because it clearly extends above the photo-frame. The plume-top is clearly visible on 15% of the hourly photos. During periods when the plume was visible, we have analysed the photos every 5 min to create a time series of the plume-top altitude, with a height resolution of 100 m. Comparison of the radar and webcam time-series of the plume-top altitudes shows that the radar is far superior than the webcams in monitoring the eruption plume. Due to poor visual conditions the webcams do not give any useful information for many consecutive days. However, the height resolution of the webcam on a clear day is an order of magnitude better than that of the radar. In the altitude range where both data sets give useful altitude estimates, there is good consistency between the two, with mean difference on the order of 100 m.