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Assessing simple models of volcanic plumes using observations from the summit eruption of Eyjafjallajökull in 2010

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A volcanic eruption plume enters into an atmosphere that has a pre-existing structure to it, in terms of temperature, moisture content, stratification, wind and wind shear. How high the plume rises depends predominantly on the strength of the eruption. However, through dynamic interactions with the rising plume, the ambient atmosphere also exerts an influence on how high into the atmosphere plume material can be lofted and how far afield it is distributed. Idealized models of volcanic plumes consider three dynamically distinct regions, the gas thrust region, where the dynamics is dominated by the exit velocity at the vent, the buoyancy driven convective region and the umbrella cloud where vertical motion is small. During the 2010 summit eruption at Eyjafjallajökull, several cameras where located with a view of the volcano. The time resolution of the images was 5 seconds and the vertical resolution was 7 m. Based on this data, and on video recordings made by a TV crew we have analyzed variations in the speed of the updraft in the plume, the horizontal wind profile above the vent, and changes in the size of individual thermals as they rise in the atmosphere. We compare the results from the analysis with results obtained using simplified models of volcanic plumes. The results tend to agree with the simplified models, in that the boyancy driven phase seems to be well resolved by the data. However, resolving the shallow gas thrust region is more of a challenge.