VESPA v1.0 - Volcanic Eruptive Source Parameters Assessment: from automatic radar-based plume height assessment to volcanic ash dispersal modelling

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The Icelandic Meteorological Office (IMO), responsible for monitoring the 32 active volcanic systems in the country, operates two fixed position C-band weather radars and two mobile X-band radars. In case of an explosive eruption, all available radars will be set to a more detailed scan optimized to observe the volcanic eruption plume. Radar volume data above the active volcano is automatically analyzed at IMO-headquarter in Reykjavík. Distribution of likely plume height is automatically estimated taking into account the radar scanning strategy, beam width, and likely plume top reflectivity gradient. These data are available for the natural hazard specialists and meteorologists staffing IMO's monitoring room in near-real-time and can be communicated to London VAAC to support their ash transport simulations for aviation safety purposes. The automatically determined plume height estimates from the radar data are input to the newly-developed VESPA software that calculates the eruptive source parameters through an inversion algorithm. This is done by using the coupled system DAKOTA-PlumeMoM which solves the 1D plume model equations iteratively by varying the input values of vent radius and vertical velocity. The model accounts for the effect of wind on the plume dynamics, using atmospheric vertical profiles extracted from the ECMWF numerical weather prediction model. Currently the VESPA software can run daily for 4 volcanoes and can populate a database with derived properties including initial vertical velocity, vent radius and mass flow rate. These automatically derived properties will eventually be available publicly. The estimate of mass eruption rate provided by VESPA are used to initialize the VOL-CALPUFF dispersion model to assess the local-scale hazards due to tephra fallout.