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Observing and Predicting Vog Dispersion from Hawai‘i’s Kīlauea Volcano

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In 2014, the Kīlauea volcano on the Island of Hawai‘i enters its 32st year of nearly continuous eruption. Since 1983, east rift SO_2 emissions have ranged from <50 tonnes, during the periods of eruptive pause, to over 30,000 tonnes per day, during periods of enhanced activity. Emissions from Kīlauea volcano pose significant environmental and health risks to the Hawai‘i community. The Vog Measurement and Prediction (VMAP) project was conceived to help mitigate the negative impacts of Kīlauea’s emissions. To date, VMAP has achieved the following milestones: (i) created a custom application of the Hybrid Single-Particle Lagrangian Integrated Trajectory (HY-SPLIT) model (Vog Model, hereafter) to produce real-time statewide forecasts of the concentration and dispersion of sulfur dioxide (SO_2) and sulfate aerosol from Kīlauea volcano; (ii) developed an ultraviolet (UV) spectrometer array to provide near real-time volcanic gas emission rate measurements for use as input to the dispersion model; (iii) developed and deployed a stationary array of ambient SO_2 and meteorological sensors to record the spatial characteristics of Kīlauea’s gas plume in high temporal and spatial resolution for model verification; and (iv) developed web-based dissemination of observations and forecasts that provide guidance for safety officials to protect the public and raise public awareness of the potential hazards of volcanic emissions to respiratory health, agriculture, and general aviation (http://weather.hawaii.edu/vmap/).

Wind fields and thermodynamic data from the state-of-the-art Weather Research and Forecast (WRF) model provide input to the vog model, with a statewide resolution of 3 km and a resolution of 1 km covering Hawai‘i Island. Validation of the vog model predictions is accomplished with reference to data from Hawai‘i State Department of Health ground-based Air Quality monitors. VMAP results show that this approach can provide useful guidance for the people of Hawai‘i. An ensemble version of the Vog Model has been developed and a description of the ensemble implementation and ensemble products will be presented.

On 29 July 2013, Tropical Storm Flossie passed the Hawaiian Islands, marking the first volcano/tropical cyclone interaction captured by the Vog Model since operational simulations began in 2010. This complex interaction prompted questions about the effects of volcanic aerosols on convective precipitation and electrification, associated with tropical cyclones. Results from the Vog Model are compared qualitatively with satellite observations, lightning data from Vaisala’s GLD-360, and National Weather Service WSR-88 Dual-Polarmetric radar to document the interaction of volcanic emissions and the storm circulation and electrification.