American Geophysical Union Meeting, Monday morning poster session
8 am – 12:20 pm, December 12, 2016
Session: Monitoring and Volcanic Processes **Paper**: V11C-2812

Volcanoes drive climate variability by emitting ozone weeks before eruptions, by forming lower stratospheric aerosols, by causing sustained ozone depletion, and by causing rapid changes in regional ozone concentrations affecting temperature and pressure differences driving atmospheric oscillations

Total column ozone observed by satellite on February 19, 2010, increased 75% in a plume from Eyjafjallajökull volcano in southern Iceland eastward past Novaya Zemlya, extending laterally from northern Greenland to southern Norway (http://youtu.be/wJFZcPEfoR4). Contemporaneous ground deformation and rapidly increasing numbers of earthquakes imply magma began rising from a sill 4-6 km below the volcano, erupting a month later. Whether the ozone formed from the magma or from very hot gases rising through cracks in the ground is unclear. On February 20-22, 1991, similar increases in ozone were observed north of Pinatubo volcano before its initial eruption on April 2 (http://youtu.be/5y1PU2Qu3ag). Annual average total column ozone during the year of most moderate to large explosive volcanic eruptions since routine observations of ozone began in 1927 has been substantially higher than normal. Increased total column ozone absorbs more solar ultraviolet-B radiation, warming the ozone layer and cooling Earth.

Most major volcanic eruptions form sulfuric-acid aerosols in the lower part of the ozone layer providing aqueous surfaces on which heterogeneous chemical reactions enhance ozone depletion. Within a year, aerosol droplets grew large enough to reflect and scatter high-frequency solar radiation, cooling Earth ~0.5^{o}C for 2-3 years.

Temperature anomalies in the northern hemisphere rose 0.7^{o}C in 28 years from 1970 to 1998 (HadCRUT4), while annual average ozone at Arosa dropped 27 DU because of manufactured CFC gases. Beginning in August 2014, temperature anomalies in the northern hemisphere rose another 0.6^{o}C in less than two years apparently because of the 6-month eruption of Bárðarbunga volcano in central Iceland, the highest rate of basaltic lava extrusion since 1783. Large extrusions of basaltic lava are typically contemporaneous with the greatest periods of warming throughout Earth history.

Ozone concentrations at Arosa change by season typically from ~370 DU during March and April to ~285 DU in October. Removing this seasonal change to calculate ozone anomaly and plotting against temperature anomaly, and climate oscillation indices such as NAM, NAO, ENSO, and SAM gives insight into the influence of volcanic eruptions on regional temperatures, pressures, winds, weather, and climate.
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