Volcanic influence on STRATOCLIM aircraft observations 2017 in the Asian Monsoon, studies with the transient CCM EMAC

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Used instruments on GEOPHYSICA during the STRATOCLIM campaign from Jul 27 to Aug 10, 2017 with base at Kathmandu, Nepal

- ERICA: Erc Instrument for Chemical composition of Aerosol, Aerosol Mass Spectrometer with flash vaporization–electron impact ionization (O. Appel), Höpfner et al, 2019
- COPAS: COndensation PArticle counting System, 4 channels including a heated one for nonvolatile fraction (R. Weigel), Weigel et al, 2009
- STRATOMAS: Chemical ionization Ion Trap Mass Spectrometer for SO₂, H₂SO₄, HNO₃, and organic acids (H. Schlager)

Model EMAC (V2.52, Jöckel et al., 2010; Brühl et al., 2018)

- GCM ECHAM5, Resolution T63/L90 (1.9° up to 1 Pa with internal Quasi-Biennial Oscillation, slightly nudged), meteorology nudged to ERA-Interim in troposphere (below 100hPa), observed transient SST.
- MECCA1 chemistry module with sulfur chemistry, scavenging by clouds.
- GMXE aerosol module (4 soluble and 3 insoluble modes with EQSAM or ISORROPIA chemistry, $\sigma_{nuc,ait}$ =1.59, σ_{acc} =1.49, σ_{cs} =1.7; lower mode boundaries (r) nucleation 0.0005, aitken 0.006, accum 0.07, coarse 1.6 µm). Interactive with dynamics and chemistry.
- Radiative forcing calculated online, aerosol types: dust, organic and black carbon, sulfate, nitrate, ammonium, sea salt and aerosol water.

SO₂ in the UTLS of the monsoon region from the 27 year transient EMAC simulation



Volcanic injections:

5 May 2017, Sinabung 26kt, others 29kt

19 May 2017, Sheveluch+Bogoslov, 20kt

16 Jun 2017, S.Maria+ Manam+Sheveluch 50kt

5 Jul 2017, Sinabung 21kt, Fuego+Sheveluch 26kt

8 Aug 2017, Sinabung 31kt, Fuego+Sheveluch+others 32kt

From OSIRIS satellite data and Smithsonian volcano database which reports activity of Sinabung for the whole period

Flight 8, observations and model data on curtains



Flight 7, observations and model data on curtains



Flight 7, observations and model data on curtains



Flight 7, observations and model data on curtains



Conclusions

- Volcanic SO₂ is needed to explain high SO₂ at about 80hPa and enhanced number concentration of nucleation mode particles near the tropopause
- Simulated sulfate in the LS appears to be high by about 25% which can be due to an overestimate of the Sinabung eruption on Aug. 8 and/or due to effects of overshooting convection
- Temporal resolution matters for explosive volcanoes active over a several months period
- Eruptions on Kamchatka contribute to LS SO₂ in monsoon region

References

- Brühl et al., 2018, ACP
- Höpfner et al., 2019, Nature Geosci
- Jöckel et al., 2010, 2016, GMD
- Weigel et al., 2009, AMT