

Response of the Brewer-Dobson circulation to the major volcanic eruptions in reanalysis datasets

*Masatomo Fujiwara¹, Marta Abalos², Patrick Martineau³, Jonathon Wright⁴

1. Faculty of Environmental Earth Science, Hokkaido University, 2. Universidad Complutense de Madrid, 3. JAMSTEC, 4. Tsinghua University

The responses of the Brewer-Dobson circulation (BDC, i.e., the residual mean circulation) to the eruptions of Mt. Agung in March 1963, El Chichón in April 1982, and Mt. Pinatubo in June 1991 are investigated using global atmospheric reanalysis datasets, JRA-55, MERRA-2, and ERA-Interim. Multiple linear regression is applied to the zonal and monthly mean time series of temperature, zonal wind, BDC stream function, Eliassen-Palm flux divergence, and other variables/terms for two periods, 1980–2010 (for the three datasets) and 1958–2001 (for JRA-55 only), by considering explanatory factors of seasonal harmonics, linear trends, Quasi-Biennial Oscillation, solar cycle, and El Niño Southern Oscillation. The residuals are used to define the volcanic signals for the three eruptions separately.

Analysis using JRA-55 data showed the following: (1) in the first DJF season after each eruption, the Northern-Hemisphere BDC cell was weakened after Mt. Pinatubo and Mt. Agung eruptions, but was strengthened after El Chichón eruption; (2) in the second-year JJA, the Southern-Hemisphere BDC cell was weakened after El Chichón and Mt. Agung eruptions, but was strengthened after Mt. Pinatubo eruption. MERRA-2 and ERA-Interim showed qualitatively the same results for Mt. Pinatubo and El Chichón eruptions as JRA-55. Thus, the BDC response was different for different eruptions and for different seasons. The EPFD response (anomaly) was found to correspond to the BDC ($\bar{v}$) response (anomaly) for all the cases. Interpretation of these results will be discussed at the meeting.

Keywords: Brewer-Dobson circulation, volcanic eruption