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The dispersion of volcanic aerosol from Mt. Nabro: trajectory mapping of CALIPSO observations and radiative forcing estimates

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We use cloud-filtered nighttime measurements from CALIPSO, and a Lagrangian trajectory model to study the hemispheric dispersion of volcanic aerosol from the eruption of Mt. Nabro (Ethiopia/Eritrea) in June 2011. Trajectory mapping of the CALIPSO data provides improved spatial coverage and temporal continuity, to illustrate the volcanic plume's development. We show that the volcanic plume was initially constrained by the Asian anticyclone, which extends from the Mediterranean Sea to China in the upper troposphere and lower stratosphere (UTLS) during boreal summer. We demonstrate that the eruption reached the low stratosphere, and that the dispersion of the volcanic plume can be explained without a critical role for deep convection in the East Asian monsoon. Detrainments of the plume from the anticyclone in early July followed two principal transport pathways: (i) westward across the tropical Atlantic, and (ii) eastward across the Northern Pacific. These distinct plumes overlapped over North America in mid – late July, leading to dispersion throughout northern mid-latitudes, thereafter. We show that the stratospheric component of aerosol extinction from Nabro may account for differences of $\sim$0.02 - 0.03 in aerosol optical depth measured from surface and airborne platforms over North America in July. We show that the volcanic aerosol rose by $\sim$10K month-1 (potential temperature) in the low stratosphere in the vicinity of the Asian anticyclone for the first 2 months following the eruption, and find peak radiative forcing of $\sim$1.6 W m-2 locally in July, approximately 10% that reported for the impact of Pinatubo in 1991.