Global warming: The aerosols cool the climate system via their effects on clouds much greater than previously estimated

With the support by the National Natural Science Foundation of China, an international collaborative study led by Prof. Daniel Rosenfeld (The Hebrew University of Jerusalem), Dr. Zhu YanNian (Meteorological Institute of Shaanxi Province), Prof. Wang MingHuai (Nanjing University), and Prof. Yu ShaoCai (俞绍才) (Zhejiang University) addresses the ways by which particulate air pollution works to cool Earth and offset part of the warming induced by the emitted greenhouse gases and finds that the extent by which the aerosols cool the climate system via their effects on clouds is much greater than previously estimated. This work was published in *Science* (2019, 363: 599, eaav0566: 1—9, DOI: 10.1126/science.aav0566).

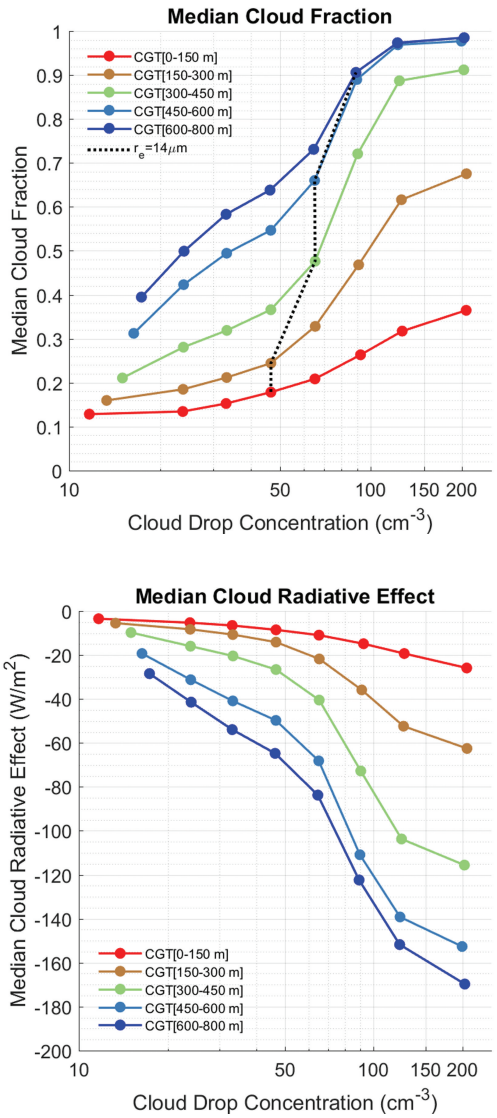

Figure Dependence of cloud properties (median cloud fractions and cloud cooling radiative effects) on cloud drop concentrations for different intervals of cloud geometrical thicknesses on the basis of the data of all the scenes over the Southern Oceans between 0° and 40°S.

Until this research it was not possible to measure the aerosol effects on clouds with sufficient accuracy, because it was impossible to separate the effects of the vertical rising winds that build the clouds and the effects of aerosols that determine the clouds composition. Our research team first developed novel methodologies to retrieve cloud geometrical thickness, cloud droplet concentrations and vertical winds from satellites. The application of this methodology to low clouds over ocean between the equator and 40°S demonstrated that aerosols explain three-fourths of the variability in the cooling effects of low-level marine clouds for a given cloud geometrical thickness. This reveals that the measured aerosol cloud—mediated cooling effect is much larger than the present estimates, especially via the effect of aerosols on the suppression of precipitation, which makes the clouds retain more water, persist longer and have a larger fractional coverage. Thicker clouds rain more and scavenge the aerosols more efficiently. Not accounting for this until now resulted in large underestimation of the aerosol effects on the amount of reflected solar radiation by low marine clouds. This fallacy is overcome when assessing the effects for clouds with a given fixed geometrical thickness. The large cooling implies that aerosols should have also a large compensating warming effect, possibly through the deep clouds, which is not accounted for in current models.