Geophysical Research Abstracts
Vol. 12, EGU2010-2262, 2010
EGU General Assembly 2010

Decadal variability of aerosol optical depth in Europe and its relationship to the global dimming and brightening and the temporal shift of the NAO

Marc Chiacchio (1), Tracy Ewen (1), Martin Wild (1), Mian Chin (2), and Thomas Diehl (2)

(1) ETH, IAC, Zurich, Switzerland (marc.chiacchio@env.ethz.ch), (2) NASA Goddard Space Flight Center, Greenbelt, Maryland, USA

Long-term aerosol optical depth (AOD) for Europe were analysed using the Goddard Chemistry Aerosol Radiation and Transport (GOCART) model for the period 1979-2007. In particular, we study the long-term sulfate AOD variability because their emission was at a maximum in 1988-1989 in Europe and they contain the largest fraction of anthropogenic components. A statistically significant decline of 68% was found for the annual mean during 1985-2007 for all of Europe. For the seasonal mean trends greatest changes occur during winter and spring followed by summer and autumn. The decrease in AOD agrees with the increase in surface all-sky annual mean solar radiation in Europe after the mid-1980s (solar brightening). However, the long-term behavior of the sulfate AOD does not explain the trends found in the all-sky solar radiation during winter and autumn, which may be due to the greater contribution from the North Atlantic Oscillation (NAO) and associated cloud cover. Thus, we investigated the link between AOD and NAO and found a significant correlation of -0.79 during winter for all of Europe with aerosols explaining 81% of the variability in the NAO. Wavelet coherence analysis revealed a strong and significant anti-phase relationship with a common power around 1-year during 1986 through 2003. Cross-correlation analysis showed a seasonal dependence with negative correlation primarily during winter and positive during summer. These results may help explain the seasonal decadal variability of solar radiation and whether sulfate aerosols have partly contributed to the large positive trend of the NAO during the 1980s.