Multi-decadal change of atmospheric aerosols and their effect on surface radiation

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We present an investigation on multi-decadal changes of atmospheric aerosols and their effects on surface radiation using a global chemistry transport model along with the near-term to long-term data records. We focus on a 28-year time period of satellite era from 1980 to 2007, during which a suite of aerosol data from satellite observations, ground-based measurements, and intensive field experiments have become available. We analyze the long-term global and regional aerosol trends and their relationship to the changes of aerosol and precursor emissions and assess the role aerosols play in the multi-decadal change of solar radiation reaching the surface (known as “dimming” or “brightening”) at different regions of the world, including the major anthropogenic source regions (North America, Europe, Asia) that have been experiencing considerable changes of emissions, dust and biomass burning regions that have large interannual variabilities, downwind regions that are directly affected by the changes in the source area, and remote regions that are considered to representing “background” conditions.

Oxygen optodes as fast sensors for eddy correlation measurements in aquatic systems

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The aquatic eddy-correlation technique can be used to non-invasively determine the oxygen flux across the sediment-water interface by analyzing the covariance of vertical flow and oxygen concentration in a small measuring volume above the seabed. The method requires fast sensors that can follow the rapid changes in flow and the oxygen transported by this flow. In this paper, we demonstrate the suitability of fast optical oxygen sensors (optodes), in place of the traditionally used electrodes. Optodes have the advantage over electrodes of being less susceptible to signal drift, more durable under field conditions, less expensive, and repairable. Comparisons of the response times of optodes and electrodes to rapid oxygen changes showed that the optimized optodes had a slightly longer response time (164 ± 70 ms) than the microelectrodes (151 ± 60 ms) but were fast enough to capture the oxygen fluctuations that are relevant for the eddy correlation flux calculations. Side by side comparisons of benthic oxygen fluxes collected with both electrode-based and optode-based eddy correlation instruments in freshwater and marine environments showed good agreement between the measured fluxes. Over a 4 h mid-day measuring period, short term (15min) oxygen fluxes in the spring-fed Wakulla River (Florida) fluctuated between 52 and 401 mmol m^{-2} d^{-1} (average 165 ± 67 mmol m^{-2} d^{-1}), revealing the importance of local light and flow variations on the benthic oxygen exchange.