

Aircraft Measurements over the Deepwater Horizon Oil Spill: The Fate of Oil Compounds and Formation of Secondary Organic Aerosol

J.A. de Gouw
NOAA Earth System Research Laboratory
Boulder, Colorado

An extensively instrumented NOAA WP-3D research aircraft made airborne measurements of the gaseous and aerosol composition of air over the Deepwater Horizon (DWH) oil spill that occurred in April-July of 2010 in the Gulf of Mexico. A narrow plume of hydrocarbons was observed downwind from DWH that is attributed to the prompt evaporation of fresh oil on the sea surface. The comparison of the hydrocarbon composition of the atmospheric plume with that of the spilled oil itself allowed quantitative estimates of the hydrocarbon fraction that was removed in the water column during the transport from the sea bottom to the surface. In addition, the atmospheric flux of hydrocarbons could be estimated and, in combination with the known composition of the spilled oil, could be used to constrain the oil leak rate quantitatively.

The narrow plume of hydrocarbons downwind from DWH contained many compounds that are known to be efficient precursors of secondary organic aerosol (SOA). Organic aerosol was indeed present at high mass loadings ($>25 \mu\text{g m}^{-3}$) downwind from DWH, but was contained in a much wider plume. We attribute the observed aerosol to SOA formation from unmeasured, less volatile hydrocarbons that evaporated more slowly from the sea surface and were therefore emitted from a wider area around DWH. These observations provide compelling evidence for the importance of less volatile hydrocarbons as SOA precursors, which has been proposed as a significant source for organic aerosol in the polluted atmosphere.