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Impact of oil spill from ship on air quality around coastal regions of Korea

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Regional air quality around coastal regions, where regular maritime traffic emissions from cargo, other commercial, fishing and military vessels are significantly active, can be affected by their direct emission of primary air pollutants (NO_x, SO_2, particulate matter (PM), etc.). For instance, harbor traffic exerted an important impact on NO_2, SO_2, O_3, and PM levels. In addition, regional air quality around coastal regions is also affected by oil spill caused by ship accident in the coast. On 7 Dec., 2007, a barge carrying a crane hit the oil tanker *MT Hebei Sprit* off the west coast of the Republic of Korea, Yellow Sea (approximately 10 km off the coast), at 0700 local time, causing the spill of total estimated 12,547 tons of Iranian heavy (IH) and Kuwait Export (KE) crude oils. Since then, oil began coming on shore late in the night on 7 Dec. More than 150 km of coastline had been identified as being impacted by 17 Dec. Much of the affected area is part of the Taean-gun National Park and the nearest coastal city to spilled area is Taean. On 8 Dec., the flow of oil from the tanker was stopped when the holes were patched. The accident is the worst oil spill in Korea and the spill area is about one-third of the size of the *Exxon Valdez* oil spill. The short- and long-term effects of oil spill on marine environment have been numerously studied, not on atmospheric environment. In this study, the air quality impact near spilled area by the evaporation of hydrocarbons from the oil spill is studied in detail.

The evaporation rates of the volatile fractions of the crude oils released by oil spill were estimated based on their mole fractions of crude oils and mass transfer coefficients. Based on a molecular diffusion process, the flux of spilled oil component (F_i^{vap}, mol m^{-2} s^{-1}) can be expressed as follows:

$F_i^{vap} = K_i^{vap}(C_i^{vap} - C_\infty^{vap})$ (1)

where C_i^{vap} is concentration (mol m^{-3}) of a component i of crude oil vapor in the air at the oil-air interface; C_∞^{vap} is the concentration of an oil component i in air at infinite altitude which can be assumed to be zero; and K_i^{vap} is a mass transfer coefficient (m s^{-1}). The mass transfer coefficient was parameterized with wind speed, environmental temperature, and oil type. These emission data were then used in the 3-D chemical transport model.

During the model period, the mean VOC emission rates were estimated to be ranged from 3.4-10.8 mol s^{-1} (medians of 0.04-3.3 mol s^{-1}). Photochemical production of secondary pollutants such as ozone and particulate matter (PM) during the spill event, which were influenced by primary oil spill from the ship, will be calculated. For the case/sensitivity study, the photochemical production of ozone and PM during the season of summer will be predicted assuming the same magnitude of oil spill. In order to identify the chemical production mechanism of secondary pollutant such as ozone, process analysis will be used. A complete discussion of the importance of the results will be begun once we have completed model simulation and analysis. Further results may be obtained if the model simulation is finished before the conference.