Earth system model study of potential response of marine OC aerosols to ocean ecosystem changes

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Model approach

It has been proposed that the marine biogeochemical sulfur cycle could stabilize the Earth's climate against perturbations by exerting a negative feedback on climate [1]. Recent findings of significant amounts of organic matter in the sub-micrometer aerosols have suggested that the insoluble organic aerosols are the dominant source for the marine aerosols during periods of increased biological activity in the ocean [2]. This work investigates the effects of ocean ecosystem changes on the marine organic carbon (OC) fluxes by using an integrated Earth System Model. We perform four different scenarios (Sc1–4) to investigate the effects of ocean ecosystem changes on the marine OC flux (Table 1).

Scenario	Chlorophyll Data	Condition of Chlorophyll
Sc1[a]	Model	Preindustrial time
Sc2[b]	Satellite	Present (2003–2007)
Sc3[c]	Model	No effect on OC
Sc4[d]	Model	Future (2080–2100)

[a]Control run with marine OC emissions.
[b]Sensitivity run with marine OC emissions constrained by the satellite observations of chlorophylls.
[c]Sensitivity run without marine OC emissions.
[d]Sensitivity run with marine OC emissions due to triple CO_2 concentrations.

Table 1: Summary of different simulations performed.

Discussion of results

Our modeled estimate of global marine primary OC emission is comparable with that constrained by the satellite observations of chlorophylls. Our estimates of enhancements in the modeled OC concentrations due to the marine sources are consistent with previous measurements of water-insoluble organic carbon in summer over the open ocean. We find the significant increase in the averaged surface OC concentration in September over the Arctic ocean (70–90°N), which is largely driven by the disappearances of sea-ice cover due to triple CO_2 concentrations. Our results imply that future OC increases over Arctic Ocean may affect the climate feedback.

[1] Charlson *et al*. (1987) *Nature* **326**, 655– 661. [2] O'Dowd *et al*. (2004) *Nature* **431**, 676-680.

Accumulation of iodine on Andosol

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Iodine is an essential element for human and plays an important role in thyroid gland function. Long lived radioiodine, ^{129}I (half-life:$1.6x10^7$y), is released from nuclear facilities and atmospheric nuclear weapons test. This nuclide is expected to accumulate in soil and behave together with stable iodine (^{127}I). Therefore, it is important to study the levels and behavior of both stable and ^{129}I in the soil environment. In this study we have analyzed concentration of iodine in soil samples by ICP-MS and ^{129}I by AMS. We also carried out sorption experiments to understand the accumulation mechanisms.

Analytical results for different soils collected in Japan showed that iodine levels were in the range about 1-50ppm (dry basis). Markedly high iodine concentrations of about 20-50ppm were found in Andosol, volcanic ash soil with high organic contents. Since the parent materials (e.g. basalt and andesit) contain low iodine (about 0.05ppm), this element would be accumulated in Andosol more than several hundred times. Vertical distribution of ^{129}I showed that this nuclide was highly accumulated in surface soil ($6x10^{-4}$Bq/kg) compared to that in the lower layers. This suggests that anthropogenic ^{129}I is strongly associated with soil constituents.

Results for the sorption experiments (batch experiments) showed that the sorption percentage for I^- differ significantly between the upper and lower layers. The values of I^- for fresh soils were 96% for upper layer and 17% for lower one. In case of IO_3^-, the sorption percentages for both upper and lower layers were high (about 94%). These results indicate that the sorption is highly dependent on the chemical forms of iodine.

To examine the effects of microorganisms on the sorption, soil samples were treated by autoclaving and heating at different temperatures prior to the experiments. Adsorption of I^- was substantially reduced by autoclaving and heating treatments, while the IO_3^- sorption was not so much influenced by such treatments. This suggests that microorganisms seem to be important in the sorption of I^-.

We also studied desorption of iodine from soil under flooded conditions. Iodine was desorbed from soil into soil solution under reducing conditions (low Eh) created by the activities microorganisms.