Sulphur aerosols released from melting sea ice may influence Antarctic climate

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Sulphur aerosols released from melting sea ice may influence Antarctic climate

The familiar seaside ‘smell’ of the sea is caused by a volatile sulphur compound called dimethyl sulphide. This sulphur substance is produced by phytoplankton (microscopic marine plants) in the ocean, as well as by seaweeds, seagrasses and corals.

As far back as 1987, scientists proposed the existence of a feedback cycle involving dimethyl sulphide production in the ocean, production of cloud condensation nuclei (the small particles on which cloud droplets form), and global temperature (Figure 1). It was suggested that the major source of cloud condensation nuclei over the unpolluted ocean appears to be dimethyl sulphide, produced by phytoplankton, which oxidises in the atmosphere to form sulphate aerosol particles. These particles grow to form cloud condensation nuclei, which then attract moisture to form clouds. As the sulphate aerosol particles are so small (about 0.0002 mm in size), they can reflect incoming radiation back to space, keeping the Earth cool.

The researchers went on to propose that as the reflectance of clouds and the Earth’s radiation balance is sensitive to the number of cloud condensation nuclei, biological regulation of global climate is possible through the effects of temperature and sunlight on oceanic phytoplankton and the amount of dimethyl sulphide it produces.

This hypothesis has yet to be fully tested but provides a rationale for continued study of the production and fate of dimethyl sulphide in the world’s oceans. If dimethyl sulphide does play an active role in low-level cloud formation, it could be a negative greenhouse gas, since doubling the amount of dimethyl sulphide particles over the unpolluted ocean could form the nuclei of cloud condensation. This would be a negative greenhouse effect, since doubling the amount of sulphur compound would play an active role in cloud formation, it could play a negative greenhouse effect, since doubling the amount of dimethyl sulphide particles over the unpolluted ocean appears to be dimethyl sulphide, produced by phytoplankton, which oxidises in the atmosphere to form sulphate aerosol particles. These particles grow to form cloud condensation nuclei, which then attract moisture to form clouds. The sulphate aerosol particles are so small (about 0.0002 mm in size), they can reflect incoming radiation back to space, keeping the Earth cool.

Scientists from France, Russia and the United States used the Vostok ice core in Antarctica to reconstruct the atmospheric concentration of methane sulphonic acid (MSA) over the past 160 000 years, covering a whole glacial-interglacial cycle. Their results suggest that concentrations of sulphate aerosols deriving from dimethyl sulphide and methane sulphonic acid are lower during warm interglacial phases and higher during ice ages.

Our results suggest that this loss of sulphate aerosols derived from dimethyl sulphide and methane sulphonic acid is associated with higher sea ice extent and lower atmospheric sulphate concentration during ice ages. In 1997 scientists from France, Russia and the United States used the Vostok ice core in Antarctica to reconstruct the atmospheric concentration of methane sulphonic acid (MSA) over the past 160 000 years, covering a whole glacial-interglacial cycle. Their results suggest that concentrations of sulphate aerosols deriving from dimethyl sulphide and methane sulphonic acid are lower during warm interglacial phases and higher during ice ages.

The sea ice is 20 million km² wide, the size of Russia – and in late spring-early summer 60% of this area melts into the surrounding seawater. Sixty-six sea ice cores were collected at 23 sites across eastern Antarctica (69° to 110°E) and processed for dimethyl sulphide (DMSP) and dimethyl sulphide (DMS). Rectangular ice panels were taken at 500 km transects through melting pack ice in 1998.

In December 1998 a 500 km transect through the melting ice edge (Figure 2) found very high concentrations of dissolved dimethyl sulphide, which had been released from phytoplankton production, agreeing with the satellite record for that year. The pattern of dimethyl sulphide concentrations in the Southern Ocean appears to be an important source of cloud nuclei that can influence climate. The data suggests that the release of dimethyl sulphide from melting sea ice may be an important source of cloud nuclei that can influence climate. The data suggests that the release of dimethyl sulphide from melting sea ice may influence Antarctic climate change.

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