Ocean acidification amplifies global warming (Update)

August 25 2013

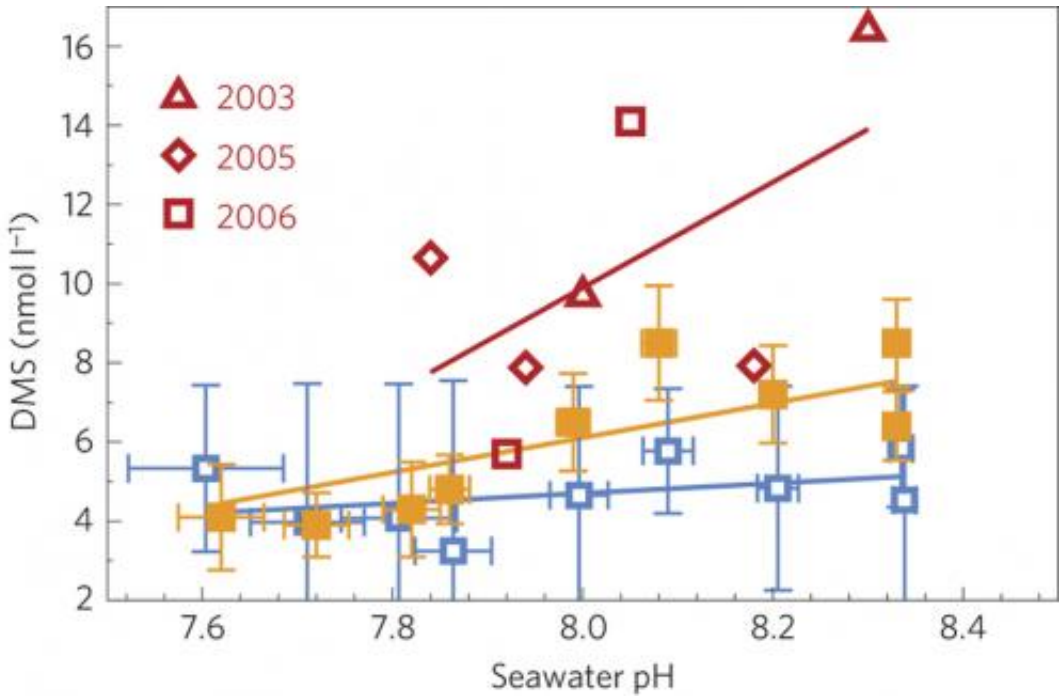

Figure 1 : Observations of reduced DMS concentration with decreasing seawater pH from different mesocosm experiments.

Scientists at the Max Planck Institute for Meteorology (MPI-M), Dr. Katharina Six, Dr. Silvia Kloster, Dr. Tatiana Ilyina, the late Dr. Ernst Maier-Reimer and two co-authors from the US, demonstrate that ocean acidification may amplify global warming through the biogenic production of the marine sulfur component dimethylsulphide (DMS).

It is common knowledge that fossil fuel emissions of CO2 lead to global warming. The ocean, by taking up significant amounts of CO2, lessens the effect of this anthropogenic disturbance. The "price" for storing CO2 is an ongoing decrease of seawater pH (ocean acidification), a process that is likely to have diverse and harmful impacts on marine biota, food webs, and ecosystems. Until now, however, climate change and ocean acidification have been widely considered as uncoupled consequences of the anthropogenic CO2 perturbation.

Recently, ocean biologists measured in experiments using seawater enclosures (mesocosms) that DMS concentrations were markedly lower in a low-pH environment (Figure 1). When DMS is emitted to the atmosphere it oxidizes to gas phase sulfuric acid, which can form new aerosol particles that impact cloud albedo and, hence, cool the Earth's surface. As marine DMS emissions are the largest natural source for atmospheric sulfur, changes in their strength have the potential to notably alter the Earth's radiation budget.

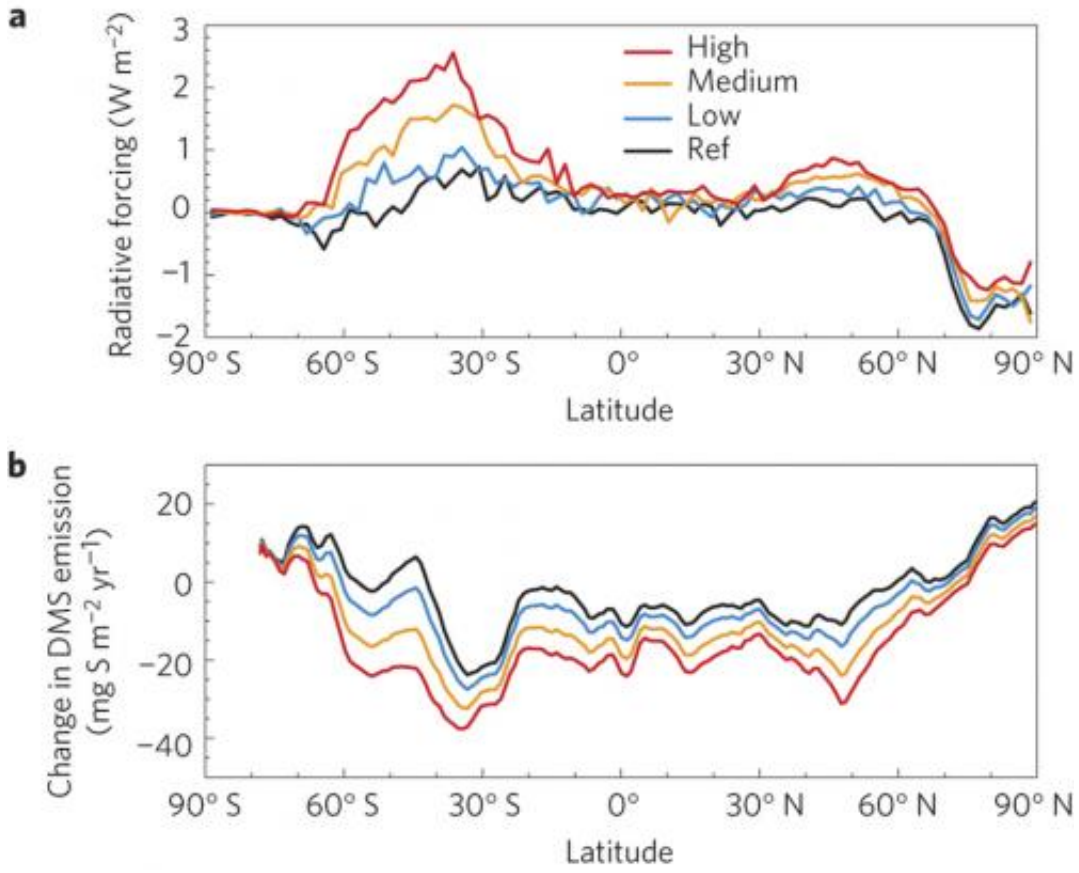

Figure 2 : Zonal averaged changes in radiative forcing (a) caused by the projected changes in DMS emission (b) for three sensitivity experiments (high, medium and low) based on the relationship shown in Fig.1 (same color coding) and a reference run (Ref).

Based on the results from the mesocosm studies the researchers from the MPI-M have established relationships between pH changes and DMS concentrations in seawater. They projected changes in DMS emissions into the atmosphere in a future climate with enhanced ocean acidification using the MPI-M Earth system model4. In the journal *Nature Climate Change* it is demonstrated, that modeled DMS emissions decrease by about 18 (±3)% in 2100 compared to preindustrial times as a result of the combined effects of ocean acidification and climate change. The reduced DMS emissions induce a significant positive radiative

forcing of which 83% (0.4 W/m2) can, in the model, be attributed to the impact of ocean acidification alone (Figure 2). Compared to the Earth system response to a doubling of atmospheric CO2 this is tantamount to an equilibrium temperature increase between 0.23 and 0.48 K. Simply put, their research shows that ocean acidification has the potential to speed up global warming considerably.

More information: Six, K. et al. (2013): Amplified global warming by altered marine sulfur emissions induced by ocean acidification, nature climate change, *Nature Climate Change*. doi: 10.1038/NCLIMATE1981. dx.doi.org/10.1038/nclimate1981

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