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Discussion Session Report:
SOLAS Large Scale Field Experiments
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The session began with Peter Liss explaining the context of the discussion. Seven ideas have been submitted to the SOLAS Scientific Steering Committee (SSC) concerning potential 'large-scale field experiments' for the future. For the purposes of the discussion, 'large-scale field experiments' were defined as:
"Larger in scale (horizontal, vertical, temporal and resource) than has been attempted before and should try to answer questions that are new, or older questions tackled in a new way"
Only five of these ideas were presented for discussion in the Barcelona discussion session (more information can be found at http://tinyurl.com/yajyu32). In this article, I will briefly introduce each idea before moving to the key parts of the discussion.

Mitsuo Uematsu and Roland von Glasow suggested experiments focussing on halogenated compounds. Mitsuo Uematsu's work builds upon a Japanese research programme approved for Jan-March 2012 and aims to link Pacific Ocean biogeochemistry with the stratosphere. Roland von Glasow proposed (on behalf of HitT; http://www.hitt-task.net/) a focus on the vertical extent of halogen chemistry in the Atlantic troposphere, possibly building upon work underway at Cape Verde.

Eric Saltzman posed the question: "What has SOLAS 'left undone'?" He noted that both satellite and *in situ* measurements have shown a link between seasonal phytoplankon blooms and cloud/aerosol properties but that a large-scale experiment considering the imprint of ocean ecosystems on aerosol/cloud properties has yet to be conducted. Peter Liss followed this with a figure from Meskhidze and Nenes (2006), which presents a tantalising correlation between ocean chlorophyll and atmospheric cloud effective radius. Of course correlation does not mean causation and this could of course indicate an atmospheric imprint on ocean ecosystems rather than vice-versa. However, Peter Liss pointed out that the aerosol/CCN population over the remote ocean are unlikely to have come from terrestrial sources and that the direction of forcing is thus more probable to be the ocean affecting the atmosphere.

Peter Liss also suggested that the large-scale iron fertilisation experiments that have been conducted so far are unlikely to be a true mimic of atmospheric dust/iron deposition and asked whether improvements could be made to any future experiments. Maurice Levasseur proposed that the successful collaboration between Japan and Canada be developed further in the Pacific Ocean, with experiments considering the impact of iron fertilisation in an acidified (i.e. high CO_2, low pH) ocean. This would require a consideration of multiple stressors acting in concert on a number of important biogeochemical processes. Specifically, nutrient limitation – major (nitrogen, phosphorous) and minor (iron) nutrients – and pH reduction influencing coccolithophore productivity and carbon export and resultant trace gas (e.g. DMS) production.

At this stage, the discussion was opened up fully to everyone in the room. For the most part, debate focussed on developing existing understanding of iron fertilisation experiments toward more natural large-scale addition experiments (i.e. using some type of atmospherically-processed dust). Some individuals pointed out that mesocosm experiments have been carried out, which used desert dust that had been processed in some manner, and that these have had some success.

Those present considered improvements in our understanding of the flux and impact of nutrients from deep water(s) to be critical if we are to gain insight into the meaning of atmospheric dust/iron experiment results. There needs to be precise quantification of these processes if atmospheric impacts are to be appropriately attributed. The international research programme, GEOTRACES (http://www.geotraces.org/), aims to address this issue. This is especially important given that some atmospheric dust impacts could potentially be either negative (e.g. copper toxicity) and/or positive (e.g. alleviation of aluminium and/or iron limitation).

Next, focus shifted toward the impact that rain may have on dust/iron solubility. Peter Liss asked whether it would be possible to make it rain over the ocean to which Cliff Law and Keith Hunter suggested that it might be possible to examine a natural system situated to the North of the Tasman Front. This region is subject to regular dust events from Australia (these tend to be low in inorganic nitrogen) and, during cyclone season, there is the potential to be able to study a natural wet iron deposition event. Such an experiment would require substantial planning and relatively small vessels 'ready to go' during the period when the event is most likely to occur (the transit time is approx. 24 hours). However, the results would be very valuable, especially if interpreted in conjunction with remotely sensed data.

At this point, time ran out and forced the close of a very successful discussion session. It provoked a lot of 'food for thought' and will hopefully stimulate the community toward at least one more large-scale SOLAS field experiment!

References

Meskhidze, N. and Nenes, A., 2006. Phytoplankton and cloudiness in the Southern Ocean. Science, 314(5804): 1419-1423.