Dynamic Biogenic Emissions for the Marine Background Aerosol

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Abstract

The ocean transfers numerous greenhouse and climate change gases into the global aerosol system, influencing boundary layer reflectivity over a majority of the planetary surface. The most variable and active substances involved are of biotic origin, including biogenic gases of the marine organosulfur cycle and carbon chain biomacromolecules within the terrestrial ocean pool. Dimethyl sulfide, protein polysaccharides, lipids, humics and many contaminants from within this pool are intimately involved. A unique program will be described which cuts across the DOD systems modeling community and underlies global scale simulation for the collective marine aerosol source material. We seek through inter-laboratory collaborations to represent chemical and physical chemistry studies, and speciated fluxes into the atmosphere are computed for material. We seek through inter-laboratory collaborations to represent chemical and undertakes global scale simulation for the collective marine aerosol source byproduct gases of the marine organosulfur cycle and carbon chain macromolecules surface. The most variable and active substances involved are of biotic origin, including aerosol system, influencing boundary layer reflectivity over a majority of the planetary

Coupling Laboratories and ESM Components

- DMS crosses ocean and ice interfaces, bridging marine biogeochemistry to the aerosol
- Requires coupling LANL scavence, LNL sulfur chemistry, PNNL model systems
- For example, aerosol producers consumed strongly in time channels, loads of sea ice
- Releases found over pan-Arctic simulations of ice algae and DMS in the pack
- Release is up the “Summer Paradox”

Global Marine Surfactant Chemistry

- First keep it simple – competitive Langmuir monolayers for cavities and interfaces
- Waves generated bubbles burst and drive several thicknesses into the boundary layer
- There organics can affect mass, hygroscopy, surface tension, vapor transport, more
- Injections into a spray aerosol highly nonlinear – not simple funtions of basic activity

On to the Sea Spray Organics

- Over last decade, primary organics shown to comprise major fraction of remote aerosol
- Affects on Kohler curve properties strong but multiple, complex, highly uncertain
- LANL-PNNL conducting first ever simulations of chemically resolved DCC in ocean
- Macromolecule types differ in basic surfactant behaviors and some stick to bubbles
- PNNL/LANL compute wave driven sourcing for competitive Langmuir monolayers
- The calculations provide a novel approach to parameterization of marine POC

Extensions of Langmuir: Multilayers

- Polysaccharides turn out to be extremely hydrophilic, hence their retard adsorption
- Yet the marine organic aerosol is rich in hydroxyl moieties (Elliott or Polysaccharides)

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Feedbacks through the Earth System

- Marine bio-emissions dominate aerosol precursor inputs over most of the planet
- Potential for CLAW-like feedbacks and we are well positioned to simulate
- LANL-PNNL-LNL, coupling both EMS and biomacromolecules into IAM within CESM
- Reduced models largely demonstrate the need for complete system run
- Hopefully upcoming in the near ACME model, emphasizing fast forcing agents

Extensions of Macromolecular Chemistry

- Even where waves don’t form bubbles, surfactants coat the ocean interface
- Gas transfer rates strongly altered by viscosities near the air-water, e.g. CO2, O2
- Also the OCC surfactant spectrum overlay that of transition metal (IO(g))
- Hence our computations are relevant to bioavailability of iron in the Southern Ocean

European EMS-modelers currently in strategic, reduced simulation of marine biogeochemical feedbacks

Left: Chlorophyll used to estimate general surface fluxes on the global carbon dioxide flux (Tan and Liu 2003). We will distinguish effects for lipids, proteins, humics etc. Below, Many of the organic aerosol precursors coordinate trace metals, e.g.

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