2.163 The bromine conundrum - Chemical coupling of halogens and OVOC over tropical oceans.

Early Career Scientist

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Abstract:

Tropospheric halogens are emitted from the ocean surface into the atmosphere in organic and inorganic form, and as sea-spray aerosols. Chemistry in aerosols and on aerosol surfaces releases bromide to the gas phase, leaving aerosols depleted in bromide relative to seawater. Bromine and iodine participate in catalytic cycles which destroy tropospheric ozone, impact oxidative capacity extending the lifetime of methane, oxidize mercury, modify aerosols, and can (iodine) form new particles which affect cloud cover and Earth's albedo. About 75% of global destruction of the greenhouse gases ozone and methane occurs at tropical latitudes.
Applying process-level representations of bromide liberation indicates sea-spray aerosol is the largest single source of atmospheric bromine. Such as source is particularly important near the sea surface. However, gas-phase bromine species are frequently found at low concentrations – most often below detection – in the marine boundary layer. This represents a conundrum for global models. State-of-the-art global models therefore often eliminate the sea-spray source in order to reproduce observations.
The sources of oxygenated volatile organic compounds (OVOC) over the ocean are an active area of research, significant concentrations over tropical oceans remain unexplained. Reactions of Br atom with OVOC, such as aldehydes, integrate gas-phase bromine into HBr, which is currently unmeasured. We have extended the set of known OVOC-Br reactions and represent these in the CABBA-MECCA box model along with the sea-spray aerosol bromine source to investigate bromine closure over the tropical eastern Pacific Ocean. The model is expanded to represent laboratory observations of Br+OVOC kinetics, which are currently not represented in global models, but which help reconcile field observations of BrO radicals, and size resolved aerosol bromide from a ship cruise over the tropical Pacific Ocean. Our insights provide a viable mechanism to explain the

long-standing bromine conundrum over remote oceans. The atmospheric implications are discussed.