5.040 Contribution of Arctic seabird-colony ammonia to atmospheric particles and cloud-albedo radiative effect.

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Abstract:

The Arctic region is vulnerable to climate change and has been warming more rapidly than the global-mean rate for the Earth. Atmospheric particles and clouds play key, but complex roles in offsetting the radiative forcing from greenhouse gases. In the summertime, the Arctic atmosphere is pristine and strongly influenced by natural regional emissions, which have poorly understood climate impacts related to atmospheric particles and clouds. Recent evidence indicates that ammonia emissions from migratory-seabird guano are a primary contributor to summertime boundary-layer ammonia levels measured in the Canadian Arctic Archipelago region. In this study, we examine the impact of pan-Arctic seabird-colony ammonia on particle number concentrations, and the cloud-albedo radiative effect. Ammonia from seabird-colony guano is found to be a key factor contributing to bursts of newly formed particles, which are observed every summer in the near-surface atmosphere at Alert, Nunavut, Canada. Our GEOS-Chem-TOMAS chemical-transport model simulations indicate that the pan-Arctic seabird-influenced particles can grow by sulphuric-acid and organic vapour condensation to diameters sufficiently large to promote pan-Arctic cloud droplet formation in the clean Arctic summertime. We calculate that the resultant cooling tendencies could be large, exceeding -1 W m^{-2} near the largest seabird colonies due to the effects of seabird-

influenced particles on cloud albedo. These coupled ecological-chemical processes may be susceptible to Arctic warming and industrialization.