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Constraints on Global Dust Inputs and Iron Cycling from Measurements and Models of Thorium Isotopes

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Dust deposition plays a critical role in supplying trace elements to marine phytoplankton at the sea surface. However, constraints on modern dust deposition rates in open ocean regions are sparse, as few direct observations exist to calibrate global dust models. Long-lived thorium isotopes have recently emerged as a key tool for quantifying dust input rates to the ocean. In-situ radiogenic ^{230}Th has a well-constrained mass budget in the upper water column that can be applied to the primordial isotope ^{232}Th, which is supplied by aerosol deposition, allowing for the determination of dust deposition rates.

In this talk, we present three new advances. First, we develop a framework to correct for advective-diffusive fluxes when using thorium-based dust reconstructions. Second, we apply these corrections to a global oceanic thorium isotope database to determine dust deposition rates distributed throughout the world oceans. Third, we present results from a new global scavenging model for thorium isotopes in the Community Earth System Model (CESM). The inclusion of thorium isotopes in CESM puts tight constraints on regional and global dust deposition rates. Finally, we will discuss the implications of our results for quantifying the supply and removal rates of iron in the world ocean.