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Influence of atmospheric chemistry on abiotic nitrogen cycling

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Nitrogen is a major component of Earth's atmosphere and plays an important role in biochemistry. However, prior to the emergence of biology, all nitrogen was cycled abiotically and this cycling may have set the stage for the origin of life. While some constraints on the evolution of the partial pressure of N2 in the atmosphere of the Earth exist, the distribution of N-species between Earth's surface and interior as a function of time is unclear. In addition, as the chemical composition of terrestrial planets is known to be diverse, we want to be able to test the sensitivity of our Earth results to a varying atmospheric composition.

To do this, we used the model developed in Laneuville et al. (2018) in which we considered N cycling via abiotic processes as understood for modern Earth. Then, in contrast to that study, we implement a simple atmospheric photochemistry model including H, C, N, and O species to self-consistently compute the deposition rate of nitrogen as a function of atmospheric C/H and O/H ratio and total pressure P instead of using a constant deposition rate parameter as used in our previous study. In addition to helping understand nitrogen cycling on early Earth, this approach allows us to set the stage for the description of atmospheric signature of abiotic processes.