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A Photolysis Scheme that Understands Clouds: Fast-JX

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The cracking of atmospheric molecules by sunlight is a crucial part of the chemistry that determines the concentration of greenhouse gases (GHGs) and aerosols that result from anthropogenic emissions. This is especially important for the GHGs such as methane (CH4), nitrous oxide (N2O), and ozone (O3), as well as the production and destruction of secondary aerosols. The scattering of sunlight by clouds and aerosols has a big impact on photolysis, and hence GHG and aerosol concentrations. However, the photolysis scheme that E3SM inherited from CESM only applies a crude correction factor when clouds are present. We have therefore implemented the Fast-JX photolysis scheme (developed at UC-Irvine) into E3SM under the atmosphere NGD. Fast-JX features 8 angular streams for scattered sunlight, an innovative cloud overlap scheme that is robust to changes in vertical resolution (Cloud-J; Prather, 2015), spherical solar ray tracing, and requires no delta-Eddington reduction in aerosol/cloud optical depths. In the future, we will update the Fast-JX radiation code to also calculate solar-heating (Solar-J; Hsu et al., 2017) to compare with the existing radiative heating code in E3SM (RRTMG).

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