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# Designing a radiation code to balance flexibility and efficiency

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Radiation is the best-understood of all atmospheric processes requiring parameterization in atmospheric models, and normally one of the most computationally expensive components of any such model. Although methods for parameterization have evolved little in the last 15 years the construction of radiative parameterizations requires substantial effort and so is undertaken relatively infrequently, leading to unnecessary spread in model predictions of quantities such as radiative forcing by greenhouse gas changes, or in hydrologic sensitivity to global temperature change. The importance of speedy-but-accurate radiative transfer suggests that a fast radiative transfer library would be broadly useful, provided the library can be made flexible enough to use in different models, on different platform, and across different contexts.

We describe the design of a new radiation framework for atmospheric models that seeks to balance computational efficiency and flexibility in a wide range of contexts. Efficiency is obtained by isolating calculations into computational kernels operating across columns in a user-configurable domain size. Using simple interfaces enhances flexibility, since the kernels may be re-implemented for efficiency on new computational platforms. Flexibility in coupling to the host atmospheric model, and especially to a wide range of physical descriptions of clouds and aerosols, is accomplished by isolating the transformation of physical properties to optical properties and encapsulating the details of this transformation in object-oriented Fortran. Data used by the library, primarily in determining the optical properties of greenhouse gases given temperature, pressure, and concentration information, is provided dynamically, so that the same library might be used for present-day weather forecasts, simulations of past or future climates, or even the simulation of radiation on other planets.