RFMIP Aerosol IRF protocol (Updated July 28th 2017)

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It is our goal to conduct these benchmark calculations and provide results useful for the practical improvement of radiative transfer parameterizations with as little iteration on the part of the modeling centers as possible. To accomplish that goal please read through the following steps and checklist and prepare your submission accordingly.

Steps to Participate in RFMIP Aerosol IRF:

1. Provide instantaneous 3-hr atmospheric state variables and aerosol optical properties on your model's native grid (see page E3hrPt of the cmvmm_RFMIP_TOTAL sheet) for requested days from historical runs*. **(Only the following dates are requested: Jan 1, Apr 1, July 1, Oct 1 for the following years: Tier 1: 1850, 2005 and Tier 2: 1980, 1992)**
2. Upload to ESGF clean-clear and clear-sky fluxes on your model's native grid corresponding to the properties mentioned above. Use a "double call" structure within your radiative code to ensure the fluxes with and without aerosol have identical underlying meteorology.
3. We will calculate line-by-line clean-clear and clear-sky benchmark fluxes on your model's native grid according to the input you provided
4. We will compare the fluxes you provided to the ones we calculated, resulting in the characterization of your model's radiative parameterization error then upload the results to ESGF.

The line-by-line benchmark fluxes can be considered the underlying radiative transfer solution resulting from your model's climate state, uncontaminated by radiative parameterization error.

***To properly benchmark your radiation code it is imperative that all fields provided are those actually seen by the radiation code**. It is very unlikely that the instantaneous three hour output of a field are by default identical to that seen by the radiation code. Specifically, quite often the radiation code will see meteorological fields calculated from an earlier time-period.

The CMIP6 protocol did not allow us to request data on a GCMs native radiation time-step. However, if provided with the data we will also perform the calculation on your GCMs native-GCM timestep for increased accuracy. You must provide this data in addition to the three hour data.

Checklist for modeling centers:

There is some metadata that will help us to properly use the data you provide. Please consider making sure the following questions are answered in the data you provide:

1. What are the units of your gas concentrations?
2. Are your gas concentrations (especially water vapor) relative to dry or moist air?
3. What solar source function is assumed within your radiative parameterization (CMIP, Kurucz, Lean, other)?
4. Does your model use a fraction-of-day or other concept that alters the perception of the solar zenith angle?
5. Does your model report both visible and near IR albedos? What is the spectral threshold between your visible and near IR albedos, and if it lies in the middle of a band how are the two albedos applied within the band? Are the albedos direct or diffuse?
6. Are aerosol properties assumed to vary within the band in anyway other than uniformly?

Additional Notes:

If we find any of the information you provide ambiguous, we may contact you to answer additional questions. Additionally, if in the course of creating benchmark calculations from the data you provided we find any potential inconsistencies that preclude us from accurately calculating the radiative parameterization error, we may ask you to provide additional diagnostic variables to aid in our “de-bugging”. In our proof-of-concept work we have found particularly useful the band-by-band fluxes at the top and bottom of the atmosphere, and the broadband fluxes at every layer of the atmosphere.