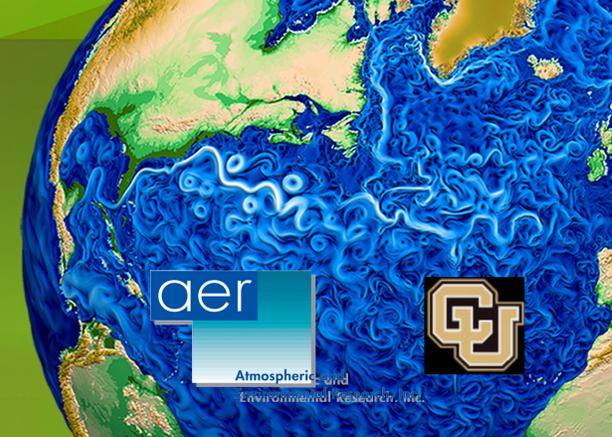


# F: Improving the Efficiency and Coupling of Radiative Transfer in the ACME Earth System Model

#A15

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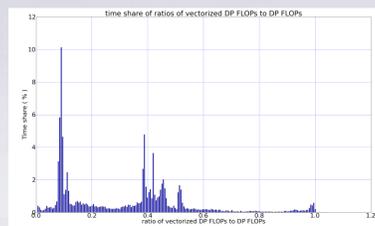
## Introduction to RRTMGP

**What is RRTMGP?** RRTMGP is a high-performance radiation code for the current generation of computational architectures.

- It is the successor to RRTMG, the accurate radiation code used in CAM/ CESM for many years
- RRTMG's design is inefficient for modern computers; vectorizes poorly ↓

**What are the objectives of our ACME project?**

- Efficiently couple RRTMG within the ACME model
  - ACME aerosol and cloud modules
- Work with ACME developers to ensure RRTMGP runs efficiently on emerging architectures
  - MIC platforms
  - GPU platforms
- Enhance the RRTMGP capabilities to support ACME priorities



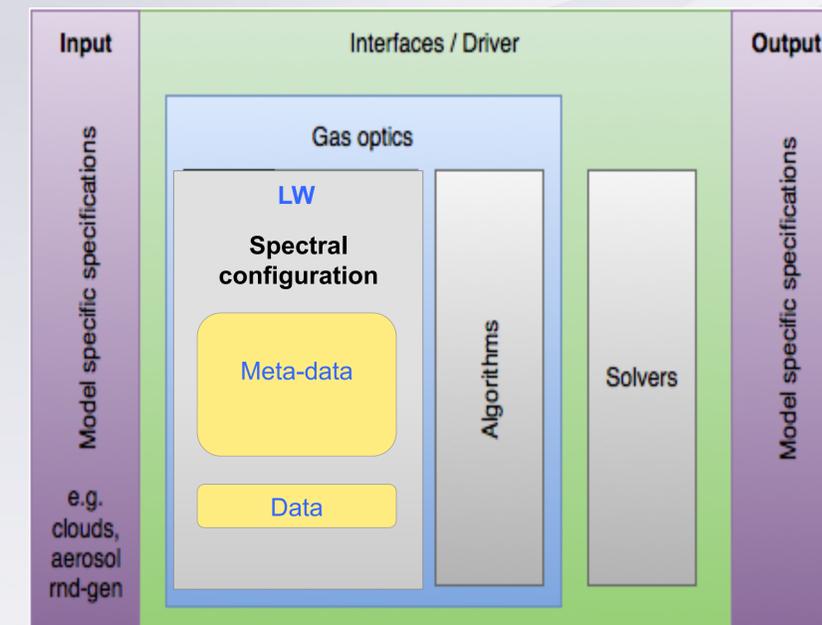
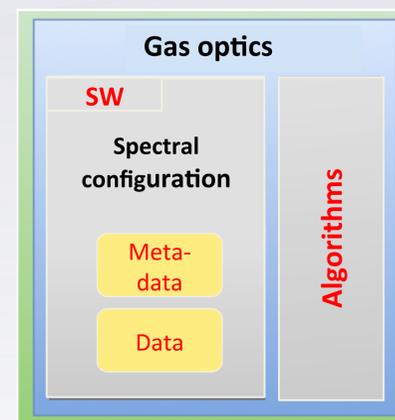
Frequency of occurrence of the ratio of vectorized to total floating point operations for RRTMG in CESM

**Current status**

- Prototype clear-sky code available, profiling underway in CAM

## RRTMGP Architecture

- **Optimized for parallel processing**
- **Modular, generalized for other atmospheres**
- **Object-oriented interfacing**



## RRTMGP Performance Advancements

**Entirely new calling structure**

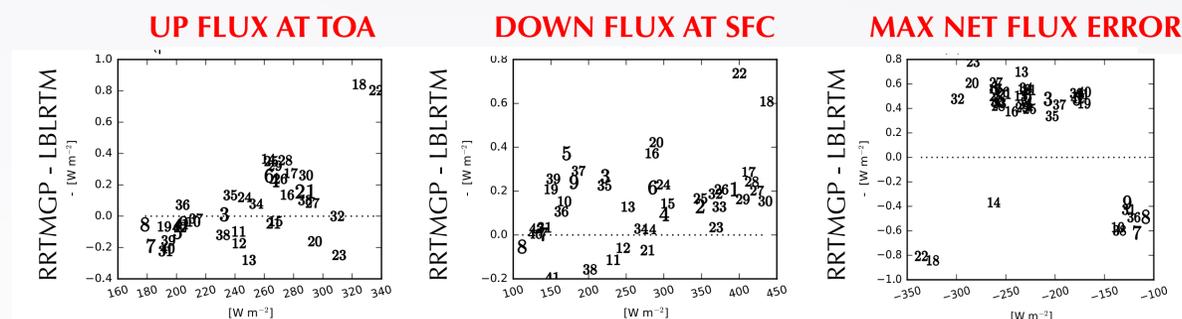
- Uses derived types or classes
  - Enables greater I/O flexibility without code changes
  - Minimizes data transfer
- Aerosol and cloud optics are user's responsibility

**High Performance should be possible**

- Code is vectorized across columns
- Large amounts of fine-grained parallelism is exposed
- Computation is isolated in kernels operating on assumed-size arrays
- Amenable to MIC and GPU implementations

## RRTMGP Clear-Sky Validation with LBLRTM

The accuracy of RRTMGP has been evaluated with respect to reference calculations by the Line-By-Line Radiative Transfer Model (LBLRTM) for a set of 42 diverse profiles:



Mean error:	0.07 W/m <sup>2</sup>	0.16 W/m <sup>2</sup>	0.25 W/m <sup>2</sup>
Mean  error :	0.18 W/m <sup>2</sup>	0.19 W/m <sup>2</sup>	0.52 W/m <sup>2</sup>

(preliminary results)