

# GAME Documentation

GAME Development Team

The *speed*  $s$  of a model is defined by

$$s := \frac{\Delta t}{\Delta \tilde{t}}, \quad (1)$$

where  $\Delta t$  is the time step of the model and  $\Delta \tilde{t}$  is the duration it takes to integrate from one time step to the next.

## 1 NWP mode

In NWP mode, one wants to be able to integrate one day within 8.5 minutes, which corresponds to  $s = \frac{24 \cdot 60}{8.5} = 169$ . As a general rule, one can say that the computation time is in equal parts needed for data assimilation, the dynamical core and the processes involving moisture and radiation. Thus, the dynamical core has a minimum speed of

$$s \geq 509. \quad (2)$$

### 1.1 Parallelization

## 2 Radiation scheme

GAME employs the so-called RTE+RRTMGP (Radiative Transfer for Energetics + Rapid and Accurate Radiative Transfer Model for General Circulation Model Applications-Parallel) [1], [2] scheme. It is bound to the C code through the API RTE-RRTMGP-C [3].

## References

- [1] Robert Pincus, Eli J. Mlawer, and Jennifer S. Delamere. Balancing Accuracy, Efficiency, and Flexibility in Radiation Calculations for Dynamical Models. In: *Journal of Advances in Modeling Earth Systems* 11.10 (2019), pp. 3074–3089. DOI: 10.1029/2019MS001621. eprint: <https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2019MS001621>. URL: <https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019MS001621>.
- [2] *RTE-RRTMGP github repository*. June 22, 2020. URL: <https://github.com/earth-system-radiation/rte-rrtmgp>.
- [3] *RTE-RRTMGP-C github repository*. June 22, 2020. URL: <https://github.com/MHBalsmeier/rte-rrtmgp-c>.