ecRad in ICON: status and plans

Mareike Burba, DWD (FE14)

COSMO-GM 2024: "Radiation, Clouds, Aerosols and Chemistry"

Outline

About me

- took over permanent position in physical parametrization group for radiation and aerosol in January 2024
- part of DWD's "Renewable Energy Program"
- Meteorologist, University of Hamburg
- previous experiences:
  - data assimilation, 5 years at DWD (regional variational DA, global assimilation of VIS reflectances)
  - radiative transfer modeling and measurement campaigns, 2 years at the European Space Agency (ESA)

About ecRad

- radiation module used operationally for NWP @ DWD
- developed in ECMWF, contributions by partners
- used in IFS, ICON, french model, . . . for NWP
- gas optics, aerosol optics, cloud optics
- several solvers available
- there are several library version of ecrad and a standalone version

Update of ecrad Version in ICON (May 2024)

- Update ecrad Version in ICON and adapt ICON interfaces accordingly
- Updates in ecrad:
  - aerosoloptical descriptions (R. Hogan)
  - scaling of greenhause gas concentrations (R. Hogan)
  - different gas optics for SW and LW are possible (R. Hogan)
    - ★ not supported in ICON, use either ecckd or rrtm (M. Burba, D. Rieger)
  - Bugfix for Planck approximation (affects SW, PAR, but VERY little)
  - GPU parallelization of McICA (D. Hupp)

Effects of the Update May 2024

- only minor, numerically not identical
- a lot of effort to understand the differences (was due to bugfix)

Improve testing capabilities of ecRad-standalone

Testing

- find out quickly if an ecrad update has effects on ICON without running ICON
- quickly isolate the origin of differences (aerosol, cloud, gas optics, . . .)
- test not only IFS way of using ecrad, but ICON's way too!
- Planned: granule test

Improve testing capabilities of ecRad-standalone

Testing

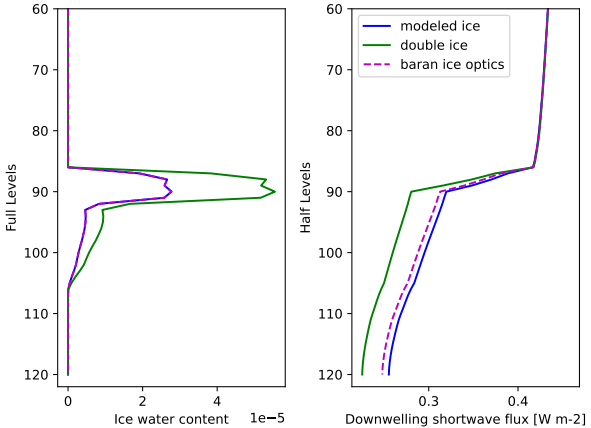
- find out quickly if an ecrad update has effects on ICON without running ICON
- quickly isolate the origin of differences (aerosol, cloud, gas optics, . . .)
- test not only IFS way of using ecrad, but ICON's way too!
- Planned: granule test

Science

- do sensitivity studies on certain input parameters of ecrad
- identify ecRad changes which are likely to have an impact on ICON's radiation budget

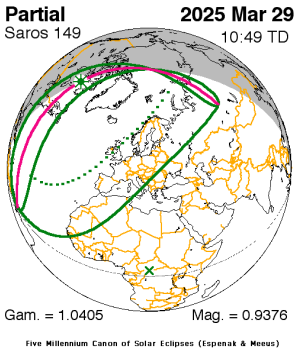
ecRad standalone: example (not sophisticated...)

- choose an ICON column with ice clouds and export optical properties etc (quite technical...)
- play with that column
  - double ice water content
  - use Baran 2016 ice optics instead of SOCRATES
  - evaluate sensitivity on the fluxes



Modeling a solar eclipse

- application area: radiation predictions for renewable energy industry
- get some coupling between ICON and reduced radiation (no pure postprocessing)
  - get changed fluxes in ICON and interaction with PBL, clouds
  - different concepts possible



Source Espenak & Meeus, NASA: https://eclipse.gsfc.nasa.gov/5MCSEmap/2001-2100/2025-03-29.gif

Optical properties

- case studies of optical properties of
  - ice
  - aerosol

Testing ecrad

- build option with cMake (WIP, B. Reuter)
- maybe move to a different repository
- technical restructuring how to best integrate ecRad into different models (joined effort: ECMWF, DWD, MeteoSwiss, MeteoFrance)

Summary

- update in May 2024
  - numerical differences to previous version
  - runs on GPU
- a lot of infrastructure related work to improve testing and the build process
- planned activities
  - solar eclipse
  - case studies using standalone ecRad
- dynamic exchange and cooperation between ECMWF, DWD, MeteoSwiss and MeteoFrance
- any comments on standalone testing?

Thank you for your Attention!

Feel free to contact me!

Mareike Burba

Physical Processes (FE14)
Research and Development (FE)
Deutscher Wetterdienst
Offenbach am Main

Tel.: 069 8062 3177

mareike.burba@dwd.de / mareike.burba@partner.kit.edu