



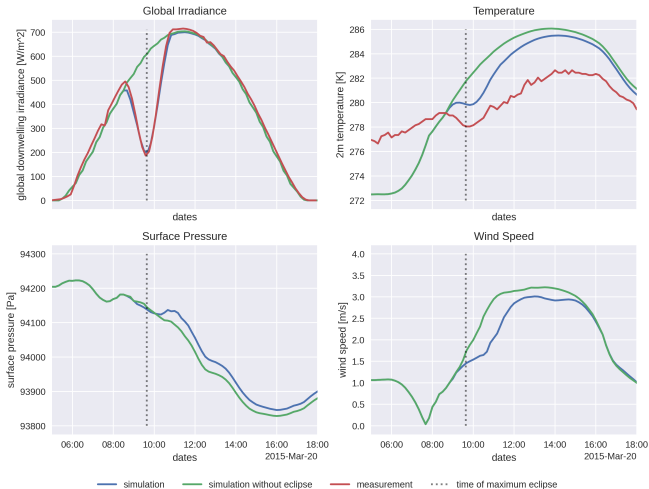
ICON's solar eclipse parametrization

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COSMO GM, RCAC Working Group, 2026-09-14

Motivation

- solar eclipse is relevant for the power production and grid stability
 - ▶ with increasing PV capacities
 - ▶ European power grids are connected
- 2-5 solar eclipses per year worldwide
- feedback on other model variables is possible
- solar eclipse parametrizations in IFS and WRF too
- last eclipse: August 12, 2026
- next European eclipse: 2. August 2027



- Hohenpeißenberg, Germany
- March 20, 2015

How does it work?



- Besselian Elements
 - ▶ coefficients to compute the movement of the shadow axis as a function of time
 - ▶ source: NASA -2000 until + 3000 years, csv format
 - ▶ trad coefficients during initialization from netcdf file
 - ▶ no solar eclipse during simulated period? no extra computation
- coordinate transform for every grid point
 - ▶ with ellipsoid assumption
- compute geometric shading
- scale solar incoming radiation at top of atmosphere every radheat time step
- neglects: limb darkening, solar shape, $\Delta T(t)$...
- 2 new namelist settings: on/off, path to input file
- python script to create your own input file
- runtime: very small impact

Study: solar eclipse in the USA, 2024

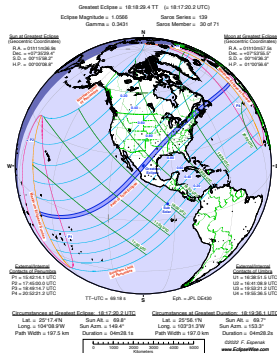
- IGLO 13km, initialized from ICON-DREAM
- meteogram output with 2-minute frequency (`dttime`), instantaneous
- our standard verification and 1-3 months experiments do not help to verify a solar eclipse parametrization

Eclipse path & radiation deficit (SW, 12h average)

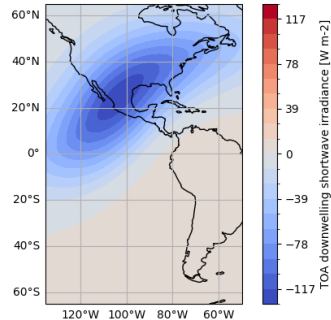
ECLIPSES DURING 2024 (Fred Espenak)

Figure 2

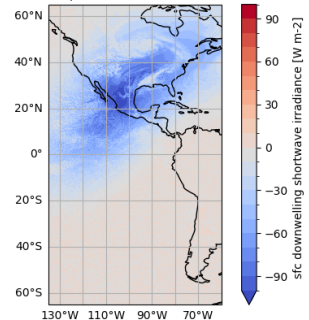
Total Solar Eclipse of 2024 Apr 08

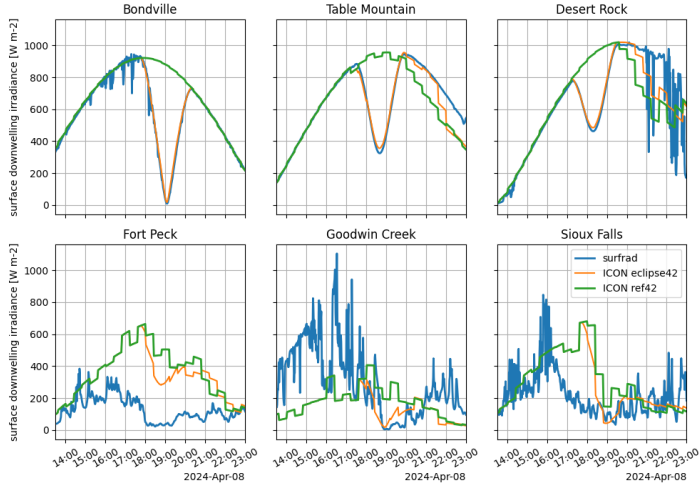


ICON eclipse42 - ref42 (12.0hr mean)



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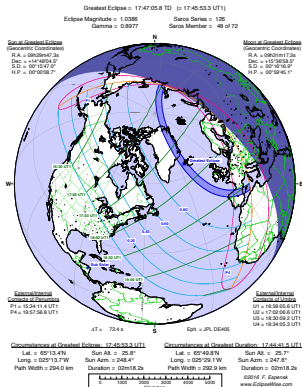


Routine: August 12, 2026 solar eclipse

- solar eclipse parametrization was introduced in August 2026 in DWD's
 - ▶ ICON and ICON-ART routine suites
 - ▶ ICON-D2 parallel suite (very limited impact in Germany)
- worked well
 - ▶ until solar eclipse was inside IAU window
 - ▶ had to be turned off from the 15UTC run (luckily: data not delivered before eclipse was over)
 - ▶ fix is being tested and revised currently

Eclipse path August 12, 2026

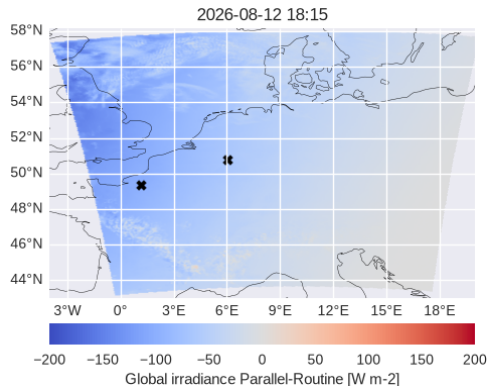
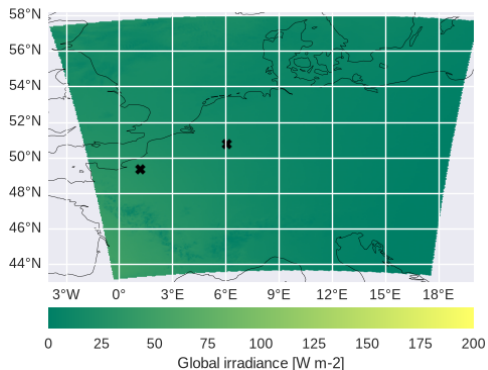
Total Solar Eclipse of 2026 Aug 12



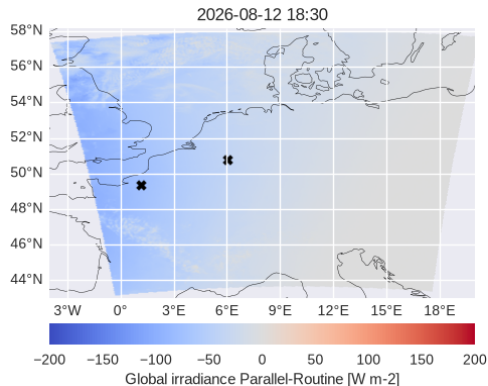
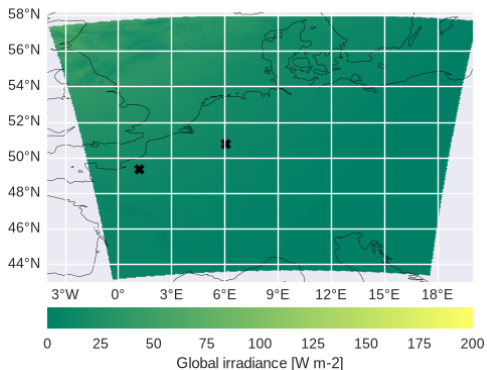
COURTESY OF "21st CENTURY CALENDAR OF SOLAR ECLIPSES", PAUL DEHNKE, ASTROPUBLIS PUBLISHING, 2016

- strongest obscuration: Greenland, Iceland, Spain, North Atlantic
- shortly before sunset in Germany
- limited effect on PV production
- good opportunity to practice for 2027 solar eclipse
 - ▶ technically less percentage obscuration
 - ▶ but in the late morning in Europe

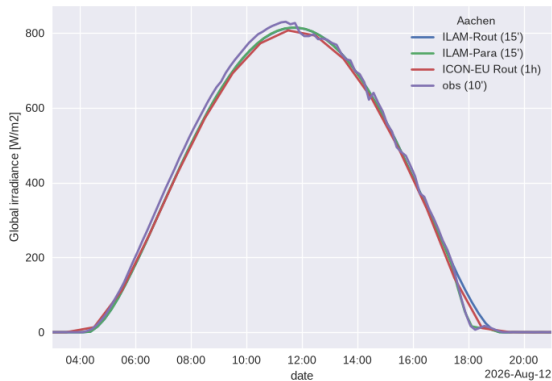
ICON-D2 parallel vs oper. suite, 2026-08-12 00UTC



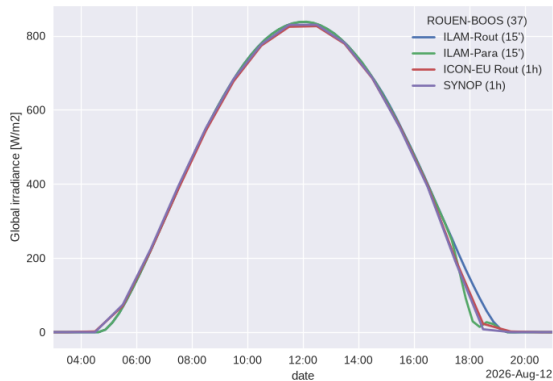
ICON-D2 parallel vs oper. suite, 2026-08-12 00UTC



./GHI_ID2-para_para-rout_2026-08-12.gif



Aix-la-Chapelle



Rouen

Wrap-up...

- new solar eclipse parametrization
- needs one fix - coming soon!
- works
- 1 new input file, 2 new namelist switches
- runtime neutral, 2-5 solar eclipses per year
- 2024 American eclipse simulation results (global ICON)
- 2026 European eclipse operational results
 - ▶ parallel suite ICON-D2
 - ▶ operational suite ICON-EU nest

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- Fred Espenak, NASA: provided coefficients for the parametrization and eclipse path images in this presentation
- Surfrad: provided high temporal resolution radiation data for April 8, 2024

Thank you!

Thank you for your Attention!

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



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