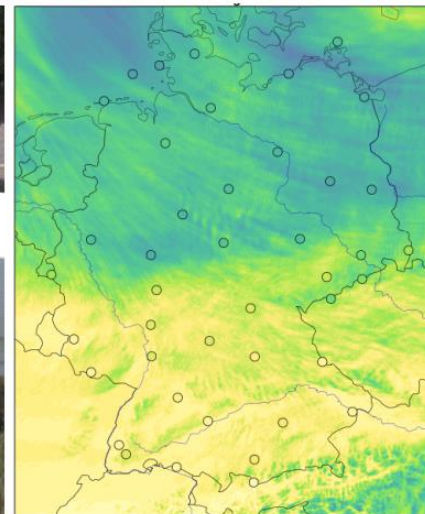
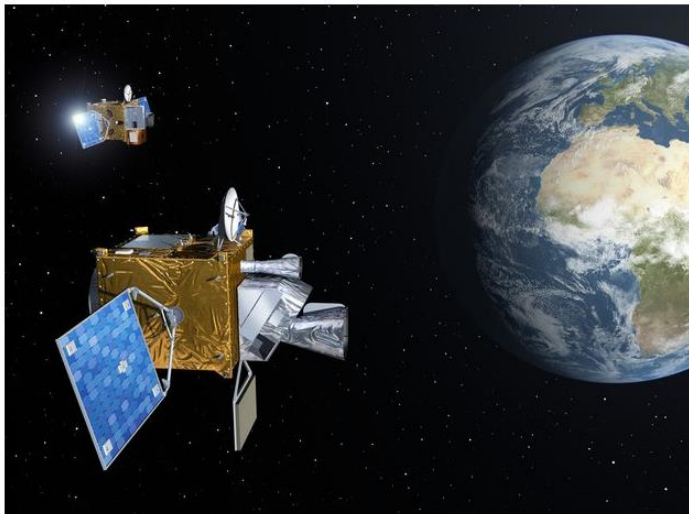




New 1 km version of the combined DUETT radiation data using the new Meteosat-FCI instrument

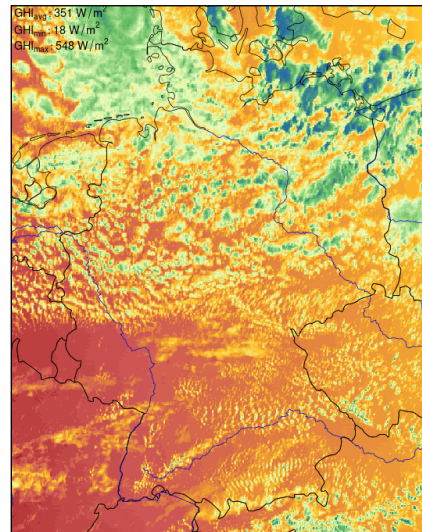
Sven Brinckmann and Jörg Trentmann

Surface Measurements



- 42 stations with two pyranometers (PYR)
- 1 min data of global and diffuse irradiance

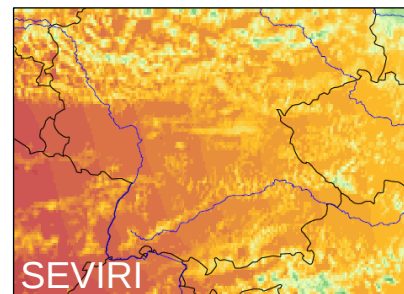
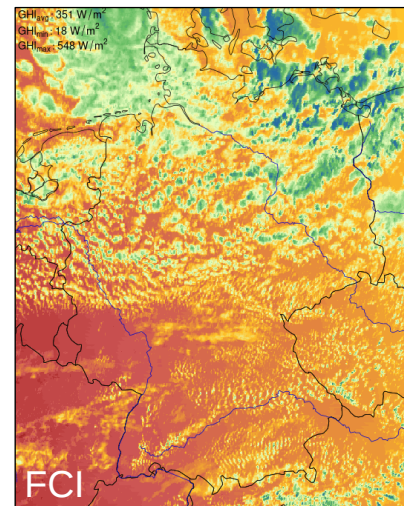
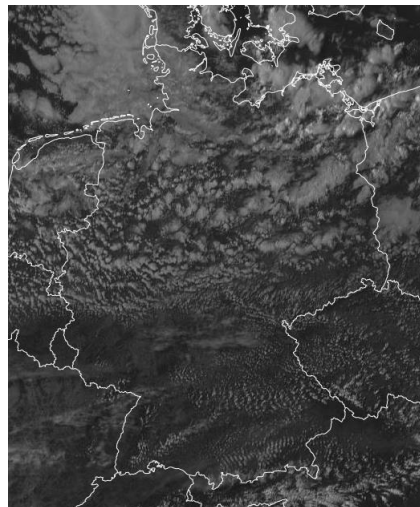
Satellite Data (near real-time)



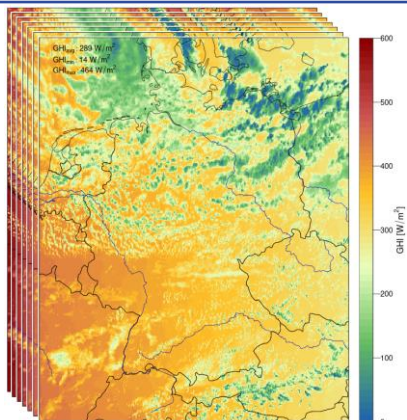
- based on visible FCI/MTG 0.6 μm data, 1 km
- every 10 min with time lag of 9 min
- global horizontal + direct normal irradiance (GHI + DNI)
- Müller et al., 2012: <https://doi.org/10.3390/rs4030622>

Satellite Data (near real-time)

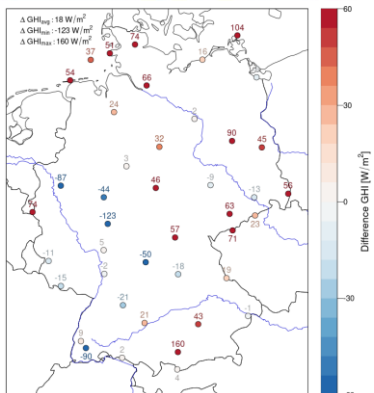
- Reflectance ,translated' to surface radiation
- now hourly H₂O vapour data from ICON-EU (instead of monthly climatology)
- Improvement for direct irradiance (bias significantly reduced)
- for Europe a resolution of 0.015° is provided
- small-scale clouds better represented, but geographical uncertainty remaining
- <https://opendata.dwd.de/weather/satellite/radiation/sis/>



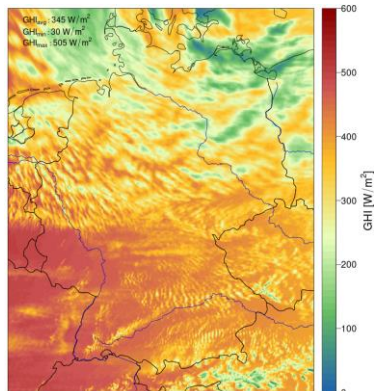
Correction snow



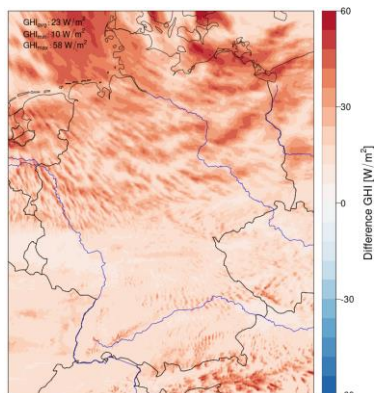
Deviations at stations



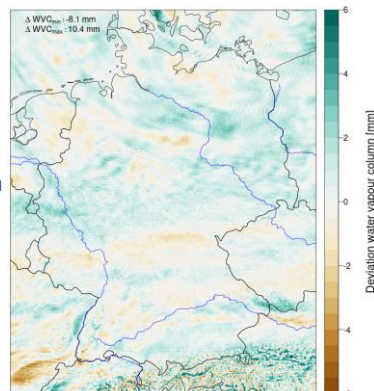
Optical Flow/ Aggregation



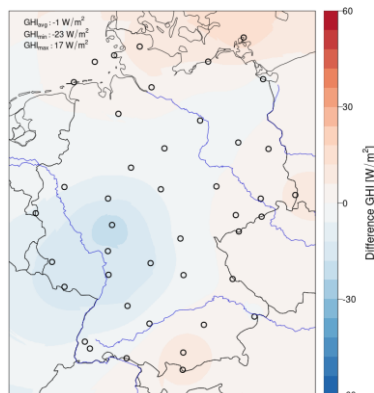
Regression of deviations



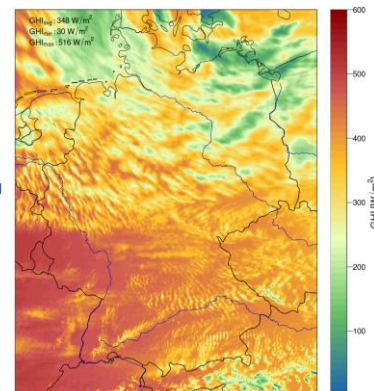
Deviations H₂O columns



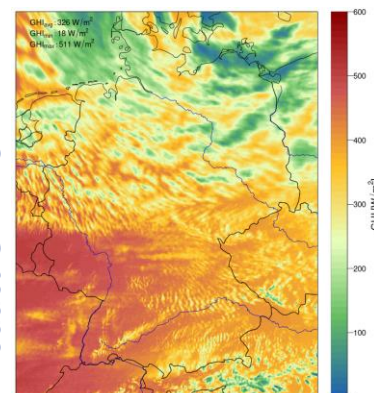
Interpolation of residuals



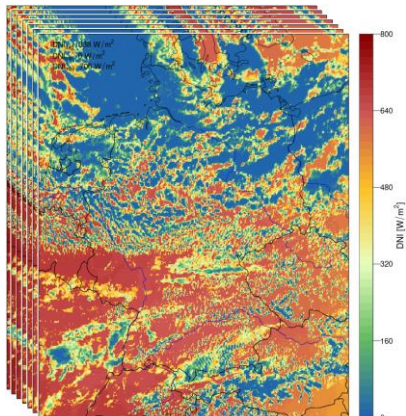
Correction H₂O columns



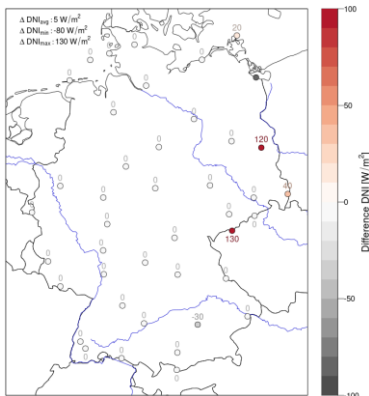
Product GHI DUETT



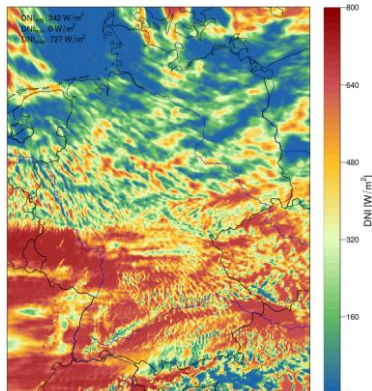
Correction snow



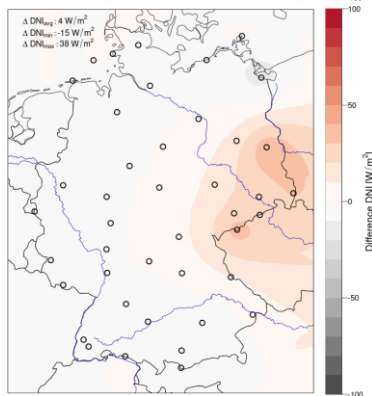
Residual deviations



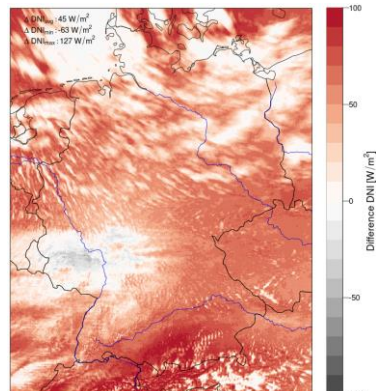
Optical Flow/ 1-min DNI



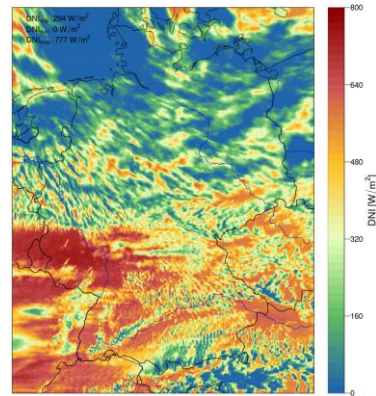
Interpolation of residuals



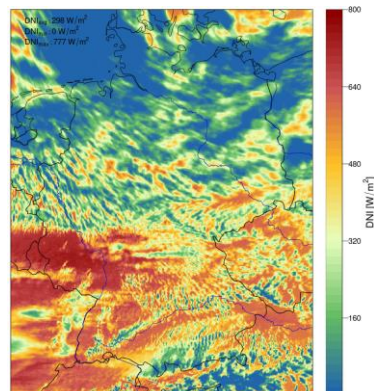
Estimation global deviations



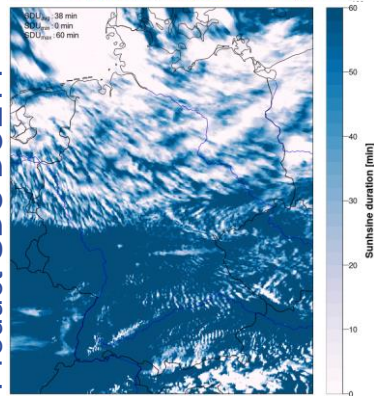
2. Correction 1-min DNI



Correction 1-min DNI SAT

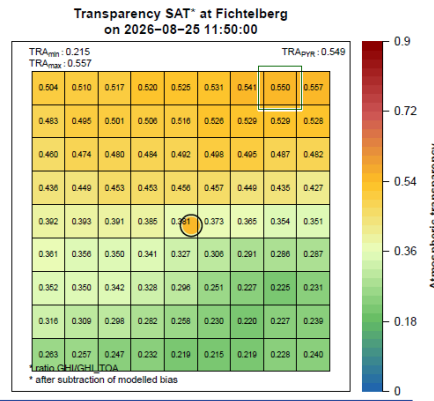
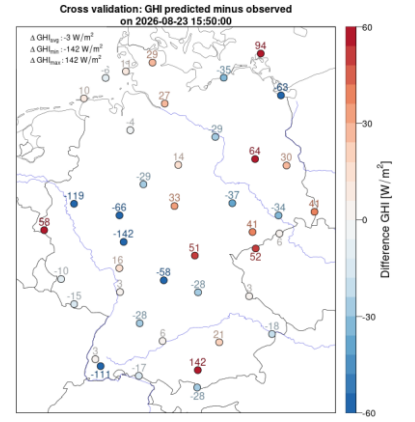


Product SDU DUETT



Further details on the merging procedures

- **Normalised data** (GHI/GHI_{clear} and GHI/GHI_{TOA}) used in merging
- **Cross validation** as quality test during merging
 - exclude/adjust outlying data points in mountain/lowland regions
- **Regression** to reduce overall bias to zero (**nearest-neighbour** comparison)
- Residual deviations based on **best-neighbour** comparison
 - issues with **spatial representativeness** and **geometric mismatch**



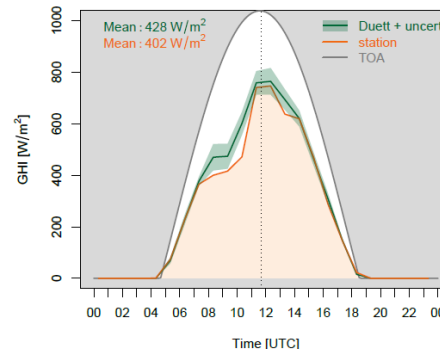
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- Residual deviations based on **best-neighbour** comparison
 - issues with **spatial representativeness** and **geometric mismatch**
- **Pseudo-station data** at 576 locations (derived from gridded data)
 - with correction of shadowing by mountains
- **Uncertainties** for gridded and pseudo-station data provided based on
 - interpolation, geometry and topography
- Leave-one-out **cross validation** and **validation**
 - similar quality compared to 2 km DUETT

MAE GHI: ~5% of GHI_{TOA}
MAE abs.: 15 – 40 W/m^2
MAE SDU: 5-6 min

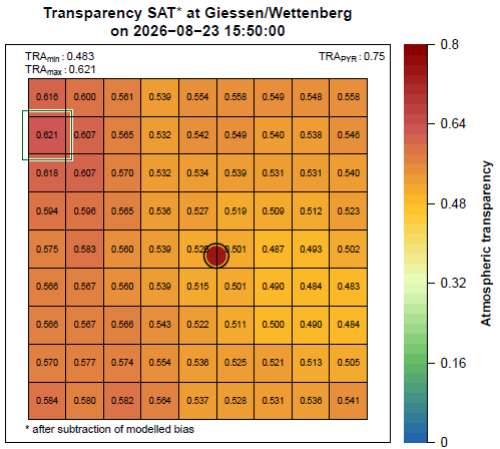
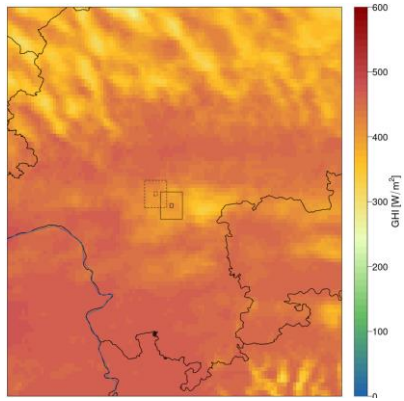
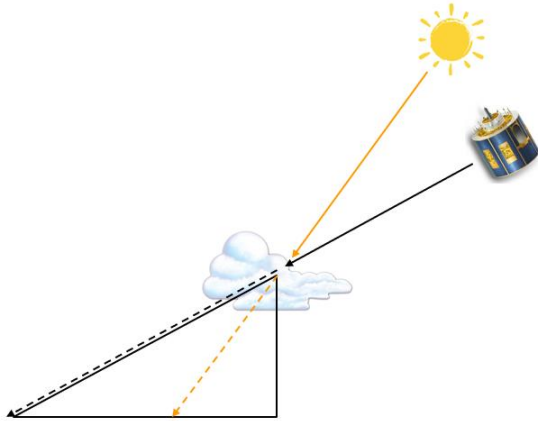


Global horizontal irradiance (GHI) at TOA and at surface on 23 Aug 2026 at Nuerburg-Barweiler



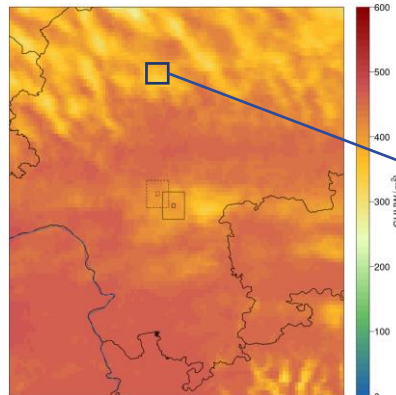
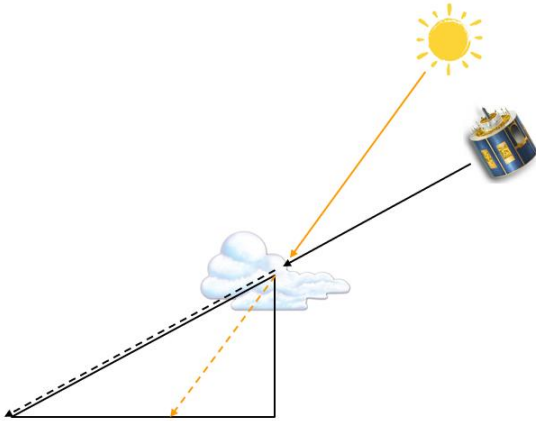
Challenges with high resolution

- Impact from ‚parallax‘ effect and sun geometry is higher than with 5 km data from SEVIRI
- Spatial offset estimated for virtual cloud height of 5 km → uncertainty estimation DUETT
- No correction in DUETT yet, but partly considered by ‚best-neighbour‘ approach
- Tests with implementation of correction planned for next months

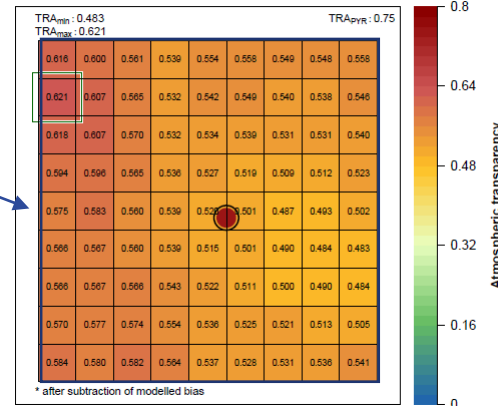


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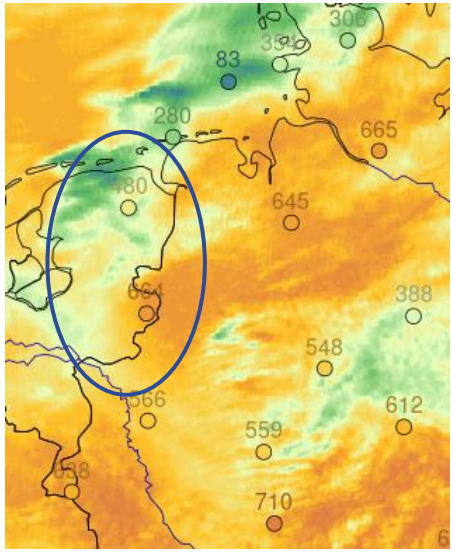


Transparency SAT* at Giessen/Wettenberg
on 2026-08-23 15:50:00

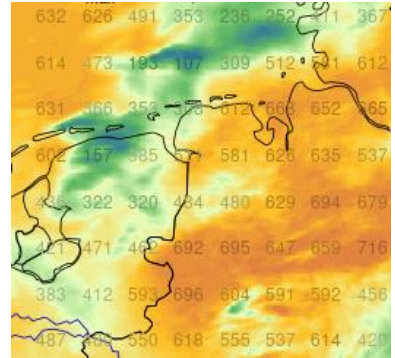


Station data from neighbouring countries

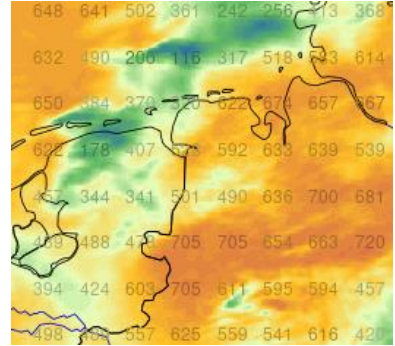
- Radiation data (10-min) from neighbouring countries available now in DWD data base
- Tests with **two stations from the Netherlands** (Groningen Airport, Twente Airport)
- can support merging, if quality is high
- in most cases only slight changes in DUETT data



GHI DUETT 02.09. 10:50 UTC



GHI DUETT + 2 stations



- **Combined hourly gridded radiation data** for Germany since Aug 2022 / Open Data (CDC): since Jan 2024
www.dwd.de/duett
- **Global horizontal irradiance** and **sunshine duration** + **std. uncertainty**
- **Pseudo station data** at 576 locations with correction of shadowing since Oct 2023 / Open Data: Apr 2024
- New processing with **FCI data (1 km)** since June 2026 replacing SEVIRI-based 2 km data (provided in parallel)
- Additional parameter: **diffuse radiation** ready, to be published in near future
- **Monthly sums** of GHI and SDU DUETT also available now
https://opendata.dwd.de/climate_environment/CDC/grids_germany/monthly/duett/

Input data

DUETT product

