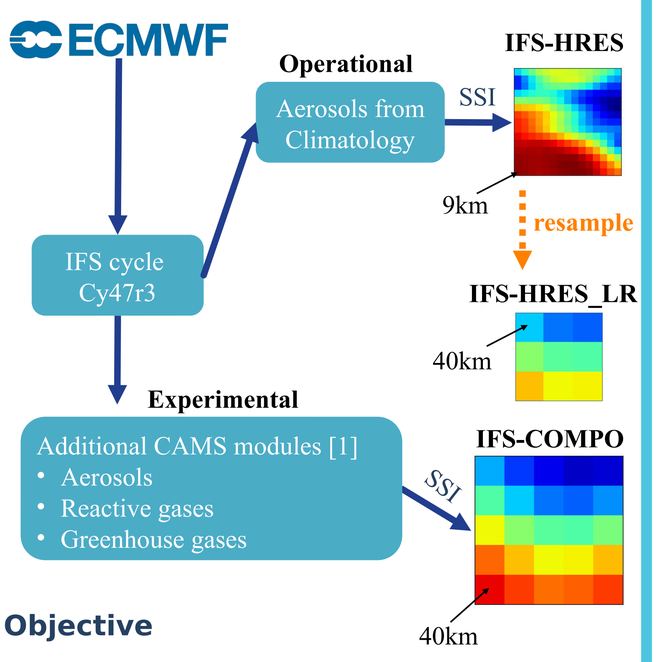
Site-Dependent Evaluation of the ECMWF IFS-HRES and IFS-COMPO Intra- and Day-ahead Forecasts with Respect to Surface Solar Irradiances

Jorge Lezaca [1*], Marion Schroedter-Homscheidt [1] and Yves-Marie Saint-Drenan [2]
[1] German Aerospace Center (DLR), Oldenburg, Germany
[2] MINES Paris – PSL University, Sophia-Antipolis, France
*corresponding author : jorge.lezaca@dlr.de

Atmosphere Monitoring Service
atmosphere.copernicus.eu

1. Introduction

The European Center for Medium-Range Weather Forecast (ECMWF) operates the Integrated Forecast System (IFS) which consists of a global numerical weather model + assimilation techniques. From the IFS different forecast products are made available:



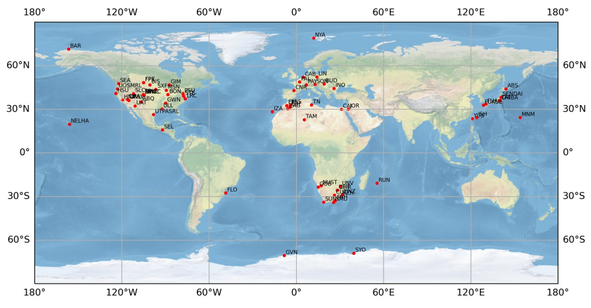
Objective

Intra-day and day-ahead evaluation of the forecast **run00** of Surface Solar Irradiance (SSI) from the **IFS-COMPO** experimental forecast for the **year 2022** on a **hourly resolution** with respect to **ground observations**. The performance obtained is compared to the **IFS-HRES** operational forecast and the resampled **IFS-HRES_LR.**

1) Is there an improvement on SSI when using a better model of the atmospheric content which has a lower resolution?
2) Can solar energy production forecasts take advantage of such an improved model ?

2. Reference data

Ground observations database [2] : 68 stations retrieved on 2022



3 Irradiance component (GHI, DHI, BNI)
1 min resolution
Expert QC + data cleaning

37 stations retained

Class	locations
Continental	13
Desert	10
Polar	1
Subpixel *	9
Mountainous	4

* less than 10km to a mass of water

resample to 1 hour → reference database

3. Result day ahead Forecast

GHI : Global Horizontal Irradiance
DHI : Diffuse Horizontal Irradiance
BNI : Beam (direct) Normal Irradiance

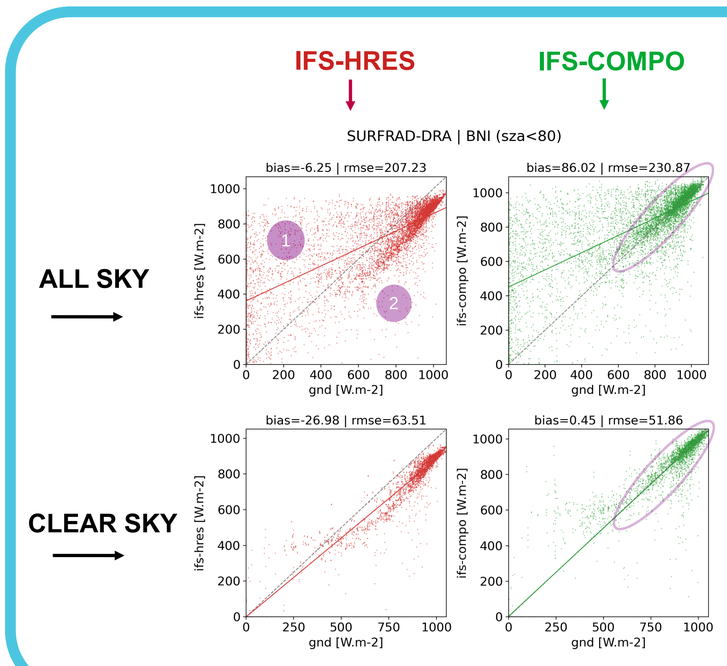
- In general, IFS-HRES BIAS improves over IFS-COMPO

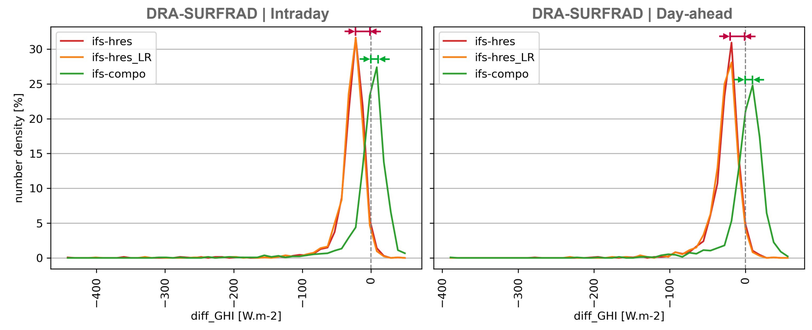
- Similar RMSE for the 3 sources
  → Double penalty effects not seen between HRES/HRES_LR.

- Clear BIAS improvement of IFS-COMPO on clear sky situations
  → very low bias for BIAS continental, Desert, Mountainous

- Still comparable RMSE

4. Specific effects





- Peak of the distribution better centered around 0 for IFS-COMPO

- Counter-intuitive as IFS-HRES forecasts outperform error metrics
  → BIAS balancing effect : seen on scatter plot (points in 1 compared to 2)
  → std. dev. balancing effect: asymmetry of the distribution (extremes)

5. Conclusions

- In general terms the IFS-HRES performs better than the IFS-COMPO for both GHI and BNI in all sky situations, but be aware that this can be the result of balancing of metrics which are not wished for in all applications.

- The IFS-COMPO presents some clear advantages on clear sky conditions with reduced BNI biases and more accurate forecasts for both GHI and BNI components.

- These clear conditions are of special interest for the solar energy community as they represent the peak production instances on any solar power plant. Users focusing on Southern European locations may prefer the IFS-COMPO forecasts due to the improved aerosol modeling capabilities and due to larger frequency of occurrence of cloud-free conditions. Users focusing on locations with more frequent clouds may prefer the IFS-HRES.

6. References

[1] Inness, A. et al. : Data assimilation of satellite-retrieved ozone, carbon monoxide and nitrogen dioxide with ECMWF's Composition-IFS, Atmos. Chem. Phys., 15, 5275–5303, https://doi.org/10.5194/acp-15-5275-2015, 2015
[2] https://viewer.webservice-energy.org/in-situ/ (THREDDS server with ground observations collected on high quality research networks all around the world)

- General inquiries -
copernicus-support@ecmwf.int

ON BEHALF OF ECMWF FOR THE EUROPEAN COMMISSION
DLR
MINES PARIS | PSL
Copernicus Europe's eyes on Earth