

Perfomance assessment of data reconstruction in meteorological timeseries

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The MeteoIO library

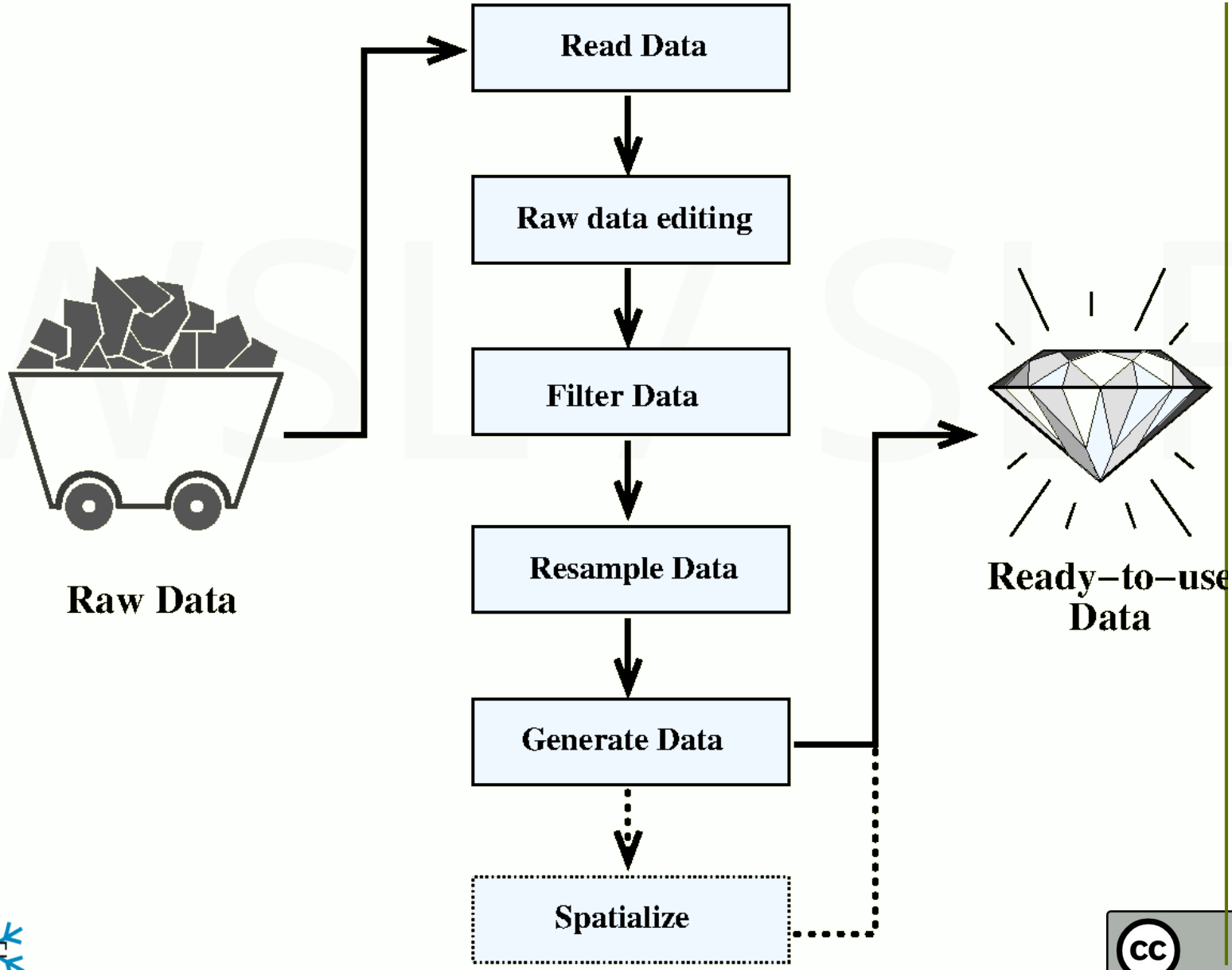
- Pre-processing library for meteorological data
- Designed for research (ie. flexiblility) and operational systems (ie. robustness)
- No hard-coded processing, the user decides
- Ingests raw data, outputs data suitable to force numerical models obeying the user's requirements
- C++, open source, actively developed since late 2008

Bavay, M., and T. Egger. *"MeteoIO 2.4. 2: a preprocessing library for meteorological data."* Geoscientific Model Development (2014).

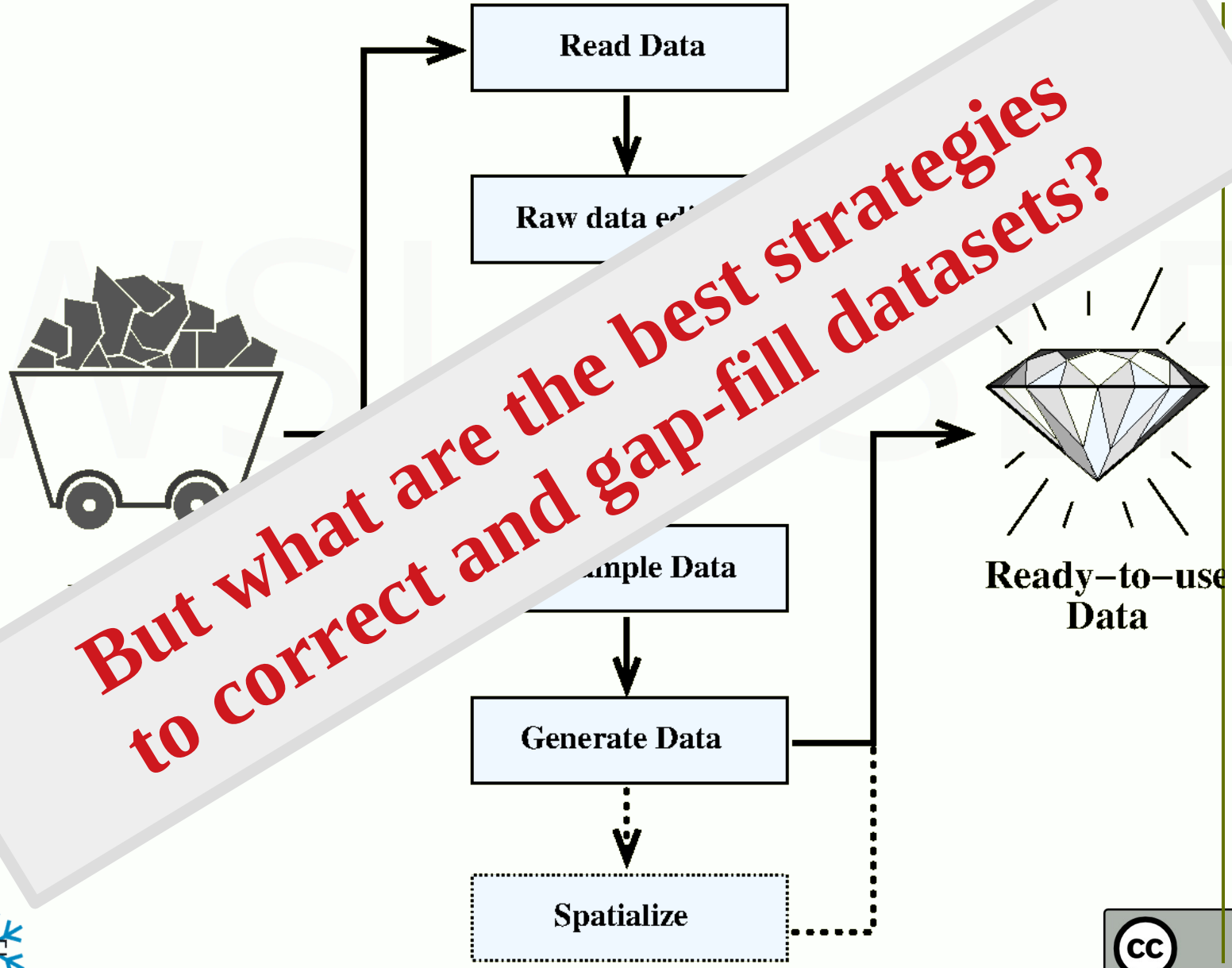
Get MeteoIO at https://models.slf.ch!

New: Inishell GUI!

MeteoIO's Workflow



MeteoIO's Workflow



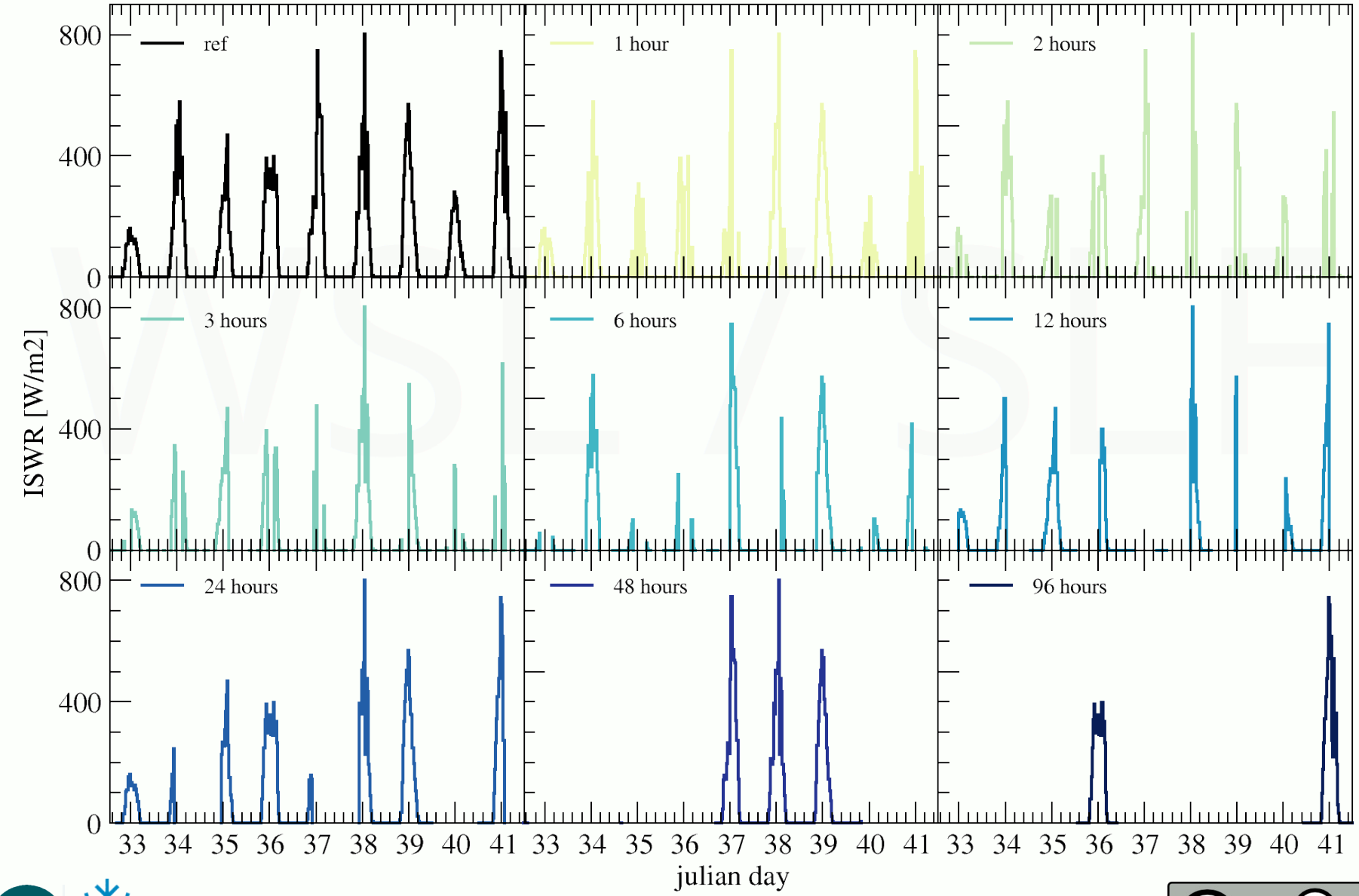
Test setup

- Area around Davos, East Switzerland
- Using 5 automatic weather stations (3 permanent, 2 temporary), half-hourly data
- 1900 m of elevation gradient
- In this presentation: from July 2013 to July 2015
- Here only looking at Incoming Shortwave / Longwave Radiation

Gaps of varying width created at random, removing 50% of the original DFB2 AWS dataset

Creating controlled data gaps

Incoming Short Wave Radiation - station DFB2 (46.820590, 9.830070, 2137)



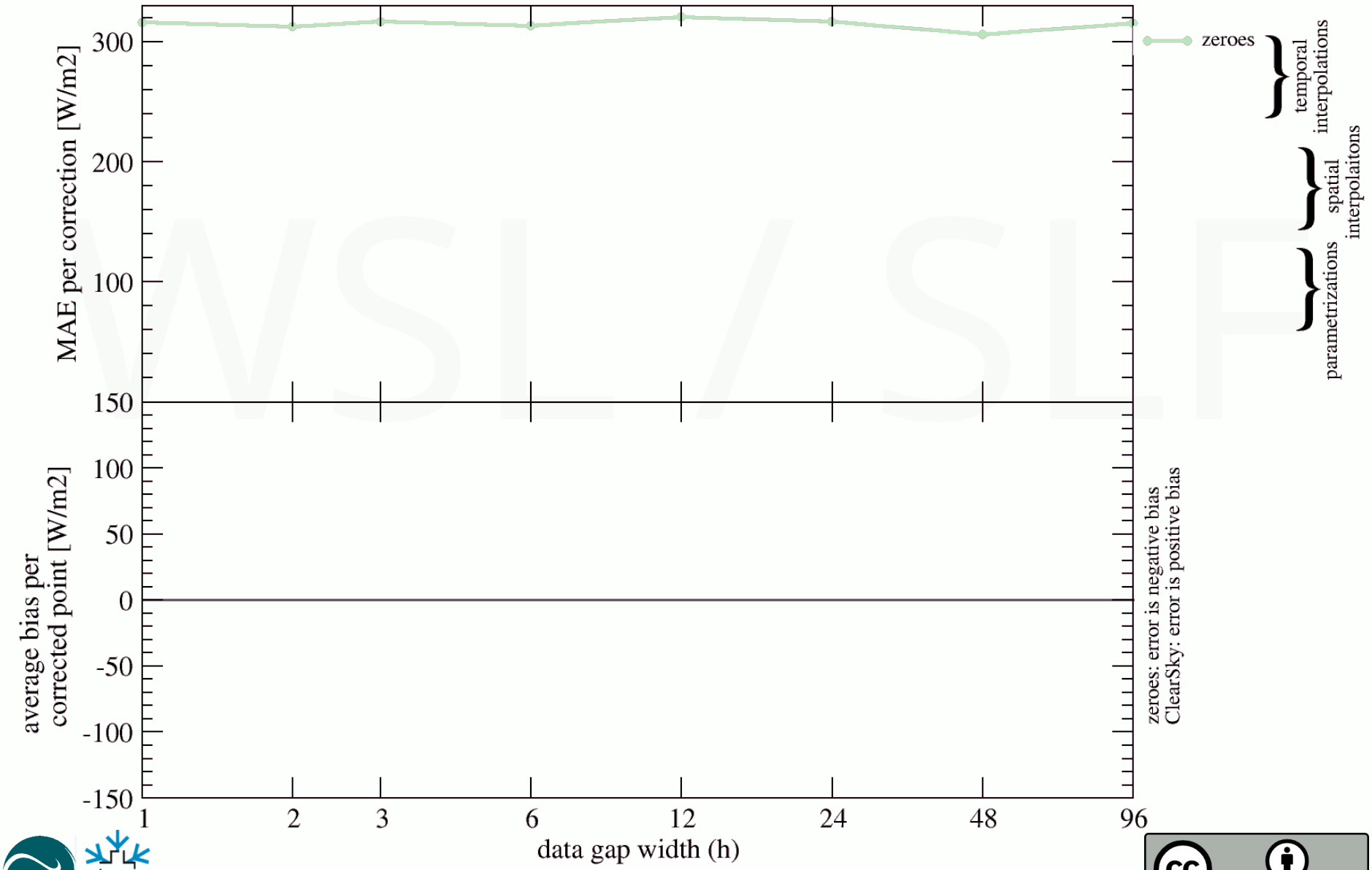
Temporal interpolations

- nothing (replacing missing point by zeroes) → benchmark
- Nearest neighbor
- Linear interpolation
- Solar: potential radiation with linearly interpolated atmospheric transmissivity and splitting coefficient (direct/diffuse radiation)

- At each reconstructed point, looking at mean error and mean bias (important for energy balance calculations)

Gap-filling error as a function of gap width

Incoming Short Wave Radiation - station DFB2 (46.820590, 9.830070, 2137)



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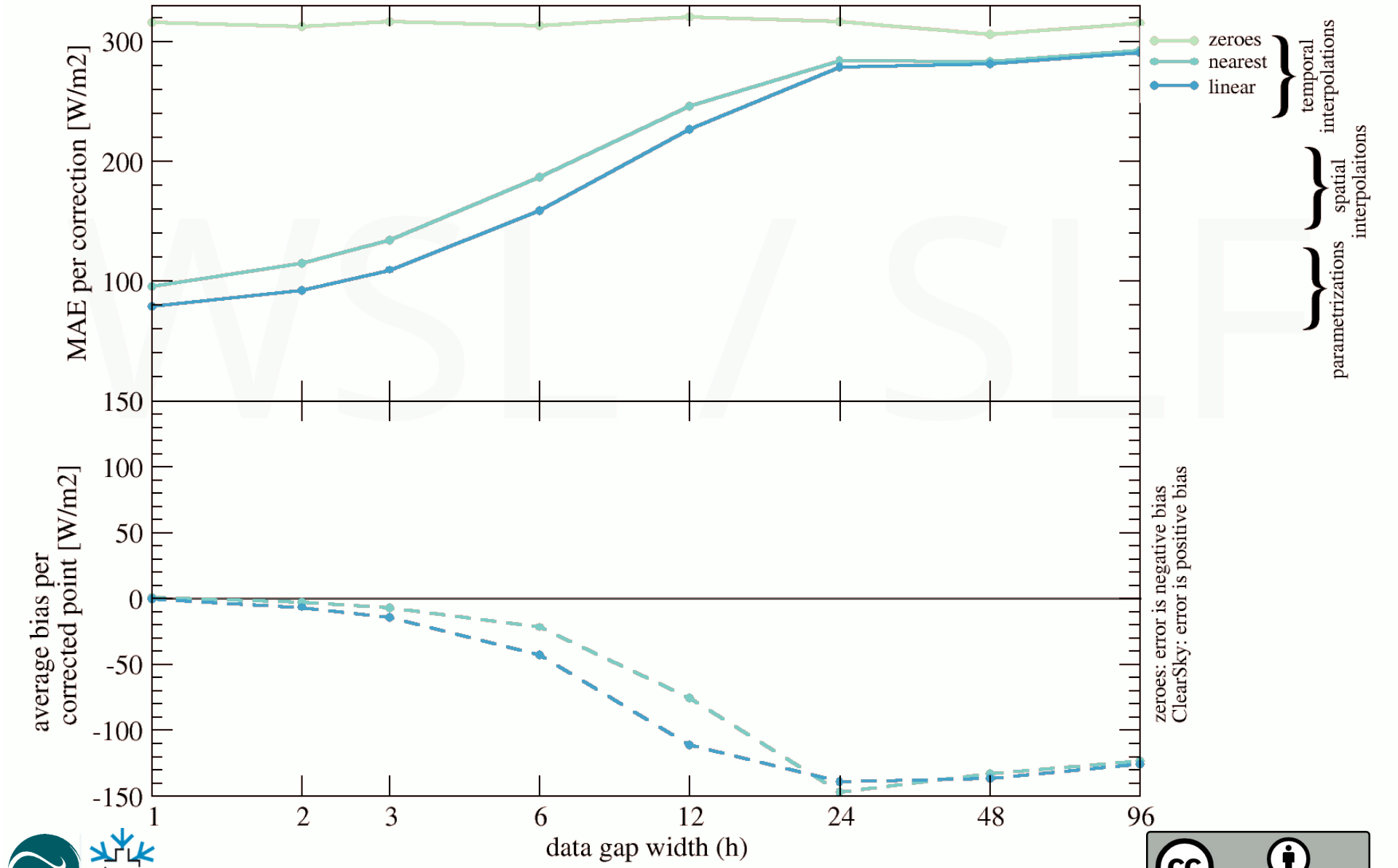

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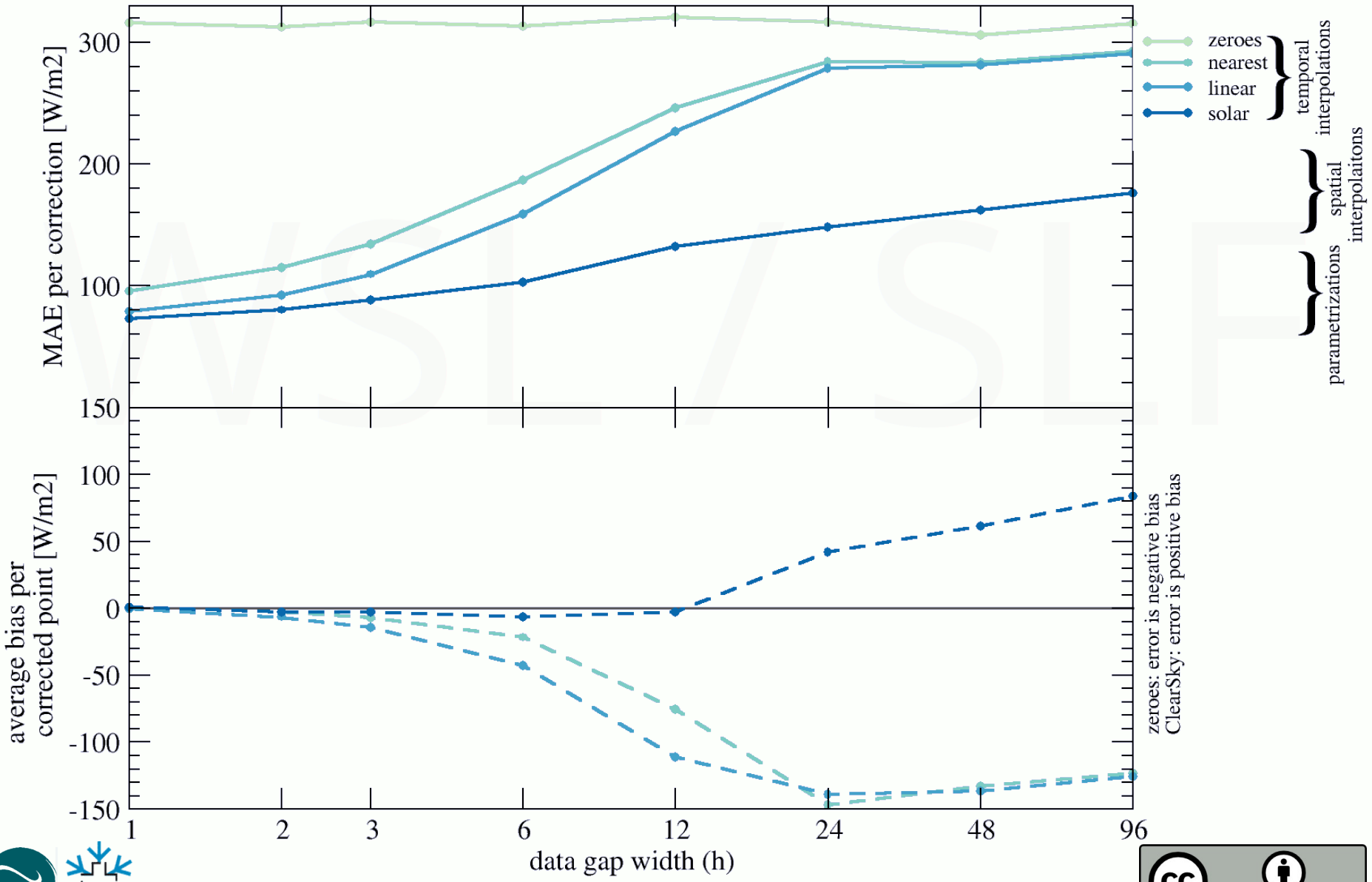

Spatial interpolations

- Inverse Distance Weighting with lapse rate (computed at each timestamp)
- swRad: potential radiation with IDWLapse spatially interpolated atmospheric transmissivity and splitting coefficient (direct/diffuse radiation)

Gap-filling error as a function of gap width

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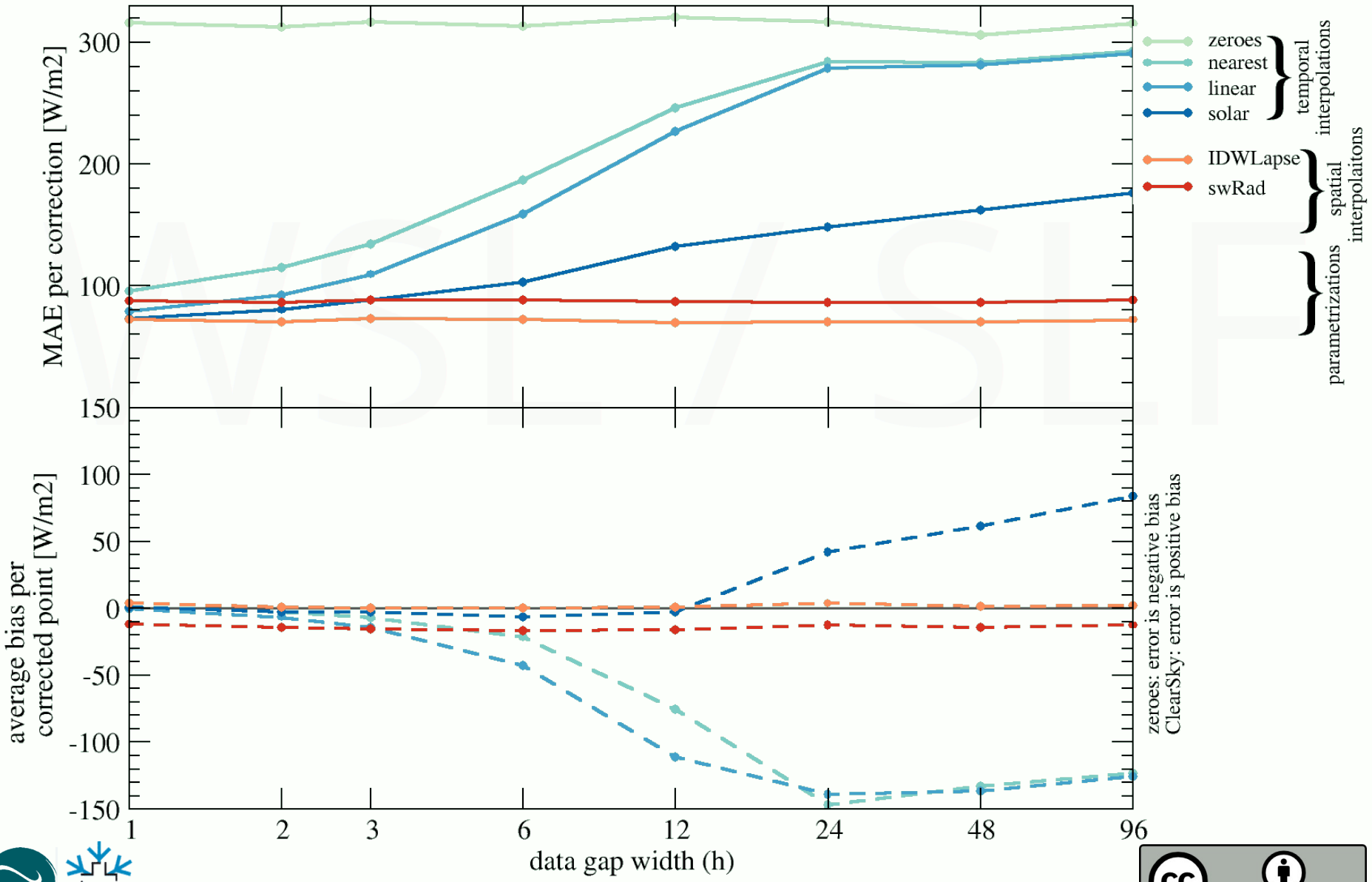

Why is swRad not better than IDWLapse? Let’s look at simply replacing missing values by values from DFB1 (station ~20m away → should be exactly the same)

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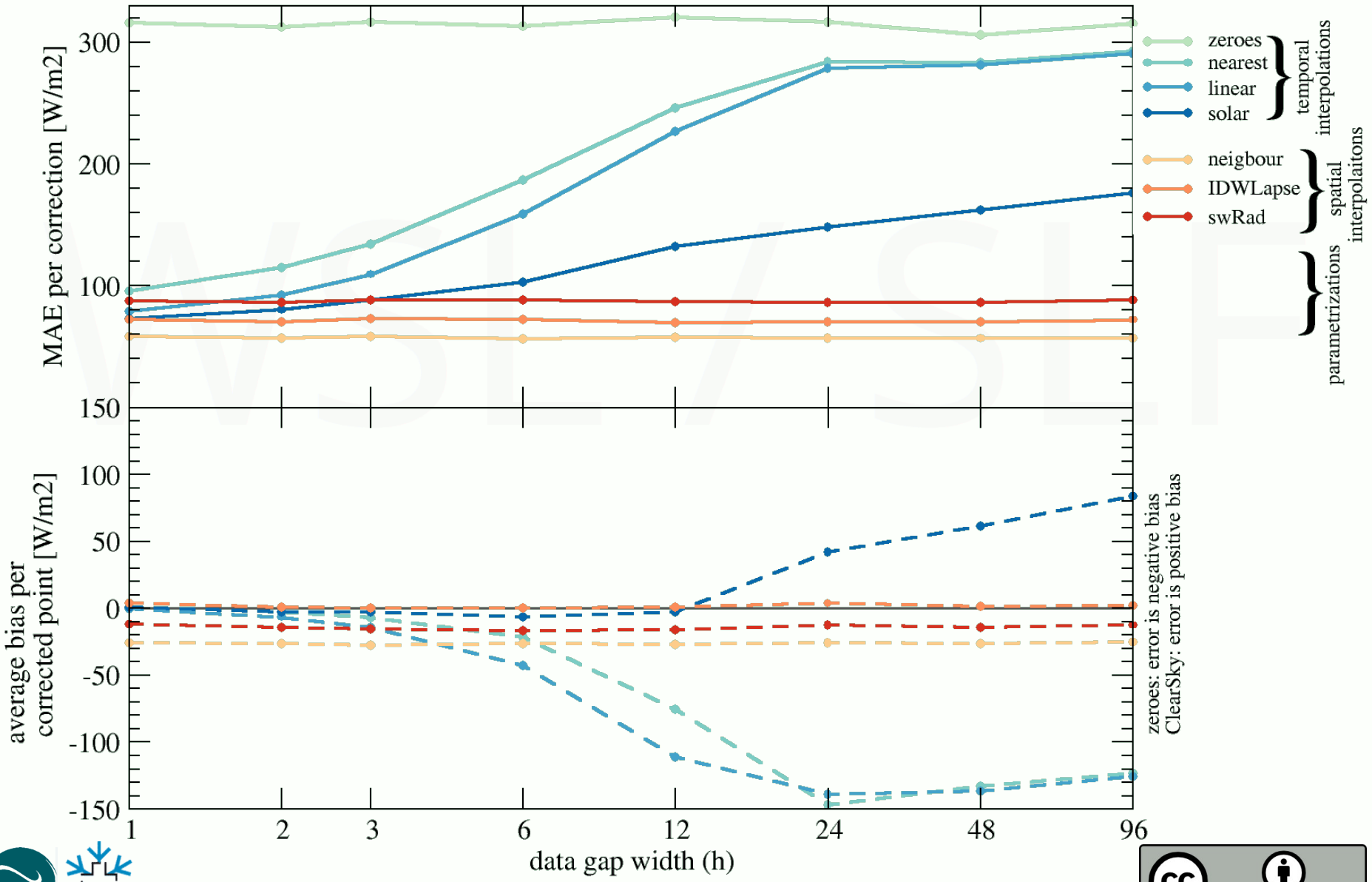
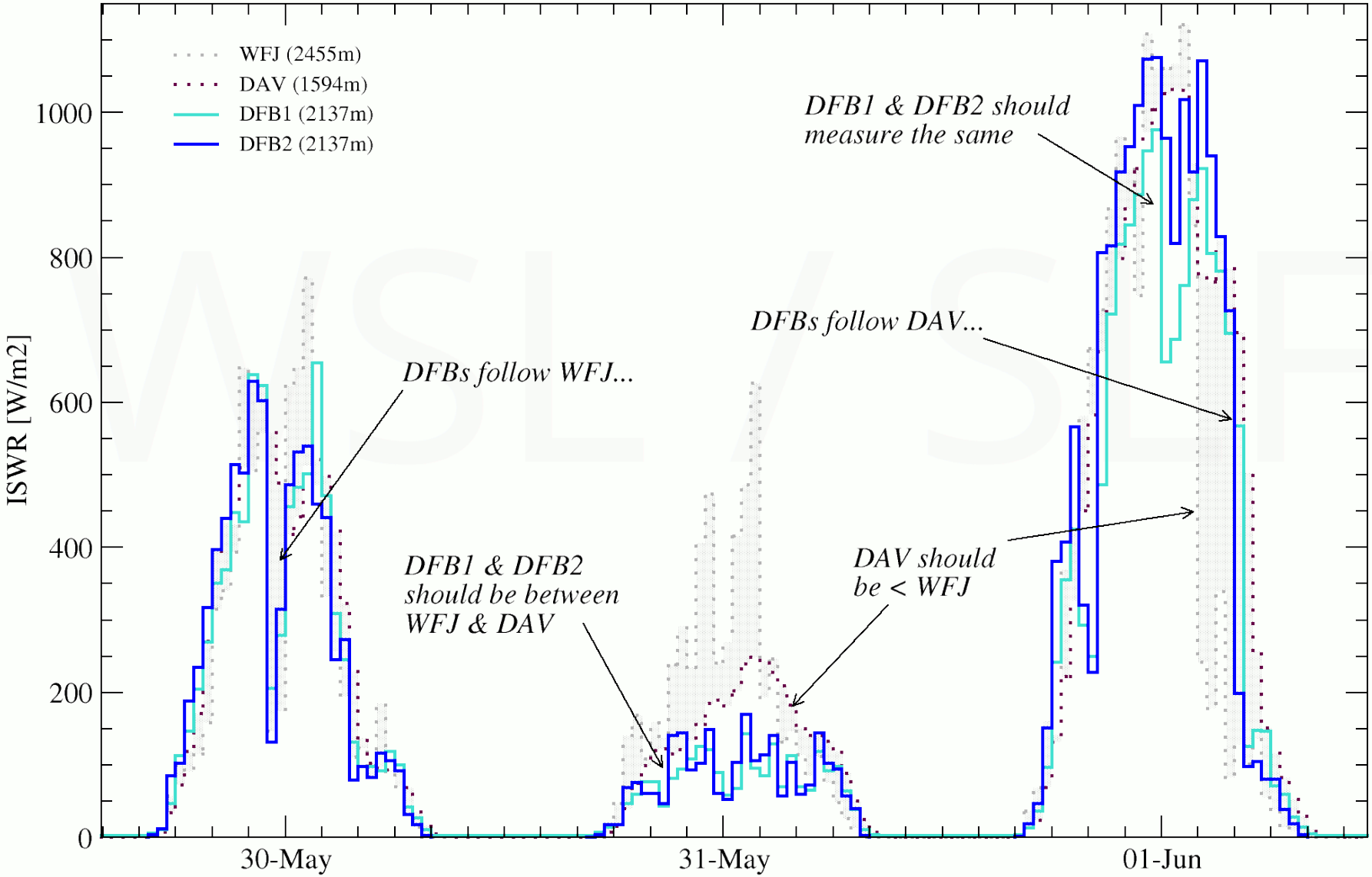


Reality is tough...

Comparison between measurements of neighbouring stations



From the point of view of simplistic models!!

Parametrizations

- ClearSky-: potential radiation with “generic” parameters
- ClearSky: potential radiation with measured meteorological parameters (air temperature and relative humidity)

- Then, using measured ILWR to evaluate the cloudiness
  → All Sky correction to the potential radiation

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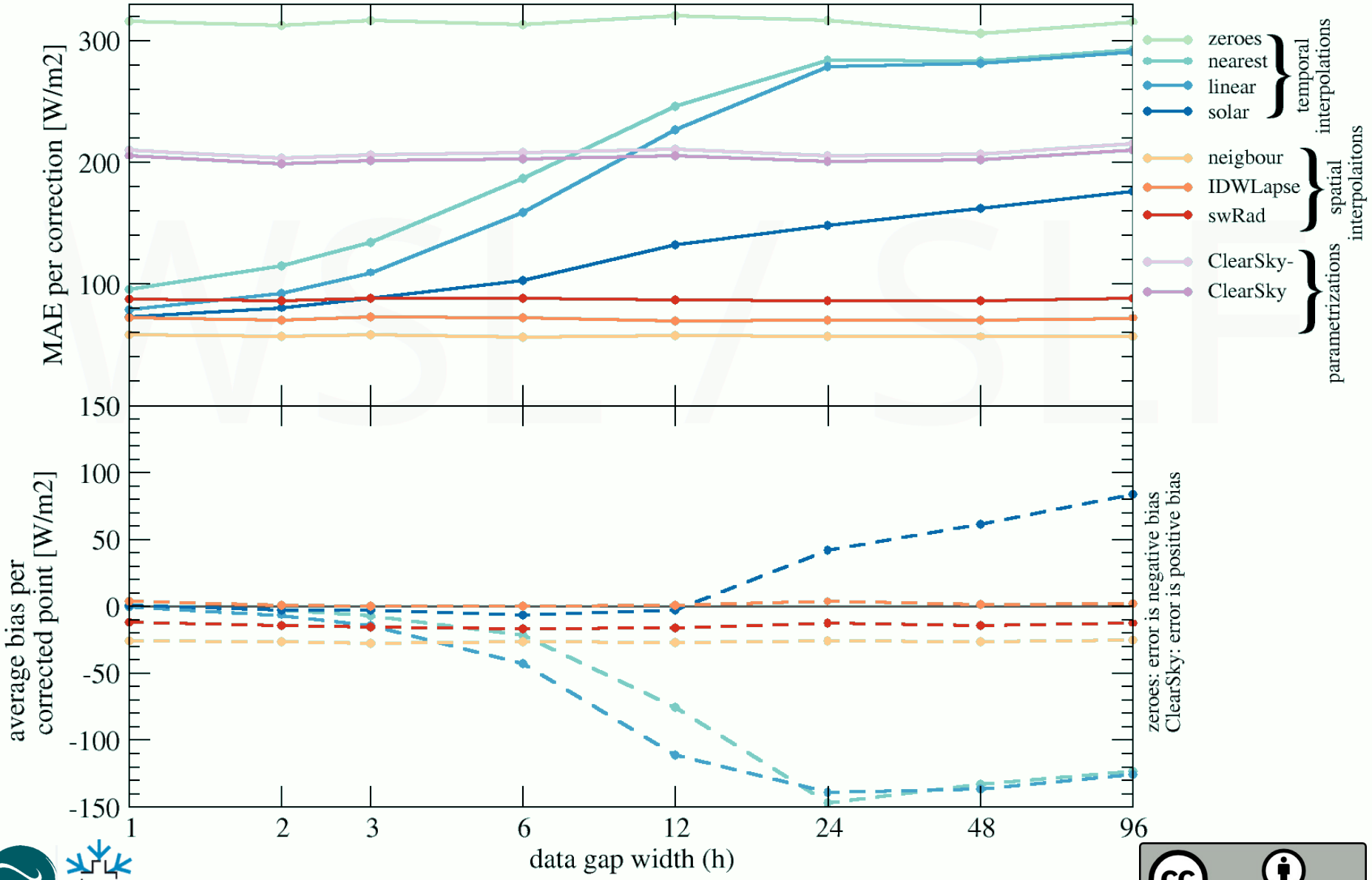

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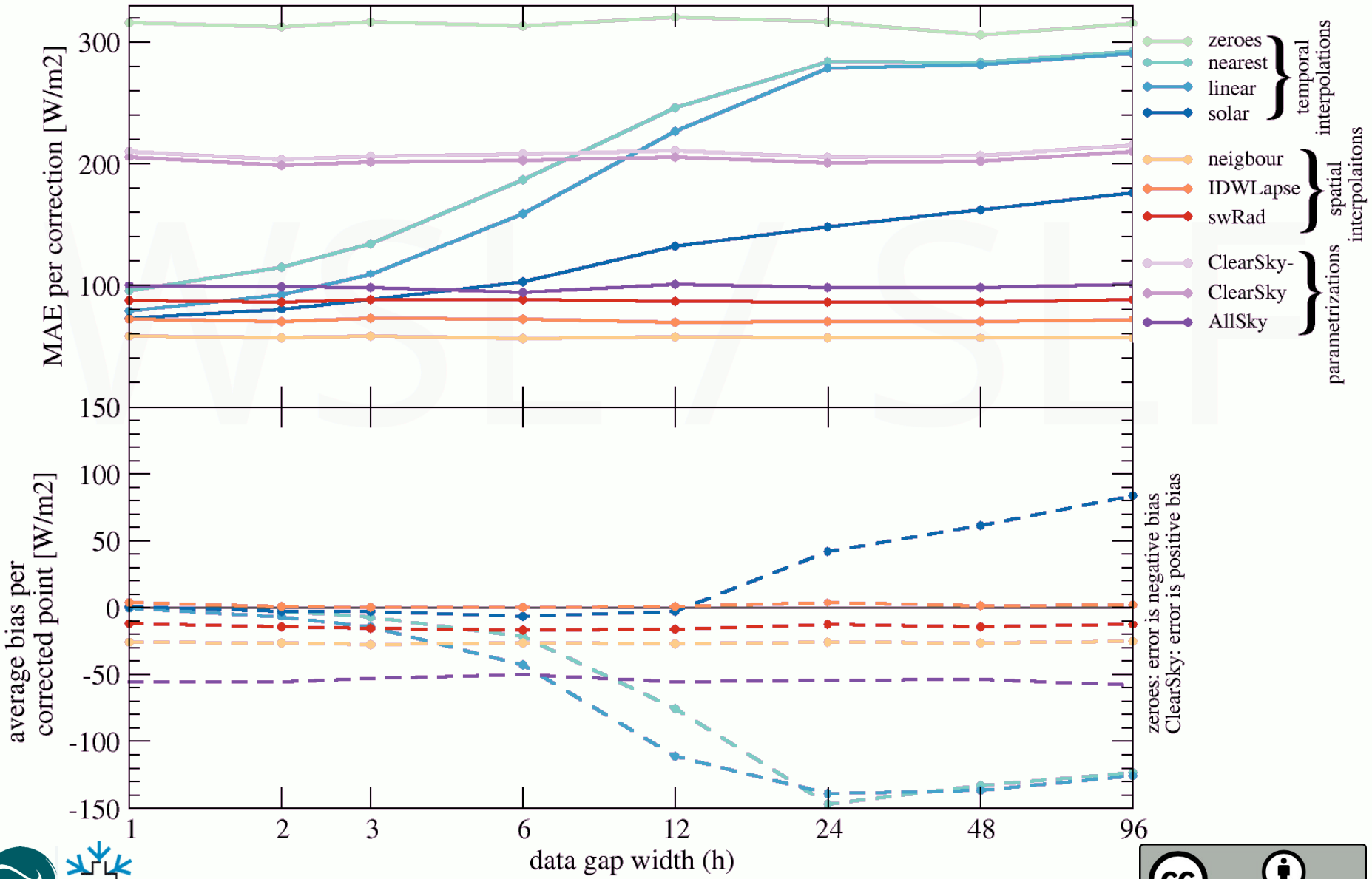
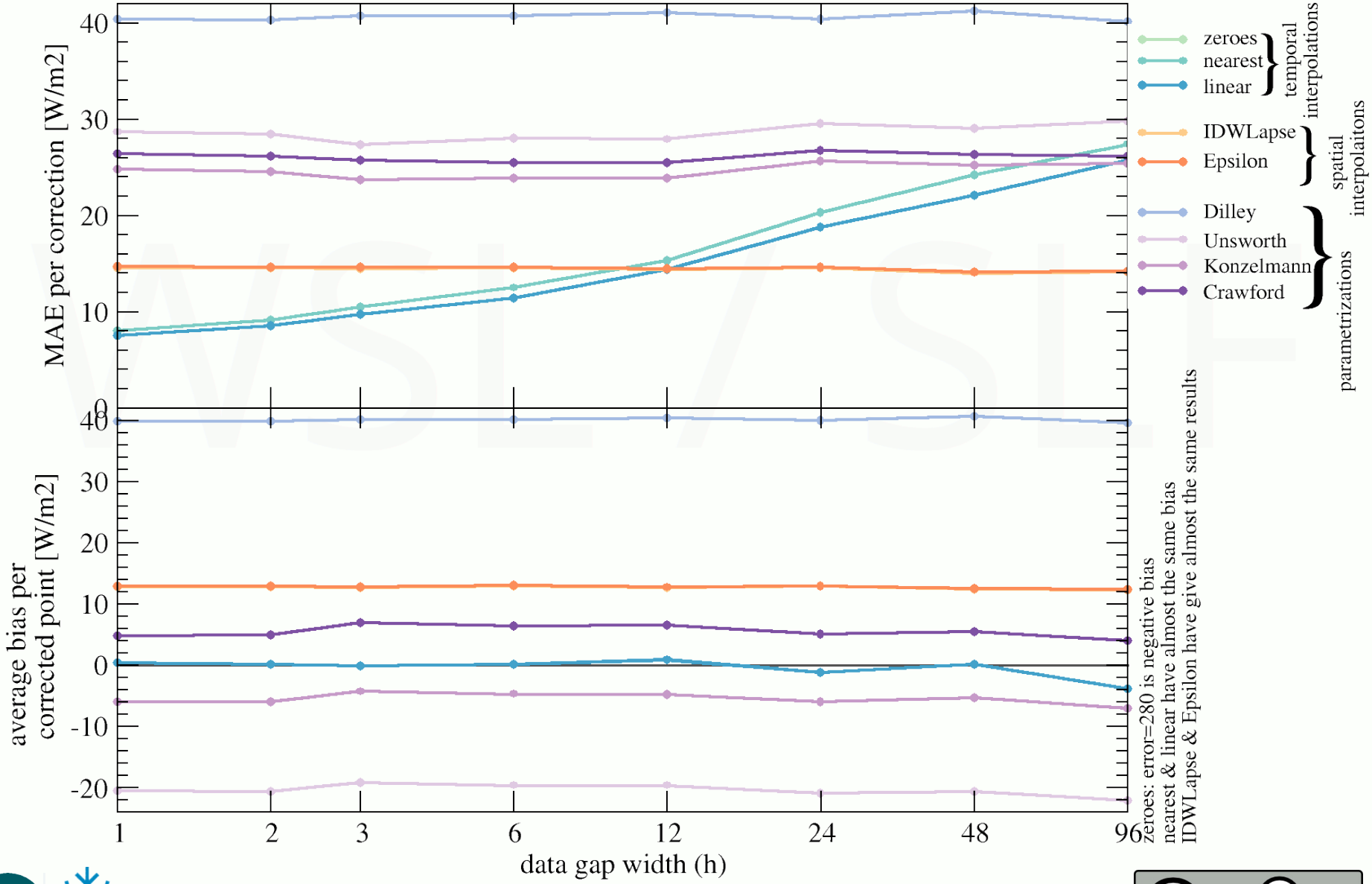


ILWR

- Trying the same temporal interpolations
- Spatial interpolations: IDWLapse and spatially interpolating the emissivity to recompute ILWR at the station
- Parametrizations: one Clear Sky (Dilley), 3 All Sky using ISWR to compute the cloudiness and then convert the potential radiation to All Sky radiation

Gap-filling error as a function of gap width

Incoming Long Wave Radiation - station DFB2 (46.820590, 9.830070, 2137)



Conclusion

- Purely statistical methods based on local data do well on small gaps
- Methods based on data from neighboring stations perform well but might be degraded by local features (sensor problems, non-representative location)
- More complex methods based on simple physical models are highly impacted by local features and are only suitable for large gaps

Much more to come in a paper being worked on: 20 years of data, 15 stations, looking at many more meteorological parameters