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# “HC-1+HC-3” a long-term data set of daily solar radiation at surface

## OBJECTIVE

Assessing methods for fusing two databases of surface solar irradiance to get a long-term time-series starting in 1985 and spanning more than 30 years and having the best accuracy possible.

## CONTEXT

The HelioClim project of MINES ParisTech aims at producing fields of surface solar downward irradiation (SSI) from satellite images.

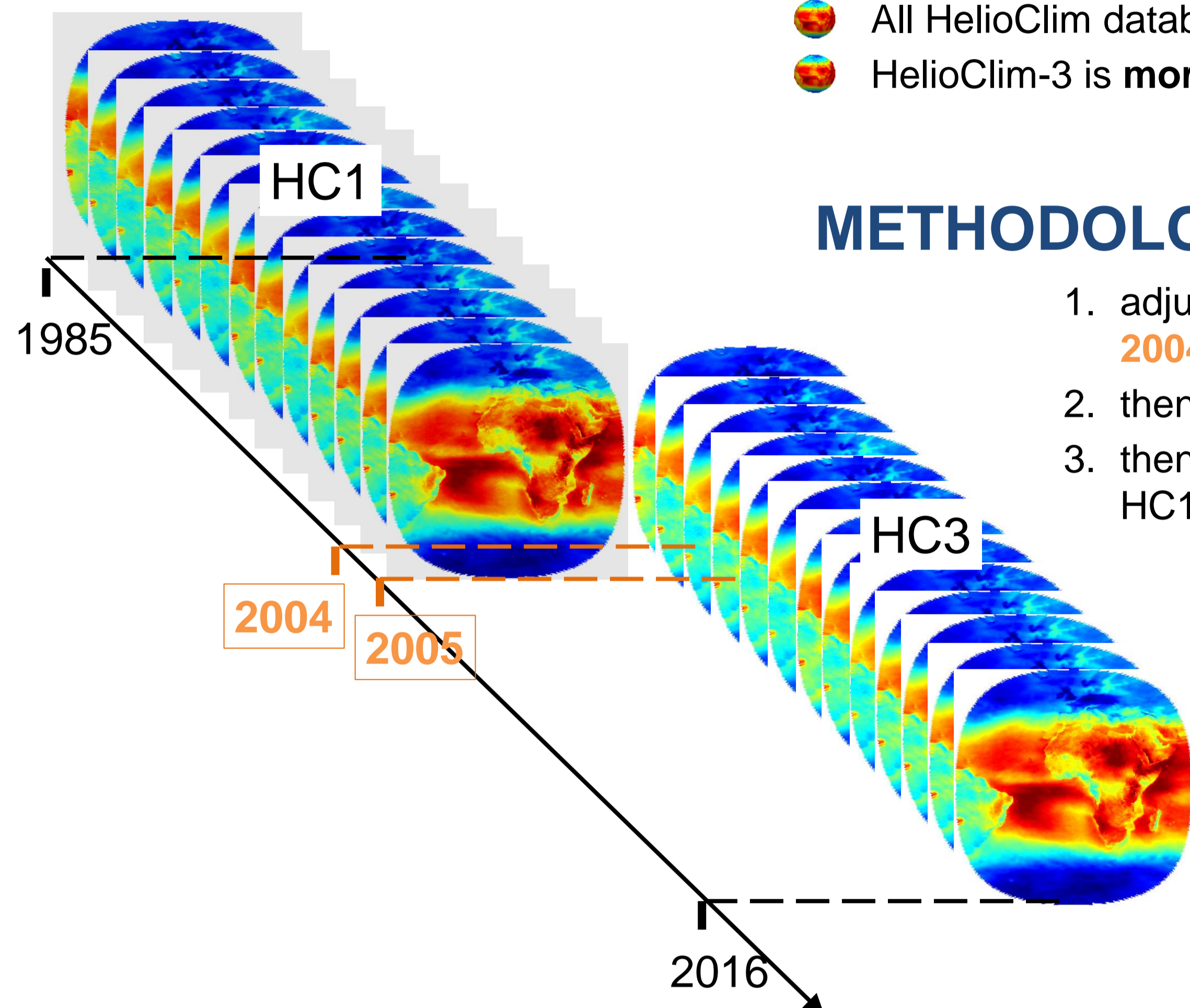
- HelioClim-1.** Daily SSI for the period 1985-2005. From the first generation of the Meteosat series of satellites processed with the Heliosat-2 method.
- HelioClim-3.** 15 min SSI for the period 2004 up to now. From the second generation of the Meteosat series of satellites processed with the Heliosat-2 method.
- Access** to the HelioClim databases is given by the SoDa Service ([www.soda-pro.com](http://www.soda-pro.com)).
- HelioClim-1 and part of HelioClim-3 (2004-2006) are labelled Data Collection of Open Resources for Everyone (**Data-CORE**) by the GEOSS (Global Earth Observation System of Systems). The GEOSS Data-CORE is a distributed pool of documented data sets with full, open and unrestricted access.
- All HelioClim databases have been **validated against measurements** performed by pyranometers at ground stations.
- HelioClim-3 is **more accurate** than HelioClim-1

## METHODOLOGY

- adjust HelioClim-1 (HC1v4) daily irradiation onto HelioClim-3 (HC3v5) daily irradiation for the common period Feb 2004-2005 (23 months),
- then apply the adjustment onto the entire HC1v4 from 1985 to Jan 2004,
- then analyse possible improvement in bias and other statistical indicators of bias-adjusted HC1v4 versus original HC1v4 using measurements of daily irradiation performed in 17 ground stations.

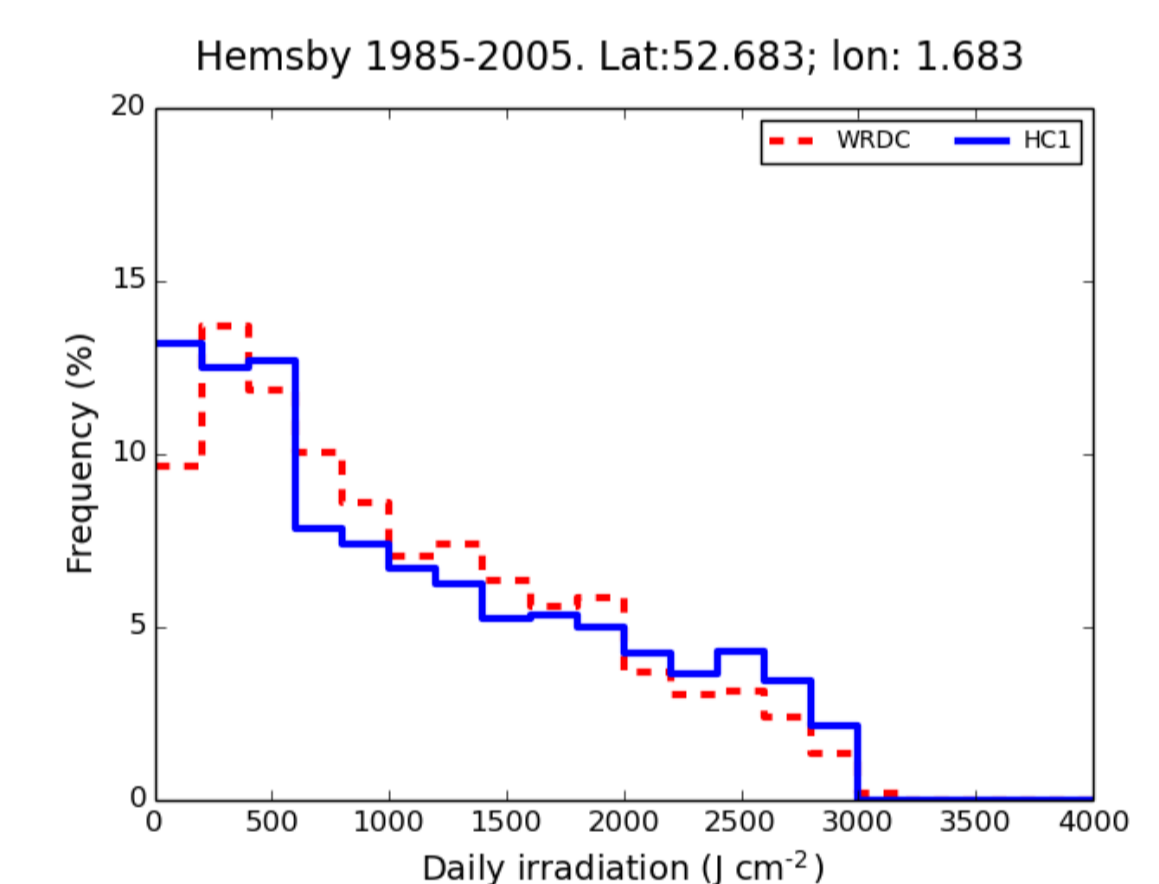
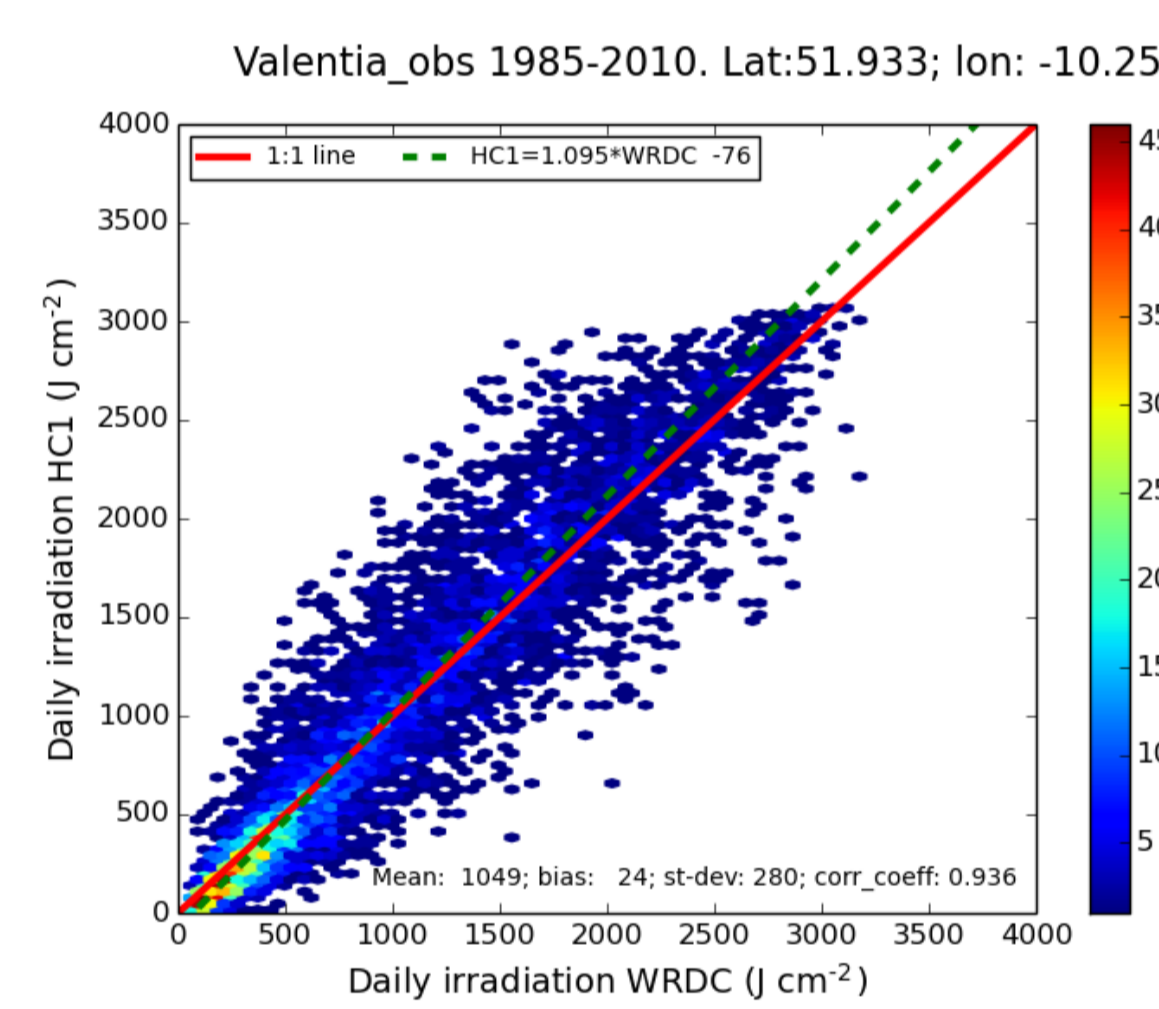
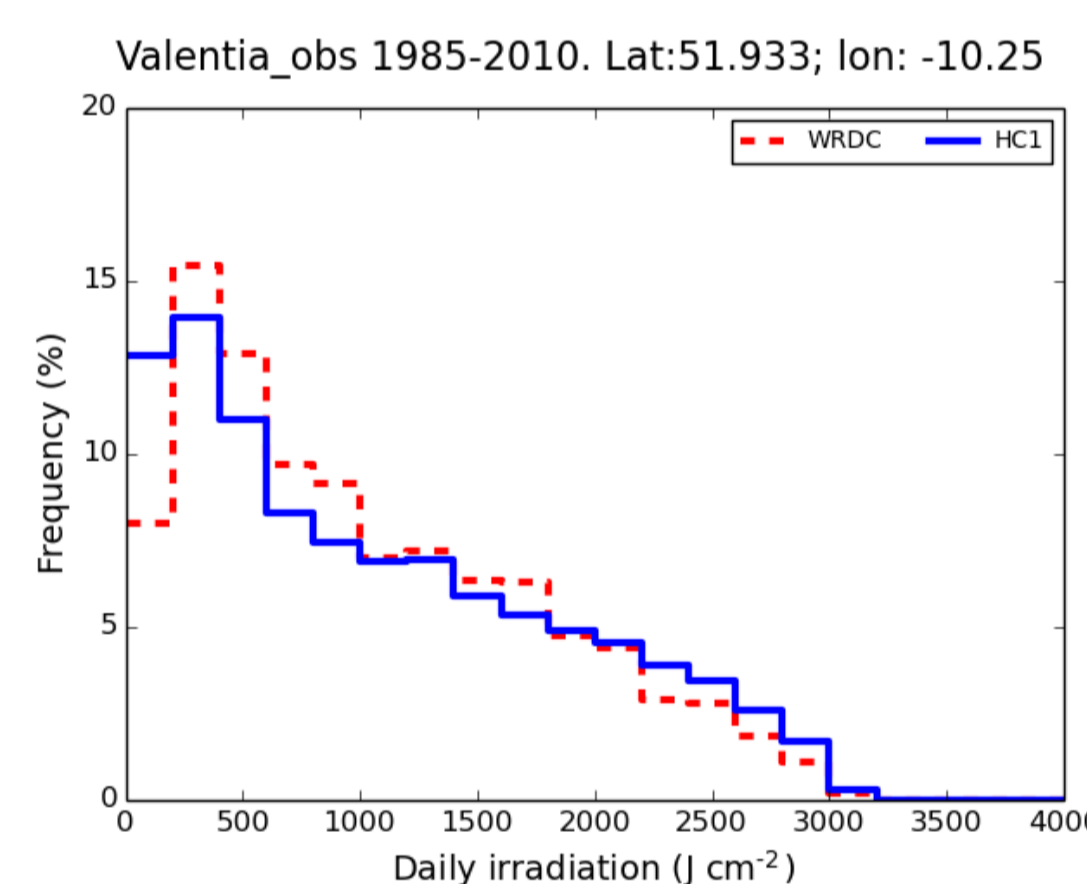
Six approaches have been investigated. Each approach may apply to the clearness indices KT as well, i.e. the HC1 KT is adjusted and then the adjusted irradiation HC1 is computed by multiplying KT by the daily irradiation at the top of atmosphere. A total of 12 (2x6) methods has been tested:

- addition of difference in means,
- ratio of means,
- affine transform
- addition of difference in modes,
- ratio of modes,
- quantile mapping.

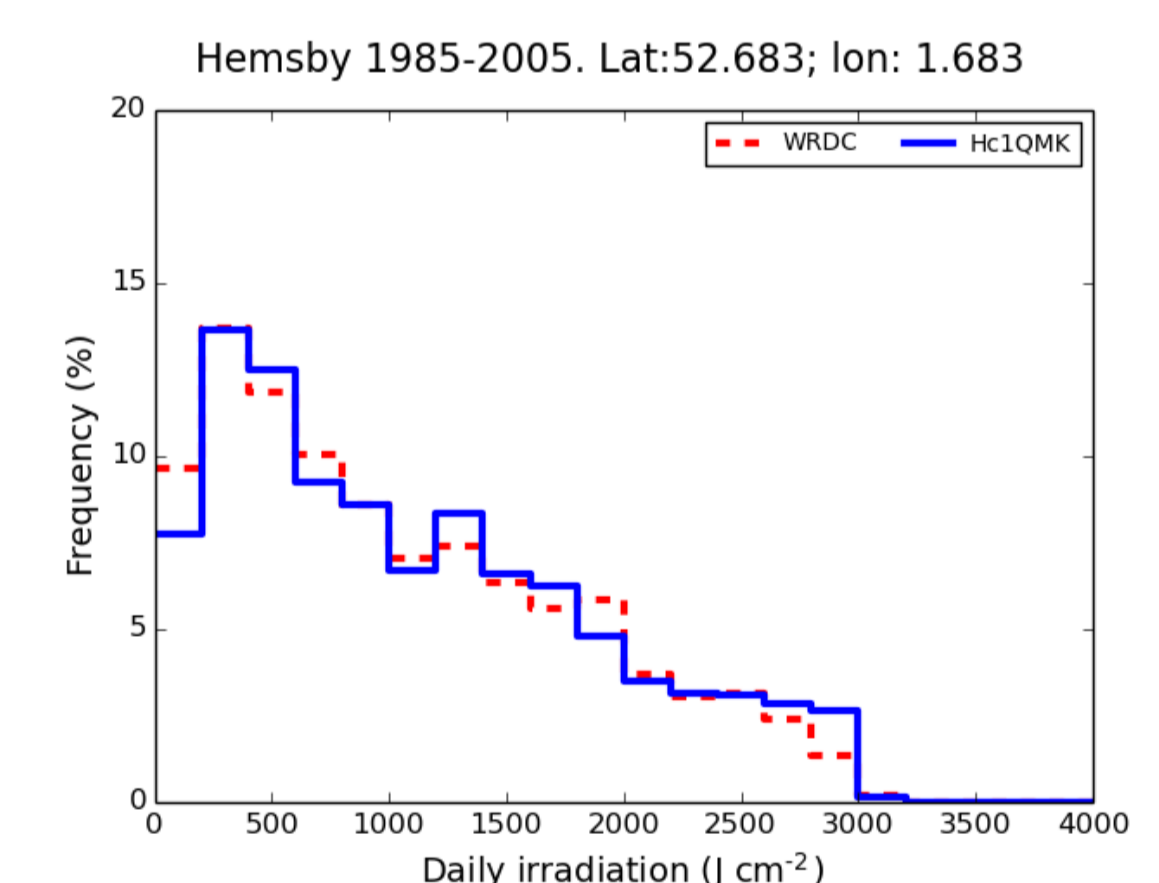
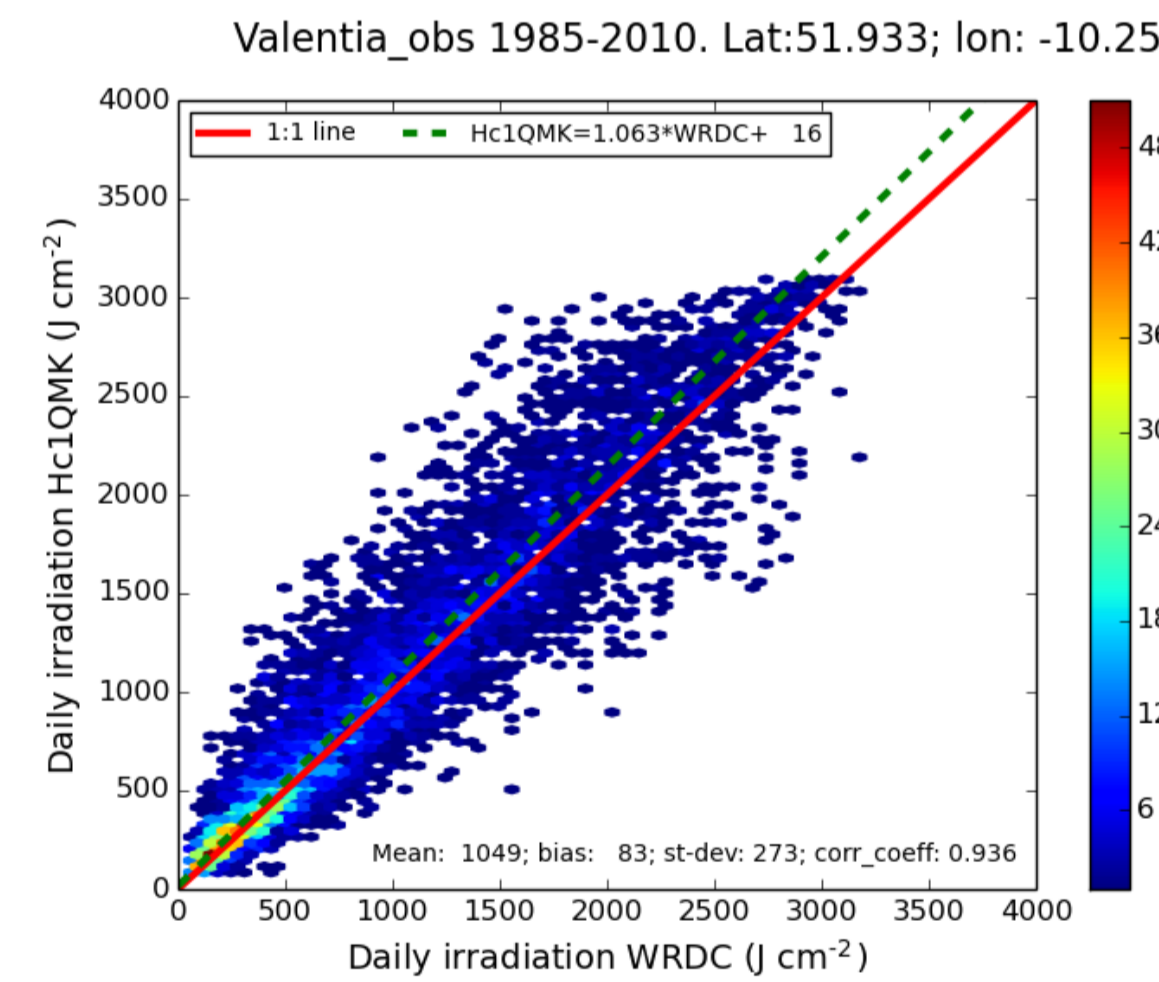
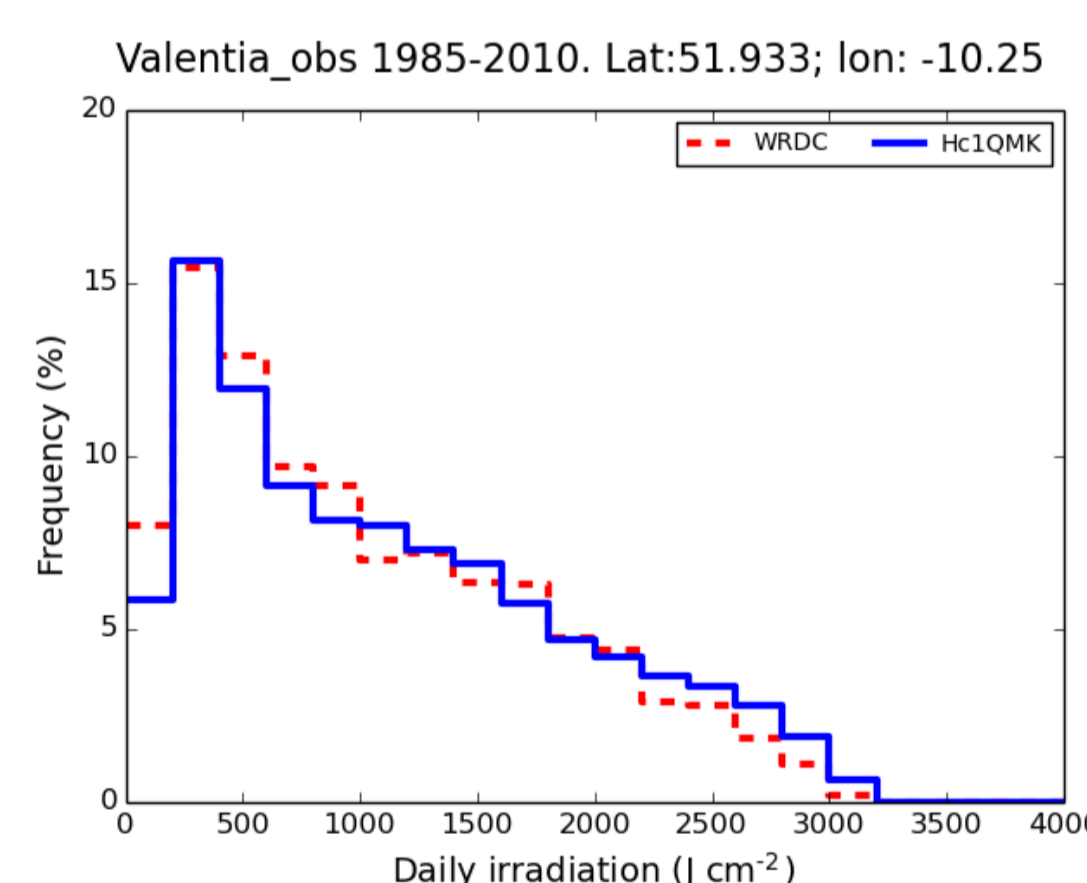


## RESULTS

Original  
HC1v4  
(1985-  
2005)



Adjusted  
HC1v4  
(1985-  
2005)



No method clearly surpasses the others. However, the method ‘quantile mapping’ applied to KT (QMK) exhibits better results than the others for all indicators: standard deviation, root mean square error, correlation coefficient, median and width of histogram of deviations (P60-P40), except the bias for which it is equivalent.

Compared to the original HC1v4, improvement brought by adjusted HC1v4 vs measurements is noticeable though not systematic.

- bias: strongly reduced by more than 40 J/cm<sup>2</sup> in 6 stations but increased in 3 sites,
- median of errors: strongly reduced in 6 stations but increased in 2 sites,
- standard deviation: reduced in 14 sites and slightly increased in 3 sites,
- correlation coefficient: greater or equal.

## CONCLUSION

The fusion of HC1v4 and HC3v5 is feasible in an easy way that can be turned into operation.

In most cases, the **adjusted HC1v4 performs better than HC1v4** when compared to qualified daily irradiation measured in meteorological networks.

It opens the way for a **consistent GEOSS Data-CORE of surface solar daily irradiation** from 1985 up to 2016 and onwards.

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