

Application of CAMS Radiation service products: Satellite-derived irradiance data for applications in low voltage grids with large PV shares

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E. Wey, L. Saboret (Transvalor)



Knowledge for Tomorrow

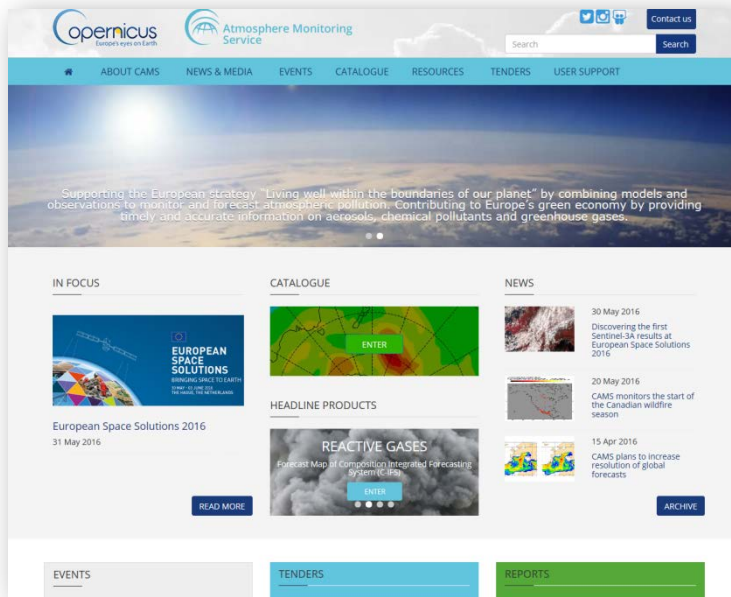


Introduction

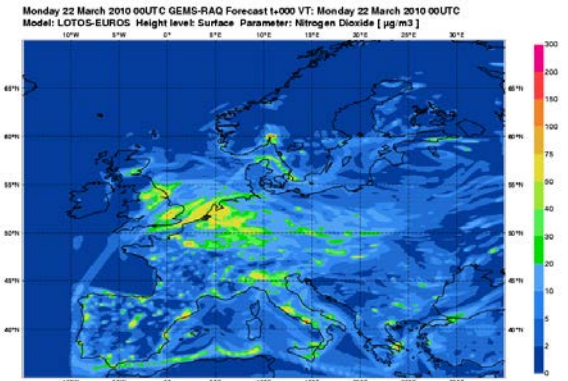
- Satellite-based solar resource information – New Copernicus service
 - What's that? What is new?
- What else do we do with the intermediate Copernicus service results?
 - Cloud/snow statistics
 - Dust aerosol statistics
 - Nowcasting clouds for large solar power plants -> low voltage grids?
 - Feed-in power and transformer load flow in a low voltage grid



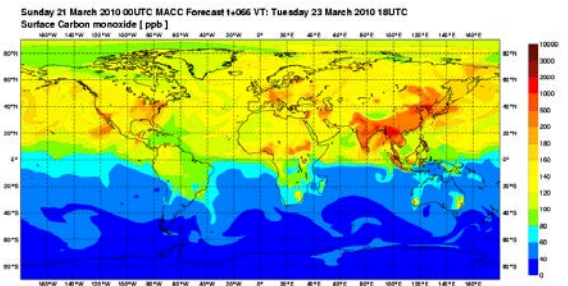
Copernicus Atmosphere Monitoring Service (CAMS)



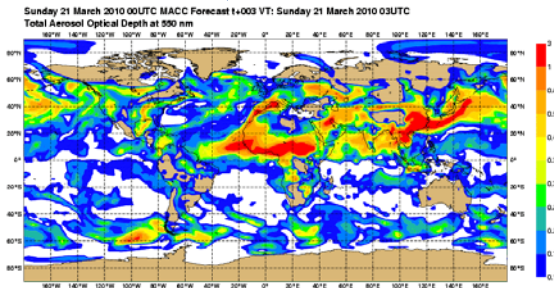
Air quality



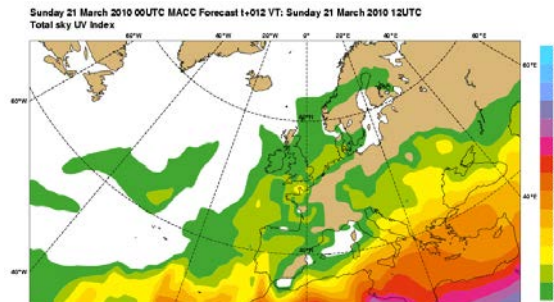
Global Pollution



Aerosol



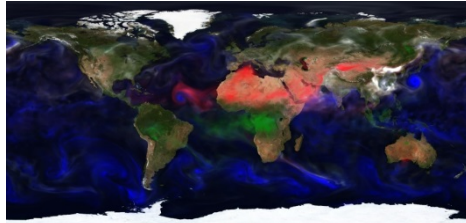
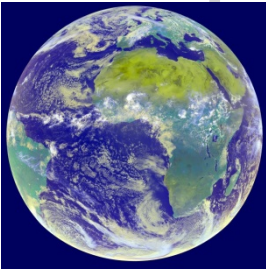
UV



<http://atmosphere.copernicus.eu>



Physical, fast retrieval method Heliosat-4



Scattering through
clouds and
aerosols

Absorption from
clouds,
aerosols, and
water vapour

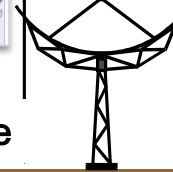
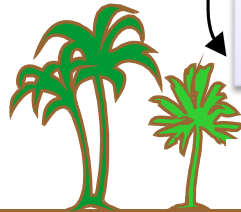


diffuse irradiance

direct and diffuse irradiance

Direct normal irradiance

diffuse irradiance



Global irradiance



McClear clear sky irradiance (GHI, DIF, DIR, DNI) time series in 1 min steps and in global coverage

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- HelioClim-3 Forecast
- MACC-RAD
- Quality Check of Radiation Measurements
- McClear - Irradiation under clear-sky**
- NASA-SSE
- HelioClim-1 + NASA-SSE
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MCCLEAR SERVICE FOR ESTIMATING IRRADIATION UNDER CLEAR-SKY

The McClear Clear-Sky Irradiation service, available worldwide, delivers time series of irradiation that would be observed in a specific site under clear sky month. The Global, Direct and Diffuse Horizontal Irradiation, as well as the Beam Normal Irradiation are provided. The time coverage of the data is from 2004-2015 (MACC-II project, 2011-2014) and no. 633080 (MACC-III project, 2014-2015).

[User's guide to the MACC-RAD services on solar energy radiation resources - March 2015 \(DOI: 10.13140/RG.2.1.5016.7521\)](#)

Reference:
Lefèvre M., A. Dumbe, P. Blanc, B. Espinar, B. Gschwind, Z. Qu, L. Wald, M. Schroedter-Homscheidt, C. Hoyer-Klick, A. Arola, A. Benedetti, J. W. Estimating downwelling solar radiation at ground level in clear-sky conditions", Atmos. Meas. Tech., 6, 2403-2418, 2013, doi:10.5194/amt-6-2403-2013

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MCCLEAR

Max Extent | Back | Search Address: Type an address



1000 km | 1000 mi


Nutzungsbedingungen

- 2004-2015 1-2 days delay online
- 7 years operations secured, > 20 years planned
- Just register and download from <http://www.soda-pro.com/web-services/radiation/cams-mcclear>
- Interactive and OGC script access possible



CAMS Radiation Service: Heliosat-4 irradiance (GHI, DIF, DIR, DNI) time series in 15 min steps in Europe/Africa/Middle East

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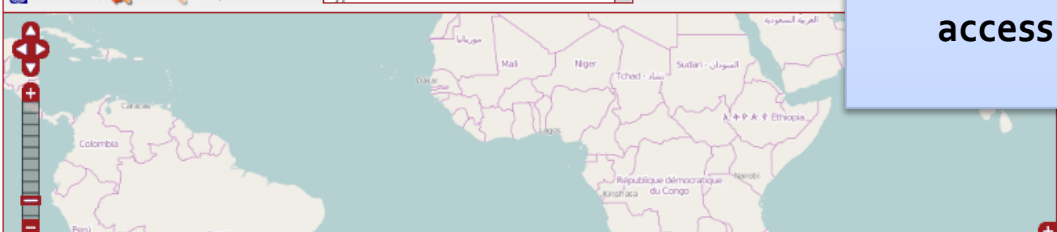
TIME SERIES OF SOLAR RADIATION DATA FROM MACC-RAD

The MACC-RAD service provides time series of Global, Direct, and Diffuse Irradiations on horizontal surface, and Direct Irradiation on actual weather conditions as well as for clear-sky conditions. The geographical coverage is the field-of-view of the Meteosat satellite, Atlantic Ocean, Middle East (-66° to 66° in both latitudes and longitudes). The time coverage of data is from 2004-02-01 up to 2 day time step ranging from 15 min to 1 month.
The number of requests (via the WPS or via this website) is limited to 5 per day.
The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) 218793 (MACC project, 2009-2011), no. 283576 (MACC-II project, 2011-2014) and no. 633080 (MACC-III project, 2014-2015).
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Please, limit the time span of the request to 5 years.

MACC-RAD

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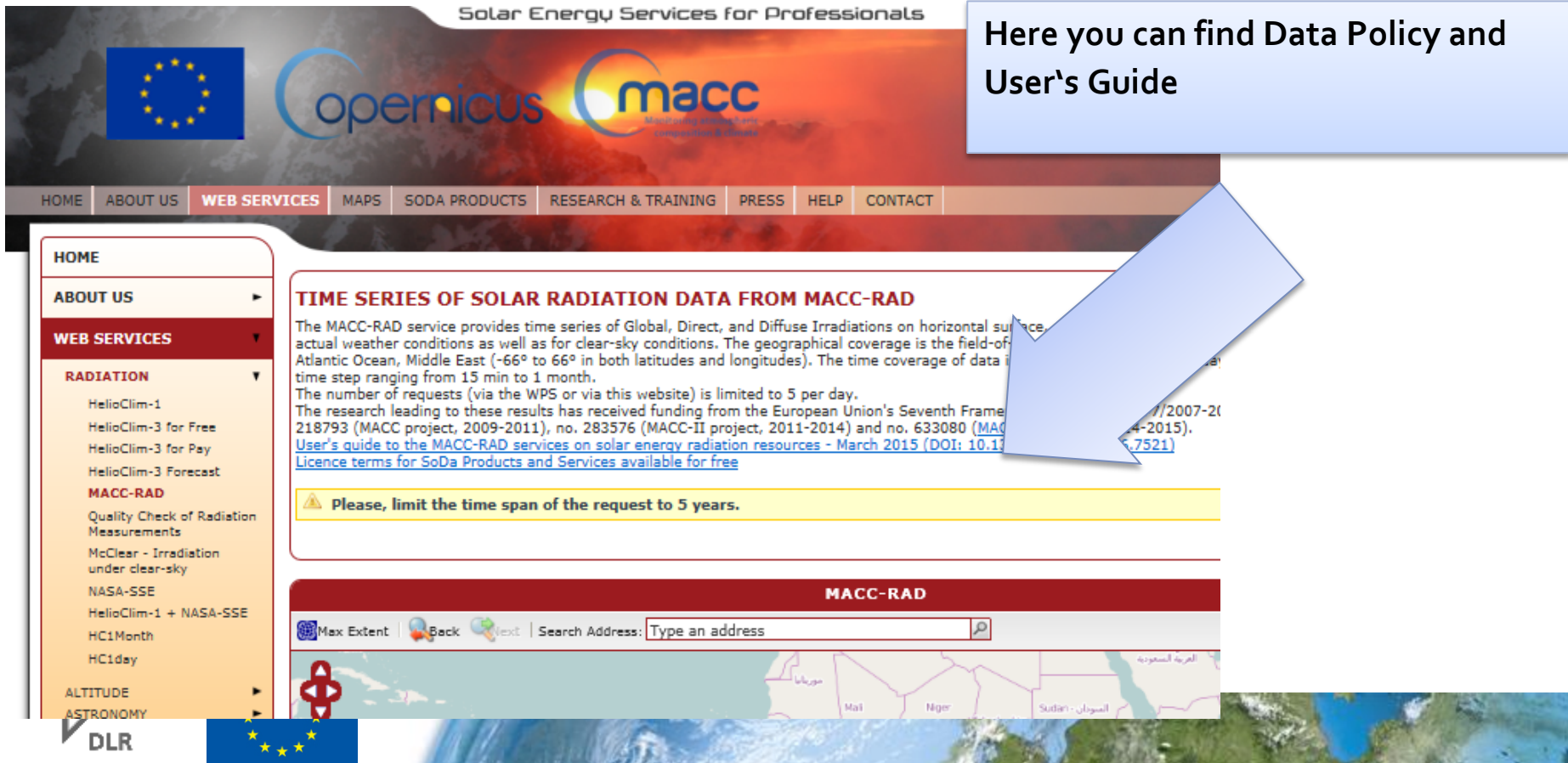


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- Interactive and OGC script access possible



Data policy

- Registration needed to justify existence of service
- Free for any use – commercial as well as R&D



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Please, limit the time span of the request to 5 years.

MACC-RAD

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العربية السعودية
Morocco
Mali Niger Sudan السودان

Here you can find Data Policy and User's Guide

Faster, higher, wider,.... Is that all? Or: Why a new Copernicus service?

Olympic goals in solar resources:

Aim to be more accurate, better resolved, more parameters...

But is that all?

Today's situation: 'I'm asking 5 data providers and will get 6 different answers ... and now there is also MACC/Copernicus'

Sure, better, more accurate, more parameters is needed...

But also:

- **transparency** – which **input data** is used?
Publish instead of company confidential status
- Detailed **validation** – publish instead of treated as company confidential
- **Continuous** validation and quality control with experienced staff – no project like approach with new PostDoc students every few years

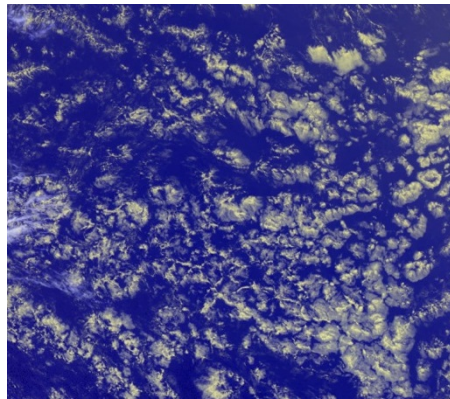


What can we do with Copernicus intermediate data?

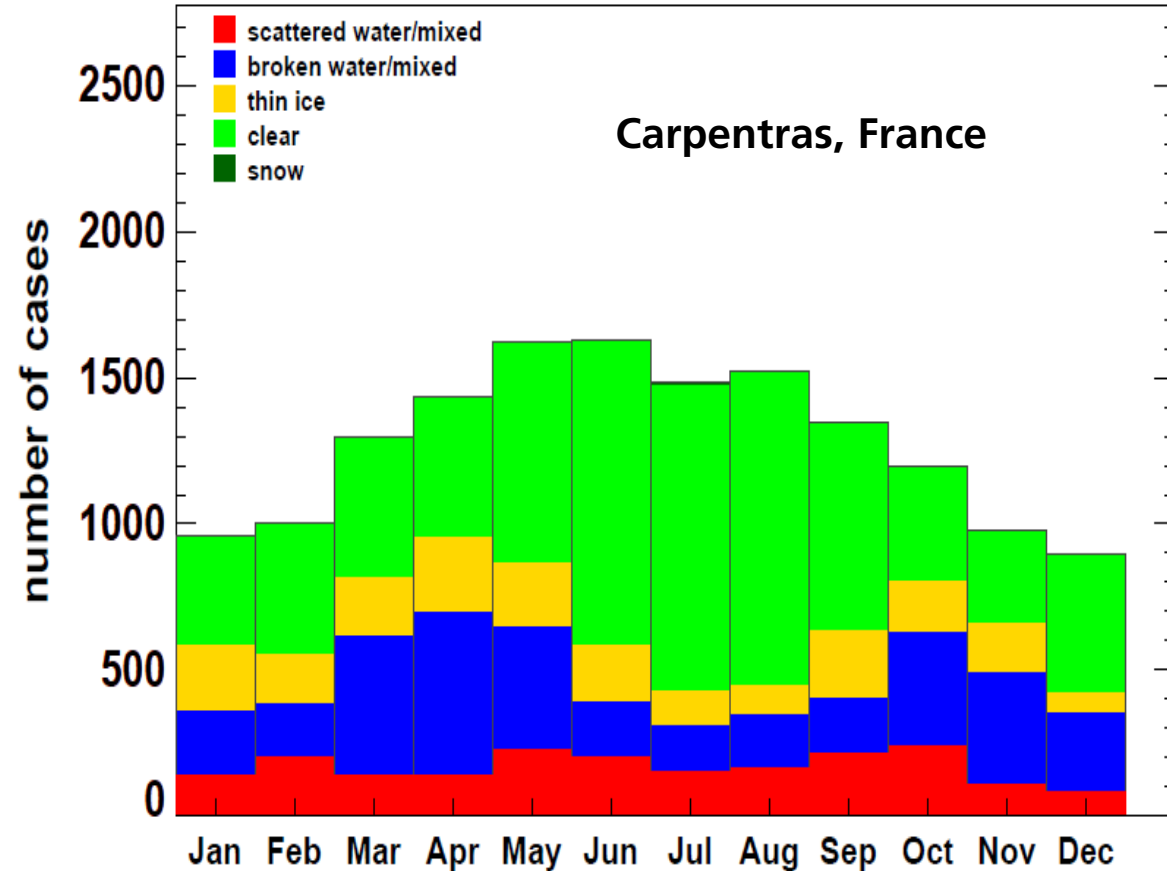




Cloud and snow statistics



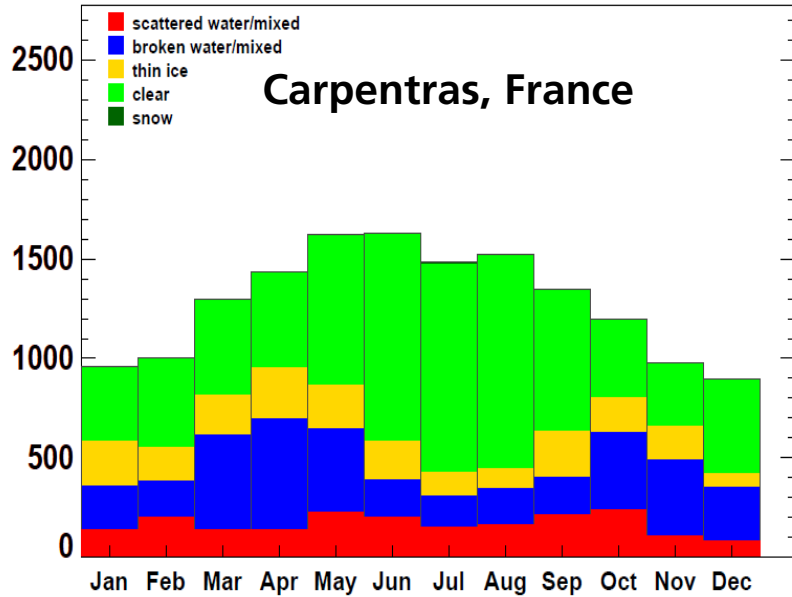
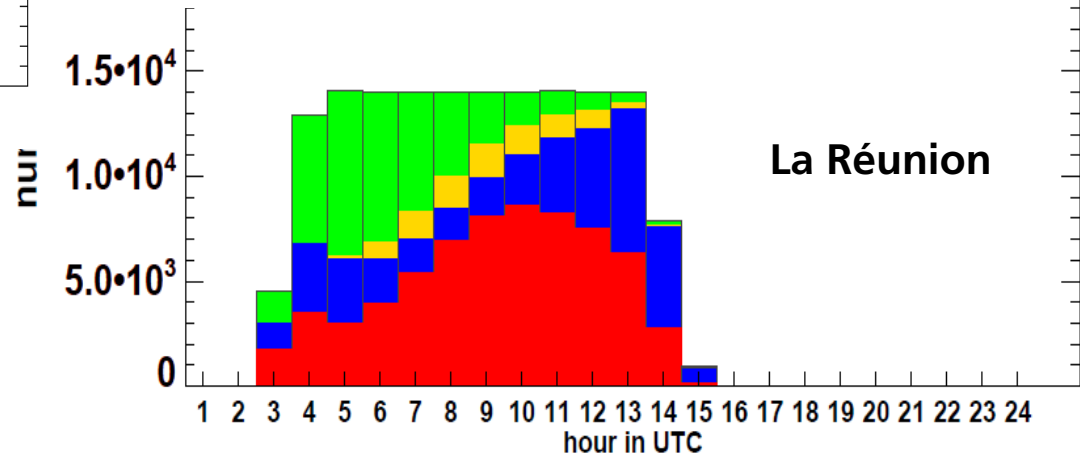
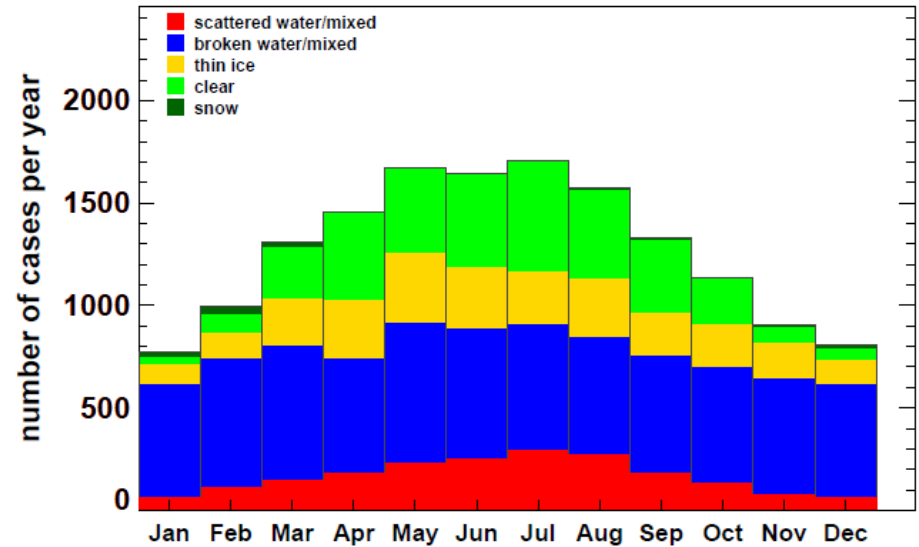
green = clear
blue = overcast/broken clouds
yellow = cirrus, thin ice
red = scattered clouds





Cloud and snow statistics

Weihenstephan-Duernast 2004-2014

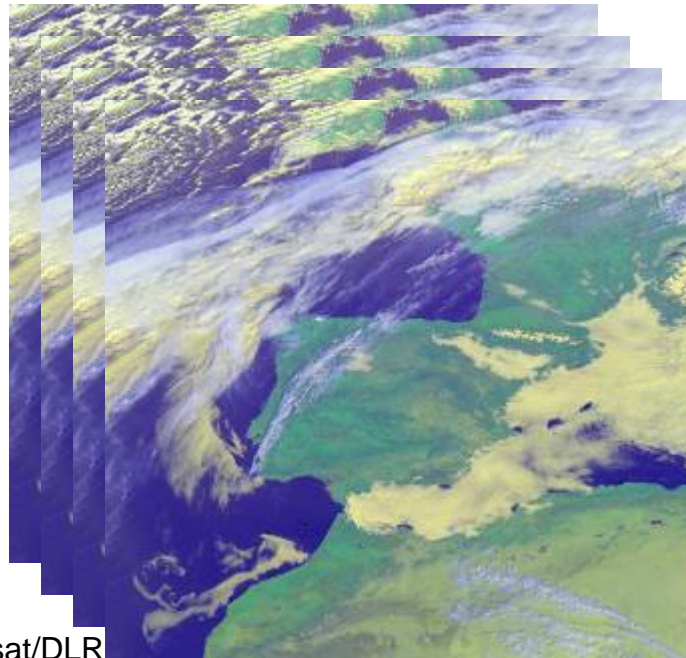


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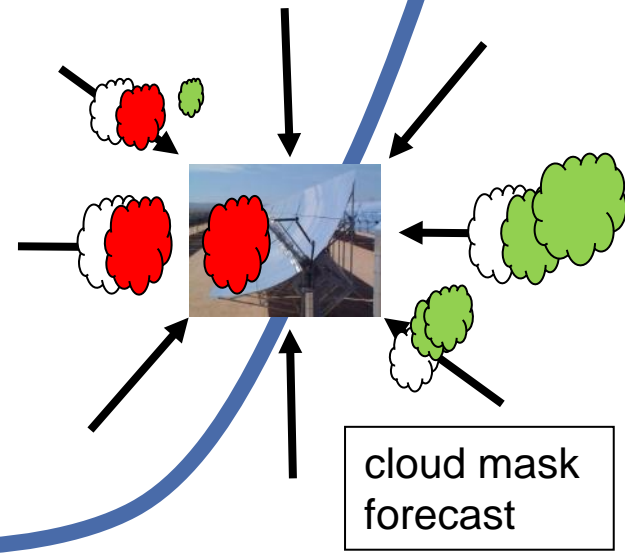
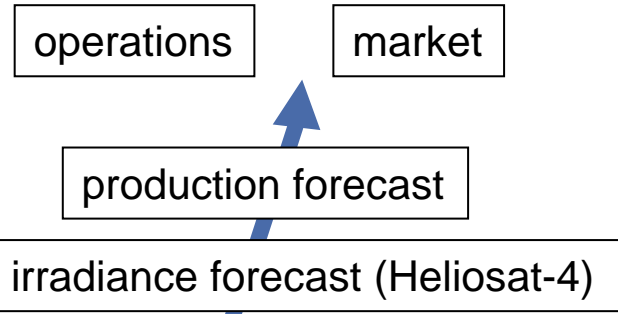


Nowcasting for solar power plants



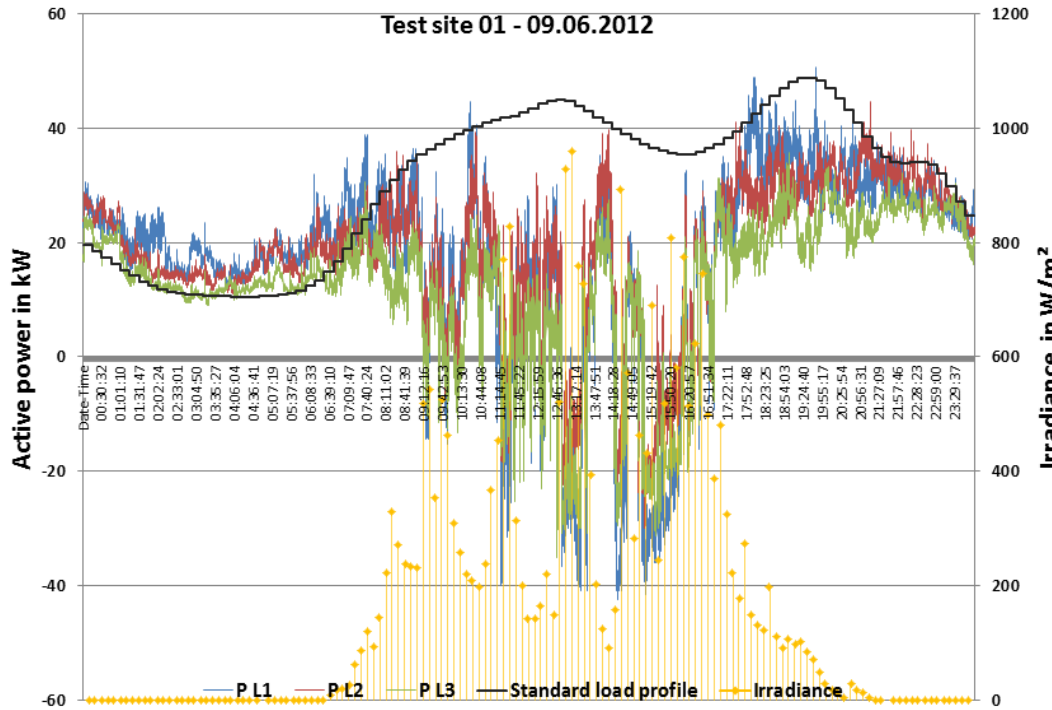
© Eumetsat/DLR

sequence of cloud masks
thin ice clouds
water/mixed phase clouds





Feed-in power and transformer load – Ulm example

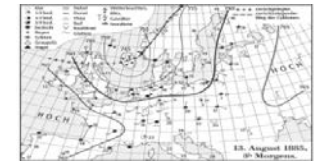


Solar irradiance at the surface

monitoring forecast



NWP



Grid simulation



Optimized solar energy integration into the existing grid – grid status (historical data) and nowcasting (expected to be used)





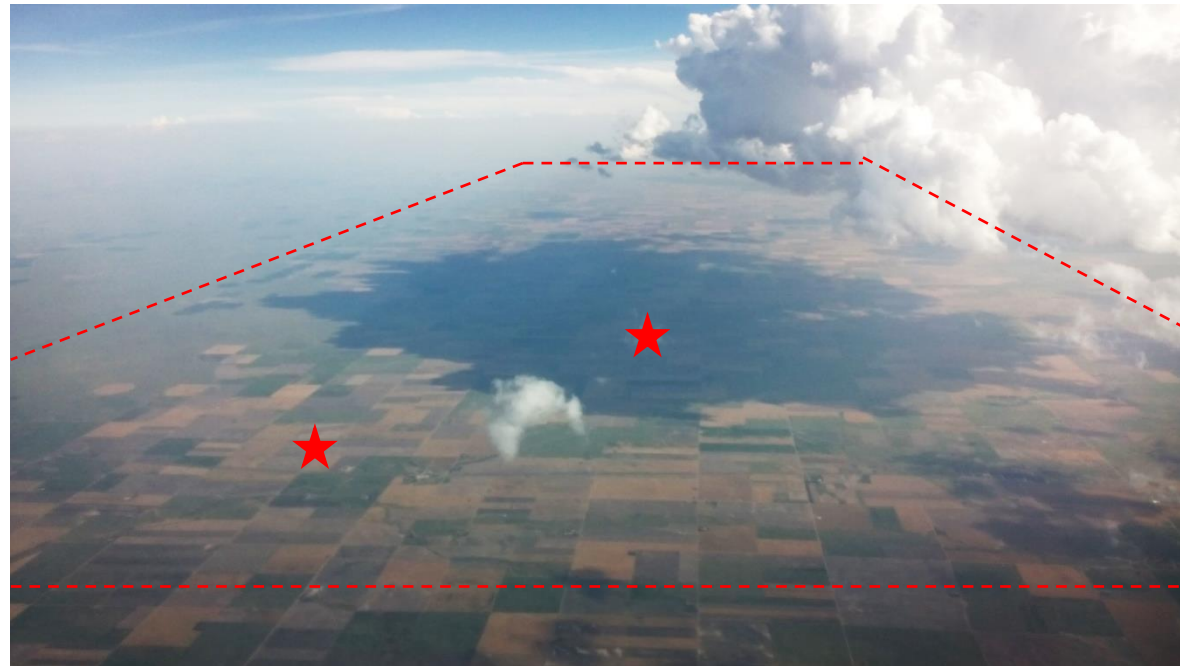
Satellite or ground observations ?

Pyranometers

- more accurate at the point
- few locations only
- maintenance needed

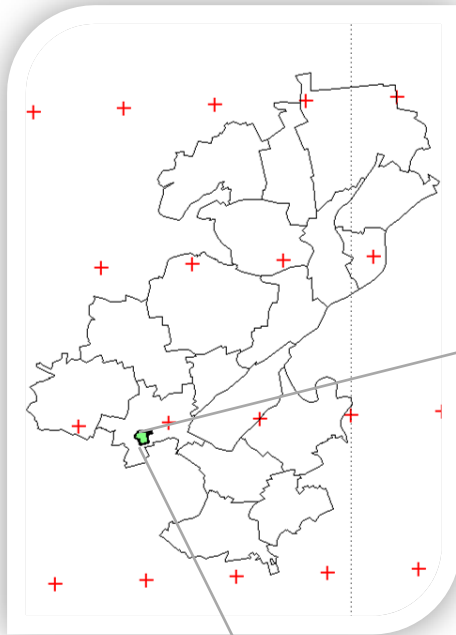
Satellite

- spatially averaged
- 15 or 5 minutes
- Long history available





Test site Ulm Einsingen

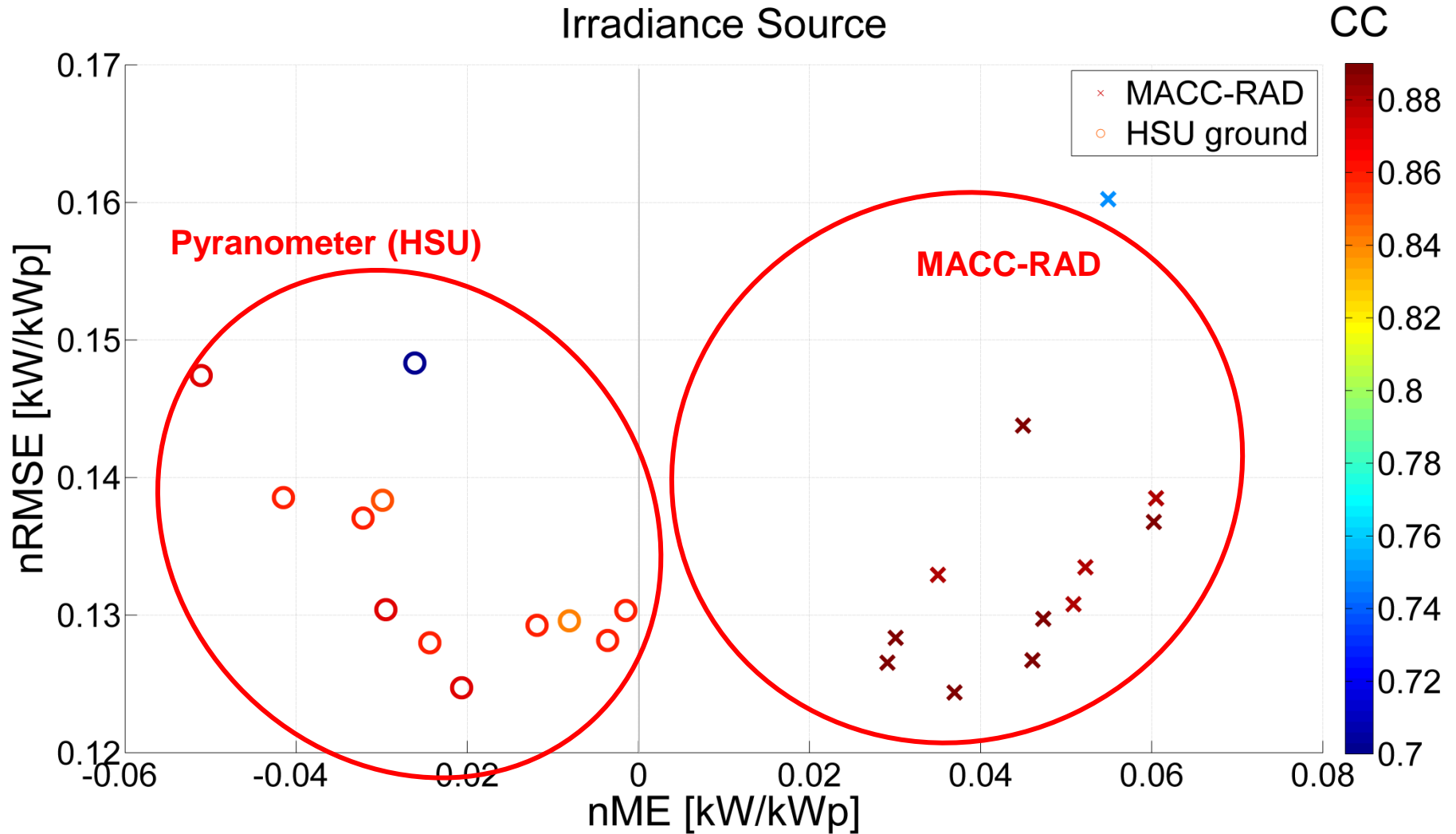


- 12 PV-Systems with smart meters (red marked)
- 15 minute resolution
- 6.7.2013 – 13.12.2014
- Comparison of individual systems and sum



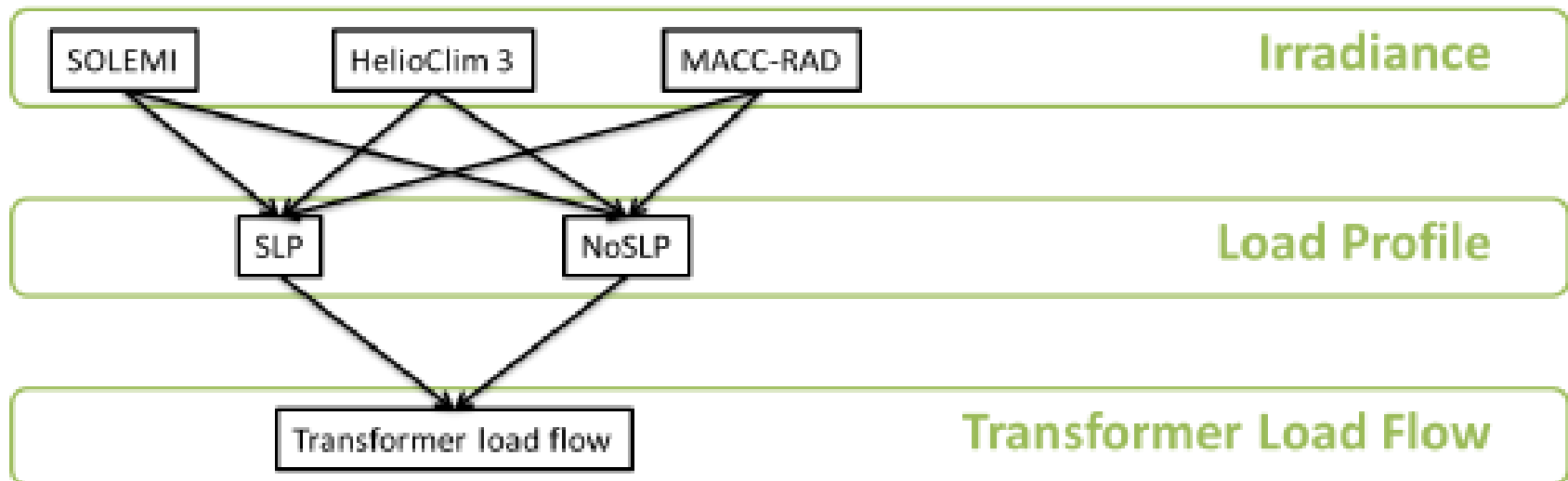


Feed-in power – Comparison vs smart meters



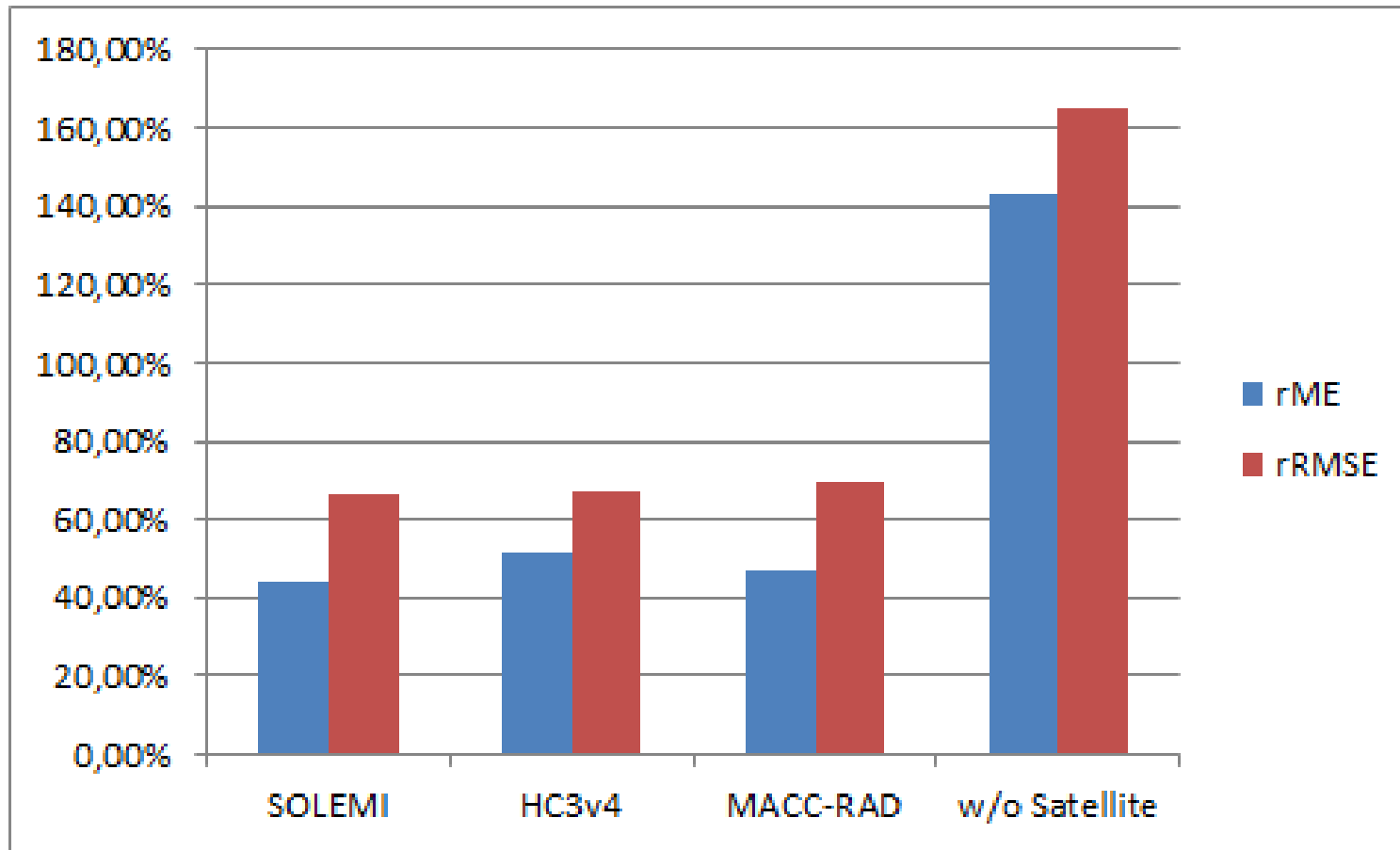


From feed-in power to load flow at the transformer





Load flow at transformer



Only values with sun elevation angles $>0^\circ$ are considered

Annual results for 2012



Wrap-Up

- The new CAMS Radiation Service has been presented
- Usage of cloud properties from space for extended site characteristics
- Cloud properties used in nowcasting for large scale solar power plants
- CAMS irradiances are used for feed-in power calculation and transformer loads in low voltage grids

Thanks to ...

... Stadtwerke Ulm for providing smart meter and transformer data

This work has recently received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 608623 and 608930 and within the Copernicus programme.

