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

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Introduction

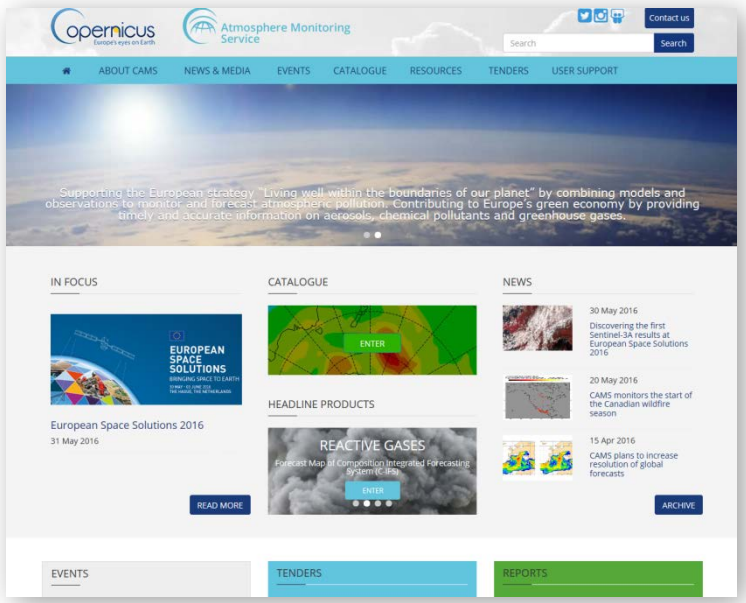
- Satellite-based solar resource information – New Copernicus service
  - What‘s that? What is new?

- What else do we with the intermediate Copernicus service results?
  - Cloud/snow statistics
  - Dust aerosol statistics
  - Nowcasting clouds for large solar power plants -> low voltage grids?

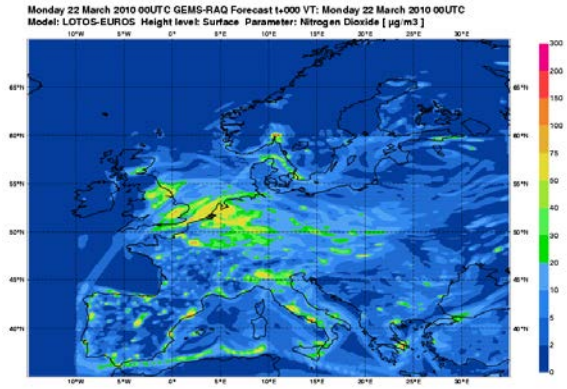
  - Feed-in power and transformer load flow in a low voltage grid

Copernicus Atmosphere Monitoring Service (CAMS)

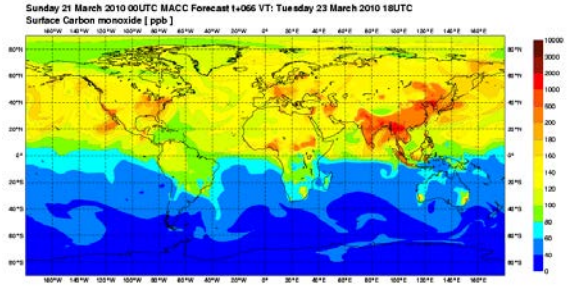
Atmosphere Monitoring Service



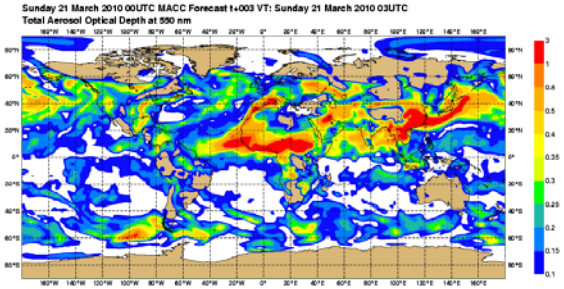
Air quality



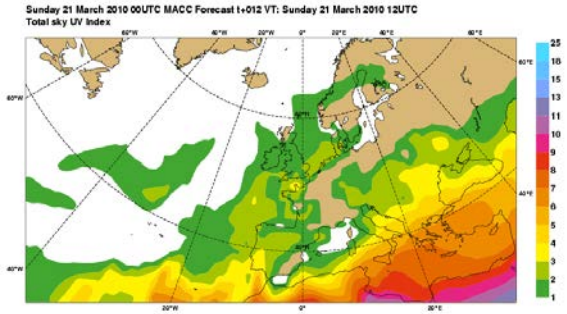
Global Pollution



Aerosol



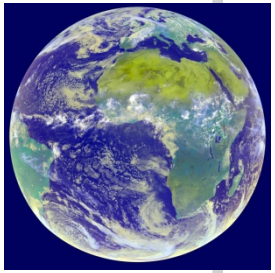
UV

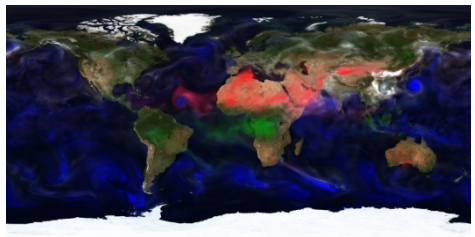


http://atmosphere.copernicus.eu

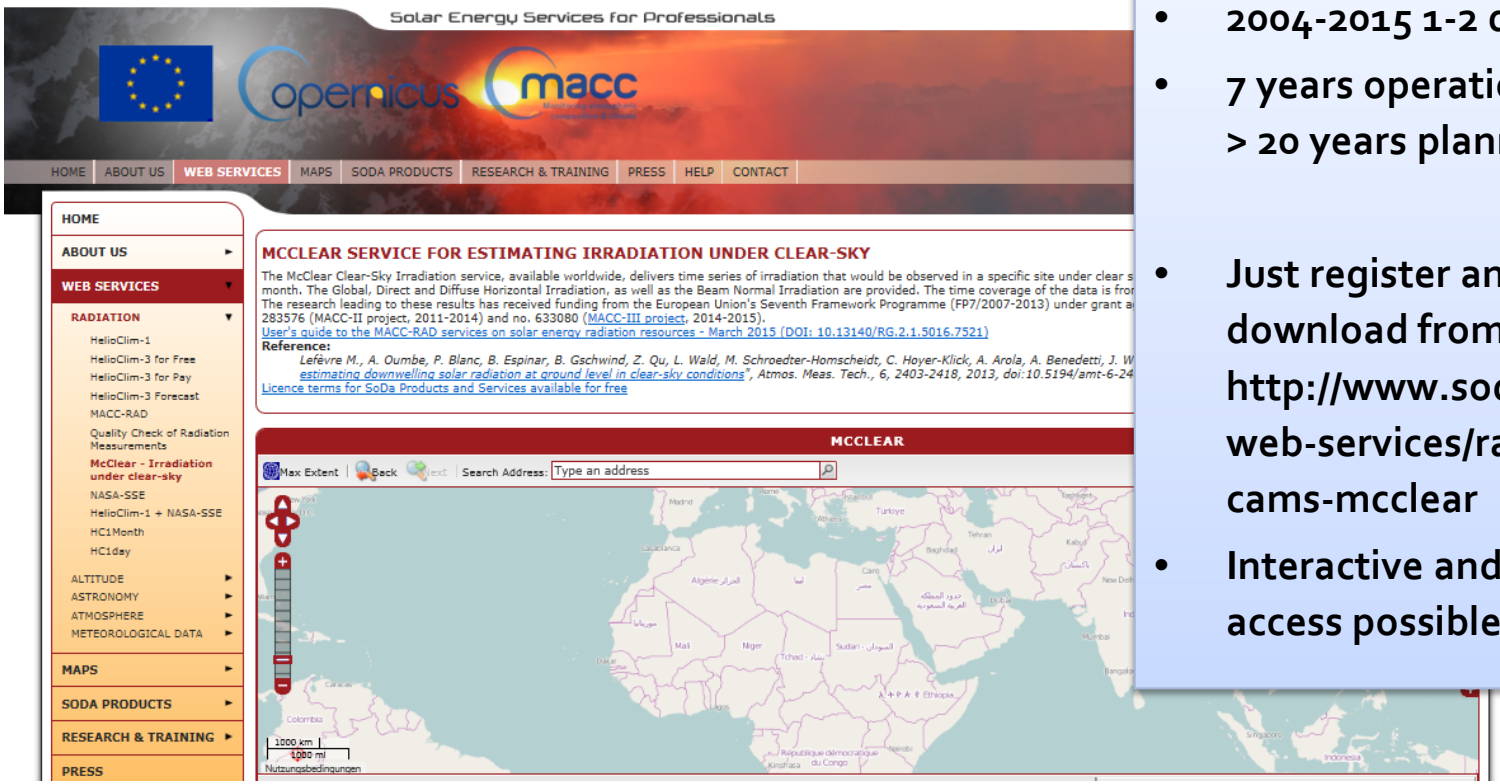
DLR

Physical, fast retrieval method Heliosat-4



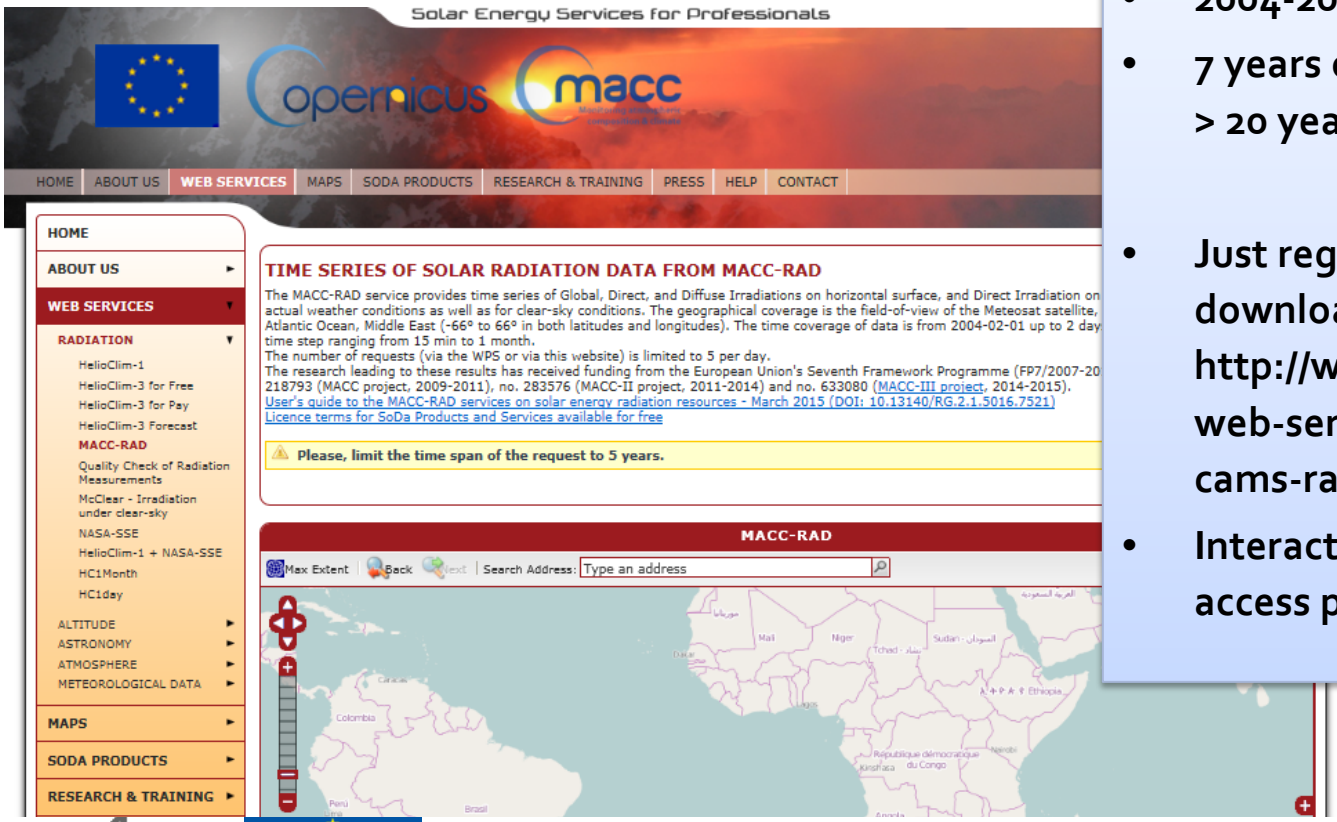


McClear clear sky irradiance (GHI, DIF, DIR, DNI) time series in 1 min steps and in global coverage



- 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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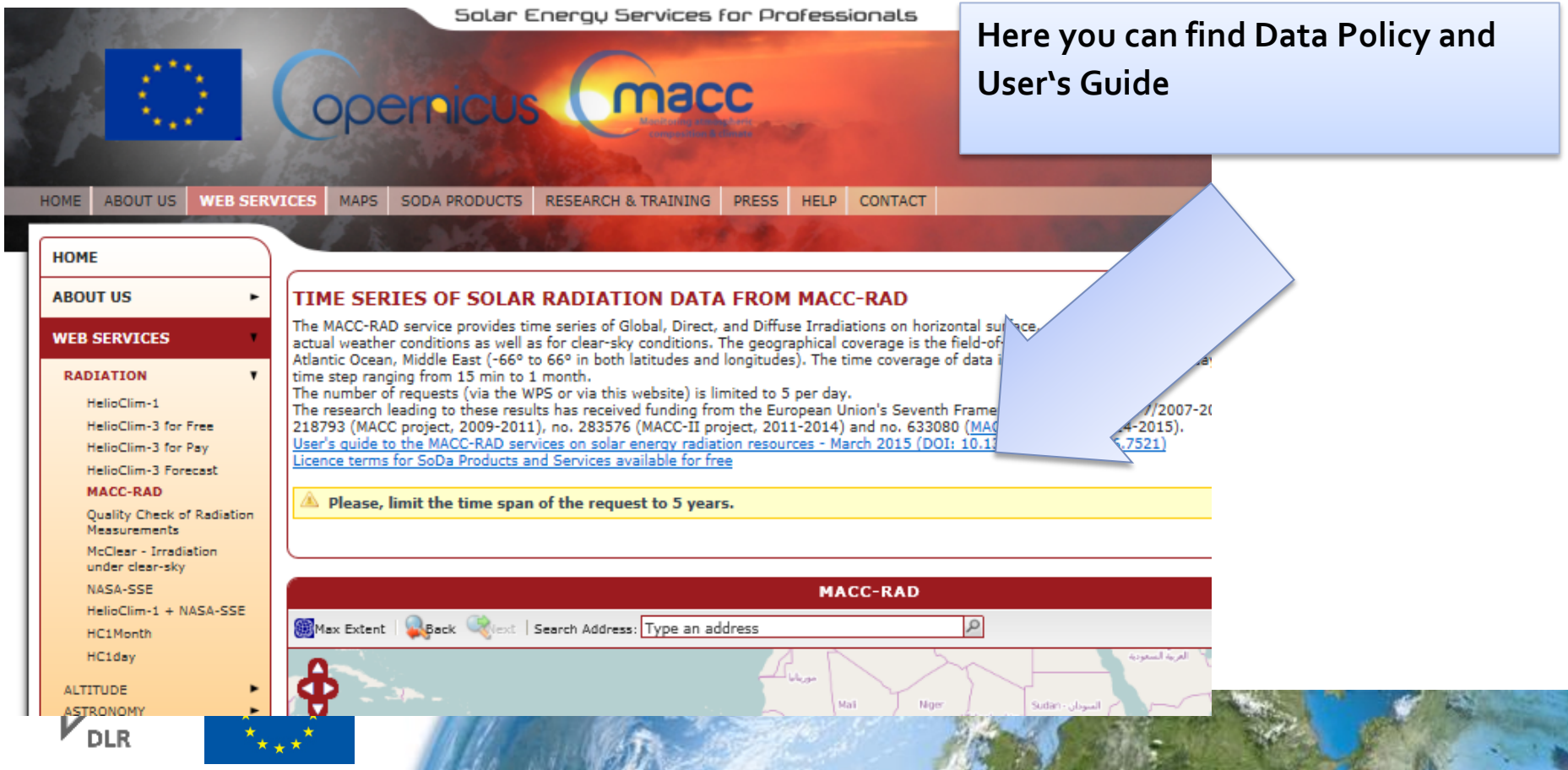
Data policy

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



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'

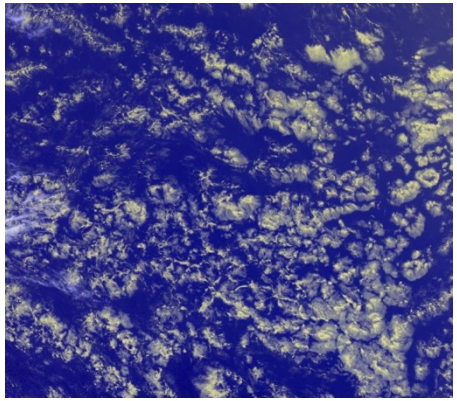
Sure, better, more accurate, more parameters is needed…

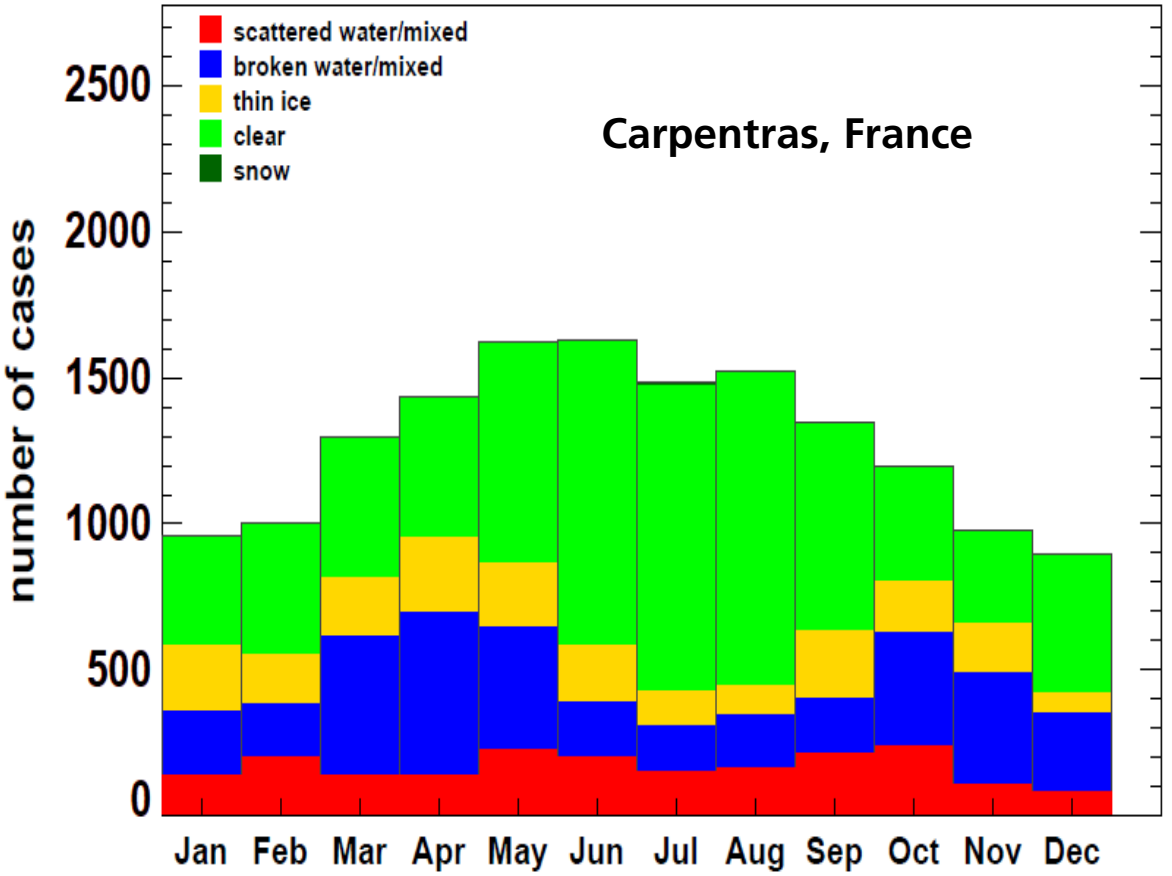
But also:

- **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?

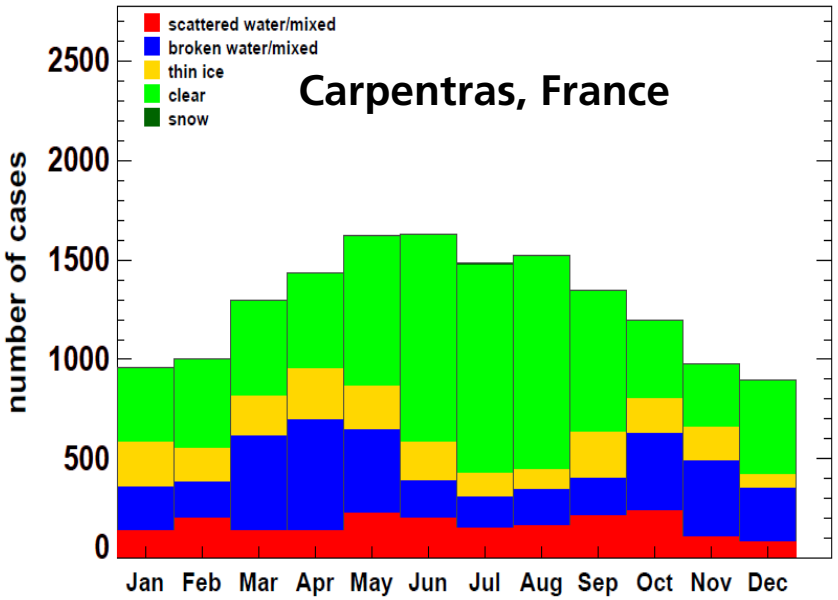
Cloud and snow statistics

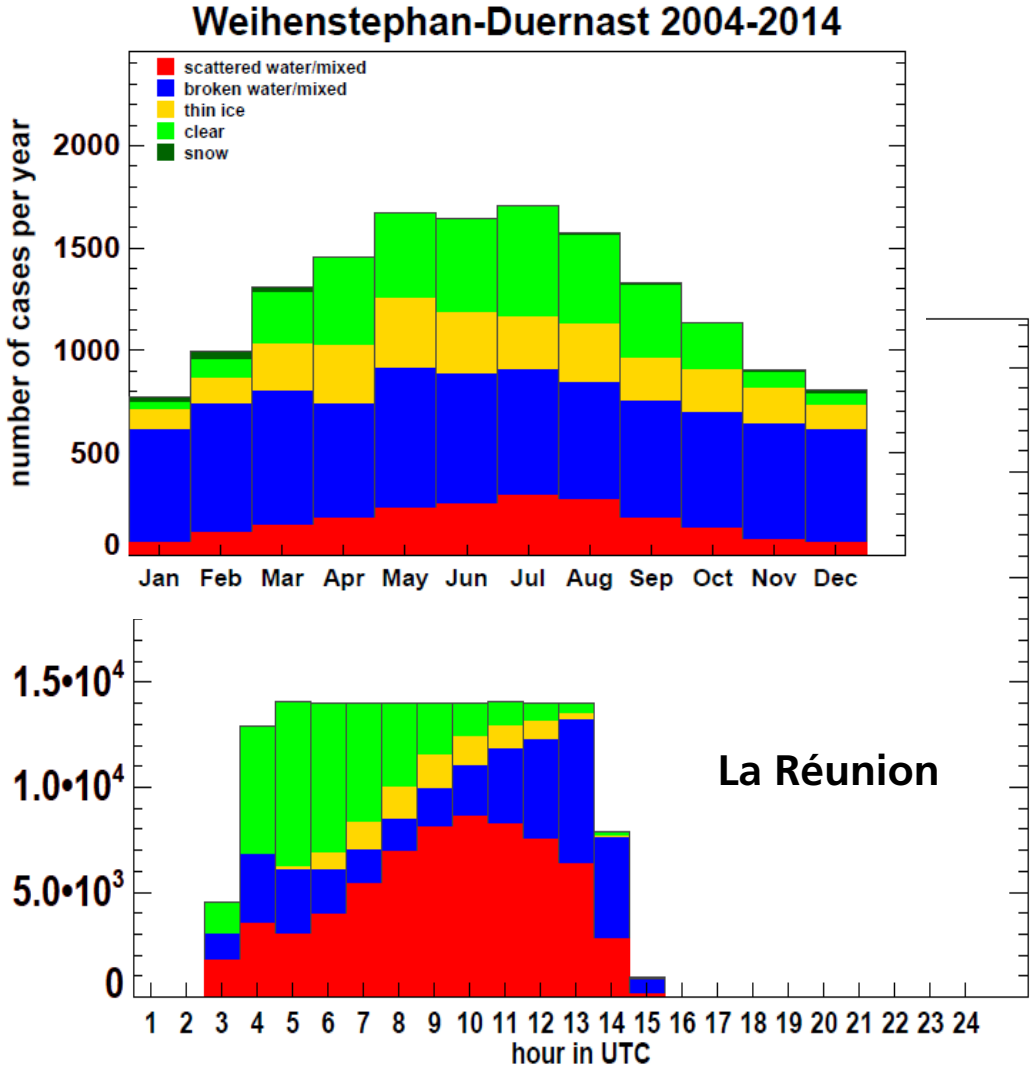




green = clear
blue = overcast/broken clouds
yellow = cirrus, thin ice
red = scattered clouds

Cloud and snow statistics





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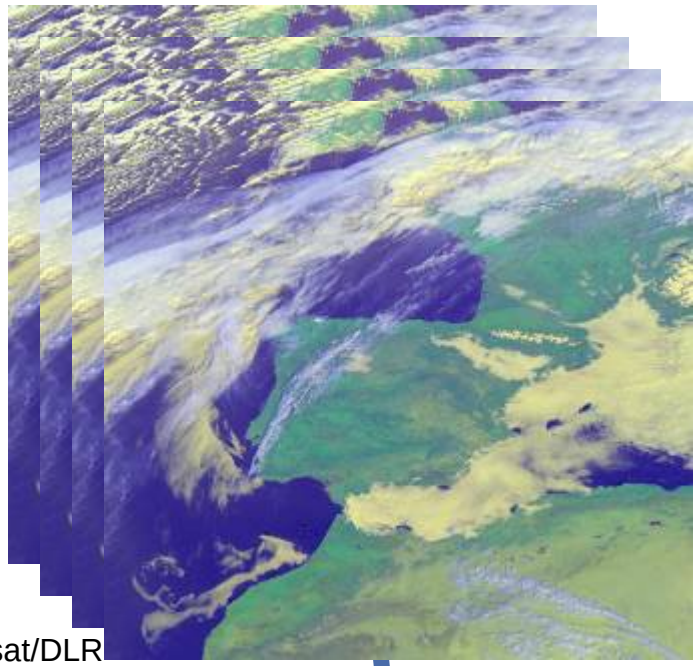
Nowcasting for solar power plants



© Eumetsat/DLR

sequence of cloud masks

thin ice clouds
water/mixed phase clouds

operations

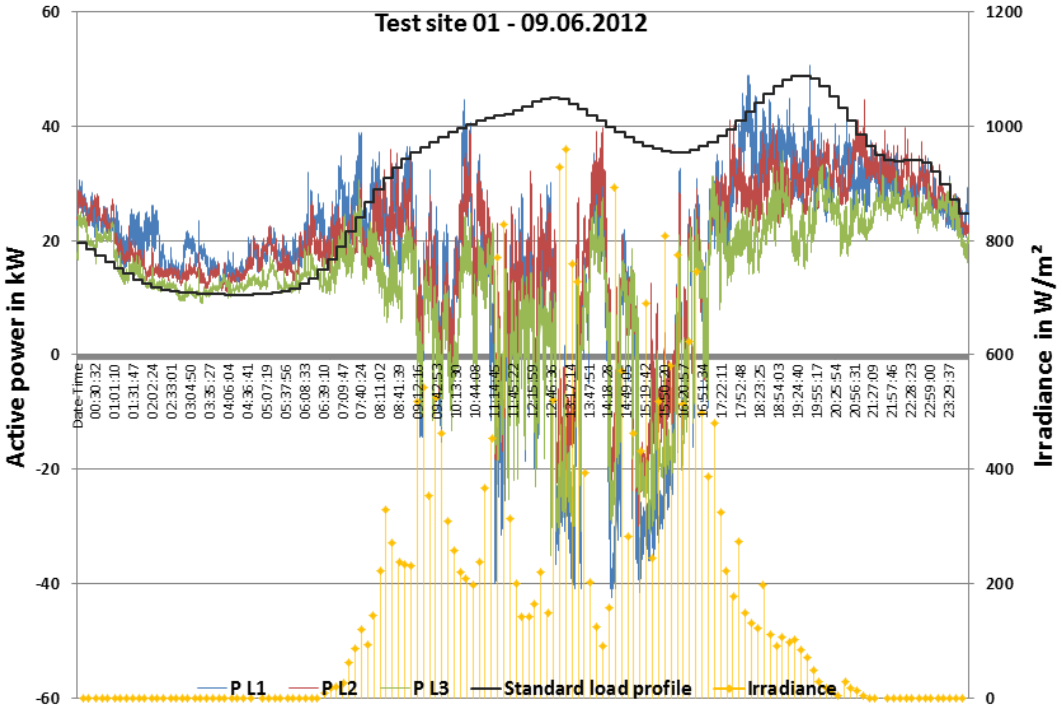
market

production forecast

irradiance forecast (Heliosat-4)

cloud mask forecast

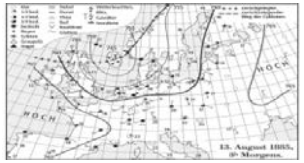
Feed-in power and transformer load – Ulm example



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)

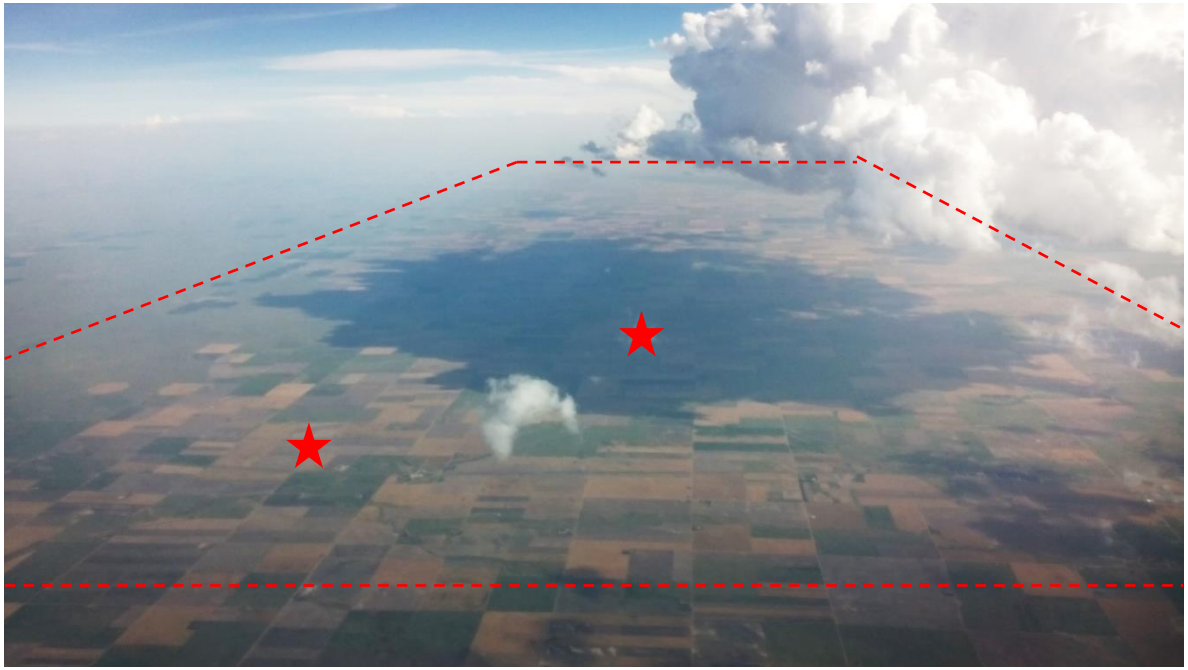
Satellite or ground observations ?

Pyranometers

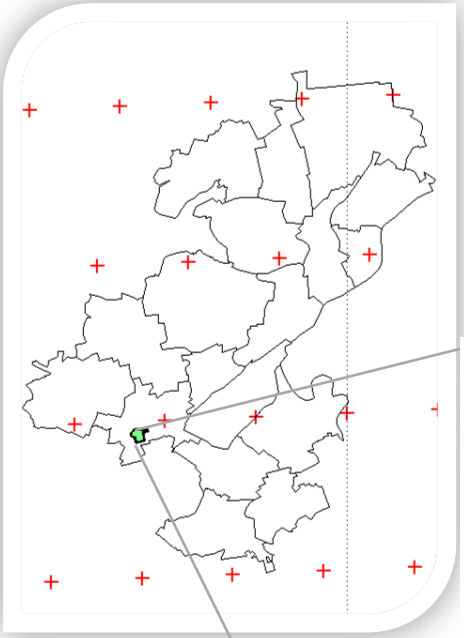
- more accurate at the point
- few locations only
- maintenance needed

Satellite

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

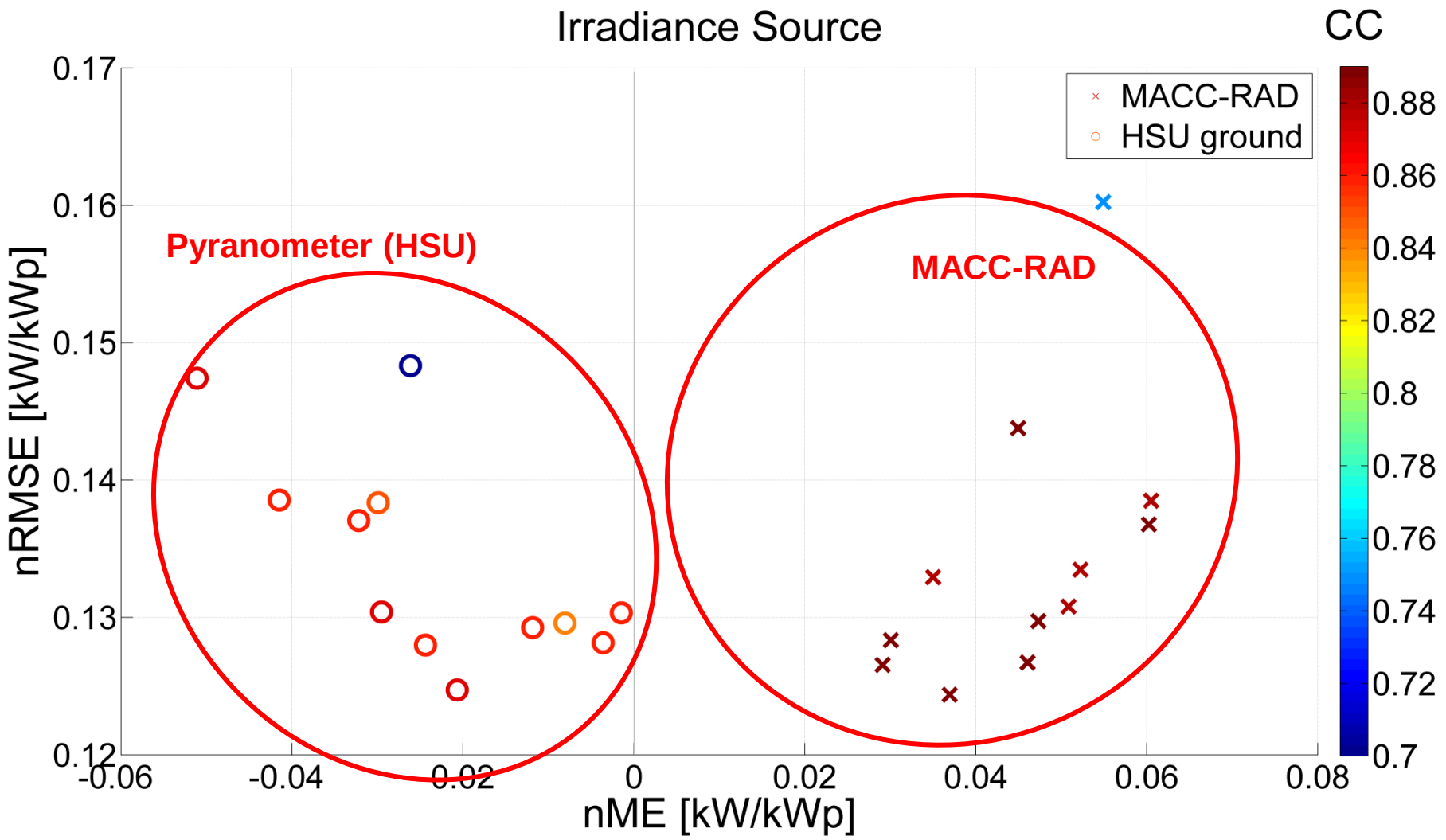


Test site Ulm Einsingen

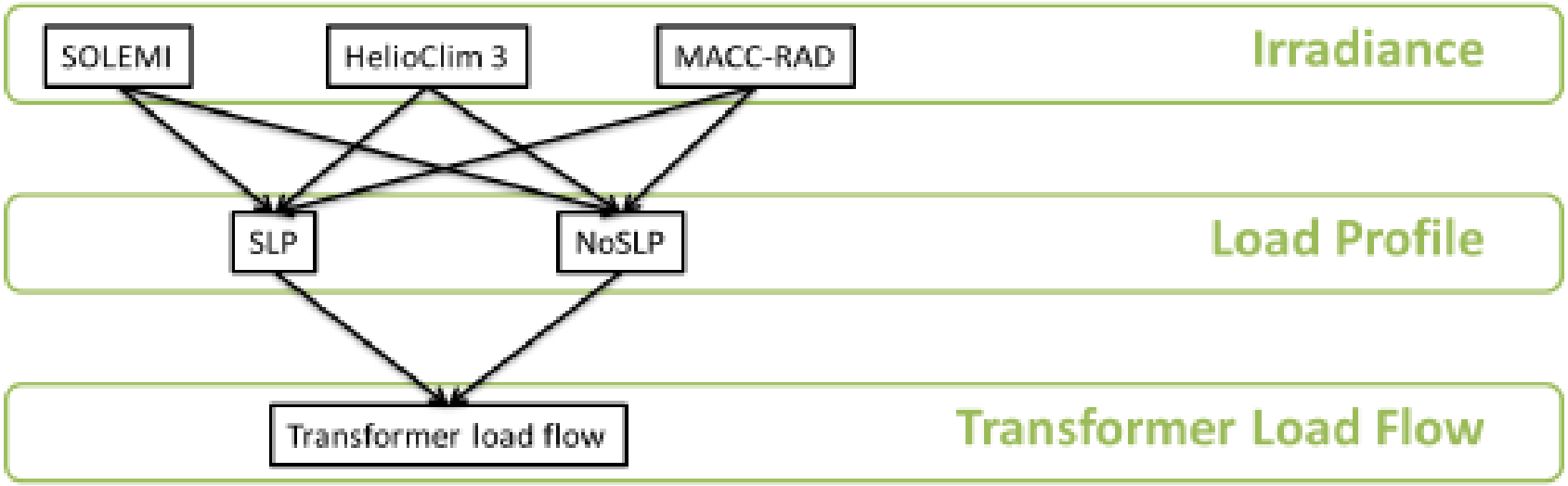


- 12 PV-Systems with smart meters (red marked)
- 15 minute resolution
- 6.7.2013 – 13.12.2014
- Comparison of individual systems and sum

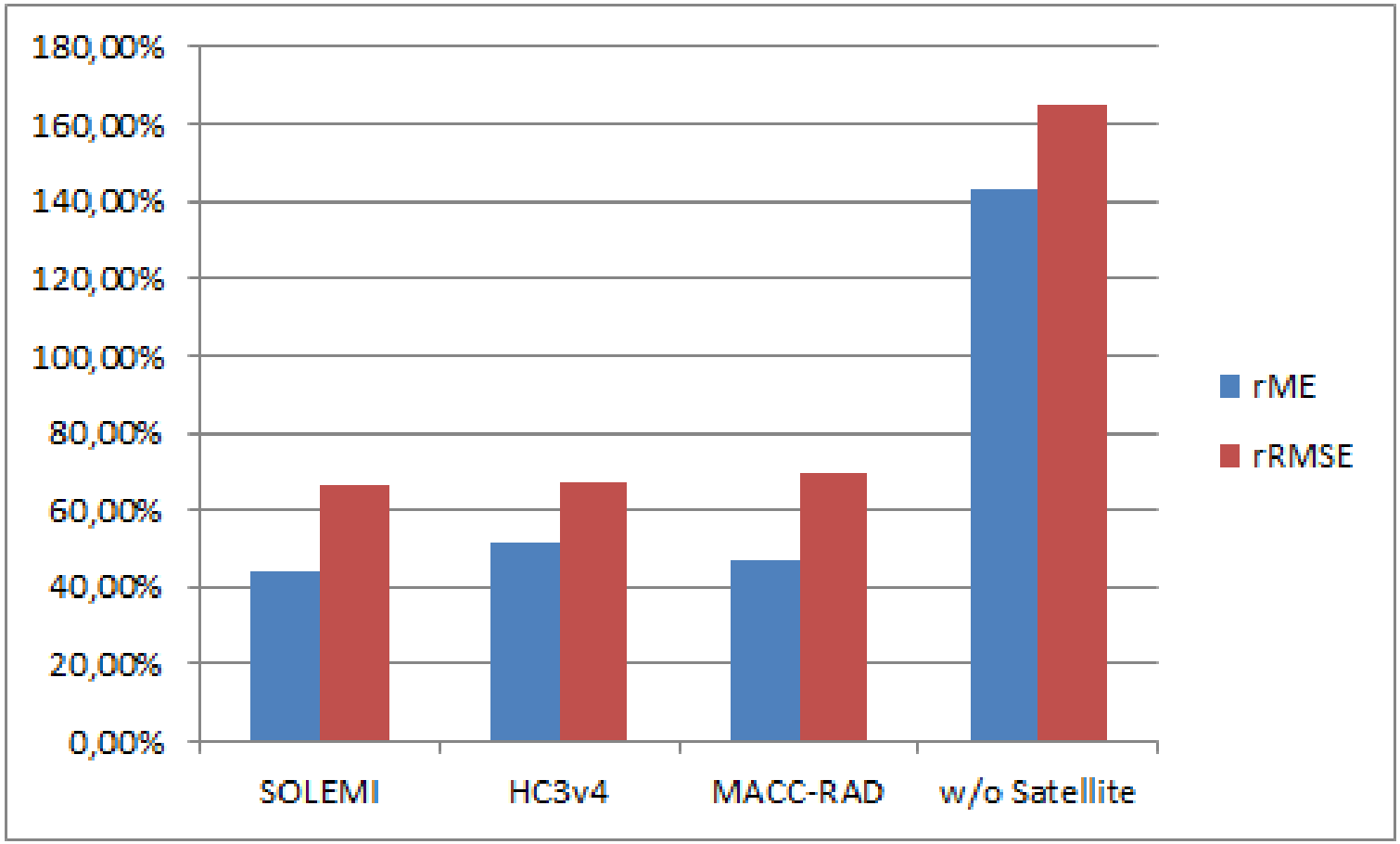
Feed-in power – Comparison vs smart meters



From feed-in power to load flow at the transformer



Load flow at transformer



Only values with sun elevation angles >0° 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

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