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A comparison of data sources for creating a long-term time series of daily gridded solar radiation for Europe

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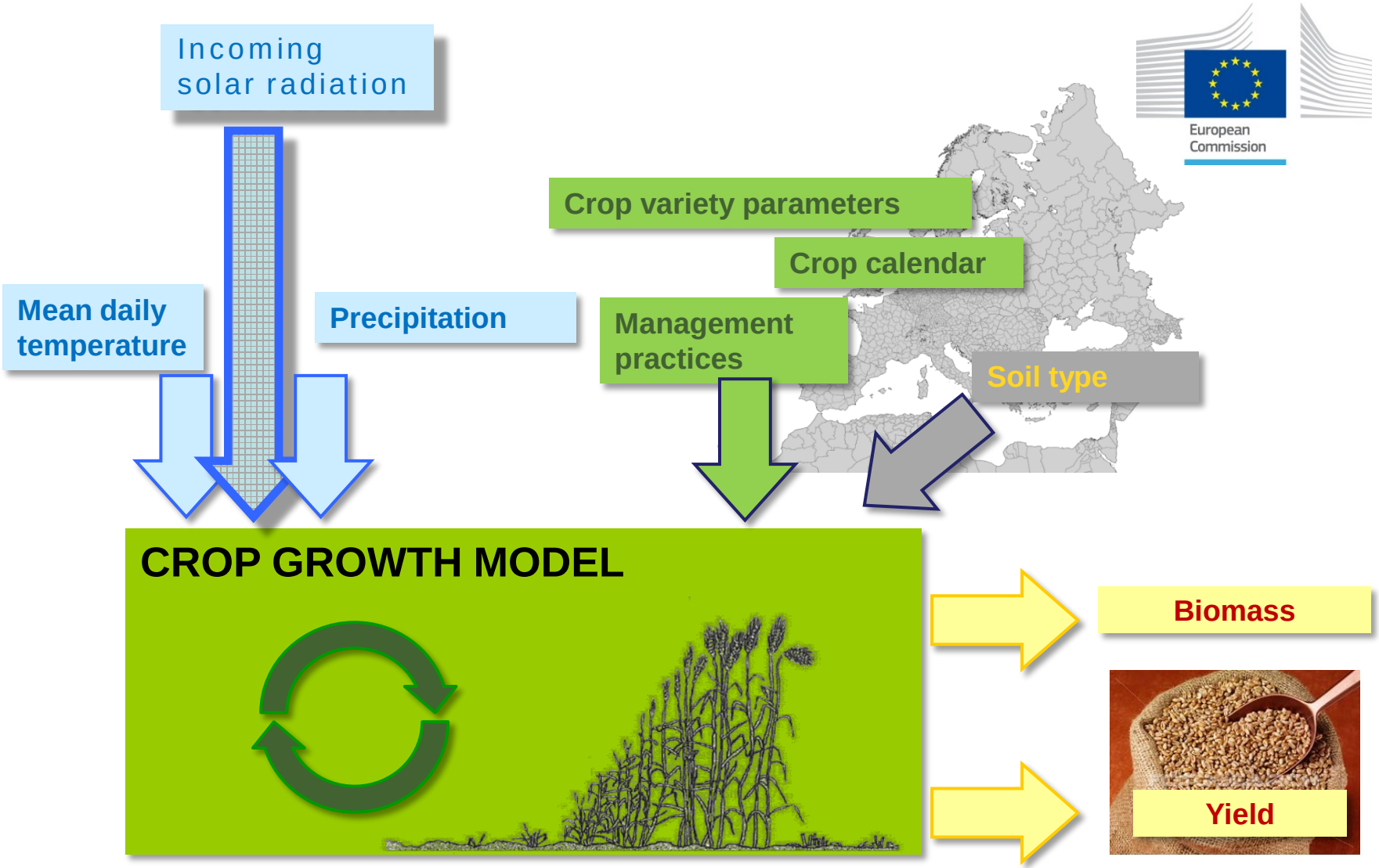
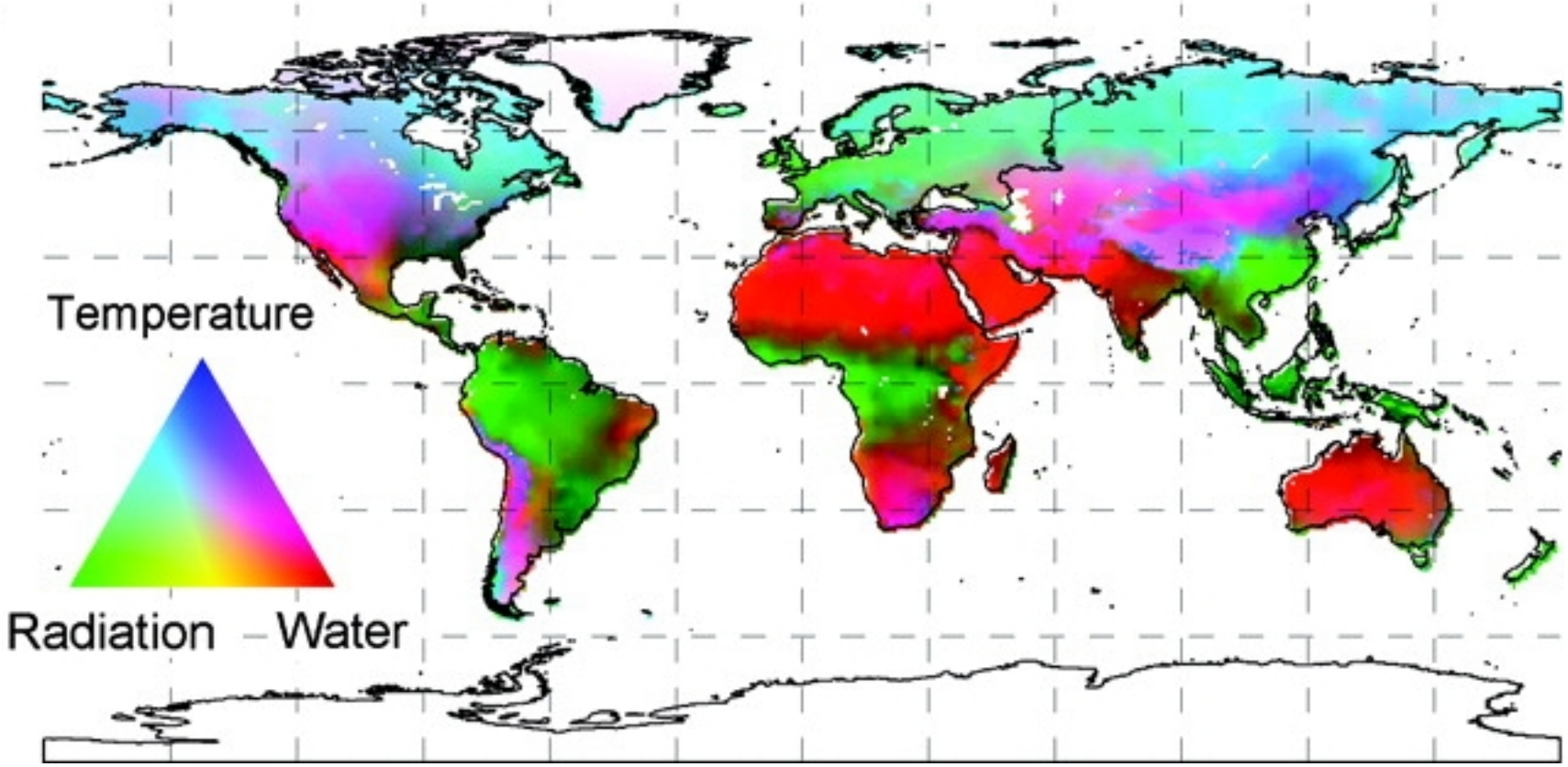
Crop monitoring and yield forecasting



What limits the plant growth?

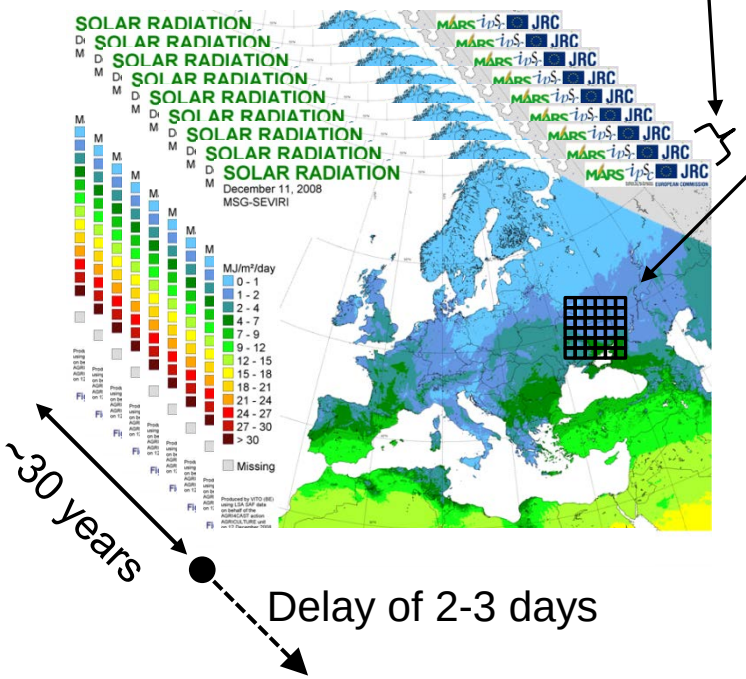


Climatic constraints to plant growth (from Nemani et al., *Nature* 2003)

Solar radiation determines the potential growth

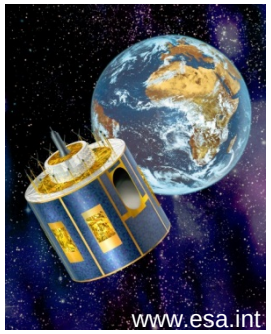
Objective

To provide an approach for accurate estimation of daily surface solar radiation



- covering Europe with ground resolution ≤ 25 km
- ~30 years of past spatio-temporal distibution
- in near real-time (delay of 2-3 days)
- consistent in spite of different data sources (not as rigorous as for a climatology)

Solar radiation data sources



Meteorological observations

Satellite

Reanalysis

Calibration improvement

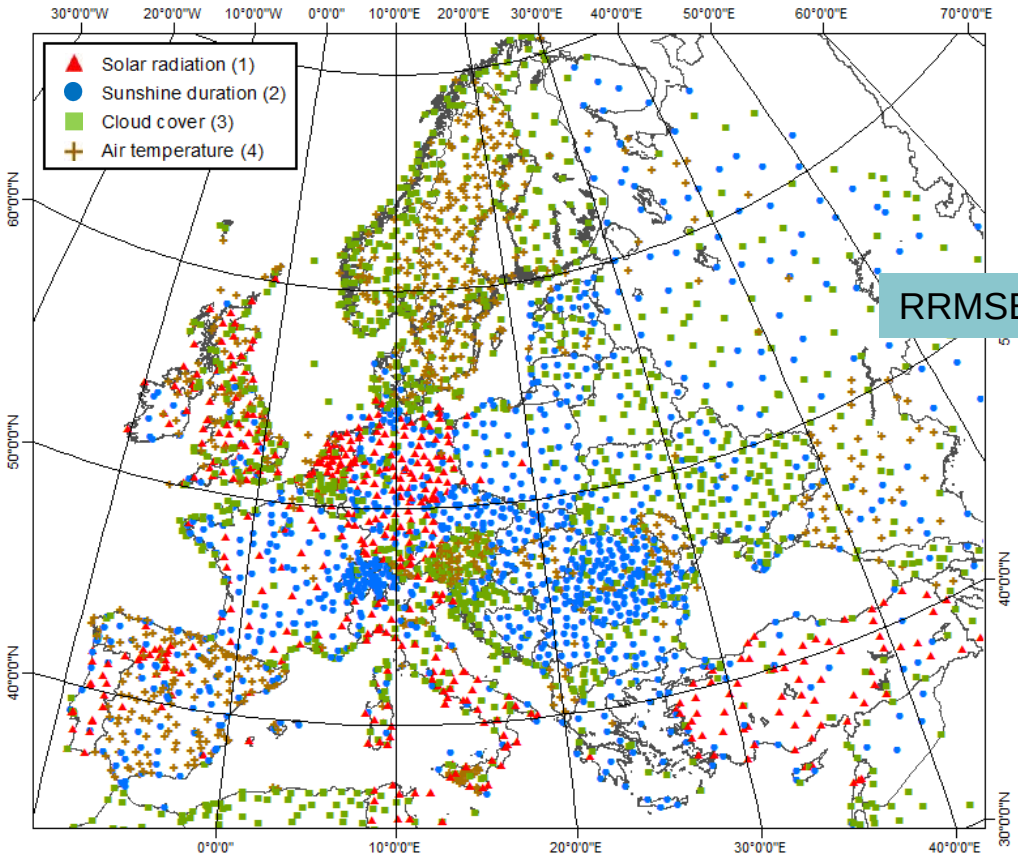
Measured and modelled solar radiation

LSA SAF MSG + CM SAF MFG

ERA-Interim

Intercomparison

Measuring & modelling solar radiation



▲ **Measured solar radiation**

Modelled from:

● sunshine duration (n)

RRMSE=15%

$$I_s = I_x\left(A_a + A_b\frac{n}{N}\right)$$

■ cloud cover (C_w) and air temperature difference (T_x-T_n)

20%

$$I_s = I_x\left[S_a\sqrt{T_x - T_n} + S_b\sqrt{1 - {C_w}/{8}}\right] + S_c$$

\+ air temperature difference

30%

$$I_s = I_x H_a\sqrt{T_x - T_n} + H_b$$

Replaced by Meteosat-derived coefficients

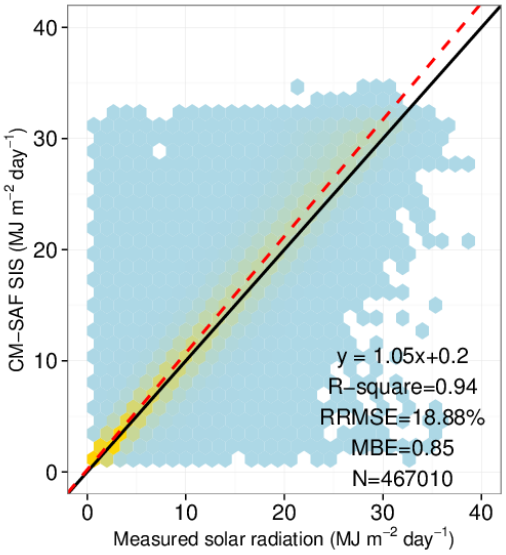
(Bojanowski et al., AgrForMet, 2013)

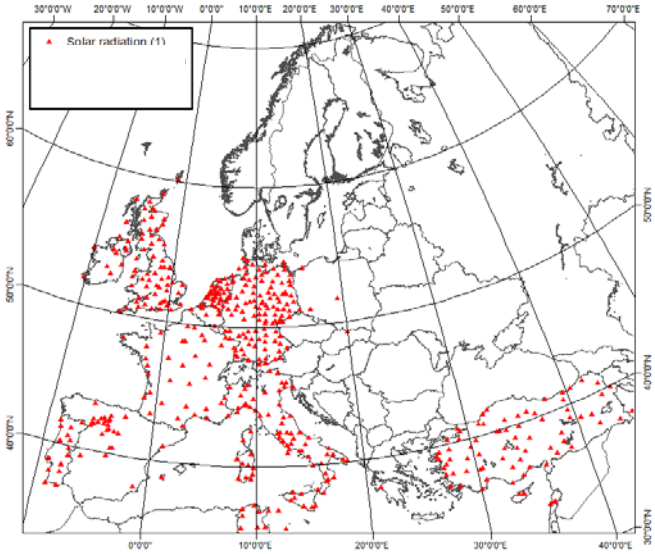
Coefficients typically determined for locations where the solar radiation is measured, and then interpolated

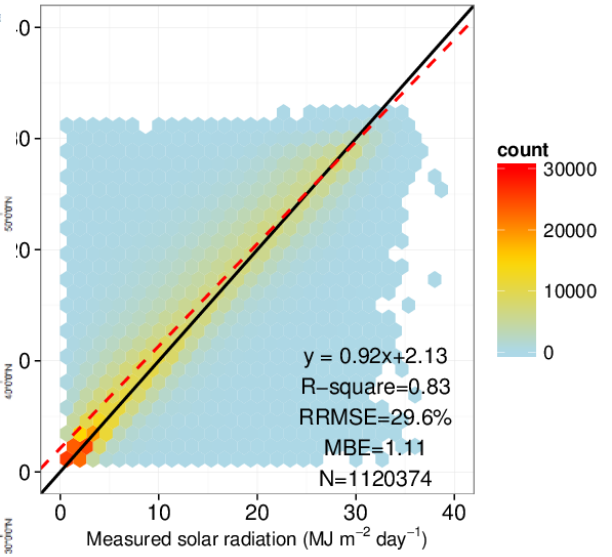
Data sources

	SIS	DSSF	ERA-Interim
Provider	Climate Monitoring SAF	Land Surface Analysis SAF	ECMWF
Satellite	Meteosat First Generation	Meteosat Second Generation	-
Sensor	MVIRI	SEVIRI	-
Time covered	1983-2005	2005-2011 /onwards	1983-2011
Status	dataset	operational, near real-time	dataset
Resolution	daily, 0.03 degree	daily, 5 km	daily (two 12h forecasts), 0.75 degree

Comparison with ground measurements



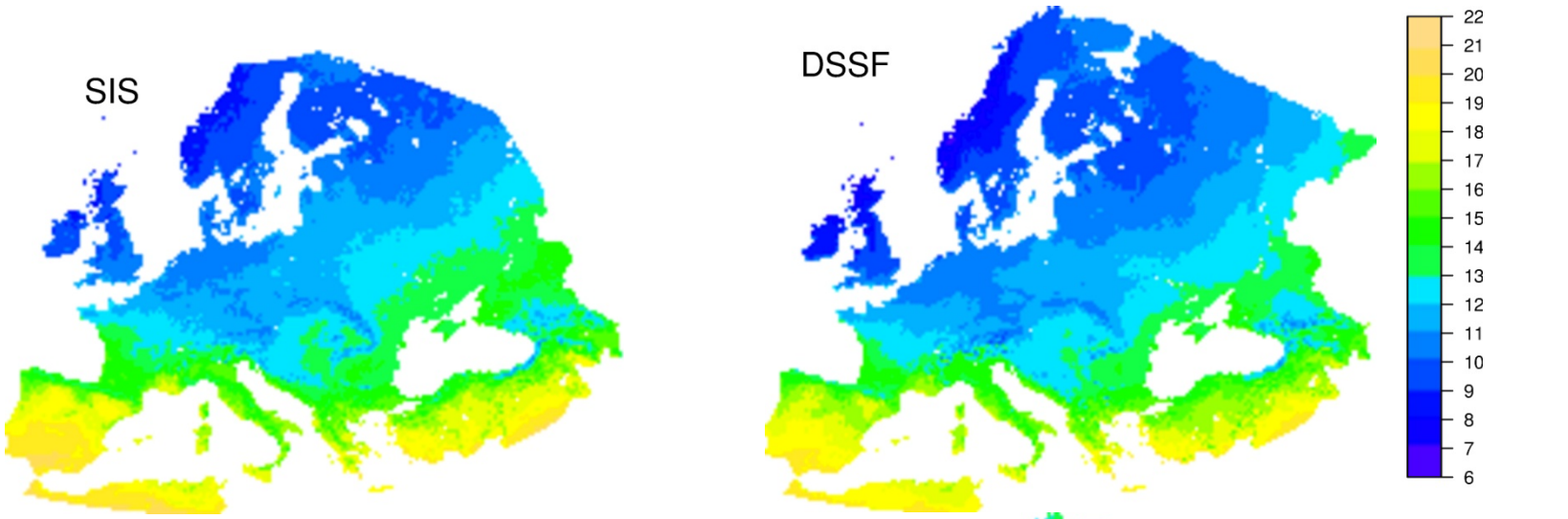




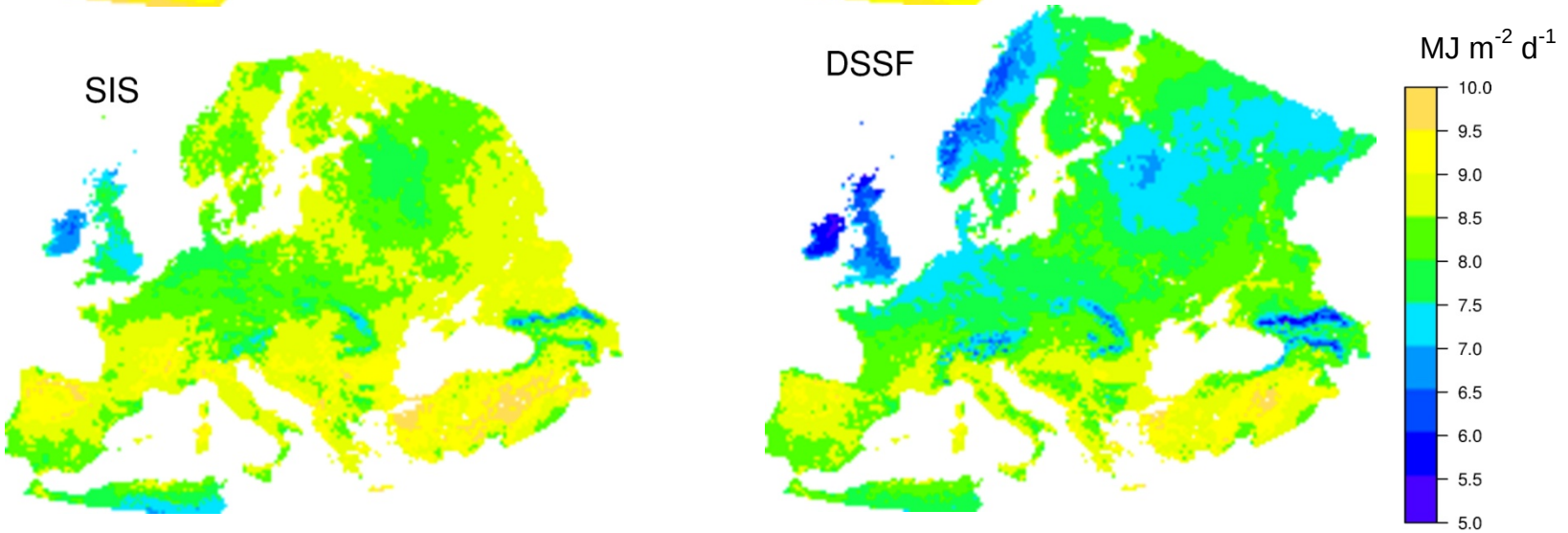
CM SAF SIS vs LSA SAF DSSF

2005 (227 overlapping days)

'Annual' average

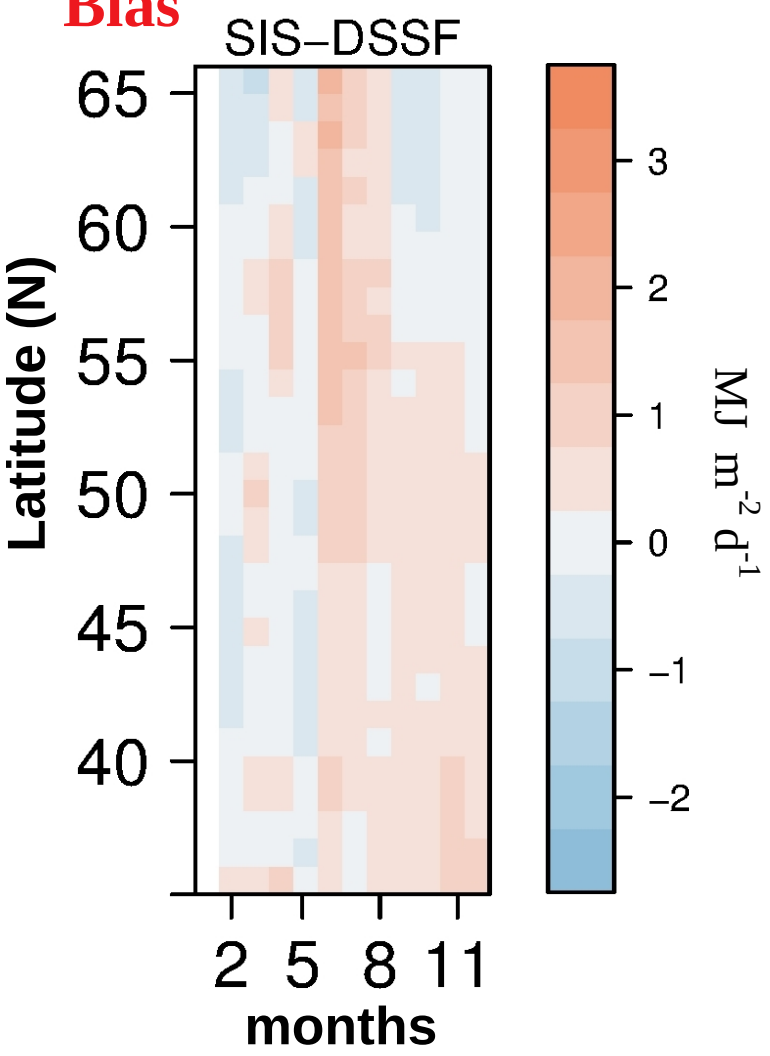


Standard deviation

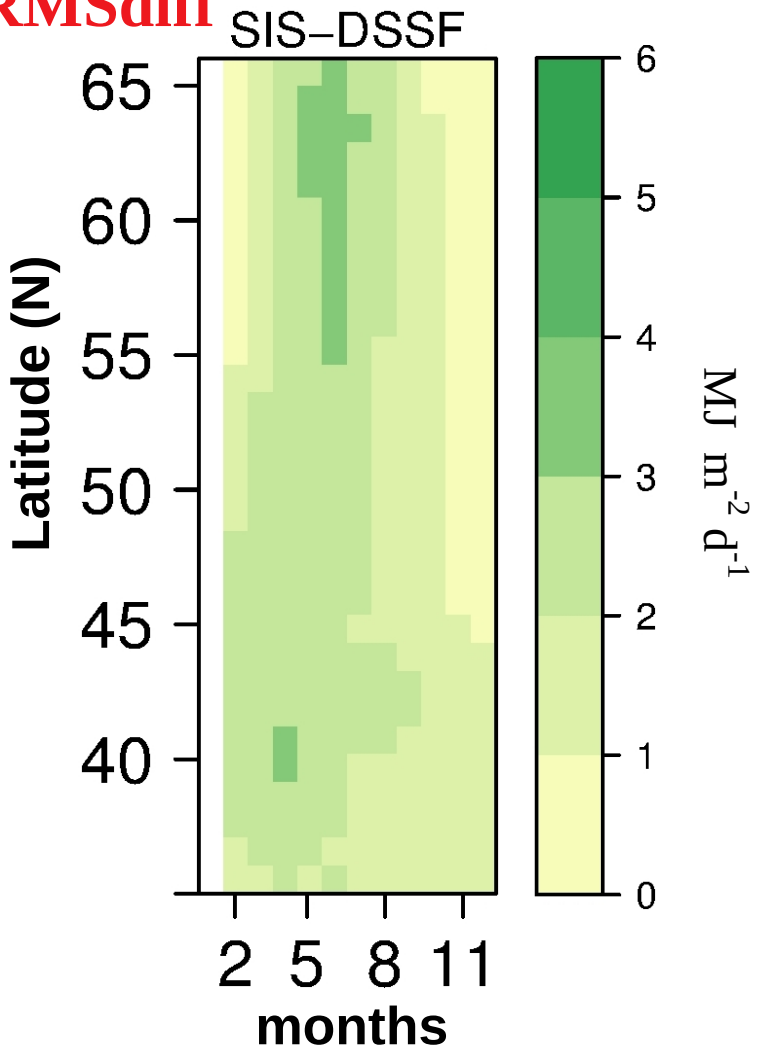


CM SAF SIS vs LSA SAF DSSF

Bias

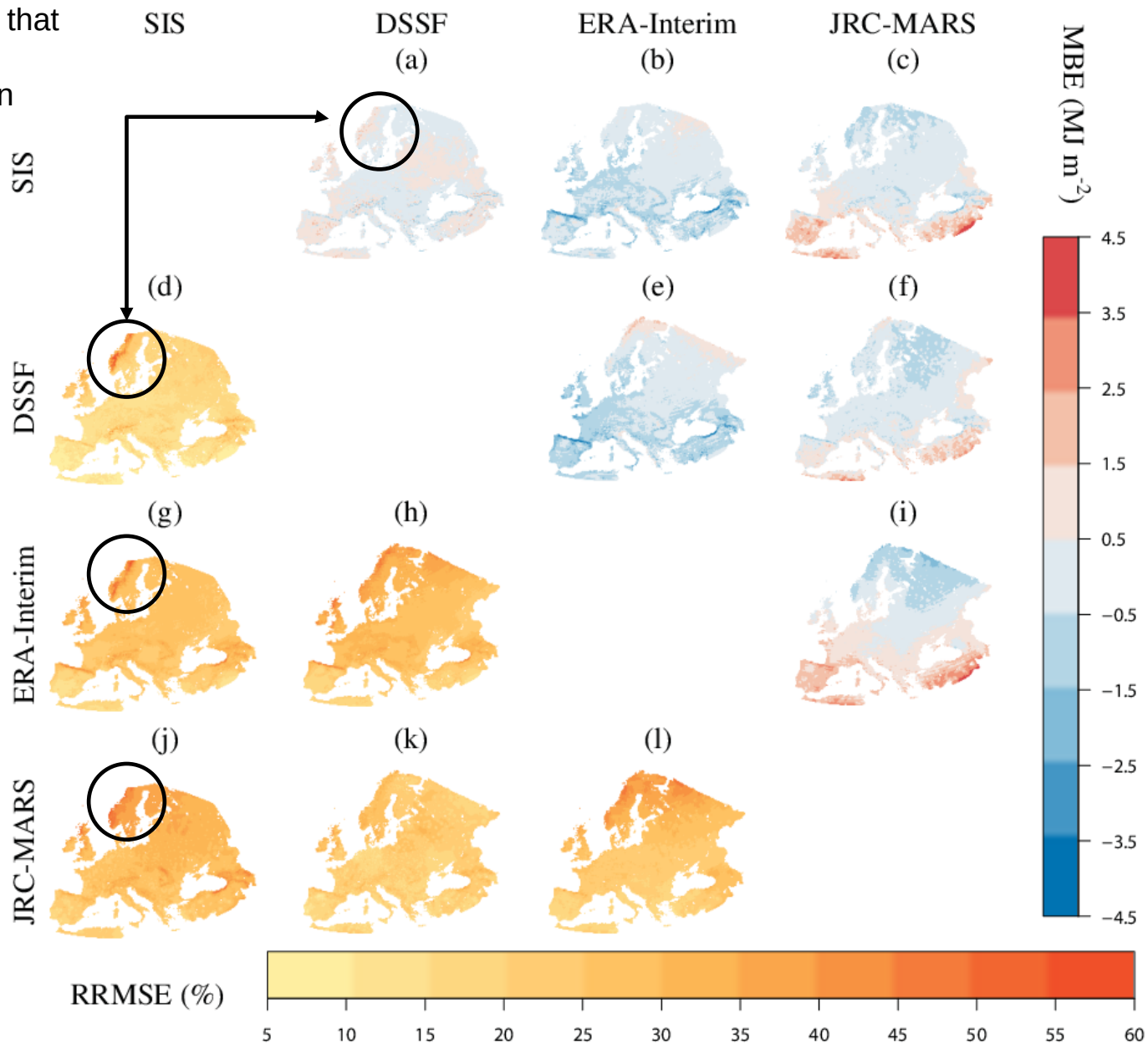


RMSdiff



Grid-based intercomparison

Positive mean bias indicates that the estimate represented by a row has a higher value than estimate represented by a column.



Bojanowski et al. 2014
Solar Energy

Creating a long-term dataset (not a climatology)

Meteosat First and Second Generation data can be merged to create the **solar radiation dataset** covering years 1983-onwards

Done by Rebekka Posselt et al. (RSE, 2014)

- the two narrowband visible channels of the MSG were combined to simulate the MFG broadband visible channel → then MagicSol (Heliosat) algorithm was applied

- How this dataset can be prolonged in near real-time? Should MSG and forthcoming MTG be used to simulate MFG to derive operational product?

Conclusions (user perspective)

- Satellite-derived solar radiation is more **accurate and consistent** than currently used *measured, modelled and interpolated* solar radiation used in the European crop model
- ERA-Interim can be used as a back-up solution for operationally working systems (such as crop monitoring)
- MFG and MSG solar radiation data are similar enough to create a dataset whose accuracy would satisfy a crop modellers community
- Is there a possibility to fill the gap between long-term data record and near real-time product?

Thank you for your attention!