

Satellite Application Facility on Climate Monitoring

CM SAF



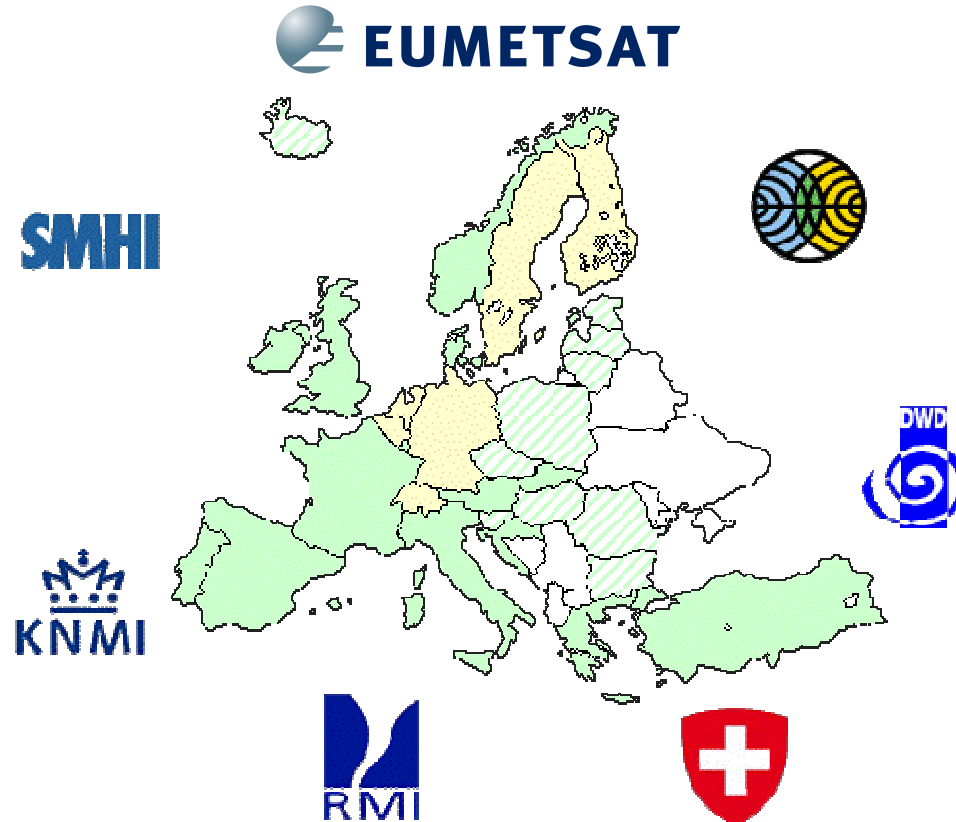
Christine Träger-Chatterjee



Jörg Trentmann

- The CM SAF
- Why Climate Monitoring?
- Requirements to Climate Data
- CM SAF Data
 - Overview
 - Data sets
 - Express products
 - Services
- Summary

Consortium



Task

Generate, archive,
and distribute climate
data records based on
satellite observations

www.cmsaf.eu

Why Climate Monitoring ?

Climate affects our every day life in various ways:



Climate

Weather



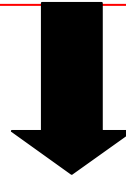
Status of the atmosphere at a certain point in time and space



Mean status of the atmosphere over a reasonably long period of time

Climate

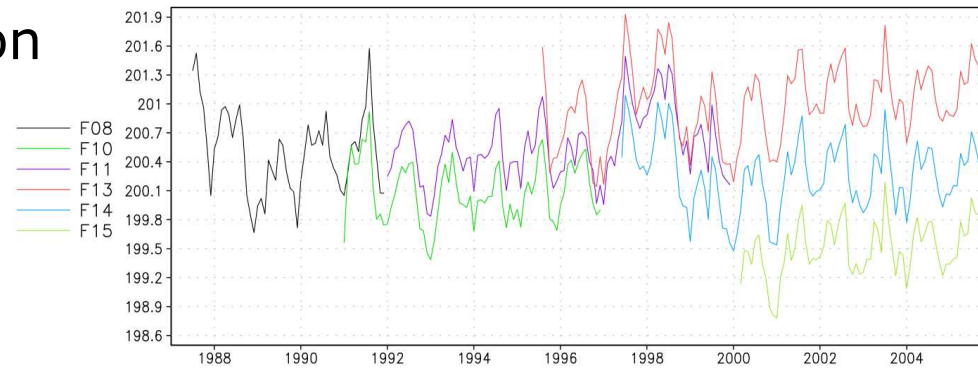
Mean status of the atmosphere over a reasonably long period of time, long enough to determine statistical properties



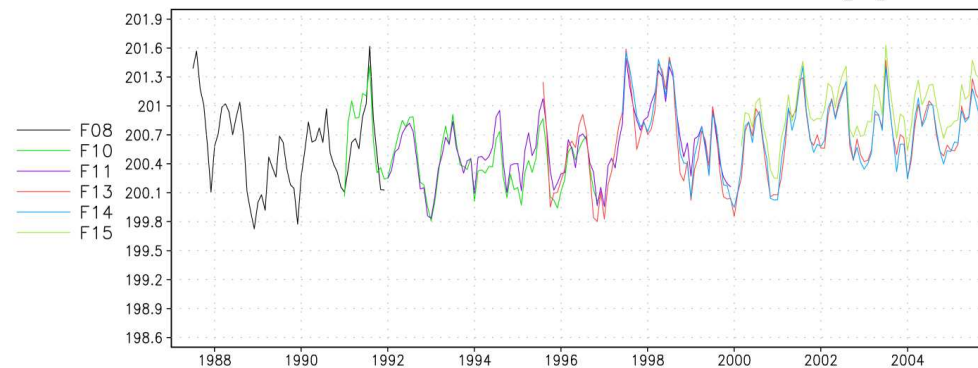
- Sufficiently long time series
- Homogeneous and Calibrated
- Representative
- Quality-controlled

Example for Intercalibration

HOAPS-3 TV19 without intercalibration [K]

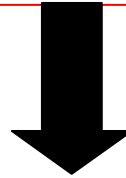


HOAPS-3 TV19 with intercalibration [K]



Climate

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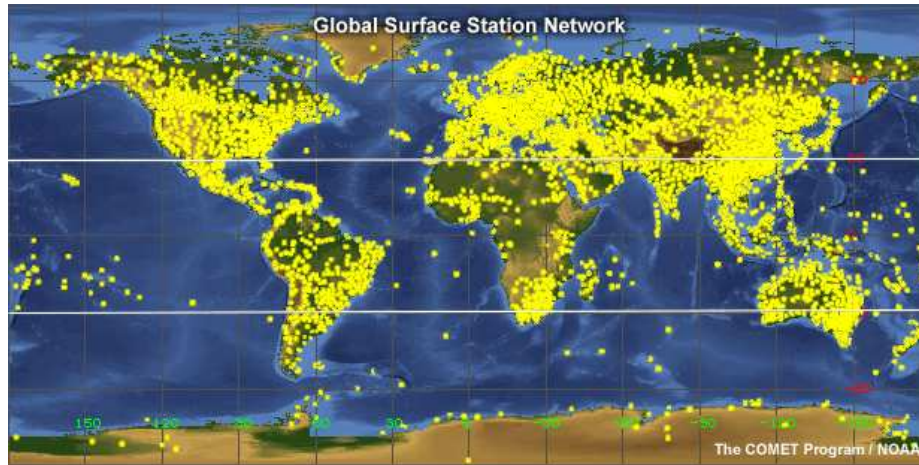


- Sufficiently long time series
- Homogeneous and Calibrated
- Representative
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Climate Monitoring from the Earths Surface

- patchy spatial coverage
- almost all measurement
only over land

Climate Monitoring from Space (Satellites)

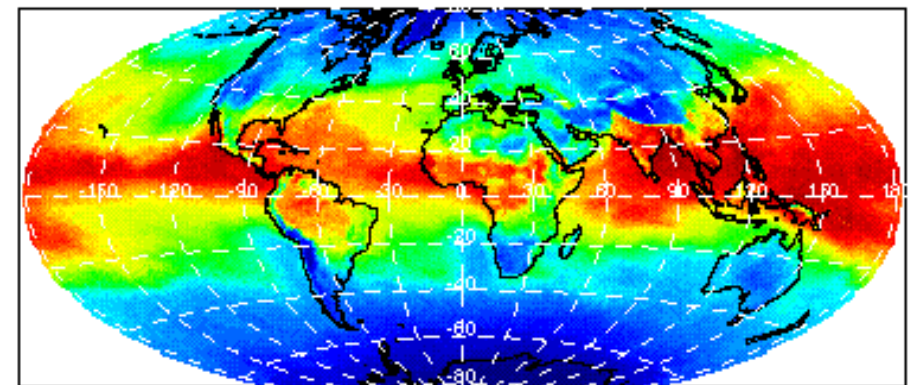
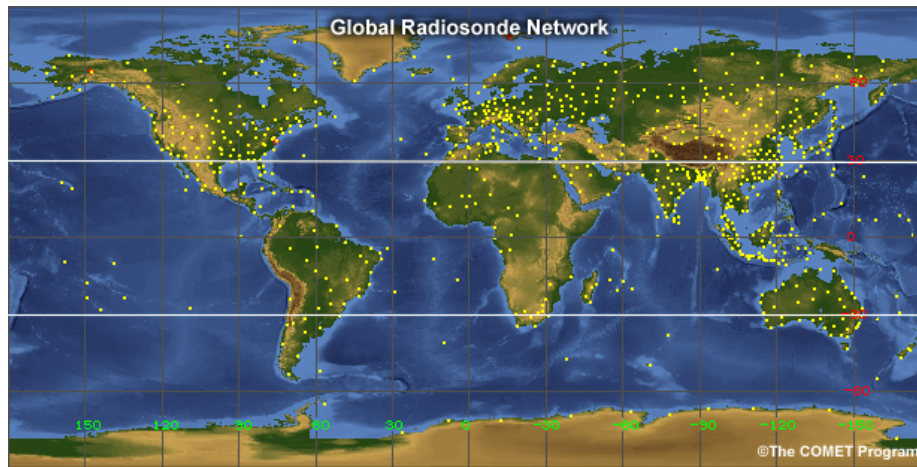


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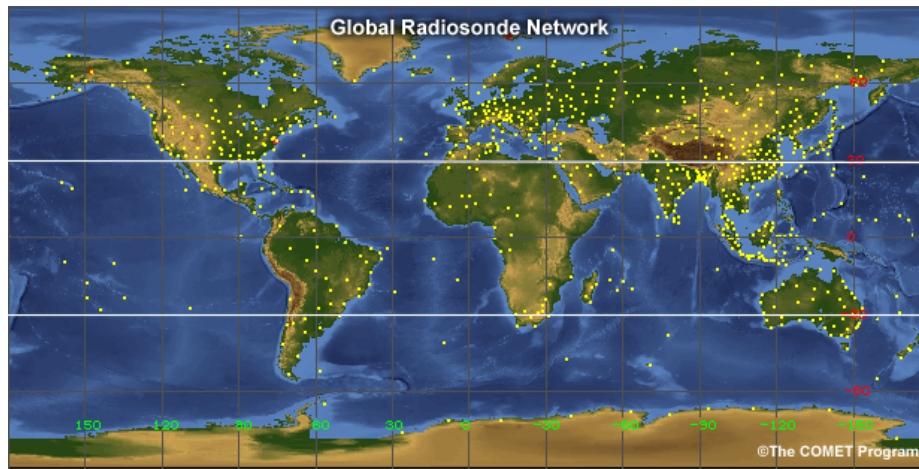
Climate Monitoring from Space (Satellites)

- global coverage / whole disk of geost. satellites



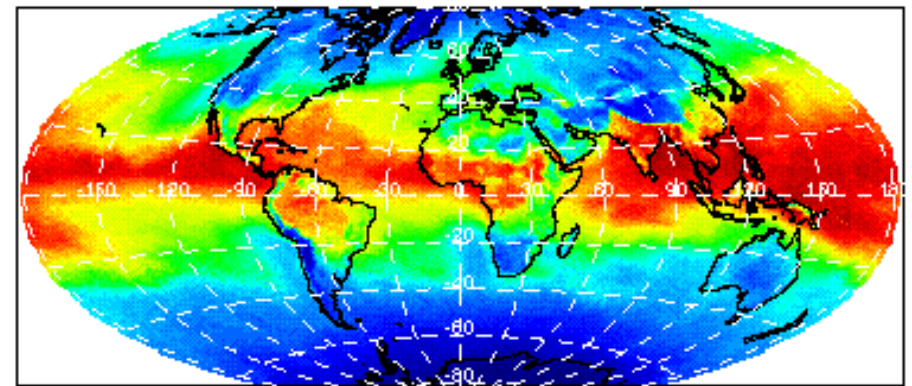
Climate Monitoring from the Earths Surface

- patchy spatial coverage
- almost all measurement only over land
- high accuracy
- validation and calibration of sat-data



Climate Monitoring from Space (Satellites)

- global coverage / whole disk of geost. satellites
- e.g. cloud-microphysics, radiation-budget at ToA, upper atmosphere temperature and humidity

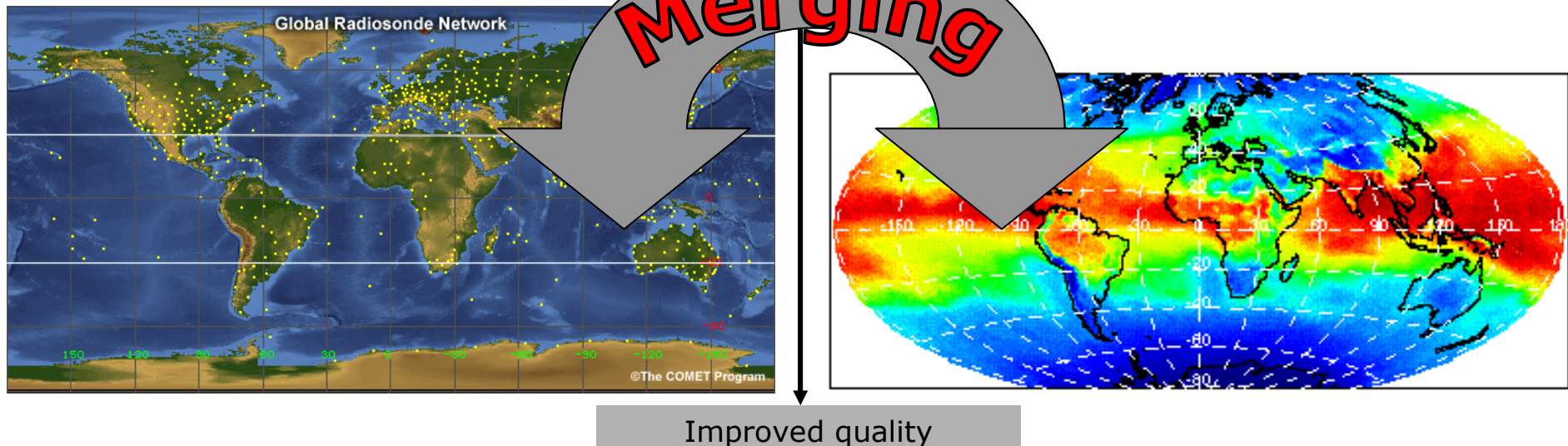


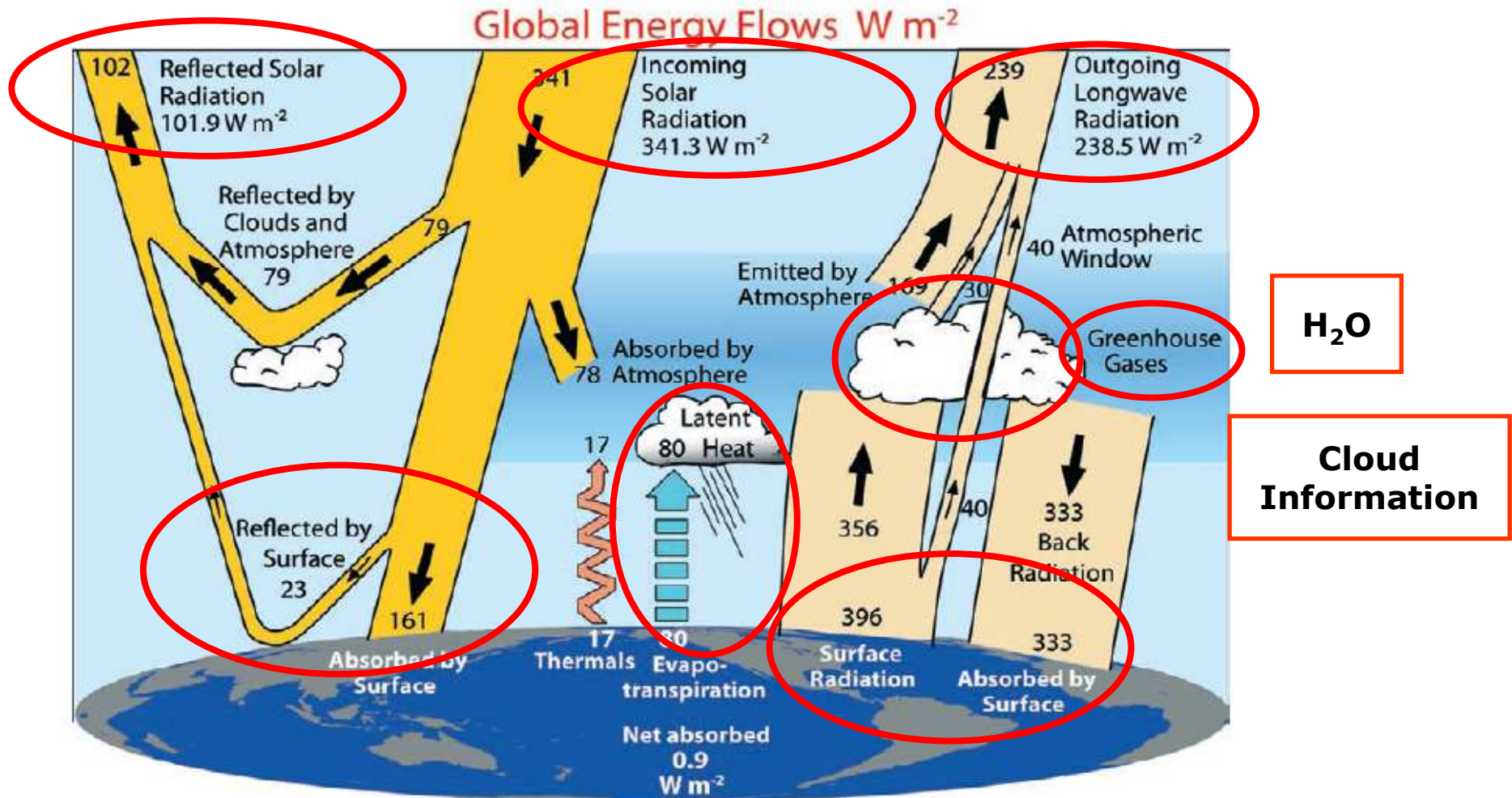
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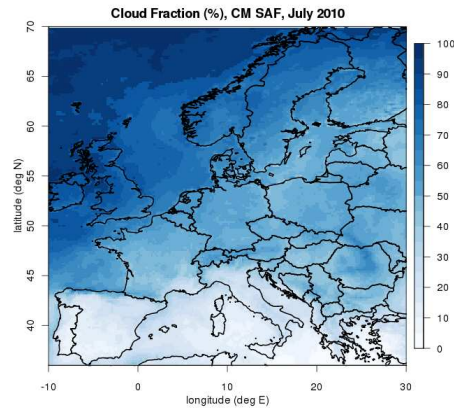
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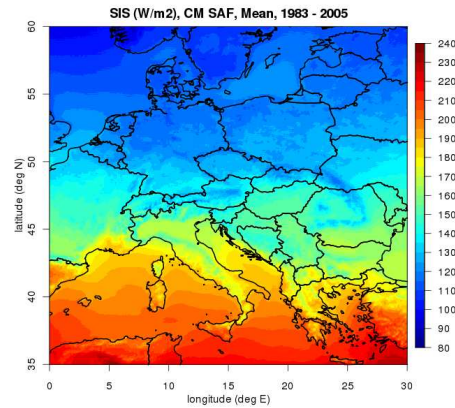


Trenberth et al., BAMS, 2009

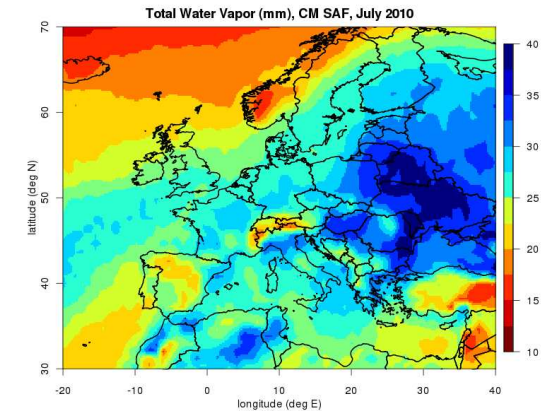
Clouds



Radiation



Water Vapor



- **data access** via Web User Interface:
wui.cmsaf.eu
- all data is available at no costs in netcdf format

(Express) Products

Data Sets

(Express) Products

- Operationally generated on a monthly basis
- First-order satellite calibration is considered
- Algorithm and input data not homogeneous over time
- Resulting time series **not applicable** for all climate monitoring purposes, e.g., trend estimation

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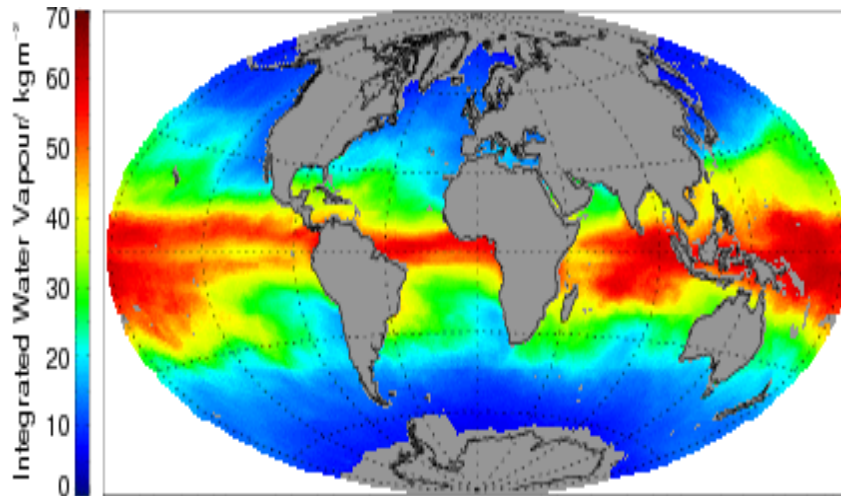
Data Sets

- Generated on an unregular basis, e.g. every two years
- Calibrated and homogenized satellite data are applied
- Algorithm and auxiliary input data are homogeneous over time
- Resulting time series should be **fully applicable** for climate monitoring purposes, including the estimation of trends, anomalies etc.

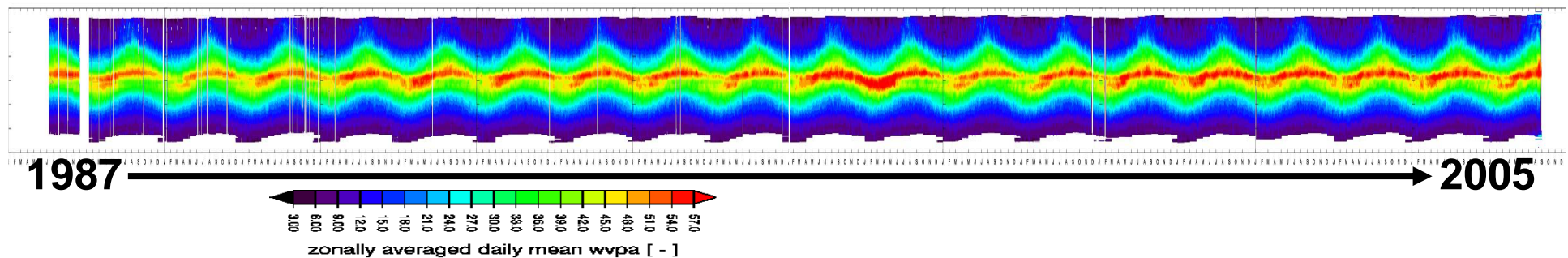
Available Climate Data Sets:

- HOAPS (Hamburg Ocean Atmosphere Parameter and Fluxes from Satellite Data)
 - over ocean, 0.5 deg, monthly means, 6-hour composites
 - 1987 – 2005: integrated water vapor
 - 1987 – 2009: near surface humidity, near surface wind speed, latent heat flux, precipitation, evaporation, freshwater flux
- Radiation
 - METEOSAT full disk, 0.5 deg, hourly-, daily-, monthly means, 1983 - 2005
 - near surface solar irradiation, direct solar irradiance, cloud albedo

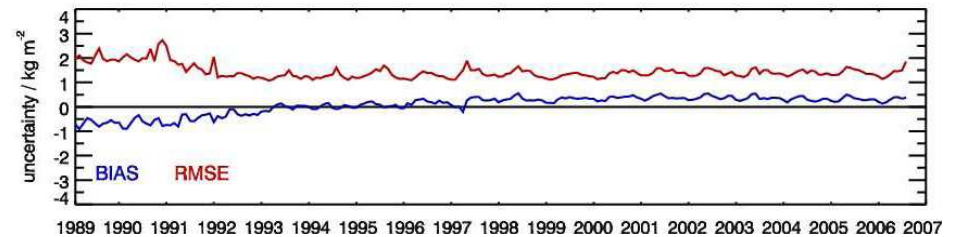
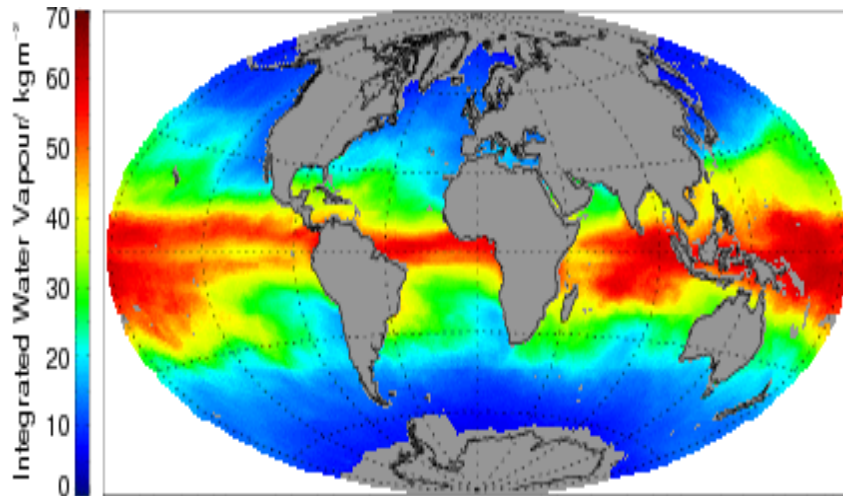
integrated water vapor over ocean



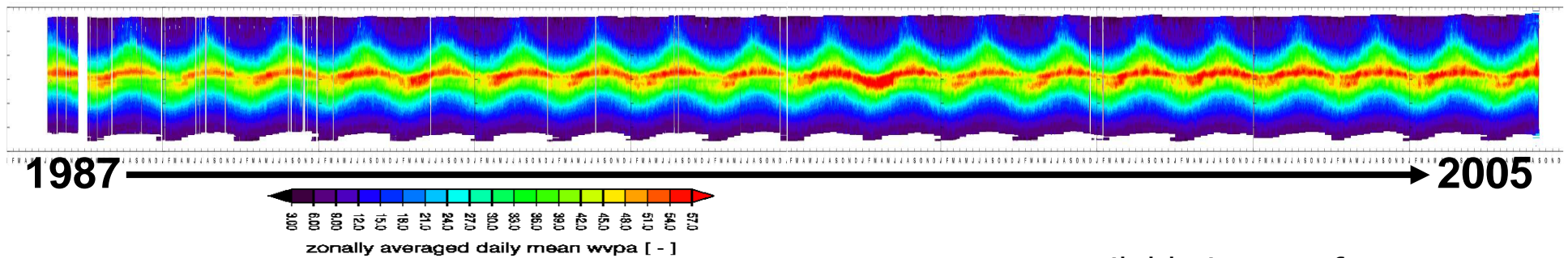
- Monthly means,
6-hour composites
- 1987 – 2005
- spatial resolution:
0.5 deg
- Available



integrated water vapor over ocean



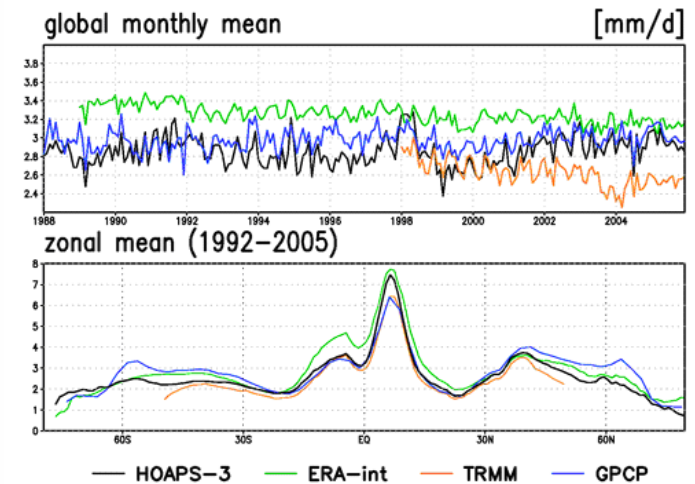
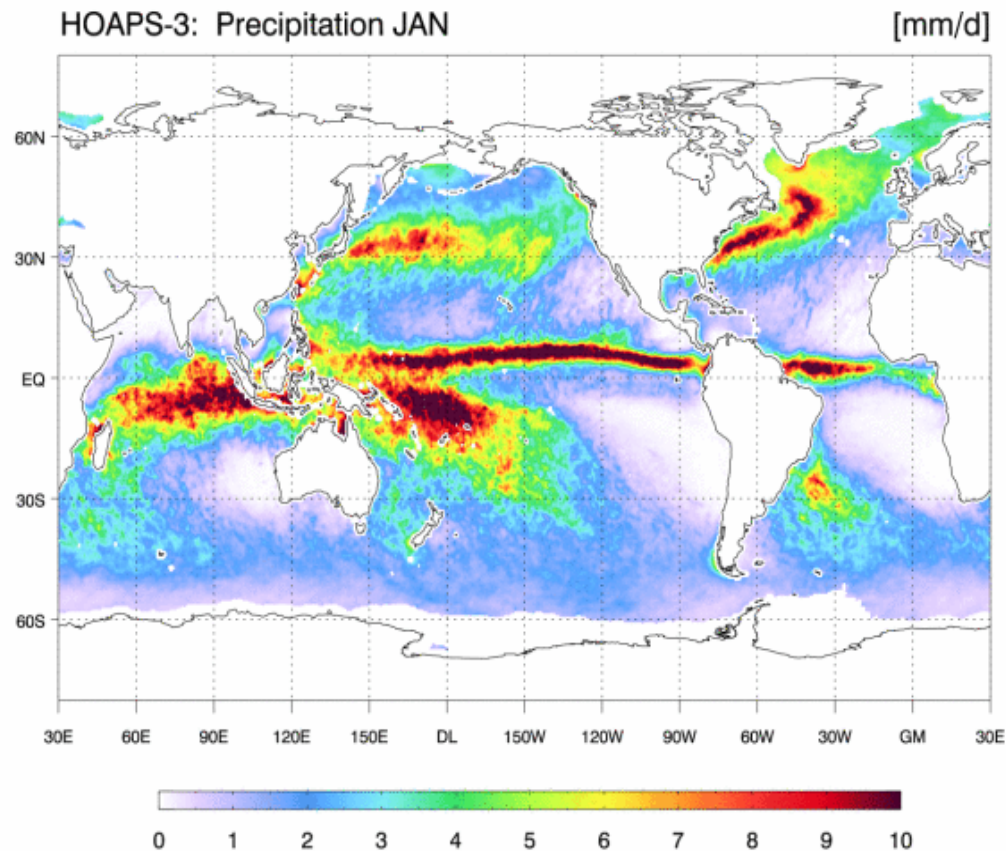
Global mean bias and RMSE for CM SAF vs ERA INTERIM re-analysis. Values in kg/m^2 , based on monthly means.



available in near future

Precipitation over Ocean

- Monthly means
- 1987 – 2008
- spatial resolution:
0.5 deg
- Available: June 2011

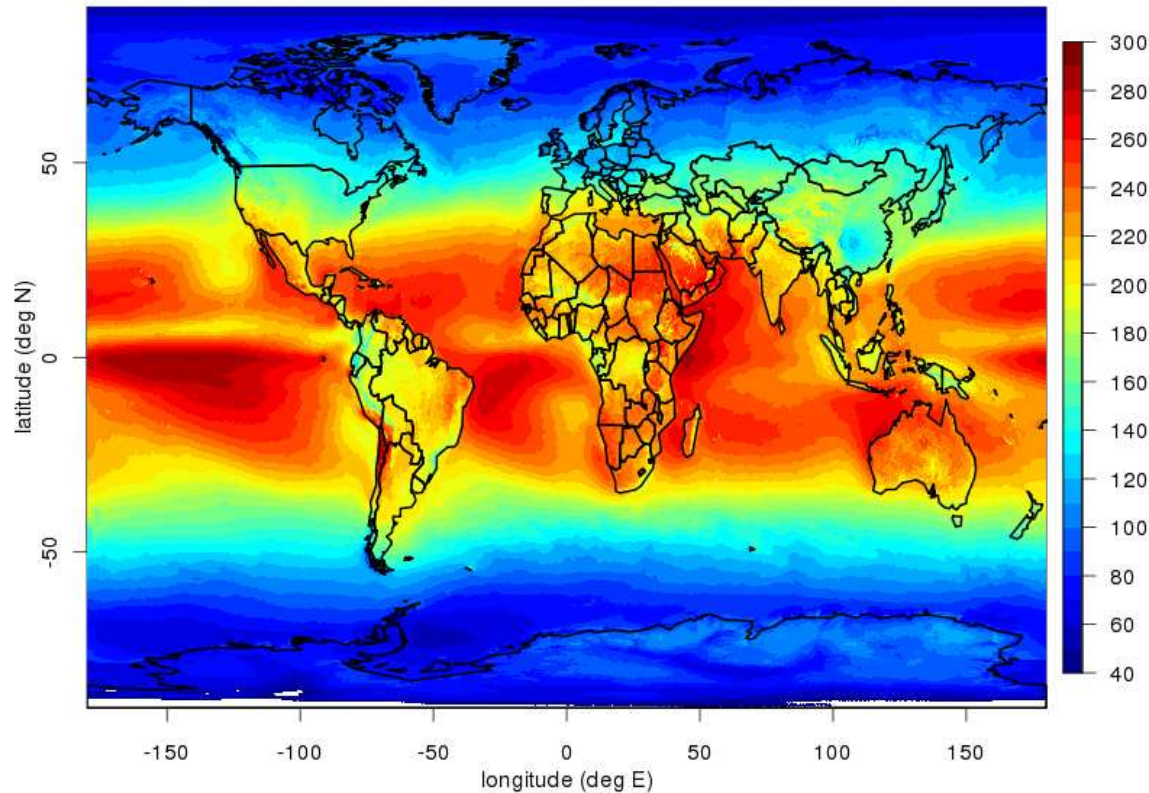


Thanks to:
www.hoaps.org
A. Andersson, S. Bakan,
K. Fennig, H. Graßl, C. Klepp



Global data set of solar irradiation

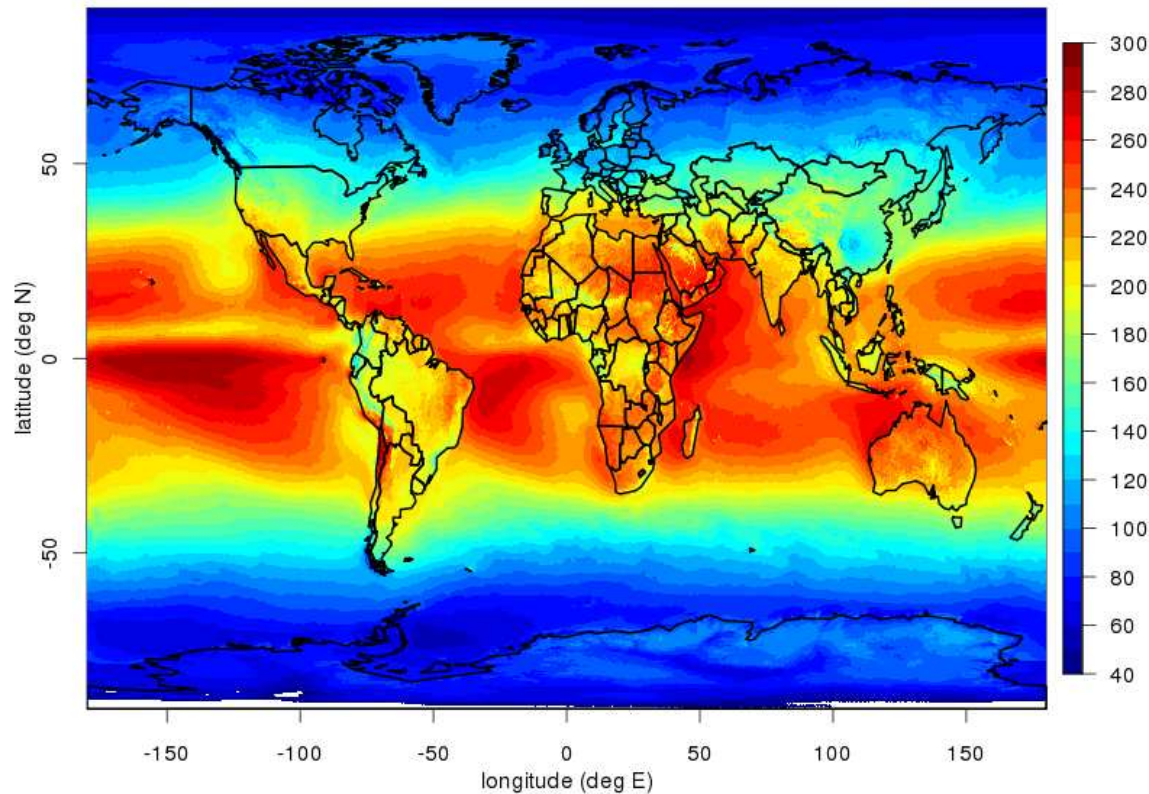
SIS (W/m²), CM SAF, GAC, Mean, 2005 - 2009



- Daily means,
Monthly means
- 1989 - 2008
- spatial resolution:
0.25 deg
- Available: spring
2012

Global data set of solar irradiation

SIS (W/m²), CM SAF, GAC, Mean, 2005 - 2009



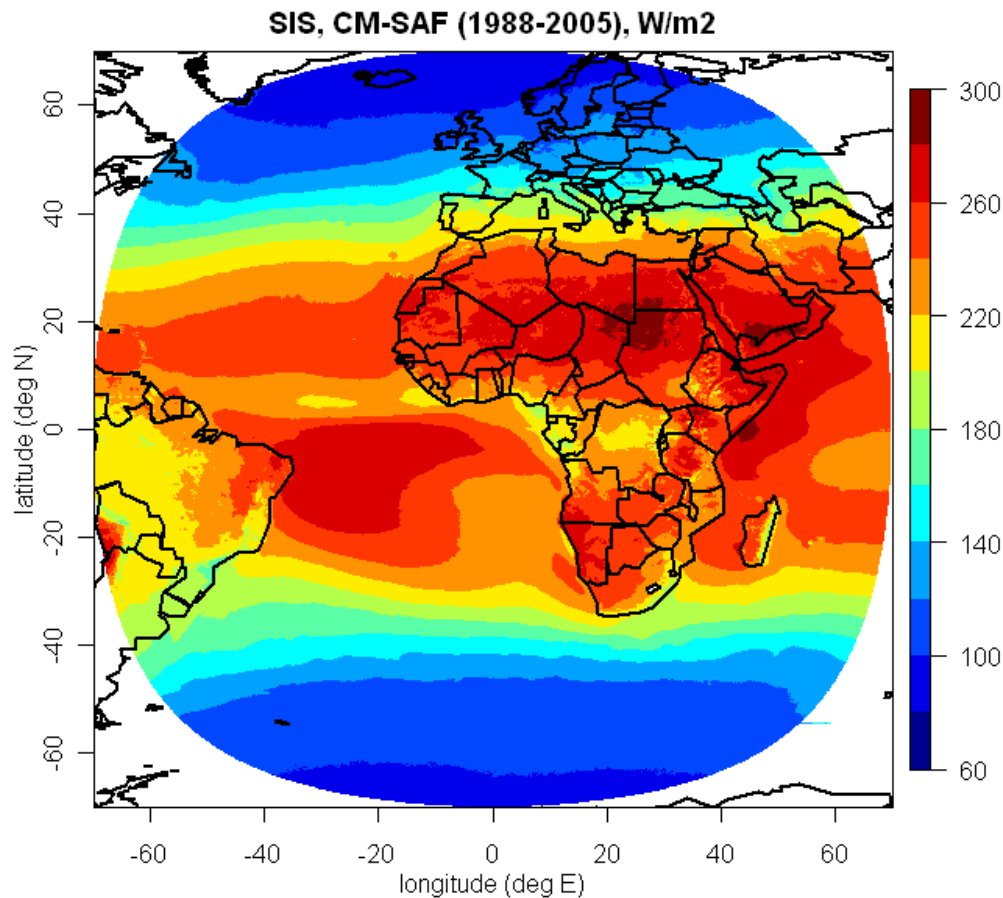
- Daily means,
Monthly means
- 1989 - 2008
- spatial resolution:
0.25 deg
- Available: spring
2012

From which type of satellite could this data set be retrieved?

Geostationary satellite

Polar orbiting satellite

Near surface solar irradiation on METEOSAT full disc

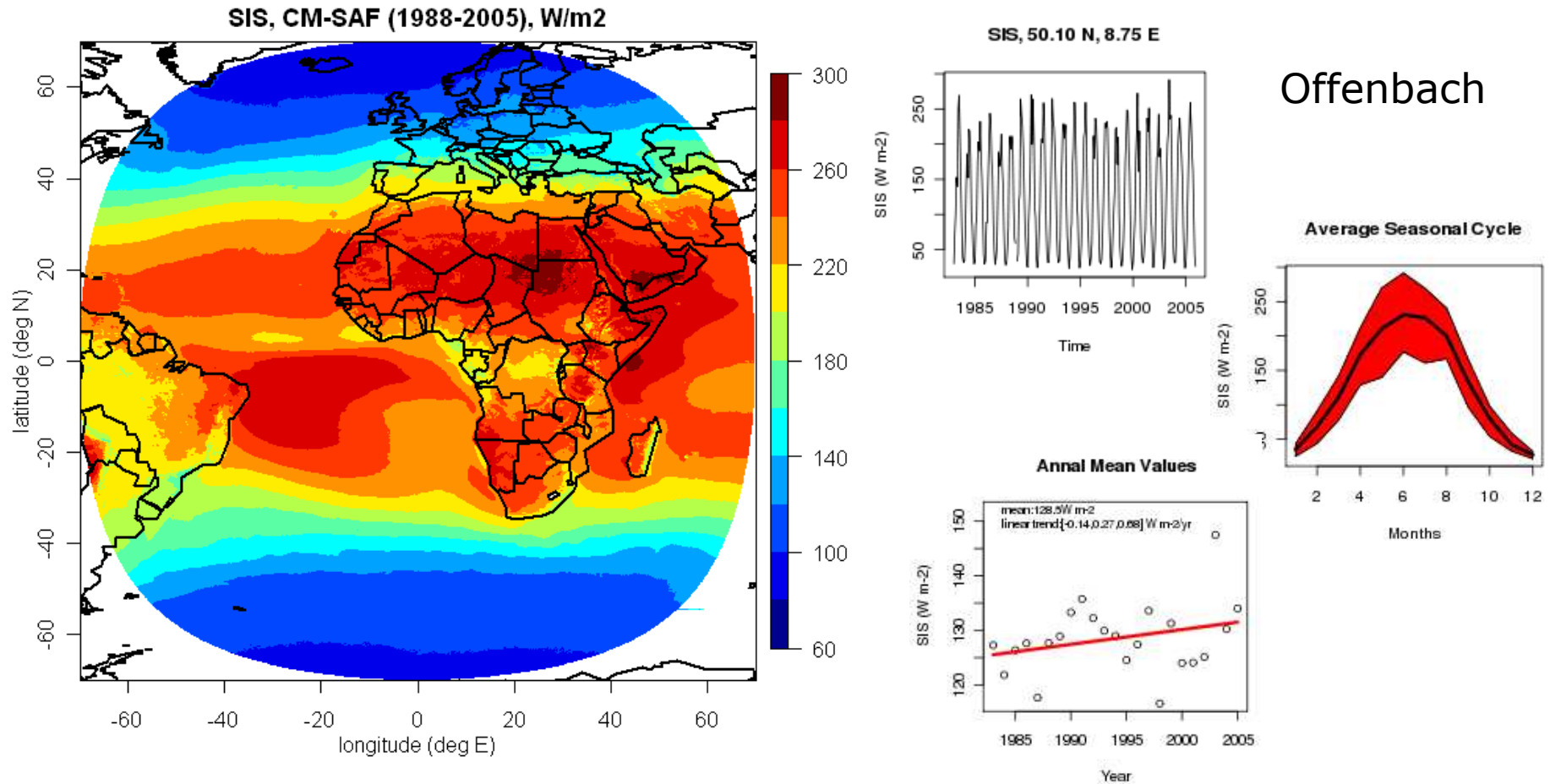


- Hourly means,
daily means,
monthly means
- 1983 -2005
- spatial resolution:
0.03 deg
- Available

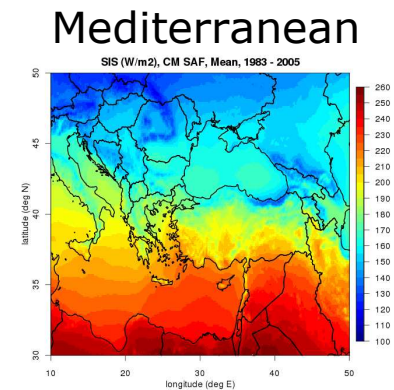
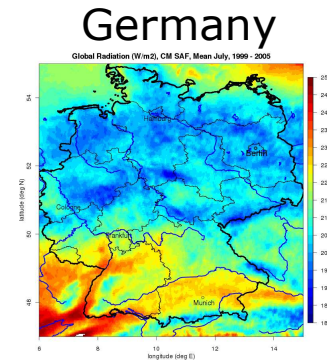
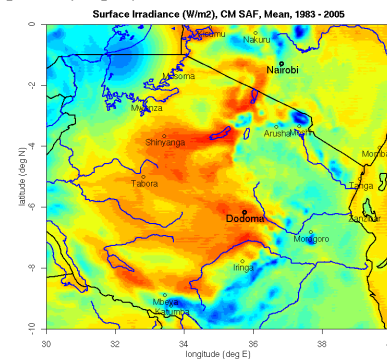
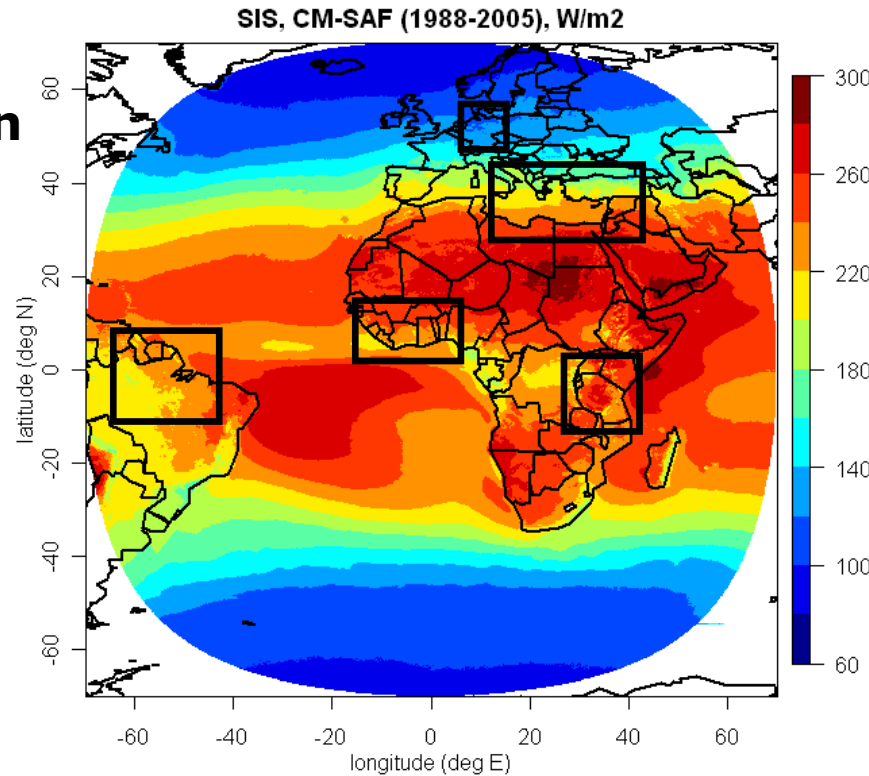
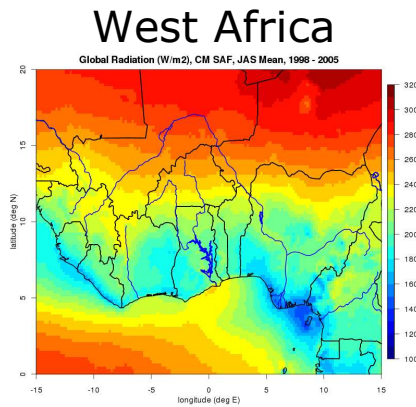
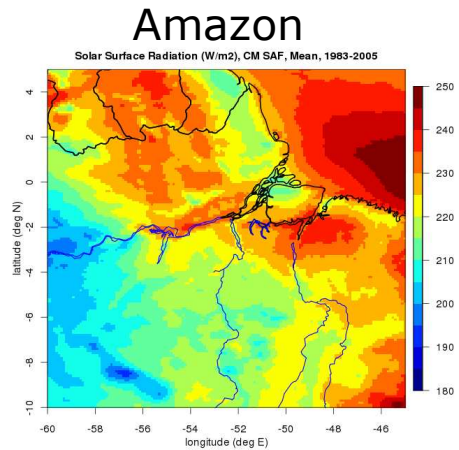
Differences to surface observations
< 10 W/m²

| SIS | N _{mon} | Bias [W/m ²] | MAD [W/m ²] | SD [W/m ²] |
|--------|------------------|-----------------------------|----------------------------|---------------------------|
| CM SAF | 878 | 4.24 | 7.76 | 8.23 |

Near surface solar irradiation on METEOSAT full disc



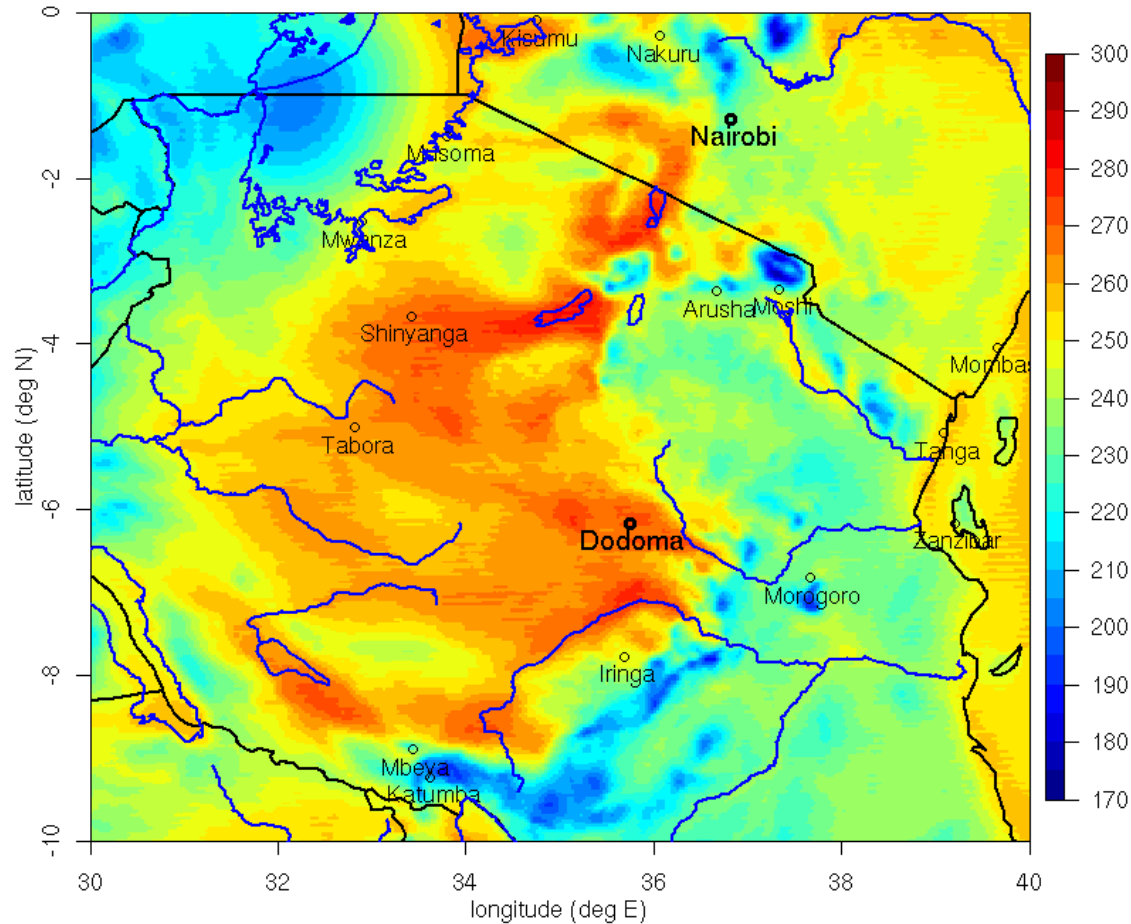
Close-up Views Solar Irradiation



Tanzania

Mean Surface Radiation, Tanzania

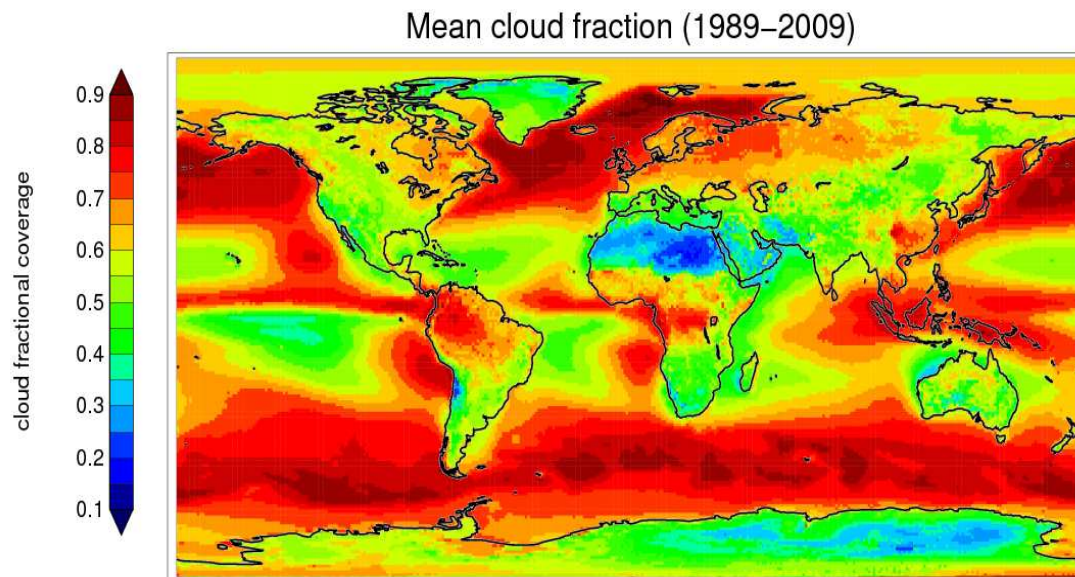
Surface Irradiance (W/m²), CM SAF, Mean, 1983 - 2005



- No surface network available
- Correspondence of surface irradiance with topographic features.

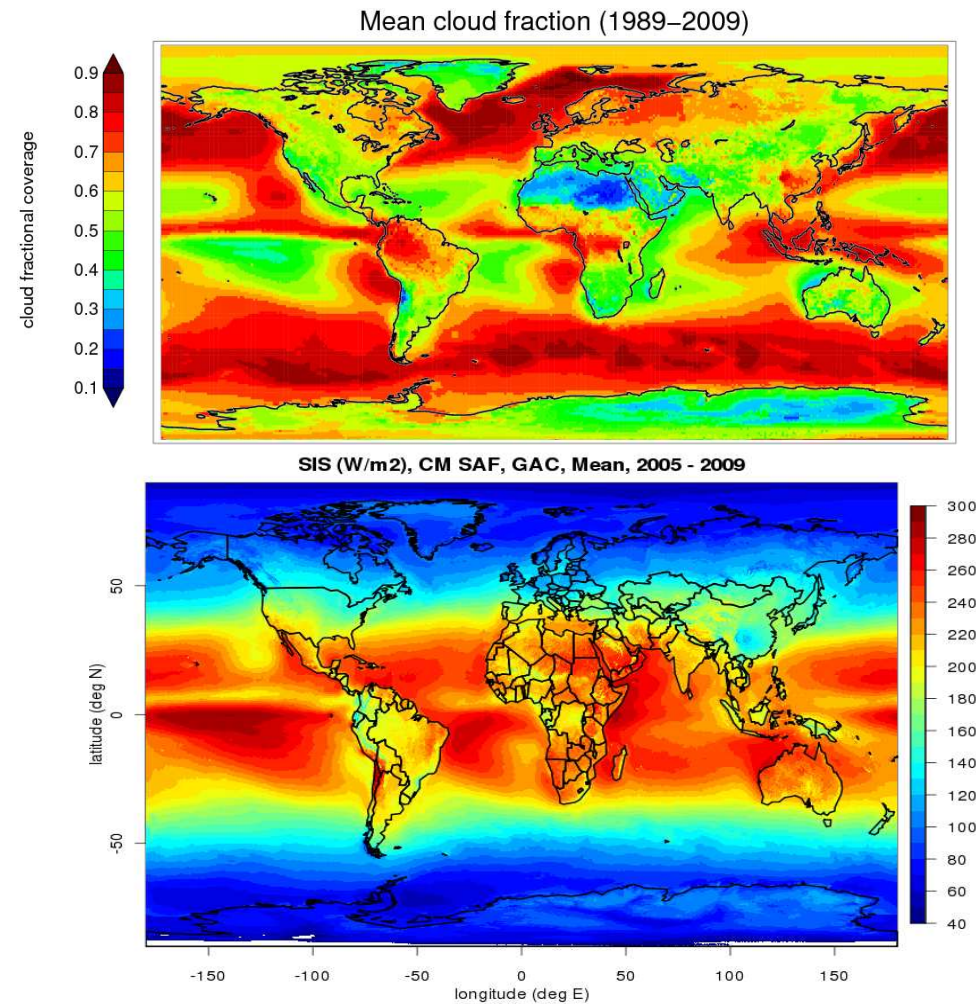
Cooperation with Jörg Bendix, University Marburg

Cloud coverage, global data set



- Monthly means
1989 -2009
- spatial resolution:
0.25 deg
- Available:
spring 2012

Global data sets of cloud coverage and solar irradiation

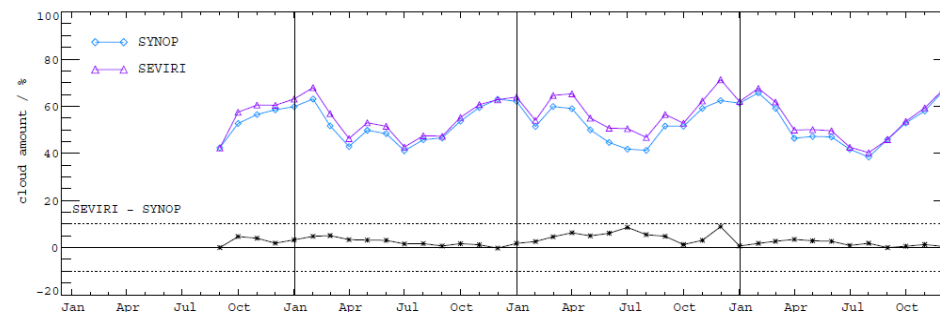
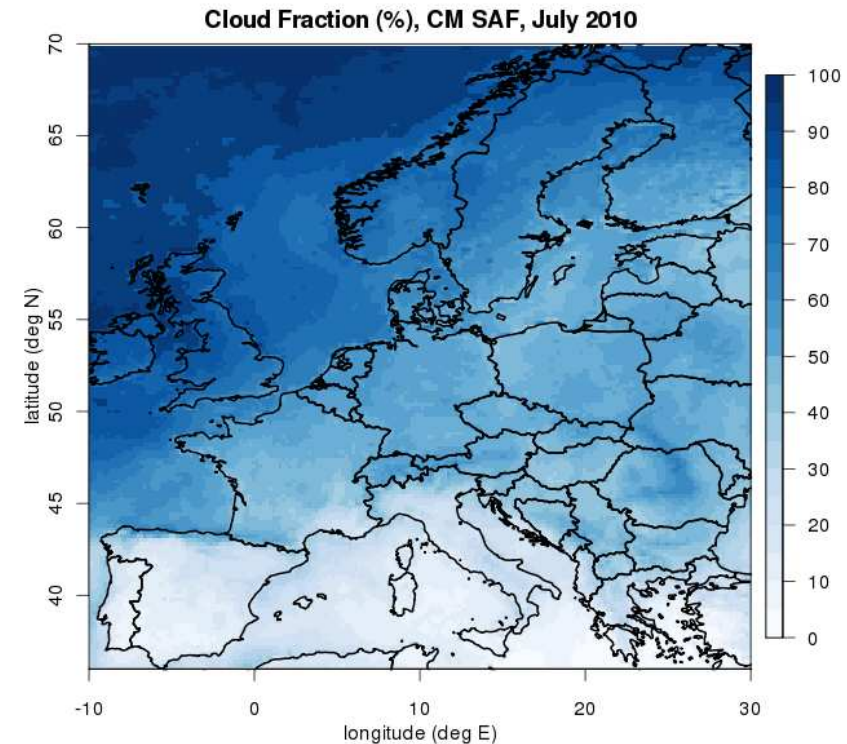


- Data presented in the previous slides (will) have climate quality
- Generation of data sets with climate quality needs time
 - approx. 2 – 3 years
- For some purposes near real time data required / sufficient
 - analysis of extremes, release of monthly means etc. (for publication in public media, ...)
 - CM SAF products available within 8 weeks after completion of the month

Clouds

- cloud fraction
- optical depth
- phase
- top height/pressure
- type
- water path

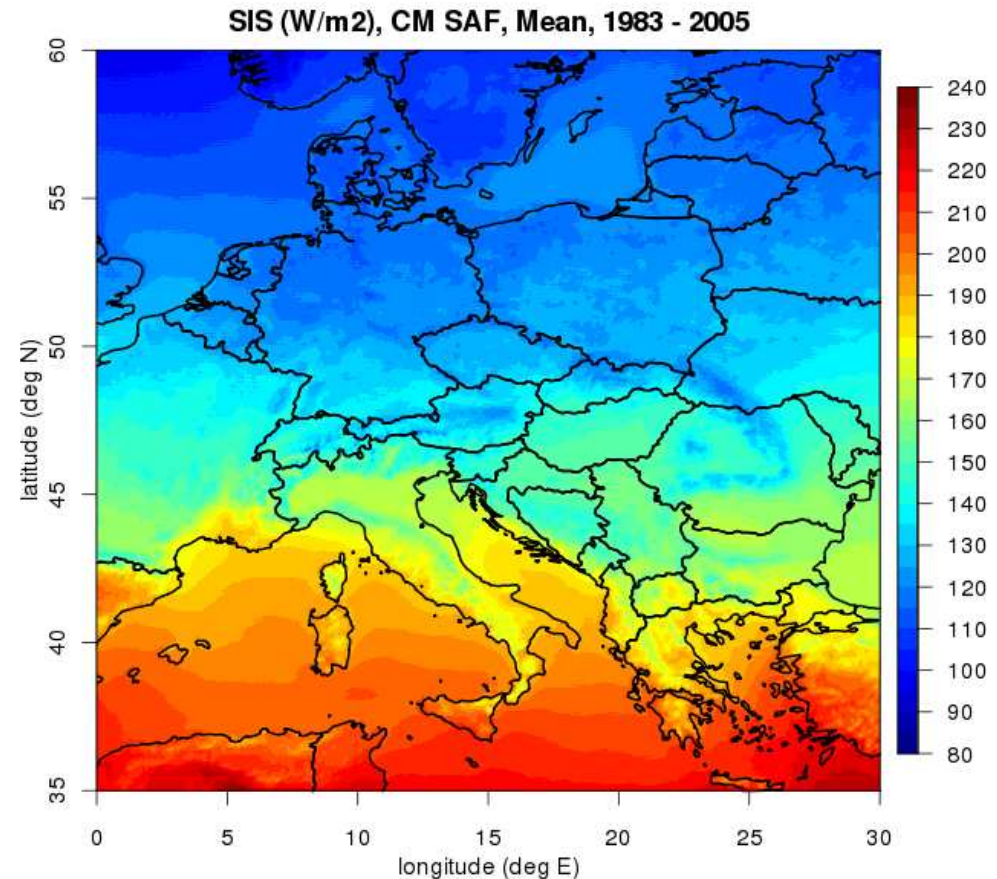
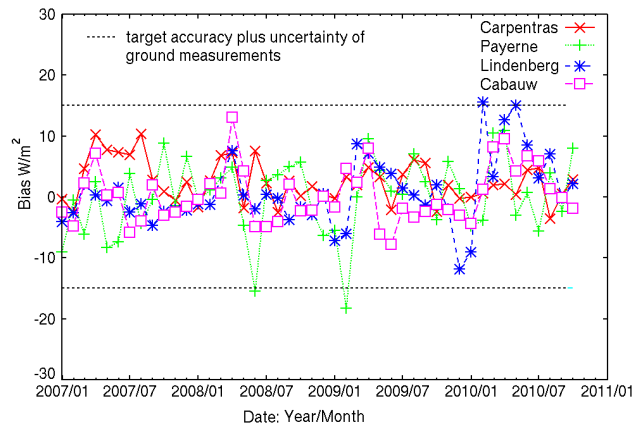
- Cloud information available since 2005
- Daily and monthly means, spatial resolution 15 x 15 km
- Difference to SYNOP < 10 % (CFC)



Monthly mean of CFC from Sep. 2006 – December 2009 calculated from Synop and SEVIRI monthly mean for full disc.

Radiation

- surface solar irradiance (SIS)
- Top-of-the atmosphere SW / LW radiation
- Surface radiation information available since 2007
- Daily and monthly means
- spatial resolution: 15 x 15 km²



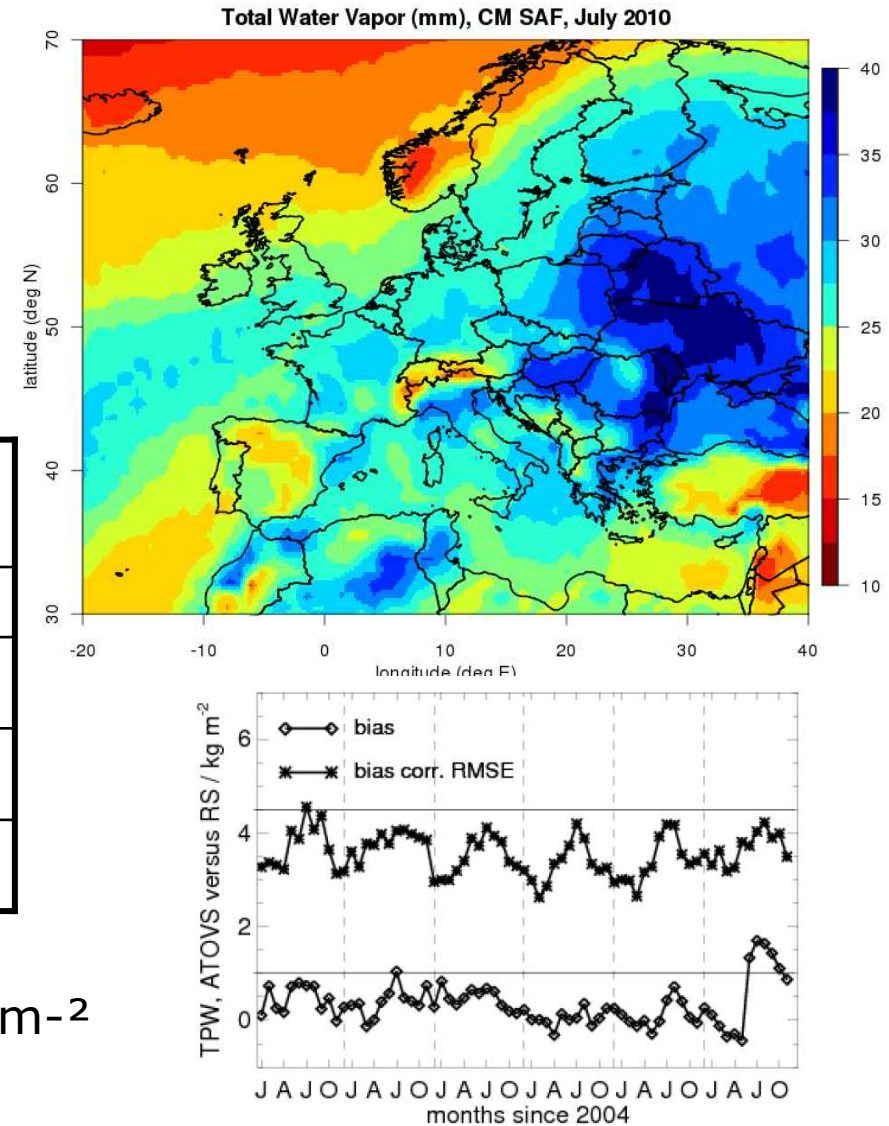
- Difference to ground measurements (monthly means) mostly < 10 W/m²

Water Vapor

- total water vapor
- water vapor / temperature on 5 vertical levels

| | | |
|---------------------------|--------------------|--|
| Parameter | total water vapour | Layerd water vapour, temperature, rel. humidity, specific humidity |
| Time range | since 2004 | since 2004 |
| Spatial coverage | globally | Ocean only |
| Means | daily, monthly | daily, monthly |
| Spatial resolution | 90 km | 90 km |

- Difference to Radiosondes < 4 kg m⁻² (total water vapor)



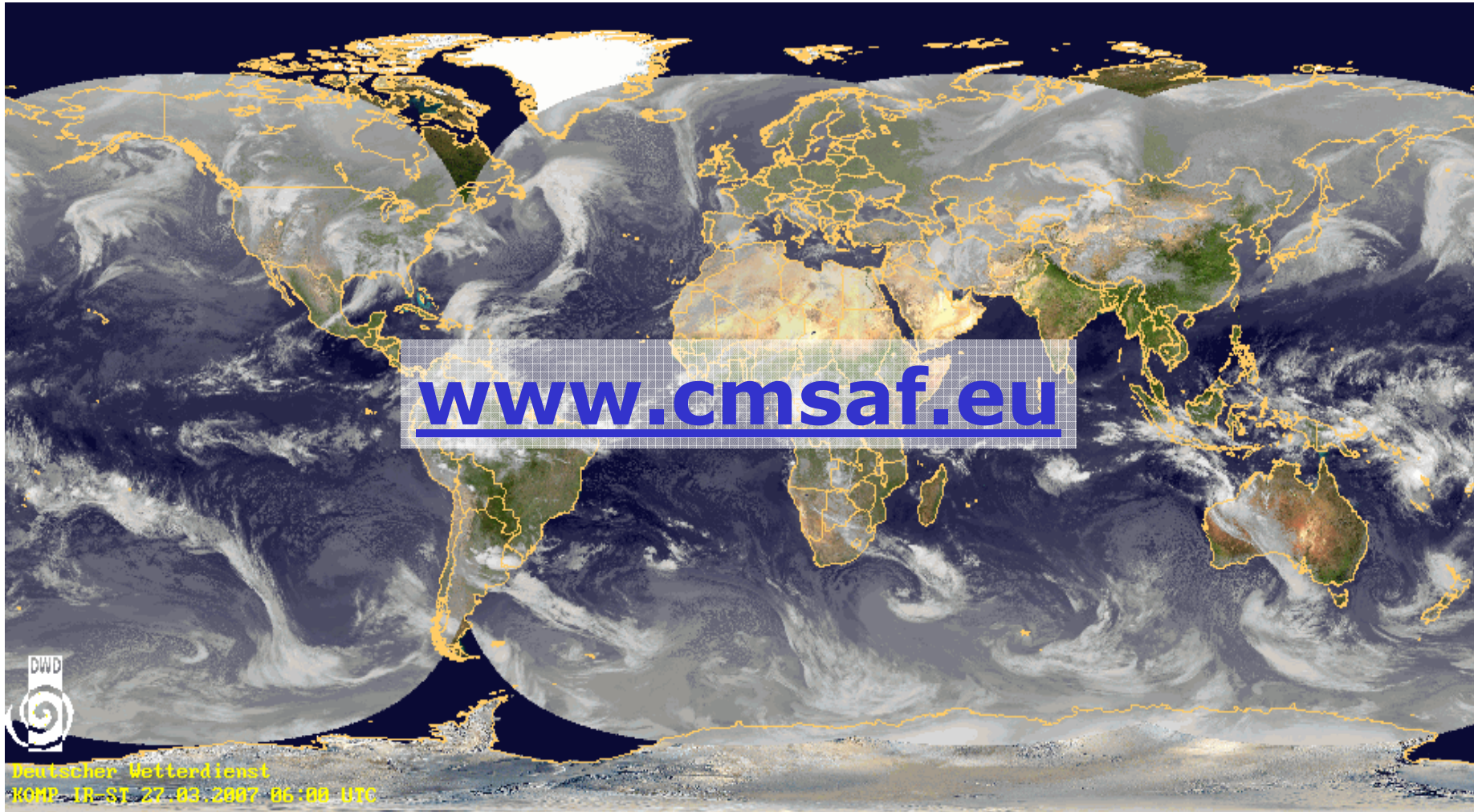
- Tools to work with CM SAF data and are provided at www.cmsaf.eu/tools
 - All software (cdo, R, cmsaf-gui) is freely available
 - Example scripts and example data are provided
- Training workshops are organised annually in close co-operation with EUMETSAT
 - Course content of the 2010 Workshop can be accessed via <http://training.eumetsat.org>; guest access, pw: cmsaf10



Workshop impressions

- Climate is the summary of atmospheric conditions over reasonably long time scales
- Requirements to climate data differ to those of weather observations
 - Archiving weather observations is not enough
 - Homogeneous long time series are needed
- Satellite data extend surface observations into new regions with less in-situ measurements
- Satellite based climate data add a high value to the databasis of the Earth's climate system
 - Enhanced knowledge of the climate system
 - Monitor possible trends and changes
 - Development / improvement of climate models
 - Provide a robust database needed to develop adaptation and mitigation strategies

- CM SAF provides „near real time“ climate data on radiation-, water vapor and cloud parameters
- CM SAF provides longterm data sets of climate quality
 - First data sets available: MVIRI full disk and global ocean
 - Global data sets will be available in early 2012
- CM SAF provides tools and training to analyse the data
 - Further information on training activities at: www.cmsaf.eu
- CM SAF data and tools are freely available at wui.cmsaf.eu and www.cmsaf.eu/tools, respectively



Thank you!