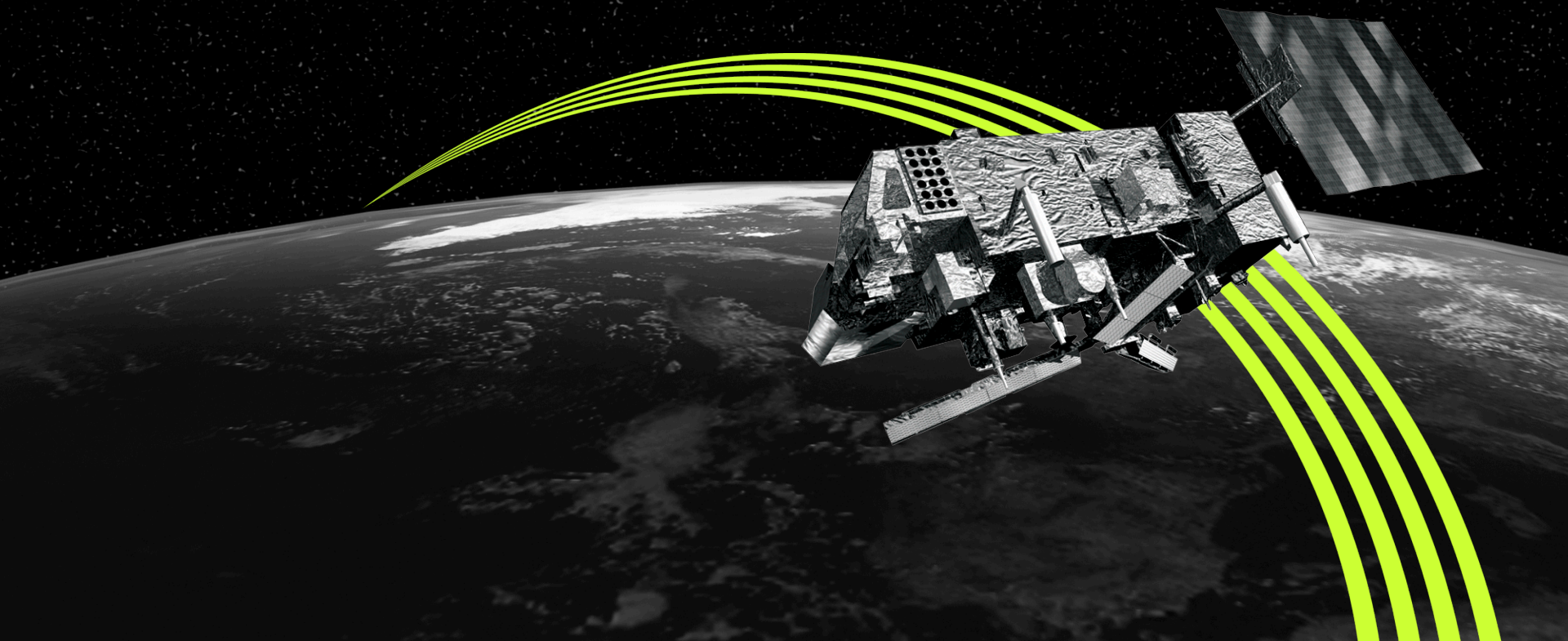
Satellite-based ECV products

Roger Saunders, Met Office
and
ESA-CCI Climate Modelling User Group



Questions to Address

- What is currently available and how is it (or could be) used for climate services?

- What kind of input data, tools and activities are needed to support further development of these products?

- What could/should be the role of Copernicus in facilitating/harmonising/stimulating this development?

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Dataset definitions

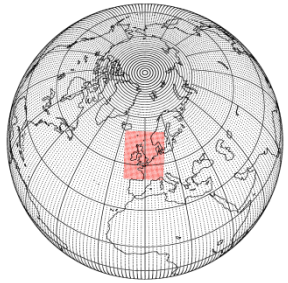
Operational Weather Prediction

Raw Satellite Data

Level 1b

Level 1c

NWP



Fundamental Climate Data Record

Interim (Thematic) Climate Data Records v2

Climate Services

Climate Models

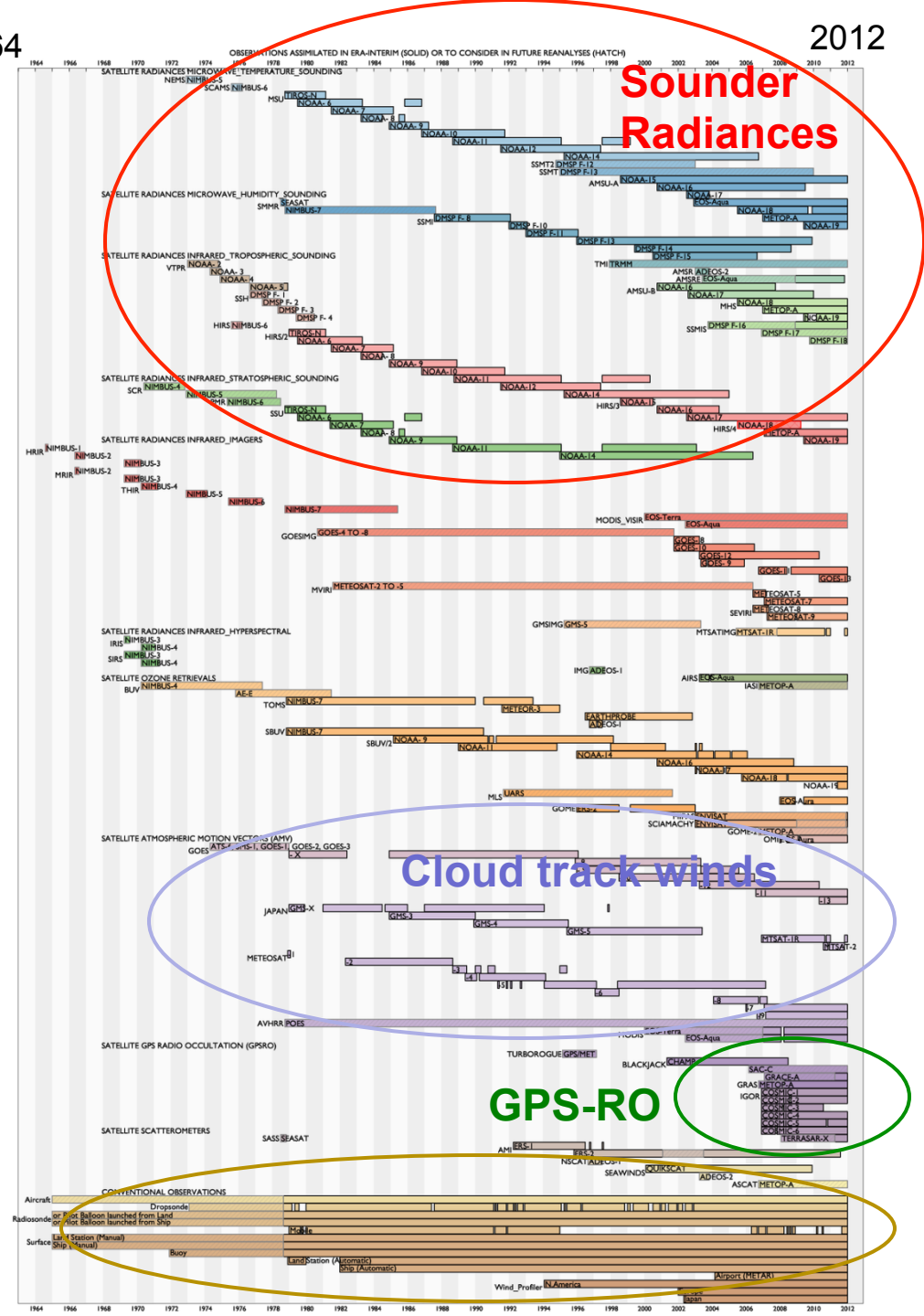
Reanalyses

Climate monitoring

Climate Dataset Production

Met Office
Hadley Centre

Timeline of satellite observations separated into different instrument types



Reprocessing Activities
Fundamental Climate Data Records

- NASA (especially very old satellites)
- NOAA
- ESA
- EUMETSAT (CAF, CM SAF)
- JMA

Reprocessing Activities Climate Data Records

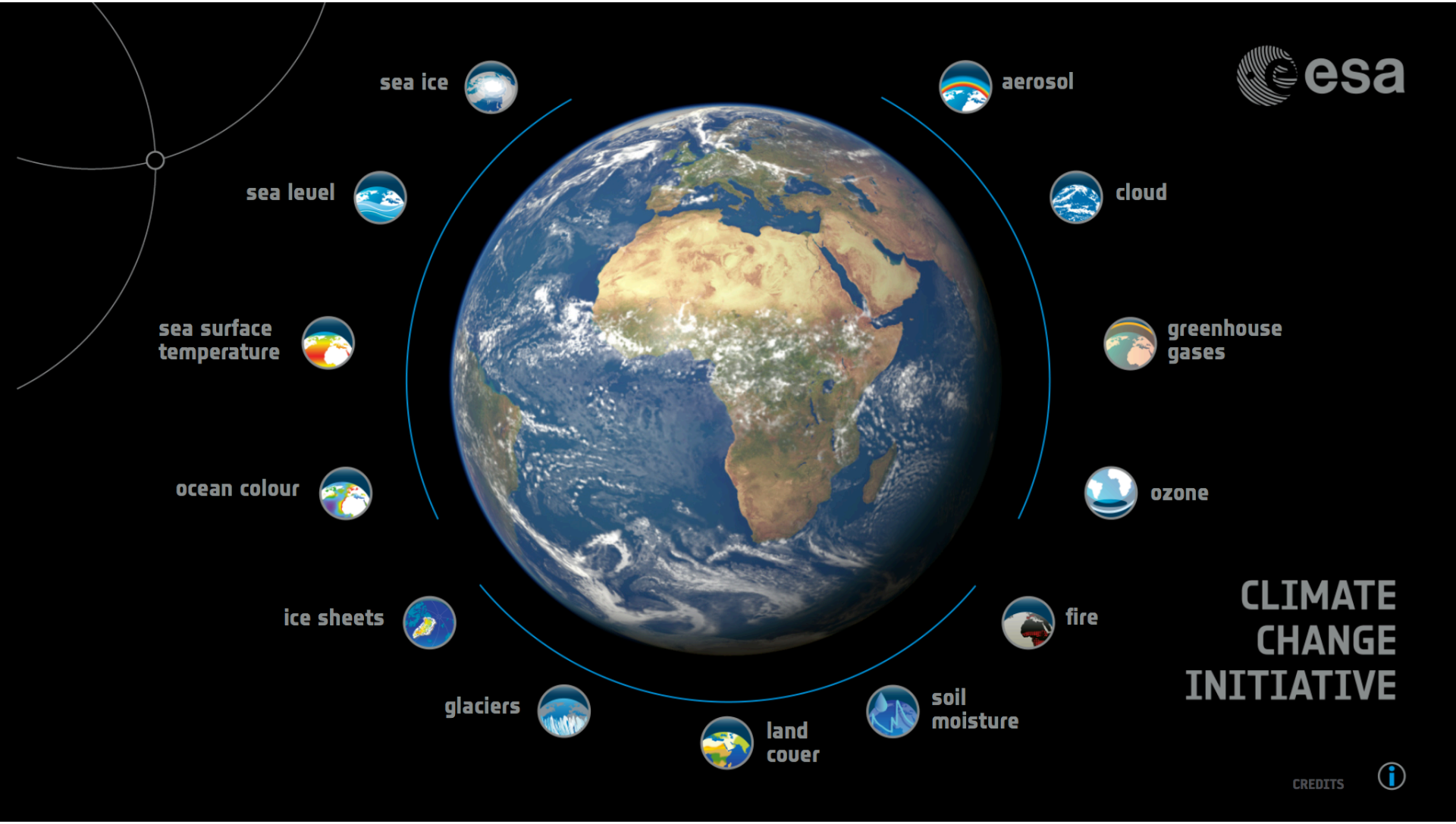
- NASA (MEaSUREs, Obs4MIPS)
- NOAA (NCDC, STAR, CIMSS, …)
- ESA (GlobXXX, Climate Change Initiative)
- EUMETSAT (CAF, CM SAF)
- SCOPE-CM (Japanese GEOs, Albedo,…)

Satellite climate data records

- **ESA CCI**
- EUMETSAT CM SAF
- NASA Obs4MIPS
- NOAA-NCDC

cci

Climate Change Initiative



Objectives of the CCI

Realise the full potential of the long-term global EO archives that ESA, together with its Member states, has established over the last thirty years …

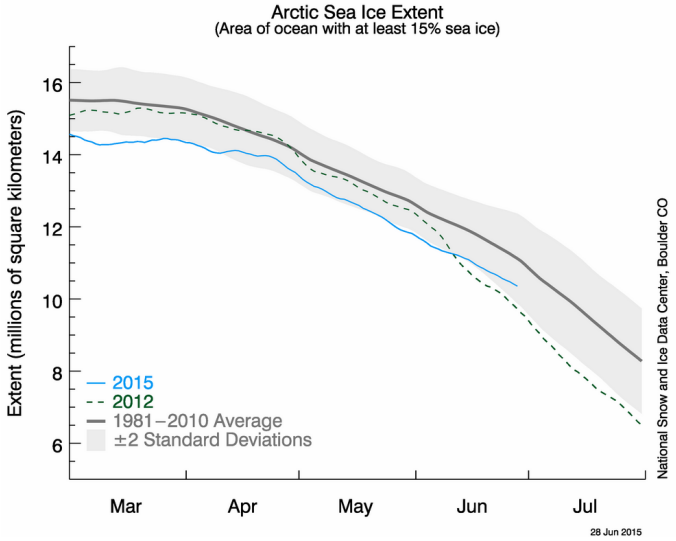
… as a significant and timely contribution to the ECV databases required by the United Nations Framework Convention on Climate Change

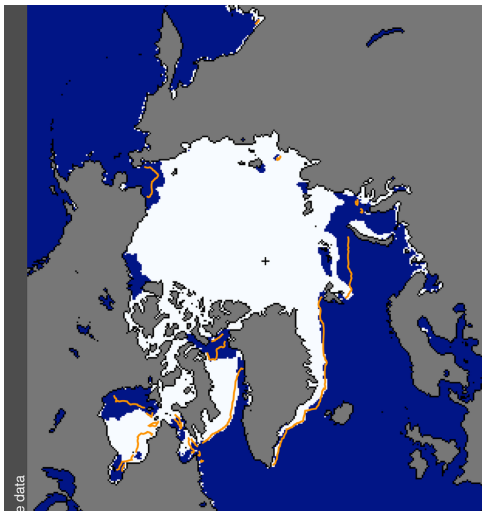
6 Years 88 Meuro

CCI Key Benefits
cci.esa.int

- User requirements determined for all ECVs including GCOS input.
- Open process of algorithm inter-comparison and selection to define best techniques
- Uncertainty provided with data
- Consistency between CDRs of different ECVs
- Long term preservation of data archives and seamless access for users (e.g. Earth System Grid Federation for modelers)
- CDRs will be openly and independently verified, validated and assessed for their utility

Consistency between datasets is important






NEWS IN FOCUS

PUBLIC HEALTH Europe seeks early warning of invading mosquitoes p.187 | MISCONDUCT Guilty verdict settles Marc Hauser case — but not the questions p.188 | ASTRONOMY Distorted galaxies scrutinized for dark energy p.190 | OCEANOGRAPHY Alvin upgraded while projects founder p.194

Larger areas of open ocean and warming surface waters will alter evaporation, cloudiness, precipitation and storm patterns across the Arctic and beyond.

CLIMATE

Ice loss shifts Arctic cycles

Record shrinkage confounds models and portends atmospheric and ecological change.

BY QUIRIN SCHIERMEIER

Before indifferent satellite eyes, the top of the world is undergoing a transformation. The Arctic ice pack, a primary indicator of climate change, has shrunk in recent weeks to an extent that no computer model and few scientists had thought possible.

After five years that all saw less ice than previously documented in the 34-year satellite record, this year's record loss has scientists questioning their models. They are also striving to understand the complex cascade of effects — from shifting weather patterns to displaced marine species — that the accelerating retreat could trigger.

The US National Snow and Ice Data Center (NSIDC) in Boulder, Colorado, announced the record decline on 26 August, saying that the ice extent had dropped to 4.10 million square kilometres (see 'Going, going...'). The figure is 70,000 square kilometres less than the previous record low, set in 2007, and it came at least two weeks before the annual low is typically reached. According to the NSIDC, by 9 September that figure had dropped by another 14%, to around 3.52 million square kilometres.

The massive melt has occurred in relatively normal weather conditions, with only one strong summer storm to hasten the break-up of the pack ice. Mark Serreze, director of the NSIDC, says that much of the Arctic pack is now thin first-year ice — frozen only last winter — which requires much less energy to break apart and disperse than multi-year ice. "We have entered a new regime," he says. "The sea ice is in such poor health in spring that large parts of it can't survive the summer melt season, even without boosts from extreme weather."

NATURE.COM For more on the receding Arctic ice, see: go.nature.com/i5w2yr

Computer models that simulate how the ice will respond to a warming climate project that the Arctic will be seasonally "ice free" (definitions of this vary) some time between 2040 and the end of the century. But the observed downward trend in sea-ice cover suggests that summer sea ice could disappear completely as early as 2030, something that none of

13 SEPTEMBER 2012 | VOL 489 | NATURE | 185

An example of why we need consistency across ECVs
Arctic Sea-ice melting

- **Extent of sea-ice melting? (monitoring)**
  E.g. sea-ice extent, thickness
- **Why is sea-ice melting? (attribution)**
  Need data on SST, SSH (eddies), ice drift
- **Effect of sea-ice melting? (impact)**
  e.g. Ocean colour (plankton), weather …
- **Future sea-ice melting? (prediction)**
  e.g. better initial / boundary conditions

Satellite climate data records

- ESA CCI
- **EUMETSAT CM SAF**
- NASA Obs4MIPS
- NOAA-NCDC

Deutscher Wetterdienst

Swedish Meteorological and Hydrological

Royal Netherlands Meteorological Institute

Royal Meteorological Institute Belgium

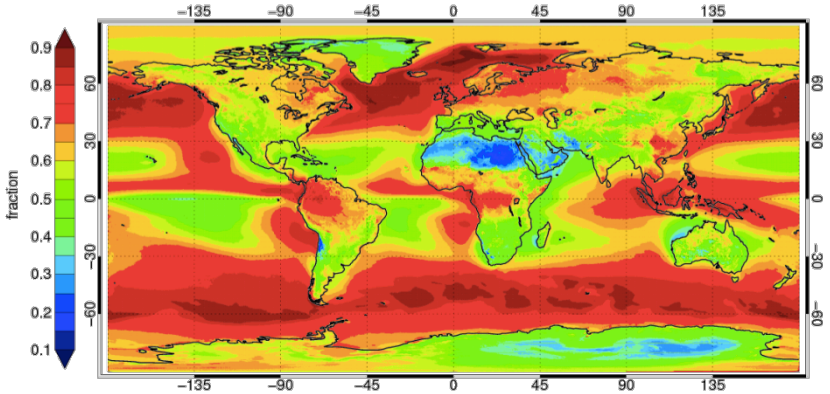
Federal Office of Meteorology and Climatology

Finnish Meteorological Institute

UK MetOffice

Climate Data Records of Essential Climate Variables from the EUMETSAT Satellite Application Facility on Climate Monitoring

Mean cloud fraction (1982-2009)



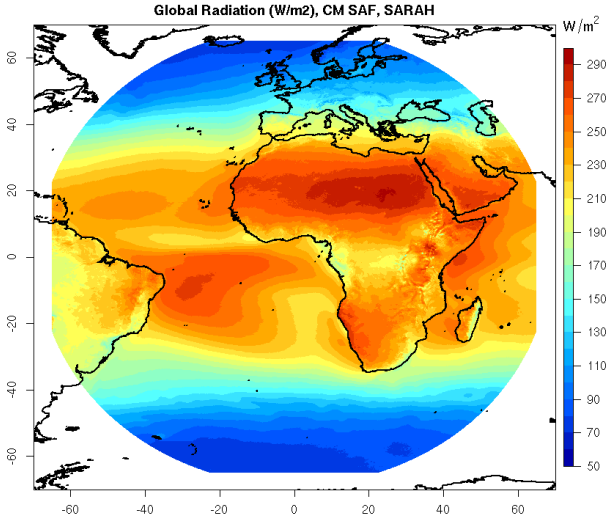
DOI:10.5676/EUM_SAF_CM/CLARA_A/V001

- CM SAF provides free data access , comprehensive documentation & user support

www.cmsaf.eu

- CM SAF provides sustained development & production of peer-reviewed Climate Data Records related to the energy & water cycle

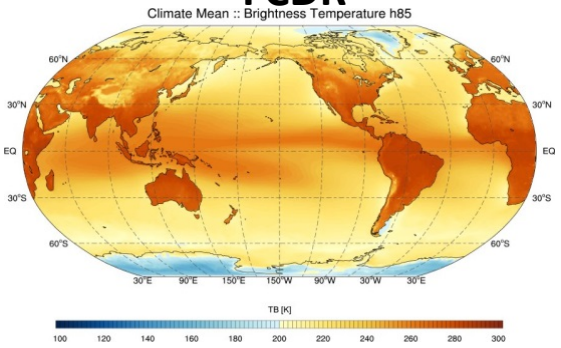
Mean global radiation (1983 - 2013)



DOI:10.5676/EUM_SAF_CM/SARAH/V001

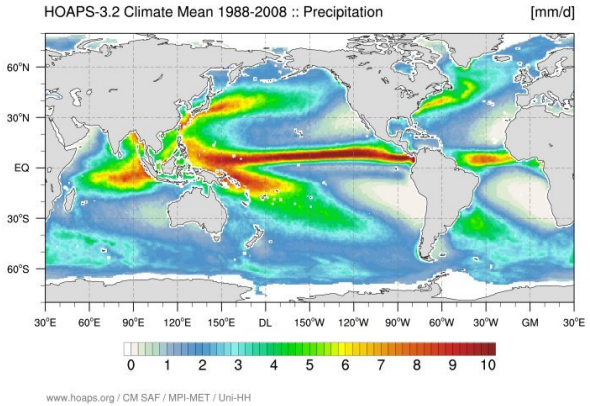
CDRs from the Satellite Application Facility on Climate Monitoring

Brightness Temperature FCDR



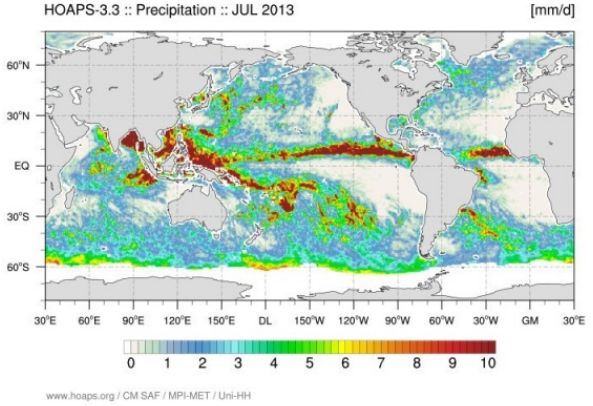
DOI:10.5676/EUM_SAF_CM/FCDR_SSMI/V001

Climatological Mean TCDR



DOI:10.5676/EUM_SAF_CM/HOAPS/V001

Monthly Mean ICDR



	FCDR	TCDR	ICDR
CDR type	Fundamental Climate Data Record	Thematic Climate Data Record	Intermediate Climate Data Record
CDR description	Calibrated /Intercalibrated Sensor data	Long time series of Essential Climate Variables	Regular & consistent updates of TCDRs

Satellite climate data records

- ESA CCI
- EUMETSAT CM SAF
- NASA Obs4MIPS
- NOAA-NCDC

https://www.earthsystemcog.org/projects/obs4mips/

Obs4MIPs

- **Observationally-based datasets used for climate model evaluation. Obs4MIPs refers to a limited collection of well-established and documented datasets that have been organized according to the CMIP5 model output requirements and made available on the ESG. Each Obs4MIPs dataset corresponds to a field that is output in one or more of the CMIP5 experiments. To summarize, products available via Obs4MIPs are:**
- **Directly comparable to a model output field defined as part of CMIP5**
- **Open to contributions from all data producers that meet the Obs4MIPs requirements**
- **Well documented, with traceability to track product version changes**
- **Served through Earth System Grid Federation**

Satellite climate data records

- ESA CCI
- EUMETSAT CM-SAF
- NASA Obs4MIPS
- NOAA-NCDC

Satellite climate data records

NOAA's Climate Data Record Program

NOAA's National Climatic Data Center (NCDC) initiated a satellite Climate Data Record (CDR) program to continuously provide objective climate information derived from weather satellite data that NOAA has collected for more than 30 years. These data comprise the longest record of global satellite mapping measurements in the world, and are complemented by data from other sources including NASA and Department of Defence satellites as well as foreign satellites.

NOAA NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Formerly the National Climatic Data Center (NCDC)... more about NCEI »

Home | Climate Information | Data Access | Customer Support | Contact | About | Search

Home > Data Access > Satellite Data

Quick Links
Land-Based Station
Satellite
- Datasets
- Sorted by Satellite/Instrument
- Satellite Imagery
- Datasets in Development

Radar
Model
Weather Balloon
Marine / Ocean
Paleoclimatology
Severe Weather

Satellite Data

The National Oceanic and Atmospheric Administration (NOAA) manages a constellation of geostationary and polar-orbiting meteorological spacecrafts. These satellites are distributed among three operational programs: the Suomi National Polar-orbiting Partnership (S-NPP), the Geostationary Operational Environmental Satellite Program (GOES), and the Polar Operational Environmental Satellite Program (POES). The U.S. Department of Defense operates the satellites of the Defense Meteorological Satellite Program (DMSP) and NCDC archives and distributes the data under the Shared Processing Program.

Suomi National Polar-orbiting Partnership satellite (S-NPP) orbiting above the Earth (artist's rendition).

Geostationary and polar-orbiting satellites provide raw radiance data that are collected by ground stations and archived by NCDC. These continuous global environmental observations are then derived to produce various geophysical variables that help to describe the Earth's atmospheric, oceanic, and terrestrial domains.

Geostationary satellites help monitor and predict weather and environmental events including tropical systems, tornadoes, flash floods, dust storms, volcanic eruptions, and forest fires. Polar-orbiting satellites collect data for weather, climate, and environmental monitoring applications including precipitation, sea surface temperatures, atmospheric temperature and humidity, sea ice extent, forest fires, volcanic eruptions, global vegetation analysis, as well as search and rescue. NOAA's satellite data improve the Nation's resilience to climate variability, maintain our economic vitality, and improve the security and well-being of the public.

- Satellite Data Access by Dataset
  NCDC archives numerous datasets such as sea surface temperature and cloud data.
- Satellite Data Access by Satellite and Instrument
  Access to datasets is sorted by satellite and instrument.
- Satellite Imagery
  Satellite imagery is described with access provided to image browsers, posters, historical imagery, and custom imagery.
- Satellite Datasets in Development
  NCDC continues to steward satellite data—checking dataset quality, producing climate records, and performing

GCOS ECVs

Atmosphere	**Surface**	**Air temperature; Precipitation, Pressure, Surface radn budget, Wind**
	Upper Air	**Clouds, Wind, Earth Radn Budget** **Upper air temp, water vapour**
	Composition	**Carbon dioxide, methane & GHGs** **Ozone, Aerosol properties**
Ocean	**Surface**	**SST, Sea-level, Sea-ice, Ocean colour** **Sea state, Salinity, CO_2 partial pressure**
	Sub-surface	**Temperature, Salinity, Current, Nutrients, Carbon, Ocean Tracers, Phytoplankton**
Terrestrial	**Glaciers & Ice caps, Land cover, Fire disturbance, FaPAR, LAI, Albedo, Biomass,Lake levels, Snow cover, Soil moisture, Water use, Ground water, River discharge, Permafrost, Seasonally frozen ground, Ice Sheets**	

CCI has 13 ECVs

Atmosphere	**Surface**	Air temperature; Precipitation, Pressure, Surface radn budget, Wind
	Upper Air	Clouds, Wind, Earth Radn Budget Upper air temp, water vapour
	Composition	Carbon dioxide, methane & GHGs Ozone, Aerosol properties
Ocean	**Surface**	SST, Sea-level, Sea-ice, Ocean colour Sea state, Salinity, CO_2 partial pressure
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CM SAF has 8 ECVs

Atmosphere	Surface	Air temperature; Precipitation, Pressure, Surface radn budget, Surface wind
	Upper Air	Clouds, Wind, Earth Radn Budget Upper air temp, water vapour
	Composition	Carbon dioxide, methane & GHGs Ozone, Aerosol properties
Ocean	Surface	SST, Sea-level, Sea-ice, Ocean colour Sea state, Salinity, CO_2 partial pressure
	Sub-surface	Temperature, Salinity, Current, Nutrients, Carbon, Ocean Tracers, Phytoplankton
Terrestrial	Glaciers & Ice caps, Land cover, Fire disturbance, FaPAR, LAI, Albedo, Biomass,Lake levels, Snow cover, Soil moisture, Water use, Ground water, River discharge, Permafrost, Seasonally frozen ground, Ice Sheets	

Obs4MIPs 12 ECVs

Atmosphere	**Surface**	Air temperature; Precipitation, Pressure, Surface radn budget, Wind
	Upper Air	Clouds, Wind, Earth Radn Budget Upper air temp, water vapour
	Composition	Carbon dioxide, methane & GHGs Ozone, Aerosol properties
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NCDC 13 ECVs

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What ECVs are missing?

Atmosphere	Surface	Air temperature, Pressure,
	Upper Air	
	Composition	
Ocean	Surface	Sea state, Salinity, CO_2 partial pressure
	Sub-surface	Temperature, Salinity, Current, Nutrients, Carbon, Ocean Tracers, Phytoplankton
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	Sub-surface	Temperature, Salinity, Current, Nutrients, Carbon, Ocean Tracers, Phytoplankton
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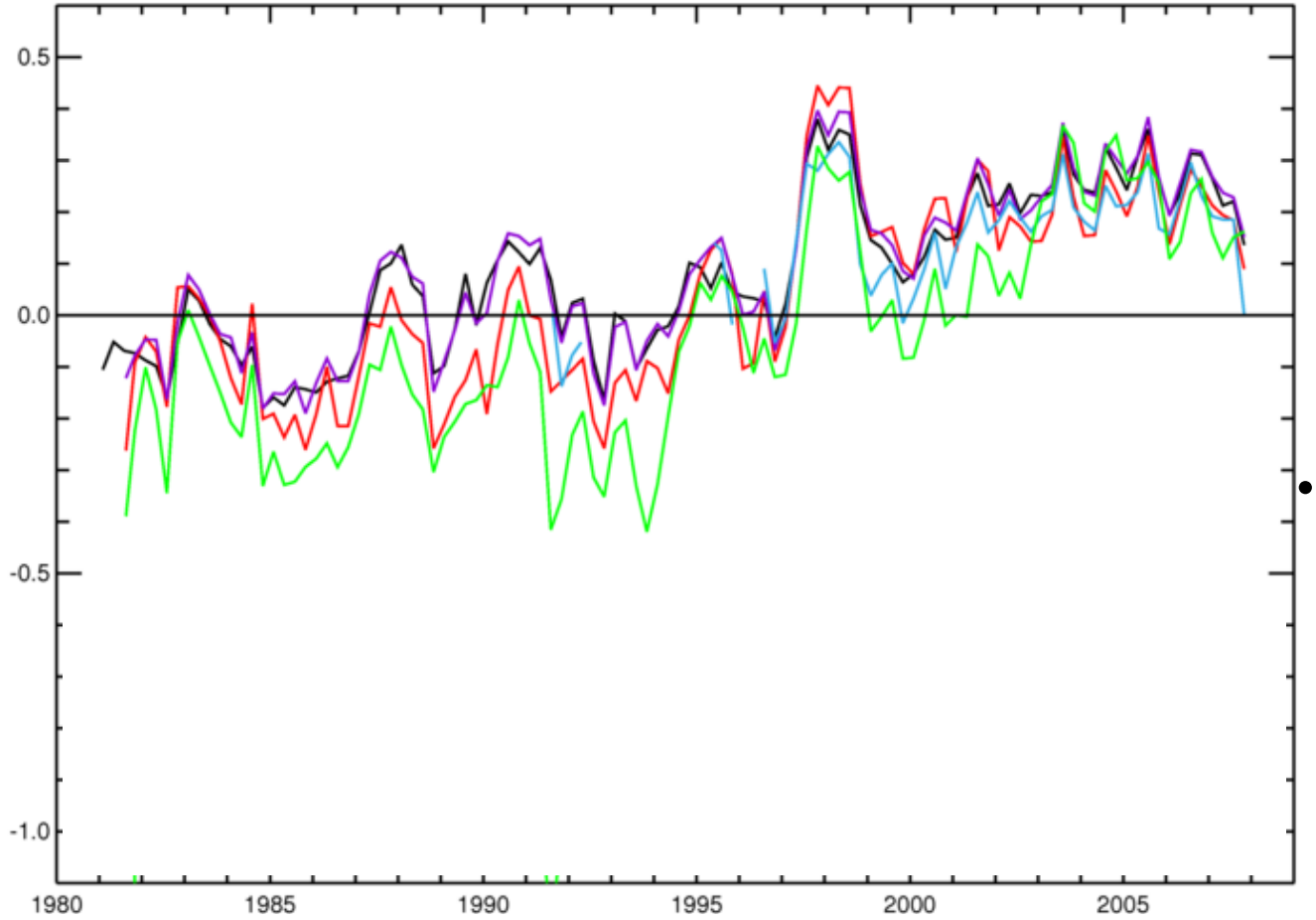
Some Examples of CDRs

- Sea surface temperature – CCI/Pathfinder
- Ocean colour- CCI
- Ozone – CCI
- Surface radiation fluxes – CM SAF
- Soil moisture – CCI
- Land Cover – CCI
- Sea-ice - Cryosat

Satellite SST datasets

Courtesy J. Kennedy

Global seasonal average SST anomalies (relative to 1961-1990 climatology)

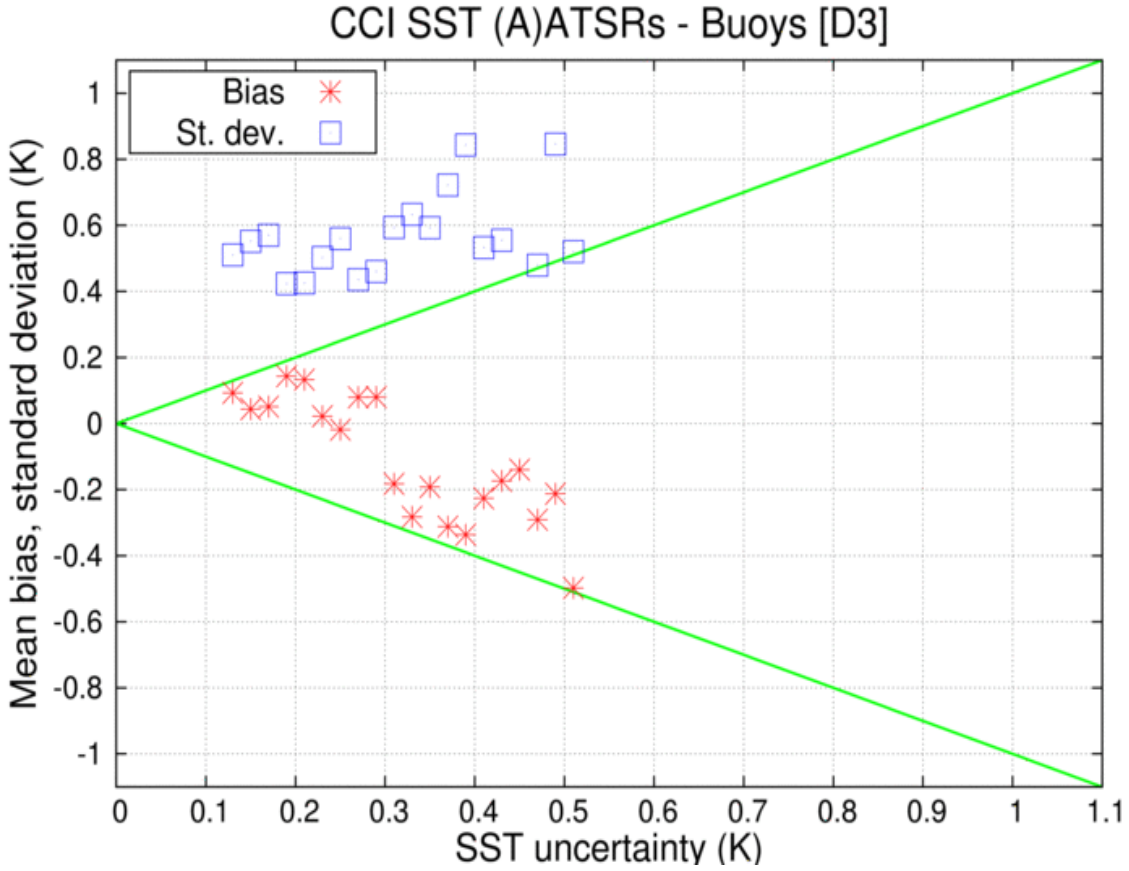


- **Bias corrected AVHRR is much closer to ARC and *in situ* data**
- **Adjusted data more stable with respect to *in situ***

Key: Single realisation of HadSST3 (*in situ* data) ARC Adjusted AVHRR
Unadjusted Pathfinder AVHRR Satellite data adjusted for combination with in situ

Validate observational uncertainty

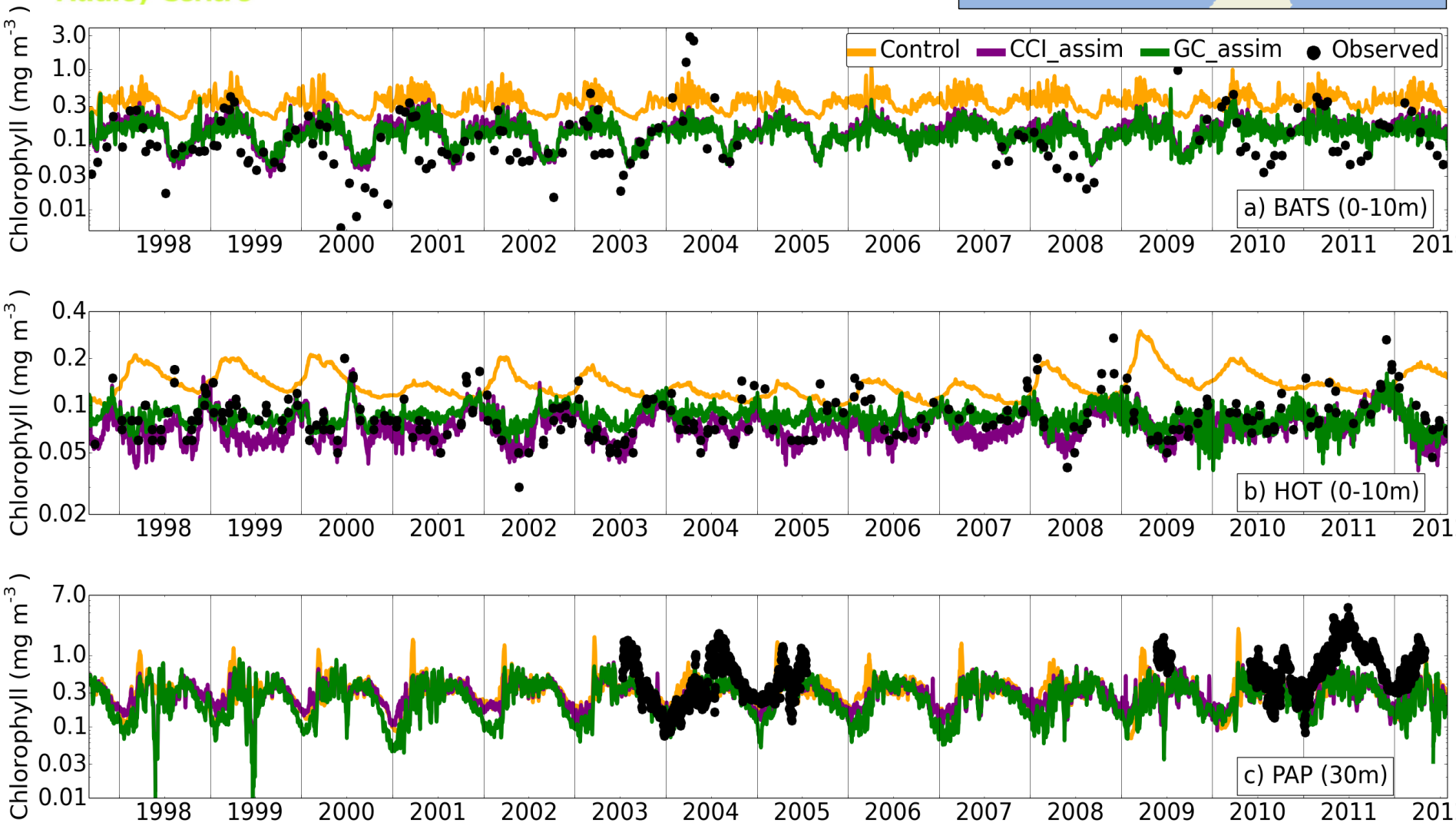
Use Buoy SSTs to validate uncertainties provided with ATSR record



Uncertainty in CCI ATSR SST

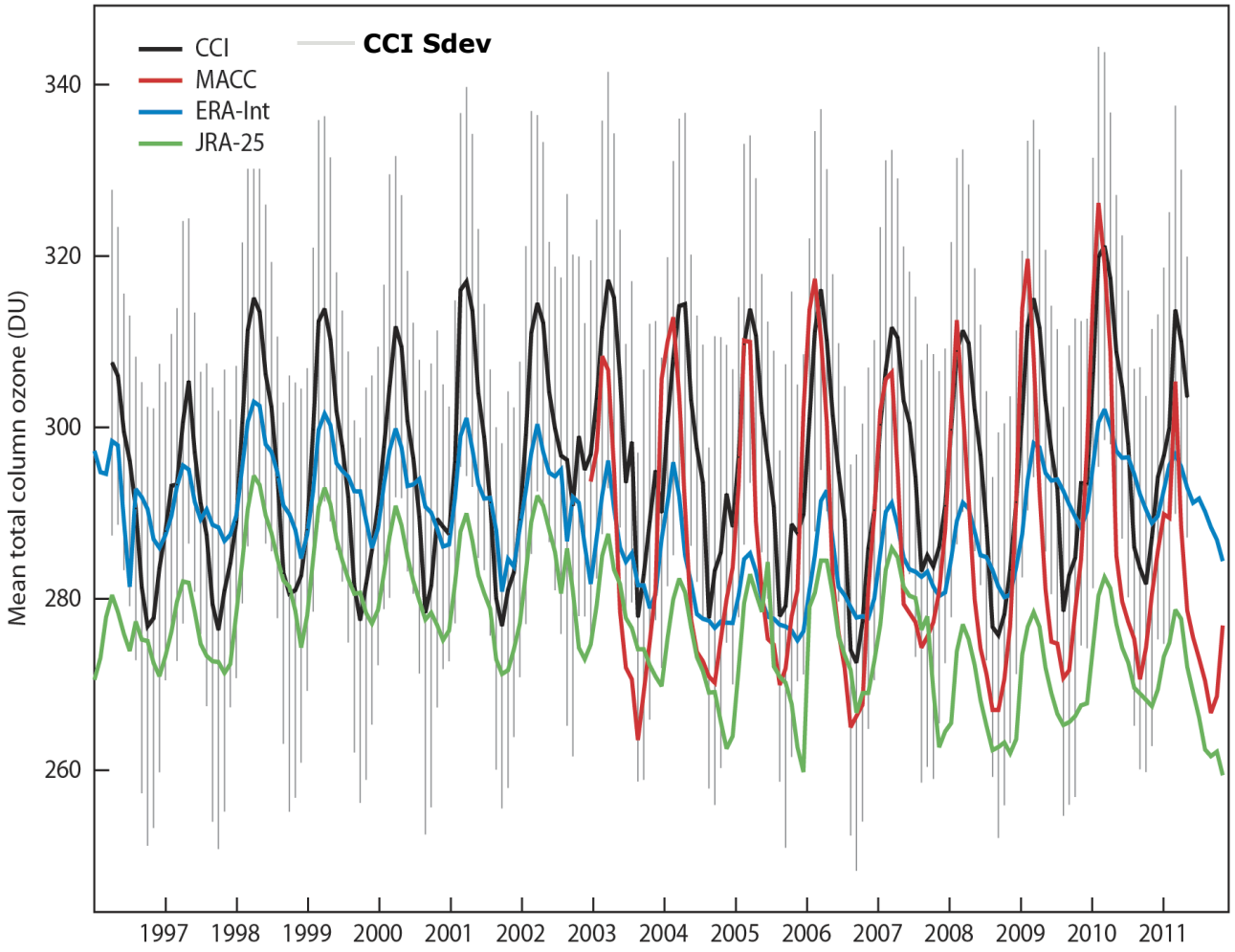
Met Office
Hadley Centre

Chlorophyll time series



Global mean total column O_3

Courtesy R. Dragani



ERA-Interim is 10DU lower than MACC or CCI and annual cycle is much less.

MACC reduction in ozone in Autumn is more rapid than CCI.

Surface Radiation August 2014 absolute anomaly

CM SAF
Climate Monitoring

RCC-CM

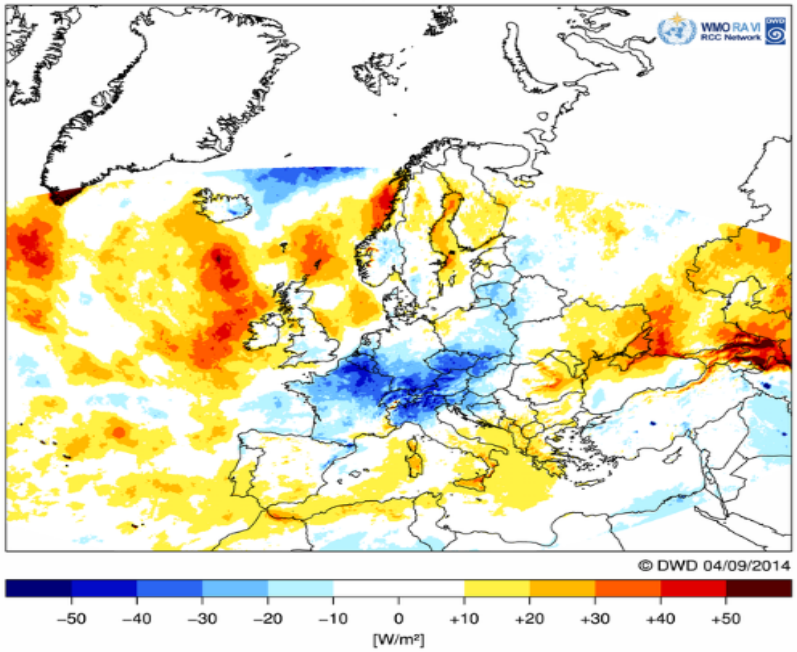
- Overview
- News
- Members
- **Products**
  - Reports
  - **Monitoring Europe**
    - Temperature
    - Precipitation
    - Sunshine
    - Droughtindex
    - Sea level pressure
    - Cloud Coverage
    - Watervapor
    - **Radiation**
      - Long-term Records
    - Snow
    - Albedo
    - Soil moisture
    - Access to gridded data of the maps
    - Description of methods
    - Model based climatology ARPEGE
    - Climate indices
    - Subregional climate centres
  - Monitoring National
  - Significant Weather Events
- Documents
- Links
- Meetings
- Contact

Radiation

Information to maps and methods see: Description of Methods

Europe | Global radiation | Anomaly (absolute) | 2014 | august | show

Absolute anomaly Global Radiation August 2014
(reference period 1983–2005)



The product shown is based on data provided by
EUMETSAT Satellite Application Facility on Climate Monitoring,
hosted by Deutscher Wetterdienst

CM SAF

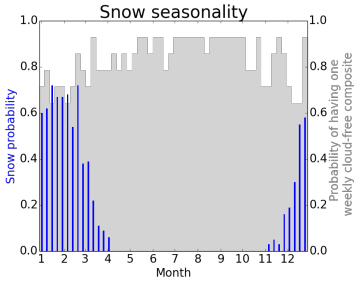
http://www.dwd.de/rcc-cm

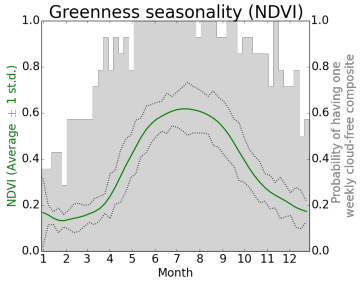
Downstream application;
Example: WMO Regional Climate Centre RA VI

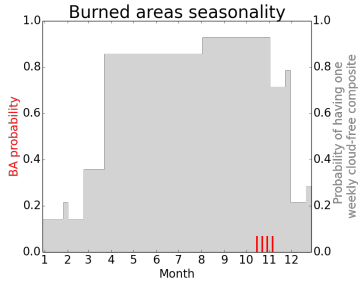
WMO RA VI
RCC Network

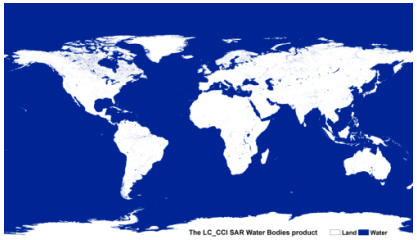
Land Cover datasets available

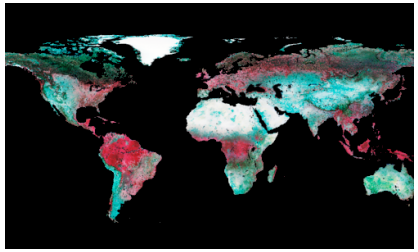
- Land cover state for 3 ‘epochs’:
  - 2000: (1998-2002)
  - 2005: (2003-2007)
  - 2010: (2008-2012)
- Land surface Condition:
  - NDVI
  - Burnt area
  - Snow cover
- Water bodies mask
- MERIS Surface Reflectance
- User tool









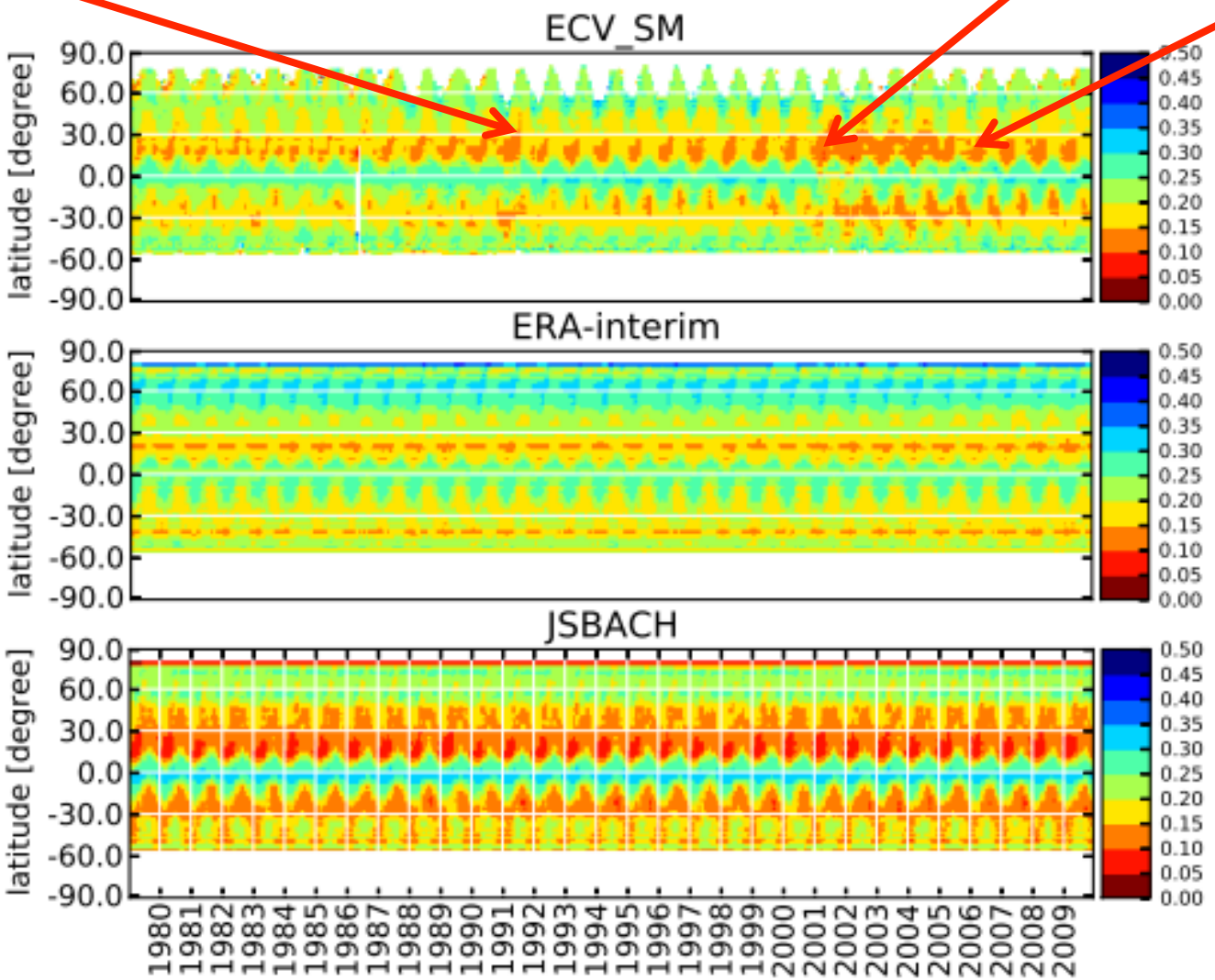


Longterm stability Soil Moisture

end SMMR

AMSR-E

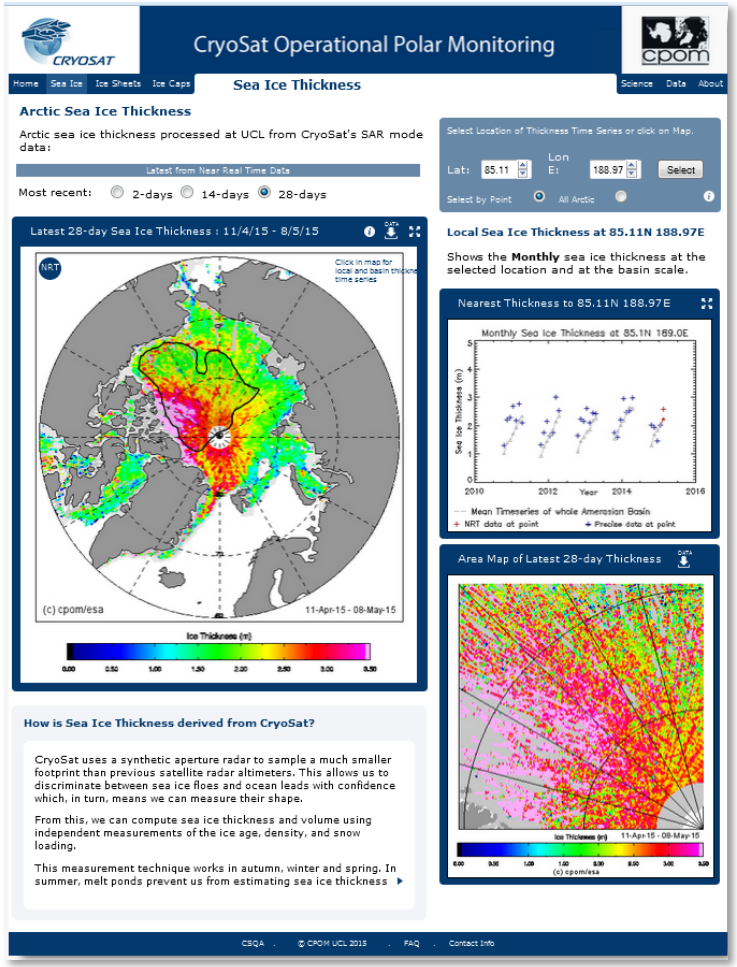
ASCAT



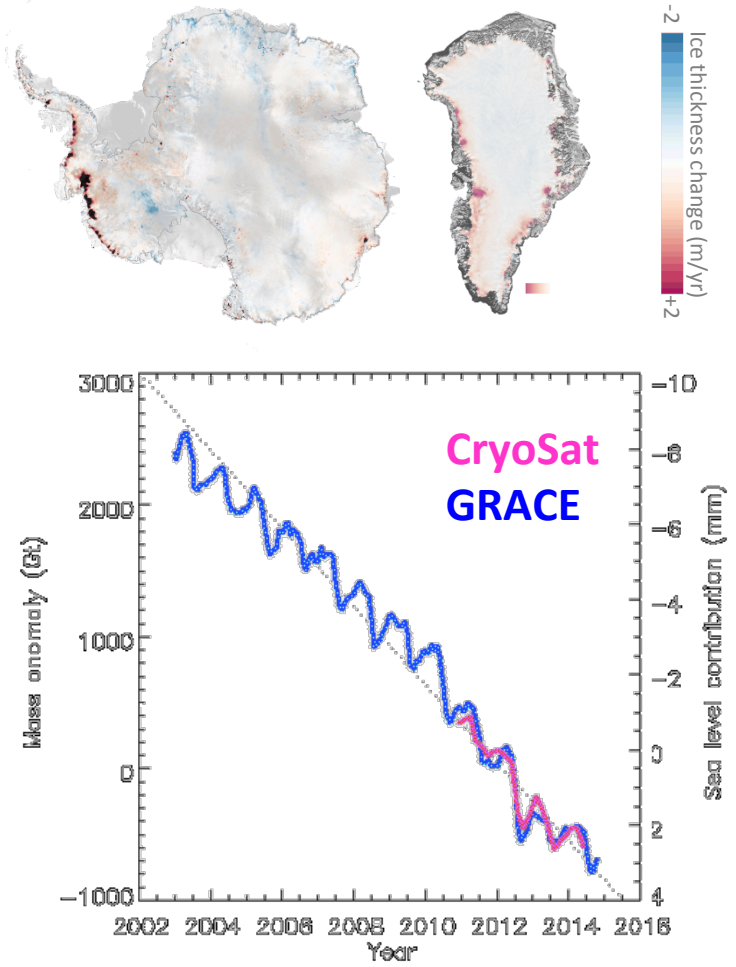
m^3/m^3

Loew et al., 2013

Sea and land ice climate data



CryoSat-2 real time sea ice thickness



Ice sheet contribution to sea level

Questions to Address

- What is currently available and how is it (or could be) used for climate services?

- What kind of input data, tools and activities are needed to support further development of these products?

- What could/should be the role of Copernicus in facilitating/harmonising/stimulating this development?

Tools, data and activities

- Uncertainties, metadata, and unique doi
- Independent assessment of CDRs (e.g. CMUG-like activity)
- Data portal (e.g. Obs4MIPS, CCI)
- Visualisation of datasets (see end of talk)
- Observation simulators for climate model comparisons
- Radiative transfer models for assimilation
- A review process to advise of improvements that could be made to CDRs and requirements for it
- Promotion of CDRs to user communities (C3S user forum, interactive web presence)

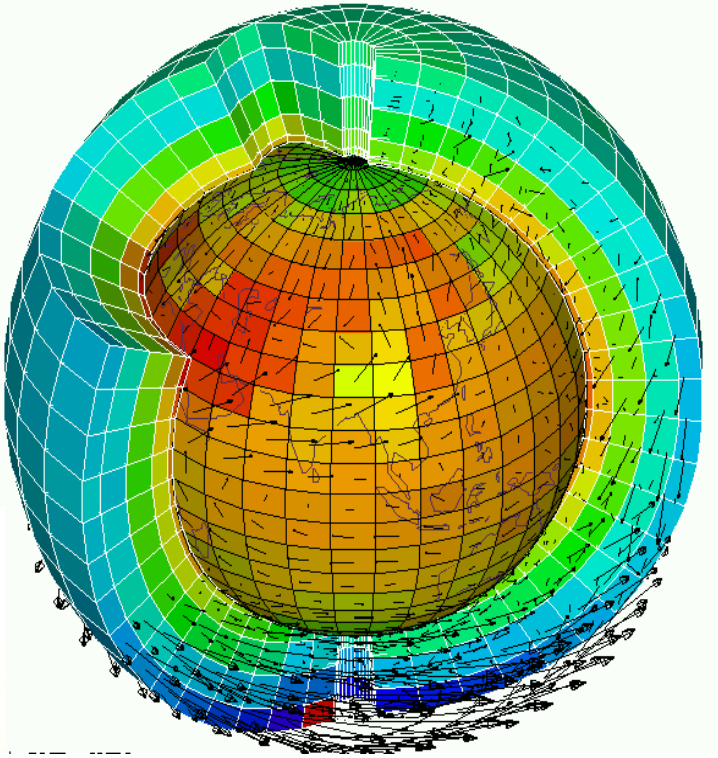
Tools, data and activities

- Uncertainties, metadata, and unique doi
- Independent assessment of CDRs (e.g. CMUG-like activity)
- Data portal (e.g. Obs4MIPS, CCI)
- Visualisation of datasets (see end of talk)
- Observation simulators for climate model comparisons
- Radiative transfer models for assimilation
- A review process to advise of improvements that could be made to CDRs and requirements for it
- Promotion of CDRs to user communities (C3S user forum, interactive web presence)

Need for Obs Simulators

Geophysical measurements
(e.g. radiance, bending angle)

?



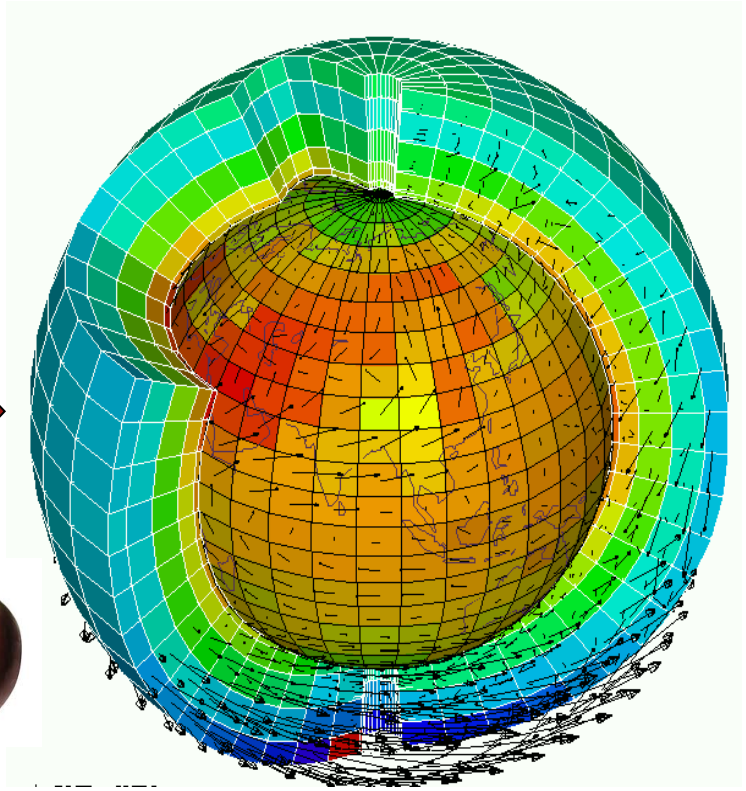
Model grid variables
(e.g. temp, water vapour, wind, etc)

Retrieve model variables

Compare in model space

Need for Obs Simulators

?



Geophysical measurements
(e.g. radiance, bending angle)

Model grid variables
(e.g. temp, water vapour, wind, etc)

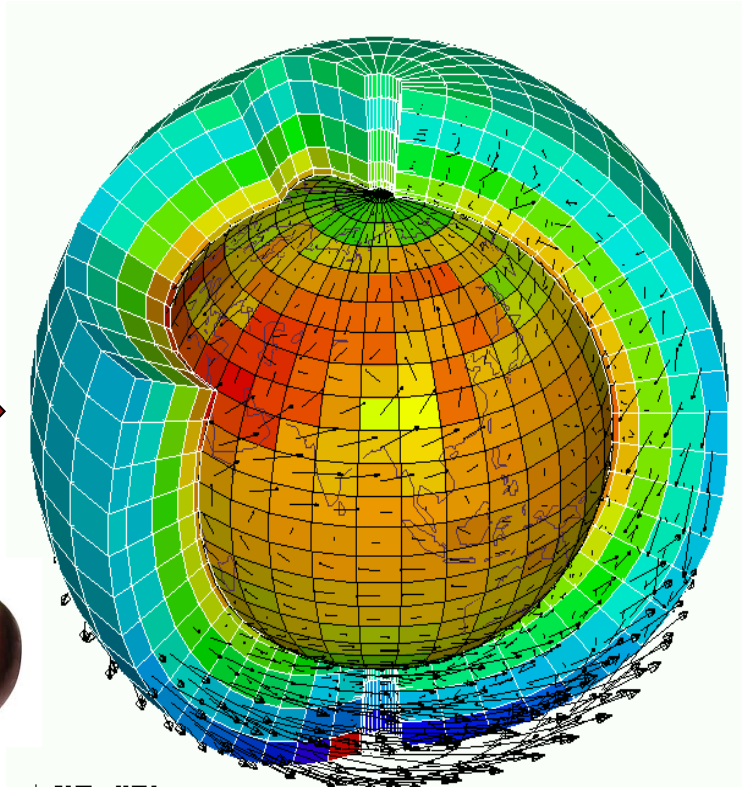
Compare measured and simulated measurements

Compute satellite measurements using simulator (e.g. COSP)

Need for Obs Simulators

Geophysical measurements
(e.g. radiance, bending angle)

?



Model grid variables
(e.g. temp, water vapour, wind, etc)

Both approaches are useful depending on the ECV

CFMIP Observation Simulator Package

COSP

Satellite simulation software for model assessment

BY A. BODAS-SALCEDO, M. J. WEBB, S. BONY, H. CHEPFER, J.-L. DUFRESNE, S. A. KLEIN, Y. ZHANG, R. MARCHAND, J. M. HAYNES, R. PINCUS, AND V. O. JOHN

By simulating the observations of multiple satellite instruments, COSP enables quantitative evaluation of clouds, humidity, and precipitation processes in diverse numerical models.

CFMIP web: http://www.cfmip.net/ -> COSP

User group: http://groups.google.com/group/cosp-user

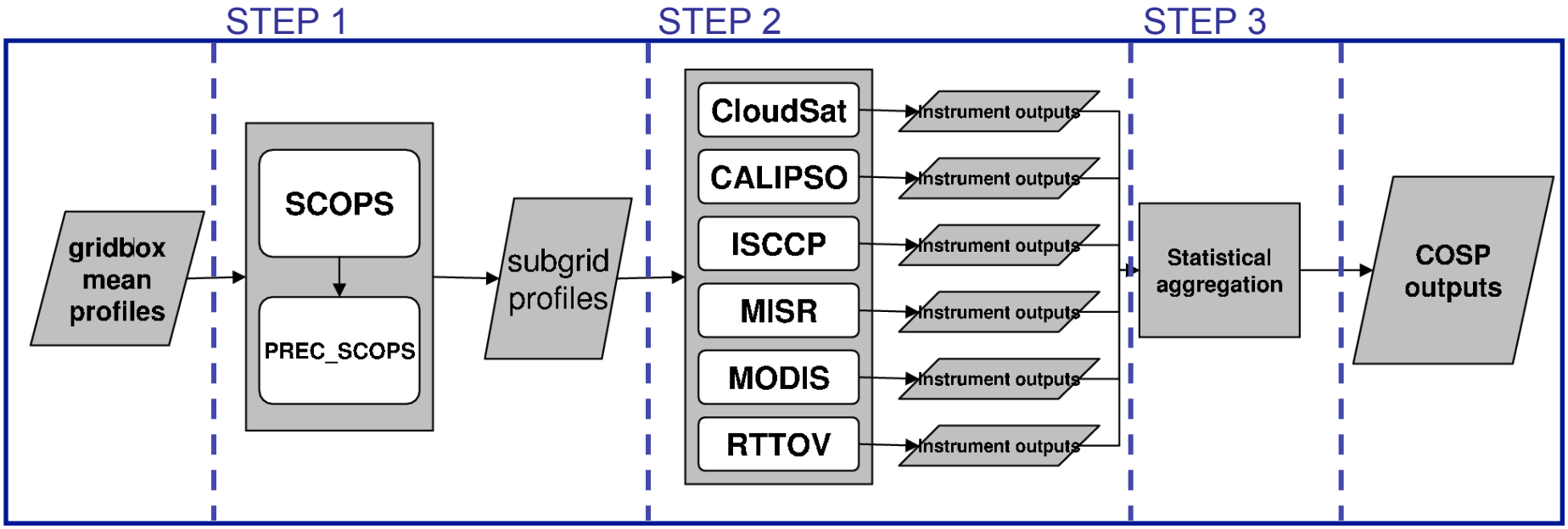
Code: http://code.google.com/p/cfmip-obs-sim/

(Bodas-Salcedo et al., BAMS, 2011)

COSP

CFMIP Observation Simulator Package

- Used in the CFMIP2 and CMIP5 experiments



CFMIP web: http://cfmip.metoffice.com/COSP.html

User group: http://groups.google.com/group/cosp-user

Code: http://code.google.com/p/cfmip-obs-sim/

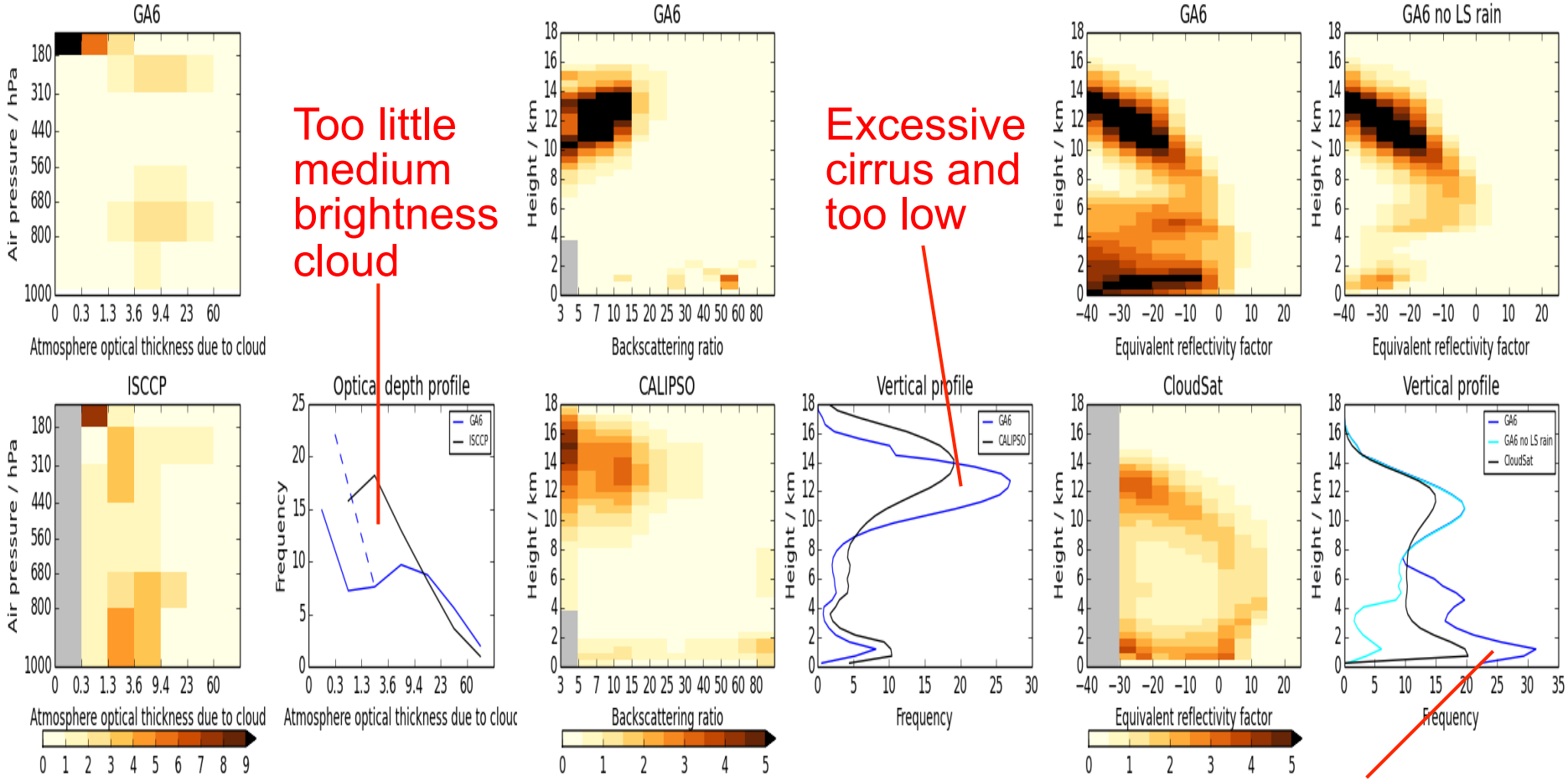
(Bodas-Salcedo et al., BAMS, 2011)

Comparison against satellite data over the tropics

ISCCP

CALIPSO

CloudSat

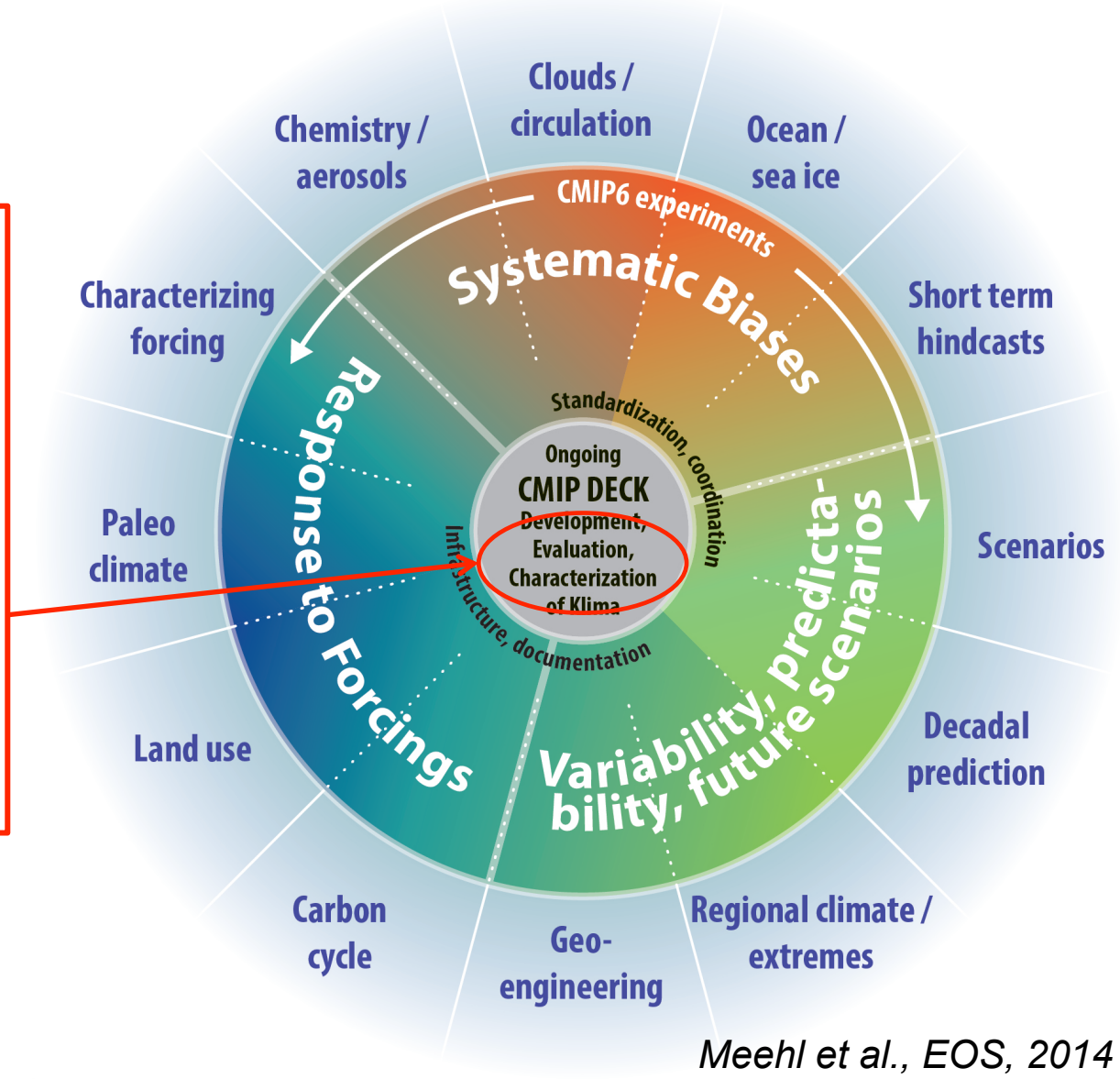


(Courtesy K. Williams)

WCRP Grand Challenges: (1) Clouds, circulation and climate sensitivity, (2) Changes in cryosphere, (3) Climate extremes, (4) Regional climate information, (5) Regional sea-level rise, and (6) Water availability, plus an additional theme on "biospheric forcings and feedbacks"

Goal

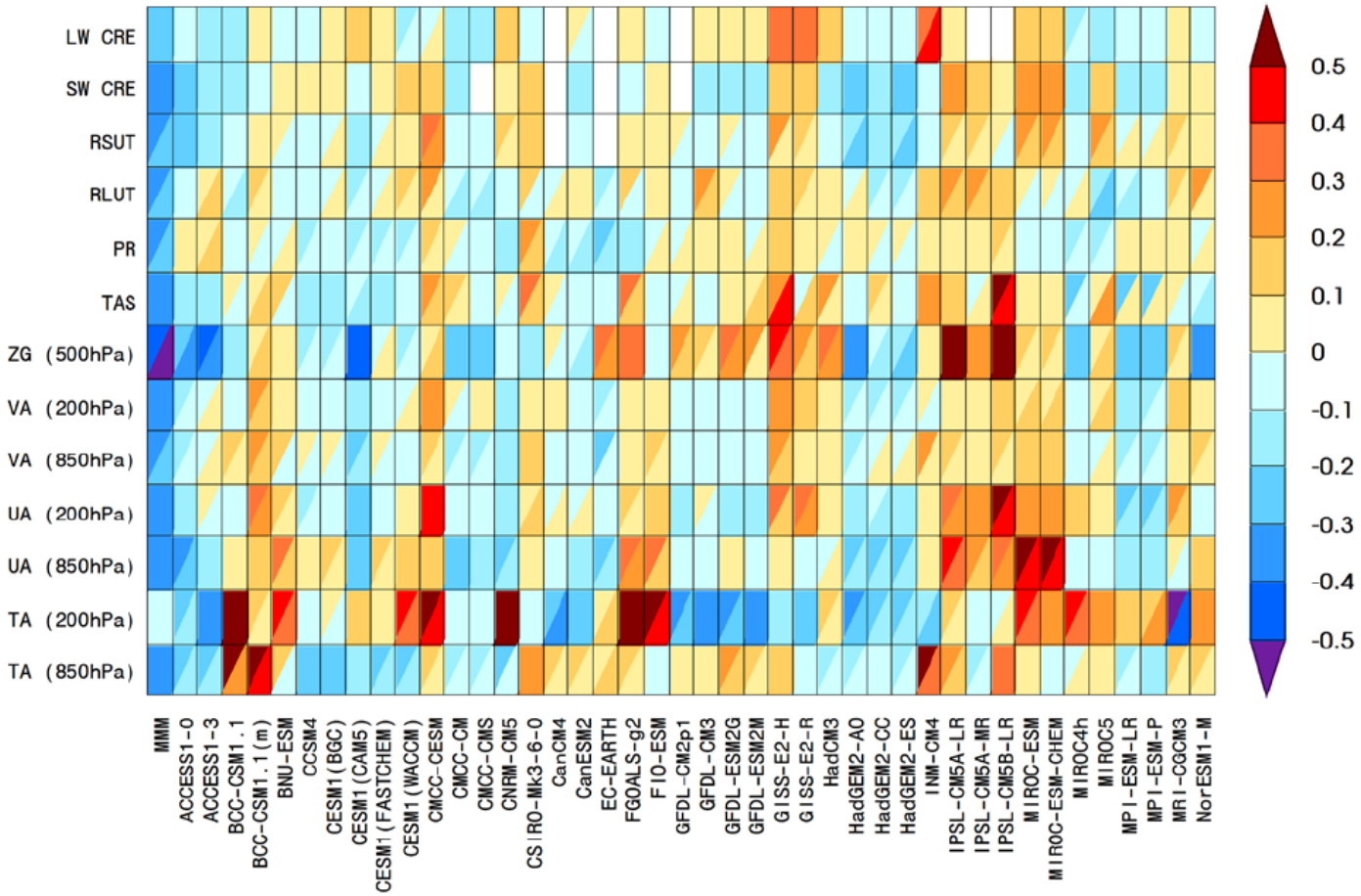
ESMValTool as one of the CMIP documentation functions to routinely assess the performance of CMIP DECK and CMIP6 simulations running alongside the ESGF



Meehl et al., EOS, 2014

DLR

Performance Metrics for Climate Models



- Relative error measures of CMIP5 model performance, based on the global seasonal-cycle climatology (1980–2005) computed from the historical CMIP5 experiments. Figure 9.8 of IPCC AR5 (Flato et al., 2013).
- A similar figure will be **produced for selected ESA CCI ECVs using ESA CCI as the reference data set** and if available an alternate observational data set for comparison.

DLR

Questions to Address

- What is currently available and how is it (or could be) used for climate services?

- What kind of input data, tools and activities are needed to support further development of these products?

- What could/should be the role of Copernicus in facilitating/harmonising/stimulating this development?

Role of Copernicus Climate Service

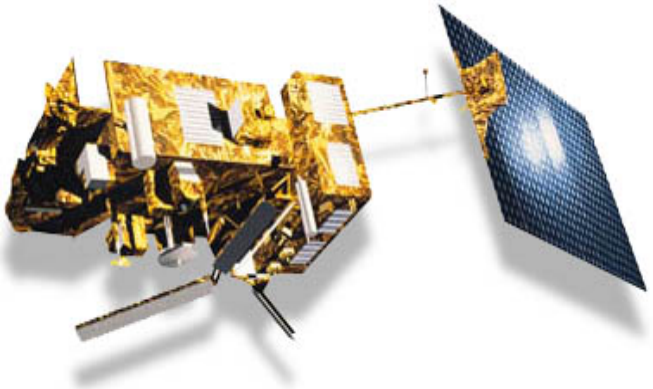
- Maintain user requirements for climate datasets
- Provide framework for routine climate dataset production
- Provide easy access to datasets and documentation
- Provide long term data preservation
- Ensure quality of climate datasets are maintained and improved through independent assessments
- Ensure access and/or compatibility with associated tools for post processing, observation simulators etc
- Provide input to future satellite climate program to ensure continuity

Ensuring future ECV measurements

GCOS ECV	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Sensors
Atmospheric																			
Surface precip																			SSMIS, AMSR, MWRI, TRMM, GPM, ATMS, GEO Vis/IR
Surface wind																			ASCAT, OSCAT, HY-2, RapidScat, WindRAD
TOA radn budget																			CERES, EarthCARE, SCARAB, RBI
Solar irradiance																			TSIS, ACRIM, SORCE, Picard
Temp profile																			Sounder radiances, GPS-RO
Water vapour profile																			Sounder radiances, GPS-ZTD
Wind profile																			AMVs, ADM
Cloud properties																			Cloudsat, EarthCare, VIS/IR imagers (GEO/LEO)
Carbon dioxide																			AIRS, IASI,OCO-2/3,CRIS, GOSAT, GAS
Methane																			AIRS, IASI, GOSAT, CrIS, MTG-IRS, Schiamachy, MOPPIT
Ozone																			GOME-2,IASI,AIRS,CRIS, IR, UV limb, OMPS, OMI
Other GHG																			IASI, GOME-2, UV/IR limb, GOSAT, Sentinel-5
Aerosols																			AVHRR, VIIRS, GOME-2, MERIS, MODIS, Sent-4/5, MTG
Oceanic																			
SST																			AATSR, SLSTR, AVHRR, AMSR-2, MODIS, VIIRS, GeoIR
Surface salinity																			SMOS, Aquarius, SMAP
Sea level																			TOPEX,Jason-1,2,3, Sentinel-3 ALT, Sentinel-6
Sea state																			Jason-1,2 Sentinel 3 ALT
Sea-ice																			SSM/I, AMSR, SSMI(S), Cryosat-2, ICESAT-2, SMOS
Currents																			Jason-1,2,3?, Sentinel-3 ALT
Ocean colour																			MERIS, MODIS, VIIRS, OLCI
Terrestrial																			
LST																			AATSR, SLSTR, AVHRR, AMSR, MODIS, VIIRS, CrIS, IASI
Lake levels																			Jason-1,2,3, Sentinel 3 ALT
Snow cover and SWE																			SSMIS, AMSR, AVHRR, MODIS, Geo Imagers
Glaciers and ice caps																			GRACE, Cryosat-2, ICESat, ASTER, Landsat
Permafrost																			MODIS, VIRSS,SAR
Albedo																			AVHRR, MODIS, VIRSS
Land cover (inc veg)																			Sentinel-2, MODIS, VIRSS, Landsat, TerraSAR
fAPAR																			MODIS, VIRSS, MERIS, Sentinel-2
LAI																			MODIS, VIRSS, MERIS, Sentinel-2
Biomass																			Sent
Fire																			Geo
Soil moisture																			ASC
Ground water																			GRA

Key

Good capability	
Some capability but needs improvement	
Poor capability	
Capability lost	
Capability reduced	
No capability	



We don’t want users of climate datasets to be like this!

But like this!

Met Office

CM SAF CDRs and System Maturity Matrix (1 lowest; 6 highest)

#	Climate Data Record	Software Readiness	Meta data	User document ation	Un certainty characteri zation	Public access, feedback and update	usage
1	**Fundamental Climate Data Record of SSM/I Brightness Temperatures** http://dx.doi.org/10.5676/EUM_SAF_CM/FCDR_SSMI/V001	1 - 4	5 – 6	2 – 5	3 – 5	4 - 5	1 - 2
2	**MVIRI+SEVIRI free tropospheric humidity (FTH) dataset** http://dx.doi.org/10.5676/EUM_SAF_CM/FTH_METEOSAT/V001	1 - 3	5 -6	3 - 5	3 - 4	4 - 5	2 - 3
3	**Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data HOAPS 3.2** http://dx.doi.org/10.5676/EUM_SAF_CM/HOAPS/V001	1 - 5	5	4 - 5	2 - 4	4 - 5	2 - 4
4	**CM SAF Surface Radiation MVIRI Data Set 1.0** http://dx.doi.org/10.5676/EUM_SAF_CM/RAD_MVIRI/V001	2 – 4	4 – 6	5 – 6	3 – 4	5 – 6	4 - 5
5	**CM SAF Clouds, Albedo and Radiation dataset from AVHRR data** http://dx.doi.org/10.5676/EUM_SAF_CM/CLARA_A/V001	3 – 5	4 – 5	4 – 5	3 – 4	5	2 - 4
6	**CM SAF ToA Radiation „GERB“ dataset - Edition1** http://dx.doi.org/10.5676/EUM_SAF_CM/TOA_GERB/V001	2-5	4-5	3-4	3-4	5	2-3
7	**CM SAF CLoud property dAtAset using SEVIRI (CLAAS), edition 1** http://dx.doi.org/10.5676/EUM_SAF_CM/CLAAS/V001	2-4	3-4	4-5	4	5	1-4
8	**MVIRI+SEVIRI free tropospheric humidity (FTH) dataset** http://dx.doi.org/10.5676/EUM_SAF_CM/FTH_METEOSAT/V001	1-4	3-4	3-5	3-4	3-5	4-5
9	**Surface Solar Radiation Data Set - Heliosat (SARAH)** http://dx.doi.org/10.5676/EUM_SAF_CM/SARAH/V001	3-4	3-5	4-6	3-4	5	4-5
10	**Fundamental Climate Data Redord of SSMI / SSMIS Brightness Temperatures** http://dx.doi.org/10.5676/EUM_SAF/FCDR_MWI/V002	1 - 4	5 – 6	2 – 5	3 – 5	4 - 5	1 - 2