

GEWEX Data and Assessment Panel

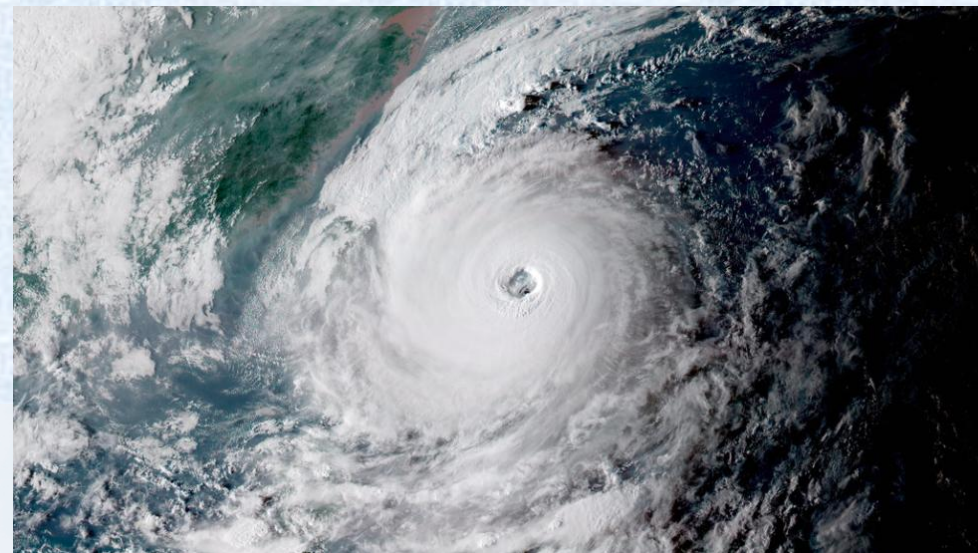
Jörg Schulz, Chair

Matthew McCabe, Vice Chair

Credits to all GDAP members, data project
and assessment leads and reviewers

GDAP Annual Meeting 2015

XIAMEN, CHINA, 29 Sep – 1 Oct 2015

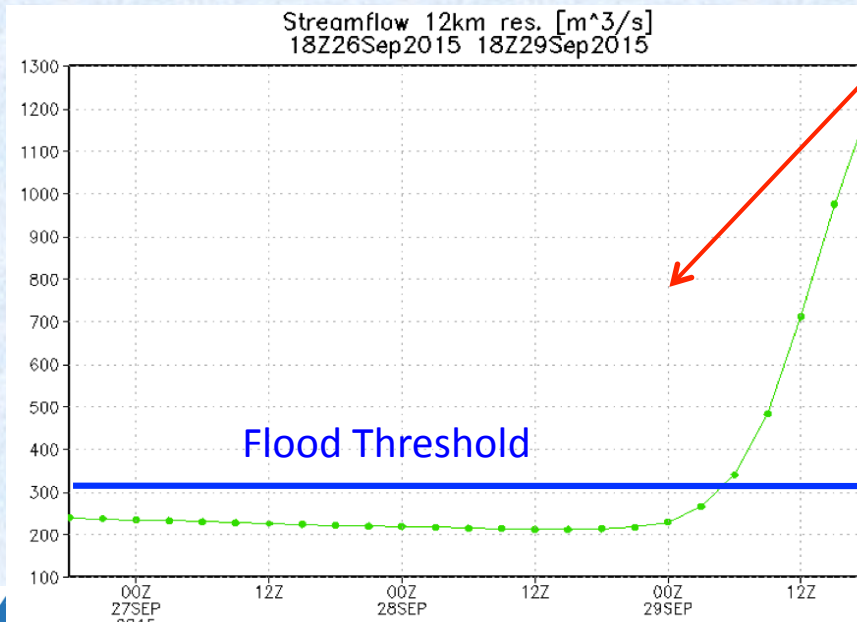
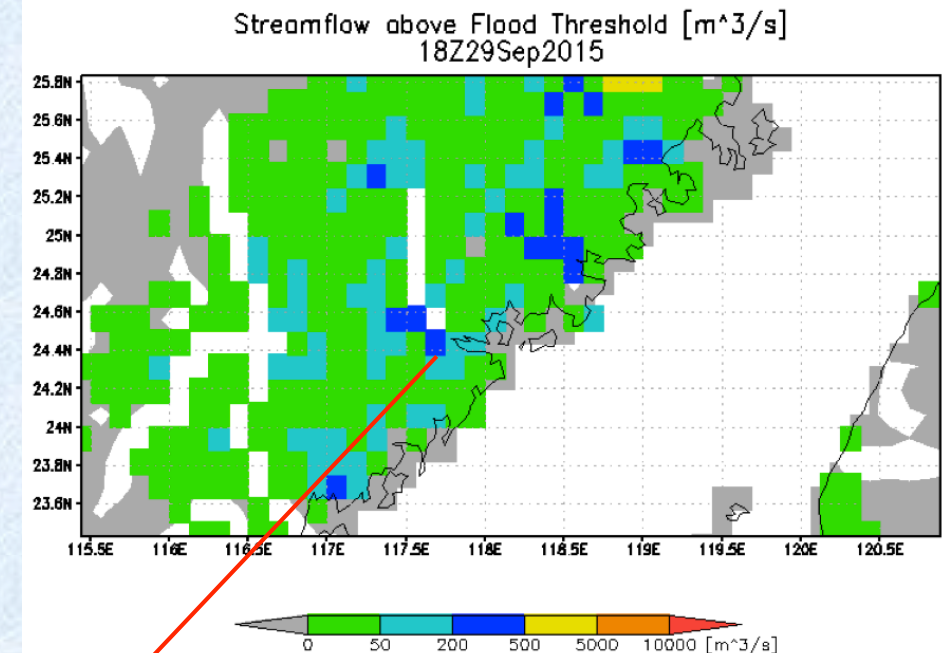
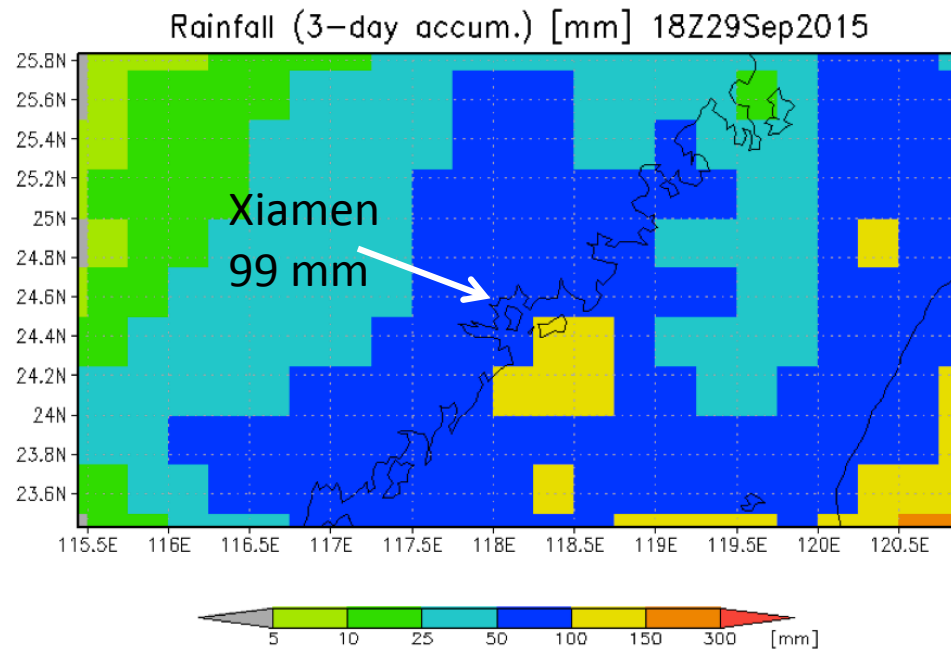


Credit: CIRA/RAMMB/Himawari



Threatened by tropical storm Dujan

Satellite Rainfall and Flooding in Xiamen Vicinity from GPCP



Satellite rainfall (TMPA/3B42)
into global flood model in “real-time”.

flood.umd.edu U. of Maryland

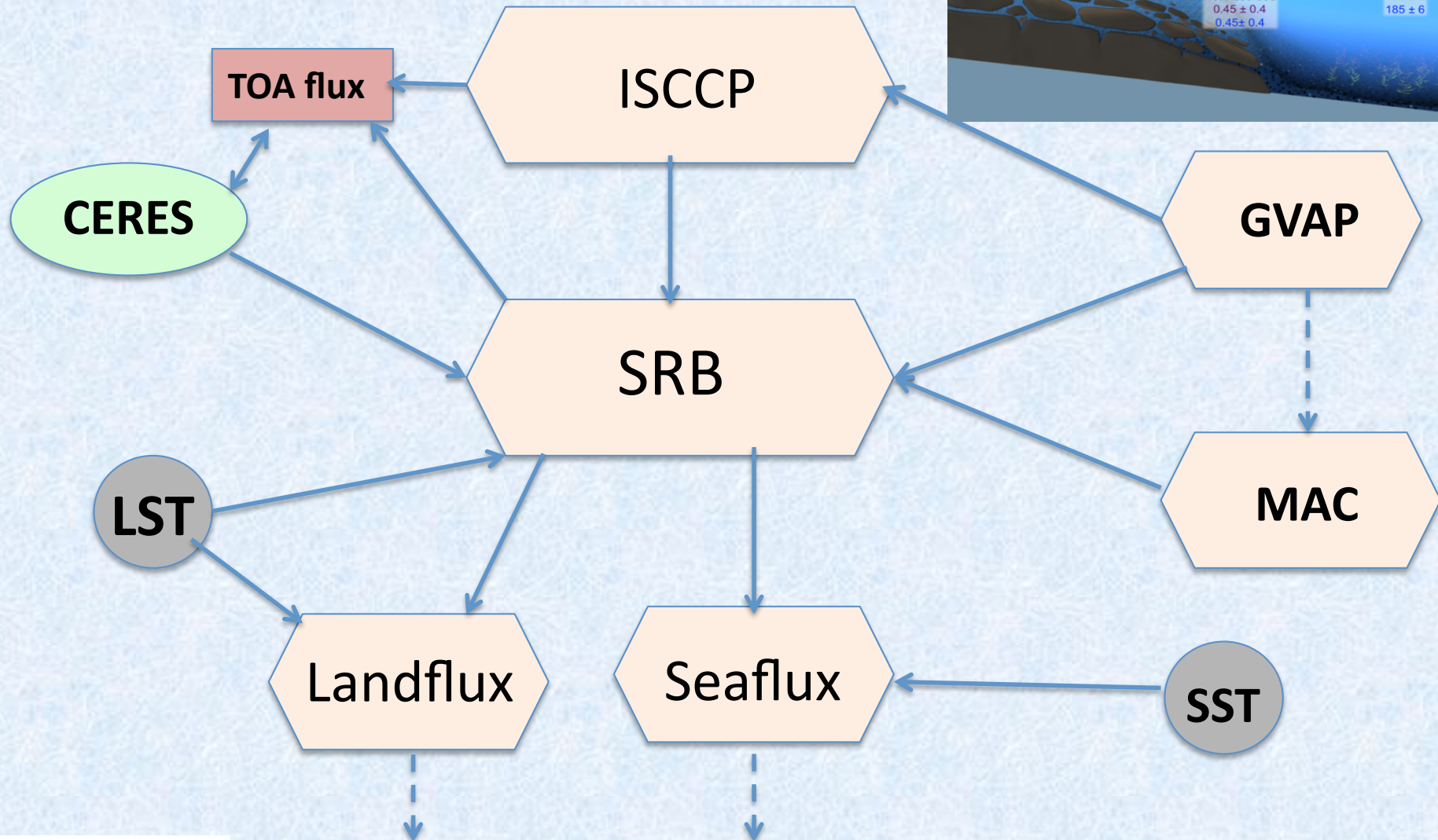
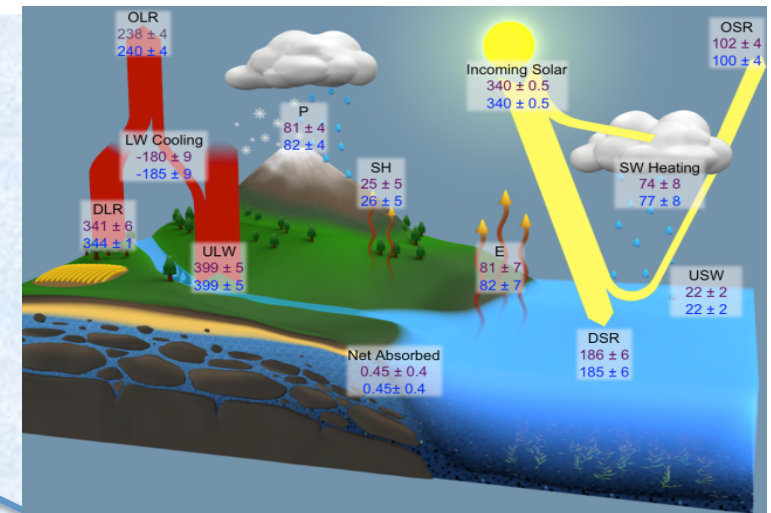
GDAP Product Status

Data Products

- ISCCP: V1 (1983-2009), V2 pending (2000-2009 becoming available end of 2016)
- MPI Aerosol Climatology (MAC) – model ensemble calibrated with Aeronet (1860-2010, 2013 v1, 2015 v2)
- SRB (improvements to previous versions are ongoing)
- GPCP (new version in early 2016 to replace Version 2.2 with calibration of satellite shifts)
- SEAFLUX (1988 – 2007) – ocean turbulent heat fluxes
- LandFlux (1984 – 2007) – land turbulent heat fluxes
- Soil Moisture – multiple sensors and data records (white book in preparation of an assessment)
- Integrated product (ancillary data constructed, awaiting ISCCP to start production)

GDAP product integration

Energy wiring diagram



Data Assessments

- Water Vapor (5th G-VAP workshop, Final assessment draft to GDAP in August 2016. The 6th meeting will take place at EUMETSAT headquarters on 22-23 September 2016);
- Aerosol (report completed at the 2015 GDAP meeting, but could not be published because it has no clearance);
- Precipitation (Kick-off meeting planned in autumn 2016 at the GDAP annual meeting. 1st interim report planned for 2018);
- Soil Moisture (a **validation white book** should be reviewed by GDAP before the 2016 annual meeting).

Ground-based observations

(needed in all assessments)

- BSRN (14th BSRN Science and Review Workshop, 26-29 April, 2016, Bureau of Meteorology, Canberra, Australia). Some concerns about station closures, secured functioning of the data centre at AWI, Germany;
- ISMN (49 networks containing ~ 2050 Stations. Financial support for 2009-June 2016 has come from ESA EOP SMOS but will stop, funding remains issue;
- GPCC

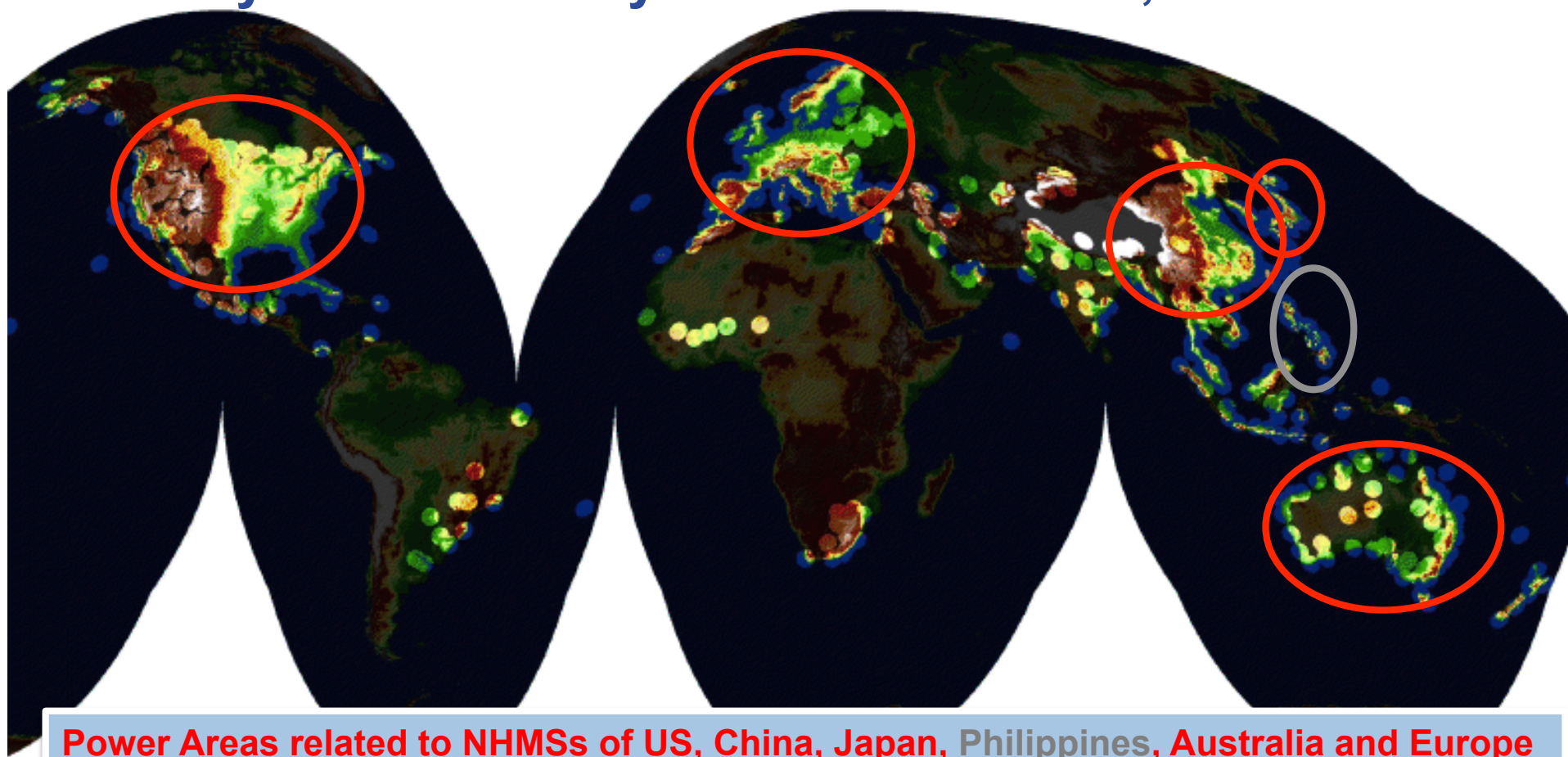
New GDAP Activities

- Use of surface radar for high spatiotemporal precipitation data record (first workshop planned for 2017/18 considering user needs, e.g., GC Extremes and Water Availability, , data availability and quality, nomenclature, and correction methodology);
- Upper Tropospheric Clouds and Convection Process Evaluation Study (UTTC) PROES (first workshop was held on 16 Nov 2015 in Paris, fall 2016 in New York). The goal of the GEWEX PROES activities is to provide observational based metrics for a better understanding of climate related physical processes;
- Uncertainty Analysis for satellite data records (some European projects such as FIDUCEO, GAIA-CLIM addressing metrological approaches to characterise ground-based reference and satellite data).

World wide weather radar coverage

Courtesy of Andreas Becker, DWD

> 800 systems listed by Heistermann et al., 2013



Power Areas related to NHMSs of US, China, Japan, Philippines, Australia and Europe

<http://www.hydrol-earth-syst-sci.net/17/863/2013/hess-17-863-2013.pdf>

Heistermann et al. (2013), HESS

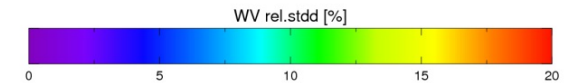
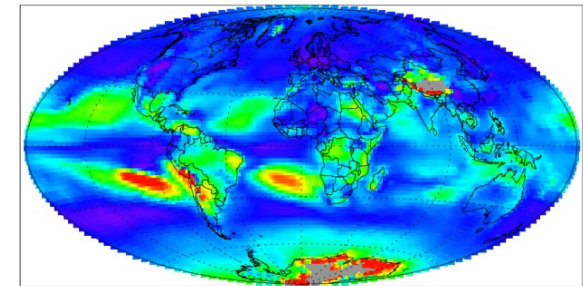
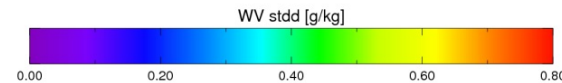
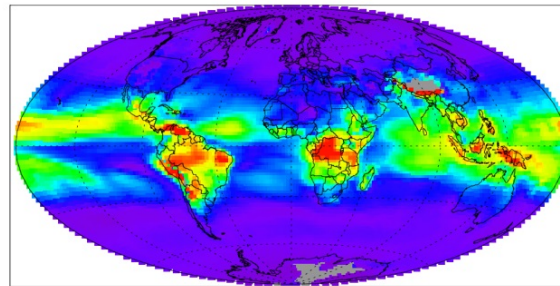
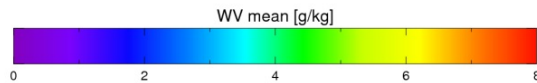
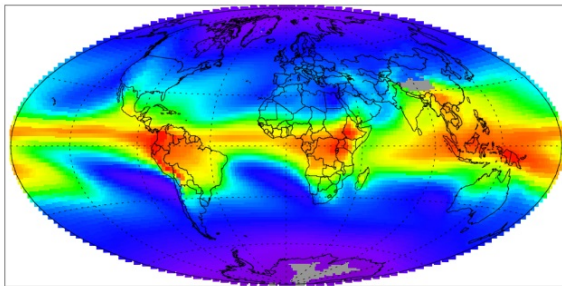
ASSESSMENTS AND UNCERTAINTY CHARACTERISATION

Water Vapour assessment G-VAP

- The major purpose of GEWEX water vapour assessment (G-VAP) is to quantify the state of the art in water vapour products (total column, profiles, upper troposphere) being constructed for climate applications;
- Support the selection process of suitable water vapour products by the GEWEX Data and Assessments Panel (GDAP) for its production of globally consistent water and energy cycle products.
- Further details, in particular the assessment plan with a description of the scope and the Science Questions and an overview of available water vapour records, are available on the G-VAP webpage, <http://gewex-vap.org>.

Global profile comparison

WV ensemble 700hPa



CFSR, ERA-Interim, JRA55, MERRA, and nnHIRS at 700 hPa: ensemble mean (left) as well as standard deviation (centre) and relative standard deviation (right) relative to the ensemble mean.

Maximum differences found in stratus/subsidence regions – points to differences in boundary layer height

Water Vapour related to Extreme Precipitation

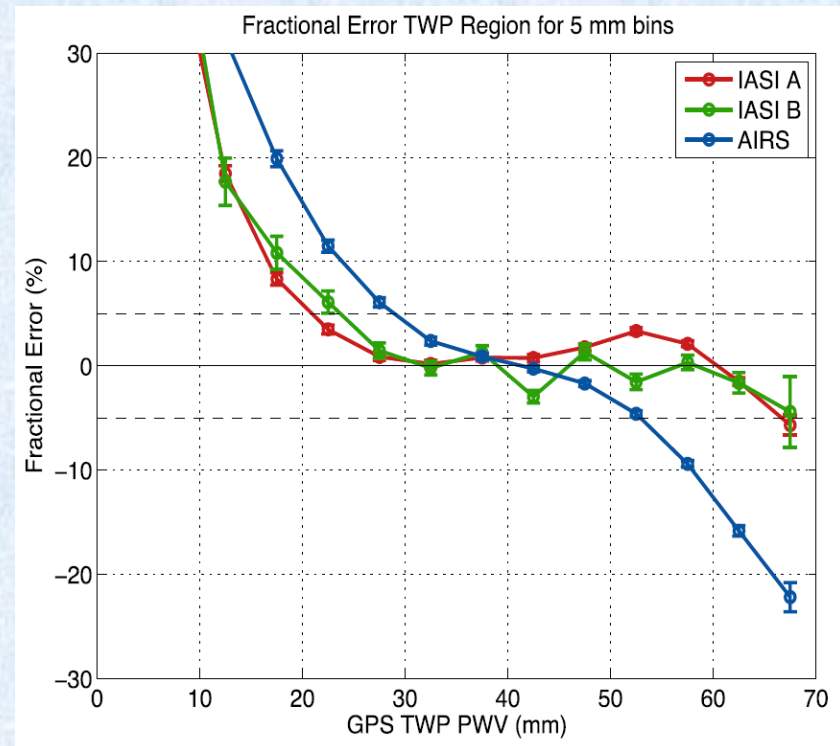
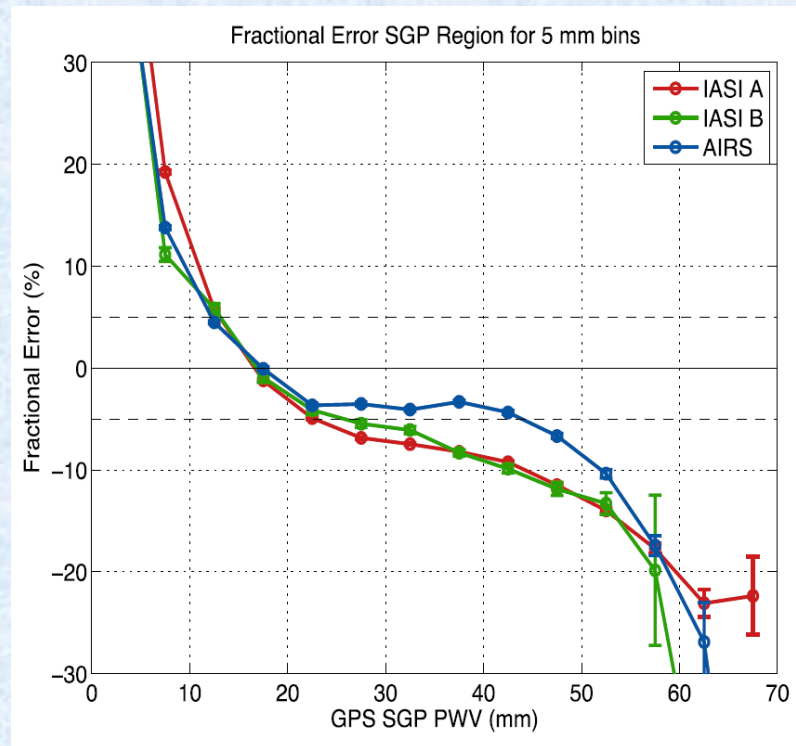


Figure 2: Fractional error in % as a function of precipitable water vapour observations with GPS at the ARM Southern Great Plains (left) and Tropical Western Pacific-Darwin (right) stations. Results are shown for NASA AIRS version 6 as well as EUMETSAT IASI version 6 applied to METOP-A and METOP-B. The dashed horizontal line marks 5% fractional error.

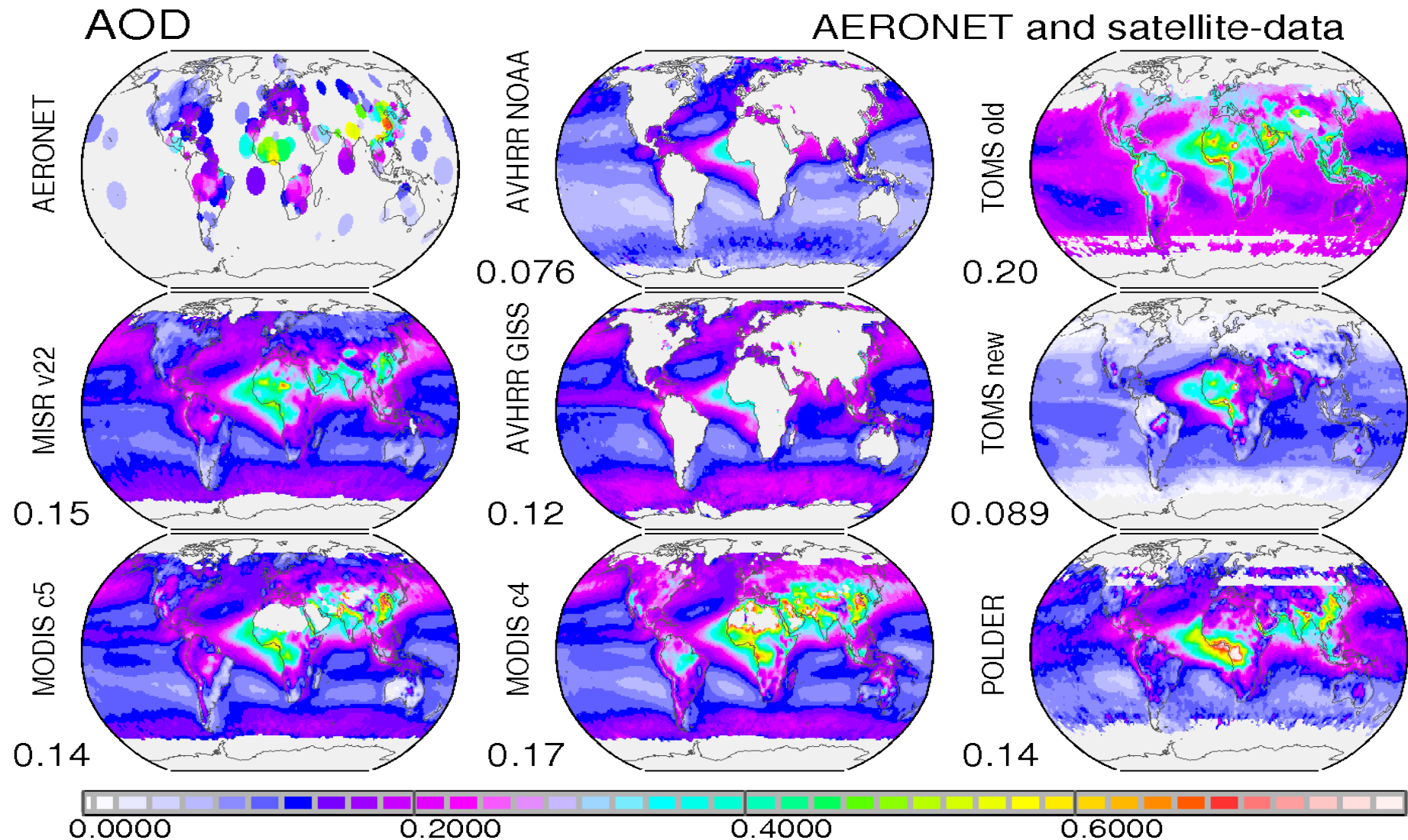
Outcomes of 5th G-VAP workshop

- Space Science and Engineering Center (SSEC), University of Wisconsin, Madison, WI, USA 4-5 November 2015, 25 participants;
- Updated plan for drafting the WCRP report and the freezing of the data archive have been confirmed by the workshop:
 - Final draft to GDAP and SSG in August 2016;
- The release of collocated data and data on common grid by G-VAP was endorsed (some limitations may apply);
- The proposal to continue G-VAP was well received and the participants are willing to support G-VAP in the future.
- More recommendations are provided in the minutes of meeting, see <http://gewex-vap.org>.
- The 6th meeting will take place at EUMETSAT headquarters on 22-23 September 2016.

Aerosol assessment report

- “ a critical review of the efficacy of commonly used Aerosol Optical Thickness retrievals: Literature assessment “ (160 pages ... w/o ref.)
 - fundamentals
 - methods, limitations, error sources
 - assessed products
 - AVHRR, MISR, MODIS, OMI, POLDER
 - evaluations
 - vs sunphoto., vs other retrievals, vs modeling
 - applications
 - climatology, trend, assimil., process underst..

Assessed products



Evaluation – to remember

- a good surface (reflectance) characterization is a key (MISR and GRASP, MAIAC, METEOSAT)
- simple is not always bad (AVHRR-NOAA)
- continual evaluation/retrieval update efforts pay out (cont. improvement MODIS 4 →5 →6)
- data combination can combine strength/ close gaps (MODIS deep blue and dark target)
- but even a composite (combining regional retrieval strength) is far from close to perfect

Usefulness – it is not just quality

- **the usefulness depends on the application**
(relative change may not require highest accuracy)
- **aside quality also repeated coverage matters**
(2MODIS offer 10times more data than 1MISR and GEO offers 10*times more than MODIS)
- **near-real-time (NRT) provision may be needed**
- **data assimilation require NRT and a data associated ERROR** (direction for future efforts)
- **observed links** (e.g. cloud, precip) **would be nice**

Executive highlights

- **Important elements**
 - verification networks (AERONET, MPL-net)
 - communication with users (ICAP, AeroCom including AeroSat)
 - continued support for retrieval efforts pays off
- **future directions**
 - AOT (pixel) retrievals have to be associated with an uncertainty and assumptions made
 - AOT is only 1 of many relevant aerosol properties ... combine temporal variability and advanced sensor (polarization, multi-angle, spectral)

GDAP Precipitation Assessment Plan

- ▶ Need for a new precipitation assessment
 - ▶ Increasing availability of precipitation products
 - ▶ Unsolved discrepancies between global models and satellite estimates
 - ▶ Recent satellite programs such as GPM
- ▶ Lessons learned from previous assessments
 - ▶ Past GRP/GDAP Assessment Reports, while thorough and detailed, took nearly a decade to complete.
 - ▶ It is desired, however, to address the urgent needs of broad science community in a timely manner.
- ▶ Strategies for timely delivery of assessment reports
 - ▶ **1)** *Publish a series of concise interim reports.*
 - ▶ **2)** *Identify the foci of assessment in advance.*



Precipitation Assessment foci

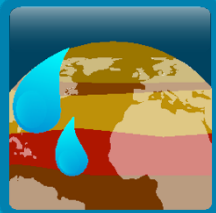
- ▶ The list of prioritized foci for the assessment
 - ▶ **1)** *Global and Regional Climatology (long-term mean and trend)*
 - ▶ with focus on the regionally dependent sources of uncertainty.
 - ▶ **2)** *Time series analysis in the context of different modes of climate variability*
 - ▶ Diurnal, intra-seasonal, seasonal, inter-annual, etc.
 - ▶ **3)** *Extremes*
 - ▶ **4)** *Frozen precipitation*
 - ▶ Snow and mixed-phase precipitation
 - ▶ **5)** *Structural Errors*
 - ▶ Errors that are not eliminated by temporal/spatial averaging.



Additional Elements and Timeline

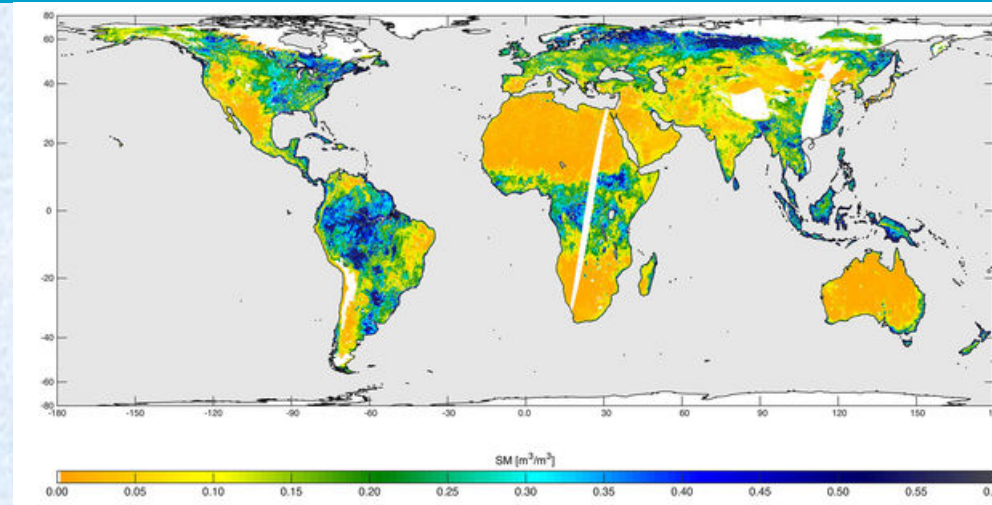
- ▶ Considered data should contain measurements to constrain precipitation such as GRACE in polar areas, surface salinity for long term freshwater budget, soil moisture as potential rain gauge, and moisture transport derived from re-analysis.
- ▶ Connect to GHP Mounterrain, INARCH, etc. projects needs to be established by assessment lead;
- ▶ Suggested to shorten own analysis and take benefit from literature, but comparisons have been done in an inhomogeneous way.
- ▶ The topic frozen precipitation shall be linked with CliC.
- ▶ Autumn 2016: Kick off meeting connected with GDAP annual meeting;
- ▶ By end of 2016: Selection of datasets (reviewed by GDAP);
- ▶ 2018: 1st interim report on first focus area

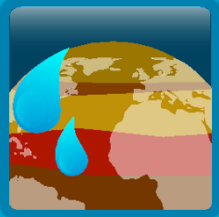




Soil moisture

- SMAP launched on Jan 31, 2015
 - L-band Radiometer works well
 - Radar failed in July, so no high resolution (3, 9 km²) products possible
- Soil moisture from highres **Sentinel-1** increasingly in the focus
- New, quasi-operational soil moisture products for **SMOS (LPRM)**
- New, quasi-operational soil moisture products from **AMSR2, Feng-Yun 1B**
- **Metop-SG** planned for launch in 2021/22, providing continuation of MetOp **ASCAT** after 2025)
- **ESA CCI multi-satellite soil moisture** product has been updated and serves over 1800 registered users: currently THE state-of-the art multi-satellite SM product and “precursor GEWEX benchmark dataset”
- **No single dataset = truth**
- > **Assessment needed towards applications**





Towards SM dataset assessment

- Uncertainty characterisation has many flavours, allowing everyone to cherry pick according to one's needs;
- Therefore, agreements on specific set out is needed:
 - What shall be evaluated? *Absolute soil moisture? Anomalies? Spatial patterns?*
 - Which metrics? *Correlation, (unbiased) RMSD, signal-to-noise ratio, error variance, trends, range, mean, bias etc.*
 - Which reference data? *In situ, reanalysis, ancillary (e.g. Precipitation?)*
 - At which spatial scales? *Native pixel, land surface model, climate model resolution?*
 - At which temporal scales? *Native, daily, monthly, yearly, etc.?*
 - How to deal with systematic differences? *Use scaling? If so, how?*



Towards SM dataset assessment

- To achieve general consensus Wouter Dorigo initiated the ISSI International Team “Adding value to soil moisture information for climate studies”
 - First meeting in November 2014
 - Second meeting in November 2015
- Group planned to draft a **validation whitebook** with a selected group scientists (2015) which is discussed and iterated with the soil moisture community at large in 2016 (e.g SMAP cal/val + SM workshop in Feb. 2016);
- The consented whitebook will be used as the **official guideline for a soil moisture assessment activity** to be kicked off in autumn 2016;
- Whitebook will be reviewed by GDAP for 2016 annual meeting.



FIDUCEO has received funding from the European Union's Horizon 2020 Programme for Research and Innovation, under Grant Agreement no. 638822



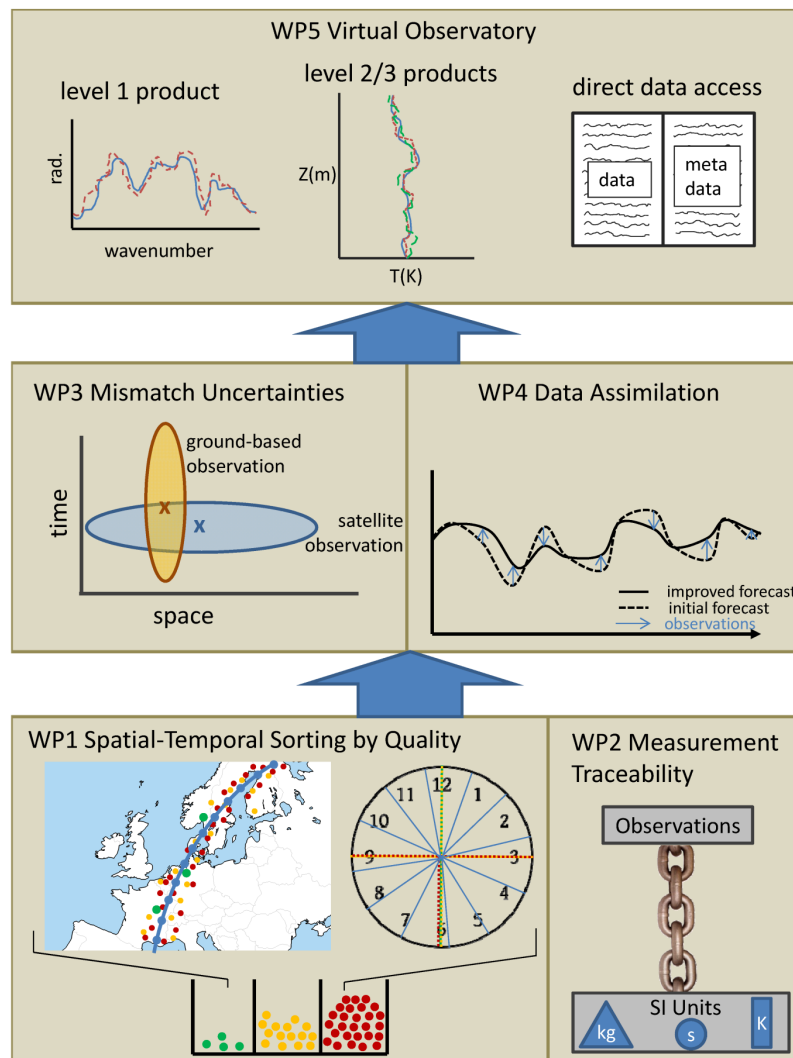
Two European Union Horizon 2020 Research Projects addressing the characterisation of uncertainty for:

1. Historic satellite data records: **FIDelity and Uncertainty in Climate data records from Earth Observations (FIDUCEO)**
2. Ground-based reference networks: **Gap Analysis for Integrated Atmospheric ECV CLimate Monitoring (GAIA-CLIM)**



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 640276.

www.gaia-clim.eu



- Define data quality attributes and map by capabilities
- Improve metrological quantification of in-situ ground-based and sub-orbital measurements
- Robustly quantify the impacts of inevitable measurement mismatches
- Use Data Assimilation to improve the usefulness of high quality measurements
- Provide useable and actionable information to end users to improve the value of both satellite and non-satellite data



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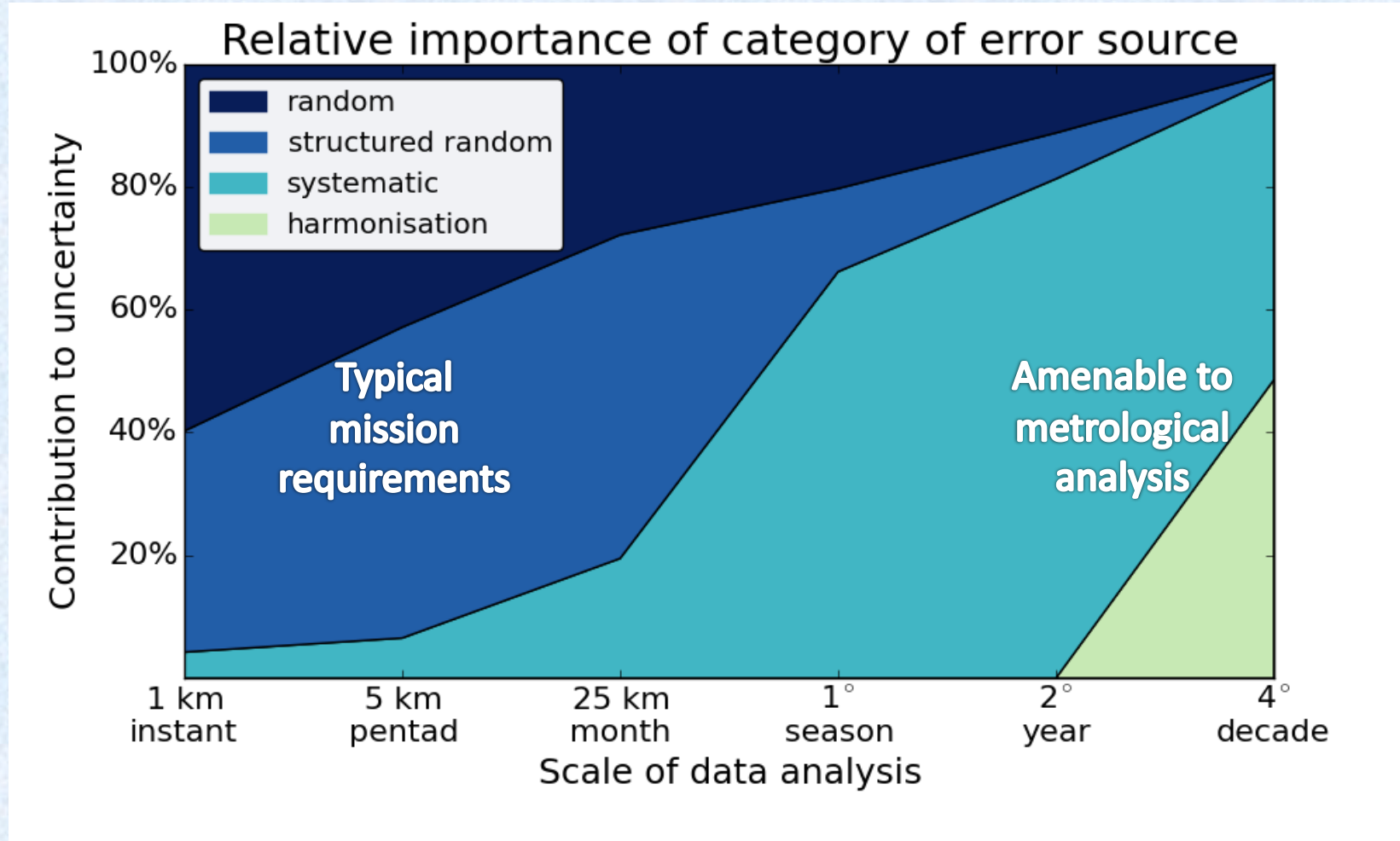
www.gaia-clim.eu

FIDUCEO



- **Key idea:** develop a widely applicable basis for the **metrology of Earth observation** including historical satellite missions
- The **motivation** is to establish “uncertainty-quantified” evidence base for long-term climate and environmental change from EO systems

Why consider **all** types of uncertainty?



If you compare two measurements on different space-time scales the dominant sources of uncertainty in that difference change.

See blog article <http://www.fiduceo.eu/node/237>

FCDR Data

Available by 2017

DATASET	NATURE	USE
AVHRR FCDR	Harmonised infra-red radiances and best available reflectance radiances, 1982 - 2016	SST, LSWT, aerosol, LST, phenology, cloud properties, surface reflectance ...
HIRS FCDR	Harmonised infra-red radiances, 1982 - 2016	Atmospheric humidity, NWP re-analysis, stratospheric aerosol ...
MW Sounder FCDR	Harmonised microwave BTs for AMSU-B and equivalent channels, 1992 – 2016	Atmospheric humidity, NWP re-analysis ...
Meteosat VIS FCDR	Improved visible spectral response functions and radiance 1982 to 2016	Albedo, aerosol, NWP re-analysis, cloud, wind motion vectors,...

- The FCDRs are very relevant for future realisations of GEWEX data products.