Global Energy and Water Exchanges Project

GEWEX

WCRP

WCRP World Climate Research Programme

WMO IOC ICSU International Council for Science

GEWEX DATA ANALYSIS PANEL

An overview

Report for SSG-30

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and

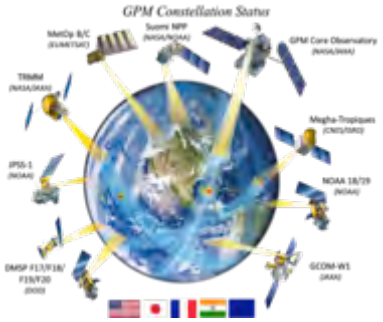
Tristan L'Ecuyer (UW-AOS)
tristan@aos.wisc.edu

A New GDAP Vision

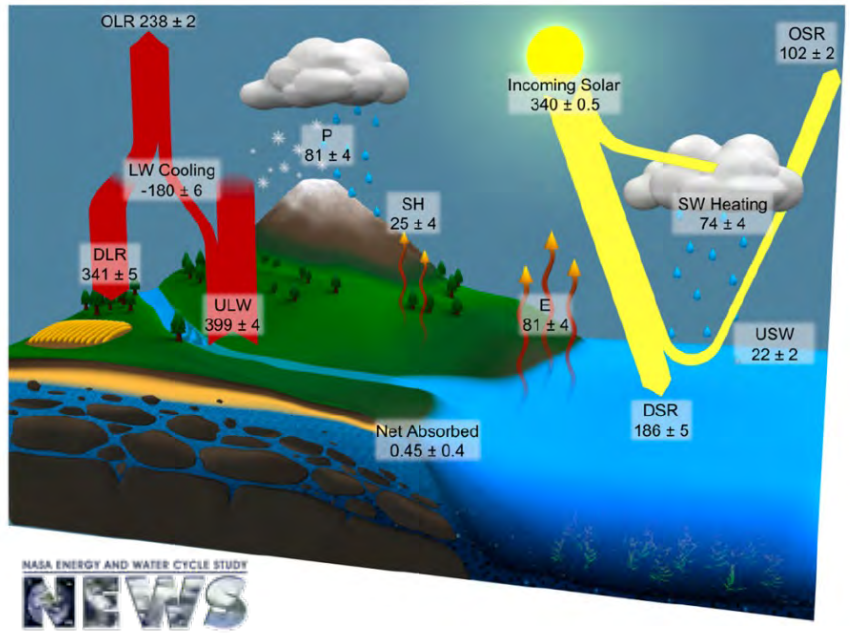
Consistency as a way of life

An integrated approach to energy-water-mass consistency based on refined uncertainty characterization

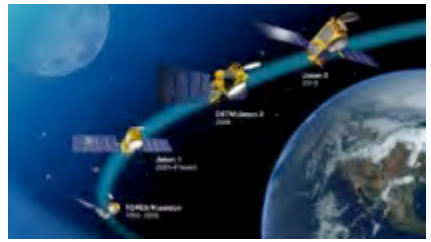
Precipitation



Radiation

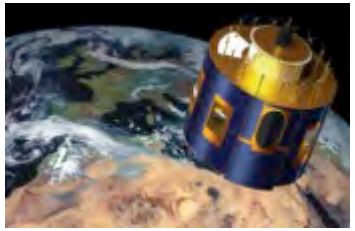


Sea level

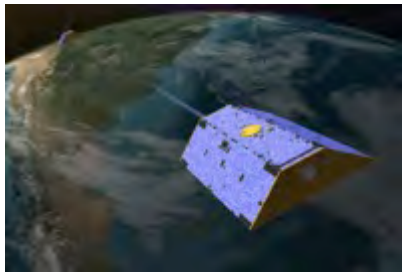


Surface Flux

Cloud



Gravimetry



A mission

Run Core buissness

- Sponsor **production and analysis** of dataset from satellite (e.g., ISCCP, GPCP)
- Sponsor **assessment of dataset** to improve uncertainty estimation for data records
- Sponsor **ground based network** (e.g., BSRN, GPCC)

Act as an interface between the GEWEX activities and the data

- PROES, GAP, GASS …, Concept-Heat , conference 2018 organisation

Represent GEWEX at various WCRP meetings, WMO and other requests

- From to assess adequacy of observing system to data prize to DOI …..

The GDAP activities portfolio and who's doing what

Panel members
Rémy Roca, chair
Tristan L'Ecuyer, vice-chair
Wouter Dorigo
Andrew Heidinger
Seiji Kato
Christian Kummerow
Hirohiko Masunaga
Isabel Trigo
Claudia Stubenrauch
Tianjun Zhou

2 to be renewed
2 more needed

Invited members
Graeme Stephens SSG Chair
Sonia Seneviratne SSG Chair
Peter van Oevelen IGPO
William Rossow Founder

« GEWEX » datasets production

Paul Stackhouse	Surface Radiation Budget
Bob Adler	Global Precipitation Climatology Project (GPCP)
Stefan Kinne	Global Aerosol Climatology Project (GACP)
Carlos Jimenez	LandFlux
Caroll Ann Clayson	Seaflux
Bill Rossow and NOAA NCEI	ISCCP
P Brown and C Kummerow	GEWEX Merged and Integrated Product

Ground data network

Wouter Dorigo	ISMN
A. Becker and Udo Schneider (DWD)	GPCC
Chuck Long (NOAA)	BSRN
Jim Mather (ARM)	ARM

« GEWEX » Assessments

Claudia Stubenrauch (CNRS)	Clouds
Marc Schröder (DWD)	Water Vapor
Jeffrey Reid (NRL)	Aerosols
Hirohiko Masunaga	Precipitation

GEWEX PROES
Claudia Stubenrauch (CNRS) UTCC
Sue Van Den Heever (CSU) GAP

GDAP in GEWEX and WCRP

- Tristan participated in GAP

- Rémy at the WCRP / **World Data Advisory Council** meeting, in March in Frascati, Italy (report here https://www.wcrp-climate.org/wdac-activities/163-unifying-themes/working-groups-wdac/wdac-activities/wdac-6/1084-wdac-6)
    - Gave an overview of GDAP activity
    - Find out about TIRA and the surface flux TT
    - TIRA, Obs4mip, GCOS/IP, RRR, CEOS/CGMS WG Climate, CEOS/CGMS IPWG

    - Try to promote GDAP needs to TIRA (first meeting set up and cancelled, rescheduled last week but I failed to join the web conference)
    - WDAC has published « Best Pratices for Assessment » (!)

    - Action: Invite SOLAS representative at GDAP meeting. I did but the invitee could not make it
- DATA Prize: it is possible to nominate folks for a prize (not only young not only scientists)
- Request for letters in support of proposals
    - No!
        - **Discussion on Thursday morning**
- Request to report GDAP activity at 2017 IRS conference in South Africa
    - No time !
    - Request to contribute to the next 2020 IRS conference sessions elaboration

- T and R are co-organizers of Concept-Heat meeting in October 2017

The 2017 GDAP meeting, Boulder, CO, USA

Joint with CONCEPT-HEAT meeting
Hosted by K. Threnberth at NCAR facility. Very nice setting and local support from Kevin !
2 days of very busy meeting
Half a day of GDAP centered discussion with only the panel members

All usual activity + new presentations (LST; OHC from Alimetry-GRACE ; TWS)
Next meeting in late Nov 2018 in Portugal hosted by Isabel Trigo

Outline of the presentation

- Endorsed data products
- Ground-based networks
- Assessments
- New items and others..

ENDORSED DATA PRODUCTS

1. Cloud (ISCCP)
2. Precipitation (GPCP)
3. Surface turbulent flux (Seaflux)
4. Radiation (surf+ toa) (SRB)
5. Aerosols
6. Land flux
7. Integrated Product
8. Soil moisture

All teams are involved in producing, validating and improving their products

ISCCP Production @ NCEI

NCEI Goals:

To develop the expertise and capabilities to produce, understand, and operationally maintain the International Satellite Cloud Climatology Project (ISCCP) H-Series Climate Data Record.

Additional Goals to sufficiently maintain the product and expand user base

- Understand end-user needs for ISCCP Cloud Products to shore up stakeholder involvement and feedback
- Engage SPC partners to acquire QC'd geostationary data
- Drive and support analysis of climate indicators using ISCCP data products

Review article

09 Aug 2017

The International Satellite Cloud Climatology Project H-Series Climate Data Record Product

Alisa H. Young[1], Kenneth R. Knapp[2], Anand Inamdar[3], William Hankins[2,4], and William B. Rossow[5]

[1]NOAA's National Centers for Environmental Information, 325 S. Broadway, Boulder CO 80305
[2]NOAA's National Centers for Environmental Information, 151 Patton Ave, Asheville NC, 28801
[3]Cooperative Institute for Climate and Satellites, North Carolina State University
[4]ERT, Inc., Asheville, North Carolina, 28801
[5]NOAA/CREST, City College of the City University of New York, New York, New York 1003

Review status

This discussion paper is a preprint. A revision of this manuscript was accepted for the journal Earth System Science Data (ESSD) and is expected to appear here in due course.

Received: 12 Jul 2017 – Accepted for review: 19 Jul 2017 – Discussion started: 09 Aug 2017

Abstract. This paper describes the new global long-term, International Satellite Cloud Climatology Project (ISCCP) H-Series climate data record (CDR). The H-Series data contains a suite of level 2 and level 3 products for monitoring the distribution and variation of cloud and surface properties to better understand the effects of clouds on climate, the radiation budget, and the global hydrologic cycle. This product is currently available for public use and is derived from both geostationary and polar orbiting satellite imaging radiometers with common visible and infrared (IR) channels. The H-Series data spans from July 1983 to Dec 2009 with plans for continued production to extend the record to the present with regular updates. The H-series data are the longest combined geostationary and polar orbiter satellite based CDR of cloud properties. Access to the data is provided in network Common Data Form (netCDF) and archived by NOAA's National Centers for Environmental Information (NCEI) under the satellite Climate Data Record Program (https://doi.org/10.7289/V5QZ281S). The basic characteristics, history, and evolution of the dataset are presented herein with particular emphasis on and discussion of product changes between the H-Series and the widely used predecessor D-Series product which spans from July 1983 through December 2009. Key refinements included to the ISCCP H-Series CDR are based on improved quality control measures, modified ancillary inputs, higher spatial resolution input and output products, calibration refinements, and updated documentation and metadata to bring the H-Series product into compliance with existing standards for climate data records.

Citation: Young, A. H., Knapp, K. R., Inamdar, A., Hankins, W., and Rossow, W. B.: The International Satellite Cloud Climatology Project H-Series Climate Data Record Product, Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2017-73, in review, 2017.

GPCP Global Precipitation Products

Version 2.3

NASA, NOAA, DWD, UMD, GMU, others

- Monthly, 2.5° Merged Analysis (1979-present) *Adler et al. (2003), J. Hydromet.*

  Huffman et al. (2009) GRL

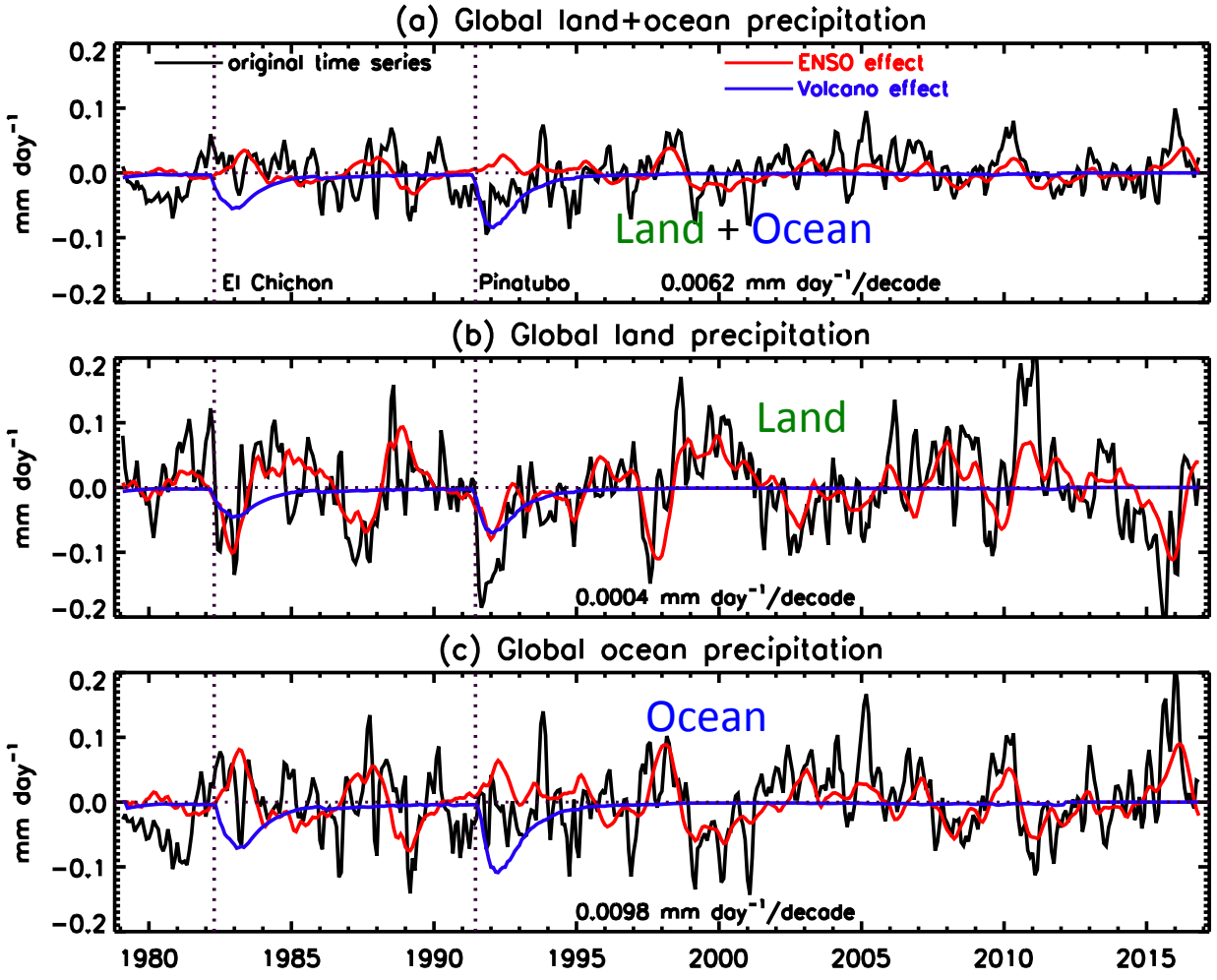
- Pentad, 2.5° Merged Analysis (1979-present) *Xie et al. (2003) J. Climate*

- Daily, 1° Merged Analysis (1997-present) *Huffman et al. (2001) J. Hydromet.*

[although produced using different data sets and algorithms, products are integrated,i.e. they add up]

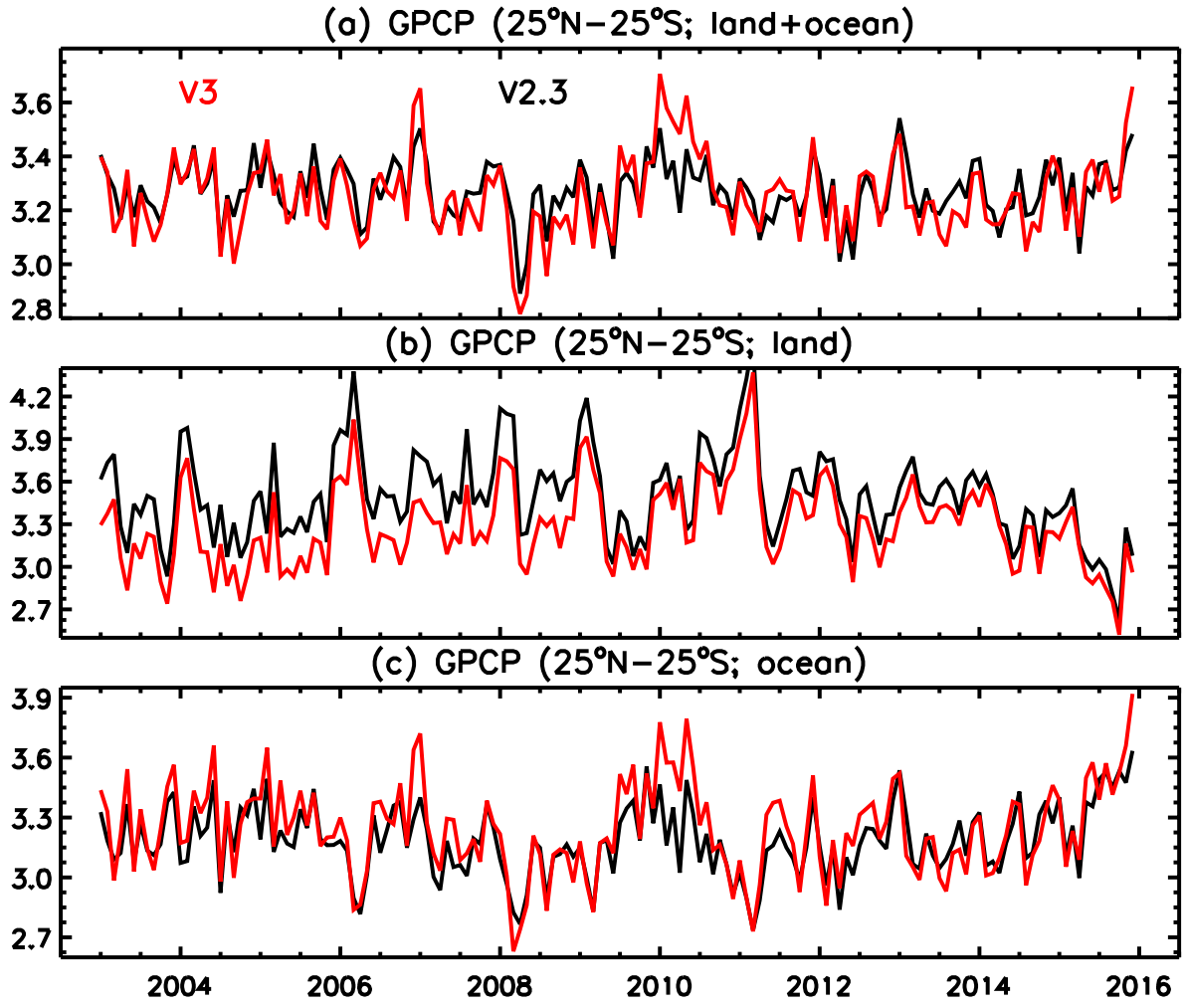
normally produced ~ 3 months after observation time

Global Precipitation (1979-2016)



Updated from Adler et al. (2017) Rev. Geophys.

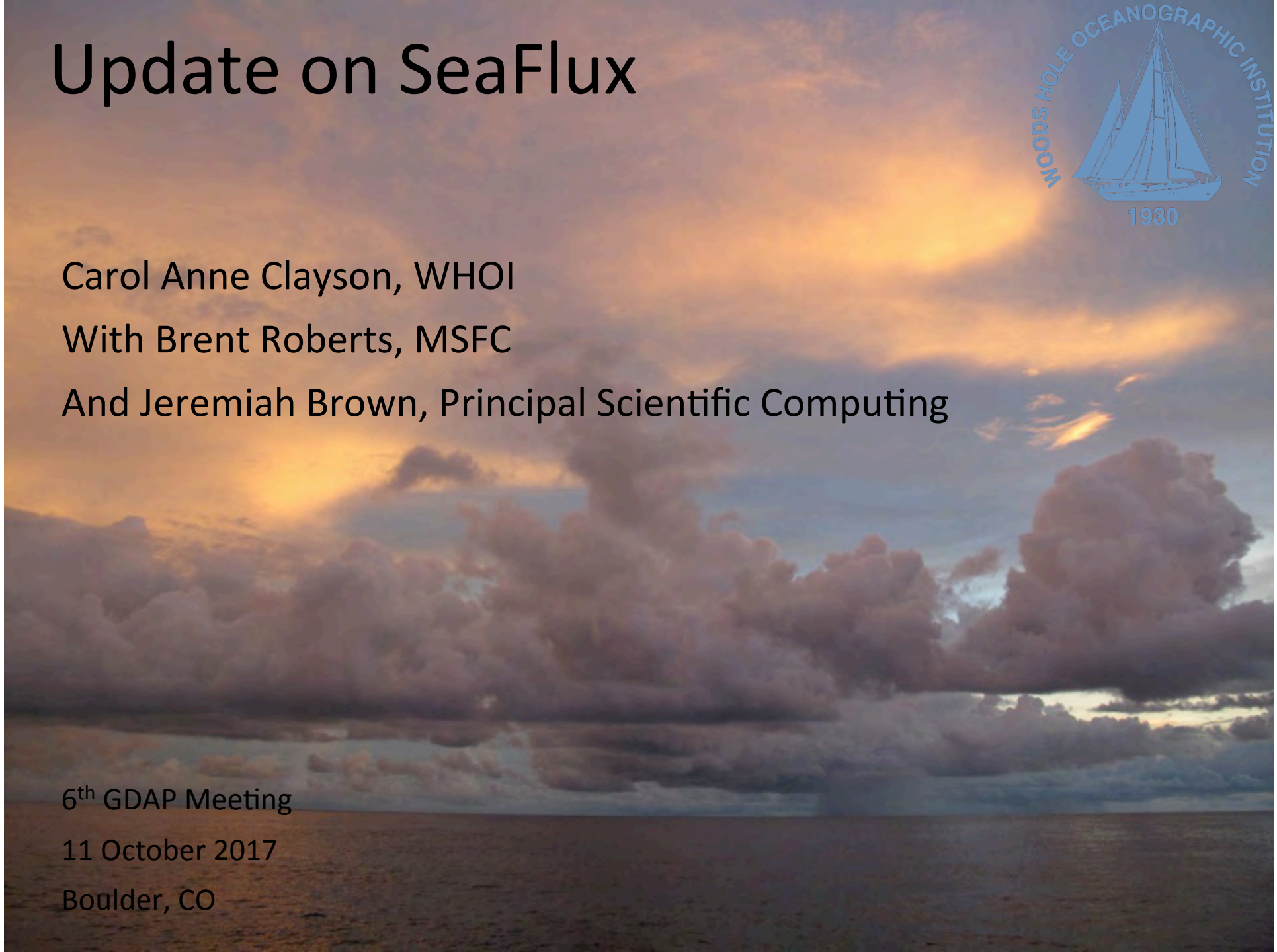
Time series of tropical precipitation (25°N-25°S)



Issues/Plans

- Version 3 behind schedule and full completion is at risk due to funding questions
- Production of V2.3 will continue, although some difficulties in terms of transfer to NOAA and concern about addressing any problems that might come up.
- Expect production of both GPCP Versions between 2-5 years as users compare and find issues that need attention.
- Continued production of V3 hopefully supported by NOAA and/or NASA

Update on SeaFlux



Carol Anne Clayson, WHOI

With Brent Roberts, MSFC

And Jeremiah Brown, Principal Scientific Computing

6th GDAP Meeting

11 October 2017

Boulder, CO

SeaFlux

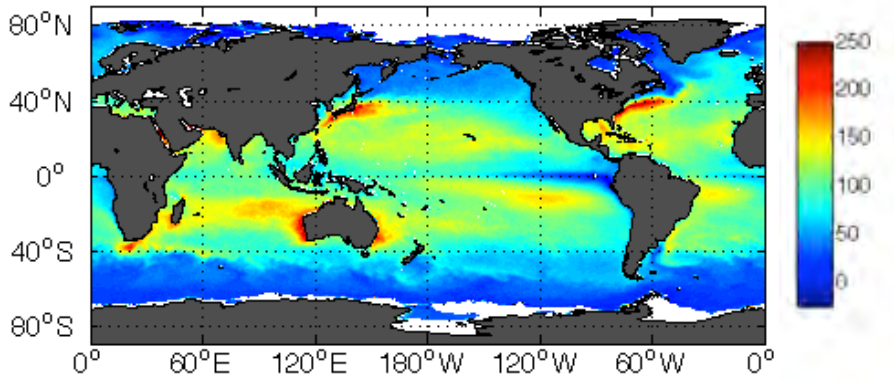
- International project under the auspices of the GEWEX Data and Assessments Panel: *to improve our understanding and determination of ocean surface turbulent fluxes*
- Our main questions:
  - What is feasible in terms of resolution and length-of-time series for satellite data?
  - Can we produce a high resolution dataset using satellites that is better than conventional climatology and NWP products?
  - What are the best methods for creating this dataset?
  - How do the different datasets perform under varying applications?
- Elements of the project include:
  - Evaluation of global flux products
  - Providing library of flux datasets and in situ data sets for easy comparisons by researchers
  - Production of a high-resolution (1^o, 3 hourly) turbulent flux dataset

SeaFlux CDR version 2

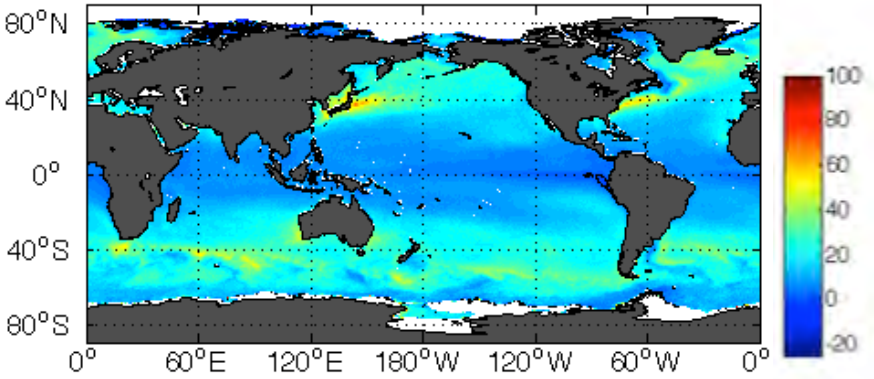
- Near-surface air temperature, humidity, and winds
  - Based on Roberts et al. (2010) neural net technique
    - CLW content used to remove rain-contamination (except for F08)
    - F10 – F18, pixels segregated by clear/cloudy sky
    - One neural net for F08, two for all others (total)
  - SSM/I and SSMIS from CSU FCDR
- SST
  - Pre-dawn based on Reynolds OISST
  - Diurnal correction
  - Uses SRB, CERES, FLASHFlux for radiation, HOAPS, GPCP and now MERRA for precipitation
- Land mask from NOAA GSHHG, ice mask from AVHRR ice fraction, ISCCP ice shelf
- Uses neural net version of COARE
- Gap-filling methodology -- use of MERRA2 variability – 3 hour

- Available from 1988 through mid-2017

1999 Latent Heat Flux



1999 Sensible Heat Flux



Global Energy and Water Cycle Experiment
GEWEX
WCRP

Under WCRP Data Advisory Council (WDAC)

- Discussion of need for coordination and highlighting surface flux issues
  - Land, ocean, ice
  - Biogeochemical, heat, moisture, momentum
  - Turbulent, radiative
  - In situ, remote
- “promote a stronger dialogue and profile of flux efforts across WCRP and with sister programmes “
- Formed Surface Flux Task Team (C. A. Clayson/Brian Ward, chairs)
  - Cuts across GEWEX, CLIVAR, other WCRP groups
  - Members:
    - Carlos Jimenez (Observatoire de Paris, land, satellite, obs;
    - Jim Edson (U. Conn, ocean, obs);
    - Pierre-Philippe Mathieu (ESRIN, satellite);
    - Peter Gleckler (LLNL, modeling);
    - Ronald Buss de Souza (National Institute for Space Research, Brazil, ocean, obs)
    - Paul Stackhouse (NASA Langley, radiative fluxes, satellite, scientist extraordinaire);
    - Hans Peter Schmid (Karlsruhe Inst. Tech., biosphere, obs);
    - Anton Beljaars (ECMWF, land, modeling);
    - Saigusa Nobuko (Japan, National Inst. for Env. Studies, land, obs);
    - Petra Heil (University of Tasmania, sea ice, obs, remote sensing, modeling);

LandFlux: data production – V1

- V1:1984-2007 3-hourly global runs of latent heat flux from GLEAM, PT-JPL, PM-MOD with “GEWEX-like” forcings (mainly SRB), publicy available from the LandFlux website.

https://hydrology.kaust.edu.sa/Pages/GEWEX_Landflux.aspx

LandFlux: data production - V2?

- Past lines of funding (ESA WACMOS-ET, NASA NEWS, KAUST …) are terminated and we do not foresee any new opportunities to fund these activities.

- Model used for LandFlux have been updated by their respective developers and run further in time, so their individual global runs are likely to be more demanded than the LandFlux products.

- Possibly the only justification for a V2 LandFLux product would be in the framework of a GEWEX integrated product, where some common forcings (e.g. SRB radiation) will allow a more consistent multi-product analysis. In that case, we may find the man power to re-run the LandFlux models with the new forcings.

- The sensible heat fluxes are still pending ….

The GEWEX Surface Radiation Budget Project: Release 4 Integrated Product Progress and Plans

GEWEX Data and Assessments

Panel Meeting

Boulder, CO

10-12 October, 2017

Paul W. Stackhouse, Jr. – NASA LaRC

Stephen J. Cox, J. Colleen Mikovitz,

Taiping Zhang – SSAI

SRB Release 3 Data Products

(Spatial Resolution: 1° x 1°; 7/83 – 12/07)

Data Types	Model Name	Temporal Resolution	Parameters
SW	GEWEX SW (Pinker/Laszlo) (v3.0)	3-hourly, Monthly Averaged 3-hourly, Daily and Monthly Averaged (UTC and local sun time)	All-sky: Surface down, up, PAR down; TOA Down, Up Clear-Sky: Surface Down, Up; TOA Up
	LPSA (Staylor/ Gupta) (v3.0)	Daily, Monthly	All-sky: Surface Down, Net, and Albedo Clear-sky: Surface Down
LW	GEWEX LW (Fu/Liou/ Stackhouse) (v3.1)	3-hourly, Monthly Averaged 3-hourly, Daily and Monthly Averaged	All-sky and clear-sky: TOA up; Surface Up and Down
	LPLA (Gupta) (v3.0)	3-hourly, Monthly Averaged 3-hourly, Daily and Monthly Averaged	All-sky Surface Downward, Net; Cloud Radiative Forcing
Input Property	CLDPROPS	3-Hourly	Surface emissivity, skin temperature, atmospheric profile; cloud phase, fraction, optical depth and LWC

Note: The LPSA and LPLA algorithms are also used in CERES Surface-Only

SRB Rel 4 versions, global fluxes: 2007

	Rel 3.0	Rel 4 baseline (OLD algorithm, NEW inputs – HXS Beta1)	Rel 4 gamma (NEW algorithm, OLD inputs - DX)	Rel 4 iota (NEW algorithm, NEW inputs -HXS Beta1)	Rel 4 nu (NEW algorithm, NEW inputs – HXS V01)
Surface down	186.1	186.1	182.3	184.3	184.8
Surface down diffuse	104.1	105.8	95.0	96.2	100.1
TOA Up	104.4	104.2	103.1	100.4	100.5
Clear surface down	247.6	246.8	240.5	239.9	239.9
Pristine surface down	258.5	258.5	252.8	252.1	252.2
Surface albedo	0.131	0.132	0.137		0.126
Surface net	163.5	163.7	158.7		161.9
Cloud Radiative Effect	-61.5	-60.7	-58.2	-55.6	-55.1

GEWEX SRB: Summary Status

- GEWEX SRB Rel 4-IP:
  - New inputs from ISCCP nnHIRS and HXS v1 obtained (in September) were processed at $1^{o}x1^{o}$
    - versions delivered for SRB Rel 4-IP Beta
  - Analysis shows improved SW fluxes relative to BSRN and ocean buoy measurements and also new inputs and algorithms relative
    - Ocean fluxes reduced; land fluxes increased
    - TOA reflectance reduced
  - Analysis shows LW still not improved
    - HXS cloud rendering testing/assessment ongoing; homogenization with new microphysics
    - Assess land surface temperatures
    - Ocean fluxes appeared biased compared to ocean buoys

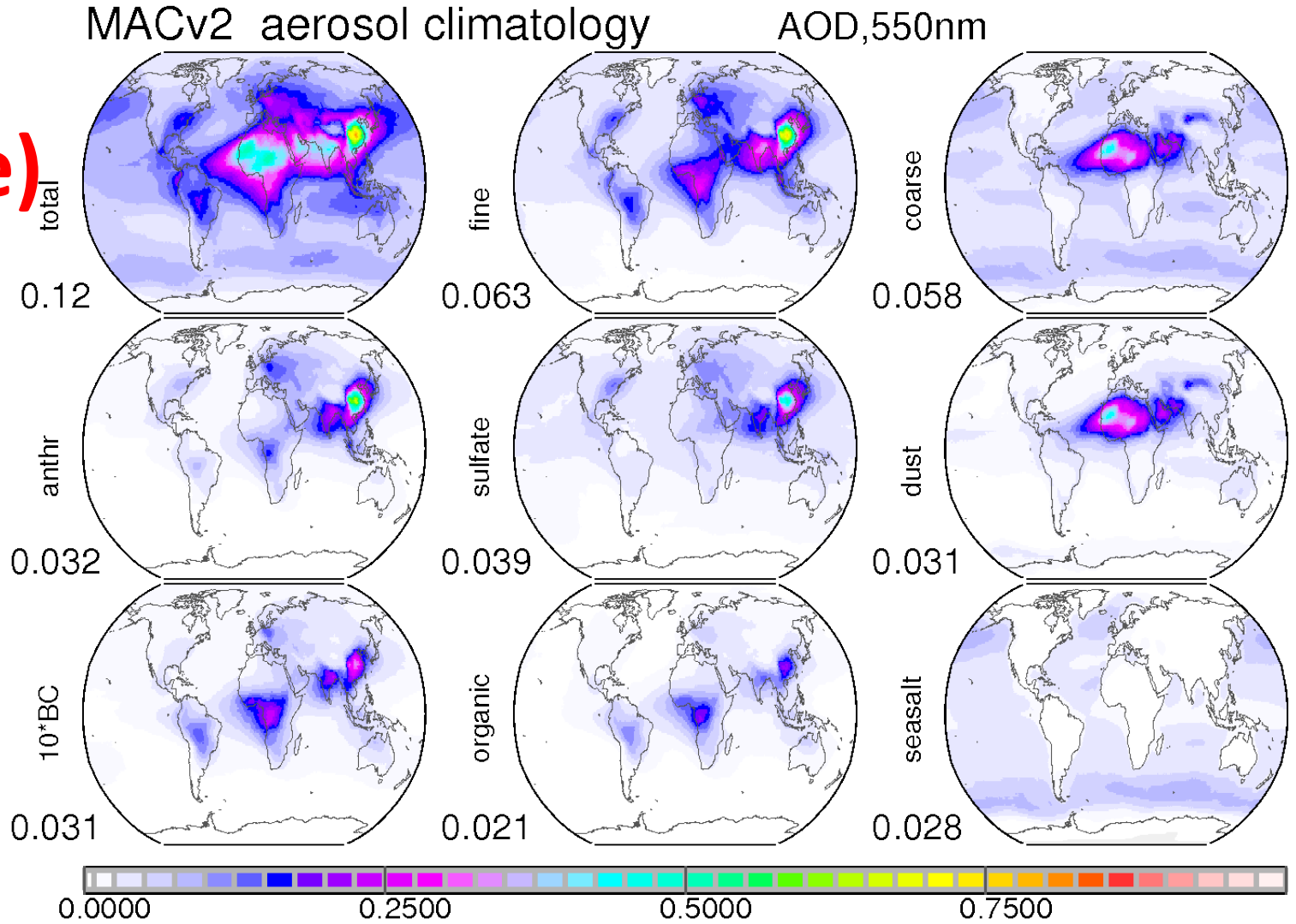
GEWEX SRB: Next Steps

- Will re-access assumptions regarding => cloud merging and gridding (1-2 months)
  - Compare and homogenize with HGG
- Reprocess 2005-2009 with revised calibration tables and cloud properties
  - Will be assessing changes to cloud properties
  - Compare to CERES, BSRN and assess
  - Production time required for 1x1: 10 years per month
- Redeliver at 1x1 time periods needed; considering not reprocessing 30 years at 1x1 => 2000 - 2009
- Progress of conversion to ½° x ½° nearly completed
  - Using full equal area sampling and data production grid
  - Will provide data provides at the ½° x ½° equal angle
  - Testing aspects on Cloud based system

Aerosols (Stephan Kinne)

spatial context by global Modeling:

AeroCom



MACv2 **from sunphotometry to aerosol component distributions**

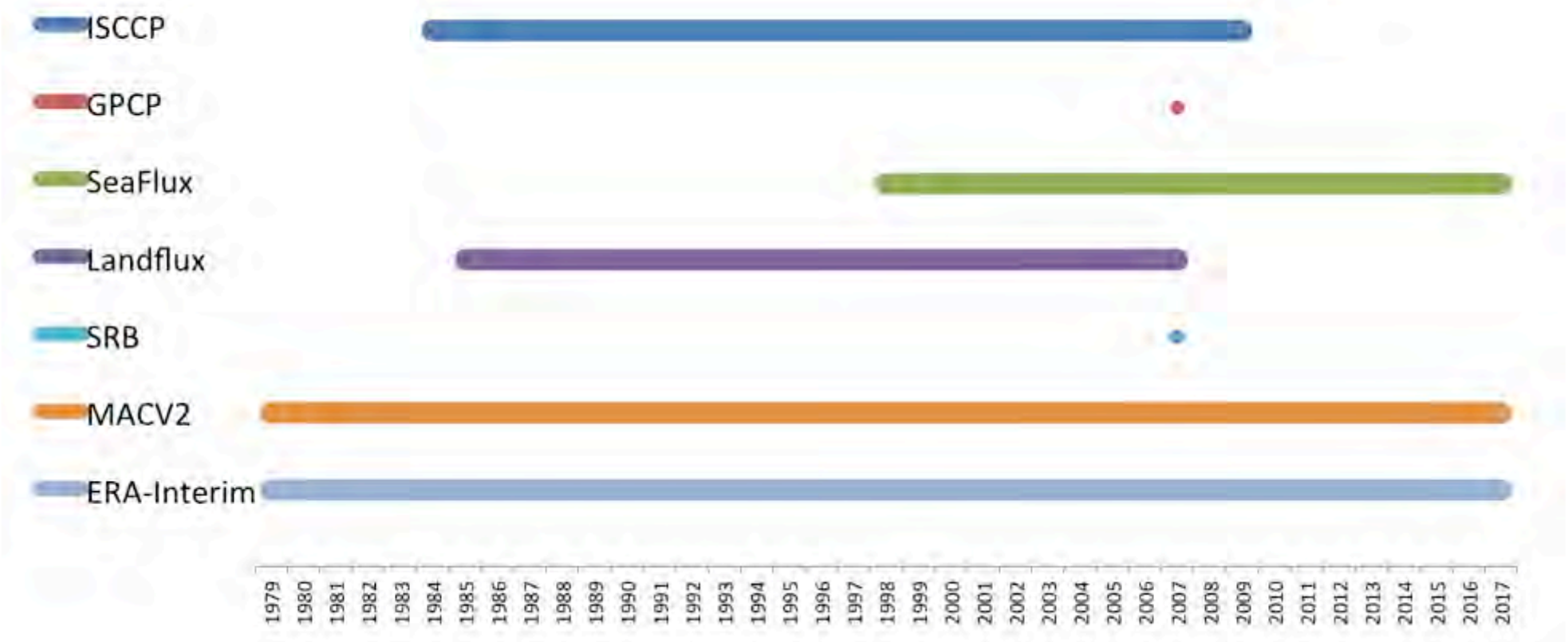
Aerosols (Stephan Kinne)

what updates ?

- monthly AOD variability (rather than one value) with impact on the AOD fine-size fraction
    - based on 6hrs data from ICAP ensemble assimilations (by seven groups) over 2 years
- merging fine-mode radius (as of Angstrom)
    - Angstrom is inaccurate at low AOD values
    - more exact fine-mode radius permits better estimates for associated CCN → for aerosol on cloud impact simulations

The “Integrated Product”

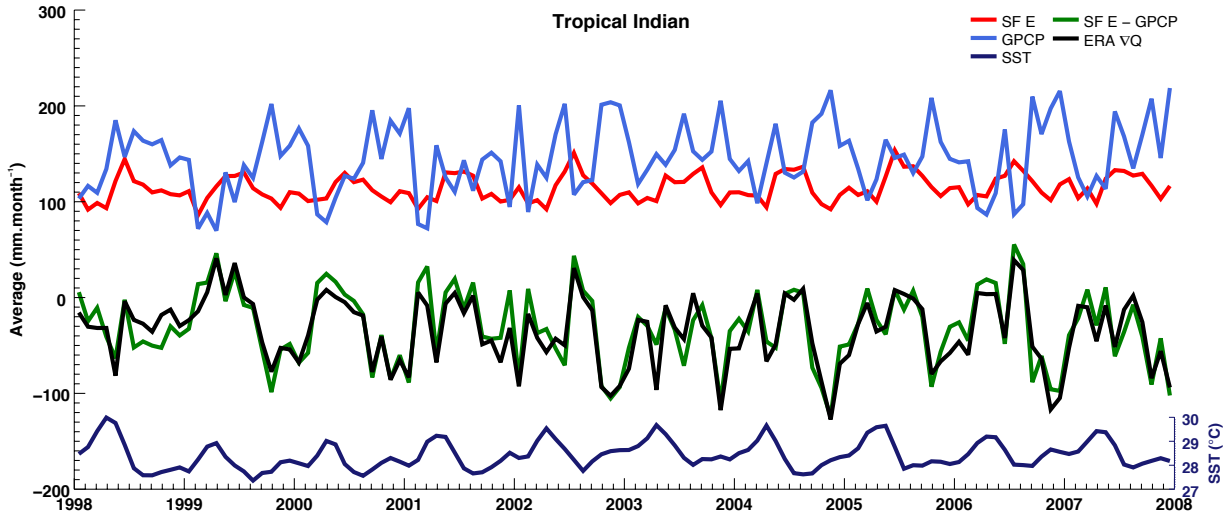
- Test period: 1 Jan 2007 – 31 Dec 2007
- **1°, 3-hourly equal-area grid**
- ISCCP Clouds, MAC V2.0 Aerosols, SRB Radiation (TOA & Sfc)
- Land/SeaFlux for Sensible and Latent heat flux,
- GPCP Precipitation
- ERA-Interim for Water Vapor transport, CAPE, dynamical context



An example from integrated products from P Brown and C Kummerow (CSU)

$$E - P = \nabla \cdot Q$$

A Water Budget Closure Test over tropical oceans



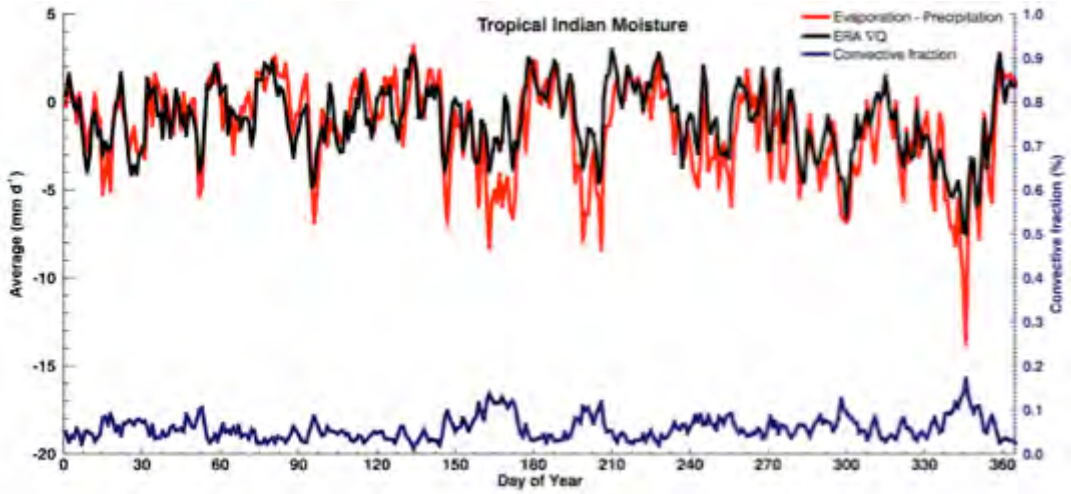
P Brown and C Kummerow, 2012

Release of 20 years Q1 2018
Science workshop March 2019 in Spain

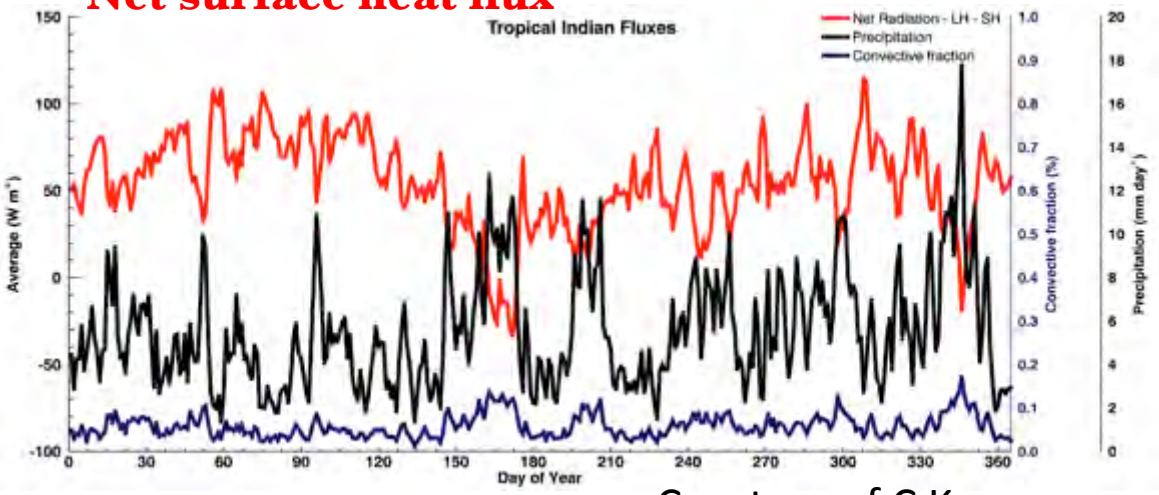
2007 GEWEX Integrated products

Deep convective cloud fraction from ISCCP

E, P and Div(Q)



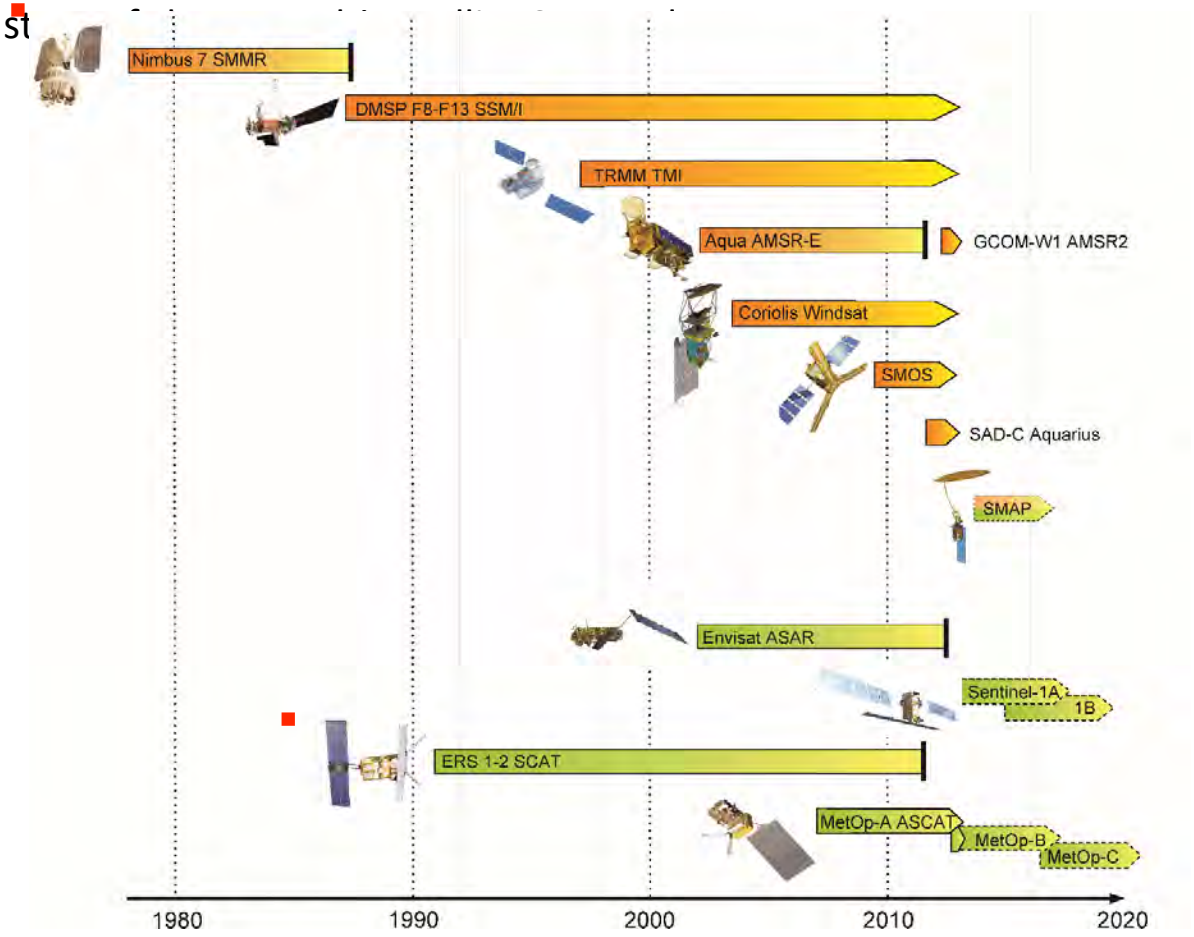
Net surface heat flux



Courtesy of C Kummerow

Towards a long-term multi-satellite data set

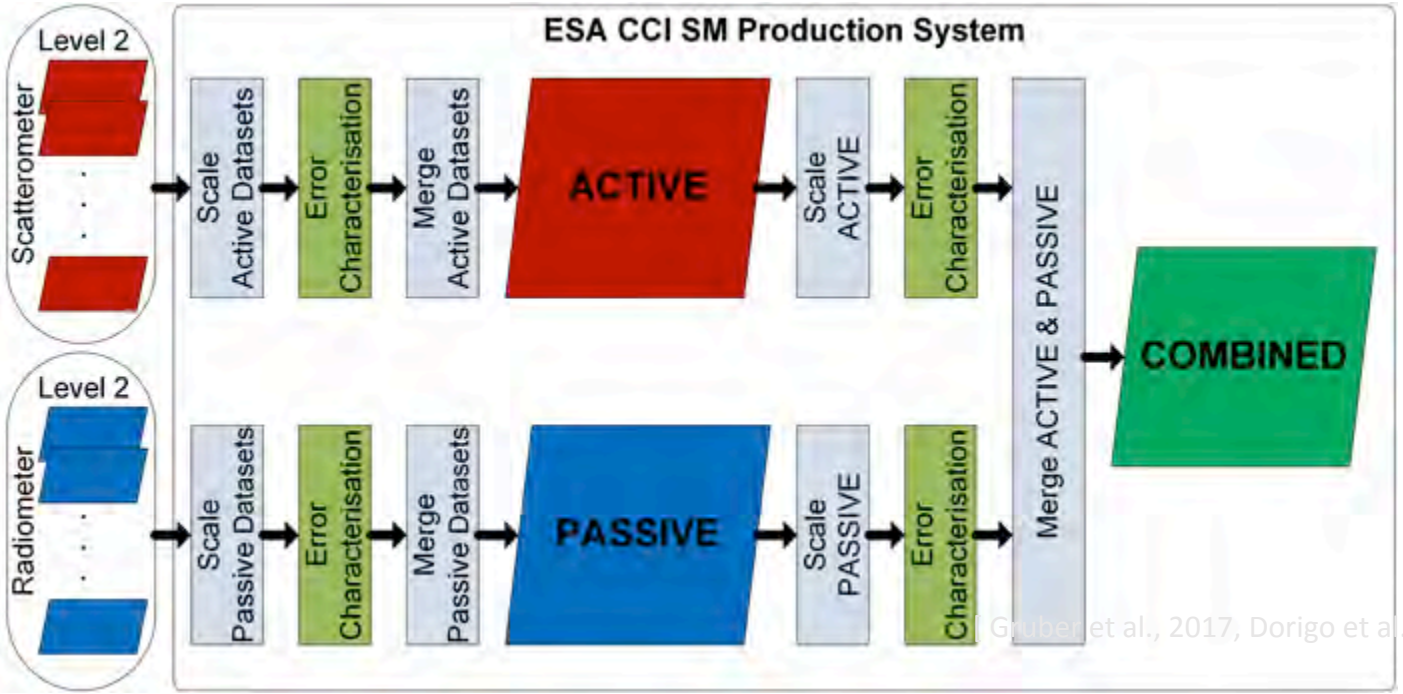
- ESA CCI ECV soil moisture data set serves over 3700 registered users:
  - Currently THE st



[Dorigo, W.A., 2015, IGARSS]

ESA CCI merging in a nutshell

- Individual data sets are harmonized, error-characterized, and merged into
  - an active-only product
  - a passive-only product
  - a combined active-passive product



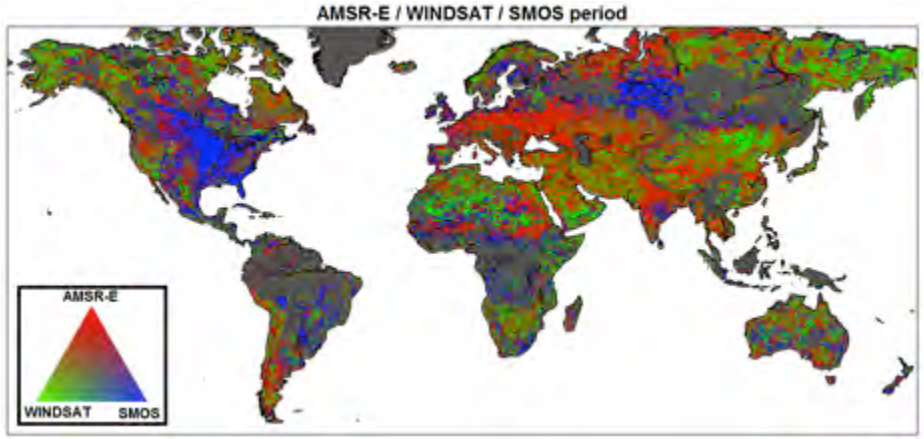
[Gruber et al., 2017, Dorigo et al., 2017, RSE]

ESA CCI merging in a nutshell

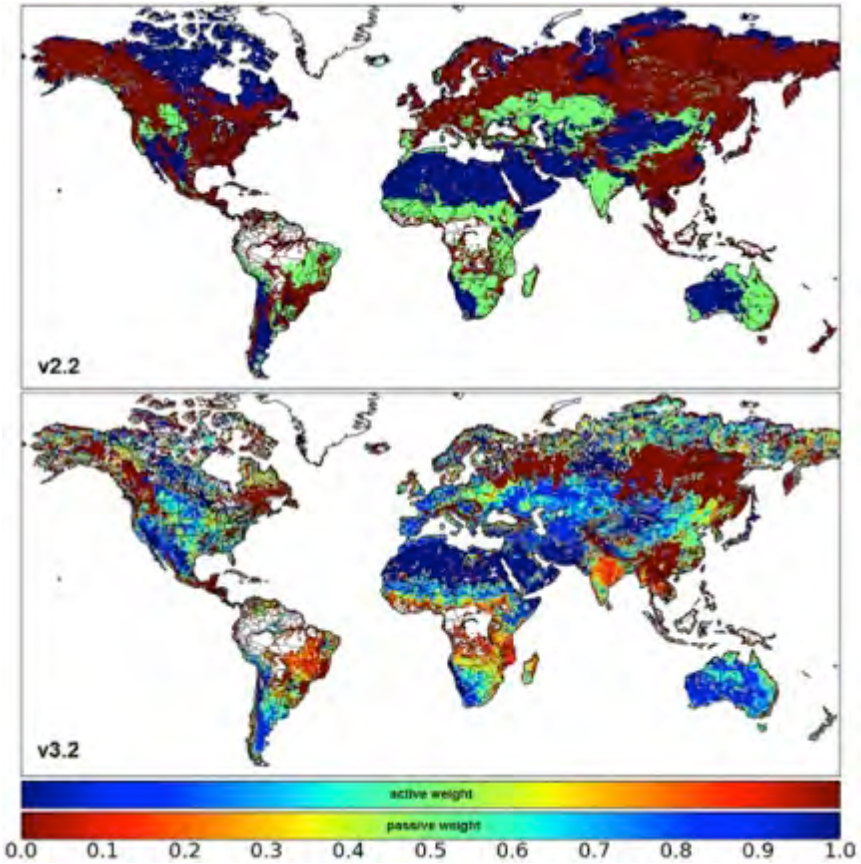
- Recent evolution from a simple ternary-class based active passive merging to a least-squares based merging using error estimates obtained from triple collocation analyses
  - Continuous weighting of different products
  - Merging of more than 2 products possible

$$\overline{x} = \mathbf{w}^{\top}\mathbf{x} = \sum_{i=1}^{n} w_i x_i$$

$$\mathbf{w}^{\top} = \left(\mathbf{1}^{\top}\mathbf{C}\,\mathbf{1}\right)^{-1}\mathbf{1}^{\top}\mathbf{C}^{-1}$$



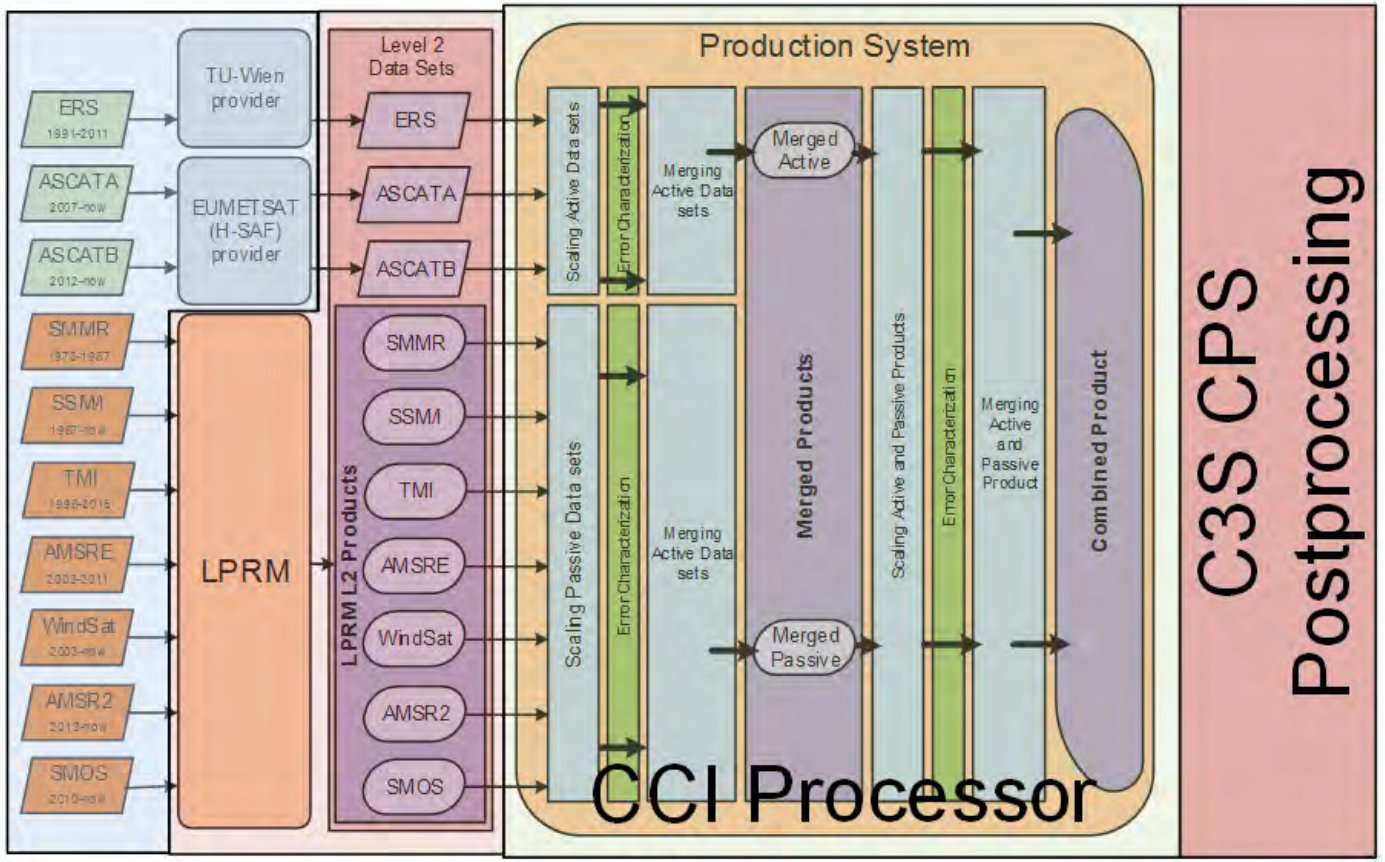
Blending weights for merging AMSR-E, Windsat, and SMOS into a merged passive dataset (July 2010- October 2011) [Gruber et al., in prep.]



Blending weights for merging ACTIVE and PASSIVE into COMBINED (period January-December 2014) [Dorigo et al. 2017, RSE]

Towards operations

- The Copernicus Climate Change Service (C3S)
  - Provides daily, decadal and monthly soil moistures estimates
  - With a 10-day latency
  - Scientific updates from the CCI implemented with a year delay (for validation purposes)



Next steps…

- What do users like?
  - Long time series
  - Good spatial-temporal coverage
  - Well error-characterized

- What should be improved?
  - Longer time series
  - Better spatial-temporal coverage / resolution
  - Reducing errors
  - Better definition/harmonization of layer-depth
  - Removing dependence on LSMs (!)

- Issues progressively tackled in new product versions!
  - ESA CCI SM v04.x to be released end 2017
  - ESA CCI SM v05.x already under development
  - No direct funding for scientific improvements!

GROUND-BASED NETWORKS

Soil moisture

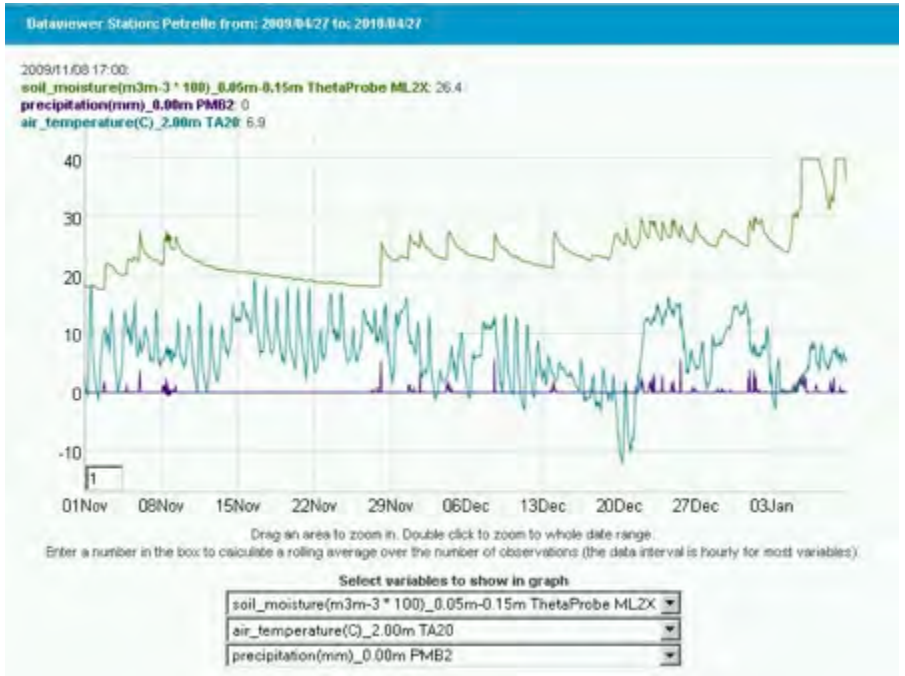
Precipitation

Surface Radiation (BSRN)

ARM

ISMN overview

- Basic processing chain of the ISMN
  - Data from different networks are collected…
  - … harmonized …
    - format, units, sampling, …
  - … quality-controlled …
    - Automated flagging of suspicious values
  - … stored into a data base …
  - … and made available for the public through a web portal
    - Various viewing and downloading options



Example of the ISMN dataviewer showing time series of different variables.

Some facts…

- Currently available at the ISMN:
  - 58 networks
  - 2436 Stations
  - Historical datasets
    - reaching back to 1952
  - Operational datasets
    - Updated in NRT

- Additional variables:
  - Soil temperature
  - Air temperature
  - Precipitation
  - Snow depth
  - Snow water equivalent
  - „Static“ variables (texture, saturation point,..)

What's next?

- The ISMN is a GEWEX success story, serving a large international scientific community and having large implications well beyond science, e.g. through
  - Improvement of weather and climate models
  - Validation of remote sensing products
  - Support to agriculture
  - …

- Good-value (costs ~ 50 kEUR/y)
  - Financial support for 2009 – June 2016 has come from ESA EOP SMOS
  - Current negotiations for a funding extension of another 1.5 years (under ESA's Sensor Performance, Products and Algorithms (SPPA) element)

- ESA's mandate is not operations, therefore a new mechanism needs to be found (soon!)
  - No concrete alternatives so far…
  - Interest of the German Federal Institute of Hydrology (BfG; well-known for the Global Run-off Data Centre)

The Atmospheric Radiation Measurement (ARM) Climate Research Facility

JIM MATHER
ARM TECHNICAL DIRECTOR

October 11, 2017

Overview of ARM Facility

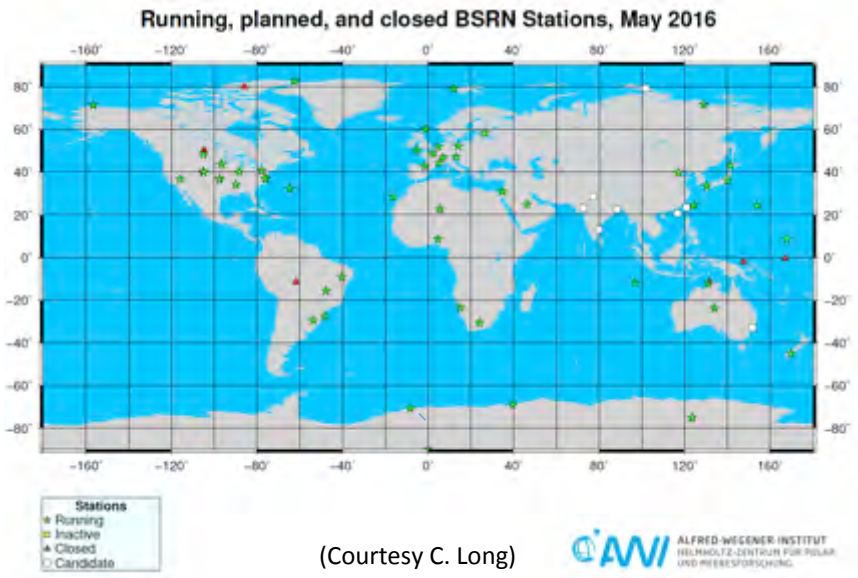
Long-term, comprehensive atmospheric observing network

- Since 1992, providing measurements of cloud & aerosol properties, & their impacts on Earth's energy balance
- Network of 3 fixed & 3 mobile atmospheric observatories providing comprehensive instrument suites across diverse climate regimes
- Manned & unmanned aerial measurement platforms
- Extensive data management infrastructure that has accumulated over 1 petabyte of data to support climate research
- Broad array of freely available data products to support the advancement of climate research & climate model development
- 200 staff spanning 9 DOE laboratories & other institutions
- Work closely with the DOE Atmospheric System Research (ASR) program & serve the international climate research community

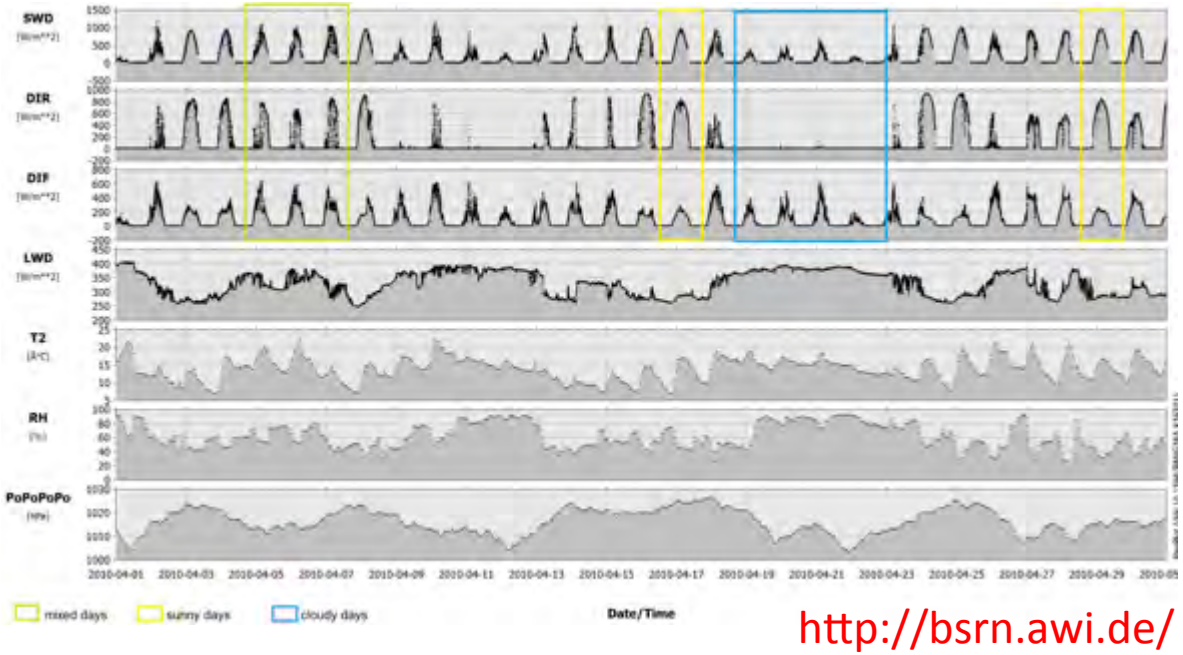
FY18 Science Product Priorities

- Products supporting LASSO
- Supporting Value Added Products for ARM Mobile Facilities
- Radar Products that make radar data accessible to users
- ARM Products for modelers
  - Variational Analysis based Forcing
  - ARM Best Estimate
  - Diagnostics & Metrics
- Improved data quality and uncertainty
  - Data epochs (virtual field campaigns)
  - Machine Learning

Baseline Surface Radiation Network
C. Long



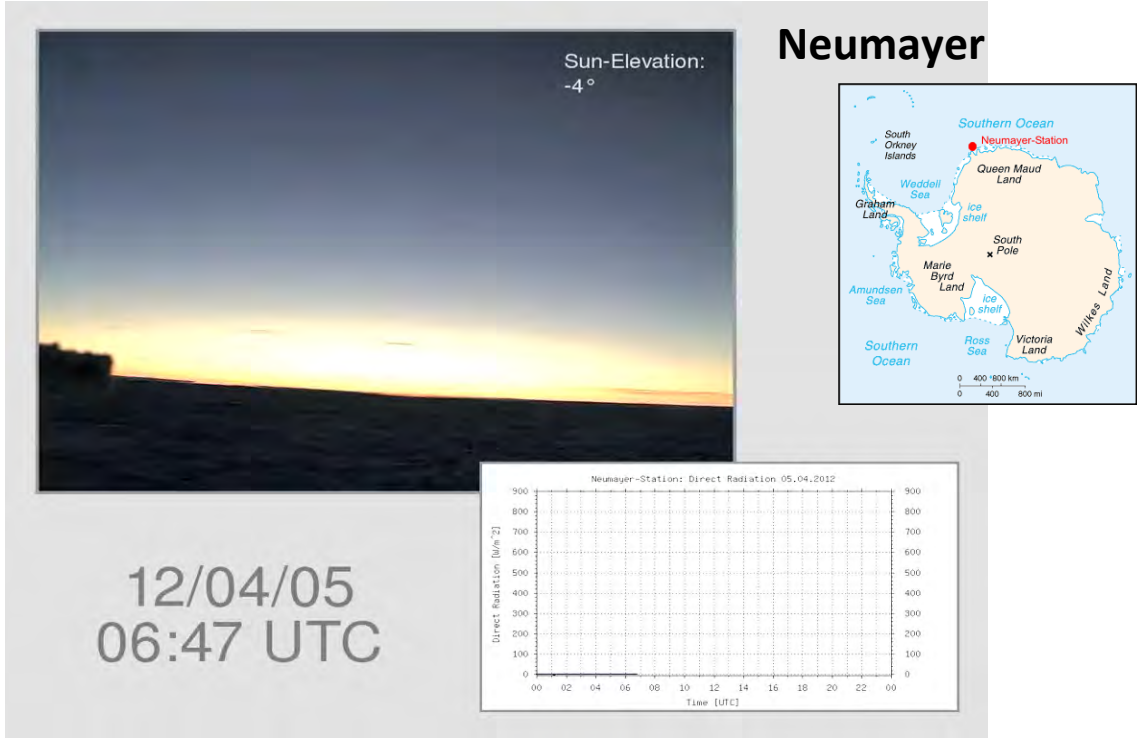
(Courtesy C. Long)



http://bsrn.awi.de/

- BSRN includes 59 stations with contributed data
  - > 750 station-years of observations
  - Dispersed from 90^{O} S through 82^{O} N
- 8 new sites have been provisionally approved
- Increasing recognition, use, and scientific impact

Upcoming meeting in July 2018 (at NCAR)



6th GDAP-Meeting, 09-12 Oct. 2017, Boulder, CO, USA

Status report and outlook of the Global Precipitation Climatology Centre (GPCC)

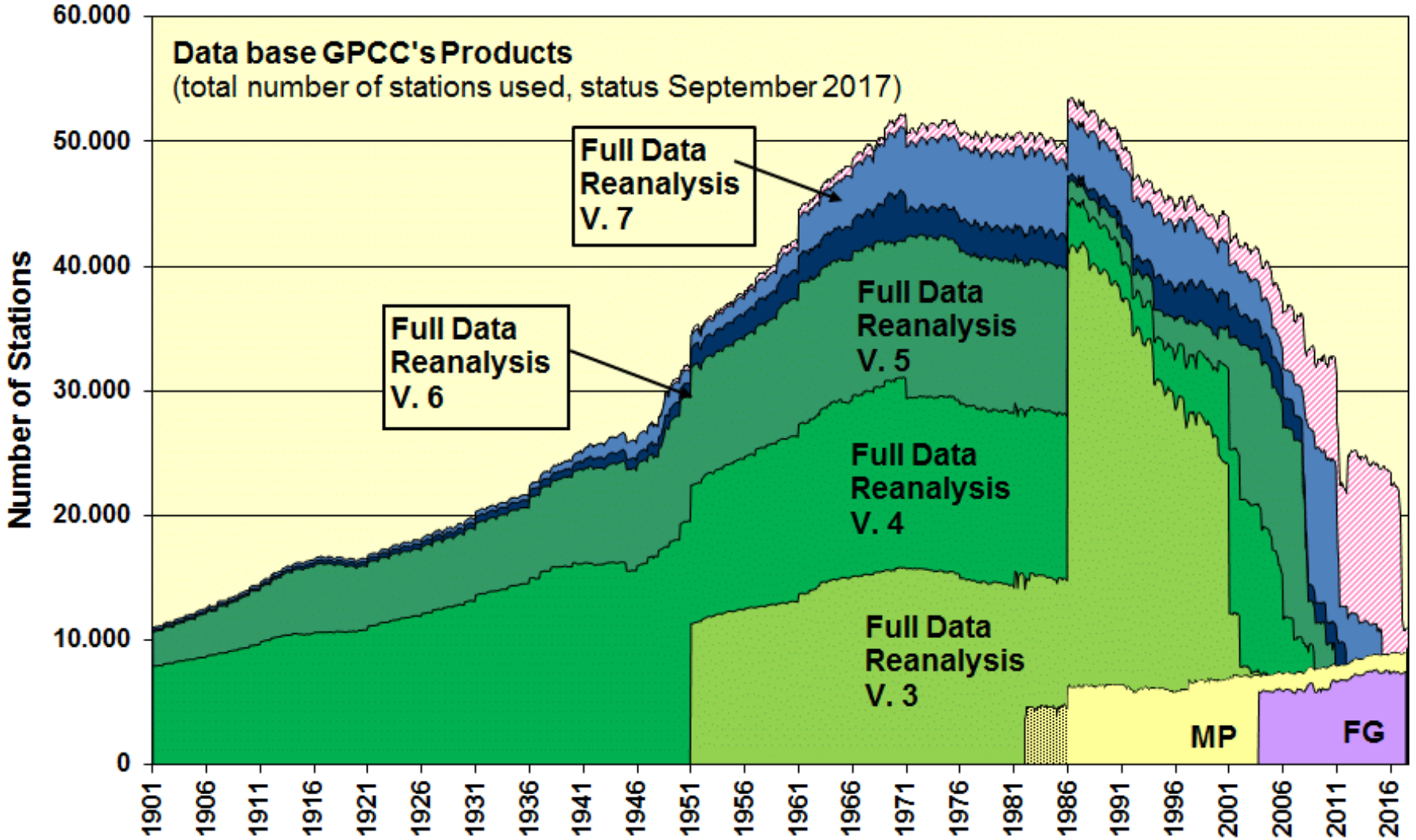
U. Schneider, A. Becker, A. Meyer-Christoffer, M. Ziese, P. Finger

Global Precipitation Climatology Centre

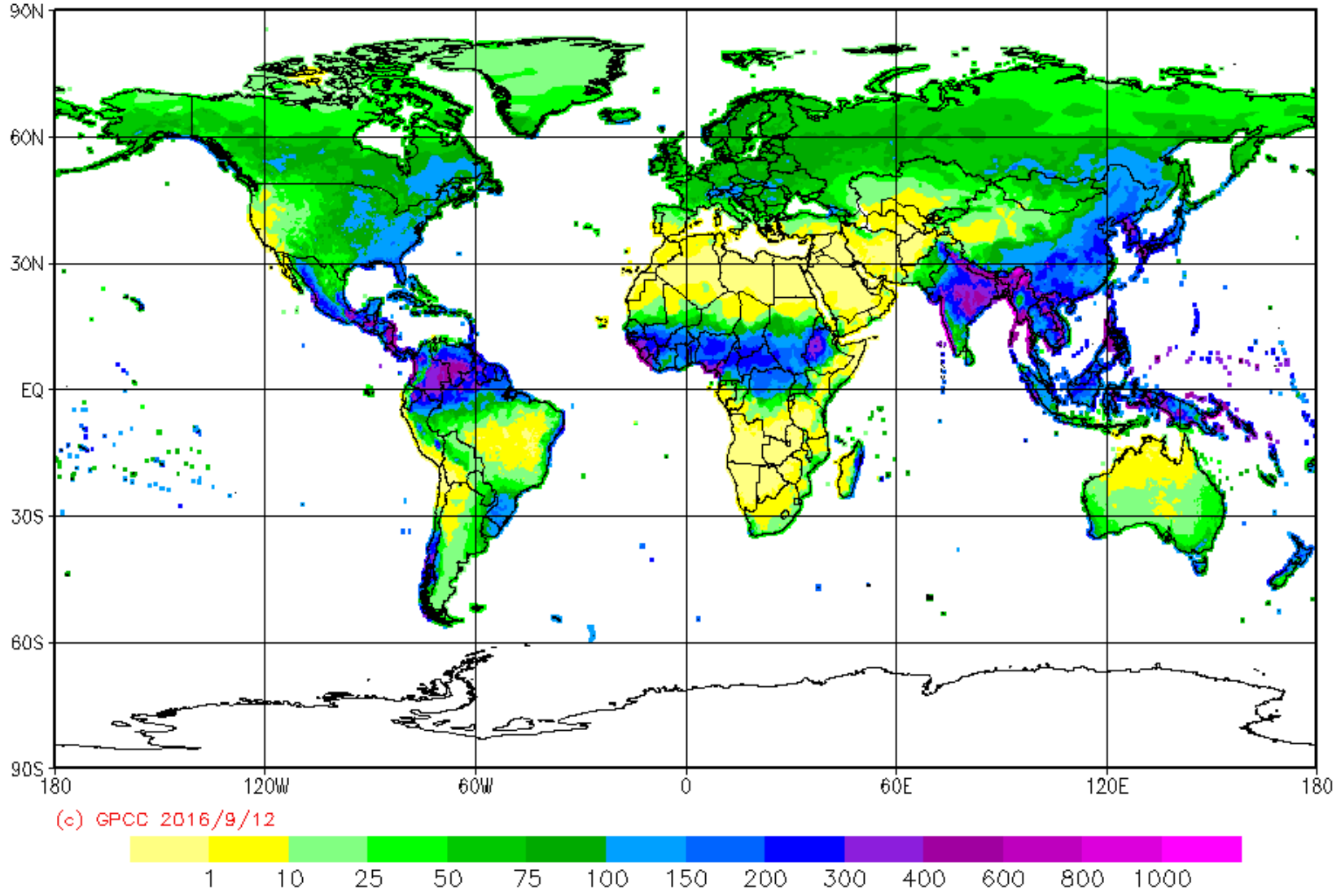
Deutscher Wetterdienst
Department Hydrometeorology

presented by R.F. Adler (GPCP)

Data base for different GPCC products



GPCC's Precipitation Climatology V.2015 for July on a 0.25° grid



Daily precipitation analysis products

- GPCC is providing the following daily gridded data sets:

  - A First Guess Daily Analysis available
    within 5 days after the end of the month via internet
    Period: Jan. 2009 to present
    Data base: ca. 7,000-8,100 stations
    described in Schamm et al. (2014)

  - The Full Data Daily Analysis (V.1) updated from time to time
    Period: Jan. 1988 to 2013
    Data base: ca. 10,000-30,000 stations

ASSESSMENTS

1. Aerosols
2. Soil moisture
3. Cloud
4. Water vapor
5. Precipitation (including the Joint IPWG-GEWEX effort)
6. Towards a guide for GEWEX assessment

Aerosols (Stephan Kinne)

why new assessments ?

- for AOD (and size) from space
  - MODIS is the main workhorse
    - twice daily coverage, NRT available
  - BUT
    - there are different MODIS retrievals and starting to combine strengths is VERY slow
    - what happens, if EOS platform fails: are sub-sequent retrievals (e.g.VIIRS) mature enough?
    - can complex retrievals (e.g. GRASP) deliver on their promise? (e.g. with 3MI sensor data)

Aerosols (Stephan Kinne)

what next

- the past (still not released) assessment
  - a good reference on aerosol remote sensing
  - but only addressed 1x1 gridded data
- NOW additional questions
  - new sensors and their retrievals
  - higher temporal and spatial evaluation also examining (provided) retrieval uncertainty

- who has assessed lately?
  - ESA's aerosol CCI … comes to an end soon
  - AeroSAT is (at least) a platform for discussions
  - Nick Schutgens: is doing detailed validation to AERONET *…invite him to a future meeting?* + many others *…some recent literature summary?*

TU WIEN
DEPARTMENT OF GEODESY
AND GEOINFORMATION
CLIMATE AND ENVIRONMENTAL REMOTE SENSING

INTERNATIONAL
SPACE
SCIENCE
INSTITUTE

Water: Soil Moisture Assessment

Alexander Gruber, Wouter Dorigo
(and many others)

GEWEX GDAP-EEI meeting
October 9 – 12, 2017
NCAR, Boulder, CO

Triple collocation analysis

- Doing triplet-wise data inter-comparison instead of classical pair-wise (e.g., R, RMSD) allows for separating signal- and random error components

- Uncertainties may be expressed as
  - RMSE
  - R (w.r.t. truth)
  - **Signal-to-Noise Ratio (SNR)**

$$\mathrm{SNR}_i[\mathrm{dB}] = 10 \log \frac{\mathrm{Var}(\Theta)}{\mathrm{Var}(\varepsilon_i)}$$

[Gruber et al. 2016]

0 dB: signal = noise variance
+3 dB: signal = double noise variance
-3 dB: signal = half noise variance

Every +/- 3 dB corresponds to a doubling / halving of the ratio

(*) Does not resolve systematic errors!!

Work in progress…

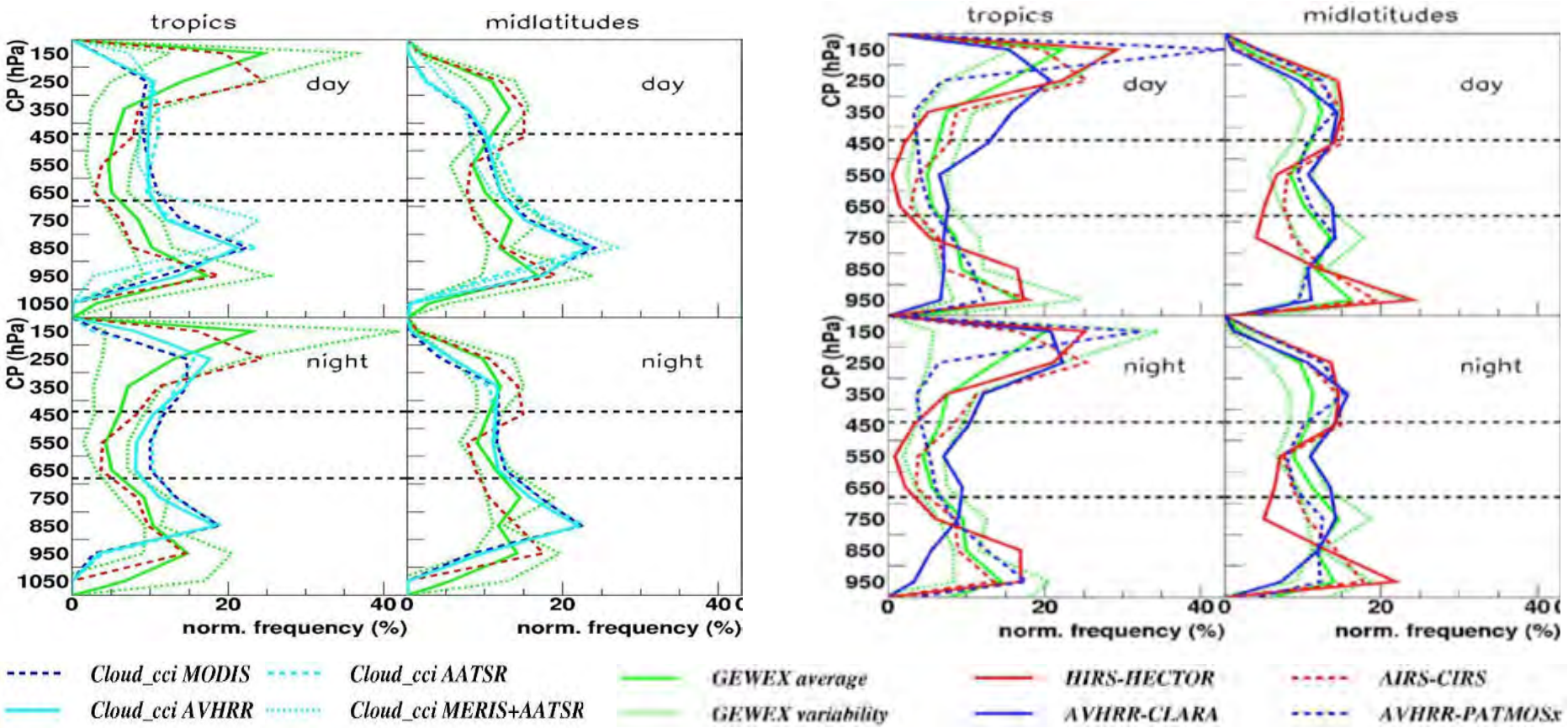
- A Validation Good Practice Document / Protocol
  - A group effort led by Alexander Gruber
    - initiated within an ISSI team workshop
    - To be submitted February 2018 (at the very latest)

- *Clement Albergel*
- *Amen Al-Yaari*
- *Brian Barrett*
- *Luca Brocca*
- *Andreas Colliander*
- *Michal Cosh*
- *Wade Crow*
- *Richard de Jeu*
- *Wouter Dorigo*
- *Seyed Hamed Alemohammad*
- *Martin Hirschi*
- *Tom Jackson*
- *Alexandra Konings*
- *William Lahoz*
- *Kaighin McColl*
- *Nadine Nicolai-Shaw*
- *Robert Parinussa*
- *Christoph Paulik*
- *Chiara Pratola*
- *Chris Ruediger*
- *Sonia Seneviratne*
- *Chun-Hsu Su*
- *Robin van der Schalie*
- *Wolfgang Wagner*
- *Simon Zwieback*
- ***(list not complete yet!)***

Cloud Assessment extended Phase (C. Stubenruach)

ESA Cloud_cci: AVHRR, AATSR, MODIS
(Retrieval based on Optimal estimation)

CM SAF: AVHRR-CLARA, HIRS-HECTOR



GEWEX CA reference: *average(ISCCP, MODIS-ST, PATMOSX, AIRS-LMD)*

Cloud_cci datasets slightly miss cirrus during day, better during night (IR spectrum)
Cloud_cci peak of low clouds slightly too high
CM SAF HIRS-HECTOR similar to AIRS-CIRS
CM SAF AVHRR-CLARA: less sensitive to low-level clouds

Cloud Assessment extended Phase

GEWEX Cloud Assessment database: 12 global 'state of the art' datasets (in 2008)

- **joint effort to build consistent database:**

  1) developing strategy for L2 -> L3 processing ***(2010 workshop)***

  2) Iterative process:

  analyses -> problems -> feedback to teams -> correction by teams

  some inconsistencies in L2->L3 processing remained;

  AM-PM definition CALIPSO, MODIS-CE histograms not usable…

Utility of database:

- **assessment of new datasets**
- **climate studies** (CFMIP-OBS database used for model evaluation)

-> demand from users to update the database

Update *(same data format, similar website structure in cooperation with AERIS)*:

- at least 7 participating datasets + 6 new datasets
- 1 analysis & note to BAMS with summary
- *Improvements due to retrieval problems, but it looks like main conclusion stays the same: sensitivity to cirrus instrument/ retrieval method dependent*
- *Ancillary data affect low-level cloud amount*
- *Next step should be really multi-instrument retrievals or intelligent combination of different data sets / variables*

Continued Analysis of the GEWEX Cloud Assessment Data (within the ICWG)

Andrew Heidinger
NOAA/NESDIS @CIMSS

Mike Foster Madison, Wisconsin USA
Martin Stengel, DWD, Germany

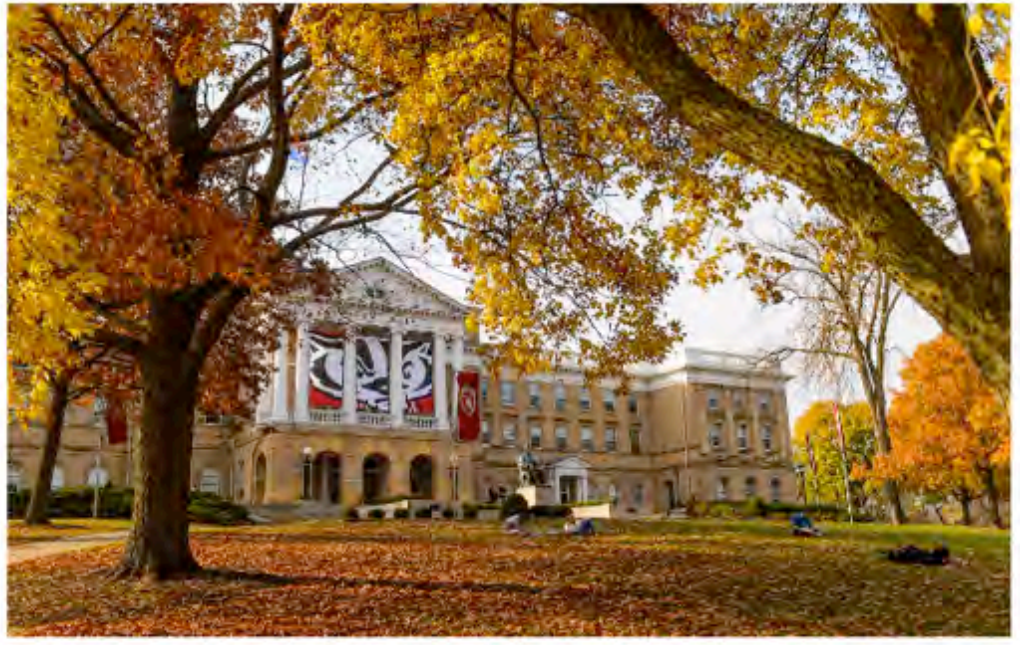
* Leads of the ICWG Climate Group

Next International Cloud Working Group (ICWG)

- Fall 2018 in Madison Wisconsin
- Hosted by Professor Ralf Bennartz of Vanderbilt
- All are welcome.
- Registration page being setup.
- Agenda and group activities in flux and please feel free to collaborate.
- Will have IWWG and IPWG participation as well.

First Announcement

2nd Workshop
CGMS International Cloud Working Group



29 October - 2 November 2018, Madison, Wisconsin, USA
Organized by Vanderbilt University, Nashville, USA
Financially supported by EUMETSAT and NOAA

Program Committee
Andrew Heidinger (co-chair), Rob Roebeling (co-chair), Dong Wu (Rapporteur), and Ralf Bennartz (local organizer)

CGMS Advisory Panel
Bryan Baum (NASA, USA), Stefan Bojinski (WMO, Switzerland), Sung-Rae Chung (KMA Korea), Lu Feng (CMA, China), Andrew Heidinger (NOAA, USA), N. Puviarasan (IMD, India), Rob Roebeling (EUMETSAT, Germany), Alexei Rublev (Roshydromet, Russia), and Daisaku Uesawa (JMA, Japan)

EUMETSAT

VANDERBILT UNIVERSITY

Change in ICWG Organization

We decided the 12 or so topical groups at the last meeting was unsustainable.

We decided to form 4 permanent topical groups which are comprised of sub-groups that form and dissolve as warranted.

We suggest making a topical group in the Climate Applications group dedicated to the continuation of the GEWEX Cloud Assessment.

Sub-groups are being finalized.

1. ***Algorithms*** *(Phil Watts)*
    - *Review of latest algorithms for geostationary imagers.*
    - *Use of Combined Sensors for Cloud Retrievals*
2. ***Assessments*** *(A. Walther)*
    - *Assessment of level-2 Cloud Parameter Retrievals*
    - *Assessment of Retrieval Uncertainties*
    - *Arctic Cloud Detection*
3. ***Climate Applications*** *(M. Stengel, /M. Foster)*
    - *GEWEX Cloud Assessment Continuation (C. Stubenrauch?)*
    - *Level-3 gridding issues*
4. ***Weather Applications (****Tbd****)***
    - *Cloud Height for Wind Applications (with IWWG)*
    - *Severe Weather Applications*
    - *Precipitation Applications (with IPWG)*

The Water Vapor Assessment Phase 2

http://gewex-vap.org.

Lead. M Schröder (DWD),

Co-leads: H. Brogniez (LATMOS) and B. HO (BCAR)

A broad, community-driven and sustained assessment

3 Essential Climate Variables (ECV) on water vapour :

- Total column water vapour (TCWV),
- Upper tropospheric humidity (UTH),
- Water vapour and related temperature profiles

GEWEX water vapor assessment (G-VAP)

- **Satellite and reanalysis data records**
- **Operational satellite data**
- **Ground-based/in-situ data records**

2016 Workshop at EUMETSAT HQ

Climate oriented assessment (stability, absolute value, PDF, etc…). Numerous peer-reviewed publications.

In 2017 a WCRP report that contains results and recommendations to international bodies, space agencies and individual PIs producing water vapour data records **PUBLISHED**

A summary is in preparation for BAMS

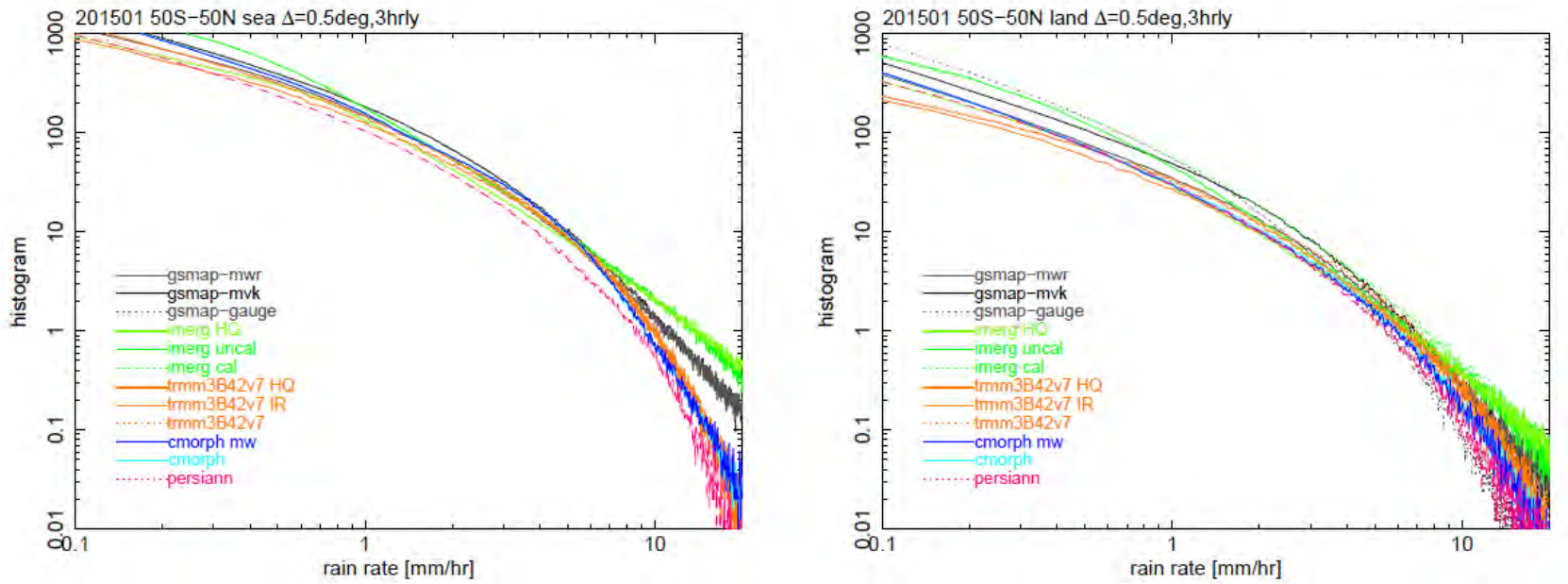
The data from the First assessment are also under consideration for public access

EUMETSAT is continuing its funding of the central data base, workshops and presentations at GDAP meetings.

Precipitation assessment under GDAP

- **On-going GEWEX GDAP precip assessment leads: H. Masunaga/C. Kummerow**
  - Broadening to more products as of 2017
  - Strong contribution to the Joint IPWG-GEWEX assessment

    - 0.5°, 3-hourly rain histogram for selected products January 2015 statistics

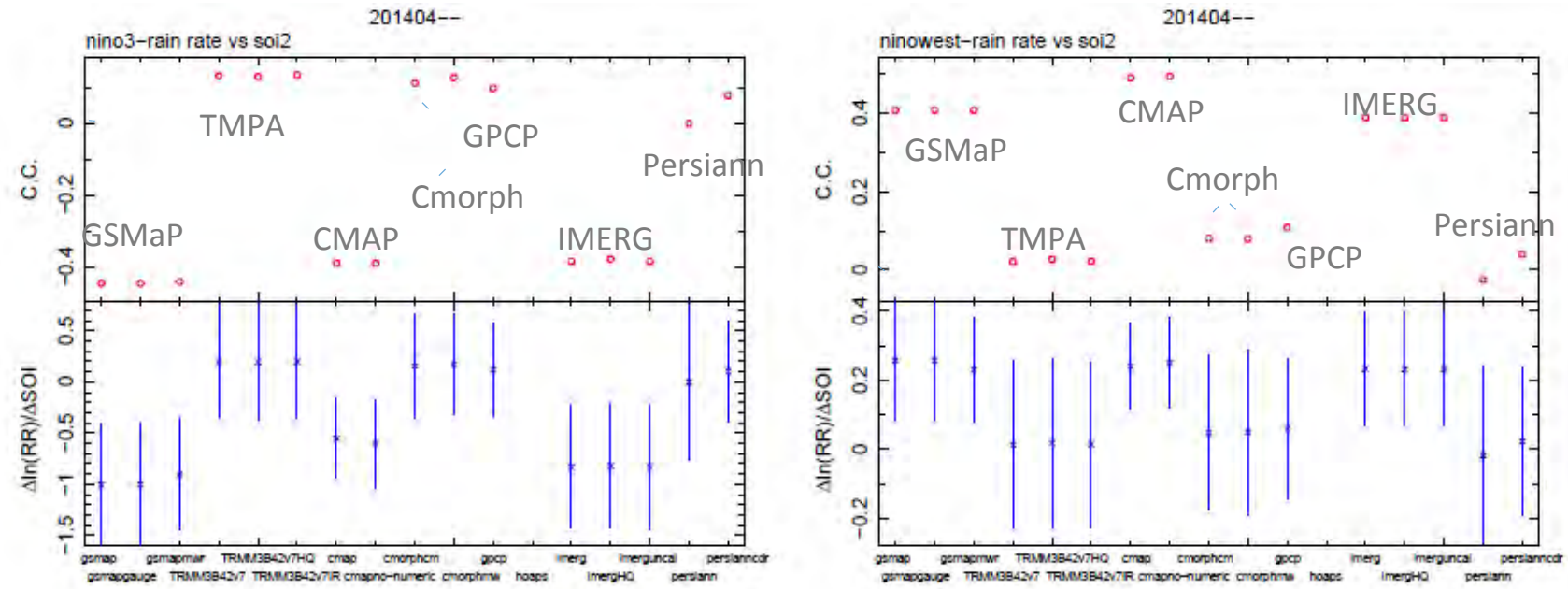


Spread is larger for extreme rains (in particular over ocean).

Courtesy Masunaga/FURUZAWA/KUMMEROW

Precipitation assessment under GDAP

- **A lot of variability related assessments: example El-Nino**
  - NINO-3 (left) and NINO-west (right) P vs. SOI CC.



The correlation is in theory expected to be negative for NINO3 and positive for NINO-West. The results are however mixed.

Courtesy Masunaga/FURUZAWA/KUMMEROW

Precipitation assessment: Joint IPWG-GEWEX effort

Leads : Z. Haddad and R. Roca

- Initially triggered by RR in April 2017 with a small discussion group
- Exposed to European scientists in May 2017 (European precip workshop in Offenbach)
- Exposed to US/international scientists in October 2017 (during the GPM science team meeting)
- First Assessment Scoping Meeting + Report October 2017 (Saturday meeting after the GPM science team meeting)
- Call for international participation November 2017
  http://ipwg.isac.cnr.it/reports/assessment_2018-21.html

Precipitation assessment: Joint IPWG-GEWEX effort

#	Name	Leads	Short description
1	Standard quality assessment	T. Kubota and H. Masunaga	catalogue with summary descriptions; intercomparisons; regime sorted statistics;quality & traceability (including WDAC doc+ FIDUCEO)
2	Uncertainty	J. Turk and P. Kirstetter	uncertainty metrics (detection, estimation); intrinsic uncertainty (sensitivity); algorithm limitations;
3	Consistency	A. Beranghi and D.B. Shin	water and energy budgets consistency; regional budgets; ancillary datasets (description and assessment for robustness)
4	Evaluation of analysis data from numerical models	H.J. Kim and G. Balsamo	performance metrics; model scales (spatial and temporal)
5	Ground based data	C. Kidd and S. Durden	sources (including weather radar where available); calibration and uncertainty characterization of sources, including polarimetric ground radars
6	Validation at weather scales in regions without ground measurements	R. Ferraro	consistency with other remotely sensed data at weather scales; consistency with reanalysis
7	Variability and trends	F.J. Tapiador	sub-seasonal, seasonal, annual, inter-annual; extremes and the ability to capture them faithfully; correlation with climate indices;
8	End users applications	Z. Haddad and G. Huffman	phenomenological assessment (consistency with agricultural indices, etc); latency issues;
9	Recommendations to algorithms developpers	G. Huffmanf and Z. Haddad	assessment of assumptions underlying the algorithms , including retrievals from ground measurements (physical validation);
10	Programmatic recommendations	G. Stephens and V. Levizzani	product sensitivity to satellite constellation configuration; sensitivity to instrument capability and performance , including ground /airborne instruments product sensitivity to satellite constellation configuration; sensitivity to instrument capability and performance , including ground/airborne instruments

Precipitation assessment: Joint IPWG-GEWEX effort

- Short term (May 2018) on going activity: The section leaders should elaborate 3 lists:
  - The first list would consist of an inventory of existing analysis results, reports, and peer-reviewed papers, that can be drawn upon for the assessment.
  - The second list would identify gaps that can realistically be addressed over the next three years (i.e. by 2020) by identified volunteer contributors who will conduct the analyses.
  - The third list would identify important gaps for which there is currently no clear contributor. This would then be a listing of opportunities for new voluntary contributions

Precipitation assessment: Joint IPWG-GEWEX effort

SCHEDULE

- February 2018: action Ziad and Rémy: : reminder to section leaders
- May 2018: (At the GEWEX Conf ? Or teleconf)
  - consolidated items lists from the section leaders
- November 2018: first meeting at IPWG-9 (Seoul)
  - to adopt scope summary document prepared from the element lead lists
- October 2020: meeting at IPWG-10
  - to review the assessment results and recommendations, and start writing the final report.

OUTREACH

- within GEWEX Hydrology with GLAS ? To GAS ?
- Within WCRP : Action Graeme Stephens -> link with Christian Jacob

Scientific Assessment framing under scientific big questions

Literatire review	Programmatoc recommendation	Variability & trends	consistency	Uncertainty	Groudn based data	Standard qaulity assessment	Recommend to providers or algorithms
Status	Constellatino sensitivity	Annual and subseasonnal				intercomparison	Underlying assumptions
Waht we got from the past	Instrument spec	interannual		Assessing the uncertainty		definition	
	programmatic	Clausiuis clapeyron extreme		Structural (regime sorted statistics)		Regime sorted statistics	
	Surface / insitu network	Correlation with climate indices				Quality (tracability) Including WADC doc+ FIDUCEO	
	OSSE data denial analysis					catalogue	

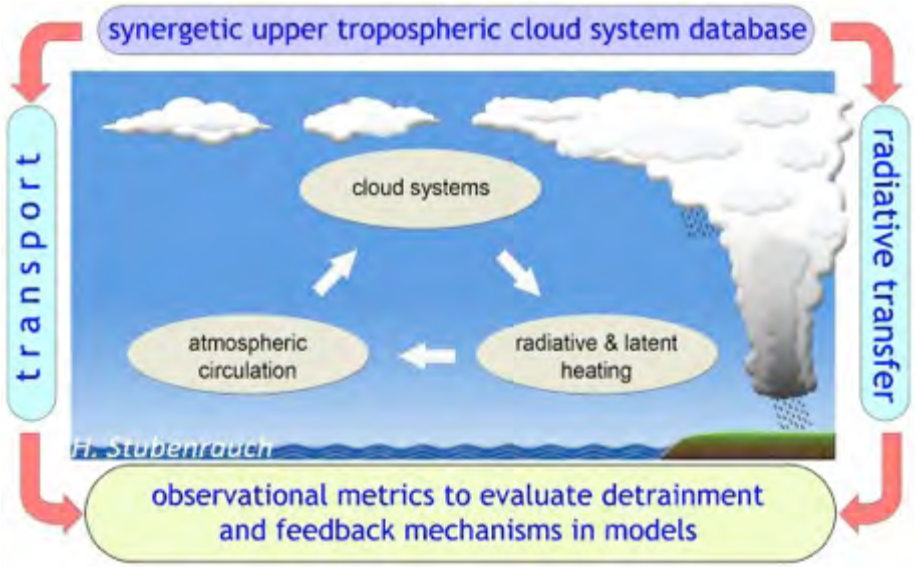
Add exemple from on going gewex stuff (seaflux weather regims, water vapor)
Write a report for WCRP with the panels

News Items and others

PROES UTCC (C. Stubenrauch and G.Stephens)

meetings: Nov 2015, Apr 2016, Mar 2017

***working group* links communities** from observations, radiative transfer, transport, process & climate modelling



focus on tropical convective systems *& cirrus originating from large-scale forcing*

- **cloud system approach, anchored on IR sounder data**

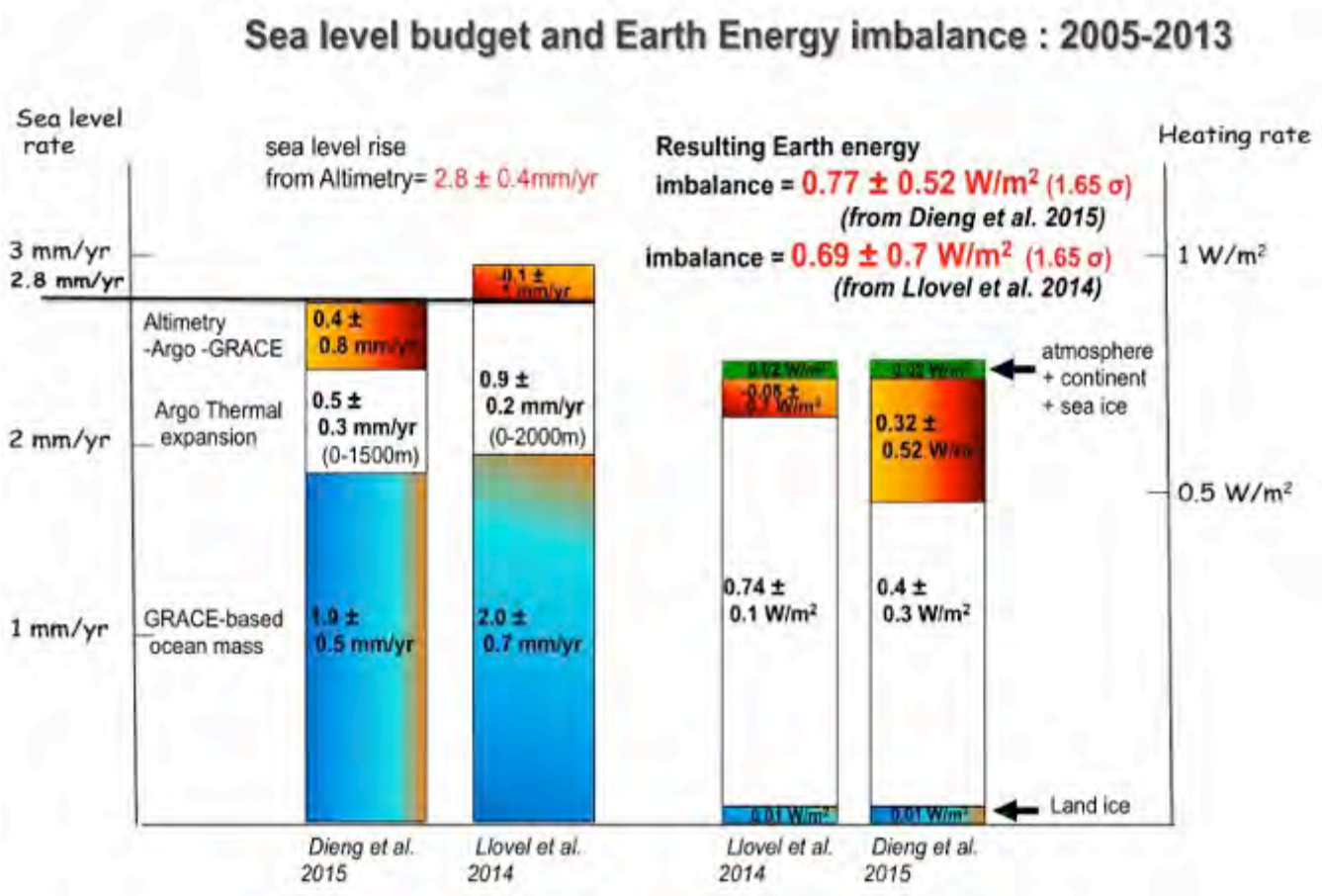
horizontal extent & convective cores/cirrus anvil/thin cirrus ***based on*** p_{cld}, ε_{cld}

- **explore relationships between 'proxies' of convective strength & anvils**
- **build synergetic data** (vert. dimension, atmosph. environment, temporal res.)
- **determine heating rates** of different parts of UT cloud systems
- **follow snapshots** by Lagrangian transfer -> **evolution & feedbacks**
- **investigate how cloud systems behave in CRM studies**

& in GCM simulations *(under different parameterizations of convection/detrainment/microphysics)*

Recent Advances from Satellite Gravimetry and Altimetry Measurements

- Sea level (from satellite altimetry) minus ocean mass (from space gravimetry) provides a satellite-based alternative to Argo for estimating OHC
- The current best estimate of the OHC change from satellite is 0.7±0.5 Wm^{-2} over 2005-2015
- GDAP endorses expansion of this activity to regional and shorter timescales as part of a new EEI-themed energy budget assessment.



Related Activities

GEWEX Integrated Dataset

- GEWEX sponsored or supported datasets on a common 1◦, 3-hourly, equal-area grid
- Supports regional water and energy budget closure analyses
- User workshop in Spain in 2019

Integrated Surface Water and Energy Assessments

- Advance land-ET and surface radiation measurements by explicitly linking to new/proposed land surface temperature, soil moisture, terrestrial water storage, and ground heat storage assessment activities

Earth's Energy Imbalance

- Grew out of CLIVAR CONCEPT-HEAT and NASA NEWS
- Integrated assessment of methods for quantifying fundamental driver of climate and reconciling top-of-atmosphere vs. surface perspectives

Continuing a Key Climate Data Record: ISCCP-Next Generation

- Cloud properties constitute a core geophysical climate record
- Instruments and expertise exist to generate a calibrated, global, 10-channel, multi-parameter cloud at 3 km with 30 minute coverage
  - Heritage to deal with such data volumes also exists (e.g. AIRS and MODIS)
- Excellent opportunity for coordinated NASA and NOAA activity to maximize scientific benefits of new geostationary and low-earth orbiting satellites
- GDAP endorses the formation of a team to develop a unified analysis approach built around the current geostationary radiance data record augmented by MODIS/VIIRS and sounder cloud information
  - Agency support for a series of international workshops
  - Target 2021 for initial implementation
- A multi-institutional (multi-national) processing chain similar to ISCCP is encouraged
  - Individual satellite operators, collect, quality control, and sub-sample radiances and provide these data to an analysis center that would conduct a refined calibration and the quantitative cloud analysis.
  - Data products to be archived and distributed by existing data centers.