GEWEX Data and Assessment Panel Overview

Jörg Schulz, Chair
Matthew McCabe, Vice Chair

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

BSRN Relation to GEWEX and GCOS

- The Baseline Surface Radiation Network (BSRN) has operated since 1992 under the auspices of GEWEX;
- It has established the relevant measurement techniques and has been recognised since 2004 as the GCOS Baseline Network for Surface Radiation;
- GCOS status report (2015) saw an improvement compared to 2009 in station availability;
- Data-scarce areas remain, however, especially over oceans and for eastern Africa and central Asia (hard to address);
- Need more BSRN tower sites in particular for albedo evaluation.

BSRN and GCOS

A14: Ensure continued long-term operation of the BSRN and expand the network

Action: Ensure continued long-term operation of the BSRN and expand the network to obtain globally more representative coverage. Establish formal analysis infrastructure.

Who: Parties' national services and research programmes operating BSRN sites in cooperation with AOPC and the WCRP GEWEX Radiation Panel.

Time-Frame: Ongoing (network operation and extension); by 2012 (analysis infrastructure).

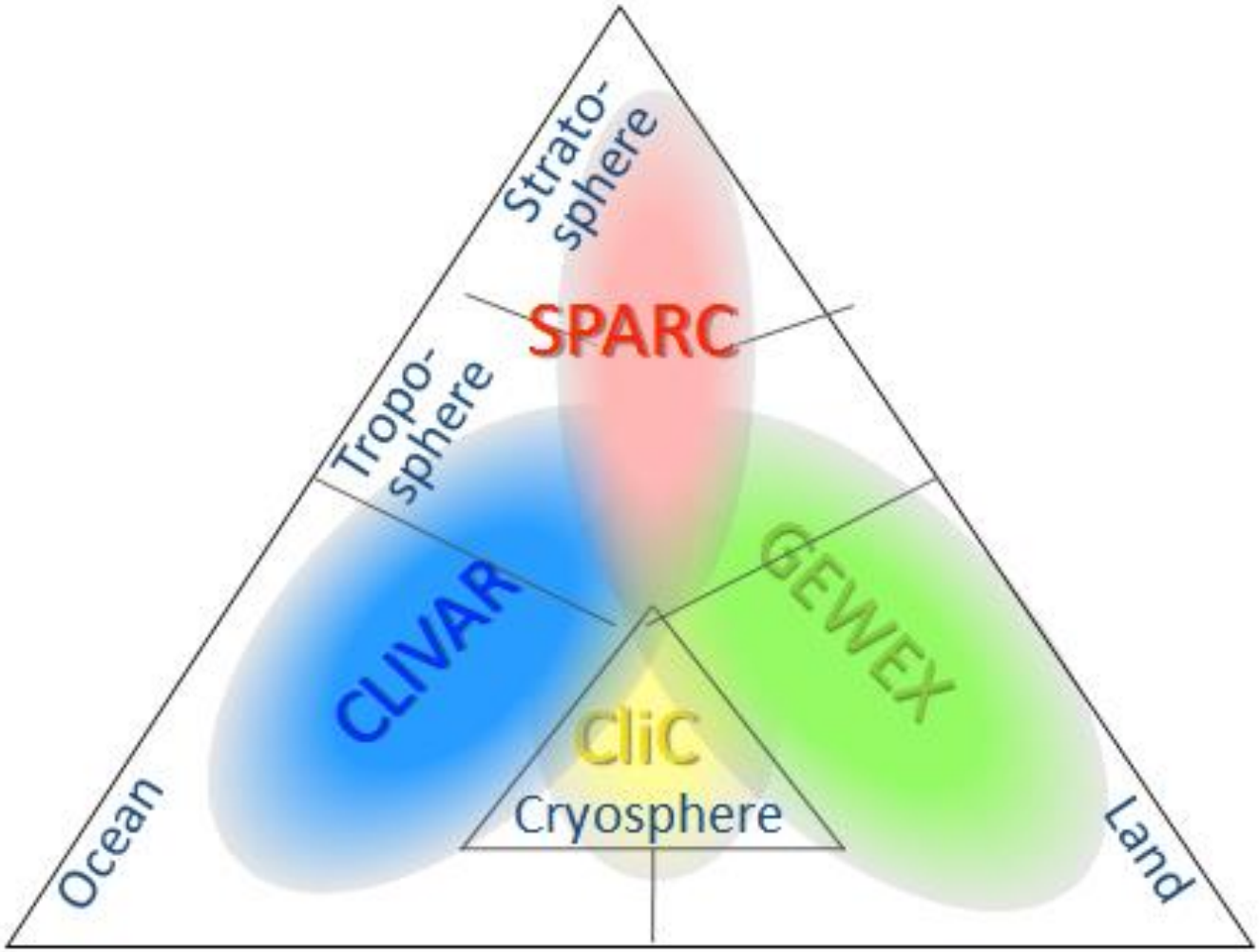
Performance Indicator: The number of BSRN stations regularly submitting data to International Data Centres; analysis infrastructure in place.

Annual Cost Implications: 1-10M US$ (20% in non-Annex-I Parties).

- GCOS is revising its Implementation Plan during 2016 and Actions may change;
- Watch out for open review of the GCOS IP during July and August 2016 and raise your voice if needed.

GEWEX

GEWEX within WCRP



WCRP Grand Challenges

Joint Scientific Committee

Joint Planning Staff

Modeling Advisory Council

Data Advisory Council

Working Groups on: Coupled Modeling (WGCM), Numerical Experiment (WGNE), Regional Climate (WGRC), Seasonal to Interannual Prediction (WGSIP)

CliC	CLIVAR	GEWEX	SPARC	CORDEX
Cryosphere-Climate	Ocean-Atmosphere	Land-Atmosphere	Troposphere-Stratosphere	Regional Climate Downscaling

Regional Sea-Level Change and Coastal Impacts

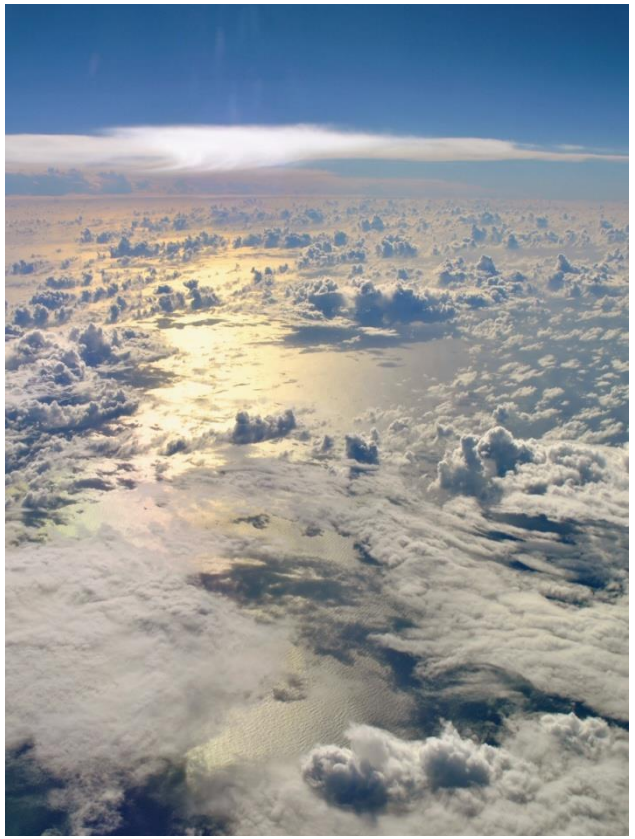
Melting Ice and Global Consequences

Changes in Water Availability

Cloud Circulation and Climate Sensitivity

Understanding and Predicting Weather and Climate Extremes

Clouds and observations of Water, Heating & Circulation



1. Atmospheric cloud radiative effects (CERES-like, for sfc radiation budget and vertical profiles of radiative cooling)
2. Highly-vertically resolved water vapor in LT (sharp gradients bw/ PBL and free troposphere)
3. Better estimates of cloud water path (separation of clouds and precipitation)
4. Vertical structure of latent heating, including surface evaporation (esp. below clouds for feedback studies)
5. Large-scale vertical velocity / convergence (esp. for mean circulation, tropics, MJO, prospects w/ ADM-Aeolus)
6. Support for a more continuous culture of complementary field experiments

(see details in S. Bony, GCOS conference 2016)

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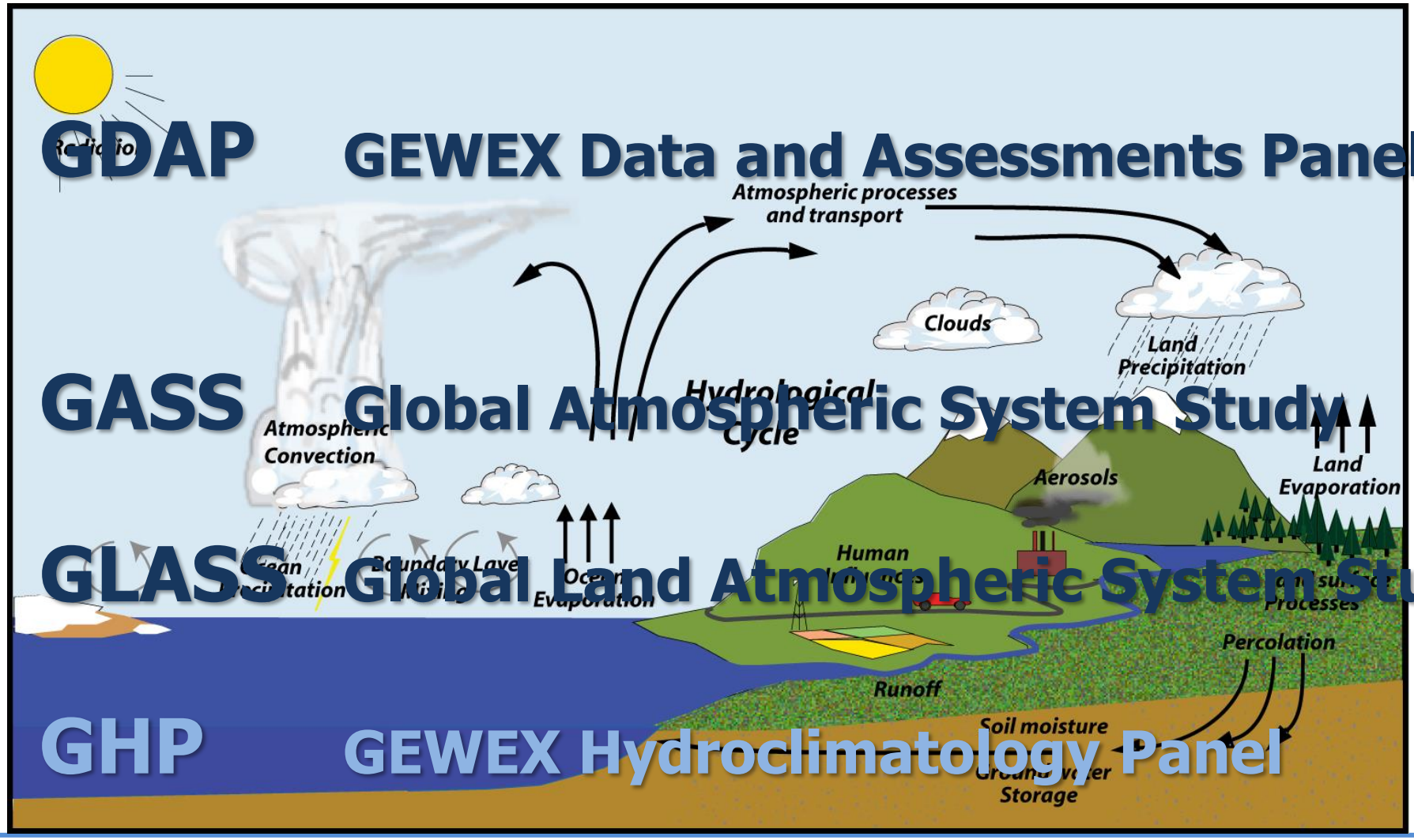
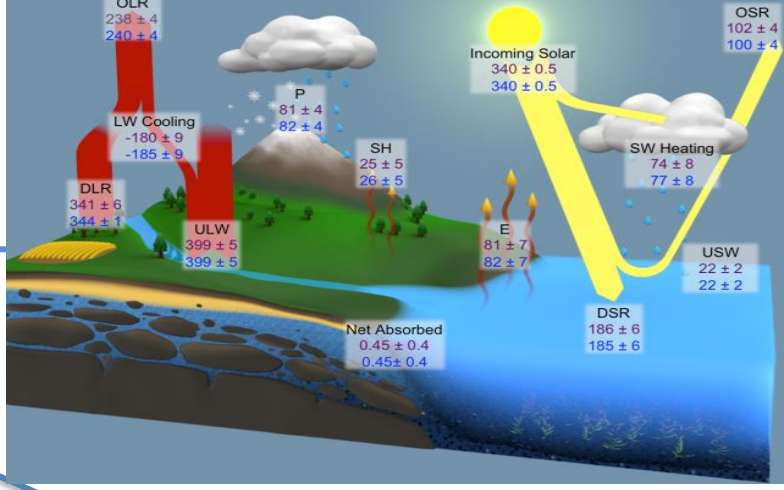
GEWEX Major Components



GDAP Objectives

- Data records (including those for climate monitoring)
  - Guide production and analysis of global data sets with respect to GEWEX questions, e.g., energy and water budget closure;
  - Use new data sources in the data sets, e.g. GPM
  - Tailor data sets to needs of GCs, e.g., water availability, extremes and PROES activities and directly participate/interact with GCs and PROESs;
  - Evaluation of climate models – obs4mips connect;
- Ground-based networks
  - Guidance of surface networks such as BSRN and GPCC needed for assessments
  - Evaluation of satellite products
  - Evaluation and tuning of models
- Data quality assessments (water vapour, aerosol, precipitation, soil moisture)
  - To assure quality and knowledge about data sets including suitability for applications;
  - To improve uncertainty estimation for data records
  - Assess adequacy of observing system - Interact with CEOS/CGMS WG Climate
- Science
  - Energy and water cycle closure
  - Process studies, e.g., Upper Tropospheric Clouds and Convection Process Evaluation Study
  - Uncertainty characterisation, e.g. following principles coming from metrology

GDAP product integration
Energy wiring diagram



TOA flux

ISCCP

CERES

GVAP

SRB

LST

MAC

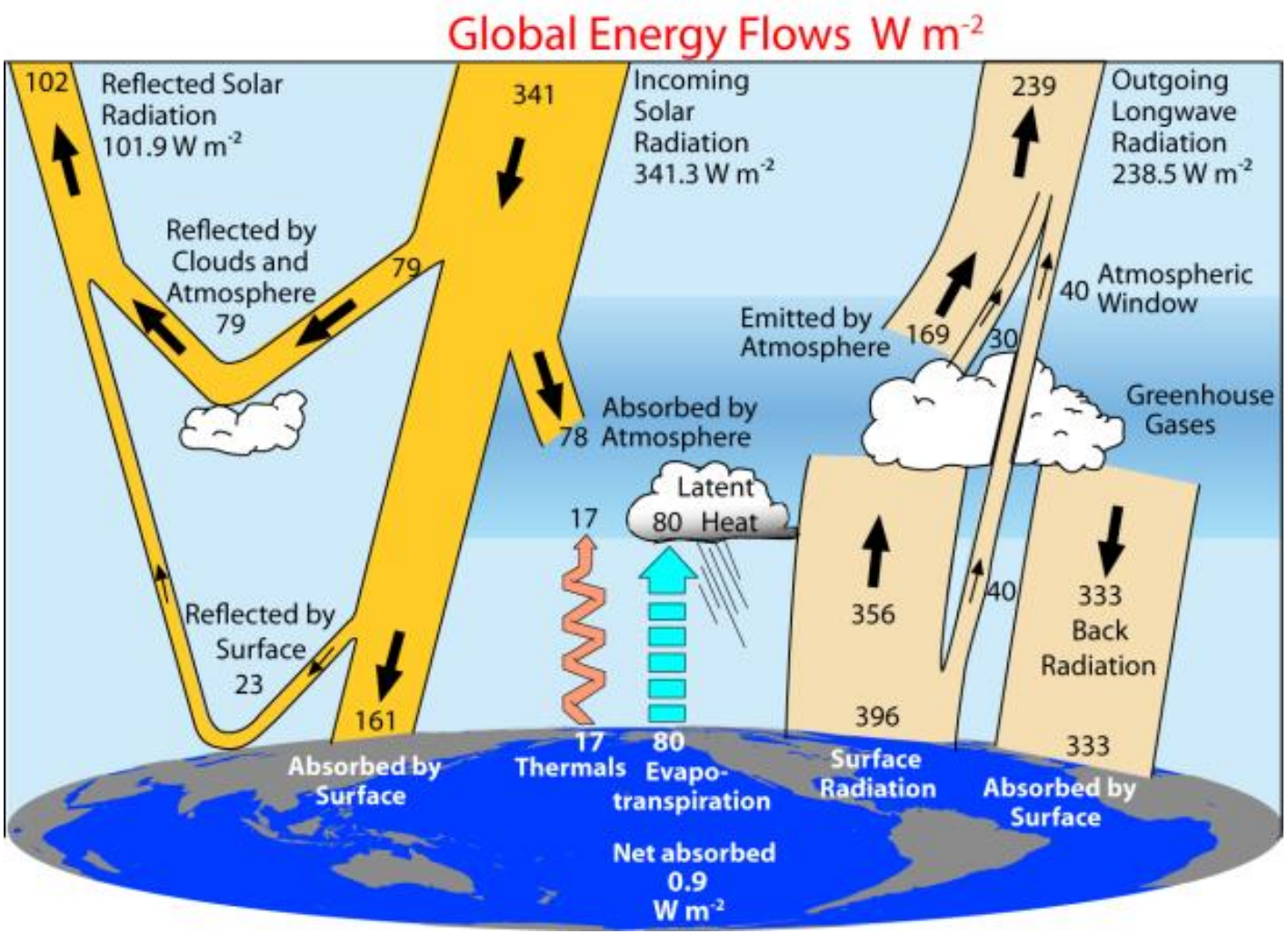
Landflux

Seaflux

SST

Water wiring diagram?

Closing the Earth's Energy Balance



Trenberth et al., 2009

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Closing the Earth's Energy Balance

Box 1 | Updated energy balance

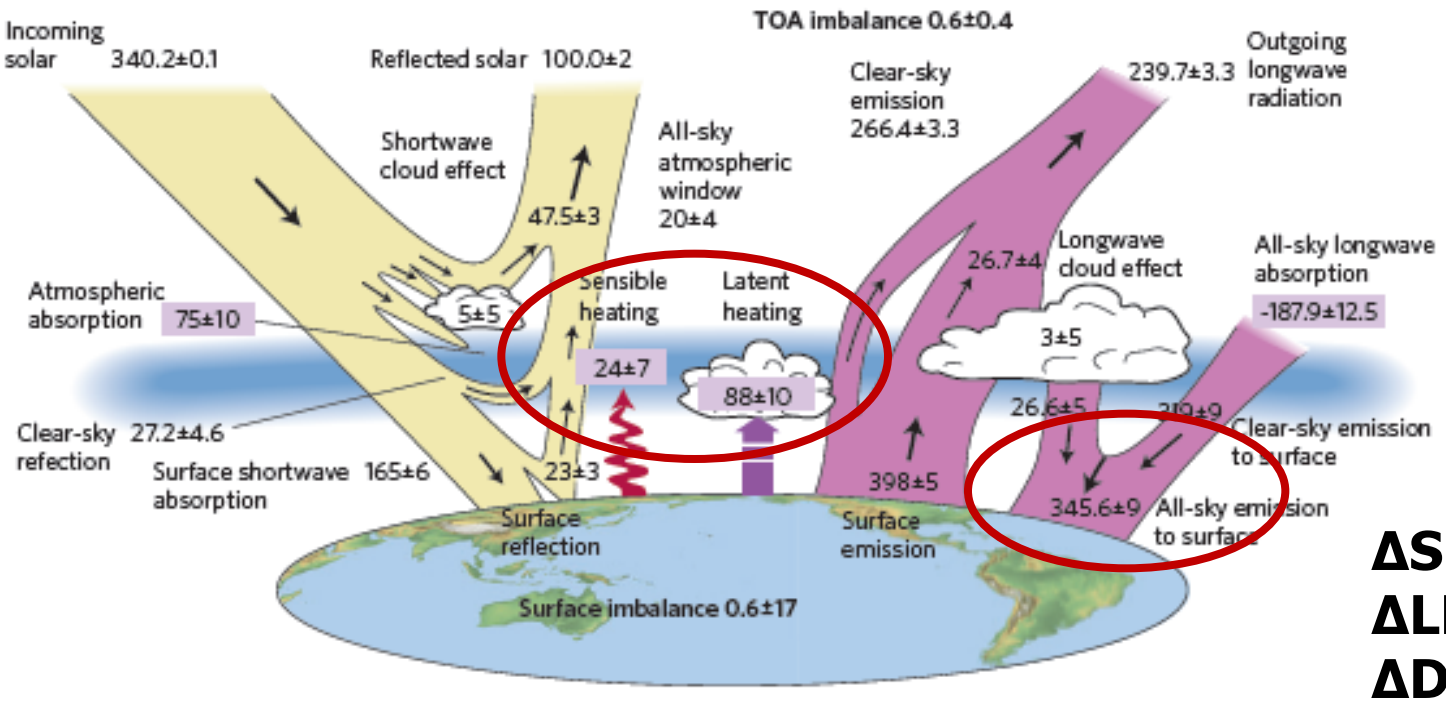
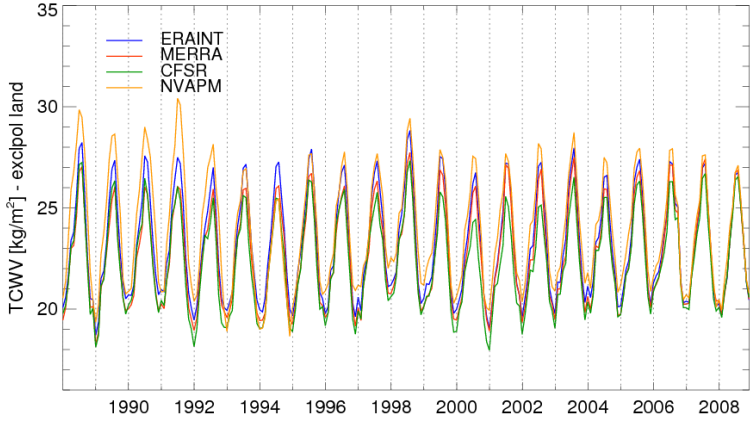


Figure B1 | The global annual mean energy budget of Earth for the approximate period 2000–2010. All fluxes are in Wm^{-2}. Solar fluxes are in yellow and infrared fluxes in pink. The four flux quantities in purple-shaded boxes represent the principal components of the atmospheric energy balance.

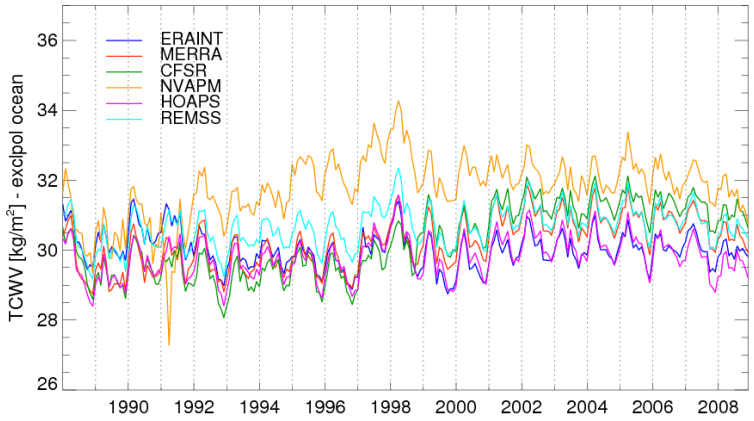
Stephens et al., 2012

GEWEX Assessment of Water Vapour Data Records

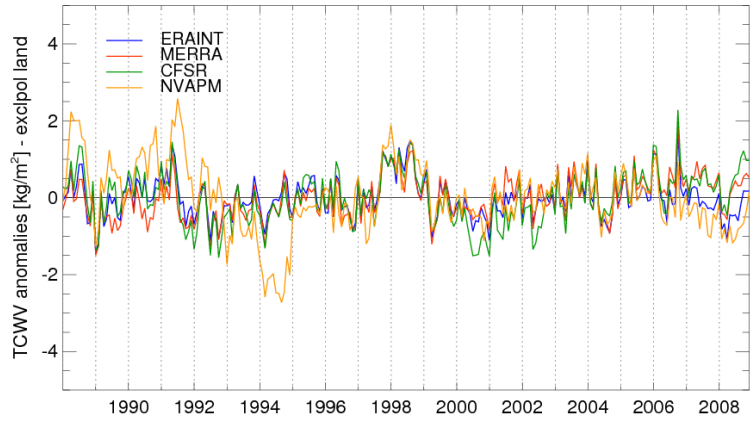
Land

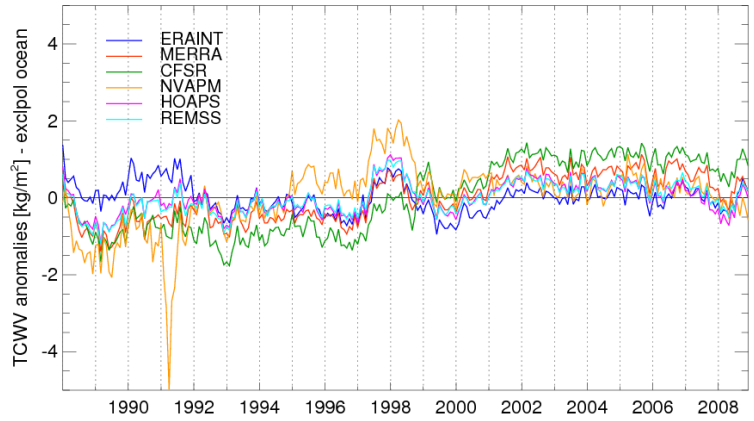


Ocean



Total Column Time Series (50°N-50°S) 1988-2008





Courtesy of M. Lockhoff and M. Schröder, 2014

Closing the Earth's Energy Balance

- To achieve a balance we are forced to make 'large' adjustments to our best estimate fluxes (10-15 Wm^{-2});
- At the TOA this is done w.r.t. the observed ocean heat uptake (e.g. Loeb et al., 2012);
- At the surface, two philosophical pathways have been followed:
  1) Small adjustment to turbulent fluxes - Big decrease to radiation - **what is the missing sink of radiant energy?**
  2) Big increase to turbulent fluxes - Small adjustment to radiation - **where is the missing source of water?**
- Recent studies (Rodell et al. (2015), L'Ecuyer et al. (2015)) try to objectively balance E&W cycles using Optimal Estimation Framework.

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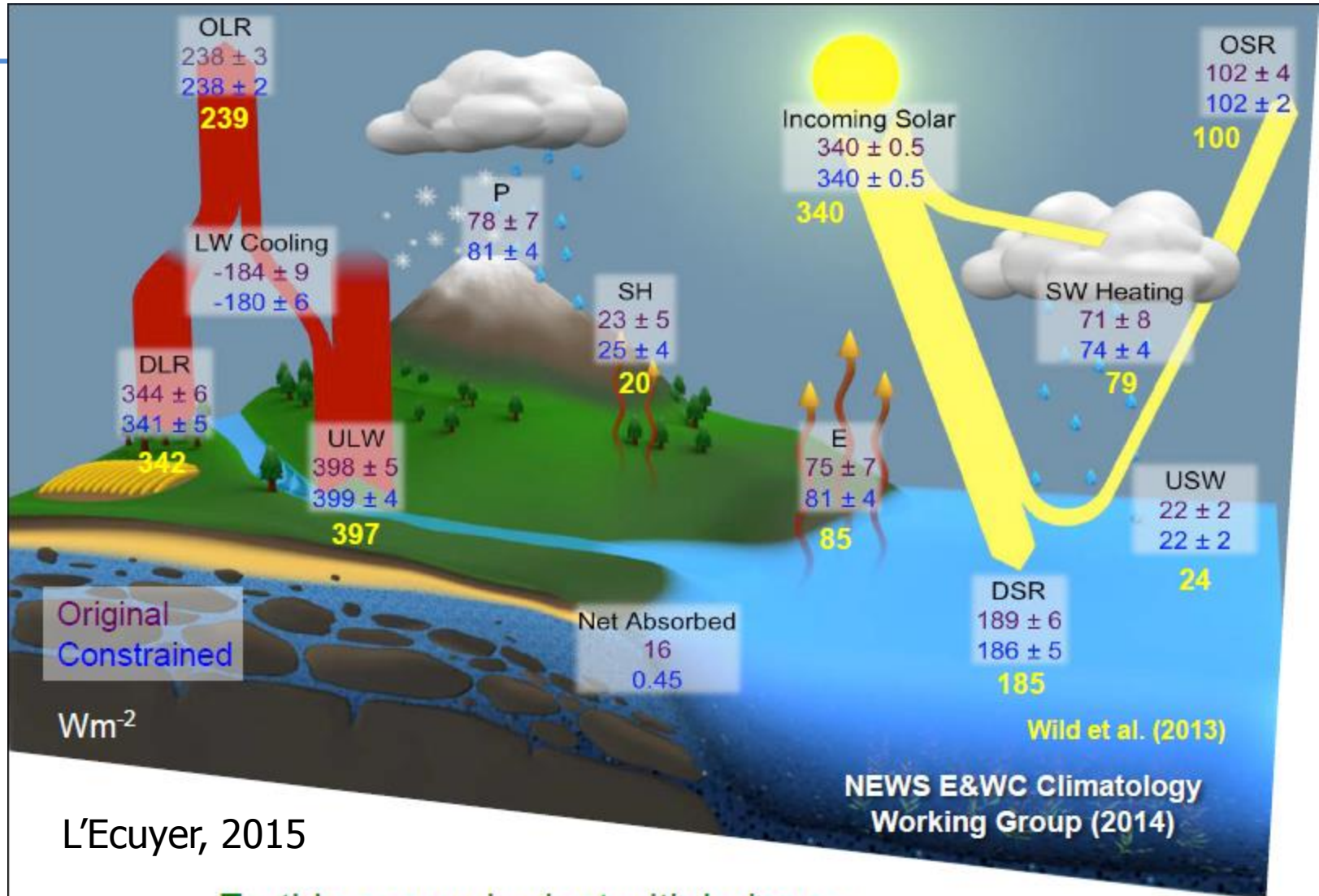
Energy Cycle

Satellite inputs include:

- Microwave radiance data,
- Lidar, radar data
- Vis/IR imaging radiance data
- GRACE gravity and Altimetry
- Assessment of uncertainties



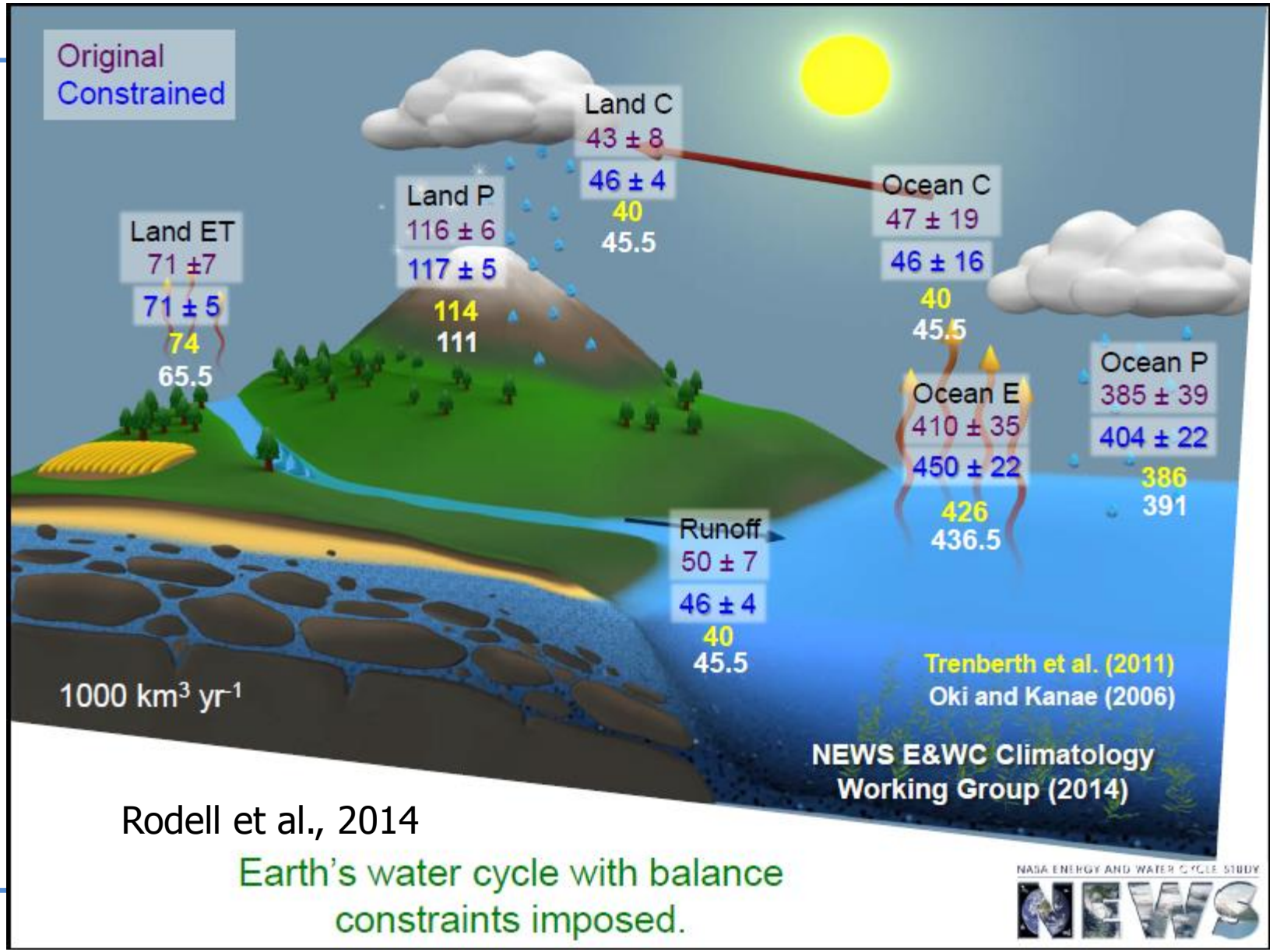
L'Ecuyer, 2015

Earth's energy budget with balance constraints imposed.

Water Cycle

Energy cycle link:

E ⟷ LH



Rodell et al., 2014

Earth's water cycle with balance constraints imposed.

Constrained Estimates Realistic?

Flux	Raw	Optimized	Change	Error
OLR	238	239	1	2
OSR	100	102	2	5
DLR	344	341	3	7
DSR	190	186	4	6
E	75	81	6	7
P	77	81	4	7
SH	21	25	4	5

BSRN

L'Ecuyer, 2015

All in Wm^{-2}

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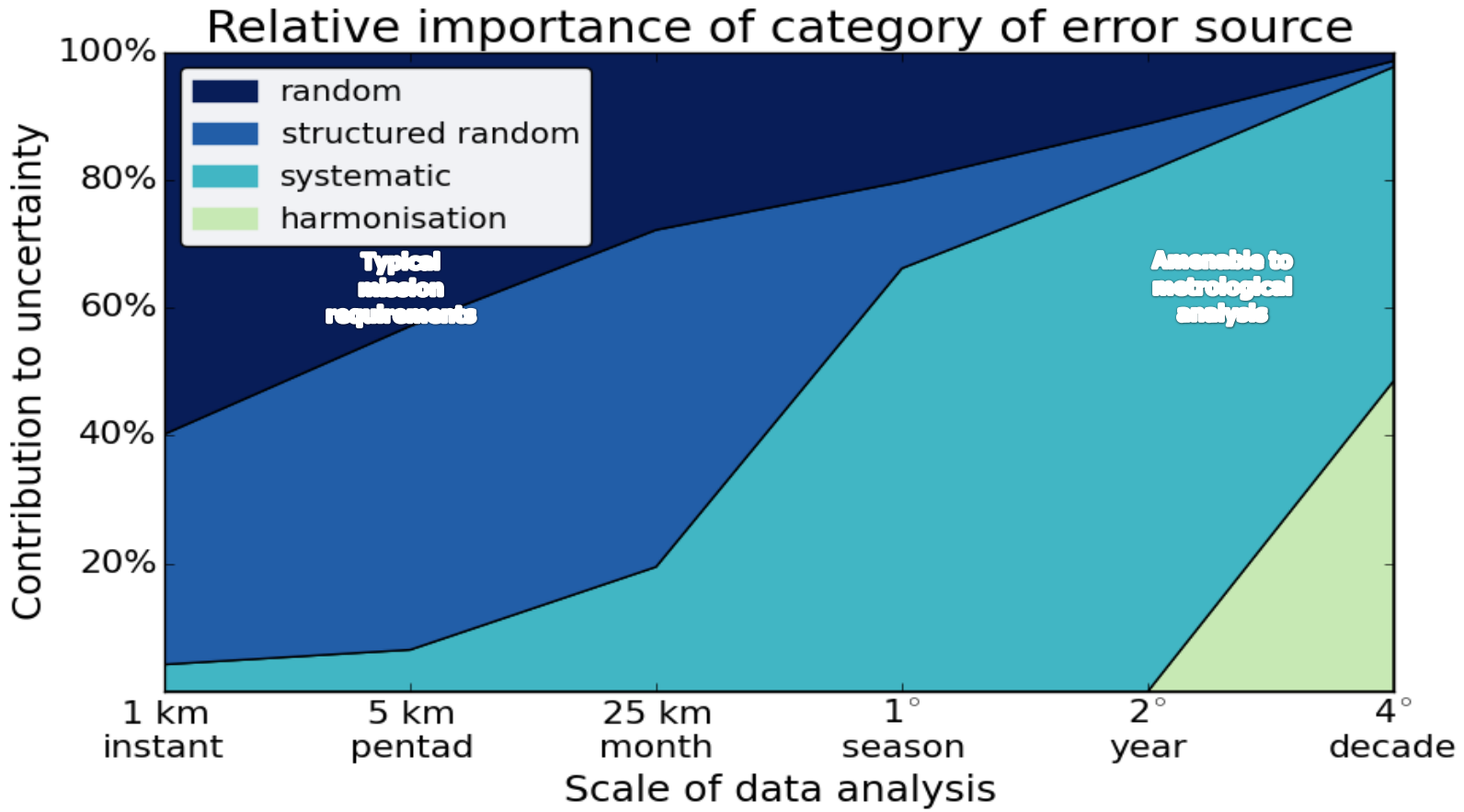
Uncertainties

- Risk management and decision making
- Propagation along the value chain
- Need for traceability and reference observations
- Capturing uncertainties
- Error co-variances
- Capturing new skill (reanalyses, sub-seasonal to decadal forecasts)
- How good is good enough? Model development and assessment

Courtesy of M. Rixen, WCRP Joint Planning Staff

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

Courtesy of Chris Merchant, U. Reading

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University of Reading

Fiduceo

Message Points

- Radiation at the Earth's surface is a fundamental component of the surface energy budget;
- Crucial to understand how the climate system works, including its energy and hydrological cycles;
- Systematic BSRN measurements are needed for monitoring climate variability and change, and for evaluating products based on satellite data (radiation fluxes, surface albedo, AOD) and from reanalyses and climate model runs;
- Spatial and temporal coverage extension remains an issue;
- Continuous calibration of BSRN *instruments across the sites* and knowledge of uncertainty for the measurements is essential.

GEWEX

Thank you!

Please continue this important work!

I wish a successful workshop that helps to further sustain the BSRN.

Do not hesitate to approach the panel chairs with issues.