ABOUT
WATER, ENERGY,
& CLIMATE

The GEWEX Core Project Report to JSC-38

Co-chairs
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Peter van Oevelen, Director IGPO

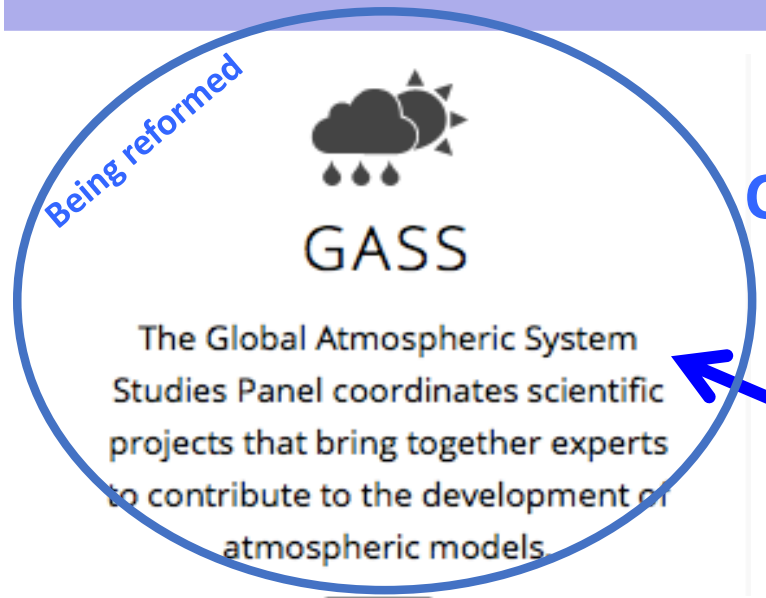
GEWEX

JSC April 2017

Outline

1. (4) Core Panel highlight
2. The new GASS and linking to WWRP
3. The GEWEX PROcess Evaluation Studies
4. Plans going forward

GEWEX Core efforts



GASS

The Global Atmospheric System Studies Panel coordinates scientific projects that bring together experts to contribute to the development of atmospheric models.

Core efforts are largely processes focused

Grand Challenges:
Extremes GC
Water GC

GLASS

The Global Land/Atmosphere System Study focuses on model development and evaluation, concentrating on the new generation of land surface models.

GHP

The GEWEX Hydroclimatology Panel aims to understand and predict continental to local-scale hydroclimates for hydrologic applications.

GDAP

The GEWEX Data and Assessments Panel guides the production and evaluation of long term, global atmospheric, surface water, and energy budget products.

Plus, cross project activities with other core projects, e.g. extremes, monsoons , ocean heat content/energy imbalance (CLIVAR), L3SMIP WITH CLIC & others developing with SPARC,CLIC

GEWEX Data Assessment Panel
New co-chairs (Nov 2016) Remy Roca; Tristen L'Ecuyer

Goals

1) **Data records** - Guide production and analysis of global data sets with respect to GEWEX questions, e.g., energy and water budget closure;

- **Surface fluxes (Seaflux,Landflux),Surface Radiation Budget, clouds (ISCCP), precipitation (GPCP), water vapor (Gvap), TOA fluxes, soil moisture, aerosol (GCP, MAC)**
- **New data initiatives**
- **Contribute to evaluation of climate models – obs4mips,PROES**

2) **In situ networks** –guidance/oversight/development of surface networks that support the global products

- **BSRN, GPCC, International soil moisture network**

3) **Data quality assessments** - assure quality and knowledge about data sets including suitability for applications & improve uncertainty estimation for data records - Interact with CEOS/CGMS WG Climate

- **Cloud,Water Vapor, Aerosol, Precipitation, Soil Moisture, ET**

4) Data integration

- **Energy balance, water balance,**

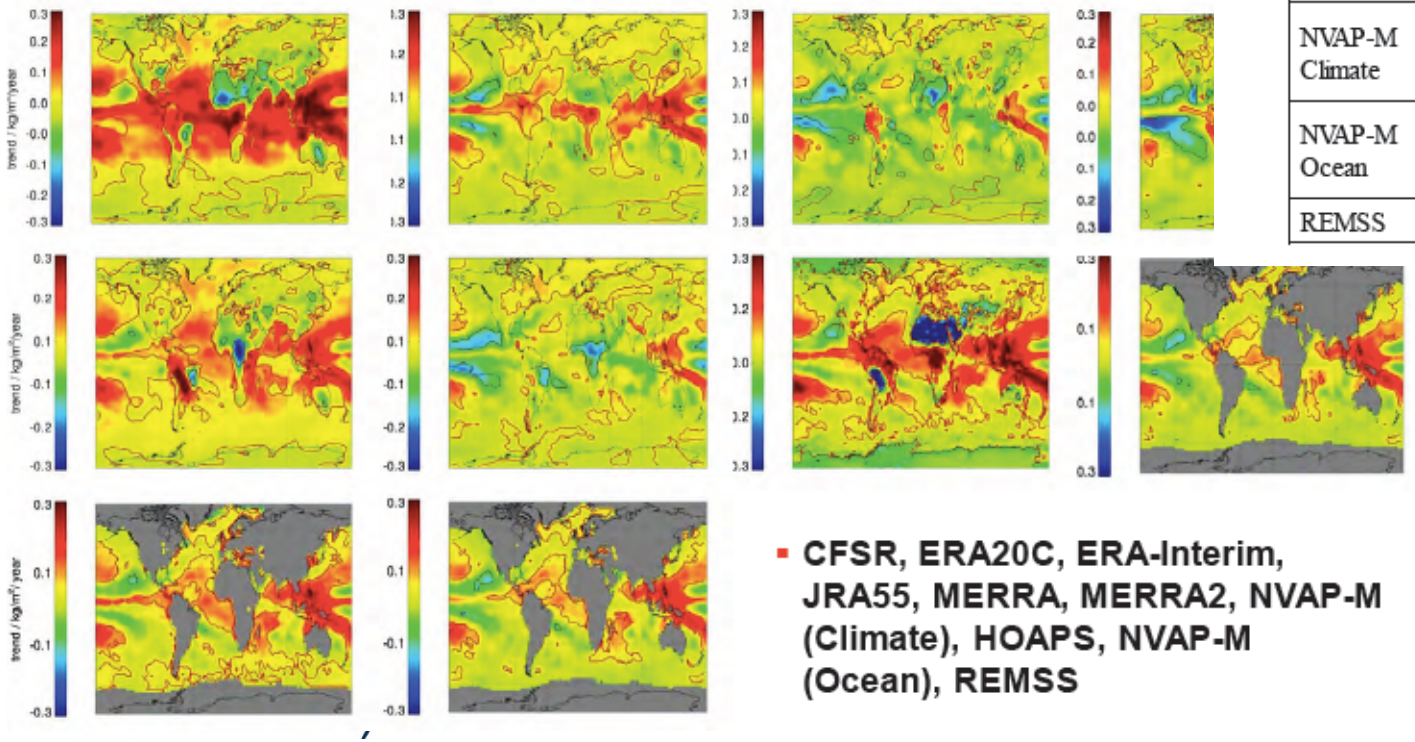
Example highlight of one GDAP assessment: Water vapor

Regression, Time-to-detect

Examination of ‘long term’ trends in global column water vapor

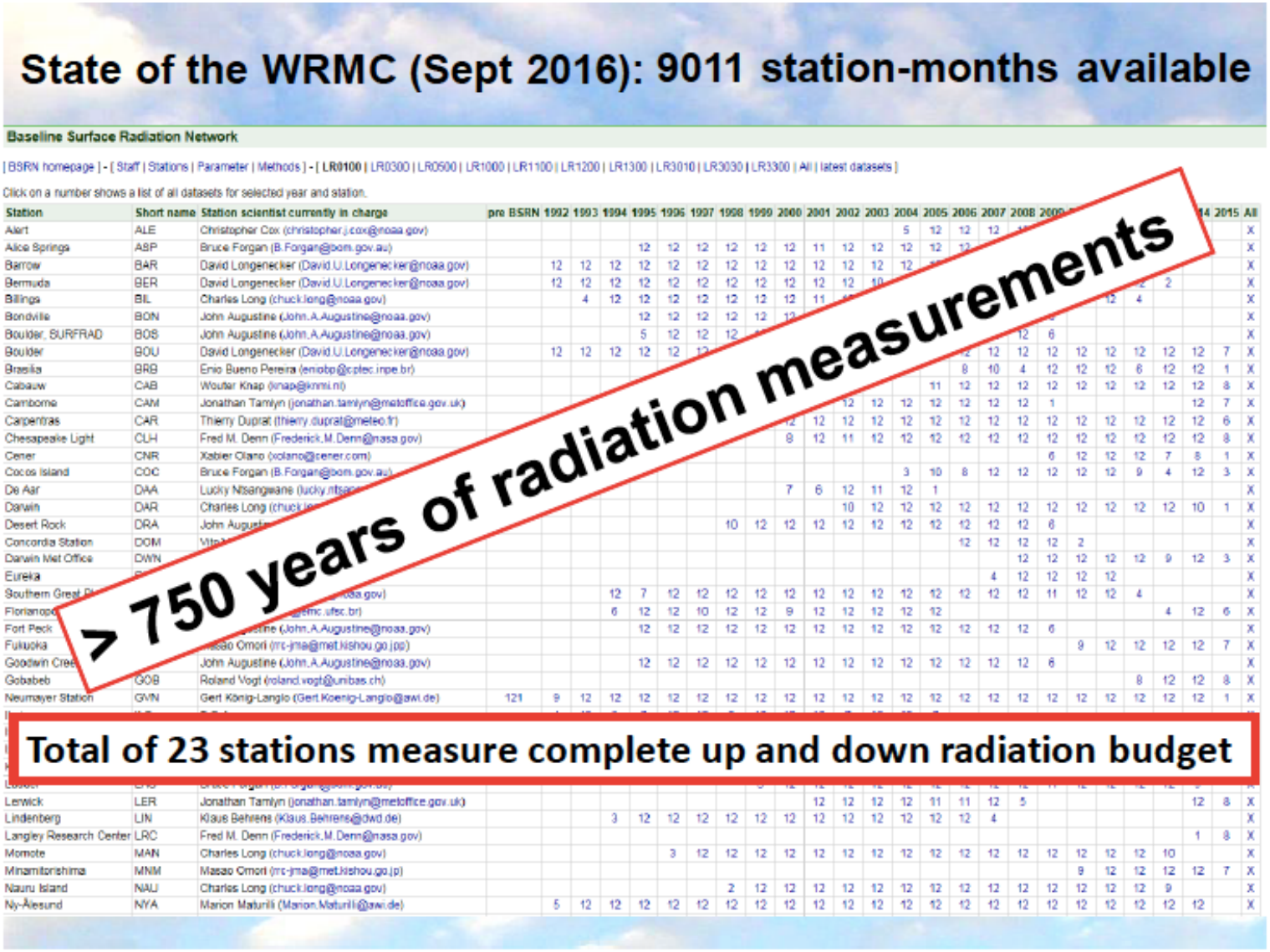
Schroder et al. 2016

	Trend kg/m²/decade	Regression % / K	TTD* years
CFSR	1.21 ± 0.16	24.9 ± 0.5	33
ERA-Interim	-0.11 ± 0.09	2.9 ± 0.5	22
ERA20C	0.37 ± 0.06	10.0 ± 0.2	18
HOAPS	0.25 ± 0.07	7.2 ± 0.3	18
JRA55	0.03 ± 0.06	2.6 ± 0.4	17
MERRA	0.75 ± 0.09	15.8 ± 0.3	22
MERRA2	0.04 ± 0.06	4.4 ± 0.3	17
nnHIRS	-1.51 ± 0.17	14.2 ± 1.3	35
NVAP-M Climate	0.68 ± 0.20	8.4 ± 0.7	37
NVAP-M Ocean	0.52 ± 0.07	10.1 ± 0.3	18
REMSS	0.34 ± 0.06	7.6 ± 0.3	17



- **CFSR, ERA20C, ERA-Interim, JRA55, MERRA, MERRA2, NVAP-M (Climate), HOAPS, NVAP-M (Ocean), REMSS**

BSRN – a major success story and one developed to support energy balance studies



State of the WRMC (Sept 2016): 9011 station-months available

Baseline Surface Radiation Network

| BSRN homepage | - [Staff | Stations | Parameter | Methods] - [LR0100 | LR0300 | LR0500 | LR1000 | LR1100 | LR1200 | LR1300 | LR3010 | LR3030 | LR3300 | All | latest datasets]

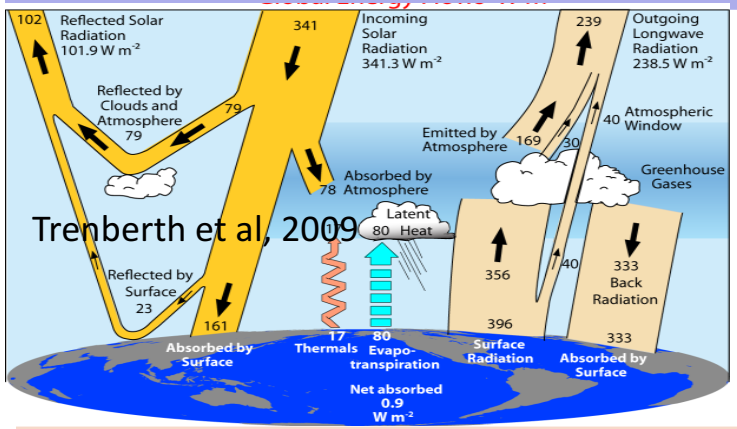
Click on a number shows a list of all datasets for selected year and station.

Station	Short name	Station scientist currently in charge	pre BSRN	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2014	2015	All
Alert	ALE	Christopher Cox (christopher.j.cox@noaa.gov)														5	12	12	12					X
Alice Springs	ASP	Bruce Forgan (B.Forgan@bom.gov.au)					12	12	12	12	12	12	11	12	12	12	12	12						X
Barrow	BAR	David Longenecker (David.U.Longenecker@noaa.gov)		12	12	12	12	12	12	12	12	12	12	12	12	12								X
Bermuda	BER	David Longenecker (David.U.Longenecker@noaa.gov)		12	12	12	12	12	12	12	12	12	12	12	10									X
Billings	BIL	Charles Long (chuck.long@noaa.gov)			4	12	12	12	12	12	12	12	11									12	4			X
Bondville	BON	John Augustine (John.A.Augustine@noaa.gov)					12	12	12	12	12															X
Boulder, SURFRAD	BOS	John Augustine (John.A.Augustine@noaa.gov)					5	12	12	12										12	6					X
Boulder	BOU	David Longenecker (David.U.Longenecker@noaa.gov)		12	12	12	12	12	12									2	12	12	12	12	12	12	7	X
Brasilia	BRB	Enio Bueno Pereira (eniobp@cptec.inpe.br)																8	10	4	12	12	12	1		X
Cabauw	CAB	Wouter Knap (knap@knmi.nl)															11	12	12	12	12	12	12	8		X
Camborne	CAM	Jonathan Tamlyn (jonathan.tamlyn@metoffice.gov.uk)												12	12	12	12	12	12	12	1			12	7	X
Carpentras	CAR	Thierry Duprat (thierry.duprat@meteo.fr)										12	12	12	12	12	12	12	12	12	12	12	12	12	6	X
Chesapeake Light	CLH	Fred M. Denn (Frederick.M.Denn@nasa.gov)										8	12	11	12	12	12	12	12	12	12	12	12	12	8	X
Cener	CNR	Xabier Olano (xolano@cener.com)																		6	12	12	12	7	8	1	X
Cocos Island	COC	Bruce Forgan (B.Forgan@bom.gov.au)														3	10	8	12	12	12	12	9	4	12	3	X
De Aar	DAA	Lucky Ntsangwane (lucky.ntsa										7	6	12	11	12	1									X
Darwin	DAR	Charles Long (chuck.lo												10	12	12	12	12	12	12	12	12	12	10	1	X
Desert Rock	DRA	John Augusti								10	12	12	12	12	12	12	12	12	12	12	6					X
Concordia Station	DOM	Vito																12	12	12	12	2				X
Darwin Met Office	DWN																			12	12	12	12	12	9	12	3	X
Eureka																			4	12	12	12	12					X
Southern Great Pl		oaa.gov)				12	7	12	12	12	12	12	12	12	12	12	12	12	12	12	11	12	12	4				X
Florianop		mc.ufsc.br)				6	12	12	10	12	12	9	12	12	12	12	12								4	12	6	X
Fort Peck		stine (John.A.Augustine@noaa.gov)					12	12	12	12	12	12	12	12	12	12	12	12	12	12	6						X
Fukuoka		sao Omori (mc-jma@met.kishou.go.jp)																				9	12	12	12	7	X
Goodwin Cree		John Augustine (John.A.Augustine@noaa.gov)					12	12	12	12	12	12	12	12	12	12	12	12	12	12	6						X
Gobabeb	GOB	Roland Vogt (roland.vogt@unibas.ch)																					8	12	12	8	X
Neumayer Station	GVN	Gert König-Langlo (Gert.Koenig-Langlo@awi.de)	121	9	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	1	X
Lerwick	LER	Jonathan Tamlyn (jonathan.tamlyn@metoffice.gov.uk)											12	12	12	12	11	11	12	5				12	8	X
Lindenberg	LIN	Klaus Behrens (Klaus.Behrens@dwd.de)				3	12	12	12	12	12	12	12	12	12	12	12	12	4							X
Langley Research Center	LRC	Fred M. Denn (Frederick.M.Denn@nasa.gov)																						1	8	X
Momote	MAN	Charles Long (chuck.long@noaa.gov)						3	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	10			X
Minamitorishima	MNM	Masao Omori (mc-jma@met.kishou.go.jp)																				9	12	12	12	7	X
Nauru Island	NAU	Charles Long (chuck.long@noaa.gov)								2	12	12	12	12	12	12	12	12	12	12	12	12	12	9			X
Ny-Ålesund	NYA	Marion Maturili (Marion.Maturili@awi.de)		5	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12			X

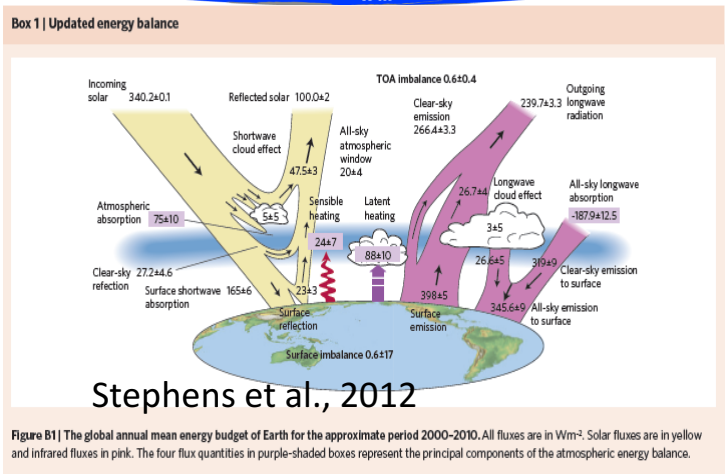
> 750 years of radiation measurements

Total of 23 stations measure complete up and down radiation budget

Comment on Energy balance efforts in GEWEX – a longstanding integrated GDAP assessment activity

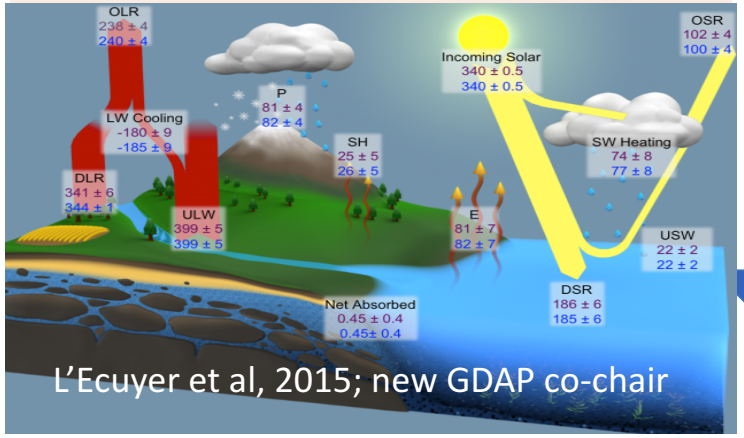


Trenberth et al, 2009



Stephens et al., 2012

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.



L'Ecuyer et al, 2015; new GDAP co-chair

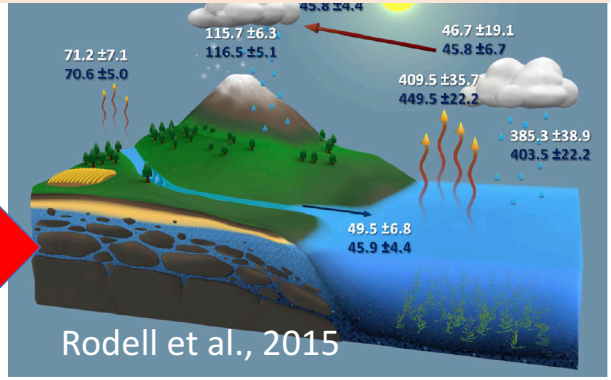
2009 Without uncertainties, balance achieved by entirely ad hoc, indefensible adjustments

2012 Uses GEWEX (GDAP) based products primarily with associated best uncertainties to rationalize adjustments but subjectivity within uncertainty remains

2015 The new GEWEX assessment – fully objective using optimization methods for adjustments, again based on assessed uncertainties - a key point is these adjustments affect water balance estimation

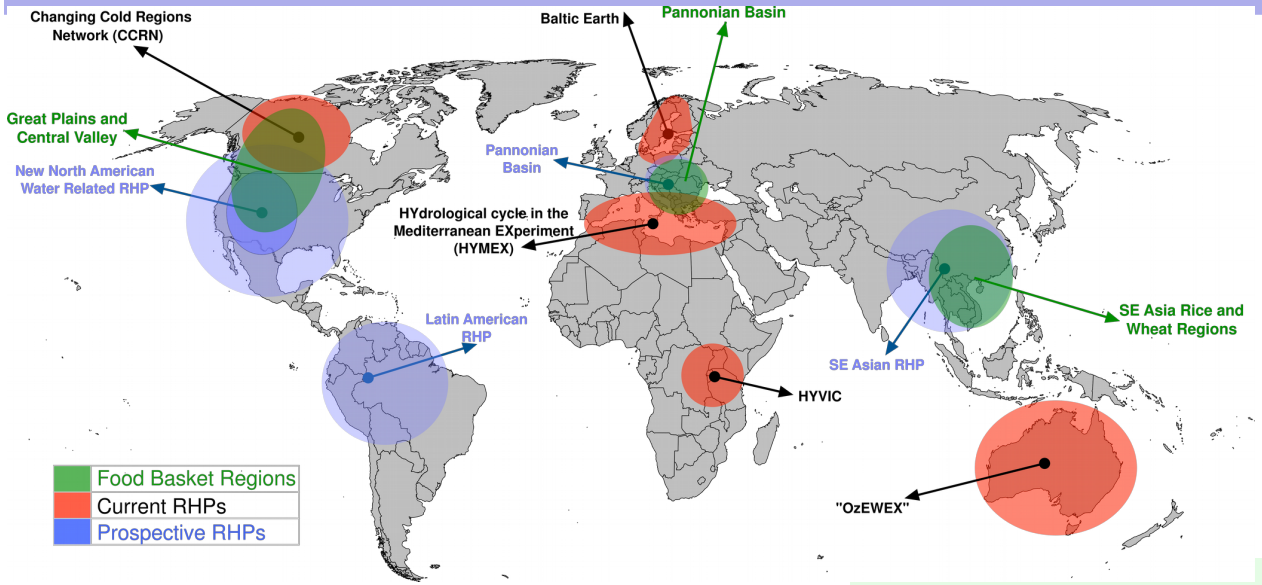
Water and energy don't balance (O~15Wm^{-2}) - balance is forced by 'adjustments' to our best estimate fluxes.

All methods constrain to input the net energy imbalance (O~0.5Wm^{-2}). Hopefully improved estimates of this is to be provided by a cross panel effort led by CLIVAR



Rodell et al., 2015

GEWEX hydroclimatology Panel , GHP
Co-chairs: Jason Evans and Joan Cuxart



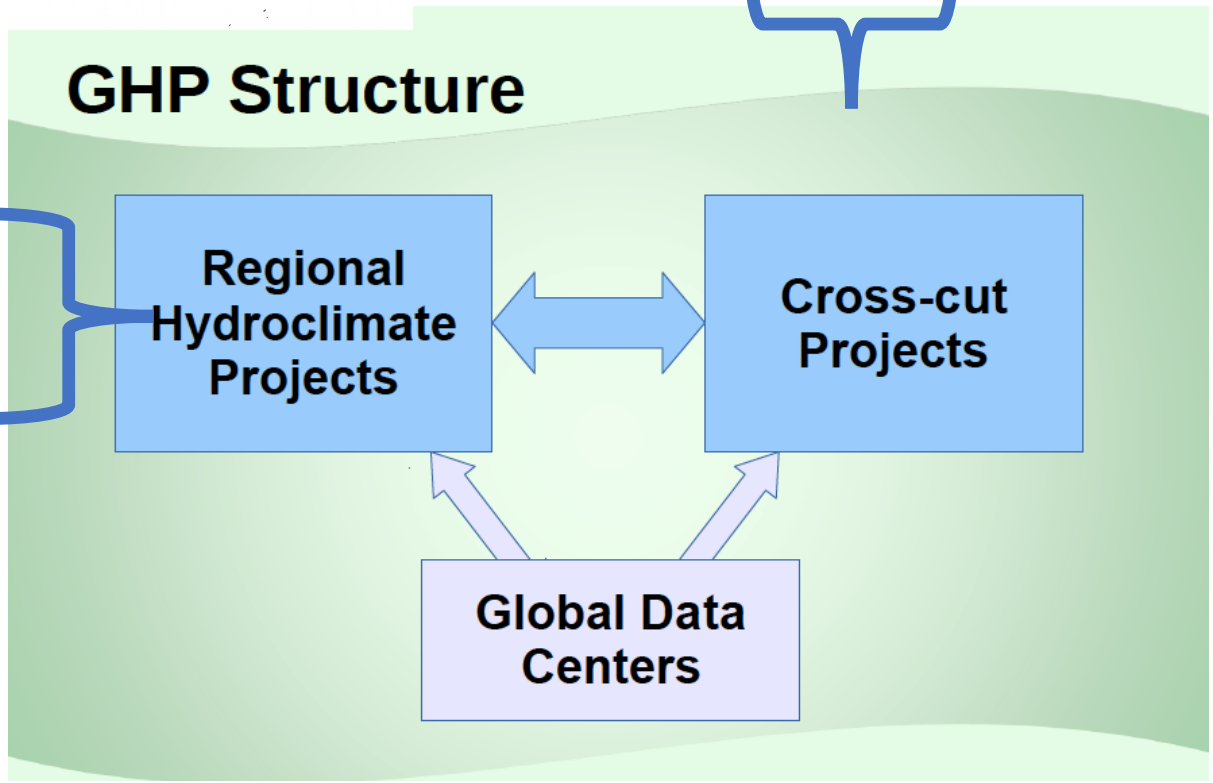
Intense – sub daily precipitation
Cold Zone: Near zero precipitation
Mounterrain: Mountain precipitation
Water management in large scale models
Inarch – mountain climate

Addressing the water cycle from physical to human and socioeconomic dimensions requires a regional perspective

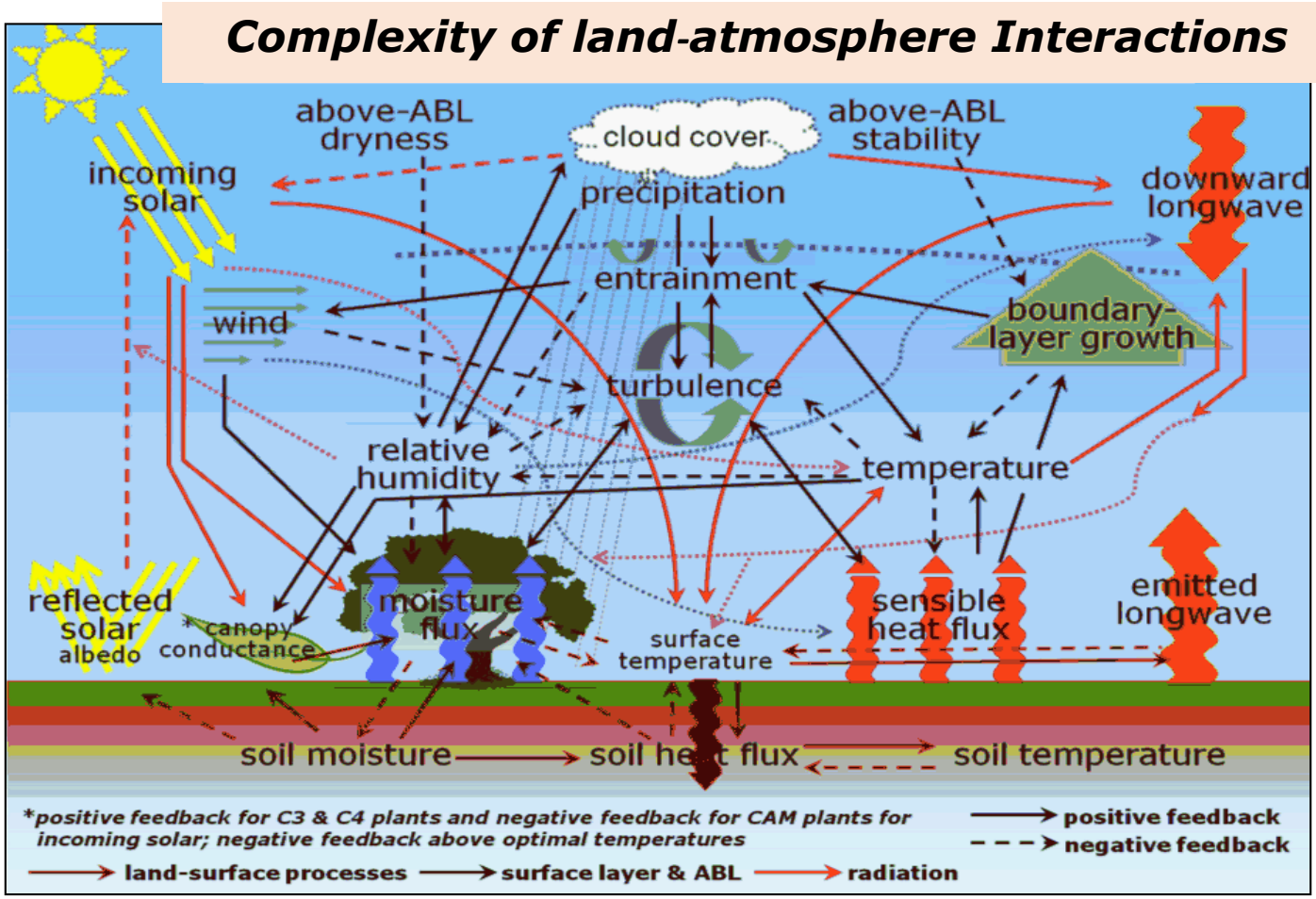
The Regional Hydroclimate Projects (RHPs) are an essential tool in this endeavour as they bring together various disciplines on water issues.

New Baltic Earth
Prospective: Pannex
In development: North American

GHP Structure



Global Land/Atmosphere System Study, GLASS
Co chairs: Michael Ek (NCEP/EMC), Gab Abramowitz (UNSW)



The land atmospheric coupling is complex, and even this view misses important processes (e.g soils, land cover etc)

GLASS Structure

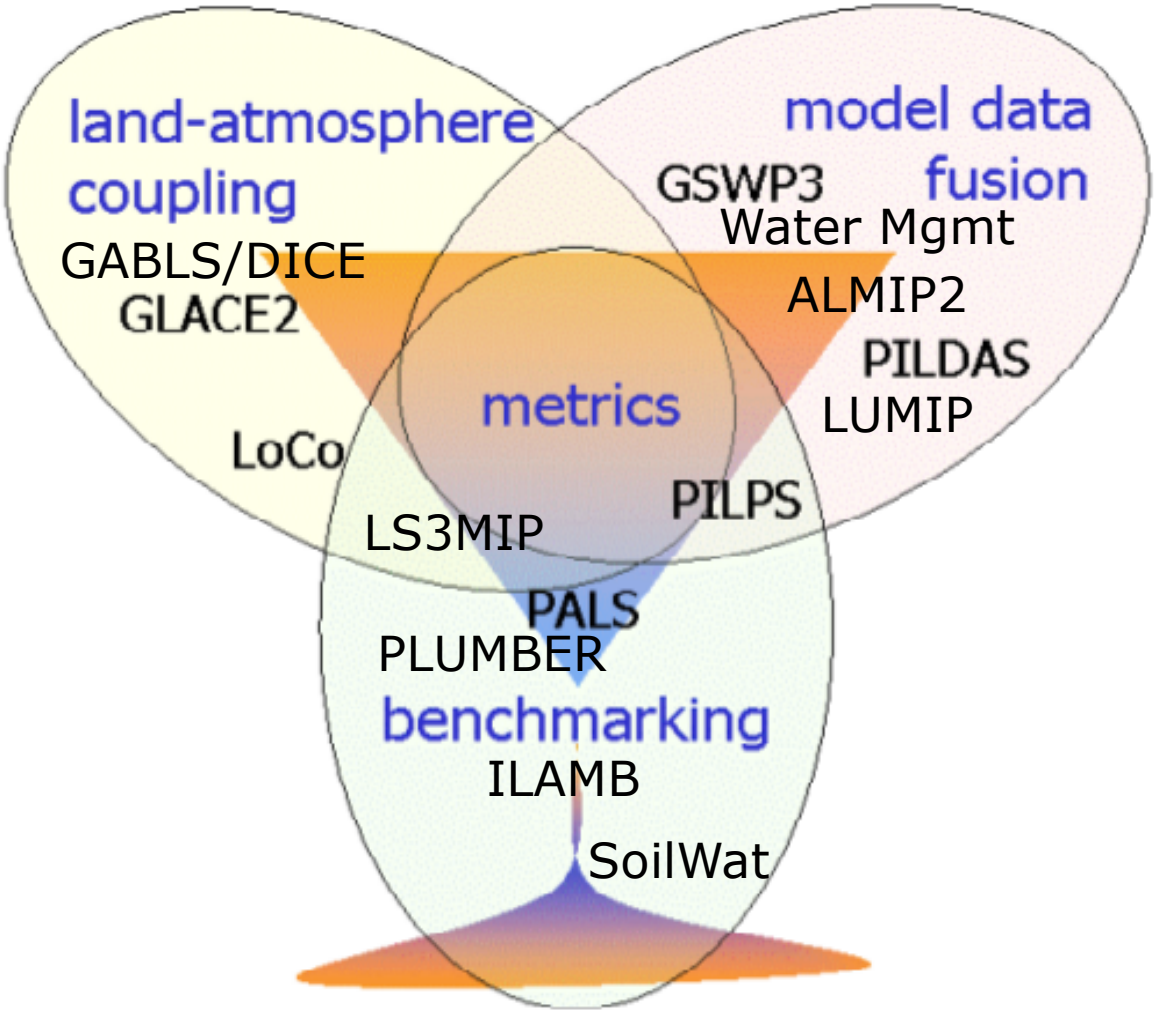
The aim of GLASS is to promote community activities that improve:

1. **our best estimates and the model representation of land atmosphere interaction processes**

1. **our understanding of land/atmosphere feedbacks**

1. **our understanding of the role of land surface in predictability**

To best achieve these aims, GLASS has been re structured into three elements:



New project: GEWEX Soils Initiative (SoilWat)

- Initiative born of International Soil Modeling Consortium (ISMC) and GEWEX communities
- Aims to improve interactions and integration of soil and subsurface processes in present climate models
- Planning workshop June 2016 in Leipzig, 25-30 people, 2 days:

Outcomes

- Now drafting perspective paper to clarify needs, objectives, future directions of the SoilWat initiative (Dani Or, Sonia Seneviratne, Peter van Oevelen, and Gerrit de Rooij)
- *Initiative 1:* survey already underway
- *Initiative 2 (SP-MIP):* scoping document distributed
- *Initiative 3:* discussion underway seeking a global groundwater database, historical and current, with the aim of committing contributing countries/monitoring authorities to submit their data to the database and possibly create a global archive of historical groundwater data.
- Second SoilWat workshop planned in 2017 to report progress and discuss processes not addressed in this workshop (e.g. soil and plant processes, human interactions)

GLASS contribution to CMIP6

- GLASS has a leading role in the CMIP6 experiment "Land Surface, Snow, and Soil moisture Model Intercomparison Project" (LS3MIP) – co-chairs (B. van den Hurk, G. Krinner, H. Kim, S. Seneviratne, C. Derksen, T. Oki) / Collaboration with CliC

- Also a strong role within the Land Use Model Intercomparison Project (LUMIP) – co-chairs (D. Lawrence, G. Hurtt)

Important step towards better consideration of land processes in climate projections (first-time experiments within CMIP)

GASS GEWEX WCRP Global Atmospheric System Studies

New co-chairs - Xubin Zeng, U Arizona;
Daniel Klocke, DWR, MPI

A common thread is the new structure will focus on cloud, convection and precipitation processes and their representation in models

1) **Quantify the role of land surface processes in S2S prediction?**
Couples directly to WWRP activities/projects and to land monsoon project (TBD), YMC & interseasonal variability, precipitation initiative and the convectively permitting hi-resolution modeling effort already developing in GEWEX. Contributes to AA1., AA3 and AA7 of WWRP

2) **Advance our ability to estimate and predict precipitation by enhancing our understanding and representation of processes (aerosol, cloud environmental couplings) fundamental to precipitation.**
Activities relevant here include warm rain PROES , UTCC PROES, GDAP precipitation assessment, GAP – microphysical influences (including aerosol) on precipitation, convection via YMC. Contributes to WWRP AA1and AA7, indirectly AA2

3) Identify the mechanisms for the diurnal cycle of precipitation over different regions and how can we improve model representation of the diurnal cycle.
Precip initiative and GDAP precip assessment, Hi res (convectively resolving/permitting modeling, contributes to AA1,AA7

4) Assess the extent that resolved/permitted convection is necessary to advance our ability to predict high impact weather.
Activities include: Greyzone project (the second phase being formulated), hi-res modeling, YMC, precipitation initiative

GEWEX

GEWEX PROES - Process Evaluation Studies

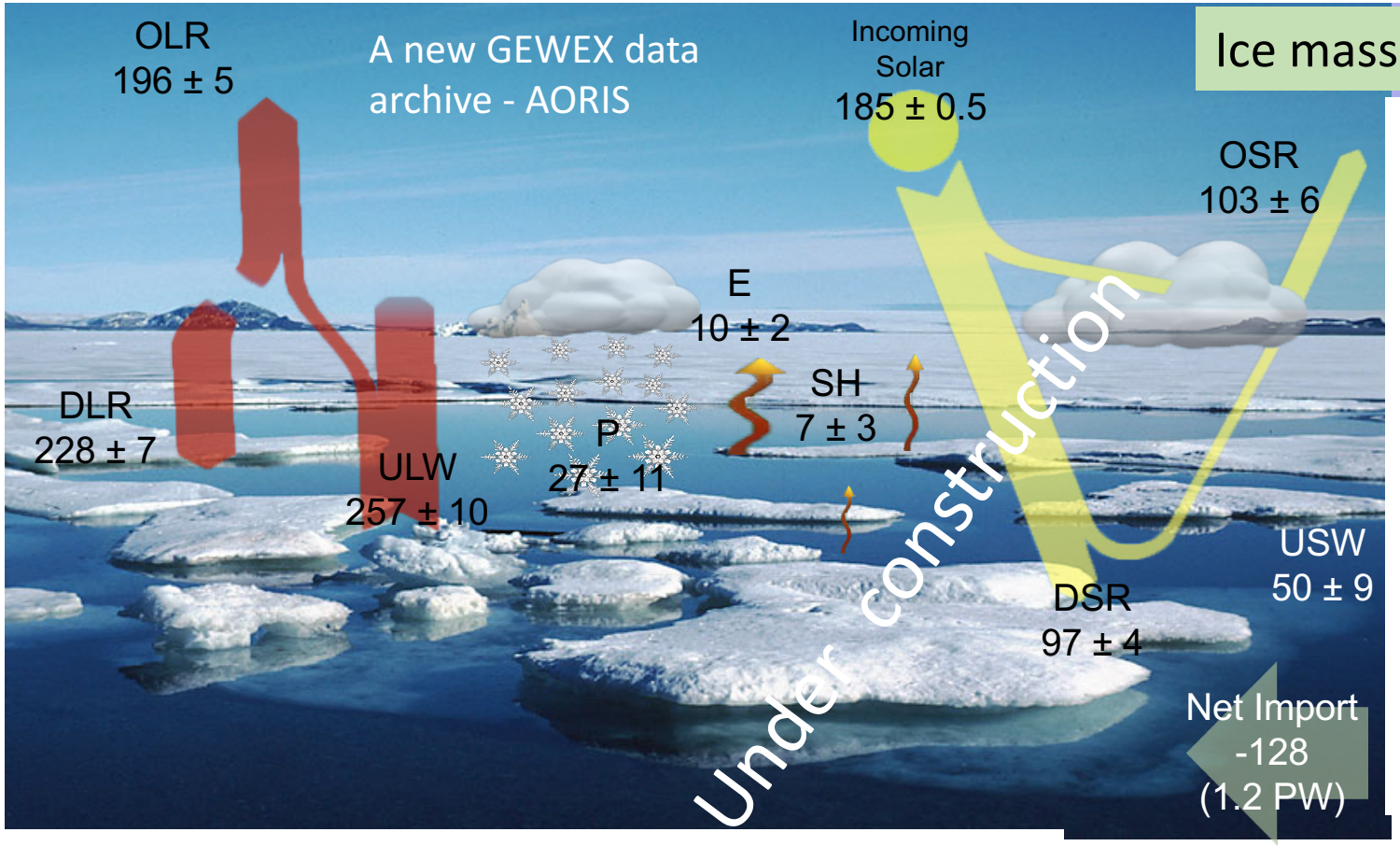
This grew out of the obs4mip meeting where data need be constructed (on different time/space scales than panned for ESGF and expected from CMIP6) to probe process understanding was completely missing from obs4mip II plans

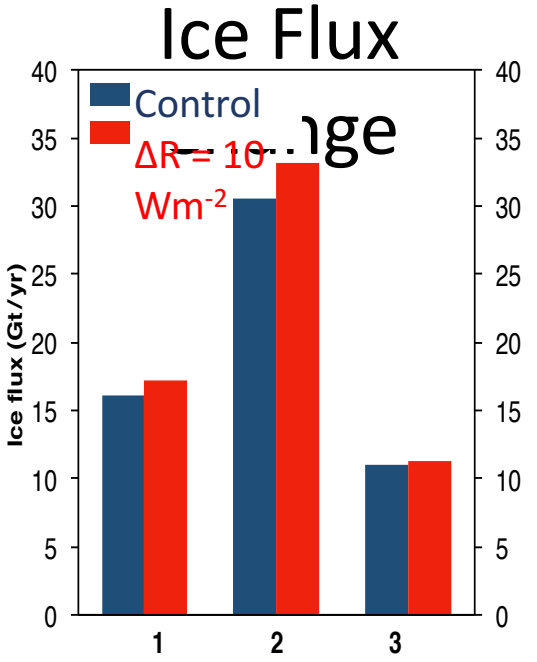
Five GEWEX-related PROES activities are in development

- Upper Tropospheric Clouds & Convection (UTCC) (Stubenrauch, Stephens) with link to SPARC – integrated data products developed & being assessed - green
- Co-lead Nicole Schlegel & Eric Laroor, JPL), GEWEX (AORIS) connects to CLiC – orange
- Radiative Kernels for Climate (lead Soden, UMiami) –orange
- Mid-lat storms (lead Tselioudis) - orange
- Warm rain process(lead Suzuki, U Tokyo) –green

Blue: indicates clouds, convection and precipitation process focus

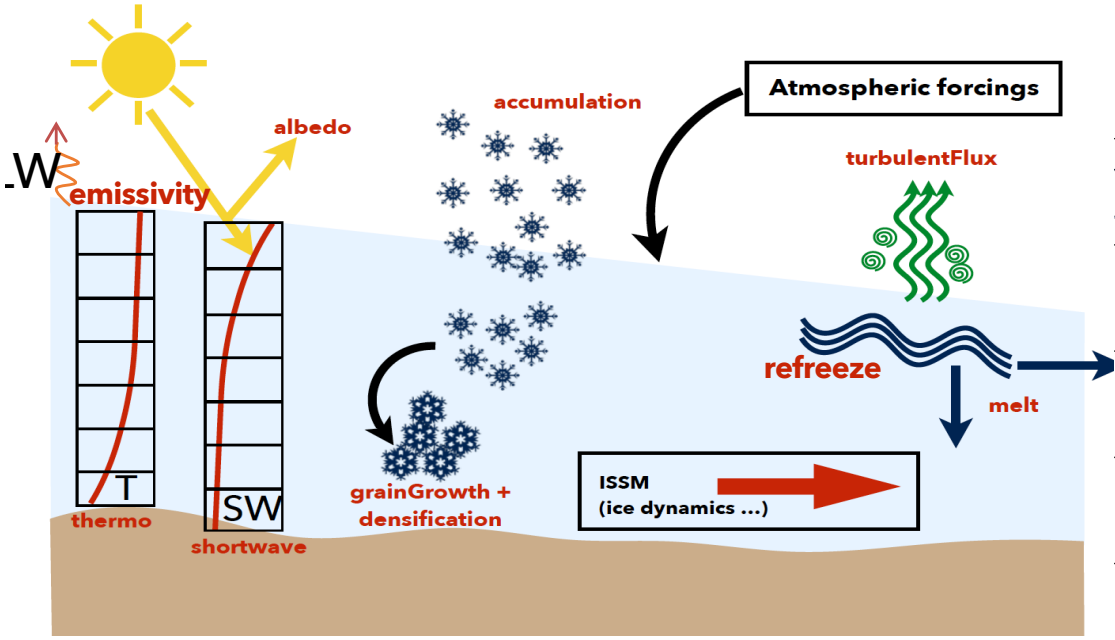
Ice mass balance PROES

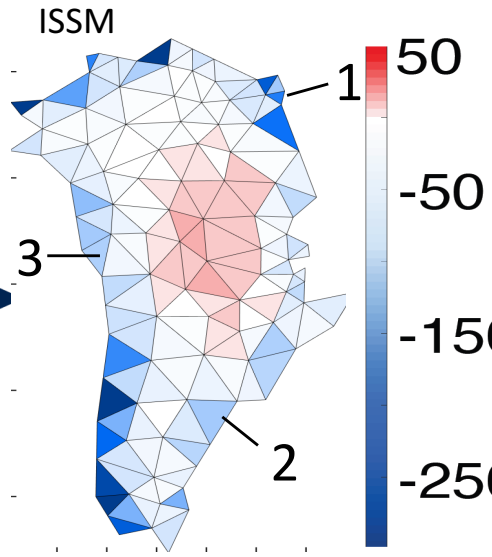




Schlegel et al., 2017

A 10Wm-2 change in radiaion balance changes melt rate by 10%





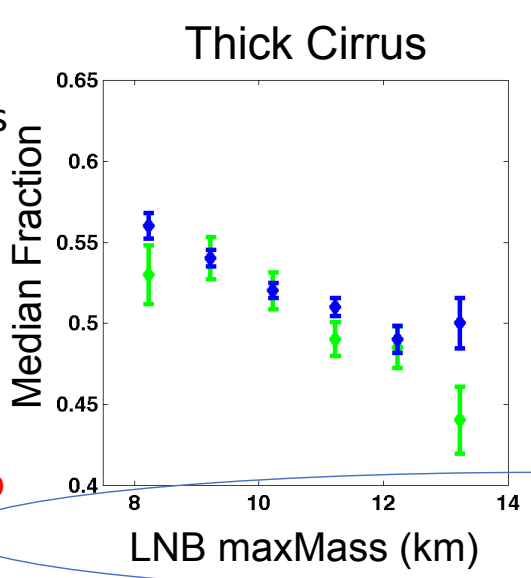
C April 2017

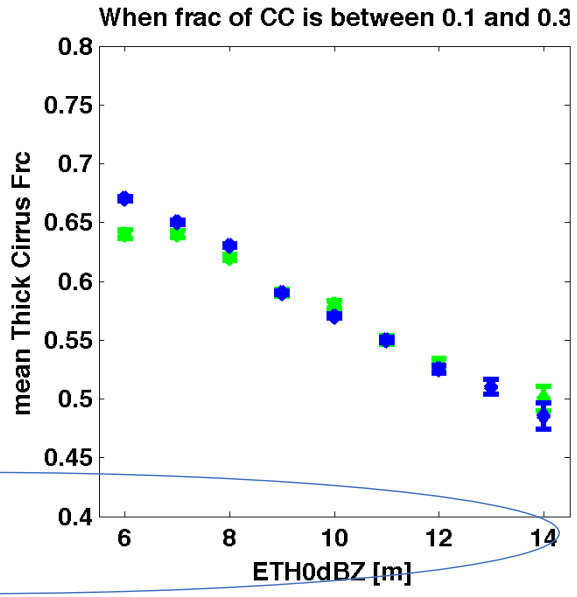
UTCC PROES highlight

- High cloud feedbacks are important factors is determining the hydrological and climate sensitivities
- An important source of high clouds is from convective detrainment
- There are NO constraints on convective detrainment

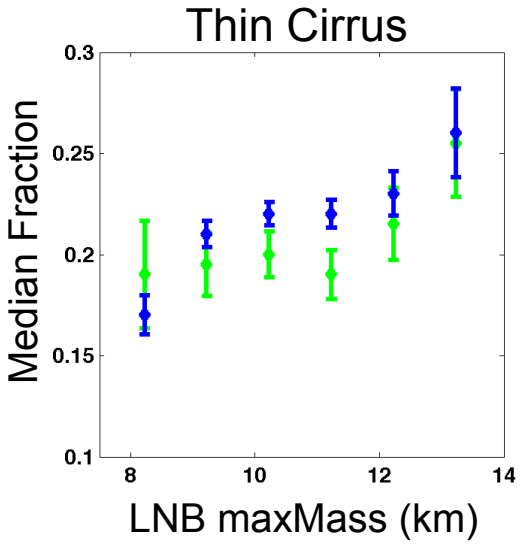
We have created new diagnostic analysis of observations with a goal to test detrainment parameterizations

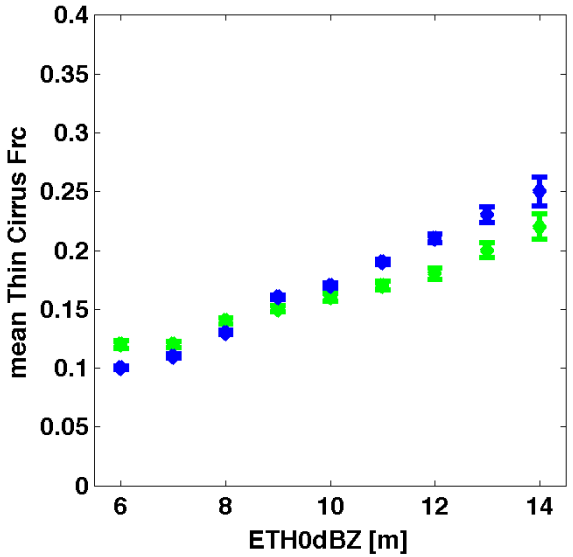
Important unanticipated robust finding: high thick clouds decrease with convective intensity, high thin clouds increase



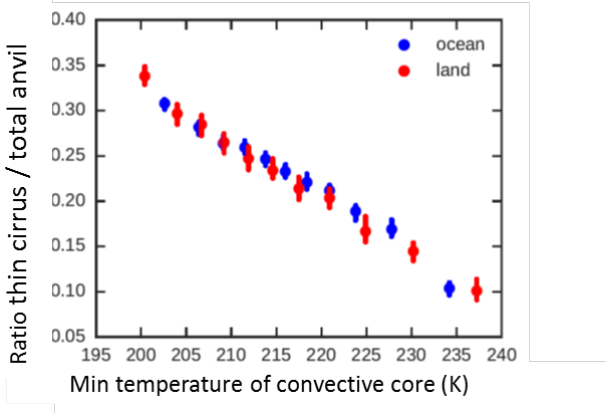


Different metrics of convective intensity inferred from radar diagnostics





IR observations



Takahashi et al., 2017

Looking forward

- GEWEX at 30 – retrospective assessment of what GEWEX has achieved over 30 years
- Revisiting GEWEX 2013 5-10 year science and implementation plan.
- Precipitation initiative – precip obs assessment, expand process diagnostic studies, advance convectively permitting modeling
- Water in the TP initiative with China
- Soils, human dimension/water cycle
- GEWEX open science conference, April 2017

One GEWEX input into the WCRP cross Precipitation Initiative

Precipitation Observation Assessment (POA)

Frequency | **I**ntensity | **D**uration | **V**olume

- Scale: space & time

Other groups

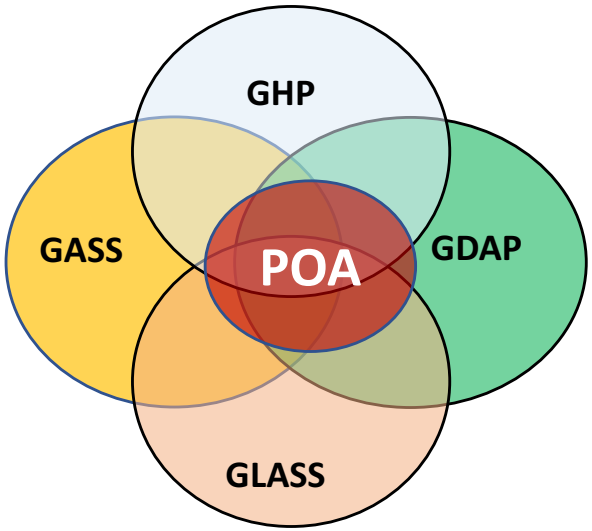
WCRP/ weather and climate extreme
https://www.wcrp-climate.org/gdis-wkshp-2014-climate-extremes

ETCCDI
CCl/WCRP/JCOMM Expert Team on Climate Change Detection and Indices
https://www.wcrp-climate.org/data-etccdi

IPWG
International precipitation working group
http://www.isac.cnr.it/~ipwg/

GDAP
Precip. assessment

GPCP
GPCC



Recent Obs. /methods

GPM: moderate and intense precipitating (**F, I , D, V**), tropics and extra-tropics

CloudSat: light rain, snowfall (**F, I, V**), high latitude, mountains?

GRACE: water balance (**V**) high latitude, mountains

Water vapor convergence

Other related topics

- Gauge correction


GEWEX Open Science Conference
Lake Louise, Banff, AB, Canada
April 29 – May 4, 2018

GEWEX Open Science Conference

"Extremes and Water on the Edge"

Venue: Chateau Lake Louise
Banff, AB, Canada

Wide range of sponsors

- Main Themes:
  - Extremes GC
  - Water GC
  - GEWEX Core Science
- ECS Events
  - Spring Sessions
  - Integral Part of Conference
- Participation limited to 450

Looking forward

OSC

Back ups

RHPs are a regional way of organizing most of the GEWEX-oriented activities and make the community grow from the bottom, attracting scientists that would otherwise act in a more isolated manner.

Interaction with the other GEWEX actions is going on and could be intensified through more transversal actions, probably stimulated by enhanced communication between Cross-cut (CC) activities and the other Core programs.

Each RHPs can define its own CC actions where basic scientific transversal research is made. Better coordination between CC among RHPs would be interesting. Also connection with general GHP CC would need extra coordination.

Mission

To measure and predict global and regional energy and water variations, trends, and extremes (such as heat waves, floods and droughts), through improved observations and modeling of land, atmosphere and their interactions; thereby providing the scientific underpinnings of climate services.