IRS Business Meeting 2016

18 April 18:00 – 20:00 at IRS 2016
Auckland, New Zealand

Welcome

- Attending list signed and agenda approved

Auckland, 18 April 2016

Attending List

IRC Business Meeting 2016 - Auckland 16 April 2016, 18:00 – 20:00

Following IRC-Commissioners attended to the 2016 Business Meeting of the International Radiation commission:

Name	First Name	Institution	Signature	"C" if commissioner
Schmutz	Werner	PMOD/WRC		C
OREOPOULOS	LAZAROS	NASA-GSFC		C
DAVIES	Roger	Uo Auckland		C
WILD	MARTIN	ETH Zurich		C
Long	Chuck	NOAA ESRL		C
Yamasoe	Marcia	IAG-USP		C
Mlawer	Eli	AER		C
Alexander	Trishchenko	CCRS, Canada		C
MARSHAK	ALEXANDER	NASA/GSFC		C
BLUMTHALER	MARIO	MED.UNIV. INNSBRUCK		C
PILEWSKIE	PETER	UNIV. COLORADO		C/o
SINGH	UPENDRA	NASA Langley Res. Cntr		C
Byung-Ju	SOHN	SNU, Korea		C
Loeb	Norman	NASA Langley Research Center		C
NAKAJIMA	Terry	JAXA		IAMAS
OKAMOTO	HAJIME	Kyushu Univ.		C.
Macke	Andreas	TROPOS		C
YANG	PING	Texas A&M Univ.		C
LU	DAREN	Inst. Atmos. Phys., CAS		C
~~KASAI~~				
KASAI	YASKO	NICT, Japan		C

Mayer	Bernhard	LMU Munich		C
Gröbner	Julian	PMOD/WRC		C
MASIELLO	GUIDO	SI-UNIBAS		C
WENDISCH	MANFRED	Uni Leipzig		C
ZHENGQIANG	LI	RADI, CAS		C
HUA	ZHANG	National Climate Center, CMA		C
Fischer	Jürgen	FU Berlin		C
Stubenrauch	Claudia	LMD, France		C
KINNE	Stefan	MPI-M		
Egli	Luca	PMOD/WRC		Assistant to the President

Welcome

Approval of Agenda:

1. Welcome (Schmutz)
   Introduction of Commissioners
2. Approval of Agenda (Schmutz)
3. President's Report (Officers)
   a. Remembrances
   b. Treasurer's Report
   c. Web site Update
   d. Recent IRC Activities (Publications, Recommendations, Meetings)
4. Working Group Status Updates
   a. Short Presentations by Working Group Chairs
   b. Updates to Working Groups' Status
5. Financial Update of 2016 IRS (Roger Davies)
6. Highlights of IRS2016 Sessions of Interest (Contributed by Commissioners)
7. Report on IAMAS (Schmutz)
   a. General update and status.
   b. IAMAS 2017 and IRC Business Meeting in Cape Town, S. Africa
8. Election of the IRC president and Officers for the 2017-2020 term
9. Other Business (Schmutz)

In Remembrance

Prof. Dr. Karin Labitzke
1935 - 2015

President's Report

Treasurer's Report (Peter Pilewskie): 2013-2016 Budget Summary

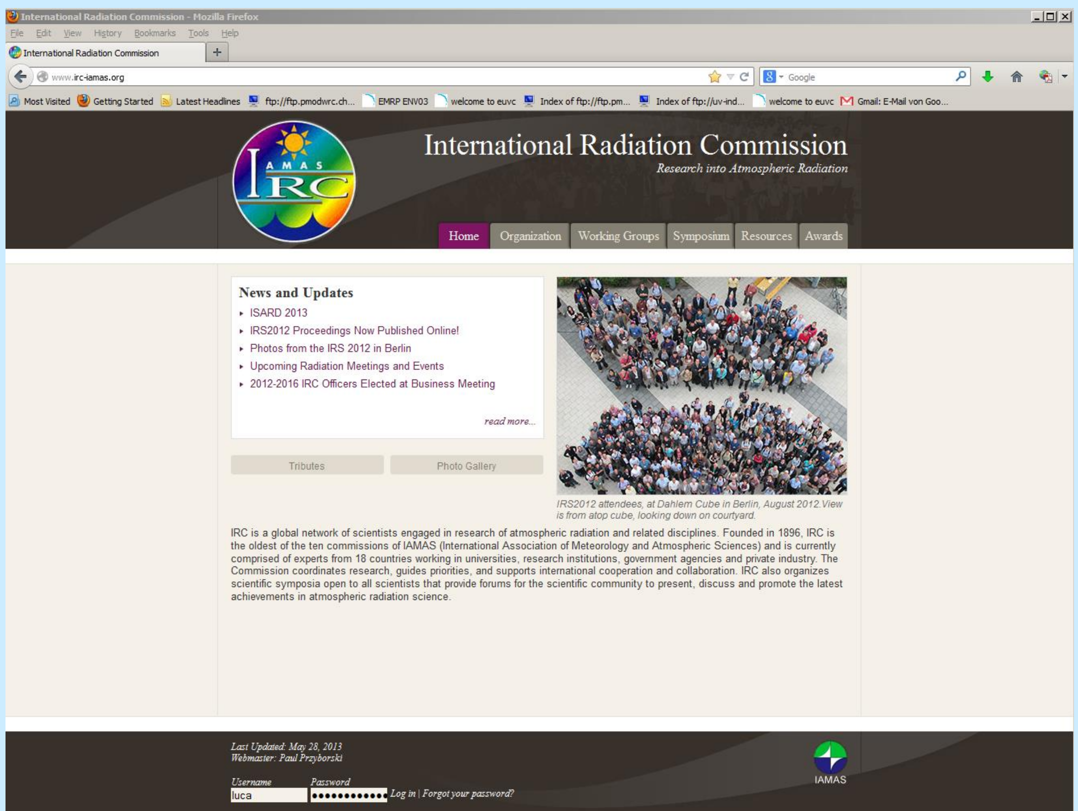
All transaction amounts in USD

Date	Transaction	Amount	Fees	Total
12/3/2013	Transfer from IRC Secretary Sohn	14255.00	-16.00	14239.00
14/8/2013	2013 IRC BM Food Payment	-850.69	-25.52	13362.79
18/3/2014	Proceeds from IRS 2012	6422.68		19785.47
30/6/2014	Cumulative Interest (30 June 2014)	8.67		19794.14
2/8/2014	Transfer to Sohn: web host payments	-291.08		19503.06
11/8/2014	2014 IRC BM Food Payment	-110.74		19392.32
31/5/2015	Cumulative Interest (31 May 2015)	6.56		19398.88
28/6/2015	Officer's Dinner	-138.82	-4.16	19255.90
29/6/2015	2015 IRC BM Food Payment	-253.78	-7.61	18994.51
21/9/15	Domain name fee	-35.03	-1.05	18958.43
31/1/16	Cumulative Interest (31 Jan 2016)	4.78		18963.21
19/2/16	Transfer from IAMAS	5500.00	-16.00	24447.21
30/3/16	IRS2016 Registration Fee Waivers	-9710.61	-35.00	14701.60
30/3/16	IRS2016 Gold Medal	-3968.34	-35.00	10698.26
31/3/16	Cumulative Interest (31 Mar 2016)	1.21		10699.47

President’s Report

Web Site:

- The web-site is updated.
- Please advertising upcoming events on the IRC webpage
  http://www.irc-iamas.org/
  by contacting Luca, legli@irc-iamas.org



President's Report

Recent IRC Activities:

- Preparing the meeting

- Publications:
  - **Proceedings of IRS2016**
  - **Advances in Atmospheric Sciences** (AAS), an IAMAS associated journal: article about IRS2016 (Nick Edkins first author).

- Recommendations:
  - **Letter of support** by IRC for **ACTRIS** (Andreas Macke)

- Past meetings:
  - IUGG 2015: **22 June - 2 July 2015**, Prague, Czech Republic

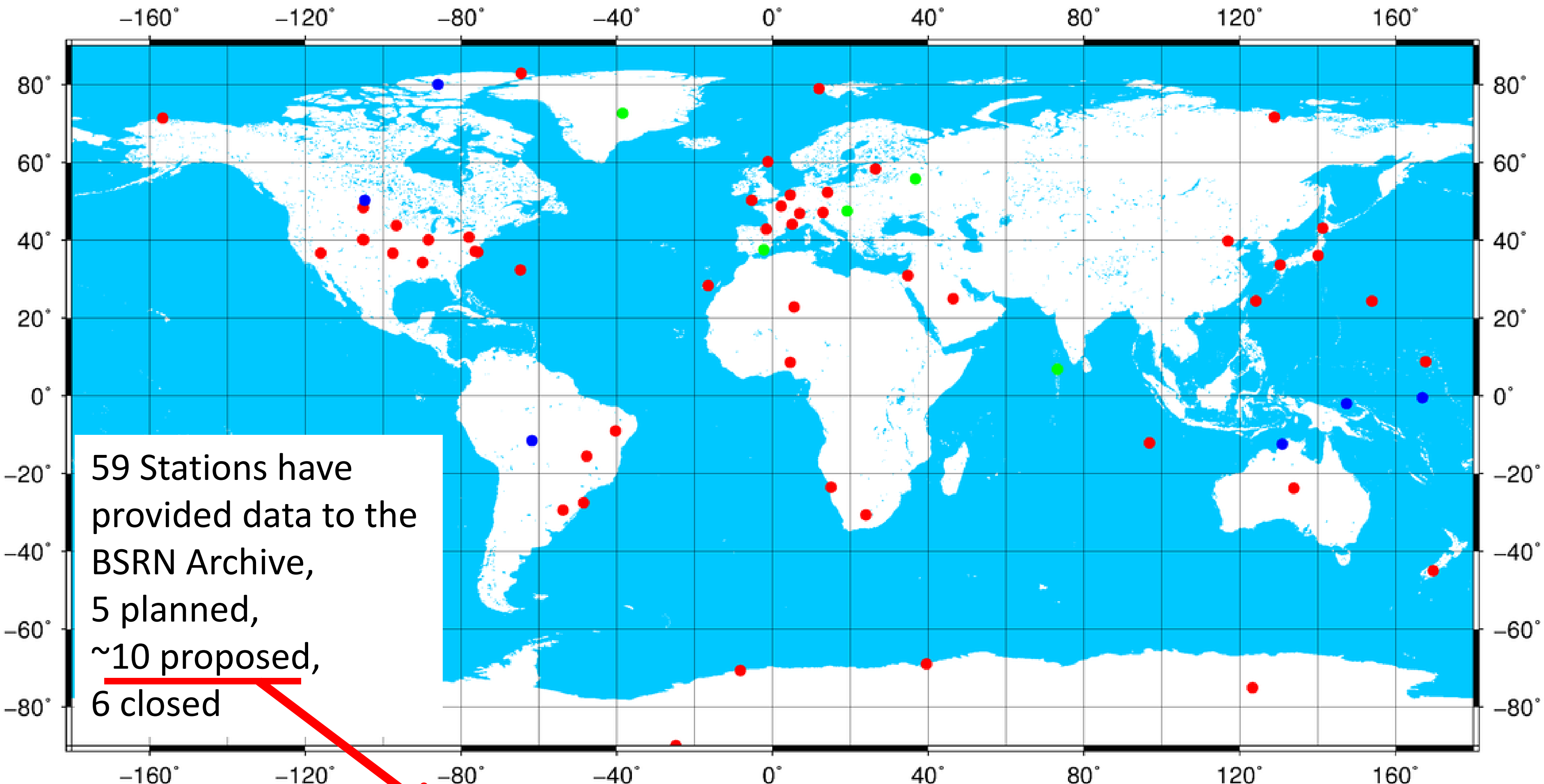
- Future meetings:
  - IAPSO-IAMAS-IAGA: **27-August – 1 September**, Cape Town South Africa: www.iapso-iamas-iaga2017.com

Working Group Status Update

Short presentations by Working Group Chairs or Peter Pilewskie

1. Atmospheric Spectroscopy Applications (ASA); Chair: Laurence Rothman
2. Baseline Surface Radiation Network (BSRN); Rapporteur: Gert Koenig-Langlo
3. Clouds and Radiation (CR); Rapporteur: Stefan Kinne
4. Continuous Intercomparision of Radiation Codes (CIRC); Co-Chairs: Lazaros Oreopoulos & Eli Mlawer
5. GEB (Global Energy Balance); Martin Wild and Norman Loeb (WG Co-chairs)
6. International Coordination group for Laser Atmospheric Studies (ICLAS); Chair: Alex Papayannis
7. International Polarized Radiative Transfer (IPRT); Co-Chairs: Bernhard Mayer & Claudia Emde
8. Solar UltraViolet Radiation (UV); Co-Chairs: Julian Gröbner and Mario Blumthaler
9. Three-Dimensional Radiative Transfer (3DRT); Co-Chairs: Alexander Marshak & Jean-Luc Widlowski

BSRN Current Stations



Upcoming 14th BSRN Science and Review Workshop Canberra, Australia, 26-29 April 2016

As of 2014 BSRN Workshop

Presently in the BSRN Archoive: 8391 station-months available

Baseline Surface Radiation Network

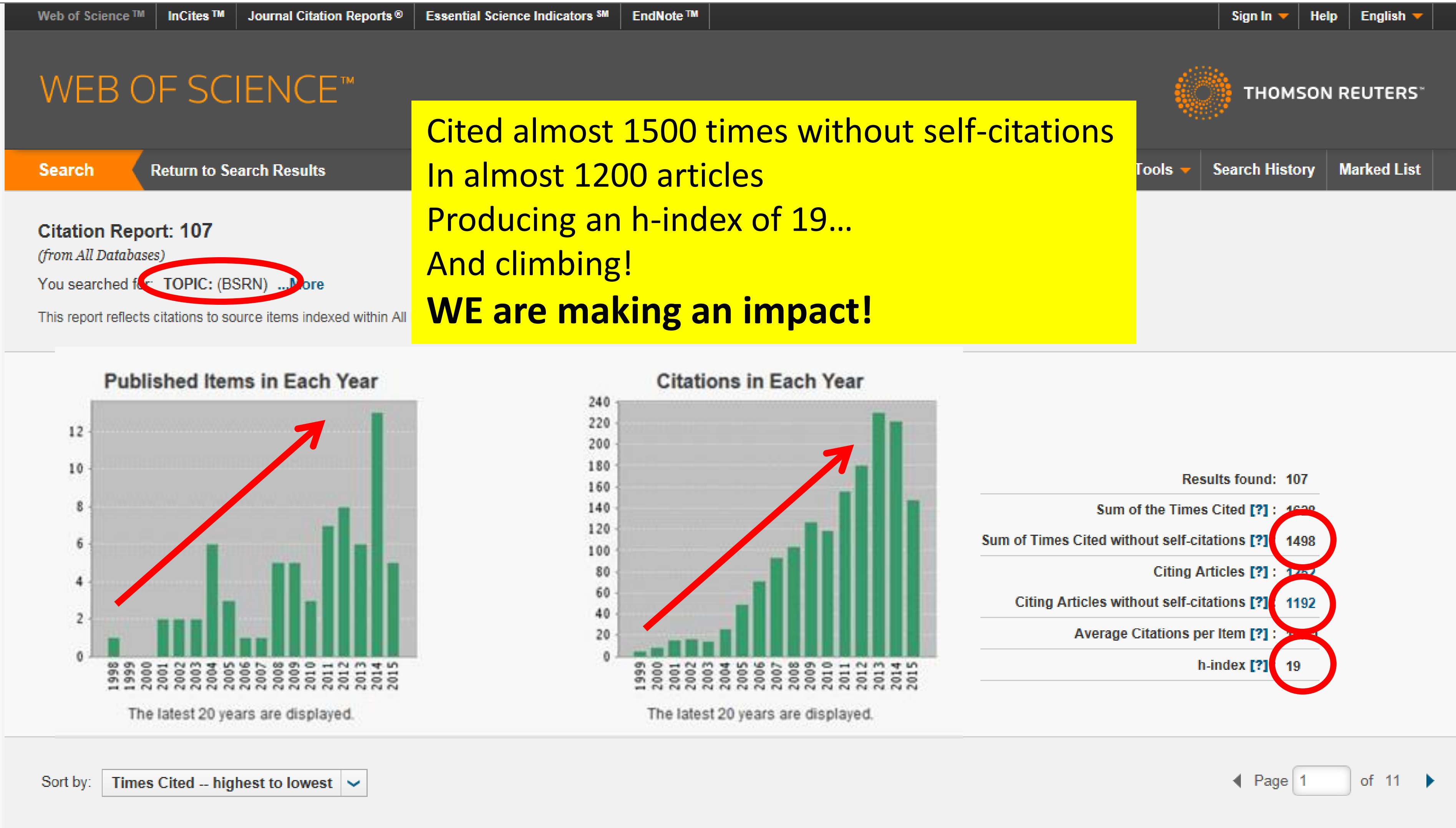
[BSRN homepage] - [Staff | Stations | Parameter | Methods] - [**LR0100** | LR0300 | LR0500 | LR1000 | LR1100 | LR1200 | LR1300 | LR3010 | LR3030 | LR3300 | All | latest datasets]

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	2010	2011	2012	2013	2014	2015	All
Alert	ALE	Christopher Cox (christopher.j.cox@noaa.gov)														5	12	12	12	12	12	12	12	12	12	2		X
Alice Springs	ASP	Bruce Forgan (B.Forgan@bom.gov.au)					12	12	12	12	12	12	11	12	12	12	12	12	12	12	12	12	12	12	11	9		X
Barrow	BAR	David Longenecker (David.U.Longenecker@noaa.gov)		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	2						X
Bermuda	BER	David Longenecker (David.U.Longenecker@noaa.gov)		12	12	12	12	12	12	12	12	12	12	12	10	12	12	12	12	12	12	12	12	12	2			X
Billings	BIL	Charles Long (chuck.long@noaa.gov)			4	12	12	12	12	12	12	12	11	12	12	12	12	12	12	12	12	12	12	4				X
Bondville	BON	John Augustine (John.A.Augustine@noaa.gov)					12	12	12	12	12	12	12	12	12	12	12	12	12	12	6							X
Boulder, SURFRAD	BOS	John Augustine (John.A.Augustine@noaa.gov)					5	12	12	12	12	12	12	12	12	12	12	12	12	12	6							X
Boulder	BOU	David Longenecker (David.U.Longenecker@noaa.gov)		12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12						7	X
Brasilia	BRB	Enio Bueno Pereira (eniobp@cptec.inpe.br)																8	10	[illegible]							1	X
Cabauw	CAB	Wouter Knap (knap@knmi.nl)															11	12									8	X
Camborne	CAM	Jonathan Tamlyn (jonathan.tamlyn@metoffice.gov.uk)											12	12	12	12	[illegible]									12	7	X
Carpentras	CAR	Thierry Duprat (thierry.duprat@meteo.fr)						4	12	12	12	12	12	12	[illegible]								[illegible]	12	12	12	6	X
Chesapeake Light	CLH	Fred M. Denn (Frederick.M.Denn@nasa.gov)										8	12	[illegible]								[illegible]	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)																	[illegible]	12	12	12	12	9	4	12	3	X
De Aar	DAA	Lucky Ntsangwane (lucky.ntsangwane@weathersa.co.za)																										X
Darwin	DAR	Charles Long (chuck.long@noaa.gov)														[illegible]	12	12	12	12	12	12	12	12	12	10	1	X
Desert Rock	DRA	John Augustine (John.A.Augustine@noaa.gov)												[illegible]	12	12	12	12	12	12	6							X
Concordia Station	DOM	Vito Vitale (v.vitale@isac.cnr.it)																12	12	12	12	2						X
Darwin Met Office	DWN	Bruce Forgan (B.Forgan@bom.gov.au)																		12	12	12	12	12	9	12	3	X
Eureka	EUR	Station closed end of 2011																	4	12	12	12	12					X
Southern Great Plains	E13	Charles Long (chuck.long@noaa.gov)						[illegible]	12	12	12	12	12	12	12	12	12	12	12	12	11	12	12	4				X
Florianopolis	FLO	Sergio Colle (colle@emc.ufsc.br)					[illegible]	12	10	12	12	9	12	12	12	12	12								4	12	6	X
Fort Peck	FPE	John Augustine (John.A.Augustin[illegible]					12	12	12	12	12	12	12	12	12	12	12	12	12	12	6							X
Fukuoka	FUA	Masao Omori (rrc-jma@[illegible]																				9	12	12	12	12	7	X
Goodwin Creek	GCR	John Augustine [illegible]					12	12	12	12	12	12	12	12	12	12	12	12	12	12	6							X
Gobabeb	GOB	Rolan[illegible]																						8	12	12	8	X
Neumayer Station	GVN	[illegible]wi.de)	121	9	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	1	X
Ilorin	IL[illegible]	[illegible]		4	12	8	7	12	12	6	12	12	12	7	12	12	7											X
Ishigakijima	ISH	[illegible]et.kishou.go.jp)																				9	12	12	12	12	7	X
Izana	IZA	[illegible]gulló (ecuevasa@aemet.es)																			10	12	12	12	12	12	8	X
Kwajalein	KWA	[illegible]Longenecker (David.U.Longenecker@noaa.gov)		9	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12			X
Lauder	LAU	Bruce Forgan (B.Forgan@bom.gov.au)									5	12	12	12	12	12	12	12	12	12	11	12	12	12	12	9		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	12	10			X
Minamitorishima	MNM	Masao Omori (rrc-jma@met.kishou.go.jp)																				9	12	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	12	9			X
Ny-Ålesund	NYA	Marion Maturilli (Marion.Maturilli@awi.de)		5	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12		X

~ 700 years of radiation measurements

BSRN Scientific Impact (mid-2015)



clouds and radiation

IRC Auckland, 2016

Stefan Kinne MPI-Meteorology

with contributions from

Anthony DeAngelis, Steve Klein, Richard Forbes, Tristan L' Ecuyer, Philip Stier, Claudia Stubenrauch

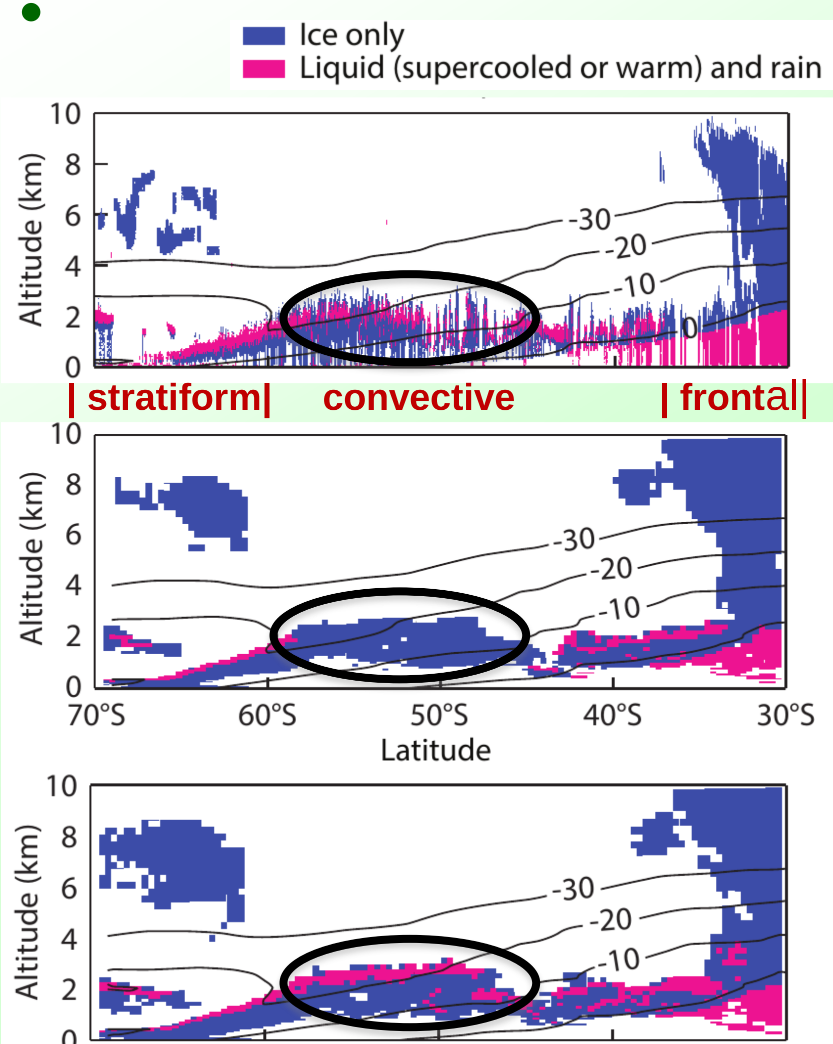
recent highlights

- missed super-cooled water: a likely explanation of the southern flux biases in global modeling
- the quality of solar RT modules in gl. modeling is often a limiting factor in some applications
- continued attempts to constrain the energy budget at the surface (radiation vs SH/LH)
- new activities towards process understanding
  - GEWEX - PROcess Evaluation Studies
  - ACPC activities (aerosol – clouds –precip.)

supercooled water to reduce TOA biases

Forbes et al. 2016 (ECMWF Newsletter 146)

cross section across Southern Ocean cold air outbreak



CALIPSO
satellite lidar
cloud phase

ECMWF IFS
along-track lidar
forward modelled
cloud phase

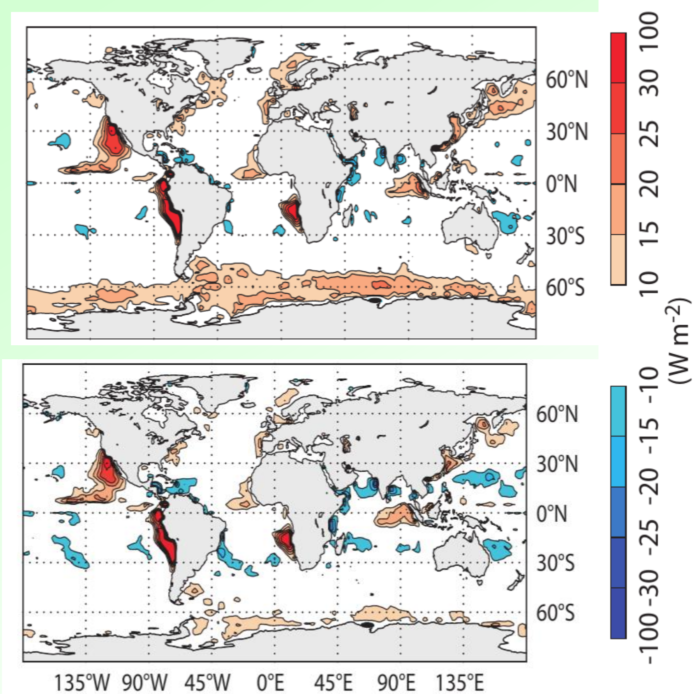
ECMWF IFS
with increased supercooled water from convection

annual **differences** of top-of-atm SW flux to **CERES-EBAF**

not reflective enough

too reflective

ECMWF Model **bias** to CERES



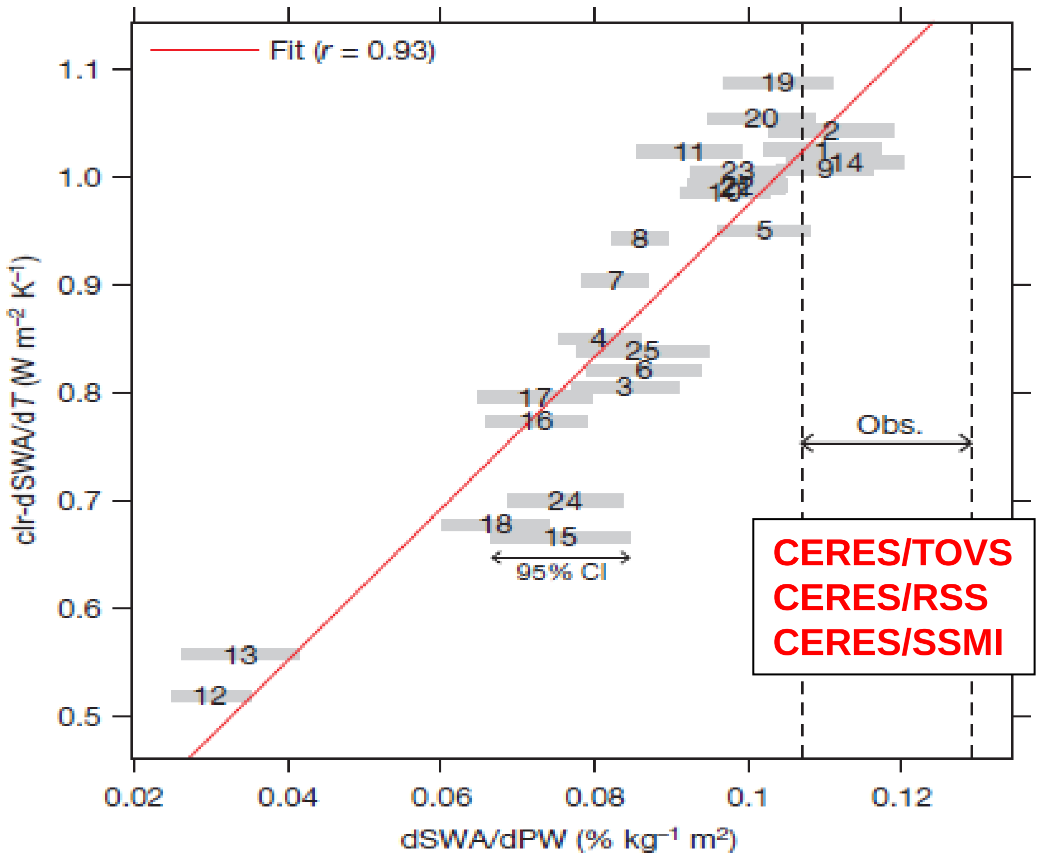
solar absorption - in global modeling

DeAngelis et al. Nature. (2015)

- **most CMIP5 models are not absorbing enough** (poor temperature dependence) **for correct hydrological cycle**

x-axiss
sensitivity of solar absorption to precipitable water in the atmospheric column

y-axis
clear-sky solar absorption increases due to increases in atmospheric temperature from CO2 increases



solar water vapor absorption is underestimated → **preciptation increase is overestimated**

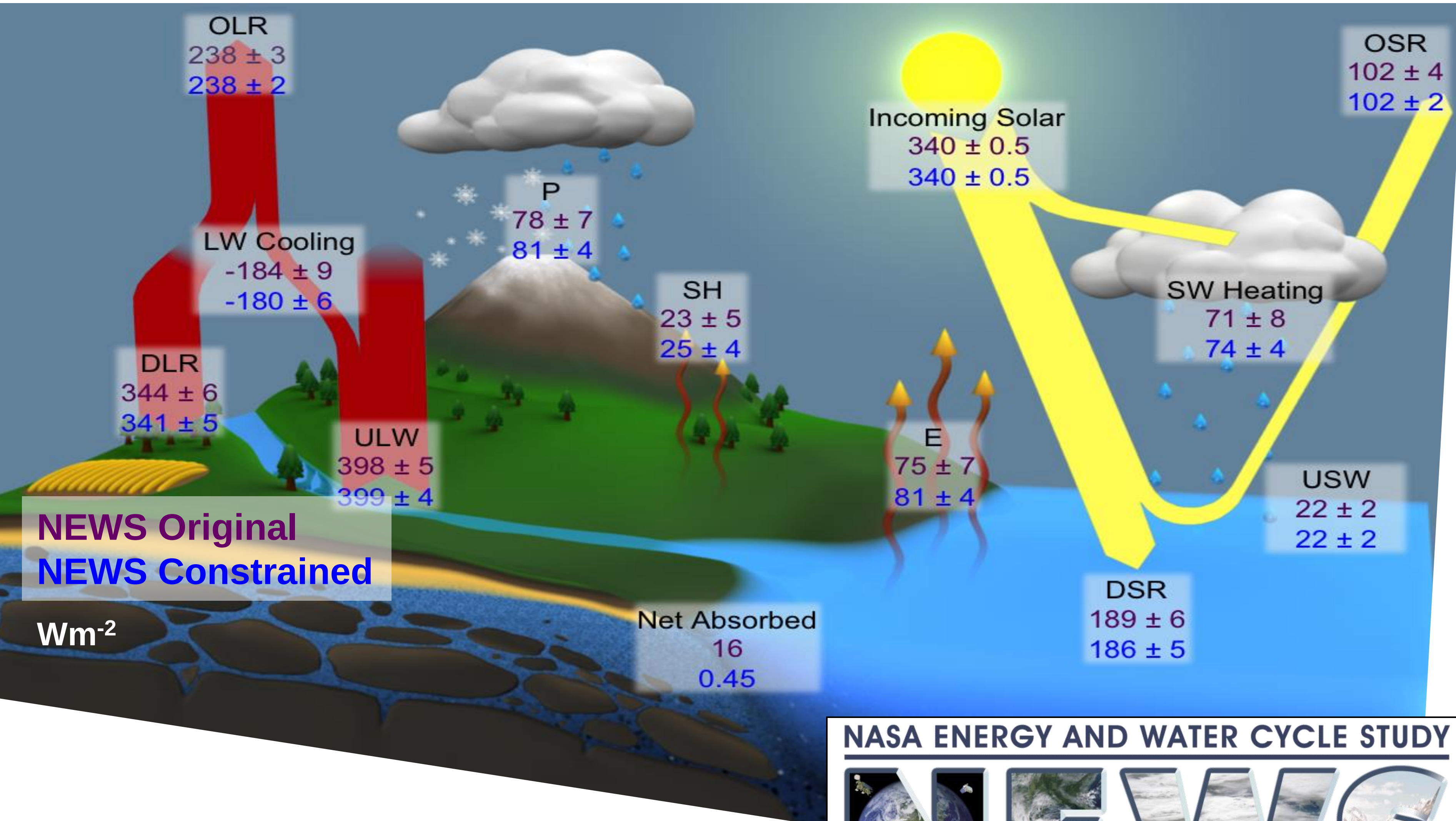
surface energy budget

- **GEWEX-GDAP (radiation panel) continues to work on a (satellite based) 'integrated data-set'**

VARIABLE	DATA-set	satellite SENSOR data
Precipitation	GPCP v. 2.2, MERRA, CMAP	SSMI, SSMIS, GOES-IR, TOVS, AIRS, TRMM
Latent Heat Flux (Evaportranspiration)	Princeton, MERRA, GLDAS, SeaFlux	AIRS, CERES, MODIS, TRMM, AVHRR, MSU, HIRS, SSU, AMSU, SSMI, SSMIS, ERS1/2, QuikSCAT, GOES, TOVS
Sensible Heat Flux	Princeton, MERRA, GLDAS, SeaFlux	AIRS, CERES, MODIS, TRMM, AVHRR, MSU, HIRS, SSU, AMSU, SSMI, SSMIS, ERS1/2, QuikSCAT, GOES, TOVS
Radiative Fluxes	GEWEX-SRB ISCCP-FD 2B-FLXHR-LIDAR C3M	CERES, AVHRR AVHRR CloudSat, CALIPSO, MODIS, AMSR-E CERES, CloudSat, CALIPSO, MODIS

-106 W/m2 - surf imbalance – constrained

L'Ecuyer et al., *J. Climate* (2015)



NASA ENERGY AND WATER CYCLE STUDY

NEWS

Earth's Energy Budget

process understanding

- **ACPC activities (aerosol – clouds –precip.)**
  - **Danny Rosenfield and Johannes Quaas**
    - **convective system (Houston case study)**
    - **shallow clouds (VOCALS)**
- **GEWEX - PROcess Evaluation Studies**
  - **Claudia Stubenrauch and Graeme Stephens**
    - **cirrus clouds and convection**
  - **others leads on**
    - **ice mass balance, radiative kernels for climate**
    - **mid-latitude storms, soil moisture climate**
- ongoing WCRP activities (4 major challenges)

surface fluxes - global averages

- **constr.** consistent with latent / sensible heat (L'Ecuyer, 2015)
- **unconstr.** best guess of individual data (L'Ecuyer, 2015)
- **Wild** global modeling scaling at BSRN sites (Wild, 2015)
- **CIS** mean of CERES, ISCCP and SRB 00-03 (Raschke, 2015)
- **CMIP 3** average in global modeling (Raschke, 2015)

data	global	land	ocean	S+L land	S+L ocea
constr.	**-106**	**-77**	**-118**	**38/39**	**19/99**
unconstr	-113			23/75	
Wild	**-105**	**-70**	**-117**	**32/38**	**16/100**
CIS	-117	-83	-146		
CMIP3	-102	-71	-127		

why process understanding ?

- **we need a better representation of clouds and cloud-systems in global modeling to have more confidence in future climate predictions**

- **to make progress focus on few questions accelerates progress**
  - **by spurring model development**
  - **by pursuing new observations**
  - **by stimulating new analyses**
  - **by exploiting paleo-records**
  - **via new collaborations on common goals**

PROES

- **observations to probe process understanding**
  - **upper tropospheric clouds & convection**
    - (lead *C. Stubenrauch, G. Stephens*), SPARC
  - **ice mass balance**
    - (lead *E. Larour, S. Nowicki*), GEWEX - CLiC
  - **radiative kernels for climate**
    - (lead *B. Soden*)
  - **mid-latitude storms**
    - (lead *G. Tselioudis, C. Jakob*)
  - **soil moisture climate**
    - (lead *S. Seneviratne*)

GEWEX UTCC PROES

- **UTCC – Upper Troposph. Clouds & Convection**

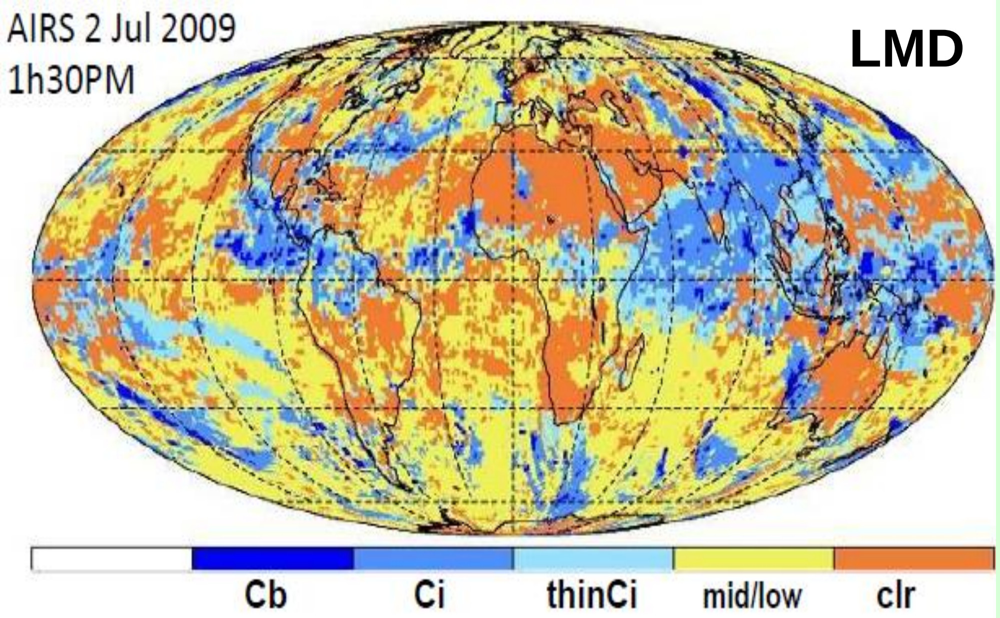
Motivation: understanding their feedback

  - **tropical convective systems**
    - **explore relation between convection, cirrus anvils & radiative heating**
    - **provide obs. based metrics to evaluate detrainment processes in models**
  - **cirrus originating from large-scale forcing**

- **resources :**
  - **obs. of cloud systems & atmos. environment**
  - **simulation at diff. scales (parcel, CRM, GCM)**
  - **radiative transfer**

importance of UT Cloud systems

- **cirrus modulates Earth's energy budget & UT heat transport**



- build cloud systems from adjacent high-altitude clouds
- distinguish convective from non-convective systems
- examine their horizontal extent, composition,vertical structure → heating rates
- *using synergetic data base*

build a simulator of UT cloud systems for the evaluation of convection schemes / microphysics in climate models

meetings: first meeting in Nov 2015, upcoming meetings: Apr 2016 at IRS & in Paris and in fall 2016 in USA

ACPC

- Questions
  - understanding entire lifecycles of clouds ?
  - what environmental parameters matter?
- focus on 2 major (simulations/data) closure experiments (deep convection & shallow cu)
  - fine-tuning of joint activities during April 2016 at Oxford
- summer conference 2017 at Bad Honnef, GER
  - contact J. Quaas for participation

experiment plan 1 – deep convection

- **deep convection experiment**
  - **where: Houston during summer**
  - **when: Aug/Sep 2013: SEAC4RS/Discover-AQ**
  - **tools: radar signature with u-physics, satellite simulator, prognostic aerosol CCN and IN**
  - **budgets: water (all types), radiation, aerosol**
  - **evaluations: consider observational errors, examine specific diagnostic** (radar retrievals, T-Reff satellite retrieval profiles, glaciation temperatures [PDF, joint histograms])

experiment plan 2 – shallow Cu

- **shallow cumulus experiment**
  - **where: VOCALS 1000x1000km, mon**
    future opportunities: ORACLES 2016-2018), Gaziosa (Azores)
  - **when: Oct/Nov 2008**
  - **why: how changes in met and aerosols project radiative forcing and energy/moisture budgets**
  - **tools: modeling at different scales** (WRF, LES)
  - **evaluations: comparisons with harmonized input and bound.cond** (1km Met-Off reanalysis)
  - **diff aerosol scenarios: total vs natural, pre-ind**

process understanding !

- **we need a better representation of clouds and cloud-systems in global modeling to have more confidence in future climate predictions**

- **to make progress focus on few questions accelerates progress**
  - **by spurring model development**
  - **by pursuing new observations**
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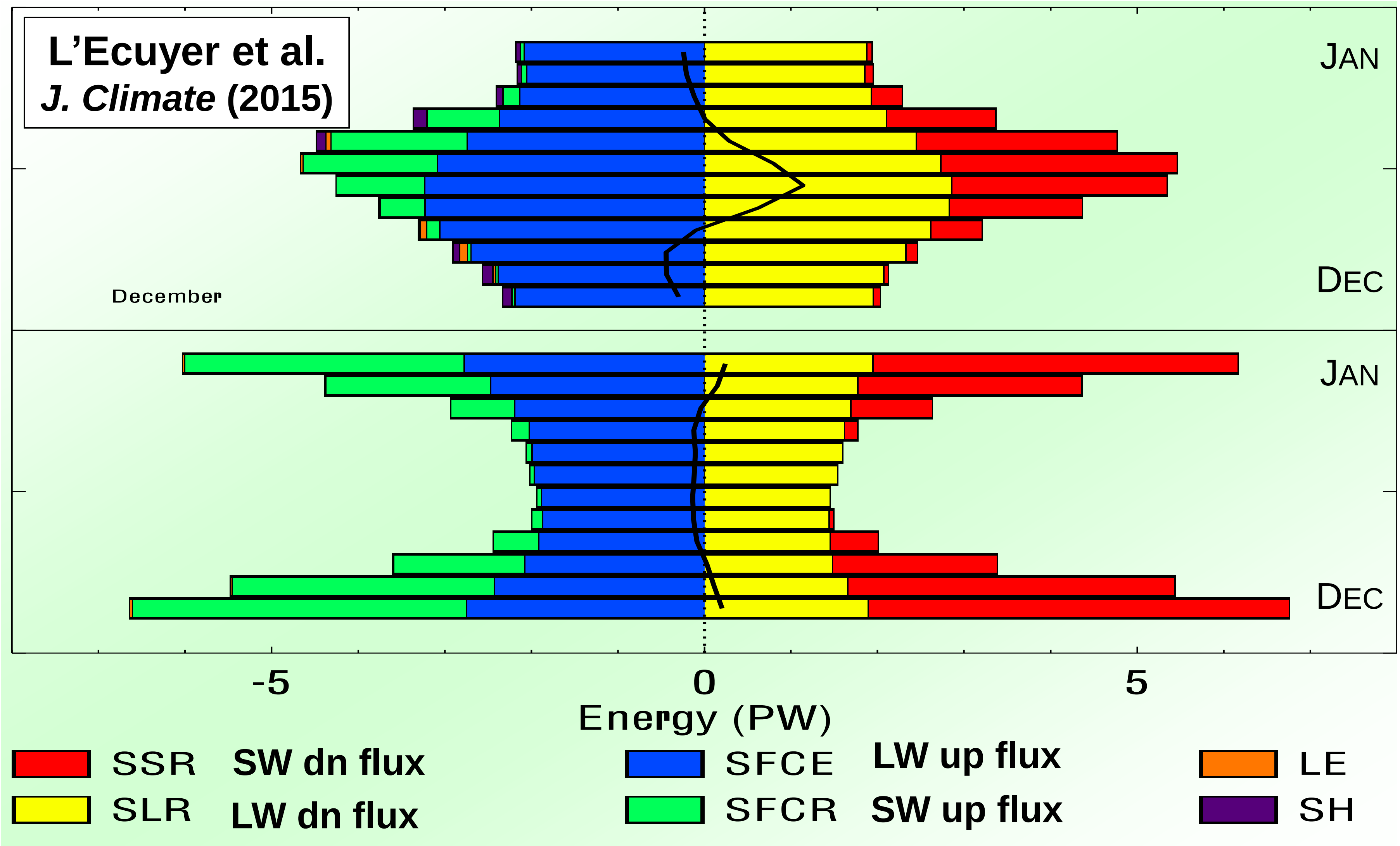
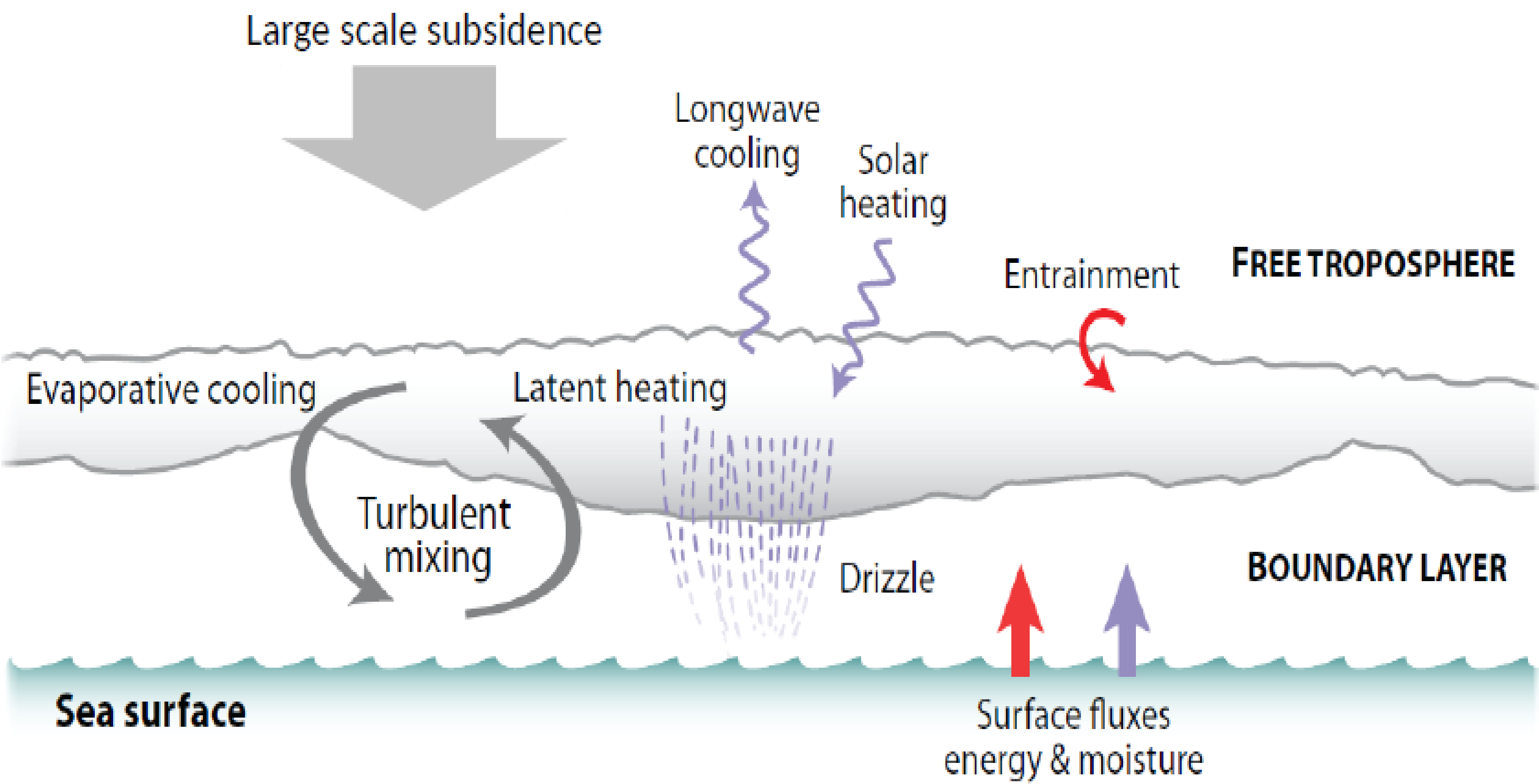
  - **via new collaborations on common goals**

polar seasonality of surf.rad.energy



Sc – key processes identified by Rob Wood



ACPC - goals

- **overall goal: conduct box closure experiments … covering full cloud life- / daily- cycles**

- **GISS workshop goal: identify …**
  - **target cloud regimes of interest** (shallow, deep)
  - **suitable geographical regions** (conditions/data)
  - **required numerical study properties** (aerosol, microphysics, domain, boundary conditions)
  - **the adequacy of available observational data sets** (data needs and/or data gaps ?)

The Continual Intercomparison of Radiation Codes (CIRC)

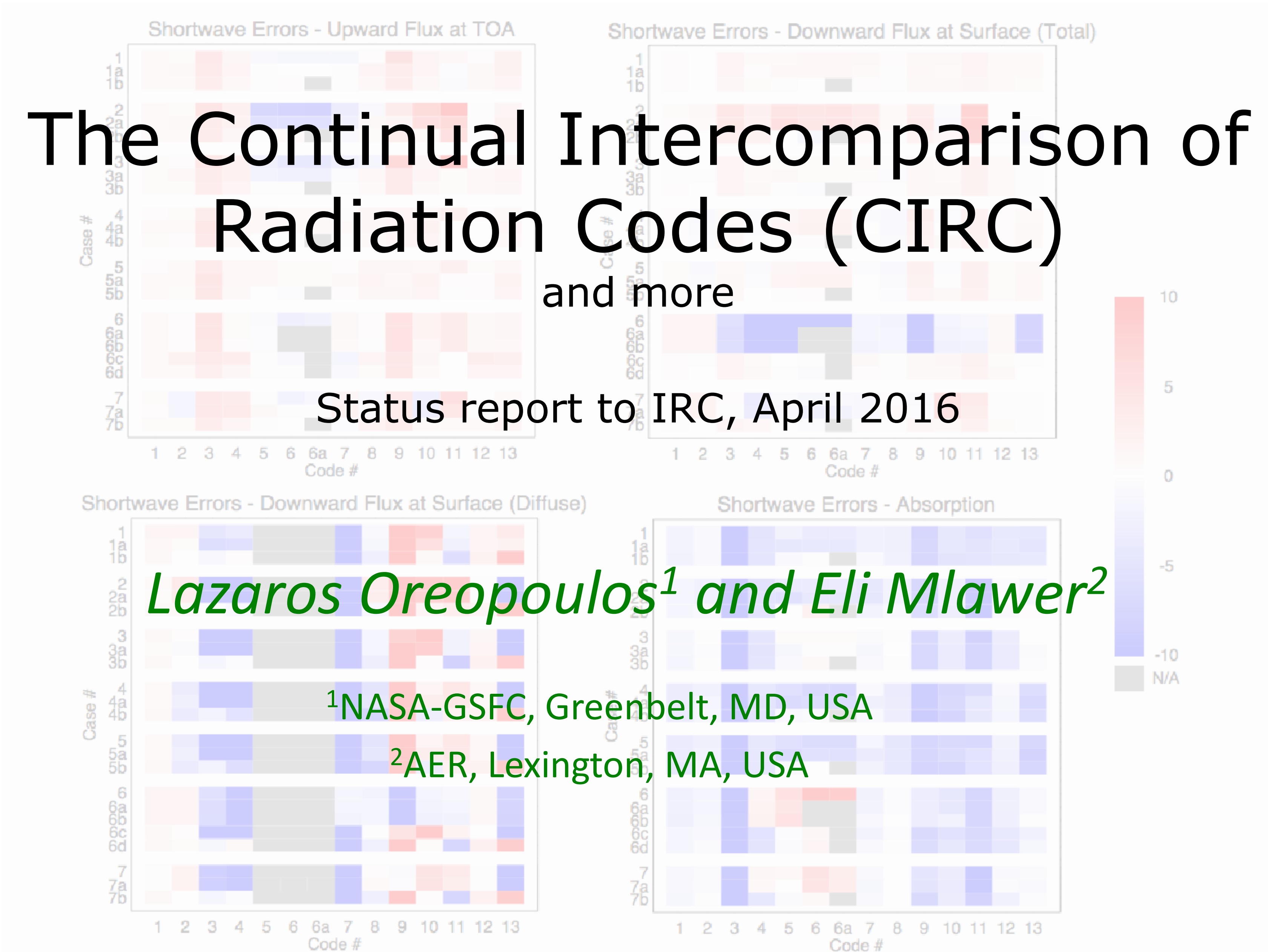
and more

Status report to IRC, April 2016

Lazaros Oreopoulos[1] and Eli Mlawer[2]

[1]NASA-GSFC, Greenbelt, MD, USA

[2]AER, Lexington, MA, USA



What CIRC is about

- RT model intercomparison intended to be the standard for documenting the performance of RT codes used in GCMs
- Working group within IRC and GEWEX's GASS (ex-GCSS)
- Goal is to have RT codes of GCMs (incl. IPCC) report performance against CIRC

  - to some extent, this has morphed into RFMIP (see last slide)
- Website: http://circ.gsfc.nasa.gov
- Two papers, BAMS 2010 and JGR 2012.

How CIRC differs from previous intercomparisons:

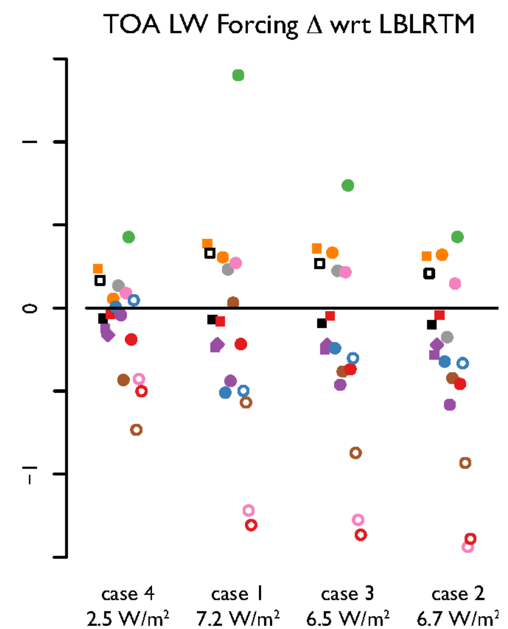
- *Observation-tested* (LW) LBL calculations are used as radiative benchmarks
- Benchmark results are publicly available
- Observationally-based input (chiefly from an ARM product named BBHRP)
- Intended to have flexible structure and be continual (i.e. updated periodically)

CIRC status report – recent activities

- Section about CIRC in "Contributions of the ARM Program to Radiative Transfer Modeling for Climate and Weather Applications" in ARM monograph - in press
- Major new release of LBLRTM planned for 2016 -- in the spirit of "Continual" we will update the reference calculations of CIRC Phase I
- 30 peer-reviewed references for main CIRC paper, 15 for shorter BAMS paper on CIRC. Recent works have referenced CIRC:
  - to test aspects of RT code performance (e.g. Masek et al. 2016)
  - as a general reference for the status of RT code accuracy (e.g. De Angelis et al., 2015 - "Intermodel variability in the accuracy of shortwave parameterization schemes probably results from model developers' ongoing challenge of balancing the need for accurate radiative transfer calculations against considerations of computational efficiency and realistic simulation of other climate system component ... As computational capabilities have grown, improvement in longwave schemes and other model components (for example, cloud processes) seem to have taken precedence over parameterization of shortwave gaseous absorption, with many modelling institutions continuing to implement outdated schemes for the latter in CMIP5"
- Related note: BBHRP dataset (foundation for CIRC Phase I) used to determine clear-sky bias of observed surface CO_2 radiative forcing (Feldman et al., *Nature*)
- Future plans
  - Support RFMIP (see next slide)
  - Ice cloud flux intercomparison for CIRC Phase II: On hold due to instrumental issues with ARM shortwave spectrometers, needed to provide observational foundation for CIRC ice cloud cases
  - CIRC remains unfunded

Radiative Forcing Model Intercomparison Project (RFMIP)

- A satellite MIPs around CMIP6 aiming to disentangle variability in radiative forcing from variability in response across the CMIP ensemble
- Extending the goals of CIRC to the global scale requires replacing observed cases with synthetic cases
- Pilot study on 4xCO2, led by Pincus, Mlawer, Oreopoulos used CIRC cases and has been published in GRL (Pincus et al. 2015, 2015GL064291)



- Substantial diversity in estimates of model instantaneous radiative forcing. Some diversity in forcing is due to errors, some due to model climatology (i.e. depends on atm. state)
- Three components of RFMIP:
  - assess forcing by greenhouse gases against reference calculations
  - assess forcing by aerosols also against benchmarks when possible; will try to untangle sources of diversity in model aerosol forcing (e.g., aerosol burden/type, optical properties, state of the model)
  - linking above with estimates of effective forcing inferred from global model integrations via careful diagnosis
- Accuracy of greenhouse gas and aerosol radiation parameterizations in present-day, future, and strongly-forced conditions can be assessed with offline calculations.

IRC working group
Global Energy Balance (GEB)

Annual Report

Martin Wild and Norman Loeb (WG Co-chairs)

Objectives WG Global Energy Balance

The main goals of this working group are the assessment of the magnitude and uncertainties of the components of the global energy balance, their decadal changes and underlying causes as well as their significance for other climate system components and climate change.

Activities: Meeting organization

- **European Geophysical Union (EGU) General Assembly 2015**, Vienna, April 2015. Organization of the session "Earth radiation budget, radiative forcing and climate change", closely linked to the aims of this working group.(Convenor Martin Wild). "10th anniversary" (consecutive till 2006)
- **International Union of Geodesy and Geophysics (IUGG)** Prague July 2015 Organization of session "Radiation in the climate system" (Convenors Martin Wild, Werner Schmutz, Norman Loeb, Graeme Stephens). Talks by Kevin Trenberth, Teruyuki Nakajima, Bill Collins, Peter Pilewskie, Werner Schmutz
- **American Geophysical Union (AGU) General Assembly 2015**, San Francisco, December 2015. Organization of the session "Improved Understanding of the Surface Energy Balance and the spatio-temporal Variation of its Components", " (Convenors Arturo Sanchez, Martin Wild, Paul Stackhouse, Chuck Long)
- **International Radiation Symposium IRS2016,** Auckland, April 2016. Organization of session "Radiation budget & Forcing" (Convenors Martin Wild, Peter Pilewskie, Stefan Kinne, Arturo Sanchez)
- **European Geophysical Union (EGU) General Assembly 2016** Vienna, April 2016, Organization of session "Earth radiation budget, radiative forcing and climate change" runs in parallel to IRS 2016

Activities

- WG-GEB Co-Chairs Norman Loeb and Martin Wild are involved in the **CLIVAR Research focus "Consistency between planetary heat balance and ocean heat storage".**
- Both Co-Chairs were part of **the ISSI (International space Science Institute) initiative "Consistency of Integrated Observing Systems Monitoring the Energy Flows in the Earth System"**, with meetings in Bern, Switzerland. => perspective letter in Nature Climate Change "An imperative to monitor Earth's energy imbalance" has been published online on January 27, 2016, co-authored by both WG-GEB Co-chairs (von Schuckmann et al. 2016).
- Swiss National Science Foundation (SNF) : "Towards an improved understanding of the Global Energy Balance: Temporal variation of solar radiation" funded for 3 years.

Challenges: Global energy balance from a surface perspective

- **Consistency between energy and water cycle on a global scale**

  Room for adjustments in surface energy budget:
  - Surface albedo
  - Partitioning of surface net radiation into sensible and latent heat

- **Thorough evaluation of surface energy budgets on regional scales**
  - requires thorough assessment of all available information on surface fluxes as derived from satellites, reanalyses and models.
  - Validation with direct (in situ) observations wherever possible, Improve methodology to evaluate gridded datasets with point observations.
  - Urge responsible institutions to expand (or at least continue!) ocean in situ radiation measurements.

- **Better quantification of surface energy flux changes**
  - Need to bring together all available information on surface flux changes as derived from direct observations, satellites, reanalyses and climate models. Consistency in satellite-derived surface radiation trends? How useful are reanalyses for decadal variations?
  - Better quality assessment of historic radiation records: Homogeneization, Representativeness, Urbanisation effects
  - Diagnose multidecadal clear sky variations in observational records
  - Make use of proxies to expand spatial and temporal coverage
  - Interpretation of the changes: forced versus unforced variations

Recommendations

Recommendations Surface Observations:

- Letters of support to some of the National agencies funding BSRN stations may help to rise the recognition of the importance of anchor sites for global energy budget studies
- Establish international mechanism for funding stations in developing countries (WMO operated world funding pool)

Selected references

Dallafior, T. N., Folini, D., Knutti, R., and Wild, M., 2015: Dimming over the oceans: Transient anthropogenic aerosol plumes in the twentieth century, J. Geophys. Res. Atmos., 120, 3465–3484, doi:10.1002/2014JD022658.

Dallafior, T. N., Folini, D., Knutti, R. and Wild, M., 2016: Mixed-layer ocean responses to anthropogenic aerosol dimming from 1870 to 2000, J. Geophys. Res. Atmos., 121, 49–66, doi:10.1002/2015JD024070.

Folini, D., and Wild, M., 2015: The effect of aerosols and sea surface temperature on China's climate in the late twentieth century from ensembles of global climate simulations, J. Geophys. Res. Atmos., 120, 2261-2279, DOI: 10.1002/2014JD022851.

Hakuba, M.Z., Folini, D., Sanchez-Lorenzo, A., and Wild, M. 2013: Spatial representativeness of ground-based solar radiation measurements, J. Geophys. Res., 118, 8585–8597, doi:10.1002/jgrd.50673

Hakuba, M.Z., Folini, D., Schaepman-Strub, G., and Wild, M., 2014a: Solar Absorption over Europe from collocated surface and satellite observations, J. Geophys. Res., 119, 3420-3437, DOI: 10.1002/2013JD021421.

Hakuba, M.Z., Folini, D., and Wild, M., 2016: On the zonal near constancy of fractional solar absorption in the atmosphere, J Climate in press.

Loeb, N. and co-authors, 2016: Observational constraints on atmospheric and oceanic cross-equatorial heat transports: revisiting the precipitation asymmetry problem in climate models. Climate Dynamics online

Long CN and Y Shi. 2008. "An Automated Quality Assessment and ControlAlgorithm for Surface Radiation Measurements." The Open Atmospheric Science Journal 2: 23-37. DOI: 10.2174/1874282300802010023.

Riihimaki, L. D. and C.N. Long (2014): "Spatial variability of surface irradiance measurements at the Manus ARM site." Journal of Geophysical Research, 119, 5475–5491, DOI: 10.1002/2013JD021187.

von Schuckmann, K., Palmer, M. D., Trenberth, K. E., Cazenave, A., Chambers, D., Champollion, N. , Hansen, J., Josey, S. A., Loeb, N., Mathieu, P.-P., Meyssignac, B., and Wild, M., 2016: An imperative to monitor Earth's energy imbalance. Nature Climate Change online

Wild, M., Folini, D., Hakuba, M., Schär, C., Seneviratne, S.I., Kato, S., Rutan, D., Ammann, C., Wood, E.F., and König-Langlo, G., 2015: The energy balance over land and oceans: An assessment based on direct observations and CMIP5 climate models. Clim. Dyn., Dyn., 44, 3393–3429, doi: 10.1007/s00382-014-2430-z.

Wild, M., 2016: Decadal changes in radiative fluxes at land and ocean surfaces and their relevance for global warming, WIRES Clim Change, 7, 91–107, doi: 10.1002/wcc.372.

Working Group-Ultraviolet

Julian Gröbner and Mario Blumthaler

pmod wrc

Overview of Activities 2015/2016

- 4 CMCs accepted in the Key Comaprison database of BIPM
- European Metrology Research Programme:
  - Project ENV59-ATMOZ has just reached half-time, with very promising results so far.
- New Uncertainty Budget for QASUME as outcome of EMRP SolarUV
- Quality Assurance using QASUME reference spectroradiometer
  - 10th RBCC-E Campaign, Spain, June 2015
  - NIWA, Lauder Intercomparison January 2016

pmod wrc

The BIPM key comparison database KCDB

CMCs for PMOD/WRC in Photometry and Radiometry

- Responsivity, solar, irradiance. Broadband detector, 0.0001 V/(Wm-2) to 40 V/(Wm-2)
  Relative expanded uncertainty (k = 2, level of confidence 95%) in %: 6
  Weighting: Erythema CIE
  Wavelength range: 280 nm to 400 nm

- Responsivity, solar, irradiance. Broadband detector, 0.0001 V/(Wm-2) to 2 V/(Wm-2)
  Relative expanded uncertainty (k = 2, level of confidence 95%) in %: 6
  Weighting: uniform, 280 nm to 315 nm
  Wavelength range: 280 nm to 315 nm

- Responsivity, solar, irradiance. Broadband detector, 0.0001 V/(Wm-2) to 0.1 V/(Wm-2)
  Relative expanded uncertainty (k = 2, level of confidence 95%) in %: 6
  Weighting: uniform, 315 nm to 400 nm
  Wavelength range: 315 nm to 400 nm

- Responsivity, solar, irradiance. Broadband detector, 0.0001 V/(Wm-2) to 0.1 V/(Wm-2)
  Relative expanded uncertainty (k = 2, level of confidence 95%) in %: 6
  Weighting: uniform, 280 nm to 400 nm
  Wavelength range: 280 nm to 400 nm

http://www.bipm.org/exalead_kcdb/exa_kcdb.jsp?_p=AppC&_q=pmod&x=72&y=15

http://kcdb.bipm.org/appendixc/

pmod wrc

Improved uncertainty Budget for spectral solar measurements with QASUME

Uncertainty Parameter	Relative Std Uncertainty %	
	QASUME	QASUME2
Radiometric calibration	0.55	
250 W lamp stability (one year) +-0.25%/sqrt(2)	0.10	
Nonlinearity ... From PMT or PC	0.25	0.17
ND filter transmission	n/a	.3 (1% full scale)
Stability	0.6 diurnal var. +-1%	0.20
Temperature Dependence of the Entrance optic (-0.11%/K)	0.2 (0.33/sqrt(3))	
Angular Response (Clear Sky) uarf=0.3%	1.2 (2.1/sqrt(3)) 0.7 (<65°SZA) 0.6 (1.1/sqrt(3)) <350nm)	0.6 (full scale +-1%)
Angular Response (Overcast), uarf=0.3%	0.6	0.3
Repeatability (std noise) (Wl>=310nm)	0.2	0.2
Repeatability (std noise) (Wl=300nm & sza=75)	3.5	3.5
Wavelength shift (after matSHIC) 0.02 nm	0.1, 0.5% (bei 300 nm)	0.1, 0.5% at 300 nm
Combined Uncertainty	1.5 (overcast, <65°: 1.1)	1.0 (overcast, <65: 0.8)
Expanded Uncertainty (k=2)	3.1 (overcast, 2.2)	2.0 (overcast, 1.6)
Expanded Uncertainty (k=2) 300 nm	7.4	7.3

To be submitted to Applied Optics

pmod wrc

Working Group Status Update

Report of the 3D RT (atmospheric part) working group

Alexander Marshak

(June 2015 – March 2016)

I3RC status (I3RC is an ongoing project initiated in the late 1990s): http://i3rc.gsfc.nasa.gov/

Objectives

- comparing methods available for 3D atmospheric RT calculations
- providing benchmark results for testing 3D RT codes
- publishing an open source toolkit (community 3D MC code)
- providing resources related to I3RC and 3D RT (codes, models, workshops, publications)

Activities

- Due to security upgrades the online 3D calculator is down. 5 people (from US and France) have downloaded the file containing all the source code of the I3RC Monte Carlo code (http://code.google.com/p/i3rc-monte-carlo-model/downloads/list). It is a drop in downloads comparing with the previous years. On the other hand, the I3RC website remained popular: during the last 9 months, 614 visitors made 1023 visits to the website. This is similar to the previous year's numbers (also around 1000 visits), and the frequency of visits remained fairly steady throughout the year, with no obvious annual cycle or trend. While 40% of the visitors visited a single page, 60% of the visitors went to more than one page. The average length of visits was 3.2 pages per visit (including single-page visits), slightly up from last year's 3 pages per visit.

- The 3D session at the 2015 Joint AGU Assembly that was held on May 3-7, 2015 in Montreal. Conveners: T. Várnai, A. Davis, H. Barker, C. Chiu. Title: *Challenges for 3D radiative transfer in the Earth and atmospheric sciences.* The session included 15 oral presentations and 13 posters.

What's now available:

- Online 3D calculator (currently not available due to GSFC security issues)
- A new image archive about 3D radiative processes
- Consensus results of I3RC intercomparison for model verification
- Publicly available codes on 3D radiative transfer
- Expanded publication list on 3D RT.

Plans

- creating an educational web pages on 3D RT;
- adding Rayleigh scattering and aerosols to the I3RC community code;
- adding polarization to the I3RC community code;
- adding thermal emission to the I3RC community code.

Working Group Status Update

Report on 3DRT activity in vegetation community

Nadine Gobron (JRC) and Mathias Disney (UCL)

The results of **RAMI-IV** for actual canopies have published in
Widlowski J.-L. et al. (2015), The fourth phase of the radiative transfer model intercomparison (RAMI) exercise: Actual canopy scenarios and conformity testing., *Remote Sens. Environ.*, **169**:, 418-437. DOI: http://dx.doi.org/10.1016/j.rse.2015.08.016.

More detailed results' comparisons have been included in http://rami-benchmark.jrc.ec.europa.eu/HTML/RAMI-IV/RAMI-IV.php. Six actual canopies were based on detailed measurements of the spectral, architectural properties encountered in a variety of existing vegetation canopies. 12 RT models were used to perform the experiments from BRF to vertical profile of fluxes. The large variability between several model results is explained by the vastly increased complexity of the scenes, and the implementation of by modellers. The level of detail in the 3D models is approaching the limit of what can be measured and/or represented in the 3D models e.g. trees down to the individual needle level. This allows for very direct comparisons of 3D models for realistic scenes (which hasn't been achieved before) but of course it means that models which are not capable of full 3D representation, require generalizing/simplifying assumptions. The impact of these on the results is also interesting and instructive. A further advance in RAMI IV was the first attempt to compare LiDAR simulation capabilities. This is already becoming important due to the wide use of airborne lidar but also increased use of ground-based terrestrial lidar scanners, UAV-mounted lidar, and of course spaceborne (NASA GEDI mission, and ICeSAT-2). It is likely that in the next iteration of RAMI, 3D canopies generated from direct lidar measurement will be used, rather than from computer-generated architecture modelling software.

The novelty in RAMI IV was also mimicking of various ground-based measurements but only a few models participated in this aspect, in part due to the difficulty of generalizing 3D structure as mentioned above. Nevertheless the 3D model-based approach for improving EO land validation has been start as for example in the FP7 Quality Assurance For Essential Climate Variable (QA4ECV) project (http://www.qa4ecv.eu/), as well as in the FP7 METEOC-2 (Metrology for EO and Climate) project (http://www.emceoc.org/).

Working Group Status Update

No presentations from two IRC working groups

1. GEWEX Data Assessment Panel (GDAP)
2. International TOVS Working Group (ITWG)

Working Group Status Update

- Updates to Working Groups' Status

There are no changes or modifications suggested by chairs or commissioners

Financial Update of IRS 2016

- **Roger Davies**, New Zealand

IRS2016 Budget
April 15th

Roger Davies
Physics Department, The University of Auckland, New Zealand

In NZ$$ after GST

- Total registration income $152,739
- Addition income (events) $6,652
- Sponsorship: physics, exhibitors $13,250

- Total Income $172,641

Expenses

- Fixed $33,397
- Variable (proportional to number of delegates@270) $125,563

- Total expenses $158,960

Bottom Line

- Income $172,641
- Expenses $158,960
- Difference $13,681
- To IRC $13,104 (273@$48) [US$8,900@0.68]
- Reserve $577

Changes pending due to actual consumption, expanded excursion, volunteer book vouchers

Highlights of IRS2016

- Sessions of Interest:

Suggestions by commissioners or attending guests:

There are no particular recommendations.

Report on IAMAS

- General update and status:

  - Teruyuki Nakajima thanks IRC for submitting a symposium to IAPSO-IAMAS-IAGA. There are now 33 sessions for IAMAS, 40 session for IAPSO and 15 sessions for IAGA proposed,
  - 2019 IUGG will be in Montreal.

- Next IAMAS meeting 2017 in Southafrica.

Next Business Meeting

- IRC Business meeting at IAMAS meeting 2017 in Southafrica.

Election

- Election of the IRC president and Officers for the 2017-2020 term.

Election Rules from: http://www.irc-iamas.org/resources/index.php?id=4

C. Election of the President and His/Her Slate of Vice-President and Secretary:

«Business Meeting Election Rule: The election of a new President of the IRC must be an item on the agenda of the last IRC business meeting of a membership term, held normally during the International Radiation Symposium of that year. The Nominee for President is presented to members in attendance at the IRC business meeting. The Nominee for President in turn presents his or her “slate” of nominees for Vice-President and Secretary, followed by discussion and then a vote of all members present at the business meeting for or against electing the Nominee as the new President»

Election

- Nominees for term 2017-2020:

For President:

Byung-Ju Sohn, Nat. University Seoul, Seoul, Korea (presently IRC vice-president)

For Vice President:

Peter Pilewskie, LASP, Boulder CO, USA (presently IRC secretary)

For Secretary:

Marcia Akemi Yamasoe, Univ. Sao Paulo, Sao Paulo, Brazil (presently IRC commissioner)

Election

- Result of the Election:

Byung-Ju Sohn, Nat. University Seoul, Seoul, Korea (presently IRC vice-president) was unanimously elected for IRC President.

Peter Pilewskie, LASP, Boulder CO, USA (presently IRC secretary) was unanimously elected for IRC Vice-President.

Marcia Akemi Yamasoe, Univ. Sao Paulo, Sao Paulo, Brazil (presently IRC commissioner) was unanimously elected for IRC Secretary.

Other Business

- No other business

IRC Business Meeting 2016 closed