The International TOVS (Soundings) Working Group (ITWG)

Summary of highlights and request for guidance from ITSC-21

Presented to IRC, July 2018 Business Meeting

Niels Bormann (ECMWF)

Mitch Goldberg (NOAA/NESDIS)

ITWG Co-Chairs

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Liam Gumley (U Winsconsin/SSEC)

International TOVS Working Group (ITWG)

- Established in 1983 as a working group of the International Radiation Commission (IRC) of the International Association of Meteorology and Atmospheric Physics (IAMAP)
- Formally adopted as sub-group of CGMS in 2012

- Provides a forum where operational and research users of atmospheric infrared and microwave sounders exchange information on:
  - Sensor status
  - Processing methods and derived products
  - Data use in Numerical Weather Prediction
  - Radiative transfer developments
  - Climate studies
  - etc

ITSC-21

Hosted by EUMETSAT in Darmstadt, Germany

- 29 November – 5 December 2017
- 180 participants
- 63 oral, 132 poster presentations
- http://cimss.ssec.wisc.edu/itwg/itsc/itsc21

Topics Covered:

- Current, new and future observing systems
- Reports from space agencies and NWP Centres
- Data assimilation applications
- Climate applications
- Processing software systems
- Advanced sounder science
- Radiative transfer models
- Cloud and precipitation applications
- Retrieval Science

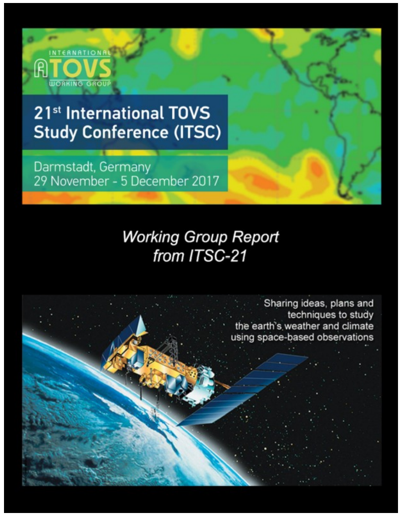
Working Groups

Six Working Groups

- Radiative Transfer and Surface Property Modelling
- Climate
- Data Assimilation and NWP
- Advanced Sounders
- International Issues and Future Systems
- Products and Software

Technical Sub-Groups

- RTTOV
- CRTM
- RARS/DBNET and direct broadcast packages



Recommendations from ITSC-21 to IRC

21. **To IRC and agencies involved in radiative transfer developments:**

ITWG strongly recommends continuous efforts in radiative transfer modelling developments, especially regarding:

- Line-by-line model development as a fundamental basis for accurate radiative transfer calculations in fast RT models.
- Development of reference-quality ocean-surface emissivity modeling, specifically Infrared, Microwave, for both active and passive simulations.
- Extension of the frequency range of scattering models to cover the ranges of current and upcoming sensors, from visible to microwave (i.e., ICI channels).

22. **To IRC and agencies involved in spectroscopy research and radiative transfer development:**

ITWG strongly recommends continuous support of theoretical and laboratory spectroscopic studies to improve the accuracy of fundamental parameters required for radiative transfer calculations (e.g., research into spectroscopy of higher frequency microwave channels up to 1000 GHz), as well as efforts to map uncertainties in spectroscopy into radiance uncertainties.

Recommendations from ITSC-21 to IRC

from Internation issues and future systems WG

The IIFS noted a need for more work on LBL spectroscopic uncertainty and a unified model for describing the shape of the relevant atmospheric water vapour lines from the microwave (MW) to the visible. This should include the thermal (TIR) and shortwave infrared (SWIR)regions. This resulted in the following recommendation to IRC.

Recommendation IIFS-1 to IRC

Development of a new unified model for describing spectroscopic and water vapour continuum absorption

IRC meeting
Vancouver 2018

CLOUDS
and
RADIATION

recent developments

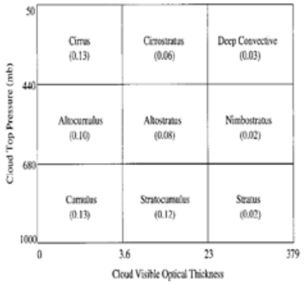
with contributions from

- Tristan L'Ecuyer
- Lazaros Oreopoulos
- Martin Wild
- Terry Nakajima
- Xiquan Dong
- Stefan Kinne
- Miklos Zagoni

Cloud Radiation Effects (CRE)

CRE = **all-sky** flux ***minus*** **clear-sky** flux

- **clouds cool the climate … but (CRE) strength (& sign) differ by cloud type**
  - **cloud boundaries from active remote sensing and (bb-radiation from) passive remote sensing offers new CRE insights**
  - **breakdown of CRE spatial distributions by (1) phase, (2) structure and (3) type**
- **solar dn CRE at high / polar latitudes appear too low *(missed liquid)* in models**
  - **affects simulated placement of the ITCZ**



ISCCP cloud classifications

CLOUDS & RADIATION

Chen / Rossow / Zhang. 2000

CRE at TOA (W/m2)

breakdown by cloud type

Cloud type	TOA SW	TOA LW	TOA TL
Cirrus	−4.2	5.5	1.3
Cirrostratus	−7.9	5.5	−2.4
Deep convective	−6.2	2.9	−3.3
Altocumulus	−3.2	1.5	−1.7
Altostratus	−8.3	2.0	−6.3
Nimbostratus	−3.4	0.7	−2.7
Cumulus	−5.2	0.6	−4.6
Stratocumulus	−12.7	1.2	−11.5
Stratus	−2.4	0.2	−2.2
Sum (true)	−53.5	20.1	**- 33.4**

on average clouds **cool** the climate

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NASA

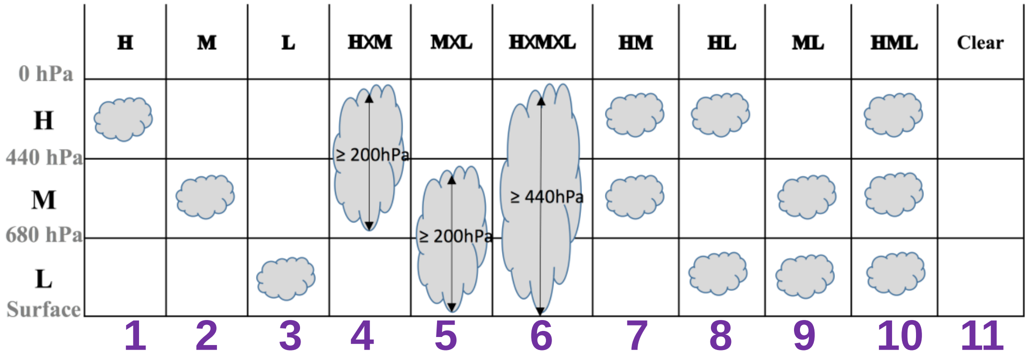
… and now with CLOUDSAT

A NASA EARTH SYSTEM SCIENCE PATHFINDER MISSION

- new information from space-borne active sensing is used
- explicit cloud boundaries and phase reveal …
  - in the past (ERBE/ ISCCP) analysis … multi-layer cloud systems were often misclassified as mid-level clouds
  - supercooled liquid clouds at higher latitudes are underestimated in modeling

Simplified Cloud Vertical Structures
(CloudSat/CALIPSO + 2B-CLDCLASS-LIDAR)

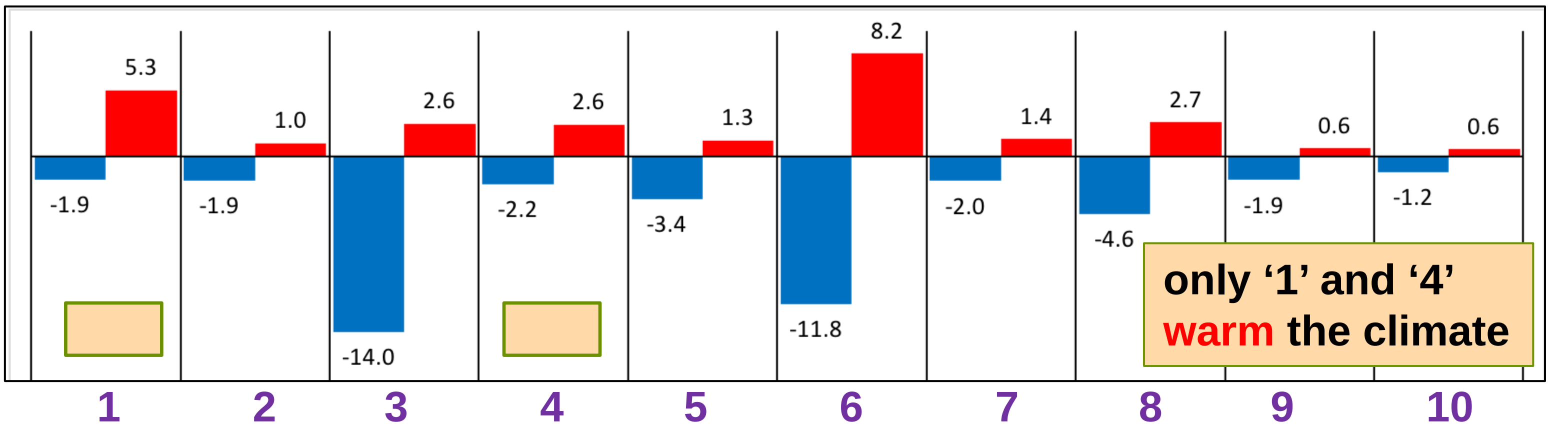
Oreopoulos et al. (2017)



CRE at TOA and surf (W/m2)

… breakdown by structure

IR
TOA
solar



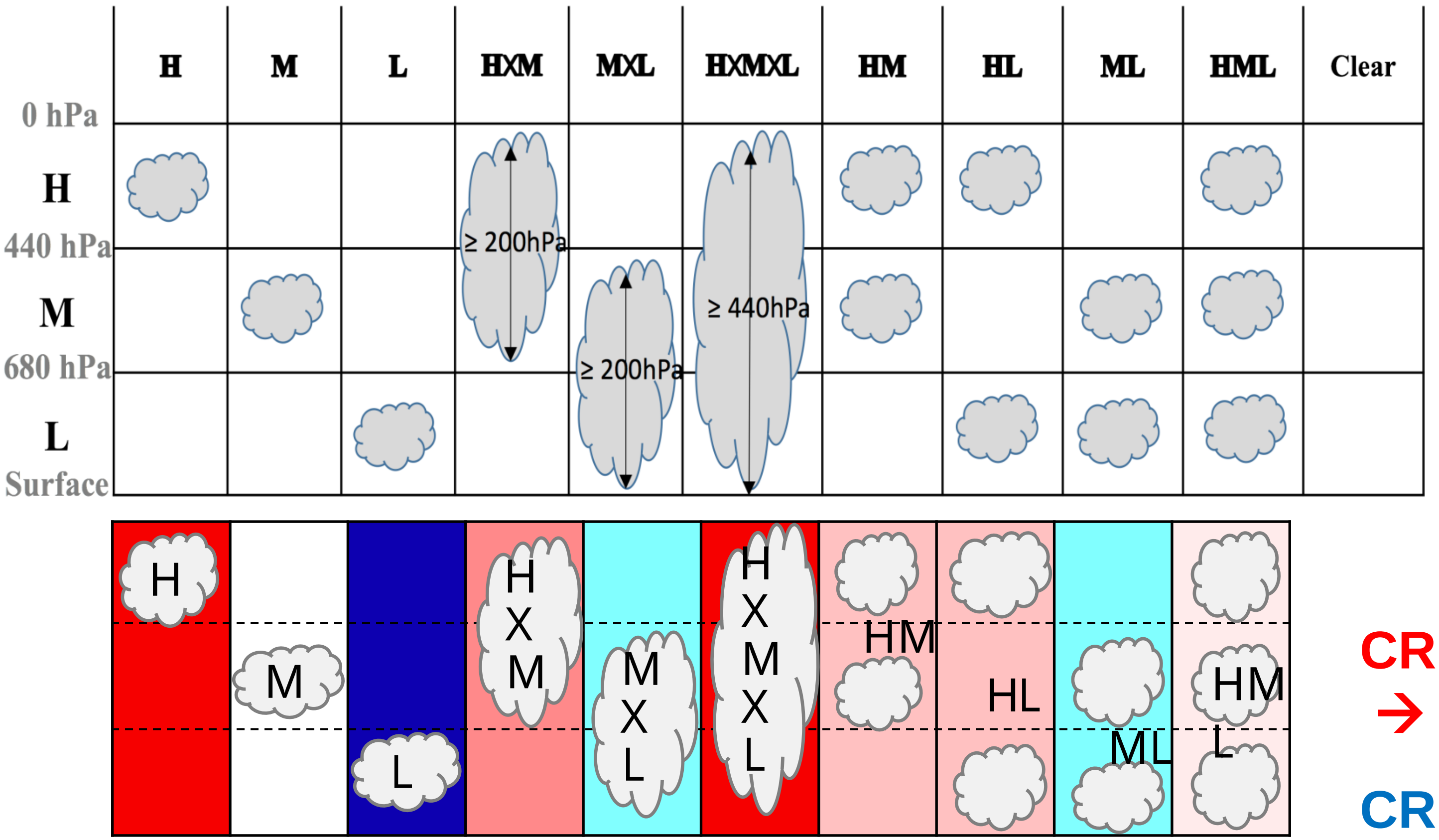
IR
surf
solar

Simplified Cloud Vertical Structures
(CloudSat/CALIPSO + 2B-CLDCLASS-LIDAR)

Oreopoulos et al. (2017)

CRE at atm (W/m2)

... breakdown by structure



+4.5 0.0 -6.4 +1.7 -0.6 +4.6 +0.7 + 0.4 -0.4 +0.1

$CRE_{ATM} > 0$ → warming

$CRE_{ATM} < 0$ → cooling

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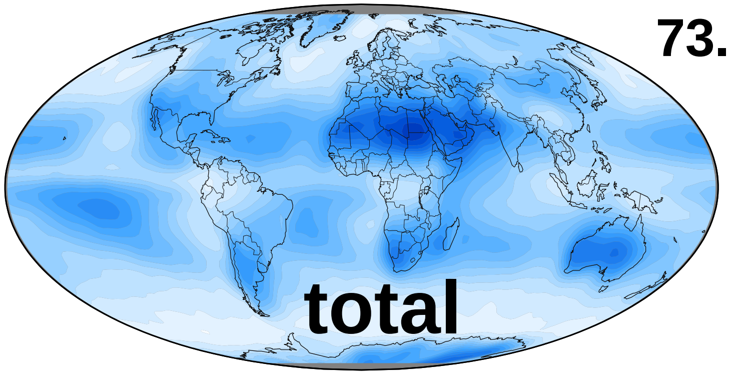
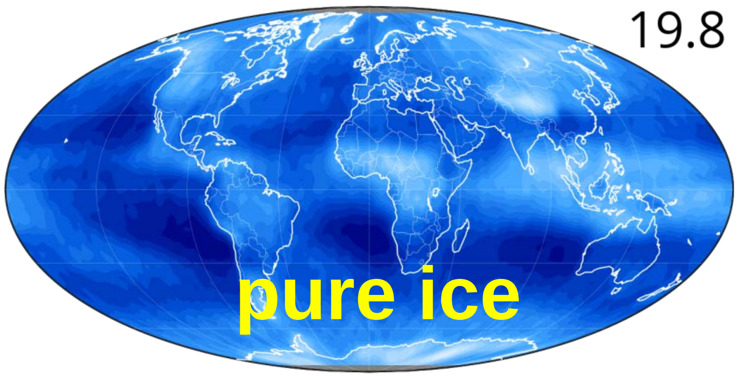
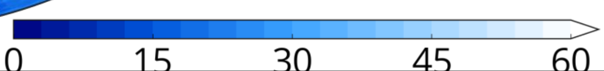
2007-2010



cloud cover (%)

breakdown
by cloud phase





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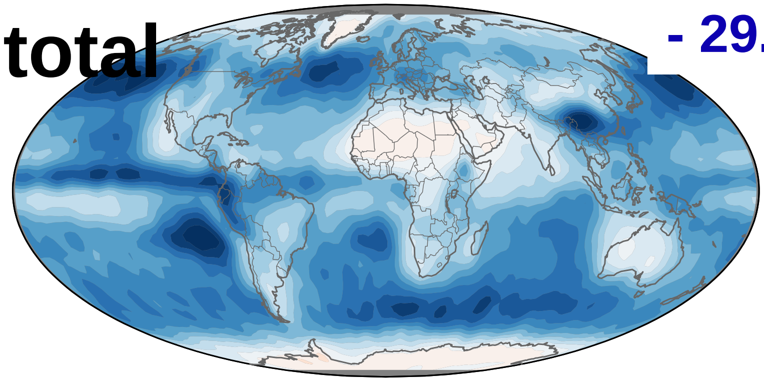
CLOUDSAT

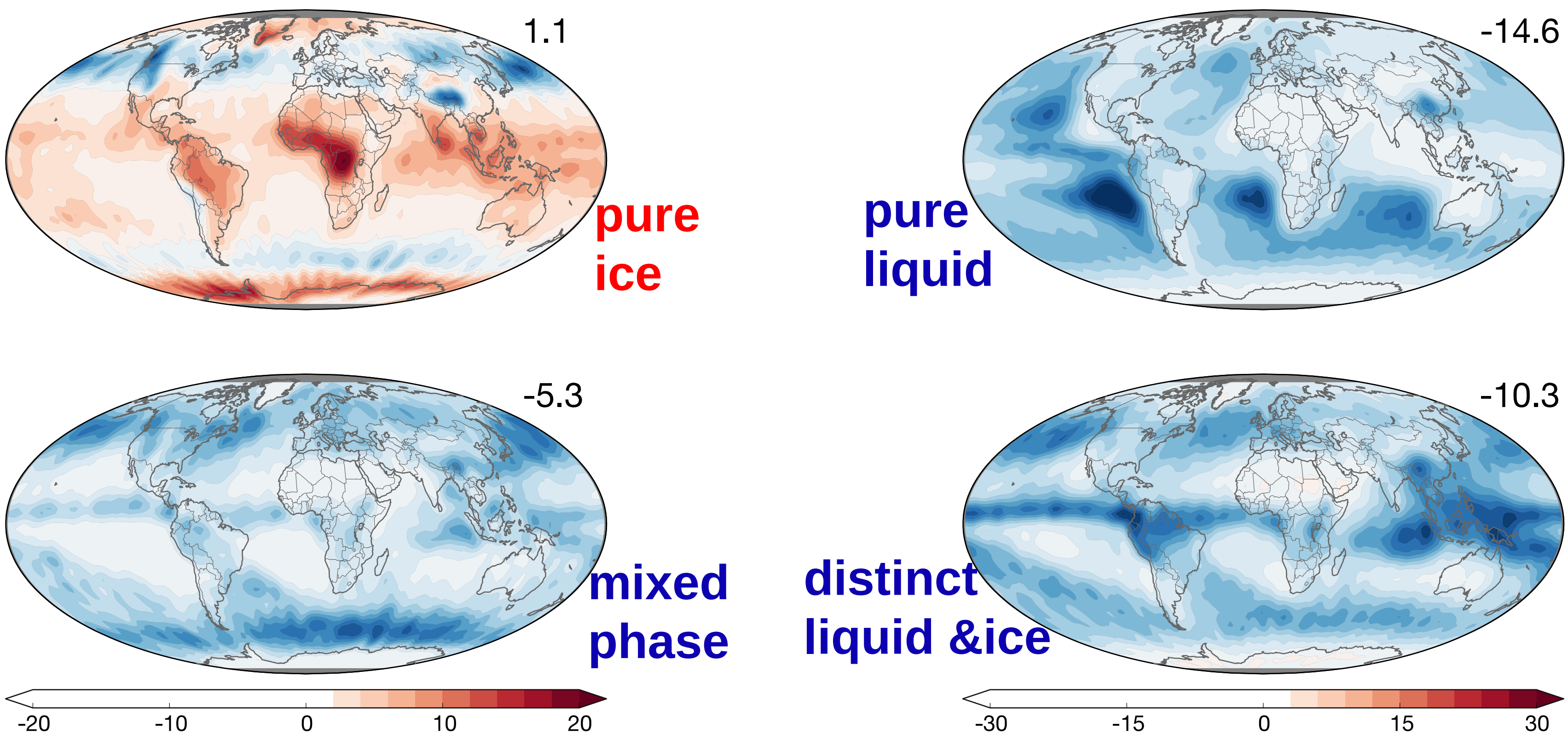
2007-2010

CRE at TOA (W/m2)

breakdown by cloud phase

Matus , L'Ecuyer, *JGR*, (2017)





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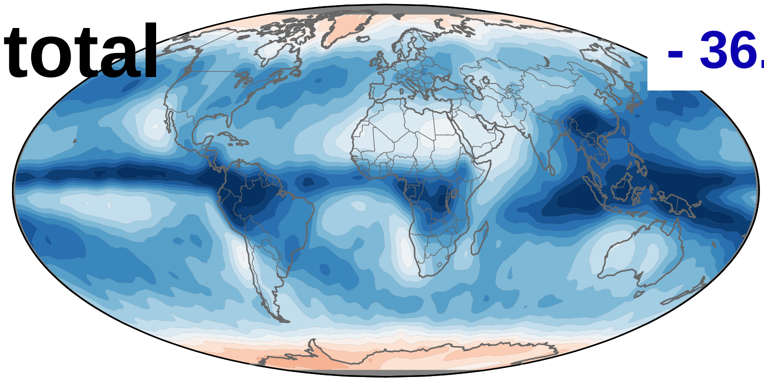
2007-2010

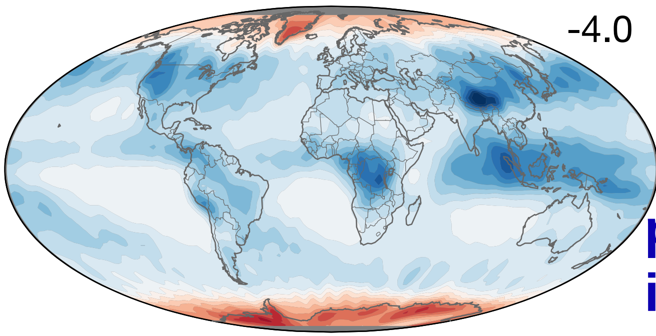
CRE at surf (W/m2)

breakdown by cloud phase

Matus , L'Ecuyer, *JGR*, (2017)

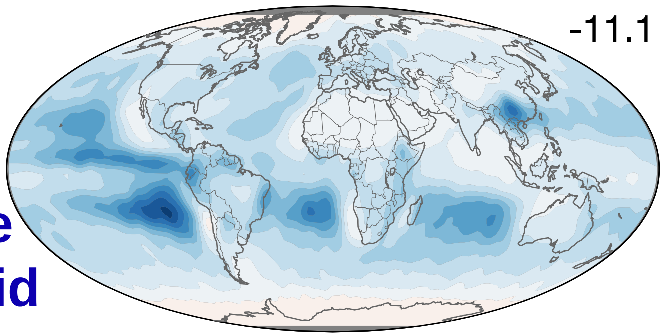
total

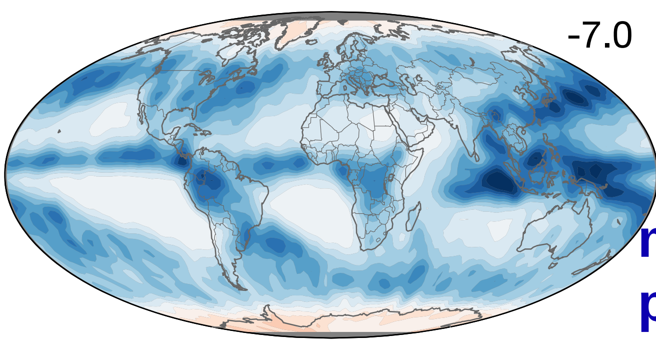




pure ice

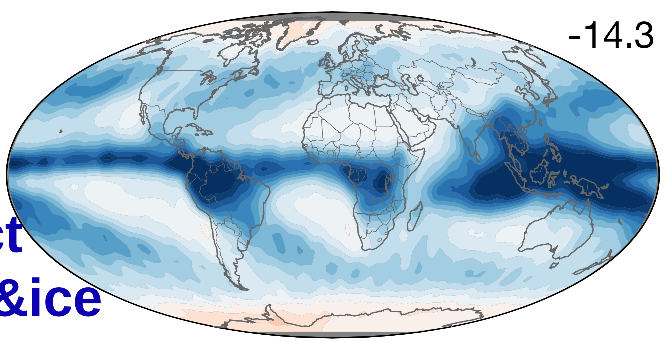
pure liquid

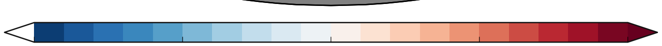




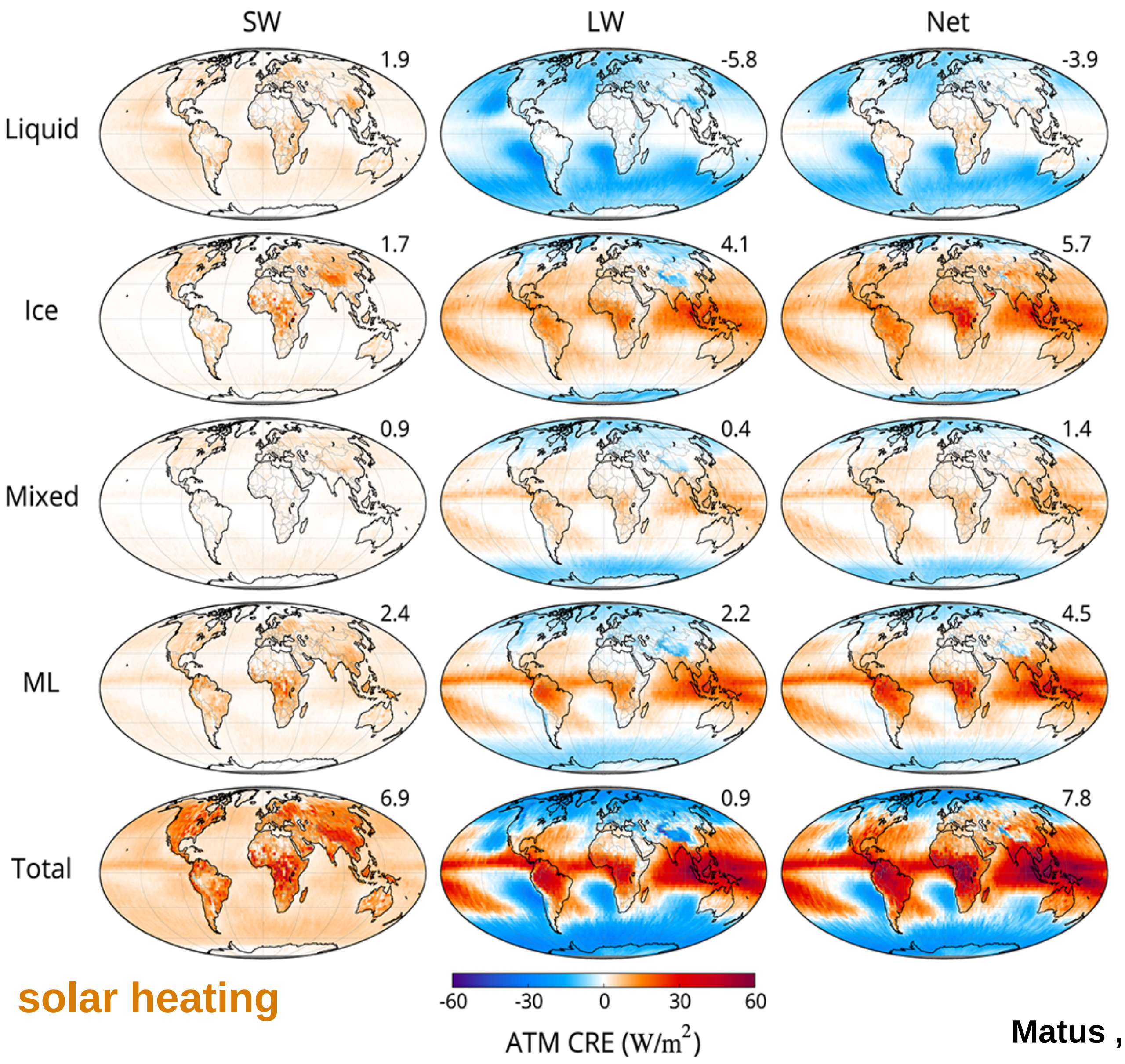
mixed phase

distinct liquid &ice





CLOUDS & RADIATION



CLOUDSAT
EARTH SYSTEM SCIENCE PATHFINDER MISSION

2007-2010

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CRE in atm (W/m2)

breakdown
- **by cld phase**
- **by solar CRE**
- **by IR CRE**

solar heating

Matus , L'Ecuyer, *JGR*, (2017)

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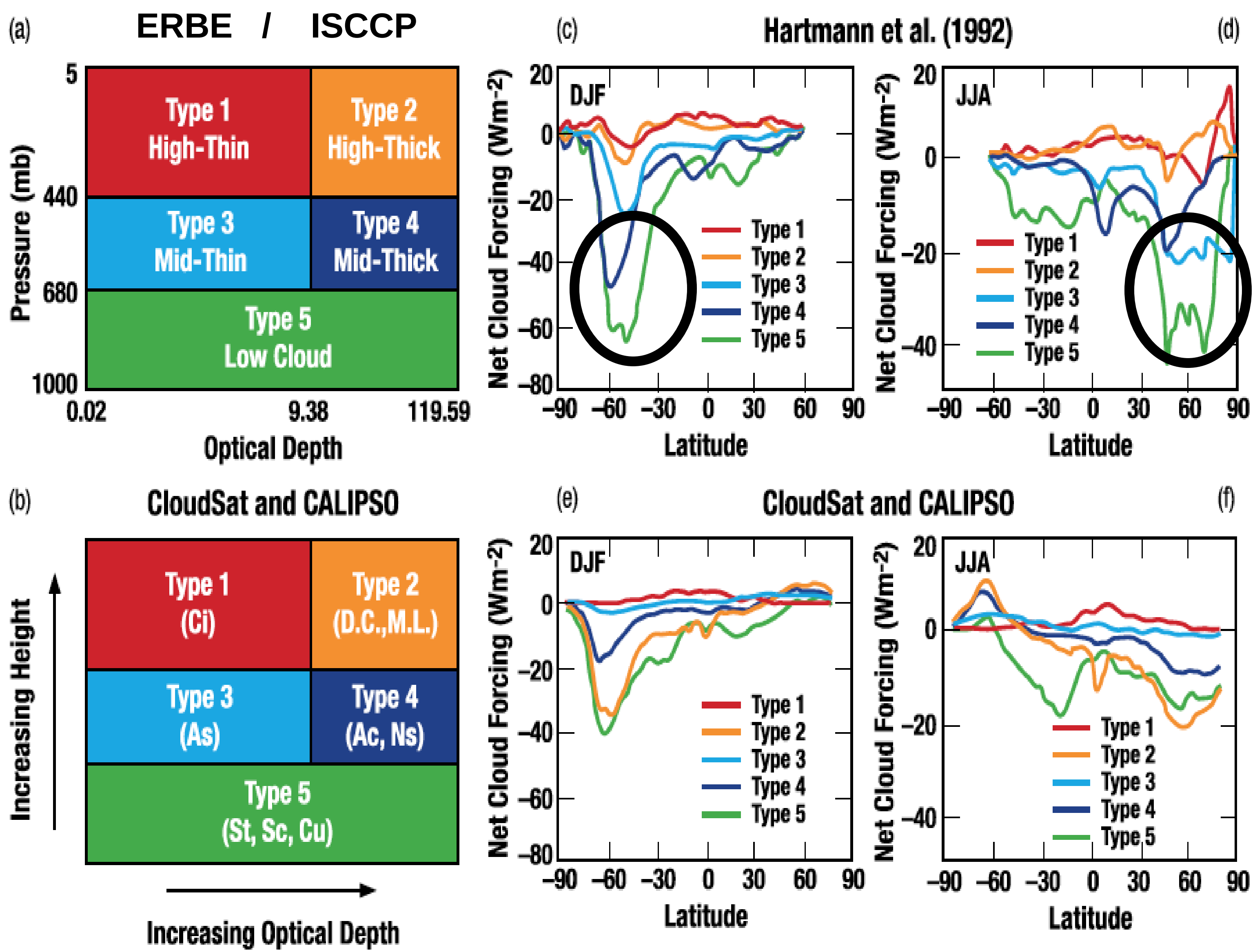
Hang and L'Ecuyer, subm to *JGR*
Stephens et al., 2018

25 yr ago

now



CMIP5 model (spread) vs satellite data

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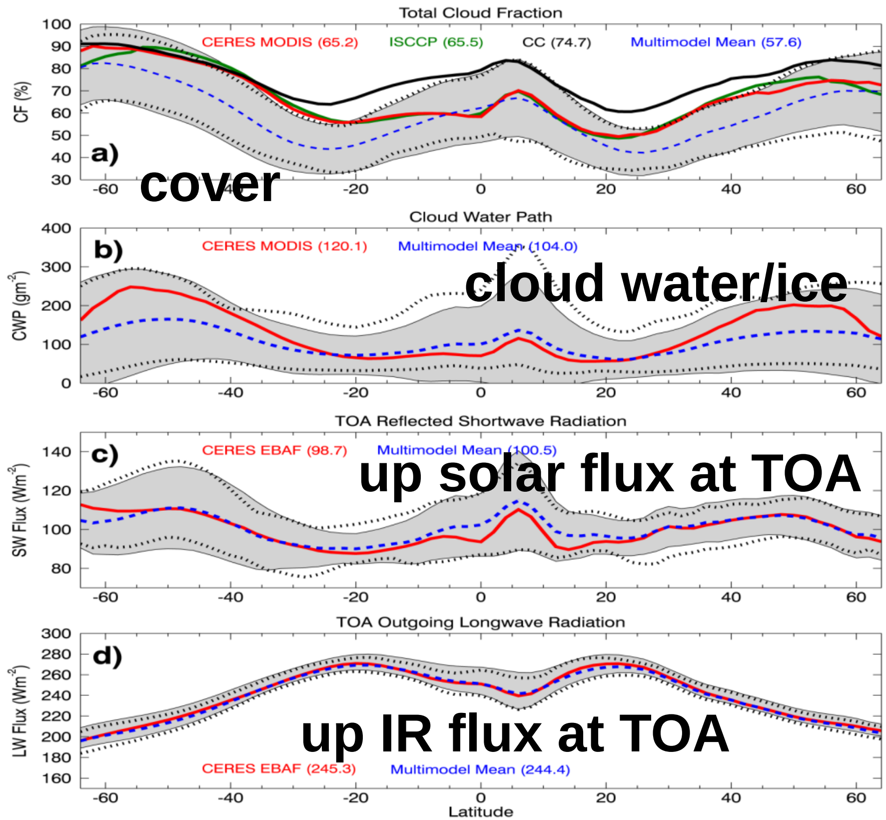
- cover : Calipso / Cloudsat (CC) most sensitive
- water content: model misses at high latitudes
  - but TOA fluxes are OK ! … ??

→ Calipso Cloudsat indicates more COT and more water at high latitudes

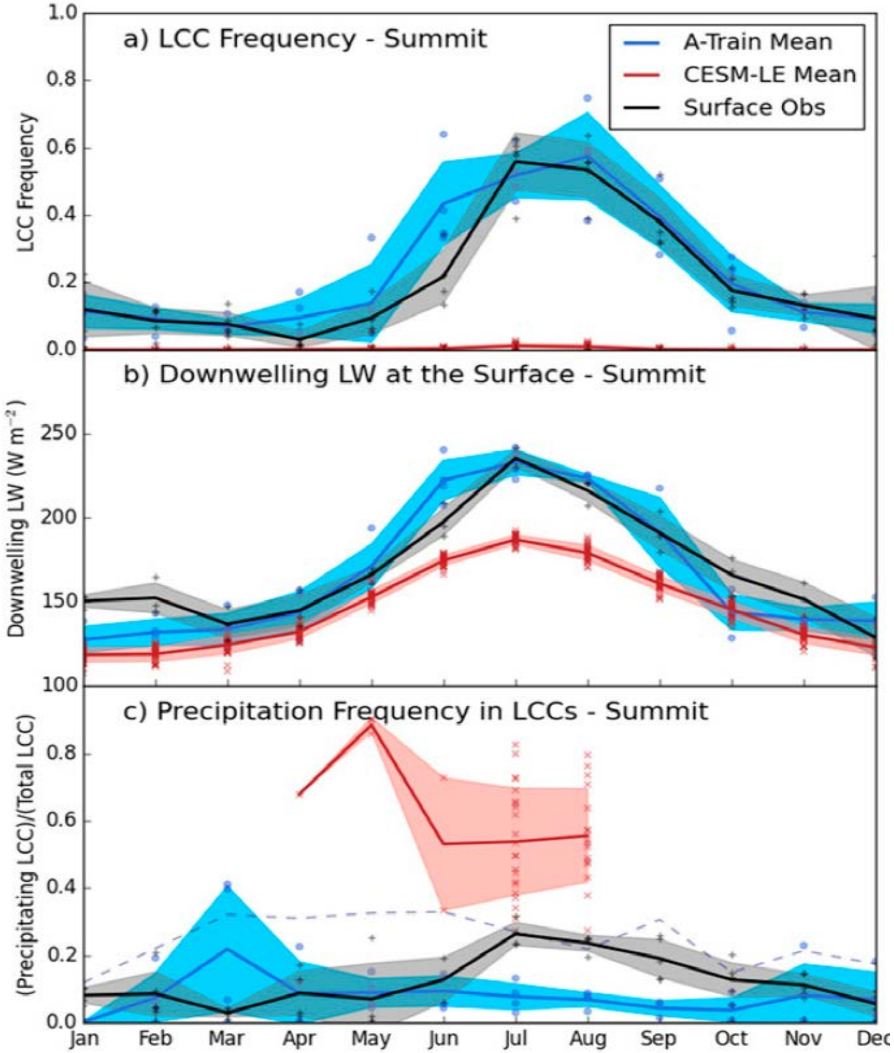


South Pole *EQ* *North Pole*

CERES ISCCP, Cloudsat/Calipso

CMIP5 modeling (cover only 58%)

A-Train vs model

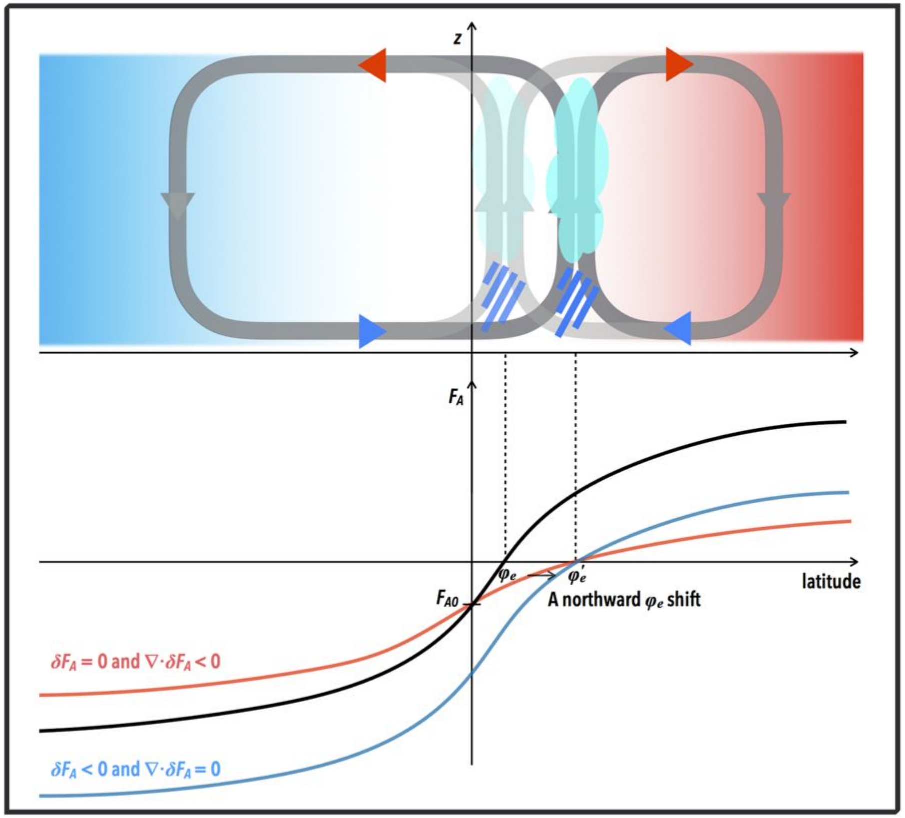


- **climate model bias in polar regions**
- **underestimate the frequency / impact of super-cooled liquid in polar reg.**
  - **… as with super-cooled liquid in models … snowfall is then too quick**

McIlhattan et al, *J. Climate*, (2017)

global model **BIAS** impact

- ‘like’ a simulated heat-source over Southern Hemis.
- sensitivity studies indicate a ITCZ shift towards a high latitude heat source



inter-hemispheric extratropical thermal forcing is balanced by the adjustment of the Hadley circulation **S.Kang et al.** Climate and Atmospheric Science (2017) 1:2

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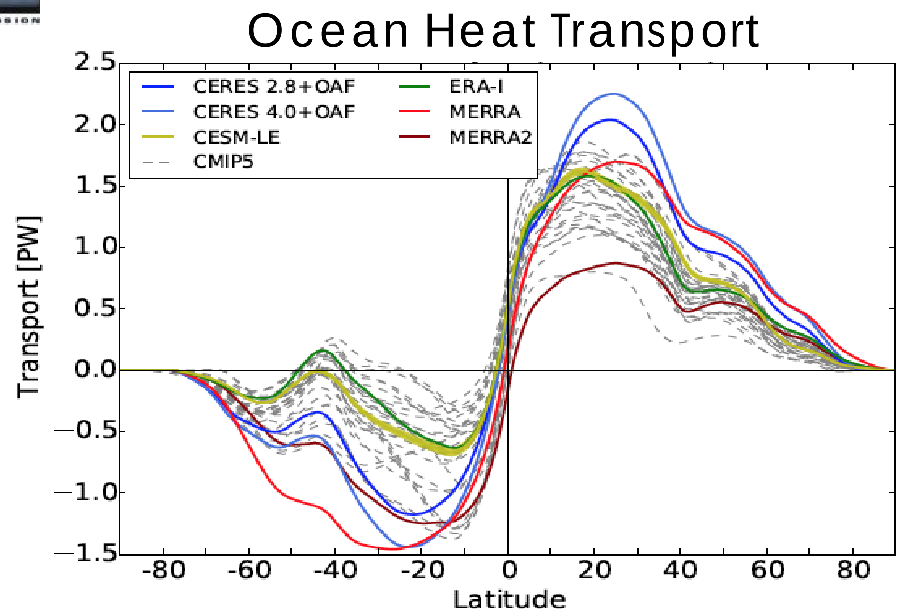
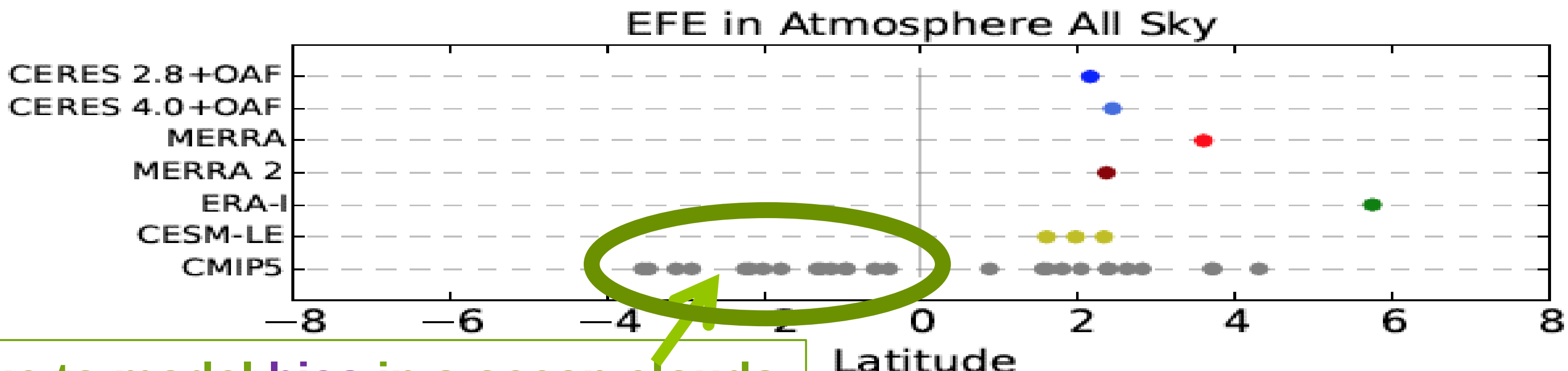
reanalysis vs model

- DIFF in ocean heat transport
  - clouds modulate oceanic heat trans
  - equal flux equator (EFE) near 2 deg N



Nelson, E. L., et, 2018: "Poleward Bound: Energy Transport Representation in the Current Era, subm to *J. Geophys. Res*.



due to model bias in s.ocean clouds

new insights with active RS

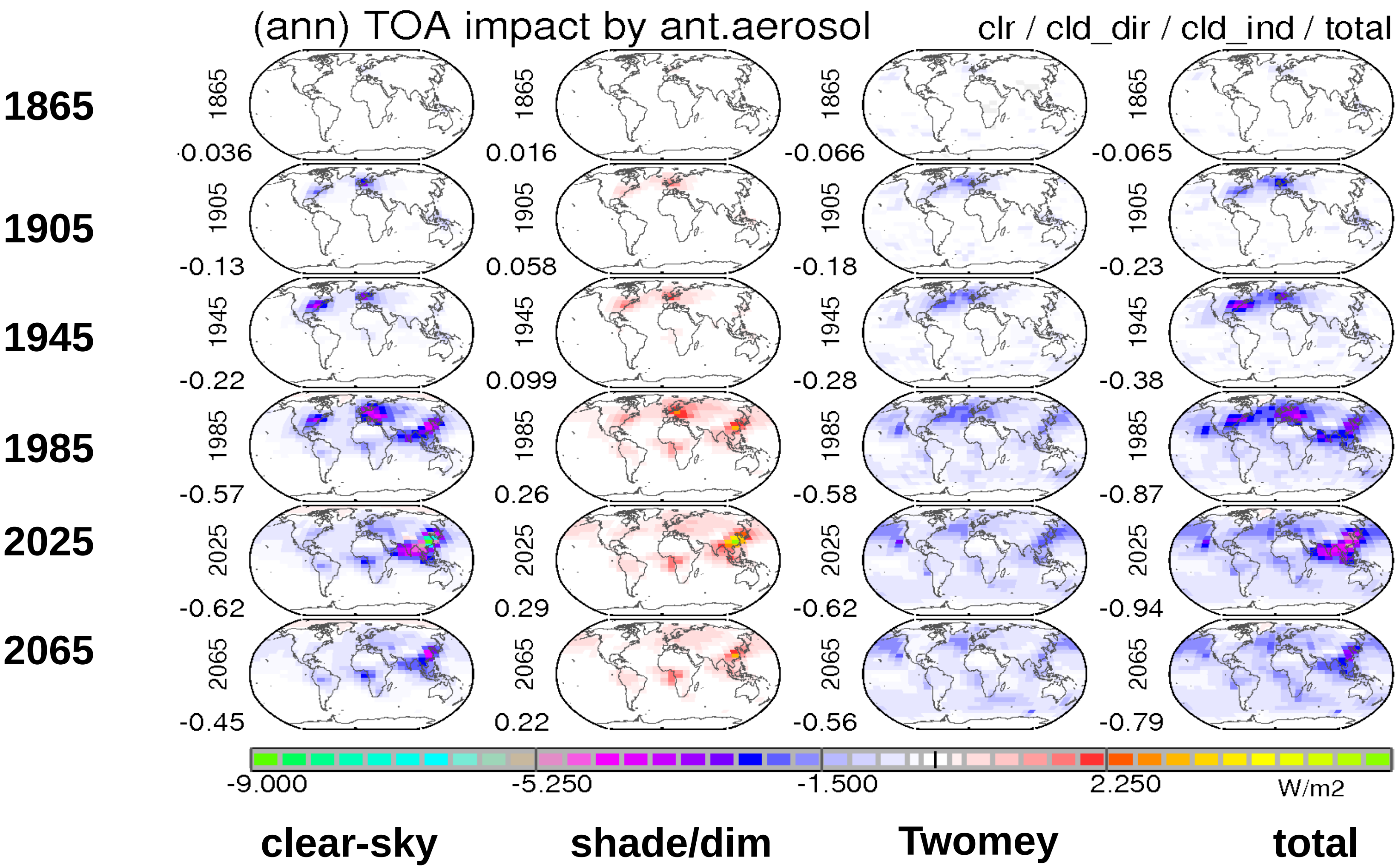
- only high cloud can warm the climate
  - …and warms the atmosphere
- liquid phase cools the climate strongest
  - … and also cools the atmosphere
- multi-layered clouds more frequent
  - … ISCCP misclassified as mid and low clouds
- too few super-cooled clouds in modeling (→ too much solar insolation) at high latitudes
  - … too southerly ITCZ locations

aerosol → clouds → radiation

- today's **anthropogenic aerosols cool** (climate)
  - lower TOA net-fluxes at all-sky conditions
- **clouds (indirect) add to clear-sky cooling**
  - **overall ca 40% stronger cooling at TOA**
  - **overall ca 20% stronger cooling at surface**
  - **reduction by cloud shading**
  - **reduction by allowing aerosol dimming (at TOA)**
  - **reduction by smaller drops / larger cld opt. dept**
- **dimming / brightening** (referred to as: local solar insolation changes over time at the surface)
  - **mainly caused by changes/shifts in anthropogenic aerosol**

ant aerosol TOA forcing
1865 - 2065

Kinne 2018, in prep



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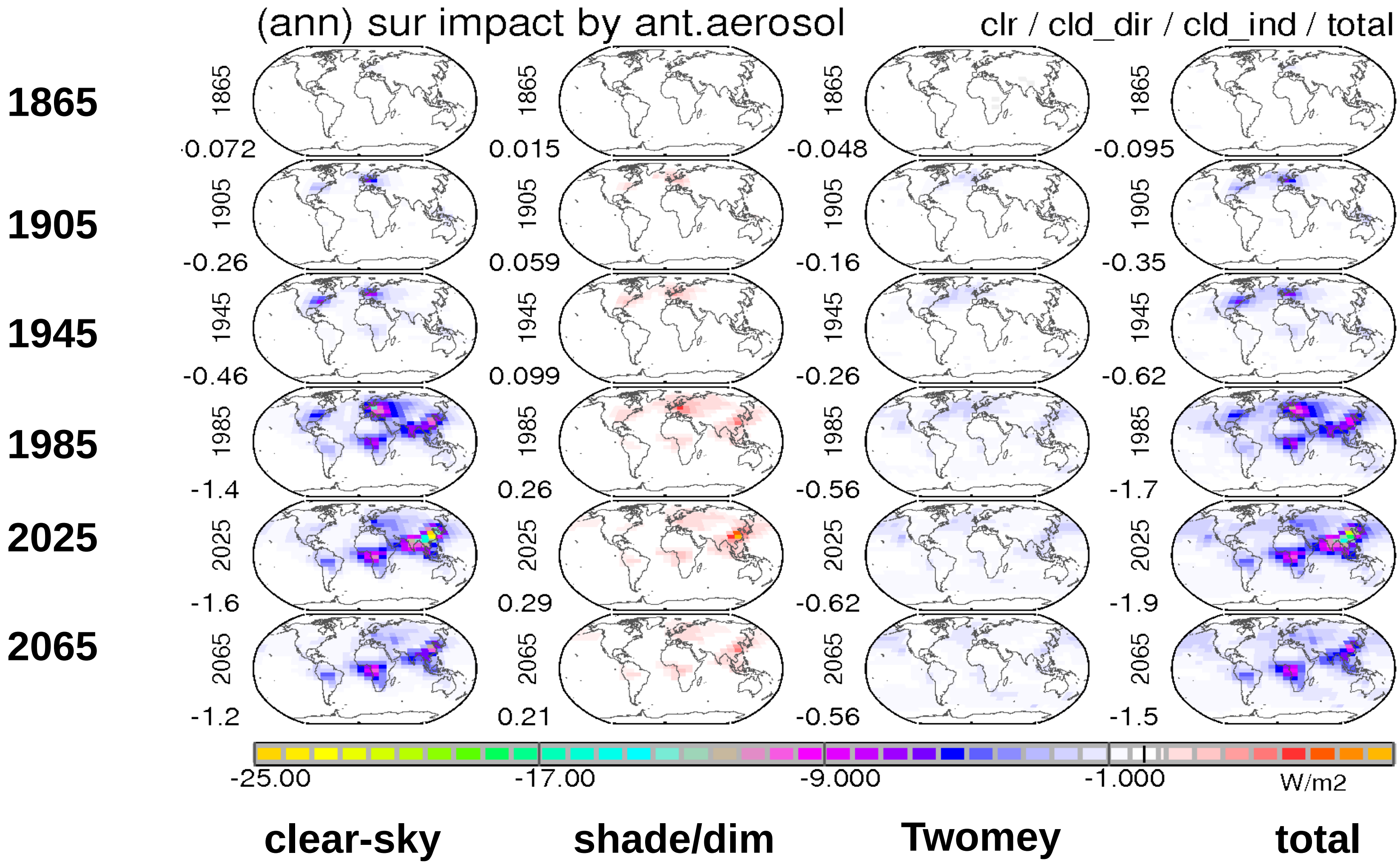
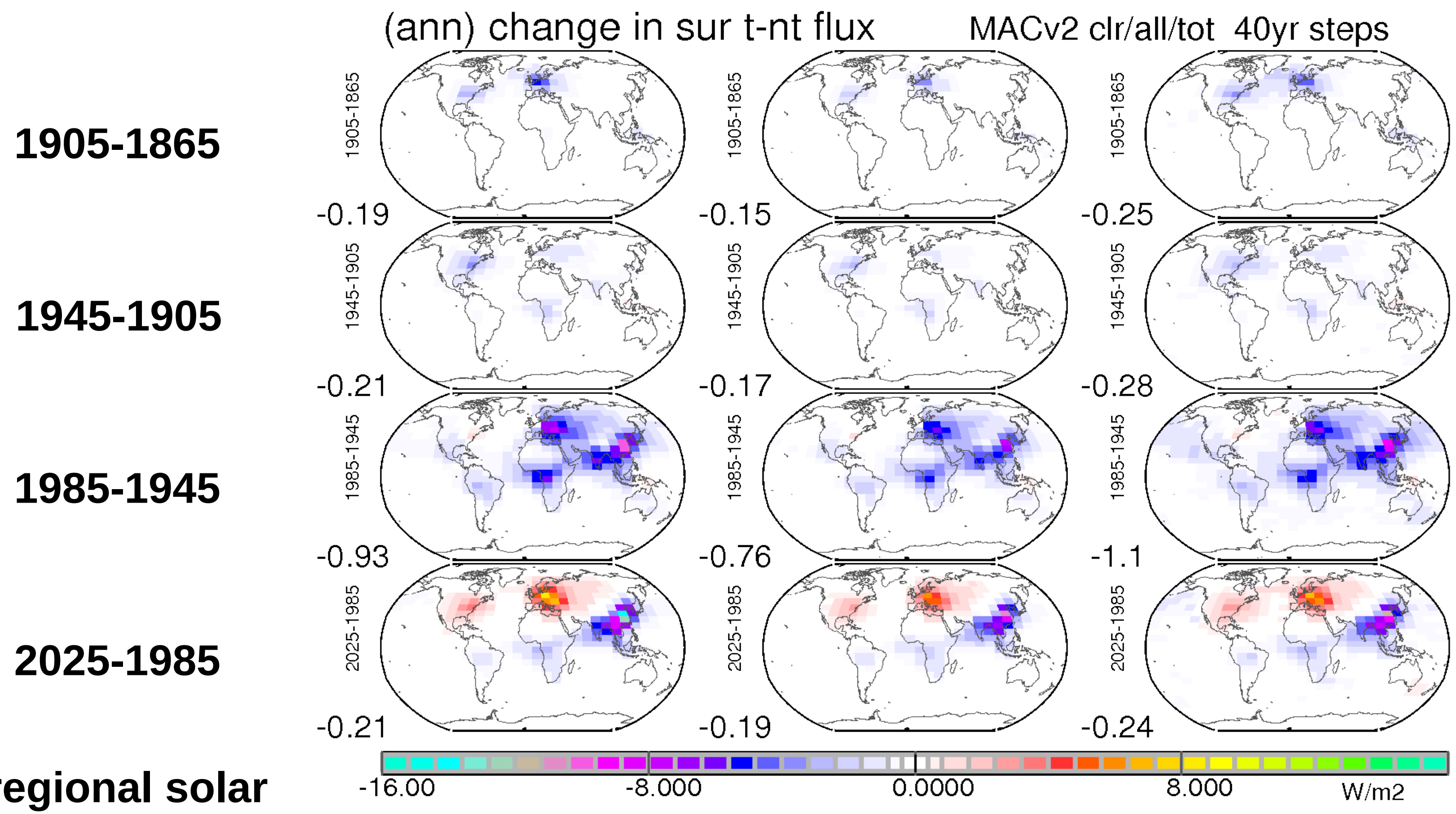
ant aerosol surf effects
1865 - 2065

Kinne 2018, in prep



regional in nature
dimming / brightening by aerosol

Kinne 2018, in prep



regional solar insolation change from changes in anthrop aerosol only (between years)

on aerosol and climate

- today's **climate** (TOA) **cooling: at -1 W/m2**
  - combined direct and indirect (via clouds) effects
  - has not changed much over last 30 years
  - unlikely to change much over next decades

- **strong regional shifts of maxima** though

  … with strong impacts on solar insolation

  - 1945-1985 dimming over EU, US, SE-ASIA
  - now-1985 continued dimming over SE-Asia
  - now-1985 brightening over EU, US

  … consistent with surface observations

on clouds (← aerosol) and climate

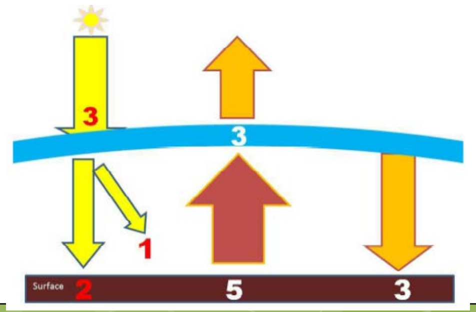
- clouds are modified by ant. aerosol
  - indirect effect: smaller drops / larger COT
    - most effective: in aerosol poor regions
- at TOA: indirect cooling > direct cooling
    - today: indirect -0.65 W/m2 direct (all-sky) -0.35 W/m2
- at sur: indirect cooling < direct cooling
    - today: indirect -0.65 W/m2 direct (all-sky) -1.6 W/m2
- in atm: only direct warming

miklos.zagoni @t-online.hu

fundamental relationships …
… in global flux averages ?

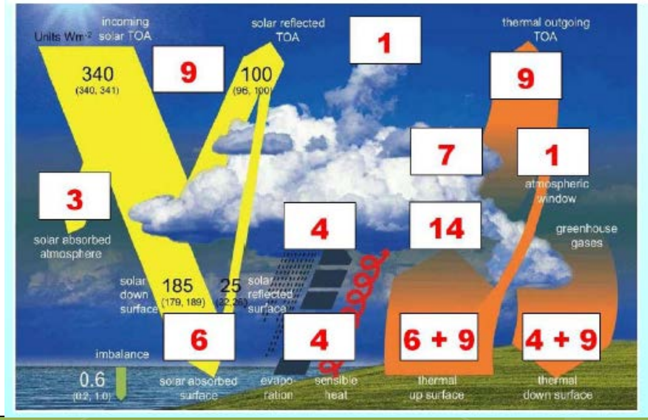
- global average radiative flux prop. are multiples of 26.6 W/m2 ?
- SW cloud radiative effects: 2 units
- LW cloud radiative effects: 1 unit

just a curiosity ?



conceptual approach →

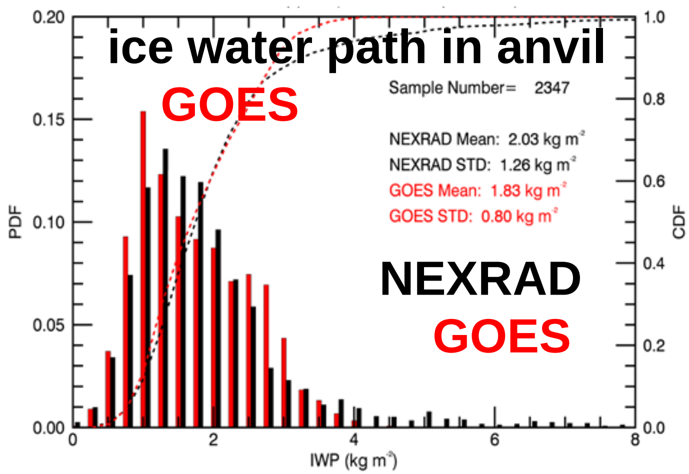
$1 = 26.6\ W/m^2$, $\Delta max(Wild\text{-}EdMZ) = -3.8\ W/m^2$ (DLR)



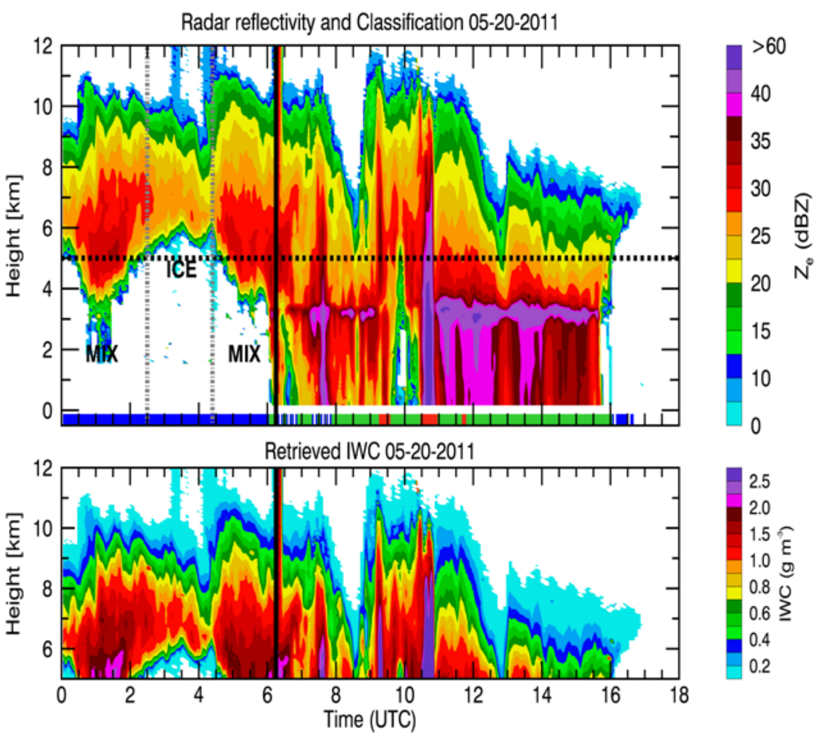
extra slides

ice in DCS

(deep convective systems)



- NEXRAD reflectivity and empirical relationships derived from in- situ data are used to retrieve IWC and IWP



Vertical distributions of S-band radar measured radar reflectivity and retrieved IWCs with DCS classification CSA (CC: **Convective Core**; SR: **Stratiform Rain**; AC_{thick}: **thick Anvil Cloud**).

Tian et al. (2018), Comparisons of ice water path in deep convective systems … to those of ground-based, GOES and CERES-MODIS retrievals. *JGR, https://doi.org/10.1002/2017JD027498*

role of wind-shear

Wu et al. (2017, JGR)

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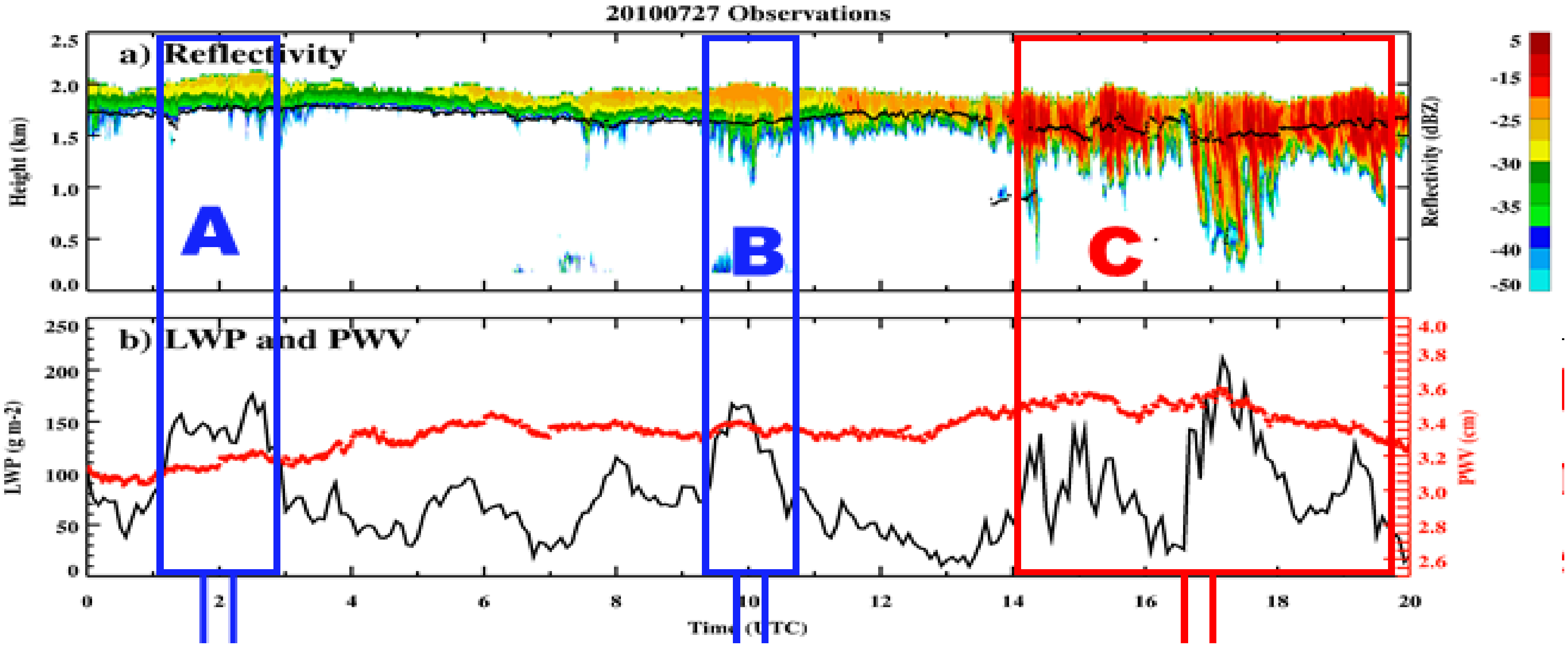
- wind-shear (in region C) enhances collision-coalescence processes in clouds for (faster) drizzle generation



CLOUDS & RADIATION

CMIP5 models vs 'data'

Dong et al.

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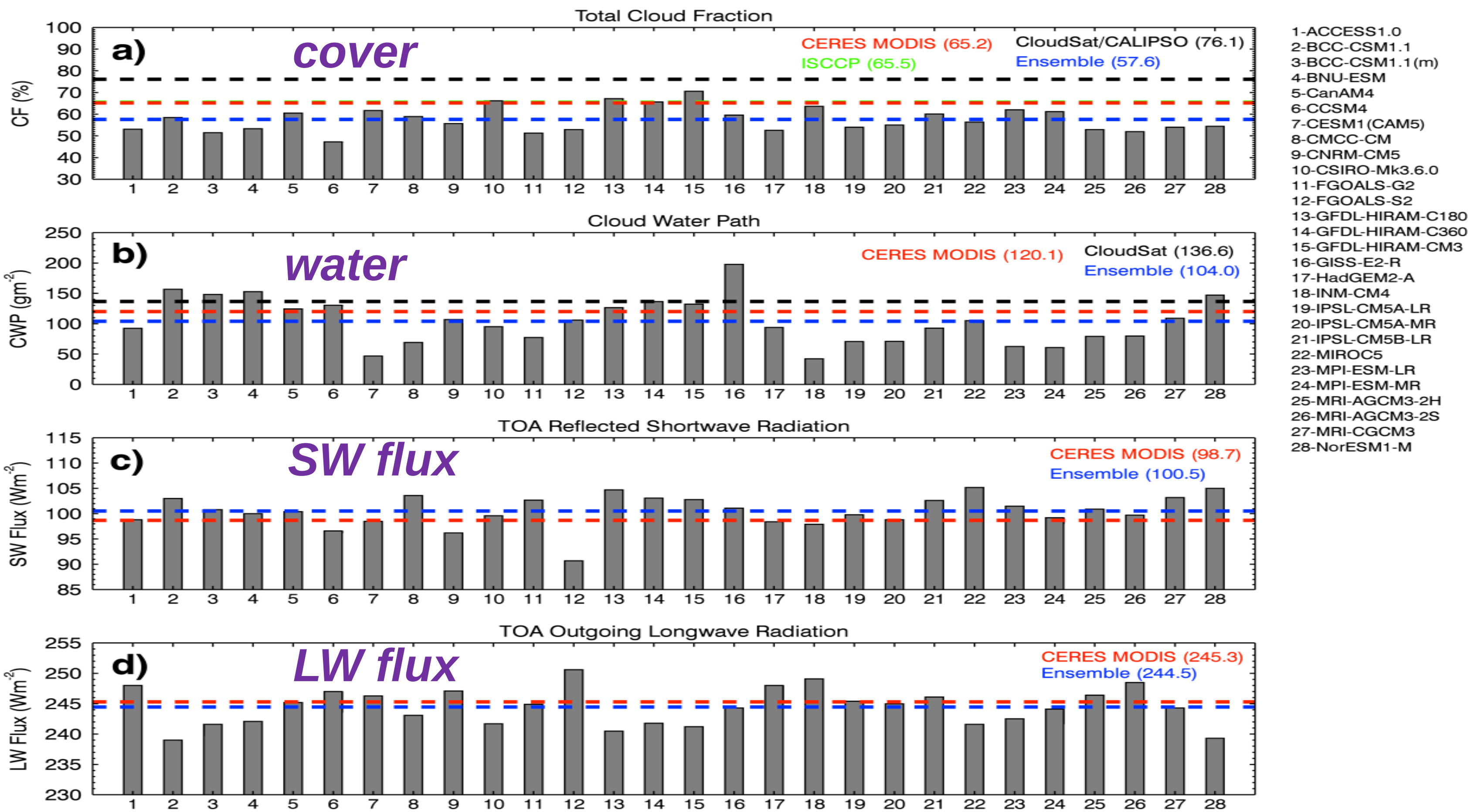
- comparing cloud cover & water / TOA fluxes



Teruyuki Nakajima, JAXA

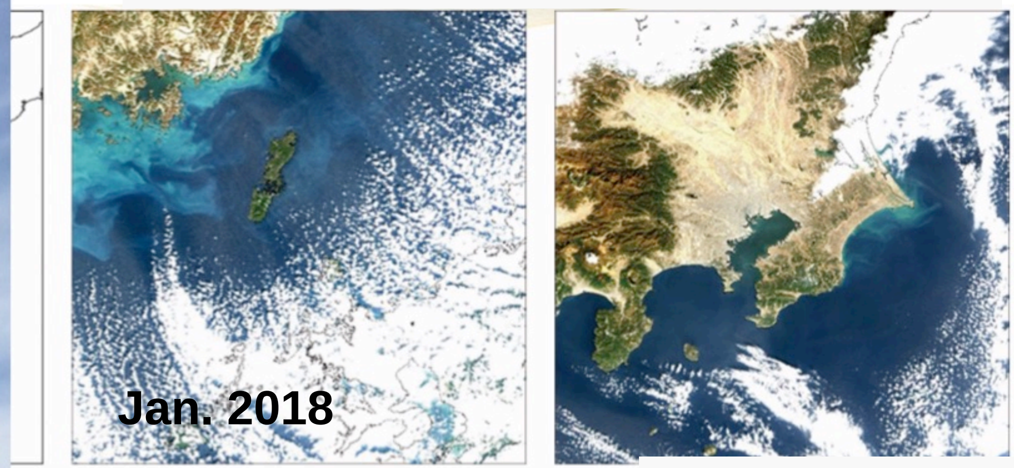
satellite mission plans …

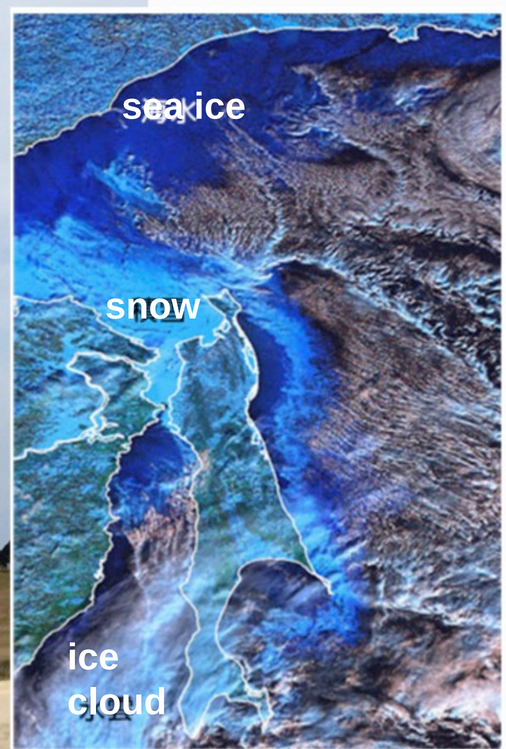
- **for understanding global scale climate change and water cycle mechanisms**
  - AMSR2 F/O 6-89/166/190GHz for solid hydrometeors
- **for forest biomass estimation**
  - combined vegetation lidar and L-band SAR.
- **for Short Lived Climate Pollutant reductions**
  - SLCP inventories via UV/VIS/SWIR＋MIR+MW
- **for understanding cloud/precip processes**
  - combined DPR and CPR measurements
- **for monitoring global environm. changes**
  - SGLI F/O and NUV-TIR imager

EARTHCARE **not** before 2022

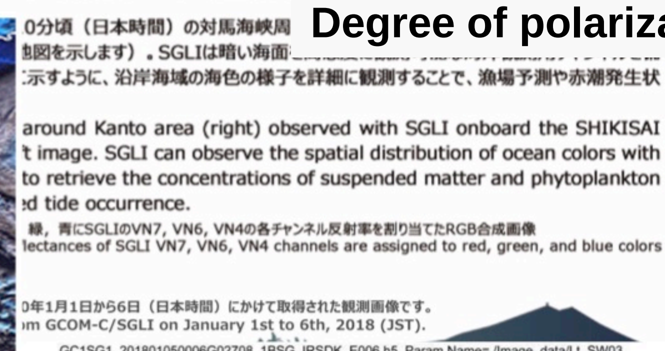
new capabilities with the GCOM-C satellite

Ocean and Land color around Japan





Degree of polarization

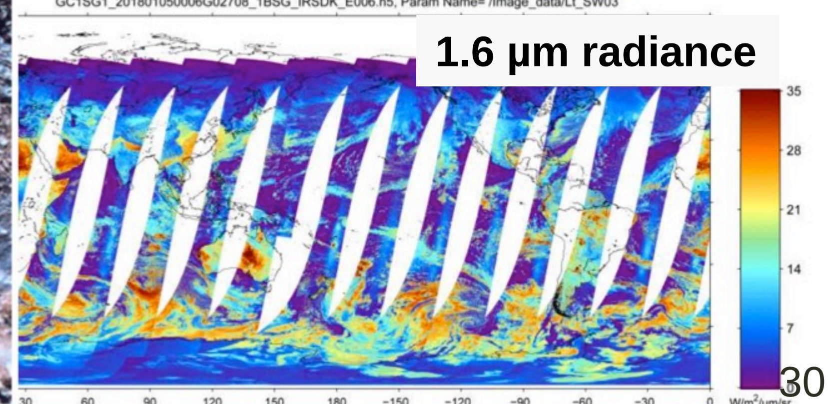

0分頃（日本時間）の対馬海峡周
地図を示します）。SGLIは暗い海面
示すように、沿岸海域の海色の様子を詳細に観測することで、漁場予測や赤潮発生状

around Kanto area (right) observed with SGLI onboard the SHIKISAI
t image. SGLI can observe the spatial distribution of ocean colors with
to retrieve the concentrations of suspended matter and phytoplankton
ed tide occurrence.

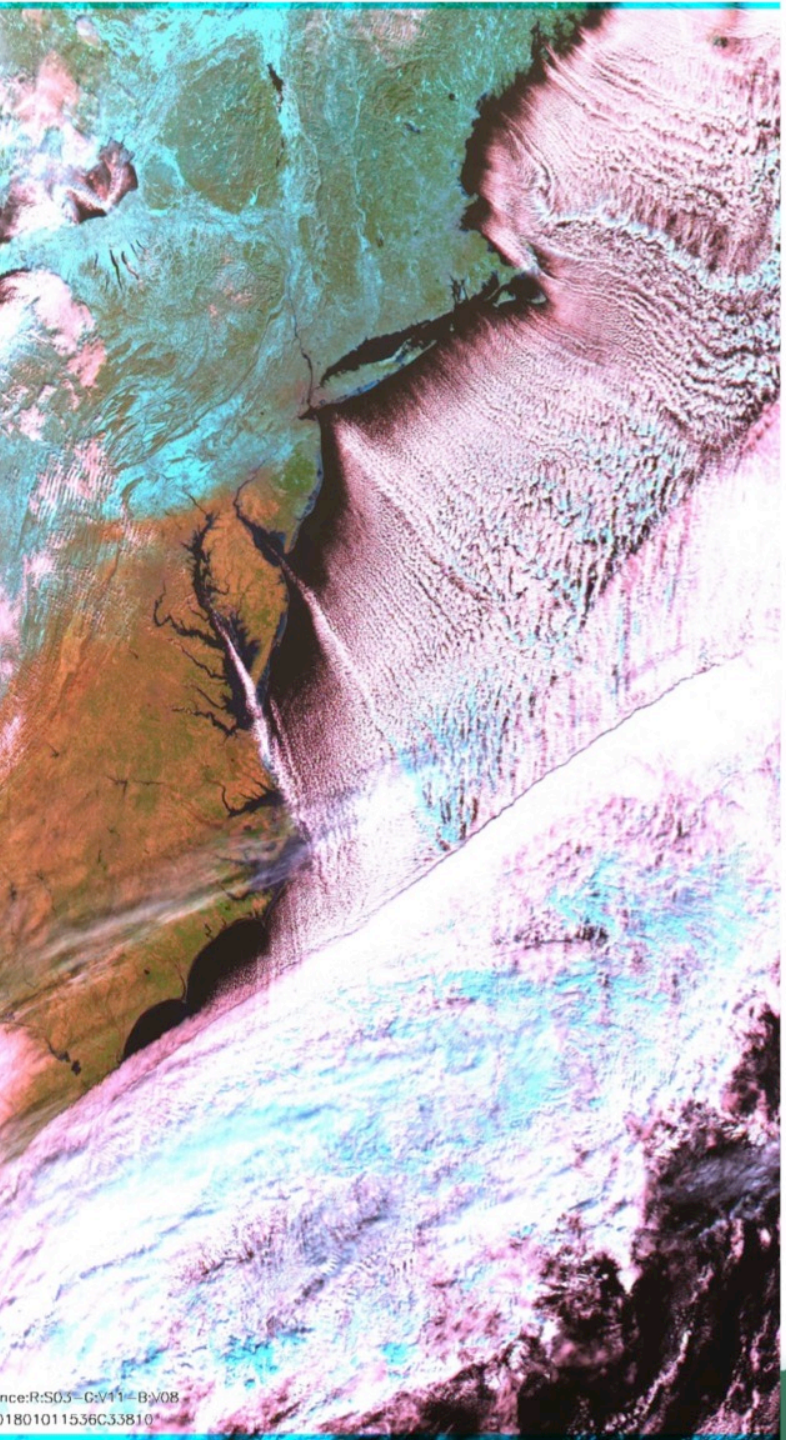
緑，青にSGLIのVN7, VN6, VN4の各チャンネル反射率を割り当てたRGB合成画像
lectances of SGLI VN7, VN6, VN4 channels are assigned to red, green, and blue colors

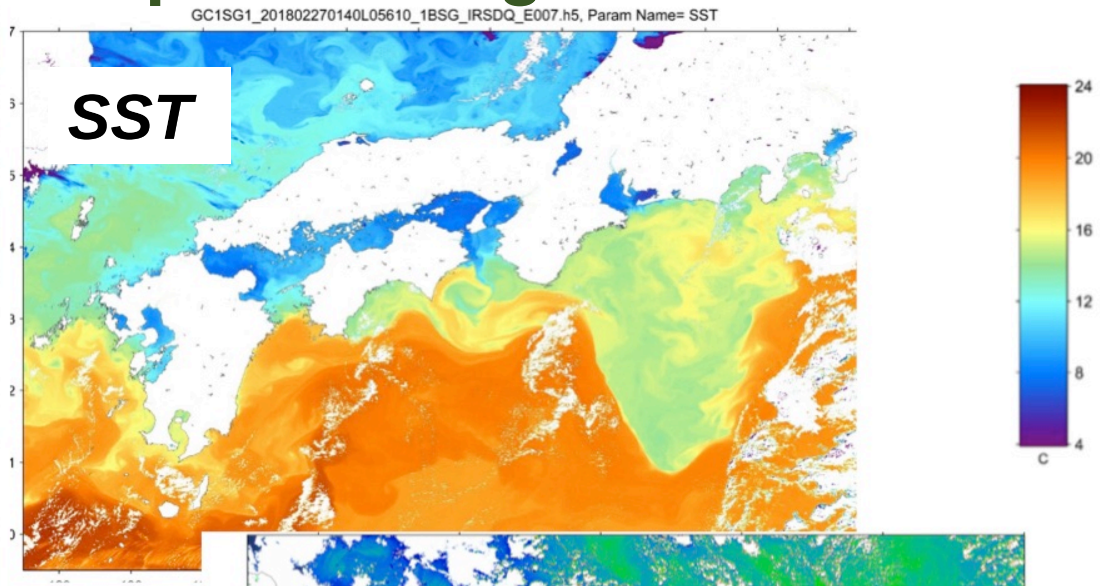
0年1月1日から6日（日本時間）にかけて取得された観測画像です。
m GCOM-C/SGLI on January 1st to 6th, 2018 (JST).

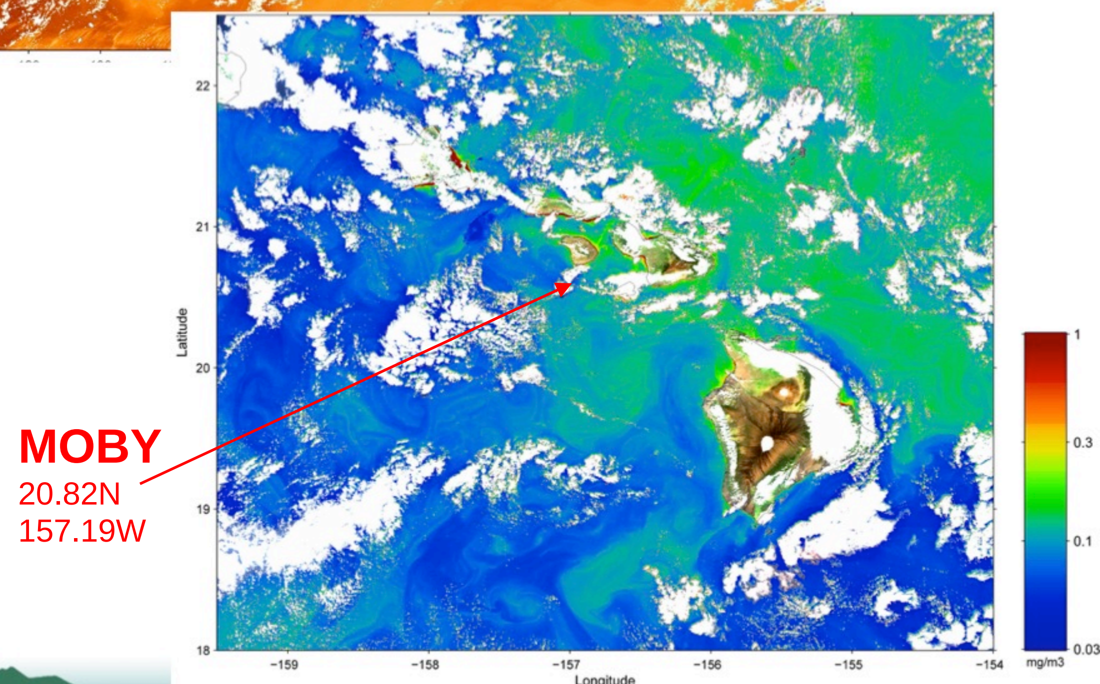
1.6 μm radiance



GCOM-C/SGLI acquired images





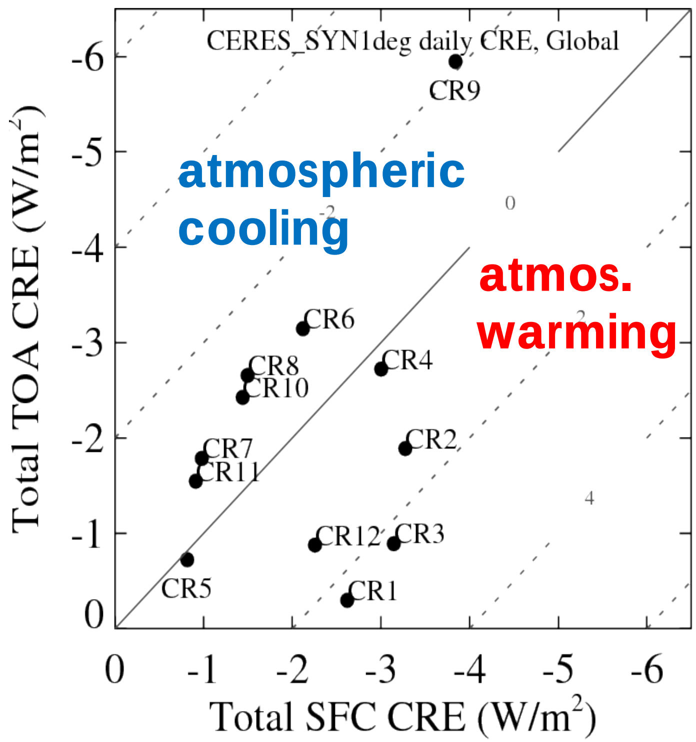


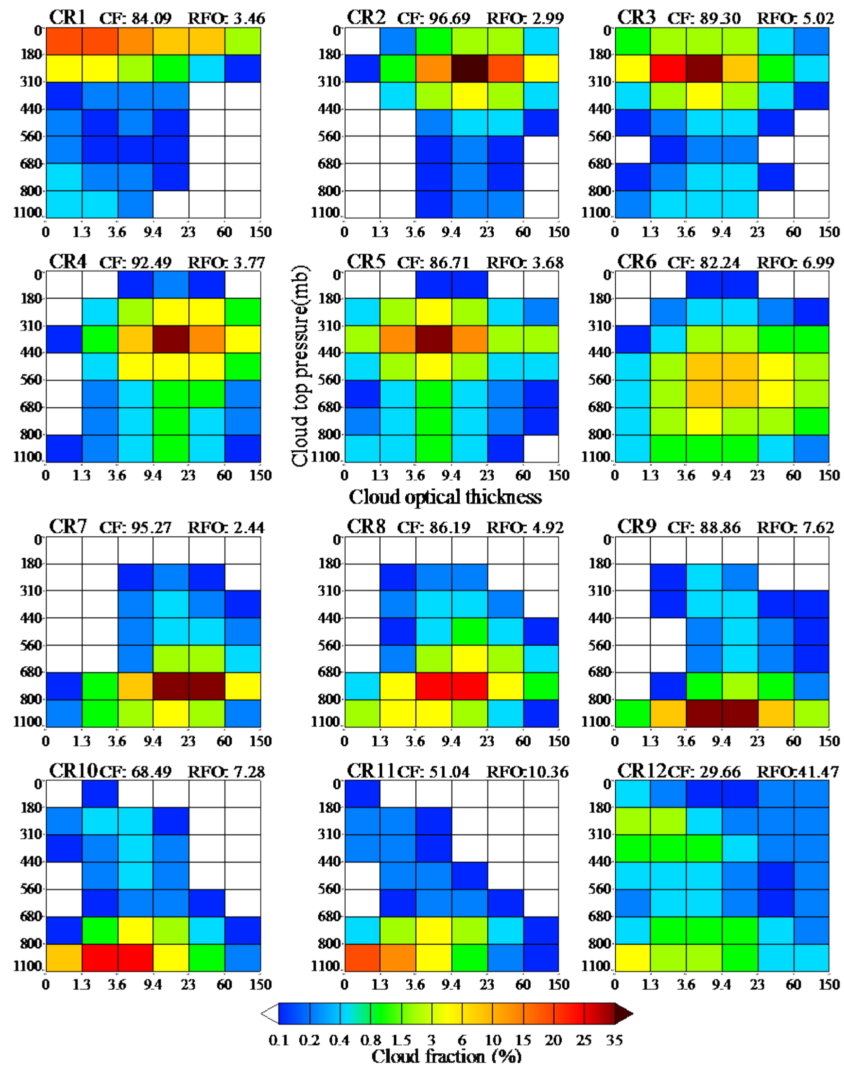
CLOUDS & RADIATION

CRE breakdown

by MODIS Cloud regimes

(into 12 clusters)





Oreopoulos et al. (2016)

IPRT - International working group on polarized radiative transfer

Claudia Emde and Bernhard Mayer

Meteorological Institute
Ludwig-Maximilians-University Munich
Germany

IRC business meeting, Vancouver, 10 July 2018

International Working Group on Polarized Radiative Transfer

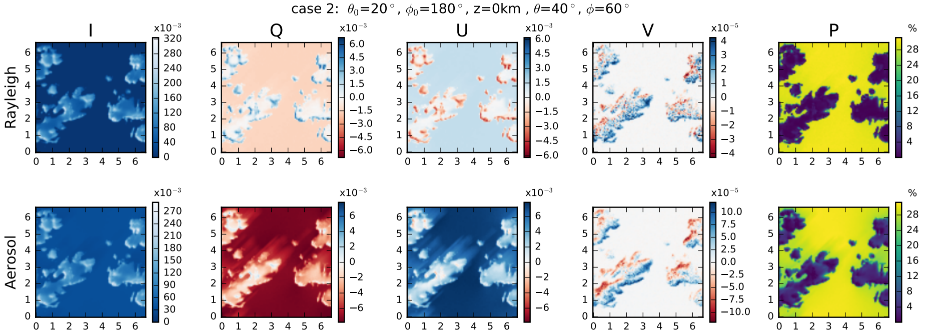
Aims of working group IPRT:

- bring the community together (workshops)
- **compare and improve models, 3D model intercomparison**
- **provide benchmark results**
- provide information about free codes
- develop new and faster, publically available codes
- provide input data (scattering matrices, BPDFs – bidirectional polarization distribution functions, ...)

Project website:
www.meteo.physik.uni-muenchen.de/~iprt

Model intercomparison for polarized radiative transfer in 3D geometry

- Test cases:
  - Step cloud
  - Cubic cloud
  - LES cloud scene



Participating 3D vector radiative transfer models

model name	method	geometry	references
3DMCPOL	Monte Carlo	1D/3D	Cornet et al. (2010), Fauchez et al. (2014)
MSCART	Monte Carlo	1D/3D	Wang et al. (2017)
MYSTIC	Monte Carlo	1D/3D[(a)]	Emde et al. (2010), Mayer (2009)
SHDOM	spherical harmonics discrete ordinate	1D/3D	Evans (1998)
SPARTA	Monte Carlo	1D/3D	Barlakas et al. (2016)

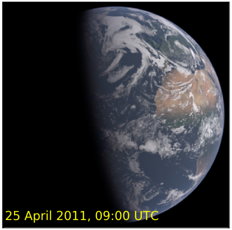
[(a)]MYSTIC includes fully spherical geometry for 1D and 3D.

Results and publication

- Results
  - Models agree mostly within expected accuracy
    (i.e. standard deviation for Monte Carlo codes)
  - Differences at cloud boundaries due to definitions of model grids
  - Several model errors identified and fixed!
  - Benchmark results established, available at IPRT website
- Publication:
  - C. Emde, V. Barlakas, C. Cornet, F. Evans, Z. Wang, L. C.-Labonotte, A. Macke, B. Mayer, and M. Wendisch.
    IPRT polarized radiative transfer model intercomparison project – Three-dimensional test cases (phase B).
    J. Quant. Spectrosc. Radiat. Transfer, 209:19-44, 2018.

Outlook - Polarized radiative transfer in fully spherical geometry

- Model intercomparison study in fully spherical geometry
- Particularly challenging for vector radiative transfer models using explicit methods (e.g. discrete ordinate or doubling-and-adding)
- Investigate accuracy of approximations
- So far no benchmark results exist!



Earth as seen by the moon, simulated with MYSTIC in fully spherical geometry.

IRC working group
Global Energy Balance (GEB)

Annual Report 2017-2018

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

2017 / 2018:

- **European Geophysical Union (EGU) General Assembly 2018**, Vienna, April 2018. Organization of the session "Earth radiation budget, radiative forcing and climate change", closely linked to the aims of this working group. (consecutive till 2006). Convenor Martin Wild. Solicited speaker: Norman Loeb
- **American Geophysical Union (AGU) General Assembly 2017**, New Orleans December 2017. Organization of the session "The Surface Energy Budget: Influences on Spatiotemporal Magnitude and Variability" Convenors: Arturo Sanchez, Martin Wild, Paul Stackhouse, Chuck Long.

Upcoming:

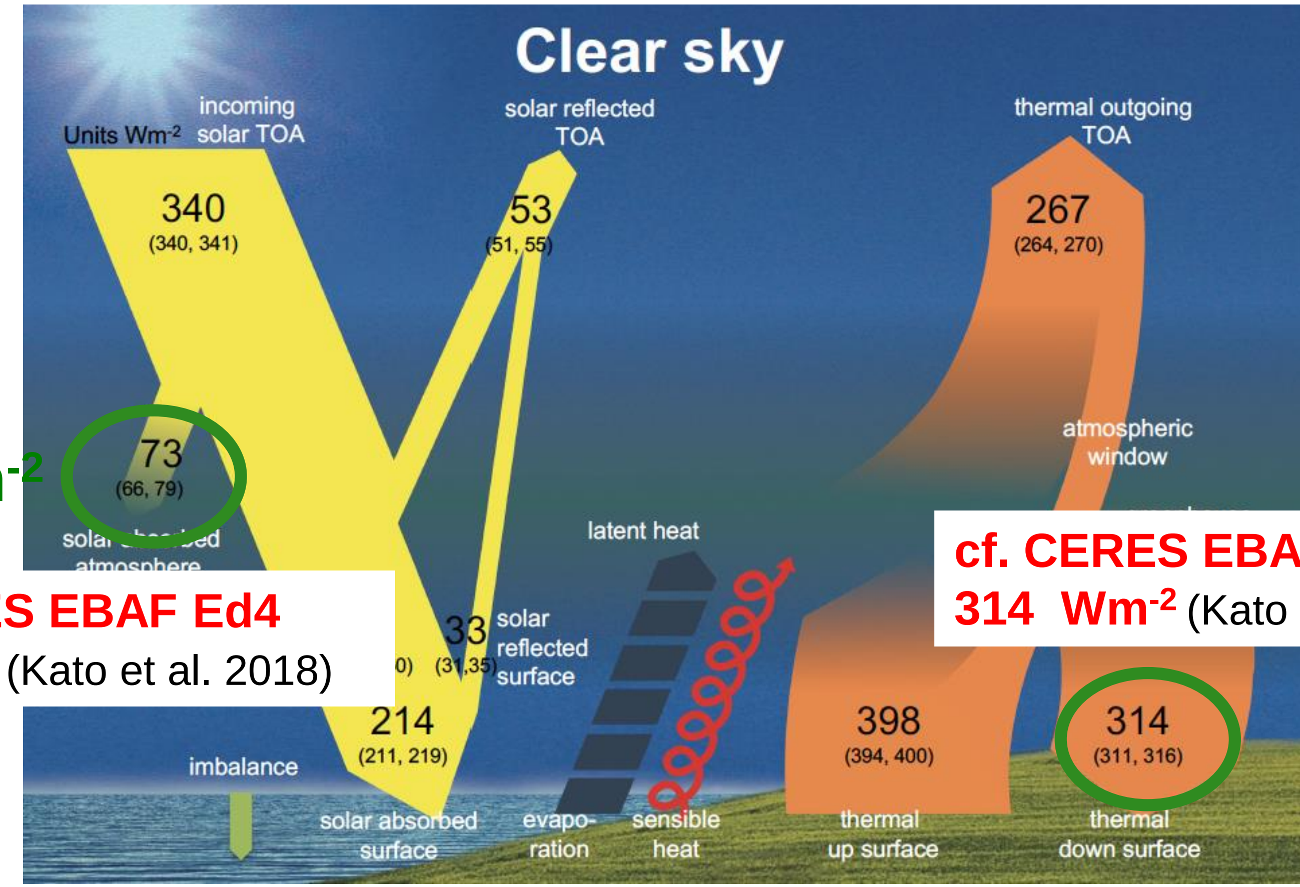
- **American Geophysical Union (AGU) General Assembly 2018**, Washington DC, December 2018. Organization of the session "The Surface Energy Budget: Influences on Spatiotemporal Magnitude and Variability"
- **IUGG 2019**, Montreal July 2019, Session M26 "Earth's energy budget" Convenors: Seiji Kato, Martin Wild, Norman Loeb

Activities: assignements

- 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".**

- WG-GEB Co-Chair Martin Wild has been assigned as a Lead Author of the **IPCC 6th Assessment report** for Chapter 7 "Earth Energy Budget, Radiative forcing and Feedbacks"

Example research: Global Energy Balance



73 Wm^{-2}

cf. CERES EBAF Ed4
73 Wm^{-2} (Kato et al. 2018)

cf. CERES EBAF Ed4
314 Wm^{-2} (Kato et al. 2018)

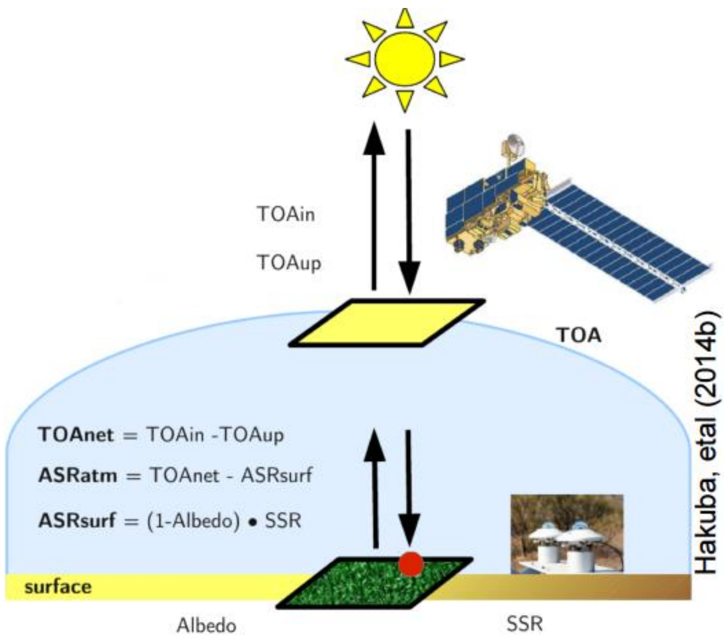
314 Wm^{-2}

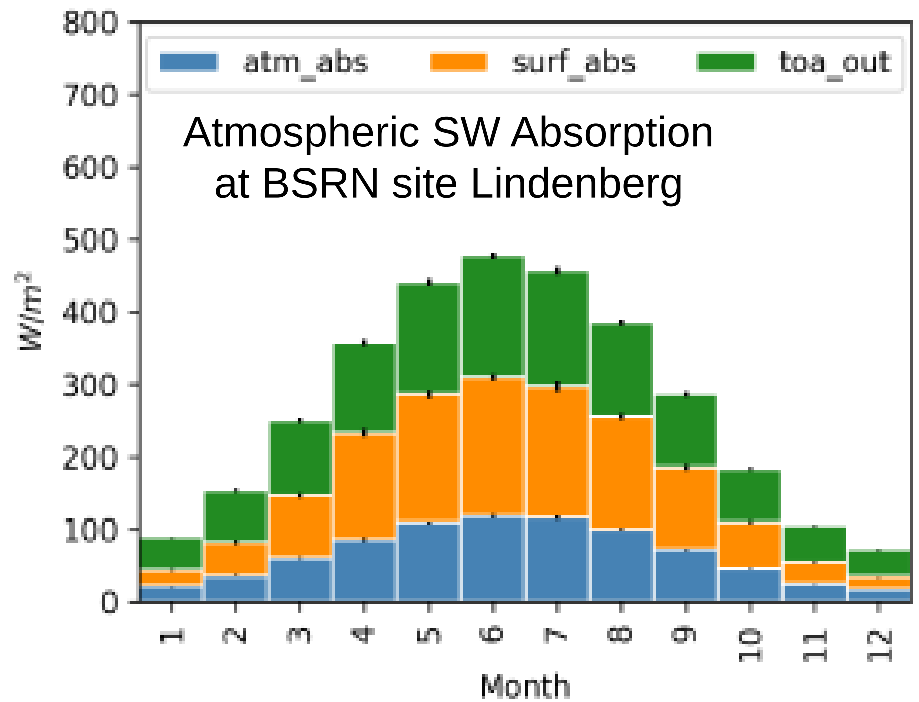
Consistent estimates from completely independent approaches improve confidence in magnitude of global energy balance

Wild et al, submitted

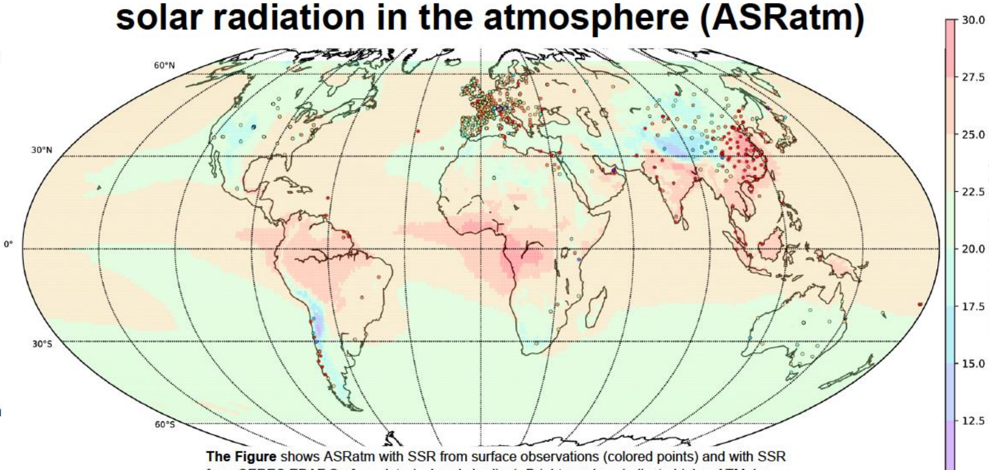
ETH Institute for Atmospheric and Climate Science

Example research: atmospheric absorption





Starting point – climatological mean absorption of solar radiation in the atmosphere (ASRatm)

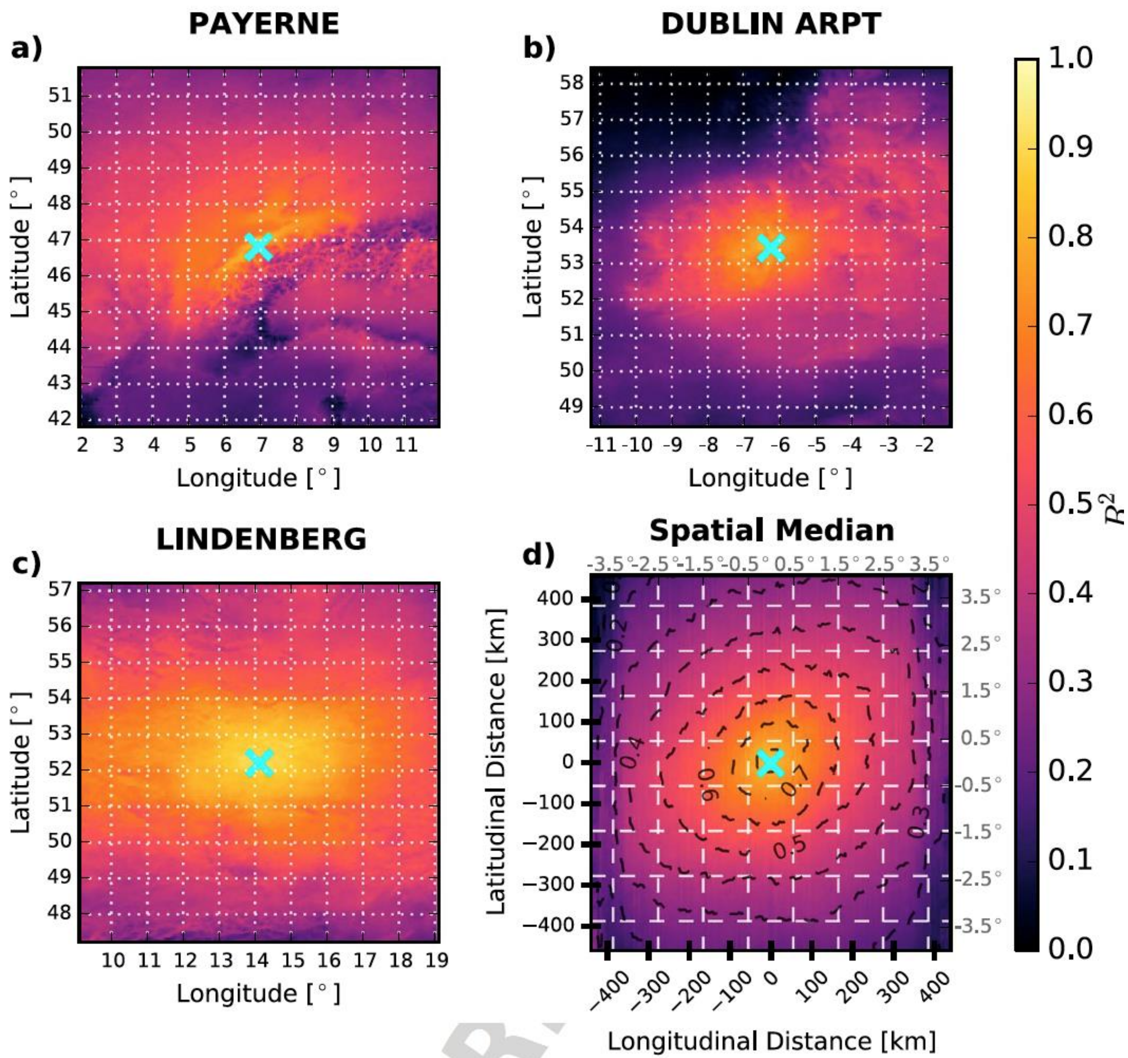


The Figure shows ASRatm with SSR from surface observations (colored points) and with SSR from CERES EBAF Surface data (colored shading). Brighter values indicate higher ATMabs.

> Poster 130
Matthias Schwarz

Example research: representativeness

How representative is a surface radiation site for its larger surounings?



Schwarz et al. 2017 JGR

ETH Institute for Atmospheric and Climate Science

Recommendations

Recommendations TOA aspects

Government agencies responsible for building the next generation of Earth Radiation Budget instruments should be urged to

- include onboard calibration equipment that can detect and correct for on-orbit contamination of optics.
- dedicate sufficient time for ground calibration activities.
- periodically re-verify the traceability of calibration targets on the ground.
- establish collaborations with other international agencies specializing in calibration standards (e.g., NIST, NRL).

The international community should provide guidance on the creation of Earth Radiation Budget climate data records. Earth Radiation Budget Climate Data Records capable of accurately characterizing climate at decadal time-scales are inherently more research data products than they are operational data products. While an operational approach works fine for processing weather data, far more rigor and quality assurance is necessary for climate data products, where reprocessing is an integral part of the effort.

Recommendations

Recommendations surface aspects

- Ensure a continued operation and maintenance of a well calibrated network of long term surface radiation stations to provide direct observations for satellite-derived products and model validation, and for the detection of changes in the radiation fields.
- High accuracy observation sites should be expanded to under-represented regions of the globe (low latitudes/ oceans). The use of newly available shortwave radiometers (SPN-1) suited for use in remote locations (buoys /ships) is recommended.
- Anchor sites should include direct and diffuse shortwave measurements in addition to total incoming shortwave along with standard surface meteorological measurements essential for radiation quality assessment.
- To improve surface albedo estimates over various surface types and for the assessment of satellite derived albedo products, high accuracy spectral and broadband measurements from towers are desirable at the anchor sites
- Atmospheric spectral optical depths should be observed to infer atmospheric column abundance of aerosol, ozone, water vapor and other atmospheric constituents.
- The spatial representativeness of surface anchor sites needs to be further assessed (Hakuba et al. 2013, 2014, Schwarz et al. 2018). Possible urbanization effects (impact of local air pollution) in surface solar radiation records needs quantification.
- Letters of support from the International Radiation Commission to National agencies funding BSRN stations may help to raise the recognition of the importance of such anchor sites. A letter of support from the IRC for the continuation of the radiation measurements at sites operationally struggling and/or at risk of being shut down may therefore be helpful.

Recommendations

Request by WG-GEB member Chuck Long

A letter of IRC to GDAP, GCOS, WCRP, and GEWEX stating the importance for BSRN representatives (project manager, archive director) to attend meetings such as IRC, GCOS, GEWEX, NDACC business meetings, where BSRN is listed as partner networks, participating networks, members of working groups, in order to facilitate travel support.

Contacts:

GDAPChair Rémy Roca (Remy.Roca@legos.obs-mip.fr) and Co-Chair TristanL'Ecuyer (tlecuyer@wisc.edu)
GCOS Carolin Richter (crichter@wmo.int)
GEWEX Peter J. van Oevelen (gewex@gewex.org)
WCRP (wcrp@wmo.int)

CIRC update

(by Lazaros Oreopoulos and Eli Mlawer)

- Dormant for a while now
- RT Community still active
    - e.g., recent ECMWF workshop on RT in NWPs:
        - optical and macrophysical properties of clouds and aerosols
        - gaseous absorption
        - solvers and efficiency
        - complex surfaces
        - beyond the stratosphere
        - evaluation and data assimilation.
- Has moved on to other RT intercomparison efforts
- Funding model in US not optimal for leading community efforts outside academia
- Last CIRC-related activity was Pincus et al. 4xCO2 forcing assessment using CIRC clear-sky cases (JGR, 2015, 15 citations in WOS)
- CIRC papers citation status (WOS)
    - BAMS 2010, 21 citations
    - JGR 2012, 55 citations
- We recommend to sunset the CIRC IRC WG

Proposal for a new IRC WG

(by Eli Mlawer and Lazaros Oreopoulos)

- “RT intercomparisons”
- Can encompass a variety of current and planned efforts (1D-3D, spectral-BB-polarized, GCM-assimilation-satellite) or be limited to 1D BB GCM-relevant (to not overlap with other WG IRC wants to preserve)
- IRC does not organize, define or oversee efforts within WG; rather advocates, advertises and encourages community participation
- WG chair(s) have good connections in RT community and actively seek updates from the leads of the efforts
- WG chair(s) provide regular updates to IRC and recommend ways IRC can help promote efforts
- Example of effort under “RT intercomparisons”: RFMIP (Pincus presentation)

Working Group-Ultraviolet Radiation

Co-chairs: Julian Gröbner and Ann Webb

Members: A. Bais, L. Egli, M. Blumthaler

MANCHESTER 1824
The University of Manchester

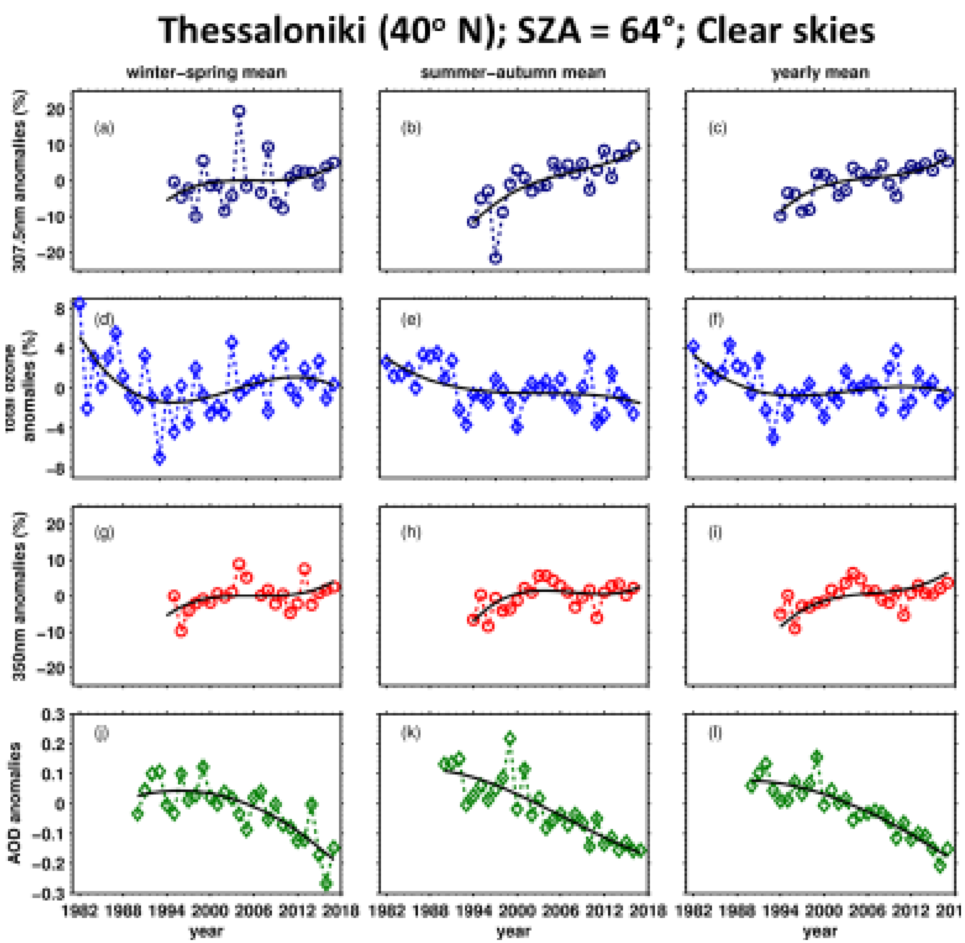
pmod wrc

Overview of Activities 2017/2018

- 2nd International UV Filter Radiometer calibration at PMOD/WRC
- ECUVM –
  European Conference on Solar UV Monitoring, 12-14 September 2018, Vienna, AT.
- Joint WMO UV & Ozone Scientific Advisory Group meeting, 24-25 May, 2018
- UNEP - United Nations Environment Programme :

  UNEP EEAP Quadrennial Report on “Environmental Effects of Ozone Depletion and Interactions with Climate Change - 2018” has several chapters on solar UV radiation and effects
  -> currently under review

A recently published UV trend result



1992 – 2017

- UV-B irradiance (307.5 nm) is increasing due mainly to decreasing aerosols. Ozone affects the short-term variations.
- Total ozone has stabilized since ~1990 to about 3% below its values in the early 1980s.
- Increases in UV-A (350 nm) are smaller. Negligible effect of ozone, smaller effect of aerosols
- The aerosol optical depth decreases steadily with higher rates after ~2000.

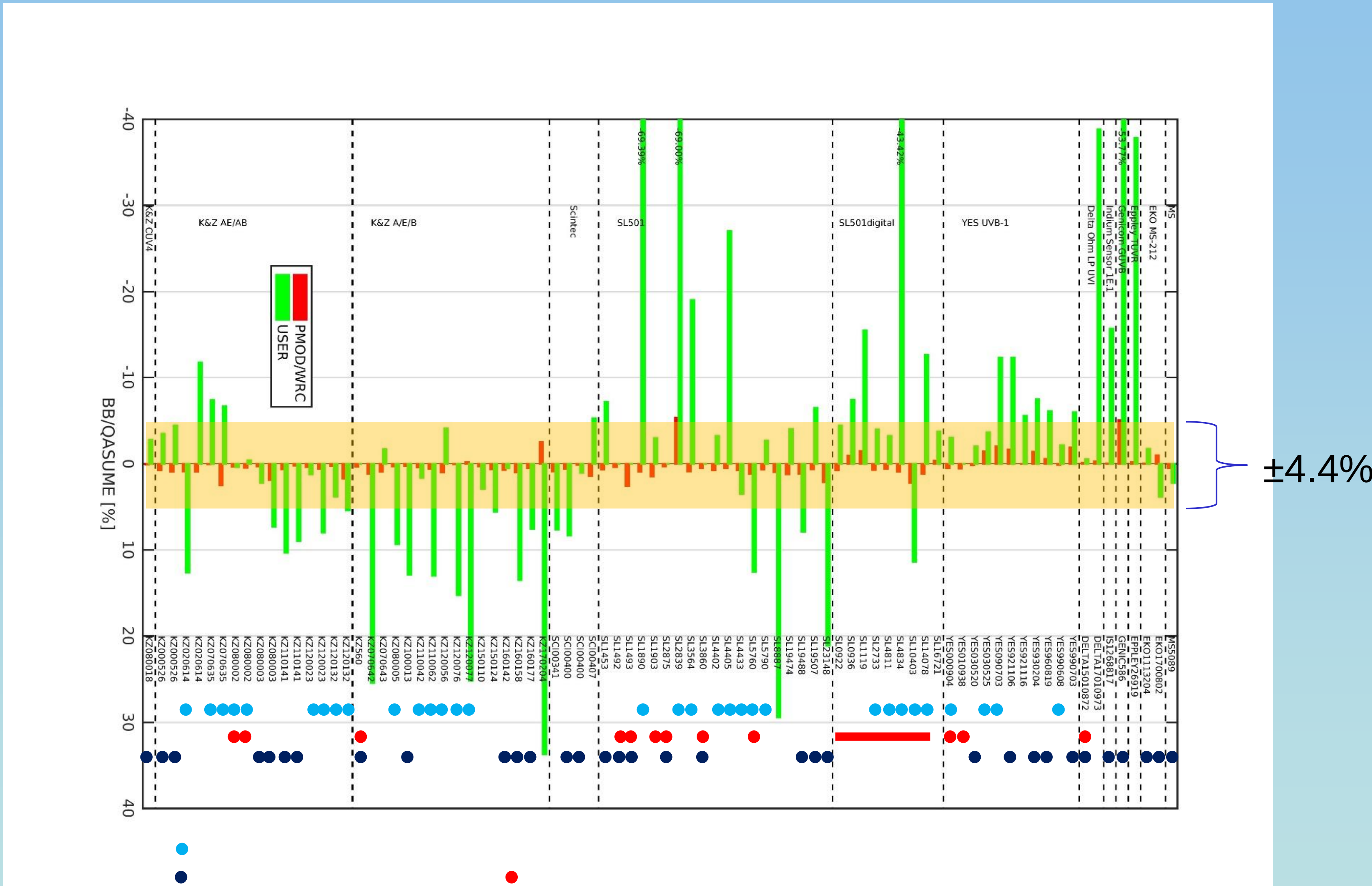
Update from Fountoulakis et al 2016, ACP

Included in the UNEP assessment

2nd International UV Filter Radiometer calibration campaign UVC-II 25 May – 5 October 2017

Input Optics of the two reference spectroradiometers QASUME and QASUMEII

UVC-II result



32 Instruments within combined expanded uncertainty of 4.4%

Summary UVC-II

1) Large number of participants from all WMO regions.
2) Low uncertainties are only achieved by applying the full radiometric equation,
3) Radiometers degrade faster than the typical calibration frequency
4) Some radiometers lack proper basic maintenance (silicagel, cleaning, …)

Published as WMO GAW report Nb. 240

UVC-III is planned for 2022

Some recent publications on UV radiation

- 12 extended proceedings from the 2016 IRS Symposium
- Fountoulakis et al., 2018, Temperature dependence of the UV Brewer global UV measurements, AMT, 2018
- Zempila et al., Validation of OMI erythemal doses with multi-sensor ground-based measurements in Thessaloniki, Greece, Atm. Env., 2018
- Lakkala et al., Performance of the FMI cosine error correction method for the Brewer spectral UV measurements, AMTD 2018
- McKenzie et al., Critical Appraisal of Data Used to Infer Record UVI in the Tropical Andes, Photochem. Photobiol. Sci., 2017,
- Meelis-Mait et al., LED-based UV souce for monitoring spectroradiometer properties, Metrologia, 2018.
- Gröbner et al., The high-resolution extraterrestrial solar spectrum (QASUMEFTS) determined from ground-based solar irradiance measurements, AMT, 2017.
- Schmalwieser, et al., UV Index monitoring in Europe, Photochem. Photobiol. Sci., 2017.

International Coordination-group for Laser Atmospheric Studies (ICLAS) Working Group Report for 2015-2017

Alex PAPAYANNIS, ICLAS P*resident*
National Technical University of Athens, Greece
Upendra N. SINGH, *Past ICLAS President*
NASA Langley Research Center, Hampton, VA, USA

- ICLAS: Promotes the development and application of laser sensing techniques and laser instrument architectures used to study the atmospheres of the Earth and other planets.
- ICLAS: Takes care of the promotion and organization of the International Laser Radar Conferences (ILRCs), gathering the laser remote sensing community and are convened every 2 years. The ILRCs are held under the auspices of the ICLAS.

ICLAS

ICLAS is composed of:

- The President, who is the WG Chairman
- The Working Group
- The Executive Committee

- ➢ The term of office of the President shall be six years
- ➢ The Working Group members shall have six-year terms
- ➢ Approximately 13 members with 6-year terms
- ➢ Committee meets at the ILRC Conference site every two years
- ➢ Candidates are proposed and selected seeking to achieve a reasonable balance in their geographical and professional distribution
- ➢ Executive Committee members include, President, Past President, with six year term and Treasurer with no term limitation
- ➢ The Executive Committee in consultation with ICLAS members elects new members and selects the winners of different awards, including Inaba Prize, Lifetime Achievement Award and various oral and poster awards

ICLAS

President		
Upendra SINGH	U.S.A.	2008-2015
Alex PAPAYANNIS	GREECE	2015-2021
Working Group Members		
Doina NICOLAE	Romania	2010-2016
Thomas McGEE	U.S.A.	2010-2016
Kohei MIZUTANI	Japan	2010-2016
Yingjian WANG	China	2010-2016
Ferdinando De TOMASI	Italy	2012-2018
Georgios TZEREMES	European Space Agency	2017-2023
Fred MOSHARI	U.S.A.	2017-2023
Dave Donovan	THE NETHERLANDS	2017-2023
Dong LIU	CHINA	2017-2023
Kevin STRAWBRIDGE	CANADA	2012-2018
Eduardo LANDULFO	BRAZIL	2012-2018
Sergey BOBROVNIKOV	RUSSIA	2012-2018
Fabien GIBERT	FRANCE	2012-2018
Makoto ABO	JAPAN	2012-2018
Shoken Ishii	JAPAN	2017-2023
Dimitrios BALIS	GREECE	2015-2021
Xinzhao CHU	U.S.A.	2015-2021
Andreas FIX	GERMANY	2015-2021
Executive Committee (includes current President)		
Outgoing President	Upendra SINGH (U.S.A.)	2015-2021
Treasurer	Tom McGee (U.S.A.)	No term limit

Report on the 27th International Laser Radar Conference (ILRC)

• 5-10 July 2015, New York, U.S.A. (http://ilrc27.org)
• 267 attendees – 27 countries (211 regular members and 56 students)
• Conference co-chairs: Prof. Dr. Fred Moshary and Prof. Dr. Barry Gross
• 302 submitted papers (92 oral and 210 posters), with the paper summaries (extended abstracts) published in a USB stick
• 14 oral sessions, plus 2 keynote presentations and 13 poster sessions
• Prior to its official start, on 4 July 2012 the second free lidar course for beginners was organized onsite.
• In total 40 travel grants were provided to students to attend this ILRC.

Report on the 28th International Laser Radar Conference (ILRC)

- 25-30 June 2017, Bucharest, Romania (http://ilrc28.inoe.ro)
- 353 attendees – 31 countries (259 regular members and 94 students)
- Conference co-chairs: Dr. Doina, INOE, Romania
- 299 submitted papers (93 oral and 206 posters), with the paper summaries (extended abstracts) published in USB stick
- 11 oral sessions, plus 8 keynote/invited presentations and 10 poster sessions
- On the 1st day of the Conference 25 June 2017 the 3rd free lidar course for beginners was organized onsite
- In total 62 travel grants were provided to students to attend this ILRC

Acknowledgements for Supporting Students, Junior and Senior Scientist's Travel to ILRC

- **Dr. Jack Kaye,** Associate Director, Science Mission Directorate, NASA HQ
- **Mr. George Komar,** Program Director, Earth Science Technology Office, NASA GSFC
- **Dr. Milton Huffaker,** President, Coherent Investments, USA
- **Laser Radar Society of Japan**
- **ILRC Organizing Committees**

Radiative Forcing MIP

One of the motivating questions for CMIP6 is "how does the Earth system respond to forcing?" But effective radiative forcing varies among models and has not been well understood in previous experiments.

RFMIP seeks to characterize ERF for CMIP, understand how differences in this forcing arise between models, and identify robust responses to aerosol forcing

Atmosphere-only fixed-SST simulations to characterize effective radiative forcing.

Complementary efforts to assess parameterization errors in instantaneous radiative forcing for greenhouse gases and aerosols

Coupled simulations using CMIP6 specification of aerosol optical properties for hypothesis testing, detection and attribution

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- Atmosphere-only simulations to characterize effective radiative forcing.
- Complementary efforts to understand parameterization errors in instantaneous radiative forcing for greenhouse gases and aerosols
- Coupled simulations using CMIP6 specification of aerosol optical properties for hypothesis testing, detection and attribution

RFMIP-IRF-GHG

Errors in aerosol-free clear-sky greenhouse gas *instantaneous radiative forcing* rely on off-line radiative transfer calculations with specified atmospheric conditions

Assessment on the global scale requires reference calculations for a much wider range of atmospheric and surface conditions than in past exercises.

We are providing (and soliciting) benchmark calculations with line-by-line models. These require substantially higher spectral resolution than do exercises aimed at aerosol IRF.

For many benchmark models global calculations are impractical. They are also unnecessary, especially for cloud- and aerosol-free skies, because profiles don't vary much.

Sampling to reproduce global-mean forcing

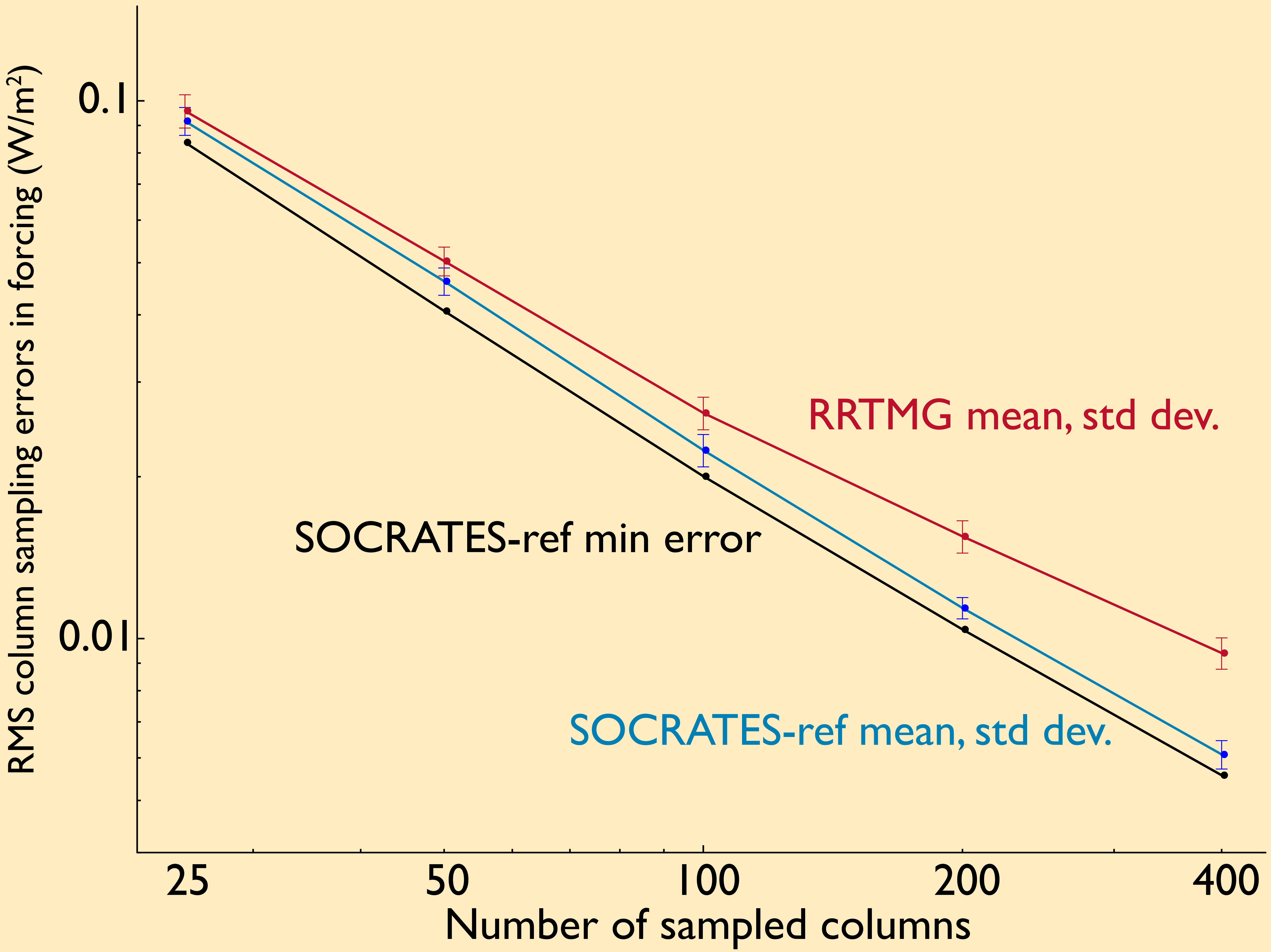
RFMIP uses 100 columns as a compromise between accuracy and computational cost.

Sampling errors are small: sampling error in the global mean forcing at present-day is 0.6% for LW at TOA and 0.2% for surface downwelling SW.

Using a wide range of perturbations and several latitude bands makes the sampling robust (e.g. to the model being used). 95th percentile errors across perturbations etc. remain < .02 W/m^2 for global mean calculations.

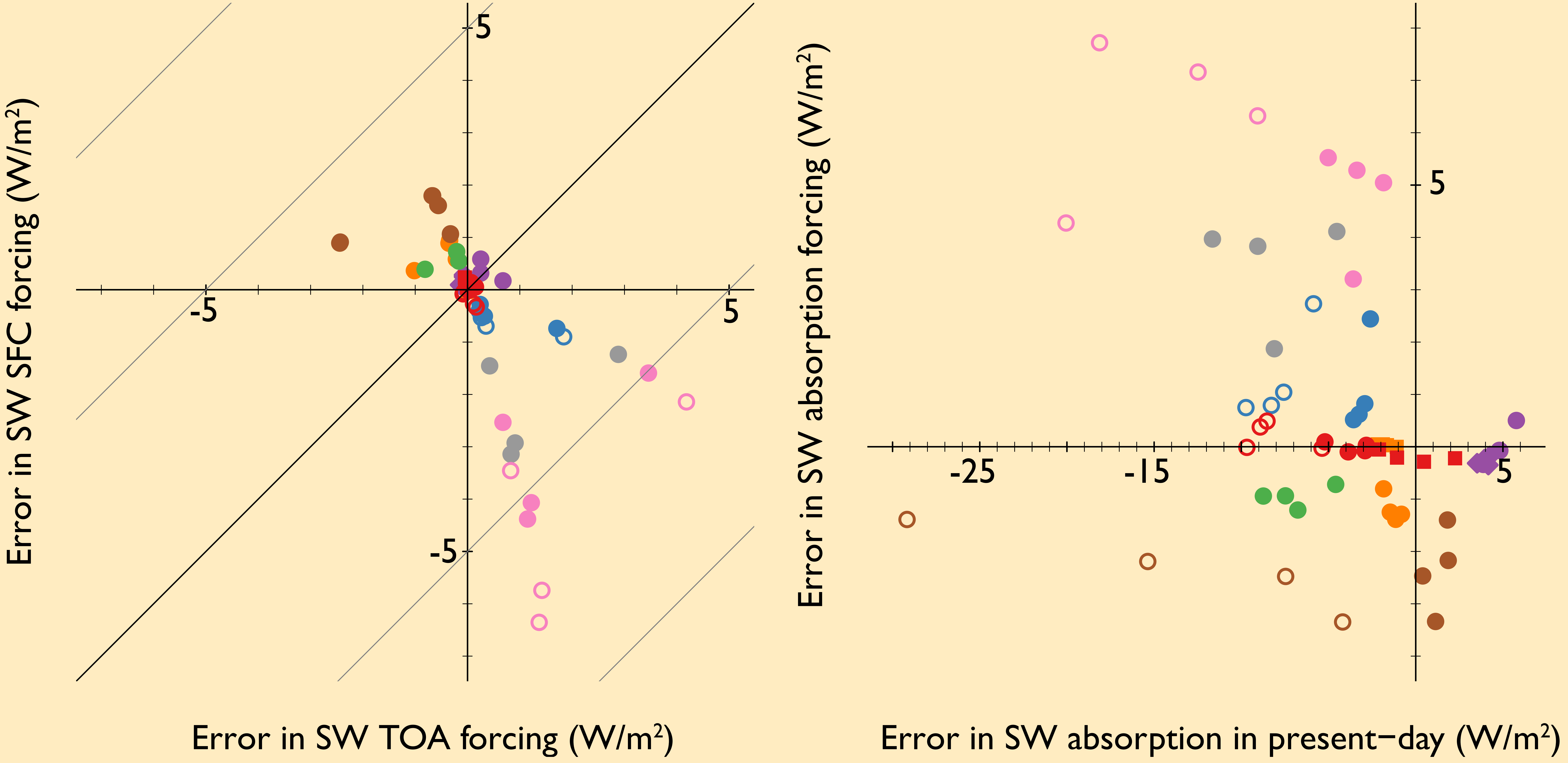
Optimization reduces sampling error by ~4 times relative to random sampling

The sample is optimal for computing global mean forcing, not stress-testing models.




Present−day LW forcing
net down (W/m²)
2.82
2.05
0.77
TOA
Surface
Divergence
Present−day SW forcing
net down (W/m²)
0.49
0.05
−0.44
TOA
Surface
Divergence

Benchmarks in context



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RFMIP-IRF-AER

The aerosol protocol is modestly more CMIP-like: sets of snapshots of

- clear-sky aerosol IRF
- spectrally detailed aerosol and surface properties + atmospheric state

GFDL and LBNL are committed to make reference calculations to assess the error in parameterized IRF