# 2024 International Radiation Commission (IRC) Business Meeting

18 June 2024

# Agenda

I. Welcome and Introductions (5)

II. President's Report (20)

   a. IRC Financial Status

   b. Upcoming meetings

   c. Recent IRC Activities

   d. In Memoriam

III. Election of IRC Officers for next term (2025-2028) (20)

IV. Working Group Presentations (40)

V. Upcoming Election of IRC Commissioners for Next Term (25-29) (10)

VI. 2025 IRC Business Meeting (5)

VII. Other Business

# Treasurer's Report 2021-2024 Budget Summary

| Date | Transaction | Amount (in)(USD) | Fees (out)(USD) | Balance (JPY) | EstimatedBalance (USD) |
|---|---|---|---|---|---|
| 5/4/2021 | Transfer from B.J. Sohn To Hajime Okamoto (fee to receive) | 9982.20 | 17 | | 9,965.2 |
| 10/9/2021 | "Estimated" differences due to exchange rate differences (4/5 1USD=109.29 JPY to 10/9 1USD=109.71 JPY) | | 38.16 | 1,089,095 | 9,927.04 |
| 10/9/2021 | Cumulative Interest (5 Apr. to 10 Sep.) | 0.08 | 0 | 1,089,104 | 9,927.12 |
| 26/06/2022 | Cumulative Interest (10 Sep.2021-26/06/2022) (1USD=138.23JPY) | 0.079 | 0 | 1,089,115 | 7,879.01 |
| 26/06/2022 | Young Scientist Award (1USD=138.23JPY) | 0 | 1000 | 950,885 | 6,879.01 |
| 26/06/2022 | Plaque (paid back to Peter Pilewskie) (1USD=138.23JPY) | 0 | 217.50 | 920,816 | 6,661.48 |
| 15/03/2023 | Cumulative Interest (27/06/2022-15/03/2023) and reflection due to exchange rate change (1USD=133.2JPY | 0.069 | 0 | 920,825 | 6,913.10 |
| 15/03/2023 | Transfer from Alkis Bais to H. Okamoto (IRS2022). 3000-18=2982EUR, 255JPY for fee, 1USD=133.2JPY, 1EUR=143.87JPY | 3220.99 | 18.77 | 1,347,361 | 10,115.33 |
| 12/07/2023 | Cumulative Interest (15/03/2023-12/07/2023) and reflection due to exchange rate change (1USD=142.12JPY | 0.031 | 0 | 1,347,365 | 9,480.47 |
| 12/07/2023 | Catering for lunch at IRC business meeting (Prime Catering) 626,40 EUR (1 EUR=156.96JPY, 1 USD=142.12 JPY) | | 691.81 | 1,249,045 | 8788.66 |
| 10/08/2023 | Catering for lunch at IRC business meeting (Prime Catering) 543.39 EUR=87534JPY+transfer fee=7,500JPY=95034 JPY (1 EUR=161.09JPY) (1USD=142.12 JPY) | | 691.81 | 1,252,331 | 8,811.8 |
| 26/05/2024 | Young scientist award(1000USD)+ young scientist plaque(225USD)=194,996 JPY (1 USD=159.18 JPY, including exchange fee) | 1225 | | 1,057,335 | 6,642.39 |
| 10/06/2024 | Cumulative Interest (12/07/2023-10/06/2024) and reflection due to exchange rate change (1USD=157.01JPY) | 1.347 | | 1,057,556 | 6,735.60 |
| **Total** | | | | **1,057,556** | **6,735.60** |

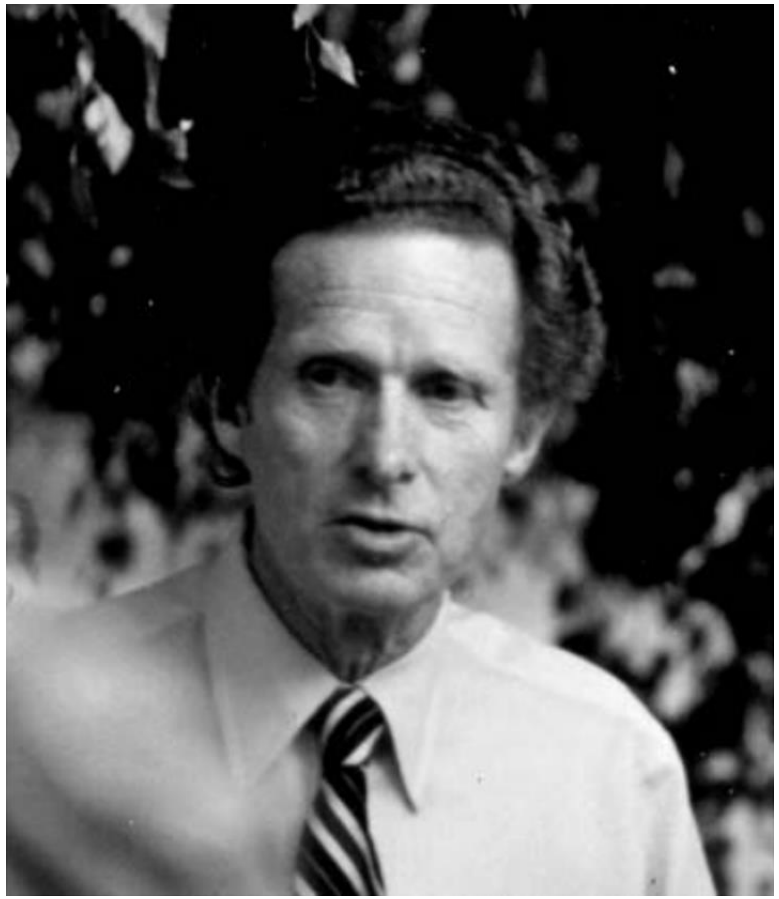
# Upcoming meetings

1. TRUTHS for Climate Workshop, **27-28 June 2024,** at ESA-ECSAT, Didcot, UK and online (https://nikal.eventsair.com/truths-workshop/)
2. 1st Stakeholder Meeting of the CIPM Sectorial Task Group on Climate Change and Environment (CIPM-STG-CENV), **16-18 September 2024**, Sèvres, France and online (https://bipm-cenv2024.org/)
3. AGU Annual Meeting, AGU24, **9-3 December 2024**, Washington, DC, USA (https://www.agu.org/annual-meeting)
4. EGU General Assembly, **EGU25, 27 April–2 May 2025**, Vienna, Austria (https://www.egu25.eu/)
5. Busan IAMAS-IACS-IAPSO Joint Assembly 2025 (BACO-25), **20–25 July 2025,** BEXCO (Busan Exhibition and Convention Center), Busan, Republic of Korea (http://www.baco-25.org/2025/english/main/index_en.asp)

   - Note: this will be the location of the IRC 2025 Business Meeting

# In Memoriam

## Richard M. Goody (1921-2023)



# Prof. Richard M. Goody (1921-2023)

- B.S. in Physics, Cambridge University (1942)
- British Army (1942-1946)
- Ph.D., Cambridge University (1949)
- Research Fellow at St. John's College, Cambridge (1949-1953)
- Reader, Imperial College (1953-1958)
- Abbott Lawrence Rotch Professor, Harvard University (1958-1991)

“Throughout his career, Goody made seminal contributions to both the theoretical and observational side of atmospheric physics, a trait that distinctively distinguished him from his peers.”

1. Radiative-Convective Equilibrium (Proc R Soc, 1949)
2. Goody’s random-band model (1952)
3. 1500K blackbody and a record of precise solar infrared measurements (mid-1950s)
4. Water-vapor continuum absorption in the mid-IR, leading to coining the term ”continuum absorption” (1958)
5. Iterative matrix method for treating the non-LTE source function (1950s)
6. Gas correlation spectroscopy (1968)
   - Enabling instruments such as HALOE on UARS, HIRDLS on Aura

*Three influential textbooks*

1. *Atmospheric Radiation: Theoretical Basis* 1st Edition (1964)
2. *Atmospheric Radiation: Theoretical Basis* 2nd Edition (with Yuk Yung, 1989)
3. *Principle of Atmospheric Physics and Chemistry* (1995)

- Chair of NASA’s Space Studies Board (1974-1976)
- A co-author of Charney’s Report 1979
- Member of the National Academy of Sciences of the US (since 1970)
- Buchan Prize of the Royal Meteorological Society (1958)
- William Bowie Medal of the AGU (1998)
- IRS Gold Medal (2004)
- Keynote speaker in Beijing IRS 1986 (Aug 26-30)

Hiking at Poison Spring, Utah, 2017 (at the age of 96)

“I found myself cast as a specialist in atmospheric radiation, although I have never regarded the study of radiation as an end in itself but rather as a tool for understanding the atmosphere.”
R. M. Goody

# In Memoriam

## Ehrhard Raschke (1936-2023)

# Election of IRC Officers for Next Term (2025-2028)

1. Review the election rules
2. Present a nominee for President
3. Present nominees for Vice-President and Secretary
4. Excuse the nominees
5. Discuss voting procedures
6. Collect the vote
7. Invite Nominees back in
8. Announcement of election result

# IRC Election Rules

https://www.iamas.org/irc/voting-procedure-for-officers-28-august-2009-2/

## Nomination of a candidate for President

- The sitting IRC President forms a Nominating Committee of two or more additional individuals consisting of Honorary members who are past Presidents of the IRC.
- The sitting IRC President and the Nominating Committee select one new candidate for President.

## Presentation of the nominee for President and vote

- The nominee for President is presented to members at the Business Meeting.
- The Nominee for President in turn presents his or her slate of nominees for Vice-President and Secretary.
- Elect only president
- If the Nominee for President is elected, then his or her nominees for Vice-President and Secretary are automatically elected

## Voting rules

- A vote of all members present at the business meeting for or against electing the Nominee as the new President for the following term.
- Each member has one vote.
- The new President is elected by a simple majority of affirmative votes.
- In the case of a tie, the vote of the sitting IRC president decides the outcome of the election.

# Nominee for President (2025-28)

*International leader in airborne radiometry; Arctic change research missions; author of radiative transfer text*

## *Manfred Wendisch*

*Professor for Atmospheric Radiation , Leipzig University, Institute for Meteorology, Germany*

- IRC member since 2012 & Current IRC Vice President
- Director of the Leipzig Institute for Meteorology (LIM)
- Chairman of the Scientific Advisory Board of the German Weather Service
- Member of the German National Committee for Polar Research SCAR/IASC
- Elected Member of the Senat of the University of Leipzig
- Member, Board of Trustees of the Alfred-Wegener-Institute, Helmholtz-Centre for Polar and Marine Research

# Nominee for Vice President (2025-28)

*Mission Co-chair for EarthCARE; expert in cloud and aerosol remote sensing; leader in combined lidar-radar techniques*

## *Hajime Okamoto*

*Professor, Research Institute for Applied Mechanics, Kyushu University, Japan*

- IRC member since 2012 & Current IRC Secretary
- Director of Research Institute for Applied Mechanics, Kyushu University
- Distinguished Professor in Kyushu University
- Co-chair of EarthCARE project
- The Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology, Prize for Science and Technology
- Meteorological Society of Japan Prize, The Meteorological Society of Japan

# Nominee for Secretary (2025-28)

*Expert in cloud, precipitation, and aerosols remote sensing; aerosol-cloud-precipitation interactions; machine learning applications in cloud processes and radiative transfer.*

## *Christine Chiu*

*Professor, Department of Atmospheric Science, Colorado State University, USA*

- IRC member since 2016
- Chair of the Cloud and Precipitation Measurements and Science Group for the Atmospheric Radiation Measurement (ARM) Climate Research Facility
- Co-Chair of DOE ASR Warm Boundary Layer Processes Working Group
- Hyperspectral Imaging and Sounding of the Environment Program Committee
- 2024 Recipient of the AMS David and Lucille Atlas Remote Sensing Prize

# Working Group Presentations

| The 12 IRC Working Groups |
|---|
| **ASA - Atmospheric Spectroscopy Applications**<br>Chair: Iouli Gordon |
| **BSRN - Baseline Surface Radiation Network**<br>Co-Chairs: Amelie Driemel, Christian Lanconelli and Laura Riihimaki |
| **CR - Clouds and Radiation**<br>Chair: Andreas Macke and Johannes Quaas |
| **GEB - Global Energy Balance**<br>Co-Chairs: Norman Loeb and Martin Wild |
| **ICLAS - International Coordination group for Laser Atmospheric Studies**<br>Chair: Fred Moshary |
| **IPRT - International Polarized Radiative Transfer**<br>Co-Chairs: Claudia Emde and Bernhard Mayer |
| **ITWG - International TOVS Working Group**<br>Co-Chairs: Fiona Smith and Reima Eresmaa |
| **UV - Solar UltraViolet Radiation**<br>Co-Chairs: Julian Groebner and Ann Webb |
| **3DRT (I3RC) - Three-Dimensional Radiative Transfer**<br>Chair: Alexander Marshak |
| **HRMM - Hyperspectral Radiation: Measurements and Modelling**<br>Chair: Ping Wang |
| **TSSI - Total and Spectral Solar Irradiance**<br>Chair: Odele Coddington |
| **MLRS** - Machine Learning Applications in Remote Sensing<br>Chair: Feng Zheng |

# WG 1: ASA - Atmospheric Spectroscopy Applications

Iouli Gordon

# WG 2: BSRN - Baseline Surface Radiation Network

Amelie Driemel (AWI), Christian Lanconelli (EC JRC) and Laura Riihimaki (NOAA CIRES)

# 2.BSRN - Baseline Surface Radiation Network

**Co-Chairs: Amelie Driemel, Christian Lanconelli and Laura Riihimaki**

## Current Status/Objectives/Activities

BSRN - a project of the Global Data and Analysis Panel (GDAP) from the Global Energy and Water Cycle
Experiment (GEWEX) under the umbrella of the World Climate Research Programme (WCRP) - is aimed
at measuring the surface radiation budget with the most accurate instrumentation and screening procedures to provide the model and satellite communities with a better benchmark for validation purposes. It also contributes to detecting any important change in the surface-based Earth's radiation field. The BSRN is an officially *"recognized GCOS"* network since 2022 (see https://gcos.wmo.int/en/networks/gcos-networks- accreditation). BSRN contributes to the Global Atmospheric Watch (GAW) and the Network for the Detection of Atmospheric Composition Changes (NDAAC). Since 2008, the BSRN archive (World Radiation Monitoring Center, WRMC) is hosted by the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany (AWI). The BSRN core staff consists of the Project Manager Christian Lanconelli (since Oct. 2018), the deputy project manager Laura Riihimaki (since 2020) and the World Radiation Monitoring Center (WRMC) Director Amelie Driemel (since 2017).

## Status of the affairs

At the moment (status May 2024) BSRN comprises 76* stations (compared to 74 in 2021) in different climatic zones, covering a latitude range from 80° N to 90° S (Figure 1). Sixteen stations are closed, 17 have been marked as inactive (no data submitted for more than 2 years). Among the stations considered during the last workshop (2022) one station (Lampedusa, LAM, Italy) has already submitted five months of data, and will be fully flagged as an *active* BSRN station as soon as 6 months of valid
data are accepted in the archive. Terra Nova Bay (TNB, Antarctica, WMO 89859) is still in candidate status (data submission pending). Stations from Nakhon Pathom (NPT, Thailand), Jambi (JAM, Indonesia), Pentakomo (CYL, Cyprus), Valentia (VAL, Ireland), and Andes East of Santiago (AES, Chile) are in pending status but most of them have already submitted data to the raw data ingest (pre-check of data quality) or have been in contact with the BSRN data quality working group to address existing issues.

More than **13,300 months of radiation data** (~13,000 in 2023) are freely available via PANGAEA https://dataportals.pangaea.de/bsrn/?q=LR0100 or upon a password request to the WRMC director via ftp: http://bsrn.awi.de/data/data-retrieval-via-ftp/. Recently, AWI implemented secure access to the same set of data by means of a SFTP protocol, as ftp protocol is being abandoned by many institutions for digital security reasons.

* Station ENA is counted here (status inactive, data status still unclear), but the candidate stations are not counted

To make citing these monthly datasets easier, the WRMC already created collection datasets for 32 stations in PANGAEA. The link to the available collections can be found in the last column here: https://wiki.pangaea.de/wiki/BSRN#Sortable_Table_of_Stations.

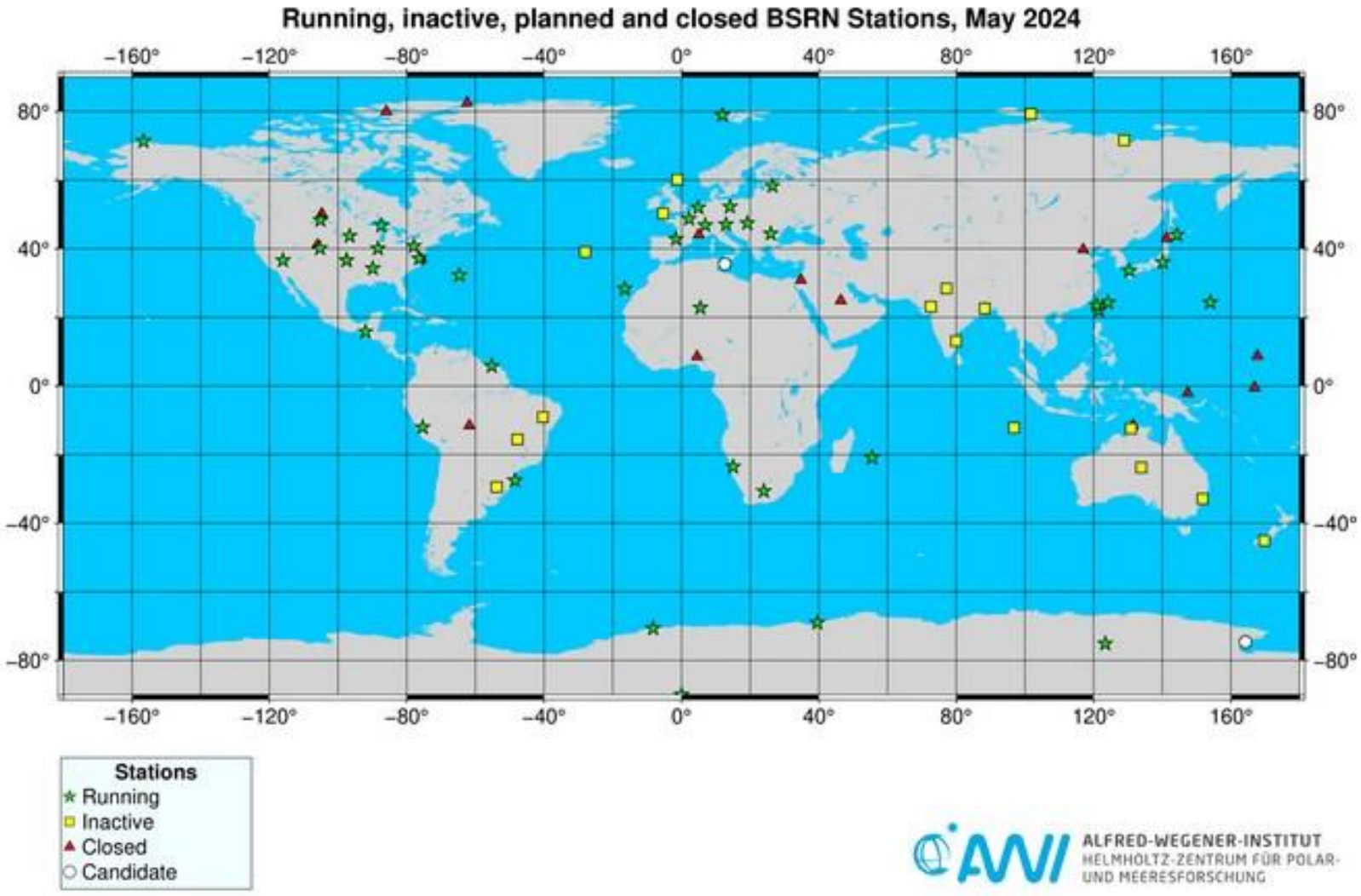



Figure 1. Map of all BSRN stations (running, inactive, closed and candidate).

## Meetings

The 18th BSRN scientific review and workshop (hybrid) will take place in Tokyo, Japan, from the 1st to the 5th of July 2024. The meeting information can be found on https://bsrn.awi.de/meetings/2024/. During the meeting, new station proposals will be illustrated. Expressions of interest from South Africa, Egypt, Cape Verde, United Emirates and China (in land and Antarctica) have been received. More than 60 registrations have been listed with about 40 requests among talk and poster presentations. Christian Lanconelli remotely attended the annual GEWEX-GDAP and NDACC annual meetings, and IRC Business meetings to report on the status and plans of the network and its active cooperations. Laura Riihimaki (NOAA CIRES) has continued to reinforce the interaction with the ocean community in the framework of OBPS activities (https://www.oceanbestpractices.org/). Amelie Driemel reported on the BSRN status during the national German GCOS meeting in April 2024 (online).

## Working Groups activities

The current BSRN working groups (WG chair) are: Infrared measurements (Wacker), Spectral meas. (Lantz), Broadband meas. (McComiskey), Uncertainties (Vuilleumier), Renewable Energies (Pereira), Data Quality (Knap), Ocean (Riihimaki), Value Added Product (VAP WG) (Lanconelli, interim), and Albedo/Satellite CAL/VAL WG (Wang). Within the Data Quality WG, regular meetings continued to takeplace every 4-8 weeks, jointly with the Uncertainty WG. More recently, following the publication of a community driven paper about best practices for radiation observation over ocean (Riihimaki et al. 2024), a series of bi-monthly involving land and sea scientists and technicians, has been kicked-off, to discuss the way forward towards a better harmonization of the surface based radiometric measurements over land and ocean. An addendum to the Update of the Technical Plan for BSRN Data Management (GCOS-174) describing the format of the new logical record LR4000 has been published on-line and most of the stations which regularly submit monthly files, are already incorporating the information on pyrgeometer signals and temperatures. The consistency checks between LR4000 and data logical records have been extended and tested, and a dedicated program has been released. BSRN continued to collect and store relevant calibration certificates in a centralized way, to guarantee better traceability.

Other activities were approached/further developed as follows

The raw data system was further developed, especially in support of candidate and pending stations, and external participants, which were encouraged to use it. The output of the RAW system has been adapted to be ingested to the pilot BSRN Data-Quality web-based tool developed by KNMI (W. Knap) in the frame of the Data Quality WG activities, to support station scientists in quality checking operations.

- The collaboration with the Italian National Research Council aimed to release temporally aggregated data of the downwelling radiative components through the Copernicus Climate Data Store (https://cds.climate.copernicus.eu/#!/home) continued, while the release of the products has been delayed due to human resources allocation. For the same reason, the publication of the QC
flag files along with the data files have been delayed, though is still on the action list. Complementary, an effort to associate an uncertainty value to the 1-minute downwelling SW components, have been initiated.

- The determination of *A, b* clear-sky coefficients of the Long and Ackermann clear-sky formulation (e.g. *Y = A (cos SZA)^b*), has been made operational over the BSRN archive with a 10-days schedule.

Results were not yet exposed to the public. Need for a peer-reviewed publication planned for this year (2024), focusing on the Cloud Radiative effects evolution from a ground-based perspective.

## Research Results

A list of **publications related to BSRN** can be found at http://bsrn.awi.de/other/publications/. Within the Web of Science, the topic "BSRN" is cited more than 6600 times (excluding self-citations) within >4600 articles. About 203 BSRN articles have been published in total (compared to 189 in June 2023), and many more scientists used BSRN data e.g. in student courses, for renewable energy research or in grey literature.

## Ongoing activities and Plans

1. Manual review, continue with established activities and drafted content (status: standing)
2. Harmonize measurements, implement ground meteorological traceability (T, p, RH) (standing).
3. Establish Albedo WG / expand albedo measurements (tower/drones?)
4. Release Time Aggregated data through the Copernicus CDS (in process)

**5. Extend inter-network interactions**

• interaction with GRUAN and GSRN in the frame of GCOS, especially for the definition of uncertainty budget for radiation components
• temporal aggregations to be released through the Copernicus Climate Data Store within 2024,
• GBOV continue to ingest BSRN data
• OASIS/GOOS and BSRN interactions
• ARRN (Antarctic Regional Radiation Network metadata, coordinated by ISP/CNR V Vitale)

6. Explore the space agencies'/private sector interests to invest in area gap coverage (Africa/Pacific) for validation purposes (EU) (a proposal submitted to EUMETSAT by Spanish Colleagues – Activity over Canarian Islands)
7. Interaction with Ocean community initiatives (Radiation measurements best practice paper lead by Riihimaki NOAA published on Frontiers (Riihimaki et al. 2024).
8. Release QC files and update them with a three-month schedule (delayed).
9. Define quantitative indicators to determine when data submission can be ingested into BSRN archive (DQWG).

**References:**

Riihimaki et al. (2024), Ocean surface radiation measurement best practices. Frontiers in Marine Science, 11:1359149. doi: 10.3389/fmars.2024.1359149

# WG 3: CR - Clouds and Radiation

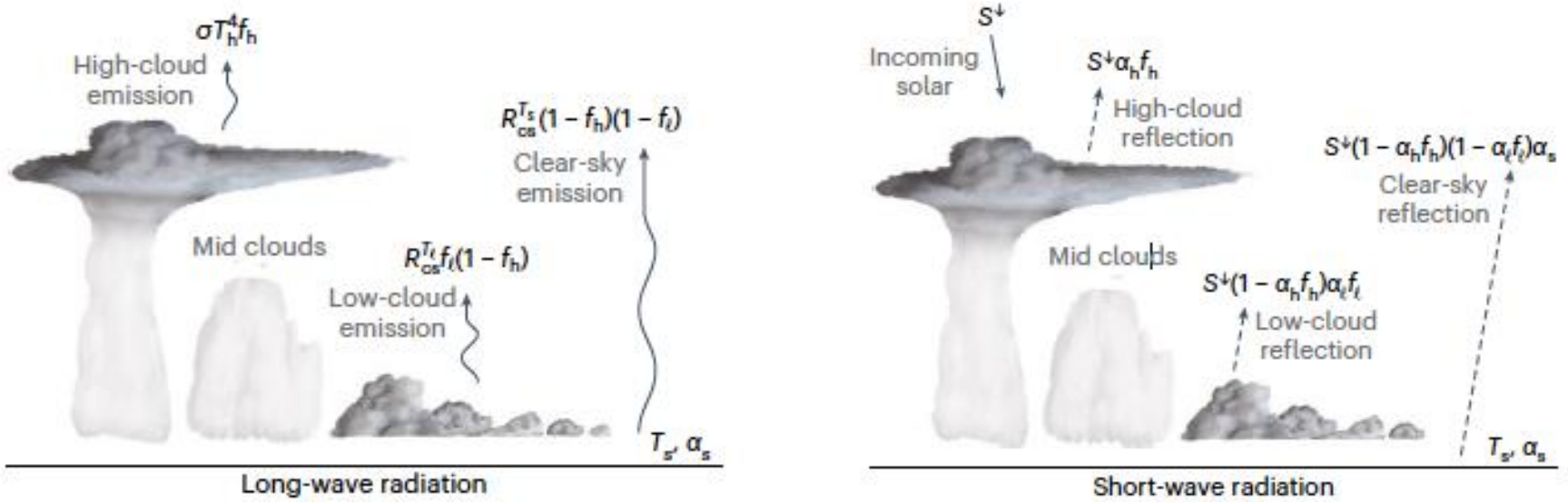
# **Clouds** and **Radiation**

## *report for IRC 2024*

**Andreas Macke** (TROPOS) and **Johannes Quaas** (Leipzig University)

# Cloud-radiation feedbacks

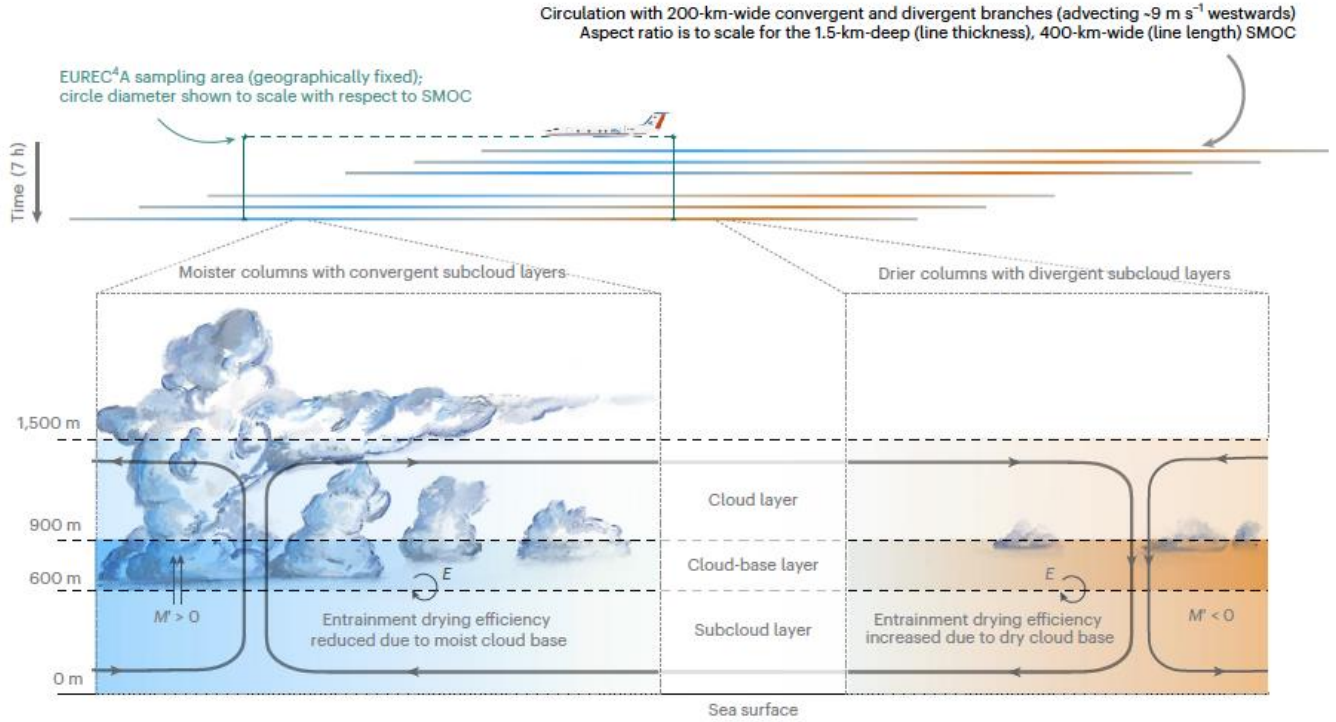
- **Sound argumentation to clarify the overall so-called Iris-effect (IR anvil-cloud climate feedback) is very small.**
- Method: Satellite data & conceptual models




McKim et al., Weak anvil cloud area feedback suggested by physical and observational constraints, Nature Geosci. 2024 (https://www.nature.com/articles/s41561-024-01414-4)

# Cloud-climate feedbacks

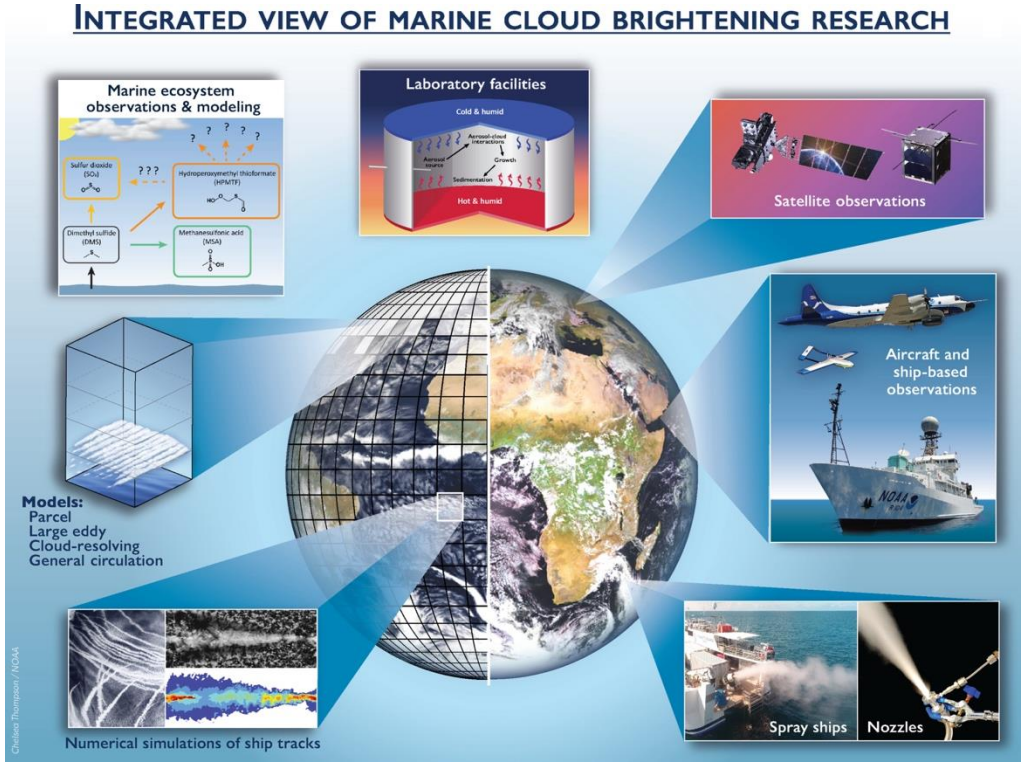
- **Observation-based analysis on the importance of mesoscale circulations for cloud dynamics, cloud properties, and cloud-climate feedbacks in the current climate.**
- Method: field campaign & modelling




George et al, Widespread shallow mesoscale circulations observed in the trades Nature Geosci 2023 (https://www.nature.com/articles/s41561-023-01215-1)

# Solar radiation management

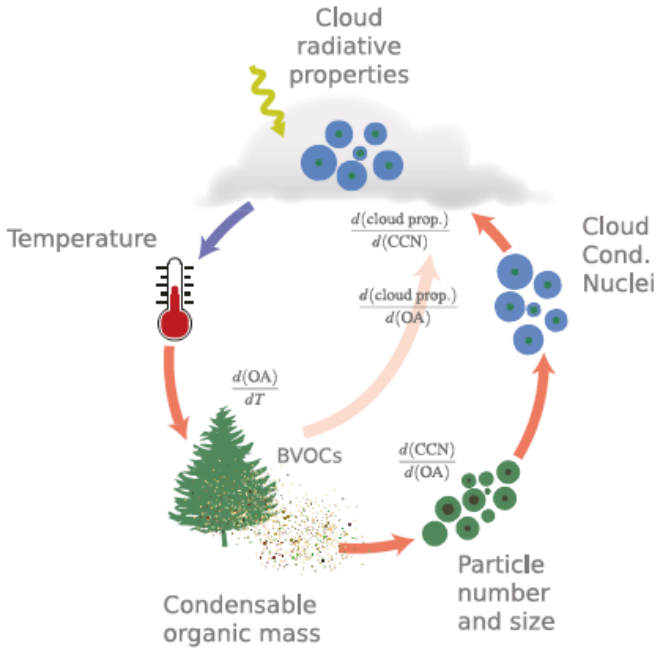
- **What research would be needed in preparation of considering solar radiation management by means of cloud brightening.**




Feingold et al. Physical science research needed to evaluate the viability and risks of marine cloud brightening Sciences Advances 2024, https://www.science.org/doi/10.1126/sciadv.adi8594

# Atmosphere-biosphere coupling

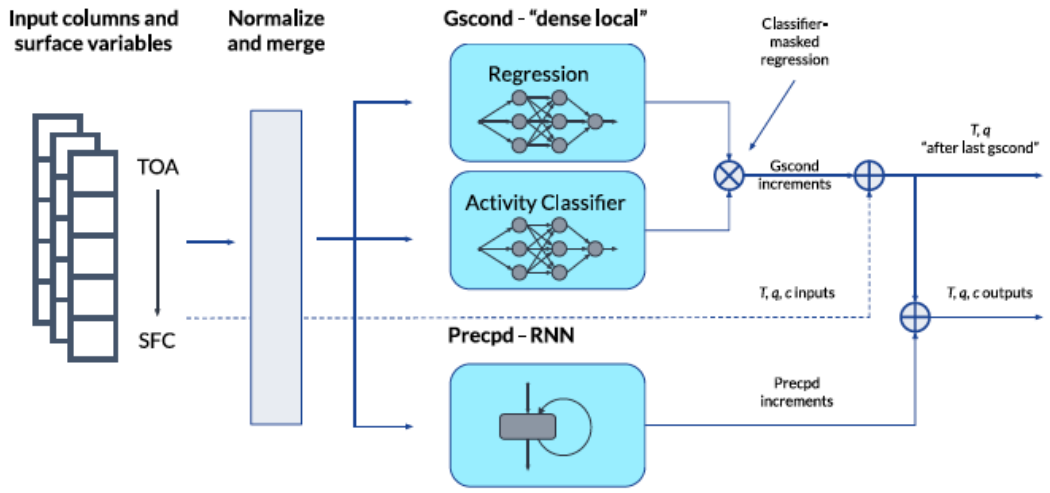
- **Observations-based evidence for biogenic aerosol-cloud interaction and critics of the current state of modelling**
- Method: analysis of long-term data sets and satellite data

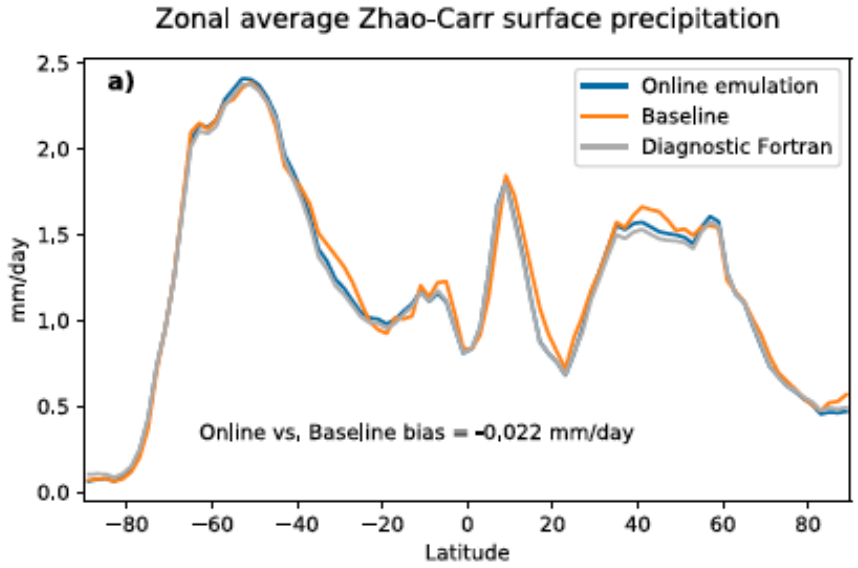



Blichner et al. Process-evaluation of forest aerosol-cloud-climate feedback shows clear evidence from observations and large uncertainty in models Nature Comms 2024, https://www.nature.com/articles/s41467-024-45001-y

# Cloud microphyiscs parameterization

- **Progress cloud microphysics parameterization by means of maschine learning**

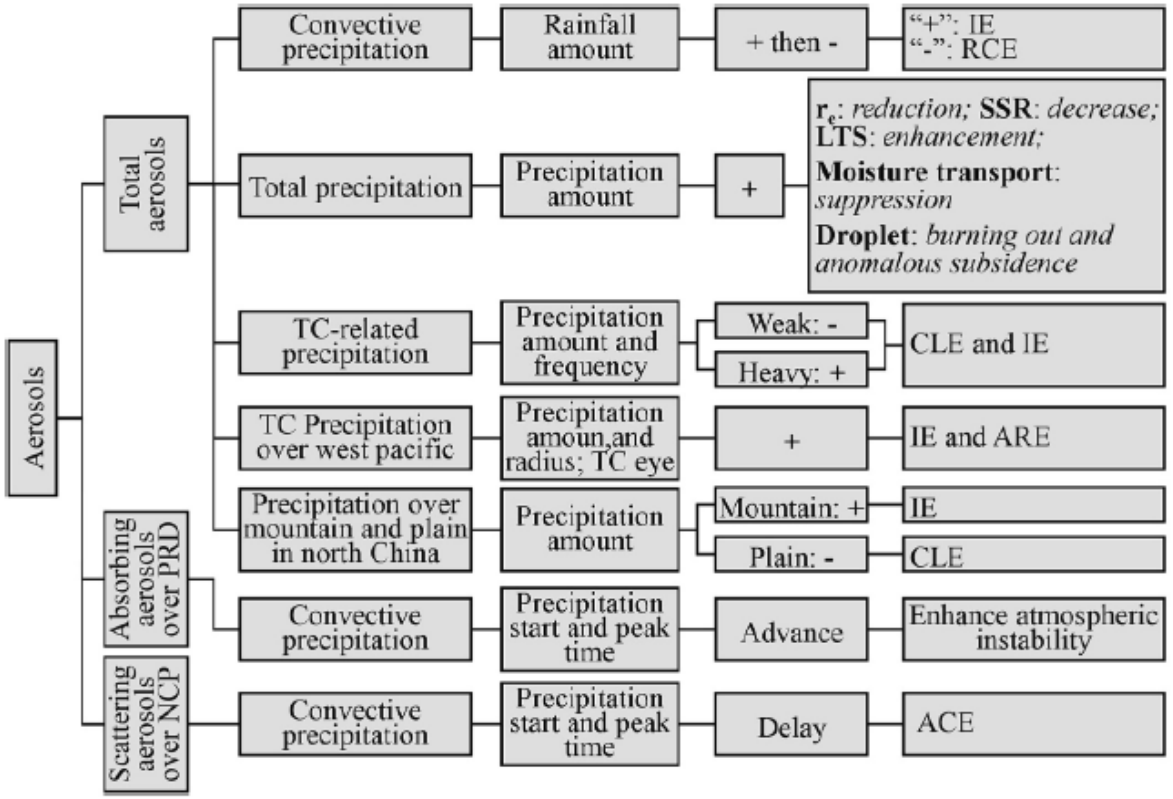



Perkins et al. Emulation of Cloud Microphysics in a Climate Model JAMES 2024
https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2023MS003851

# Cloud physics and radiation

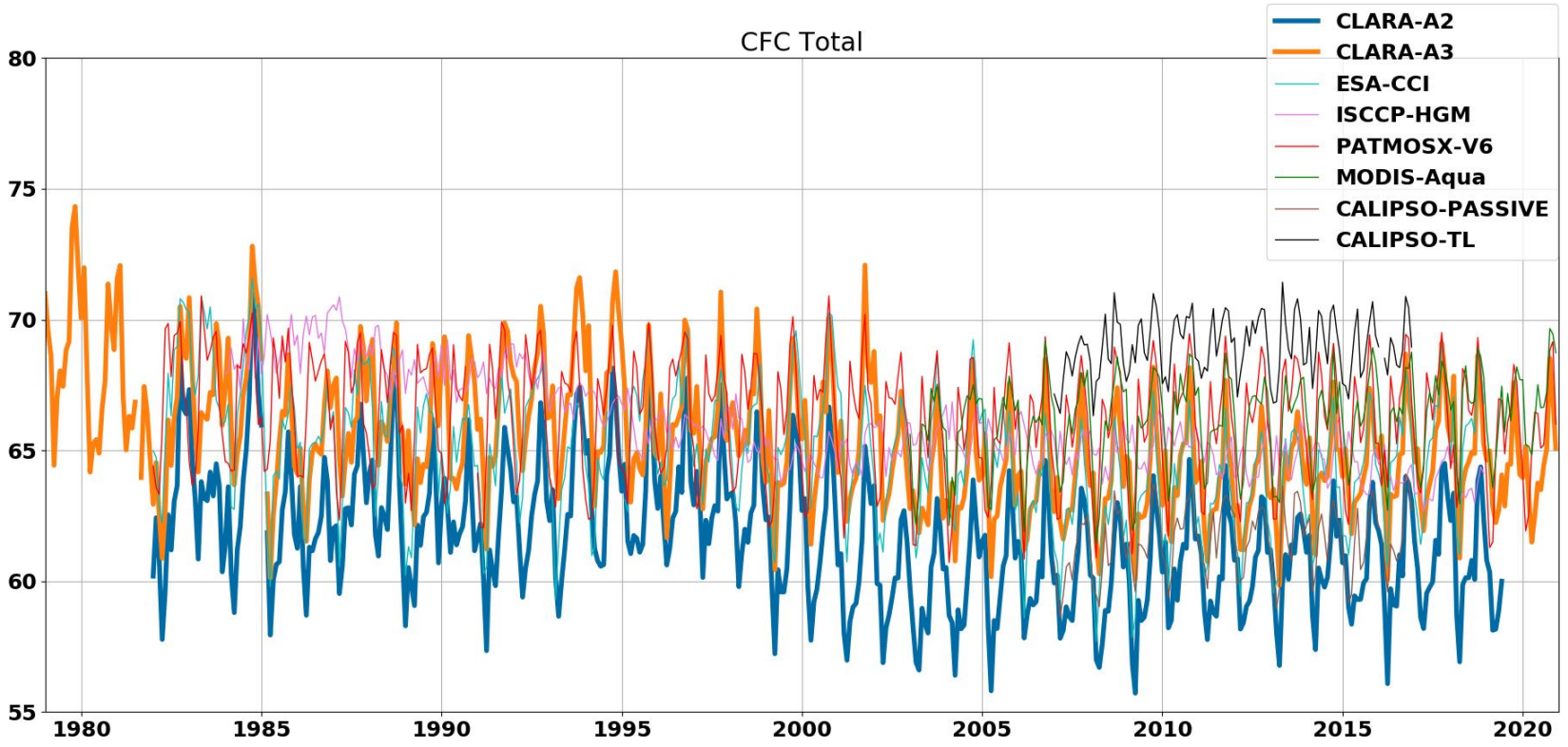
- **Holistic approach to cloud physics and resulting effects**




Chuanfeng Zhao et al. Recent progress in cloud physics and associated radiative effects in China from 2016 to 2022, https://doi.org/10.1016/j.atmosres.2023.106899.

# Cloud & radiation climatology

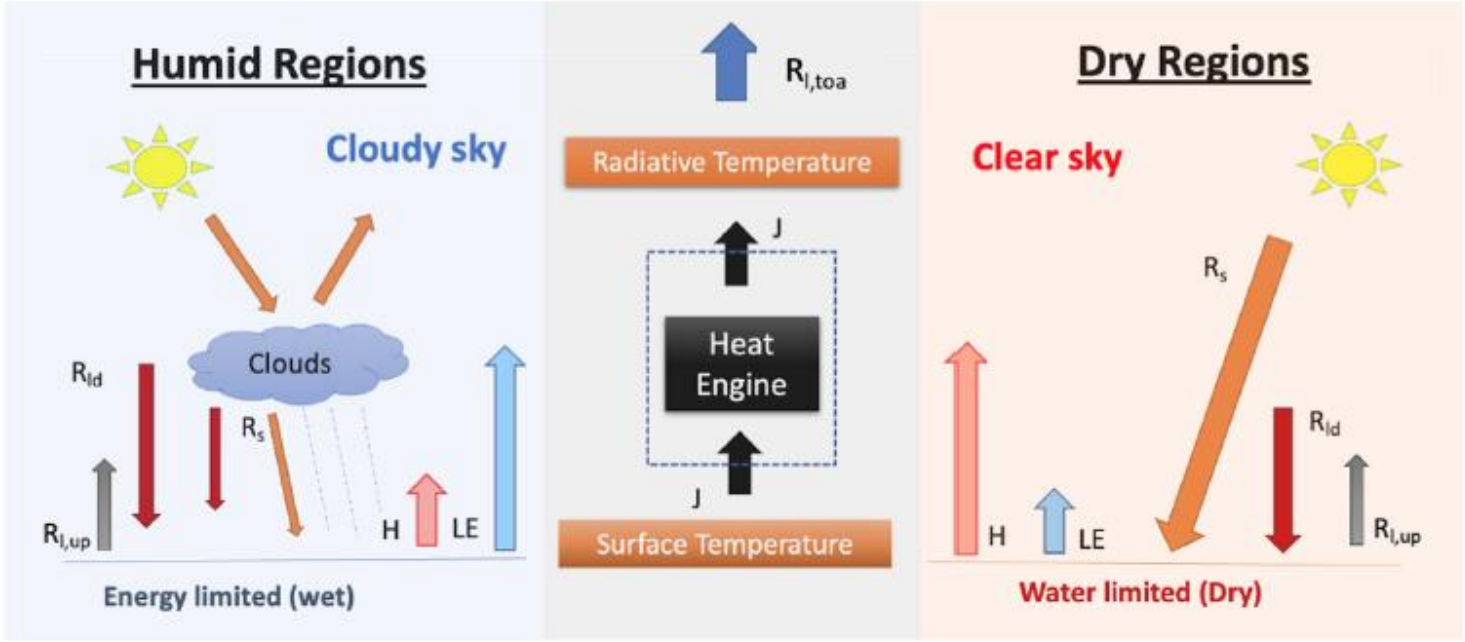
- **Important and physically consistent long-term data set.**




Karlsson, K.-G. et al.: The third edition of the AVHRR-based CM SAF climate data record on clouds, radiation and surface albedo covering the period 1979 to 2023, https://doi.org/10.5194/essd-15-4901-2023

# Cloud-land interaction

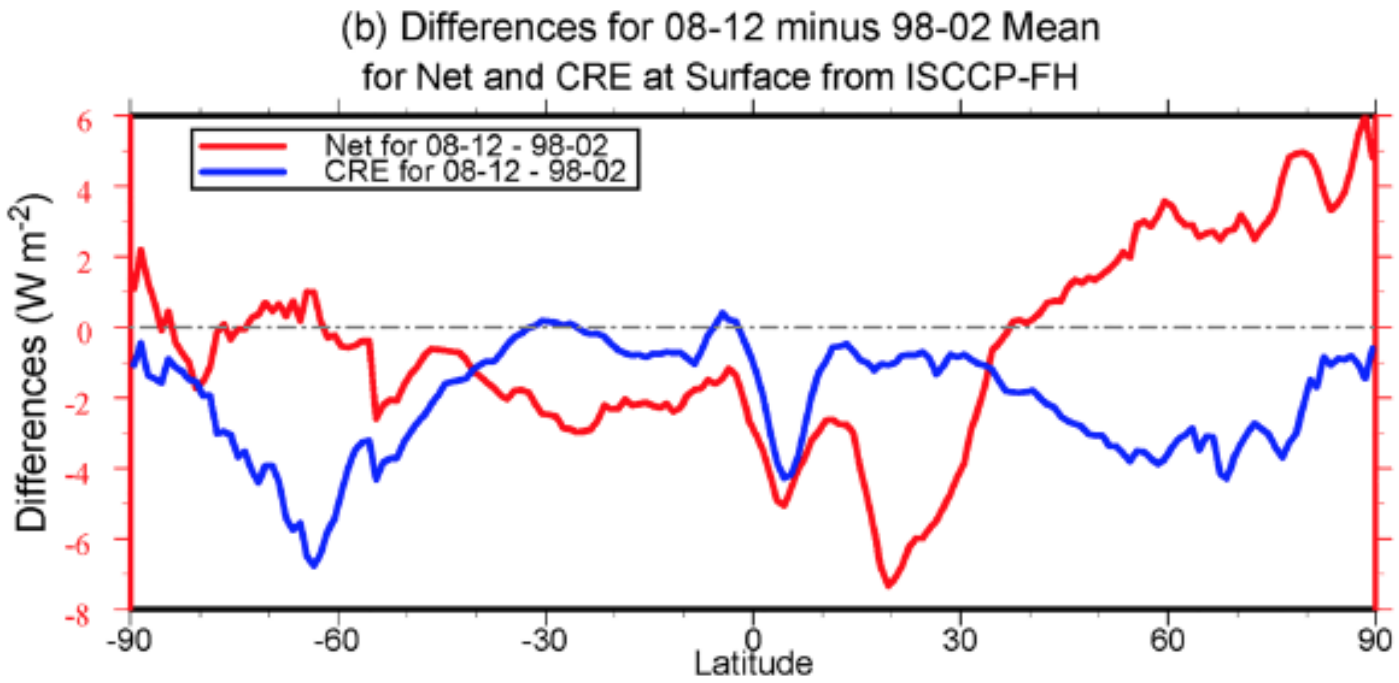
- **Climatological variations in LSTs across dry and humid regions are mainly mediated through radiative effects.**
  - Method: satellite data and surface energy balance model




Ghausi et al. Radiative controls by clouds and thermodynamics shape surface temperatures and turbulent fluxes over land, PNAS, https://doi.org/10.1073/pnas.2220400120

# Clouds and radiation climatology

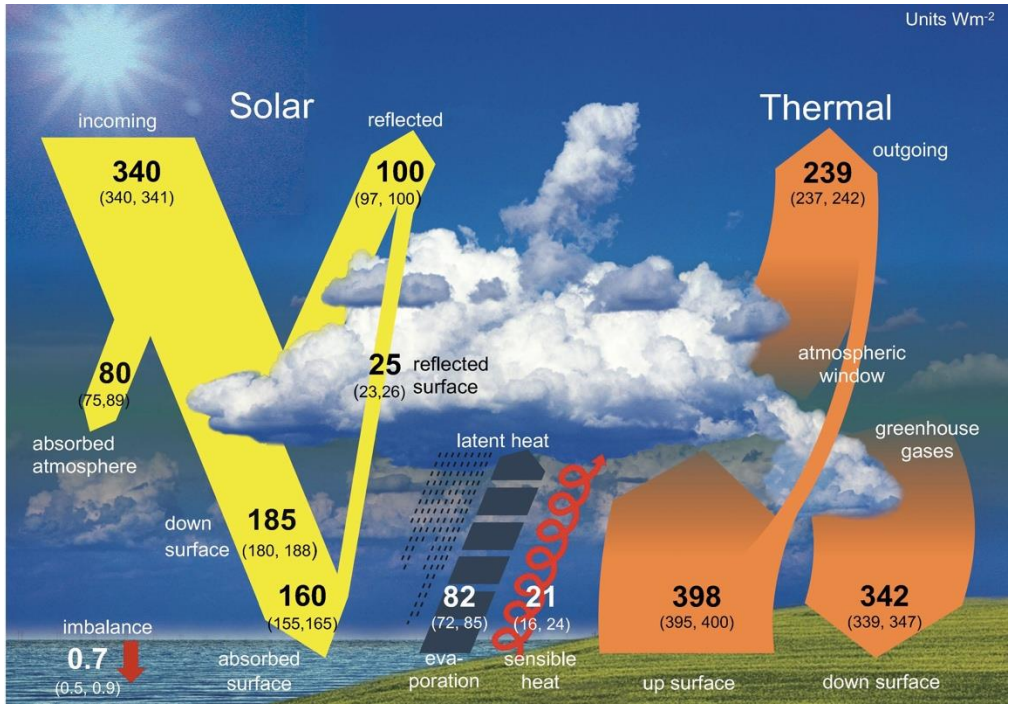
- **The cloud and flux variations from 1998 to 2012 suggest a positive cloud-radiative feedback on the oceanic circulation and a negative feedback on the atmospheric circulation.**
  - Method: Satellite data




Zhang and Rossow: Global Radiative Flux Profile Data Set: Revised and Extended, https://doi.org/10.1029/2022JD037340

# WG 4: GEB - Global Energy Balance

# 4. Report of the IRC Working Group Global Energy Balance: 2023 / 2024





Martin Wild
ETH Zurich

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

# Working group Global Energy Balance

Co Chairs: Martin Wild and Norman Loeb

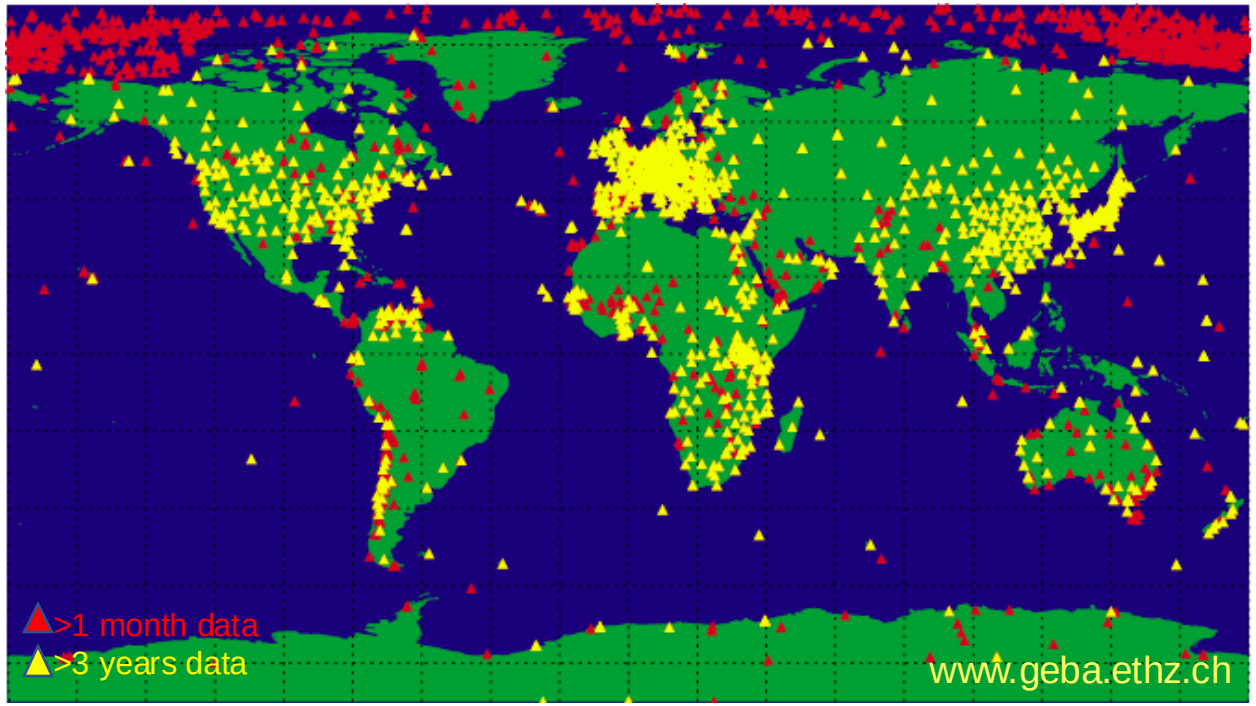
***Objectives**:*

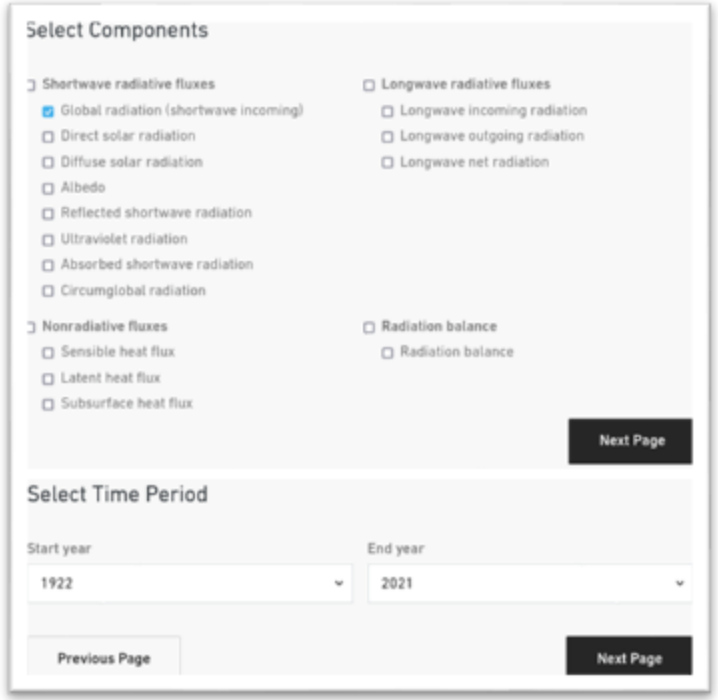
The main goals of this working group are the assessment of the magnitude and uncertainties of the components of the global energy balance, their decadal changes and underlying causes as well as their significance for climate change.

# Activities: Meeting organization

- **European Geophysical Union (EGU) General Assembly 2024**, April 2024, Vienna. Organization of the session “Earth radiation budget, radiative forcing and climate change” closely linked to the aims of this WG (Conveners Martin Wild, Paul Stackhouse, Jörg Trentmann, Maria Hakuba). (19th edition, consecutive since 2006) Solicited speakers: Maria Rugenstein, Michael Mayer
- **European Meteorological Society (EMS) General Assembly 2023**, September 2023, Bratislava. Organization of the session “Radiation, clouds and aerosols: From observations to modelling to verification“ closely linked to the aims of this WG (Convenrrs Stefan Wacker, Martin Wild, Laura Rontu, Antti Arola). Solicited speaker Stelios Kazadzis
- **American Geophysical Union (AGU) General Assembly 2023.** Dec 2023, San Francisco Organization of the session “The Flows of Energy through the Climate System”, closely linked to the aims of this working group (Conveners Maria Hakuba, Karina Schuckmann, Lijing Cheng, Martin Wild). Solicited speakers Mark Zelinka, Aaron Donohoe
- **International Union of Geophysics and Geodesy (IUGG) General Assembly 2023**, July 2023, Berlin. Organization of the session M11 “Earth’s Energy Budget”, closely linked to the aims of this WG (Conveners Seiji Kato, Norman Loeb, Maria Hakuba, Martin Wild)
- Upcoming: **European Meteorological Society (EMS) General Assembly 2024**, September 2-6 2024, Barcelona, session “Radiation, clouds and aerosols” Conveners S. Wacker, M. Wild, A. Arola

# Activities: Update on the Global Energy Balance Archive (GEBA)



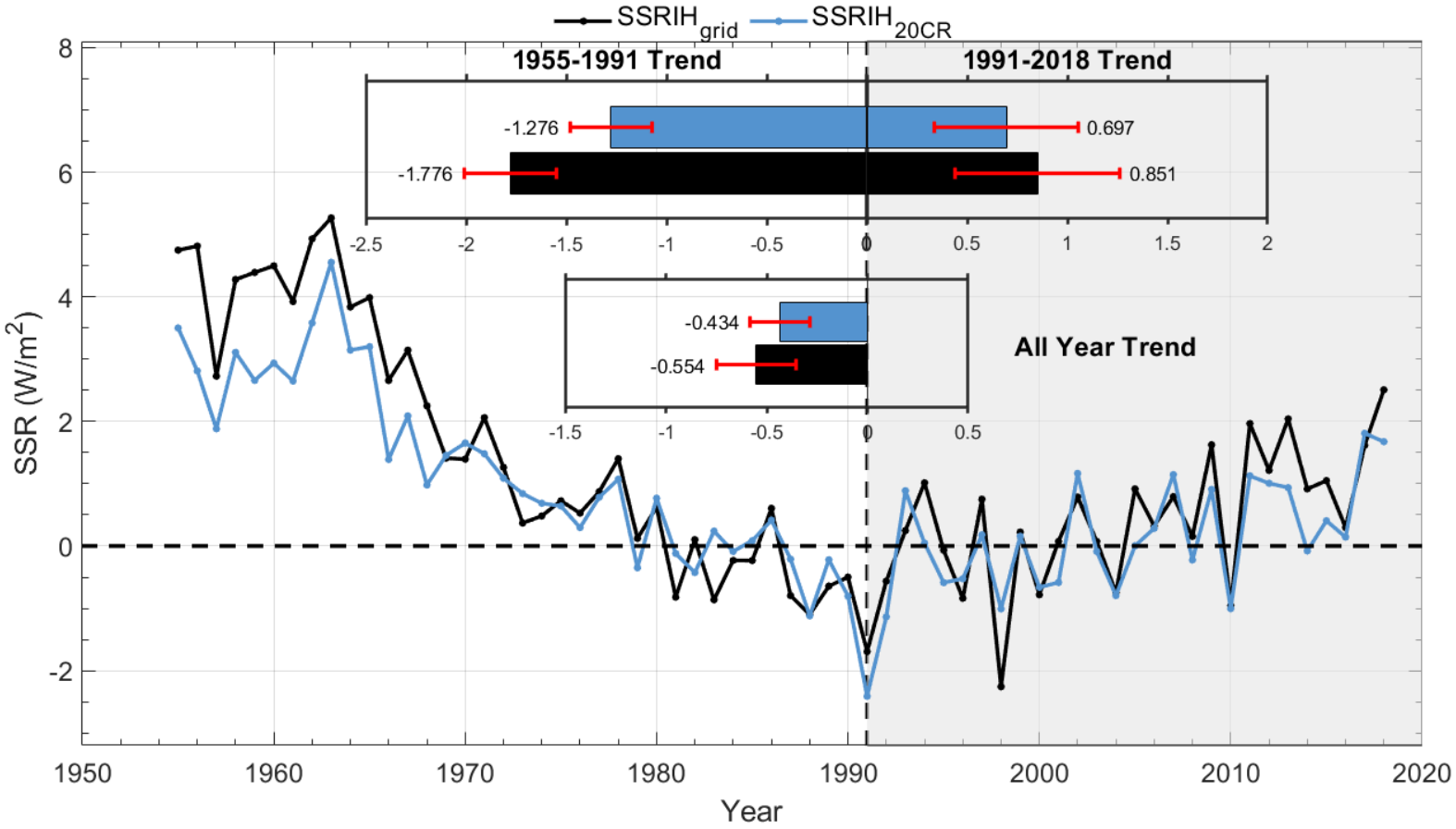

- Database for worldwide measured energy fluxes at the surface (>2500 sites)
- Maintained at ETH Zurich and online accessible at: www.geba.ethz.ch
- New technical infrastructure (POSTGRESS database) and web-interface
- Data at > 2500 sites, many multidecadal records, updated to contain > 600'000 monthly data entries
- Used in various studies related to the global energy balance and in IPCC assessments

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

*Mission: provide a central platform for the worldwide measured surface energy fluxes*

# Activities: Extrapolation of GEBA data to global land with AI methods

Surface solar radiation: Global terrestrial trend 1955-2018




Jiao, B., Su, Y., Li, Q., Manara, V., Wild, M., 2023: An integrated and homogenized global surface solar radiation dataset and its reconstruction based on an artificial intelligence approach, *Earth Syst. Sci. Data, **15**,* 4519–4535, 2023

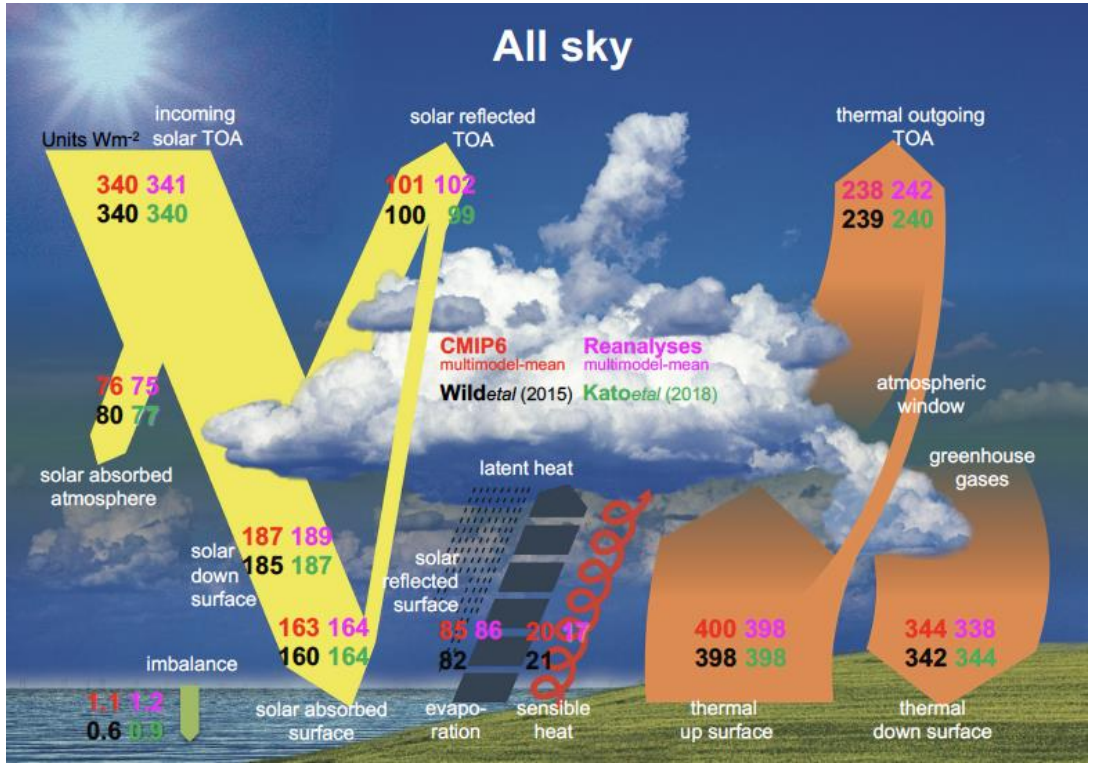


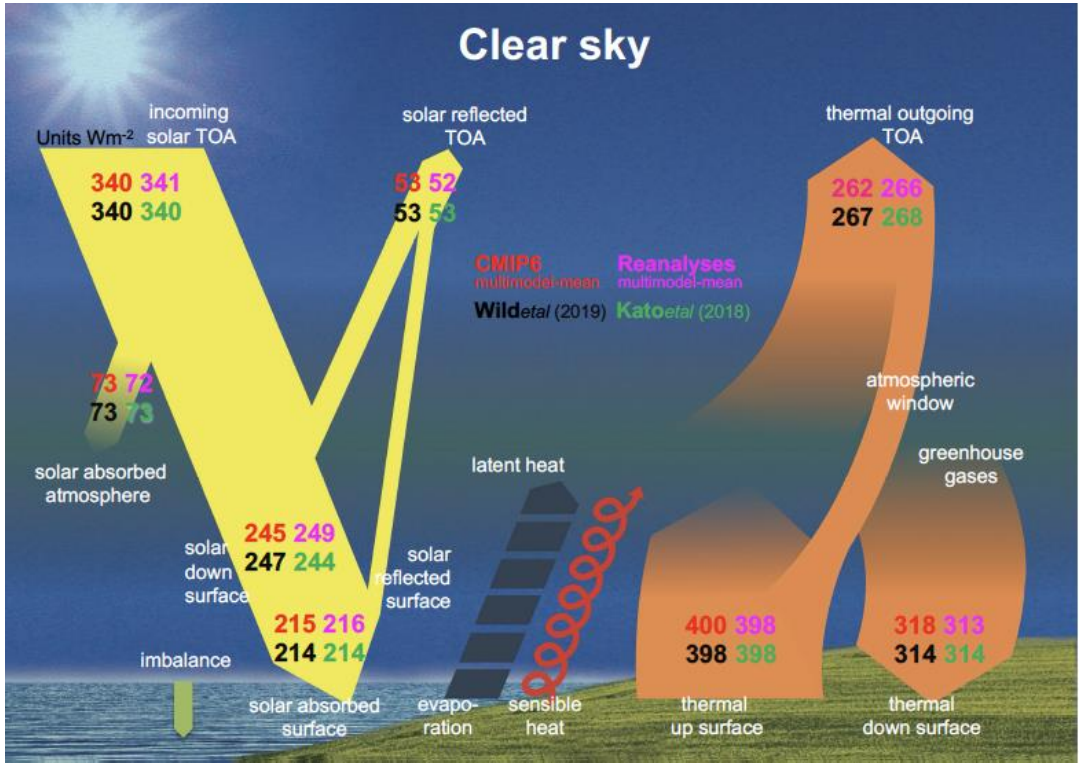
*=> Surface solar dimming / brightening large scale phenomenon*

# Activities: Radiation budgets in Reanalyses

Cooperation with Mike Bosilovich, NASA Goddard Space Flight Center

9 renalyses: MERRA, MERRA-2 / AMIP, JRA-55, ERA5, NCEP-R2, 20CRv3, ERA20C, ERA20CM




Wild and Bosilovich 2024, submitted

*Reanalysis multimodel mean too low surface downward longwave and too high downward shortwave radiation compared to reference estimates*

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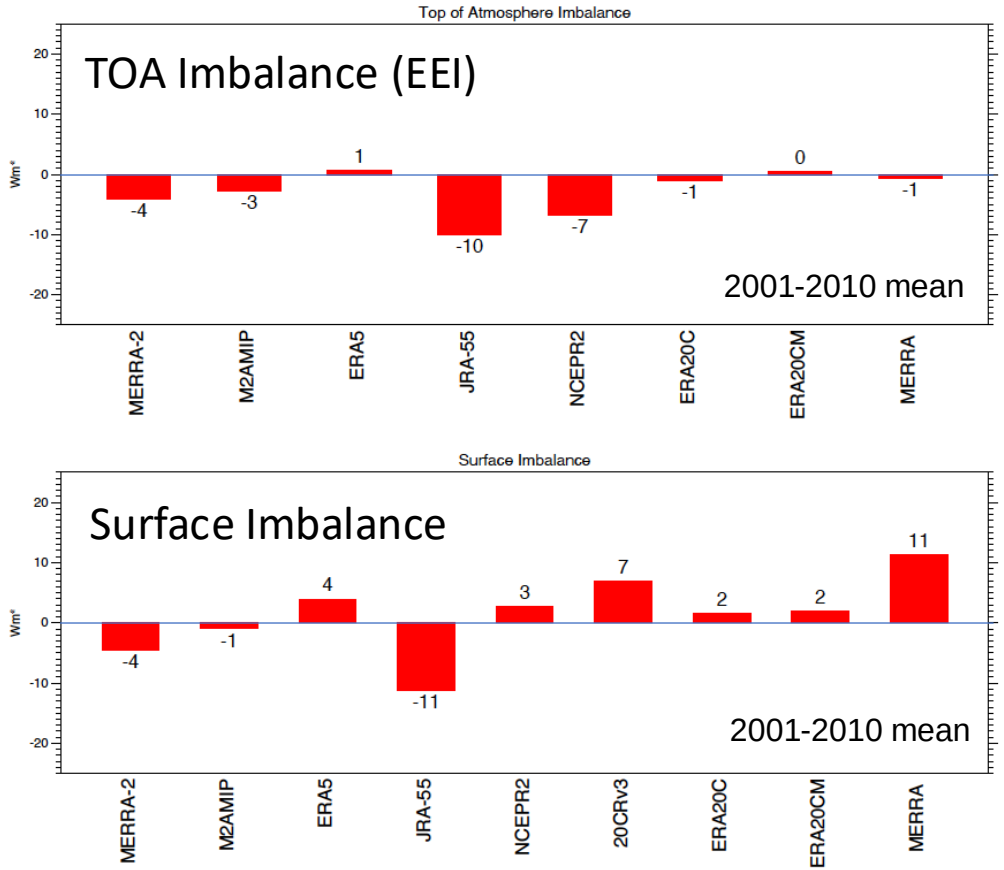


Wild and Bosilovich 2024, submitted

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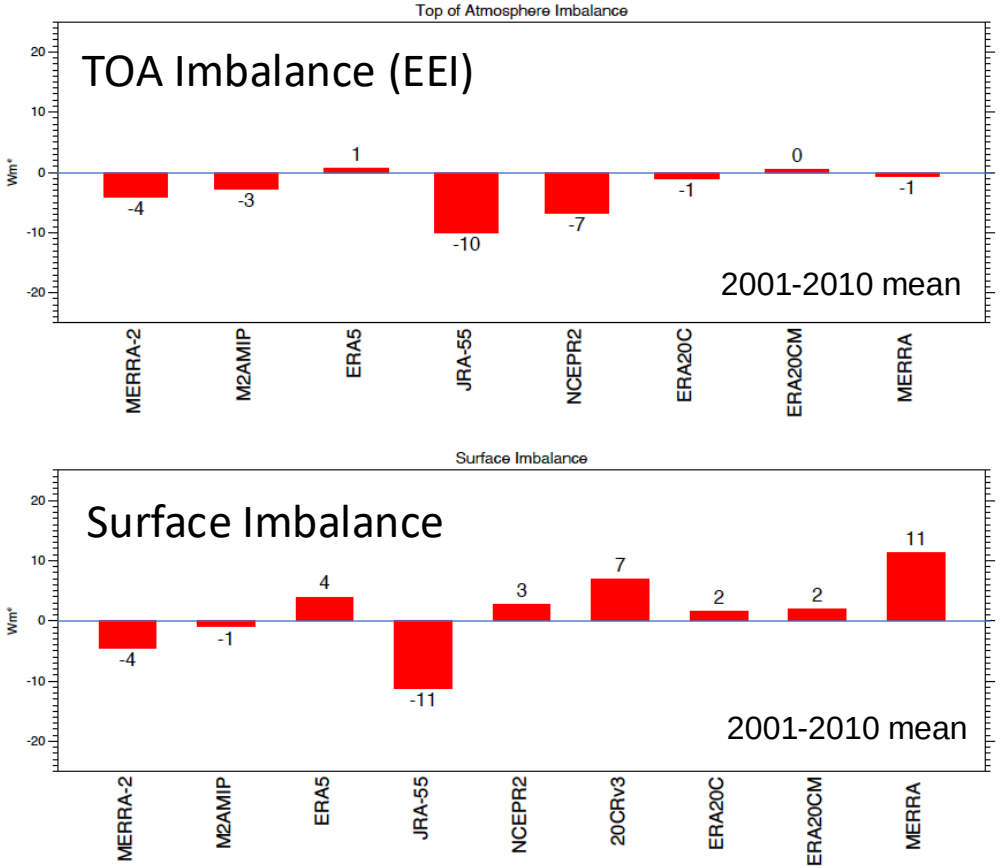
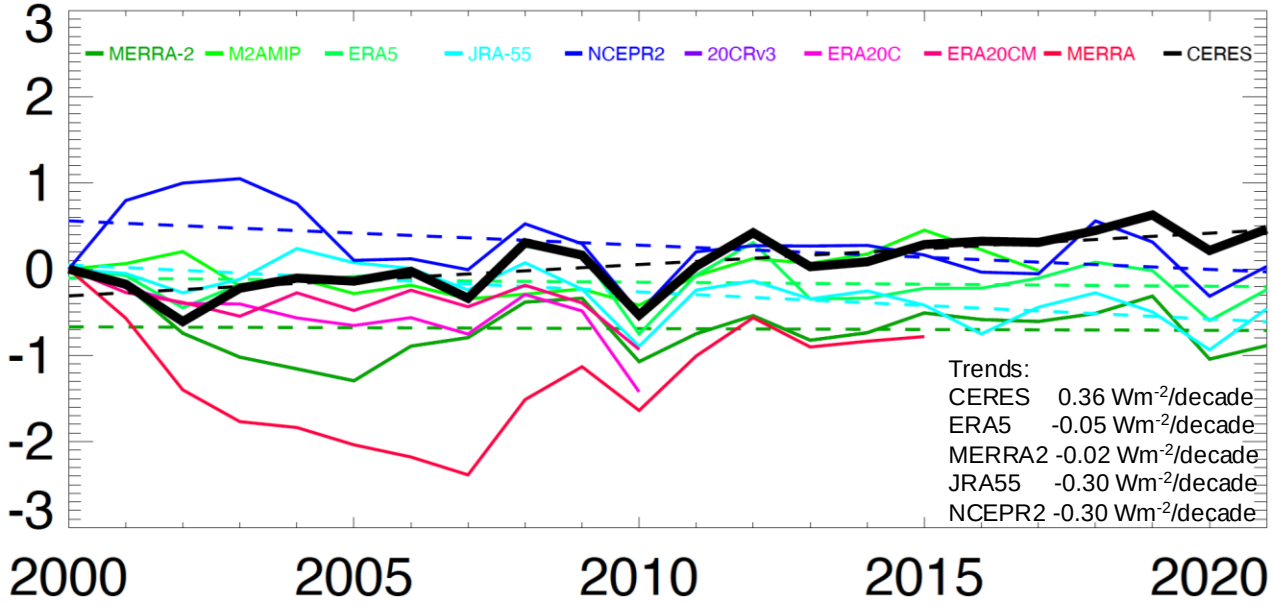



TOA Imbalance (EEI): Change 2000 - 2020




Wild and Bosilovich 2024, submitted

*Unrealistic surface and TOA imbalances in most reanalyses.*
*Reanalyses fail to reproduce the increasing imbalance seen in CERES*

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Swiss Federal Institute of Technology Zurich

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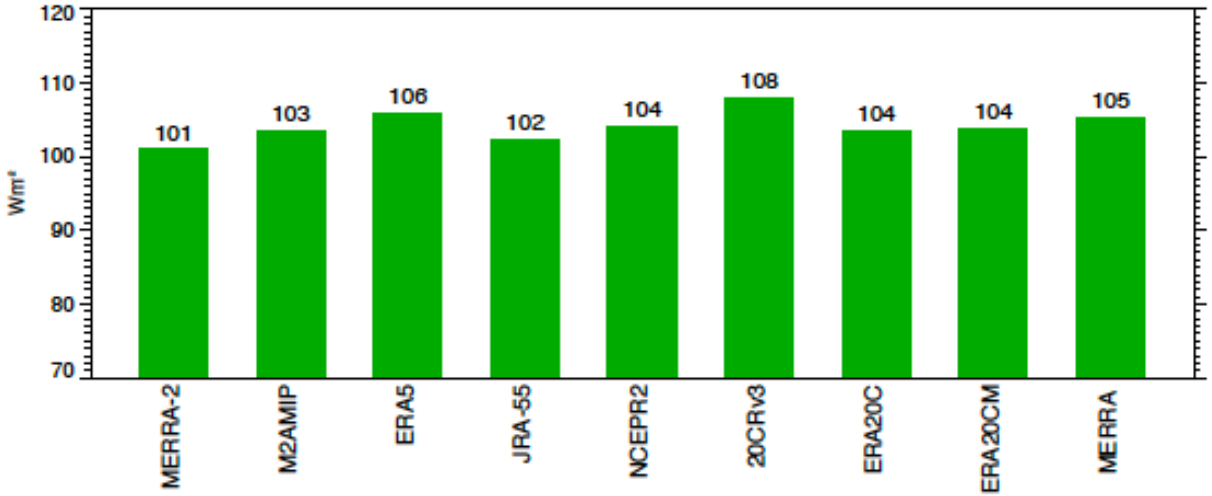
Surface net radiation (global mean)




Wild and Bosilovich 2024, submitted

*Reanalyses largely differ in their surface net radiation and the partitioning into sensible and latent heat fluxes*

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Cooperation with Mike Bosilovich, NASA Goddard Space Flight Center

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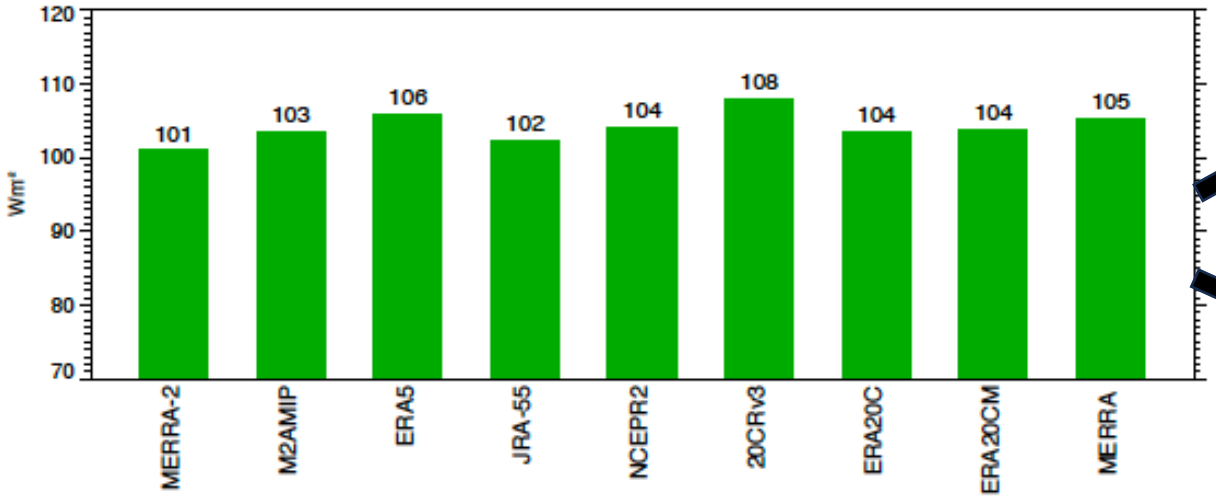
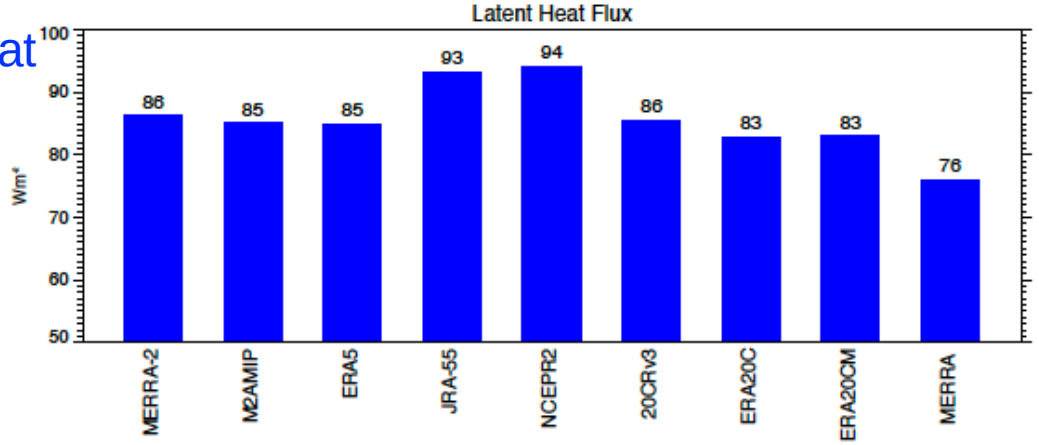
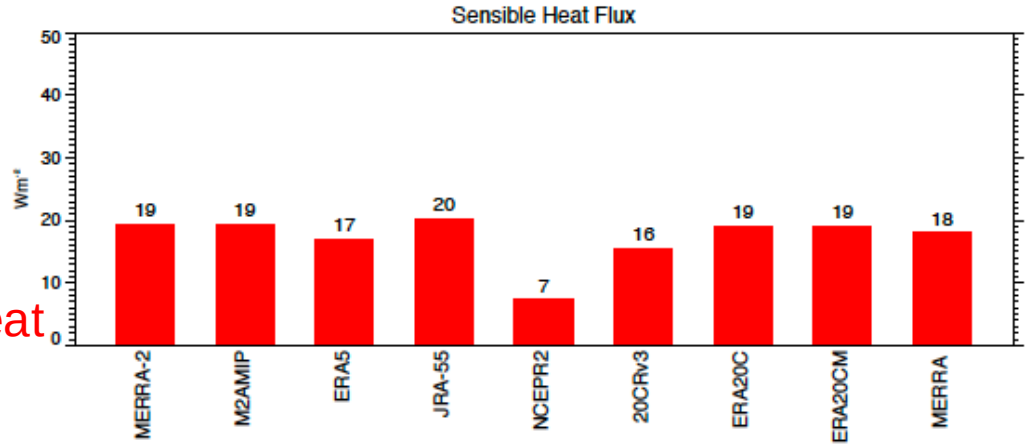



Wild and Bosilovich 2024, submitted

Latent heat




Sensible heat




*Reanalyses largely differ in their surface net radiation and the partitioning into sensible and latent heat fluxes*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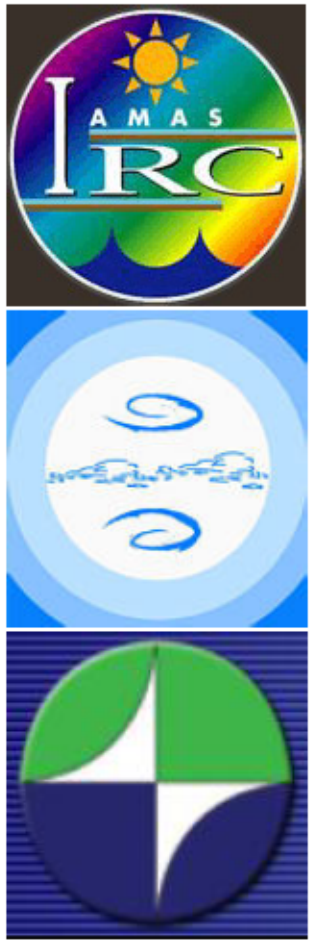
# WG 5: ICLAS - International Coordination group for Laser Atmospheric Studies

# WG 6: IPRT - International Polarized Radiative Transfer

# International WG on Polarized Radiative Transfer

Aims of working group IPRT:

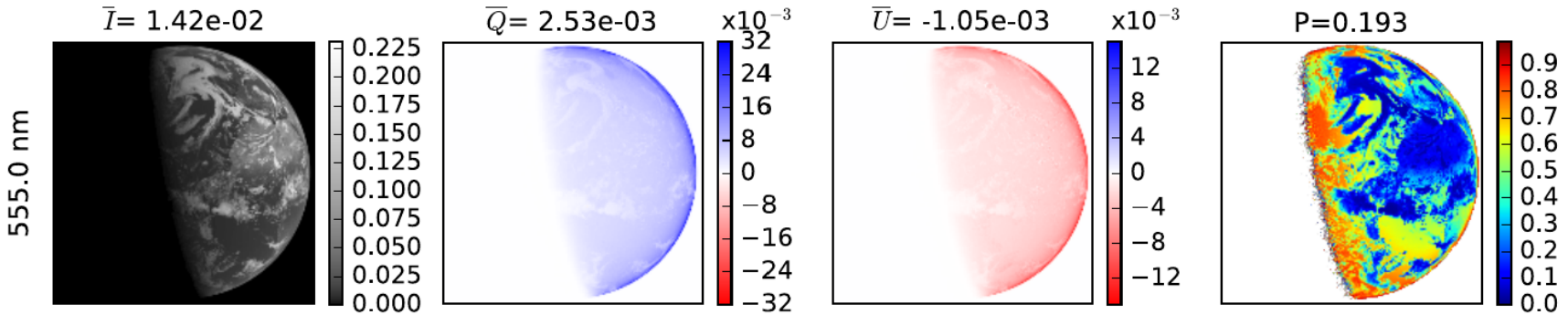
- bring the community together (workshops)
- **compare and improve models, 3D model intercomparison**
- **provide benchmark results**
- provide information about free codes
- develop new and faster, publically available codes
- provide input data (scattering matrices, **BPDFs – bidirectional polarization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




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

# Vector radiative transfer in spherical geometry

- Motivation
  - Satellite limb sounding of Earth atmosphere
  - Twilight observations from ground
  - RT in exoplanetary atmospheres
  - Intercomparison studies performed and benchmark results published (clear sky, aerosol, only specific geometies)
- Plans: more comprehensive model intercomparision
  - Observation geometries (limb, twilight)
  - Aerosol and cloud cases
  - Refraction
  - 3D spherical geometry
  - Status: various models under development




MYSTIC simulation of Earth as seen from Moon

# Further plans, ongoing work

- **BPDF models:**
  Collect literature and corresponding codes and update “surface polarization” section on IPRT website

- **Optical properties of liquid water droplets:**
  New Mie phase matrix tables for radii up to 1mm to simulate the impact of rain on polarimetric retrievals using e.g. the cloudbow

- New BPDF models and Mie tables are currently implemented in libRadtran

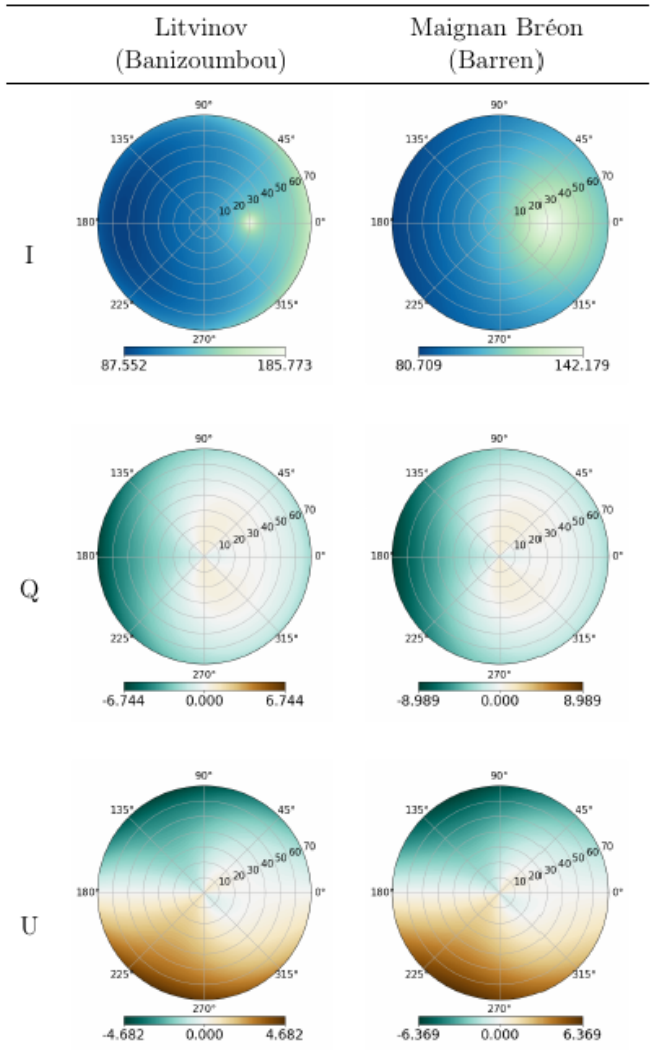



Figure from C. Wehrum 2023

# WG 7: ITWG - International TOVS Working Group

# 7. International (A)TOVS Working Group

Fiona Smith and Reima Eresmaa

IRC Business Meeting June 2024

# ITSC Leadership

Vincent Guidard and Liam Gumley ended their term as co-chairs in 2023.

New co-chairs were elected in May 2023:

**Fiona Smith**
Bureau of Meteorology

**Reima Eresmaa**
Finnish Meteorological Institute

ITSC-24 Conference Report can be found here:
https://itwg.ssec.wisc.edu/wordpress/wp-content/uploads/2024/05/itsc24_wg_report.pdf

# Current ITWG WG co-chairs

(new appointments in **bold**)

- Advanced Sounders WG:
  - Mr Dave Tobin (SSEC UW), Ms Dorothee Coppens (EUMETSAT)
- Climate WG:
  - Mr Bill Bell (ECMWF), Ms Nathalie Selbach (DWD)
- Numerical Weather Prediction WG:
  - Mr Brett Candy (UK Met Office), **Ms Christina Köpken-Watts (DWD)**
- International Issues and Future Systems WG:
  - Mr Niels Bormann (ECMWF), **Mr Heikki Pohjola (WMO)**
- Products and Software WG:
  - Mr Graeme Martin (SSEC UW), **Ms Anna Booton (UK Met Office)**
- Radiative Transfer and Surface Properties WG:
  - Mr Ben Johnson (JCSDA), Ms Vito Galligani (CIMA)

# Intersessional virtual ITWG WG to be held in June-July 2024:

- Advanced Sounders WG
  - 27 June 11 am UTC
- Climate WG:
  - 25 June 12 pm UTC (TBC)
- Numerical Weather Prediction WG
  - 10 July 9 am UTC
- Products and Software WG
  - Date TBD
- Radiative Transfer and Surface Properties WG
  - Date TBD
- (International Issues and Future Systems WG)
  - Not going to hold a meeting

# Radiative Transfer

## A reminder of ITWG recommendations

- Use of Satellite Sounder observations is Critically dependent on Radiative Transfer models – LBL models, Fast models and underlying Spectroscopy.
- ITSC-24 recommendations include:
  - Encourage comparison studies in model and/or laboratory spectroscopic measurements working more closely with the planetary/astronomy community for knowledge of LBL / spectroscopy information.
  - Continuous support of theoretical and laboratory spectroscopic studies.
    - A compilation of basic line parameters must be maintained
    - Characterisation of biases and uncertainties, mapped into radiance uncertainties
  - Continued support for development and maintenance of LBL models; regular reports that they are at risk, currently Rosenkrantz
  - Improvements to microwave RT:
    - Spectroscopy of higher frequency microwave channels up to 1000 GHz inc sub-mm H2O lines for the upcoming launch of ICI onboard Metop-SG
    - Evaluation of needs for hyperspectral MW missions
  - Development of FAR-IR models to support future missions such as FORUM

# WRC-23 outcomes

Thanks to Markus Dreis, EUMETSAT (ESSEO) and the ITWG RFI Subgroup co-chairs

- Stronger protection for passive microwave sensing 100-102 GHz, 148.5-151.5 GHz, 182-185 GHz, 190-191.8 GHz and 226-231.5 GHz now
  - Bands have been protected by a footnote prohibiting emission, which is contradicted by a statement to consider studies into sharing the bands with active services
  - The studies on sharing are now limited to other parts of the spectrum, and studies into compatibility of active services that may in future be allocated in bands adjacent to the above are indicated
  - 182-185 GHz is our core humidity sounding band and protection is vital
- New allocation for passive sensing at 239.2-242.2 and 244.2-247.2 GHz (instruments such as ICI)
- Limits to protect 18.6-18.8 GHz and 36-37 GHz from new commercial services/applications
- Avoided allocation to active services in MetSat L-band (used for uplink/downlink)
- C-band SST frequency (not strictly ITWG remit):
  - 6-7 GHz traditionally used for passive sensing for SST despite no protection. Now significant RFI due to IMT and WiFi.
  - Output of Agenda item WRC23 1.2 was a new agenda item WRC27 1.19 to study passive use of 4200-4400 and 8400-8500 MHz for SST measurements

# WRC-27 planning

Thanks to Markus Dreis, EUMETSAT (ESSEO) and the ITWG RFI Subgroup co-chairs

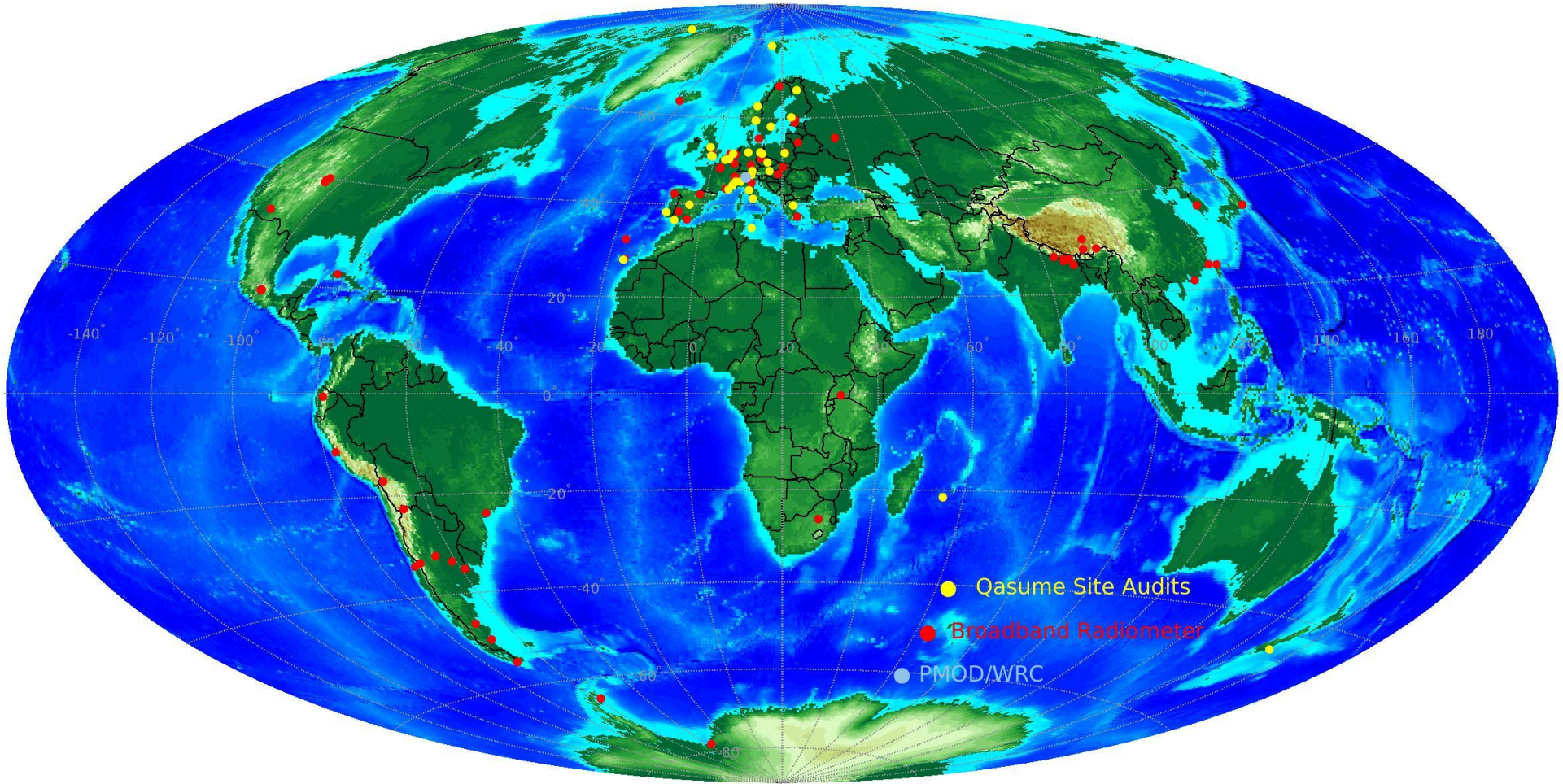
- Jean Pla will attend ITU-R Working Party 7A meeting (Time signals and frequency standard emissions) in Kazakhstan, September 2024
  - ITU-WMO forum/meeting and Jean will present the all WRC27 agenda items where EESS and METSAT allocations are under scope.
- For WRC-27, following CPM27-1, Jean was designated chapter rapporteur 4 for scientific issues (5 agenda items) for CPM27-2.

- Stephen English is a chair of ESSEO, an ESA initiative supported by ECMWF, EUMETSAT and other organisations in Europe to respond to the ever-growing threat of RFI at microwave frequencies
  - Planning studies to support preparation of information on impacts of RFI to ensure spectrum managers are prepared for WRC-27 matters
  - On the organising committee of the RFI2024 conference to bring together EO, Weather and Radio Astronomy communities together with Spectrum Managers

- Nancy Baker is a member of the US National Academy's *Views on WRC-27* committee

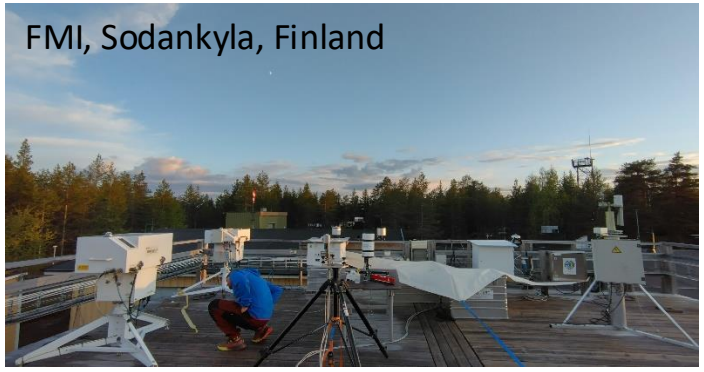
# WG 8: UV - Solar Ultra-Violet Radiation

# 8. UV Working Group – Overview
Ann Webb and Julian Groebner

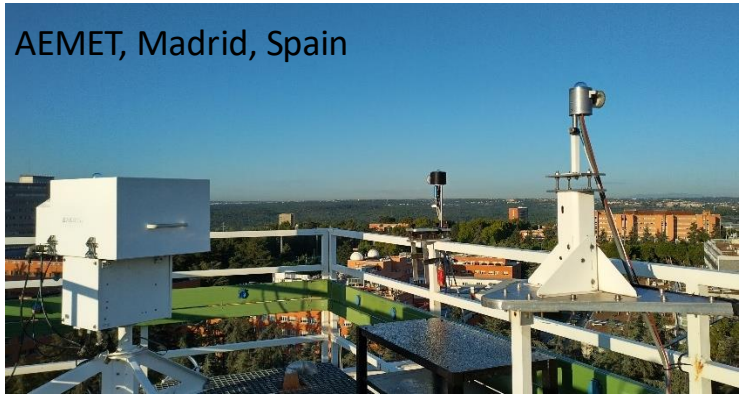


# Quality Assurance of spectral solar UV measurements in 2023










QASUME campaigns in 2023

- ARPA Aosta, Italy, 15-18 May
- FMI Sodankyla, Finland, 29 May - 2 June
- FMI Helsinki, Finland, 4-9 June
- El Arenosillo, INTA, Spain, 4-14 September
- AEMET, Madrid, Spain, 18-22 September
- A further 5 campaigns are planned for 2024

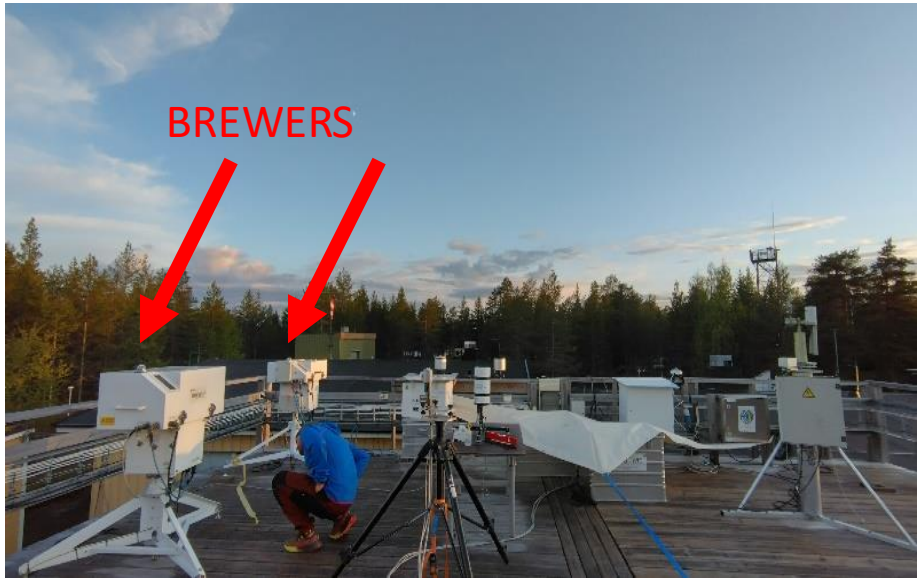
In Austria (2), Germany (2) and Davos.

# Good News, and concerns:

The Memorandum of understanding between the WMO and PMOD/WRC related to the provision of a World Calibration Center for Ultraviolet Radiation (WCC-UV) to the World Meteorological Organization, Global Atmosphere Watch Programme was renewed in 2024 for a 5 year period.

Covers both spectral UV (via QASUME) and Broadband UV (Davos)

The Brewer spectrophotometer that provides for spectral UV radiation measurements at many (but not all) sites globally, as well as column ozone measurements, is no longer manufactured.
Designed for long-term monitoring, but future maintenance and support becomes a concern.



# Selected Publications

*Maintaining measurement standards:*

2022: UVC-III (Ultraviolet Intercomparison), report published and available at https://library.wmo.int/records/item/68642-report-of-the-third-international-solar-uv-radiometer-calibration-campaign-uvc-iii

2022: Calibration campaign at PTB to validate the spectral irradiance scale of WCC-UV. Gröbner et al., AMT 2023, https://amt.copernicus.org/articles/16/4667/2023/amt-16-4667-2023.html

*UNEP report:*

Assessment Update of the UNEP Environmental Effects Assessment Panel. Chapters published in Photochemical and Photobiological Sciences Volume 22 (2023) e.g.

Stratospheric Ozone, UV Radiation and Climate Interactions

The effects of exposure to solar radiation on human health.

*Other example publications:*

Petkov B et al. (2023) An Unprecedented Arctic Ozone Depletion Event During Spring 2020 and its Impacts Across Europe. JGR-Atmospheres. J. Geophys. Res. - Atmos. 128, e2022JD037581. doi: 10.1029/2022JD037581

Elliott TM et al. (2024) Estimating population-level 25-hydroxyvitamin D concentrations in Australia and New Zealand using the Sun Exposure (SUNEX) microsimulation model. J Photochemistry and Photobiology 21, 100234 https://doi.org/10.1016/j.jpap.2024.100234

# WG 9: 3DRT (I3RC) - Three-Dimensional Radiative Transfer

# 9. 3DRT(I3RC)-Three-Dimensional Radiative Transfer

Alexander Marshak
NASA - Goddard Space Flight Center

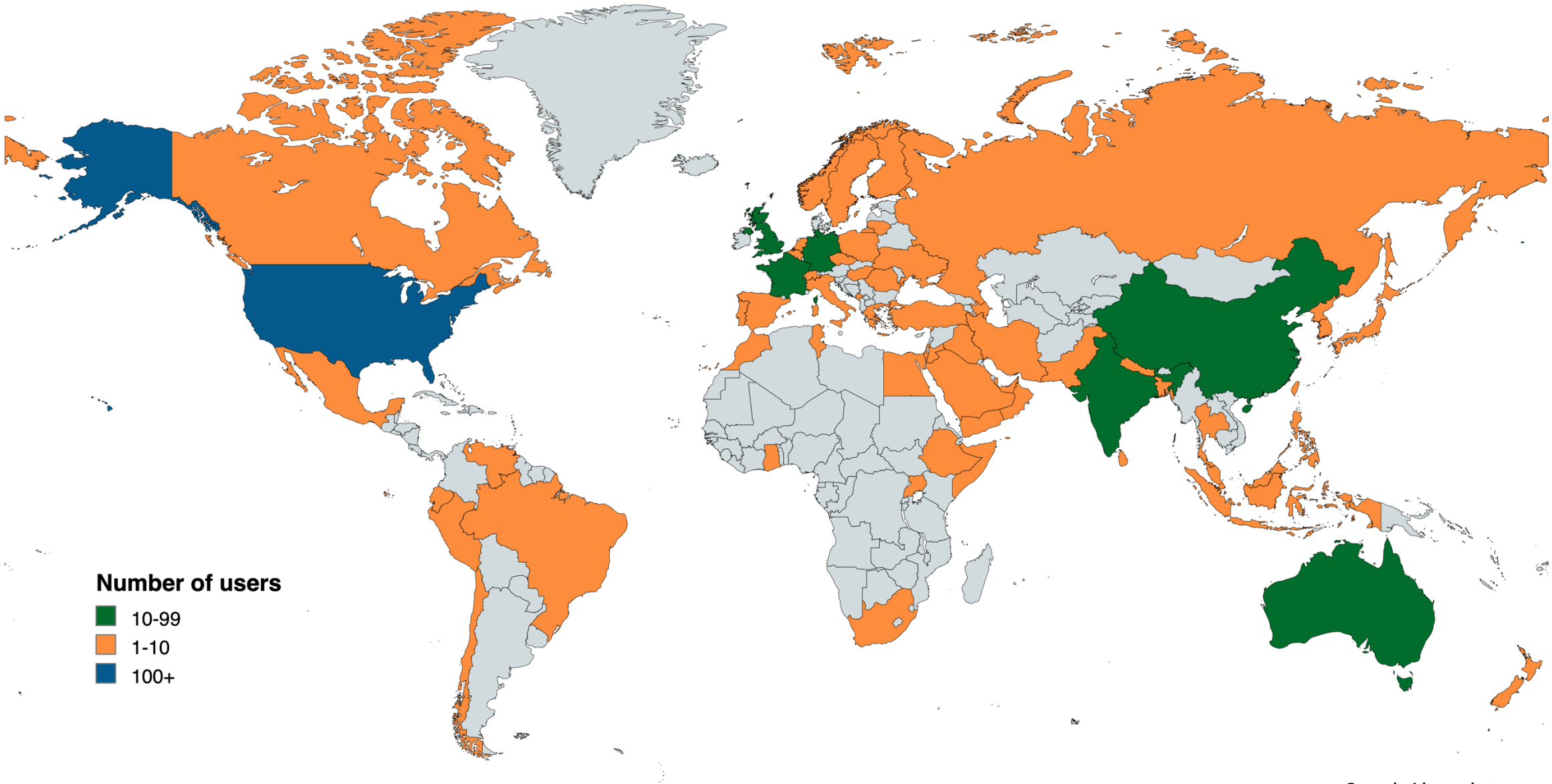
•The I3RC public site found a new home at NASA Goddard: https://earth.gsfc.nasa.gov/climate/model/i3rc.

•The list of publications on 3D radiative transfer in cloudy atmosphere has been created and maintained. (https://earth.gsfc.nasa.gov/sites/default/files/lab_climate/i3rcpublications.pdf)

•The I3RC public Monte Carlo code was obtained by a single researcher, who is from China. This is fewer than in the last four years, when we gave the code to 4 or 5 people each year. The downturn may be due to the public availability of other 3D radiation codes and perhaps to the I3RC code being also available through github, which we don't track.

•The I3RC online simulator (http://i3rcsimulator.umbc.edu) gained 288 new users since June 21, 2023. This is a large jump from previous years, as we gained 40, 18, 26, and 20 in each of the previous four years. This means that the number of users tripled in the past 11 months, jumping from 139 to 427. The user population now includes people from 68 countries, with the US being the country with the most users. Also, let me attach a map of the countries where the users are from.

•The 2nd Workshop on "Remote sensing in oxygen absorption bands" was held in De Bilt (The Netherlands) 29-31 May 2024.


Number of users
10-99
1-10
100+
Created with mapchart.net

# WG 10: HRMM - Hyperspectral Radiation: Measurements and Modelling

# WG 11: TSSI - Total and Spectral Solar Irradiance

# 11. The Extraterrestrial Solar Irradiance Working Group (SIWG):

*Highlights from the 2023-2024 Annual Report*

Odele Coddington, SIWG Chair

LASP, University of Colorado Boulder

# SIWG Mission Statement

To facilitate the proper representation of total solar irradiance (TSI) and solar spectral irradiance (SSI) on multiple time scales we will:

- ❖ specify and understand solar irradiance and its variability using measurements and models,
- ❖ define application-based measurement requirements for solar irradiance, and
- ❖ communicate recommendations to national and international scientific organizations and to the research community.

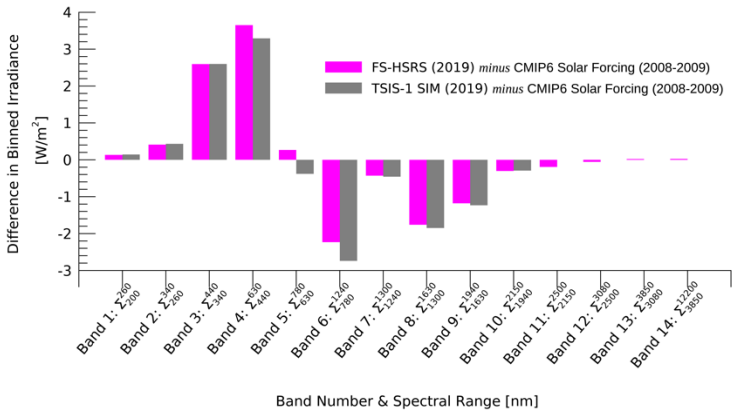
# Key Updates

1. A recommendation for the solar forcing dataset for CMIP7 has been made.
2. A new NOAA Solar Irradiance CDR will be released this fall, at the baseline irradiance scale of TSIS-1 and CTIM total and spectral solar irradiance observations (and many other improvements)
3. Several agencies (NASA, PMOD/WRC, and China) are supporting instruments to measure TSI and SSI. Studies comparing the accuracy and stability of the various datasets are underway.
   - ❖An agency plan for the continuity of the NASA solar irradiance record beyond TSIS-2 (launch in 2025; 3 year mission) has not been established, although a Compact Total and Spectral Irradiance Sensor (CTSIS) Pathfinder approach has been defined by LASP/CU Boulder with CTIM and CSIM instruments.

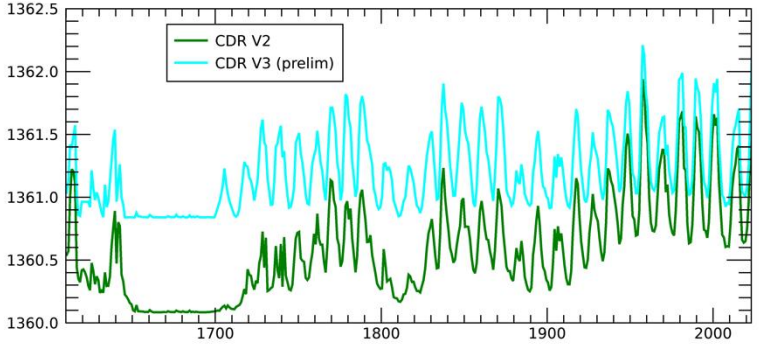
# CMIP7 Solar Forcing Recommendation

- The CMIP7 solar forcing working group recommended the NRLSSI4 dataset, at the TSIS-1 Hybrid Solar Reference Spectrum, as the official CMIP7 solar irradiance reference, with *no averaging with other datasets* as was done in CMIP6.
- The SATIRE model will be used to estimate confidence intervals and as an independent dataset for climate model testing to different forcing.

Baseline Spectral Difference from CMIP6




Historical TSI Difference from NRLSSI2 (CDR V2)




**A new name:** The Naval Research Laboratory (NRL) solar variability models are being renamed to 'NASA NOAA LASP' (NNL) and the version/numbering will be restarted.

NRL Version 4 → NNL Version 1

The ‘NASA NOAA LASP’ (NNL) solar irradiance variability models are the baseline for the NOAA Solar Irradiance Climate Data Record (CDR) Version 3, which provides operationally-updated SSI and TSI at the TSIS-1 HSRS baseline irradiance spectrum, consistent with CTIM and Total Irradiance Monitor TSI observations.

SORCE

NRL v2 Model Development

NOAA

CDR, Version 2

*>20,000 website “hits” since 2016*

*validation*

CDR, Version 3

*Also for space weather studies*

*Public release August 2024*

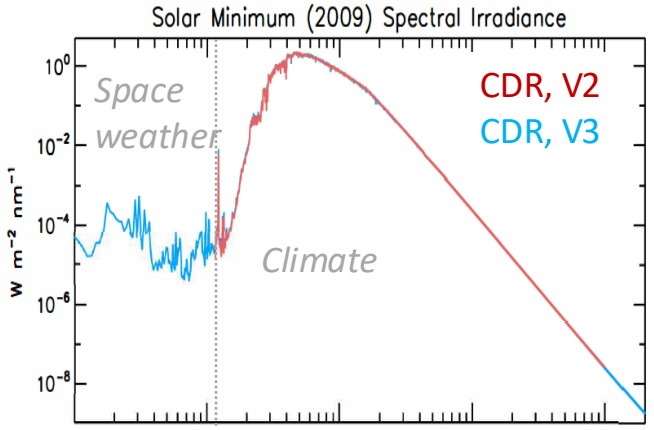
****CMIP7 recommended dataset***

TSIS Total and Spectral Solar Irradiance Sensor

NNL v1 Model Development

SIST Solar Irradiance Science Team

**Numerous Research Advances & New Capabilities**
**Incl. high-resolution SSI model & Solar Irradiance prediction to 2100**




0 to 200,000 nm

# Current Operational Solar Irradiance Sensors

| Mission | Observable | Operational | Comment |
|---|---|---|---|
| TSIS-1 | TSI | Yes | Data gaps due (primarily) to ISS operations |
| | SSI | Yes | Anomaly resolution of SIM Digital Signal Processer and Electrical Substitution Radiometer are ongoing. Data gaps due to ISS operations and, since Oct 21, 2023 due to above anomalies (data at 1600-1800 nm not published currently) |
| Fengyun-3E | TSI (Chinese SIM instrument) | Yes | |
| | SSI (Chinese SSIM instrument) | Yes* (not public?) | 2.5 years of L1A products acquired (requires reprocessing of spectral and radiometric calibration). SAA causing anomalies and observation interruptions. |
| | TSI (PMOD/WRC instrument) | Yes | |
| VIRGO | TSI | Yes | |

**PROBA-3/DARA and NorSat-1/CLARA updates are pending (available by time of meeting).*

# Membership

| Name | Affiliation | Country |
|---|---|---|
| Odele Coddington - Chair | Laboratory for Atmospheric and Space Physics (LASP) | USA |
| Mustapha Meftah | Laboratoire Atmosphères, Milieux, Observations Spatiales (LATMOS) | France |
| Wolfgang Finsterle | Physical Meteorological Observatory in Davos (PMOD) | Switzerland |
| Margit Haberreiter | Physical Meteorological Observatory in Davos (PMOD) | Switzerland |
| Natalie Krivova | Max Planck Institute for Solar System Research (MPS) | Germany |
| Judith Lean | Laboratory for Atmospheric and Space Physics (LASP) | USA |
| Janet Machol | National Oceanic and Atmospheric Administration (NOAA) | USA |
| Erik Richard | Laboratory for Atmospheric and Space Physics (LASP) | USA |
| Martin Snow | South African National Space Agency (SANSA) | South Africa |
| Mark Weber | University of Bremen | Germany |
| Peng Zhang | China Meteorological Administration (CMA) | China |

# WG 12: Machine Learning Applications in Remote Sensing

IRC business meeting, 18 June 2024

# **BDAI** -Big Data and Aritificial Intelligence

**Feng Zhang**

Fudan University

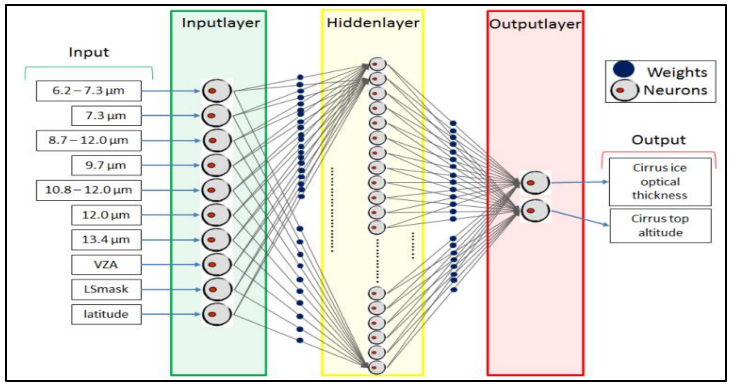
Objectives: The main objective of this working group is to promote the development of machine learning methods in areas such as improving and accelerating radiative transfer model solutions and satellite remote sensing retrieval methods, and to share ideas, techniques, and high-quality datasets for machine learning in radiative transfer and remote sensing.

# BDAI WG

## ➢ Application of machine learning to cloud parameters retrieval

Spectral characteristics

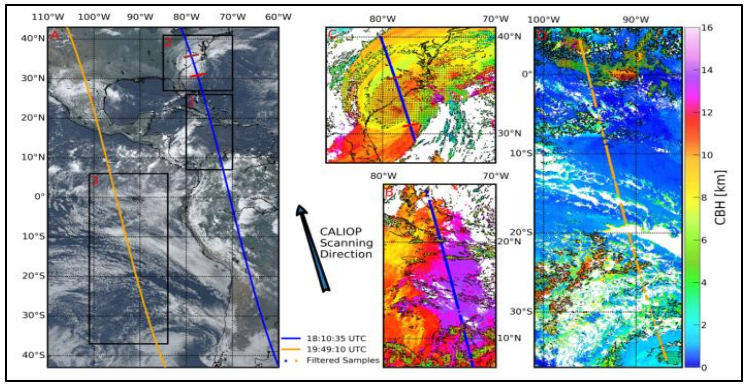
### Cirrus Ice Optical Thickness and Top Altitude




**Neural Network**

(S. Kox, et al. ***AMT*** , 2014)

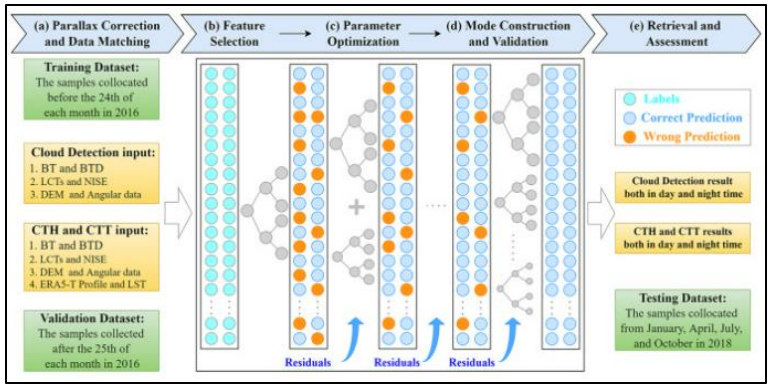
### Cloud Base Height




**Gradient Boosting Regression Tree**

(Han Lin, et al. ***RSE*** , 2022)

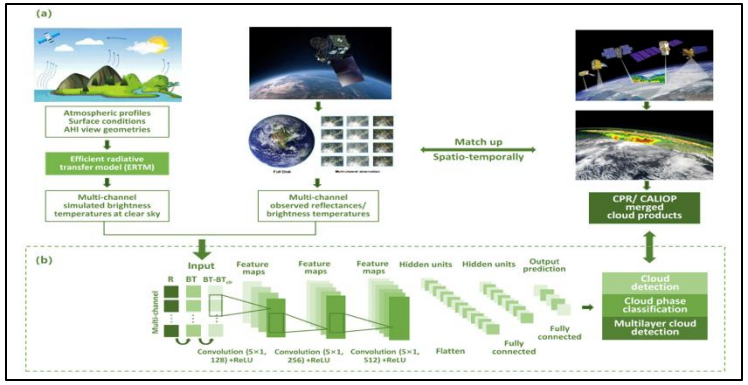
### Cloud Top Height and Cloud Top Temperature




**XGBoost**

(Yikun Yang, et al. ***RSE*** , 2022)

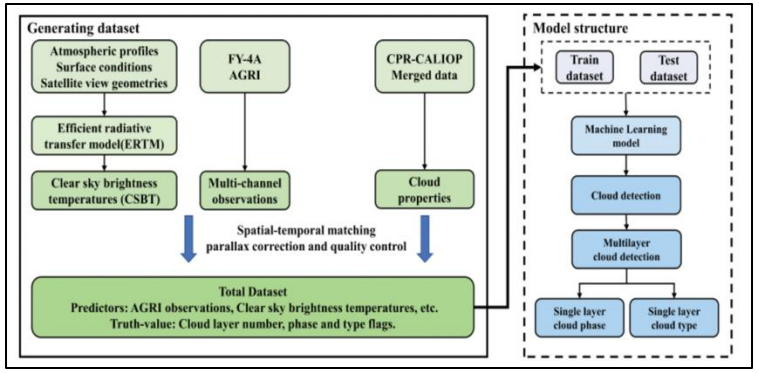
### Cloud Phase and Cloud Mask




**Deep Neural Network**

(Wenwen Li, et al. ***TGRS*** , 2022)

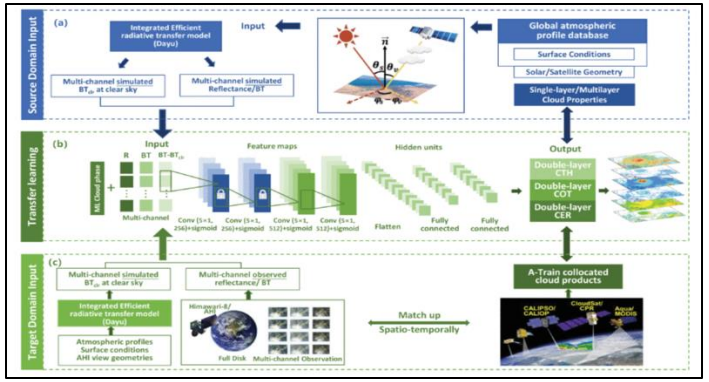
### Cloud Classification




**Deep Neural Network**

(Bin Guo, et al. ***TGRS*** , 2024)

### Multilayer Cloud Property



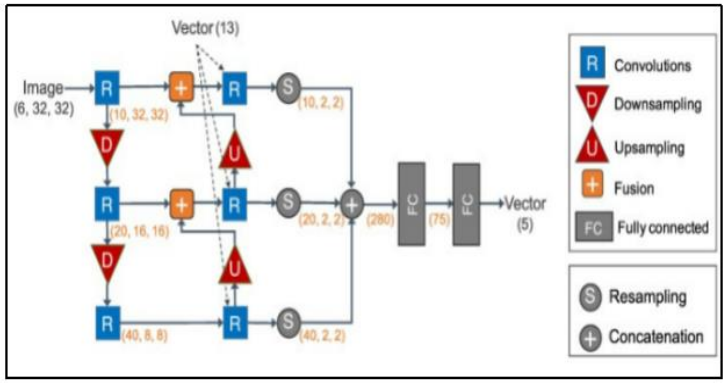

**Deep Neural Network**

(Wenwen Li, et al. ***TGRS*** , 2024)

# ➢ Application of machine learning to cloud parameters retrieval

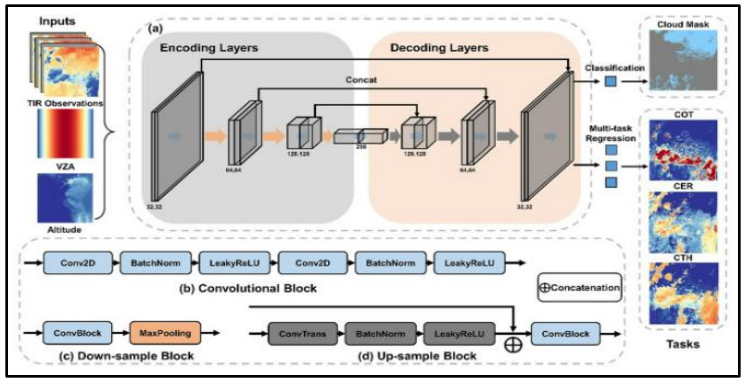
## Neighboring information / Spatial texture characteristics

### Ice Cloud Top Height and Cloud Optical Thickness



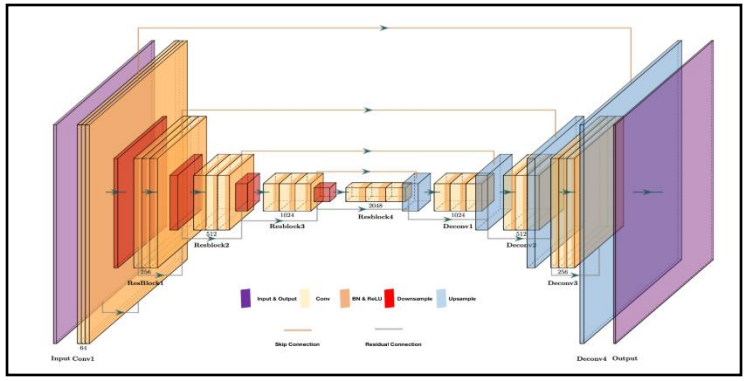

**Deep Convolutional Neural Network**
(Xinyue Wang, et al. ***RSE*** , 2022)

### Cloud Effective Radius and Cloud Optical Thickness



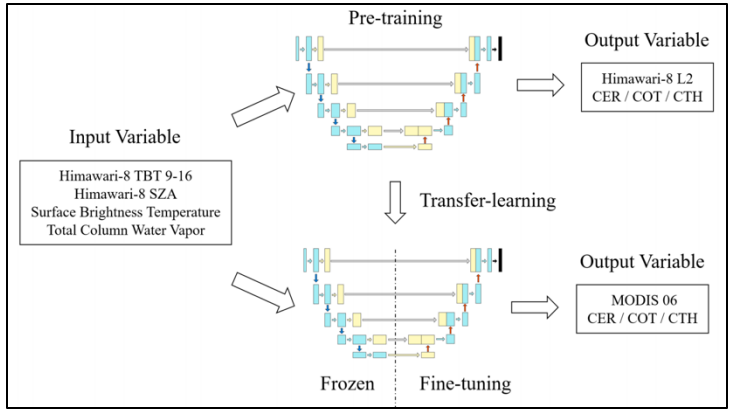

**Convolutional Neural Network**
(Quan Wang, et al. ***RSE*** , 2022)

### Cloud Phase



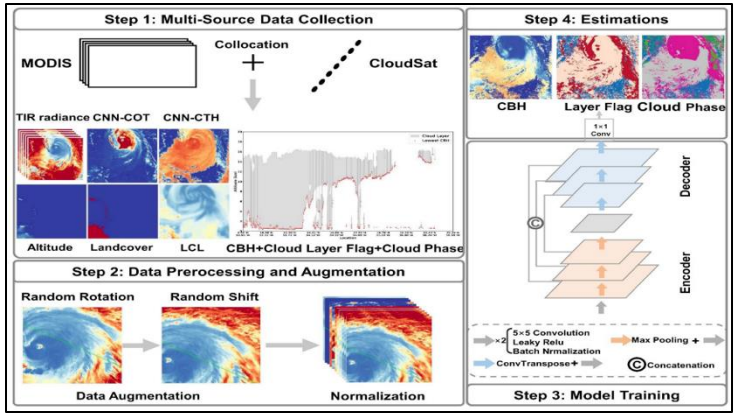
**Res-Unet Network**
(Xuan Tong, et al. ***GRL*** , 2023)

### Cloud Top Height, Cloud Optical Thickness and Cloud Effective Radius



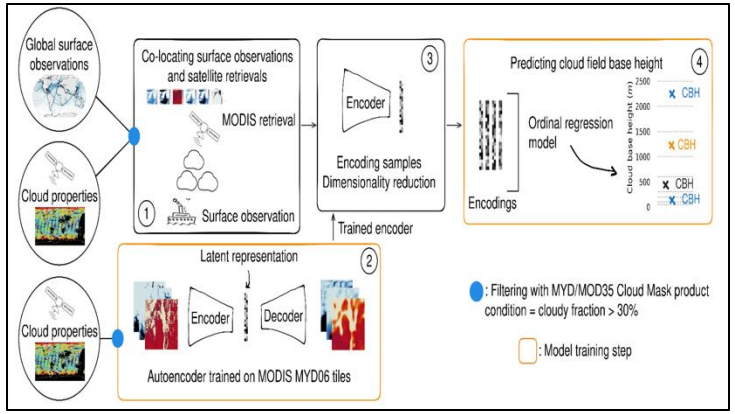

**Transfer-learning-based UNet**
(Jingwei Li, et al. ***TGRS*** , 2023)

### Cloud Base Height and Phase




**Convolutional Neural Network**
(Quan Wang, et al. ***TGRS*** , 2023)

### Marine Cloud Base Height



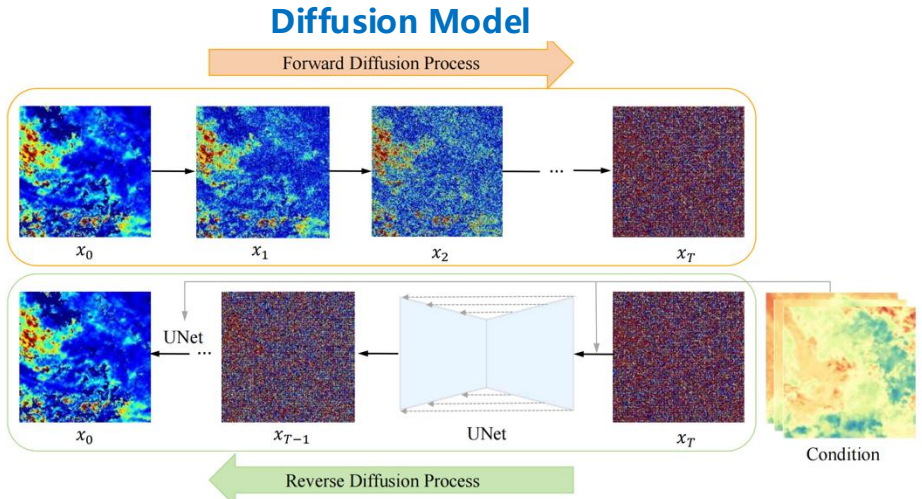

**Autoencoder**
(Julien LENHARDT, et al. ***EGUsphere***, 2024)

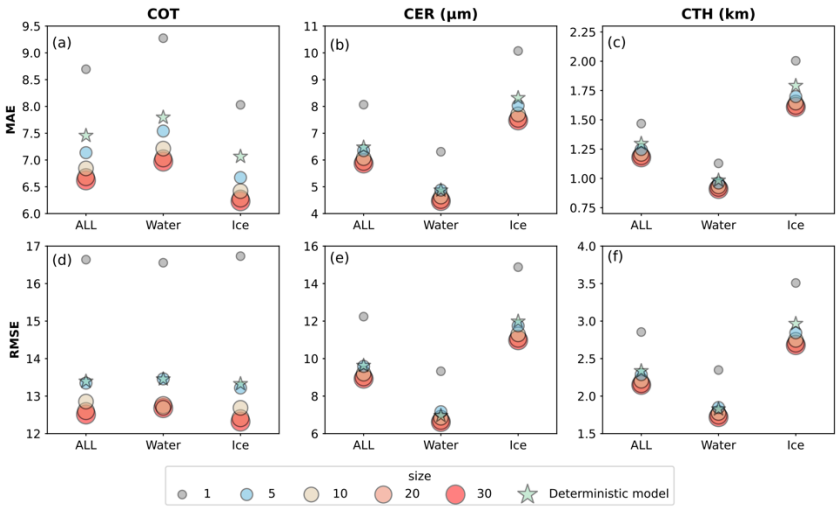
# BDAI WG

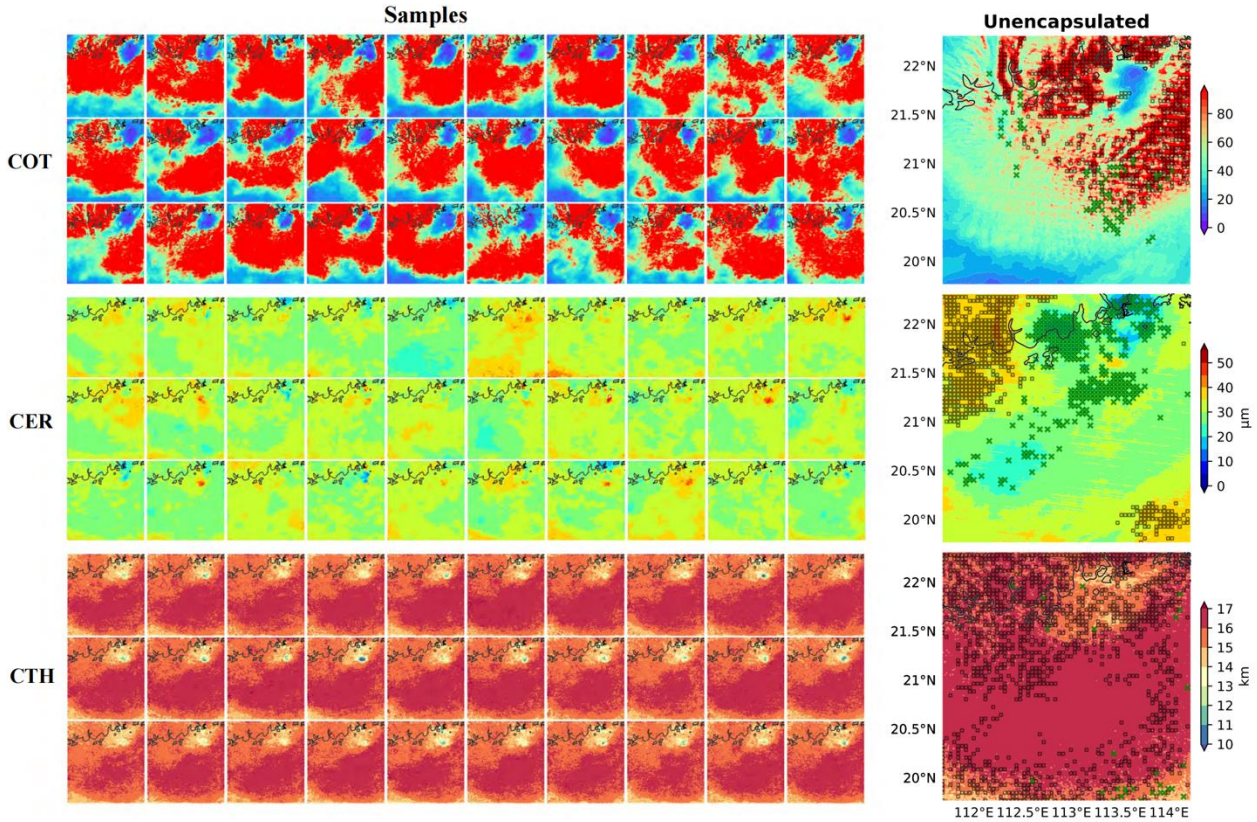
## ➢ Application of machine learning to cloud parameters retrieval

### Generative Model => CloudDiff: Super-resolution ensemble retrieval of cloud properties

(Haixia Xiao, Zhang Feng* et al. ***Arxiv***, 2024)




- The high spatiotemporal (1km,10min) cloud properties were retrieved by a generative diffusion model, applicable both day and night.
- Compared with the deterministic model, the conditional diffusion model can generate sharper images and capture finer local features.

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Yikun Yang, Wenxiao Sun, Yulei Chi, Xing Yan, Hao Fan, Xingchuan Yang, Zhanshan Ma, Quan Wang, Chuanfeng Zhao, Machine learning-based retrieval of day and night cloud macrophysical parameters over East Asia using Himawari-8 data, Remote Sensing of Environment, Volume 273, 2022, 112971, ISSN 0034-4257, https://doi.org/10.1016/j.rse.2022.112971.

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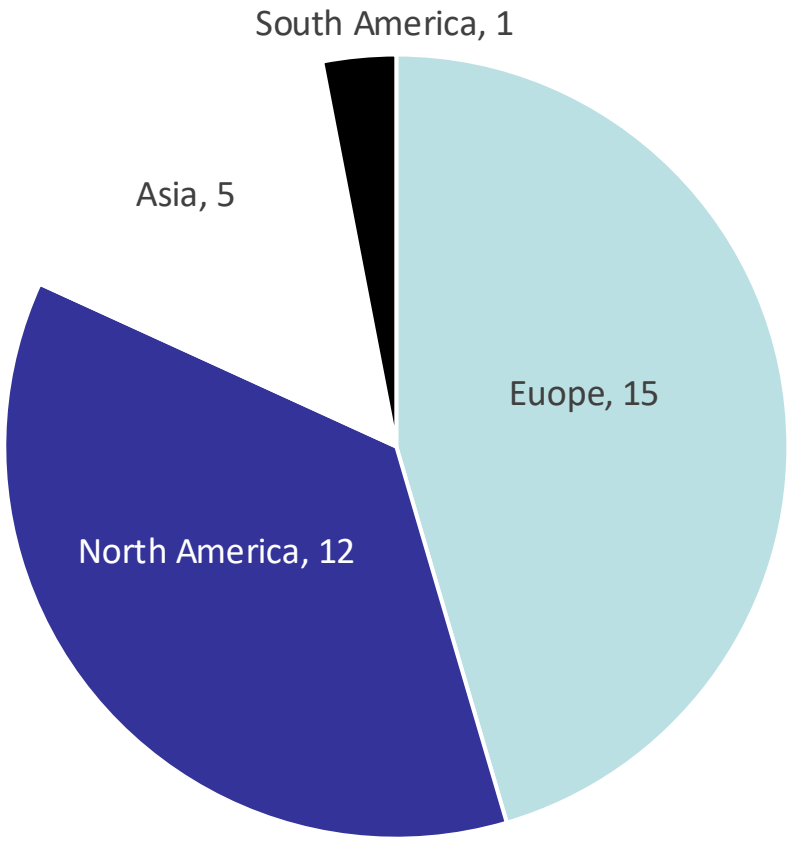
Lenhardt, Julien, Johannes Quaas, and Dino Sejdinovic. "Marine cloud base height retrieval from MODIS cloud properties using machine learning." EGUsphere 2024 (2024): 1-26.

Xiao, Haixia, zhang feng et al. "CloudDiff: Super-resolution ensemble retrieval of cloud properties for all day using the generative diffusion model." arXiv preprint arXiv:2405.04483 (2024).

# Upcoming Election for New Commissioners (2025-2028 term)

IRC Geographical Distribution




Total 33 Commissioners

Outgoing members

- 11 from Europe
- 5 from North America
- 1 from South America
- 4 from Asia

Total 21

# Next IRC Business Meeting

# Next IRC Business Meeting

The IRC has proposed the following sessions at BACO-25:

- Title: Earth's Radiative Energy Budget
  - Suggested Conveners: Seiji Kato, Norman Loeb, Martin Wild, Maria Hakuba
- Title: Advances in Atmospheric Radiation
  - Suggested Conveners: Manfred Wendisch, Hajime Okamoto, Christine Chiu
- Joint session with ICCP on Cloud-Precipitation-Aerosol Studies