2022 International Radiation Commission (IRC) Business Meeting

5 July 2022

Agenda

I. Welcome and Introductions (10)

II. President's Report (20)

   a. IRC Financial Status
   b. IUGG 2023 IRC-sponsored/co-sponsored Sessions
   c. Upcoming meetings

III. Presentation of IRS 2024 Proposals (50)

   a. Lei Bi: Hangzhou, China
   b. Feng Zhang: Shanghai, China

IV. Vote on IRS 2024 bids (10)

V. Working Group Presentations (45)

VI. Proposal for new Working Group: Feng Zhang (10)

VII. Next Business Meeting to be held during the 28th IUGG General Assembly, 11-20 July 2023, Berlin (5)

VIII. Other Business

Treasurer's Report

2021-2022 Budget Summary

Date	Transaction	Amount (in)(USD)	Fees (out)(USD)	Balance (JPY)	Estimated Balance (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
total				920,816	6,661.48

IAMAS/IRC Sessions at IUGG 2023

- Earth’s Energy Budget
  - Conveners: Seiji Kato, Norman Loeb, Martin Wild, Maria Hakuba
- Advances in Atmospheric Radiation
  - Conveners: Peter Pilewskie, Manfred Wendisch, Hajime Okamoto
- Solar Influence on the Atmosphere and Climate (Joint with IAGA)
  - Conveners: Odele Coddington, Christoph Jacobi, Luc Damé
- Cloud-Radiative Interactions (IAMAS/Joint with ICCP)
  - Conveners: Greg McFarquhar, Sebastian Schmidt, Yi Huang, Mahen Konwar, David Noone, Odran Sourdeval, Trude Storelvmo, Andreas Macke

Upcoming meetings

1. COSPAR 44th Scientific Assembly, **16-24 July 2022,** Athens, Greece (https://www.cosparathens2022.org/)
2. AMS 16th Conference on Cloud Physics/16th Conference on Atmospheric Radiation, **8-12 August 2022**, Madison, WI USA (https://www.ametsoc.org/index.cfm/ams/meetings-events/ams-meetings/collective-madison-meeting/)
3. Metrology for Climate Action 2022 Workshop (https://bipmwmo22.org/), **26-30 September** (fully virtual). Hosted by BIPM and WMO
4. AGU Fall Meeting, **12-16 December 2022**, Chicago, USA (https://www.agu.org/Fall-Meeting)
5. EGU General Assembly 2023, **23-28 April 2023**, Vienna, Austria (https://www.egu23.eu/)
6. IUGG 2023, **11-20 July 2023**, Berlin, Germany (https://www.iugg2023berlin.org/)

IRS 2024 Proposals

Lei Bi: Hangzhou, China

Feng Zhang: Shanghai, China

Summary of Proposals

	Hangzhou, China	Shanghai, China
Dates	1-6 June (6 days)	5-9 August (5 days)
Climate (Temp. / Precip.)	21-29 °C / precip. 211 mm	28 °C / 12 days of precip
Hosting body	Zhejiang University	Fudan University
Local Organizing Committee	Lei Bi (12 LOC members)	Feng Zhang(37 LOC members)
Direct international access	China, Japan, Korea, Malaysia, Singapore, Russia, Netherlands, Spain, Italy, Australia, USA , Canada, Egypt	39 countries and regions in Asia, Europe, Africa, Oceania and North America
Alternative access	Shanghai Pudong or Hongqiao; 1 hour from Shanghai by train	Shanghai railway hub
Conference Venue	Mengminwei Building/Zijingang Theatre, Zhejiang University	Shanghai International Convention Center
Auditorium	2	
500+ PAX rooms	2	
250 PAX rooms	several	
50 to 800 PAX rooms		30
Registration fees		
Early full/student	380/190 USD	360/300 USD
Normal full student	460/230 USD	420/360 USD
Accompanying person	140 USD	
Accommodations	On campus and several nearby	At the convention center and several nearby
Local transport	metro, bus, taxi shared, bicycles	metros, buses, ferries, and taxis
Tourist attractions	Many attractions in an ancient city	Many attractions in an ancient city
Net proceeds to IRC	~ USD 10K	~ 10K USD

IAMAS

Vote on Location of IRS 2024

IRS 2024 BALLOT Vote (X) for One Proposal Only	
Shanghai	☐
Hangzhou	☐

Working Group Presentations

The 11 IRC Working Groups
ASA - Atmospheric Spectroscopy Applications Chair: Iouli Gordon
BSRN - Baseline Surface Radiation Network Co-Chairs: Amelie Driemel and Christian Lanconelli
CR - Clouds and Radiation Chair: Andreas Macke
GEB - Global Energy Balance Co-Chairs: Norman Loeb and Martin Wild
ICLAS - International Coordination group for Laser Atmospheric Studies Chair: Alex Papayannis
IPRT - International Polarized Radiative Transfer Co-Chairs: Claudia Emde and Bernhard Mayer
ITWG - International TOVS Working Group Co-Chairs: Liam Gumley and Vincent Guidard
UV - Solar UltraViolet Radiation Co-Chairs: Julian Groebner and Ann Webb
3DRT (I3RC) - Three-Dimensional Radiative Transfer Chair: Alexander Marshak
HRMM - Hyperspectral Radiation: Measurements and Modelling Chair: Piet Stammes
TSSI - Total and Spectral Solar Irradiance Chair: Odele Coddington

WG 1: ASA - Atmospheric Spectroscopy Applications

Iouli Gordon

CENTER FOR ASTROPHYSICS
HARVARD & SMITHSONIAN

ASA progress report

I. Gordon, L. Rothman, R. Hargreaves, F. Skinner, and HITRAN community worldwide

- The HITRAN2020 edition is now being implemented into radiative transfer codes
- Substantial improvements ae noticed, and remaining sources of uncertainties identified
- Work toward future edition is underway and includes.

A) Incorporation of new high-precision measurements and calculations

B) Further expansion of the non-Voigt line shape parametrisations (methane is next "big thing")

C) Incorporation of water vapor continuum (led by Eli Mlawer)

D) Validations and improvement of user-friendly tools (including HAPI)

ASA-HITRAN CONFERENCE – REIMS – FRANCE

AUGUST 24 –26, 2022

https://www.univ-reims.fr/asa-hitran/

Metrology for Climate Action

September 26 –30, 2022

https://www.bipmwmo22.org/

Bureau International des Poids et Mesures

WORLD METEOROLOGICAL ORGANIZATION

WG 2: BSRN - Baseline Surface Radiation Network

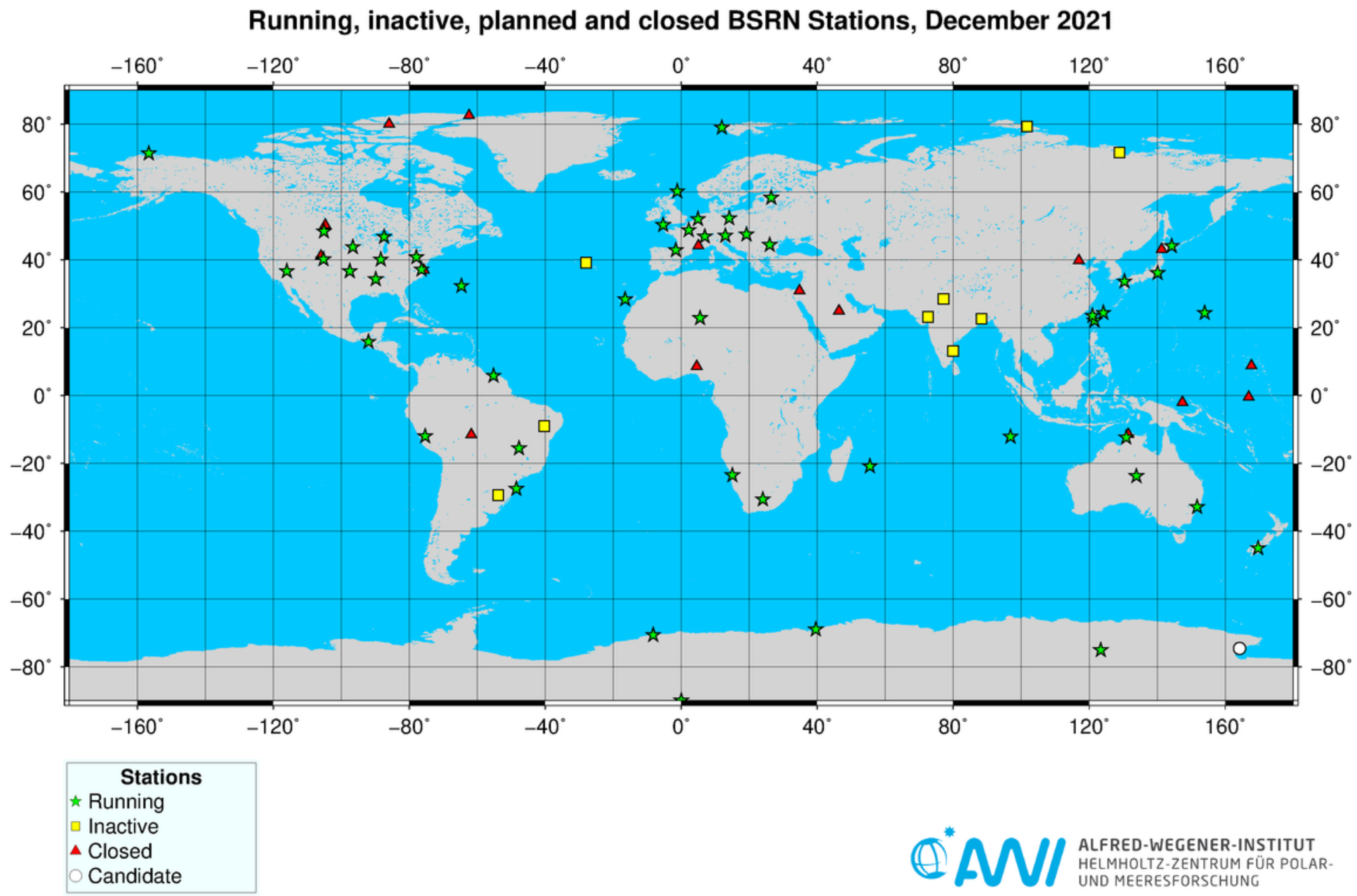
Amelie Driemel (AWI), Christian Lanconelli (EC JRC) and Laura Riihimaki (NOAA CIRES)

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. BSRN is designated as the global surface radiation network for the Global Climate Observing System (GCOS) and 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 Laura Riihimaki (since 2020) and the WRMC Director Amelie Driemel (since 2017). Christian Lanconelli attended several GEWEX-GDAP and NDAAC 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. Amelie Driemel reported on the BSRN status during the national German GCOS meeting in April 2022 (online).

At the moment (status May 2022) BSRN comprises 76* stations (compared to 74 in 2021) in contrasting climatic zones, covering a latitude range from 80°N to 90°S. Sixteen stations are closed, 9 have been marked as inactive (no data submitted for more than 2 years), one station (Terra Nova Bay, Antarctica (WMO 89859)) is still in candidate status (data submission pending). Three stations from Thailand, Indonesia and Cyprus are in pending status.



ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR-
UND MEERESFORSCHUNG

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

About **12,500 months of radiation data** (~12,200 in 2021) are available either via PANGAEA or via the BSRN ftp server (https://dataportals.pangaea.de/bsrn/?q=LR0100 or http://bsrn.awi.de/data/data-retrieval-via-ftp/), and downloadable upon a password request to the WRMC director.

The next a BSRN scientific review and workshop is planned for the end of June, 2022 in hybrid form. It will be structured following classical BSRN workshop agendas, with sessions dedicated to station operations, data analysis towards value-added-products, modelling, remote-sensing, campaigns (instrument inter-comparison), Working Group roundtable and reports. Issues to be considered are new challenges in term of stakeholders' requirements (space agencies and climate services in particular), compliance with GCOS monitoring principles, Fiducial Reference Measurements metrological concepts, FAIR principles, measurements on harsh environments, harmonization of the practices with the ocean community, and gaps coverage.

The update of the BSRN Manual (WG head Gary Hodges) took up its work again after a break in 2021. The overall outline has been drafted, and leads responsible for each section were identified. Besides, the GCOS-174 technical document is under revision, in particular to include the format for a new logical record (LR4000) pertinent to raw measurements collected by the pyrgeometers, and to update the general information on the status of BSRN (last update was in 2013).

The active BSRN working groups (WG head) are: Infrared measurements (Wacker), Spectral measurements (Lantz), Broadband (McComiskey) measurements, Uncertainties (Vuilleumier), Renewable Energies (Pereira), Data Quality (Knap), Ocean (Riihimaki), Value Added Product (VAP WG) (Lanconelli, interim), and Albedo/Satellite CAL/VAL WG (Wang). During the upcoming BSRN meeting the activities of all WG, will be reviewed with the aim to reinforce their role to foster the support to data users, remote sensing and modelling communities. Particular attention will be given to Analysis Ready Data (ARM) concepts based on BSRN data, prepared by experienced users (such as averages, cloud screened data, cloud radiative affects, etc.). The Cold Climate Issue (Cox) working group has stopped.

Within the Data Quality WG, regular meetings continued to take place leading to a Data Quality Workshop in April 2022 (held twice to serve the different parts of the world, 60 participants in total). The Workshop consisted of a presentation of the basic principles of BSRN data quality and the application of these principles to real station data. Then, a centralized web site for the visualization of the data quality of various BSRN stations was introduced (developed by W. Knap (KNMI). An interaction with the Solar RE community on solar QC has been established.

BSRN quality checked data feed initiatives such as the "Ground Based Observation for the Validation of Copernicus Products" (GBOV/Copernicus Global Land Service) with solar irradiance (diffuse and global), albedo and skin temperature (as obtained from LW upwelling and downwelling combined measurements). The management is interacting with the "Copernicus CAL/VAL Solution" (CCVS) project to reinforce the role of the network, in synergies with other partners, for a better support to space agencies.

Recently, April 2022, the request for a renewed partnership (to be a recognized reference network) with GCOS has been submitted.

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 4900 times (without self citations) within 3500 articles (without self citations, see Figure 1). About 175 BSRN articles have been published (compared to 164 in August 2021), and many more scientists used BSRN data e.g. in student courses, for renewable energy research or in grey literature.

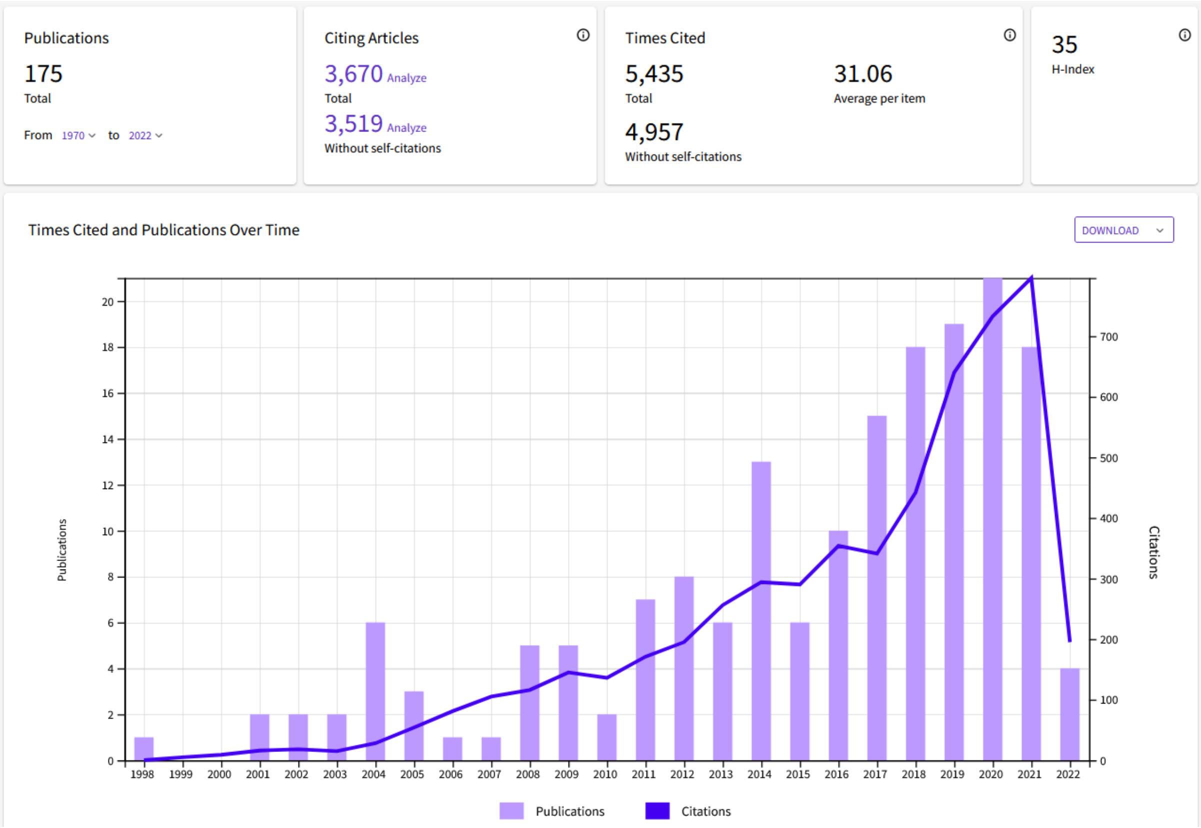


Figure 1 Web of Science Citation Report for the Topic “BSRN” (2022-05-05)

On going activities and Plans

1. Manual review, continue with established activities and drafted content (status: on-going)
2. Cover the network knowledge gaps, setup of a dedicated user group on Capacity4Dev platform of the EC (stopped)
3. Harmonize measurements, implement ground meteorological traceability (T, p, RH) (on-going).
4. Establish Albedo WG / expand albedo measurements (tower/drones?) (on-going, within CCVS in particular)
5. Establish VAP WG (status of the affairs will be presented at IRS / Poster Lanconelli/Riihimaki)
6. Extend inter-network interactions (on going within CCVS)
7. Explore the space agencies'/private sector (SE) interests to invest in area gap coverage (Africa/Pacific) for validation purposes (EU) (on-going)
8. Organize the physical Workshop in 2022 (June 27-30 2022, hybrid, at European Commission Joint Research Centre Ispra, Italy)
9. Interaction with Ocean community initiatives (Radiation measurements best practice white paper lead by Riihimaki NOAA).

WG 3: CR - Clouds and Radiation

Clouds Processes & Radiation (CPR)

focus on processes between environmental and cloud (macro-, microphysical and radiative) properties

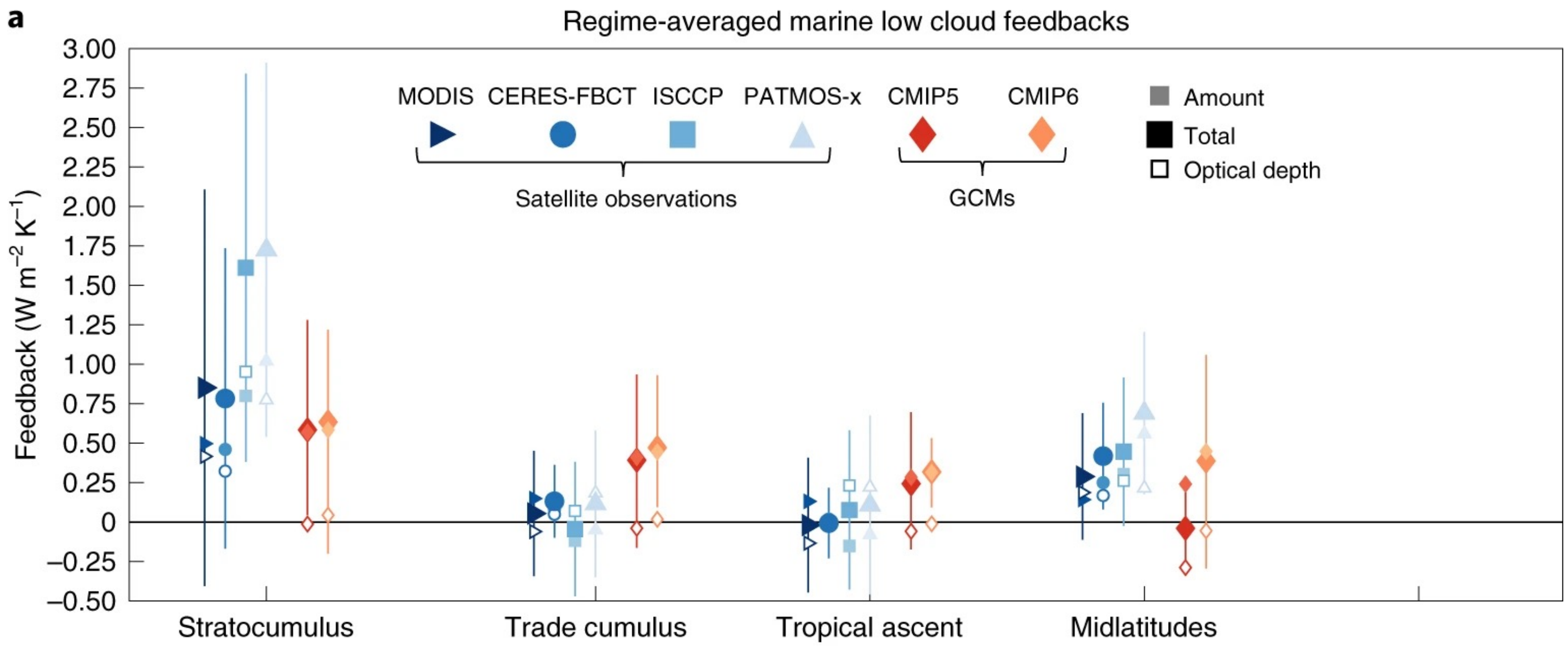
report for IRC 2022

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

Cloud-climate feedbacks

- **constrain cloud-controlling factors in satellites and CMIP**
  - yields a moderate climate sensitivity of 3 K (Myers et al. NCC 2021)

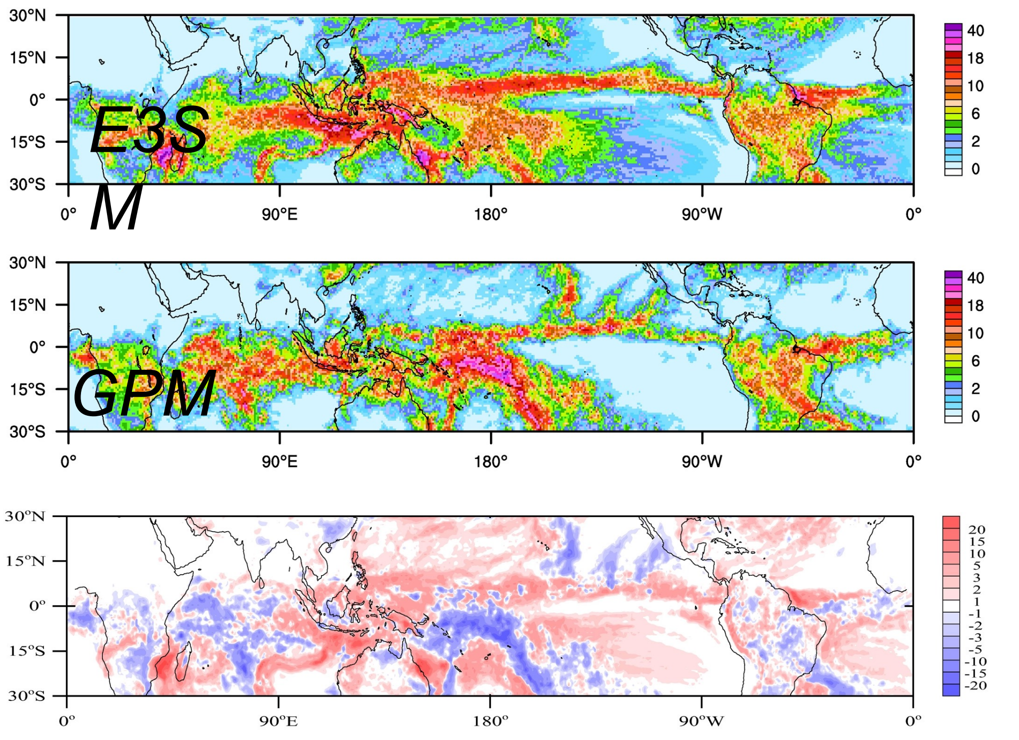
  - similar result from Cesana and Del Genio (NCC 2021, at 3.5 K)



Cloud model improvements

- **machine-learning approaches**
  - e.g. for autoconversion (Gettelman et al. JAMES 2021)

- **global storm-resolving models**
  new: E3SM (Caldwell et al. JAMES 21)
- *motivation: adaptation and impact research (Bauer, Stevens, Hazeleger NCC 2021)*



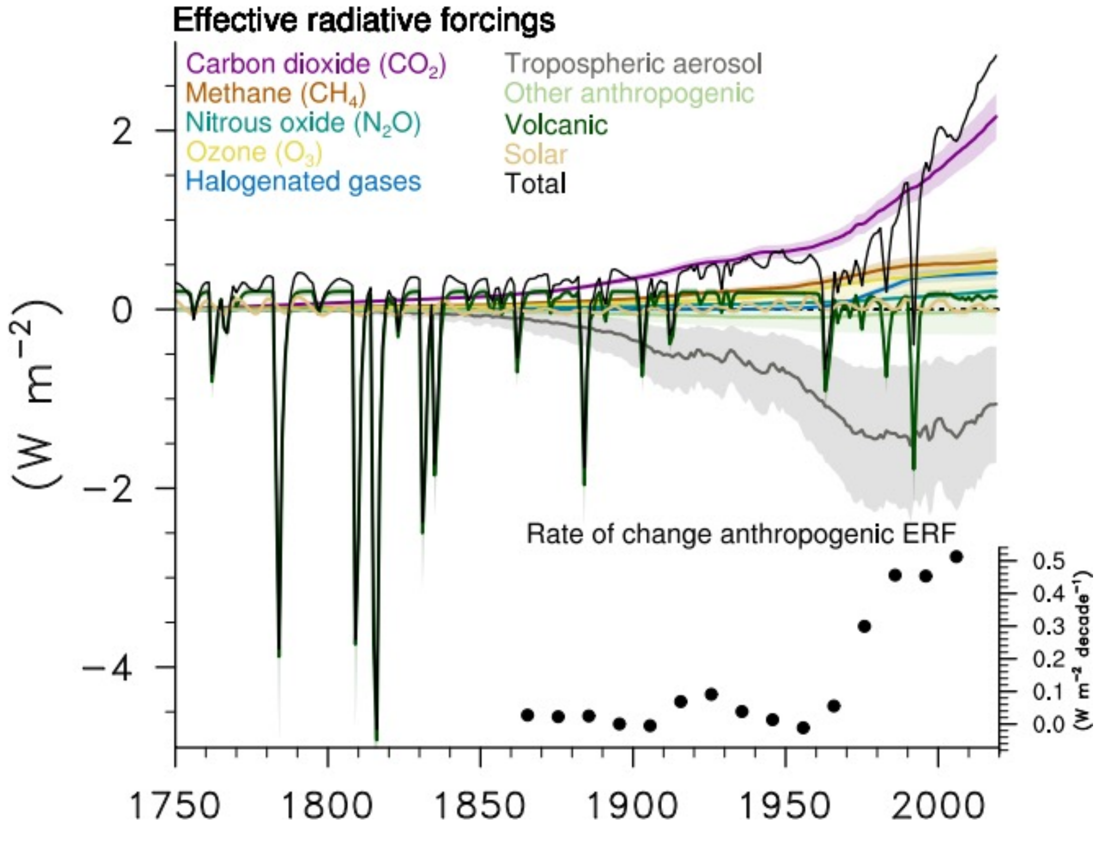
E3SM - Energy Exascale Earth System Model (das Modell des Department of Energy / PNNL)

GPM - Global Precipitation Mission (Satellite-radar)

Trend in radiative forcing

- **positive forcing increases at increasing rate**

Raghuraman et al (N Comm 2021); Kramer et al. (GRL 2021); Quaas et al. (ACPD 2022)

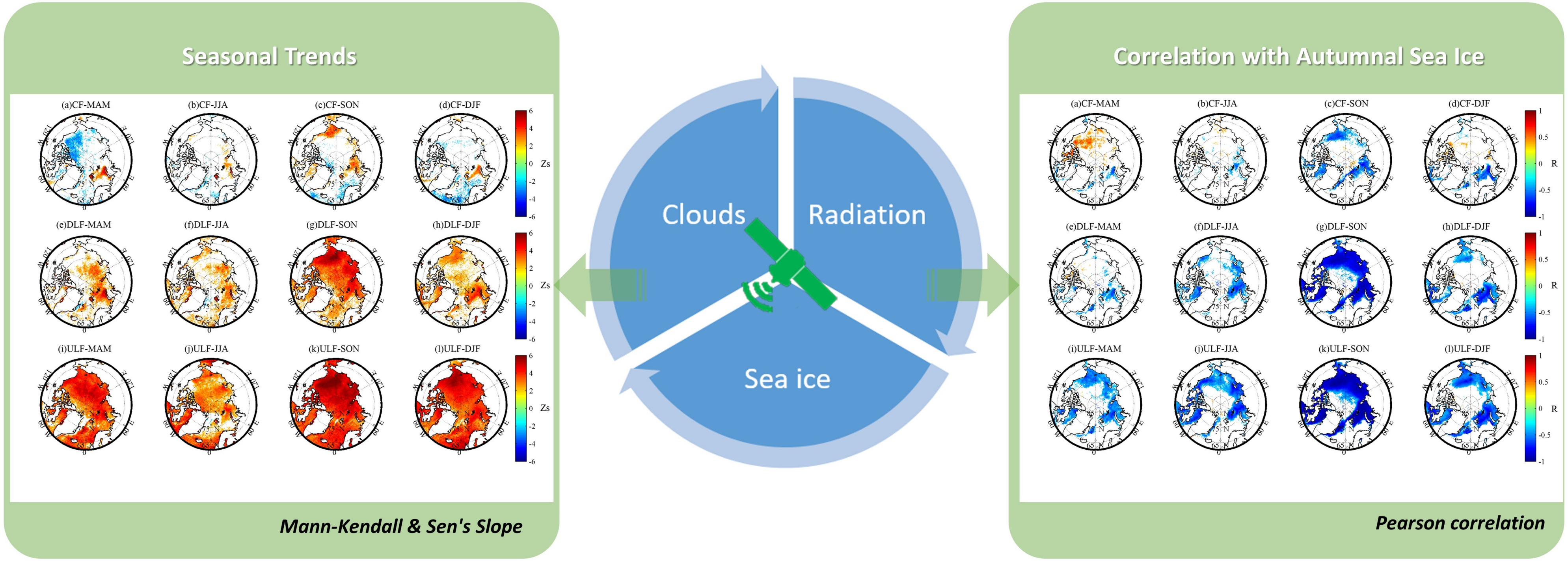


IPCC AR6 Fig. 2.10

Arctic Cloud-Radiation-Sea ice Feedback

- **increase in cloudiness contributes to sea ice retreat**

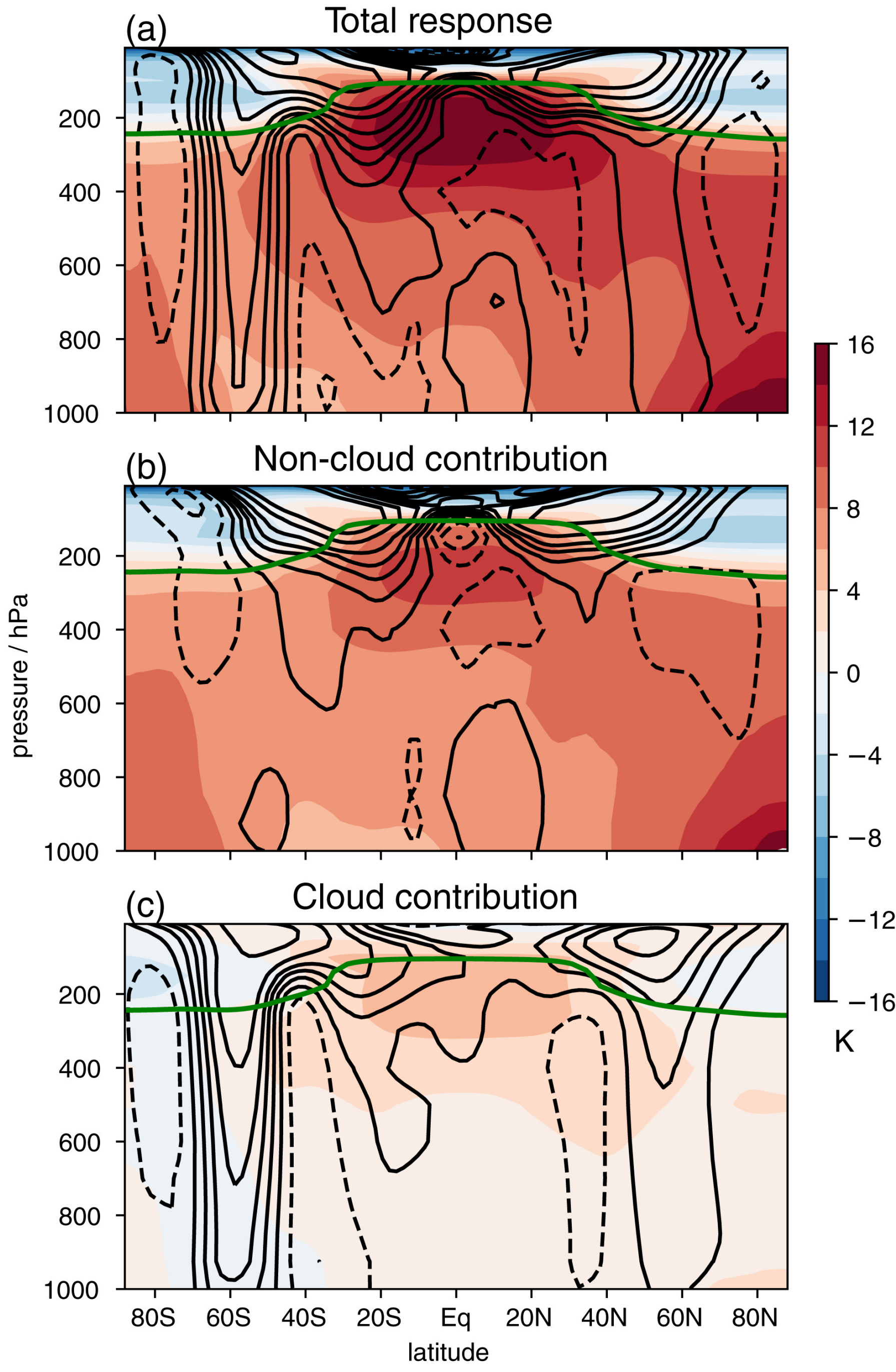
Seasonal Trends in Clouds and Radiation over the Arctic Seas from Satellite Observations during 1982 to 2019, Xi Wang et al. (2021), remote sensing



Clouds and Future Climate

- **most of the poleward circulation expansion in response to global warming can be attributed to radiative changes in clouds.**

Clouds, radiation, and atmospheric circulation in the present-day climate and under climate change, Aiko Voigt et al. (2021), WIREs Climate Change, https://doi.org/10.1002/wcc.694



IPCC AR6 Fig. 2.10

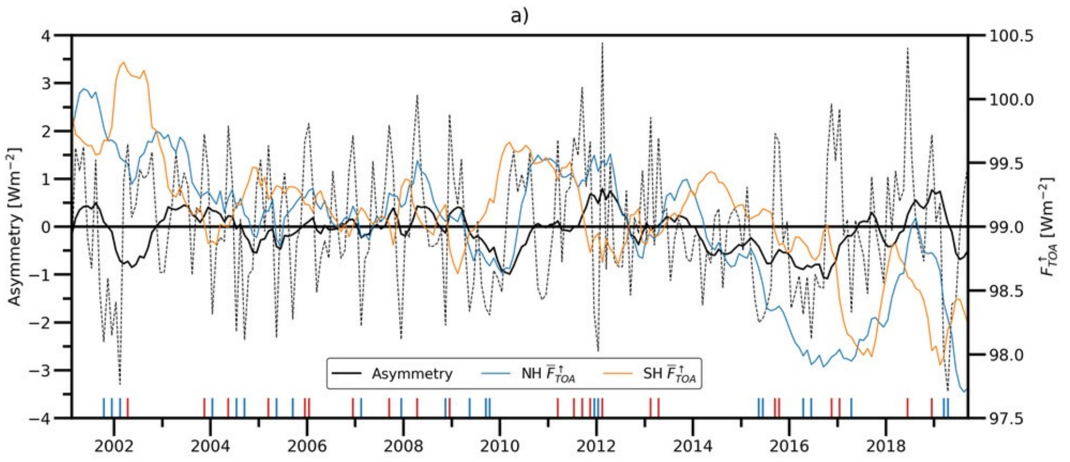
Puzzle of planetary albedo hemispheric symmetry

- **temporally constant over CERES period**

  Jönsson and Bender, J Climate 2022

- **driven by clouds compensating surface albedo, effects operate on time scales**

  Datseris and Stevens AGU Advances 2021



Towards accounting for 3d radiation effects in cloud remote sensing

- **feasible machine learning algorithm to account for 3d effects in passive cloud remote sensing from satellite**

Nataraja, V., Schmidt, S., Chen, H., Yamaguchi, T., Kazil, J., Feingold, G., Wolf, K., and Iwabuchi, H.: Segmentation-Based Multi-Pixel Cloud Optical Thickness Retrieval Using a Convolutional Neural Network, Atmos. Meas. Tech. Discuss. [preprint], https://doi.org/10.5194/amt-2022-45, in review, 2022.

Agenda Setting

- Machine learning approaches in cloud processes & radiation
- ARM & ACTRIS joint workshop on CRP
- Next generation satellites & CRP?
- Advanced Training Module “Cloud processes & radiation”: Open for international access, hybrid, organized by Andreas and Johannes, fall 2022
- more people to join the working group?

WG 4: GEB - Global Energy Balance

Report of the IRC 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 other climate system components and climate change.

Activities:

- **Outreach activities related to IPCC 6th assessment reports (AR6) WGI-III, published 2021-2022** Martin Wild Lead Author AR6 WG-I Chapter 7 “The Earth’s energy budget, climate feedbacks, and climate sensitivity”. Norman Loeb and Seiji Kato (contributing authors). Reporting in the Swiss Parliament

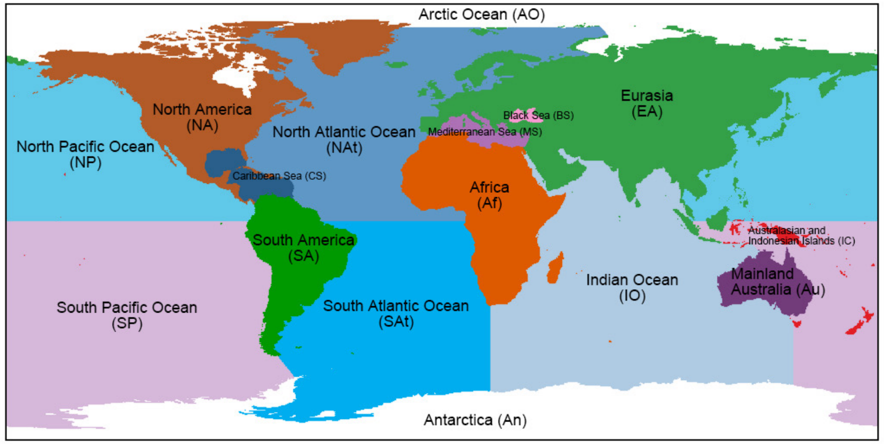
- **Meeting organization**

Meeting organization

- **European Geophysical Union (EGU) General Assembly 2022 (hybrid meeting)**, May 2022, Vienna. Organization of the session “Earth radiation budget, radiative forcing and climate change”, closely linked to the aims of this WG (Convenors Martin Wild, Paul Stackhouse, Jörg Trentmann, Maria Hakuba). (consecutive since 2006)
- **IRS 2022 (physical meeting),** July 2022, Organization of the session “Radiation Budget and Forcing”, closely linked to the aims of this working group (Convenors Seiji Kato, Norman Loeb, Martin Wild).
- **European Meteorological Society (EMS) General Assembly 2022 (hybrid meeting)**, September 2022, Bonn. Organization of the session “Radiation, clouds and aerosols: From observations to modelling to verification“ closely linked to the aims of this WG (Convenors Stefan Wacker, Martin Wild, Laura Rontu, Antti Arola).
- **American Geophysical Union (AGU) General Assembly 2021 (hybrid meeting).** Dec 2020. Organization of the session “GC034: Earth’s Energy Balance and Energy Flows through the Climate System”, closely linked to the aims of this working group (Convenors Maria Hakuba, Karina Schuckmann, Lijing Cheng, Martin Wild).

Research example:

Regional Energy Budgets: NASA NEWS versus CERES-EBAF Surface



Regions according to NASA/NEWS (L'Ecuyer 2015)

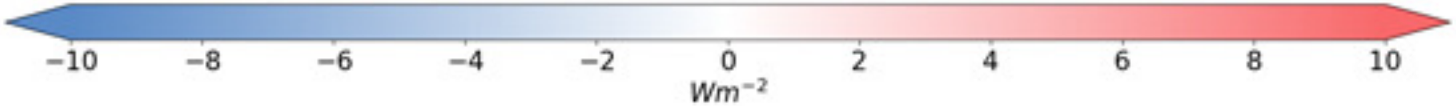
Reference data:
CERES-EBAF Surface (Kato et al. 2018)
NASA/NEWS (L'Ecuyer et al, 2015)

53 CMIP6 and 46 CMIP5 models

Differences between NASA/NEWs and CERES-EBAF Surface (Wm^{-2})

Bias(NEWS – EBAF Surface)

	Continents							Ocean basins											
	EA	Af	NA	SA	An	Au	IC	SP	NP	IO	SAt	NAt	AO	CS	MS	BS	Land	Oceans	Globe
Area ($10^6\,km^2$)	53.2	29.9	24	17.7	12.7	7.56	1.48	99.9	81.8	75.4	46.5	43.5	10.2	4.35	2.6	0.47	146.7	364.6	511.2
DSR	-1.6	6.4	-3.2	4.2	-15.5	-4.7	-24.1	0.8	0.0	-5.1	-3.5	4.1	-2.5	12.7	8.6	6.1	-1.1	-0.6	-0.8
USR	1.7	-0.9	11.6	3.4	10.5	-1.9	4.2	-0.3	-1.2	0.2	2.1	0.0	8.7	0.1	1.7	2.1	3.6	0.2	1.2
Surface net SW	0.0	5.4	8.4	7.7	-4.9	-6.7	-19.9	0.5	-1.2	-4.9	-1.4	4.1	6.2	12.8	10.2	8.2	2.5	-0.5	0.5
DLR	-1.2	0.5	6.5	-4.0	-15.9	7.1	-26.2	-9.5	-8.2	-3.7	-3.1	-1.9	-4.8	-2.7	0.7	-2.6	-1.0	-6.0	-4.6
ULR	-0.1	-7.4	-14.0	-4.2	6.5	-5.5	25.8	1.1	-1.5	2.3	3.6	-1.0	10.4	1.9	-1.5	1.6	-3.8	1.1	-0.3
Surface net LW	-1.3	-7.0	-7.5	-8.1	-9.4	1.6	-0.4	-8.5	-9.7	-1.5	0.5	-2.9	5.6	-0.7	-0.8	-0.9	-4.8	-4.9	-4.9
Surface net radiation	-1.3	-1.5	0.9	-0.5	-14.3	-5.0	-20.3	-7.9	-10.9	-6.4	-0.9	1.3	11.7	12.1	9.4	7.3	-2.3	-5.4	-4.4

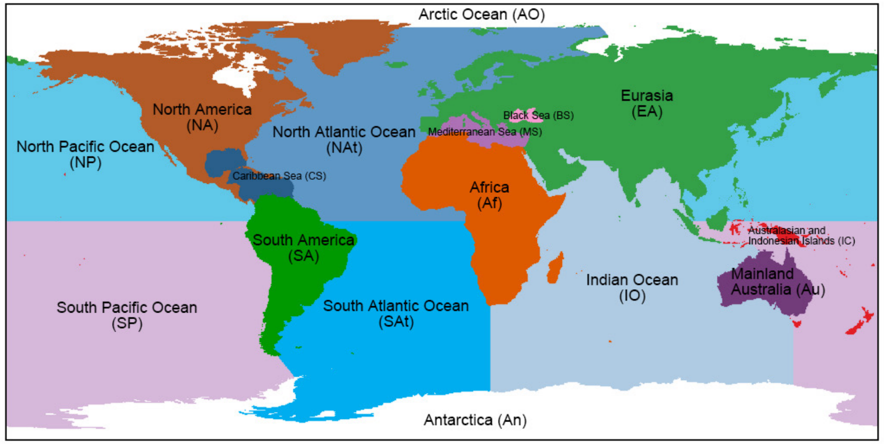


Research example: Regional Energy Budgets

CMIP6 / CMIP5 model spread and biases versus reference estimates in 16 world regions

Reference data:
CERES EBAF (Loeb et al. 2018) for TOA
CERES-EBAF Surface (Kato et al 2018) for Surface
NASA/NEWS (L'Ecuyer et al 2015) for Surface

53 CMIP6 and 46 CMIP5 models
Regions according to NASA/NEWS (L'Ecuyer 2015)



GLOBE(16 regions)	median absolute bias against NASA NEWS		median absolute bias against CERES		median standard deviation		median spread	
	CMIP6	CMIP5	CMIP6	CMIP5	CMIP6	CMIP5	CMIP6	CMIP5
TOA								
SW down TOA			0.0	0.8	0.6	1.0	4.5	4.5
SW up TOA			1.6	2.4	4.9	6.5	23.8	27.7
SW absorbed TOA			1.6	2.1	5.0	6.4	24.0	26.4
LW up TOA			2.1	1.9	3.8	4.1	19.0	19.0
Imbalance TOA			1.9	2.0	4.2	4.9	18.5	21.4
Atmosphere								
SW absorbed atmos.			2.1	2.1	2.8	3.5	12.6	15.7
LW net atmos.			5.6	7.3	5.2	5.2	22.7	26.4
Surface								
SW down surface	4.6	5.7	2.6	2.4	6.2	8.9	31.9	40.9
SW up surface	2.6	3.2	1.5	2.0	4.2	3.7	18.8	17.9
SW absorbed surface	4.4	4.5	1.6	2.6	5.3	7.2	26.6	33.7
LW down surface	4.7	6.6	3.9	7.4	6.7	6.5	30.0	25.5
LW up surface	3.9	3.9	2.2	3.5	5.6	5.2	22.5	25.3
LW net surface	3.3	4.7	3.9	4.9	4.7	5.5	19.1	25.0
Net radiation surface	5.7	4.1	2.8	3.5	4.5	5.3	21.6	24.5
Latent heat flux	5.1	5.0			4.6	6.0	23.0	24.8
Sensible heat flux	5.6	6.0			3.9	4.2	16.6	21.3
Surface Imbalance	2.9	3.4			2.0	2.0	9.5	10.7
MEAN	4.3	**4.7**	**2.6**	**3.5**	**4.4**	**5.1**	**21.6**	**24.8**

Research example: Regional Energy Budgets

CMIP6 / CMIP5 model spread and biases versus reference estimates in 16 world regions

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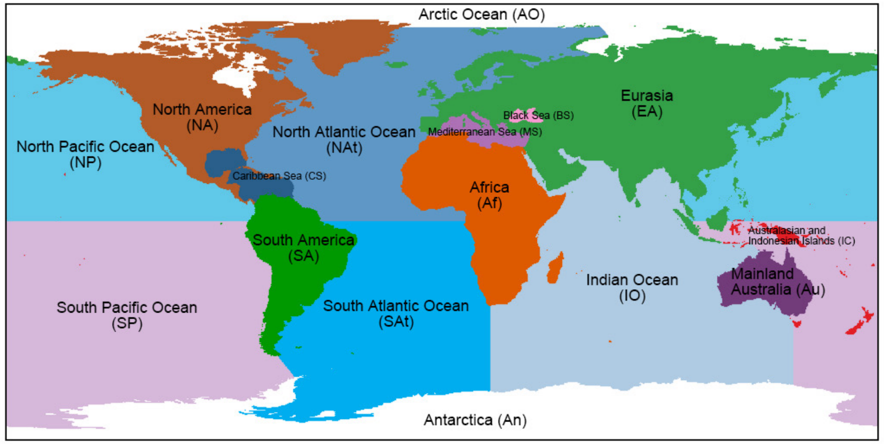


GLOBE(16 regions)	median absolute bias against NASA NEWS		median absolute bias against CERES		median standard deviation		median spread	
	CMIP6	CMIP5	CMIP6	CMIP5	CMIP6	CMIP5	CMIP6	CMIP5
TOA								
SW down TOA			0.0	0.8	0.6	1.0	4.5	4.5
SW up TOA			1.6	2.4	4.9	6.5	23.8	27.7
SW absorbed TOA			1.6	2.1	5.0	6.4	24.0	26.4
LW up TOA			2.1	1.9	3.8	4.1	19.0	19.0
Imbalance TOA			1.9	2.0	4.2	4.9	18.5	21.4
SW up surface	2.6	3.2	1.5	2.0	4.2	3.7	18.8	17.9
SW absorbed surface	4.4	4.5	1.6	2.6	5.3	7.2	26.6	33.7
LW down surface	4.7	6.6	3.9	7.4	6.7	6.5	30.0	25.5
LW up surface	3.9	3.9	2.2	3.5	5.6	5.2	22.5	25.3
LW net surface	3.3	4.7	3.9	4.9	4.7	5.5	19.1	25.0
Net radiation surface	5.7	4.1	2.8	3.5	4.5	5.3	21.6	24.5
Latent heat flux	5.1	5.0			4.6	6.0	23.0	24.8
Sensible heat flux	5.6	6.0			3.9	4.2	16.6	21.3
Surface Imbalance	2.9	3.4			2.0	2.0	9.5	10.7
MEAN	4.3	**4.7**	**2.6**	**3.5**	**4.4**	**5.1**	**21.6**	**24.8**

- CMIP6 models overall show smaller biases and are more consitent in their regional Energy budgets compared to CMIP5 models.

Recommendations I (> complete list in submitted GEB working group report 2022)

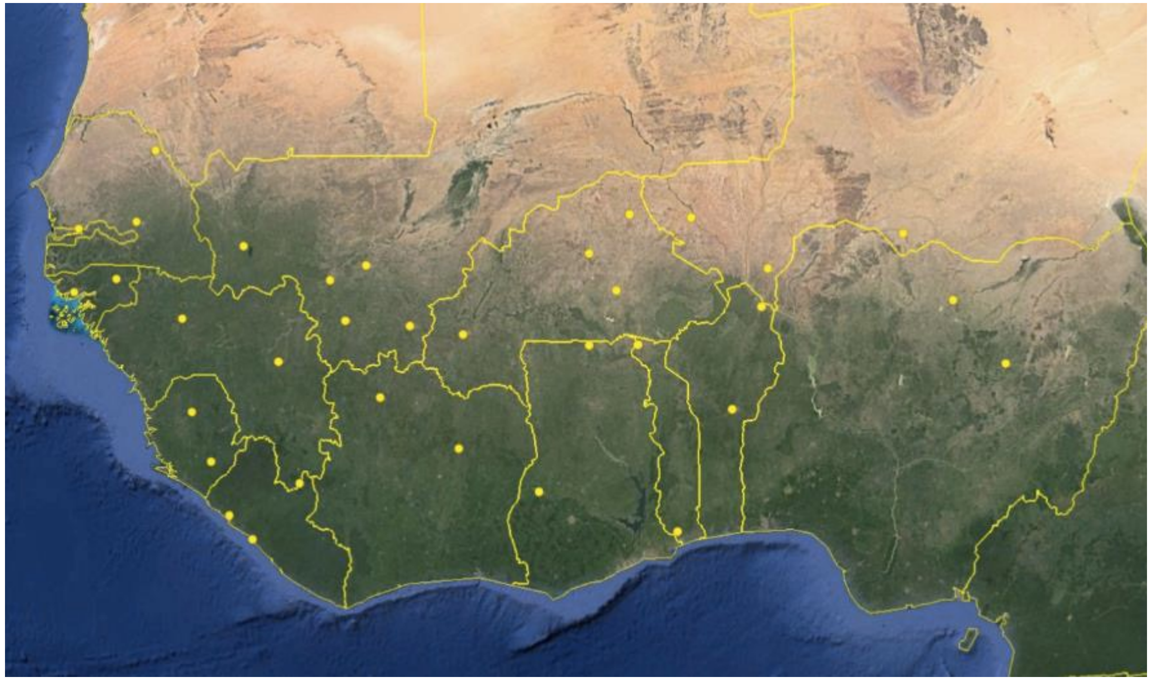
b) Recommendations with respect to the surface/atmospheric radiation budget components

Input from Christian Lanconelli:

In order to close geographical gaps of surface radiation measurements, contacts should be established with private companies who increasingly invest in renewable energy related studies in developing countries (Africa and South America). In many cases they are adopting BSRN best practices but typically with a short term investigation commitment.

Network of 33 stations with BSRN type instrumentation in Westfrica for 2 years run by a private company

Presented by Birk Kraas, CSP Services GmbH at BSRN meeting at JRC on June 29, 2022



Recommendations II (> complete list in submitted GEB working group report 2022)

Recommendations with respect to climate model simulations:

Climate modelling centers should be urged to perform AMIP type simulations (with prescribed SSTs) up to 2022, in order to be comparable to recent observational records (e.g. CERES).

AMIP simulations for IPCC AR6 so far were only carried out to 2014.

WG 5: ICLAS - International Coordination group for Laser Atmospheric Studies

International Coordination-group for Laser Atmospheric Studies (ICLAS) Working Group Report for 2020-2022

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

5 new elected members
Terms ending on 2021 are extended to 2022 due to COVID-19 pandemic

NAME SURNAME	COUNTRY	TERM
PRESIDENT		
Papayannis A.	Greece	2015-2021
VICE-PRESIDENT		
Singh U.	USA	2015-2021
TREASURER		
McGee T.	USA	No term limit
EUROPE		
Rairoux P.	France	2020-2026
Ptashnik I.	Russia	2020-2026
Balis D.	Greece	2015-2021
Fix A.	Germany	2015-2021
Donovan D.	The Netherlands	2017-2023
Tzeremes G.	ESA	2017-2023
USA/CANADA		
Chu X.	USA	2015-2021
Leblanc T.	USA	2020-2026
Moshary F.	USA	2017-2023
ASIA-PACIFIC		
Okamoto H.	Japan	2020-2026
Ishii S.	Japan	2017-2023
Liu D.	China	2017-2023
S. HEMISPHERE		
Bencherif H.	S. Africa/La Reunion	2020-2026

Report on the 30th International Laser Radar Conference (ILRC-30)

The 30th ILRC Conference was held (in person) at Big Sky, Montana (USA) on June 26th – July 1st, 2022, as well as on a hybrid mode (https://meeting-info.org/ilrc-30/)

It was organized by scientists of NASA (Jet Propulsion Laboratory-JPL and Goddard Space Flight Center-GSFC)

252 abstracts submitted (most of attendants were online)

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

VRT in spherical geometry

JQSRT, vol. 287, 2022

Numerical results for polarized light scattering in a spherical atmosphere

S. Korkin[a,b,*], E.-S. Yang[b,c], R. Spurr[d], C. Emde[e,f], P. Zhai[a], N. Krotkov[b], A. Vasilkov[b,c], A. Lyapustin[b]

[a] *University of Maryland Baltimore County, Baltimore, MD, USA*
[b] *NASA Goddard Space Flight Center, Greenbelt, MD, USA*
[c] *Science Systems and Applications Inc., Lanham, MD, USA*
[d] *RT Solutions Inc., Cambridge, MA, USA*
[e] *Meteorological Institute, Ludwig-Maximilians-Universität, Munich, Germany*
[f] *Deutsches Zentrum für Luft- und Raumfahrt, Oberpfaffenhofen, Germany*

- Atmospheric setup: Rayleigh scattering atmosphere with height dependent single scattering albedo above dark surface
- Monte Carlo models: MYSTIC, MCSSA (fully spherical geometry)
- Discrete Ordinate model: VLIDORT (approximations: pseudo-spherical or spherical correction)
- Benchmark results from fully-spherical MC models provided as tables
- Approximations validated by comparison against MC results

VRT approximations in spherical geometry

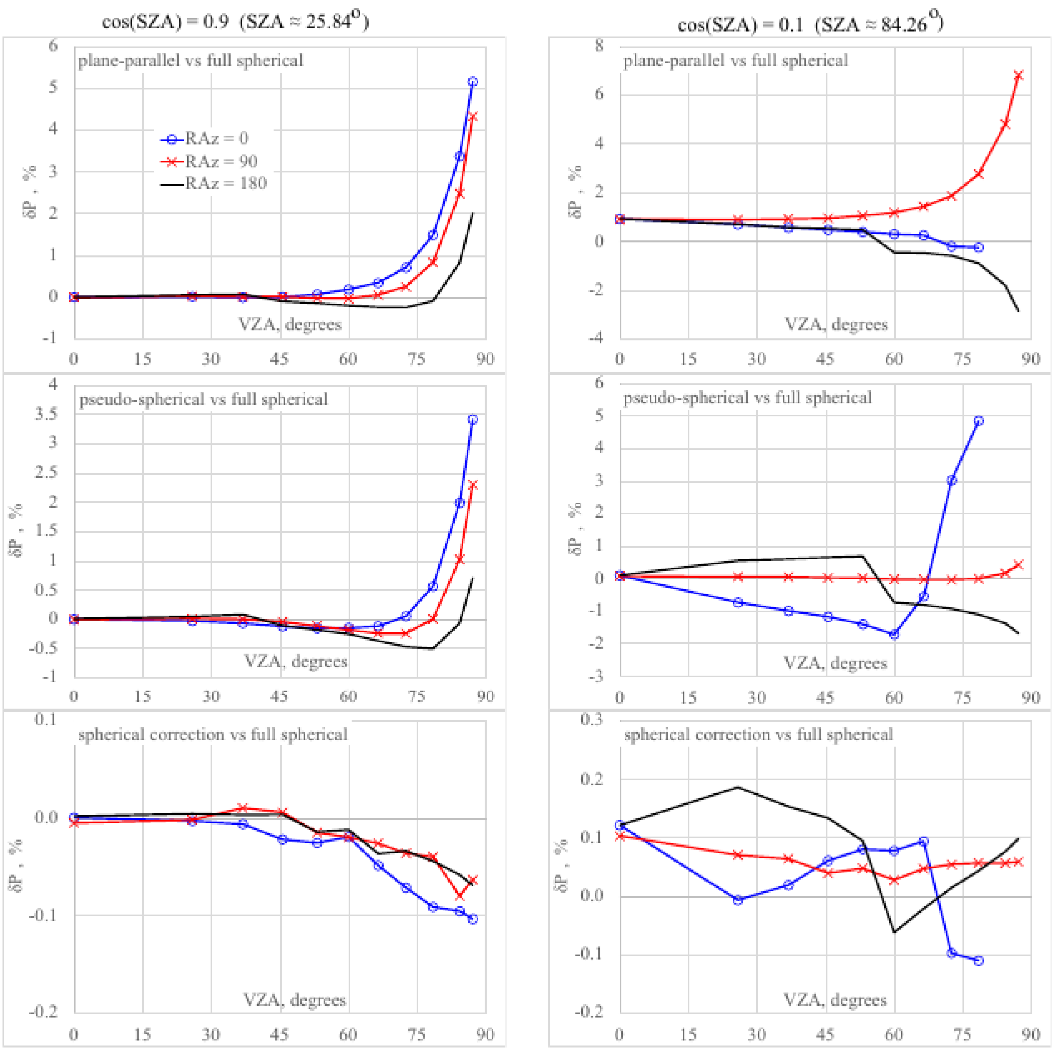


Fig. 2. Relative deviations for the degree of linear polarization, *P*, as function of solar/view geometry for the uniform atmosphere scenario, g = 0 in Eq. (1), and total OT = 1. Rows compare results with VLIDORT plane-parallel (top), pseudo-spherical (middle), and spherical correction (bottom) against full-spherical MC baselines. Refer to Table 2b for clarification regarding the two missing points, cos(VZA) = 0.1 and 0.05, for cos(SZA) = 0.1 (right column) at RAz = 0° (blue line, circle marker).

from Korkin et al. 2022

WG 7: ITWG - International TOVS Working Group

WG 8: UV - Solar Ultra-Violet Radiation

UV Working Group – Overview

Ann Webb, Julian Groebner, Andreas Kazantzidis

QASUME (UV) and RBCC-E (O3) calibration events

Overview of Recent Activities

Monitoring at many sites around the world has continued

Calibrations by intercomparison (UV and ozone) are back on schedule

- EUROSKIN UV and Skin Cancer Prevention Conference, including UV Index workshop. September 7-9, 2021 (virtual)
- Biennial Brewer Intercomparison, September 6-17, 2021, El Arenosillo, Spain
- NOG – Nordic Ozone and UV Group Meeting, 26-27 April, 2022. NILU, Norway
- Vitamin D and Biologic Effects of Light Symposium, 4-6 May, 2022, Homburg, Germany

Upcoming:

- ECUVM –
  European Conference on Solar UV Monitoring and Personal UV Exposure, September, 2022, Vienna, Austria

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

Chair: Alexander Marshak

• The Intercomparison of 3D Radiation Codes (I3RC) public RT code was obtained by 4 researchers (one each from the US, Taiwan, Finland, and Brazil).

• The I3RC online simulator gained 18 new users, so the total number of users is now 99. The worldwide distribution of the new accounts is as follows: 4 each in both China and the US, 3 in France, 2 in Germany, and 1 each in Australia, Japan, Mexico, Poland, and Sweden.

• The I3RC website is in the state of transition. The old website is still alive at the moment, while the new website is already available at https://earth.gsfc.nasa.gov/climate/model/i3rc . We requested that visitors of the old address be redirected to the new website, but this has not yet taken effect.

Publications about 3D radiative transfer in cloudy atmospheres by years can be found here https://earth.gsfc.nasa.gov/sites/default/files/lab_climate/i3rcpublications.pdf. As far as we know, there are 4 3DRT papers published in 2022 and 13 in 2021.

WG 10: HRMM - Hyperspectral Radiation: Measurements and Modelling

WG 11: TSSI - Total and Spectral Solar Irradiance

Solar Irradiance Working Group

Membership Roster

Name	Affiliation	Country
Odele Coddington - co Chair	Laboratory for Atmospheric and Space Physics (LASP)	USA
Mustapha Meftah - co Chair	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	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	National Satellite Meteorological Center, China Meteorological Administration (NSMC/CMA)	China

Our membership is drawn from the international community and reflects expertise in solar irradiance measurements & modeling, solar activity indices and proxies of solar activity, the development of solar reference spectra and the development of composite irradiance records.

*We are a new working group and our first meeting was March, 2022

Mission Statement & Focus Area(s)

Mission Statement: To facilitate the proper representation of total solar irradiance (TSI) and solar spectral irradiance (SSI) on multiple time scales as input to radiative transfer models, remote sensing algorithms, instrument calibration and intercalibration efforts, and global models (e.g., general circulation models and atmospheric chemistry/transport models).

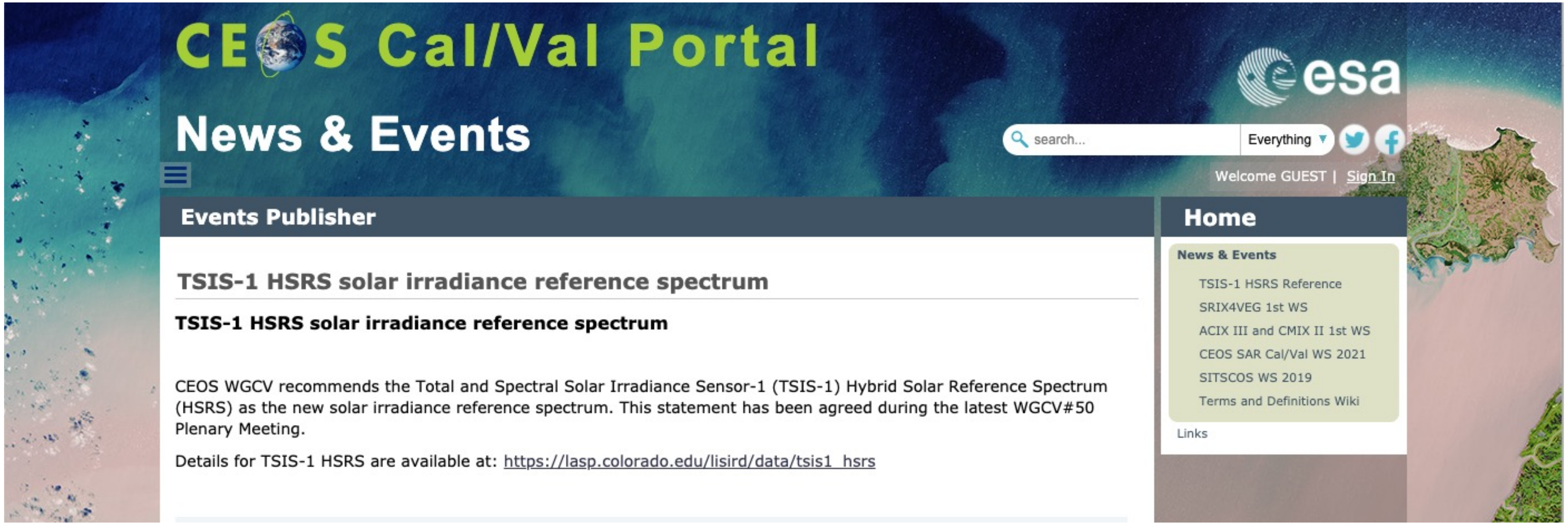
Focus Areas: Solar irradiance is a key variable at the intersection of many science disciplines such as Earth and planetary science, solar and stellar science, and space weather. The following focus areas will guide the Solar Irradiance Working Group activities towards achieving its stated mission.

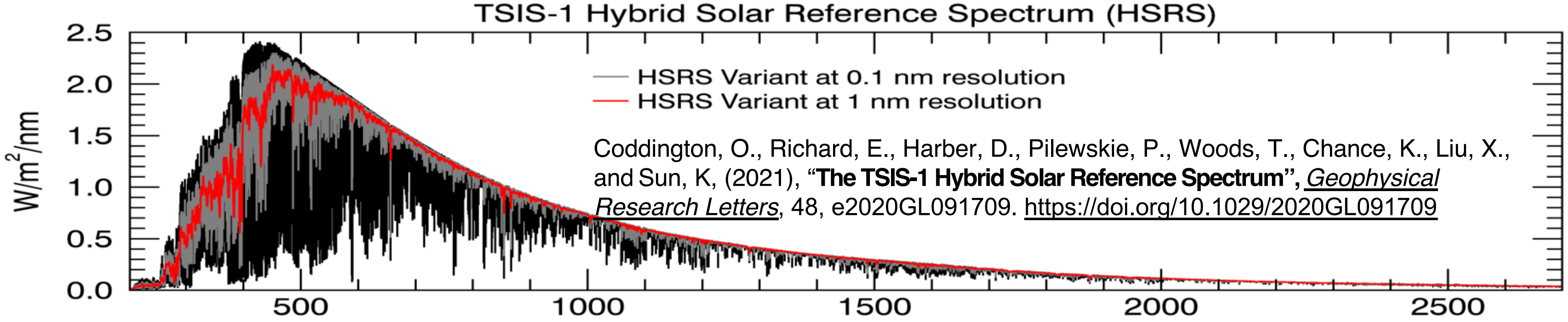
1. Specify and understand solar irradiance and its variability using measurements and models.
2. Define application-based measurement requirements (absolute accuracy, spectral range and resolution, temporal variability) on solar irradiance.
3. Communicate recommendations to national and international scientific organizations

*Focus Area Suggestions Welcome from other IRC Working Groups!

TSIS-1 HSRS Formally Recognized

March 2022: The Committee on Earth Observation Satellites (CEOS) Working Group on Calibration and Validation (WGCV) recommended the TSIS-1 HSRS as the new solar irradiance reference spectrum [https://calvalportal.ceos.org/events/].





Coddington, O., Richard, E., Harber, D., Pilewskie, P., Woods, T., Chance, K., Liu, X., and Sun, K, (2021), **"The TSIS-1 Hybrid Solar Reference Spectrum"**, *Geophysical Research Letters*, 48, e2020GL091709. https://doi.org/10.1029/2020GL091709

New Working Group Proposal
Feng Zheng

MLRTRS

Machine Learning in Radiative Transfer and Remote Sensing

Feng Zhang
Fudan University

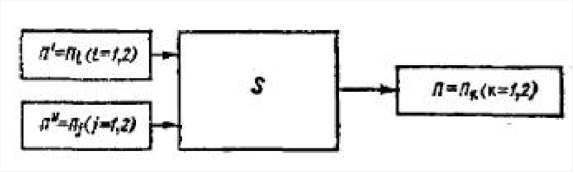
CONTENTS

Development of Machine Learning in Remote Sensing

Expert system period

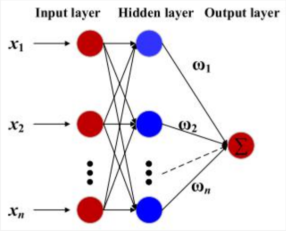
Canadian convective storm Meteor system

1987, sea fog prediction expert system of France at BrestA-Guipavas meteorological station

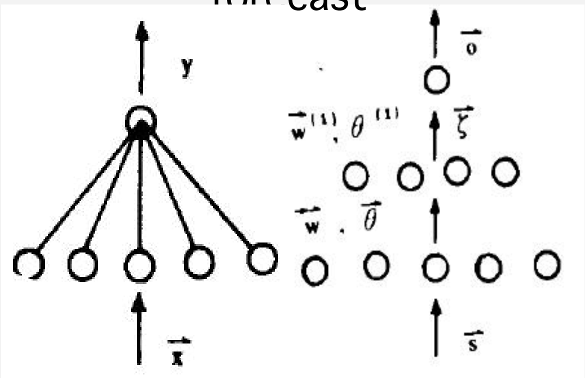


Traditional machine learning period

American Neural Network Profession II

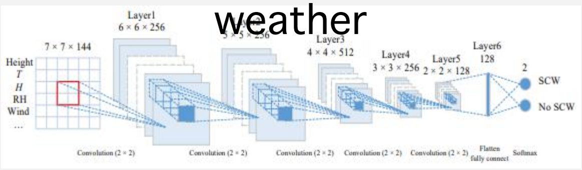


1994, application of artificial neural network in rainstorm forecast



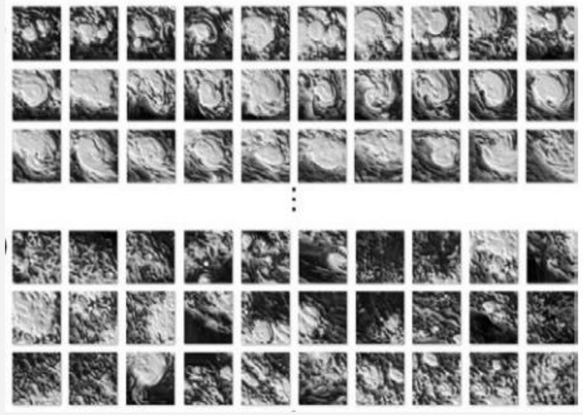
Deep learning period

2019, prediction of severe convective weather



1980 1990 2000 2010 2020

2017, detection of tropical cyclone precursors

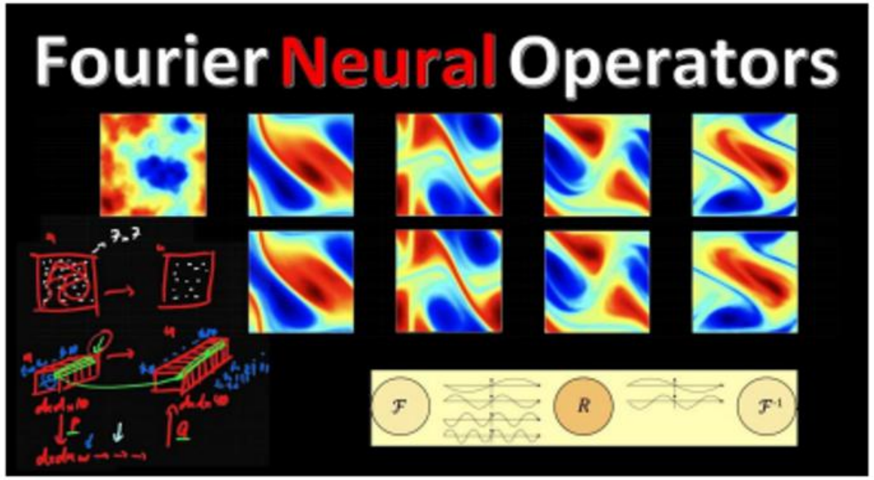


Application of Machine Learning

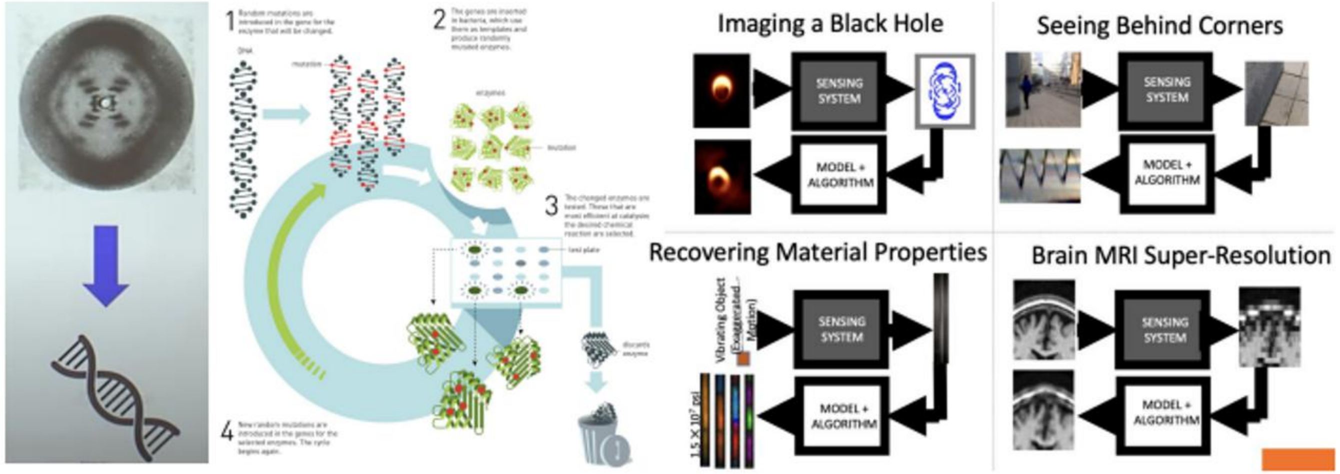
a. Exploration & control

b. Fill in the missing

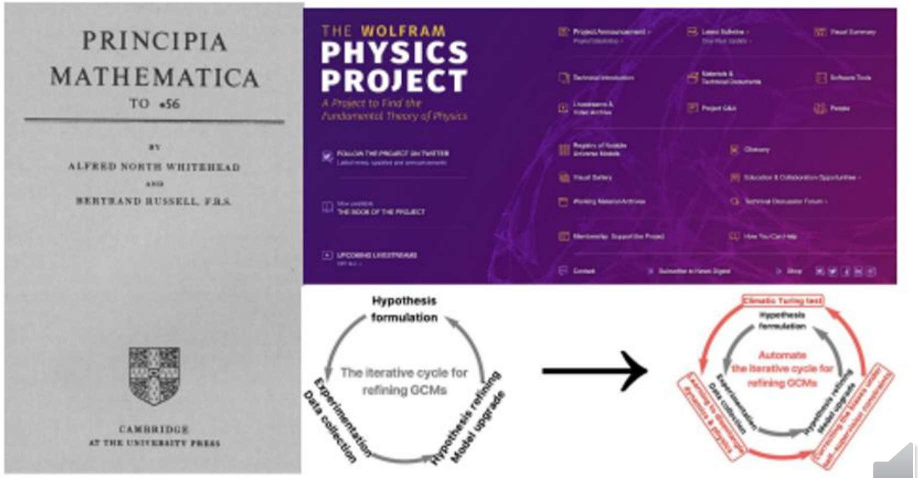
c. Computation acceleration



d. Inverse modeling

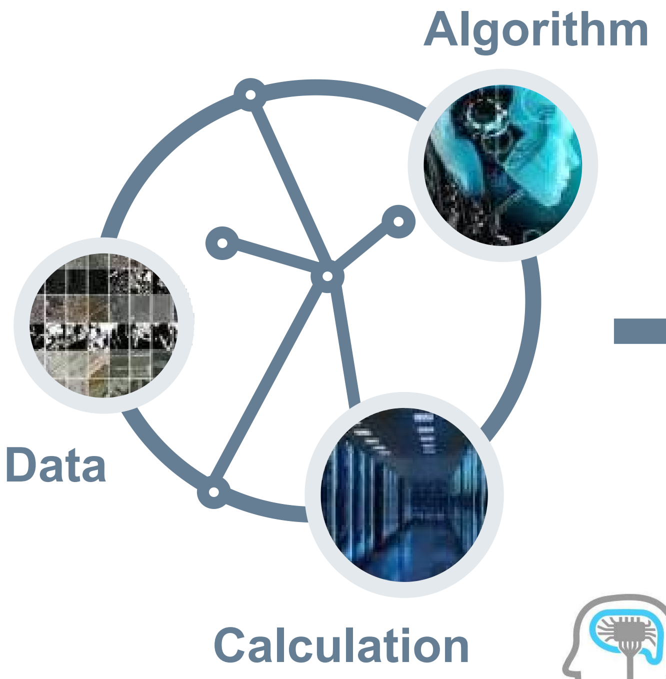


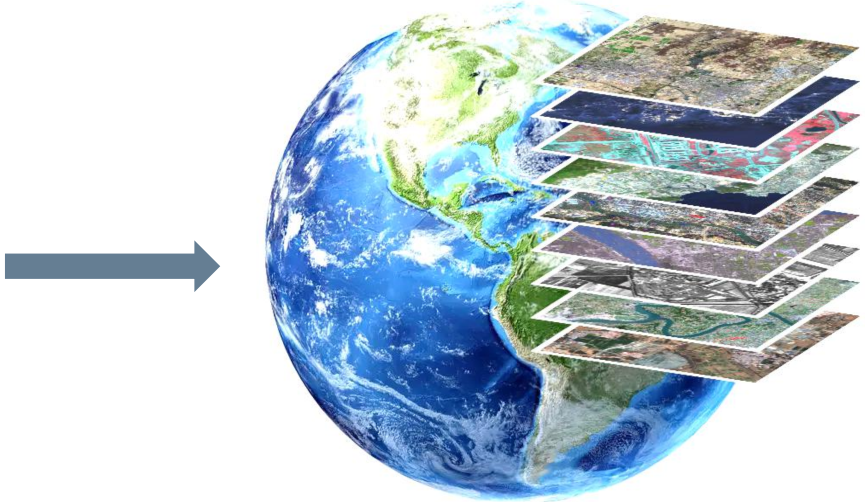
e. Automated scientific discovery

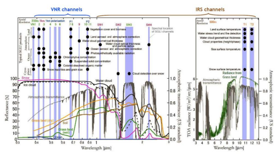


Machine Learning in Radiative Transfer and Remote Sensing

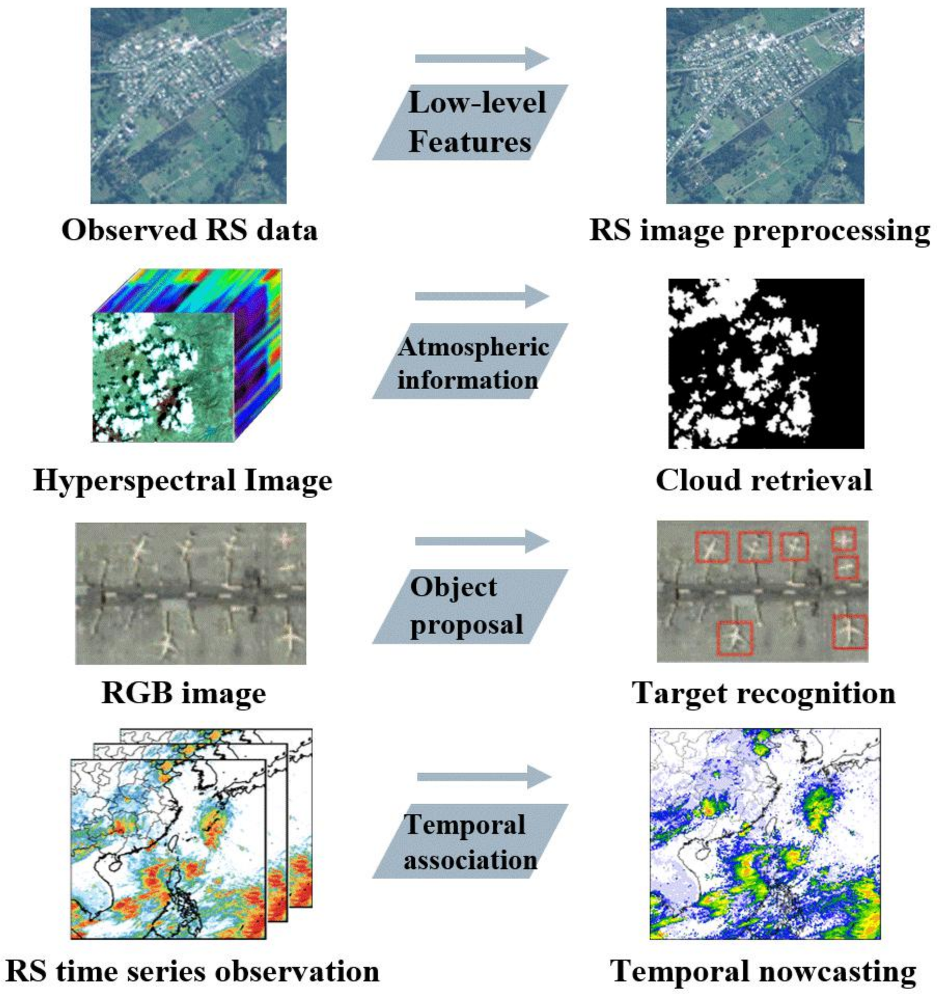
Integrate target characteristics and domain knowledge to realize the leap in quantitative remote sensing based on machine learning.



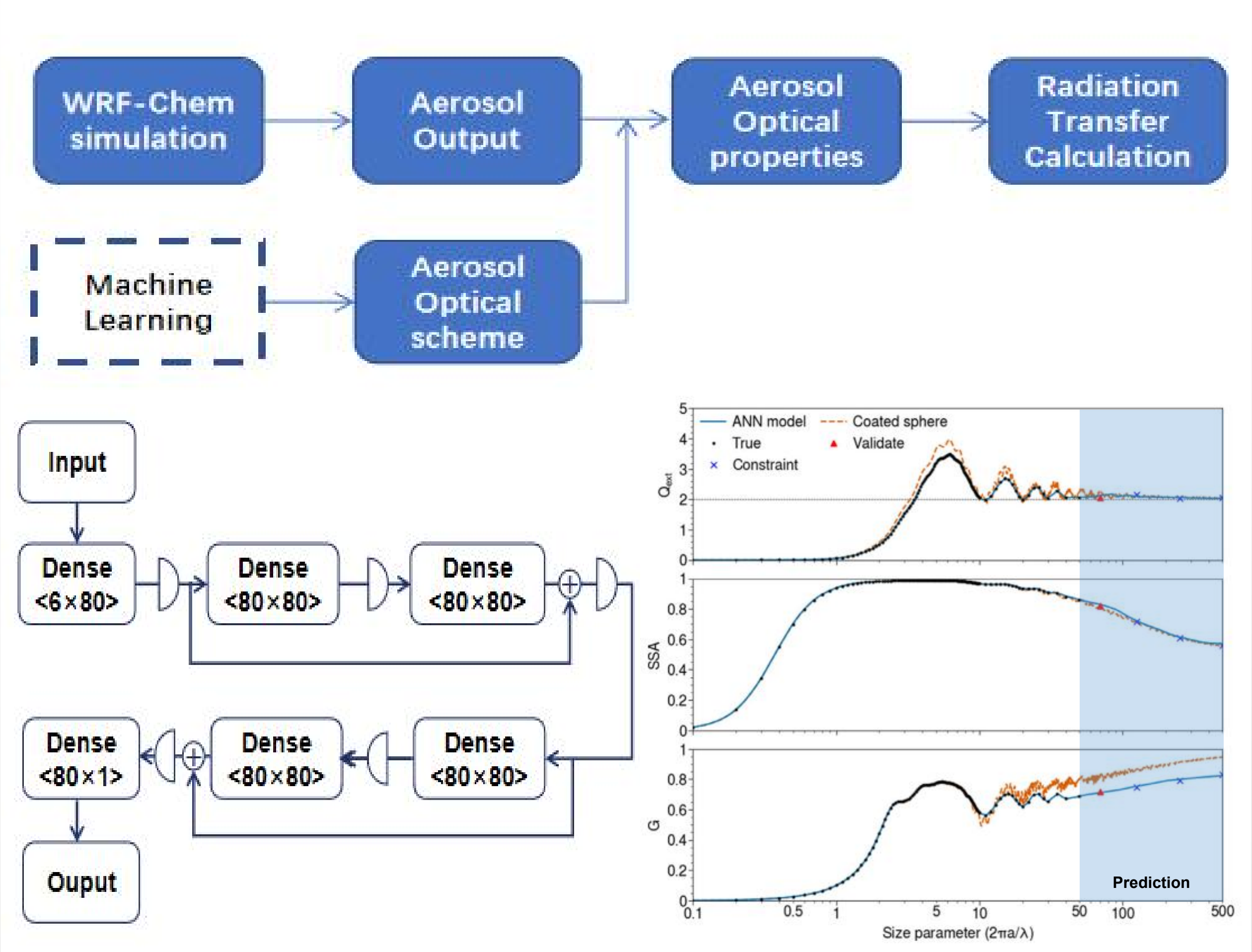




Knowledge Feature

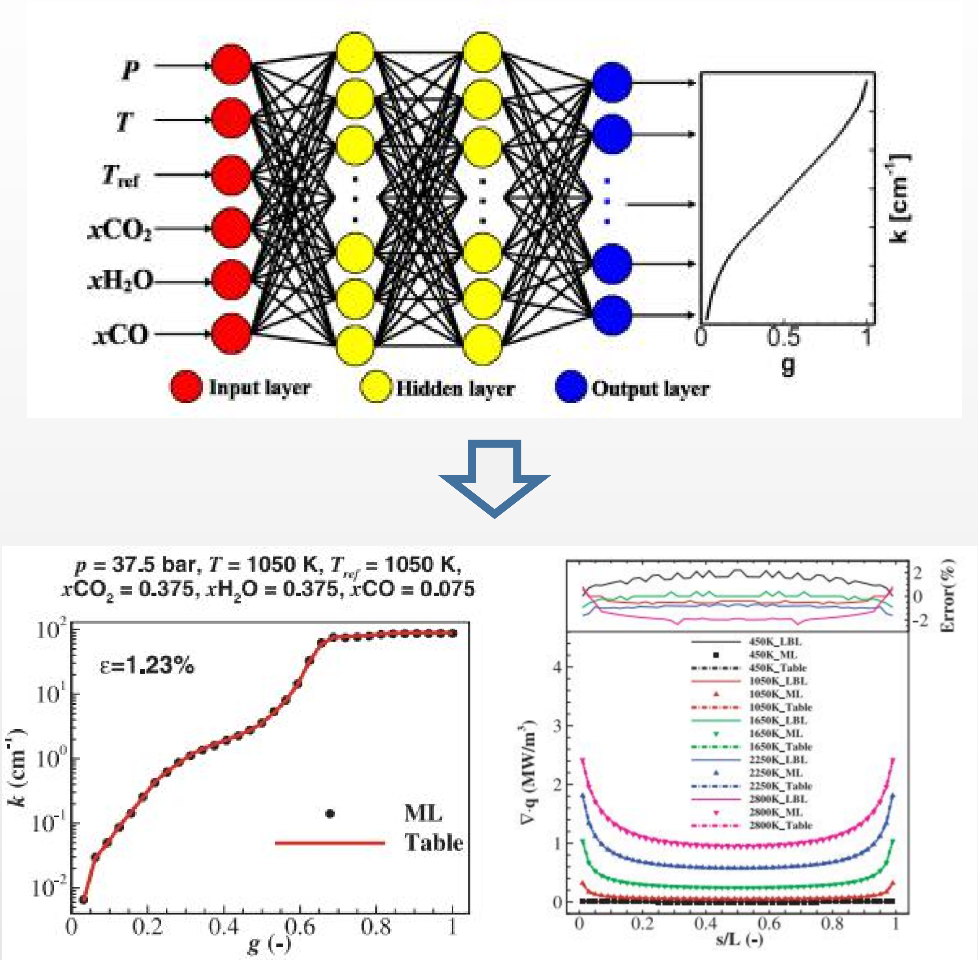


Machine Learning in Radiative Transfer



Evaluation of a new internally-mixed aerosol optics scheme in the weather research and forecasting model

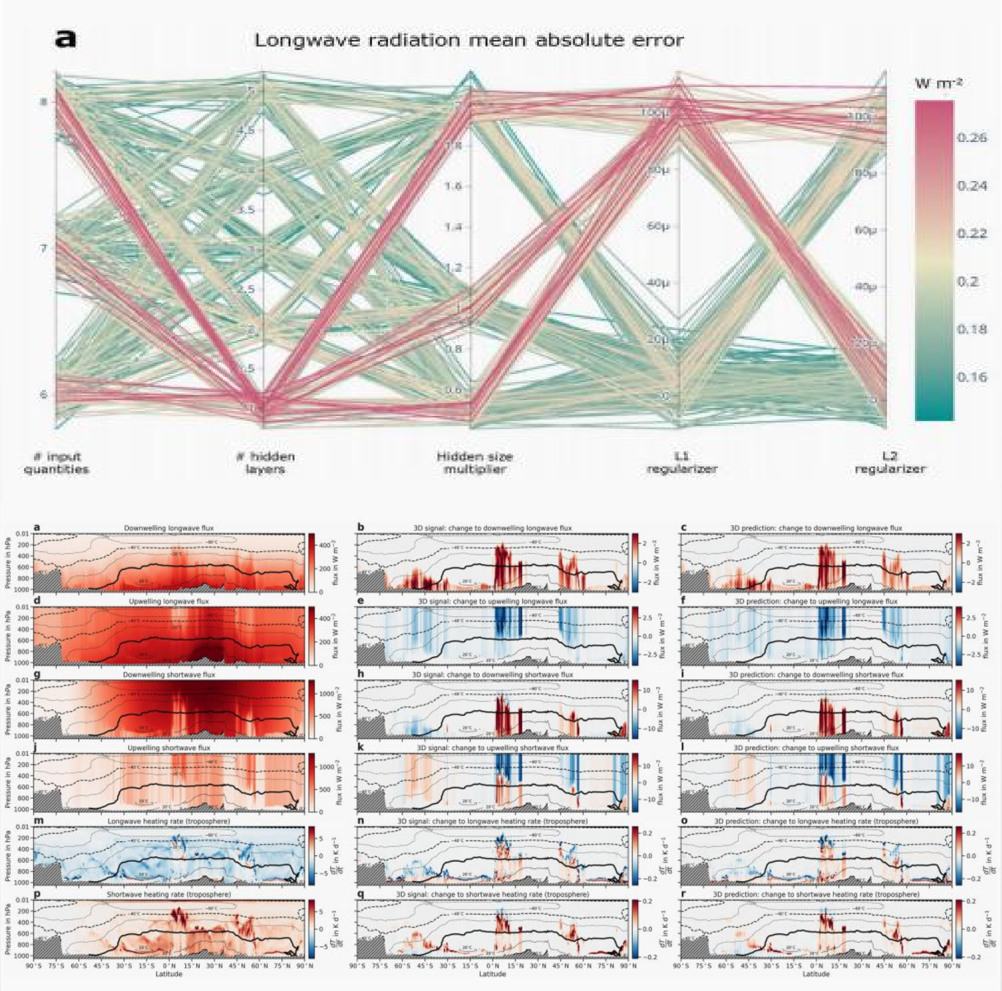
Wang Z , et al. ***JQSRT*** , 2022.



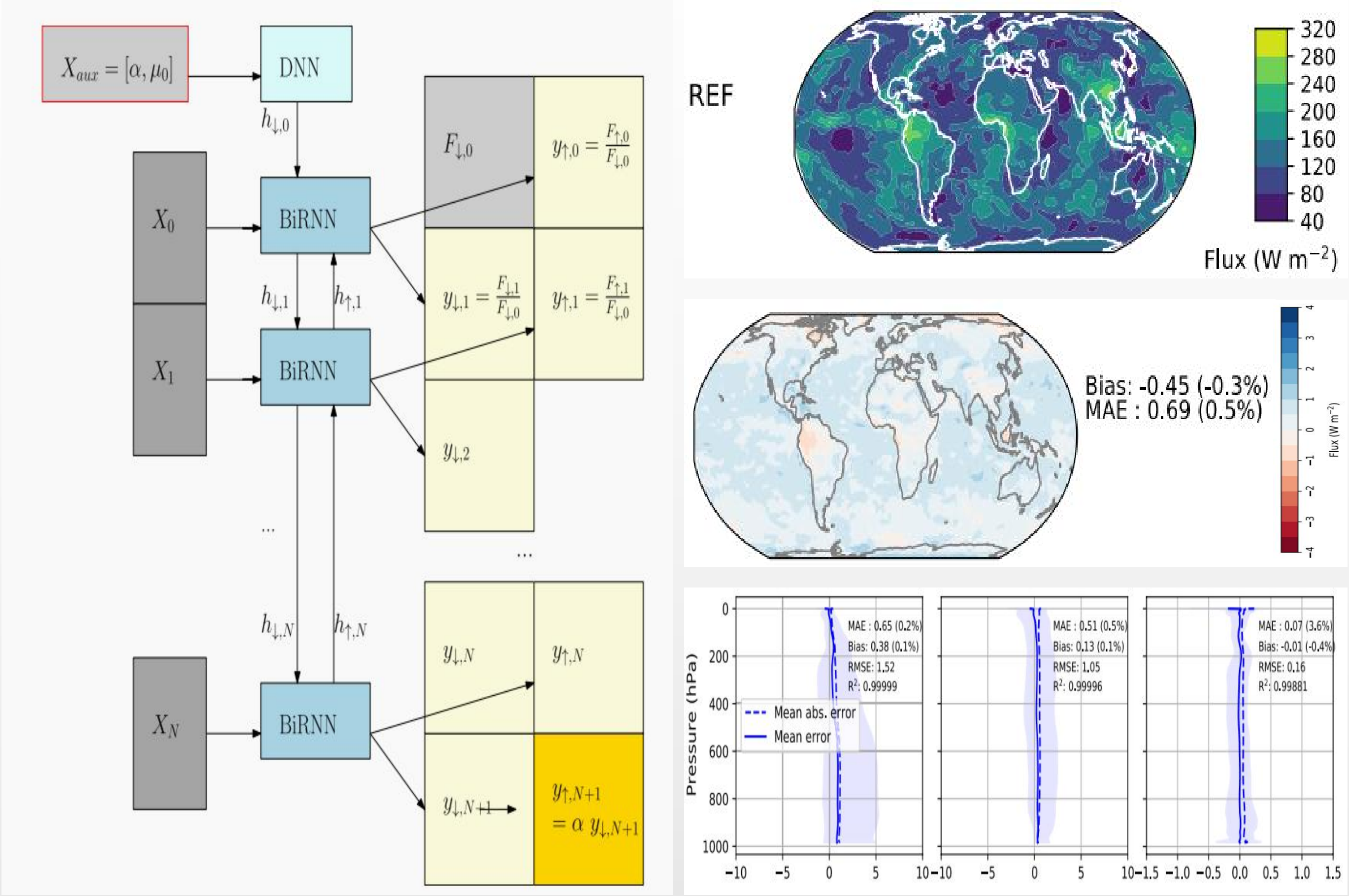
A machine learning based efficient and compact full-spectrum correlated k-distribution model

Zhou Y, et al. ***JQSRT*** , 2022.

Machine Learning in Radiative Transfer

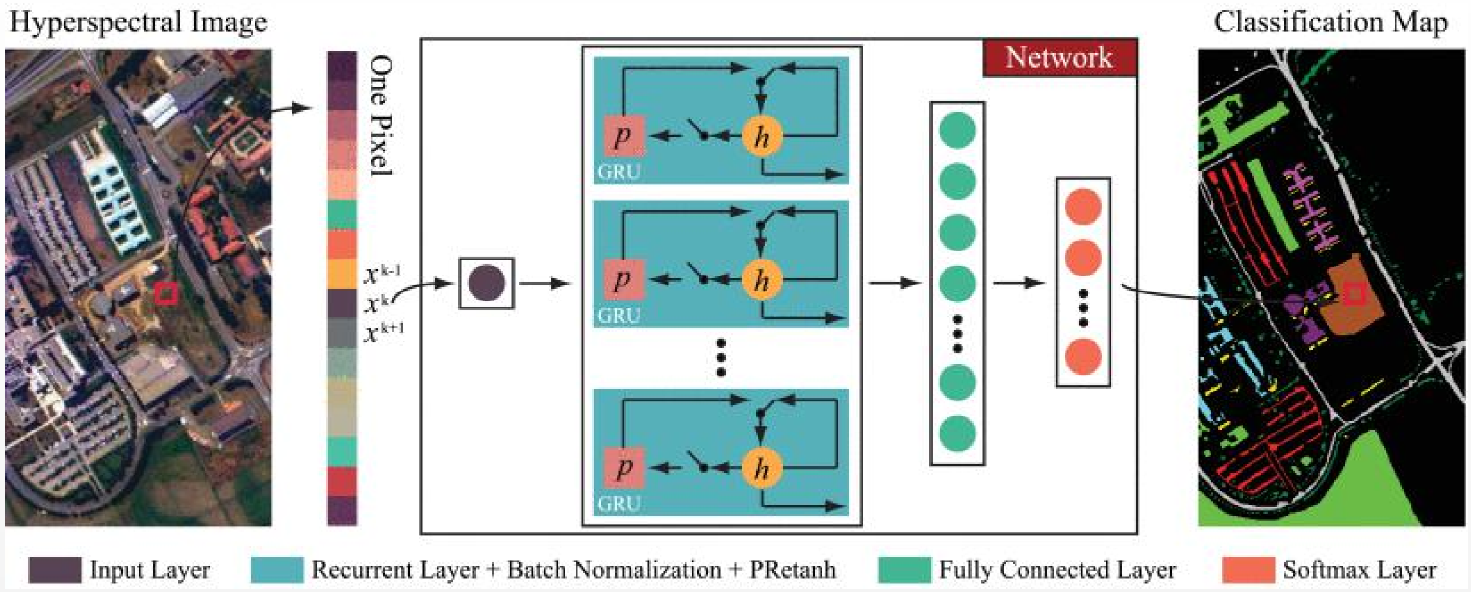


Machine Learning Emulation of 3D Cloud Radiative Effects
Meyer D, et al. ***JAMES*** , 2021.



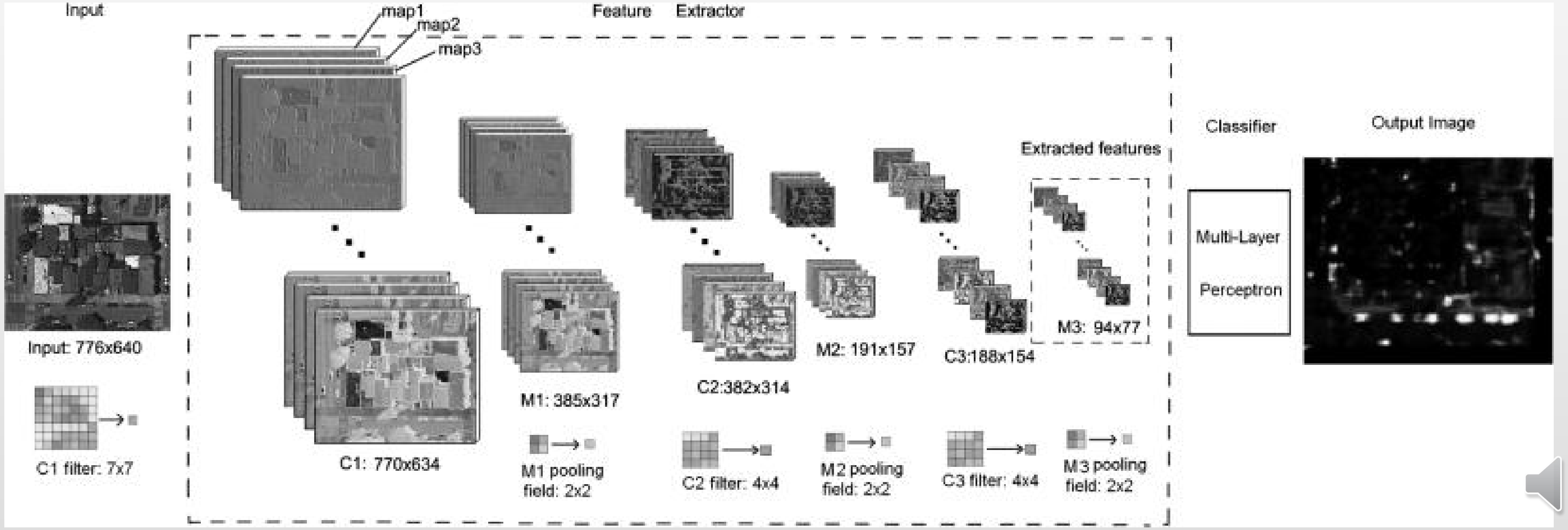
Exploring Pathways to More Accurate Machine Learning Emulation of Atmospheric Radiative Transfer
Ukkonen P, et al. ***JAMES*** , 2022.

Machine Learning in Remote Sensing



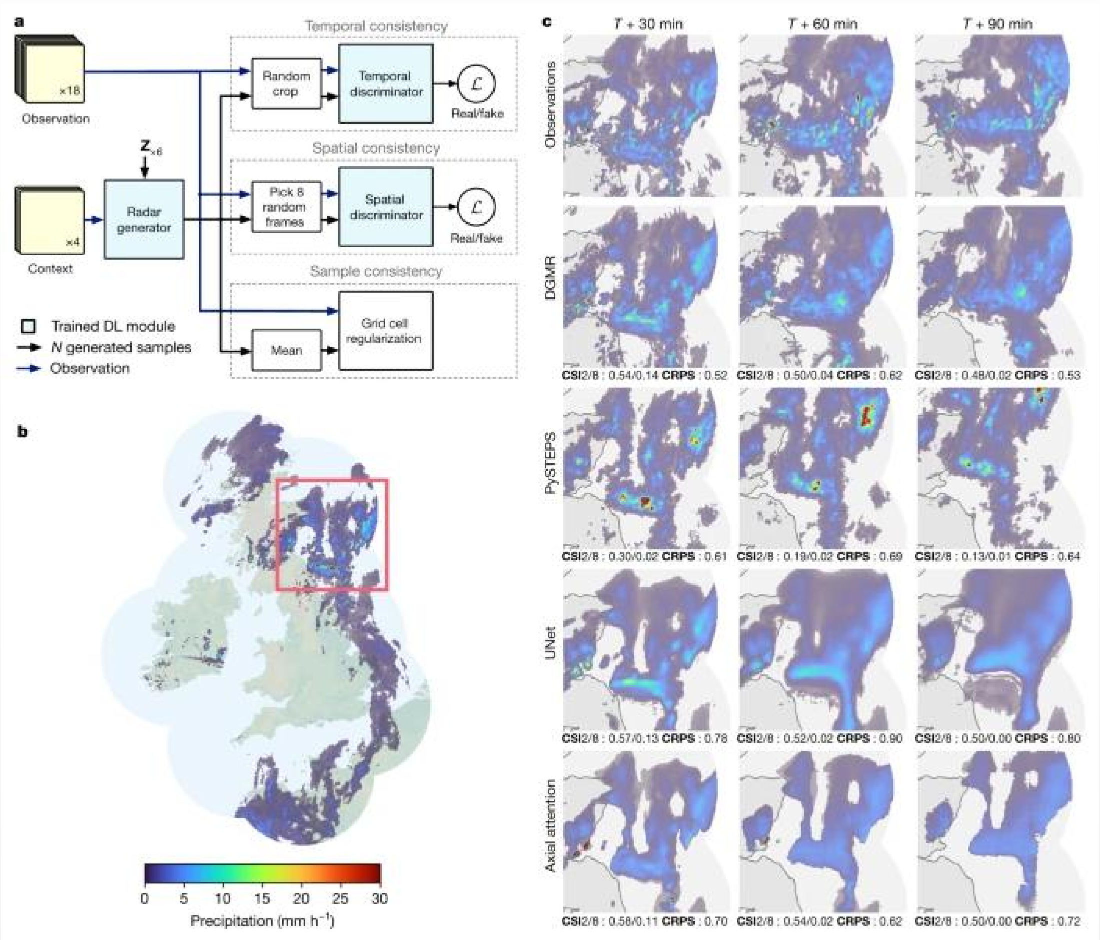
Surface classification and target recognition

The RNN proposed for the surface classification task based on hyperspectral image
Mou L. et al. ***TGRS*** , 2017.



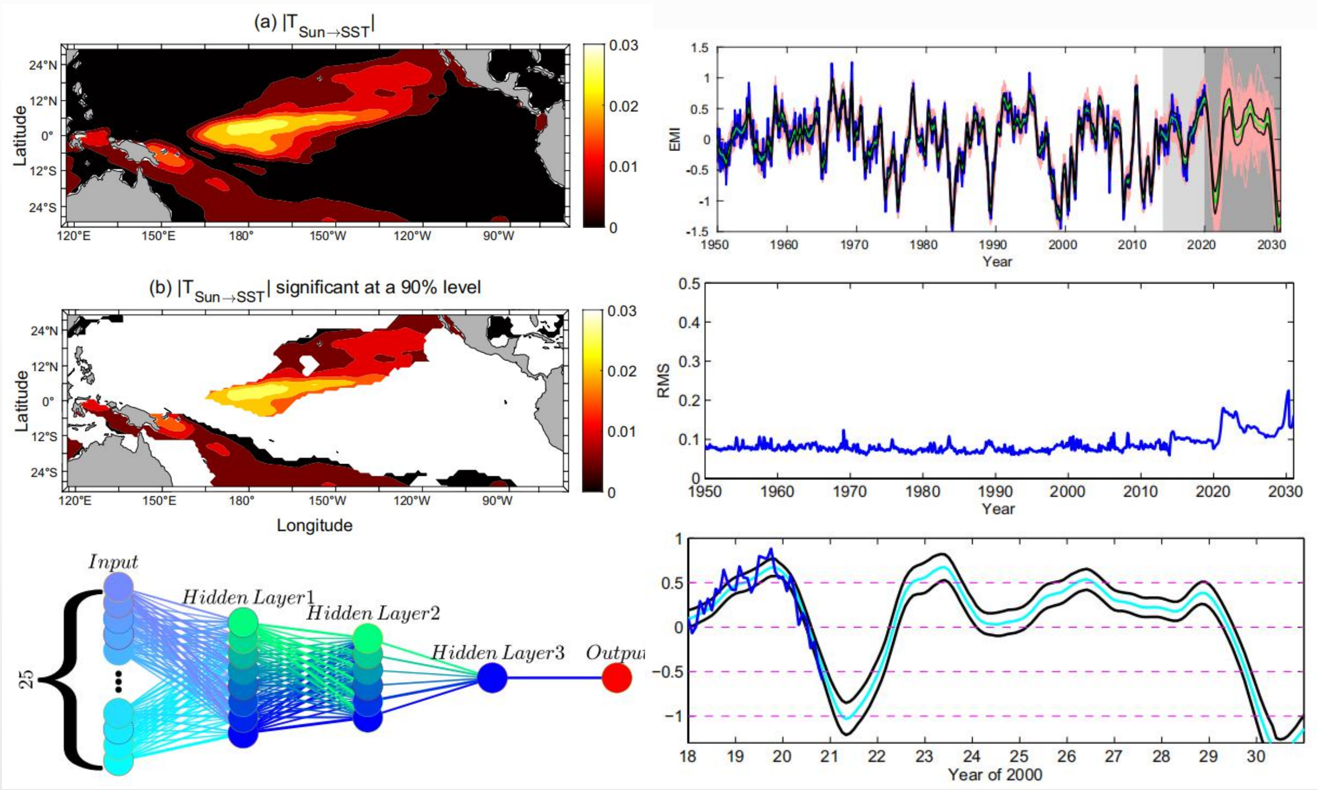
The DNN proposed for the target recognition task based on multiple gradient image
Chen X. et al. ***GRSL*** , 2014.

Machine Learning in Remote Sensing



Precipitation nowcasting using deep generative models of radar
(Ravuri, S., et al. *Nature*, 2021)

Temporal nowcasting



El Niño Modoki can be mostly predicted more than 10 years ahead of time
(Liang, X. S., F. Xu, Y. Rong, R. Zhang, X. Tang, and F. Zhang, ***Scientific Reports.***, 2021)

Necessity of establishing the MLRTRS working group

Remote Sensing Data

- **Volume**: Data size
- **Velocity**: Speed of change
- **Variety**: Diverse data sources
- **Veracity**: Uncertainty of data

‘Knowledge from data’

Machine Learning

Patterns and Knowledge

- Small and ‘digestible’
- Real-time critical in some areas, not all
- Integrated across disciplines
- Confidence robustness

Opportunity

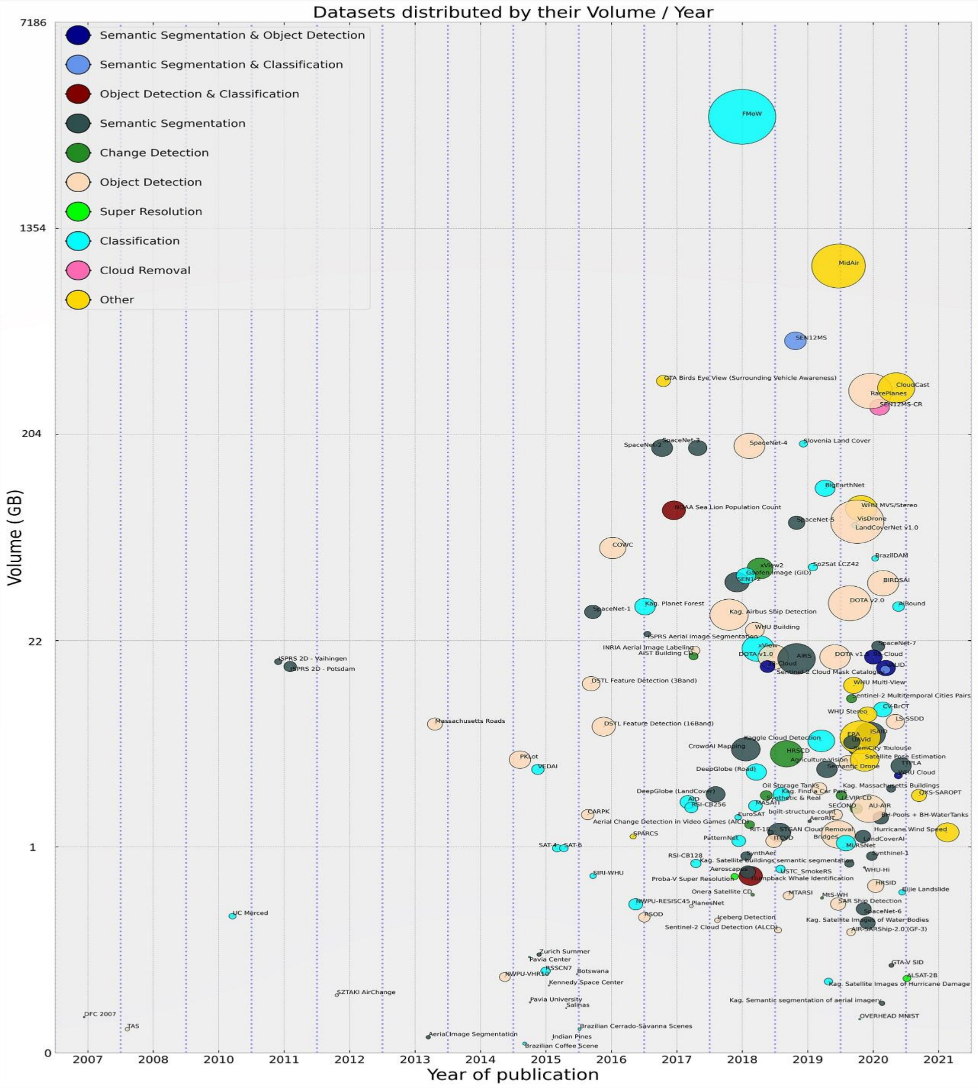
- Massive number of RS data
- Development of ML algorithms
- High performance computing

Challenge

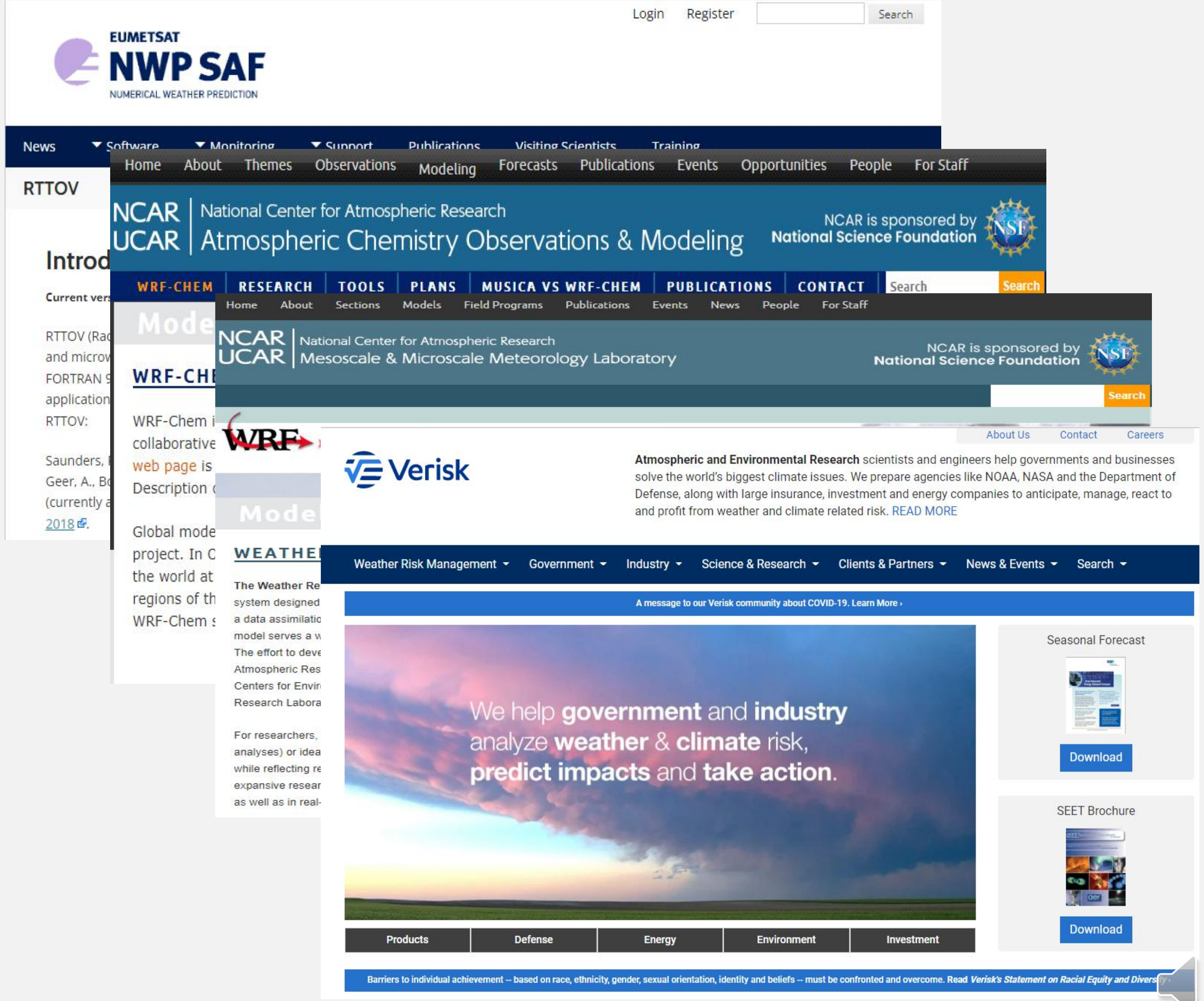
- Limited large scale labeled RS retrieval dataset
- Combined ML algorithm with physical principles
- Simplify complex calculation process

Necessity of establishing the MLRTRS working group

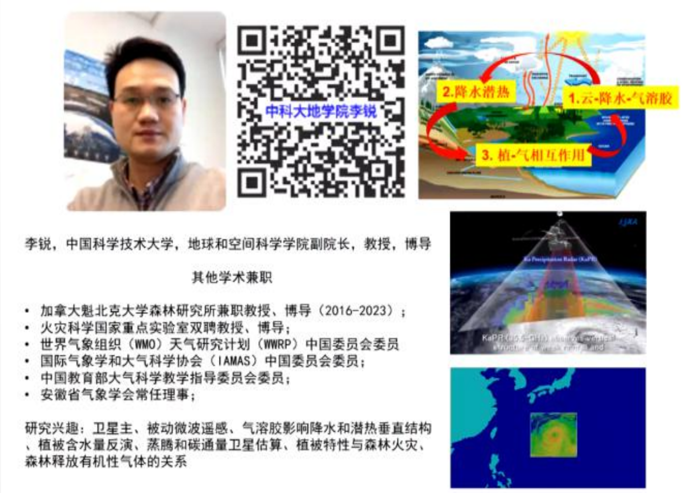
Awesome Satellite Benchmark Datasets



Relevant International Organizations



Feasibility of establishing the MLRTRS working group



Feasibility of establishing the MLRTRS working group

- 'The First Summer Course of Atmospheric Radiation and Remote Sensing' is held online and offline at the same time, with nearly 100 students attending the session. The Tencent conference has about 200 participants, and the online live conference of Kouxiang Academic gathers more than 6,000 views.

Objectives

Development

① The main objective of the working group is to develop and extend the application of machine learning methods in areas such as improving radiative transfer model solutions and satellite remote sensing retrieval methods, and to share ideas, techniques, and high–quality datasets of machine learning techniques in radiative

Communication

The Working Group will also regularly organize forums on the latest advances in machine learning techniques applicable to radiative transfer and remote sensing and, where appropriate, make recomm–endations highlighting areas where further work is needed ②

Resume

Feng Zhang, born in 1984,. Professor of Fudan University

Research interests:
Atmospheric radiative transfer and remote sensing

Time	Department	Position
2020.1-now	**Institute of Atmospheric Science of Fudan University**	**Professor**
2014.2-2020.1	**Nanjing University of Information Science & Technology**	**Lecturer, Professor**
2018.8-2019.7	Institute of Remote Sensing Science and technology, German Aerospace Center	Humboldtian
2016.5-2018.5	Tohoku University	JSPS fellow
2010.8-2014.1	Shanghai Typhoon Research Institute of China Meteorological Administration	Research assistant
2010.9-2013.6	School of Earth Sciences, University of Chinese Academy of Sciences	Doctor of Philosophy
2007.9-2010.6	China Academy of Meteorological Sciences	Master
2002.9-2006.6	Zhejiang Normal University	Bachelor

Thanks!

Q&A

Next Business Meeting

IUGG 2023

11-20 July 2023, Berlin, Germany

https://www.iugg2023berlin.org/

Hope to see all of you there!