2023 International Radiation Commission (IRC) Business Meeting

13 July 2023

Agenda

I. Welcome and Introductions

II. President's Report (15)

   a. IRC Financial Status

   b. Upcoming meetings

   c. Website update

   d. In Memoriam

III. Summary of IRS 2022 (5)

   Alkis Bais

IV. IRS 2024 Status (15)

   Lei Bi: Hangzhou, China

V. Working Group Presentations (40)

VI. IAMAS Resolution on Weather and Climate Engineering (10)

VII. Next Business Meeting to be held during the IRS 2024, Hangzhou, China (5)

VIII. Other Business

Treasurer's Report 2022-2023 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
Total				1,249,045	8788.66

Upcoming meetings

1. 2023 LASP/Goddard Sun-Climate Symposium, **16-20 October 2023**, Flagstaff, Arizona, USA (https://lasp.colorado.edu/meetings/2023-sun-climate-symposium/)
2. World Climate Research Programme (WCRP) 2nd Open Science Conference (OSC), **23-27 October 2023,** Kigali, Rwanda (https://wcrp-osc2023.org/)
3. AGU Fall Meeting, **11-15 December 2023**, San Francisco, CA , USA (https://www.agu.org/Fall-Meeting)
4. EGU General Assembly, **14–19 April 2024**, Vienna, Austria (https://www.egu24.eu/)
5. International Radiation Symposium 2024 (IRS 2024), **17–21 June 2024,** Hangzhou, China (http://www.irs2024.org)

IRC Website


International Radiation Commission
UNDER CONSTRUCTION
IAMAS > IRC
Home
IRC is a global network of scientists engaged in research of atmospheric radiation and related disciplines. Founded in 1896, IRC is the oldest of the ten commissions of IAMAS (International Association of Meteorology and Atmospheric Sciences) and is currently comprised of experts from 18 countries working in universities, research institutions, government agencies and private industry. The Commission coordinates research, guides priorities, and supports international cooperation and collaboration. IRC also organizes scientific symposia open to all scientists that provide forums for the scientific community to present, discuss and promote the latest achievements in atmospheric radiation science.
News and Updates
A tribute to Dr. Kuo-Nan Liou (1943-2021)
IRS2022 rescheduled to 4-8 July 2022
Official page of commemorating the life of Dr. Michael I. Mishchenko (1959-2020)
read more.....
Adobe Stock | #259112674

Be on alert for phishing attempts!

An example …

From: Peter Pilewskie <**ppressidentt@gmail.com**>
Sent: Wednesday, July 12, 2023 10:53:23 AM
To: Odele Coddington <odele.coddington@lasp.colorado.edu>
Subject: IRC

Dear XXX,

How are you doing? I'm in a meeting at the moment and I need you to help get something done on behalf of the association. Are you free at the moment? I am unable to take calls, email back.

Thanks

Peter Pilewskie

In Memoriam

John Harries

26 March 1946 – 21 December 2022

International Radiation President 1992-1996

- Developed the he Halogen Occultation Experiment (HALOE) that flew on Upper Atmosphere Research Satellite (UARS)
- Developed the Geostationary Earth Radiation Budget (GERB) instrument.
- Associate director of the Rutherford Appleton Laboratory
- President of the Royal Meteorological Society
- First chief scientific adviser for Wales
- NASA distinguished public service medal
- Mason Gold Medal of the Royal Meteorological Society

Summary of IRS 2022

Alkis Bais, Laboratory of Atmospheric Physics, AUTH

IRC Business Meeting, Berlin, 13-7-2023

Geographic distribution of IRS 2022 Participants

Country	Number of Participants	Country	Number of Participants
Argentina	2	Italy	15
Austria	6	Japan	11
Belgium	6	Netherlands	11
Brazil	2	Poland	6
Cyprus	2	Reunion	2
Czechia	3	Russia	6
Denmark	1	South Korea	21
Finland	6	Spain	19
France	47	Sweden	1
Germany	42	Switzerland	10
Greece	36	United Kingdom	12
India	1	United States	79
Israel	9		

Symposium data

- Participants: **350**
- Presentations: **281** oral and **160** posters
- Extended abstracts: **76**
- Reviewed by the conveners
  - (with assistance of co-conveners or external reviewers)
- Proceedings material submitted to AIP on **29 March 2023**
- Waiting for processing (delays due to high work load at AIP)

International Radiation Commission (IRC)

- After a successful, twice-delayed IRS 2022 in Thessaloniki, the International Radiation Symposium will resume its normal cadence in 2024 in Hangzhou, China.
- Please check http://www.irs2024.org for updates.

INTERNATIONAL RADIATION SYMPOSIUM

INTERNATIONAL RADIATION SYMPOSIUM 2024

17-21 June 2024 Hangzhou, China

http://www.irs2024.org

1. Topical Union Session: Current Problems in Atmospheric Radiation
2. Radiative Transfer Theory and Modeling
3. Particle Radiative Properties
4. General Remote Sensing
5. Ground-based Measurements and Field Observations
6. Radiation Budget and Forcing
7. Weather, Climate and Environment Applications
8. Solar UV Radiation
9. China's Satellite Remote Sensing Programs
10. Radiation Science in the Tibetan Region

Working Group Presentations

The 12 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 Co-Chairs: Andreas Macke and Johannes Quaas
GEB - Global Energy Balance Co-Chairs: Norman Loeb and Martin Wild
ICLAS - International Coordination group for Laser Atmospheric Studies Chair: Fred Moshary and 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
MLRS - Machine Learning Applications in Remote Sensing Chair: Feng Zheng

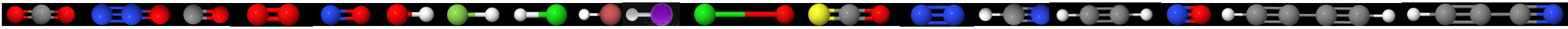
WG 1: ASA - Atmospheric Spectroscopy Applications

Iouli Gordon

CENTER FOR ASTROPHYSICS
HARVARD & SMITHSONIAN

ASA progress report

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



- Continuous work on improved atmospheric spectroscopy (towards HITRAN 2024) is underway. Some of the highlights:
- Incorporated water vapor continuum https://hitran.org/mtckd/ (led by Eli Mlawer). Paper https://doi.org/10.1016/j.jqsrt.2023.108645
- All PNNL cross-sections will be featured in the HITRAN2024 edition
- Upcoming improvements include

A) Incorporation of new high-precision measurements and calculations

B) Further expansion of the non-Voigt line shape parametrizations

C) Methane will be the molecule where the most drastic improvements can be achieved across all spectral regions, thanks to the recent experimental and theoretical works

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

IAMAS

ASA-HITRAN CONFERENCE – REIMS – FRANCE

Held in AUGUST 24 –26, 2022

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

Upcoming:
HITRAN-ASA CONFERENCE – Cambridge, MA-USA

June 24 –26, 2024

WG 2: BSRN - Baseline Surface Radiation Network

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

Short version will be remotely presented by the WG chairs

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 Global Climate Observing System (GCOS) renewed its endorsement to BSRN by flagging it as a recognized GCOS network during 2022 (https://gcos.wmo.int/en/networks/gcos-networks-accreditation, Figure 1). 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).

Network Certificate

Baseline Surface Radiation Network

(Accreditation date: 01/09/2022)

Figure 1: Since September 2022 BSRN officially is a „GCOS recognized network“.

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).

Status of the affairs

At the moment (status May 2023) 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, 13 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) – see Figure 2. Stations from Thailand, Indonesia, Cyprus, Ireland, Chile and Lampedusa are in pending status.

About **13,000 months of radiation data** (~12,500 in 2022) 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. To make citing these monthly datasets easier, the WRMC plans to create collection datasets for each station. Already, collections for 29 stations are available 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. Additionally, a new BSRN data snapshot was published in March 2023: "*Lanconelli, C. et al. (2023): Baseline surface radiation data snapshot 2023-03-31. PANGAEA, https://doi.org/10.1594/PANGAEA.957398*". This snapshot contains the data as well as the QC codes produced using the BSRN Toolbox over the whole archive. The snapshot has been created in the frame of a collaboration with the Italian National Research Council to support an initiative aimed at releasing temporally aggregated data of the downwelling radiative components through the Copernicus Climate Data Store (https://cds.climate.copernicus.eu/#!/home). The products are under development and debugging and it is foreseen to have a first version published early next fall. It is also foreseen to update the status of the QC with a three months interval schedule, and to publish the QC flag files along with the data files. The format of the files is under discussion within the Data Quality WG.

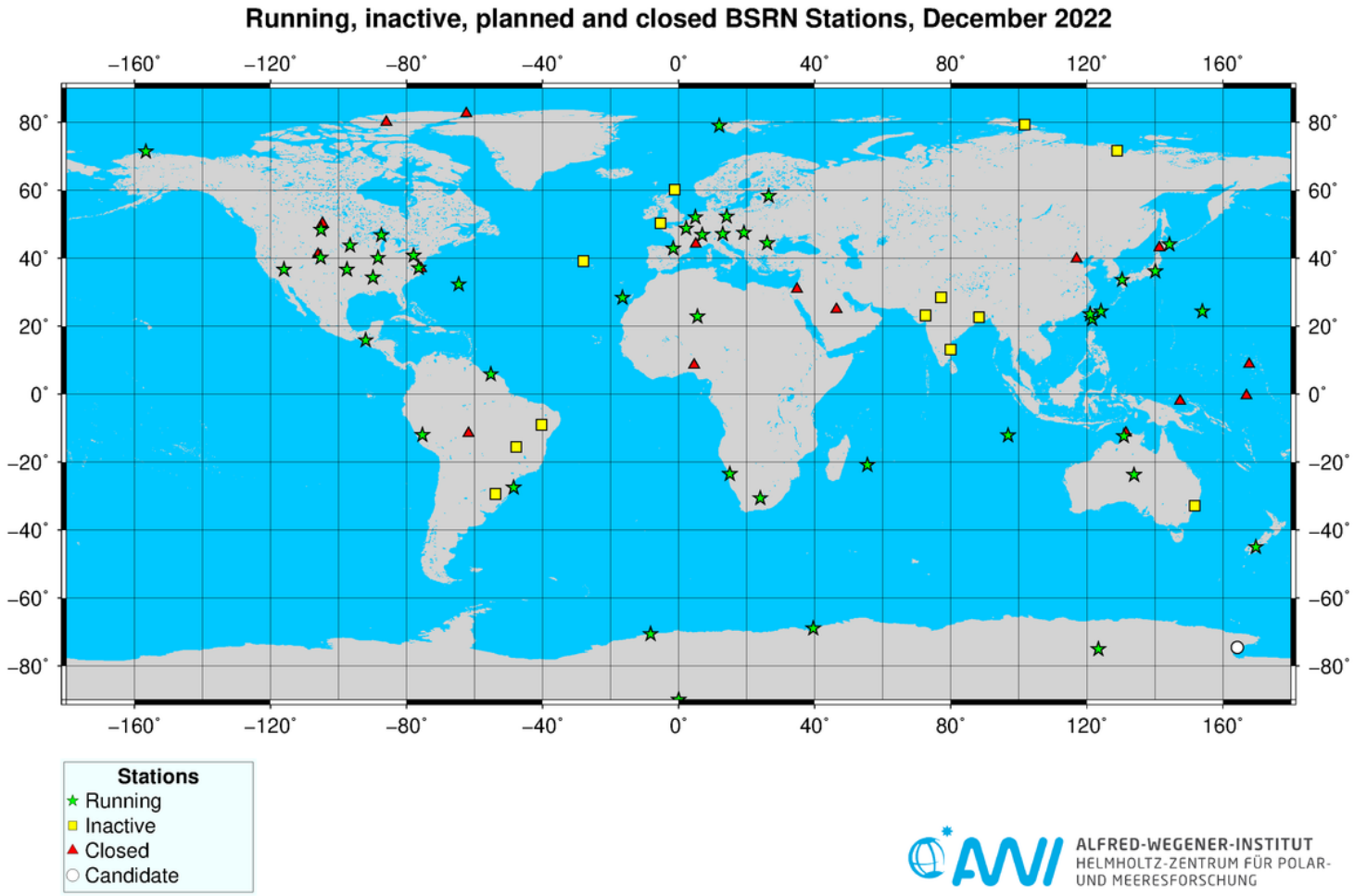


Figure 2.Map of all BSRN stations (running, inactive, closed and candidate).

Meetings

The 17th BSRN scientific review and workshop was held in hybrid form during June 27-30, 2022 in Ispra, Italy, hosted by the Joint Research Centre of the European Commission. About 40 presentations were given across several sessions dedicated to station operations, data analysis towards value-added- products, modelling, remote-sensing, campaigns (instrument inter-comparison), Working Group roundtable and reports. 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 were discussed. The agenda and the presentations are available through the BSRN webpages, see links in https://bsrn.awi.de/meetings/2022/.

Christian Lanconelli attended the annual GEWEX-GDAP and NDACC meetings (September 2022), and IRC Business meeting (July 2022) 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 fame of OBPS activities (https://www.oceanbestpractices.org/). Amelie Driemel reported on the BSRN status during the national German GCOS meeting in March 2023 (hybrid). During this meeting, an initiative was started by Stefan Rösner (German GCOS Coordinator) involving Tim Oakley (GCOS Network Manager) and the Tamanrasset station scientist Sidi Baika to get funding for the Tamanrasset tracker, which broke in 2018.

Figure 3. Group photo of the 17th Biannual BSRN Scientific review and Workshop (Ispra, Italy).

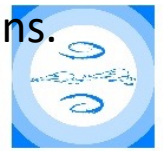
Working Groups activities

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). Within the Data Quality WG, regular meetings continued to take place every 4-8 weeks.

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 better support to space agencies.

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. A full revision of GCOS-174 is underway. LR4000 contains the pyrgeometer raw data (signal and temperatures) and it is needed to recalculate the longwave component for any eventual variation of the international standard (under discussion within the WMO Radiation Task-Team). All stations were requested to start submitting the new LR4000 for any new station to archive file within 2023. A program to verify the consistency between LR4000 and the data logical records has been implemented. BSRN now stores relevant calibration certificates in a centralized way to guarantee better traceability. This will be expanded to shortwave components.

The raw data system is further developed though it is currently used by few stations. Candidate and pending stations are encouraged to use it, along to the pilot BSRN Data-Quality web-based tool developed in the frame of the DQWG activities, which serves as a further support to station scientists in quality checking operations.



IAMAS

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 5800 times (excluding self-citations) within >4000 articles. About 189 BSRN articles have been published in total (compared to 175 in June 2022), and many more scientists used BSRN data e.g. in student courses, for renewable energy research or in grey literature.

On going activities and Plans

1.Manual review, continue with established activities and drafted content (status: on-going)
2.Harmonize measurements, implement ground meteorological traceability (T, p, RH) (on-
3.going).
4.Establish Albedo WG / expand albedo measurements (tower/drones?) (on-going)
5.Establish VAP WG (first action set to Release Time Aggregated data through the Copernicus
6.CDS)
7.Extend inter-network interactions (interaction with GRUAN, and level 2 data foreseen to be
8.released through the Copernicus Climate Data Store, GBOV continue to ingest BSRN data)
9.Explore the space agencies'/private sector (SE) interests to invest in area gap coverage
10.(Africa/Pacific) for validation purposes (EU) (on-going)
11.Interaction with Ocean community initiatives (Radiation measurements best practice white
12.paper lead by Riihimaki NOAA).
13.Release QC files and update them with a three-month schedule.
14.Define quantitative indicators to determine when data submission can be ingested into BSRN
15.archive (DQWG).

WG 3: CR - Clouds and Radiation

Andreas Macke and Johannes Quaas

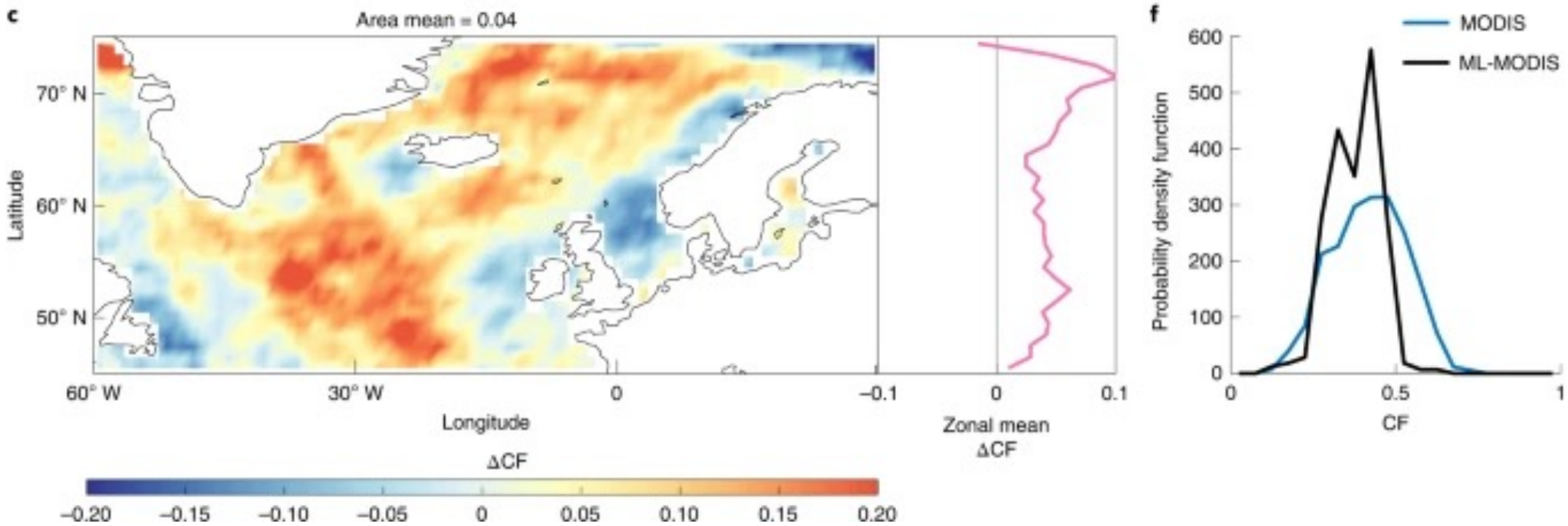
Clouds and **Radiation (mostly ACI)**

report for IRC 2023

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

Aerosol-cloud interactions

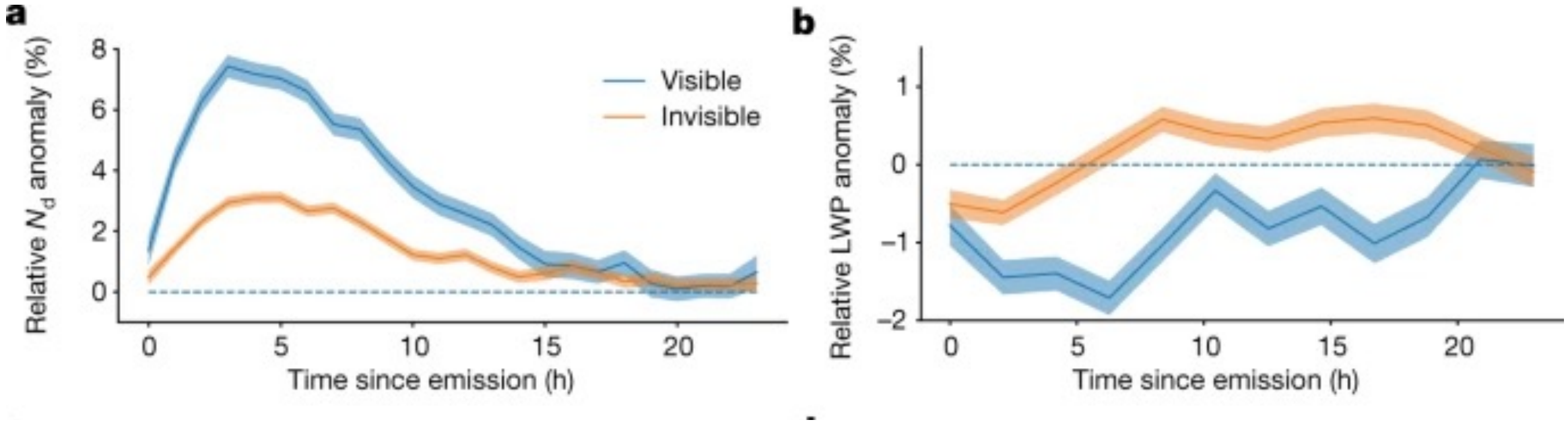
- **Increase in cloud fraction due to Holuhraun volcanic aerosol stronger than increase in cloud brightness**
  - machine learning approach for counterfactual from satellite dat



Chen, Haywood, et al., Nature Geoscience 2022: Machine learning reveals climate forcing from aerosols is dominated by increased cloud cover

Aerosol-cloud interactions

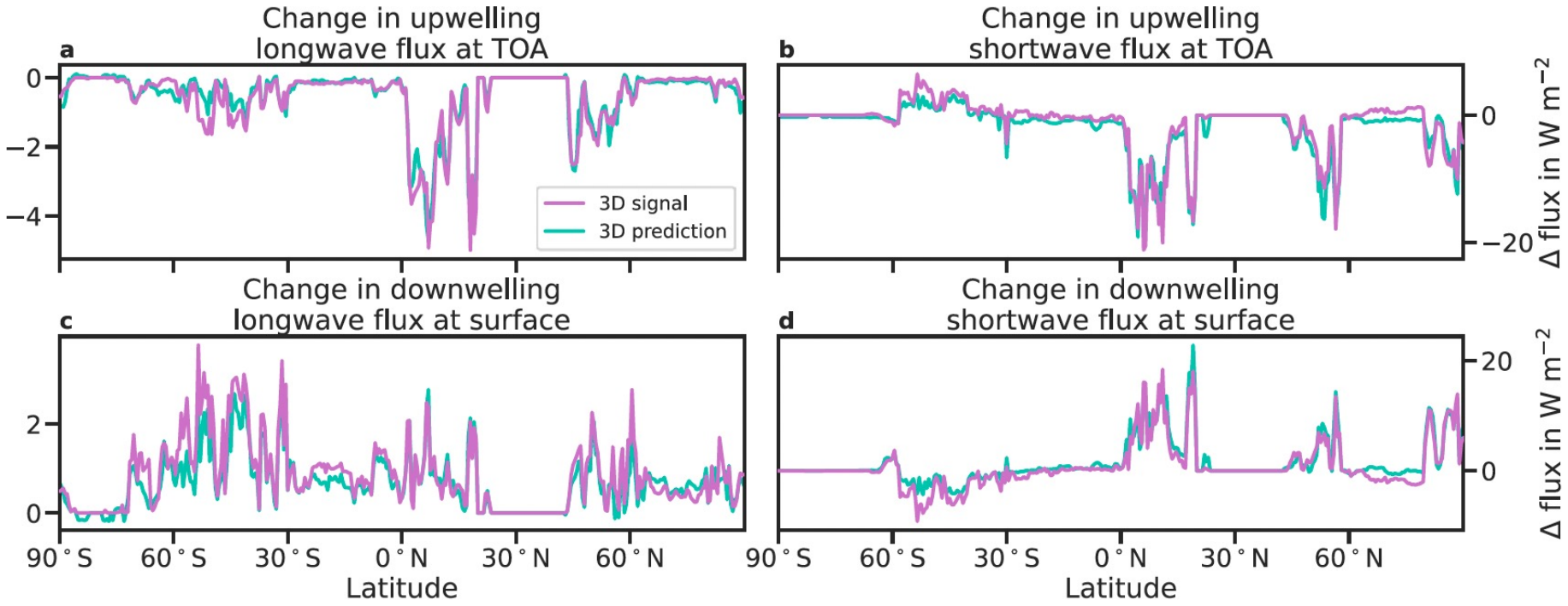
- **Invisible ship tracks have stronger effect than visible ones**
  - tracking ship emissions and sample cloud retrievals
  - drop number enhancement strong for visible ship tracks
  - but liquid water path enhanced for invisible ones (decrease for visible ones)



Manshausen et al., Nature 2022: Invisible ship tracks show large cloud sensitivity to aerosol

3D radiation emulation

- hybrid physical machine learning approach to correct a fast but less accurate 1D radiative transfer scheme with two neural network emulators of shortwave and longwave 3D cloud effects



Meyer, Hogan, Dueben, Mason, JAMES 2022: Machine Learning Emulation of 3D Cloud Radiative Effects

WG 4: GEB - Global Energy Balance

To be presented in M12

Wild, M., Report of IRC Working Group Global Energy Balance: Downward longwave radiation - a critical component of the Global Energy Balance

Saturday, 15 Jul 2023 15:30 - 15:45

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

Fred Moshary and Alex PAPAYANNIS

International Coordination-group for Laser Atmospheric Studies (ICLAS) Working Group Report for 2022-2023

Fred Moshary, ICLAS *President*
City College of the City University of New York, USA
Alex PAPAYANNIS, *Past* ICLAS *President*
National Technical University of Athens, Greece

- ICLAS: Promotes the development and application of laser remote sensing techniques and laser instrument architectures for the study of Earth and Planetary Atmospheres
- ICLAS oversees the organization and planning of the International Laser Radar Conferences (ILRCs); a gathering of the laser remote sensing community usually convened every 2 years. The ILRCs are held under the auspices of the ICLAS.

ICLAS

Current Members of the ICLAS Working Group

NAME SURNAME	COUNTRY	TERM
PRESIDENT		
Moshary, F.	USA	2022-2028
Past President		
Papayannis, A.	Greece	2022-2028
TREASURER		
McGee T.	USA	No term limit
EUROPE		
Rairoux P.	France	2020-2026
Ptashnik I.	Russia	2020-2026
Amiridis V.	Italy	2022-2028
Mona, L	Germany	2022-2028
Donovan D.	The Netherlands	2017-2023
Tzeremes G.	ESA	2017-2023
USA/CANADA		
Sarah Tucker	USA	2022-2028
Leblanc T.	USA	2020-2026
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 International Laser Radar Conference (ILRC-30)

The 30th ILRC Conference was held virtually on June 26th – July 1st, 2022.

It was organized by scientists Thierry Leblanc NASA (Jet Propulsion Laboratory-JPL) and John Sullivan NASA *Goddard Space Flight Center-GSFC)

467 Registered
252 abstracts submitted
249 presentaitons: 57 Oral and 192 Poster Presentations

Proceedings complete and in publication by Springer

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

The 30th ILRC Conference Topical Areas

- Emerging lidar techniques, methodologies, and discoveries
- Atmospheric clouds and aerosol properties
- Atmospheric temperature, water vapor, wind, turbulence, and waves
- Atmospheric boundary layer processes
- Greenhouse gases, tracers, and transport in the free troposphere and above
- Measurements in the stratosphere, mesosphere and thermosphere
- Measurement techniques and observations of ocean properties
- Space-borne lidar missions, instruments and science
- Synergistic use of multiple instruments and techniques, networks and campaigns
- Model validation and assimilation using lidar data
- Joint CLRC-ILRC Session: Past, present and future synergy of heterodyne and direct detection lidar applications
- 50 years of lidar observations: the tip of the laser remote sensing iceberg?

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

Inaba Prize (Young Scientist Unver 40): Dr. John Sullivan - NASA Goddard Space Flight Center, USA "Advances in Characterizing Pollution Transport with Ground-Based and Airborne Profilers: Case Studies within Houston, TX"

Lifetime Achievement Awards

Prof. Joe She, Colorado State University. USA

Dr. Edward Browell – NASA Langely Research Center, USA

Best Student Oral Presentation: Arunima Prakash- University of Colorado, Boulder. USA "Long-Term Lidar Observations of Polar Mesospheric Clouds in Antarctica for Studies of Solar Cycle and Polar Vortex Effects"

Best Student Poster Presentation: Madison Hetlage- Texas AM University, TX USA "Atomic Barium Vapor FIlter for Ultraviolet High Spectral Resolution Lidar"

Report on the 30th International Laser International Laser Radar Conference (ILRC-31)

The 31th ILRC Conference is in the Planning Phase for June 23rd – June 28th, 2024 in Landshut, Bavaria, Germany

It will be held together with the Coherent Lasere Radar Conference, andis jointly organized by Andreas Fix and Stephan Rahm (DLR, Germany)

467 Registered
252 abstracts submitted
249 presentaitons: 57 Oral and 192 Poster Presentations

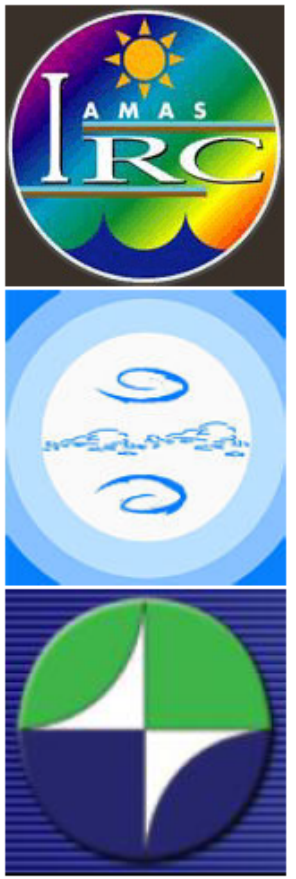
Proceedings complete and in publication by Springer

IRC Business Meeting, 13 July, 2023

WG 6: IPRT - International Polarized Radiative Transfer

Claudia Emde and Bernhard Mayer

International WG on Polarized Radiative Transfer



Aims of working group IPRT:

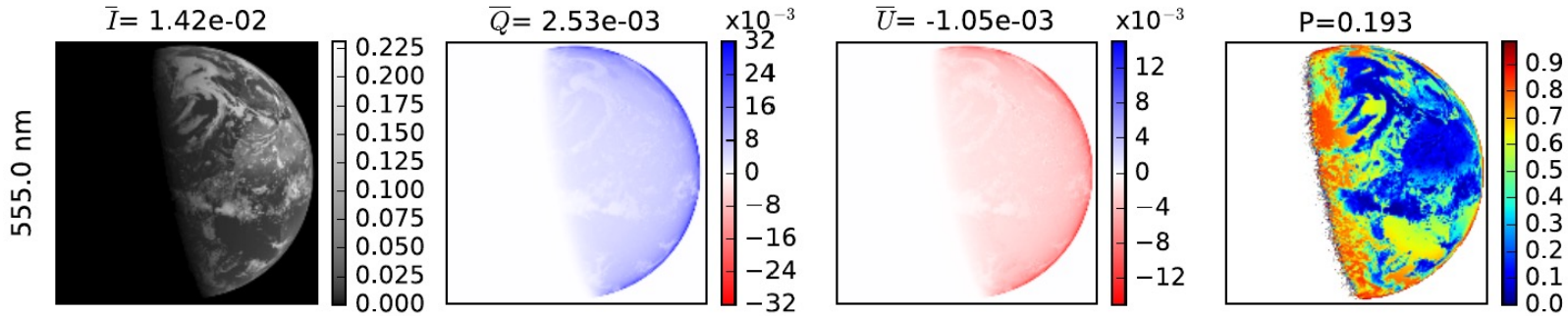
- bring the community together (workshops)
- **compare and improve models, 3D model intercomparison**
- **provide benchmark results**
- provide information about free codes
- develop new and faster, publically available codes
- provide input data (scattering matrices, **BPDFs – bidirectional polarization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

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

Vector radiative transfer in spherical geometry

Motivation:

- Limb sounding of Earth atmosphere (ATLIUS mission)
- Twilight observations from ground
- Exoplanetary atmospheres



MYSTIC simulation of Earth as seen from Moon

Model intercomparision studies

- Completed model intercomparisons studies for spherical geometry
  - Clearsky scalar RT

    S. Korkin, E.-S. Yang, R. Spurr, C. Emde, N. Krotkov, A. Vasilkov, D. Haffner, J. Mok, and A. Lyapustin. **Revised and extended benchmark results for Rayleigh scattering of sunlight in spherical atmospheres.** J. Quant. Spectrosc. Radiat. Transfer, 254:107181, 2020.
  - Vector RT in spherical geometry for clearsky and aerosol cases, limb geometry, refraction partly included

    D. Zawada, G. Franssens, R. Loughman, A. Mikkonen, A. Rozanov, C. Emde, A. Bourassa, S. Dueck, H. Lindqvist, D. Ramon, V. Rozanov, E. Dekemper, E. Kyrölä, J. P. Burrows, D. Fussen, and D. Degenstein. **Systematic comparison of vectorial spherical radiative transfer models in limb scattering geometry.** Atmos. Meas. Tech., 14(5):3953-3972, 2021.
  - Vector RT for clearsky cases

    S. Korkin, E.-S. Yang, R. Spurr, C. Emde, P. Zhai, N. Krotkov, A. Vasilkov, and A. Lyapustin. **Numerical results for polarized light scattering in a spherical atmosphere.** Journal of Quantitative Spectroscopy and Radiative Transfer, 287:108194, 2022.
- Plans: comprehensive model intercomparision within IPRT including
  - More complete observation geometries (limb, twilight)
  - Aerosol and cloud cases
  - Refraction
  - 3D spherical geometry
  - Status: various models under development

Further plans

- Various BPDF models have been developed, e.g.

  F. Maignan, F.-M. Bréon, E. Fédèle, and M. Bouvier. **Polarized reflectances of natural surfaces: Spaceborne measurements and analytical modeling**. RSE, 2009

  P. Litvinov, O. Hasekamp, O. Dubovik, and B. Cairns. **Model for land surface reflectance treatment: Physical derivation, application for bare soil and evaluation on airborne and satellite measurements**. JQSRT, 2012

- Information about BPDF models and codes for specific land surfaces is very difficult to find
- Collect literature and corresponding codes and update "surface polarization" section on IPRT website

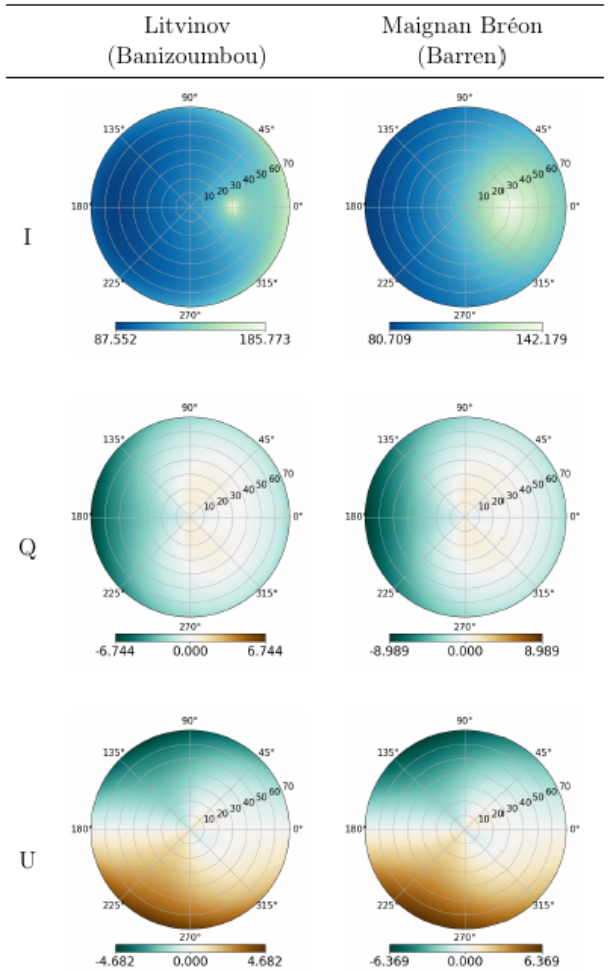


Figure from C. Wehrum 2023

WG 7: ITWG - International TOVS Working Group

To be presented in M12

V. Guidard, V. and L. Gumley, IUGG23-2941: Overview of the activities within the International TOVS Working Group

Sunday, 16 Jul 2023 14:15 - 14:30

2022

ITWG activity updates and recommendations

Vincent Guidard

INTERNATIONAL ATOVS WORKING GROUP

ITSC-24 held in Tromsø, 16-22 March 2023

166 participants (in-person only)

78 oral presentations
+ 1 invited talk

92 posters (displayed during all the conference)

17 NWP centre reports
(1st time to reach that number)

4 Space Agency reports
(missing Eumetsat, KMA and Russian Space agency)

Information from other WGs
IPWG and IESWG

INTERNATIONAL ATOVS WORKING GROUP

ITSC-24 held in Tromsø, 16-22 March 2023

17 sessions, including
- Artificial Intelligence and Machine Learning
- Small Satellites Assimilation
- Geo Hyperspectral Sounder Assimilation
- Earth System Approach

Equal gender representation in the session co-chairs

Meetings of **6 working groups**
- Advanced Sounders
- Climate
- International and Future system
- Numerical Weather Prediction
- Products and Software
- Radiative transfer and Surface properties

and **2 technical sub-groups**
- RTTOV / CRTM (radiative transfer models)
- Radio Frequency Interference

All presentations and reports on ITWG (new) website: https://itwg.ssec.wisc.edu/

INTERNATIONAL ATOVS WORKING GROUP

ITSC-24 held in Tromsø, 16-22 March 2023

Host institutes: Météo-France, SSEC/U Wisconsin and Met Norway

Additional sponsors: CNES, EUMETSAT, NASA, NOAA and Orbital System

Best oral presentation and best poster awards
Both from the committee and the people's choice

Chris Burrows	ECMWF
Hanna Hallborn	Chalmers Uni.
Katie Lean	ECMWF
Emma Turner	Met Office
Ethel Villeneuve	Météo-France

INTERNATIONAL ATOVS WORKING GROUP

Selection of some recommendations raised during ITSC-24

Recommendation from the Radiative Transfer and Surface Properties WG

Spectroscopy

Recommendation RTSP-5 to Spectroscopy Community

A strong emphasis should be put on the continuous support of theoretical and laboratory spectroscopic studies. It is crucial that a compilation of basic line parameters is maintained. In this regard, it is recommended to work more closely with the planetary/ astronomy community for knowledge of LBL / spectroscopy information.

Line by line modelling:

The group discussed the status of the Community LBLM (CLBLM) and noted that the model has not yet been officially released. Doubts were raised regarding the funding of the project.

Recommendation RTSP-4 to CLBLM developers

Maintain the latest LBRTM version when CLBLM is released.

Selection of some recommendations raised during ITSC-24

Recommendation from the Radiative Transfer and Surface Properties WG

Aerosols

It was discussed that the RTTOV OPAC/CAMS database now includes the following species: volcanic ash, Asian dust and the ICON-ARTS species. There is concern by RTTOV developers that there are many users, but they do not know who they are nor their needs.

Recommendation RTSP-6

Reach out to the aerosol community and survey their aerosol (physical) needs

Recommendation RTSP-7 to aerosol community

The group encourages the publication of a literature review that includes new aerosol studies and challenges regarding VIS/near-IR aerosol sensitivities and spectral dependencies

Recommendation RTSP-8 to aerosol community

The group continually supports field campaigns and the community to use field campaign data for validation studies. The group further recommends to connect aerosol FCs to RT evaluation

Selection of some recommendations raised during ITSC-24

Recommendation from the Radiative Transfer and Surface Properties WG

Clouds

The group discussed that far-IR spectral information content enables additional information on cloud properties, similar to the “scattering index”.

Recommendation RTSP-10

Continue support to exploit synergy (i.e., FORUM+IASI-NG) in studies and retrievals.

Recommendation RTSP-12 to RT developers

The group continues to recommend the development of cloudy RT model validation datasets.

The group discussed whether physical consistency across the spectrum in fast models is a priority.

Renewing ITWG co-chairs

Vincent Guidard and Liam Gumley have served as ITWG co-chairs since 2018.
3 ITSCs have been organised as well as interim working group meetings.

New co-chairs have been elected in May 2023:

Fiona Smith
Bureau of Meteorology

Reima Eresmaa
Finnish Meteorological Institute

INTERNATIONAL ATOVS WORKING GROUP

WG 8: UV - Solar Ultra-Violet Radiation

Ann Webb and Julian Groebner

UV Working Group – Overview

Ann Webb and Julian Groebner

3rd International Solar UV Radiometer calibration campaign, UVC-III, 13 June – 29 August 2022

Solar Light:
16 analog
10 digital

YES: 7

EKO MS: 6

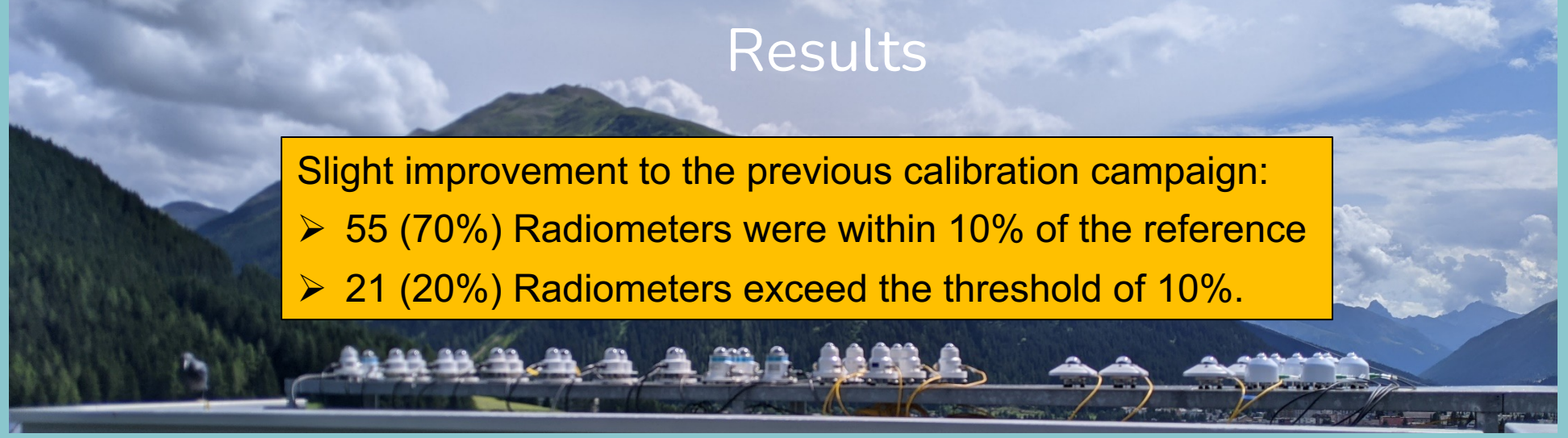
Kipp & Zonen:
Analog 21
SUV 8

CMS, Indium Sensors, DeltaOhm, EKO, SGLUX, Aerospace Newsky Technology : 8

Input Optics of the two reference spectroradiometers QASUME and QASUMEII

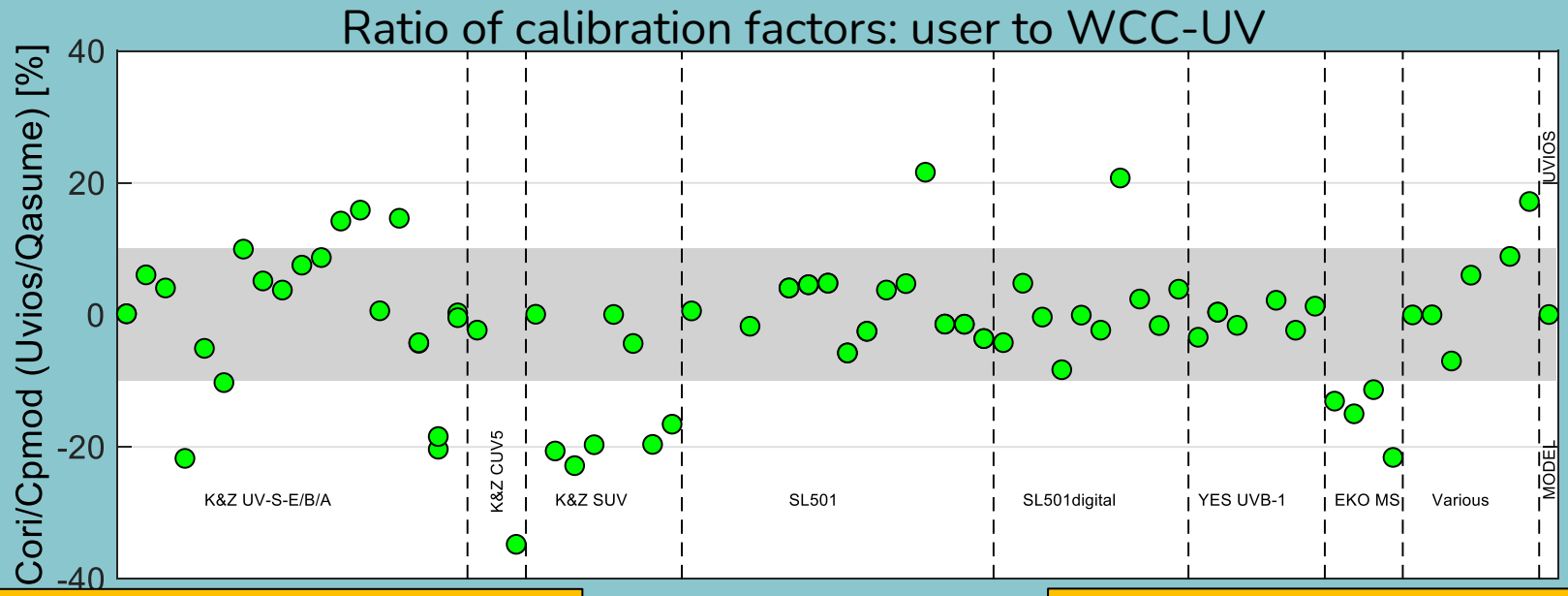
Instruments: 76
Participants: 42
Countries: 29

Results



Slight improvement to the previous calibration campaign:

- 55 (70%) Radiometers were within 10% of the reference
- 21 (20%) Radiometers exceed the threshold of 10%.



Results from UVC-II (2017)

Relative difference to WCC-UV

Radiometers ≤ 10%	48 (64%)
≥ 10%	**27 (36%)**

Total radiometers 75

Results from UVC-III (2022)

Relative difference to WCC-UV

Radiometers ≤ 10%	55 (72%)
≥ 10%	**21 (28%)**

Total radiometers 76

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

Alexander Marshak and Nadine Gobron

3D radiative transfer working group report

Alexander Marshak (NASA/GSFC) and Nadine Gobron (JRC)

I3RC (Intercomparison of 3D Radiation Codes) report

The I3RC project was initiated by Robert Cahalan in the mid 1990s, with funding from the Department of Energy Atmospheric Radiation Measurement Program and the NASA Radiation Sciences Program, and with endorsements from International Radiation Commission and GEWEX Radiation Panel.

- The I3RC website transition to a new server has been completed. Visitors going to the old address (i3rc.gsfc.nasa.gov) are automatically redirected to the new address (https://earth.gsfc.nasa.gov/climate/model/i3rc).

- The I3RC public code was obtained by 5 researchers (3 from China, and one each from Israel and Japan). This is similar to the last three years, when we gave the code to 4 or 5 people each year.

- The I3RC online simulator gained 40 new users from 17 countries spread across 5 continents (11 from the US, 6 from China, 4 from India, 2 from France, Spain, Israel, Germany, UK, and 1 from Australia, South Korea, Ghana, Malaysia, Pakistan, Saudi Arabia, Nepal, Japan, and New Zealand). This is up from 18, 26, and 20 in each of the previous three years. The simulator now has 139 users (excluding ourselves and those who got “courtesy accounts” as they have helped setting up the simulator).

RAMI (Radiation transfer model intercomparison) report (see the attached slides)

RAMI-V focuses on the radiation transfer through abstract and actual canopies. Currently, RAMI (https://rami-benchmark.jrc.ec.europa.eu/) faces two active phases. It is oriented to Copernicus optical missions such as S2 (MSI) and S3 (OLCI), and to MODIS, from which real sun-observation geometries was adopted to simulate the DHR, BHR and BRF over 13 bands.

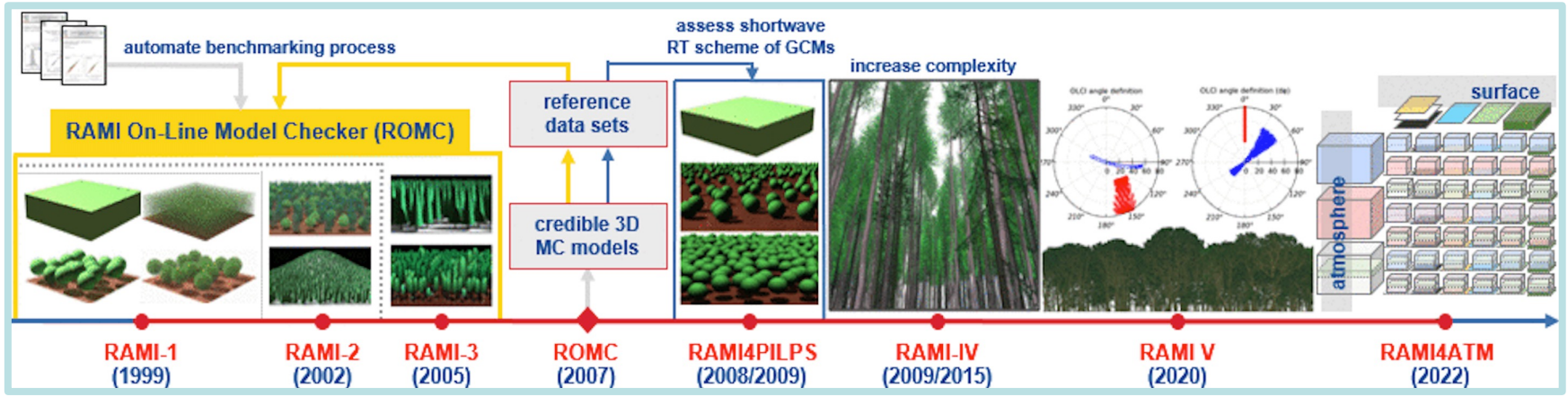
- Two new empirical scenes of savanna and deciduous forest with respect to RAMI-IV. RAMI-V counted 14 participating models (8 **new** models) and the results were presented during the 1st RAMI workshop (Varese, 7-9 June 2023).

- RAMI4ATM (RAMI for Atmosphere) is dedicated to surface-atmosphere RT coupling. The participants (16 models from 10 different institutions) were requested to simulate top-of-atmosphere BRF in the principal and orthogonal plane and surface albedo and hemispherical-directional reflectance factor (HDRF) at bottom-of-atmosphere (BOA).

Radiation Transfer Model Intercomparison exercise

- (1D)-3D Radiative Transfer model **independent** assessment
- **Oriented to vegetated surfaces**
- 20+ years activities
  - **six phases (RAMI-1 to RAMI4ATM)**
  - +ROMC: RAMI On-Line Model Validator
  - +RAMI4PILS
- Increased complexity of scenarios and experiments
- **RAMI-V:** Oriented to satellite and in-situ observations
- **RAMI4ATM:** towards coupled atmosphere-surface scenes

https://rami-benchmark.jrc.ec.europa.eu



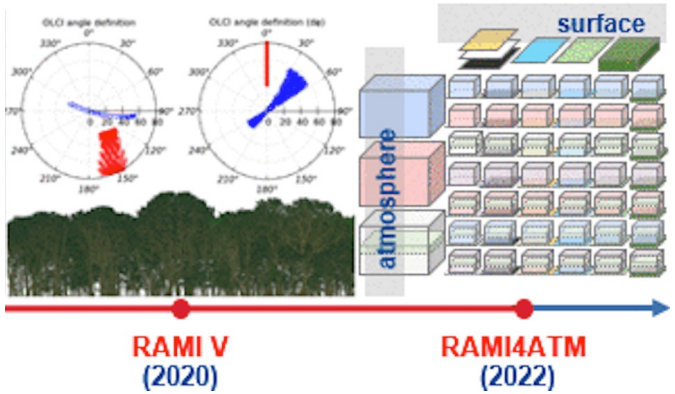
Ongoing activities

- **RAMI-V (2020-):** final analysis completed and drafting report peer-reviewd papers
  - 106k experiments proposed (BRF, Albedo, absorption and transmission through the canopy, in situ meas such as THP and TRAC)
  - Oriented to Copernicus optical missions (OLCI, MSI) and MODIS
  - 14 participants, 8 new models w.r.t. RAMI-IV (2009-2015)
  - References can be identified for Abstract, less agreement still affect Actual scenarios, although better round-robin comparison results were observed
- **RAMI4ATM (2022-):** The first RAMI excercise dedicated to surface atmosphere coupling
  - 7 atmosphere families with increasing complexity (Rayleigh, gas, aerosol, full) and 8 surfaces, combined to simulate BRF at TOA and HDRF and Albedo at BOA.
  - 16 models from 10 institutions
  - Submission still active to fix major model deviations
  - Rather promising agreement among models at least for the simpler atmospheres
- RAMI Workshop held in Varese, Italy hosted by the Joint Rersearch Centre and supported by Copernicus 7-9 June 2023
  - 20+ presentation in person and remotely
  - A Report of the outcomes will be published

RAMI-V and RAMI4ATM participant lists

RAMI-V

Model	Participants	Reference
dart	Yingjie Wang	Gastellu-Etchegorry et al. (1996)
dirsig5	Adam Goodenough	Goodenough & Brown (2017)
Discret	Nadine Gobron	Gobron et al. (1997)
eradiate	Sebastian Schunke	Eradiate.eu (Copernicus Community Model - 2021)
flies	Hideki Kobayashi	Kobayashi & Iwabuchi (2008)
frt13 (*)	Andres Kuusk	Kuusk & Nilson (2000), Kuusk et al. (2010, 2014)
less	Jianbo Qi	Qi et al. (2019)
librat	Nial Oregon	Disney et al. (2009)
randerjay	Martin van Leeuwen	van Leeuwen M. et al. (2021)
rapid	Huaguo Huang	Huang et al. (2018a, 2018b)
raytran	Christian Lanconelli	Govaerts & Verstraete (1998)
spartacus	Robin Hogan	Hogan et al. (2018)
starter1	Zeng Yelu	Zeng et al. (2018) and Wu et al. (2021)
wps	Feng Zhao	Zhao et al. (2015, 2016)



RAMI4ATM

Model	#	Institution	Participants	Reference
6sv	*Second Simulation of the Satellite Signal in the Solar Spectrum v2.1*	Magellium	Jorge VICENT SERVERA	*S.Y. Kotchenova et al. (2008), J. Vicent et al. (2020)*
modtran6	*MODerate resolution atmospheric TRANsmission*			*A. Berk et al. (2014), L. Guanter et al. (2009)*
sbdart	*Santa Barbara DISORT Atmospheric Radiative Transfer*			*P. Ricchiazzi et al. (1998), J. Vicent et al. (2020)*
6sv2.1	*6SV v2.1 (2014)*	*EC-JRC*	Christian LANCONELLI	*S.Y. Kotchenova et al. (2008)*
sixsnad	*Modified 6SV, RT coupled model used for ESA*		Nadine GOBRON	*S.Y. Kotchenova et al. (2008); Gobron et al. (1997)*
eradiate	*A cal/val-oriented 3D radiative transfer model*	RAYFERENCE	Nicolas Misk	*Reference: https://www.eradiate.eu*
rtmom	***R**adiative **T**ransfer **M**atrix **O**perator **M**ethod*			*Y. Govaerts (2006)*
pnims	***P**olarized radiance **I**mproved **M**ultiple and **S**ingle scattering (PnIMS)*	GRASP	Masahiro Momoi	*Lenoble et al. (2007)* *Momoi et al. (2022)* *Nakajima and Tanaka (1988)*
waqh	*Waquet and Herman radiance correction*			*Lenoble et al. (2007), Waquet and Herman (2019)*
model-iao	*Model of V.E. Zuev Institute of Atmospheric Optics SB RAS*	IAO	Zhuravleva Tatiana	*T. Zhuravleva (2008), T. Zhuravleva and I. Nasrtdinov (2018)*
smartg	*Speed-Up Monte Carlo Advanced Radiative Transfer using GPU*	HYGEOS	Mustapha MOULANA	*Ramon et al. (2019)*
smartmom	*Simulated measurement of the atmosphere using radiative transfer based on the Matrix Operator Method*	JPL	Sanghavi Suniti	*Sanghavi, S., et al. (2013)*
vsmartmom	*Vectorized Simulated measurement of the atmosphere using radiative transfer based on the Matrix Operator Method*			*Sanghavi, S., et al. (2014)*
sos-abs	*Successive Orders of Scattering code including gas absorption*	CS Group	Stéphan Gwendoline	*J. Lenoble, et al. (2007)*
pydome	*python library for radiative transfer computations*	DLR	Dmitry Efremenko	*A. Doicu and T. Trautmann (2009)*
wps	*Weighted Photon Spread*	Beihang University	Feng Zhao	*Zhao et al. (2022, 2015)*

WG 10: HRMM - Hyperspectral Radiation: Measurements and Modelling

Not yet received

WG 11: TSSI - Total and Spectral Solar Irradiance

To be presented in M12
Coddington et al., Progress in Extraterrestrial Solar Irradiance Science: Updates from the International Radiation Commission's Solar Irradiance Working Group.
Saturday, 15 Jul 2023 15:45 - 16:00

WG 12: Machine Learning Applications in Remote Sensing

Feng Zhang

IRC business meeting, 13 July 2023

BDAI -Big Data and Aritificial Intelligence

Feng Zhang

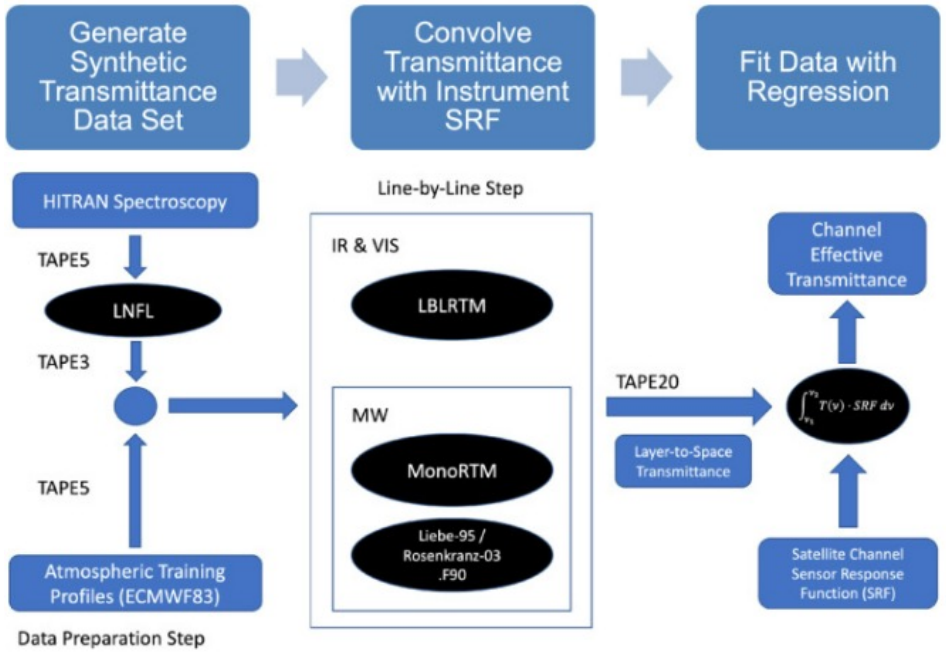
Fudan University

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

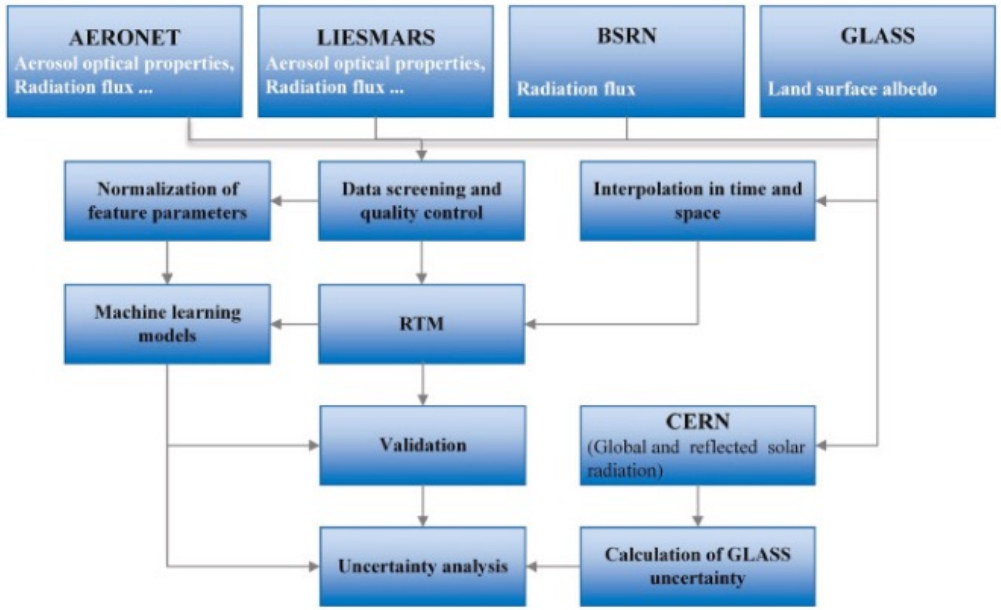
- **Accelerate the solving process of radiative transfer model**
- **Substitute for complicated retrieval algorithm in remote sensing**

Using deep learning approach to replace the regression coefficients in the fast RT model



A deep learning approach to fast radiative transfer
(Patrick G. Stegmann, et al. ***JQSRT*** , 2022)

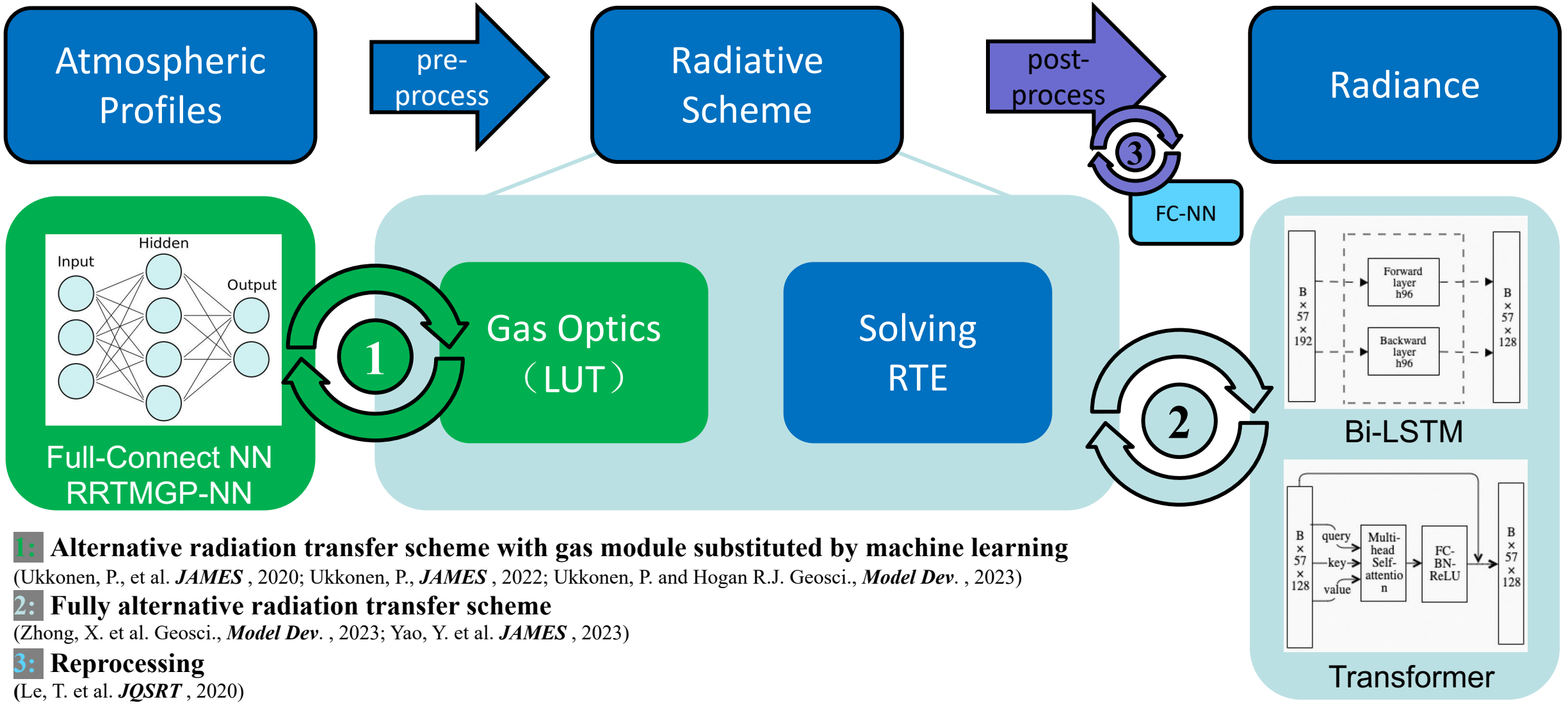
Combining machine learning with radiative transfer model



Predicting surface solar radiation using a hybrid radiative Transfer–Machine learning model
(Yunbo Lu, et al. ***RSER*** , 2022)

BDAI WG

- **Accelerate the radiative scheme**



1: Alternative radiation transfer scheme with gas module substituted by machine learning
(Ukkonen, P., et al. ***JAMES*** , 2020; Ukkonen, P., ***JAMES*** , 2022; Ukkonen, P. and Hogan R.J. Geosci., ***Model Dev***. , 2023)

2: Fully alternative radiation transfer scheme
(Zhong, X. et al. Geosci., ***Model Dev***. , 2023; Yao, Y. et al. ***JAMES*** , 2023)

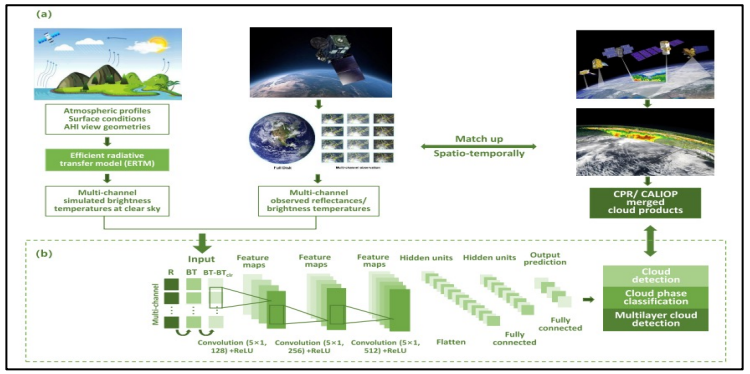
3: Reprocessing
(Le, T. et al. ***JQSRT*** , 2020)

BDAI WG

➢ Application of machine learning to cloud parameters retrieval

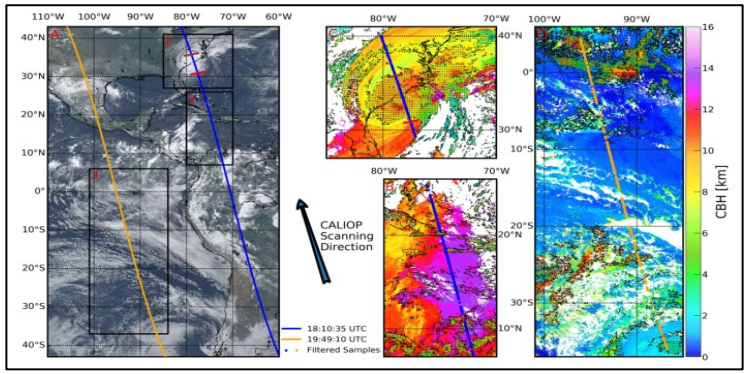
Spectral characteristics

Cloud Phase and Cloud Mask



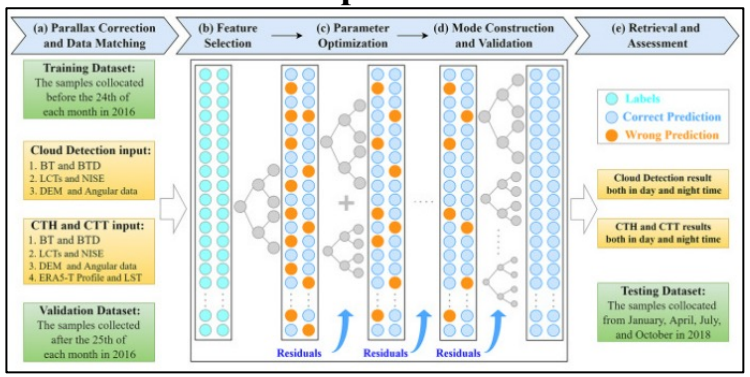
Deep Neural Network
(Wenwen Li, et al. ***TGRS*** , 2022)

Cloud Base Height



Gradient Boosting Regression Tree
(Han Lin, et al. ***RSE*** , 2022)

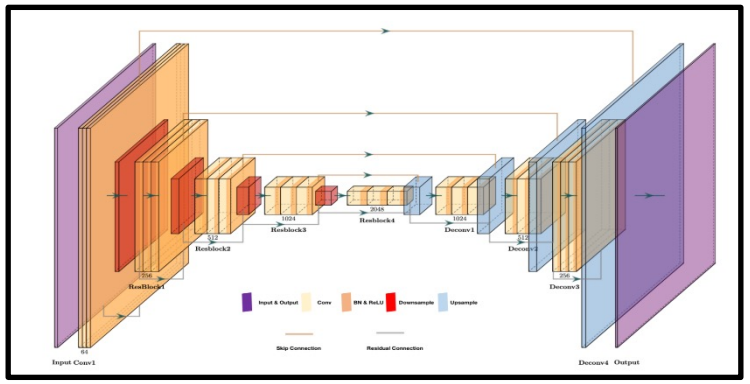
Cloud Top Height and Cloud Top Temperature



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

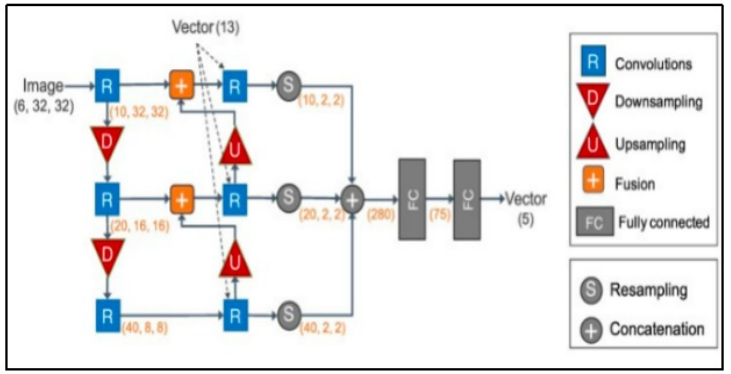
Neighboring information / Spatial texture characteristics

Cloud Phase



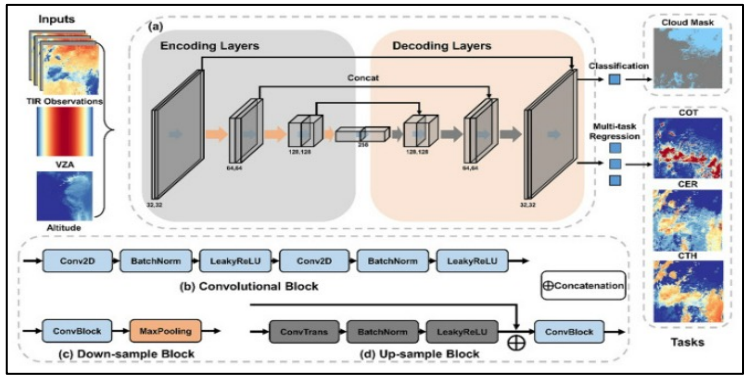
Res-Unet Network
(Xuan Tong, et al. ***GRL*** , 2023)

Ice Cloud Top Height and Cloud Optical Thickness



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

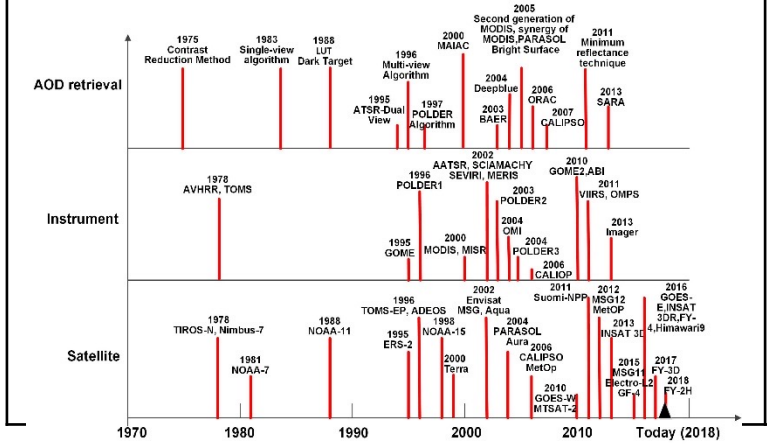
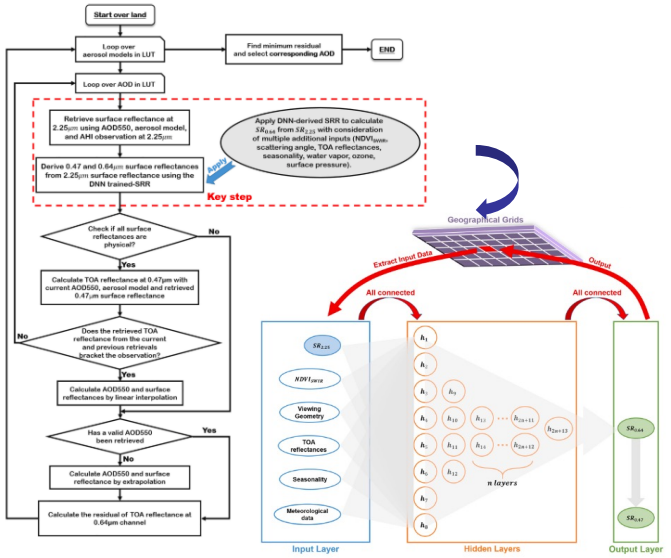
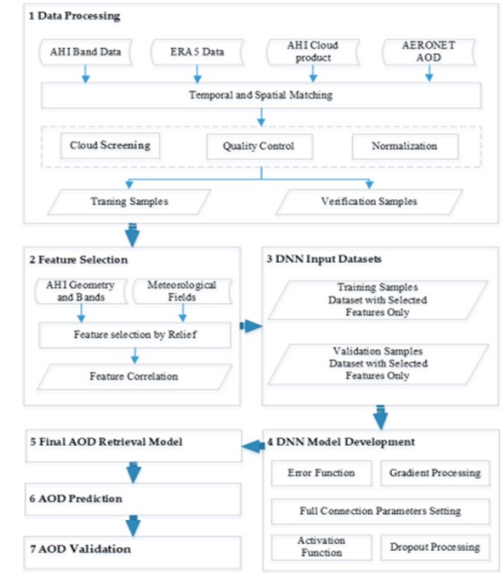
Cloud Effective Radius and Cloud Optical Thickness



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

BDAI WG

➢ Substitute for aerosol properties retrieval algorithm in remote sensing

Conventional Physical model (Dark Target, Deep Blue, MAIAC,…)	**Machine Learning Methods Integrated with Physical Model**	**Machine Learning Methods** (Deep Neural Networks, Random Forest, Support Vector Machine,…)
		

- Machine learning methods is proposed in AOD retrieval to avoid errors and reduce time consumption of conventional physical model;
- Machine learning algorithms are mostly used to construct high-precision retrieval parameters such as land surface reflectance in machine learning and physical integrated models.

BDAI WG

Multiband AOD
Water vapor
Absorbent AOD

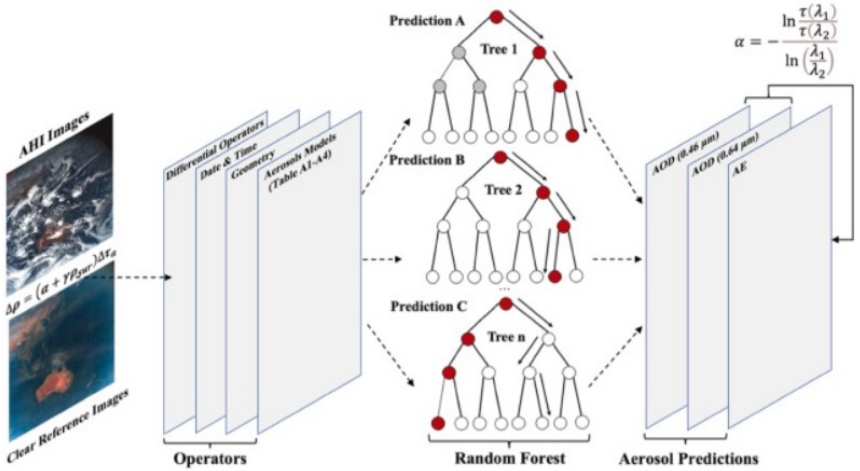
↓

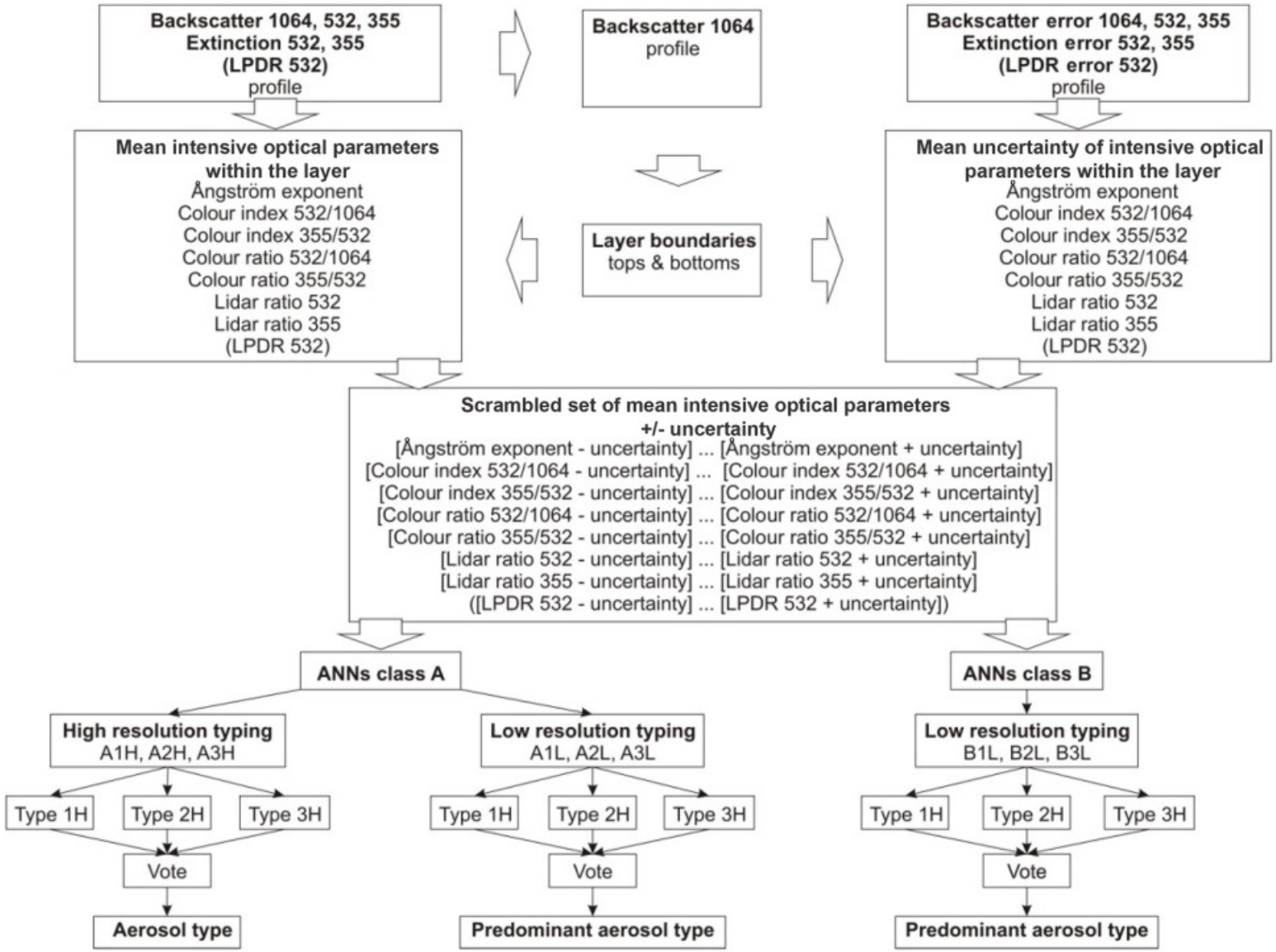
AE （Ångström Exponent）
FMF（Fine Mode Fraction）
SSA（Single scatter albedo）
CRI （Complex Refractive Index）

…

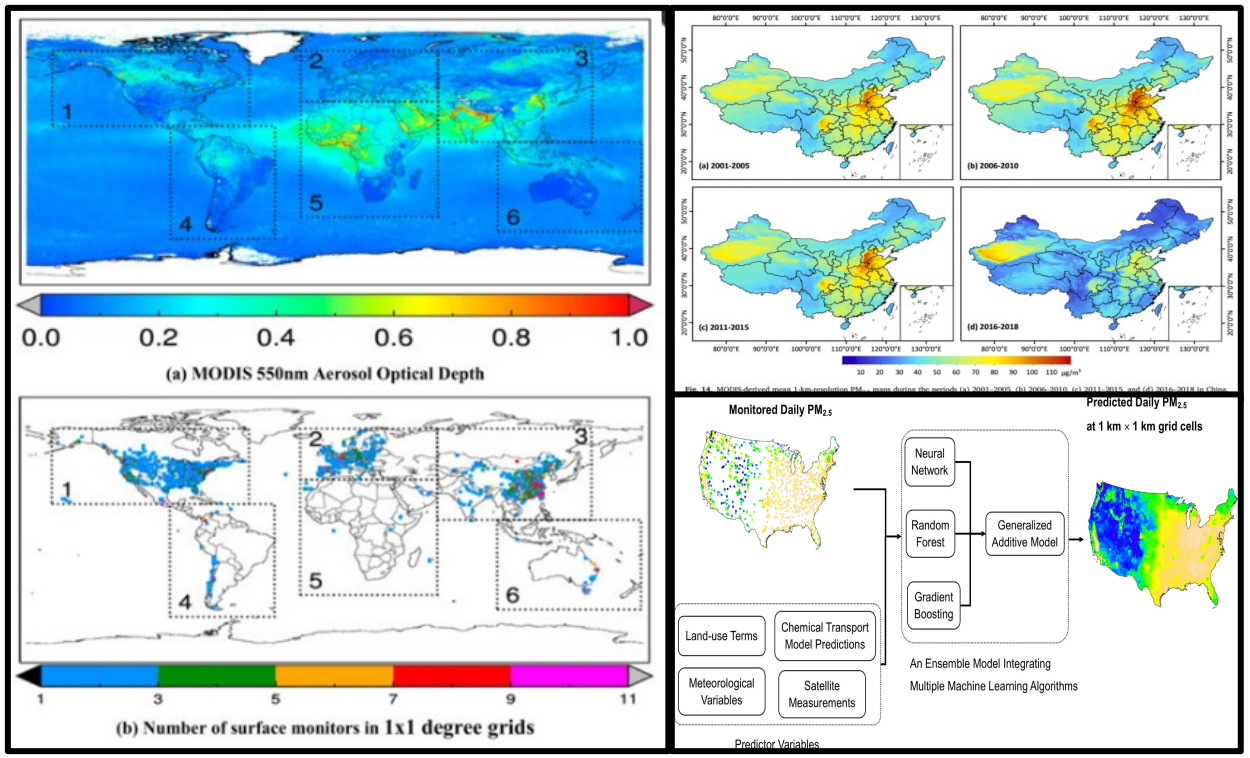
↓

Aerosol classification





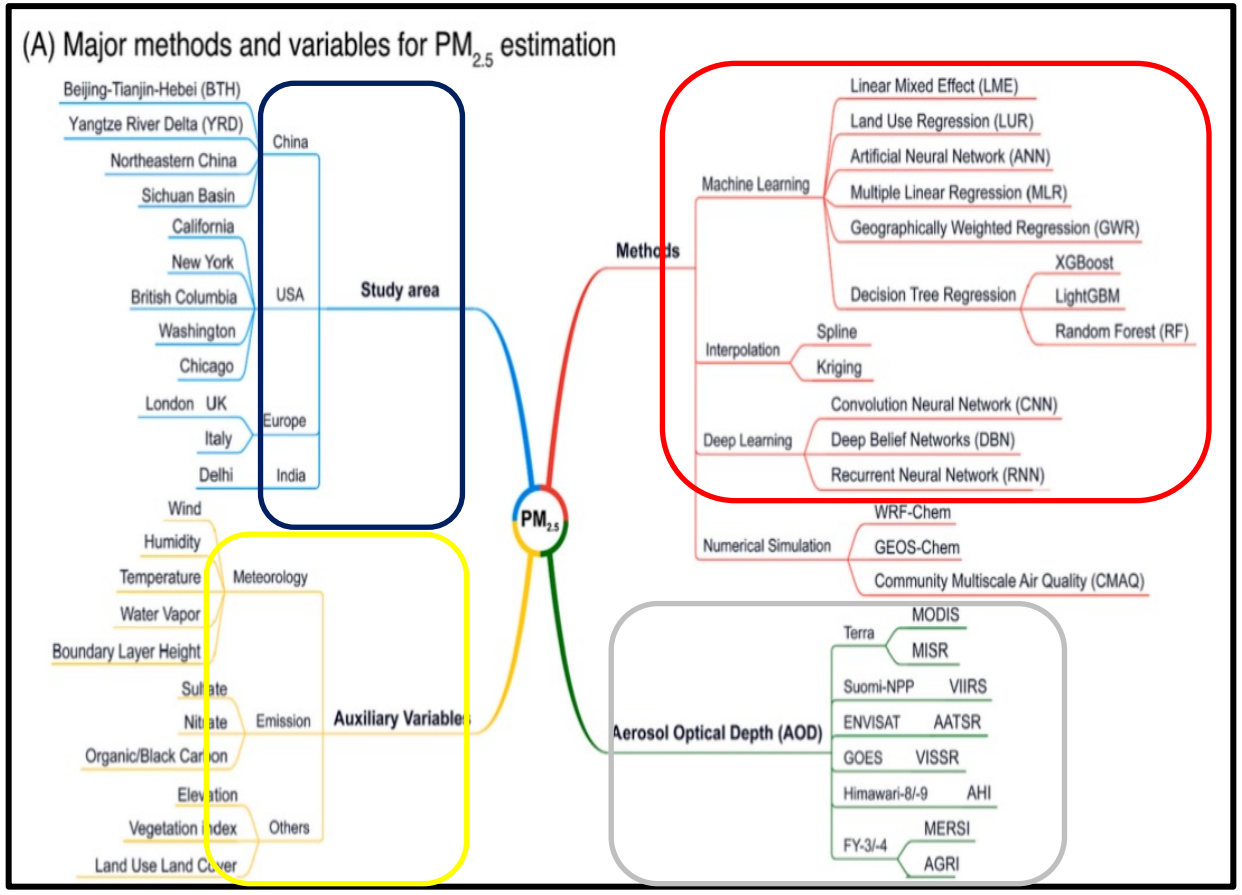
$PM_{2.5}$ estimation from remote sensing and Artificial Intelligence



Satellite AOD-PM2.5

(Christopher, S., et al. ***RS*** , 2020; Bai, K., et al. ***ER*** , 2023; Wei, J., et al. ***RSE*** , 2021; Li, L., et al. ***EI*** , 2021)

Major methods and variables for PM2.5 estimation



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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.

W. Li, F. Zhang, H. Lin, X. Chen, J. Li and W. Han, "Cloud Detection and Classification Algorithms for Himawari-8 Imager Measurements Based on Deep Learning," in IEEE Transactions on Geoscience and Remote Sensing, vol. 60, pp. 1-17, 2022, Art no. 4107117, doi: 10.1109/TGRS.2022.3153129.

Xinyue Wang, Hironobu Iwabuchi, Takaya Yamashita, Cloud identification and property retrieval from Himawari-8 infrared measurements via a deep neural network, Remote Sensing of Environment, Volume 275, 2022, 113026, ISSN 0034-4257, https://doi.org/10.1016/j.rse.2022.113026.

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