WGCV-53

Land Product Validation Subgroup

Michael Cosh, USDA

Agenda Item #2.3

WGCV-53, Córdoba, Argentina

5th - 8th March 2024

Committee on Earth Observation Satellites

Land Product Validation

Land Product Validation

Good Practices for Land Product Validation - GRSS-IEEE

Land Product Validation

- Elevating Soil Moisture to Stage 4 with the release of FRM4SM
- Elevating Albedo to Stage 4
- Elevating Burned Area to Stage 3

	Validation Stage - Definition and Current State	Variable
0	No validation. Product accuracy has not been assessed. Product considered beta.	
1	Product accuracy is assessed from a small (typically < 30) set of locations and time periods by comparison with in-situ or other suitable reference data.	**Snow** **Fire Radiative Power**
2	Product accuracy is estimated over a significant (typically > 30) set of locations and time periods by comparison with reference in situ or other suitable reference data. Spatial and temporal consistency of the product, and its consistency with similar products, has been evaluated over globally representative locations and time periods. Results are published in the peer-reviewed literature.	**fAPAR** **Phenology** **LAI** **Biomass**
3	Uncertainties in the product and its associated structure are well quantified over a significant (typically > 30) set of locations and time periods representing global conditions by comparison with reference in situ or other suitable reference data. Validation procedures follow community-agreed-upon good practices. Spatial and temporal consistency of the product, and its consistency with similar products, has been evaluated over globally representative locations and time periods. Results are published in the peer-reviewed literature.	**Vegetation Indicies** **LST & Emissivity** **Active Fire** **Burned Area**
4	Validation results for stage 3 are systematically updated when new product versions are released or as the interannual time series expands. When appropriate for the product, uncertainties in the product are quantified using fiducial reference measurements over a global network of sites and time periods (if available).	**Land Cover** **Albedo** **Soil Moisture**

	First Name	Last Name	Institution	Institution	End of Term
Admin	Michael	Cosh	USDA	USA	Apr 2025
	Fabrizio	Niro	ESA	Italy	Apr 2025 (promotion to Chair)
	Jaime	Nickeson	GSFC	USA	
Land Cover	Alexandra	Tyukavina	University of Maryland	USA	March 2024 (1st term)
	Sophie	Bontemps	Université Catholique de Louvain	Belgium	Oct 2023 (2nd term)
Biophysical	Marie	Weiss	INRA	France	Sep 2023 (2nd term)
	Sylvain	Leblanc	Natural Resources Canada	Canada	Sep 2023 (2nd term)
	Luke	Brown	University of Salford	UK	Jan 2026 (1st term)
Fire/Burn Area	Louis	Giglio	University of Maryland	USA	Sep 2026 (2nd term)
	Bernardo	Mota	National Physical Lab	UK	Jan 2026 (1st term)
Surface Rad	Zhuosen	Wang	UMass Boston	USA	ex-officio
	Angela	Erb	UMass Boston	USA	Jan 2026 (1st term)
	Jorge	Sanchez-Zapero	EOLab	Spain	Jan 2026 (1st term)
Soil Moisture	John	Bolten	NASA GSFC	USA	Apr 2026 (2nd term)
	Alex	Gruber	TU Wien	Austria	Sept 2026 (1st term)
LST	Glynn	Hulley	NASA/JPL	USA	July 2024 (2nd term)
	Lluis	Perez Planells	Karlsruhe Institute of Technology	Germany	Sept 2026 (1st term)
Phenology	Joshua	Gray	North Carolina State University	USA	Jan 2025 (2nd term)
	Victor	Rodríguez-Galiano	University of Seville	Spain	Aug 2025 (2nd term)
Snow Cover	Carrie	Vuyovich	NASA GSFC	USA	Jan 2026 (1st term)
	Juha	Lemmetyinen	FMI	Finland	Sept 2026 (1st term)
Veg Index	Tomoaki	Miura	University of Hawai'i	USA	Dec 2022 (2nd term)
	Else	Swinnen	VITO	Belgium	Apr 2023 (2nd term)
Biomass	Laura	Duncanson	UMD/GSFC	USA	ex-officio
	Kim	Calders	Ghent University	Belgium	Feb 2026 (1st term)
	Neha	Hunka	UMD	USA	Feb 2026 (1st term)
ET	Yun	Yang	Mississippi State	USA	~Jan 2027 (1st term)
	Carmelo	Cammalleri	Politecnico di Milano	Italy	~Jan 2027 (1st term)
GPP/NPP	TBD				
	TBD				

Land Product Validation

PROTOCOLS

Focus Area	Protocol Timeline
Biophysical	LAI (2014), Needs update
Fire/Burn Area	Burned Area Targeting 2023 Active Fire (?)
Phenology	Targeting 2023
Vegetation Index	Targeting 2023 (60%)
Land Cover	Targeting 2023 (95%)
Snow Cover	(?)
Surface Radiation	Albedo (2019) Downwelling surface solar radiation (80%)
Soil Moisture	SM (2020)
LST and Emissivity	LST (2019)
Aboveground Biomass	AGWB (2021)

Land Product Validation

ECV Requirements

The latest WMO GCOS requirements from the latest version for each LPV ECV have been placed in your GoogleDrive folders.

Requirements have changed and the target, goal, and threshold requirements has changed. For instance, instead of Accuracy they have Required Measurement Uncertainty.

The changes affect the Collaboration page where we display the GCOS requirements. We need to review and decide what to include on the page.

https://library.wmo.int/records/item/58111-the-2022-gcos-ecvs-requirements-gcos-245#.ZFzCd6VBxjs

Land Product Validation

Biodiversity

nature ecology & evolution

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nature > nature ecology & evolution > perspectives > article

Perspective | Published: 13 May 2021

Priority list of biodiversity metrics to observe from space

Andrew K. Skidmore ✉, Nicholas C. Coops, Elnaz Neinavaz, Abebe Ali, Michael E. Schaepman, Marc Paganini, W. Daniel Kissling, Petteri Vihervaara, Roshanak Darvishzadeh, Hannes Feilhauer, Miguel Fernandez, Néstor Fernández, Noel Gorelick, Ilse Geijzendorffer, Uta Heiden, Marco Heurich, Donald Hobern, Stefanie Holzwarth, Frank E. Muller-Karger, Ruben Van De Kerchove, Angela Lausch, Pedro J. Leitão, Marcelle C. Lock, Caspar A. Mücher, ... Vladimir Wingate + Show authors

Nature Ecology & Evolution **5**, 896–906 (2021) | Cite this article

https://www.nature.com/articles/s41559-021-01451-x

Land Product Validation

Biodiversity

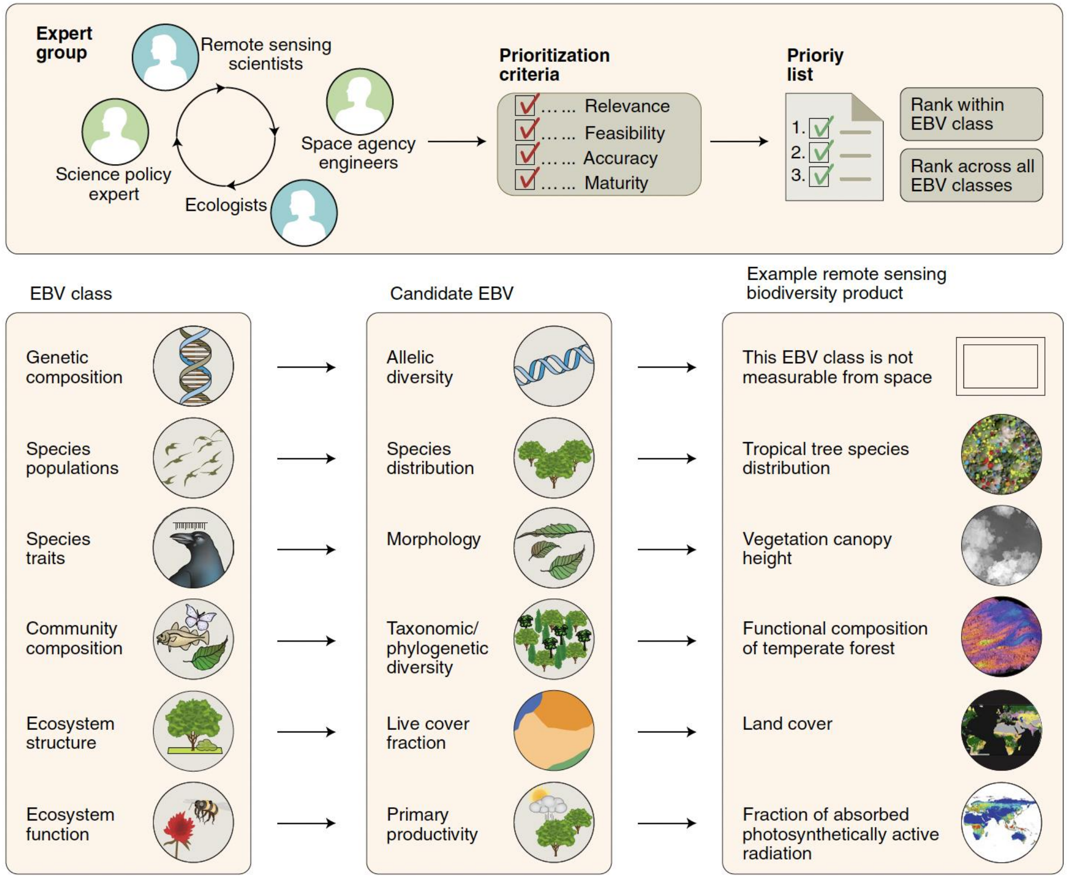


Fig. 1 | Ranking and scoring approach for example remote sensing products. Tropical tree species distribution image adapted from ref. [18] under a Creative Commons license CC BY 4.0; vegetation canopy height image adapted with permission from ref. [25], Elsevier; functional composition of temperate forest image adapted from ref. [46] under a Creative Commons license CC BY 4.0; land cover image adapted from ref. [34] under a Creative Commons license CC BY 4.0; fraction of absorbed photosynthetically active radiation image adapted from ref. [27], Copernicus Global Land Service (contains modified Copernicus Service information [2020]).

Land Product Validation

Biodiversity

Table 2 | The 30 remote sensing biodiversity products with the highest rankings

Number	Remote sensing biodiversity product	Remote sensing-enabled biodiversity variable	EBV class	Rank within EBV class	Rank across all EBV classes
1	Biological effects of fire disturbance (direction, duration, abruptness, magnitude, extent and frequency)	Ecosystem disturbance	Ecosystem function	1	1
		Habitat structure	Ecosystem structure	1	1
2	Biological effects of irregular inundation	Ecosystem disturbance	Ecosystem function	1	1
		Habitat structure	Ecosystem structure	1	1
3	LAI	Ecosystem physiology	Ecosystem function	3	5
		Habitat structure	Ecosystem structure	3	5
		Species physiology	Species traits	1	21
4	Land cover (vegetation type)	Habitat structure	Ecosystem structure	3	5
5	Ice cover habitat	Habitat structure	Ecosystem structure	5	8
6	Above-ground biomass	Habitat structure	Ecosystem structure	6	9
7	Foliar N/P/K content	Ecosystem physiology	Ecosystem function	4	9
		Species physiology	Species traits	2	28
8	Net primary productivity	Ecosystem physiology	Ecosystem function	5	11
		Species physiology	Species traits	2	28
9	Gross primary productivity	Ecosystem physiology	Ecosystem function	5	11
		Species physiology	Species traits	2	28
10	Fraction of absorbed photosynthetically active radiation	Ecosystem physiology	Ecosystem function	5	11

Land Product Validation

New Focus Areas

- Consideration of the potential for GPP/NPP land product Focus Area within LPV

- Consideration of the potential for Evapotranspiration land product Focus Area within LPV

Evaporation

Evapotranspiration

Please welcome our new focus area leads,

Yun Yang (Mississippi State University)

and

Carmelo Cammalleri (Polytechnic University of Milan)

Assessing the accuracy of OpenET satellite-based evapotranspiration data to support water resource and land management applications

John M. Volk, Justin L. Huntington, Forrest S. Melton, Richard Allen, Martha Anderson, Joshua B. Fisher, Ayse Kilic, Anderson Ruhoff, Gabriel B. Senay, Blake Minor, Charles Morton, Thomas Ott, Lee Johnson, Bruno Comini de Andrade, Will Carrara, Conor T. Doherty, Christian Dunkerly, MacKenzie Friedrichs, Alberto Guzman, Christopher Hain, Gregory Halverson, Yanghui Kang, Kyle Knipper, Leonardo Laipelt, Samuel Ortega-Salazar, Christopher Pearson, Gabriel E. L. Parrish, Adam Purdy, Peter ReVelle, Tianxin Wang & Yun Yang — Show fewer authors

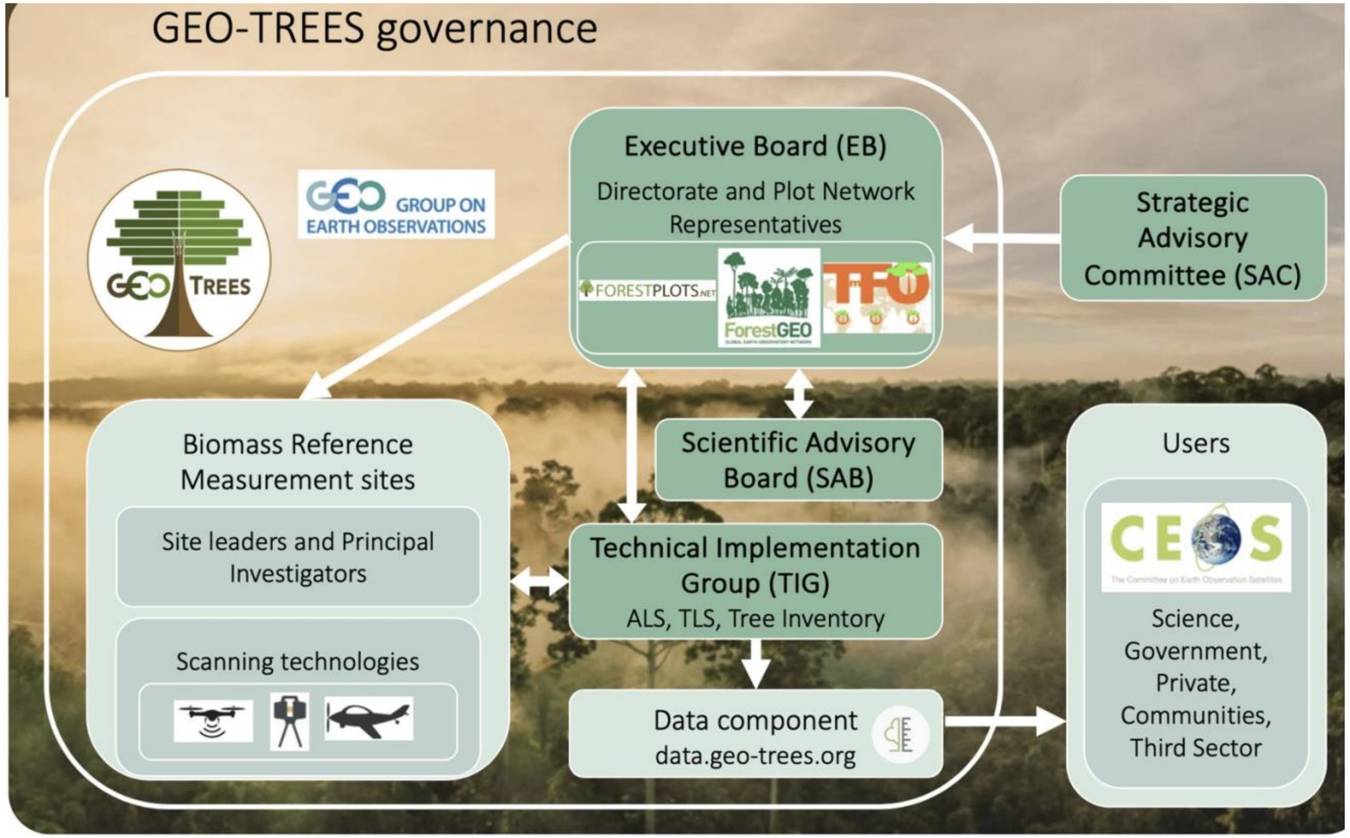
Nature Water **2**, 193–205 (2024) | Cite this article

Land Product Validation

Biomass

GEO-TREES updates:

- BCI Panama TLS processing as “showcase” (processing + capacity building)
- TIGs being set up now
- First/launch workshop of the GEO-TREES initiative on May 15-17. The workshop will take place at the Smithsonian Institution in Washington, DC (invitation only)



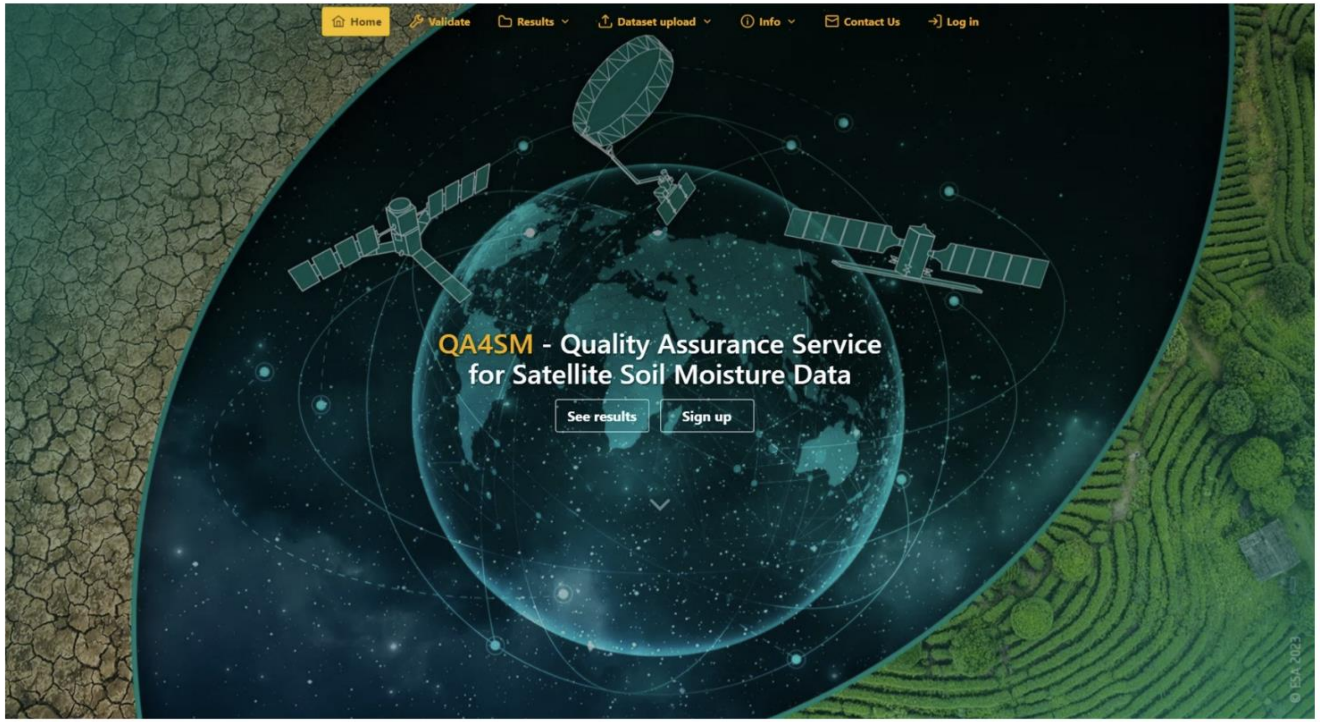
The governance structure for GEO-TREES is currently under review. Our mission is for the governance to represent all key stakeholders in the global GEO-TREES initiative. We expect to implement an updated governance model by the end of January 2024.

Land Product Validation

Soil Moisture

Quality Assurance for Soil Moisture (QA4SM; https://qa4sm.eu/)

- New release (facelift, new features…)
- Soon: functionality for fully automated regular dataset validation using FRMs and good practice protocols
- QA4SM workshop planned during the 7th Soil Moisture Validation and Application Workshop (East Lansing, 4 – 7 June 2024)



Land Product Validation

Biophyiscal

Dataset

View XML

ESA Vegetation Parameters Climate Change Initiative (Vegetation_Parameters_cci): LAI and fAPAR, Version 1.0

Open Access | Download | See Related Documents

Update Frequency:	Not Planned
Latest Data Update:	2023-11-15
Status:	Completed
Online Status:	ONLINE
Publication State:	Citable
Publication Date:	2023-12-18
DOI Publication Date:	2023-12-18
Download Stats:	last 12 months
Dataset Size:	54.01K Files | 263GB

Land Product Validation

Biophysical

Upcoming Conferences

- Surface Biology and Geology (SBG) annual workshop, June 4-6, 2024
- EARSeL Symposium, Manchester, June 17-20
- IGARSS, Athens, 7-12 July 2024 special session on TIR:
  - Innovative EO applications based on high spatial and temporal resolution thermal data
- 7th International Symposium on Recent Advances in Quantitative Remote Sensing (RAQRS'VII), Valencia, Sep 23-27

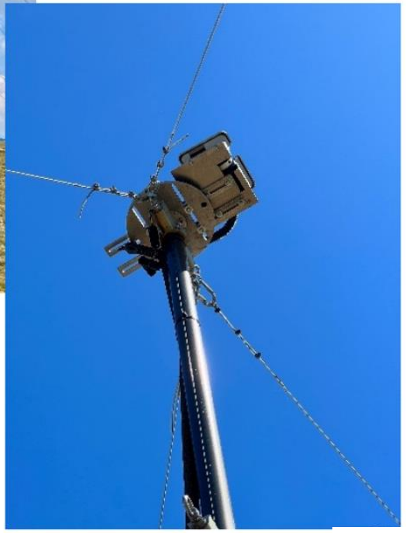
- TIRCALNet preparation study, coordination meeting in January 2024
- Extension of Copernicus LAW stations is ongoing
- ECOSTRESS forward processing and reprocessing for Collection 2 higher level products (ET, ESI, WUE) has begun
- SBG-TIR Key Decision Point (KDP)-B expected in March 2024
- International science workshop on High resolution Thermal remote sensing expected in India during November 2024

Land Product Validation

Biophysical

TIRCalNet Preparation Study

- Goal: Prepare the roadmap for the TIRCalNet operations.
- Cooperation between TIRCalNet Preparation Study team (Uni. Leicester, KIT, RAL Space) and CNES and JPL.
- Study at La Crau site:
  - Characterization of site uncertainties.
  - Characterization of instruments uncertainties.
  - Characterization of atmospheric propagation approach.



Land Product Validation

LST

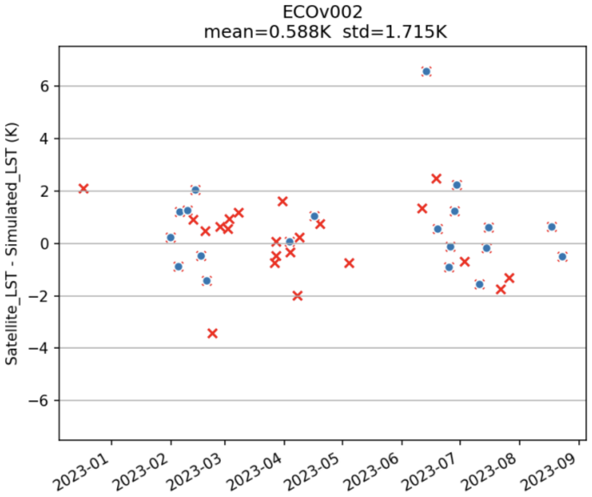
First LST validation results at La Crau, France

CNES decision to develop an instrumented site for thermal infrared sensors for future TIR missions, including CNES/ISRO mission TRISHNA, at La Crau, France in addition to the current RadCalNet site

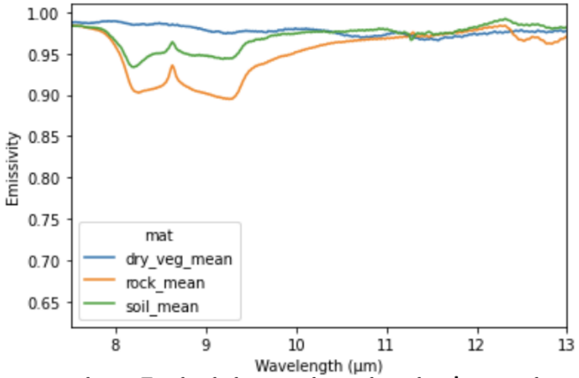
- Dec 2022: Installation of a JPL radiometer (NASA/JPL)
- June 2023: Installation of a CIMEL CE312 radiometer (LOA)

Slight positive bias + significant dispersion

Blue dots → visual check of the image (cloud mask / radiometric artefacts)



Current processing: Emissivity derived from the fraction of vegetation and sample measurements (NASA JPL)



→ Future processing: Emissivity estimation is the main area for improvement

→Temperature/Emissivity separation using the CIMEL CE312 multi-spectral data

Land Product Validation

LST

Upgrade and extension of LSA-SAF land surface albedo archive from EPS Metop/AVHRR: description and quality assessment

Anthéa Delmotte, Daniel Juncu, Xavier Ceamanos, Isabel F. Trigo & Sandra Gomes

Article: 2300043 | Received 03 Dec 2022, Accepted 22 Dec 2023, Published online: 21 Jan 2024

- Surface Albedo CDR based on EPS Metop/AVHRR.

Data generation	Satellite	Sensor	Metop-A	Metop-B	Spatial Coverage
Reprocessing (ETAL-R)	Metop-A and B	AVHRR	2007/01/25–2014/12/31	2015/01/01–2021/06/30	Global

- Validation based on CEOS LPV protocol, but spatially limited:
  - Evaluation completeness and stability.
  - Direct validation is very limited: only data from 6 stations are used.
  - Local product intercomparison with MODIS as reference (6 stations + 4 additional areas).

LST

Upcoming Meetings

- **International Radiation Symposium 2024,** Hangzhou, China -- 17-21 June 2024
  http://www.irs2024.org/

- **18th BSRN Scientific Review and Workshop,** Japan Meteorological Agency Headquarters, Tokyo, Japan-- 1-5 July 2024.
  https://bsrn.awi.de/meetings/2024/

- **7th International Symposium on Recent Advances in Quantitative Remote Sensing,** Torrent (Valencia)-Spain-- 23-27th September 2024.
  https://ipl.uv.es/raqrs

- **Special Issue – "Remote Sensing of Solar Radiation Absorbed by Land Surfaces“**
  https://www.mdpi.com/journal/remotesensing/special_issues/V7S2F2XJ36

Land Product Validation

Snow

Recent Publications

Article

Evidence of human influence on Northern Hemisphere snow loss

https://doi.org/10.1038/s41586-023-06794-y
Received: 2 March 2023
Accepted: 24 October 2023
Published online: 10 January 2024
Open access
Check for updates

Alexander R. Gottlieb[1,2] & Justin S. Mankin[2,3,4]

Documenting the rate, magnitude and causes of snow loss is essential to benchmark the pace of climate change and to manage the differential water security risks of snowpack declines[1–4]. So far, however, observational uncertainties in snow mass[5,6] have made the detection and attribution of human-forced snow losses elusive, undermining societal preparedness. Here we show that human-caused warming has caused declines in Northern Hemisphere-scale March snowpack over the 1981–2020 period. Using an ensemble of snowpack reconstructions, we identify robust snow trends in 82 out of 169 major Northern Hemisphere river basins, 31 of which we can confidently attribute to human influence. Most crucially, we show a generalizable an highly nonlinear temperature sensitivity of snowpack, in which snow becomes marginally more sensitive to one degree Celsius of warming as climatological winter temperatures exceed minus eight degrees Celsius. Such nonlinearity explains the la of widespread snow loss so far and augurs much sharper declines and water security risks in the most populous basins. Together, our results emphasize that human-forc snow losses and their water consequences are attributable—even absent their clear detection in individual snow products—and will accelerate and homogenize with near-term warming, posing risks to water resources in the absence of substantial climate mitigation.

News & views

Climate science

Snow loss pinned to human-induced emissions

Jouni Pulliainen

Analysis of a large, varied data set reveals that snow cover in the Northern Hemisphere has undergone marked changes in the past four decades. Evidence that humans caused the shift suggests that snow loss will accelerate in the future. See p.293

climate-model predictions of these variables. The authors modelled the historical change in snow water equivalent on the basis of observations, and estimated the impact of humans on snow loss by combining the data-based model with climate-model predictions.

In general, climate-model simulations do not capture the spatio-temporal behaviour of snow water equivalent accurately enough to register changes at the scale of river basins. Gottlieb and Mankin overcame this problem by assessing the relationship between snow mass and the two driving variables – precipitation and temperature – through analysis of an extensive data set of observations in the Northern Hemisphere.

The analysis revealed that anthropo-

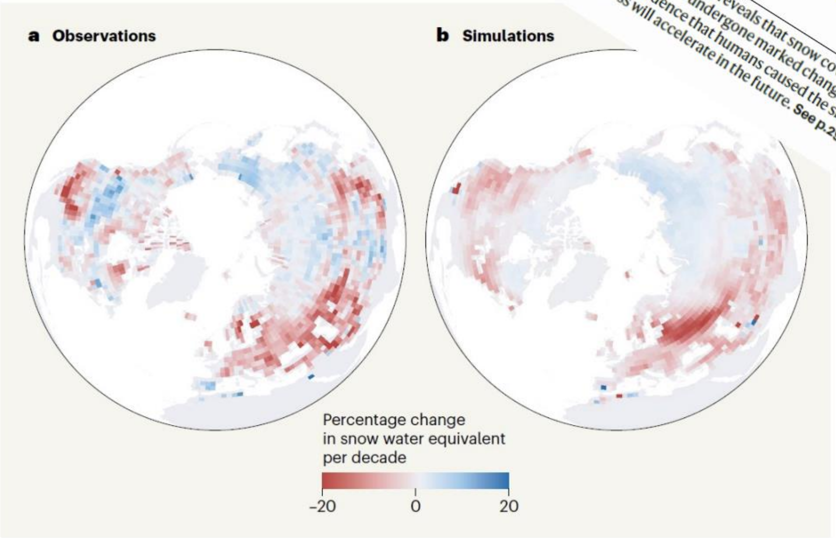


Figure 1 | Mapping human-induced snow loss. Gottlieb and Mankin[1] assembled data from various sources to reveal the temperature dependence of a measure of snow mass known as snow water equivalent. **a**, They showed that March snow mass generally decreased between 1981 and 2020 at low latitudes in the Northern Hemisphere. Shown here is an ensemble of 'gridded' snow data, which are interpolated over a spatially uniform grid. **b**, Climate-model simulations that include both natural and anthropogenic drivers correlate with the observations shown in **a** more closely than do simulations that include only natural drivers (not shown). However, simulations alone are not sufficient to reproduce river-basin-scale trends. This disagreement highlights the need for Gottlieb and Mankin's innovative fusion of data and modelling to predict the impact of humans on the future availability of fresh water. (Adapted from Fig. 2 in ref. 1.)

Snow

SNOW – Field Measurement Schools

SNOW MEASUREMENT FIELD SCHOOL 2024

JANUARY 8 - 11, 2024

Location: AMC Highland Center at Crawford Notch in Bretton Woods, New Hampshire

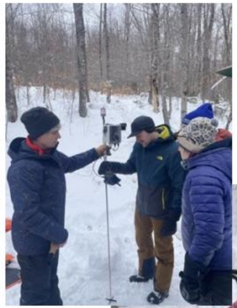




Photo credit: CUAHSI

EGU SNOW SCIENCE WINTER SCHOOL 2024

FEBRUARY 25 – MARCH 2, 2024

Location: FMI Arctic Research Centre, Sodankylä, Finland

Lots of interest:

- Over 80 applications for CUAHSI school (30 slots)
- Over 60 applications for EGU school (26 slots)

Land Product Validation

Snow

Campaigns:

- University of Waterloo is conducting ongoing flights with their L-band and Ku-band (low) radar, CryoSAR, with coordinated ground measurements
  - Regular flights over Powassan, Ontario
  - Campaign planned for April in Cambridge Bay
- Finnish Meteorological Institute (FMI) has been conducting tower-based radar experiment at Sodankylä site
  - Focus on microwave signatures over northern wetlands, as proxy for methane emissions (2023-24)
  - SAR interferometry (L-band) for SWE over boreal forest
- **NASA IIP instrument, SNOWWI - C, Ku-band (low and high) - will be flown over Grand Mesa, CO in Feb** and April, 2023

Missions:

- Preparations for CIMR – passive microwave mission, will include retrieval algorithm for snow
- NASA Earth System Explorer – 2 snow mission concepts in review
- TSMM – Canadian snow mission concept (pre-Phase A)

Snow Water-equivalent Wide Swath Interferometer and Scatterometer (SNOWWI)

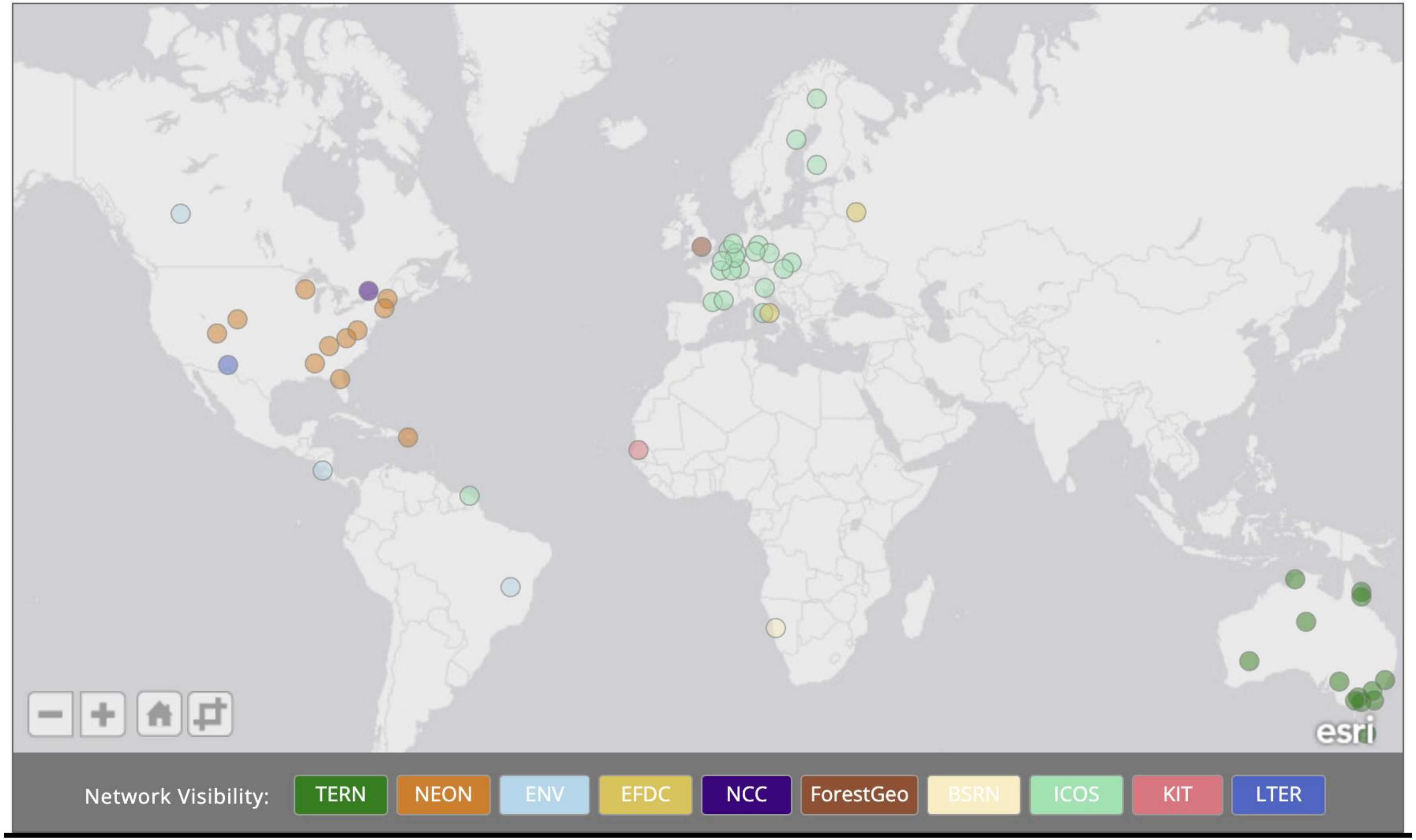
	Band	Freq (GHz)	Pol
Active	C	5.35	VV,VH
Active	Ku-Lo	13.60	VV,VH
Active	Ku-Hi	17.25	VV,VH

	Band	Freq (GHz)	Pol
Active	C	5-6	VV, HH, HV, VH
Active	Ku	14-15	VV, HH, HV, VH

Land Product Validation

- Review Supersites for LPV considering new focus areas and updated needs (outside of LPV)

Supersites



Land Product Validation