GOFC-GOLD

Global Observations of Forest Cover and Land Use Dynamics

https://gofcgold.org

NASA

UNIVERSITY OF MARYLAND

GOFC-GOLD

Global Observations of Forest Cover and Land Use Dynamics

Program Focus

- Coordination of Spaceborne and In-Situ Measurements of Land cover change and Fire
- Derived Data and Information Products
- Data Availability and Access
- Assistance for Improved Data Utilization through Regional Science Networks (with the START Program)
- Communication between Science and Decision Makers
- Coordination with other programs – e.g. UN REDD+, GCOS ECVs, CEOS LPV, GEOGFOI, GEOGLAM, etc.

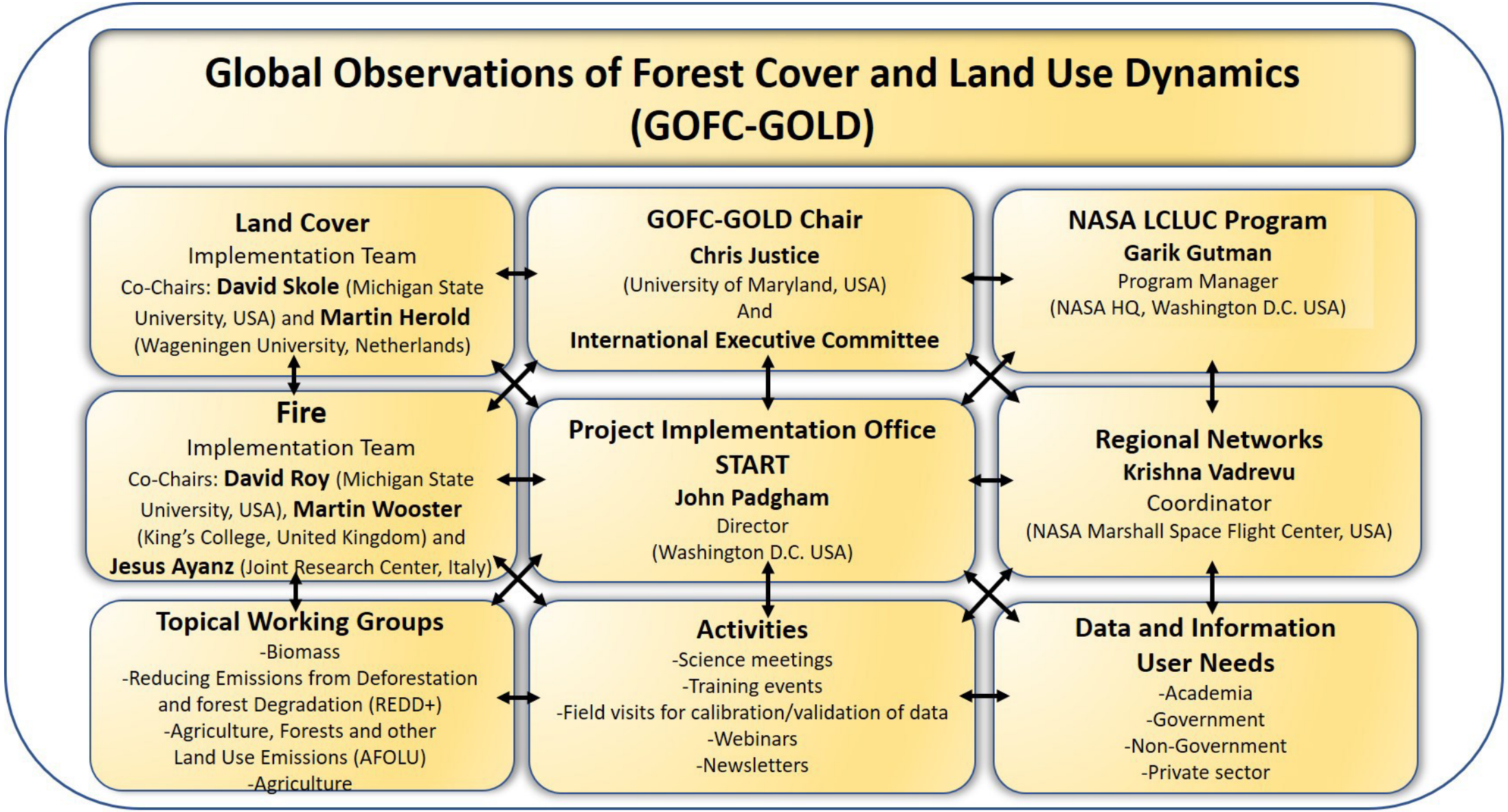
An international forum for coordination concerning Earth Observations

GOFC-GOLD Chair

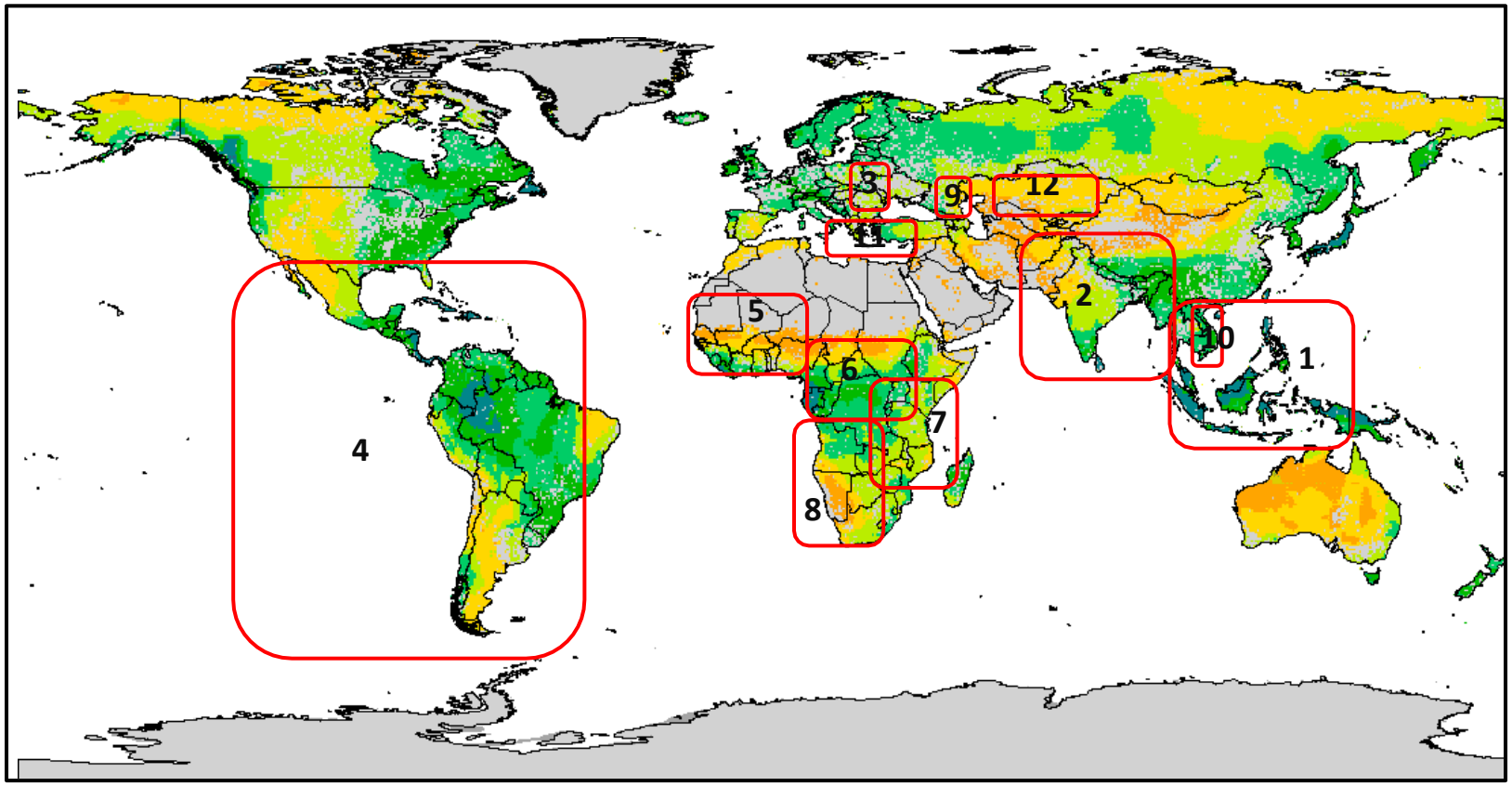
Dr. Tony Janetos
Boston University
1954-2019
GOFC-GOLD Chair Till mid-2019;

Prof. Chris Justice
University of Maryland College Park
GOFC-GOLD Chair Since end of 2019

GOFC-GOLD Structure

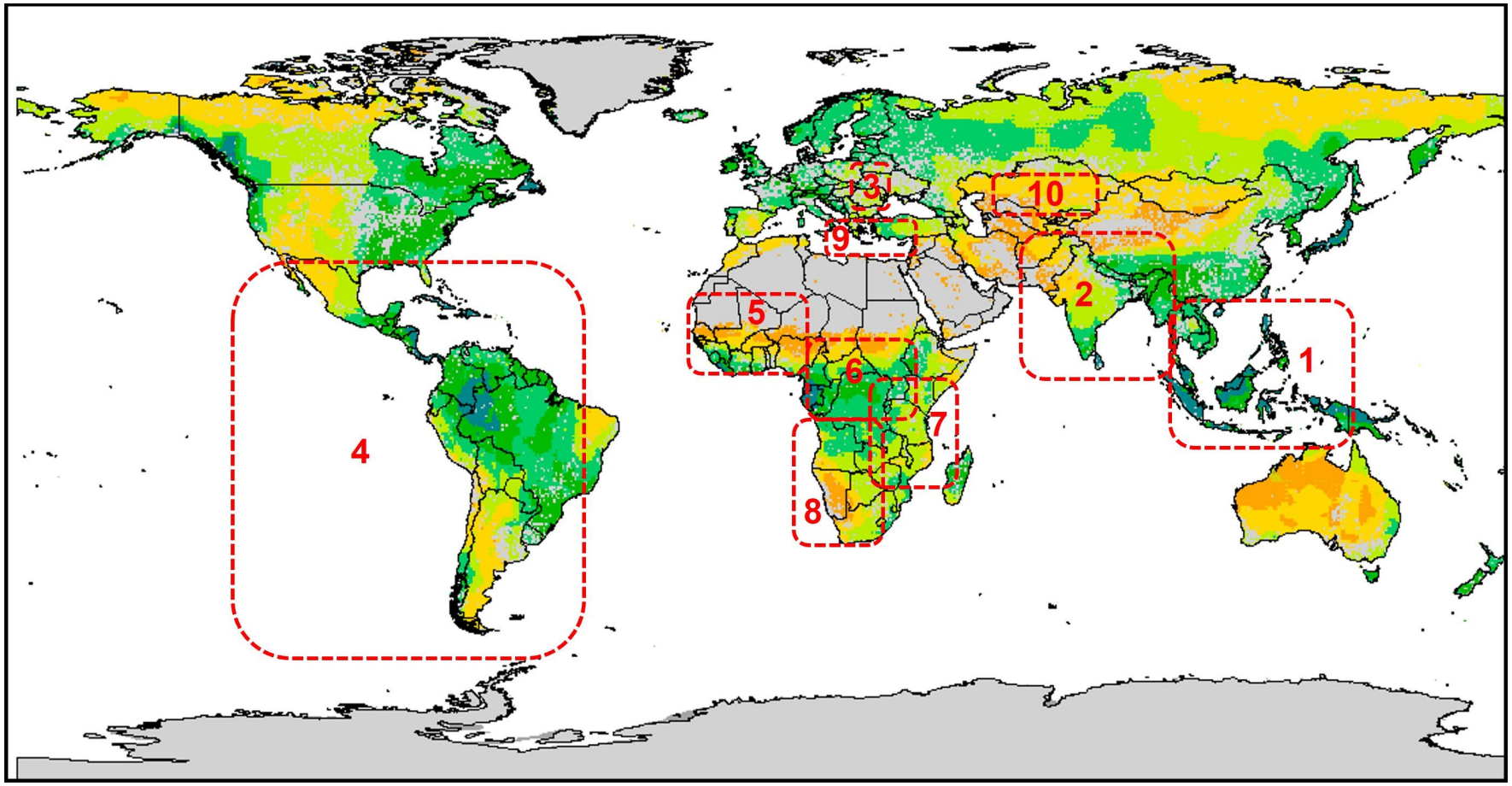


GOFC-GOLD Regional Networks



Currently active GOFC-GOLD regional networks. 1.Southeast Asia Regional Research and Information Network (SEARRIN); 2. South Asia Regional Information Network (SARIN); 3. South Central European Regional International Network (SCERIN); 4. Red Latinoamerica de Teledeteccion e Incendios Forestales (RedLaTIF); 5. West African Regional Network (WARN); 6. Observatoire Satellital des Forets d'Afrique Central (OSFAC); 7. Miombo Network (MIOMBO); 8. Southern Africa Fire Network (SAFNET); 9.Caucasus Regional Information Network (CaucRIN); 10.Mekong Regional Information Network (MekRIN); 11. Mediterranean Regional Network (MedRIN); 12. Central Asia Regional Information Network (CARIN)

Revised GOFC-GOLD Regional Networks



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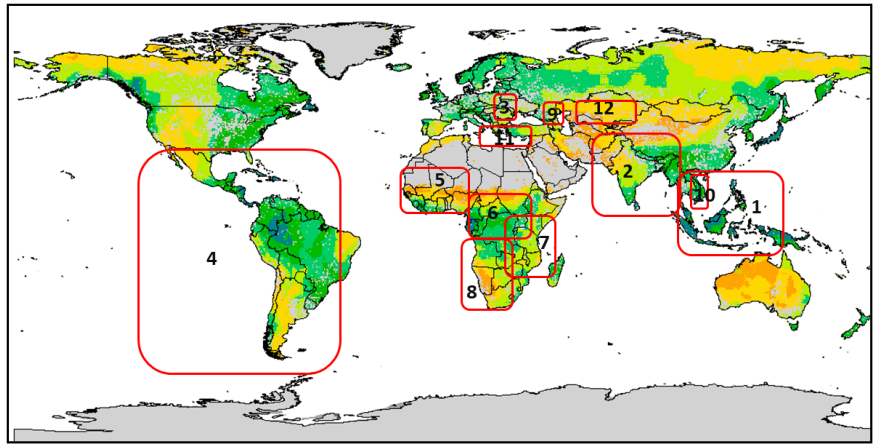
Role of Regional Networks



- Strengthen involvement of local scientists for improved validation of satellite products.
- Play increased role in future satellite missions/products through responding to questionnaires/surveys from agencies.
- Share local data more openly and assist in product calibration and validation.
- Focus on evaluating satellite products, and link with GOFC related themes including policy.
- Interact with the other Regional network scientists and GOFC Executive Committee members to secure funding from International agencies.
- Improve and extend capacity building and training activities in the region through involving local/regional researchers.

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Benefits of a Regional Network

- Build projects through collaborations – GOFC support and through regional and international partners
- Funding for annual GOFC RN meetings (at least 1 per year)
- Capacity building options
  - Meetings and training activities facilitated by GOFC. At least 1-network meeting and training per year and virtual events.
- Networking opportunities with other international partners and GOFC networks on international work (eg: fire algorithms calibration and validation; land products calibration and validation; trees outside of forests mapping, AFOLU, REDD+ research)
- Identify capacity building needs and priorities and reach out to us
  - Training topics
  - Focused science themes
- Participation in other GOFC regional network meetings

GOFC-GOLD
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Recent (2024) GOFC-GOLD Network Meetings and Accomplishments

South/Southeast Asia Meeting, Hanoi, Vietnam – February, 2024

- **Topic: LCLUC in Southeast Asia and Synthesis**
- **Outputs:** presentations addressed satellite based LCLUC issues, GHG emissions inventories, their impacts and mitigation options. Special issue of papers in "Environmental Research Letters ", journal.

South Asia Meeting and Synthesis, New Delhi, India – February, 2024

- **Topic: LCLUC in South Asia and Synthesis**
- **Outputs:** presentations addressed satellite based forest LCLUC issues, trees outside forests, emissions, social forestry Special issue of papers in "Environmental Research Letters ", journal.

Joint Workshop of the GOFC-GOLD SCERIN and MedRIN Networks, Chania, Greece - July, 2024

- **Topic: Recent terrestrial ecosystems LCLU changes in SCERIN and MeDRIN countries**
- **Outputs: presentations and discussions identified important** driving forces and how to address those challenges to monitor LCLUC dynamics in the region.

GOFC-GOLD Fire Implementation Team meeting, Milan, Italy – September, 2024

- **Topic:** Satellite remote sensing of fires
- **Outputs:** provided a guidance on the needs and priorities for satellite fire product research, development and applications.

RedLaTIF meeting, Columbia – December, 2024

- **Topic:** utilization of Earth Observation data for forest fire analysis, including enhancing collaborations.
- **Outputs: TBD**

GOFC-GOLD 20th Anniversary Celebrated
Sep 13-16th 2018, Tbilisi, Georgia

Summary of the GOFC–GOLD Twentieth-Anniversary Regional Networks Summit

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Giorgi Ghambashidze, Scientific-Research Center of Agriculture, Georgia, giorgi.ghambashidze@srca.gov.ge
Cheikh Mbow, START International, Inc., cmbow@start.org
David Roy, South Dakota State University, david.roy@sdsu.edu
Martin Herold, Wageningen University, Netherlands, martin.herold@wur.nl
Tony Janetos, Boston University, ajanetos@bu.edu
Chris Justice, University of Maryland, College Park, cjustice@umd.edu
Garik Gutman, NASA Headquarters, ggutman@nasa.gov

Introduction

Global Observation for Forest and Land Cover Dynamics (GOFC–GOLD) is a coordinated international program working to provide ongoing space-based and *in situ* observations of the land surface to support sustainable management of terrestrial resources at different scales. The GOFC–GOLD program acts as an international forum to exchange information, coordinate satellite observations, and provide a framework for and advocacy to establish long-term monitoring systems. It was established as a part of a Committee on Earth Observation Satellites (CEOS) pilot project in 1997, with a focus on global observations of forest cover. Since then, the program has expanded to include two Implementation Teams: Land Cover Characteristics and Change, and Fire Mapping and Monitoring. In addition, two working groups—Reducing Emissions from Deforestation and Forest Degradation (REDD), and Biomass Monitoring—were also formed. GOFC–

GOFC–GOLD Twentieth Anniversary meeting participants. **Photo credit:** Agricultural University of Georgia team

September 13-16, 2017. There were 45 people from 20 countries in attendance—including participants from Africa, Asia, South America, Eastern and Southern

GOFC-GOLD All Networks (10) Meeting being planned:

In place for 2025

Tentatively: Turkey

Asia Fire and GHG Emissions Updates

International Meeting on Land Cover/Land Use Change (LCLUC) in South/Southeast Asia and Synthesis
Hanoi, Vietnam - 01/31/2024 to 02/02/2024

Local Host
Vietnam National Space Center (VNSC)
Hanoi, Vietnam

80-participants; 3-day meeting + 2-day training events

-Day-1 – Space Agency and Programmatic Presentations

-Day-2 – LCLUC, Forestry and Agriculture

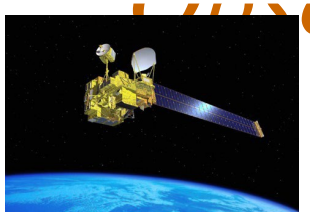
-Day-3 – Air Pollution and Land Atmospheric Interactions

Training Workshop on Fundamentals of Remote Sensing and Applications – Open Source Tools.

Early Career Researchers: ~60 people attended

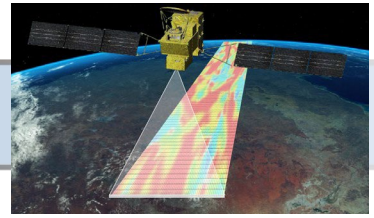
History of GOSAT Series and Earth Observation Satellite Projects at NIES

00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19



- ADEOS-2 (2002)
- **GOSAT (2009-)**
- **GOSAT-2 (2018-)**
- NIES GOSAT Research Team (2004-)
- NIES GOSAT Project Office (2006-)
- NIES GOSAT-2 Project (2013-)
- NIES Satellite Observation Center (2016-)
- **Kyoto Protocol (1997)**
- **Paris Agreement (2015)**

20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39

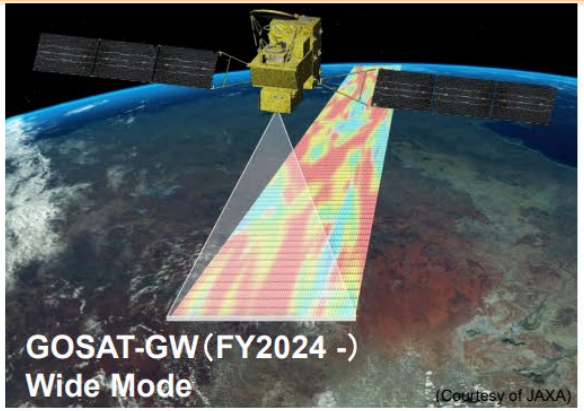


- **GOSAT-GW (2024 -)**
- NIES GOSAT-GW Project (2021-)
- **1st Global Stocktake (2023)**
- **GST-2 (2028)**

G4?

Tsuneo Matsunaga (matsunag@nies.go.jp), National Institute for Environmental Studies, Japan

Specifications of GOSAT, GOSAT-2, and GOSAT-GW



	GOSAT	GOSAT-2	GOSAT-GW
Launch / lifetime	2009 / 5 years	2018 / 5 years	FY2023 / 7 years
Satellite mass / power	1.75 t / 3770 W	1.8 t / 5000 W	2.9 t / 5200 W
Orbit	666 km, 3 days, 13:00, descending	613 km, 6 days, 13:00, descending	666 km, 3 days, 13:30, ascending
Spectrometer	FTS	FTS-2	TANSO-3 (Grating)
Major targets	CO_2, CH_4	CO_2, CH_4, CO	CO_2, CH_4, NO_2
Spectral bands	0.7 / 1.6 / 2 μm + TIR	0.7 / 1.6 / 2 μm + TIR	0.45 / 0.7 / 1.6 μm
Spectral Resolution (Sampling interval)	0.2 cm^{-1}, (≈ 0.01 nm @ 0.7 μm, ≈ 0.05 nm @ 1.6 μm)		< 0.5 nm @ 0.45 μm, <0.05 nm @ 0.7 μm, < 0.2 nm @ 1.6 μm
Swath	Discrete, 1 – 9 points	Discrete, 5 points	Selectable, 911 km (Wide Mode) or 90 km (Focus Mode)
Footprint size, nadir	10.5 km	9.7 km	Selectable, 10 km (Wide Mode) or 1 – 3 km (Focus Mode)
Pointing	±20 /±35 deg (AT/CT)	±40 /±35 deg (AT/CT) Intelligent Pointing	± 40 /± 34.4 deg (AT/CT) for Focus Mode
Other instruments	CAI (Cloud and Aerosol Imager)	CAI-2 (Cloud and Aerosol Imager 2)	AMSR3 (Advanced Microwave Scanning Radiometer 3)

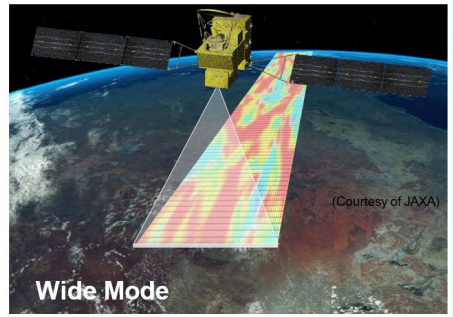
Specification of GOSAT-GW

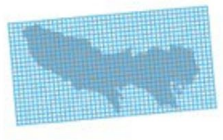
Launch/lifetime		FY2024/7 years
Orbit		666 km, ascending
Revisit cycle/observation time		3 days/13:30 LT
Spectrometer		TANSO-3
Targets		CO_2, CH_4, NO_2
Spectral bands		0.45, 0.7, 1.6 μm
Sampling intervals		< 0.5 nm@0.45 μm < 0.05 nm@0.7μm < 0.2 nm@1.6 μm
Observation modes		Wide, Focus
Swath	Wide mode	911 km
	Focus mode	90 km
Pixel size at nadir	Wide mode	10x10 km^2
	Focus mode	1x1 – 3x3 km^2
Pointing (Focus mode)		±40° / ±34.4° (AT/CT)
The other instrument onboard		AMSR3

GOSAT-GW

Wide Mode

- Swath ≈ 911 km
- Footprint ≈ 10 km
- No AT/CT Pointing
- Default observation

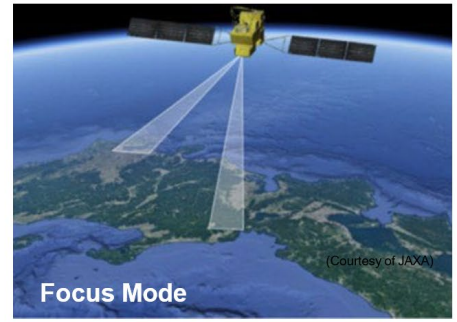




Footprint ≈ 1 - 3 km

Focus Mode

- Swath ≈ 90 km
- Footprint ≈ 1 - 3 km
- AT/CT Pointing
- Upon requests



Sentinel-3 Wildfire Atlas – Need Refinements

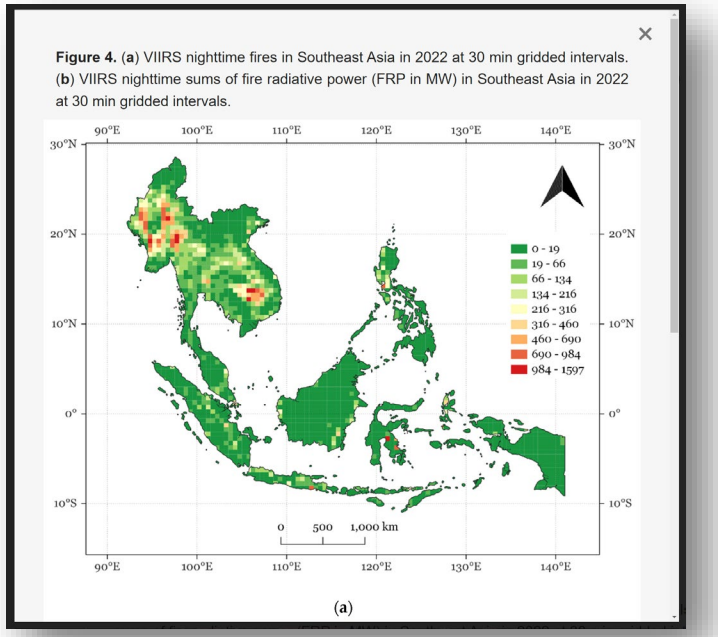


Figure 4. (**a**) VIIRS nighttime fires in Southeast Asia in 2022 at 30 min gridded intervals. (**b**) VIIRS nighttime sums of fire radiative power (FRP in MW) in Southeast Asia in 2022 at 30 min gridded intervals.

(a)

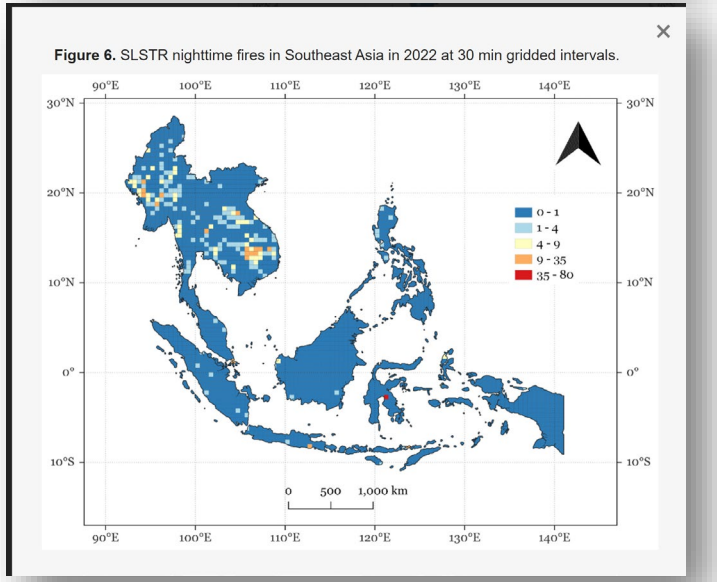


Figure 6. SLSTR nighttime fires in Southeast Asia in 2022 at 30 min gridded intervals.

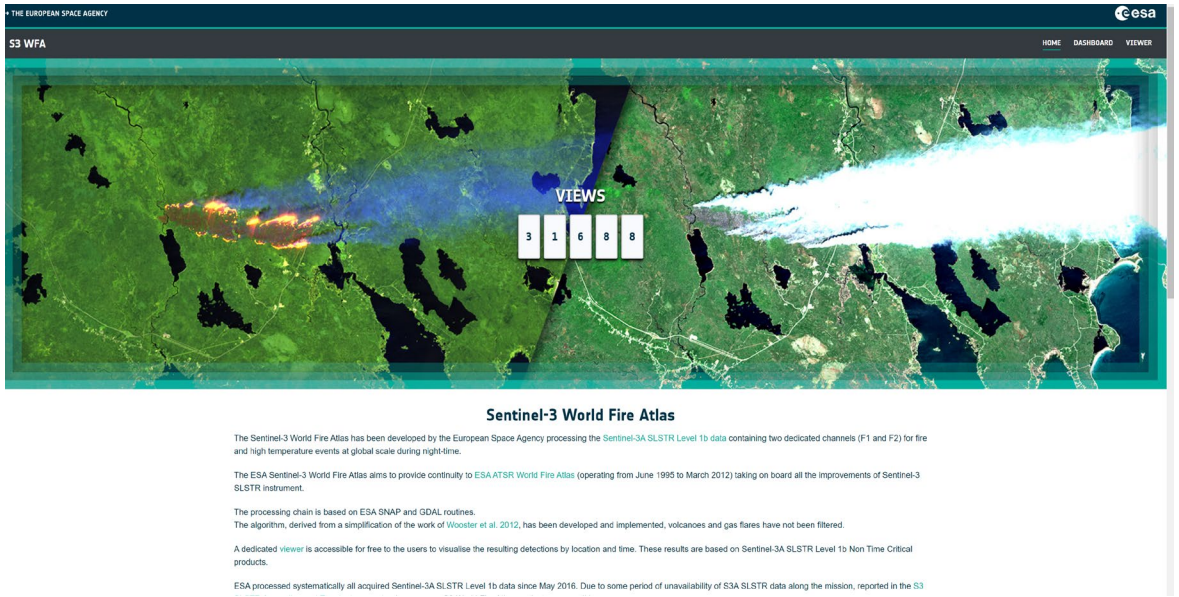
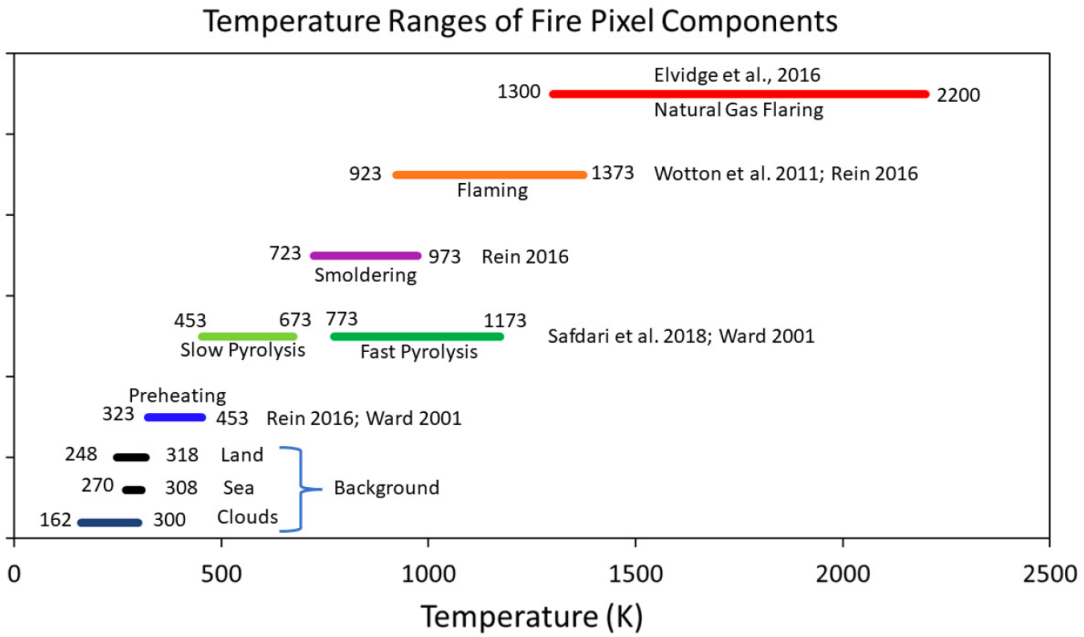


Table 1. Comparative analysis of nighttime fire trends in South Asian countries: VIIRS (2012–2022 average) vs. SLSTR (2017–2022 average) data.

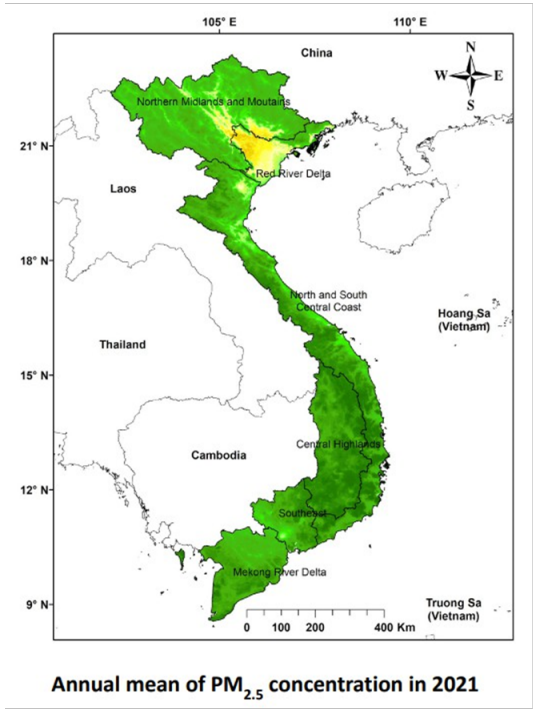
Country	VIIRS Nighttime Fires	Sentinel SLSTR Nighttime Fires	VIIRS Number of Times Greater Than SLSTR
Afghanistan	533	15	36.4
Bangladesh	1037	14	73.5
Bhutan	336	9	37.3
India	196,136	1505	130.4
Nepal	15,552	90	172.3
Pakistan	12,419	137	90.4
Sri Lanka	617	6	101.3

VIIRS Nightfire V4.0 (new product from Elvidge et al. – Data from September 2023 onwards

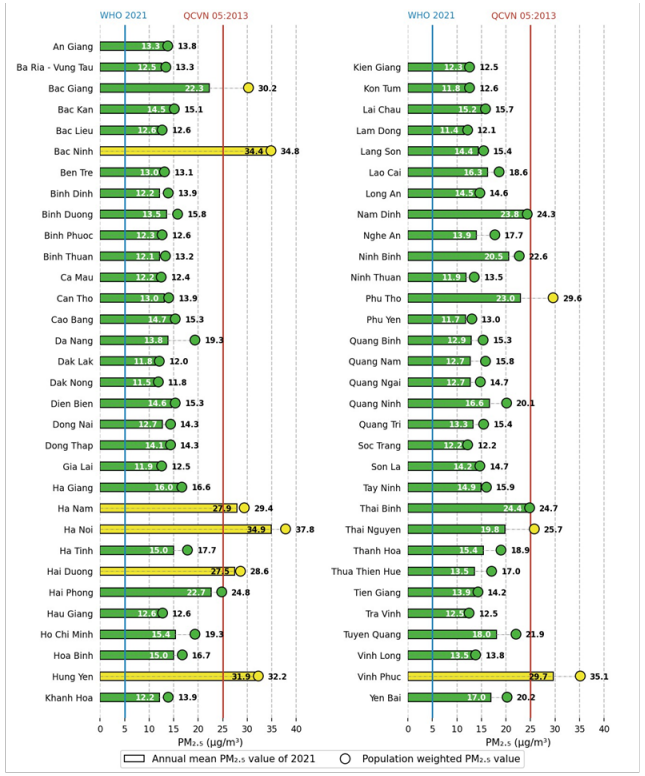


- Introduces an atmospheric correction to account for atmospheric transmissivity differences.
- Instantaneous estimates of flared gas volume (introduced with VNF v3.5).
- Continues the dual curve Planck curve analysis (IR emitter and background) from VNF v.3 with atmospherically corrected radiances
- Adds a triple-phase analysis for pixels having SWIR and MWIR detection to derive primary and secondary emitters, plus background.
- VNF pixel labeling of multiyear IR emitter identification numbers.
- Improved the MWIR (M12-M13) detector to reduce false detections of combustion sources.
- Added an M14 long-wave infrared detector to provide further confirmation of secondary emitters.
- Utilizing M7 and M8 radiances in Planck curve fitting - even when detection is only in the SWIR.

Both in Vietnam and Thailand – Efforts to map PM2.5 integrating Ground Based Measurements with Satellite Data (MODIS, VIIRS)



Annual mean of $PM_{2.5}$ concentration in 2021



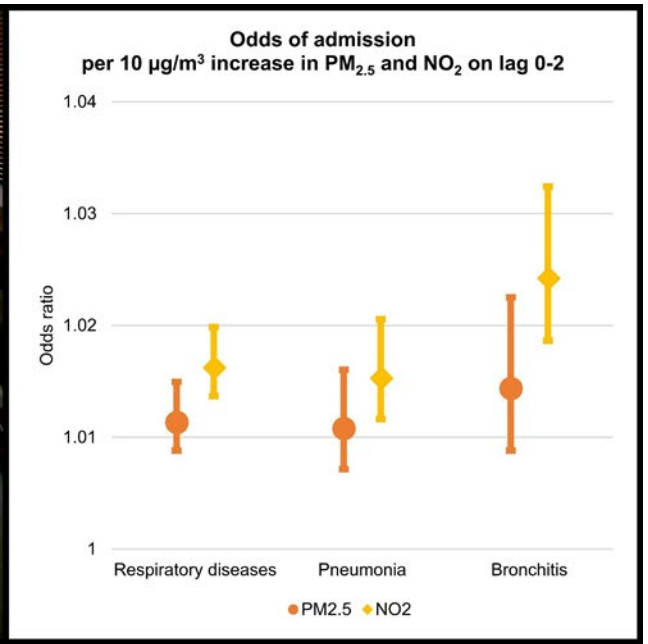
Mean of $PM_{2.5}$ concentration and population-weighted $PM_{2.5}$ concentration by province in 2021

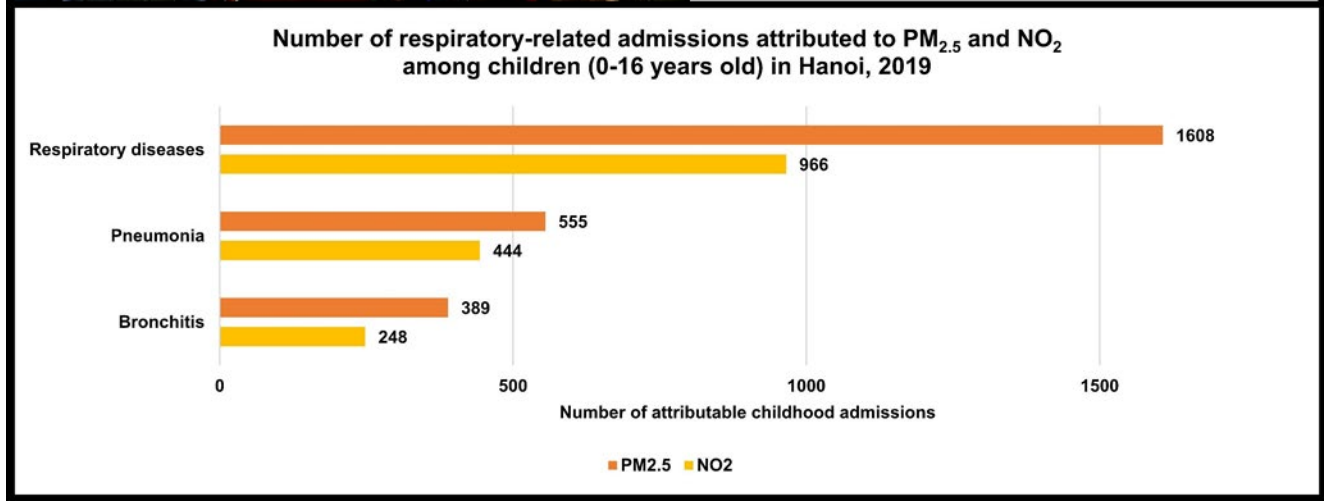
PM2.5 measurements using less expensive portable instruments

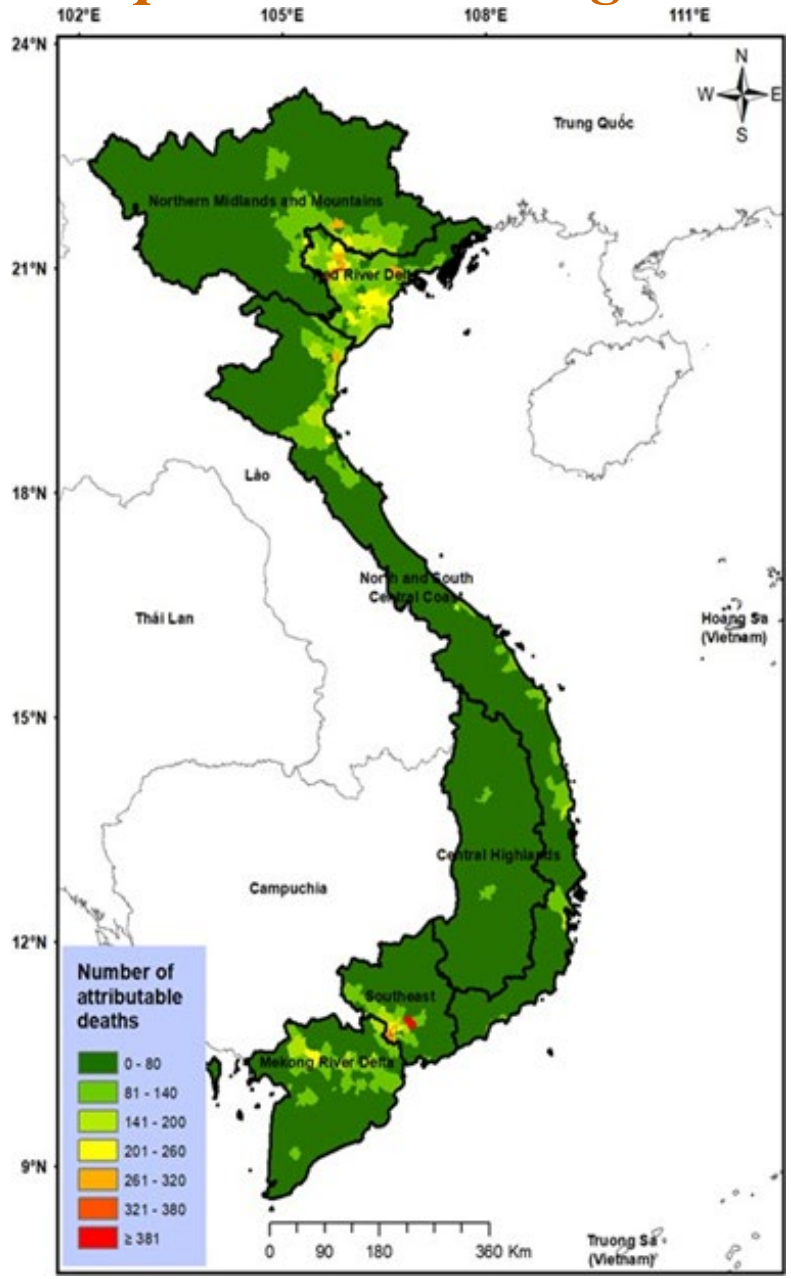
- **PurpleAir PA-II-SD** (~$250-$300)
- **Temtop M10 Air Quality Monitor** (~$90-$120)
- **Atmotube Pro** (~$150-$200)

WMO standards for PM2.5 monitors specify that instruments must have very low measurement uncertainty, generally below 5%. Many consumer-grade sensors have higher uncertainties, often between 10-15%, depending on conditions.

Health burden of air pollution – Urban pollution + Crop Residue burning





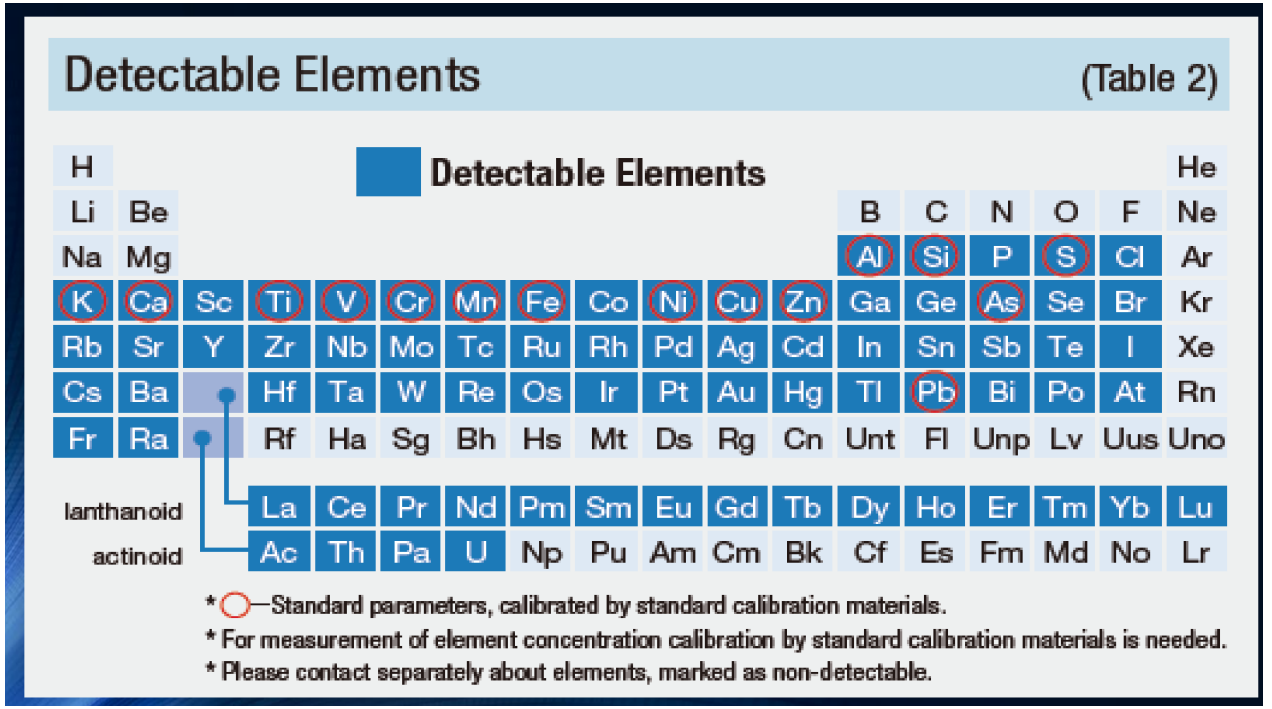


Elemental Composition Continuous Measuring Instrument

Ambient Multi-Elemental Monitor PX-375

PX-375 features

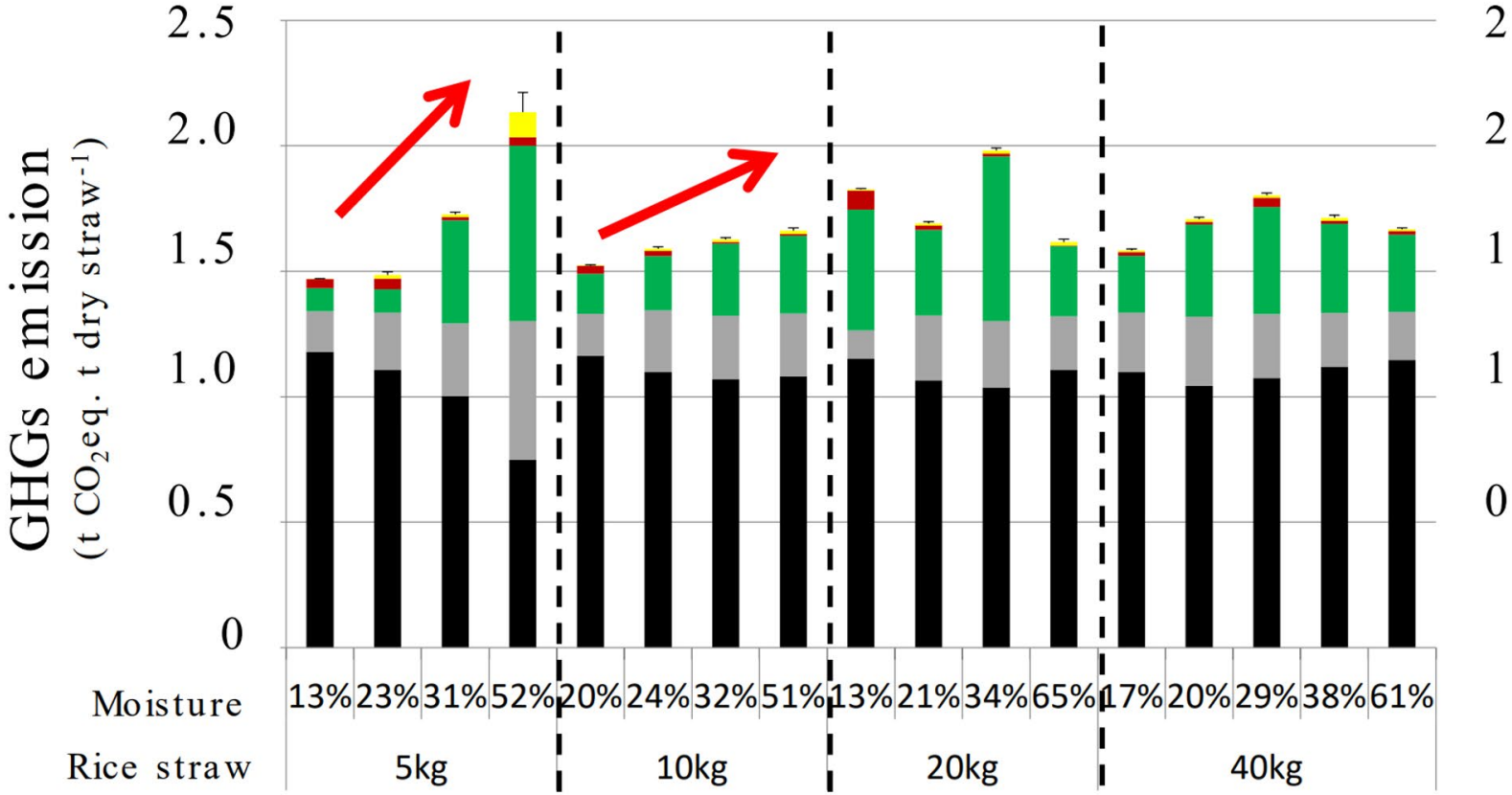
- Sampling,
  PM mass concentration (β-ray attenuation),
  metal concentration (XRF) all in ONE!
- Automatic near-real time analysis
  (Shortest 30 minutes)
- Continuous monitoring and visualizing time trend

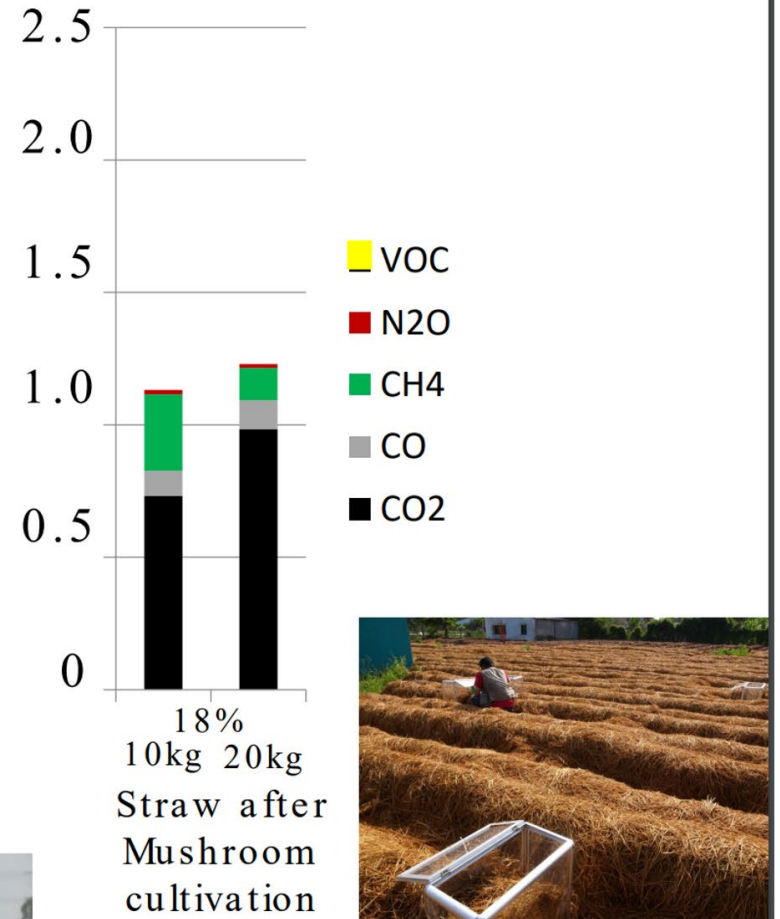


Uses X-ray fluorescence (Element analyzer) and Beta-ray attenuation (Mass) to provide continuous, in-field analysis of particulate matter (PM) concentrations and elemental composition.

Elements measured by the PX-375 that are biomass burning tracers include Potassium (K), Chlorine (Cl), Zinc (Zn), Calcium (Ca), Magnesium (Mg), Sulfur (S), Iron (Fe), and Aluminum (Al). NO Organic ones (requires thermal optical analysis)

Greenhouse gas emission derived from straw burning





Arai et al., 2022

Next Southeast Asia GOFC RN meeting in the Philippines, February, 2025

Co-hosts

- **Philippines Space Agency (PhilSA)**
- **NIES, Japan**
- **Several other local and regional institutions**

Please reach out to us if you are planning to organize a GOFC RN meeting

GOFC-GOLD Website

https://gofcgold.org/

Thank you!

- Questions?

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