

# Systematic Observations from Space

Frank Martin Seifert (ESA)  
Earth Observation Programmes

Forests in Africa @ COP27  
9 November 2022



United Nations  
Climate Change

## Paris Agreement



Transparency Framework

## Global Stocktake

Mitigation

Adaptation

Means of  
Implementation:  
Finance, Technology,  
Capacity Building

Cross-cutting:  
Response measures,  
Loss & Damage,  
Equity

# Systematic Observations



## Systematic Observations Community



WORLD  
METEOROLOGICAL  
ORGANIZATION



GCOS  
GLOBAL CLIMATE OBSERVING SYSTEM



EUMETSAT



GROUP ON  
EARTH OBSERVATIONS







# Copernicus Sentinels for operational monitoring



**250 TB**

satellite data  
distributed per day



**full, free & open**  
data policy

**sentinel-1**

→ **RADAR VISION**

**sentinel-2**

→ **COLOUR VISION**

**sentinel-3**

→ **A BIGGER PICTURE**

**sentinel-4**

→ **EUROPEAN AIR MONITORING**

**sentinel-5p | sentinel-5**

→ **GLOBAL AIR MONITORING**

**sentinel-6**

→ **SURFING THE SEAS**

**Mission Status:** <https://sentinels.copernicus.eu/web/sentinel/missions>



→ THE EUROPEAN SPACE AGENCY



PROGRAMME OF THE  
EUROPEAN UNION



Food Security and  
Water Management

Monitoring Land  
and Natural Resources

Combating  
Climate Change

Safeguarding  
the Arctic

Strengthening  
Systematic  
Observations with  
the Sentinel  
Expansion Missions

CO2M

LSTM

CHIME

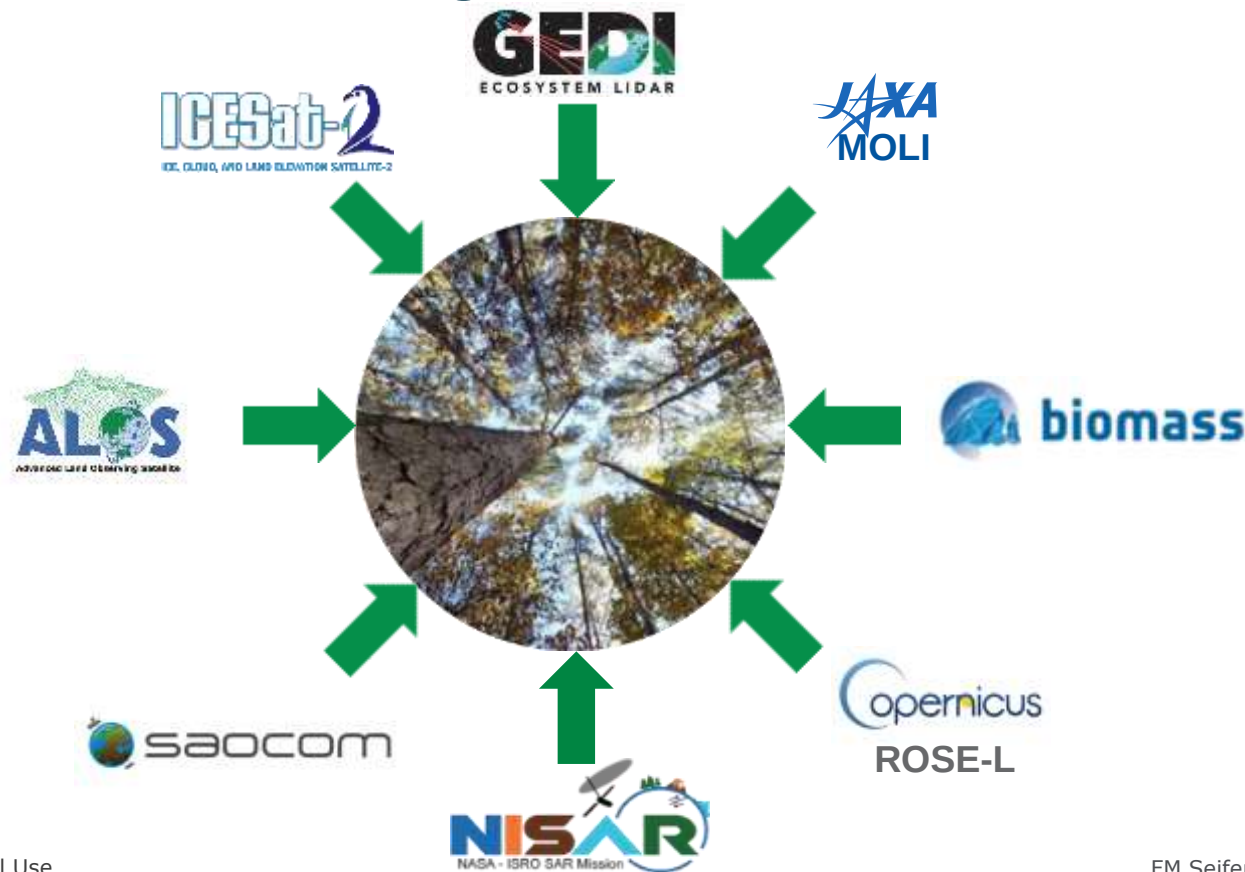
ROSE-L

CIMR

CRISTAL



THE EUROPEAN SPACE AGENCY





# Mitigation - AFOLU

Agriculture, Forestry and Other Land Use (AFOLU) contributes the second largest source of emissions (after fossil fuel use) globally, and is the primary source of emissions in many developing nations



Aboveground Biomass Density (Mg/ha)



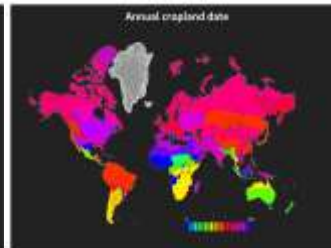
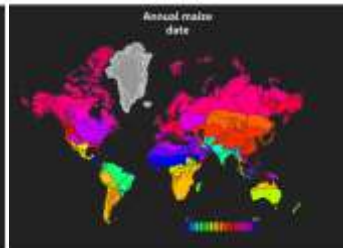
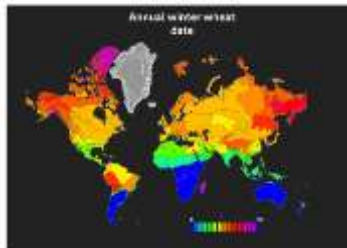
Forests



Land Cover



Mangroves

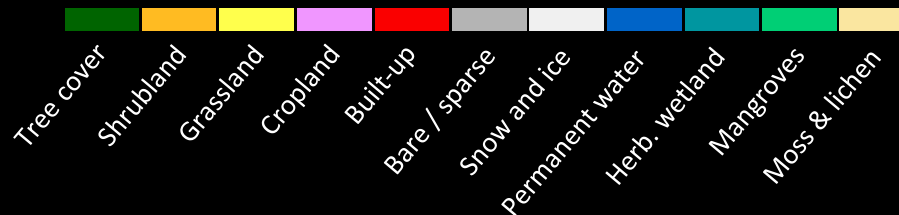


Agriculture

Global 10 meters land cover  
2020 & 2021 (just released)  
Based on Sentinel-1 & 2  
Fast generation  
11 classes  
5 Key end-users  
75% OA, Independent validation



### WORLDCOVER 2020 – 10M





- Global maps 2010, 2017 & 2018
- 2020 map under validation
- Consistency: a decade of change





# JAXA partial column GHG product



- JAXA developed a new retrieval algorithm to derive the partial column.
- GOSAT observes both solar reflected light and thermal emission.
- Products are free available ([https://www.eorc.jaxa.jp/GOSAT/Global\\_GHG\\_Map/index.html](https://www.eorc.jaxa.jp/GOSAT/Global_GHG_Map/index.html)).

## Upper troposphere:

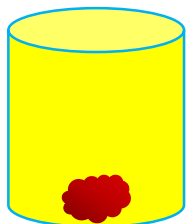
Serves as a **new reference** (background) CO<sub>2</sub> concentration for local analysis.

## Lower troposphere:

Better reflects CO<sub>2</sub> changes due to local

emissions.  
**Conventional Method**

Use only solar reflected light

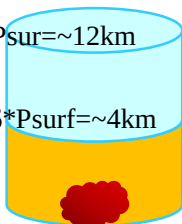


**JAXA/EORC new Method**

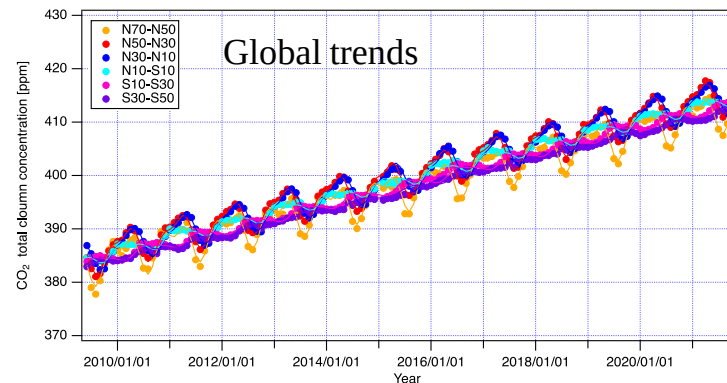
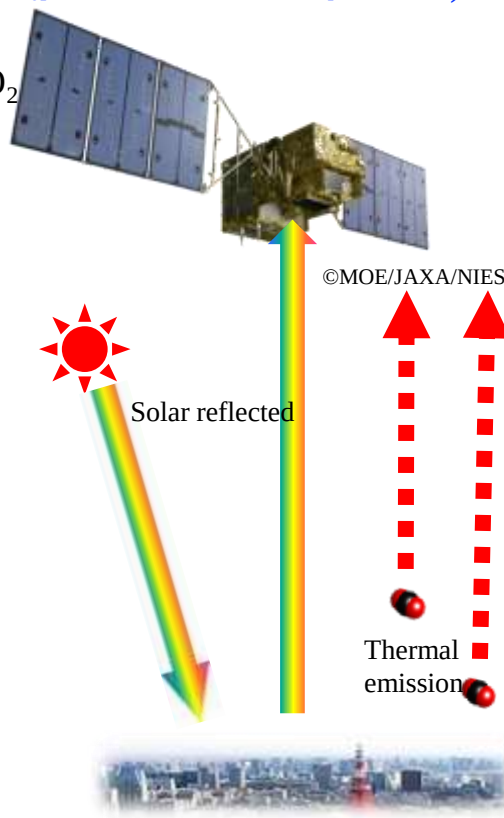
Use both solar reflected light & thermal

$0.2P_{\text{sur}} \sim 12\text{km}$

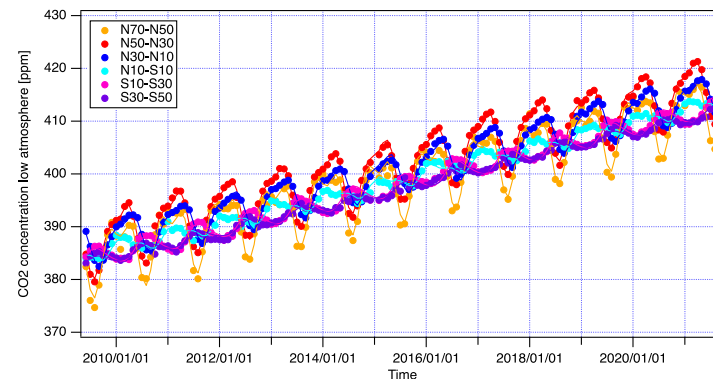
$0.6 \cdot P_{\text{surf}} \sim 4\text{km}$



CO<sub>2</sub> emission and enhanced density of the lower troposphere



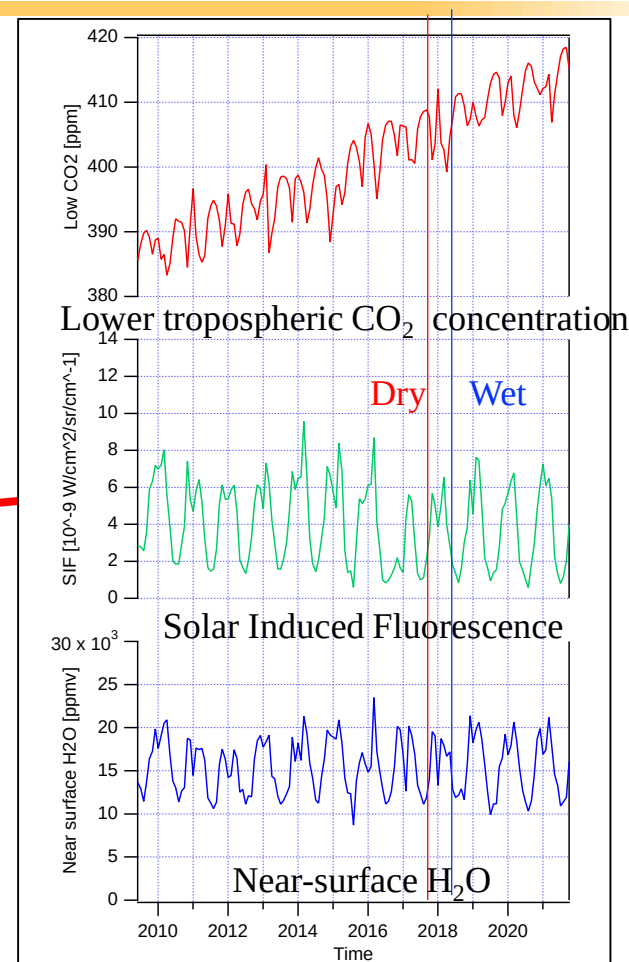
Total column concentration



Lower tropospheric concentration



# Visualizing of GHG trend by GOSAT







- 
- A collage of various satellite images and 3D models. The top left shows a satellite with a large antenna and solar panels. The top right shows a satellite with a large antenna and solar panels. The middle left shows a satellite with a green body and solar panels. The middle right shows a satellite with a large antenna and solar panels. The bottom left shows a satellite with a large antenna and solar panels. The bottom right shows a satellite with a large antenna and solar panels.