Standardization of methods to produce official land cover and crop statistics using EO data.

EO-STAT

Hand-in-Hand Initiative

Organización de las Naciones Unidas para la Alimentación y la Agricultura

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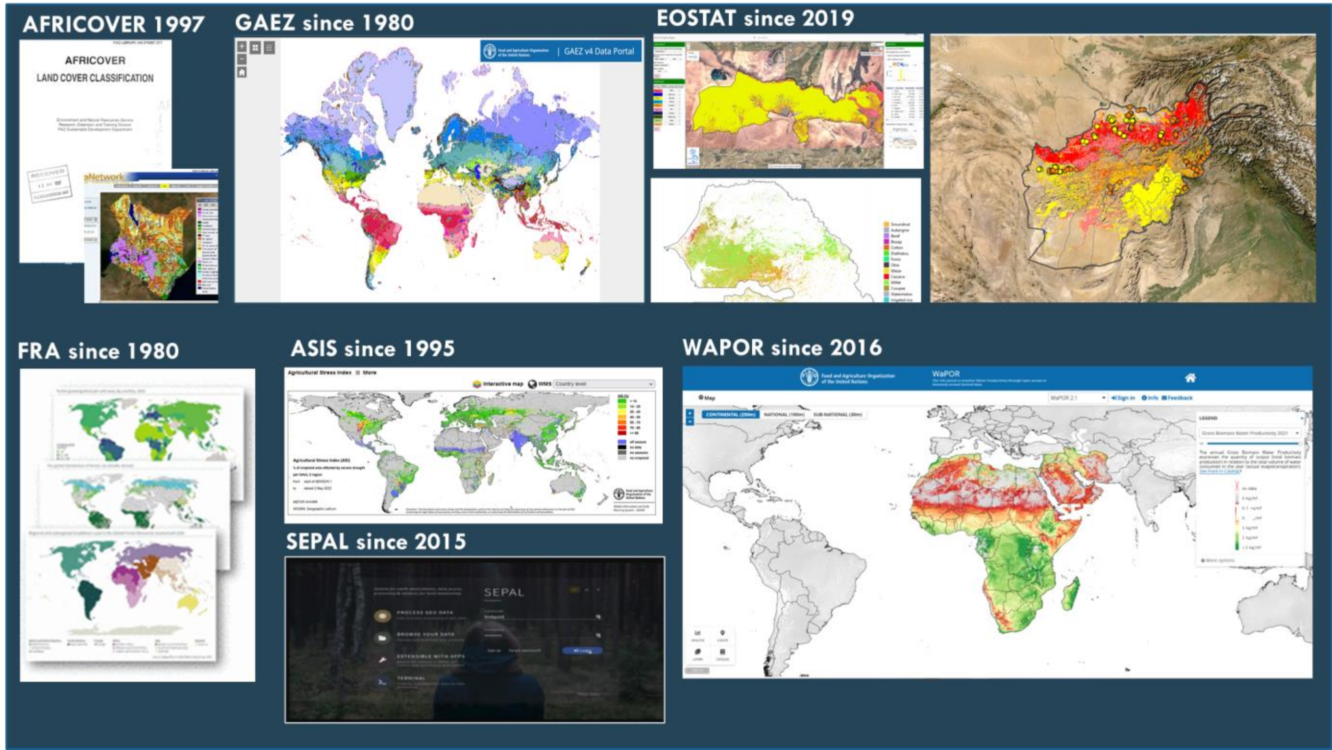
CONTENTS

1. Use of EO data at FAO
2. FAO Partnerships: opportunities and challenges
3. Sources of heterogeneity in LCLU applications
4. Perspectives on standardization
5. New FAO governance of data and statistics
6. Global governance of EO data and statistics
7. SDG 15.4.2: example of methodological development and standardization

USE OF EO DATA AT FAO

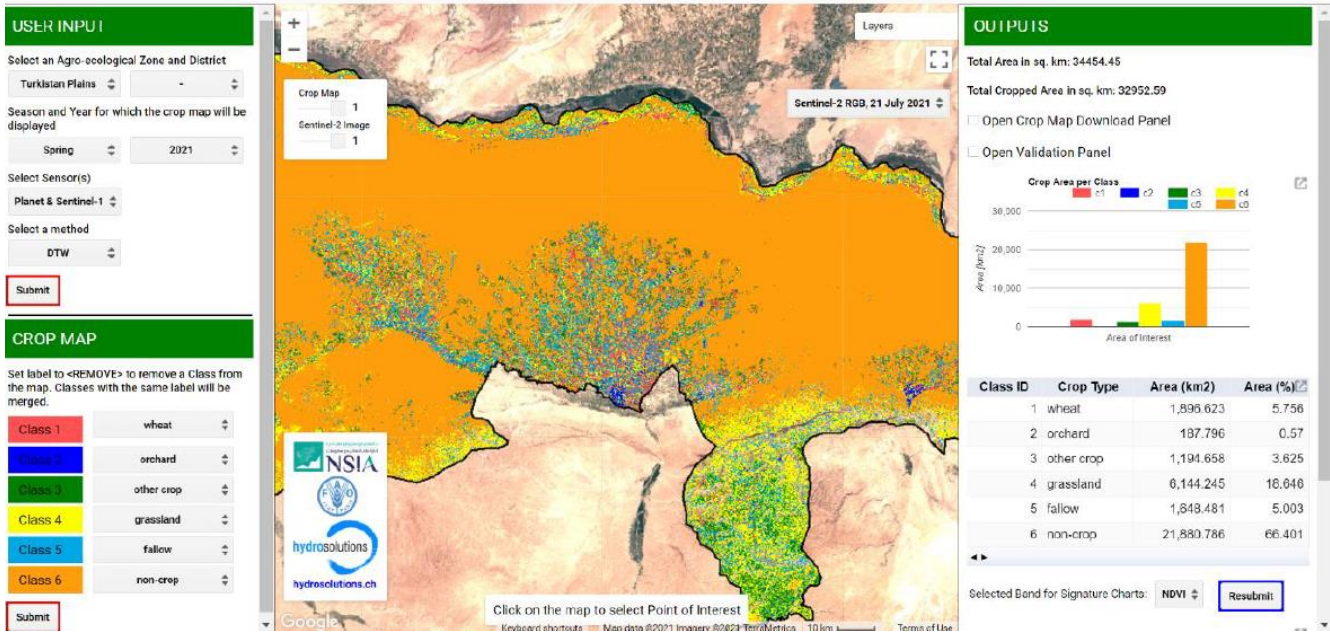
- FAO has been using EO data for over 35 years to monitor trends in agricultural and environmental resources, with the overall aim of ensuring global Food Security and Agricultural Sustainability. However, the concomitant development over time of a variety of FAO applications relying on different methods, data and tools has introduced a remarkable heterogeneity and lack of standardization. The same applies to the work of many international agencies, private sector entities and governments who are investing in EO data applications.
- FAO's applications cover a wide range of topics, including:

a. Land cover and Crop monitoring
b. Forestry
c. Water
d. Agroecology
e. Early warning



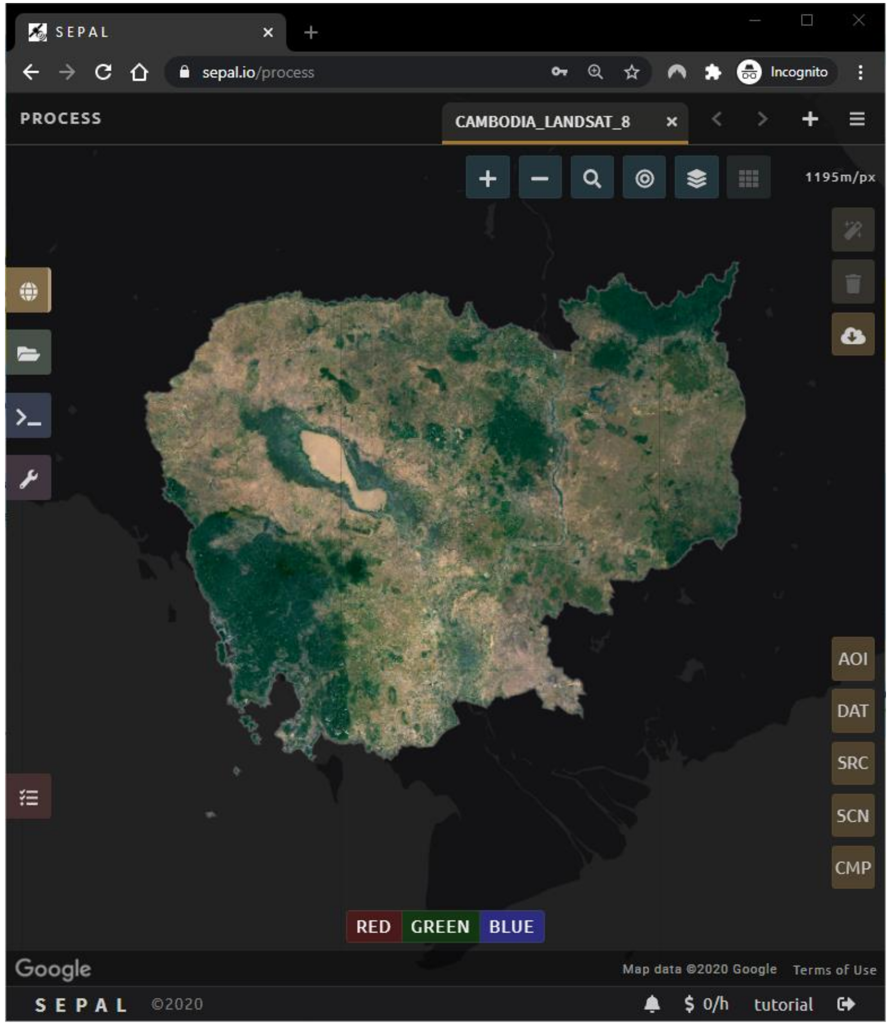
EOSTAT CROP MAPPER AND LAND COVER MAPPER

- Supervised land cover classification
- Supervised & Unsupervised crop classification
- Land cover statistics
- Land cover change statistics
- Crop statistics (acreage and yield)
- Crop yield forecasts
- Automatic generation of in-situ data
- In situ-data QA/QC



SYSTEM FOR EO DATA ACCESS, PROCESSING & ANALYSIS FOR LAND MONITORING - SEPAL

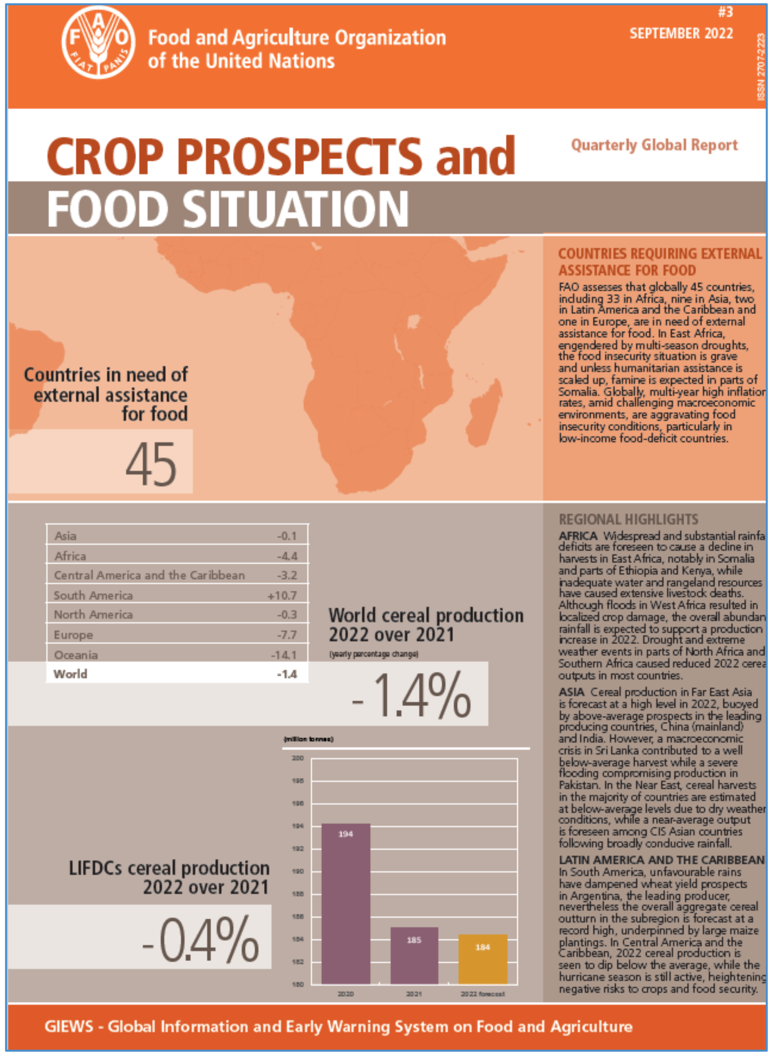
- Forest Mapping
- Deforestation mapping
- Support to Forestry Resource Assessment
- Tool to monitor SDG indicator 15.4.2 (Mountain Green Cover Index)



GLOBAL INFORMATION AND EARLY WARNING SYSTEM ON FOOD AND AGRICULTURE - GIEWS

- Global cereal production bulletin
- Food Insecurity Early warning

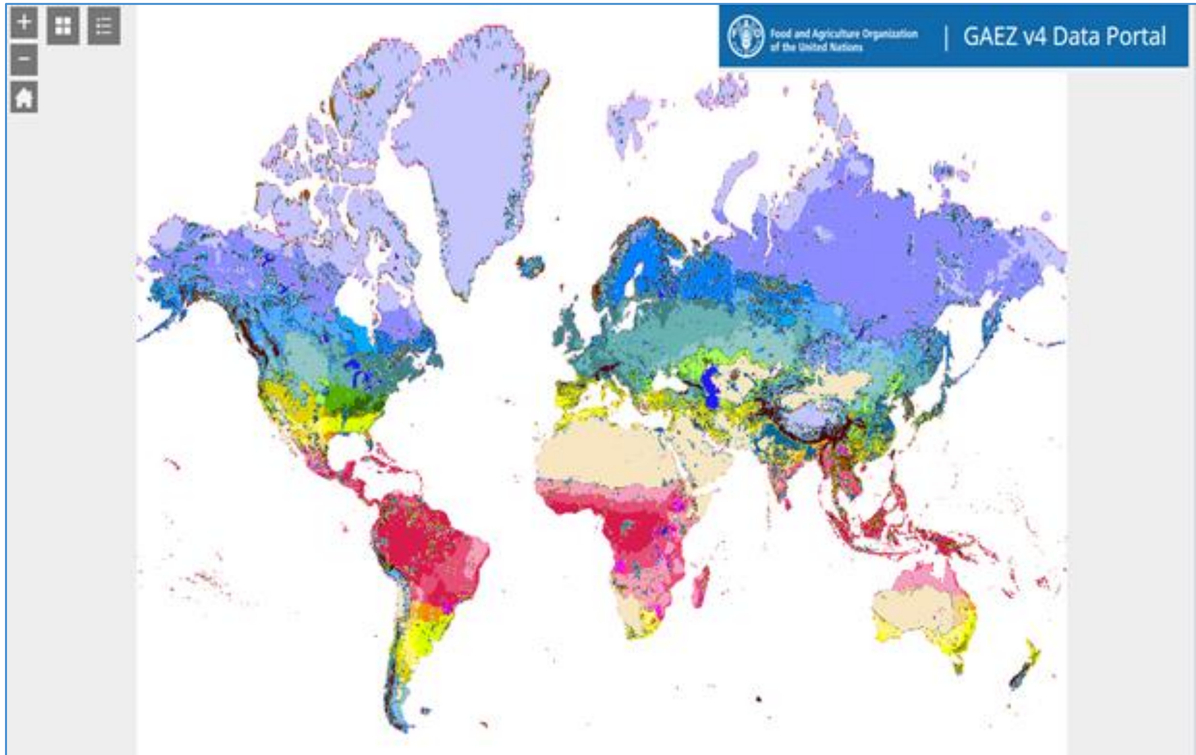
Uses EO data to assess crop stress, which is then combined with other inputs to predict loss of crop production



GLOBAL AGRO-ECOLOGICAL ZONES MODELLING FRAMEWORK AND DATABASES - GAEZ

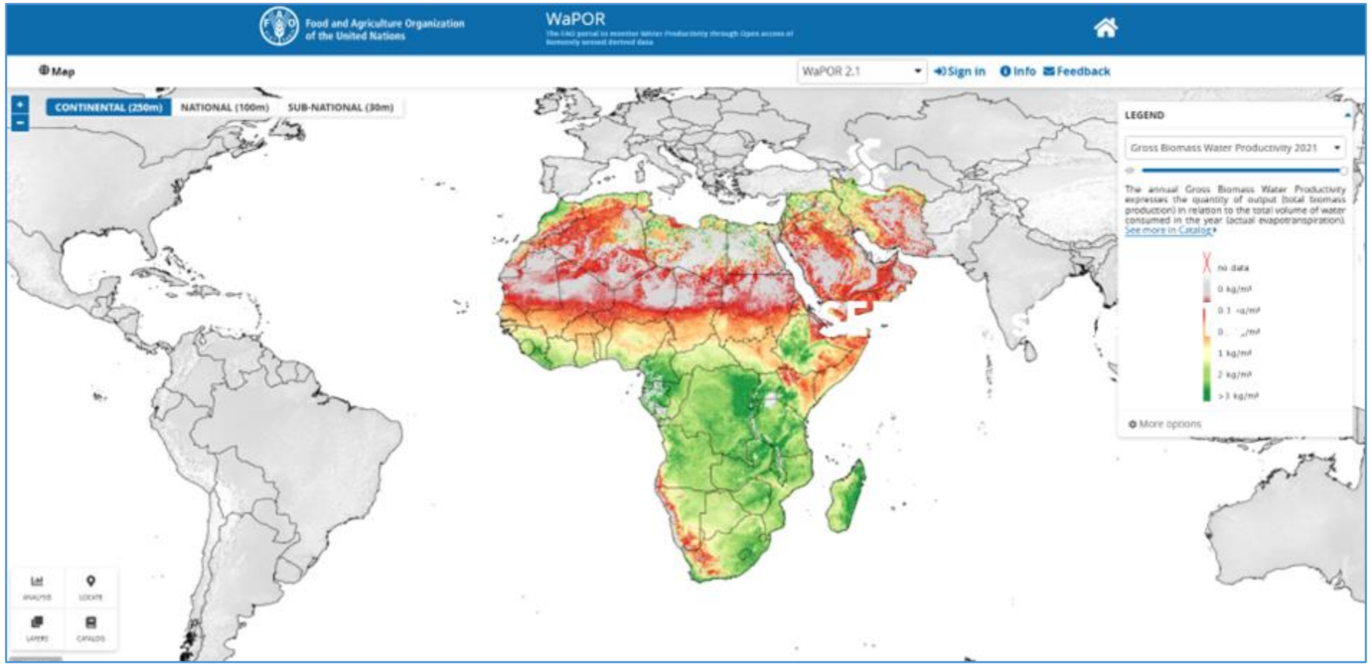
Based on land evaluation criteria to assess natural resources for finding suitable agricultural land utilization options. Multi-layered spatial database organized in six themes, representing both inputs and outputs of the modeling:

- Land and Water Resources
- Agro-Climatic Resources
- Agro-Climatic Potential Yield
- Suitable and Attainable Yield
- Actual Yields and Production
- Gaps in Yield and Production



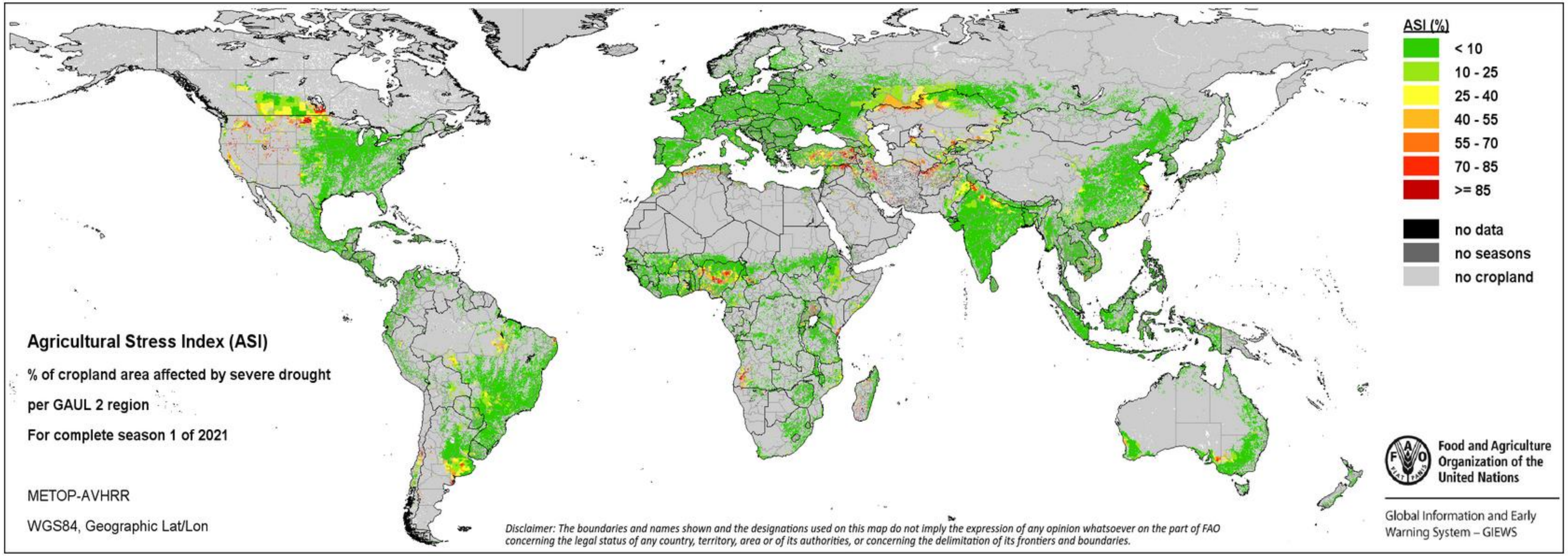
WATER PRODUCTIVITY PORTAL - WAPOR

- Gross Biomass Water Productivity
- Net Biomass Water Productivity
- Harvest Index
- Actual evapotranspiration and interception (Annual & Monthly)
- Net Water Productivity



AGRICULTURAL STRESS INDEX - ASIS

- Vegetation health in cropland and rangeland
- Linked to GIEWS

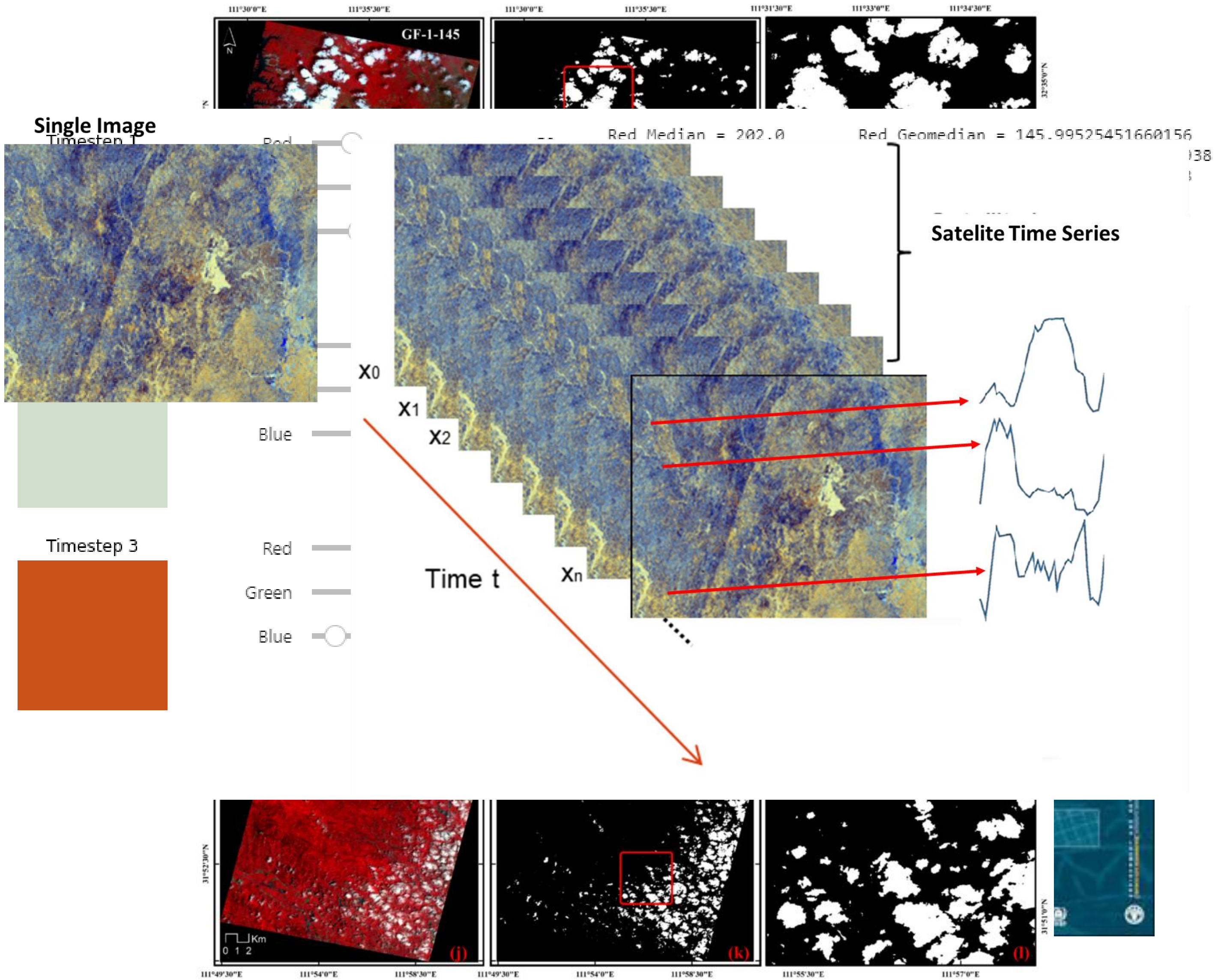


FAO PARTNERSHIPS: OPPORTUNITIES AND CHALLENGES

- FAO has established a wide portfolio of collaborations with external entities, such as space agencies (ESA, NASA), geospatial international bodies (UNGGIM, GEO, etc.), geospatial/big data technology platforms (UN Global Platform, Google, Amazon, ESRI, Digital Earth Africa), academia (University of Louvain, Michigan State University, University of Wageningen, etc.), NGO's.
- Such wide portfolio of collaborations, while it provides endless opportunities to develop new methods/tools and build capacities in countries, it contributes the large landscape of FAO's applications of EO data. On one side it is a great opportunity to achieve important project goals. However, it also constitutes a source of heterogeneity and lack of standardization.

SOURCES OF HETEROGENEITY IN LCLU APPLICATIONS

- Differences in the definition of land cover and land use classes
- Differences in definitions of in-situ data and different geo-referencing approach
- Differences in image sources and pre-processing:
  - Cloud cover thresholds and cloud masking algorithms
  - Different approaches for gap filling
  - Different temporal approaches:
    - Single data
    - Time series approach
    - Different density of time series

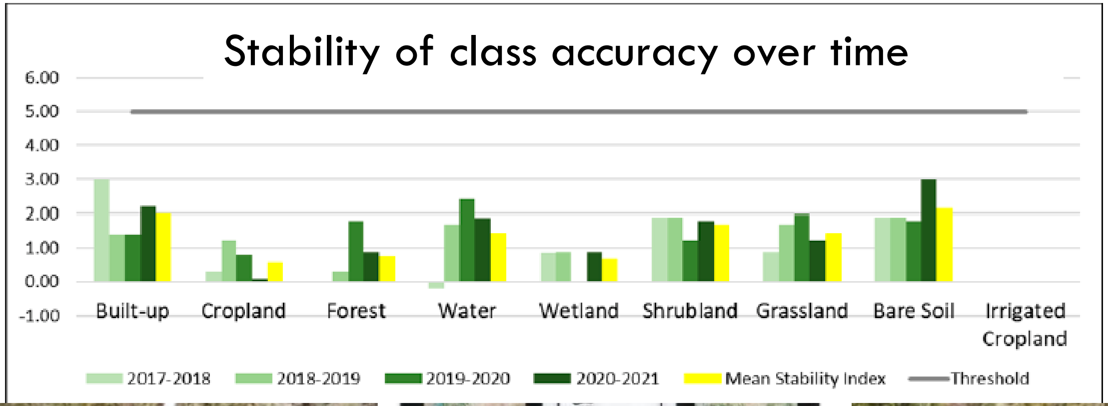


SOURCES OF HETEROGENEITY IN LCLU APPLICATIONS (CONT.)

- Differences in processing images:
  - Differences in spatial and temporal resolution
  - Differences in classification approaches
    - Unsupervised
    - Supervised
      - Pixel/Object based analysis
      - Use of in-situ data
      - Use of pseudo in-situ data (e.g. visual interpretation)
- Class accuracy classification and its stability over time

Confusion Matrix

	Built-up	Cropland	Forest	Water	Wetland	Shrubland	Grassland	Bare Soil	Irrigated Cropland	User Accuracy
Built-up	5	4	0	0	2	0	0	1	0	41.67
Cropland	0	70	0	0	1	1	13	0	0	82.35
Forest	2	1	536	1	4	13	11	0	0	94.37
Water	0	1	1	29	1	0	0	0	0	90.63
Wetland	0	11	1	0	418	0	29	0	0	91.07
Shrubland	0	1	3	0	1	36	33	1	0	48.00
Grassland	0	11	2	0	5	11	169	9	0	81.64
Bare Soil	0	4	0	0	0	0	2	9	0	60.00
Irrigated Cropland	0	0	0	0	0	0	3	0	3	50.00
Producer Accuracy	71.43	67.96	98.71	96.67	96.76	59.02	65.00	45.00	100.00	



3			
Terra	1	16 days	16 days

PERSPECTIVES ON STANDARDIZATION

A quality assurance framework for EO data, a set of standards and a governance mechanism for their endorsement should be identified. Such standards, should then be implemented by countries.
The overall compliance to the QAF and set of standards could be used to inform a scoring system which would be used to finally certify the fitness for use by official statistics of the geospatial product.

Some of the key standards to be developed include:

1. Revison of the LCLU International Classification
2. Minimum requirements for number of land cover classes & in situ data
3. Minumum threshold for class accuracy classification and its stability over time
4. Standardized workflows for image preprocessing (e.g. minimum number of composites to produce an annual land cover map; threshold for cloud coverage of satellite images).
5. Standardized template for metadata documentation

NEW FAO'S GOVERNANCE OF DATA AND STATISTICS

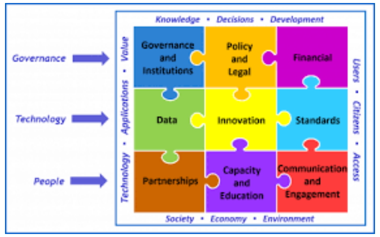
- The FAO Council established a Data Coordination Group as the apex body in the broader, renewed internal coordination system for data (including big data and geospatial data) and statistics.

- The DCG is chaired by the Executive Data Champion
- Main objective of the DCG is to ensure greater coherence and enhanced managerial support to data harmonization and data innovations, as well as to accelerate the data-driven transformations needed to achieve the 2030 Agenda
- The DCG, consisting of senior managers representing both the users and producers of data and statistics at FAO, is supported by a Technical DCG which is in charge of developing internal policies and standards for data for statistics.
- This Technical DCG consists of appointed senior technical staff from all units producing data and statistics in FAO.

GLOBAL GOVERNANCE OF EO DATA AND STATISTICS

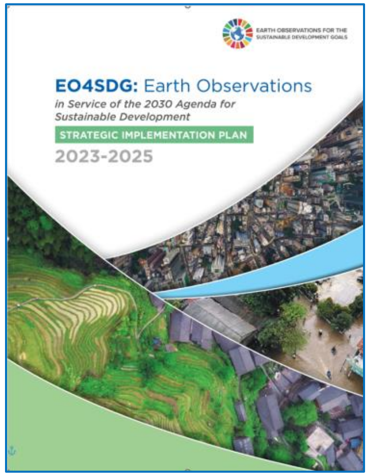
1. UNGGIM

- Established by ECOSOC as the apex intergovernmental mechanism for making joint decisions and setting directions with regard to the production, availability and use of geospatial information within national, regional and global policy frameworks.
- Integrated Geospatial Information Framework (IGIF)
- Global Statistical Geospatial Framework (GSGF)



2. UN Statistical Commission - (2022)

- ECOSOC adopted the revised ToRs of the Commission that broaden its mandate as the primary intergovernmental body for the coordination of the UN statistical and <u>data-related system</u>.
- Adoption of the SDG Geospatial Road Map



UN COMMITTEE OF EXPERTS ON BIG DATA AND DATA SCIENCE FOR OFFICIAL STATISTICS - TASK TEAM ON EO DATA FOR AGRICULTURAL STATISTICS

- **Co-chairs: FAO, WB and INEGI**
- Methods and research
  - In-situ data minimum requirements
  - Innovative, more data frugal classification algorithms
  - Land cover/land use mapping for official statistics
- Data sharing
  - Standard definition of in-situ data
  - Confidentiality issues of georeferenced data
  - Infrastructures for in-situ data sharing
- Training
  - EO training courses: AI aided course selection based on user profile
  - Collaboration with UNITAR

SDG 15.4.2: EXAMPLE OF METHODOLOGICAL DEVELOPMENT AND STANDARDIZATION

- 2020: FAO developed a n… …igital elevation data. Method wa…
- 2020/2021: The new meth… …nal estimates on a global scale… …untries.
- 2021 The method was endo… …ission
- 2021/2022: the EO metho… …sion of land cover degradation int… …en because of climate change… …endorsed by the IAEG-SDG in July 2… …red by countries.
- Next step February 2023: … …s on a global scale to be validate…

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Article

Using Standardized Time Series Land Cover Maps to Monitor the SDG Indicator "Mountain Green Cover Index" and Assess Its Sensitivity to Vegetation Dynamics

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Abstract: SDG indicators are instrumental for the monitoring of countries' progress towards sustainability goals as set out by the UN Agenda 2030. Earth observation data can facilitate such monitoring and reporting processes, thanks to their intrinsic characteristics of spatial extensive coverage, high spatial, spectral, and temporal resolution, and low costs. EO data can hence be used to regularly assess specific SDG indicators over very large areas, and to extract statistics at any given subnational level. The Food and Agriculture Organization of the United Nations (FAO) is the custodian agency for 21 out of the 231 SDG indicators. To fulfill this responsibility, it has invested in EO data from the outset, among others, by developing a new SDG indicator directly monitored with EO data: SDG indicator 15.4.2, the Mountain Green Cover Index (MGCI), for which the FAO produced initial baseline estimates in 2017. The MGCI is a very important indicator, allowing the monitoring of the health of mountain ecosystems. The initial FAO methodology involved visual interpretation of land cover types at sample locations defined by a global regular grid that was superimposed on satellite images. While this solution allowed the FAO to establish a first global MGCI baseline and produce MGCI estimates for the large majority of countries, several reporting countries raised concerns regarding: (i) the objectivity of the method; (ii) the difficulty in validating FAO estimates; (iii) the limited involvement of countries in estimating the MGCI; and (iv) the indicator's limited

THANK YOU