The Second International Seminar on Big Data of the United Nations Global Platform for Big Data China Hub

The seminar is jointly organized by the National Bureau of Statistics of China (NBS), the United Nations Statistics Division (UNSD), and the United Nations Global Platform for Big Data China Hub

Nanning City, China
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Joint Task Team on Earth Observation
Co-chairs

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Virtual presentation
Gordon Reichert

New Joint Task Team

- At the September 25, 2020 meeting of UN Committee of Experts on Food Security, Agricultural and Rural Statistics (UN-CEAG), the creation of a joint task team on the use of earth observation for agriculture statistics and land cover mapping between UN-CEAG and UN-GWG on Big Data was approved

- Includes UN-CEAG members from Asian Development Bank, Columbia (DANE), Data4Now, Egypt, FAO, German Space Agency (DLR), Indonesia, Mexico (INEGI), Senegal, Statistics Canada, Statistics Poland, USDA-NASS, UNSD, Queensland University of Technology (Australia), and the World Bank

2. Objectives of the Joint Task Team

1. Mandate:

   The joint task team aims to provide strategic vision, direction and development of a work plan on utilizing satellite imagery and geo-spatial data for official statistics and indicators for UN Sustainable Development Goals by:

   - Identifying approaches for collecting representative training data
   - Developing and implementing methods using satellite imagery and the training data for producing official statistics

3. Focus of the joint task team is to:

   - Identify reliable and accurate statistical methods for estimating data of interest
   - Suggest approaches for collecting representative training and validation data of sufficient quality
   - Research, develop and implement assessment methods for the proposed models including measures of accuracy and goodness of fit
   - Establish strategies for reuse and adapt algorithms across topics and to build implementations for large volumes of data

4. The joint task team's deliverables are:

   - To recommend EO data sources, methods and training for producing agricultural statistics, and
   - Use EO data for land cover and land use

2a. Agricultural Statistics

1. **NEW collaborative work with FAO**
    1. Objective:
        - Provide technical hosting support on the UN Global Platform to the FAO, and collaboration on a research project with members of the EO Task Team.
        - Complements the analytical work with the development of best practices/methodology and specific training on EO preprocessing, and the actual analysis (Convolutional Neural Networks, Random Forest, Spatial Regressions, Dynamic Time Warping, etc.)

    2. Methodology
        - Optical data from Sentinel-2, Radar data from Sentinel-1, and in-situ measurements (field location, filed size, crop type and crop yield) with work implemented in Senegal, Uganda and Afghanistan
        - Use of spectral and phenological features extracted from Vegetation Index fitted models
        - Transferability of models (semi-supervised)

2b. Land cover and land use statistics

1. New standard for land cover classification

- FAO has developed a standard for land cover classification, the LCCS, which is the de-facto ISO standard,
- Has been used to develop the land cover definition under the United Nations' System of Environmental-Economic Accounts (SEEA).

2. Potential future collaborations with the FAO

The development of a national land cover mapping tool for production of annual land cover map

- To support the monitoring of land cover and production of national land cover statistics. Pilot implemented in Lesotho using Google Earth Engine. Final tool may be deployed on the Digital Earth Africa.

The development of a global land cover product

- To support SDG monitoring ensuring standardization and harmonization of national and sub-national figures.
- Adequate accuracy (> 90%) remains a void to be filled

3. Task team contribution : Handbook

Handbook on *Earth Observation for Official Statistics*

- In December 2017, the Task Team released a handbook on *Earth Observation for Official Statistics*, which provides a guide for National Statistical Offices considering using satellite imagery data.

- Link: https://unstats.un.org/bigdata/task-teams/earth-observation/UNGWG_Satellite_Task_Team_Report_WhiteCover.pdf

- Contains a brief introduction on the use of earth observation (EO) data for official statistics, types of sources available, methodologies for producing statistics from this type of data and quality indicators for spatial data.

- Summarizes the results of pilot projects produced by members of the task team:
  - Australian Bureau of Statistics (ABS), Australia - *Application of satellite imagery data in the production of agricultural statistics*
  - UNSD and Google - *Skybox Commodity Inventory Assessment - now part of Planet*
  - Departamento Administrativo Nacional de Estadistica (DANE), Colombia - *Use of satellite images to calculate statistics on land cover and land use*

Five case studies were included in the report to complement the Task Team Pilot Projects

Case Study 1: an evaluation of the implementation of various machine learning techniques for analysis of EO data for crop classification, undertaken by the Department of Science Information Technology and Innovation (DSITI) Australia and Queensland University of Technology (QUT) Australia.

Case Studies 2 and 3: two published implementations of EO data analyses for estimation of crop yield.

Case Studies 4 and 5: two fully operational methods developed for the analysis of EO data to derive official statistics. These have been developed by the National Statistics Office in Canada and the DSITI in Australia.

3a Task team contribution : Methodology

Leveraging the UN Global Platform – Collaboration between FAO and UN-GP

1. **Project objectives**
   - Build in-country capacity in Senegal and Uganda in the operational use of EO data for the production of official crop statistics employing established methods and tools.
2. **Methodology**
   - Sen2Agri tool box developed by the European Space Agency, was identified as the tools box of choice as it allows for the semi-automatic EO data preprocessing and provides a user friendly graphic interface allowing for the actual classification of the EO data into crop type maps.
3. **Outcomes**
   - Overcome such barriers by deploying the Sen2Agri tool box on the UNGP on one end, and by developing Lambda scripts on the other end to automatize further deployment of the Sent2Agri tool box for other projects.
   - In April/June 2020, the design of the EOSTAT solution was finalized and a technical document was produced.

     The requirements of the Sen2Agri workflows and the data requirements, such as the number of Sentinel-2 Tiles to acquire and process, for Senegal and Uganda, allowed a solution design that provides sufficient storage and computing power, optimizes performance/costs, and allows for automatic deployment through Amazon Lambda scripts. The final solution is therefore easy to scale up for more countries.

3b. Task team contribution: Training

- The Task Team has created a training sub-task team on the use earth observation data for agricultural statistics, which is deemed to be a training priority by member countries.
- The training task team is led by Australia's Queensland University of Technology and FAO.
- They provide expertise in training and the use of earth observation data for agricultural statistics.
- The assignment is backed by many task team members who have provided material and links, fundamental to the creation of the courses.
- To date, the team has developed a three-stage curriculum which is meant to lead students from introductory remote sensing knowledge to advanced courses with up-to-date data and training sources. The curriculum has been created with the overall goal to teach the fundamentals of using satellite imagery, and provide programming skills with relevant use cases for its users.

3c. 6th International Conference on Big Data for Official Statistics

Session 8: Use of Satellite Data for Agriculture, Environmental and Ocean Statistics

- The Task Team organized and chaired a virtual session on the use of satellite data for agriculture, environmental and ocean statistics held on September 1, 2020.
- The session had seven presentations from experts in the field of remote sensing to showcase how this technology has transformed production of statistics for agriculture, environment and ocean science around the globe.
- Presentations on:
  - research work on random forest classifiers
  - overview of ecosystem accounting through the joint efforts with the UN's Artificial Intelligence for Environment and Sustainability (ARIES)
  - use planes and drones for country wide land cover and agricultural statistics
  - use of EO data for crop statistics in developing countries; leveraged the UN Global Platform
  - EO data to map changes in the ocean environment for environmental protection policies
  - developments in AI for education in environmental and ecological changes in response to human impacts

Link: https://unstats.un.org/unsd/bigdata/conferences/2020/

4. Ongoing Deliverables

- ***Projects***
  - The Research sub-task team, co-led by Canada and Columbia, is collecting a list of use cases to be onboarded as part of the UN Global Platform, and to be used by earth observation professionals who have a common goal of using earth observation for official statistics.
  - The research agenda aims to engage experts who use various methods of remote sensing estimations and classifications as part of an official statistical process.
  - Deliverables are expected for March 2022 - Statistical Commission
- ***Methodology***
  - The World Bank has added to the toolbox of methods for agriculture statistics under the 50 x 2030 initiative, in particular for Malawi.
- ***Training***
  - The Training Sub-task Team included the integration of the material onto the UN Global Platform, in addition to a special project with partner the FAORAP.
  - Team worked closely with the Task Team on Training, and planned a side event for the 52nd Session of the UN Statistical Commission (March 2021).

International Invitation

The Joint Task Team would like to extend an invitation to anyone interested in participating in this work.

Please contact one of the following individuals for additional information:

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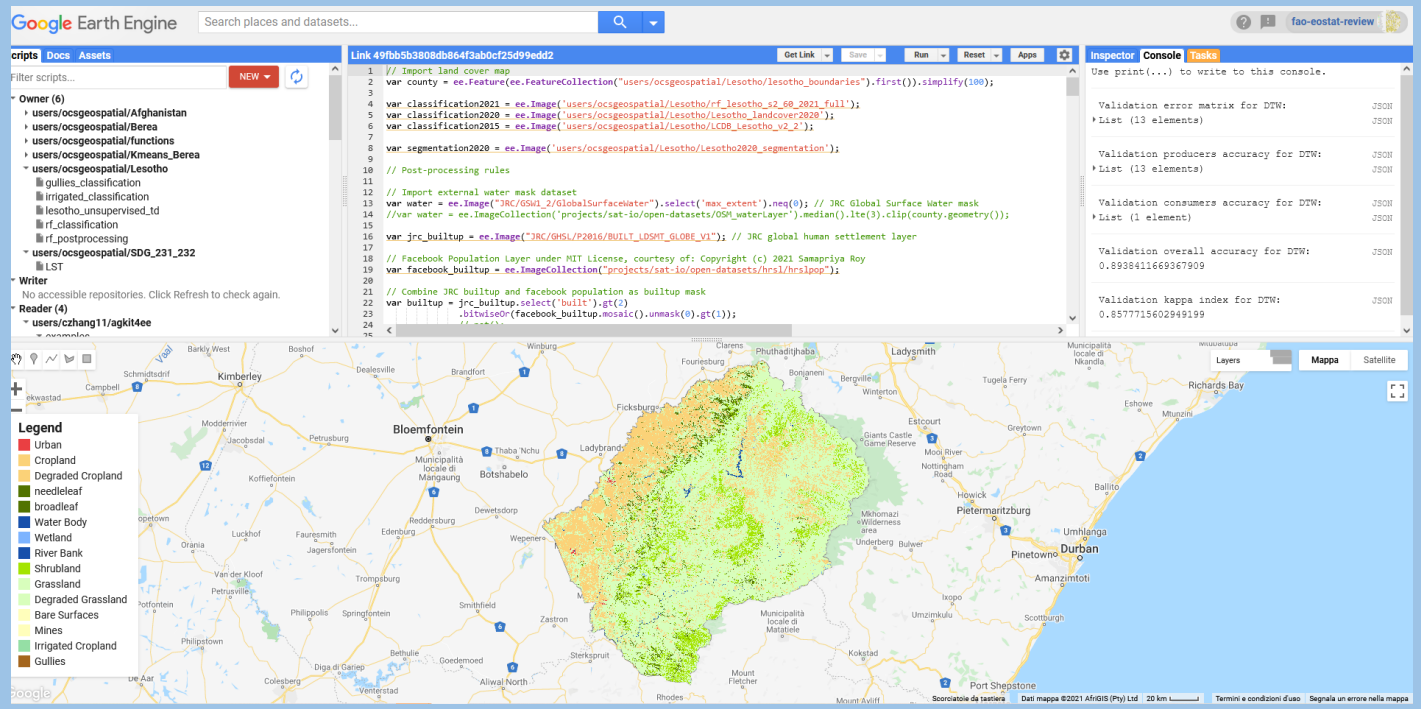
LESOTHO

Deliverables from FAO on Land Cover

- Land Cover source code developed in Google Earth Engine
- Land Cover national map produced 2021 (Overall Accuracy 89%)



Next Steps

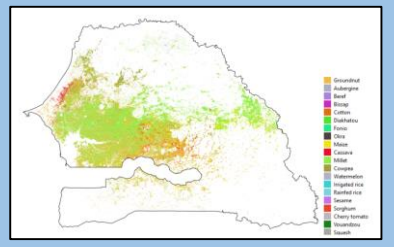
- Development of EOSTAT Land Mapper web app (graphic user interface)
- Produce national LC map time series (2016-2022)
- Apply method to other countries under HH focus.

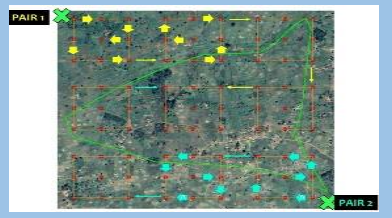
SENEGAL

Deliverables from FAO on Crop Mapping

- Deployed Sen2Agri on AWS under the UN-Global Platfform
- Delivered 5 training workshops (3 on EO and Sen2Agri, and 2 on field survey)
- Delivered National Crop Map (20 crops types) and Crop Area Indicator Statistics
- Developed an ad-hoc survey protocol for Nioro
- Carried out pilot survey in Nioro (ongoing)
- Obtained sponsorship from GEO for AWS to ensure computing and storage for next seasonal iteration

UNBigData





GEO GROUP ON EARTH OBSERVATIONS

Discussion