

The background of the cover is composed of several geometric sections. The top-left section is a purple-to-blue gradient with a faint mountain range. The top-right section is a yellow-to-orange gradient with blue and green patches, possibly representing water or vegetation. The bottom-left section is a dark green-to-blue gradient with a textured, forest-like pattern. The bottom-right section is a red-to-orange gradient with blue and white patches, possibly representing a coastal or urban area. The text is centered in the white space between the top and bottom sections.

# **GROUP ON EARTH OBSERVATIONS**

**2020 HIGHLIGHTS REPORT**

<b>MESSAGE FROM THE GEO CO-CHAIR &amp; DIRECTOR</b>	<b>3</b>
<b>1. RESPONDING TO COVID-19</b>	<b>5</b>
<i>GEO Community's Response</i>	5
<i>C3S Supports Health Experts</i>	6
<i>Launch of Earth School</i>	8
<i>GEOGLAM &amp; COVID-19</i>	9
<i>Togo Cropland Map</i>	11
<i>The Indigenous HACK4COVID</i>	13
<i>Virtual GEO Symposium</i>	17
<b>2. NEW INITIATIVES AND PROGRAMMES</b>	<b>18</b>
<i>2020 GEO Working Groups</i>	18
<i>New Participating Organizations</i>	20
<i>New Associates</i>	25
<b>3. INDIGENOUS ACTIVITIES IN GEO</b>	<b>27</b>
<i>Indigenous Activities in GEO</i>	27
<i>GEO Indigenous Alliance</i>	29
<i>Indigenous-led EO</i>	31
<b>4. GEO ON CLIMATE ACTION</b>	<b>32</b>
<i>GFOI</i>	32
<i>EO4EA</i>	33
<i>SCO International</i>	34
<i>Climate-OBS</i>	35
<i>GEOARC</i>	36
<b>5. GEO ON URBAN RESILIENCE</b>	<b>38</b>
<i>EO for Climate Change Impact</i>	38
<i>GEO Human Planet</i>	40
<i>CIESIN</i>	41
<b>6. GEO ON DISASTER RISK REDUCTION</b>	<b>42</b>
<i>GWIS</i>	42
<i>Black Marble Satellite Imagery</i>	44
<i>Japan DIAS</i>	46
<i>GEO-GSNL</i>	48
<b>7. GEO ON SUSTAINABLE DEVELOPMENT</b>	<b>51</b>
<i>SDG 2</i>	51
<i>SDG 3</i>	58
<i>SDG 6</i>	63
<i>SDG 11</i>	67
<i>SDG 14</i>	70
<i>SDG 15</i>	73
<i>Potential of Citizen Science</i>	77
<i>Country EO Uses</i>	79
<i>Digital Earth Americas</i>	80
<b>8. EO CLOUD SERVICES</b>	<b>82</b>
<i>GEO BON &amp; Microsoft AI</i>	82
<i>GEO &amp; Google Earth</i>	84
<i>GEO &amp; Amazon Web Services</i>	86

# MESSAGE FROM THE GEO CO-CHAIR & DIRECTOR

## A MESSAGE FROM THE GEO LEAD CO-CHAIR VICE MINISTER HUANG

2020 was a milestone year for GEO. We promoted the GEO Strategic Plan 2016-2025: Implementing GEOSS, launched the implementation of the Canberra Declaration and we started the GEO Work Programme 2020-2022 as well.



However, 2020 was also a challenging year for GEO. In the context of COVID-19, adjustment and change have been the new normal. 2020 became an innovative year for GEO. Everyone has been cultivating new opportunities during the crisis, it has made us all develop new approaches due to the changing situation.

Building on the solid work of the previous Lead Co-Chairs, I was honoured and proud to serve as the 2020 Lead Co-Chair. I was pleased to lead the GEO community to move forward without hesitation, even during times when the pandemic was impacting everyone globally.

GEO acted quickly when COVID-19 turned into a pandemic and called for COVID-19 projects from the global GEO community to be shared and communicated. This also showed to the international community the achievements and experience in response and recovery of COVID-19 utilizing Earth observation technology and geospatial information, which fully reflects GEO's global perspective and momentum.

GEO welcomed new members and partners this year, notably more developing countries and small, medium, and micro-sized enterprises (SMMEs). We continued support for climate action, disaster risk reduction, and sustainable development.

We have also deepened cooperation with various United Nations agencies and organizations. For example, with UN-Habitat we have laid a solid foundation for the promotion of urban resilience and sustainable urbanization. We also achieved a new breakthrough in the development of GEOSS—the Implementation Plan of the GEO Knowledge Hub was finalized after many rounds of discussions, and actions were kicked off immediately.

For the very first time, GEO successfully held Executive Committee meetings and the GEO Symposium virtually, which overcame time zone differences and other constraints while international travel was difficult. We have also prepared the virtual GEO Week 2020, containing a variety of special activities and engaging broadly. Furthermore, the GEO Selection Panel has done a great job to recruit the new GEO Secretariat Director. We expect that all this work will continue to ensure the great value of GEO, and further pursue the vision and mission of GEO.

This year, we are more deeply aware that we live in the same global village and only mutual support, solidarity, and cooperation are the right way to overcome the crisis. This thinking is aligned with GEO's mission where it “envision[s] a future where decisions and actions for the benefit of humankind are informed by Earth observations.”

I hope that the GEO community can continue to move forward in the future, live up to our mission, adapt to the times, and continue to gain public trust.

## A MESSAGE FROM THE GEO SECRETARIAT DIRECTOR

# GILBERTO CAMARA

As the GEO Secretariat Director for the last 2 years, I reflect on the enormous impact of Earth observations data to inform science-based policy-making and the critical role that GEO plays in this regard. I advocate now and always, to democratize data, to create an enabling environment for users to access freely available information and knowledge, and to support public initiatives to make data accessible to all – for the benefit of all.



# RESPONDING TO COVID-19

## THE GEO COMMUNITY'S RESPONSE TO COVID-19

**This year many significant global challenges were presented to us related to the COVID-19 pandemic. The GEO community is supporting the pandemic response and recovery efforts. Earth observation (EO) data offers extensive historical and near real-time information to advance scientific inquiry, inform decision making, and enhance policy interventions.**

The GEO Health Community of Practice which uses EO to support public health efforts increased its efforts in response to COVID-19. In April 2020, the GEO Secretariat issued a Call to the GEO Community to provide examples of work underway using EO in support of COVID-19 monitoring, response, or recovery. There was a strong response to the open call from more than 40 projects from the GEO global community, which are listed here.

Starting in March 2020, the GEO Health Community of Practice and the Earth Observations for Health (EO4HEALTH) Initiative – chaired by John Haynes (NASA) and Juli Trtanj (NOAA) – have coordinated weekly teleconferences with hundreds of global practitioners. These virtual meetings led to focused work on specific topics (for example, environmental determinants and seasonality, air and water quality, regional efforts) and event coordination

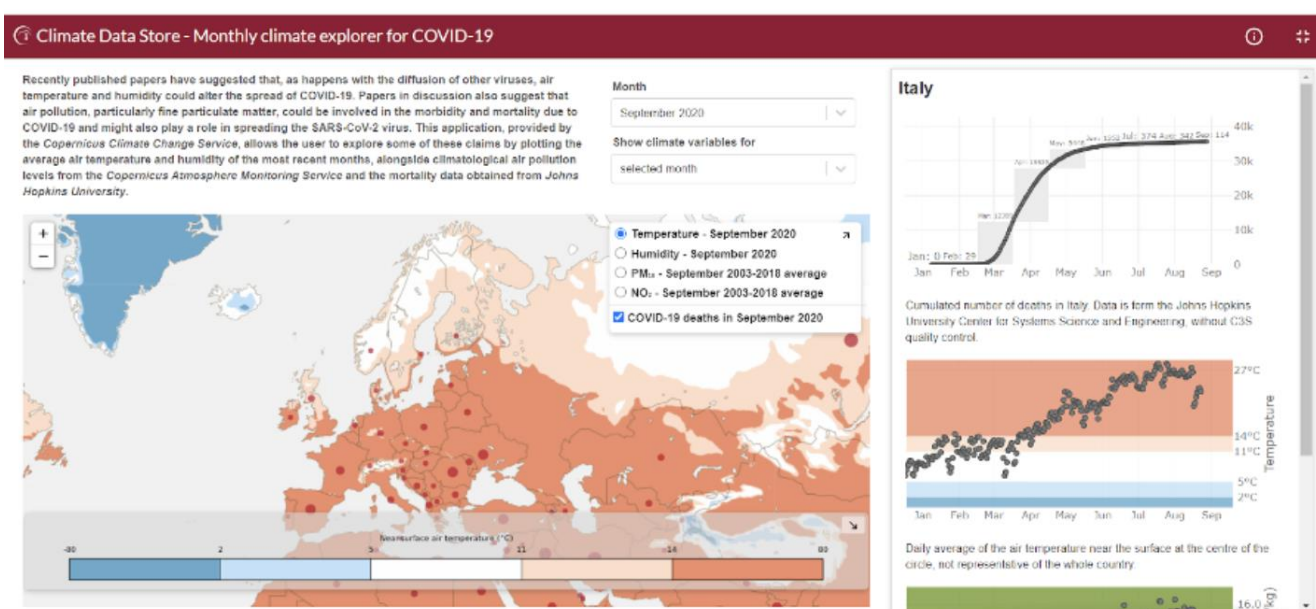
(for example, WMO/WHO Workshop on Climatological, Meteorological, and Environmental Factors in the COVID-19 Pandemic, August 2020). To learn more, please see slide presentations and summary notes from previous teleconferences and participate in upcoming teleconferences here.

The GEO Health Community of Practice also coordinated a special session of the GEO Virtual Symposium focused on Earth Observations for COVID-19 Response and Recovery. This session – facilitated by John Haynes, Juli Trtanj, Astrid-Christina Koch (European Commission) and Helena Chapman (NASA) – guided participants on a “world tour” to showcase actions taken to leverage global expertise, share resources and discuss priorities and challenges across geographic regions during the COVID-19 pandemic.

# C3S RESPONDING TO COVID-19

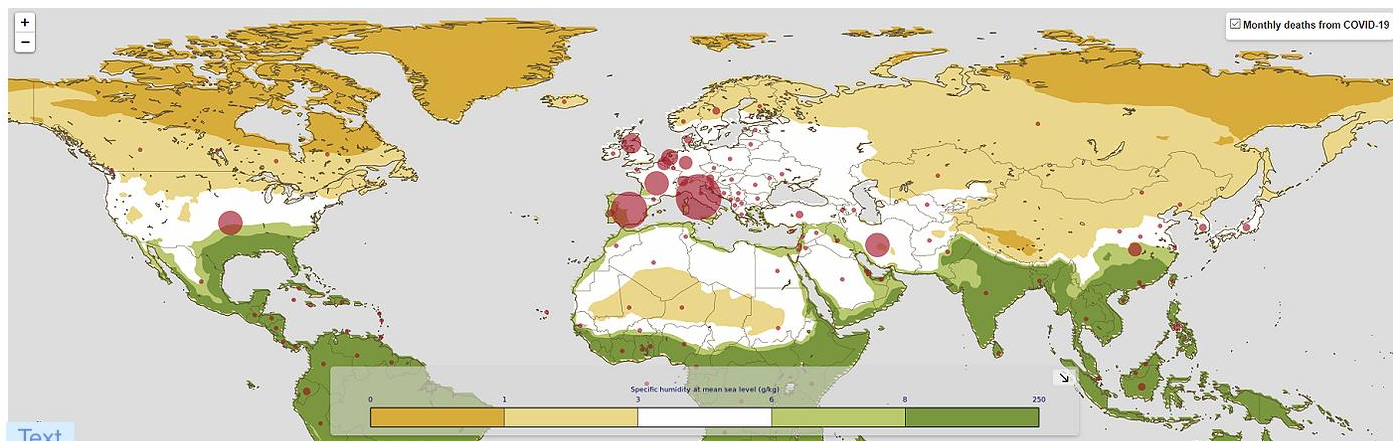
**The Copernicus Climate Change Service (C3S) helps experts explore how temperature and humidity affect virus spread.**

The European Centre for Medium-Range Weather Forecasts (ECMWF) developed the Monthly Climate Explorer for COVID-19. The application is available on ECMWF's Climate Data Store (CDS), which is part of the Copernicus Climate Change Service (C3S). It allows users to explore the relations between the spread of the SARS-CoV2 virus and atmospheric and environmental variables. Average air temperature and humidity of the most recent months are plotted alongside climatological air pollution levels from the Copernicus Atmosphere Monitoring Service (CAMS) and the mortality data obtained from Johns Hopkins University.

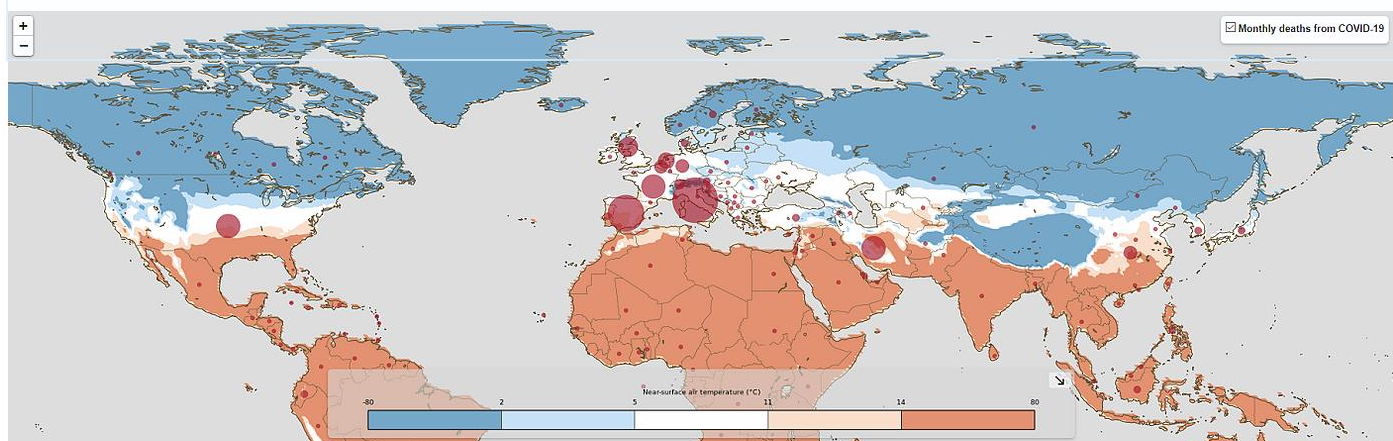


***“The application allows health authorities and epidemiology centres to explore the claims that temperature and humidity could affect the spread of coronavirus”***

Carlo Buontempo, Director of Copernicus Climate Change Service (C3S), at ECMWF



A screenshot from the application, showing COVID-19 mortalities and worldwide temperature for March 2020. White areas show regions where climate conditions are considered to be more conducive to the spread of coronavirus.



A screenshot from the application, showing COVID-19 mortalities and worldwide humidity for March 2020. White areas show regions where climate conditions are considered to be more conducive to the spread of coronavirus.

# THE LAUNCH OF EARTH SCHOOL

**In response to the COVID-19 crisis, an unprecedented coalition came together in April 2020 and launched “Earth School,” a portal to help students, parents, and teachers around the world to explore the science and beauty of planet Earth.**

The European Centre for Medium-Range Weather Forecasts (ECMWF) developed the Monthly Climate Explorer for COVID-19. The application is available on ECMWF's Climate Data Store (CDS), which is part of the Copernicus Climate Change Service (C3S). It allows users to explore the relations between the spread of the SARS-COV2 virus and atmospheric and environmental variables. Average air temperature and humidity of the most recent months are plotted alongside climatological air pollution levels from the Copernicus Atmosphere Monitoring Service (CAMS) and the mortality data obtained from Johns Hopkins University.



The portal was launched on the 50th anniversary of Earth Day by the United Nations Environment Programme (UNEP), TED-Ed, UNESCO and supported by more than 30 other collaborators including GEO and more than 100 individual contributors. Earth School features videos, reading materials and activities — which will be translated into 10 languages — to help students gain an understanding of the environment while considering their role within it.

# GEOGLAM & COVID-19: RESPONDING TO THE FOOD SECURITY EMERGENCY

**In response to the COVID-19 crisis, an unprecedented coalition came together in April 2020 and launched “Earth School,” a portal to help students, parents, and teachers around the world to explore the science and beauty of planet Earth.**

Providing and maintaining objective and transparent information on global agriculture in near real time has never been so critical. GEOGLAM was launched in 2011 by the G20 Ministers of Agriculture to increase market transparency and improve food security. GEOGLAM produces timely and actionable information on agricultural conditions and production at national, regional, and global scales. Monthly global Crop Monitors provide near real-time information on crop conditions. The Crop Monitor for the Agricultural Monitoring Information System (AMIS) promotes transparency in international food markets and thus helps to prevent unexpected price hikes. The Crop Monitor conditions for May 2020 can be viewed [here](#).

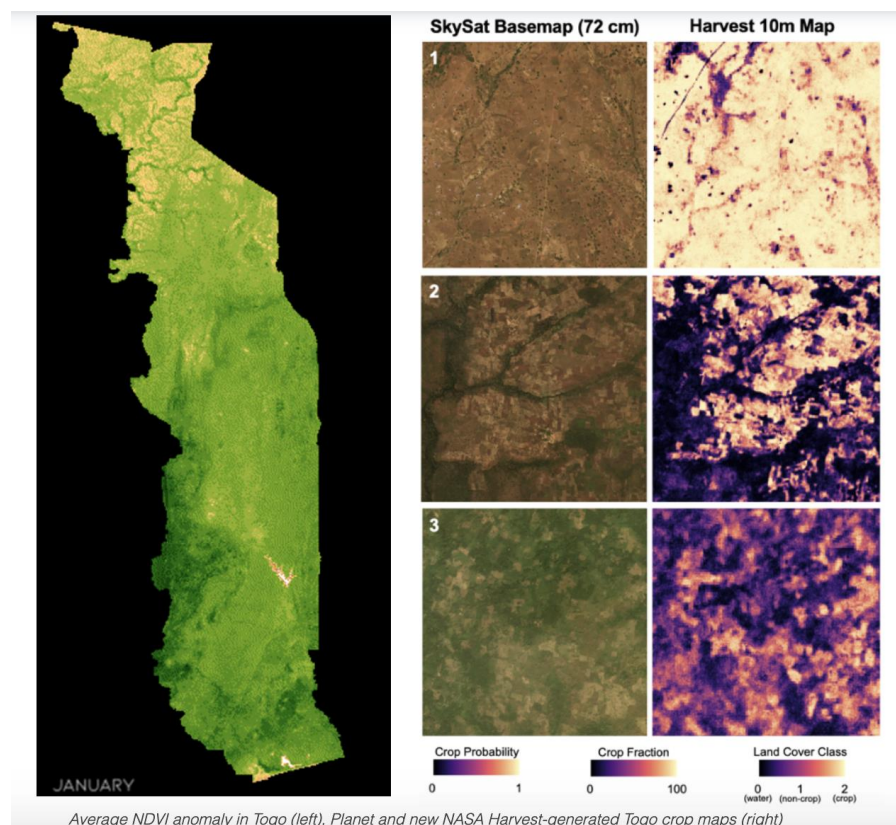
For food insecure regions of the world, the Crop Monitor for Early Warning (CM4EW) reveals crop conditions for key staple crops. It also provides early warning of potential impacts to crop production. GEOGLAM has worked with several nations to build their own national Crop Monitors, improving food security decision-making.

The GEOGLAM Crop Monitor community is monitoring crop conditions and providing sufficient early warning throughout this crisis and it will be important to continue to monitor as the growing seasons progresses. Reliable and early information will help decision makers in AMIS countries, the international community and national governments to address the looming food shortages. It will allow for appropriate actions for any major production shortfalls that could further exacerbate the prevailing difficult situations in many countries.



# NASA HARVEST: TOGO CROPLAND MAP

COVID-19 shutdowns in Togo constrained agricultural production by small farmers. The Togolese government needed a precise country-wide cropland map to develop a loan programme that would help fund the cost of farming essentials. In the past, farmers eligible for such loans would have been identified using Togo's census data but the existing census underestimates informal smallholders who rely on subsistence farming. Satellite data filled the census data gaps and enabled the loan distribution to reach all smallholder farmers.



NASA Harvest developed a national level satellite-derived cropland map for Togo at 10-meter resolution within a 10-day timeframe using data from the European Space Agency's Copernicus Sentinel 2, from commercial partner Planet Inc, and from NASA-USGS Landsat satellites. This data, alongside poverty and census information, rapidly and effectively identified priority areas for the loan programme. With the cropland maps, Togolese government officials had trustworthy information on the physical size and geographic location of agricultural lands that census data might have missed.

NASA Harvest, operating as NASA's Food Security and Agriculture Program, is part of NASA's contribution to GEOGLAM.



***“When rapid action was needed and mobility across the country was limited due to the COVID-19 outbreak, satellite data offered an effective and accelerated means to map the country’s distribution of croplands and characterize the nature of agricultural fields during the pandemic,”***

*Dr. Inbal Becker-Reshef, NASA Harvest Program Director.*

# 2020 INDIGENOUS HACK4COVID

**From Peru to Ghana to New Zealand, 146 participants from around the world joined the GEO Indigenous Alliance and indigenous leaders and communities to produce solutions to crowdsourced challenges developed through a process of co-design.**



The project involved curating a series of virtual hackathons in various indigenous and under-represented communities with the intent of co-designing locally relevant EO-based challenges that are culturally appropriate to indigenous beliefs and conceptions about diseases. Learn more about some of the teams on the next pages:

## First Place Winner: Team Visibilidade and the Symbols Maps Team

The Symbols Maps Team solved a challenge submitted by [Titus Letaapo](#) called [The Namunyak/blessed App](#). The challenge was to develop an app that would allow the Samburu Tribe in northern Kenya to build their own culturally relevant map. Members of the Symbols Maps team included: Lucandrea Mancini (Italian rocket scientist based in Italy), Yoanna Dimitrova (Bulgarian archaeology and anthropology student based in the UK), Mirosława Alunowska (Mexican Engineer currently working as a data analyst in the UK) and Nicolas Marin (Ecologist from Colombia based in Australia). Learn more about their winning solution [here](#).

Also recognized in first place, Team Visibilidade solved the [Visibilidade challenge](#) submitted by [Claudinete Cole de Souza](#) to develop a visualization tool to allow the Quilombola community to tell a story of how COVID19 is affecting their community in Brazil. Members of team Visibilidade included: Douglas Mbura (Founder and Chief Technology Officer of [Geo-Appsmith](#) from Kenya) and Rasha Elnimeiry, (Epidemiologist and GIS data specialist from Sudan). Their solution can be found [here](#).



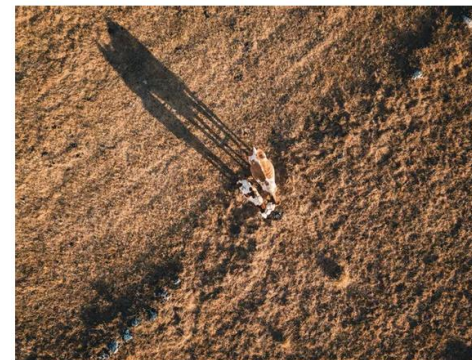
## Second Place Winner: Terrastories Map

The Terrastories: Lakhota Makha was submitted by Rudo Kemper from the US in response to the Lapi Wowapi Challenge to develop an app that will support the transmission of knowledge between the Elders and the youth whilst advancing the use of the Lakota language via digital stories that have a connection with the landscape. This challenge was submitted by James Rattling Leaf Sr. from the Rosebud Sioux Tribe, South Dakota, US.



## Third Place Winner: Journey to the Market App

The Ondjila ya Sankoni (Journey To The Market) App was submitted by Wilhelmina Nekoto from Namibia in response to the Sokoni app/market challenge to develop an app that will allow the Samburu Tribe in Northern Kenya to sell and purchase livestock without having to go to the market. This challenge was submitted by Titus Letaapo from the Samburu Tribe in Kenya.





As part of the GEO Indigenous Hack4Covid event, the overall winning team and the indigenous community that submitted the challenge will receive, as a prize, mentorship from the Google Earth Outreach Team and from the indigenous-owned consultancy [The Firelight Group](#). Additionally, they will receive mentorship on the protection of Indigenous/traditional knowledge and on the [CARE Principles of Indigenous Data Governance](#) by the [Global Indigenous Data Alliance](#). The Indigenous community that submitted the challenge to the winning team will receive a voucher to purchase mobile phones or laptops from the Firelight Group. The winning teams will also be featured in the [Geospatial Insights](#) newsletter of the [Knowledge Transfer Network](#) and in an upcoming feature on the GEO Observations Blog.

The challenges that have not been solved will remain open until the indigenous communities find a suitable solution. We will also be adding more challenges from other Indigenous communities. And we will be adding more challenges co-designed with other Indigenous leaders from around the world.

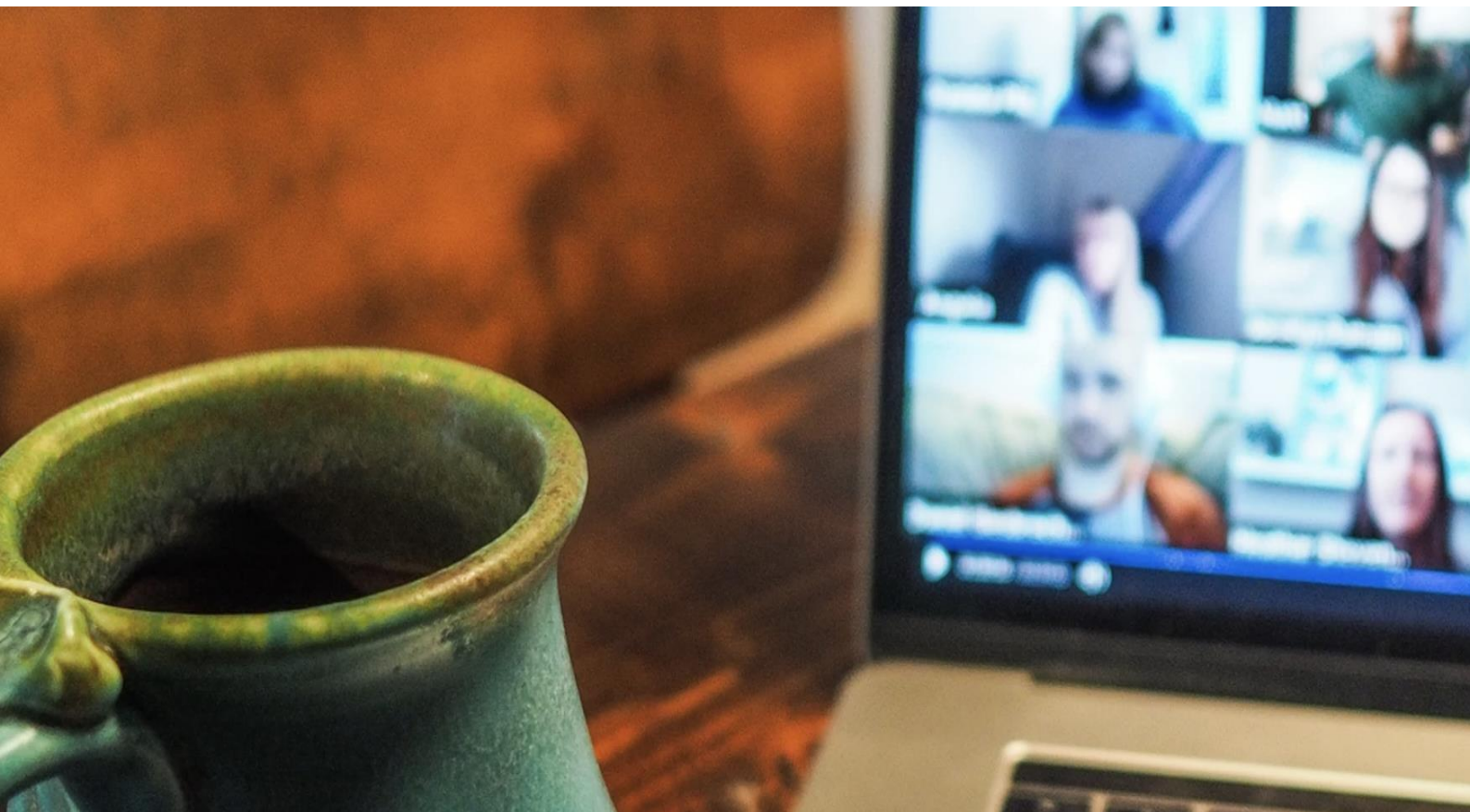
The emergence of the global data revolution and associated new technologies can be a double-edged sword for Indigenous Peoples. If Indigenous Peoples have control over what and how data and knowledge will be generated, analyzed and documented, and over the dissemination and use of these, positive results can come about. The collection and disaggregation of data on Indigenous Peoples and the documentation and transmission of their knowledge to younger generations can be facilitated. They can be the primary beneficiaries of the use of data, their knowledge and their cultural heritage. If, however, Indigenous Peoples lose control because there are no existing laws and policies that recognize their rights and regulate the behavior of institutions and individuals involved in gathering and disseminating data and knowledge, marginalization, inequality and discrimination will persist. The respect of their right to have their free, prior and informed consent obtained before data are gathered and disseminated is crucial to prevent this from happening. To inspire more Indigenous Peoples to assert and actualize their rights to control, own and further develop their knowledge and cultural heritage and to effectively transmit these to the younger generations.

# THE 2020 GEO VIRTUAL SYMPOSIUM

In response to the COVID-19 pandemic, GEO decided that the event be held remotely from 15-19 June 2020. The global GEO community benefited from a series of interactive webinars over the course of one week that provided in-depth discussions from practitioners on a range of issues relevant to the GEO Work Programme.

During this first year of the 2020-2022 GEO Work Programme, the Symposium focused on strengthening the capability of GEO Work Programme activities to implement their plans effectively. It covered topics, such as:

- Leveraging Advanced Technologies
- Engaging UN Agencies and Intergovernmental Organizations
- Contributing to Reproducible Knowledge
- Resource Mobilization and Sustainable Funding
- Co-designing Capacity Development
- Focusing on Impact: Regional GEOs
- Monitoring Essential Variables
- Water and Coastal Observations



# NEW INITIATIVES AND PROGRAMMES

## NEW 2020 GEO WORKING GROUPS

In 2020, four new GEO Working Groups were established as part of the GEO Work Programme. The Working Groups link together the efforts of individual Work Programme activities, thereby increasing coordination and impact.

Members of the Working Groups were nominated by GEO Members and Participating Organizations in response to an open call in early 2020. In total, more than 300 individuals were nominated to dedicate their time and energy to these important tasks.





## Climate Change Working Group (CC-WG)

The CC-WG works to advance the use of Earth observations in support of climate adaptation and mitigation including actions related to the pillars of the Paris Agreement.



## Disaster Risk Reduction Working Group (DRR-WG)

The aim of DRR-WG is to increase the use of Earth observations in support of disaster risk reduction and resilience efforts. These efforts are related to the provisions of the Sendai Framework for Disaster Risk Reduction.



## Capacity Development Working Group (CD-WG)

The CD-WG promotes the principle of co-creation and supports capacity development activities. With a focus on end-user engagement, this group aims to strengthen the capacity of organisations and individuals to use open Earth observations data and tools.



## Data Working Group (Data-WG)

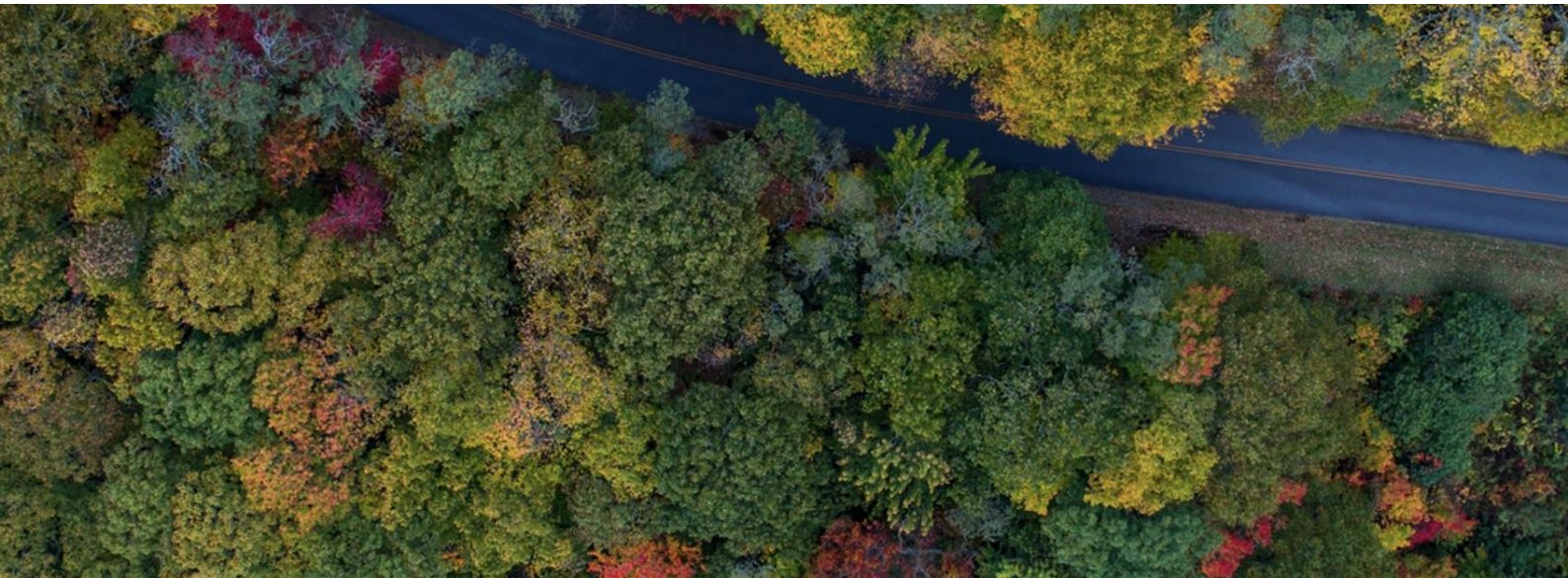
The Data-WG is working with the GEO community and with external stakeholders to address data policy, data ethics and data governance issues related to the collection and use of Earth observations. This group will help GEO advance open data sharing, broadening the global use of Earth observations.

# NEW PARTICIPATING ORGANIZATIONS

**In 2020, four new GEO Working Groups were established as part of the GEO Work Programme. The Working Groups link together the efforts of individual Work Programme activities, thereby increasing coordination and impact.**

GEO is pleased to welcome the newest Participating Organizations:

- Micronesia Conservation Trust (MCT);
- Pan American Institute of Geography and History (PAIGH);
- Plan4all; and
- United Nations Economic Commission for Europe (UNECE).



## Micronesia Conservation Trust (MCT)

The Micronesia Conservation Trust (MCT) supports biodiversity conservation and related sustainable development for the people of Micronesia in the Federated States of Micronesia (FSM), the Republic of Palau (ROP), the Republic of the Marshall Islands (RMI), the US Territory of Guam and the Commonwealth of the Northern Mariana Islands (CNMI).



The entire Micronesia Conservation Trust staff

***“MCT looks forward to our partnership with GEO to support the development of technology and scientific methods and tools for acquiring and analyzing Earth observations to benefit communities with Conservation and Climate Change resilience across the region.”***

Tamara Greenstone-Alefaio  
Conservation Program Manager, Micronesia Conservation Trust

## Pan American Institute of Geography and History (PAIGH)

The Pan American Institute of Geography and History (PAIGH) is a technical and scientific body of the Organization of American States specializing in the areas of cartography, geography, history and geophysics.



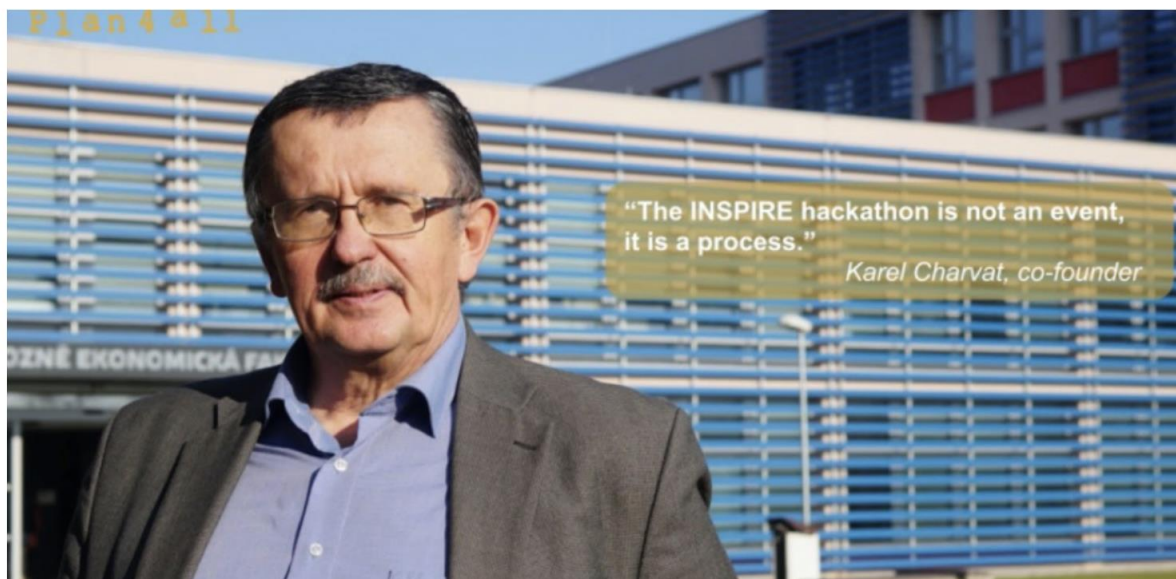
4th Technical Meeting of the Commissions. Members of the Commissions of PAIGH (Cartography, Geography, History and Geophysics). Santo Domingo, Dominican Republic, July 2019.

***“What we hope to achieve together is to establish a cooperation mechanism between the PAIGH and AmeriGEO to boost the importance of the information produced by the official mapping agencies as a national reference.”***

Cesar Rodriguez  
Secretary General, PAIGH.

## Plan4all

Plan4all is a non-profit association sustaining and further enhancing results of multiple research and innovation projects. Plan4all conducts research and experimental development and transfers results of such activities into practice.



Plan4all Committee Member Karel Charvat.

***“We believe that our membership in GEO will help us to better link our activities with global communities and help to support innovation in Earth observation.”***

Karel Charvat  
Plan4all Committee Member

## The United Nations Economic Commission for Europe (UNECE)

Plan4all is a non-profit association sustaining and further enhancing results of multiple research and innovation projects. Plan4all conducts research and experimental development and transfers results of such activities into practice.



# UNECE

***“Effective implementation of the environmental policies in countries very much depends on the availability of well-structured, user-friendly and interoperable environmental information systems. ”I welcome valuable cooperation with the Group on Earth Observations in this regard and very much look forward to continuing the future work in synergy.”***

Ms. Valentina Tapis  
The Chair of the Convention's Task Force on Access to Information

# NEW GEO ASSOCIATES

The GEO Associates category officially recognizes the valuable contributions made by commercial and non-governmental, not-for-profit, and civil society organizations in realizing the GEO vision and implementing the GEO Work Programme to join governments and international organizations as official GEO collaborators.

## AmericaView

AmericaView is a nationwide partnership of remote sensing scientists who support the use of [Landsat](#) and other public domain remotely sensed data through applied remote sensing research, K-12 and higher STEM education, workforce development, and technology transfer.



*Students participate in the AmericaView Earth Observation Day event at the Pecora 21 / ISRSE 38 in Baltimore, Maryland, USA, October 2019. EOD is an AmericaView Science, Technology, Engineering, Art, and Math (STEAM) program.*

**"AmericaView is honored to become part of the global GEO community. AmericaView was founded on the principles of advancing Earth observation (EO) science through education and outreach, workforce development, applied research, and technology transfer to the public and private sectors."**

Christopher McGinty, AmericaView Executive Director.

## Eversis

Eversis was recently announced as one of the 32 winning projects to be supported by the GEO- Google Earth Engine Programme.



*Team members include Piotr Gala, Maciej Miernecki, Oleksandr Pakhomov, Piotr Zaborowski*

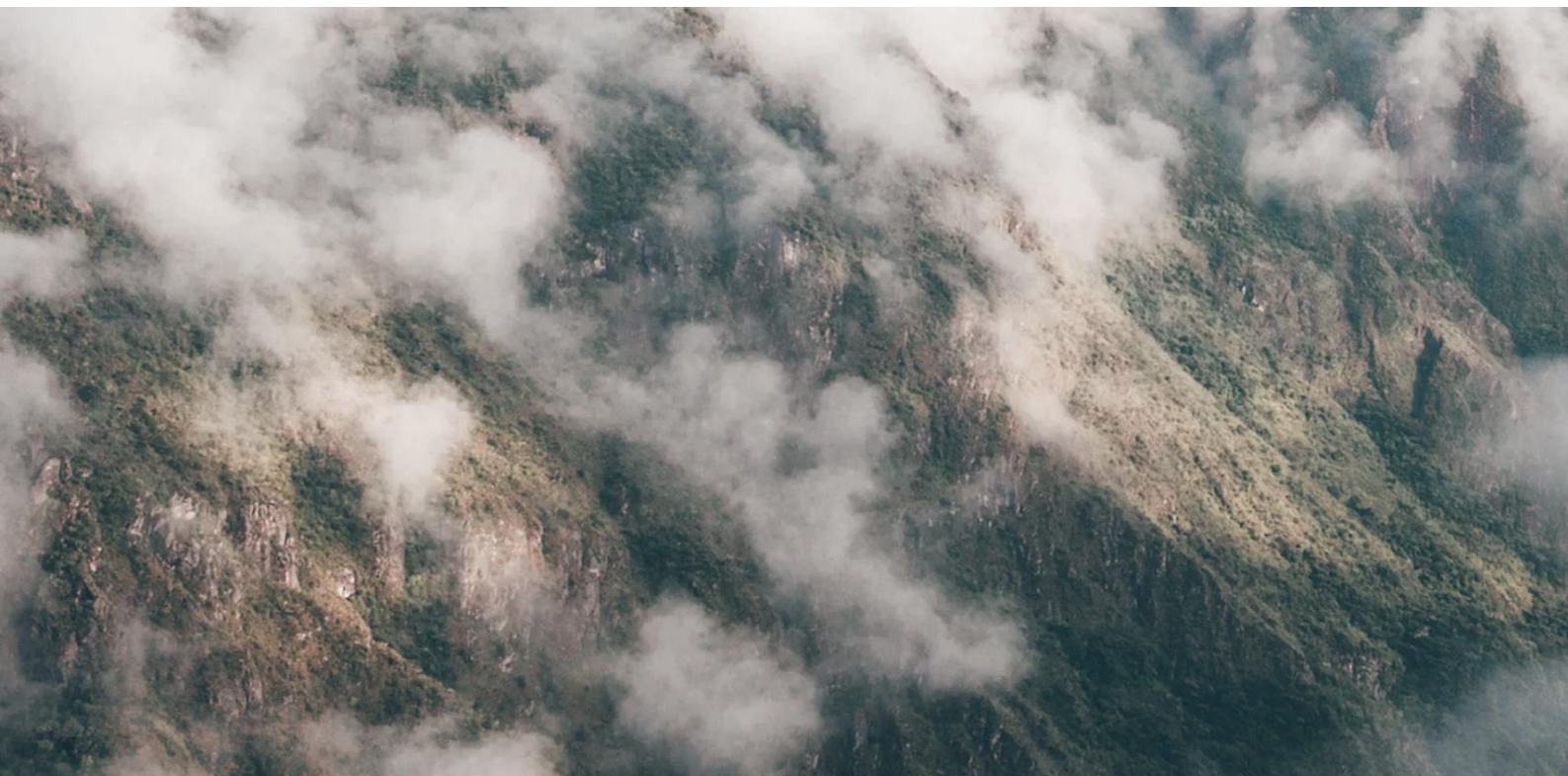
**“We're very excited to have been selected to work on the Fire Hazard Warning System project and build on our experience with GEE technology. We are glad we can contribute to the application of science in creating a safer world for all of us.”**

Piotr Zaborowski, Business Development Manager at Eversis.

# INDIGENOUS ACTIVITIES & LEADERS IN GEO

## EARTH OBSERVATIONS FOR INDIGENOUS-LED LAND MANAGEMENT

Through a collaborative process including in-person assessments of community needs, training courses and a NASA webinar series, the EO4IM program enables indigenous peoples to use geospatial technology — tools to map and monitor Earth's geographies — to address threats to their lands.



Conservation International, a GEO Participating Organization, is leading a project to put monitoring tools in the hands of indigenous people. These tools help them sustainably manage their territories. The Earth Observations for Indigenous-led Land Management (EO4IM) project is being carried out with the Awajún people of Peru and the Achuar Nation of Ecuador — two indigenous groups whose land is increasingly vulnerable to encroachment from new migrant settlements and illegal logging.

Based on these pilot programs, Conservation International will develop targeted training materials and technologies to support indigenous peoples as they build on their existing knowledge of nature to help face modern threats to their lands



Women in the Palomar community review a cultural map created by the Suri indigenous community in Brazil to digitally record their people's cultural and ecological knowledge.

**“We have many challenges with colonizers in our territories who destroy our forests and resources, and technology can help us. Our communities are traditional, yes, but we can learn to use these tools through this project and they will help us manage our lands.”**

*Awajún leader*

# THE GEO INDIGENOUS ALLIANCE

The GEO Indigenous Alliance is an organized group of Indigenous peoples, and those who work with them, working in partnership with GEO to enhance the utility of Earth observations by incorporating Indigenous knowledge and practices.



The Alliance was founded at the GEO Week 2019 in Canberra, Australia. Founding members include: Titus Letaapo, James Rattling Leaf Sr., Lawford Benning, Vonda Malone and Mario Vargas Shakaim; and partner organizations: NASA, Conservation International, Geoscience Australia, FAO, Citizen Science/Global Partnership, AfriGEO and AmeriGEO.

Indigenous peoples steward more than a quarter of Earth's surface, yet represent just 5 percent of the world's population. Indigenous lands overlap with 80 percent of the planet's biodiversity. Forests inhabited by indigenous peoples store six times the amount of all human-caused carbon emissions in 2018.



# INDIGENOUS-PEOPLES LED USE OF EARTH OBSERVATIONS

Recognizing and honouring indigenous culture and knowledge, as well as supporting indigenous stewardship of the millions of acres of land under indigenous management represents a potential transformative pathway to meeting the SDGs.



*James Rattling Leaf Sr. joins Indigenous leaders from around the world for a panel discussion during GEO Week 2019 in Canberra, Australia.*

In June 2020, GEO Indigenous Alliance representatives Diana Mastracci, James Rattling Leaf Sr. and Titus Letaapo joined a forum for Indigenous Peoples at the United Nations High-Level Political Forum (HLPF) to discuss opportunities and challenges for increasing Indigenous Peoples engagement in the co-development, co-creation, and use of Earth observations (EO) data and tools. This session was moderated by Steven Ramage from the GEO Secretariat.

# GEO ON CLIMATE ACTION

## THE GLOBAL FOREST OBSERVATIONS INITIATIVE (GFOI)

In August 2020, the Global Forest Observations Initiative (GFOI) released the [third edition of its Methods and Guidance Documentation \(MGD3.0\)](#) on integrating remote sensing and ground-based observations for estimation of emissions and removals of GHG in forests.

Forests and other land sector activities play an important role in mitigating global climate change. The MGD provides guidance for countries to monitor changes in their forests and report the associated GHG emissions under the UNFCCC. This MGD is compliant with the [IPCC 2019 Refinement to its Good Practice Guidance](#) and relevant UNFCCC decisions taken since the second edition was released in 2016.

The MGD promotes good practices for National Forest Monitoring Systems (NFMS) and associated emissions Measurement, Reporting and Verification (MRV) procedures. It enables GEO Members to generate information for international reporting and to inform domestic action to protect forests and reduce GHG emissions.

***“The MGD provides practical guidance, which incorporates UNFCCC decisions and supports the technical assessment of advanced carbon measurement methodologies, which countries are increasingly using in their REDD+ submissions.”***

Dirk Nemitz, Program Officer from the UNFCCC Secretariat.

# EARTH OBSERVATIONS FOR FOR ECOSYSTEM ACCOUNTING (E04EA)

In August 2020, the Global Forest Observations Initiative (GFOI) released the [third edition of its Methods and Guidance Documentation \(MGD3.0\)](#) on integrating remote sensing and ground-based observations for estimation of emissions and removals of GHG in forests.



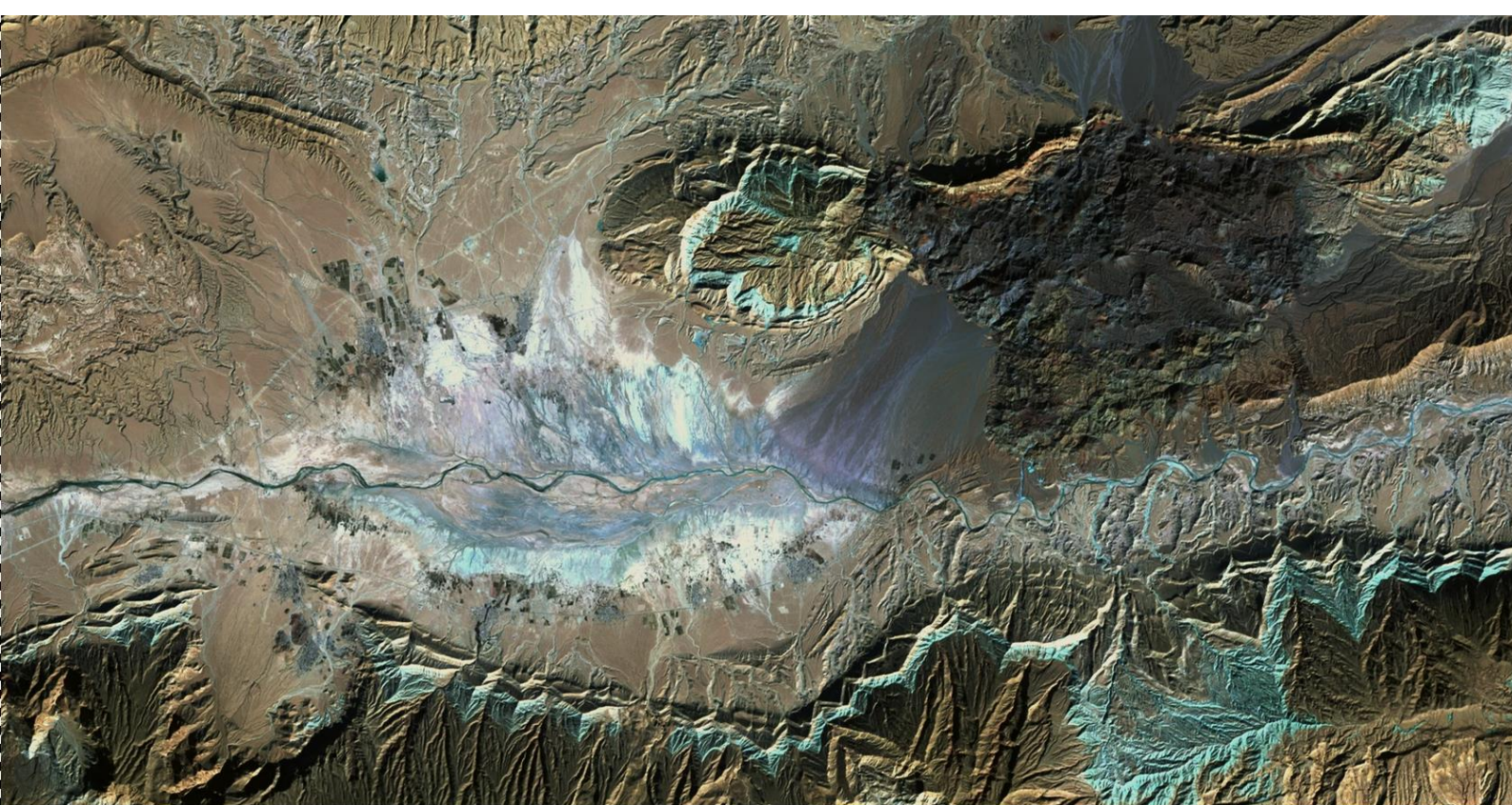
To achieve global policy commitments, such as the sustainable development goals, the Paris Agreement, and the Convention on Biological Diversity (CBD) targets, countries are going to need to incorporate the value of nature into decision making. This requires understanding and valuing the role that ecosystems play to benefit people and the economy.

As countries around the world start to develop ecosystem accounts, there is a need for methods to utilize EO data for accounting. The United Nations System of Environmental Economic Accounts (UN-SEEA) is releasing an updated guidance on Ecosystem Accounts. The Earth Observation for Ecosystem Accounting (EO4EA) initiative is working with the UN-SEEA to support ecosystem accounting and test the proposed methods.

“Ecosystem accounting is a coherent and integrated approach to the assessment of the environment through the measurement of ecosystems, and measurement of the flows of services from ecosystems into economic and other human activity”  
(SEEA EEA 2012)

# SPACE CLIMATE OBSERVATORY (SCO) INTERNATIONAL

In August 2020, the Global Forest Observations Initiative (GFOI) released the [third edition of its Methods and Guidance Documentation \(MGD3.0\)](#) on integrating remote sensing and ground-based observations for estimation of emissions and removals of GHG in forests.



The Space Climate Observatory (SCO) International Initiative was created in June 2019 by a group of space agencies and international organizations with the goal of providing end users the capacity and tools to study, monitor, and adapt to the impacts of climate change through the use of satellite-based EO tools alongside field data and models. Space Agencies, as SCO Partners, are responsible for nurturing SCO projects in their own country as well as for helping to structure their national SCO and/or regional SCO.

The SCO International initiative will continue to operate in tandem with climate change programmes and initiatives, supporting and accelerating work already underway within our space and scientific communities, as well as actions on the ground led by international organizations, such as the UN. Current ongoing projects are focusing on monitoring agriculture, air quality, water management, coastal areas, mountain areas, forests, health, urban areas, thereby the SCO covers most of the GEO initiatives and flagship activities.

# COMMUNITY ACTIVITY:

## CLIMATE-OBS

**CLIMATE-OBS is a community activity launched by Tsinghua University and WMO in 2017 to "augment GEOSS's observation data with climate reanalysis data, and Earth system model simulation data to present the past, current, and future climate information".**

It aims to build a common description to link EO data, models, satellites, instruments and journals, and thus support GEO's Knowledge Hub.

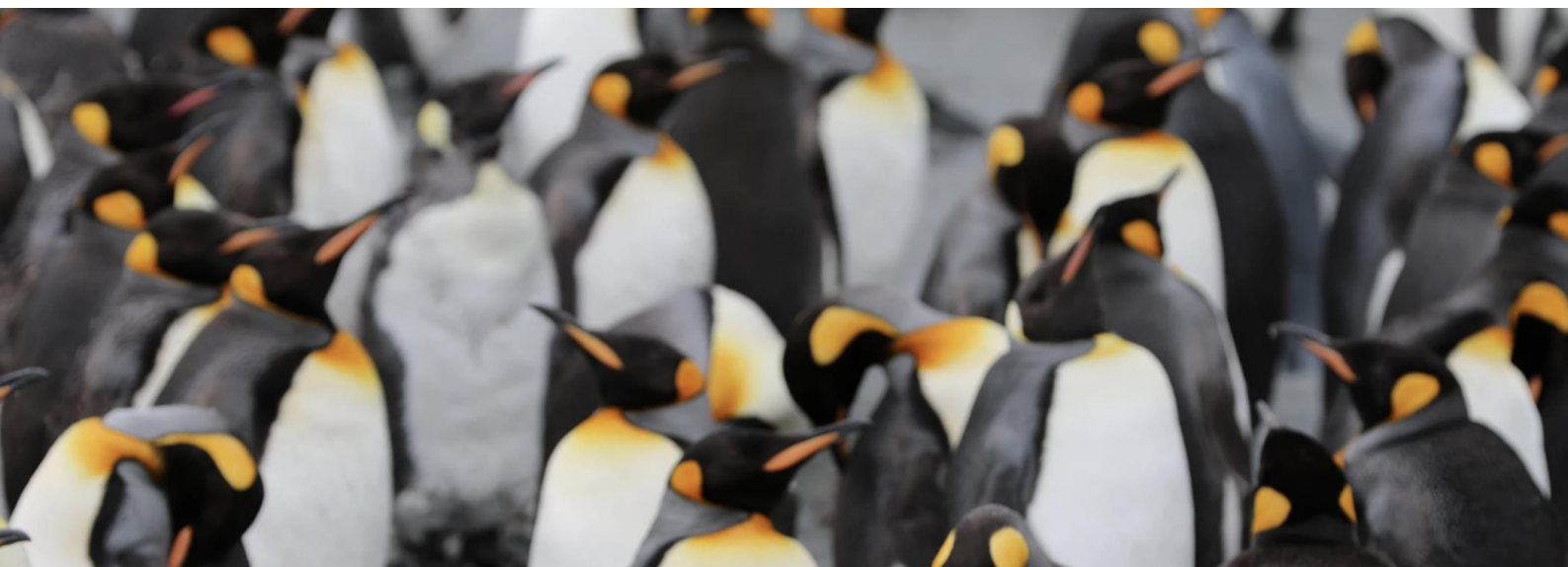
The aim of CLIMATE-OBS is to develop a common ontology for different resources of climate observation and simulation. This ontology will allow researchers and practitioners to find and use data and models.

# COMMUNITY ACTIVITY: GLOBAL ECOSYSTEM & ENVIRONMENT OBSERVATION ANALYSIS RESEARCH COOPERATION

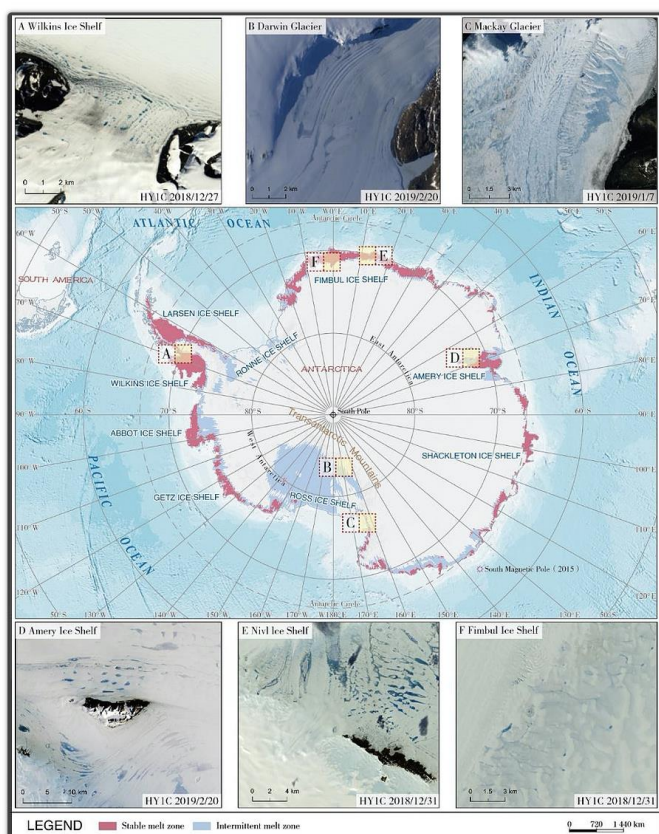
## Understanding the Antarctic Ice Sheet change and the impact on the penguin colony

The GEO community activity GEOARC (Global Ecosystem and Environment observation Analysis Research Cooperation), works to produce knowledge on the status and trends across different terrestrial and marine ecosystems. One of its activities is the monitoring of the Antarctic ice sheet, a sensitive element of global climate change.

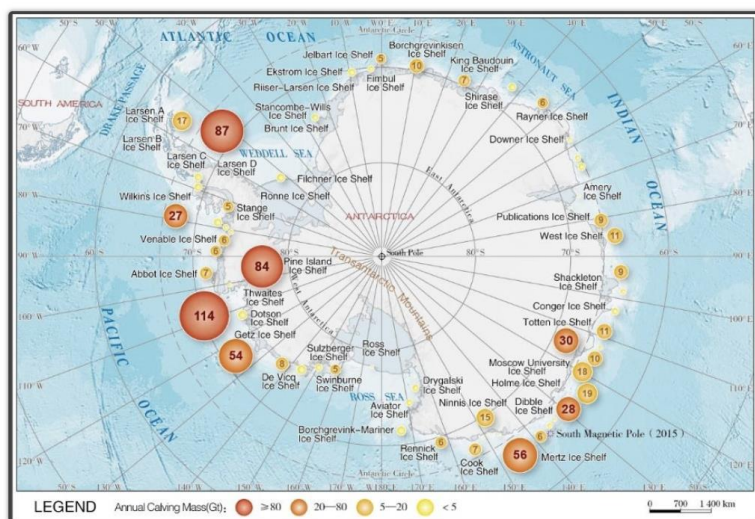
Penguins are known as an eco-indicator species of the Southern Ocean marine ecosystem. Their distribution of great significance to understand the evolution of the Antarctic ice sheet, ice shelves and Antarctic ecosystem, and to provide scientific support for policy makers to cope with climate change and participate in global governance.



Satellite data have been used to identify the iceberg calving of the Antarctic ice shelves at the continental scale. Based on multi-source satellite imagery, we detected 1786 annual calving events, whose areas were larger than 1 km<sup>2</sup>, to precisely evaluate the loss of ice shelves and processed the long-time series calving dataset. Satellite data and aerial images were used to identify the location of the penguin colony and population size. Pan-Antarctic emperor penguin colonies were identified in 2000, 2014, and 2018. Variations in the penguin population and colony spatial extent were investigated in 1983, 2012, and 2018.



The melting extent and surface hydrological systems in the Antarctic ice sheet



The spatial distribution of the multi-year average calving mass of different Antarctic ice shelves from 2005 to 2019



Dalk Glacier, East Antarctica

# GEO ON URBAN RESILIENCE

## EO CLIMATE CHANGE IMPACT ON WORLD HERITAGE SITES

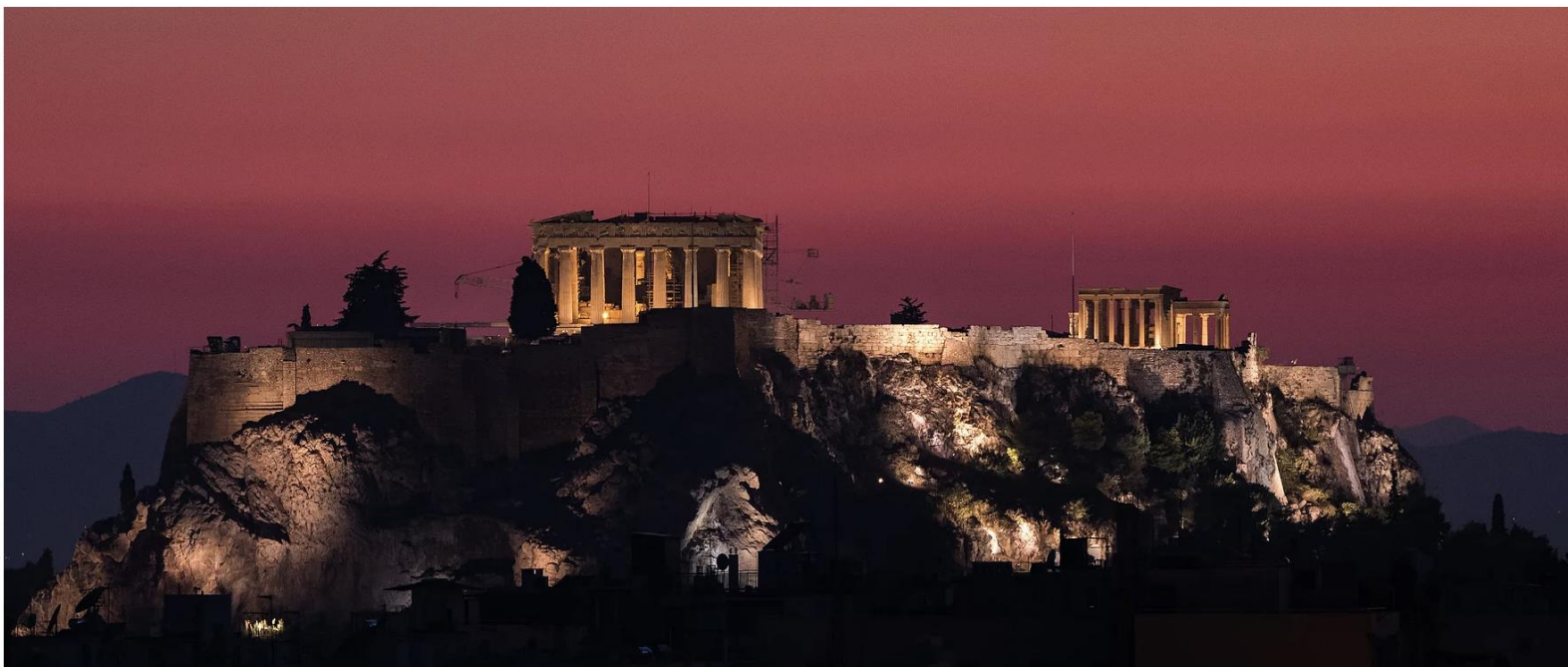
**The impact of climate change on our cultural heritage, without urgent and substantial action, could lead to irreversible damage and undermine the ties between heritage sites and future generations.**

For millennia, people have engaged with cultural landscapes, archaeological sites, historic townscape, buildings and associated intangible values, allowing for past lessons to be preserved and provide future generations a sense of belonging. The protection of heritage sites, whether of local, national or universal value, is globally recognized through organizations such as UNESCO and its 1972 Convention Concerning the Protection of the World Cultural and Natural Heritage.

Heritage is an important asset for identity as well as social development and livelihood. In addition, World Heritage properties serve as climate change observatories to gather and share information on applied and tested monitoring, mitigation and adaptation practices. Historic towns that were densely built with a mix of commercial and residential uses and often pedestrian, also serve as models for developing mitigation/adaptation solutions.

*World Heritage Sites are increasingly at risk from impacts from climate change. Image shows the Quebrada de Humahuaca*

In 2020, GEO launched a new Community Activity on Climate Change Impacts on World Heritage Cities, in cooperation with the United Nations Educational, Scientific and Cultural Organization (UNESCO). This Community Activity will draw on the GEO community's rich expertise to realize the untapped potential of Earth observations to monitor and enable specific mitigation and adaptation strategies to shield urban cultural heritage from climate change risks.



*World Heritage Sites are increasingly at risk from impacts from climate change. Image shows the Acropolis.*

Earth observation offers a means to continuously monitor and standardize practices around climate change risk to cultural heritage. Especially in World Heritage Cities, it can accelerate and improve the provision of documentary evidence of cultural heritage, engaging multiple disciplines and building upon systems and frameworks already in place. Satellite imagery, combined with in situ data, is extremely useful for monitoring and managing sites, as well as for change detection analysis, and disaster monitoring and risk assessment (both pre and post), although gaps remain in heritage sites geographical coordinates collection and integration and usability of products for stakeholders.

# GEO HUMAN PLANET (GEO HP): LANDSCAPE CHANGES

**The impact of climate change on our cultural heritage, without urgent and substantial action, could lead to irreversible damage and undermine the ties between heritage sites and future generations.**

Arrival of refugees is commonly believed to lead to localized environmental degradation and destruction, however landscape-wide, long-term environmental change analysis had never been performed to assess the rigor of such claims.

The study found that refugees' effect on the landscape has mainly been associated with localized agricultural deforestation: a 1% increase in the refugee population amplifies the transition from dominant forested areas to cropland by 1.4%. These findings show that forest cover loss around refugee settlements results from refugee dependence on the landscape for food production rather than some wholesale land clearance or biomass extraction.



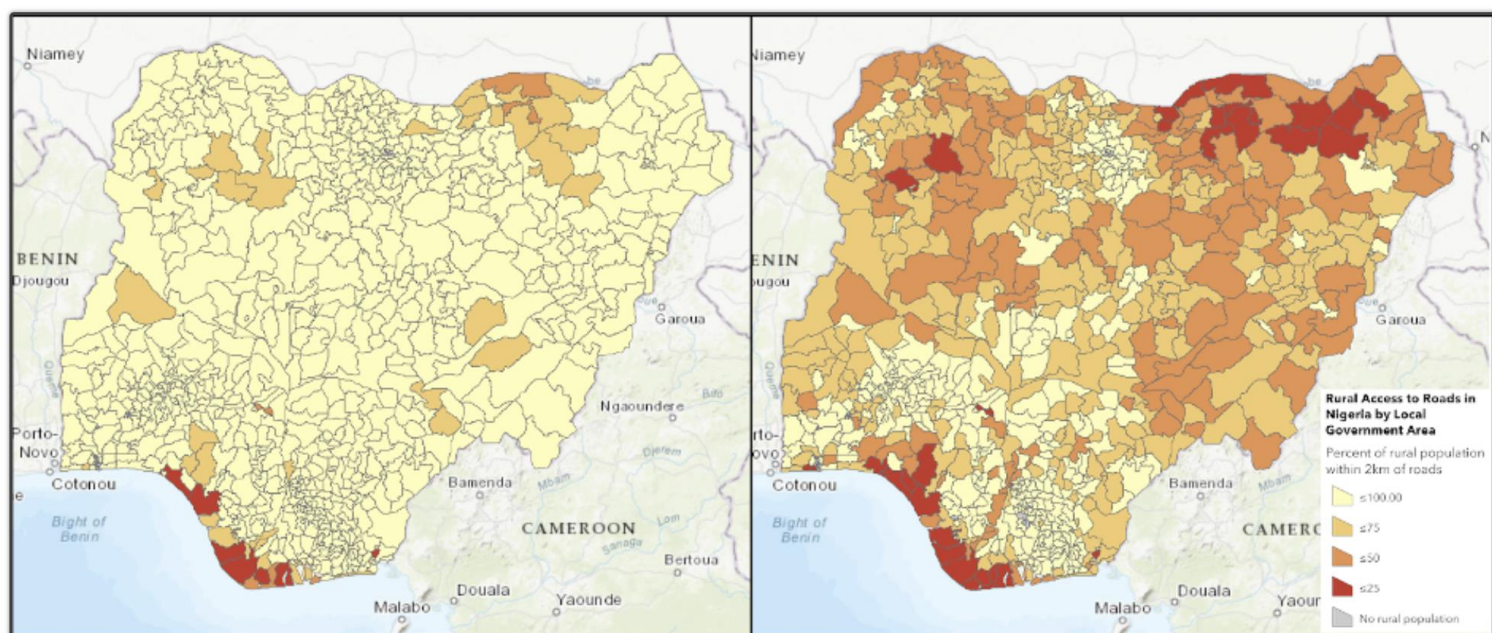
South Sudan from the Copernicus Sentinel-2B. Composite modified Copernicus Sentinel data (2018), processed by

# CIESIN : RURAL ACCESS TO ROADS

The GEO Human Planet Initiative uses EO data to assess Sustainable Development Goal (SDG) indicator 9.1.1, known as the Rural Access Index (RAI), which measures the proportion of a country's rural population that lives within 2 kilometers walking distance of an all-season road.

The RAI is the most widely accepted metric for assessing rural population access to transport consistently across countries and time. It is based on three data sets: where people live, the road network, and road quality. GEO is working to help countries to compute SDG 9.1.1 to support local decisions and to report to the UN.

As a complement to CIESIN's work, the UN Sustainable Development Solutions Network (SDSN), working with Esri and National Geographic, has established "SDGs Today: The Global Hub for Real-Time SDG Data" in order to make quality and timely data for the SDGs more accessible.



Both Earth Observations and citizen science approaches can be harnessed to improve the timeliness and quality of this indicator. The partners developed an Esri Story Map on Rural Access to Roads, released as part of the SDGs Today Hub in July 2020. This work is done with partners in Nigeria, Colombia, and Spain to illustrate some of the key issues surrounding selection of different data sets, computation of RAI using different assumptions, and estimation of the RAI under different conditions.

# GEO ON DISASTER RISK REDUCTION

## THE GLOBAL WILDFIRE INFORMATION SYSTEM (GWIS)

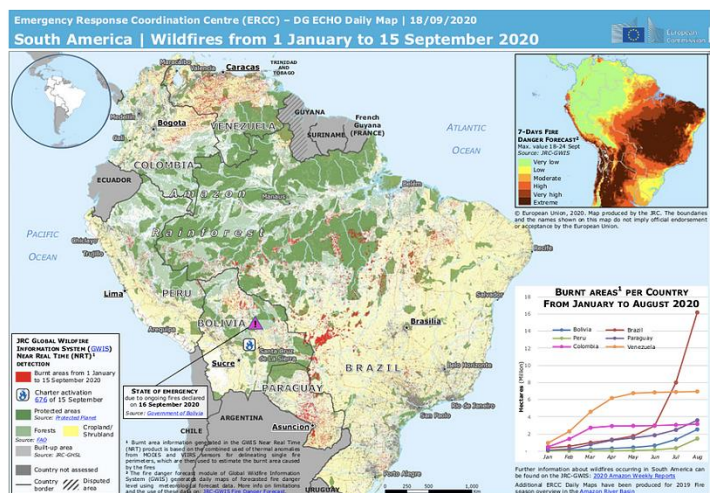
**(GWIS) provides services for global early warning and monitoring of wildfires, whose impacts are aggravated by climate change.**

Fires have recently affected areas across Australia, Indonesia, Brazil, Europe and the USA. GWIS produces near-real-time estimates of the effect of wildfires globally, and assesses their impact against wildfire trends and regimes in countries, with time-series data from 2001 to the present.

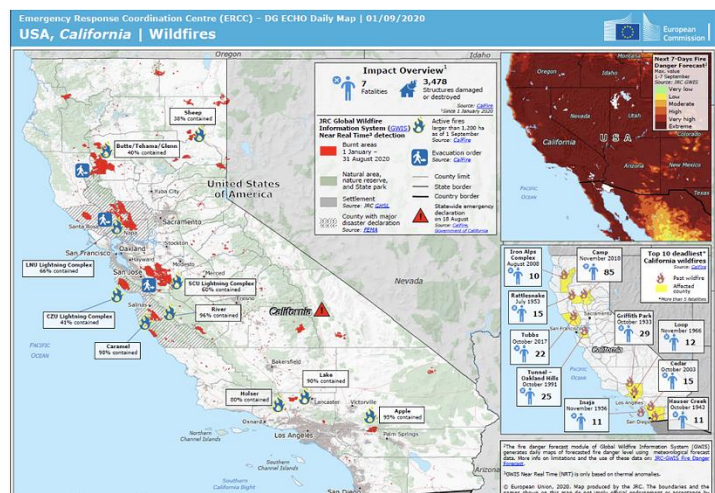
Its data services follow international standard data sharing protocols. Examples of GWIS wildfire products are available at its web site, including fires in the Arctic Circle, California, the Amazon region, and Europe.



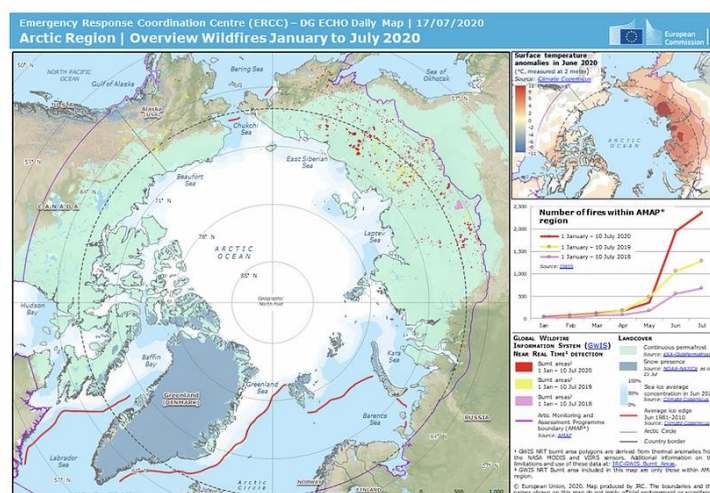
## ECHO Daily Map of 18 September 2020 - South America



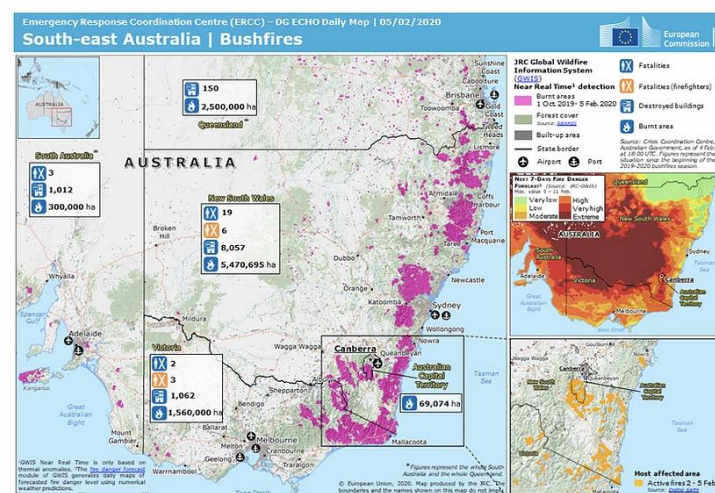
## ECHO Daily Map of 01 September 2020 - USA, California Wildfires



## ECHO Daily Map of 17 July 2020 - Arctic Wildfires



## ECHO Daily Map of 5 February 2020 - Australia Bushfires update



**Wildfire science is at a loss for comprehensive data: An international monitoring initiative is crucial for understanding wildfires and reducing their damage**

Nature (Bowman, July 2018)

# BLACK MARBLE

## SATELLITE IMAGERY

NASA developed the Black Marble, a daily calibrated, corrected, and validated product suite, making nightlight data can be used effectively for scientific observations. Black Marble is playing a vital role in research on light pollution, illegal fishing, fires, disaster impacts and recovery, and human settlements and associated energy infrastructures.

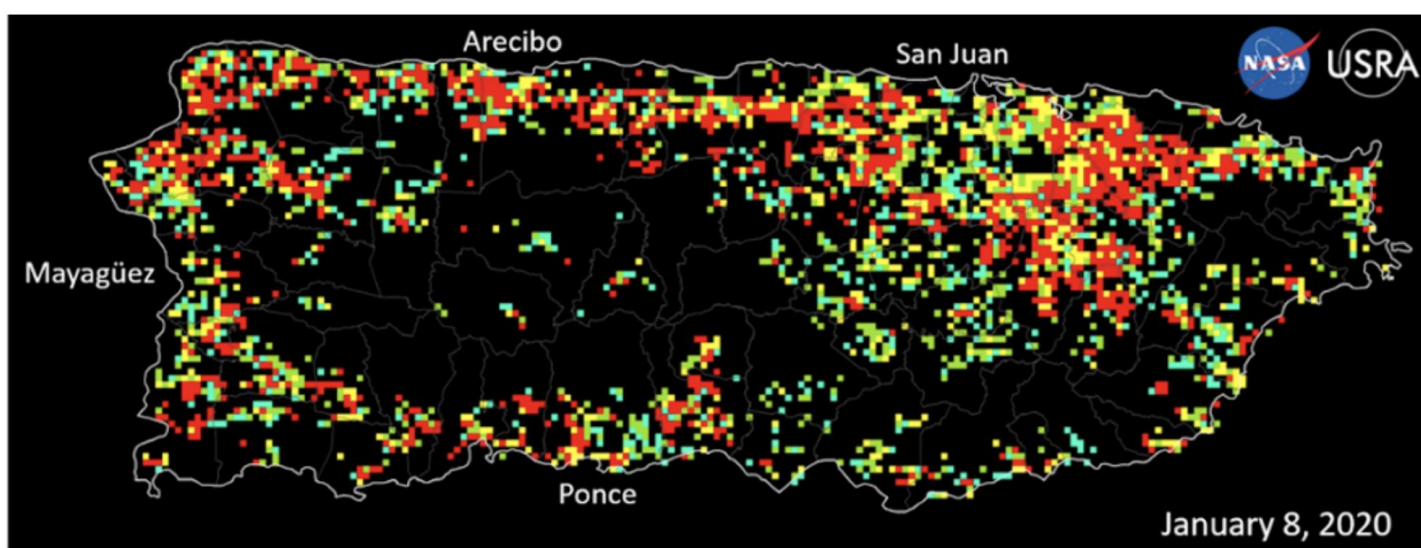
On 7 January 2020, Puerto Rico's southwest coast was damaged by an earthquake of magnitude 6.4. Multiple large magnitude aftershocks, resulting in 120 landslides, were recorded for the next couple of days throughout the island.

The earthquakes resulted in 10 casualties, and approximately 3,000 homes destroyed or damaged, with a total economic impact of around US \$3.1 billion. During the earthquakes, Puerto Rico also suffered extensive damage to its electric grid due to collapsed buildings and structures.

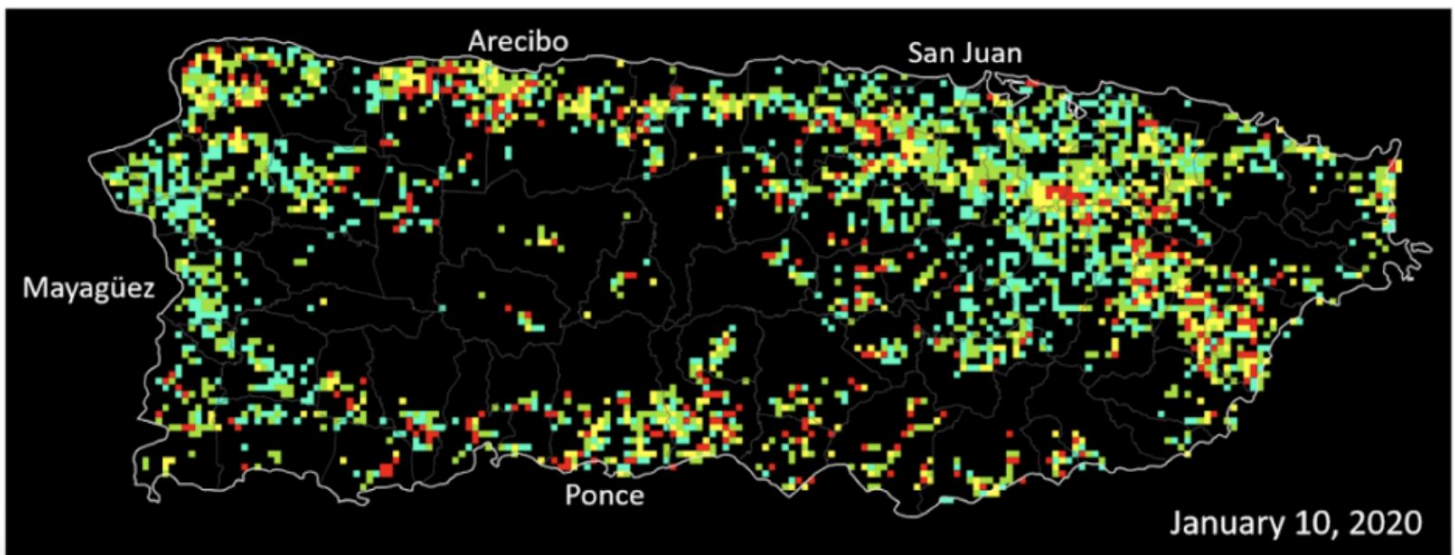
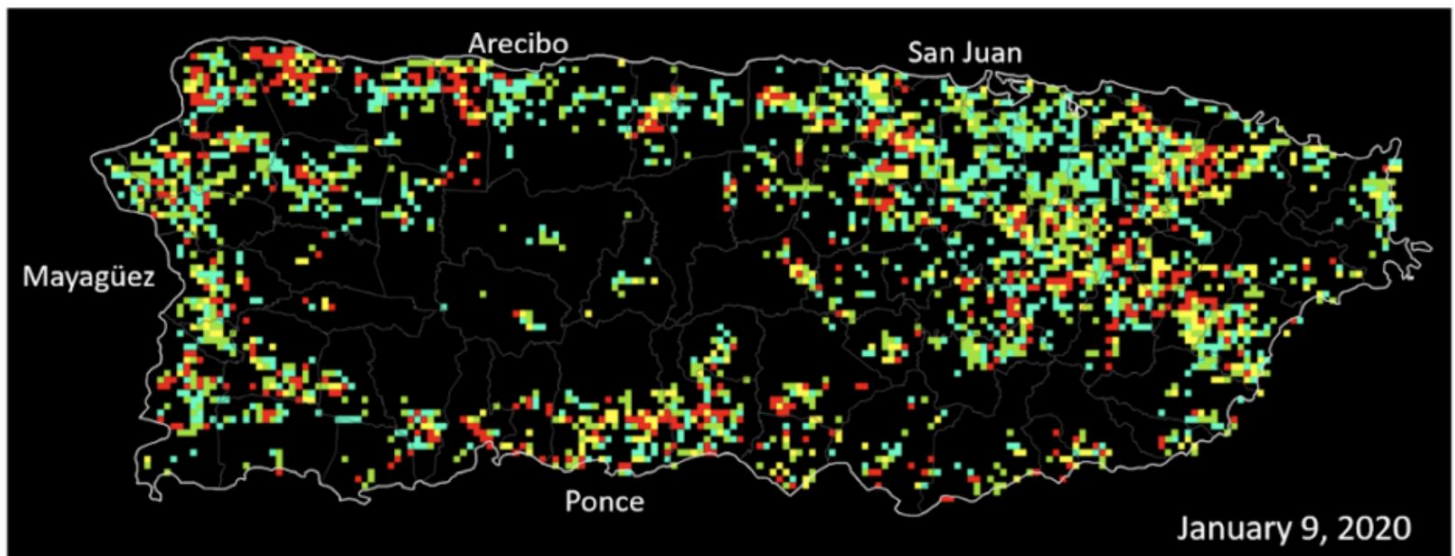
NASA's Black Marble product suite was used to assess the impacts of the earthquake on the electrical grid through power outage maps (see Figures below).

***"To respond to power outage events and to mitigate their cascading social and economic costs, we need to produce and improve access to Earth Observations about who has lost access to electricity, and for how long. NASA and USRA have taken a major first step by releasing the entire Black Marble time series record free-of-charge, but this is just the beginning."***

*Miguel Román, Director, Earth from Space Institute/USRA*



The first map shows the percentage reduction in outdoor illumination on 8 January (immediately after the 6.4 magnitude earthquake on 7 January).



	Reduction in Outdoor Illumination	Radiance Decrease (%)	Population Affected on Jan 8	Population Affected on Jan 9	Population Affected on Jan 10
	Very High	75 – 100	666,259	214,623	142,207
	High	50 – 75	426,589	267,003	247,595
	Moderate	25 – 50	406,731	491,911	626,010
	Low	10 – 25	272,227	486,239	551,560

January 9 and 10th maps show some recovery, particularly in the densely populated areas of San Juan, Ponce, and Arecibo.

# JAPAN-DIAS

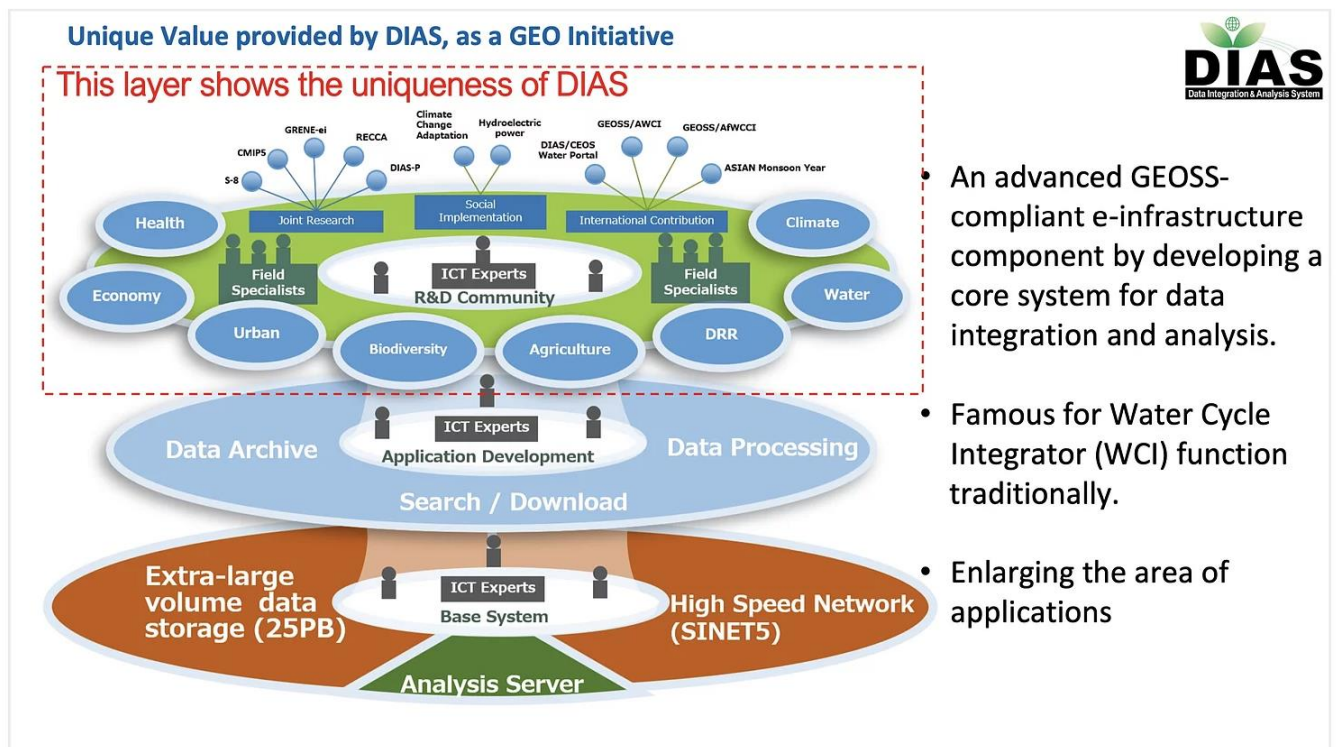
**The Data Integration and Analysis System (DIAS) is a GEO initiative that supports a computational infrastructure to evaluate the impact of climate change and support adaptation measures on the water cycle and agriculture.**

DIAS uses a large data sets of earth observation, climate predictions, hydrological data and socio-economic data. The DIAS infrastructure has been successfully used to support decision-making in South-East Asia and Africa.

DIAS is currently working with UNESCO on the project “Water Disaster Platform to Enhance Climate Resilience in Africa (WADiRE-Africa) which aims to develop a flood early warning system for West Africa (Niger River Basin and Volta River Basin).



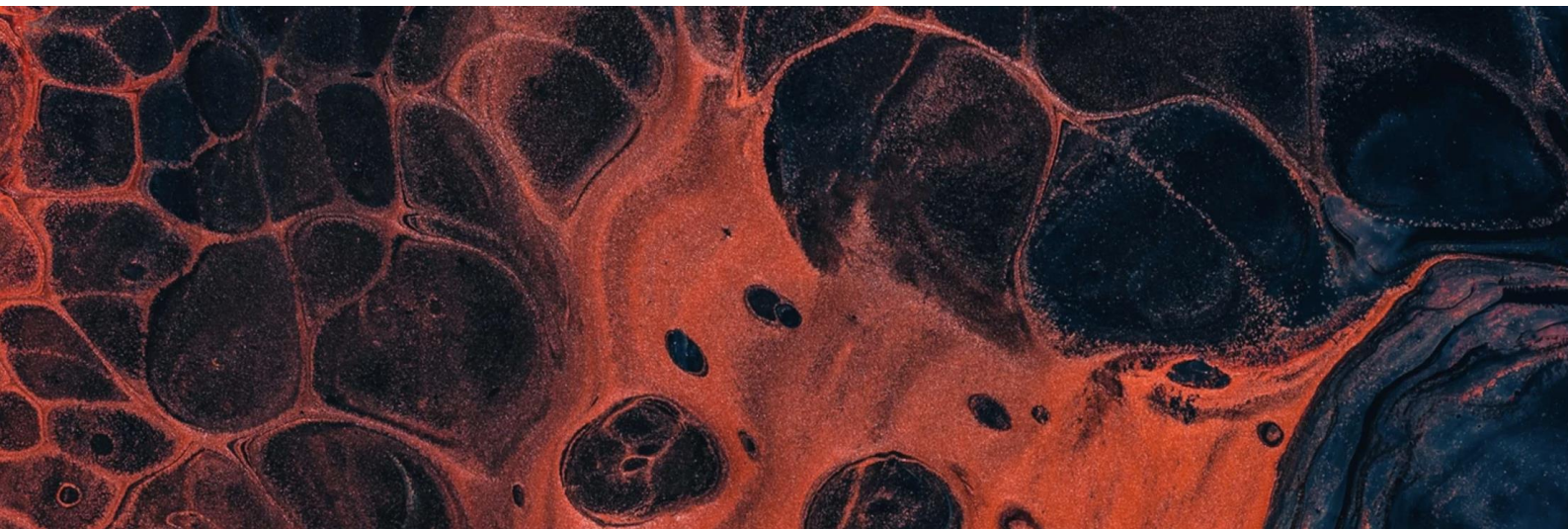
In this region, flooding of the Niger and Volta rivers has caused extensive damage. The project is being developed in cooperation with UNESCO, AGRHYMET, the Volta Basin Authority (VBA), and the Niger Basin Authority (NBA).



## GEO-GSNL Ecuador Supersite supports emergency response during the 2020 Sangay volcano eruption

GEO's GSNL Initiative maintains a network of 12 Geohazard Supersites spread over six continents. For each Supersite a large number of EO datasets is made openly available by local monitoring institutions and by the CEOS space agencies, to support scientific research and hazard assessment for risk prevention and emergency response.

The Instituto Geofísico of the Escuela Politécnica Nacional (IGEPN) in Quito, coordinator of the Ecuador Supersite, receives hundreds of satellite images per year by which, together with ground data, it monitors the activity of over 10 active volcanoes.



The most recent eruption of the Sangay volcano started on 20 September 2020 at 04h20LT with pulses of seismic tremor and explosions that hoisted an eruption cloud to over 14 km. Conditions were cloudy, but GOES-16 satellite imagery allowed observation in near real time of the propagating ash cloud, so that an early warning of impending ashfall could be given to provincial governments downwind. Interferometric processing of Sentinel-1 and TerraSarX imagery starting in January 2019 shows that an inflationary zone (3-7 cm/yr) on the NE summit area has notably increased in the past 8 months, while the W flank has a gradual sinking, perhaps from magma migration. Two weeks before the 20 September eruption, a deflationary signal was registered on the NE summit zone.

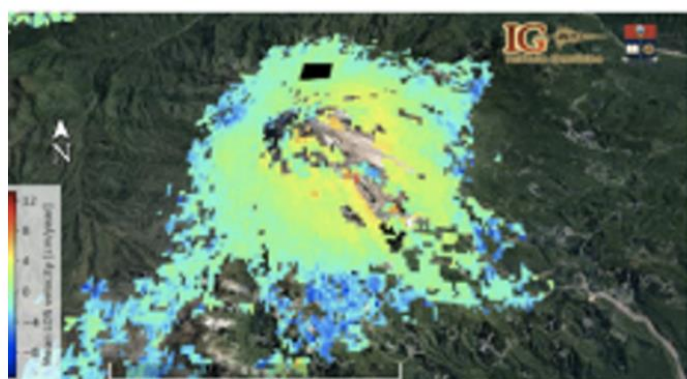


Fig. 1: Velocity map and NE time series from Sentinel 1 data (Descending track) between January 22nd, 2019 and September 25th, 2020. Software processing: ISCE and Mintpy. Red broken lines represent eruptions on 08 June (smaller) and 20 September (larger) of 2020.

The mostly positive InSAR values and their correlations with upticks in seismicity and gas emissions (SO<sub>2</sub>) allowed the IGEPN staff to indicate to local and national authorities that Sangay was in a very active state and that a stronger eruption was likely. The information was communicated via Webpage reports, press releases, radio and television interviews and tweets to the IG's 1.3 M followers.

To firmly establish that important deformation is occurring on Sangay's summit and also on the middle flanks, the Supersite-provided data is invaluable, since it picks up a signal in very inaccessible areas. Additionally, other Supersite volcanologists are also contributing with their expertise in a joint evaluation of the InSAR results seen before and post eruption.

## TerrasarX Interferograms

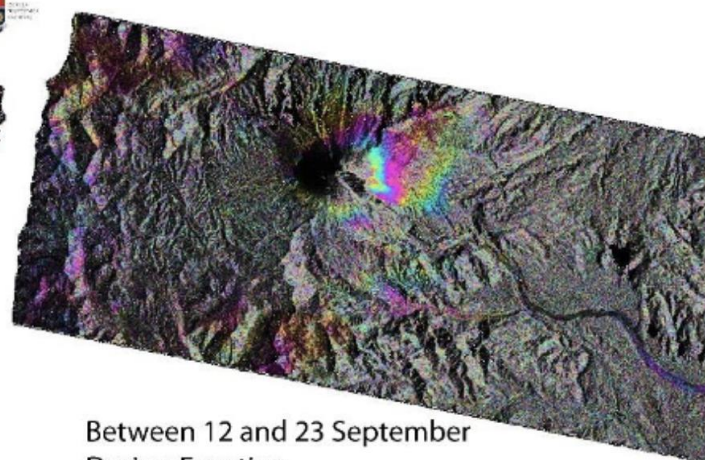
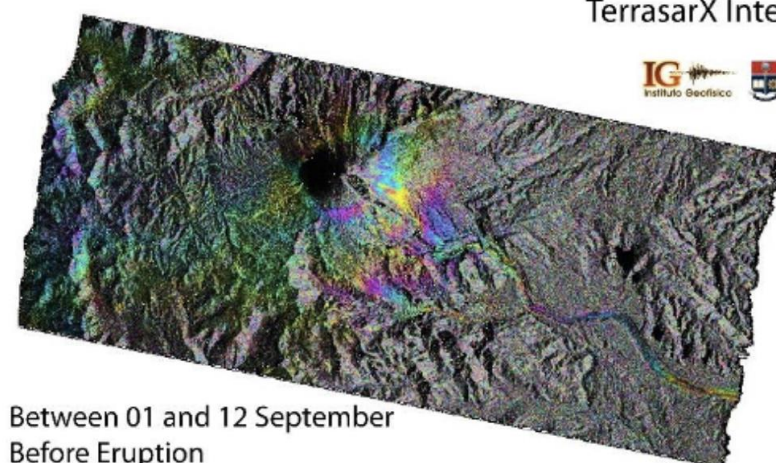


Fig. 2: TerrasarX Interferograms on the Sangay Volcano Area, showing the deformation before the eruption (left) and during the eruption (right), especially in the NE part of Sangay's summit. The interferogram fringe is equivalent to 3.2 cm in line of sight. These values are similar to those shown for LOS change in cm in Fig. 1B. Processed with ISCE.

Globally, GSNL Supersites serve as paradigms of how open EO data and focused international collaboration can effectively support volcano and seismic monitoring and generate actionable information for disaster risk management.

During the short-lived crisis, more than 80,000 hectares of crop lands were covered in ash, including banana plantations and the airport in Guayaquil had to close down for half a day (see figure 3).

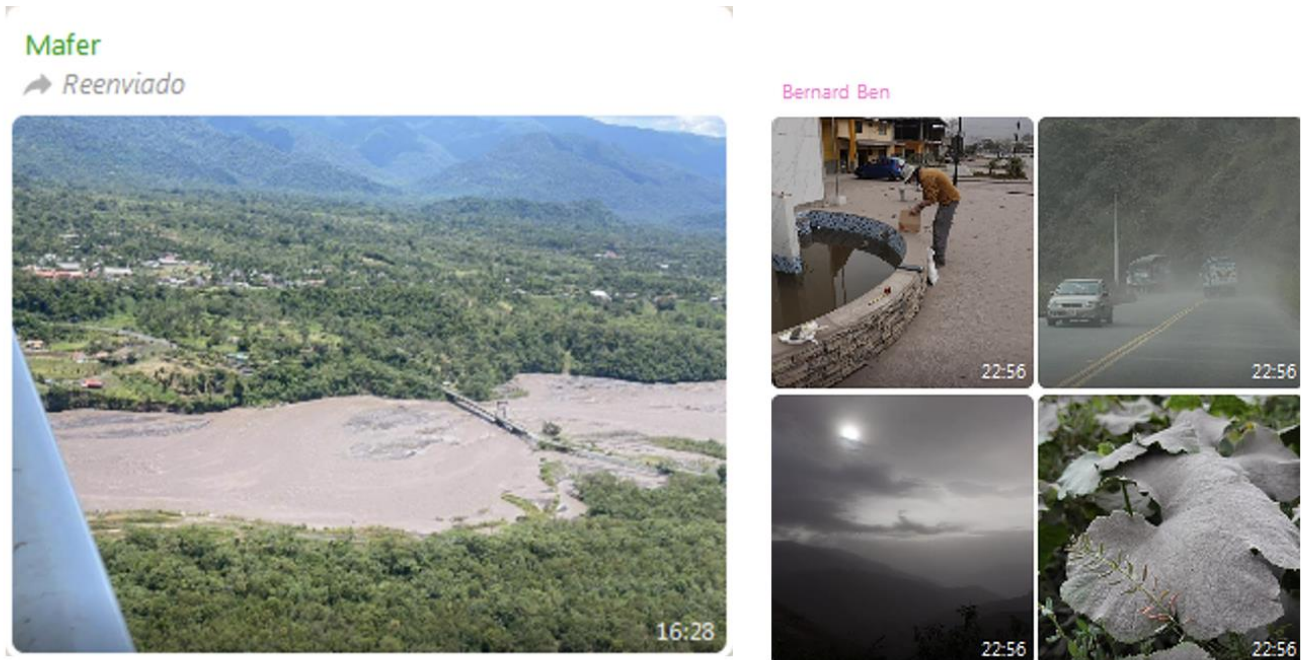


Fig. 3: Photos taken by members of IGEPN of secondary lahars which threaten a main bridge to the provincial capital of Macas; and ash-covered areas to the west and ash covering vegetation, 21 September, 2020.

After the eruption the volcano displayed sporadic tremor intermixed with explosions, and ash columns rising a km or so above the 5200 m summit ( See Fig. 4).



Fig. 4: Photos of Sangay's NE flank taken on 26 September, 2020. The ash column emanates from a deep crater whose E side is blown out by eruptive activity and erosion of lava collapse flows. Photos used with permission given by Jaime Arteaga.

# GEO ON THE SUSTAINABLE DEVELOPMENT GOALS

**2** ZERO  
HUNGER

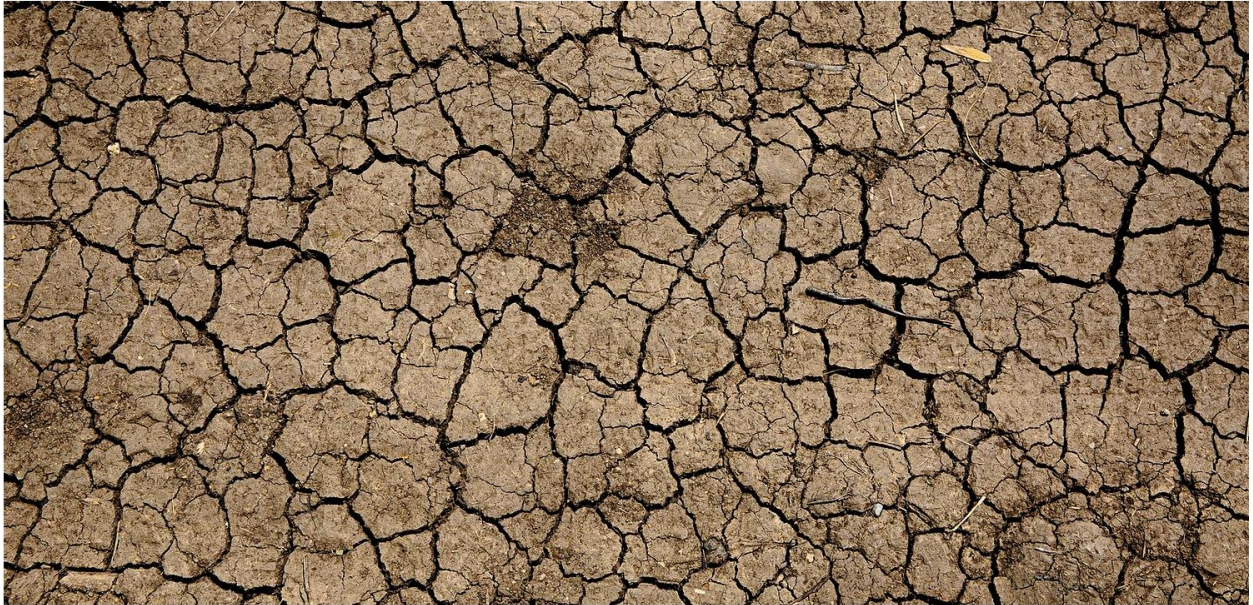


**READ THE SPOTLIGHT STORIES ON  
SDG 2: ZERO HUNGER**



## SDG 2: CROP MONITOR SPECIAL REPORTS

GEOGLAM Crop Monitor Special Reports provide critical and timely information on developing threats to crop production including droughts, floods, and extreme events that are likely to result in yield shortfalls with critical food security outcomes.



These reports support national and regional agencies and humanitarian organizations in their relief response, strategy, and planning. Since the first Crop Monitor Special Report in February 2019, seventeen Special Reports have been published providing key insight to developing threats to agricultural production.

This year has brought numerous threats to crop production across different regions. East Africa and South Asia has been hit by a triple threat of devastating floods, desert locust infestations and COVID-19 impacts while areas of Southern Africa faced concerns over drought, water shortages, and COVID-19 impacts.



In times of international crisis and heightened uncertainty with numerous threats to crop production, there is an even greater need for more frequent and detailed reports that represent an international consensus to reduce speculation and provide earlier warning of potential production shortfalls. In 2019, at the request of the United Nations Office for Coordination of Humanitarian Affairs (OCHA), the GEOGLAM Crop Monitor developed the capability to produce rapid consensus assessments and reports to respond quickly to areas of emerging concern for agricultural production and food security.

In 2020 alone Crop Monitor reported on: the developing drought in Southern Africa affecting main season crops, Zimbabwe's record drought and worsening food security concerns, East Africa flood impacts on agricultural production from the record 2020 seasonal rains, and heavy flooding in August and September in the Democratic People's Republic of Korea that affected the main agricultural producing areas with potentially severe food security outcomes.

As an example, the May 2020 Crop Monitor Special Report on the Eastern Africa records seasonal rainfall and flooding conditions provided vital and necessary consensus-based updates on developing flood impacts across the region. This report was used as a key resource in the development of the East Africa's Intergovernmental Authority on Development (IGAD) 2020 Food Security and Nutrition Response Strategy Report.

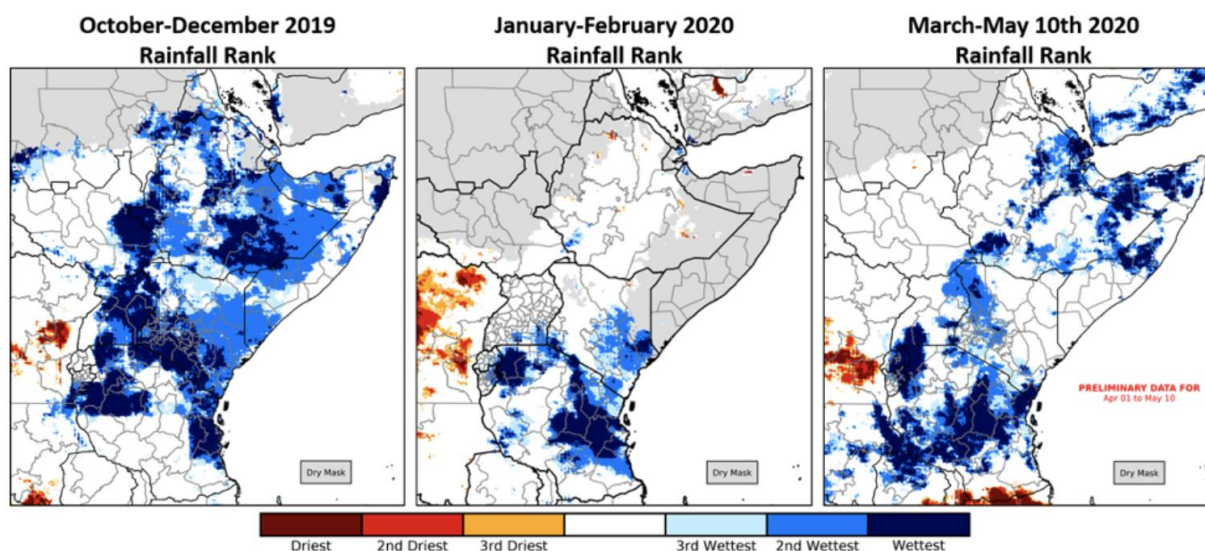
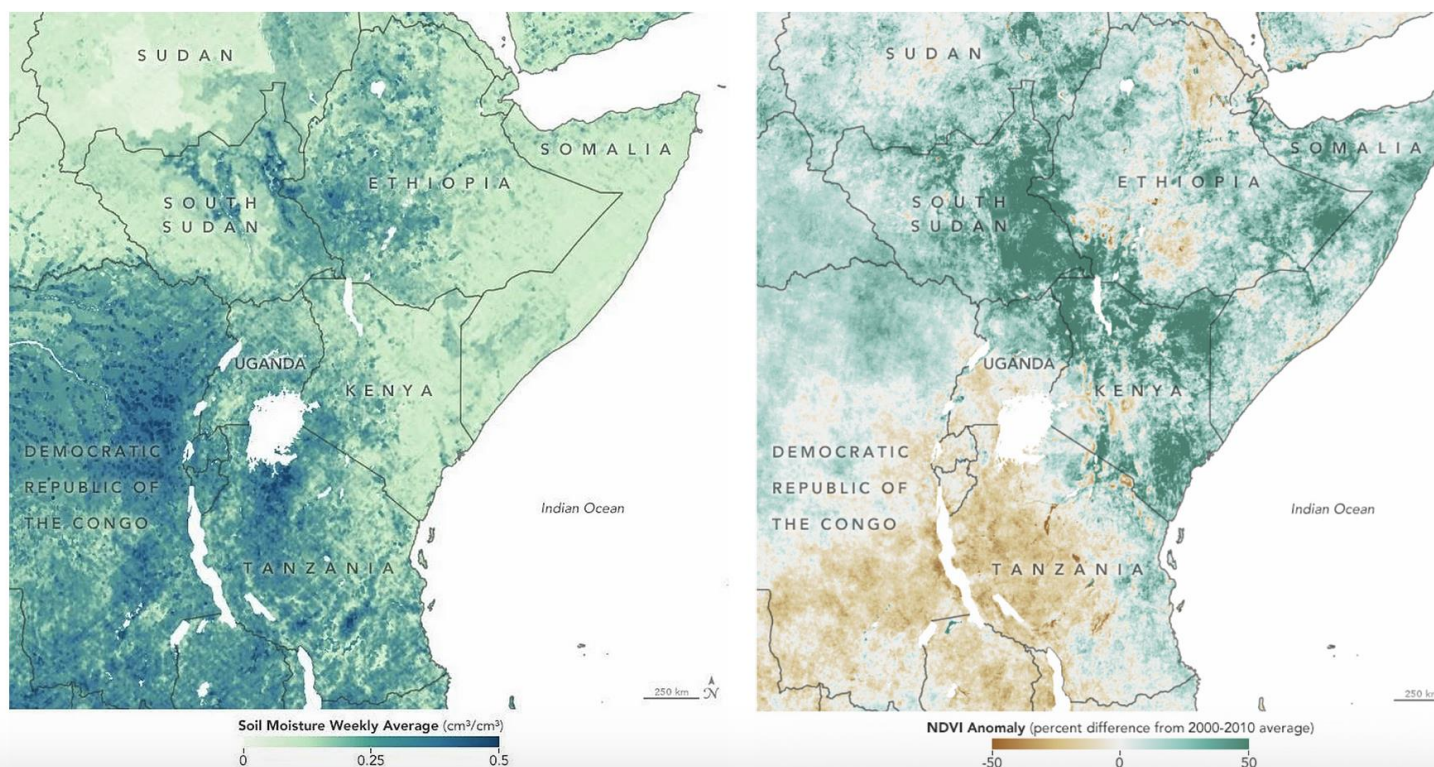


Figure 1. CHIRPS Rainfall Rank for Eastern Africa which indicate where rainfall totals for a given interval are ranked in the three wettest or three driest, relative to the CHIRPS historical record (1981-2019). The left panel shows the CHIRPS Rank for October to December, 2019. The middle panel shows the CHIRPS Rank for January to February, 2020. And the right panel shows the CHIRPS Rank for March to May 10th, 2020. Source: UCSB Climate Hazards Center.

## SDG 2: DESERT LOCUST INVASION

NASA Harvest and GEOGLAM are using remotely-sensed Earth observations of soil moisture and vegetation to track the influence of locust life cycles throughout Africa in order to decrease the potential food security threat affecting over 70 000 hectares of agricultural land.



A single desert locust can consume its body weight in vegetation in just one day and when 40 million of these pests gather—considered a small swarm—they can devour the food needed by 35 000 people. In a single day, a small swarm can ultimately jeopardize a farmer's livelihood. Kenya is experiencing the worst desert locust outbreak in 70 years. In February of 2019, the swarms spread to over ten countries in eastern Africa, threatening food supplies for millions of people.

Since February 2020, the GEOGLAM Crop Monitor for Early Warning has been tracking and publicizing alerts on desert locust spread and resulting impacts on crop conditions. Organizations such as NASA Harvest, FAO, USAID, SERVIR, the World Food Program, RCMRD, IGAD, and NASA SpO<sup>RT</sup> have been collaborating to provide remotely-sensed data and agricultural monitoring resources to decision makers in affected regions. This data provides governments and farmers with timely and accurate information about crop forecasts and locust migration paths which are ultimately used for policy implementation and mitigation efforts.

## SDG 2: Global Agriculture Monitoring System

In the early 2000s, the University of Maryland (UMD) together with NASA and the US Dept of Agriculture (USDA) developed the first web-based platform to enable near-real-time monitoring of global croplands using NASA MODIS data, enabling operational users across the globe to track crop conditions as seasons unfolded.

The UMD system is one the basis for the GEOGLAM GEO flagship. Currently, UMD, NASA and USDA are developing a new cloud-based implementation of the the platform.

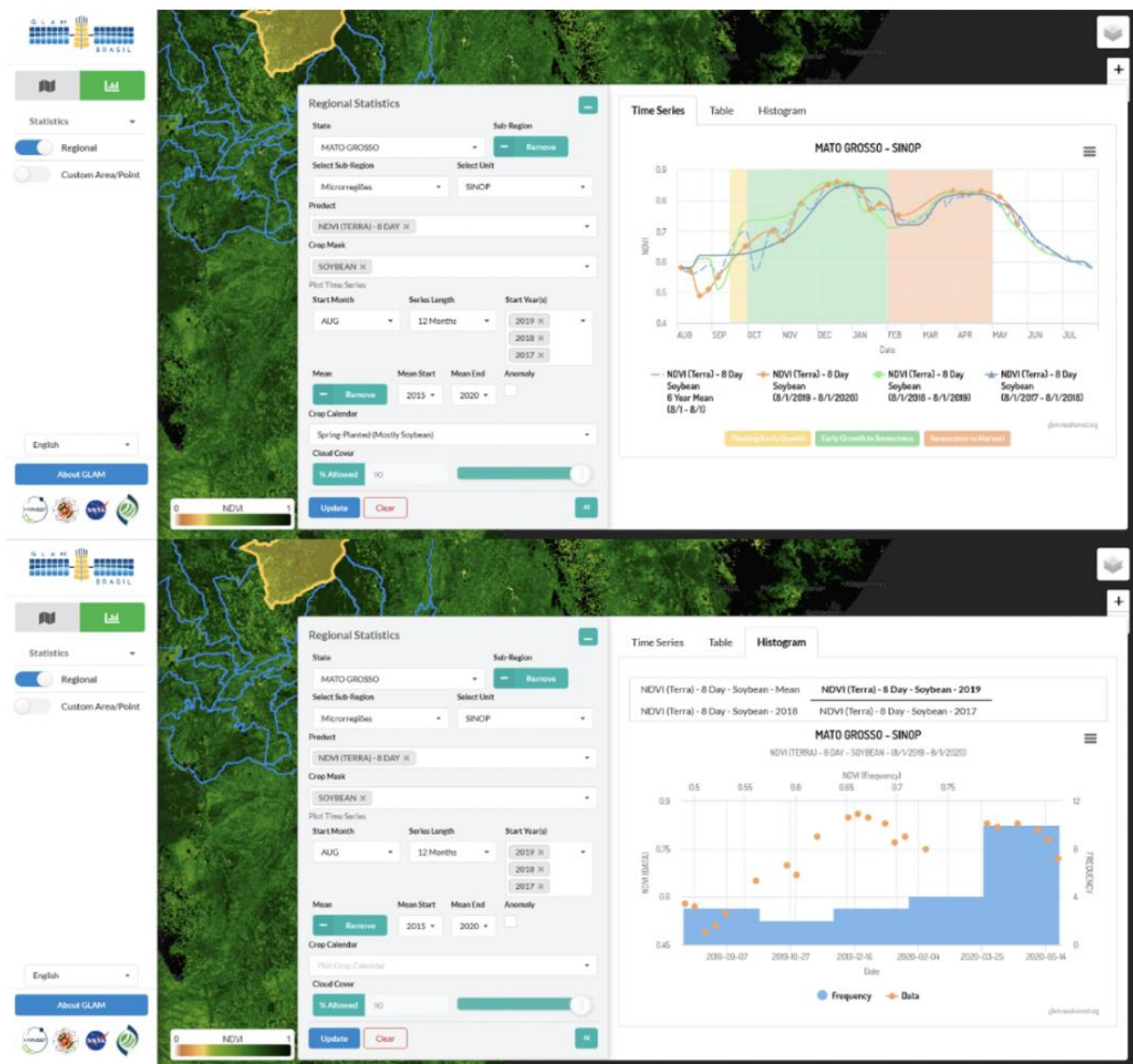


The new cloud-based provides on-the-fly data projection, masking, color table application, image differencing, and statistics calculation. Collection of datasets, crop masks, and color ramps is highly flexible.

The system has been expanded to include precipitation, temperature, and soil moisture along with EO data. In addition to the global interface, the new architecture allows customized country level interfaces, enhancing usership and accessibility of relevant EO data to specific regions around the world. Through the regional initiative Agriculture Monitoring in the Americas (a joint working group bridging GEOGLAM and AmeriGEO), end users in Argentina (INTA, MinAgri, Bolsa de Cereales), Chile (INIA), and Brazil (Conab) were engaged in the co-design of the new cloud-based service.



Screenshots from the global GLAM Interface



Screenshots from the Brazil-Conab Interface

**3** GOOD HEALTH  
AND WELL-BEING



**READ THE SPOTLIGHT STORIES ON  
SDG 3: GOOD HEALTH & WELL-BEING**



## SDG 3 : GOS4POPS

The Global Observation System for Persistent Organic Pollutants (GOS4POPS) initiative brings together efforts from around the globe, harmonizes their content, holds unique datasets and showcases them for better protection of human health and the environment.



The objectives of GOS4POPs are to provide:

1

Increased availability and quality of Earth observation data and information needed to track these chemical pollutants

2

Harmonization of metadata production, archiving and sharing among networks

3

Development of advanced services in support of the policy mandate and effectiveness evaluation of the Stockholm Convention on Persistent Organic Pollutants

The task of the GOS4POPS Initiative is the development of the electronic data warehouse, analyses and visualization system (GMP DWH), in line with the latest listings under the Stockholm Convention on Persistent Organic Pollutants (POPs) to support the global decision making on the basis of the largest harmonized global POPs datasets in air, human tissues and water. As of 2020, the GMP DWH already contains a full dataset available for human matrices data since 1987 WHO/UNEP surveys and the largest set of data from global and regional air monitoring networks providing its users with information on time trends and levels of listed toxic chemicals online.

The initiative contributes to global informed decision making and serves as the main source of information to prepare the third round of regional reports under the Global Monitoring Plan of the Stockholm Convention on POPs. In line with the approval procedures, the content of the GMP DWH is currently open just to the authorized experts. After the global endorsement will take place in the next Stockholm Convention Conference of the Parties in 2021 (COP), the content will be publicly released and accessible to all 24/7 .

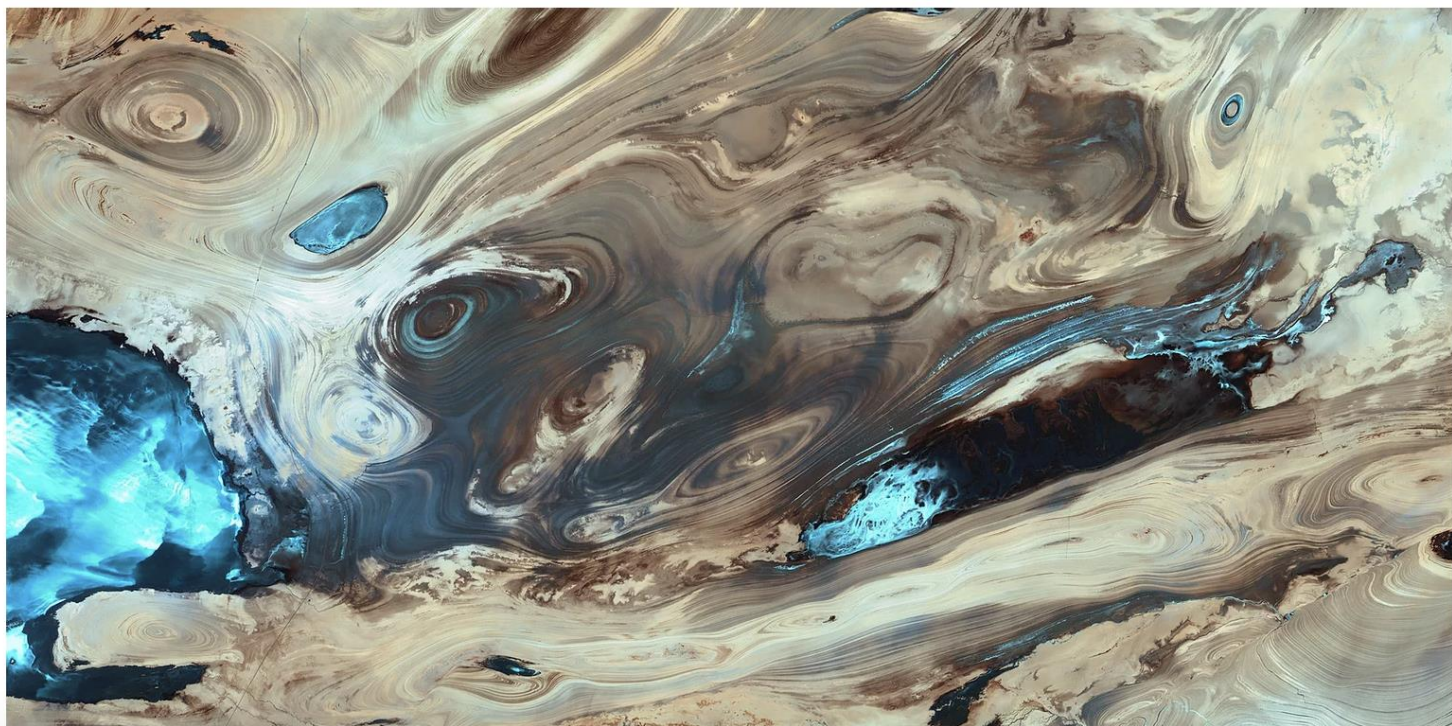
The GOS4POPS Initiative continues to generate inputs for global evidence based decision making as requested by the Stockholm Convention decision SC 8/18 and supports the Stockholm Convention Secretariat and its experts in the preparation of the third regional reports under the Global Monitoring Plan of the Stockholm Convention on POPs.

***“The GMP DWH is a unique platform in which global data on POPs occurrence in the environment is gathered in order to provide wide range of users such as scientists and policy-makers with the opportunity to assess progress in tackling POPs, establish trends and/or draw conclusions.”***

Representative of the Stockholm Convention Secretariat

## SDG 3: GOS4M SUPPORTS THE MINAMATA CONVENTION ON MERCURY

The GEO Flagship Global Observation System for Mercury (GOS4M) was designed to support nations, the UN Environment Programme (UNEP) and all interested Parties to characterize the linkages between impacts and effect of mercury contamination of Earth system on human health and provide EO data sets and validated interoperable tools to support policy makers in co-designing policy-driven scenarios that nations may implement for achieving the objectives of the Minamata Convention on Mercury (MCM).



The MCM is the first multilateral environmental agreement that aims to protect both the environment and human health by addressing activities that are likely to increase human exposure to mercury.

Mercury is a harmful substance for people exposed to its organic compounds. It is released by anthropogenic sources and natural-driven emission processes, can be transported long distances from the emission region/source and be deposited to terrestrial and aquatic receptors. Once deposited to marine and freshwater ecosystems may partly be deposited to sediments and partly be accumulated in biota. In marine and freshwater biota can be found at concentrations that increase with trophic levels. The impact on human health may occur through different patterns of exposure such as ingestion of Hg-contaminated food such as fish and seafood. Once accumulated in human body it may have toxic effects on the nervous, digestive and immune systems, as well as on lungs, kidneys, skin and eyes, causing serious health problems.

Mercury is a harmful substance for people exposed to its organic compounds. It is released by anthropogenic sources and natural-driven emission processes can be

transported long distances from the emission region/source and be deposited to terrestrial and aquatic receptors. Once deposited in marine and freshwater ecosystems may partly be deposited in sediments and partly be accumulated in biota. In marine and freshwater biota can be found at concentrations that increase with trophic levels. The impact on human health may occur through different patterns of exposure such as ingestion of Hg-contaminated food such as fish and seafood. Once accumulated in the human body it may have toxic effects on the nervous, digestive, and immune systems, as well as on lungs, kidneys, skin and eyes, causing serious health problems.

GOS4M is promoting a number of key actions to leverage the effort of nations and all interested parties in the implementation of the MCM, these include the harmonization of Standard Operating Procedure (SOPs) for in-situ monitoring, modeling intercomparison to assess the uncertainty associated to different atmospheric and biogeochemical modeling systems used worldwide, methodologies for co-designing policy scenarios aimed to evaluate possible cost-effective strategies that nations may implement in order to achieve the goals of the MCM and promote capacity building initiatives to ensure the transfer of knowledge to all interested parties and stakeholders.

On October 7-8, GOS4M held its virtual kick-off workshop officially launching the GOS4M Flagship by nominating the Governing Bodies and planning activities for the coming months. The virtual event was opened by Nicola Pirrone, Research Director of CNR (Institute of Atmospheric Pollution Research in Italy) and GOS4M lead, Monika Stankiewicz, Executive Secretary of the Minamata Convention on Mercury, and Gilberto Camara, Director of the GEO Secretariat. The agenda of the kick-off workshop is available [here](#).

## 6 CLEAN WATER AND SANITATION



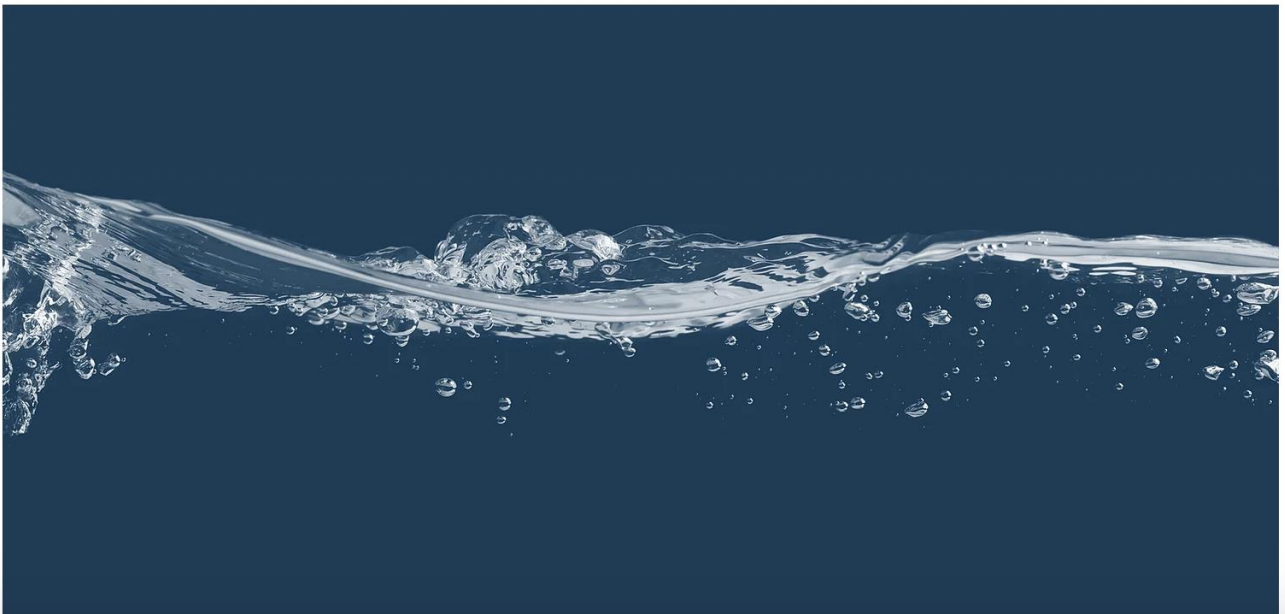
**READ THE SPOTLIGHT STORY ON  
SDG 6: CLEAN WATER & SANITATION**



## SDG 6:

# GEOGloWS

**Since 2017, through the GEOGloWS Partnership experts from around the world have been working to produce freely available streamflow forecasts.**



In 2018, the World Bank and the Global Facility for Disaster Reduction and Recovery (GFDRR) conducted an overview of the global status of hydrological information and services. They concluded that particularly low- and middle-income countries struggle to provide reliable, quality-assured hydrological services to meet user demand, affecting their business productivity, development, and economic growth.

As of 2020, the research has moved into operations by the European Centre for Medium-Range Weather Forecasts as the [GEOGloWS](#) ECMWF Streamflow System.

Gridded surface runoff, provided by ECMWF, is downscaled and routed to the streams using the Routing Application for Parallel computation of Discharge (RAPID).

A 35-yr historical simulation was produced based on ECMWF's ERA-Interim dataset. From this historical simulation, return periods for each reach are calculated and used to color the stream segments when/where events exceed these thresholds. The [GEOGloWS](#) ECMWF Streamflow System is now being used and validated in countries worldwide.

In Ethiopia, Mr. Mihretab Gebretsadik Tedla, Senior Water Resource Engineer from the Basins Development Authority (BDA)/ Ministry of Water Irrigation and Energy (MoWIE) stated: "The system is very important for disaster mitigation with further adaptation to the current forecasting and early warning system available at the BDA."



Through stakeholder evaluations, seasonal biases and limited accuracy were identified in the GEOGloWS-ECMWF global forecast. The Ministry of Water, Irrigation, and Electricity of Ethiopia evaluated the global forecast's potential application. Mr. Mihretab Gebretsadik Tedla, Senior Water Resource Engineer from the Basins Development Authority (BDA)/ Ministry of Water Irrigation and Energy (MoWIE) said "The system is very important for disaster mitigation with further adaptation to the current forecasting and early warning system available at the BDA." The predictions were validated using in-situ data, and the assessment was performed in three river reaches in the Awash river basin. This evaluation provided significant insights into the specific issues GEOGloWS needed to address. A second evaluation of the GEOGloWS-ECMWF global streamflow forecast was conducted by the Regional Committee of Hydraulic Resources (CRRH) in Central America with similar results as those from Ethiopia.

Similar partnerships have also been developed for Colombia (IDEAM), Dominican Republic (INDRHI), the International Centre for Integrated Mountain Development (ICIMOD) with applications for Nepal, Bhutan, Bangladesh, and other regional member countries of the Hindu Kush Himalayas.

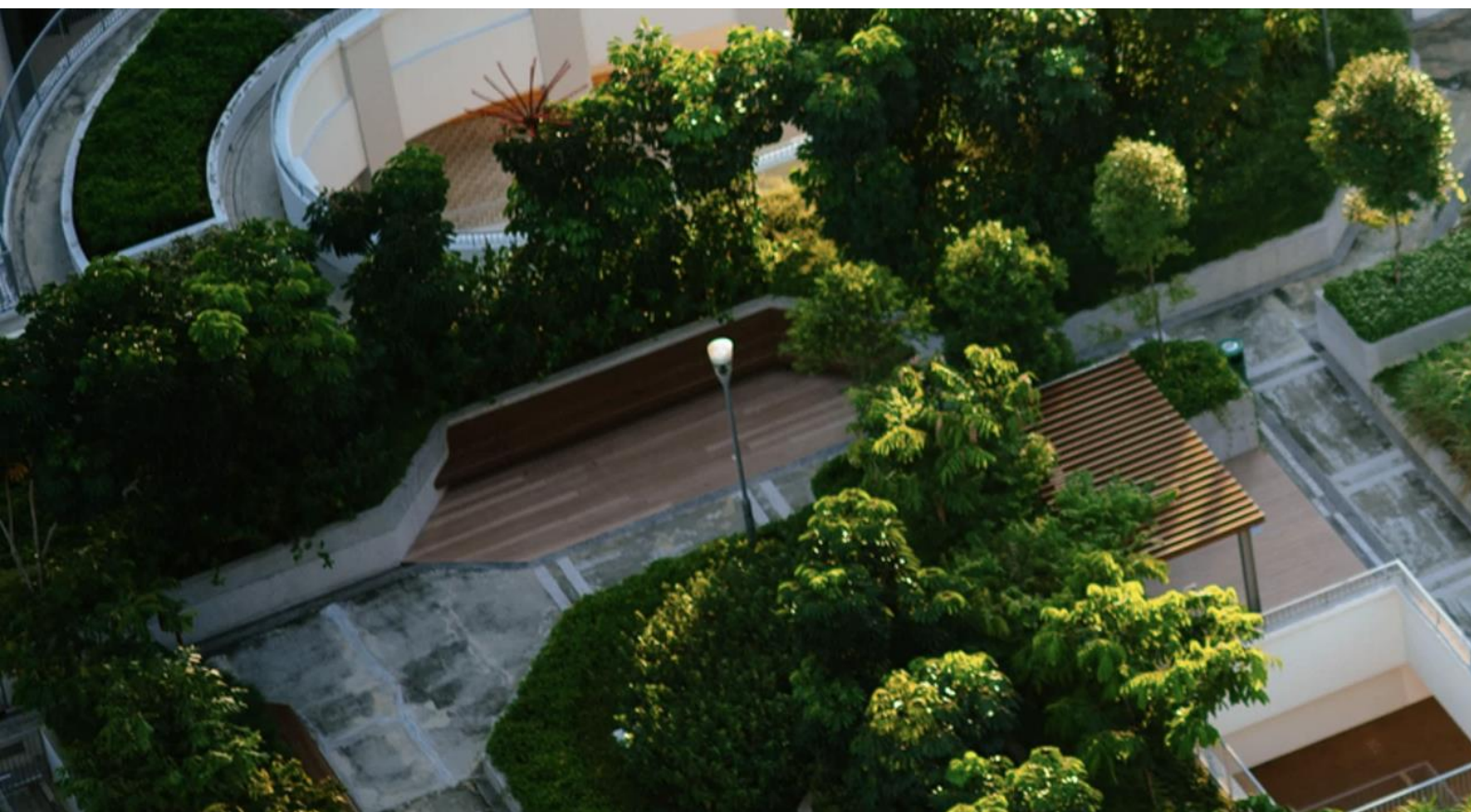
In response to evaluations from local stakeholders, the GEOGloWS-ECMWF global streamflow services team developed tools that allow local hydrologists who access in-situ observation data to correct seasonal biases. Ongoing work is being done to regionalize the methodology by extending the corrections to nearby and similar ungauged sites with very positive results.

A further response to the stakeholders' needs is the GEOGloWS toolbox, a set of web-based applications that can be customized for local requirements and accessed through the ESRI Portal or the Tethys Platform.

# 11 SUSTAINABLE CITIES AND COMMUNITIES



**READ THE SPOTLIGHT STORY ON  
SDG 11: SUSTAINABLE CITIES & COMMUNITIES**



# SDG 11: EARTH OBSERVATIONS TOOLKIT FOR SUSTAINABLE CITIES & COMMUNITIES

**GEO and UN-Habitat joined forces and are working to build an “Earth Observation Toolkit for Sustainable Cities and Communities” to support UN Member States to achieve the UN Sustainable Development Goal (SDG) 11 to “make cities and human settlements inclusive, safe, resilient and sustainable,” and to implement the New Urban Agenda (NUA) using EO data.**

In April 2020, GEO EO4SDG released a [joint call](#) with UN Habitat, in collaboration with the Human Planet and GUOI initiatives, for an Earth observations Toolkit for SDG 11 and the NUA. The aim is to develop methods to use EO data in urban monitoring and SDG reporting.

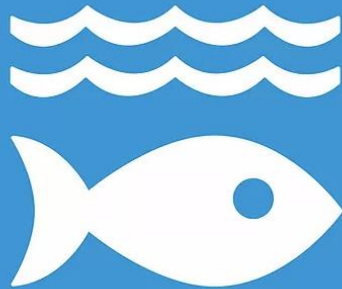


There were 60 responses to the call from global, national and city-level organizations. An evaluation panel, comprised of representatives from the UN-Habitat, GEO Work Programme, GEO Secretariat and GEO PB Urban Resilience Sub-group, selected 19 countries, cities and global initiatives to be part of the Toolkit Steering Committee to:

- a) actively contribute to the toolkit development
- b) participate in activities associated with the toolkit such as evaluation of usability of different Earth observation products for local monitoring activities
- c) make their data and methods available via the Toolkit
- d) share their use cases and innovative practices
- e) where applicable, serve as advocates of Earth observations for SDG 11 and the NUA

The toolkit, developed through a consultative process with countries and cities, will complement [guidance published by UN-Habitat](#), and will be produced in conjunction with UN-Habitat and a selected number of regionally representative countries and cities. It will provide practical guidance on the integration of remotely sensed and ground-based EO data with national statistics, socioeconomic data, and other, ancillary information to help countries monitor, report and drive progress on SDG 11 and the NUA.

# 14 LIFE BELOW WATER



**READ THE SPOTLIGHT STORY ON  
SDG 14: LIFE BELOW WATER**

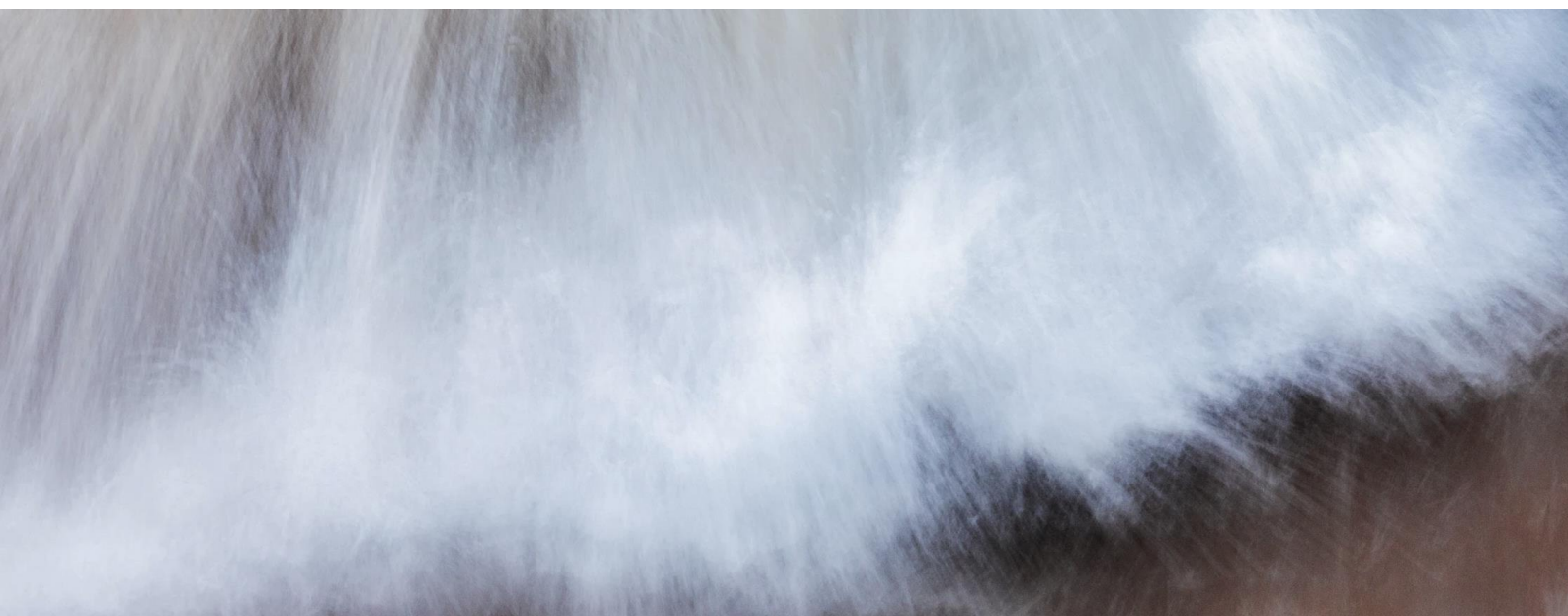


# SDG 14: GEO BLUE PLANET

**GEO Blue Planet is the coastal and ocean arm of GEO, connecting ocean and coastal information with society. By connecting openly available satellite data to decision-makers, the initiative bridges the gap between data and services to deliver usable information that supports informed decision-making toward reaching the Sustainable Development Goals.**

To address capacity development goals, additional workflows and training materials are provided for individual countries to further refine their modeling with locally available data.

Eutrophication is a process by which excess nutrient inputs into coastal ecosystems cause excessive growth of marine plants and algae. This can lead to harmful algal blooms, dead zones, and fish kills. Many countries do not have in-situ nutrient data to assess eutrophication, and therefore need other tools to measure eutrophication in order to track and monitor progress on SDG 14.1.1a – Index of Coastal Eutrophication.



Partners in GEO Blue Planet developed a methodology for measuring SDG 14.1.1a. Experts from NOAA CoastWatch, Plymouth Marine Lab, Mercator Ocean International found out how to extract information on chlorophyll-a from remote sensing data.

This methodology is now available as part of Esri Oceans Hub, which hosts the chlorophyll-a dashboard and provides information to UN Member States on measuring coastal eutrophication. This operational data processing system produces an updated chlorophyll-a map every day, published as free and open web services for use in this dashboard application or other applications. This enables countries to track and report on SDG progress, which they would not have the capacity to do otherwise. This methodology will be included in the 2021 UN SDG report, the first time any data is reported for this indicator.

***"We believe open science is good science, and a way to reassert science as a global public good; this collaboration demonstrates that philosophy by openly sharing the jointly developed methodology and the resulting data in an accessible way".***

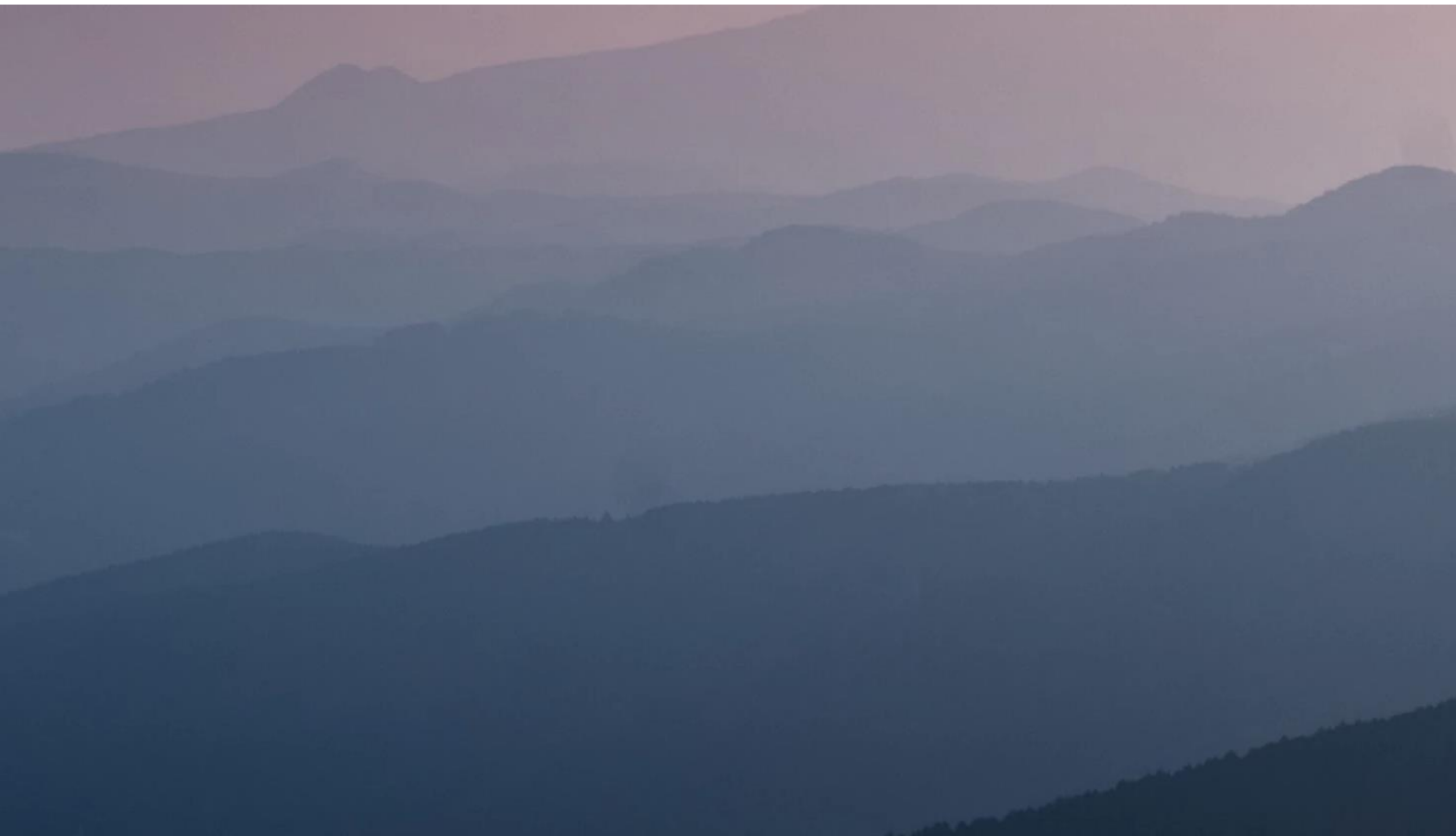
*Dawn Wright, Esri Chief Scientist*

***"UNEP collaboration with GEO Blue Planet and Esri to develop the methodology and the usage of Satellite Imagery was fundamentally important to fill in the data gap and help to understand how the freshwater-marine link works in order to establish appropriate measures to maintain a good oceans health."***

*Jian Liu, Science Division Director and Chief Scientist United Nations Environment Programme*



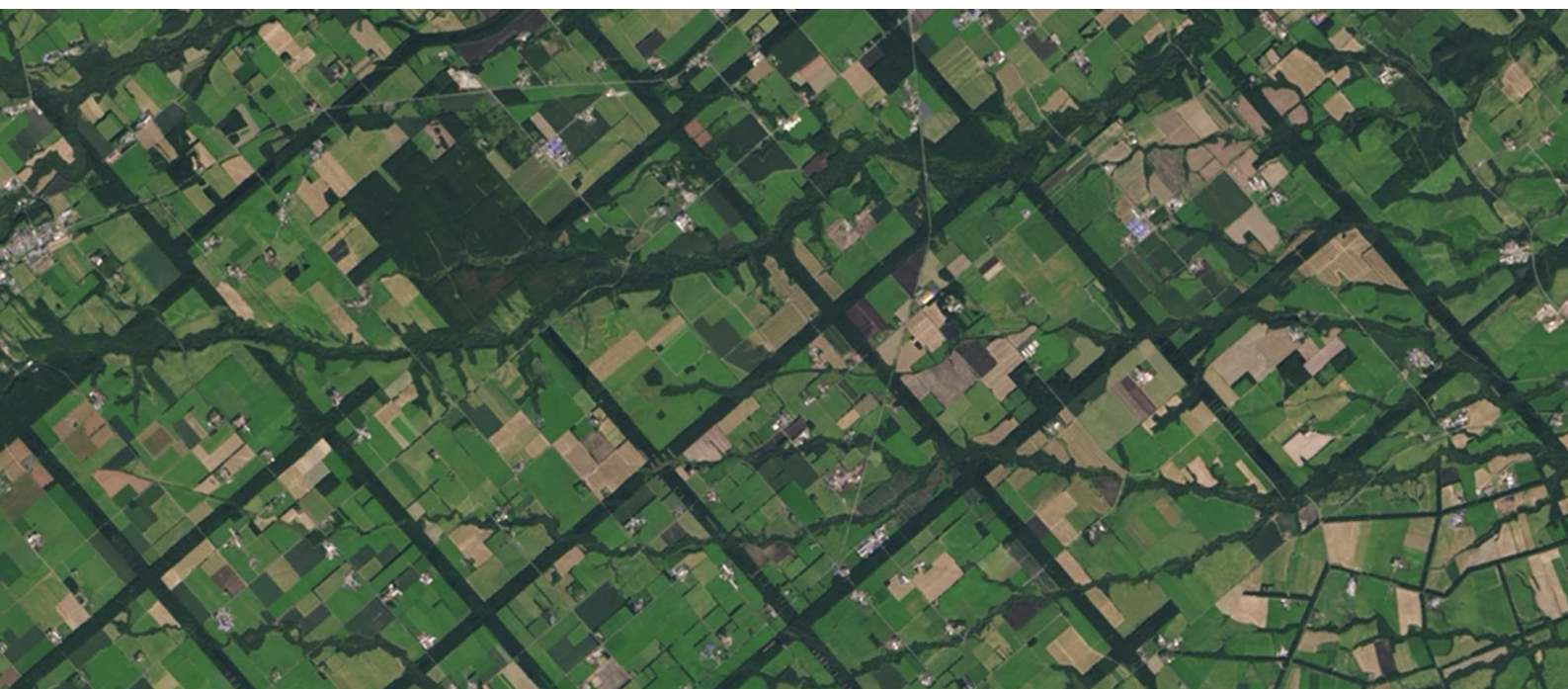
**READ THE SPOTLIGHT STORY ON  
SDG 15: LIFE ON LAND**



## SDG 15: GEO LDN

**With the right information about land, and the right tools to use it, countries can work together with Earth observation organizations to “build back better” after the COVID-19 pandemic. But collaboration between data experts and data users is needed to make sure the information is right.**

That’s why over 100 decision makers joined a Data Quality Standards Workshop hosted virtually by the GEO LDN Initiative and the [United Nations Convention to Combat Desertification](#) (UNCCD) last week.



*From above, the Kosen Plateau in eastern Hokkaido, Japan offers a remarkable sight: a massive grid that spreads across the rural landscape like a checkerboard. The —180-meter (590-foot) wide rows of coniferous trees that help shelter grasslands and animals from harsh weather. Image Credit: [Operational Land Imager on Landsat 8](#)*

The idea is straightforward – if we can optimize and share quality information on what we do and where we can bring land back into balance. In turn, this can help us bring nature, climate, and people’s needs, such as food and energy, into balance. And in the process, we can stabilize the [primary transmission pathway for emerging infectious diseases](#) like COVID-19, which is land-use change.

But getting this done requires unprecedented cooperation among the many providers and many users of that information. In the dedicated Workshop, those end-users provided key inputs on improving the quality of data used to monitor land.



The good news is the necessary framework for success is in place. In 2015, world leaders agreed to [17 Global Goals](#), officially known as the Sustainable Development Goals, that have the power to create a better world. Under [Goal 15](#) (Life on Land) is SDG Target 15.3 on land degradation neutrality, where countries are striving to avoid, reduce, and reverse land degradation. To date, [123 countries are actively engaged](#) and in 2019, over 140 countries [reported on this target](#) in a harmonized way for the first time.

Enhancing the monitoring data so that countries can take effective action has been taken on by the [Group on Earth Observations](#) (GEO), an [intergovernmental](#) body that brings countries and the major data providers together to solve Earth information challenges.

With the [GEO LDN Initiative](#), they have taken on one of the most difficult challenges countries face: harmonizing the myriad of data options and analytical tools into a workstream that is open to all (efficiency and flexibility), capable of meeting the needs of countries in a consistent way (comparability), and capable of empowering countries in the application of complex data sets (national ownership). Thanks to a timely pledge from the government of Germany, data providers have collaboratively contributed to a set of minimum data quality standards, and these are now being reviewed by the policymakers in countries – the ultimate end users of the data.

The countries and organizations collaborating on the GEO LDN Initiative have reached a critical juncture in producing a major upgrade. Turning this aspiration into

action means doing the right things in the right places at the right scale; a holistic approach on how we use and manage land in order for the world to [build back better](#).

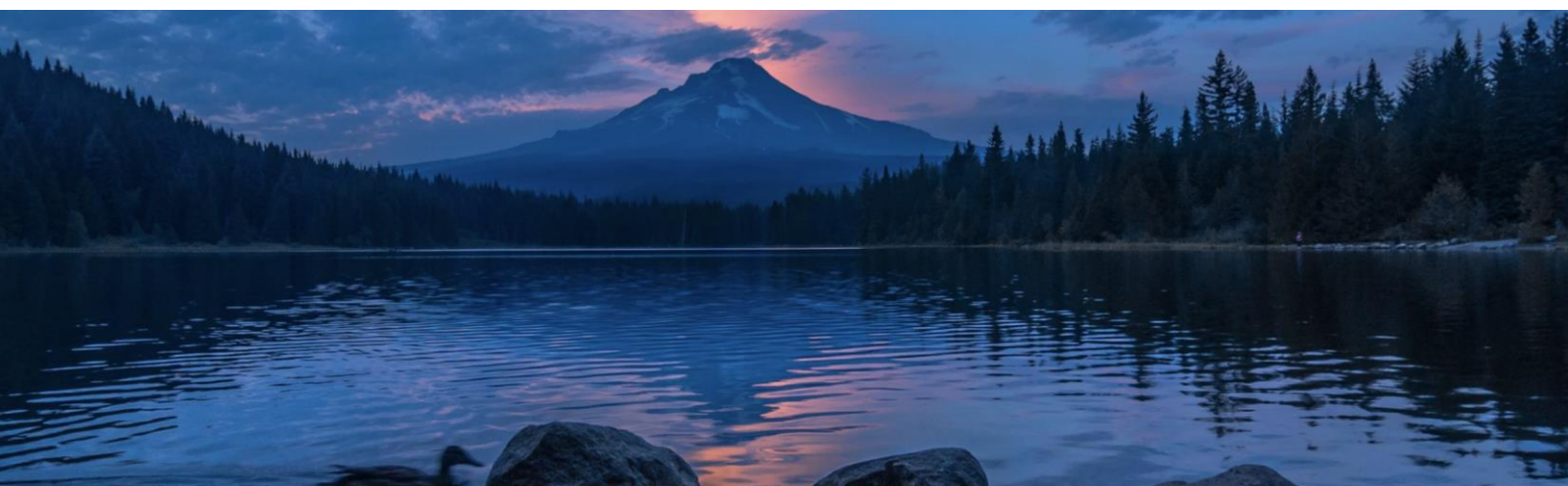
***“We need to turn the recovery into a real opportunity to do things right for the future.”***

*United Nations Secretary-General António Guterres, in his International Mother Earth Day message*

# THE POTENTIAL OF CITIZEN SCIENCE IN MONITORING THE SDGs

To better track the impact of the 17 Sustainable Development Goals (SDG), the UN General Assembly tasked a group of technical and statistical experts with developing a global monitoring framework. This initiative led to the creation and adoption of the current list of 244 SDG indicators by the UN General Assembly.

The SDGs are a vision for achieving a sustainable future. Therefore, reliable, timely, comprehensive, and consistent data are critical for measuring progress towards and ultimately achieving, the SDGs.



Data from citizen science represent one new source of data that could be used for SDG reporting and monitoring. This concept led a team of experts, in association with the Sustainable Solutions Development Network (SDSN) and the Thematic Research Network on Data and Statistics (TReNDS), to develop a research project analyzing the contributions of citizen science on SDG monitoring. This research resulted in the recent publication of [“Mapping Citizen Science Contributions to the UN Sustainable Development Goals”](#) in the Journal of Sustainability Science.

The most remarkable finding of this research was that citizen science could contribute to the achievement of all 17 SDGs by providing data for 33% of SDG indicators. Another important finding of this research is that the greatest potential for citizen science could occur within SDG 15 (Life on Land), SDG 11 (Sustainable Cities and Communities), SDG 3 (Good Health and Wellbeing), and SDG 6 (Clean Water and Sanitation). Additionally, of the [93 environmental indicators in the SDG indicator framework identified by UNEP](#), citizen science could provide inputs for 37 (around 40%) indicators. Currently, around [68% of these environmental SDG indicators lack data according to UNEP](#). If we are to achieve the SDGs by 2030, we need to continue pursuing and highlighting the value of citizen science in the global data ecosystem through initiatives such as the [WeObserve the SDGs CoP](#) by building cross-discipline partnerships surrounding citizen science.

# SUSTAINABLE DEVELOPMENT GOALS



By engaging the public in scientific research, citizen science has the potential to fill research and data gaps, while providing a more interactive platform, in turn allowing for broader participation in addressing the world's greatest challenges. Working together, we can harness the potential of citizen science to achieve the SDGs.

Alongside notable projects and research, GEO, in partnership with the [Earth Day Network](#) and others launched the Earth Challenge 2020 - the world's largest coordinated citizen science campaign to date. Earth Challenge 2020 aims to increase the amount of open and interoperable citizen science data to help answer more complex, global questions than any dataset could address alone. Through a public call to action, the Earth Challenge mobile application empowers volunteers and equips people around the world to understand and act on the data collected to build safer, healthier communities. It is our hope that Earth Challenge 2020 will help engage millions of global citizens while integrating billions of data points from new and ongoing citizen science projects.

# COUNTRY EO USES FOR SDG INDICATORS

**In 2019, EO4SDG conducted a survey on EO uses for the SDGs by GEO Member countries, which helped identify 25 existing EO use cases and 20 forthcoming (planned) use cases.**

A follow-up survey was conducted in 2020, tailored to GEO Members with identified or planned use cases.



This follow up survey requested detailed information, based on a standardized template, on existing EO use cases including the state of use (operational, verifying, or feasibility testing), the types of data and methodologies, and associated gaps and lessons learned. Detailed information on a total of 22 cases from 8 countries has been received, including 7 country EO use cases — from Sweden, Portugal, Germany, and the European Commission — consolidated by the UN-GGIM Data Integration Working Group. Germany compiled supporting information for SDG indicators 11.7.1 (average share of the built-up area of cities that is open space for public use) and 15.4.2 (Mountain Green Cover Index).

These country EO use cases provide invaluable information. From these use cases, other countries can learn and replicate the process to produce SDG indicators and avoid duplication of extra efforts. EO4SDG has also started working more closely with regional GEOs (e.g., AmeriGEO and AOGEO) to collect additional country EO data uses. As a result, the National Administrative Department of Statistics (DANE) of Colombia has provided four country use cases on indicators 9.1.1 (access to all season roads), 11.2.1 (access to public transport), 11.3.1 (land use efficiency), and 11.7.1 (access to open shared spaces). A collaboration with AOGEO to collect EO use cases in the Asia-Oceania region is also in the planning phases.

# DIGITAL EARTH AMERICAS & THE SDGs

The United Nations Economic Commission for Latin America and the Caribbean (ECLAC), the United States National Aeronautics and Space Administration (NASA) and the National Institute of Statistics and Geography of Mexico (INEGI) organized and hosted a Virtual Workshop titled "Digital Land of the Americas".

The main objective of this event was to propose an initial scheme for the project "Digital Earth Americas," with a plan that makes it possible to build operational, analytical, sovereign and open capacity in users from the Americas region for the analysis, use and management of satellite images through the Open Data Cube.



Common needs in the region could be addressed more efficiently as the use of this data solution can also be coordinated with other data solutions in the region or similar data solutions in other regions to take advantage of the strengths of each initiative and to avoid unnecessary duplication of efforts. Hence, the initial focus of this regional platform is the support to the SDGs, a need that is transversal to the region and globally.

While data and technology are available from many sources around the world, there are still significant challenges regarding data access, data preparation, human and technical capacity; focusing on SDGs, the main data source types and methodologies used would be standard and common to any user. A regional cloud-based satellite data solution built with open-source software that uses analysis-ready

data, as well as tools that are already implemented, would significantly benefit country analyses and reporting.

For example, this infrastructure could support monitoring efforts for SDG-2.4.1 (agriculture extent), SDG-6.3.2 (water quality), SDG-6.6.1 (water extent), SDG-11.3.1 (urbanization), SDG-15.1.1 (deforestation), and SDG-15.3.1 (land degradation). Equally, countries could use such a platform to support local and national decision making to address applications such as vegetation phenology, land use and land change, disaster risk reduction, and illegal mining.

# EARTH OBSERVATIONS CLOUD SERVICES

## GEO BON & MICROSOFT AI FOR EARTH

Microsoft's AI for Earth and the GEO BON Secretariat launched the program "Essential Biodiversity Variables in the Cloud", a US\$1 million grant program providing financial support and Microsoft Azure credits to monitor Earth's biodiversity.



Esri joined forces and offered to provide free licenses to the grantees. The call was designed for advancing research that leverages cloud-scale computation to improve biodiversity information.

The program attracted 60 proposals aiming to contribute to developing the Essential Biodiversity Variables. Five projects were selected:

- **Using AI to validate and downscale ecosystem-related Essential Biodiversity Variables (EBVs) in mountain environments (Ruth Sonnenschein, EURAC Research)**
- **AI for the Belize National Marine Habitat Map (Arlene Young, Coastal Zone Management Authority & Institute, Belize)**
- **AMAZECO: Covering the Amazon with an Ecosystem Structure EBV product combining satellite and airborne LIDAR (Ruben Valbuena PI)**
- **Extracting the signal of change in community-composition EBVs from big unstructured species-occurrence datasets through Azure-enabled spatiotemporal analytics (Simon Ferrier and Andrew Hoskins, Commonwealth Scientific and Industrial Research Organisation, Australia)**
- **Bioacoustics and Machine Learning for Automated Avian Species Monitoring in Global Biodiversity Hotspots (Naomi Bates, Songs of Adaptation)**

The nine runners-up were also offered Microsoft Azure credits worth up to US\$15K, technical advice and support, online Azure training materials, and invitations to AI for Earth Summit for networking and education.

# GEO & GOOGLE EARTH ANNOUNCE FUNDING FOR 32 PROJECTS TO IMPROVE OUR PLANET

In 2019, GEO and Google Earth Engine (GEE) [announced a call to action](#) for Earth observations projects monitoring the pulse of the planet to apply for the GEO-GEE Programme.



More than 50 projects were submitted from around the globe on a range of social and environmental topics including climate monitoring, water and coastal observations, sustainable development and other key areas related to environmental protection and conservation

Through a careful review process, the GEO-GEE programme selected proposals from organizations and initiatives that will deliver significant impact using Earth observations and data science with respect to improved decision making. Projects with direct relevance to global policy agendas including the Sendai Framework for Disaster Risk Reduction, the Paris Agreement on Climate Change, the United Nations 2030 Agenda for Sustainable Development, as well as ocean conservation and biodiversity preservation were encouraged and considered essential elements of the proposals.

***“Impact begins with insights. Organizations globally are using Google Earth Engine to achieve an unprecedented understanding of our changing environment and turn data into action...We are honored that Google Earth Engine can support the people behind these 32 winning projects as they tackle pressing global issues, from forest degradation and flood monitoring to natural resource management and global climate change.”***

Rebecca Moore, director of Google Earth, Earth Engine & Outreach

On July 13, 2020, GEO and GEE announced 32 projects from 22 countries that were awarded \$3 million USD towards production licenses and \$1 million in technical support from EO Data Science to tackle some of the world’s greatest challenges using open Earth data. The GEO-GEE Programme is also supporting projects with

the United Nations Environment Programme (UNEP) and the United Nations Economic and Social Commission for Western Asia (UNESCWA) to use Google Earth Engine to support climate change and disaster monitoring activities over the next two years.

The winning projects are responding to a wide range of environmental and social challenges using real-time Earth observation data coupled with cloud computing, some of which include: mapping poverty data and vulnerable settlements, deforestation and land degradation, flood warnings, marine coasts, ice shelf monitoring, environment, and climate stress, food and agriculture and many more.

***"GEO is very proud to be supporting these projects in collaboration with Google Earth Engine and EO Data Science. I am thoroughly impressed with the number, quality, and diversity of proposals we received. The diversity in terms of the topics, regions, and approaches is a testament to the fact the Earth observations are instrumental for a wide range of applications and solutions."***

Gilberto Camara, GEO Secretariat Director.

The GEO-GEE programme is carried out in cooperation with the GEO Secretariat, GEO Programme Board, Google and EO Data Science. Google is providing production licenses to use GEE and EO Data Science is providing ongoing technical support, mentoring and capacity development support through a targeted outreach programme

# **GEO & AMAZON WEB SERVICES: CLOUD GRANTS TO IMPROVE UNDERSTANDING OF OUR PLANET**

In December 2018, GEO and Amazon Web Services (AWS) announced the Earth Observation Cloud Credits Programme, a joint collaboration to offer GEO members and research organizations access to AWS Cloud services to help countries realize the potential of Earth observations for sustainable development.



Access to and analysis of large volumes of Earth observation data is challenging for many of GEO's members, particularly in developing countries where resources are limited, and internet connectivity is poor or unreliable. To help address some of these challenges, the GEO-AWS Earth Observation Cloud Credits Programme offers developing countries access to complimentary cloud services to help with the hosting, processing and analysis of big data in the field of Earth observations.

Through this programme, GEO encouraged agencies and research organizations from GEO members categorized as Developing Countries by the United Nations Development Programme (UNDP) to apply for cloud grants to support non-commercial projects. Agencies and organizations from a single country could apply for up to \$60,000 of AWS Promotional Credits over a three-year period, while multinational projects could apply for up to \$100,000 in AWS Promotional Credits over the same period. Submissions were accepted from December 2018 through April 2019.

Through this request for proposals, GEO has received and approved support for 21 projects which have received access to AWS Promotional Credits to offset the cost of developing cloud-based sustainability applications using Earth observations. Recipients of cloud credits through this initiative are also receiving support from the

GEO community and AWS experts to refine and implement their projects for the best possible results.



Awardees span a broad range of applications from monitoring of wildfires, managing ground water resources, improving agricultural yield to mapping and monitoring of forested areas. All the awarded projects are contributing to activities of the GEO Work Programme, in particular GEO's three engagement priorities: the Sendai Framework for Disaster Risk Reduction, the Paris Agreement for Climate and the United Nations 2030 Agenda for Sustainable Development. They will leverage Earth observation data from open, free, and fully accessible sources and are encouraged to use the GEOSS Platform the Registry of Open Data on AWS. The GEO Secretariat is also facilitating access to analysis-ready data from the Copernicus and Landsat programmes for projects wishing to make use of this data.

