*2020-2022 GEO Work Programme*
*Track 2 – Guidance for Development of Implementation Plans for GEO Community Activities*

# Next-EOS Implementation Plan

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# 1. Executive Summary

**Full title of the Community Activity**

Next Generation Earth Observation Services

**Short title or acronym**

NEXT-EOS

**Proposed or existing category**

Community Activity

**Overview**

The quantity and quality amount of Earth observations, both space-based and in-situ, is growing rapidly, yet the transformation of data to information and knowledge to benefit our society remains a significant challenge.

The aim of NEXT-EOS Community Activity is to facilitate **faster uptake** of Earth observations in science, applications, industry and services in support of the UN Sustainable Development Goals, the Paris Agreement, the Sendai Framework and the GEO Societal Benefit Areas, and demonstrate the power of Earth observations in critical decision making process.

The **NEXT-EOS Community Activity** seeks to achieve faster uptake through operating a datahub and a set of platform services in support of Earth observation technology innovators & application builders. The NEXT-EOS Community Activity relies firstly on existing federated services provided by its members, leveraging EU funded resources and more. The NEXT-EOS Community Activity will work with other GEO Community Activities, Initiatives, and Flagships especially the regional hubs EuroGEO, AmeriGEO, AfriGEO and AOGEO, with the goal to improve interoperability and embrace best practices.

The NextGEOSS Data Hub and Platform provides the core resources with its data hub, platform services, based on internationally accepted standards, as well as the on-boarding process and capacity building resources designed as an ecosystem of interlinked services. Additional resources in terms of technology services and expertise from the GEO community at large ensures the testing and integration of new EO applications and technologies.

NEXT-EOS Community Activity aims to offer a collaborative testbed environment dedicated to the integration, testing and transfer to operations of Earth observation based applications and knowledge. The results enrich the existing thematic knowledge throughout the GEO work program.

The NEXT-EOS community is fundamentally user-centric, continuously identifying the needs of the GEO communities for the evolution of platform services serving the GEO communities.

**Planned activities** (summary of section 4 below)

1. Setup the Governance structure of the Community Activity;
2. Engage with stakeholders within the GEO Work Programme and beyond;
3. Maximise the engagement with data, applications and knowledge providers;
4. On-board new users and partners in NEXT-EOS;
5. Gather requirements from the users;
6. Organise Testbed Implementation Pilot (TIP) activities based on the testbed environment for applications in prototype phase;
7. Organise Testbed Operations Pilot (TOP) activities, incubating advanced applications going beyond the demonstration phase;
8. Collaborate with existing organisations for additional testbed activities and Architecture Implementation Pilots;
9. Operate, maintain and evolve the existing services of the NEXT-EOS testbed environment;
10. Disseminate the NEXT-EOS activities and achievements.

**Points of Contact** (primary contact persons for the Community Activity and their email addresses)

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# 2. Purpose

The aim of NEXT-EOS Community Activity is to facilitate **faster uptake** of Earth observations in science, applications, industry and services in support of UN Sustainable Development Goals, Paris Agreement, Sendai Framework, and the GEO Societal Benefit Areas as well as demonstrate the power of Earth observation in critical decision making process in GEO. Starting with the NextGEOSS platform services and 5-step user experience for its on-boarding process, the NEXT-EOS Community Activity offers a testbed environment for co-design that is open to application developers coming with new technology and ideas or challenges. The core principle of NEXT-EOS is to collect application requirements and identify potential technology gaps from the thematic experts in the GEO community. The NEXT-EOS testbed environment provides the support and resources to prototype and implement these ideas and applications, and open and freely return the knowledge back to the community. This allows the GEO community at large to benefit from the results of developments made by the H2020 NextGEOSS partners (ICT partners, standards specialists, scientific domain experts and user communities) as well as the experiences gained already within most of the GEO Social Benefit Areas, via more than 10 pilot applications on-boarded already. The GEO community at large will also benefit from the return of experience of the current vibrant communities of existing pilots, as users of the NextGEOSS Data Hub and Platform, including from training and engagement activities that have demonstrated that it is possible to transfer knowledge across disciplines. The purpose of the NEXT-EOS Community Activity is to allow the different regional GEOs to benefit from the proven initial engagement concept and capacity building contributing to the scalability of

results from the various regions, showcasing the benefit of combining components developed in other GEO related activities. The purpose is also to bridge science, technology and operational services in a way that is reusable and possible to tailor to the different GEO regions. NEXT-EOS activities - from data discovery to cloud integration and analytics monitoring - can be individually selected by application providers for prototyping in the TIP[1] and TOP[2] activities, encouraging flexible cooperation and strengthening a global Earth observation community, able to absorb new technology and solutions for society at large.

# 3. Background and Previous Achievements

The NEXT-EOS Community Activity consolidates resources and developments from the H2020 project *NextGEOSS: Next Generation of the Global Earth Observation System of Systems* (2016-2020). This H2020 project (www.nextgeoss.eu) is an European contribution to GEO and GEOSS, and the project activities and results are distributed over several GEO flagships, initiatives, and communities, including the GEOSS platform (former GCI).

The NEXT-EOS community activity will facilitate increased use of a set of Platform Services: 1) User Management for single sign-On (SSO) with Authentication, Authorisation and Accounting (AAA); 2) Data cataloguing and archiving; 3) Service cataloguing; 4) Geospatial user feedback; 5) Cloud integration environment; 6) Cloud bursting to production environment(s); 7) Operations, analytics and monitoring dashboards service; and 8) Service Desk operational support. The NEXT-EOS activities will also be comprised of the access to these services and their underlying resources by application builders, developer user support on the testbed environment for the evolution and prototyping of applications, and the delivery of monitoring insights to application providers having their applications deployed in operations.

NEXT-EOS engages the main providers of Earth Observation assets, including several GEO activities, Copernicus Collaborative Ground Segments and Core Services, supporting the GEOSS Platform with standard interfaces for middleware component in charge of interconnecting the heterogeneous and distributed capacities contributing to GEOSS. NEXT-EOS adheres to GEO Data Management and Sharing principles.

NEXT-EOS relies on demonstrative GEO pilot applications and other Earth observation related activities to showcase the importance of Earth observations in support of the GEO goals, while supporting their exploitation in research projects or in operational contexts.

NEXT-EOS will offer a 5-step user experience with the support of an advanced onboarding process. Capacity building is integrated in these steps. Innovative educational engagement through hackathons facilitates the uptake and secures the relevance of the NEXT-EOS services.
NEXT-EOS will leverage the past achievements and resources which demonstrated already a large set of added-value to Earth observation-based applications from several application providers - see the testimonials and return of experience presented during the Platform Integration session at the NextGEOSS Summit-3 in Lisbon, July 3rd, 2019.

[1] Testbed Implementation Pilots.
[2] Testbed Operations Pilots.

# 4. Key Activities

During the 2020-2022 period, NEXT-EOS will focus on *A)* **ensuring operational availability**, maintenance and evolution of the NEXT-EOS Testbed Environment services[3] in support of selected GEO activities; *B)* Delivering sustained **support to the applications** that have been integrated over 2018-2020 as "Pilots" of the EC project NextGEOSS; *C)* **engaging** with additional data, applications and knowledge providers; *D)* Identifying the **technology needs**, challenges and pain points from the EO thematic experts, and evolve/complement the NEXT-EOS technology suite through collaborative initiatives.

The proposed activities are:

1. Setup NEXT-EOS governance structures;
2. Organise a KickOff meeting of the Community Activity's Steering Committee (followed by Steering Committee progress meetings to be held yearly) as a satellite to a GEO event (e.g. GEO Week);
3. Consolidate the participation in NEXT-EOS Community Activity with NextGEOSS project partners and additional individual participants, and also international partners and collaborations (e.g. GEO Community Activities, initiatives, Regional Groups, Flagships and Foundational Tasks);
4. Engage with GEO-Sec and funding institutions;
5. Engage with additional EO application providers (e.g. H2020 E-SHAPE) and data providers, including ongoing funded projects;
6. Engage with the EO application providers in the GEO community to identify the current technology gaps and challenges and new ideas;
7. Engage and invite new technology providers complementing the NEXT-EOS services to address the needs of the GEO community;
8. Promote and implement a TIP-TOP activities to address the needs of the communities in terms of prototyping, testing, implementing and assessing new technology solutions. This encompasses co-design, standards implementation, processes development and integrated capacity building including:
    a. Exploring the **data hub** potential for demonstration usage of data resources, and relevance for the research and business community;
    b. Continued **support to EuroGEO** in particular through E-SHAPE, supporting interoperability between regional catalogues following the model for collaboration with AmeriGEO on sharing common, open APIs;
    c. Demonstrating **technological scalability** and ICT resources provider agnosticity of pilot applications;
    d. Assessing **geographical scalability** of NEXT-EOS EO application pilot activities, through the identification of data and interface requirements for using selected pilot applications for new geographic areas;
    e. Facilitating the transition from research to operations;
9. Sharing the results, knowledge, tools and resources from NEXT-EOS' activities open and freely with the GEO community, to advocate the value of GEO and contribute to broad capacity development;

[3] Currently, the NextGEOSS Platform Services are 1) the User Management service; 2) Data Cataloguing; 3) Service Cataloguing; 4) User Feedback service; 5) the Cloud Integration service; 6) Operations, Analytics and Monitoring Dashboards service; and 7) Service Desk operational support.

10. Perform operations, maintenance and evolutions of NEXT-EOS services based on the GEO community needs, including continued support for ongoing pilot applications.

# 5. Relationship to GEO Engagement Priorities and to other Work Programme Activities

The NEXT-EOS Community Activity will support all regional GEOs. Originating as a major contribution to EuroGEO and GEO, working on defining common open APIs with AmeriGEO, this activity will support the interoperability of all regional GEOs: EuroGEO, AmeriGEO, AfriGEO, AOGEO as well as providing testbed environment for all.

The NEXT-EOS Community Activity provides its knowledge, facilities and resources (the data hub and platform services), as a collaborative testbed environment to all interested Flagships, Initiatives and Communities, as well as with selected Foundational Tasks on technology and data handling.

By serving as a collaborative environment for next generation technologies and users, NEXT-EOS Community Activity also contributes to GEOSS. It provides a space where new ideas and technologies can be tested and results from the NEXT-EOS Community Activity - including the technology evolution and EO applications - can be demonstrated to relevant GEO Foundational Tasks (i.e. connected with data handling and GEOSS).

The initial proposed set (see below table) of Pilot activities (from NextGEOSS) have been addressing the needs of the user communities from various thematic areas and contributing to the UN Sustainable Development Goals, Paris Agreement and Sendai Framework. NEXT-EOS pilot activities are not limited by this initial scope.

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| SDG 2 (Zero Hunger) | Crop Monitoring Supporting Food Security<br>(Led by VITO) |
| SDG 3 (Good Health and Well Being) | Disaster Risk Reduction<br>(Led by NOA)<br>Air Pollution, Urban Growth and Health Risks in Megacities<br>(led by DLR) |
| SDG 4 (Quality Education) | Essential Biodiversity Variables<br>(Led by ITC) |
| SDG 7 (Affordable and Clean Energy) | High Resolution Solar Mapping at Urban Scale<br>(Led by ARMINES) |
| SDG 11 (Sustainable Cities and Communities) | High Resolution Solar Mapping at Urban Scale<br>(Led by ARMINES)<br>Disaster Risk Reduction<br>(Led by NOA)<br>Air Pollution, Urban Growth and Health Risks in Megacities<br>(Led by DLR)<br>High Resolution Mapping for Territorial Planning<br>(Led by DEIMOS) |

| | |
|---|---|
| SDG 12 (Responsible Consumption and Production) | Air Pollution, Urban Growth and Health Risks in Megacities<br>(Led by DLR) |
| SDG 13 (Climate Action) | High Resolution Solar Mapping at Urban Scale<br>(Led by ARMINES)<br>Disaster Risk Reduction<br>(Led by NOA)<br>Essential Biodiversity Variables<br>(Led by ITC) |
| SDG 14 (Life Below Water) | Essential Biodiversity Variables<br>(Led by ITC) |
| SDG 15 (Life on Land) | Essential Biodiversity Variables<br>(Led by ITC) |

The *Disaster Risk Reduction pilot* lead by NOA is aligned with the *Sendai Framework for Disaster Risk Reduction.* The pilots in Renewable Energy (*High Resolution Solar Mapping at Urban Scale*), *Disaster Risk Reduction* led by NOA, *Air Pollution, Urban Growth and Health Risks in Megacities* led by DLR are aligned with the Paris Agreement objectives. NEXT-EOS is committed to continuously support the objectives of Sustainable Development Goals, Sendai Framework and the Paris Agreement.

# 6. Governance

The proposed NEXT-EOS Governance Structure for the period 2020-22 is the following:

The **Steering Committee** (SC) will be composed of all participants of the Community Activity. The SC is the highest authority of the activity, having the ultimate responsibility for the definition of the strategy and for ensuring the fulfillment of objectives.

The **Executive Committee (**ExCo**)** is responsible for preparing the NEXT-EOS Action Plan for approval by the SC, for ensuring that SC decisions are implemented, and for creating Working Groups (see below). It will be composed of the chairs of each of the Working Groups.

The initial proposed **Working Groups** in the NEXT-EOS Community Activity, for each of the following areas of activity[4] are:

1. *Coordination*: including managerial and technical coordination, interface with the GEO-Sec and funding institutions and responsible for resource planning, collaboration agreements, request for funding and general sustainability;
2. *Architecture and Interoperability*: support infrastructure needs, interoperability, handling IT issues, process optimisation and automation, UX/UI optimisation, improvement of platform metrics, assessment of new technologies (e.g. data cubes, knowledge hub, artificial intelligence);
3. *Data Management*: (meta-)data curation and preservation through the existing datahub, enforcing data quality (Quality of Service and User Feedback included), data discoverability and access, securing new datasets, compliance with standard

[4] This Governance model closely follows the approach presented by the NextGEOSS partner EuroConsult at the NextGEOSS General Assembly of 5th June 2019, entitled *"NextGEOSS Sustainability Assessment Presentation"*.

metadata models, handle licencing issues, establishing data provision partnerships, promoting publication of data and adoption of GEO data sharing and data management principles;

4. *Platform Services*: to continuously assess the technical and operational needs and requirements of emerging GEO applications and services, cluster applications into groups with similar technology needs, assess effective user value created in NEXT-EOS, prepare a living gap analysis repository, involve application providers in the co-design of the NEXT-EOS services support the operationalisation of applications;
5. *Operations and Monitoring*: monitor and operate NEXT-EOS services, evolve automated monitoring systems to detect and fix errors, monitor and report metrics, operate Service Desk for support of application developers/integrators, have a defined and rapid and easy onboarding process for newly engaged partners, and for data and service providers;
6. *Dissemination*: responsible for community[5] engagement and growth, support the thematic and geographic outreach of services through engagement with users, through hackathons, ideathons, etc. represent NEXT-EOS at high profile events and conferences, branding of activity and services, website, social media, promotion and outreach;
7. *Capacity building*: responsible for integrated capacity building throughout the activity, creating training materials, and organizing user training events, webinars and hackathons.

\+ *Thematic user groups*: to be the voice of the user community of Earth observation thematic application developers and defining their needs and requirements for the NEXT-EOS technology evolutions and identifying the technology layers that can be further incorporated to empower EO Application builders. A number of thematic groups will be formed by inviting the participation of experts from several thematic areas e.g. Marine, Land, Renewable energy, etc.

# 7. Data Policy

NEXT-EOS adheres to the GEO Data Sharing principles:

- *There will be full and open exchange of data, metadata and products shared within GEOSS, recognizing relevant international instruments and national policies and legislation;*
- *All shared data, metadata and products will be made available with minimum time delay and at minimum cost;*
- *All shared data, metadata and products being free of charge or no more than cost of reproduction will be encouraged for research and education*

As an example of the adoption of these principles, the Datahub, to be available for NEXT-EOS is an open metadata catalogue of EO datasets.

NEXT-EOS also closely follows the GEO Data Management Principles of Discoverability, Accessibility, Usability, Preservation and Curation[6]. By making a large amount of relevant data discoverable online and with a standard API, Data Hub is directly targeting not only DMP-1 and DMP-2, but also supporting GEO communities in accomplishing DMP-3 and DMP-4 by enriching metadata records using standardised methods, and also in DMP-5, by

[5] Including other GEO activities; GEO regional groups; data, services and knowledge providers.
[6] See to DMP-LV for references to the individual Data Management Principles, DMP-x.

recognising all data providers in a clear and open way in the Data Hub. To address DMP-6 and DMP-8, the quality and integrity of the (meta)data records are continuously monitored through 1) the QoS service and the Sentinels Data Linker service (both services currently in evolution). The assessment of EO data quality is supported by the User Feedback mechanism, where the data user can easily give feedback on the data and its usage. The preservation (DMP-7) and curation (DMP-9 and DMP-10) process is currently being assessed to ensure that all data generated is guaranteed to be preserved at least for a reasonable time horizon (e.g. with a visibility of 3-5 years) for the GEO community

# Tables

## A. Individual Participants

*(To be provided at a later stage)*

## B. Confirmed Contributions

The expected contributions include the platform services and pilot applications of the NextGEOSS project partners, as well as additional contributions from the enlarged community. The EC funded NextGEOSS project is confirmed to contribute to mid 2020. Several E-SHAPE pilots are confirmed contributions.

# Annexes (additional annexes may be added as required)

## I. Acronyms and abbreviations

N/A

## II. Brief CV of Project Leader(s)

**Nuno Catarino**

Nuno Catarino is the Head of Data Systems / Payload Data Ground Segment Division of the DEIMOS Group, being responsible for the operations and business development activities across locations of the division in Madrid, Lisbon and Harwell, with more than 20 people. Nuno has lead many projects for ESA, the European Commission and other clients, in the areas of Data Systems, Satellite Ground Segment and Data Processors, including for the the European Sentinel missions, ESA's SMOS Earth Explorer, the GEAF intelligent Ground Segment orchestrator, as well as many studies and development actives on the state-of-the-art GNSS Reflectometry technologies (H2020 E-GEM, ESA's PARIS IOD, GEROS-ISS, GARCA and GNSS-R for Land). He is also currently the Coordinator of the H2020 NextGEOSS 10M€ project, building an European data and processing hub for GEO, leading a consortium of 27 partners, and is also co-responsible for the SARGO product development at DEIMOS, using GNSS-R technologies. Nuno has a PhD in Applied

Mathematics from the University of Warwick, and a first degree in Physics Engineering from Instituto Superior Técnico in Lisbon. Nuno joined DEIMOS in June 2006.

**Pedro Gonçalves**

Dr. Pedro Gonçalves is Terradue director, a company he started in 2006 as a spinoff of the European Space Agency following his postdoctoral work designing the Grid infrastructure in ESRIN, the ESA G-POD (Grid Processing on Demand for Earth Observation). Pedro is a member of the GEO Expert Advisory Group and also editor of Open Geospatial Consortium (OGC) specifications promoting the interoperability of Earth Observation discovery and processing services. He just co-chartered a new Domain Working Group focusing Earth Observation Exploitation Platforms that brings together EO data, services and technology providers in an open forum for the discussion and presentation of interoperability requirements, use cases and pilots.

**Bente Lilja Bye**

Bente Lilja Bye is the founder and CEO of BLB, a research and consulting company specializing in the gathering, management and application of business intelligence, as well as decision making support, risk management and corporate social responsibility. Previously, Lilja Bye was Research Director of the Norwegian Mapping Authority. She also served as Director of the European Sea Level Service (ESEAS) Central Bureau and coordinated the EUfunded European Sea Level Service Research Infrastructure project. She has a scientific background in theoretical astrophysics and has been involved in international and national science policymaking and administration for many years. She has held several commissions of trust (chair, board member, etc.) in private companies as well as in international organizations. As Managing Director of ViaNova IT – an ICT company producing advanced software for civil engineering worldwide, she gained operational experience from the private sector. She contributes to the Group on Earth Observations (GEO) through the company BLB representing Norway in the GEO Program Board. She has represented both Norway and international organizations in the GEO plenary and GEO subgroups, including the GEO Working Group on Tsunami Activities. She is also involved in GEO's Cold Regions activities and Citizen Science activities both in GEO and Europe. She has contributed to several working groups in Research Data Alliance (data brokering, spatial data and cost recovery). Lilja Bye was a member of the Svalbard Integrated Arctic Earth Observing System (SIOS) administration team at the Norwegian Research Council responsible for the SIOS distributed data management system implementation plan and data policy in particular. She started science outreach work as a member of the Global Geodetic Observing System (GGOS) Steering Committee and chaired the GGOS Working Group on Outreach and User Linkage. She is a featured writer on Science 2.0, a leading international science site and has won several awards for her outreach productions. Bente Lilja Bye are involved in multiple capacity building activities, including running educational webinars, organizing hackathons, etc.
Her specialties include: geodesy, climate change, geohazards, disaster management, data management, science policy, astrophysics and Material and nanotechnology.

**Marie-Françoise Voidrot**

Marie-Francoise Voidrot (female) is responsible for planning and managing interoperability initiatives such as testbeds, pilots and interoperability experiments with an emphasis on activities in Europe and initiatives related to Earth Observations. She is involved in several initiatives of importance to GEO the Group on Earth Observations, including the H2020 NextGEOSS and E-SHAPE projects, and OGC's Disasters Concept Development Study. She is also part of the GEOSS-EVOLVE initiative, alternate representative for OGC to the GEO Program Board and participated in the GEO Expert Advisory Group.
Prior to joining OGC, Mrs Voidrot was Senior Project Manager for numerous meteorological information systems for use by Meteo-France and by major customers in spatial, defense or aeronautical activities. Hence, she brings a global end to end vue of the information systems from production to a large variety of community application activities. From 2009-2016 she served as the Meteo-France representative to the OGC and as a co-chair of the OGC Met Ocean Domain Working Group working to align representatives from across the Met Ocean community with OGC standards experts regarding a range of interoperability requirements.
Mrs. Voidrot holds 2 degrees from Grandes Ecoles Françaises : graduated in Informatics from Ecole Centrale Paris and graduated in Meteorology from Ecole Nationale de la Météorologie. As part of her MS degree in informatics, she worked on multi-dimensional data visualization at the Space Science and Engineering Center in Madison, Wisconsin.