

**Space Climate Observatory Program
Application to the
GEO Work Program 2020-2022
As a GEO Initiative
by CNES and SCO Founding Partners**



A world Observatory of Climate Change and its impacts

Executive Summary

The Space Climate Observatory founding partners are proposing to the Group on Earth Observations that the Space Climate Observatory (SCO) becomes a GEO Initiative in the GEO Work Program 2020-2022. The SCO is a response mechanism aiming to address Planet Earth global changes along with proposition of key adaptation and mitigation measures: its ultimate objective is to fill the gap currently existing at international, regional and national levels to assess and monitor the impact of climate change using space and in-situ observations with models. It will therefore provide an easier access to multisource data in addition to existing global climate datasets (e.g. ECV) and to downscale scenarios on impacts of climate change to finer scale. The SCO will reinforce climate change impacts monitoring capacities such as forest fires, impacts on crops, coastal areas, urban heat island, ocean biology, glacier retreat, health ... The SCO will be science based, co-build in an international partnership framework and will take direct benefit from recently available high-resolution Earth Observation data.

While international research programs on climate have already well demonstrated the role of anthropogenic impacts on climate change with identified key trends at the global level (rise of the T° , rise of the height of the oceans, amplification of the extreme events ...), there is still an urgent need to address the climate change induced risks at thinner scales to allow effective actions from all parties including civil society, the private sector, financial institutions, cities and other subnational authorities, local communities and indigenous peoples.

To address these needs, the SCO program will promote at the international level an easier access to high-resolution satellite data, in-situ data, processing and modelling capacities that are needed for the production of thinner scale climate change scenarios. This will be done through international cooperation on climate change adaptation issues between space agencies, research institutions, citizen science entities and stakeholders. In general terms, the SCO proposal intends to participate to four international engagements: *i*) the Cancun Adaptation Framework ; *ii*) the article 7 of the Paris agreement on climate change ; *iii*) the SDG 13 and different other SDGs such as SDG 6,..“Take urgent action to combat climate change and its impacts” of the 2030 agenda and the Sendai Framework for Disaster Risk Reduction. While launched in the framework of the One Planet Summit in Paris (December 2017), the SCO can also be considered as an outcome of the IAA Mexico Summit declaration stating that international coordination is imperative to address climate change issues. The SCO will be complementary to existing international programs and work in coordination with the UNOOSA, the CEOS, the GCOS and will sustain the work of the UNFCCC and the IPCC. Downstream from these major programs, the SCO aims to help regions, countries and subnational entities to prepare for climate change in relation to GEO social benefit areas, to provide trans- and multi-disciplinary expertise in monitoring the impacts already visible and to build, exchange and transfer realistic scenarios to best address them across the territory. The initiative is relevant to GEO strategic objectives and follows the model of GEO projects. Main outcome from the SCO should be the emergence of an international forum/platform gathering space agencies, frontier technologies, research institutions, citizen science entities, funding agencies, national and subnational stakeholders willing to promote the co-production and use of thinner scale climate change impact scenarios, products and indicators to promote actions, strengthen resilience and reduce vulnerability with regard to climate change impacts.

1. Synopsis of objectives and benefits

The essential objective of the SCO will be to **track the impacts of climate change impacts**, in relation to the 8 GEO Social Benefit Areas. To do so, the SCO will network and complement the existing systems to provide needed environmental data and information (from both Space and In Situ databases). Highlighting the impacts of climate change will **stimulate the definition and implementation of mitigation and adaptation** actions at regional/national/local scales by policy makers.

To achieve its general objectives, the SCO will have to pursue technical enabling objectives in the field of data and information production, access and dissemination, and deploy efficient procedures and technical means about : i) **Information, Outreach, Communication, Education** : reaching users, promoting SCO and disseminating results; ii) **Improving multi-source data access** fitted to users' needs and methodological approaches in the broad domain of climate change impact identification; iii) **Products and Services** : definition, development and distribution of products and services relative to climate change impact at regional/national/local scales.

The SCO will adopt a **co-designing approach** to achieve these objectives, the collective international effort aiming at stimulating, supporting and multiplying local/individual initiatives in a joint approach. Through SCO coordination, duplication of efforts and expenses will be minimized. Relevant procedures, information and data will be made available to a number of countries to which they wouldn't be affordable otherwise. SCO will be dedicated at filling the gap between on one hand operational and well assessed products and data produced globally, particularly from space, and on the other hand the needs for relevant information to track Climate Change impacts in various domains, contexts and environments : this will require specific collection and consultation of information, case studies, and robust, well-established and well referenced methods to track impacts. These would result in fully documented, fully assessed protocols designed by the SCO or referenced by the SCO when they already exist. It would allow building a worldwide network of Climate Change impact assessments, whose methods could be at least partially mobilized and used by stakeholders facing a specific climate change impact.

SCO is **relying on a network of organizations addressing climate change issues in all countries keen to participate**. The missions of SCO would be deployed in each country by national stakeholders and the outputs and results in terms of impact of climate change and related indicators and scenarios would then be freely available, shared and disseminated to all through the SCO network. One challenge facing the SCO is to provide an easy access to all available data and to **establish indicators and decision-support tools at population level (national and subnational scale) in coordinated and cross-disciplinary fashion, including with social and economic sciences**.

Because of the unique characteristics and added value of satellite data, space agencies have a major role to play articulating their efforts in order to deploy an easy multi-source data access through the SCO international gateway or HUB. This gateway will be open to the science community and public authorities, supporting them to develop products using space data in complement of in-situ data, in their efforts to identify and characterize the impacts of climate change. Specifically, the SCO, defined as a network of organizations designing, referencing and

assessing climate change impact cases and scenarios, would be a major user of climate data production services (ESA, Copernicus Climate Change Service, EUMETSAT, NASA, NOAA, etc.), among others and in combination with other high-resolution space data. The products, the associated expertise and methodology, will be promoted and made available through the SCO so that they can be mobilized, reproduced or adapted in quasi-similar contexts. This way, the regional, national or local added value brought by international experts establishing the climate change impact identification and related protocols would be recognized to the benefit of other countries or users.

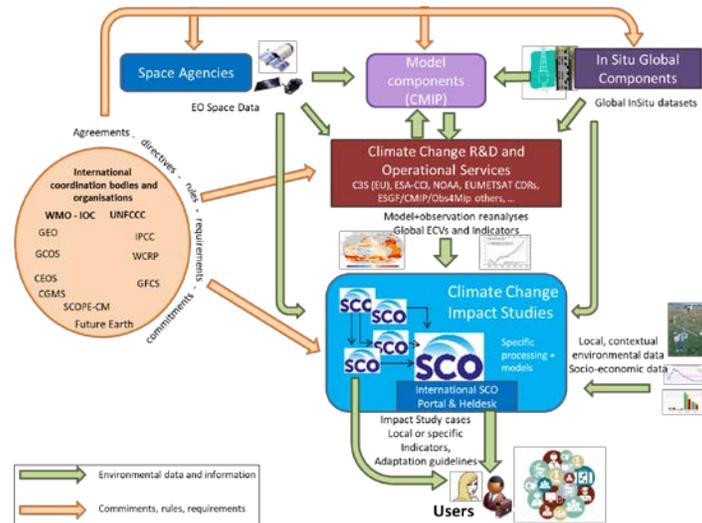
The specific SCO added value in the monitoring of the impacts of climate change can be synthesized in the following way:

- **Key role of Satellite Earth Observation data for monitoring the impacts of climate change: Space agencies have a major role to play**, in complement to already existing services delivering global datasets, Climate Data Records and Essential Climate Variables, to provide dedicated or tailored space data addressing the impacts of climate change at local (regional/national/sub-national) scale. These can be for instance High Resolution data, multi-mission/multi-sensor data from data fusion processing, etc, needed to support specific studies when associated to other sources of data (global environment datasets, records, ECVs, infrastructure, socio-economic data and statistics, etc). Indeed a large variety of space data may be necessary for monitoring the impacts of climate change in specific application domains or geographical areas, but are not in the list of existing ECVs or global Climate Data Records. One can cite for instance optical High Resolution data for monitoring the shoreline or local ground motion measurements from Radar interferometry.
- **Data, results and indicators produced from studies tackling the impacts of climate change:** each regional/national/local initiative will produce study reports, specific indicators, as results of analysis of the impact of climate change from heterogeneous sources of data. This information will be produced for the specific benefit of the particular and local study, but it could also be made available through the SCO for a better international dissemination (e.g. to promote the exchange of best practices), improving global knowledge and awareness about the impacts of climate change for different kinds of audience like policy makers, local and international media and citizens.
- **International coordination of regional/national/local initiatives about the impacts of climate change** is another major SCO objective. It will be highly valuable, when appropriate and possible, to facilitate agreements between different initiatives, for sharing input data, protocols, knowledge, processing, results, etc. Such procedures could be made at least partly re-usable in other contexts or areas, therefore saving regional/national/local funding and not duplicating efforts. When made available through the SCO these data and information would be made available according to coordinated rules and standards, if appropriate. Through the SCO, a specific support will be provided for the deployment of impact case studies building upon already existing and shared initiatives, and enabling an easy interface between local actors from different contexts and data information providers, including Space Data providers.
- **An international shared data portal to monitor the impacts of climate change:** this portal will be the enabling unified system through which most objectives of the SCO will be made possible. It will give access to all sources of data and information relevant to monitoring the impacts of climate change. Built in a co-constructing effort as a network of regional/national/local portals, it will be designed as the one-stop-shop for users interested on

the impacts of climate change. Through this portal, each local initiative keen to contribute will provide valuable information and procedures that can be re-produced, with adaptation, when deploying similar studies in other domains or geographical areas, and at the same time will see its audience extended. Through the international SCO portal, it will be eventually possible to design common tools, processing capabilities, access to existing datasets, so that climate change impact studies would be made easier and affordable at a lower effort, in particular in developing countries.

2. Relationship to previous developments and results

The SCO is a new activity but will benefit from many existing international initiatives and systems in the Climate Change data chain and in the international organization as shown on the following figure. SCO has to be considered as a Hub giving to users/stakeholders access to the necessary data/products/information/tools on climate change impacts in the region they are acting. As an international Hub SCO will benefit from existing Earth Observation data sharing program from the Space agencies, the CEOS and in particular the GEOSS. SCO is fully compliant with GEO's Vision of a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations. SCO will also benefit from existing global in situ datasets and from existing local, contextual, environmental and socio-economic existing data. SCO will also be based on existing operational services on climate change issues such as CS3, ESA-CCI, EUMETSAT, CDRs, ESGF/CMIP/Obs4Mip among others.



3. Participants / contributors

- **Organizations, institutions, government agencies, private sector**

Initiated by CNES, SCO is a project that must federate energies at the global level in order to create the world's reference hub for local modeling of climate change. This vision has been shared during the first international meeting of the SCO on February 1st 2019 with the participation of 25 space agencies and international organizations such as UNDP. SCO is also open to the participation of private parties through public-private partnerships.

SCO will also build its networks on national SCO entities, countries like Vietnam, China, Morocco, Greece and France have already expressed their willing to create a SCO national entity. As well as ESA that proposed to present the SCO during the next Program Board for Earth Observation.

4. Description of activities

- **Tasks definition & description**

The SCO precise task definition will be co-defined during the first six months of the program by the SCO participants together with the national parties. However the SCO overall architecture was already defined as follow:

One challenge facing the SCO is to provide an easy access to all available data and to **establish indicators and decision-support tools at population level (national and subnational scale) in coordinated and cross-disciplinary fashion, including with social and economic sciences.** This will be underpinned by large-scale digital technologies like big data and artificial intelligence.

At technical level, the SCO also has an international existence through its infrastructure via a dedicated international web portal linked to regional/national/local web portals (potential grouping of several countries) delivering information and data related to impacts of Climate Change

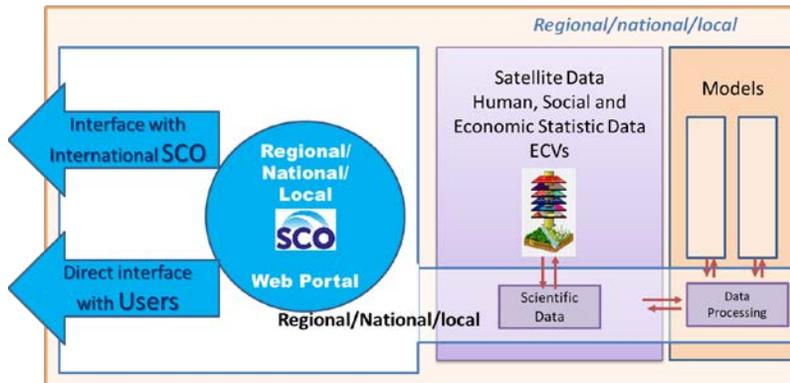
According to the concept of a co-designed architecture, it assembles main services provided by regional/national/local SCOs.

It is based on a fully distributed architecture, but provides also users with virtualized central access to SCO services.



Network of the SCO organizations from a user point of view.

Each portal (SCO at international level and regional/national/local centers) will have its own catalogue (and its own archive database and services), but the SCO international catalogue will harvest the contributing regional/national/local catalogues, therefore providing an overall view of the SCO data, information and services.



Main services provided at each regional/national/local SCO front end.

The international SCO platform gives also access to case studies defined by regional/national/local SCOs.

The SCO hub is also linked to Space Agencies and International Organizations allowing to retrieving data such as reprocessing and reanalysis datasets, Climate Data Records, ECVs produced by e.g. Copernicus, NOAA, EUMETSAT, ESA, etc. by use of dedicated links.

It complies with rules and agreements enacted by international coordination bodies like WMO, CEOS, GCOS, WCRP, etc., without substituting for their mandate. This can particularly apply to terminology, data units, uncertainty requirements, formats, etc.

Therefore, via this International Web Portal, the SCO is a hub throughout which all users can access to data, products, services, information available at international SCO level or at regional/national/local SCO level thanks to large interoperability of systems.

The international platform groups all services of data and information provision, case study referencing, and actors/users identification.

Moreover, international SCO offers a specific and major service: “**Help Desk**” allowing users (and/or potential future contributors) to have a contact point in the scope of project submission or climate change impact indicators and adaptation research. Indeed, this service is in charge of analyzing user requests and providing recommendations for redirection to the regional/national/local SCO or SCOs providing similar or adaptable case study and data on their own platform data. In the case of a non-similar case study, the helpdesk will forward this need to the different committees for a potential new project in coordination with the original applicant.

The SCO architecture shall be such that the international portal and individual regional/national/local portals are interoperable. However it shall be independent from internal regional/national/local system architecture and hosting.

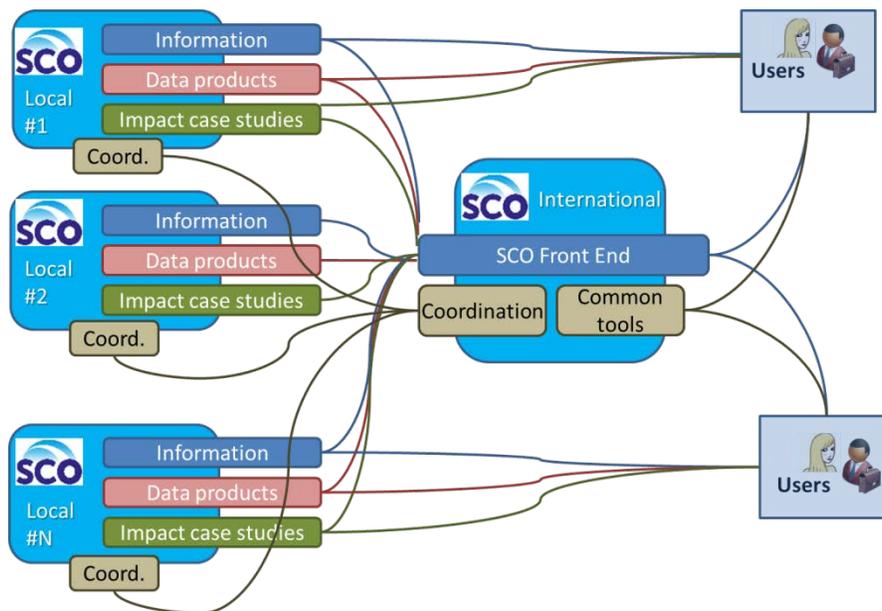
To ensure this compatibility, the international SCO will define rules for regional/national/local SCOs technical interfaces so that services provided to users are ensured regardless of the particular implementations within the various SCO distributed instances.

Interoperability applies to operations at technical level but also through common working rules to articulate effectively in operating mode.

The SCO is complementary to other data providers involved in Climate Change. It doesn't duplicate the efforts already made by these institutions but builds upon the services already developed by them. With respect to the global climate databases delivering ECVs, long time series of Space or In Situ data, model reanalyzes, etc., offered by institutions like the Copernicus

Climate Change Service, EUMETSAT or NOAA, CMIP, etc., the SCO is located downstream in the data value chain. It benefits from, and is connected with, these already existing components. The SCO implements downstream impact study cases at local or socio-economic levels.

The internal architecture of the SCO, with its international body and the connection with the network of regional/national/local SCOs is shown on the following figure. The figure also depicts the coordination links between the international body and all local SCO instances. Users are interfaced either directly to local SCOs for obtaining the requested services (Access to data, information and referenced climate change impact cases studies) or to the international SCO front end which gives access to this information in a distributed architecture. In addition, users can obtain organizational advices from the SCO international body which gathers all necessary information to redirect them on relevant local SCO or to provide them with toolkits, computing resources, etc.



*Network of services provided by the distributed SCO architecture. Virtually centralized interfaces in a coordinated and distributed network of services.
"Local" means here regional, national or sub-national.*

- **Geographical scope**

The SCO initiative geographical scope is global but is focused on local and regional scale applications.

- **Capacity building/science & technology/training activities; communication/outreach/branding**

SCO will address some of the research and education specific needs on climate change impacts understanding. The scientific community needs access to data or information within its expertise area but also within other areas in order to broaden the cross-use of various indicators and further develop realistic forecasts whilst considering indicators from different scientific fields. Being a Hub giving access to inter-disciplinary data, the SCO will facilitate and enable more scientific

research on climate change impacts at local and regional scale and consequently at global scale. The education world is also interested in accessing to climate change impact information, in particular when concrete and local use cases showing the impact of climate change are available. This allows increasing the awareness of future citizens about the impacts of climate which they will undoubtedly be faced with. **Traditional and New Media** will be able to use information available from the SCO to disseminate appropriate and well-documented information. A special care to guarantee a easier access to scientific information for journalist and new media actors will be carefully taken in account.

The SBSTA (UNFCCC Subsidiary Body on Scientific and Technological Advice) noted the urgency for enhanced science communication. It welcomed the work of the scientific community on science communication, including some examples to support action under the Paris Agreement.

The SBSTA noted the importance of regional institutions and networks and the importance of providing and exchanging knowledge at the regional, national and local level. The SBSTA also noted that regional initiatives on science communication would be valuable, organized in close collaboration with regional research organizations and networks and other relevant stakeholders, subject to the availability of financial resources. It urged Parties to continue to engage with the scientific community. The SCO will have a special attention concerning regional and local communication on climate change impacts to encourage dissemination of the scientific results to the local and regional communities.

- **Expected connections to other areas of the GEO Work Programme**

SCO is expected to create connections with the following existing GEO flagships and GEO Initiatives:

Flagships: Global Forest Observation Initiative (GFOI)

Initiatives: Climate Change Impact Observation on Africa's Coastal Zones (GEO-CCIOoACZ), EuroGEOSS, Geo Carbon and GHG Initiative, Geo Wetlands Initiative, Global Drought Information System (GDIS), AfriGEOSS: Reinforcing Regional African Engagement, AmeriGEOSS, Asia-Oceania GEOSS (AOGEOSS), Geo Cold Regions Initiative (GEOCRI), Earth Observations in Service of the 2030 Agenda for Sustainable Development, Oceans and Society: Blue Planet, Global Wildfire Information System (GWIS).

Community Activities: Access to climate data in GEOSS, Copernicus Climate Change Service (C3S), Data Analysis and Integration System (DIAS), Earth Observations and Citizen Science, Earth Observations for Health (EO4HEALTH), TIGGE (Thorpex Interactive Grand Global Ensemble) evolution into a Global Interactive Forecast System (GIFS).

5. Involvement of end-users

- **How established user communities link to, or participate in the initiative**

Climate change has become a reality increasingly affecting every ecosystem on a global scale. As a consequence, humanity is directly affected by those changes which impact on our societies. Thereby, everyone is impacted and SCO users can be any group or individuals likely to seek information about the potential impact of climate change on society. The SCO Hub will be designed to link with :

- **Society, citizens**

- Different types of stakeholders: NGOs, associations, opinion leaders in the environmental sector. The civil society: this is an important category of future SCO Users hence representing the societal contribution and participation to SCO, especially through their local involvement, through “citizen science”. Local engagement of society should be enabled by capacity building.

- **Industry and private sector**

Private companies are not only involved in the attenuation and adaptation actions to be decided against potential impact of climate but can also be involved in the impact assessment itself, developing specific technologies and protocols that can benefit to several application sectors.

SCO outcomes will result from a co-construction of climate change adaptation scenarios between scientist and national and subnational stake-holders. It will eventually involve citizens through citizen science Earth Observation enabled applications. All projects labelled by SCO will be transversal and will have to claim participation from stake-holders since their beginning.



- **How the activity would benefit stakeholders (in particular developing countries)**

One way of engaging with developing countries national stakeholders will be through National Adaptation Plans under the Cancun Adaptation Framework. On a regular basis SCO will organize regional workshop with stake-holders to share experiences and address specific regional needs. SCO will count on the participation of the GEO secretariat to promote information on EO efforts and programs for adaptation and mitigation issues to National Delegates.

SCO is intended to address the very different needs of a large community of Regional, national, basin scale, local actors and decision makers. These institutional users are the ones responsible of the mitigation of the risks related to climate change. At territorial level, the users shall base their environmental and socio-economic development policy on accurate, science based, well documented and concrete climate change impact measures for attenuation and adaptation

strategies. These are the main actors in charge of adaptation to the effects (risks) of climate change. These users can also frequently be involved (actors) in the local co-construction of the SCO, as they influence or take decisions about local infrastructure design and funding.

- **How it feeds into decision-making processes**

Stakeholder adaptation strategy to climate change impacts for the cities, territories, regions, they have in charge can benefit directly from the SCO. By reinforcing local and regional climate change impact simulations through better international cooperation and easier access to remote sensing data

6. Planning, including specific milestones and deliverables

- **Implementation plan**

If successful in its first development, the SCO should become a GEO Initiative and aggregate more countries to reinforce its international ambition. The scope is to reach a more global range of regional and local participants and users. While launched by a limited group of countries during the One Planet Summit, the ambition is to make it grow very quickly to a much larger number of countries and regions of the globe. The ambition is also to structure the program by a real co-construction between data provider, scientist and stake-holders from different countries and cultures.

The SCO implementation plan has been initiated since the first One Planet Summit in December 2018 with key contributions on the definition and engagement steps from the founding partners during the First SCO International Meeting in February 2019 which gathered 25 space agencies and 4 international organizations including EC, African Union and UN. This meeting will be followed by the signature of the founding partners in March 2019 during the the second One Planet Summit event in Nairobi of a letter of intention to confirm engagement towards the SCO implementation. After this political phase, the SCO implementation plan will be set-up in two phases, a two years and five years period: during the first two years from 2019 to 2020, the SCO will address climate change impact through a selection of use cases to validate the approach/concept and to demonstrate the clear added value for the Society, both internationally and locally. During the following three years (2021-2023), the SCO will develop its full capacity to address the climate change impacts on the SDGs at all scale.

The following issues are planned for the first 2-year period :

- international agreements
 - Signed an international Protocol Agreement with Agencies willing to participate,
 - Coordinated definition and partnership with international bodies: GEO, CEOS, GCOS, WCRP, GFCS, etc.
- Setting up governance bodies and as a first step the Steering Committee
 - Referencing local initiatives as SCO candidates.
- at technical level, the International SCO system first version could gather:
 - A Web portal,
 - Space Agencies coordination to build up a unified space data access,
 - Referenced information about impact studies,

- Reference of local initiatives,
- First definition of the common architecture and common tools.
- impact case studies: it would be desirable that demonstrations are available for each priority areas as defined by the GFCS, i.e.:
 - Agriculture and food security, Disaster risk reduction, Energy, Health, Water.
- As a first step, and within 2 years from its creation, the SCO should show concrete realizations in areas already presented as proofs of concept at the Toulouse Space Show in June 2018, e.g.:
 - Global warming, heatwaves and urban hothouses,
 - Glaciers melting faster, sea level rise impact at the coasts,
 - Pollutants and green gases, impact on city air quality,
 - More frequent droughts: impacts on agriculture and water resources management,
 - Extreme events, precipitations and floods,
 - Freshwater reserves.

Similarly, tentative objectives were fixed for a 5-year period. At this stage the the SCO will be almost completely deployed, maybe not with all sub-systems and SCO local instances, but with the full scope of functionalities and services. The proposition objectives for this period are :

- At organizational level:
 - Complete Comprehensive governance in place.
 - Several local SCOs labelled according to a coordinated agreement.
- International agreements:
 - Second step of SCO agreement signatures (almost final number of agreements).
 - Implementation of coordination with international bodies (CEOS, CGOS, CGMS, GFSC, etc....).
- technical level:
 - Availability of web portal with full capacity.
 - Dynamic links to all referenced SCOs for data and information access: full access to data, information and case study description sheets implemented by local SCOs.
 - Deployment of common tools and computing capacity at international SCO level.
 - Agreements on SCO labelling specifications.
 - Network of SCOs in operations.
- impact case studies
 - All priorities as defined by GFCS covered by use cases – achieved and complete.

7. Data management & data policy

SCO data management and data policy will be built upon existing initiatives, notably with regard to data standardization. Here are the main data concerned and corresponding data policies :

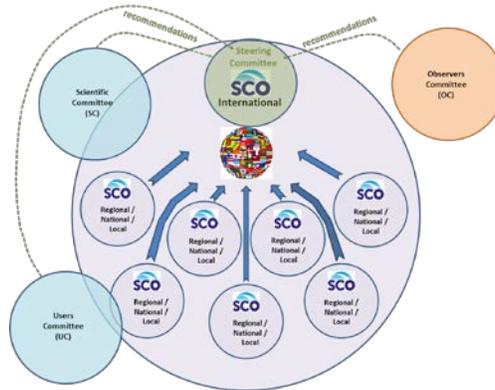
- **Improved multi-source web-based access** fitted to users' needs gathering at the same place all data or data links relevant to the impacts of climate change and reference methodological approaches in the broad domain of climate change impact identification.
 - It should follow, as much as possible, an open source approach to promote and expand capabilities and usage of data relevant to the impacts of climate change.

- It will provide a “ready-to-use” environment for users to facilitate usage and exploitation of data (in particular space data) and to support the development of climate change impact-related applications.
- **Free access to existing Data products generated outside the SCO**
 - Copernicus data, already existing High-resolution satellite data such as Pleiades data, archive historical data (Landsat, Spot World heritage Aster...), ESA Earth Explorer data (SMOS, .), etc.
 - ECVs, CDRs, reanalysis products (from C3S, CCI, NOAA, EUMETSAT, ...).
 - socio-economic data.
- **Free access to Data products specifically generated by the SCO or by centres contributing to the SCO**
 - **Tailored or specific space data which are necessary to analyzing the impact of climate change but which are not in the list of current CDRs and ECVs. This is where the involvement of Space agencies in the SCO should be major and specifically required.** These data can be:
 - multi-mission/multi-sensor combined data, specifically designed space data, time-series of multi-dimensional (space, time, data type) stack of spatially aligned pixels ready for analysis, high level space data products resulting of specialized processing dedicated to climate change impact.
 - Analysis Ready Data (ARD).
 - Indicators about the impact of climate, resulting from SCO referenced case studies.
 - Specific or contextual data (local in situ data, particular socio-economic data, etc.).
- **Full description of Climate Change impact Case Studies performed as part of the SCO:**
 - climate change impact descriptive sheets (Inputs/Outputs description, data collection procedures, processing description).
 - If appropriate and publishable, open source code implementing the specifically designed impact study.

8. Management and governance

- **Organizational structure**

The SCO should be developed in an inclusive manner and each partner is invited to propose its own contribution at the level it wishes, based on its own achievements and responsibilities. The international SCO is the organization's primary overarching body with a governance body representative of regional/national/local SCOs. The SCO is therefore the consistent and coordinated assembly of each individual regional/national/local SCOs, represented by the SCO international. The international SCO shall be **representative of all regional/national/local SCO initiatives, partners or stakeholders who sit at the SCO general assembly.**



The international SCO is governed by a **Steering Committee**, which provides **vision, strategy, policy, and guidance** for the SCO. It establishes and controls **partnerships with regional/national/local SCO activities**. The SCO Steering Committee is responsible for the **external relationships** with other international coordination bodies and programs related climate change. It is in charge of the **external communication and outreach activities for the SCO at international level**.

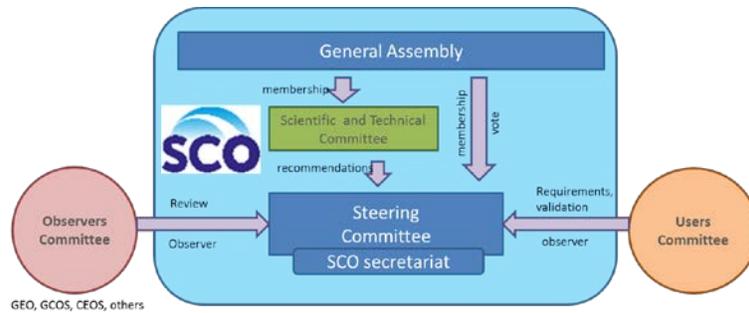
The **Steering committee** reports to the **General Assembly**, it benefits from the recommendations of the **Scientific Committee**. It receives requirements and validation statements from users represented in the **Users Committee**. The SCO implementation and consistency with respect to other international initiatives on climate change is independently reviewed by the **Observers Committee**.

Day to day implementation and technical activities of the international SCO are carried out by the **SCO Executive Secretariat, which acts on behalf of the SCO Steering Committee** and reports to it.

General Assembly

The General Assembly gathers one representative of each SCO (regional, national, local). It nominates the members of the Steering Committee besides the founding members and approves those of the Technical and Scientific Committee under proposition of the Steering Committee.

The General Assembly meets annually to assess SCO achievements, current status, and both yearly work plan and mid-term roadmap. It controls annually the orientations made by the Steering Committee and can be asked to vote under request of the Steering Committee in case of any strategic decision. Each member of the general assembly represents one voice when decisions have to come to vote.



SCO governance with internal and external bodies

Steering Committee

The SCO Steering Committee provides strategy, policy and technical guidance and recommendations for the implementation of the SCO. In particular:

- It is responsible of the development of a long-term strategy for the SCO.
- It identifies and mobilizes potential funding opportunities for the SCO activities.
- It is responsible for the SCO external communication and outreach at international level.
- It assesses progress of the SCO activities.
- It advises, and responds to requests from, the SCO Executive Secretariat on day to day and technical implementation of the SCO activities.
- It reviews the documents submitted by the SCO Executive Secretariat about any SCO initiative goals, achievements, implementation plans, and progress, as well as strategic issues requiring guidance.
- It activates the SCO Scientific and Technical Committee on the main issues to be solved at Scientific and Technical levels.
- It receives requirements and users' validation for the SCO from the Users Committee.
- It receives recommendations from the external Expert Group on SCO orientations and interfaces with international coordination bodies or programs related to Climate Change.
- It represents the SCO programme at official meetings.

The SCO Steering Committee is composed of:

- Members from the founding institutions and elected members within the ranks of the General Assembly. Founding institutions are the ones who committed to contribute actively to the first phase (two years) of SCO implementation.
- Observers, one from the Users Committee and one from the external Observer Committee.

Membership is reviewed annually by the General Assembly under proposition of the Steering Committee, in particular for inclusion of new members.

The members of the SCO Steering Committee are individuals in a position to provide strategic advice and help identify and mobilize international support, partnerships or funding for the implementation of the SCO.

The Steering Committee is led by one Chair person, nominated on a periodic basis (e.g. annual or biennial) from the Steering Committee. The Steering Committee Chair person is the primary point of contact for the SCO Executive Secretariat, for the Scientific Committee, for the Users Committee and for the Observers Committee.

The Steering Committee convenes periodic (twice a year and quarterly in the initial part of the program) meetings in order to take decisions on the day-to-day implementation of the SCO to be operated and monitored by the SCO secretariat. To this end, it receives the support of the Scientific Committee which submits recommendations to it. Observers from both Users Committee and external Observers Committee also attend the meetings to provide respectively requirements, validation statements and recommendations.

Executive Secretariat

The SCO Executive Secretariat acts on behalf of the SCO Steering Committee which delegates to it the day-to-day implementation of the SCO activities.

It ensures all activities needed to implement SCO Steering Committee decisions and recommendations. In particular:

- It prepares Steering Committee meetings, agenda and organization.
- It prepares the Steering Committee decisions by analyzing in advance all issues, in particular at technical and implementation levels.
- It proposes the SCO external communication and outreach plan at international level to the Steering Committee and implements the approved plan.
- It interfaces with all other committees on behalf of the Steering Committee.
- It monitors SCO progress and achievements and reports to the Steering Committee.
- It requests advices and guidance to the SCO Steering Committee on any issue related to strategy, partnership or international relationships.
- It works on a daily basis on all technical subjects relative to the SCO and specifically:
 - analyses the users requirements and translates them into high level technical specifications to be agreed by the Steering Committee, after consultation of the Scientific Committee.
 - collects validation reports and assessments from the Users Committee and proposes necessary action plans to take them into account.
 - works in advance on external Observer Committee recommendations in order to translate them into potential decisions to be taken by the Steering Committee.

The SCO Executive Secretariat Members are nominated by the Steering Committee and shall be sufficiently well experienced, scientifically and technically skilled persons, seconded from the SCO partners.

Considering the amount and diversity of tasks needed for the SCO Executive Secretariat, full time and part time appointment for one or several positions will have to be considered.

Scientific Committee (SC)

The Scientific Committee is in charge of analyzing the scientific and technical (use of data, IT issues and technologies, technical interfaces) relevance of existing or new SCO projects. In

particular it supports creation of any new SCO initiative on a scientific and technical point of view.

It provides guidance on publications strategy and assess the scientific outputs.

It advises the Steering Committee on scientific issues on a regular basis (Steering Committee meeting) or on request from the Steering Committee.

It reports annually to the General Assembly.

Scientific Committee members are nominated by the General Assembly upon proposition by the Steering Committee.

Day to day interactions of the SC with the Steering Committee are processed through the SCO Executive Secretariat which acts on behalf of the Steering Committee.

Users Committee (UC)

The Users Committee is composed of internationally representative users from the main thematic field of applications covered by the different national SCO.

Its main roles are:

- To synthesize collected user needs in the field of the impact of climate change and provide the high level recommendations on the indicators and scenarios to be produced.
- To produce assessment and validation reports about the adequacy of SCO regional/national/local initiatives from a user point of view (fitness for purpose, societal impact, etc....).

The Users Committee outputs are produced regularly (yearly as a minimum when reporting to the General Assembly).

The members of the User Committee are nominated by the General Assembly upon proposition of the Steering Committee.

One designated member of the Users Committee sits at Steering Committee as observer in order to provide recommendations and collect information on a regular basis.

Day to day interactions of the UC with the Steering Committee are processed through the SCO Executive Secretariat which acts on behalf of the Steering Committee.

Observers Committee (OC)

The Observers Committee is composed on internationally representative and independent experts in the Climate Change adaptation and international coordination bodies (members of WMO, UN organizations, GEO, GCOS, CEOS, CGMS, WCRP, GFCS...).

Its main role is to provide recommendations (with an external point of view) to the SCO Steering Committee at programmatic, scientific and technical levels. All OC members are invited to the General Assembly to which the OC reports.

Day to day interactions of the OC with the Steering Committee are processed through the SCO Executive Secretariat which acts on behalf of the Steering Committee.

- **Project coordinator and supporting organization**

Selma Cherchali, from CNES (selma.cherchali@cnes.fr) is the project coordinator and CNES is the supporting organization.

9. Summary of committed resources and annual budget(s)

- **Secured and expected resources (cash and in-kind)**

The SCO Program is built over 5 years and requires resources to implement the following 5 axes:

- "An infrastructure for computing and storing mass data (with ultra-fast access) and human resources to control it and manage its external interface (access to data, products, and to allow the launch of processing to develop custom products). France will engage in this field through the French Earth System Research Infrastructure. [€40M]
- "World-class teams of specialists in the fields of big data handling, artificial intelligence, and economics related to sustainable development, to help researchers optimize their models , offer them new approaches in these emerging areas and interface it with the ecosystem of downstream users (institutional, companies, start-ups) [€10M]
- "Financial resources for research laboratories to cover mission expenses, measurement campaigns essential for validation of model outputs and indicators implemented and to stimulate downstream technology transfer and implementation public and private services [10M €]
- "Financial means to organize international calls for ideas, competitions / challenges awarded to stimulate, emulate individual creativity or teams and lead to the design of products and services closer to society. [10M €]
- "Thesis, post-doc and mobility grants for foreign researchers to attract the best global competencies in the fields concerned. [10M €]

Total investments to be made amount to €160 million over five years. A direct aid amount of €80M was requested to the French government (the breakdown is proposed in square brackets). The search for private and international co-investments (e.g. forthcoming Horizon Europe, Belmont Forum) and the reallocation of existing resources will make it possible to carry out this ambitious program.

ANNEXES

A. Acronyms and Abbreviations

CEOS	Committee on Earth Observation Satellites
IAA	International Academy of Astronautics
IPCC	Intergovernmental Panel on Climate Change
GCOS	Global Climate Observing System
UNFCCC	United Nations Framework Convention on Climate Change
UNOOSA	United Nations Office for Outer Space Affairs
SCO	Space Climate Observatory
SDG	Sustainable Development Goals

B. CV of Project Leader and names

SCO Project coordinator, Selma Cherchali, CV

Since February 2018, Dr. Selma Cherchali is the Program Director of the Space Climate Observatory (SCO) focusing on the impacts of Climate Change, a commitment of the One Planet Summit in Paris (December 2017). She is also the SWOT Program manager. She is leading and coordinating the SWOT preparatory program which aims to prepare the scientific and user's community (applications) to use SWOT and all space missions' data dealing with hydrology and ocean and coastal objectives.

In January 2016, she joined the CNES Science, Applications and Innovation Directorate within Earth Observation team where she became the Land and Hydrology program manager.

From 2009 to December 2015, she was the program manager of Land and Hydrology Programs within the Directorate for Strategy, Programs and International Relations of CNES.

Within this Directorate, she was responsible for leading, coordinating and supervising the programmes of national, European and international space missions, relating to Land environment and Hydrology (SWOT, SMOS, Biomass, Sentinel 2, Venus. She does supports research in the field of Land and Hydrology. With over 25 years of experience in applying remote sensing data to earth application issues, Dr. Cherchali managed several international projects. She serves on GEO and CEOS programs as a co-chair of GEOGLAM, Water, SDG Working Groups, and is a member of the GEOGLOWS Steering Committee.

She joined CNES in 2003, where she was responsible for R&D in man-made and natural disasters, humanitarian relief and civil security dealing with GMES European projects and in charge of coordinating ORFEO preparatory program.

Prior to joining CNES, she was as project manager and head of eLearning Department at GDTA in Remote Sensing Applications, a subsidiary of CNES.

Selma received an Engineering Degree in Signal Processing in 1989 and a Master in 1991 from the ENSEEIHT ("Ecole Nationale Supérieure d'Electronique, Electrotechnique, Informatique et Hydraulique de Toulouse"), Toulouse - France.

She received her PhD degree in Physics and Remote Sensing from University Paul Sabatier of Toulouse at CESBIO ("Centre d'Etudes Spatiales de la Biosphère"), France in 1994.