

WP23_25: Earth Observations for the Water-Energy-Food Nexus

1188,282

Basic Information

Full title of the Initiative

Earth Observations for the Water-Energy-Food Nexus

Short Title or Acronym

EO4WEF

Current category in the 2020-2022 GWP

Community Activity

Proposed category in the 2023-2025 GWP

Pilot Initiative

Points of Contact

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Purpose

Objective

The main purpose of the EO4WEF Pilot Initiative is to foster the development and delivery of products and services that will be used by practitioners of the WEF Nexus approach to resource management and to further develop the community of WEF Nexus (also referred to herein as the FEWS Nexus) users who rely on Earth observations for decision-making. This will be done through the development of prototype products, case studies, and services that will disseminate WEF Nexus research-to-practice capabilities for all stakeholders through the applications of Earth observations and Earth science modeling.

Please provide a short description of the Initiative

This initiative blends three streams to foster support planning and decision-making for the WEF Nexus stakeholders and users over both the short-term and long-term time horizons. The short-term component takes advantage of the extensive data sets and products as well as tools for analyzing these information streams for application in different sectors within the WEF Nexus. The long-term component involves the development of a climate model that can be used to explore options for the development of an integrated assessment climate-WEF-Policy framework model that can be used to explore decision-making tradeoffs and options to support integrated resilience planning for WEF infrastructure and climate response activities in the WEF Nexus sectors.

For the short-term applications, the suite of data and tools will be chosen through ongoing consultative workshops with users and targeted projects reflecting WEF perspectives. using Earth observations and models within a WEF framework. These will include, but not be limited to, water resource management in urban environments, development of irrigation management systems, improvements in farm yields and pollution containment strategies, and the expansion of renewable energies by using Earth observations and models within a WEF framework.

The initial stage will involve specific projects with interested stakeholders, and subsequently the delivery of more generalized services via web platforms. In some cases, field studies will be undertaken to show the effectiveness of new technologies such as agrivoltaic systems and the areas where they will be most effective. Particular attention will be given to the water footprint of renewable energies and the possibility of using renewable energy to increase the availability of water. Sources for information include public domain applications from space agencies and other public services.

For the long-term applications, the initiative will rely on an NSF-funded C-FEWS study (Climate-induced Extremes on the Food, Energy, Water Nexus), which is exploring the impact of climate change trends and extremes on the performance of the FEWS nexus in a macro-regional context (the US Northeast and Midwest) to better understand the role of green (nature-based) and gray (traditionally engineered) infrastructures in creating resilience across the major FEWS sectors. Stakeholder engagement to co-design future sustainability pathways, based on a core data integration and modeling framework will ensure the relevancy of the WEF Nexus research and encourage the adoption of research results by a broader non-scientific user community.

The framing for CFEWS (the climate FEWS model) links models of agricultural inputs and their resulting products including crops and biofuels; carbon sequestration via land use; fossil and renewable-based energy systems; nutrient and thermal pollution; and economic valuation.

The third service is a data and information portal that will be developed for the Red River Basin for the North. Initially, it will incorporate publicly available observations and forecasts with knowledge about the landscape, infrastructure, historical agricultural production patterns, etc., to provide information to producers, consumers, and regional decision-makers. It builds on analysis already completed which will be incorporated into a prototype information portal. It will begin as a portal containing publicly available information and will be followed by a more sophisticated portal that will tailor the information to the needs of individual users based on their location and a profile of their needs. Earth observations will be combined with more static information to provide information. The opportunities arising from the short- and long-term initiatives in terms of new technologies, applications, and advisory services from the other components of the pilot initiative will also be made available through this portal.

Why is this Initiative needed?

In general, the water, energy, and food activities are managed as separate silos both within and outside government. This leads to many inefficiencies and potential conflicts when the interests, concerns, and policies where the individual sectors overlap. The W-E-F Nexus data and information services are intended to help resource managers integrate their plans and approaches for these overlapping areas.

Every nation has a basic need to provide its societies with nutritious food, reliable energy, and clean water. Globally, the production and delivery of food use approx. 70% of the freshwater that is withdrawn and consumed, and approx. 30% of the energy that is produced worldwide. In developing and arid countries these percentages are often higher than the global average. Managing these three resources in an integrated way is critical for the well-being of humanity and for the achievement of the UN SDGs. In addition, these services will support a large community with concerns about future pathways in these critical resources including World Economic Forum, the UN Food and Agriculture Organization, the Future Earth Science Programme, the European Union, and many other organizations which have been discussing the importance, challenges, and opportunities for this Nexus over the past decade,

This information system will build on the experience of more limited portals developed through PRIMA farmers in developing countries using funding by the EU as well as government programs and services for water managers for specific regions (Lake Winnipeg). The services operated through the PRIMA project for farmers have been highly successful with improved productivity being realized in a number of test farms from the application of the data services.

This project is unique in its ability to incorporate satellite data and other data into models and a platform for users in the WEF Nexus. It will also be unique in incorporating climate change information and advice on resiliency for resource managers and producers. It provides an opportunity for GEO to demonstrate how Earth observations

can be used to provide a service that supports the integrated management of key natural resources that are critical for human well-being and the efforts to achieve SSG targets and climate change adaptation goals.

What evidence is there to support this need?

Every nation has a basic need to provide their societies with nutritious food, reliable energy, and clean water. Globally and on an annual basis, the production and delivery of food use approx. 70% of the freshwater that is withdrawn and consumed, and it uses approx. 30% of the energy that is produced worldwide. In developing and arid countries these percentages are often higher than the global average. Managing these three resources in an integrated way is critical for humanity. This initiative will support a large community with concerns about future pathways in these critical resources including World Economic Forum, the UN Food and Agriculture Organization, the Future Earth Science Programme, the European Union, PRIMA, and many other organizations which have been discussing the importance, challenges, and opportunities for this Nexus over the past decade,

Is this Initiative open to participation by representatives of any GEO Member, Participating Organization, and GEO Associate?

Yes

Are you aware of other projects or initiatives at a global or regional scale (both in GEO and externally) that provide similar products or services?

No

Please identify the most important actual and/or intended outputs (products, services, etc.) produced by the Initiative, along with their intended and/or actual users. This list does not need to be comprehensive but should identify the outputs which are most used and are expected to have the greatest potential impact.

| Output | Status | Users | Additional info |
|---|-------------------|--|------------------------|
| Service to WEF stakeholders | Planned | Users: farmers, resource managers | |
| Strategy for linking GEO initiatives in WEF area | Planned | GEO Members, GEO Initiatives | |
| Strengthening WEF networks | Regularly updated | Expert community that supports the development of the WEF approach | |
| Assessment tools for agrivoltaics | In development | Farmers, Government policy makers | |
| Irrigation Management for selected areas | Regularly updated | Farmers | |
| Irrigation Management on a national basis | In development | Farmers, Government policy makers | |
| Assessment of national hydropower output from snow melt | In development | Government planners | |
| Advisory services on climate change impacts | In development | Government planners, the public | |
| Basin-wide information portal | In development | Government planners, farmers, water managers, energy producers | |
| WEF scenarios under climate change | In development | Planners and managers for WEF Sectors | |

If needed, please provide additional comments or explanation to accompany the outputs table

- no answer given -

What kinds of decisions are the outputs of this Initiative primarily intended to support?

Initially, this pilot initiative will test the implementation of specific services that have been under development for near-term implementation including the irrigating management system in Sweden and the assessment tool for estimating hydropower production. In the later part of the work term tools for assessing the viability of agrivoltaics being used in cropped fields will be developed and new technologies will be developed for commercial adaptation. In the longer term, a model to assess the impacts of climate change on different WEF Nexus components will be made available for the development of new policies and proposed infrastructure developments. A testbed in the Red River Basin of North will assess the transferability of these concepts to other regions and will provide farmers, water resource managers, and energy producers with the best routine information possible to improve basic efficiencies and profitability in that region. The information will be used to 1) improve the timing and magnitude of irrigation applications resulting in water savings and improving soil quality, 2) provide guidance for crop planting and harvesting leading to increased production and higher profits from farming operations, 3) support the assessments of areas where agrivoltaic solar panels can combine agricultural outputs and energy production to maximize the economic benefits of the land, 4) identify areas where stricter regulations (longer time scale), green infrastructure (longer time scale) and timely interventions (short time scale) can lead to better outcomes for the WEF Nexus and greater resilience in light of climate change, 5) improve the urban environments by increasing the information available to plan urban renewal with expanded domestic water treatment and supply, and improved use of urban agriculture and renewable energy to reduce the impacts of cities on the need for resources from conventional sources.

How will these decisions benefit from the outputs of this Initiative?

The outputs of this initiative will result in the more effective use of water applied in irrigating corps, the better planning of hydropower contracts based on the improved observations of snowpack in mountainous regions, more options for using land for simultaneous solar energy and agriculture production, the commitment to green infrastructure options for solutions to problems in the WEF Nexus requiring new or improved infrastructure, and reduced reliance on fossil fuels. The information platforms developed for producers will give them more options to reduce their costs and increasing their outputs making their operations more profitable. For government managers and planners who consider more sectors in their decision making it is likely to increase economies of scale and other efficiencies for data services and encourage more coherent policies by improving collaboration in planning and delivering programs that are harmonized with natural processes (e.g., green or gray infrastructure).

What kinds of impacts (for example, reduced loss of life, monetary savings, conservation of biodiversity, etc.) are anticipated as a result of the use of the outputs of this Initiative?

This initiative is expected to have direct benefits through 1) increased profitability for producers, 2) more responsible and efficient use of natural resources, and 3) reduced costs in many operations through integrated planning. In terms of secondary benefits it is expected to 1) improve health and well-being by supplying more nutritious food, especially in parts of the world with food shortages, 2) encourage more efficient land use by offering models and technologies for combining solar energy and crop production on the same land area, 3) greater reliance on non-carbon energy sources reducing the cause and impact of climate change, 4) promote improved water availability and quality to meet the needs of underdeveloped countries and poor communities, and 5) improve longer-term planning by giving guidance on appropriate green infrastructure for different environments.

Has this Initiative been asked to provide specific information (for example, reports, data, services) on an ongoing basis to an international convention, organization, or other multilateral body?

No

Technical Synopsis

Please provide a brief description of the methods used by the Initiative to produce its (actual or planned) outputs.

Short-term products and services: The Mälardalen University (MDU) in Sweden has developed an irrigation model in conjunction with NASA/JPL which provides information to selected validation sites in Sweden. The prototype irrigation management service can be viewed at: <https://swedims.se/>. The model and preliminary visualization platform aim to not only inform farmers, but also water management agencies, and energy agencies on the water and energy consumption in agriculture, as well as crop response to water and energy input. Remote sensing data to provide better accuracy in terms of crop yield, and water and energy use in the agricultural sector. Applications have been submitted in partnership with the Swedish Meteorological Service to implement the service on a national basis. In the period 2023-2025, MDU plans to extend the service by providing water-food-energy nexus guidelines on a local to national level. This will include a resources allocation optimization model for optimal resources allocation service, and a hydrological model structured to support the better allocation of water resources.

Another service-oriented development linking snowfall in Sweden with the output of hydropower production from the country's many hydropower stations. The project "SnowSat-an AI approach towards efficient hydropower production" uses Artificial Intelligence (AI) and Internet-of-Things (IoT) for improving the estimation of snow water storage in mountain areas of Sweden from satellite observations. The algorithms developed will be used to develop a prototype of service, at the beginning only for a basin but later at a national level to inform decision-makers in the hydropower sector about the potential water content of snow. Validation and visualization work is being planned in 2023 before offering this product to an agency to use as a service.

Services are also expected to arise from the work of models for agriphotovoltaic systems using remote sensing data (especially short wave radiation measurements).

Portal Services: The WEF basin portal for the Red River of the North will be developed in two stages. The first stage will be based on user feedback and include all the updated publicly available information on climate and hydrologic factors that could affect the activities of producers and managers in the food, water, and energy sectors. In the second phase the information will be made more specific and available to the farm level and tailored to the individual producer's needs.

Work will be undertaken during 2024 to develop the model to provide personalized information for each producer and access to information that is tailored to where the person lives. Depending on the level of service requested through the website people may access these specialized services through a subscription service. This service would also include outputs and links to information services from the short-term and long-term components of this pilot initiative as they can be applied to the Red River Basin of the North.

Long-term services: The C-FEWS framework, being developed under US NSF-funding, exercises a set of six the core models through digital data exchanges in a soft-linked configuration. Climate forcings drive the C-FEWS Models in either prescribed (e.g., from NLDAS archives for the historical period) or dynamically or statistically downscaled (e.g., by WRF, ARRM2, respectively). The climate forcings are then combined with exogenous water/land resource demand, technologies, operations, and management to test hypotheses and provide options for stakeholder co-design of FEWS climate response scenarios. Hydrologic models simulate water supply, multi-sectoral use, and pollution impacts. Food and biofuel feedstocks are modeled in process mode with (food/energy crops, biomass, resource demand, adaptation, agricultural emissions, nutrient leaching) and synoptically (terrestrial C, biofuels, resource demand, greenhouse gas emissions, nutrient cycling). C-FEWS energy models treat biofuels as well as thermo/hydroelectricity. For the latter, production and demand is determined by climate with technology/innovation/policy targets and deployments. Power plant performance and thermal pollution is computed with a dedicated model, which then iteratively re-configures technology deployments, should production constraints appear, e.g., insufficient cooling water during a drought. C-FEWS models also estimate levels of competition between the electric energy sector and food and biofuel production, whenever water becomes limiting.

A stakeholder engagement effort is linked to the framework activities. Current target groups include regional planners, government agencies and commissions, energy/climate stakeholders, agricultural organizations, environmental and conservation NGOs, and emergency management. An important component of the engagement effort is a unique C-FEWS services portfolio is also created from the biogeophysical model outputs, translated into inputs to economic valuation models that estimate in dollar terms the FEWS scenario outcomes. Contributions from both traditionally engineered and ecosystem-based infrastructures are considered. An optimization scheme maximizes positive outcomes while minimizing externalities. C-FEWS performance metrics (distillations of core model biogeophysical outputs) are used to evaluate the state of engineered and natural capital. The portfolio then helps to guide stakeholders in a charrette process, including scenario co-design with researchers and stakeholders jointly developing policy or technology targets. As model outputs reveal otherwise unrecognized tradeoffs across the nexus, new targets can evolve and FEWS specifications are appropriately revised.

If you would like to provide further details on the technical methods, you may upload one or more documents here.

- no supporting documents provided -

Are there any significant scientific or technical challenges that need to be resolved by the Initiative during the 2023-2025 period?

Yes

Please describe these challenges and the steps being taken to solve them.

Technical challenges include the lack of high-resolution soil moisture measurements at the sub-field scale needed for the evaluation of agrivoltaic systems. (NDVI fields may be an acceptable way to infer high-resolution soil moisture fields). The lack of measurements of indirect PAR has also caused problems but an algorithm has recently been developed to provide estimates of indirect PAR.

Does the Initiative expect to complete any key new outputs, improvements to existing

outputs, or improvements to the methods of producing outputs, in the 2023-2025 period?

Yes

Please describe these new outputs or improvements.

New outputs from this initiative will include: 1) visualizations to show the changes in key inputs for crop production and the need for irrigation, 2) agrophotovoltaic system designs and prototypes, 3) assessments of where these systems can be optimally used, 4) combinations of IoT snow depth measurement and remote sensing data combined with AI to produce estimates of spring and summer hydropower production for Sweden, and 5) advice from the CFEWS model on areas where green or grey infrastructure would be most effective for improving resiliency to the effects of climate change.

Please identify the key tasks that must be implemented to ensure delivery of these changes, with target dates for completion.

| Task | Task description | Expected completion (month/year) |
|-------------------------------------|---|---|
| Model refinement | Configure Reduced Complexity Model and Extend over Full NE/MW USA Domains: CFEWS-Model | Quarter 1 2023 |
| System design | Workshops to Co-Design Analysis: | Quarter 1 2023 |
| Upgrade Funding Support | Hold Meetings with Government/NGO Sources of Support: to obtain additional funding for component models and the full C-FEWS | Quarter 1 2023 |
| Broaden CFEWS Model Links | Develop C-FEWS Services Portfolio and Exercise with Economic Model | Quarter 2, 2023 |
| Prototype Portal Developed | Prototype Red River of the North Basin portal available for testing | Quarter 4 of 2023 |
| Scenario Development | Configure and Execute 1st Set of Future Scenarios | Quarter 1 of 2024 |
| Launch CFEWS Portal | Reconvene Stakeholders to Reveal Outputs and Re-configure Models: Launch of the Regional CFEWS portal. | Quarter 1 of 2024 |
| Final Irrigation model prototype | Improve the visualization interface for the Irrigation model to make the final prototype before being transformed into an operational service. of the new service will be compared to traditional irrigation practice | Quarter 1 of 2024 |
| Snow/ hydropower prototype services | Prototype preparation service for projections of hydropower production based on snowfall information | Quarter 2 of 2024 |

| | | |
|---|---|--------------------------|
| Generalize results from CFEWS model | Final Results Shared with Stakeholders: • Design phase: for the generalization of model results to multiple US regions | Quarter 2 of 2024 |
| Implement Irrigation Advisory Service | Couple the irrigation advisory system with the Swedish Meteorological and Hydrological Institute's Numerical Weather Forecast model to provide forecast advisories. | Quarters 3 and 4 of 2024 |
| Prototype advisory service of hydropower production in Sweden | Development of a prototype visualization system for the results of assessments of hydropower production based on snow | Quarters 3 and 4 of 2024 |
| Launch of individualized services in RRN Basin | Launch of the data system for use by all WEF stakeholders in the RRN Basin | Quarters 3 and 4 of 2024 |
| Avisory services developed | Test and evaluate the long-term advisory services using CFEWS outputs | |

Resources

Have all resources required to implement the Initiative's planned work in the 2023-2025 period been secured?

- Gap in financial resources
- Gap in human resources

What is the estimated funding gap for the 2023-2025 period?

\$300K USD per year

What are the essential skill sets needed by the Initiative but are not currently resourced?

Experts in processing large data sets and in setting up data platforms for users.
Expert in user consultations and product co-design

What actions is the Initiative taking to obtain the required resources?

Resource for the irrigation model has been provided internally with some support from NASA (JPL).

Applications have been submitted in partnership with the Swedish Meteorological Service to implement the service on a national basis.

Work linking snowfall in Sweden with the electrical output from the country's hydropower stations is being funded until 2024 by Vinnova (the Swedish Government's Innovation Agency) and a possibility may exist for an extension.

Services are also expected to arise from the work of models for agrivoltaic systems using remote sensing data (especially short wave radiation measurements). Although practical services are anticipated based on financial support available these will be developed throughout the Work Plan period and if successful prototypes should be available for testing by 2025.

Current resourcing for the long term elements involves NSF funding, with plans to engage specific stakeholder groups for dedicated funding requests. These include, for example, new opportunities anticipated

to arise from: ongoing dialogue with the US EPA Region 2 Office and its Office of Research and Development; the new US Inflation Reduction Act and its numerous energy and climate-resilience elements; and FEWS-relevant industrial consortia (Public Service Enterprise Group, EPRI).

The MDU has recently sent out a research proposal to one of the Swedish research councils. More research proposals will be sent out nationally and internationally. In 2022, MDU has been involved in an EU proposal led by the German Aerospace Center to apply the above-mentioned concepts in a basin in Africa to support the decision-making process (Decision Pending). There are several projects on agriphotovoltaic systems and the use of earth observation for agriphotovoltaic systems that can be used to support those research activities.

Please list all financial and non-financial contributions to the Initiative (other than in-kind, voluntary participation by individual contributors) having a value of more than USD 50,000.

| Contributing Organization | GEO Status | Type of Resource | Value | Currency |
|--|-------------------|-------------------------|--------------|-----------------|
| Natiioal Science Foundation | United States | Financial | TBD | |
| Swedish Energy Agency | Sweden | Financial | TBD | |
| Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning | Sweden | Financial | TBD | |
| NASA | United States | Data | Unknown | |

Lessons from the 2020-2022 Period

Were all planned activities for the 2020-2022 period implemented as expected?

No

Please describe which activities were delayed or not implemented and how has this affected plans for 2023-2025.

The Pandemic and funding situation in 2020 -2022 delayed progress on plans for an information system in the Red River Basin of the North. Interest remains high in WEF Nexus portal but the challenge in 2023 to 2025 will be transitioning this interest into committed action. The work planned for the Red River Basin was delayed in 2020-2022 was delayed by the pandemic and its restrictions on cross-border travel for more than two years. It is expected that these restrictions will be fully lifted by the beginning of this work plan (2023). The Red River Basin is still being developed as a prototype portal and service facilitator. It will be a vehicle for demonstrating the value of Earth observations, outputs from Earth science models and the results of the short and long term outputs of this pilot initiative Efforts will be undertaken to carry out a user workshop in conjunction with the Global Water Futures Institute in Saskatoon.

The group plans to work more closely with the NASA Goddard DAAC to develop a possible dashboard with WEF Nexus information. A strong thrust to acquire more financial support will be undertaken and the EO4WEF network strengthened. More emphasis will be given to serving as a bridge among activities concerned with Energy, Food, and Water. At the coordination level more attention will be given to the links of the WEF Nexus to climate change and SDGs.

Were there any key challenges faced by the Initiative in the 2020-2022 period?

Yes

Please describe.

A number of plans did not go ahead because of the pandemic and one individual went into retirement.

Were there any impacts or changes to operations due to COVID-19?

Yes

Please describe.

A users' workshop tentatively planned for Saskatoon Saskatchewan was canceled.

The plan to bring the CoP together for a face-to-face meeting was canceled. In lieu of this, a (very successful) virtual workshop was held by Zoom.

Please describe the key changes proposed for the 2023-2025 period, for example, new projects, new areas of focus, or adjustments to the activity governance.

The group plans to work more closely with the NASA Goddard DAAC to develop a dashboard with WEF Nexus information. A strong thrust to acquire more financial support will be undertaken and the EO4WEF network strengthened. The sources of this funding will influence the new directions taken at the project level. More emphasis will be given to serving as a bridge among GEO projects concerned with Energy, Food, and Water issues. At the coordination level, more attention will be given to the links of the WEF Nexus to climate change and SDG issues.

The group plans to work more closely with the NASA Goddard DAAC to develop a possible dashboard with WEF Nexus information. A strong thrust to acquire more financial support will be undertaken and the EO4WEF network strengthened. More emphasis will be given to serving as a bridge among activities concerned with Energy, Food, and Water. At the coordination level more attention will be given to the links of the WEF Nexus to climate change and SDGs.

We plan to engage more regions and countries including all parts of the USA, one or more basins in Canada, national activities for Sweden and more general engagement of Europe, countries around the Mediterranean Sea (through PRIMA), and eastern Asia. Within GEO we will seek to make better use of systems developed by GEOGloWS. We will explore funding opportunities through the World Bank: PRIMA. European Union, NASA, NSF and other organizations.

Does the Initiative have outputs (products, services, etc.) available to users now, even if only on a pilot or testing basis?

No

Do you have evidence of any impacts that have occurred in part as a result of using the outputs of the Initiative (for example, policy decisions taken, behaviour changes by users, risks mitigated)?

Yes

Please provide examples, with evidence where available.

The work by MDU on irrigation management and hydropower estimates from snow accumulation has stimulated interest by several national Swedish institutes. Although still in its R&D phase, the work on agrivoltaics is producing interest in Sweden and should be of interest in the Mediterranean regions. Validation work is underway to document the benefits arising from better irrigation management.

Publications outlining the philosophy and potential of the WEF Nexus concept and the contributions of Earth observations have been referenced frequently in the scientific literature during the 2020-2022 period showing that there is considerable interest in these ideas. EO4WEF is currently developing a special issue for Frontiers and two leads have a published and invited chapter in an Elsevier book on renewable energy that

will be used in the educational system.

Please provide supporting documentation if available.

- no supporting documents provided -

Have there been any internal or external reviews or evaluations of the Initiative since 2019?

No

Please indicate any GEO Work Programme activities with which you have ongoing collaboration.

- EUROGEO - European Group on Earth Observations
- GEOGLOWS - GEO Global Water Sustainability

Please indicate any additional GEO Work Programme activities with which you would like to establish new collaborations.

- AFRIGEO - African Group on Earth Observations
- AMERIGEO - Americas Group on Earth Observations
- AQUAWATCH - AquaWatch
- AOGEO - Asia-Oceania Group on Earth Observations
- CLIMATE-OBS - Climate Observation, Simulation and Impacts
- DIAS - Data Integration and Analysis System
- EO4SENDAI-MONITORING - Earth Observation and Copernicus in support of Sendai Monitoring
- EO-IIP - Earth Observation Industrial Innovation Platform for Sustainable Development
- EO4SDG - Earth Observations for the Sustainable Development Goals
- AFRICULTURES - Enhancing Food Security in African Agricultural Systems with the Support of Remote Sensing
- EUROGEO - European Group on Earth Observations
- GEO-EV - GEO Essential Variables
- GEOGLAM - GEO Global Agricultural Monitoring
- GEOGLOWS - GEO Global Water Sustainability
- GEO-VENER - GEO Vision for Energy
- GEO-WETLANDS - GEO Wetlands
- GEOSS Data, Information and Knowledge Resources - GEOSS Data, Information and Knowledge Resources
- AGRI-DROUGHT - Global Agricultural Drought Monitoring
- GDIS - Global Drought Information System
- GLOFAS - Global Flood Awareness System
- GFRM - Global Flood Risk Monitoring
- LAND-COVER - Global Land Cover
- GEO-MOUNTAINS - Global Network for Observations and Information in Mountain Environments
- NEXT-EOS - Next Generation Earth Observation Services

Stakeholder Engagement and Capacity Building

Are there specific countries or organizations that your Initiative would like to engage?

Yes

Please list these countries, regions or organizations.

Countries and Regions: Sweden, USA. Canada, Europe. Countries around the Mediterranean Sea, China,
Organizations: World Bank: PRIMA, NASA, Future Earth, Texas A&M University

What are your plans to engage them?

At the country level, we plan to engage more experts from these countries and would propose to make contacts with national GEO principals for their help.

At the organization level, we will solicit the interest of key players by personal consultation.

In the case of the countries around the Mediterranean, we plan to have an on-going relationship with the new Community of Practice that PRIMA is forming for this area.

Future Earth has been undergoing some changes but we will continue to work with their WEF Knowledge Action Network (KAN) and the Water Futures program,.

Does your Initiative engage users in the work of the Initiative (for example, consultation, testing, co-design)?

Yes

Please briefly describe the Initiative's approach to engaging users.

There are several approaches that are used in engaging users. These include:

Participation in general policy and coordination meetings such as the Red River Basin Commission to meet potential users and understand their problems better.

The work on the Agrivoltaic systems has a committee of farmers and experts who are helping with the testing and evaluation of these systems.

Future participation is planned in other local committees and groups to develop a better rapport with users.

Plans are in place to publish articles and organize special issues which draw attention to the opportunities of the WEF Nexus and its importance,

Members will also support the activities of groups in other parts of the world whenever the opportunity arises to participate (e.g. Review committees).

Does the Initiative have a user engagement strategy or similar kind of document?

No

Are there categories of users that are not represented at this time, but you would like to engage?

Yes

Please list these user categories or regions.

User Categories: More representation from the agricultural sector, the renewable energy community; the mineral and fossil fuel extraction users would be helpful. The base of the group is water-oriented so this remains a stog point in the group.

What are the plans for further engagement of users in the Initiative?

Engaging new users in the initiative is essential. We need to engage users as partners in defining the planned information system and its content.

Workshops and consultative meetings will be held where users will provide briefings on what they are doing (or would do) with different types of information.

A special emphasis will be given to making connections with state and provincial ministries to engage them in discussions because they generally have the responsibility for the policies related to the WEF Nexus resources in their territory.

Stakeholder meetings for the CFEWS part of the initiative will involve regional, state, and federal agencies as well as NGOs, and designed as bi-directional information exchanges to identify topics and technical capabilities to assess strategic resource tradeoffs. Reduced complexity models are exercised in this component of the work.

Does the Initiative have a documented capacity development strategy?

No

Please describe the approach to capacity development that is being implemented by the Initiative?

To date, there has not been a large effort in capacity building apart from potential user communities in Sweden and to a lesser extent North America.

Are there any commercial sector organizations participating in this Initiative?

No

Are there opportunities for commercial sector uptake of the outputs of the Initiative?

Yes

Please describe these opportunities.

If successful, the agrophotovoltaic system in this initiative could have widespread applications since it allows land to be used to simultaneously produce food and energy. To date, there has been no significant uptake of these products by the commercial sector.

Is there already commercial uptake occurring?

No

Are there opportunities for further commercial sector participation in the Initiative?

Yes

Please describe these opportunities.

There is considerable private sector interest and some limited financial support for the agriphotovoltaic systems being tested in Sweden coming from the private sector.

Does the Initiative have a plan for commercial sector engagement?

No

Governance

Please describe the roles of each of the key leadership positions, as well as any team structures involved in day-to-day management.

At present, the EO4WEF Pilot Initiative Community of Practice is the primary convening mechanism for this effort with the CFEWS activity having its own project management structure. As the inventory of projects emerges the two co-chairs of the EO4WEF Pilot Initiative will take a stronger leadership role in the management of the activity. When an increased number of projects arise, program leads will be identified for the various groups of tasks. At that point in time, a Board of Directors and/or an advisory group is anticipated.

Is there a steering committee or other governance bodies that advise the Initiative but are not involved in day-to-day management?

No

What methods does the Initiative use to communicate with its participants?

- Email / e-newsletters
- Regular conference calls
- Website
- Regular events

Please describe the key risks that could delay or obstruct the completion of the planned activities and outputs of the Initiative, along with any actions taken to mitigate these risks.

| Description of the hazard | Description of the possible impacts | Scale of impact | Likelihood of occurrence | Mitigation measures |
|--|---|------------------------|---------------------------------|--|
| Lack of funding for infrastructure support | Failure in the ability to build the network and coordinate the projects | Severe | Possible | Develop a strategy to find funding |
| Lack of qualified experts | Failure in individual projects | Moderate | Possible | Ensure a minimum of duplicate expertise on the project team |
| Retirement, sickness of departure of key individuals | Failure in a specific aspect of the program | Moderate | Possible | Ensure several people are familiar with each task. Rotate assignment for coordination activities |

What methods are used by the Initiative to monitor its effectiveness?

- Informal discussions with users / beneficiaries
- Consultations or events

Would the Initiative be interested in assistance from the GEO Secretariat for developing an impact plan?

Yes

How are the results of the monitoring and evaluation activities shared with participants and the wider GEO community?

The results of feedback from the evaluation of the program by GEO and by other groups is usually openly discussed at the CoP's regular Zoom calls. Based on those discussions and related decisions, changes in the approach are likely to be determined and implemented.

Are any monitoring or evaluation activities required by funders/contributors?

Yes

Please describe and provide reports if available.

NSF and Swedish funders require periodic reports. These are retained by the universities and the investigators and not shared outside their groups.

- no supporting documents provided -

Participants

Please list the active individual participants in the Initiative

| First name | Last name | Email address | Member | Org |
|------------|------------|-----------------------------|---------------|--|
| Sushel | Unninayar | sushel.unninayar@gmail.com | | NASA - National Aeronautics and Space Administration |
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| Jennifer | Wei | jennifer.c.wei@nasa.gov | United States | NASA - National Aeronautics and Space Administration |
| Junguo | Liu | junguo.liu@gmail.com | China | |

Other information

Please provide any other comments or information that was not included in the previous sections, but you would like to appear in the Implementation Plan.

In addition to the list of participants engaged in the initiative -the CFEWS effort involves approximately an additional 20 researchers, spanning senior researchers to graduate and undergraduate students.

- no supporting documents provided -

Co-Editor Management

List of co-editors for this initiative

- no answer given -