MapX highlights

This document introduces MapX, an online platform for managing and visualizing geospatial data on natural resources

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Introducing MapX

MapX is an online platform for managing geospatial data on natural resources, developed by UNEP/GRID-Geneva - a data centre resulting from the partnership between UN Environment Programme, the Swiss Federal Office for the Environment and the University of Geneva. Field applications of MapX are varied and include, though not limited to, biodiversity planning, chemicals management, climate change, disaster risk reduction, environmental security, extractive industries, land use planning, and renewable energy. MapX is used by a wide community of users, primarily UNEP, the Secretariats of Multilateral Environmental Agreements (MEAs) and other UN agencies mandated to collect and use geospatial data in environmental decision making. Civil society groups, non-governmental organizations, academia and citizens complement this set of users. MapX has been developed since 2014 and since then has continuously improved through wide international stakeholder consultations.

MapX philosophy

The MapX philosophy is to *help stakeholders access and use the best available data in dialogues and decision-making processes.* The MapX philosophy in developing a stakeholder solution is based on the practical experiences gained in deploying MapX in a range of different contexts. It requires a technical approach, as well as capacity building to ensure ownership, uptake and action, and a political process to create impact. Core elements include:

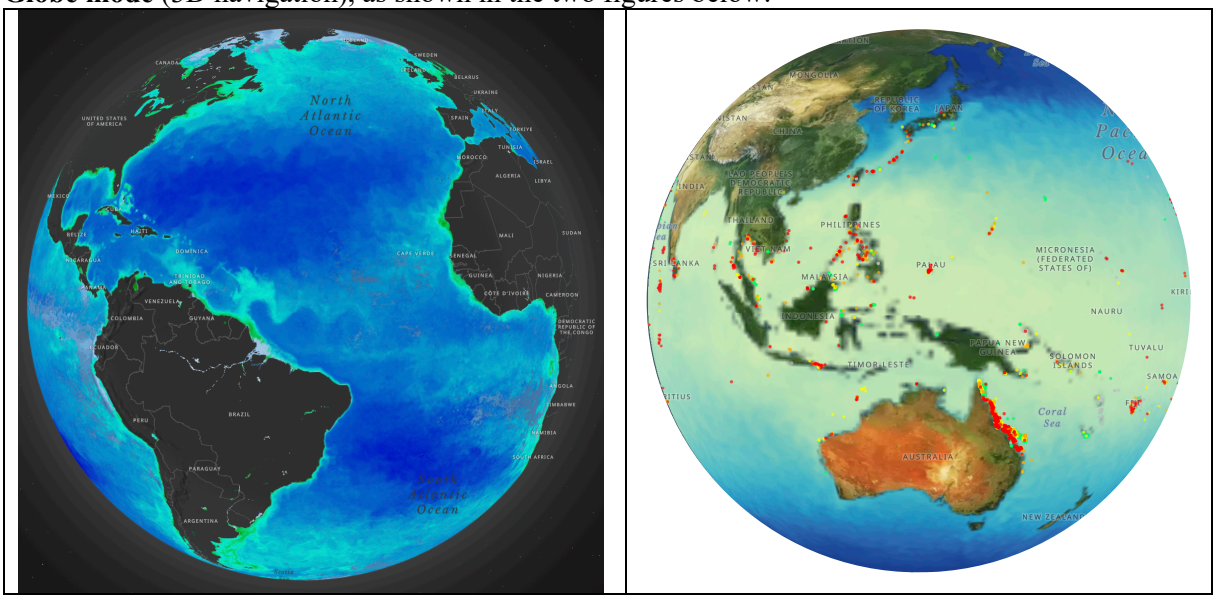
- **Problem/solution orientation**: we start with the problem users wish to solve, not the available data. We ensure solutions are fit for purpose.
- **Build stakeholder capacity**: local stakeholders need the capacity to support the solution in the longer term.
- **Measure incentives and impact**: we understand how improved access to data changes behavioral incentives and leads to improved impact. MapX works to improve transparency by integrating economic, social and environmental factors in the approach. MapX helps users contextualize data and understand the real development impact.
- **Address barriers to uptake**: we anticipate barriers to data use and work to remove or mitigate them from the outset of an engagement.
- **Process matters**: a credible process to define a problem and explore solutions using geospatial information is a critical success factor.
- **Think beyond open data**: an effective solution should harness a combination of open data as well as private data held by different stakeholders.
- **Be independent and impartial:** MapX is underpinned by UN impartiality. It can act as a trusted data broker and engage directly in sensitive political processes where data impartiality must be maintained.

Key MapX services

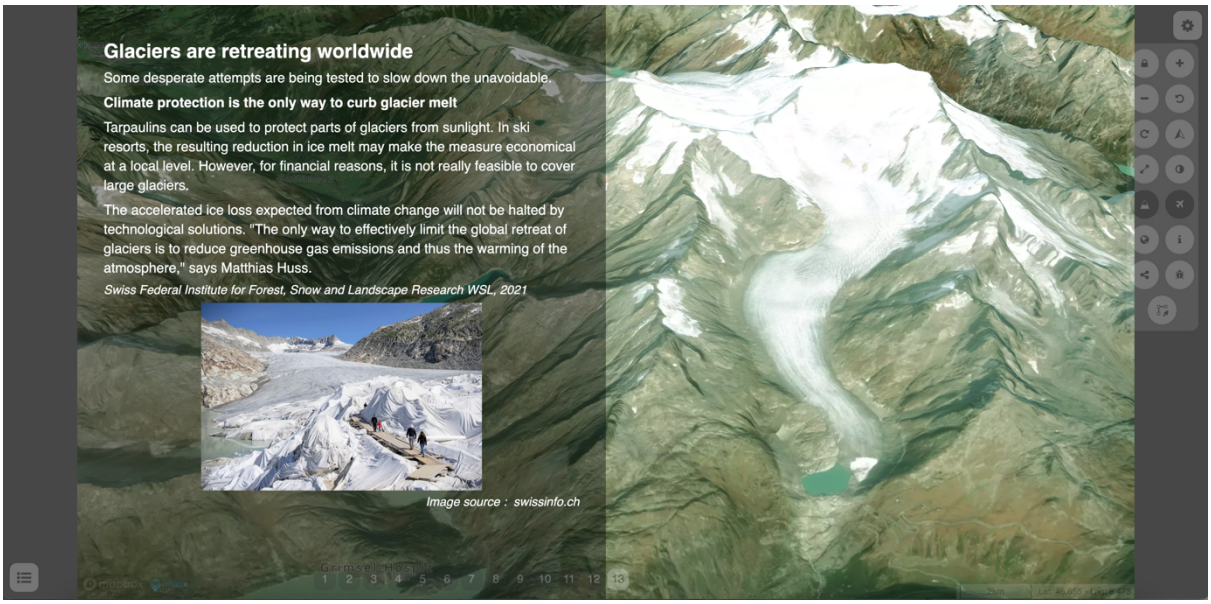
Key features and functions

- **A catalog** of the best available **geospatial data**: https://app.mapx.org
- **Cartographic functions** for **vector** (building on vector tiles) as well as **raster** and **tabular** data.

- **Globe mode** (3D navigation), as shown in the two figures below:



- **Real time** and near-real time **analytics** for monitoring environmental processes.
- **Story map** builder, telling cartographic stories step by step, or "slide" by "slide". An example slide is presented in the figure below, showing that glaciers are retreating worldwide, the map being centered on a glacier of the Swiss Alps:



See here for selected pieces of story maps.

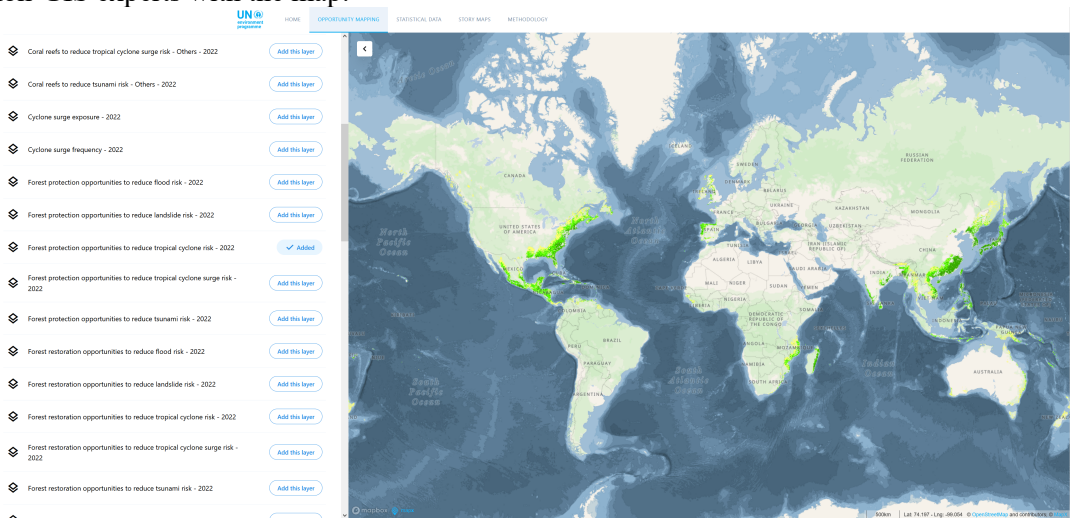
- Dynamic communication products (e.g., dashboards and story maps) and services to inform action and decision-making.
- System of **isolated workspaces with membership**.
- **Gradual user permissions** on workspaces, data and functions.
- **Data in public or private mode** (depending on users' requirement), offering secure and authoritative data.
- **Map composer** to create, customize and export maps in generic formats.

Interoperability and standards

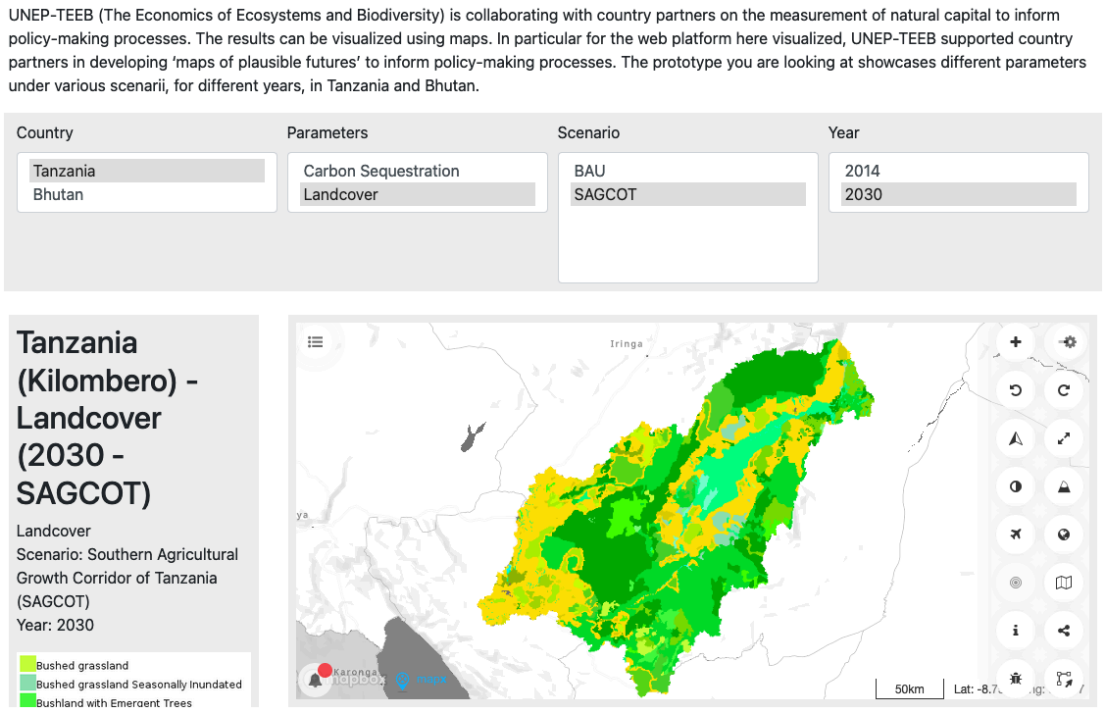
- The MapX base map shows the **UN Official international and administrative boundaries**, the first subnational level and the names of the countries. Those layers come from the United Nations map geodatabase (scale: 1:1 million, version: 2020). They are styled according to the

'Guidance for the Publication of Maps' document released by the United Nations in November 2020.

- MapX was built on **open-source libraries**, but it can exploit many proprietary formats through web services and APIs.
- It contains a catalog of datasets that are compliant with **international standards** for geospatial data (Open Geospatial Consortium) and metadata (ISO), some being live streamed from external data repositories.
- The Group on Earth Observations "Land Degradation Neutrality" Flagship (GEO-LDN) has been developing since 2023 a framework for examining the quality of new software tools wishing to access the **GEO-LDN** toolbox. The process must include minimum technical, interoperability and content **standards**. MapX is one of the applications that was tested and passed the test, obtaining a score of 226 out of 260.
- Data streaming is performed automatically using **external APIs** and **web services**.
- The **MapX SDK (**Software Development Kit) makes it possible to embed MapX in external websites, with a complete customization of the data and the graphical user interface. See some examples in the fields of disasters risk management and biodiversity planning. In the figure below MapX layers' visibility is piloted from an external webpage (the catalog, on the left side; and the icon, on the top): the graphical user interface is reduced, facilitating the interaction of non-GIS experts with the map:



Same principle in the figure below, the legend (left) and the dropdown lists (top) belonging to the web page:



- **Sharing** of data layers and story maps **on social media**.
- Graphical user interface in the **six UN official languages**: Arabic, Chinese, English, French, Russian and Spanish.
- MapX is integrated into the World Environment Situation Room (WESR), which is the UNEP data, information and knowledge platform.

Infrastructure

- **Fast** & light application.
- Optimized for **low bandwidth** environments.
- Cloud-optimized.
- Scalable to support variable **workloads**.

MapX knowledge base

- MapX documentation is available in English with detailed step-by-step explanations covering all the functions of the application.
- MapX training material is available in English, French and Spanish. The material is composed of the following items: background ; platform overview ; MapX fundamentals ; how to create views ; system architecture ; understanding and using MapX key features ; developing and using dashboards ; developing story maps ; reporting a bug on GitHub.
- MapX also offers a GitHub repository where anyone can report issues, bugs and ideas for new features development.

MapX key figures

MapX has collaborated with **36** scientific projects, covering **all environmental topics**, operating at **4 geographical scales** (global, regional, national –**73 countries are covered**—and local) and supporting **7 International Conventions**. MapX is interoperable with **dozens of data repositories** and platforms. It offers a free access to **2'000 public datasets**. **3'900 users have registered** on the platform to access

more data and features than public users. MapX counts **385 participants to trainings**, in person or online. MapX has a bug reporting platform with **800** issues (around 80-90% of them being fixed & closed).

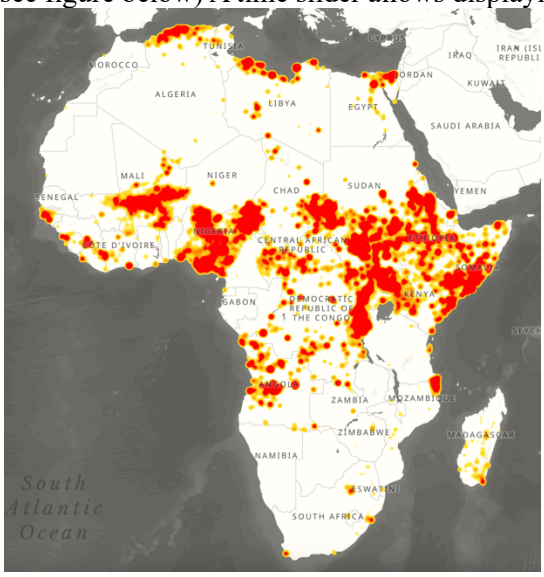
Examples MapX products

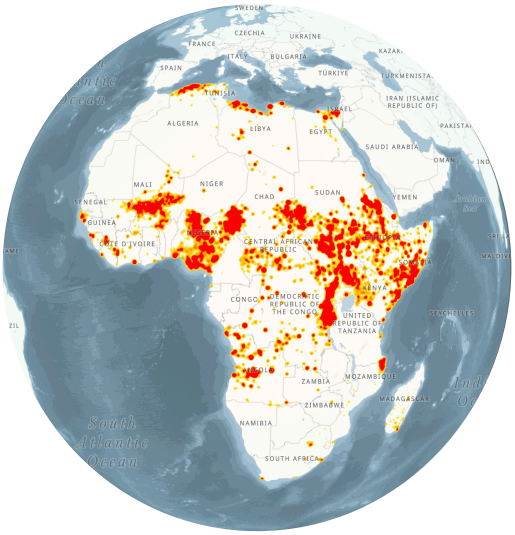
Climate change and Air quality

- Dissemination, in the form of geospatial datasets, of some outputs of the Swiss Data Cube initiative, which provides Earth Observation (EO) analysis ready data (ARD) for monitoring the environment of Switzerland in space and time.
- Key geospatial datasets showcasing the hidden risk of countries, for seven natural hazards (earthquakes, tsunamis, landslides, riverine floods, hydrological droughts, and tropical cyclones - wind and storm surge), considering the effects of climate change.

Disasters and conflicts

- Heat map showing the number of fatalities due to conflict events in Africa from 1997 to present (see figure below) A time slider allows displaying the conflicts through time.





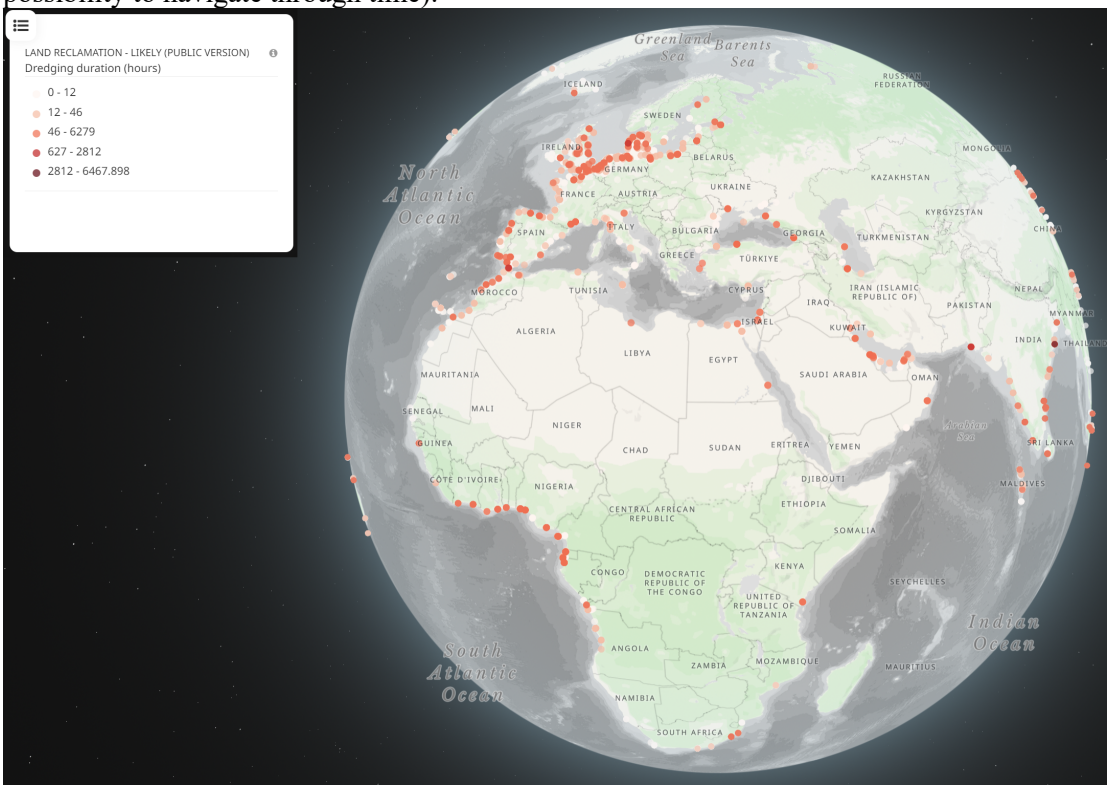
- The Nexus Environmental Assessment Tool (NEAT+) is a project-level environmental screening tool, maintained by the UNEP-OCHA Joint Environment Unit, designed for humanitarian practitioners. MapX was used as a platform to host and present results from pilot testing and participatory mapping activities of the NEAT+ in four countries.
- Story map supporting the work of UNEP and the World Bank in their fragility assessment of the Sahel.
- Key geospatial datasets supporting the Drought Impact Needs Assesment (DINA) in Somalia.

Extractives

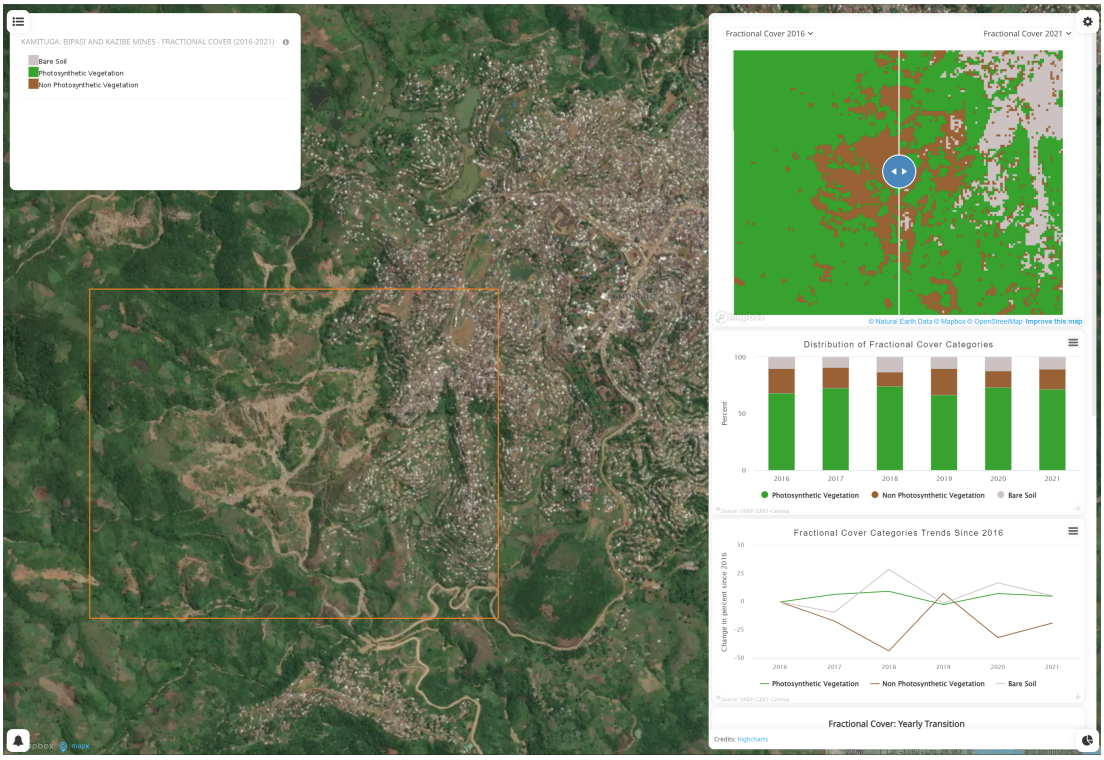
- Story map showcasing how remote sensing techniques can support artisanal and small-scale gold mining (ASGM) policy development, implementation and evaluation.
- Dissemination, in the form of geospatial datasets, one story map and one scientific paper, of the outputs of the CopX project, piloted in Colombia, addressing the challenge of increasing transparency and equalization of information at mining sites using Copernicus satellite imagery.
- In collaboration with the Extractive Industries Transparency Initiative (EITI), MapX was piloted in DR Congo to help mainstream transparency in government systems and improve stakeholder access to financial information from EITI reports linked to the location of specific mining concessions. Where possible, financial information was also related to socio-economic

and environmental performance indicators to support overall performance monitoring of the sector.

- Key geospatial datasets published in the frame of the Marine Sand Watch platform. The figure below shows vessel positions used to reclaim land as well as the dredging activity (with a possibility to navigate through time):



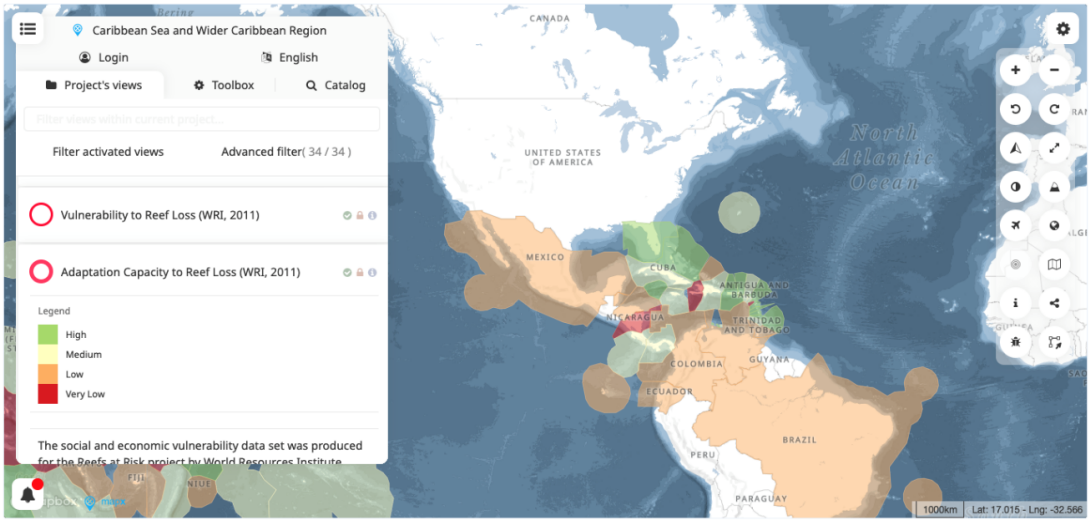
- Key geospatial datasets supporting the prioritization, implementation and monitoring of clean-up activities in Ogoniland, Nigeria, in the frame of the Hydrocarbon Pollution Remediation Project (HYPREP).
- Geospatial datasets supporting developing countries in managing information related to mercury use and reduction in the artisanal and small-scale gold mining (ASGM) sector.
- Connection of MapX with the data cube technology to develop different pilots for monitoring land degradation by mineral resources extraction over time. One of the pilots was conducted in the region of Kamituga, DR Congo. It shows how it is possible to monitor land cover changes due to artisanal and small-scale gold mining activities (see figure below):



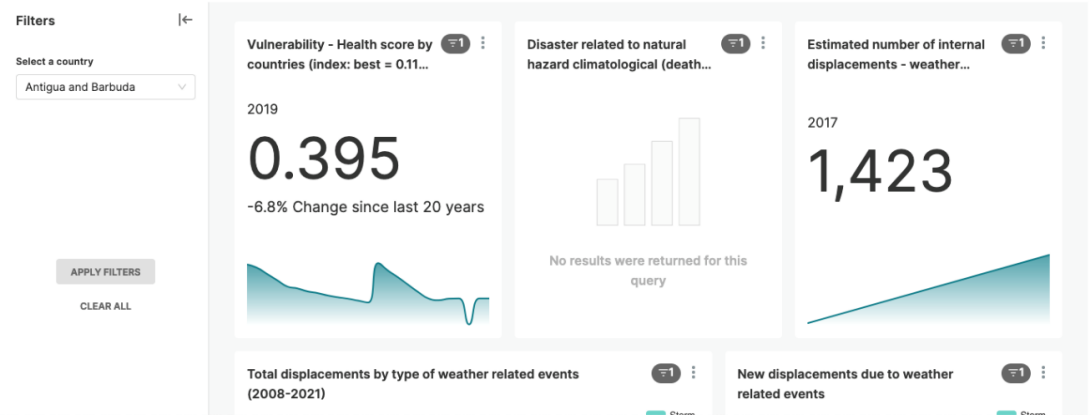
Ocean, seas and coasts

- Regional environment monitoring platform facilitating the compilation of information from national monitoring and assessment programmes to make environmental information generated in the Wider Caribbean Region (WCR) more accessible to stakeholders for national and regional decision-making. The figure below shows key geospatial and statistical information that are showcased on the regional platform:

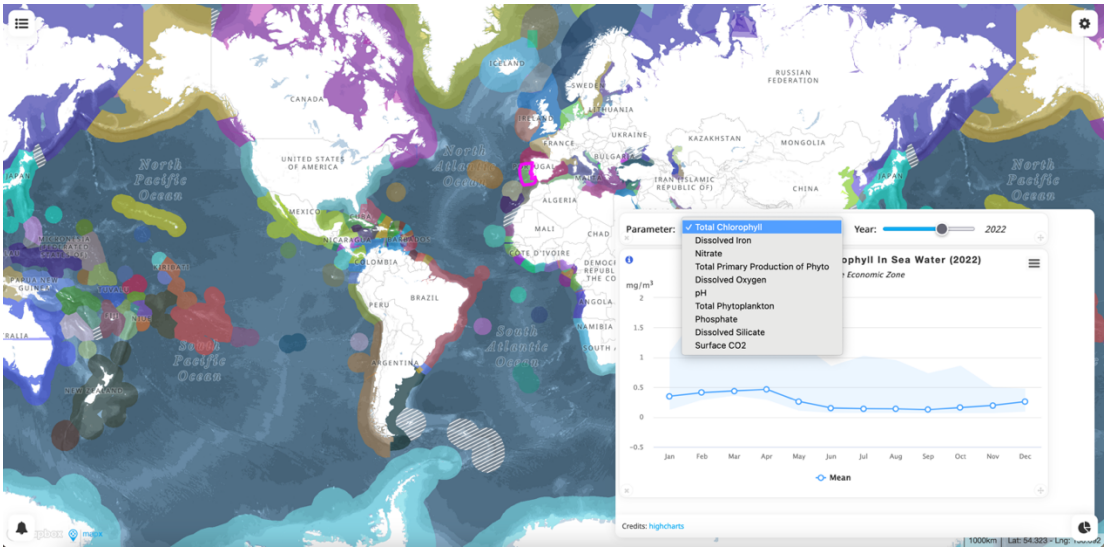
Geospatial resources



What are the key values and trends?



- Story map explaining how digital tools such as MapX can help monitor progress towards sustainable development in the Mediterranean basin.
- Knowledge management platform to facilitate information sharing and promotion of the achievements of the UNEP Global Environment Facility (GEF) MedProgramme.
- Key marine indicators live streamed from the Copernicus Marine Service platform.
- Key geospatial datasets supporting the UNEP Global Environment Monitoring System for the Ocean and Coasts (GEMS-Ocean).

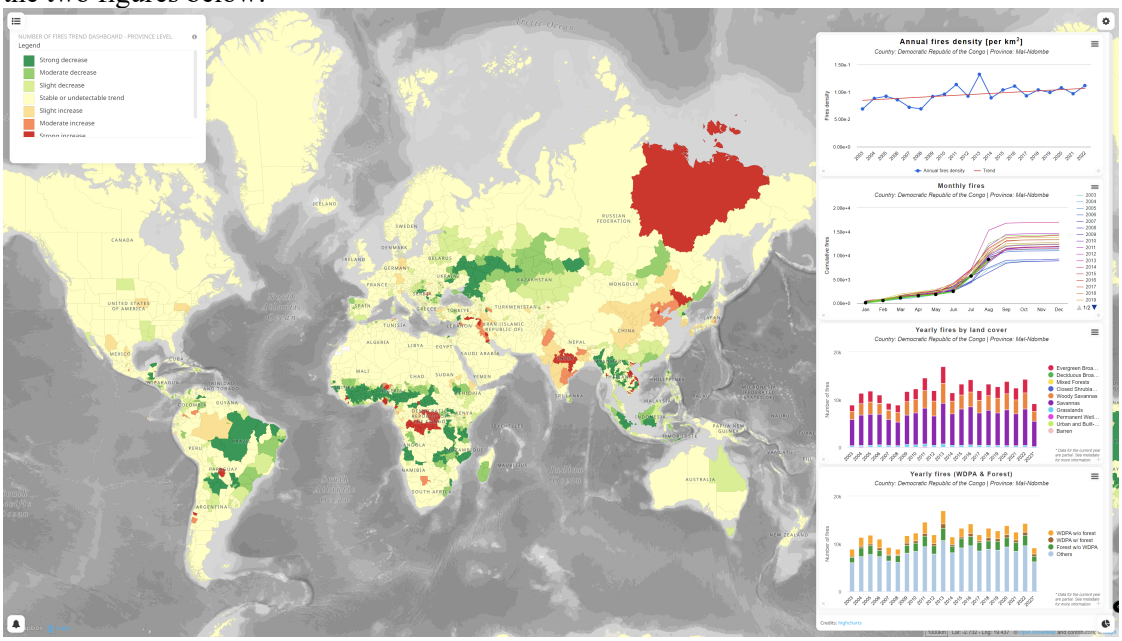


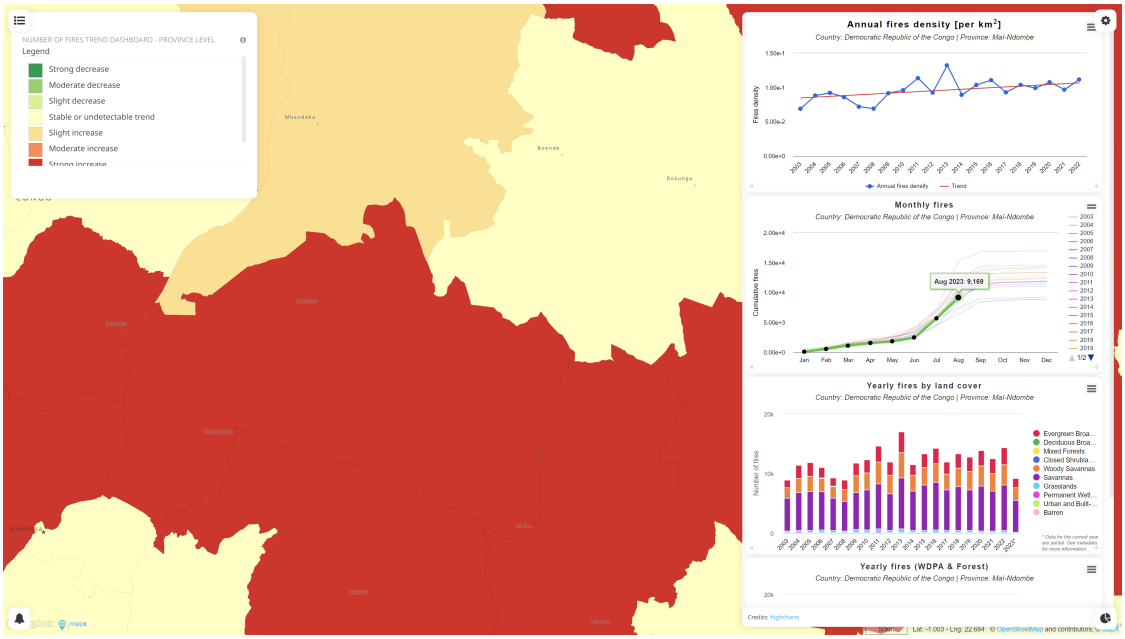
Pollution

- Geospatial datasets supporting country reporting to the Stockholm Convention on persistent organic pollutants (POPs), e.g., in Ethiopia, Gabon, Kenya, Senegal, and Tanzania.
- In August 2006, the ship Probo Koala dumped 528 cubic metres of toxic waste around the port of Abdijan, Côte d'Ivoire. MapX supported spatial data management for the independent environmental audit.
- System of interactive and updatable environmental profiles for the analysis of environmental situations and performances of countries around the world. Covering eight environmental pillars, including Pollution, this online tool, building on MapX, aims to provide information on key national policies and actions, and offers a single-entry point to over a hundred of up-to-date datasets.

Risk

- Geospatial datasets supporting the Ecosystem-based approach for disaster risk reduction (Eco-DRR) approach.
- Global dashboard showing the trend of the number of fires at the province level, as shown in the two figures below:





- Near real-time data on the occurrence of natural hazards (e.g., active fires, earthquakes) streamed from authoritative data providers (e.g., NASA, USGS)
- Global risk data platform.
- Global infrastructure risk and resilience index (GIRI) platform
- Geospatial datasets supporting the development of the Niger Disaster Risk Information System.

Scientific papers

MapX has contributed to various research projects and publications in international peer-reviewed journals:

1. Lehmann A., Giuliani P., Jarvis I., Serral I., Maso J., Lacroix P., Gilliams S., Giuliani G. Group on Earth Observations (GEO) Essential Variables (EVs) report, 2023. GEO community activity report: Mainstreaming EVs across GEO. Geneva, 75 pp. WWW
2. Moomen A., Lacroix P., Benvenuti A., Planque M., Piller T., Davis K., Miranda M., Ibrahim E., Giuliani G. (2022). Assessing the Applications of Earth Observation data for Monitoring artisanal and small-scale gold mining (ASGM) in Developing Countries. **Remote Sensing** 14(3), 2971. WWW
3. Lehmann A., Mazzetti P., Santoro M., Nativi S., Maso J., Serral I., Spengler D., Niamir A., Lacroix P., Ambrosone M., McCallum I., Kussul N., Patias P., Rodila D., Ray N., Giuliani G. (2022). Essential earth observation variables for high-level multi-scale indicators and policies. **Environmental Science and Policy** 131:105-117. WWW
4. Poussin C., Massot A., Ginzler C., Weber D., Chatenoux B., Lacroix P., Piller T., Nguyen L., Giuliani G. (2021) Drying conditions in Switzerland - Indication from a 35-year Landsat time-series analysis of vegetation water content estimates to support SDGs. **Big Earth Data** X(X):XX. WWW
5. Ibrahim E., Jingyi J., Lema L., Barnabé P., Giuliani G., Lacroix P., Pirard E. (2021). Cloud and cloud-shadow detection for applications in mapping small-scale mining in Colombia. **Remote Sensing** 13(4):736. WWW
6. Ibrahim E., Lema L., Barnabé P., Lacroix P., Pirard E. (2020). Small-scale surface mining of gold placers: detection, mapping and temporal analysis through the use of free satellite imagery. **International Journal of Applied Earth Observation and Geoinformation** 93:102194. WWW

7. Giuliani G., Piller T., Chatenoux B., Moser F., Lacroix P. (2020). Data Cube on Demand (DCOD): Generating Earth Observation Data Cube Anywhere in the World. **International Journal of Applied Earth Observations and Geoinformation** 87:102035. WWW
8. Lacroix P., Moser F., Benvenuti A., Piller T., Jensen D., Petersen I., Planque M., Ray N. (2019). MapX: an open geospatial platform to manage, analyse and visualise data on natural resources and the environment, **SoftwareX**, 9:77-84. WWW
9. Atibu E., Lacroix P., Sivalingam P., Ray N., Giuliani G., Mulaji C., Otamonga J.P., Mpiana P., Slaveykova V., Poté J. (2018) High contamination in the areas surrounding abandoned mines and mining activities: an impact assessment of the Dilala, Luilu and Mpingiri rivers, Democratic Republic of the Congo, **Chemosphere**,191: 1008-1020. WWW
10. Mantzouki, E., Campbell, J., van Loon, E. *et al.* A European Multi Lake Survey dataset of environmental variables, phytoplankton pigments and cyanotoxins. **Scientific Data 5**, 180226 (2018). WWW
11. Ray N., Lacroix P., Giuliani G., Upla P., Rajabifard A., Jensen D. (2016). Open Spatial Data Infrastructures for the Sustainable Development of the Extractives Sector: Promises and Challenges. Ed. Coleman D., Rajabifard A., Crompvoets J. **Spatial Enablement in a Smart World**. GSDI Association press, 53-69. WWW