# EnfTech Platform -SentinElegxos Sea Water Quality Application

**Competition Category Theme:** Beyond Horizons – Redefining Travel with Space Innovation
**Team:** GeoOpEN - GREECE
**Date:** November 2025

## 1. Project Summary

The first Implementation of our EnfTech (Enforcement Technology) Platform is **SentinElegxos - A tool for Sea-Water Quality Application**.

Major Mediterranean Tourist Destinations are places where signs of over-tourism and other human activities coincide. The **local ecosystems** are under pressure due to climate change, increasing demands from seasonal touristic waves even due to fisheries by Aquaculutere activities (fisheries and fish breeding cages). Water resources are scarce and unpredictability of tourist seasonal demand cannot be solved by simply over-dimensioning infrastructure facilities. **Wastewater treatment plants operational failures** often but not, lead to untreated wastewater ending up in water reservoirs either in mainland or the open sea.

In Greece, **four separate authorities** monitor wastewater and swimming water quality. Ministry of Environment, Ministry of Health, Regional Administrations and Municipalities. Authorities are struggling to cooperate via paperwork for the protection of public-health and environment. The reason is that Governance is **missing a digital information backbone** – a data pipeline. Decrees announcing illegal swimming zones miss digital visualizations and standardization, therefore fail to inform the public, tourists and swimmers on the **Health risks**. Abiding by EU WFD Water Framework Directive (2000/60/EC) and Bathing Water Directive (2006/7/EC) as well as Open Data Directive 2019/1024 and INSPIRE Directive 2007/2/EC can be achieved only by using Information Computer Technologies.

**GeoOpEN's** first product **SentinelElegxos,** covers this gap. It does not compete with commercial water quality monitoring systems, nor with IoT sensor manufacturers. Instead, we target the enforcement layer / implementation of the Regulations in National and European level and dissemination to the public. SentinElegxos is part of **GeoOpEN's EnfTEch**, **Enforcement Technology framework** that addresses the 2024 Draghi Report proposal to reduce the burden of compliance-monitoring at scale in an increasingly digitized economy. SentinelElegxos innovation / functionality in summary:

- Like a tin-can opener, GeoOPEN SentinelElegxos **OPENS** up closed public Geographic datasets (astikalimata.ypeka.gr, keraies.eett.gr and paper decrees )from their data silos. We automate the production of maps and reusable datasets ready to be consumed by authorities or the public,
- The (Geo)OpEN SentinelElegxos uses **Sentinel2 Earth Observation images** to estimate possible sea water contamination around all points of interest like Wastewater Treatment Plants extraction outlets, Marinas and Ports as well as Sea farm sites breeeding places of the European Aquaculture Industry.
- The (Geo)OpEN SentinelElegxos – consumes **Copernicus Digital Elevation Model** dataset to optimise selection locations for deploying wireless buoys / IoT /water quality real-time sensors either for the needs of monitoring water quality by the authorities or by Compliance and Quality Assurance players.
- GeoOp(EN) SentinElegxos helps Public Administrations **ENforce the National and European** Law timely, accurately and precisely with limited cost, therefore rightfully considered an initiative with the potential to reach in the coming years LEVEL 5 on the EnfTECH.org scale of automation.
- **Tourists, Swimmers and Citizens** benefit from the visualization with live maps of the legal decrees issued by Ministry of Health describing **Forbidden Swimming Areas** . The android app on smartphones use **EGNOS and GALILEO GNSS receivers** to alert in real time when entering a no-swim zone.

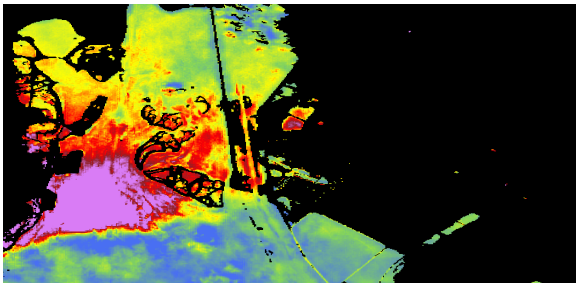
Public Administrations with GeoOpEN's EnfTech Tools can combat Information Assymetry and expand visibility on water pollution, identify possible wrongdoers with easily deployable and low-cost solutions. **Travel expenses** for monitoring environmental compliance are reduced to a minimum and to the areas that are sorted by automated procedures based on Sentinel2 satellite data products. **Travel and Tourism environmental impacts** will be measurable centrally, providing all necessary data to plan and engineer better treatment facilities. Real time mobile app gamefies the **eco-consiousness and eco-friendly behaviours** for users, citizens and tourists.

**Travellers/Tourists/Citizens** gain awareness on their destination and safe water swimming zones. Attractiveness of **Tourist product** is enhanced. Public Health is protected against urine, retinal and prostate infections as well as skin rashes. Dissemination of Visualisation and maps will self-regulate Tourist industry in Over-Tourism-affected summer destinations.

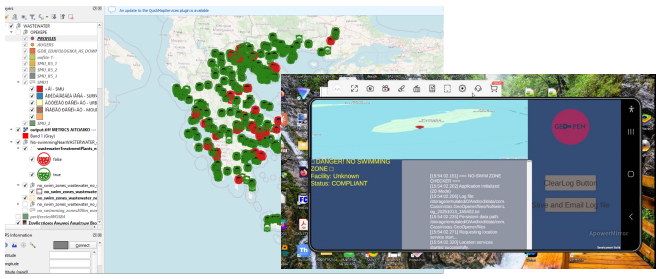
**GeoOpen SentinElegxos REDEFINES TRAVEL WITH SPACE INNOVATION**.

In our Demonstration – Proof of concept: The GeoOpen (SentinElegxos) uses the following technologies:

1. **Automated Collection of Data and Aggregation**: Scraping public datasets (astikalimata.ypeka.gr, keraies.eett.gr) with python and Apify.com platforms to create comprehensive datasets in harmonised standard filetypes (geojson, kml, geoparquet, shp). Process is fully automated for GIS functions (Coordinate system transformations and calculation of the circular 200m buffer no-swim zones made use of Python Serverless Functions on Google Cloud Platform Run code . Dev with VsCode, QA with QGIS and for the CI/CD repository Gihub was used.
2. **Sentinel Hub and Copernicus Services**: Use of **Sentinel-2/Se2WAQ Script**. We consume **Sentinel-2 (L1C & L2A)** to display the spatial distribution of six relevant indicators of water quality: (i) Chlorophyll a (Chl_a), (ii) cyanobacteria (Cya), (iii) turbidity (turb), (iv) colored dissolved organic matter (CDOM), (v) dissolved organic carbon (DOC), and (vi) water color (Color). The script addresses pollution indicators of inland waters bodies. We extrapolate to sea water without repeating the base research of Estonian Marine Institute, University of Tartu and Polytechnic Institute of Beja, Portugal.
3. **Sentinel Hub and Copernicus Services:** Use of **Sentinel-2 DEM dataset** to calculate the elevation (Elevation Profile) of each IoT location. Locations of licenced antennas of diffrerent technologies (UHF/VHF, GSM/5G, 2.4GHz ) across the Hellenic Territory that were collected in step1. We used OpenEO editor, Copernicus Jupyter Notebook and local Jupyter lab.
4. **GIS Visualisation**: Mapping treatment plants, discharge points, and restricted zones leaflet.js in Single Page Application on VERCEL.COM. , Development: Javascript on nodejs with Vscode, QA: QGIS, Android app development on Unity and Arcore.



Sentinel Jupyter Notebook Se2WaQ script



Internet web App and android app UI