



The International Maritime Transport and Logistics Conference

“MARLOG 12”

**Sustainable & Innovative
Technologies**

Towards a Resilient Future

12 - 14 March, 2023 Alexandria - EGYPT





Prof. Nikitas Nikitakos
University of the Aegean, Chios, Greece
nnik@Aegean.gr

Environmental Impact of Maritime Logistics Using Satellite Data

**N. Nikitakos, D. Kitsiou, M. Banela, A. Patera & A.A
Stefanakou**



Introduction

- The phenomenon of marine eutrophication is the most common environmental problem that contributes to the degradation of the quality of coastal ecosystems & the marine environment by excessively increasing phytoplankton and phytobenthos;
- Shipping has a negative impact on the marine environment, contributing among others to eutrophication through NOx emissions;
- Ship detection is a key aspect of maritime surveillance, as it enables the monitoring of various maritime activities, such as maritime traffic, search & rescue, cargo transportation, maritime defense, illegal fishing, and also includes environmental aspects (e.g. oil spill detection and monitoring, etc.);
- Today, maritime surveillance can be implemented using a variety of methodologies & tools, using either cooperative systems (e.g. AIS, LRIT & VMS) or non-cooperative systems, which do not demand any action from the ships.

Introduction (Cont.)

- Ship detection using Sentinel 1 Synthetic Aperture Radar (SAR) data: Non-cooperative systems- Allow the tracking of ships that may not require AIS or similar systems (e.g. small-scale fishing vessels), or vessels involved in illegal activities (piracy, illegal and unregulated fishing, etc.);
- Independent of weather, thus enabling detection on a regular basis.

Paper presents a methodology that aims to collect, process, & analyze data on a large temporal and spatial scale for the assessment of environmental impacts due to maritime traffic, using satellite data;

The rapid development of remote sensing as well as the free availability of satellite data and other related products to the scientific community contribute to this objective.

Methodological Framework for Environmental Assessment Using Satellite Data

a) Tools & Data for Ship Detection

- **Data:** Sentinel-1 C Band SAR images from Alaska Satellite Facility (ASF).
- 30 images downloaded, 15 of each frame, all level 1-Ground Range Detected (GRD)
- **Beam Mode:** IW*, **Polarization:** VV+VH**, **Flight Direction:** Descending
- **Timeframe (From-to) :** 01/07/2021 - 31/12/2021
- **Tools:** SNAP software: European Space Agency (ESA) through Science Toolbox Exploitation Platform (STEP).

*IW: Interferometric Wide

**VV: vertical transmit, vertical receive;

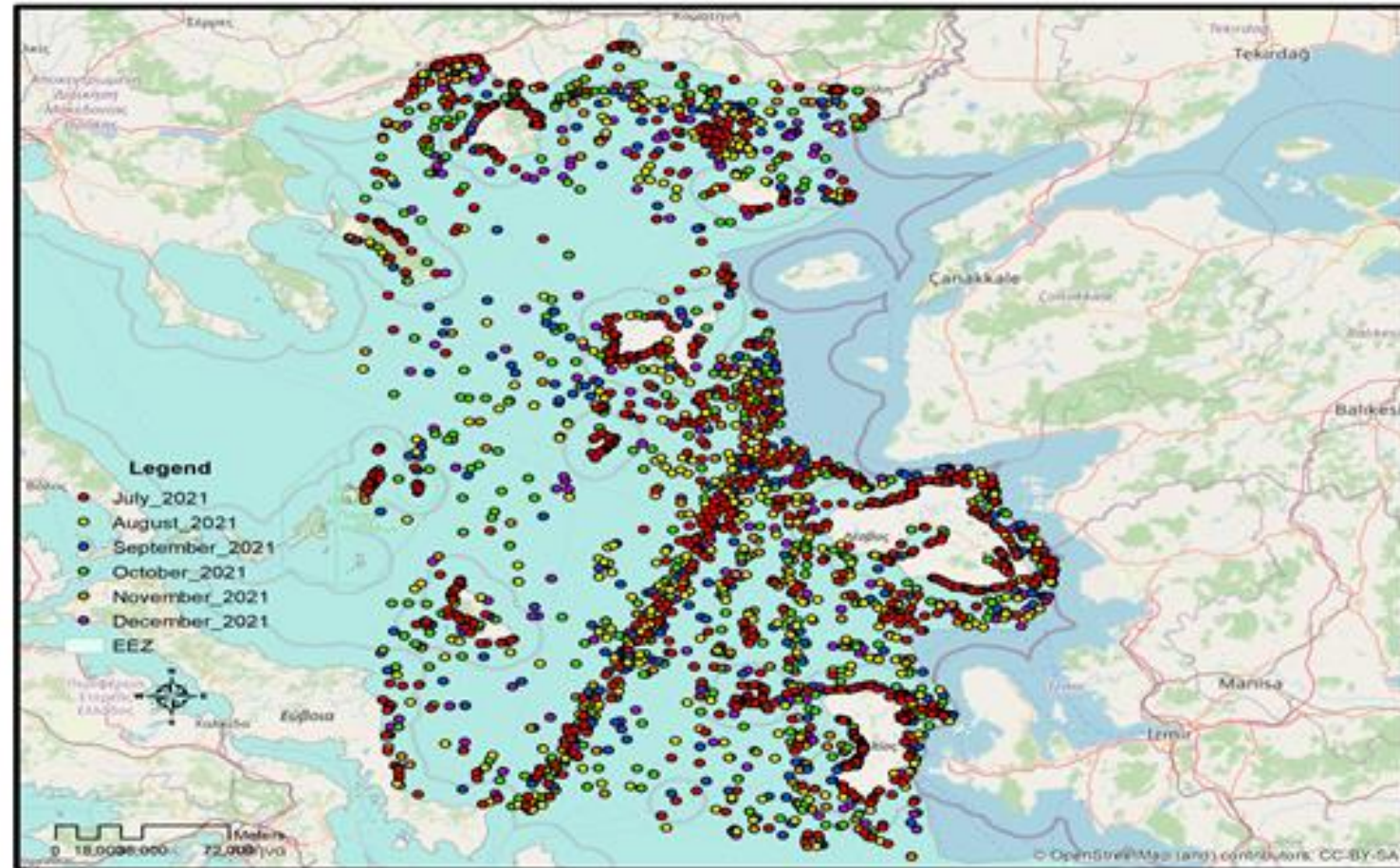
**VH: vertical transmit, horizontal receive



**Area of Interest (Aoi): A&B Frame
North Aegean Region (Greece)**

Methodological Framework for Environmental Assessment Using Satellite Data

- Sen
D
- Proce
So
- PRE-PRC
 - Open &
 - Apply C
 - Add Ver
- RUN SHI
 - Land Se
 - Calibra
 - Adaptiv
 - Object
- Expo
Sh



Visualization of Final Results for Aoi in ArcGisPro Environment

Methodological Framework for Environmental Assessment Using Satellite Data

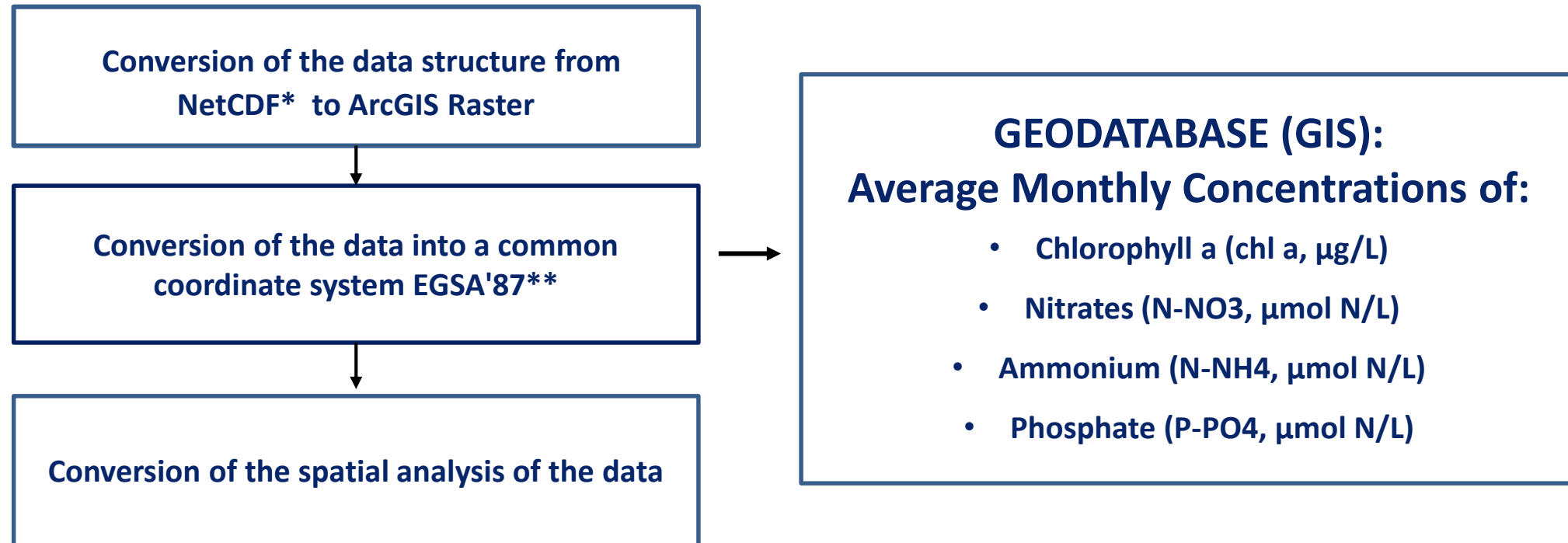
a) Data for Eutrophication Level Assessment

- **Data:** Marine Copernicus Database
- **Timeframe (From-to):** 2012-2021
- **Processing Level Data:** L4
- Satellite measurements of surface **chlorophyll a**, & numerical model products of **variables related to marine eutrophication**

Methodological Framework for Environmental Assessment Using Satellite Data

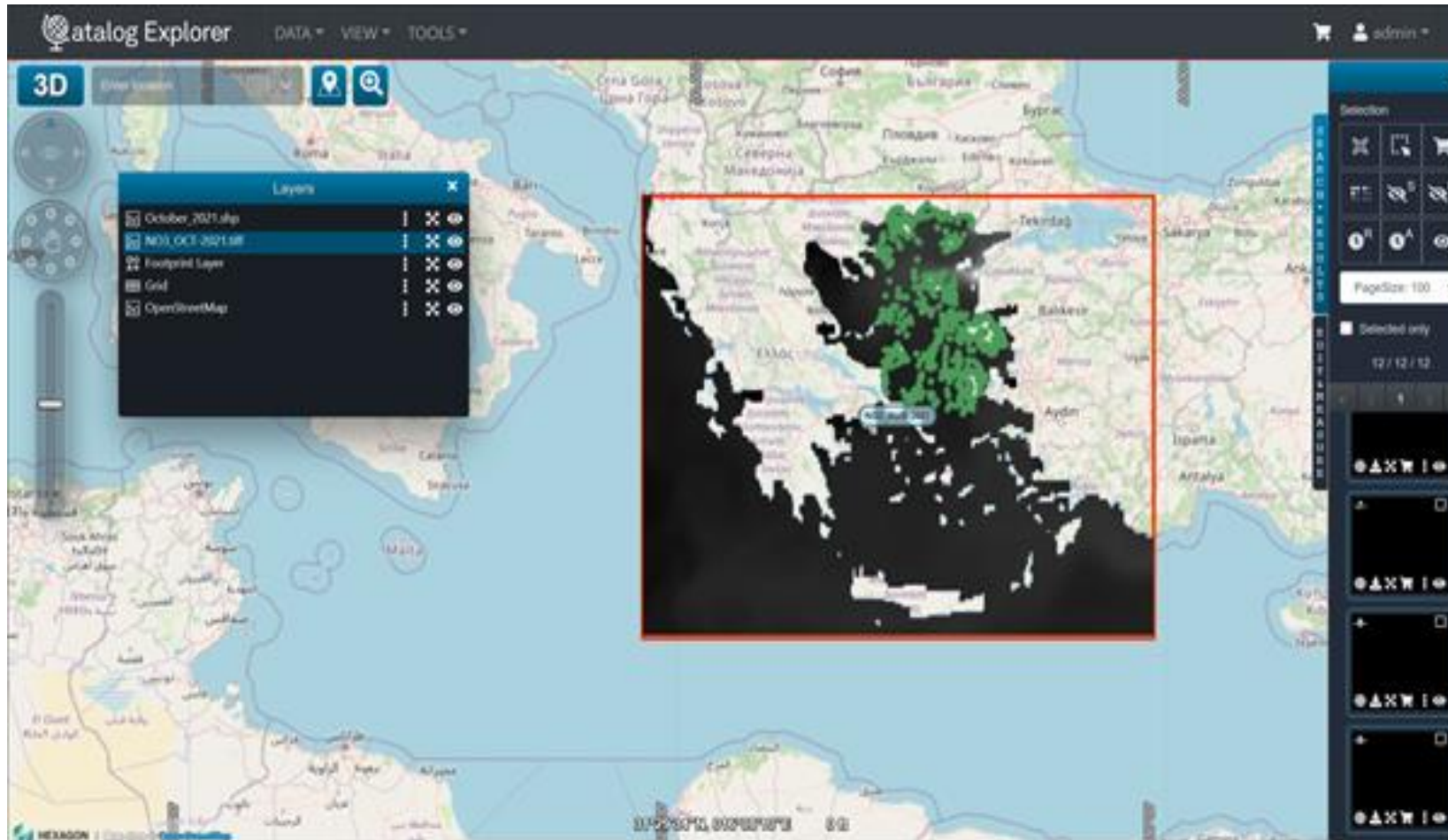
a) Data for Eutrophication Level Assessment (Cont.)

DATA PRE-PROCESSING:



*Network Common Data Form, **Greek Geodetic Reference System

Development of The Geospatial Portal



tributes, edits &

to any client, on any

Geospatial portal interface where are selected to visualized the (a) concentration of nitrates and (b) the shipping detection for the October 2021.

Discussion

The methodological framework can serve as a tool for maritime/environmental policy in the long term.

- Traffic Separation Scheme-TSS can be redefined to avoid problems of marine collisions in environmental sensitive areas, which are the main cause of accidents;
- Support the management of environmental risks in sensitive areas with increased shipping traffic;
- By processing data from the method it is possible to issues specific guidelines on ship operation (e.g. non discharge of liquid waste) to avoid polluting the areas;
- The maritime pollution response network (emergency stations) can be revised using data from maritime traffic and provide real time awareness of any environmental accident.

Conclusions

- Ship detection & nutrients datasets related to the phenomenon of eutrophication are collected, stored and visualized through a developed geoportal;
- The entire data infrastructure can be regularly updated & delivered to any client, on any device;
- As a result, a large group of people, scientists, local authorities, decision-makers & other involved groups have an online tool with which they can combine visualized data on ship position & marine eutrophication levels;
- High-resolution and easy-to-understand spatial data;
- Tool can assist in adoption of strategies and more generally policies related to the maritime traffic and conservation and restoration of the environmental quality of the sea.

Future Steps

- Integration of a geoprocessing tool to assess eutrophication levels & visualize the spatial distributions of eutrophication levels;
- Integration of a Terrestrial-AIS dataset in order to compare/correlate AIS data with that obtained after processing from satellite SAR data. This comparison aims to double check and identify vessels that may not transmit AIS due to illegal activities (e.g. piracy, illegal fishing);
- A Web Map Service (WMS) will be provided by the geospatial portal providing information on shipping density and covering a period from 2017 to 2021.

Thank You

ACKNOWLEDGMENTS

This research is part of the Action “e-Aegean-Geo-spatial data services” funded by the Research e-Infrastructure “[e-Aegean R&D Network] R&D Network in Aegean Archipelagos: Supporting Regional Innovation, Entrepreneurship and Excellence” {Code Number MIS 5046494} which is implemented within the framework of the “Regional Excellence” Action of the Operational Program “Competitiveness, Entrepreneurship and Innovation”. The action was co-funded by the European Regional Development Fund (ERDF) and the Greek State [Partnership Agreement 2014–2020].

Prof. Nikitas Nikitakos
University of the Aegean, Chios, Greece
nnik@Aegean.gr