BEeS

The LifeWatch ERIC Biodiversity & Ecosystem eScience Conference

LifeWatch ERIC

Heraklion, 30 June - 3 July 2025

01 July 2025 | 09:15

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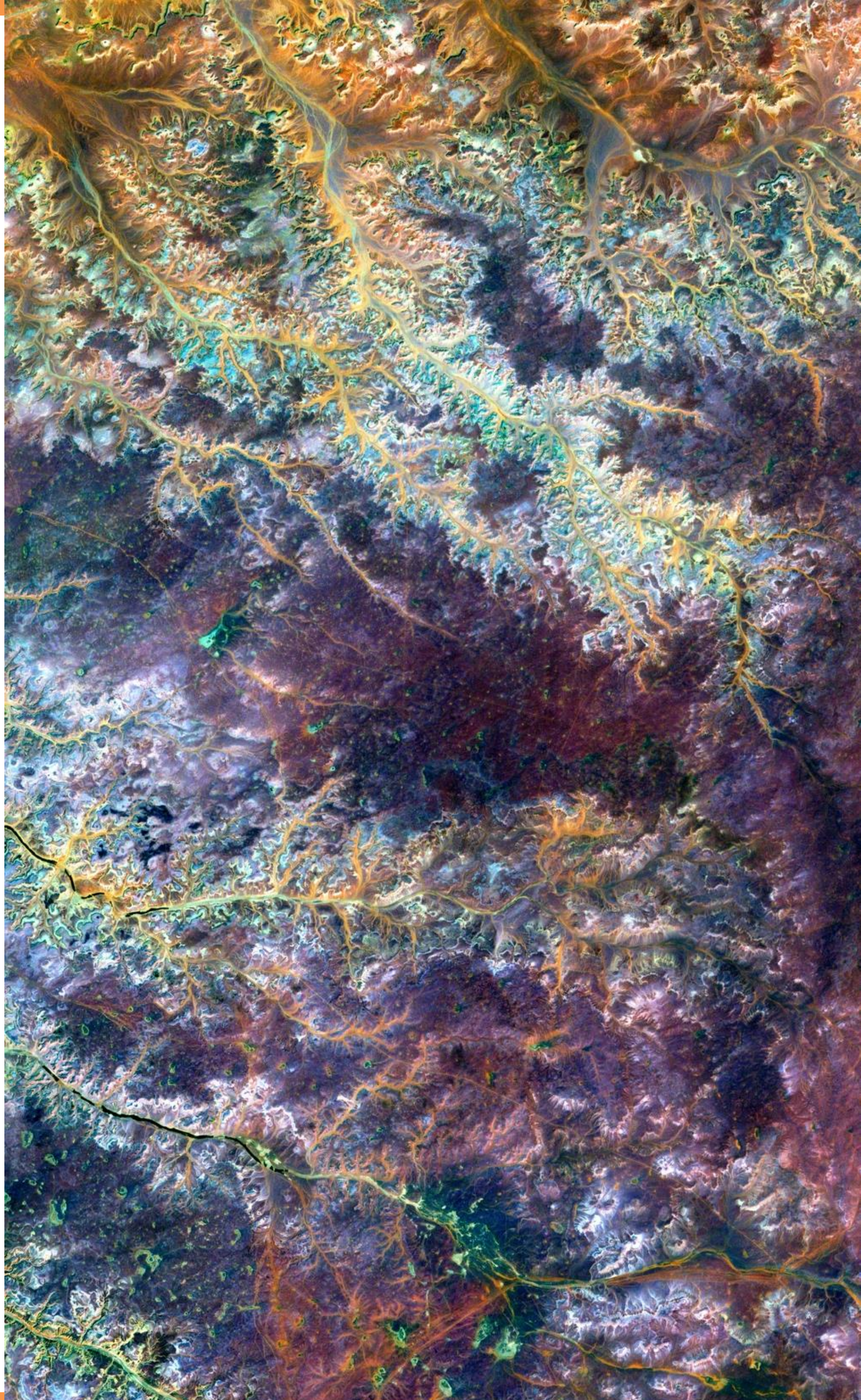
Heraklion
30 June - 3 July 2025

Session: Ecological Responses to Climate Change

1 July 2025 | 08:30-10:30



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Shifting Baselines: Patterns and Trends Linking Ocean Productivity and Biodiversity in a Changing Climate

Authors: Francesco De Leo | Gianmarco Ingrosso | Mariantonietta La Marra | Milad Shokri | Alberto Basset

Presenter: Carmelo Bonannella, Francesco De Leo

OPEN EARTH MONITOR
CNR IRET
LifeWatch ITALIA

About Open-Earth-Monitor Cyberinfrastructure

Funded by
the European Union

OPEN EARTH MONITOR

- Consortium: 23 partner organizations
- Funding: EUR 12 720 045,00
- Period: June 2022 - July 2026
- Call: Horizon CL6 2021 governance 01

Consortium

Funded by
the European Union

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OpenGeoHUB
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International Institute for Applied Systems Analysis
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ifgi

FONDAZIONE EDMUND MACH

MultiOne

GFZ
Helmholtz Centre
Potsdam

eurac research

CREAF
Severo Ochoa Excellence

cmcc
Centro Euro-Mediterraneo sui Cambiamenti Climatici

Brockmann Consult GmbH

TERRASIGNA

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ETH Zürich

The Association of Balkan Eco-Innovation

Main objectives

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OPEN EARTH MONITOR

1. GAPS AND NEEDS ANALYSIS

Find out what are the bottlenecks of data platforms together with stakeholders.

2. OPEN SOURCE EO COMPUTING ENGINE

Integrate EO with in-situ data and release cloud-based, cutting-edge AI algorithms.

3. BUILD BETTER DATA PORTALS

Harmonize and bridge existing platforms and build novel, connected portals.

4. MAKE DATA PLATFORMS F.A.I.R.

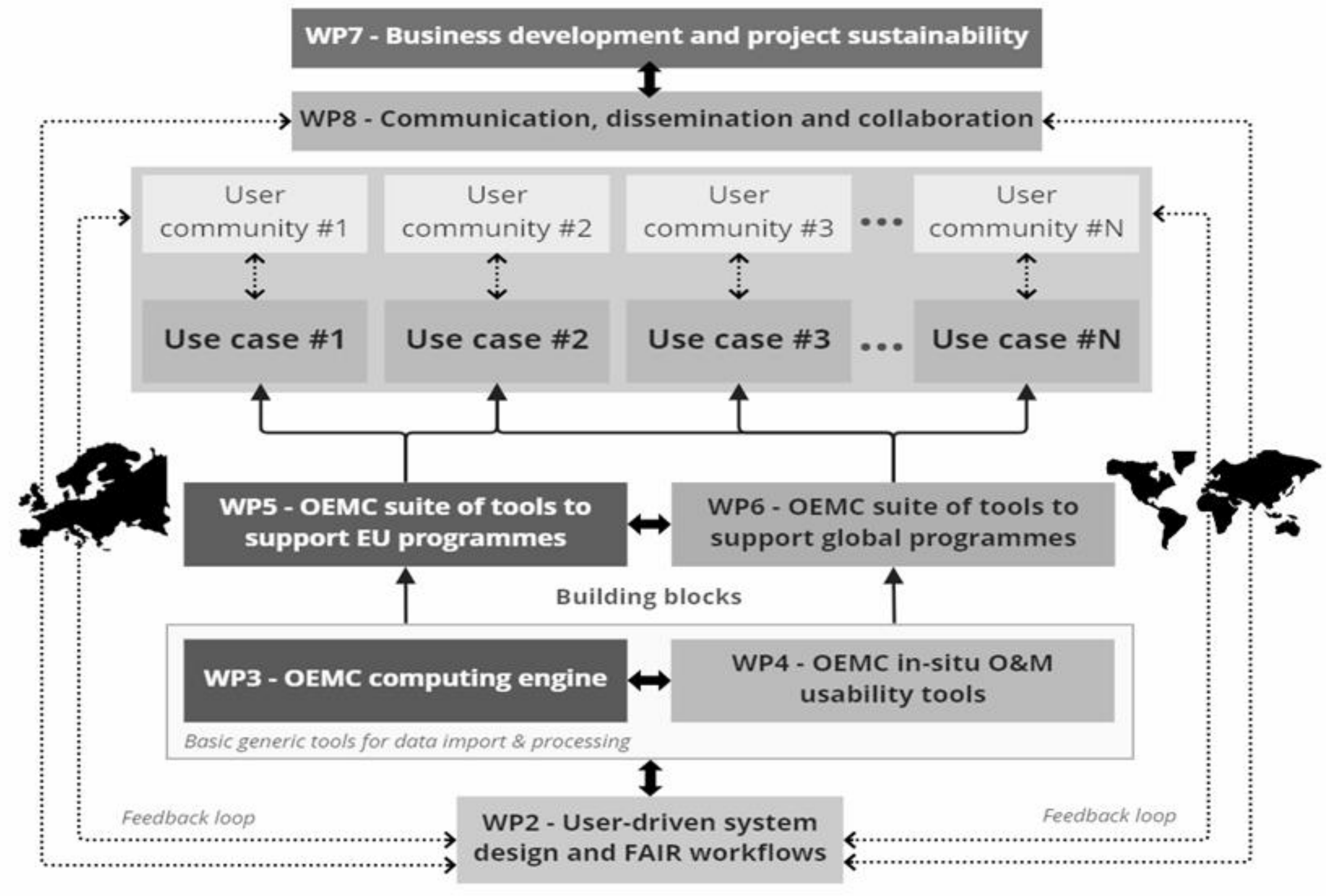
Improve accessibility of data with open-source licenses and capacity building.

5. SERVE CONCRETE GOALS

Generate concrete use cases, support European and global sustainability goals.

Copernicus Europe's eyes on Earth
European Green Deal
JRC
esa
Destination Earth initiative
European Data Science Cloud
EuroGEO
GEO Group on Earth Observations
OSGeo
European Open Science Cloud

Internal organization



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Use cases

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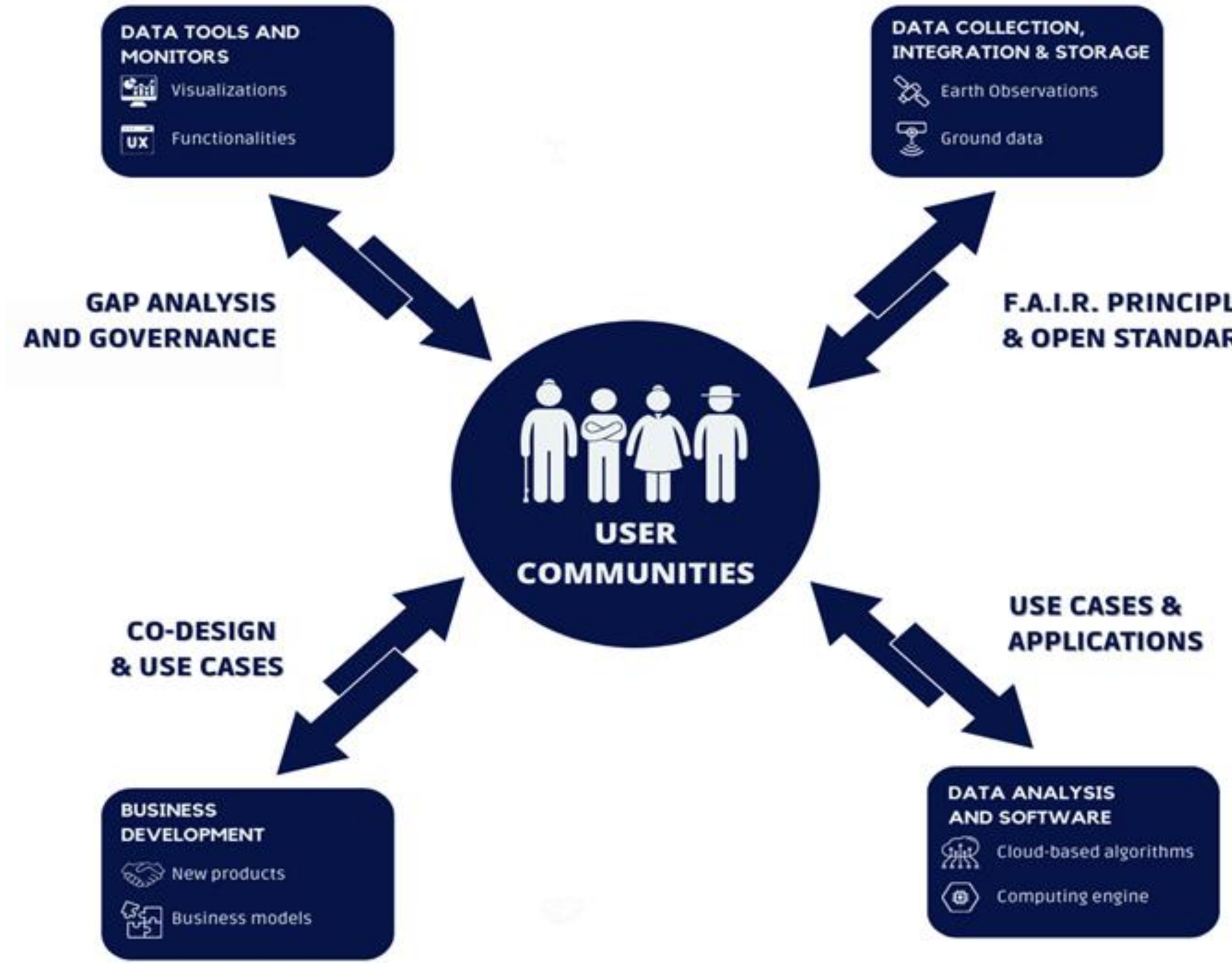
Stakeholder roles



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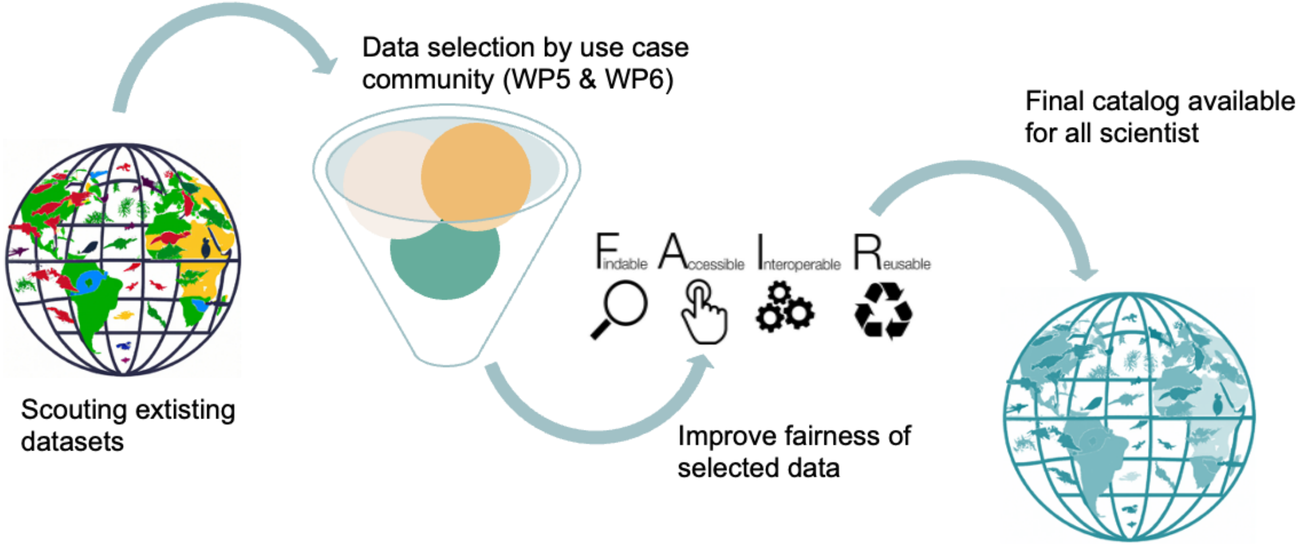
LifeWatch ERIC – Tasks Overview and Responsibilities

Task 4.4: Preparation of marine / terrestrial biodiversity and landscape diversity in-situ data

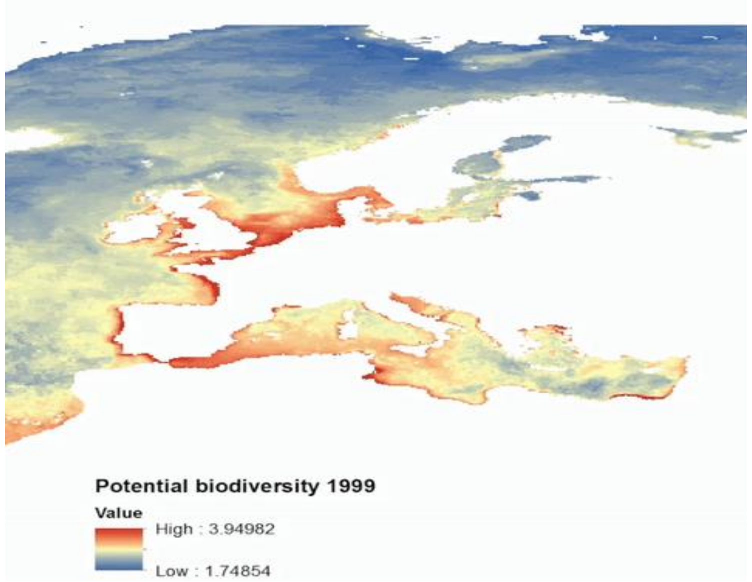


Task 4.5: Preparation of ocean, seas and coastal waters in-situ data

LifeWatch ERIC – Tasks Overview and Responsibilities

Task 5.5: Development of EU-coastal monitor

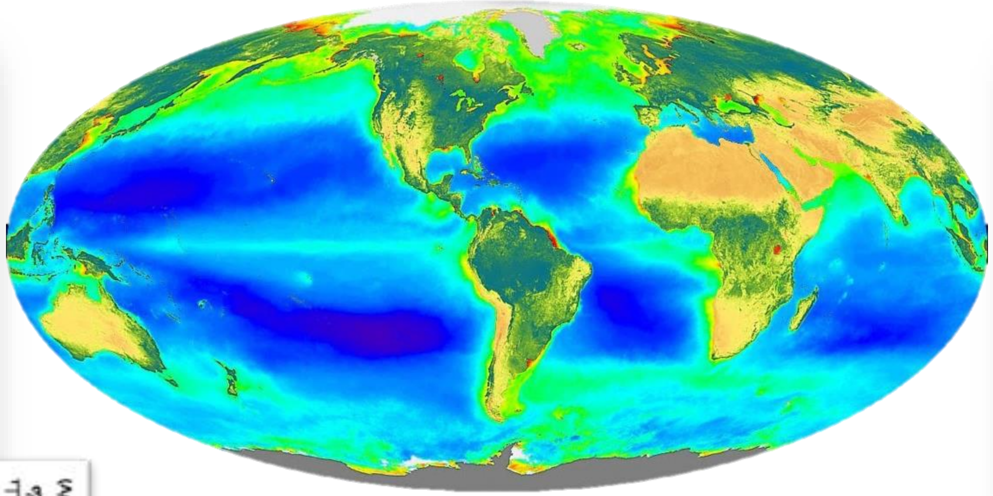
Objective: tool for scenario building to predict the 'potential' spatial distribution of biodiversity at both national and European scales, with a specific focus on coastal areas pertinent to the Marine Strategy Framework Directive (MSFD).

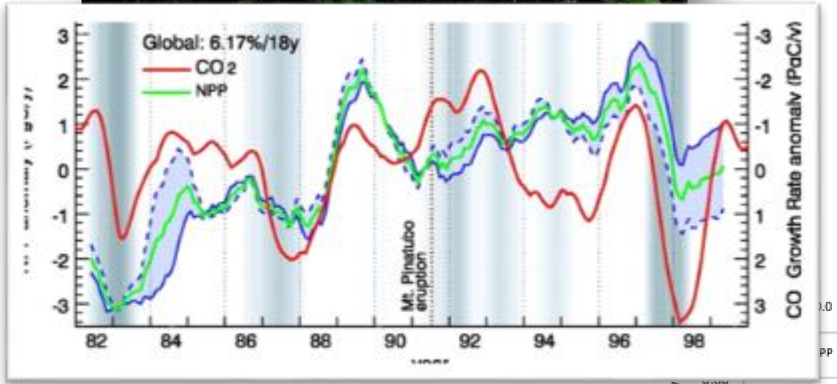


GEO Knowledge Hub Links

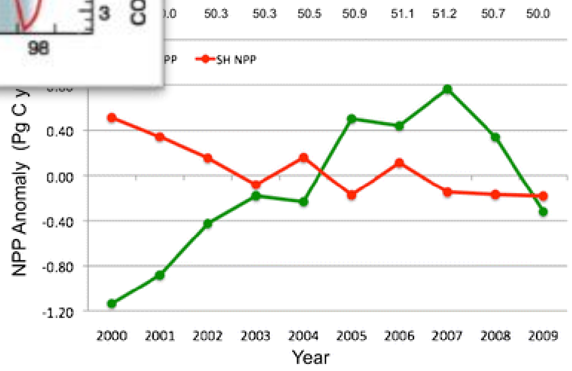
http://doi.org/10.60566/m3mr6-6bm34

NPP global trend, Land vs Ocean

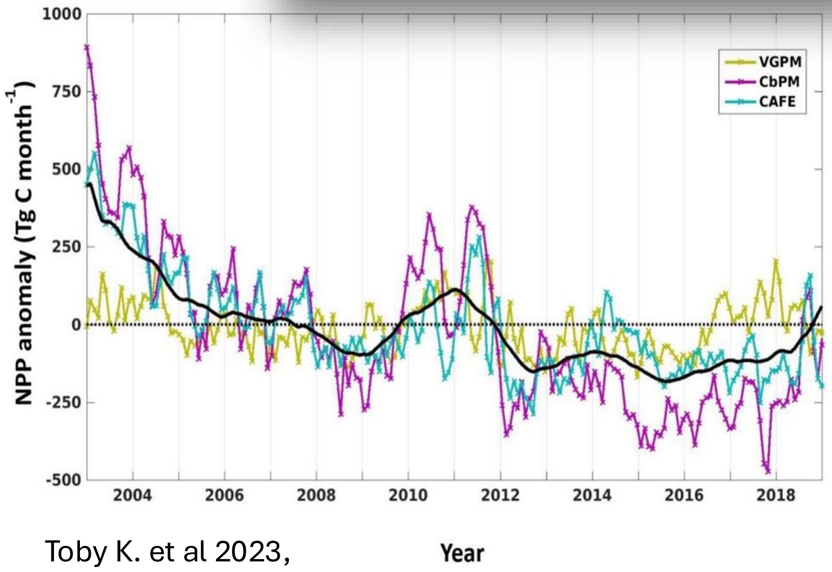




Nemani et al. 2023 DOI: 10.1126/science.1082750

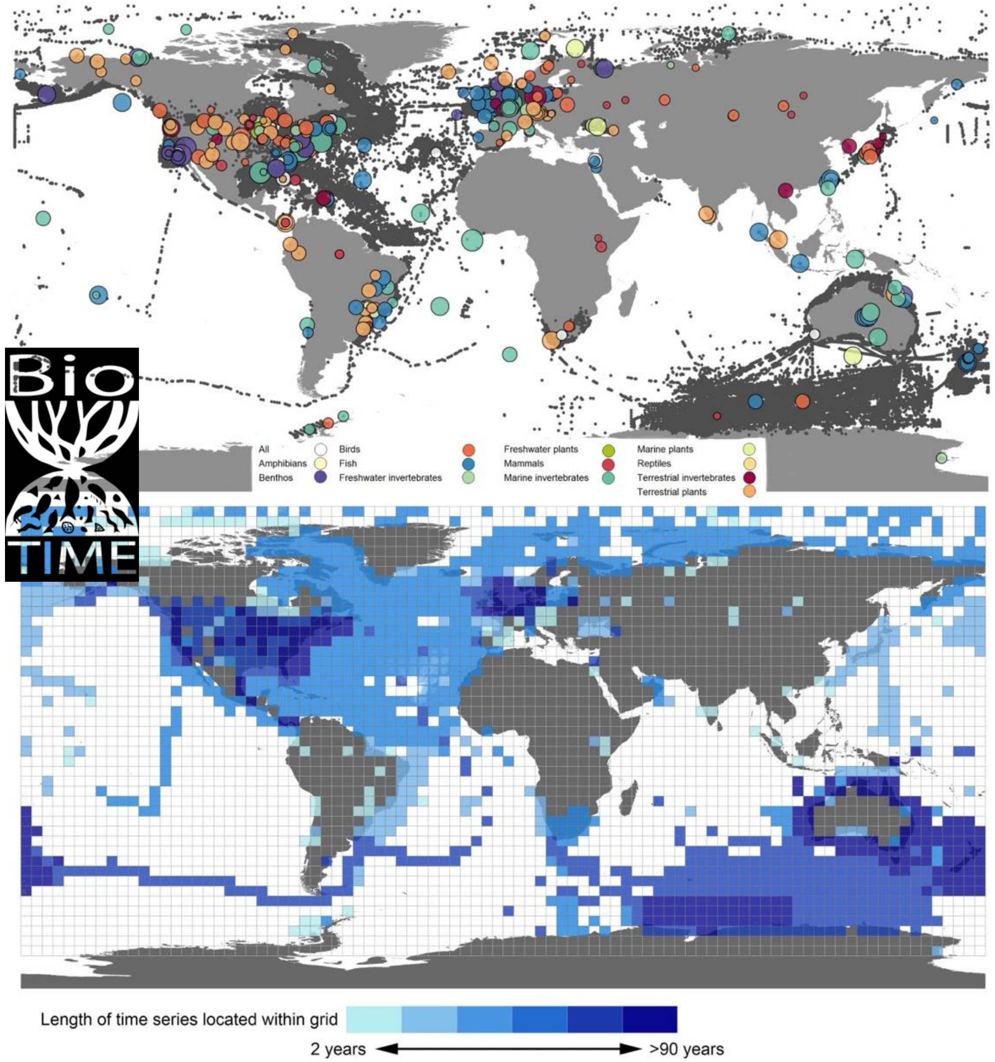


Potter et al. 2012 doi.org/10.1007/s10584-012-0460-2

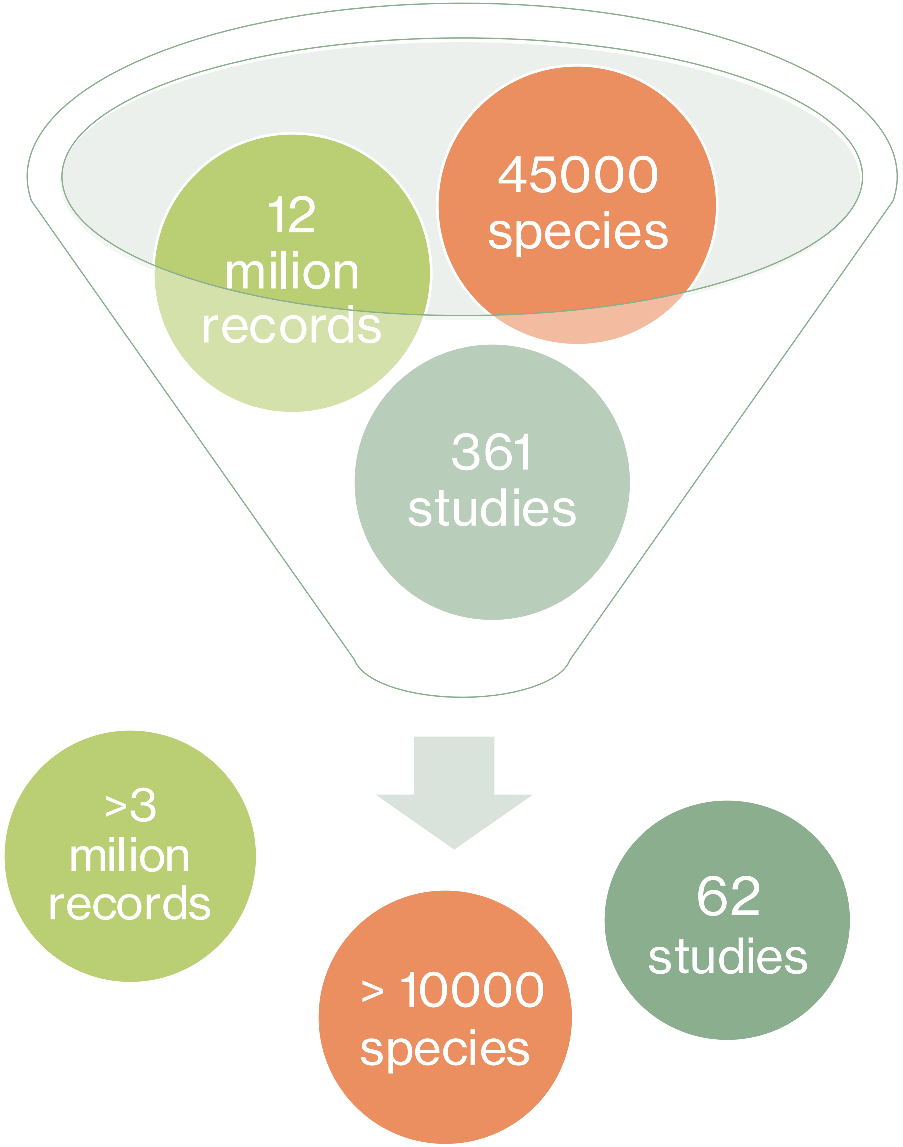


Toby K. et al 2023, https://doi.org/10.1016/j.earscirev.2023.104322.

Biodiversity input database



(Dornelas et al. 2018) https://biotime.st-andrews.ac.uk



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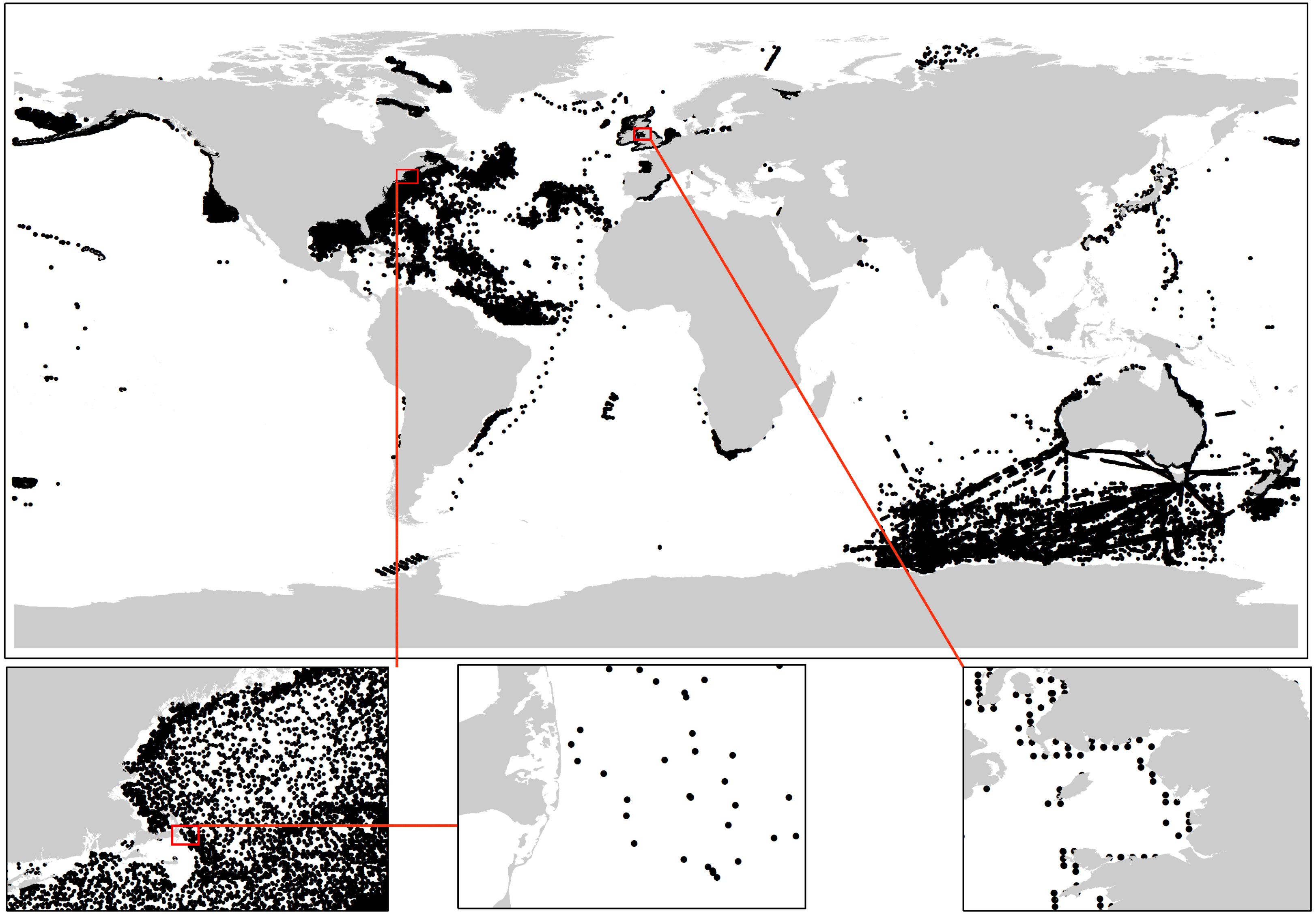
Biodiversity input database



>3 milion records

> 10000 species

62 studies

234945 sample sites

NPP input database

Primary production remote sensing data of the global ocean (Westberry et al. 2023)

- 3 models (VGPM, CbPM, CAFÉ)
- 26 years (1997 -2023)

VGPM

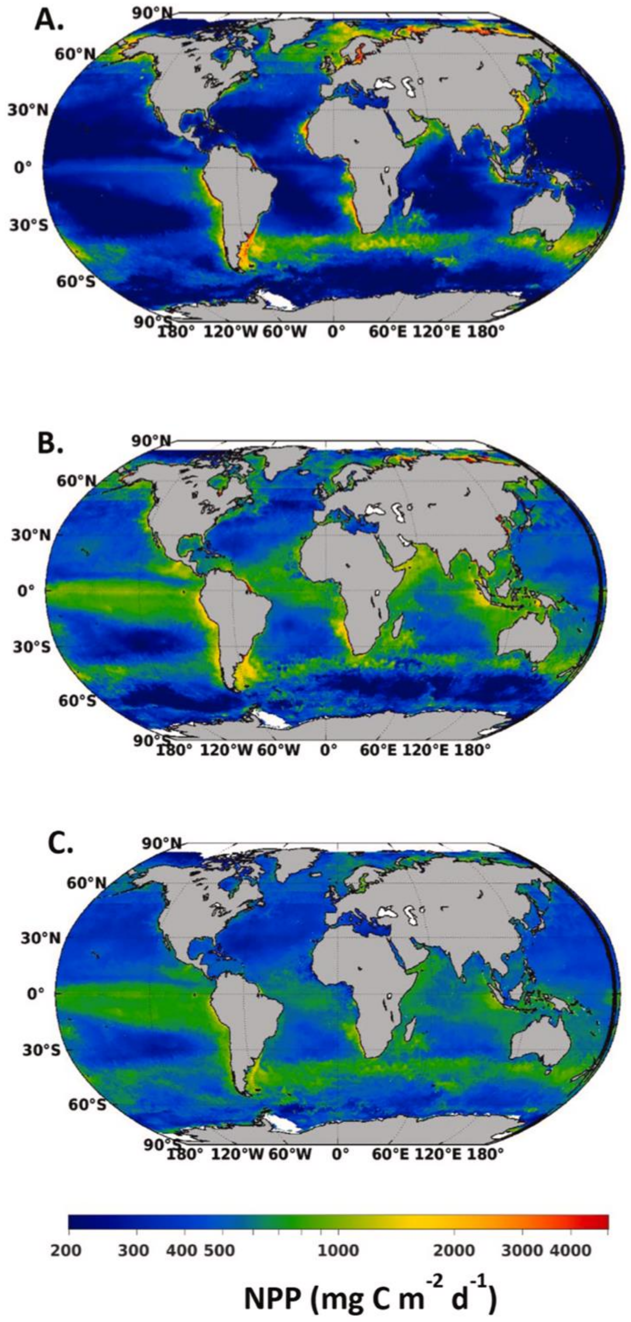
[Chl, SST, PAR]

CbPM

[Chl, PAR, Kd(490), bbp]

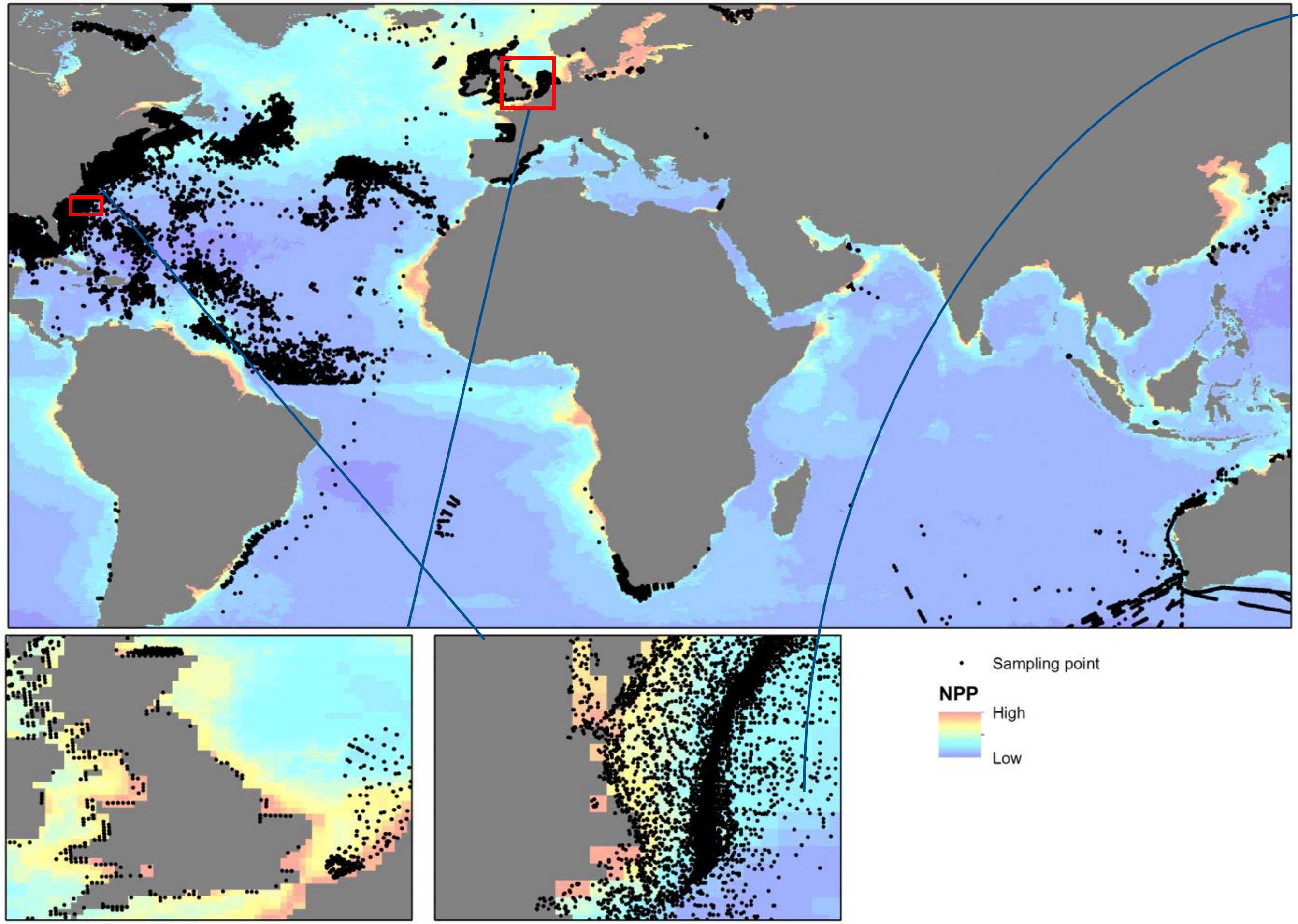
CAFE

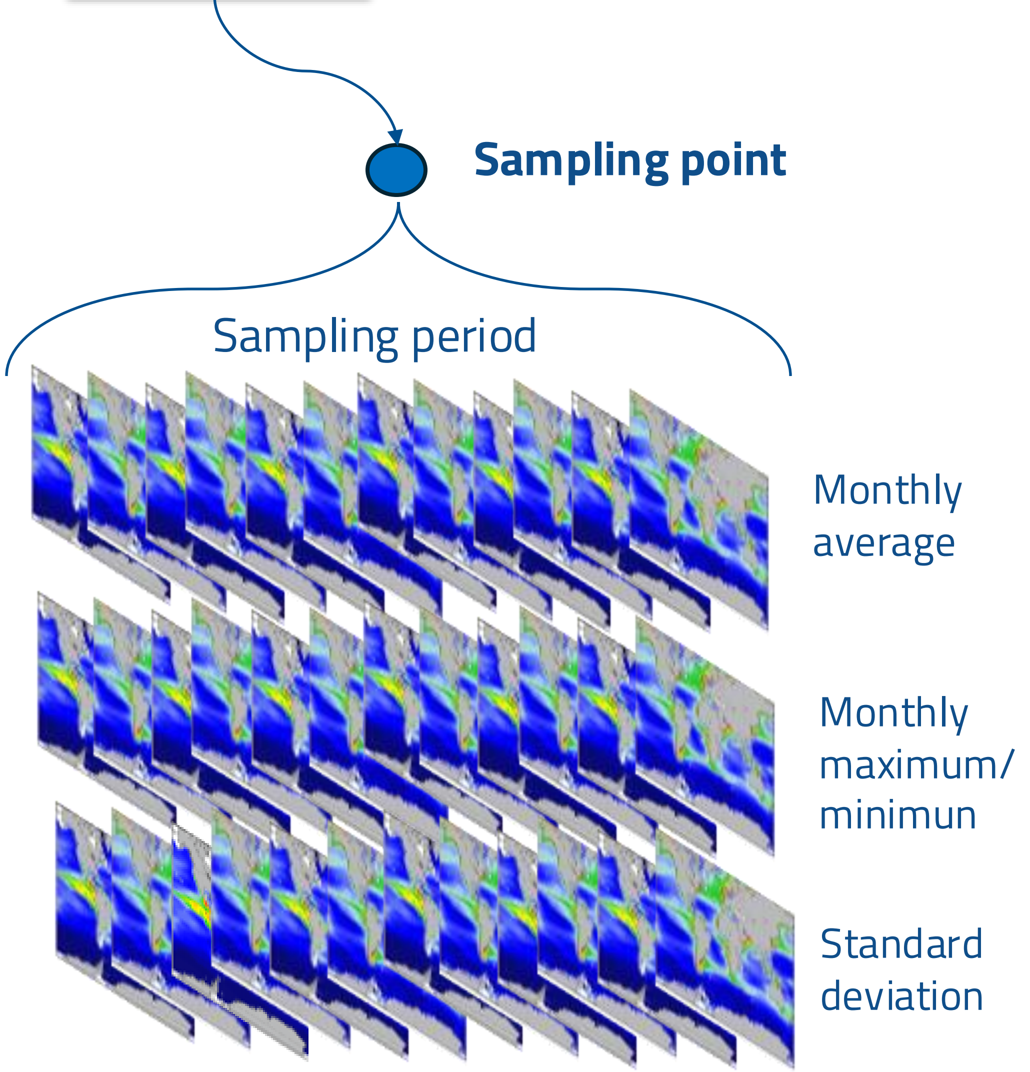
[aph, acdm, bbp, Chl, PAR, SST, Kd490]



NPP/Biodiversity input database

LifeWatch DataLabs





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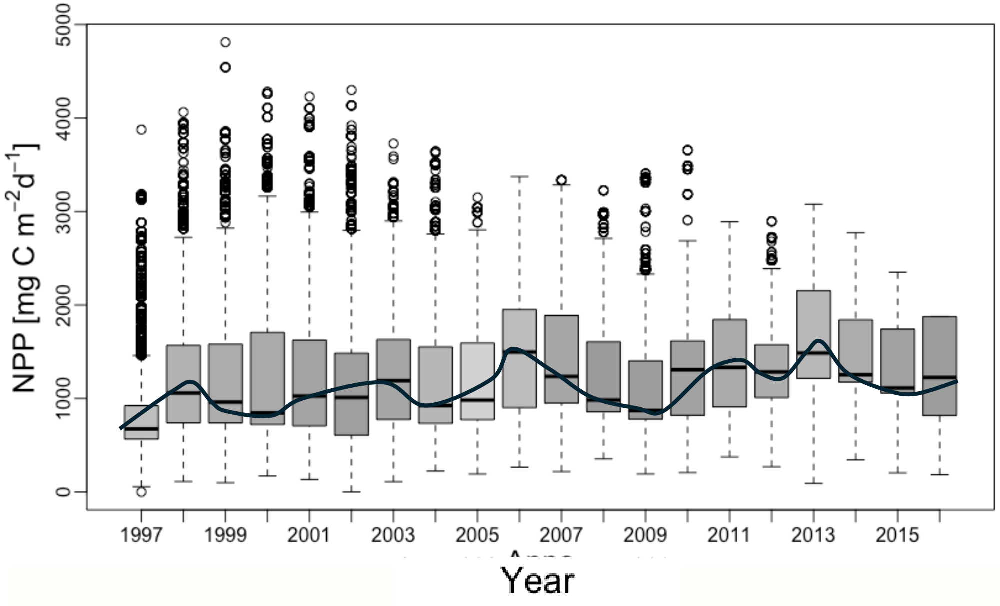
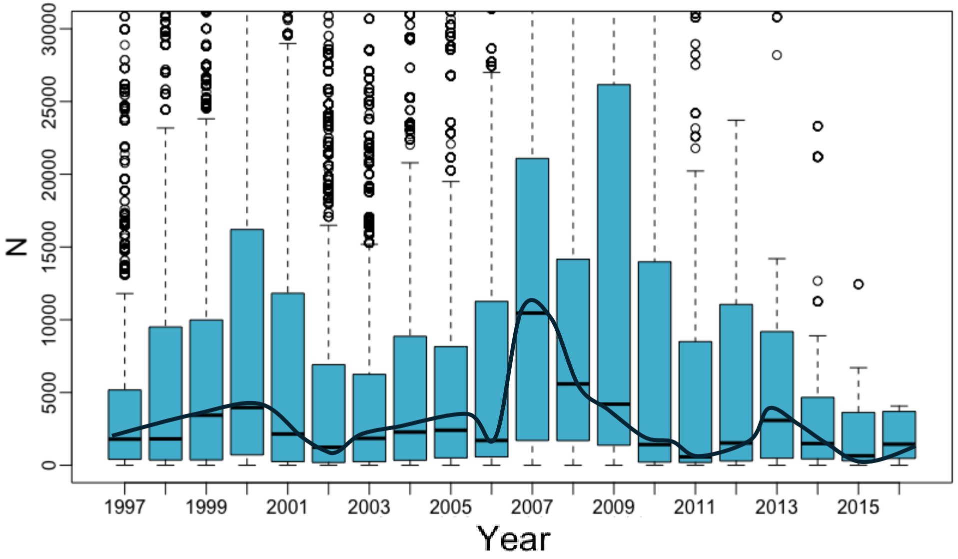
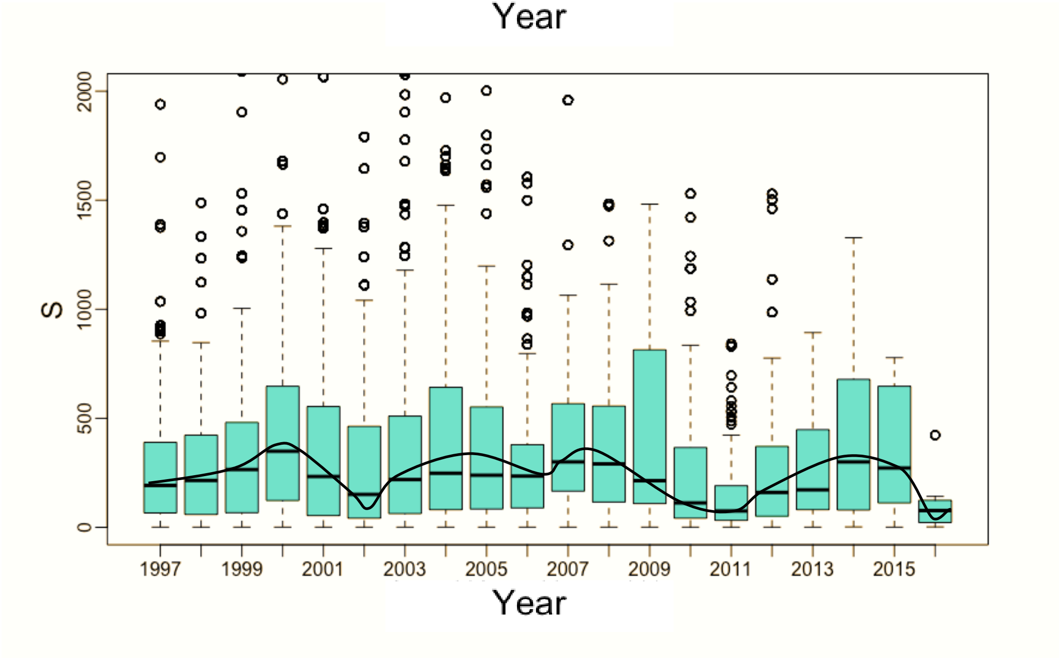
Temporal Trends in NPP, Species Abundance, and Species Richness

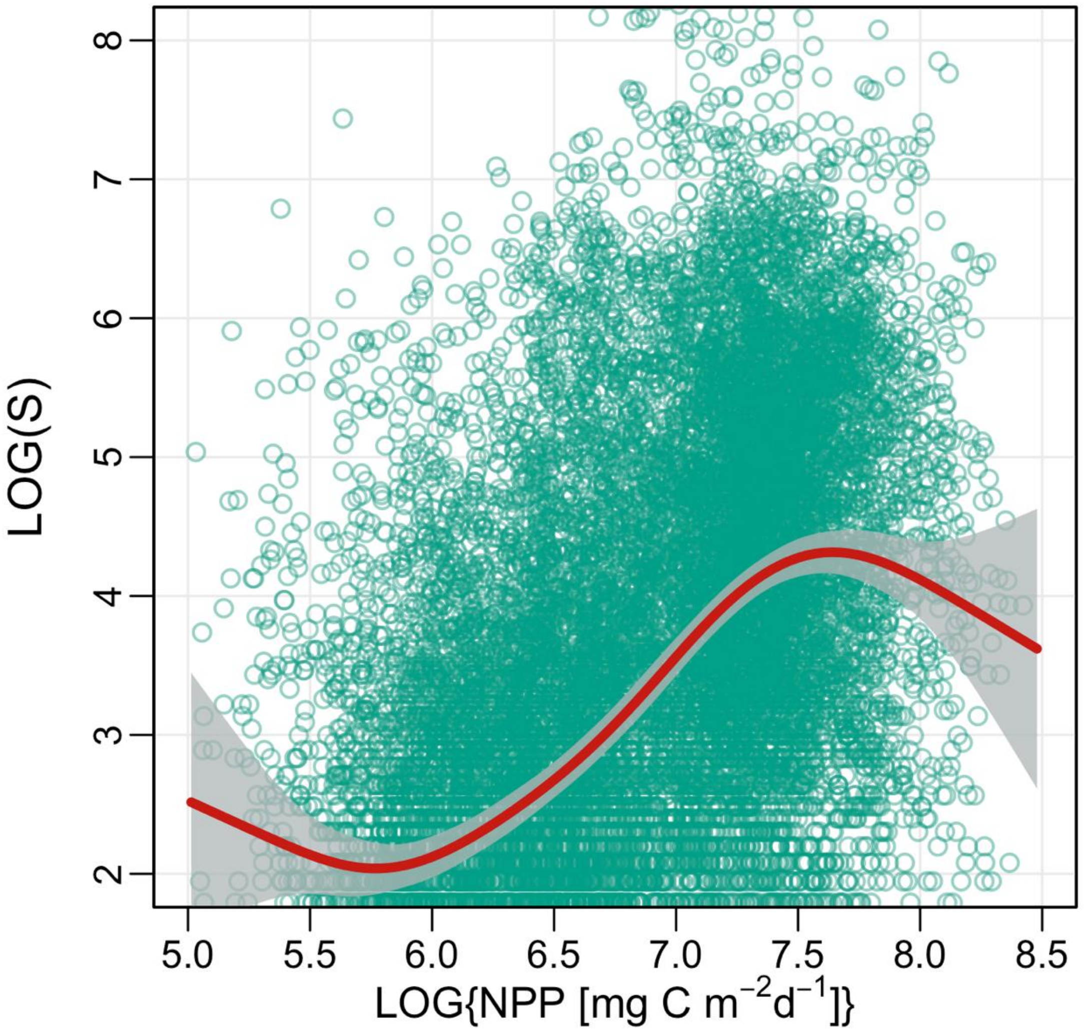






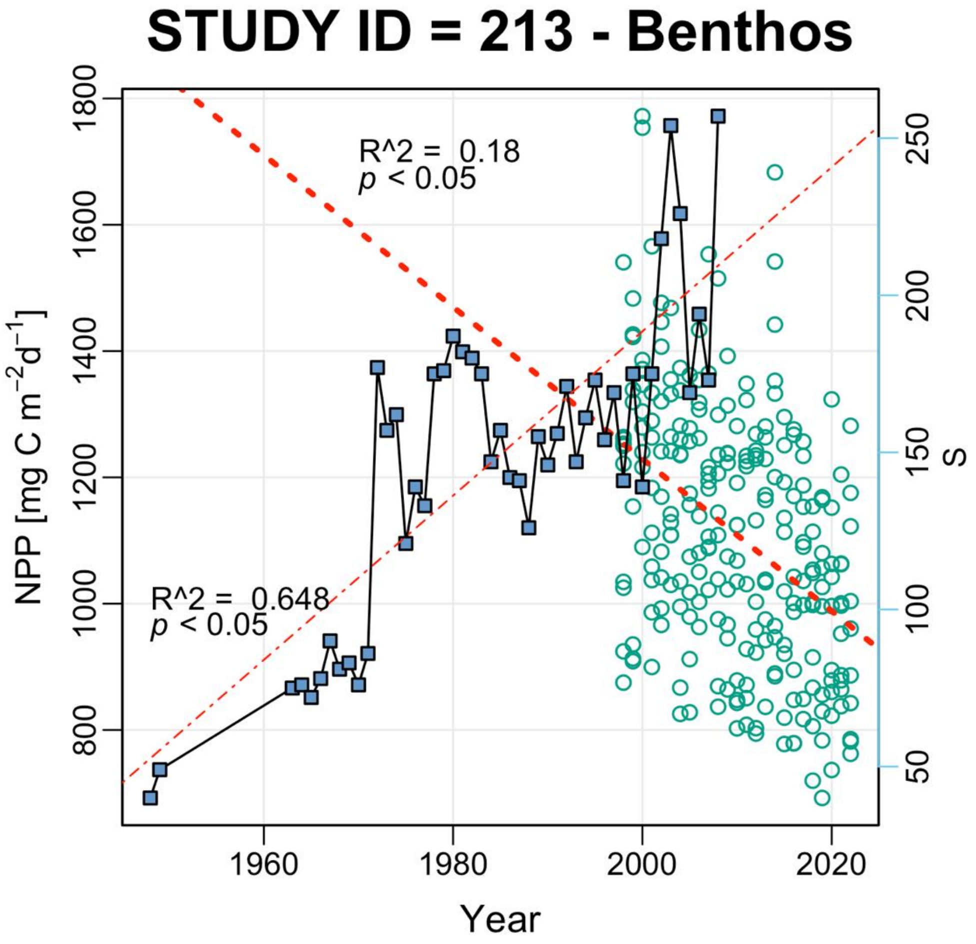
Relationship Between NPP and Species Richness

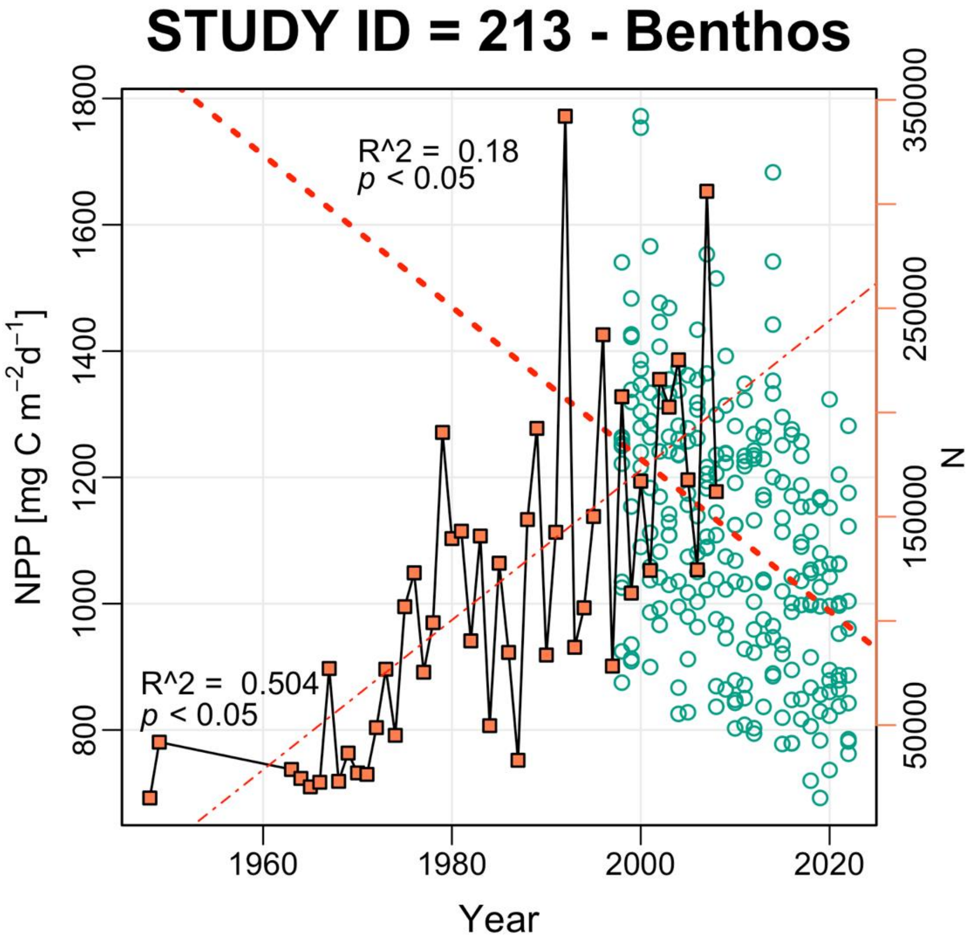
This plot illustrates the relationship between the logarithmic values of Net Primary Productivity (NPP) and species richness (S), used as a proxy for biodiversity. The red line represents the smoothed fit from a Generalized Additive Model (GAM), capturing the non-linear relationship. The trend shows an increase in species richness with rising NPP



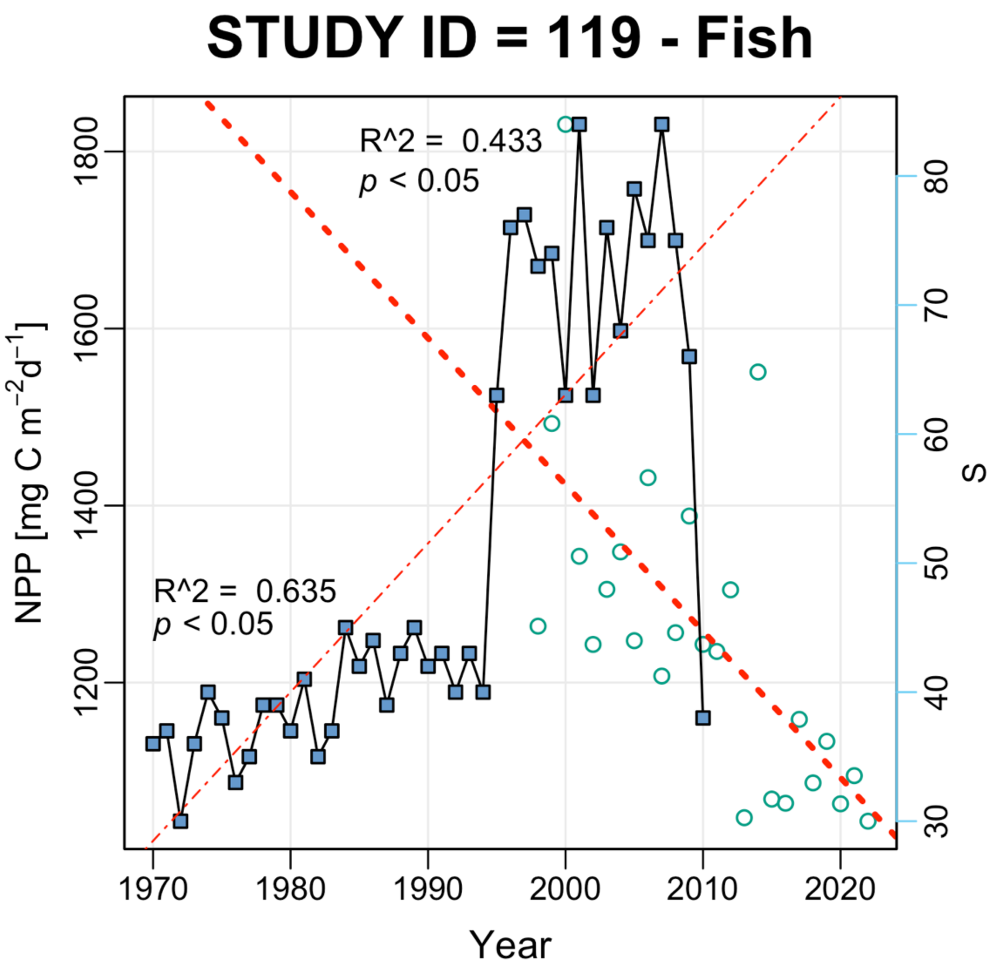
R-sq.(adj) = 0.236

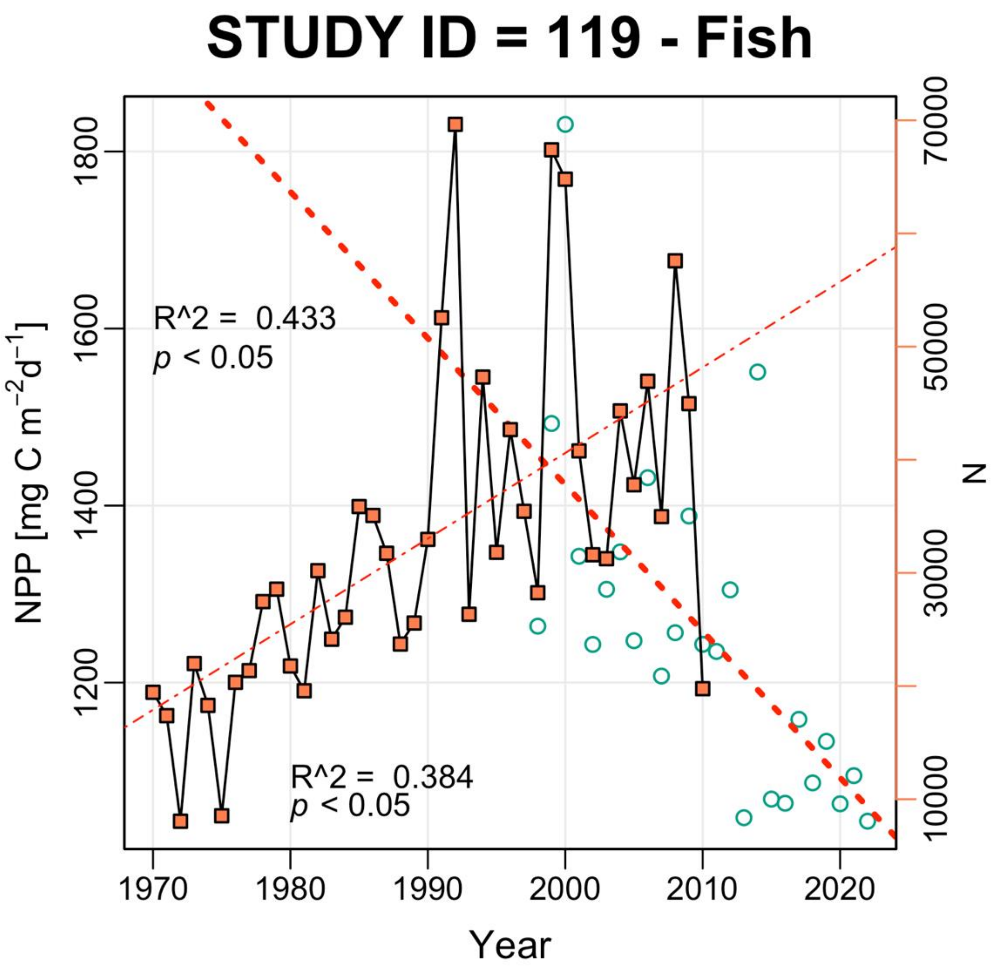
Relationship Between NPP and Species Richness/Abundance: inverse trend



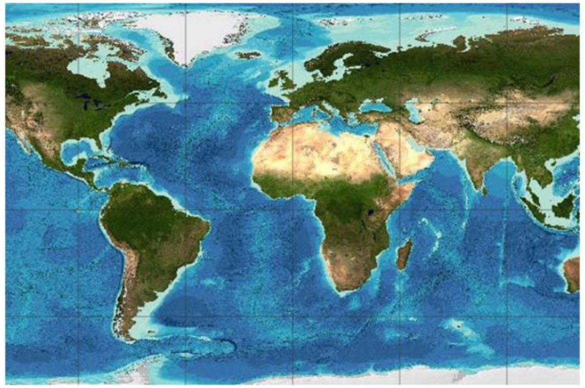


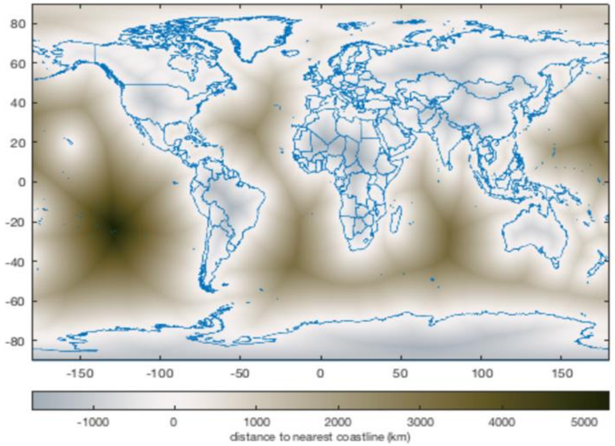
Relationship Between NPP and Species Richness/Abundance: inverse trend

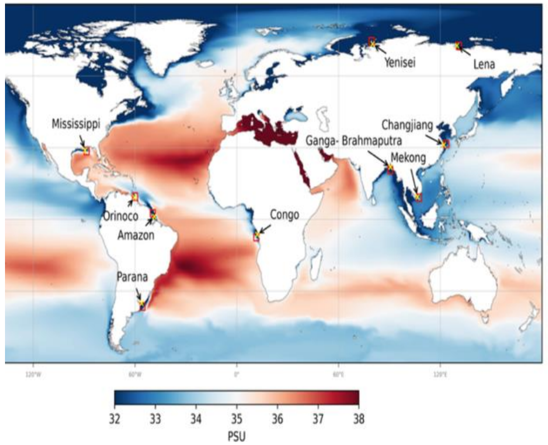


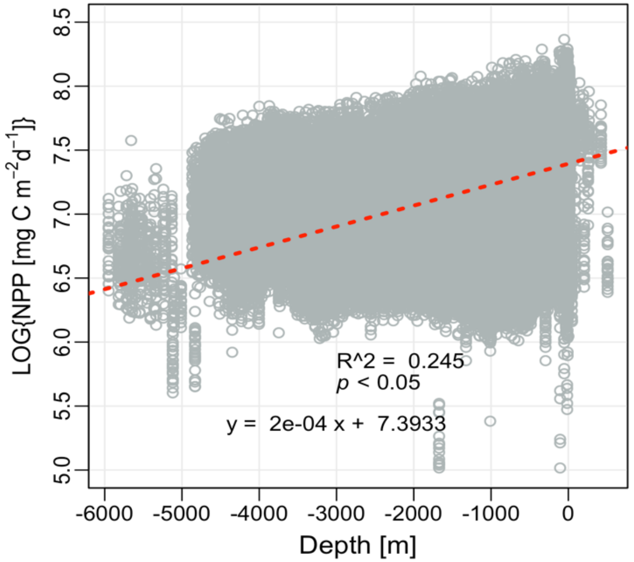


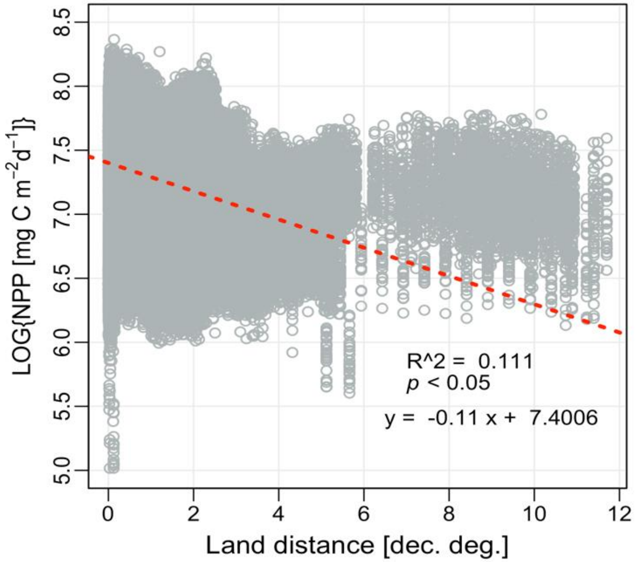
Interpolation with Physical Variables

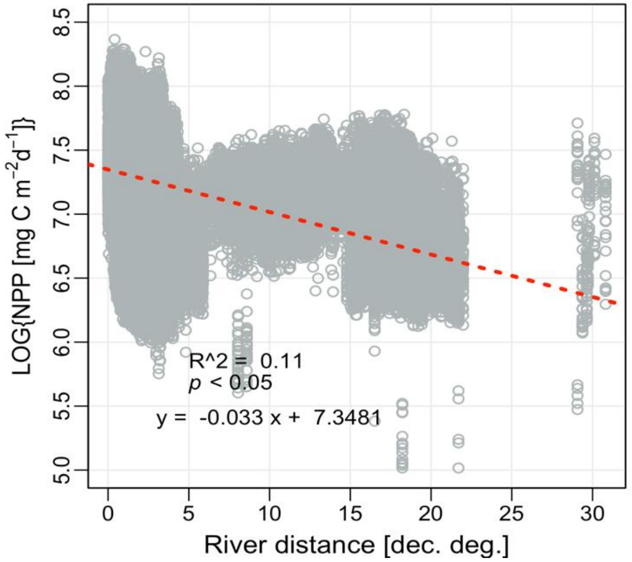




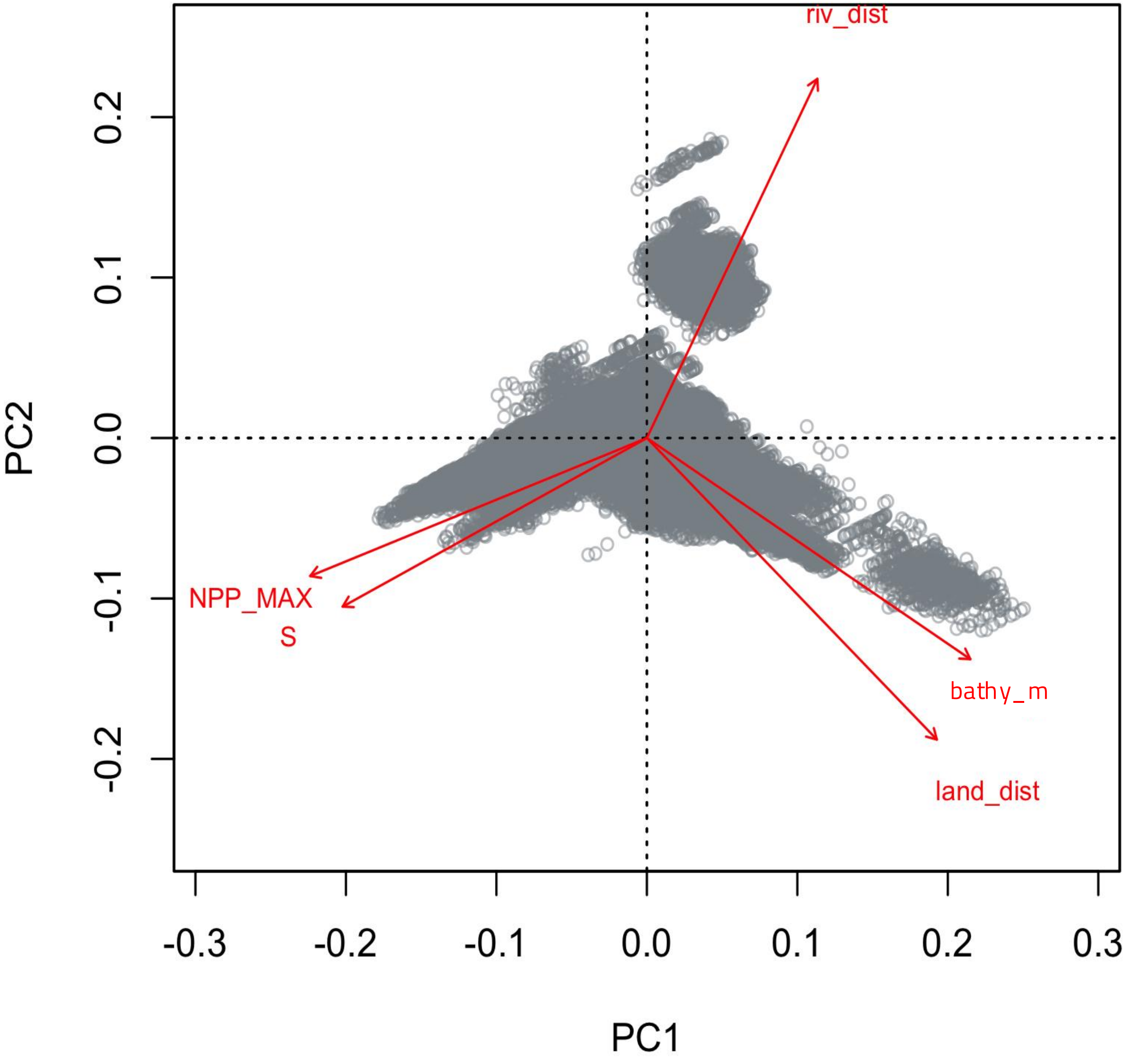


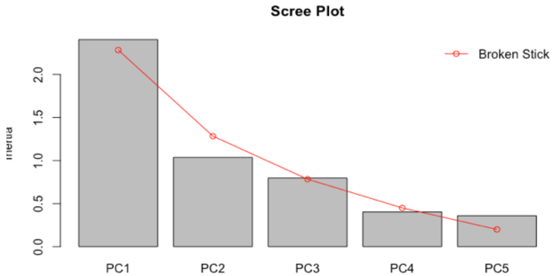






PCA of Species Richness and Physical Variables





PC1	PC2	PC3	PC4	PC5
0.4809228	0.2072493	0.1594482	0.0806563	0.0717234

	PC1	PC2	PC3	PC4	PC5
NPP_MAX	-8.986	-2.799	3.115	-3.4827	3.8876
bathy_m	8.634	-4.485	2.189	3.4188	3.7935
riv_dist	4.550	7.283	7.153	-0.7672	0.1939
land_dist	7.740	-6.115	2.526	-3.7668	-2.7666
S	-8.120	-3.420	5.296	3.4687	-2.7971

The PCA biplot illustrates the relationships between species richness (S), Net Primary Productivity (NPP_MAX), and physical factors such as river distance, land distance, and depth. The first principal component (PC1) is largely driven by productivity and species richness, while the second component (PC2) is influenced by proximity to rivers. The scree plot highlights the dominant role of PC1 and PC2 in explaining the variance within the dataset

From Environmental Drivers to Spatial Prediction of Expected Species Richness

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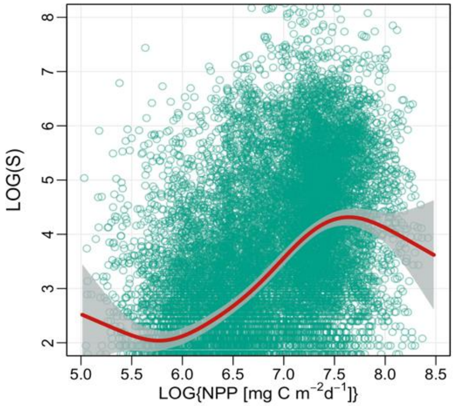
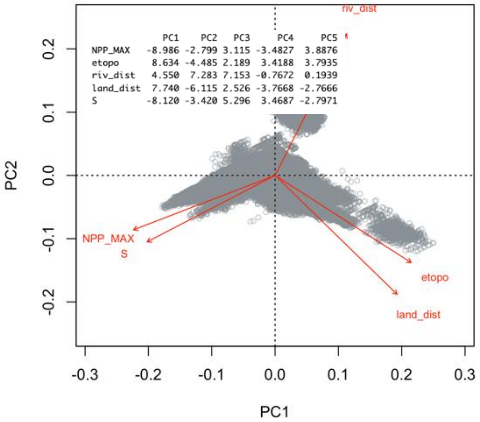
1. **GAM Analysis**

"Non-linear relationship between Net Primary Productivity (NPP) and observed species richness using a Generalized Additive Model (GAM)."



2. **PCA**

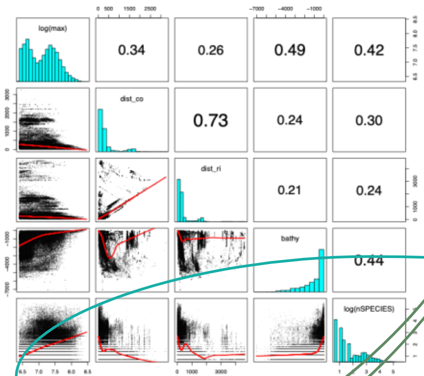
"Principal Component Analysis revealing environmental gradients influencing species richness across NPP, bathymetry, coastal and riverine distances."



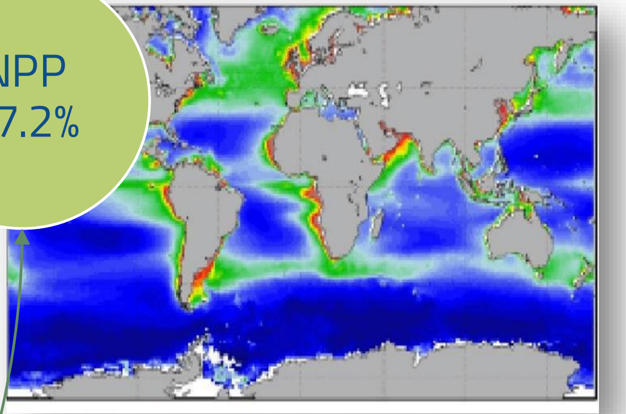
	PC1	PC2	PC3	PC4	PC5
NPP_MAX	-8.986	-2.799	3.115	-3.4827	3.8876
etopo	8.634	-4.485	2.189	3.4188	3.7935
riv_dist	4.550	7.283	7.153	-0.7672	0.1939
land_dist	7.740	-6.115	2.526	-3.7668	-2.7666
S	-8.120	-3.420	5.296	3.4687	-2.7971

3. **Univariate Correlations**

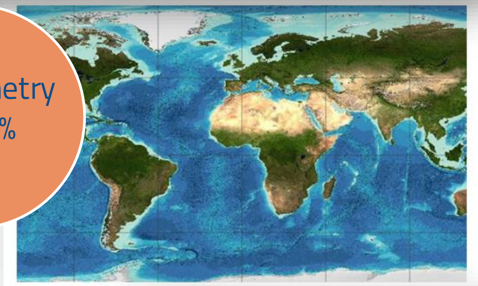
"Correlation plots between species richness and individual environmental variables. Each variable was later weighted based on its explanatory power."



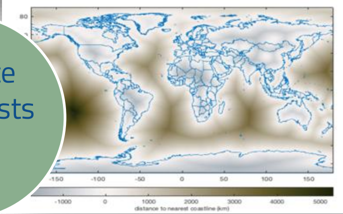
NPP 47.2%



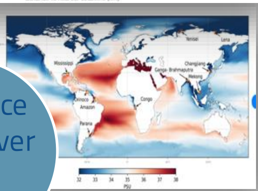
Bathymetry 33.4%



Distance from coasts 14.1 %



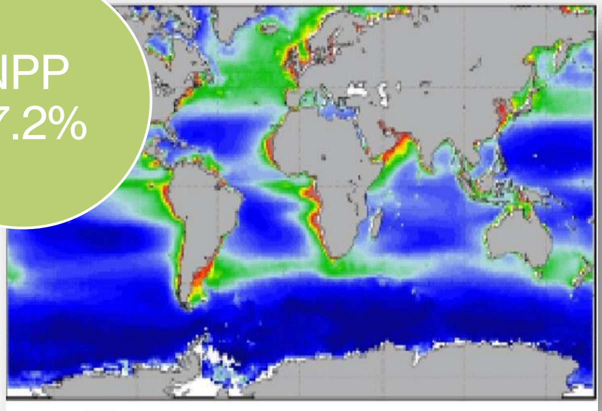
Distance from river 5.3 %



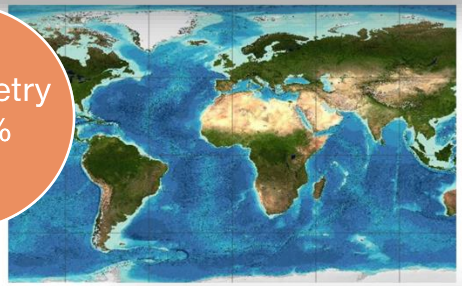
Primary productivity (NPP) alone explains 23% of the variability in species richness (GAM); when including bathymetry, distance from the coast, and distance from river mouths (PCA), the explained variability increases to 47%

From Environmental Drivers to Spatial Prediction of Expected Species Richness

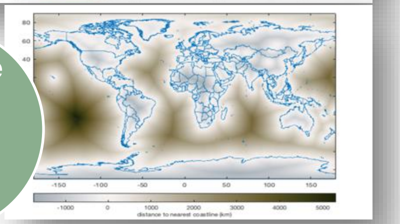
NPP
47.2%



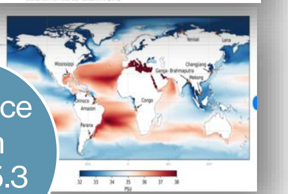
Bathymetry
33.4%

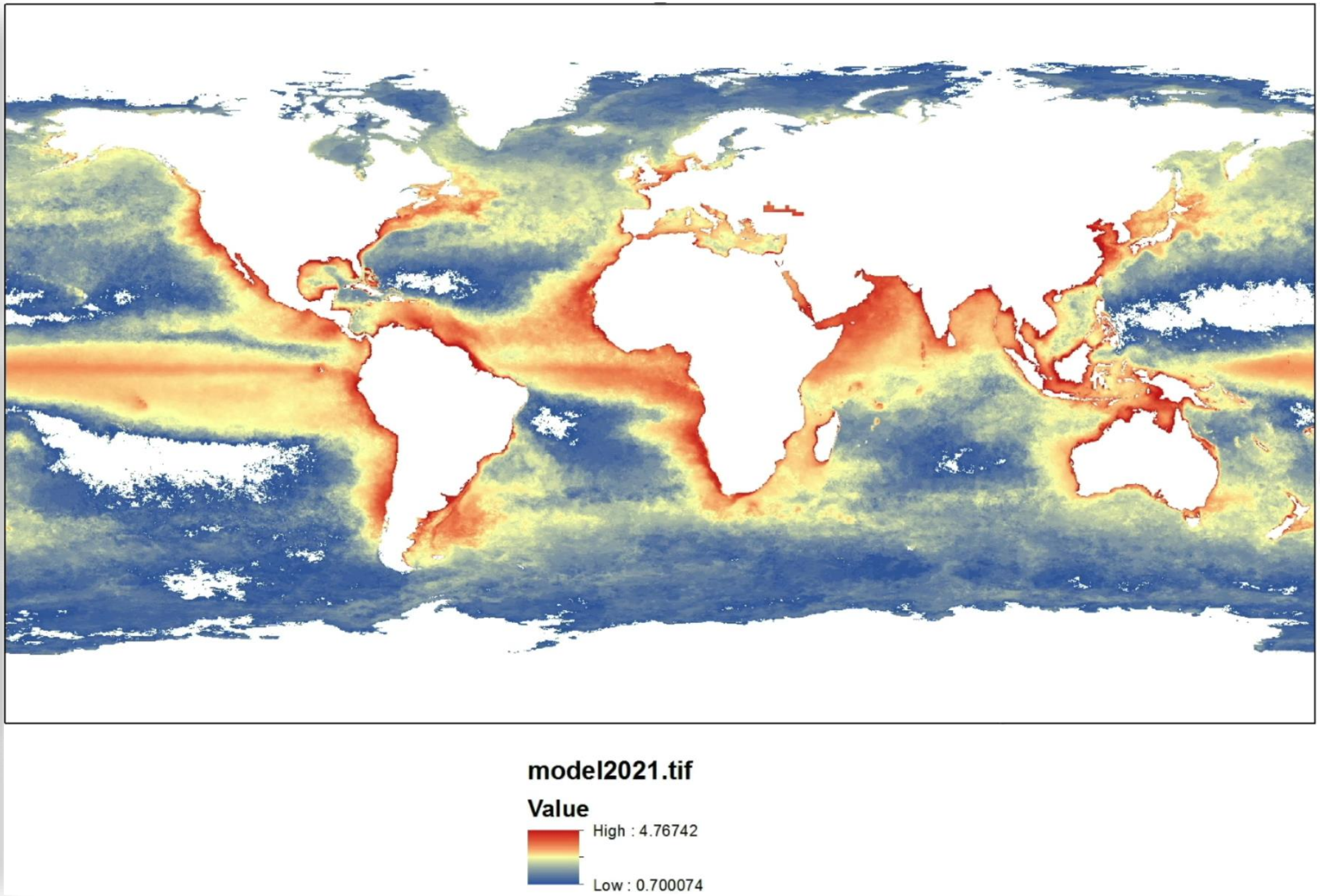


Distance from coasts 14.1 %

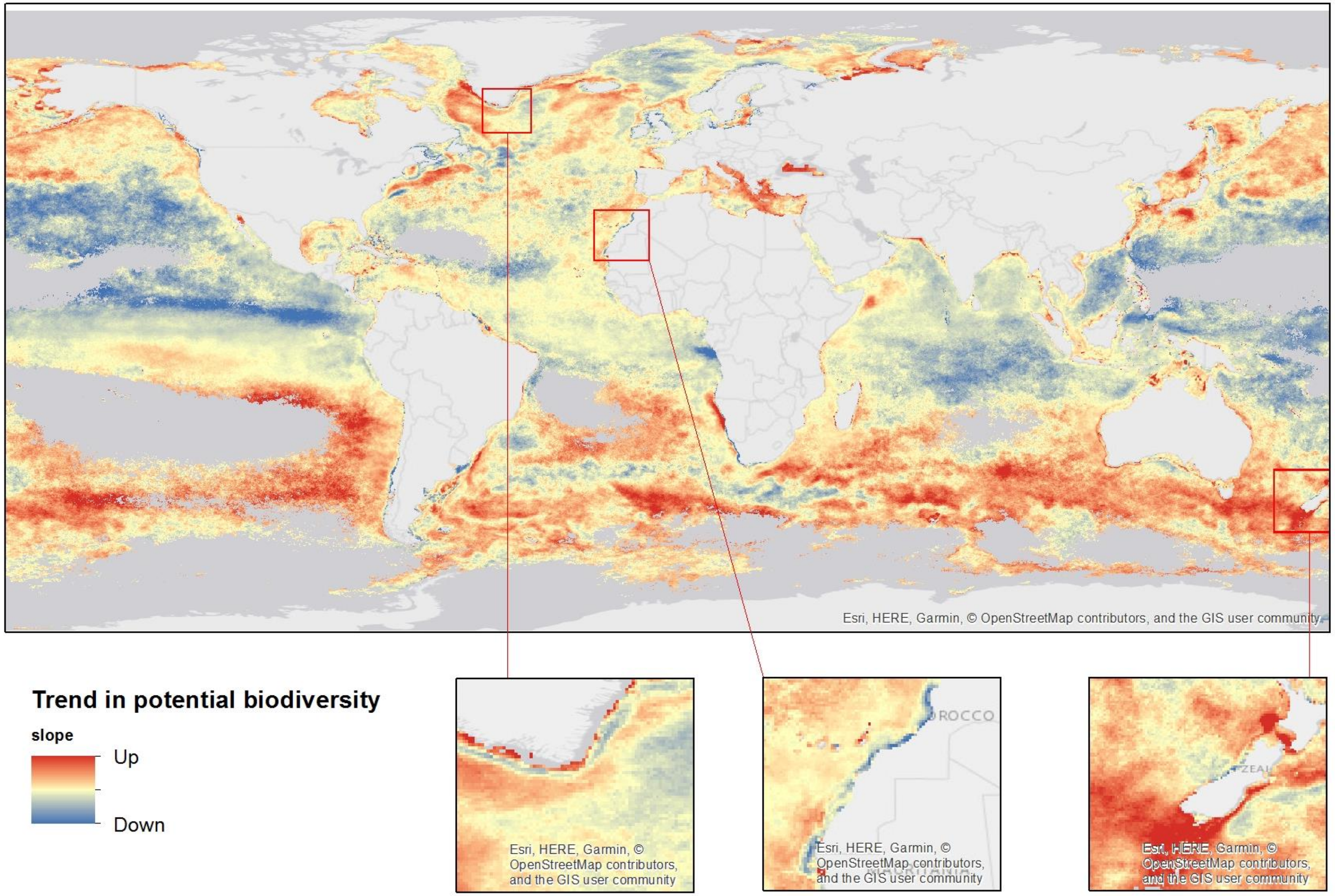


Distance from river 5.3 %



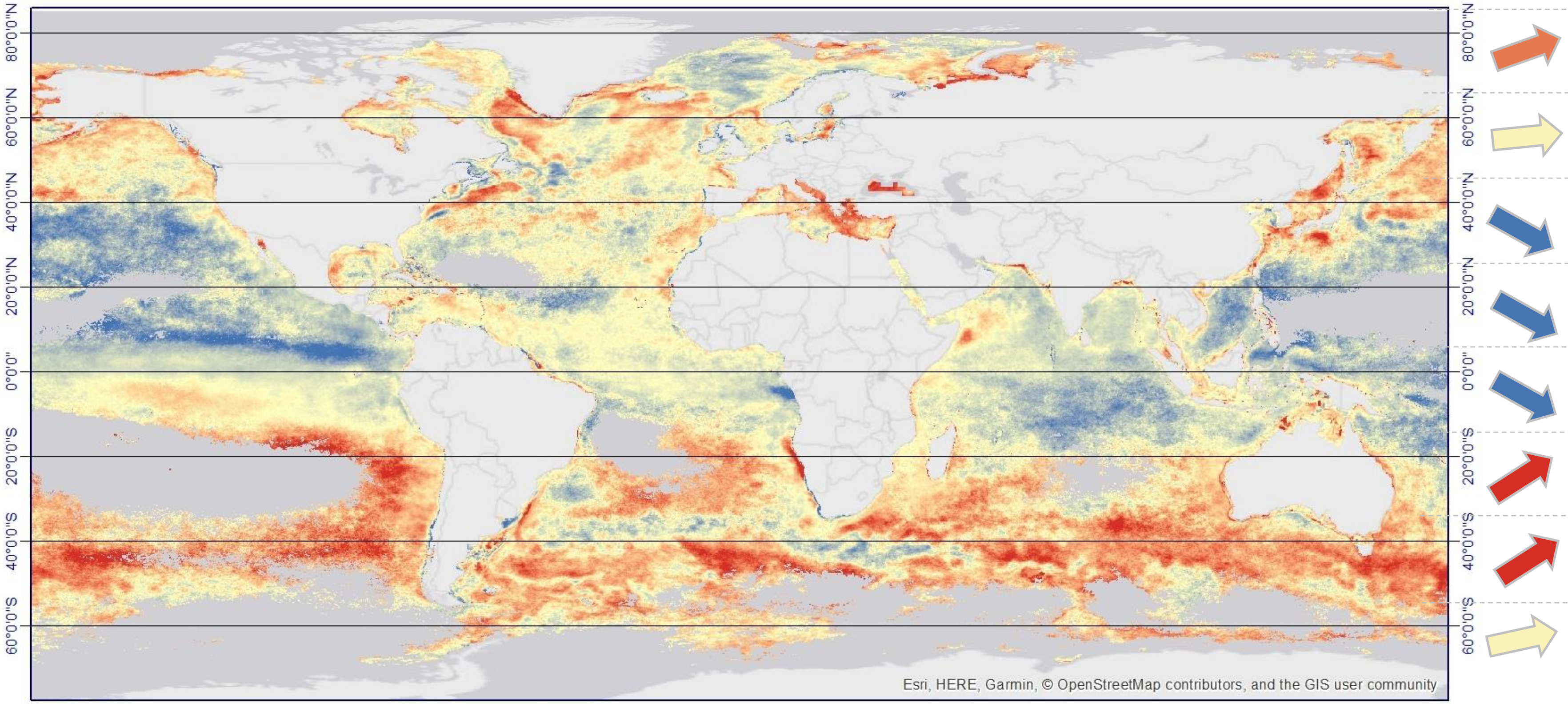


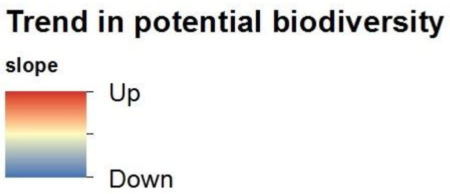
Global Trends in Potential Biodiversity (1998-2023)



- The map presents a global analysis of trends in potential biodiversity, based on annual data from 1998 to 2023.
- The trend measure implicitly reflects changes in global potential biodiversity, highlighting critical areas.
- Blue areas indicate regions where potential biodiversity is decreasing over the years.
- Yellow areas represent regions where biodiversity remains relatively stable.
- Red areas show an increase in estimated potential biodiversity according to the model.
- This model is valuable for identifying critical zones and guiding conservation efforts.

Latitudinal Trends in Potential Biodiversity (1998-2023)

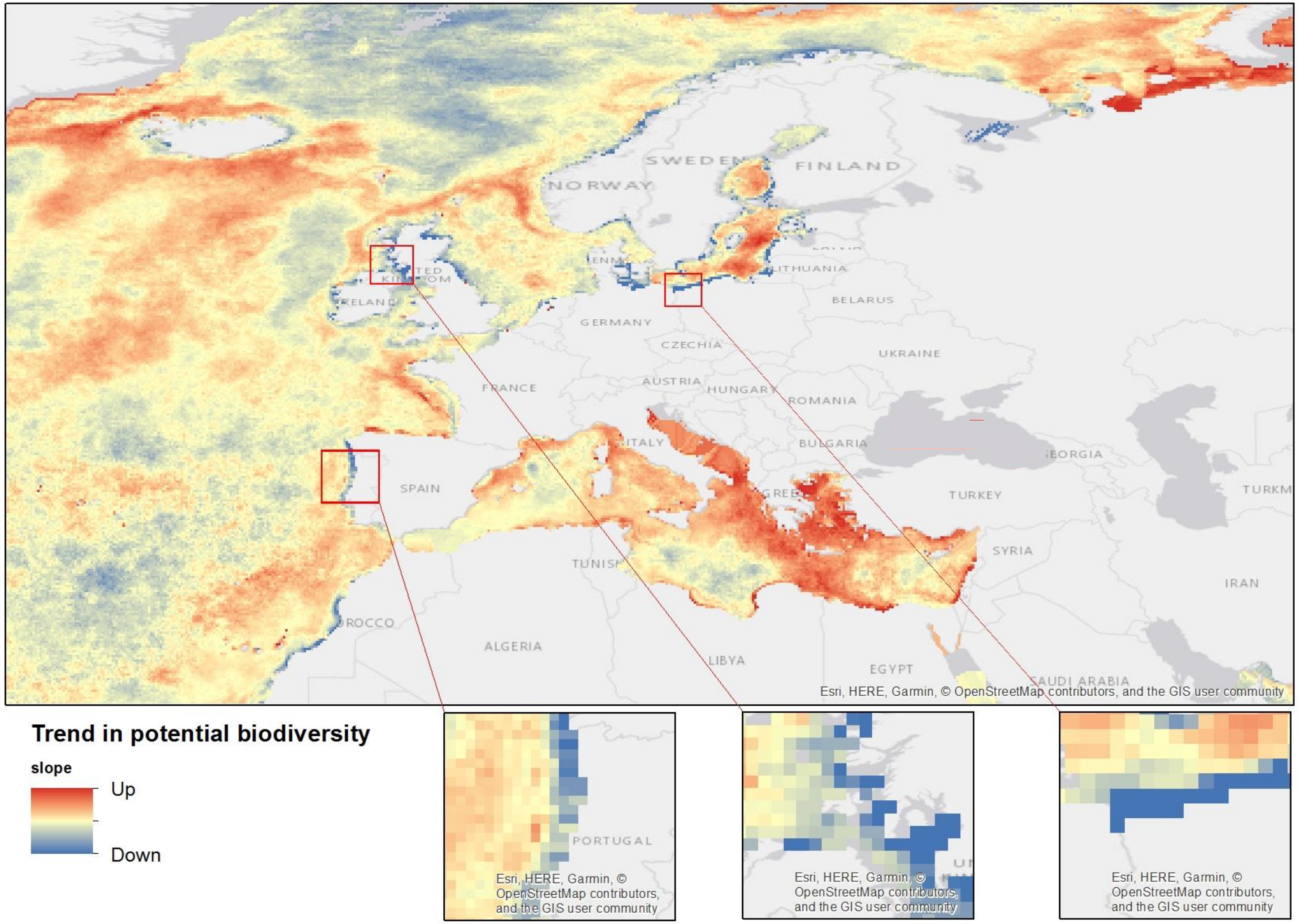




- The map displays global trends in potential biodiversity with arrows indicating changes based on latitude.
- A clear latitudinal gradient is observed, with a marked decline in potential biodiversity between +40°N and 20°S.
- Areas immediately above and below this range show an increase in potential biodiversity.
- The trend of increasing biodiversity is also evident in peri-Arctic regions.
- Overall, there are notable differences between hemispheres: the Northern Hemisphere shows a negative trend, while the Southern Hemisphere shows a positive trend.
- Globally, a decrease in potential biodiversity is observed, as indicated by the red line in the summary graph.

Temporal Trends in Potential Biodiversity Across European Seas (1998-2023)

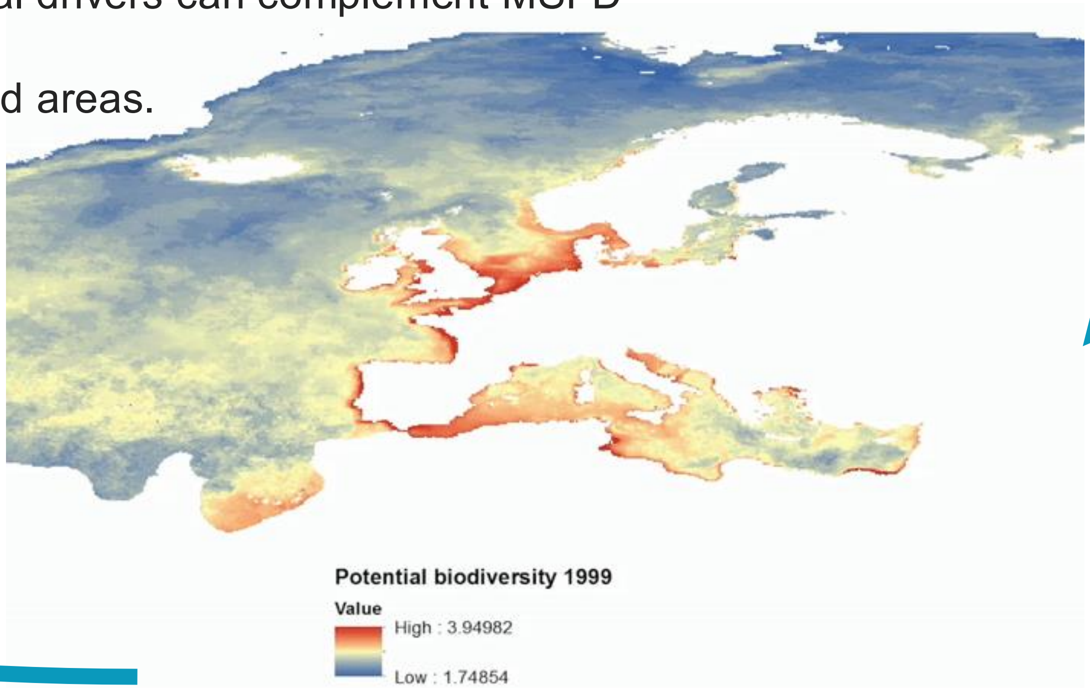
- The map illustrates the temporal trends in potential biodiversity across European seas from 1998 to 2023.
- Areas with negative trends are predominantly concentrated along the temperate and subtropical Atlantic coasts.
- This trend analysis highlights significant changes in marine biodiversity, emphasizing the need for targeted conservation efforts in affected regions.
- Understanding these patterns is crucial for developing strategies to mitigate biodiversity loss and promote sustainable marine ecosystems.



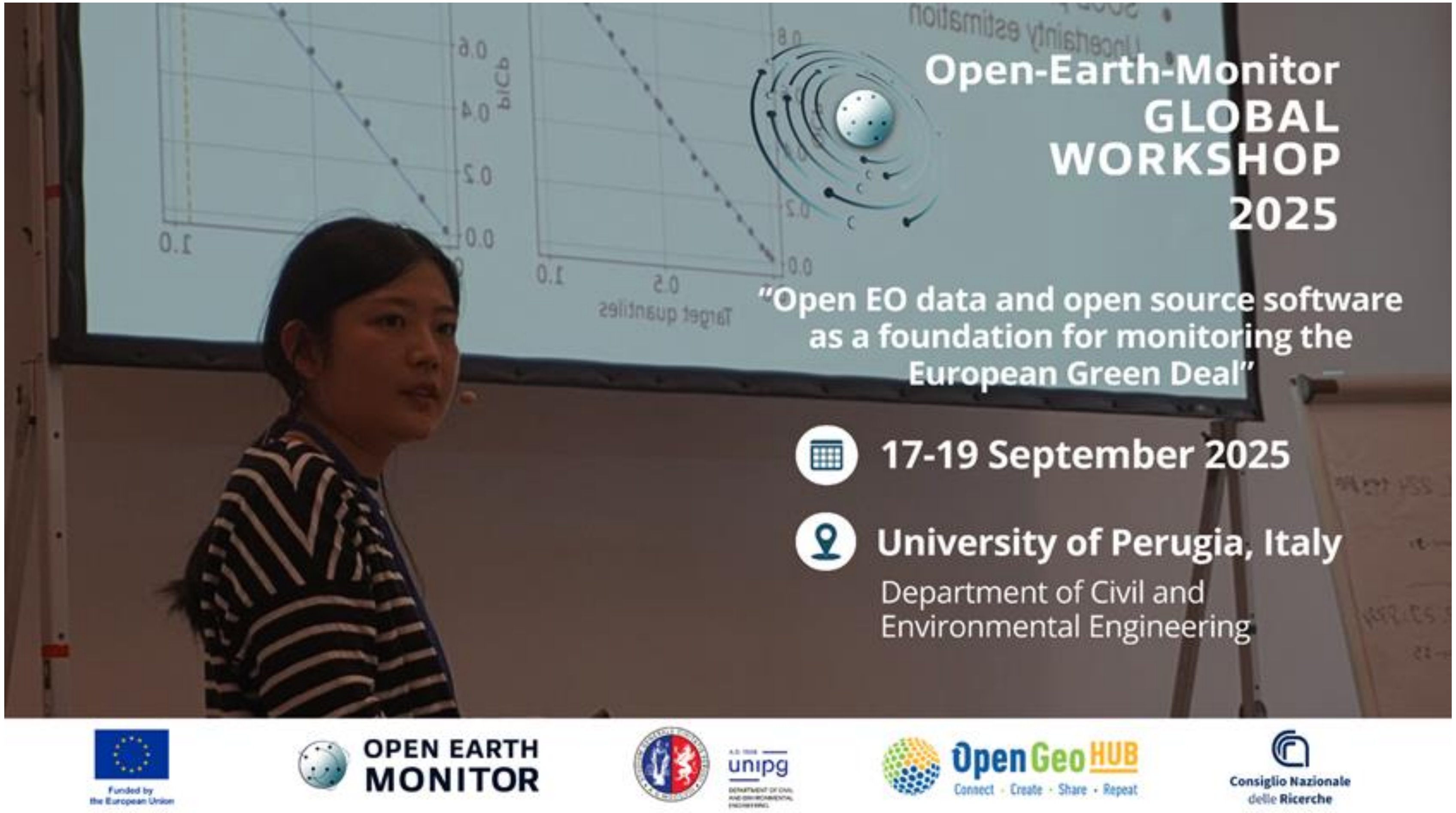
MSFD
MARINE STRATEGY FRAMEWORK DI...

- The model was developed **using abiotic variables** in relation to their distribution based on in situ data collected.
- The **MSFD** monitoring framework provides invaluable, **high-quality** datasets that are essential for validating ecological models.
- The possibility of testing the model with historical data series from the Marine Strategy could enhance the model's robustness.
- Predictive spatial models based on environmental drivers can complement MSFD efforts by:
    - Offering biodiversity insights in unsampled areas.
    - Detecting potential crisis zones.
    - Highlighting emerging trends.

The enhanced model, through data interaction, can be transformed into a user-friendly digital tool that supports decision-makers in marine management policies.



Global Workshop 2025



Submit your abstract for a oral, workshop or poster session

Thank you!

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Questions?
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hcmr ΕΛΚΕΘΕ
iMBBC ΙΘΑΒΒΥΚ

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Acknowledgements
This work has been supported by the Open-Earth-Monitor Cyberinfrastructure (OEMC) project, which has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101059548.