Earth and Planetary Research Centre

AI AND BIG DATA CHALLENGES IN SCIENCE:

Examples from Marine Science

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GEOPLANET CONFERENCE
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AI in Oceanography

1. Oceanographic Data Analysis and Quality Check
2. Climate Change and Ocean Health Monitoring
3. Marine Ecosystem Monitoring
4. Pollution and Environmental Monitoring
5. Extreme Weather Prediction
6. Underwater Exploration and Mapping
7. Fisheries and Resource Management
8. Ocean Energy Development
9. Marine Safety and Navigation
10. Ocean-Atmosphere Interactions
11. Autonomous Vehicles and Robotics
12. Data Integration and Modeling
13. Ocean Science Education and Awareness

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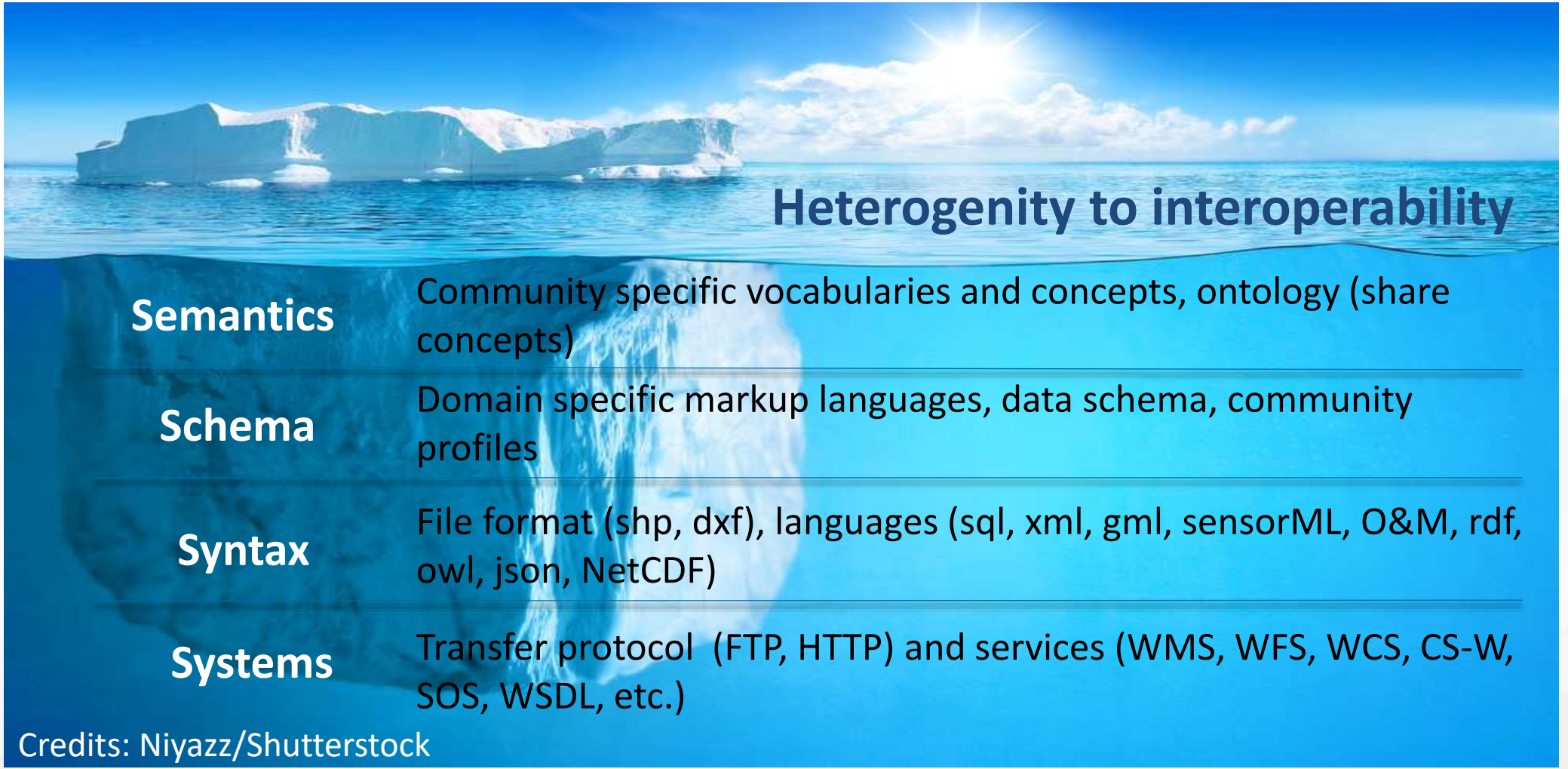
Heterogeneity to interoperability



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The FAIR guiding principles

Findable:
F1. globally unique and persistent identifier
F2. rich metadata
F3. metadata include the identifier of the data
F4. data indexed in a searchable resource

Accessible:
A1. (meta)data are retrievable by PID
A1.1 the protocol is open and free
A1.2 the protocol allows for an authentication
A2. metadata are accessible eternaly

Interoperable:
I1. formal language for data and knowledge
I2. (meta)data use vocabularies
I3. (meta)data use URI to other (meta)data

Reusable:
R1. meta(data) described with relevant attributes
R1.1. (meta)data released with usage license
R1.2. (meta)data with detailed provenance
R1.3. (meta)data meet community standards

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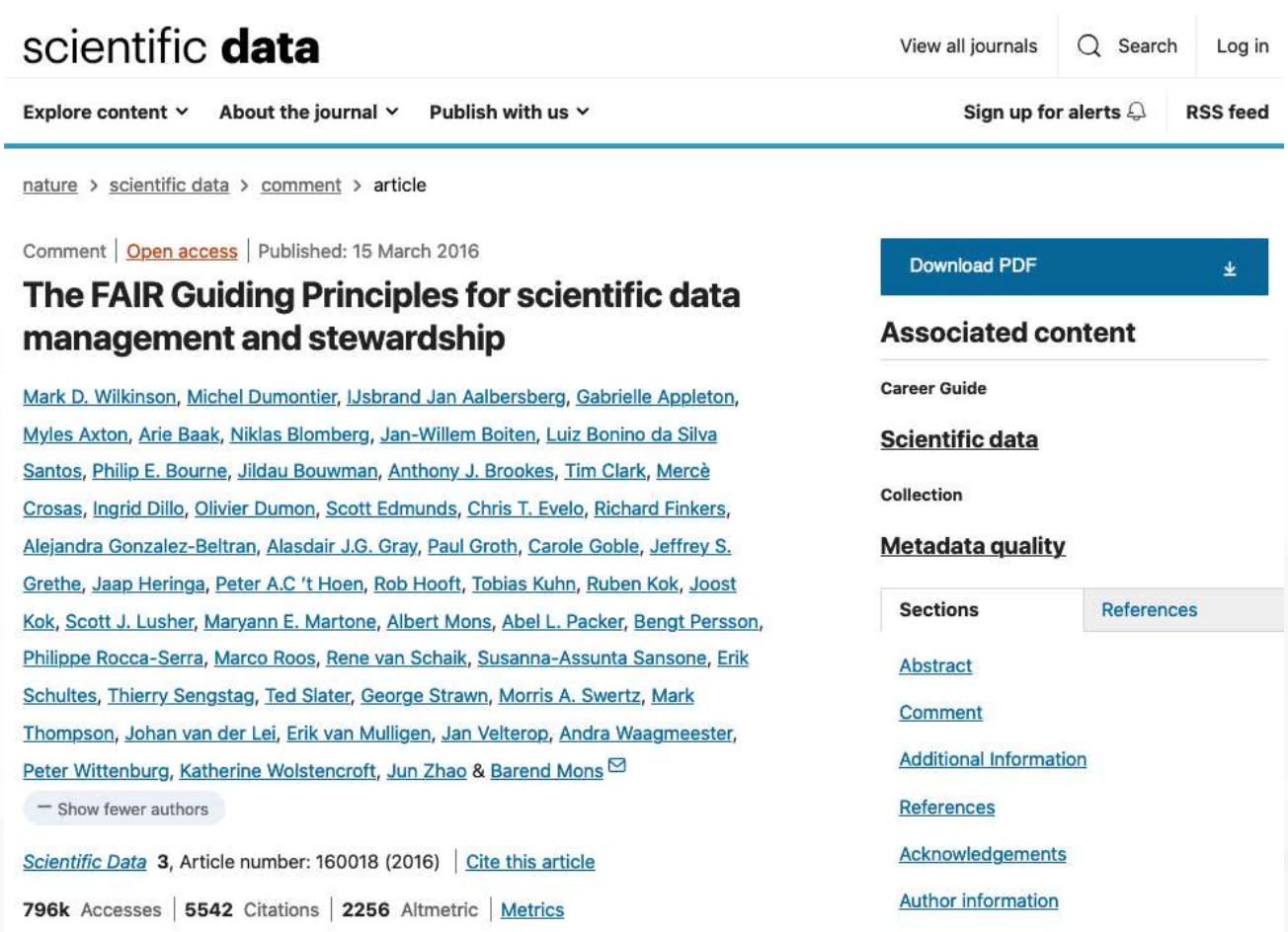

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The FAIR Guiding Principles for scientific data management and stewardship

Mark D. Wilkinson, Michel Dumontier, IJsbrand Jan Aalbersberg, Gabrielle Appleton, Myles Axton, Arie Baak, Niklas Blomberg, Jan-Willem Boiten, Luiz Bonino da Silva Santos, Philip E. Bourne, Jildau Bouwman, Anthony J. Brookes, Tim Clark, Mercè Crosas, Ingrid Dillo, Olivier Dumon, Scott Edmunds, Chris T. Evelo, Richard Finkers, Alejandra Gonzalez-Beltran, Alasdair J.G. Gray, Paul Groth, Carole Goble, Jeffrey S. Grethe, Jaap Heringa, Peter A.C 't Hoen, Rob Hooft, Tobias Kuhn, Ruben Kok, Joost Kok, Scott J. Lusher, Maryann E. Martone, Albert Mons, Abel L. Packer, Bengt Persson, Philippe Rocca-Serra, Marco Roos, Rene van Schaik, Susanna-Assunta Sansone, Erik Schultes, Thierry Sengstag, Ted Slater, George Strawn, Morris A. Swertz, Mark Thompson, Johan van der Lei, Erik van Mulligen, Jan Velterop, Andra Waagmeester, Peter Wittenburg, Katherine Wolstencroft, Jun Zhao & Barend Mons

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https://doi.org/10.1038/sdata.2016.18

The FAIR guiding principles and more

FAIR Principles (Findability, Accesibility, Interpoperability, Reusablity)
The FAIR principles focus on improving the usability and management of data, ensuring it is handled in a way that facilitates discovery, sharing, and reuse, especially in research and scientific communities.

CARE Principles (Collective Benefit, Authority Control, Responsibility, Ethics)
The CARE principles were developed to complement FAIR, addressing the ethical and social dimensions of data, particularly for Indigenous and marginalized communities. They emphasize a human-centered approach to data governance.

TRUST Principles (Transparency, Responsibility, User focus, Sustainability, Technology)
The TRUST principles were designed to support digital repositories in their efforts to provide reliable, secure, and sustainable data storage and access. They focus on building confidence in data stewardship. TRUST principles aim to ensure that repositories are reliable stewards of data, building trust in their services and fostering collaboration.

BigData

1. Volume
2. Velocity
3. Variety

Doug Laney's 3 V's

4. Variability
5. Veracity
6. Visualisation
7. Value

Mark van Rijmenam

Veracity, Validity, Volatility, **Venture**

BigData in Oceanography

Sources:

- **Satellites**
- **Underwater Sensor Networks**
- **Autonomous Underwater Vehicles (AUVs)**
- **Acoustic Systems**
- **Oceanographic Cruises**
- **Citizen Science and IoT**
- **Historical and Modeled Data**

Future Prospects

1.Real-Time Ocean Observation: Enhanced integration of IoT devices for continuous global monitoring.

2.Predictive Analytics: Improved accuracy in forecasting climate events, marine migrations, and human impacts.

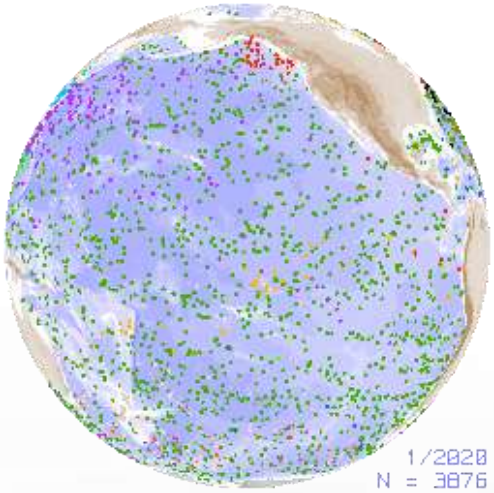
3.Global Collaboration: Unified data platforms such as Copernicus Marine Service and the Ocean Data Platform to share insights.

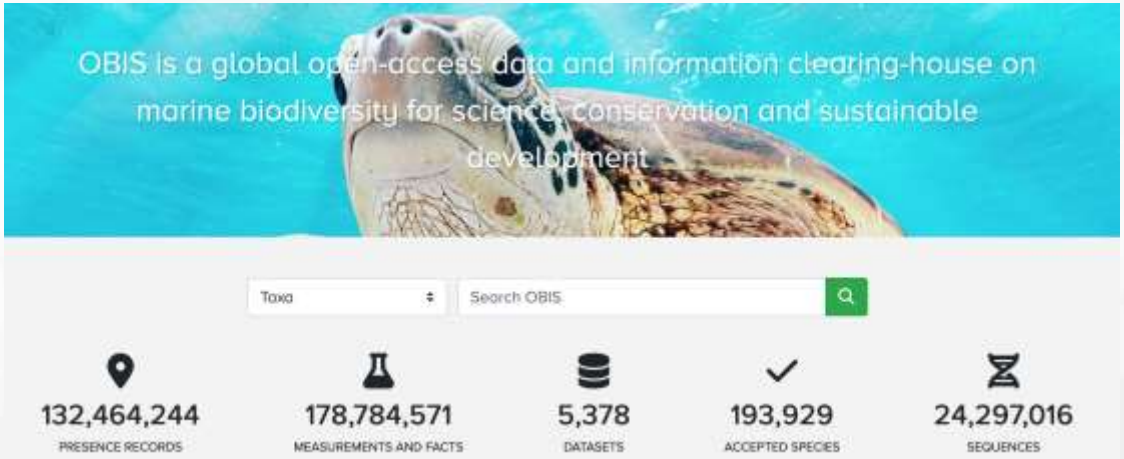
4.AI-Driven Insights: Leveraging deep learning to uncover hidden patterns in ocean data.

Big Data in oceanography holds immense potential for advancing scientific knowledge, supporting sustainable development, and addressing global challenges like climate change and biodiversity loss.

BigData in Oceanography

- Copernicus Marine Environment Monitoring Service (CMEMS)
- Argo Program: An Array of Profiling Floats Observing the Ocean in Real-Time
- NOAA National Data Buoy Center (NDBC)
- Ocean Biodiversity Information System (OBIS)
- GEBCO (General Bathymetric Chart of the Oceans)
- Global Ocean Acidification Observing Network (GOA-ON)





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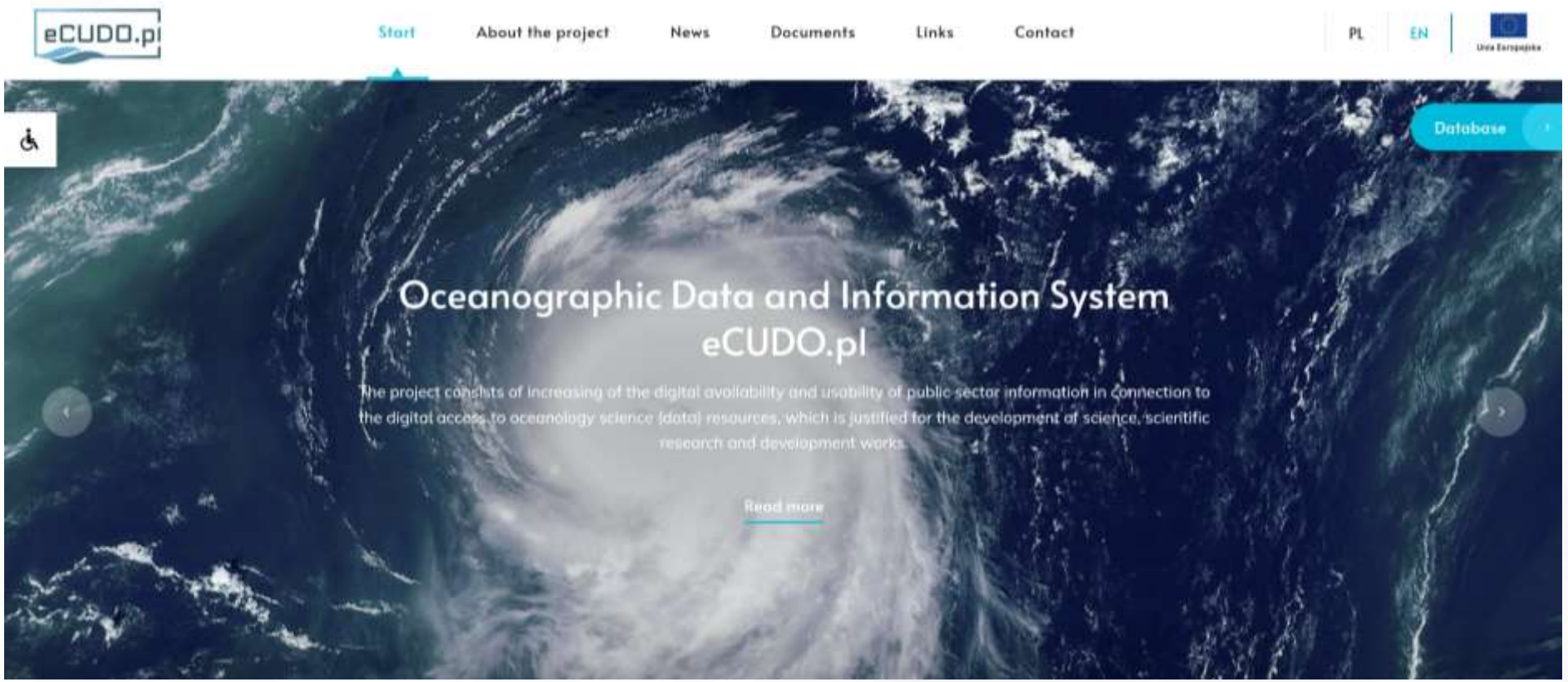

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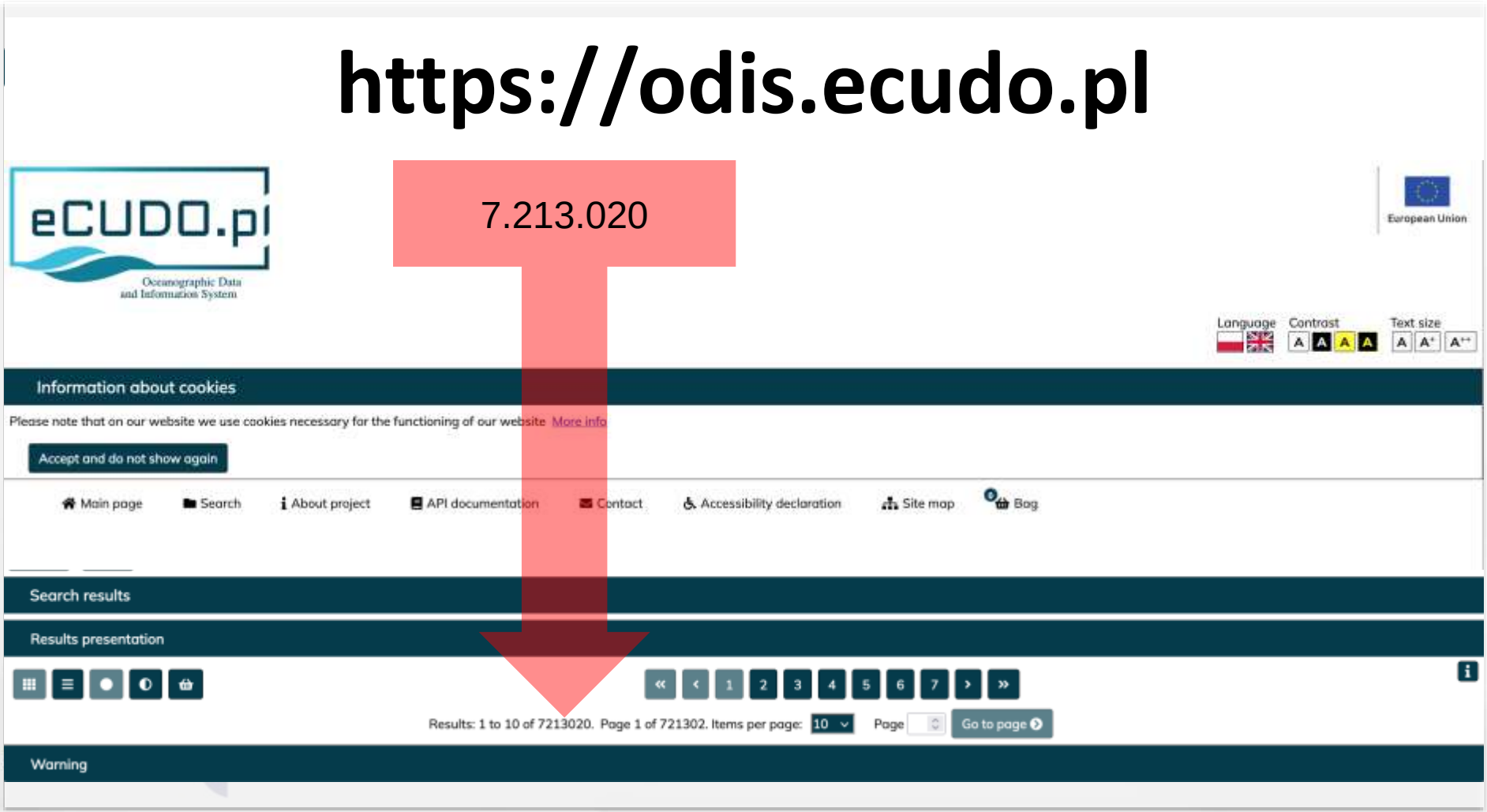
https://odis.ecudo.pl

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Thank you!