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GEOSPATIAL WORLD FORUM

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AI-Cubes: Scalable, Intelligent, Powerful

Geospatial World Forum, Rotterdam, NL, 2024-05-16

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Constructor University | rasdaman GmbH

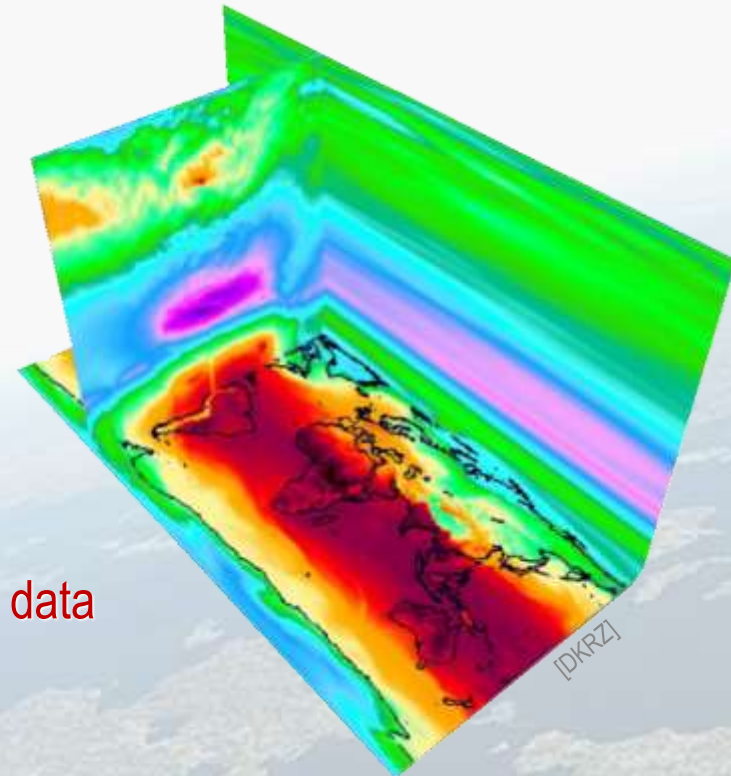


Datacubes

```

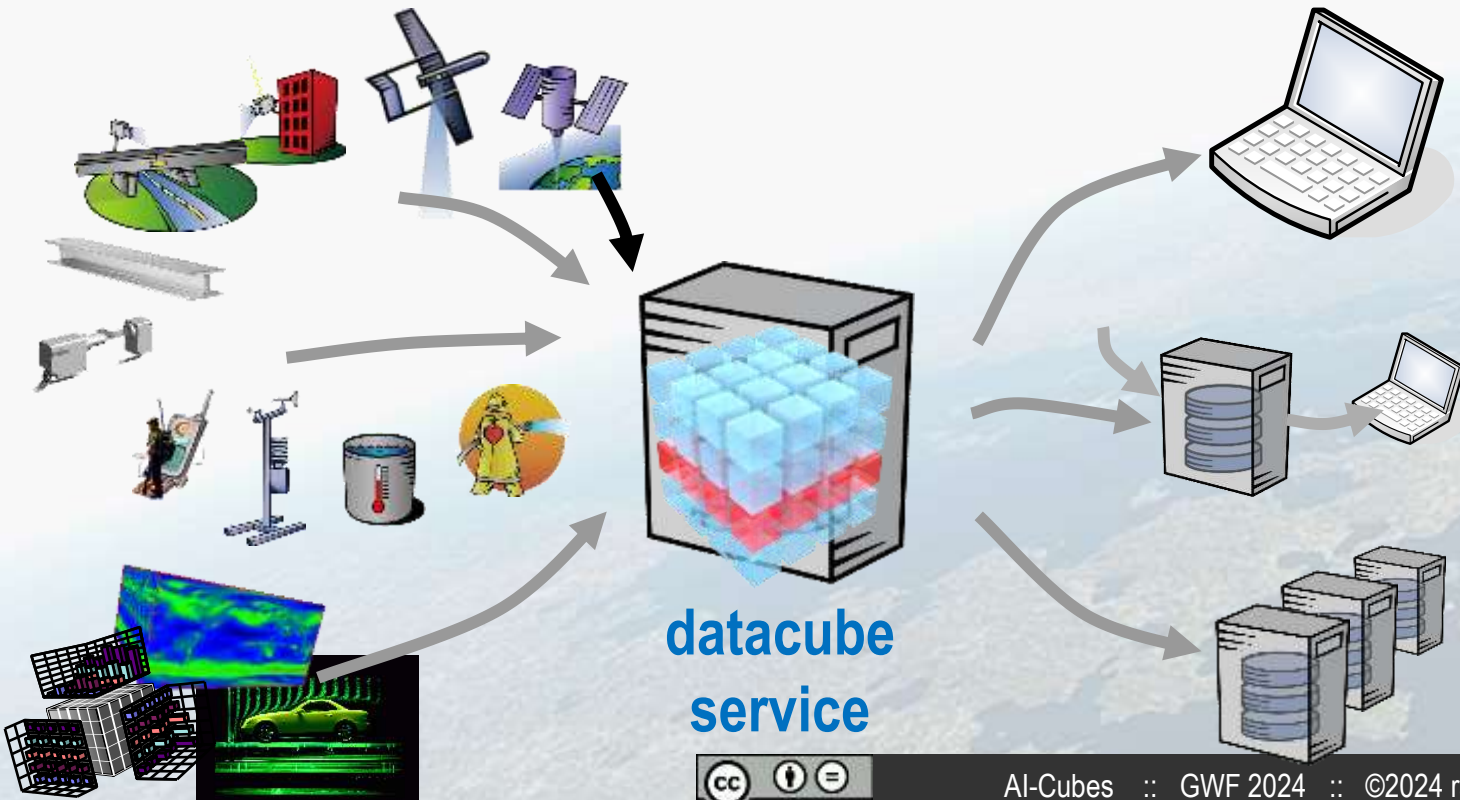
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```



- Natural paradigm for spatio-temporal, n-D data
- Powerful services

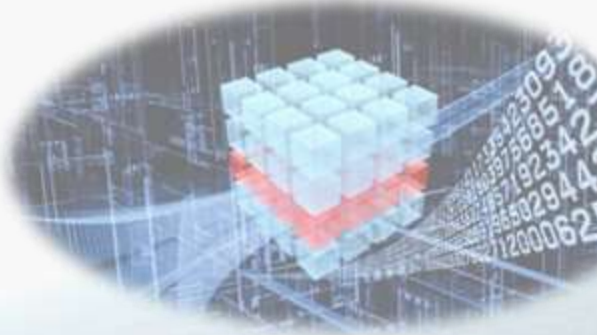
Homogenized, Analysis-Ready Datacubes



rasdaman

= „raster data manager“: n-D actionable datacubes

- pioneered datacubes, cf. publications & patents
- massively scalable **Big Datacube Management & Analytics**
 - full-stack implementation: ; 1000x parallelization; federation; security; GreenCubes®
 - Multi-PB deployments
- **Interoperable**: official OGC Reference Implementation, INSPIRE Good Practice, blueprint for standards





EarthServer

- datacube provider federation
 - 160+ PB location-transparent data space
 - Open standards, zero-coding
- Open, free, transparent, democratic
 - Open & private; free & commercial
 - Have data offerings? **Join!**

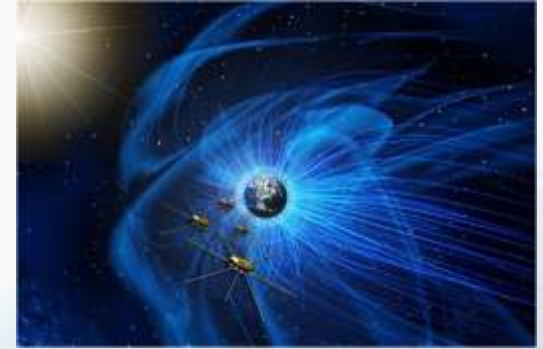


Standards for Datacubes

- Uniform definition in OGC, ISO, EU INSPIRE:
- **Coverages** = spatio-temporal „field“ in physics
 - technically: regular and irregular **grids**, point clouds, meshes
- Coverage **data** model:

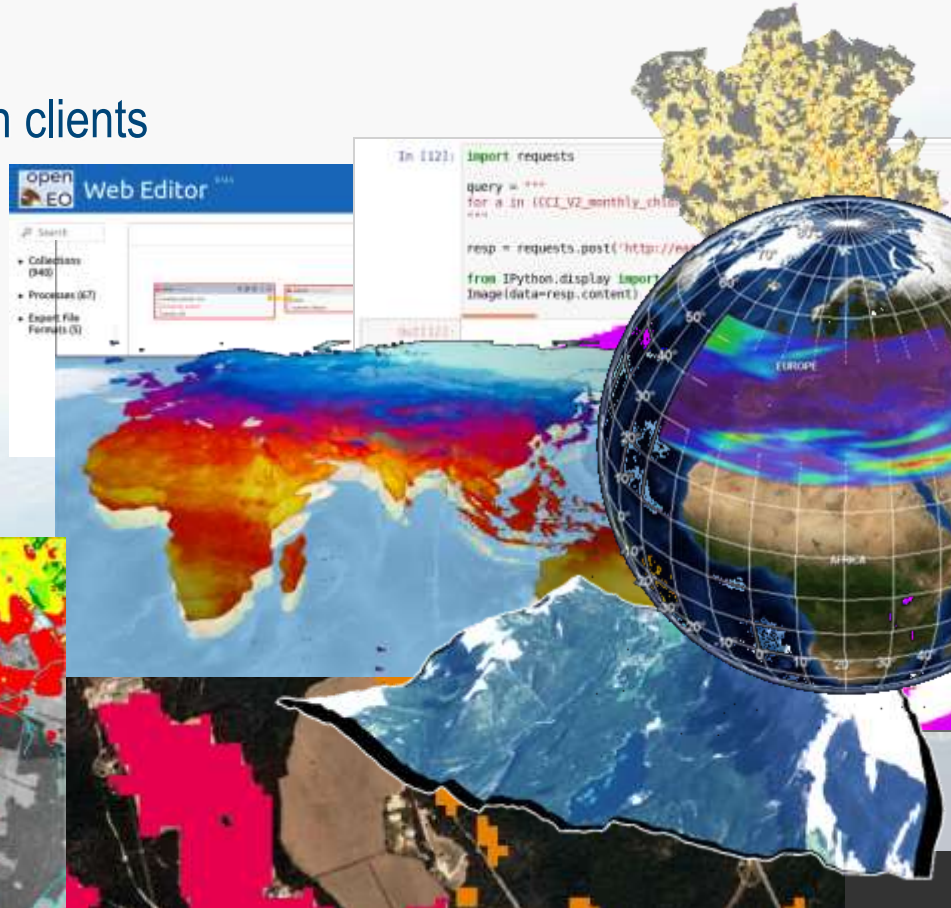
datacubes

 - Concepts & terminology: ISO 19123-1 = OGC Abstract Topic 6 Part 1
 - Interoperable model: ISO 19123-2 = OGC Coverage Implementation Schema
- Coverage **processing** model:
 - Abstract: ISO 19123-3 = OGC WCPS
 - Interoperable model: OGC WCS, WCPS
 - Under work, not mature: OAPI-Coverages, GeoDataCube



Bring Your Favourite Client

- users remain in comfort zone of well-known clients
 - **Map navigation:** OpenLayers, Leaflet, ...
 - **Virtual globe:** NASA WorldWind, Cesium, ...
 - **Web GIS:** QGIS, ArcGIS, ...
 - **Analysis:** GDAL, R, python, openeo, ...



AI + Datacubes, Part 1

- ML in datacube engine – „ship code to data“
- UDFs in OGC WCPS datacube analytics language

```
for $c in (Sentinel_2a),  
    $m in (CropModel)  
return encode( nn.predict($c[...], $m), "tiff" )
```

- With TU Berlin: add Natural Language Processing
- Demo: <https://ai-cu.be>
- Seamless integration
 - ML + optimization + distribution + fusion + ...
- Projects: BMWi AI-Cube, EU FAIRiCUBE, NATO SPS Cube4EnvSec



[ConstructorU, WageningenR]

AI-Cube Demo

AI + Datacubes, Part 2

- **Chatbot** as datacube query assistant
 - Non-experts: intro to datacube queries
 - Experts: convenient look-up tool
 - Based on OGC/ISO WCPS standard
-
- Prototype: <https://ai-cu.be/chatcube>



NATO SPS Cube4EnvSec

- Big Datacube Analytics for Environment & Security on federated AI-Cubes
- Fixed & moving data sources & sinks, rasdaman datacubes



 **NATO OTAN**

This project is supported by: **The NATO Science for Peace and Security Programme**

Take-Home Messages

- **Datacubes simplify** multi-dimensional Big Data
 - Mature **standards**, supported by large implementation basis:
OGC/ISO/INSPIRE CIS, WCS, WCPS
- **Datacubes unify**, acting as integrating platform
 - Location-transparent federation – EarthServer
 - AI-Cubes
- **rasdaman** for datacube management & analytics

