## GERMAN COLLABORATIVE GROUND SEGMENT ACTIVITIES

Simon König, German Space Agency at DLR Hendrik Zwenzner, German Remote Sensing Data Center

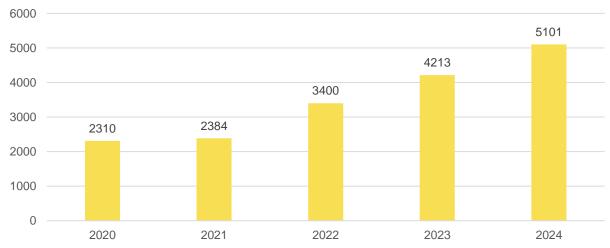
## CODE-DE: Germany's Core CollGS Element

- CODE-DE: Germany's National Copernicus Data Platform (code-de.org)
- Part of Germany's Copernicus strategy, financed by Federal Ministry of Digital and Transport
- Easy access to Sentinel data, plus large-scale processing resources for German public authorities
- All Copernicus data for Germany is permanently kept online
- Contracted to CloudFerro, synergies with CDSE (CREODIAS included as second catalogue)
- Data Security certified by the Federal Office for Information Security (BSI)

## **CODE-DE 3: State of Operations**



CODE-DE Users: 2020 - 2024





■ 5101 Users (+21 %)

- 2,46 Million Data Products; a total of 2,2 PB
- More than 50 institutions with own processing infrastructures (esp. federal level), very high utilization
- Extensions of the data portfolio: Planet Basemaps, digital orthophotos of German federal states

3

## **CODE-DE and EO-Lab Contract Extensions**

- EO-Lab builds on CODE-DE but offers extended features
  - Stronger focus on AI
  - Additional Data (German national missions + commercial data)
- Core user group: German research facilities, startups
- CODE-DE and EO-Lab share system architecture and backend
- Contracts for both platforms have been extended until 09/25
- Integration of EO-Lab resources and functionalities into CODE-DE
  - Functionalities available to all users, easier switching between both platforms
  - During the extension period, platforms are further connected, but no full integration yet



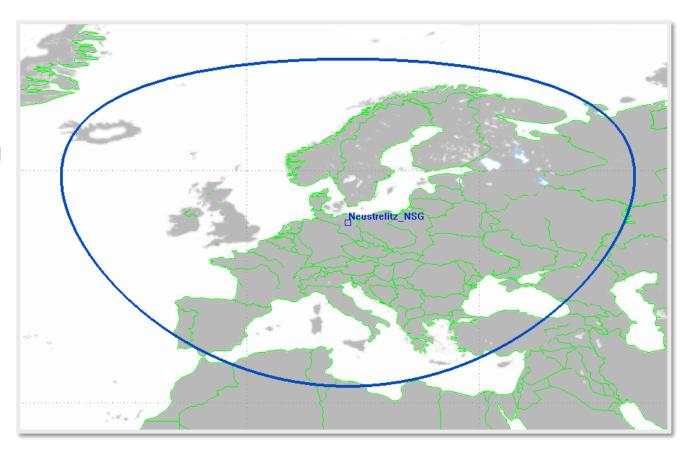
## **CODE-DE: Future Plans**



- Goals: Continuity for users, further technical development, integration of CODE-DE and EO-Lab
- Extended with Copernicus Data Space Ecosystem
  - CDSE: no BSI certification & few free resources, but more data & tools
  - Benefit from data, services and further developments
- Integration with EO-Lab
  - Access to national EO data, EnMAP and NewSpace data (synergetic use)
  - Additional cloud resources, tools and user support specifically for R&D
- Extended possibility to integrate third parties
  - Possibility for users with very high needs (sustainable services, very large projects) without burdening CODE-DE resources
  - Elasticity via additional cloud must be maintained and access simplified as much as possible

# Sentinel-1 Listening and Near Real-Time NRT pass-through mode Products for Maritime Services

- NRT pass-through mode Services
  - On demand
  - Rule based AOI subscription
  - L1 GRDH + value adding quicklook,
  - L1 GRDH + on the fly Level 2 processing
- DLR processor-based L2 processing
  - Vessel Detection, SAR | AIS Fusion
  - Wind-U10,
  - Significant Wave Height
- Dissemination
  - Delivery server
  - GeoServer/Web-Client
  - E-Mail

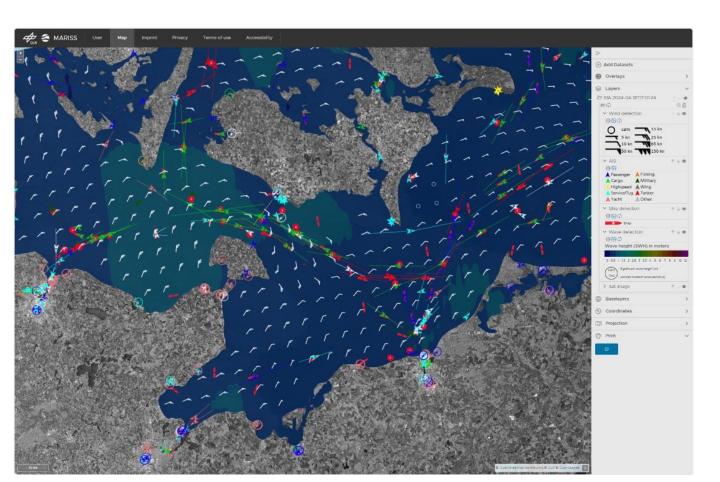


Reception horizon 5 degrees Neustrelitz Ground Station



## **NRT Processing Next Steps**

- Upgrade Processing Chain
  - Replace DLR Processing System Management Framework PSM by Workflow Management Platform WMP
  - L0 SAR Processing replace DLR Front End Processor FEP L0 SAFE processing by ESA Sentinel1 All In One Processor AIOP
- Sentinel-1C integration
  - SAR processing and value adding
  - AIS processing
  - L2 processing
- L2 Extension
  - Oil Spill Detection (prototype)



DLR Maritime Surveillance Services MARISS – Web Client



## Atmospheric Composition Monitoring SAF DLR Sentinel-4/Sentinel-5 Activities

#### **Sentinel-4 L2 Products**

- Total column water vapour
- SO2 plume height (proposed)

#### **Sentinel-5 L2 Products**

- Total column water vapour
- Total column OCIO
- Total column BrO
- Tropospheric BrO
- Status: passed EPS-SG system/ component verification test result review part 1

Within the EUMETSAT Atmospheric Composition Monitoring Satellite Application Facility (AC SAF), DLR is responsible for the operational processing, archiving and dissemination of L2/L3 atmospheric trace gas products.

EUMETSAT

MONITORING

The S4/S5 L2 AC SAF products complement the official "day-1" Copernicus L2 products. AC SAF products are widely used by CAMS and various applications/research for climate, meteorology and air quality. The AC SAF is co-funded by the partner institutes.



**INPULS -** <u>Innovative</u> <u>Produktenwicklung</u> zur Ana<u>lyse</u> der Atmo<u>sphärenzusammensetzung</u> DLR Sentinel-5P + (Sentinel-4+Sentinel-5)

Sentinel-5P Gridded L3 Products

- O<sub>3</sub>
- NO<sub>2</sub>
- HCHO
- SO<sub>2</sub>
- UV-Index
- Aerosol parameters
- Cloud physical parameters

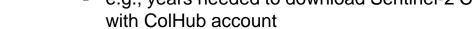
Sentinel-5P Gridded L4 Products

Tropospheric NO2 @ surface level

The projekt *inpuls* combines the expertise of multiple DLR institutes in

- Algorithm/retrieval development,
- operational processing on HPDA platforms,
- user-friendly data dissemination using innovative interfaces (OGC WM\* and STAC) and
- operational generation of high-quality data visualisations for web and media (e. g. for the ozone hole period).

INPULS is funded by DLR programmatic.



## **HPDA** terrabyte Interoperable HPC infrastructure for scientific use

- High-performance earth observation analytics platform for scientific use
- 50 PB online storage for curated EO data linked to 100 PB DLR's long-term archive (D-SDA)
- Contributions to ESA's open source EO Exploitation **Platform Common Architecture (EOEPCA)**
- Open for science collaborations with data centers for federated data access and processing

## Challenges

10

- Inconsistent inventories / data duplication
  - e.g., thousands of Sentinel-1 GRD duplicates
- Limiting download quotas for reprocessed datasets
  - e.g., years needed to download Sentinel-2 Collection 1 (L1C + L2A)







Additional information on https://docs.terrabyte.lrz.de

## **Production of Analysis-Ready-Data**

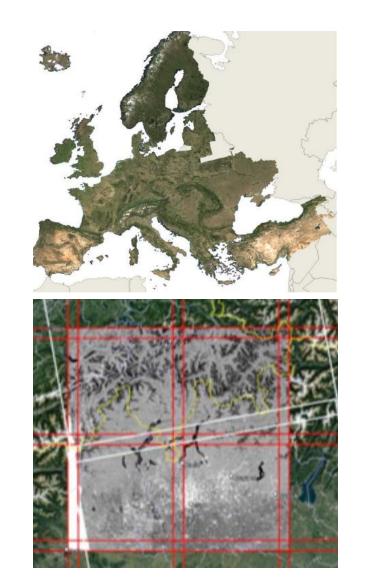


## ✓ Sentinel-2 L2A – MAJA processor

- Europe 2018 2022
- Atmospheric correction calculation for each L1C scene
- Processing on terrabyte: 3 months time, 500 TB storage
- Used for bare soil composites

### ✓ Sentinel-1 Normalized Radar Backscatter

- Based on ESA's and CEOS-ARD specification
- Currently being converted to in-house processor (MultiSAR)
- Global 2014 2025
- 4 Petabyte Sentinel-1 IW GRD Input, 9 Petabyte output
- Planned processing time: 2-3 months for all GRD scenes using 10% of terrabyte infrastructure



11