CB Activities in EO at DLR

Dieter Hausamann - German Aerospace Center
WGCapD-5 Agenda Item #19
Working Group on
Capacity Building & Data Democracy
Hampton, Virginia, USA
March 29th – April 1st, 2016
Outline

- The German Aerospace Center DLR
- CB Issues 1: SAR-EDU, TSX & TDX
- CB Issues 2: EOC
- CB Issues 3: K12 Edu
Outline

- The German Aerospace Center DLR
- CB Issues 1: SAR EDU, TSX & TDX
- CB Issues 2: EOC
- CB Issues 3: K12 Edu
DLR
German Aerospace Center

- Research Institution
- Space Agency
- Project Management Agency
Locations and employees

8,000 employees across 33 institutes and facilities at
- 16 sites

- **Space Directorate**


In Oberpfaffenhofen/Bavaria:
- >1,800 employees
- 10 institutes and facilities
- **EO Sites**
Financing of DLR and research funding 2016

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount (in million euro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Administration</td>
<td>880</td>
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<tr>
<td>Project Management Agency</td>
<td>1087</td>
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<tr>
<td>Research and Operations</td>
<td>455</td>
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<tr>
<td>German ESA contributions BMWi/BMVBS</td>
<td>305</td>
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<tr>
<td>National Space Program incl. management</td>
<td>164</td>
</tr>
<tr>
<td>DLR Project Management Agency incl. management</td>
<td>453</td>
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</tbody>
</table>

All figures in million euro; therefore, the rounding differences.
Financing of DLR and research funding 2016

DLR is a publicly funded private entity
DLR Site
Oberpfaffenhofen

Employees: More than 1,800
Size of site: 245 000 m²
Research institutes and facilities:

1. Microwaves and Radar Institute
2. Institute of Communications and Navigation
3. Institute of Atmospheric Physics
4. Remote Sensing Technology Institute
5. Institute of Robotics and Mechatronics
6. Institute of System Dynamics and Control
7. German Remote Sensing Data Center
8. German Space Operation Center
9. Galileo Control Center
10. Flight Experiments

In RED: involved in CB activities
2. Earth Observation: Time Matters

for CEOS WGCapD-5 Annual Meeting

Gunter Schreier,

German Aerospace Center (DLR)

Earth Observation Center (EOC)
German Remote Sensing Data Center (DFD)
Remote Sensing Technology Institute (IMF)

March 2016
Earth Observation: response time vs. update

- Meteorology, Weather: hourly
- Disaster Mapping: daily
- Maritime Security: weekly
- Ecological mapping: monthly
- Precision Farming: yearly
- Infrastructure: decadal
- Global Change: response time vs. update
Time Scales in Earth Observation

– Programming the data take
  – the next command uplink
  – the next revisit

– Getting the data
  – the next direct access/ dump station
  – relay data from station to processing

– Processing, information extraction
  – ancillary data
  – process being done
  – manual interaction, visual interpretation

– Long time availability
  – Time series
  – archives
Missions
The Sentinel Missions

<table>
<thead>
<tr>
<th>Year</th>
<th>Santa 1 – SAR imaging</th>
<th>Sentinel 2 – Multispectral imaging</th>
<th>Sentinel 3 – Ocean and global land monitoring</th>
<th>Sentinel 4 – Geostationary Atmosphere</th>
<th>Sentinel 5 – Low-orbit Atmosphere/ Air quality</th>
<th>Sentinel 6 – Low-orbit Altimetry</th>
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<tr>
<td>2013</td>
<td></td>
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<td>a</td>
<td>Payload on EUMETSAT geostationary</td>
<td>Payload on EUMETSAT polar orbiting</td>
<td>CNES JASON heritage</td>
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<td>2023</td>
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</table>

- Sentinel 1: SAR imaging
- Sentinel 2: Multispectral imaging
- Sentinel 3: Ocean and global land monitoring
- Sentinel 4: Geostationary Atmosphere
- Sentinel 5: Low-orbit Atmosphere/Air quality
- Sentinel 6: Low-orbit Altimetry
### ESA Data Hub all Sentinels user products

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<tbody>
<tr>
<td>Average Data Rate [Mbit/s]</td>
<td>194</td>
<td>257</td>
<td>1.194</td>
<td>1.753</td>
<td>1.928</td>
<td>1.987</td>
<td>2.162</td>
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</tbody>
</table>
Copernicus Contributing Missions from Germany (all with EOC involvement)

**TerraSAR-X/TanDEM-X (DLR-Airbus-PPP)**
- Ground Segment development and operations

**Resourcesat; Indian Satellites (GAF)**
- Ground Segment Operations & improvement

**WorldView-2/3, (EUSI) Skybox (Google)**
- Ground Segment Operations & improvement

**RapidEye (Blackbridge/PlanetLabs)**
- Science Data support/ Archive

**Korean Kompsat Missions (VHR optic & SAR)**
- data acquisition, support to KARI

**EnMAP (DLR)**
- Ground Segment development and operations
3 - Sendai Airport:
Parts of the runways of Sendai airport are flooded or covered by mud and debris. Many of the nearby buildings disappeared.
Final TanDEM-X DEM Product (1°x1° Tiles with 12 m resolution)

- Processed for 75% of global land surface (Oct 2015).
- Global absolut height error at +/- 1,13m (Spec is +/- 10m for 90% of data)
- 98,6% of tiles meet all quality/accuracy criteria
Tandem-L-Formation
Comparison of Imaging Capacity

State of the Art (z.B. TerraSAR-X)
1 global coverage / year

Digital Beamforming (Tandem-L)
2 global coverages / week

1 Days
Ground Segment
Copernicus Collaborative Ground Segment and national Services at EOC

- Near/Quasi Real Time Data Access
- Marine Services
- Emergency Response
- Civil Security
- Atmosphere
- Land
- Urban
- … and more
- Big Data in Copernicus
- Data Access
Global Station Network of DLR-DFD
ISSF: Inuvik Satellite Station Facility

- 13 m DLR Antenna
- 13 m SSC/CNES Antenna & 2nd 13m Antenna (2016)
- 13 m CCMEO Antenna (2014)
- ... more
- Fibre connection (2016) ... second line planned
- Copernicus Core Station location (ESA contract to KSAT)
- Site extension for > 30
QRT/NRT Services from DLR Neustrelitz

- Acquisition of SAR satellites
  - TerraSAR-X (& follow-ons)/
    Sentinel-1/ Radarsat-2/ other

- QRT/NRT SAR product generation:
  SAR/oil image/Ship detection – wind/wave fields

- New acquisition technologies:
  AlphaSat, EDRS

- Near real time maritime scencarios

- User training/ facilities
DFD-Department National Ground Segment

- Ground Stations
- Data Management
- Realtime Services
- Maritime Security Lab
- Calibration- and Validation Testsite DEMMIN
50 (+33) PetaByte storage capacity

Includes:
Sentinel PAC Archive

~ 1.5 PetaByte of product data per year per Sentinel
DLR-EO Issues:

- Disaster Response
- Maritime Security
- Urbanization
- ...
- Water Management
Disaster Response
one hour to few days
Satellite Based Crisis Mapping

1. **Mobilization**
   - satellite tasking
   - archive search
   - auxiliary data

2. **Data acquisition**
   - geometric correction
   - image enhancement

3. **Pre-Processing**
   - data fusion
   - information generation

4. **Analysis**
   - integration of auxiliary data

5. **Map Production**
   - quality control
   - maps (printed; online)
   - GIS-ready geodata
   - information dossiers

6. **Dissemination**
   - Cooperation with national/local authorities
   - Relief organisations, NGOs
   - Public,...

**Planning and Decision Support**

- Integration in collaborative platform
International Charter on Space and Major Disasters

An International agreement among participating Space Agencies to provide space-based data and information in support of relief efforts during emergencies caused by major disasters.
Taifun, Philippines, November 2013
Philippines - Cebu North / Daanbantayan and Medellin

Earth Observation Center

Situation as of November 14, 2013 - Damage Assessment Map

Legend

Population per km² (Census 2010)

- < 500 (min. 108)
- 500 - 1000
- 1000 - 2500
- 2500 - 5000
- > 5000 (max. 9000)

Infrastructure

- Town
- Village
- Primary road
- Secondary road / Track

Other

- Administrative Boundaries
- Water

Infrastructure

- Settlement
- Primary road
- Secondary road
- Industrial Area
- Harbour

Hydrology

- Streams
- Water body

Topography

- Coastline
- Contour lines

Damage Assessment

- > 13 (max. 108)
- 6 - 13
- 1 - 5
- Road possibly blocked

1:35,000

1:25,000
Differential Ground Movement

Earthquake Nepal (April 2015 – Sentinel 1)

Done by DLR-EOC-IMF
Maritime Security
... better than one hour

WV2 acquisition of the Costa Concordia.
(19 Jan 2012)
(c) DigitalGlobe, provided by European Space Imaging
Sentinel-1
Acquired and processed at DLR Neustrelitz
Research and Application Development for the Maritime Situational Awareness

- Bathymetry
- Land-Water Line
- Wave groups & Forecast
- Wave breaking
- Surface Currents
- Sea State
- Wind
- Ship-detection
- Oil Spills
- Iceberg-detection, Ice classification
Urbanisation
decades of observation
3. WaMaPro – Water Mask Processor

DFD – DLR German Remote Sensing Data Center