Agency and Liaison Report

CEOS WGISS Meeting #37
14-18 April, 2014, Cocoa Beach, Florida, USA
Hosted by NASA

M. Albani (European Space Agency)
THE ESA EARTH OBSERVATION PROGRAMME

Meteorological Missions
Driven mainly by weather forecasting and climate monitoring needs, these missions developed in cooperation with EUMETSAT include the Meteosat Geostationary Operational Satellites (MetOp) series, the Meteosat Second Generation (Meteosat-11 & MetOp-A) and the new generation of Geostationary Meteosat satellites (Meteosat-12 & MetOp-B satellites).

Copernicus Sentinel Missions
Driven by the needs of the Copernicus Users to contribute to the European Global Monitoring of Environment & Security (GMES) initiative, these satellite missions developed in partnership with the Copernicus program include Sentinel-1A, high-resolution optical (Sentinel-2A), optical and infrared radiometry (Sentinel-3A), and atmospheric composition monitoring (Sentinel-4 & Sentinel-5P) capacity.

Earth Explorer Missions
Driven by the need to advance our understanding of the ocean, atmosphere, cryosphere, and Earth's interior and interact with a part of an interconnected system, these research missions, exploiting Europe's excellence in technological innovation, pave the way towards new development of future EO applications.

European Space Agency
GOCE (2009 - 2013)

- **Status**: Re-entered atmosphere the 11th Nov 2013
- **Objectives**: Earth gravity field
- **Instruments**: Electrostatic gravity gradiometer, satellite-to-satellite tracking instrument, laser retro-reflector
- **Users**: Hundreds of scientists
- **Facilities**: Stations in Kiruna, Svalbard; Archives & Processing at ESRIN (L1b) and distributed over Europe (L2)
- **Data volume**: ~1 TB of products by end of mission

5th Release of gravity field products (L2 gravity field and geoid products) being processed: will be ready during summer 2014

5th GOCE User Workshop will be held from 25 to 28 November 2014 at UNESCO, Paris
**EARTH EXPLORERS - 2**

**Swarm (2013 - )**

- **Status**  Successfully launched on the 22\textsuperscript{nd} of November 2013
- **Lifetime**  4 years
- **Objectives**  Earth magnetic field and near-Earth environment
- **Satellites**  3 identical satellites in low polar orbits, injected at 490 km, 87.55° inclination
- **Orbits**  Swarm A & C side-by-side on a 462 km orbit at 87.35° inclination. Swarm B on a 510 km orbit at 87.75° inclination
- **Instruments**  Vector field magnetometer, advanced scalar magnetometer, electric field instrument, accelerometer, GPS receiver, Laser Retro-reflector
- **Users**  Magnetic field community, aeronomy, ionosphere and magnetosphere
- **Facilities**  Kiruna, Farnborough, Level 2 processing by science consortium as part of PDGS
- **Data volume**  Modest
Launched with ROCKOT on 22\textsuperscript{nd} November 2013 from Plesetsk.

IOCR successfully held in Mar14; Phase E1 commissioning completed.

All 3 satellites and PDGS working nominally. Swarm data have been routinely processed and distributed to "special users”.

Swarm A, B and C already in their final orbit altitude.

Hand-Over from Phase E1 to Phase E2 (Operational Phase) in mid April.

3\textsuperscript{rd} Swarm Science Meeting in Copenhagen on 19-20 June.
EARTH EXPLORERS - 3

**SMOS (2009 - )**
- **Status**  
  Operational since May 2010
- **Objectives**  
  Soil moisture and Ocean Salinity
- **Instruments**  
  Passive microwave (L-band)
- **Users**  
  Hundreds of scientists (hydrologists, oceanographers, meteorologists etc)
- **Facilities**  
  Stations in ESAC Villafranca and Svalbard, Facilities in Kiruna, Satellite ops in CNES Toulouse
- **Data volume**  
  ~10 GB per day

**Cryosat-2 (2010 - )**
- **Status**  
  Operational since October 2010
- **Objectives**  
  Thickness of sea and land ice
- **Instruments**  
  SIRAL radar altimeter, DORIS
- **Users**  
  > 300; ~200 institutions worldwide
- **Facilities**  
  Kiruna, CNES, ESRIN
- **Data volume**  
  ~50 GB per day

Both operating well, mission extension being planned. Continuous evolution of products and interfaces, reprocessing campaigns.
ADM - Aeolus

- **Status**: Launch end 2015
- **Objectives**: Wind Profiles
- **Instruments**: Lidar
- **Users**: Met. Offices and scientists,
- **Facilities**: Stations in Svalbard & Tromsø, Facilities at DLR & ECMWF
- **Data volume**: 5 TB over the entire mission

EarthCARE

- **Status**: Launch end 2016
- **Objectives**: quantifying aerosol-cloud-radiation interactions so as to allow their inclusion in climate and numerical weather forecasting models
- **Instruments**: Backscatter Lidar (ATLID, Cloud Profiling Radar (CPR) provided by JAXA, Multi-Spectral Imager (MSI), Broad-Band Radiometer (BBR)
- **Users**: Meteorology - Climatology
- **Facilities**: FOS – ESA PDGS – JAXA PDGS
- **Data volume**: Level 1: 100 GB/day

BIOMASS

- **Status**: Launch in 2020
- **Objectives**: Understand Earth’s carbon cycle
- **Instruments**: P-Band Radar

Development ongoing
THE ESA EARTH OBSERVATION PROGRAMME

Meteorological Missions
Driven mainly by Weather forecasting and Climate monitoring needs. These missions developed in partnership with EUMETSAT include the Meteosat Operational satellite programme (Meteosat) and the new generation of Geostationary Meteosat (MSG) & Metop satellites.

Copernicus Sentinel Missions
Driven by Users needs to contribute to the EUMETSAT's Polar System (EPS) and the new generation of Geostationary Meteosat satellites (MSG & Metop satellites).

Earth Explorer Missions
Driven by Scientific needs to understand the dynamics of the ocean, atmosphere, hydrosphere, cryosphere and Earth's interior and to operate and interact as part of an interconnected system. These Research missions, exploiting Europe's excellence in technological innovation, pave the way towards new development of future EO applications.

Data from non-ESA Missions

European Space Agency
Proba-V

- Built by ESA D/TEC as a technology mission, now part of the EOP Earthwatch programme.
- Launched in Kourou with a VEGA rocket on 7 May 2013
- IOCR successfully completed and mission handover to D/EOP completed in December 2013; Phase E2 started.
- Vegetation Instrument (same as Spot-4/5)
- Products:
  - 1Km resolution products under ESA management (full and open access, free of charge).
  - 300 meters resolution products property of BELSPO and distributed by Vito (commercial distribution).
Copernicus is a European space flagship programme led by the European Union.

ESA coordinates the space component.

Copernicus provides the necessary data for operational monitoring of the environment and for civil security.
Copernicus dedicated missions

**Sentinel-1 (A/B) – SAR imaging**
All weather, day/night applications, interferometry

**Sentinel-2 (A/B) – Multi-spectral imaging**
Land applications: urban, forest, agriculture,... Continuity of Landsat, SPOT

**Sentinel-3 (A/B) – Ocean and global land monitoring**
Wide-swath ocean color, vegetation, sea/land surface temperature, altimetry

**Sentinel-4 (A/B) – Geostationary atmospheric**
Atmospheric composition monitoring, trans-boundary pollution

**Sentinel-5 precursor/ Sentinel-5 (A/B) – Low-orbit atmospheric**
Atmospheric composition monitoring

**Jason-CS (A/B) – Low inclination Altimetry**
Sea-level, wave height and marine wind speed

*S-1A LAUNCHED 3RD APRIL 2014*
VIDEO AT

http://www.esa.int/spaceinvideos/Videos/2014/04/Sentinel-1A_rides_into_space_on_a_Soyuz
Separation in Space from Fregat

VIDEO AT

http://www.esa.int/spaceinvideos/Videos/2014/04/Separation_in_space
Solar Wings and SAR antenna opening sequence

VIDEO AT

http://www.esa.int/spaceinvideos/Videos/2014/02/Sentinel-1_unfolds
This picture was acquired by one of its onboard cameras. Viewed looking down one of the deployed solar wings with the radar open below - with Earth as the backdrop.
Launch and Early Orbit Phase (LEOP) successfully performed according to the planned timeline and declared closed on 6 April
- Deployments of the solar panels and of the SAR antenna
- Achievement of Satellite Nominal Mode and AOCS Nominal Pointing Mode
- Switch ON and initial checks of the spacecraft sub-systems
- First on-board telemetry and navigation data in band-X was received at the Matera ground station on 6 April, early morning
- First SAR instrument data acquisition was performed on 6 April (3 min wave mode). The related measurement was successfully processed at UK-PAC.

Commissioning started on 7 April for three months (very dense).
- Start of orbit manoeuvre sequence to acquire the target reference orbit
- Calibration, etc...
Sentinel-1A Collision Avoidance Manoeuvre
A long day

- 4 April: danger of a collision with a NASA satellite called ACRIMSAT (not manoeuvrable)
- Collision avoidance manoeuvre during LEOP never done before and not simulated
- Need to reach normal pointing mode before doing the manoeuvre
- Significant risk of collision confirmed (20 meters distance) in two possible occurrences on 5 April in the morning
- Decision to change orbit to Sentinel-1A with a 39 seconds long manoeuvre
- The sequence of commands was uplinked during pass 37 in Alaska/Svalbard/Kiruna on 5 of April at 04:33 UTC for execution at 05:14 UTC, outside visibility
- Following pass over Troll Ground Stations showed that satellite was in Orbit Control Mode and manoeuvre had been successful
Captured on 12 April, just one day after the satellite was put into its operational attitude.

Demonstrates the potential of Sentinel-1A’s radar vision.

Strip map’ mode with a swath width of 80 km, resolution 5x5 m.
Namibia flooded by the Zambezi river
Pine Island Glacier in Antarctica. This glacier is in a state of ‘irreversible retreat’ so it is important to keep a very close eye on glaciers such as these as they lose ice to the ocean.
Transect over the northern part of the Antarctica Peninsula
Sentinel-1A Data Access

• Free, full and open data policy adopted for the Copernicus programme → access available to all users for the Sentinel data products, via a simple pre-registration.
• Following registration, users will have the possibility to download a test data set that simulates the data products that will be generated by Sentinel-1 and will be granted early access to Sentinel-1 data samples, even before the full operational qualification of the products is completed.
• On-line self-registration at: https://senthub.esa.int/
• Technical information on Sentinel missions and users products can be found at: https://sentinel.esa.int/
VIDEO AT

http://www.esa.int/spaceinvideo/Videos/2014/01/Sentinel-1
FREE and OPEN DATASET:

→ For data collections available on-line, i.e. most of ESA EO data:
  - open and free of charge
  - user registration done electronically

→ If datasets not (yet) available on-line, i.e. mainly ESA SAR data:
  - user project proposals received by ESA; data provided free of charge but with data quota limit due to processing capacities constraints

Third Party Missions → Data Policy of individual data providers

Copernicus information & data policy established by EU

sentinel-1
sentinel-2
sentinel-3
sentinel-5p
Few numbers:

✓ 1700 participants (all ages !)
✓ 200 high school students and teachers attending the School Lab
✓ 1750 abstracts
✓ 740 oral presentations and 920 posters
✓ 18 hours of web-streamed oral presentations
✓ ... and a lot of beers and whiskies

Programme and all info available at: http://www.livingplanet2013.org/index.asp