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ESA WP-1
Prepared by ESA
Agenda item: C.1

STATUS OF THE ENVISAT AND EARTH EXPLORER MISSIONS

(Submitted by ESA)

Summary and purpose of document

CGMS is informed of the status of the European Space Agency Envisat and Earth Explorers missions.

DISCUSSION

INTRODUCTION

1. The Applications Directorate of the European Space Agency (ESA) is currently running a number of Earth Observation (EO) programmes. T wo of them, MSG and Metop (both in phase C/D) are in co-operation with EUMETSAT. The Envisat programme, which mission objectives and system description were presented at CGMS-XXVII in ESA's Working Paper 1, is well advanced in phase C/D. The Earth Explorer missions are undertaken under the new so-called Envelope Program, a rolling programme designed to underpin European efforts in EO from space.

STATUS OF THE ENVISAT PROGRAMME

2. The programme continued to make good progress coherent with the latest schedule leading to a ***target launch date of June 2001***.

3. All FM instruments are integrated on the satellite. System and functional satellite tests have been executed in the second quarter of 2000 and involved operation of the satellite and payload controlled from the Flight Operation Control Centre at ESOC. The Service Module flight model has undergone successfully the shock tests simulating critical phases of the Ariane-5 launch. Following acoustic and mechanical tests, to be performed over the summer, the satellite will undergo radio frequency compatibility tests towards the end of the year 2000.

4. The Payload data Segment (PDS) has been deployed on the two ESA sites of ESRIN (I) and Kiruna (S) and the acceptance test of this PDS Version 2 was successfully completed end of the first quarter 2000. The in orbit commissioning will be supported by the PDS Version 3, this upgrade is presently under development.

5. The Ground Segment Overall validation and the implementation of the Processing and Archiving Centres are in progress.

6. The teams, which will support the in orbit calibration of the instrument and the validation of the products, have been put in place and are preparing the in orbit commissioning phase.

STATUS OF THE EARTH EXPLORER MISSIONS

Scope of the Earth Explorers

7. The Earth Explorers are space missions tackling critical Earth science issues. There are two types of such missions, subject to different financial limits and programmatic functions i.e.

- **Opportunity Missions, <**80 MEuro designed to be a fast and flexible response to a single critical scientific issue;
- **Core Missions**, < 400 MEuro, a more complex and larger in scope mission, which must tackle a range of fundamental problems of wide community interest whilst remaining well focused. It must be supported by a wide (international) community of scientists.

8. The financial limits only relate to the ESA contribution, but the Envelope Program is designed to encourage international co-operation. In the context of international co-operation, a core mission would be expected normally (but not exclusively) to be led by ESA, with minor contribution from the partner.

9. In the past two years, four missions have been selected for implementation, namely two ***Core*** missions, out of four:

- **GOCE** (Gravity and Ocean Circulation Explorer);
- **ADM-Aeolus** (Doppler Wind Lidar).

and two ***Opportunity*** Missions out of 27:

- **Cryosat** (Polar Ice Monitoring)
- **SMOS** (Soil Moisture and Ocean Salinity)

10. While **ACE** (Atmospheric Climate Experiment) is maintained as a hot stand-by mission to replace either of the above if unforeseen problems were encountered.

11. A new call of ideas for ***Core*** Missions was issued in June 2000, with the deadline of 1 September 2000, for scientists in the ESA Member States and Canada. The research themes were:

- Theme 1: **Earth Interior**
- Theme 2: **Physical Climate**
- Theme 3: **Geosphere/Biosphere**
- Theme 4 : **Atmosphere and Marine Environment**

12. The general selection procedures, including a public consultation workshop (Granada III) will identify up to three missions to go into phase A study. A final selection of an ordered pairs for implementation is expected after 2002 , with launch in 2008 and 2010.

GOCE

13. The aim of the GOCE mission is to provide global and regional models for the Earth's gravity field and for the geoid, its reference equipotential surface, with high spatial resolution and accuracy. Such models will be used in a wide range of research and application areas, including global ocean circulation, physics of the interior of the Earth and leveling systems based on GPS. The mission responds to the requirements put forward by many international scientific programmes such as the WOCE, CLIVAR and GOOS. It is designed for the determination of an accurate description of the ocean dynamic topography and, thereby, the mean ocean circulation, as an essential complement to the precise monitoring of ocean temporal variability already provided by altimetry.

14. The gravity vector cannot be measured directly in orbit, but can be inferred from other observations. The GOCE carries a gravity gradiometer that measures gravity gradients and GNSS (Global Navigation Satellite Systems) receivers for precise satellite position.

15. After conclusion of phase A activities, the preparation of a competitive ITT for the Space segment phase B/C/D/E1 was initiated at the beginning of January 2000, with the aim at starting the contract in October 2000.

ADM

16. The scope of the Atmospheric Dynamics Mission ADM is to demonstrate the possibility of providing observations of 3-D wind fields in clear air thereby helping to correct a major deficiency in the current (meteorological) operational observing network. Such data will be assimilated into NWP models. The mission will also provide data needed to address some of the key concern of the WCRP i.e., quantification of climate variability, validation and improvement of climate models

and process studies relevant to climate change. The data will help as well to accomplish some of the objectives of the GCOS, by contributing directly to the study of the Earth's global energy budget by measuring 3-D wind fields globally in clear air. It will further provide information for the study of the global circulation and relate features such as precipitation systems, the El Niño and the SO phenomena and stratospheric/tropospheric exchange.

17. The main space element of the ADM is the ALADIN instrument i.e., a Doppler wind Lidar intended to provide profiles of the tropospheric wind above or in absence of thick cloud. It also includes a GNSS receiver for position and velocity determination as well as atmospheric temperature profiling.

18. Initially, the instrument will be the subject of two parallel studies including the detailed design of ALADIN and the definition of a pre-development model PDM to validate its overall performance. After the design phase, kicked off in June 2000, one of two contractors will be chosen; the PDM is expected to be completed by mid-2003.

Cryosat

19. The goals of CRYOSAT are to measure fluctuations in marine and land ice mass fluxes within the limit set by natural variability. Predicting future climate and sea level depends on knowledge of such fluctuations, while present observations are deficient in time and space. CRYOSAT and International Programs will provide a decade of focussed study of the roles of the cryosphere.

20. The technical concept consists in adding a synthetic aperture and interferometry to the present altimeters, in order to meet the science requirements of measuring variations in the thickness of perennial sea and land ice fields, on spatial scales varying over three orders of magnitude.

21. The Phase A studies by MMSS (UK) and DSS(D) started February 2000 and were completed end of June 2000. A consolidated design has been achieved.

SMOS

22. In spite of the fact that both Soil Moisture (SM) and Sea Surface Salinity (SSS) are used in predictive atmospheric, oceanographic, and hydrologic models, to date, no capability exists to measure directly and globally these key variables. The main objective of SMOS is to deliver a crucial variable of the land surface: SM as well as SSS fields.

23. Over land, water and energy fluxes at the surface/atmosphere interface are strongly dependent upon Soil Moisture (SM). Evaporation, infiltration and runoff are driven by SM while soil moisture in the vadose zone governs the rate of water uptake by vegetation. Soil moisture is thus a key variable in the hydrologic cycle. For the oceans, Sea Surface Salinity (SSS) plays an important role in the northern Atlantic sub polar area where intrusions with a low salinity influence the deep thermohaline circulation and the meridional heat transport. Variations in salinity also influence the oceans near surface dynamics in the tropics where rainfall modifies the buoyancy of the surface layer and the tropical ocean-atmosphere heat fluxes. SSS fields and their seasonal and interannual variabilities are thus tracers and constraints on the water cycle and on the coupled ocean-atmosphere models.

24. Low frequency microwave measurements (around 1 GHz) offer a unique means to achieve such goals. At such wavelengths, the measured signal is directly related to the brightness temperature of the surface (negligible atmospheric contribution), which in turn, through the emissivity, is directly linked to the dielectric constants of the target (i.e., moisture or salinity). Actually, the sensitivity of brightness temperature to soil moisture and salinity is optimum in the L

band (1.4 GHz). The mission should also deliver information on surface temperature, vegetation and biomass through the multi-angle dual polarisation observations.

25. Currently in phase A, the objective is to establish which is an affordable system by September 2001 in terms of performance within the programmatic constraints.

References

26. Further information about the ENVISAT and Earth Explorers missions can be found on the following WWW addresses which offers the possibility to download many supporting relevant documentation:

http://envisat.estec.esa.nl/
http://www.estec.esa.nl/explorer/