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CURRENT STATUS OF JASON-2 AND PLANNED ACTIVITIES FOR THE JASON-3 PROGRAM In response to CGMS action 37.37

The Ocean Surface Topography Mission (OSTM)/Jason-2 and Jason-3 missions are a joint effort among four organizations: NOAA (National Oceanic and Atmospheric Administration), EUMETSAT (European Organisation for the Exploitation of Meteorological Satellites), CNES (Centre Nationale d'Etudes Spatiales), and NASA (National Aeronautics & Space Administration), to measure sea surface height by using a radar altimeter mounted on a low-earth orbiting satellite. The collection of precise measurements of sea surface height is essential for ocean climatology and ocean weather applications. Ocean climatology includes global sea-level rise, a key indicator of climate change, decadal variability in the ocean, seasonal/inter-annual variability, and coastal variability and its impact on ecosystems. Ocean weather involves operational oceanography, surface wave forecasting and evaluation, and hurricane intensity forecasting.

Research satellites, TOPEX/Poseidon and Jason-1, have been instrumental in providing sea surface height measurements necessary for ocean modelling, forecasting El Niño/La Niña events, and hurricane intensity prediction. The currently operational satellite OSTM/Jason-2 launched in June 2008 maintains data measurements continuity.

The Jason-3 mission will ensure the continuity of the 20 plus year data record. Jason-3 is a joint U.S. and European mission. The current launch readiness date of Jason-3 is 2014.

This paper presents the operational Jason-2 mission status and an overview of NOAA activities performed to support the Jason-2 mission and plans for the Jason-3 mission.

CURRENT STATUS OF JASON-2 AND ACTIVITIES FOR THE JASON-3 PROGRAM

1 INTRODUCTION

The OSTM/Jason-2 and Jason-3 missions are a joint collaboration among four organizations: National Oceanic and Atmospheric Administration (NOAA), National Aeronautics & Space Administration/Jet Propulsion Laboratory (NASA/JPL), Centre Nationale d'Etudes Spatiales (CNES) and European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT). This mission was established through a Memorandum of Understanding (MOU) among the partners.

The Jason-2 satellite was launched in June 2008, with a design lifetime of three years and an extended lifetime of two additional years.

The development activities for the Jason-3 mission are already underway. Its mission orbit is follows the same ground track as the Jason-2 orbit but will have an over-flight time separation of 1 to 10 minutes. The Jason-3 and Jason-2 missions will observe, for all intended and practical purposes, the same atmospheric column and sea surface. The overlap period will be used to conduct initial cross-calibration and validation activities, complete on-orbit check-out operations, and to maintain consistent observations of sea surface height between the successive altimeter missions. The Jason-3 mission will ensure the continuity of the 20 plus year sea surface height data record.

2 The Missions

The OSTM/Jason-2 mission provides service continuity for the predecessor research missions TOPEX/Poseidon and Jason-1. The Jason-2 instruments collect sea surface height measurements as well measurement of significant wave height and wind speed at ocean surface using a satellite mounted radar altimeter.

For NOAA, the Jason-2 system implementation leverages and augments the existing NOAA operational polar satellite ground segment.

Jason-3 will continue to provide the data continuity. Jason-3 will have a similar instrument suite and the same orbital characteristics as OSTM/Jason-2. The Jason-2 ground system will be upgraded to support dual Jason-2 and Jason-3 operations.

2.1 Background

Between 1992 and 2004, NASA/JPL and CNES tracked global ocean surface topography with TOPEX/Poseidon. TOPEX/Poseidon was joined in 2001 by Jason-1, and is still operational today after nearly 10 years on orbit.

The successes of the TOPEX/Poseidon, Jason-1, and OSTM/Jason-2 satellites have demonstrated that radar altimetry plays an important role in oceanographic studies. NOAA's participation in OSTM/Jason-2 and Jason-3 is based on its overall need for the mission data and its desire to leverage investments made in ground systems required by NOAA's operational satellite systems.

The sea surface height measurements are used for Ocean Climatology and Ocean Weather applications, as described below.

1.1.1 Ocean Climatology

Global sea-level rise - A fundamental indicator of climate change. Altimeter time series of several decades will be needed to distinguish signals related to manmade warming from those related to natural variability, as well as to clarify whether the rate of sea-level rise is accelerating.

Decadal variability in the ocean - Has an impact on fishery regime changes, and correlates with droughts on land and changes in hurricane activity.

Seasonal/inter-annual variability - On seasonal to inter-annual timescales, ocean-atmosphere interactions in the tropical Pacific, the El Niño / Southern Oscillation phenomena, currently provide much of the signal for seasonal forecasts.

Coastal variability & its impact on ecosystems - Provide observations for modelling the ocean basin and the broader coastal area. Coastal forecasting is needed in responding to environmental problems such as oil spills and harmful algae blooms, as well as forecasting tides and currents important to commercial shipping.

1.1.2 Ocean Weather

Operational Oceanography - Altimetry provides inputs to operational integrative services based on global and regional ocean models that provide real-time and prognostic information on the state of the global ocean. This capability helps users understand and monitor the world's marine environment and facilitate a safe, non-polluting and sustainable human exploitation of the ocean environment.

Surface wave forecasting & evaluation - Accurate surface wave forecasts are a major requirement for offshore operators (e.g., oil rig operations, fishing fleets, sailing). Over the last decade altimeter-derived significant wave height data have been critical for improvements in wave prediction systems.

Hurricane intensity forecasting - The knowledge of the upper ocean heat content (OHC) is a critical factor in forecasting the intensity of hurricanes as they approach the U.S. east and Gulf coasts where high OHC varies with the position of large warm-core ocean eddies.

2.2 OSTM/Jason-2 System Overview

The Jason-2 System is comprised of the Jason-2 Satellite and Ground System. The ground system consists of NOAA, NASA, EUMETSAT, and CNES ground segments.

1.1.3 OSTM/Jason-2 Satellite and Mission

The OSTM/Jason-2 ground segment consists of satellite command & control and near real-time data activities since its June 2008 launch. The OSTM space segment, the Jason-2 satellite consists of the satellite-bus, the payload module, and the payload instruments. CNES provides the satellite-bus (the PROTEUS platform) and the payload module. CNES and NASA jointly provide the payload instruments. Jason-2 has a required mission life of three years with a design life goal of five years. It is in an orbit with 66 degrees inclination, with apogee of 1,380 km and perigee of 1,328 km. Its orbital period is 112 minutes which provides for a repeat cycle of 9.9156 days. This June, 2011, Jason-2 achieved a major milestone. Jason-2 satellite mission met its 3 years required design life.

The Jason-2 spacecraft core instruments are presented in Table 1.

Type	Instrument	Description
Core Mission	Poseidon-3 Radar Altimeter	This is the mission’s main instrument. It measures sea-level height, wave height, and wind speed.
	Advance Microwave Radiometer (AMR)	The AMR measures <i>water vapor</i> content in the atmosphere. It is used to correct for delays in the <i>radar</i> signal propagation due to atmospheric water vapor content.
Location System	Doris Tracking Receiver	This receiver locates the on orbit satellite in real time, information essential for providing <i>altimetry</i> data in near real time or offline.
	Laser Reflector Array (LRA)	The LRA is a totally passive reflector designed to reflect laser pulses back to their point of origin on Earth, allowing the OSTM spacecraft to be tracked with centimeter accuracy by 40 satellite laser ranging stations.
	GPS Payload receiver (GPSP)	This tracking system uses the GPS constellation of satellites to determine the exact position of a transmitter. It also provides backup precise orbit determination.

Table 1. Jason-2 Core Instrumentation

1.1.4 OTMS/Jason-2 Ground System, Data Processing, and Distribution

The Jason-2 Ground System for the OSTM is made up of NOAA, NASA, CNES, and EUMETSAT ground segments. The NOAA Satellite Operations Control Center (SOCC) is the primary mission operations center. NOAA operates and controls the Jason-2 satellite with support from CNES and NASA/JPL for mission planning, satellite, and instrument monitoring. NOAA schedules and conducts satellite operations through the NOAA Command & Data Acquisition Stations (CDASs) at Wallops and Fairbanks and remotely through the Usingen Earth Terminal (ET) for satellite telemetry collection and commanding.

NOAA and EUMETSAT receive and store the satellite telemetry and instrument data at their respective ground stations (CDASs, ET), process the near-real-time (NRT) science data and

products, and make them available to the four partners and science users. EUMETSAT and NOAA produce and exchange Operational Geophysical Data Records (OGDRs). The OGDRs are made available within 3 to 5 hours of observation.

CNES produces and distributes off-line products: the altimetry science products called Geophysical Data Records (GDRs). The GDR is a fully validated product that uses a precise orbit and the best environmental/geophysical corrections. This product is available per repeat cycle with a latency of 60 days. The GDRs are disseminated to users as they become available, and are ingested in the two mission archives at CNES and NOAA.

1.1.5 OSTM/Jason-2 Operational Performance Status

Jason2 GDRs for 110 cycles have been processed and archived. The archived GDRs are publicly available. Each cycle consists of 254 “pole to pole” passes. A total of 12-14 Jason-2 revolutions (24-48 passes) are taken every day. OGDR production has routinely met the timeliness metrics and the OGDR product quality has been well within the specifications. For the last year The OSTM/Jason-2 there has been no significant loss of data. The core mission instruments, The POS3, DORIS and AMR instrument availability has been 100%, and the DORIS/DIODE onboard orbit performance is excellent. The Ground segment data availability for PLTM1 is about 99.996 % and for PLTM2 it is about 99.4 %.

2.3 Jason-3 Mission and Systems Overview

With a planned launch date in 2014, the Jason-3 mission will ensure the continuity of the 20 plus year sea surface height data record. NOAA and EUMETSAT are the lead agencies for the program. CNES will act as the system coordinator at the technical level, and NASA will support science team activities.

The Jason-2 ground system will be upgraded to support dual Jason-2 and Jason-3 operations.

The accuracy requirements for Jason-3 sea surface height, wind speed, and significant wave height data are identical to OSTM/Jason-2.

Major responsibilities of the organizations are described below:

1.1.6 NOAA Responsibilities:

NOAA will provide the Advanced Microwave Radiometer (AMR) and its antenna, a laser retroreflector array (LRA), and a Global Positioning System Payload (GPSP) receiver package. NOAA will also provide the launch vehicle and launch services. NOAA will be responsible for the operation of the satellite and the generation of near-real-time products from the data collected at the CDASs. NOAA will archive and disseminate all near-real-time and off-line data products

1.1.7 EUMETSAT/CNES Responsibilities:

EUMETSAT and CNES will jointly provide the PROTEUS platform, the Poseidon dual-frequency radar altimeter and antenna, and the Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) receiver package, the payload module and its integration, the command and control center for the satellite, and a second European Earth Terminal (EET) at Usingen. EUMETSAT will be responsible for generation of near-real-time products from the data collected at the EET. CNES will archive and disseminate all near-real-time and off-line data products.

1.1.8 Jason-3 Status

Multiple design reviews have been successfully completed and the development for the instruments has started. The launch vehicle is expected to be selected by the end of 2011. The ground system upgrades have started and initial testing with the partners is expected to start in 2012.

3 CONCLUSIONS

The operational OSTM/Jason-2 mission has demonstrated that a research project can be successfully transitioned to an operational system that provides continuity of data to the international oceanic/scientific community. It has also demonstrated that international cooperation for an operational mission can provide benefits to the entire scientific community. The major benefits derived from the mission data and products are:

- Altimetry assimilation into global and regional ocean models
- Forecasting hurricane intensification
- Hazard monitoring
- Monitoring sea level rise, global climate change
- Monitoring high seas wind and wave conditions

Jason-3 will continue the international cooperation and will extend the continuity of more than 20-years of sea surface height measurements for Ocean Climatology and Ocean Weather.