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

The Ocean Surface Topography Mission (OSTM)/Jason-2 is 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 JPL (Jet Propulsion Laboratory), 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 planned Jason-3 mission will ensure the continuity of the nearly 20-year data record. Jason-3 is planned as a joint U.S. and European mission. The planned launch in 2013 will provide an overlap with the Jason-2 mission of about 6 months. The overlap period will be used to conduct initial cross-calibration and validation activities, complete on-orbit check-out operations, and maintain consistent observations of sea surface height between the successive altimeter missions.

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

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

1 INTRODUCTION

The OSTM/Jason-2 mission is 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.

Planning for the Jason-3 mission is already underway. A Jason-3 launch in 2013 will provide about a six-month overlap with the Jason-2 mission. The overlap period will be used to conduct initial cross-calibration and validation activities, complete on-orbit check-out operations, and maintain consistent observations of sea surface height between the successive altimeter missions. The Jason-3 mission will ensure the continuity of the nearly 20-year data record.

2 THE MISSIONS

The OSTM/Jason-2 mission provides service continuity of predecessor research missions—TOPEX/Poseidon and Jason-1. The Jason-2 instruments collect sea surface height measurements for production of significant wave height, wind speed at ocean surface, and other related parameters using a satellite mounted radar altimeter.

For NOAA, the Jason-2 system implementation primarily entailed leveraging and augmenting the existing NOAA operational polar satellite ground segment.

Jason-3 will also continue to provide the data continuity. Jason-3 will have a similar instrument suite and orbital characteristics. The NOAA Jason-3 system implementation will again leverage and augment the existing NOAA operational polar satellite ground segment.

2.1 Background

Since 1992, NASA/JPL and CNES have been tracking global ocean surface topography with TOPEX/Poseidon. TOPEX/Poseidon was joined in 2001 by Jason-1, which continues to enhance the scientific database.

The successes of both the TOPEX/Poseidon and Jason-1 satellites have demonstrated that radar altimetry data plays an important part in oceanographic studies. NOAA's participation in support of the OSTM 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.

2.1.1 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 anthropogenic warming from those related to natural variability, as well as to clarify whether the rate of sea-level is accelerating.
Decadal variability in the ocean - Has an impact on fishery regime changes, and it 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 Nino / Southern Oscillation phenomena, currently provide much of the signal for seasonal forecasts.
Coastal variability & its impact on ecosystems - Provide observations for modeling 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.

2.1.2 Ocean Weather

Operational Oceanography - Input 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 is quite variable.

2.2 OSTM/Jason-2 System Overview

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

2.2.1 OSTM/Jason-2 Satellite

The OSTM space segment comprises the Jason-2 satellite. The Jason-2 satellite consists of a satellite-bus—the PROTEUS platform and a payload module—provided by CNES, and payload instruments provided jointly by CNES and NASA. Jason-2 has a design life of three 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.

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 heights, and wind speed.
	Advance Microwave Radiometer (AMR)	The AMR measures *water vapor* content in the atmosphere. It is used to determine how water vapor content impacts *radar* signal propagation.
Location System	Doris Tracking Receiver	This receiver locates the on orbit satellite in real time, information essential for providing *altimetry* 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

2.2.2 Ground System, Data Processing, and Distribution

The Jason-2 Ground System for the OSTM is made up of NOAA, 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 and satellite monitoring. NOAA schedules and conducts satellite operations through the NOAA Command & Data Acquisition Stations (CDASs) at Wallops and Fairbanks and remotely through the Usingen 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 partners and users. EUMETSAT and NOAA produce and exchange Operational Geophysical Data Records (OGDRs). OGDRs have been made available within a latency of 3 to 5 hours as specified in the requirements.

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. GDRs are disseminated to users as they become available, as well as ingested in two main archives (at CNES and NOAA).

2.3 Jason-3 Mission

In future (2013) the Jason-3 mission will ensure the continuity of the nearly 20-year data record. Jason-3 is planned as a joint mission with EUMETSAT. The Jason-3 satellite and ground system will be similar to the Jason-2 satellite and ground system.

2.4 Jason-3 Status

Planning for the Jason-3 mission is already underway by the four international partners, with NOAA and EUMETSAT taking the lead for the program. CNES will act as the system coordinator at the technical level, and NASA will support science team activities. Funding to begin development of the Jason-3 mission has already been requested in the FY 2010 budget.

Major responsibilities of the organizations are described below:

2.4.1 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

2.4.2 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 European Earth Terminal (EET). EUMETSAT will be responsible for generation of near-real-time products from the data collected at the EET. EUMETSAT will archive and disseminate all near-real-time and off-line data products.

CNES will prepare research announcements and support selection of European investigators.

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
- Forecasting hurricane intensification

Jason-3 as planned will continue the international cooperation and will extend the continuity of 20-year sea surface height measurements for Ocean Climatology and Ocean Weather.