

Solutions Network Formulation Report

The Potential Contribution of the Ocean Surface Topography Mission to the General NOAA Oil Monitoring Environment

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1. Candidate Solution Constituents

- a. Title: The Potential Contribution of the Ocean Surface Topography Mission to the General NOAA Oil Monitoring Environment
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- c. Identified Partners: NOAA (National Oceanic and Atmospheric Administration) OR&R (Office of Response & Restoration), Hazardous Materials Response Division
- d. Specific DST/DSS: GNOME (General NOAA Oil Monitoring Environment)
- e. Alignment with National Application: Coastal Management, Water Management, Ecological Forecasting, Disaster Management, Public Health, and Homeland Security
- f. NASA Research Results – Table 1:

| Missions | Sensors/Models | Data Product |
|---|----------------------|---|
| OSTM (Ocean Surface Topography Mission) | Poseidon-3 altimeter | Sea surface height, wind speed, wave height, geostrophic velocity vectors |

- g. Benefit to Society: Assists emergency responders in evaluating an oil spill's probable threat to coastlines

2. Abstract

Data collected by the OSTM could be used to provide a solution for the GNOME DST. GNOME, developed by NOAA's Office of Response and Restoration Hazardous Materials Response Division, geospatially models oil spill trajectories using wind, current, river flow, and tidal data. Data collected by the OSTM would supply information about ocean currents and wind speeds. This Candidate Solution is in alignment with the Coastal Management, Water Management, Disaster Management, Public Health, Ecological Forecasting, and Homeland Security National Applications and will benefit society by improving the capabilities of emergency responders who evaluate an oil spill's probable threat.

3. Detailed Description of Candidate Solution

- a. Purpose/Scope

Globally, oil and oil-based products serve both as fuels for operating industrial machinery and transportation vehicles and as ingredients in numerous products, including plastics, nylon, paints, and tires. The United States, on average, consumes over 250 billion gallons of oil and petroleum products each year. The United States both produces and imports large quantities of oil to meet its demands.

Storage tanks hold oil at nearly every point during the production, distribution, and consumption stages.

With so many storage tanks holding such large quantities of oil, accidents happen. In fact, an average of 70 oil spills occurs in the United States every day. Many of these spills involve tanks located away from water bodies. However, oil spills also occur in or nearby fresh- and salt-water bodies. Spill sources include oil extraction platforms and tanker ships (EPA, 2006c).

Unfortunately, it often takes a major accident to raise awareness of oil spills and associated environmental damages. One such accident, the *Exxon Valdez* oil spill of 1989, raised public concern and led to the passage of the OPA (Oil Pollution Act) in 1990 (EPA, 2006a; NOAA, 2006). The Nation improved its prevention and response capabilities by passing the OPA. The legislation created a national Oil Spill Liability Trust Fund that provides up to \$1 billion per oil spill, provides new contingency planning requirements, and increases regulatory noncompliance penalties (EPA, 2006b).

b. Identified Partner

In response to 1990's OPA, the Hazardous Materials Response Division of NOAA's OR&R developed the geospatially based GNOME DST to support oil spill response activities. GNOME assists in the prediction of oil spill movement over time. Winds, waves, tides, density gradients, and deep ocean currents determine the horizontal movement of a given oil slick. GNOME applies available measurements of these data types to make predictions on the movement of the oil slick.

GNOME also predicts the effects of weathering on the oil spill over time. The fate of oil slicks is often determined by physical, chemical, and biological processes, such as spreading, evaporation, emulsification, entrainment, sedimentation, biochemical decay, and coastline or sea ice contact. The GNOME software outputs both GIS shape files and movie files (NASA, 2004a; NOAA, 2006).

GNOME's results are used by both the USCG (U.S. Coast Guard) and the EPA (Environmental Protection Agency) when responding to an oil spill. The USCG is responsible for accidents occurring along the Nation's coastline, while the EPA responds to spills occurring in the Nation's interior (EPA, 2006d).

c. NASA Earth-science Research Results

The planned OSTM is identified as a potential source of both wind speed and current data for input into GNOME. Scheduled for launch in 2008, the OSTM will extend ocean surface topography beyond the earlier TOPEX/Poseidon and Jason missions. As a collaboration between NASA, NOAA, the French Space Agency (CNES), and the EUMETSAT (European Organization for the Exploitation of Meteorological Satellites), OSTM's science objectives include improving open ocean tide models, measuring global sea-level change, and measuring time-averaged ocean circulation. OSTM should provide at least 3 years of data, which would allow the determination of ocean circulation variability at decadal time scales via the addition of OSTM data to data collected previously by the TOPEX/Poseidon and Jason missions.

OSTM will be launched into the same orbit as Jason: a circular, non-sun-synchronous orbit. At an altitude of 1336 km and an inclination of 66°, the satellite will offer global coverage between 66°N and 66°S latitude at a temporal resolution of 10 days at an accuracy of ±1 km. The satellite's engineers would like to maintain both a global mean sea level measurement that drifts less than 1 mm/year over OSTM's projected lifespan and the accuracy of the significant wave height to 50 cm or 10 percent of the value (whichever is greater).

OSTM's payload will contain five sensor systems:

1. The CNES-provided Poseidon-3 Altimeter will measure the height above the sea surface;
2. NASA's AMR (Advanced Microwave Radiometer) will measure the total water vapor along the altimeter path, allowing for the correction of pulse delay;
3. Precise orbit determination, satellite tracking, and ionospheric correction data for the altimeter will be provided by CNES' DORIS (Doppler Orbitography and Radiopositioning Integrated by Satellite) tracking antenna;
4. NASA's GPSP (Global Positioning System Payload) receiver will provide precise orbit ephemeris data; and
5. NASA's LRA (Laser Retroreflector Array) will track the satellite, calibrate the satellite's other location systems, and verify altimeter measurements (NASA, 2007).

d. Proposed Configuration's Measurements and Models

This Candidate Solution focuses on determining the potential contribution of the OSTM to GNOME. Use of satellite-derived ocean surface topographic data may improve GNOME's capabilities, which may improve oil spill emergency response.

OR&R personnel do not currently incorporate NASA-derived satellite data when using GNOME. Instead, they use NOAA-produced forecasts related to oceanic winds and ocean circulation. However, OR&R is interested in incorporating NASA-derived data, especially if issues such as data format and continuity are properly addressed (NASA, 2004a).

4. Programmatic and Societal Benefits

This Candidate Solution aligns with several National Applications Elements of the Applied Sciences Program, including Coastal Management, Water Management, Disaster Management, Public Health, and Homeland Security. It also aligns well with the stated focus of the Applied Sciences Program as presented in the *Earth Science 2004 Applications Plan* (NASA, 2004b). This Candidate Solution proposes the integration of NASA Earth science observations into the NOAA GNOME DST to help emergency responders evaluate an oil spill's probable threat to shorelines. Such integration is a significant benefit to society given the important roles of shorelines in providing ecological habitats and recreational areas.

5. References

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