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TOPEX/Poseidon and Jason-1 Formation Flying; Applications of the Tandem Mission Data

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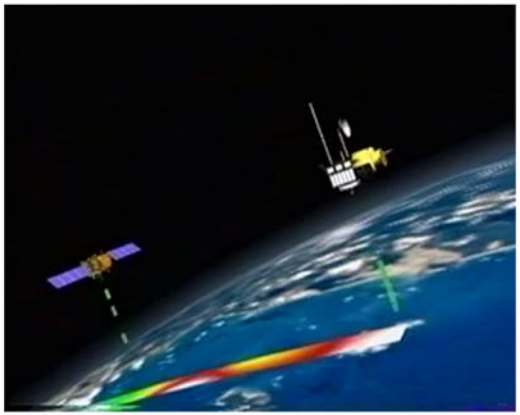


Jason-1 will join a suite of oceanographic satellites in Earth orbit following its planned December 2001 launch from Vandenberg Air Force Base in California. Jason-1 will be positioned along the same groundtrack that TOPEX/Poseidon has faithfully flown for over nine years. During the Jason-1 Assessment Phase (~2 months) and the Calibration/Validation Phase (~6 months), the two satellites will fly over the same spot of the ocean with only one-minute separation. This cal/val phase of the Tandem Mission will allow the Jason-1 measurement to be calibrated relative to TOPEX/Poseidon to minimize any bias between the two data records.

After the Cal/Val Phase, TOPEX/Poseidon will be maneuvered to an interleaved groundtrack, half way between the tracks of its former path. TOPEX/Poseidon will continue collecting data in this new orbital position, thereby increasing the altimetry dataset by a factor of two during this Science/Application Phase of the Tandem Mission. Jason-1 will remain on the original TOPEX/Poseidon groundtrack and assume its role as the primary source of ocean surface topography data for many researchers and operational users.

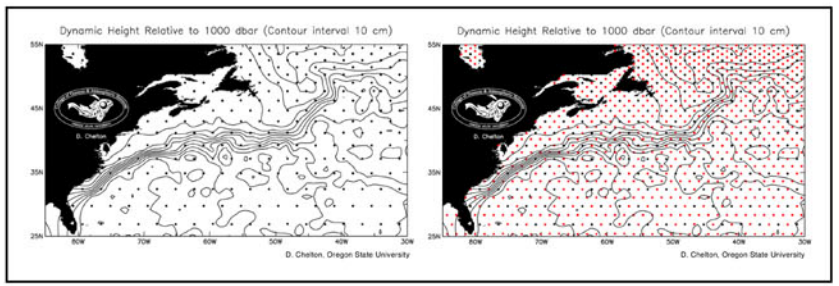
Jason-1 has a primary mission phase of three years, with a projected five year extended life. As long as TOPEX/Poseidon remains operational, this enhanced dual data set from the Tandem Mission will provide an unprecedented opportunity for improved resolution in ocean surface topography mea surement which will lead to many new scientific discoveries and practical applications. These include, but may not be limited to, ocean eddy velocity and interaction with mean currents, Rossby wave dynamics, coastal currents and tides, oceanic internal tides, fisheries management, ship routing, ocean debris tracking, and offshore operations.

Examples of efforts that will benefit from the Tandem Mission

Mesoscale sampling – Most of the kinetic energy of the ocean resides in the mesoscales: temporal scales of 100 days and spatial scales of 100 km, such as the meadering of the Gulf Stream and its eddies and rings. These energetic currents play a profound role in transporting mass, heat, salt, nutrients, and carbon dioxide around the oceans affecting climate, marine ecosystem, as well as human activities at sea. However, these currents have not been observed properly by TOPEX/Poseidon owing to the rather wide spacing between the ground tracks (left panel).

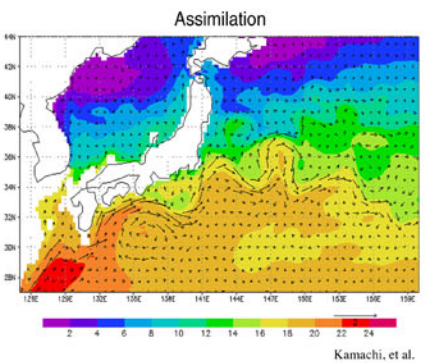
During the Science/Application Phase of the Tandem Mission, the combined ground tracks from the two satellites will double the spatial resolution (right panel). The number of points where the two ground tracks intersect, called crossover points, will even be quadrupled. Ocean surface velocity vectors can be determined only at these crossover points. The quadrupling of these points will go a long way towards improving the understanding of the dynamics of the Gulf Stream and its eddy shedding process.

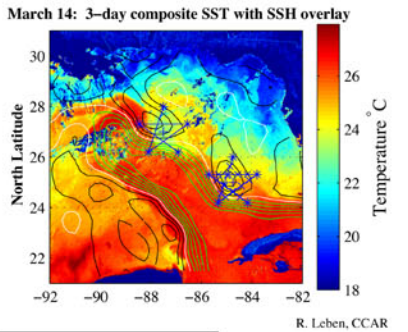
Mesoscale information is also important in providing the initial conditions for weather systems that affect large populations. An example of this was the "Storm of the Century" in 1993, a strong winter storm that affected the entire east coast after forming by winter cyclogenesis over a warm eddy in the northwestern corner of the Gulf of Mexico. The importance of this information has prompted the design of a proposed deep-water array in the Gulf of Mexico to take advantage of the tandem mission orbit, which is remarkable given the reluctance of observational oceano-graphers to change anything based on a satellite that isn't already on orbit. The tandem sampling will also help the monitoring of the cyclonic eddies on the periphery of the Loop Current, which are important biological habitat and are difficult to observe with satellite ocean color and temperature alone.



Marine industrial operators – Marine operators using TOPEX/Poseidon data in the Gulf of Mexico and other high-traffic marine regions find that using TOPEX/Poseidon data alone, eddy locations can be off by as much as 20 to 30 km (based on comparison to in situ data). For ships at sea and offshore drilling operations, uncertainties of that scale mean that eddy fronts cannot be adequately tracked to ensure the optimization and safety of their operations. The Tandem Mission will provide more accurate position and size information of eddies to enhance the safety and efficiency of offshore operations.

Near Real-Time data users – The Tandem Mission will aid users of near real-time data to more accurately monitor mesoscale ocean circulation. The fine-scale structures of currents and eddies are important to many processes including support of biological habitat and production, initialization of air-sea interactions, and in mixing and transport of tracers and pollutants in the ocean environment. Leben, R., Born, G., Colorado Center for Astrodynamics Research, University of Colorado





Japan Meteorological Agency – Ocean conditions in the western North Pacific are important to ship navigation, optimizing fishery yields, and enhancing coastal safety. The skills of model simulation with data assimilation will be improved during the Tandem Mission with enhanced resolution of smaller-scale variability. With T/P data alone, only 50% of the true signals in the middle of the data void regions can be reconstructed. With the expected data from the Tandem Mission, 90 % of the true signals are expected to be reconstructed. Recent numerical studies indicate that small-scale variabilities contribute to Kuroshio current variability. The Tandem Mission will provide a powerful dataset for answering questions about this variability in the Kuroshio current. Kamachi, M., T. Kuragano, N. Yoshioka, J. Zhu and F. Uboldi (2001), Ocean data assimilation of satellite altimetry and predictability in the western North Pacific. Adv. in Atm. Phys., 18, 767-786.

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