WITTEX-Wide: Synergy between WITTEX and a Wide-Swath Ocean Altimeter
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Background. The Jet Propulsion Laboratory has been promoting a wide-swath concept [JPL] aimed at extending ocean altimetry beyond the confines of a single nadir-looking instrument. The Johns Hopkins University Applied Physics Laboratory has been promoting a three-satellite altimeter concept known as WITTEX [APL], intended primarily to measure in near-real time the cross-track and the along-track components of the surface gradient. Given the limited resources available to mount any new satellite altimetry mission, it would be constructive to combine these two approaches to realize a system that would be more capable than either one alone.

Concept. WITTEX-Wide would be a constellation of three co-planar radar satellites [APL], except that the center satellite (DD2-WS) would be a wide-swath altimeter [JPL] rather than just a nadir-sensing instrument. The JPL concept sweeps out a swath of approximately ∀100-km from a TOPEX-class orbit. From the same orbit, two co-planar altimeters (DD1 and DD3 in the WITTEX plan [APL]), one leading and one trailing DD2-WS, would create parallel tracks to each side of the swath’s center line. If DD1 and DD3 were separated from DD2-WS by about 1200 km along their orbit, the resulting cross-track nadir spacings would be about 75 km at the equator. The set of three satellites in such a WITTEX-Wide constellation would pass each observation neighborhood within five minutes of each other.

Aside. Although appealing in principle, a wide-swath altimeter has several disadvantages that have to be overcome before it might live up to its promise. These disadvantages include: (i) a large sensitivity to errors in satellite roll knowledge, (ii) dependence on models rather than direct measurements to correct for wet atmosphere delays in the off-nadir channels, (iii) a time-delay of many days before cross-track and along-track height measurements can be reconciled, and (iv) a necessity to develop and qualify new analysis algorithms. The main disadvantage of the original WITTEX concept is that it is able to gather data only along the sub-satellite tracks, leaving the spaces between their respective nadirs unobserved.

Benefits. WITTEX-Wide defeats all of these disadvantages. Pulse-limited nadir height measurements from the “outrigger” altimeters DD1 and DD3 provide continuous and precise data that can be used as reference profiles to remove roll errors and wet atmosphere path delay errors from the wide-swath off-nadir measurements. With continuous correction of the height measurements from the outriggers, two-dimensional near-real-time precision altimetry across a ~200-km wide swath becomes feasible. This enables the wide-swath altimeter data to be applied to local short-term phenomena on a variety of scales, a totally new capability. Further, insertion of the DD1 and DD3 nadir height data removes the primary dependence of a wide-swath altimeter on new and unproven algorithms.

Vision. Assume that a wide-swath altimeter will fly on Jason-2, although neither the approval nor the launch date of Jason-2 is assured. WITTEX-Wide could be realized by two WITTEX-like altimeters flown in the same TOPEX-Jason orbit. These altimeters could be launched during the mission of Jason-1, then switched over to work with Jason-2 when available. This approach would serve to fill the gap in altimeter data now anticipated at the end of Jason-1, would provide an in-orbit operational capability for the first time, and would lay the foundation for a major leap forward in satellite radar altimetry.

References