Zhongxiang
Zhao
Applied Physics Laboratory, University of Washington
James Girton, Applied Physics Laboratory, University of Washington
Matthew Alford, Applied Physics Laboratory, University of Washington
Poster
Internal tides are internal gravity waves of tidal frequency originating from barotropic tidal flow over rough seafloor bathymetry. Globally, about 1 TW of power is input into internal tides, most of which is transported far away from generation sites as low-mode internal tides (with 50–200 km wavelength). Their ultimate breaking provides about half of the mechanical energy required for deep ocean mixing, with important implications for large-scale ocean circulation and heat transport.

Satellite altimetry offers a revolutionary observational tool for internal tides by detecting their centimeter-scale displacements in sea-surface height (SSH). However, the task is challenging because: (1) In general, any given location can contain multiple internal tides propagating in different directions (forming a complex interference pattern). (2) Internal tides have multiple baroclinic modes (with different wavelengths and vertical structures) in the continuously stratified oceans. (3) Broad-band mesoscale motions contain significant energy at the tidal aliasing frequencies, adding uncertainties to internal tide estimates. (4) Internal tides lose coherence as they propagate through the time-varying mesoscale fields, whereas satellite altimeters can only observe the coherent (tidally phase-locked) components. (5) Internal tides and their interference patterns have short wavelengths compared to the wide inter-track spacing of satellite altimeters.

Some of these issues have been addressed in our recent work: (1) We have evolved a plane-wave fit technique to separately resolve internal tides traveling in multiple directions. (2) We have separated mode-1 and -2 internal tides using different band-pass filters. (3) We have improved spatial resolution by using the merged SSH data from multi-satellite altimetry (TOPEX/Poseidon, Jason-1/2, Geosat Follow-On, ERS-1/2, and Envisat). Here we present our latest global maps of mode-1 M2 internal tides, which reveal a number of strong generation sites and well-defined internal tidal beams traveling over 3000 km. We also discuss planned future improvements. Our results may provide constraints and guidance to numerical model simulations. In particular, the removal of internal tide signals from altimetric SSH estimates has the potential to benefit the study of other mesoscale and submesoscale processes.

OSTS session
Science Results from Satellite Altimetry