A Look at Oceanic Internal Waves With TerraSAR-X Along-Track InSAR

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TerraSAR-X ATI Images of Internal Waves

Dongsha (South China Sea), full scene = 30 km × 180 km, shown scene = 29 km × 89 km

2010-04-22 22:14 UTC   2010-05-03 22:14 UTC
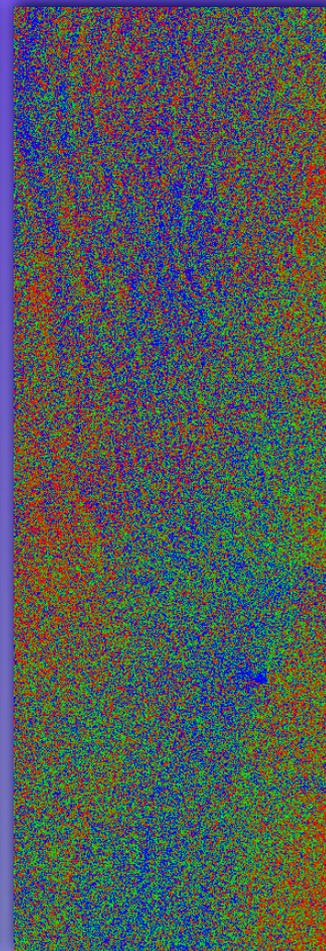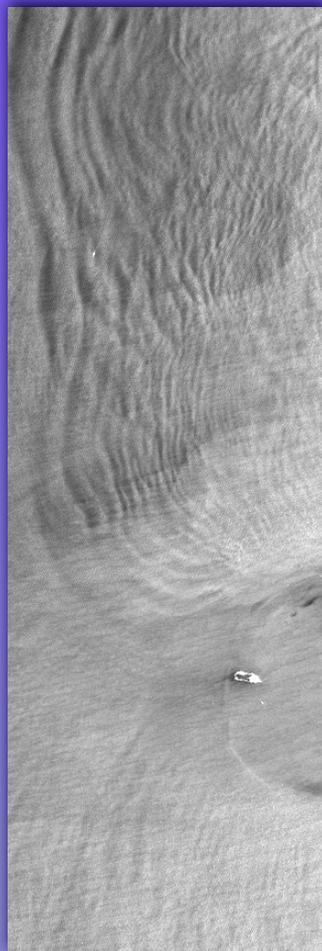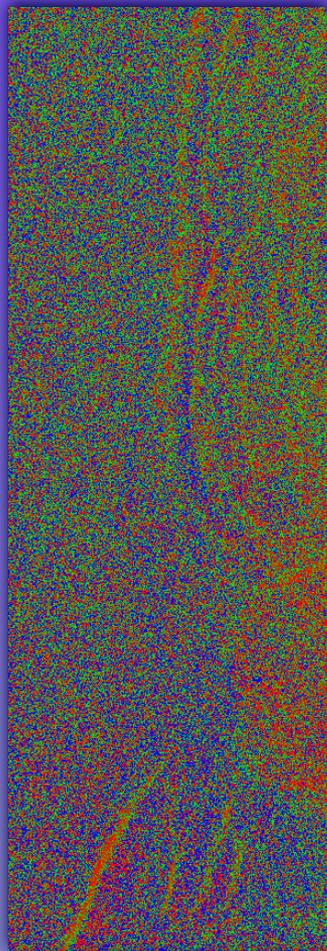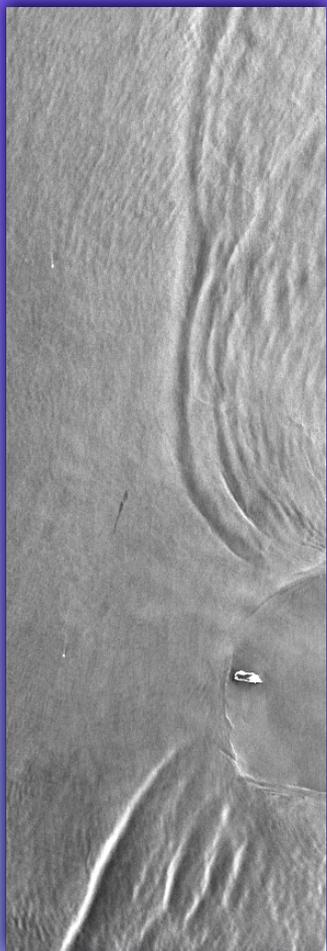
- DRA Mode
- Baseline = 1.2 m
- θ = 31°
- Sensitivity = 1.9° per 1 m/s
- Full-res pixel size = 1.69 m × 2.05 m
- Array size = 12 GB (18,000 × 88,000)
- Here reduced to 100 m × 100 m (averaged over 60 × 50 pixels)
- HH polarization

10 dB Range Intensity   −1.5°   +1.5°
                                      Phase

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Enhancement of Internal Wave Signatures
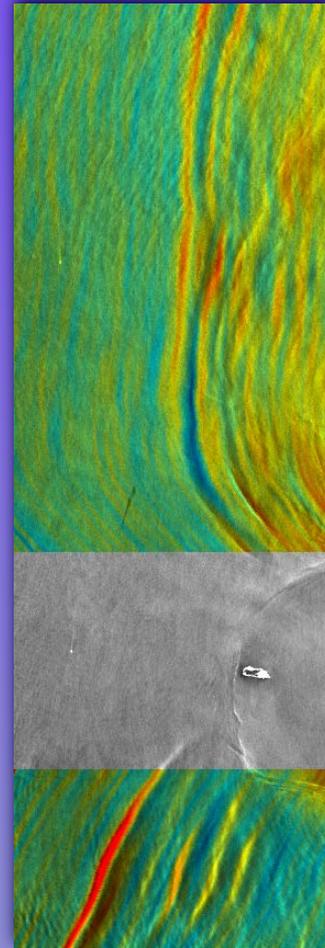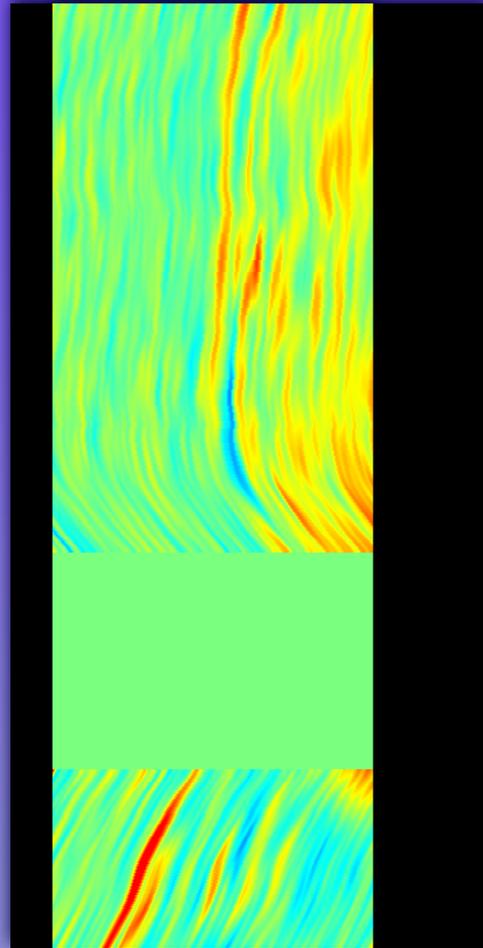
- Straighten
- Smooth
- Convert
- Unstraighten
- Combine

- Phase signatures well correlated with intensity signatures

10 dB Range
Intensity

−0.5 m/s   +0.5 m/s
Doppler Velocity

CSTARS
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ADVANCED REMOTE SENSING

RSMAS

DEPARTMENT OF THE NAVY
ONR
Science & Technology

Quantitative Analysis
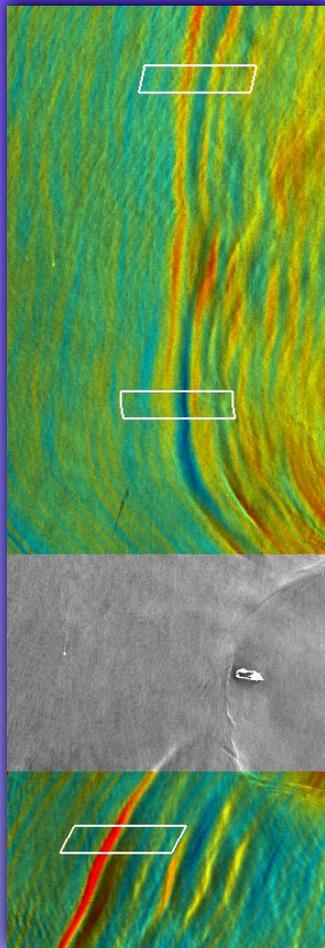
−0.5 m/s   +0.5 m/s

10 dB Range
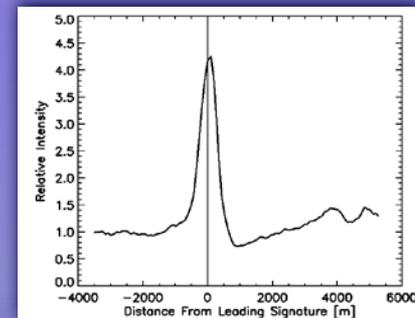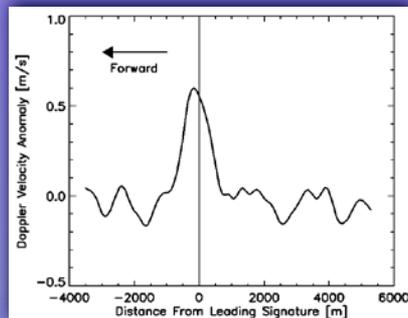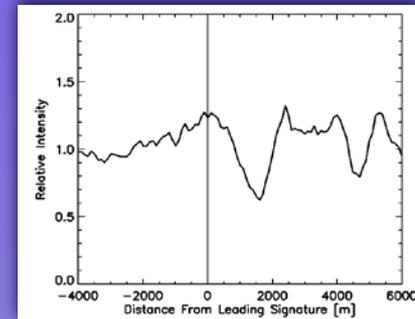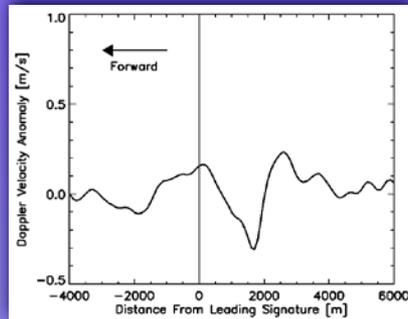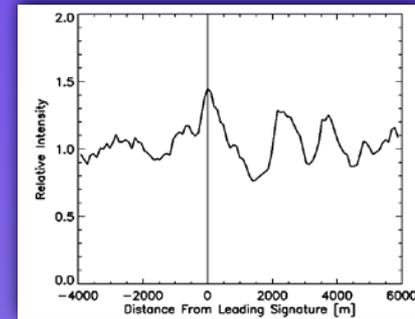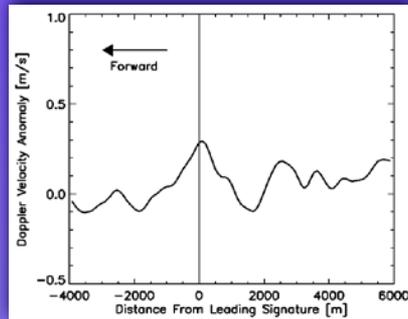
Numerical Modeling of the Signatures

Based on two-layer soliton solutions of the KdV equation, $\delta\rho = 2.5$ kg/m^3

Depth	280 m
Interface depth	100 m
Amplitude	35 m
Wind speed	4.4 m/s
Wind direction	225°
Relax. rate factor	1.000
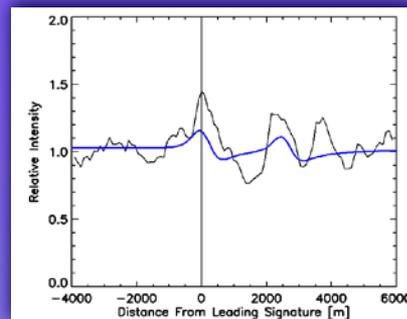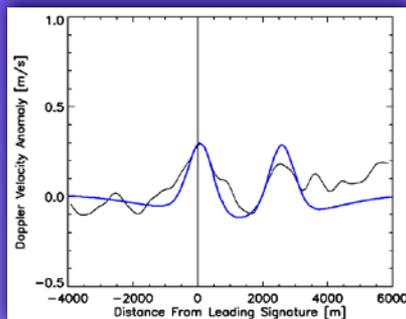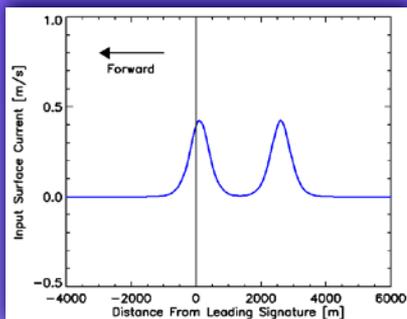
Depth	280 m
Interface depth	100 m
Amplitude	40 m
Wind speed	4.4 m/s
Wind direction	225°
Relax. rate factor	1.000
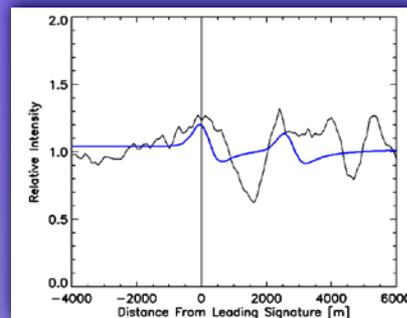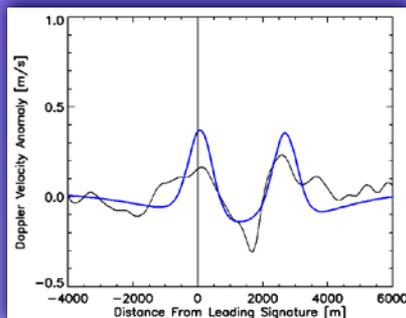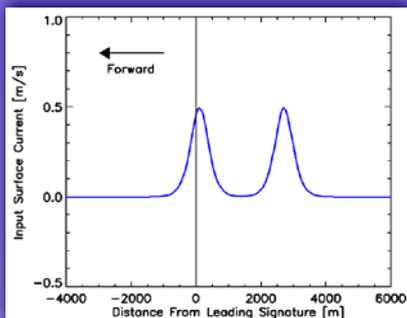
Depth	350 m
Interface depth	100 m
Amplitude	80 m
Wind speed	4.4 m/s
Wind direction	225°
Relax. rate factor	1.000
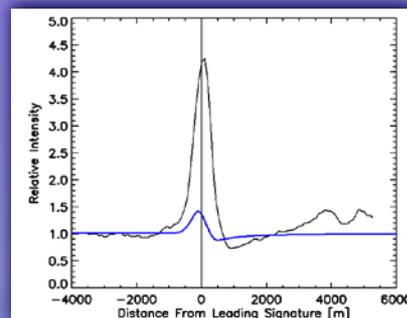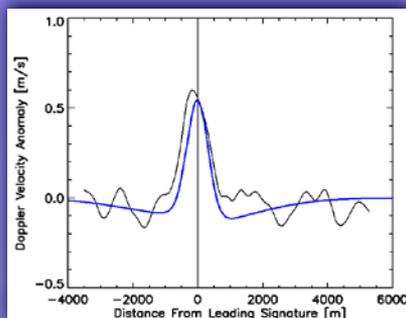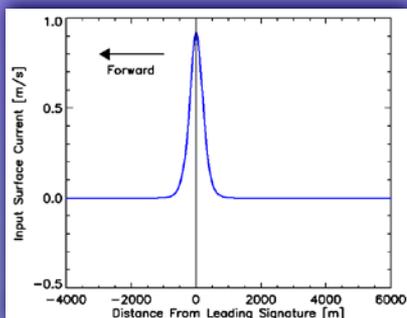
Conclusions and Outlook

- TerraSAR-X along-track interferometry (ATI) can resolve surface current variations over oceanic internal waves

- Numerical ATI model can reproduce observed Doppler velocity signatures with realistic input current fields

- Model tends to underestimate SAR intensity signatures, as usual

- Doppler signatures are much more robust with respect to wind uncertainties and parameterization of wave-current interaction

- Use of ATI will permit more straightforward and more accurate estimates of internal wave parameters and stratification

- Planning to compare results with in-situ data

- Planning to acquire more TerraSAR-X / TanDEM-X ATI images of internal waves through CSTARS

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