On the First Observed Wave-Induced Stress over the Global Ocean

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Introduction

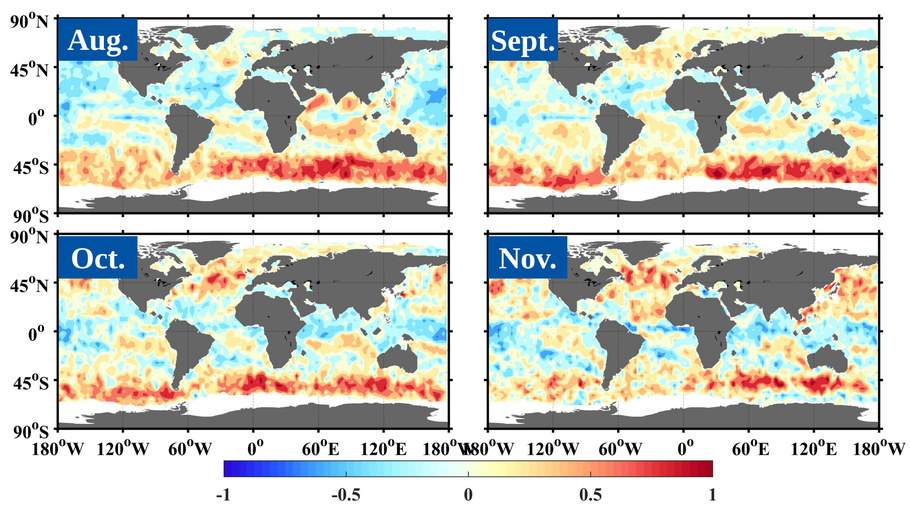
Surface waves modulate the wind stress at the air-sea interface, and the modulation processes can be reflected by the wave-induced stress. The global features of wave-induced stress have never been presented due to the extreme difficulty of observing the wave spectra and wind over the world's ocean simultaneously.

The China France Oceanography Satellite (CFOSAT) is able to simultaneously detect the ocean surface winds and wave spectra under different sea state, which provides us a unique opportunity to evaluate the global surface wave-induced stress, and then the total wind stress. As an example of application of the data from CFOSAT, we here investigate the global property of wave-induced stress for the late summer and autumn.

Results

1. Wave-induced Stress

$$\tau_{wave0}/u_*^2 = \int_0^\infty \frac{C_\beta g k}{c^2} E(k)dk$$

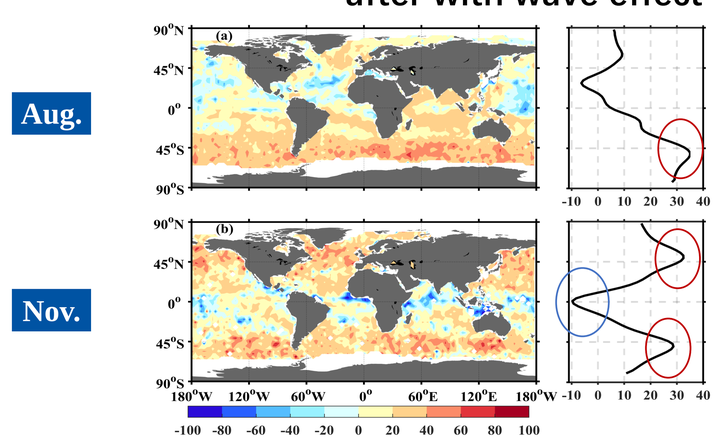


Monthly mean τ_{wave0}/u_*^2 , Factors : wind and wave fields

2. Wind stress

$$\tau = \tau_{turb} + \tau_{wave}$$

Percentage of increase or decrease of wind stress after with wave effect

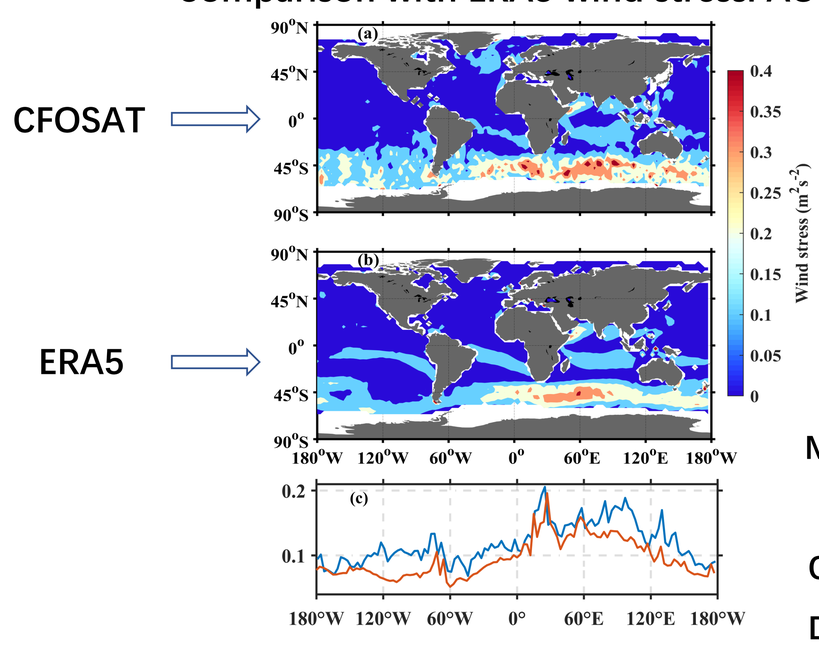


1) + 30% (Wind-sea)

2) - 10% (Swell)

3. Comparison

Comparison with ERA5 wind stress: AUGUST



Meridional mean wind stress

Correlation: 0.85

Difference: ~20%

Conclusions

- For the first time CFOSAT realizes the inversion of the surface wave-induced stress, and then the wind stress.
- The wave-induced stress can increase zonal mean wind stress by more than 30%.
- The temporal and spatial variations of wave-induced stress are closely related to the global wind and wave fields.

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