KELVIN WAVE PROPAGATION ALONG THE CHINESE COAST

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Wind driven circulation events on the continental shelf occur over periods of one week or less. The TOPEX/POSEIDON altimeter measurement scheme aliases these events in time, and a particular event would probably not even be observed by the satellite. However, the T/P data may be used in a statistical manner to correlate the SSH response at a point to the regional wind stress.

This is done by computing the linear time-invariant transfer function (**h**) from the wind stress ($\mathbf{W}(x'_i,t)$) at N_W points to the SSH at each ground track point (**x**):

$$SSH(\mathbf{x},t)=Sum(i=1,N_W)[Sum(j=-T,0)[\mathbf{h}^T(\mathbf{x},t+j,\mathbf{x}'_i)\mathbf{W}(\mathbf{x}'_i,t+j)]]$$

where the temporal influence of the wind forcing (T) is taken to be 48 hours. Wind stress from 1993 through 1996 is obtained from the Navy Operational Global Atmospheric Prediction System (NOGAPS). The transfer function is calculated by first performing an extended empirical orthogonal function (EEOF) decomposition of the regional wind stress and then computing the SSH response to each mode based on the observations from T/P. The first 25 modes (of 1090 total) are used to reconstruct the SSH variations at the temporal resolution of the wind stress field (12 hours), and the short period wind-driven variations are recovered. The SSH response observed in this statistical manner compares favorably with in situ sampling (Figure 1).

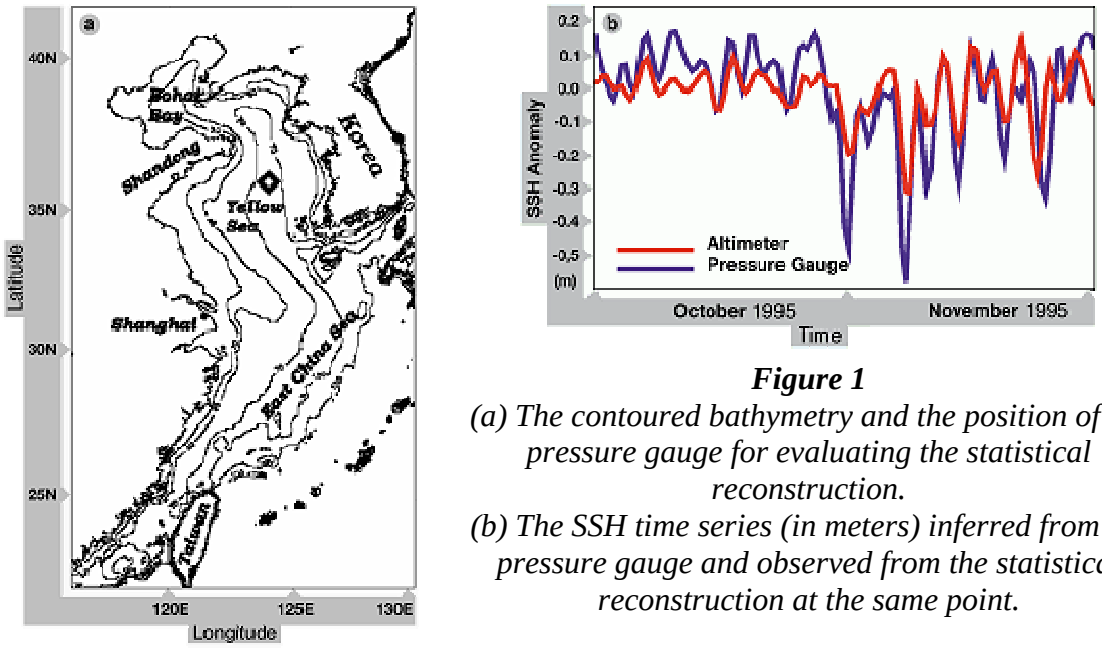

Figure 1

(a) The contoured bathymetry and the position of the pressure gauge for evaluating the statistical reconstruction.

(b) The SSH time series (in meters) inferred from the pressure gauge and observed from the statistical reconstruction at the same point.

Time lags from 36 to 0 hours in 12 hour increments from the 4 years of reconstructed SSH are used in an EEOF analysis to observe the basic processes occurring in the region. The first EEOF mode accounts for 50% of the SSH variability and indicates a standing wave pattern with the northern Yellow Sea and Bohai Bay having an SSH anomaly of opposite sign to the central and East China Seas. This is the SSH setup caused by northerly and southerly wind stresses. The second EEOF mode (Figure 2) accounts for 20% of the total SSH variability and indicates a wave propagating from the Bohai Bay to the Taiwan Strait along the Chinese coast. The propagation speed is about 12 m/s, which is in agreement with a barotropic shallow water wave in 15m depth. This is a Kelvin wave generated in response to the setup in the Bohai Bay. The spatial plots indicate an amplitude of about 5 cm. At any particular time, the spatial plot is multiplied by the modal time series. Typical peaks of 3 in the time series indicate a Kelvin wave amplitude of 15 cm. The currents induced by this amplitude wave are about 12 cm parallel to the coast.

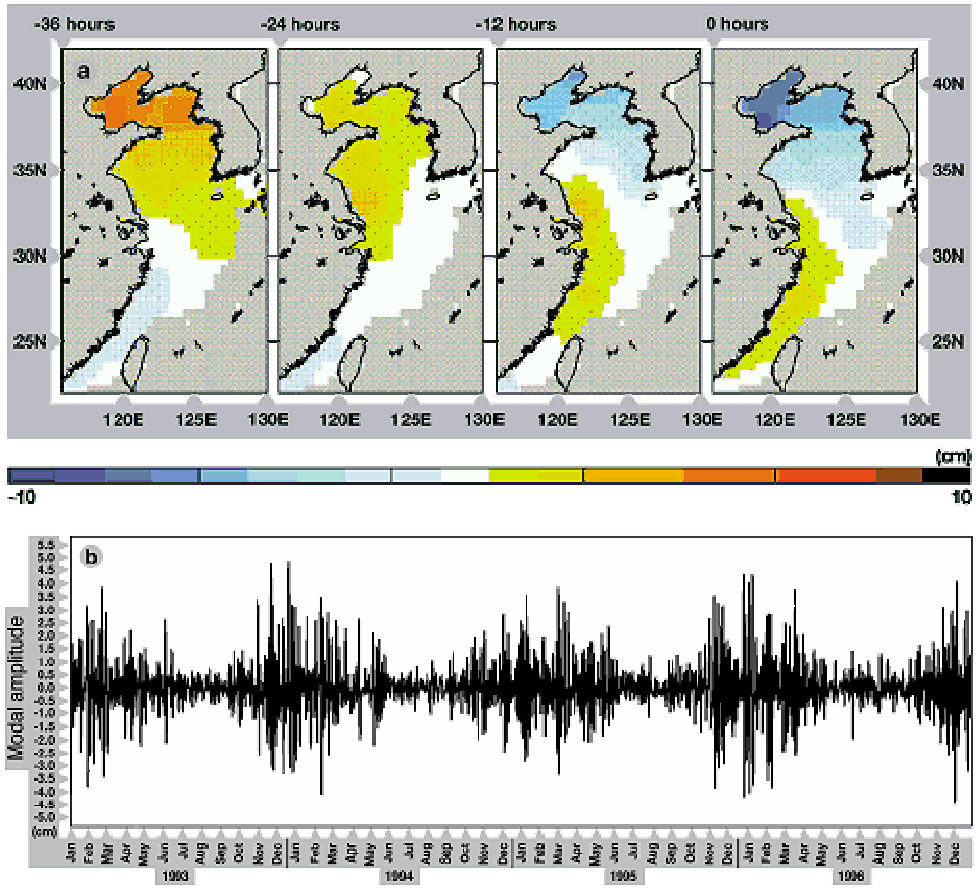

Figure 2

(a) An EEOF analysis of the statistical SSH response (in cm) from 4 years of data (1993-1996). Data over water depths less than 150 m are used in this analysis to observed events only on the continental shelf. The results indicate a positive anomaly in the Bohai Bay and Northern Yellow Sea at the beginning of the event's development (-36 hours Iag). As the event develops (from left to right), the area of positive SSH anomaly propagates southward.

(b) The modal amplitude time series. The modal time series indicates that largest events occur in winter, which is associated with strong wind stress.