DIRECT AND INVERSE CASCADE OF ENERGY, MOMENTUM AND WAVE ACTION IN WIND-DRIVEN SEA

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The time-dependent, spatially uniform Hasselmann kinetic equation for surface gravity waves in presence of wind forcing and white-capping dissipation is studied numerically. We use conventional parametrizations of wind wave generation (Snyder *et al.* 1981; Plant 1982; Hsiao & Shemdin 1983; Donelan, Pierson 1987) that are consistent with weakly nonlinear scaling. Strong dissipation due to white-capping is assumed to be essential for short waves only (with frequencies above 1Hz) and can be neglected in the range near the spectral peak. We compare our numerical results with the predictions given by the theory of weak turbulence and found a very good coincidence. Numerical solutions for the Hasselmann equation have been obtained for different conventional parametrizations of wind forcing and wave dissipation in order to verify the concept of Kolmogorov's weakly nonlinear cascades in spectra of wind waves.

1. First, it is shown that asymptotic behavior of wave spectra is in perfect agreement with stationary solutions of the Hasselmann equation — Kolmogorov's solutions for direct (Zakharov & Filonenko 1966) and inverse (Zakharov & Zaslavskii 1982) cascades. This asymptotic behavior appears at rather early stages of wind wave evolution;

2. We found that quantitative characteristics of spectra (evolution of total energy, mean frequency *etc.*) are susceptible to a choice of the wind forcing term S_{in}. Choosing S_{in} in a form suggested by Hsiao & Shemdin (1983) we obtain a very good coincidence with the results of duration limited observations summarized in the monograph by Young (1999);

3. A strong tendency of solutions to self-similar behavior is found in numerical experiments for rather wide range of initial conditions and external forcing. This is of great interest in view of self-similarity properties of fetch-limited observations that will be reported by Prof.Zakharov in this Workshop.

Present wave prediction models are based on fairly crude parameterizations of the nonlinear energy transfers. In large part due to inaccuracies in these parameterizations, these models have had to rely on empirical fitting of general growth equation as a basis for constraining additional source-sink terms in the detailed balance equations. Results of our study could be used to reformulate a complete energy balance equation for wave generation, propagation and decay, which could lead to substantially improved predictions in the near future.