THEORETICAL INTERPRETATION OF FETCH LIMITED WIND-DRIVEN SEA OBSERVATIONS

V.E. Zakharov[1,2,3]

[1] Waves and Solitons LLC
Phoenix, Arizona, USA
[2] Landau Institute for Theoretical Physics of Russian Academy of Sciences
Moscow, Russia
[3] Department of Mathematics, University of Arizona
Tucson, Arizona, USA

Among field studies of wind-generated surface gravity waves on deep water the case of fetch-limited wave-growth is of special importance. This case is characterized by a constant (in space and time) offshore wind at a normal angle to the straight coastline. Under these idealized conditions the wave field depends on the fetch x only which is defined as a distance from the shoreline.

In the present study we suggest a theoretical explanation of key results obtained in the following experiments on fetch-limited wind-wave growth:

1. Measurements in Nakata Bay by Mitsuyasu *et al.* (1971);
2. The JONSWAP studies by Hasselmann *et al.* (1973);
3. Measurements in the Bothnian Sea by Kahma (1981);
4. Measurements in Lake Ontario by Donelan *et al.* (1985);
5. Measurements off the Nova Scotia coast by Dobson *et al.* (1989);
6. Measurements in Lake St.Clair, Canada, by Donelan *et al.* (1992).

We show that the most observations under limited fetch conditions find a rather simple theoretical framework based on the Hasselmann non-uniform stationary kinetic equation for spectral density of wave action in absence of external forcing and dissipation. In particular, the spatial evolution of spectral peak, at least for moderate values of the fetch, is in a good quantitative agreement with self-similar solution for this equation.

Let us emphasize that the present study is based on the "first principles" and does not include any adjustable parameters. Nevertheless, the model yields results which are not only qualitatively correct but are in a good quantitative agreement with field observations.