

# **Retention Rate of Air-Sea Momentum Exchange in the Wind-Generated Ocean Wave System**

**Paul Hwang, David Wang** , and Shahrddad Sajjadi

One of the most challenging measurements in wind-wave research is the source functions, which are the driving force governing the dynamics of the wind-wave system and determining the quantitative exchanges of air-sea energy and momentum. The dominant source terms for ocean surface waves are wind input, breaking dissipation, and nonlinear wave-wave interaction. In shallow and finite depth water, bathymetric scattering and bottom friction also contribute to the loss of wave energy. These source terms act on the wave field at the same time and are usually difficult to be differentiated. The similarity laws governing the fetch limited and duration limited growth of wind-generated waves can be used to produce estimate the resultant function.

In this presentation, we derive the retention rate of air-sea momentum exchange using the fetch- and duration-growth laws. The dimensionless retention rate follows a square power law dependence on the dimensionless wave frequency, which is equivalent to the inverse wave age. The quadratic dependence of the retention rate is similar to the growth rate function of individual wave components. The result suggests that an actively growing wave field can be represented by its significant wave parameters (variance or significant wave height, and peak or significant wave period). The proportionality coefficients ( $\beta$ ) of the retention rate and growth rate of the two systems are also quite comparable and are in the neighborhood of 15.