Wind stress over water surfaces: Comparisons of various estimation methods

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The wind stress over water surfaces is fundamental in air-sea momentum exchanges including wind-wave and wind-current interactions. Various methods to estimate the wind stress, \( \tau = \rho U^* U^2 \), where \( U^* \) is the friction velocity, are reviewed and compared. It is found that, after the onset of wave breakers when the wind speed at 10m, \( U > 7.5 \text{ m/s} \), a power law between \( U^* \) and \( U \) works the best for marine meteorology and physical oceanography (met-ocean) applications. As shown below, \( U^* = 0.017U^{1.32} \), where the units are m/s.

![Graph showing the relationship between U10 and U* with a power law fit]

\[ y = 0.017x^{1.3213} \]
\[ R^2 = 0.9643 \]
\[ R = 0.98 \]

U10, m/s, based on Hurricanes Inez, Kate, Lili, and Rita

Biography

S A Hsu is Professor of Oceanography and Coastal Sciences (Emeritus), Louisiana State University (LSU) since 1969 after he completed his PhD in Atmospheric Sciences (specializing in the physics of air-sea-land interaction and engineering hydrometeorology), Department of Civil and Environmental Engineering, The University of Texas. He published world-first textbook entitled “Coastal Meteorology” by Academic Press in 1988 and over 120 articles in refereed journals, encyclopedias, and book chapters in the fields of coastal and marine meteorology, air-pollution meteorology, air-sea interaction, and hydro- and engineering meteorology. He is a Certified Consulting Meteorologist (certified by American Meteorological Society in 1979) for numerous corporations and law firms. He is also the Co-Editor-in-Chief for “The Open Ocean Engineering Journal.”

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