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Laboratory Measurement of Heat Transfer and Thermal Structure Near an Air-Water Interface

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ABSTRACT

Experiments have been conducted in a wind-water tunnel to establish a quantitative relationship between wind profile parameters, heat flux through the air-water interface, and the temperature difference across the water thermal boundary layer as observed with an infrared radiometer. Two distinct regimes of boundary layer characteristics were identified which are separated by a transition that coincides with the onset of surface waves. At low wind speeds the boundary layer can be characterized as laminar and a relatively large temperature difference is observed; a surface-active film enhances the temperature difference. At higher wind speeds, when the surface is roughened by waves, the boundary layer appears to become turbulent, resulting in a marked decrease in the temperature difference across the layer. Based on these results, estimates of sea surface, boundary-layer temperature differences agree with the few published field measurements. By using a simple laminar model of the water boundary layer, estimates are made of the variation in layer thickness with wind speed.

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