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Structure of Small-Scale Turbulences at the Free Air-Water Interface

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In this contribution we will present a new approach for analyzing interfacial shear induced turbulence at the free air-water interface. We use an infrared imager sensitive in the spectral range form 3-5 μm for visualizing the water sided turbulence from passive thermography. Due to a heat flux present at the interface, a temperature difference exists between the skin layer and the water bulk below the diffusive sub-layer. Turbulence disrupts the boundary layer, the temperature footprint of which can be seen in the images. Due to the shear at the interface, turbulences are not isotropic but exhibit elongated streaks in wind direction. We will present a novel image processing based approach for classifying and segmenting the streaks. From these segmentation, statistical distributions of streak spacings can be analyzed. As expected, a trend towards smaller streak spacings with increasing friction velocity is evident. Surprisingly, above a certain threshold friction velocity, streak spacings appear to remain constant. Besides small-scale structures, we also examine larger scale coherent structures, which can be associated with Langmuir circulations. We relate our findings to the Langmuir number for a first indication of the production processes of these structures. Results from laboratory and field measurements will be presented.