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Reduction of wind stress due to swell at high wind conditions

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Wind stress over the ocean depends on the sea surface roughness which is determined by the sea state. Underdeveloped wind-seas, rougher than their fully developed counterpart, have been associated with increased drag. The presence of swell can modify wind stress by exchanging momentum with the air flow and by modifying the wind-sea roughness. The former mechanism, important at low wind speeds, increases or reduces the drag depending on the swell relative direction of propagation. The latter mechanism, less studied and poorly understood, is believed to have a greater impact at high winds whenever underdeveloped local waves coexist with swell. Detailed measurements of wind stress and wave field in fetch-limited conditions were made in an area subjected to strong and persistent winds. Through modeling and analysis of the observations it is found that swell reduces the drag at winds as high as 20 ms^{-1}. The reduction of wind stress seems to be caused by a decrease of energy levels on the high frequency part of the wind-sea spectrum.