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A global perspective of the air-sea momentum flux

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Ocean surface waves are generally thought to act as a drag on the boundary layer winds. In this regime the air-sea momentum flux is directed into the waves so that the waves are driven by the wind. Recent observations during conditions of light winds and fast travelling ocean swell have reported upward momentum transfer from the ocean waves to the atmosphere, leading to a wave-driven wind jet.

Here simple models are used to deduce the dynamics of these wave-driven wind jets, which leads to a simple condition for the existence of a wave-driven wind. ERA-40 wave data is then used to calculate the global distribution of air sea interaction to determine whether there are regions of the ocean that are usually in the wind-driven wave regime and others that are predominantly in the wave-driven wind regime. The wind-driven wave regime is found to occur most often in mid-latitude storm tracks where wind speeds are generally high. Upward momentum transfer and wave-driven winds are found to be prevalent in the equatorial east Pacific, where wind speeds are generally light and swell can propagate from storms at higher latitudes. The picture that emerges is of momentum being taken up by ocean waves from the wind in the storm tracks. Some of this momentum is deposited locally into the ocean, driving currents. The remainder propagates away from the storm tracks where some of the momentum is returned to the atmosphere through wave-driven wind jets.