On the variability of the Charnock constant

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A model for the air-sea interface, based on the coupled pair of similarity relations for 'aerodynamically' rough flow in both fluids, is presented, which is applied to fetch-limited and high wind speed conditions such as occur in hurricanes. It is shown that the specification of the maximum 10 m drag coefficient and the 10 m wind speed and the peak wave speed at which it occurs are sufficient to uniquely determine the drag law, which asymptotes at low wind speeds to a Charnock constant similar to that for the fully developed wind wave sea, and is almost independent of the peak wave speed at the maximum in drag coefficient. A feature of the drag law is that it is of Charnock form, almost independent of the wave age, consistent with the transfer of momentum to the wave spectrum being due to the smaller rather than the dominant wavelengths. The analysis is also applied to a variable sea state in which either the surface wind or the surface Stokes drift vary, but the peak wave speed is kept constant. The corresponding variability in the Charnock constant is in general accord with observations.