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A diagram of wind speed versus air-sea temperature difference to understand the dynamics of the marine atmospheric boundary layer off northwest Europe

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Wind speed and atmospheric stability have an important role in determining the turbulence in the marine atmospheric boundary layer (MABL) as well as the surface wave field. The understanding of MABL dynamics in northwest Europe is complicated by fetch effects, the proximity of coastlines, shallow topography, and larger scale circulation patterns (e.g., cold air outbreaks). Numerical models have difficulty simulating the marine atmospheric boundary layer in coastal areas and partially enclosed seas, and this is partly due to spatial resolution problems at land-sea coastline discontinuities. In these offshore environments, the boundary layer processes are often best understood directly from time series measurements from measurement platforms or buoys, in spite of potential difficulties from platform flow distortion as well as the spatial sparseness of the data sets. This contribution presents updated results of measurements from offshore platforms in the North Sea and Norwegian Sea in terms of a summary diagnostic – wind speed versus air-sea temperature difference (U-ΔT) – with important implications for understanding atmospheric boundary layer processes. The U-ΔT diagram was introduced in earlier surveys of data from coastal and offshore sites in northwest Europe to summarize boundary layer conditions at a given location. Additional information from a series of measurement purpose-built offshore measurement and oil/gas production platforms from the North Sea illustrates how the wind characteristics vary spatially over large distances. The results are important for the offshore wind industry because of the way that wind turbines accrue fatigue damage in different conditions of atmospheric stability and wind speed.