EO data to assess rain erosion of wind turbine blades

Hasager, Charlotte; Tilg, Anna-Maria; Badger, Merete; Karagali, Ioanna

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Author(s): Hasager, Charlotte; Tilg, Anna-Maria; Badger, Merete; Karagali, Ioanna

DTU Wind Energy, Roskilde, Denmark

Abstract

Wind turbines operate 24/7 during 25 years to produce electricity for society. Beyond general service, it has recently been necessary to also repair many wind turbine blades due to erosion caused by the impact of precipitation particles, mainly raindrops. The erosion typically starts near the tip and grows along the leading edge of the turbine blade towards the hub. Modern turbines have high tip speeds when operating at full capacity, thus when intense rain occurs during those times, the erosion starts and develops. Turbines with eroded blades produce less electricity as the aerodynamic efficiency is lower. Blade repair mitigates this problem but is very costly and challenging at sea. Thus, there is a need to characterize the precipitation climate at sea for wind turbine operation, blade repair solutions and for planning future wind farms.

Learnings from soil erosion caused by rain, is a good starting point for assessing rain parameters for leading edge erosion at wind turbines. However, important differences are that wind speed is very relevant for wind turbines while e.g. terrain and slope are important for soil erosion.

Our study focuses on rain from the Global Precipitation Mission to prepare a pilot investigation of the co-occurrence of rain and wind over the North Sea and the Atlantic Ocean offshore from Portugal. Our analyses include data from coastal meteorological stations as a proxy for the offshore environment. The rain climatology offshore was investigated by Tait et al. (1999) using SSM/I. Schlünzen and Krell (2004) also focus on the North Sea while Kidd (2001) reports at global scale. Interestingly, Tait et al. (1999) show that there are major differences in yearly rainfall in the North Sea. Kidd (2001) shows variation in the Atlantic between different data sources. Our aim is to utilize Earth Observation data for assessing the rain climate, e.g. from the Global Precipitation Mission, in combination with wind speed information from the Advanced Scatterometer (ASCAT) on MetOp.

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