Effect of Stratocumulus clouds on the Earth's Boundary Layer

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Stratocumulus clouds are the most common type of cloud, as they cover more than 20% of the Earth's surface on annual average (Mellado, 2017; Wood, 2012). As such, they strongly influence the Earth's radiative balance, and thus Earth's climate. However, the effects of these clouds on the Earth's Boundary Layer are not yet fully understood, as it is still a challenge to study their complex physics experimentally or numerically. In this work, we study Stratocumulus-topped Boundary Layers (STBL) using an in-house Large Eddy Simulations (LES) code, with the aim of understanding the effects of these clouds on key properties of the Earth's Boundary Layer, and in order to draw possible scenarios for wind farms performance in STBLs.

First, we show that LES is a suitable tool to study STBLs. To this aim, we compare our results with data from in situ and radar measurements (Stevens et al., 2005; v. d. Dussen et al., 2013). Then, we focus on the convective instability generated by the radiative cooling at the cloud top, studying its effect on the Atmospheric Boundary Layer. And finally, for the first time, we study the influence of clouds physics on the performance of wind farms, demonstrating that there is also a reciprocal interaction.

Overall, this study is a first step towards understanding the effects of Stratocumulus clouds on the Earth's Boundary Layer, and on wind farms in particular. Our results will be useful for the development of new models of Earth's Boundary Layer, and for the optimization of wind farms in STBLs.

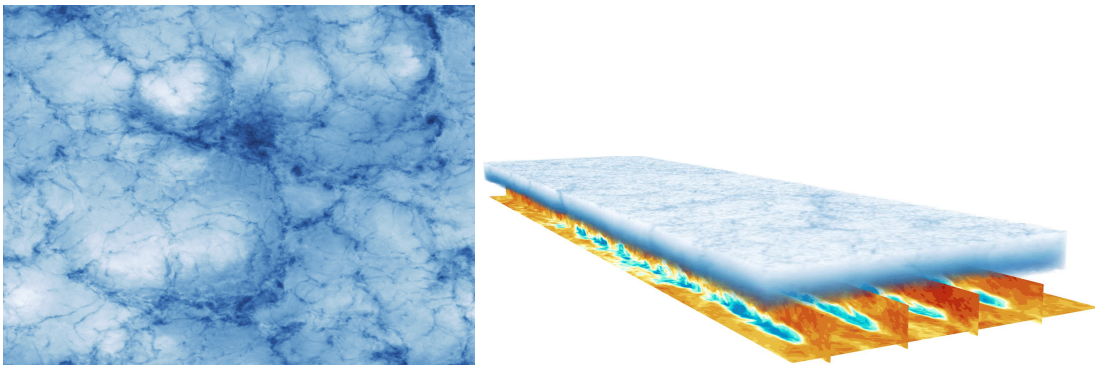

Figure 1: Snapshot of the vertically integrated liquid water humidity in the absence of wind turbines (left); visualisation of the wind farm in a Stratocumulus-topped Boundary Layer (right).

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