Optimizing turbine set-point distribution to mitigate effects of wind-farm induced gravity waves LUCA LANZILAO, JOHAN MEYERS, KU Leuven — Recently, it has been shown that flow blockage in large wind farms can lift up the top of the boundary layer, thereby triggering atmospheric gravity waves in the inversion layer and in the free atmosphere. These waves impose significant pressure gradients in the boundary layer causing detrimental consequences in terms of the farms efficiency. In the current study, we investigate the idea of controlling the wind-farm in order to mitigate the efficiency drop due to wind-farm induced gravity waves. The analysis is performed using a fast boundary layer model which divides the vertical structure of the atmosphere in three layers; the wind-farm drag force is applied over the whole wind-farm area and is directly proportional to the thrust set-point of the wind turbines. We implement an optimization model in order to derive the turbine thrust coefficient distribution that maximizes the wind-farm energy extraction. Interestingly, when the flow is sub-critical the optimal wind turbine thrust set-point assumes a sinusoidal behavior in the streamwise direction while it becomes a U-shaped curve when the flow is super-critical. Time-dependency effects are also investigated.

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