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A new conceptual model for the nocturnal low level jet

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More than 50 years ago, Blackadar introduced his conceptual model for nocturnal inertial oscillations. Since then, it is generally known that the inertial oscillation (IO) is an important mechanism behind the occurrence of low-level wind maxima or low-level jets. Due to the simple and elegant structure of his concept, the Blackadar model is frequently referred to in textbooks for educational purposes to explain the qualitative behaviour of the LLJ. According to this theory nocturnal winds oscillate around the geostrophic wind with a period 2 pi/f ('f' the Coriolis parameter), the amplitude being determined by the a-geostrophic wind component at sunset. As an important consequence the maximum amplitude of the oscillation is predicted at the ground, i.e. where the initial a-geostrophic component is largest. Clearly, this part of the model conflicts with the observed fact that the wind becomes zero at the surface.

In the present study we generalize the Blackadar concept such that this feature is included, while maintaining model simplicity. The new concept predicts dynamic behaviour of the jet that, at least qualitatively, resembles typical observed characteristics (i.e. intensification and lowering of the jet in time at the initial stage). As such the concept could be useful for educational purposes as well. Finally, we illustrate the model by comparison with observed LLJ cases from the Cabauw observatory.