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Impact of wind speed on nighttime temperature increase due to higher atmospheric carbon dioxide

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Long-term surface observations over land have shown temperature increase during the last century, especially during nighttime. Routine synoptic observations show similar long-term trends for calm and windy conditions at night, and therefore earlier studies suggested that the possible effect of urban heat effects on long-term temperature trends are small. On the other hand, physical intuition would suggest that the resultant long-term temperature trends over land should depend on height and strongly on wind speed, mostly due to alterations in the rate of nocturnal cooling in the stable boundary layer. In order to clarify the controversy, in this work we perform a model study by using a validated atmospheric boundary-layer model with elaborated atmospheric physics compared in order to explore the response of the SBL over land to a change in radiative forcing. We find that the screen level temperature response is surprisingly constant for a rather broad range of both geostrophic wind speed and 10 meter wind. This is mostly due to land surface-vegetation-atmosphere feedbacks taken into account in the present study which were not considered by earlier studies.