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Numerical modeling of the wind flow over a transverse dune

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Transverse dunes, which form under unidirectional winds and have fixed profile in the direction perpendicular to the wind, occur on all celestial objects of our solar system where dunes have been detected. Here we perform a numerical study of the average turbulent wind flow over a transverse dune by means of computational fluid dynamics simulations. We find that the length of the zone of recirculating flow at the dune lee — the *separation bubble* — displays a surprisingly strong dependence on the wind shear velocity, u_*: it is nearly independent of u_* for shear velocities within the range between $0.2\,\mathrm{m/s}$ and $0.8\,\mathrm{m/s}$ but increases linearly with u_* for larger shear velocities. Our calculations show that transport in the direction opposite to dune migration within the separation bubble can be sustained if u_* is larger than approximately $0.39\,\mathrm{m/s}$, whereas a larger value of u_* (about $0.49\,\mathrm{m/s}$) is required to initiate this reverse transport.