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The effect of moist convection on density current propagation

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To a first approximation a sea breeze propagating in a dry atmosphere can be viewed as a density current propagating into a warmer fluid and classical density current formulation can be employed to infer its propagation velocity. In this study we investigate the case of a sea breeze propagating in a moist atmosphere and interacting with moist precipitating convection. To that aim sensitivity experiments are performed with a large-eddy simulation model. It is found that the formation of clouds and precipitation significantly affects the propagation of the sea breeze and leads to an acceleration of the breeze front. Classical density current theory fails to represent this acceleration and is here extended to account for the effect of moist convection on the propagation speed. The new theory is found to give good agreement with the large-eddy simulation results. In a second step, the new theory is used to understand differences in sea breeze propagation across models using different resolutions and different treatments of convection (fully explicit, partly explicit and parameterized).