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Formulation of a Lagrangian stochastic model of dispersion in the convective boundary layer with skewed turbulence conditions and vertical density gradient

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The vertical gradient of air density has been included in a skewed probability density function formulation for turbulence in the convective boundary layer and the related drift term for Lagrangian stochastic particle modelling has been obtained based on the well-mixed condition. The formulation has been extended to include unsteady turbulence statistics. Tests were carried out to validate the model including consistency between forward and backward simulations and preservation of well-mixed state with unsteady conditions. The stationary state CBL drift term with density correction was incorporated in the FLEXPART/FLEXPART-WRF Lagrangian models. Currently only the steady state horizontally homogeneous drift term were included. To avoid numerical instability, using the steady homogenous drift in the presence of non-stationary and horizontally non-homogeneous conditions, a re-initialization procedure for particle velocity was used. The criteria for re-initialization and resulting errors were assessed.