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A study of differences between velocity fields generated by planetary boundary layer parameterizations and their effects in atmospheric transport calculations

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The estimation of a wind field from wind data is necessary for numerical modelling of transport and dispersion of pollutants in the atmosphere. In the literature the logarithmic and the power law profiles have been widely used to the date to estimate an initial wind field in the planetary boundary layer [1]-[3], and its use in atmospheric transport calculations [1]. In order to study the reliability and consistency of these profiles, we used data from a stationary and analytic velocity field $\mathbf{v}_s = u_s(x,y)\mathbf{i} + v_s(x,y)\mathbf{j}$ in a region $\Omega = D \times [0,H]$, with $D=[-L, L]$, L = 7 km and H = 300m. The graphs t versus u_s, v_s, confirm that the later have characteristic values of 10m/s in D. The field $\mathbf{v}_s$ was extrapolated vertically by means of the logarithmic and power law profiles, giving three-dimensional fields $\mathbf{v}_{log}(x,y,z)$ and $\mathbf{v}_{pl}(x, y, z)$, respectively. In order to compare these velocity fields, we integrated them to get known the behavior of the instant coordinates $x(t)$, $y(t)$, of a fluid particle, as t increases. The graphs of t v.s. $x_{log}(t)$, $x_{pl}(t)$, give values of x that oscillate between $-L$ and $L \sim 10$km. In despite of the fact both profiles have been widely studied and used, we find that the graphs of t versus x yield as opposite values as $x_{log} \sim -L$ and $x_{pl} \sim L$ in a time of order $t \sim 1.5$ h. Possible causes and effects of these differences are discussed. The results pose the necessity of adjusting the velocity profiles by means suitable data assimilation schemes. The adjustment by means of variational mass consistent models is discussed [4].

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