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Atmos. Chem. Phys., 7, 5003-5019, 2007

[www.atmos-chem-phys.net/7/5003/2007/](http://www.atmos-chem-phys.net/7/5003/2007/)

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## The diurnal evolution of $^{222}\text{Rn}$ and its progeny in the atmospheric boundary layer during the Wangara experiment

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**Abstract.** The diurnal atmospheric boundary layer evolution of the  $^{222}\text{Rn}$  decaying family is studied using a state-of-the-art large-eddy simulation model. In particular, a diurnal cycle observed during the Wangara experiment is successfully simulated together with the effect of diurnal varying turbulent characteristics on radioactive compounds initially in a secular equilibrium. This study allows us to clearly analyze and identify the boundary layer processes driving the behaviour of  $^{222}\text{Rn}$  and its progeny concentrations. An activity disequilibrium is observed in the nocturnal boundary layer due to the proximity of the radon source and the trapping of fresh  $^{222}\text{Rn}$  close to the surface induced by the weak vertical transport. During the morning transition, the secular equilibrium is fast restored by the vigorous turbulent mixing. The evolution of  $^{222}\text{Rn}$  and its progeny concentrations in the unsteady growing convective boundary layer depends on the strength of entrainment events.

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Citation: Vinuesa, J.-F., Basu, S., and Galmarini, S.: The diurnal evolution of  $^{222}\text{Rn}$  and its progeny in the atmospheric boundary layer during the Wangara experiment, Atmos. Chem. Phys., 7, 5003-5019, 2007. [Bibtex](#) [EndNote](#) [Reference Manager](#)

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