Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union










Atmos. Chem. Phys., 7, 5003-5019, 2007
www.atmos-chem-phys.net/7/5003/2007/


# The diurnal evolution of $^{222}$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 $^{222}$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 $^{222}$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 $^{222}$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 $^{222}$Rn and its progeny concentrations in the unsteady growing convective boundary layer depends on the strength of entrainment events.

Final Revised Paper (PDF, 6861 KB) Discussion Paper (ACPD)

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