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Chemistry-clouds interactions over West Africa: the role of moist thermals on the atmospheric oxidation capacity

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In the framework of the EU-funded (FP7) DACCIWA project, this work aims at quantifying the impact of turbulent mixing on the chemical reactivity in the atmospheric boundary-layer (ABL). The Large-Eddy Simulation version of the french model Meso-NH is used which explicitly resolves the turbulent and convective advection terms. The effect of homogeneous emissions representative of biogenic environment and mixing induced by thermals on the redistribution of chemical species is assessed in a convective ABL. Typical dynamic conditions during the monsoon period over coastal West Africa are considered for this study. The chemical reactions are calculated on-line with a detailed chemical scheme describing reactions of ozone and SOA gaseous precursors.
The objective is to estimate the impact of mixing by thermals on the spatial distribution and segregation of chemical reactants and to understand the contrasted oxidizing capacity inside versus outside of the thermals. A reduction of almost half of the reaction rate is obtained due to the segregation of reactive compounds on the top of the boundary-layer compared to unperturbed, non turbulent conditions. A focus is made on the reactivity of OH, whose chemical timescale is much shorter than the turbulent timescale. Additional effects of spatial heterogeneous emissions including anthropogenic emissions and aqueous phase chemistry are discussed.