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

Atmos. Chem. Phys., 6, 5559-5572, 2006
www.atmos-chem-phys.net/6/5559/2006/

Regional lightning NO_x sources during the TROCCINOX experiment

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Abstract. A lightning NO_x (LiNOx) source has been implemented in the deep convection scheme of the Meso-NH mesoscale model following a mass-flux formalism coherent with the transport and scavenging of gases inside the convective scheme. In this approach the vertical transport of NO inside clouds is calculated by the parameterization of deep convective transport, thus eliminating the need for a-priori LiNOx profiles. Once produced inside the convective column, NO molecules are redistributed by updrafts and downdrafts and detrained in the environment when the conditions are favorable. The model was applied to three particular flights during the Tropical Convection, Cirrus and Nitrogen Oxides (TROCCINOX) campaign over the tropical area around Bauru on 3–4 March 2004. The convective activity during the three flights was investigated using brightness temperature at 10.7 μm observed from GOES-12 satellite. The use of a model-to-satellite approach reveals that the simulation appears rather realistic compared to the observations. The diurnal cycle of the simulated brightness temperature, CAPE, number of IC flashes, NO entrainment flux are in phase, with a succession of three marked peaks at 18:00 UTC (15:00 LT). These simulated peaks precede the observed afternoon one by about three hours. Comparison of the simulated NO_x with observations along the flight tracks show that the model reproduces well the observed NO_x levels when the LiNOx source is applied. The budget of entrainment, detrainment and LiNOx convective fluxes shows that the majority of the NO detrained back to the environment comes from lightning source inside the convective columns. Entrainment of NO from the environment and vertical transport from the boundary layer were not significant during the episode. The troposphere is impacted by detrainment fluxes of LiNOx from 4 km altitude to 16 km with maximum values around 14 km altitude. Detrainment fluxes vary between 75 kg(N)/s during nighttime to 400 kg(N)/s at the times of maximun convective activity. Extrapolation of the regional LiNOx source would yield a global LiNOx production around 5.7 Tg(N)/year which is within the current estimates but should not hide the overestimation of the number of flash rates by the model.

Final Revised Paper (PDF, 3224 KB) Discussion Paper (ACPD)

Citation: Mari, C., Chaboureau, J. P., Pinty, J. P., Duron, J., Mascart, P.,

Cammas, J. P., Gheusi, F., Fehr, T., Schlager, H., Roiger, A., Lichtenstein, M., and Stock, P.: Regional lightning NO_x sources during the TROCCINOX experiment, Atmos. Chem. Phys., 6, 5559-5572, 2006. Bibtex EndNote Reference Manager