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Lightning characteristics observed by a VLF/LF lightning detection network (LINET) in Brazil, Australia, Africa and Germany

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Abstract. This paper describes lightning characteristics as obtained in four sets of lightning measurements during recent field campaigns in different parts of the world from mid-latitudes to the tropics by the novel VLF/LF (very low frequency/low frequency) lightning detection network (LINET). The paper gives a general overview on the approach, and a synopsis of the statistical results for the observation periods as a whole and for one special day in each region. The focus is on the characteristics of lightning which can specifically be observed by this system like intra-cloud and cloud-to-ground stroke statistics, vertical distributions of intra-cloud strokes or peak current distributions. Some conclusions regarding lightning produced NO_x are also presented as this was one of the aims of the tropical field campaigns TROCCINOX (Tropical Convection, Cirrus and Nitrogen Oxides Experiment) and TroCCiBras (Tropical Convection and Cirrus Experiment Brazil) in Brazil during January/February 2005, SCOUT-O3 (Stratospheric-Climate Links with Emphasis on the Upper Troposphere and Lower Stratosphere) and TWP-ICE (Tropical Warm Pool-International Cloud Experiment) during November/December 2005 and January/February 2006, respectively, in the Darwin area in N-Australia, and of AMMA (African Monsoon Multidisciplinary Analyses) in W-Africa during June–November 2006.

Regional and temporal characteristics of lightning are found to be dependent on orographic effects (e.g. S-Germany, Brazil, Benin), land-sea breeze circulations (N-Australia) and especially the evolution of the monsoons (Benin, N-Australia). Large intra-seasonal variability in lightning occurrence was found for the Australian monsoon between the strong convection during build-up and break phases and the weak active monsoon phase with only minor lightning activity. Total daily lightning stroke rates can be of comparable intensity in all regions with the heaviest

events found in Germany and N-Australia. The frequency of occurrence of such days was by far the largest in N-Australia. In accordance with radar observed storm structures, the intra-cloud stroke mean emission heights were found distinctly different in Germany (8 km) as compared to the tropics (up to 12 km in N-Australia). The fraction of intra-cloud strokes (compared to all strokes) was found to be relatively high in Brazil and Australia (0.83 and 0.82, respectively) as compared to Benin and Germany (0.64 and 0.69, respectively).

Using stroke peak currents and vertical location information, lightning NO_x (LNO_x) production under defined standard conditions can be compared for the different areas of observation. LNO_x production per standard stroke was found to be most efficient for the N-Australian and S-German thunderstorms whereas the yield from Brazilian and W-African strokes was nearly 40% less. On the other hand, the main NO contribution in Brazil was from intra-cloud (IC) strokes whereas in Benin it was due to cloud-to-ground (CG) components. For the German and Australian strokes both stroke types contributed similar amounts to the total NO outcome.

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