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LINET Lightning Characteristics Observed on 4 Different Continents

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During recent field campaigns DLR operated its six-station VLF/LF lightning detection network LINET in co-operation with the University of Munich and nowcast GmbH as well as local partners in 4 different continents. For TROCCINOX (Tropical convection, cirrus and nitrogen oxides experiment) the network was set in Sao Paulo state in Brazil during Jan/Feb 05, for the tropical EU SCOUT-O3 (Stratospheric-Climate Links with Emphasis on the Upper Troposphere and Lower Stratosphere) and TWP-ICE (Tropical Warm Pool - International Cloud Experiment) campaigns during Nov/Dec 2005 and Jan/Feb 2006, respectively, in the Darwin area in N-Australia, for AMMA (African Monsoon Multidisciplinary Analyses) in Benin/W-Africa during June-Nov 2006 and for measurements in Southern Germany during June-August 2005. Using the same experimental set up in all areas it became possible to compare the lightning characteristics for the different climatic regions and also to assess the relative significance for lightning NOx production.

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 wet monsoon phase with only minor lightning activity. Total daily lightning 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 0.74, respectively) as compared to Benin and Germany (0.67 and 0.69, respectively).

Using stroke peak currents and vertical location information, lightning NOx (LNOx) production under defined standard conditions can be compared for the different areas of observation. LNOx 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 amount to the total NO outcome.