Geophysical Research Abstracts
Vol. 12, EGU2010-1280-1, 2010
EGU General Assembly 2010

Cloud-to-Ground Lightning in Canada: 1999 - 2008

Bob Kochtubajda (1) and William Burrows (1,2)

(1) Environment Canada, Meteorological Service of Canada, Edmonton, Alberta, CANADA (bob.kochtubajda@ec.gc.ca), (2) Environment Canada, Science and Technology Branch, Downsview, Ontario, CANADA

An analysis on 20x20 km grid squares of the temporal and spatial characteristics of approximately 23.5 million cloud-to-ground (CG) lightning flashes detected by the Canadian Lightning Detection Network for the period 1999-2008 was undertaken to advance our knowledge of lightning over Canada. This study has improved our understanding of the regional differences in lightning characteristics, and provided detailed information for use in a variety of operational applications. In this presentation we highlight some of the main findings in terms of flash density, occurrence, polarity, multiplicity, and first-stroke peak current. Regional differences in these characteristics reflect the complex nature and structure of thunderstorms across the country. Lightning activity is seen to be highly influenced by length of season, proximity to cold water bodies, and elevation. The diurnal heating/cooling cycle exerted the main control over lightning occurrences in most land areas, however, storm translation and transient dynamic features complicated the time pattern of lightning production.

The large scale shape and locations of lightning occurrence and flash density patterns originally identified with three years of CG plus cloud flash data (1998-2000) were found to be the same with ten years of CG data. New areas of enhanced lightning occurrence over northwest Ontario and southern Quebec were also identified. These appear to be northward extensions of regions of enhanced lightning from the United States. Average CG flash density did not exceed 3 flash km-2yr-1 anywhere in Canada, and over much of the country it was between 0.5 flash km-2yr-1 and 1.5 flash km-2yr-1. The Canadian maximum average flash density was 2.789 flash km-2 yr-1 in southwest Ontario. Further analysis at a resolution of 1 km2 has provided much detail on local patterns of CG lightning flash density. As expected there was a gradual decrease in the length of the lightning season from southern Canada to northern Canada. However we found significant west-east differences between regions and even within regions, and the Pacific and southern Atlantic coastal regions experienced lightning virtually year round. Lightning occurs approximately 15-30 days per year over much of the interior of the country on the 20x20 km grid squares analyzed here. The greatest average number of days with lightning in western Canada per year occurred in the Alberta foothills near Rocky Mountain House (32.9), and in eastern Canada in extreme southwest Ontario near Harrow (35.9). While the Pacific coastal region has a nearly year-round lightning season, lightning occurs there only about 1-10 days per year on average and the flash density is very low.

The annual mean percentage of positive CG flashes was found to be lowest in eastern Canada and highest in northern Canada. Their monthly variations reflected a strong seasonality across the country, with higher fractions in winter than in summer. Positive CG flashes are generally single-stroke flashes in all regions. The monthly negative CG flash multiplicity is greatest in summer and early fall, varying between 2 and 2.4 strokes per negative flash in all regions. The multiplicity of positive flashes is slightly over 1 stroke per positive flash and shows little variation throughout the year in all regions. The annual variation of median negative and positive first-stroke peak currents reflects a latitudinal dependence over the past decade. The lowest values for each polarity are observed in the areas of southern Canada and the highest values occur in the North. The monthly variation of median peak currents for both negative and positive CG flashes exhibits lower values in the summer than in the winter in all regions.