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THE CANADIAN LIGHTNING RISK DISPLAY

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Abstract

The Meteorological Service of Canada is developing a new risk-based lightning display. The maps and call to action statements in the display will support Canadians in making appropriate personal safety decisions based on the near term risk of lightning. Rather than displaying actual lightning strikes, lightning risk areas will be identified based on the past 20 minutes of lightning activity. The design of the risk areas will reflect, and be consistent with current lightning safety messaging.

1. Introduction

Each year lightning kills approximately 10 Canadians and injures approximately 100 to 150 others. Despite this, lighting is not explicitly mentioned in Meteorological Service of Canada forecasts. Instead the words thundershowers or thunderstorms are used in regular public forecasts. When warnings are issued, they are issued for organized thunderstorms with a focus on phenomena such as tornadoes, hail, damaging wind gusts and heavy downpours.

The Meteorological Service of Canada (MSC) currently provides a public lightning product on its Weatheroffice web site. The current product displays lightning density information. Data is updated hourly at 25 minutes past the hour meaning that information is anywhere from 25 to 85 minutes old by the time that it is initially displayed. Data is displayed on national and regional/provincial scales at a coarse resolution. It is displayed as a single image and is not animated. Feedback from the public has indicated that while this product is able to give users and idea of where lightning has occurred it does not convey information about where lightning is currently occurring and is not suitable for proactive decision making.

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2. Canadian Lightning Risk Display

A risk based lightning display known as the Canadian Lightning Risk Display (CLRD) is currently being developed. This risk based display will support Canadians in making appropriate personal safety decisions based on the real time risk of lighting. Lightning risk areas will be determined based on recent lightning activity. It will not be a forecast of future lightning activity and will not be a real time display of actual lightning strikes. A targeted education and outreach component will accompany the new display. Without this it is unreasonable to expect that simply redesigning the current display will achieve the desired outcome of Canadians making informed decisions with respect to lightning safety.

This display will be based on the 30/30 rule for lightning safety (Holle et al). The first part of the 30/30 rule states that people should take shelter when the time between when a lightning flash is seen and thunder is heard is 30 seconds or less. The second part of the 30/30 rule states that people should remain sheltered for 30 minutes after the last thunder clap has been heard.

Holle et al (2003) has shown that current lightning is a useful predictor of future lightning. On average in North America the next lightning strike will occur within 5 minutes of a previous lightning strike. The average distance of the next strike varies from 5.2 to 8.6 km. This distance is regionally dependent and is also dependent on the type of convective storm causing the

lightning. A 30 second span between lightning being seen and thunder being heard corresponds to the strike being 10 km away from the observer.

CLRD maps will be updated every 10 minutes. Lightning risk areas will be determined by the previous 20 minutes of lightning activity. A two color scheme will be used to distinguish between areas with the highest level of risk and areas with a high level of risk. Areas identified as being the highest level of risk will be colored in red. Areas identified with a high level of risk will be colored in yellow.

- For lightning strikes in the past 5 minutes, a red circle will be plotted with a 10 kilometre radius from the strike. A yellow area will be plotted with a 10 to 20 km radius from the strike.
- For lighting strike in the past 5 to 10 minutes, a red circle will be plotted within a 10 kilometre radius of the strike. A yellow area will be plotted within a 10 to 15 km radius of the strike.
- For lightning strikes within the past 10 to 20 minutes a yellow area of high lightning risk will be plotted within a 10 km radius of the strike. This area corresponds to the second portion of the 30/30 rule which states that persons should remain sheltered for 30 minutes after the last lighting strike. Based on a 10 minute update cycle strikes in this area will be 20 to 30 minutes old by the time the next panel is updated.

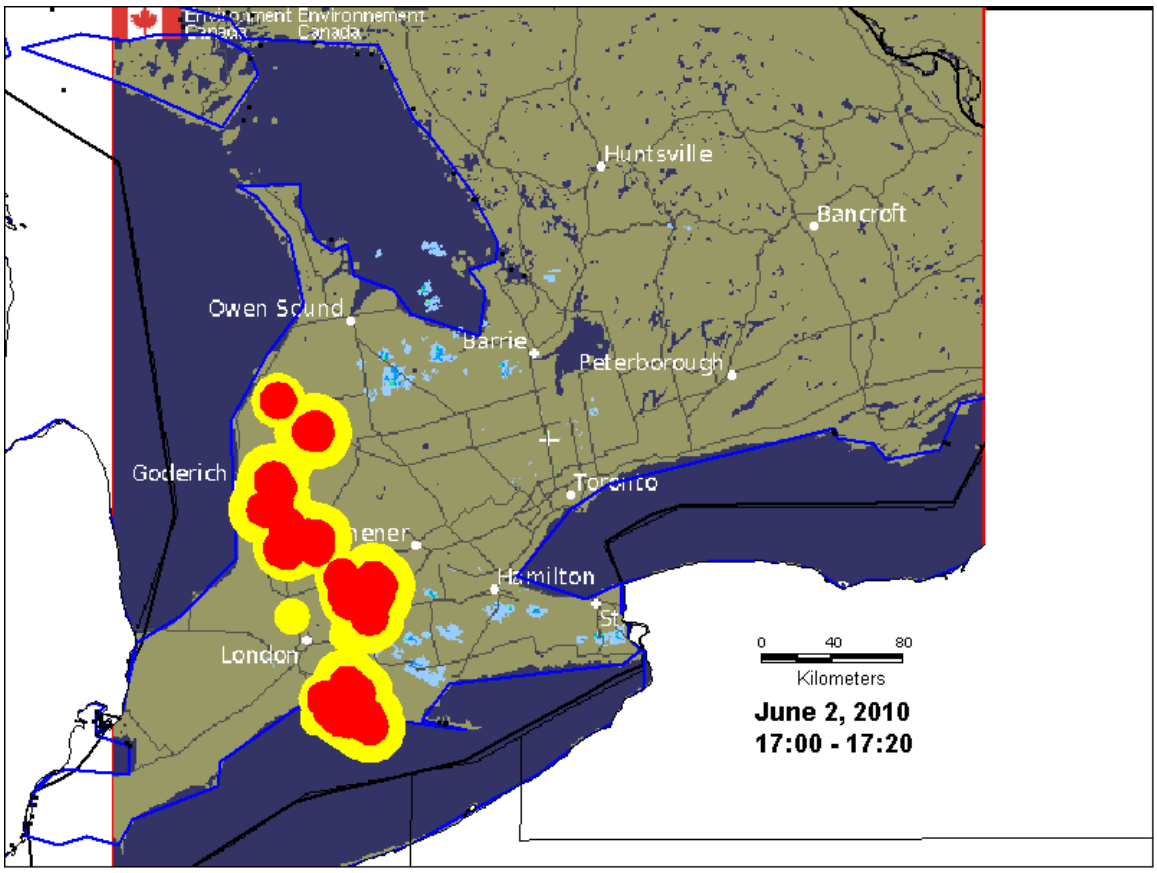

Figure 1. Sample Canadian Lightning Risk Map

3. Social Science Considerations

MSC, like many national meteorological organizations, is seeking ways to incorporate social science principles in its warnings and in the methodology used to develop and evaluate them. Research tells us that in order for warnings to be effective they must be communicated in language understandable to the user and that the warnings must be actionable. Warnings need to address the vulnerabilities in a population and must contain messaging on what actions to take in order to mitigate the situation. The December 2008 Report of the Commissioner of the Environment and Sustainable Development – Office of the Auditor General of Canada stated that the clarity of the message is also important. If users do not understand the potential impacts and hazards associated with the forecasted severe weather event, they may not take the necessary precautions to protect themselves and minimize risks to persons and property. (2008 December Report of the Commissioner of the Environment and Sustainable Development)

Research has shown that communicating the threat for severe weather is only part of the equation… even a warning message inclusive of all determinants or possible consequences of a threat may not trigger people to respond in the intended way or at the expected time. According to Lindell and Perry (2004), people need to first believe that a threat exists before they take protective action.

Some of the ways social science has been incorporated into the development of the CLRD are through ethnographic research on reactions to lightning information, qualitative analyses of the proposed lightning maps and feedback collected on draft call-to-action statements.

Lightning risk areas in the CLRD are color coded with the highest level of risk shaded in red. Each color will have an associated call to action statement. Since the risk areas are based on recent lightning activity (rather than a forecast that may have been made several hours ago) that it will be easy for the public to confirm that the threat is real and take the related appropriate action.

4. Feedback Received So Far

Mock-ups of maps similar to the CLRD were shown to groups in fall 2011. Respondents indicated that they were comfortable with maps of lightning risk provided that they were accompanied by statements that tell them what action should be taken. All respondents indicated that they would like actual lightning strikes to be displayed on the maps or something that would give them an idea of the intensity of lighting that has occurred. This was also communicated as a desire to have the display communicate the chance of lightning. Respondents would like to access the lightning display on mobile devices. Finally respondents indicated the need for improved education on lightning safety awareness and education on basic lightning facts.

5. Future Work

Verification of the CLRD algorithm will take place summer 2012. Statistics on Probability of Detection (POD), False Alarm Ratio (FAR), Critical Success Index (CSI) and number of misses will be calculated. Scores will be sorted regionally to see if there are any differences regionally which may be due to geography and the climatological differences in the types of lightning storms.

In 2013 the CLRD will be displayed on MSC's beta website to gather feedback from the public regarding its utility and relevance as a decision support tool. It is envisioned that the CLRD will eventually be displayed on an interactive map as well as being used in mobile applications. Throughout 2012 and 2013 educational materials will be created to support the CLRD and promote better understanding of the dangers related to lightning.

6. References

Holle, R.L., M.J. Murphy, and R.E. López, 2003: Distances and times between cloud-to-ground flashes in a storm. Preprints, International Conference on Lightning and Static Electricity, September 16-18, Blackpool, England, Royal Aeronautical Society, paper 103-79 KMI, 8 pp.

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Lindell, M.K. and Perry, R. W. (2004). *Communicating environmental risk in multi-ethnic communities*. Thousand Oaks, CA: Sage Publications Inc.

2008 December Report of the Commissioner of the Environment and Sustainable Development – Office of the Auditor General of Canada (Section 2.7.1 http://www.oag-bvg.gc.ca/internet/English/parl_cesd_200812_02_e_31819.html#hd5n)