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WEATHER & SOCIETY ADVISOR

A Study Group of The

Interdisciplinary Centre on Climate Change IC3

Inside this Issue:

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If you have weather stories, ideas, photos or expertise that you would like to contribute to future newsletters, please contact Amber Silver at a2silver@uwaterloo.ca

UNIVERSITY OF WATERLOO

The Reflection Pool

It is with great enthusiasm, hope, and a dose of humility that we bring this inaugural issue of the *Canadian Weather & Society Advisor* into being. *We* are presently just a small collection of graduate students and academics from the University of Waterloo Faculty of Environment—*the Weather and Society Study Group*—who share a keen interest in exploring the interactions of weather and society. We draw upon many disciplines and areas of professional practice in our research and discussions. Our enthusiasm for the subject is coupled with the hope that the *Advisor* will reach out to Canadian and eventually North American and international audiences interested in similar topics and willing to share their ideas, questions, opinions, stories, publications, and experiences.

The original impetus for the *Advisor* was the unfortunate loss of *Weather and Society Watch*, an on-line newsletter that was published by the Societal Impacts Program (SIP) at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado. Back issues for this document and its predecessor, *WeatherZine*, may be accessed at: http://www.sip.ucar.edu/news/ and http://sciencepolicy.colorado.edu/zine/archives/, respectively.

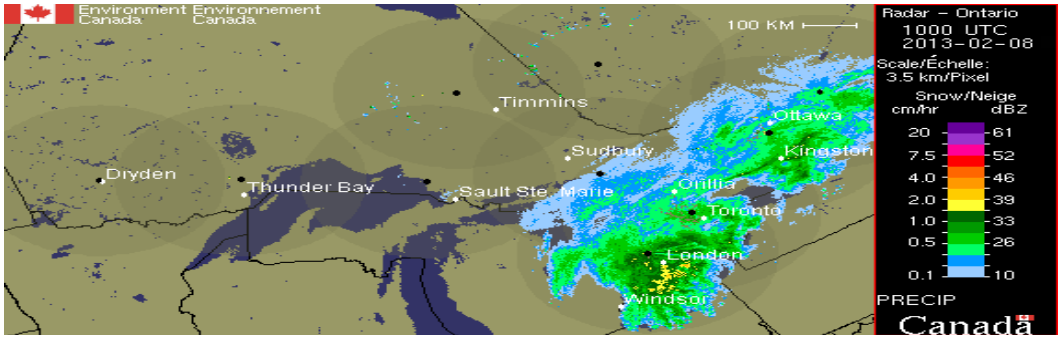
Like these publications, the *Advisor* aims to create an open environment for contributions and to build a sense of community around weather and society in order to advance our understanding and application of knowledge. Our humility lies in our appreciation of those who spearheaded these past efforts—we've retained many of the same elements—and the challenge associated with restoring a small amount of that original capacity.

In this issue, we focus on winter weather. We hope you enjoy this first quarterly edition and look forward to your feedback and contributions in the coming months.

Sincerely,
Jean Andrey, Brian Mills, Michelle Rutty, & Amber Silver

STORM OF THE SEASON, WINTER 2013

News headlines in Central and Eastern Canada and the American Northeast referred to the winter storm of February 8 and 9, 2013 with adjectives such as “fierce”, “deadly” and "mammoth". Beginning on February 7, meteorologists issued snowfall warnings and special weather statements as an Alberta clipper moved across North America. This system then combined with a low pressure cell that moved up the Atlantic seaboard. The systems brought heavy snowfalls and high winds to a region occupied by some 65 million people. In Ontario, the city of St. Catharines had the highest snowfall accumulation during this period—some 44 centimetres. In Atlantic Canada, wind gusts of up to 150 kilometres per hour reduced visibility and contributed to storm surges and power outages. Parts of the U.S.A. were also hard hit, with Boston receiving 63 centimetres of fresh snow, which is the fifth highest accumulation in the city’s history. Named by the American Weather Channel as storm Nemo, the multi-day event disrupted transportation services in both Canada and the U.S.A. Literally thousands of flights were cancelled, regional passenger rail services were shut down and some roads were closed. Despite accurate and advanced warnings, the readiness of snow crews, and other efforts taken to mitigate the storm’s effects, dozens of deaths are being attributed to this storm of the season.



Radar image depicting snowfall across southern Ontario on February 8th, 2013 (from Environment Canada).


Photograph taken by Angela Fang, University of Waterloo student


Photograph taken by Andrea Fournier, University of Waterloo student

Photograph taken by Wayne Hsu, University of Waterloo student


Photograph taken by Christina Kong, University of Waterloo student

The Snowtweets project and the utility of event-based citizen science: an example from Winter Storm Nemo in February 2013.

Richard Kelly
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Introduction

Snowtweets is a crowdsourcing initiative that was started in 2009 by Richard Kelly, Raymond Cabrera and Joshua King at the University of Waterloo's Department of Geography and Environmental Management. The idea behind the project is to explore the use of social media in science, especially in the reporting of cold season weather measurements, specifically snow depth. The key idea is to encourage users of the Twitter microblogging site, to broadcast ("Tweet") their local snow depth in a fast and friendly way. With a minimal amount of training, participants tweet their total snow depth measurement along with their location of where the measurement was made (e.g. postcode or latitude/longitude).

Snowtweets is not intended to replicate or replace formal *in situ* observation networks, such as World Meteorological Organization standardized or national snow depth data sets. Rather, it is designed to leverage reporting of snow depth data via social media networks from non-specialists with interests in citizen science and snow reporting who are likely located in different places than the standard sites thereby potentially augmenting existing formal expert network measurements for various applications.

Winter Storm Nemo

To illustrate the power of citizen science, a winter storm system in February 2013 provided an opportunity to explore the nature and quality of snow depth data submitted to the Snowtweets project and to compare them with a standard global network data set collected under the WMO Global Terrestrial Network (GTN). The

GTN snow depth observation data are used for the snow depth analysis at the Canadian Meteorological Centre (CMC) (see Brasnett, 1999). Called "Winter Storm Nemo", the February storm evolved from the combination of a northeastern low and a southern low pressure system that converged in the southern Ontario region on 8th February and tracked eastwards towards the Eastern seaboard of the United States and leaving around 11th February.

Snowtweet (ST) responses peaked in the afternoon of the 8th and morning of 9th February. CMC and ST data were extracted for a 3° x 4° latitude/longitude region in southern Ontario and for a 1.8° x 3.8° latitude/longitude region in southern New England on 8th and 9th February. Figure 1 shows a map of all data locations for 8th and 9th February combined. The figure shows that the two data sets are complementary and do not duplicate each other; the ST sites (red squares) are located in places where the GTN data (blue circles) are generally non-existent. There are 24 unique sites in total for the CMC data with 5 located in the southern New England region and 19 in the southern Ontario region. During the two day period there were 122 time unique GTN snow depth measurements made from these 24 GTN sites. For the ST data, snow depths from 92 unique locations were reported from 82 Twitter accounts with 13 unique sites in southern New England and 79 from southern Ontario. In total, 134 time unique measurements were reported. Only two anomalous ST measurements were omitted form the analysis.

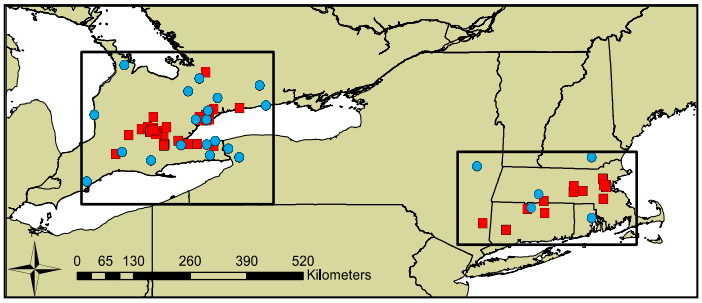

Figure 1 Locations of Snowtweet sites (red squares) and GTN reported snow depth sites (blue circles) for 8th and 9th February, 2013. The two black boxes indicate the regions from which the data sere selected

The Snowtweets project (cont.)

(Continued from page 3)

A comparison of GTN and ST data is illustrated in Figure 2 and shows the average snow depths (bars) and standard deviations (error bars) of the two data sources over time. The left graph is for southern Ontario while the right one is for southern New England. The snow depth trends at both sites for both GTN and ST are similar except that the ST data show a larger accumulation at each time-step than the CMC. This could be because the ST locations are closer to regions of local maximum accumulation. Furthermore, it should be remembered that the ST data are acquired in real time and often reflect conditions within the last few minutes prior to reporting which, while during a storm event such as this, can change rapidly from hour to hour. The GTN data are reported up to four times a day. Therefore, differences in accumulation averages between the ST and GTN data are likely related to the different periods of aggregation. Finally, the standard deviations for the ST are generally smaller than for the GTN data suggesting that the ST data better capture localized snow accumulation conditions compared with the GTN data which are more sparsely distributed; in general, snow depth measurements more closely separated are likely to be more similar than snow depth measurements that have larger separations.

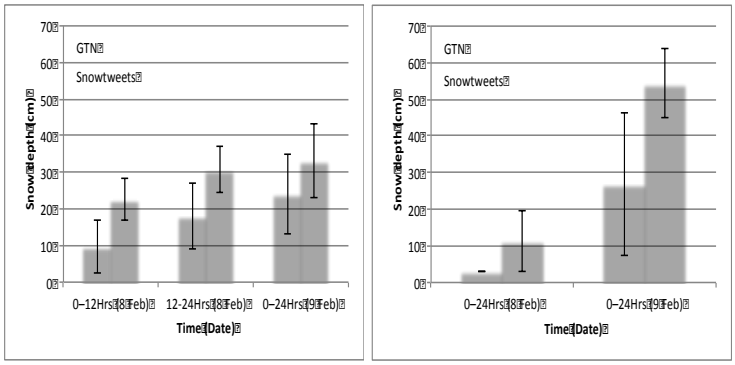

Figure 2 Variations in GTN and ST mean snow depth through time on 8th and 9th February 2013 for southern Ontario (left) and southern New England (right). The error bars represent +/- 1 standard deviation from the mean.

Concluding remarks

The Snowtweets project is proving to be an interesting project for assessing snow accumulation during snowfall events because it provides insight into spatial and temporal processes that are reflected differently by the standard network of snow measuring gauges. From the point of view of Twitter and citizen science, the Nemo storm was a good test case because many people in southern Ontario, Quebec and the Maritime provinces, and New England were receptive to the novelty of social media and simple citizen science likely on account of mandated school and business closures. We are further exploring the nature of the relationship between the ST and GTN data and how well ST data match the CMC analysis product which is derived from the GTN data. In addition we are using these combined data to test satellite retrievals of snow accumulation from spaceborne observations.

You can find out more about how to contribute at www.snowtweets.org.

Reference

Brasnett, B. (1999). A Global Analysis of Snow Depth for Numerical Weather Prediction. *Journal of Applied Meteorology*, *38*(6), 726–740.

UP COMING EVENTS:

Canadian Meteorological and Oceanographic Society (CMOS) Annual Congress, 26-30 May 2013 in Saskatoon, SK.
http://www.cmos.ca/congress2013/index.htm

American Meteorological Society (AMS) 2nd Conference on Weather Warnings and Communication, 26-28 June 2013.
http://www.ametsoc.org/MEET/meetinfo.html

Canadian Association of Geographer's Annual Meeting, 11-15 August 2013 in St. John's NFLD.
http://www.mun.ca/cag2013/

Canadian Risks and Hazards Network (CHRNet) 10th Annual Symposium, 5-8 November 2013 in Regina,SK.
http://www.crhnet.ca/annualsymposium/annualsymposium.htm

Ask a Professional: A Day in the Life of a Meteorologist

Mark Robinson
Storm chaser and Meteorologist with The Weather Network

I can barely hear the crack of the spintering fence over the howl of the wind and the roar of the waves. The water sprays over the top of the fence and slaps me in the face. I can barely make my voice heard as I try to tell the home audience exactly what's going on in the heart of Hurricane Sandy. Seawater laps around my knees and I can barely keep my feet as waves of crest and flow down the street that I'm standing on. Just another day at the office for me.

Ok, this isn't exactly a normal day for me, but as a forecaster at the Weather Network, heading into the heart of the storm is sometimes a part of the job. The rest of the time, I'm normally found in an area known as the "briefing desk" with four computer monitors and two separate computer systems. My job as a briefing meteorologist is not always easy, but it's always great fun. Even with the 12-hour shifts.

The job of a briefing meteorologist is to translate the usually complex, detailed forecasts done by the mets in the forecast centre to something that the "in front of the camera" people can understand. As the OCP's (On Camera Personality) don't usually have a full meteorology degree, the translation for them is very important. A final translation for the general public is usually needed and that's the job of the OCP.

My job also entails creating graphics that are used by the OCP's to tell the weather stories of the day. These graphics are anything from basic graphs of temperature trends to fully animated movies of the fronts and pressure centres moving across the country.

On quiet days, things move along smoothly, but on severe weather days, it can get just a bit crazy. Weather warnings and watches coming out quickly means that I can end up running from the desk to the studio on a nearly constant basis. Summer severe weather can get even busier as new thunderstorm and tornado warnings can come out as fast as one a minute. That's why I bring my running shoes most of the time when the weather gets warm.

So, be it inside or outside, being a meteorologist for the Weather Network is never boring. But, generally, my life is in a little less danger when I'm working at the desk. Unless I really flub a forecast…

Student Corner: A Student's Perspective on Winter Weather

Sarah Greene
2B Geography and Environmental Management

Because winter weather in Ontario can be severe, district school boards, colleges and universities have to consider their options during major storms: keep the school open, cancel buses but keep the school open for students that can make it there safely, or close the school and cancel related activities.

On February 8, 2013, the Kitchener-Waterloo Area, along with the majority of southern Ontario, received up to 40 centimetres of fresh snow. The storm caused all flights to be cancelled at Pearson Airport, major delays on the road, and many organizations to be closed. The local school boards along with the University of Waterloo and Wilfrid Laurier University were among those that closed. The case was not the same in Toronto where most schools had bus and taxi cancellations, but the doors of many schools remained open.

Although not all had the day off, many who did took straight to the snow. All over Waterloo, snowman and forts were seen along with dugout toboggan hills that looked more like mountains. As well, neighbours were helping out each other with the shoveling of sidewalks and driveways along with assisting with stuck vehicles, either buried beneath the snow or trying to get to their destination on the impassible roads.

For most, the snow day that was issued for the two universities here in Waterloo was a day they were thankful for. Whether it was the extra couple days of studying for a midterm, an extension on a paper or assignment, or just a day of relaxation, the snow day was well received. The sad realization sunk in later that some Waterloo students would have to make up for lost class time on Saturday March 2nd 2013. Snowstorms like this one are not very common. And many of those who 'survived the storm' took great pictures, some of which are shared on page 2 of the newsletter. So, until the next snow day … hopefully not until 2014.

Worth Reading

Weather Extremes

1. Morak, S., Hegerl G.C., & Christidis, N. (2013). Detectable Changes in the Frequency of Temperature Extremes. *Journal of Climate*, 26(5), 1561–1574.

2. Lee, S-K., Atlas, R., Enfield, D., Wang, C., & Liu, H. (2013). Is There an Optimal ENSO Pattern That Enhances Large-Scale Atmospheric Processes Conducive to Tornado Outbreaks in the United States?. *Journal of Climate*, 26(5), 1626–1642.

3. Sampson, C.R., Wittmann, P.A., Serra, E.A., Tolman, H.L., Schauer, J., & Marchok, T. (2013). Evaluation of Wave Forecasts Consistent with Tropical Cyclone Warning Center Wind Forecasts. *Weather and Forecasting*, 28(1), 287–294.

4. Mohan, P., & Strobl, E. (2013). The Economic Impact of Hurricanes in History: Evidence from Sugar Exports in the Caribbean from 1700 to 1960. *Weather Climate and Society*, 5(1), 5–13.

5. Drost, R. (2013). Memory and Decision Making: Determining Action when the Sirens Sound. *Weather Climate and Society*, 5(1), 43–54.

6. Hoyos, N., Escobar, J., Restrepo, J.C., Arango, A.M., & Ortiz, J.C. (2013). Impact of the 2010–2011 La Niña phenomenon in Colombia, South America: The human toll of an extreme weather event. *Applied Geography*, 39, 16-25.

7. Neal, R.A., Boyle, P., Grahame, N., Mylne, K., & Sharpe, M. (2013). Ensemble based first guess support towards a risk-based severe weather warning service. *Meteorological Applications*, DOI: 10.1002/met.1377.

Things that Matter … Happiness, Health, Security

8. Tsutsui, Y. (2013). Weather and Individual Happiness. *Weather Climate and Society*, 5(1), 70–82.

9. Bannister-Tyrrell, M., Williams, C., Ritchie, S.A., Rau, G., Lindesay, J., Mercer, G., & Harley, D. (2013). Weather-Driven Variation in Dengue Activity in Australia Examined Using a Process-Based Modeling Approach. *The American Journal of Tropical Medicine and Hygiene*, 88(1), 65-72.

10. Martin, G.V., Houle, T., Nicholson, R., Peterlin, A., & Martin, V.T. (2013). Lightning and its association with the frequency of headache in migraineurs: An observational cohort study. *Cephalalgia*, 33, n/a.

11. Malone, E.L. (2013). Climate Change and National Security. *Weather Climate and Society*, 5(1), 93–95.

12. Bassi, A., Colacito, R., & Fulghieri, P. (2013). 'O Sole Mio: An Experimental Analysis of Weather and Risk Attitudes in Financial Decisions. *The Review of Financial Studies*, 26, doi:10.1093/rfs/hht004.

Weather in Different Contexts: From Farms to Cities to Outer Space

13. Hoffmann, P., & Schlünzen, K.H. (2013). Weather pattern classification to represent the urban heat island in present and future climate. *Journal of Applied Meteorology and Climatology*, DOI: 10.1175/JAMC-D-12-065.1.

14. Frisvold, G.B., & Murugesan, A. (2013). Use of Weather Information for Agricultural Decision Making. *Weather Climate and Society*, 5(1), 55–69.

15. Brekke, P., Steen, R., Onsager, T., Wintoft, P., Olaussen, A., Pirjola, R., Stauning, P., Sundelius, B., Ohnstad, T., & Marti, L. (2013). Space Weather and Challenges for Modern Society. *Space Weather*, 11(1), 3-4.

Acknowledgements

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