Cat tales

e-newsletter of the Institute for Catastrophic Loss Reduction

Volume 2, Issue 2
Second quarter 2008

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4th International Symposium on Flood Defence a great success

By Slobodan P. Simonovic, Director of Engineering, ICLR

The 4th International Symposium on Flood Defence was organized in Toronto (May 6-8, 2008) by the Institute for Catastrophic Loss Reduction under the leadership of Prof. Slobodan P. Simonovic, ICLR's director of engineering. The Symposium was a true international event. The list of supporters and co-organizers includes: Canadian Society for Civil Engineering; Canadian Water Resources Association; Conservation Ontario; Emergency Management Ontario; RIMAX project on Risk Management of Extreme Flood Events, Europe; Institute for Water Resources, U.S. Army Corps of Engineers; American Water Resources Association; UNESCO International Hydrologic Programme; WMO Associate Programme on Flood Management; UN International Strategy for Disaster Reduction; UN University; International Association of Hydrological Sciences; International Association of Hydraulic Engineering and Research; and International Centre For Water Hazard and Risk Management – ICHARM.

The Symposium was attended by more than 300 participants from six continents. Conference proceedings are available on a CD ROM and include 160 scientific papers. In addition more than 20 posters were presented at the conference. The Symposium was preceded by a technical tour of the Don River restoration project, attended by 50 participants.

The Symposium was opened on May 6th by Paul Kovacs, Executive Director, ICLR; Honourable Donna Cansfield, Minister of Natural Resources, Ontario, Canada; Honourable John Paul Woodley, Jr., Assistant Secretary of the Army (Civil Works), USA; and Dr. Salvano Briceno, Director, United Nations, International Strategy for Disaster Reduction.

The main program of the Symposium included four plenary sessions: (1) Red River Flood of the Century – 10 Years Later; (2) Hurricane Katrina – Perspectives on Risk and Reliability; (3) Assessing Flood Risk; and (4) Strategy for Mainstreaming Flood Risk Reduction in Society. In addition 34 parallel sessions were used to present 160 papers. All Symposium presentations are available from the Symposium website www.flood2008.org

Presentations at the Symposium, plus plenary and parallel session discussions, resulted in the Toronto Symposium Statement which includes a message from participants and summarizes the main findings of the Symposium. ►

4th International Symposium on Flood Defence a great success *cont*...

The Toronto Symposium Statement:

1) Acknowledges

- that floods in their natural state play a vital role in support of economic and environmental sustainability;
- that costs associated with floods in terms of both lives lost and damages sustained continue to rise on a global scale;
- that societies of all types continue to occupy floodplains and delta areas that are highly prone to the incidence of severe flooding;
- that the threat from climate change continues to grow and changes the frequency and severity of floods and coastal storms;
- that flood management is defined as the management of flood risk by integrated measures of legislation, economy, administration, structures, technologies and education; and
- that international and regional cooperation and collaboration, particularly within trans-boundary basins, is critical to the flood damage reduction process.

2) Takes into account

- that trans-boundary measures and institutional arrangements are improving, albeit on an incremental basis;
- that a well designed and properly maintained flood control system with moderate standards, safety and credibility, and proper utilization provides a vital framework for living with floods;
- that the role that non-structural measures, such as floodplain expansion and public awareness, play in reducing the overall flood risk continues to expand in importance;
- that flood-related information technology continues to improve and be diffused throughout all economic sectors;
- that the principles of integrated floodplain management, taking into account economic, social, and environmental dynamics, continues to gain in stature; and
- that the measures used for flood adjustment are highly variable and region dependent.

3) Recommends

- the continued advancement of integrated floodplain management principles and practices, including a more fully balanced approach to structural and non-structural flood protection measures;
- the development of variable procedures to more effectively manage the flood risk within various sectors of society;
- the full exploitation of basic and advanced information technologies to improve environmental representation, flood characterization and prediction, and to foster inter-sectoral communications, and collaboration;
- the advancement of strategies to involve a broader range of groups and individuals in decision-making processes based on common, basin-wide visions;
- the continued exchange of information related to flood management through regional and international initiatives and meetings;
- the introduction of flood risk and impact assessment with any new development proposal; and
- the enhanced awareness of local flood management capacities and the need for affected groups and individuals to assume their share of the risk.

4) Agrees

- to change the name from the "International Symposium on Flood Defence (ISFD)" to the "International Conference on Flood Management (ICFM)";
- to distribute this statement at key international events, such as the 5th World Water Forum (Istanbul, 2009) and the Hyogo Framework for Action (Geneva, 2009).

5) Invites

- the Ad Hoc Committee to organize a 5th ICFM to continue the exchange of innovative flood management research and practices and national, regional and international policy developments.

The Symposium ended with the announcement that Professor Slobodan P. Simonovic has been nominated and elected as the new Chairperson of the Ad Hoc Committee for the International Conference on Flood Management. Prof. Simonovic will lead the committee together with two new co-chairs Prof. Xiaotao Cheng from China and Dr. Jos van Alphen from the Netherlands.

Slobodan Simonovic, Professor of Engineering, UWO and ICLR Director of Engineering Studies.

The driest of times, the wettest of times

**By Ronald Stewart, NSERC Chair in Extreme Weather
McGill University**

The occurrence and evolution of drought over various regions is a ubiquitous feature of the global water cycle. Such an extreme does not necessarily lead to an overall change in the magnitude of the global water cycle but it, of course, affects the regional cycling of water. Droughts are recurring aspects of weather and climate extremes as are floods and tornadoes, but they differ substantially since they have long durations and often lack easily identified onsets and terminations.

Drought is a relatively common feature of the North American and Canadian climate system. However, it tends to be most common and severe over the central regions of the continent far away from oceanic moisture sources. The Canadian Prairies are, therefore, prone to drought; one example is the recent event that began in 1999 and largely ended in 2005.

A catastrophic rainstorm struck the Northern U.S. Plains and the Canadian Prairies in June 2002 in the midst of this drought. The Canadian Dam Association estimated the return period of such a rainfall event to be 258 or 1,486 years depending whether the event is included or not.

This article characterizes some of the features of this recent drought and storm and points out their inter-relation.

The drought

Drought is a major concern in Canada but rarely has it been as serious or extensive as the 1999-2005 episode. This event produced the worst drought in over a hundred years in parts of Canada and, in particular, the Canadian Prairies, where over 65% of the Prairies' cropland was affected. Precipitation was continuously below normal in parts of Alberta and Saskatchewan for more than four consecutive years from autumn 1999 to spring 2004. In 2001, Saskatoon was 30% drier than in any year since 1891. In May 2002, the number of recorded natural Prairie ponds was the lowest since record keeping began. In 2002, the incidence of forest fires in Alberta increased to five times the ten-year average (in 2003 such fires also ravaged the British Columbia interior including Kelowna). In 2001, at least 32 incidents of massive dust storms were reported in Saskatchewan which led to numerous traffic accidents and fatalities.

The drought had a huge impact on the Canadian economy. For example, in 2001-2002 alone it is estimated that GDP was reduced by approximately $5.8 billion in 2001 and 2002 and over 41,000 jobs were lost. The drought led to a ►

negative or zero net farm income for several provinces for the first time in 25 years.

The storm

Despite the drought, periods of intense rainfall sometimes occurred. One example was in June 2002. From June 8 to 11, extreme precipitation was produced and lead to major flooding across all Prairie provinces, northwestern Ontario, and as far east as Peterborough, Ontario. The total water deposited during the June 2002 rainstorm was enormous. Over the Prairies, for example, it deposited in five days the equivalent of 14 times the yearly water delivered to the reservoir held by Saskatchewan's Gardiner Dam.

The storm set numerous station records. For example, at Lethbridge, Alberta, the associated rainfall was the longest in duration since hourly observations were recorded. It also set a record for the amount of precipitation produced over a month regardless of the time of year.

The effect of the rainstorm is even evident when examining long term averages over North America. The western region of North America was experiencing low rainfall accumulations in association with the drought. However, along the track of the storm, precipitation anomalies for 2002 approached the 90 percentile level. This means that over the period of the observational record, close to 100 years at some locations, only 10% of the years had more precipitation. This effect was almost all due to this one event in June. Interestingly, David Phillips, a senior climatologist at Environment Canada, rated the June 2002 rainstorm the number four weather event in Canada for 2002 with the drought itself ranking number one.

Inter-connections

The moisture for the storm came from the Gulf of Mexico. There was little local moisture over the Prairies due to the drought. This warm moist air was gently rising over much of its path from the South. As air rises, it expands and this expansion leads to cooling. Since cool air cannot hold as much moisture as warm air, excess moisture is produced and this leads to clouds (either in the form of ice or liquid) and eventually to precipitation. In the case of the June 2002 storm, this precipitation reached the surface over southern regions of the Prairies as well as over large sections of the northern U.S.

Over the northern Prairies during the storm, there were large areas of cloud and precipitation above the surface (from approximately 3 km to 10 km) that did not reach the ground. The rising moist air from the South led to this elevated cloud and precipitation, but the drought had produced very dry conditions at the surface and for approximately 3 km above it. Precipitation falling from the high-level cloud evaporated and/or sublimated into this dry air before reaching the surface. (From the surface, this mechanism was visible by the presence of widespread virga.) The process of converting precipitation (in the form of snow and/or rain) into water vapour requires that energy be extracted from the atmosphere. This is accomplished by chilling the air. Consequently, a huge pool of cold dense air was produced above the surface over the northern Prairies in the case of the June 2002 storm.

The pool of cold air led to an intensification of precipitation. Because it was dense, it descended to the surface and, to replace it at the upper levels, more warm moist air had to be drawn in from the South. The ensuing increase in the amount of moisture ultimately led to more precipitation. In addition, at the surface, the pool of cold air moved underneath the warm air coming from the South. The warm air was then forced to rise faster above this dense air than it would otherwise have done. This led to the more rapid production of cloud and to even more precipitation. The storm was more intense because of the drought.

The precipitation from the storm also brought the drought to an end for many months. Although there was a major impact from the flooding, the precipitation along the storm track produced saturated soils. This, in turn, led to huge improvements in crop yields and farm income in comparison with those regions missing the precipitation. The drought was alleviated because of the storm.

Summary

Canada suffers from drought as well as from heavy precipitation. Catastrophic rainfall events sometimes occur even during drought periods. The regions affected then suffer from two types of extremes: dry and wet. When preparing for drought, one needs to be aware that catastrophic flooding can be an intertwined extreme.

Dr. Ronald Stewart

Role of tornado and downburst damage surveys for the assessment of wind speeds in severe storms

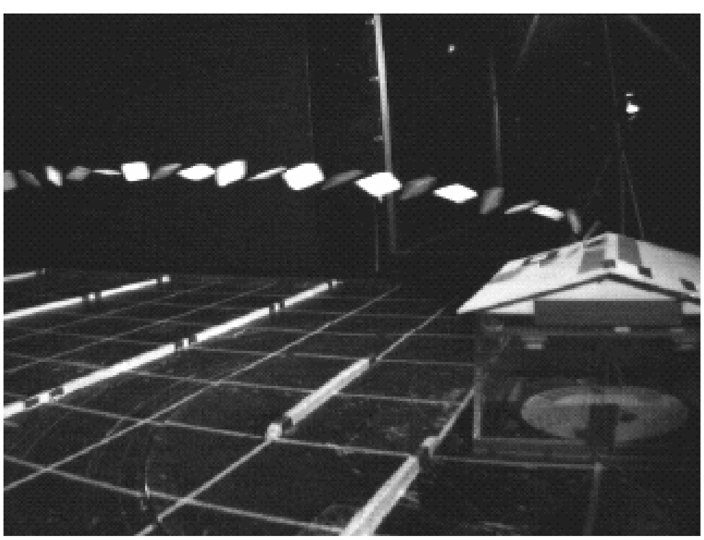
By Gregory A. Kopp, Professor Boundary Layer Wind Tunnel Laboratory, University of Western Ontario

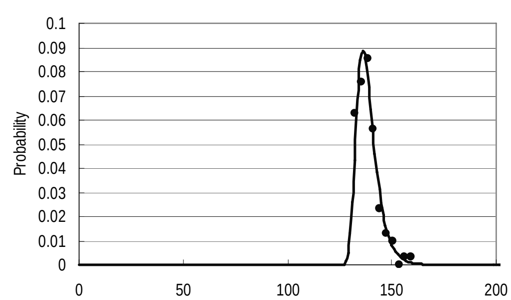
Wind-bourne roofing material “caught” by a tree in Elie, MB.

Knowledge of tornado and downburst wind damage is critical to engineering evaluations of structural performance and, in particular, for the development of appropriate design guidelines for critical infrastructure systems. For example, the design of electrical power distribution systems for wind loads is governed by tornadoes in southern Ontario, so knowledge of wind speeds, tornado size distributions, track lengths, etc., is required. Tornado sizes and track lengths come from damage surveys, while the wind speeds are associated with damage indicators as well. These are based on the well-known Fujita Scale.

In the United States, the Fujita Scale was recently revised with what is now called the Enhanced Fujita Scale, which includes a wider range of structural damage indicators which include a new range of (reduced) wind speeds at the higher end of the scale. It is important to realize that all of the information we use regarding tornado wind speeds comes from damage surveys and the resulting Fujita Scale. Thus, one could have a powerful tornado, but if it does not hit anything, there is no record of it in the statistics for a particular area. In addition, the maximum damage rating depends on the (expected) strength of the structure, so if a powerful tornado hits a weak structure, the maximum rating possible is limited.

None of this is intended as a criticism of the Fujita Scale, rather it indicates the truly limited knowledge we have about these severe winds. To aid our understanding, wide ranging wind damage research is being conducted at the University of Western Ontario (under the sponsorship of ICLR and NSERC, in partnership with Environment Canada) to develop greater numbers of damage indicators - based on scientific testing - to obtain more realistic wind speed estimates for severe windstorms. We are focussing on two aspects which have not been previously utilized, namely wind throw of trees and flight of wind-borne debris. In this brief note, we focus only on the latter. ►





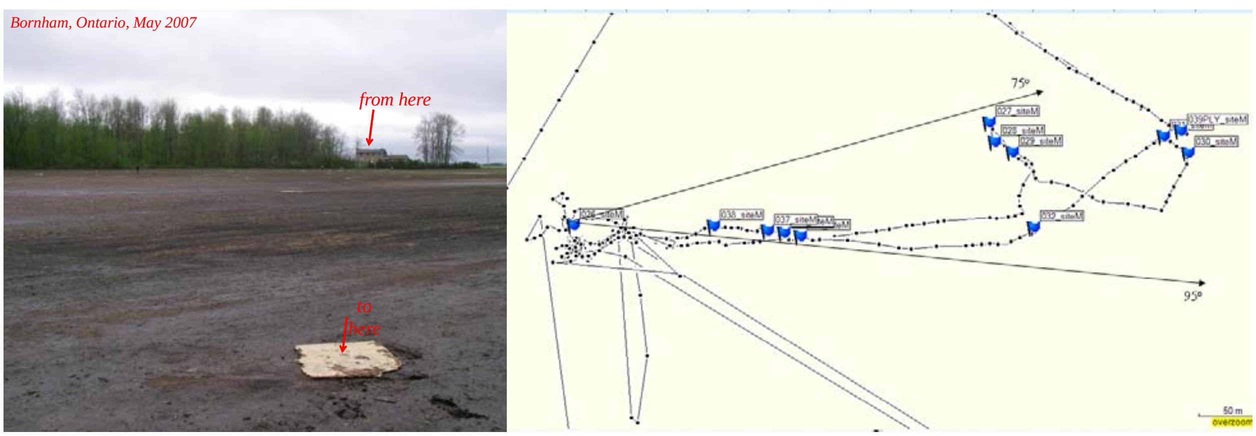
(Left) Flight of a roof sheathing panel from a gable roof in a wind tunnel study simulating Hurricane Andrew conditions. Wind is from right to left, with the (Right) distribution of failure wind speeds as measured over many repeated tests.

Role of tornado and downburst damage surveys *cont*...

Wind-borne debris arises when a building element fails and subsequently flies through the air. The main problem with debris is that it often hits downwind structures, causing additional damage. This can be particularly severe if a window or door is destroyed because subsequent internal pressurization could lead to roof failure. It is estimated that wind-borne debris caused about 40% of the damage in Hurricane Andrew (August 1992). However, well-defined failures and flight distances, as observed post-storm, allow the possibility of assessing wind speeds.

We have conducted research of debris flight for particular failure mechanisms by using carefully designed models in wind tunnel experiments. In particular, detailed data have been obtained for common debris types including roof shingles and tiles and roof sheathing, and even a full wood-truss, gable roof. One of the limitations is that this has been performed only for hurricane-type wind conditions, but a new downburst simulator at the University of Western Ontario will be used to determine the effects of thunderstorm winds. Tornado wind fields are still beyond our current capacity although details of tornado vortices have been obtained at UWO as well as by full-scale portable Doppler radar in the U.S. and through model scale vortex chambers at other universities.

Once we have debris flight data from carefully controlled wind tunnel experiments we have data relating flight distances with wind speeds. One could use this database then to infer wind speeds from full-scale damage observations where conditions were similar between full-scale and wind tunnel. However, greater use comes from the development of computer models which can predict the flight speeds based on the physics of flight, calibrated against the wind tunnel experiments. This, then, allows estimation of wind speeds for a much larger range of observations. Data from damage surveys plays a key role in the development of these models. As this research progresses, we hope to provide new damage indicators for severe wind storms based on such numerical models, and enhancing the usefulness of the Fujita Scale for engineering design of critical infrastructure.



(Left) Roof sheathing from a downburst near Bornholm, ON, in May, 2007, and (Right) GPS waypoints indicating locations of roof sheathing relative to the source.

Institute for Catastrophic Loss Reduction

Mission
To reduce the loss of life and property caused by severe weather and earthquakes through the identification and support of sustained actions that improve society's capacity to adapt to, anticipate, mitigate, withstand and recover from natural disasters.

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