

## Final Report Instructions for Partners and Cooperative Projects

Listed below are the content elements that should be included in your final report. While the report does not need to be lengthy, it should provide a summary of the **entire** project (not just the accomplishments since the last 6-month report). **Both** the academic and the operational forecasting partners should complete the report. It is **particularly important** that the operational partner provide as much information as possible in the Benefits section (section 3) in order to demonstrate the value of the Outreach Program to the NWS and other funding agencies.

Please send the final report in electronic form to the [Outreach Program](#) so that we can post it on the COMET Outreach Program's Website. We also appreciate receiving copies of journal publications and student theses that have resulted from the project.

### **FINAL REPORT**

**University:** McGill

**Name of University Researcher Preparing Report:** John R. Gyakum

**NWS Office:** Burlington, Vermont

**Name of NWS Researcher Preparing Report:** Paul A. Sisson

**Type of Project (Partners or Cooperative):** Partners

**Project Title:** A regional climatology of high impact wind events in the Saint Lawrence and Champlain Valleys

**UCAR Award No.:** Z12-93242

**Date:** 21 December 2012

## **Section 1: Summary of Project Objectives**

The scientific objectives for this Partners Project are:

- To understand the spatial variability of surface winds in the St. Lawrence and Champlain Valleys
- Identify regional susceptibility to anomalously-strong high-impact wind events
- Relate these severe winds to synoptic-scale flow patterns
- Identify the pertinent dynamical mechanisms by which these high winds are realized, including terrain-forced channeling or other mesoscale processes
- To understand the role of changing synoptic-scale flow patterns, and its effects on secular trends in severe wind events

**Section 2: Project Accomplishments and Findings** Describe the research/development activities and accomplishments carried out to date. These accomplishments may relate specifically to the original project objectives, or they may be ones that arose during the course of the project (e.g., development of an innovative method for accomplishing the objective or insight into a related problem). Highlight any major changes to the scope of work. If the project involved separate research topics, please list each separately.

We have accessed the comprehensive hourly surface data from two stations, BTV (Burlington, VT) and MSS (Massena, NY), which are located in the Burlington Forecast Office region of responsibility, and also representative of two very different topographic regions. BTV is located in the Champlain Valley, and MSS is situated in the Saint Lawrence Valley. These data are being used to produce a comprehensive wind climatology, which when combined with our existing NARR (North American Regional Reanalysis), will result in a synoptic-dynamic representation of the BTV and MSS wind climatologies. The identification of unique synoptic- and mesoscale features for varying wind regimes will provide the forecaster with enhanced tools to facilitate the prediction of extreme sensible weather in the context of a changing climate. This research will be completed in the summer of 2013, as part of Sophie Splawinski's M. Sc. thesis.

John Goff, lead forecaster Burlington, VT, has completed climatological research to determine maximum wind gusts and range of gusts that have occurred at BTV (see Goff in section 3) This is important for forecasters to know what the range of expectations are with respect to maximum wind gusts and what synoptic situations produce these gusts.

A statistical forecasting technique is currently being developed by Sophie Splawinski, and collaborators, in an effort to improve predictions of the freezing rain in the Saint Lawrence

River Valley. A presentation of preliminary results was given by Sophie Splawinski at the 29 November 2012 NWS/BTV Winter Weather Workshop (see Splawinski et al. 2012 in section 5).

We have also completed research on the relationship between transitioning tropical cyclones in the Saint Lawrence Valley. This publication (Milrad et al. 2012) has been accepted in the journal *Weather and Forecasting*.

We are currently preparing for publication (to the *Weather and Forecasting* journal) a manuscript documenting the synoptic-scale environments of heavy warm-season precipitation events in the Saint Lawrence River Valley (Milrad et al. 2013).

Additional refereed publications, relating to Saint Lawrence River Valley freezing rain (Splawinski et al. 2012; Splawinski 2012; Ressler et al. 2012) and wind channeling (Razy et al. 2012) have also been completed in 2012.

**Section 3: Benefits and Lessons Learned: Operational Partner Perspective** List the benefits to the NWS office from the collaboration and any significant lessons learned during the study. Please be as specific as possible, particularly in regard to any improvements in forecasting resulting from the COMET project ([see examples](#)). Identify any major problems encountered and describe their resolution.

We have achieved a better understanding of the impacts from an extratropical transition (ET) in terms of precipitation production and high winds. We have also achieved a better understanding of the importance of the antecedent conditioning by precedent rains on the impacts of heavy ET rains. We have also compared recent events (Irene) to historical events (Nov. 1927 Flood, Floyd, among others) to determine their evolution and impacts to our area. This has given us a basis to evaluate future events based on past impacts.

Sophie Splawinski's work on wind related to high-impact freezing rain events in the St Lawrence Valley is relevant to our wind and freezing rain forecasts for the St. Lawrence Valley including Massena and Ogdensburg, NY. Her recent equation for indicating the probability of freezing rain based on wind has the potential to be converted to a Graphical Forecast Editor (GFE) Smarttool. When complete, it has the potential of quickly implementing the results of research into operations in a very short (~1 year) period of time.

Additionally, her work to determine the duration and ending time of freezing rain based on the pressure gradient in the St. Lawrence valley has helped to explain the observations of lingering freezing rain at Massena. This is due to the replenishment of cold air to the north and east with sufficient pressure gradient. Our forecast problem lies with determining the ending time of the freezing rain and to help we incorporated her results into an AWIPS pressure gradient/change too.

John Goff's research and presentation of the results on the BTV and MSS wind gust climatologies has provided us with a better awareness of the strengths and limitations of wind data, it's evolution over time with respect to instrumentation and siting. He has been able to create a maximum wind gust climatology and show the forecasters the relationship to synoptic and mesoscale patterns to help with situational awareness of future forecast challenges.

Another benefit of continuous academic infusion into the office is to foster an active and relevant operational research program in the forecast office to address real forecast problems.

We currently have other activities related to high impact snow squalls, downslope winds/upslope snow related to the Froude Number and have developed a AWIPS and GFE tools to implement the results.

Finally, through our strong relationship with McGill, we now have access to an operational meteorological email list where current forecast and climate issues are addressed and are often related to ongoing research, new techniques, tools, and web sites that we can make available to forecasters.

For future collaborations, internet bandwidth should be increased at forecast offices to be able to do interactive video meetings. Current bandwidth at the forecast office is not sufficient to carry out video calls in addition to our routine internet use. More frequent, regularly scheduled, face-to-face meetings, whether in person or through video are much preferred to accomplish projects such as these.

**Section 4: Benefits and Lessons Learned: University Partner Perspective** Describe the benefits to the University resulting from the collaboration and any significant lessons learned during the study. Identify any major problems encountered and describe their resolution.

As a result of our in-person meetings at McGill University and at the NWS/BTV Forecast Office, the students have benefited from a new knowledge of such forecasting issues as high wind warnings, and quantitative precipitation predictions. The continuation of partnering with the BTV forecast office personnel is facilitating regular email discussions on particularly prominent and timely forecast problems. Our in-person meetings on 1 and 30 August 2012, at the BTV Forecast Office were particularly insightful and productive. We also took advantage of our proximity to the BTV Forecast Office by participating in the 29 November 2012 Winter Weather Workshop.

The significant benefit of our interactions with our operational partners at the NWS/BTV forecast office involves the opportunities to identify and implement forecasting research that has the potential to provide both insight and improvements in forecasting. We appreciate these opportunities, and look forward to continuing our interactions with Paul Sisson, and his NWS colleagues.

**Section 5: Publications and Presentations** Provide complete citations using the AMS bibliographic format for each thesis, dissertation, publication or presentation prepared as part of this project.

**Publications:**

1. Milrad, S. M., E. H. Atallah, and J. R. Gyakum, 2012: Precipitation modulation by the Saint Lawrence Valley in association with transitioning tropical cyclones. *Wea. Forecasting*, in press.
2. Splawinski, S., J. R. Gyakum, and E. H. Atallah, 2012: The role of anticyclones in replenishing surface cold air and modulating freezing rain duration. *McGill Science Undergraduate Research Journal*, **7**, 54-60.
3. Ressler, G. M., S. M. Milrad, E. H. Atallah, and J. R. Gyakum, 2012: Synoptic-scale analysis of freezing rain events in Montreal, Quebec. *Wea. Forecasting*, **27**, 362-378.
4. Razy, A., S. M. Milrad, E. H. Atallah, J. R. Gyakum, 2012: Synoptic-scale environments conducive to orographic impacts on cold-season surface wind regimes at Montreal, Quebec. *J. Climatology and Appl. Meteorology*, **51**, 598-616.
5. Milrad, S. M., E. H. Atallah, J. R. Gyakum, and G. Dookhie, 2013: Synoptic-scale precursors and typing of warm-season heavy precipitation events at Montreal, Quebec. In preparation for submission to *Weather and Forecasting*.
6. Splawinski, S., 2012: The role of anticyclones in replenishing surface cold air and modulating freezing rain duration. *The Undergraduate Journal*, **4**, 35-55.

**Presentations (Author indicated in bold is the presenter):**

**The 37<sup>th</sup> Annual Northeast Storms Conference (Rutland, Vermont; 2-4 March 2012)**

Milrad, S. M., E. H. Atallah, and **J. R. Gyakum**, 2012: Precipitation modulation by the St. Lawrence River Valley in Association with Transitioning Tropical Cyclones. Oral presentation.

**Splawinski, S.**, J. R. Gyakum, and E. H. Atallah, 2012: The role of anticyclones in replenishing surface cold air and modulating severe freezing rain event duration. Oral presentation.

**Sisson, P. A.** J. M. Goff, S. L. Whittier, J. R. Gyakum, E. H. Atallah, and S. M. Milrad, 2012: Tropical Cyclone Irene's Devastating Flash Flooding in Vermont on 28 August 2011. Oral presentation.

**The 4<sup>th</sup> International Workshop on Extratropical Transitions (Mont Gabriel, Quebec; 21-25 May 2012)**

**Milrad, S. M.**, E. H. Atallah, and J. R. Gyakum, 2012: Precipitation modulation by the St. Lawrence River Valley in Association with Transitioning Tropical Cyclones. Oral presentation.

**CMOS/AMS Congress 2012 (Montreal, Quebec; 29 May-1 June 2012)**

**Splawinski, S.**, J. R. Gyakum, and E. H. Atallah, 2012: The role of anticyclones in replenishing surface cold air and modulating severe freezing rain event duration. Oral presentation.

**Milrad, S. M.**, E. H. Atallah, and J. R. Gyakum, 2012: Precipitation modulation by the St. Lawrence River Valley in Association with Transitioning Tropical Cyclones. Oral presentation.

**The Burlington Warm-season workshop (Burlington, VT; 14 May 2012)**

**Sisson, P. A. J. M. Goff, S. L. Whittier, J. R. Gyakum, E. H. Atallah, and S. M. Milrad, 2012:**  
Tropical Cyclone Irene's Devastating Flash Flooding in Vermont on 28 August 2011.  
Oral presentation.

**2012 Lake Champlain Flood Resilience Conference (Burlington, VT; 5 June 2012)**

**Sisson, P. A. J. M. Goff, S. L. Whittier, J. R. Gyakum, E. H. Atallah, and S. M. Milrad, 2012:**  
Tropical Cyclone Irene's Devastating Flash Flooding in Vermont on 28 August 2011.  
Oral presentation.

**2012 Asia Oceana Geosciences Society Conference (Singapore; 13-17 August 2012)**

**Gyakum, J. R., G. Ressler, S. M. Milrad, and E. H. Atallah, 2012:** North American extreme weather at 45 degrees N: A study of meteorological processes in the Montreal-Saint Lawrence Valley region. Invited oral presentation.

**Southern New England Weather Conference (Blue Hill Observatory, Milton, MA; 27 October 2012)**

**Sisson, P. A., and W. E. Misinger, M. D., 2012:** Vermont's Greatest Disasters: Comparing Irene with the Great Flood of November 1927. Oral presentation.

**Ouranos Symposium (Montreal, Quebec; 19-21 November 2012)**

**Milrad, S. M., E. H. Atallah, and J. R. Gyakum, 2012:** Precipitation modulation by the Saint Lawrence River Valley (SLRV) in association with transitioning tropical cyclones.  
Poster presentation.

**National Weather Service; Burlington, VT Office; Winter Weather Workshop (29 November 2012)**

**Splawinski, S., J. R. Gyakum, E. H. Atallah, and B. Borgo, 2012:** The prediction of onset and duration of freezing rain in the Saint Lawrence River Valley. Oral presentation.

**Goff, J., 2012:** Establishing a Historical Maximum Wind Gust Climatology at Burlington, VT.  
Oral presentation.

## **Section 6: Summary of University/Operational Partner**

**Interactions and Roles** Describe the responsibilities of the various project participants over the course of the entire project.

The interactions among the partners have been particularly strong during 2012, as is evidenced by our regular in-person meetings at both McGill University and at the NWS/BTV Forecast office. Additionally, the extensive list of related conference and workshop presentations demonstrates the comprehensive nature of our academic/operational partner interactions. There is a mutual set of interactions that characterizes the research being conducted.