

Nowcasting and Decision Making for Environmental Problems

Principal investigator

Dr. Charles Lin

CERCA and McGill University

Tel: 369-5208,

Fax: 369-3880,

Courriel : lin@cerca.umontreal.ca

Co-investigators

Dr. Michel Gendreau

CRT and Université de Montréal

Dr. André Langevin

GERAD and École polytechnique de Montréal

Dr. Bernard Sinclair-Desgagné

CIRANO and École polytechnique de Montréal

Dr. Alain Vincent

CERCA and Université de Montréal

Description of project

Background

This proposal is a collaborative initiative which involves researchers from four rcm_2 centres (CERCA, CRT, GERAD, CIRANO), and focuses on nowcasting (short term weather forecasting) and real-time decision making. There is expertise at CERCA on high resolution atmospheric modelling and the comparison of model simulated precipitation with radar retrieved values. Operations research expertise (real-time decision making, contingency planning, optimization procedures) is found at the other three centres. There has traditionally been little dialogue between the meteorological forecasting and operations research communities. The theme of nowcasting offers an exciting possibility for the two communities to work together, so that scientific weather information can be best used by decision makers for societal benefit.

The collaboration among the four centres has already started. On November 25, 1999, a workshop on Nowcasting and Decision Making organised by the principal investigator (C. Lin) was held at CERCA, with the participation of co-investigators M. Gendreau, B. Sinclair-Desgagné and André Langevin. The workshop was supported by CERCA and rcm_2 . We note that the workshop and this proposal is made possible only through the existence of the research network rcm_2 .

- To combine nowcasting information from weather radars and numerical models, and operations research methods, for winter road maintenance in Montreal.

Methodology

To fulfill the above objectives, we propose the following projects. The main participants of each project are also indicated. All project investigators will be kept informed of progress through regular team meetings.

- a. C. Lin's group at CERCA has been working on the coupling of meteorological and hydrological models for severe precipitation and flood prediction. This work is partially supported by rcm_2 through the "Flood risk" project. We propose to build upon this expertise to perform an in-depth study of the flood warning system in Quebec. The first step is to characterize and understand the current warning system, focusing on the Saguenay flood. We will then prepare scenarios of flood forecasts with different lead times, using the coupled meteorological-hydrological system being developed at CERCA. The need to disseminate information and issue warnings will be examined for each of these scenarios, taking into account the quality of the forecasts, and the likely socio-economic impact of the flood. A strategy for information dissemination will then be determined.

C. Lin and B. Sinclair-Desgagné will be the main participants. As mentioned already, Lin has significant experience with the prediction of severe precipitation and floods using numerical models. Sinclair-Desgagné has worked extensively in contingency planning for the occurrence of undesirable events. This combination of expertise is thus most appropriate for the proposed project.

- b. We will undertake a cost-benefit analysis of the value of short term meteorological and hydrological prediction for severe precipitation and floods, using the Saguenay flood as a case study. The cost of installing a flood warning system based on hydro-meteorological models in Quebec and the benefits of such a system to society will be estimated. The willingness to pay of various user groups for different weather and hydrological information will be assessed.

The main participants of this project will be B. Sinclair-Desgagné, M. Gendreau and A. Langevin. This group has extensive experience with decision making and management under risk and uncertainty. More specifically, Gendreau and Langevin have made significant contributions to operations research modelling and computing in the presence of noisy information and stringent time constraints. Sinclair-Desgagné has recently worked on the design of human-

with less accuracy. We attempt to reach the same accuracy of advection methods for longer lead times than an hour, by assimilating radar precipitation data into a high resolution regional model. This can be done by physical initialization, where the moisture distribution and diabatic heating are adjusted taking into account the radar-retrieved precipitation.

We will combine operations research methods with output from meteorological models to determine the schedules and routes for the spreading of salt and chemicals. The goal is to be "just in time" in planning such operations. This will lead to better service, added road security and a reduction of cost.

The main participants in this project are A. Langevin, C. Lin, M. Gendreau and A. Vincent. Langevin has worked extensively with Dr. J.F. Campbell (University of Missouri-St. Louis) in the use of operations research methods in roadway snow and ice control. Lin has worked with the comparison of radar-retrieved precipitation with model results. He has collaborated with Isztar Zawadzki, the Director of the McGill radar (Marshall Radar Observatory). Lin and Vincent have also worked with meteorological models of the Atmospheric Environment Service. Drs. Campbell and Zawadzki will both participate in the project.

Training

We will be working with graduate students and postdoctoral fellows in this project. We are asking for funds to support graduate students. The team will meet regularly, together with students, to discuss progress. We note that because of the interdisciplinary nature of the project, we are exposing students to both meteorological forecasting and operations research methods, and their applications to real environmental problems.

Links with other centres, industry and government agencies

As mentioned earlier, this proposal is the result of ongoing discussion among researchers (Lin, Gendreau, Sinclair-Desgagné, Langevin) of the four centres CERCA, CRT, CIRANO and GERAD. An important step toward further collaboration was the Workshop on Nowcasting and Decision Making held on November 25, 1999, organised by Lin, with Gendreau, Langevin and Sinclair-Desgagné as members of the organizing committee. There were 30 participants at the Workshop, including representatives from Environment Canada, Lockheed Martin Canada, Ville de Montréal, Santé Canada, Institute for Catastrophic Loss Reduction (insurance industry), Ministère des Transports