





The Development of The **Churchill River Flood Forecasting Service to Support The Monitoring of Open Water, Ice Formation** and Ice Breakup Flood Risks

Flood Modeling and Mapping The Cornerstones of Flood Safety and Management in Ontario Canadian Water Resources Association Ontario Branch March 5th and 6th, 2019

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Presentation

Presenters

- Flood Forecasting in the Province of Newfoundland and Labrador
 - Amir Ali Khan



- Churchill River Flood Risk Mapping and Forecasting Project
 - David Brown



- Churchill River Flood Forecasting Service HydrologiX-CRFFS
 - Steven McArdle





NL Provincial Prediction System

Mandate and Responsibilities

Water Resources Management Division,

The Department of Municipal Affairs and Environment

- The Water Resources Management Division in the Department of Municipal Affairs and Environment, is responsible for water resources management as per provisions of the Environmental Protection Act and the Water Resources Act
- The Division has four sections, each headed by senior professionals with extensive expertise in water resources management. We employ engineers, scientists, water resources officers, technicians, and clerical staff



Water Resources Management Division

Responsibilities

- Water Rights Investigation and Modeling Section
- Drinking Water & Waste Water Section
- Water Agreement Section
- Groundwater Section



Background

In May 2017, the lower Churchill River in Labrador, Canada was impacted by a large ice-jam flood event that caused flood damage to infrastructure and property along the banks of the river, the community of Mud Lake and the community's boat access point on the outskirts of the Town of Happy Valley/Goose Bay, close to the river's mouth.





Figure 2: Stage recorded at the English Point water level station on the Churchill River.







David Brown



Flood Risk Mapping & Forecasting Service Project

- Project Scope:
 - LiDAR Surveys
 - Topographic & Bathymetry Surveys
 - Stakeholder Consultation
 - Remote Sensing Land Use Mapping
 - Hydrology Stochastic & Numerical Modeling
 - Hydraulics Open Water & Ice Modeling
 - Current & Future Climate Change Modelling
 - Flood Plain & Flood Risk Mapping
 - Forecasting System

UNIQUE ASPECTS:

Flood risk maps for both open water and ice affected conditions.

Monte Carlo approach to develop ice affected/ jam frequency event

Forecasting system based on the same models used to develop flood risk maps



Acknowledgement – A Team Approach



KGS Team David Brown, P.Eng Andrew Weiss, P. Eng Brian Bodnaruk, P. Eng. Rick Carson, P Eng. Scott Pokorny, EIT Mark Wilcox



Petr Zuzek

viding solutions through mapping technology...

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ATLIS



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Global Institute of Water Security Dr. Karl-Erich Lindenschmidt P.Eng



Hydrologic Model

• HEC-HMS Model





Note that the daily calibration accounts for 8 years of peaks while the hourly only counts 2 years



Open Water Hydraulic Model – HEC-RAS



Ice Hydraulic Model – RIVICE

• **RIVICE Model**

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Нудго
Welcome to Churchill River Flood Forecast Services
Username: Password:
Sign in
Disclaimer and Usage
Access to this system is restricted to designated unars and in closely monitored. Effect has been taken to provide the most result and reliably information a visibility, and accessite delivery of data and information from this system through the Internet is not guaranteed. Users aboud use the information on this vehicles with caution and do so at their own risk. Data used in this site and information grodueed are considered "as-si" and harven ot undergone verification and review for quality sourcases. 4DM access to liability for the accessing, azailability, reliability, reliability, maintaine, grodueed are considered "as-si" and harven ot undergone verification and review for quality sourcases. 4DM access to liability for the accessing, azailability, reliability, reliability, and harven ot undergone verification and review for quality sourcases. 4DM access to liability for the accessing, azailability, reliability, reliability, and harven ot undergone verification and review for quality sourcases.
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Steve McArdle



Forecasting System



HydrologiX - CRFFS

- Forecast flows and water levels 3 Days
- Automated system daily forecasts
- Web Based for intranet/internet access
- Configurable adjustable system and forecast parameters
- System Notifications automatically notifying users of system process, data feeds and model runners
- Email Alerts automatic/manual external/internal email groups using Common Alert Protocol (CAP)
- Data Historian retains watershed information



Forecasting Data

Automated Data Feeds

- MSC Raster Gridded Numerical Weather Prediction Data (RDPS/GDPS) (2 times per day)
- MSC Raster Gridded Canadian Precipitation Analysis Data (4 times per day)
- WRMD Tabular observed near-real time hydrometric data (daily)
- WSC Tabular observed near-real time hydrometric data (daily)
- C-Core Ice Coverage (seasonal-daily)
- C-Core Ice Thickness (seasonal-daily)

Historical Data Loads

- WSC Tabular observed historical hydrometric data
- DFO Tidal Data (3 years)
- Nalcor Churchill Falls historical discharge (3 years)
 ~ 450 Mb per day



Implementing Forecast Model Adapter



Implementing Forecast Models



Implementing Forecast Models

Open Water Level Forecast based on rating curves developed from calibrated HEC-RAS model based on forecast flow at Muskrat Falls and tidal levels on Lake Melville



			Terrington Basin Water Level (m)								
			-0.1	0.0	0.1	0.2	0.3	0.4	0.5	0.6	
		800	-0.096	0.004	0.104	0.204	0.303	0.403	0.503	0.603	
	n ³ /s	1000	-0.093	0.006	0.106	0.206	0.305	0.405	0.504	0.604	
	s (n	1200	-0.090	0.009	0.109	0.208	0.307	0.407	0.506	0.606	
	Fall	1400	-0.086	0.013	0.112	0.211	0.310	0.409	0.509	0.608	
	rat I	1600	-0.082	0.017	0.115	0.214	0.313	0.412	0.511	0.611	
	low at Muski	1800	-0.077	0.021	0.119	0.218	0.317	0.416	0.514	0.614	
		2000	-0.072	0.026	0.124	0.222	0.321	0.419	0.518	0.617	
		2200	-0.066	0.031	0.129	0.227	0.325	0.423	0.522	0.620	
		2400	-0.060	0.037	0.134	0.232	0.330	0.428	0.526	0.624	
		2600	-0.053	0.043	0.140	0.237	0.335	0.432	0.530	0.628	

Multi-Dimension Rating Table



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River Water Level Profile



Forecast Cycle



Preliminary Results – Operational System Release



Example Web Pages

- Dashboard
- Forecasts Display
- Water Level Alerts
- Diagnostics



Preliminary Results – Forecasts

• Preliminary results: Refining Hydrological Model Forecasts at Muskrat Falls



Forecasting System



Next Steps

- The forecast system is operational in Evaluation Mode and will be deployed in Production Mode this Spring 2019.
- The team is conducting testing and improvements to the system and the forecast information
- Model performance, data feeds, ice conditions from SAR/Optical EO and ice thickness from SAMBA Ice Buoy's will closely be monitored this spring freshet
- Future advancements the snow cover/ice thickness remote sensing

wToundlan







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Thank You – Questions?



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