

DAM OPERATIONS, FLOOD MANAGEMENT ADJUST TO CHANGING CLIMATE PATTERNS

BY STEVE ELGIE, REGIONAL SALES & SUPPORT MANAGER

Radar Data, NowCast, Alert Thresholds Mobilize Local Knowledge of Flood Risk

Climate extremes are manifesting as more frequent, often bigger rainstorms over Ontario. Combined with accelerated rates of snowmelt, extreme weather makes springtime flooding more unpredictable and severe. Dam operators and flood management agencies are adopting digital innovations to overcome unforeseen weather events and their impacts.

Flood forecasting systems are hardly new, but two critical components of them are getting a big boost: monitoring of weather forecasts and warnings in addition to data processing and information management.

Real Time Monitoring

Ensemble weather forecasts are conventionally used, but they have missed events including the 23 June 2017 storm. Over three to four hours, 126 mm became the highest daily total rainfall on record since 1950. In contrast, commercial data services like HydroMaster are using radar observations with a 10 minute time interval and a spatial resolution as small as one square kilometer. Model output statistic forecast products and hyperlocal information are informing features like NowCasts, or three-hour projections into the future, and multi-threshold alerts.

“Better awareness of unpredicted storms and antecedent conditions is a game changer,” remarked Johan Jaques, a career meteorologist and the solution owner of HydroMaster, a collaboration between KISTERS, DTN, and DHI.

Working closely with water companies, energy utilities, and network operators allows KISTERS to directly address needs and frustrations identified by today’s water professionals who require innovative decision support tools. The cloud service also delivers deterministic forecasts up to 9 days and probabilistic forecasts up to 15 days into the future to support weather forecast-informed operations.

Not only is information from radar and ground-based rain gauges consolidated into a single intuitive web browser, but also the rarity or recurrence intervals of the rainfall event is reported in real-time. Map and personal dashboard visualization options empower staff on duty to more quickly assess risk of flooding and potential impacts on a specific catchment as well as areas or points of interest like dams.

network information and local knowledge of milestone events, enhances post event analyses and calibrates existing hydrologic models.

Grand River Conservation Authority (GRCA) is anticipating receipt of radar observations dating back to 2013 to further review significant flood events in its watershed. New insights will mobilize staff to update existing models and consequently, inform flood mapping. As the agency continues to improve its non-structural approaches to flood management, GRCA is using an Application Programming Interface (API) to feed better input into flood forecasting processes to recover more time to foresee and manage risks, especially those associated with its seven dams, three of which generate hydropower.

Contemplating the 23 June 2017 event over Luther Dam, Dwight Boyd, Director of Engineering at GRCA, remarked that the “NowCast feature would have bought three hours of warning time, time that would have been very useful to assess risk, options, and make proactive decisions”. Instead, staff were on emergency response mode because the rainfall event was unforeseen.

To further the practical application of the tools, Boyd and colleague Vahid Taleban, Water Resources Engineer, used HydroMaster to analyze the 17-19 May 2020 event within the Tittabawassee subwatershed, in the U.S. about 350 km west of their location. Trying to understand conditions that caused the Michigan dam failures and better understand vulnerabilities of GRCA assets, they chose data from three NOAA radar stations and rain gauges in the vicinity and then superimposed the hourly conditions over the Grand River watershed.

After extrapolating and simulating the flood response over the northern parts of the Grand River watershed, inflows into the authority’s two largest dams and associated recurrence intervals revealed a five-year flow range. The 2017 and 2020

events had similar rainfall totals, but rain fell over Grand River in four hours versus 24 hours over Michigan. The GRCA flood control team recognized the May, 2020 event, had it occurred in the Grand River watershed, would have been fairly easily managed without results of flooding or dam failure.

GRCA’s comprehensive flood management also includes structural approaches – dams, dykes, and channel works to convey water away from people. Boyd emphasizes the importance of regular maintenance, dam safety inspections, and addressing any design deficiencies.

Lessons can be learned from every flood event and dam failure and new IT innovations lessen uncertainty overall, but knowledge that becomes available has to be transferred by people and applied by organizations.

For more information about KISTERS’ radar rainfall data service, power generating optimization and dam safety solutions, water information platforms and integration with decision-support systems, please contact Steve Elgie at kna@kisters.net.

Dynamic summary:
Present at 2020/05/20 12:20, all rainfall units in mm

Name	Type	Alert	Warning	Mean per object
Conestogo	Zone of interest	✓	✓	30 mm
Guelp	Zone of interest	✓	✓	1 hour 2 hours 6 hours 12 hours 24 hours
Laurel	Zone of interest	✓	✓	2 years < 2 years < 2 years < 2 years < 2 years
Luther	Zone of interest	✓	✓	2 years < 2 years < 2 years < 2 years < 2 years

TABLE OF EVENT SEVERITY OR RETURN PERIODS
This table features Intensity-Duration-Frequency (IDF) information from Environment Canada. The context helps flood control staff to quickly assess risk and ease statistical communication.

Long-Term Knowledge Mobility

Real-time utilization of HydroMaster radar forecasts and nowcasts are an important part of the picture, but there are additional elements to consider. New availability to historical radar observations, when combined with in-situ monitoring

Dynamic summary maps (Present at 2020/05/20 12:20)

- Observation moving totals
- Observation totals
- Observation return period
- Nowcast
- Forecast moving totals
- Forecast totals
- Extreme forecast index

MAP OF RAINFALL OVER AREAS OF INTEREST
Extensive menus give on-duty staff fast access to moving totals and post event analysts antecedent conditions.

May 17-19 Michigan Rainfall Event Shifted Over the Grand River Watershed

Shand Dam Inflow and Discharge

Conestogo Dam Inflow and Discharge

Map of 15-17 May 2020 rainfall over Michigan’s Tittabawassee subwatershed superimposed over the Grand River watershed and simulated flood response, inflow & discharge at GRCA assets, Shand Dam and Conestogo Dam.