Advanced Hydrologic Prediction on the Lower Great Lakes for Lake Ontario Regulation

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This project was completed in 1999

The Buffalo District of the US Army Corps of Engineers is concerned with providing advice and making decisions on the regulation of Lake Ontario water levels. They consider the balance between interests on Lake Ontario and downstream on the St. Lawrence Seaway. In particular, they provide direction in the administration of Plan 1958-D and advise on when to invoke or revoke Criterion k as an exception under more extraordinary circumstances. Their present procedure for doing this relies on comparison of trends in supplies from the upper Great Lakes with supplies of the past. The Corps recognizes that uncertainties present in their current procedure must be quantified and have elected to explore a risk-based decision model approach in making their regulation decisions. This approach will allow them to incorporate some of the uncertainty inherent in forecasts, to properly consider the wide range of possibilities always present, and to consider the risk associated with their decisions, not possible with the current procedure. This is in keeping with the recommendation of the International Joint Commission to improve forecasts of the frequency of extreme water levels, which came from the IJC Great Lakes Levels Reference Study.

1999 Plans

Build software tools to assist in determination of acceptable risk in regulation decisions on Lake Ontario by the Buffalo Army Corps of Engineers.

Make about 36 forecasts (actually hindcasts), 6 for each of 6 dates recognized by Buffalo as critical in the past for suspending the operating rule used on Lake Ontario. Each hindcast will begin on or near the first of the month (Friday closest) starting 6 months prior to the date, 5 months prior, 4, 3, 2, and 1. Estimate the a priori probability of exceeding criterion h of the orders of approval for each of these hindcasts. Provide criterion k probabilities for each of these hindcasts in the form of ìcriterion k graphs’ used by the Corps.

Make probabilistic forecasts for all hydrologic variables currently reported in the Corps 'Regulation Representatives Letter' which they send out monthly to their users. Finish the tools for graphics outputs, particularly the user interface as requested by the Corps (including multiple quantile curves, preproject and current levels and flows, long-term averages, and previous-year levels).

Develop a standard operating procedure for the Corps to use AHPS in deciding when to invoke/revoke criterion k.

1999 Accomplishments

Finalized GLERL's AHPS extensions to facilitate Lake Ontario regulation via probabilistic outlooks by the Buffalo District of the US Army Corps of Engineers. This included making 36

forecasts (actually hindcasts) over 6 dates recognized by the Corps as critical in the past for suspending the Lake Ontario operating rule. The apriori probabilities, associated with criterion h and criterion k, were estimated for each of these hindcasts. Also, derivative probabilistic forecasts were completed for all hydrologic variables currently reported in the Corps Regulation Representatives Letter.

1998 Accomplishments

Most recently, GLERL completed a working report that reviews the Buffalo Corps current procedures and case histories, which summarizes hydrologic, social, and economic parameters relevant to their decision-making, and which identifies those parameters for which we can estimate probabilities. We have enhanced our Advanced Hydrologic Prediction System to estimate probabilities for the identified parameters. We took existing Corps software for probabilistic outlooks of total basin supply and lake levels for Ontario and the St. Lawrence Seaway and replaced and modified sections of it. These included: (1) criterion k calculations, (2) modifications to pre-project and plan 1958D conditions for water flow and level forecasts and lake regulation, (3) modifications of forecast methodology while preserving routing and regulation logic so that the Corps can maintain that, (4) movement to daily time steps in mid-lake routing computations, and (5) addition of total basin supply outlooks to the AHPS for Ontario and all the lakes. We have nearly completed tools for graphics outputs so that probabilistic outlooks of all variables for weekly time steps may be made, including various reference levels.

Products

Lee, D.H., and T.E. Croley II, 1998. *Advanced Hydrologic Prediction on the Lower Great Lakes for Lake Ontario Regulation. Phases I and II Project Report*. Great Lakes Environmental Research Laboratory, Ann Arbor, 141 pp.

Lee, D. H., T. E. Croley II, and F. H. Quinn, 1997. Lake Ontario regulation under transposed climates, Journal of the American Water Resources Association, *AWRA*, 33(1):55-69. Awarded 1998 Boggess Award for Best Paper by AWRA.