Requirements for Future Streamflow Data in British Columbia

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ABSTRACT

Continuous (uninterrupted) streamflow data over long periods is essential not only in examining trends but also in analyzing the data collection process. This paper predicts the needs for such long term continuous data in the future and outlines the actions which are necessary now to ensure sufficient data is available. The outline includes the minimum gauging requirements and strategy for allotment of extra resources.

Introduction

As the capability for numerical modelling of runoff evolves, due to better understanding of physical processes, improved modelling techniques and availability of more powerful computers, the need for high quality long term data increases. This need is particularly apparent for the examination of the hydrologic data gathering process, particularly for regional hydrometric networks. This paper examines the value of such long term data and estimates the minimum requirements in terms of numbers of hydrometeorological stations. As well as minimum requirements, a strategy for allotment of extra resources (i.e. other long term stations) is examined.

This paper, an extension of studies conducted by the Shawinigan Company in 1970 and Kreuder (1978), is motivated by concern over possible discontinuance of hydrometeorologic stations. Suggestions to the effect that thirty or forty years of record is sufficient for any station have recently been made. But in light of recent studies, the value of long term record, particularly for the regional network, is becoming apparent. This paper claims that if good records are being achieved at a regional network station, then close consideration should be given to continuing the data collection as long as possible.

At this point in the development of this paper two key phrases require definition. First, the regional hydrologic network refers to the collection of the hydrometeorologic stations of Water Survey of Canada, Pacific and Yukon Region which gauge streams draining basins which are in a natural condition. The assumption is that these basins yield data which can be used to make estimates of flow quantities for ungauged streams within the hydrologic region.

Second, a hydrologic region is a geographic area within which hydrologic response of basins is similar to the extent that the mean of the response can be represented by a model. The model will usually be statistical, for example, a regression equation using basin characteristics and meteorologic quantities.

Proposed Action

There is no hydrometeorological station in British Columbia with continuous records from 1900 to the present. The longest continuous record from a regional station is 55 years beginning in 1930. There are no long term regional records from the northern or from the dry regions of the province. Recent studies on monthly streamflows have indicated statistical structure which requires at least 50 years of record to study. Obviously, the province is data deficient both geographically and for analysis of monthly streamflows.

Previous studies have identified up to eight hydrologic regions in British Columbia. The number of regions depends upon the quantities analyzed, for example, mean annual flow, monthly flows or floods. In general, the number of regions increases as the time span of the hydrologic quantity decreases, so that the number of regions for floods is greater than the number of regions for annual flows. A second consideration to the identification of hydrologic regions is that the province north of 55° N latitude is sparsely gauged and many of the basins that are gauged are large, drainage basins with areas of thousands of square kilometres. So the hydrologic regions in the northern part of the province may not be well identified.

The obvious minimum requirement is that one basin should be chosen from each hydrologic region. The basin should have a drainage area between 200 and 600 square kilometres, large enough to provide an indication of regional hydrologic response. The hydrometric station gauging the basin should have a stable section producing a reliable stage-discharge relation (a calibration curve to estimate flow from depth of water). The station should show a history with few operational problems and little missing record. The flows at the station should show high correlation with flows from other basins in the region. In other words, the basin must be typical of the region.

Regional network stations gauge basins whose flow is judged to be natural. Basins chosen for long term data collection should be those with little chance of intervention with the flow regime. But intervention can arise not only through human activities but also through natural events such as forest fires or insect infestation.

The dry regions of the province are probably the most troublesome for data transferability (Leith (1981)) and for gaining sufficient data to study trends and processes. Eagleson (1981) has estimated that dry regions probably require ten times the data of wet regions to specify processes.

In light of the data deficiencies in certain parts of the province and possible loss of stations to interventions in natural flow regime, more stations should be assigned to long term data collection if resources permit. This is especially true in the northern part of the province and for the dry central interior.

In the future, monthly flows, peak flows and low flows will be in greater demand by hydrologic data users both for planning and for operation. The number of requests for these quantities and enquiries concerning studies on these quantities has been increasing. These are quantities whose structure must be studied and this study can only be done with long term continuous records.

Analytic procedures for estimating the optimum number of stations and for locating stations within a hydrologic region are lacking. But new techniques for analyzing data are appearing. These techniques are more sensitive to and provide a more realistic representation of data structure and should provide better indications of transferability and value of data. These include: multivariate analysis, non-linear models, and models which use spatially distributed inputs and parameters. To make the best use of these models it is necessary to have the best possible data available. It is highly probable that the above methods will be able to make better use of long term uninterrupted records especially extreme events, both floods and droughts. For these extremes, long records are necessary to place events in perspective, that is, to place a specific flood as the highest in five years, in fifty years. As more is known about the processes, more can be done about estimating the optimum (or at least a reasonable) number of stations.

Conclusions

As best can be estimated at present, the need for long term continuous hydrologic record will increase in the future. To meet this need steps must be taken now to continue existing hydrometeorologic stations and to establish new stations in undergauged regions. The full effects of these actions cannot be assessed until long term data is available, but best judgement indicates that this data gathering will be valuable and should have immediate attention. In particular, stations gauging basins of 200 to 600 square kilometres which are intended for long term operation should be established in the dry central interior and in the northern parts of British Columbia and existing stations should be examined so that a list of candidate long term stations is available.