COMPARABILITY OF DCP DATA WITH STANDARD STATION OBSERVATIONS

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INTRODUCTION

The Water Survey of Canada (WSC) has been gathering water level data on a real-time basis for a number of years in order to provide information to users for water management purposes. Initially, this was accomplished by installing and operating Stevens Telemarks at gauging stations. These were used mainly at locations where there was reasonable access to telephone lines or where radio communication systems could be installed, although the latter were considerably more costly.

During the past decade, with the development of satellite technologies for data retransmission, another method became available for collecting hydrological data from widely dispersed and remote locations. Experiments with various satellite systems and data collection platform (DCP's) have shown them to be both highly reliable and suitable for transmitting data from the field (Reid et al., 1981). Consequently, plans have been formulated for a considerable increase in the use of DCP's in the stream gauging network. Within the next five years, the WSC will install in excess of 350 DCP's at remote gauging station locations in Canada (Figure 1).

Along with this expanded use of DCP's by WSC, there exists a possible logical alternative for other agencies to acquire field data from remote areas. The potential co-location of other hydrometeorological sensors at WSC gauging stations could minimize field installation and operating costs. It is now necessary to develop and investigate operating strategies to make optimum use of this potential. To explore some of the advantages and problems associated with such a venture, a gauging station was installed at Lemieux Island on the Ottawa River at Ottawa and meteorological sensors were subsequently co-located by the Atmospheric Environment Service.

In the fall of 1982 a full complement of hydrometeorological sensors were connected to a Bristol Hydrometeorological DCP located at Lemieux Island. The main objectives of this installation were threefold:

i) to install and operate common Atmospheric Environment Service (AES) recommended meteorological instruments on a WSC platform;

ii) to gain experience in operating a joint agency DCP station;

iii) to compare the data from the DCP sensors with those obtained from standard synoptic or climate stations.

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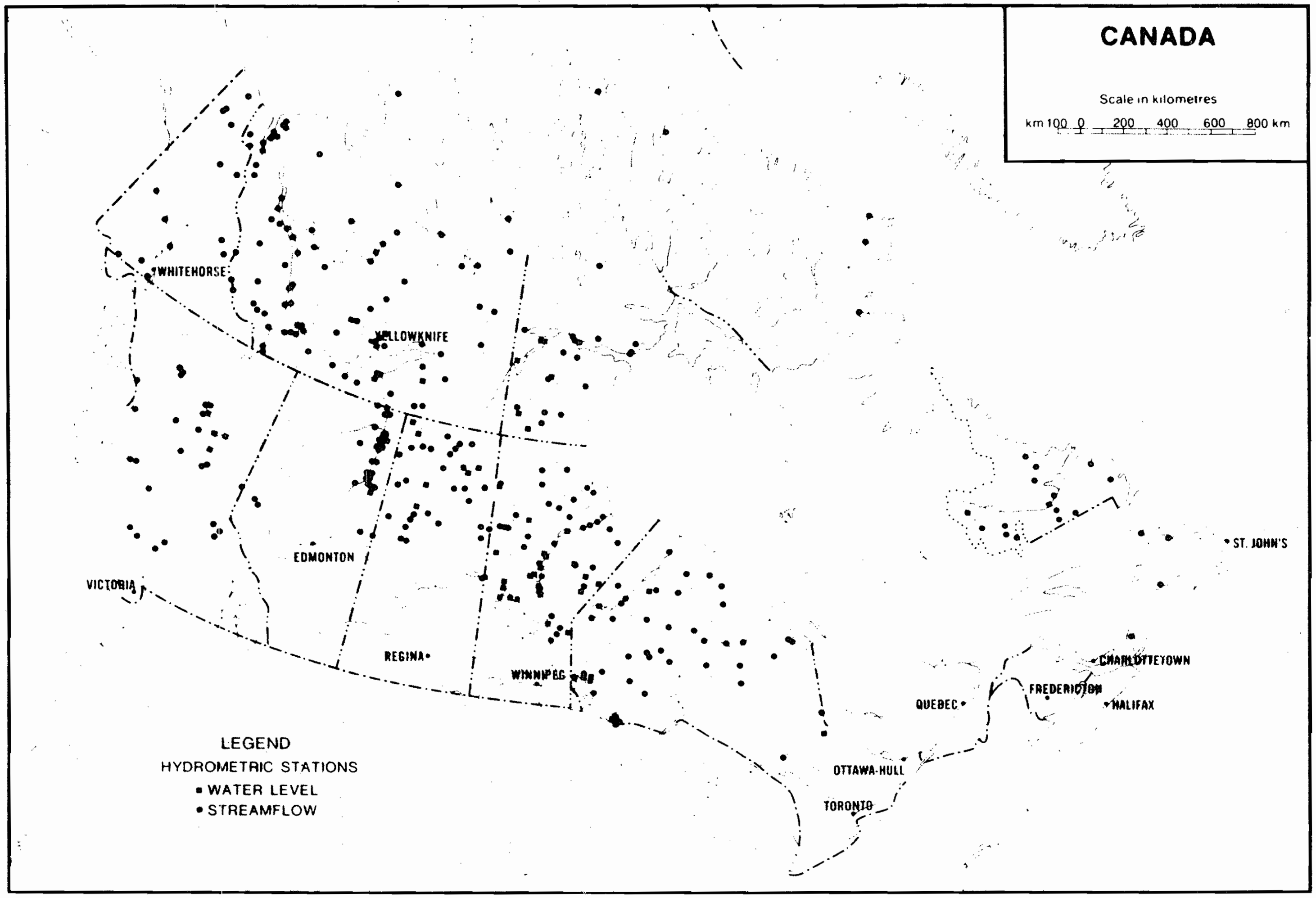

WATER SURVEY OF CANADA DESIGNATED REMOTE ACCESS HYDROMETRIC STATIONS

FIGURE 1

THE DCP SYSTEM

The Bristol Hydrometeorological DCP was designed to interface to a number of hydrological and meteorological sensors through the use of dedicated software algorithms and input ports. Meteorological sensors chosen for the Lemieux Island platform conformed to the recommendations of the DOE DCP Co-ordinating Committee (Environment Canada, 1983) and to manufacturers' specified inputs. The Bristol Hydromet DCP accepts data from the following specified sensors:

- one anemometer (45B or 77C)
- Fischer and Porter precipitation gauge fitted with Baldwin absolute position shaft encoder
- one or two stage recorders (such as Leupold and Stevens Memomark II or III)
- external temperature probe (YSI 44212 element)
- external humidity sensor (such as Lambrecht Pernix Humidity Teletransmitter)

In addition to the dedicated inputs, the following user definable channels are provided:

- four differential analog input channels (0-5.0 volt)
- six event input channels (MSC tipping-bucket raingauge)

Data were acquired by dialing-in to the National Environmental Satellite Service (NESS) in Camp Springs, Maryland and "dumping" the data to a hardcopy terminal. Data storage is guaranteed for a 24 hour period, but usually data for the past 72 hours were available at NESS.

INSTALLATION

The meteorological equipment, including a 7 m tower, were installed by two AES personnel in one day. Some trouble was experienced in interfacing the Fischer and Porter precipitation gauge, Pernix humidity sensor and the 77C anemometer; however, all of the problems were associated with incorrect wiring or manufacturers' alterations to original specifications. All of the sensors installed at Lemieux Island were located within 15 m of the DCP. Cables at this site were not placed in flexible metal conduit; however, this practice would be mandatory for all remote, permanent installations.

The Fischer and Porter precipitation gauge was fitted with an absolute position shaft encoder, which permitted precipitation totals to the nearest millimetre to be measured and transmitted in real-time. The standard punch paper tape assembly was left on the gauge and operated to provide on-site back-up and a comparative data set. The gauge was fitted with a large Nipher-type shield.

MESSAGE FORMAT

The original format (Figure 2) for the Hydromet DCP was fixed since all sensors were sampled with each data acquisition. The number of fixed data sets sent with each transmission may vary from one to five. The Lemieux Island DCP message contained five sets of hourly observations, from the oldest to the most recent data. The DCP transmitted every three hours.

DATA COMPARISON

Standard meteorological measurements from Ottawa International Airport and the Ottawa Central Experimental Farm (CEF) were compared to the Lemieux Island DCP observations for November 1982 and February 1983. The Lemieux Island test site was not an ideal meteorological site since it was located in a river valley and sheltered by nearby buildings. Ottawa Airport is an AES hourly reporting synoptic station located on the outskirts of Ottawa approximately 20 km from Lemieux Island and 60 m higher. Ottawa CEF is an AES climate station operated by Agriculture Canada; observations are taken twice daily. The station is located in the centre of the city of Ottawa and is approximately 25 m higher than the

Lemieux Island station. Therefore, differences in meteorological data among the three stations could be a result of site, sensor or data abstraction.

Figure 2. Hydromet DCP Message Format

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                         558AA50 308114922 I.D. -Date-Time

Newest  008 00 0024 8528 0000 0202 3819 3090 0960 0777 0000 0000 0000 0000
        010 00 0026 8582 0000 0210 3819 3066 0960 0783 0000 0000 0000 0000
        009 33 0027 8635 0000 0215 3819 3045 0960 0780 0000 0000 0000 0000
        006 00 0028 8642 0000 0220 3816 3033 0963 0783 0000 0000 0000 0000
Oldest  008 30 0030 8612 0000 0227 3816 3018 0960 0783 0000 0000 0000 0000 47+ONN 19E

      F&P
    Precip.                   Battery   External     Analog Inputs
                              Voltage    Temp.
                                                                 Satellite Data
Wind Speed&Direction
                          Tipping Bucket     Humidity
                   Water Level       Internal Temp.
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Precipitation storm totals were compared for the three stations for the test series. No bias was observed in rainfall or snowfall measurements at any of the stations; small differences in precipitation amounts were attributable to showery conditions or storm track differences. Hourly values of temperature and relative humidity were used to determine mean daily vapour pressure. The correlation of vapour pressure between the DCP and the AES stations was surprisingly good, considering one might expect higher humidity at the DCP site, which was located on the river.

Wind speed and direction proved to be much more difficult parameters to relate. Wind directions at Lemieux Island were quite different from those at the airport due to the sheltered location and river valley influence at the DCP site. Mean daily wind speeds at the Lemieux station were consistently lower than the airport. This would be expected because of the sheltered location of the Lemieux platform.

Figures 3 and 4 compare the daily maximum and minimum temperatures for Ottawa International Airport and the Lemieux Island DCP. The correlation coefficient in each case was about 0.95. Maximum daily temperatures at the DCP site and at the airport were very similar across the wide range of temperatures sampled during the November and February period. Minimum daily temperatures, on the other hand, tended to be as much as 5°C colder at Lemieux Island when minimum values fell below − 10°C (Figure 4). The difference is most likely due to a combination of cold air drainage into the river valley, which affects the DCP site, and/or local heating at the airport observation site, which is located in front of the terminal building.

Water level data were acquired over a period of time and found to compare favourably with those obtained by conventional means (Gagne, 1983).

CONCLUSIONS

The experiment at Lemieux Island has demonstrated that AES meteorological sensors can be operated successfully on a WSC data collection platform (Goodison, 1982). It has also demonstrated that:

i) the DCP with its own complement of sensors and cables should be hooked-up and pre-tested prior to field installation;
ii) meteorological sensors should be sited to represent regional climate;
iii) precipitation (rain <u>and</u> snow) measurement is preferred to rainfall measurement only;

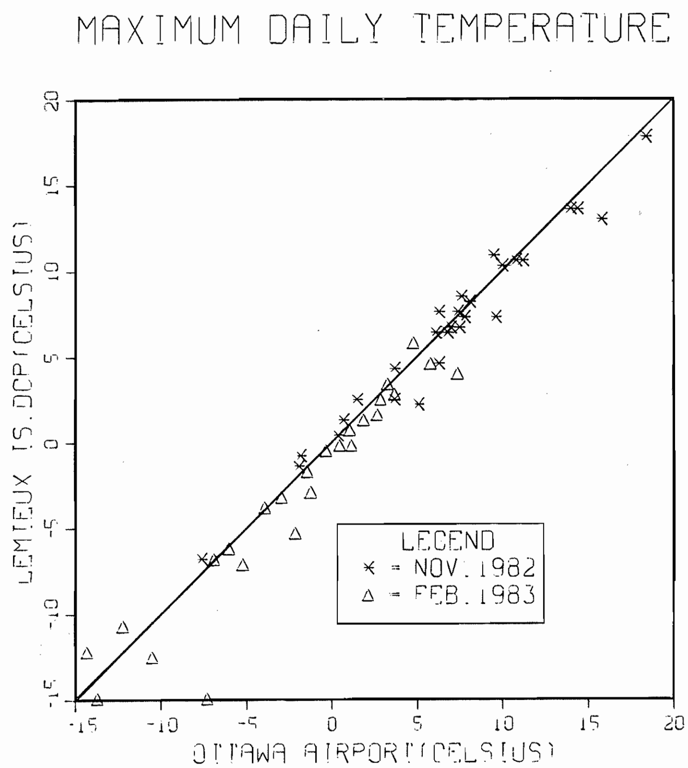

Figure 3. Comparison of daily maximum temperature at Lemieux DCP and Ottawa Airport.

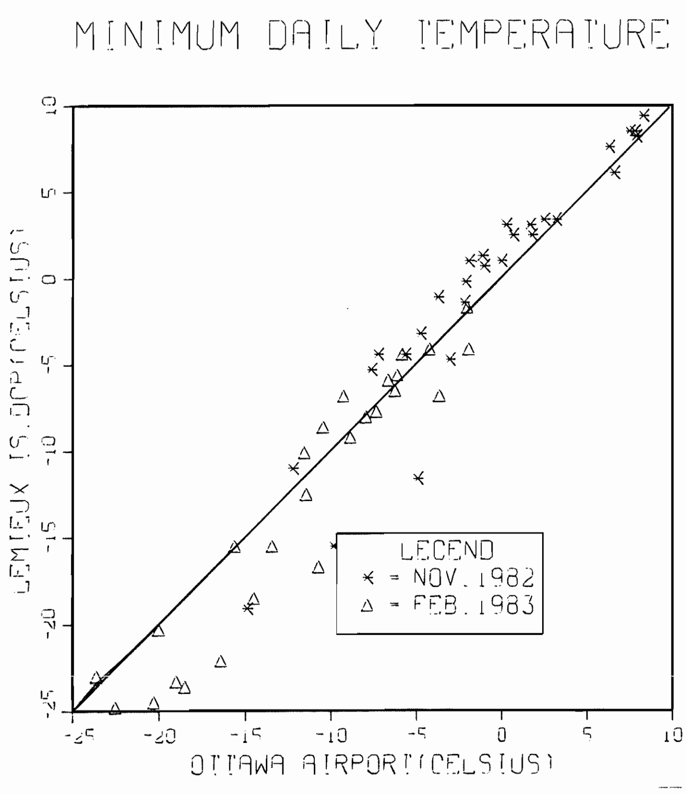

Figure 4. Comparison of daily minimum temperature at Lemieux DCP and Ottawa Airport.

iv) technical training on Hydrometeorological DCP's and sensors is required;
v) on-site testing and calibration of the DCP and sensors are necessary.

It should be noted that meteorological data at a DCP station may differ from nearby climate or synoptic stations. The difference may be attributable to site, sensor or method of data abstraction. WSC stations will be located in river valleys where local wind speeds may be lower than the regional wind. Cold air drainage may affect daily temperature extremes. Precipitation data from a Fischer and Porter gauge with a large Nipher shield are compatible with nearby synoptic station totals.

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