

# GREAT EXPECTATIONS: IMPROVING CLIMATE DATA SERVICES

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## 1. INTRODUCTION

Two decades ago, the majority of climate and historical weather data requests came in to regional Climate Services offices via phone or mail. The response time varied from several days to a matter of weeks and clients were content just to have their requests fulfilled. Ten years ago, requests started to come in by email and for many data users an annually published CD including a snapshot of daily data in the archives met their climate data needs. Today, with hourly data easily available and a website that serves up data almost as soon as it is recorded, the demands for increased climate data services have wildly multiplied.

In 2003, Environment Canada made more data available to the general public via the launch of Canada's National Climate Archives On-line website:

(<http://www.climate.weatheroffice.gc.ca/>). National Climate Archives On-line provides live access to basic historical climate and weather data from the National Climate Data and Information Archive. Since then, the demand for on-line historical climate data and information from both public and private sectors has increased dramatically. Today the on-line website is the second most popular Environment Canada website, behind only the WeatherOffice (forecast) page. The climate site averaged more than 220 000 visits per month with 6.9 million pageviews and over 400 Gigabytes of climatic data downloaded in the first half of 2009.

Due to increasing popularity and demand, an Access Services Unit in the Data Analysis and Archives Division of Environment Canada was established in 2008 to improve and enhance the relevance, visibility and availability of historical climate

data on-line. Since then, a number of improvements to National Climate Archives On-line have been implemented such as the adoption of the new Common Look and Feel Standards and the inclusion of new features including real-time messaging, weather trivia, an historical radar viewer and the availability of downloadable publications from the National Climate Archives library.

Coincidentally, monthly average pageviews have increased dramatically from 132 000 in January to 414 000 in June and then 856 000 in December of 2009. The average number of visits has remained relatively consistent in 2009; however, the increase in pageviews suggests that existing users are making more use of the site than they previously were. It is believed that the growth in pageviews can be attributed to a number of these improvements. This paper will review the recent enhancements to National Climate Archives On-line in greater detail and discuss plans to provide further improvements to services which are necessary to meet the growing expectations of users.

## 2. IMPROVEMENTS AND ENHANCEMENTS

### 2.1. *Common Look and Feel (CLF 2.0) Standards*

According to the Treasury Board of Canada Secretariat website (<http://www.tbs-sct.gc.ca/clf2-nsi2/index-eng.asp>), recognition that the internet is an increasingly important communication tool that provides effective means for the government and the public to exchange information led to the Common Look and Feel Standards (CLF 2.0), which were designed to assure consistent and predictable presentation of web-based government services and content. The new Common Look and Feel Standards for the internet were developed to reflect modern practices on the Web and changes in technology and issues raised by the Web community over the past six years.

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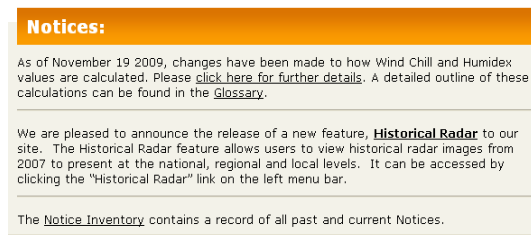
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In order to improve navigation and format elements, CLF 2.0 includes standards on web addresses, accessibility and interoperability, usability of web sites, common web page formats and email. Keeping in line with the goals of the Access Services Unit for improvements to services, the implementation of CLF 2.0 resulted in modifications of the entire site template for National Climate Archives On-line. Some of the high-level enhancements included: improved navigation, improvements to the site's overall accessibility for the use of assistive technologies, improved display of the site on a variety of browsers and alignment with W3C checkpoints (international web standards).

## 2.2 Real-Time Messaging

The Real-Time Messaging component to National Climate Archives On-line was designed to allow a Real-Time Messaging Administrator the ability to update the website with "urgent" messages and display them for external users when it is not possible to wait for the next scheduled website release. Real-Time Messaging serves to keep users of National Climate Archives On-line informed and up to speed on issues such as delays in data display, new services that are available, and changes to how data is being collected and/or displayed at various climate sites. This can help to avoid questions and complaints that would have previously come in via email.

The Real-Time message box is displayed underneath the header, or as a sidebar, and is present on all pages:



**Figure 1.** A real-time messaging feature allows us to quickly inform our clients of changes and updates.

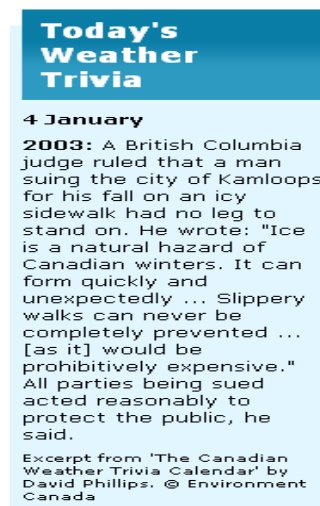
The administrator has the ability to create a new message, edit an existing message or

review old messages as appropriate. All messages that are active are displayed in the "Notices" box for the set time period as decided by the Administrator. Once a message has expired it will no longer be displayed. Recently, a *Notice Inventory* feature was introduced to allow users to view a record of all past and current notices.

## 2.3 Weather Trivia

As an added educational and fun feature to National Climate Archives On-line, a display of daily excerpts from The Canadian Weather Trivia Calendar was added. The annual Canadian Weather Trivia Calendar is Canada's best selling calendar and is written by Environment Canada's senior meteorologist and weather expert, David Phillips. It is a compilation of some of the most amazing Canadian weather stories ever recorded.

The Weather Trivia feature on National Climate Archives On-line displays two types of text from the Calendar; historical weather events and weather trivia questions for a specified day. The daily text display is synchronized with the date of the calendar year but is randomized among the available sources of the Trivia Calendar. At present, excerpts on-line are available from the 2006 to 2009 calendars with plans to add passages from calendars for upcoming years.



**Figure 2.** An entry from Today's Weather Trivia feature on National Climate Archives On-line.

## 2.4 Historical Radar Viewer

Environment Canada's RADAR network of 31 sites (28 Environment Canada radars, 2 Department of National Defence radars and 1 radar from McGill University at the Marshall radar Observatory) covers 98% of the most populated areas in Canada. Their primary purpose is the early detection of developing precipitation, thunderstorms and high impact weather ([http://www.msc-smc.ec.gc.ca/projects/nrp/index\\_e.cfm](http://www.msc-smc.ec.gc.ca/projects/nrp/index_e.cfm)).

RADAR images are currently archived in the National Climate Data and Information Archive. The following image types are available; rain and snow Constant Altitude Plan Position Indicator (CAPPI's), rain and snow precipitation images (PRECIP's), Echo Tops, Rainfall Accumulation (RFA's, since 2006) and Precipitation Accumulation (PA's, since 2009).

Archived radar files serve the need for both technical/scientific study, as well as public access to basic RADAR imagery. Recognition of the need for public access led to the creation of Environment Canada's Historical Radar Viewer which was launched in October 2009 on the National Climate Archives On-line website.

The Historical Radar Viewer was designed to allow public access to files contained in the radar archives. At present, the Radar Viewer provides access to historical rain and snow PRECIP images for all sites, except for the McGill radar site, for which only CAPPI's are produced and available. The PRECIP image is designed to show the precipitation close to the ground by using Doppler technology processing for echoes within 128 km from the radar site. Beyond this limit the RADAR operates in non-Doppler mode and the echoes from a constant altitude above ground, CAPPI's are displayed ([http://climate.weatheroffice.gc.ca/radar/how-to-use\\_e.html](http://climate.weatheroffice.gc.ca/radar/how-to-use_e.html)).

The Historical Radar site was designed to emulate the existing real-time WeatherOffice display by allowing for basic animation of the images. Users can view historical radar images at the national, regional and local levels for periods of 2, 6 or 12 hours. At present, images in the radar viewer are only available as far back as 2007. Plans are underway for Phase II of the project, to backfill with more historic images

as well as allow for a greater selection of image types to be available. Phase II of the Radar Viewer is expected to be implemented in 2010.

## 2.5 Downloadable Publications

Recently, popular historical Environment Canada publications, studies, and reports from the National Climate Archive library were made available for download as electronic files in the Products and Services section of National Climate Archives On-line. Although many of these documents were published almost two decades ago, they contain valuable climate information for researchers and engineers. Downloadable publications that are available are as follows:

1. Principle Station Data (1983): A series of publications for principal climate stations across Canada providing a summary of hourly weather observations, climate normals and extremes.

2. Rainfall Frequency Atlas for Canada (1985): A compilation of Canadian rainfall frequency maps, this publication has compiled data using extreme value analysis and other statistical analyses from a total of 504 recording precipitation gauges with at least 7 years of record.

3. Climate Atlas (1988): A climatic atlas based on the 1951 to 1980 Climate Normals which provide a series of over 400 national maps portraying Canada's climate within five volumes:

- I. Temperature & Degree Days
- II. Precipitation
- III. Pressure, Humidity, Cloud, Visibility, and days with... Thunderstorms, Hail, Smoke/Haze, Fog, Freezing Precipitation, Blowing Snow, Frost, Snow on the Ground
- IV. Bright Sunshine & Solar Radiation
- V. Wind

4. Wind Energy Resource Maps of Canada (ARD Report 92-003) (1992): A publication containing maps and tables, the ARD report 92-003 provides information such as wind energy frequency distributions, annual and monthly mean values, frequency and duration episodes, and low & high wind energy potential for 144 Canadian locations.

[http://climate.weatheroffice.gc.ca/prods\\_services/historical\\_publications\\_e.html](http://climate.weatheroffice.gc.ca/prods_services/historical_publications_e.html)

In early 2010 two of Environment Canada's engineering climate datasets will also be made available for electronic download on the Products and Services page of National Climate Archives On-line. They are the Canadian Weather Energy and Engineering Datasets (CWEEDS) and Canadian Weather Year for Energy (CWEC) datasets.

CWEEDS is a data set of hourly weather conditions occurring at Canadian locations for their entire period of record. The files start as early as 1953, and end for most locations in 2005. The primary purpose of these files is to provide long term weather records for use in urban planning, siting and design of wind and solar renewable energy systems, and design of energy efficient buildings. One of the main reasons for developing CWEEDS files is the provision of estimated hourly solar radiation amounts (through the use of a model), for weather observation locations at which solar radiation is not observed.

The CWEC files were created by concatenating twelve Typical Meteorological Months selected from a database of, in most cases, 30 years of Weather Year for Energy Calculations 2 (WYEC2) data. WYEC2 data files were developed specifically for use with building energy simulation programs. The months are chosen by statistically comparing individual monthly with long-term monthly means for daily total global radiation, mean, minimum and maximum dry bulb temperature, mean, minimum and maximum dew point temperature, and mean and maximum wind speed.

### **3. FUTURE PLANS**

#### **3.1 Usability Study**

In 2010 the Access Services Unit is hoping to conduct a Usability Study to determine the effectiveness and presentation of the National Climate Archives On-line website. This will help to ensure that complex information is

accessible and presented in an understandable and usable format.

The most widely used feature of the National Climate Archives On-line website is Climate Data On-line, which provides users with direct access to historical climate data for specific locations and dates through use of a customized search function. Users can currently search data availability for a custom location by province, station name or proximity. The Usability Study will be designed to identify whether the current labels, navigation, and layout of the Climate Data On-line website lead to successful completion of assigned tasks. It will identify any shortcomings of the design through analysis of failed tasks and one-on-one exit interviews with participants. The goal is to achieve an elegant query interface that meets the needs of the general public and climate scientist alike while integrate existing content with effective architecture, design and navigation.

The study will consist of three phases. Phase I will involve a client-centered analysis of the existing site, consisting of an expert review by 10 targeted users and two focus groups. Phase II will consist of 20 one-on-one usability interviews in which interviewees will navigate a new query interface prototype. Phase III will involve work on plans to implement suggestions from the usability study.

The new concepts developed from the study will help the Climate Data Online site meet its goals of ensuring that labels, content and functions facilitate navigation and user movement, are intuitive and usable from a client perspective, achieve the client's task objectives and use effective graphic design and visual presentation techniques. Environment Canada also aims to understand the user's motivation and the range of decision making based on the use of climate information specifically; the value placed on climate information, the appropriate level of detail and the frequency of use.

#### **3.2 Bulk Data Access Improvements**

Over the past few years, it has become clear that improvements in bulk access on-line services are needed to match the growing expectations from users. The current bulk data access tool available on National Climate Archives On-line is part of the Climate Data On-line Website. It is limited to CSV and XML format downloads of 1 month of hourly data, 1 year of daily data or 10 years of monthly data on a station-by-station basis. These restrictions were defined with the implementation of National Climate Archives On-line in 2003 and were based on the assumed needs of clients at the time of the website launch, as well as limitations on bandwidth at the time.

Several years before the launch, another form of bulk access to data was made available to Canadian climate data users; the Canadian Daily Climate Data (CDCD). First created in 1990, the CDCD product was later made available online, allowing users with high speed internet connections to download all daily temperature, precipitation and snow on the ground data for over 7000 climate stations in Canada. It was last updated to contain data for the complete period of record for each station up to 2007 for most locations. While CDCD has been a very popular and useful product for clients, it also has limitations. As a legacy product it is DOS-based and many users have found it difficult to download and navigate. Also, when the product was created, the programmer did not intend its use for mass extractions and therefore users are only able to extract data for a few stations at a time from the dataset. In addition, as the product is created as a snap-shot of the archives at a particular time, any archive corrections or updates made to the data in the database are not reflected in the product until an update has been created.

As a result of the limitations of the current bulk data access tools, typical users such as, researchers, educational institutes, government organizations and private companies (i.e. consultants) have been required to request bulk data services on a cost-recovery basis. Several considerations such as data format, user need and user knowledge must be taken into account

before improvements to bulk data access can be made. Delivery options to provide the best all-round services are currently being investigated.

### **3.3 GIS Interface**

Currently, the Climate Data On-line website incorporates a static map with many of the major Canadian cities located on it. The customized search function helps users find stations near a particular location of interest; however, it has been recognized that users aren't always familiar with a station's geography. A map interface which shows all stations and allows users to select an area of interest to see what stations are located nearby is highly desired. This improvement is currently a top priority.

### **3.4 Increases in Data Availability**

In 2006, several new elements were added to the archive. They included; altimeter setting, new cloud layers, obscuring phenomena, wind character and wind gust speed from the Hourly Aviation network, and twenty-five new Reference Climate Station (RCS) elements pertaining to precipitation, wind, and solar radiation (Cerny, C., Sopoco, T.H, Tiongson, K., 2006).

At present only selected hourly, daily and monthly elements from the National Climate Data and Information Archive are displayed and are available for download from Climate Data On-line. Hourly elements available are listed below in Table 1.

<b>Hourly Elements</b>
Temperature (°C)
Dew point temperature (°C)
Relative Humidity (%)
Wind Direction (10's degrees)
Wind Speed (km/h)
Visibility (km)
Station Pressure (kPa)

Humidex
Wind Chill
Present Weather (Observations of atmospheric phenomena including the occurrence of weather and obstructions to vision.)

**Table 1.** Hourly elements displayed on Climate Data On-line.

Daily and monthly elements are listed below in Table 2.

Daily and Monthly Elements
Minimum/ Maximum/Mean Temperature (°C)
Heating Degree Days (°C)
Cooling Degree Days (°C)
Total Rain (mm)
Total Snow (cm)
Total Precipitation (mm)
Snow on the Ground (cm)
Direction of Maximum Gust (10's degrees)
Speed of Maximum Gust (km/h).

**Table 2.** Daily and Monthly elements displayed on Climate Data On-line.

To provide greater access to more data, the addition of other commonly requested elements which are only available on a cost-recovery basis at moment, are under consideration. They include parameters such as solar radiation data which are archived as hourly and recently, minutely observations, and are frequently requested by researchers and the renewable energy sector. As well, hourly rate of rainfall data recorded from Tipping Bucket Rain Gauges (TBRGs) which are commonly requested for engineering purposes.

### **3.5 Temperature and Precipitation Records Bulletins**

In the past, bulletins were sent out from all the regional forecast offices across Canada, indicating any new temperature

and precipitation records for the previous day or month. The records, combining station data for a local area, were commonly used by the media and were also of great interest to the general public. Many of these locations had records dating back into the 1800s. In recent years regional climate resources have been strained and this product was dropped in most regions due to the difficulty in maintaining the regional records databases. As a result of significant demand for this product by the media and others a national solution, a web-based temperature and precipitation records generator and data base, has been proposed. This project is currently underway and should be available for public access via the National Climate Archives On-line website in the future.

## **4. SUMMARY**

The National Climate and Information Archive is part of the Meteorological Service of Canada and is operated and maintained by Environment Canada. It concentrates on archiving and maintaining historical climate and weather observations for the entire country from MSC operational monitoring networks, and ensuring accessibility of data.

Changes in the demands for information and data access throughout the years led to the 2003 launch of Canada's National Climate Archives On-line website. The goal of the site was to provide a means for making more data and information available to the public via the internet. Since then, the demand for on-line historical climate data and information from both public and private sectors has increased dramatically. In 2008, the Data Analysis and Archives Division of the Meteorological Service of Canada established the Access Services Unit to improve and enhance the relevance, visibility and availability of historical climate data on-line. As a result, a number of improvements to the National Climate Archives On-line website have been implemented.

Common Look and Feel (CLF 2.0) web-based government standards were introduced and resulted in modifications of the entire site template of National Climate Archives On-line. Some of the high-level



enhancements included: improved navigation, improvements to the site's overall accessibility for the use of assistive technologies, improved display of the site on a variety of browsers and alignment with W3C checkpoints (international web standards).

Recognition of the need for public access to historical RADAR imagery led to the creation and launch of the Historical Radar viewer. The Historical Radar viewer emulates the existing real-time WeatherOffice display of RADAR images by allowing for basic animation of the images. Users can view historical images since 2007 at the national, regional and local levels for periods of 2, 6 or 12 hours.

Other enhancements to the website included the addition of downloadable historical publications from the National Climate Archive library and the addition of a Real-Time Messaging component. Real-Time Messaging serves to keep users informed and up to speed on issues such as delays in data display, new services that are available, and changes to how data is being collected and displayed at various sites.

Finally, other improvements and enhancements that are in the scope of work for the future include; a Usability Study, a GIS based map interface, increases in on-line data availability, improvements to bulk access and the creation of a temperature and precipitation record generator and database.

## 5. ACKNOWLEDGEMENTS

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