Steffi LaZerte & Sam Albers

weathercan

An R package for accessing
Environment and Climate Change Canada weather data

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PCAG 2017

Historical weather data

- Environment and Climate Change Canada
- 1840 to Present
- Hourly, daily, monthly intervals
- > 26,000 stations (past and present)

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Lots of Data!

Accessing data from ECCC website

Government of Canada | Gouvernement du Canada

Search Canada.ca

Jobs | Immigration | Travel | Business | Benefits | Health | Taxes | More services

Home ➜ Environment and natural resources ➜ Weather, Climate and Hazard ➜ Past weather and climate

Historical Data

To determine data availability for a custom location and date, please complete and submit one of the following searches:

Search by Station Name | Search by Province | Search by Proximity

How to Use - Search by Station Name

Name:

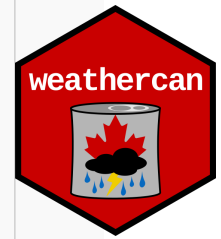
contains begins with

with data available between: 1840 to 2017

with data on: 2017 September 25

Display 25 **results per page.**

Search Reset



Station Results - Historical Data

7 stations found with name containing "Brandon", with data available between 1840 and 2017. Stations are listed in alphabetical order. Confirm the Data Interval and the date for one of the stations listed and click "GO" to display the historical data.

Station	Prov.	Data Interval	Year	Month	Day	
BRANDON #1 WINTER BAY	MB	Daily	2002	Apr	30	Go
BRANDON A	MB	Hourly	2012	Dec	6	Go
BRANDON A	MB	Hourly	2017	Sep	25	Go
BRANDON CDA	MB	Daily	2010	Mar	10	Go
BRANDON RCS	MB	Hourly	2017	Sep	25	Go
BRANDON SOUTH	MB	Daily	1975	Sep	30	Go

Hourly Data Report for September 25, 2017

All times are specified in Local Standard Time (LST). Add 1 hour to adjust for Daylight Saving Time where and when it is observed.

BRANDON A
MANITOBA

Latitude:	49°54'36.000" N	**Longitude:**	99°57'08.000" W	**Elevation:**	409.30 m
Climate ID:	5010481	**WMO ID:**	71140	**TC ID:**	YBR

Related Data

Almanac Averages & Extremes (September 25)

Daily Data (September 2017)

Additional Search Options

Nearby Stations with Data

Historical Data Search

Download Data

Hourly Data (September 2017)

CSV XML

Download Data

Get More Data

Previous Day

2017 | September | 25 | Go

Hourly Data Report for September 25, 2017

	Temp °C	Dew Point Temp °C	Rel Hum %	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Hmdx	Wind Chill	Weather
TIME										
00:00	7.6	6.9	95	34	7	24.1	97.12			Cloudy
01:00	8.2	5.7	84	2	13	24.1	97.14			NA

Hourly Data Report for September 25, 2017

All times are specified in Local Standard Time (LST). Add 1 hour to adjust for Daylight Saving Time where and when it is observed.

BRANDON A
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Latitude:	49°54'36.000" N	**Longitude:**	99°57'08.000" W	**Elevation:**	409.30 m
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Related Data

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Hourly Data Report for September 25, 2017

	Temp °C	Dew Point Temp °C	Rel Hum %	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Hmdx	Wind Chill	Weather
TIME										
00:00	7.6	6.9	95	34	7	24.1	97.12			Cloudy
01:00	8.2	5.7	84	2	13	24.1	97.14			NA

Data good but not ready

```
"Station Name","BRANDON A"
"Province","MANITOBA"
"Latitude","49.91"
"Longitude","-99.95"
"Elevation","409.30"
"Climate Identifier","5010481"
"WMO Identifier","71140"
"TC Identifier","YBR"
"All times are specified in Local Standard Time (LST). Add 1 hour to adjust for Daylight Saving Time where and when it is observed."

"Legend"
"E","Estimated"
"M","Missing"
"NA","Not Available"
"‡","Partner data that is not subject to review by the National Climate Archives"

"Date/Time","Year","Month","Day","Time","Data Quality","Temp (°C)","Temp Flag","Dew Point Temp (°C)","Dew Point Temp Flag","Rel Hum (%)","Rel Hum
Flag","Wind Dir (10s deg)","Wind Dir Flag","Wind Spd (km/h)","Wind Spd Flag","Visibility (km)","Visibility Flag","Stn Press (kPa)","Stn Press
Flag","Hmdx","Hmdx Flag","Wind Chill","Wind Chill Flag","Weather"
"2017-09-01 00:00","2017","09","01","00:00","‡","20.8","","17.3","","80","","18","","18","","24.1","","96.21","","26","","","","Cloudy"
"2017-09-01 01:00","2017","09","01","01:00","‡","20.8","","17.2","","80","","17","","27","","24.1","","96.15","","26","","","","NA"
"2017-09-01 02:00","2017","09","01","02:00","‡","20.0","","16.9","","83","","17","","25","","24.1","","96.09","","25","","","","NA"
"2017-09-01 03:00","2017","09","01","03:00","‡","19.4","","16.9","","85","","16","","19","","24.1","","96.07","","","","","","Cloudy"
"2017-09-01 04:00","2017","09","01","04:00","‡","19.2","","17.2","","88","","19","","13","","24.1","","96.08","","","","","","Thunderstorms"
"2017-09-01 05:00","2017","09","01","05:00","‡","18.8","","17.8","","93","","17","","13","","24.1","","96.05","","","","","","NA"
"2017-09-01 06:00","2017","09","01","06:00","‡","18.9","","17.9","","94","","16","","13","","16.1","","96.04","","","","","","Mostly Cloudy"
"2017-09-01 07:00","2017","09","01","07:00","‡","18.3","","17.7","","96","","18","","14","","24.1","","96.03","","","","","","NA"
"2017-09-01 08:00","2017","09","01","08:00","‡","19.9","","17.8","","88","","20","","18","","24.1","","96.01","","","","","","NA"
"2017-09-01 09:00","2017","09","01","09:00","‡","20.6","","18.2","","86","","23","","19","","24.1","","96.02","","27","","","","Cloudy"
```

weathercan: An R package

What's R?

What's R?

An open source, programming language, and software environment

What's R?

An open source, programming language, and software environment

Often used with RStudio IDE 

File Edit Code View Plots Session Build Debug Profile Tools Help

Go to file/functio Addins Project: (None)

example.R

Source on Save Run Source

```
1  library(weathercan)
2  library(ggplot2)
3
4  # Get Data
5  w <- weather(50821, start = "2017-09-01")
6
7  # Plot Data
8  ggplot(data = w, aes(x = time, y = temp, colour = station_name)) +
9    theme_bw() +
10   geom_line() +
11   labs(x = "Date", y = "Temperature C", colour = "Station")
12
```

12:1 (Top Level) R Script

Console ~/

```
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> library(weathercan)
> library(ggplot2)
> w <- weather(50821, start = "2017-09-01")
> ggplot(data = w, aes(x = time, y = temp, colour = station_name)) +
+   theme_bw() +
+   geom_line() +
+   labs(x = "Date", y = "Temperature C", colour = "Station")
>
```

Environment History

Import Dataset List

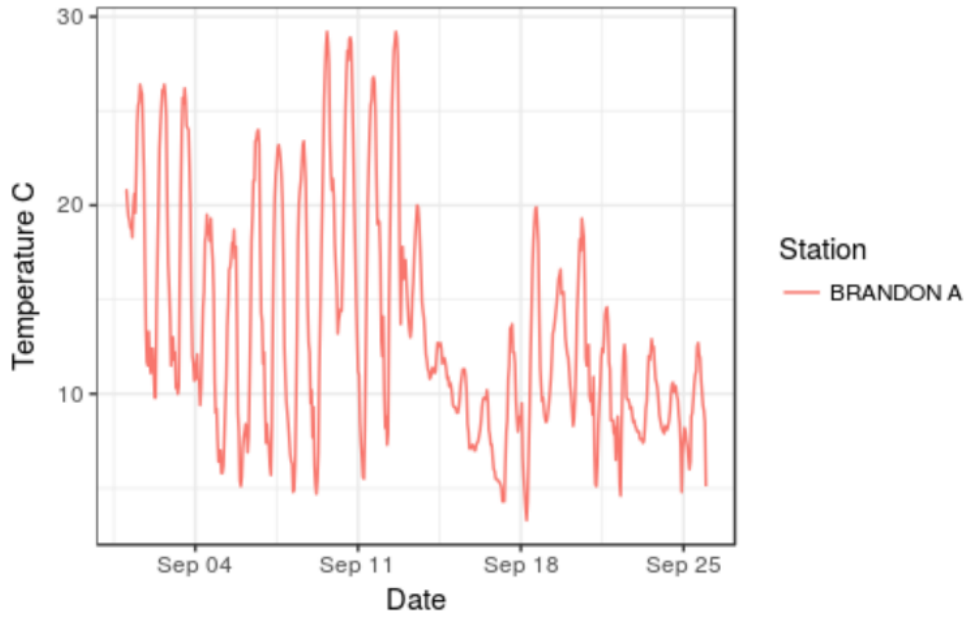
Global Environment

Data

w 600 obs. of 35 variables

Files Plots Packages Help Viewer

Zoom Export Publish



Why use `weathercan`?

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Free

- Free *and* open-source software (FOSS)

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Fast and Easy

- One line of code to download data from many stations, over many years
- Instantly usable

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Fast and Easy

- One line of code to download data from many stations, over many years
- Instantly usable

Customizable

- Data is trimmed to start and end times
- You can specify stations, time intervals, timezones, etc.

Why use `weathercan`?

Reproducible!

- Scripts provide a record of actions
- Just note the `weathercan` version (`packageVersion(weathercan)`)
- Hard to document mouse clicks or website searches

Getting started with weathercan

Installing devtools

```
install.packages("devtools")
```

Installing weathercan with devtools

```
devtools::install_github("steffilazerte/weathercan", build_vignettes = TRUE)
```

Basic usage

Code

```
library(weathercan)
w <- weather(station_ids = c(50821, 51097), start = "2017-09-01")
```

Basic usage

Code

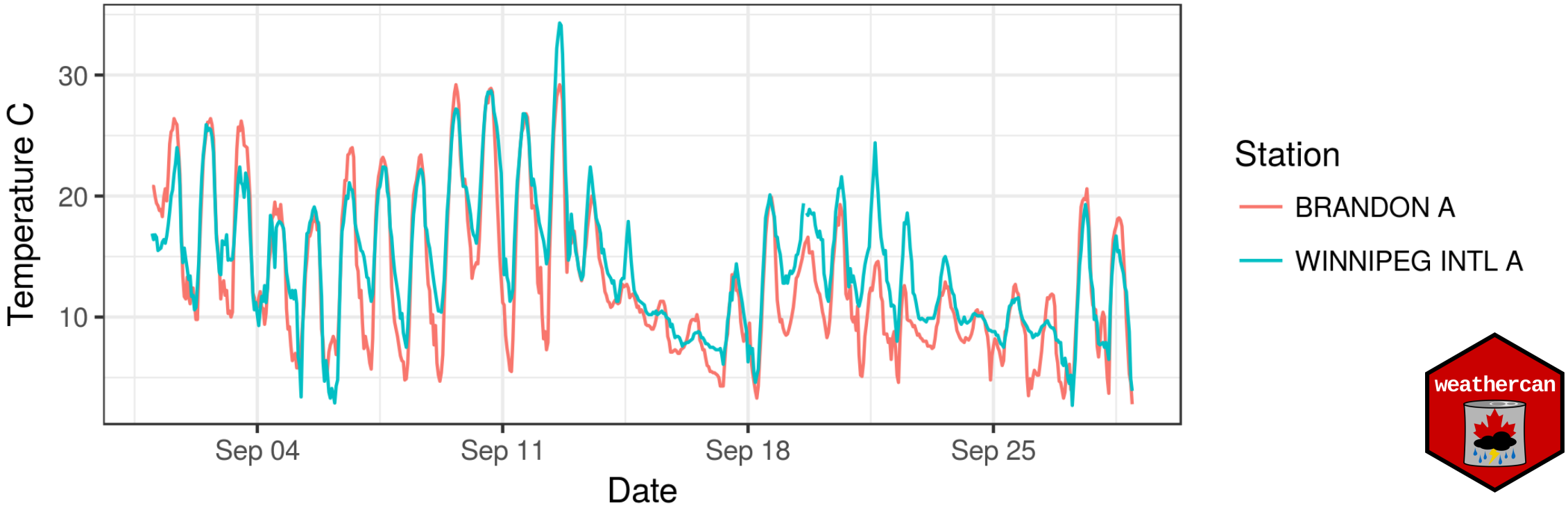
```
library(weathercan)
w <- weather(station_ids = c(50821, 51097), start = "2017-09-01")
```

Output

```
## # A tibble: 1,344 x 28
##   station_name station_id   prov   lat    lon                time  hmdx hmdx_flag pressure
## *        <chr>      <dbl> <fctr> <dbl>  <dbl>              <dttm> <dbl>     <chr>    <dbl>
## 1    BRANDON A      50821     MB 49.91 -99.95 2017-09-01 00:00:00    26                96.21
## 2    BRANDON A      50821     MB 49.91 -99.95 2017-09-01 01:00:00    26                96.15
## 3    BRANDON A      50821     MB 49.91 -99.95 2017-09-01 02:00:00    25                96.09
## 4    BRANDON A      50821     MB 49.91 -99.95 2017-09-01 03:00:00    NA                96.07
## 5    BRANDON A      50821     MB 49.91 -99.95 2017-09-01 04:00:00    NA                96.08
## # ... with 1,339 more rows, and 19 more variables
```

Plotting

```
ggplot(data = w, aes(x = time, y = temp, colour = station_name)) +
  theme_bw() +
  geom_line() +
  labs(x = "Date", y = "Temperature C", colour = "Station")
```



And done!

```
library(weathercan)
w <- weather(station_ids = c(50821, 51097), start = "2017-09-01")

ggplot(data = w, aes(x = time, y = temp, colour = station_name)) +
  theme_bw() +
  geom_line() +
  labs(x = "Date", y = "Temperature C", colour = "Station")
```

Hmmm...

```
library(weathercan)
w <- weather(station_ids = c(50821, 51097), start = "2017-09-01")

ggplot(data = w, aes(x = time, y = temp, colour = station_name)) +
  theme_bw() +
  geom_line() +
  labs(x = "Date", y = "Temperature C", colour = "Station")
```

?

Hmmm...

```
library(weathercan)
w <- weather(station_ids = c(50821, 51097), start = "2017-09-01")

ggplot(data = w, aes(x = time, y = temp, colour = station_name)) +
  theme_bw() +
  geom_line() +
  labs(x = "Date", y = "Temperature C", colour = "Station")
```

?

How do we get station ids?

Searching by station name

```
stations_search(name = "Brandon", interval = "hour")
```

Searching by station name

```
stations_search(name = "Brandon", interval = "hour")
```

```
## # A tibble: 3 x 10
##     prov station_name station_id climate_id   lat    lon  elev interval start   end
##   <fctr>        <chr>     <fctr>     <fctr> <dbl>  <dbl> <dbl>    <chr> <int> <int>
## 1     MB    BRANDON A       3471    5010480 49.91 -99.95 409.4     hour  1958  2012
## 2     MB    BRANDON A      50821    5010481 49.91 -99.95 409.3     hour  2012  2017
## 3     MB  BRANDON RCS      49909    5010490 49.90 -99.95 409.4     hour  2012  2017
```

Alternative: Searching by coordinates

- Alternatively search according to location: `c(latitude, longitude)`
- Search within 10km of this location: `dist = 10`

```
stations_search(coords = c(49.84847, -99.95009), dist = 10, interval = "hour")
```

Alternative: Searching by coordinates

- Alternatively search according to location: `c(latitude, longitude)`
- Search within 10km of this location: `dist = 10`

```
stations_search(coords = c(49.84847, -99.95009), dist = 10, interval = "hour")
```

```
## # A tibble: 3 x 11
##     prov station_name station_id climate_id   lat    lon  elev interval start   end distance
##   <fctr>        <chr>     <fctr>     <fctr> <dbl>  <dbl> <dbl>    <chr> <int> <int>    <dbl>
## 1     MB  BRANDON RCS      49909    5010490 49.90 -99.95 409.4     hour  2012  2017 5.731565
## 2     MB    BRANDON A       3471    5010480 49.91 -99.95 409.4     hour  1958  2012 6.843848
## 3     MB    BRANDON A      50821    5010481 49.91 -99.95 409.3     hour  2012  2017 6.843848
```

Understanding the data

Flags

```
## # A tibble: 7 x 6
##   station_id       date mean_min_temp mean_min_temp_flag mean_temp mean_temp_flag
## *      <dbl>     <date>         <dbl>              <chr>     <dbl>          <chr>
## 1       5401 2017-01-01          -7.9                         -4.4
## 2       5401 2017-02-01          -8.7                         -4.3
## 3       5401 2017-03-01          -9.6                         -5.2
## 4       5401 2017-04-01           3.3                          7.9
## 5       5401 2017-05-01           6.7                  E      11.8              E
## 6       5401 2017-06-01          12.3                         17.5
## 7       5401 2017-07-01          14.3                         19.3
```

Understanding the data

```
vignette("flags", package = "weathercan")
```

code	meaning
E	Estimated
M	Missing
NA	Not Available
‡	Partner data that is not subject to review by the National Climate Archives
A	Accumulated
C	Precipitation occurred, amount uncertain
F	Accumulated and estimated
L	Precipitation may or may not have occurred
N	Temperature missing but known to be > 0

Understanding the data

Units and measurements

```
## # A tibble: 1,344 x 6
##    station_id                time  temp temp_dew rel_hum wind_dir
##  *      <dbl>              <dttm> <dbl>    <dbl>   <dbl>    <dbl>
##  1      50821 2017-09-01 00:00:00  20.8     17.3      80       18
##  2      50821 2017-09-01 01:00:00  20.8     17.2      80       17
##  3      50821 2017-09-01 02:00:00  20.0     16.9      83       17
##  4      50821 2017-09-01 03:00:00  19.4     16.9      85       16
##  5      50821 2017-09-01 04:00:00  19.2     17.2      88       19
##  6      50821 2017-09-01 05:00:00  18.8     17.8      93       17
##  7      50821 2017-09-01 06:00:00  18.9     17.9      94       16
##  8      50821 2017-09-01 07:00:00  18.3     17.7      96       18
##  9      50821 2017-09-01 08:00:00  19.9     17.8      88       20
## 10      50821 2017-09-01 09:00:00  20.6     18.2      86       23
## # ... with 1,334 more rows
```

Understanding the data

```
vignette("glossary", package = "weathercan")
```

Interval	ECCC Name	Formated weathercan name	units	Reference
hour	Date/Time	time	ISO date/time	NA
hour	Year	year	year	ECCC glossary page
hour	Month	month	month	ECCC glossary page
hour	Day	day	day	ECCC glossary page
hour	Time	hour	hour	ECCC glossary page
hour	Data Quality	qual	note	ECCC glossary page
hour	Temp (°C)	temp	°C	ECCC glossary page
hour	Temp Flag	temp_flag	note	See the 'flags' vignette
hour	Dew Point Temp (°C)	temp_dew	°C	ECCC glossary page
hour	Dew Point Temp Flag	temp_dew_flag	note	See the 'flags' vignette
hour	Rel Hum (%)	rel_hum	%	ECCC glossary page
hour	Rel Hum Flag	rel_hum_flag	note	See the 'flags' vignette
hour	Wind Dir (10s deg)	wind_dir	10s deg	ECCC glossary page
hour	Wind Dir Flag	wind_dir_flag	note	See the 'flags' vignette

Combining with other data

- Adding weather data to other data sets
- Times don't always line up

Combining with other data

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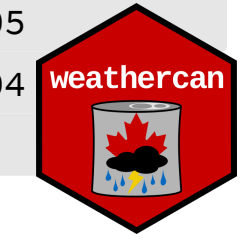
- Times don't always line up

Sediment data

```
## # A tibble: 1,392 x 2
##                   time   amount
##                 <dttm>    <dbl>
## 1 2017-09-01 00:05:34 168.3133
## 2 2017-09-01 00:35:34 156.9122
## 3 2017-09-01 01:05:34 175.6169
## 4 2017-09-01 01:35:34 184.5908
## 5 2017-09-01 02:05:34 163.2017
## 6 2017-09-01 02:35:34 169.2177
## 7 2017-09-01 03:05:34 167.8620
## # ... with 1,385 more rows
```

Brandon Weather data

```
## # A tibble: 672 x 3
##                   time  temp pressure
##                 <dttm> <dbl>    <dbl>
## 1 2017-09-01 00:00:00  20.8    96.21
## 2 2017-09-01 01:00:00  20.8    96.15
## 3 2017-09-01 02:00:00  20.0    96.09
## 4 2017-09-01 03:00:00  19.4    96.07
## 5 2017-09-01 04:00:00  19.2    96.08
## 6 2017-09-01 05:00:00  18.8    96.05
## 7 2017-09-01 06:00:00  18.9    96.04
## # ... with 665 more rows
```



Interpolating

- Linear interpolation where possible
- Only a single weather station at a time

```
w <- weather(station_ids = 50821, start = "2017-09-01")
```

```
sediment <- add_weather(data = sediment,
                        weather = w,
                        col = c("temp", "pressure"))
```

Interpolating

Sediment data

```
## # A tibble: 1,392 x 4
##                  time    amount      temp pressure
##                <dttm>     <dbl>     <dbl>    <dbl>
## 1 2017-09-01 00:05:34 168.3133 20.80000 96.20443
## 2 2017-09-01 00:35:34 156.9122 20.80000 96.17443
## 3 2017-09-01 01:05:34 175.6169 20.72578 96.14443
## 4 2017-09-01 01:35:34 184.5908 20.32578 96.11443
## 5 2017-09-01 02:05:34 163.2017 19.94433 96.08814
## 6 2017-09-01 02:35:34 169.2177 19.64433 96.07814
## 7 2017-09-01 03:05:34 167.8620 19.38144 96.07093
## # ... with 1,385 more rows
```

Weather data

```
## # A tibble: 672 x 3
##                  time  temp pressure
## *                <dttm> <dbl>    <dbl>
## 1 2017-09-01 00:00:00  20.8    96.21
## 2 2017-09-01 01:00:00  20.8    96.15
## 3 2017-09-01 02:00:00  20.0    96.09
## 4 2017-09-01 03:00:00  19.4    96.07
## 5 2017-09-01 04:00:00  19.2    96.08
## 6 2017-09-01 05:00:00  18.8    96.05
## 7 2017-09-01 06:00:00  18.9    96.04
## # ... with 665 more rows
```

Recap!

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1. Load `weathercan` package

```
library(weathercan)
```

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```
library(weathercan)
```

2. Find a station

```
stations_search("Brandon")
```

Recap!

1. Load `weathercan` package

```
library(weathercan)
```

2. Find a station

```
stations_search("Brandon")
```

3. Download weather

```
w <- weather(station_ids = 50821, start = "2017-09-01")
```

Recap!

1. Load `weathercan` package

```
library(weathercan)
```

2. Find a station

```
stations_search("Brandon")
```

3. Download weather

```
w <- weather(station_ids = 50821, start = "2017-09-01")
```

4. Add weather data to an existing data set

```
sediment <- add_weather(data = sediment, weather = w, cols = "temp")
```

We invite contributions!

Openly developed on GitHub

Contribute what you can (**You don't have to be an R programmer!**):

- Ideas / Feature-requests
- Bugs
- Bug-fixes
- Development

: http://github.com/steffilazerte/weathercan

Help with `weathercan`

Tutorials and Reference: http://steffilazerte.github.io/weathercan

This presentation: https://steffilazerte.github.io/Presentations/

Contact Steffi: @steffilazerte steffilazerte steffilazerte.ca

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Thanks!

Dr. David J. Hill

THOMPSON RIVERS UNIVERSITY

Slides created via the R package xaringan, using remark.js, knitr, and R Markdown

`weathercan v0.2.3`