Heat Map Weather Data

Glenn J Tattersall

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Heat Maps of Weather Data

Code Sourced from: https://gist.github.com/johnmackintosh/520643a1f82a0c7df00cf949ba98a4e9

```
rm(list=ls())

library(ggplot2)    # required for the geom_tile
library(viridis)    # colour blind friendly palette, works in B&W also
```

```
## Loading required package: viridisLite
```

```
library(Interpol.T) # will generate a large dataset on initial load
```

```
## Loading required package: date
```

```
## Loading required package: chron
```

```
library(lubridate)  # for easy date manipulation
```

```
##
## Attaching package: 'lubridate'
```

```
## The following objects are masked from 'package:chron':
##
##     days, hours, minutes, seconds, years
```

```
## The following object is masked from 'package:base':
##
##     date
```

```
library(ggExtra)    # remembering ggplot theme options is beyond me
library(tidyr)      # for data wrangling
library(dplyr)      # for data wrangling
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:lubridate':
##
##     intersect, setdiff, union
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

Load the data into the working environment using the data command. This will create a number of variables. The one we want is the h_d_t data.frame that we will add names to the relevant columns:

```
data<- data(Trentino_hourly_T, package = "Interpol.T")
names(h_d_t)[1:5]<- c("stationid","date","hour","temp","flag")
```

Create a working data.frame, df, which filters out aall other stations and keeps only stationid T0001. Then use the mutate function from dplyr to add new variables to the df data.frame. These new variables are simply the extrated year, month, and day, derived from the date variable within the data.frame:

```
df<- tbl_df(h_d_t) %>%
  filter(stationid =="T0001")

df<-droplevels(df)

df<- df %>% mutate(year = year(date),
                   month = month(date, label=TRUE),
                   day = day(date))
anyNA(df$temp)
```

```
## [1] TRUE
```

```
sum(is.na(df$temp))
```

```
## [1] 5
```

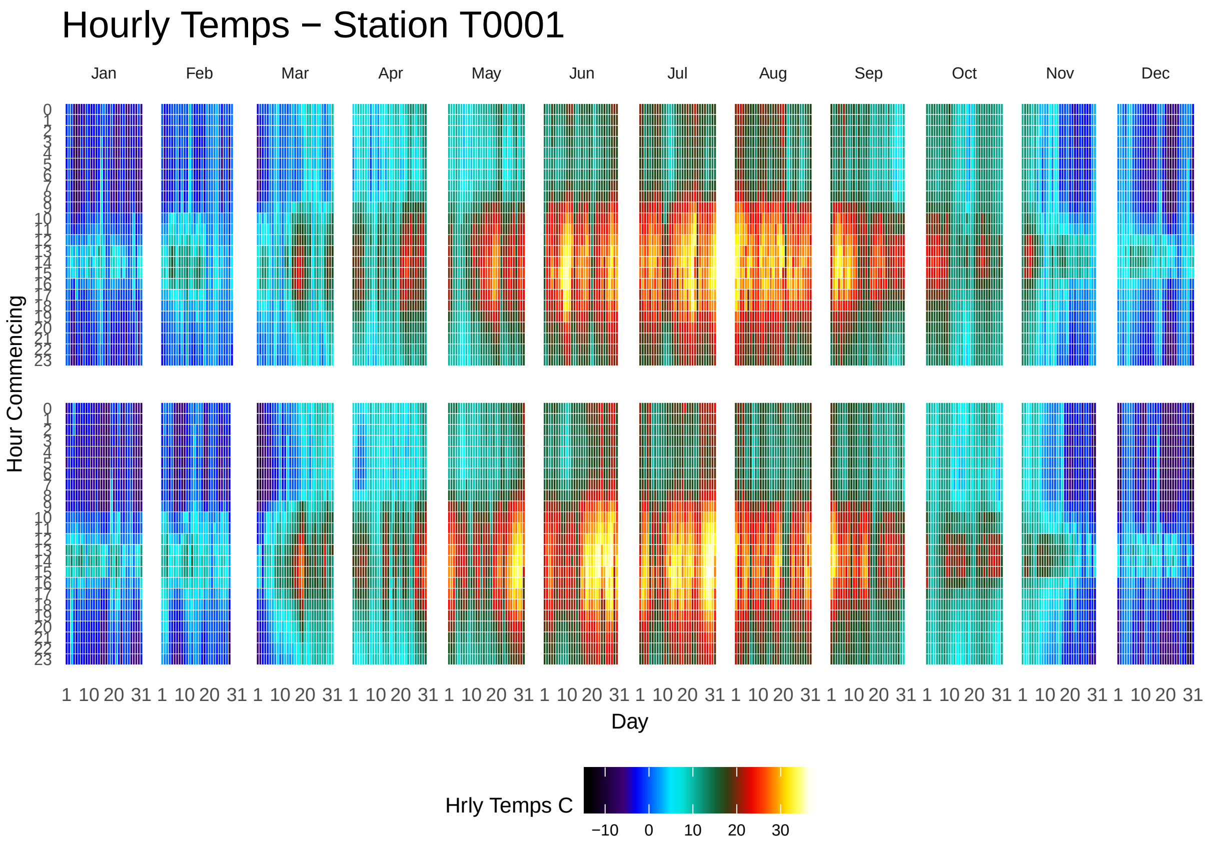
Note how there some NA values in the temperature data. In fact there are 5 NA values. Although this is frowned upon, for illustration purposes we will fill those NA values with the previous value. Technically you should not do this with real data, but I am showing this to demonstrate:

```
df <-df %>% select(stationid,day,hour,month,year,temp) %>%
  fill(temp) #optional - see note below
```

Now create the heat map

```
statno <-unique(df$stationid)
library(Thermimage) # access to a high contrast paleette (rainbow1234palette)

p <-ggplot(df,aes(day,hour,fill=temp))+
  geom_tile(color= "white", size=0.1)+
  # scale_fill_viridis(name="Hrly Temps C",option ="B")
  scale_fill_gradientn(name="Hrly Temps C", colours=rainbow1234pal)+
  facet_grid(year~month)+
  scale_y_continuous(trans = "reverse", breaks = unique(df$hour))+
  scale_x_continuous(breaks =c(1,10,20,31))+
  theme_minimal(base_size = 8)+
  labs(title= paste("Hourly Temps - Station",statno), x="Day",
            y="Hour Commencing")+
  theme(legend.position = "bottom")+
  theme(plot.title=element_text(size = 14))+
  theme(axis.text.y=element_text(size=6)) +
  theme(strip.background = element_rect(colour="white"))+
  theme(plot.title=element_text(hjust=0))+
  theme(axis.ticks=element_blank())+
  theme(axis.text=element_text(size=7))+
  theme(legend.title=element_text(size=8))+
  theme(legend.text=element_text(size=6))+
  removeGrid() #ggExtra
p
```



Now let's try this on some Environment Canada Historical Weather data.

Source: https://github.com/ropensci/weathercan

Install the weathercan package using the following. Remember ot remove the # to run this on your machine if you have never installed packages from github before:

```
# install.packages("devtools") # If not already installed
# devtools::install_github("steffilazerte/weathercan")
```

```
library(weathercan)
library(dplyr)
library(lubridate)
library(ggplot2)
```

Once you have weathercan installed you can glance at what weather stations have data:

```
head(stations)
```

```
## # A tibble: 6 x 13
##   prov  station_name station_id climate_id WMO_id TC_id   lat   lon  elev
##   <fct> <chr>        <fct>      <fct>      <fct>  <fct> <dbl> <dbl> <dbl>
## 1 AB    DAYSLAND     1795       301AR54    <NA>   <NA>   52.9 -112.  689.
## 2 AB    DAYSLAND     1795       301AR54    <NA>   <NA>   52.9 -112.  689.
## 3 AB    DAYSLAND     1795       301AR54    <NA>   <NA>   52.9 -112.  689.
## 4 AB    EDMONTON CO~ 1796       301BK03    <NA>   <NA>   53.6 -114.  671.
## 5 AB    EDMONTON CO~ 1796       301BK03    <NA>   <NA>   53.6 -114.  671.
## 6 AB    EDMONTON CO~ 1796       301BK03    <NA>   <NA>   53.6 -114.  671.
## # ... with 4 more variables: tz <chr>, interval <chr>, start <int>,
## #   end <int>
```

```
glimpse(stations)
```

```
## Observations: 26,217
## Variables: 13
## $ prov         <fct> AB, AB, AB, AB, AB, AB, AB, AB, AB, AB, AB, AB, A...
## $ station_name <chr> "DAYSLAND", "DAYSLAND", "DAYSLAND", "EDMONTON COR...
## $ station_id   <fct> 1795, 1795, 1795, 1796, 1796, 1796, 1797, 1797, 1...
## $ climate_id   <fct> 301AR54, 301AR54, 301AR54, 301BK03, 301BK03, 301B...
## $ WMO_id       <fct> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, N...
## $ TC_id        <fct> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, N...
## $ lat          <dbl> 52.87, 52.87, 52.87, 53.57, 53.57, 53.57, 52.15, ...
## $ lon          <dbl> -112.28, -112.28, -112.28, -113.57, -113.57, -113...
## $ elev         <dbl> 688.8, 688.8, 688.8, 670.6, 670.6, 670.6, 838.2, ...
## $ tz           <chr> "Etc/GMT+7", "Etc/GMT+7", "Etc/GMT+7", "Etc/GMT+7...
## $ interval     <chr> "day", "hour", "month", "day", "hour", "month", "...
## $ start        <int> 1908, NA, 1908, 1978, NA, 1978, 1987, NA, 1987, 1...
## $ end          <int> 1922, NA, 1922, 1979, NA, 1979, 1990, NA, 1990, 1...
```

Let’s search for a nearby station:

```
stations_search("Welland", interval = "hour")
```

```
## # A tibble: 2 x 13
##   prov  station_name station_id climate_id WMO_id TC_id   lat   lon  elev
##   <fct> <chr>        <fct>      <fct>      <fct>  <fct> <dbl> <dbl> <dbl>
## 1 ON    PA WELLAND ~ 52499      6136305    <NA>   W5Z    43.0 -79.3  186.
## 2 ON    WELLAND-PEL~ 44283      6139449    71752  TWL    43.0 -79.3  178
## # ... with 4 more variables: tz <chr>, interval <chr>, start <int>,
## #   end <int>
```

```
stations_search(coords = c(43.1, -79), dist = 100, interval = "hour")
```

```
## # A tibble: 69 x 14
##    prov  station_name station_id climate_id WMO_id TC_id   lat   lon  elev
##    <fct> <chr>        <fct>      <fct>      <fct>  <fct> <dbl> <dbl> <dbl>
##  1 ON    ST CATHARIN~ 53000      6137304    <NA>   YSN    43.2 -79.2  97.8
##  2 ON    ST. CATHARI~ 50131      6137286    <NA>   YSN    43.2 -79.2  97.8
##  3 ON    ST CATHARIN~ 4683       6137287    <NA>   YSN    43.2 -79.2  97.8
##  4 ON    PA ROYAL CA~ 52734      6136290    <NA>   Z4W    43.2 -79.3  90.5
##  5 ON    PORT WELLER~ 7790       6136699    71432  WWZ    43.2 -79.2  79
##  6 ON    PA WELLAND ~ 52499      6136305    <NA>   W5Z    43.0 -79.3 186.
##  7 ON    WELLAND-PEL~ 44283      6139449    71752  TWL    43.0 -79.3 178
##  8 ON    PA ATMOS FE~ 52743      6136285    <NA>   A0T    43.0 -79.4 193
##  9 ON    PA VINELAND~ 52722      6136300    <NA>   L6B    43.2 -79.4 112.
## 10 ON    PORT COLBOR~ 9005       613F606    71463  WPC    42.9 -79.2 184.
## # ... with 59 more rows, and 5 more variables: tz <chr>, interval <chr>,
## #   start <int>, end <int>, distance <dbl>
```

Looks like our Welland Station will suffice for hourly data downloads. The station id is 44283.

Now download the data using the weather_dl function. Try not to overload the server bandwidth running long searches multiple times.

```
wel <- weather_dl(station_ids = 44283, start = "2016-01-01", end = "2018-12-31")
head(wel)
```

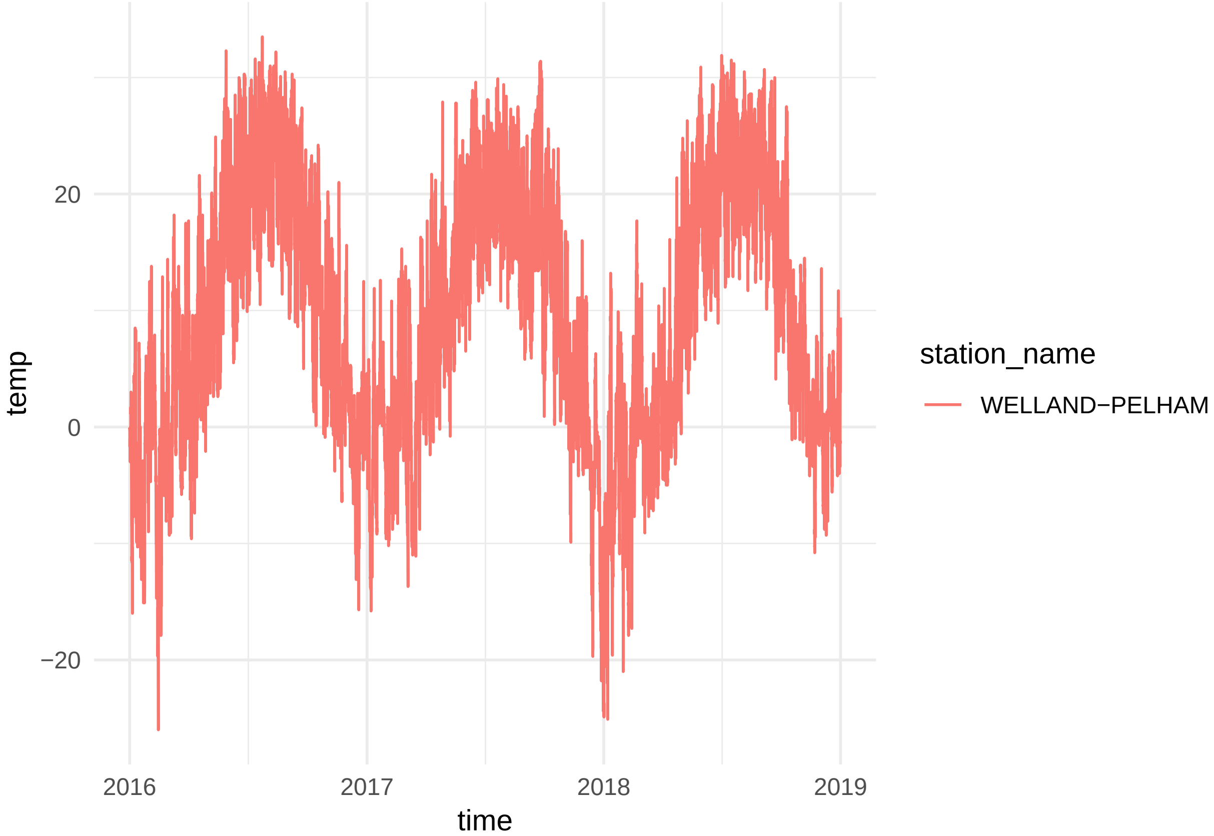
```
## # A tibble: 6 x 35
##   station_name station_id station_operator prov    lat   lon  elev
##   <chr>             <dbl> <chr>            <fct> <dbl> <dbl> <dbl>
## 1 WELLAND-PEL~      44283 Environment and~ ON     43.0 -79.3   178
## 2 WELLAND-PEL~      44283 Environment and~ ON     43.0 -79.3   178
## 3 WELLAND-PEL~      44283 Environment and~ ON     43.0 -79.3   178
## 4 WELLAND-PEL~      44283 Environment and~ ON     43.0 -79.3   178
## 5 WELLAND-PEL~      44283 Environment and~ ON     43.0 -79.3   178
## 6 WELLAND-PEL~      44283 Environment and~ ON     43.0 -79.3   178
## # ... with 28 more variables: climate_id <chr>, WMO_id <chr>, TC_id <chr>,
## #   date <date>, time <dttm>, year <chr>, month <chr>, day <chr>,
## #   hour <chr>, weather <chr>, hmdx <dbl>, hmdx_flag <chr>,
## #   pressure <dbl>, pressure_flag <chr>, rel_hum <dbl>,
## #   rel_hum_flag <chr>, temp <dbl>, temp_dew <dbl>, temp_dew_flag <chr>,
## #   temp_flag <chr>, visib <dbl>, visib_flag <chr>, wind_chill <dbl>,
## #   wind_chill_flag <chr>, wind_dir <dbl>, wind_dir_flag <chr>,
## #   wind_spd <dbl>, wind_spd_flag <chr>
```

```
str(wel)
```

```
## Classes 'tbl_df', 'tbl' and 'data.frame':    26304 obs. of  35 variables:
##  $ station_name    : chr  "WELLAND-PELHAM" "WELLAND-PELHAM" "WELLAND-PELHAM" "WELLAND-PELHAM" ...
##  $ station_id      : num  44283 44283 44283 44283 44283 ...
##  $ station_operator: chr  "Environment and Climate Change Canada - Meteorological Service of Canada"
##  $ prov            : Factor w/ 13 levels "AB","BC","MB",..: 9 9 9 9 9 9 9 9 9 9 ...
##  $ lat             : num  43 43 43 43 43 ...
##  $ lon             : num  -79.3 -79.3 -79.3 -79.3 -79.3 ...
##  $ elev            : num  178 178 178 178 178 178 178 178 178 178 ...
##  $ climate_id      : chr  "6139449" "6139449" "6139449" "6139449" ...
##  $ WMO_id          : chr  "71752" "71752" "71752" "71752" ...
##  $ TC_id           : chr  "TWL" "TWL" "TWL" "TWL" ...
##  $ date            : Date, format: "2016-01-01" "2016-01-01" ...
##  $ time            : POSIXct, format: "2016-01-01 00:00:00" "2016-01-01 01:00:00" ...
##  $ year            : chr  "2016" "2016" "2016" "2016" ...
##  $ month           : chr  "01" "01" "01" "01" ...
##  $ day             : chr  "01" "01" "01" "01" ...
##  $ hour            : chr  "00:00" "01:00" "02:00" "03:00" ...
##  $ weather         : chr  NA NA NA NA ...
##  $ hmdx            : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ hmdx_flag       : chr  "" "" "" "" ...
##  $ pressure        : num  99.8 99.7 99.6 99.6 99.6 ...
##  $ pressure_flag   : chr  "" "" "" "" ...
##  $ rel_hum         : num  68 67 70 74 71 69 68 68 77 74 ...
##  $ rel_hum_flag    : chr  "" "" "" "" ...
##  $ temp            : num  -0.2 -0.2 -0.1 -0.1 -0.3 -0.4 -0.6 -0.8 -1.7 -1.4 ...
##  $ temp_dew        : num  -5.4 -5.5 -4.9 -4.2 -5 -5.4 -5.8 -5.9 -5.2 -5.4 ...
##  $ temp_dew_flag   : chr  "" "" "" "" ...
##  $ temp_flag       : chr  "" "" "" "" ...
##  $ visib           : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ visib_flag      : chr  "" "" "" "" ...
##  $ wind_chill      : num  -5 -5 -5 -5 -6 -6 -6 -6 -7 -6 ...
##  $ wind_chill_flag : chr  "" "" "" "" ...
##  $ wind_dir        : num  27 27 27 27 27 27 28 27 27 27 ...
##  $ wind_dir_flag   : chr  "" "" "" "" ...
##  $ wind_spd        : num  20 19 19 19 25 24 23 20 18 14 ...
##  $ wind_spd_flag   : chr  "" "" "" "" ...
```

Here is a quick glance at the temperature data:

```
ggplot(data = wel, aes(x = time, y = temp, group = station_name, colour = station_name)) +
  theme(legend.position = "top") +
  geom_line() +
  theme_minimal()
```



Let's create a plot ready data frame like we did earlier with the sample data:

```
wel2 <- wel %>% mutate(year = year(date),
                       month = month(date, label=TRUE),
                       day = day(date))
wel2 <-wel2 %>% select(station_id,day,hour,month,year,temp)
head(wel2$hour)
```

```
## [1] "00:00" "01:00" "02:00" "03:00" "04:00" "05:00"
```

Since the hour data in the data frame is in a character format, and we want this to be a numeric, let's sub out the first two characters and convert these to a numeric:

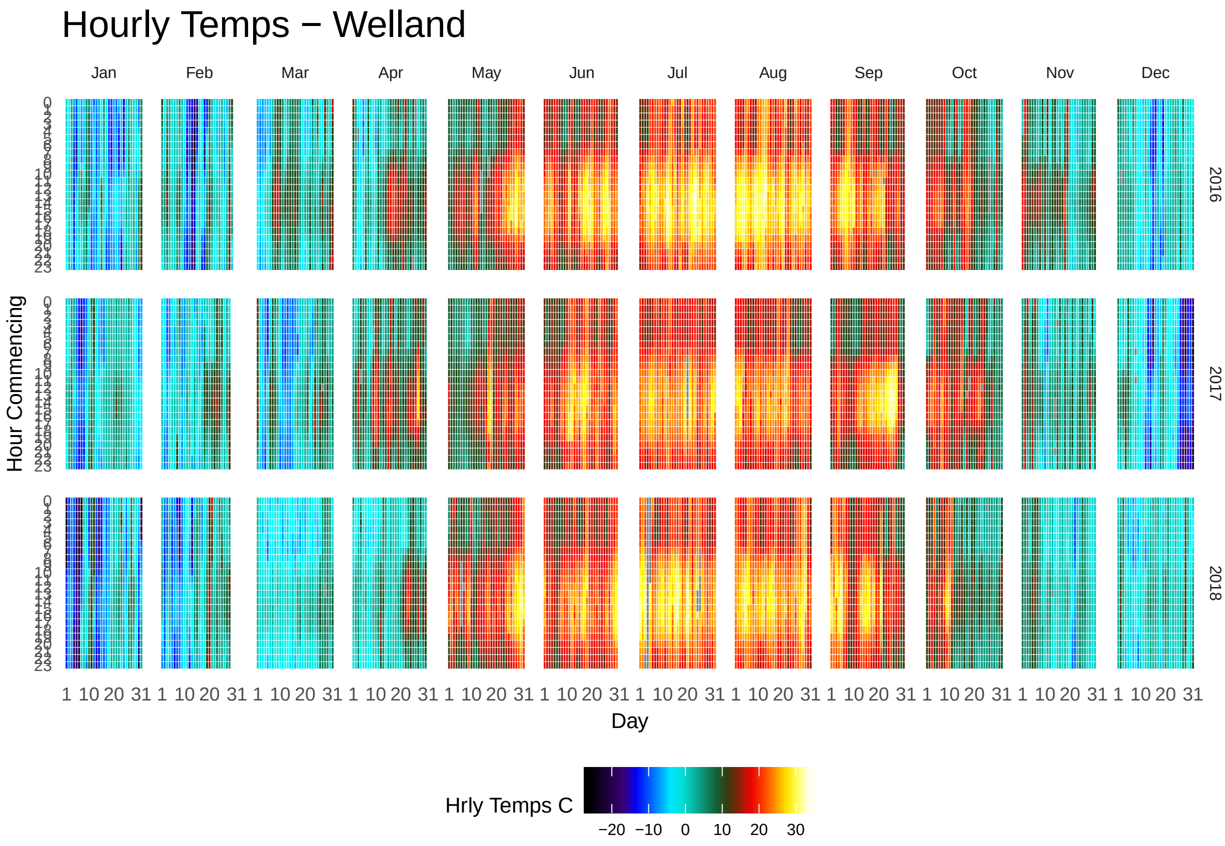
```
wel2$hour<-as.numeric(substr(wel2$hour,1,2))
head(wel2$hour)
```

```
## [1] 0 1 2 3 4 5
```

Now plot as we did previously:

```
library(Thermimage)  # access to rainbow1234palette
p <-ggplot(wel2,aes(day,hour,fill=temp))+
  geom_tile(color= "white", size=0.01)+
  # scale_fill_viridis(name="Hrly Temps C",option ="B")
  scale_fill_gradientn(name="Hrly Temps C", colours=rainbow1234pal)+
  facet_grid(year~month)+
  scale_x_continuous(breaks =c(1,10,20,31))+
  scale_y_continuous(trans = "reverse", breaks = unique(wel2$hour))+
  theme_minimal(base_size = 8)+
  labs(title= paste("Hourly Temps - Welland"), x="Day", y="Hour Commencing")+
  theme(legend.position = "bottom")+
  theme(plot.title=element_text(size = 14))+
  theme(axis.text.y=element_text(size=6))  +
  theme(strip.background = element_rect(colour="white"))+
  theme(plot.title=element_text(hjust=0))+
  theme(axis.ticks=element_blank())+
  theme(axis.text=element_text(size=7))+
  theme(legend.title=element_text(size=8))+
  theme(legend.text=element_text(size=6))+
  removeGrid() #ggExtra

p
```


Hourly Temps − Welland
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Hour Commencing
Day
Hrly Temps C