R Session 5

Introduction to Plot Techniques

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Outline

1. Packages for Plotting
2. Base graphics
   - Standard routines
   - Extension: plotWAC ( )
3. ggplot2

SOME PACKAGES PROVIDING PLOTS:

Base graphics (in package graphics, always available)

- Easy to construct basic plots; e.g.,
  - histographs, bar charts, box-and-whisker, violin, ...
  - scatterplots, caterpillar plots, density plots
  - time series, line charts, ...
- Often used for exploratory analysis

ggplot2 (“grammar of graphics”):

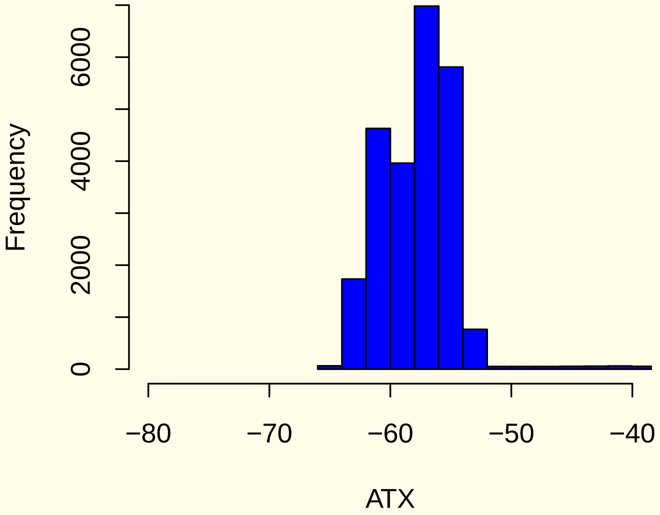
- Often used for final-presentation plots
- Great flexibility and a structured approach
- Can duplicate base-graphics plot functions

lattice graphics

implementation of “trellis” graphics – an alternate structured approach to generating plots, esp. for exploratory analysis

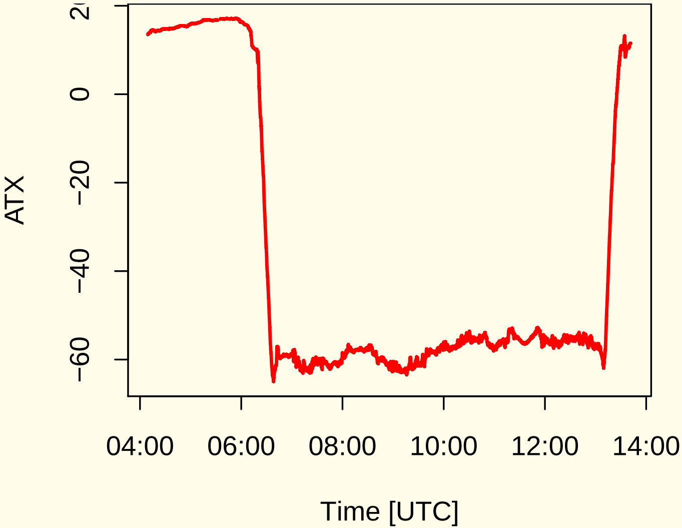
BASE GRAPHICS (console ?hist, or 'hist' in RStudio-help)

```
hist(Data$ATX[Data$TASX > 130], breaks = 40, xlab = "ATX",
    xlim = c(-80, -40), main = NULL, col = "blue")
```



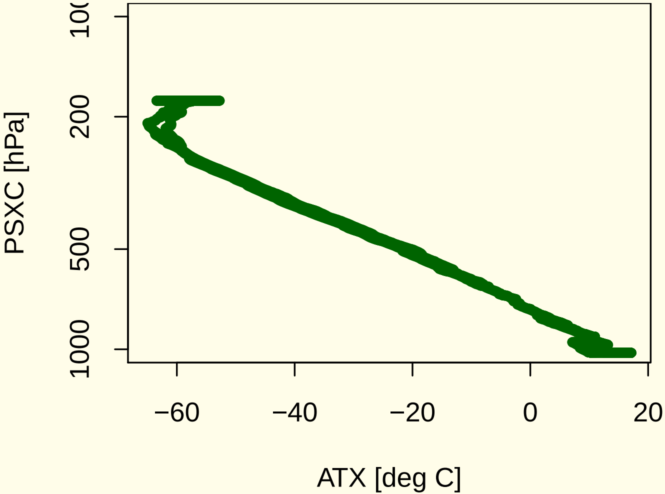
BASE GRAPHICS: line plot'

```
plot(Data$Time, Data$ATX, ylab = "ATX", col = "red",
     type = "l", xlab = "Time [UTC]", lwd = 2)
```



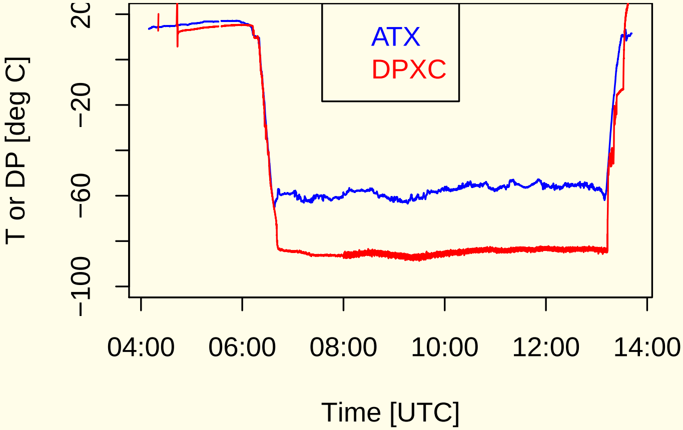
BASE GRAPHICS: scatterplot

```
plot(Data$ATX, Data$PSXC, type = "p", pch = 20, log = "y",
    xlab = "ATX [deg C]", ylab = "PSXC [hPa]", ylim = c(1000,
        100), col = "darkgreen")
```



BASE GRAPHICS: multiple lines'

```
plot(Data$Time, Data$ATX, ylab = "T or DP [deg C]", type = "l",
    col = "blue", ylim = c(-100, 20), xlab = "Time [UTC]")
lines(Data$Time, Data$DPXC, col = "red")
legend("top", legend = c("ATX", "DPXC"), text.col = c("blue",
    "red"))
```

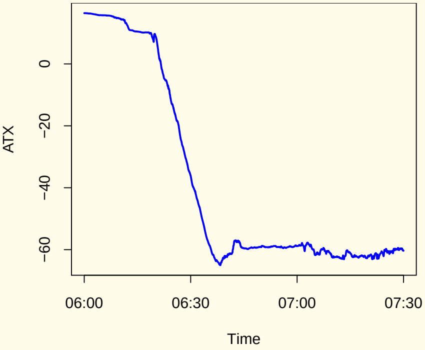


BASE GRAPHICS: adding structure with a data.frame'

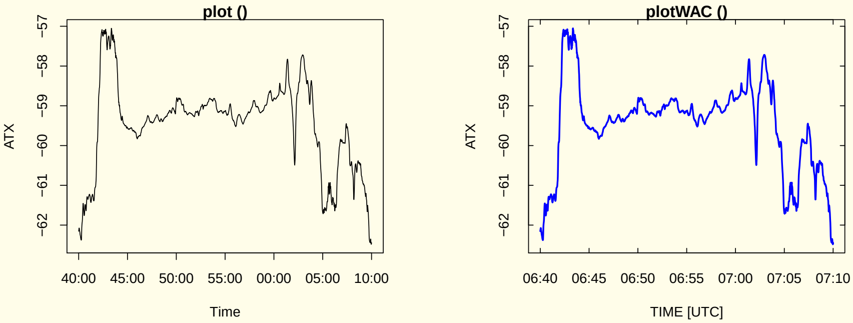
Consider using a data.frame to hold data for a plot:

- subset appropriately
- apply plot operations to this object
- optionally save for archiving
- example:

```
r <- setRange(Data$Time, 60000,
    73000)
Plot1Data <- Data[r, c("Time",
    "ATX")]
plot(Plot1Data, type = "l",
    col = "blue", lwd = 2)
```



BASE GRAPHICS: see 'plotWAC'



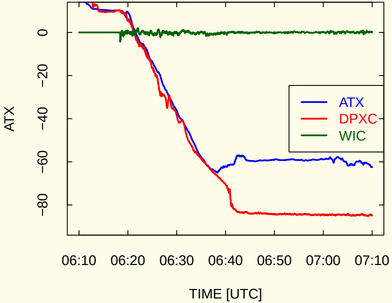
Differences:

1. Some differences in time labels
2. Default line thickness lwd=2
3. Ticks inward and duplicated on opposite axis

BASE GRAPHICS: another 'plotWAC' feature:

```r
r <- setRange(Data$Time, 61000,
    71000)
Plot1Data <- Data[r, c("Time",
    "ATX", "DPXC", "WIC")]
```

```r
plotWAC(Plot1Data, legend = "right",
    ylim = c(-90, 10))
```



REASONS TO CONSIDER ggplot:

Based on a structure called the 'Grammar of Graphics':

- independent components assembled to final plot
- layers: encourages structured composition
- particularly useful for constructing original plots with, e.g., a layer representing the result of a fit.

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Supports constructing some very nice plots, although with what seems extra work at first.

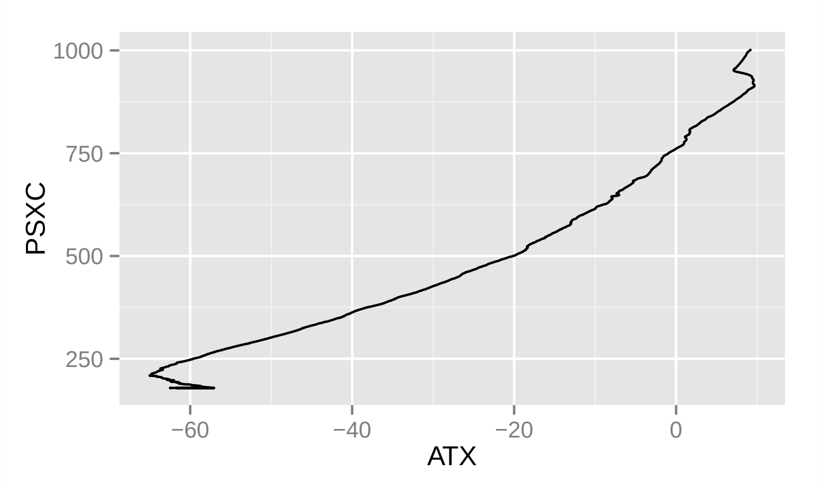
COMPONENTS OF A ggplot

Items that can be added, usually via g <- g + item

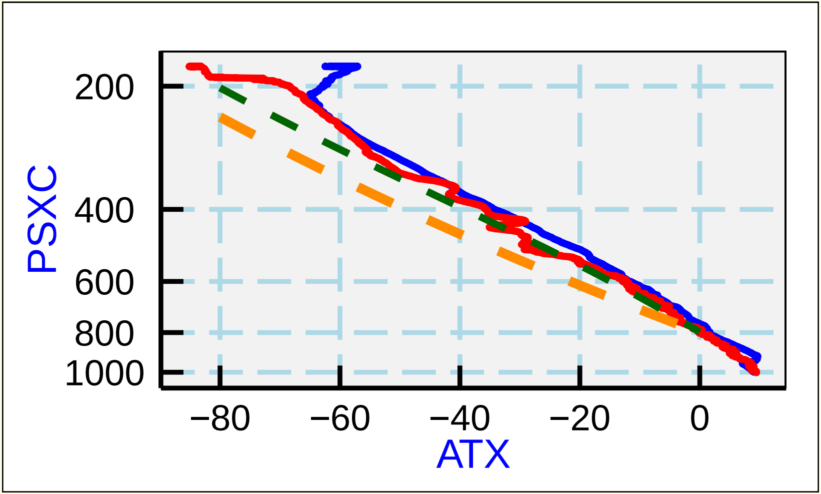
1. An initial definition for the basis of the plot, usually resembling 'g <- ggplot (data=Data, aes(x=Time, y=ATX)', containing:
   (a) The data, often best specified as a data.frame
   (b) "aesthetic mappings" – e.g., which variables are mapped to the abscissa and to the ordinate
2. 'geom's – data representations visible on the plot like lines, points, etc.
3. 'stat's – fits or creating sub-groups for further analysis as in a violin-plot
4. 'scale's – axes, colors, line-widths, symbol-types, ..., anything that helps retrieve an original datum from information on the plot.
5. 'coord's: the mapping from the data values to the plot. linear or log, e.g.; the mapping itself, vs 'scale's like axes that represent the coords with items appearing on the graph.

CONSTRUCTING A SIMPLE ggplot:

```
D <- Data[setRange(Data$Time, 61900, 71000), c("ATX", "PSXC")]
ggplot(D, aes(ATX, PSXC)) + geom_path()
```



CONSTRUCTING A TAILORED ggplot:



HOW THIS FITS IN THE "SESSIONS"

The Plan:

1. Introduction to R and esp. to RStudio
2. The data.frame and other variables
3. Basic math operations; vector operations
4. Packages, including 'Ranadu'
5. Constructing plots
6. Fit procedures; showing fits in plots and tables
7. Reproducible Analyses using R and knitr
8. Specific examples of application for RAF tasks

Next: Fitting

- linear fits: simple regression, parameterized fits, Deming fit
- non-linear fits: numerical methods
- maximum likelihood via R