

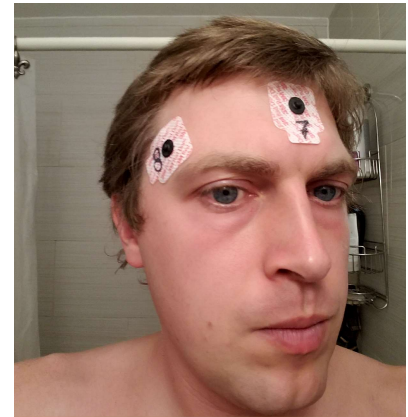
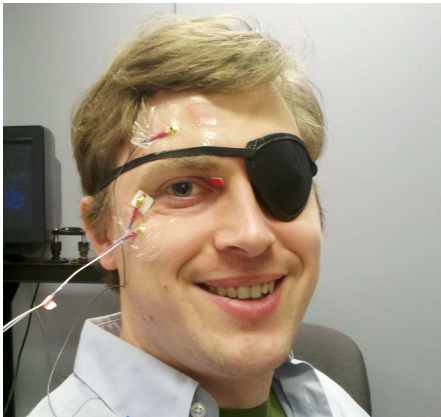
Visualizing time

Benjamin Smarr

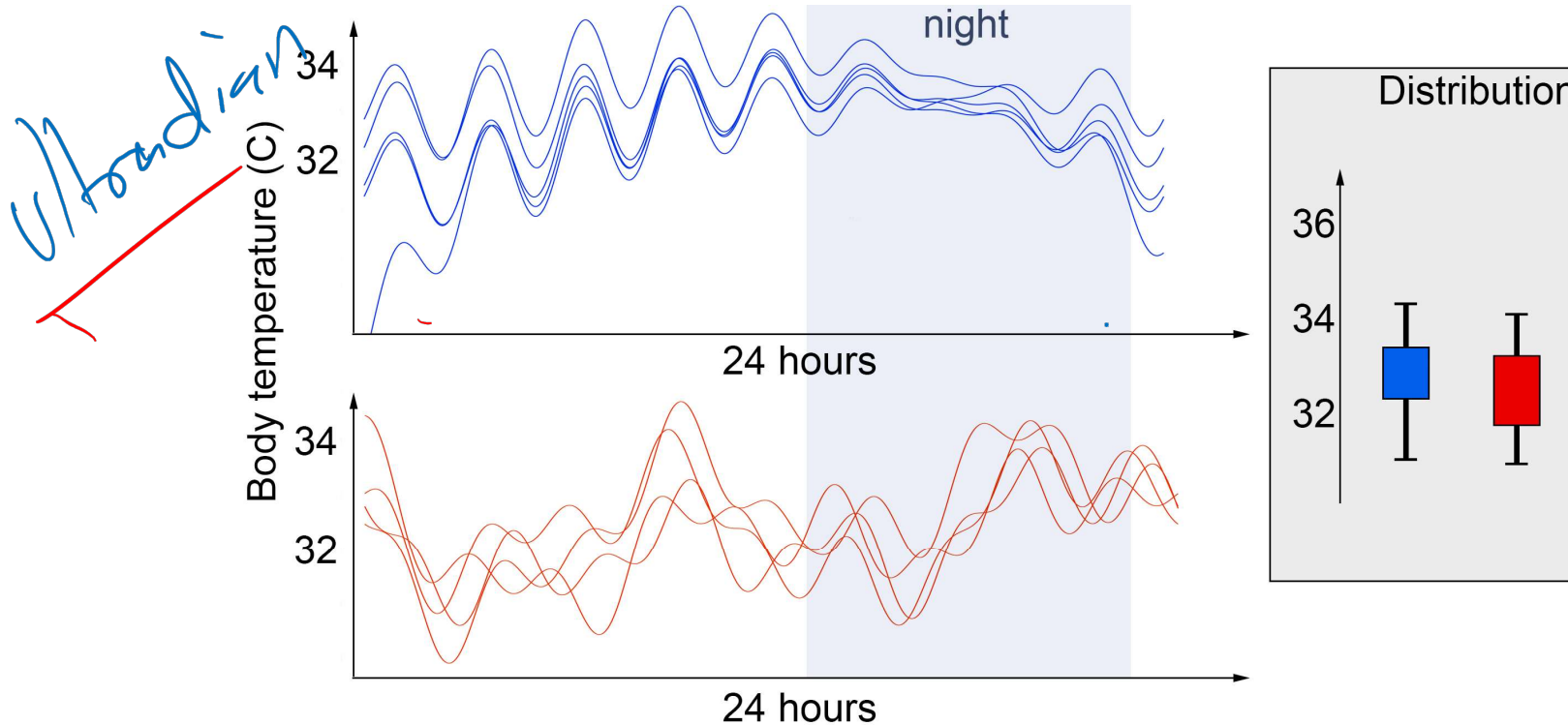
Asst. Prof. Halicioglu Data Science Institute

Shu Chien - Gene Lay Department of Bioengineering

DSC 106 W25



Why does visualizing time series matter?



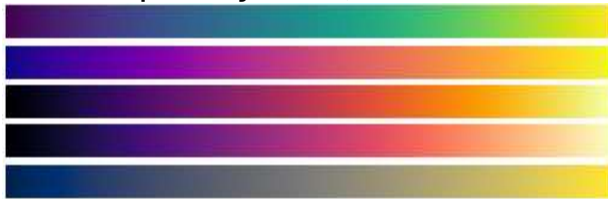
1. BIG IDEAs Lab Glycemic Variability and Wearable Device Data
2. VitalDB Korean Surgery Dataset *—*
3. Physionet – collection datasets *—*
4. Mouse Data (you'll see today!)

Questions to ask about a good visualization

1) What do you want to compare (windows, individuals, trends)?

2) What do you want to highlight (Distance, Sign, Label)?

Perceptually even, monomodal



Divergent



Cyclic

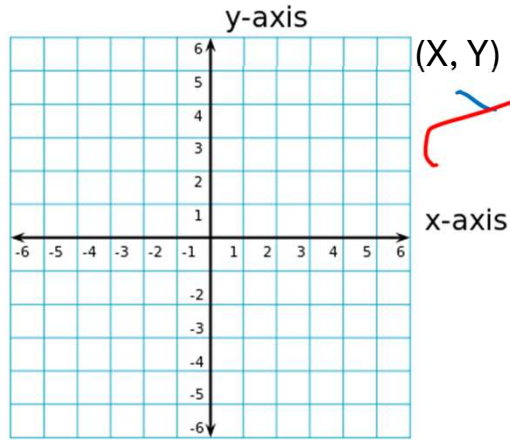


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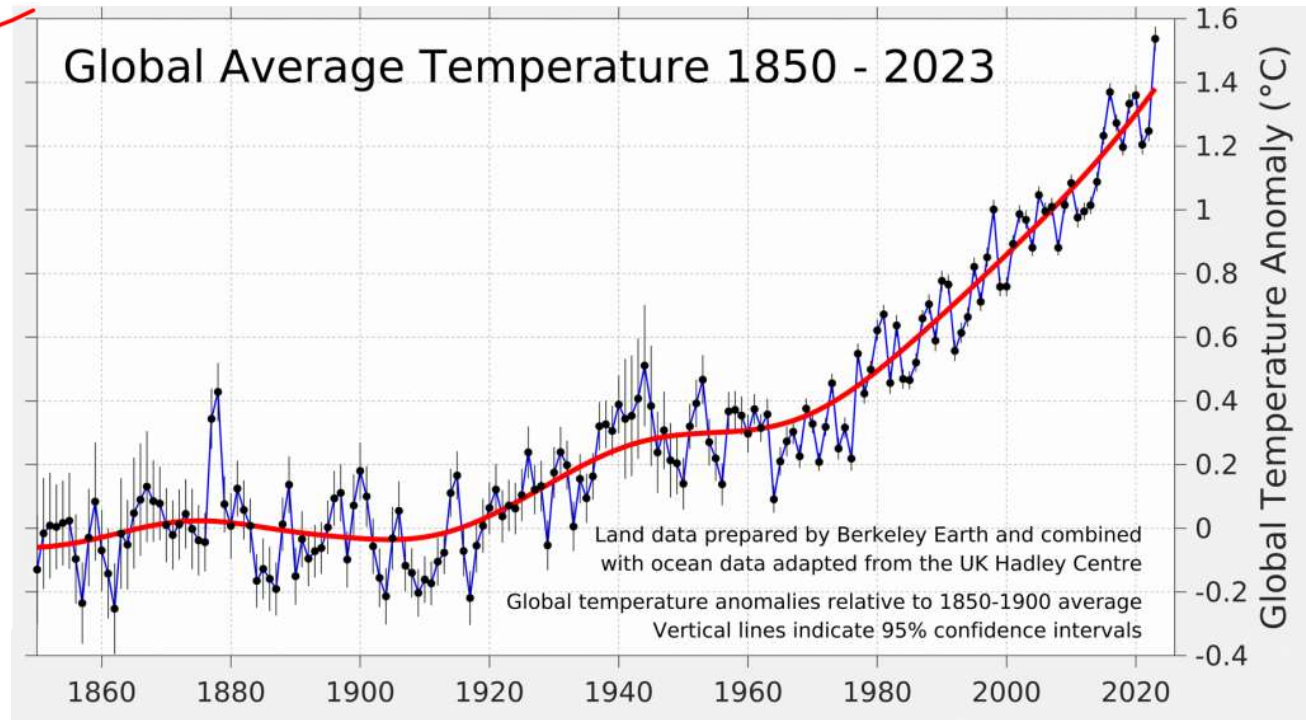
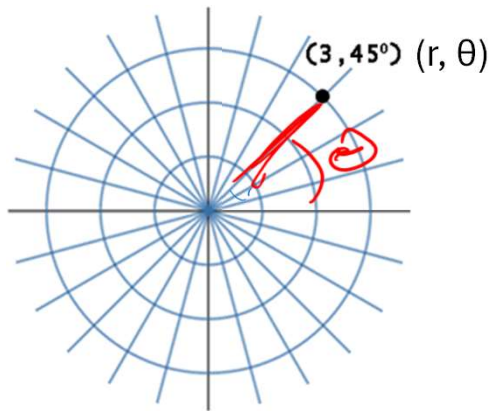
3) What aspect of time matters (linear, modules, phase, frequency)?

Radial plots

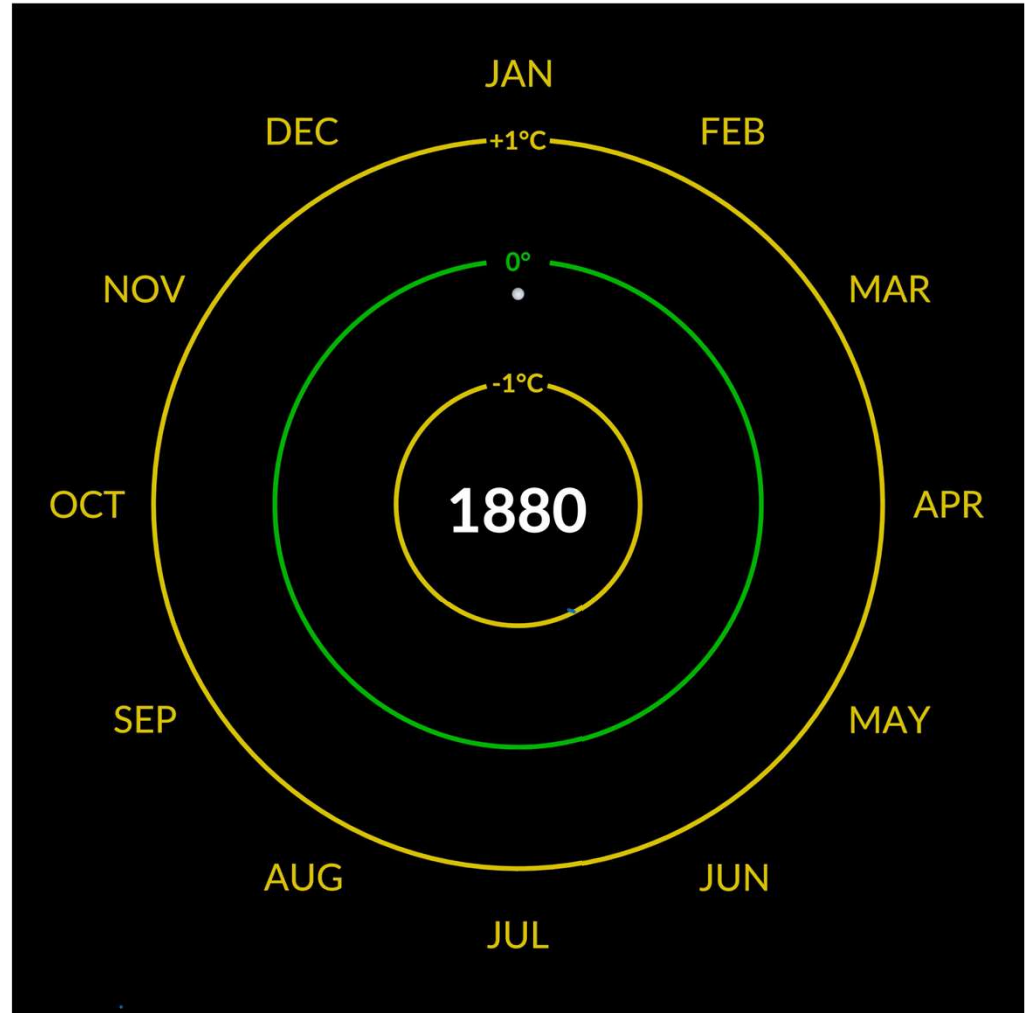
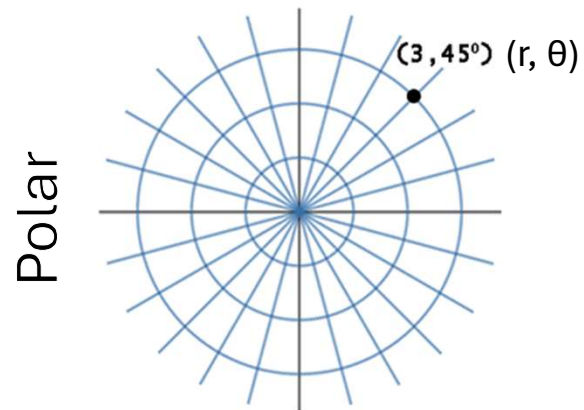
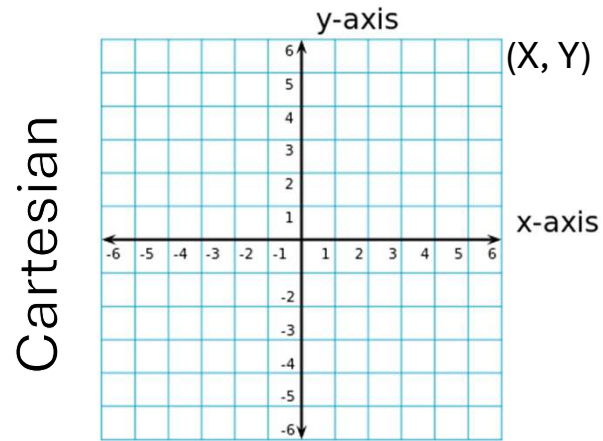
Cartesian



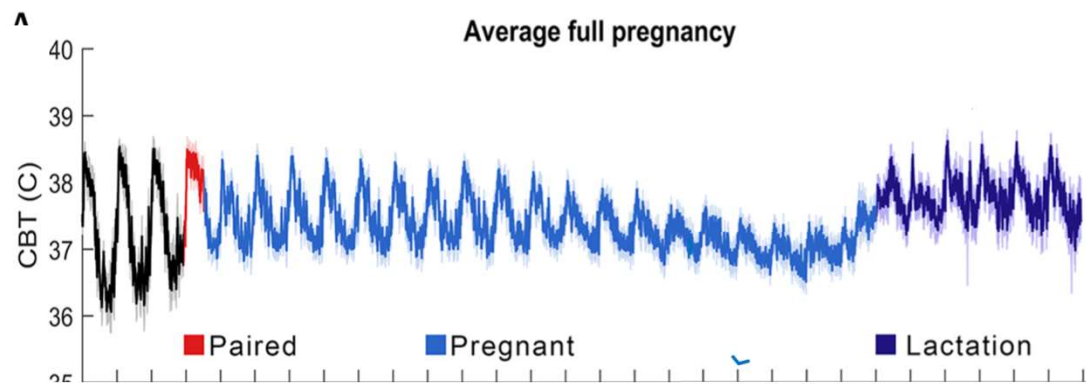
Polar



Radial plots

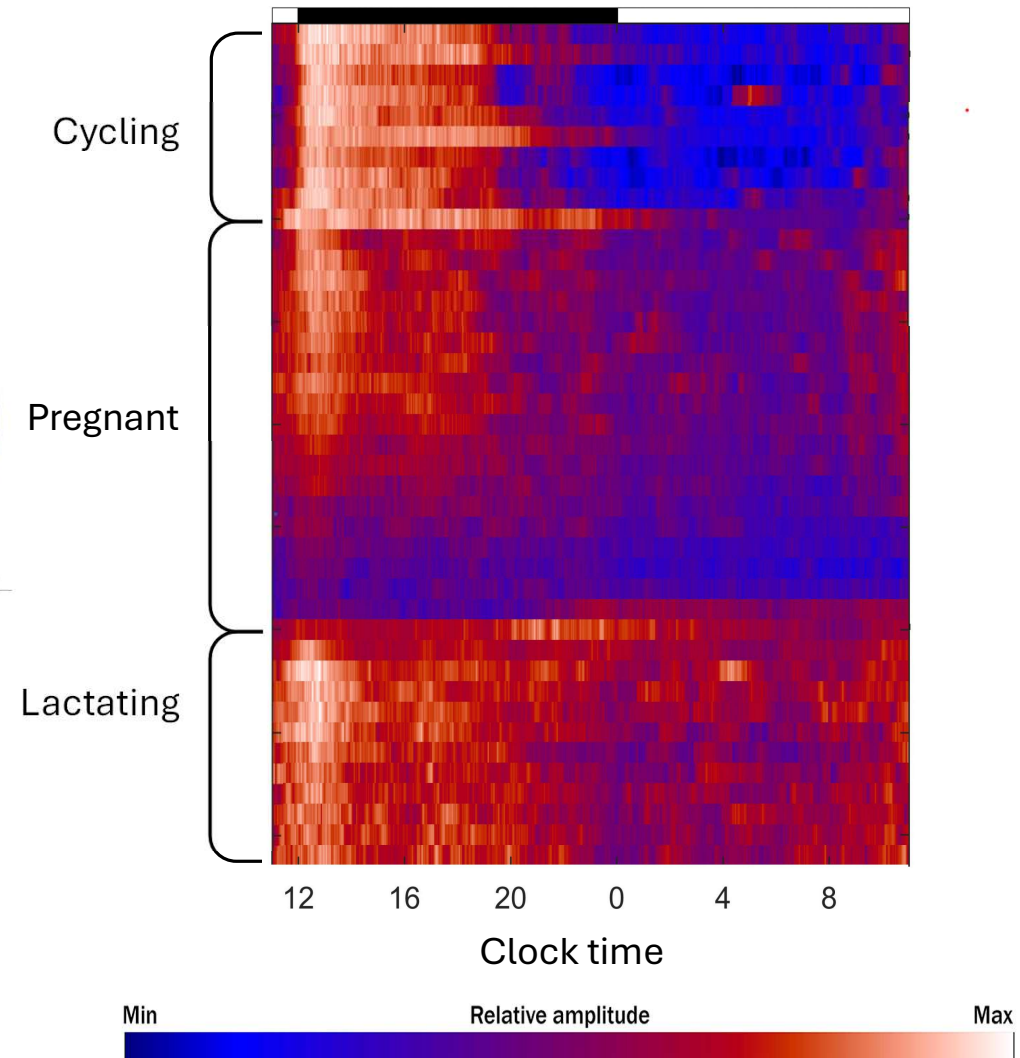


Heatmaps and aggregation



Remapping a line into a matrix:

- 1) Assess alignment by mode/unit
- 2) See more time resolution
- 3) Takes more space
- 4) Difficult to compare replicates

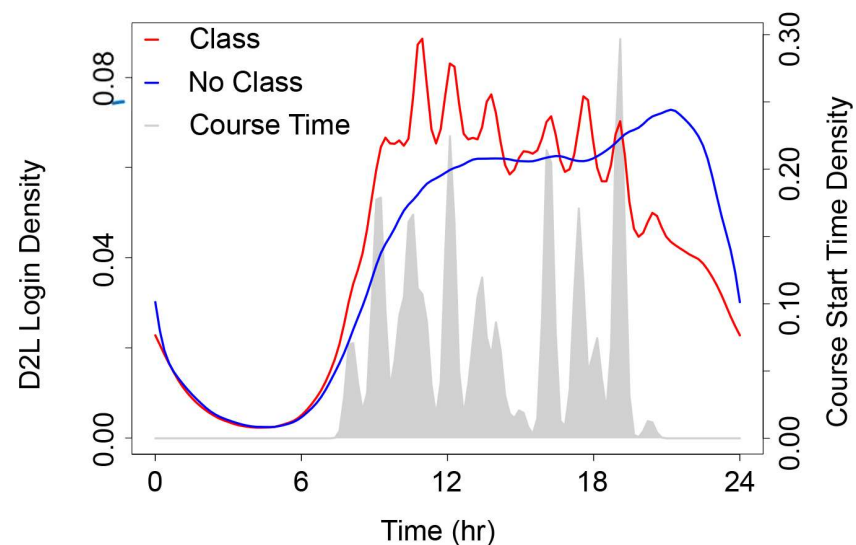
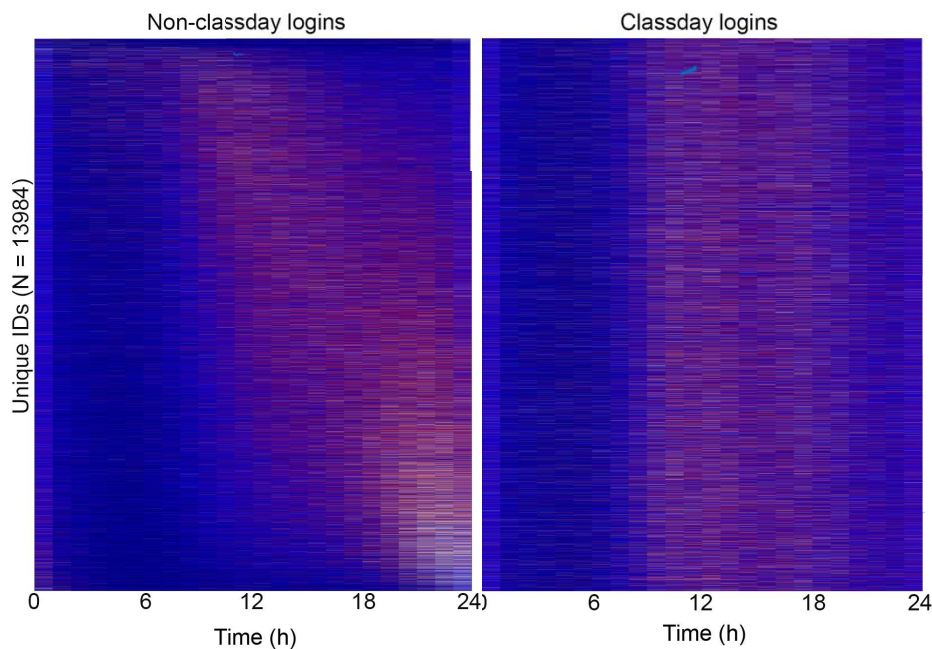
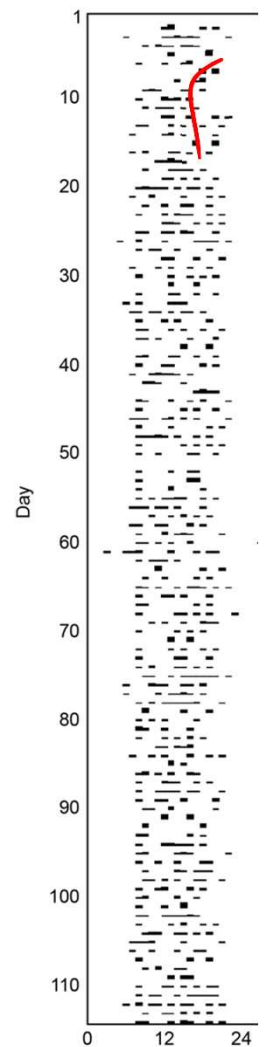


Heatmaps and aggregation

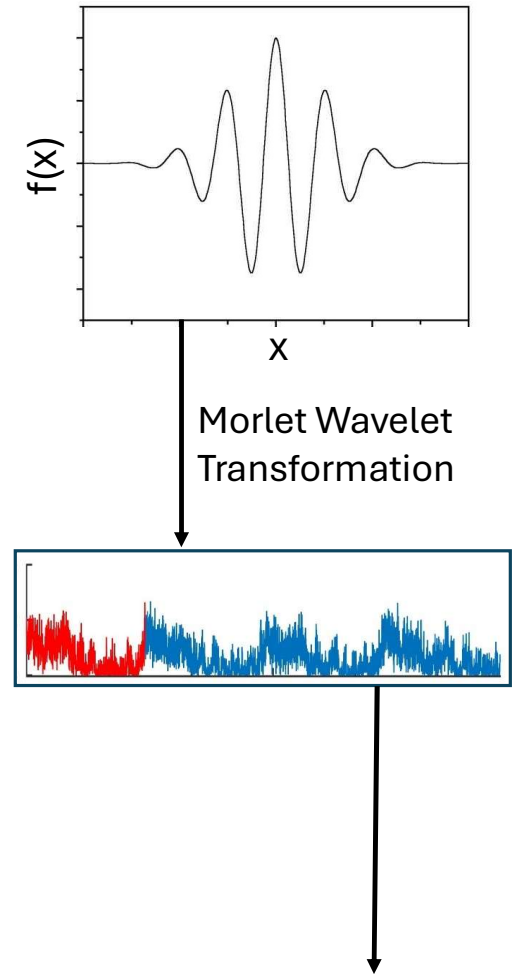
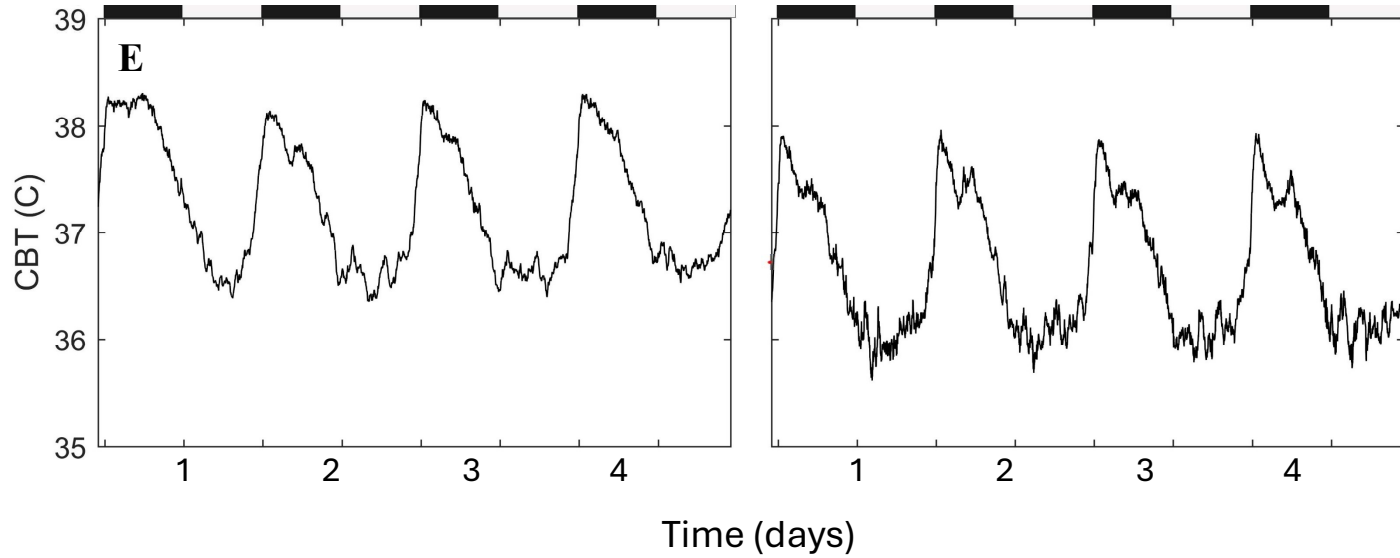
Dissect time by type (here, class and non-class days)

Aggregate by a sorted feature (here, midpoint phase)

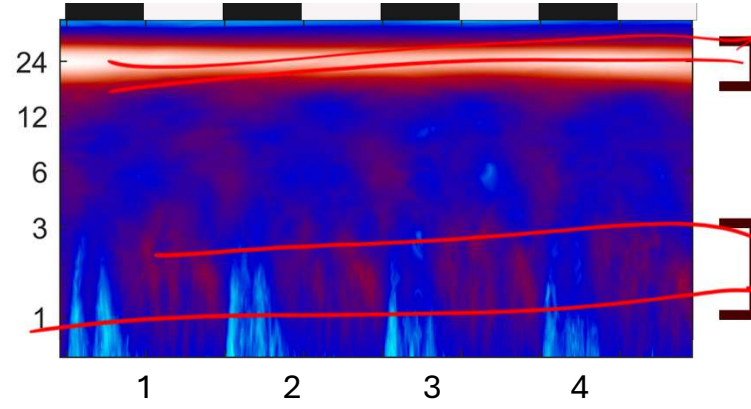
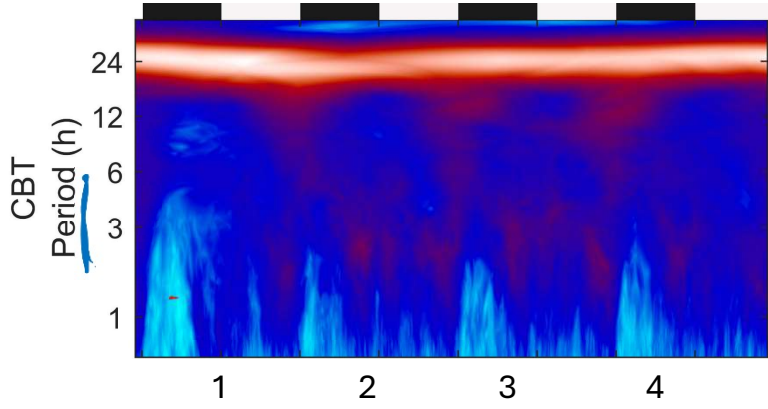
Compare averages/stats across individuals



Frequency transformations



Spectrogram 3D “surface” from 2D lines



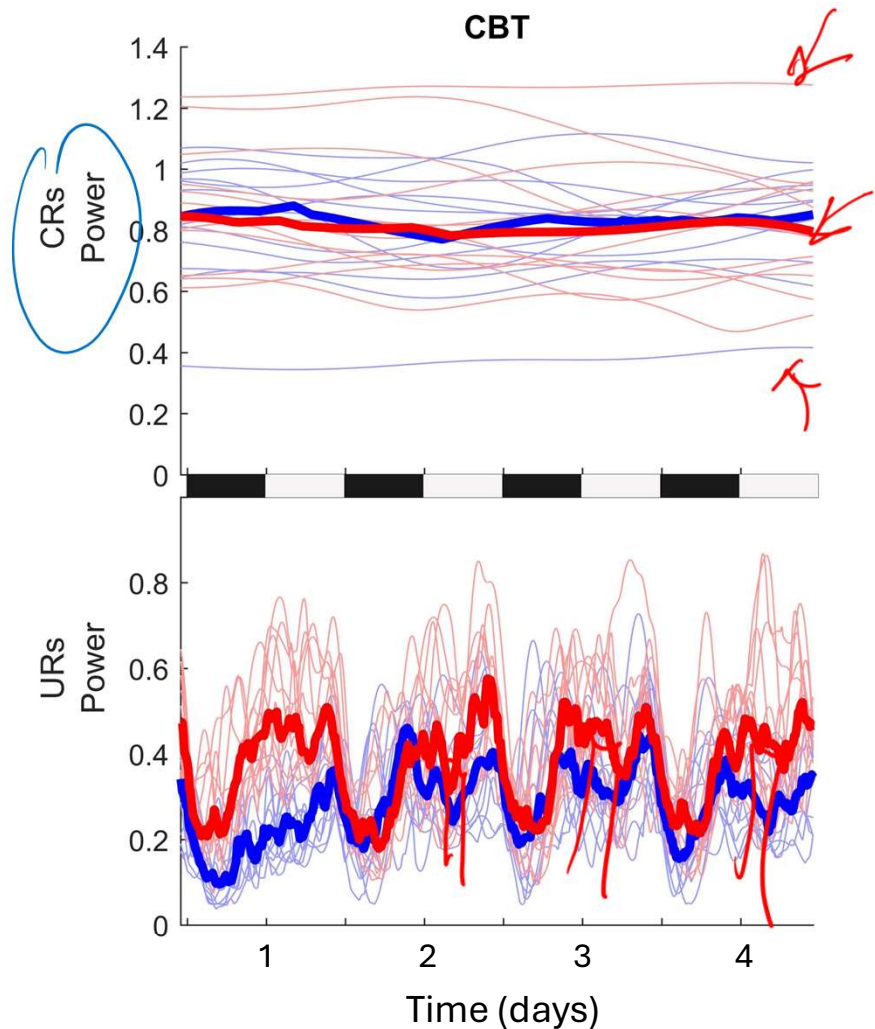
“Circadian rhythms”

“Ultradian rhythms”

In EEG
Bands come from literature
Boxes on continua...

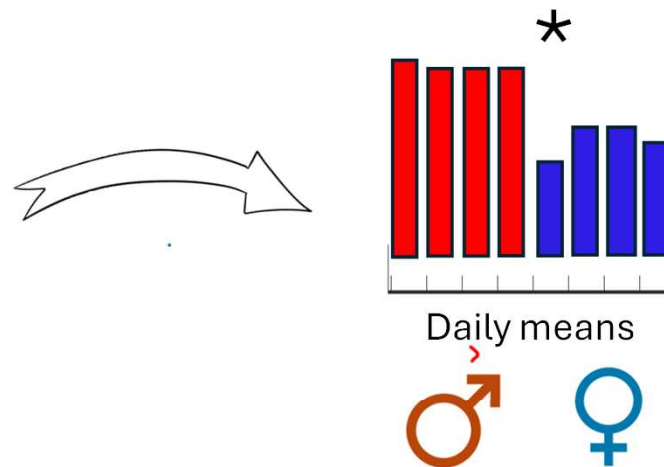


Frequency can be treated just like other data

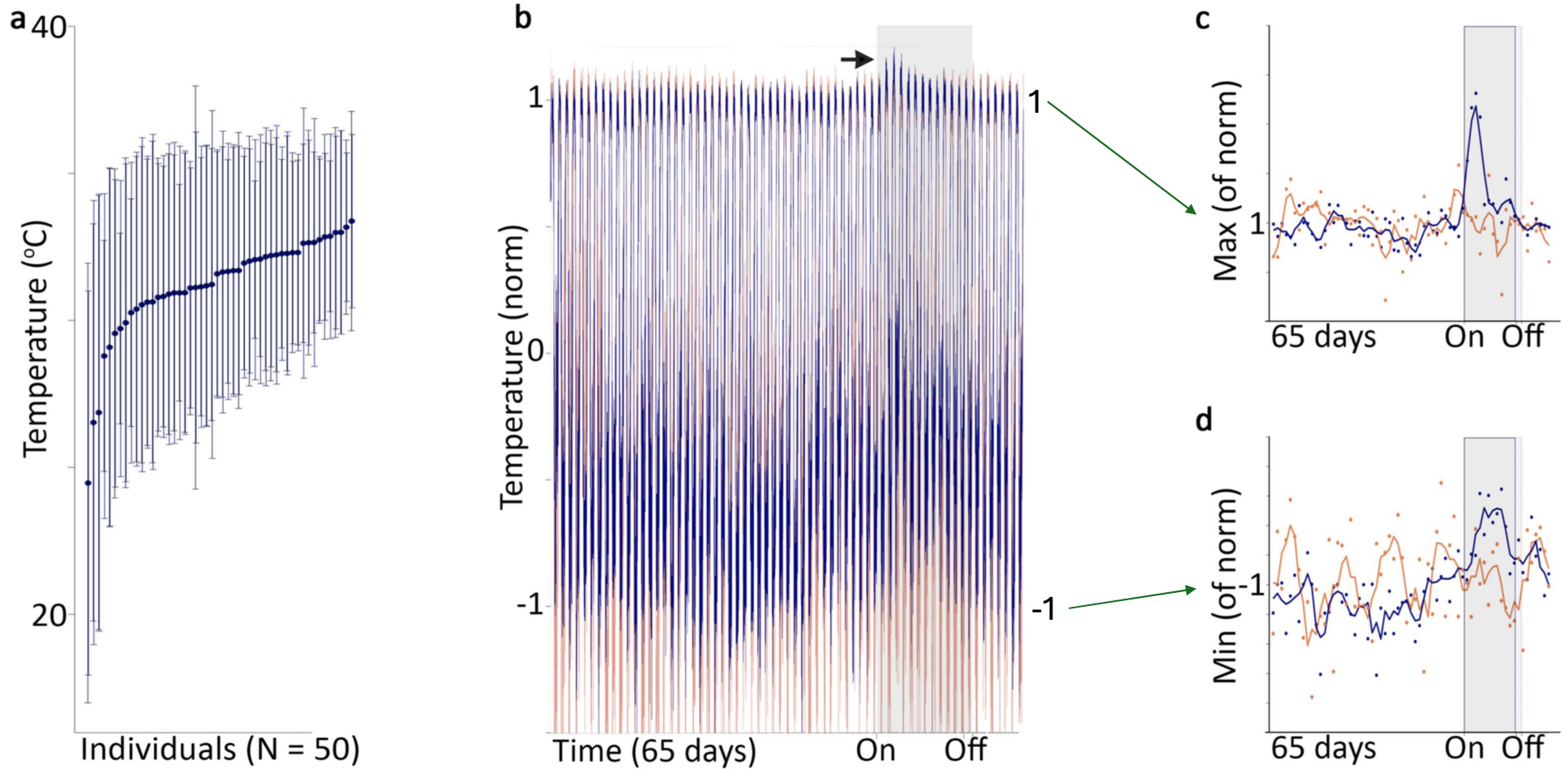


Frequency transformations:

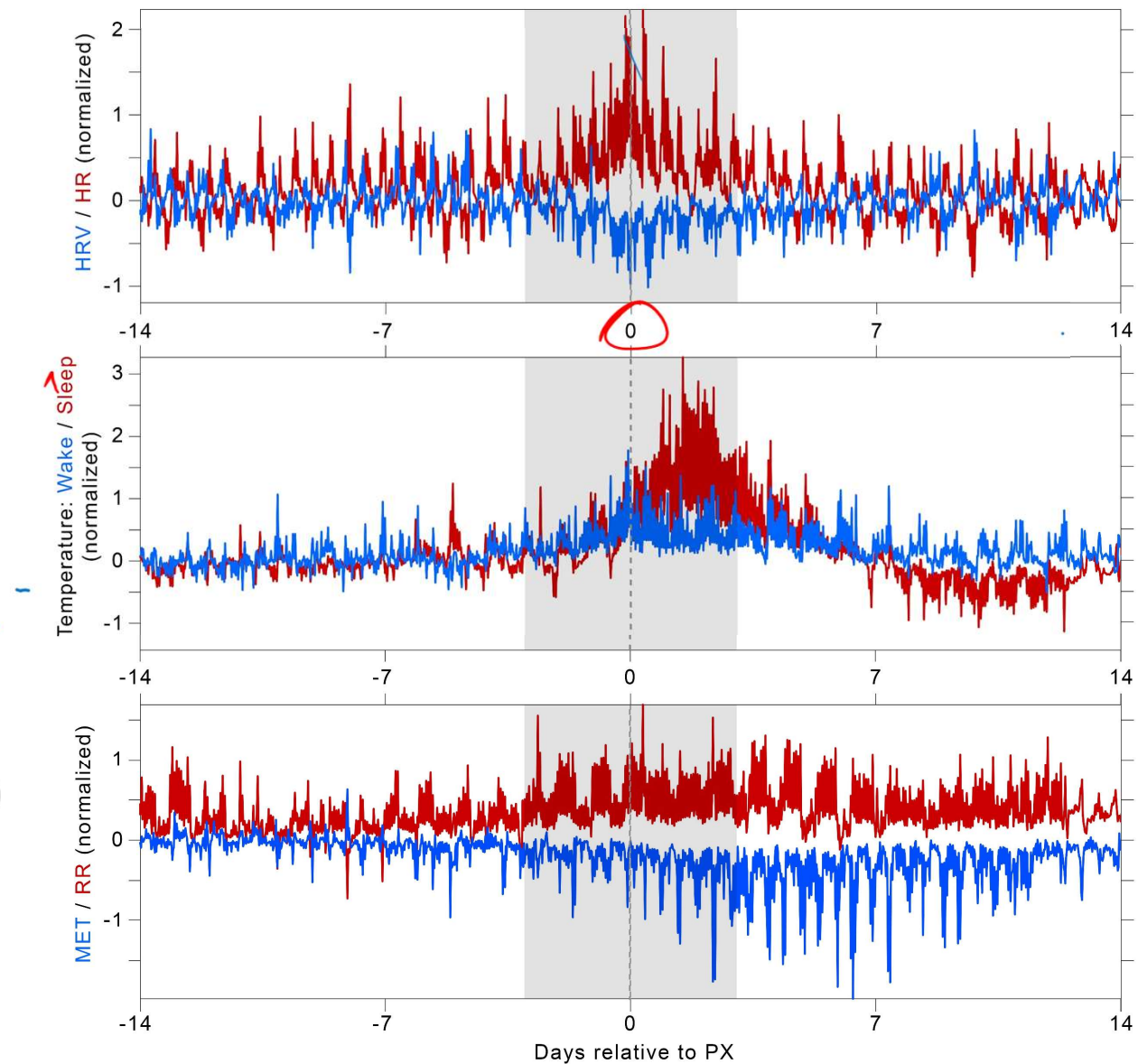
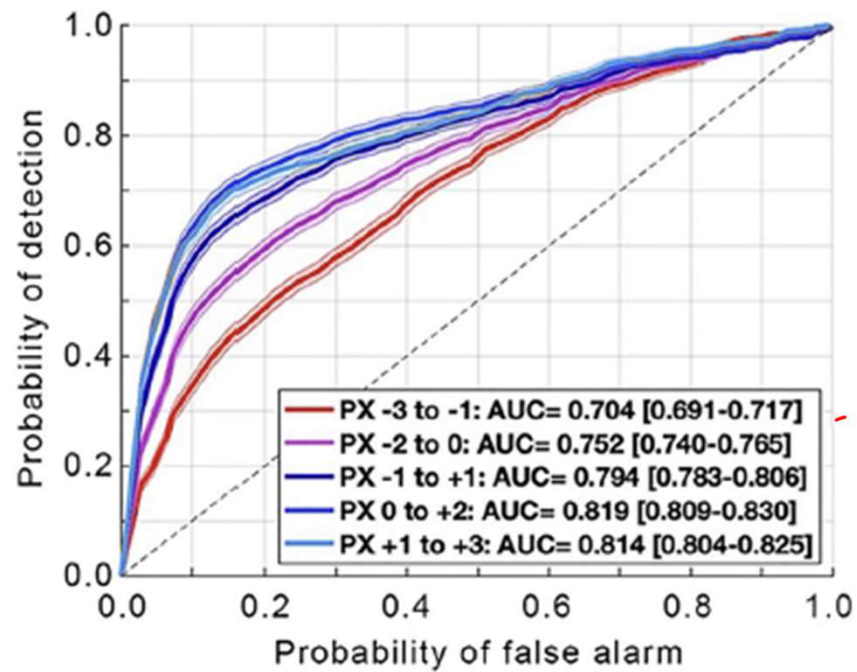
- 1) Compare band by band
- 2) Quantify dynamics
- 3) Takes more compute
- 4) Infinite ways to transform



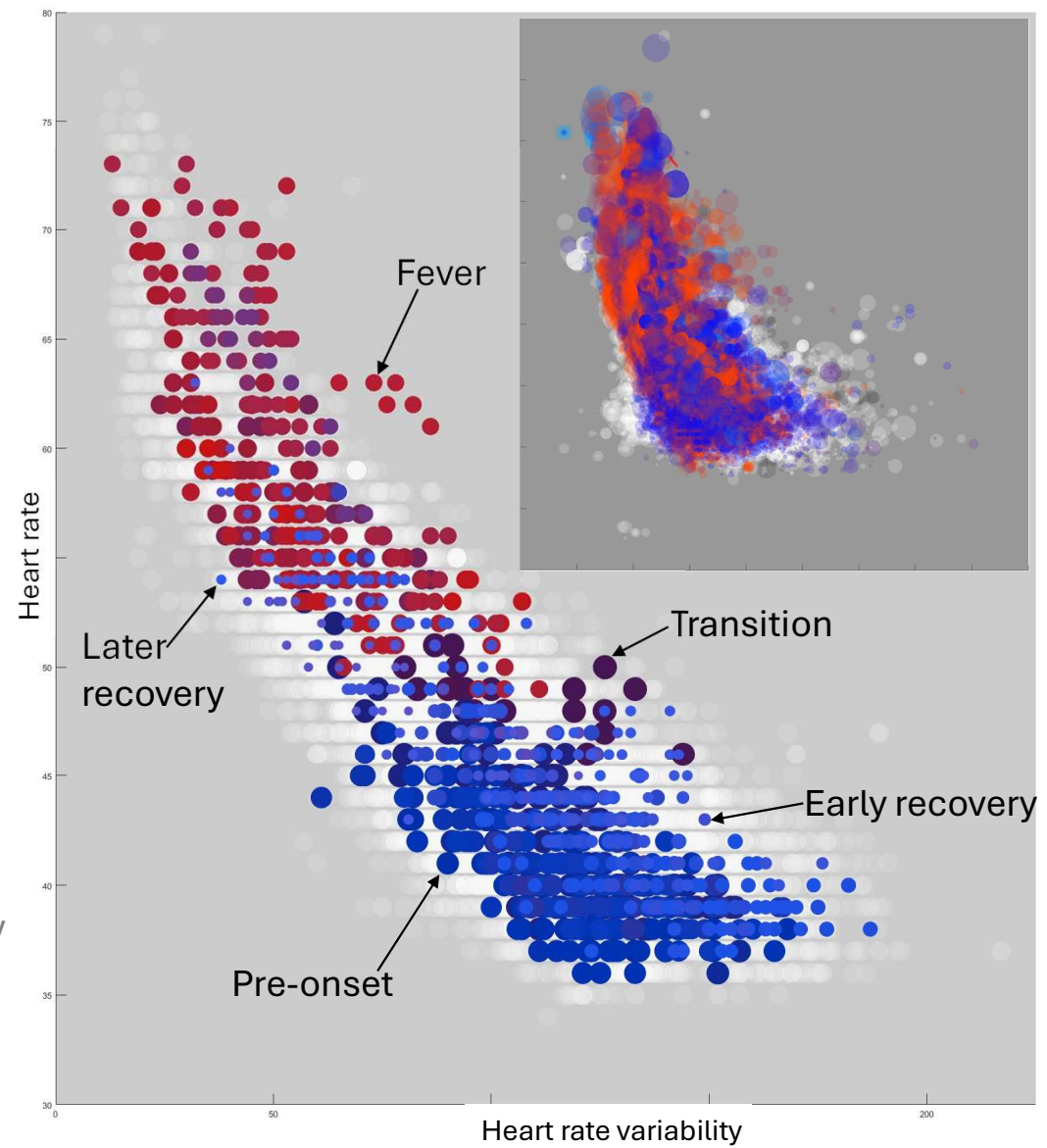
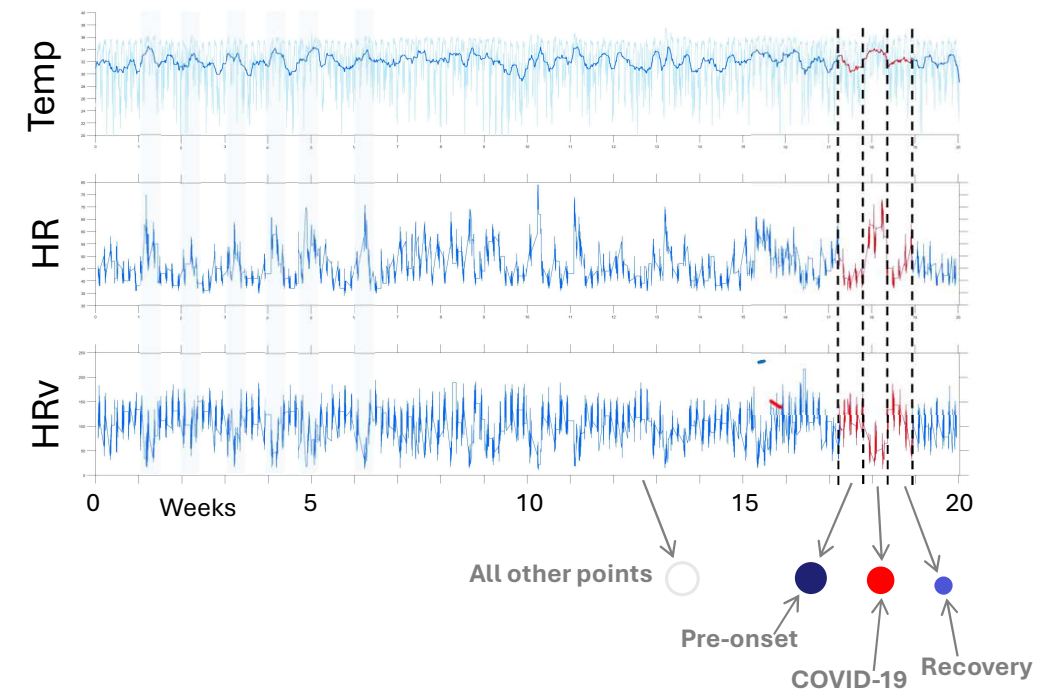
Visual exploration supports feature engineering



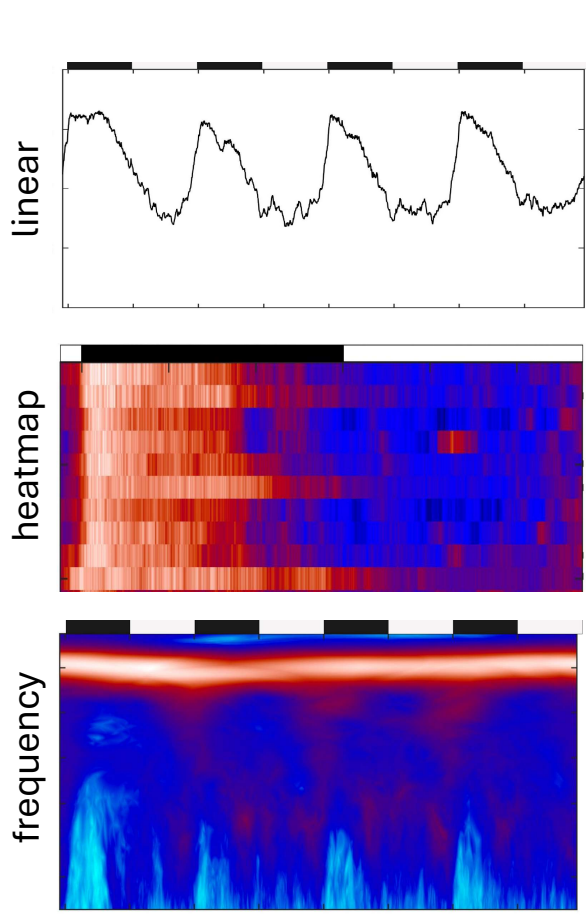
Classification in time



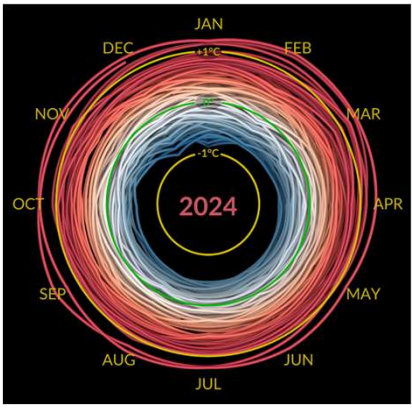
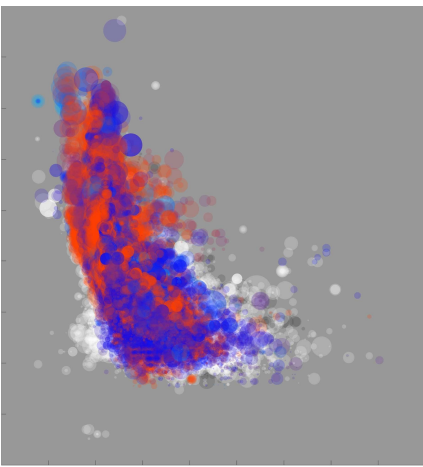
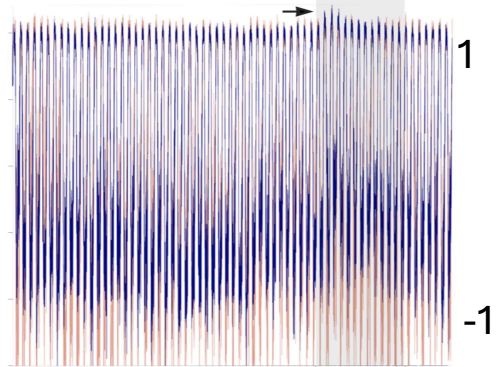
Time without time



Conclusion: lots of options/trade offs to consider



Normalized, non-normal



Iterate unsupervised and supervised learning

- Different time series visualizations:
1. Build your intuition for what matters
 2. Improve feature selection
 3. Allow comparison at different scales
 4. Allow comparison of dynamics by group
 5. Support a more compelling story/argument