Spatio-temporal data-formats

$$(x, y, t)$$

- **spatio-temporal point process**

  $(x_i, y_i, t_i) : i = 1, ..., n$
- **spatial time-series**

  $W_{ij} = W(x_i, y_i, t_{ij}) : i = 1, ..., n; j = 1, ..., m_i$
- **spatial diffusion**

  $t_i = T(x_i, y_i)$
- **spatial trajectories**

  $X(t_i), Y(t_i) : i = 1, ..., n$

Data-characteristics

- spatially/temporally continuous or discrete?
- spatially/temporally dense or sparse?
- measurement errors?
- incommensurate observation protocols for multivariate data
  (eg disease counts in regions, pollution exposures at monitored locations)

Graphical design

- **spinning? No, because** $2 + 1 \neq 3$
- **colour? Yes, but should be used carefully**
- **animation? Can be very effective, but also need static displays for posterity**
- **plotting symbols, aspect ratios,...**
- **defaults are usually bad choices**

Tufte *Visual Display of Quantitative Information*

A.N.Autre *Semiotics of Graphs*

Example 1

Archaeology

- data consist of approx 40 to 80 locations and dates, both observed with estimates of limits of uncertainty
- goal is to describe spatio-temporal spread

Dynamic display?

- spatio-temporal animation: plot locations according to best-guess times

Static display?

- dual-colour plotting symbols (disc-within-disc) to represent range of uncertainty at each location?
- separate dot-maps of colour-coded dates and estimates of associated uncertainties?

  dynamic variant: draw repeated samples at each location from corresponding predictive distribution

Example 2

Chemistry

- 8×8 **grid of locations**
- **apply increasing voltage, measure resulting current** $z(t)$ **at** $n = O(1000)$ **time-points at each location**
- **does** $z(t)$ **show (interesting) spatial variation?**

Plot as real-time animation of colour-coded values,

$z_{ij}(t) : i, j = 1, ..., 8$

Software

- `R`
  - contributed packages on CRAN
  - Example: *Loa loa* mapping in Cameroon (`Rmap`)
- is there a good open-source GIS package?
- XLISP-STAT? (open-source)