Advanced topics

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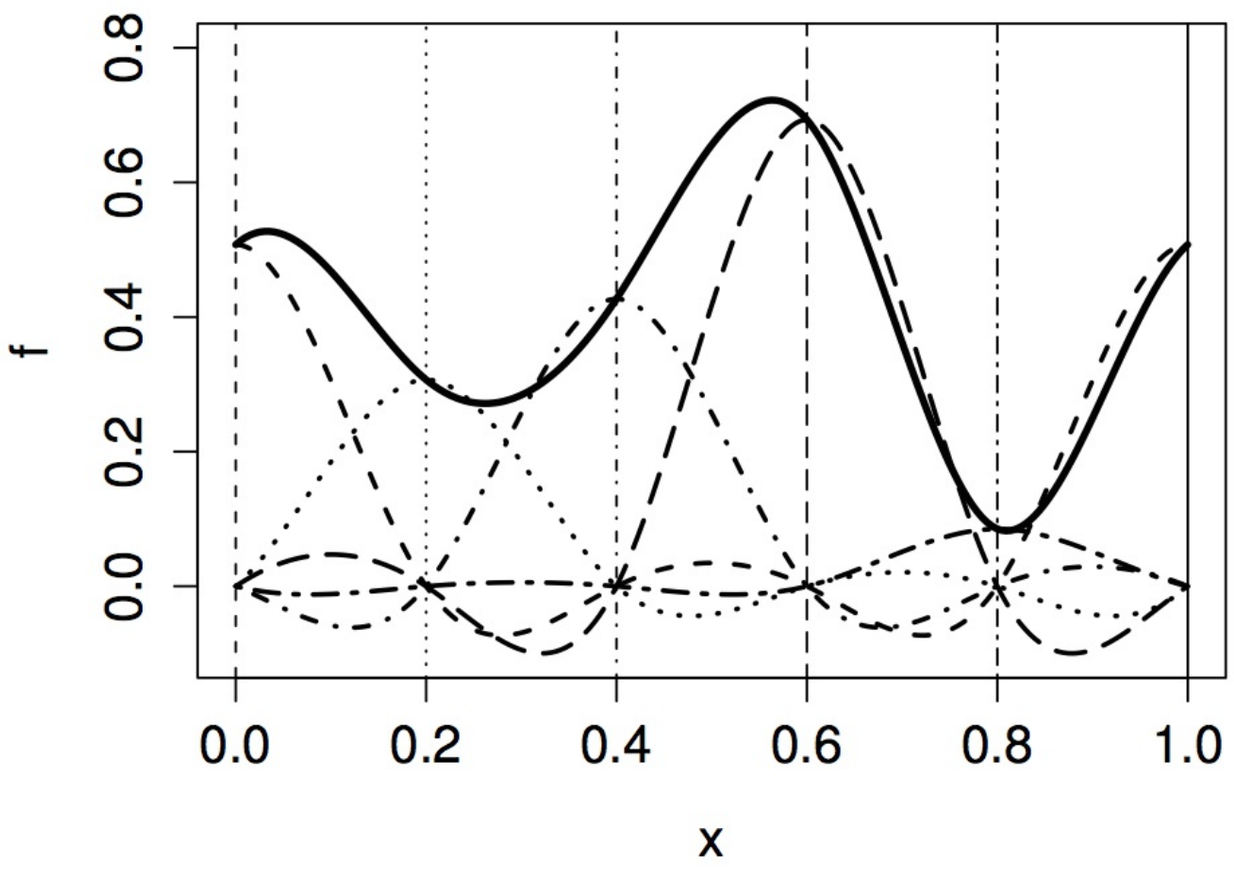
This is a whirlwind tour...

...and some of this is experimental

Smoother zoo

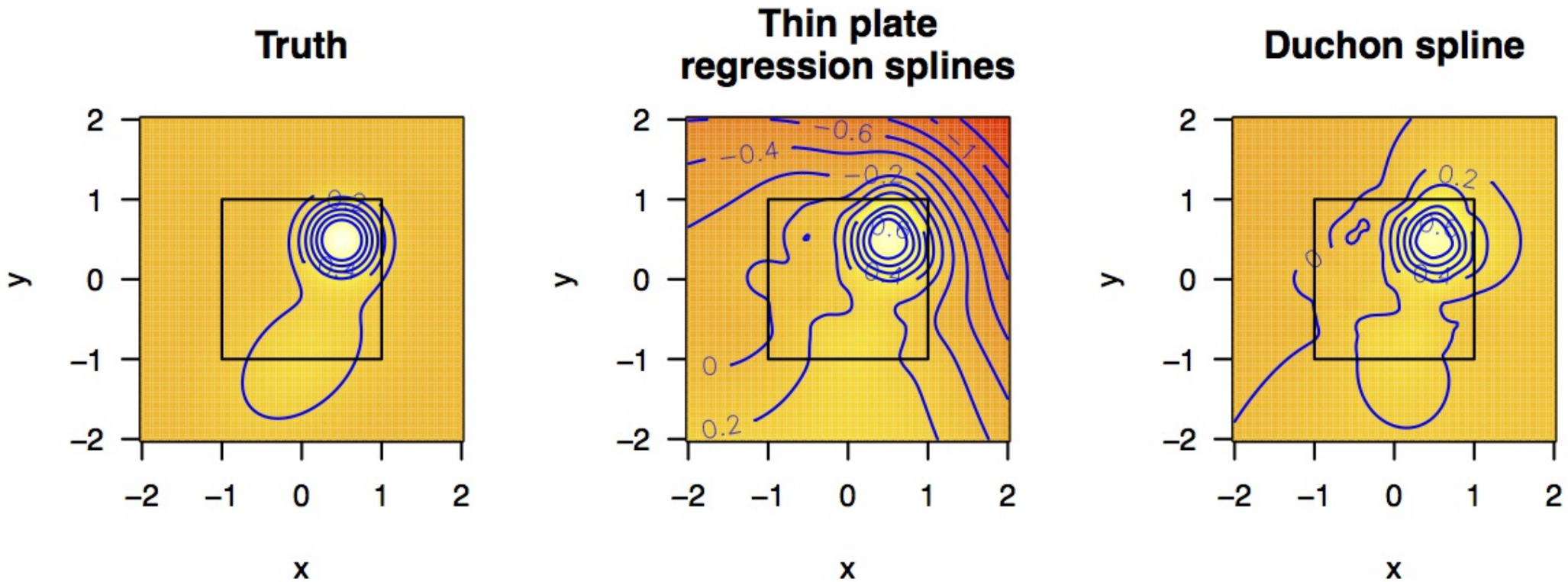
Cyclic smooths

- What if things “wrap around”? (Time, angles, …)
- Match value and derivative
- Use `bs="cc"`
- See `?smooth.construct.cs.smooth.spec`



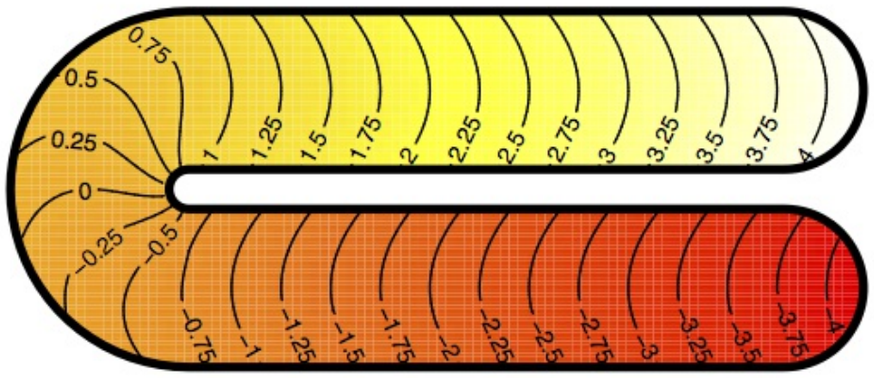
Duchon splines

- Thin plate splines do weird things far from data
- Local bits are fine, but unpenalised planes are bad
- Remove the badly behaved bits?
- (Miller and Kelly, in prep)
- `?smooth.construct.ds.smooth.spec`



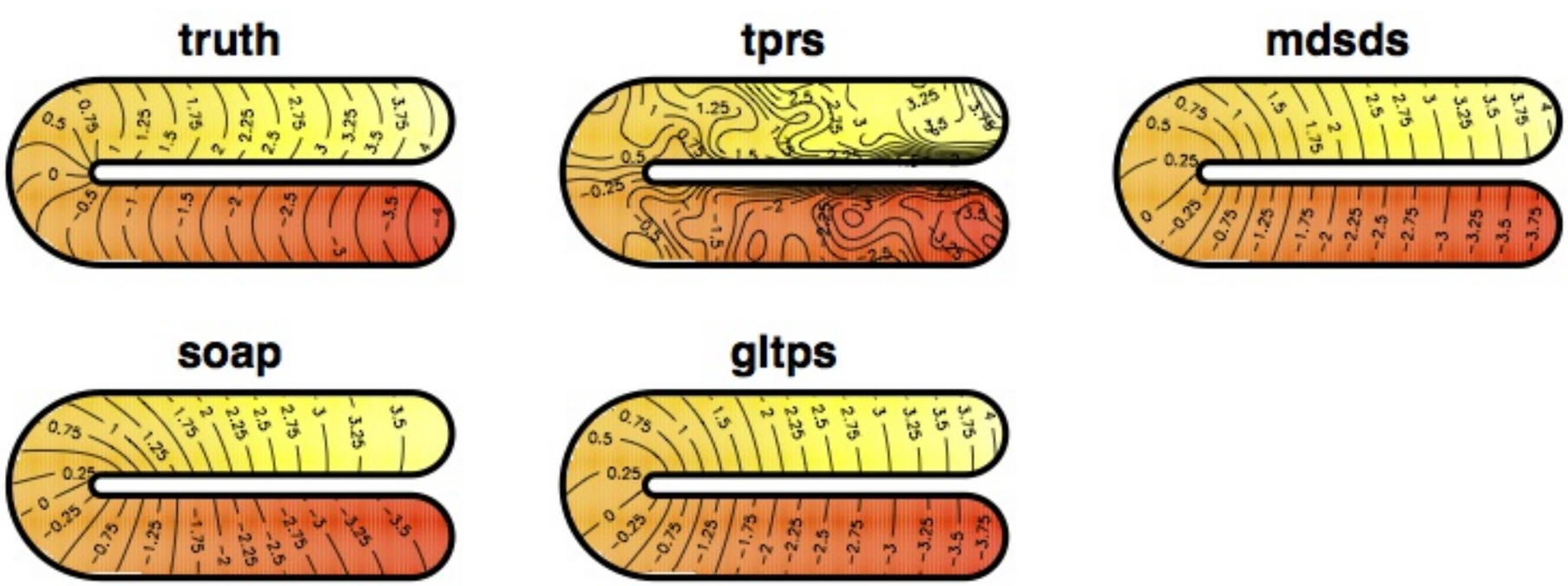
Smoothing in complex regions

- Edges are important
- Whales don't live on land
- Bad things happen when we don't account for this



”Finite area” smoothing

- Soap film smoothing is one solution
- Include boundary info in smoother
- Basis functions are “correct” by construction
- `?smooth.construct.so.smooth.spec`

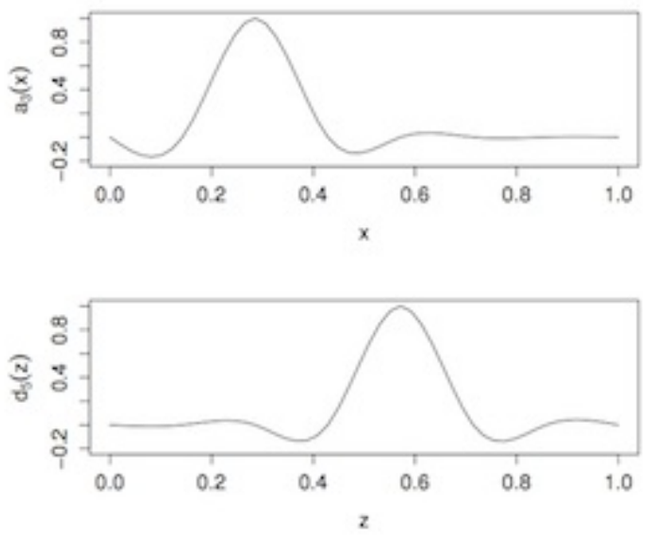


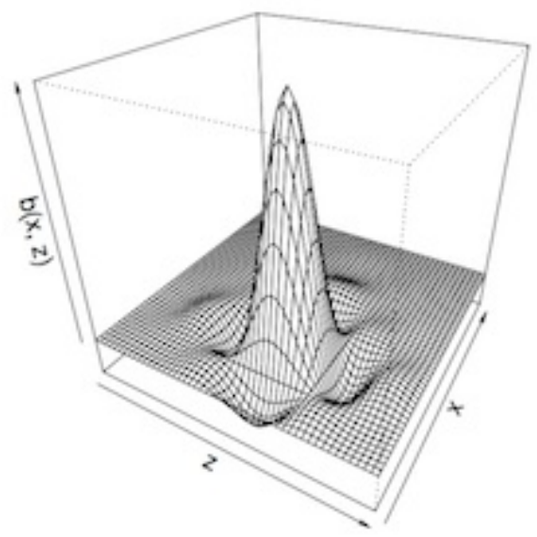
Multivariate smooths

- Thin plate splines are *isotropic*
- 1 unit in any direction is equal
- Fine for space, not for other things

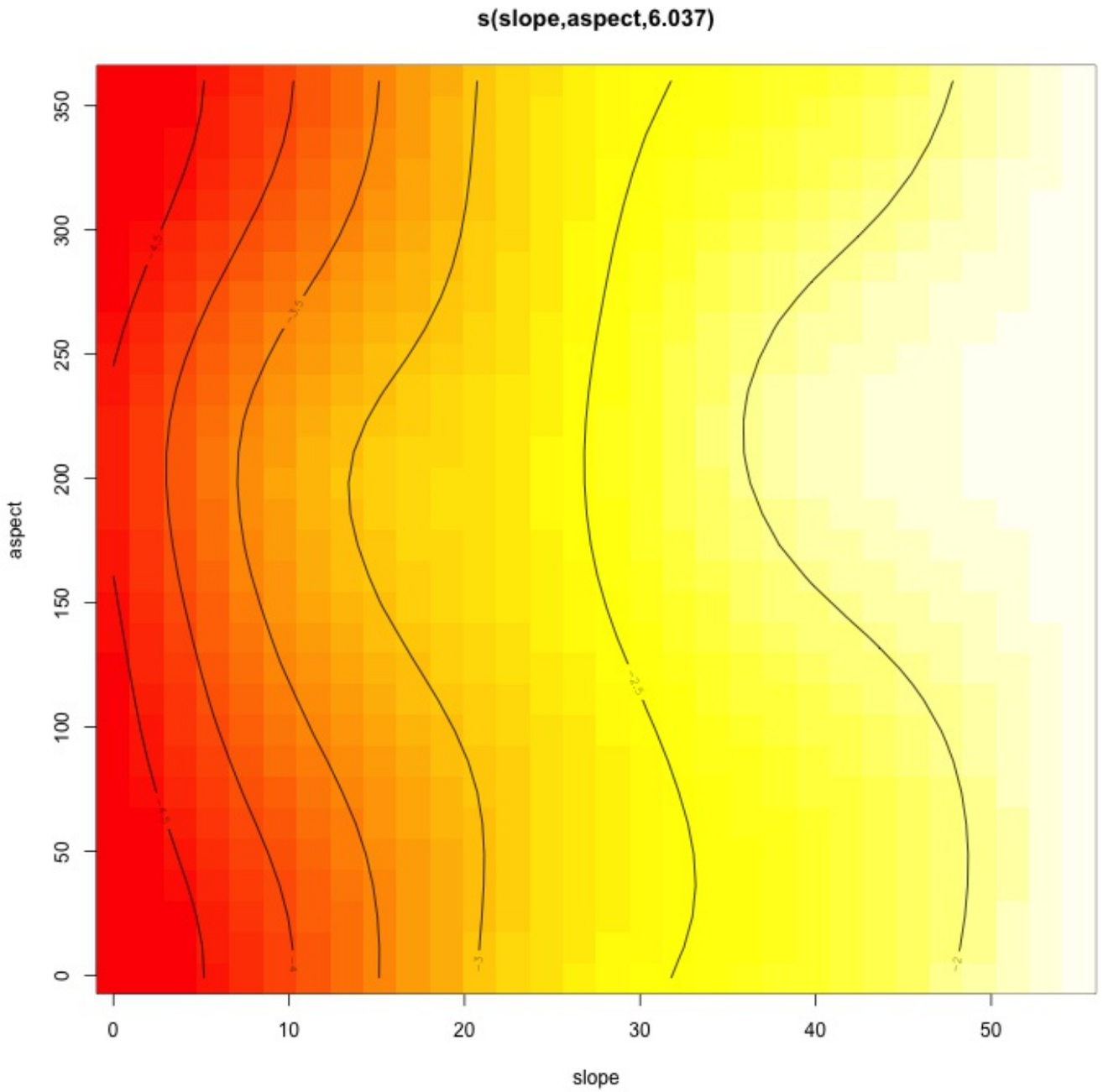
Tensor products

- Take smooths of each covariate
- $s_{x,z}(x,z) = \sum_{k_1} \sum_{k_2} \beta_k s_x(x) s_z(z)$
- As many covariates as you like! (But takes time)
- `te()` can be used like `s()` in `mgcv`





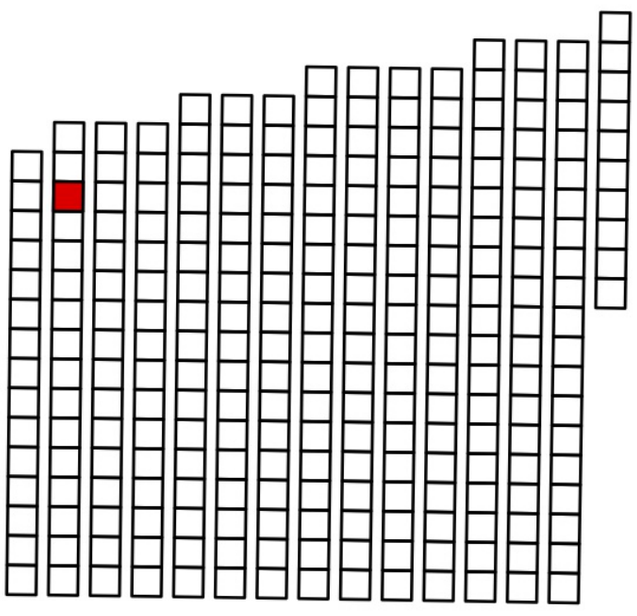
Example of tensors being used

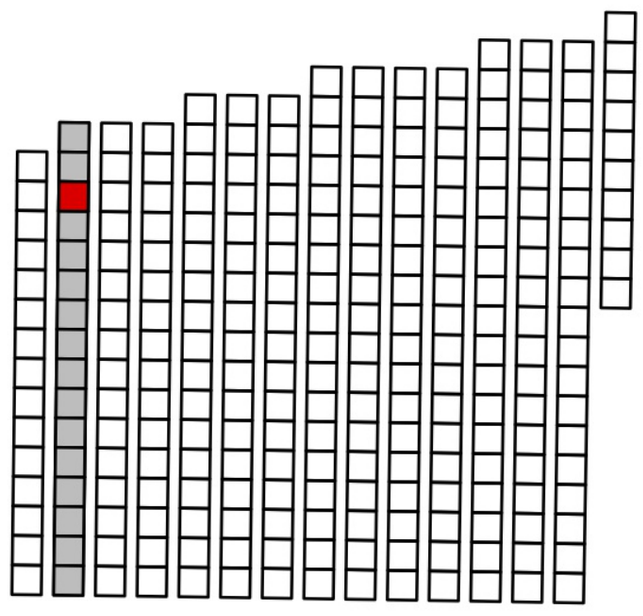


Space and time

Spatial autocorrelation

- $\mathrm{AR(p)}$ process (“obvious” structure)
- In general this is unstable
  - Random effects are sparse but splines are “dense”
  - $\Longrightarrow$ bad for optimisation
- `engine="gamm"` & `correlation=...`





Temporal effects

- Could do tensor product space-time?
- Can marginalise other terms - time trends
- Does anyone have such long term data?

Making things faster

Parallel processing

- Some models are very big/slow
- Run on multiple cores
- Use `engine="bam"`!
- Some constraints in what you can do
- Experimental, but potentially useful

Modelling philosophy

Which covariates should we include?

- Dynamic vs static variables
- Spatial terms? Habitat models?

Over to Jason and Laura…