



Design and Analysis of Longitudinal Population Studies for Climate-Health Research

Challenges & Opportunities

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Nissan, Diggle and Fronterre, (2021). *Climate Science and Longitudinal Population Health Studies: bridging two research communities*. London: Wellcome Trust (to appear)

The Constituent Data...typical scenarios

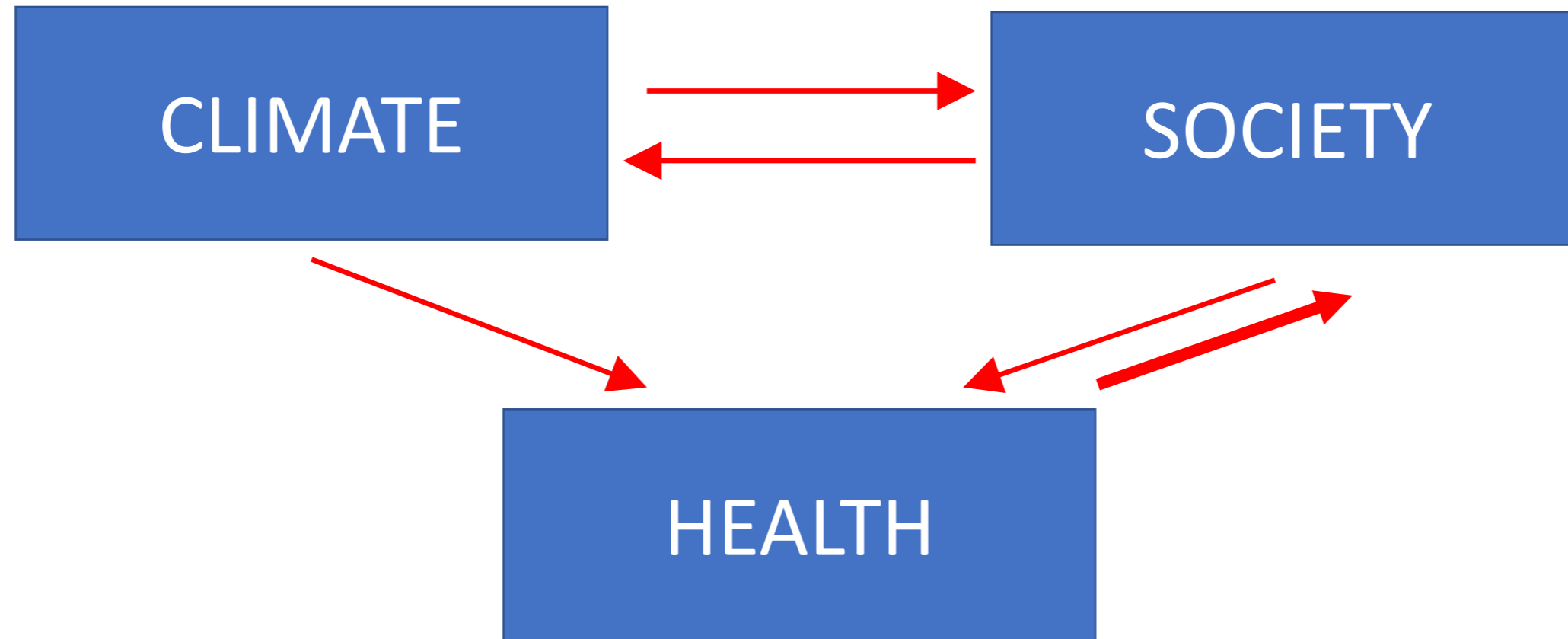
Longitudinal population studies

- Large number of individuals
- Small number of follow-up times
- Yearly (or longer) follow-up intervals
- Many variables
- Tight geographical span

Climate data

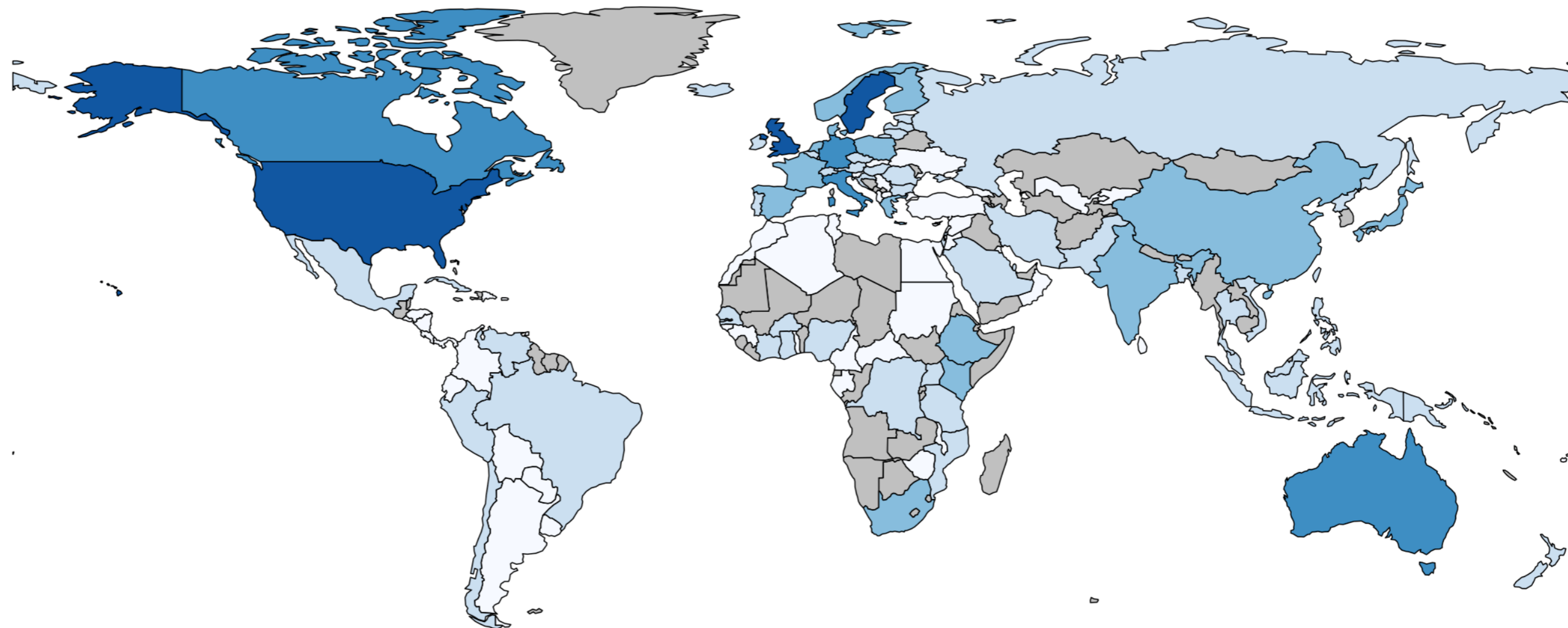
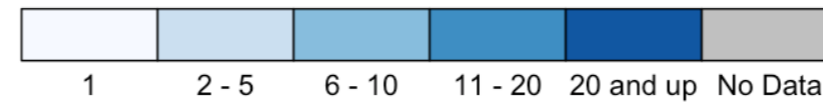
- Network of monitoring sites
- Long time series at each site
- High-frequency data: daily, hourly,...
- Small number of variables
- Wide geographical span, but locally sparse

The Inter-disciplinary Challenge

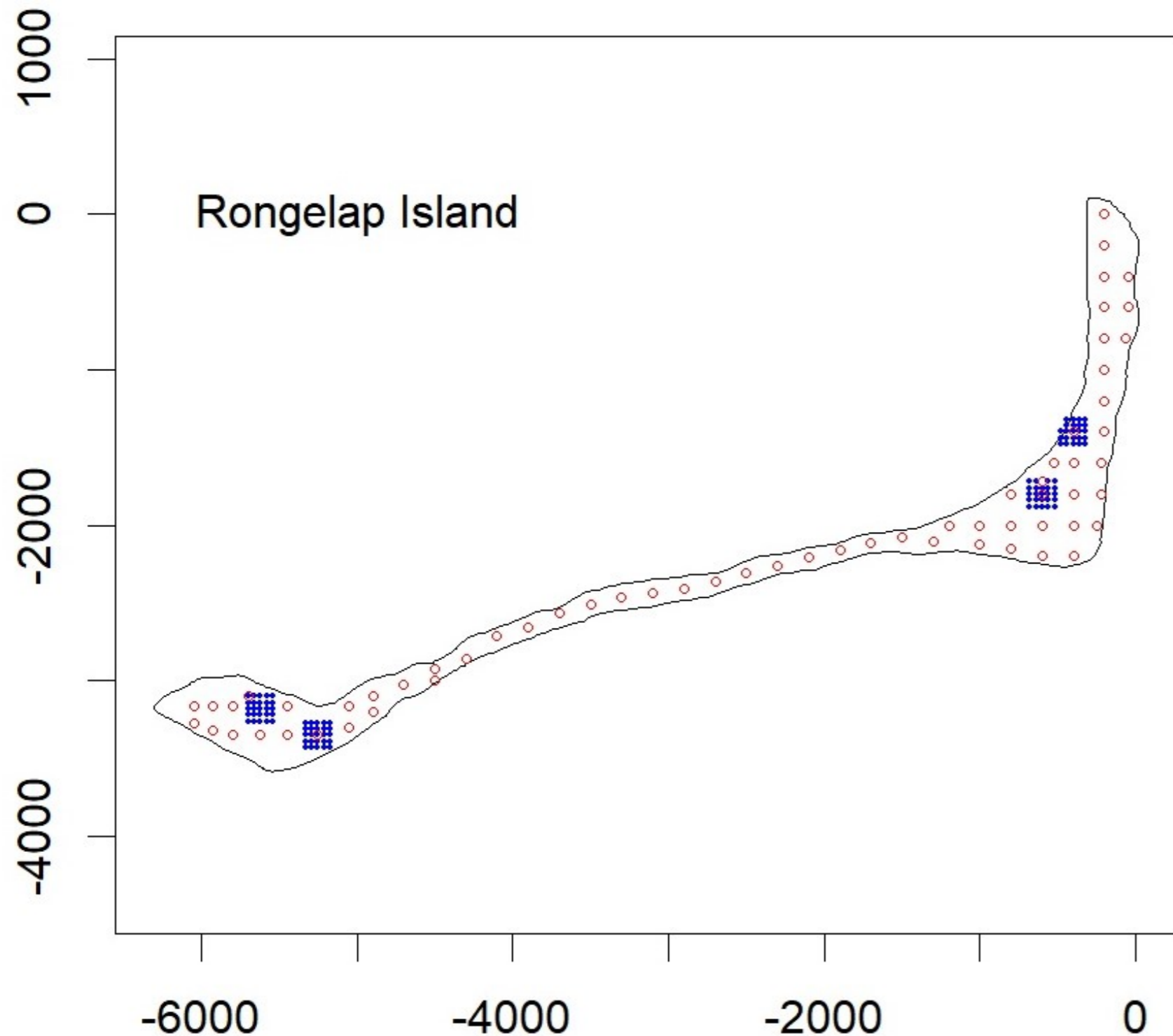


The Geographical Challenge

Number of studies per country



The design challenge: multi-scale effects in time and space

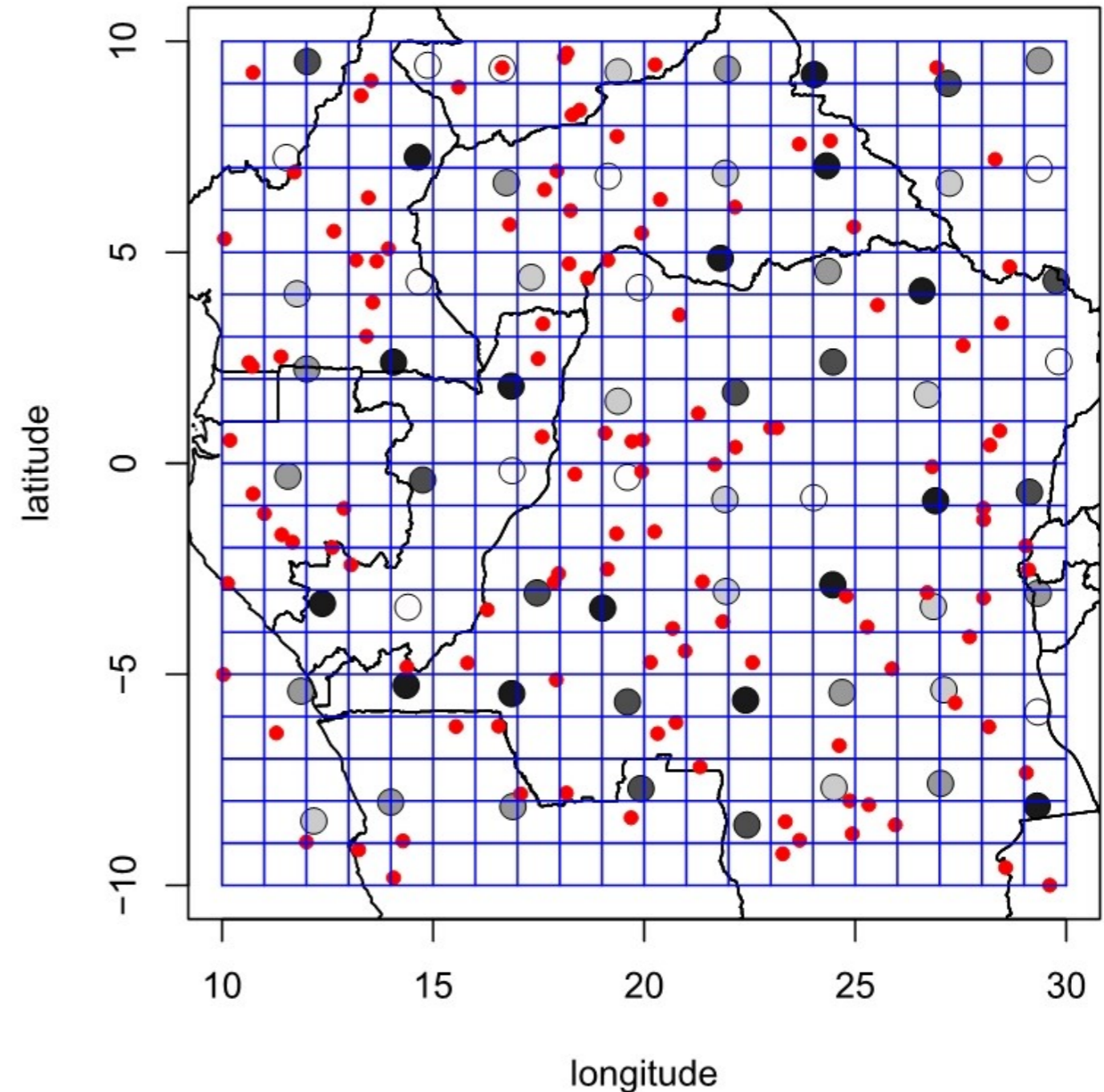


- Contaminated by nuclear testing in 1954
- Evacuated by Greenpeace in 1985
- Estimating residual contamination in 1997: what are the important spatial scales?

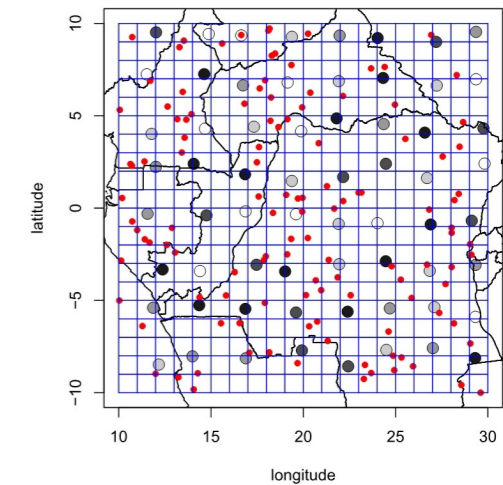
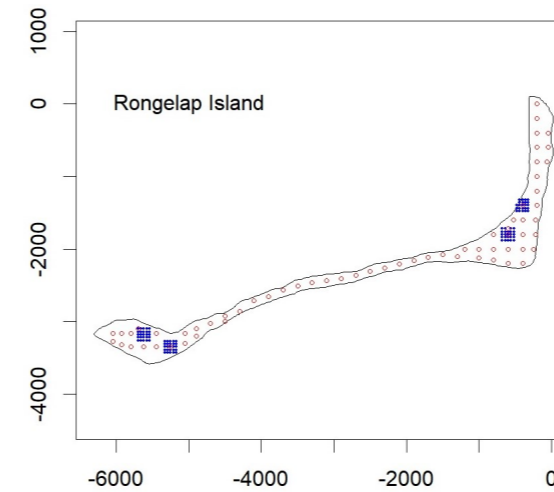
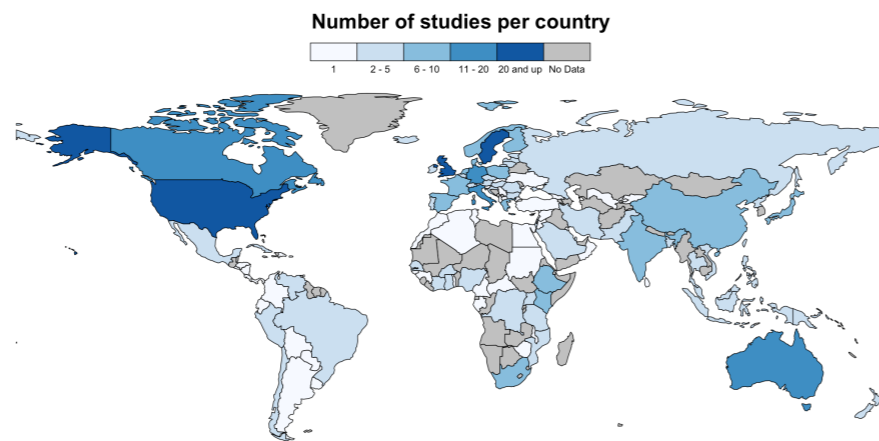
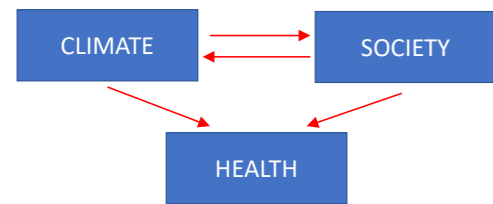
The analysis challenge: data-synthesis

- Combining LPS data and electronic health records
- **Example:** Brazilian 100M study
- Exploiting spatial and temporal correlation for greater efficiency
- Combining point, area and image **data**, D_1, \dots, D_m , to learn about a scientific **process**, P
- Hierarchical model structure:

$$[P] \times [D_1|P] \times \dots \times [D_m|P] \rightarrow [P|D_1, \dots, D_m]$$



Challenges are also opportunities



Inter-disciplinarity

Geography

Design

Analysis

How should Wellcome respond?

- **Work with existing LPS and climate data?**
- **Modify existing LPS better to incorporate climate science?**
- **Fund new LPS with explicit health-climate focus?**
- **Single studies or consortia?**
- **A global-scale centre of excellence for climate-health research?**

— Our recommendations to Wellcome

- ❑ **Use existing grant and fellowship schemes** to fund:
 - secondary analyses of existing LPS and climate data
 - development of novel statistical and computational methods
 - projects to support better understanding of the indirect drivers in climate-health pathways

- ❑ **Construct a web-based platform** to visualise relevant metadata from different LPS, climate and other relevant datasets

- ❑ **Engage in discussion with Brazil 100M** and INPE with a view to developing an exemplar country-wide, real-time climate and health surveillance system.

- ❑ **Commission selected LPS consortia** to consider how they could re-orient some of their work towards climate-health research