modern statistical methods for spatio-temporal data – understanding patterns in space and time

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spatial patterns

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spatial patterns

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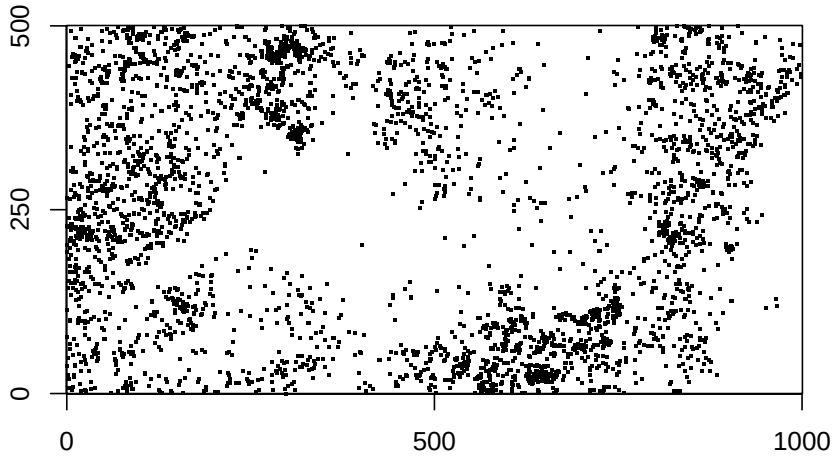
They all form **spatial patterns**...



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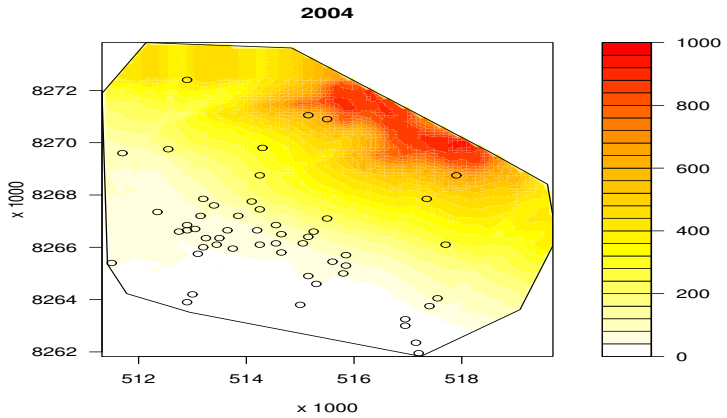

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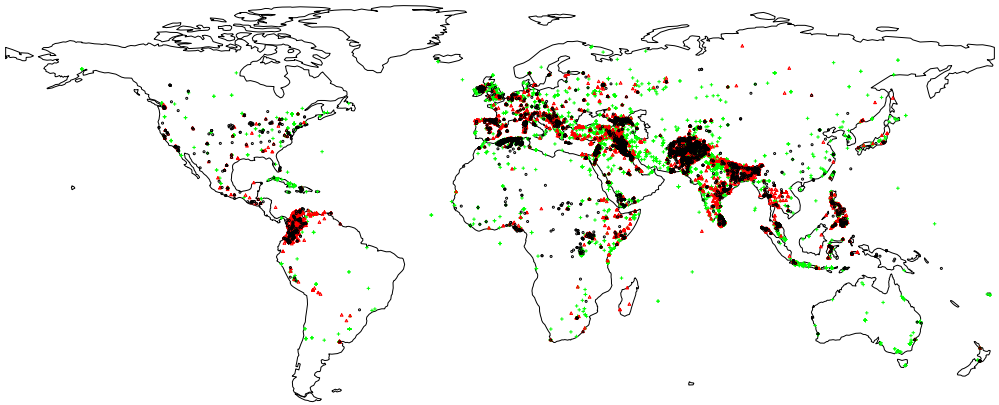

making sense of spatial patterns

aim

spatial pattern analysis:
understanding underlying mechanisms by analysing the (abstract) spatial pattern

spatial data I

spatial statistics...

- analyses data collected "in space"

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- **not** this kind of space:

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- analyses data collected "in space"
- **not** this kind of space:

- but data for which the **sampling location is known and "relevant"**

spatial data II

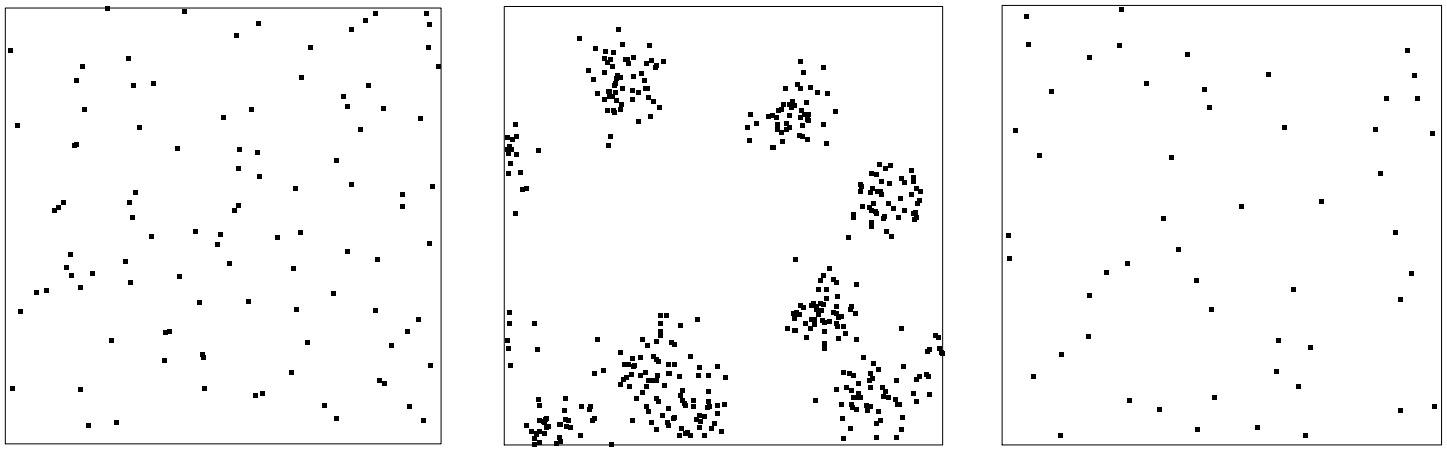
well, what do we mean by **relevant**?

two scenarios:

1. spatial structure in the data is of interest;
   aim is to **describe and analyse** the spatial structure
2. spatial structure in the data is a "nuisance";
   aim is to account for the spatial structure or **spatial autocorrelation**

We typically have to deal with both issues...

spatial structure...?



random, clustered and regular patterns

making sense of spatial patterns of crime

aim

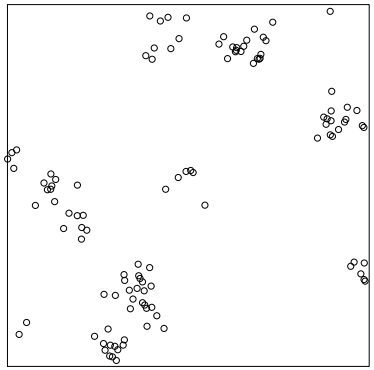
spatial statistics understanding spatial structures in patterns of crime by identifying clusters ("hotspots")

clustering revisited

Finding clusters – why do we need statistics – can't we just see them?

Let's see...

clustered pattern (artificial data)



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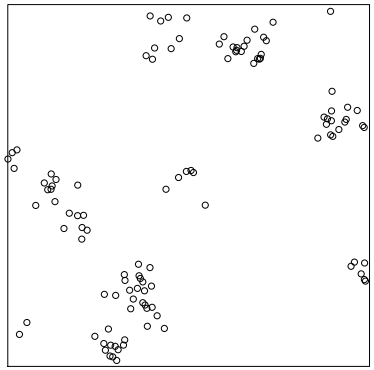

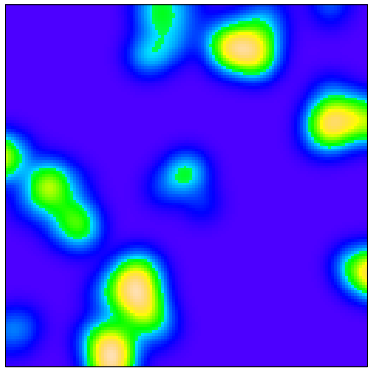

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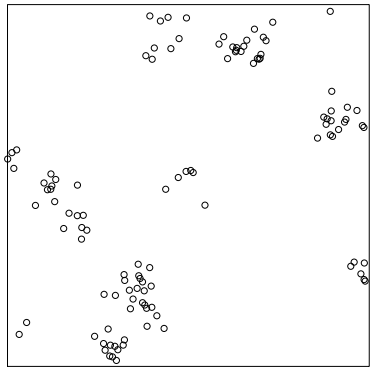

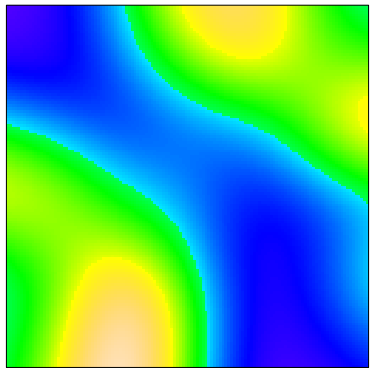

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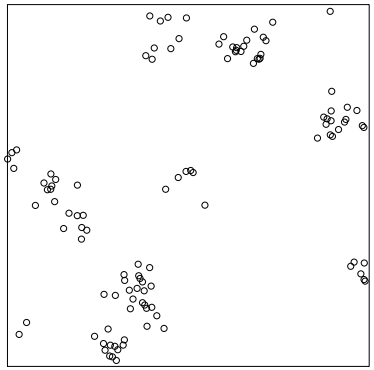

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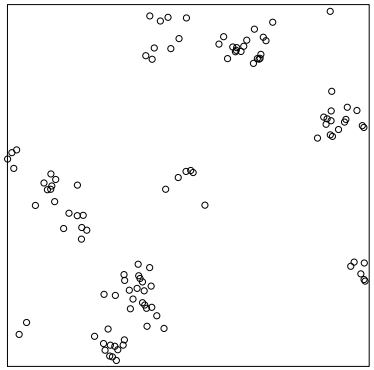

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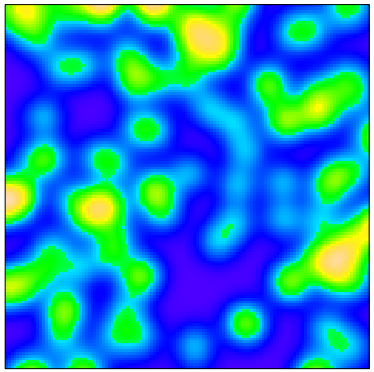
- **however:** degree of smoothing and plotting method determines if we can find them or not...
- not good...

clustering revisited

Finding clusters – are they really there?

Similarly...

another pattern... (artificial data)



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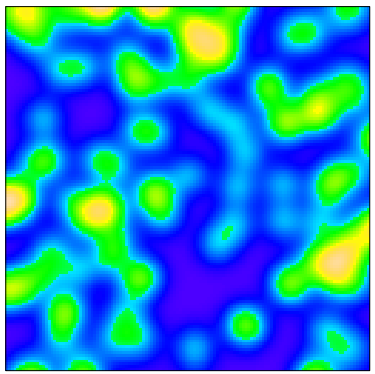

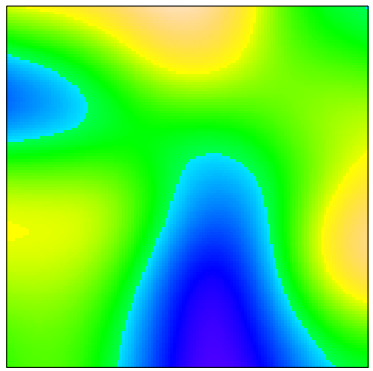

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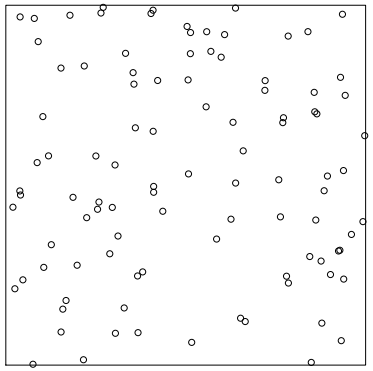

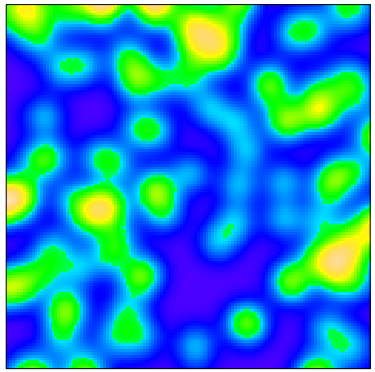

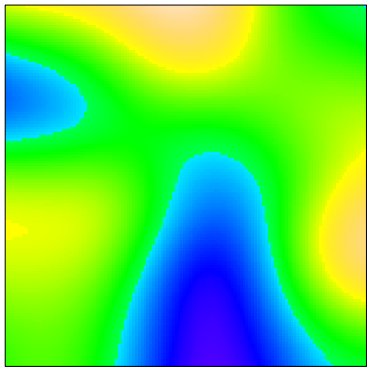

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$\Rightarrow$ this is where statistical models come in...

the case for a (statistical) model

a statistical model allows us to use **inference**
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spatial statistical models

- decide if observed clusters are real clusters
- relate observed spatial patterns to potential explanatory factors – in space
- provide mechanisms to tell us how relevant these are

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this implies...

- increased understanding of mechanisms that facilitate crime
- prediction... aiding policing decisions

complexity...

spatial statistical models are complex – why?

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spatio-temporal models – even more complex...

statistical research...?

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$\Rightarrow$ interdisciplinary work

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interaction among two or more "species" with **mutual benefit**

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- developing methods that are
  - statistically interesting and
  - practically relevant

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$\Rightarrow$ develop a common language and **common interests**