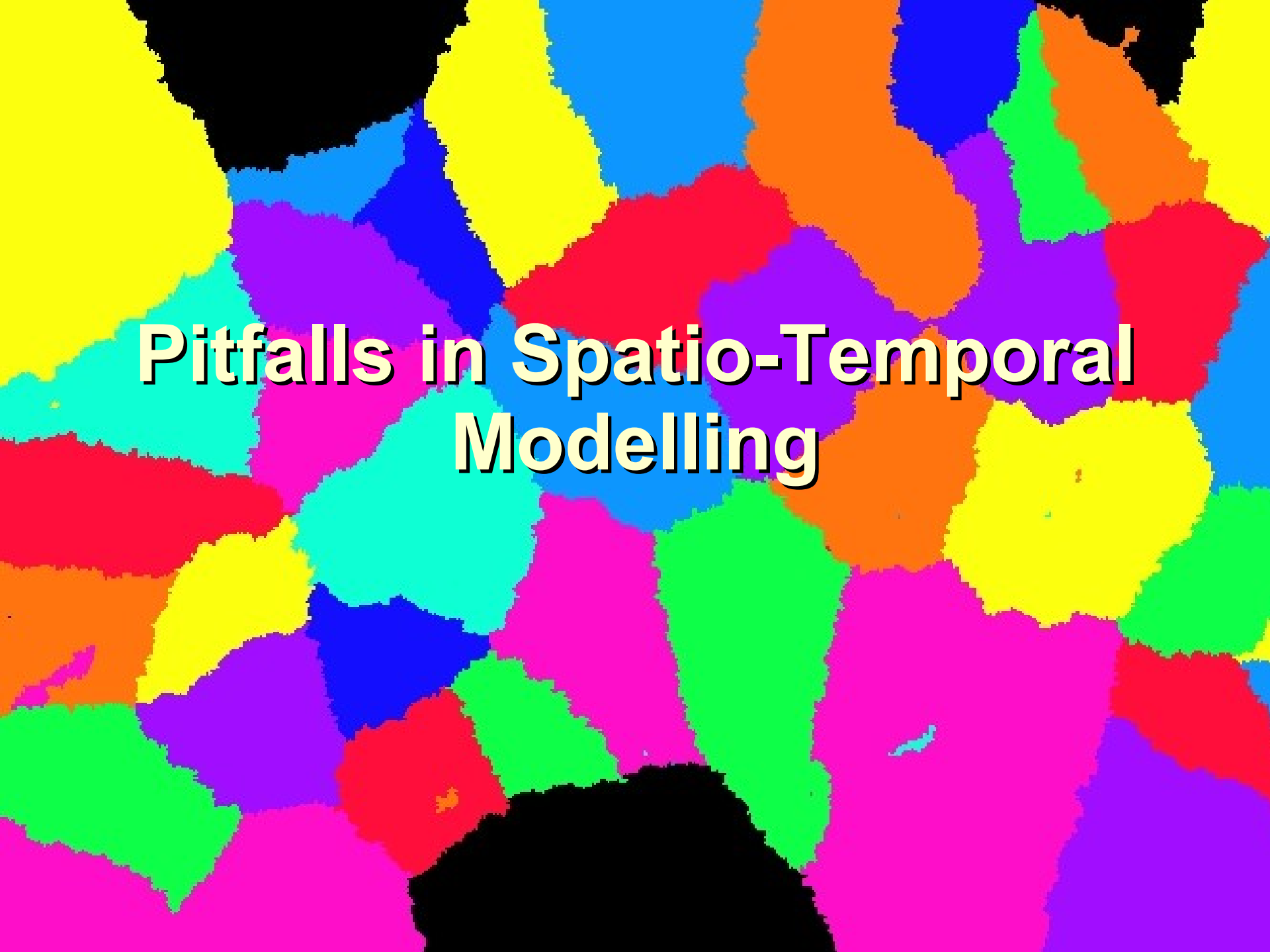

Pitfalls in Spatio-Temporal Modelling

What is a model?

- A model is an abstraction of a real system for the purpose of improving understanding, or for predicting system behavior

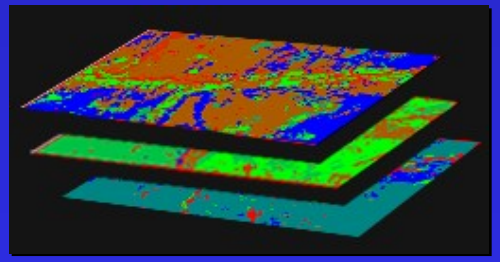
- *"All models are wrong. Some models are useful" Deming*

"By operating the model, the computer faithfully and faultlessly demonstrates the implications of our assumptions and information. It forces us to see the implications, true or false, wise or foolish, of the assumption we have made. It is not so much that we want to believe everything that the computer tells us, but that we want a tool to confront us with the implications of what we think we know"

Botkin (1977)

Spatial Modelling

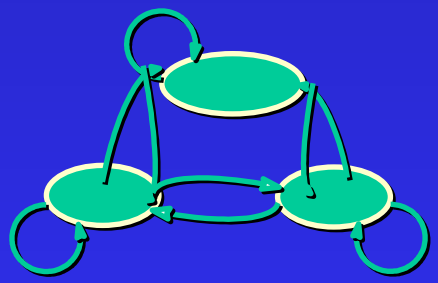
- Explicit representation of pattern and spatial relationships



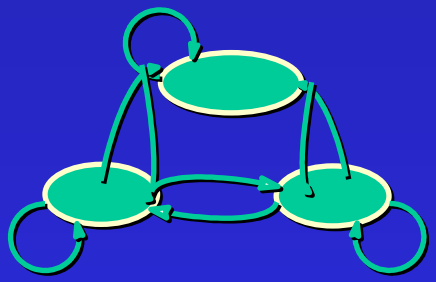
- Example: GIS overlays

Temporal Modelling

- **Explicit representation of process and change over time**

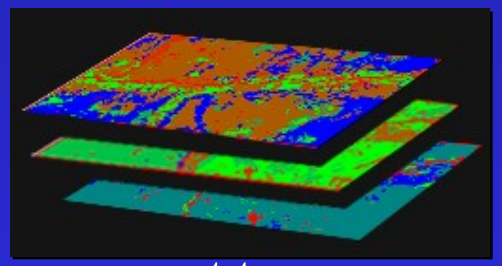


Temporal Modelling



process

Spatial Modelling

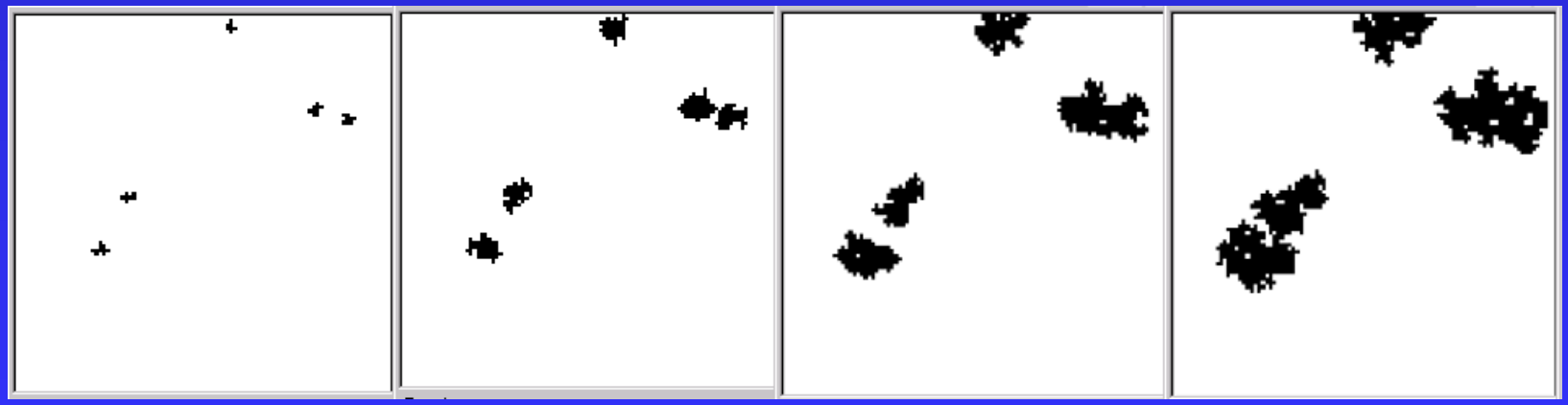


pattern

Spatio-Temporal Modelling

Dynamic Spatial Landscape Models

- Explicitly simulate changes over time
- Dynamic feedback of state changes
- Output a sequence of models states, not a single map



Challenges and Rewards

+ modelling of *lateral fluxes* (material, energy, etc.)
+ interaction between pattern and process

- model complexity
- error propagation
- data limitations

Challenges and Rewards

“I thought at first you had done something clever, but I see there was nothing in it after all."

Jabez Wilson to Sherlock Holmes
in The Red Headed League
by Sir Arthur Conan Doyle

Spatio-Temporal Models

A Dozen Deadly Pitfalls

Pitfall #1

- *failure to define an achievable goal* (CACI*)
  - Know why you are modelling
  - A model should never be pressed to do, nor criticized for failing to do, that for which it was never intended (Smith)

*CACI - A company developing and marketing SIMSCRIPT, MODSIM and other simulation software products.

Pitfall #2

- *mistakes you make in the first 10 minutes will return to haunt you for the remainder of the project* (C. Walters)
  - work out a solid, semiformal conceptual model before implementation
  - use prototypes to try out ideas and test assumptions

Pitfall #3

- *Incomplete mix of essential skills* (CACI)
  - Project leadership
  - Conceptual modeling
  - Model implementation
  - System knowledge

Pitfall #4

- *Inadequate levels of user participation* (CACI)
  - Who is the model being built for?

Pitfall #5

- *Garbage in – garbage out*
  - a model cannot be any better than the information that goes into it
  - i.e., data-free models will be free of recommendations about real things

Pitfall #6

- *KISS: Keep it simple, stupid*
  - Small models are beautiful (Ludwig)
  - Don’t create a model you can’t understand (Lertzman)
  - Do not build a complicated model when a simple one will suffice (Smith)

Pitfall #7

- ***inappropriate level of detail and system bounding***
  - **Scale and resolution a critical**

"There is a tendency to spend a great deal of effort modeling in unnecessary detail those portions of the system that are well understood, while glossing over poorly defined portions that may be more important" **(CACI)**

Pitfall #8

- *beware of molding the problem to fit the technique* (Smith)
  - modeling language/platform should fit the model requirement

Pitfall #9

- *hidden assumptions*
  - Documentation is the road to salvation (COMMENT YOUR CODE!!!)
  - Modelling can be viewed as exploring the consequences of our assumpions
    - This is only useful if assumptions are explicit

Pitfall #10

- *using an unverified model*
  - Verification, validation and sensitivity analysis are not optional
  - Attempt to reject your model, not support it (Lertzman)

Pitfall #11

- *a model should never be taken too literally – models cannot replace decision-makers* (Smith)
  - A model does not replace critical thinking
  - never trust the results of a model unless you can explain them

Pitfall #12

- *Poor communication* (CACI)
  - Assumptions
  - Results