Bracing for the future

Day 2: How modelling and data contribute to foresight and scenario analysis

Aims for the day

Introduce

- Role of models and data in foresight analysis
- What different models can do
- Key models used for food systems
- Data needs for models and key datasets for EGP
- How models can inform policy, dialogue and debate

Modelling 101

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Models - definition

A simplified representation of real world systems to

- Help understand processes and interactions
- Extrapolate beyond known time / location / conditions
- Build a shared understanding of the system

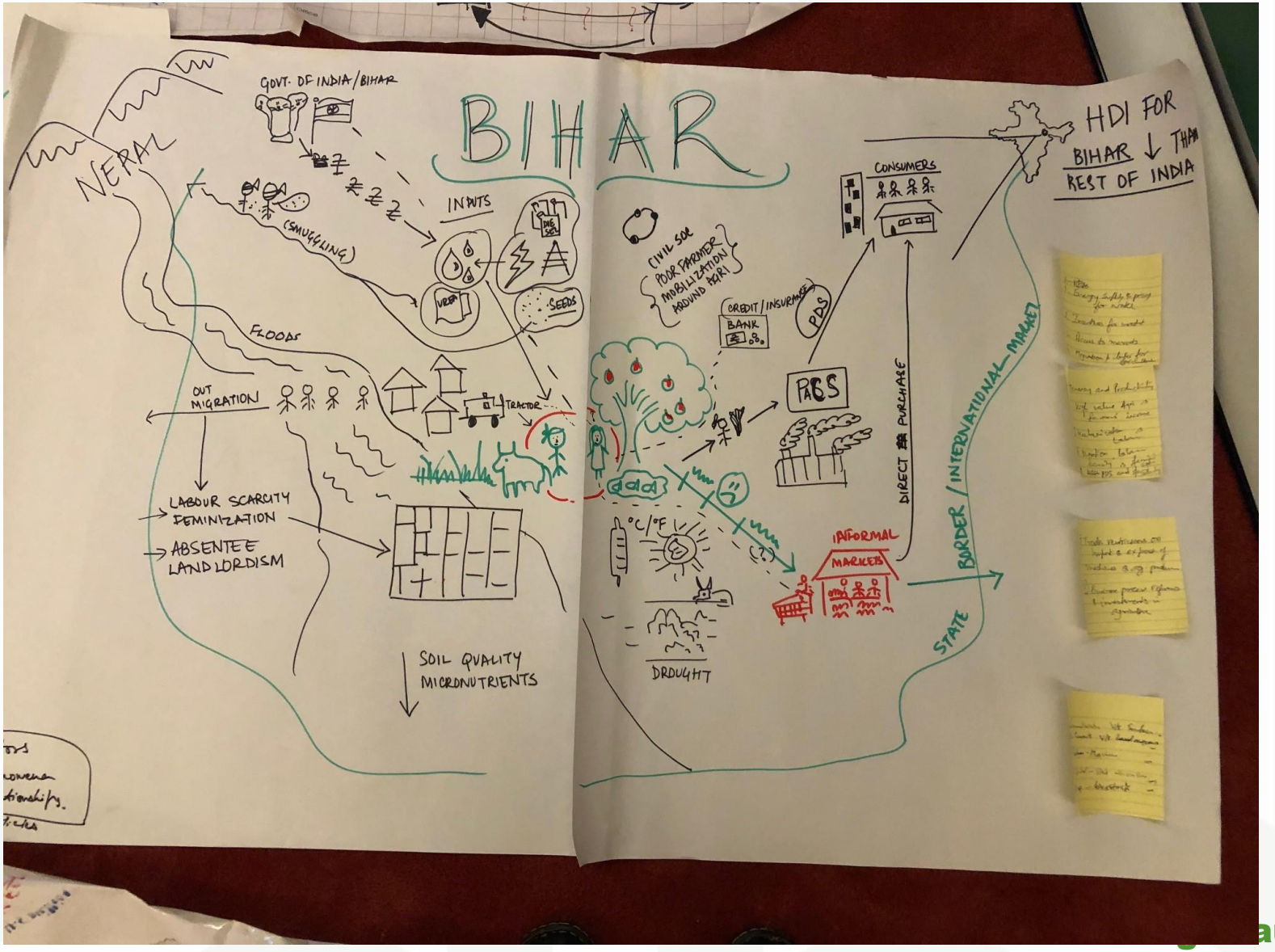
Types of models

- Physical (3D)
- Conceptual
- Visualisation
- Quantitative (mathematical / statistical)

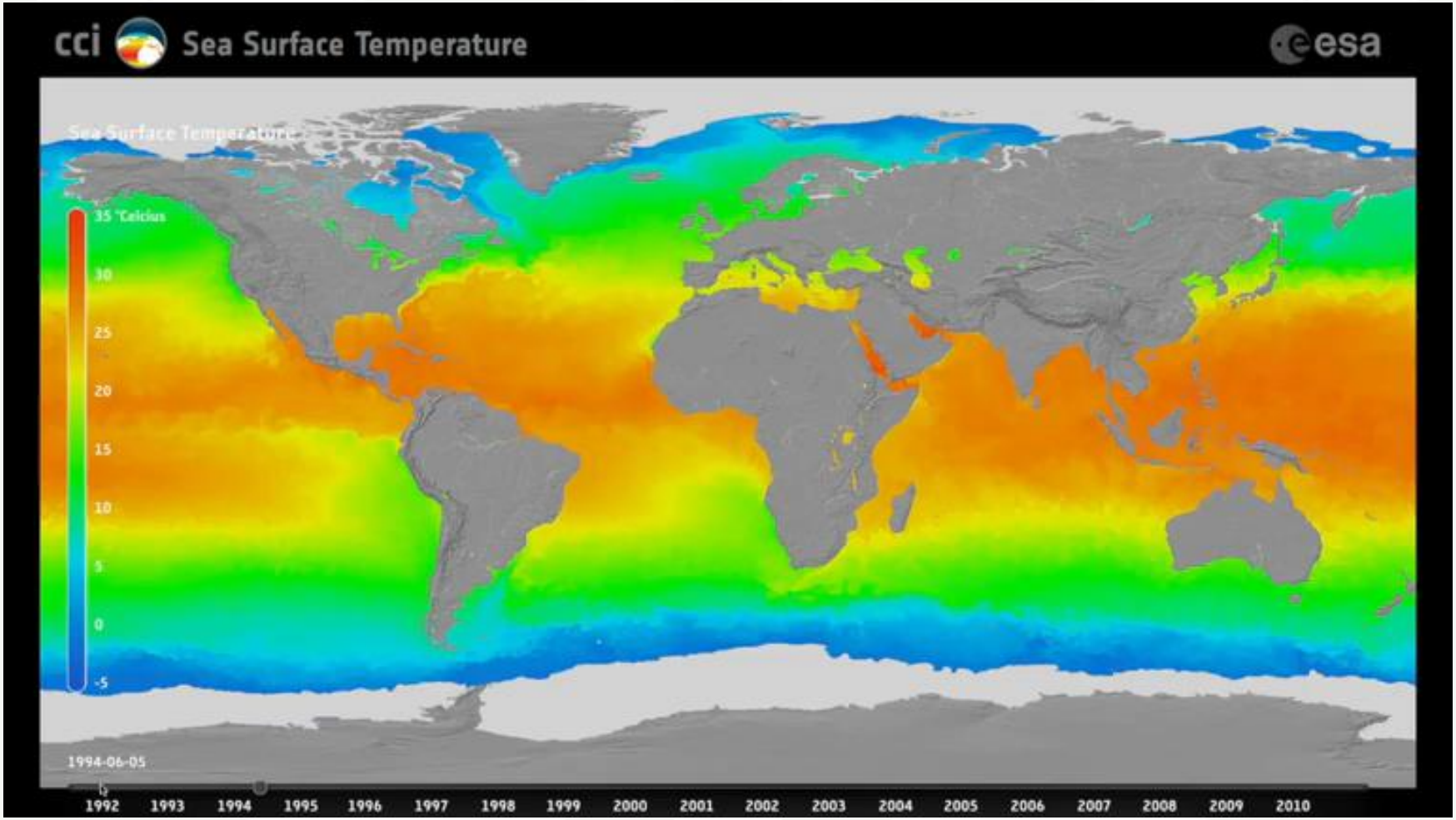
Physical models

Ayeyarwady State of Basin Assessment – 3D basin model

Conceptual models



Visualisation of observed or modelled data



Visualisation of observed or modelled data

https://www.youtube.com/watch?v=PhbdyNnUliM

Quantitative models

- Mathematical and/or statistical ways to
  - Explore and quantify interactions within systems
  - Extrapolate from observations or experiments to larger spatial or temporal domains, or to different systems
- Operate at a range of scales (in space and time)
- Deal with complexity
  - Loops and feedbacks, multiple runs / scenarios
- Coupled models
  - can link biophysical and economic / social processes
  - linking models vs linking results from models

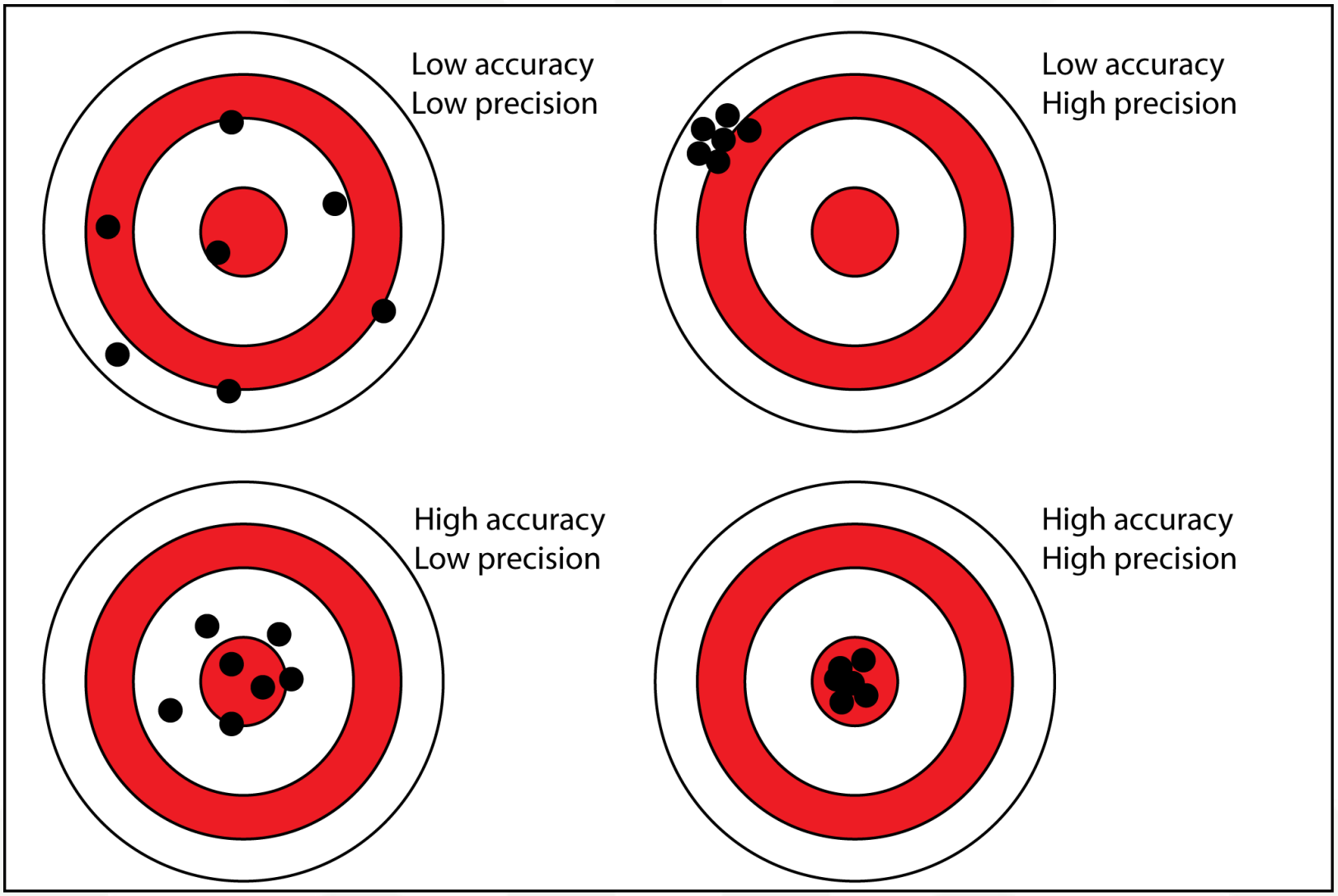
Uncertainty

Uncertainty – many sources including data quality, parameters, algorithms, assumptions, model bias, unmodelled effects and more

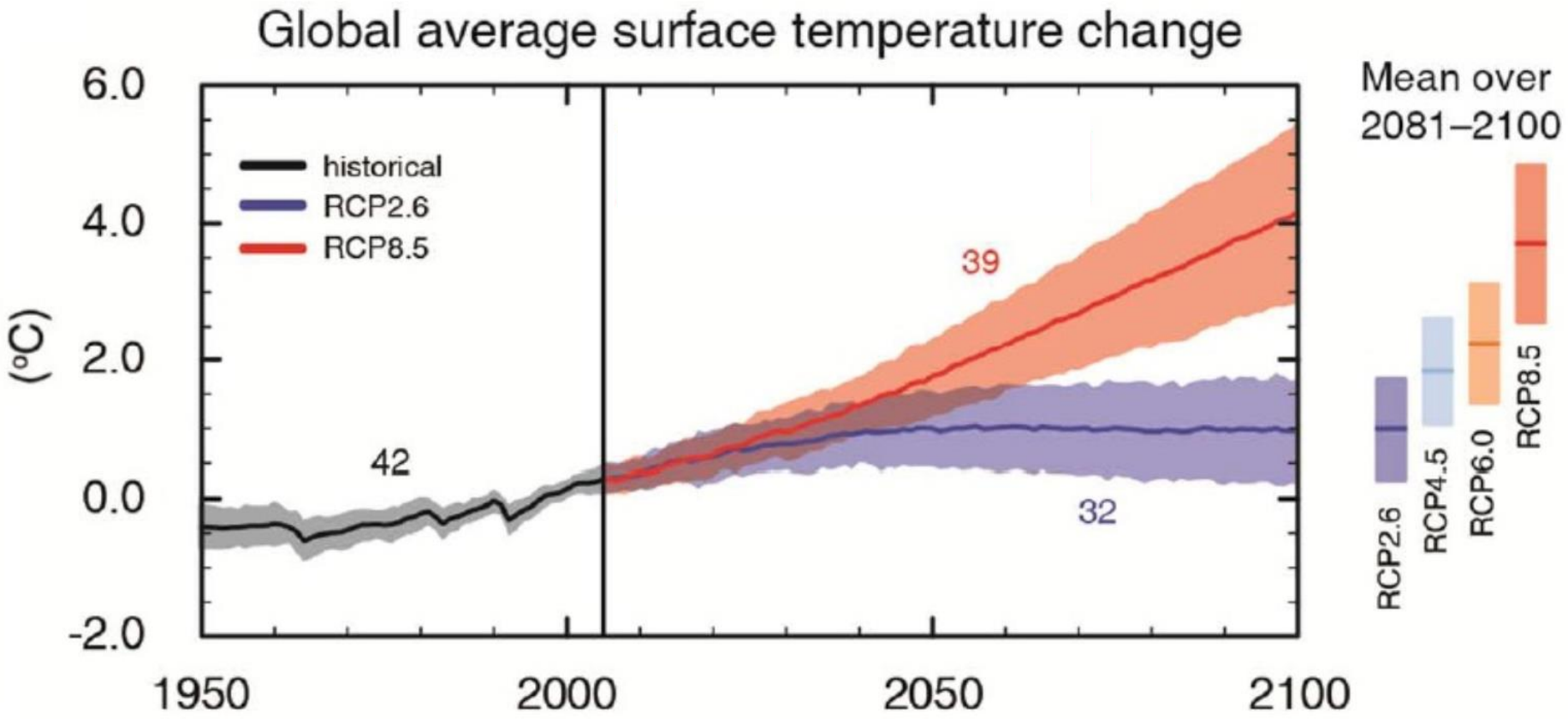
Model calibration - estimating model parameters from observed data for one part of the system (*making the model fit the system*).

Model validation - judging the performance of the **calibrated model** using observed data which have not been used for the calibration (*checking that the model describes the system)*

Uncertainty - accuracy, precision



Uncertainty – assumptions



Uncertainty – assumptions

The new buzz words

Fuzzy logic is an approach to computing based on "degrees of truth" rather than the usual "true or false"

Bayesian models - a statistical model where you use probability to represent relationships and uncertainty

Artificial neural networks are computing systems inspired by the biological neural networks of animal brains

Ways of dealing with complexity and uncertainty

Models

The most that can be expected from any model is that it can supply a useful approximation to reality:

All models are wrong; some models are useful

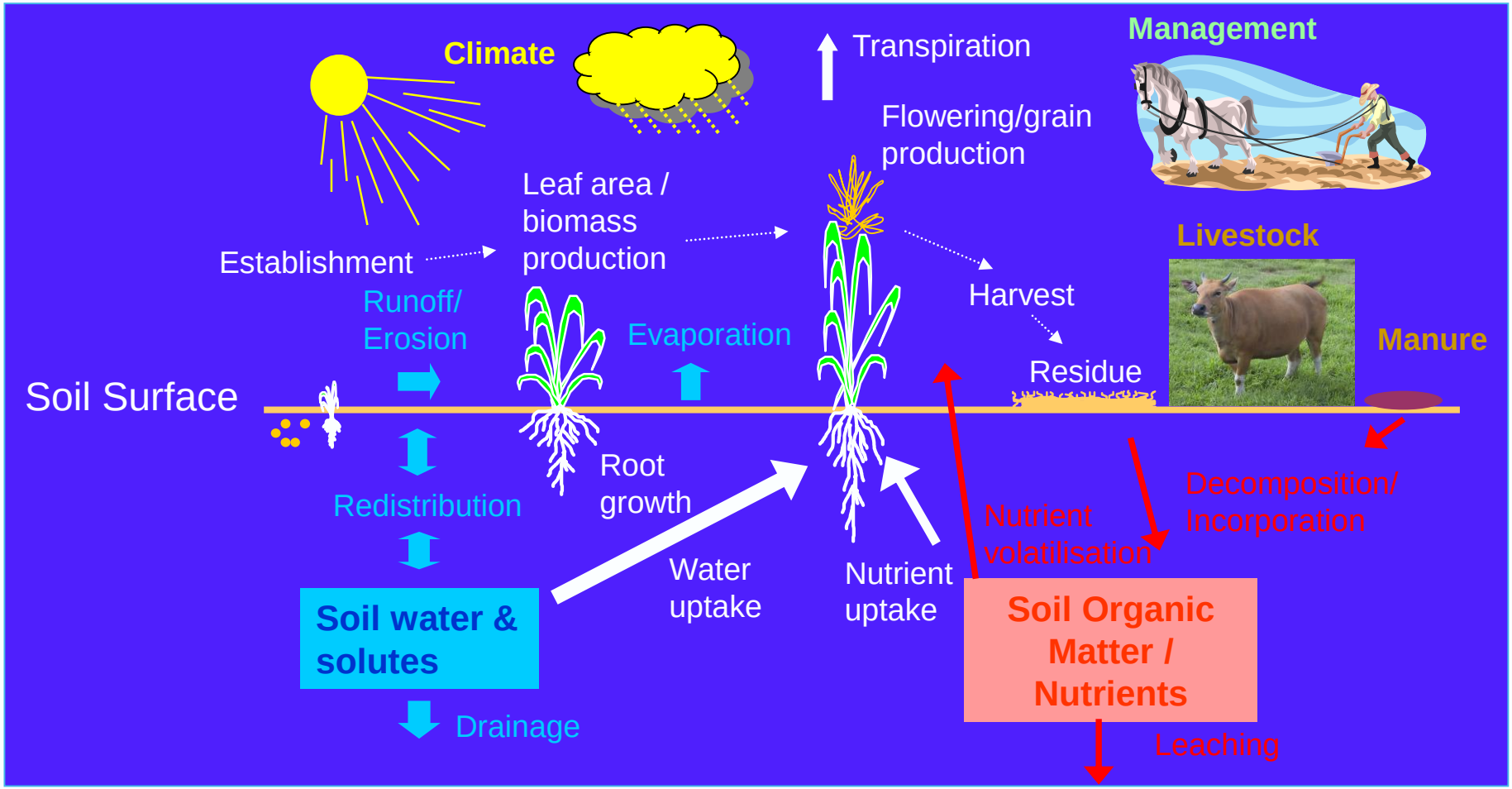
George Box

Always ask:

- What is the overall uncertainty?
- What are the underlying assumptions, and how sensitive are the results to those assumptions?

Some examples of systems that we model…..

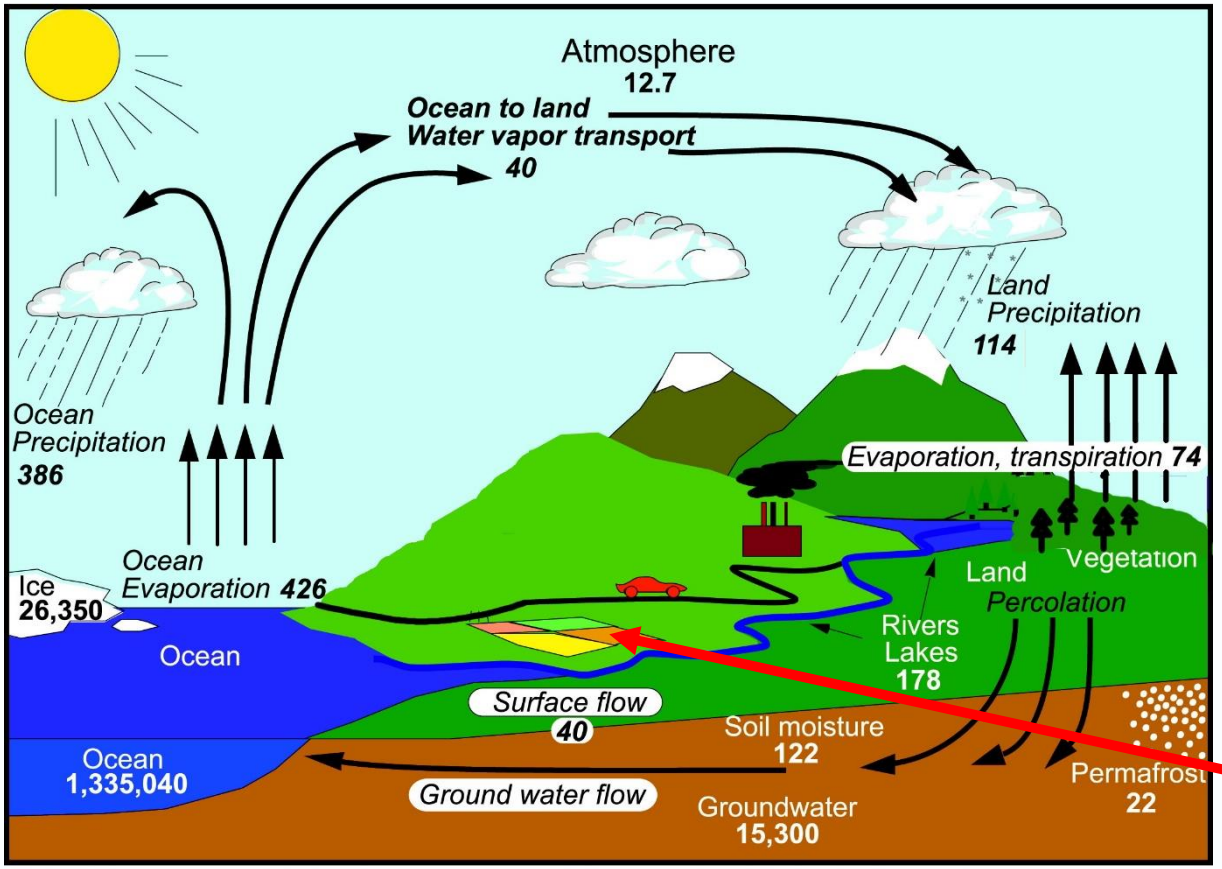
Soil-biosphere-atmosphere systems



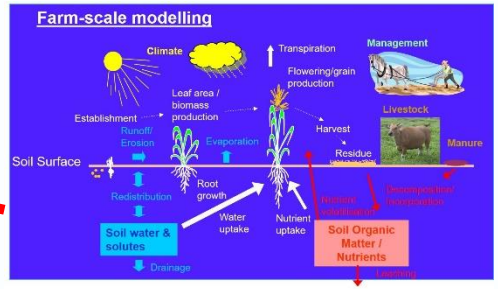
Farm-scale models

Some examples of systems that we model…..

Soil-biosphere-atmosphere systems

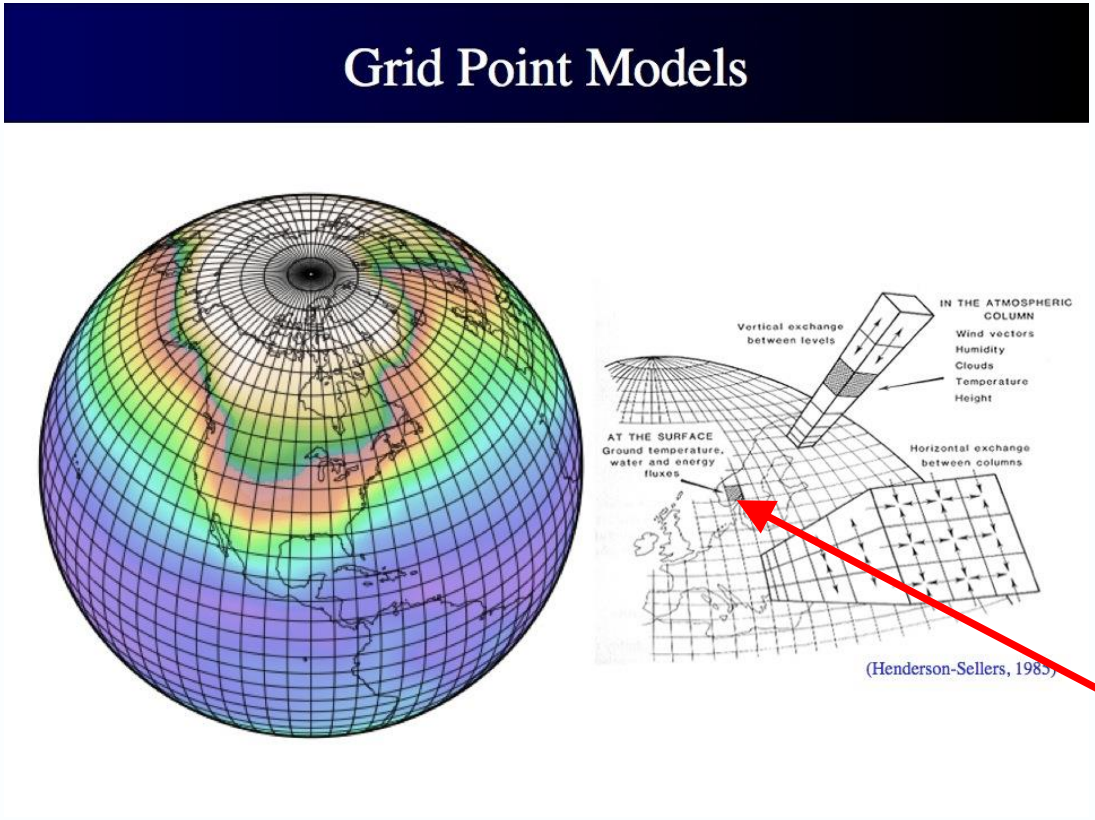


Hydrological models

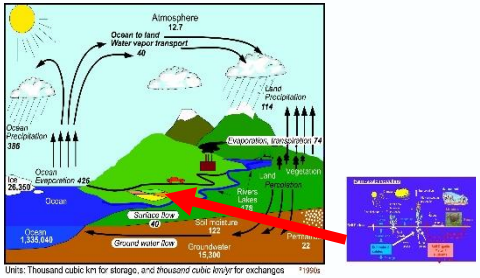


Some examples of systems that we model…..

Soil-biosphere-atmosphere systems

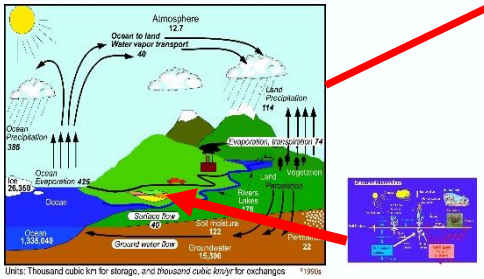


Global Climate Models

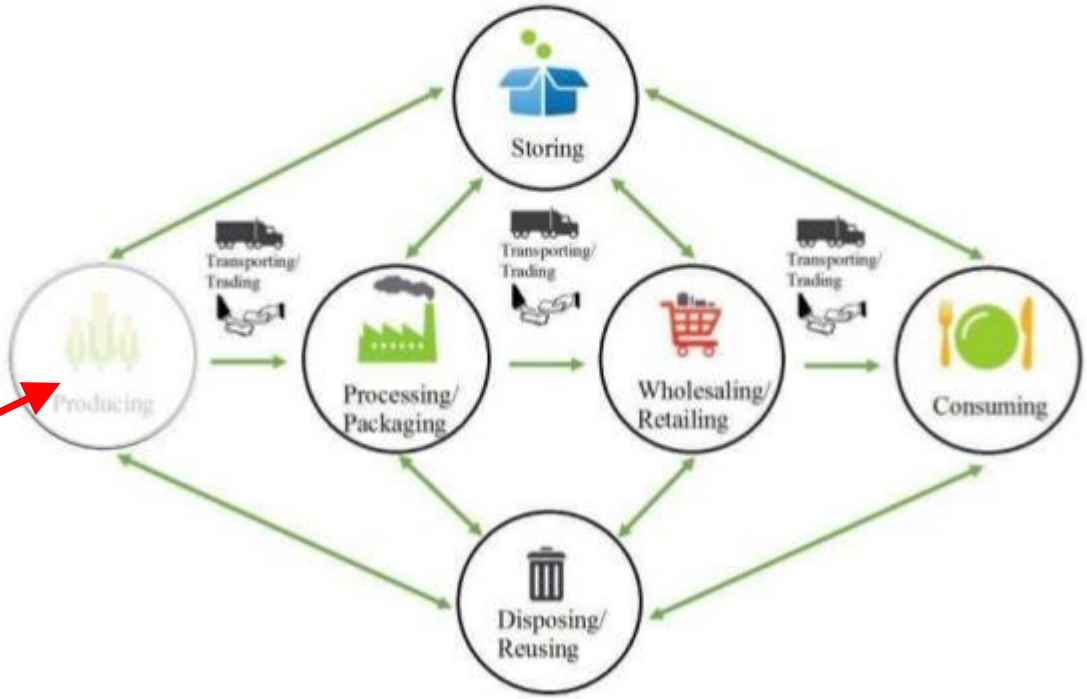


Some examples of systems that we model…..

Food Systems models

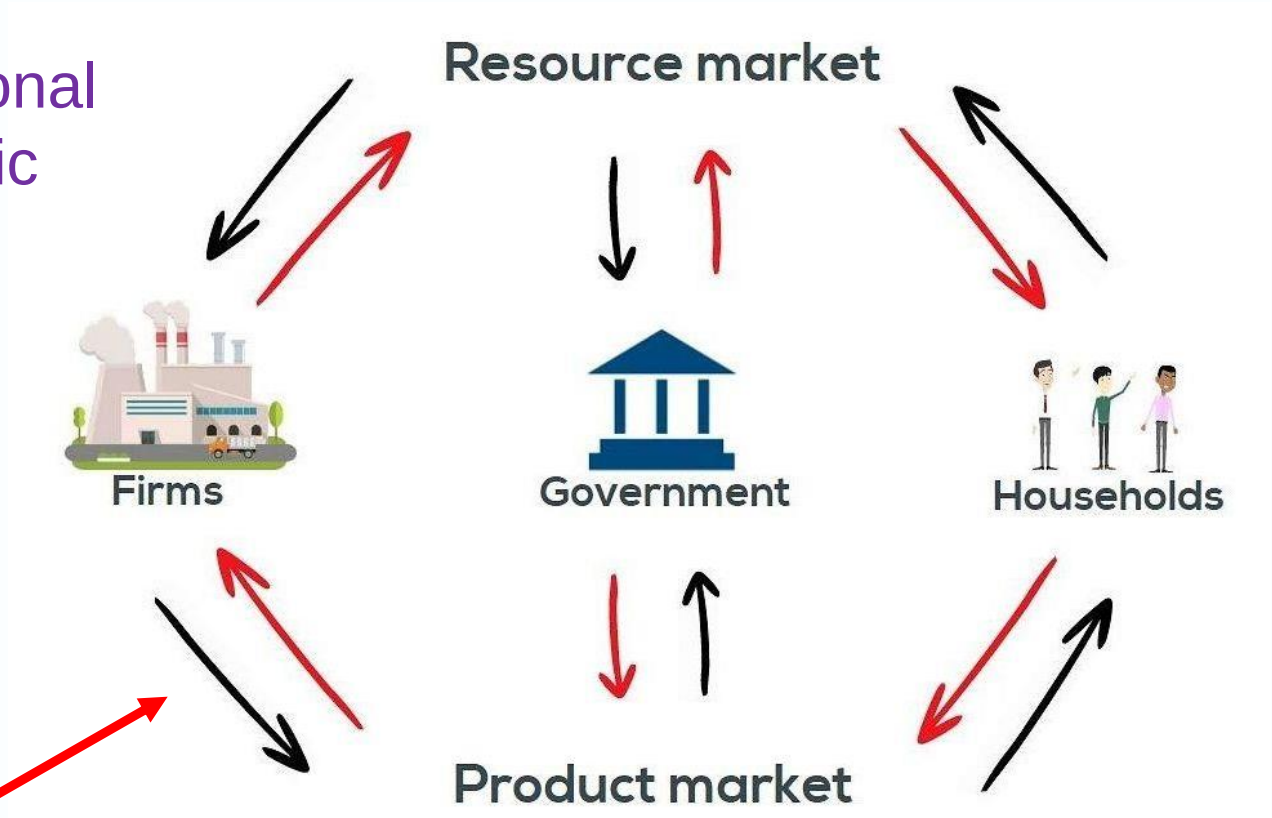


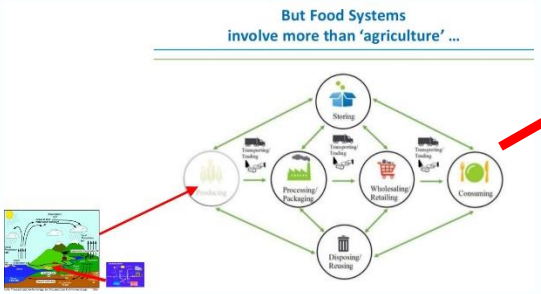
But Food Systems involve more than 'agriculture' …



Some examples of systems that we model…..

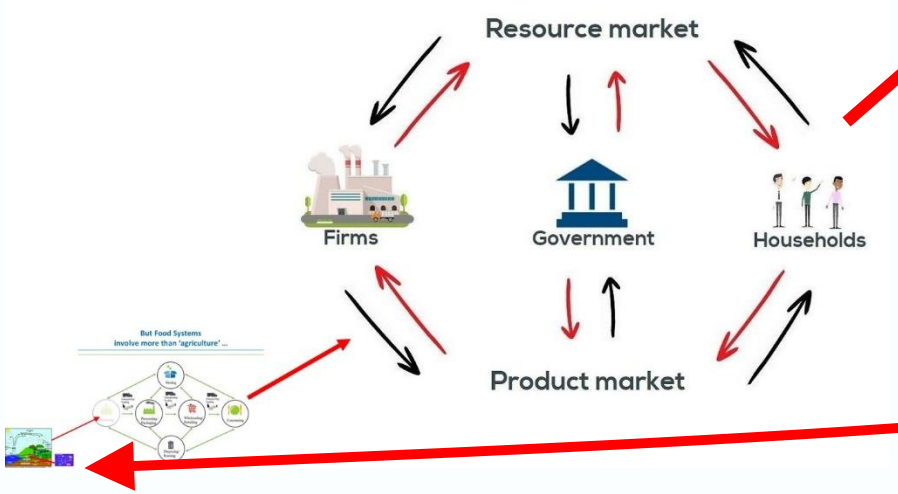
Regional or National Socio-Economic models





Some examples of systems that we model…..

Global Economic models



comes back to farmer….. fuel prices, grain prices etc