

# The modelling approach

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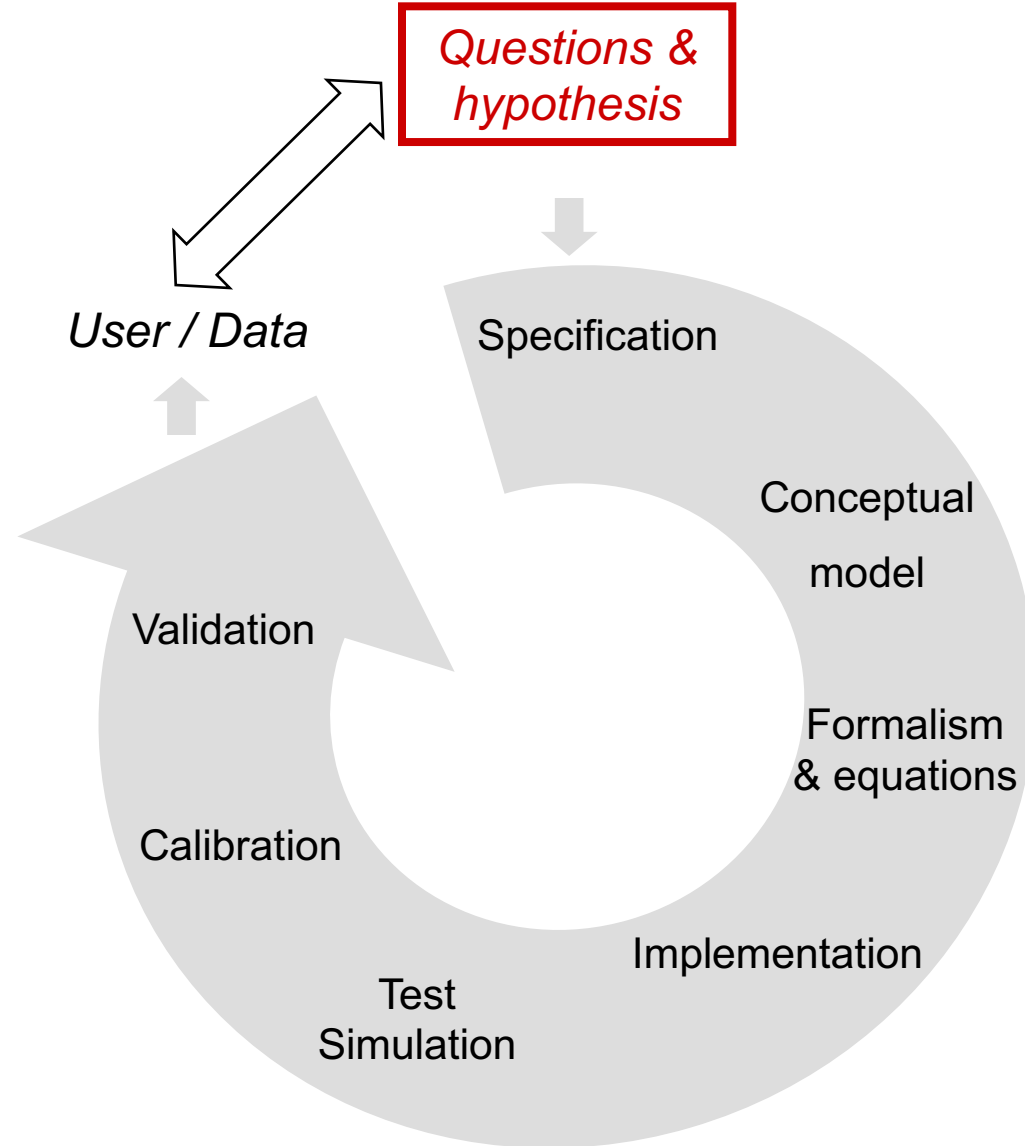
# Modelling : a scientific approach

- A model is a **simplified** representation of a **system**
  - Simplified => **hypothesis**
  - **System** : a set of entities with their interactions / relationships
- A model of **simulation**
  - A **numerical** model => use of computer (not only equations)
  - A **dynamic** model => evolves through **time**

# What is the purpose of a model?

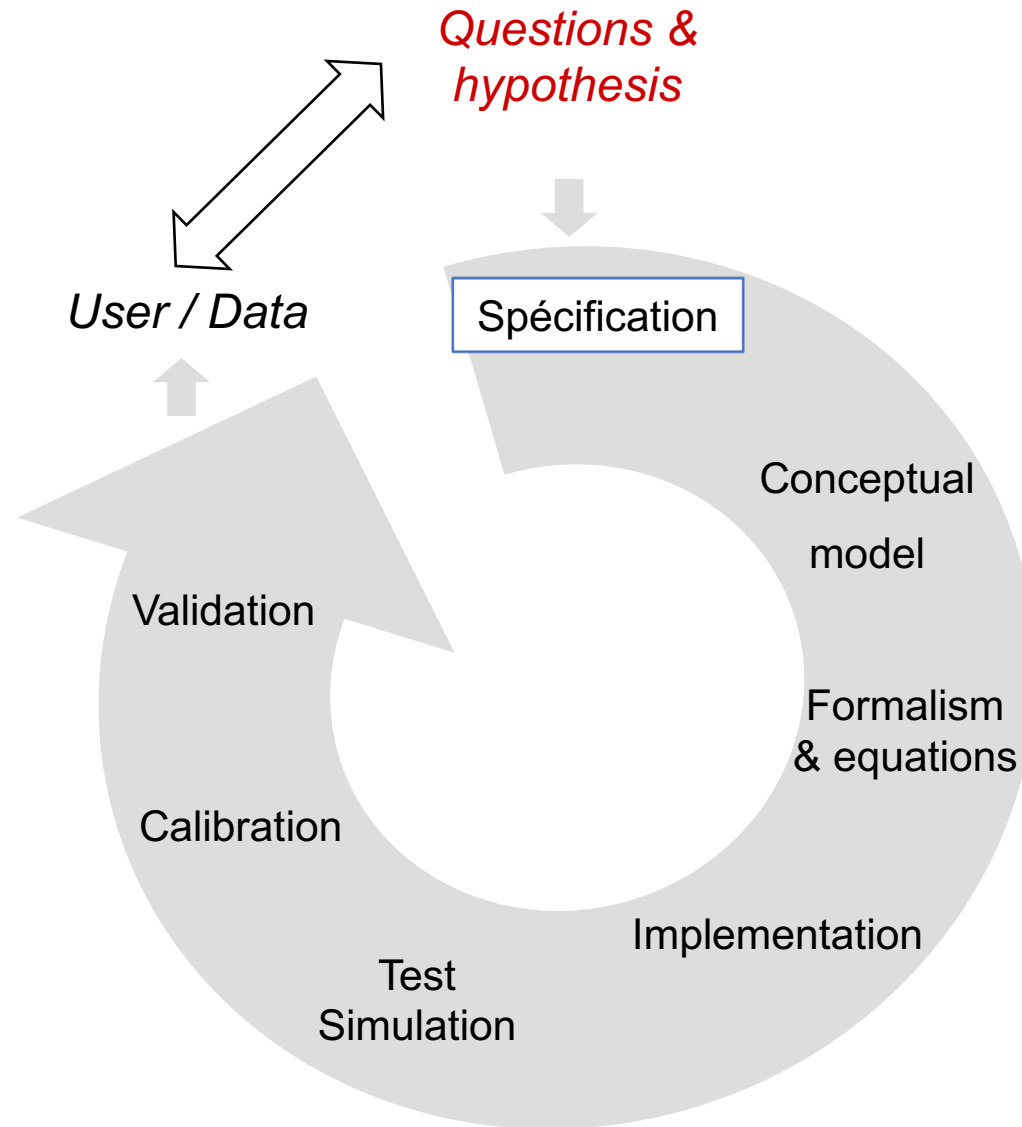
- Integrate **knowledge** on isolated entities of the system
  - What are the emerging properties of the system?
- **Understanding** system behaviour
  - What are the main factors / parameters (sensitivity analysis)
- **Test of scenarios** to find levers to adapt the **(real)** system

# Establish Modelling Steps



- *Identify an issue*
- ***Define 1 question***
- *Formulate hypotheses*

# Establish Modelling Steps

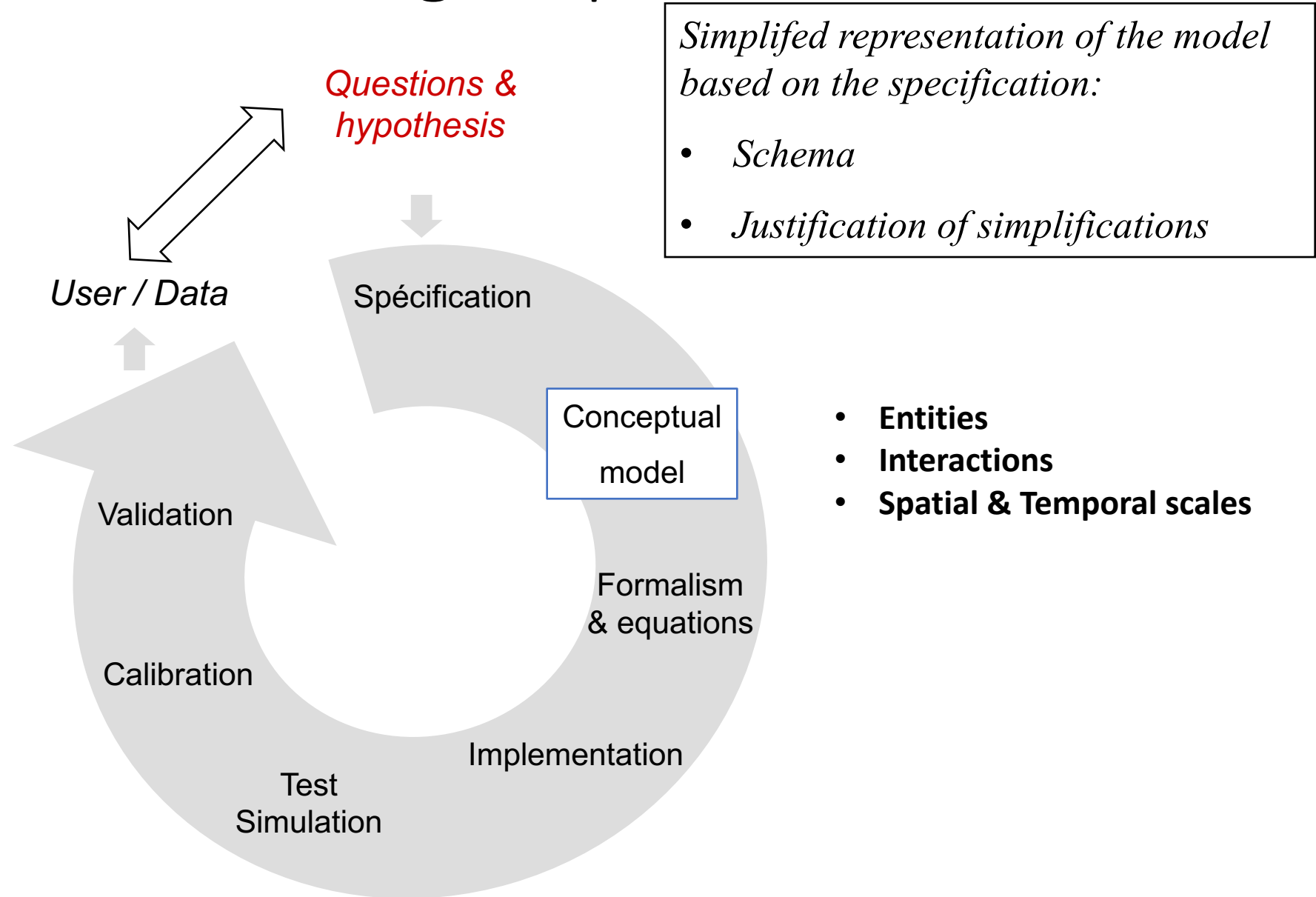


- *What are the main objectives of the model?*  
*=> criteria for simplification*

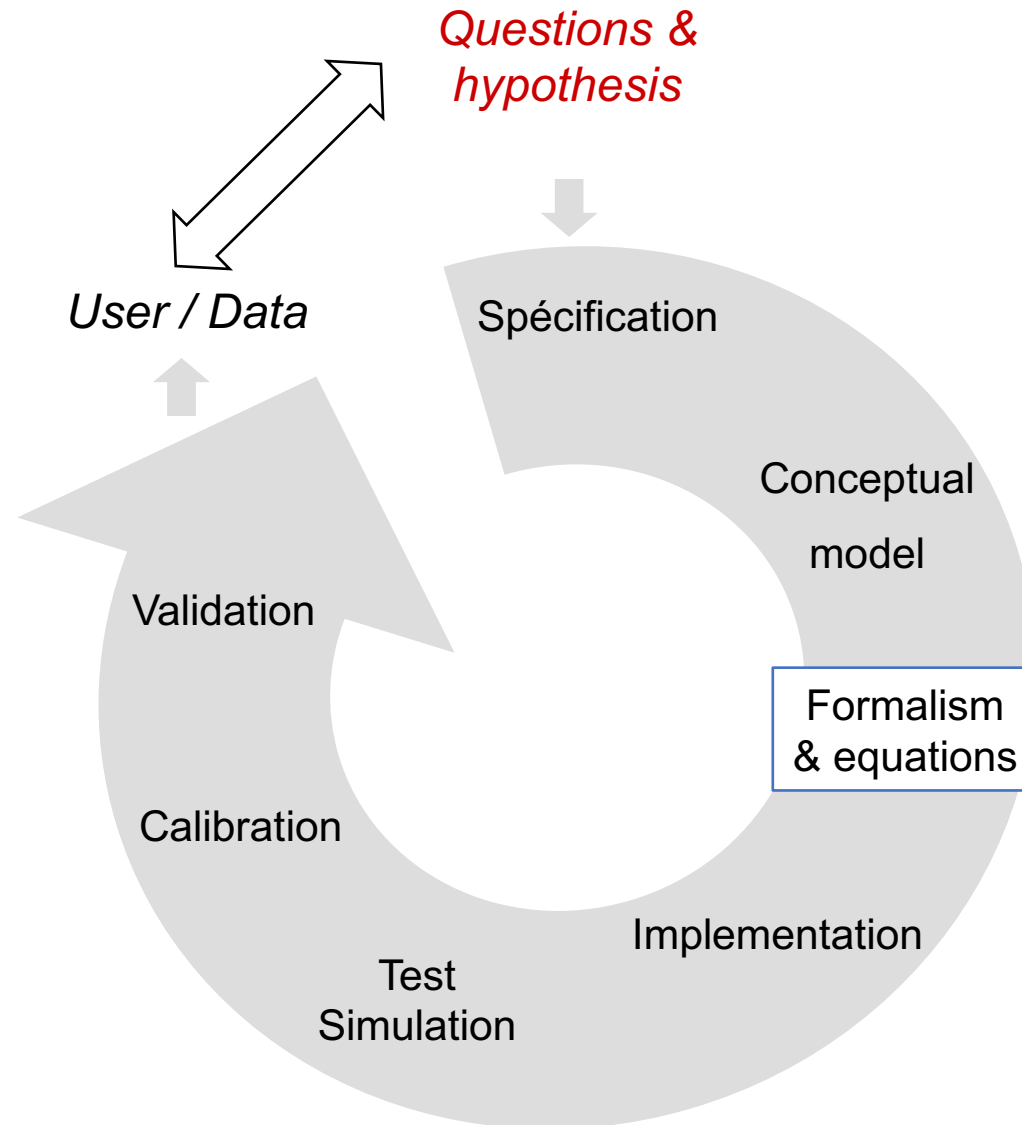
# Main points for specification

- Description of the system
  1. Limits
  2. entities / interactions
- Questions asked
  - Point of view on the system?
- Usage of the model
  - For who?
  - State Variables
  - Usage of the model
- Inputs and Outputs

# Establish Modelling Steps



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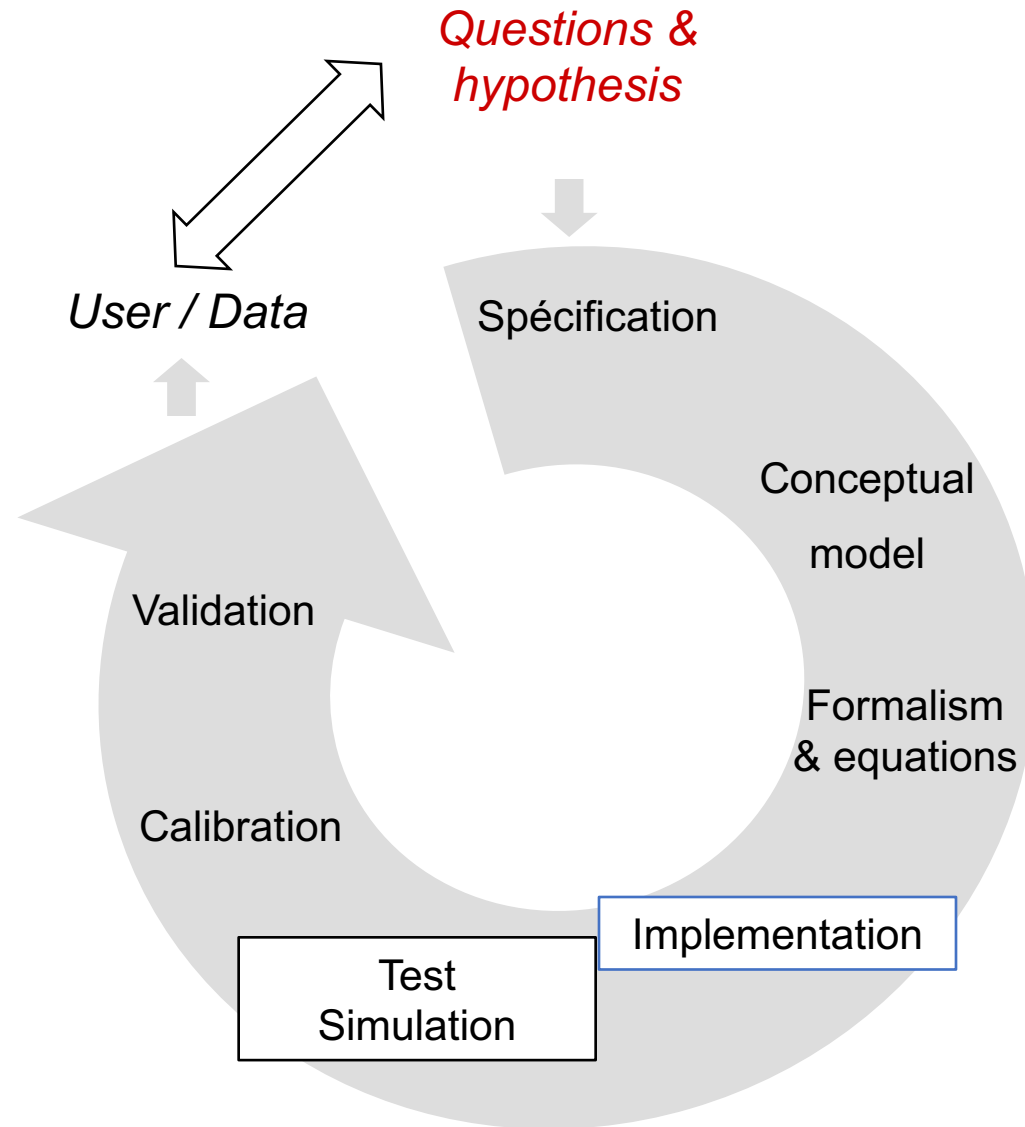


- *Lsystem*
- *Ecophy. Model*
- *Topology / Geometry*
- ...

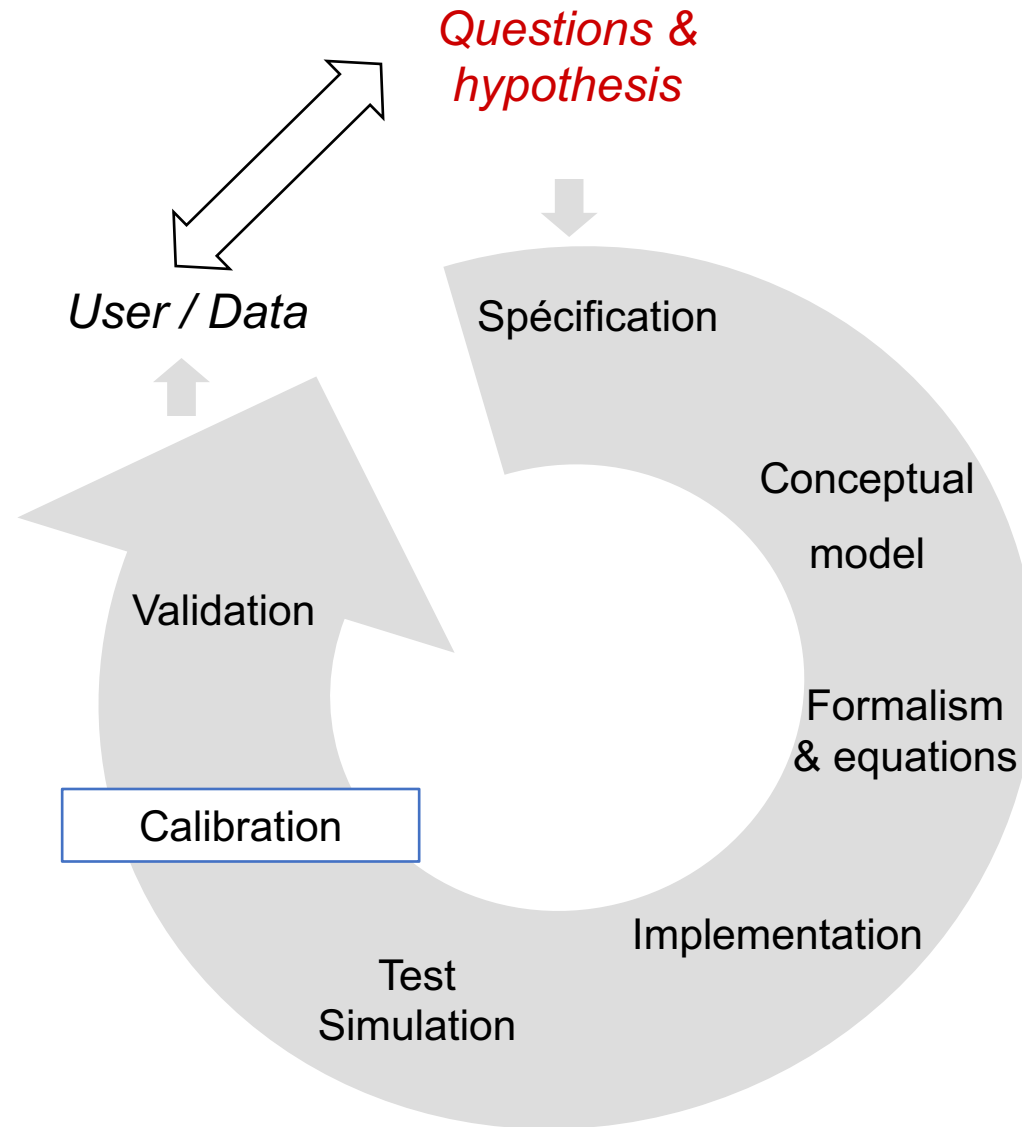


# Establish Modelling Steps

- *Python*
- *Lsystems*



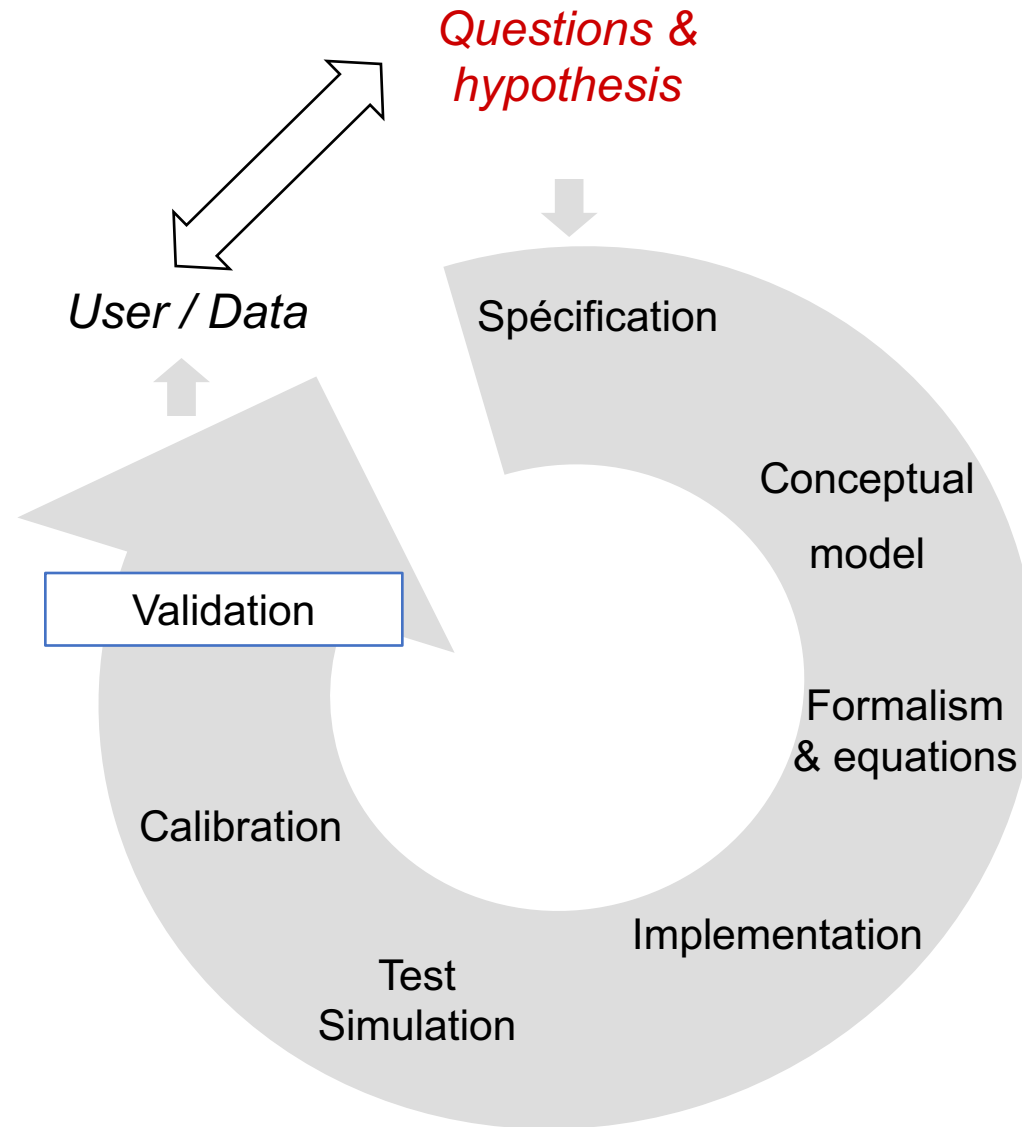
# Establish Modelling Steps



*Finding parameter values of the model based on:*

- *Available knowledge (papers, data)*
- *Or to reproduce documented situations*

# Establish Modelling Steps



*Confront model predictions with known realities to know*

- *Accuracy*
  - *Domain of validity*
- => *Sensitivity analysis*

# Modelling steps

- Specifications
  - What are the scales of interest?
  - For which users? Limits, ...
- Conceptual model
  - Hypotheses and simplifications
  - System definition: components and interactions
- Formalism
  - Mathematical expression of the model
- Implementation
  - To be able to simulate and/or solve the model
- Calibration / Sensitivity Analysis / Validation