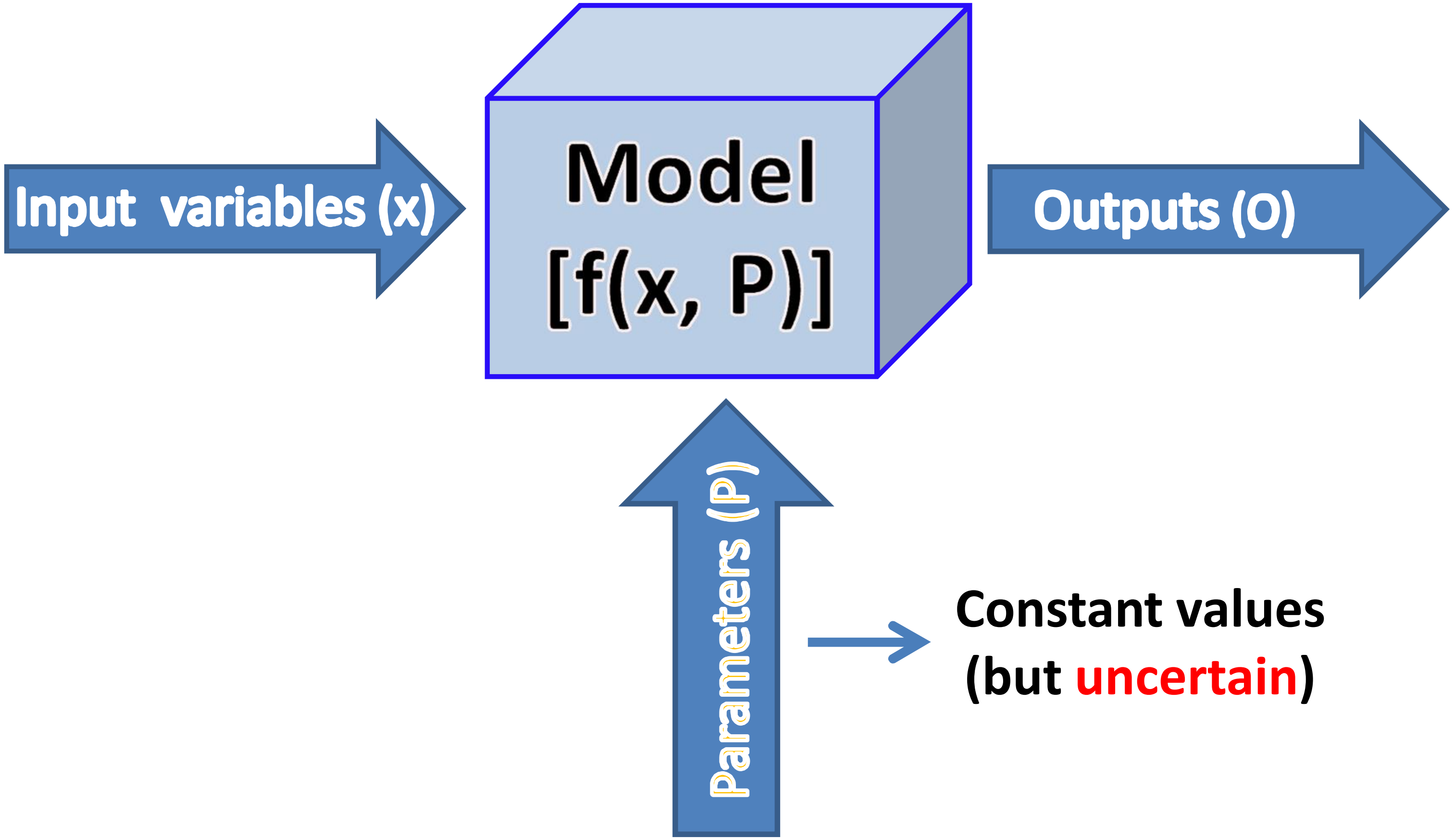
Model parameterisation, calibration and needs

Gianni Bellocchi, Rich Conant, Ward Smith

UR874 ï Grassland Ecosystem (INRA-UREP), Clermont-Ferrand (France)

Natural Resource Ecology Laboratory & Department of Ecosystem Science and Sustainability, Colorado State University, Fort Collins CO (USA)

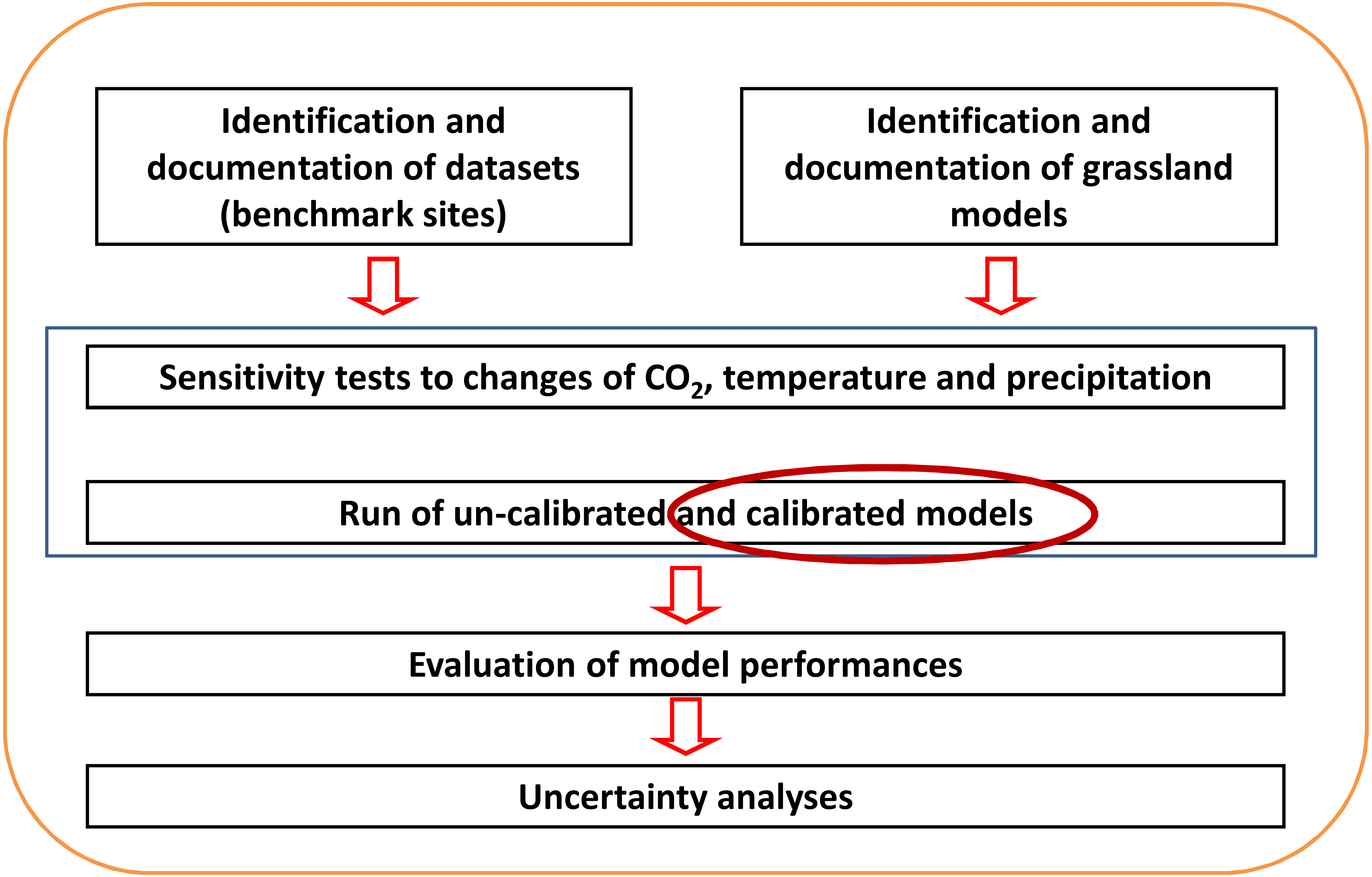
Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada (AAFC), Ottawa ON, Canada



Uncertainty

A state of having limited knowledge where it is impossible to exactly estimate one or more variables (existing states, future outcomes).

Model intercomparison



Problem definition

- Most biophysical models run into problem when introduced to a new situation
- Describing a solution to this difficulty with a procedure involving the whole model is problematic
  - Simulation results should be examined to detect the failure of a sub-process and, ideally, lead to experimental elucidation of its problematic components

What to avoid

- « Adjustment for a particular function » (Merriam-Webster, 1998): useful when a model is applied to a specific situation but, as a rule, it cannot be used to improve its scientific validity

- "Cumbersome method of curve fitting" (de Wit, 1970): calibration on the model as a whole can reduce the power of the mechanistic model structure to an empirical exercise

- The better fit "used as a criterion for judging the scientific merit of the model" (Sinclair and Seligman, 2000): the extrapolation is not feasible without readjustment of the parameters

Some criteria

Considering that processes represented by models in a system context cannot be disentangled and independently assessed by the average user, good calibration practice would imply:

- Selection of a limited number of processes (ex. the closest to the output level)
- Identification of a limited number of parameters (ex. from a sensitivity analysis)
- Preservation of the biophysical meaning of parameters by setting a range of variability to each of them
- Preserve the coherence of the system by calibrating the model against multiple output variables at the same time
- Application to a variety of circumstances “wherever” (multiple sites) and “whenever” (multiple years) the agro-ecosystem is established

What a challenge?

- Output variables: multiple outputs (GHG emissions, other fluxes, etc.)
- Calibration technique: trial-and error or advanced techniques (Bayesian inference, simplex algorithm, Levenberg-Marquart algorithm, etc.)
- Parameters to be calibrated: type (vegetation, soil, etc.) and number (ex: <10 to avoid autocorrelation)
  - Need to document de parameters values
- Which sets / sub-sets of data: calibration versus validation set, site-scpecifi versus multi-site ("A test of model performance is better served scientifically when based on all available data covering a wide range of conditions", Sinclair and Seligman, 2000)

- Ensure tracability of parameters used
- Don’t change universal parameters