HWRS 505: Vadose Zone Hydrology

Lecture 22

11/7/2023

Today:

Parameter estimation/Inverse modeling

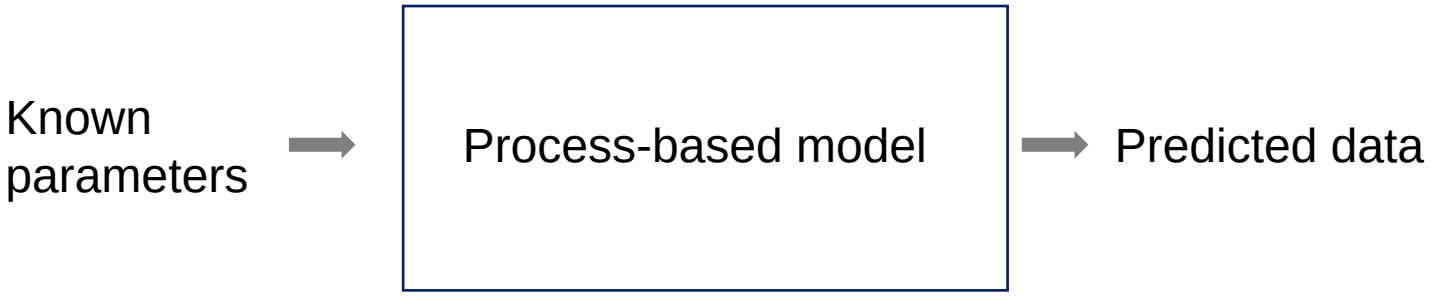
Review of Lecture 19

Measurement methods to estimate parameters

1. Laboratory methods
   - SWC (Pressure cell method)
   - Ksat (Constant head permeameter; Falling head permeameter)
   - K(θ) (Steady-state flux method; Instantaneous profile method)
2. Field methods
   - Water content (Neutron probes; Time domain reflectometry)
   - Water pressure head (Tensiometer)
   - K(θ) (Instantaneous profile method)

Inverse Modeling

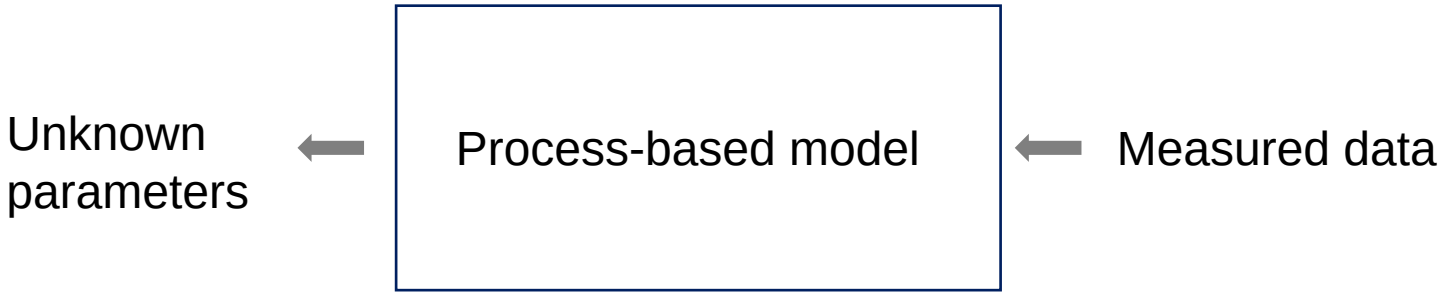
Forward modeling



Examples:

- Use Richards' equation to predict water saturation and water pressure head.

Inverse modeling



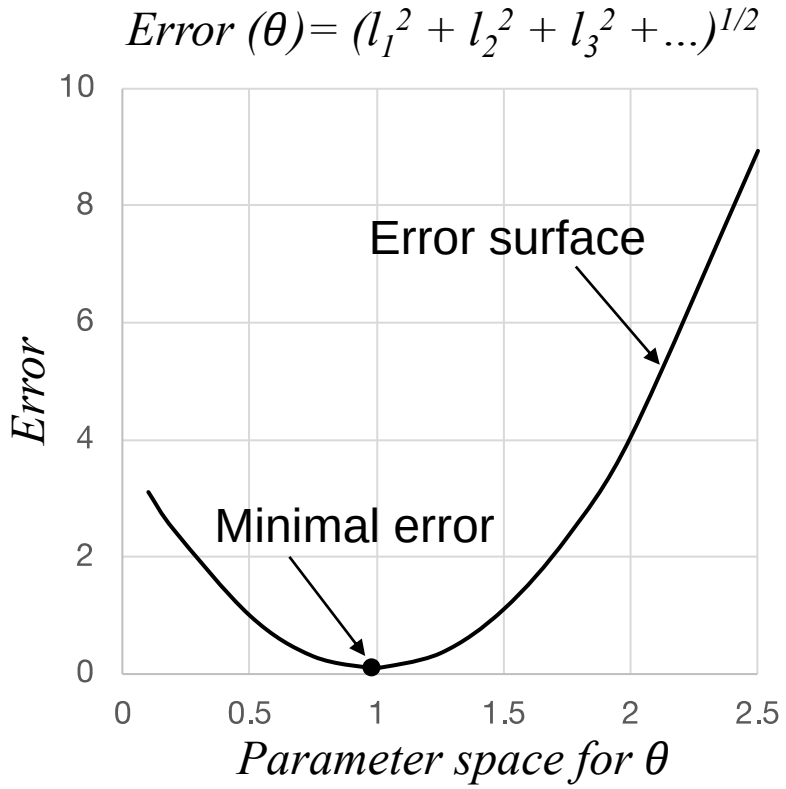
Examples:

- All of the measurement methods discussed in Lecture 19.

Inverse Modeling with One Parameter

Classical Parameter estimation

Single-objective optimization



Goal: searching through parameter space to find *the parameter* that gives the best predictions.

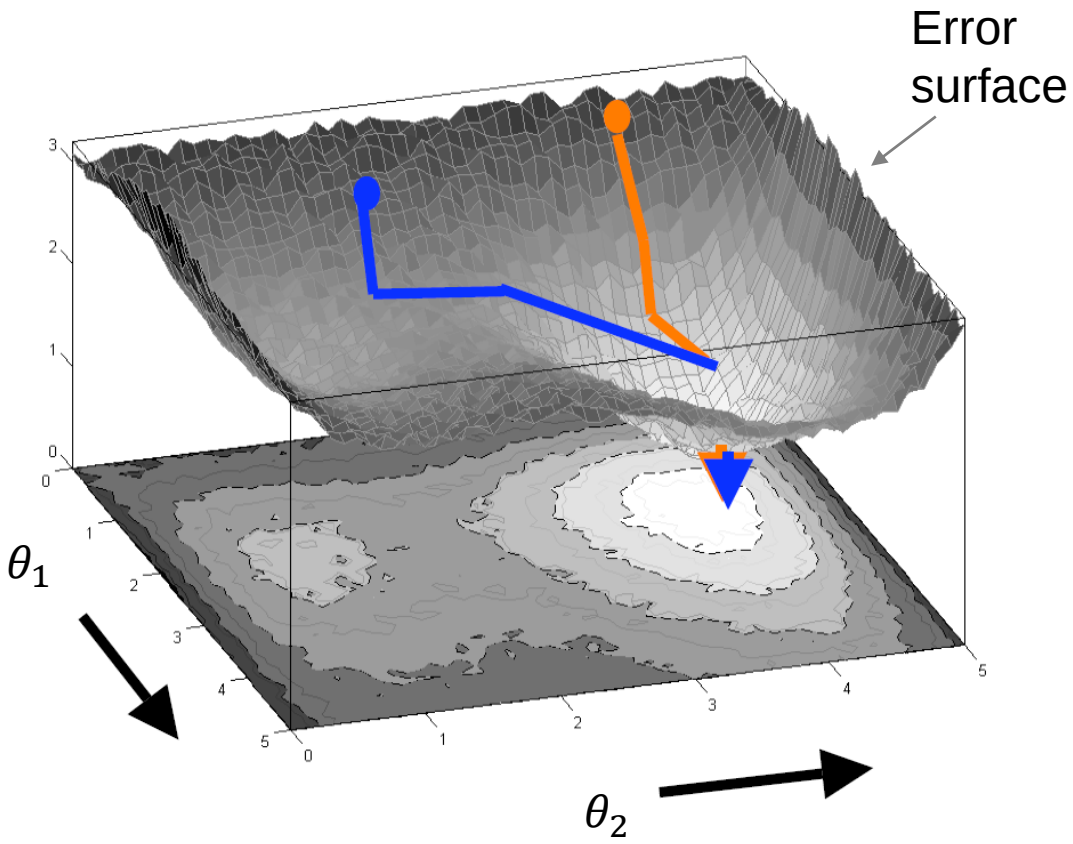
Complications:

- Measurement errors
- Calibration errors
- Scaling errors
- Determine a single error surface for multiple measurements

Inverse Modeling with Multiple Parameters

Classical Parameter estimation

Single-objective optimization



Ferre Lecture Notes

Goal: searching through parameter space to find the *parameter set* that gives the best predictions.

Complications:

- Measurement errors
- Calibration errors
- Scaling errors
- Determine a single error surface for multiple measurements

Inverse modeling using the spreadsheet models

Use the spreadsheet model (1d-unsat – inverse.xls) to perform inverse modeling under various conditions

Exercises:

1. Manual inverse modeling (w/o and w/ noises in the data)
2. Automatic inverse modeling (w/o noises, reduced data and w/ noises, part of the data w/ noises)