Mimicking nature

Using ICOS data to control the climatic conditions inside the Ecotron Hasselt University.

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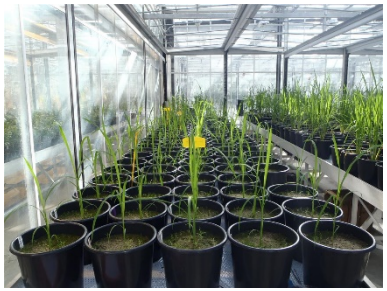
Introduction

- Mimicking nature in the Ecotron
  - Why
  - How
- Challenges
- Current implementation
- Reliability
- Future improvements

Why mimicking nature?

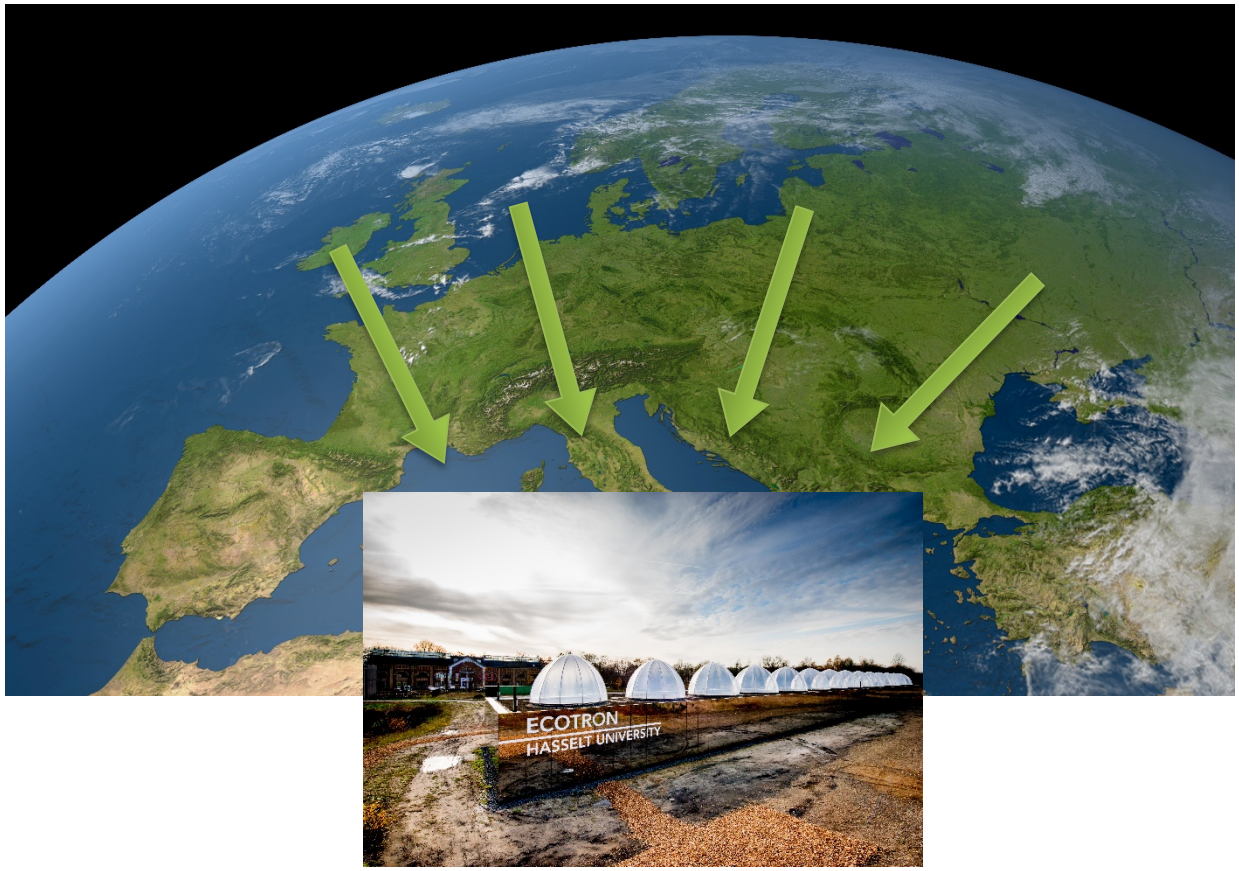
In vitro

In vivo

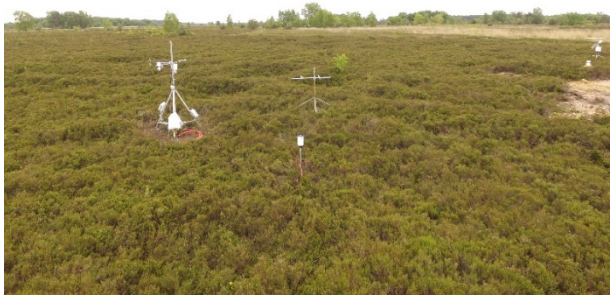


How to mimic nature?

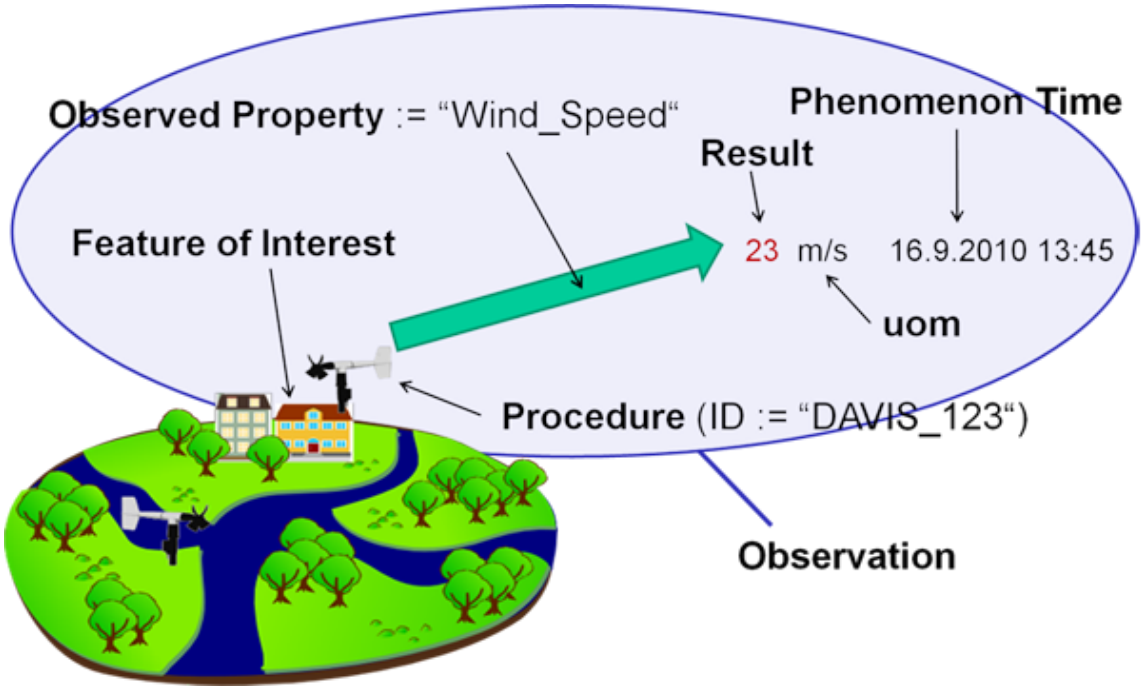
- Ecosystems in the Ecotron can come from any location.
- Reference needed



Different measurement setup



Compare measurements



Reference for heathland

Air temperature
Air pressure
Relative humidity
Wind speed
Wind direction

Net radiation
PAR

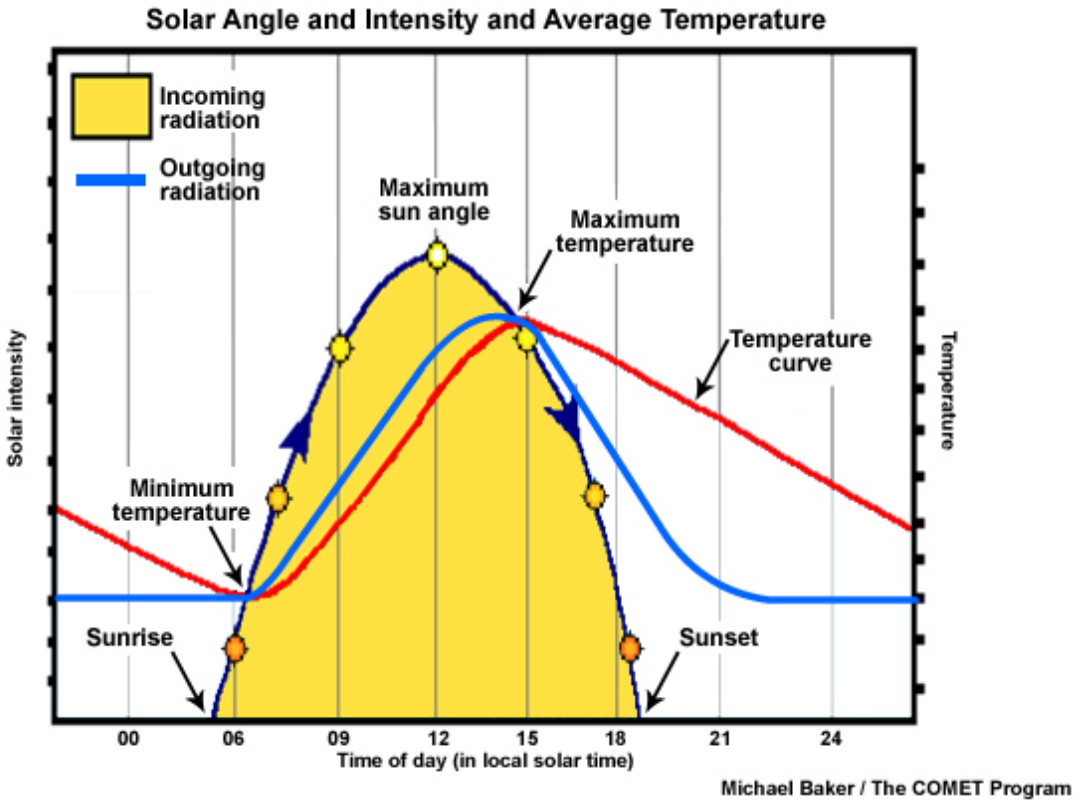
Precipitation

Soil temperature
Soil water tension
Soil water content
Soil CO_2 concentration

Air CO_2 concentration
Air CH_4 concentration
Air N_2O concentration

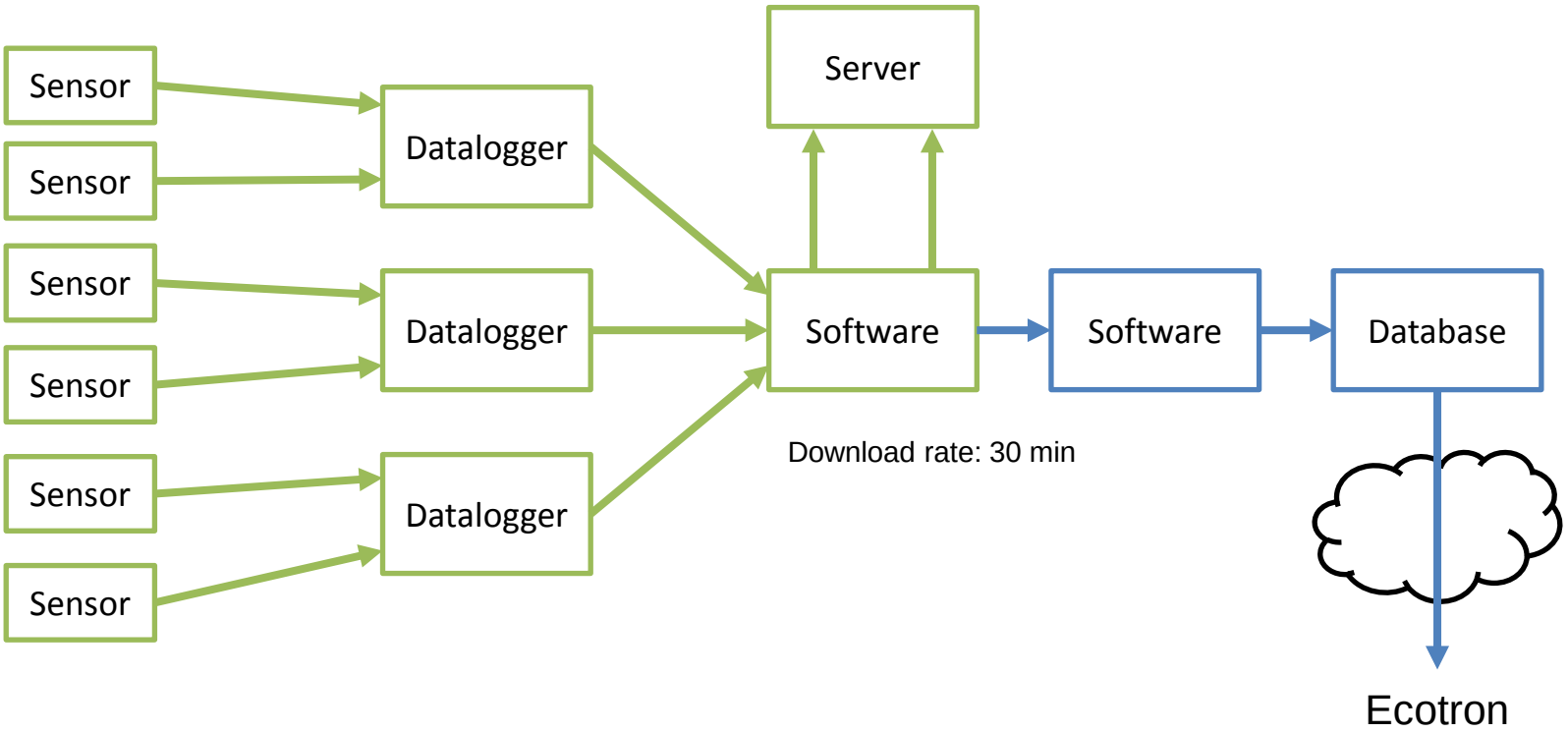
Sample frequency

- Speed of control in the Ecotron => 1 min



Current implementation at the ICOS station

- Direct download from the data loggers into a local database each half hour
- Ecotron reads from the local database

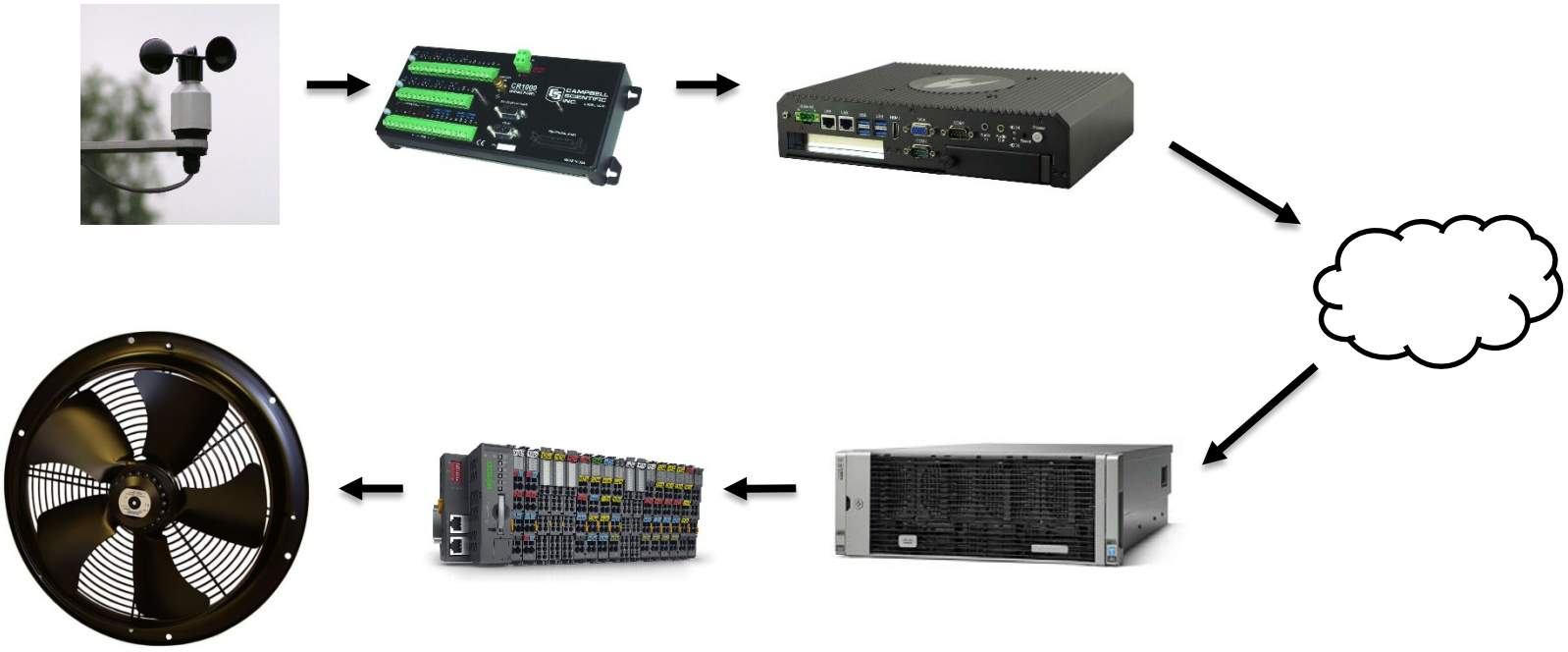


Drawbacks of the current implementation

- To make the connection multiple software packages from the logger manufacturer that come at a cost
- Limitations of the software
- Redundant storage of data at the measure station (database to maintain)
- Computer in measure station acts as a server => 12 connections
- Tailor made for this specific case

Drawbacks further investigated

- Reliability
  - Failure mode and effect analysis
    - Where can the system fail?
    - From measurement to reproduction in the Ecotron



Reliability

- Currently only detection of lost connection
- A lot more failure cases are possible

- Difficult to receive reliable measurements reliable
  - Example: what happens when a sensor gives a wrong value?
  - Example: internet reliability

- Solution: redundant system

Redundancy in practice

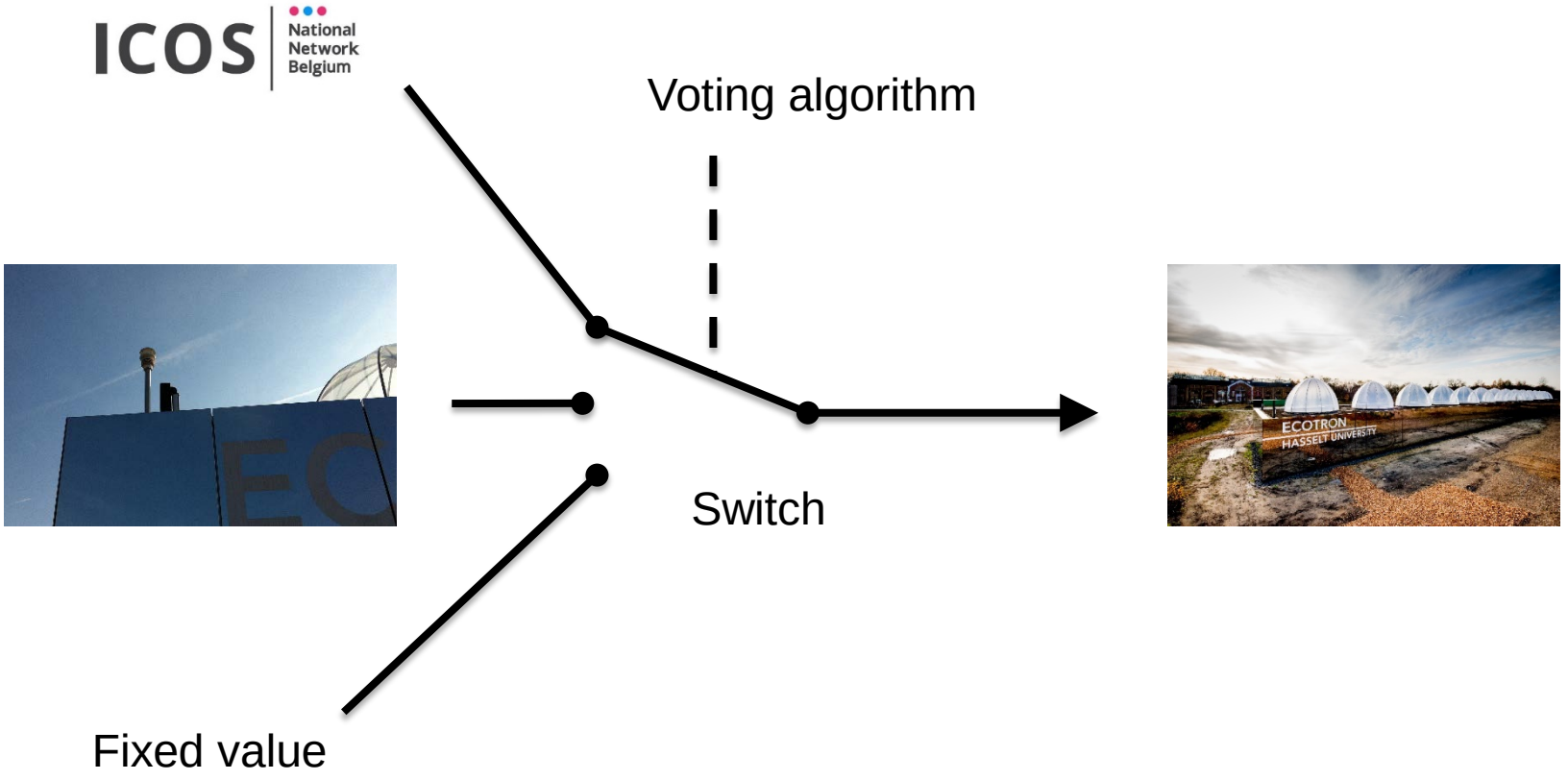
ICOS National Network Belgium

KMI

Voting algorithm

Compare readings → Decide

Redundancy in practice



Future improvements

- Software reads the desired parameters directly in the data loggers or sensors
- Implementation using open source tools
- Ecotron decides what data to use
- ICOS station as an IoT node

Thank you for your attention

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