Mimicking nature

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

Observed Property := “Wind_Speed"

Phenomenon

Time

Result

23 m/s

16.9.2010 13:45

uom

Feature of Interest

Procedure (ID := “DAVIS_123“)

Observation
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 CO₂ concentration**

**Air CO₂ concentration**
**Air CH₄ concentration**
**Air N₂O concentration**
Sample frequency

- Speed of control in the Ecotron $\Rightarrow 1$ 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

Diagram:

- Sensors connected to Dataloggers
- Dataloggers connected to Software
- Software connected to Database
- Ecotron connected to Database with a download rate of 30 min
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

Voting algorithm

Compare readings ➔ Decide

ICOS National Network Belgium

KMI

Field Research Centre
Redundancy in practice

Voting algorithm

Switch

Fixed value

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UHasselt Knowledge in Action
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