The effect of transient weather conditions on outdoor surface mould growth

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Outdoor case study

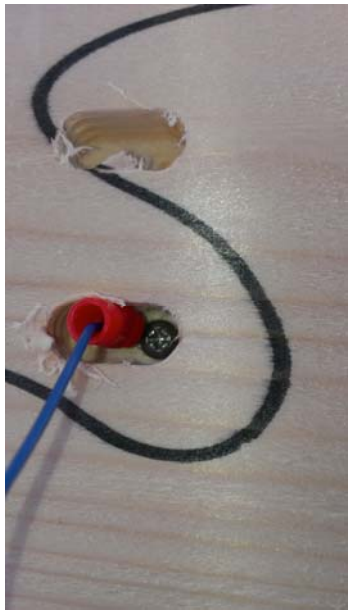
Ås, Norway - National weather station
Start : August 2013 – test is still running

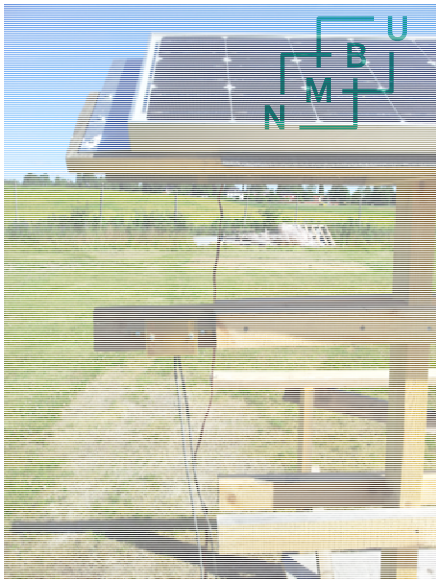
- Coated Spruce heartwood
- Spruce heartwood
- Pine heartwood
- Aspen
- Acetylated SYP

Study :

- Influence of weather conditions
- variation between substrates
- compare methods for mould evaluation
- predict aesthetic service life

- wood moisture content
- material temperature
- RH, temperature in air
- leaf wetness

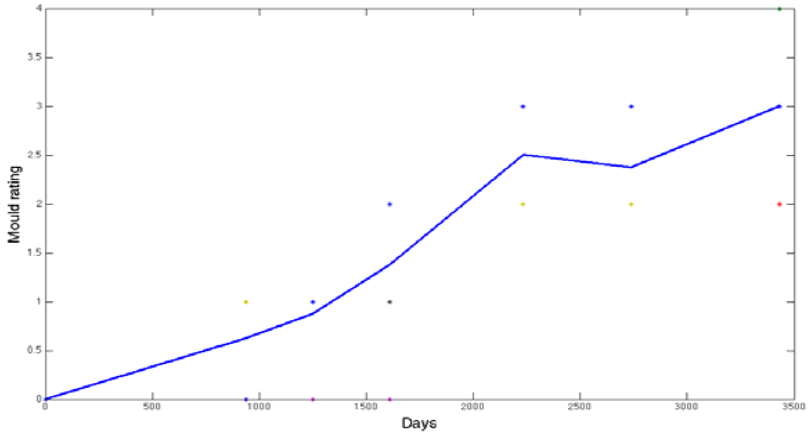




Evaluation of mould growth

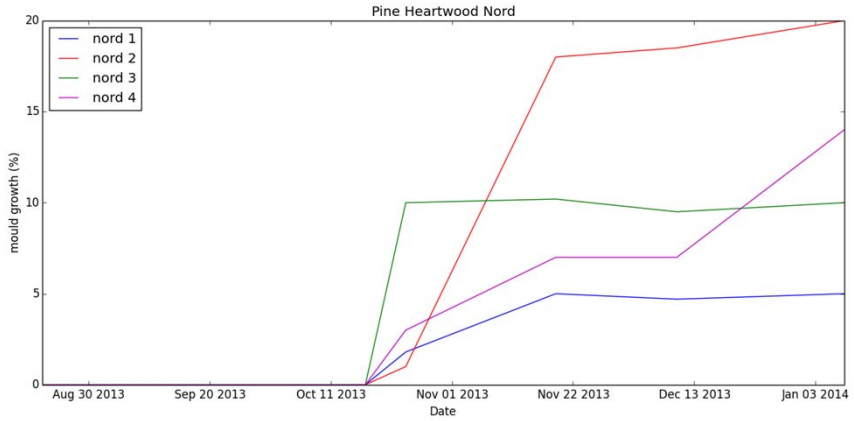
Visual inspection

- Scale 0 - 5
- Current method
- Subjective
- Needs people specially formed

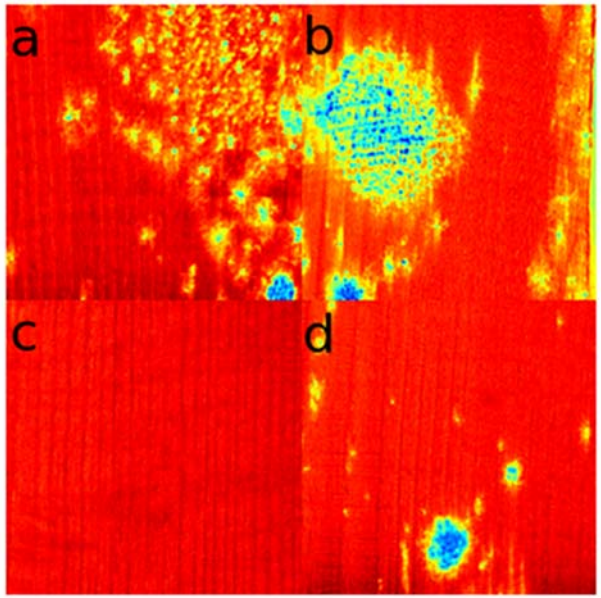


NIR hyperspectral imaging:

- Scale 0 – 100 %
- Find a combination of wavelengths that can help us to detect and quantify mould
- Is NIR hyperspectral imaging a method that can be applied to study the development patterns on fungi colonies on woods ?

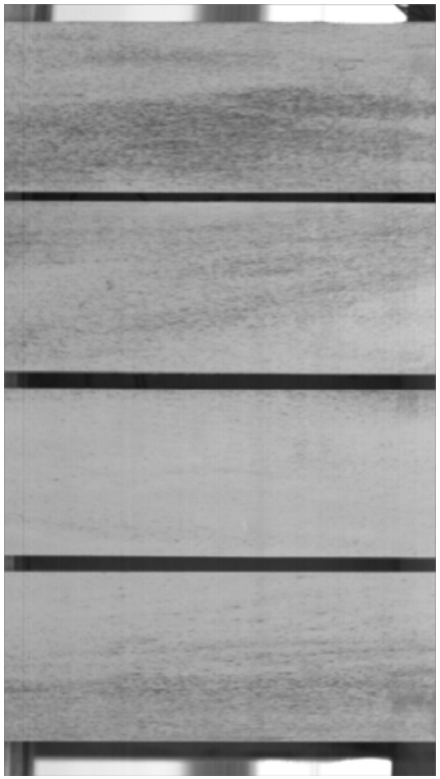


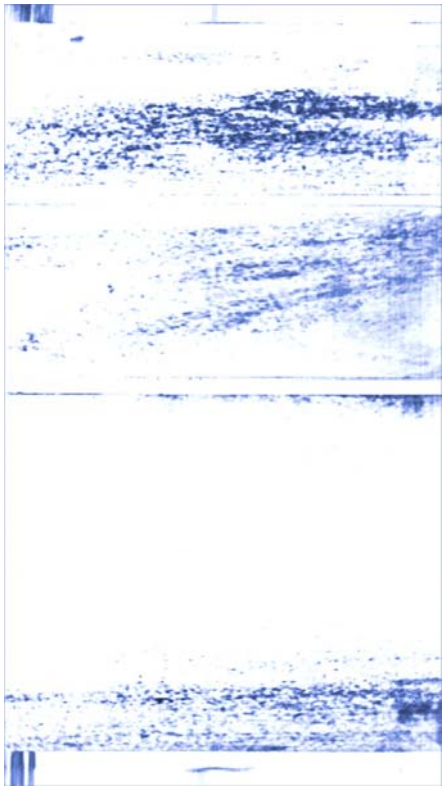
Lab measurement



Burud et al. 2014

Outdoor



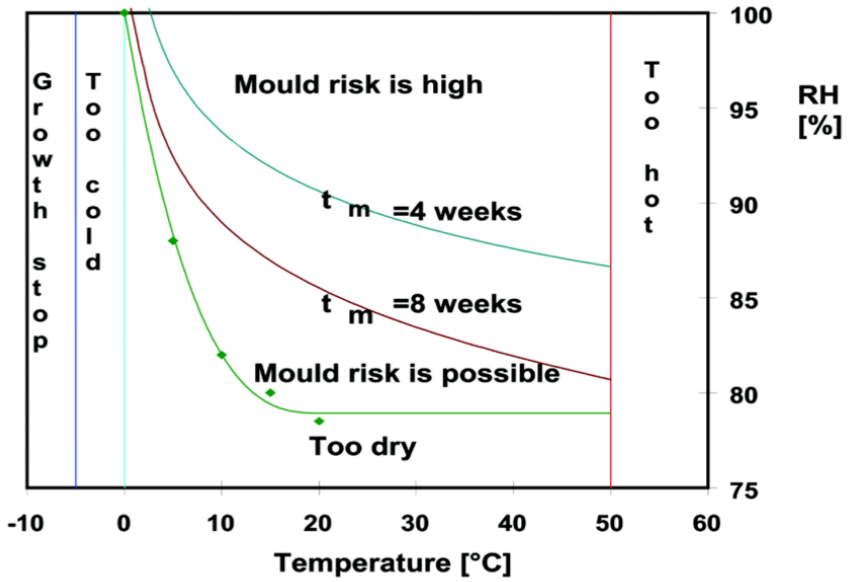


Existing models for predicting mould growth

Based on indoor studies with controlled climate

Most important
Influencing factors :

- Temperature
- Moisture
- Time
- Quality of substrate



Challenges :
Time intervals for growth conditions
Set back periods of mould growth

Viitanen 2007

Can we model mould growth outdoor ?

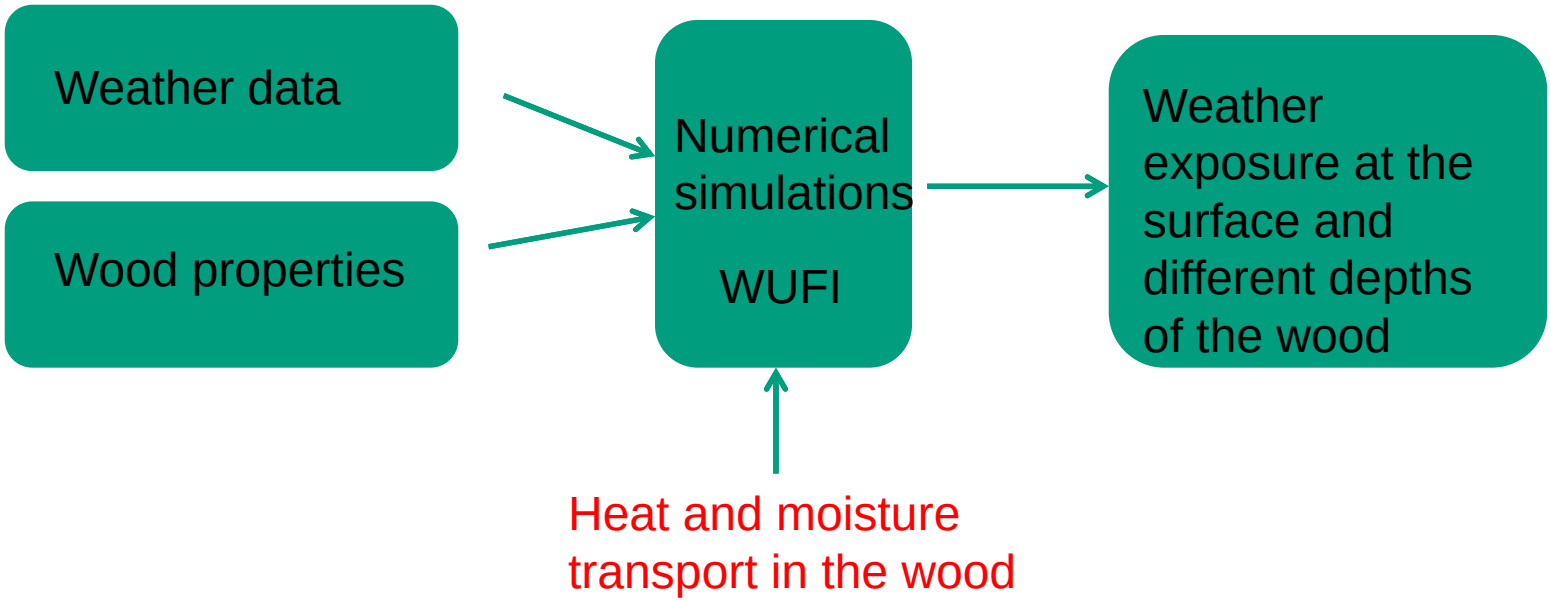
– Gobakken et al. looked at factors influencing the mould growth on wood surface in an outdoor environment
  - Measured RH and temperature in air
  - Prediction model of mould on different substrates with different coatings

- ➢ RH in the air does not take into account microclimate variations
- ➢ Some studies measure RH in 3mm depth
- ➢ What we really want is the RH on the surface

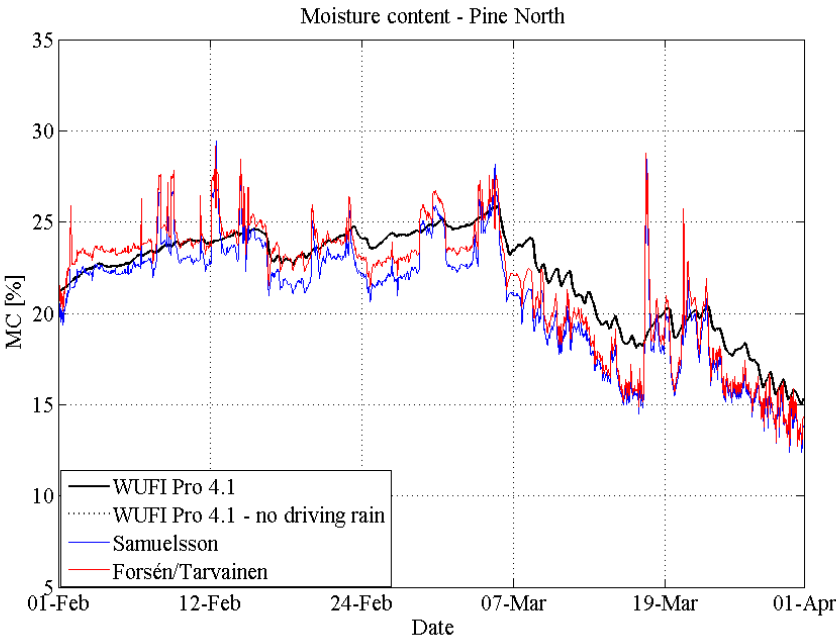
Gobakken et al.

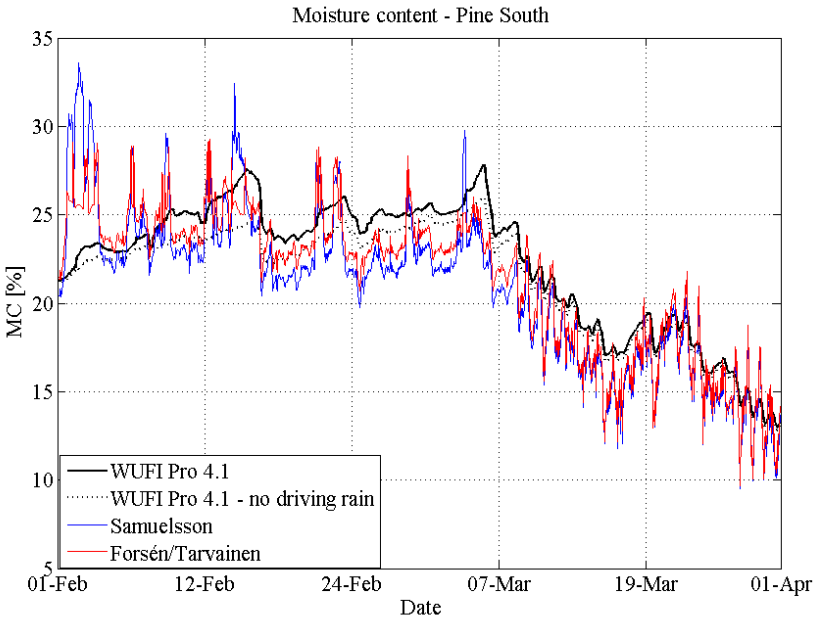
Numerical simulations

We have studied the weather conditions on the surface where mould growth takes place



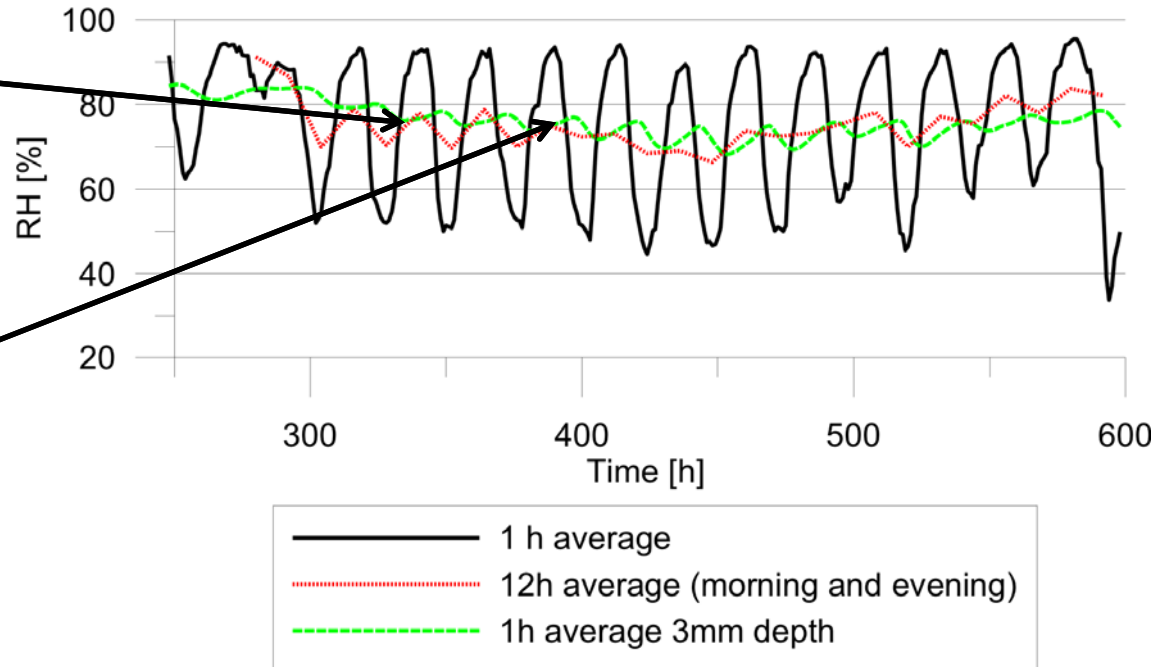
Measured versus simulated moisture content in 3mm depth





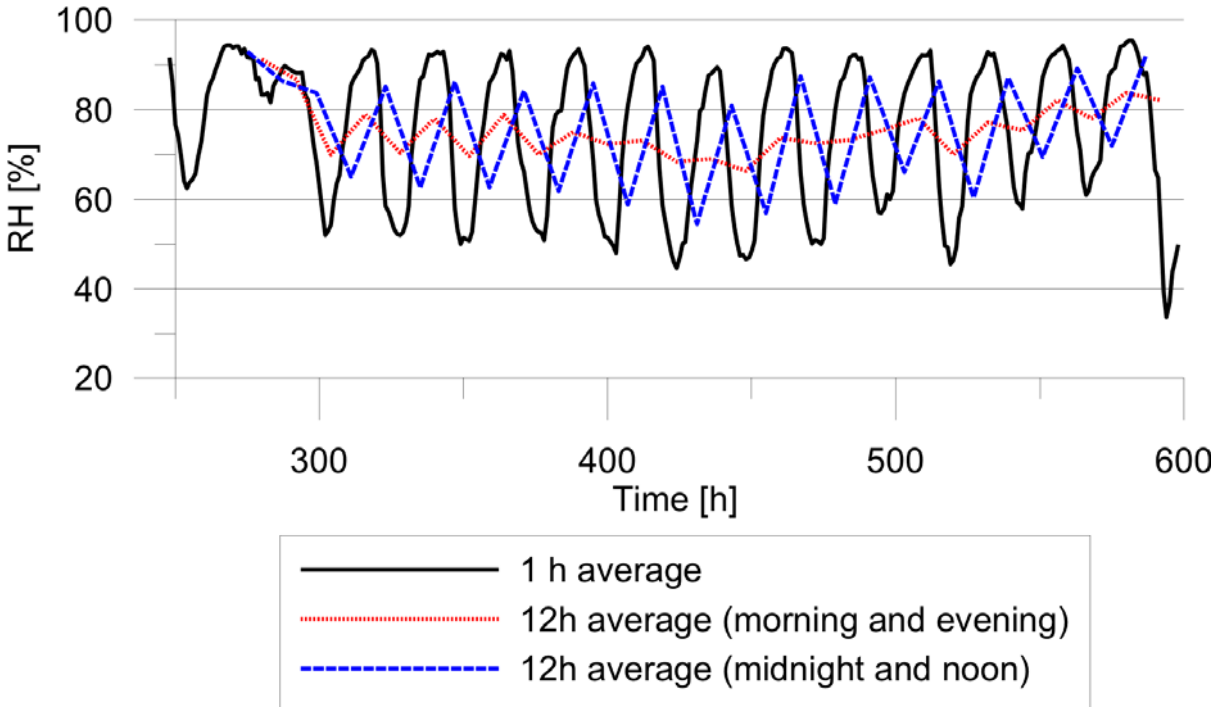
Simulated RH in 3mm depth versus RH at surface

- Missing RH>80% at 3mm depth and in the 12h average
- Time lag between surface amplitude and 3mm amplitude

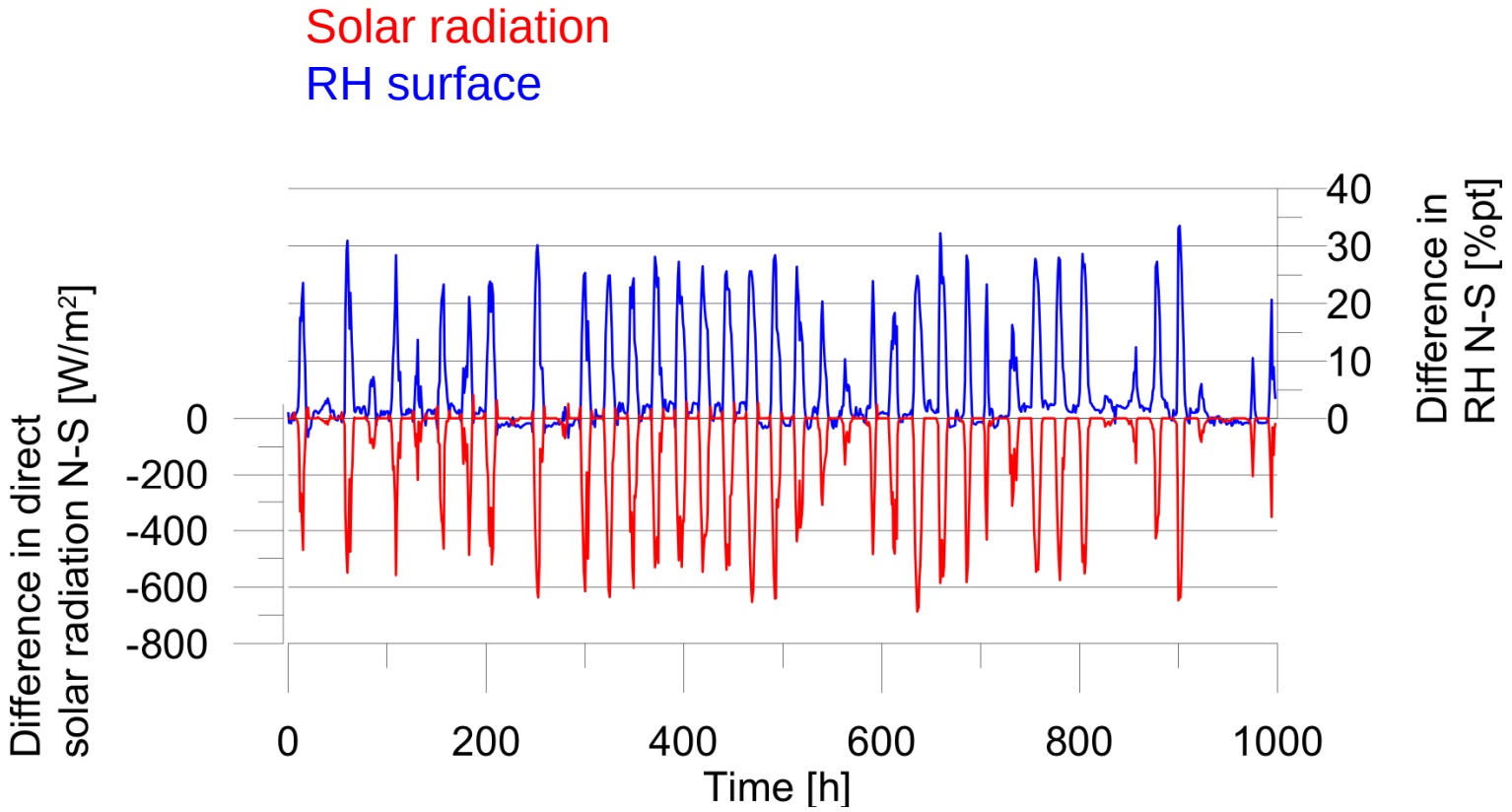


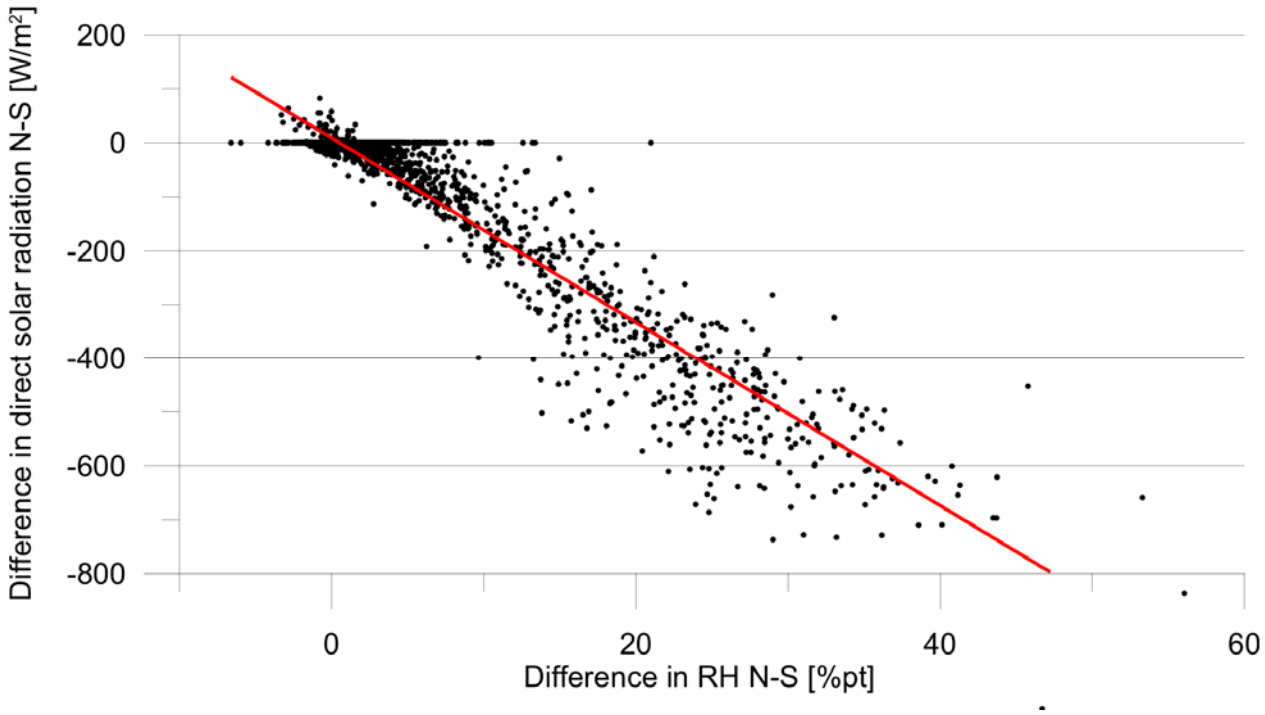
Which time interval should be used ?

- What is 12h average ?
- Difference between 12h from morning to evening and 12h average from midnight to noon



Difference between north and south

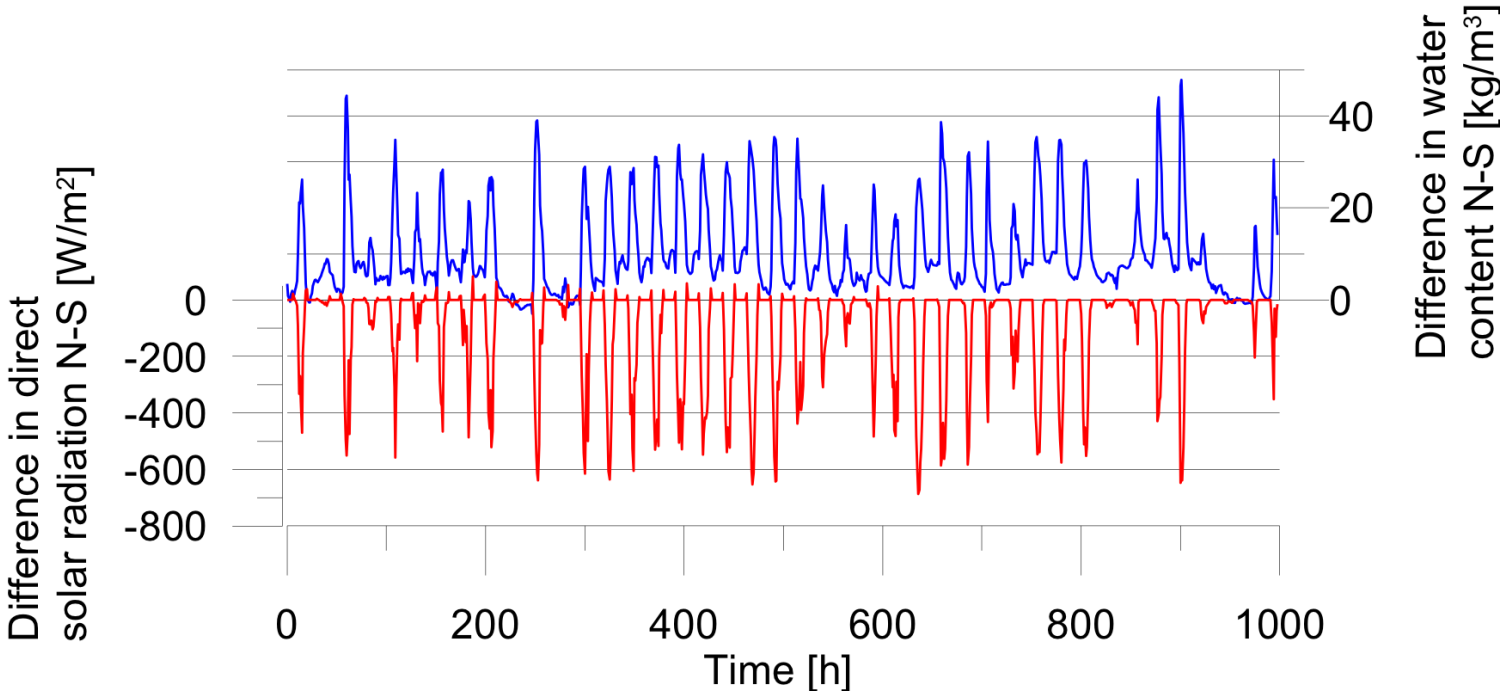



Difference in direct solar radiation N-S [W/m²]
200
0
-200
-400
-600
-800
0
20
40
60
Difference in RH N-S [%pt]

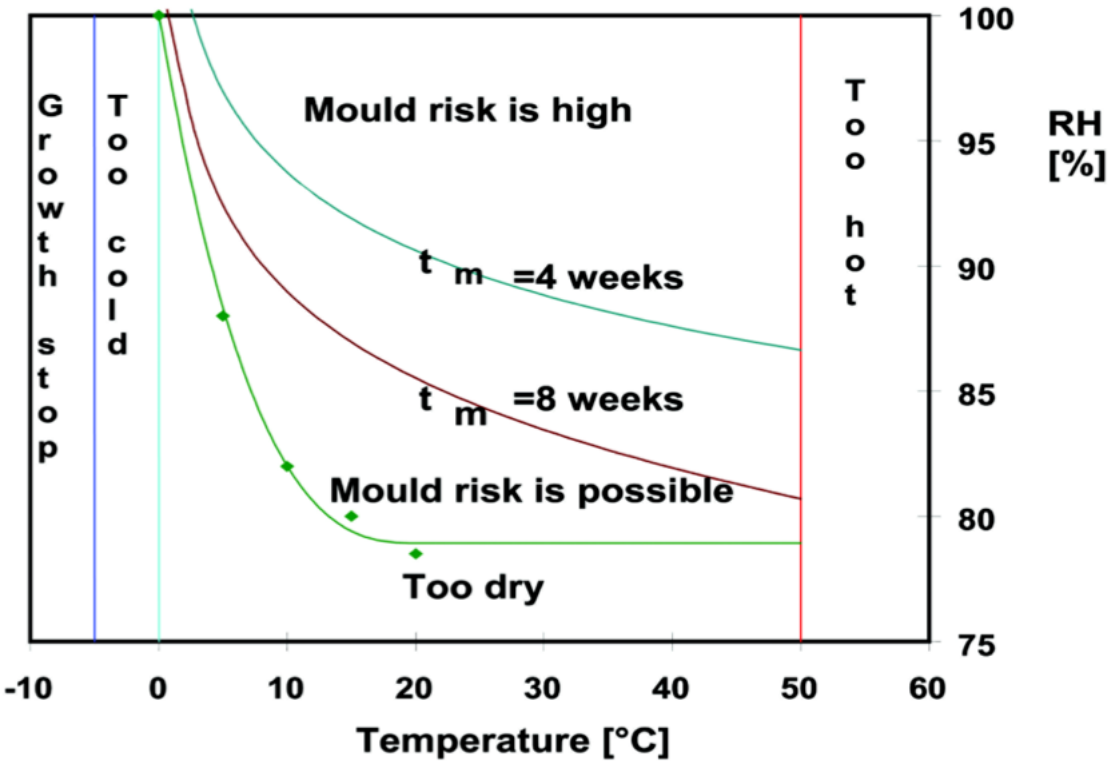
Difference between north and south

Solar radiation

Moisture content in the outer 1mm



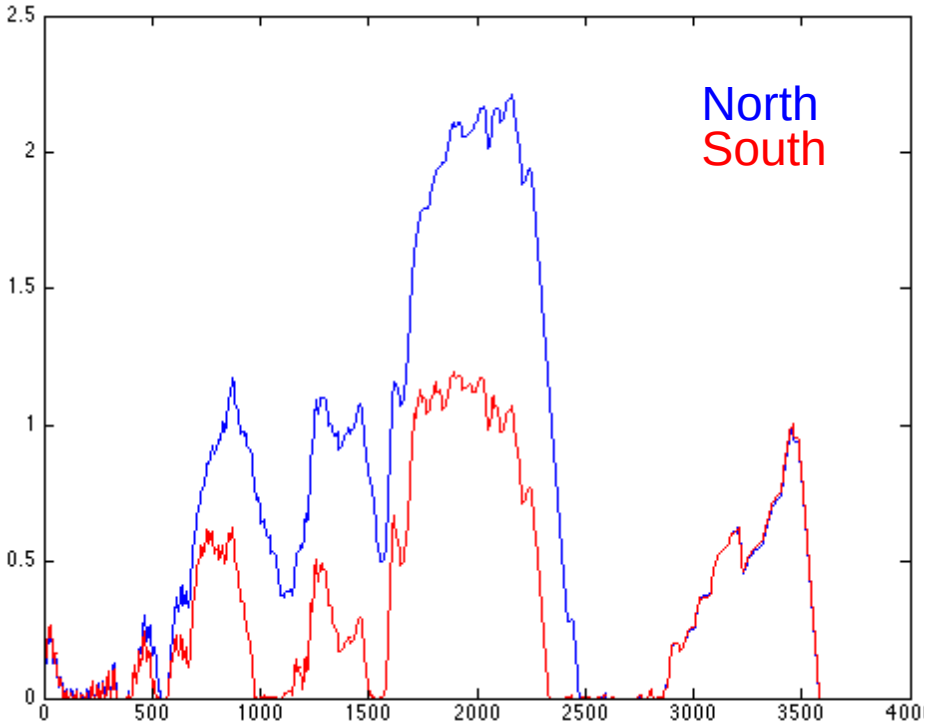
Modelling the mould growth



- Temperature
- Moisture
- Time intervals
- Set back times

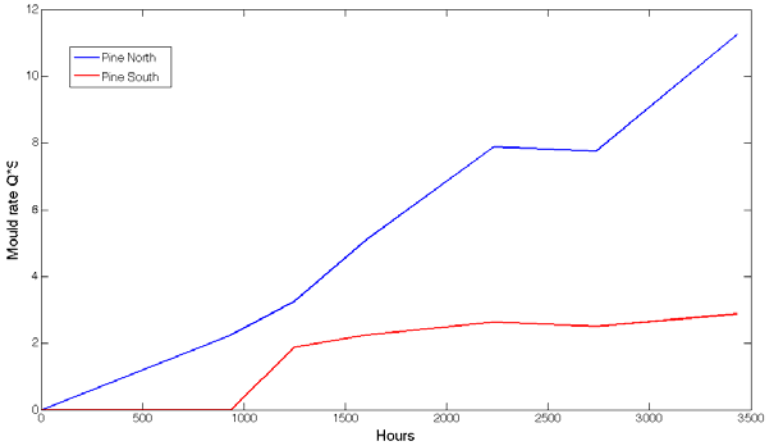
Viitanen 2007

Accumulated dose using model from Thelandersson & Isaksson 2013

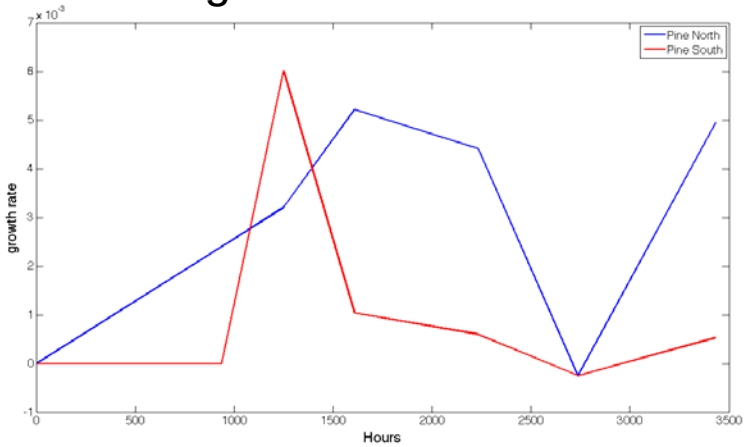


Mould = dry/dead mould + fresh living mould

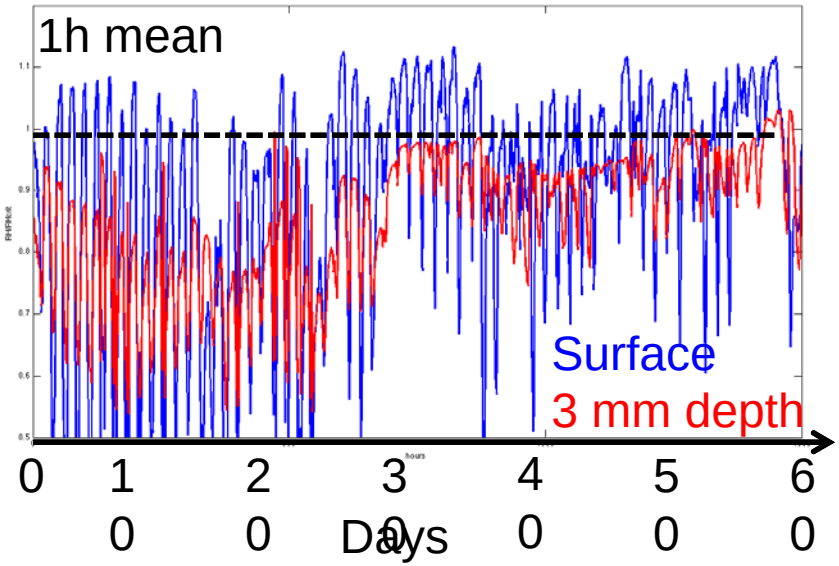
Mould rating

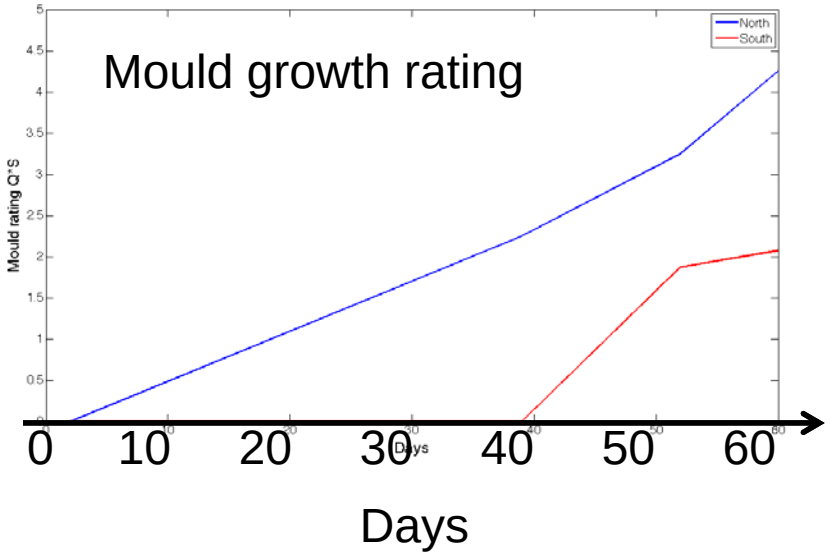


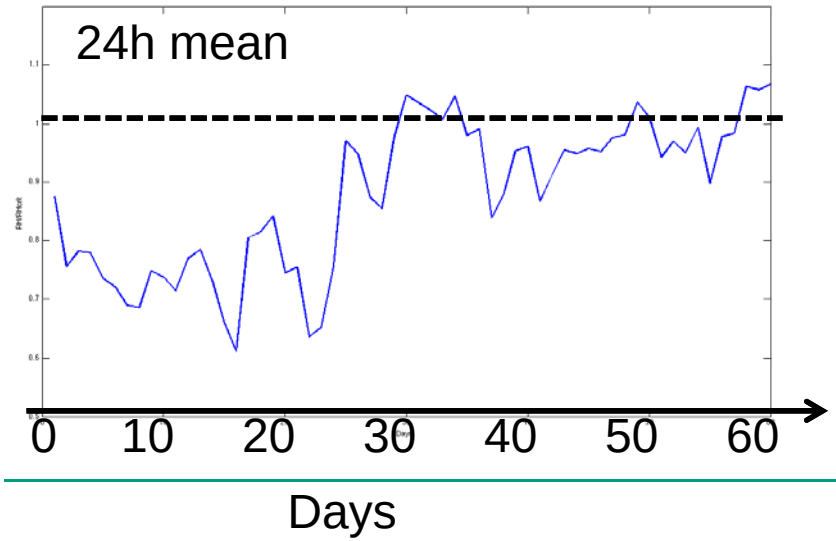
Mould growth rate

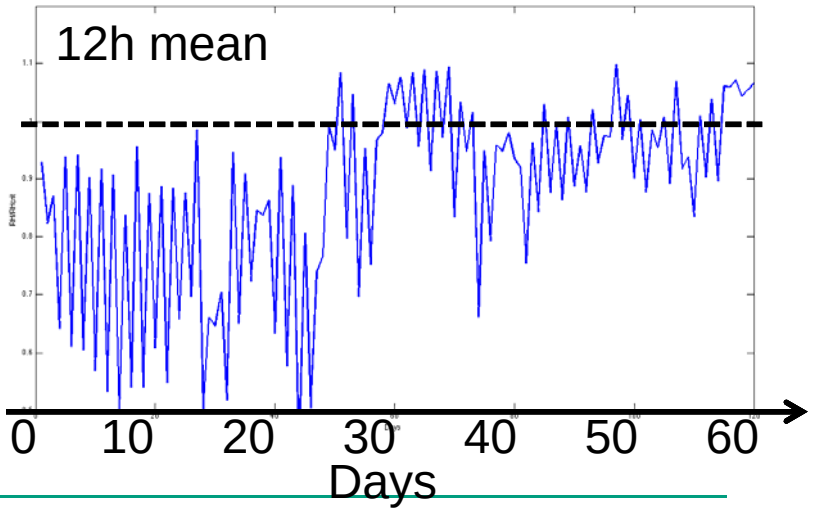


RH/Rhcrit North side









Summary

- We have an ongoing study of mould growth on wooden surfaces in an outdoor environment

- Mould growth is rated both by visual inspection and by hyperspectral measurements
- We simulate the weather conditions at the surface of the wood where the mould grows
- We have started to look at influencing factors and time scales of these
- RH at the surface is highly correlated with the solar radiation
- We currently work to gather more data in order to develop a prediction model for mould growth in outdoor environments

Thanks for your attention !