



Model house for monitoring of performance of wood and quality of insulation envelope

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Why

- It is difficult for **Architects, end users, decision-makers** to link the field test site applications with end use

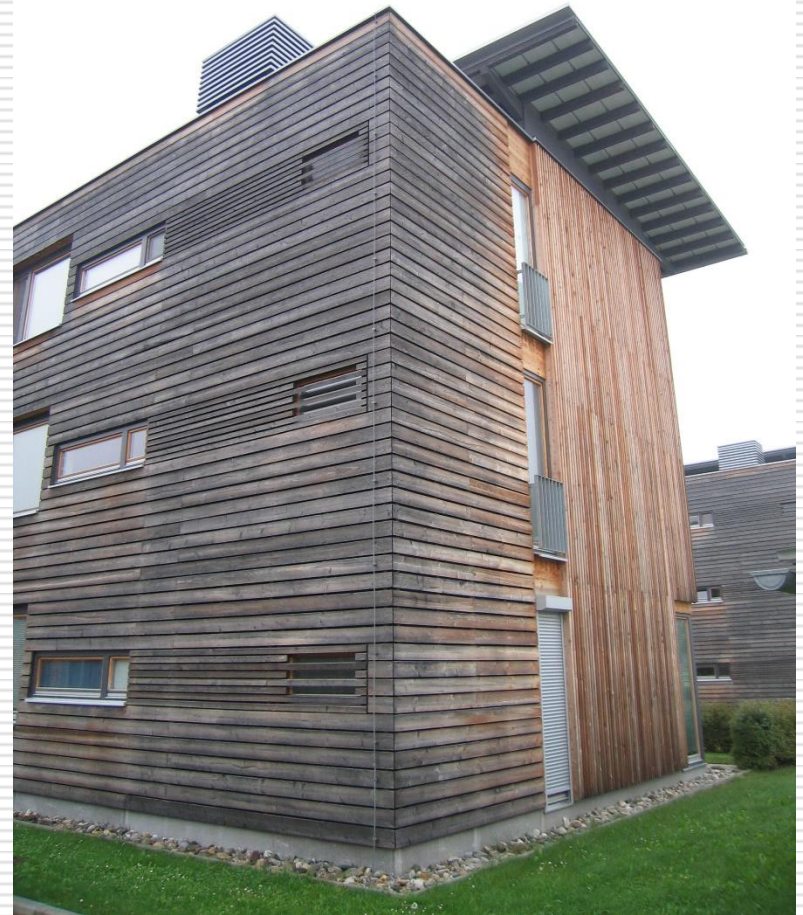


Missleading

We order



We have



Color as an decision making factor



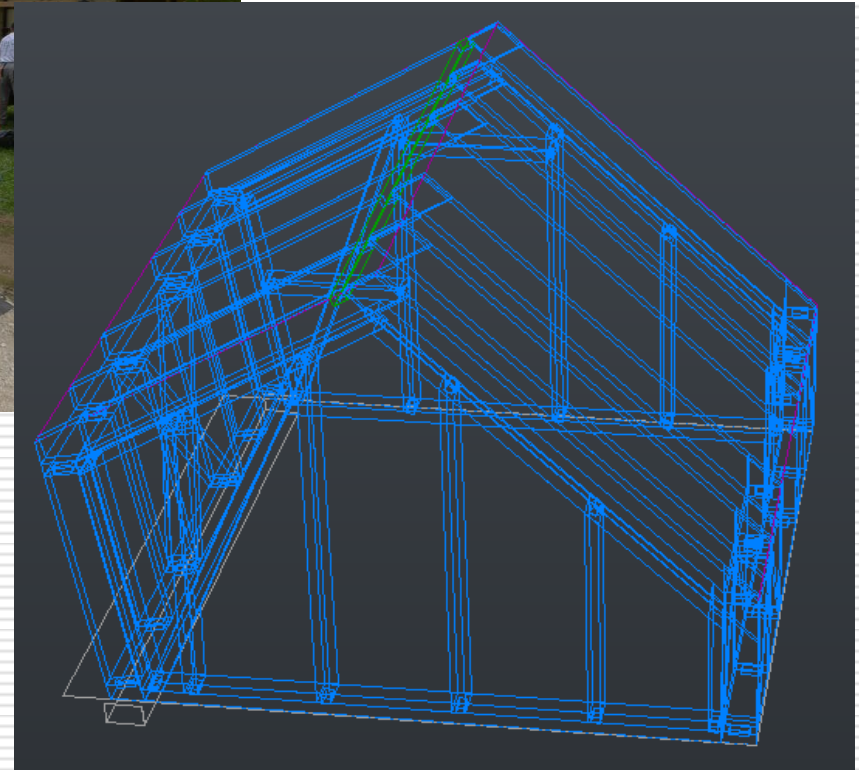
Grey rules them all



Why

- To provide information regarding
 - Visual appearance
 - Maintenance intervals
 - Service life
 - Insulation
 - Corrosion
 - Overall performance
 - Temperature, phase shift
 - Object for education

Timber frame construction



Watertight and vapor-open membrane



Loose-fill cellulose fibres



Façade and decking





Materials used in the façade and decking application on the model house

| Wood species | Treatment |
|----------------------|---|
| Norway spruce | Untreated Treated with montan wax Surface coated with acrylic coating Treated with copper-ethanolamine solution Treated with copper-ethanolamine solution and montan wax Thermally modified Thermally modified and impregnated with montan wax Thermally modified and impregnated with copper-ethanolamine Thermally modified and coated with acrylic coating |
| European larch | Untreated Thermally modified |
| Beech | Untreated Thermally modified Thermally modified and impregnated with montan wax |
| Sweet chestnut | Untreated |
| Scots pine sapwood | Untreated |
| Scots pine heartwood | Untreated |
| Black poplar | Untreated Thermally modified |
| Ash | Untreated Thermally modified |



Roof



Interior



Milestones

- ❑ March 2013 start of the project
- ❑ July 2013 beginning of the construction
- ❑ October 2013 façade was finished
- ❑ May 2014 90% of the sensors are mounted
- ❑ May 2014 beginning of observations

Monitoring

- Color changes
- CIE $L^*a^*b^*$

October
2013



October
2014



Monitoring

- Color changes
- Fungal disfigurement
- Decay
 - Visual assessment



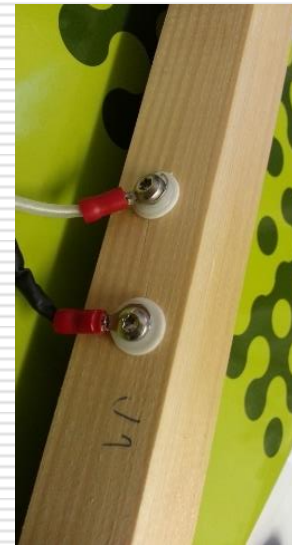
Monitoring

- ❑ Color changes
- ❑ Fungal disfigurement
- ❑ Corrosion of fasteners



Monitoring

- Color changes
- Fungal disfigurement
- Corrosion
- Moisture content (160 MC sensors)
- Scanntronik Gigamodule



MC Calibration curves



Monitoring

- Color changes
- Fungal disfigurement
- Corrosion
- MC
- Temperature

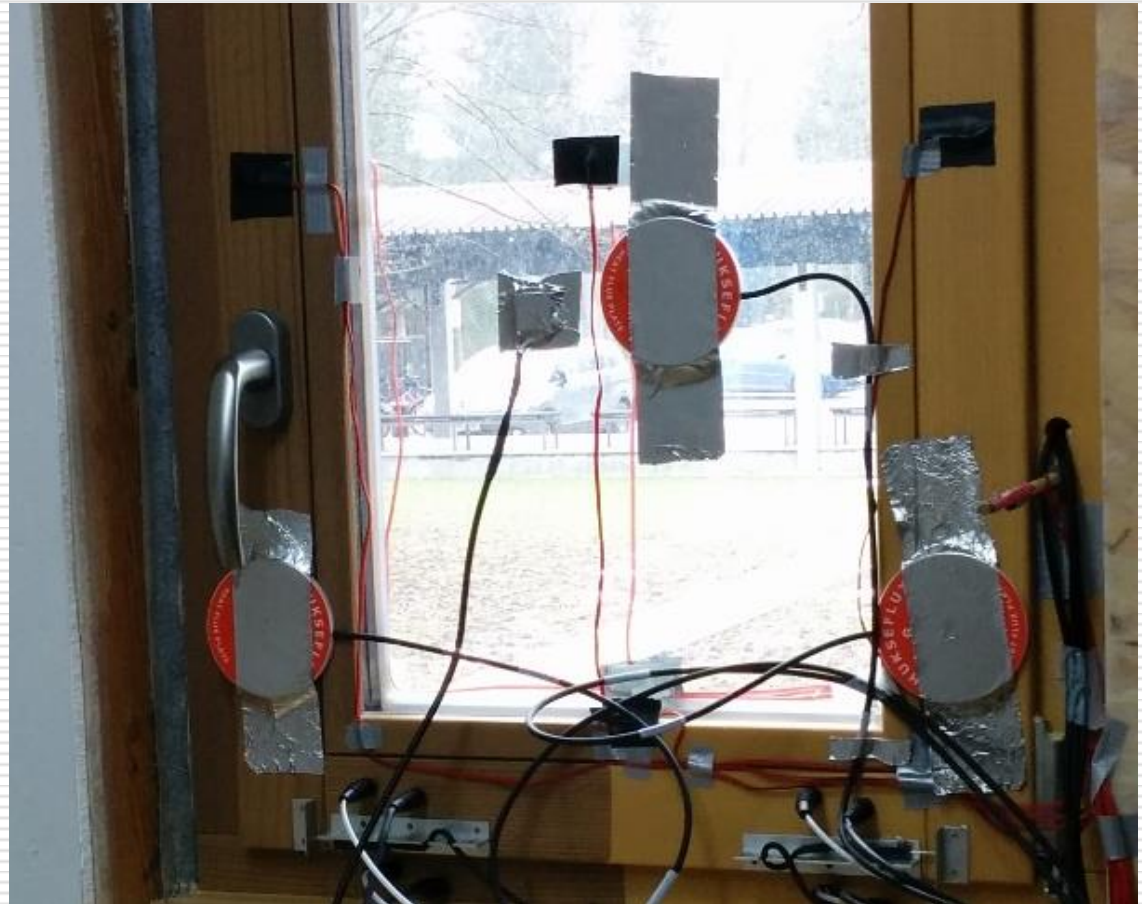
100 #

Scantronik,
thermofox



Monitoring

- Color changes
- Fungal disfigurement
- Corrosion
- MC
- Temperature
- Heat flux
 - Huxeflux



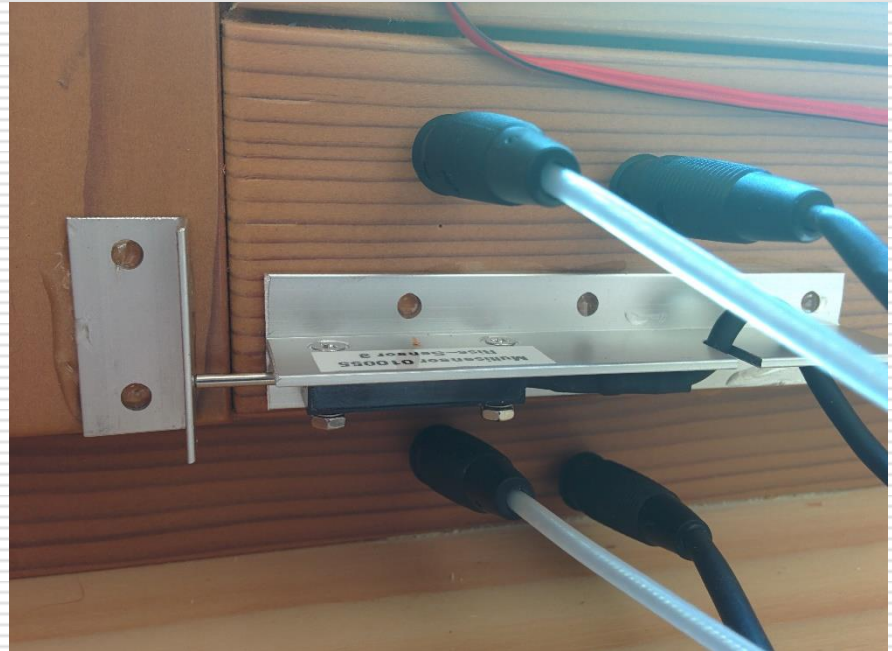
Monitoring

- Color changes
- Fungal disfigurement
- Corrosion
- MC
- Temperature
- **t, HCHO, VOC, RH**
 - Haarla



Monitoring

- ❑ Color changes
- ❑ Fungal disfigurement
- ❑ Corrosion
- ❑ MC
- ❑ Temperature
- ❑ t , HCHO, VOC, RH
- ❑ Cracks



Monitoring

- Color changes
- Fungal disfigurement
- Corrosion
- MC
- Temperature
- t , HCHO, VOC, RH
- Cracks
- Weather
 - t , RH, precipitation, solar radiation...
 - Davis



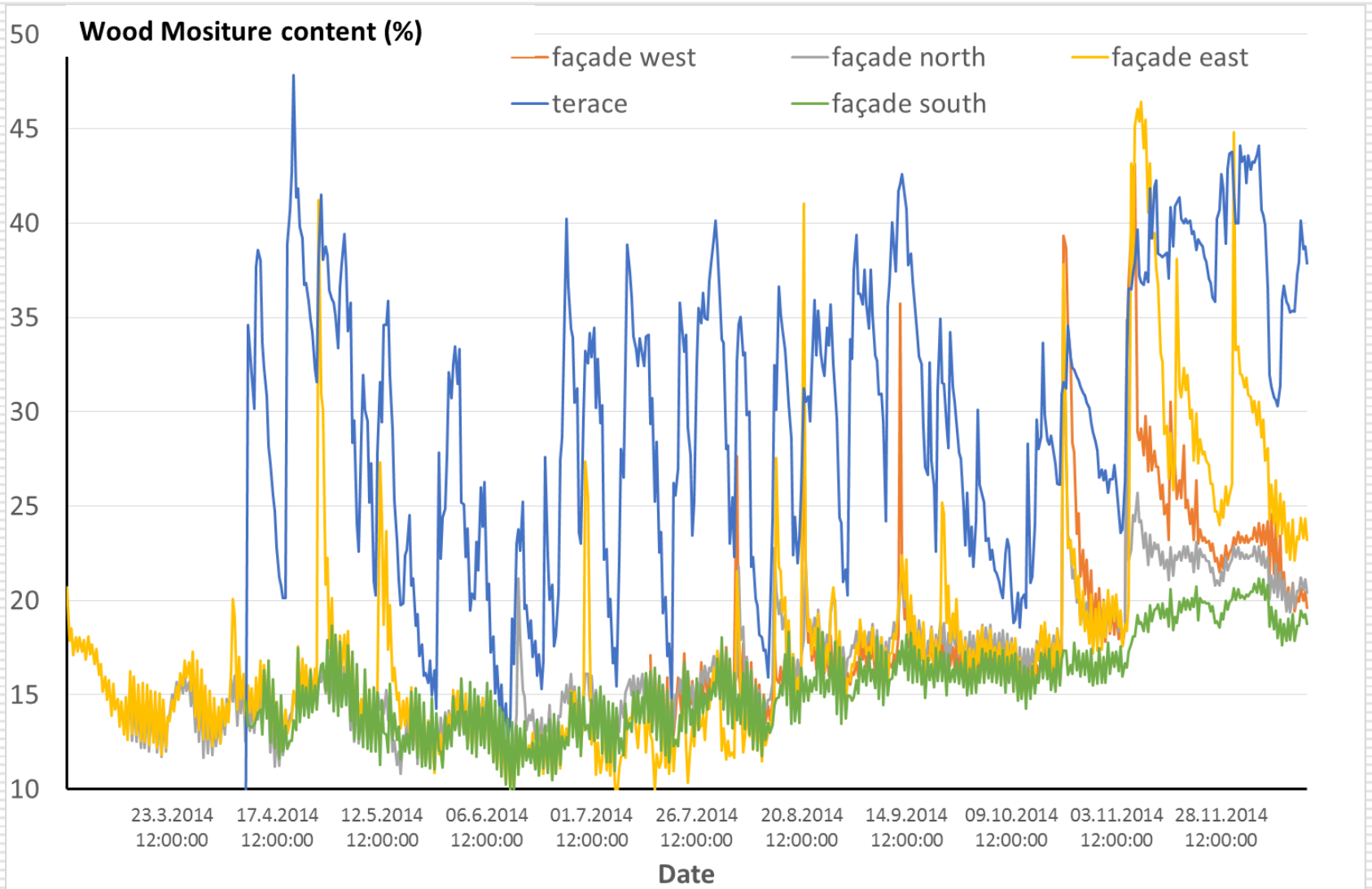
Interior



Data

| | Measurements per day | Measuremnts per year |
|----------------------|----------------------|----------------------|
| Temperature | 1260 | 459.900 |
| MC | 240 | 87.600 |
| Cracks | 120 | 43.800 |
| RH, VOC, HCOOH... | 336 | 122.640 |
| Wather | 1152 | 420.480 |
| Sum | 3108 | 1.134.420 |

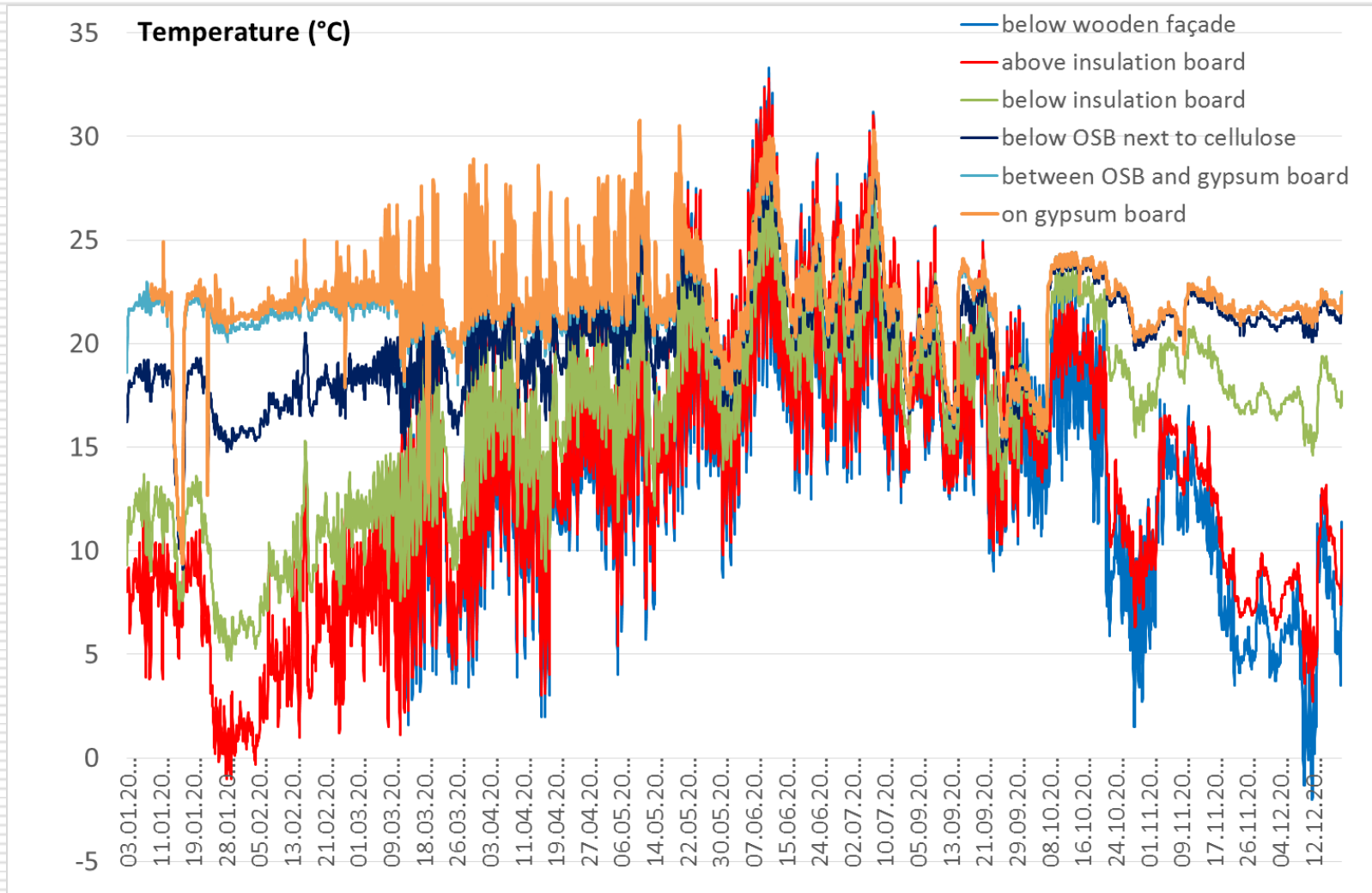
First outcomes – MC spruce



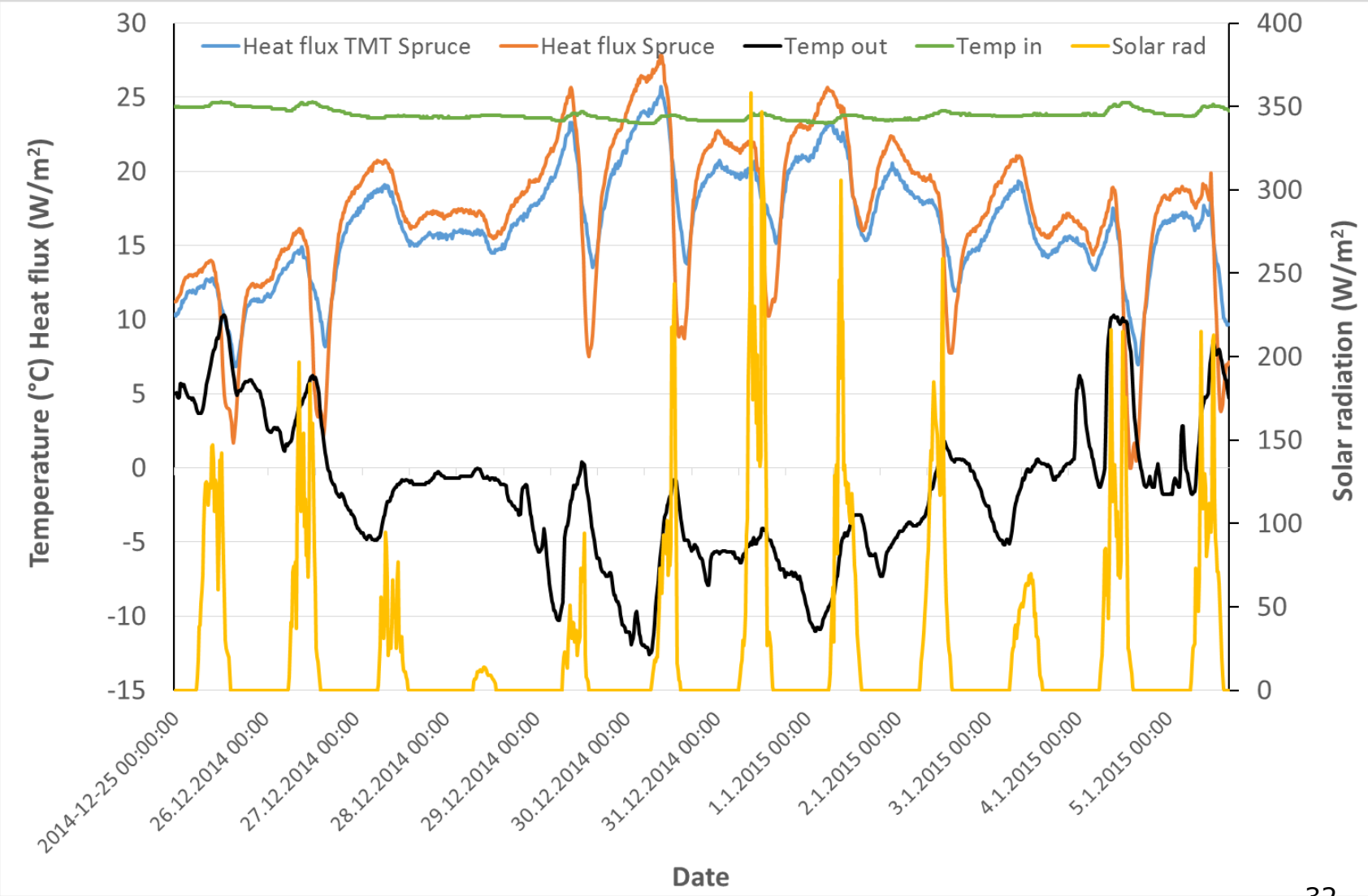
Summary MC Spruce

| | decking | façade north | façade south | façade west | façade east |
|------------------|----------------|---------------------|---------------------|--------------------|--------------------|
| count | 253 | 281 | 254 | 330 | 296 |
| average | 29,9 | 16,7 | 15,5 | 13,5 | 17,8 |
| U > 25 | 180 | 2 | 0 | 19 | 39 |
| U > 20 | 224 | 51 | 12 | 52 | 64 |

Temperature distribution through the wall



Heat flux – window TMT vs spruce



Future work and Chalanges

- Correlation between different data and decay and discoloration
- Correlation between lab data and in service performance
- Challenges
 - Huge amount of data
 - Selection of proper software
 - Statistical analysis

Acknowledgement

Silvaprodukt



Zimic



Slovenian Research Agency



Thank you

