

# Suitability of the new paradigm for winter observation of road condition

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# Purpose of the study

- To examine the remote road surface state sensor for temperature and for road surface condition (comparison between remote and embedded road sensors).
- To assess the suitability of its application on Slovenian roads (RWIS with RWS of different producers; development of roadcast in Slovenia).

# Sensors

- Vaisala *DST111* — *remote* measurement of the road surface temperature, air temperature and humidity.
- Vaisala *DSC111* — *remote* measurement of the road surface conditions and grip.
- Vaisala *DRS511* — a sensor *embedded* into the road surface.



# Data acquisition and manipulation

- January — April 2009 from the same RWS.
- Road temperature and road surface condition.
- Observers inspections.
- Pairs and harmonization.





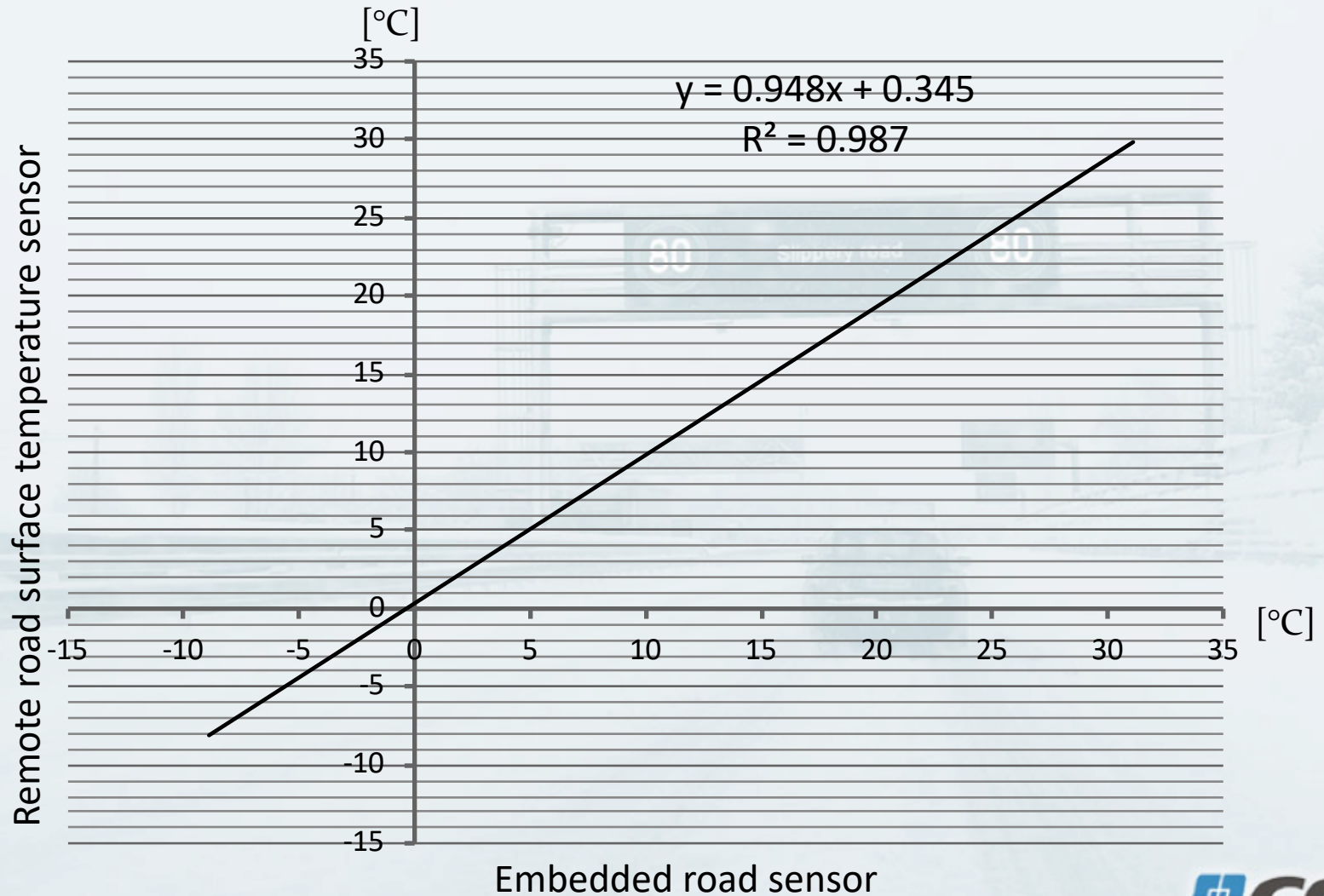
# Analysis and results

# Road surface temperature

## Results: embedded / remote sensors

- 5 239 pairs,
- 20.7 % of measurements differ for more than 1 °C,  
arithmetic mean = 0.7 °C,  
standard deviation = 0.6,  
coefficient of determination = 0.987.
- Embedded road sensor has mainly indicated a *higher* temperature compared to the remote road surface state sensor.

# Dispersed graph of the road surface temperature



# Road surface condition

## Results: embedded / remote sensors

- 5 399 pairs,
- 14.2 % of measurements differ.
- Main difference: *moist* → *dry*, *moist* → *wet*.
- Remote road surface state sensor has generally detected changes *sooner*.

		Remote road surface state sensor			
		dry	moist	wet	snow
Embedded road sensor	dry	3338 (61.8 %)	90 (1.7 %)		
	moist	314 (5.8 %)	472 (8.7 %)	67 (1.2 %)	
	wet	44 (0.8 %)	226 (4.2 %)	803 (14.9 %)	24 (0.4 %)
	snow	2 (0.04 %)			19 (0.4 %)



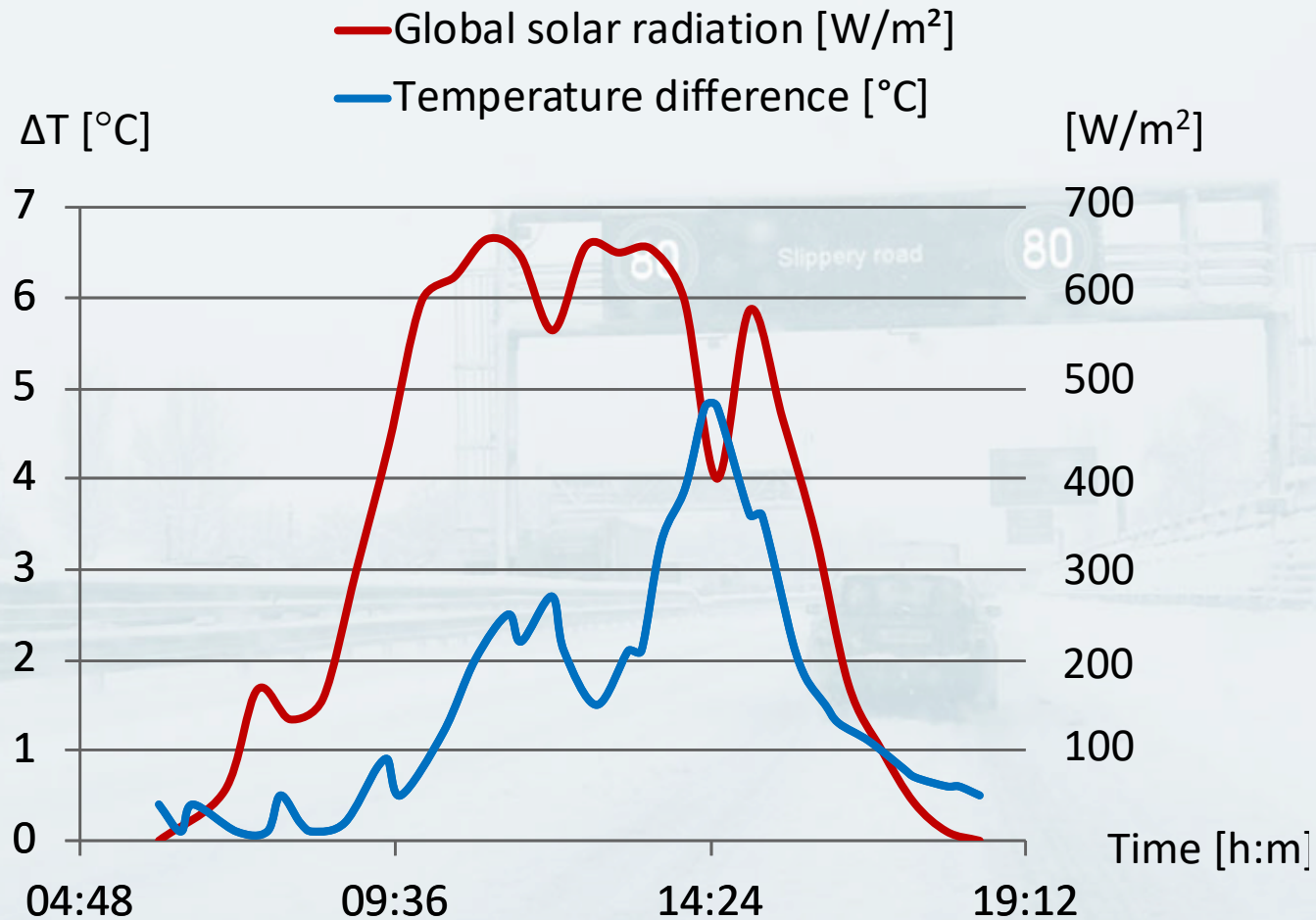
# Road surface condition

## Results: observer / remote sensor

- 79 pairs with  $\Delta t = \pm 5$  min,
- 22.8 % of measurements differ.
- In most cases the remote road surface state sensor indicated *dry*, while the observer recorded *moist* condition (and a vice versa).

		Observer		
		dry	moist	wet
Remote road surface state sensor	Road surface condition			
	dry	37 (46.8 %)	14 (17.7 %)	
	moist	4 (5.1 %)	13 (16.5 %)	
	wet			11 (13.9 %)

# Correlation with meteorological data



# Conclusions

- Results between embedded and remote sensors show a high degree of correlation.
- Thus remote sensor is suitable for operation on Slovenian roads.
- Our RWIS needs additional depth road temperature for roadcast.
- Salinity is still an important parameter affecting the decisions in winter maintenance.



*Will grip (not friction) kick out salinity  
from road monitoring?  
What about environmental issue?*