Young Researchers Seminar 2009

Torino, Italy, 3 to 5 June 2009

Water flow paths through roads

- a field study

Klas Hansson

Presentation outline

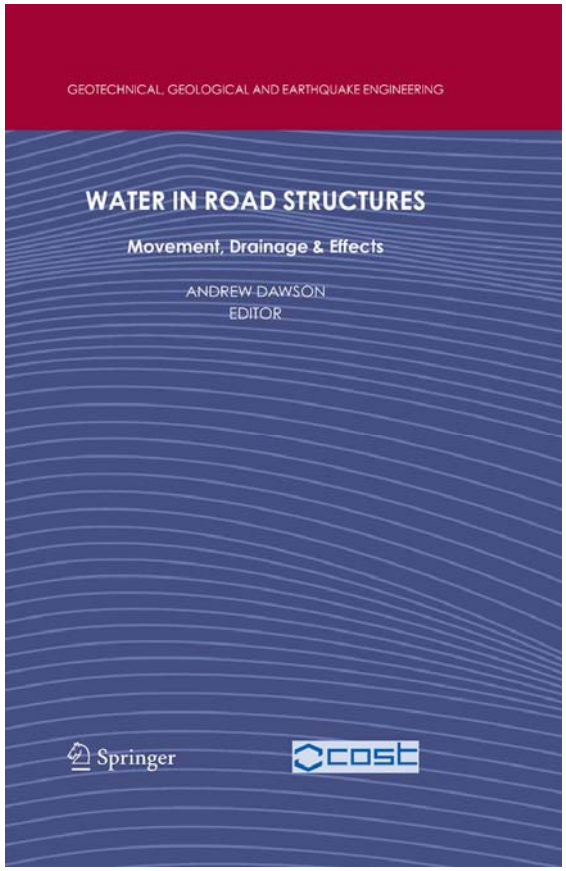
- Introduction
- Objectives
- Materials and methods
- Infiltration and water flow pattern
- Conclusions
- Future studies
- Contact info

Introduction

- Water affects bearing capacity, the severity of freeze/thaw cycles and transports pollutants from the road – of interest to many groups

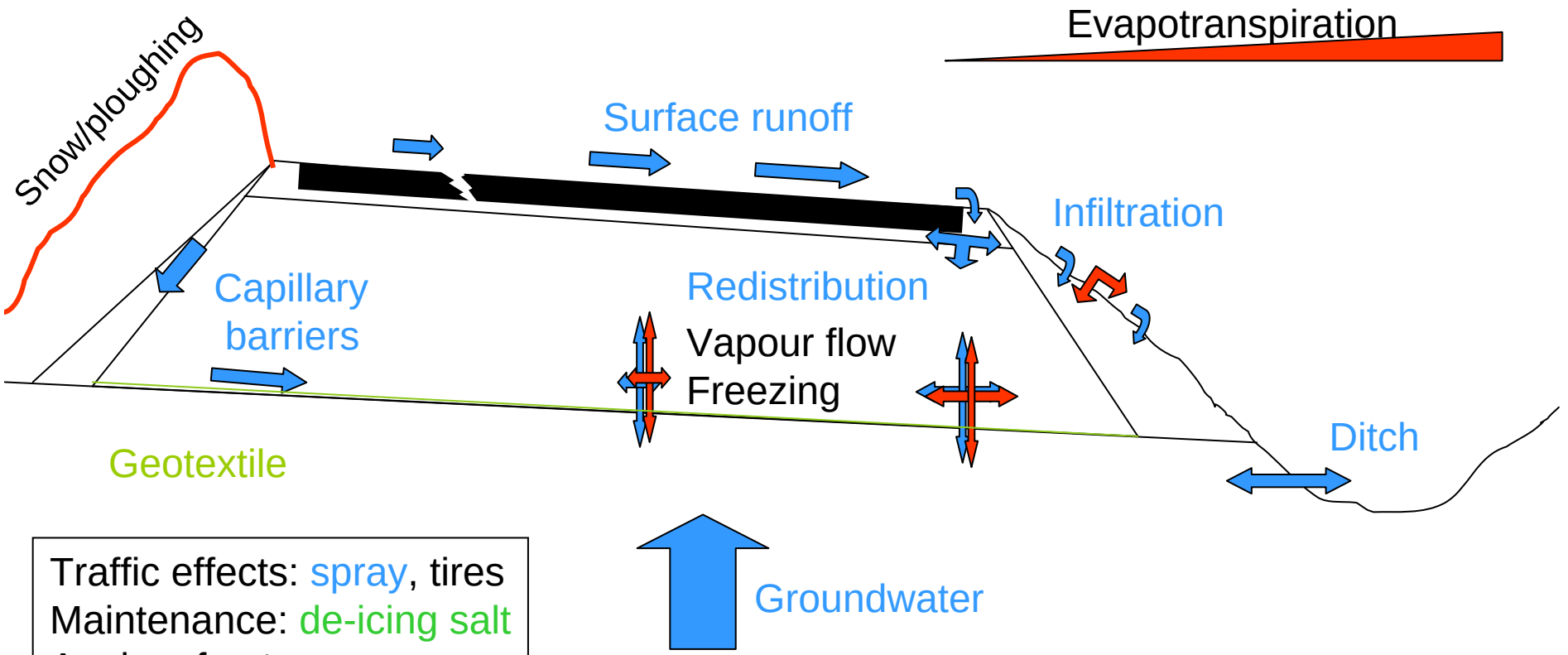
- EU Water Framework Directive

- A. Dawson (2008): ‘Water and road construction do not make for a harmonious couple!’



Introduction

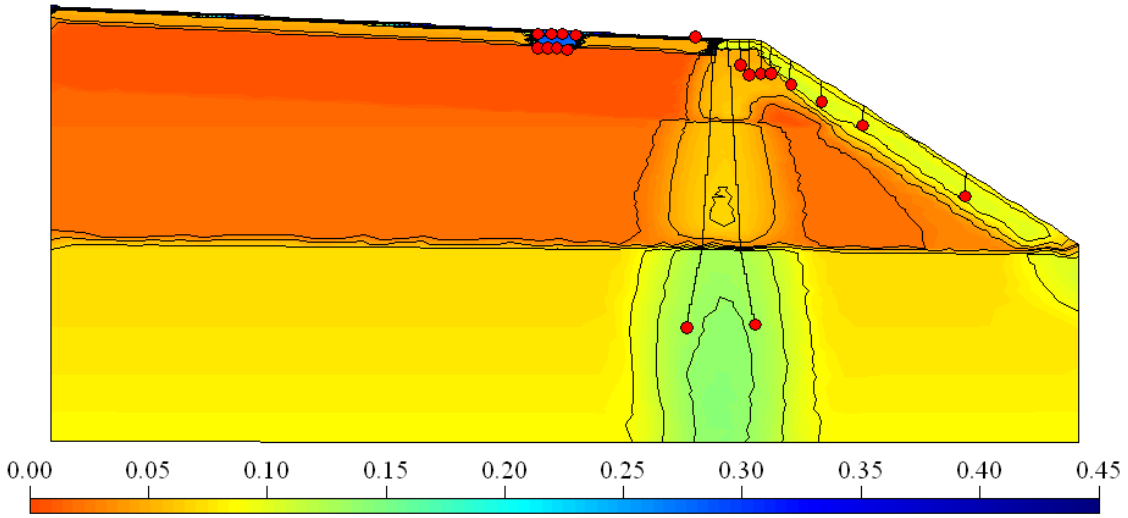
Water flow and roads



Traffic effects: spray, tires
Maintenance: de-icing salt
Ageing: fractures

Introduction

Previous simulations of rainfall, runoff and infiltration into a highway → help when positioning sensors



Water content (-)

Ref: Hansson, K., Lundin, L-C., Simunek, J., 2005. Modeling water flow patterns in flexible pavements. Transportation Research Record: J. of the Transportation Research Board, No. 1936, pp. 133-141.

Objectives

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1. investigate by direct measurements if water infiltrated near the asphalt edge as indicated by previous simulations and independent leaching experiments

2. establish the long- and short-term dynamics and patterns of water distribution within the road

+ some secondary objectives…

Materials and methods

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- Site photo:

Materials and methods

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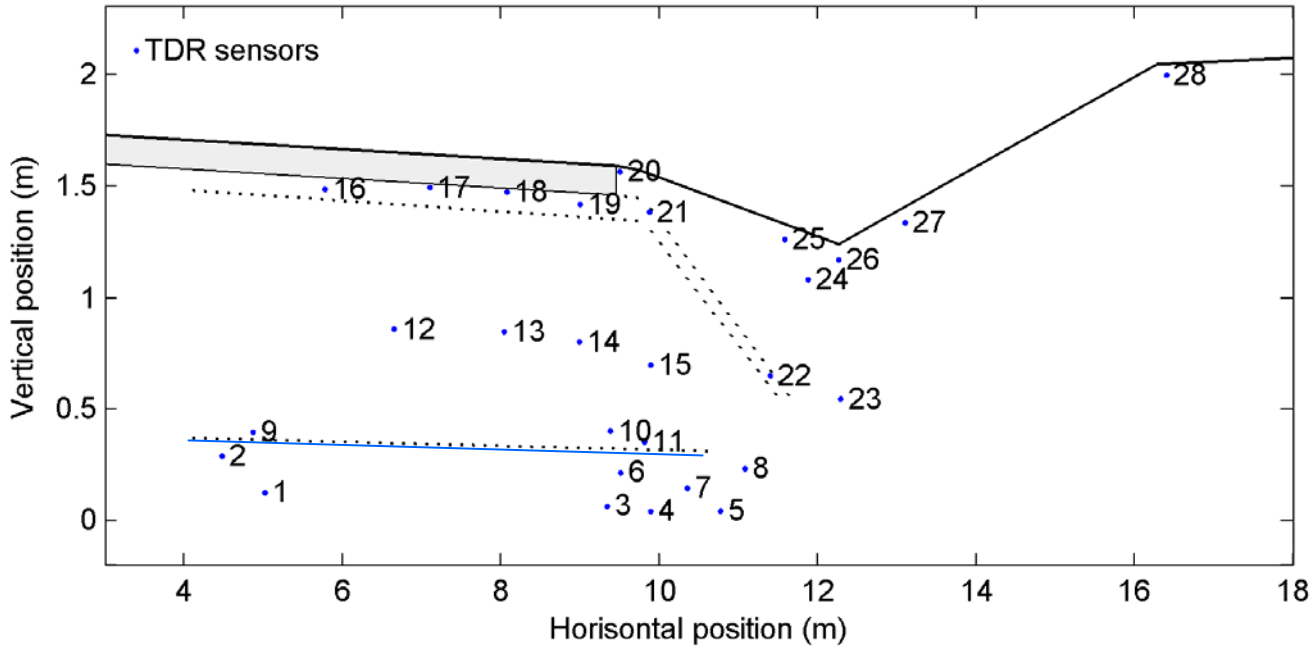
Materials and methods

- Schematic of the test road cross-section with TDR sensors (dots).



Materials and methods

Structure of the road:

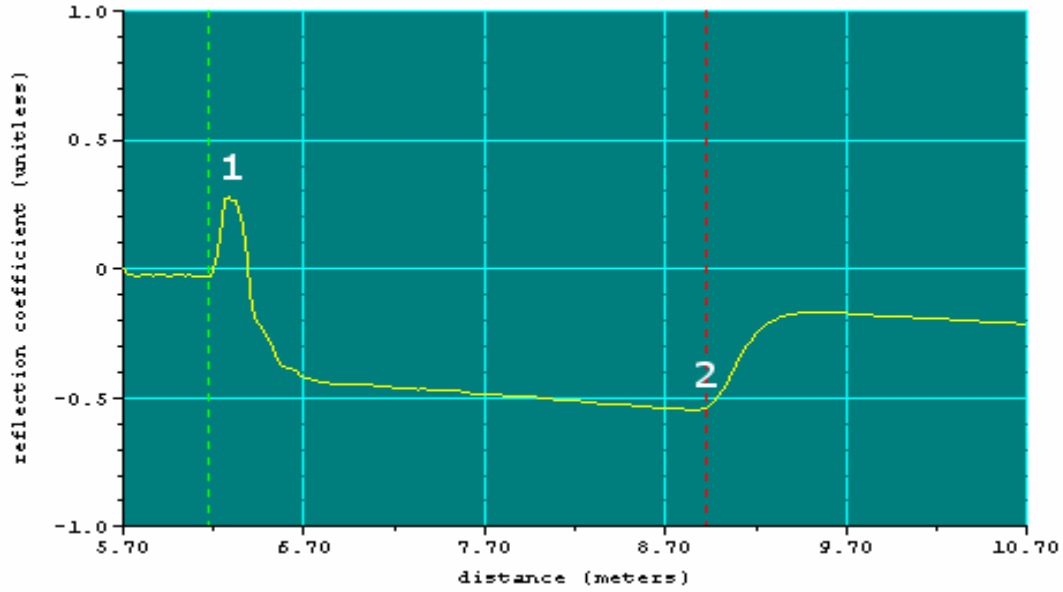
1. 20 cm asphalt concrete
2. 8 cm unbound base layer
3. 100 cm subbase layer made from crushed rock
4. gravelly boulder and cobble till soil.

Particle-size distribution for the base and subgrade materials:

Sieve size (mm)															
Mat	0.063	0.125	0.25	0.5	1	2	4	5.6	8	16	22.4	31.5	45	63	600
Passing sieve (% by mass)															
Base	3.3	5.5	8.9	12.8	16.6	20.3	25.2	29.4	35.9	59.9	77.1	93.8	100	100	100
Soil	2.8	4.2	5.6	7	8.5	10.1	11.8	13	14.6	17.7	20.7	23.9	29	33	73

Materials and methods

- TDR technique to measure water content (by volume)

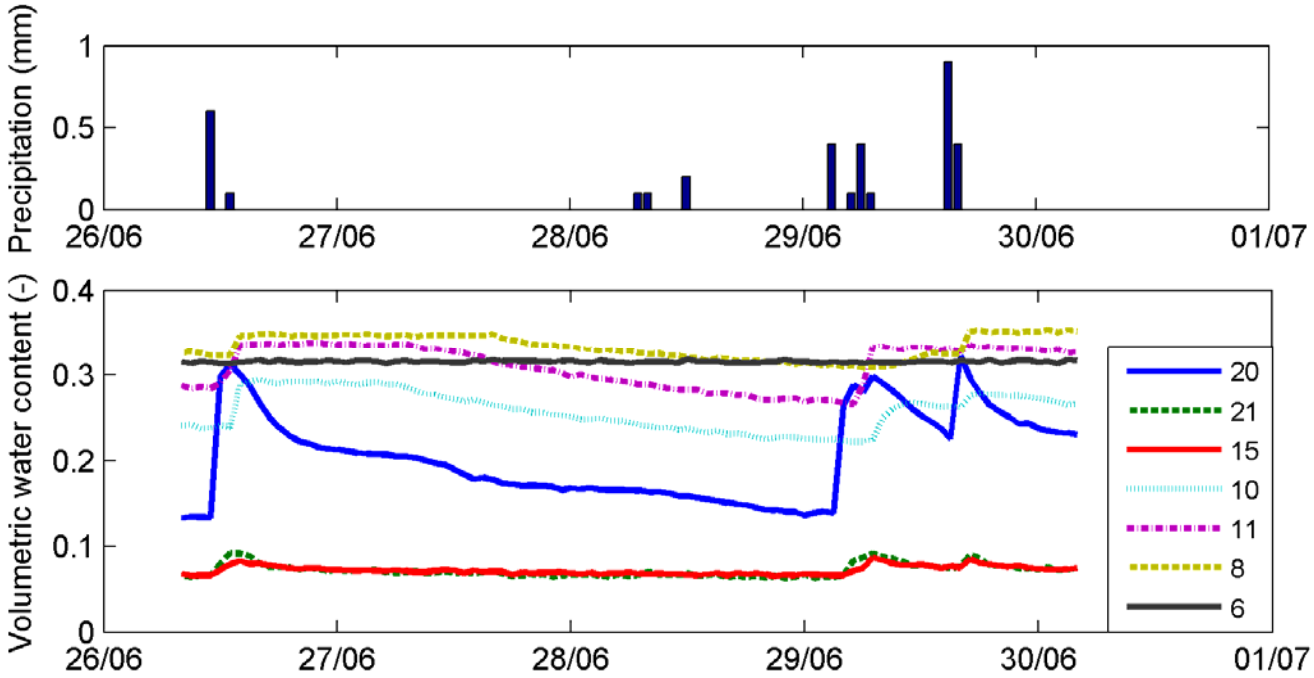


Infiltration and water flow pattern

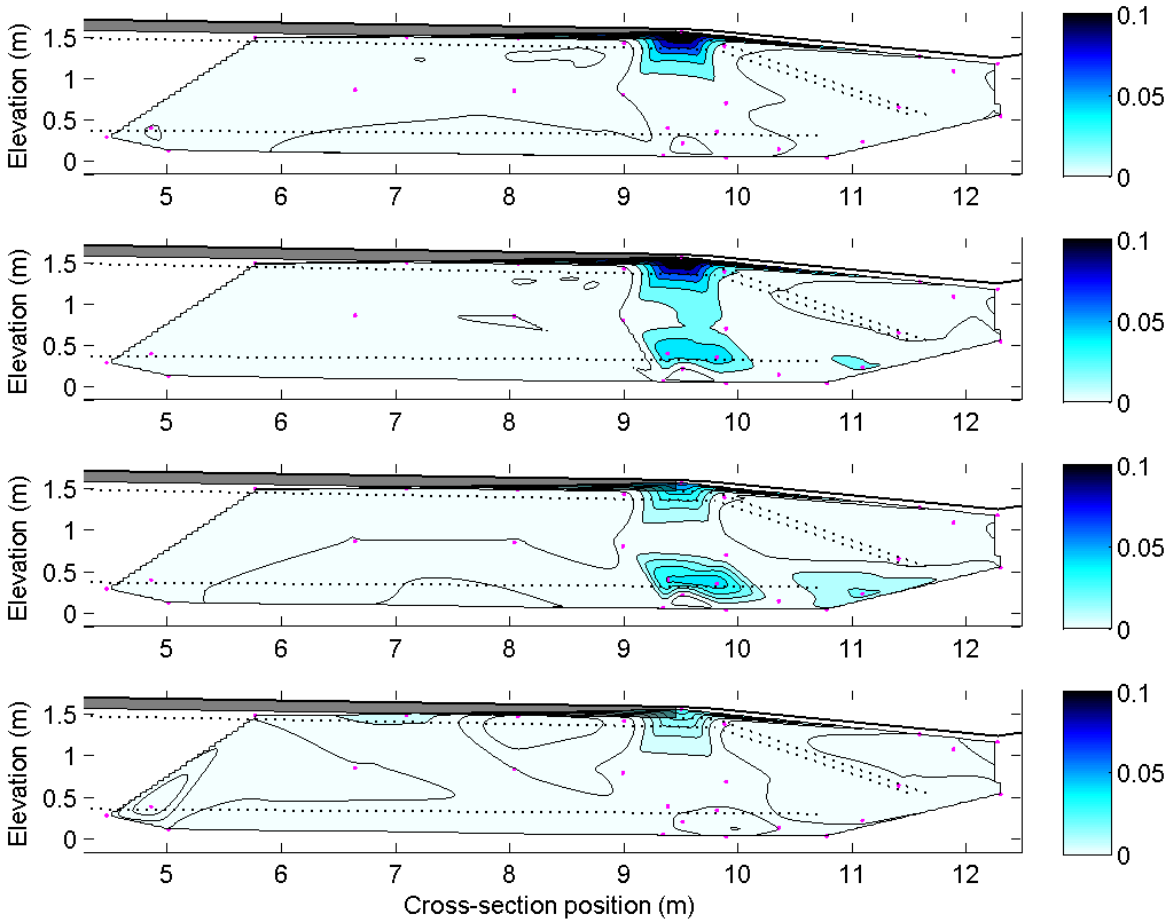
Infiltration and water flow pattern

Infiltration and water flow pattern

- Top: rain
- Bottom: volumetric water content (m^3m^{-3}) in the highway



Infiltration and water flow pattern



The increase in volumetric water content (m^3m^{-3}) 2, 4, 24, and 48 hours after the onset of rain. First rainfall from previous example.

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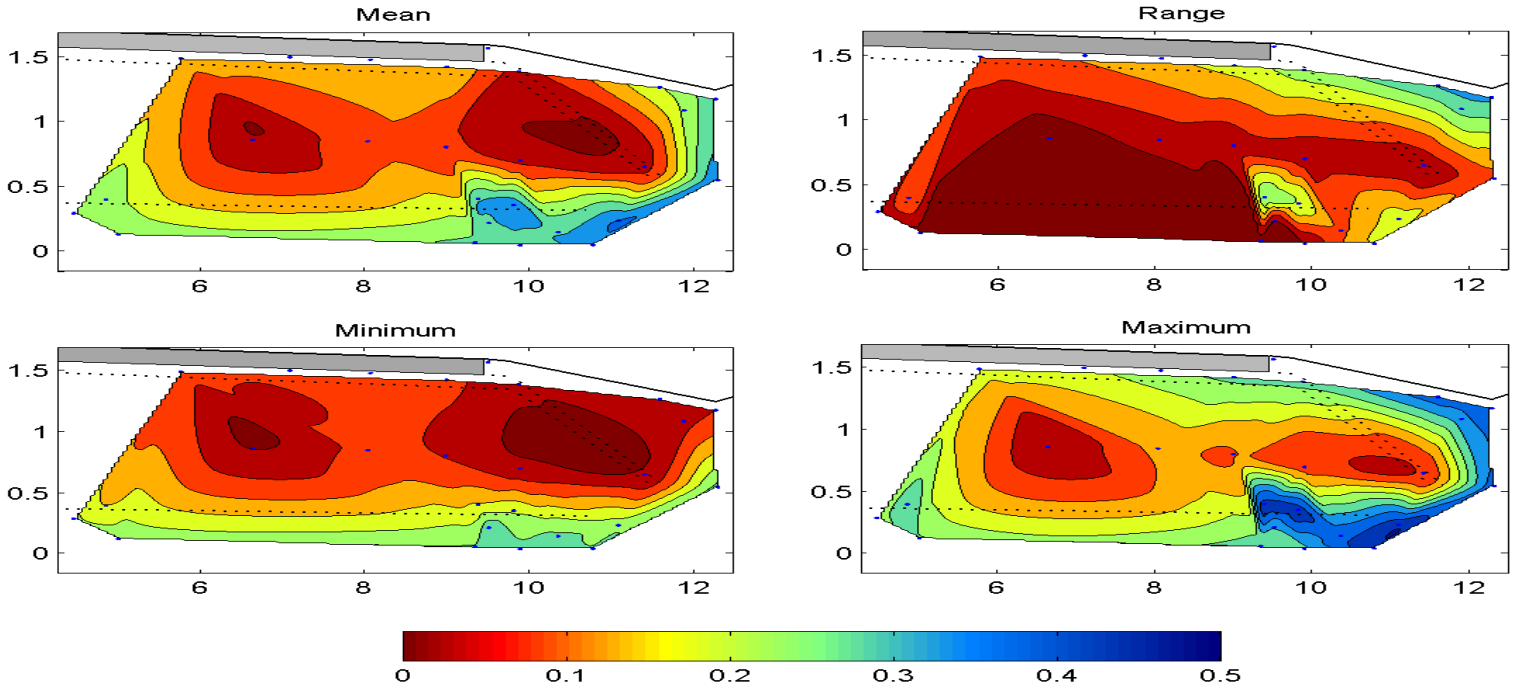
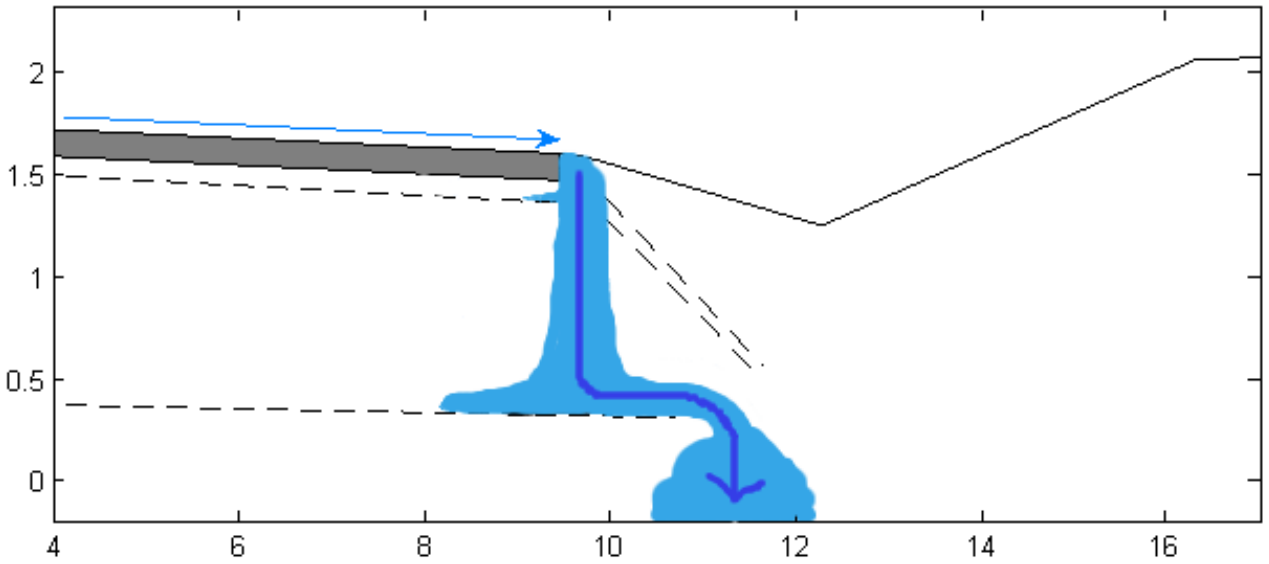
Infiltration and water flow pattern



Mean, range of, minimum and maximum volumetric water contents (m^3m^{-3}) during 2007. Positions are given in meters.

Infiltration and water flow pattern

- Dominant water flow path:



Conclusions

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- Infiltration occurs mostly in the verge, with some diversion sideways (expects an increase in diversion with time)
- Quick transport through the highway (<1 week)
- Geotextile + fines diverts water
- New guidelines may be necessary for geotextiles

Conclusions

- Water dynamics are strongest in the inner slope and in the ditch
- Recycled materials prone to leaching should not be placed under the verge
- Small variations in water content in the road (exception freeze/thaw)

Future studies

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Future studies

Another test site with:

- Groundwater level measurements
- Moisture measurements
- Interaction with drainage system

→ Maintenance guidelines

End

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