Seasonal variations in infiltration in cold climate raingardens

a case study from Norway

By Sondre Balstad, Tone Muthanna, Jardar Lohne and Edvard Sivertsen

NTNU
Norwegian University of Science and Technology

KLIMA 2050

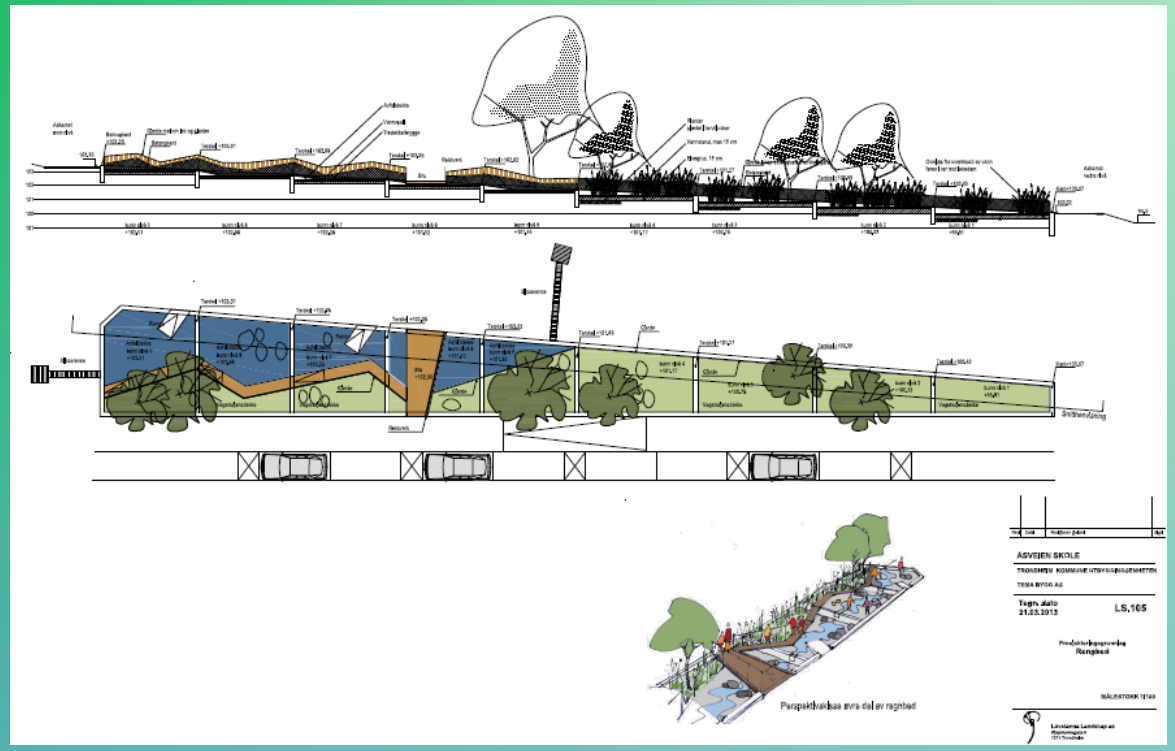
14th IWA/IAHR International Conference on Urban Drainage, 10-15 Sep 2017, Praque

The objectives of the research

- Investigate how winter conditions influence the infiltration capacity in a raingarden
- Investigate necessary modifications to the MPD-method for Ksat-measurments on frozen soils
- Investigate the design implications of seasonal variations in infiltration capacity


Trondheim
Sverige
Sweden
Norge
Suomi
Finland
Gulf of Bothnia
Baltic Sea
Eesti
Estonia
Latvija
Latvia
Lietuva
Lithuania
North Sea
Danmark
Denmark
United
Kingdom
Москва
Moscow
Беларусь
Belarus
Polska
Poland
Nederland
Netherlands
Berlin
London
Deutschland
Germany
Prague
België
Belgique
Belgium
Česko
Czechia
Slovensko
Slovakia
Україна
Ukraine
Paris
Wien
Österreich
Austria
Moldova
Magyarország
Hungary
France
România
Romania
Hrvatska
Croatia
Bay of Biscay

The Raingarden



Properties	
Established	2015
Area raingarden [m^2]	147
Areal catchment [m^2]	6938
Raingarden/reduced catchment	2.8 %
Clay	1.5 %
Silt	12 %
Sand	86 %

Method

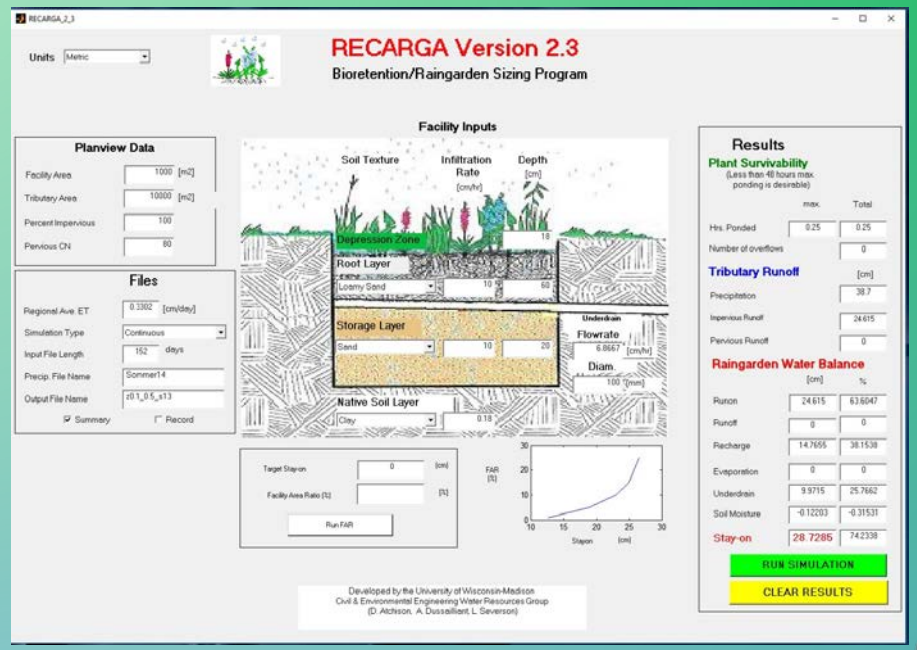
- Modified Phillip-Dunne (MPD)
- Saturated hydraulic conductivity (Ksat [cm/time])
- Measured change in water level => Ksat

Method/Results

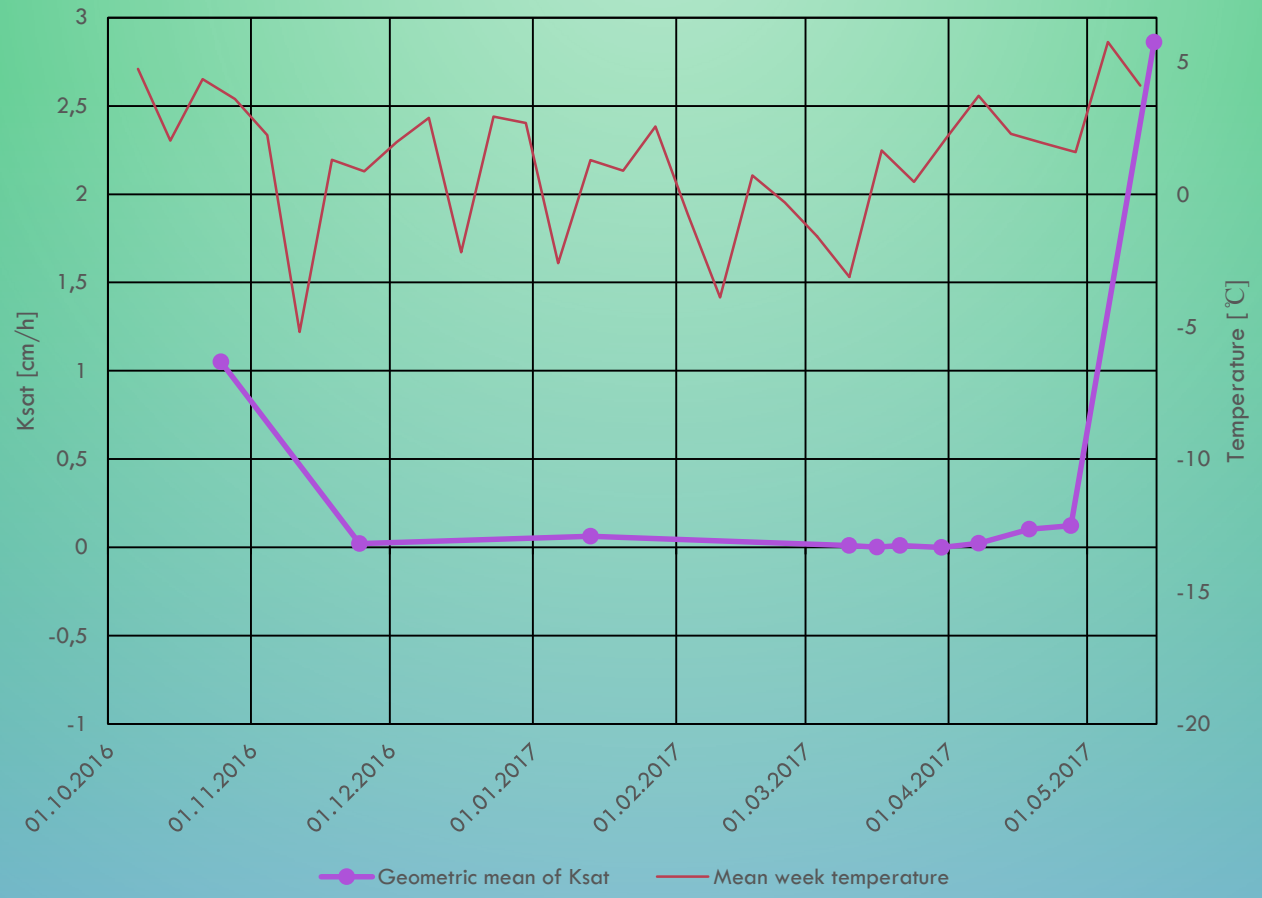
- Problems with winter measurements
- Modified the MPD method
- Balstad Modified Phillip-Dunne (BMPD)

Method

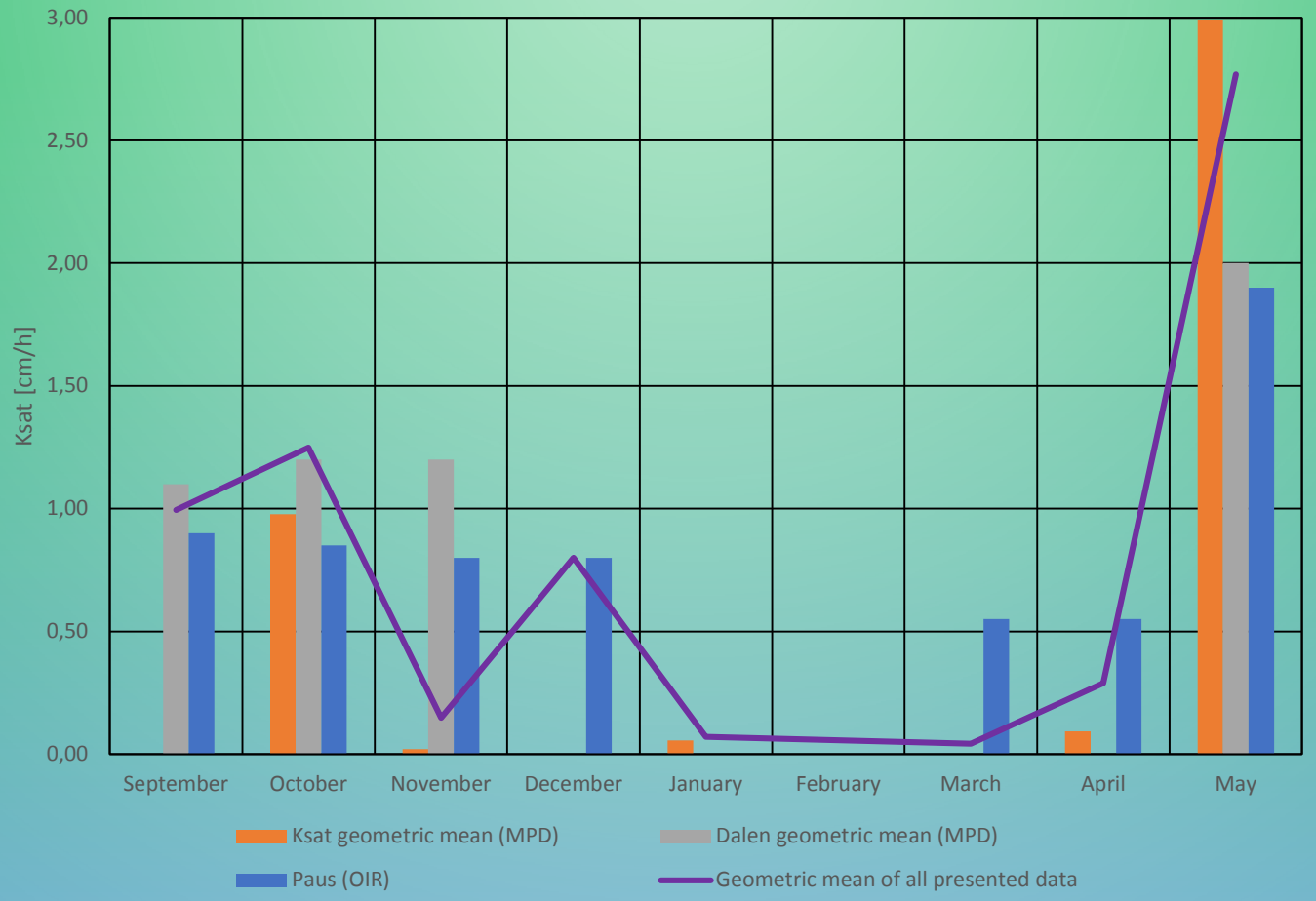
- Simulated a typical raingarden in Norway
- Recarga model
- Investigate the design implications of Ksat



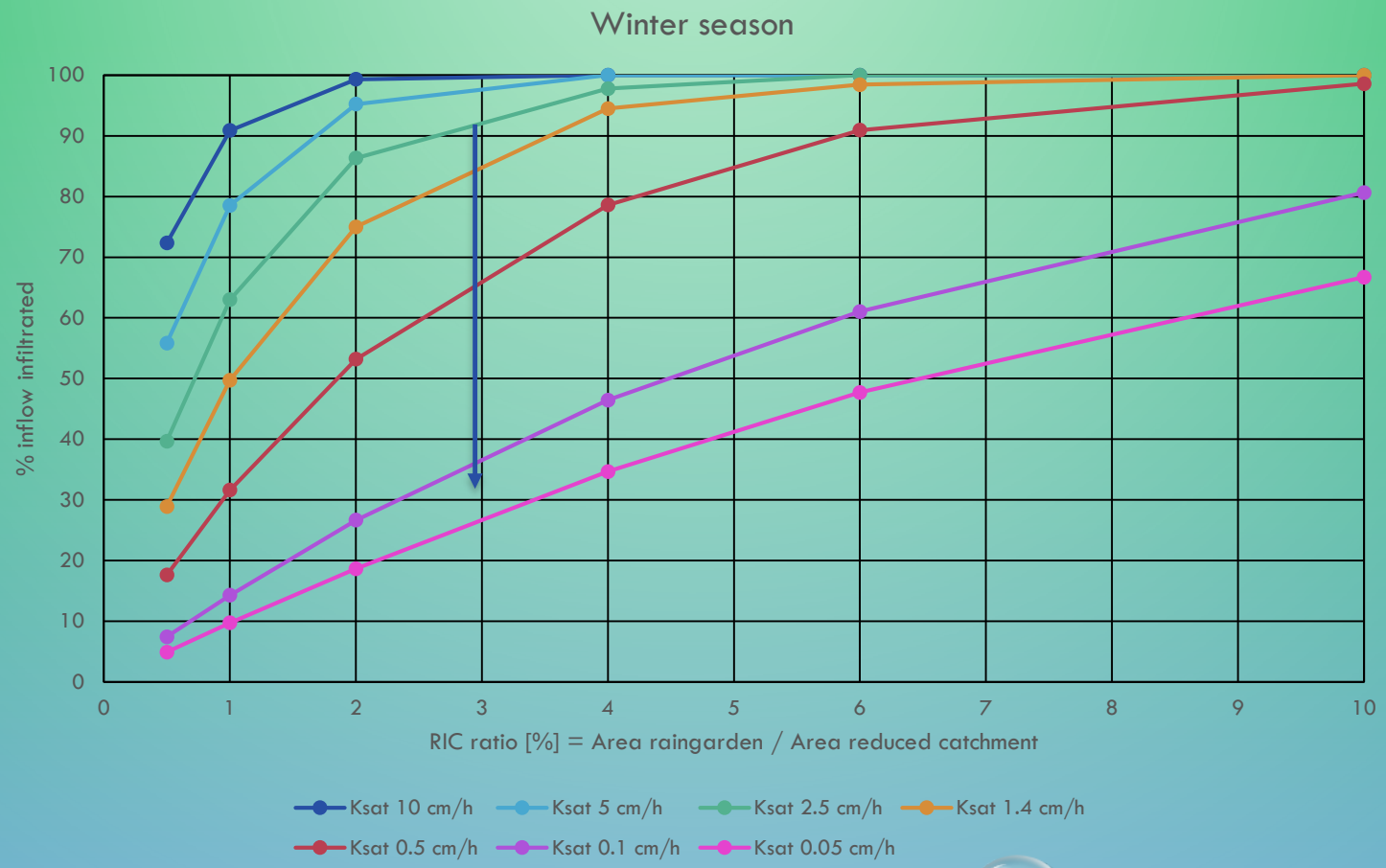
Results


3
2,5
2
1,5
1
0,5
0
-0,5
-1
Ksat [cm/h]
5
0
-5
-10
-15
-20
Temperature [°C]
01.10.2016
01.11.2016
01.12.2016
01.01.2017
01.02.2017
01.03.2017
01.04.2017
01.05.2017
Geometric mean of Ksat
Mean week temperature

Results


3,00
2,50
2,00
1,50
1,00
0,50
0,00
Ksat [cm/h]
September
October
November
December
January
February
March
April
May
Ksat geometric mean (MPD)
Dalen geometric mean (MPD)
Paus (OIR)
Geometric mean of all presented data

Results


Winter season
% inflow infiltrated
100
90
80
70
60
50
40
30
20
10
0
0
1
2
3
4
5
6
7
8
9
10
RIC ratio [%] = Area raingarden / Area reduced catchment
Ksat 10 cm/h
Ksat 5 cm/h
Ksat 2.5 cm/h
Ksat 1.4 cm/h
Ksat 0.5 cm/h
Ksat 0.1 cm/h
Ksat 0.05 cm/h

Conclusion

- BMPD works on winter conditions
- Large variation in infiltration rate through the winter
- Low Ksat can be due to hard packed soil, but not the variation in Ksat
- Infiltrates 25% of rainfall in winter season with Ksat = 0.05 cm/h (RIC ratio = 2.8 %)

KLIMA 2050

NTNU
Norwegian University of Science and Technology

IN COOPERATION WITH