**M+P – consulting engineers**
Müller-BBM group
*Acoustics*
*Noise and vibration control*
*Air quality*

# Effect of (optimised) noise barriers on air quality

## Test Site IPL A28

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MBBM
MÜLLER-BBM GROUP

# Goal and research questions

Questions

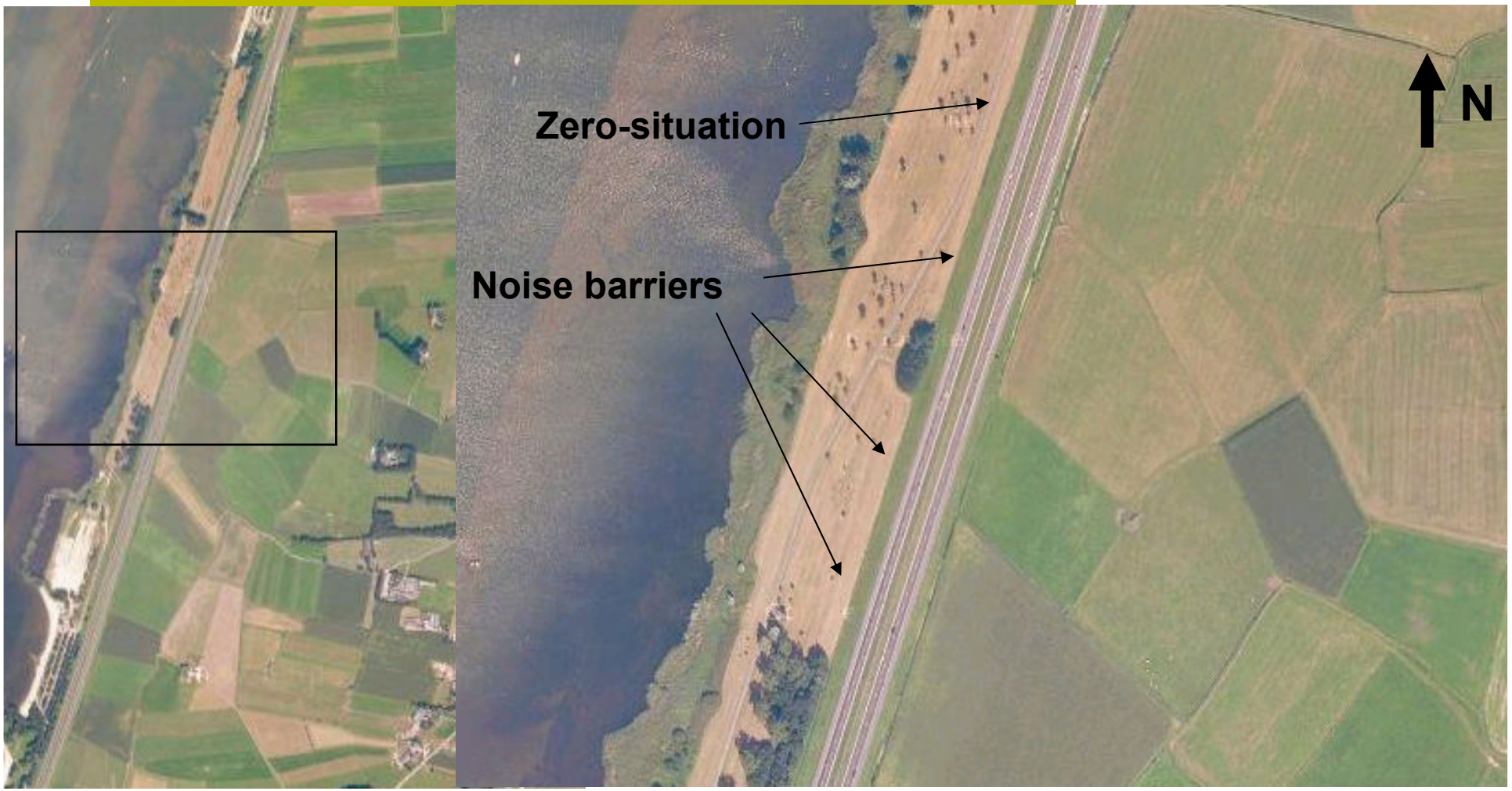
- do (noise) barriers have a significant impact on the dilution of airborne pollutants?
- can barriers be optimised for this purpose ?

Approach

- competition to induce market players to come with ideas
- investigation of ideas at the IPL Test Site

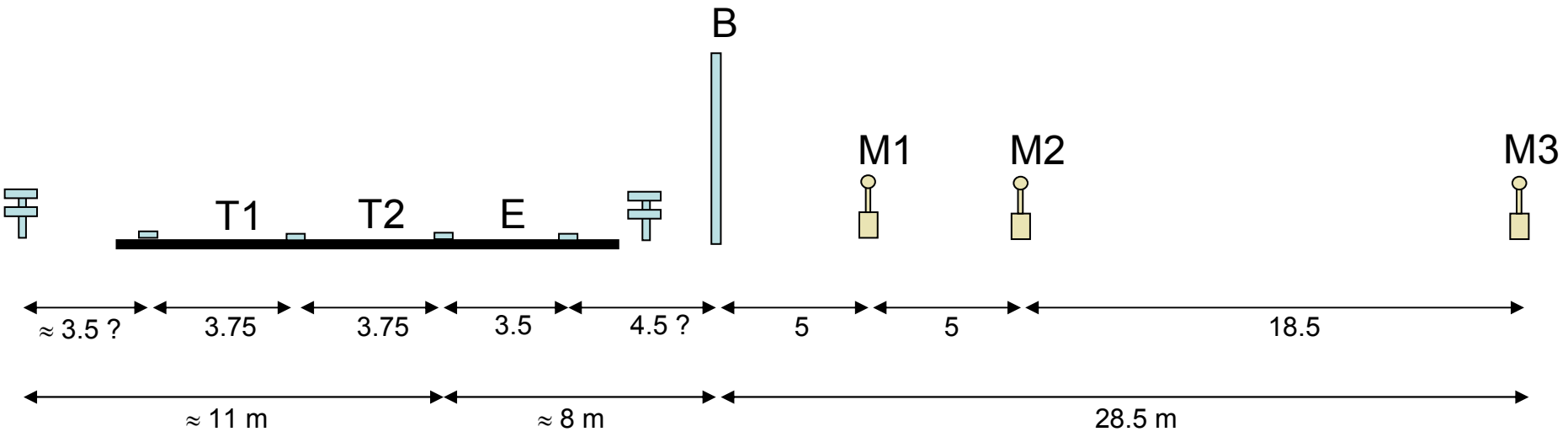
Putten
Amsterdam
Rotterdam
Den Haag
Utrecht
Amersfoort
Arnhem
Nijmegen
Eindhoven
Tilburg
's-Hertogenbosch
Breda
Antwerpen
Gent
Brussel
Bruxelles
Leeuwarden
Groningen
Assen
Zwolle
Lelystad
Almere
Enschede
Deventer
Apeldoorn
Hilversum
Haarlem
Leiden
Delft
Dordrecht
Roosendaal
Bergen op Zoom
Terneuzen
Venlo
Roermond
Maastricht
Aachen
Düsseldorf
Duisburg
Essen
Krefeld
Mönchengladbach
Köln
Bonn
Leverkusen
Wesel
Emmen
Hengelo
Almelo
Hardenberg
Meppel
Coevorden
Oss
Uden
Veghel
Helmond
Geldrop
Heerlen
Sittard
Venray
Bocholt
Borken
Dorsten
Gelsenkirchen
Mülheim an der Ruhr
Viersen
Solingen
Wuppertal
Langenfeld (Rheinland)
Grevenbroich
Erkelenz
Heinsberg
Geleen
Kerkrade
Düren
Eschweiler
Erftstadt
Troisdorf
Bornheim
Bergisch Gladbach
Leverkusen
Haltern am See
Recklinghausen
Herne
Witten
Hamm
Dülmen
Coesfeld
Ahaus
Gronau (Westfalen)
Lingen
Rheine
Ochtrup
Oldenzaal
Losser
Enschede
Hengelo
Almelo
Rijssen
Raalte
Hellendoorn
Nordhorn
Twenterand
Dalfsen
Steenwijk
Hoogeveen
Noordoostpolder
Emmen
Haren (Ems)
Stadskanaal
Borger
Midden-Drenthe
Oosterstellingwerf
Heerenveen
Sneek
Wons
Boarnsterhim
Smallingerland
Franeker
Harlingen
Terschelling
Vlieland
Texel
Den Helder
Waddenzee
IJsselmeer
Schagen
Medemblik
Enkhuizen
Hoorn
Alkmaar
Castricum
Purmerend
Velsen
Zaandam
Haarlemmermeer
Amstelveen
Katwijk
Wassenaar
Leidschendam
Zoetermeer
Westland
Schiedam
Vlaardingen
Spijkenisse
Hellevoetsluis
Barendrecht
Ridderkerk
Westvoorne
Goeree-Overflakkee
Middelburg
Vlissingen
Veere
Goes
Borsele
Kapelle
Reimerswaal
Schouwen-Duiveland
Halderberge
Etten-Leur
Zundert
Moerdijk
Woerden
Zeist
Nieuwegein
Veenendaal
Gouda
Barendrecht
Overbetuwe
Tiel
Heusden
Kleve
Goch
Uden
Veghel
Deurne
Bakel
Veldhoven
Eindhoven
Turnhout
Mol
Geel
Beringen
Lier
Sint-Niklaas
Beveren
Zeebrugge
Damme
Sluis
Hulst
Aalst
Asse
Dendermonde
Mechelen
Vilvoorde
Heist-op-den-Berg
Deinze
Waregem
Kortrijk
Ninove
Dilbeek
Uccle
Ukkel
Geraardsbergen
Tienen
Sint-Truiden
Hasselt
Genk
Bilzen
Tongeren
Visé
Stolberg
Weert
Leudal
Maasgouw
Heinsberg
Beringen
Meerssen
Maastricht
Eijsden
Margraten
Vaals
Simpelveld
Landgraaf
Heerlen
Kerkrade
Bergheim
Kerpen
Hürth
Brühl
Wesseling
Bonn
Troisdorf
Siegburg
Overath
Bergisch Gladbach
Gummersbach
Wipperfürth
Radevormwald
Hückeswagen
Remscheid
Solingen
Wuppertal
Velbert
Ratingen
Mettmann
Hilden
Langenfeld
Monheim am Rhein
Leverkusen
Dormagen
Neuss
Grevenbroich
Jüchen
Erkelenz
Hückelhoven
Wassenberg
Heinsberg
Selfkant
Gangelt
Waldfeucht
Übach-Palenberg
Herzogenrath
Kerkrade
Simpelveld
Vaals
Aachen
Stolberg
Eschweiler
Düren
Erftstadt
Troisdorf
Bornheim
Bonn
Sankt Augustin
Hennef
Eitorf
Windeck
Waldbröl
Gummersbach
Bergneustadt
Wiehl
Reichshof
Nümbrecht
Lindlar
Overath
Rösrath
Bergisch Gladbach
Leverkusen
Köln
Brühl
Wesseling

# Test Site Location

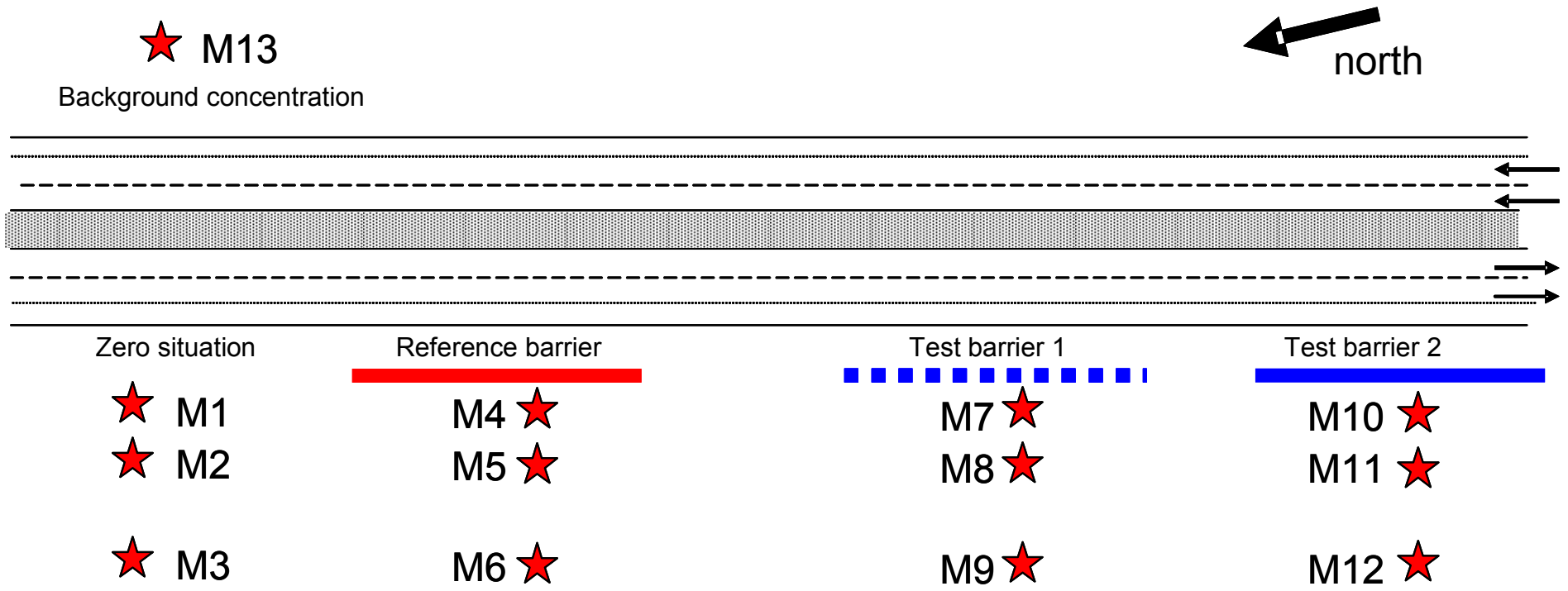


# Artist impression of the Test Site

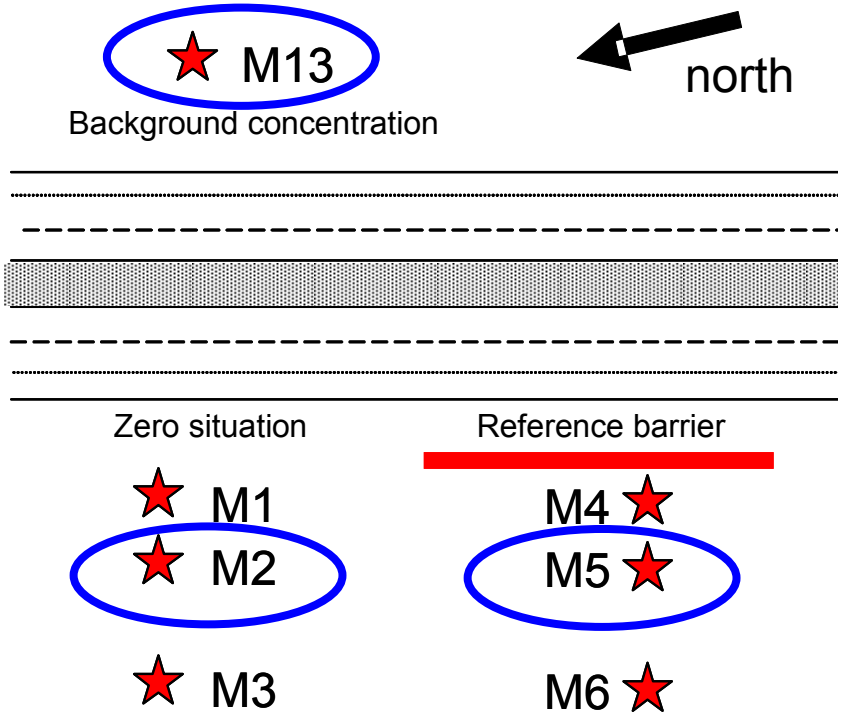
# Cross-section of the road profile



# Schematic view of measurement positions



# Experimental approach




barrier effect = (M5-M13) / (M2-M13)

With eastern wind:

background concentration = M13
road contribution = M2 – M13

# What was measured?

NOx
- continuous with NOx-monitor
- Ozon at 3 positions

$PM_{10}$
- 24-hours with reference method (LVS)
- continuous with Osiris
- continuous with TEOM

Meteorological data

Traffic (partly)

airpointer
www.mp.nl

# NOx and Ozon with Airpointer

# Measurement systems
# PM - LVS

- 24-hours with reference method (LVS)

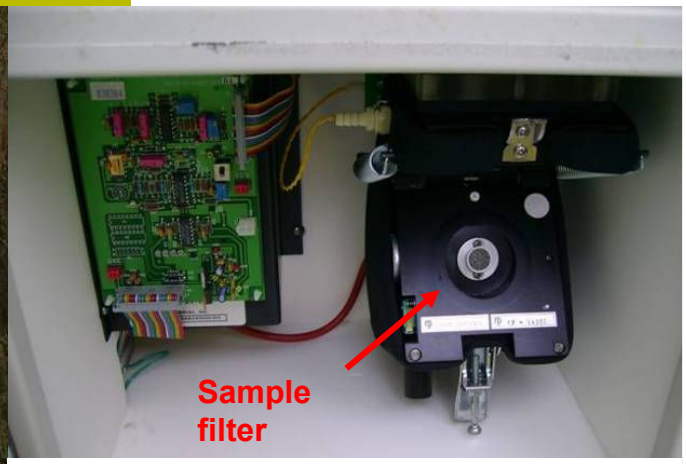
# Measurement systems
# PM - Osiris

Osiris

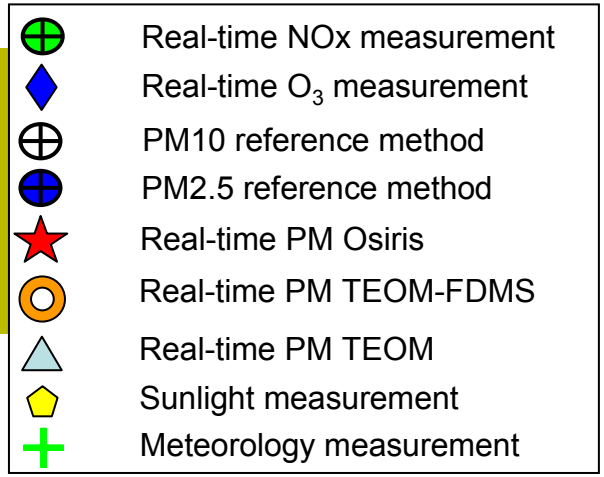
- continuous
- based on light scattering

- in results too much uncertainty

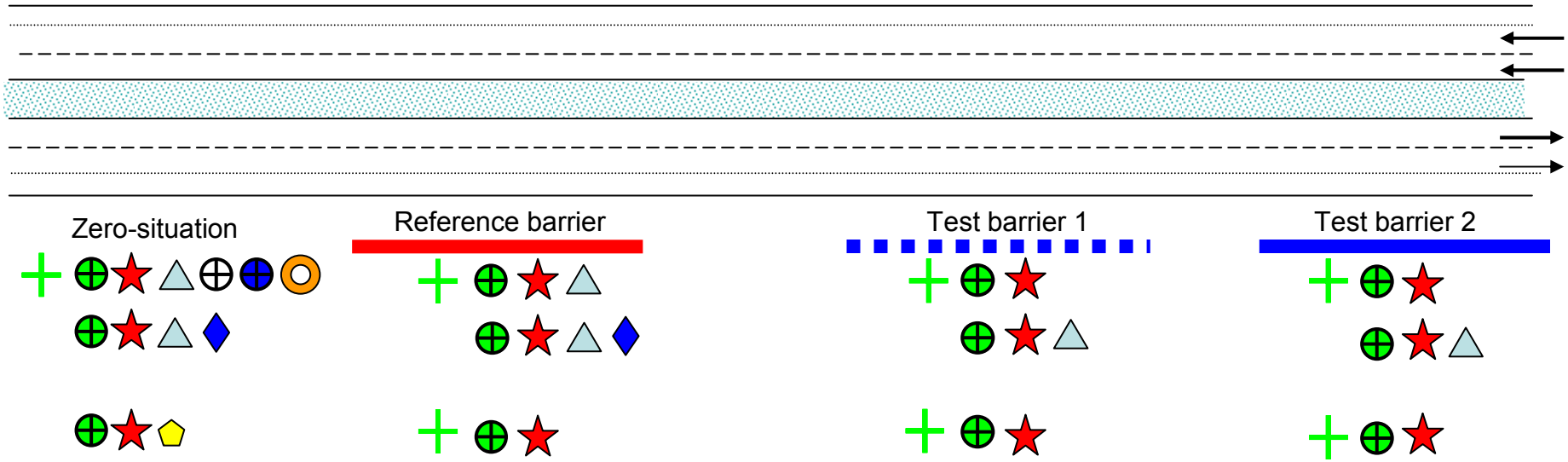
# PM with TEOM



# Instrument configuration




Background concentration



# Instrument comparison

# Which barriers and when?

| Session / period | barrier 1 | barrier 2 | barrier 3 |
|---|---|---|---|
| 1: July - October 2007 | 7-meter-high standard barrier | fibreboard concrete with $TiO_2$ coating (Durisol) | 4-meter-high reference barrier |
| 2: December 2007 – March 2008 | T-top barrier | vegetated barrier (Mostert de Winter) | |
| 3: April – August 2008 | Cleanscreen (Redubel) | Active Green noise barrier (Aacoustics) | |
| 4: August – November 2008 | Cleanstone (Tauw/Holland) | Greenbreath (MOWI/Bos variant) | |
| 5: December 2008 - March 2009 | 7-meter-high standard barrier | no barrier | |

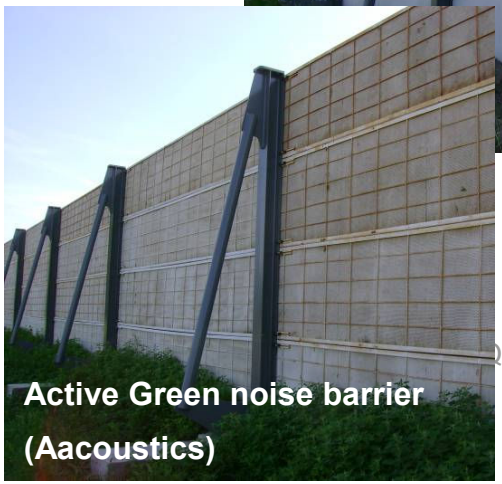
4-meter
reference barrier

7-meter
standard barrier

vegetated barrier
(Mostert de Winter)

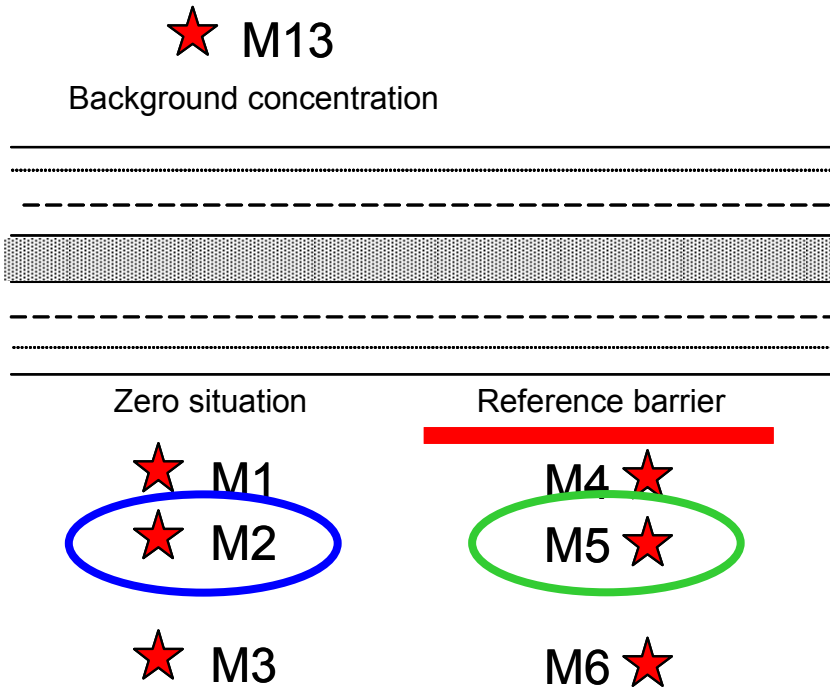
barrier with T-top

Cleanscreen
(Redubel)

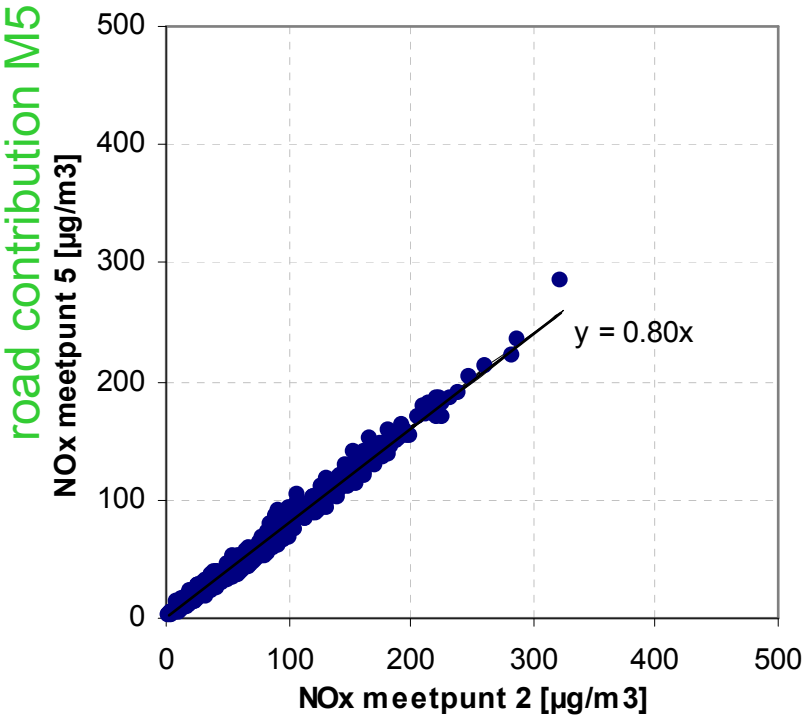



fibreboard concrete with $TiO_2$
coating (Durisol)

# NOx
# 10 m behind reference barrier

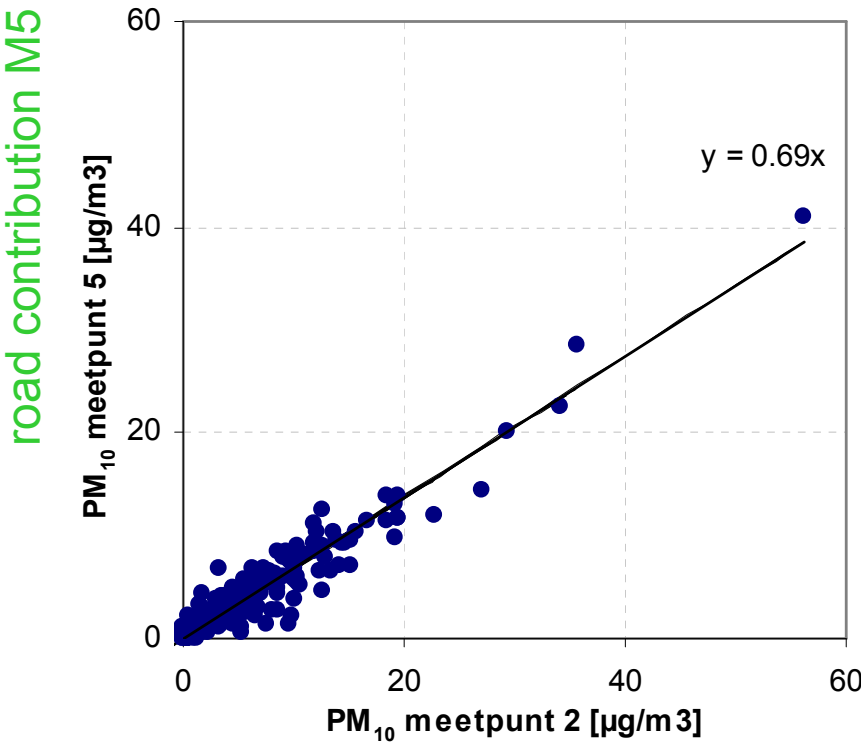



contribution of the road 10 m

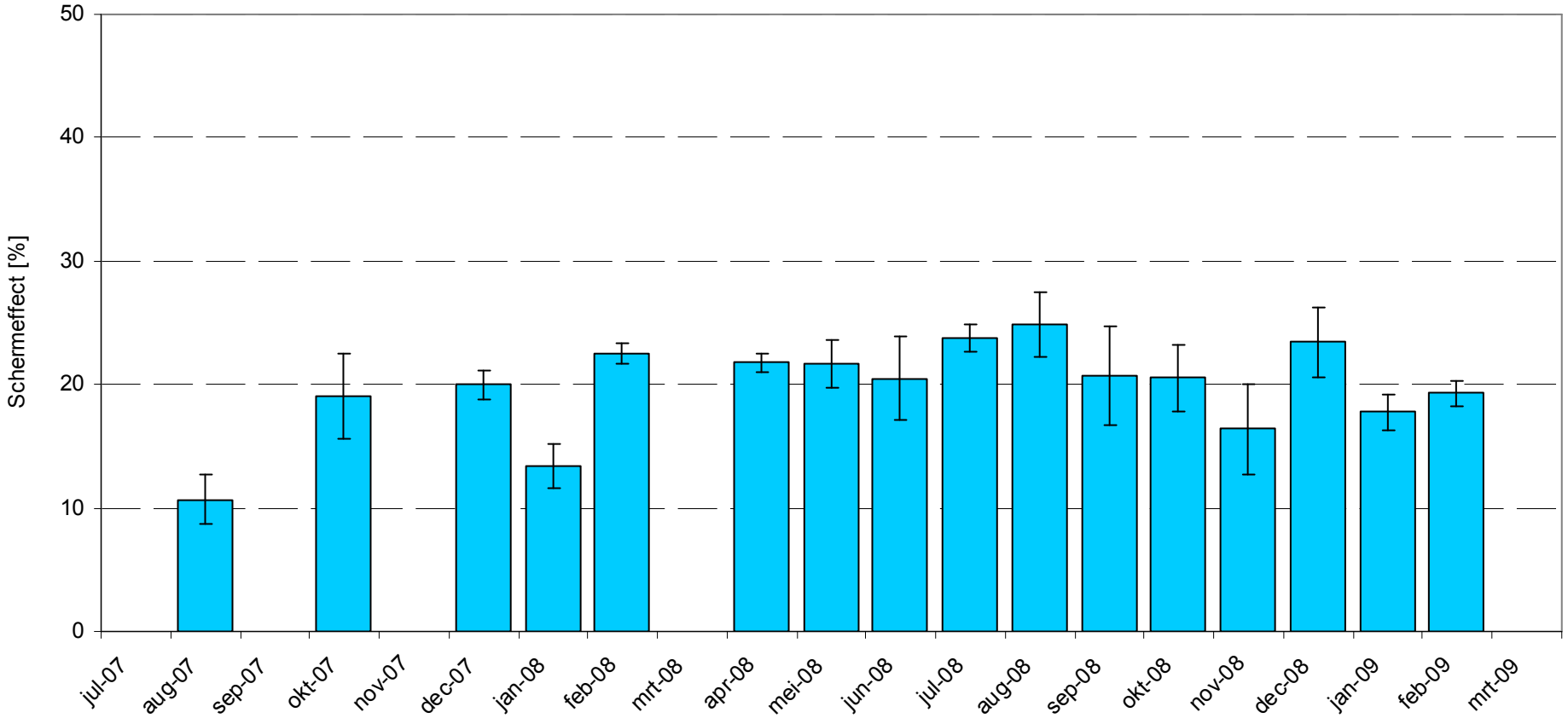


# $PM_{10}$
# 10 m behind reference barrier

contribution of the road 10 m

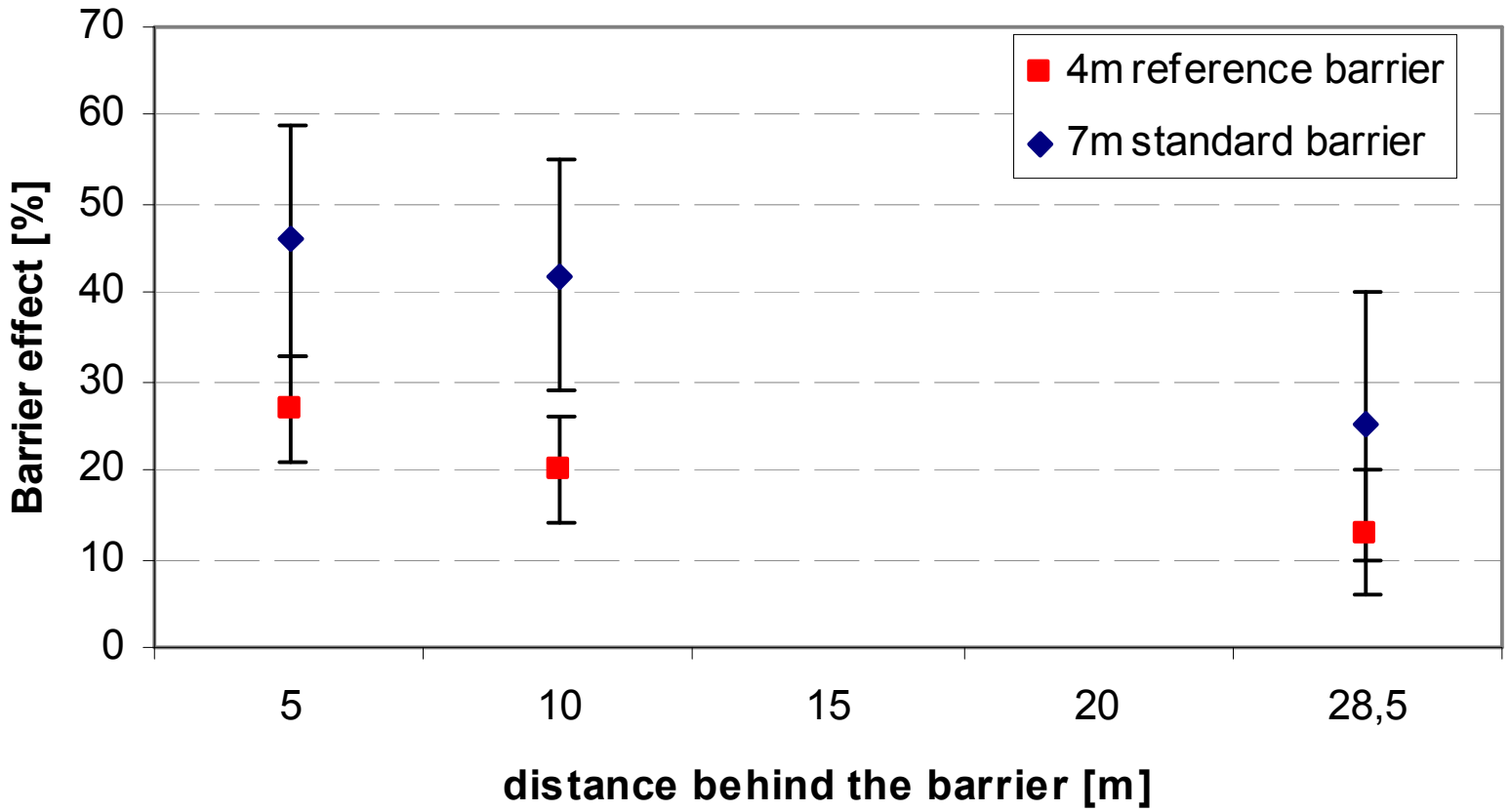


# Barrier effect for NOx, by month

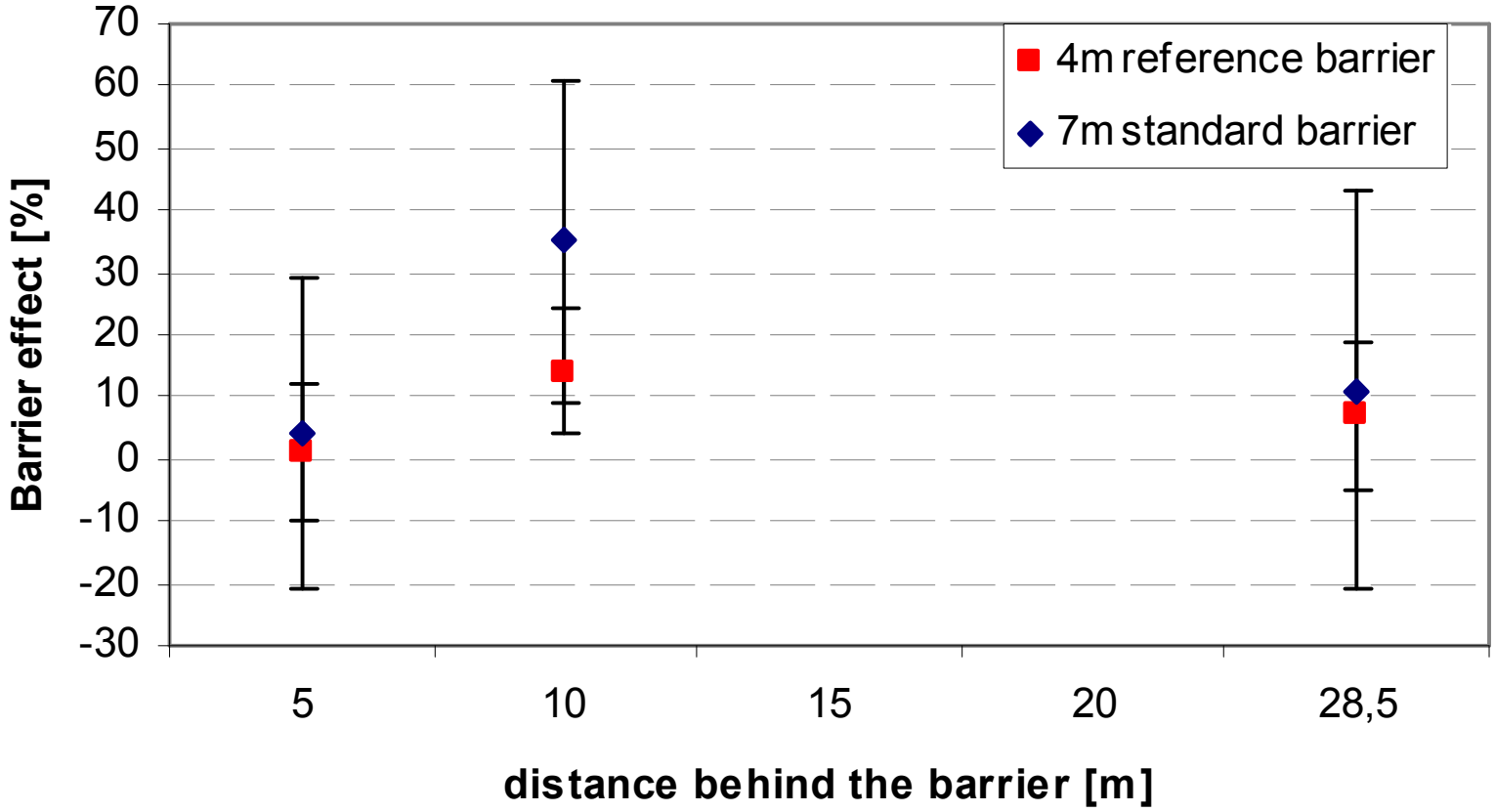


# 4m reference barrier
# 7m standard barrier

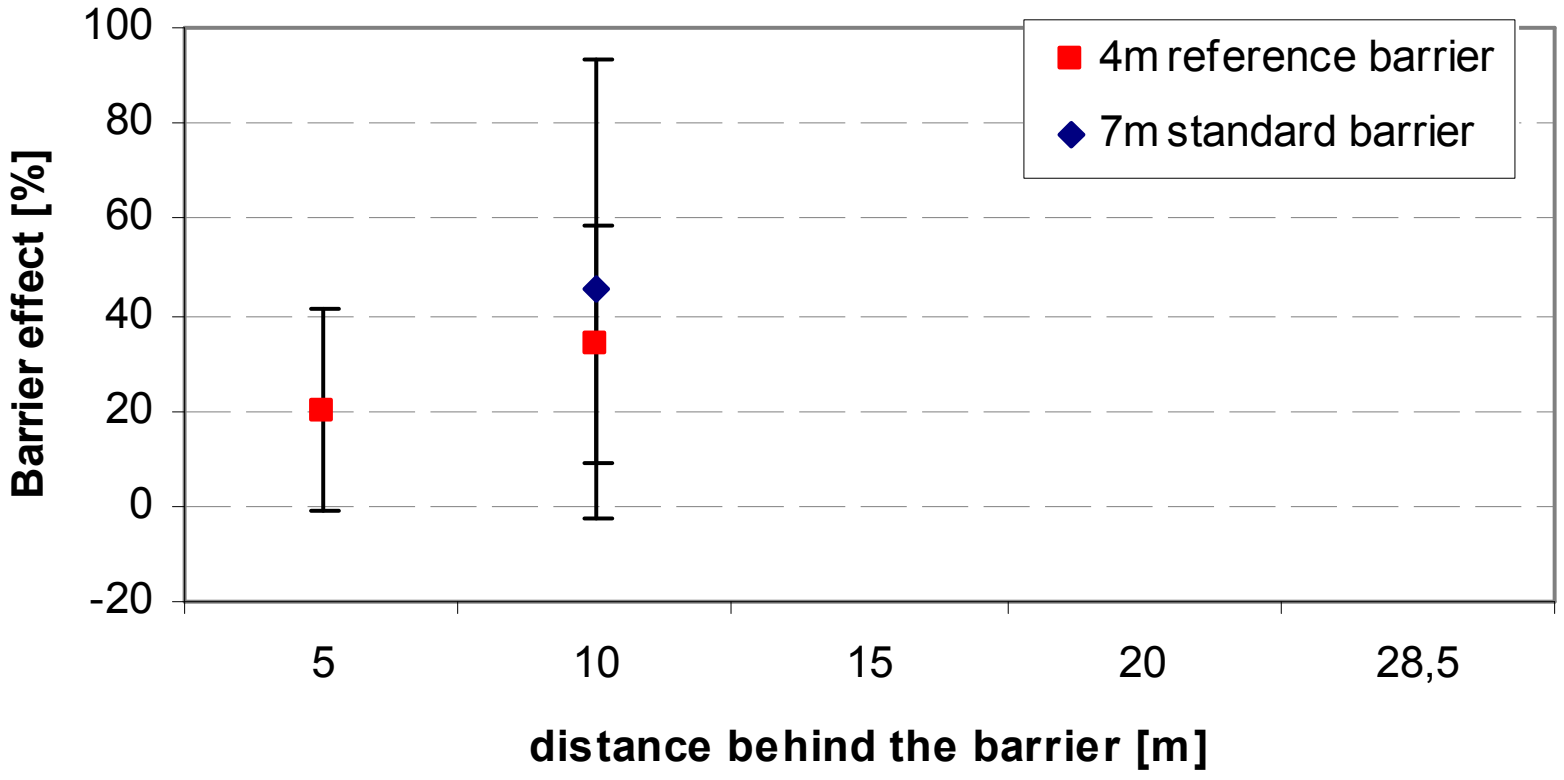
# NOx


70
60
50
40
30
20
10
0
Barrier effect [%]
4m reference barrier
7m standard barrier
5
10
15
20
28,5
distance behind the barrier [m]

# $NO_2$


70
60
50
40
30
20
10
0
-10
-20
-30
Barrier effect [%]
4m reference barrier
7m standard barrier
5
10
15
20
28,5
distance behind the barrier [m]

# $PM_{10}$ with TEOM



# Total uncertainty

| | $PM_{10}$ TEOM | NOx | $NO_2$ |
|---|---|---|---|
| Instrument | 25% | 4% | 9% |
| Measurement line | 4% | 4% | 4% |
| Random errors | 4% | 1% | 2% |
| **Total** | **26%** | **6%** | **10%** |

## Average effect reference barrier

Sessions 1 t/m 5

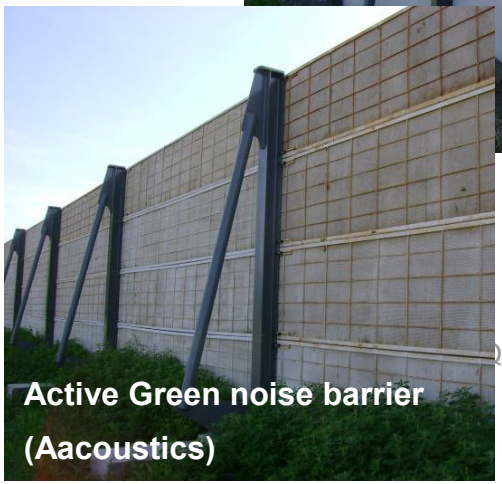
- 10 m behind barrier
- period Juli 2007 – March 2009
- valid for …

| | Average effect [%] |
|---|---|
| **NOx** | **20 (6)** |
| **$NO_2$** | **14 (10)** |
| ***$PM_{10}$*** | ***34 (25)*** |

vegetated barrier
(Mostert de Winter)

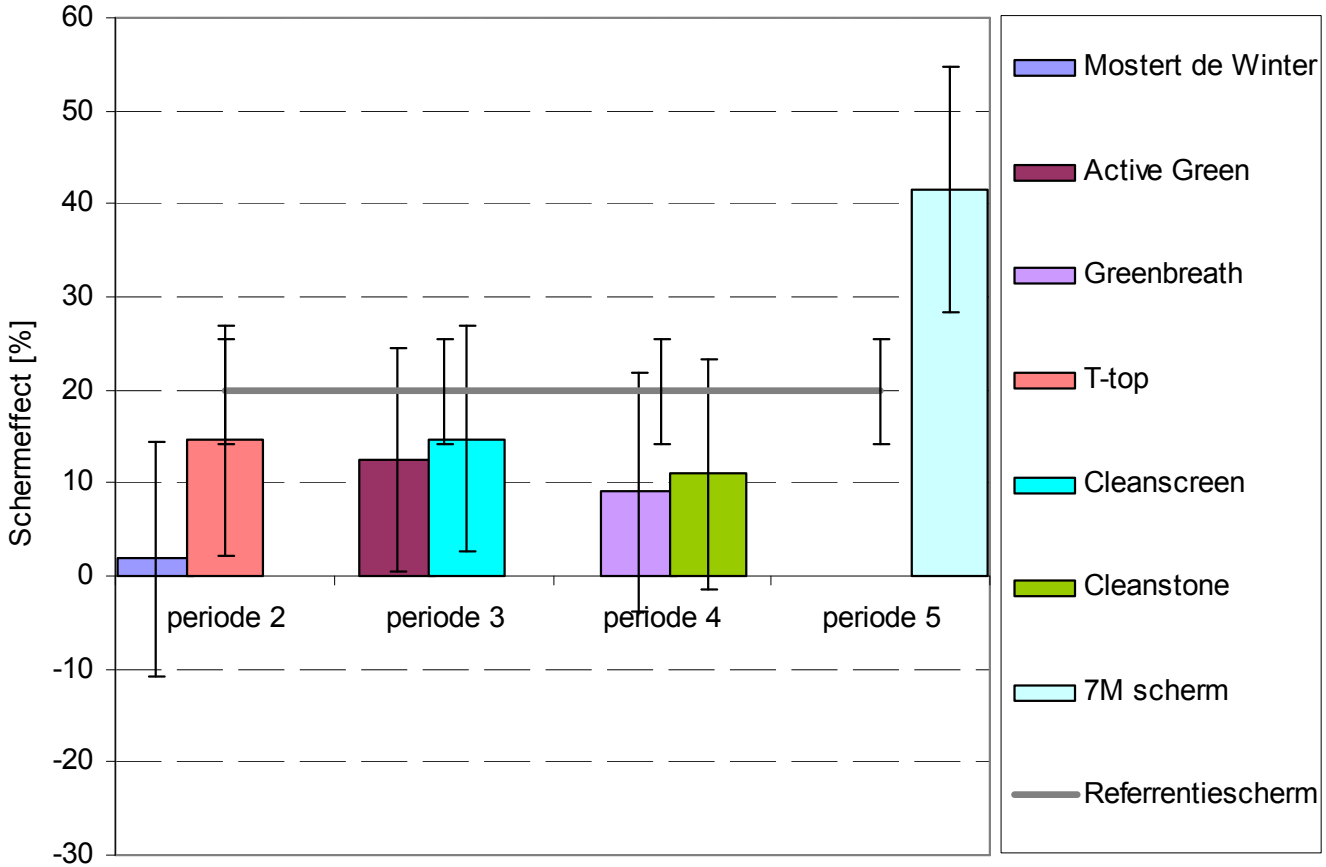
barrier with T-top

Cleanscreen
(Redubel)

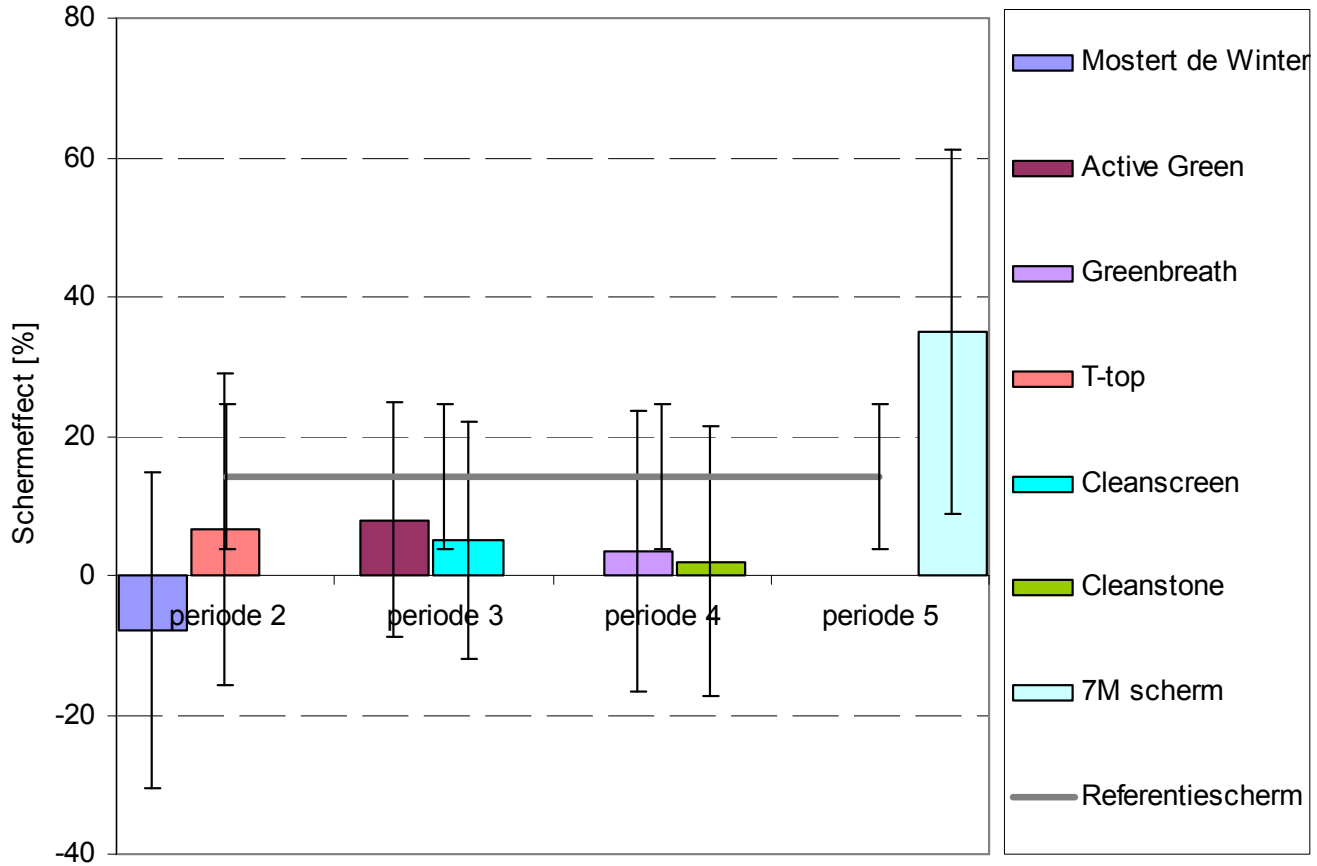



fibreboard concrete with $TiO_2$
coating (Durisol)

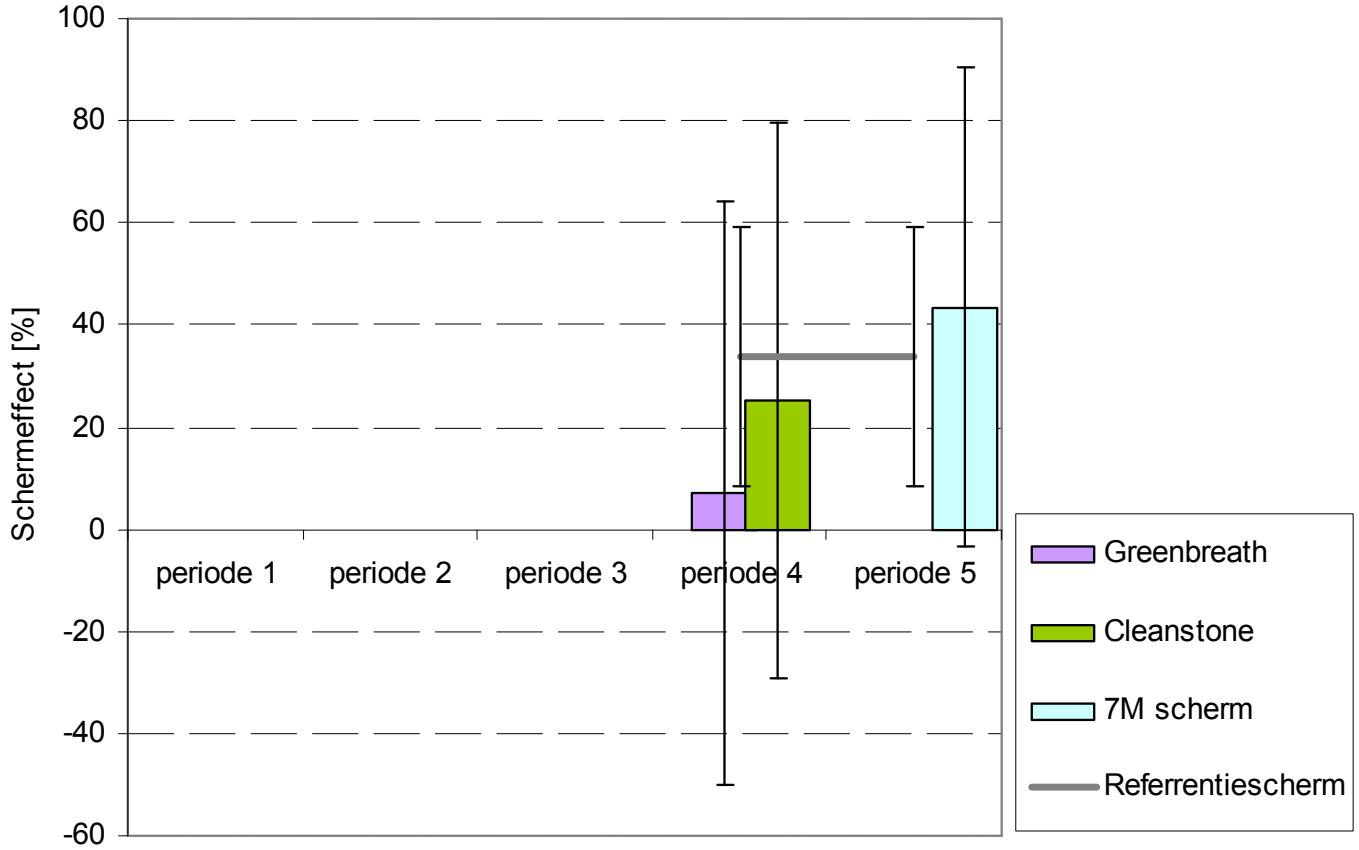
# Optimised barriers
# NOx



# Optimised barriers
# $NO_2$



# Optimised barriers
# $PM_{10}$



# Conclusions

Question 1

- do (noise) barriers have a significant impact on the dilution of airborne pollutants?

Answer

- both for NOx and $PM_{10}$ significant effects
- barrier height is a important factor for the barrier effect

# Conclusions

Question 2

- can barriers be optimised for this purpose?

Answer

- none of the innovative barriers scored significantly better than the ‘reference barrier’

**Thank you for your attention**