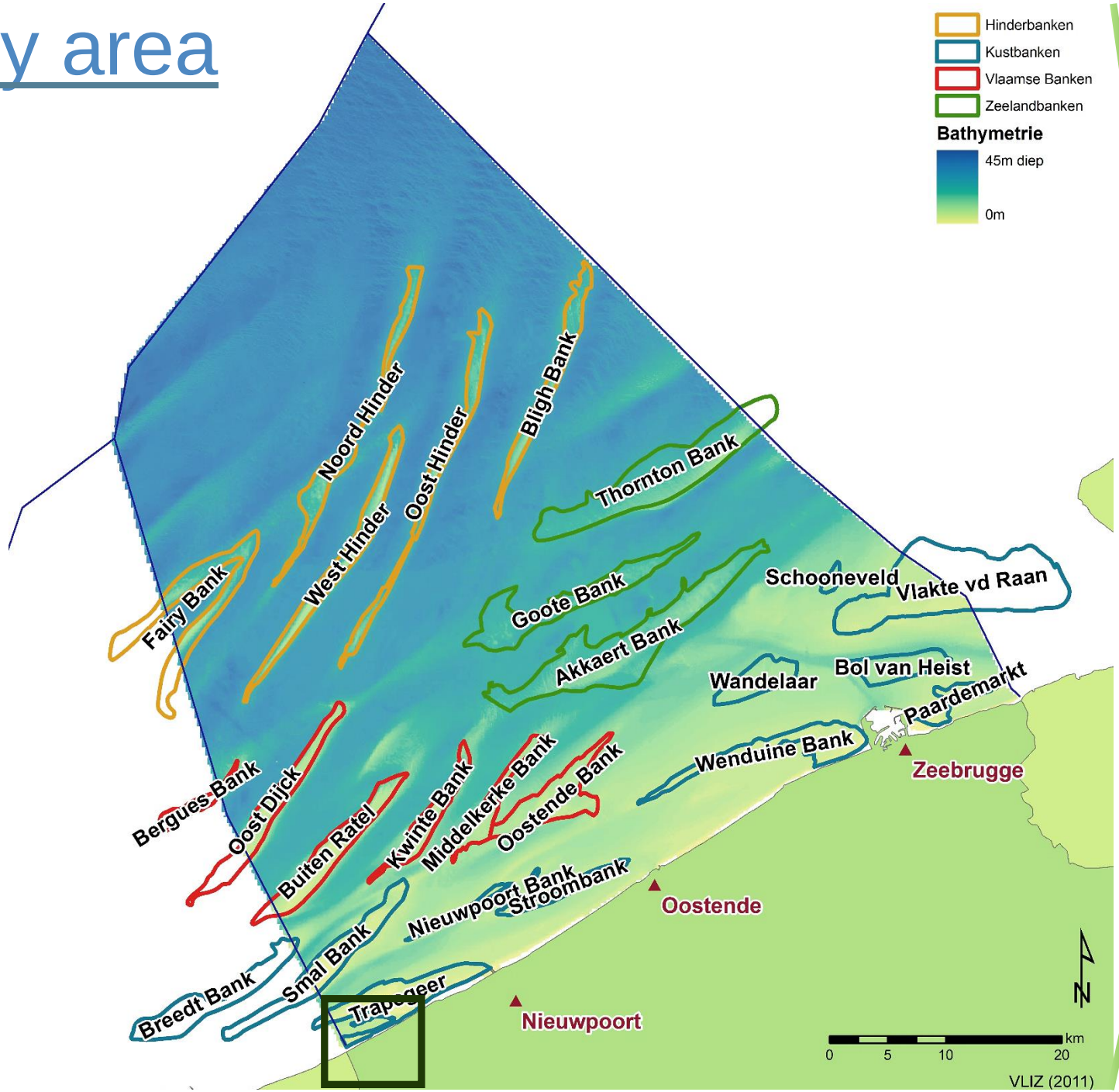
FACULTY OF SCIENCES
DEPARTMENT OF GEOLOGY
HYDROGEOLOGY AND APPLIED RESEARCH UNIT
FACULTY OF BIOSCIENCE ENGINEERING
*DEPARTMENT OF ENVIRONMENT
*RESEARCH GROUP SOIL SPATIAL INVENTORY GEOLOGY TECHNIQUES

Marieke Paepen, Daan Hanssens*, Philippe De Smedt*, Kristine Walraevens, & Thomas Hermans

Combining geophysical methods to investigate the salt/ freshwater interface at the vicinity of water extraction facilities

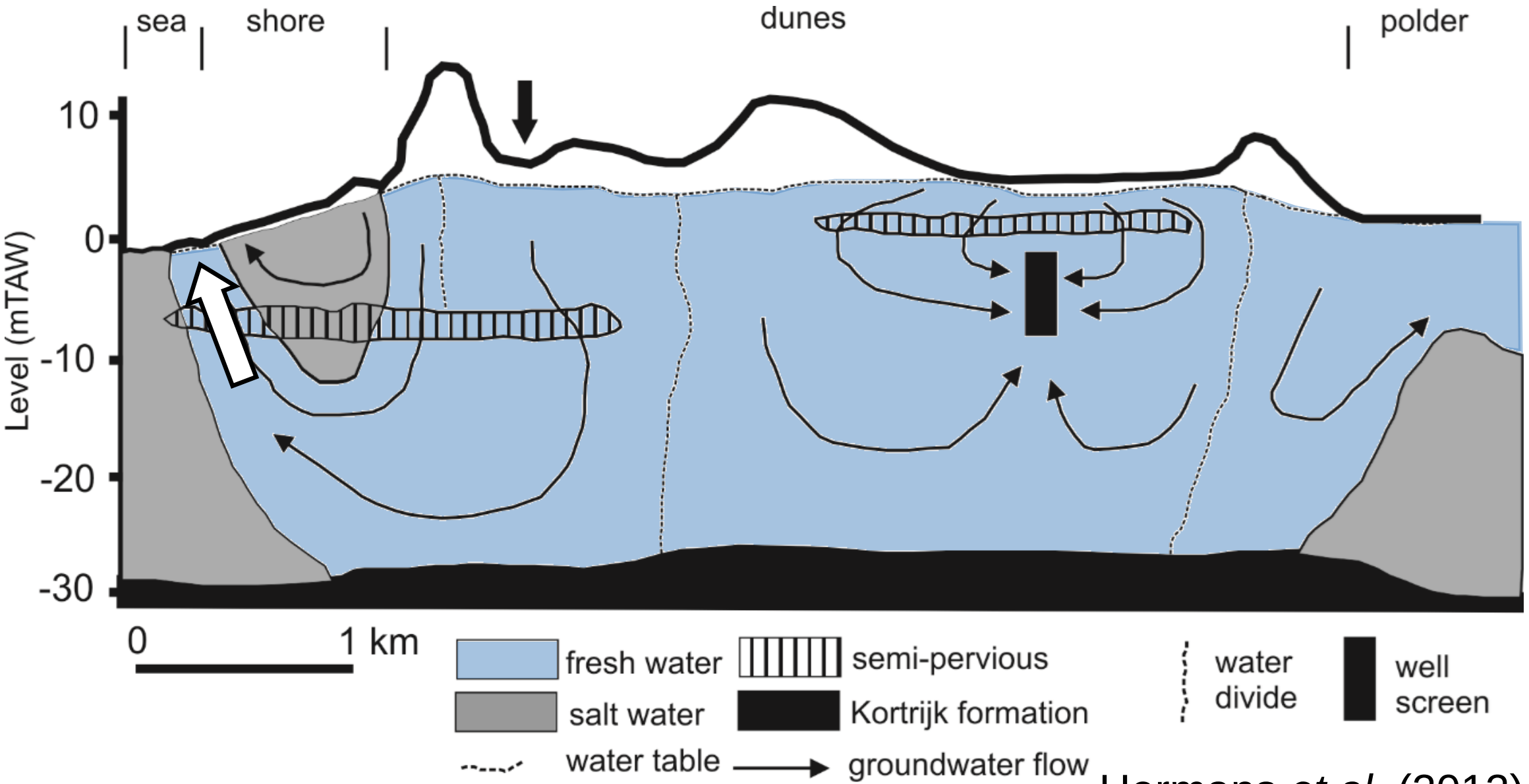
Study area


Hinderbanken
Kustbanken
Vlaamse Banken
Zeelandbanken
Bathymetrie
45m diep
0m
Noord Hinder
Oost Hinder
West Hinder
Bligh Bank
Fairy Bank
Thornton Bank
Goote Bank
Akkaert Bank
Schooneveld
Vlakte vd Raan
Wandelaar
Bol van Heist
Paardemarkt
Wenduine Bank
Zeebrugge
Bergues Bank
Oost Dijck
Buiten Ratel
Kwinte Bank
Middelkerke Bank
Oostende Bank
Nieuwpoort Bank
Stroombank
Oostende
Smal Bank
Breedt Bank
Trapegeer
Nieuwpoort
N
0 5 10 20 km
VLIZ (2011)


North Sea
NETHERLANDS
Zeebrugge
Oostende
Brugge
Antwerp
FLANDERS
Gent
Mechelen
Kortrijk
Aalst
Leuven
BRUSSELS
GER.
Liège
Mons
Charleroi
Namur
Botrange
WALLONIA
ARDENNES
Bastogne
LUX.
FRANCE
Maas
Schelde
Meuse
Escaut
0 20 40 km
0 20 40 mi

WESTHOEK

WESTHOEK



Hermans *et al*. (2012)

Methods

Geophysics: » Frequency domain electromagnetics

» Electrical resistivity tomography

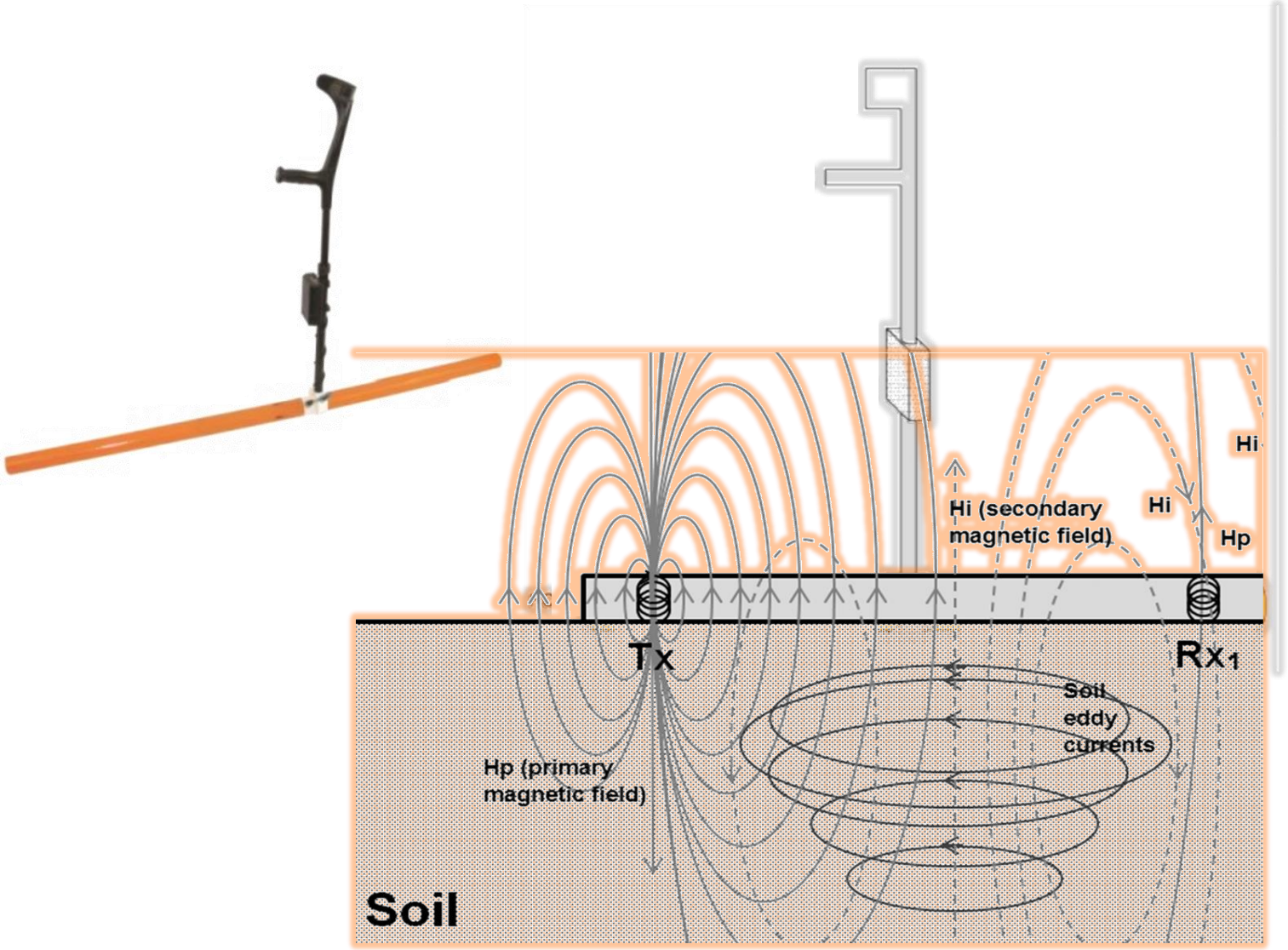
» Continuous resistivity profiling

→ electrical conductivity/resistivity ~ water quality

- Fast mapping fresh-/salt water interface
- Relatively large spatial coverage

FDEM

CMD-Mini explorer



Visconti & de Paz (2016)

FDEM

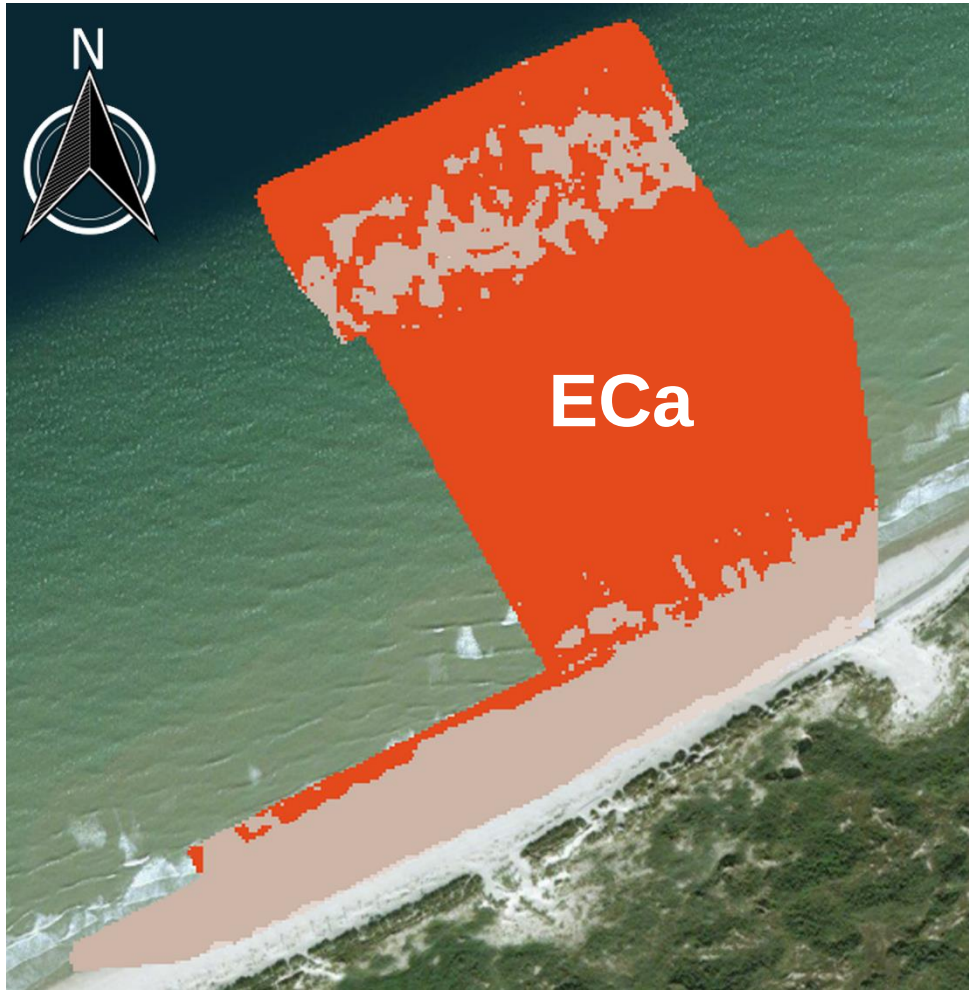
DUALEM-421S

FDEM IN HIGHLY CONDUCTIVE ENVIRONMENT

Pseudodepth ≈ 0,9-1,8m

Paepen *et al.* (in progress)

FDEM IN HIGHLY CONDUCTIVE ENVIRONMENT



Paepen *et al*.
(in progress)

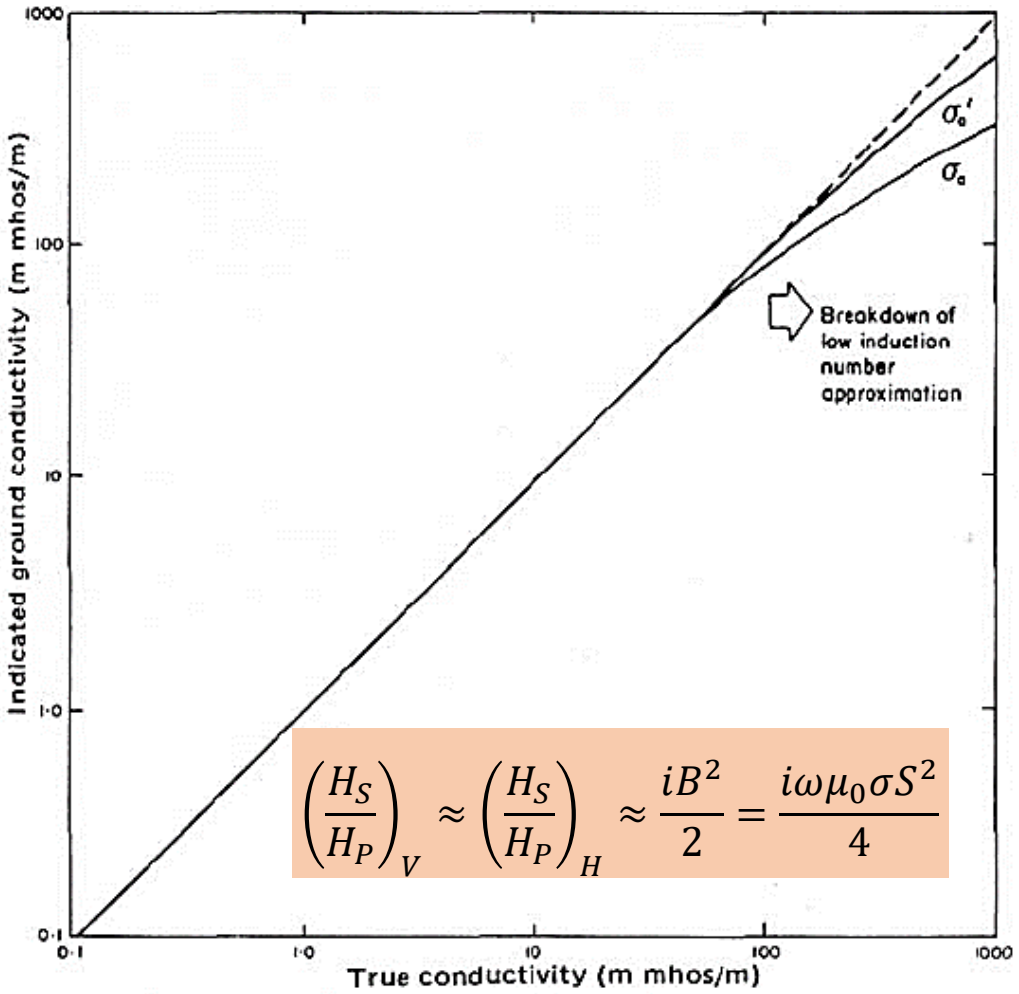
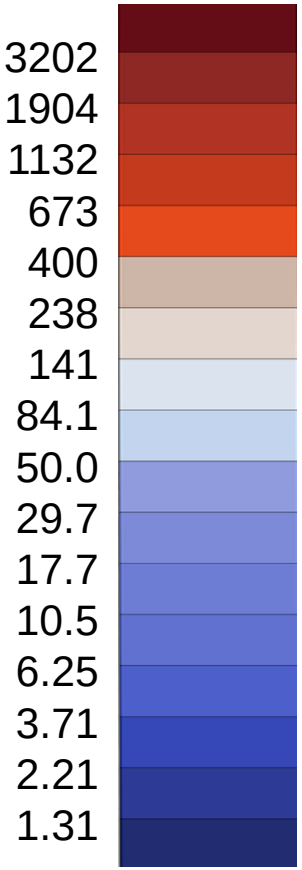


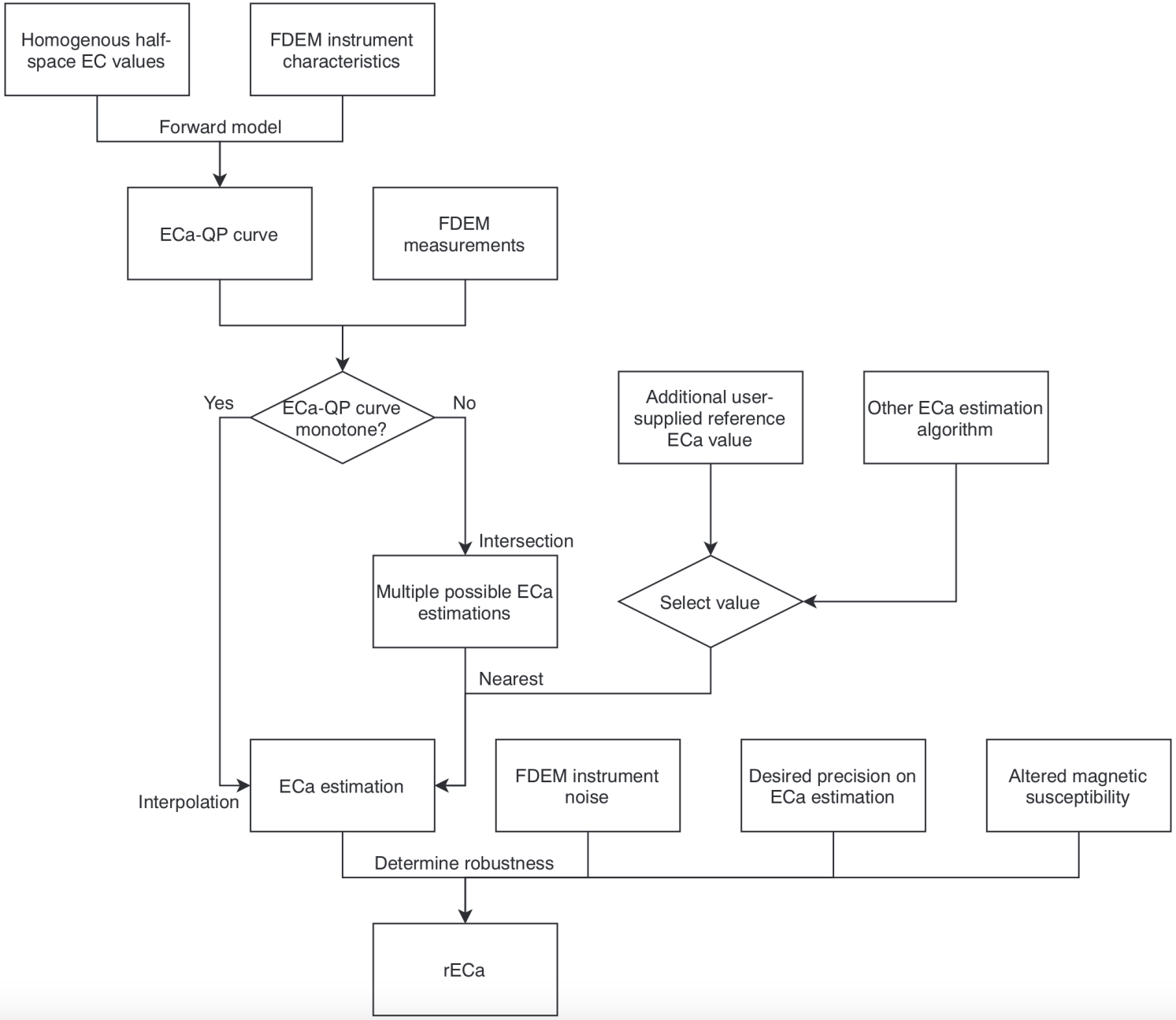
FIGURE AIV. Plot of indicated conductivity for EM31 versus true (homogeneous half-space) conductivity for both vertical (σ_a) and horizontal (σ_a') dipoles.

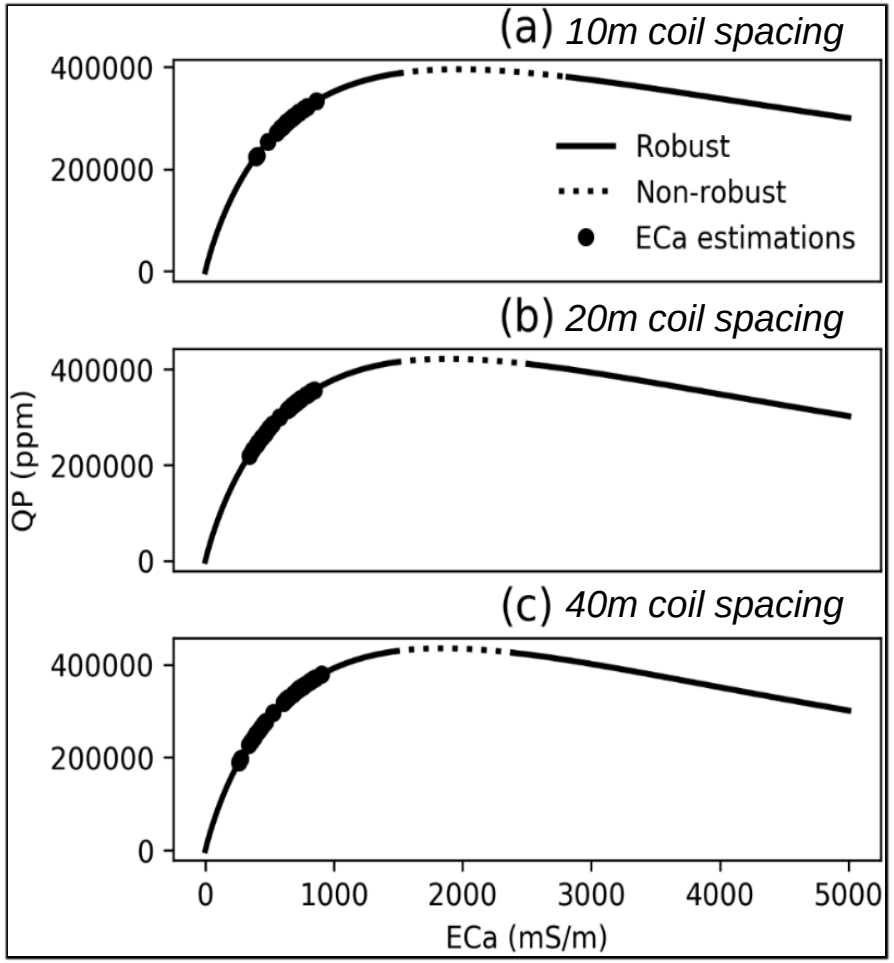
McNeil (1980)

Conductivity (mS/m)



FDEM IN HIGHLY CONDUCTIVE ENVIRONMENT





$$QP = \frac{ECa \cdot \mu_0 \cdot \omega \cdot r^2}{4} \cdot 10^3$$

Hanssens *et al*. (2019)

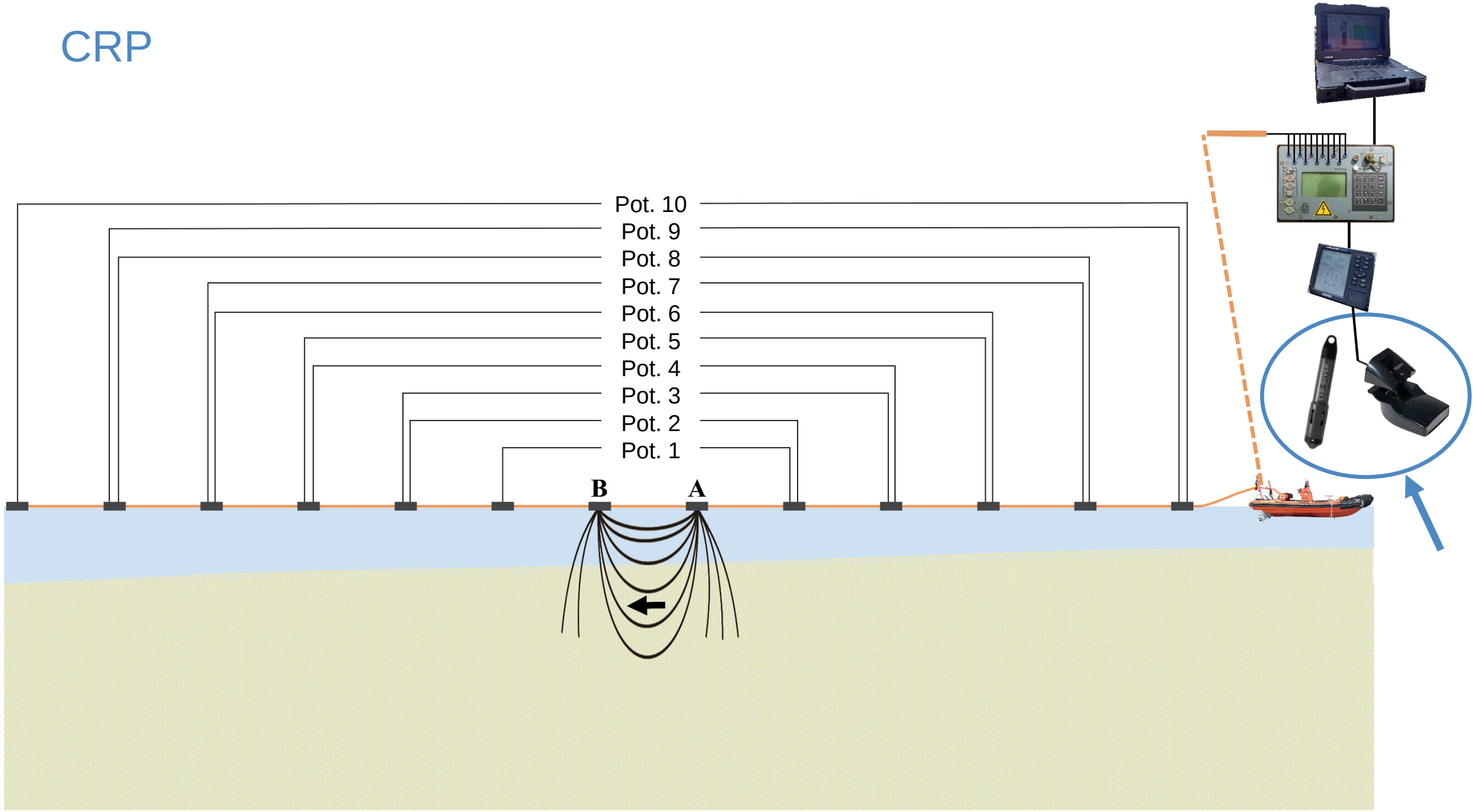
FDEM IN HIGHLY CONDUCTIVE ENVIRONMENT

Pseudodepth ≈ 0,9-1,8m

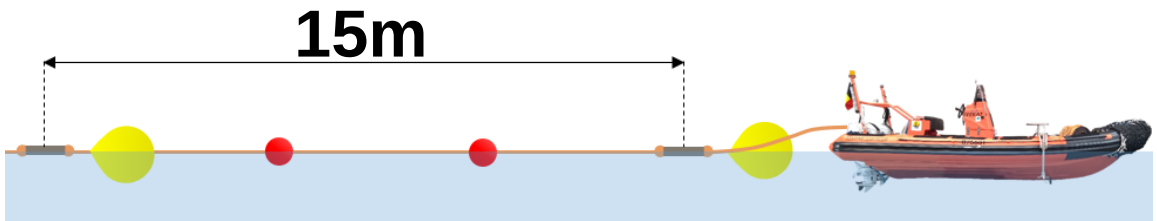
Paepen *et al.* (in progress)

ERT ON LAND

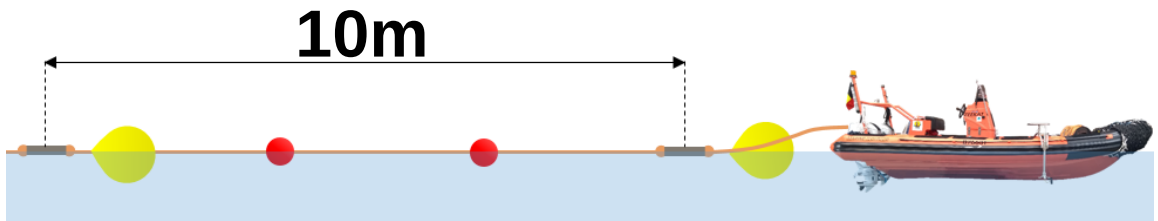
CRP



CRP

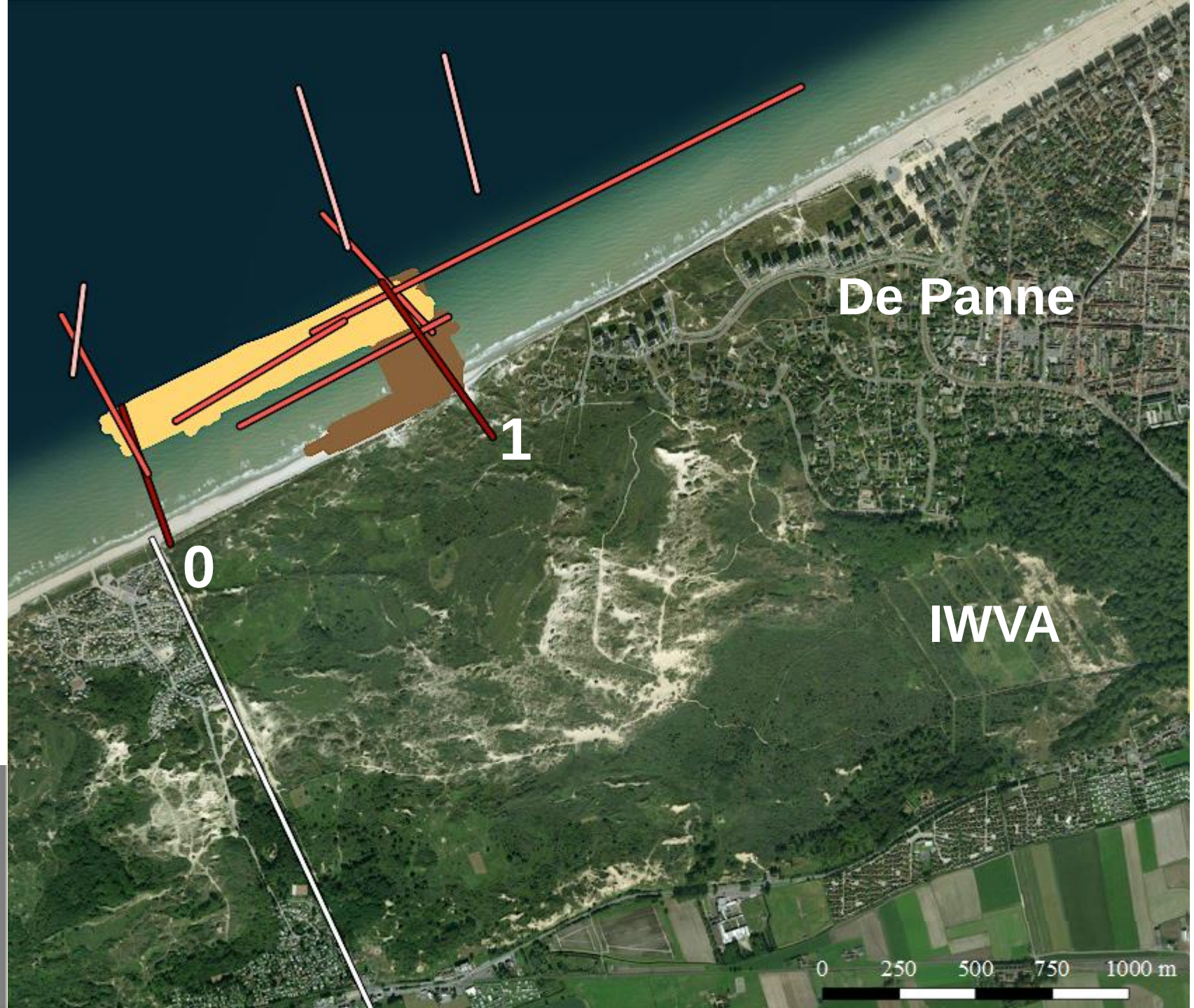


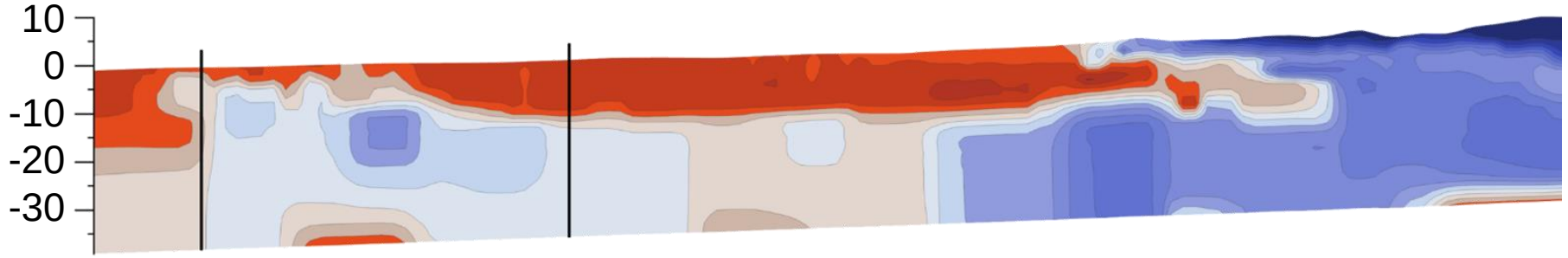
CRP



Results

Paepen *et al*.
(in progress)



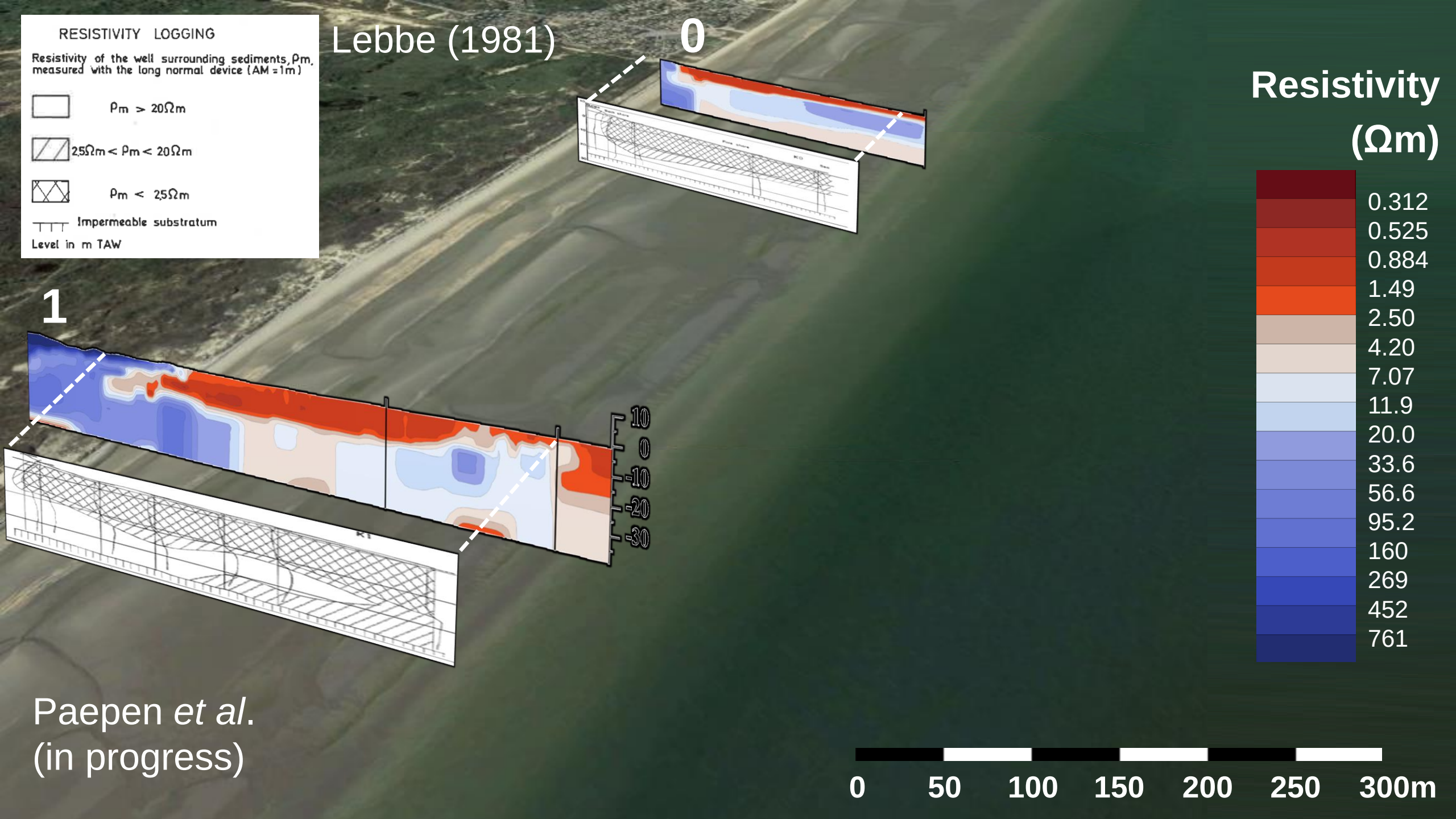


Conductivity (mS/m)

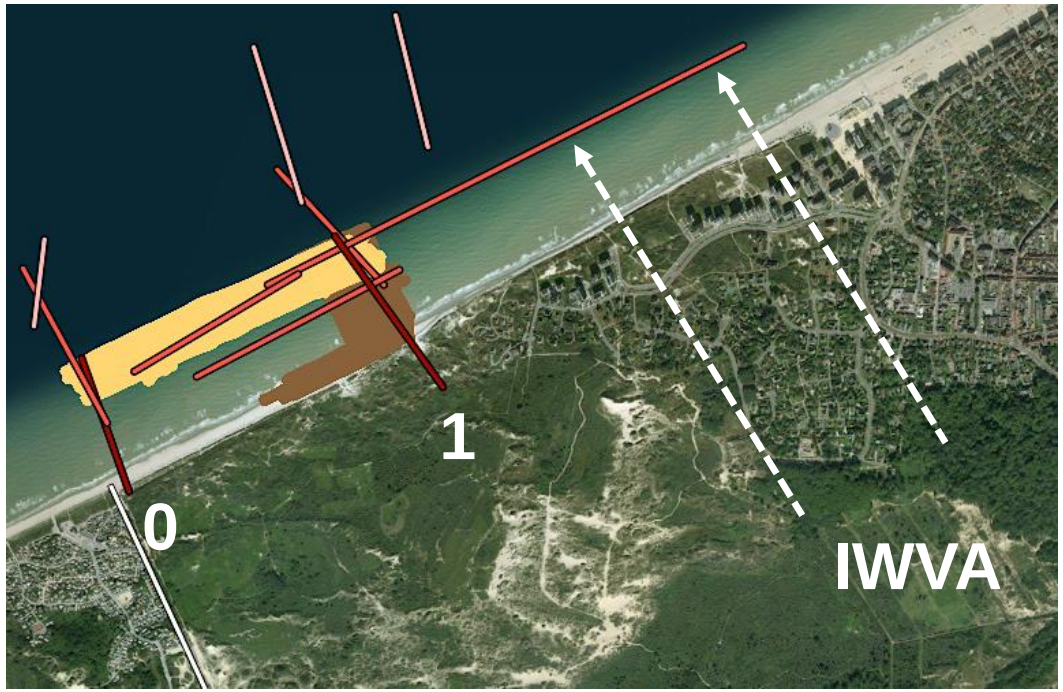
3202	0.312
1904	0.525
1132	0.884
673	1.49
400	2.50
238	4.20
141	7.07
84.1	11.9
50.0	20.0
29.7	33.6
17.7	56.6
10.5	95.2
6.25	160
3.71	269
2.21	452
1.31	761

Resistivity (Ωm)

Paepen *et al*. (in progress)


RESISTIVITY LOGGING
Resistivity of the well surrounding sediments, Pm, measured with the long normal device (AM = 1m)
Pm > 20Ωm
2.5Ωm < Pm < 20Ωm
Pm < 2.5Ωm
Impermeable substratum
Level in m TAW
Lebbe (1981)
0
1
10
0
-10
-20
-30
Resistivity (Ωm)
0.312
0.525
0.884
1.49
2.50
4.20
7.07
11.9
20.0
33.6
56.6
95.2
160
269
452
761
Paepen et al.
(in progress)
0
50
100
150
200
250
300m

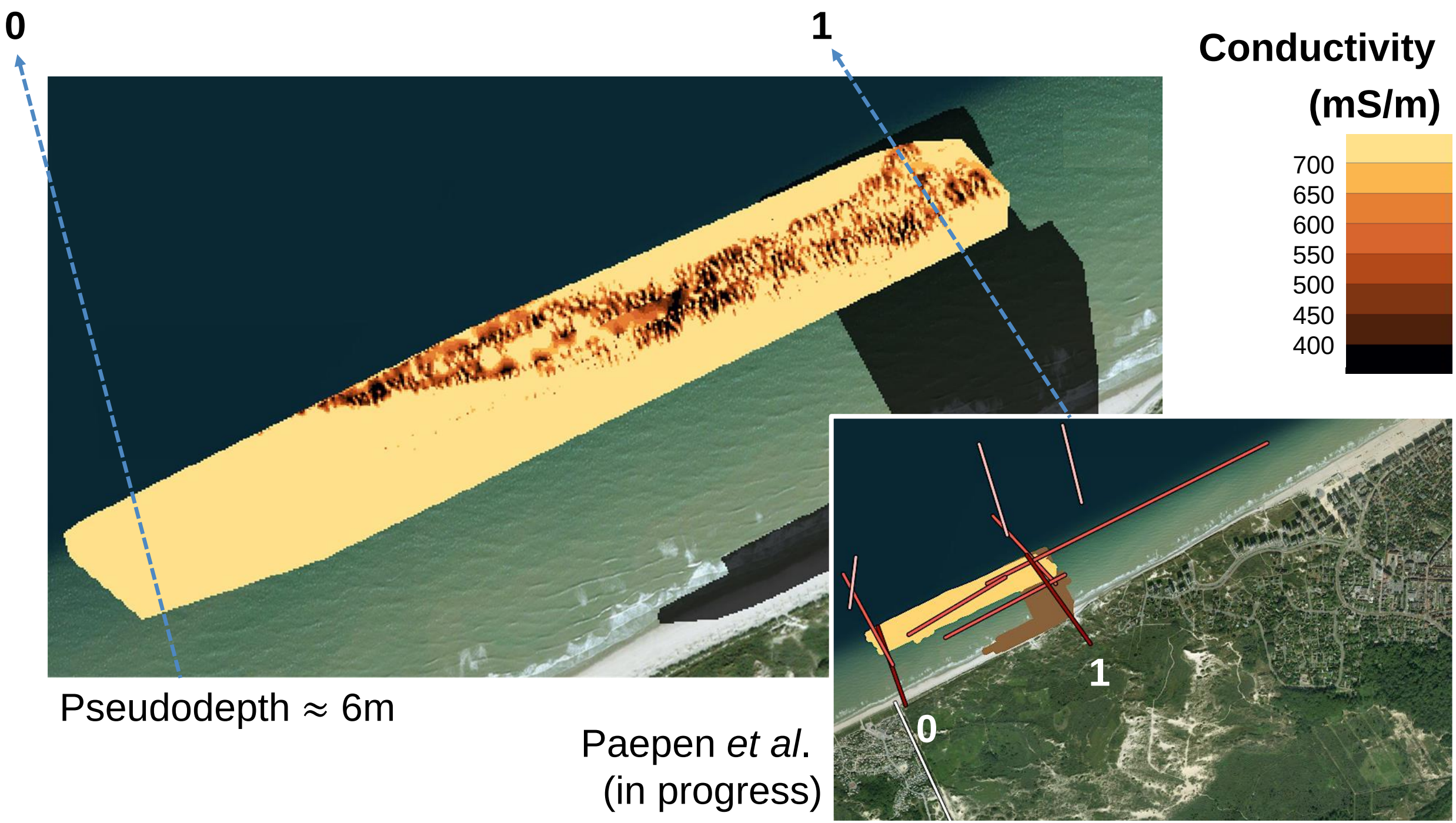

0
1
0
50
100
150
200
250
300m



Paepen *et al*.
(in progress)

0.312
0.525
0.884
1.49
2.50
4.20
7.07
11.9
20.0
33.6
56.6
95.2
160
269
452
761

Resistivity (Ωm)


0
1
Conductivity
(mS/m)
700
650
600
550
500
450
400
Pseudodepth ≈ 6m
Paepen *et al*.
(in progress)
1
0

Conclusions

ERT/ CRP/FDEM:

- Qualitative interpretation
- Spatial variation

“De Westhoek”

- Freshwater discharge
- Saltwater lens
- Shift zone SGD












THANKS TO:

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FOLLOW US:

Project

Quantitative and qualitative assessment of the fresh groundwater discharge in the Belgian coastal area.