Enhancement of Apparent Resistivity Sensitivity in Offshore DC Surveys Using Local Seafloor Insulation

Presented by : Nourhan Tartoussi

OSUNA/ Nantes Université ; GeoEND-GERS/Université Gustave Eiffel

Université Gustave Eiffel

Nantes Université

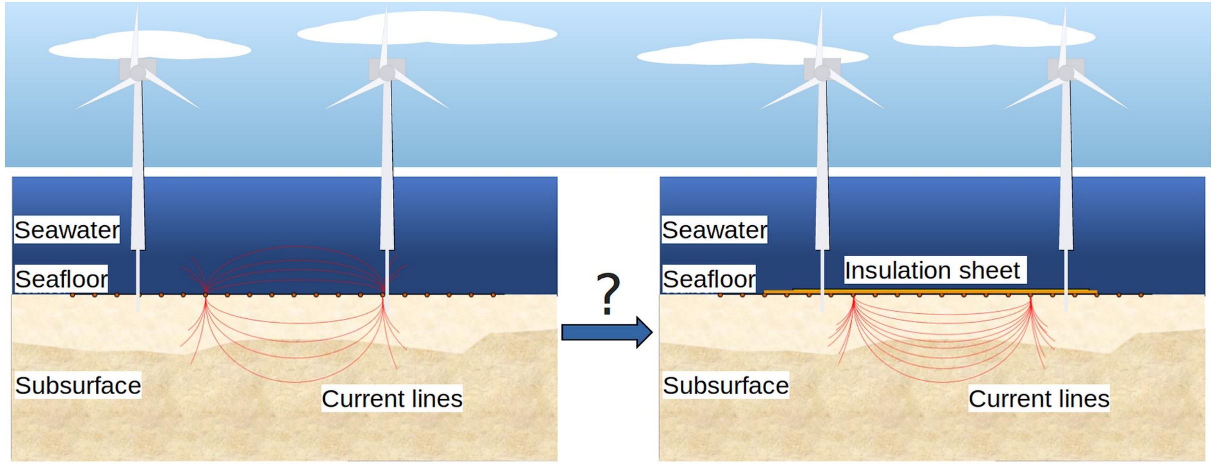
INTRODUCTION AND OUTLINES

The Challenge of Marine DC Resistivity

Offshore wind energy expansion demands accurate shallow subsurface characterisation for foundation design.

DC resistivity has been used in marine investigations since the 1980s, but its effectiveness is severely limited by seawater conductivity.

Conductive seawater causes significant current leakage, reducing sensitivity to subsurface targets, especially in deeper water or where strong resistivity contrasts exist between seawater and the subsoil.



The Solution : Seafloor Insulating Sheet (Lafont et al., 1991)

METHODOLOGY

Numerical Model Setup (FEM: COMSOL Multiphysics 5.4)

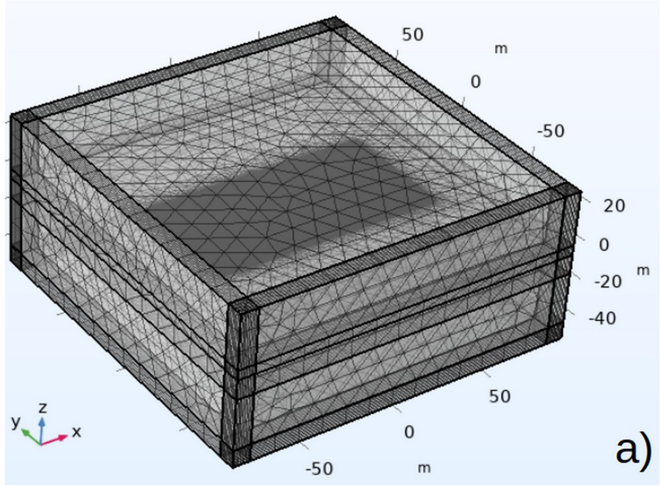
3D domain 100×100×50 m. Poisson's equation solved per injection pair of electrodes.

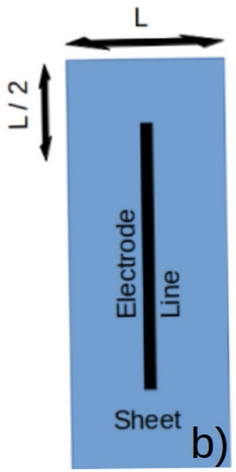
31 electrodes at 2 m spacing. Mesh refined to 0.025–0.05 m at electrode locations.

Sheet: 0.2 m thick, $\rho = 10^7$ Ω·m, width L varied 1–100 m.

Deviation Factor : DF (%) = (ρa,marine − ρa,terr) / ρa,terr. DF = 0% → perfect recovery.

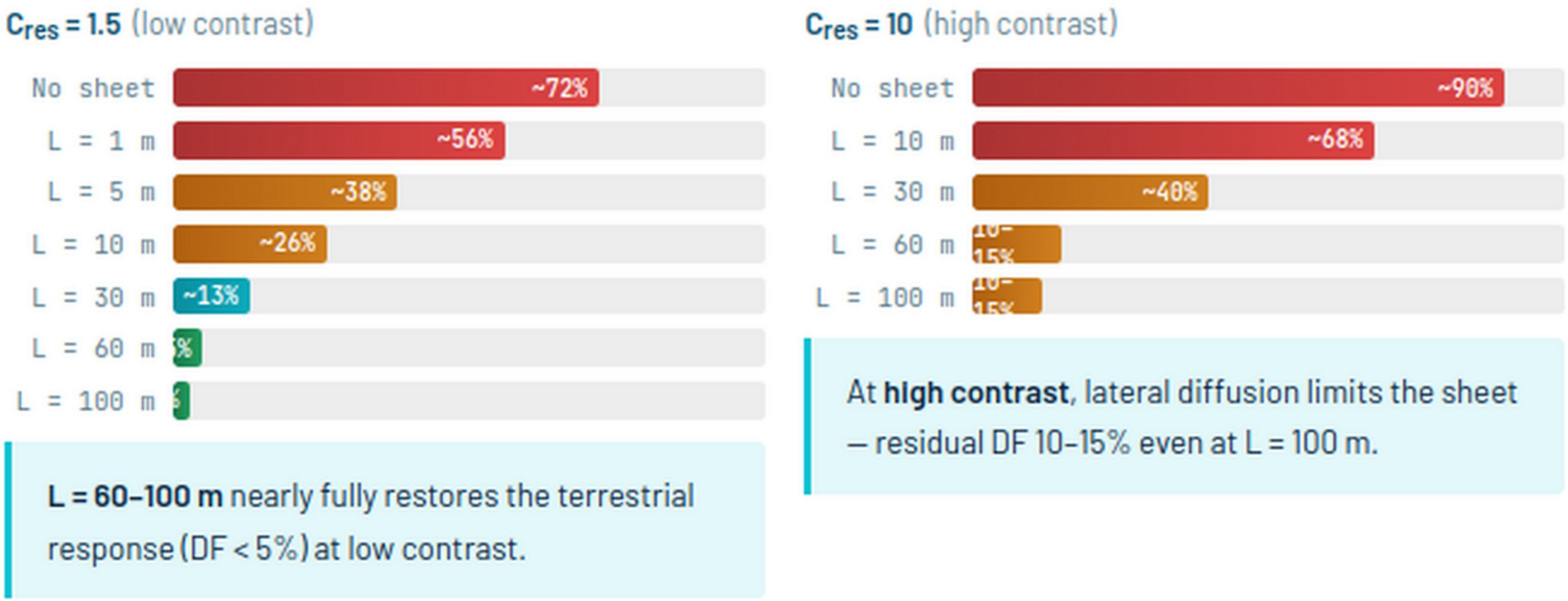
Infinite element domains applied on the lateral and bottom boundaries.





Effect of Sheet Width on Deviation Factor

Homogeneous half-space beneath seawater. Single subsoil layer. Varies: Cres = 1.5–10, Wenner spacing a = 2–30 m, sheet width L = 1–100 m, Dw = 28 m..

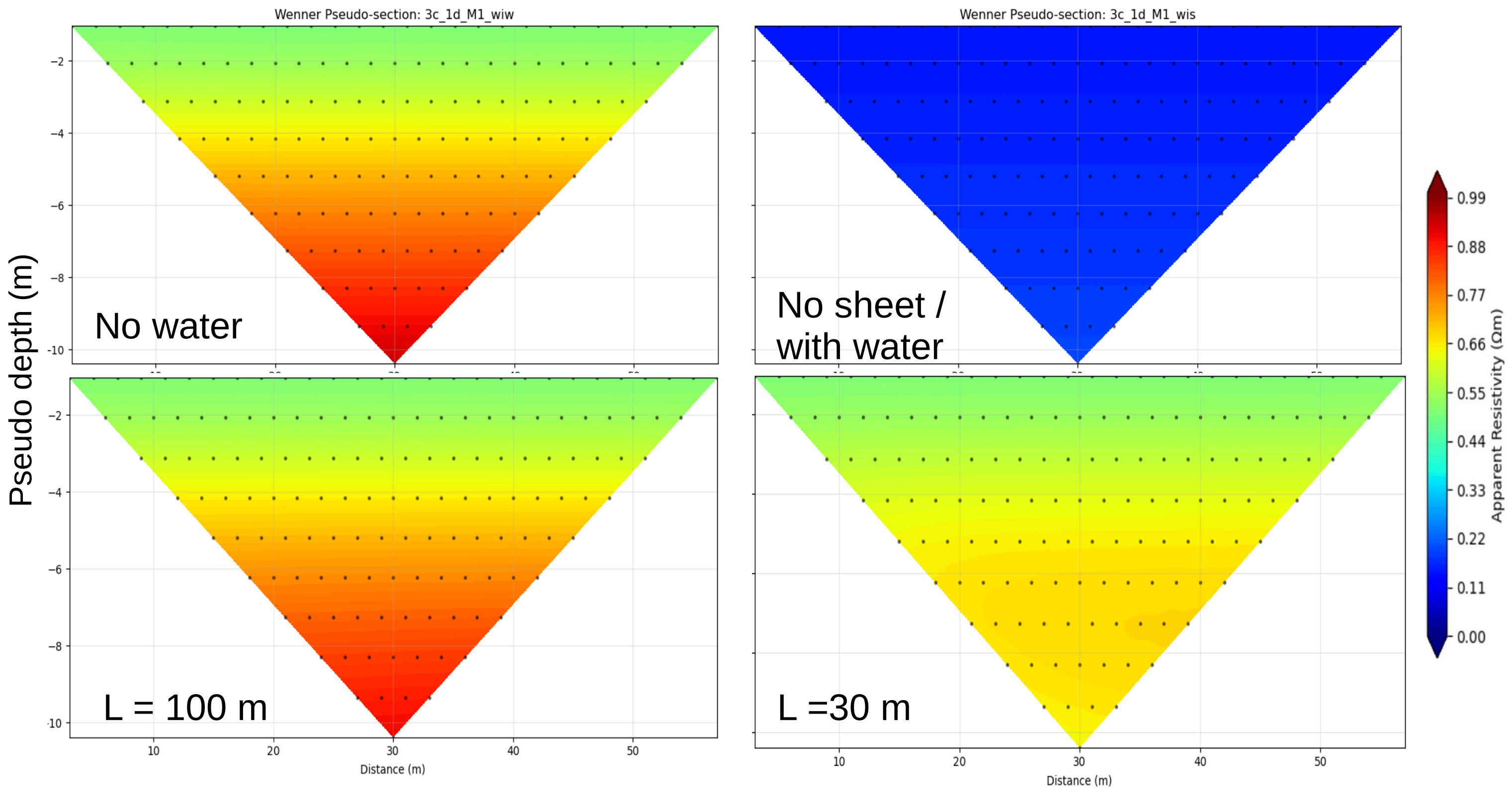


Nourhan TARTOUSSI – Université Gustave Eiffel
Nourhan.tartoussi@univ-eiffel.fr

PART2 - PARAMETRIC STUDY - THREE LAYER MODEL

Effect of Sheet Width on Wenner Pseudo-Section

Three sedimentary layers beneath 28 m seawater. S1: ρ=0.5 Ω·m, e=5 m; S2: ρ=1 Ω·m, e=5–10 m; S3: ρ=1.5 Ω·m e = ∞. Sheet widths L = 100, 30, 10, 0 m vs terrestrial reference.



Sheet L	DF_{max}	DF_{mean}	Result
No sheet	~90%	–	Unusable
L = 10 m	26%	–	Poor
L = 30 m	5%	2%	Acceptable
L = 100 m	<1%	0.5%	Excellent

CONCLUSIONS

- Increasing sheet width systematically reduces DF and improves ρ recovery across all configurations.
- The achievable recovery is strongly controlled by the seawater–subsoil resistivity contrast; higher contrasts limit effectiveness even at large L.
- Full coverage (L = 100 m) restores pseudo-sections to DF < 0.5%; L = 30 m gives DF < 5%, while L = 10 m provides negligible correction at 28 m depth.
- First quantitative design guidelines for insulating sheet dimensioning in offshore DC resistivity surveys.

THANK YOU !