

# Initial hydrogeological settings of River Neretva Valley

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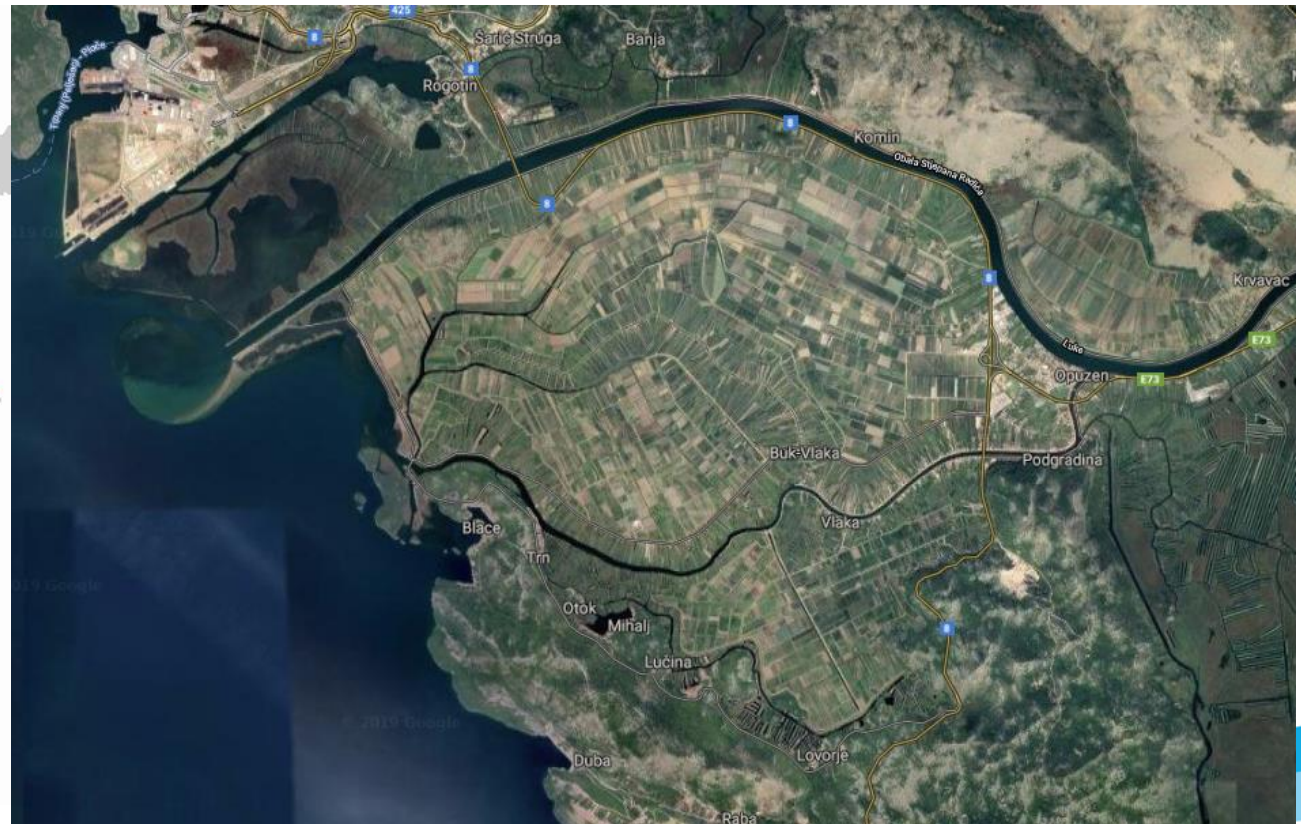
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# Content

- River Neretva Valley;
- Before and after;
- What happened during 1960s...
- Site characterization;
- Hydrogeological parameters estimation
- Conclusions

# River Neretva Valley

- Study site in south eastern Adriatic coast;
- App. 4500 ha, 90 % cultivated area;
- Used within the WP3, WP4 and WP5;

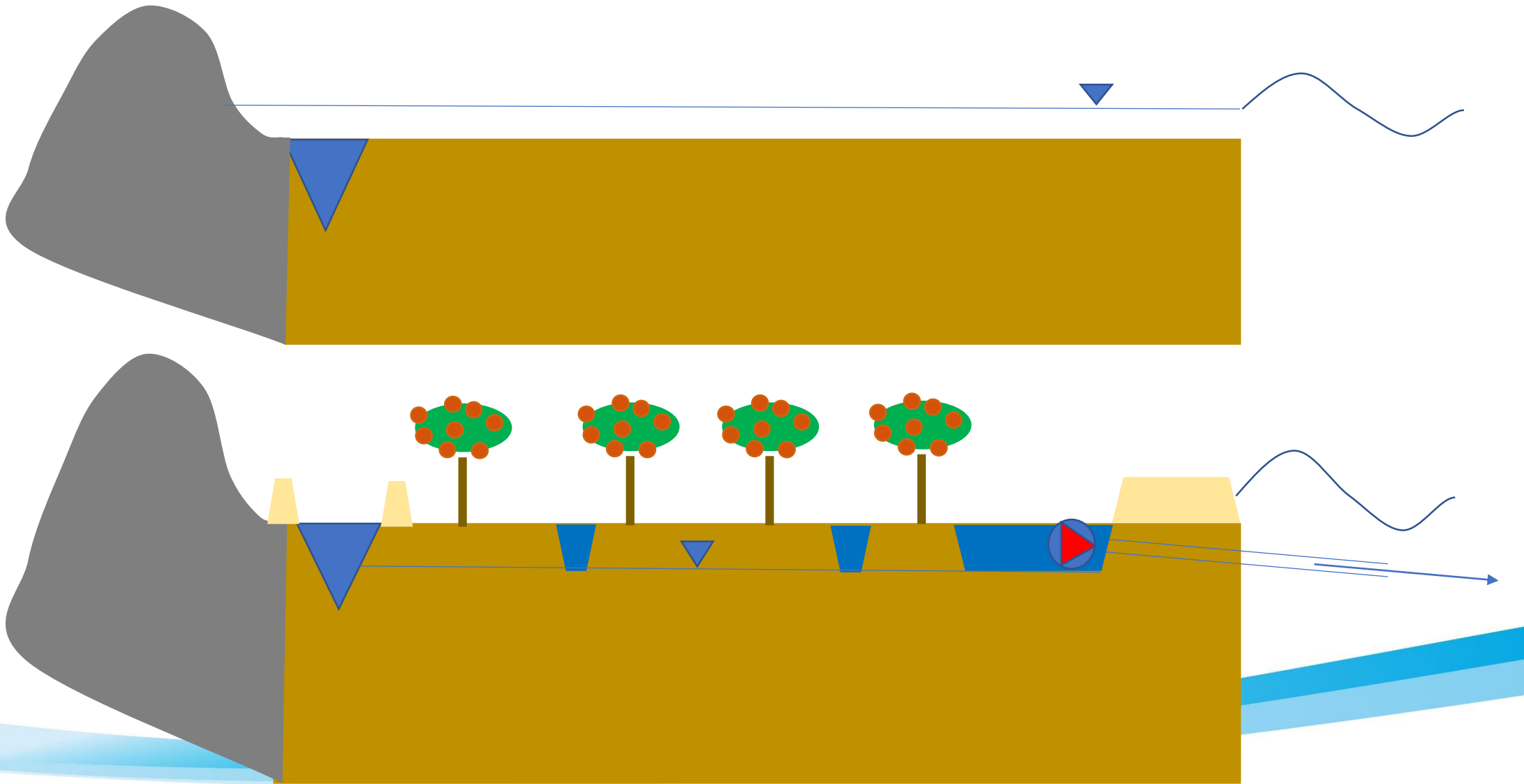




# Before and after.....



# What happened during 1960s...





# What happened during 1960s...





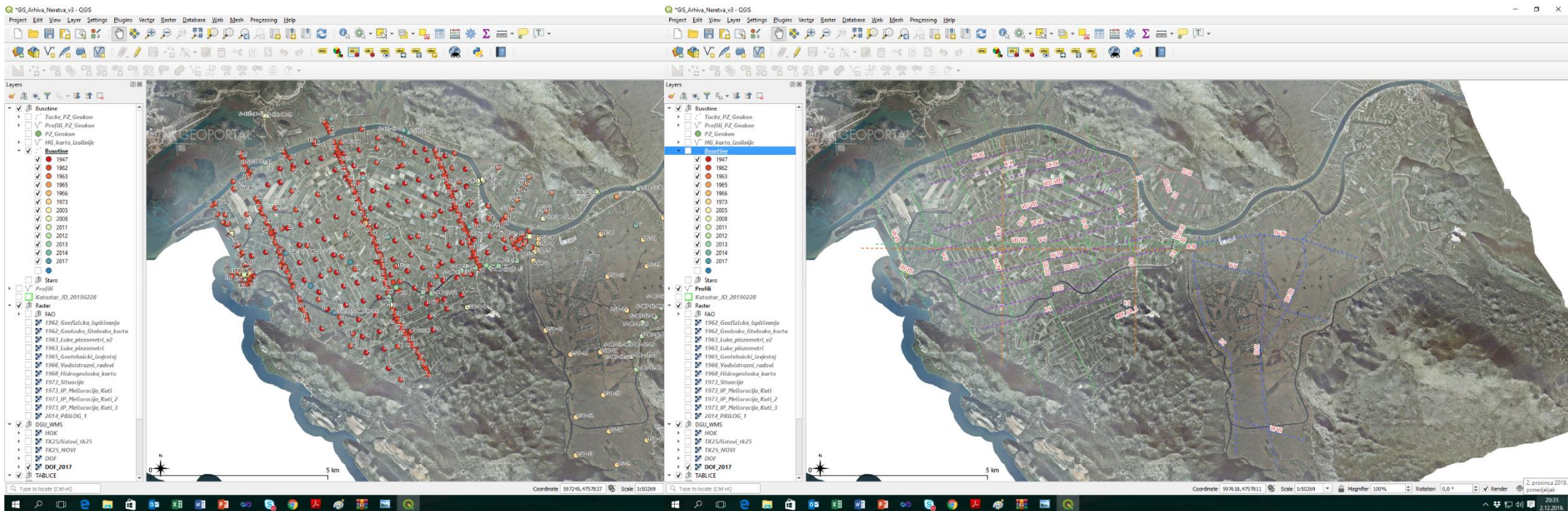




# Site characterization

## Initial hydrogeological conditions:

- Second cycle covers the digitalization of all available documentation within the GIS data base;
- Data base is organised so the user can pick for different search criteria (alphabetical search, chronological search, data type search);
- More than 500 local data, more than 35 planar data sets;

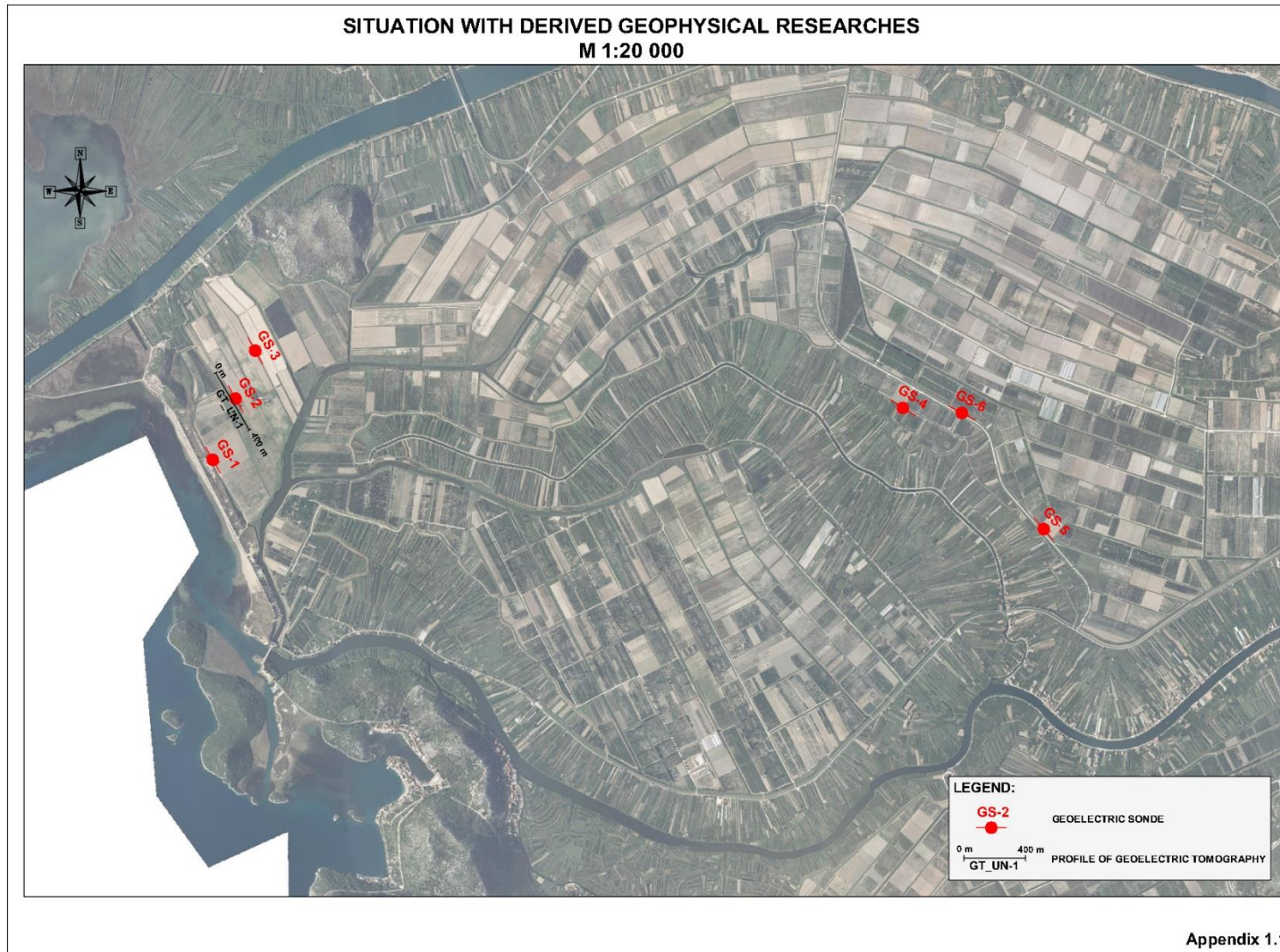




# Site characterization

## Preliminary in situ works

- To distir
- conduct
- Confirm
- Existenc
- Perform
- Results

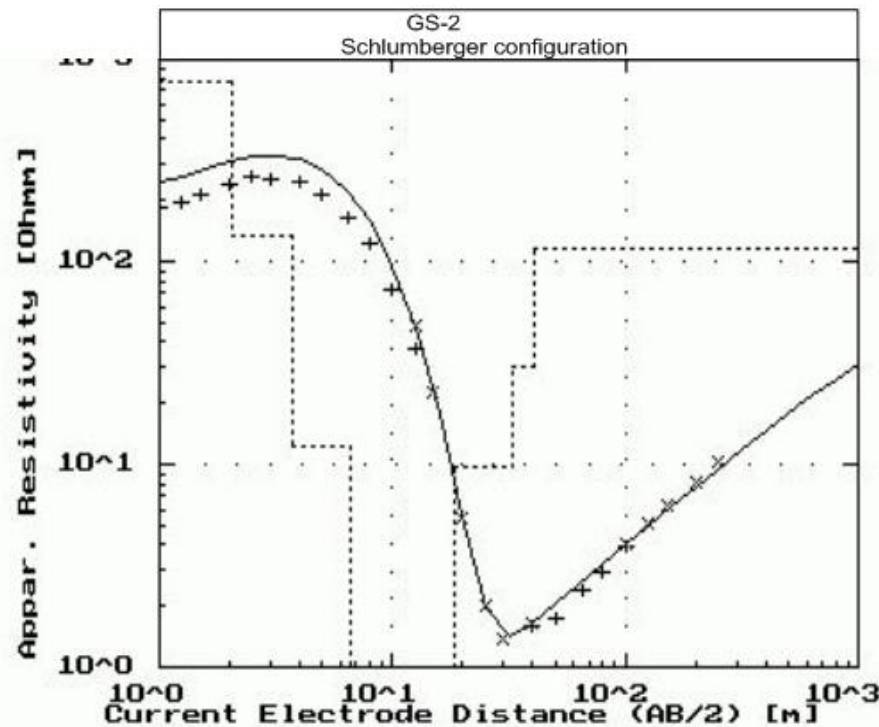
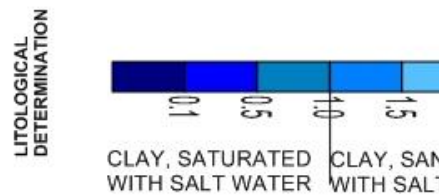
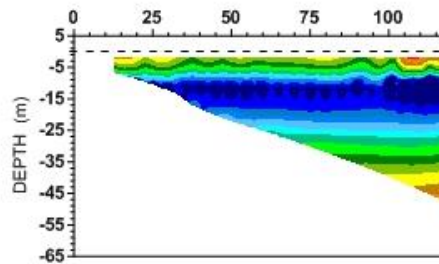


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# Site characterization

## Preliminary in situ works:

- ERT was performed in the near coast area.;
- Four dominant layers identified, sandy partially saturated aquifer, clay layer of 20 m height, gravel layer, variable height ranging from 10 to 15 m, bedrock found inbetween - 37 and - 45 m bmsl;



No	Res	Thick
1	215.2	0.9
2	76.4	1.1
3	132.4	1.1
4	120.3	2.9
5	90.0	11.4
6	9.9	14.6
7	30.1	8.0
8	116.7	-

\* RMS on smoothed dat

GS - 2  
INTERVAL LITOLOGICAL DETERMINATION

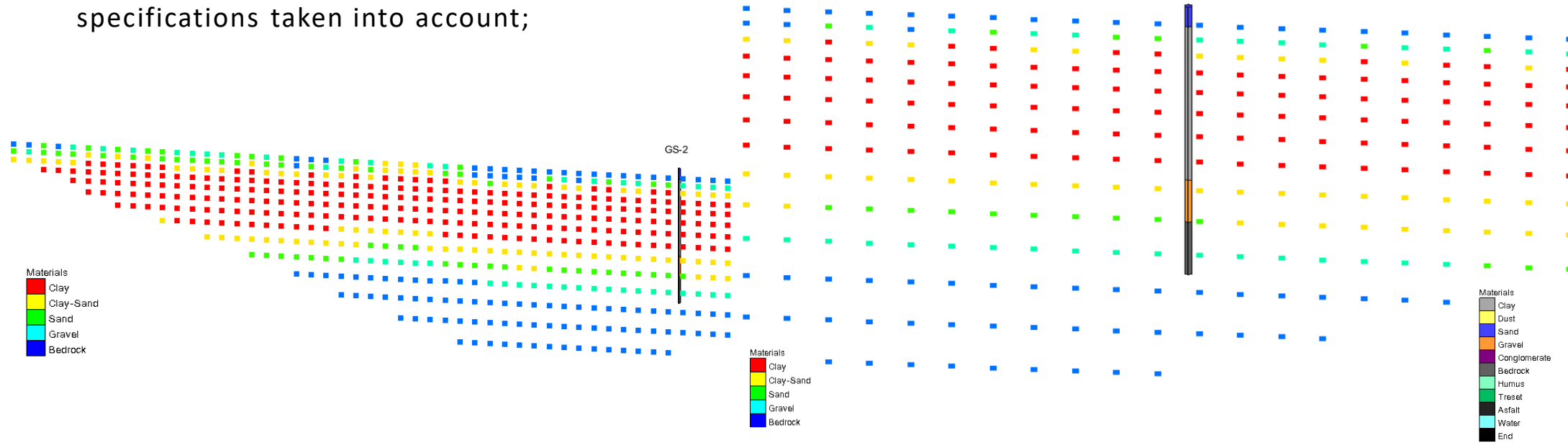
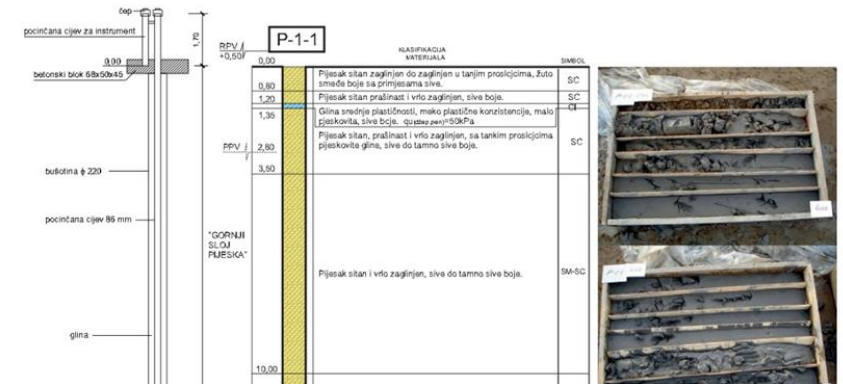
- 1,2,3 - SAND, CLAYEY, DRY ZONE
- 4 - SAND, CLAYEY, SILTY SATURATED WITH WATER
- 5 - CLAY, SATURATED WITH SALT WATER
- 6 - CLAY, SANDY SATURATED WITH SALT WATER
- 7 - GRAVEL, CLAYEY, MEDIUM TO COARSE GRAIN SIZE, WEATHERED AND FRACTURED LIMESTONE WITH SALT WATER
- 8 - BADROCK (LIMESTONE), DIFFERENTLY FRACTURED



# Site characterization

## Verification:

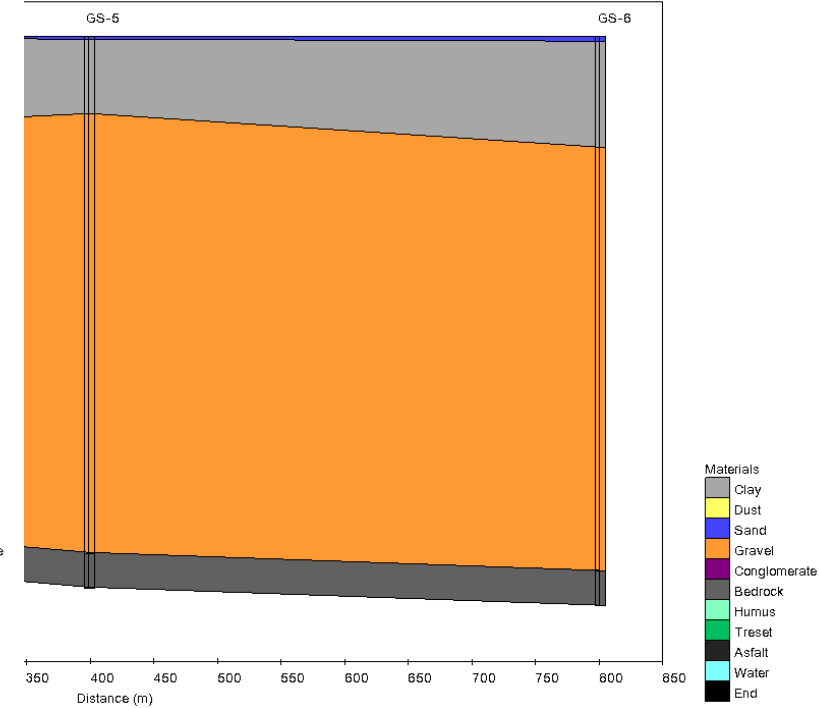
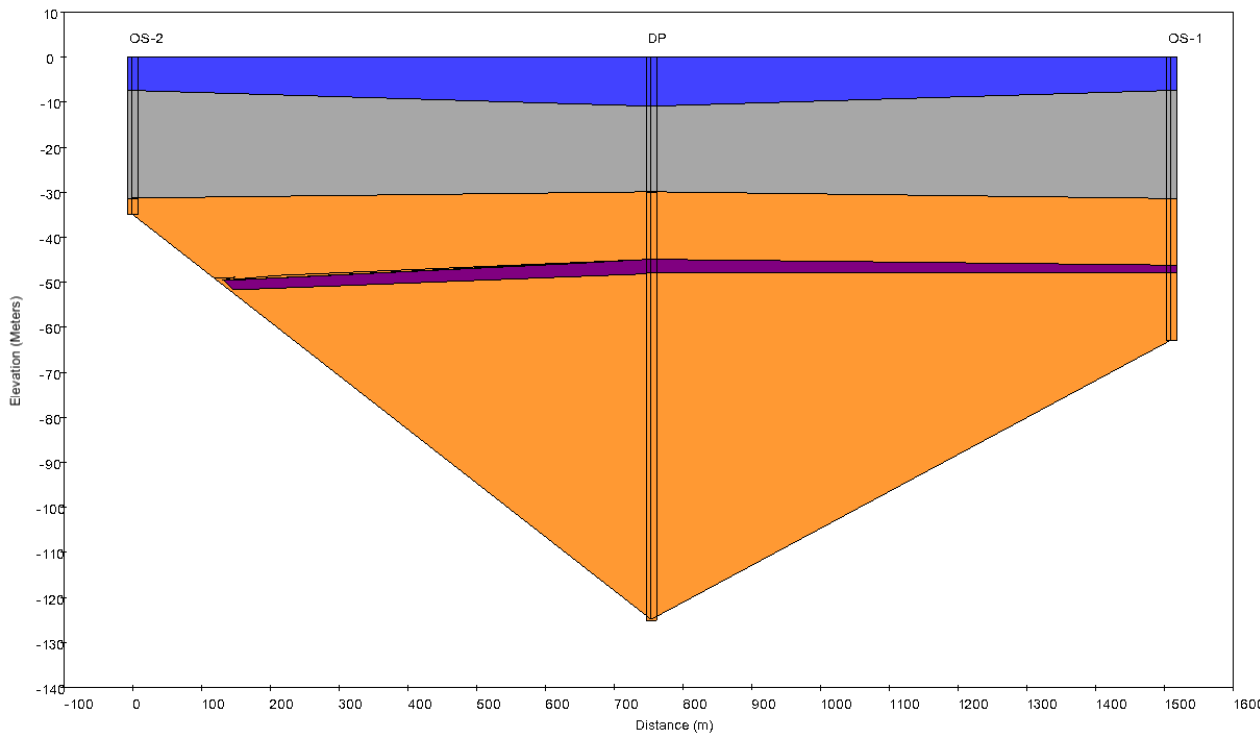
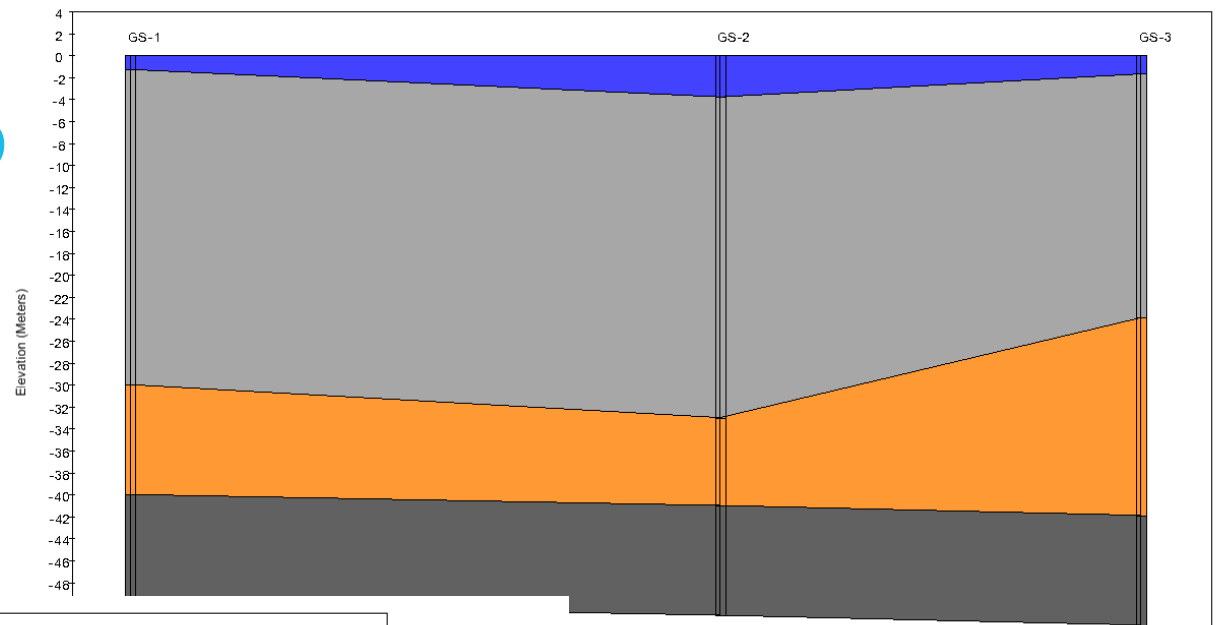
- Borehole cross sections from the area of interest (first and second cycle of initial hydrogeological condition activities);
- ERT and first order data verification by matching stratigraphy;
- Local EC conditions in combination with soil specifications taken into account;



# Site characterizatio

## Characteristic cross sections:

- Coastal area shows clear stratigraphy, presence of three geological layers, sandy unconfined layer on top; clay layer, gravel confined layer and bedrock;





# Site characterization

## Borehole logs:

- In 2015. 125 m deep borehole has been designed;
- Insight to geological settings and layer stratigraphy;
- Confirmation of generated cross sections and initial settings;



1,0 – 5,0 m



6,0 – 10,0 m



12,0 – 17,0 m



36,0 – 40,0 m



41,0 – 45,0 m



46,0 – 50,0 m



18,0 m – 24,0 m



25,0 – 30,0 m



31,0 – 35,0 m



51,0 – 55,0 m



56,0 – 60,0 m

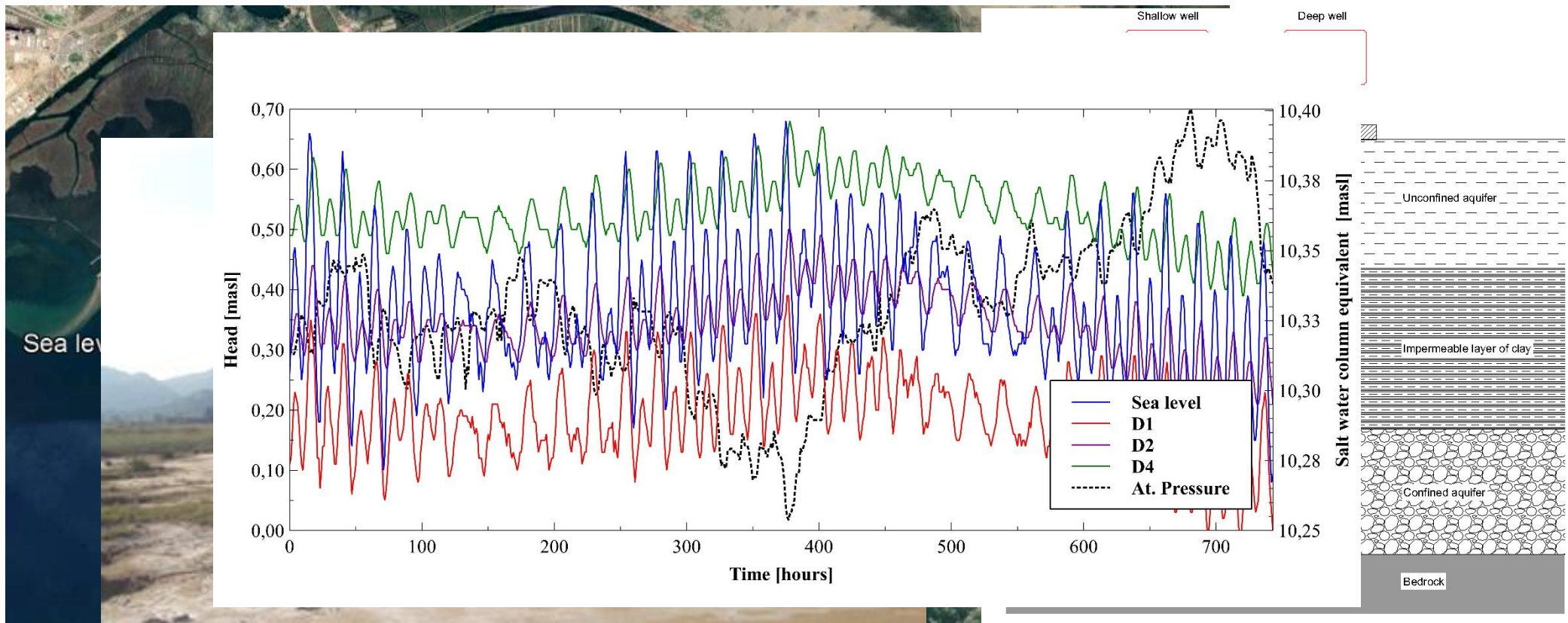


60,0 – 65,0 m

# Hydrogeological parameters estimation

## Monitoring system:

- Data sets of observed sea level oscillations and piezometric head time series from different monitoring locations;

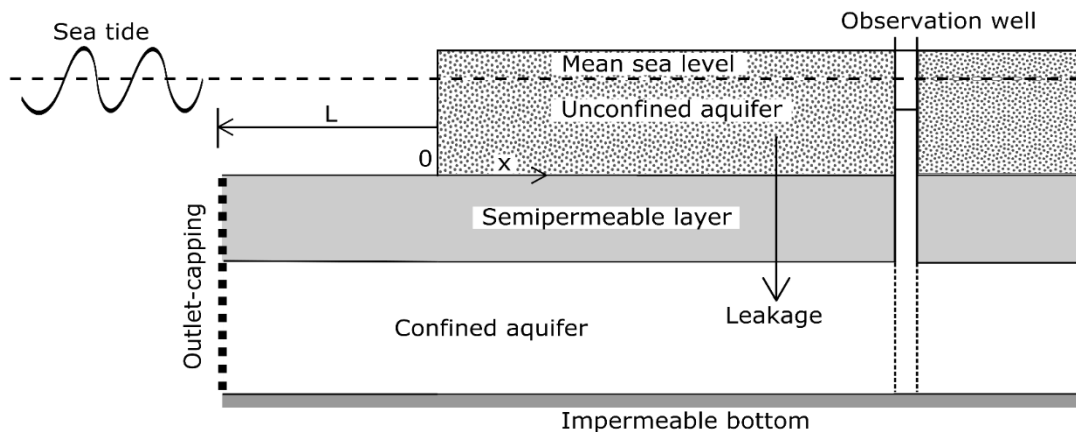




# Hydrogeological parameters estimation

## Conceptual model application:

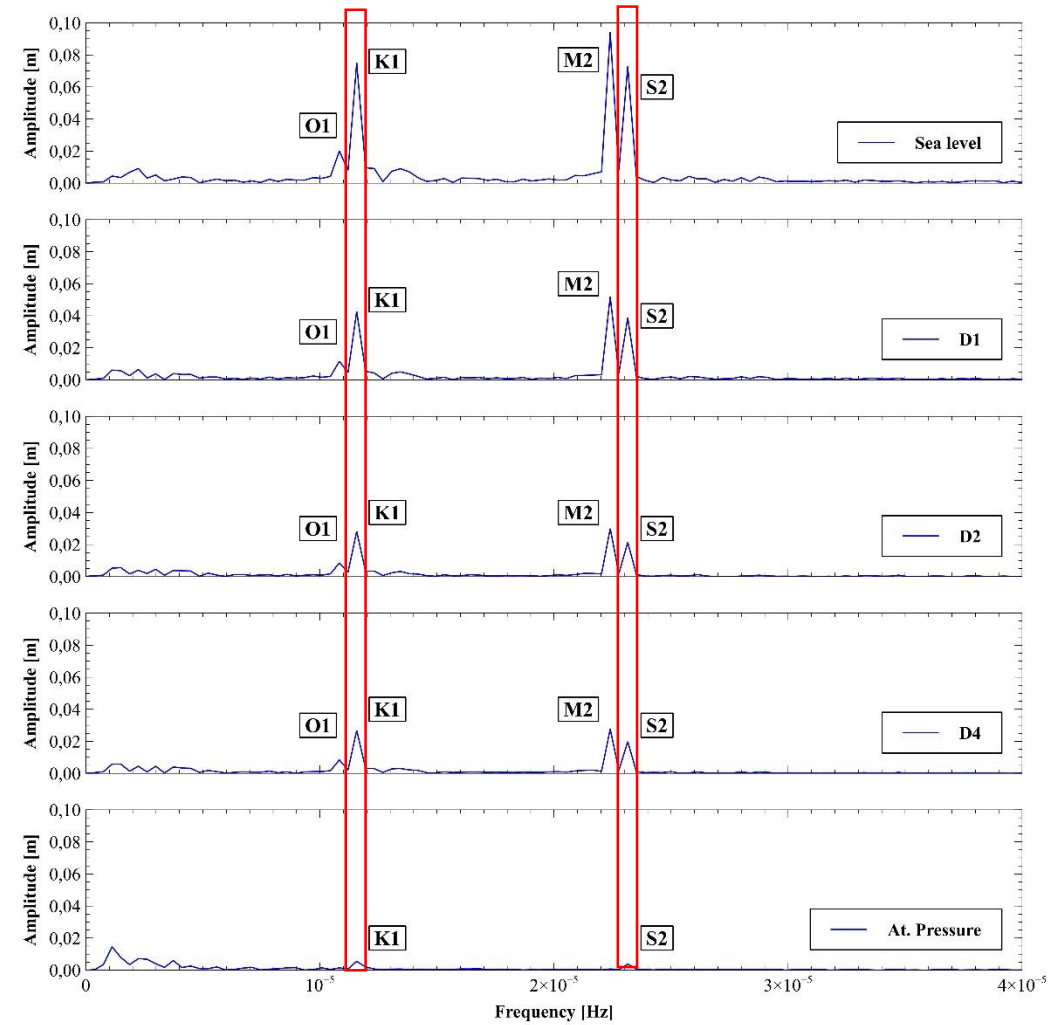
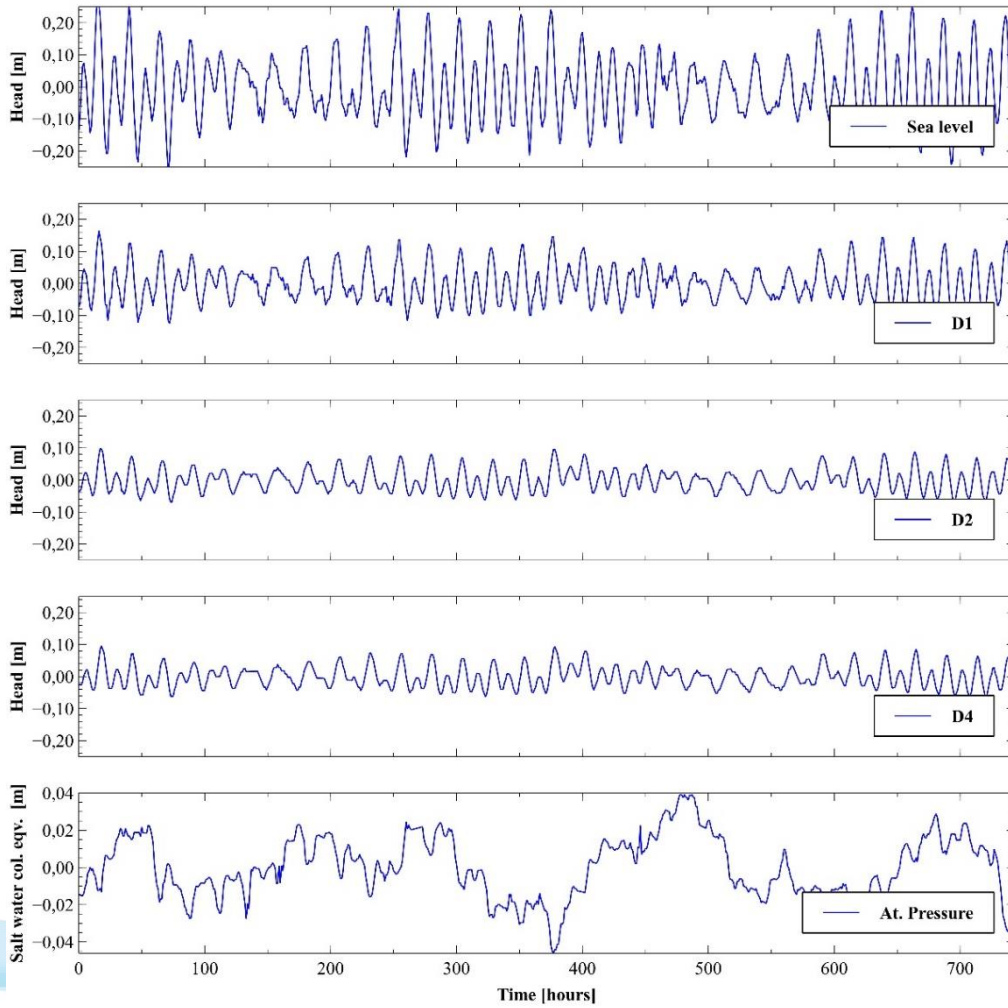
- Selection of appropriate model based on available information, performed analysis and results (geochemistry, geology, etc.);
- Model set up to cover for wide range of parameters (loading efficiency, barometric efficiency, extended roof, outlet capping, hydraulic diffusivity, storativity, hydraulic conductivity);
- Application of tidal methods – the idea relies on hypothesis groundwater fluctuations are induced by tidal fluctuations and aquifers connection to the sea;
- In case of known sea level constituents, piezometric head can be determined as a linear superposition of present constituents;



$$h(x, t) = AC_e e^{-apx} \cos(\omega t - aqx - \varphi), \quad x \geq 0$$

# Hydrogeological parameters estimation

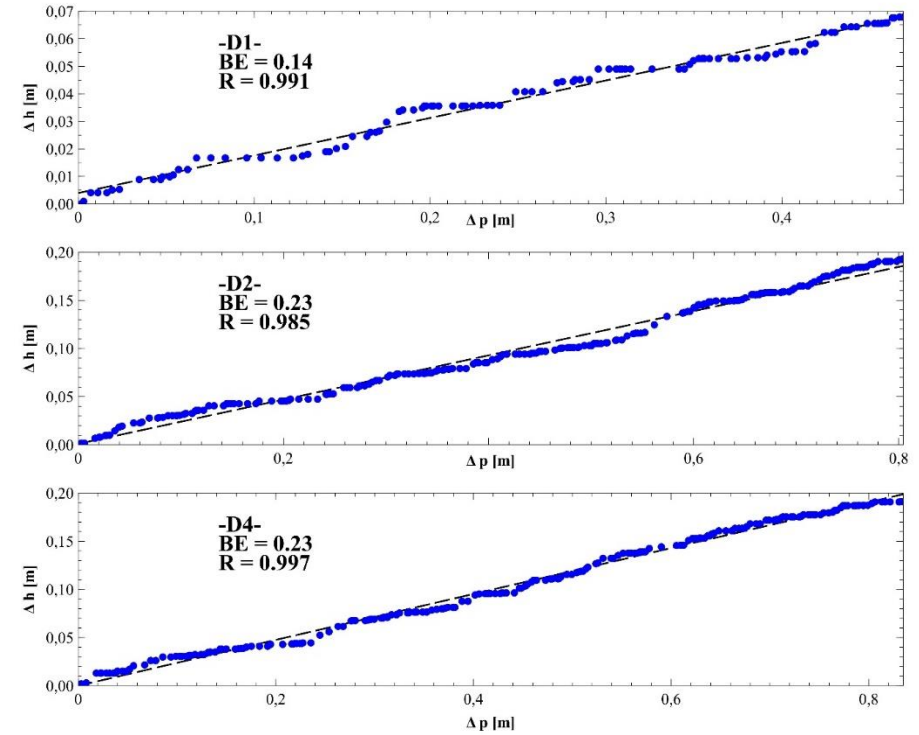
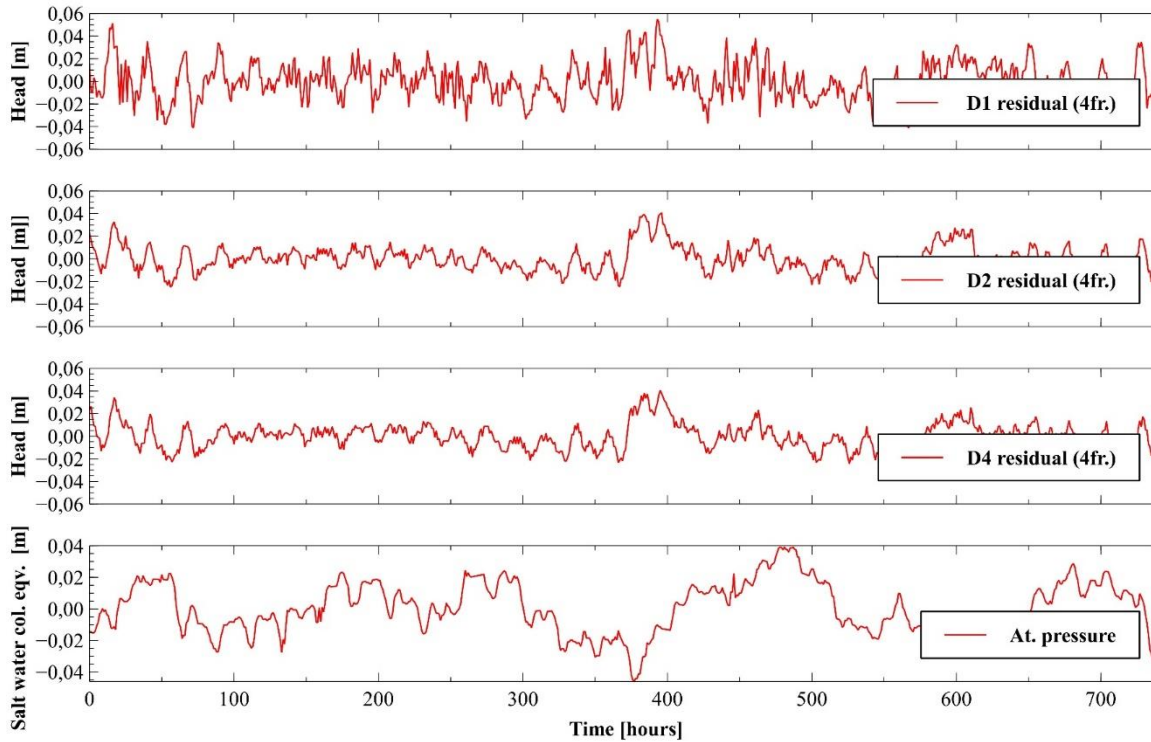
Frequency domain analysis:





# Hydrogeological parameters estimation

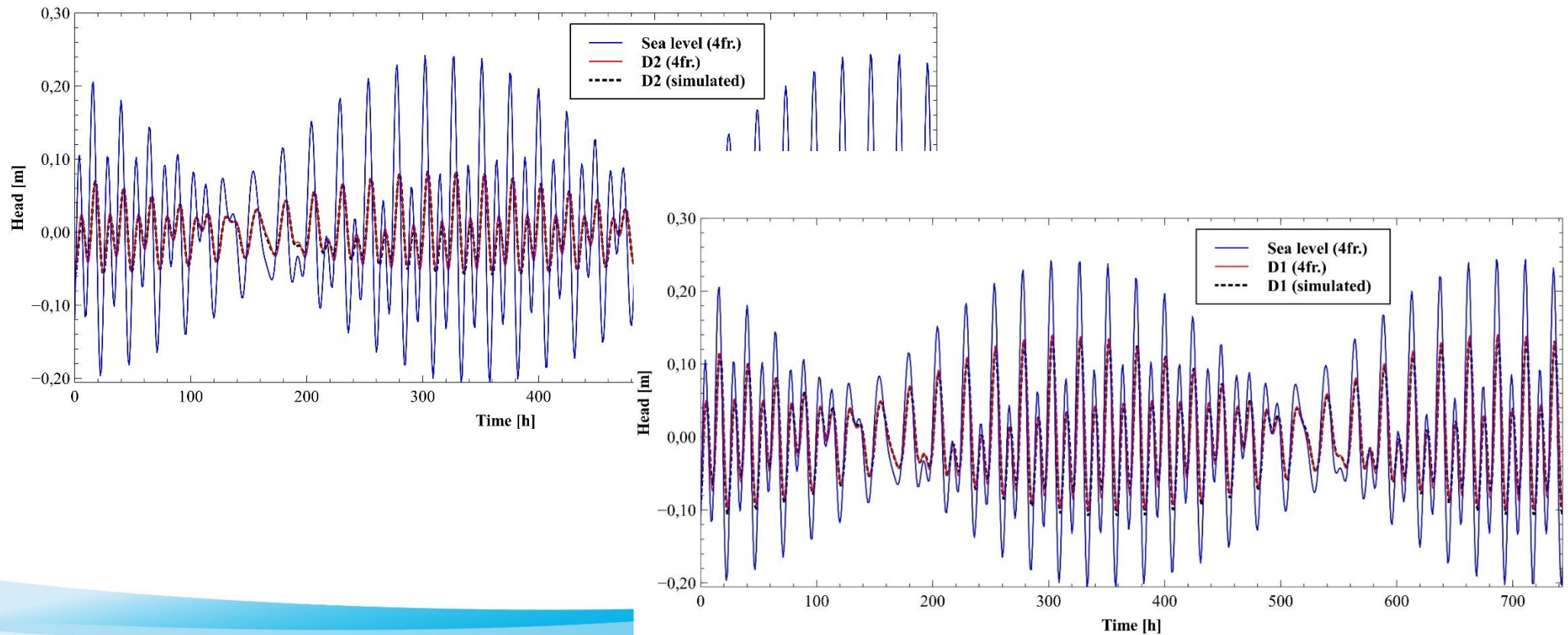
Barometric and loading efficiency estimation:



# Hydrogeological parameters estimation

## Monte Carlo analysis:

- Model performed for various range of parameters unless minimum RMSE is observed;
- Generated time series of piezometric head;





# Conclusions


- Hydraulic diffusivities defined as 430, 1200 and 650 m<sup>3</sup>/s respectively for DF1, D2 and D4;
- Confined aquifers height defined from geological model;
- Hydraulic conductivity values defined from performed slug tests ( $10^{-5} - 10^{-3}$  m/s);
- Storativity values  $10^{-6} - 10^{-4}$  ;
- Extended roof length  $L = 1450$  m;
- Leakage  $0 - 10^{-4}$  /day;
- Confinement of the deep aquifer confirmed via leakage values and spectral features;


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