

MoST SCIENTIFIC MEETING

Monitoring Sea-water intrusion in coastal aquifers and Testing pilot projects for its mitigation



WHEN:

11 OCTOBER 2021



WHERE:

IDROVORA CA' BIANCA, CHIOGGIA, VENEZIA

Management and modelling of the water table in the Ca' Pasqua pilot site

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with the contribution of all the Italian partners (DICEA and DAFNAE, University of Padova, CNR-IGG, Regione Veneto, and Consorzio di Bonifica Adige Euganeo)



European Regional Development Fund



EUROPEAN UNION



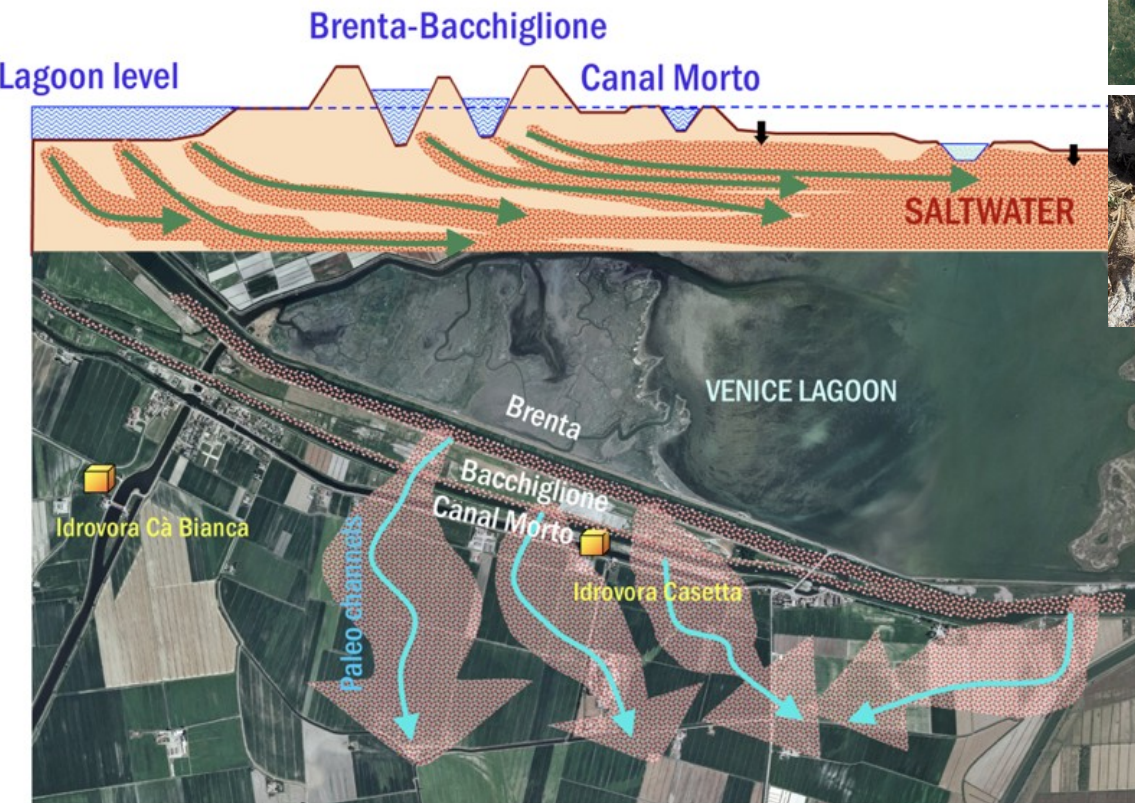
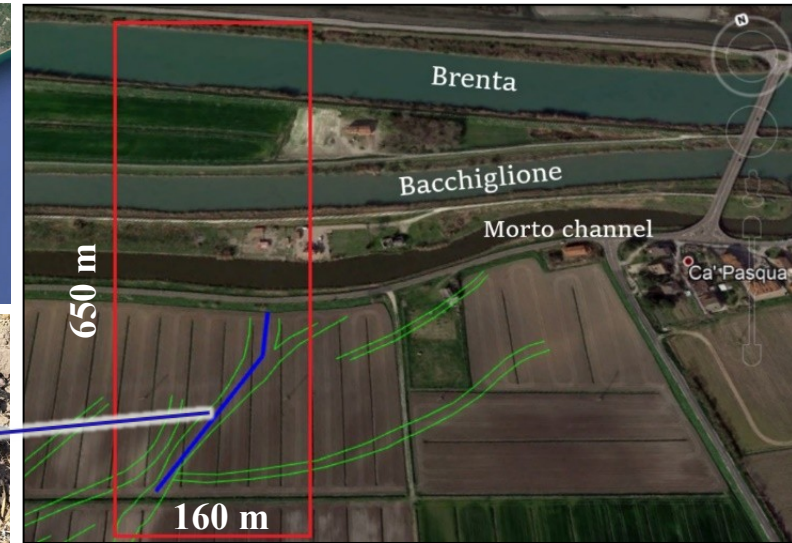
Outline of the presentation

- Case study presentation
- Research questions
- The management of the Ca' Pasqua pilot site
- The numerical modeling of the Ca' Pasqua pilot site - updates



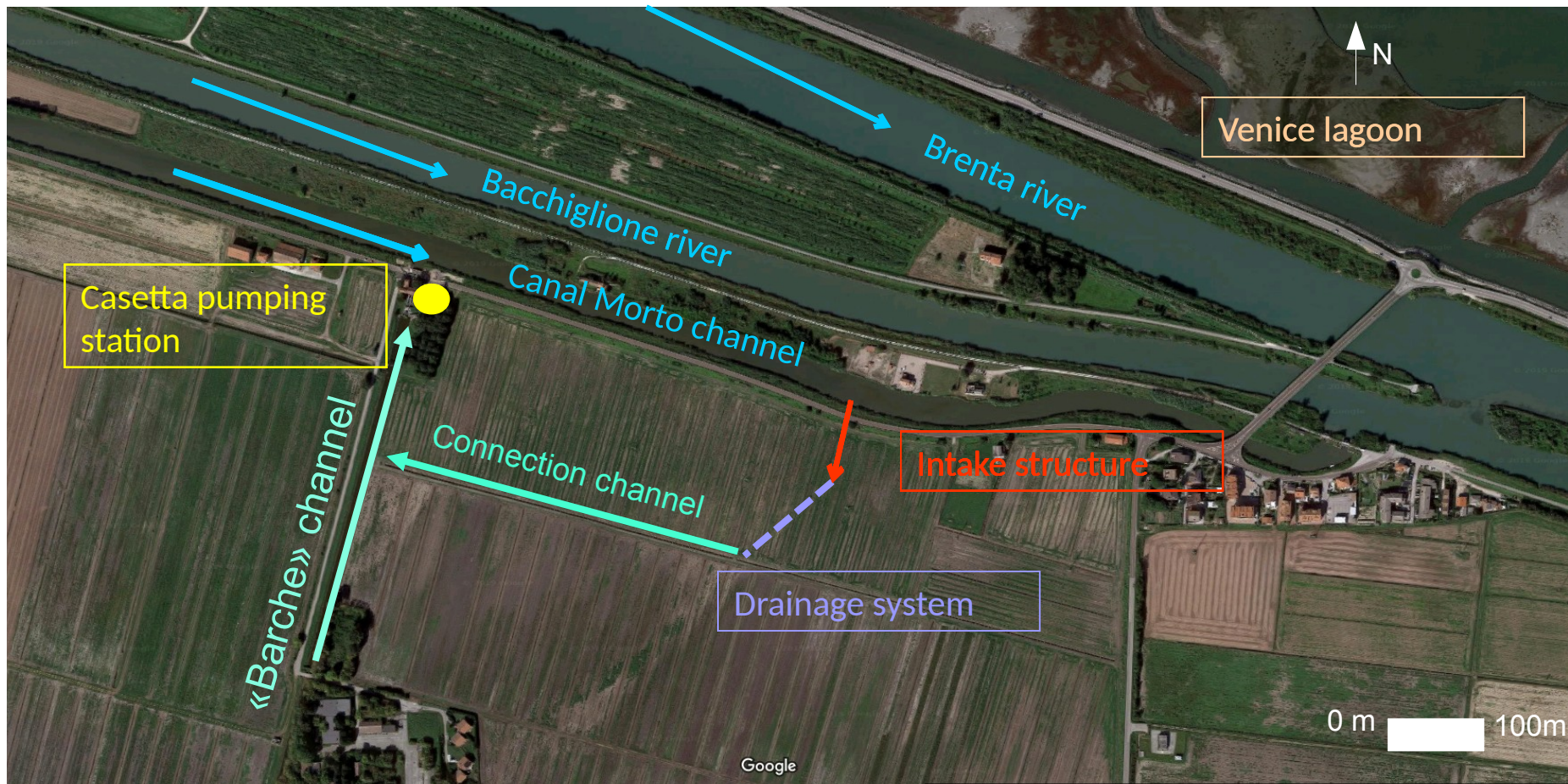
Case Study and Research question

- Saltwater intrudes inland for 20 km from the coastline
- Depth of fresh-saltwater interface varies from 2 to 30 meters below the ground surface.

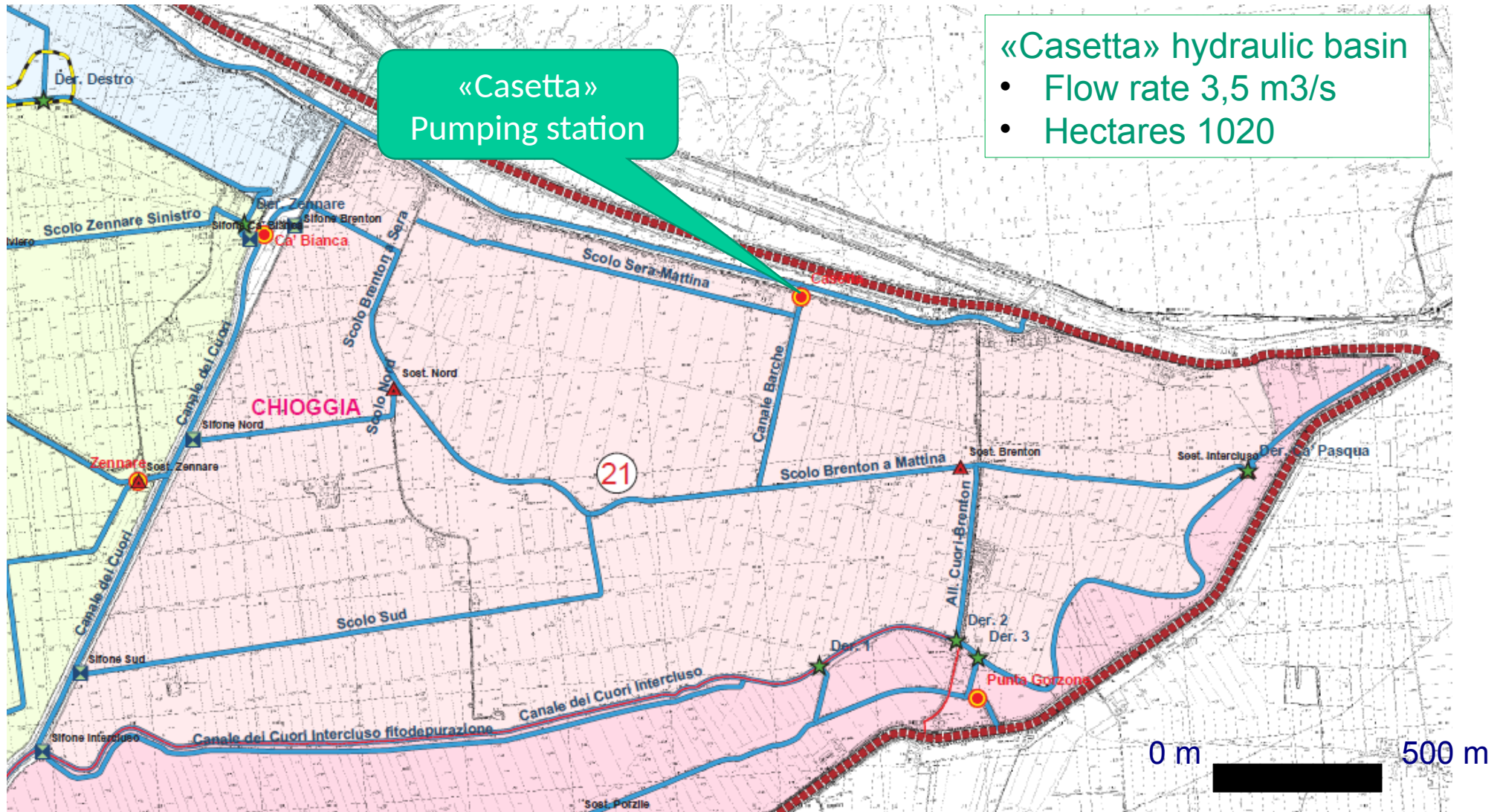


• An *a priori* proper estimation of the water table dynamics of the pilot site is essential to mimic saltwater intrusion and to assess properly the effectiveness the fresh-water mitigation countermeasures (the drain)

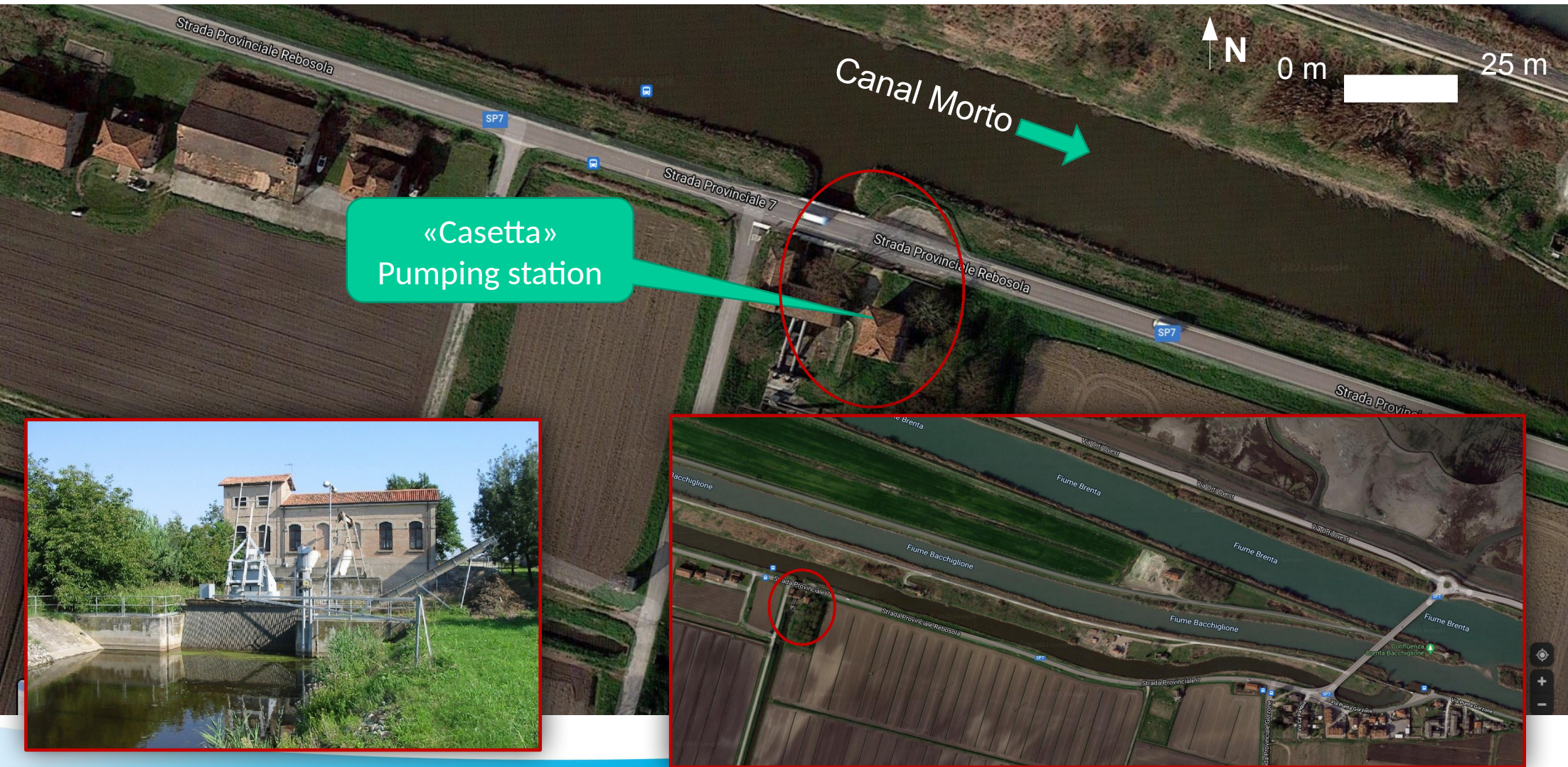
The management of the Ca' Pasqua pilot site- hydraulic scheme



The management of the Ca' Pasqua pilot site- «Casetta» hydraulic basin



The management of the Ca' Pasqua pilot site- «Casetta» pumping station



The management of the Ca' Pasqua pilot site- «Casetta» operating levels

CASSETTA

0 Livelli

- Liv Asp ■
- Liv Sca ■

1 Tensione

- PT ■
- PB ■

2 Stato Pompe

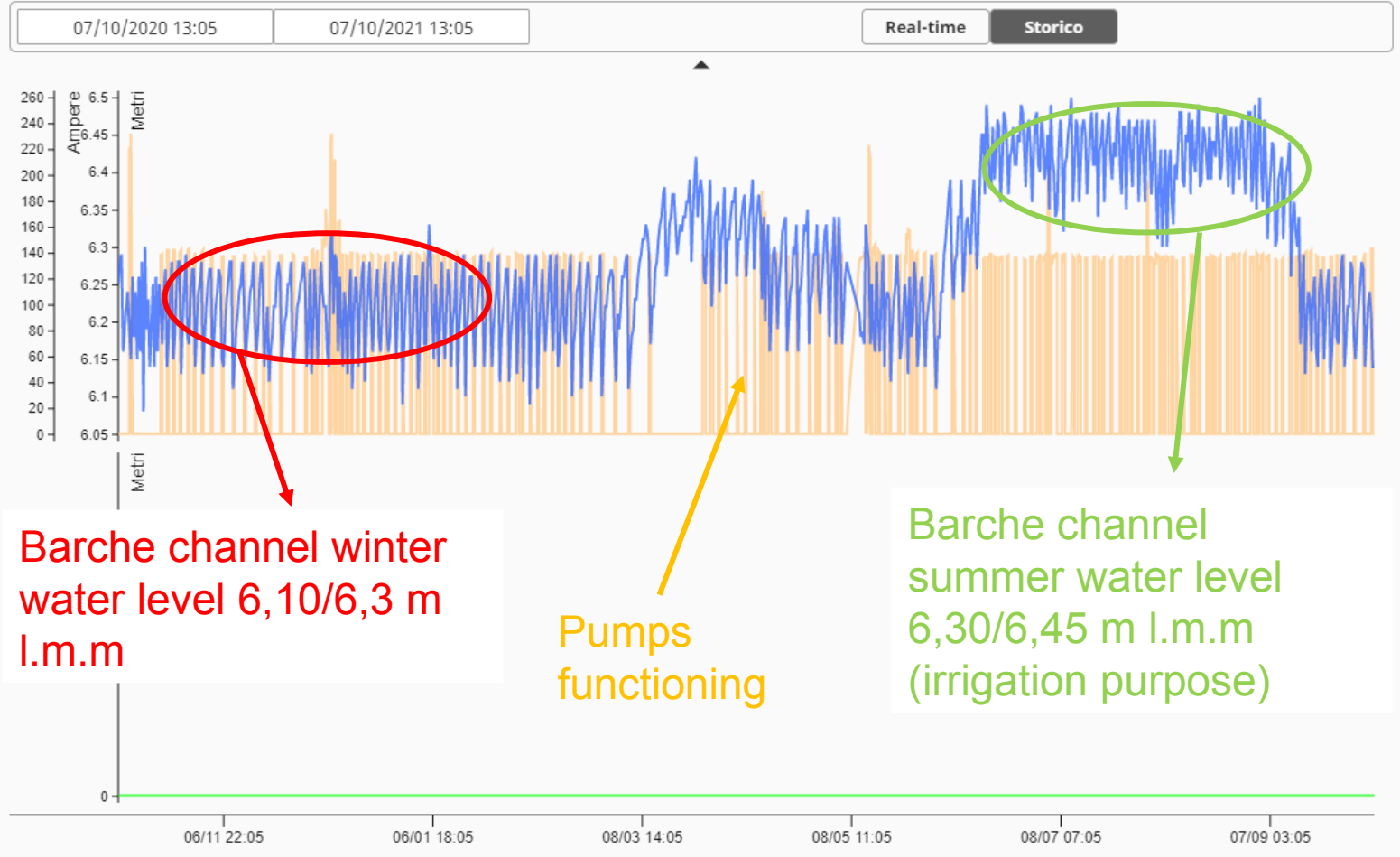
- P1 corrente ■
- P2 corrente ■
- P1 blocco ■
- P2 blocco ■
- P1 marcia ■
- P2 marcia ■

3 Selettori Pompe

- P1 auto ■
- P2 auto ■

4 Conducibilità

- Conducibilita ■



The management of the Ca' Pasqua pilot site- «Trezze» operating levels

TREZZE

0 Livelli

- Liv Asp
- Liv Bac
- Liv PV

1 Start-Stop

- Start 1
- Start 2
- Start 3
- Start 4
- Stop1
- Stop2
- Stop3
- Stop4

2 Stato Pompe

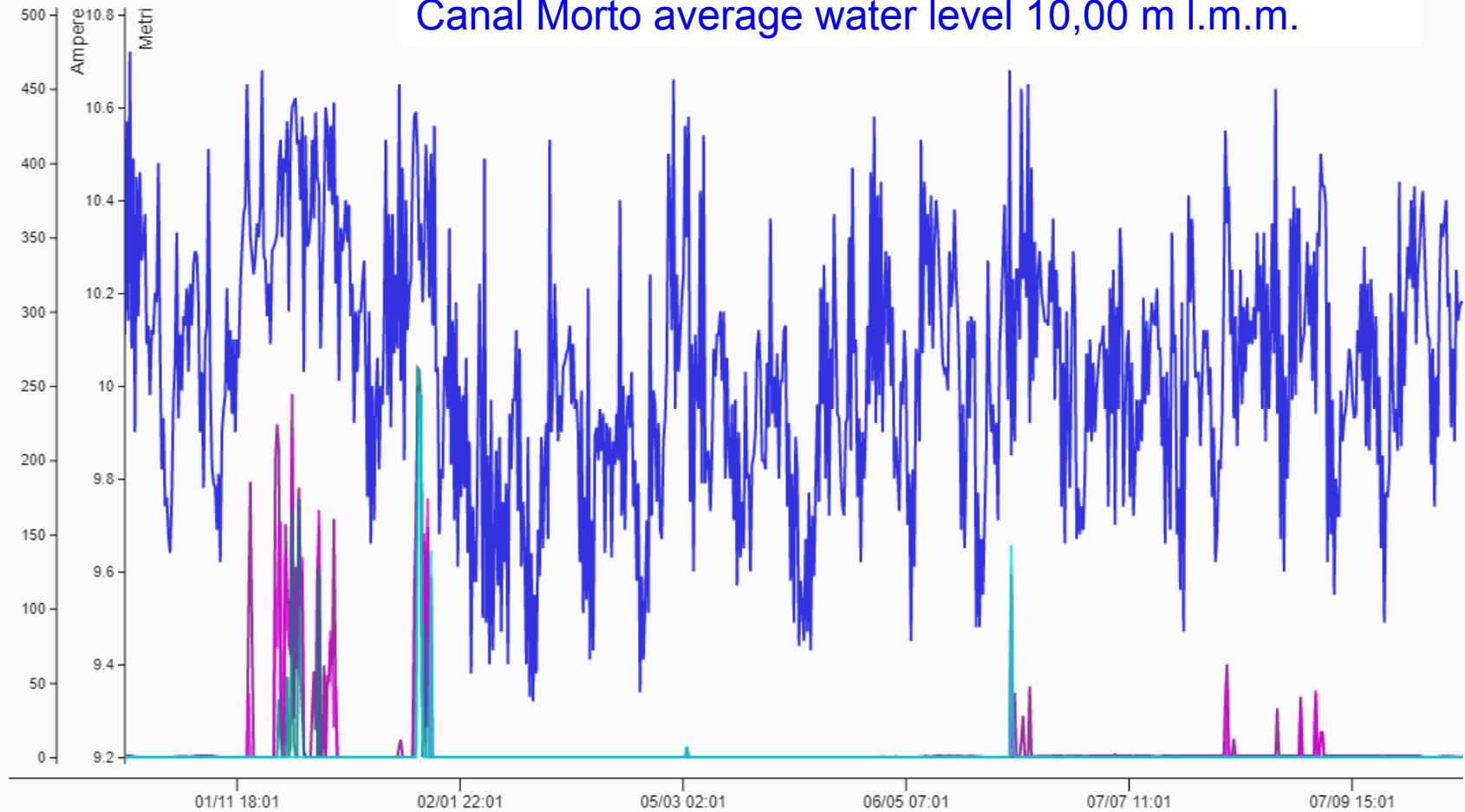
- P1 corr
- P2 corr
- P3 corr
- P4 corr
- P1 blocco
- P2 blocco
- P3 blocco
- P4 blocco
- P1 marcia
- P2 marcia
- P3 marcia
- P4 marcia

Ultimo anno

Real-time

Storico

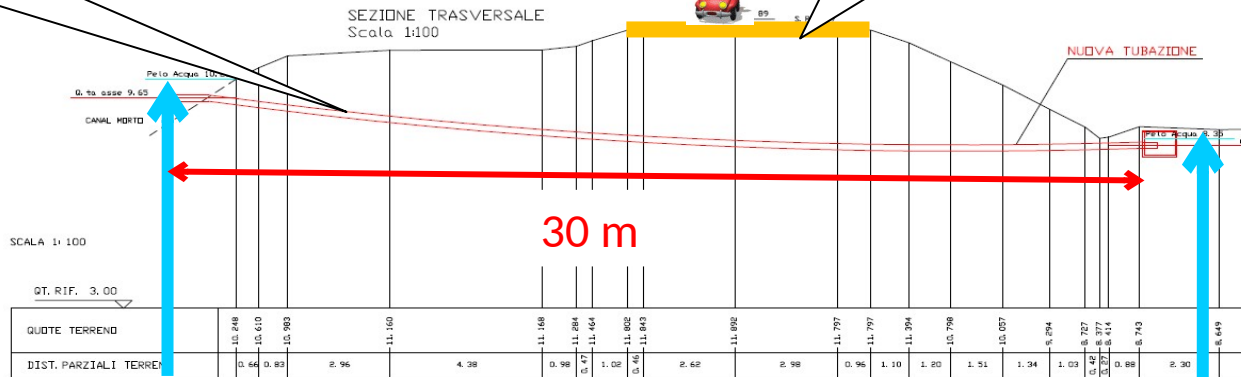
Canal Morto average water level 10,00 m l.m.m.



The management of the Ca' Pasqua pilot site- Intake structure levels

**Pipe PEAD
Ø200 mm**

**Provincial
road no.7**



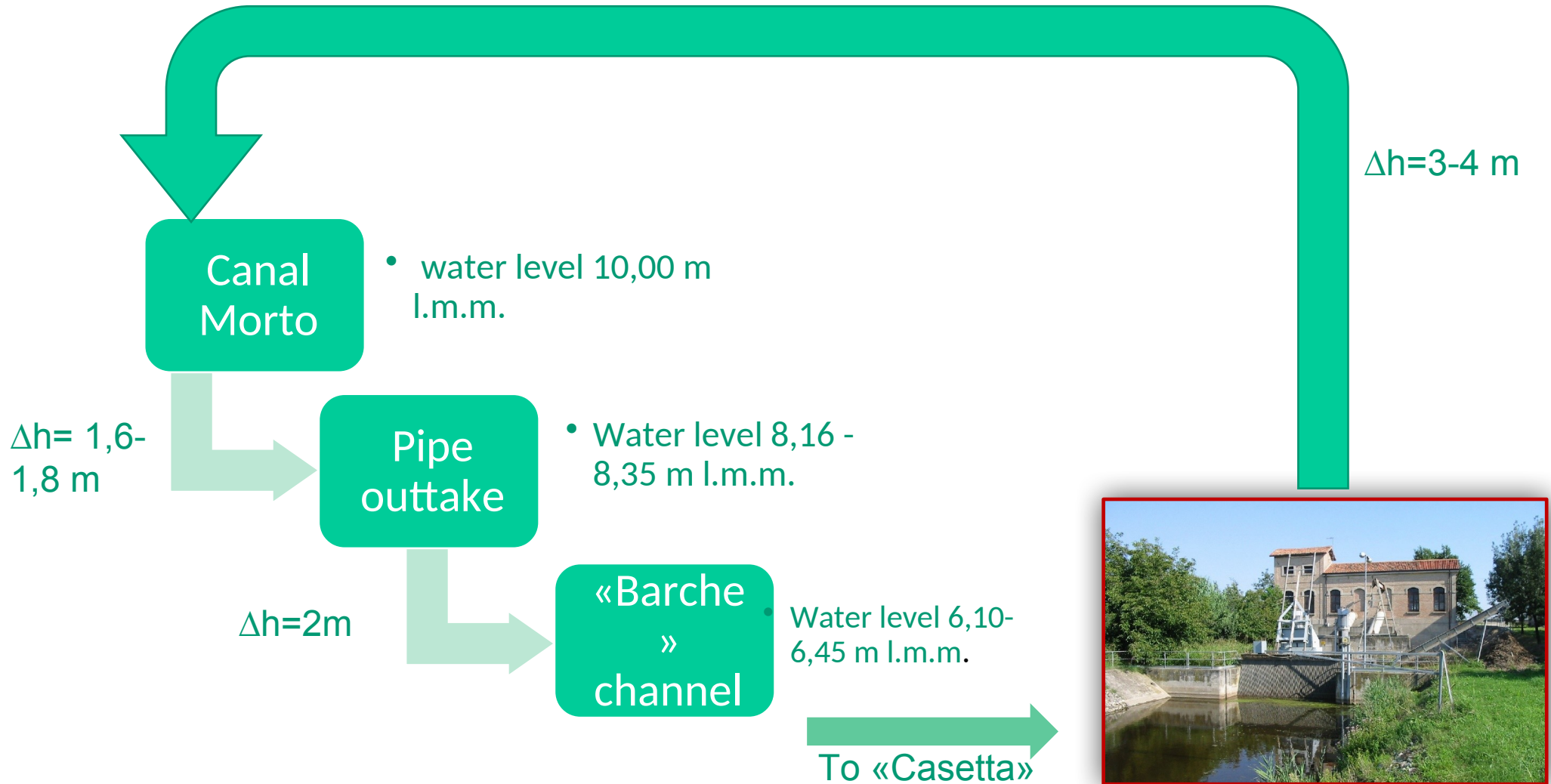
Canal Morto river water level 10,25 m
Pipe intake level 9,65 m

Outflow level 8,35 m
Pipe out take level 8,16 m

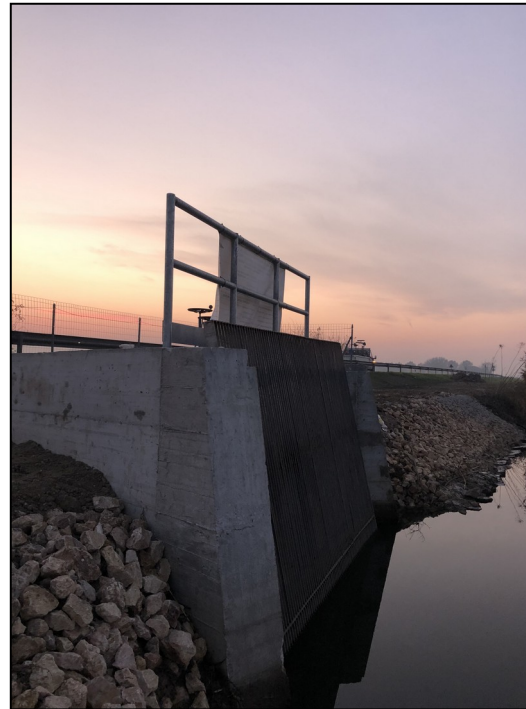
A PEAD pipeline starts from the intake structure for a length of about 35 m and crosses the embankment, in order to bring the fresh water of the canal to the neighboring countryside.



The management of the Ca' Pasqua pilot site- Water levels scheme



REALIZED INTAKE STRUCTURE

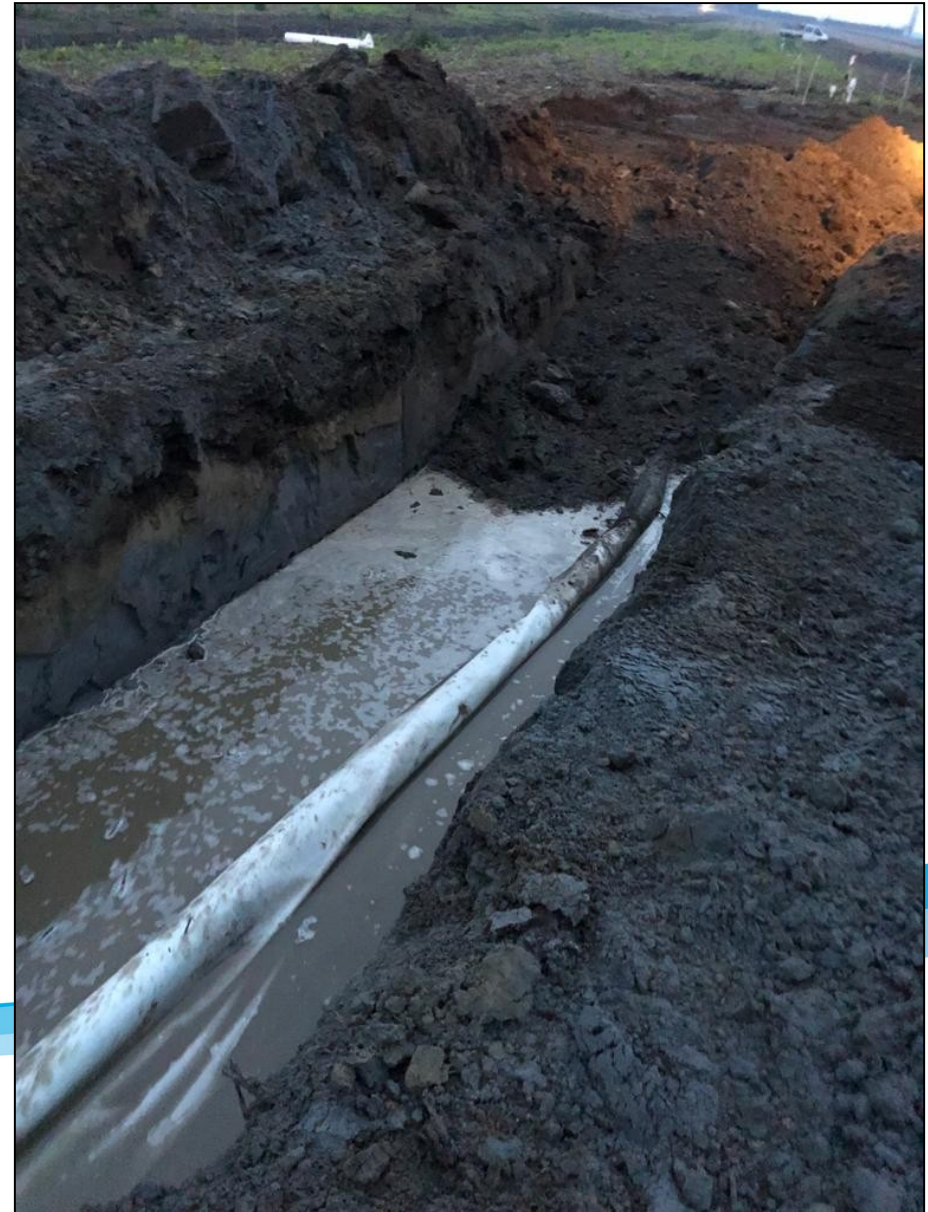


Finished construction of the intake work from the Canal Morto.

In the intake work there are two stainless steel guillotine gate valves placed at different heights in order to derive the most suitable water both in terms of flow rate and concentration of salinity.

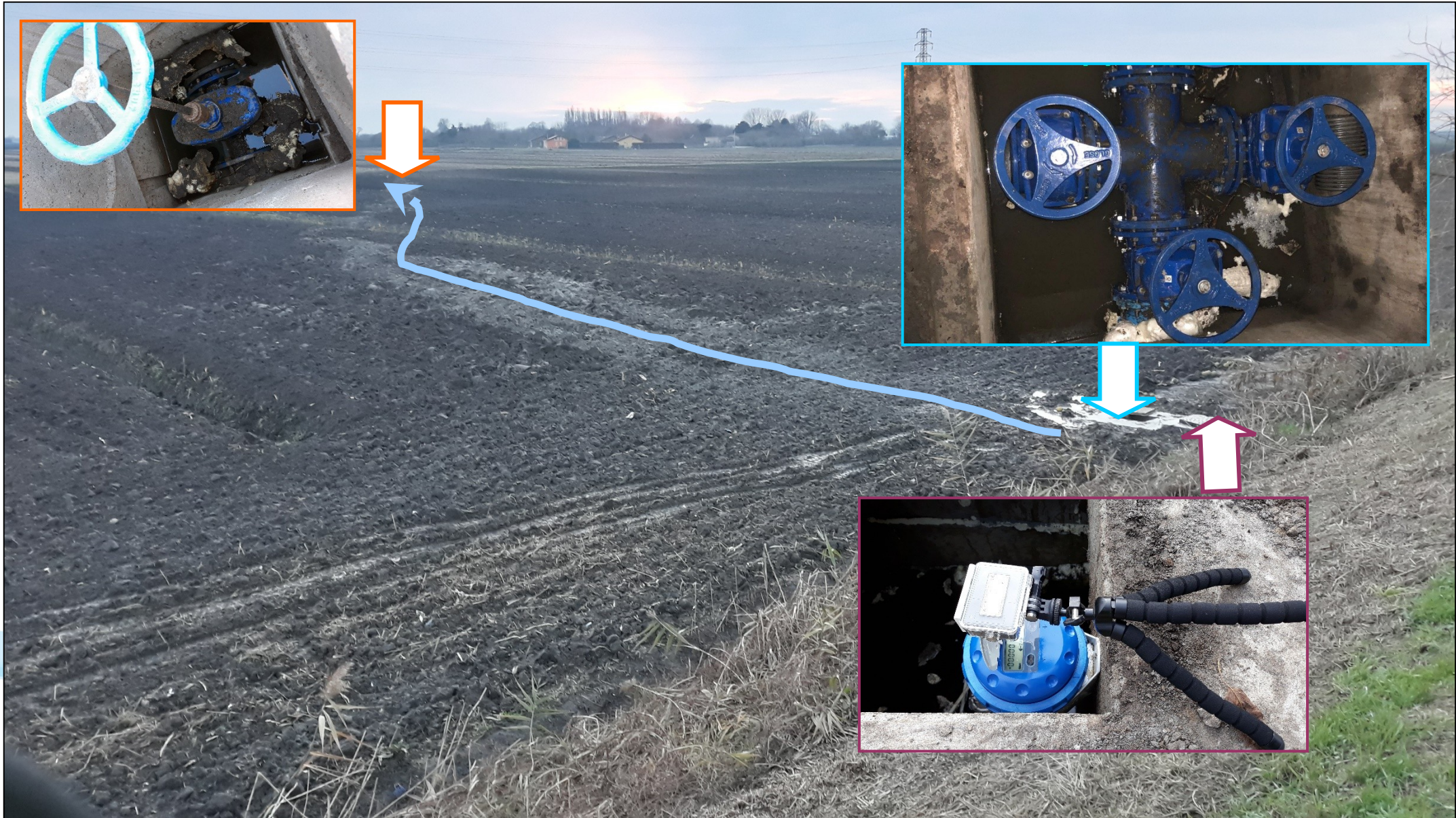
LAYING THE DRAIN FOR SUB IRRIGATION

For a length of 220 m, a 160 mm diameter drain pipe will have to fill an existing paleo riverbed using the water taken from the Morto channel.



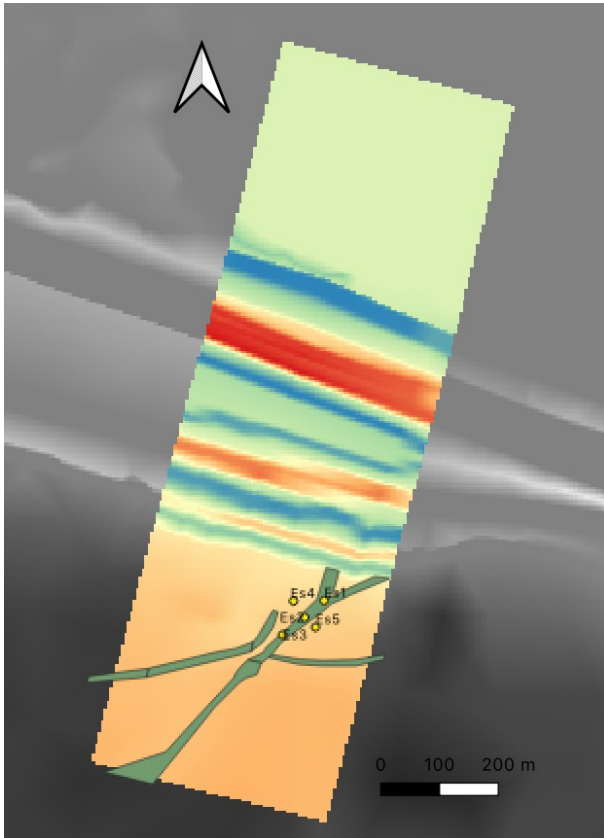
LAYING THE DRAIN FOR SUB IRRIGATION

At the beginning of the drain pipe, two wells contain operating devices and a flow meter. A data logger has been purchased and it is soon to be installed.



Numerical modeling of the pilot site

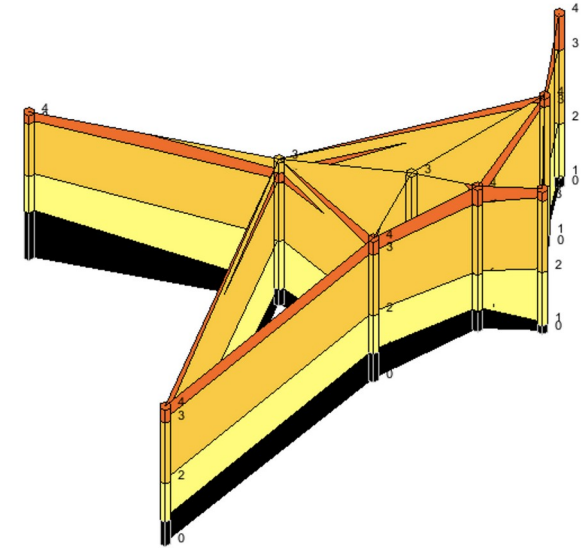
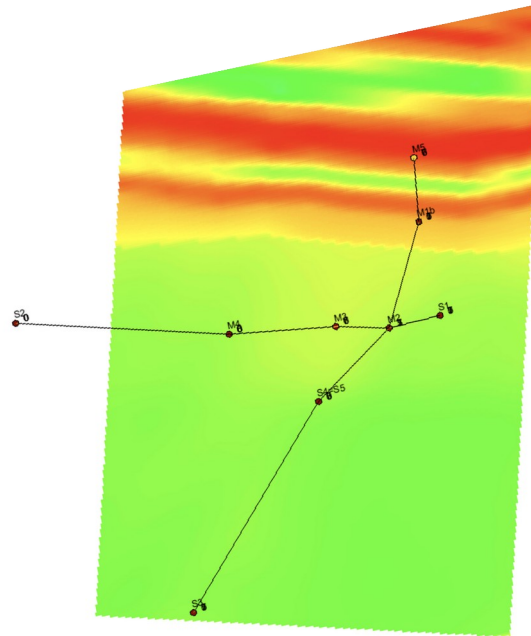
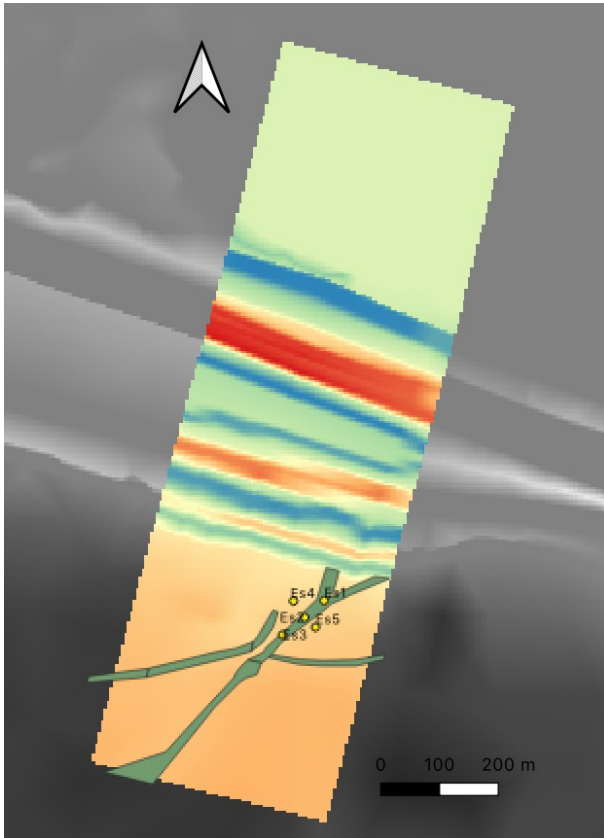
Topography and Stratigraphy updating



- Definition of the **bathymetry** (RAS mapper in HEC-RAS) with PAI 2000 sections and integration with the **inland interpolated DEM**.

Numerical modeling of the pilot site

Topography and Stratigraphy updating



- Definition of the **bathymetry** (RAS mapper in HEC-RAS) with PAI 2000 sections and integration with the **inland interpolated DEM**.
- Stratigraphical models: **new boreholes** information.

Numerical modeling of the pilot site

Building up a physical and a finite difference numerical model

- Definition of the main **materials (trade-offs)**: **silt, medium sand, coarse sand silty clay** (caranto is considered an impermeable layer)
- Further material have been added for specific purposes – **levees and rivers conductivity**

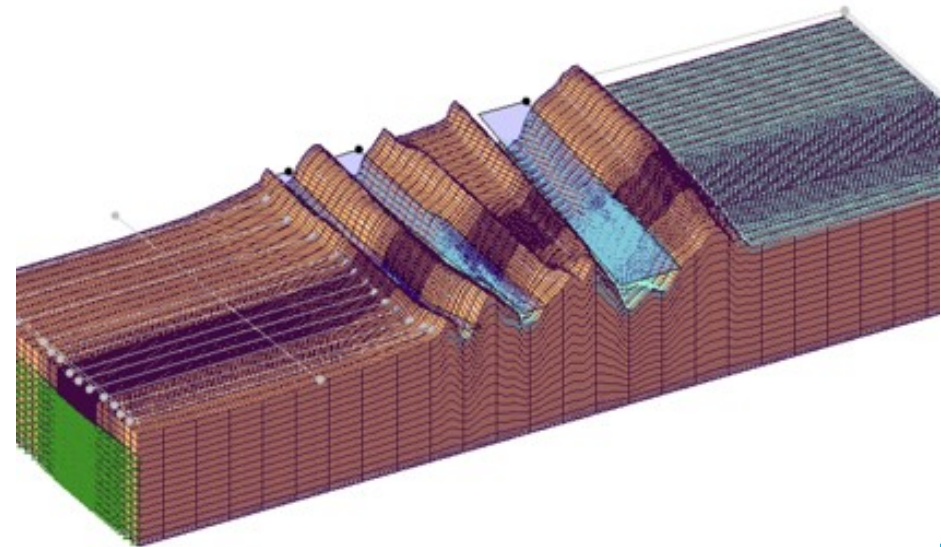
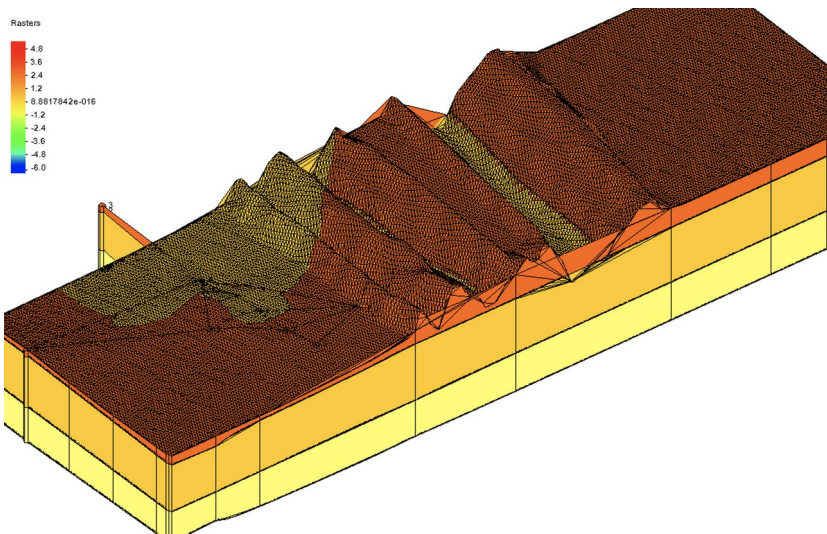
Mesh type: finite difference cell centered 400*72*15

N° nodes: 468368 N° cells: 432000

X length=444.73 m; Y length=1289.57 m;

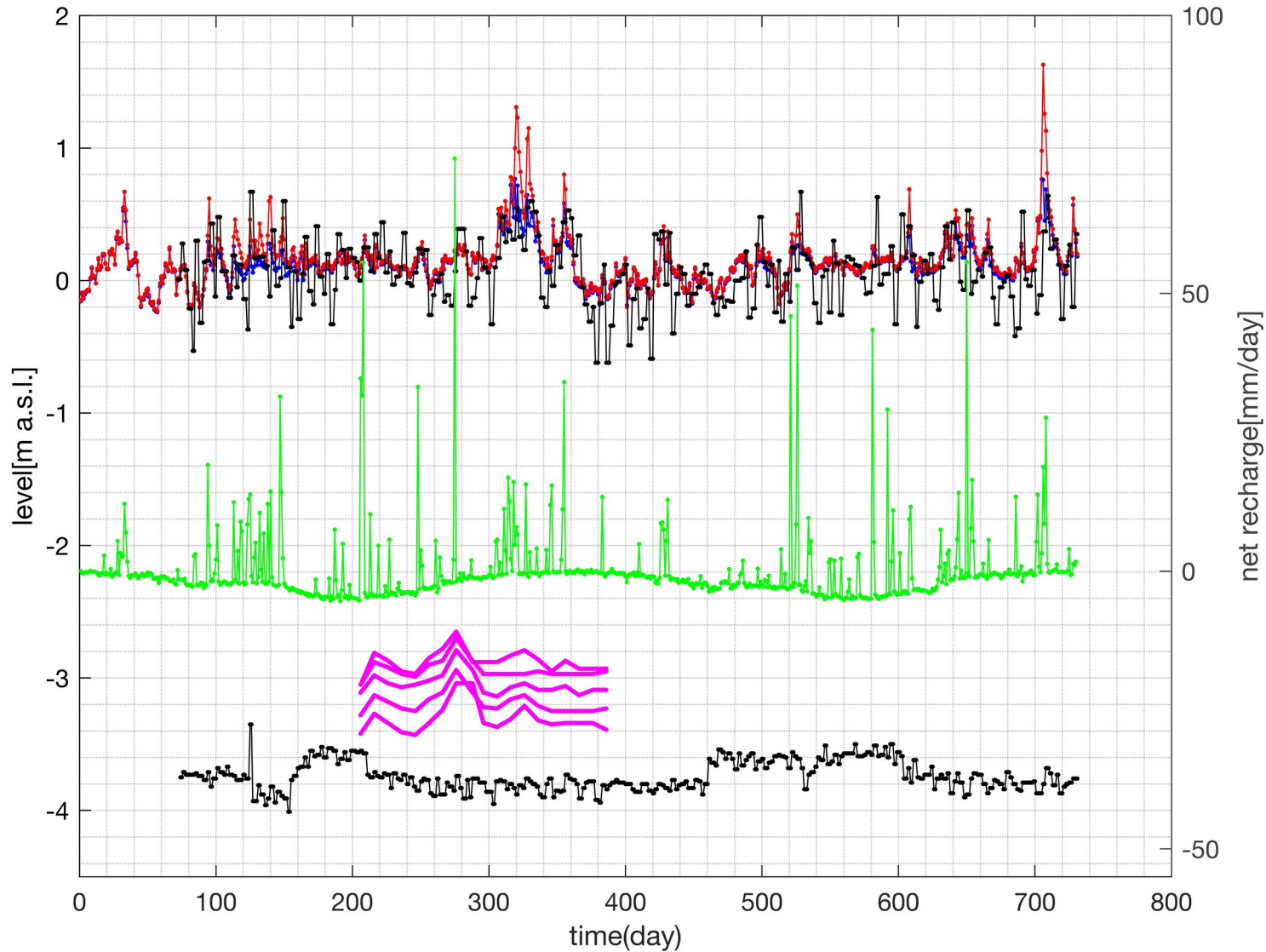
Z length= 22.96 m

Vertical element dimension > 1 m



Numerical modeling of the pilot site

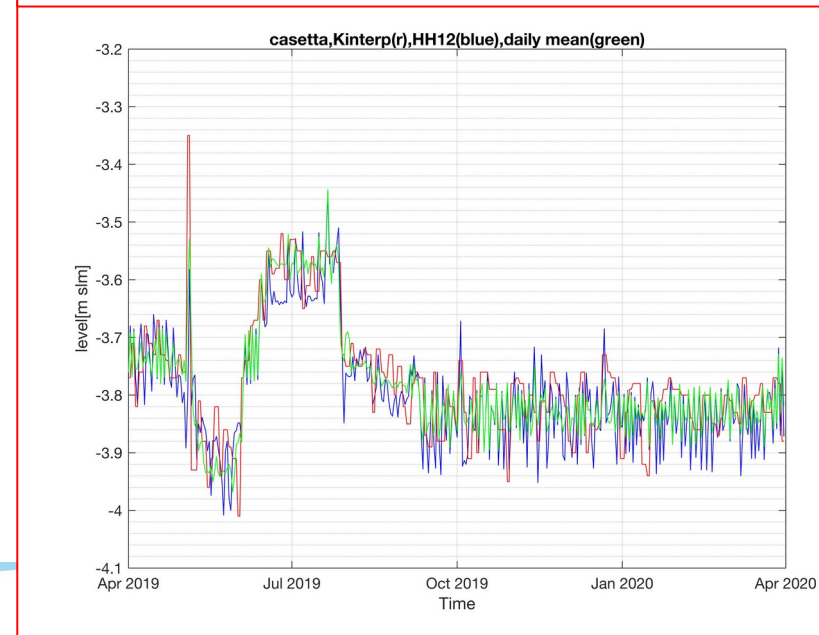
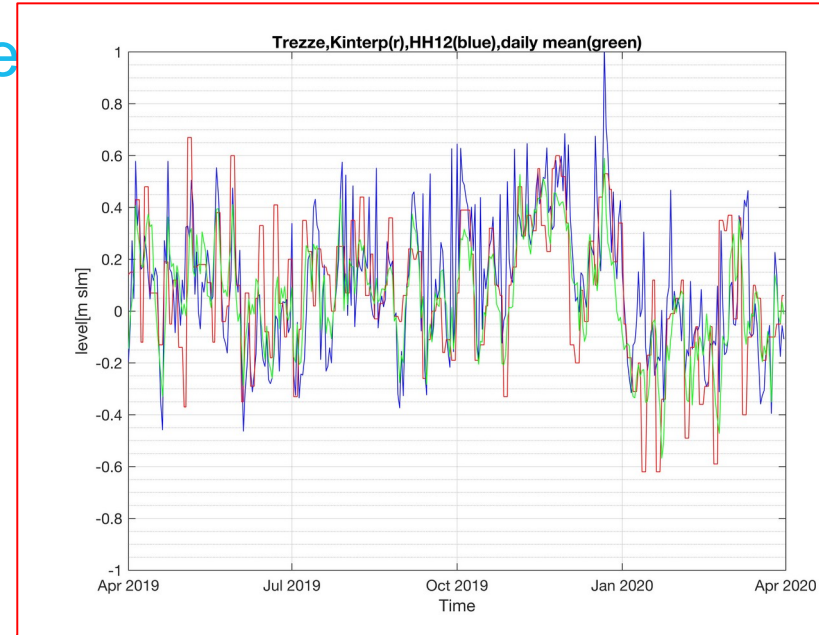
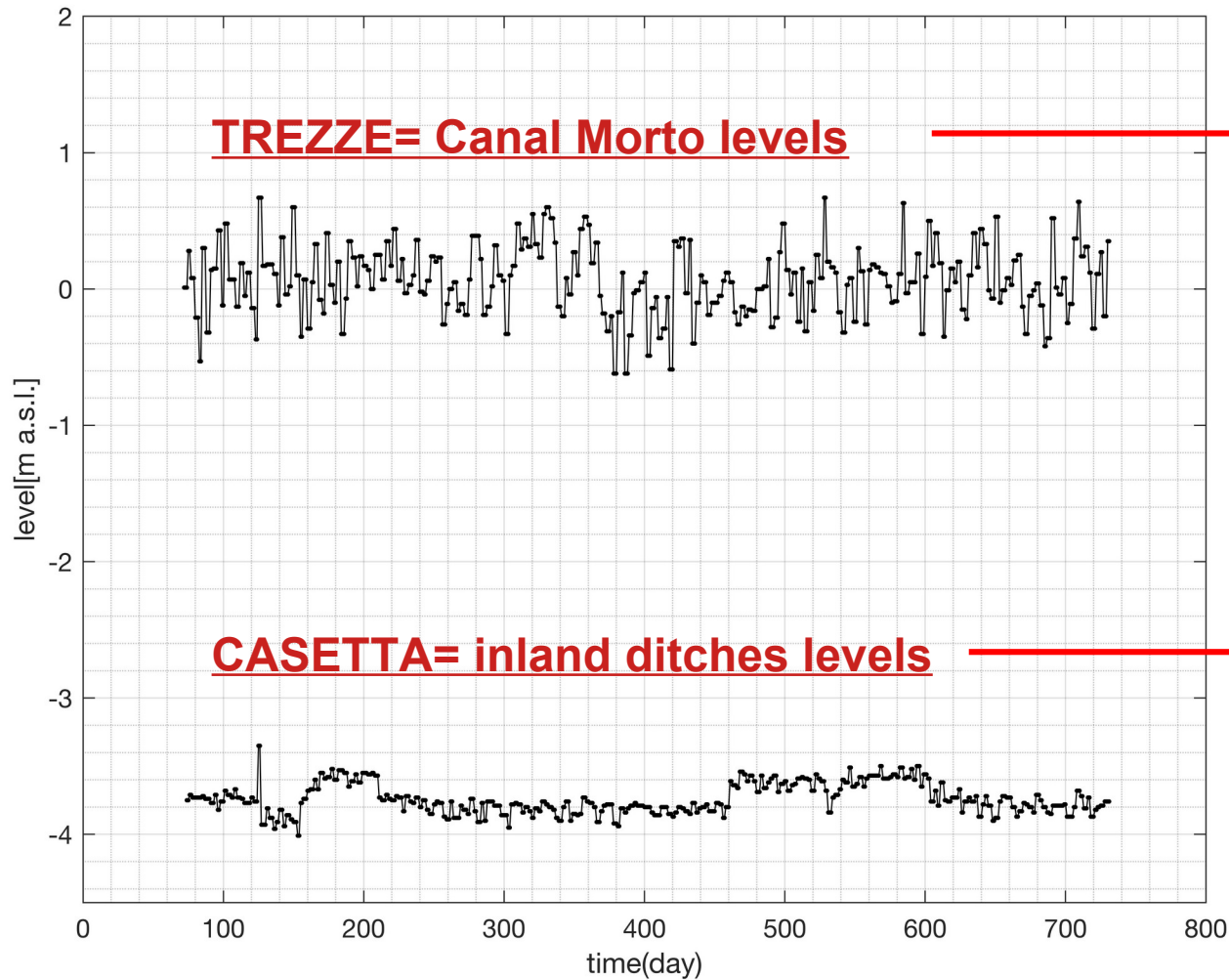
Forcings actions updates



- Lagoon level – light blue
- Brenta and Bacchiglione river levels – red – HEC-RAS model
- **Net recharge – green, contribution of the potential and corrected Evapotranspiration**
- Trezza levels=Canal morto – black
- Casetta levels= ditch network and guard ditches
- Measurements -magenta

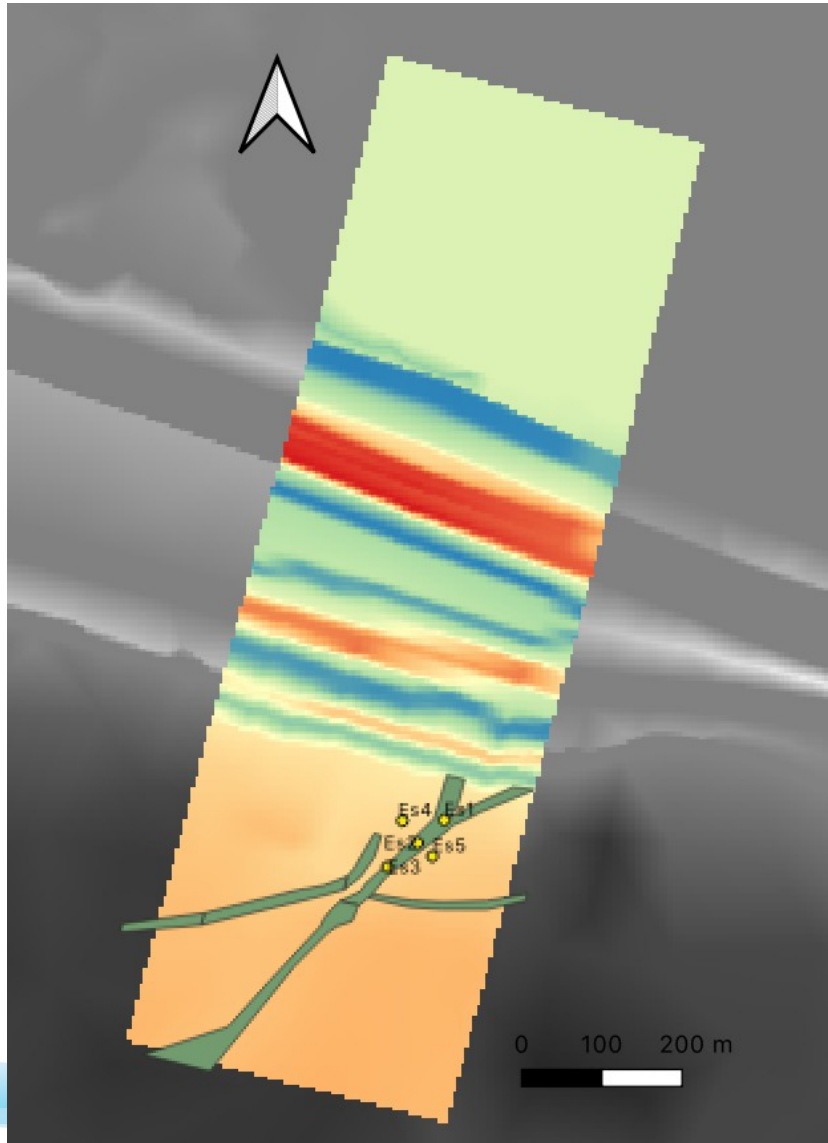
Numerical modeling of the pilot site

Forcings actions: insights on Casetta and Trezze



Numerical modeling of the pilot site

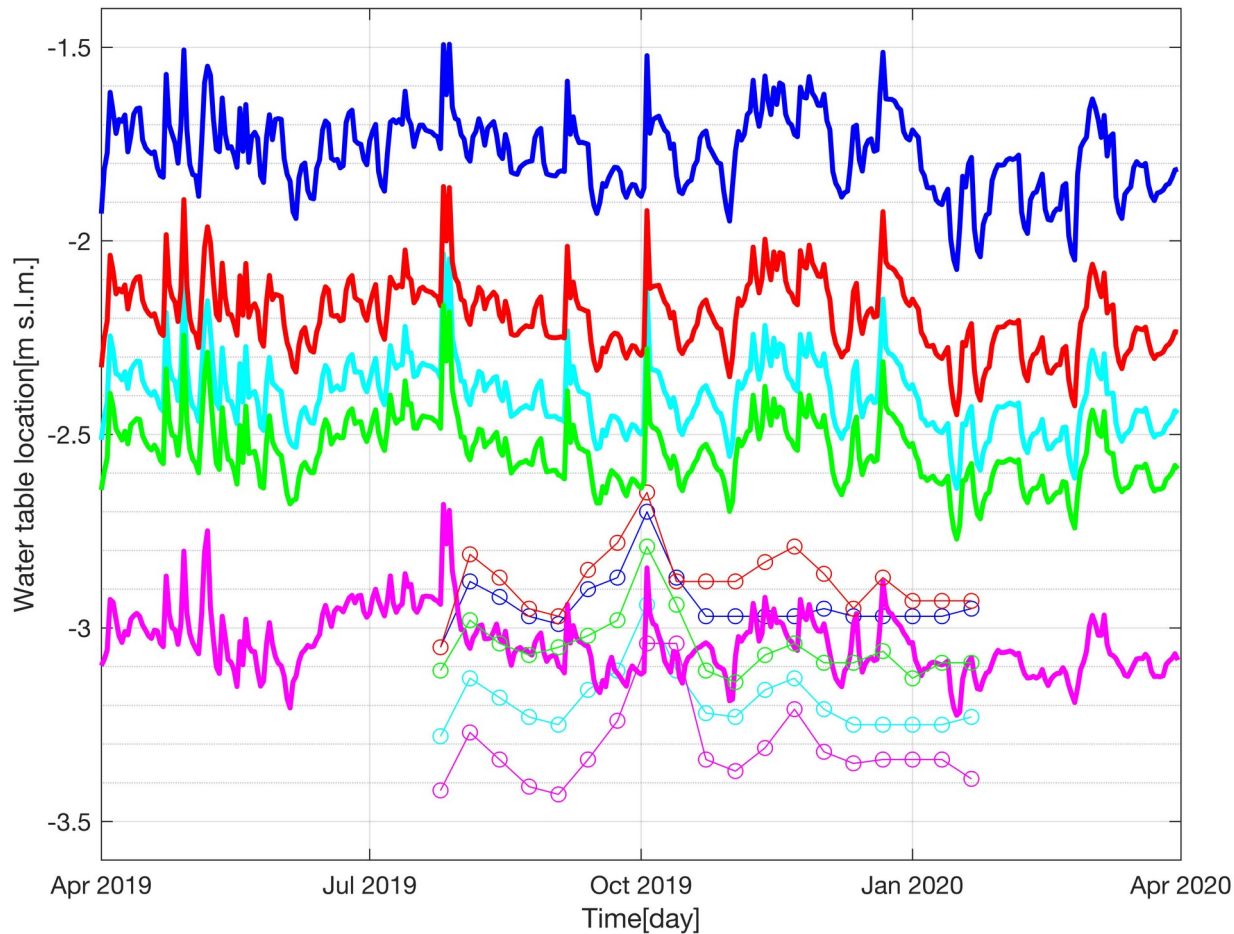
Boundary conditions: new developments



- **Lagoon** = daily resolution HH=12:00
Type of boundary conditions: CHD, Dirichlet
- **Brenta** = HECRAS hydraulic models , daily resolution
Type of boundary conditions: CHD, Dirichlet
- **Bacchiglione** = see HECRAS hydraulic model, daily resolutions
Type of boundary conditions: CHD, Dirichlet
- **Canal Morto** = **TREZZE** levels
Type of boundary conditions: CHD, Dirichlet
- **Guard ditch 1 and 2** = **CASSETTA** levels
Type of boundary conditions: **GHB, Neuman**
- **Ditch network** = **CASSETTA** levels
Type of boundary conditions: **GHB, Neuman**

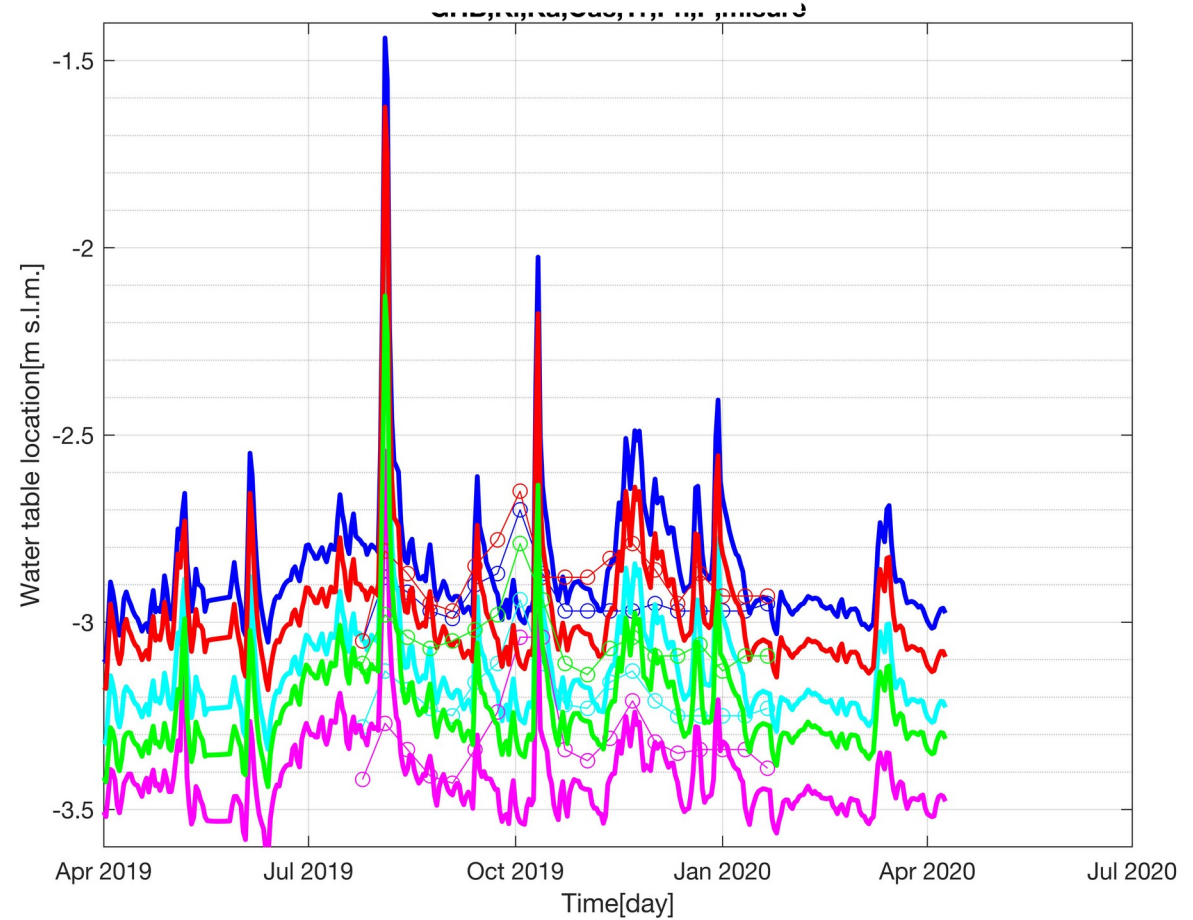
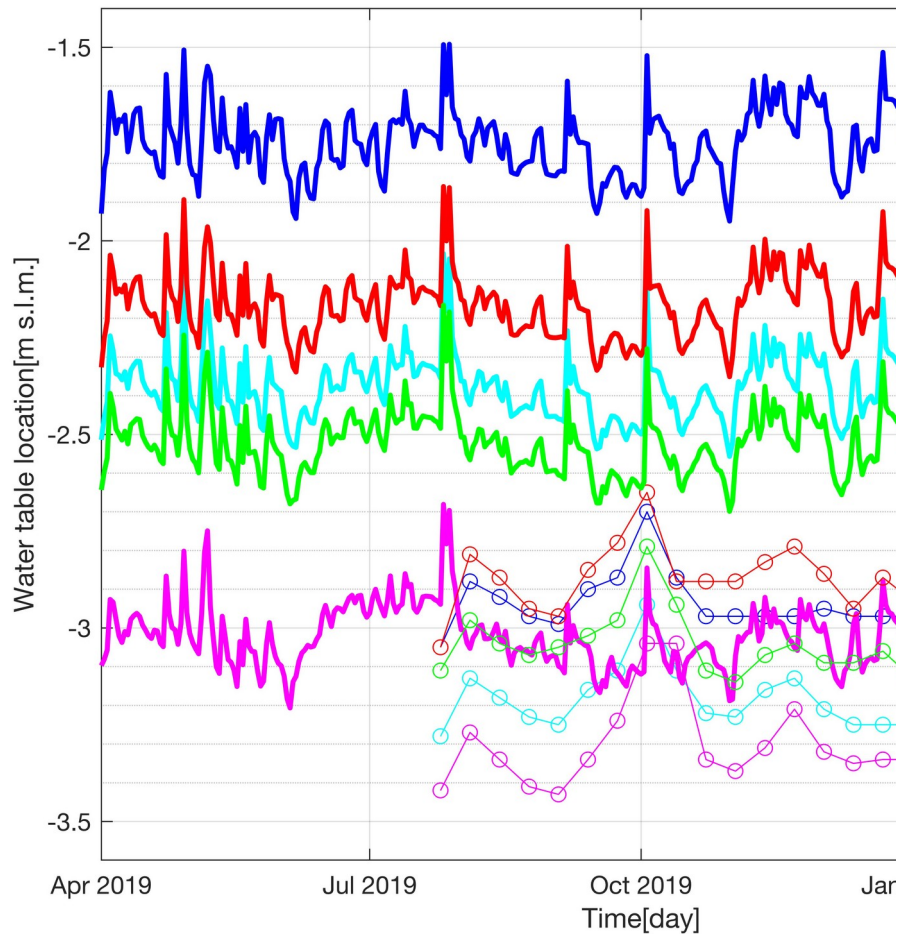
Numerical modeling of the pilot site

Water Table results and comparison



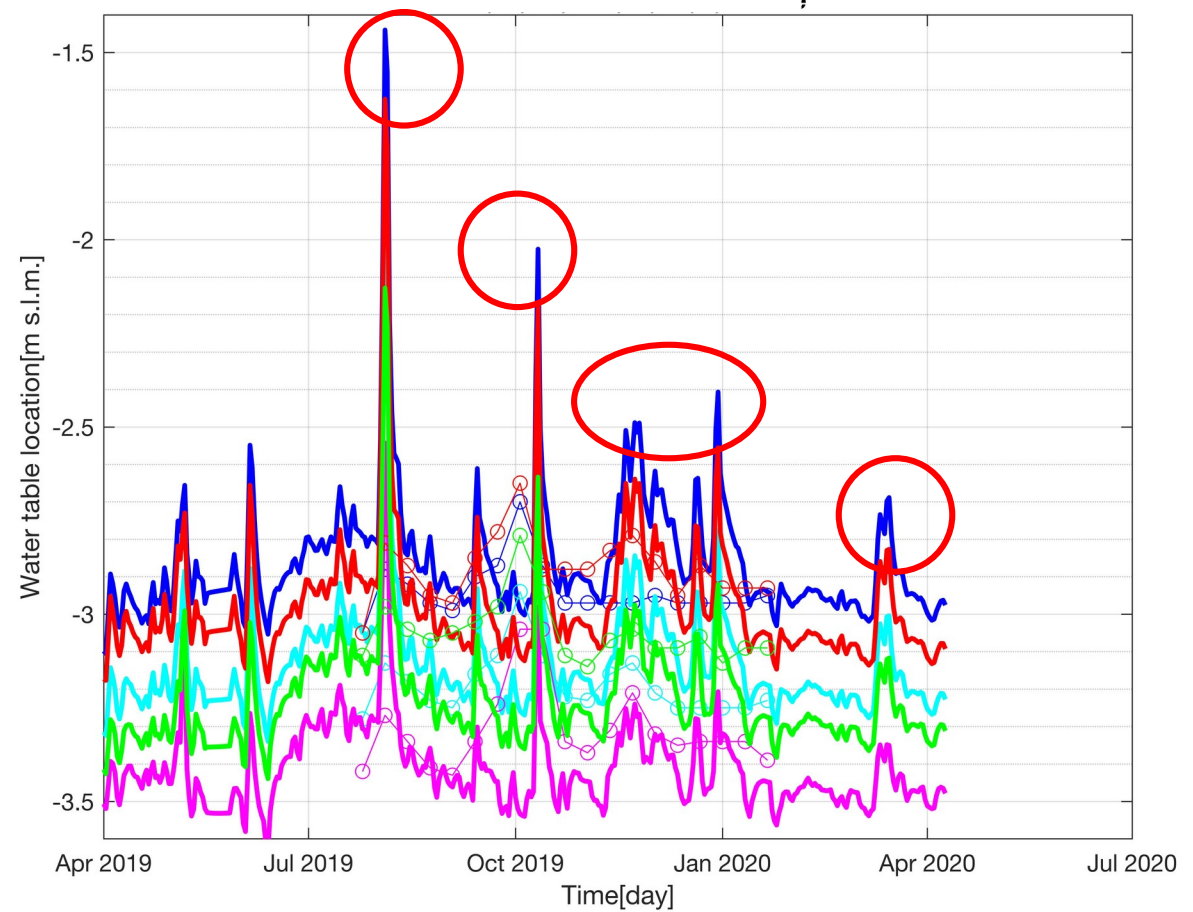
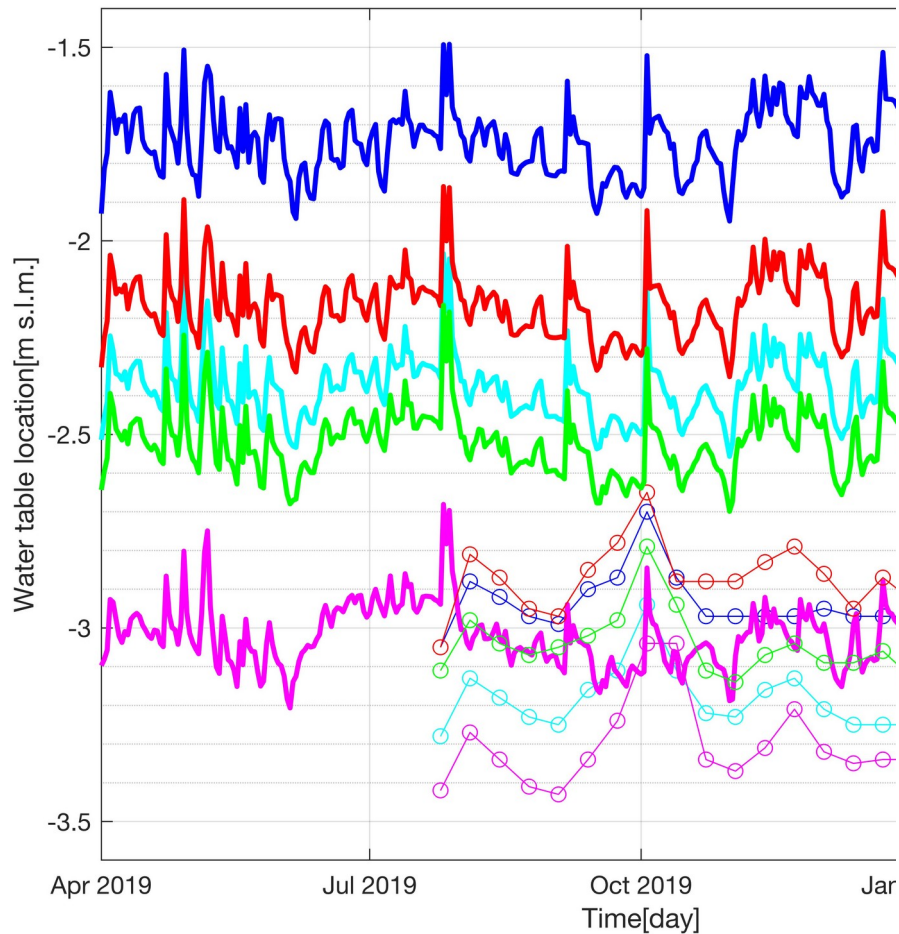
Numerical modeling of the pilot site

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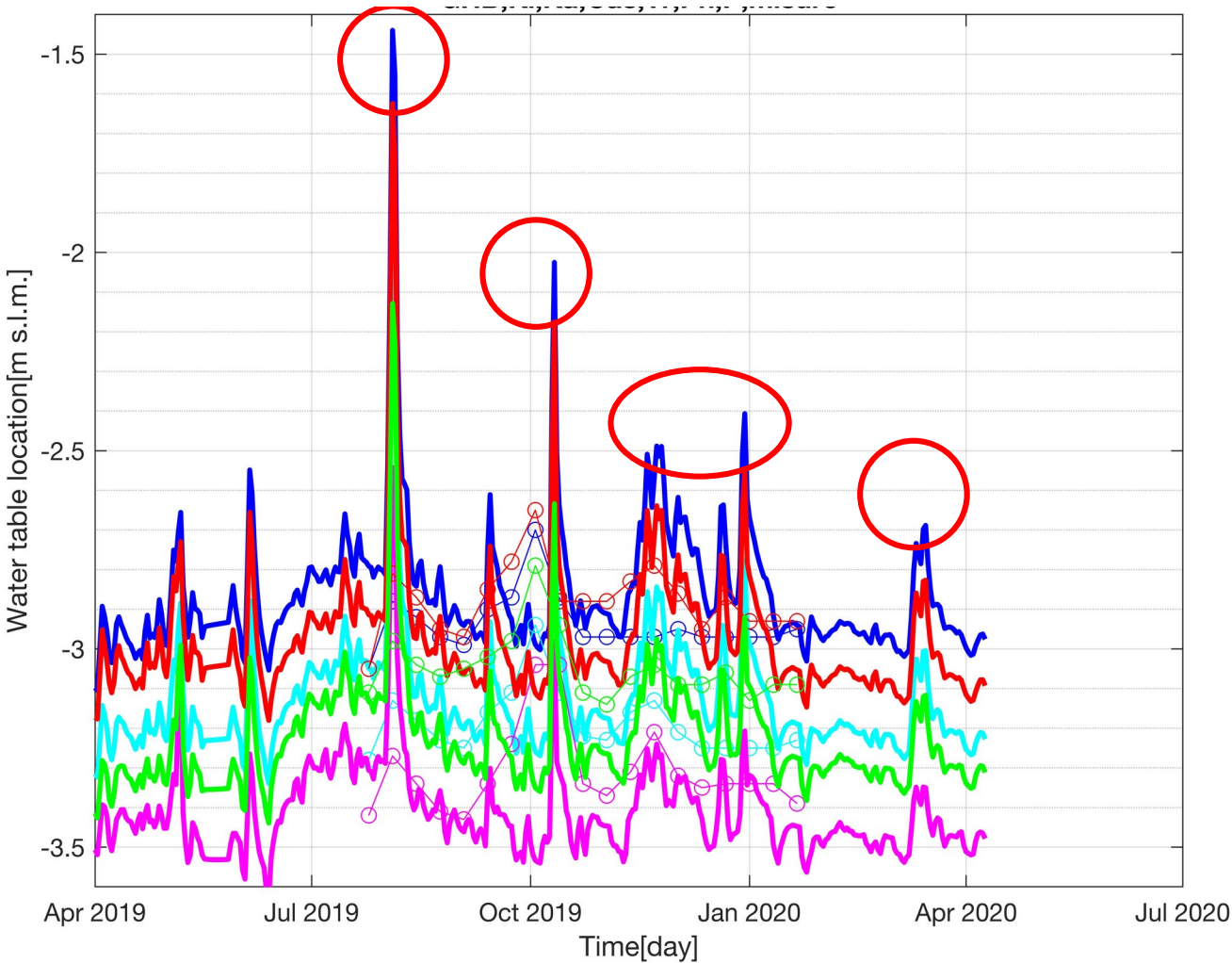
Numerical modeling of the pilot site

Water Table results and comparison



Numerical modeling of the pilot site

Water Table results and comparison



Improvements on the water table DYNAMICS: possible strategies

- **VADOSE ZONE** modelling (Brooks and Corey WRC)
- Better Characterization of the **PARAMETERS** → **PEST inverse model**

Conclusions

- Numerical modelling can be a **useful tool** to mimics the processes therein only if a **proper knowledge** of the physical characterization and dynamics is acquired.
- **Water table analysis** is a preliminary essential step to improve the definition of the saltwater intrusion phenomenon.
- The pilot site is characterized by a **complex equilibrium** of water levels for **reclamation and irrigation** purposes depending on the season.
- Preliminary water table modelling results show a **good connection** between simulations and filed measurements.
- **Conductivity parameters** may play a role (PEST analysis) as well as the modelling of the **vadose zone**.

MAAKE
 TERMA KASIH RAIBH MAITH AGAT
 JUSPAXAR
 OBRIGADO
 MATONDO
 SALAMAT
 KIITOS
 MOCHCHAKKERAM
 MULTUMESC
 KIA ORA
 CHOKRANE
 SALAMAT
 CAM ON BAN
 GRAZIE
 MULTUMESC
 MERCI
 RAIBH MAITH AGAT
 OBRIGADO
 MOCHCHAKKERAM
 MERCI
 MOCHCHAKKERAM
 ASANTE
 CHOKRANE
 MATUR NUWUN
 UA TSAUG RAU KOJ
 MOCHCHAKKERAM
 MATONDO
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