

SeCure

Saltwater intrusion and climate change: monitoring, countermeasures and informed governance

Deliverable 2.1.3 – Final high-level event and
related documentation

July 2023 – Final version

Contributing partners:

LP – UNIPD , PP1 – CNR-IGG , PP2 – REGVEN , PP3 – UNIST ,
PP4 – DUNEA , PP5 – PIDNC , PP6 - CW

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1. SeCure final high-level event

The final high-level event of the SeCure project was organized on 28 June 2023 by Veneto Region (PP2), University of Padova (LP) and CNR-IGG (PP1), as planned in the AF of the SeCure Project and in the WP2 Communication Plan. Collaboration with Delta Po Reclamation Authority allowed the event to be held at the Regional Museum of Land Reclamation Ca' Vendramin (Taglio di Po - RO). The event was mainly addressed to Public Authorities (Local, Regional, and National) and also to Universities, Research institutes, and General Public. Participation was possible both in-person and online after registration. The link for the participation to the streaming event was sent to online participants. Translation from Italian to English and vice versa was provided on site. 52 participants attended the event: 36 on-site and 16 online. The signature list of the on-site participants and the record of online presence are provided in Appendix A. A few photos of the event are shown in Fig. 1, Fig. 2, Fig. 3, Fig. 4 and Fig. 5.



Fig. 1 – Aerial view of the Regional Museum of Land Reclamation Ca' Vendramin, location of the event.



Fig. 2 – Registration of participants at the beginning of the event.



Fig. 3 – The conference room with some of the attendees just before the start of the event.



Fig. 4 – During registration, each attendee received the agenda of the event.



Fig. 5 – Photo of all the Project Partners attendees.

2. Agenda

The agenda of the event was finalized after an intensive work carried out by PP2, supported mainly by LP and PP1 for the scientific interventions.

09:00 – 09:30

Registration

09:30 – 10:15

Greetings from the Authorities

Introduction and coordination of the event:

Paolo Salandin – Prof. at University of Padova, DICEA – Lead Partner of the SeCure project

Projection of the Final SeCure Video

10:15 - 10:30

Renata Marušić – Joint Secretariat of Interreg Italy - Croatia CBC Programme 2014-2020

10:30 - 11:30

The Croatian site: activities and results of the SeCure project

Veljko Srzić (FGAG – University of Split): *Benefits from the CBC Interreg IT-CR: Neretva site 2019-2023*

Ana Tutavac (Public Institution for Management of Protected Natural Areas of the Dubrovnik-Neretva County – PIDNC): *Climate changes in Neretva River Delta: Awareness raising and Biodiversity research*

Petra Sušak (DUNEA): *Communication activities on the SeCure project*

Danko Holjević (Croatian Waters): *Hrvatske vode in SeCure project - Informing the professional and scientific public and educating the youngest*

11:30 – 12:00

Coffee break

12:00 – 13:00

The Italian site: activities and results of the SeCure project

Valentina Bassan (Veneto Region – Soil and Coast Defence Directorate):

The dissemination of knowledge to increase awareness in the territory

Luigi Tosi (Institute of Geosciences and Earth Resources - National Research Council): *Monitoring and analysis of saltwater intrusion mechanisms: consolidated results to address the next challenges*

Pietro Teatini (Dept. ICEA – Padua University): *Mitigation of shallow aquifer salinity through recharge with sub-surface drains. The SeCure test at Ca' Bianca, Venice*

Paolo Salandin (Dept. ICEA – Padua University): *Insights on the movement of the salt wedge affected by drought periods from numerical and physical experiments*

13:00 – 13:15

Rodolfo Laurenti (Deputy Director of the Delta del Po Reclamation Authority): *The Po Delta, general overview of the territory, challenges, and solutions from the reclamation world to counteract saline intrusion*

13:15 – 13:30

Discussion and Conclusion

2.1 Greetings from authorities and introduction of the event

The final high-level event started with greetings from public authorities and scientists (Fig. 6): Adriano Tugnolo (President of the Delta del Po Reclamation Authority and Ca' Vendramin Foundation), Paolo Salandin (Professor at University of Padova, DICEA – Lead Partner of the SeCure project), Enrico Lorenzetti (Director of the Hydrogeological Planning Unit - Veneto Region, Directorate for Land and Coastal Defense), and Sandra Donnici (Head of the Padua Branch of CNR-IGG).



Fig. 6 – Greetings from authorities. In order from left to right: Paolo Salandin, Adriano Tugnolo, Sandra Donnici, and Enrico Lorenzetti

A short introduction of the SeCure project was given by Prof. Paolo Salandin (Lead Partner of the SeCure project) which also moderated the event. A short video was projected to highlight the main results of the SeCure project which is available at this link:

<https://www.youtube.com/watch?v=941uycGsBfg> and on the project website (<https://programming14-20.italy-croatia.eu/web/secure/about-the-project>).

During the introduction, Renata Marušić (Fig. 7), from the Joint Secretariat, showed the major achievements of the Interreg Italy - Croatia CBC Programme 2014-2020 and introduced the next programming period.



Fig. 7 - Dr. Renata Marušić during her speech.

2.2 The Croatian site: activities and results of the SeCure project

Four presentations were given by the Croatian partners highlighting the main results and dissemination of the project. A summary of their interventions is provided in the following and presentations' slides are attached in Appendices B.

Benefits from the CBC Interreg IT-CR: Neretva site 2019-2023

Veljko Srzić, *University of Split, Faculty of Civil Engineering*

Sea water intrusion (SWI) has been evidenced as a mechanism influencing ground and surface water bodies in coastal aquifer systems along the Mediterranean. During the past, SWI has been monitored either modeled leading to the unique conclusion coastal systems are significantly affected by the decrease of the natural water quality thus resulting in the reduction of agricultural production in these areas.

Neretva coastal system is located in the southeastern Croatia, at the coast of the Adriatic Sea. The area is mainly arable, offering in total 4300 ha of land found within three melioration sub systems. Along the hydrological year two main periods are recognized, rain and dry one, creating different local conditions and resulting in variable salinity regimes of ground and surface water.

Following climate changes influence, we demonstrate spatio temporal salinity features driven by the increase of the sea water elevation and reduction in precipitation as found along the area of interest. As a baseline, SEAWAT has been used to conduct a 3D variable density model to mimic local conditions observed by the local monitoring system. After the model calibration and verification performance, implementation of the climate induced changes has been performed. For the purpose of simultaneous effects of SWI and climate change mitigation to control the groundwater salinity, specific mitigation measures have been tested in the laboratory conditions and afterwards implemented into the model.

To demonstrate the potential of applied mitigation measures and climate changes in the same time a modification of the GALDIT method has been applied to assess the SWI vulnerability

along the Neretva valley coastal aquifer system. Our study presents a data based and reliable baseline for future water management of the study area.



Fig. 8 - Prof. Veljko Srzić during his speech.

Climate changes in Neretva River Delta: Awareness raising and Biodiversity research

Ana Tutavac, *Public Institution for Management of Protected Natural Areas of the Dubrovnik-Neretva County – PIDNC*

Great efforts were dedicated by SeCure project partners to raise awareness on salt water intrusion problem and climate change in the Neretva river Delta, highlighting current achievement and future challenges. Dissemination activities were addressed to the general public, local, regional and national public authorities, education and training centres, and universities and research institutes, with the aim to: i) provide information for discussion; ii)

point out the links between climate change and the environment, ranging from damage in the economy to the loss of biodiversity; and iii) propose guidelines for adaptation and mitigation of climate change effects.

To this end a number of activities have been carried out, including: i) a scientific conference on the Neretva Delta with well-known Croatian scientists; ii) a visit to the pilot site in the Neretva River Delta, showing monitoring activities; iii) creation of promotional material for secondary and high schools; iv) on-site visit of journalists; v) several press releases, interviews and short videos. Furthermore, a research on the impact of salinity on Eurasian otter (*Lutra lutra*) in the Neretva River delta was carried out.



Fig. 9 – Dr. Ana Tutavac during her speech.

Communication activities on the SeCure project

Petra Sušak, *Regional Development Agency of Dubrovnik Neretva Region*

The presentation focuses on the results achieved on communication activities of the SeCure project, which include: study visit to Croatian representative site, press releases, social media, and short, high quality video on results.

The study visit to Croatian representative site was held on 02 June 2023, organized by DUNEA, focusing on the problems caused by salinization that are present at the location and the existing monitoring system. Six plain language articles from various events on the project were published and a series of radio guest appearances by the project team and radio reports from the pilot area were broadcast. The social media campaign was fruitful: on Facebook and Instagram the campaign has reached over 132,066 users and marked over 567,683 impressions thanks to engaging video and posts. Target audience included: i) general audience, ii) public authorities that have jurisdiction over land planning and management, water and drainage management, risk management, agriculture, natural environment, Natura2000 areas, at the local, regional and national level; and iii) Schools (e.g. secondary agricultural...), Universities and research institutes. To effectively engage target audiences, custom communication outputs were created to tailor ads to the specific characteristics, preferences, and interests. The campaign has reached:

- 68,242 users in general audience (people living in the region in demographic group 18 - 65+);
- 29,033 users who are business owners, involved in management and environmental impact with interest in Agribusiness, Farm or Agriculture;

- 77,543 users who are students in high school or at university level and share interest of Small business, Agribusiness, Farm or Agriculture.



Fig. 10 – Dr. Petra Sušak during her speech

Hrvatske vode in SeCure project - Informing the professional and scientific public and educating the youngest

Danko Holjević, *Croatian Waters, Dept. of Water Resources*

According to the unique communication plan of the project partners, Hrvatske vode was assigned the area of water management, and encouraging socially responsible behavior in the field of water conservation. Several articles were published on the project itself and on the

fruitful cooperation between Italy and Croatia. As a support to the achievement of the SeCure Project objectives, a conference took place intended for the interested professional and scientific public. Its purpose was to transfer knowledge about adverse environmental impacts of salt water and to strengthen cooperation between scientists and experts for efficient water resource management and adjustment to unavoidable consequences of climate change.

In the view of generous experience in educating the youngest Hrvatske vode prepared educational materials for preschool and elementary school age presenting importance of the negative consequences of climate change and, consequently, the salinization of agricultural land with far reaching consequences for humans. Educational materials were presented at workshops both for the youngest and for teachers who will pass on the acquired knowledge.



Fig. 11 – Dr. Danko Holjević during his speech.

2.3 The Italian site: activities and results of the SeCure project

Four presentations were given by the Italian partners highlighting the main results and dissemination of the project. A summary of their interventions is provided in the following and presentations' slides are attached in Appendices C.

The dissemination of knowledge to increase awareness in the territory

Valentina Bassan, *Veneto Region – Soil and Coast Defence Directorate*

Dissemination activity aimed to: (i) Preserve lowlying coastal environments, (ii) Empower cooperation among research centers and local administrations, (iii) Transferring durable mitigation strategies.

To this end, material, posts, short videos, and photos were posted on social media and in the project web site. In addition, in order to reach population, journalists, local and national authorities, university and research centers, the results were presented at meeting and events organized in collaboration with local authorities, and international conferences. Dissemination in high schools through lectures and field trips played a key role in raising awareness of saltwater intrusion and water protection among the younger generation.



Fig. 12 – Dr. Valentina Bassan during her speech

Monitoring and analysis of saltwater intrusion mechanisms: consolidated results to address the next challenges

Luigi Tosi, *Institute of Geosciences and Earth Resources - National Research Council*

Salt water intrusion is a paramount problem that greatly affects agricultural activities in the Italian Adriatic coastal plains. The presentation gives a brief overview of the problem and the extent of this process at the Adriatic scale and then focused on the study area of the SeCure

project. The presentation highlights the knowledge gained on salinization process and describe the next challenges that need to be addressed.

Results that consolidate the knowledge about salinization processes of the Holocene aquifer and agricultural soils include: i) the aquifer is always highly saline and the attenuation effect by rainfall is transient; ii) finer sediments, even in thin layers, act as morpho-stratigraphic constraints on groundwater dynamics; iii) paleo-saline water associated with maximum marine transgression is present in much of the coastal plain; iv) construction of sluices/barriers at river mouths to prevent tidal intrusion does not completely solve the problem of aquifer salinization.

Among the next challenges that need to be addressed to further refine knowledge of saltwater intrusion, attention was given to: i) developing comprehensive mapping of saltwater intrusion into agricultural lands of the low-lying coastal plains on a national or at least regional scale; ii) developing high-resolution maps of the vulnerability of various crops to saltwater intrusion under projected sea level rise and land subsidence to support predictive assessment of farmland management under climate change impacts; iii) improving a hydrogeologic monitoring network for saltwater intrusion; and iv) identifying new strategic water resources (freshwater or low salinity water) that can be used in the event of a water crisis.



Fig. 13 – Dr. Luigi Tosi during his speech

Mitigation of shallow aquifer salinity through recharge with sub-surface drains. The SeCure test at Ca' Bianca, Venice

Pietro Teatini, *Department of Civil, Environmental and Architectural Engineering, University of Padova*

Saltwater intrusion seriously threatens coastal aquifers and agricultural activities in the Venice coastal plain facing the Adriatic Sea reducing water quality and agricultural production. In order to mitigate the shallow aquifer salinity, saltwater intrusion was firstly monitored and analysed through monitoring systems providing qualitative and quantitative information on the processes influencing groundwater and surface water dynamics, and then countermeasures against salt contamination were tested in situ.

Numerical models were used to reproduce the field initial condition and simulate the effects of a buried drainage mitigation measure under different scenarios.

The results show that the use of buried drains to mitigate the salinization of soils and shallow aquifers appears potentially interesting when they are placed along sandy paleo-morphology with high permeability and supplied with "fresh" water taken from drainage channels. The effect appears however localised, not able to "solve" the problem at the scale of interest. In addition, the implementation and use of the intervention are quite complex and require a significant "calibration" period.



Fig. 14 – Prof. Pietro Teatini during her speech

Insights on the movement of the salt wedge affected by drought periods from numerical and physical experiments

Paolo Salandin, *Department of Civil, Environmental and Architectural Engineering, University of Padova*

The present work describes the design and the realization activities developed to reproduce a controlled heterogeneous porous media in a laboratory flume, aimed at defining the influence of the hydraulic conductivity spatial variability on the density-dependent transport in coastal phreatic aquifers.

The sandbox measures 500 cm long by 30 cm wide by 60 cm high, with 3 cm thick plexiglass walls. Two tanks are located upstream and downstream of the sandbox, with volumes of approximately 0.5 m³ and 2.0 m³, respectively. The upstream tank is filled with fresh-water and is continuously supplied by a small pump, providing fresh-water recharge. The downstream tank is filled with salt-water, previously prepared by adding salt to fresh-water till a proper density is reached, and it represents the sea. In both tanks the level is maintained constant via two spillways, whose height can be adjusted. The discharge through the downstream spillway can be measured. The flume has been used in previous works, but here the homogeneous porous media has been substituted by three different nominal size ranges of glass beads, equal to 0.3-0.4, 0.4-0.8 and 1.0-1.3 mm respectively, organized in 250 cells, each of size 20x30x5 cm³ to reproduce a prescribed statistical anisotropic structure. The tank was used to model the functioning of the system under normal condition, during drought periods and with possible countermeasure (e.g., subsurface barriers). Results of the different runs are described in the presentation.



Fig. 15 – Prof. Paolo Salandin during his speech.

2.4 Intervention of the Delta del Po Reclamation Authority

A contribution was given also by the local land reclamation public authority: the Delta del Po Reclamation Authority, focusing on the challenge of saltwater intrusion in the Po Delta territory. A summary of the intervention is provided in the following and presentation's slides are attached in Appendices D.

The Po Delta, general overview of the territory, challenges, and solutions from the reclamation world to counteract saline intrusion

Rodolfo Laurenti, *Deputy Director of the Delta del Po Reclamation Authority*

The Po river Delta territory, with a total area of 62 780 Ha, is a complex environment where human activities and natural ecosystems are intertwined: agricultural and urban areas, fishing farms, and local towns, co-exist with lagoons, swamps, coastal area, and beaches. The area is subsiding and most of the ground level lay below mean sea level. A number of measures have been taken to protect human activities from relative sea level rise, including several embankments, water pumping systems, and irrigation stations. The area is affected by saltwater intrusion with consequences on: interruption of fresh water derivations, interruption of aqueduct supplies, groundwater salinization, and drying up of coastal areas and micro-desertification. This presentation focuses on the Delta del Po Reclamation Authority's effort to efficiently manage all the infrastructures to prevent further salinization and economic losses, and facing the challenges caused by climate changes. Attention is given to salt barriers at the mouth of several branches of the river and their effectiveness in contrasting saltwater intrusion along the river.



Fig. 16 – Ing. Rodolfo Laurenti during his speech.

3. Visit to Delta del Po Land Reclamation infrastructures

During the afternoon, participants and project partners were guided by Eng. Rodolfo Laurenti to visit Delta del Po Land Reclamation infrastructures. Informative material was provided to each participant with a description of the main infrastructures of the territory (attached in Appendix E): the Pumping Station Ca’ Dolfin, the salt barriers in Po di Tolle and Ca’ Mello Canal (Fig. 17, Fig. 18, and Fig. 19).



Fig. 17 – Photos of the visit to Pumping Station Ca' Dolfin



Fig. 18 – Photos of the visit to the salt barriers in Po di Tolle.



Fig. 19 – Photos of the visit to a site where the levees and the bridge were raised (Ca' Mello Canal).

4. Final high-level event dissemination on local press and social media

An article advertising the event to the general public appeared in the local newspaper "Il Gazzettino" (Fig. 20). The journalist, Giannino Dian, attended the conference and later on published an article on the final event and on the problems of the saltwater intrusion in the same newspaper (Fig. 21).



Fig. 20 - Detail of the "Il Gazzettino" on June 28th advertising the event.

Risalita del cuneo salino: confronto Italia-Croazia

► A Ca' Vendramin l'evento conclusivo del progetto SeCure

TAGLIO DI PO

Al Museo Regionali della Bonifica a Ca' Vendramin l'evento finale del progetto Interreg Italia-Croazia denominato "SeCure" che ha trattato il tema dell'intrusione salina delle acque nei territori costieri anche in relazione al cambiamento climatico in atto. Si sono dati appuntamento per presentare i principali risultati del progetto tutti i principali partner: l'Università di Padova con la Facoltà di Ingegneria e il Consiglio Nazionale delle Ricerche la Regione Veneto mentre dalla Croazia erano presenti l'Università di Spalato, l'Agenzia Regionale di Sviluppo della Contea di Dubrovnik-Neretva, l'Ente pubblico per la gestione delle aree naturali protette di Dubrovnik-Neretva.

ATTIVITÀ BIENNALE

Il progetto SeCure, che ha avuto durata biennale e un budget di 600 mila euro è inserito nel gruppo "Adattamento ai cambiamenti climatici: governance e capacity building" e ha massimizzato i principali risultati ed esperienze sviluppati nei progetti Interreg It Hr most. Asteris e Change we care. Le sinergie già consolidate tra i partner del progetto hanno per-

meso di migliorare la visibilità e consolidare i risultati -raggiunti in precedenza, aumentando la trasferibilità e incrementando la base di conoscenza sulla contaminazione salina delle coste dell'Adriatico centrale e settentrionale: in sintesi il monitoraggio del processo, la valutazione delle strategie di mitigazione efficaci e la condivisione delle conoscenze con le Autorità competenti e le parti interessate sono stati i tre pilastri principali di SeCure.

Sono stati illustrati gli studi svolti insieme ai partner croati, partendo dai risultati ottenuti dal progetto SeCure che ha svolto ricerche, monitoraggio e divulgazione scientifica in relazione alla problematica dell'intrusione salina nelle acque sotterranee delle zone costiere adriatiche, con lo sviluppo di metodologie per la mitigazione in due aree pilota: di Ca' Bianca di Chioggia, sulla costa italiana, e di Ca' della Neretva, su quella croata.

Giannino Dian



BONIFICA Direttore presidente



L'articolo è stato pubblicato sul giornale "Il Gazzettino" di Venezia il 5 luglio 2023. È stato realizzato e pubblicato con il contributo del progetto SeCure.

Fig. 21 – Article on “Il Gazzettino” - July 5th, by Giannino Dian summarizing the final high-level event.

Another journalist, Leandro Maggi, attended the event and published an article in the local newspaper 'la Voce di Rovigo', and with a video disseminated on social media and on youtube (<https://youtu.be/YDAIC36iGB0>) (Fig. 22).



Fig. 22 – Article on “La Voce di Rovigo” - June 29th, by Leandro Maggi and dissemination on social media of the final high-level event.

Appendix A – Signature list of the on-site and online participants



Final Event of SeCure Project “Saltwater intrusion and climate change: monitoring, countermeasures and informed governance “
28th June 2023

Foglio firme per ritiro brochure, consenso privacy e liberatoria per uso video e foto



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www.italy-croatia.eu/SeCure



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(*) INFORMATIVA PER LA TUTELA DELLA PRIVACY

- Al sensi degli artt. 12 e 13 del Regolamento UE 2016/679 "Regolamento Generale sulla Protezione dei Dati" (di seguito GDPR), La informiamo che:
- il titolare del trattamento dei Suoi dati è la Regione del Veneto con sede in Venezia, Palazzo Linetti, Cannaregio, n. 99, in persona del dott. ing. Vincenzo Artico - Direttore della Direzione della Difesa del Suolo e della Costa;
 - il responsabile della protezione dei dati è il dott. ing. Vincenzo Artico;
 - i Suoi dati personali sono raccolti ai fini della partecipazione all'iniziativa organizzata dalla Regione del Veneto - Direzione della Difesa del Suolo e della Costa nell'ambito delle proprie attività istituzionali e saranno trattati mediante sistemi informatici e/o manuali e con procedure idonee a garantire la sicurezza e la riservatezza;
 - i dati saranno trattati per la durata dell'iniziativa e al termine del procedimento saranno conservati in conformità alle norme sulla conservazione della documentazione amministrativa nell'archivio della Struttura consentendone l'accesso secondo le disposizioni normative vigenti;
 - i dati non saranno comunicati a terzi né diffusi se non in base ad una specifica disposizione di legge e relativamente alla verifica della veridicità di quanto dichiarato, fermo restando il rispetto della normativa sul diritto di accesso;
 - potrà esercitare i diritti di cui al predetto Regolamento, in particolare chiedere al titolare l'accesso ai dati personali (art. 15 GDPR), la rettifica degli stessi (art. 16 GDPR), la limitazione del trattamento che li riguarda (art. 18 GDPR), la portabilità dei dati (art. 20 GDPR) e l'opposizione al loro trattamento (art. 21 GDPR);
 - potrà revocare il consenso in qualsiasi momento senza pregiudicare la liceità del trattamento basato sul consenso prestato prima della revoca;
 - ricorrendone i presupposti potrà esercitare il diritto di proporre reclamo al Garante quale autorità di controllo secondo le procedure previste;
 - la comunicazione dei dati personali è necessaria per la registrazione delle presenze all'incontro organizzato dalla Regione del Veneto - Direzione Difesa del Suolo e della Costa.

LIBERATORIA PER L'UTILIZZO DI FOTOGRAFIE O VIDEO

Firmando il presente foglio firme, autorizzo a titolo gratuito, ai sensi altresì degli artt. 10 e 320 cod. civ. degli artt. 96 e 97 legge 22.4.1941, n. 633 e del Regolamento UE n. 679/2016 - GDPR, l'utilizzo, anche su Internet e sui portali sociali, di foto e video che mi ritraggono, realizzate da personale della Regione del Veneto o da terzi autorizzati dalla stessa durante le iniziative e gli eventi organizzati dalla Regione del Veneto, nell'ambito del progetto europeo SeCure nonché la loro conservazione negli archivi informatici della Regione del Veneto, Direzione Difesa del Suolo e della Costa.

European Regional Development Fund

12

Appendix B – Slides by Croatian Partners

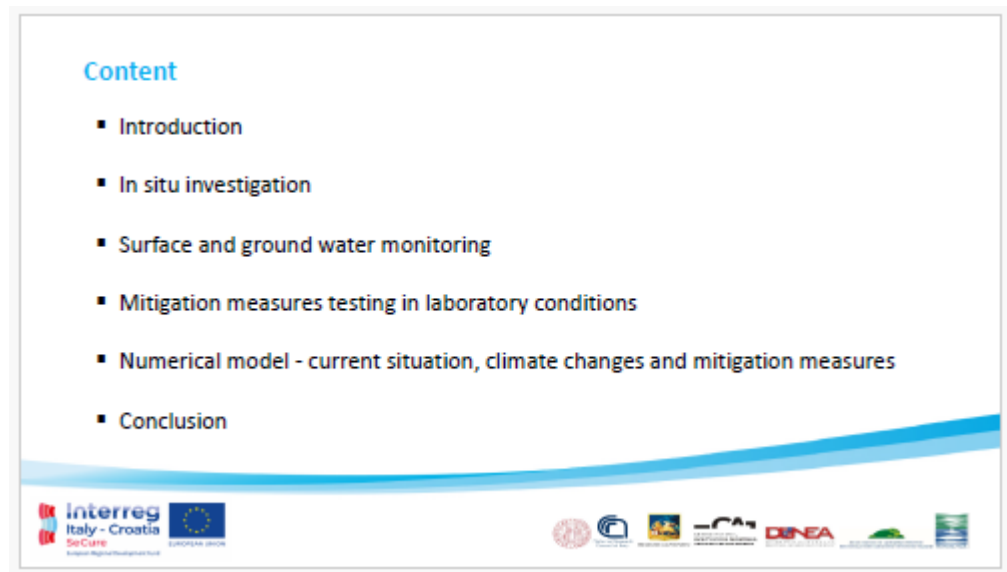




Benefits from the CBC Interreg IT-CR: Neretva site 2019-2023







SeCure | FGAG – University of Split
Veljko Srzić

Final event
Padua, Italy | June 28th 2023.



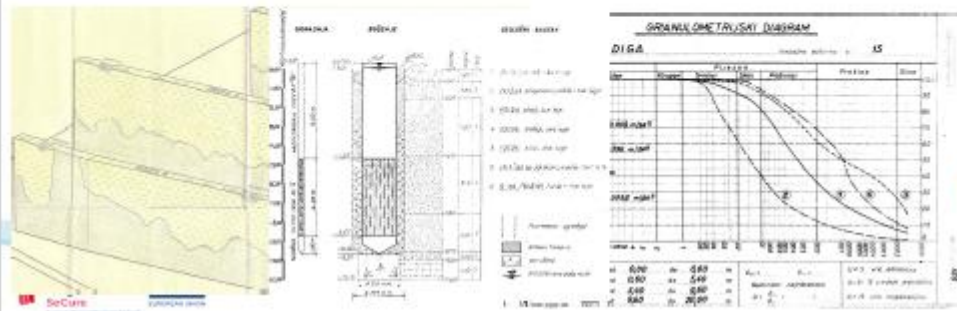
Content

- Introduction
- In situ investigation
- Surface and ground water monitoring
- Mitigation measures testing in laboratory conditions
- Numerical model - current situation, climate changes and mitigation measures
- Conclusion



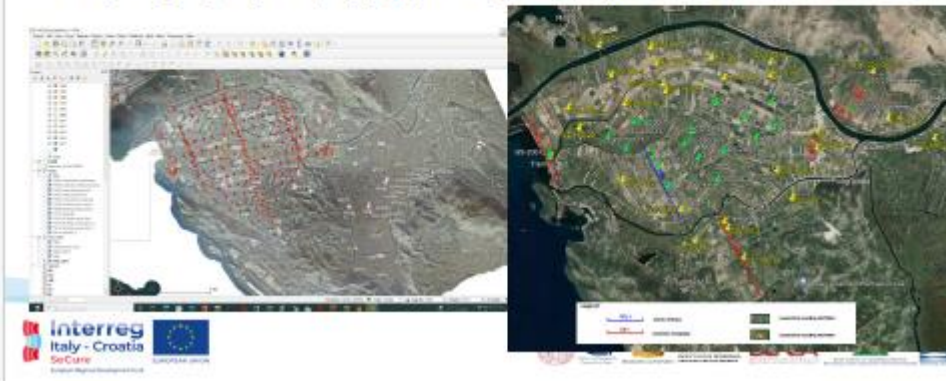
In situ investigation and description of the model domain

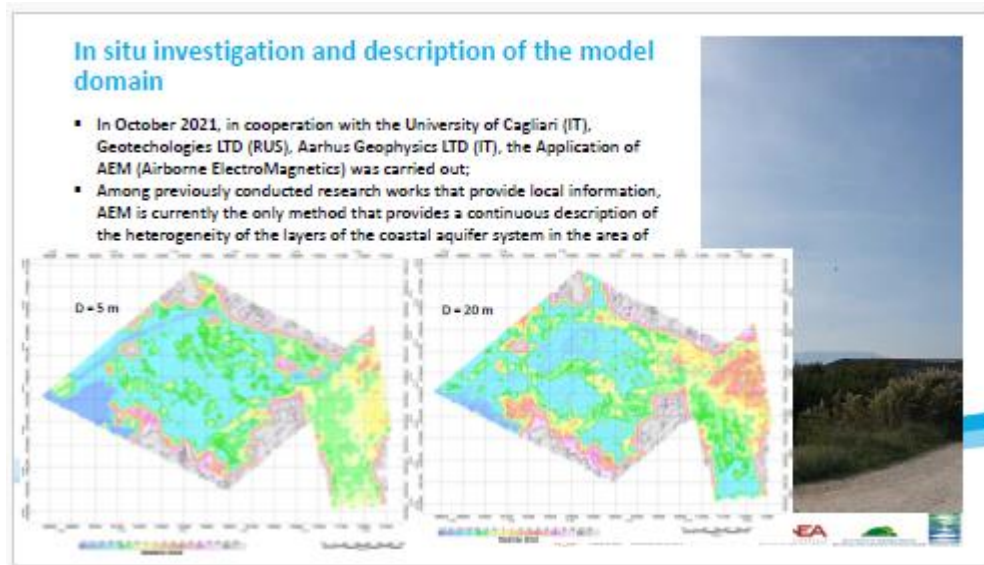
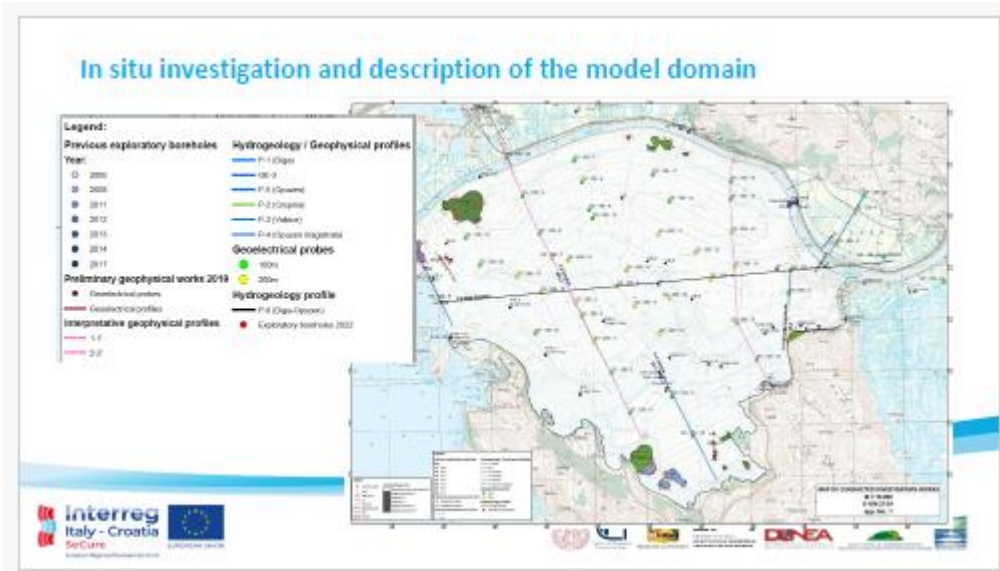
- Available data on the conducted investigation works from the 1960s up to date are used;
- It includes boreholes, granulometric description of extracted cores, application of geophysical methods, engineering and geological models;
- The GeNera georeferenced database and the initial litho-stratigraphic definition of the coastal aquifer system of the Neretva valley was created

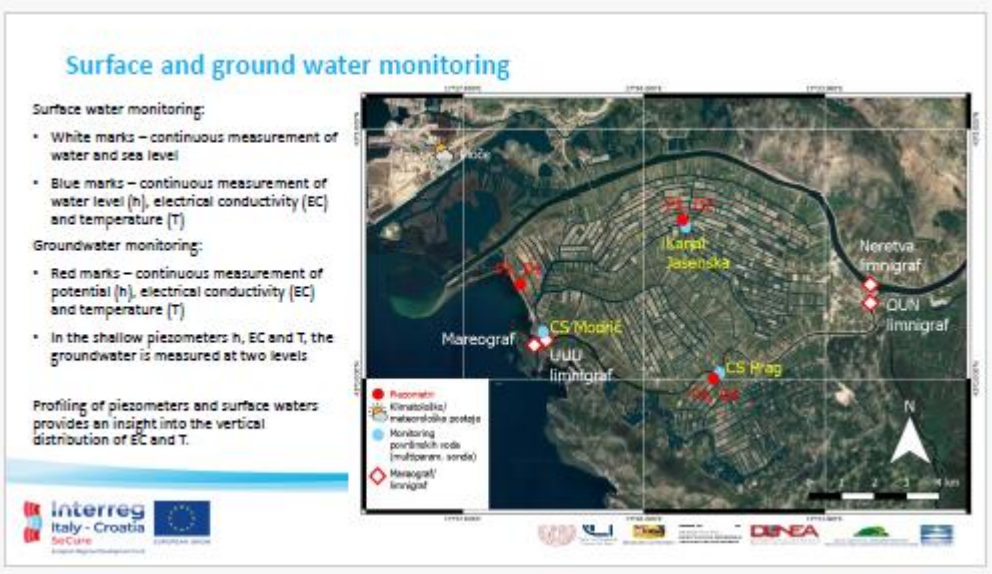
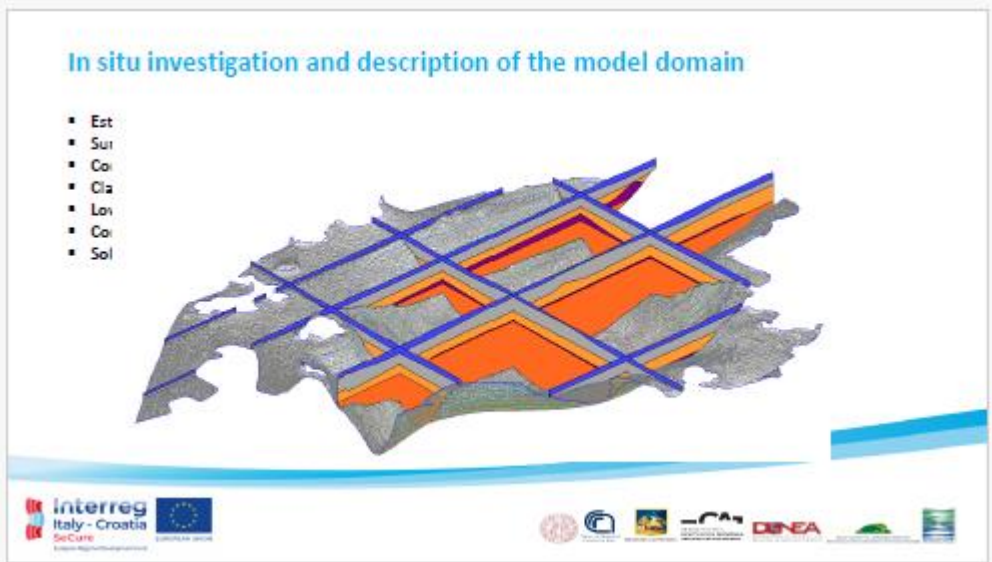


In situ investigation and description of the model domain

- Planned and implemented investigation works done during the period 2019-2022;
- Exploratory boreholes up to 90 m deep, extraction of disturbed and undisturbed samples, lab processing, engineering and geological mapping, geophysical investigation works (geoelectric probes, ERT, seismic reflection)



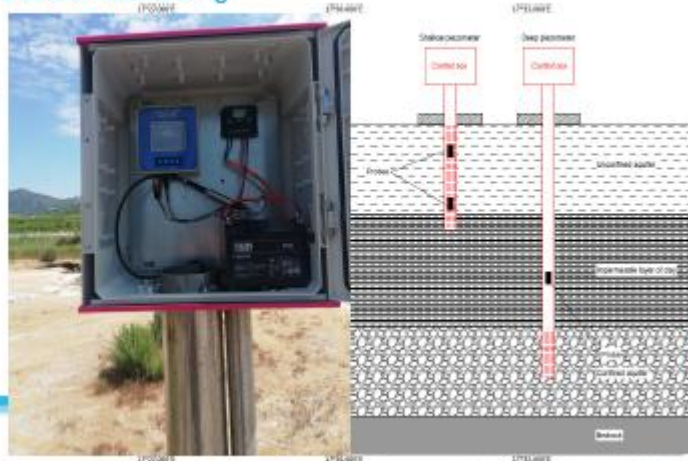




Surface and ground water monitoring

From 2021, the monitoring system consists of:

- 4 locations where the surface water level is measured
- 3 locations where surface water level, EC and T are measured
- 3 locations where piezometric conditions, EC and T are measured in confined and unconfined aquifer.



Surface and ground water monitoring

- The observed time series are displayed in the time domain, and additionally analyzed in the frequency domain by using Wavelet and Fourier transformation.
- In the frequency domain, the dominant constituents in certain time series and their periodicity are determined.
- The identification of time series properties according to the cause and effect model is ensured by the application of coherence models that provide information on the connection of two constituents within two signals and the phase between them.

Wavelet coherence (WTC):

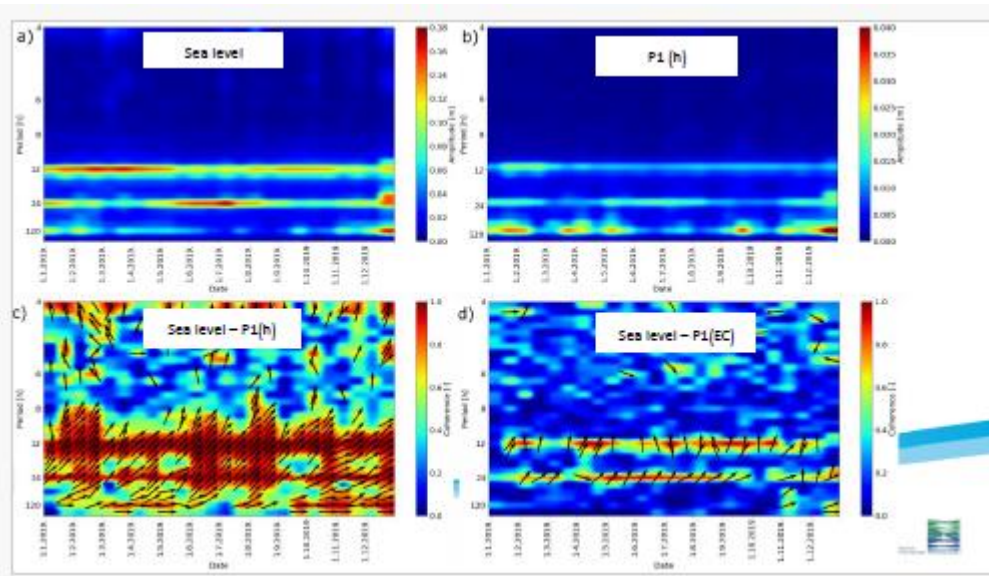
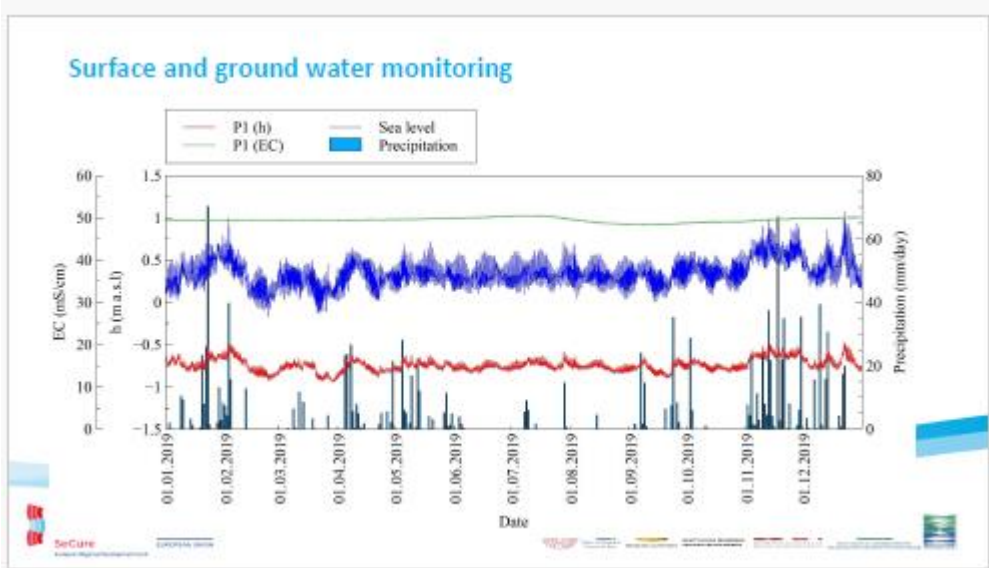
$$WTC = \frac{|W_n^{XY}(s)|^2}{W_n^{XX}(s)W_n^{YY}(s)}$$

WTC – koherencija
 s – skala valjeka
 W_n^{XY} – cross wavelet transformacija
 W_n^{XX} and W_n^{YY} – wavelet spektral snage

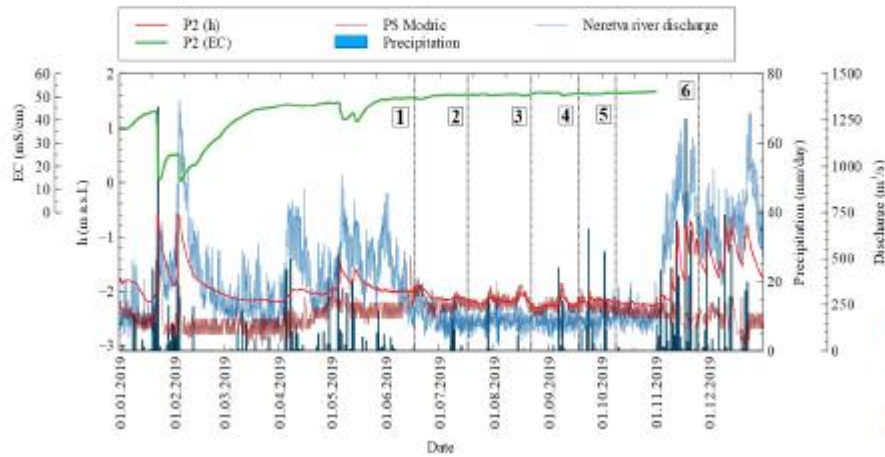
Fourier coherence:

$$R^2(k) = \frac{|G_{XY}(k)|^2}{G_{XX}(k)G_{YY}(k)}$$

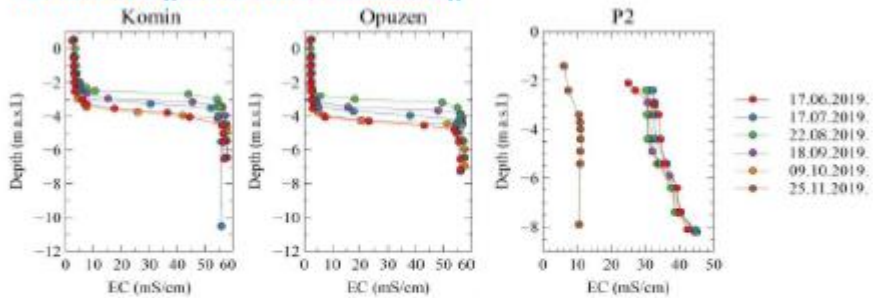
R – koherencija
 G_{XY} – cross-spektar snage
 G_{XX} | G_{YY} – spektar snage



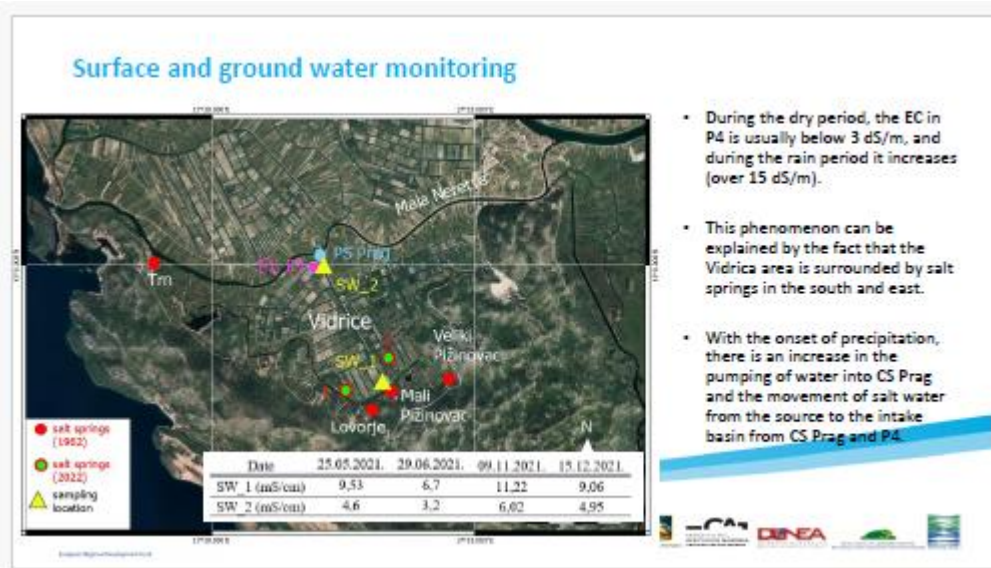
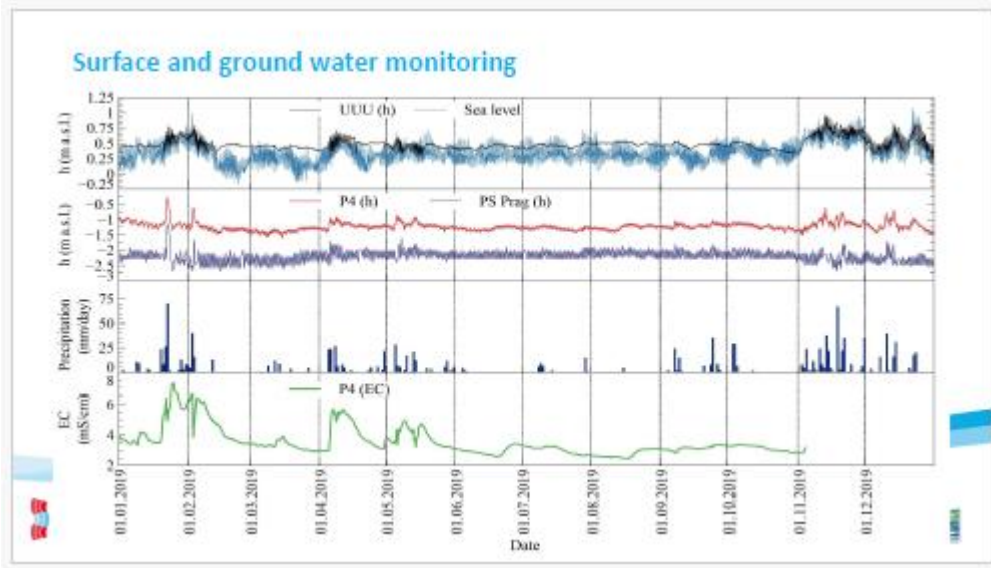
Surface and ground water monitoring



Surface and ground water monitoring

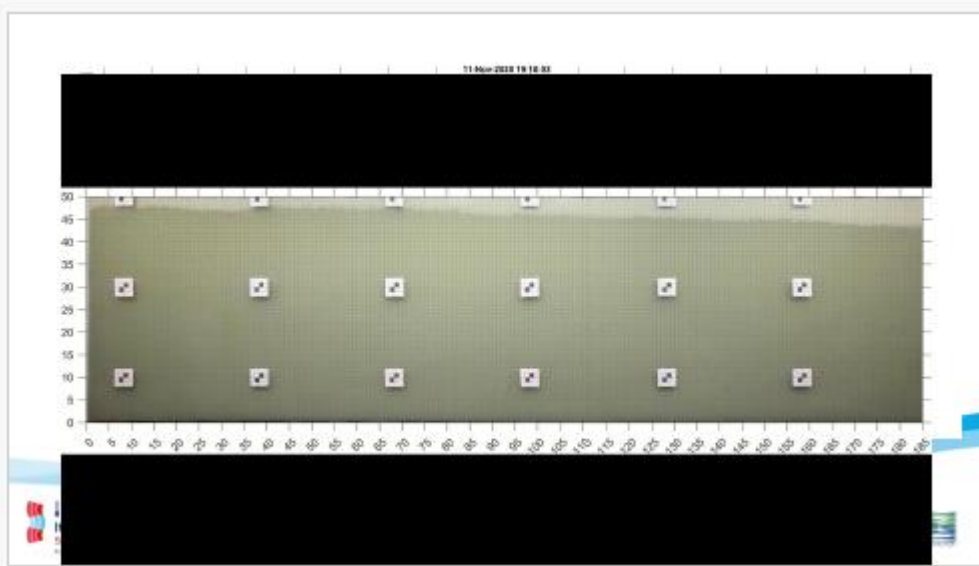
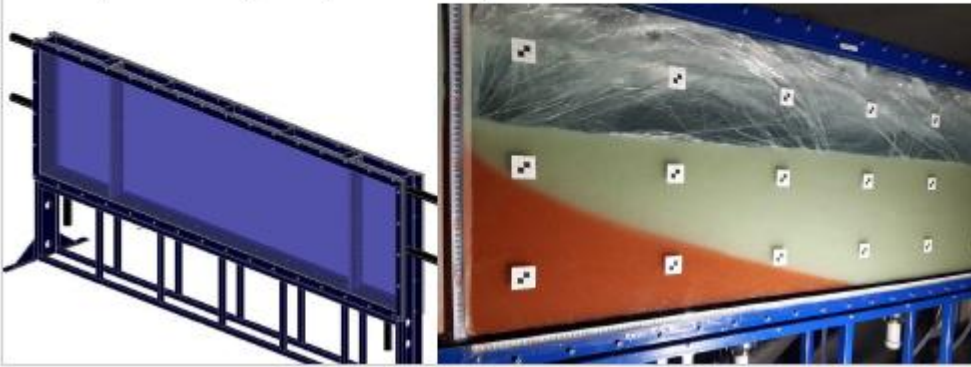


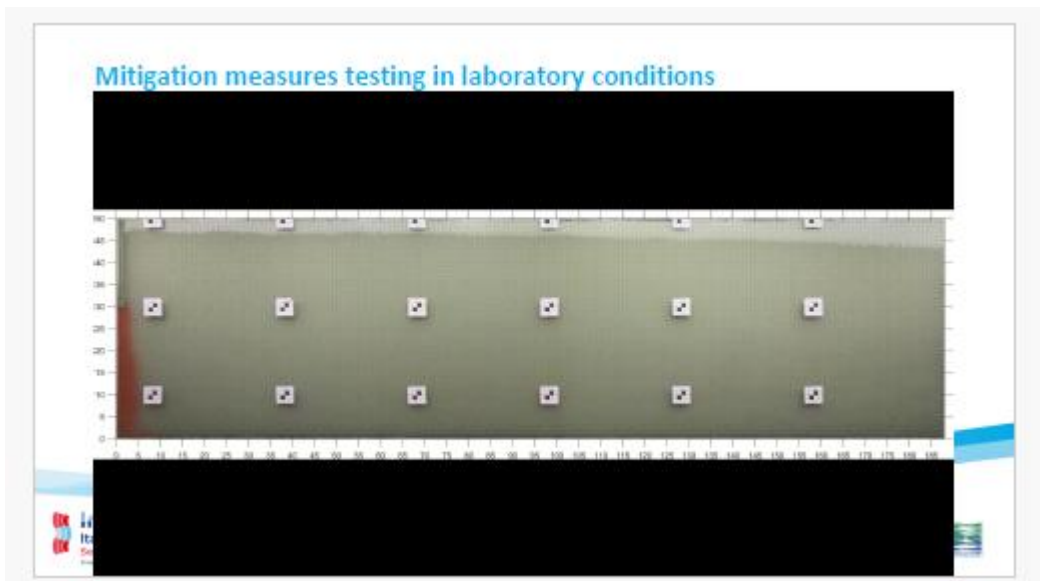
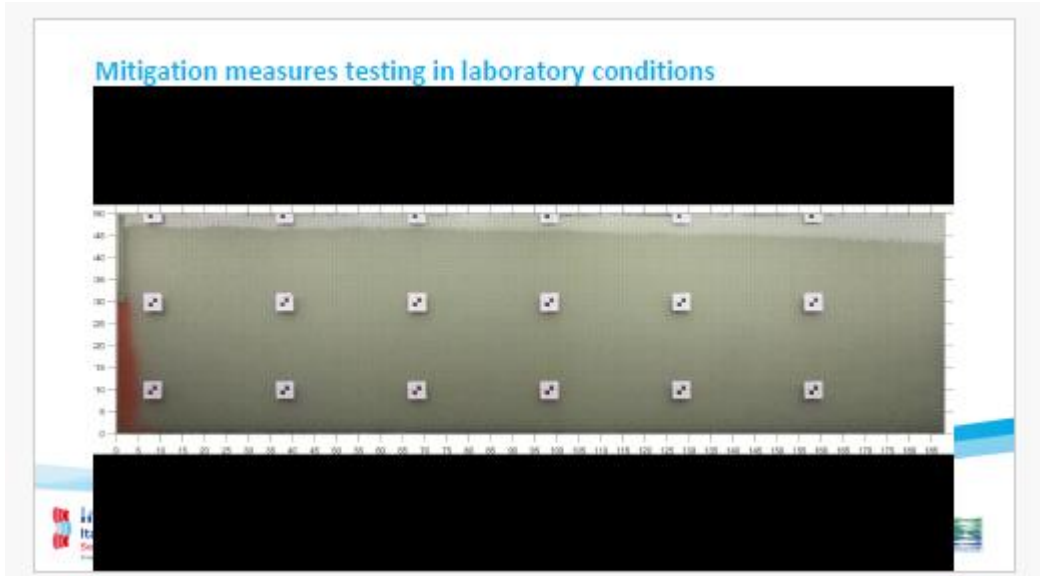
- Precipitation has the opposite effect on the groundwater level and EC in the area of Jasenska
- During the rain part of the year, the ground water level is dominantly under the influence of the hydrological regime of the Neretva River, and during the dry part of the year under the influence of the operational regime of the reclamation system.
- EC in P2 is highest during the dry part of the year when there is a salt wedge in the Neretva River.



Mitigation measures testing in laboratory conditions

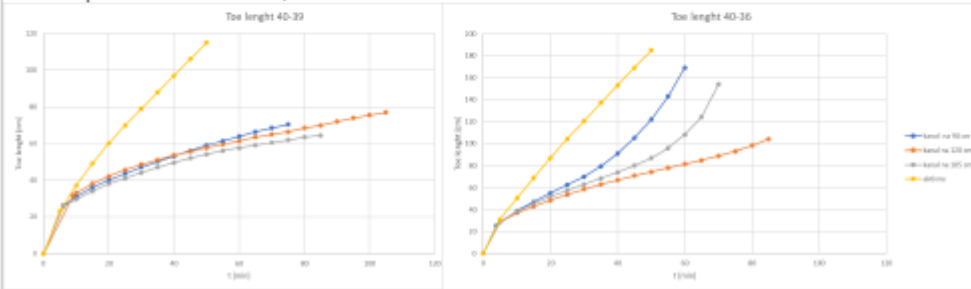
- For the purposes of physical modeling of seawater intrusion, a laboratory channel with chambers for liquids of variable density was created;
- The central chamber is filled with a porous medium;
- A system for monitoring boundary conditions and wedge condition in real time;





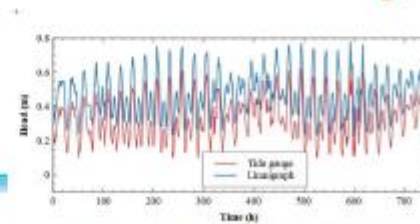
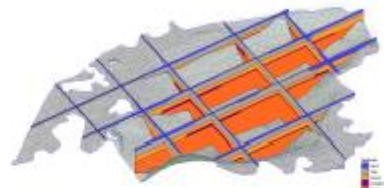
Mitigation measures testing in laboratory conditions

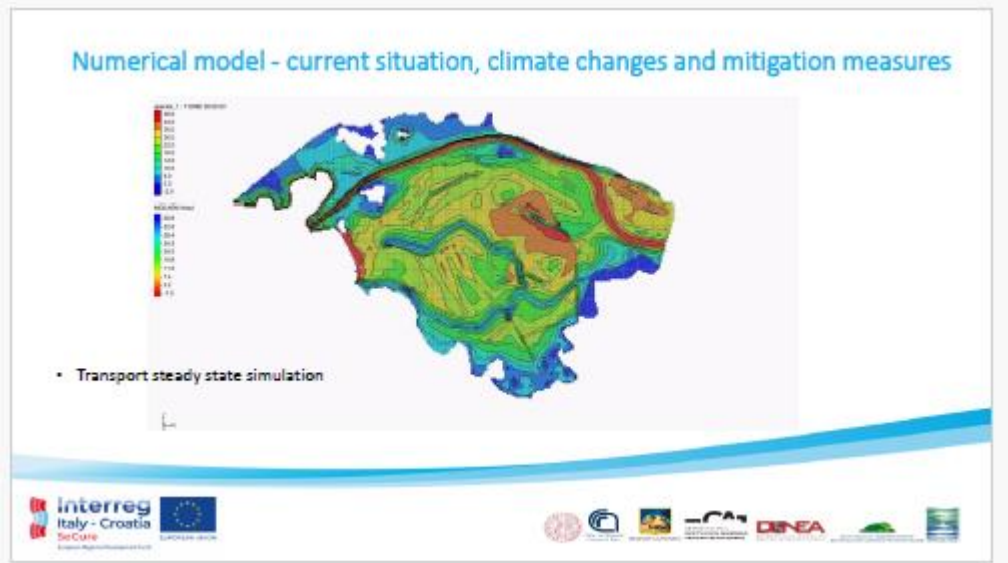
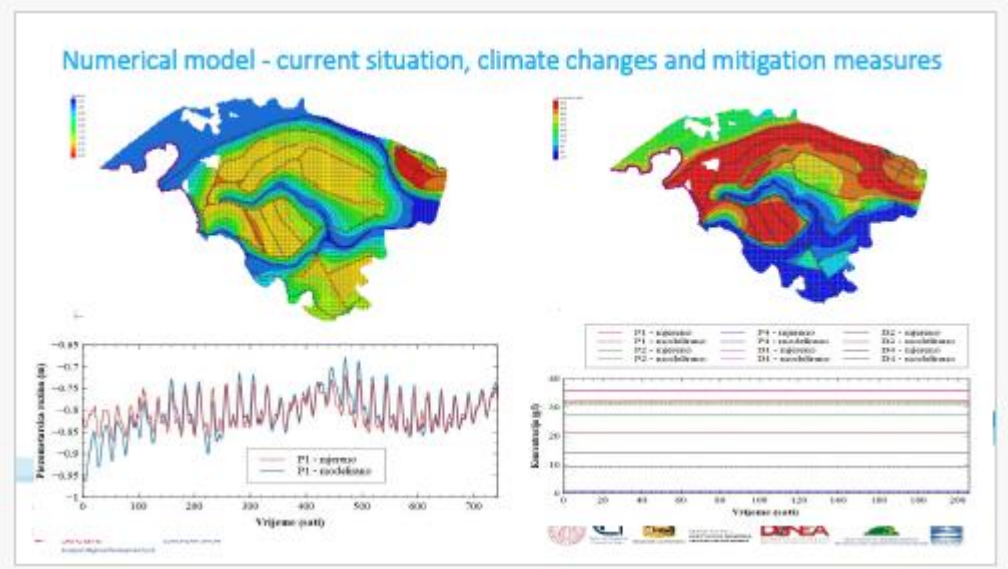
- The spatio-temporal properties of wedge for variable penetration depth of an impermeable injection curtain at the marine boundary condition were examined;
- The effect of an irrigation canal along a stratified marine boundary condition (water level in the canal, distance of the canal from the boundary condition and gradient) was examined;
- In conditions of active seawater intrusion into the coastal aquifer, the partially submerged barrier affects the time scale of changes in groundwater salinity, however, improvement of water conditions remains;
- The irrigation channel changes the flow regime of underground water, which results in the transition from active to passive seawater intrusion;

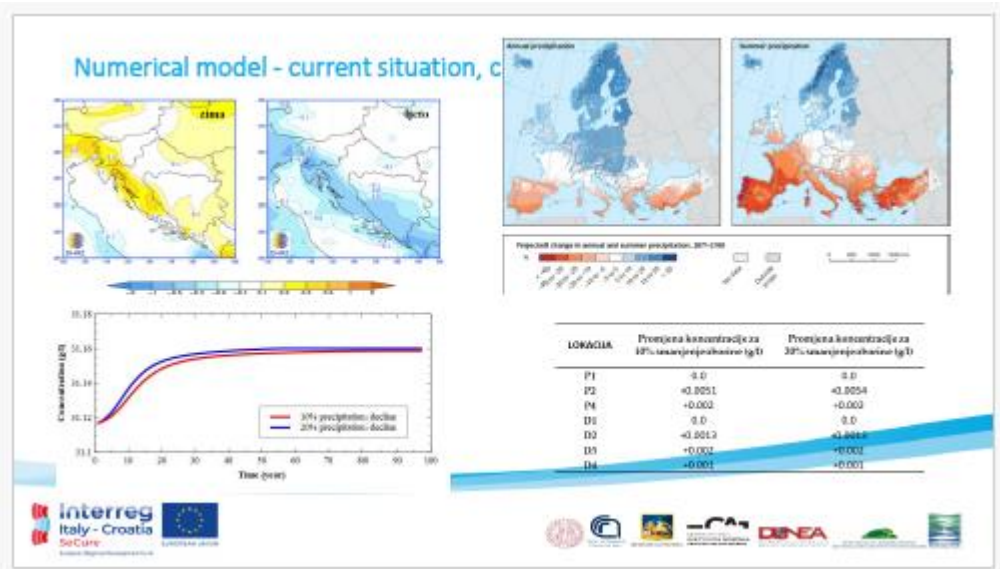
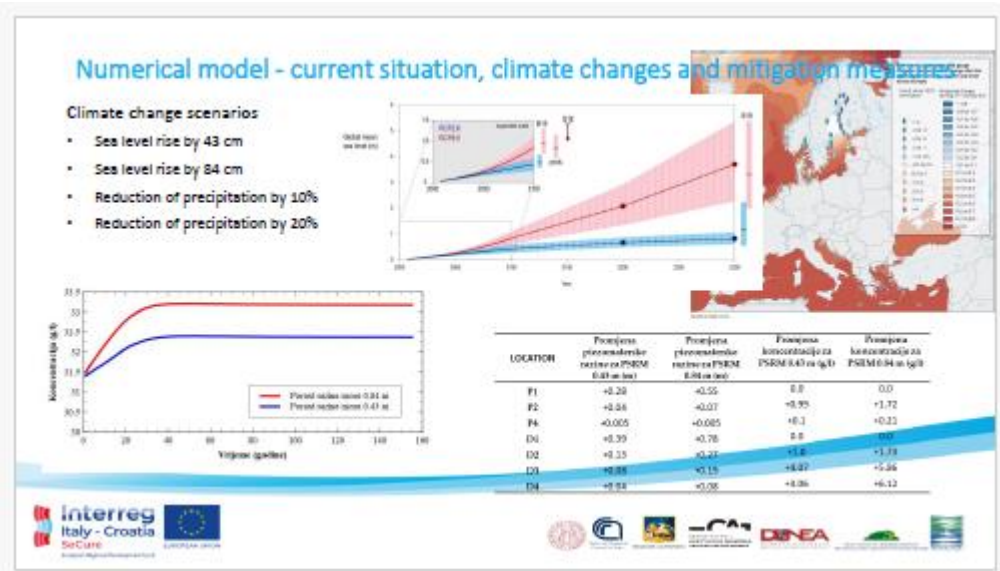


Numerical model - current situation, climate changes and mitigation measures

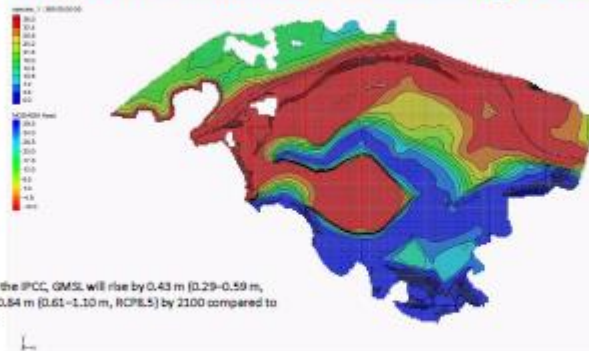
- Modeling of the existing state
- Model geometry set based on provided investigation works
- Determination of boundary and initial conditions
- Defining model steps
 - Flow steady state simulation
 - Transient flow simulation
 - Flow and transport steady state simulation
 - Transient flow and transport simulation
- Distribution of piezometric conditions and salinity regimes
- Calibration and verification of the model according to time series provided by monitoring system







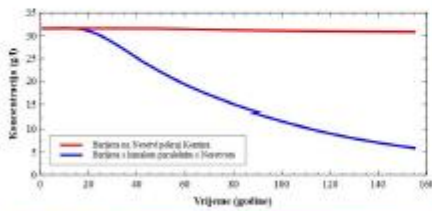
Numerical model - current situation, climate changes and mitigation measures



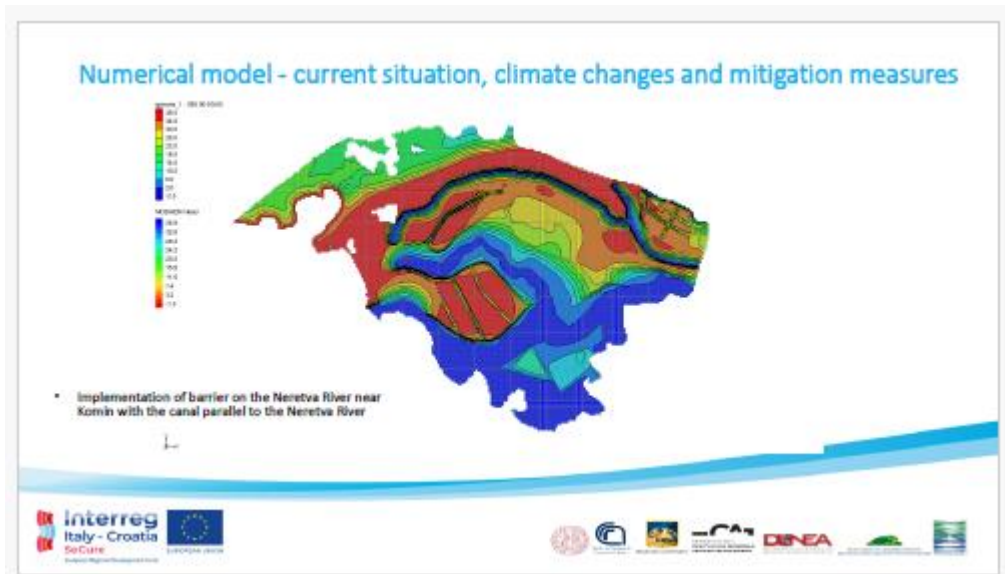
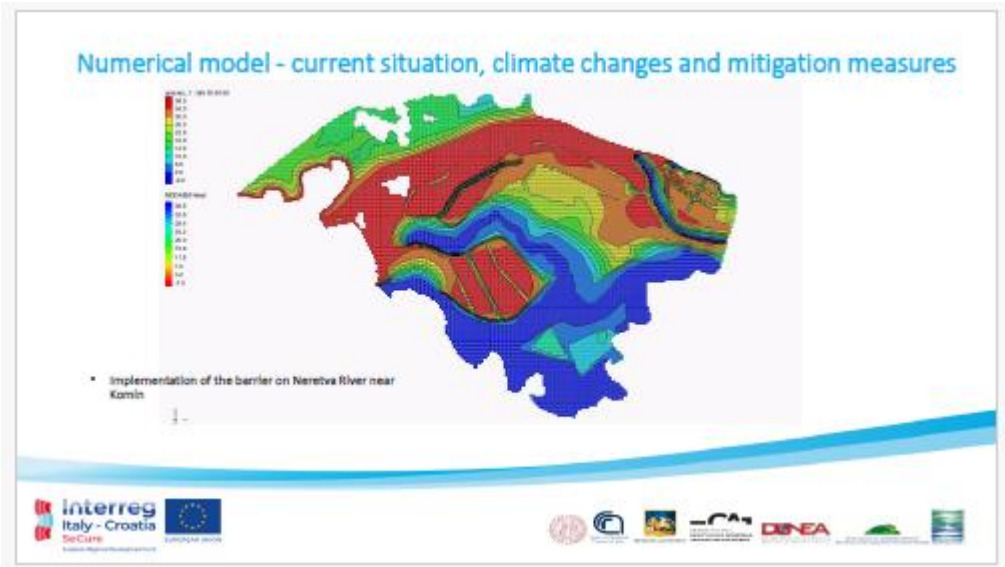
Numerical model - current situation, climate changes and mitigation measures

Scenarios of mitigation measures

- An impermeable underground barrier under the Diga embankment
- Barrier on the Neretva River near Komin
- Barrier on the Neretva River near Komin with the canal parallel to the Neretva River



| LOKACIJA | Promjena koncentracije za MM1 (g/l) | Promjena koncentracije za MM2 (g/l) | Promjena koncentracije za MM3 (g/l) |
|----------|-------------------------------------|-------------------------------------|-------------------------------------|
| P1 | -0.05 | 0.0 | 0.0 |
| P2 | -0.04 | -26.39 | -0.89 |
| P4 | 0.00 | -0.03 | -0.05 |



Conclusion

- Increase of research groups interested into the River Neretva Valley site;
- Number of publications increased during last 5 yr for 120 %;
- Project SeCure provided additional investigation works and continuation of monitoring activities with the improvements of existing monitoring systems;
- As a part of Interreg CBC Italy – Croatia 2021-2027 call, 2 project proposals have been submitted;
- Total budget used by UNIST – FGAG is 645 000 € (MoST- acquired equipment 56 000 €, external services 285 000€) + 80 000 € (SeCure)
- 9 persons employed on project activities;

Thank you!

UNIST-FGAG
 Veljko Srzić
 Iva Aljinović
 Ivan Lovrinović
 Ivan Racetin



<https://www.italy-croatia.eu/web/most>
<https://www.italy-croatia.eu/web/secure>



interreg Italy - Croatia SeCure 

Climate changes in Neretva River Delta: Awareness raising and Biodiversity research

SeCure | PIDNC | Ana Tutavac

Final Event | Taglio di Po | 28/06/2023

European Regional Development Fund          

ACTIVITY: 2.1 Online and offline events

DELIVERABLE: 2.1.2 Local Meetings / Info Day / Visit in the pilot site



interreg Italy - Croatia SeCure           2

Scientific Conference: Neretva Delta - climate change, current achievements and future challenges

- Metković, Croatia
- 03/11/2022
- 53 participants
- addressed to:
 - general public
 - local, regional and national public authorities and related entities
 - education and training centers
 - universities and research Institutes
- well-known Croatian scientists held lectures based on their research and knowledge related to climate change in Croatia and in the Neretva delta site
- the aim of the Conference was to:
 - provide information for discussion
 - point out the links between climate change and the environment, ranging from damage in the economy to the loss of biodiversity
 - propose guidelines for adaptation and mitigation of climate change effects



Visit in the Neretva River Delta site

- 03/11/2022 (immediately after the Scientific Conference in Metković)
- 16 participants
- visit to measuring stations (*Mouth of Neretva and Jasenska*)
- measuring stations set up as part of the *MoST* project
- regular field testing of salinity and other parameters of surface and underground water



ACTIVITY: 2.2 Promotional campaigns and media relations

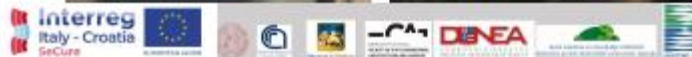
DELIVERABLE: 2.2.5 Promotional material for secondary & high schools



ACTIVITY: 2.2 Promotional campaigns and media relations

DELIVERABLE: 2.2.8 Journalists on-site visits

- 03/11/2022 (immediately after the Scientific Conference in Metković)
- the journalists from local radio station and from regional and local internet portals were present at the measuring stations (*Mouth of Neretva and Jasenska*)



ACTIVITY: 2.2 Promotional campaigns and media relations

DELIVERABLE: 2.2.6 Press releases



ACTIVITY: 2.3 Digital and web-based activities

DELIVERABLE: 2.3.3 Interviews and short videos



ACTIVITY: 3.1 Exchange and exploitation of projects' result

DELIVERABLE: 3.1.3 Technical report on the investigation on climate change...



Research on the impact of salinity on Eurasian otter (*Lutra lutra*) in the Neretva River delta

- target species of Natura 2000 site Neretva River Delta (HR5000031)
- Habitat Directive (Annex IV)
- Bern Convention (Annex II)
- strictly protected species (Croatian Nature Protection Act)



- determination of presence of Eurasian otter in Neretva River Delta with an emphasis on areas that are more exposed to salinity
- survey methodology:
 - otter presence signs (feces, gelatinous digestive secretions, footprints, food remains, shelters above ground, dens underground, etc.)
 - camera trapping


➤ the final study with the results will be delivered by the end of this week





Thank You for Your Attention!

Public Institution for Management of Protected Natural Areas of the Dubrovnik-Neretva County

-  Branitelja Dubrovnika 41, 20000 Dubrovnik
-  atutavac@zastita-priode-dnz.hr
-  +385 20 672 673
-  www.zastita-priode-dnz.hr





Communication activities on project
SeCure

SeCure | DUNEA | Petra Sušak

Padova, 28.06.2023

European Regional Development Fund

Content:

- Study visit to Croatian representative site
- Press releases
- Social media
- Short, high quality video on results



2

Study visit to Croatian representative site

- The "study visit to Croatian representative site" was held on 02 June 2023, organized by the DUNEA.
- These are measuring stations that were set up as part of the MoST project
- The study visit consisted of a presentation of the problems caused by salinization that are present at the location and the existing monitoring system



Press releases

- Dunea contracted the media coverage of the SeCure project with the Dubrovacki vijesnik (online portal) and with Delta radio.
- 6 articles from various events on the project were published
- Radio guest appearances by the project team and radio reports from the pilot area were broadcast



SeCure Website and social media

Facebook and Instagram:

- In the period from 11 January - 20 June the campaign has reached over 132,066 users and marked over 567,683 impressions.
- Different creatives were used to accomplish this goal:
 - engaging videos to compelling captions, conclusions from partner meetings, recaps of panels, and strategic promotion of SECURE posts on social media.



SeCure Website and social media

Campaign target audience

- General audience
- Public authorities that have jurisdiction over land planning and management, water and drainage management, risk management, agriculture, natural environment, Natura2000 areas, at the local, regional and national level.
- Schools (e.g. secondary agricultural...) & Universities and research institutes

To effectively engage target audiences custom audiences were created to tailor ads to the specific characteristics, preferences, and interests.

The campaign has reached:

- 68,242 users in general audience (people living in the region in demographic group 18 - 65+)
- 29,033 users who are business owners, involved in management and environmental impact with interest in Agribusiness, Farm or Agriculture
- 77,543 users who are students in high school or at university level and share interest of Small business, Agribusiness, Farm or Agriculture

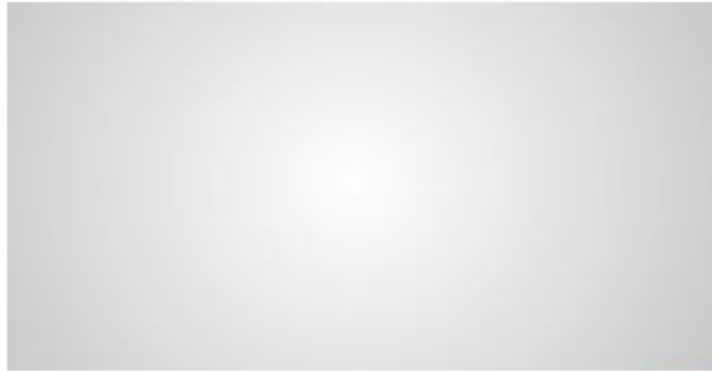
SeCure Website and social media

Generating engagement through likes, comments, and shares & raise awareness about the project's goals, initiatives and impact among a broader audience.

This engagement allows to build a community around the project and encourage discussions and support.

- The campaign has resulted in 15,777 post engagements.
- 20,044 reached users and 146,813 impressions
- In accordance with the agreed monthly document, all indicated posts were promoted as planned, the video materials were cropped and adjusted to the format, ensuring optimal presentation and engagement.
- As of recently, all posted posts were set in the engagement campaign so all project progress is promoted which further expands the reach of the content.

Short, high quality video on results



Thank you!

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20 355 Opuzen, Hrvatska

 psusak@dunea.hr

 +38520/672-673

 www.italy-croatia.eu/SeCure

„Hrvatske vode in SeCure project. Informing the professional and scientific public and educating the youngest“

Danko Holjević, Stjepan Kamber, Julija Prpić

Pedua | 28 June 2023

Introduction





According to the unique communication plan of the project partners, Hrvatske vode has been assigned the area of water management, and encouraging socially responsible behavior in the field of water conservation.

In the view of generous experience in educating the youngest, Hrvatske vode prepared educational materials for preschool and elementary school age presenting importance of the negative consequences of climate change and, consequently, the salinization of agricultural land with far-reaching consequences for humans.

Educational materials will be presented at workshops both for the youngest and for teachers who will pass on the acquired knowledge.



2

Publication of articles



Hrvatska vodoprivreda, July/September 2022, Issue 240 (XXX)

"Salinization of Aquifers – Threat to Coastal Regions", Kamber-Stjepan, Prpić Julija

The topic of the whole issue was "Climate Change and Water Management". The paper was published as a short notice about the project itself and the fruitful cooperation between Italy and Croatia. Intended for the wider public. (Left)



Hrvatske vode (scientific journal), December 2022, Issue 122 (30)

"Scientific Conference Neretva Delta – Climate Change, Current Achievements and Future Challenges" – Metković, 3 November 2022", Prpić Julija, Kamber Stjepan, Tomas Damić

Published under the heading OVERVIEW OF EVENTS, including a report about the conference and a short description of the presentation. (Right)




"Round Table: Current Challenges in the Development of Soil Improvement Practices in Croatia", Poreč, 10-11 November 2022

Conference Proceedings, edited by: Danko Biondić, Danko Hojjević

"SeCure Project – Saltwater intrusion and climate change: monitoring, countermeasures and informed governance", Prpić Julija, Stjepan Kamber

The SeCure Project was presented by Stjepan Kamber and a paper was published in the Conference Proceedings.



3

Conference, Hrvatske vode, 22 February 2023



„Climate Change and Phenomena of Soil and Water Salinization”

As a support to the achievement of the SeCure Project objective, a conference took place intended for the interested professional and scientific public. Its purpose was to transfer knowledge about adverse environmental impacts of salt water and to strengthen cooperation between scientists and experts for efficient water resource management and adjustment to unavoidable consequences of climate change.

Lecturers and topics:

- Iveta Pandić** – “The contributions of Intergovernmental Panel on Climate Change Working Groups to the IPCC Sixth Assessment Report about climate status and projections by the end of the 21st century”
- Josip Rubčić** – “Water resources in the Neretva river basin and climate change impact”
- Josip Terzić** – “Hydrogeological relations in the karst ground of the right catchment of the Neretva River and impact of seawater on karst aquifers”
- Davor Dolar** – “Pressure membrane processes to mitigate climate change”
- Veljko Smit, Ivan Lovrihović, Ivica Aljčević** – “Model analyses of the response of the Neretva valley coastal aquifer to climate change and implementation of potential mitigation measures”




Due to big interest to participate at the conference, online ZOOM participation was also made possible, thus bringing the total number of participants to 96 (of which 40 participated online).

4

Participation at a conference: First European GREEN Conference (EGC 2023), Vodice, 23-26 May 2023




The first European GREEN Conference was organized by the International Association of Environmental Scientists and Professionals (IAESP) and the Faculty of Food Technology in Osijek with a support of a network of partner institutions, aimed at knowledge exchange and networking of scientists and experts, with a focus on the necessity of applying a multi-disciplinary approach in environmental protection and achievement of sustainable development guidelines.

Hrvatske vode took part by presenting a poster communication: “Impact of climate change on water salinization (Interreg projects MoST and SeCure)” under thematic area “Climate Change”, authors: Demir Tomas, Julija Pypić, Stjepan Kamber





5

Educational material for the youngest

The picture book addresses the topic of the Neretva River salinization (SeCure Project) and gives a broader picture of climate change: causes, consequences, and solutions. Illustrations are very instructive and give plenty information about climate change. They are supplemented by rhymed text in Croatian that clarifies the Neretva river salinization and climate change.



Educational picture book under the title "Hrvoje and his friends have a message: Climate change induces humans too!", was presented on 2 June 2023 in elementary school 3003 and was distributed to 100 grade pupils. The picture book was also presented and distributed to pupils in secondary school 3003 during the promotion and study visit to the locations of the SeCure pilot project on the Neretva River.

A small poster with stickers, representing a game in which children are supposed to recognize icons and classify them into the fields Cause, Consequences, and Solutions, in order for them to repeat and clarify what they have learned from the picture book.




A big poster (B1) that follows the picture book's content supplements the material with additional interesting information.

3D animations which bring Hrvoje into life on a mobile phone through a free AR application. The 3D animations appear five times in the picture book, as well as on the big poster in order for the content to attract attention from a large number of school children. In the animations Hrvoje sends the most important messages about the preservation of water and the planet, about the reduction of human impact on climate change, and gives advice about how we can adapt to or reduce climate change consequences in order to minimize the damage.


The educational material will be used in further education in elementary schools and will be made available to the wider public on Hrvatska voda's website.

Organisation name
Contact person

 Address

 email@

 Telephone number

 www.italy-croatia.eu/acronym