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Ministero dell'Università e della Ricerca

FU.CO.KA. Future scenarios in coastal karst: saltwater intrusion, loss of water resources and sinkhole development as effects of climate changes

Mario Parise

Dipartimento di Scienze della Terra e Geoambientali
Università Aldo Moro, Bari

UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

mario.parise@uniba.it

From where we started…..

Bando PRIN 2022 PNRR n. 1409 del 14 settembre 2022:
finanziamento di progetti di ricerca pubblica, al fine di promuovere il sistema nazionale della ricerca, di rafforzare le interazioni tra università ed enti di ricerca in linea con gli obiettivi tracciati dal Piano Nazionale di Ripresa e Resilienza (PNRR) e favorire la partecipazione italiana alle iniziative relative al Programma Quadro di ricerca e innovazione dell'Unione Europea

Application form submitted on: November 30, 2022 – Linea Sud

Main ERC field: PE10_17 Hydrology, hydrogeology, engineering and environmental geology, water and soil pollution

The project idea

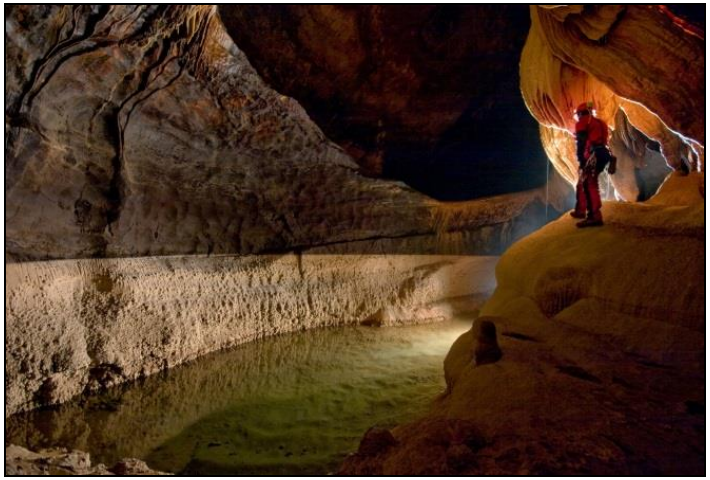
Future scenarios in coastal karst: saltwater intrusion, loss of water resources and sinkhole development as effects of climate changes

Key words

- ✓ saltwater intrusion
- ✓ sinkholes
- ✓ climate change
- ✓ hydrogeology
- ✓ karst
- ✓ coast

Karst landforms

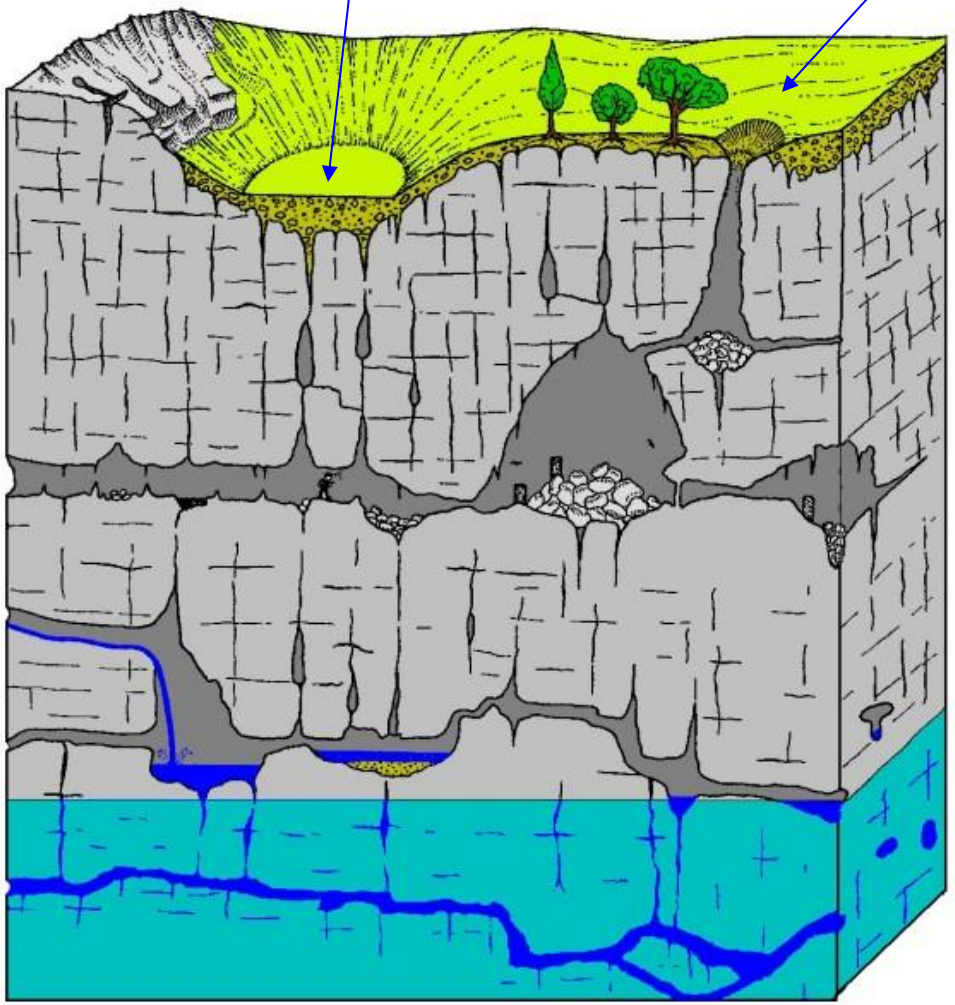
photo: F. Maurano



Vadose zone

Doline

Ponor



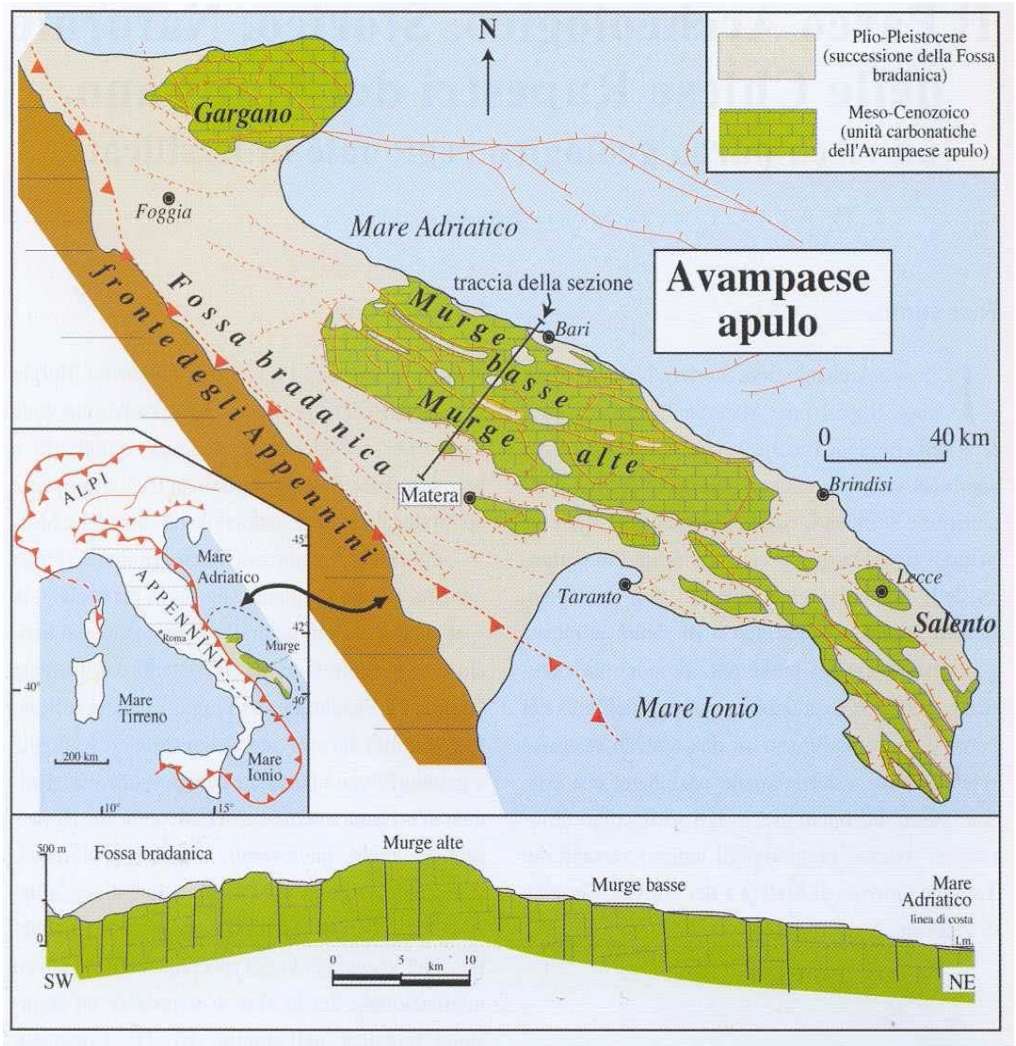
Phreatic zone

PUGLIA

Among the most significant regions in the Mediterranean Basin as regards karst and percentage of outcrops of soluble rocks

Three main karst areas:

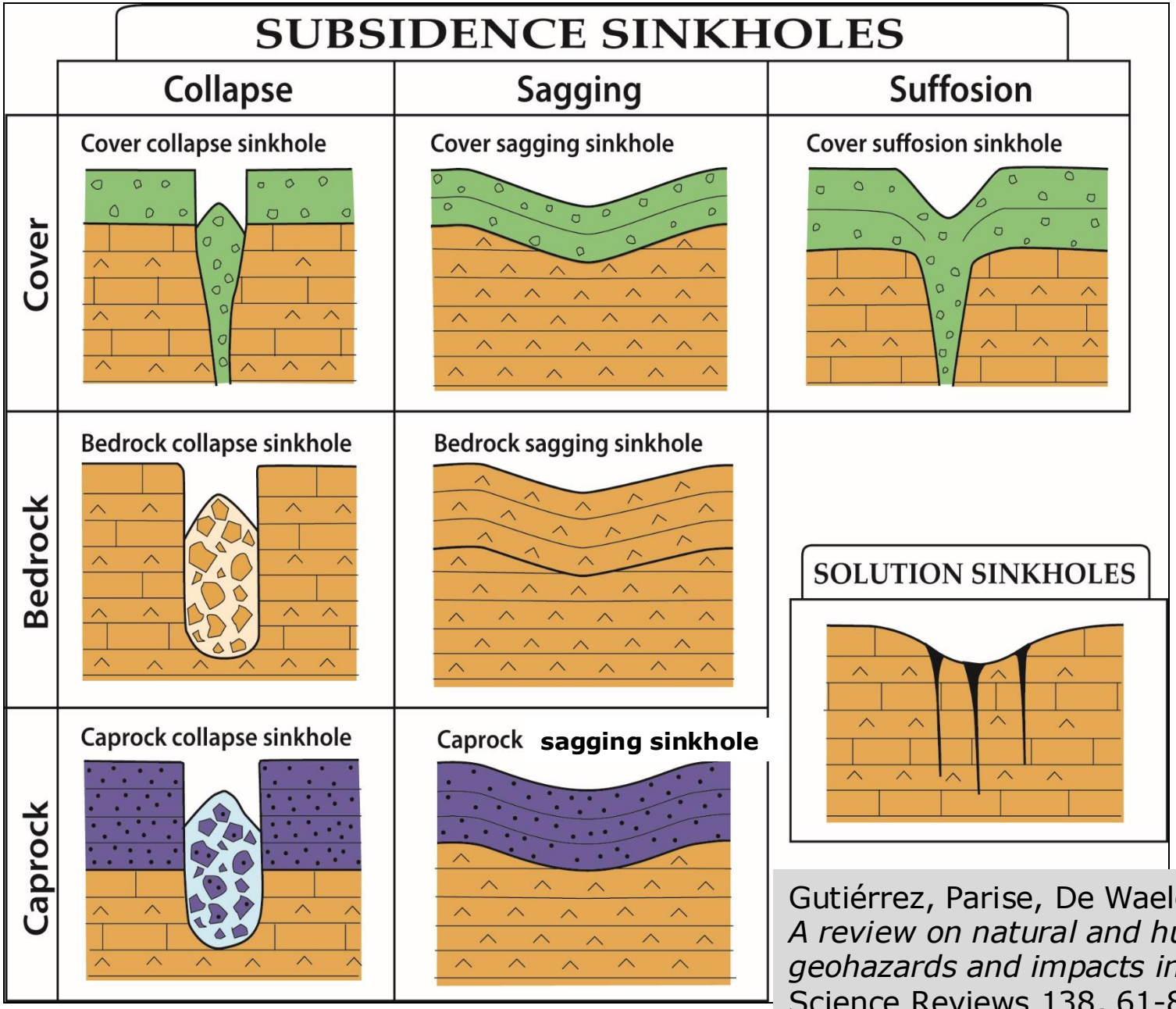
- Gargano
- Murge
- Salento



Pieri et al., 1997

photo A. Pagliara

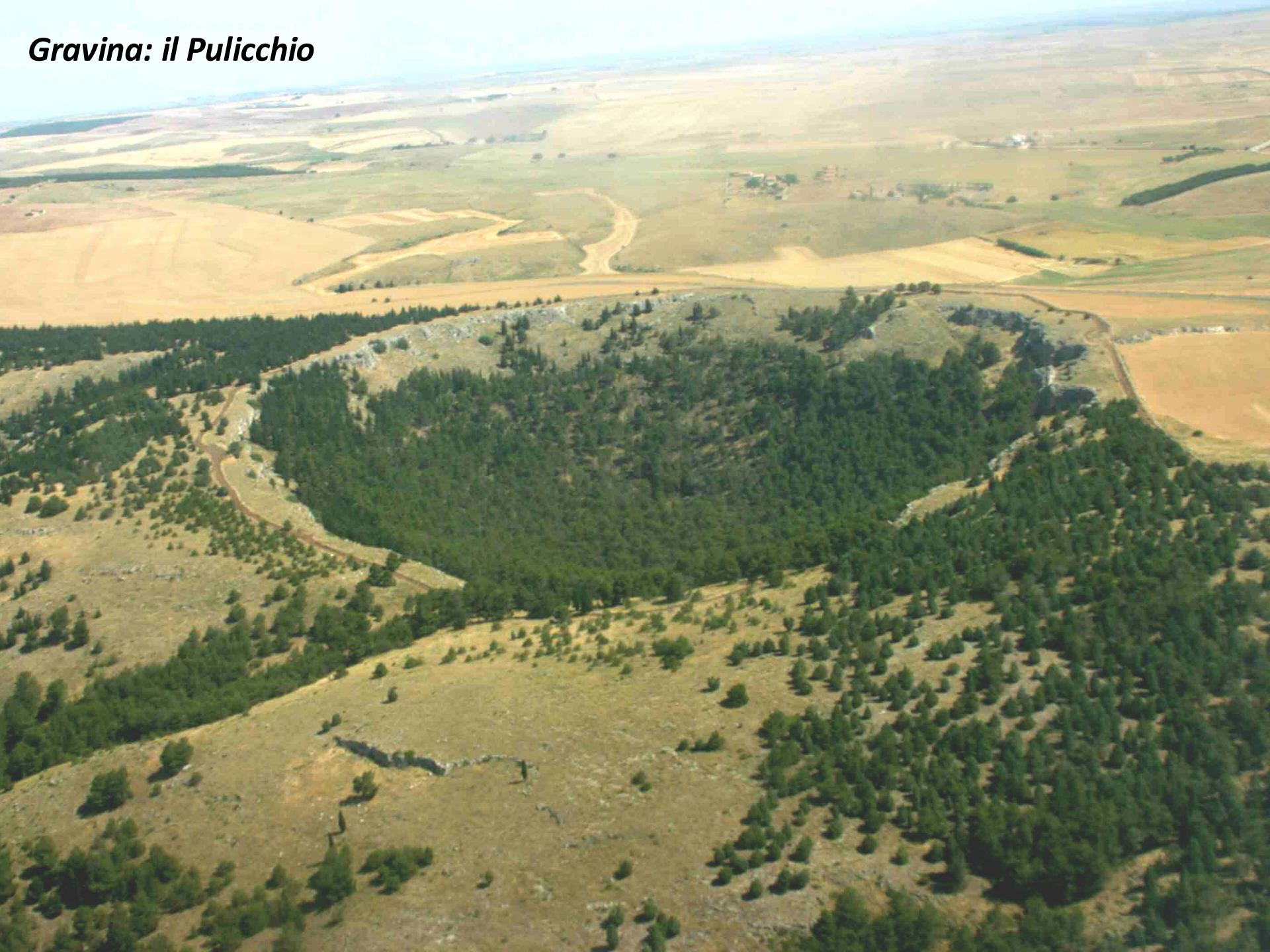
Sinkholes



Gutiérrez, Parise, De Waele & Jourde, 2014, *A review on natural and human-induced geohazards and impacts in karst.* Earth Science Reviews 138, 61-88.

Pulo di Altamura (Murge)

Gravina: il Pulicchio



Pulo

variations: *puro*, *pure*, *pulicchio*

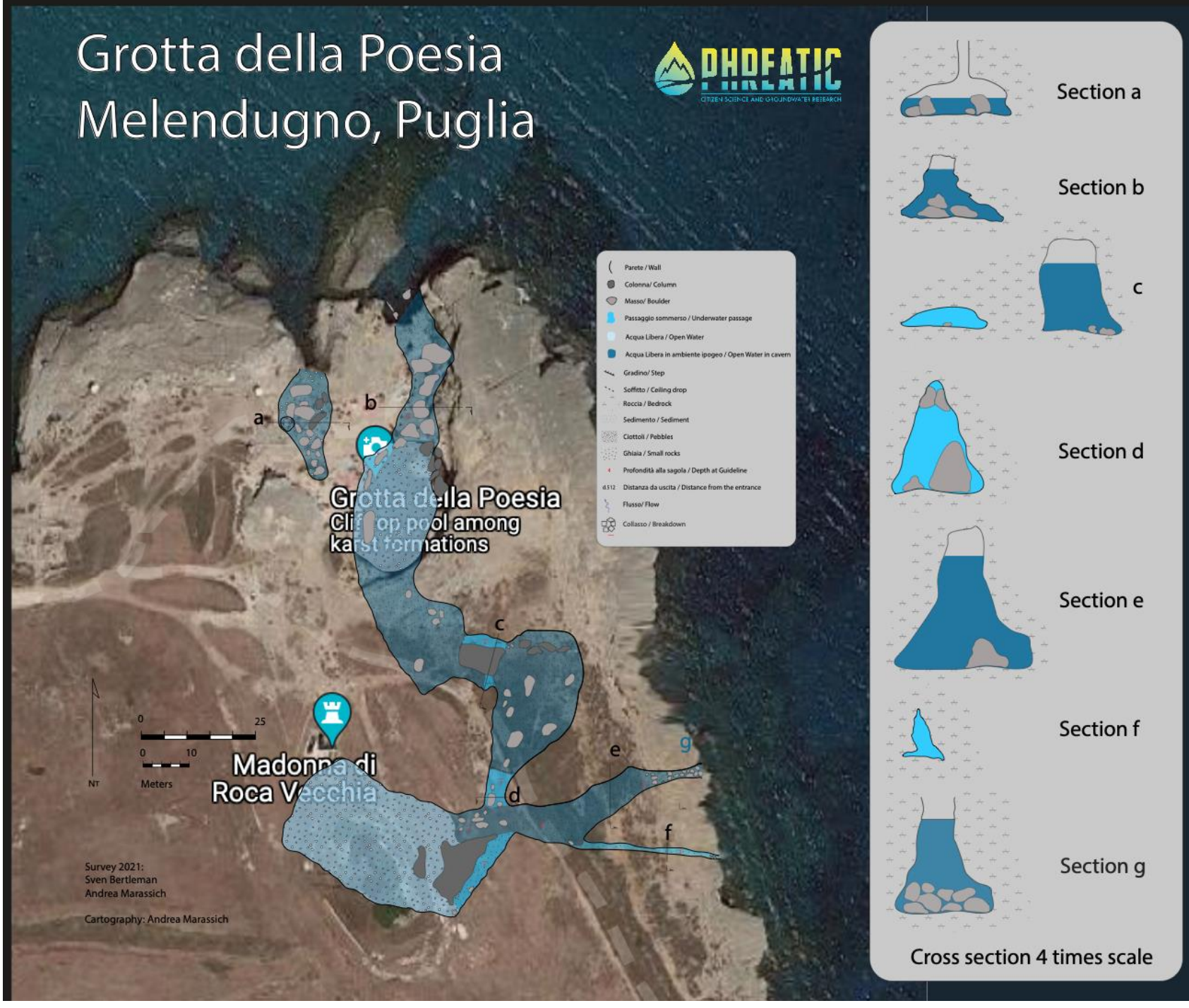
after the greek πύλη = gate, narrow access

In the form πύλαι it is also used as narrow valley

	Max diameter (m)	*Min diameter (m)*	*Depth (m)*
Pulo di Altamura	500	450	75
Pulicchio di Gravina	710	550	99
Pulo di Molfetta	170	130	30

Grotta della Poesia
Melendugno, Puglia

PHREATIC
CITIZEN SCIENCE AND GROUNDWATER RESEARCH



Spunnulate

Research Units

Dipartimento di Scienze della Terra e Geoambientali
Università Aldo Moro, Bari
Principal Investigator: Mario Parise

Dipartimento di Scienze e Tecnologie
Università del Sannio, Benevento
Scientific Responsible: Francesco Fiorillo

Consiglio Nazionale delle Ricerche
Istituto di Ricerca sulle Acque (IRSA)
Scientific Responsible: Maria C. Caputo

From where we started.....

Approved for funding on: July 31, 2023
(total score 94/100)

Budget

Research Unit	Initial proposal	Re-modulation
UniBA	101.[illegible]62	81.090
UniSannio	[illegible]365	66.052
CNR IRSA	82.207	65.766
total	**266.134**	**212.908**

20% cut

Starting date: November, 29, 2023

Duration of the project: 24 months

Time table

	Activity	assigned to	I year						II year					
			Bim 1	Bim 2	Bim 3	Bim 4	Bim 5	Bim 6	Bim 1	Bim 2	Bim 3	Bim 4	Bim 5	Bim 6
Milestone 1	Site-scale analysis of saltwater intrusion and sinkhole development	UniBA, UniSannio, CNR BA		▲										
Activity 1.1	Design of database	UniBA, UniSannio, CNR BA												
Activity 1.2	Design and realization of project website	UniSannio												
Activity 1.3	Collection of ancillary data on study areas (caves, sinkholes, saltwater intrusion)	UniBA, UniSannio, CNR BA												
Activity 1.4	Detection of main driving factors for sinkhole occurrence	UniBA												
Activity 1.5	Geomorphological and geo-structural analysis	UniBA												
Milestone 2	Analysis of the freshwater-saltwater interaction processes	UniBA, UniSannio, CNR BA					▲							
Activity 2.1	Design, realization and elaboration of geophysical surveys	CNR BA												
Activity 2.2	Monitoring of selected flooded caves/wetlands	UniBA												
Activity 2.3	Hydraulic characterization of rock samples	CNR BA												
Activity 2.4	Production of thematic maps	UniSannio												
Milestone 3	Assessment of the coastal processes in relation to Sea Level Rise	UniBA, UniSannio, CNR BA												▲
Activity 3.1	Water analysis and interpretation (chemico-physical parameters, isotopes)	UniBA, CNR BA												
Activity 3.2	Reconstruction of hydrological data series	UniSannio												
Activity 3.3	Analysis of recharge phenomena	UniSannio												
Activity 3.4	Definition of Sea Level Rise scenarios	UniBA, UniSannio, CNR BA												
Activity 3.5	Dissemination and exploitation of the results	UniBA, UniSannio, CNR BA												

▲ Meeting

Project activities

Milestone 1 (months 1-4)

Site-scale analysis of saltwater intrusion and sinkhole development

Activity 1.1	Design of the database	UniSannio
Activity 1.2	Collection of ancillary data on study areas (caves, sinkholes, saltwater intrusion)	UniBA, UniSannio, CNR BA
Activity 1.3	Detection of main driving factors for sinkhole occurrence	UniBA
Activity 1.4	Geomorphological analysis	UniBA

Milestone 2 (months 5-12)

Analysis of the freshwater-saltwater interaction processes

Activity 2.1	Design and realization of geophysical surveys	CNR BA
Activity 2.2	Monitoring of selected flooded caves/wetlands	UniBA
Activity 2.3	Hydraulic characterization of rock samples	CNR BA
Activity 2.4	Production of thematic maps	UniSannio

Project activities

Milestone 3 (months 5-24)

Assessment of the coastal processes in relation to Sea Level Rise

Activity 3.1	Water analysis (chemico-physical parameters, isotopes)	UniBA, CNR BA
Activity 3.2	Geological-structural analysis	UniBA
Activity 3.3	Reconstruction of hydrological data series	UniSannio
Activity 3.4	Analysis of recharge phenomena	UniSannio
Activity 3.5	Definition of Sea Level Rise scenarios	UniBA, UniSannio, CNR BA
Activity 3.6	Dissemination and exploitation of the results	UniBA, UniSannio, CNR BA

Final workshop

“Climate change effects in coastal karst areas”.

The Workshop will span over 4 days, with two days of scientific presentations, inviting the major world experts in the field of seawater intrusion in karst, underground stability and hypogenic speleogenesis, and two days of excursions.

The proceedings of this workshop, together with some papers on general issues, will be published in a special issue of an international journal, to be printed within one year from the end of the Project.

As an additional, not less important, goal, a significant effort will be dedicated to transferring the new data on saltwater intrusion and water quality to managers of Apulia Region and Local Authorities, aimed at writing regional procedures and protocols to control the advancement of the saltwater intrusion process.

Steering Committee

3 international experts

Zoran Stevanovic
University of Belgrad, Serbia
Karst hydrogeology

Mohammad Farzamian
Instituto Nacional de Investigacao Agraria
e Veterinaria (INIAV), Lisbon, Portugal
Geophysics

Evangelos Tziritis
Soil and Water Resources Institute
(SWRI), Thessaloniki, Greece
Saline intrusion

Tentative study areas

Choice of the areas is driven by availability of previous data on seawater intrusion, and by the occurrence of severe situations causing problems in water resource management and in agricultural practices, in sectors of high touristic value.

Adriatic side: from Frigole to Otranto

Ionian side: Torre Castiglione – Palude del Capitano

Acquatina di Frigole, litorale adriatico leccese

hydrology

MDPI

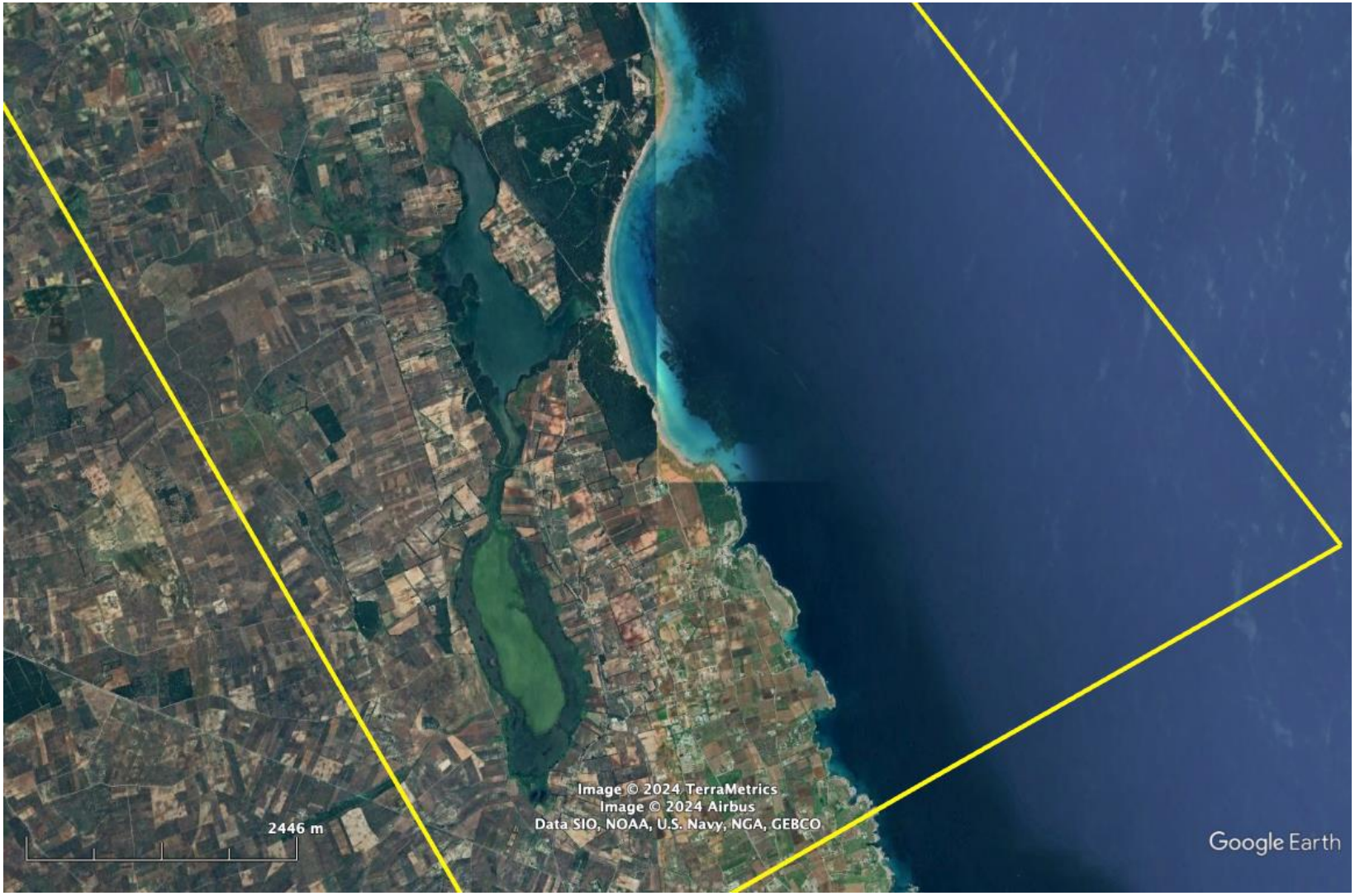
Article

Hydro-Stratigraphic Conditions and Human Activity Leading to Development of a Sinkhole Cluster in a Mediterranean Water Ecosystem

Stefano Margiotta [1], Gabriele Marini [1,2], Sergio Fay [3], Francesco M. D'Onghia [4], Isabella S. Liso [5], Mario Parise [5,*] and Maurizio Pinna [1,2]

Tentative study areas

Adriatic side: from Frigole to Otranto



Tentative study areas

Ionian side: Torre Castiglione – Palude del Capitano

Tentative study areas

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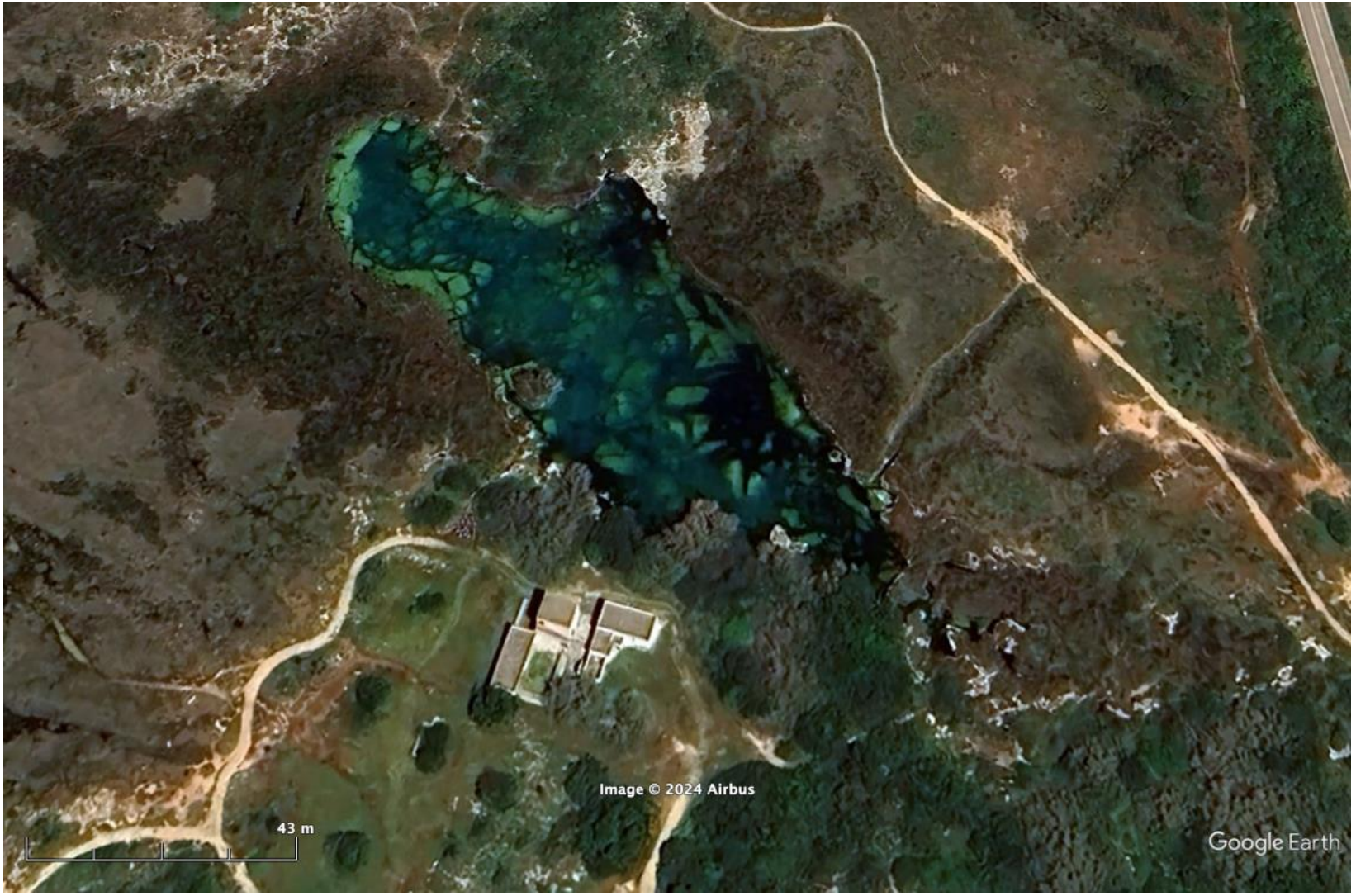

Tentative study areas

Ionian side: Torre Castiglione – Palude del Capitano

Invited stakeholders

- ARPA Puglia
- Asset
- Acquedotto Pugliese
- Autorità Distretto Appennino Meridionale
- Ass. Ambiente e Territorio - Regione Puglia
- Servizio Protezione Civile Regione Puglia
- Servizio Difesa del Suolo- Regione Puglia
- Sezione Demanio e Patrimonio - Regione Puglia