Feasibility study for ET Infrastructure for Sardinia site: location optimization, GIS-BIM three-dimensional modelling, multicriteria analysis

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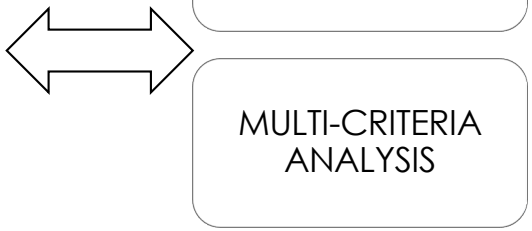
- adopted approach for optimizing the infrastructure localization based on a GIS-BIM and multi-criteria analysis
- collection and managements of the main requirement and constraints
- triangle Reference Solution (TC)
- L-configuration hypothesis (LC)
- comparative cost-benefit analysis for the two configurations

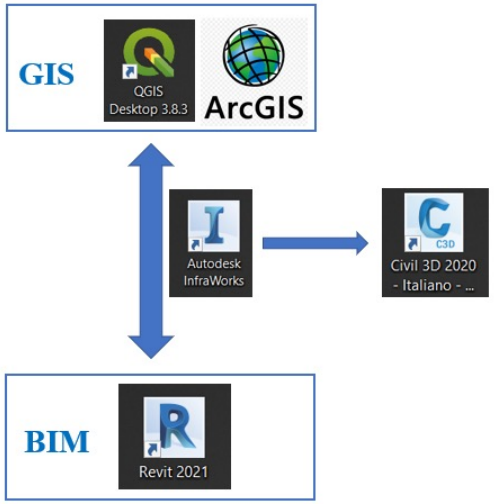
methodology for localization

- scientific requirements
- morphological and topographical characteristics
- geological and geotechnical conditions
- anthropogenic/settlement interferences
- environmental conditions and/or the existence of constraints



GIS-BIM model

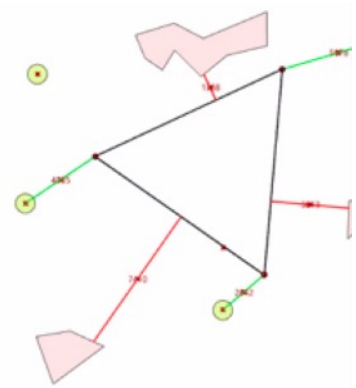
MULTI-CRITERIA ANALYSIS



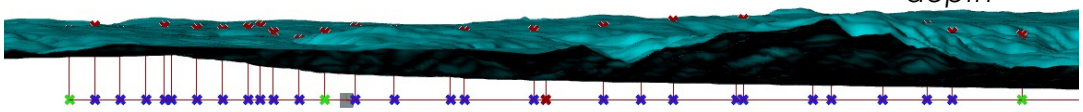
multiple criteria decision-making for geometry and positioning

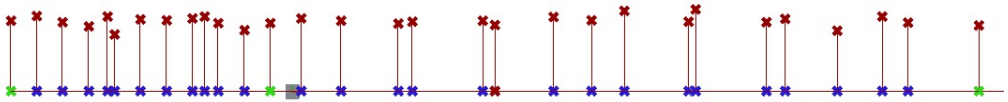
Multi-objective optimization by evolutionary solvers

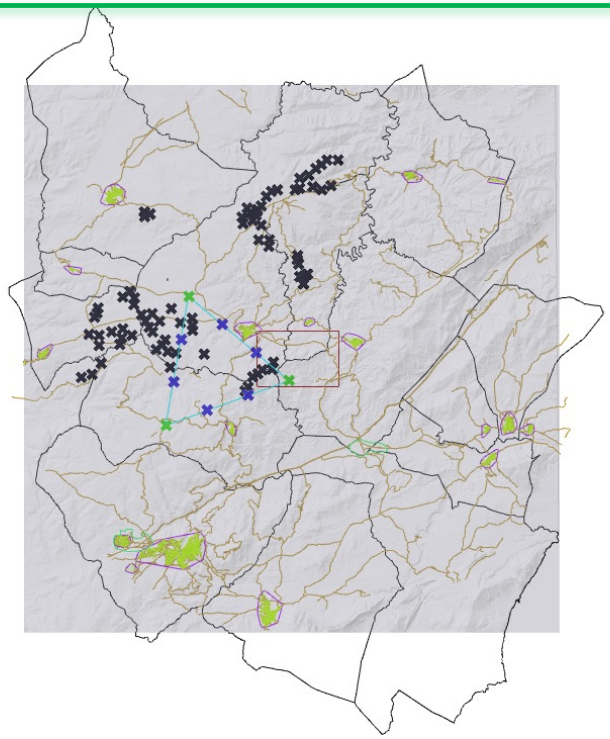
- *parametric models based on predefined variables*
- *best combination of positioning parameters to satisfy constraints.*



- ✓ *maximizing the distance from noisy areas, industrial zones, windmills*
- ✓ *minimizing the distance of the vertices to access roads and service areas*
- ✓ *comply geology and geotechnical constraints*
- ✓ *optimize access points*
- ✓ *calibrate the optimal depth*







Rhinoceros

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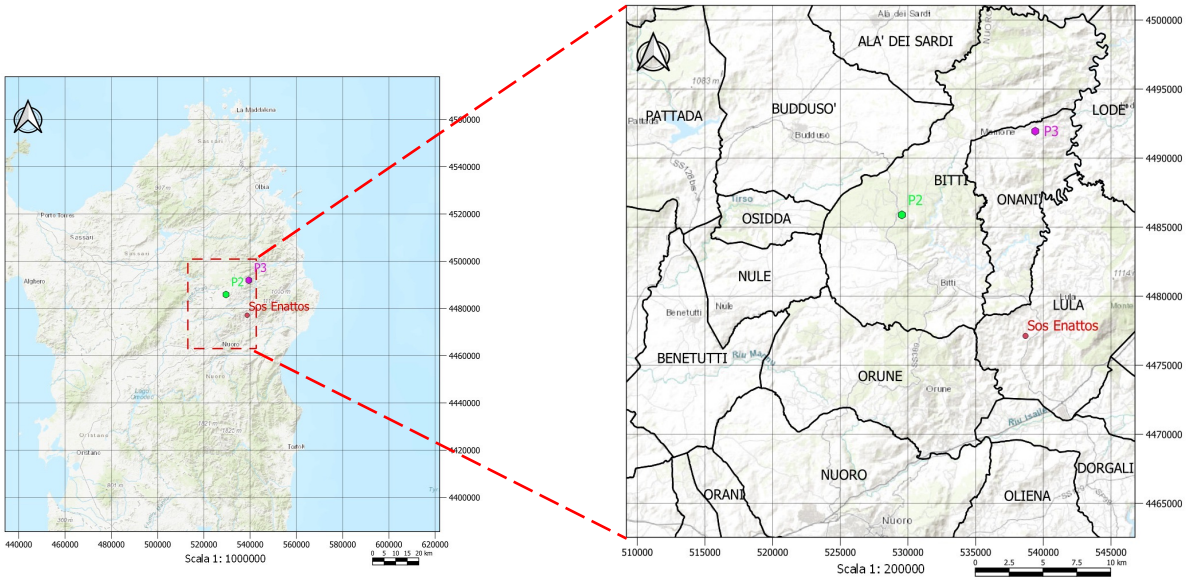
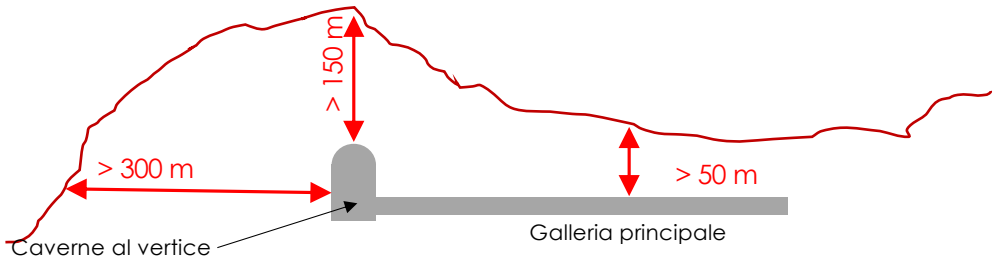
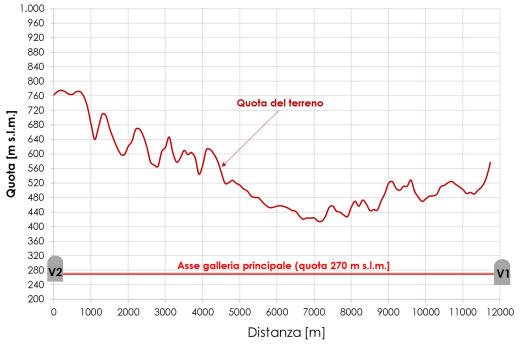
Requirements and constraints for the general framework

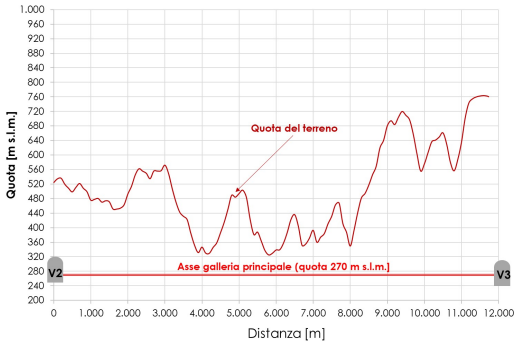
- minimum rock cover above and sideways of the main caves and tunnels
- Proximity of the V1 summit to Sos Enattos
- Incidence in protected areas, reserves and subject to constraints (e.g. Colonia di Mamone) for construction and operation
- distance from anthropogenic noise sources (urbanized and industrial areas, wind farms, etc.) depending on propagation patterns and instrumental tolerances
- characteristics of the geological formations affected by the excavation (in particular for the vertices) and the presence of discontinuities/faults for stability
- connections with the main and secondary roads at the main and secondary exits for accessibility during construction and operation
- presence of areas suitable for hosting the buildings on the surface and the accesses of the descendants at the main summits and safety exits

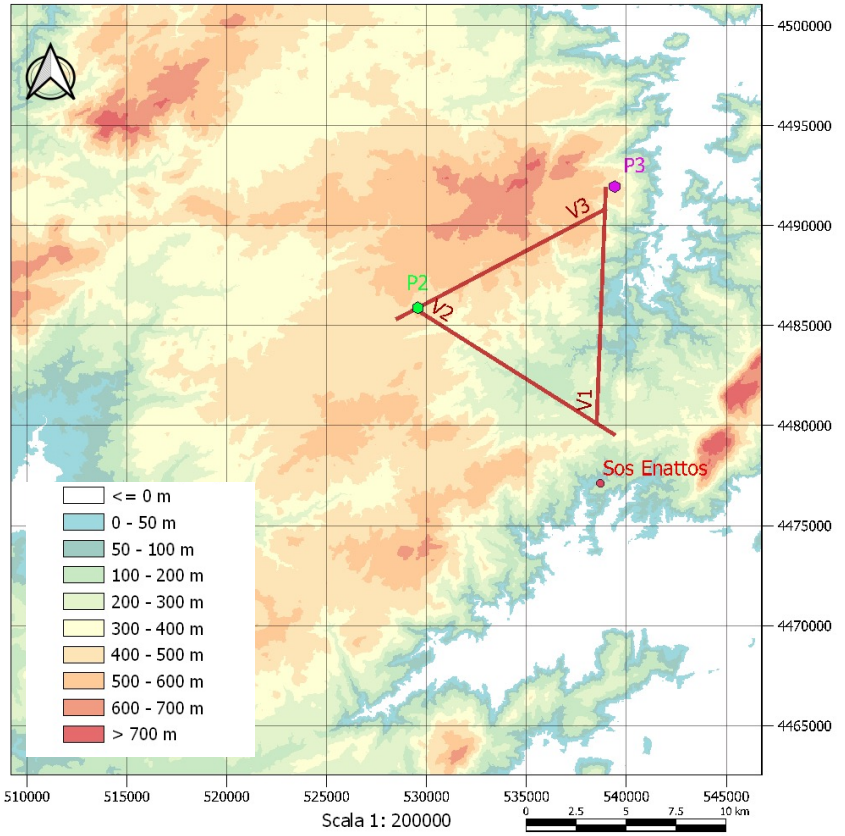




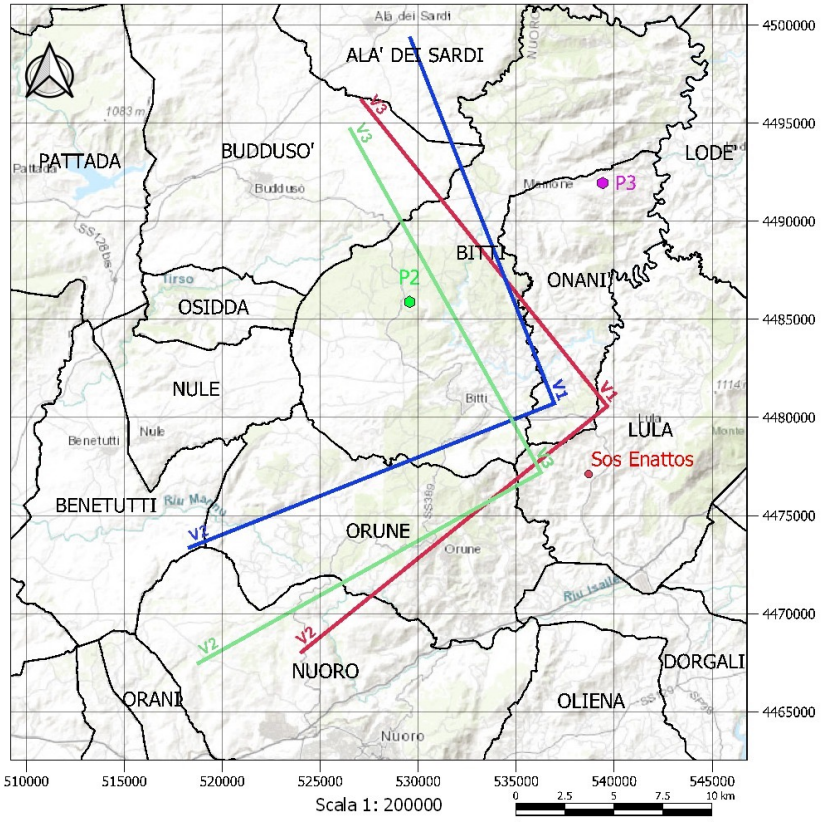
Topographic sections and roof thicknesses - CT_10

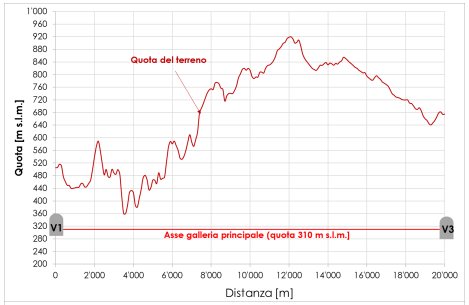


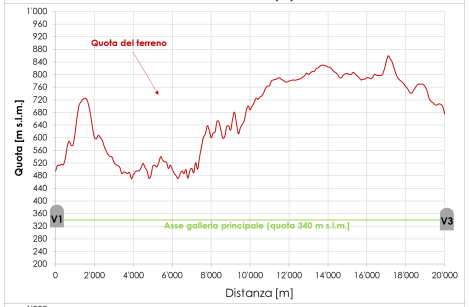


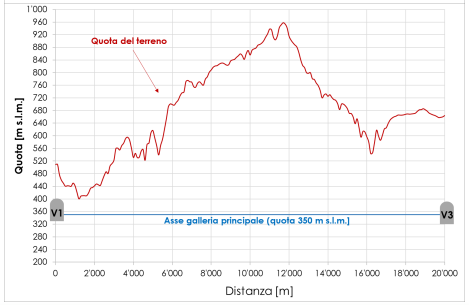


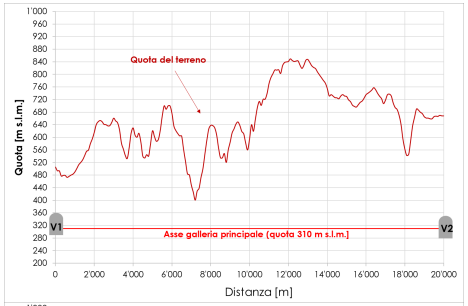
Topographic sections - CL_20km (3 alternatives)

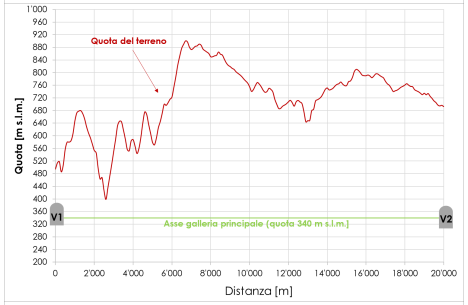




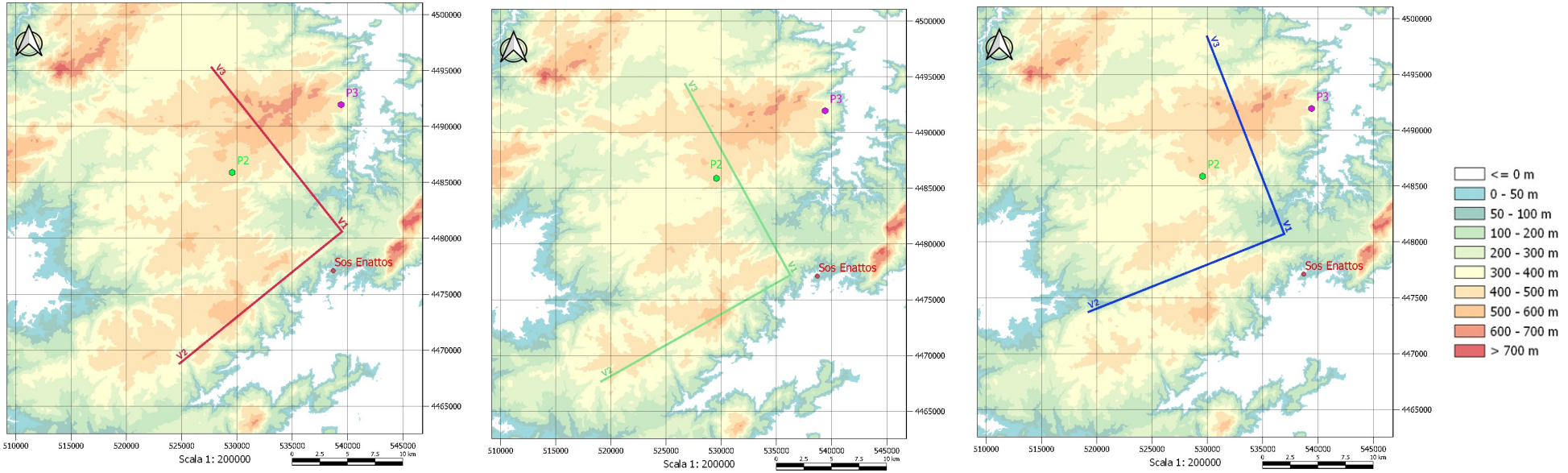


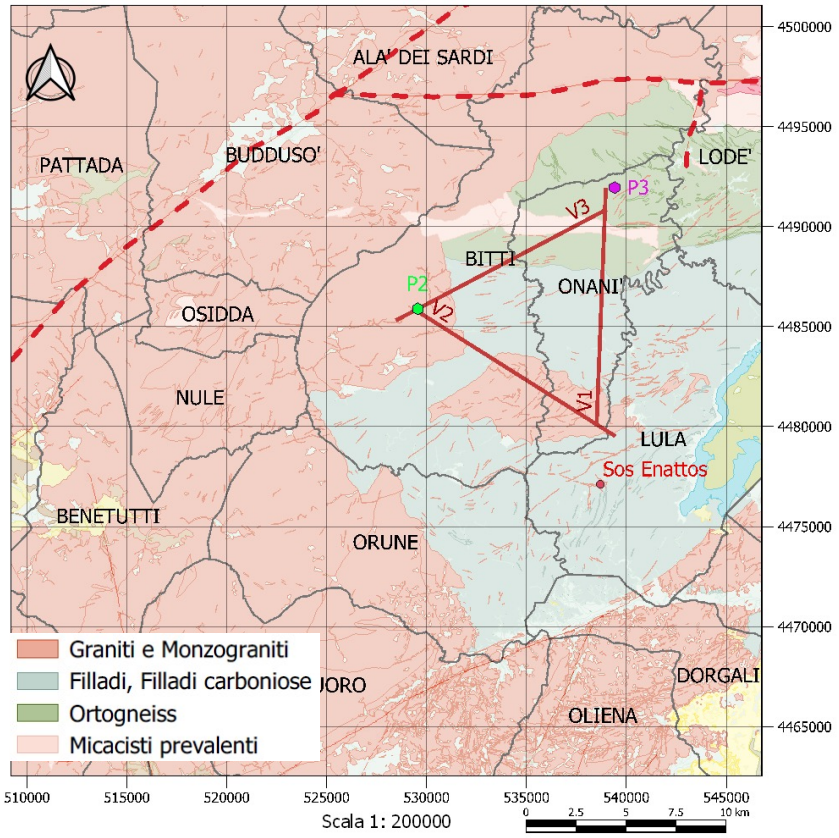




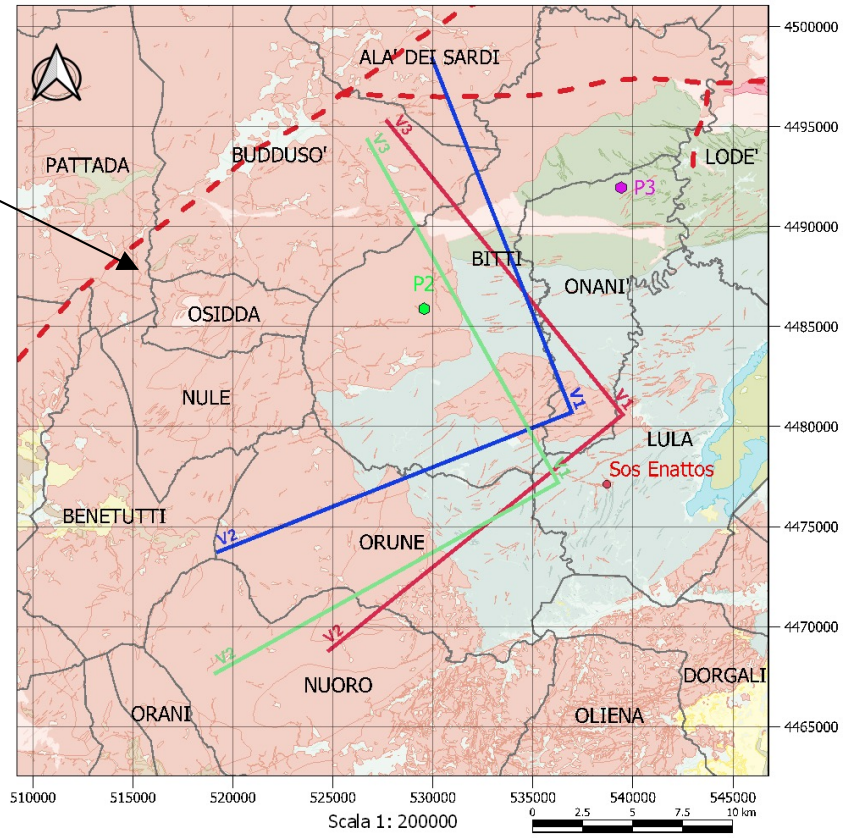


Distribution of coverage thicknesses - CL_20km (3 alternatives)





Fault trail layout (drafting of a detailed geological study in progress, Univ. Of Sassari)



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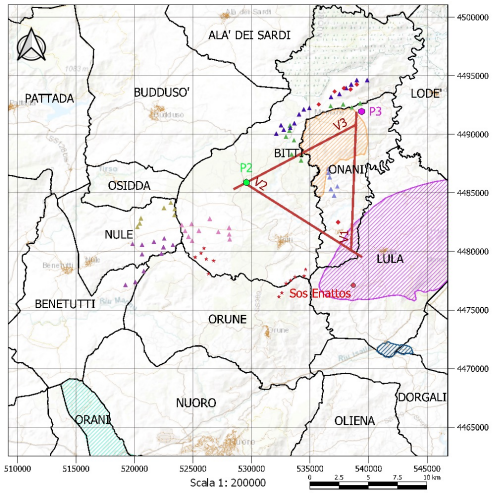
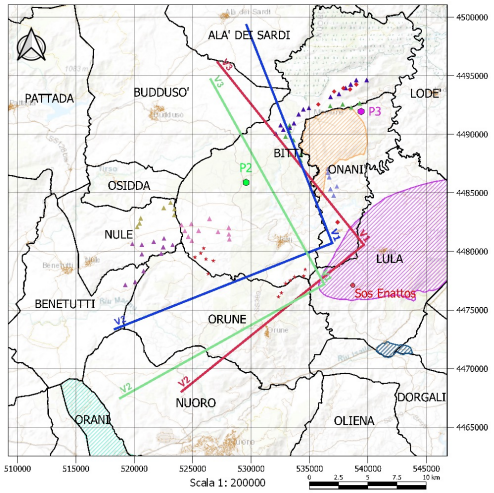
Land use constraints and protected area CT_10 vs LC_20 (3 alternatives)





SOS Enattos-Sar Grav
- Miniera di Sos Enattos

Pozzi
Pozzo P2 e P3
- P2
- P3

ET Vincoli

Parchi Geominerari
- Parco_Geominerario_DM_080916
- GUZZURRA - SOS ENATTOS
- ORANI
- Grandi Aree Industriali_DGR1624280317
- COLLONIA PENALE DI MAMONE
- Comuni

ESRI Topo

ZPS+SIC
- Oasi permanenti di Protezione faunistica e di cattura Istituite
- Parchi regionali istituiti L.R. 31_89
- ZPS - Zone Protezione Speciale 2014
- SIC - Siti Interesse Comunitario 2014

ET Sorgenti di rumore
- Elemento stradale
- Grandi Aree Industriali_DGR1624280317

Eolici esistenti
- Bitti Esistenti
- Onanie Esistenti

VIA Parchi Eolici
- Bitti (NU) e Buddusò (SS)-Istruttoria tecnica
- BITTI -Area PIP -Istruttoria tecnica
- BITTI TERENASS-Istruttoria tecnica
- Gomoretta-Bloccato
- Nule Benetutti -Istruttoria tecnica
- Nule Osidda e Budusso -Istruttoria tecnica

ONANIE-Istruttoria tecnica
- Alt 1

	TC10	LC_20A	LC20B	LC20C
quadrame to mministrativ	V1: Onanì-Lula V2: Bitti V3: Onanì	V1: Lula V2: Nuoro V3: Budduso/Ala dei Sardi	V1: Lula V2: Nuoro V3: Budduso	V1: Onanì/Lula V2: Benetutti V3: Ala dei Sardi
uota riferimento [m s.l.m.]	270	310	340	350
Interferenze territoriali	Mamone	Mamome	-	-
Contesto geologico	V1: Graniti V2: Ortogneiss V3: Graniti	V1: Graniti V2: Graniti V3: Graniti	V1: Filladi V2: Graniti V3: Graniti	V1: Graniti V2: Graniti V3: Graniti
	No interferenza faglie	V3 in prossimità faglie	No interferenza faglie	Galleria TBM attraversa faglia
Sorgenti	Parchi eolici	Parchi eolici	Parchi eolici	Parchi eolici
Possibile estensione	no	no	no	Si (30 km?)

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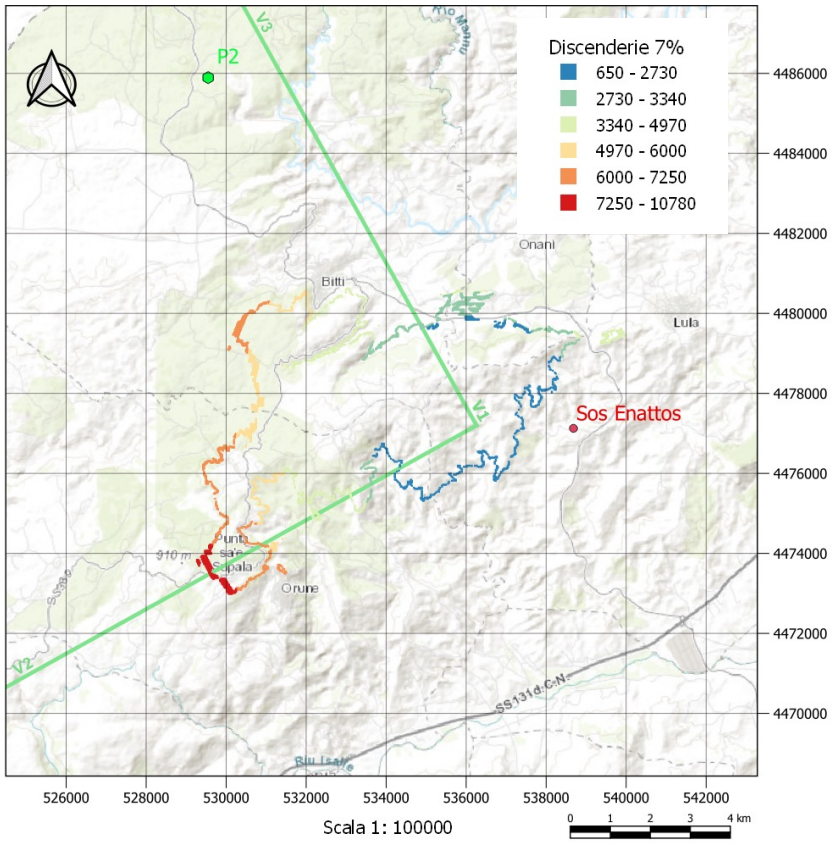
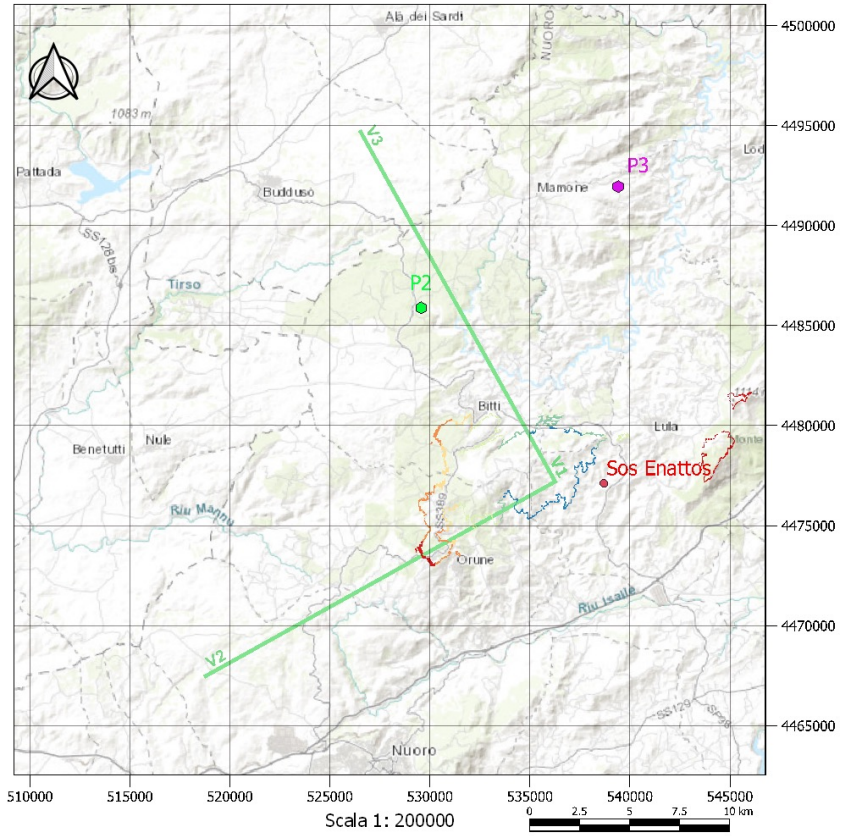
Localization of descendant accesses (max 7%)- CL_20





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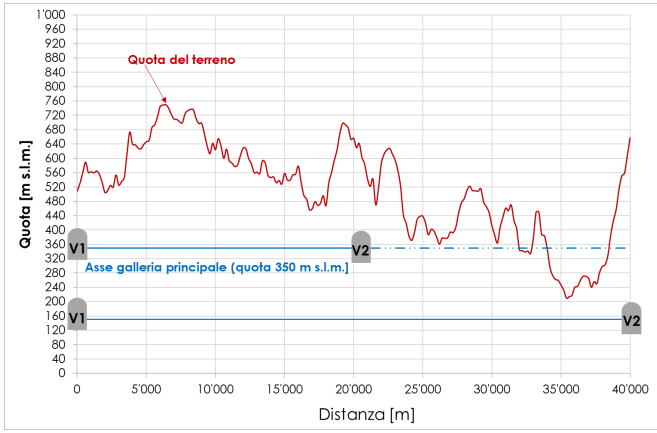
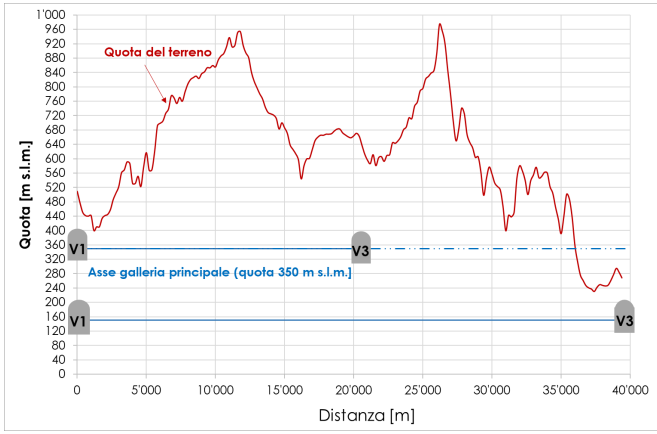
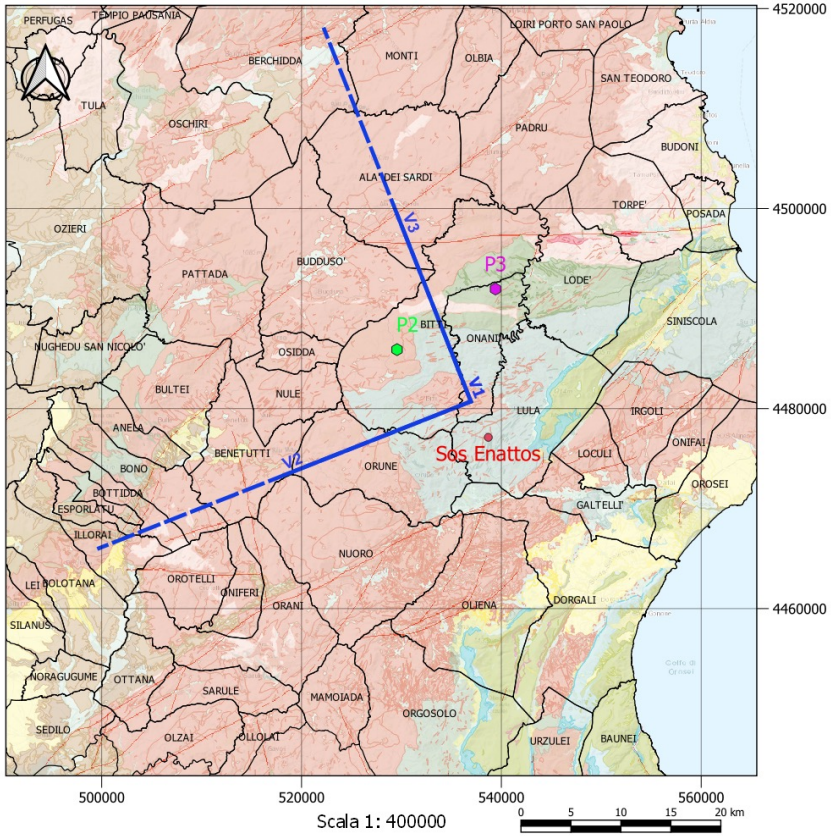
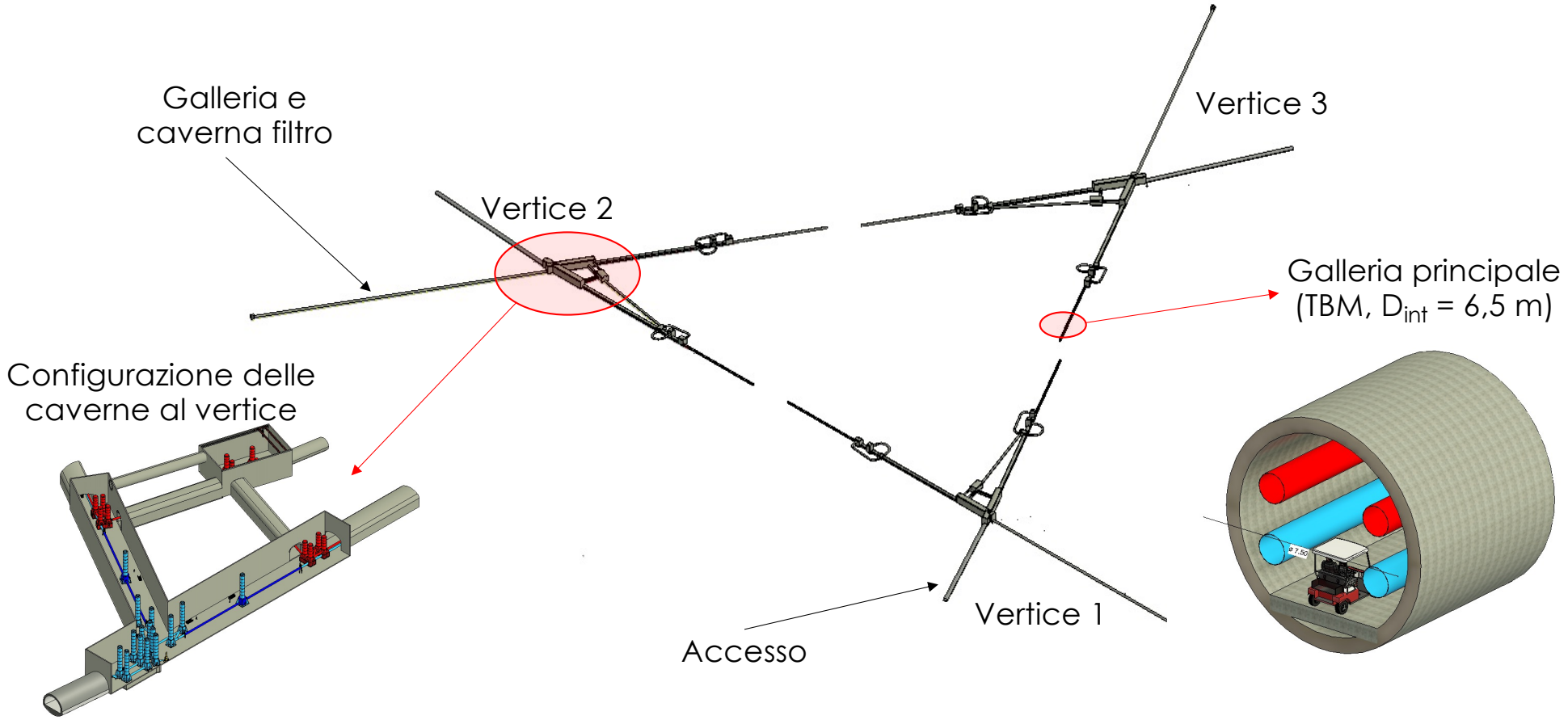
Potential extension - CL_20



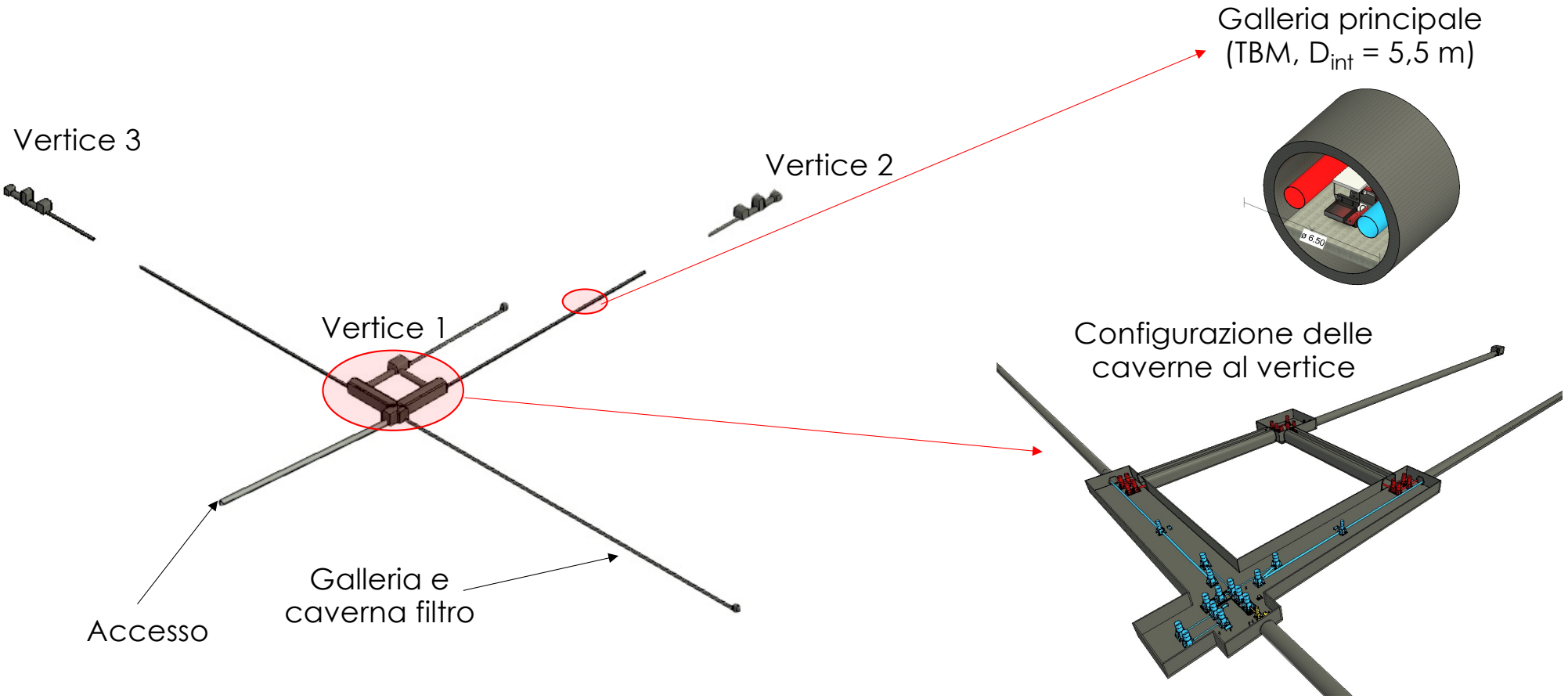




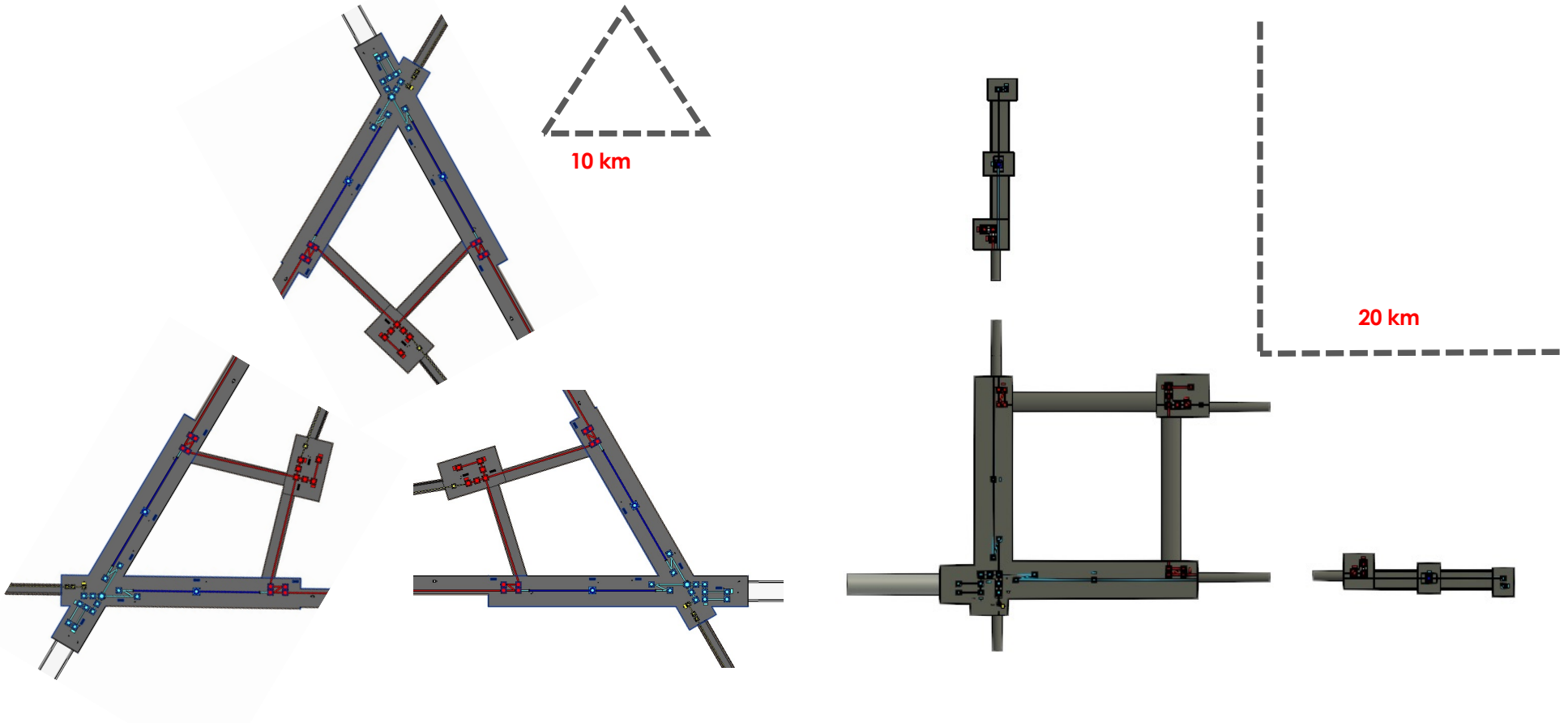
Layout TC_10km



Layout LC_20km

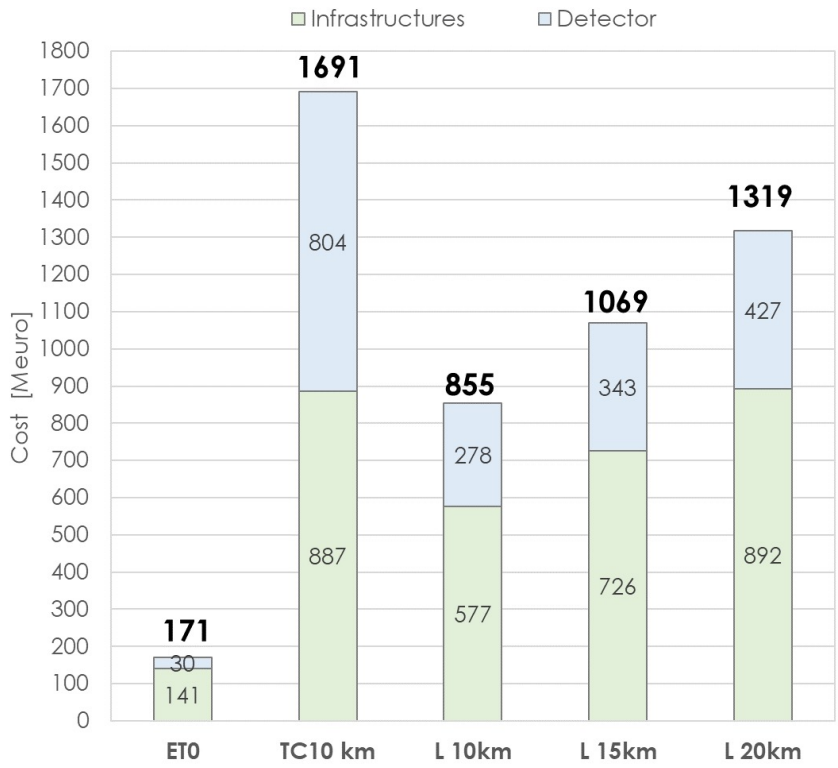


TC vs LC vertice geometries



Construction cost assessment

1. INFRASTRUCTURES
1.1 Underground (+15% contingency)
1.1.1 Tunnels
1.1.2 Caverns
1.1.3 Access
1.2 Surface works
1.3 Installation
1.4 Direction of civil works
2. DETECTOR
2.1 Vacuum system
2.2 Optics and laser
2.3 Suspension system
2.4 Cryogenics
2.5 Installation



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consideration

- For the CT the realization of 3 distinct interferometers involves the realization of a more coplex system of caves and tunnels at the 3 vertices
- The LC can be extended to lengths longer than 20 km
- The costs for the construction of the infrastructure are comparable (TC has more caves, a larger but shorter main tunnel diameter and fewer exits/entrances).
- LC realization times may be shorter than CT (longer tunnels (TBM) but less complex caverns (D&B)