



ET teleconf

20 giugno 2018

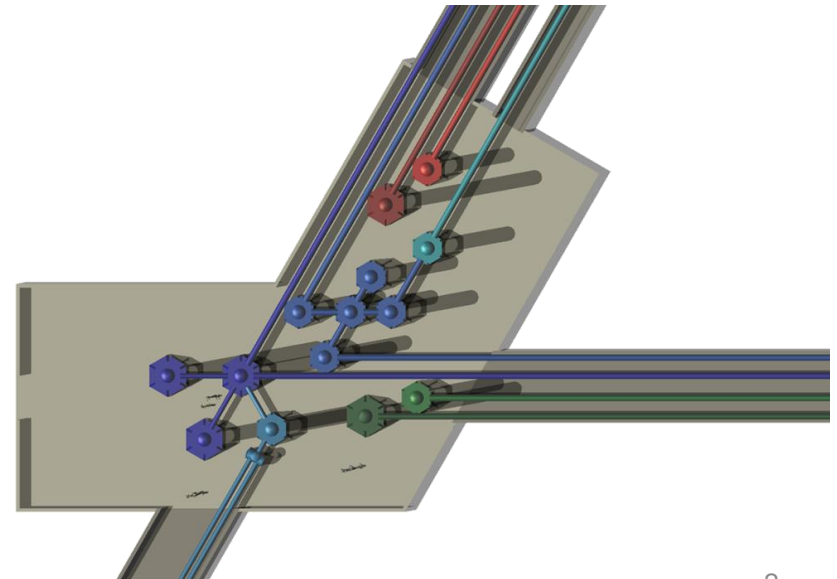
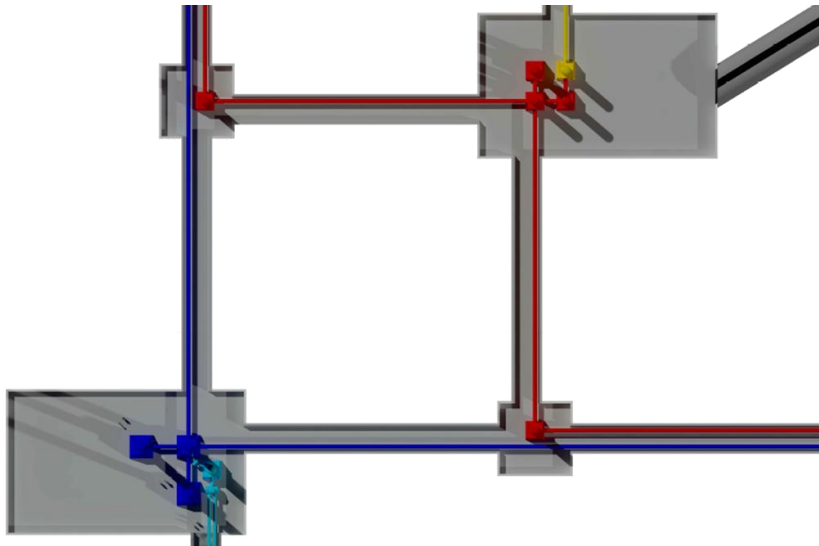
Infrastrutture a Sos Enattos

Stato dell'arte - Questioni aperte

Andrea Paoli

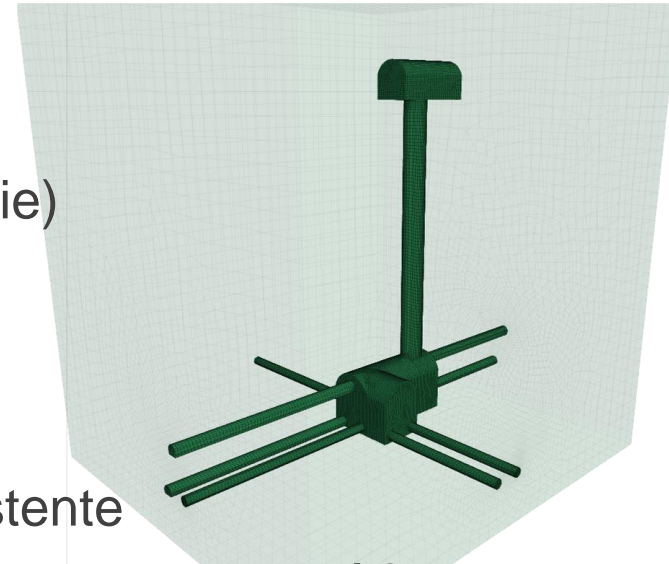
Dal CD verso il TD

- Dimensionamento degli spazi interni (verifica della 1^a ipotesi) per:
 - basi torre (meccanica)
 - criogenia
 - vuoto
 - impianti meccanici/elettrici
 - impianti di sicurezza
 - racks elettronica
- Stabilire come procedere → Task specifica?



Dal CD verso il TD

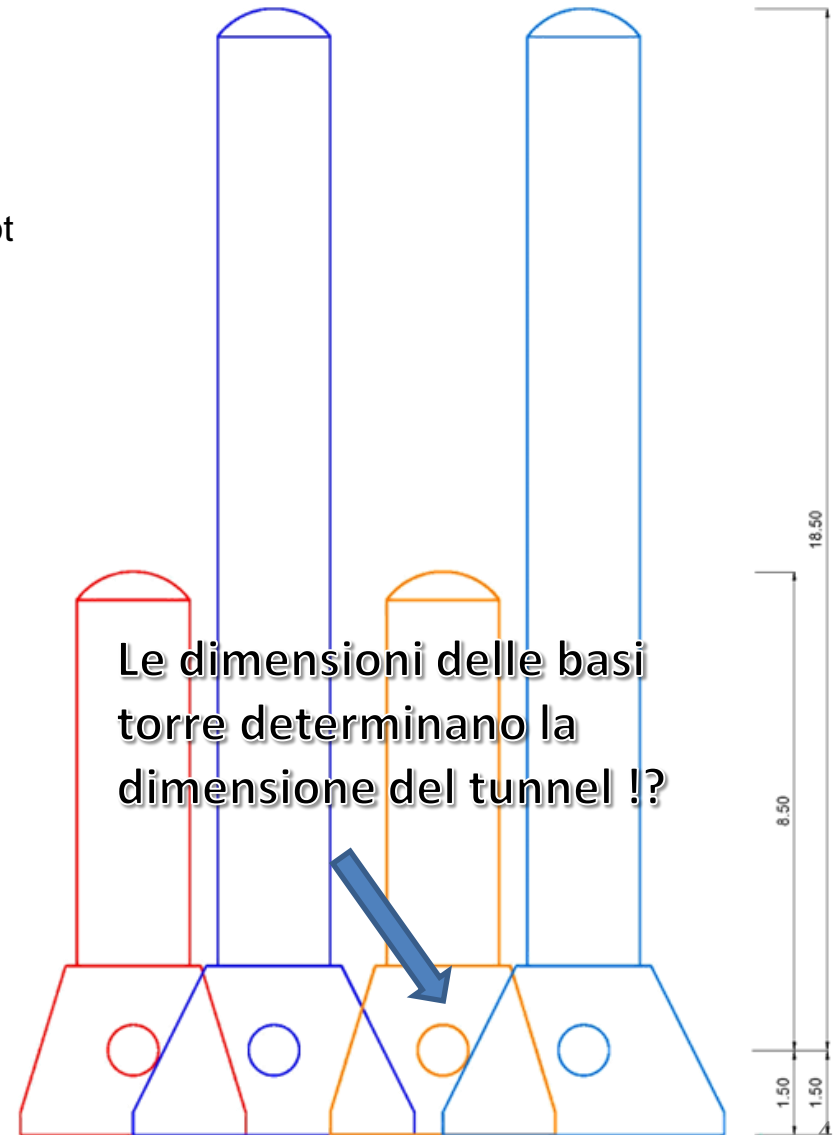
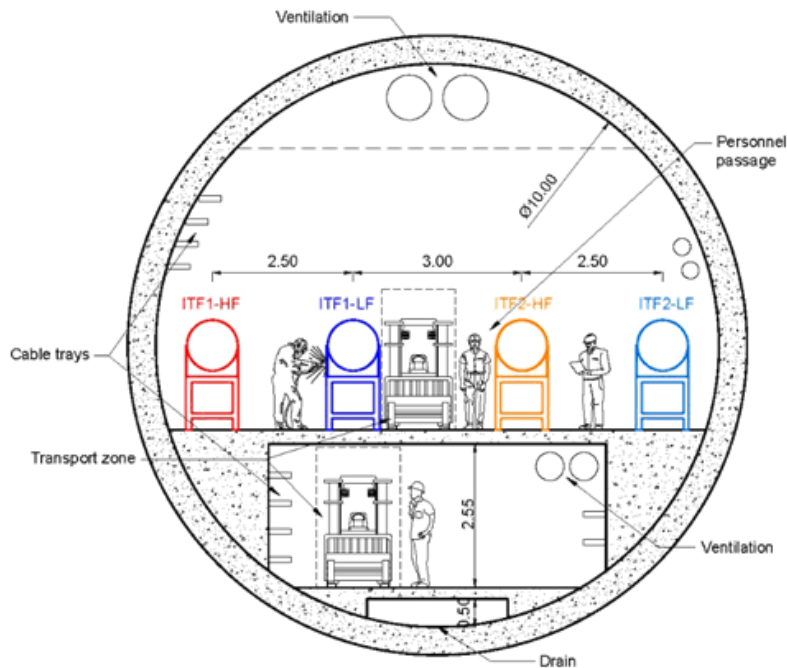
- ❑ Scavi: coefficiente di risulta 1.3?
- ❑ Forma/Dimensioni caverne determinate dal tipo di roccia: forma cilindrica non realistica, $\varnothing 65\text{m}$ \rightarrow luce eccessiva
- ❑ Schema e dimensioni Filter Cavities
- ❑ Accessi (shaft $\varnothing 20\text{m}$ non realistico)
- ❑ Accessi per scavo Main Caverns (discenderie)
- ❑ Accessi per TBM (discenderie)
- ❑ Uscite di sicurezza (shaft?)
- ❑ Indagini geognostiche
- ❑ Localizzazione sul sito – Rilievo terreno esistente
- ❑ Sinergia con Regione Sardegna per le opere di accessibilità?
Tempi differenti?
- ❑ Monumentazione del network utile per il futuro



Triangolo vs L numeri principali

Realistic tower bases force to shift pipes horizontally

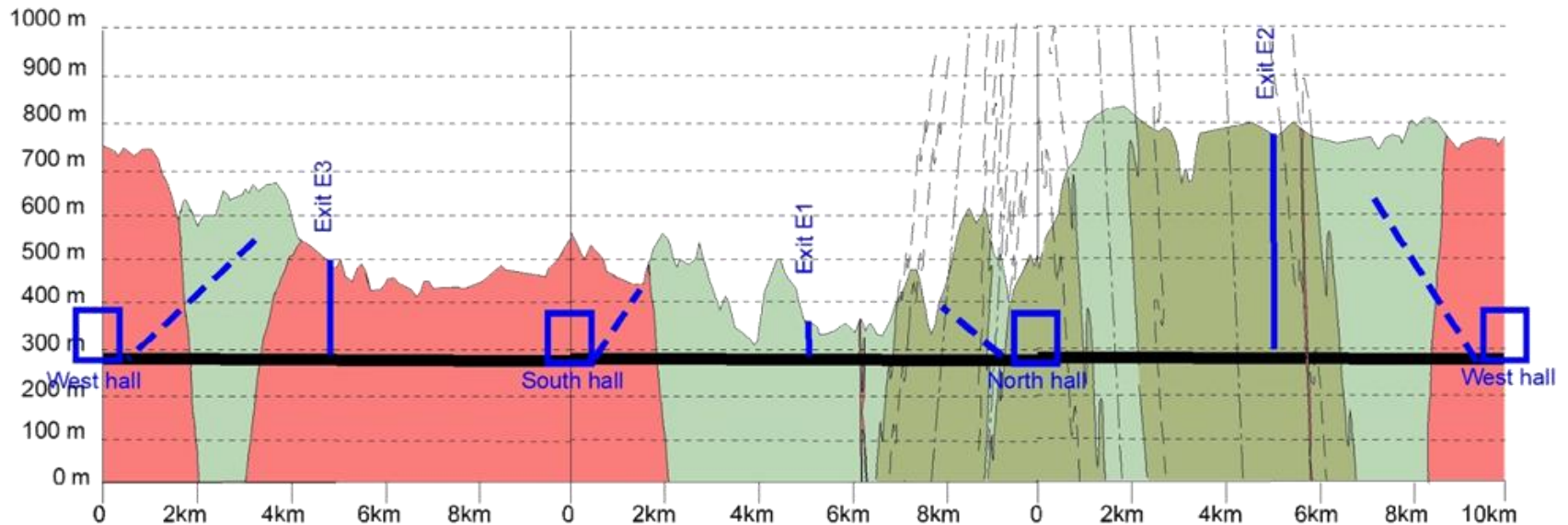
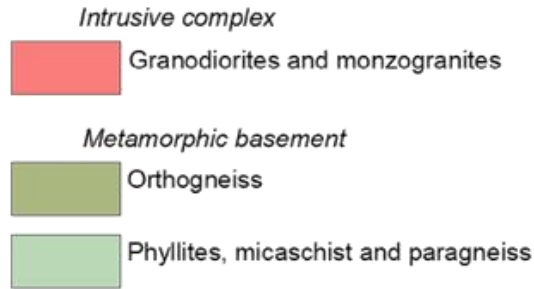
Our assumption is probably optimistic since cryostats and auxiliary instrumentation are not taken into account



Triangolo vs L

Sezioni geologiche Triangolo

Legend



vertical exaggeration 10x

Triangolo vs L numeri principali



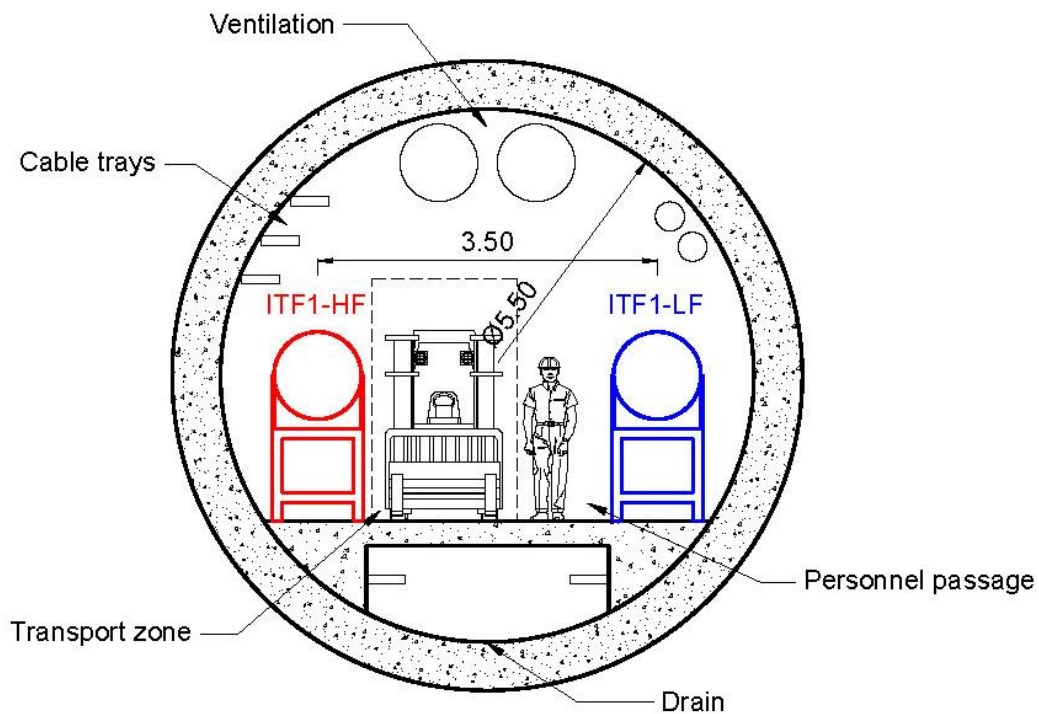
Conceptual Design Reviewed
Configuration:

Xylophone - Triangular

Total Excavation (net volume) [Mm ³]	5.443
Total Excavation (excavation factor 1.3) [Mm ³]	7.075
Total Cost [M€]	988
Contingency 20%	198

ID	Item Description	Comment	nr.	∅-Sur. [m] [m ²]	W -H [m]	L [km] [m]	Quantity [m ³]	Un. cost [k€/m ³] [k€/m]	SubTotal [k€]
1	Main Tunnel excavation	D=11.4m, D_inner 10.0 m, 30 km		11.4		30.675	3129421	18	552150
2	FC Tunnel excavation	3 Filter cavities, 1 km		11.4		2.940	299935	18	52920
3	57 pumping/bake-out areas	Inside tunnels							
4	Access Tunnel	S=132 m ² , L=4.1+2.3+1.7km		132.2		8100	1070820	0.133	142123
5	Main Caverns	#3: S=2730 m ² , Hmed=36m	3	1231.5		88.4	326594	0.095	31092
6	Satellite Caverns 1	#6: S=256 m ² , Hmed=32m	6	813.0		41.0	199998	0.115	23060
7	Satellite Caverns 2	#12: S=256 m ² , Hmed=22m	12	588.0		16.0	112896	0.145	16370
8	Access Tunnel Caverns	#3: S=315 m ² , Hmed=18m	3	318.0	18		17172	0.238	4093
9	Auxiliary (Safety) Caverns	#3: S=540 m ² , Hmed=10m	3	540	10		16200	0.482	7812
10	Safety Shafts	#3:D=6m L=95+500+200m		6.0		765	38434	0.230	8829
11	Conn. crown cavern's Tunnel	S=102 m ² , 2 km		102.0		2000	204040	0.123	25117
12	Portals	#3	3	30	20	15	27000	0.056	1501
14	Tooling; Surface finishing	type 2				2000		2.000	4000
15	Tooling; Surface finishing	type 3				33615		3.500	117653
16	Laboratory Tests (all incl.)								1280

Triangolo vs L numeri principali



Triangolo vs L

Sezioni geologiche L

Legend

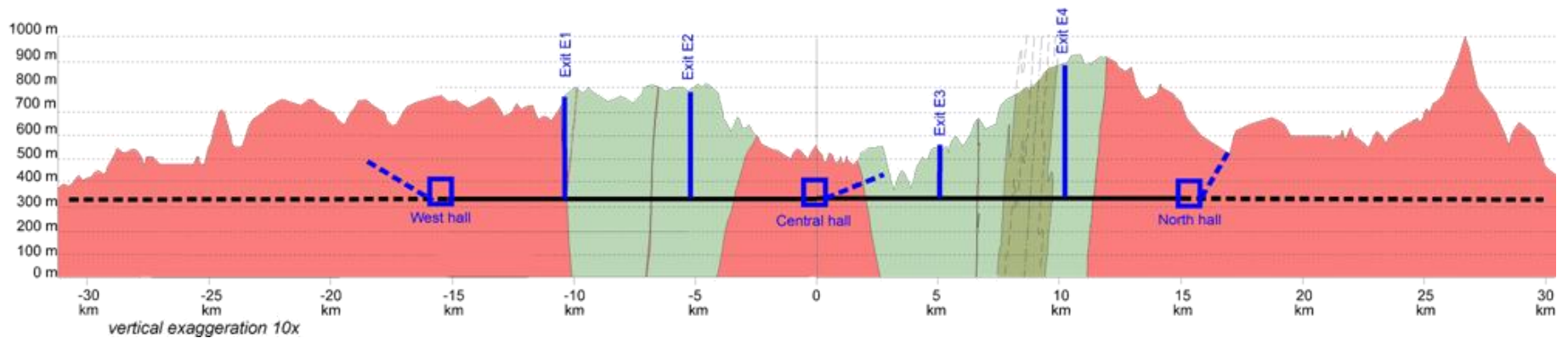
Intrusive complex

Granodiorites and monzogranites

Metamorphic basement

Orthogneiss

Phyllites, micaschist and paragneiss



Triangolo vs L numeri principali



L Topology

Configuration:

L shape

Total Excavation (net volume) [Mm ³]	2.456
Total Excavation (excavation factor 1.3) [Mm ³]	3.193
Total Cost [M€]	544
Contingency 20%	109

ID	Item Description	Comment	nr.	Ø-Sur. [m] [m ²]	W -H [m]	L [km] [m]	Quantity [m ³]	Un. cost [k€/m ³] [k€/m]	SubTotal [k€]
1	Main Tunnel excavation	D=6.6m, D_inner 5.5 m, 30 km		6.6		30.400	1039516	9	273600
2	FC Tunnel excavation	3 Filter cavities, 1 km		6.6		2.940	100532	9	26460
3	57 pumping/bake-out areas	Inside tunnels							
4	Access Tunnel	#3: L=2.4+1.7+2.4km		102.0		6500	663130	0.123	81627
5	Main Caverns	#2: S=1581 m ² , Hmed=37.5m	2	1231.5		52.0	128076	0.101	12923
6	Satellite Caverns 1	#4: S=861 m ² , Hmed=36.5m	4	813.0		41.0	133332	0.115	15373
7	Satellite Caverns 2	#4: S=256 m ² , Hmed=22m	4	588.0		16.0	37632	0.145	5457
8	Access Tunnel Caverns	#3: S=315 m ² , Hmed=18m	3	318.0	18		17172	0.238	4093
9	Auxiliary (Safety) Caverns	#4: S=540 m ² , Hmed=10m	4	540	10		21600	0.482	10416
10	Safety Shafts	#4: D=6m L=445+485+230+555m		6.0		1675	84152	0.230	19331
11	Conn. crown cavern's Tunnel	S=102 m ² , 2 km		102.0		2000	204040	0.123	25117
12	Portals	#3	3	30	20	15	27000	0.056	1501
13	Tooling; Surface finishing	type 1				33340		1.500	50010
14	Tooling; Surface finishing	type 2				8500		2.000	17000
16	Laboratory Tests (all incl.)								1280

Indagini geognostiche – stima SWS



Triangle/L

Sondaggi principali [€] 511062

Zona	Q superficie [mslm]	Perforazioni [m]	Appr. Cant. [€]	Perforazione [€]	Test in situ [€]	Test di laboratorio [€]	Prove sismiche		
							Rilievo geom.	Rifrazione	MASW
Caverna 1	755-735	465-405	3852	112500	31346	7239			
Caverna 2	540-540	210-210	3852	75500	24646	5697			
Caverna 3	500-705	375-250	3852	43000	17946	4155			
Portale accesso 1		50	3852	6000	4546	1071			
Portale accesso 2		50	3852	6000	4546	1071			
Portale accesso 3		50	3852	6000	4546	1071			
			23112	249000	87576	20304	4400	63870	62800

Sondaggi secondari [€] 766593

Totale [M€] 1.28

- ❑ Piano effettivo dei sondaggi
- ❑ Quali strettamente necessari in fase preliminare
- ❑ Consulenza esterna?

Localizzazione preliminare

P.ID	Gauss-Boaga		UTM		Q _{top} [mslm]	Q _{ITF} Copertura	WGS84 geographic coordinates				
	E [m]	N [m]	E [m]	N [m]			Lat	Log	Lat	Log	
Lshape_localizzazione finale						330					
ET_Lshape_W	1524427.4728	4474197.7335	524483.5550	4474376.2170	735	405	40.419652	9.288602	40° 25' 10.7472" N	9° 17' 18.9683" E	
ET_Lshape_C	1538532.0080	4480126.6530	538587.9980	4480304.9990	540	210	40.472528	9.455216	40° 28' 21.1010" N	9° 27' 18.7775" E	
ET_Lshape_N	1532603.0885	4494231.1882	532659.2170	4494409.4420	705	375	40.599846	9.386005	40° 35' 59.4465" N	9° 23' 09.6192" E	
Triangle_localizzazione finale						290					
ET_Triangle_W	1529945.3139	4485976.5063	530001.4170	4486154.8500	755	465	40.525584	9.354201	40° 31' 32.1007" N	9° 21' 15.1225" E	
ET_Triangle_N	1539304.7825	4490487.8749	539360.8270	4490666.1220	500	210	40.565832	9.464977	40° 33' 56.9950" N	9° 27' 53.9174" E	
ET_Triangle_S	1538532.0080	4480126.6530	538587.9980	4480304.9990	540	250	40.472528	9.455216	40° 28' 21.1010" N	9° 27' 18.7775" E	

Vincoli principali – Verifica della localizzazione preliminare

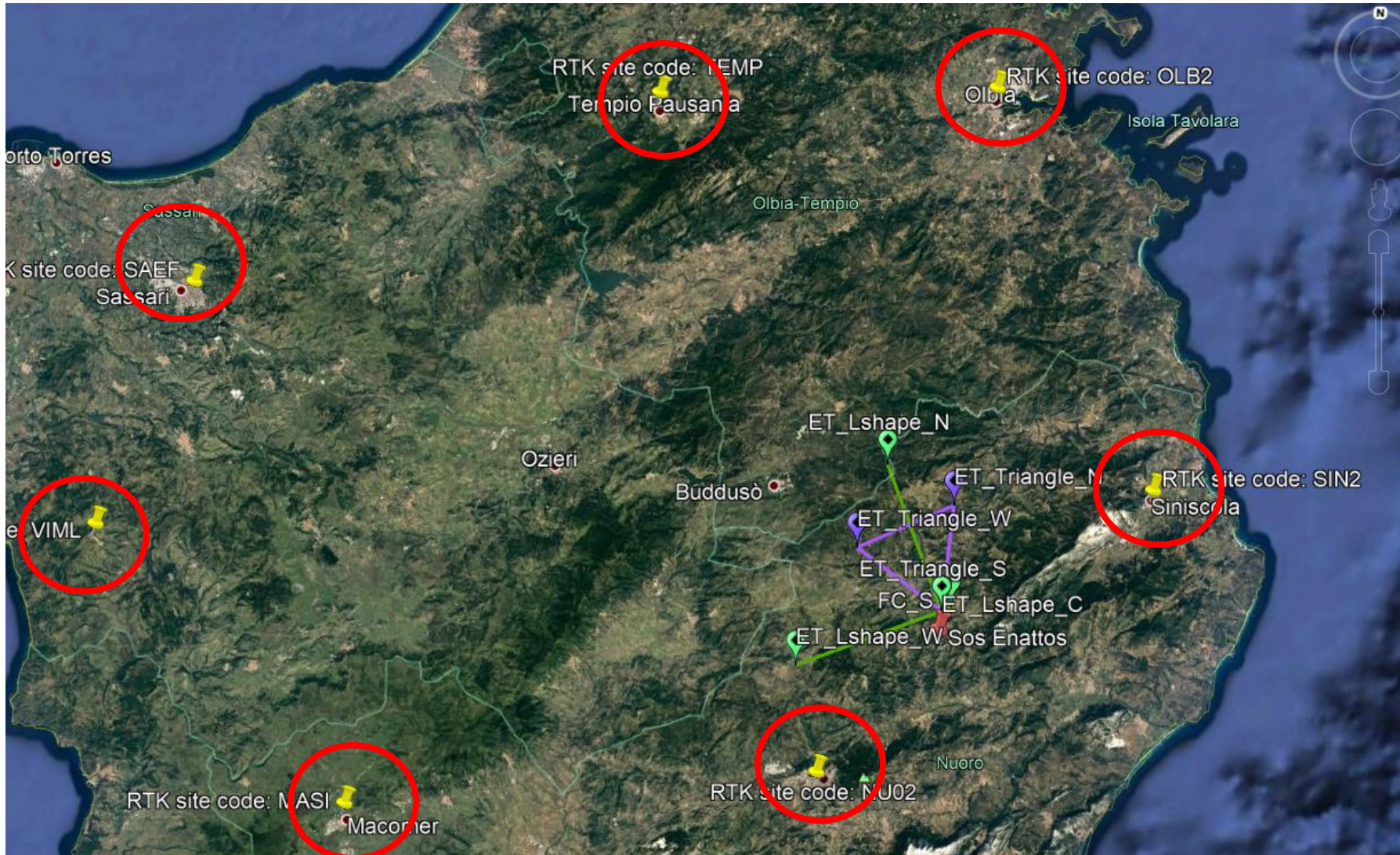


- ❑ Dimensioni max caverne (Limiti strutturali - NN noise?)
- ❑ Quota piano interferometro
- ❑ Copertura caverne
- ❑ Accessibilità (discenderie)
- ❑ Orientamento (L-shape)
- ❑ Uscite di sicurezza - Compartimentazioni
- ❑ Impianti di ventilazione – Estrazione aria
- ❑ Sorgenti di noise in superficie (no caverne dedicate?)

→ Ottimizzazione del design

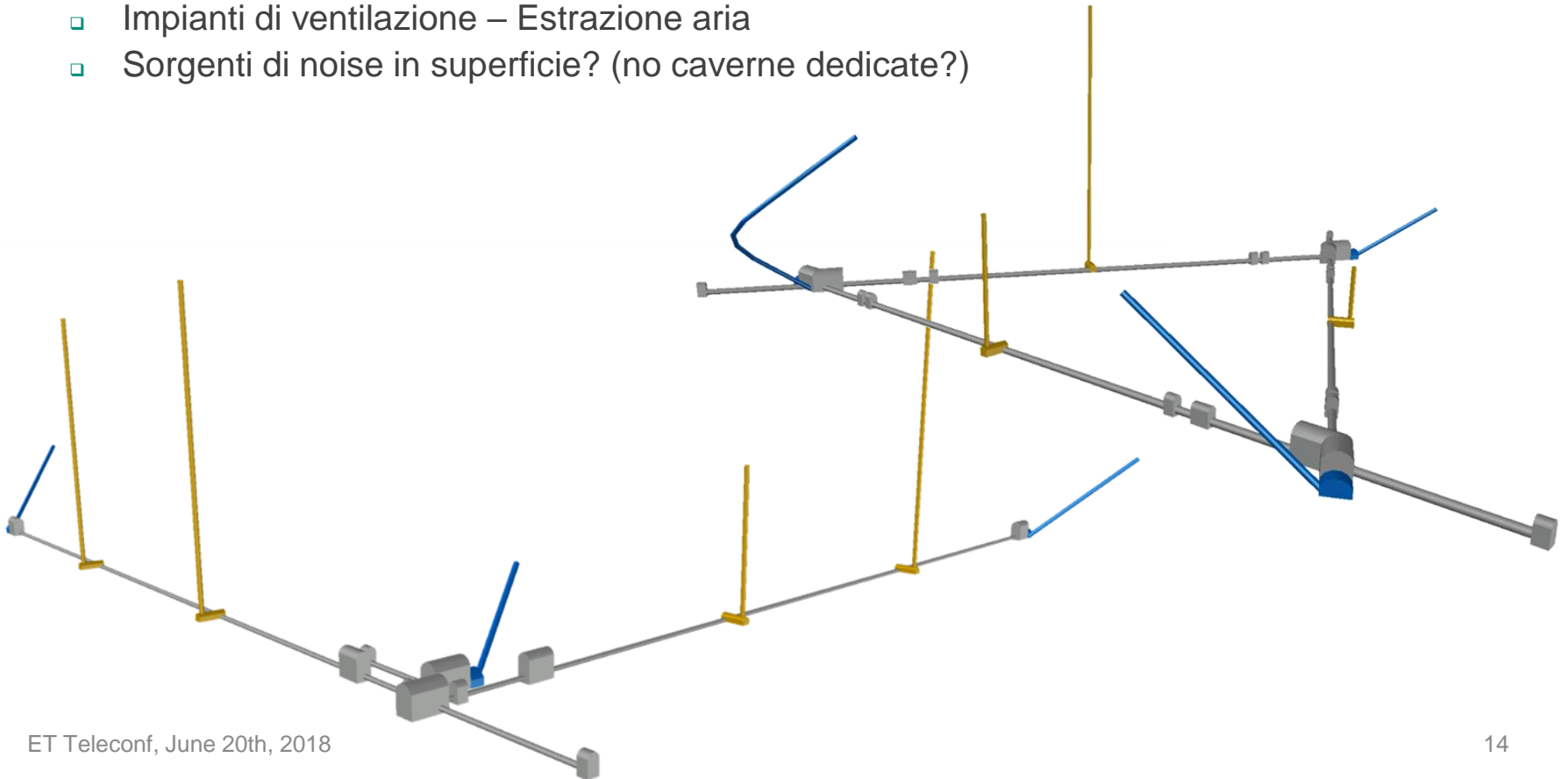
Verifica della localizzazione preliminare - Rilievo RTK delle aree di superficie?

○ Stazioni GPS permanenti rete ITALPOS

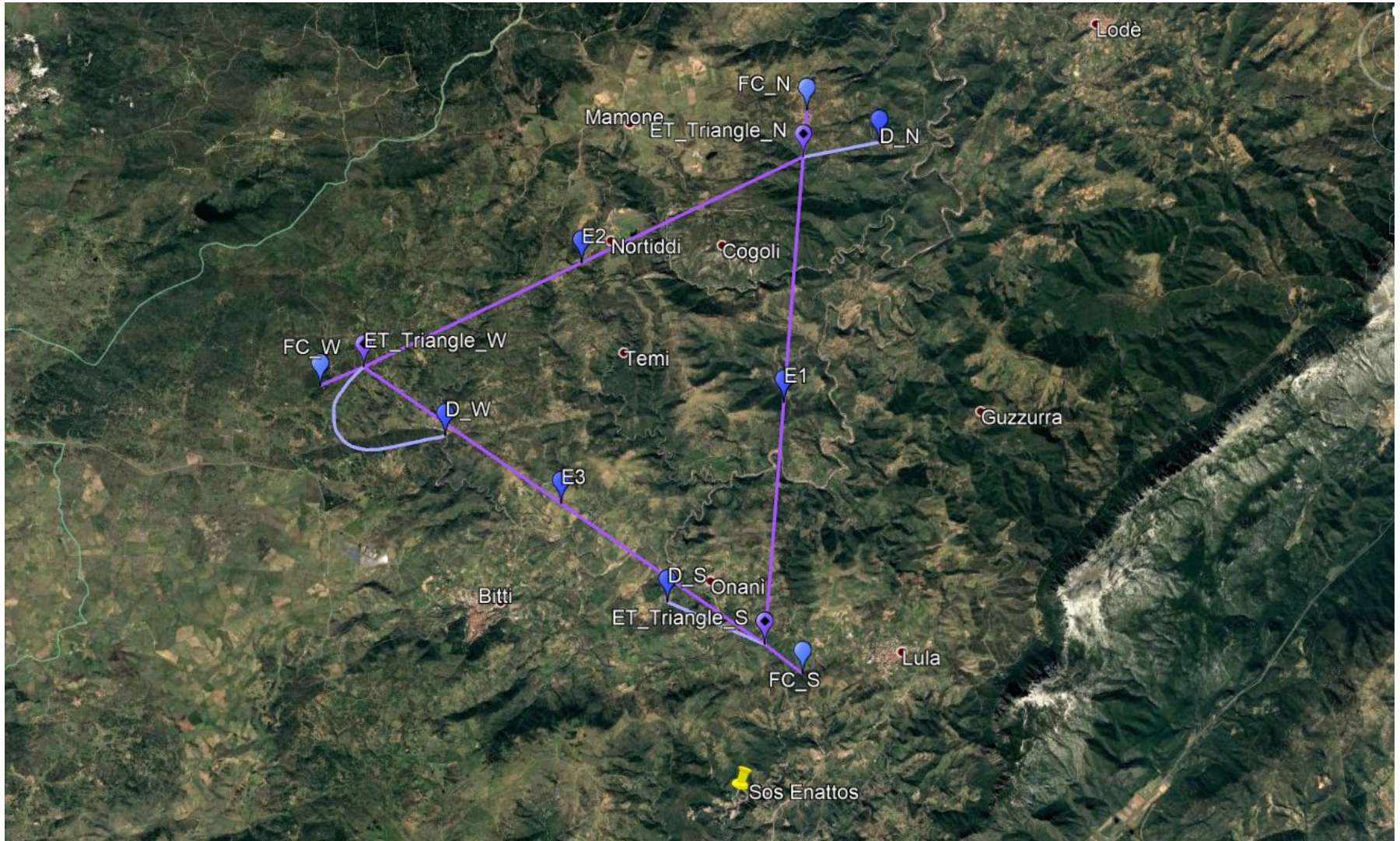


Revisione della localizzazione preliminare

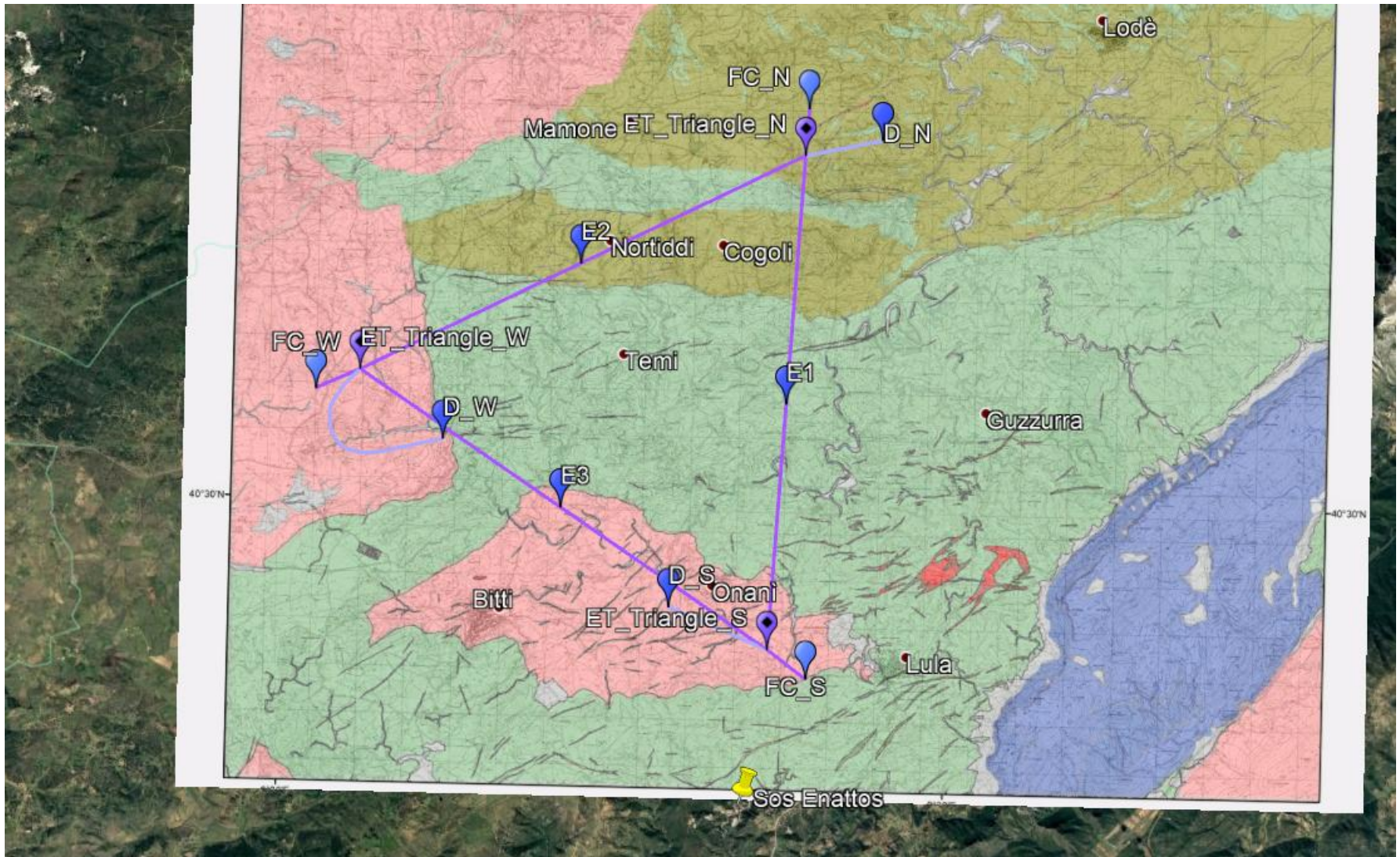
- Criteri adottati:
 - Caverne di maggiore luce in zone di roccia di resistenza maggiore
 - Accessibilità tramite tunnel di discesa
 - Uscite di sicurezza - Compartimentazioni
 - Impianti di ventilazione – Estrazione aria
 - Sorgenti di noise in superficie? (no caverne dedicate?)



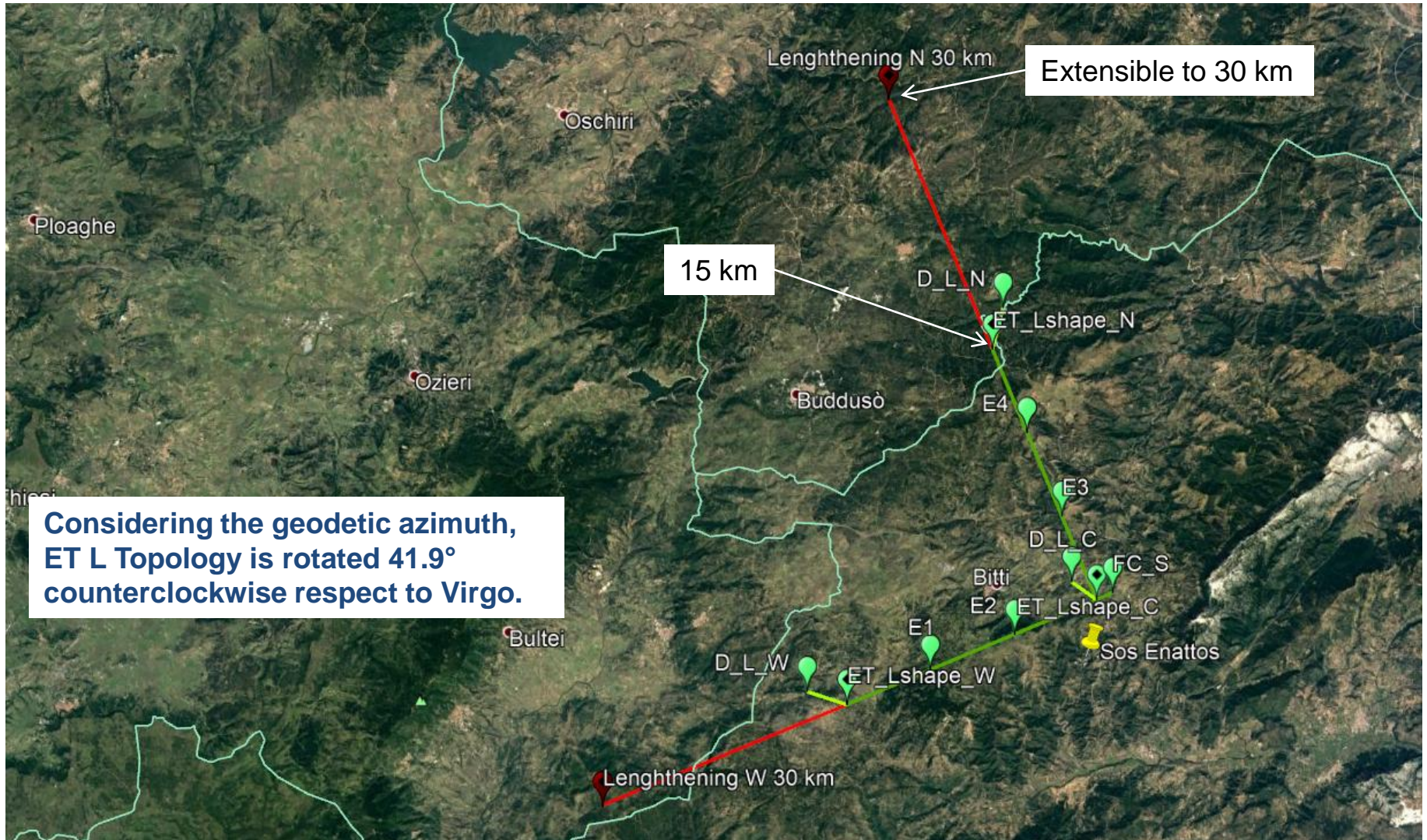
LOCATION - TRIANGLE



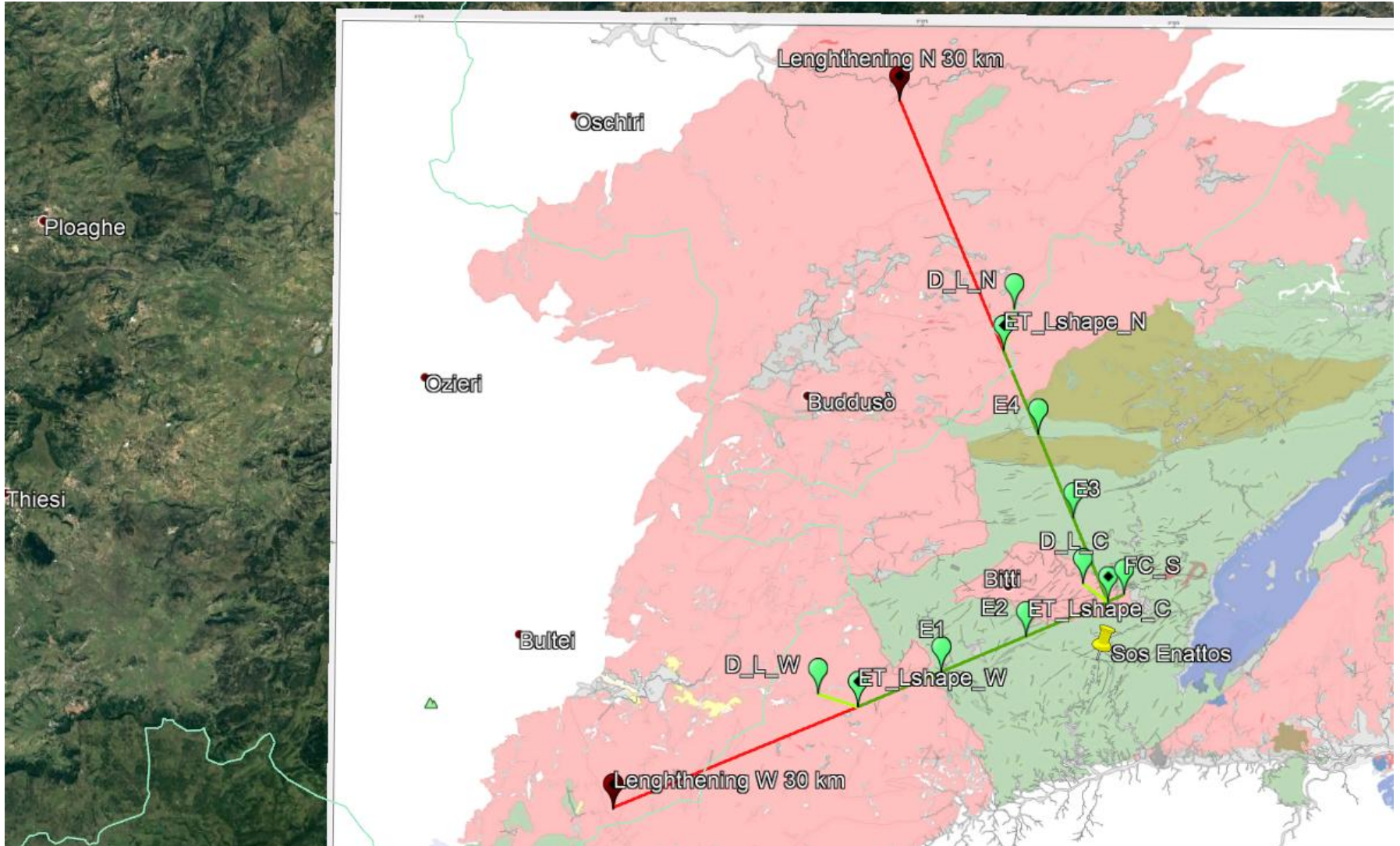
LOCATION - TRIANGLE



LOCATION - L



LOCATION - L



COST - SUMMARY TABLE



	ET book p.313	Triangle “realistic”	L
TUNNELS	280	727	367
CAVERNS	110	97	60
ACCESSES	61	164	117
TOTAL	451	988	544

cost in Meuros, no contingency

EXCAVATION VOLUME

	ET book p.313 (no excavation factor)	Triangle “realistic” (excavation factor 1.3)	L (excavation factor 1.3)
TUNNELS	1.081	4.458	1.482
CAVERNS	0.426	0.831	0.654
ACCESSES	0.236	1.786	1.057
TOTAL	1.742	7.075	3.193

volume in Mm³