The geometric configuration of the ET Sardinia: understanding the surface site characteristics and investigating the underground settings.

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P. Puppo[6], M. Perciballi[6], E. Majorana[6], L. Naticchioni[6],
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[6] *INFN Sezione di Roma, Roma, Italy*
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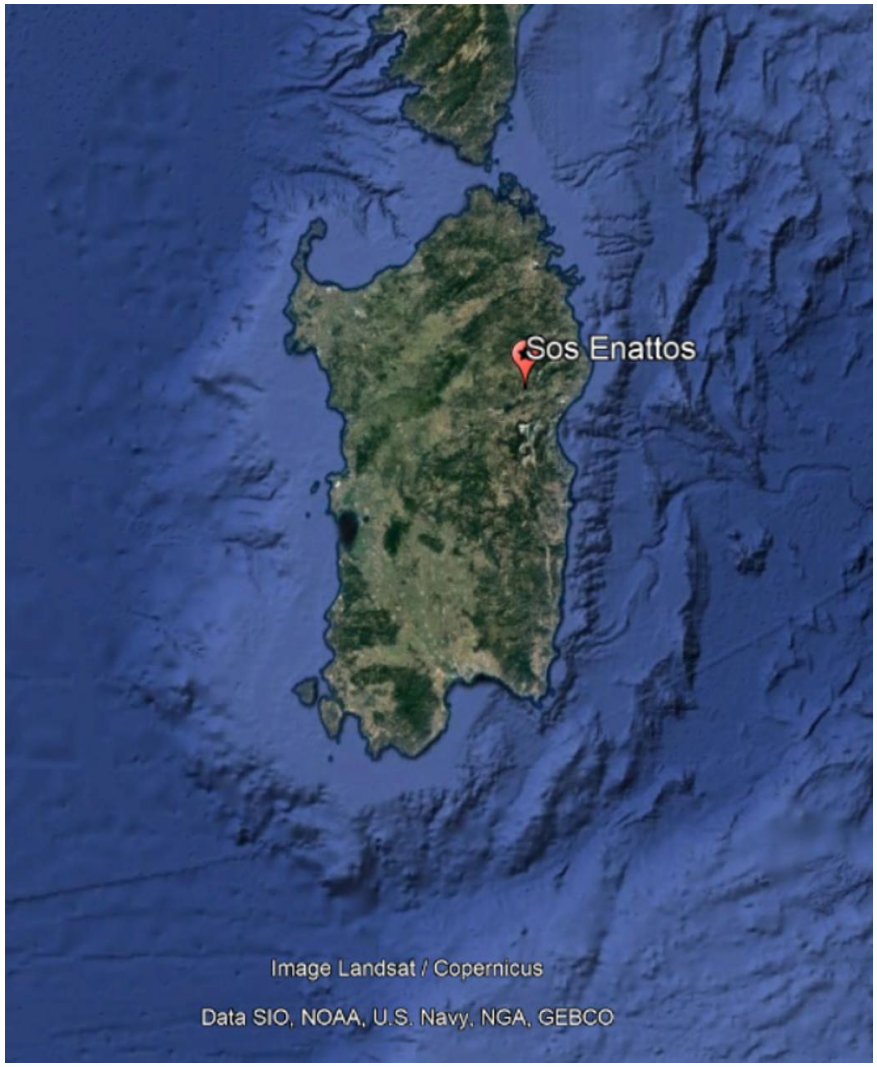
PRELIMINARY LOCALIZATION

GEOLOCALIZATION STUDY



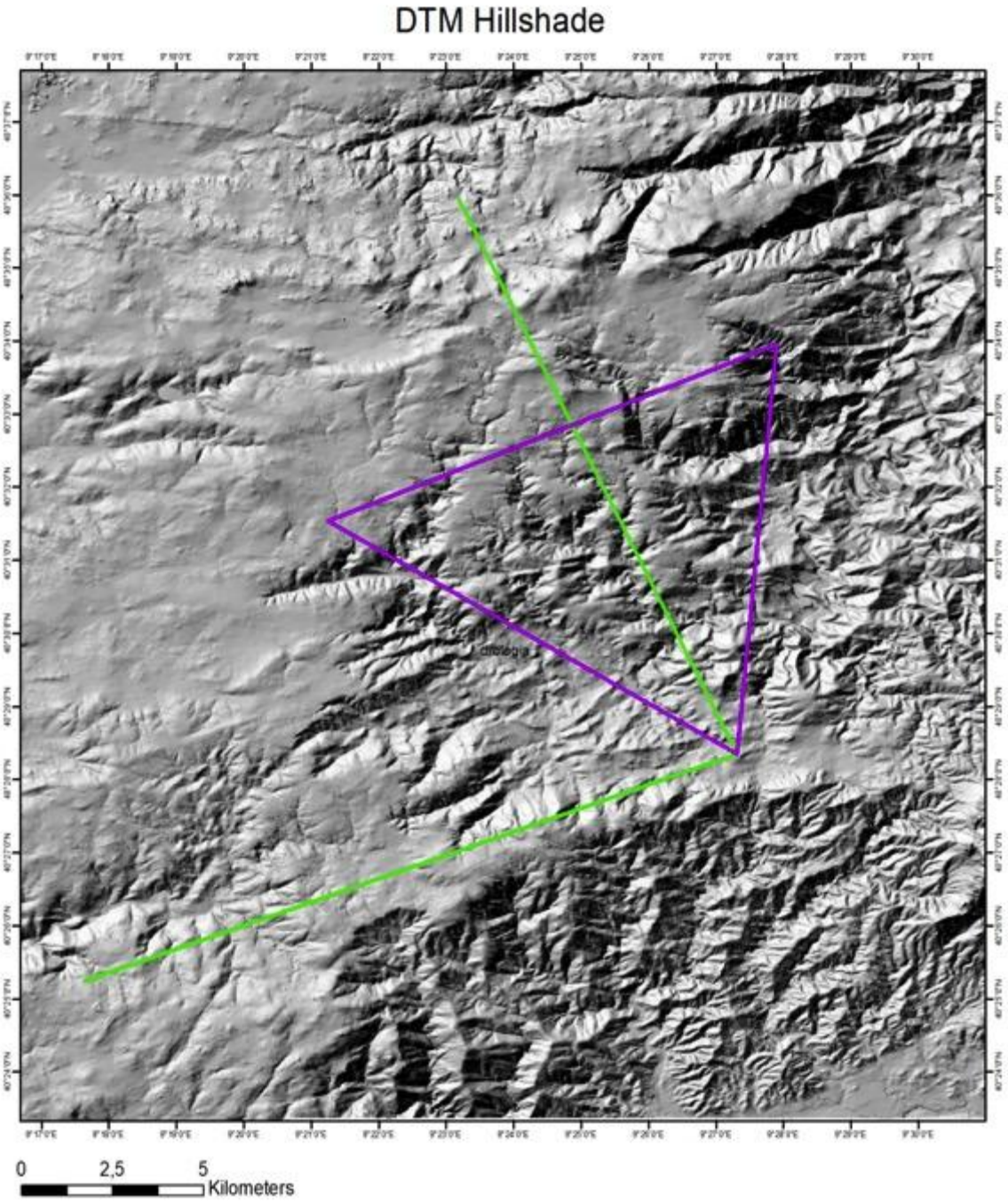
ET EINSTEIN TELESCOPE

THE PRELIMINARY STUDY

- Analysis of the surface conditions
  - Collection of updated numerical maps and geodatabase (CTR Sardinia Region)
  - Extraction of updated orthophotos and 3D digital surface model (1:2000)
  - Analysis of ground stability through DInSAR analysis
  - Land use, parks and protected areas, hazard maps
- Analysis of the descendery portals
  - Identification and evaluation of the potential hosting areas
  - Monumentation of the surface network
  - GPS and classical surveying
- Direct and indirect surveying (whole ET site)
  - Geological surveys
  - Geomorphological analysis
- Construction of a dedicated GIS (Geographic Information System)
  - Formulate different site scenario
  - Perform quantitative and geo-referenced analysis
  - Provide a coherent and multidisciplinary database
  - Support decision makers through quantitative and visual tools

Analysis of the surface conditions

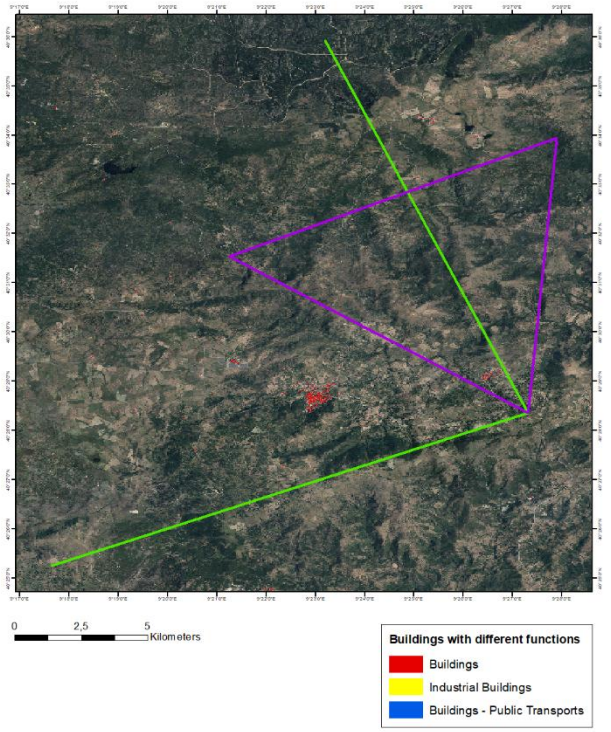
Morphology
Digital Terrain Model



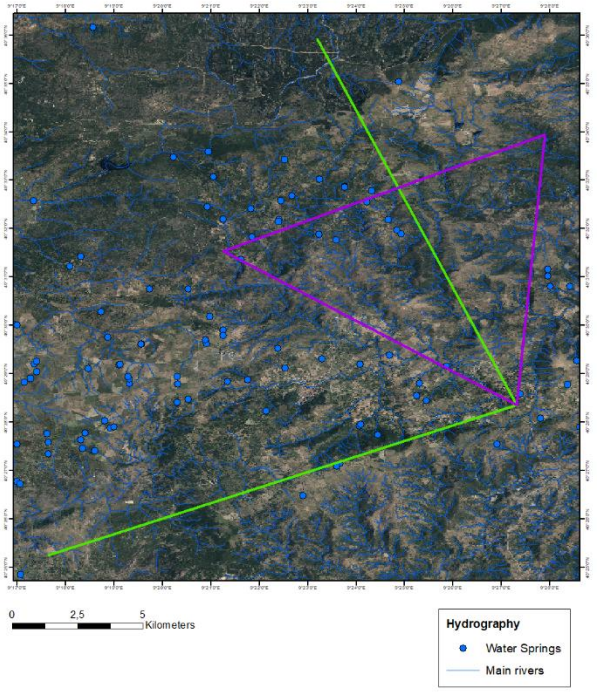
INTERFERENCE ANALYSIS

Urban areas - Hydrography - Roads

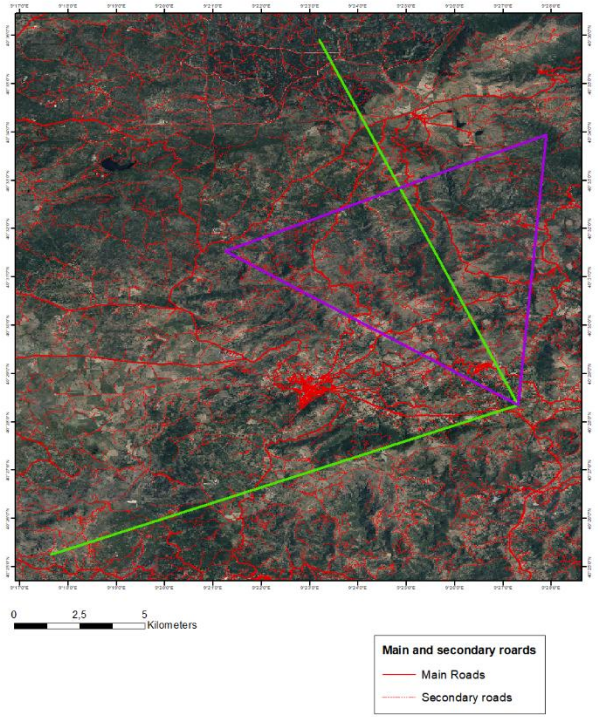
Buildings with different functions

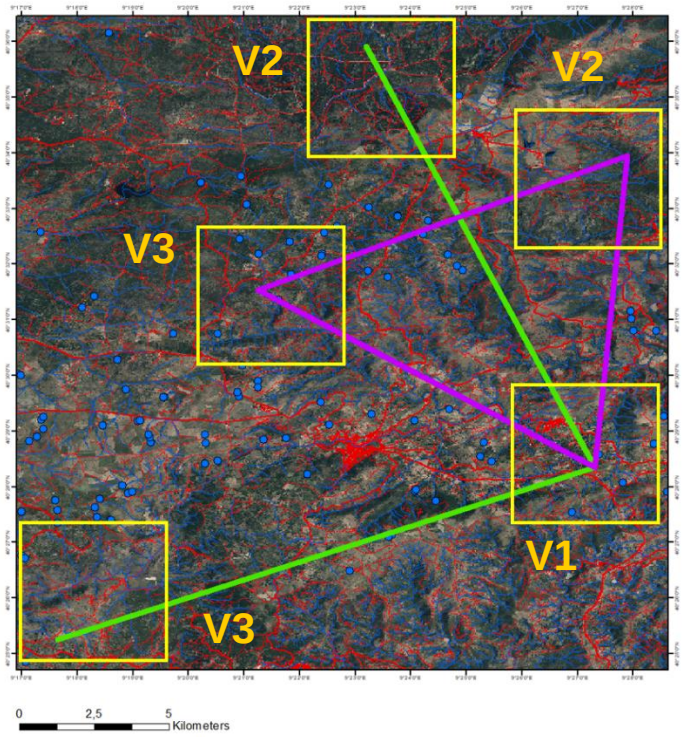


Hydrography

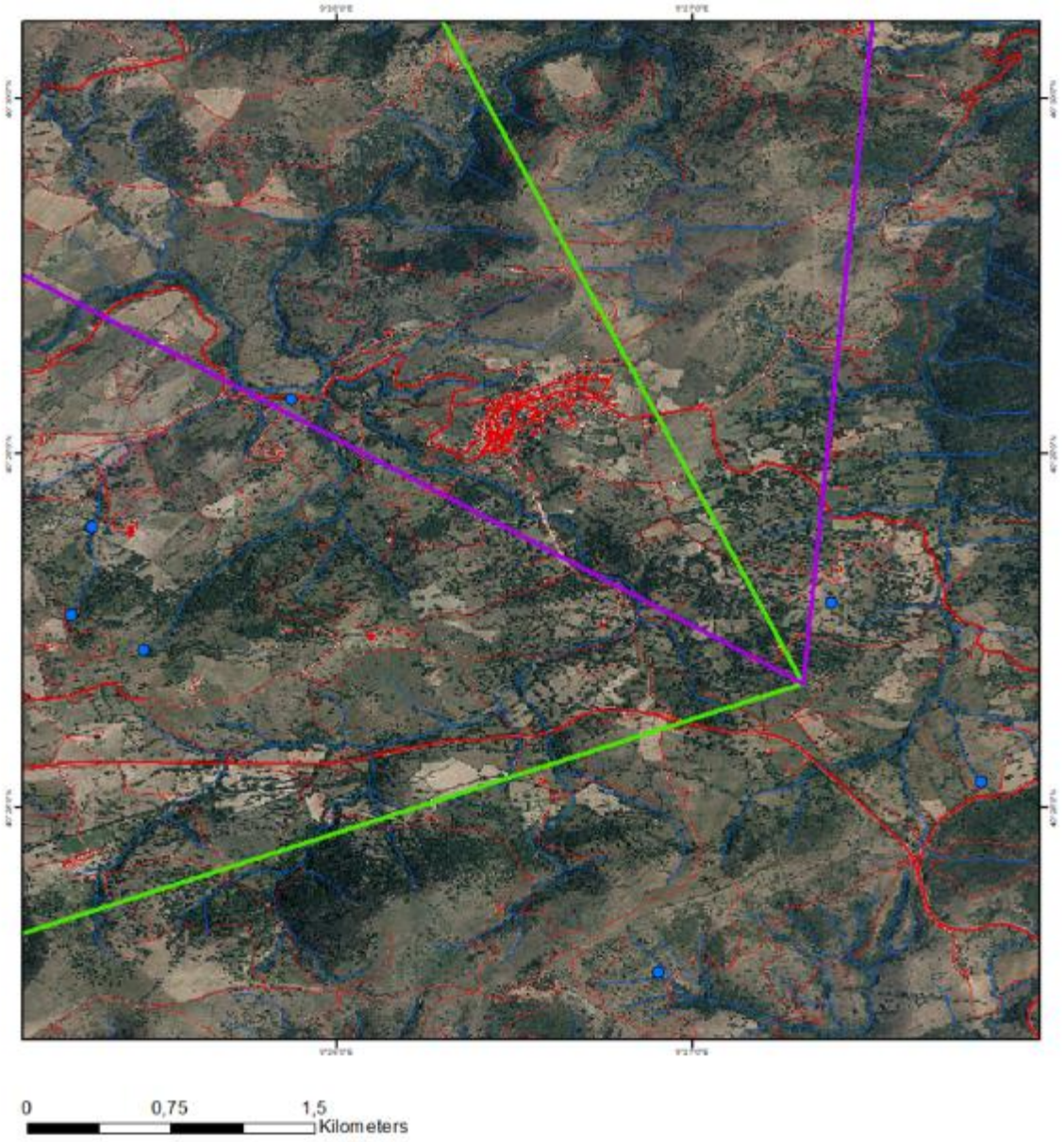


Main and secondary roads



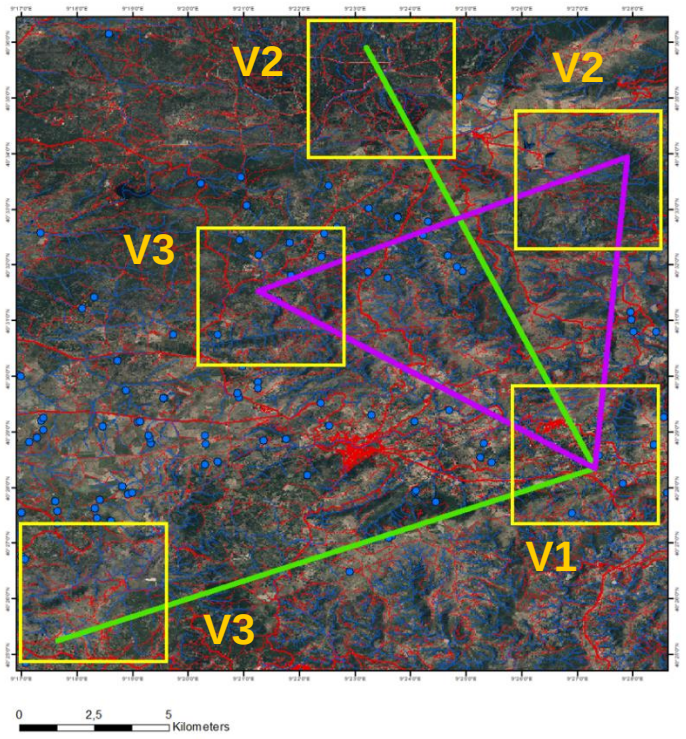


V1



Main Thematisms

- Water Springs
- Main rivers
- Buildings - Public Transports
- Industrial Buildings
- Buildings
- Main Roads
- Secondary roads



Main Thematisms

- Water Springs
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- Buildings - Public Transports
- Industrial Buildings
- Buildings
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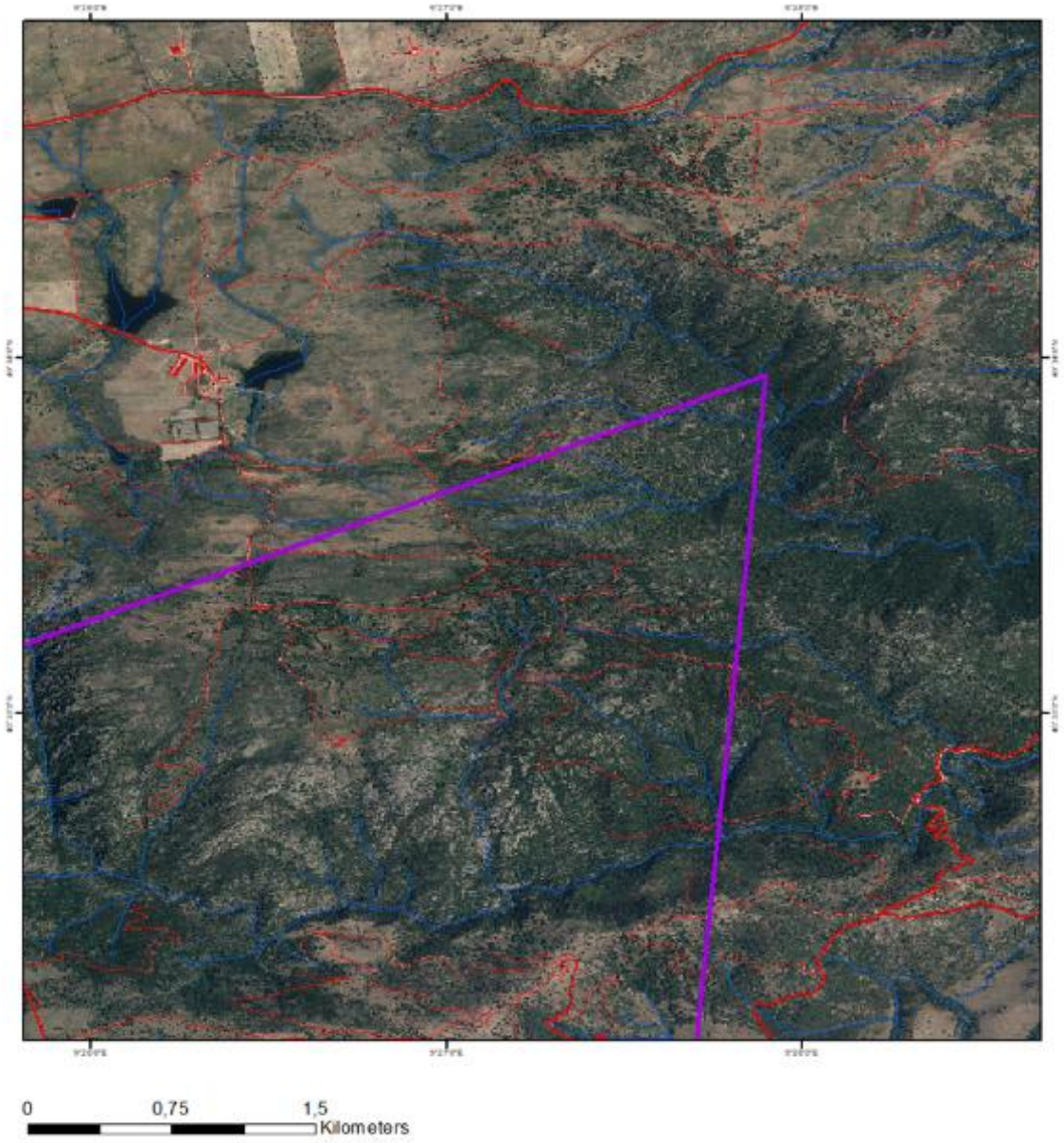
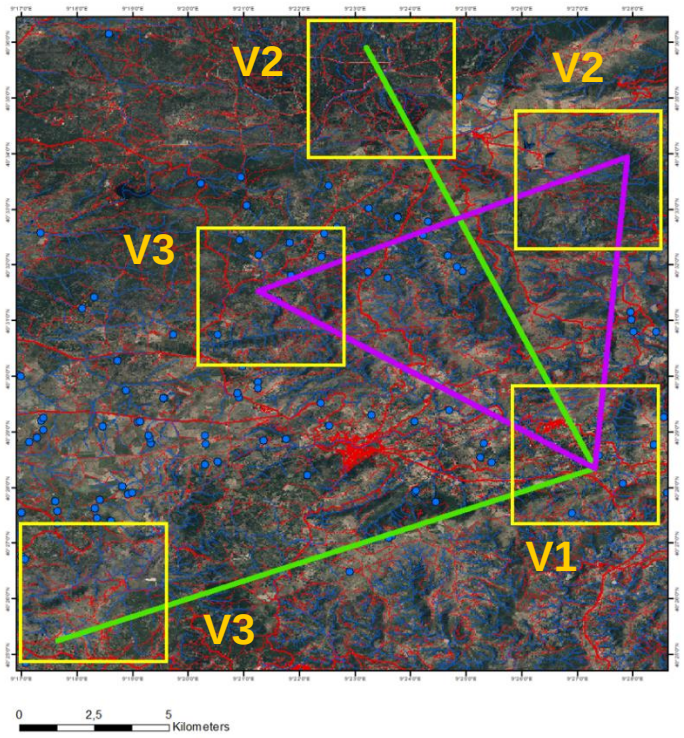
- Secondary roads

V2





Main Thematisms

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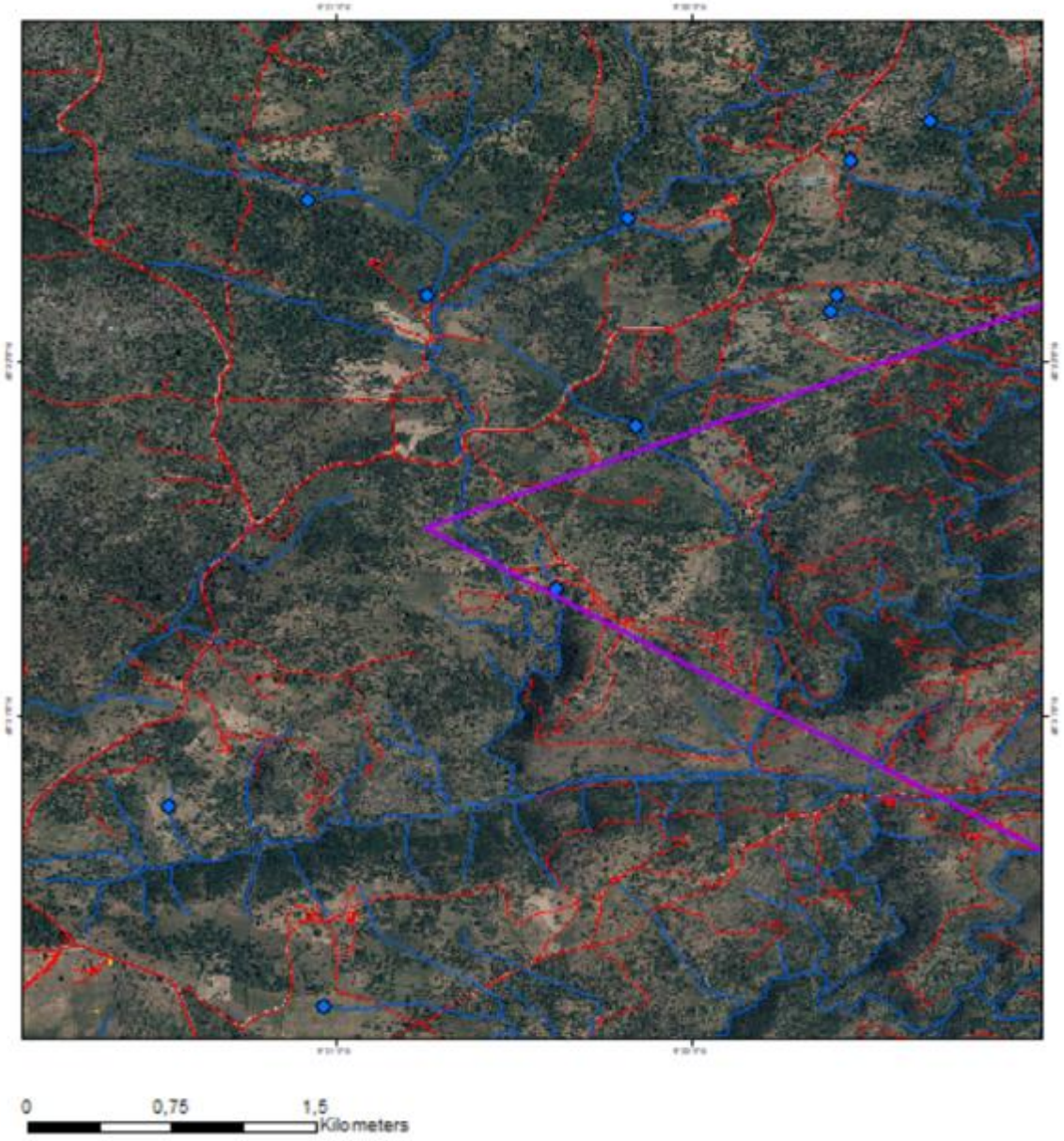
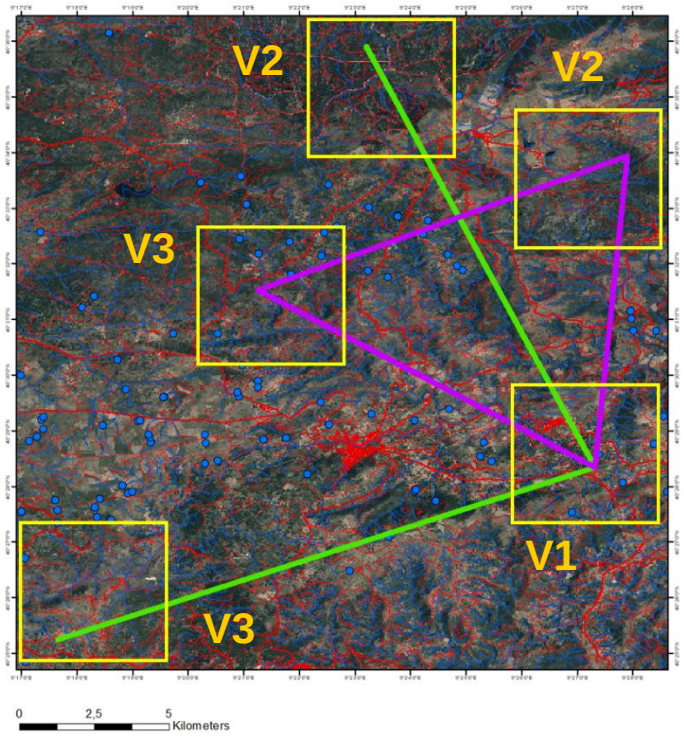
V3





Main Thematisms

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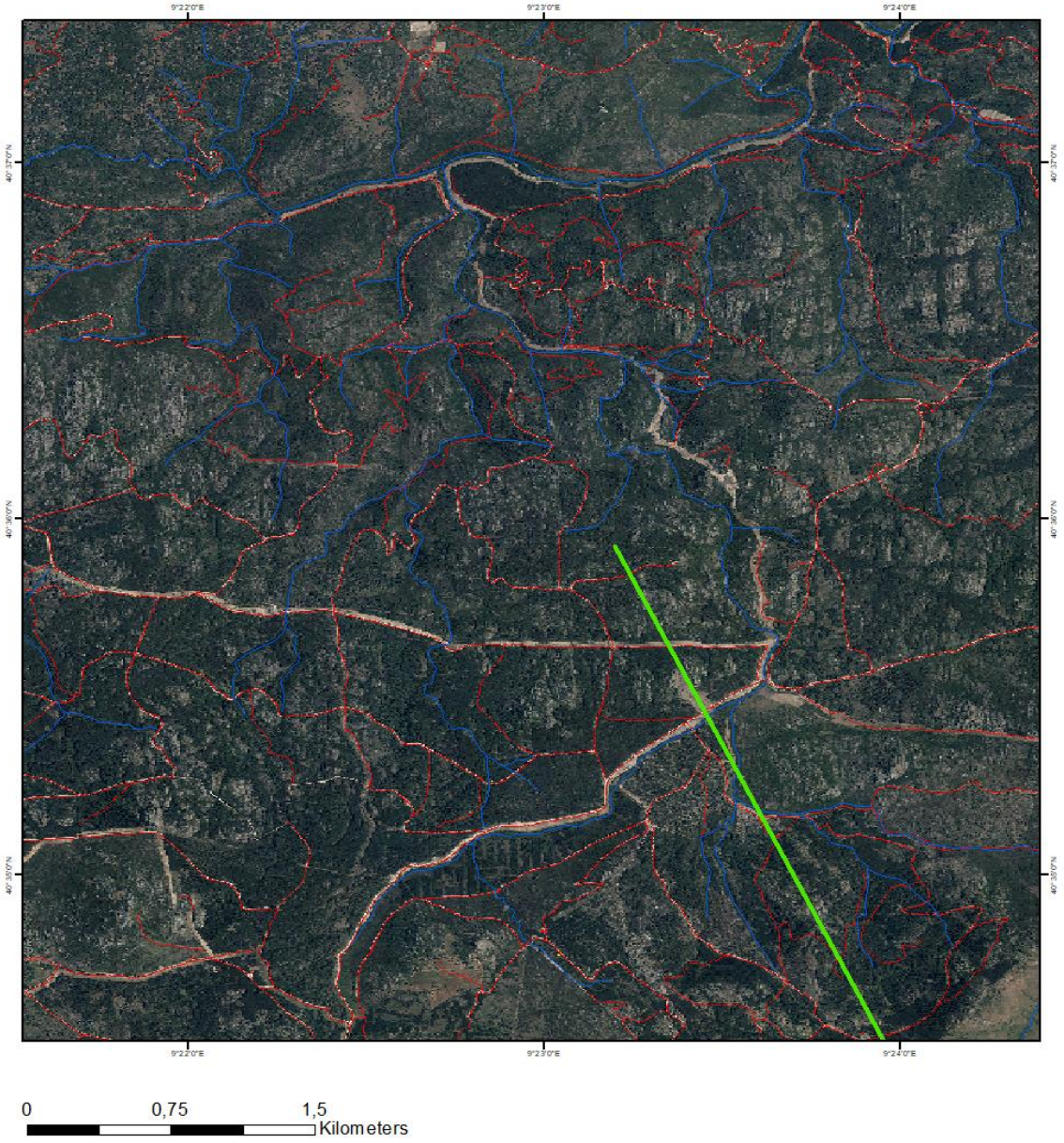
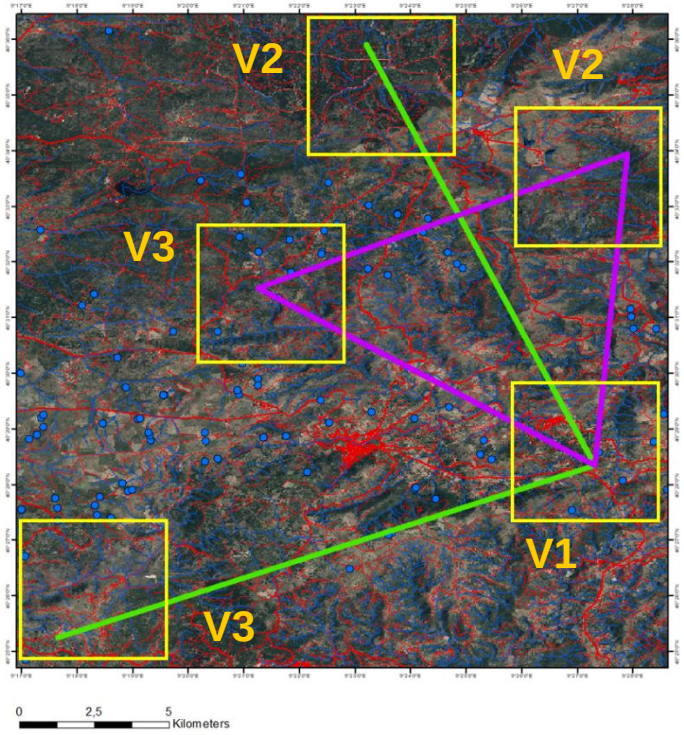
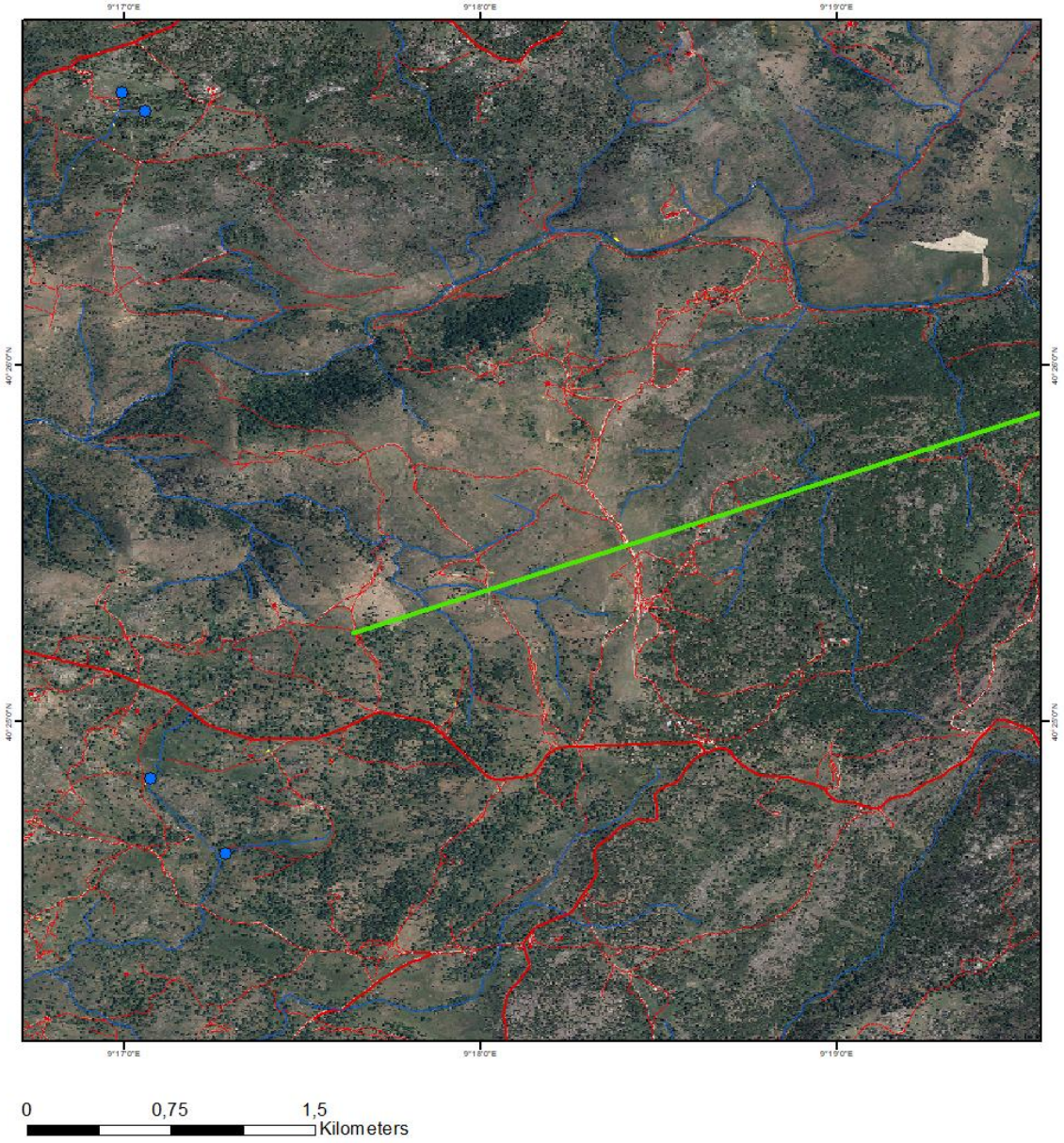
V2



V3



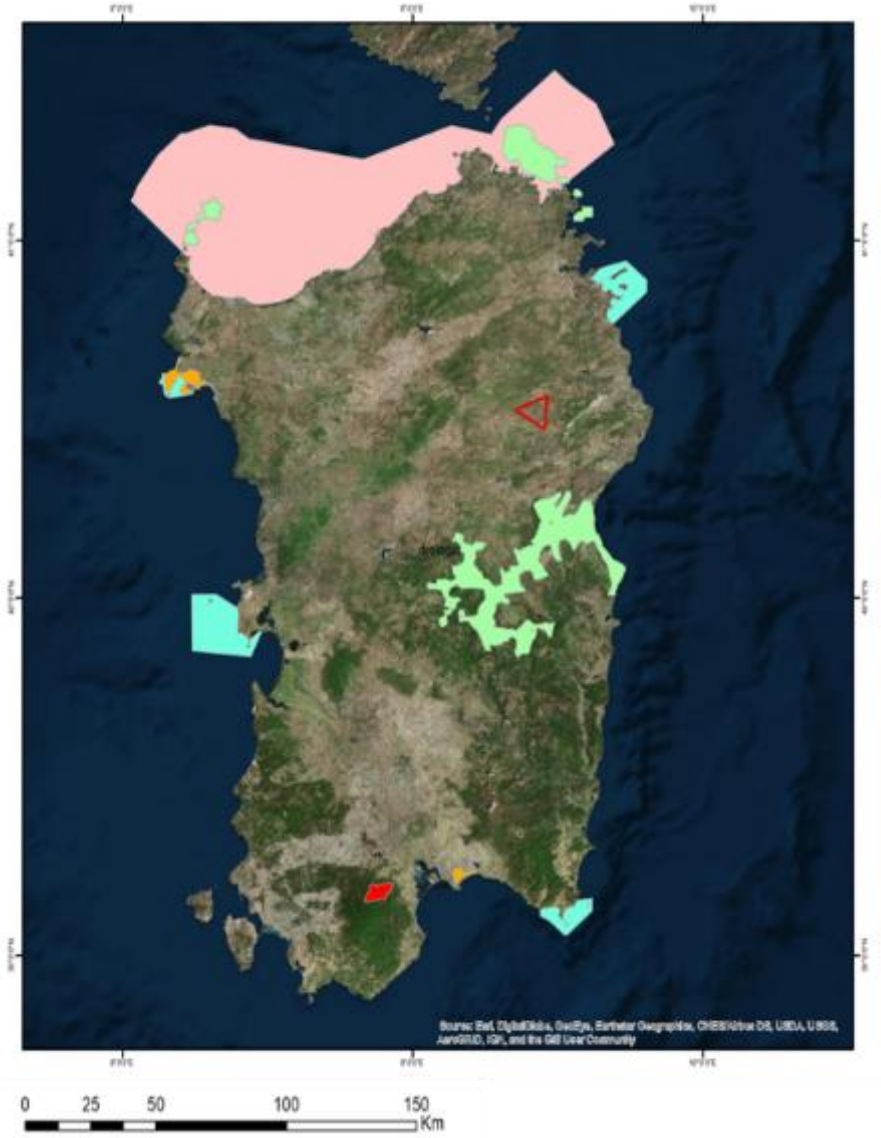


Main Thematisms

- Water Springs
- Main rivers
- Buildings - Public Transports
- Industrial Buildings
- Buildings
- Main Roads
- Secondary roads

INTERFERENCE ANALYSIS

Protected areas – Regional and National Parks



ET

Parchi naturali nazionali

Parchi naturali regionali

Riserve naturali statali

Riserve naturali regionali

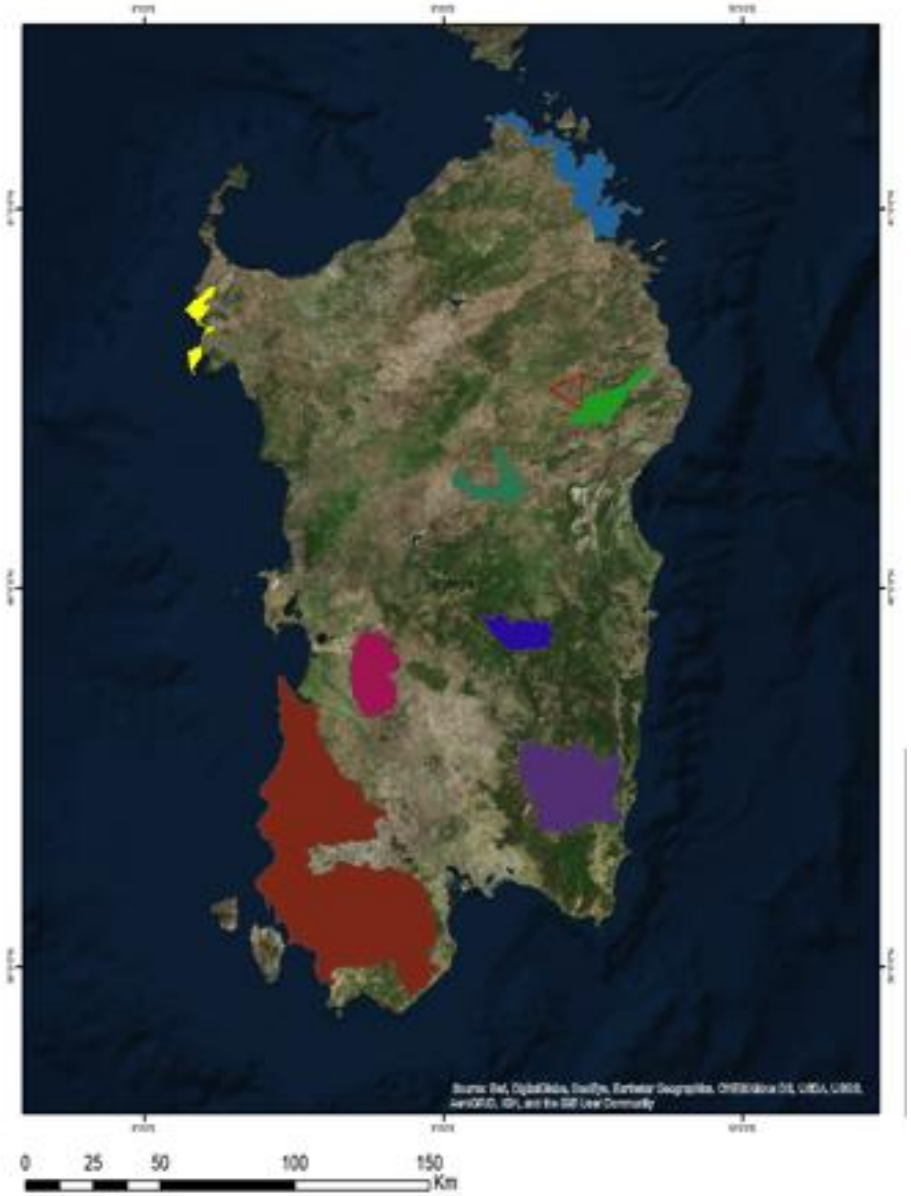
Altre aree naturali protette

Riserve Naturali Marine

Altre aree naturali protette

INTERFERENCE ANALYSIS

Geo-Mining Parks



ET

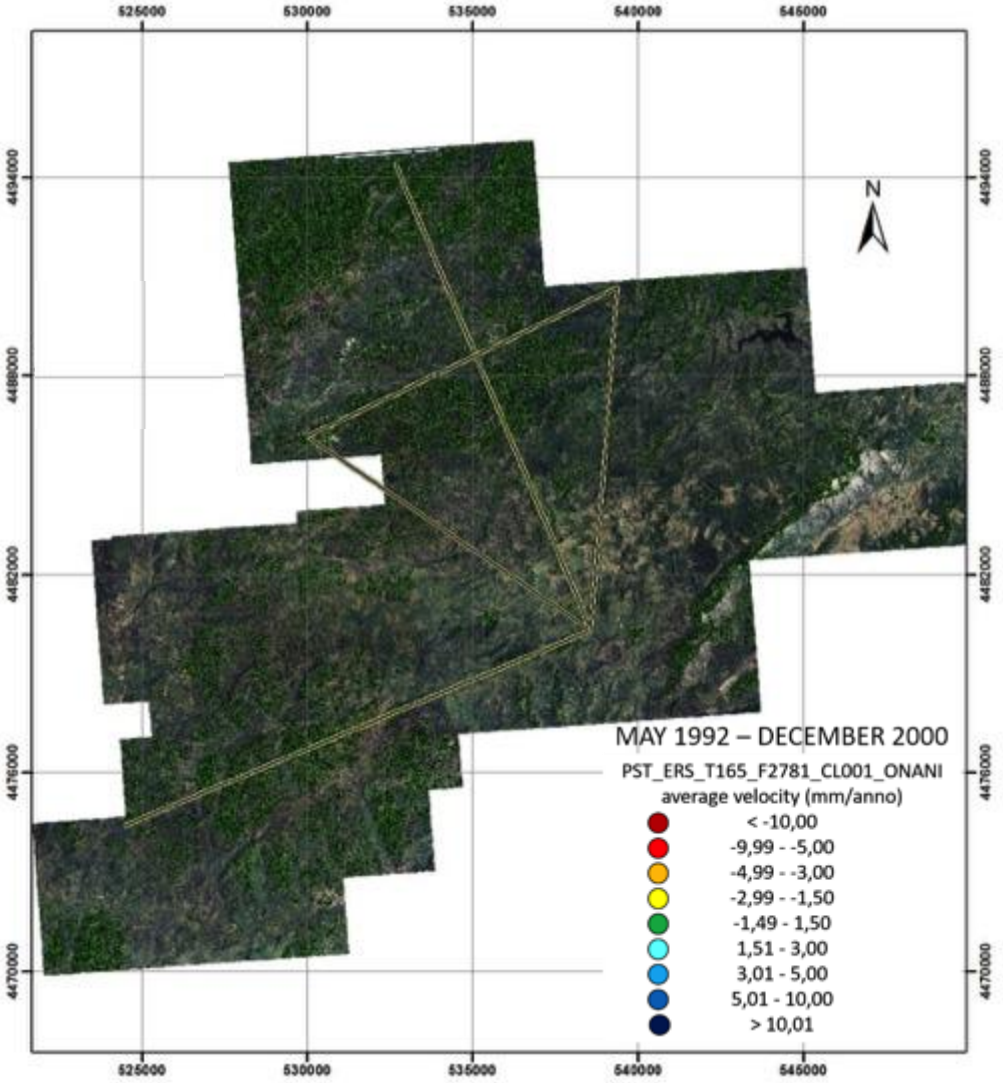
Parco Geominerario Ambientale Storico

nome

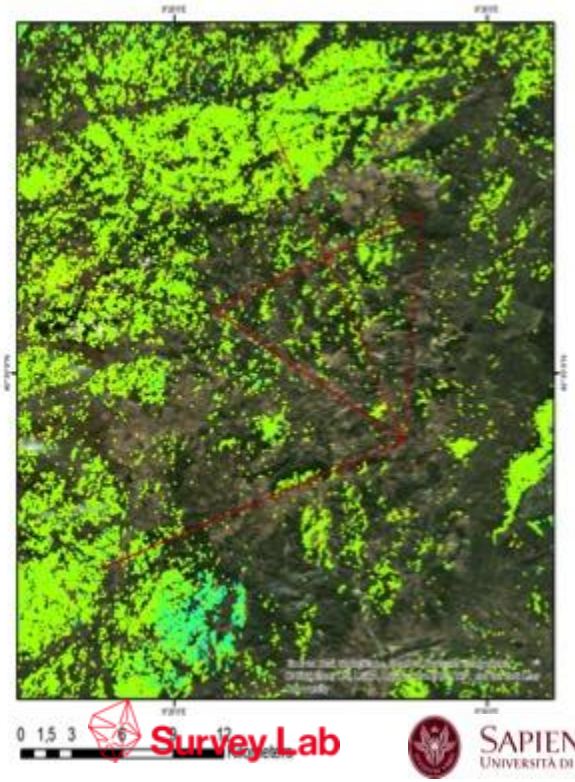
- ARGENTIERA NURRA
- FUNTANA RAMINOSA
- GALLURA
- GUZZURRA - SOS ENATTOS
- MONTE ARCI
- ORANI
- SERRABUS - GERGEI
- SULCIS - IGLESIENTE - GUSPINESE

Crustal Deformation and Ground Motion

DInSAR Analysis

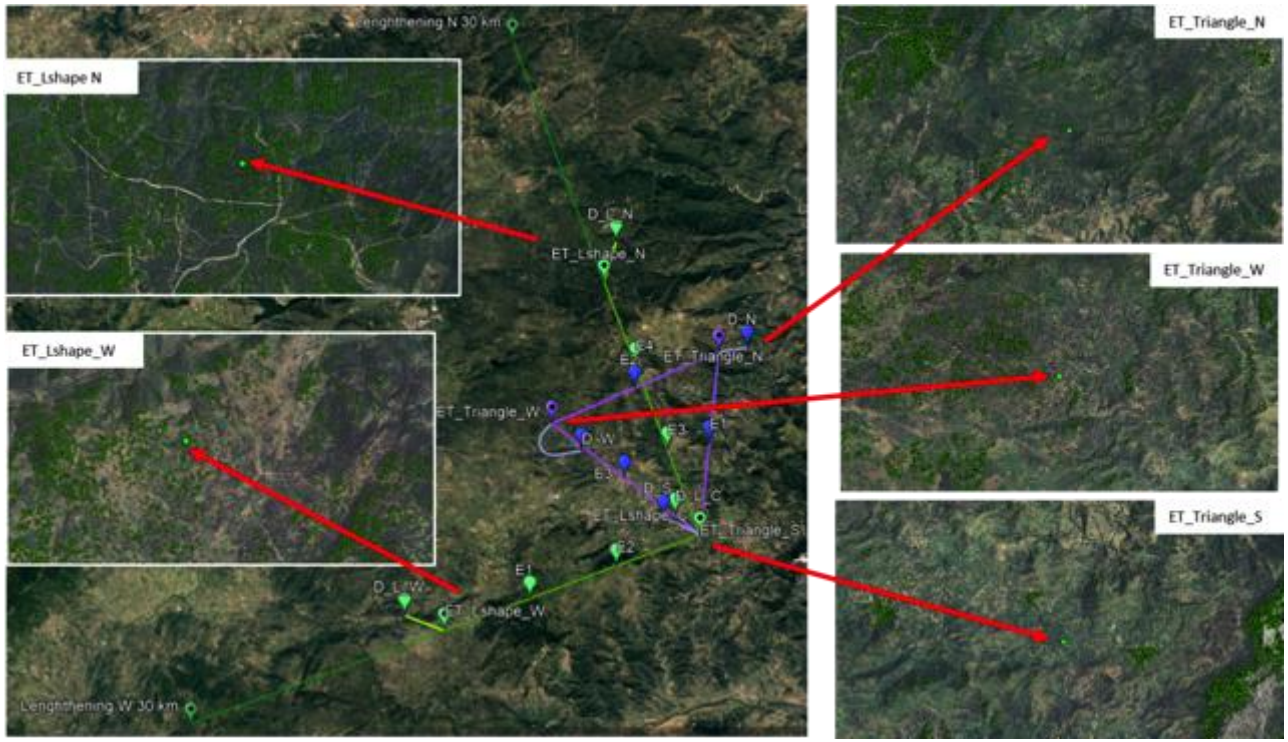


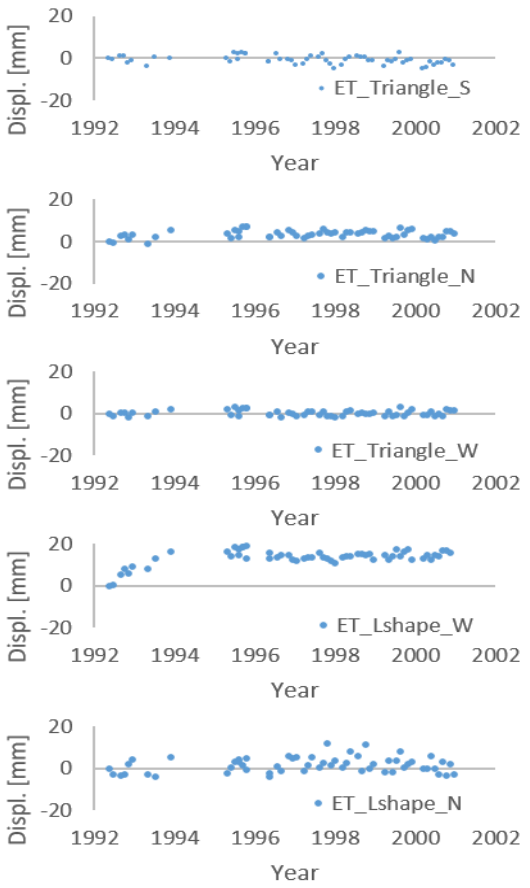
- Very stable geodynamic setting
- No evidence of ground settlements due to local factors
- Link to the Space Geodesy Center in South Sardinia for reference frame issues



Crustal Deformation and Ground Motion
DInSAR Analysis

- Surface deformation processes are not observed by Satellite Differential SAR Interferometry since 1992
- Seasonal oscillations of few mm
- Many persistent scatterers act as natural control points for continuous monitoring

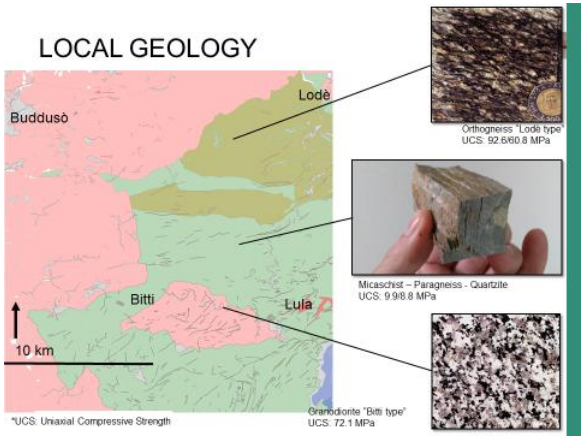




CRITERIA FOR THE SITE CHOICE

CRITERIA FOLLOWED

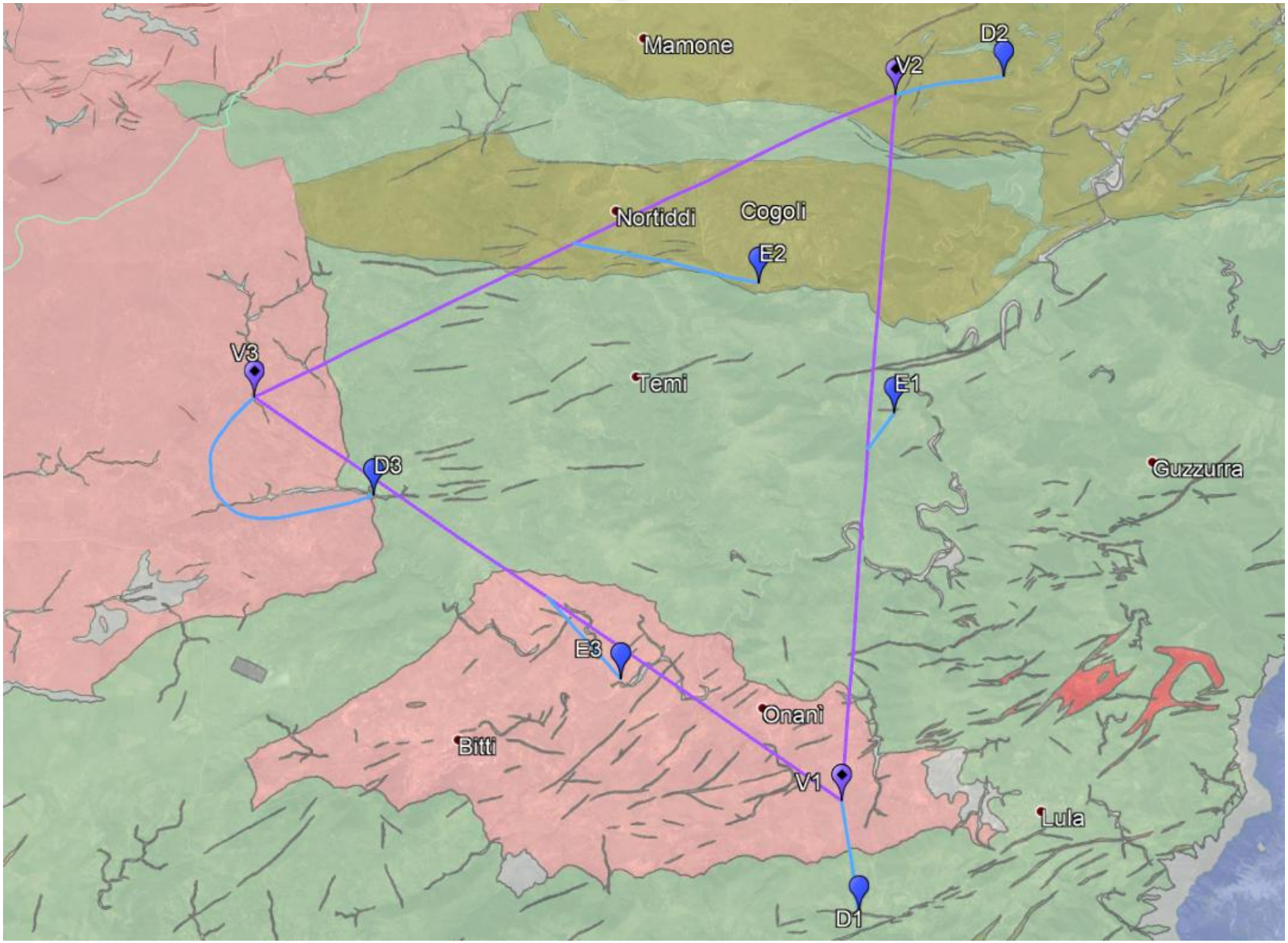
- Deep (soil coverage) of the experimental halls > 200 m
  - Triangle configuration → ITF H_{top} 290 m.a.s.l.
  - Lshape configuration → ITF H_{top} 330 m.a.s.l.
- Location of the experimental halls in granodiorite “Bitti type” or orthogneiss “Lodè type”
- Access to the ITF through descenderies
  - Allowing the preparation of underground construction sites
  - max slope 7%
  - Deep shafts in rock ø > 6 m not feasible
  - TBM parts must be carried underground
  - Taking out the excavated material



- Safety exits along tunnels
  - Also through descenderies
  - To be evaluated the best trade-off between descenderies and deep shafts (realized by Raise Borer technique)
- Link to the existing public road network

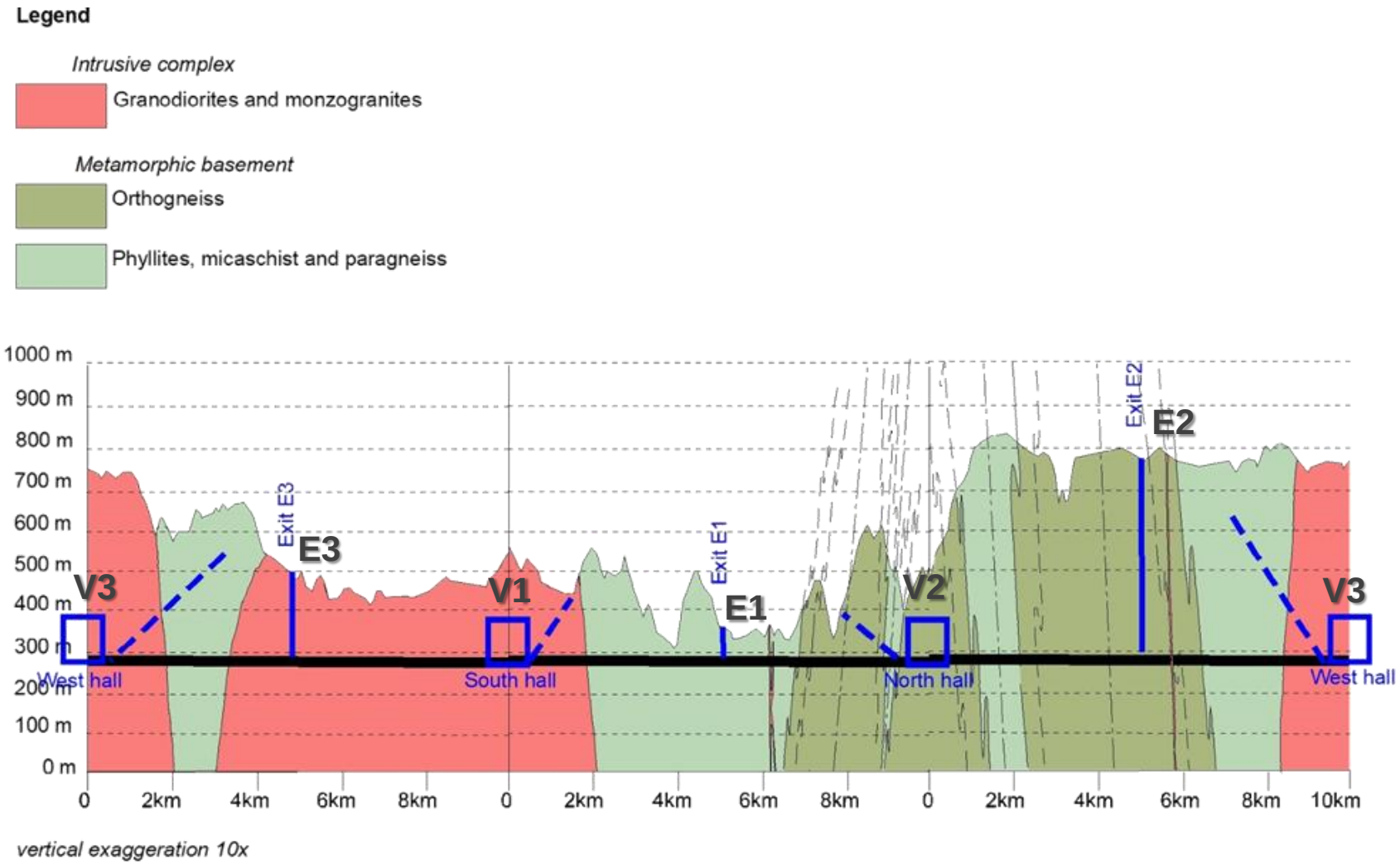
TRIANGLE CONFIGURATION

Geological Map



TRIANGLE CONFIGURATION

Geological profile



TRIANGLE CONFIGURATION

Vertexes UTM coordinates H_{ITF} = 290m

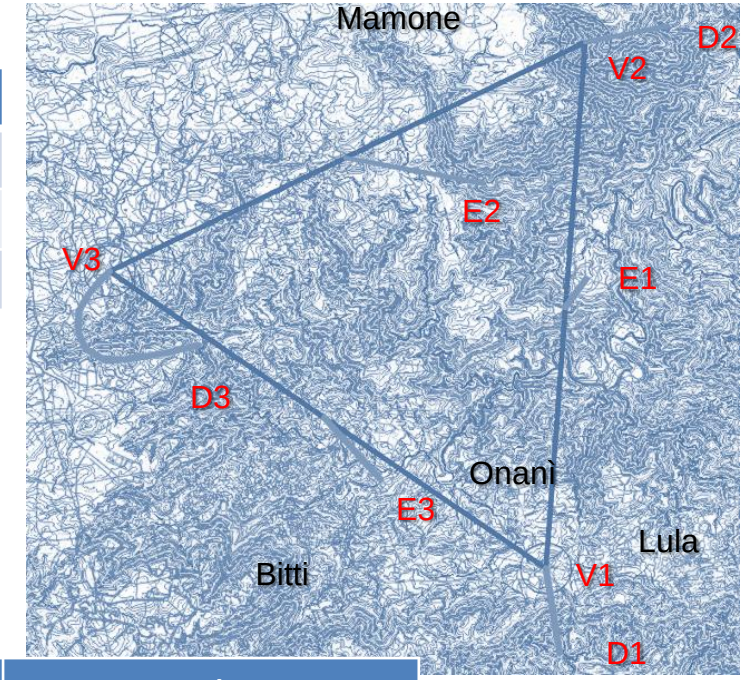
P.Id.	E [m]	N [m]	H_{sur} [m.a.s.l.]	cover [m]
V1	538 588	4 480 305	540	250
V2	539 361	4 490 666	500	210
V3	530 001	4 486 155	755	465

Vertexes GPS coordinates

P.Id.	Lat	Long
V1	40° 28' 21.10" N	9° 27' 18.78" E
V2	40° 33' 56.99" N	9° 27' 53.92" E
V3	40° 31' 32.10" N	9° 21' 15.12" E

Descenderies UTM coordinates

P.Id.	E [m]	N [m]	H_{sur} [m.a.s.l.]	L [m]	s_{aver} [%]
D1	538 858	4 478 652	395	1 675	6.27
D2	540 984	4 490 986	390	1 730	5.78
D3	531 748	4 484 700	575	4 100	6.95

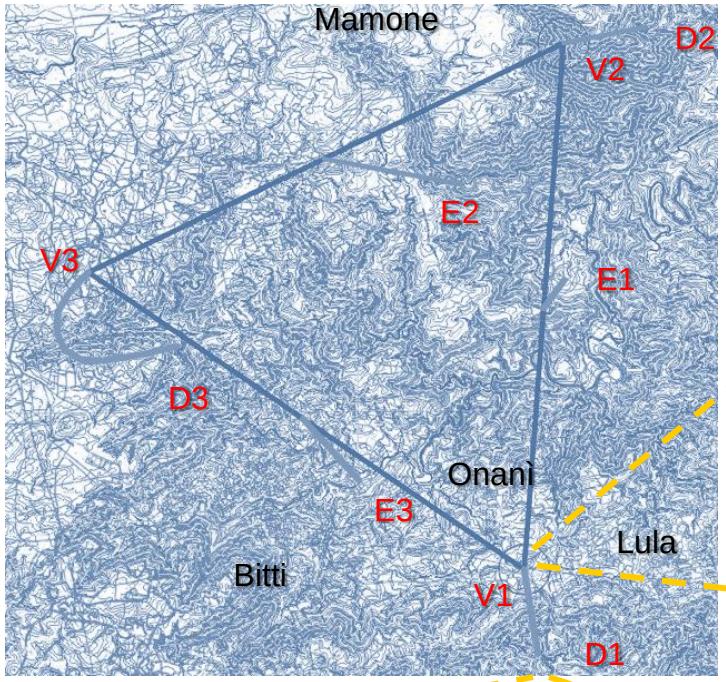


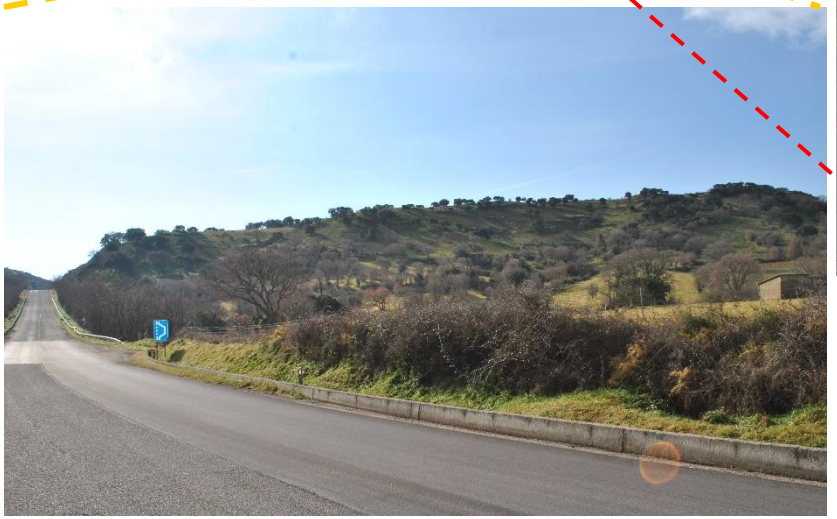
Safety Exits UTM coordinates

P.Id.	E [m]	N [m]	H_{sur} [m.a.s.l.]	L [m]	s_{aver} [%]	note
E1	539 375	4 486 001	325	680	5.15	Alternative: shaft 100m deep
E2	537 350	4 487 888	450	2 750	5.82	Alternative: shaft 490m deep
E3	535 331	4 482 062	410	1 630	7.36	Alternative: shaft 200m deep

TRIANGLE CONFIGURATION

V1 landscape



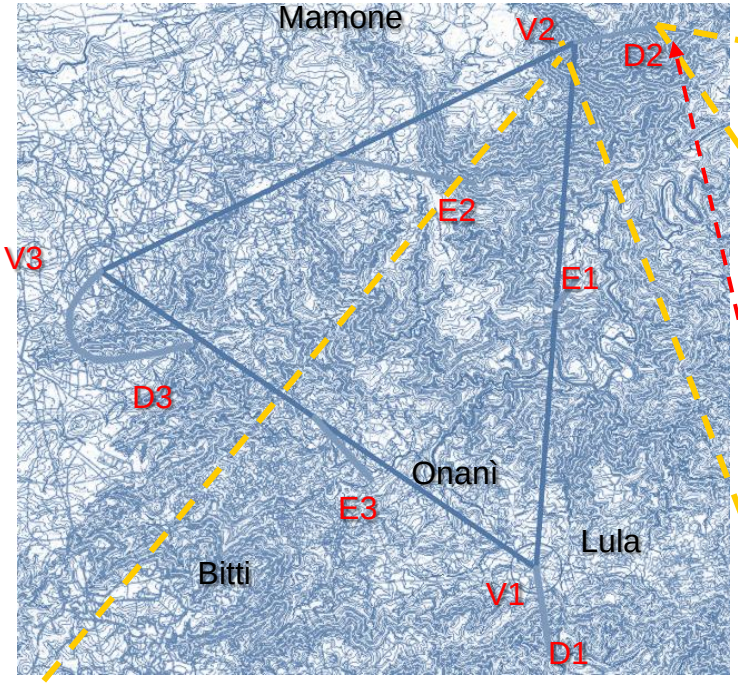


V1

V1 (Sos Enattos) - Accessibility

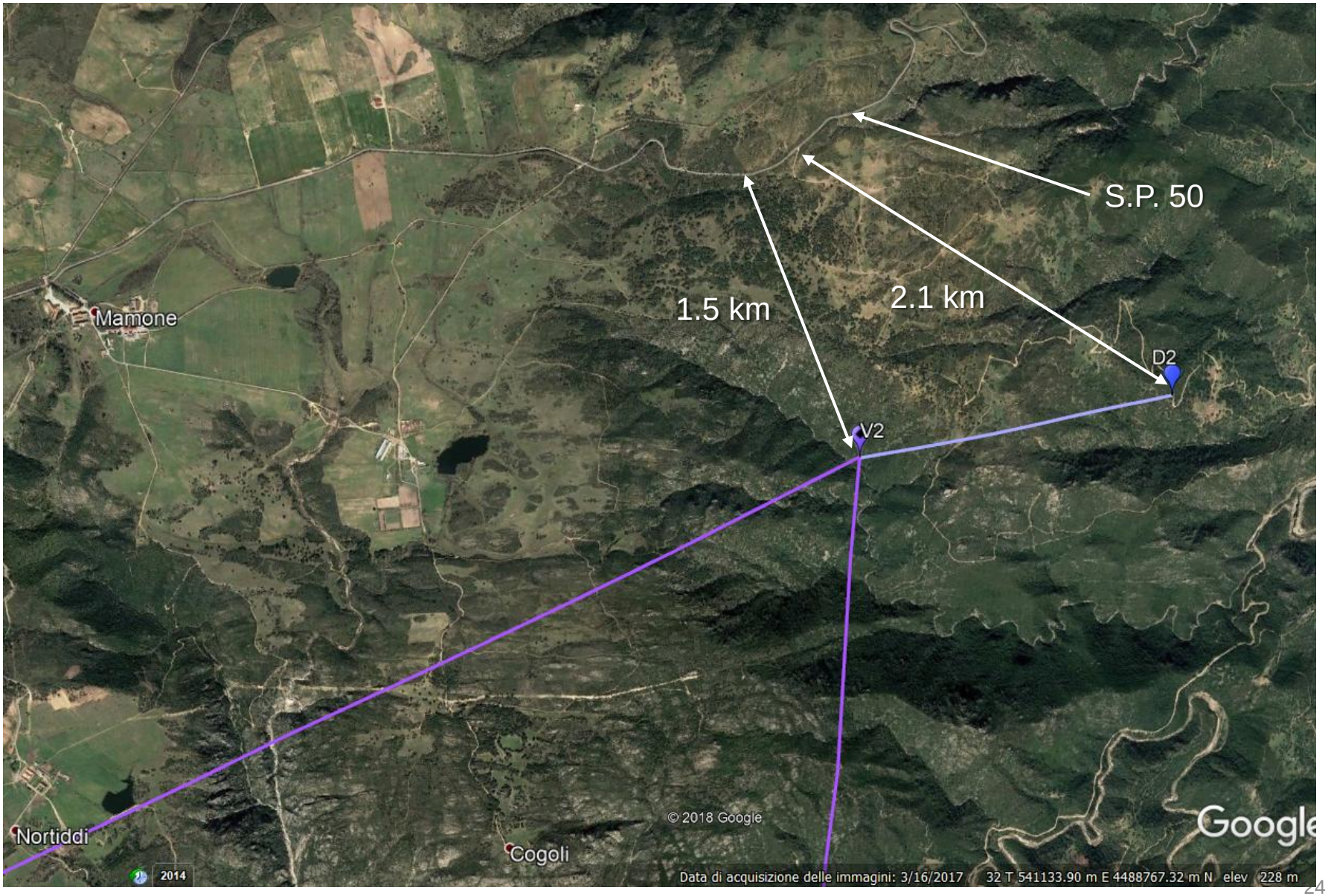
TRIANGLE CONFIGURATION

V2 landscape



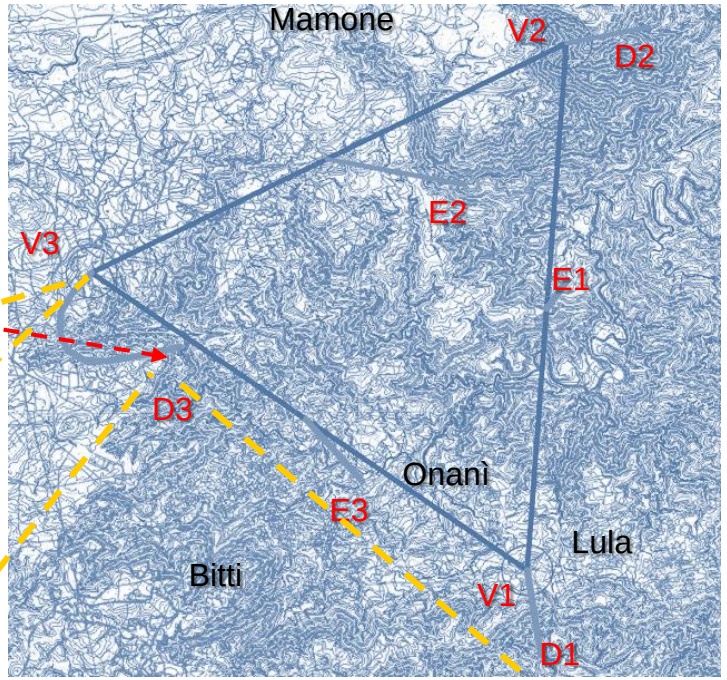
V2

V2 - Accessibility



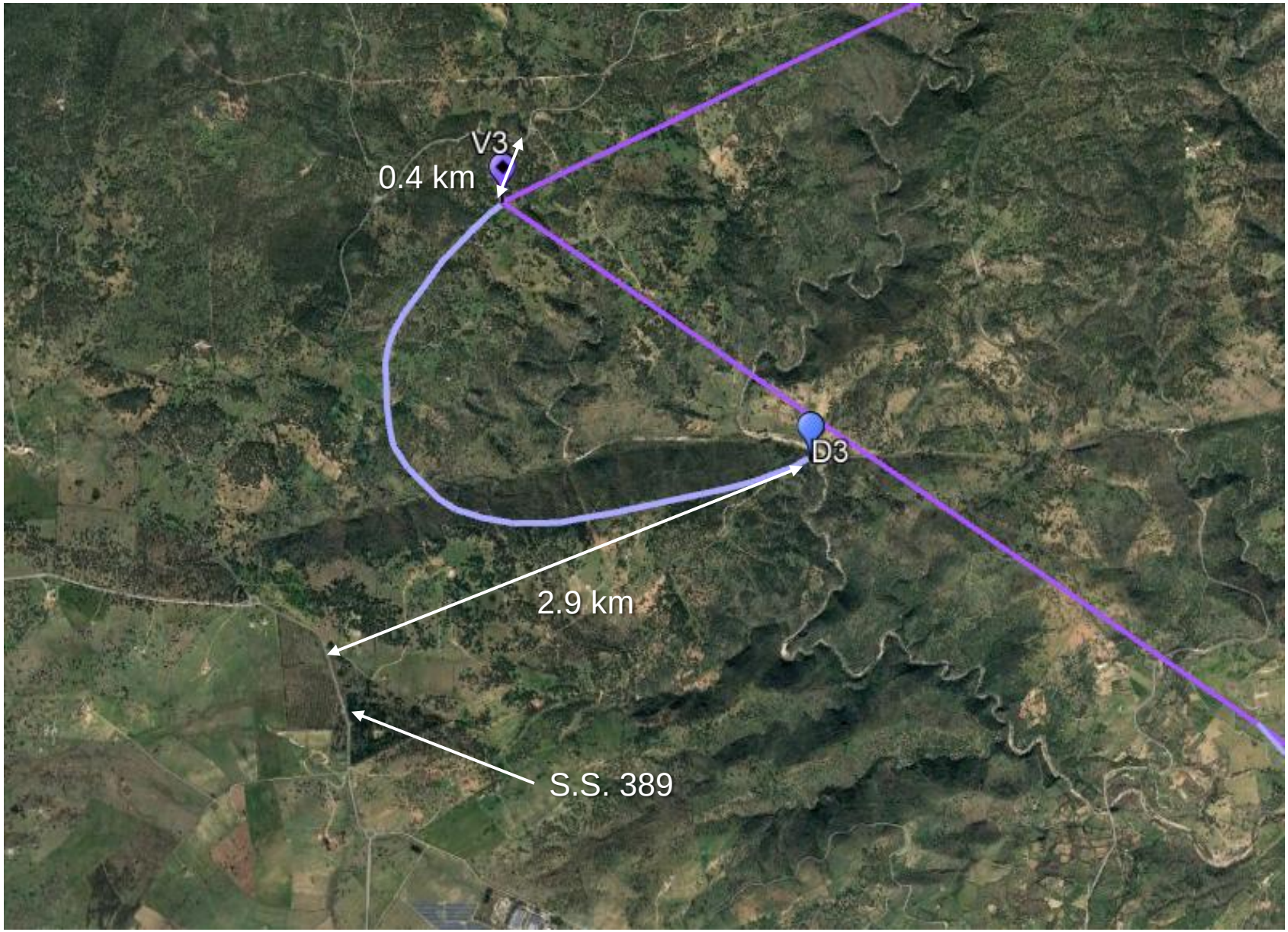
TRIANGLE CONFIGURATION

V3 landscape



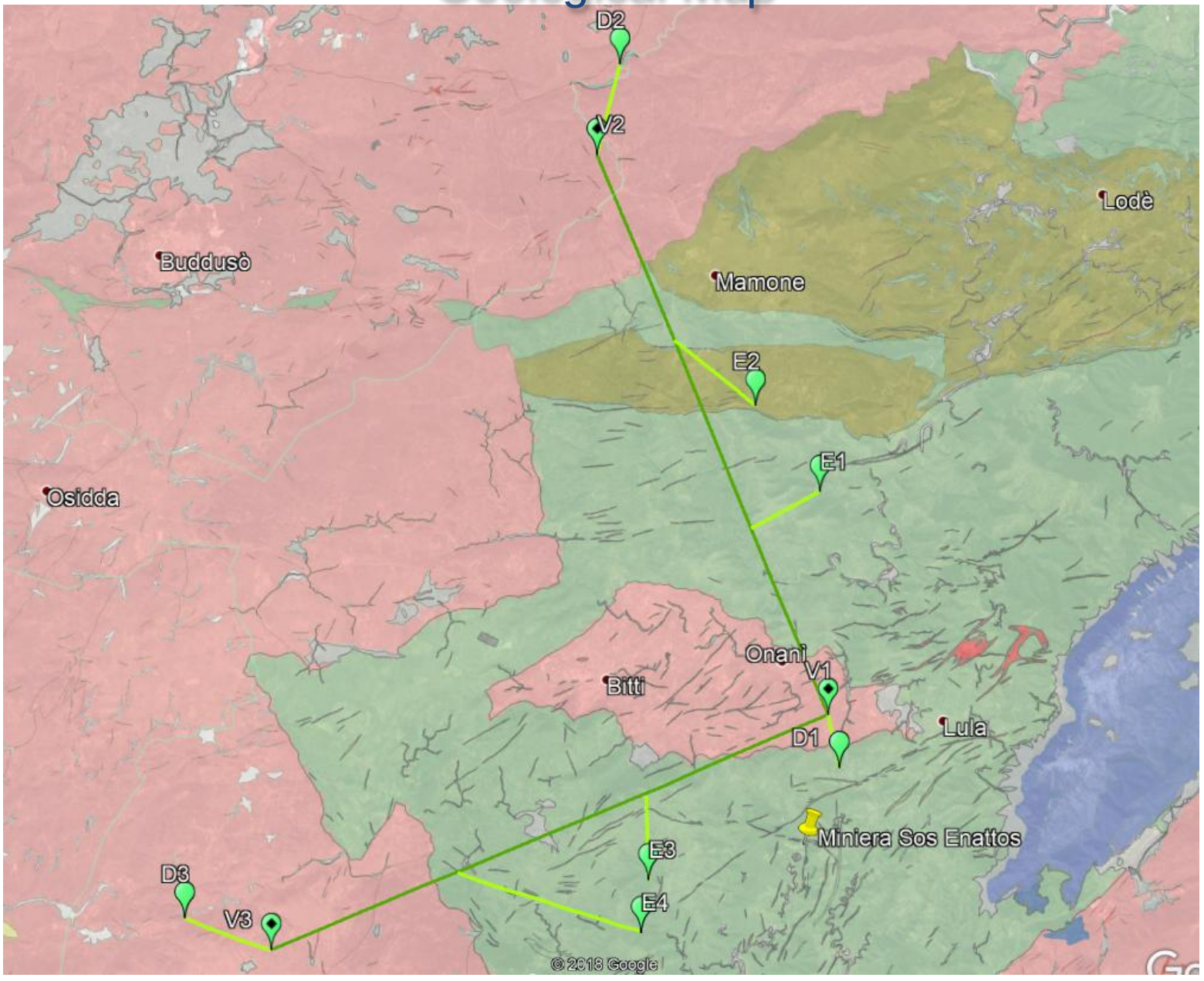
V3

V3 - Accessibility



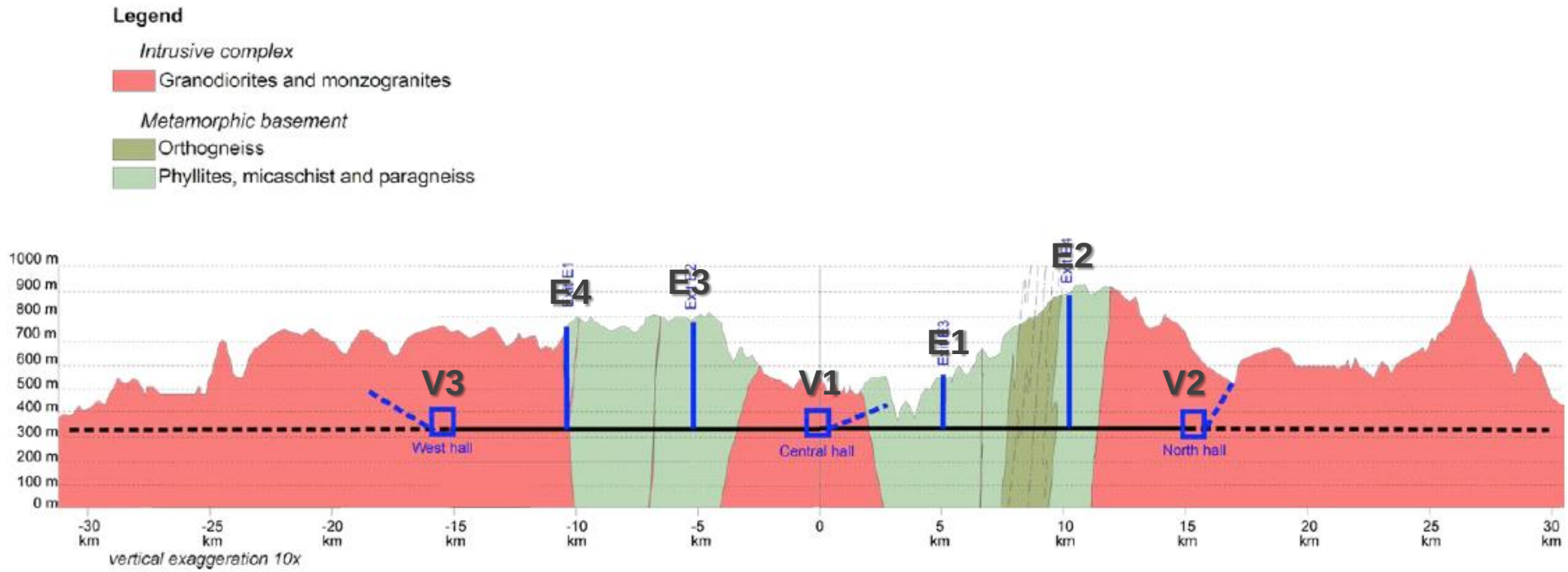
L-SHAPE CONFIGURATION

Geological Map



L-SHAPE CONFIGURATION

Geological profile



L-SHAPE CONFIGURATION

Safety Exits UTM coordinates

P.Id.	E [m]	N [m]	H_{sur} [m.a.s.l.]	L [m]	s_{aver} [%]	note
E1	538 378	4 485 949	400	2 000	3.50	Alternative: shaft 200m deep
E2	536 875	4 488 210	500	2 705	6.28	Alternative: shaft 540m deep
E3	534 031	4 476 084	410	2 250	3.56	Alternative: shaft 460m deep
E4	532 819	4 475 250	525	3 825	5.10	Alternative: shaft 450m deep

Descenderies UTM coordinates

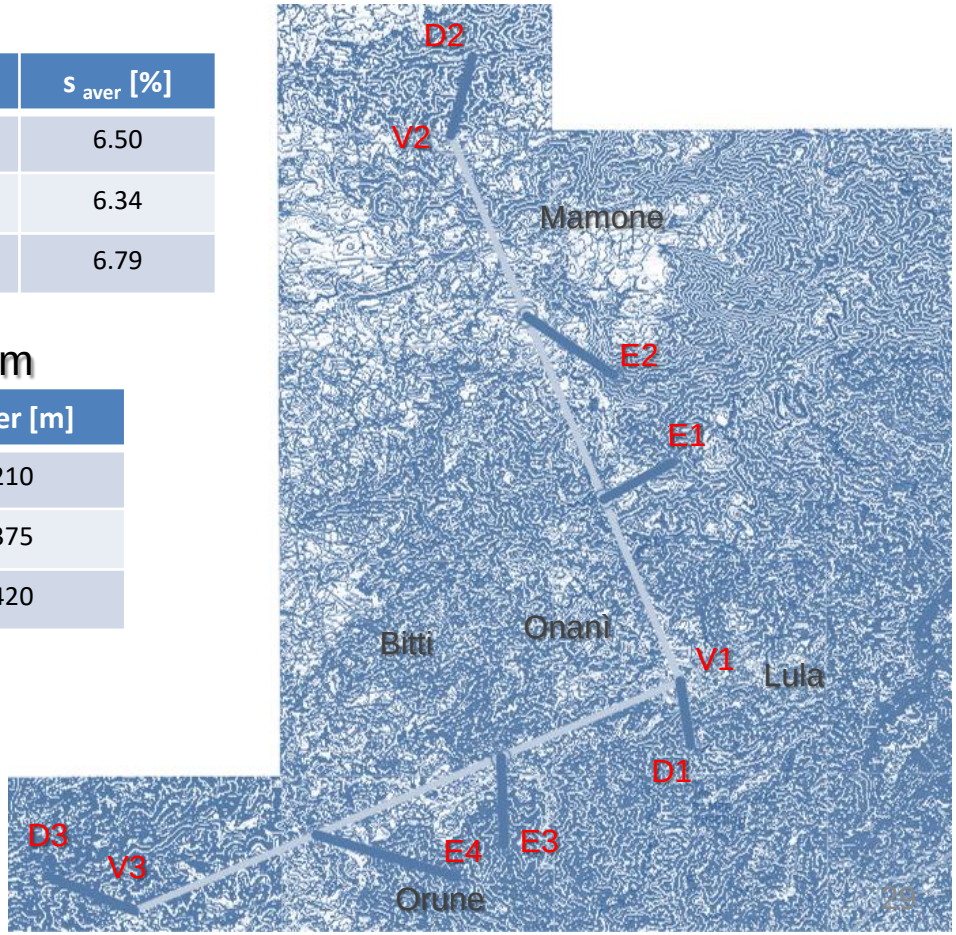
P.Id.	E [m]	N [m]	H_{sur} [m.a.s.l.]	L [m]	s_{aver} [%]
D1	538 888	4 478 953	420	1 385	6.50
D2	533 364	4 496 999	500	2 680	6.34
D3	522 228	4 475 101	495	2 430	6.79

Vertexes UTM coordinates H_{ITF} = 330m

P.Id.	E [m]	N [m]	H_{sur} [m.a.s.l.]	cover [m]
V1	538 588	4 480 305	540	210
V2	532 659	4 494 409	705	375
V3	524 484	4 474 376	750	420

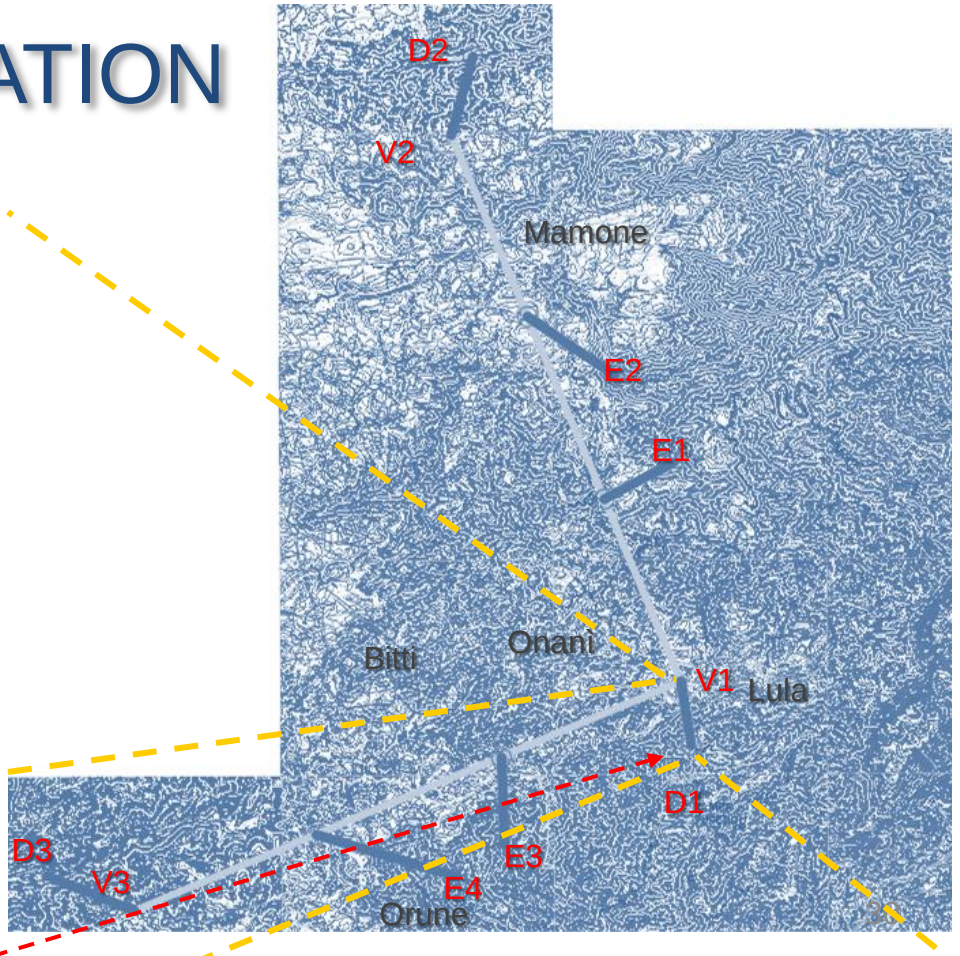
Vertexes GPS coordinates

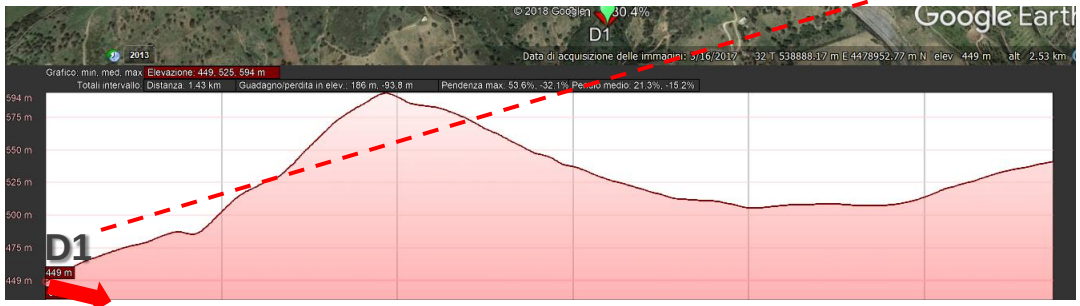
P.Id.	Lat	Long
V1	40° 28' 21.10" N	9° 27' 18.78" E
V2	40° 35' 59.45" N	9° 23' 09.62" E
V3	40° 25' 10.75" N	9° 17' 18.97" E



L-SHAPE CONFIGURATION

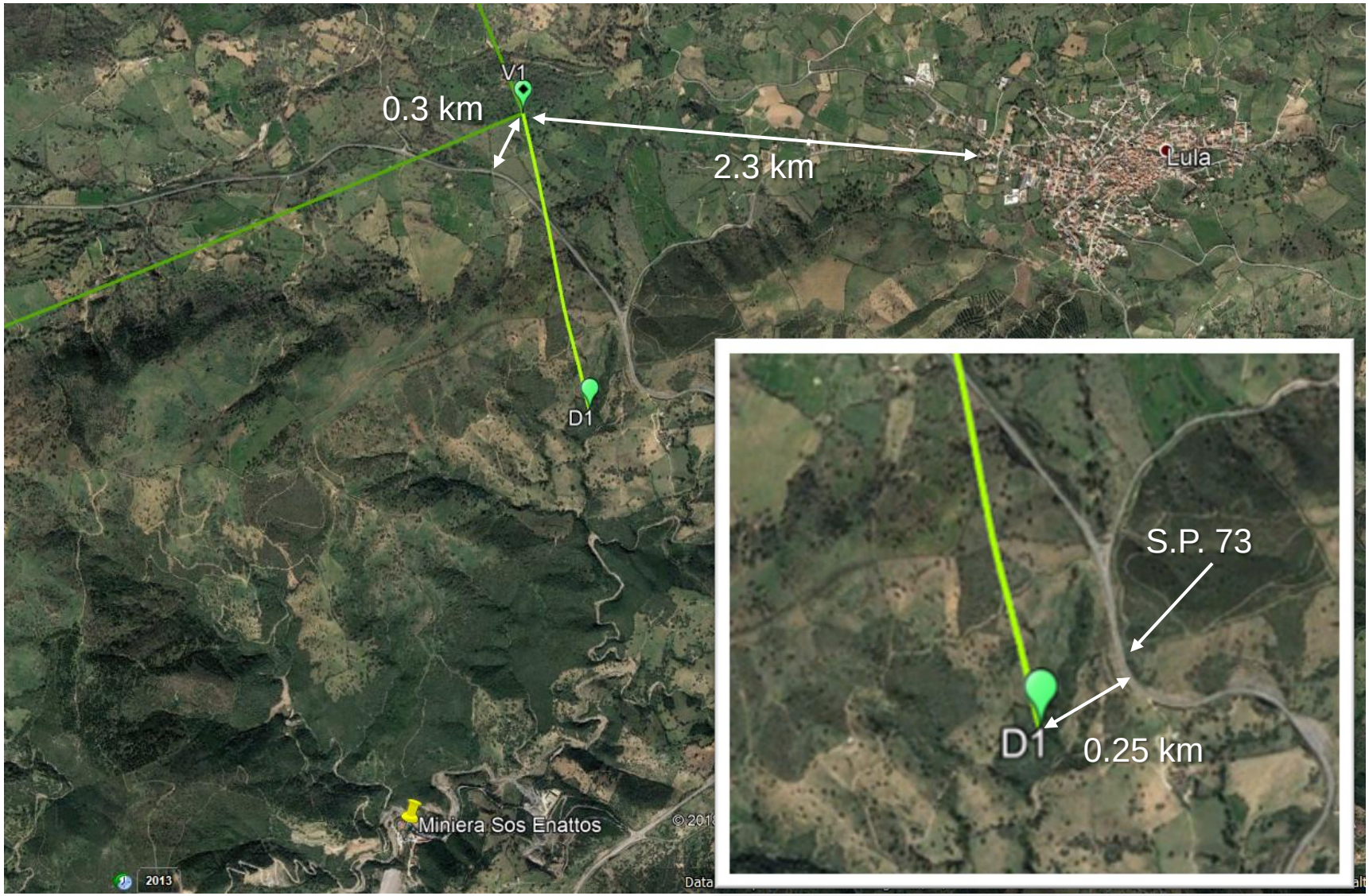
V1 landscape





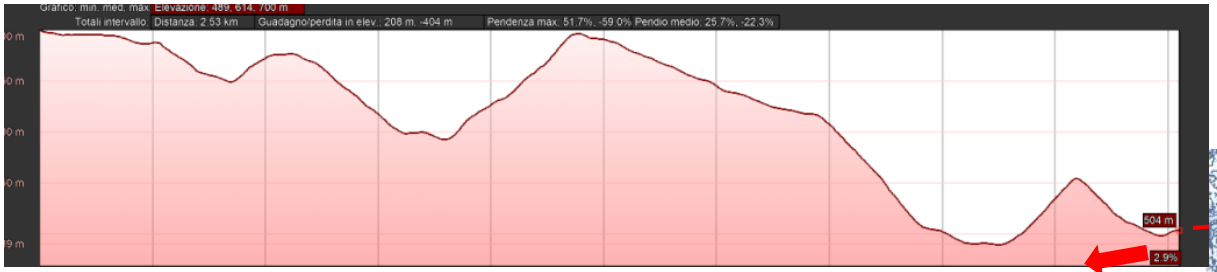
V1

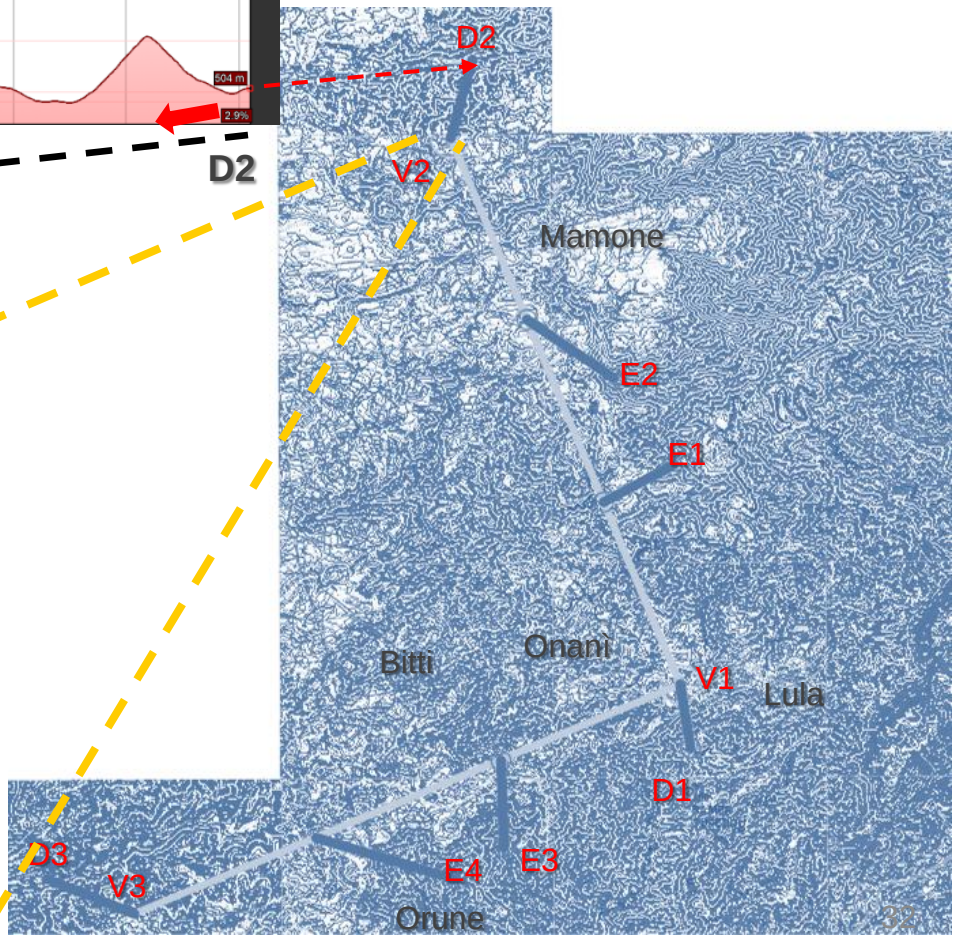
V1 (Sos Enattos) - Accessibility



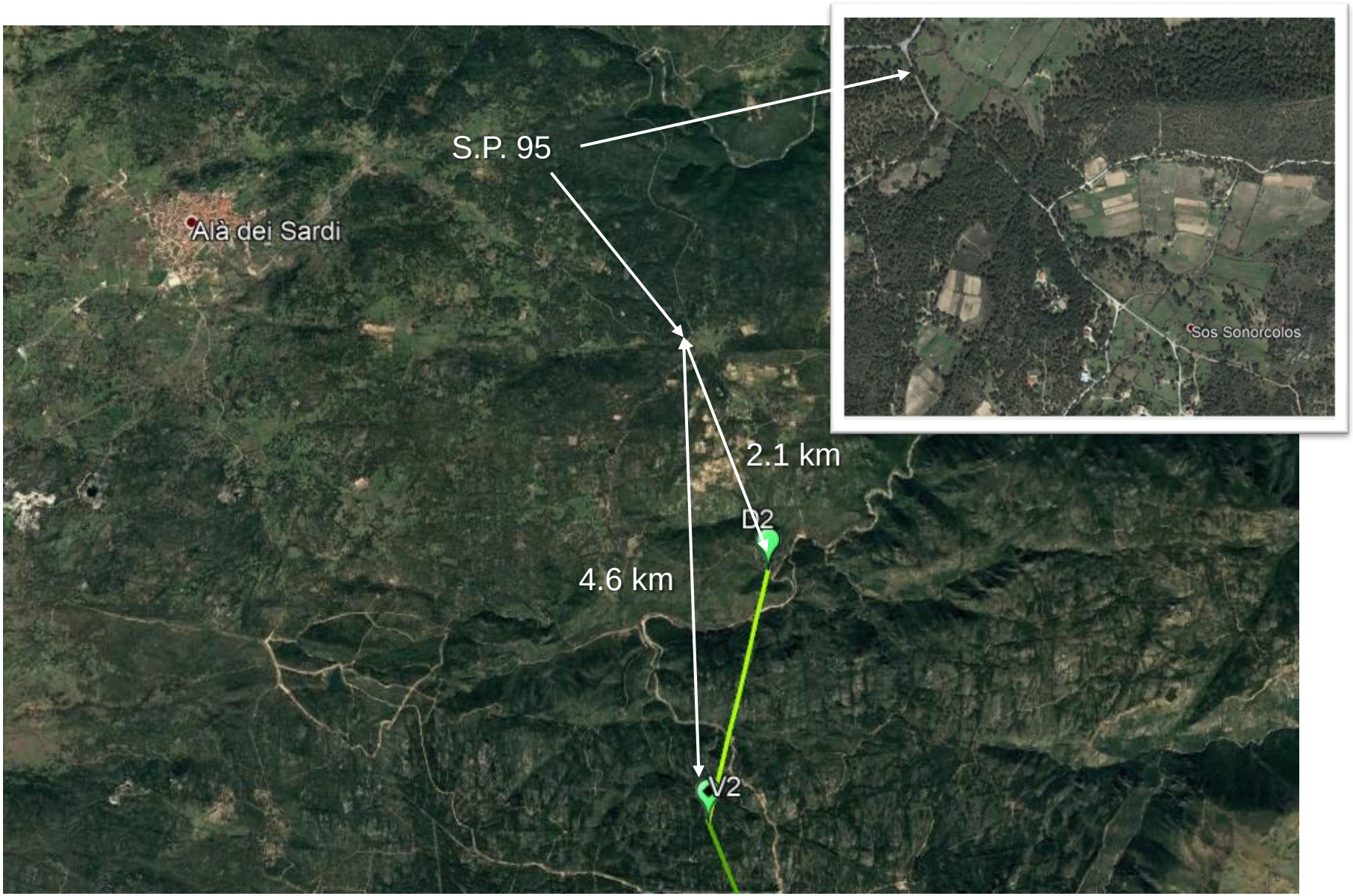
L-SHAPE CONFIGURATION

V2 landscape



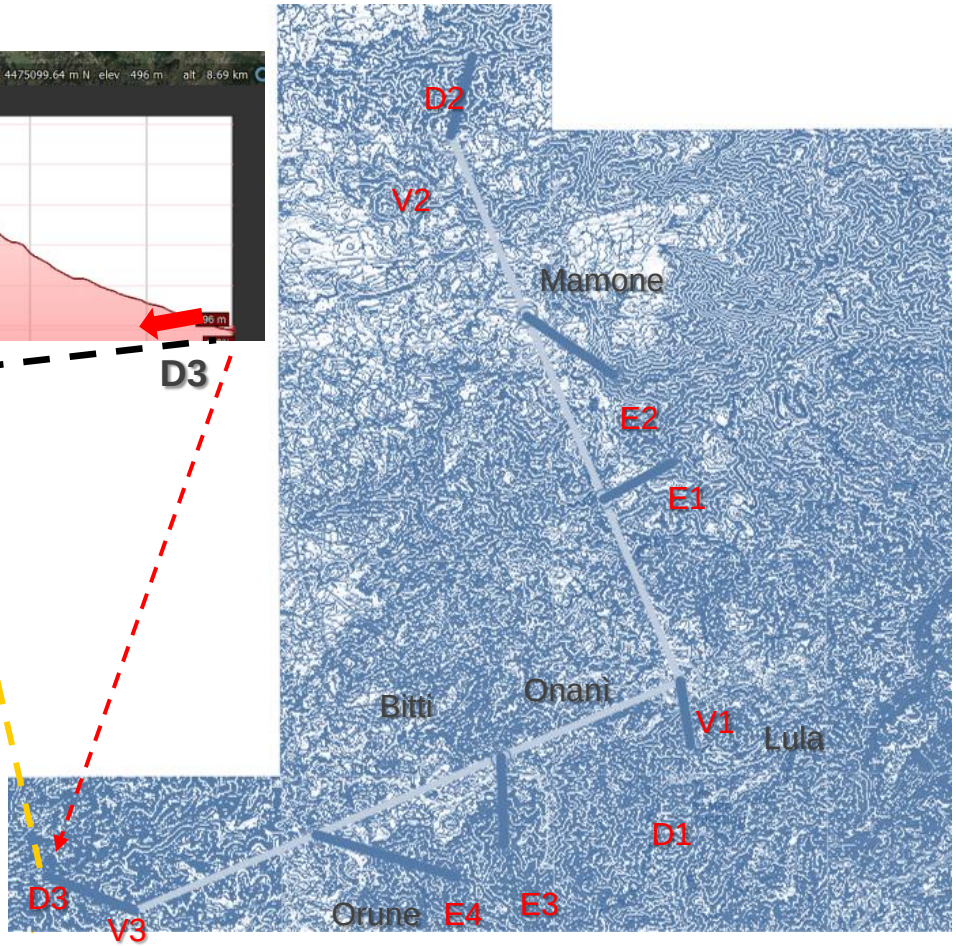


V2 - Accessibility

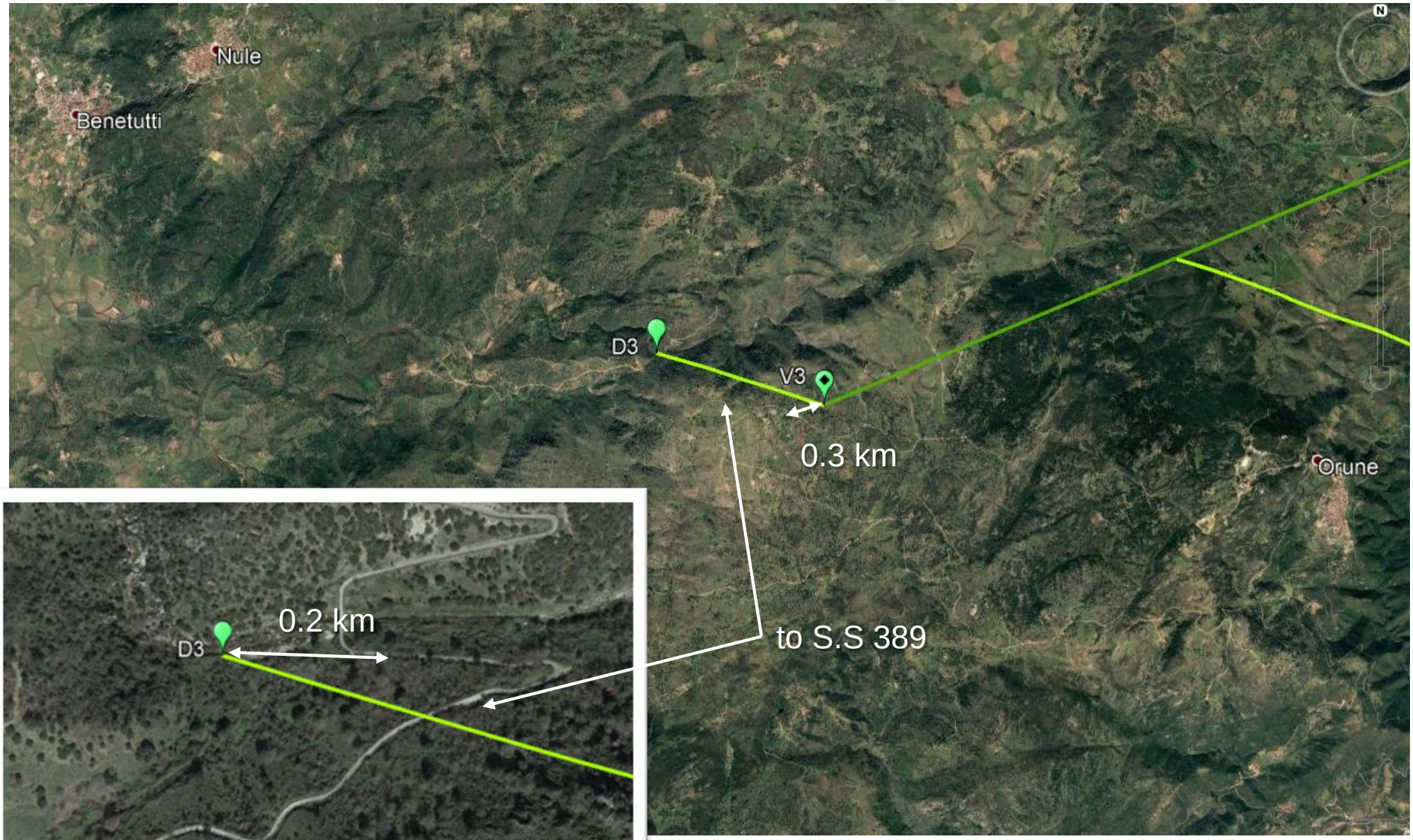


L-SHAPE CONFIGURATION

V3 landscape



V3 - Accessibility



NEXT STEPS

NEXT STEPS

- Legal issues and compliance to urban and rural planning
  - Authorization procedure
  - Identification of competent authorities
  - Analysis of territorial constrains
- Interference with infrastructural and technological networks
  - Characteristics and distance of the proximal roads
  - Power and data networks
  - Water supply and (possibly) gas network
  - Register of existing wells
  - Public sewage network
- Direct and indirect surveying (whole ET site)
  - Geophysical prospections
- BIM (Building Information Modelling) tool for design optimization
  - Interaction with GIS
  - Site condition assessments

From GIS to BIM

- Develop a dedicated GIS to collect geodata and information useful to start the designing approach
- For the whole design process adopt a BIM approach is required since the start of the preliminary design (similar to CERN model for FCC)

- Collect thematic maps and geodata in support of the preliminary site condition assessments and the design optimization
- Organize and maintain outcomes from early project data
- Allow to implement iterative and comparative procedures for performance evaluation and requirement fulfilment

Credits: J. Osborne LVC meeting – CERN Sep2017

THANKS FOR THE ATTENTION