Deep Ocean Cabled Observatories
Amsterdam, 24-25 May 2012

Introduction to future synergy options

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25.05.2012

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FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG

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The next 20 minutes

- Synergy opportunities
- Mediterranean nodes in a wider network
- Future installations
- Strategic considerations

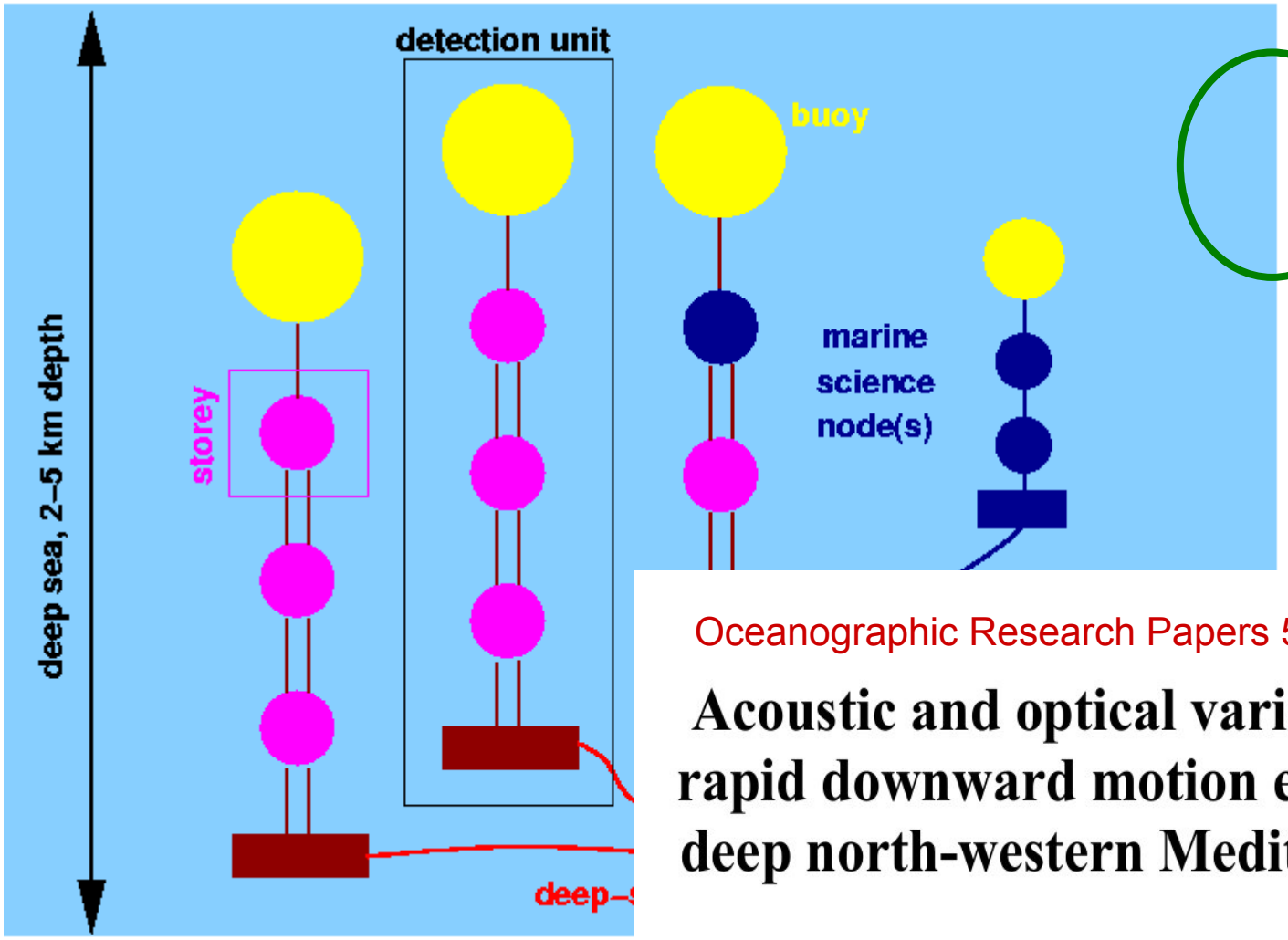
Synergy is two or more things functioning together to produce a result not independently obtainable. The term *synergy* comes from the Greek συνεργός, meaning "working together". (wikipedia.org)

Don‘t forget: the following is from the perspective of a neutrino telescope person!

Synergy opportunities

- Neutrino telescope data used by other science communities
- Neutrino telescope connectivity used by other science communities
- Deep-sea technology: mutual profit from developments in different fields
- Deep-sea scientific expertise used by neutrino telescope community

NT data for earth and sea sciences



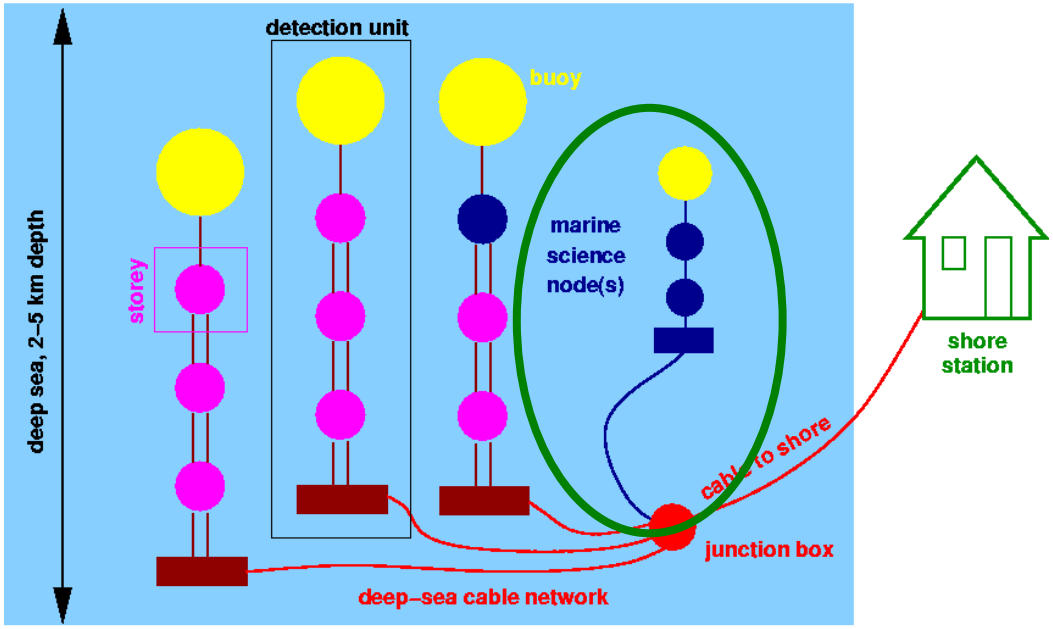
Oceanographic Research Papers 58 (2011) 875-884

Acoustic and optical variations during rapid downward motion episodes in the deep north-western Mediterranean Sea

H. van Haren[z,*], I. Taupier-Letage[ah,l], J.A. Aguilar[a], A. Albert[b], M. Anghinolfi[c], G. Anton[d], S. Anvar[e], M. Ardid[f], A.C. Assis Jesus[g], T. Astraatmadja[g,2], J-J. Aubert[h], R. Auer[d], B. Baret[i], S. Basa[j], M. Bazzotti[k,ℓ], V. Bertin[h], S. Biagi[k,ℓ], C. Bigongiari[a], M. Bou-Cabo[f], M.C. Bouwhuis[g], A. Brown[h], J. Brunner[h,3], J. Busto[h], F. Camarena[f], A. Capone[m,n], G. Carminati[k,ℓ,4], J. Carr[h], D. Castel[b], F. Castorina[o,p], V. Cavasinni[o,p], S. Cecchini[ℓ,q], Ph. Charvis[r], T. Chiarusi[ℓ], M. Circella[s]

NT connectivity for earth and sea sciences

- Neutrino telescope provides continuous connectivity:
  - Electric power
  - Data bandwidth
  - Control
  - Standard connectors
- Earth & sea science instrumentation connected to dedicated junction box
- Installation and operation under common NT and E&S control



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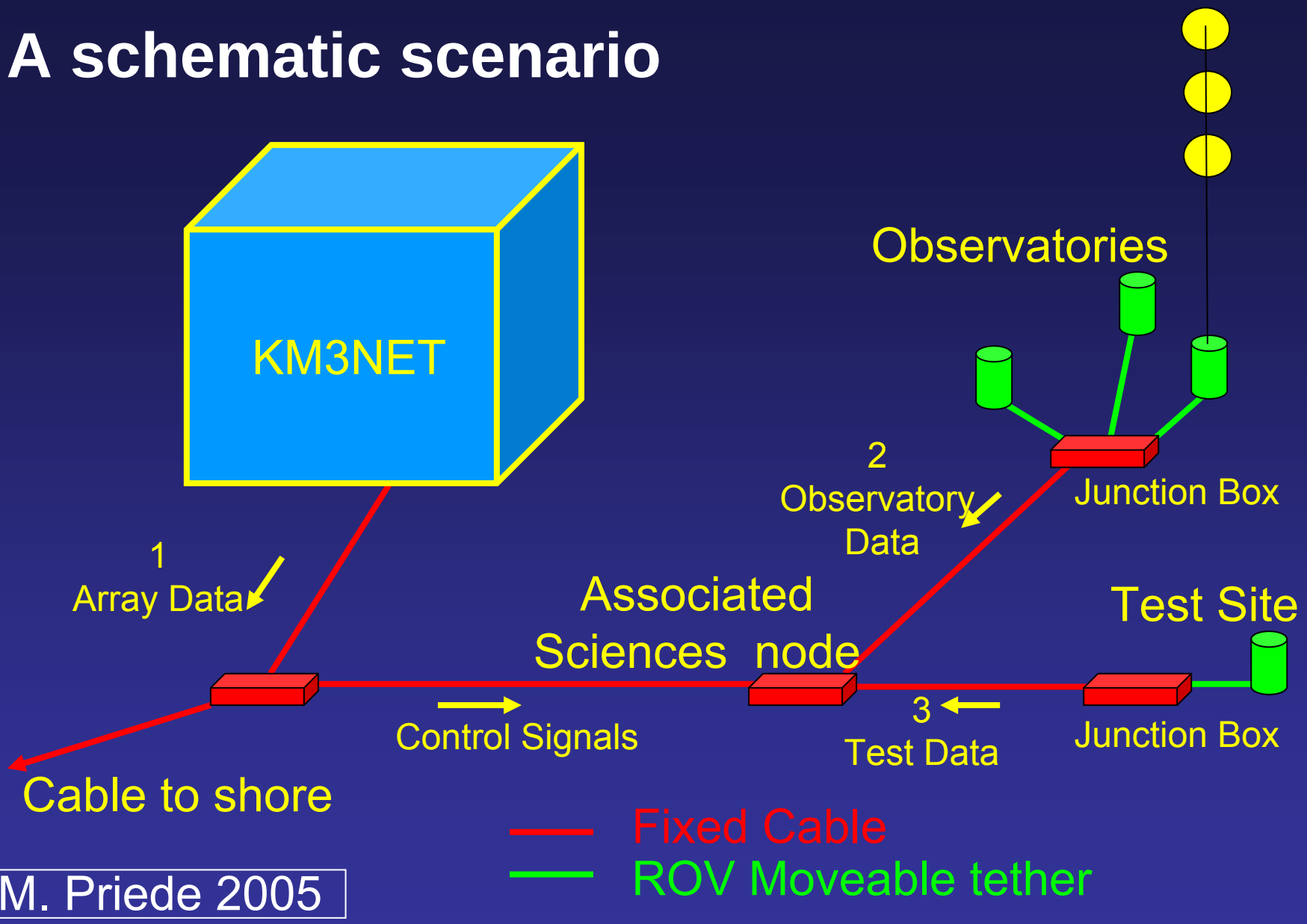
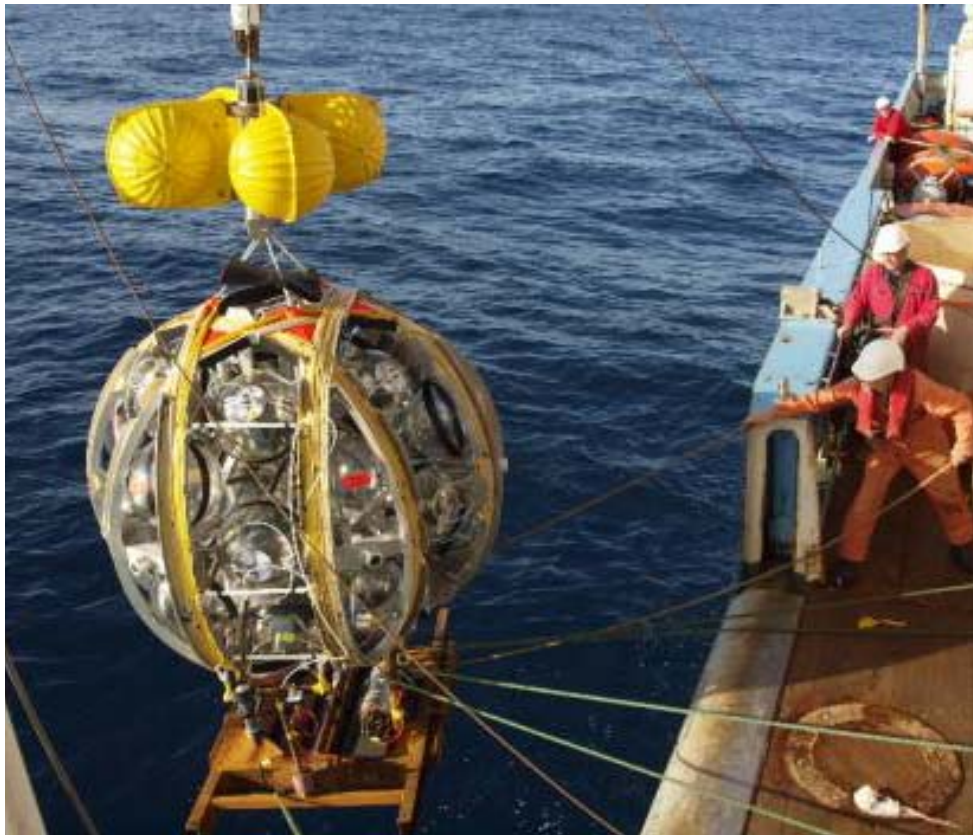
A schematic scenario



M. Priede 2005

Technology synergy

- Earth and sea sciences have experience and expertise in
  - Deep-sea components (e.g. plugs, penetrators, junction boxes, cables, materials …)
  - Deep-sea operation (vessels, procedures, reliability, safety …)
- Neutrino telescopes pose new challenges:
  - Continuous connectivity
  - Interactive operation
  - High-bandwidth data connections
- Cooperation helps and provides new opportunities



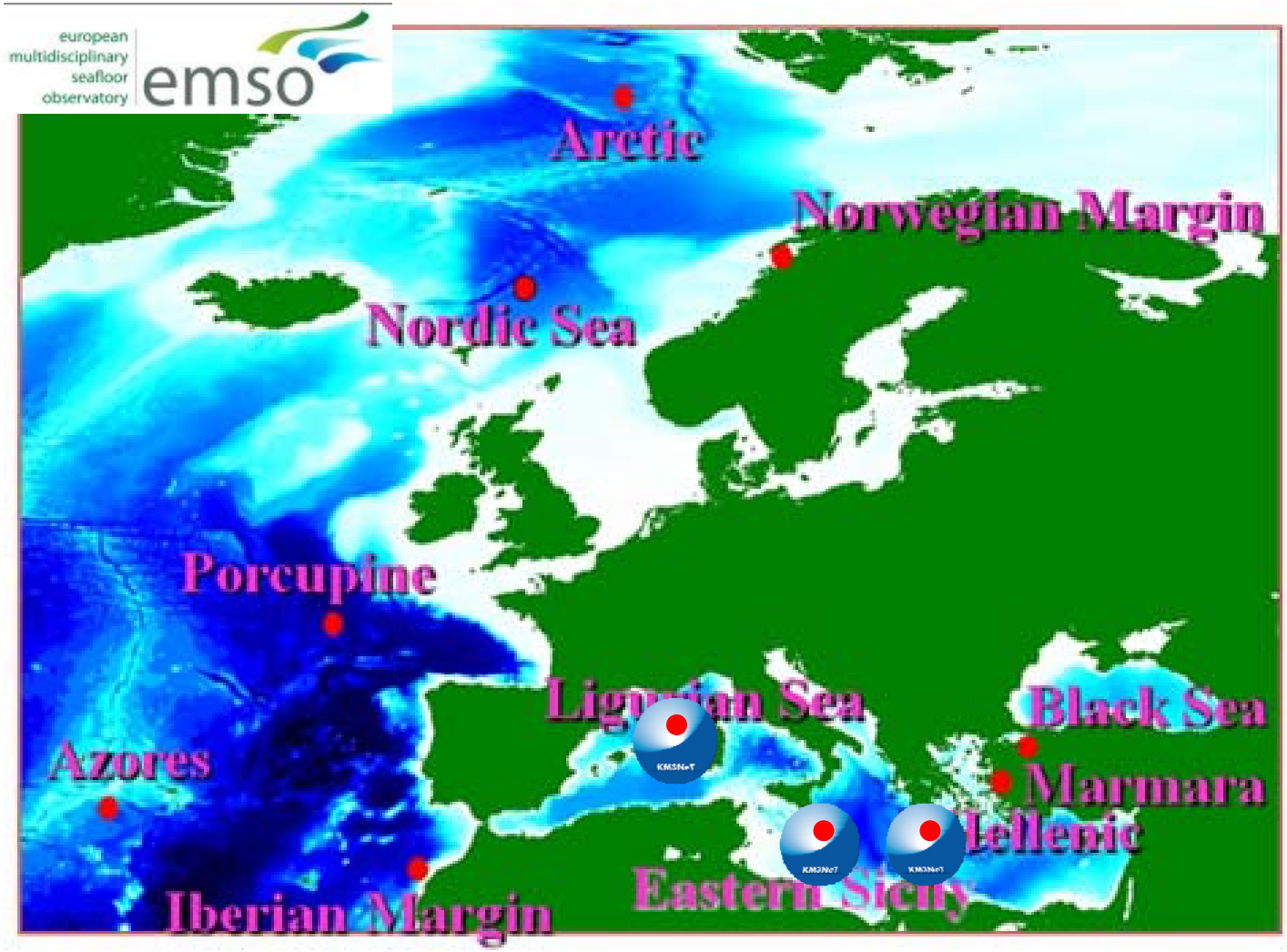
String deployment concept developed by NIOZ: Successful test Dec. 2009

Deep-sea wisdom for neutrino hunters

- What do we know about the deep-sea environment and how do we measure what we don't know?
- Which phenomena will/can/may interfere with the neutrino telescope operation?
- Which components or operations could be environmentally problematic?
- What needs to be done when the neutrino telescope has reached its end of operation?

Future deep-sea observatories in Europe

- EMSO: 11 nodes
- 3 in Medit. Sea (all KM3NeT candidate sites)



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Why in the Mediterranean Sea?

- Many earth sea science questions are likely to be site specific. The Mediterranean Sea is unusual:
  - The straits of Gibraltar isolate it from global ocean circulation, so observations are not representative.
  - The deep water is warm
  - Biological activity is low compared with open ocean

Courtesy M. Priede

- What can be done in the Mediterranean Sea?
  - Experiments that are not location sensitive (depth only is a concern);
  - Experiments that are substrate/slope specific, e.g. studies on sediment mechanics;
  - Location specific experiments: e.g. measuring seismicity at Etna, Ocean drilling program boreholes, studies at extreme depth at Pylos, mud volcanoes, … (not necessarily compatible with NT site requirements, high-resolution mapping will be necessary to identify such features);
  - Regional experiments; e.g. Ionian sea deep plankton or Rhone delta outflow effects (Ligurian Sea);
  - Network of deep water sensors on a grid throughout the Mediterranean. The KM3NeT site(s) could contribute one or few of these.

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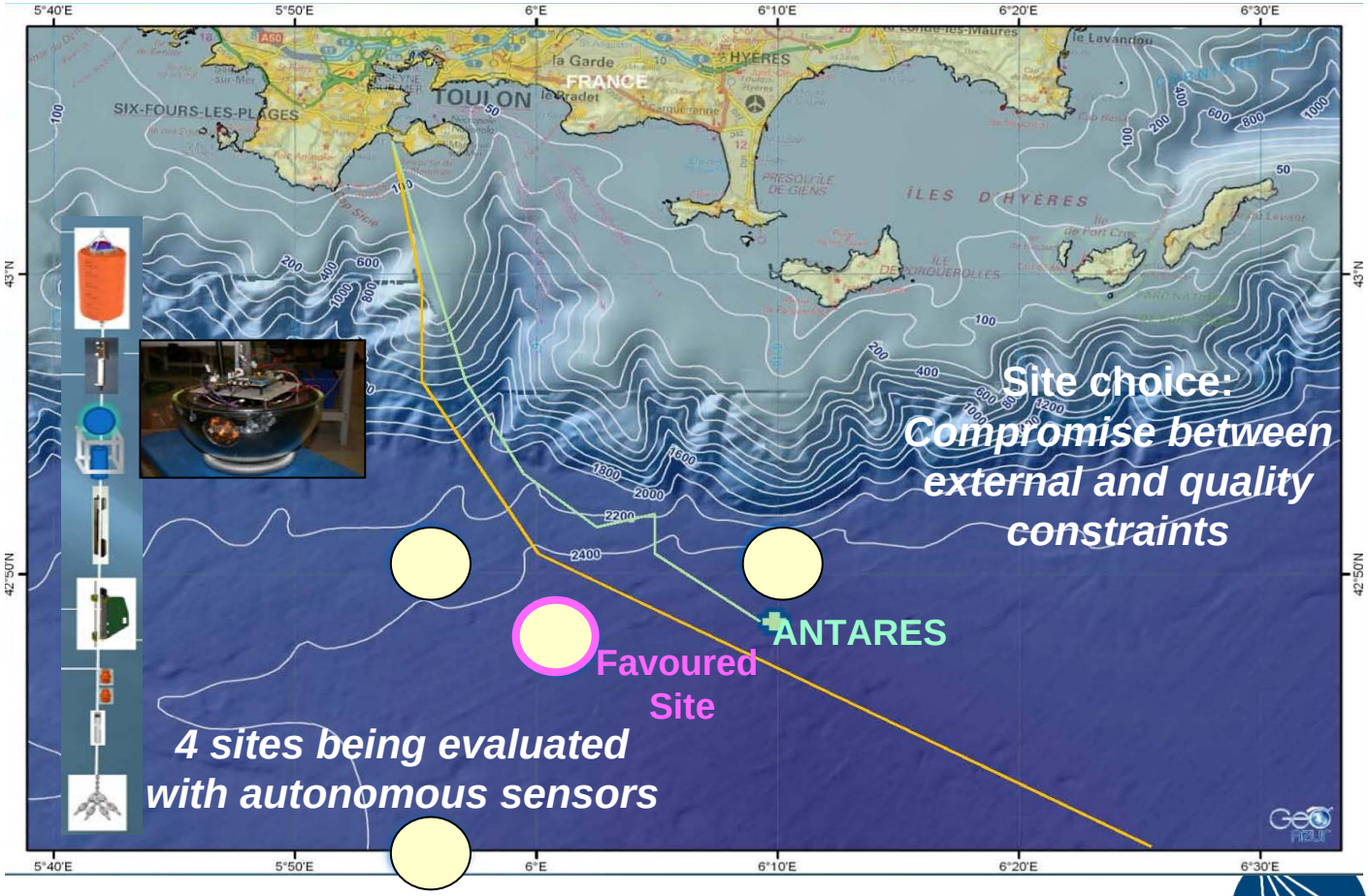
The MEUST project

MEUST goal:

Deploy a 2nd-generation shared submarine observatory offshore of Toulon, within the framework of the future KM3NeT and EMSO European networks



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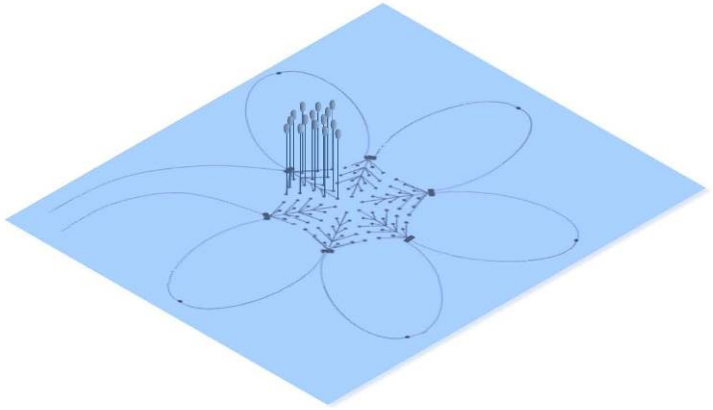
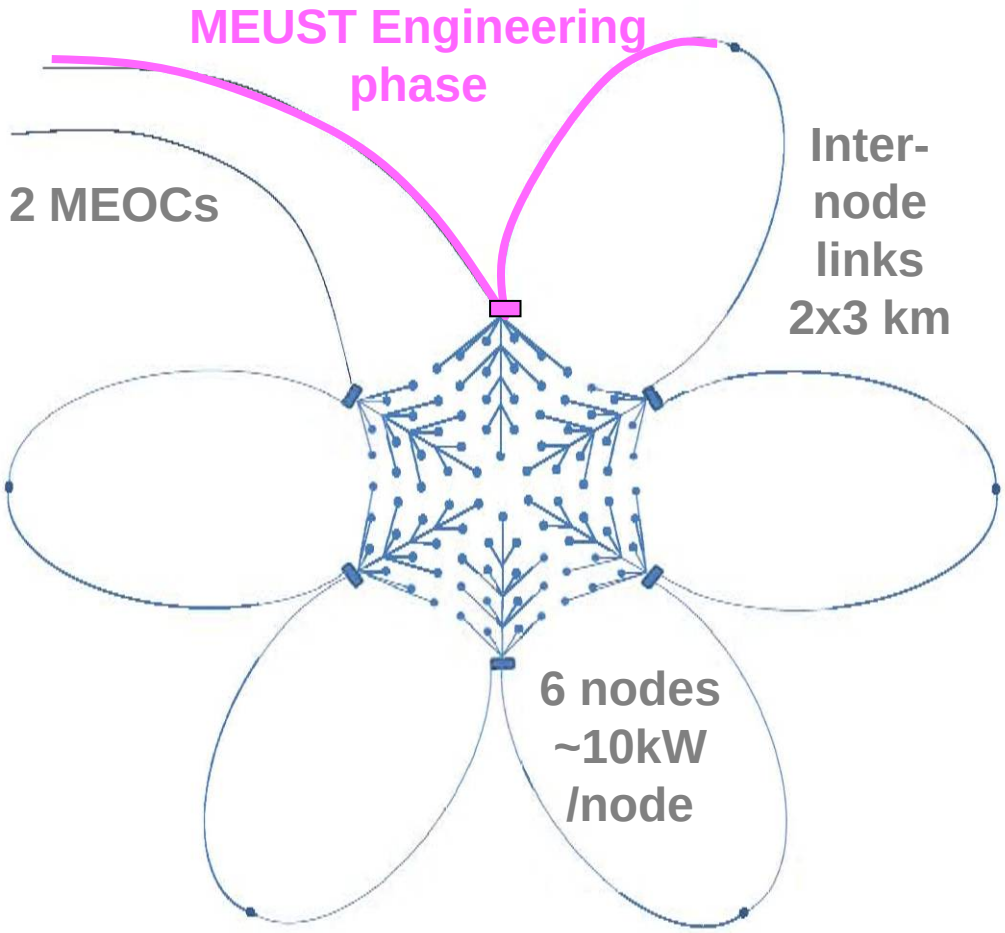
A possible sea floor network layout

- Nodes provide connectivity to NT and E&S instruments
- Long inter-node links allow for node maintenance





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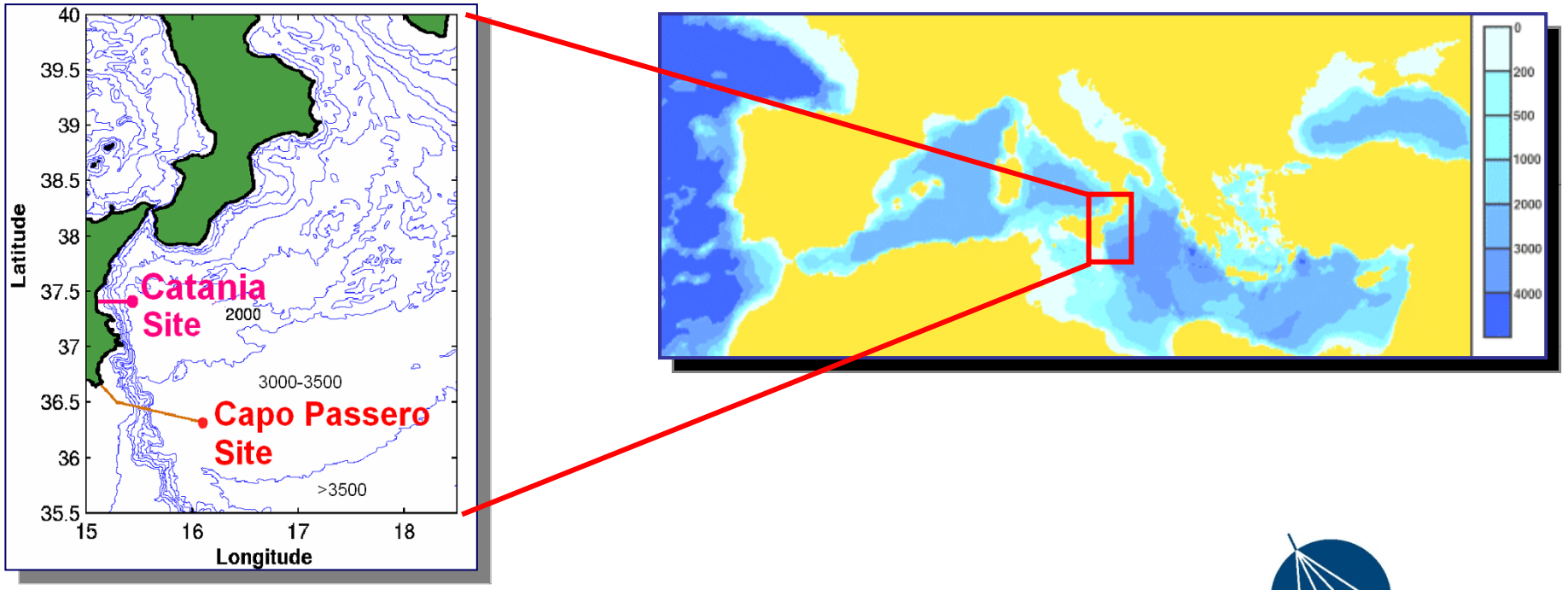
Activities and plans in Italy

- Candidate site for KM3NeT: Capo Passero (3500 m)
  Cable and shore station ready, construction activity ahead
- Plan: Construct research infrastructure for neutrino astronomy and earth & sea science
- Test site near Catania (2100 m) – bioacoustics, geophysics



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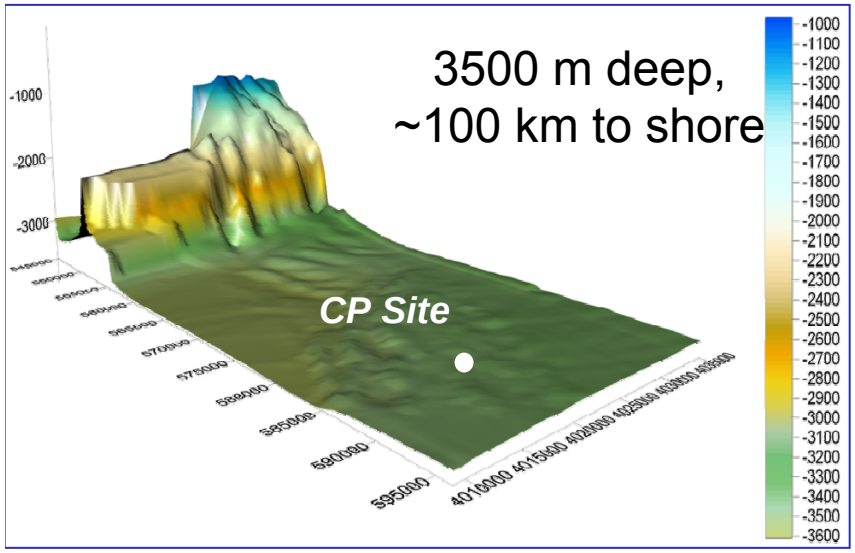
The Capo Passero site



Shore laboratory operational:

- On shore power supply 10 kV / 50 kW
- Submarine cable and infrastructure (100 km / 20 fibres, DC-sea return, DC/DC Converter 10 kV/375 V)
- Optical-fibre link to high speed internet
- Construction hall, data acquisition room, guest house

Strategic considerations

- Common usage of infrastructure requires common planning and management
- Continuous consultations are necessary
- The specific characteristic of the site (Mediterranean Sea) needs consideration
- Synergies in science and technology should create synergies in funding
- Are we doing enough to emphasise the synergies and use the multidisciplinary aspects as arguments in our favour?