

**Workshop on Marine Robotics and Underwater Acoustics
Bringing Together System Designers and Prototype
Developers**

EXPO2000 - Portuguese Pavillion

**Hannover, Germany
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by

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Acoustic Tomography: a tool for understanding the ocean

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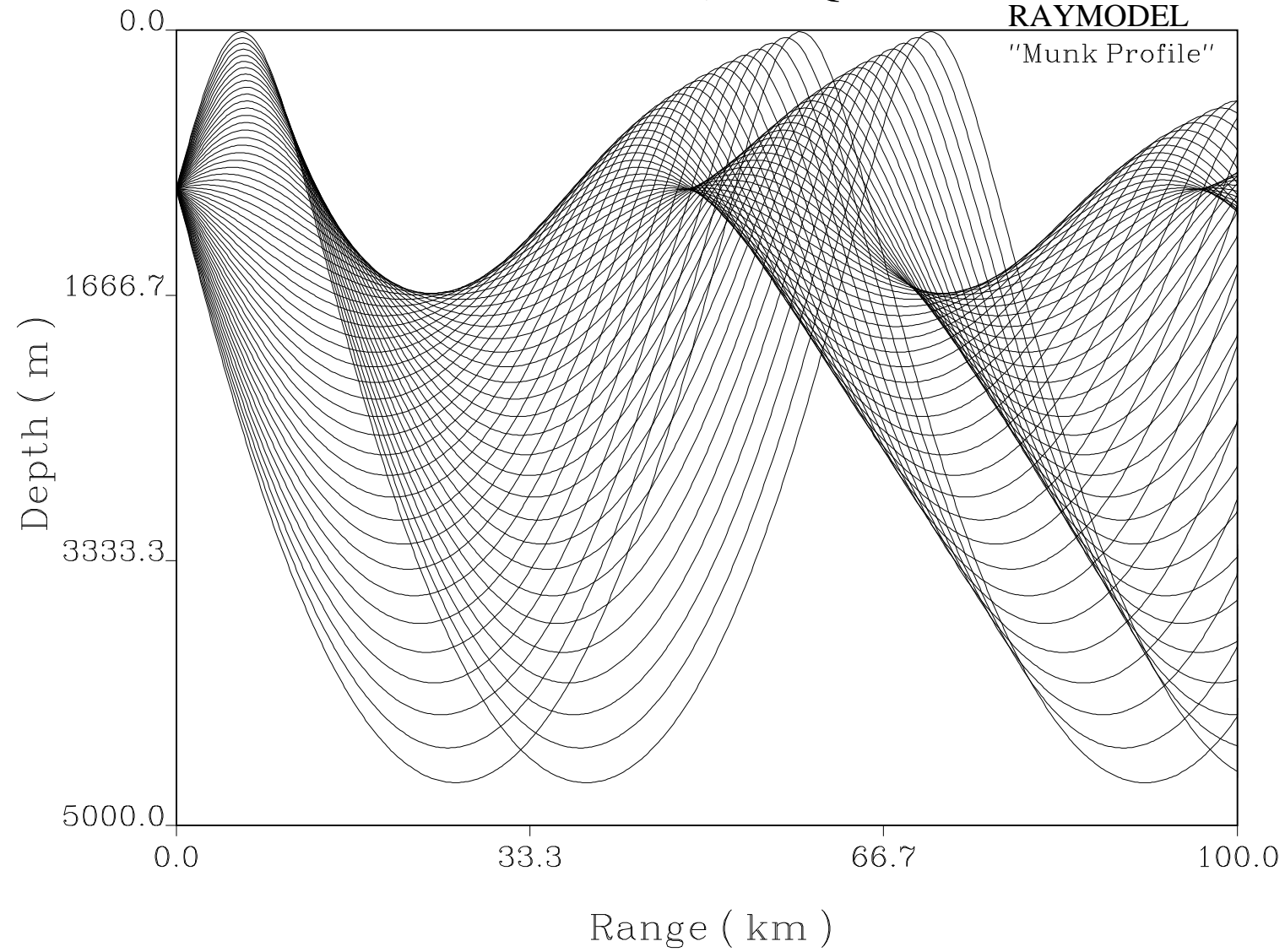
This work was partially supported under contract 2./2.1/MAR/1698/95, PRAXIS, FCT, Portugal, by the French Navy, CMO-EPSHOM, Brest, France and by the Office of Naval Research (USA).

BELLHOP

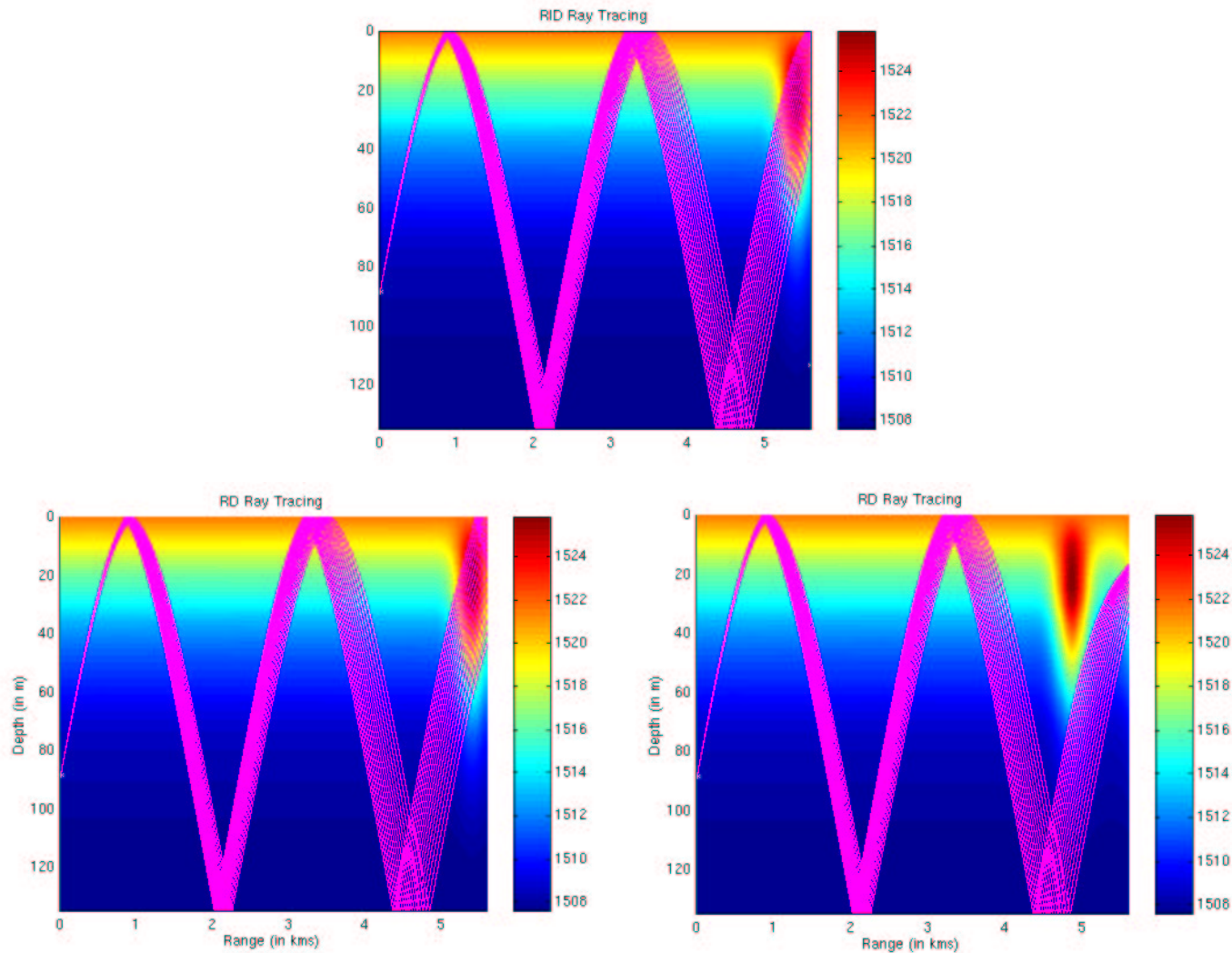
SD = 1000.0 m , FREQ = 50.0 Hz

RAYMODEL

"Munk Profile"

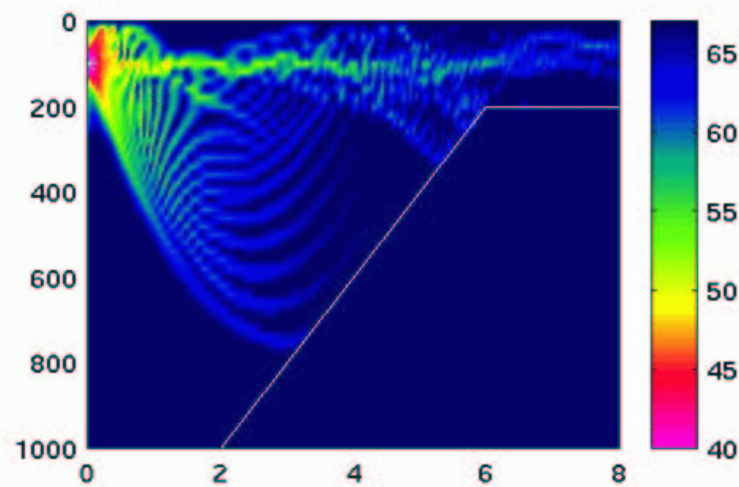
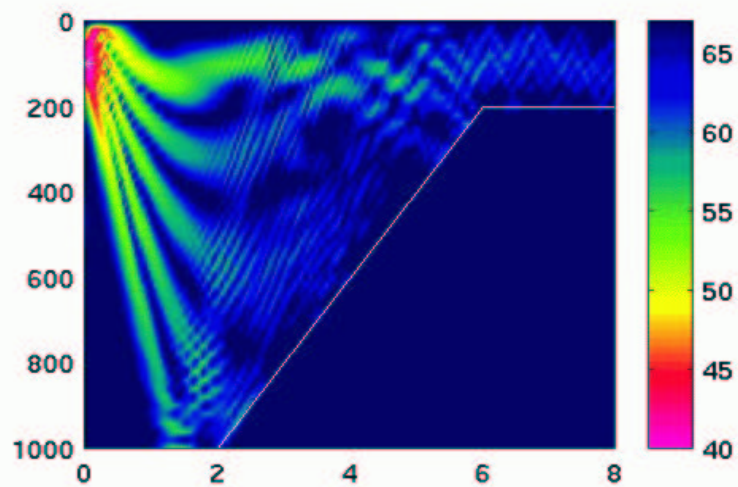
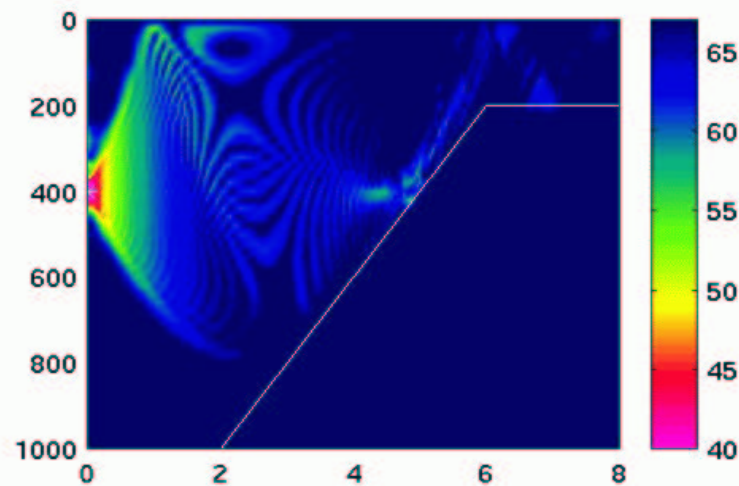
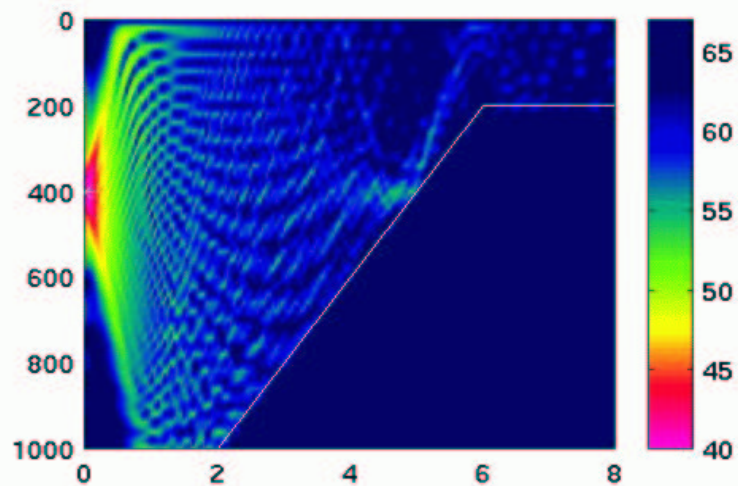


Ray Tracing through a SWP



Ray Tracing: Range-independent case (*top*) and range-dependent cases (*bottom*), showing beam spreading (*right*) and beam focalization (*left*).

ACOUSTIC PROPAGATION IN A RANGE-DEPENDENT ENVIRONMENT



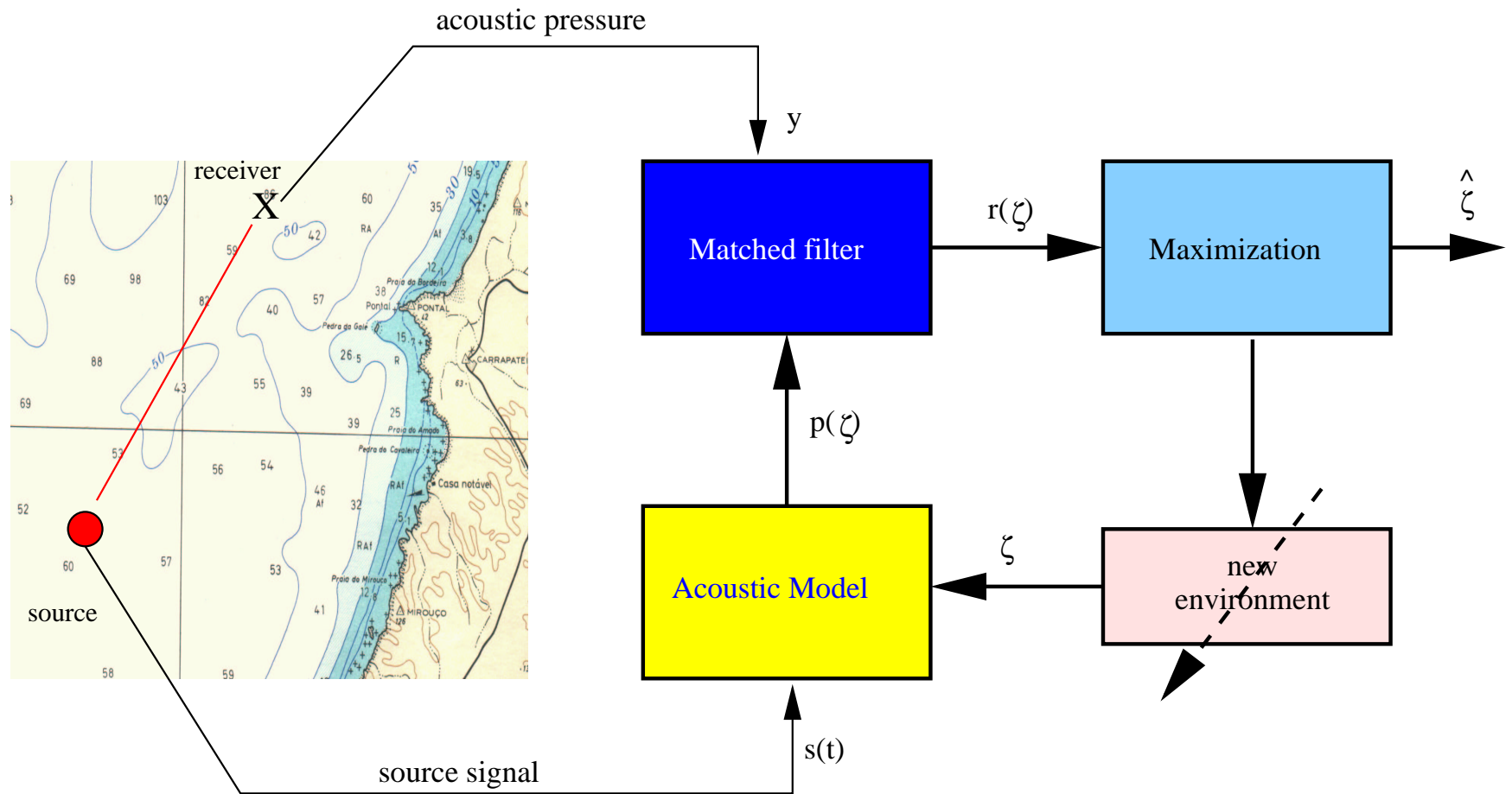


Motivation

- remote ocean monitoring (temperature, currents, etc...)
- ocean bottom survey (compressional characteristics, material type,...)
- decrease costs
- exploration of natural resources (oil, gas, ...)
- biological applications (marine mammals, fishing)
- underwater communications
- military applications



How does OAT work ?





Systems, models, algorithms,...

Systems:

- source/array of sources
- vertical/horizontal arrays
- planar (2D) arrays
- full volumetric (3D) arrays

Models:

- ray tracing (RD or RI)
- normal-mode (RI or weakly RD)
- full-field - finite element (RI)
- parabolic approximation (RD)

Matched-filters:

- correlator (pressure, time/frequency/space/wavenumber)
- energy based (Bartlett power, MVDR, ...)

Optimization:

- local methods (gradient, steepest descent,...)
- global methods (GA, SA, search and branch,...)



Internal Tide Measurements with Acoustic Tomography Experiments (INTIMATE)

Objectives

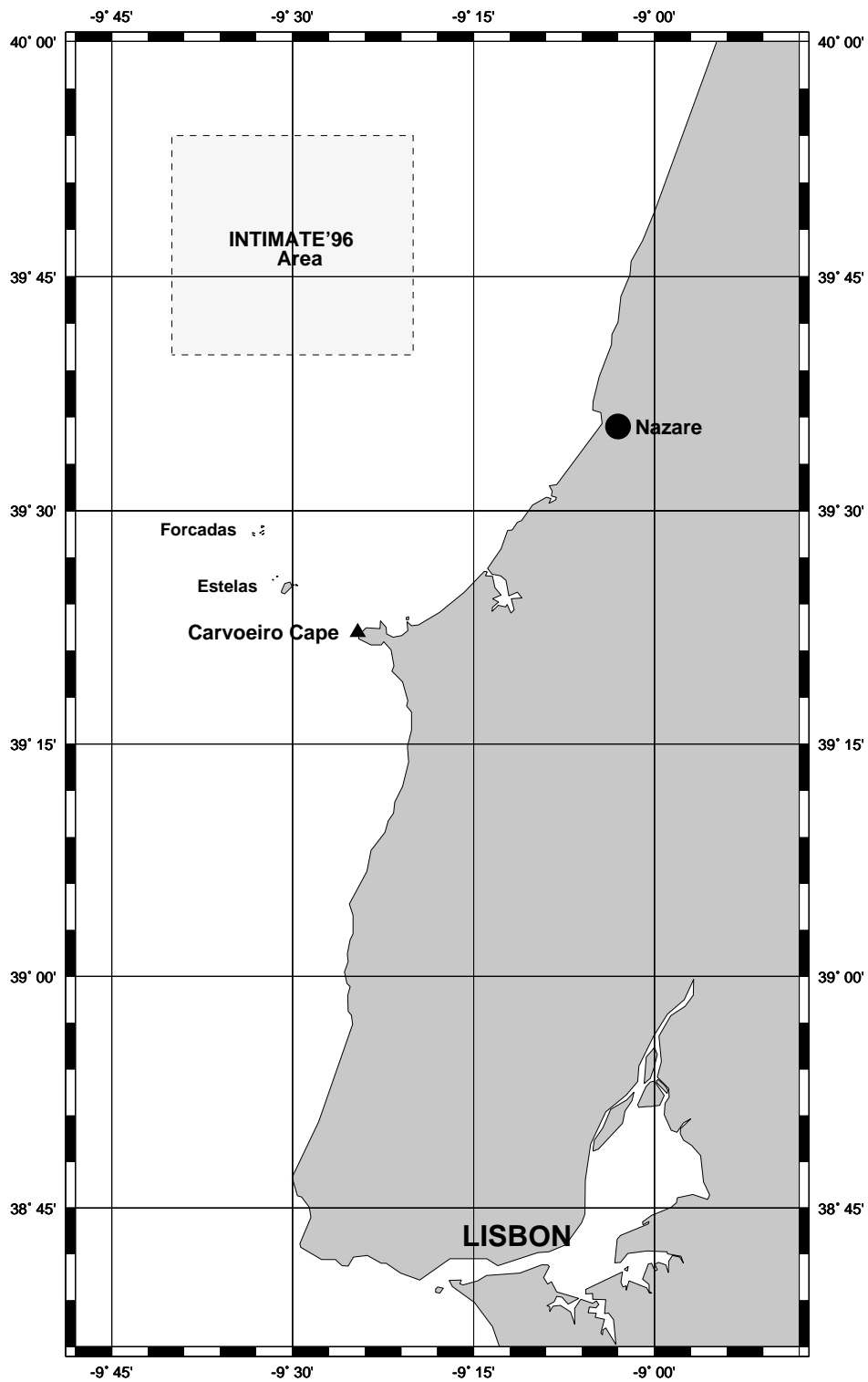
- to establish the capabilities of acoustic tomography for estimating internal tide parameters in shallow water
- to design an experimental system and setup procedures for inverting acoustic data in shallow water



The INTIMATE Team

Open participation policy

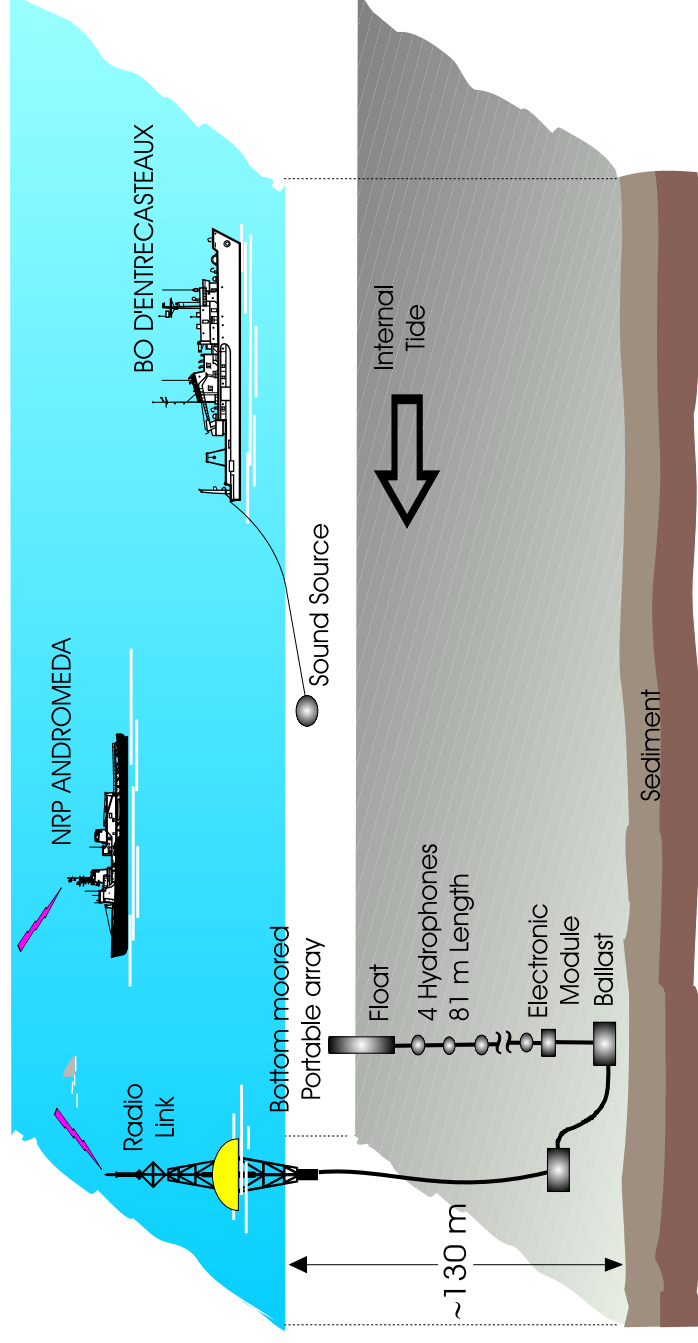
- SiPLAB, Univ. of Algarve [signal processing, OAT]
- Instituto Hidrografico, Lisboa [oceanography, experimental procedures]
- CMO-EPSHOM, Brest (France) [OAT, experimental procedures]
- M.B. Porter, SAIC (US) [acoustic modelling, signal processing]
- DERA, Winfrith (UK) [oceanography, satellite data]
- NATO SACLANTCEN, La Spezia (Italy) [experimental proc.]
- DUNE Srl., Roma (Italy) [signal processing]



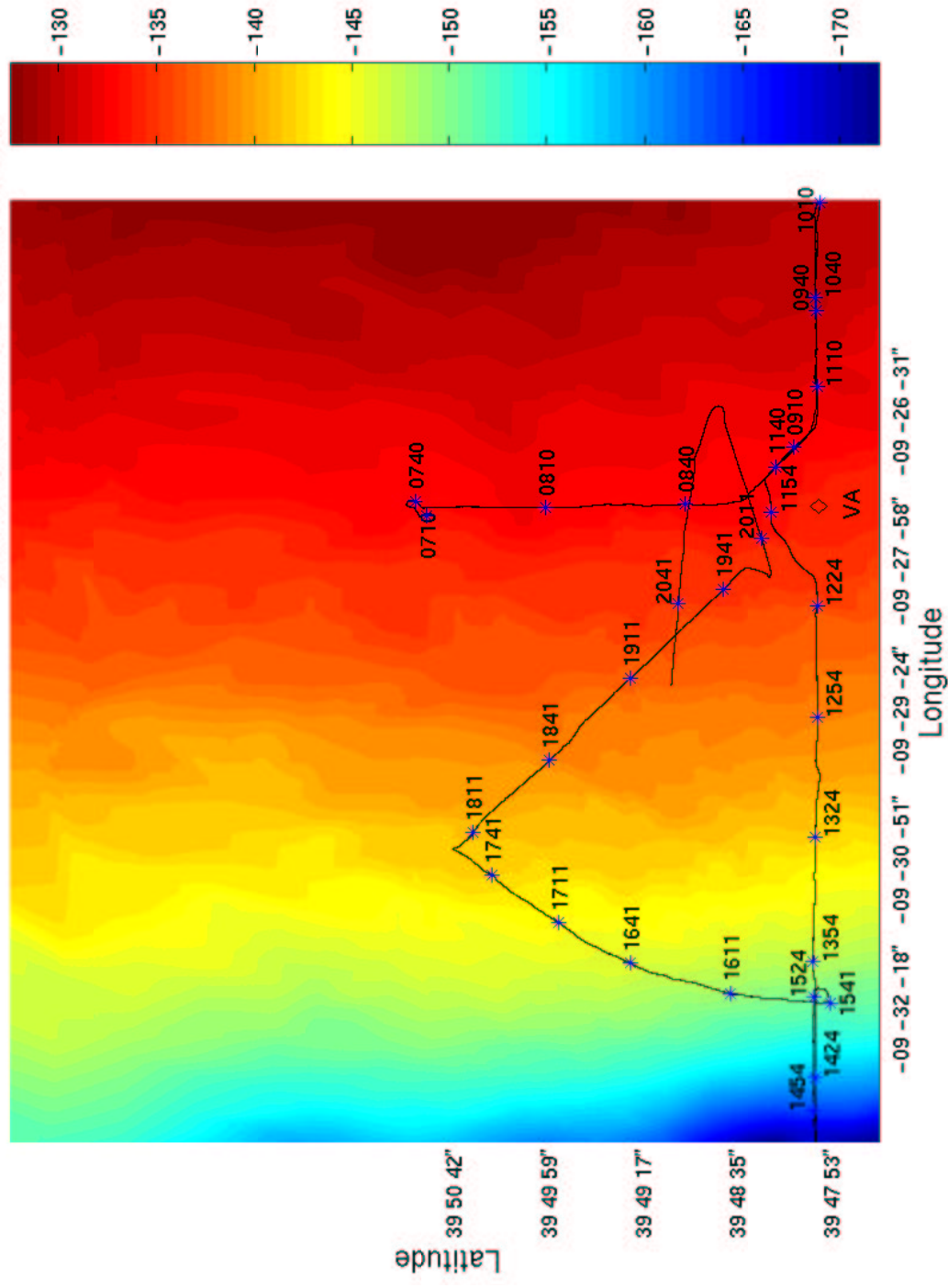


Real Data Acquisition Scenario

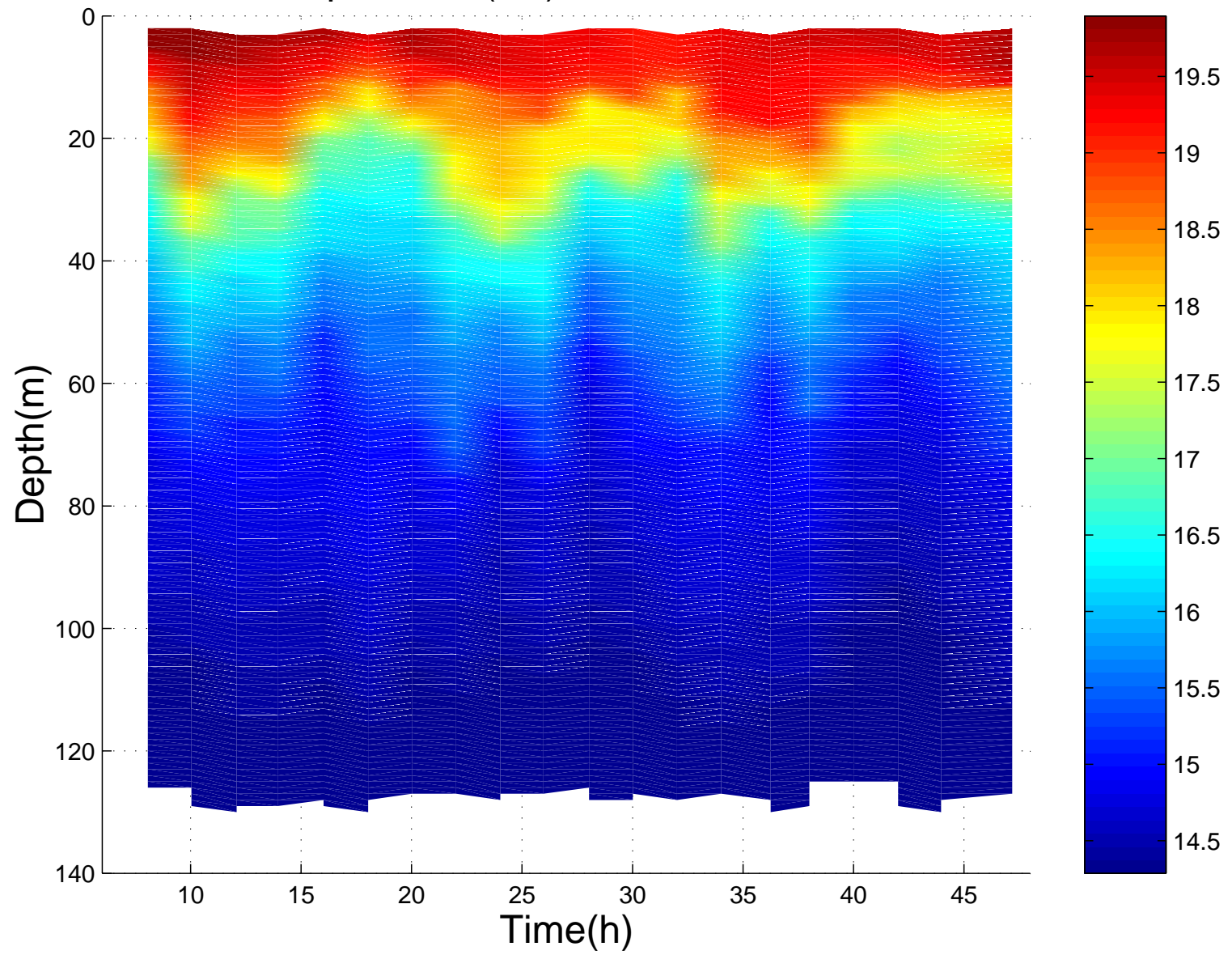
INTIMATE'96, JUN 1996 - NW Nazaré site



Intimate 96: event II – June 16, 1996



Temperature ($^{\circ}\text{C}$) June 16–17, 1996





Conclusions and perspectives

- OAT took off in Portugal with INTIMATE
- continue with ATOMS (Acoustic TOMography Monitoring System)

Issues:

- easy deployable survey systems (few sensors)
- integration of information of different nature
- the passive tomography concept (TOMPACO)