

NL research programme for Military Oceanography

MREA-10 conference, Lerici, Oct. 2010

TNO | Knowledge for business



Frans-Peter Lam, Lianke te Raa

Present research aim

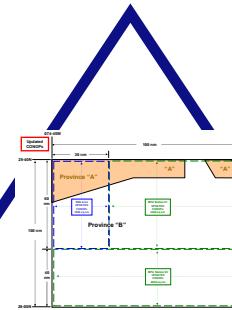
- Explore added value of oceanographic modelling
 - Demonstrate relevance in time and space
 - Whatever relevant: show how to implement
- Applications
 - ASW (sonar performance)
 - Amphibious ops
 - Submarine ops
 - AUV support
 - Search and Rescue (related to drifting mines)



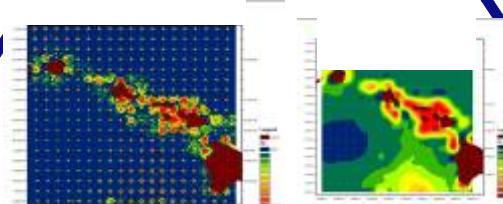
Information pyramid of Battlespace Preparation

Slide (adapted) by courtesy of:
E.C. Gough, Jr.
REA-conference, Lerici, 25 Sep.2007

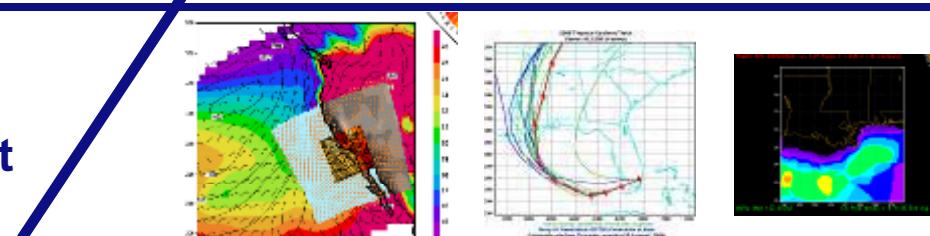
Tier 3 – Decisions



Tier 2 – Sensor Performance



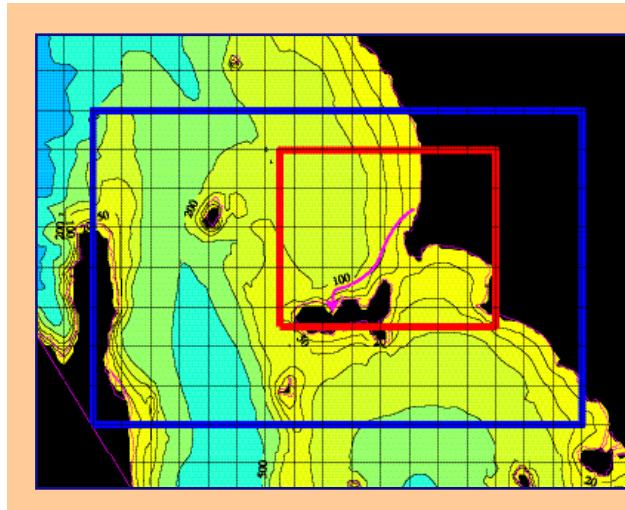
Tier 1 – Environment



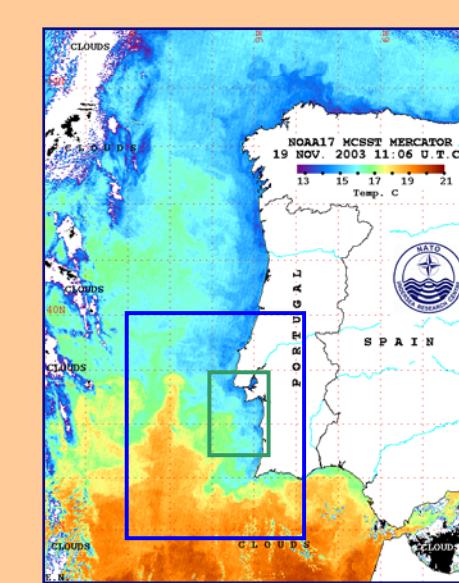
Basis –
observations



Past NL contributions to MREA



MREA03
2003, Elba



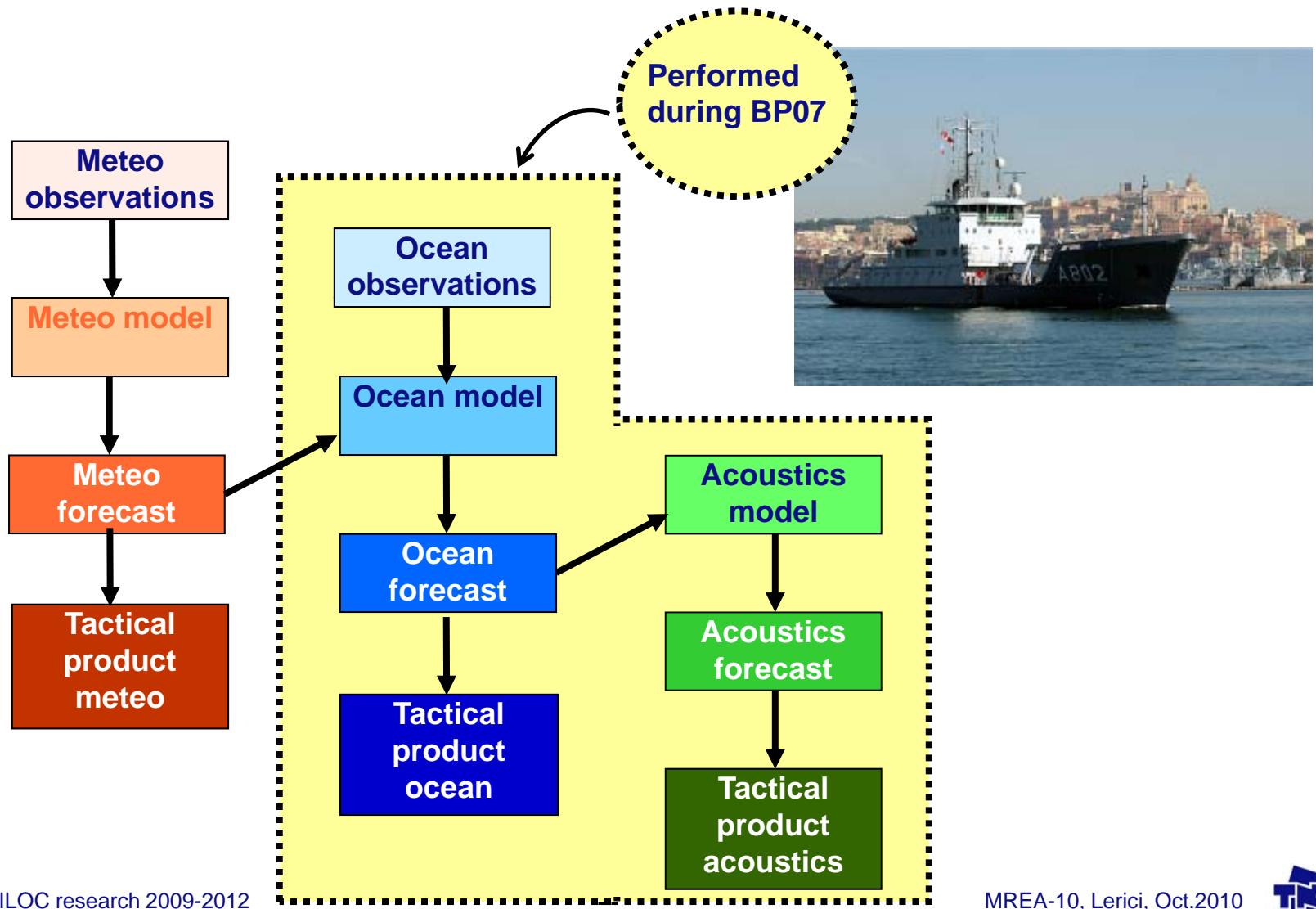
MREA04
2004, Portugal

BP07
2007, Elba



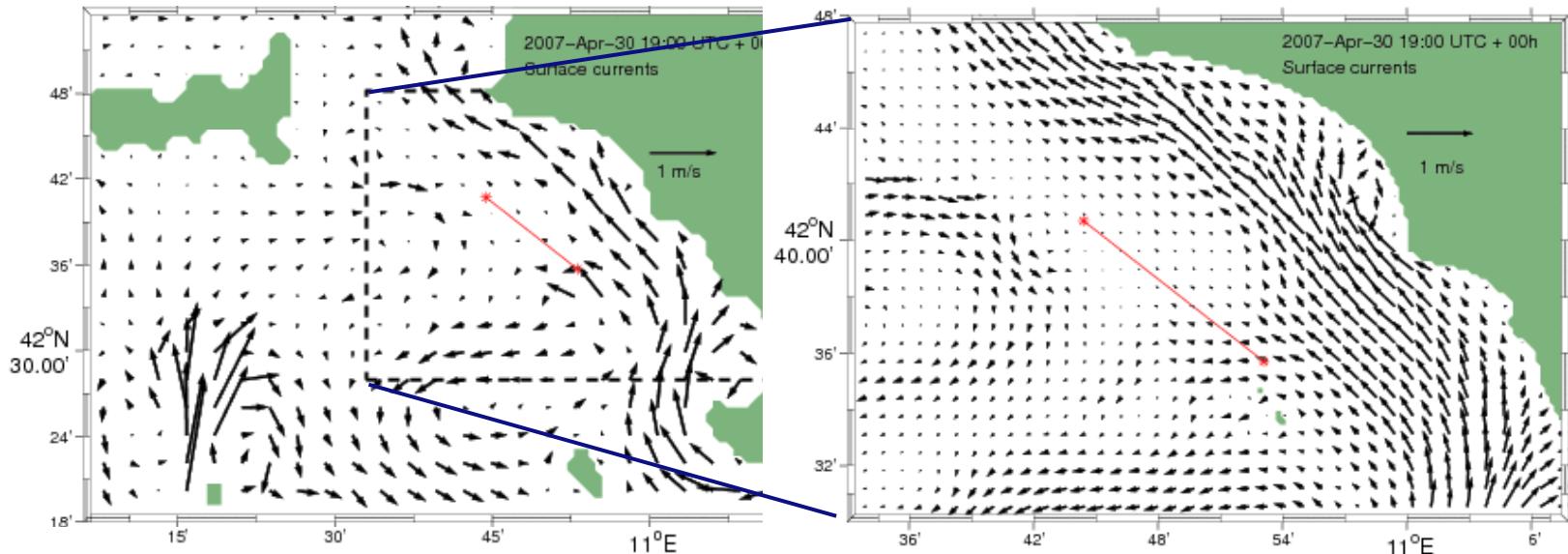
+ plans for REP-10

Real-time delivery of tactical ocean and acoustic products on board HNLMS Snellius

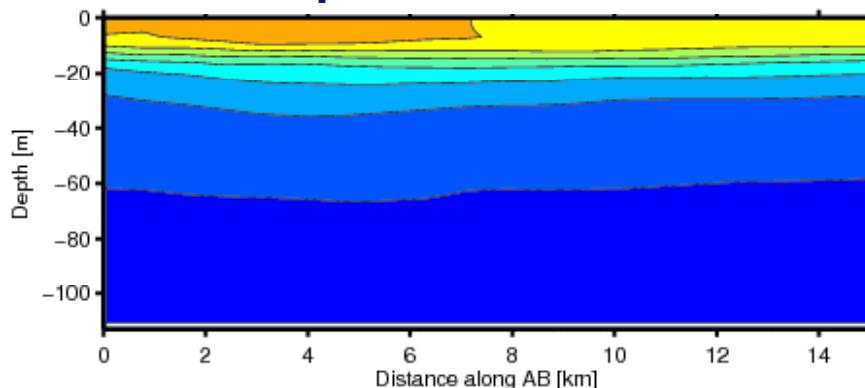


Ocean forecasts / tactical products during BP07

Surface Current forecasts

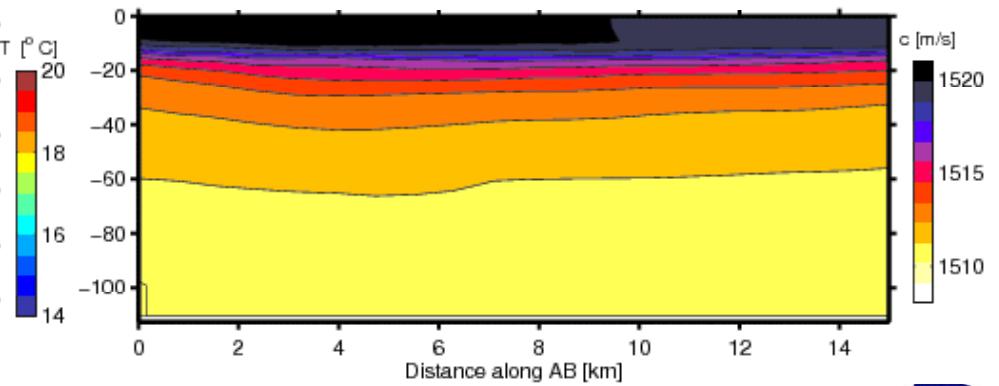


Temperature forecasts



6 NL-MILOC research 2009-2012

Sound speed forecasts



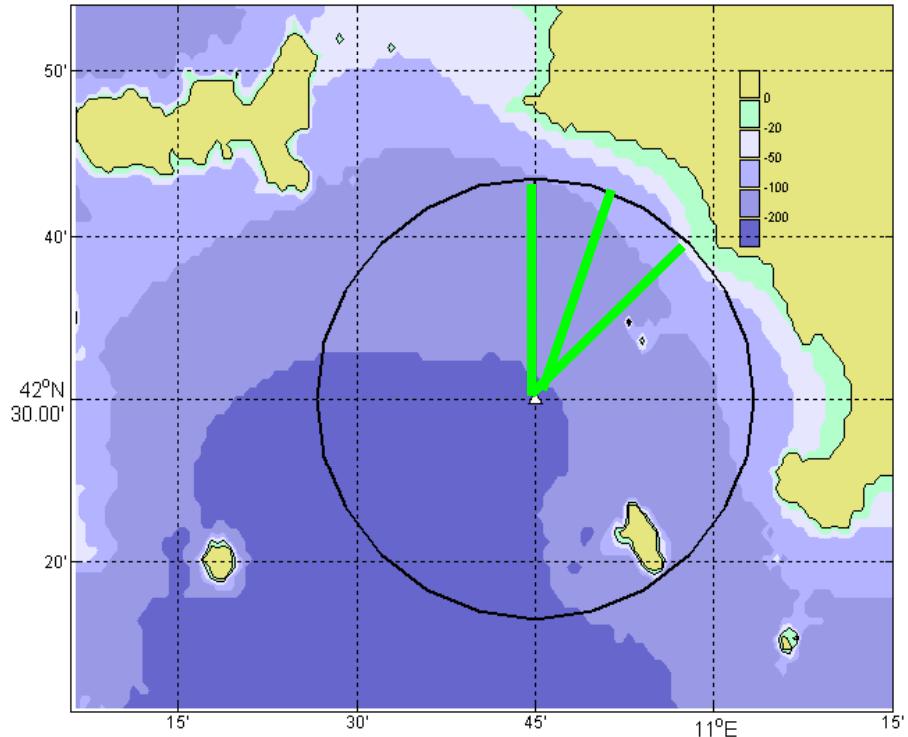
MREA-10, Lerici, Oct.2010



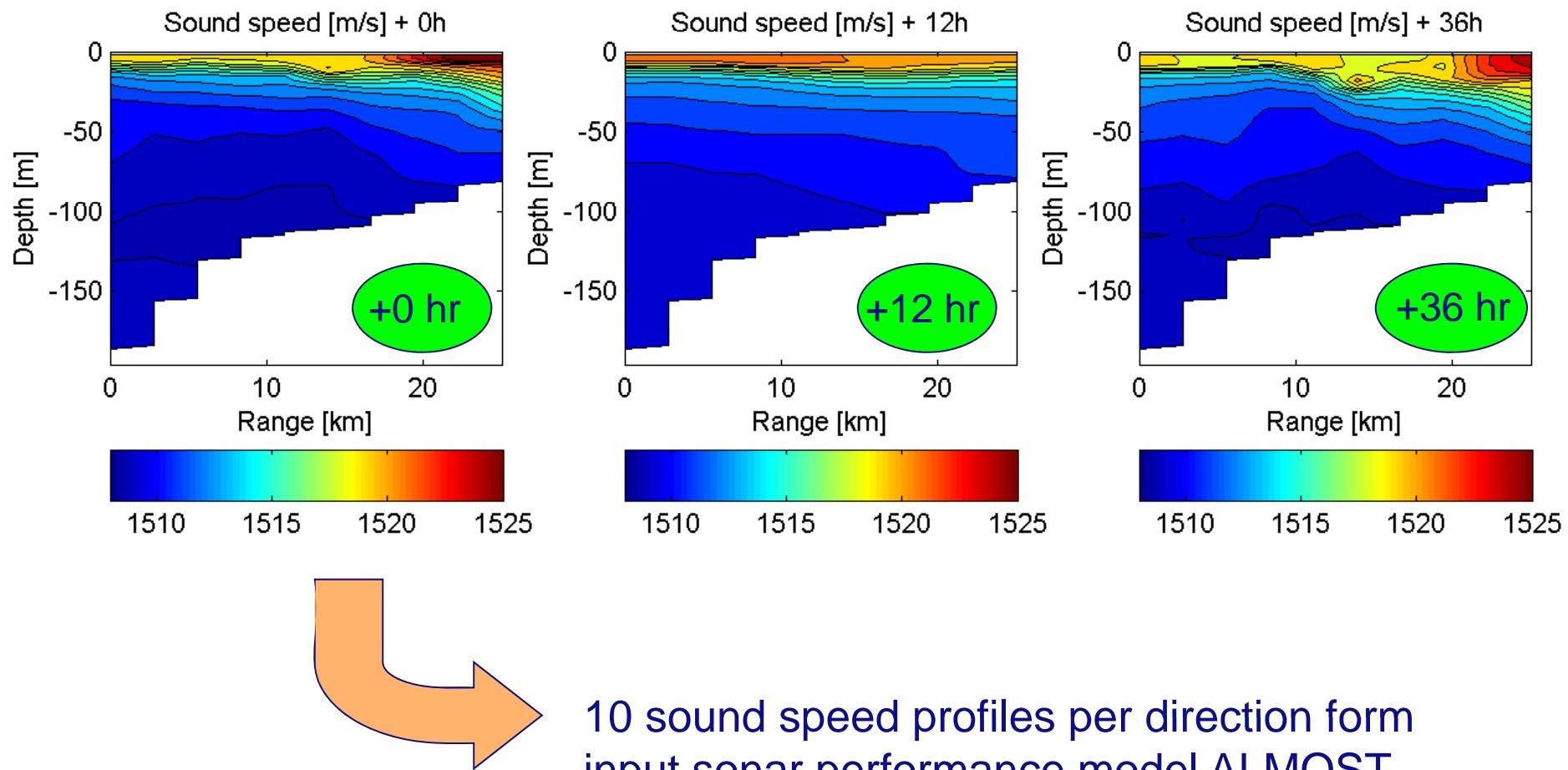
Sonar performance prediction BP07

ALMOST-REACT model, ASW scenario

- Sonar:
 - LFAS sonar system
 - 1500 Hz, wideband
 - 96 elements towed array
 - operation depth 50 m
 - prob. of false alarm 10^{-5}
- Target
 - target strength 10 dB re 1 m^2
 - depth 50 m
- Environment
 - range-dependent sound speed profiles from MSEAS forecasts
 - sediment type: clay
 - bathymetry as in MSEAS



Typical sound speed variations



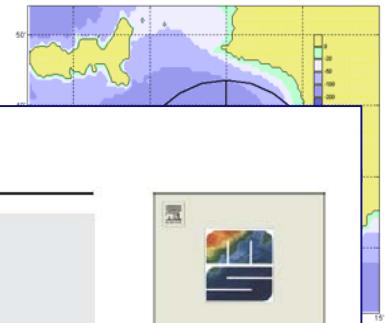
10 sound speed profiles per direction form
input sonar performance model ALMOST

Sonar performance prediction ALMOST

Probability of detection based on:

- range-dependent sound speed forecasts

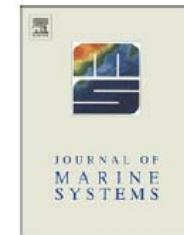
Journal of Marine Systems 78 (2009) S306–S320



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At-sea real-time coupled four-dimensional oceanographic and acoustic forecasts during Battlespace Preparation 2007

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ARTICLE INFO

Article history:

ABSTRACT

Systems capable of forecasting ocean properties and acoustic performance in the littoral ocean are becoming

Information pyramid of Battlespace Preparation

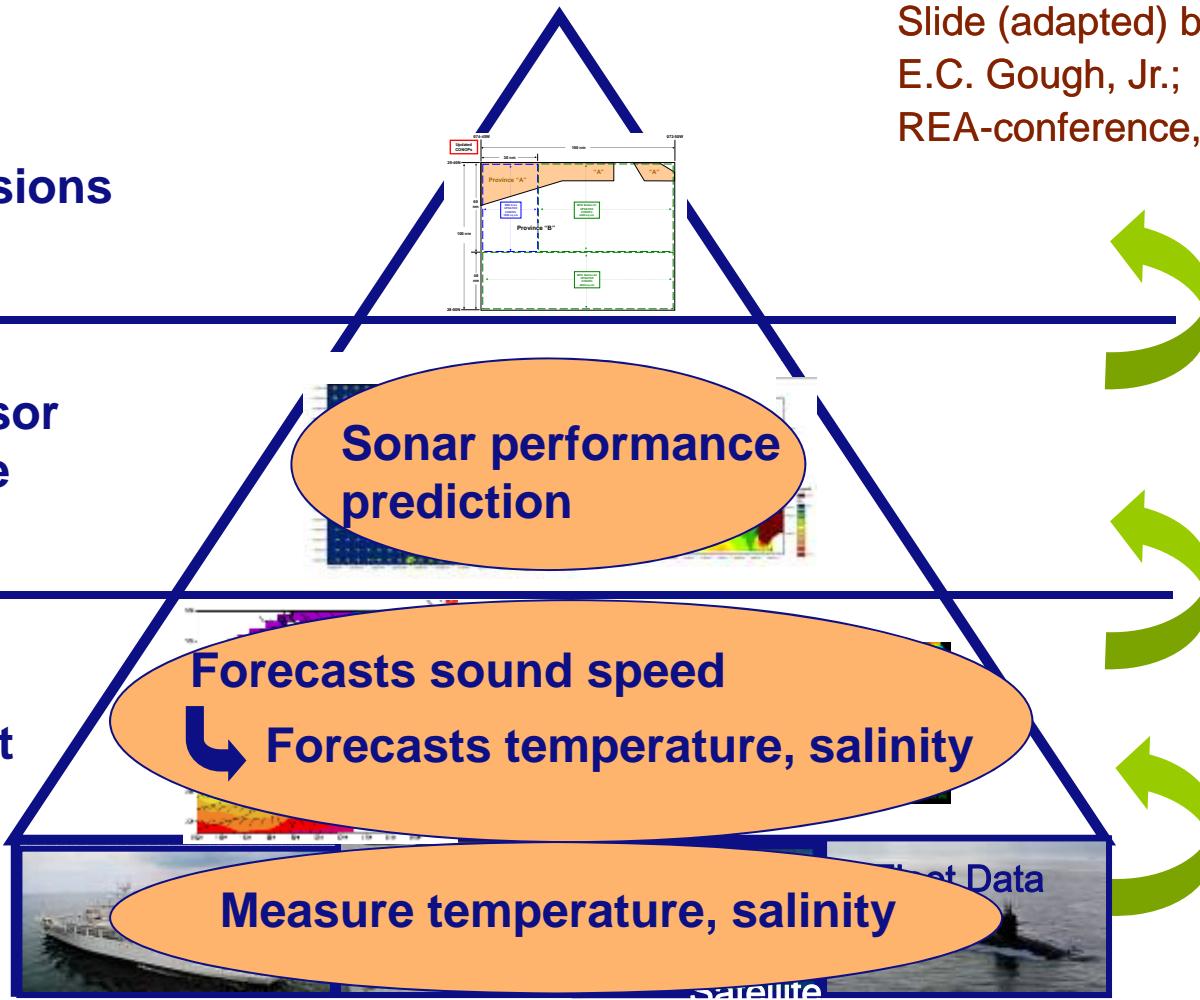
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Tier 3 – Decisions

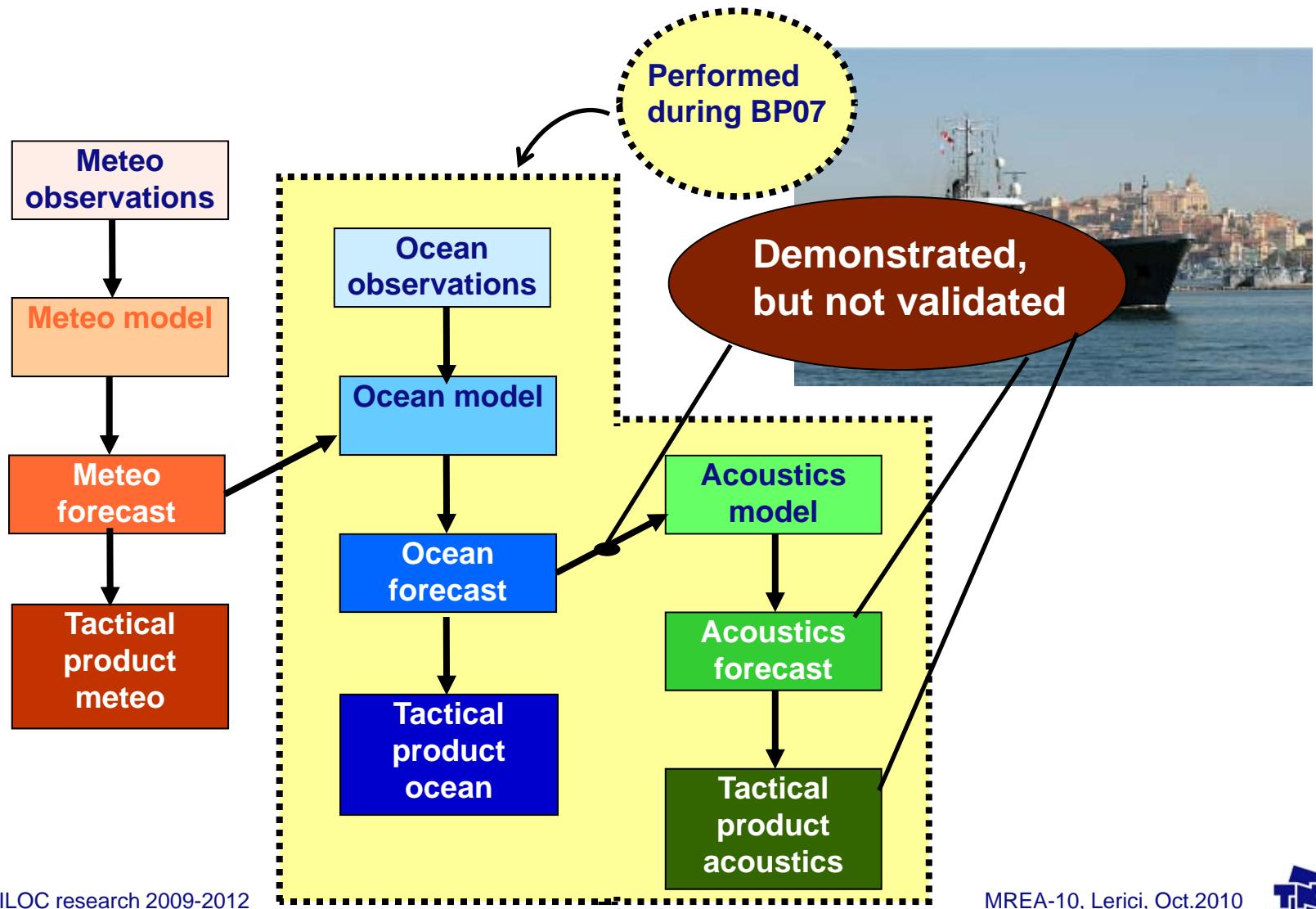
Tier 2 – Sensor Performance

Tier 1 – Environment

Basis – observations



Real-time delivery of tactical ocean and acoustic products on board HNLMS Snellius



Present research aim

- Explore added value of oceanographic modelling
 - Demonstrate relevance in time and space
 - Whatever relevant: show how to implement
- Applications
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Recent activities

- Operational need listed



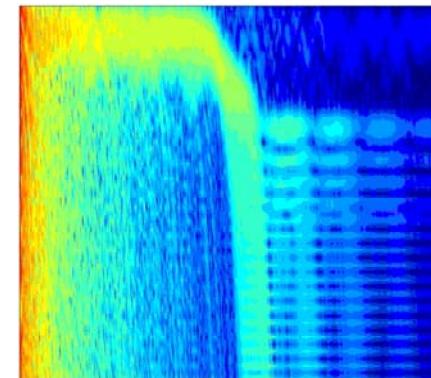
- 2009: Workshop with representatives of various navy departments
- Follow-up interviews with specialists
- Prioritized and reported



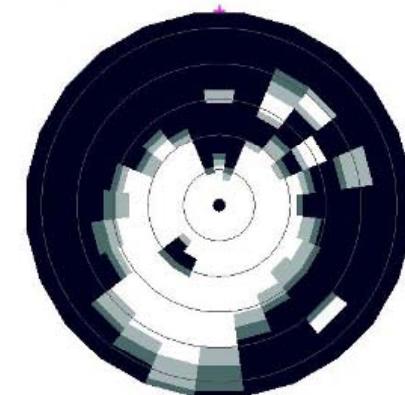
Explore relevant phenomena

- Showcase for most important generic oceanographic phenomena

- Fronts
- Eddies
- Internal waves and tides



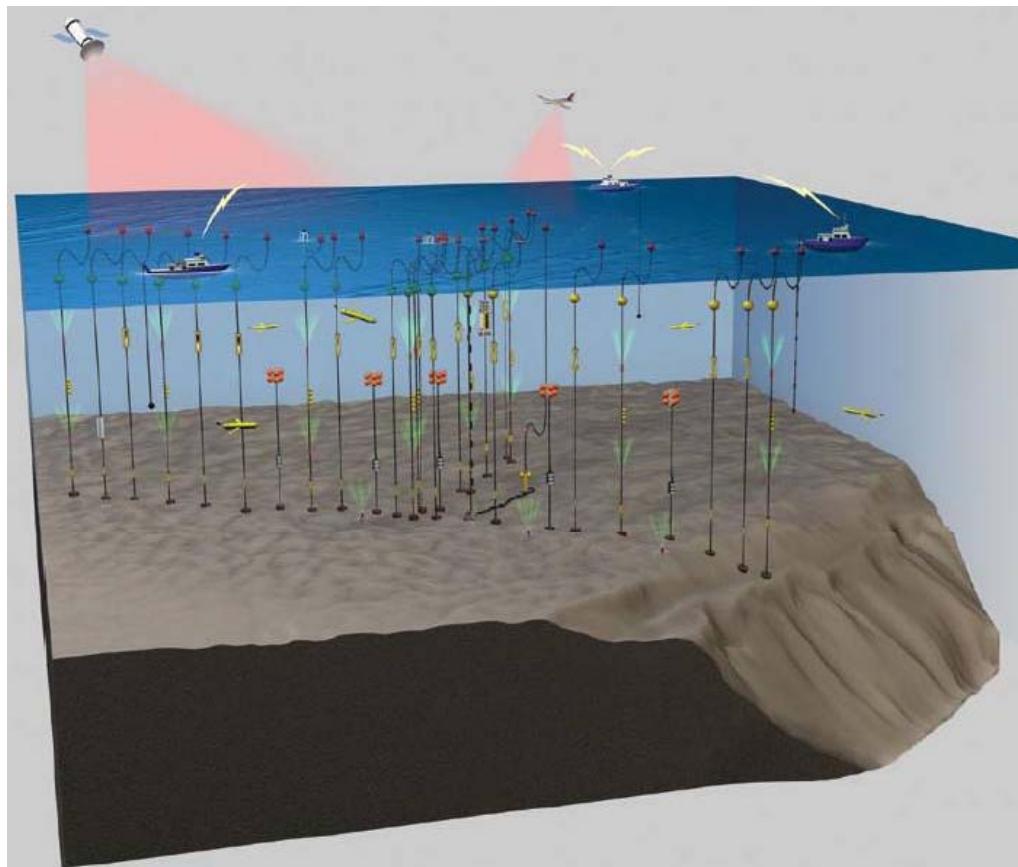
- Focusing on impact on sonar performance



Future plans

- Demonstrate modelling benefit with actual data/experiment
- Validate acoustics
- Looked for alternative of original plans REP-10
- SW-06 data (WHOI, oceanographic & acoustic data)
 - Explore added value of operational ocean forecast for sonar performance
 - Explore acoustic impact of modelling uncertainty
 - Using MSEAS modelling, with help of MIT

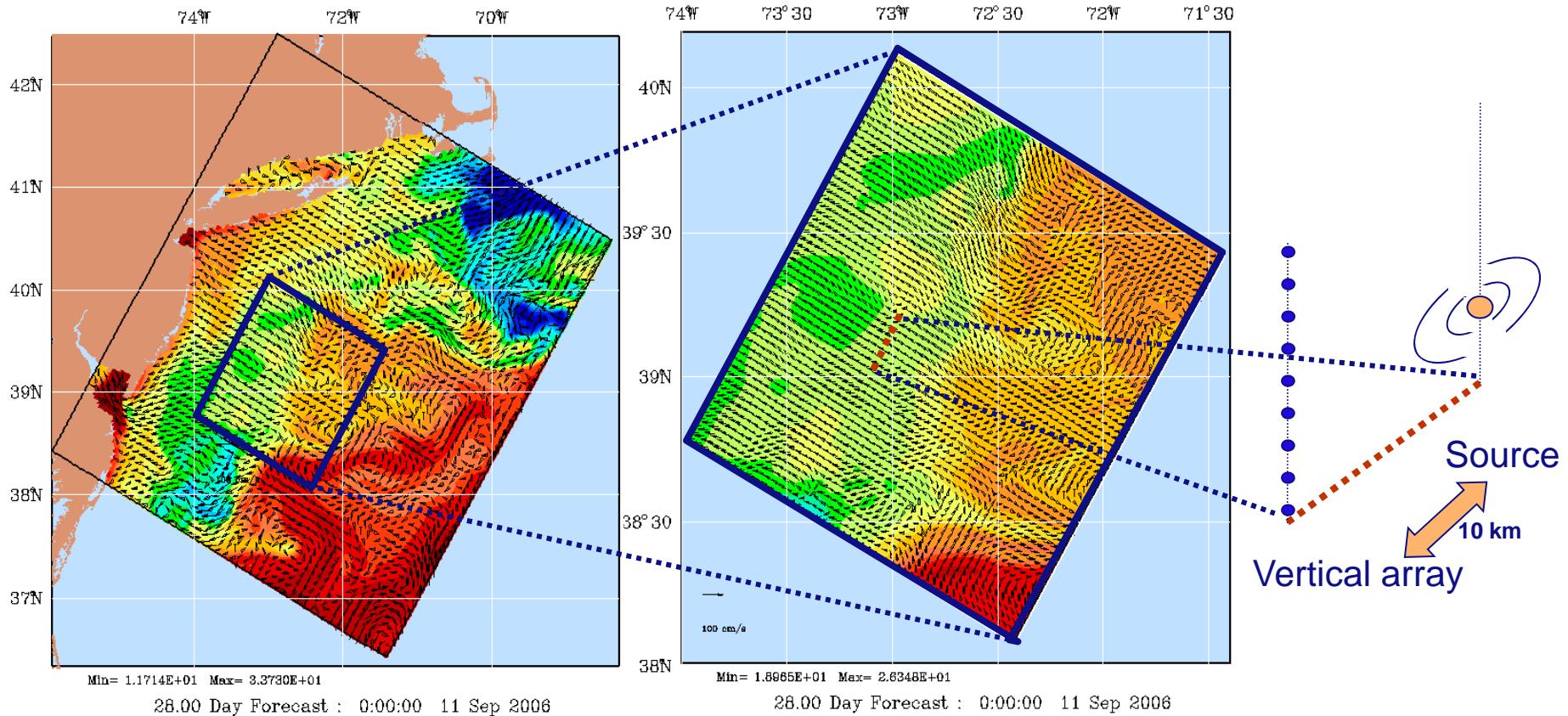
Shallow Water 2006 experiment (SW-06)



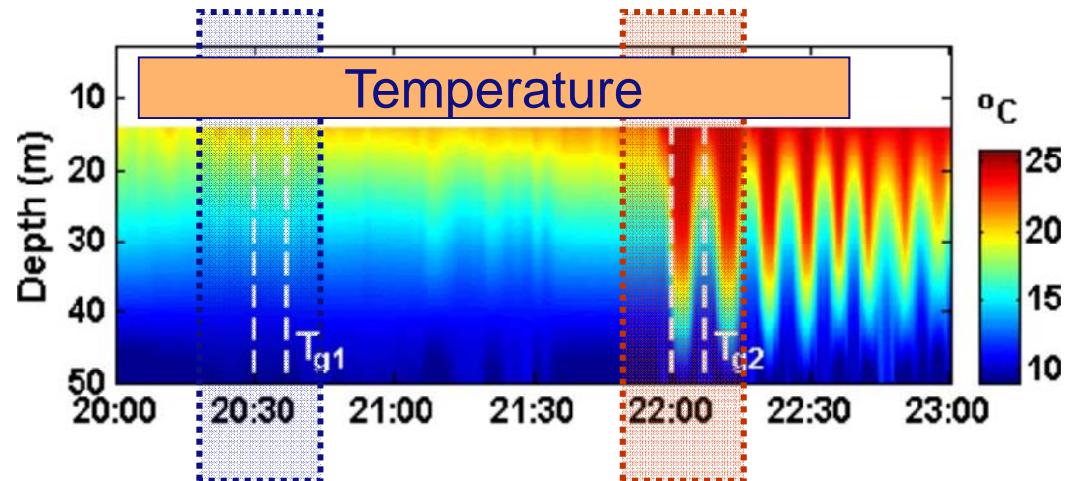
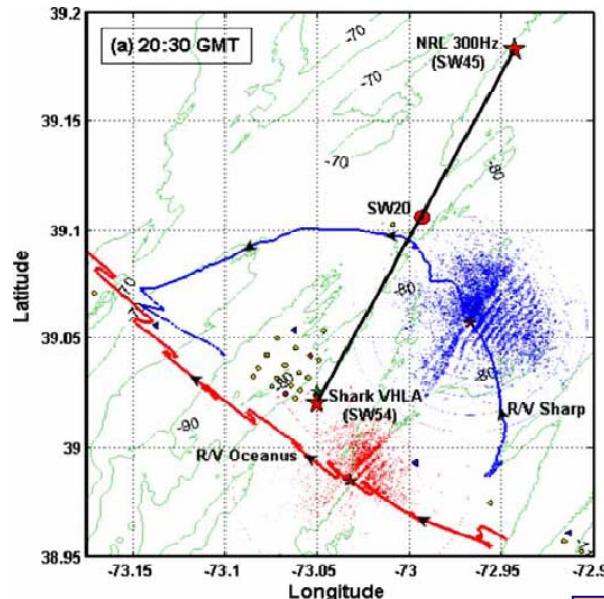
Tang et al. 2007

- Existing data set, many partners
- Explore operational use of model output
- Check strength/weakness of forecast
- Contribute to additional feature modelling (internal waves and tides)

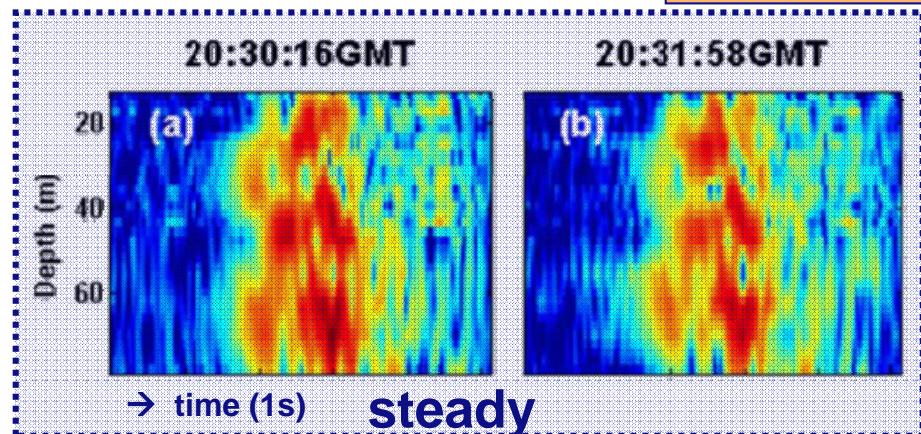
SW06 ocean forecasts MSEAS



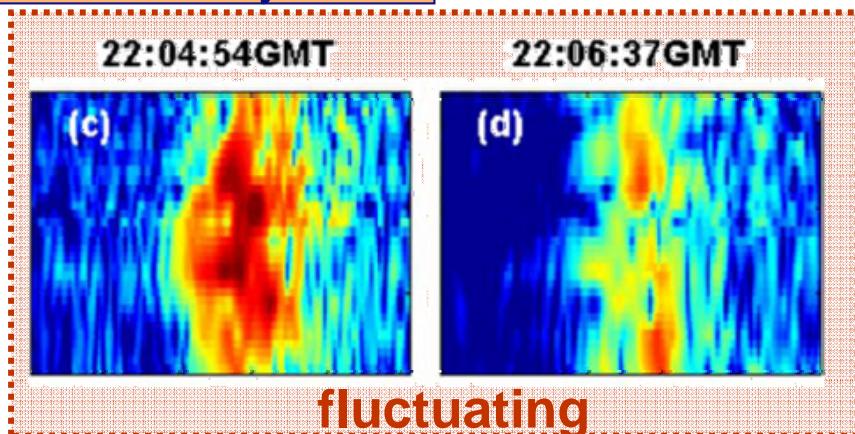
SW06 Acoustical observations – vertical array (300 Hz)



Acoustic intensity



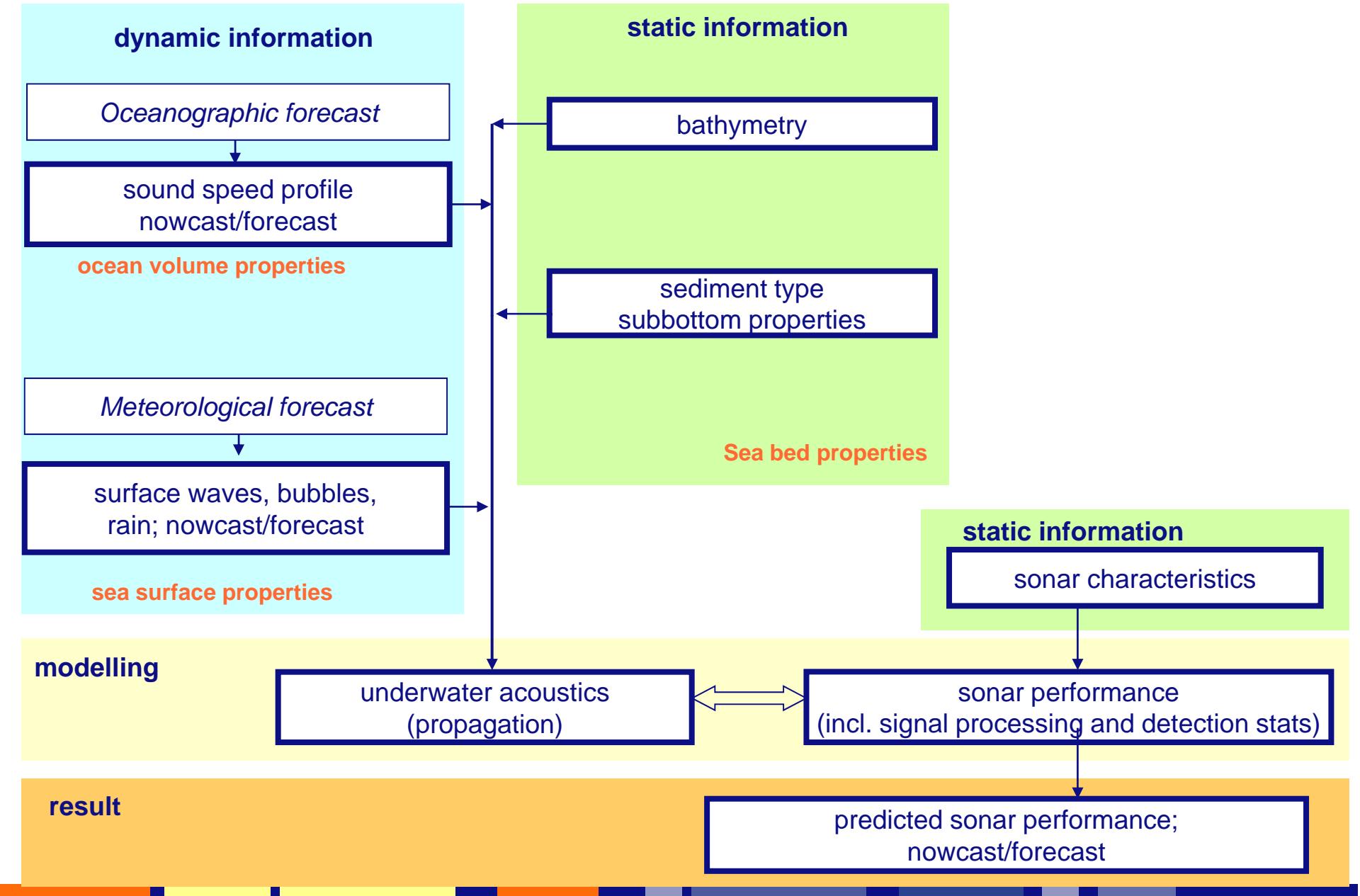
→ time (1s) steady



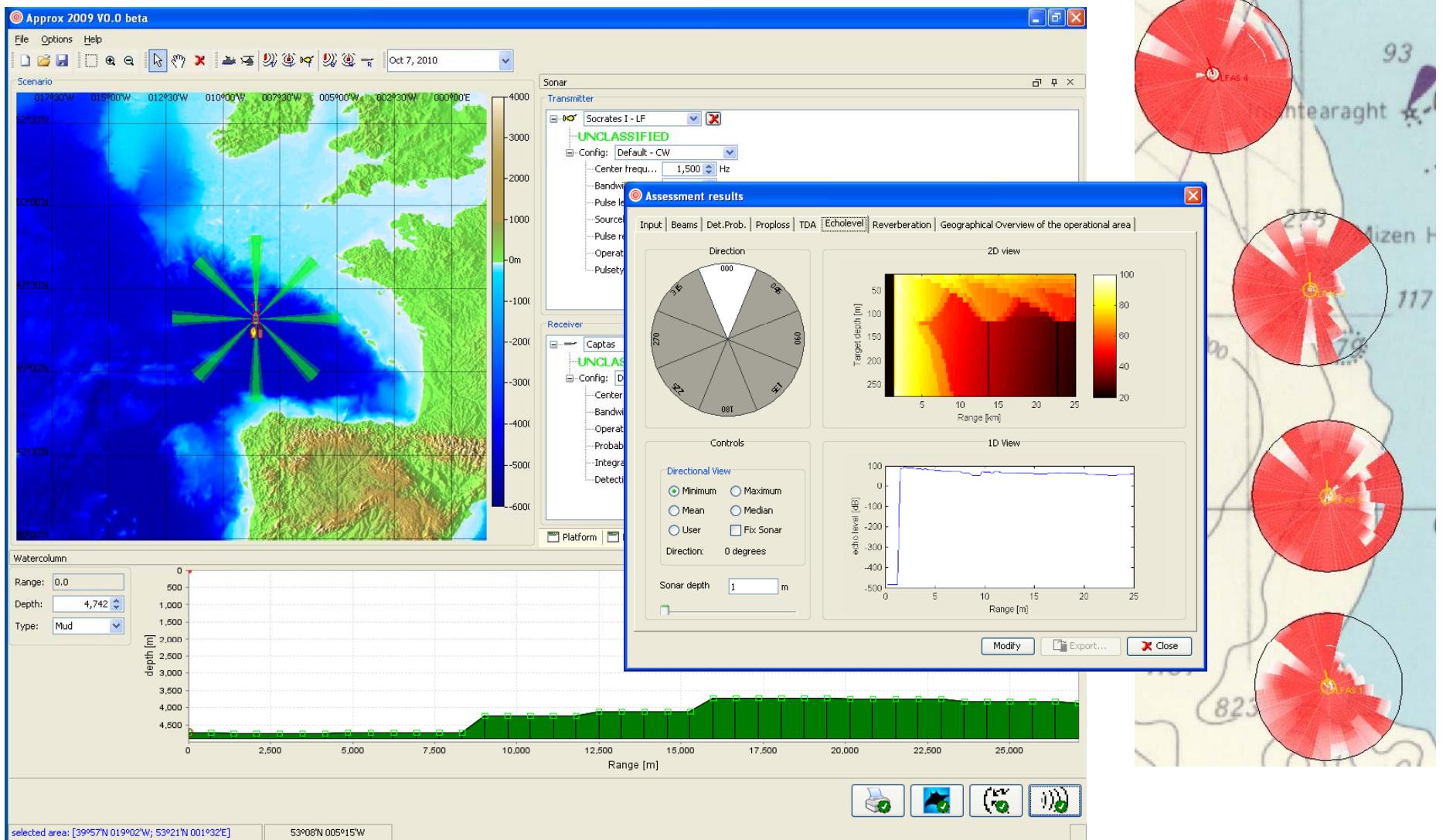
fluctuating

Luo et al. 2008: JASA 124 (3) Sound fluctuation due to internal waves

Integrated Sonar Performance Prediction



Integrated sonar performance



Our approach

- NL= small nation
- No strong ocean modelling history → collaborate
- Strong on acoustics and tidal modelling/phenomena
- Small, but compact organization
 - Research very close to operational use and feedback

We are on a mission . . .



Photo: PA van Walree