

CMRE's input to ONR Seabed Characterization Experiment 2016

Seabed characterization using hydrophone equipped gliders and active sources

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NATO – STO – CMRE

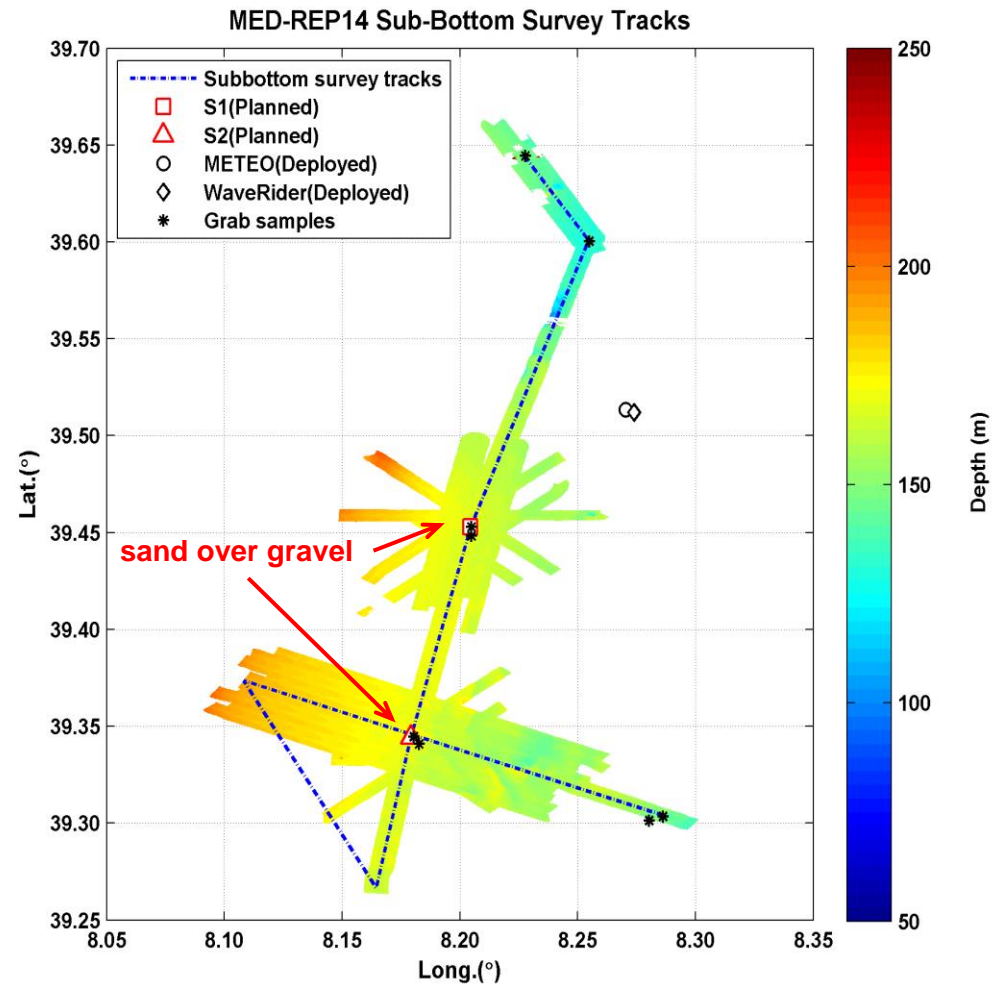
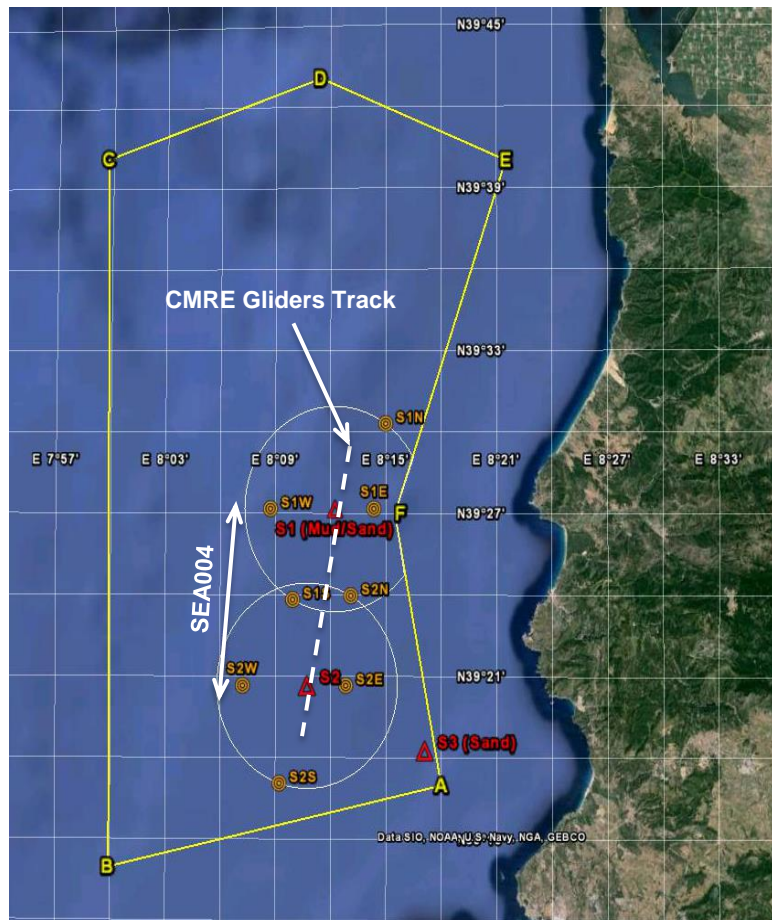
Viale San Bartolomeo 400, 19126, La Spezia, Italy

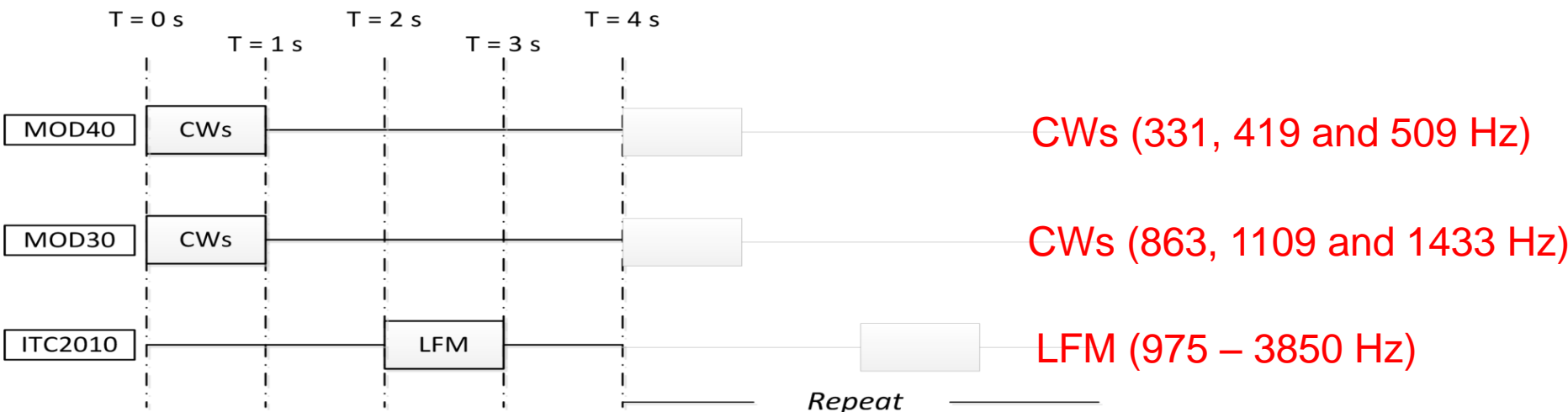
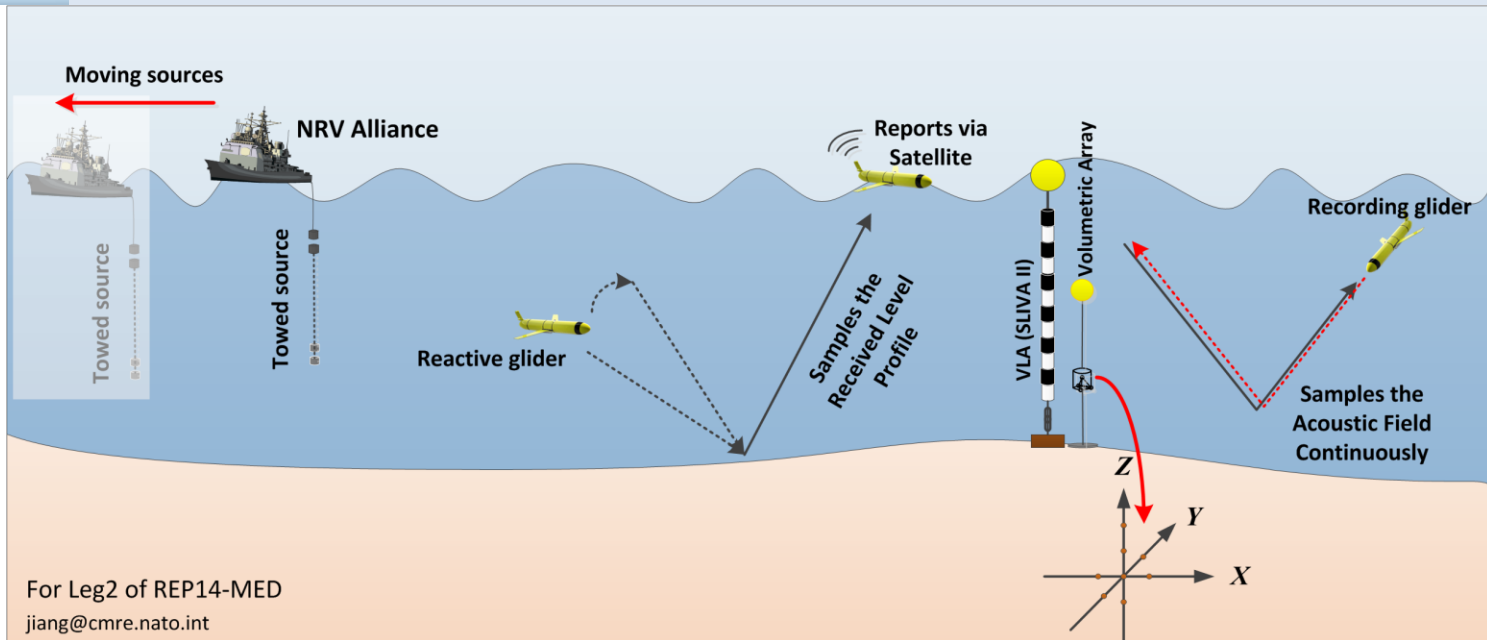
REP series:

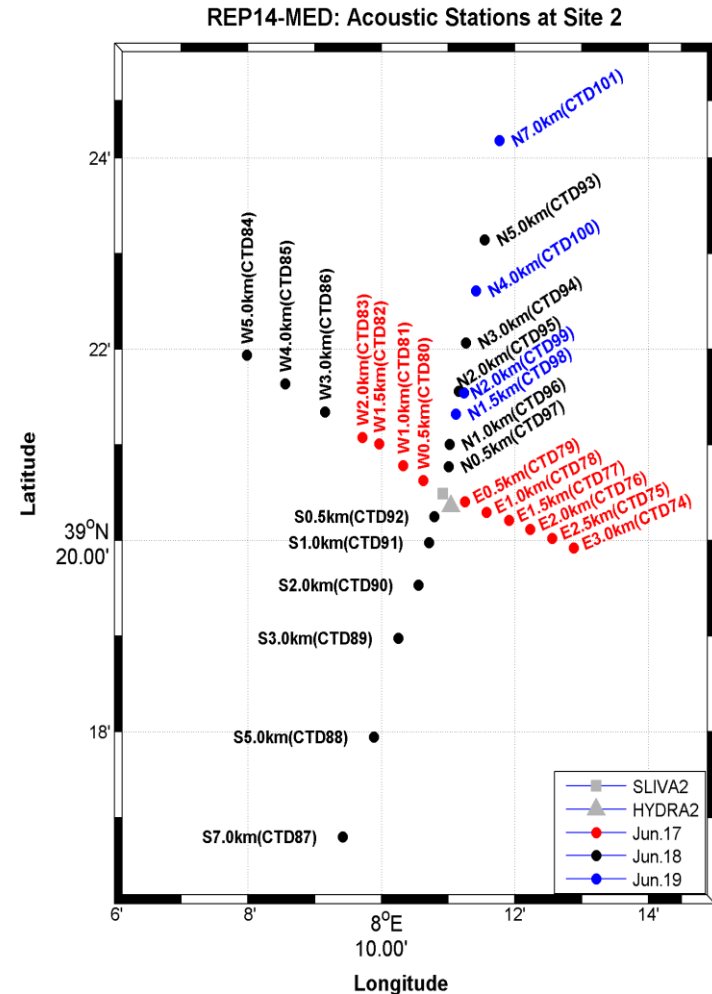
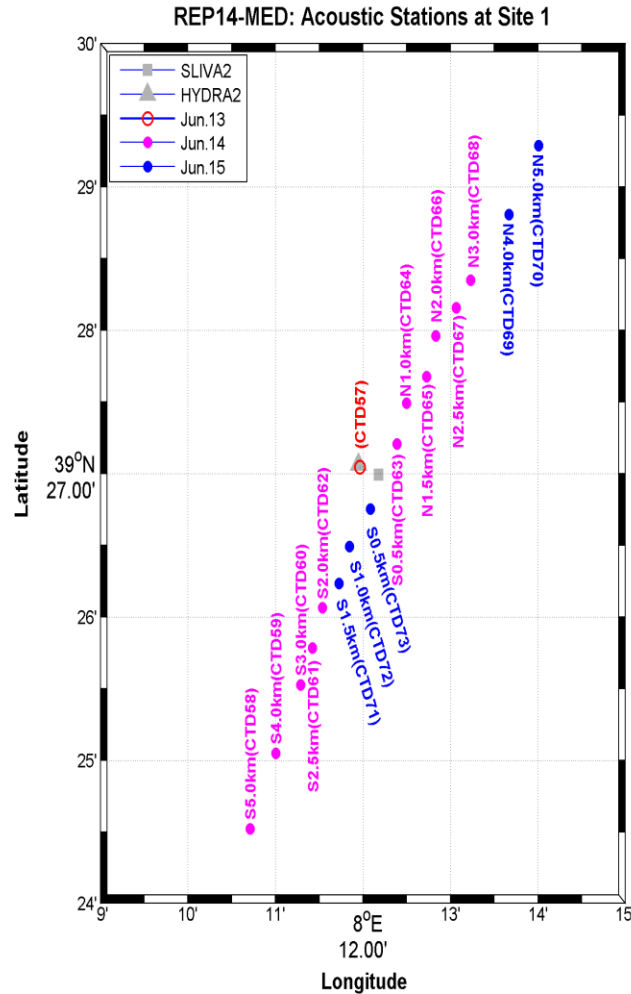
- **REP11:** Ocean environmental variation on acoustic signal fluctuations
 - Acoustic signals were collected by a 32 elements VLA
- **REP12(NOMR12):** Sonar performance validation (signal excess)
 - Acoustic signals were collected by a 32 elements VLA, a bottom moored tetrahedral array and a **hydrophone equipped glider**
- **REP13:** Acoustic evaluation of a heterogeneous data collection asset-network
 - Acoustic signals were collected by a 32 elements VLA **and hydrophone equipped glider (with reactive behavior)**
- **REP14:** **a) Bottom characterization using man-made and naturally occurring ambient noise, and b) In-situ acoustic received level measurements with glider based reactive behavior**
 - Acoustic signals were collected by two 32 elements VLAs, one 8-element VLA, one 8-element compact volumetric array, **two hydrophone equipped gliders (with reactive behavior)**
 - In an inhomogeneous area (bottom layer structure)

GLASS: 2012 and 2013, Peter Nielsen

12 June to 21 June, 2014 (including transit and port call)

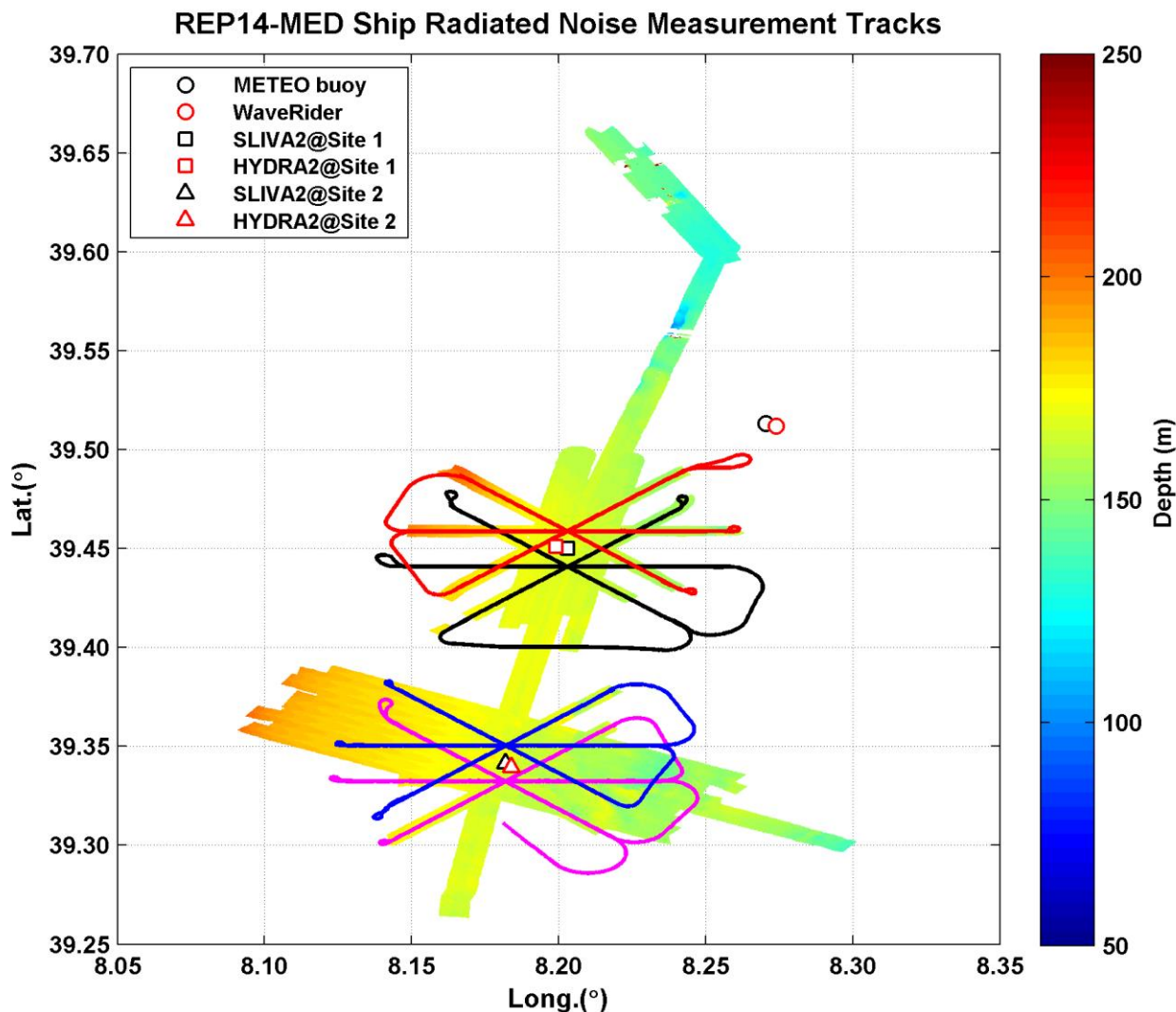


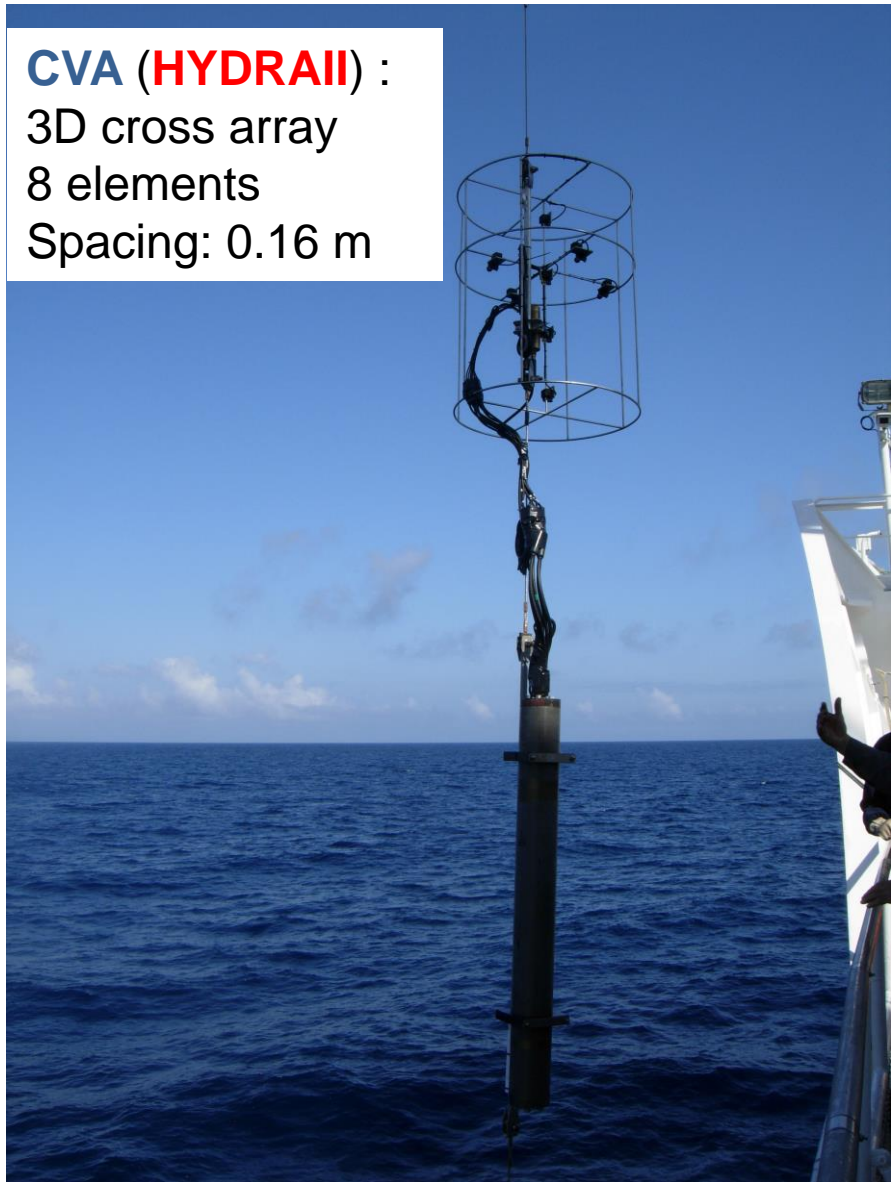




Total 44 acoustic stations and 45 CTDs

**Total 12 high speed
(12 knots) tracks
and 12 low speed
(6 knots) tracks**

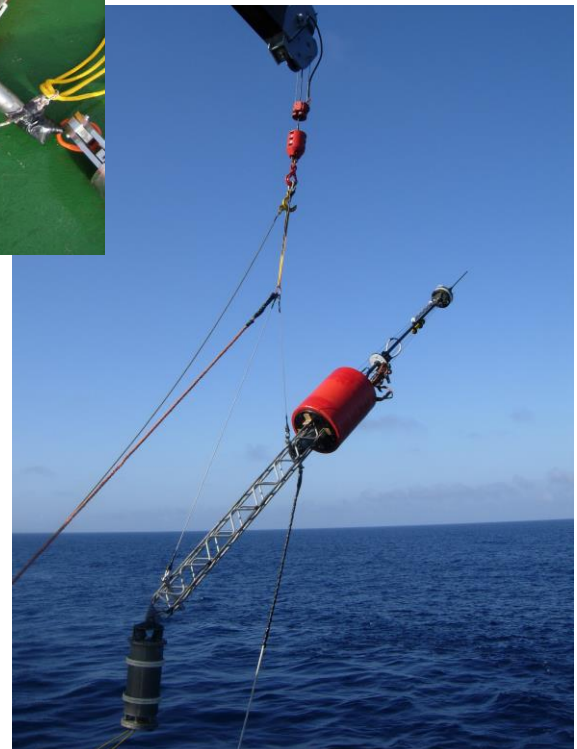




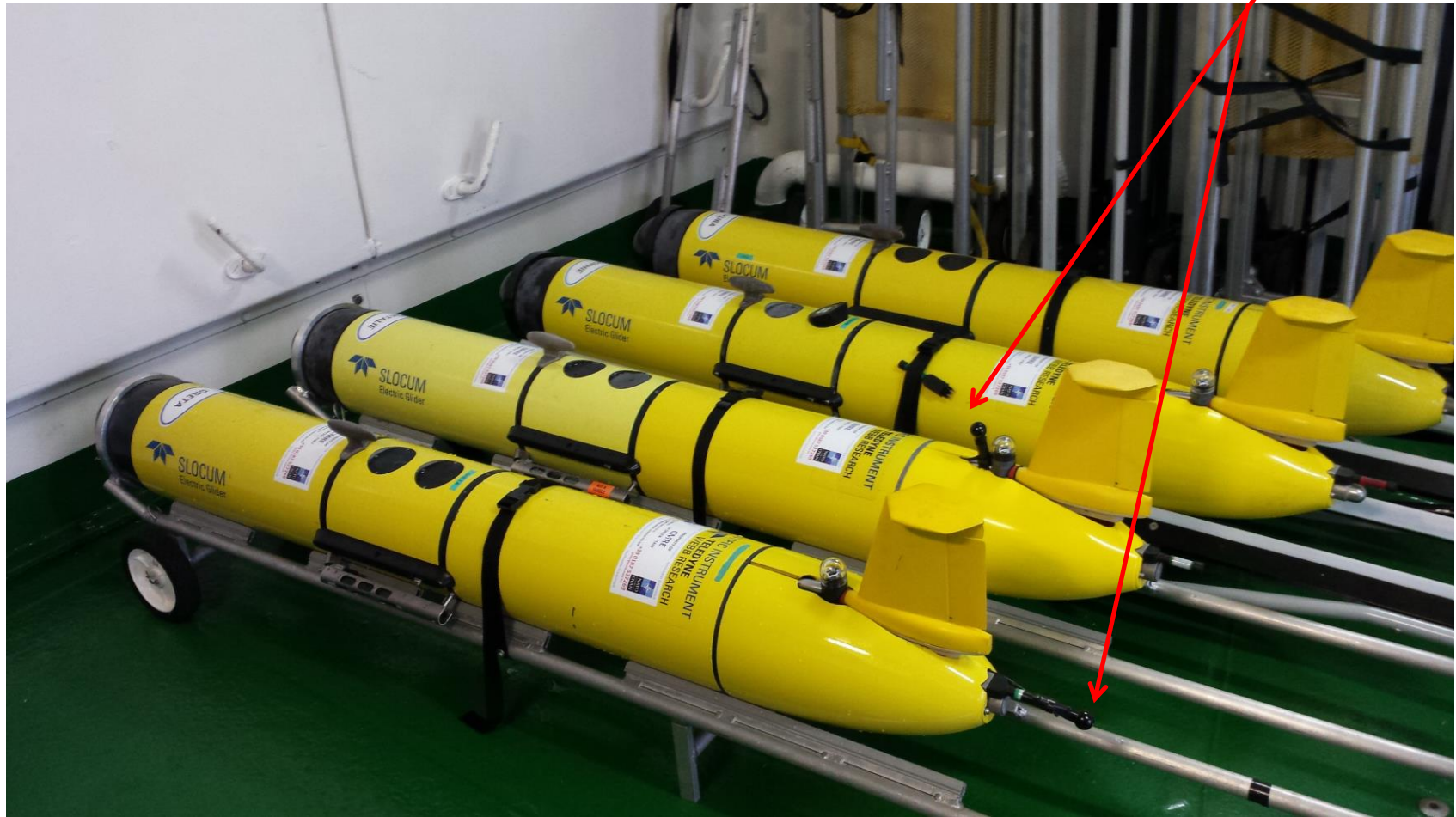
CVA (HYDRAII) :
3D cross array
8 elements
Spacing: 0.16 m



VLA (SLIVAI) :
Reference array
32 elements
46.5 m long
Spacing: 1.5 m

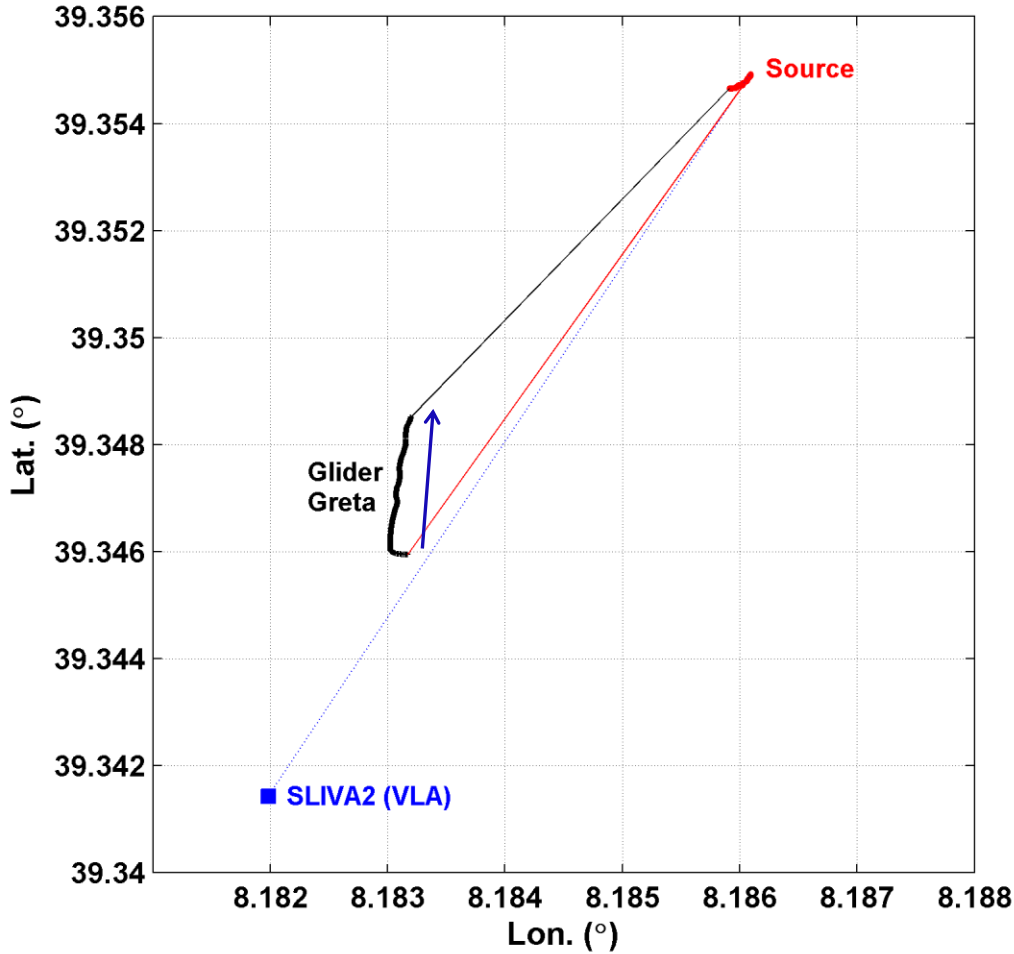


Hydrophones

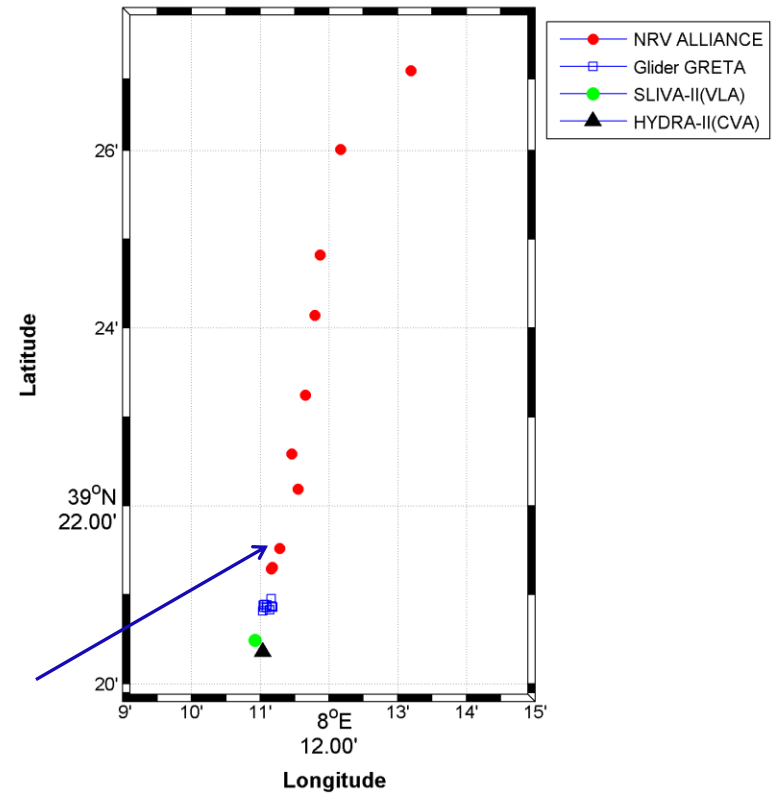


CMRE
(with reactive behavior)

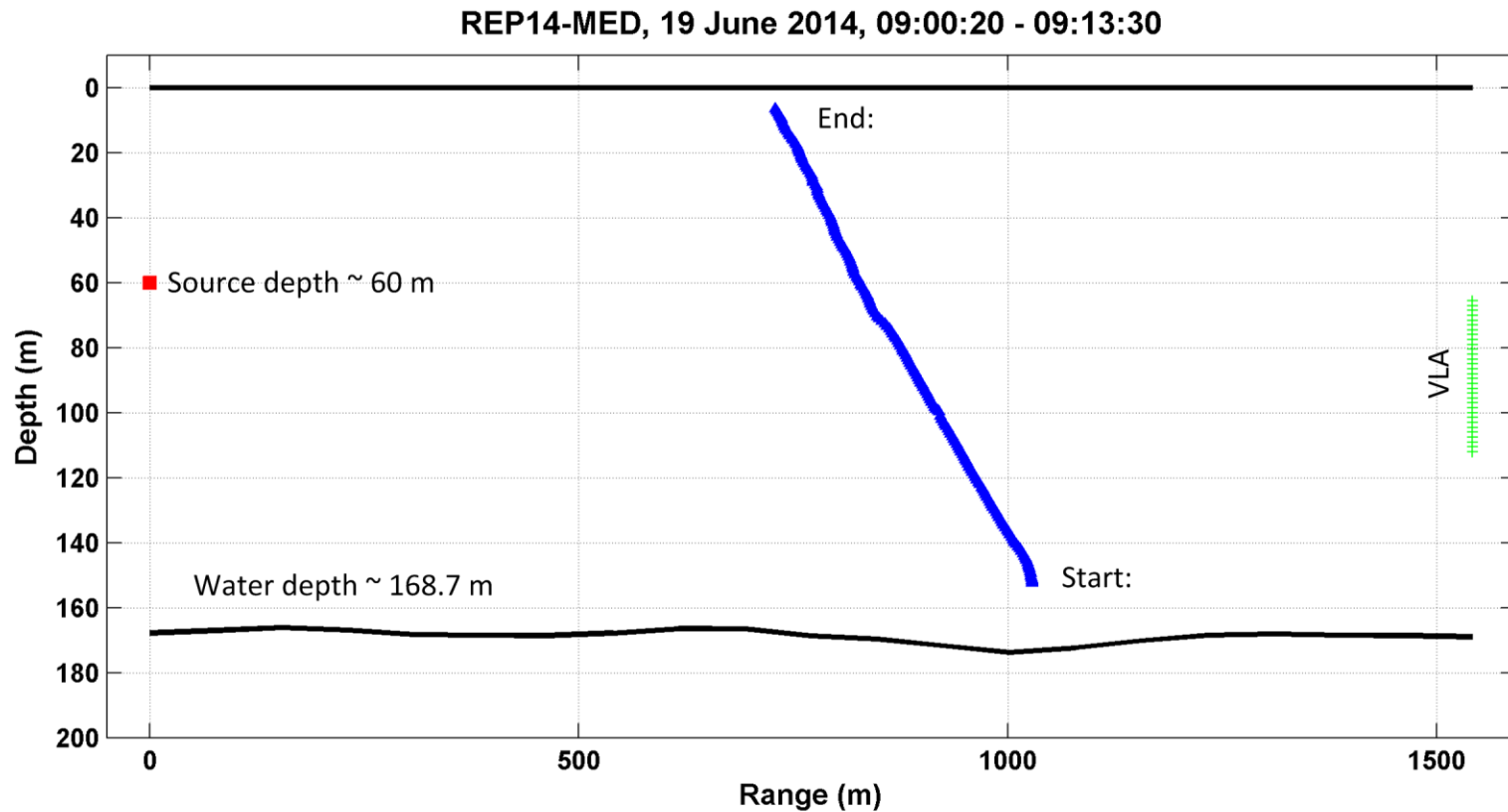
2014/06/19, 09:00:20.0-09:13:29.3



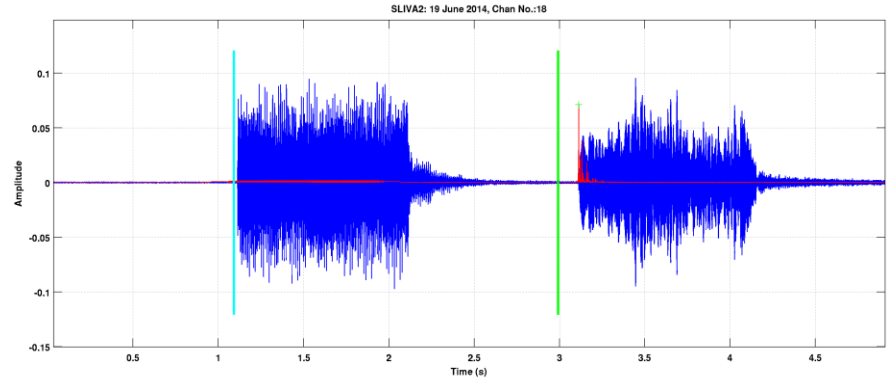
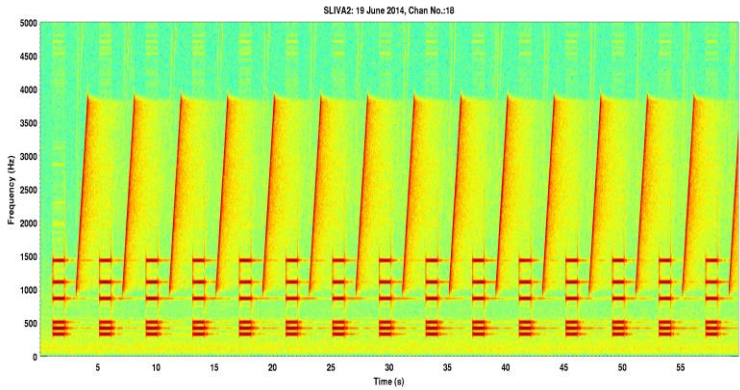
Glider Acoustic Reactive Experiment on June 19, 2014



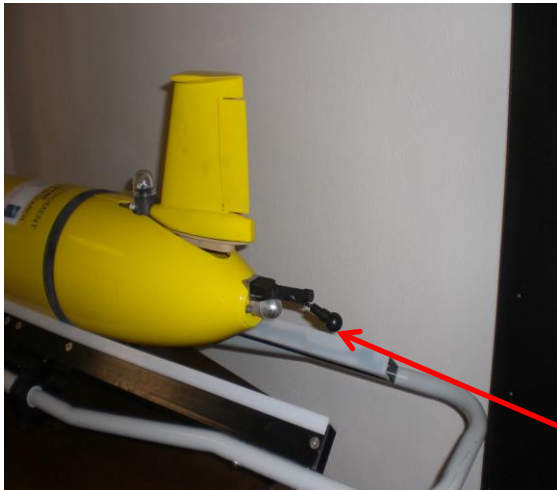
The experimental geometry:



VLA data:

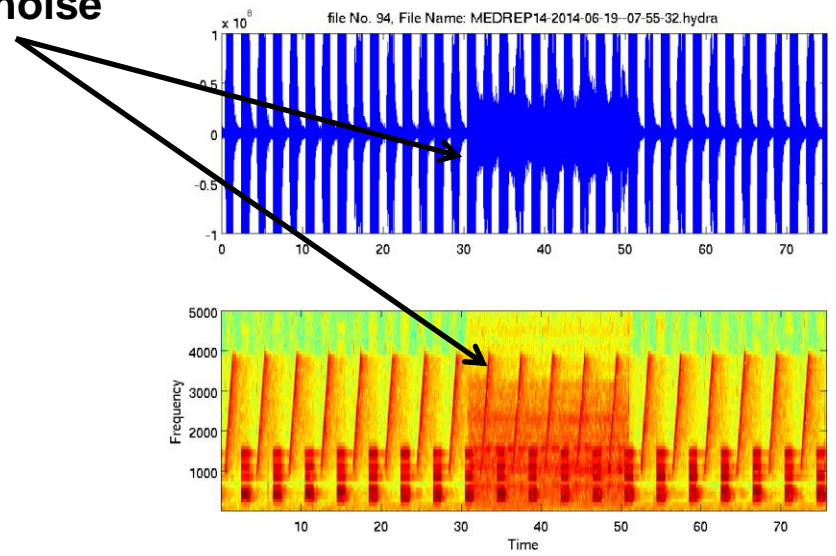


Glider data:

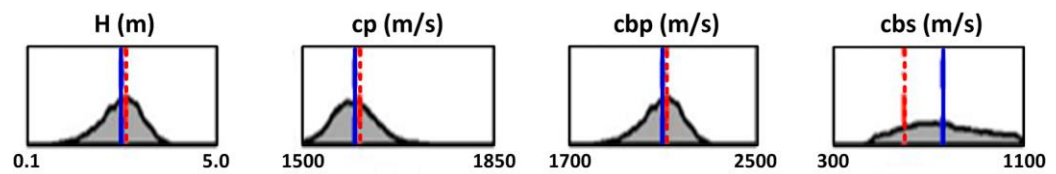


Hydrophone

Glider noise

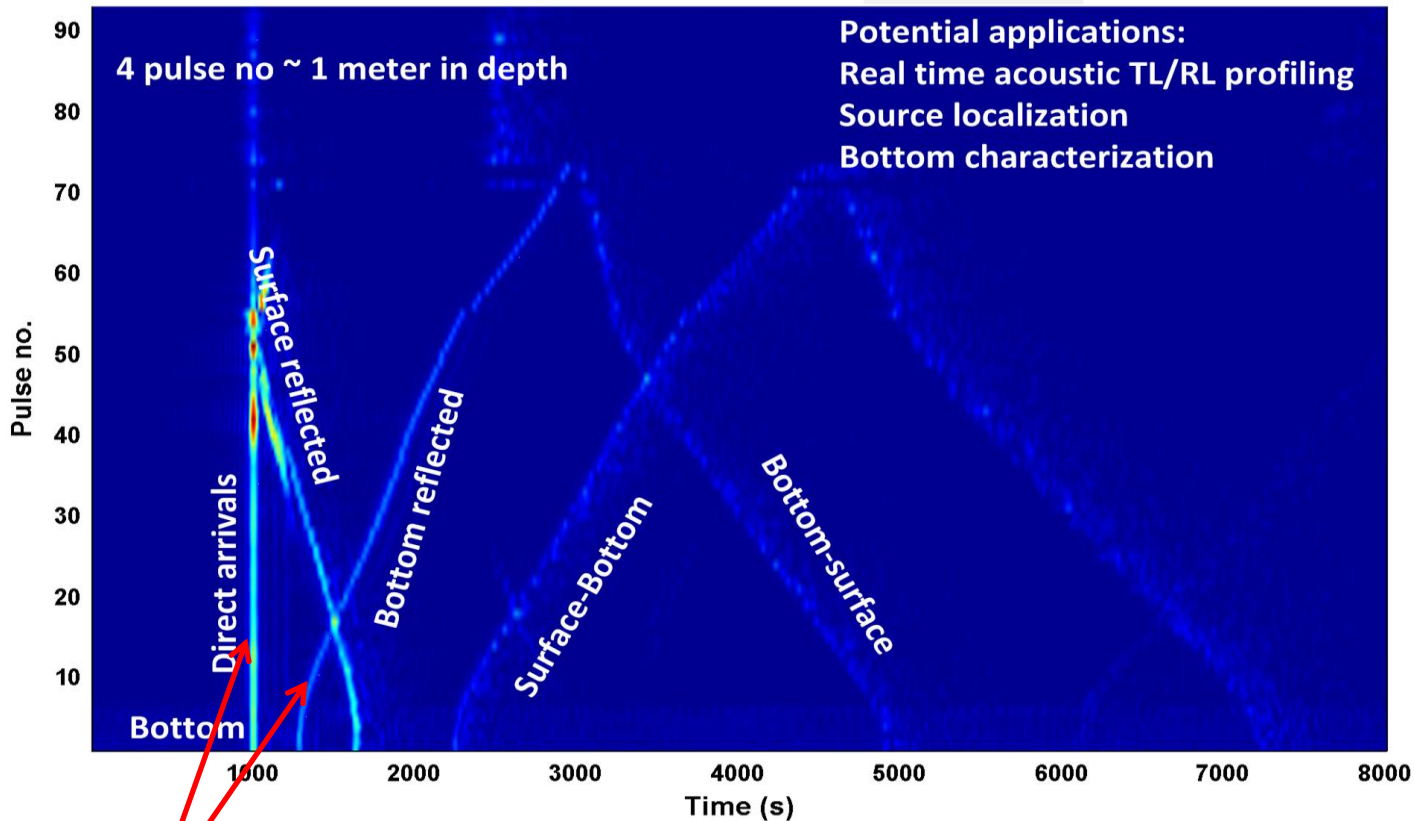


- Preliminary results (sensitive parameters only)
 - ❖ There is sensitivity in the shear wave speed of the half space
 - ❖ p-wave speed of the half-space seems to be higher than expected



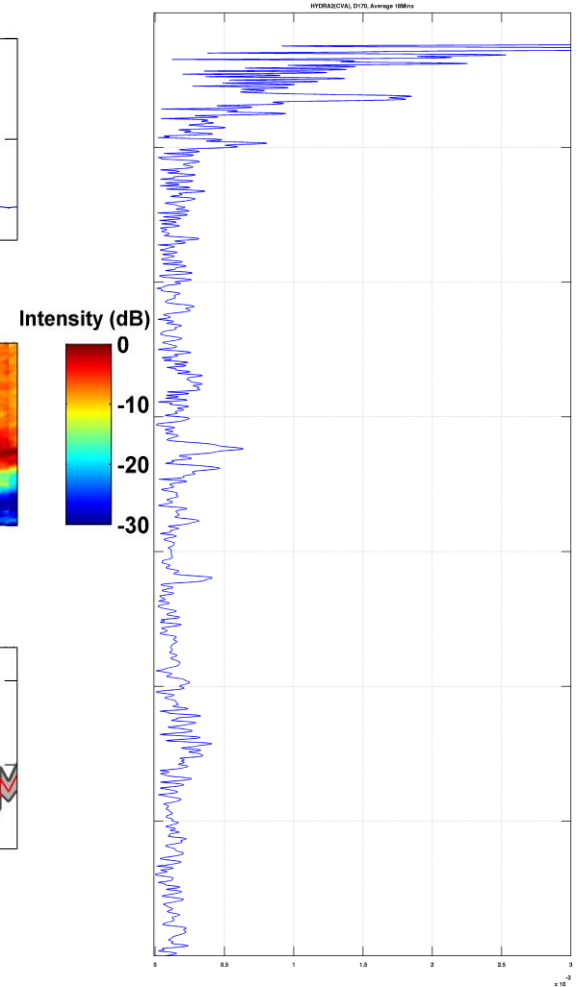
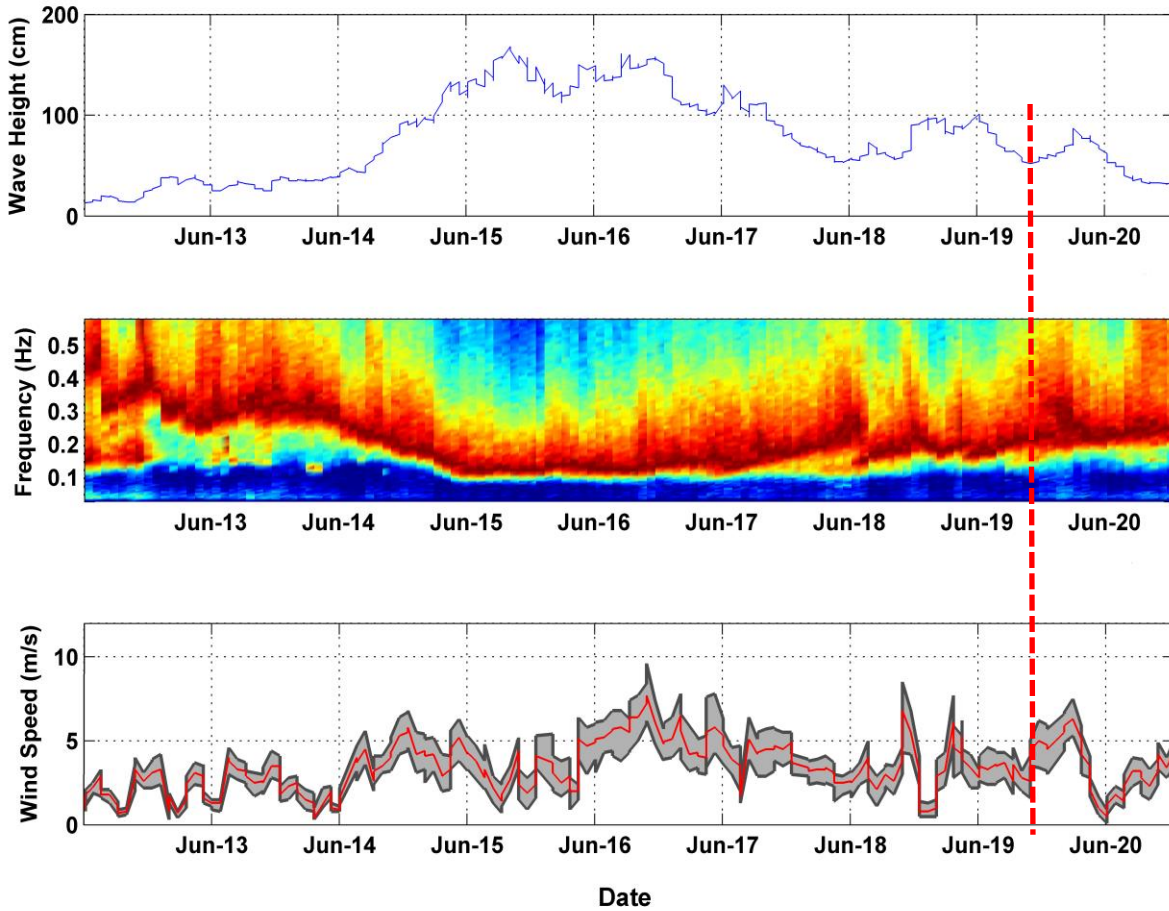
Grey area: 1-D marginal distribution from VLA data, **Blue line**: maximum a posteriori
Red dotted line: optimization results from glider data

MED-REP14 ET, 23 April 2014



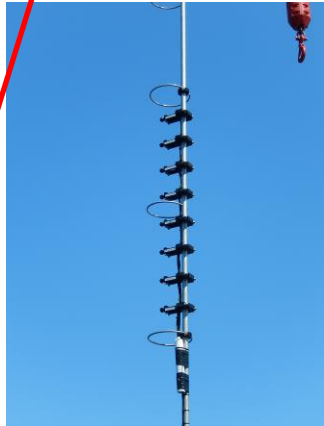
‘Wide angle’ reflection coefficient can be retrieved

REP14-MED Significant Wave Height and Wind Speed



- *Glider 'network'*
- *Bottom characterization: arrays on glider, with active sources/ambient noise*

Tested in REP14-MED

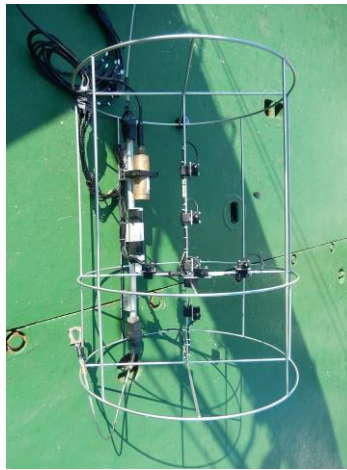


(8-element VLA)

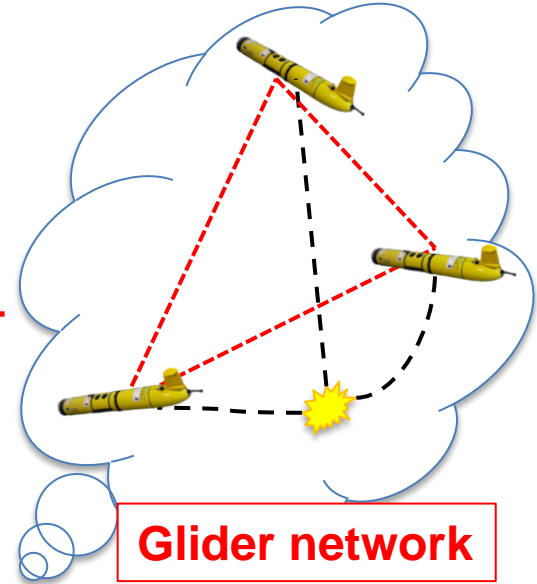


Glider equipped with **One** hydrophone

- CVS - 'Vector' sensor concept
- Complementary to GI using naturally occurring noise approach
 - Use ship noise / active sources
 - Smaller in size
 - 'super directionality'

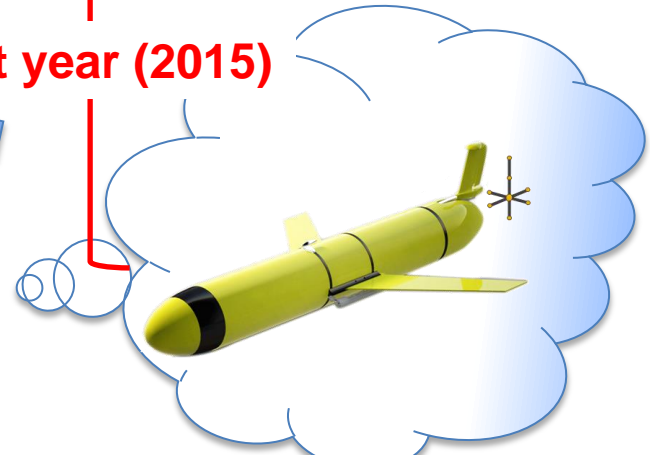


Compact **Volumetric Array** (8 sensors ~ 'vector' sensor)



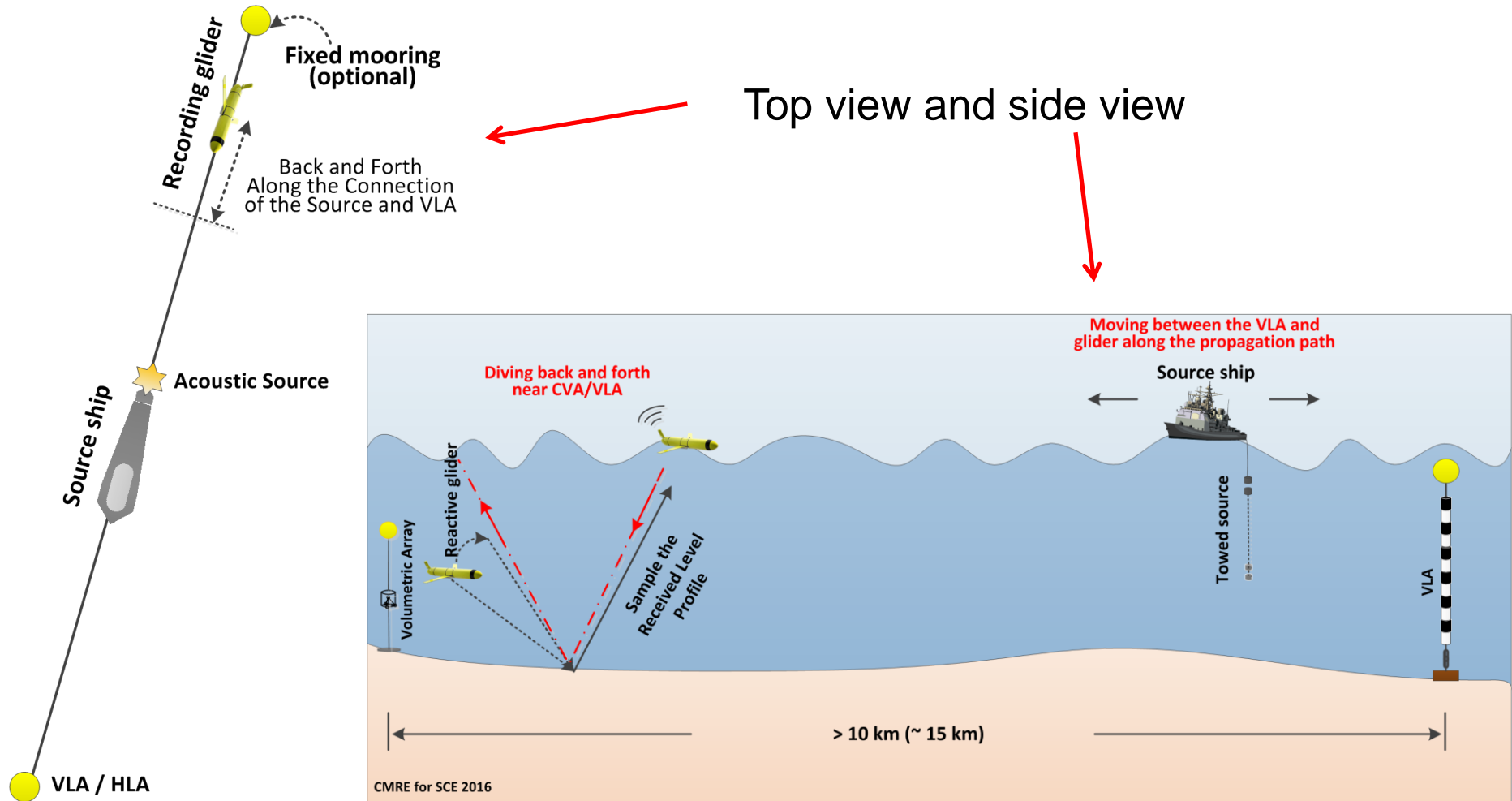
Glider network

Next year (2015)

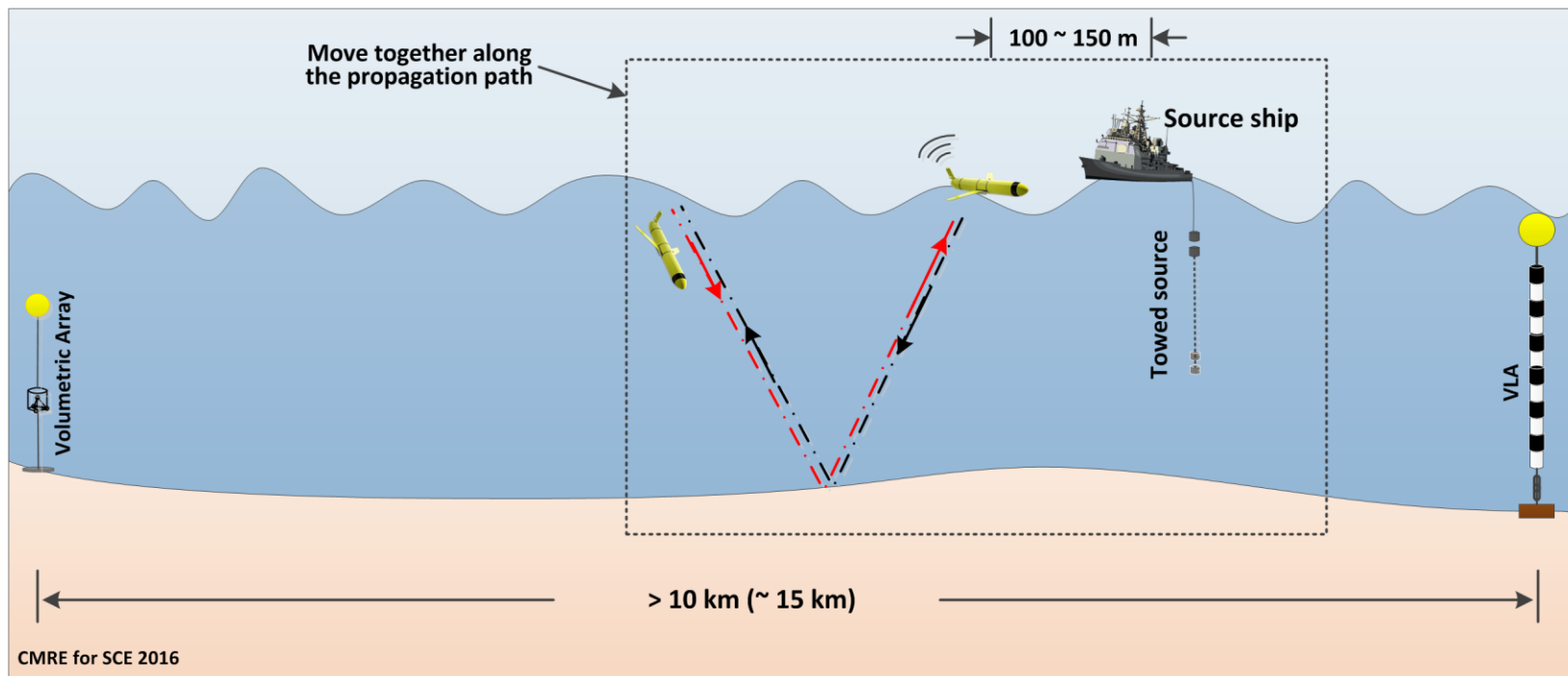


Glider equipped with **CVA and VLA**

- *Longer range: cross check the inversion results at both ends*



- *Wide angle reflection coefficient measurements with mobile platforms*
 - *What do we do with local information?*
 - *Does the local information add value to long range propagation?*



- *CMRE has stuff...however it's hard to ship them over (maintain and deploy)*
 - *For example: 32 elements , 46.5 m long VLA with radio buoy*
- *But, we have:*
 - *Bottom moored HYDRA systems (suitable for deep water deployments, **at least two people**)*
 - *4 elements tetrahedral structure*
 - *8 elements compact volumetric array (array spacing variable)*
 - *8 elements vertical line array (Peter Nielsen, array spacing variable)*
 - *Hydrophone equipped underwater glider(**at least two people**)*
 - *With reactive behavior*
 - *Can sample the acoustic field and CTD at the same time*
 - *Arrays on gliders (8-element compact volumetric and vertical arrays) to be tested in 2015*