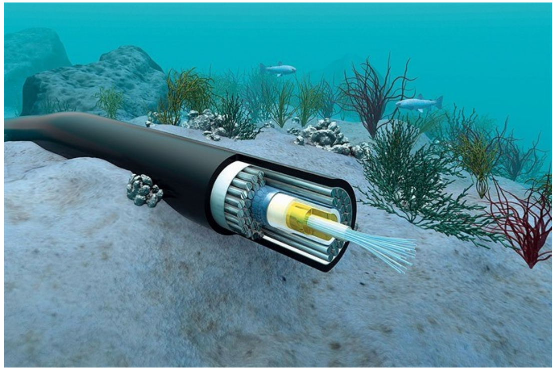
Relocation of underwater optic fiber cable with DAS technology



PhD Lucas Papotto

Supervisor Géoazur : D. Rivet, J-P Ampuero (HDR)

Supervisor Thales : B. de Cacqueray

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Problematic and goals

- Problem : Deployment of the cable → only ship location is known. Cable can drift up to hundreds of meters from the boat’s position.

- Propose a method to relocate the deep water cable using narrowband ship noise

Proposed method

Analytical model : Reproduce the passage of the ship near the fiber

- AIS data (Long/Lat)
- Bathymetry
- Prior location of the cable
- DAS data
- Beamforming (Delay and Sum method adapted to 2D antennas)

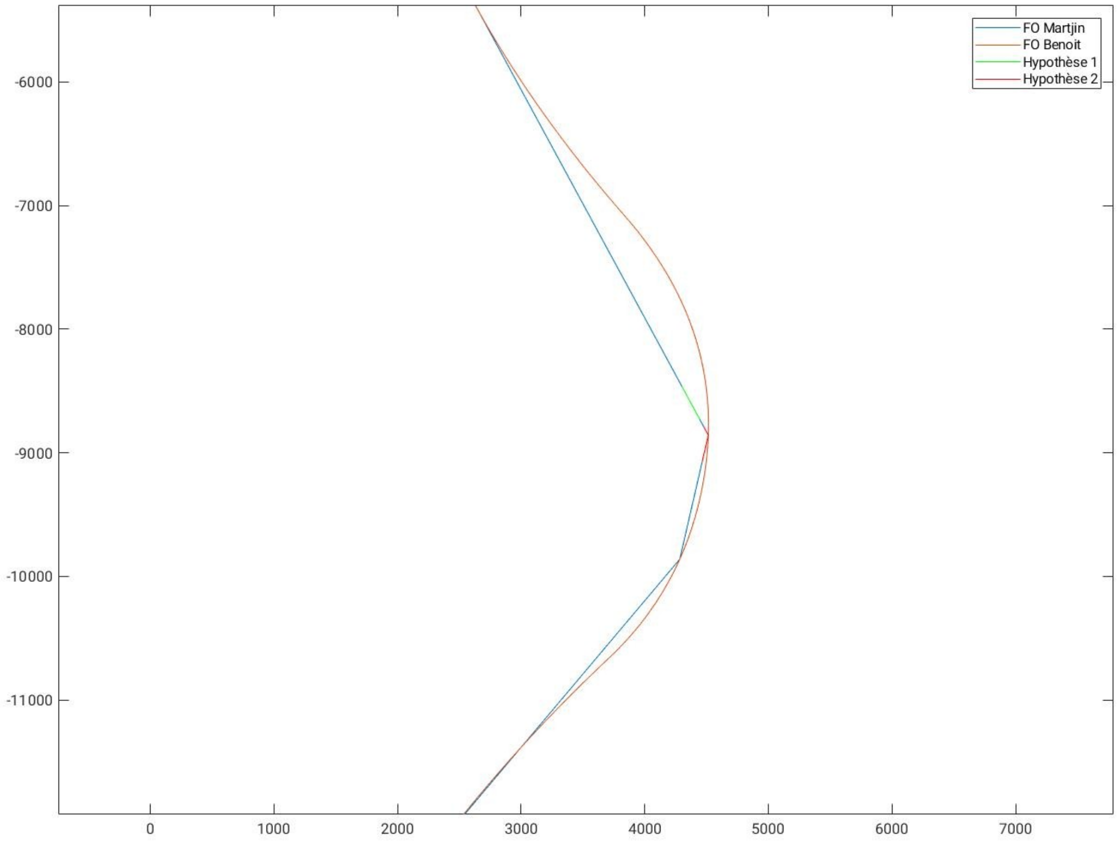
Compare the real and synthetic data to relocate the cable

Recalibration of the sensors of the cable

Ensure that the section interrogated is accurately determined

Various possibilities to shift the calibration of the sensors

List indicating the offset to be applied to a particular section



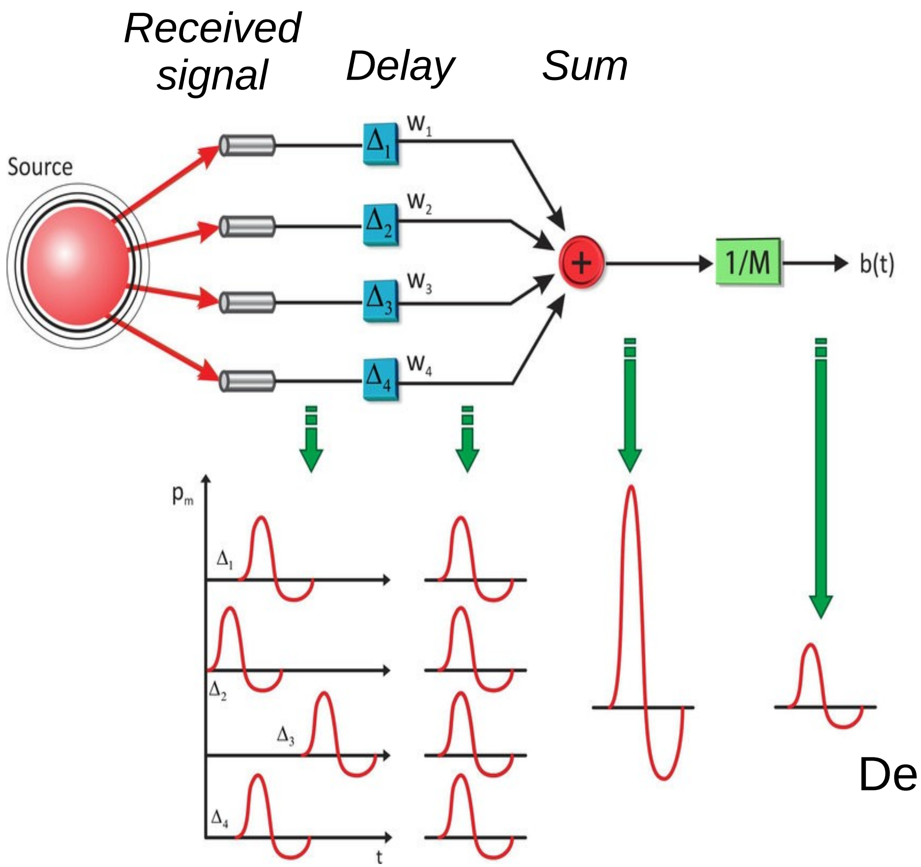
Geometry of the cable : 2 data sets show various geometries

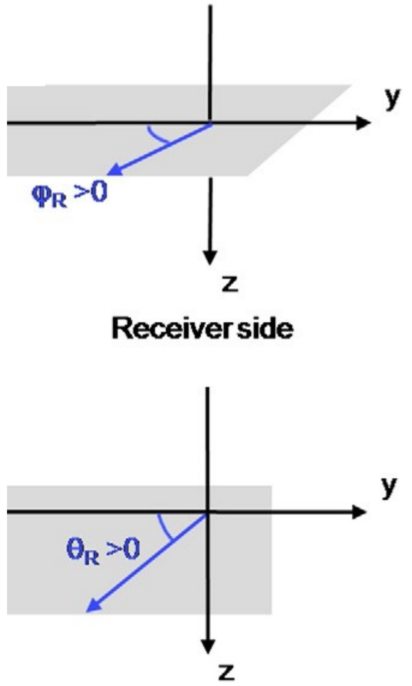
Beamforming

Delay and Sum method of beamforming

Adapted to 2D antennas

1D → pseudo bearing to be determined
2D → Azimuth and bearing



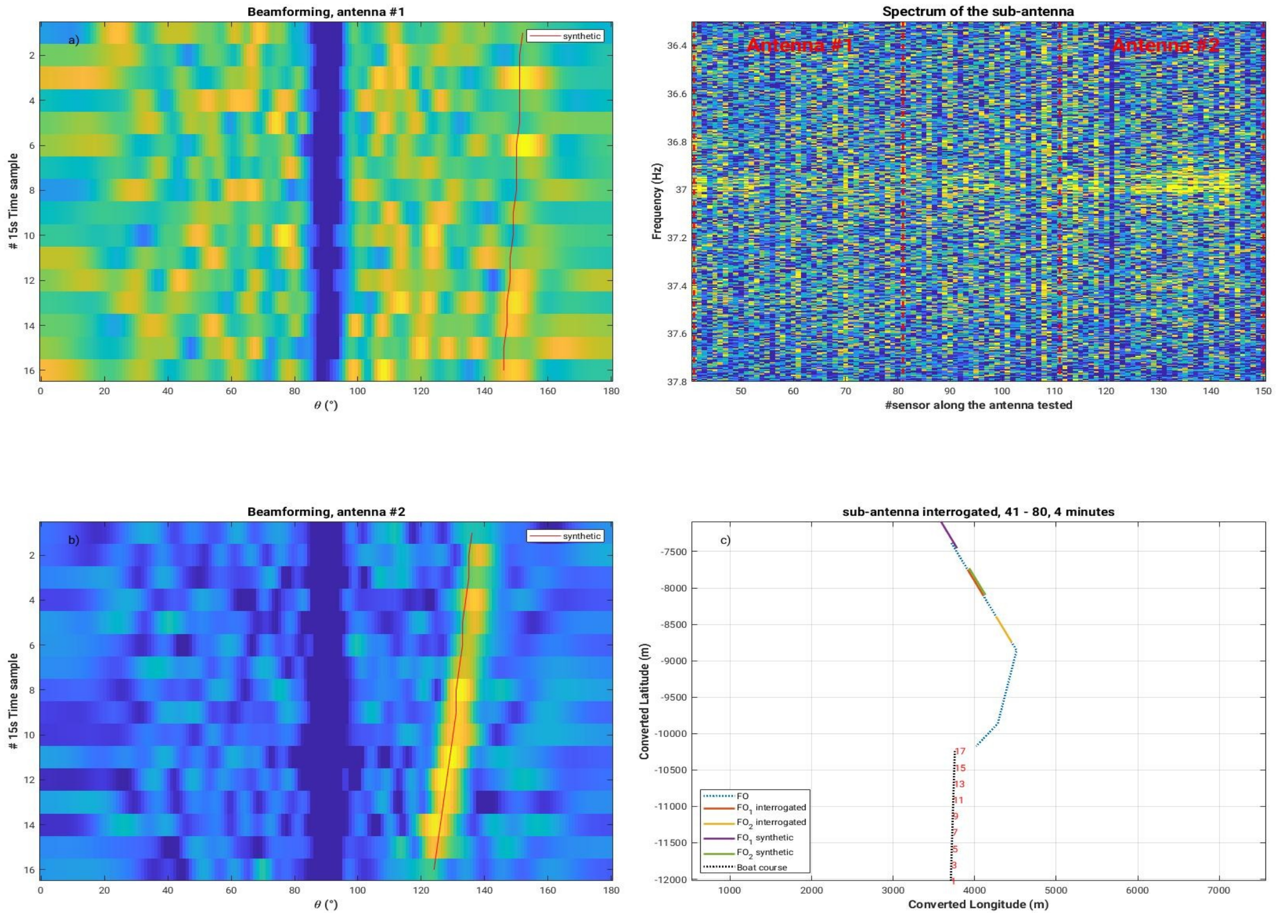


De Cacqueray et al. 2011

Recalibration of the sensors of the cable

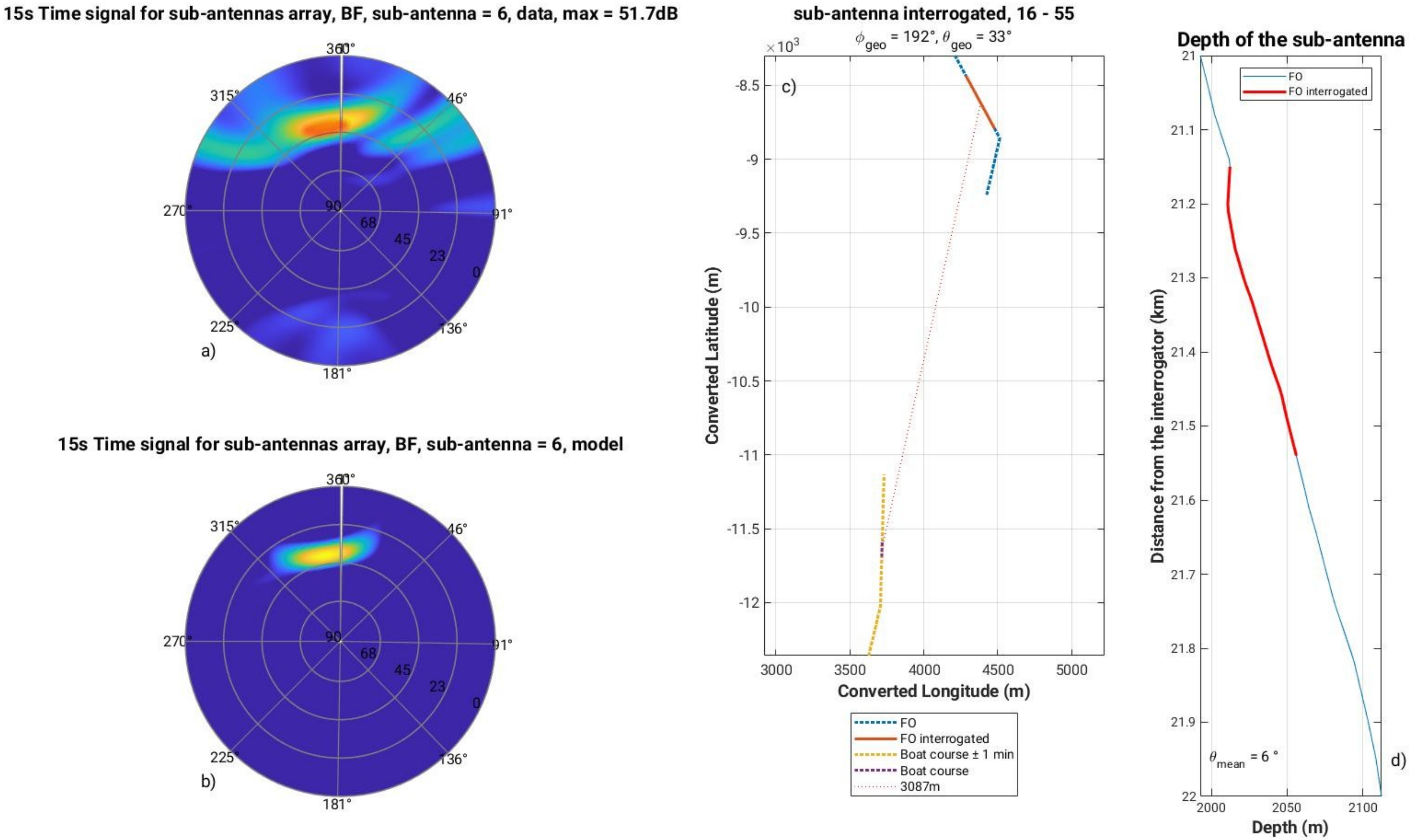
2 antennas interrogated and compared with synthetic BF shift by 65 sensors (650m).

Method repeated for different portions of the cable

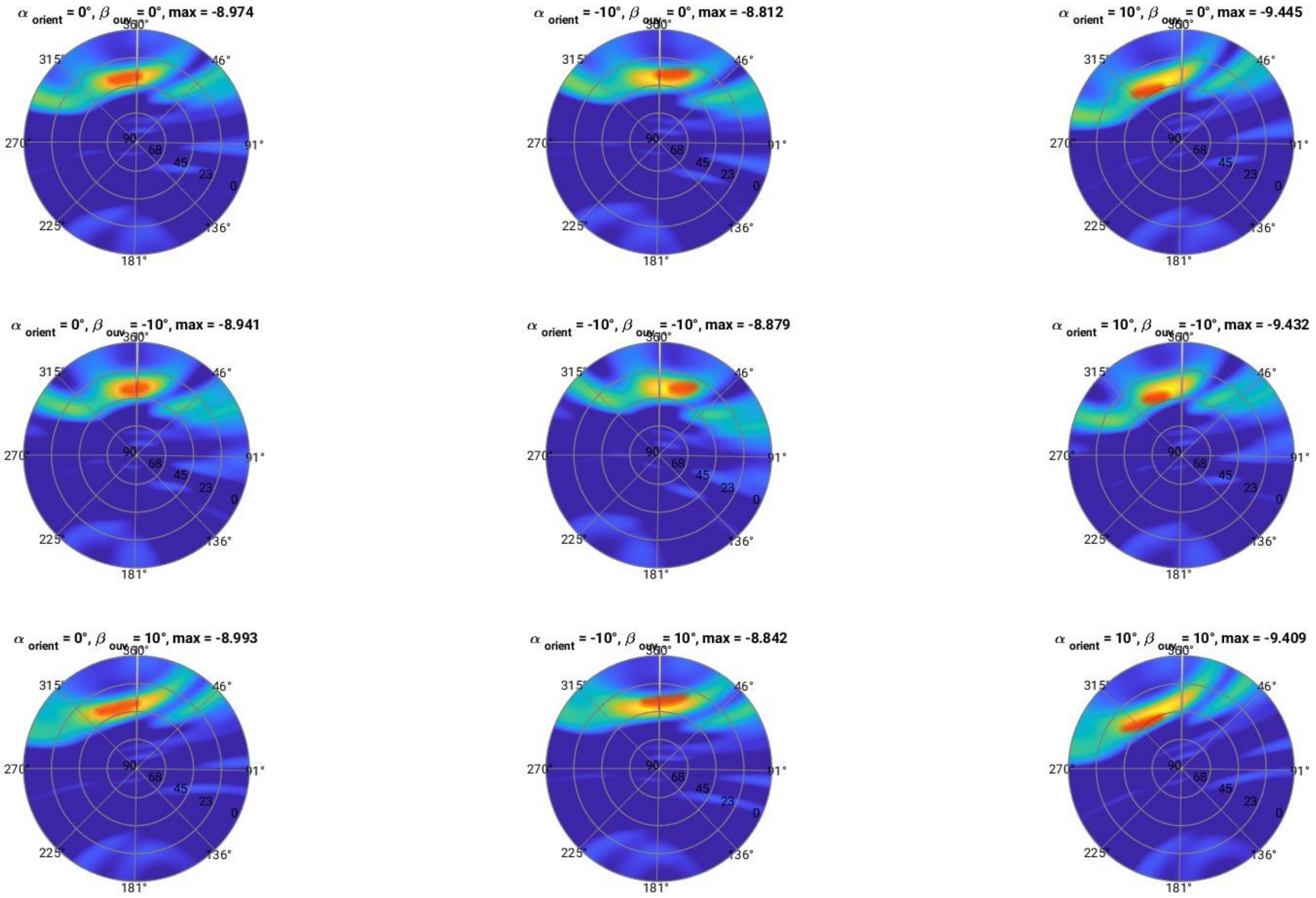


Recalibration of a portion of the cable. a) : BF of a fisrt antenna, red line is the synthetic BF of a shifted antenna. b) : BF of a second antenna. c) : configuration tested. d) : bathymetry. e) : spectrum of the portions interrogated

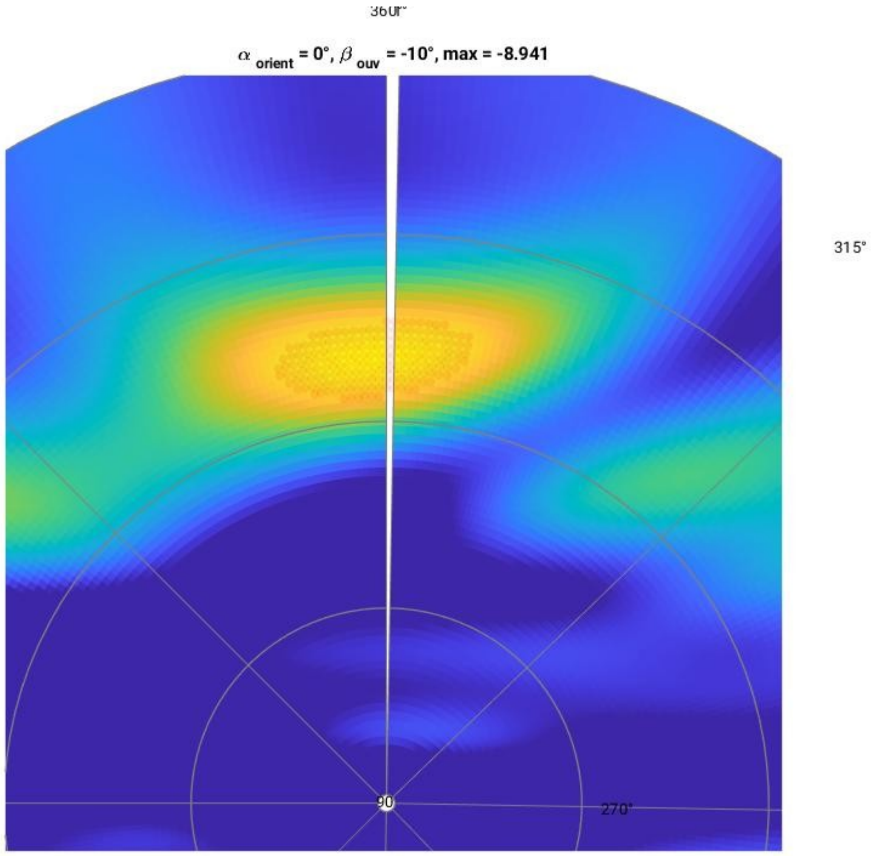
Determination of the turning point - Offset taken into account

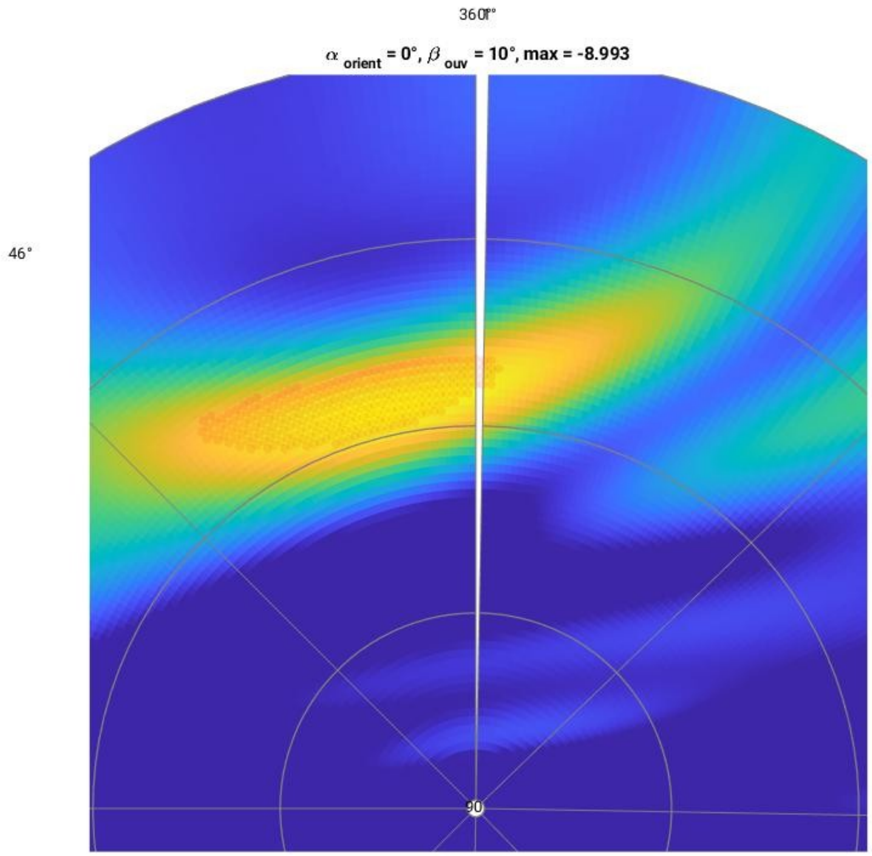


Determination of the turning point – Grid search

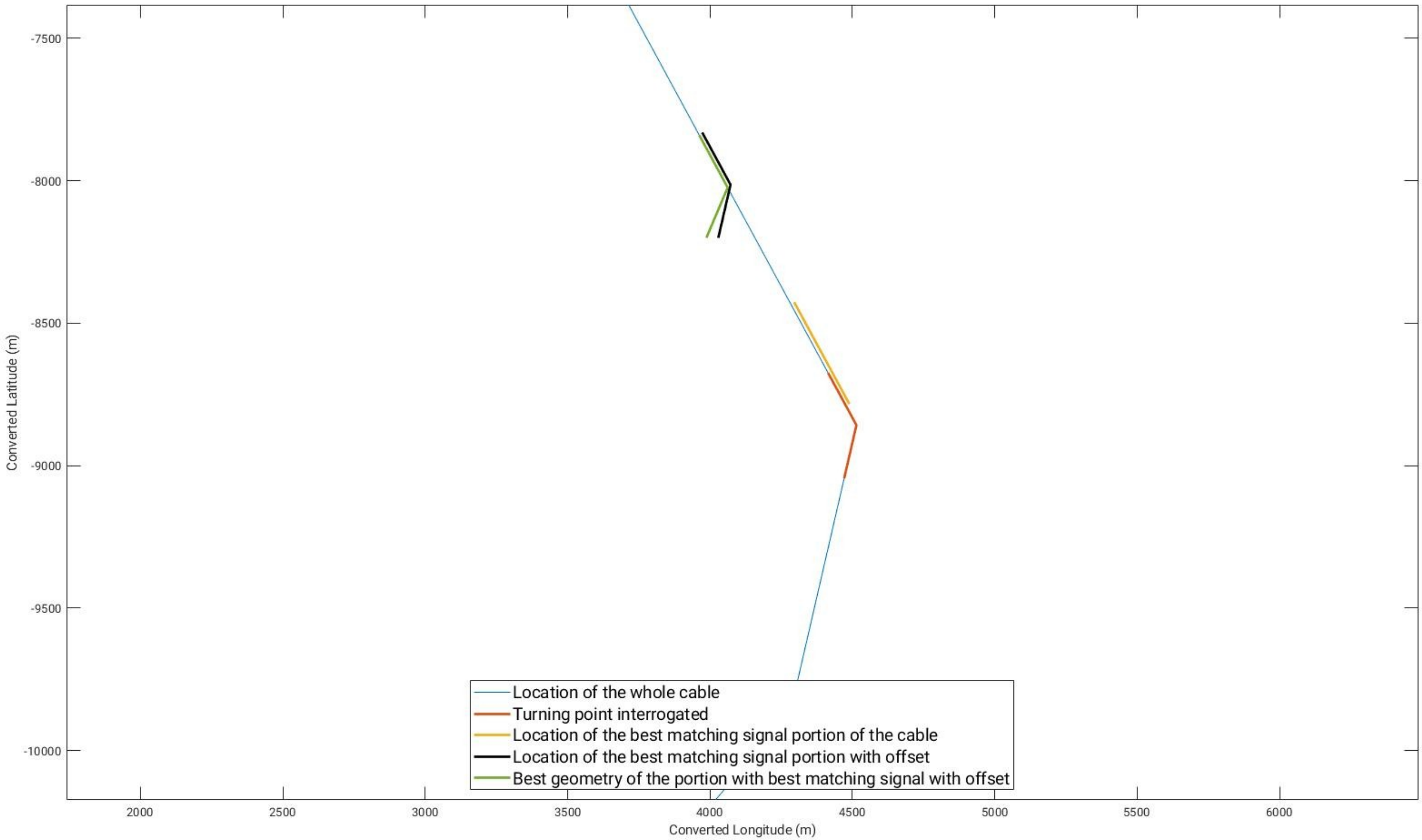


Determination of the turning point – Grid search





Determination of the turning point – Conclusion



Discussion

- Recalibrate the sensors for some portions of the cable
- Match the BF by modifing some parameters (slope of the sea floor, geometry of the antenna)
- Confirm the results with other signals

<u>Other methods for relocation</u>

- Cramer-Rao Bound with MUSIC algorithm (Gera et al. 2009)
- Cepstrum signal (Trabattoni et al. 2019)
- Cross-correlation within the sensors of the antenna (Sabra et al. 2005)