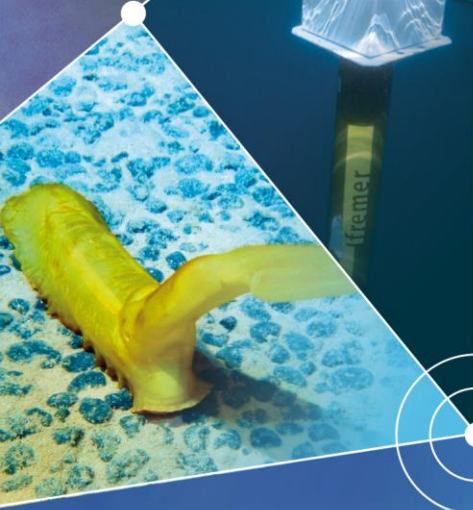
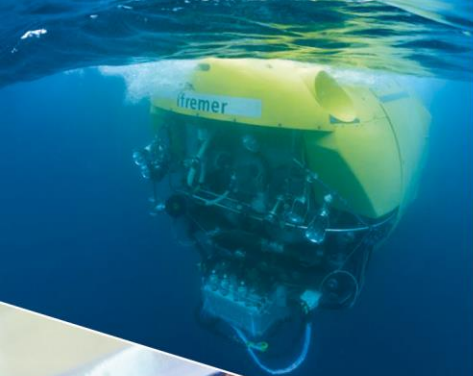




INTERVENTION ON MOMAR OBSERVATORY Gilbert DAMY

WORKSHOP ON SEA OPERATIONS FOR
OCEAN OBSERVATORIES
TOULON JULY 25-27, 2019



This presentation reports a collaborative work :

thanks to Patrick Simeoni, Christophe Duchi, Marc Nokin, Loic Dussud, Pascale Lherminier ...

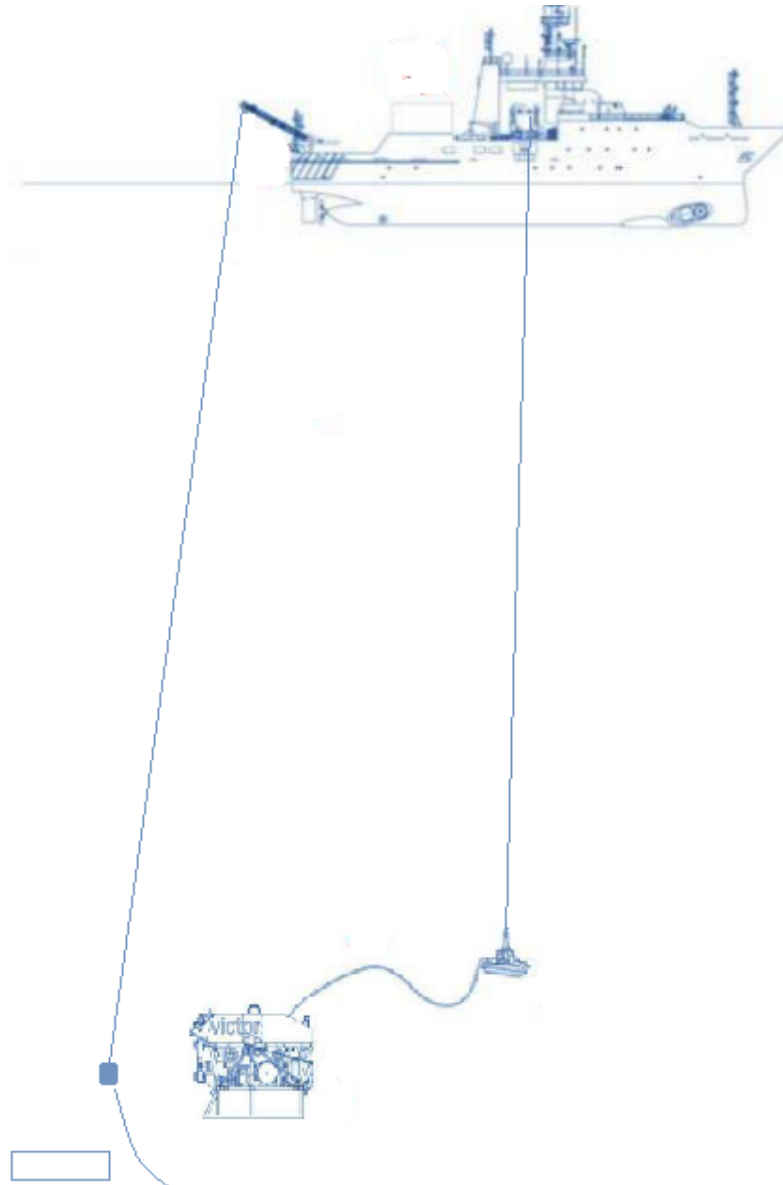
MoMAR : a multidisciplinary acoustically linked observing system with satellite connection to shore.

**2 "SeaMoN" stations, serviced every year :
a recovery and a re-installation procedure**

Recovery phase

- **time-consuming operation**
- **a deadweight is left on the seafloor**

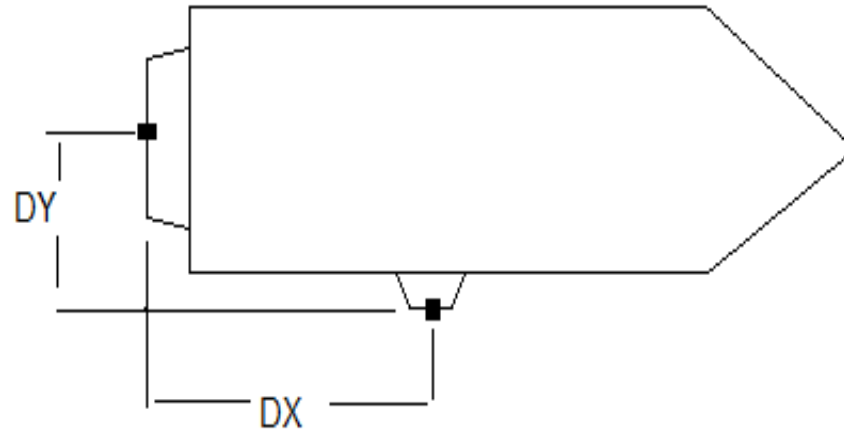
Operation with 2 cables ?



Issues to be addressed

- **the risk of contact between the 2 cables, (or between the ROV tether and the ascending station)**
- **the dynamic behaviour of the handling cable with the station attached to its lower end**

Ship data

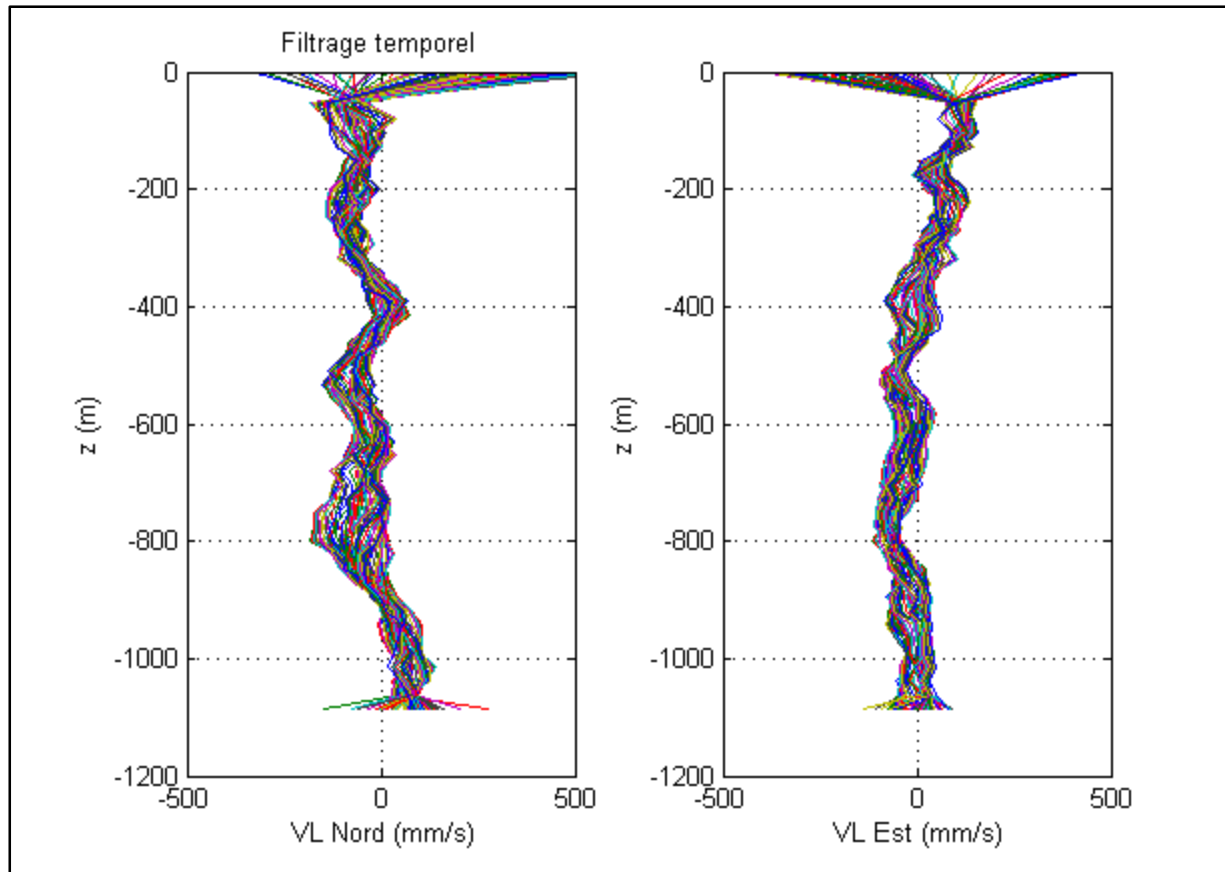


	Atalante	Pourquoi-Pas
Length	85 m	107 m
DX	19 m	29 m
DY	13 m	18 m

Can we optimize the ship control strategy ?

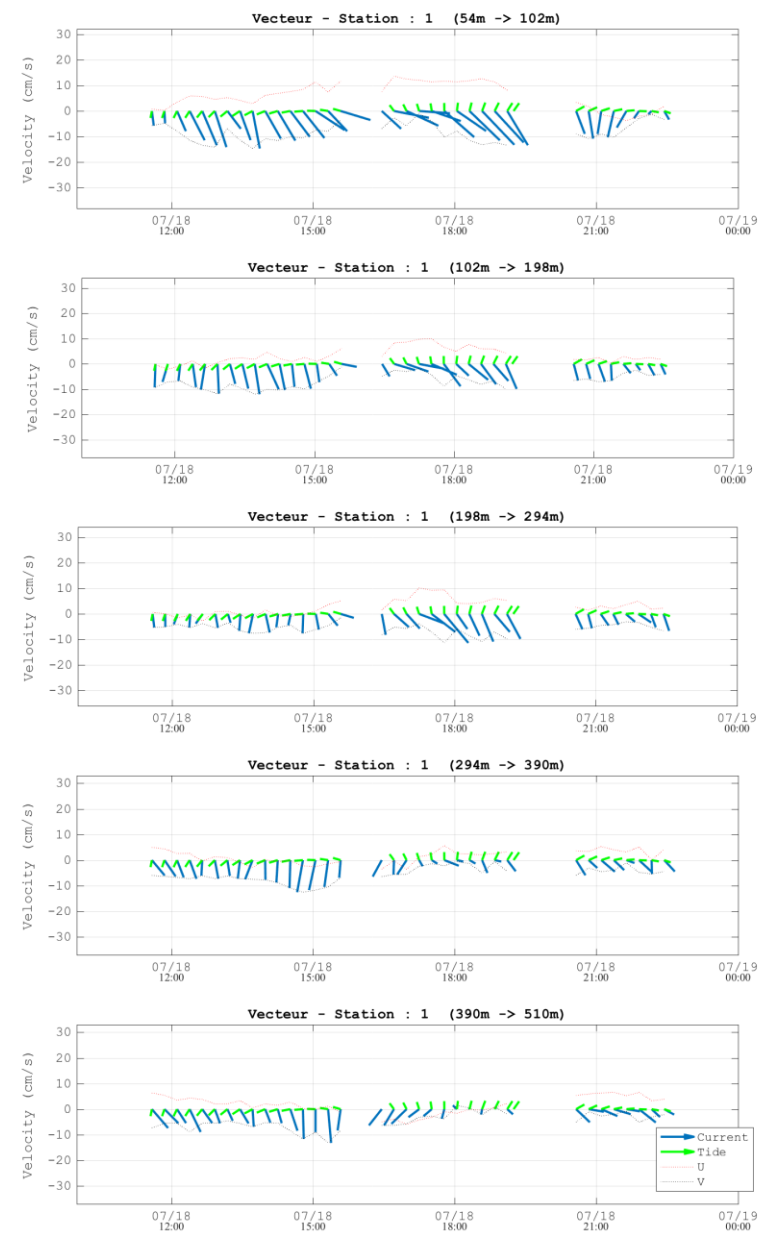
Which information on current profiles is available ?

ADCP data



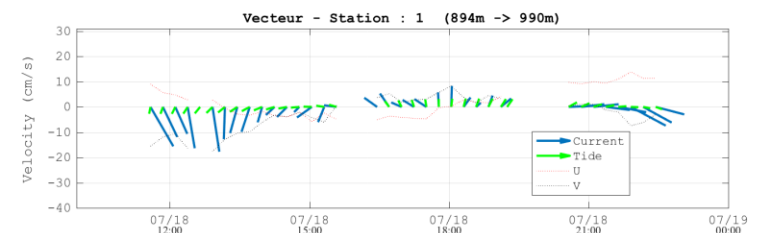
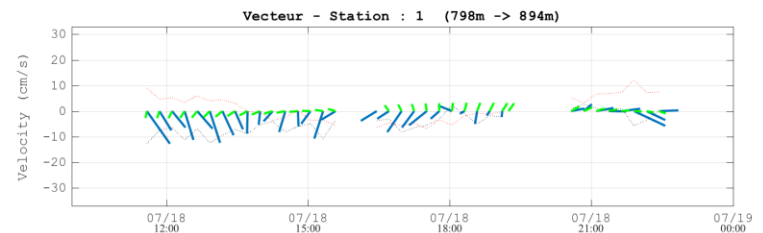
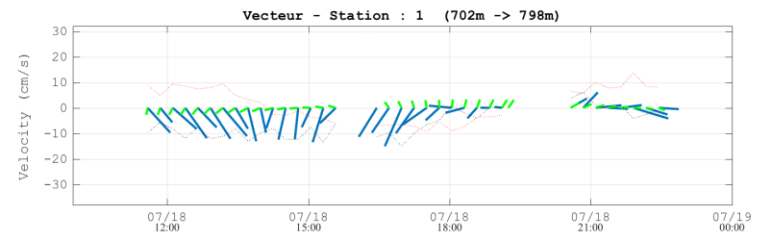
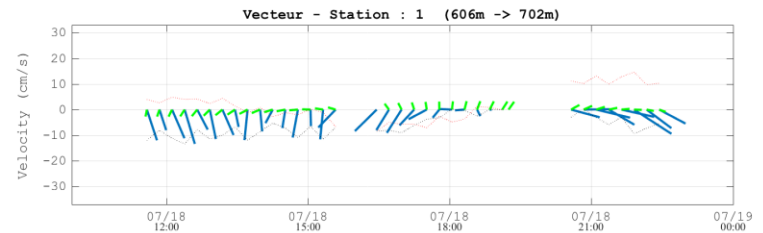
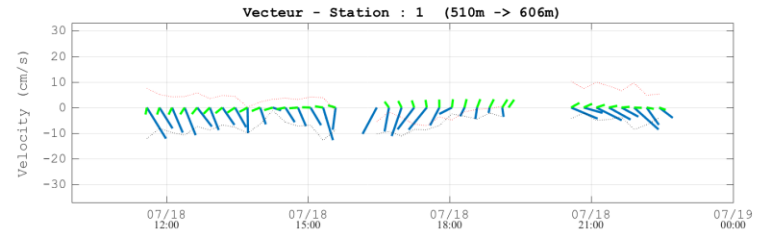
ADCP data

**Current velocity and direction,
averaged on the first 6 layers
(≈ 100 m height) :**
54 m to 510 m



ADCP data

**Current velocity and direction,
averaged on the last 6 layers
(≈ 100 m height) :**
510 m to 990 m



Cable models

Useful for

- feasibility studies
- real-time support to operations - predicting the response to a ship displacement for example.

Uncertainties

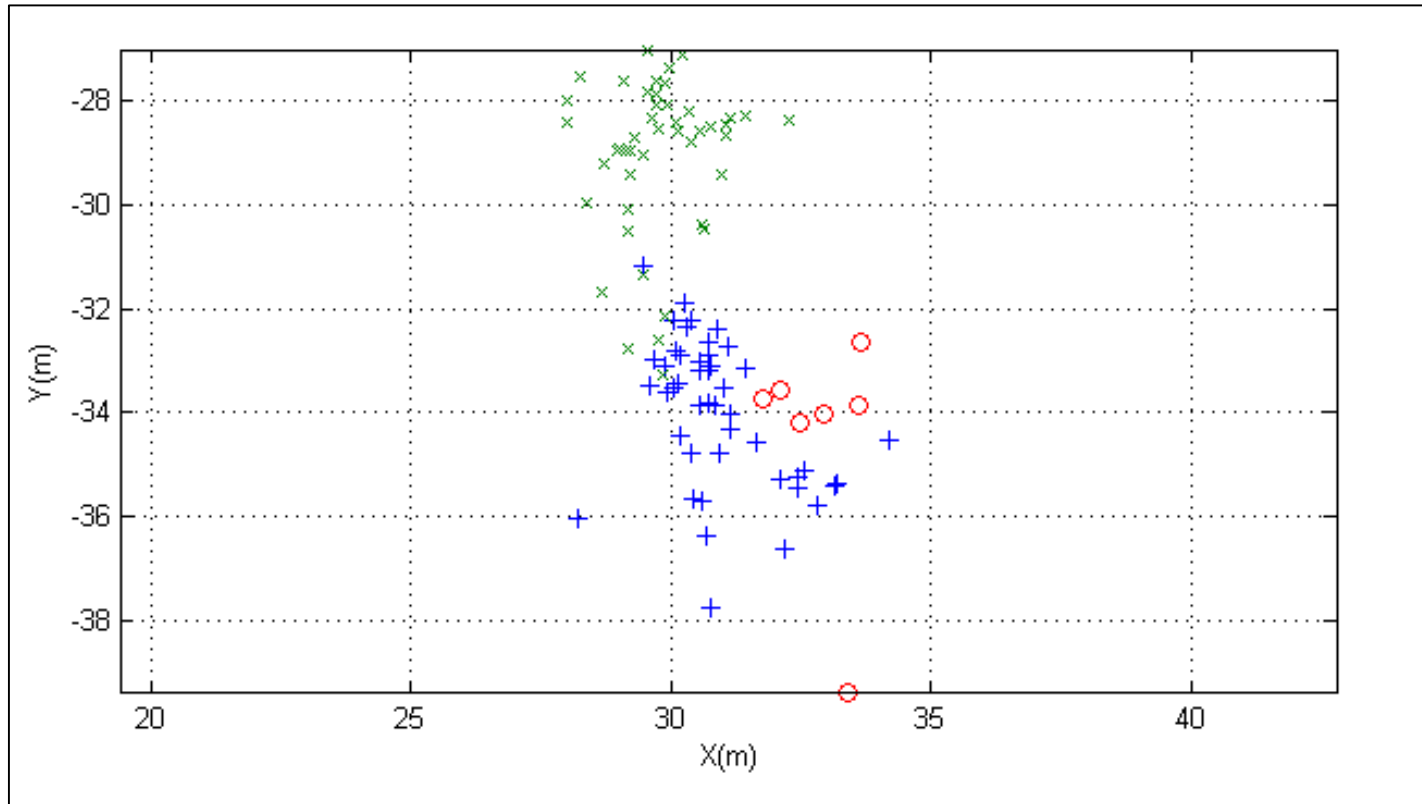
- Current profile
- Drag coefficient (Vortex Induced Vibrations)
 $C_d \in [1.2 \ 2.3]$

Cable model validation based on MoMarSat experiments

Measurements :

- Ship position and attitude (heading)
- Cable paid-out length
- Acoustic beacon position (USBL)
 - one beacon at bottom end
 - second beacon 750m above bottom end.
- ADCP data

Dive 1/ July 18th 2017 station 1 (12')

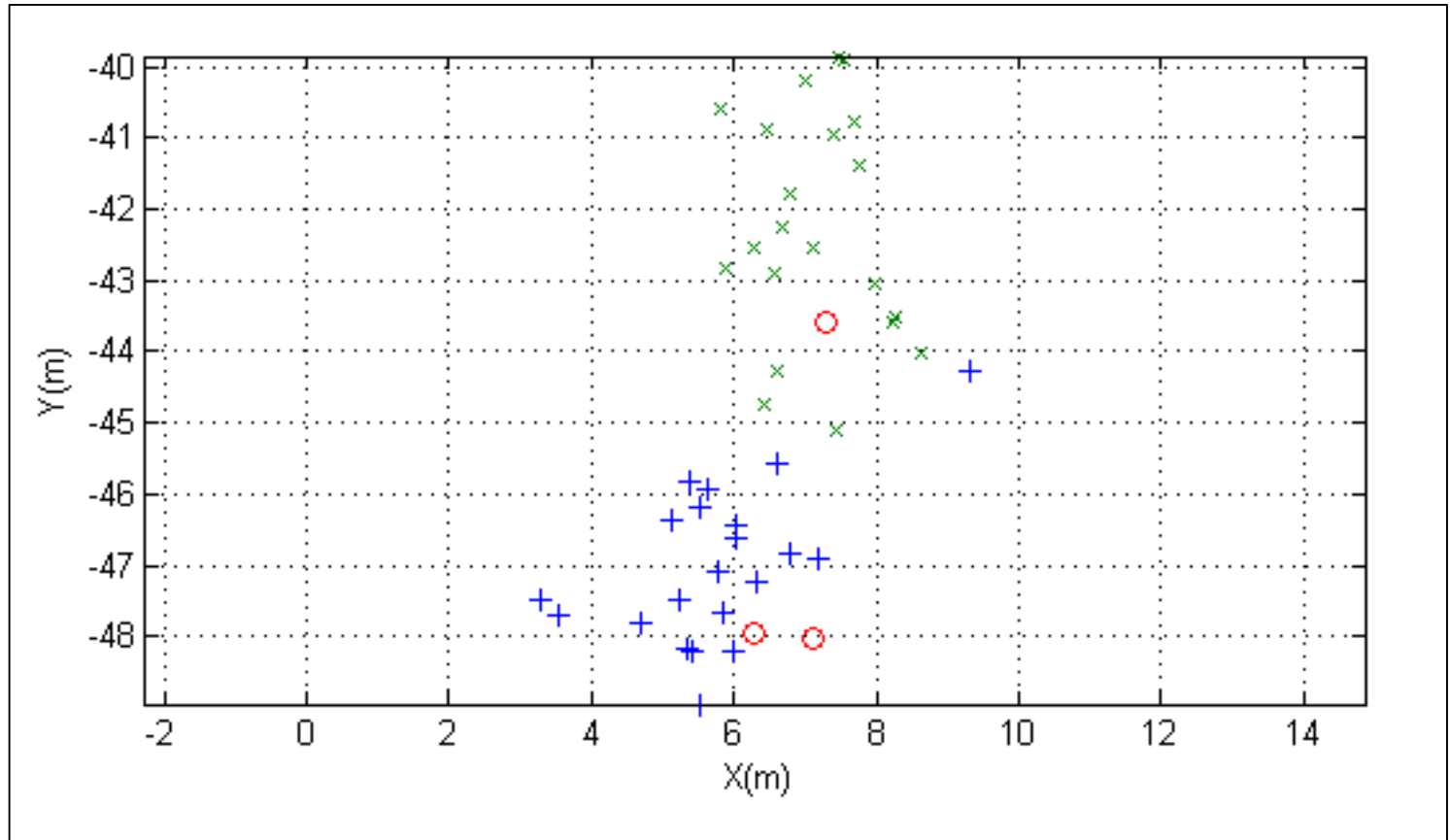


Cable length 750 m, $C_d = 1.5$

x ship position, o cable end calculated position,

+ cable end USBL position

Dive 1/ July 18th 2017 station 3 (5')

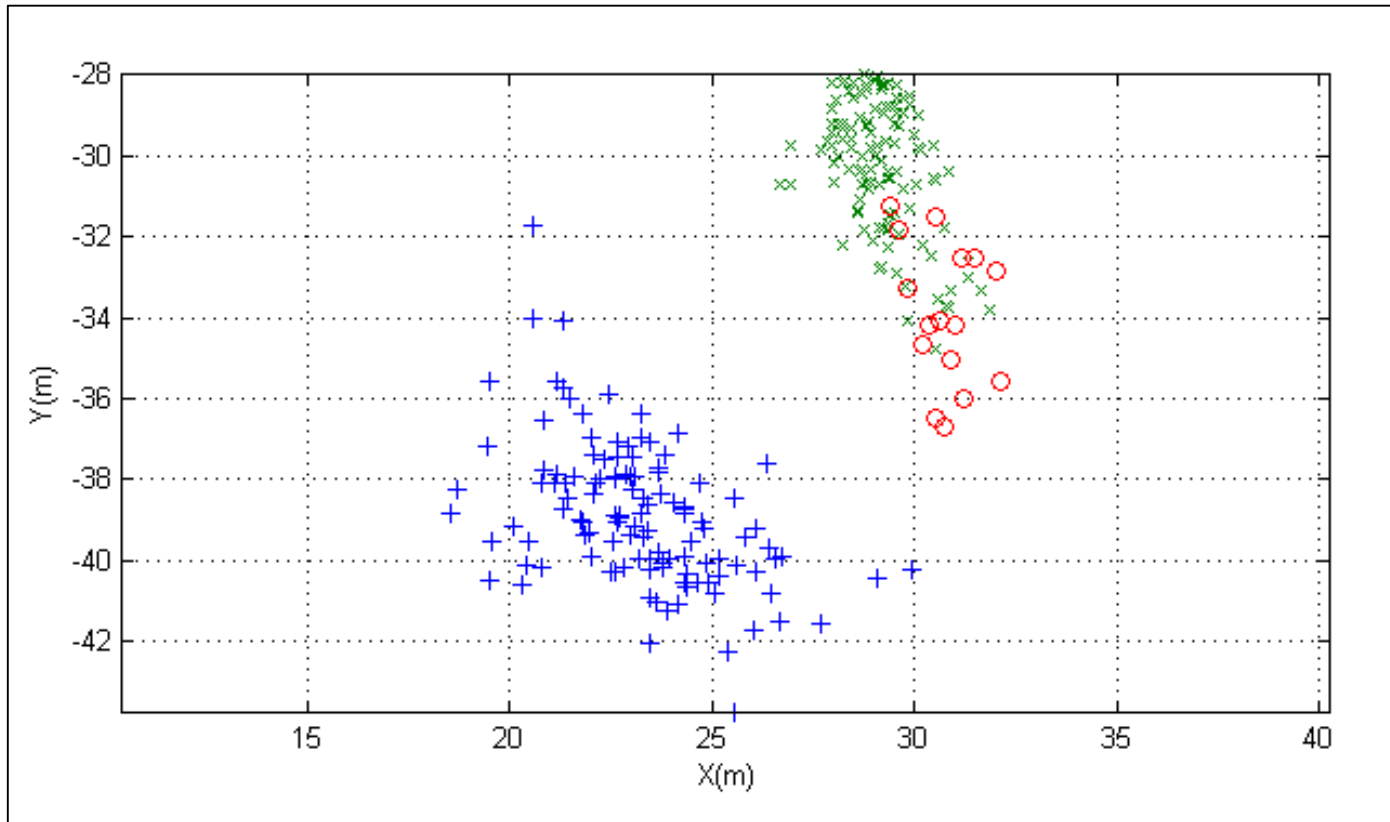


Cable length 750 m, $C_d = 1.5$

x ship position, o cable end calculated position,

+ cable end USBL position

Dive 1/ July 18th 2017 station 2 (40')



Cable length 1500 m, $Cd = 1.5$

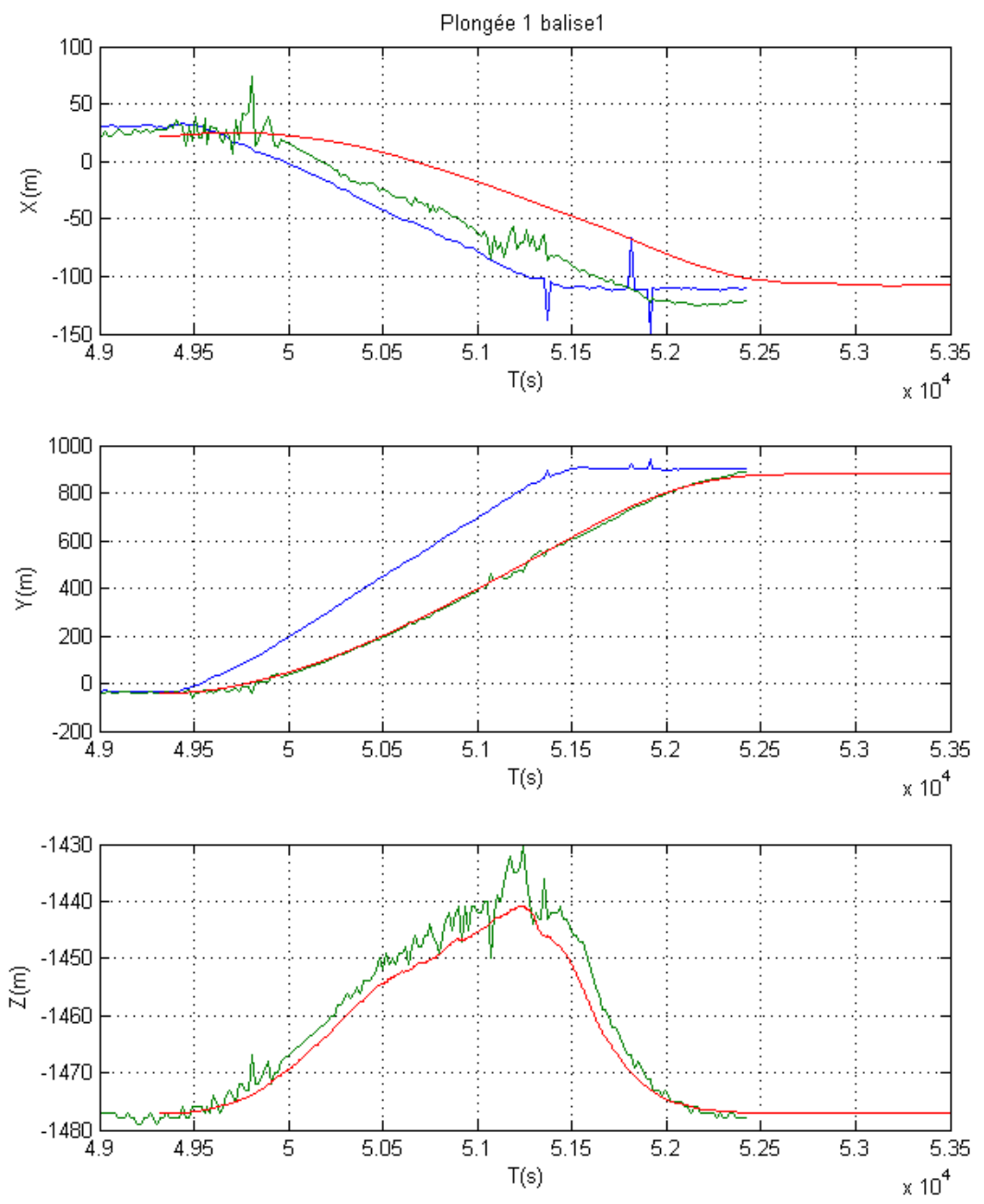
x ship position, o cable end calculated position,

+ cable end USBL position

Dive 1 displacement

Cable length 1500 m,
Cd = 2.3

- blue ship position,
- red cable end calculated position,
- green cable end USBL position



Risk of contact : available cables

	unit	VICTOR	hydro_AT	dredging_AT	dredging PP
diameter	mm	20.5	9	19.5	21.52
mass/u.length	kg/m	1.451	0.54	1.688	2.004
weight in water/u.length	N/m	10.889	4.605	14.411	17.099
Cfd/pl		1.74	1.80	1.25	1.16
critical angle (1 knot)	°/vert	6.51	6.74	4.7	4.37

FDn normal component of the drag force per u. of length :

$$FDn = Cfd Vc^2 \cos^2 \phi \quad \text{where } Cfd = 1/2 \rho_{\text{seawater}} Cd Dia$$

Pn normal component of the in-water weight per u. of length :

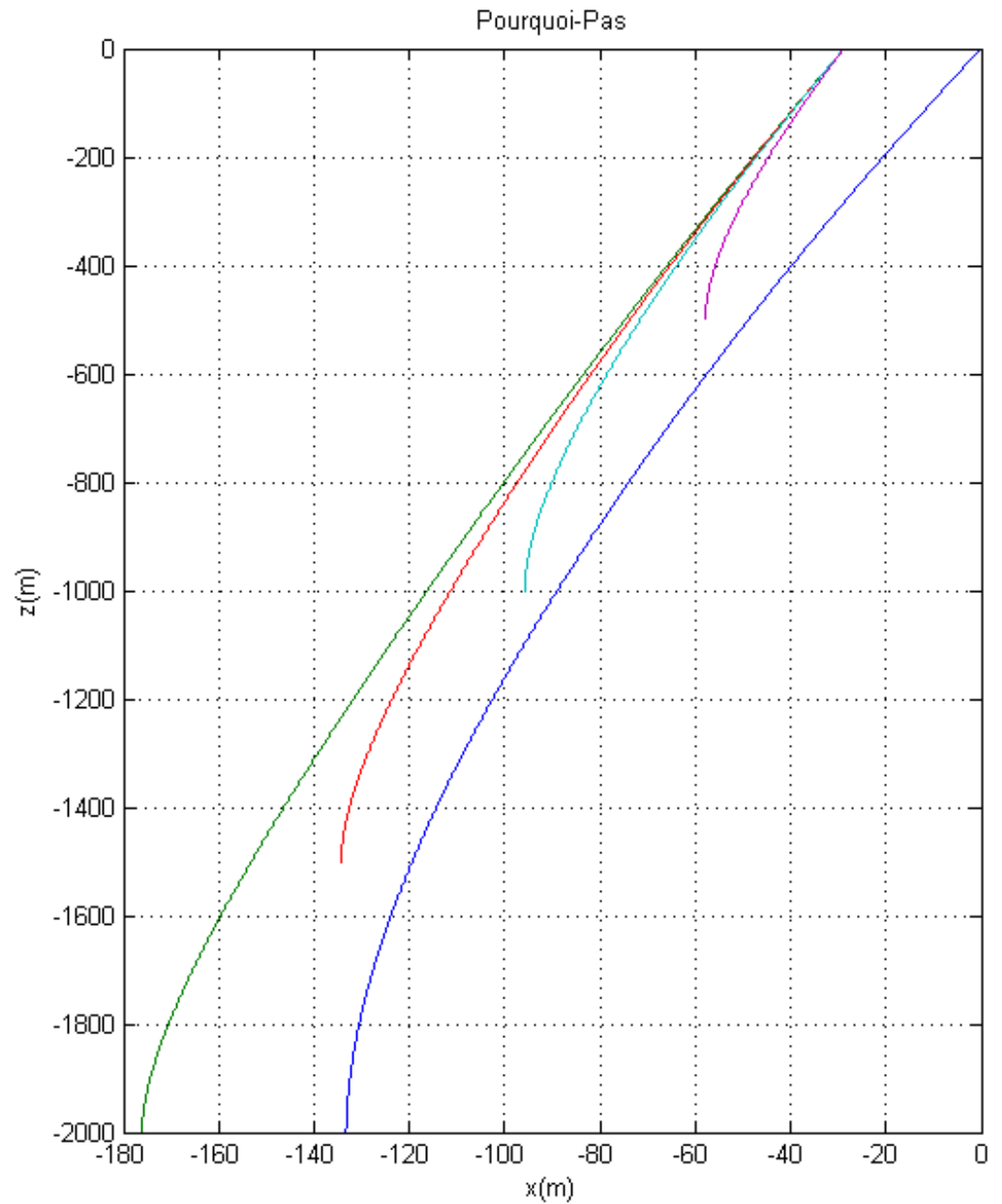
$$Pn = pl \sin \phi.$$

ϕ_c is solution of equation $FDn - Pn = 0$;

Two cables with the ratio Cfd/pl will have the same critical angle

Calculation of cable deflection :
Blue : ROV tether
Other colours : Pourquoi-pas maneuvering cable
ROV on stbd beam

Deadweight Victor 1.2 t
Deadweight Dredging cable 0.5



Calculation of cable deflection :

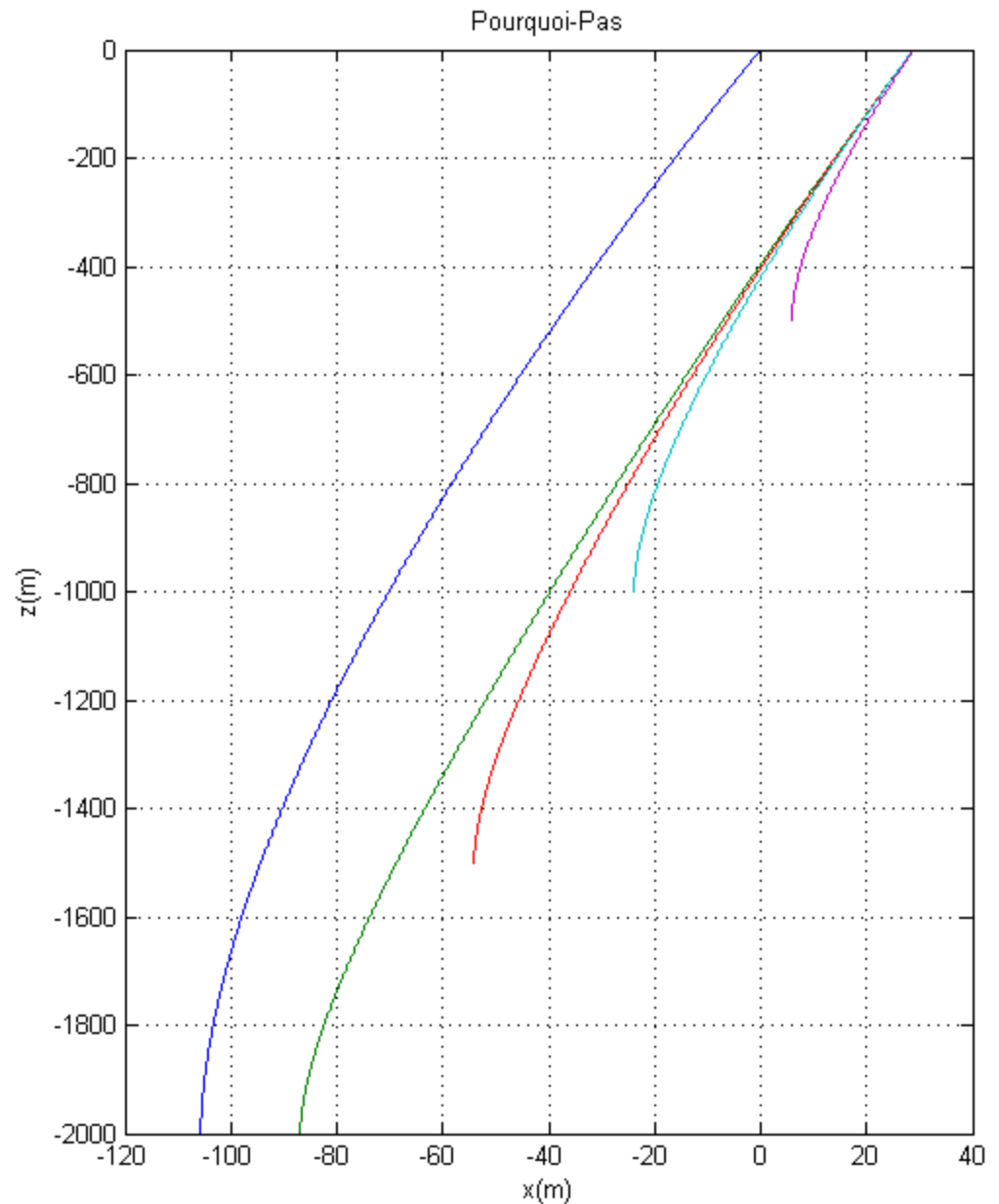
Blue : ROV tether

**Other colours : Pourquoi-pas
maneuvering cable**

ROV on rear A-Frame

Deadweight Victor 1.2 t

Deadweight Dredging cable 0.5 t



Concluding remarks

- ADCP data are of little help due to their limited range
- cable models are relevant to predict response to ship maneuvers
- operation with 2 cables should not be performed on the Atalante due to insufficient distance between A-frames and inadequacy of second winch/cable
- operation with 2 cables could be exceptionnaly performed on the Pourquoi-Pas, if metocean conditions are mild, only on a temporary basis : an active deadweight system is to be developed.
- USBL positioning may hopefully give an estimate of the global effect of the current on the cables to help manage the operation



Thank you for your attention.

Discussion ?