

Shelf / Upper Slope Circulation in the Bay of Biscay from July 2009 to August 2011

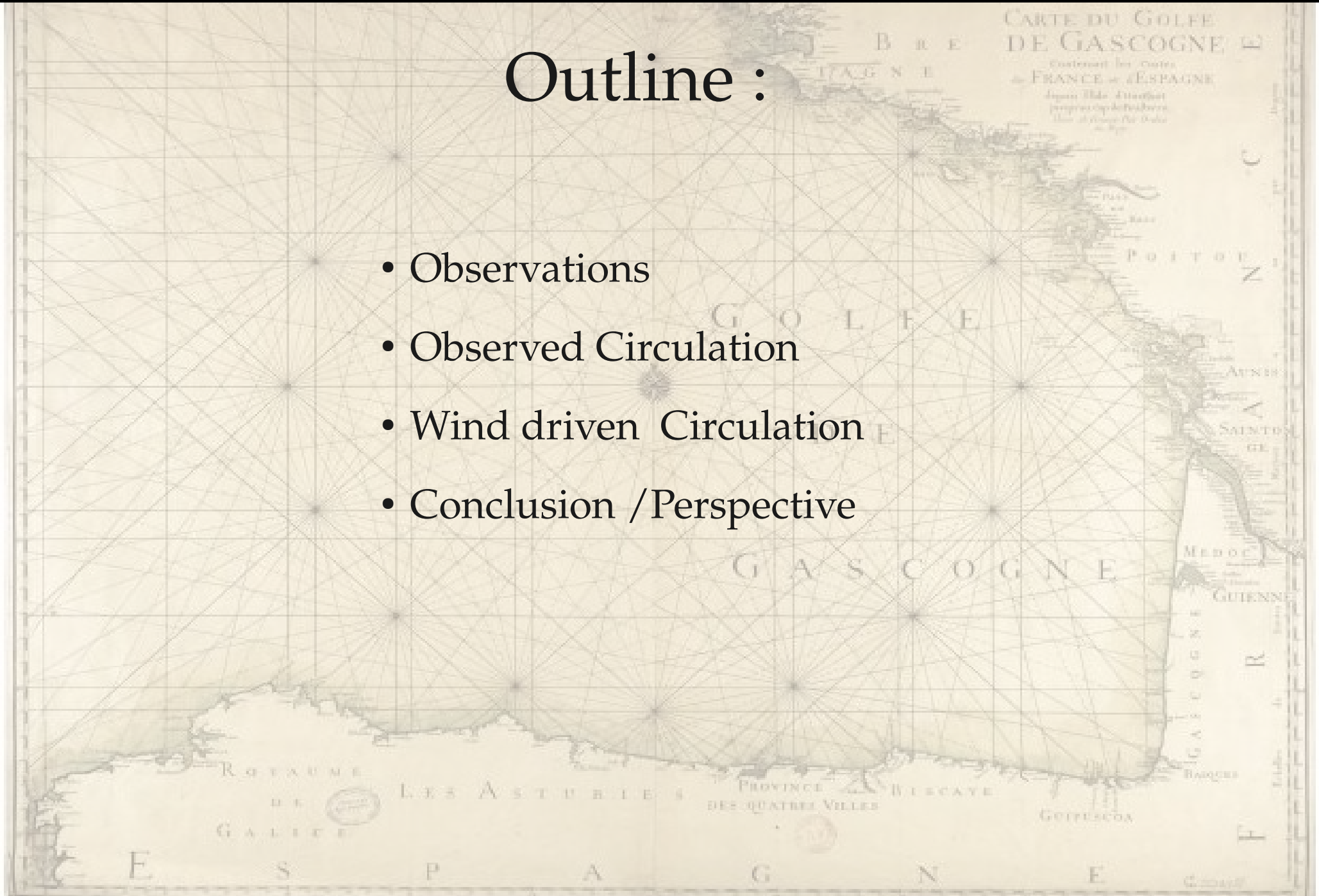
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² LPO, IFREMER-Brest, France

Outline :

- Observations
- Observed Circulation
- Wind driven Circulation
- Conclusion / Perspective

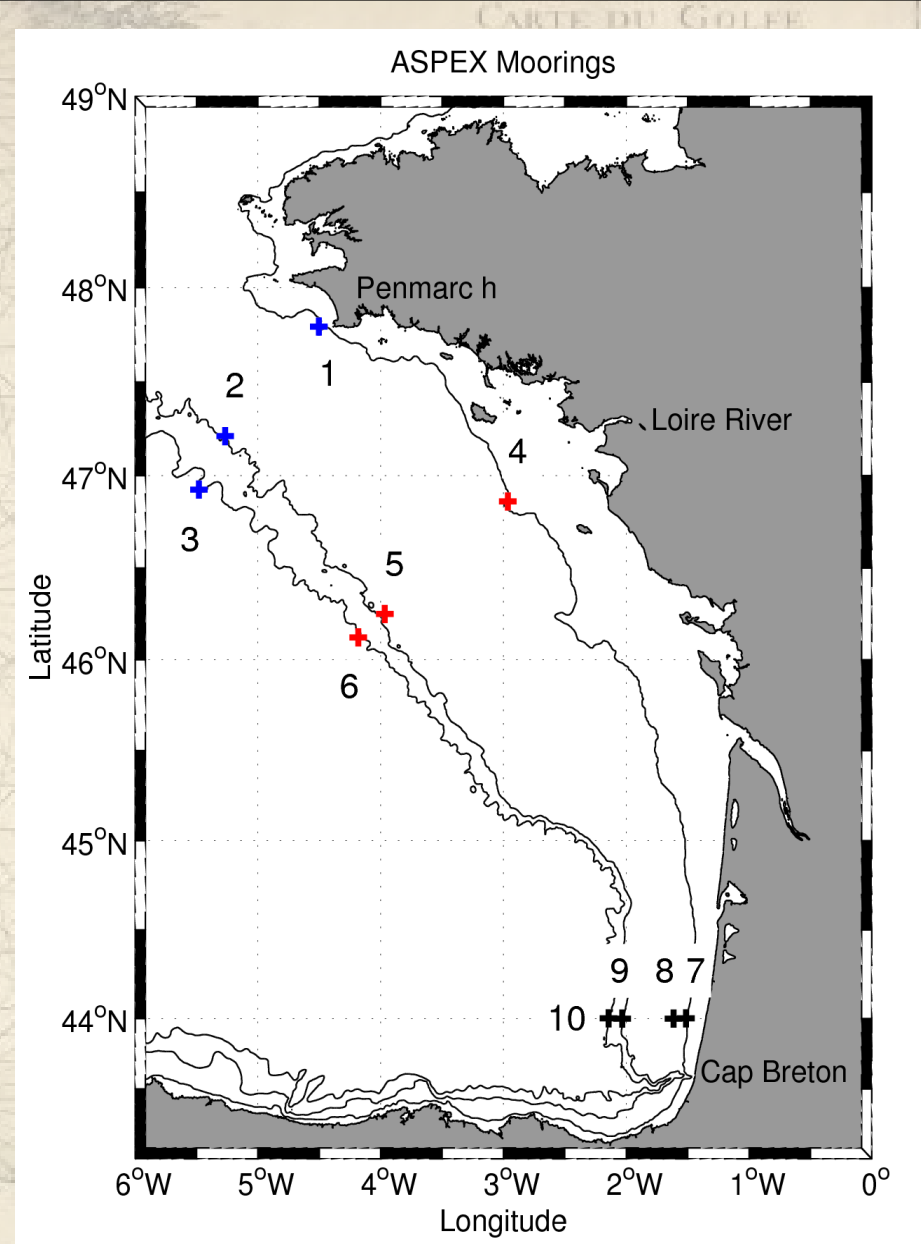


ASPEX Project :

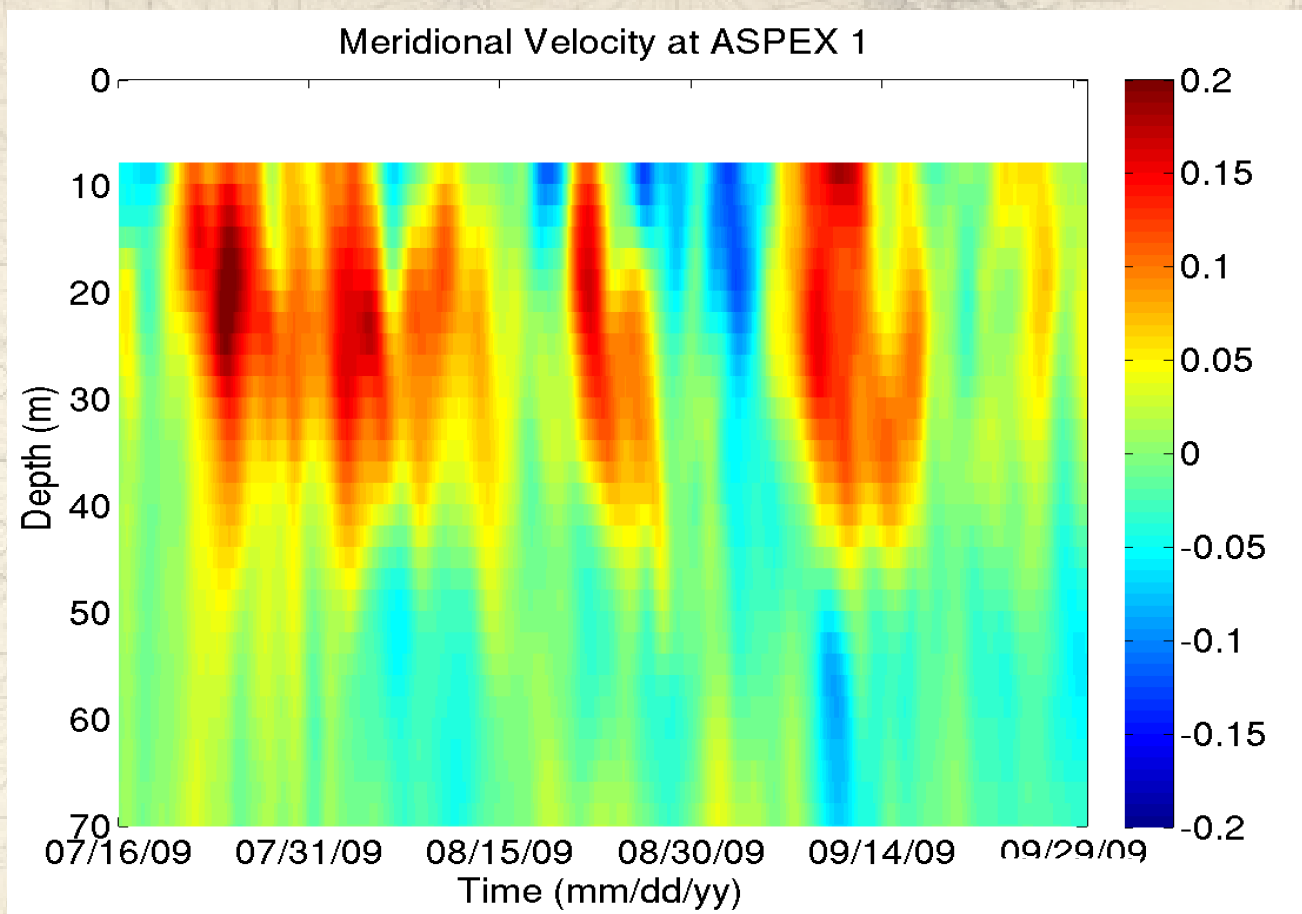
10 ADCP organised in 3 sections
 Penmarc'h (Blue), Loire (Red), South (Black)
 3 instrumented isobath : 60 m, 150 m, 450 m

Record from July 2009 to August 2011

isobath	60 m	150 m	450 m
Sampling period (s)	30	30	150
Size cell (m)	2	8	16



Data analysis : Time series



Tidally- filtered meridional velocity at ASPEX 1 for Summer 2009

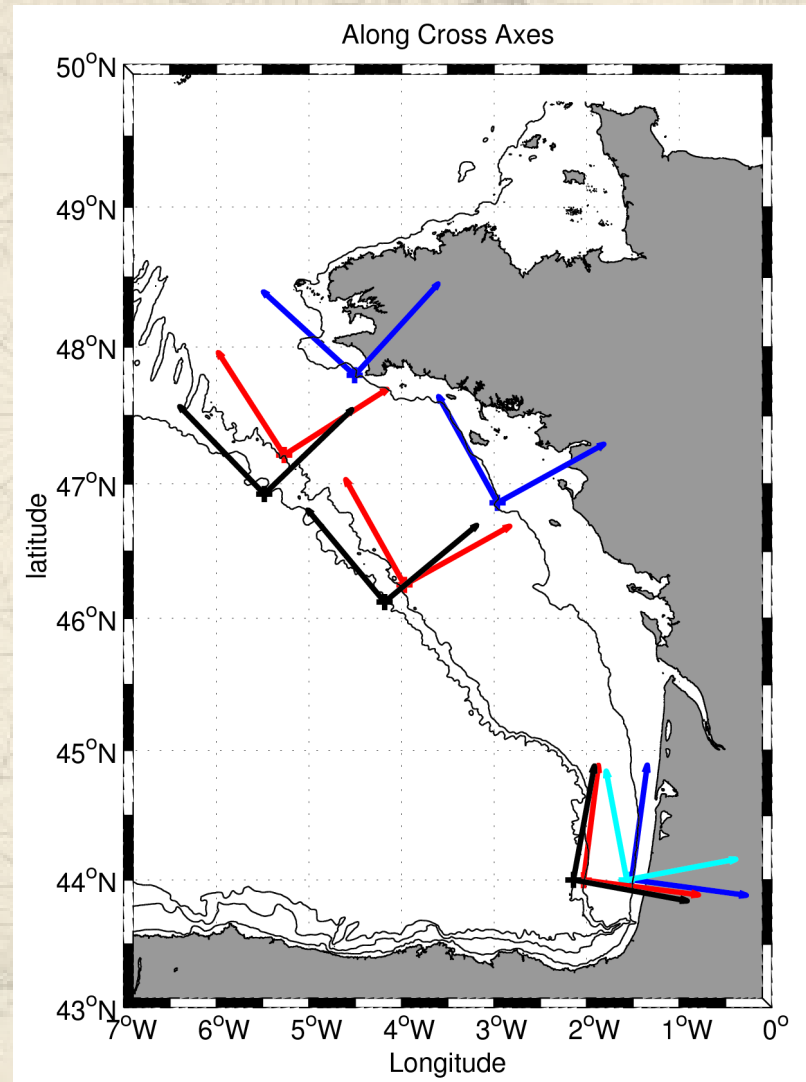
- Tidally-filtered time series
- 80 % of water column can be observed

Data analysis : Along – Cross shore Projection

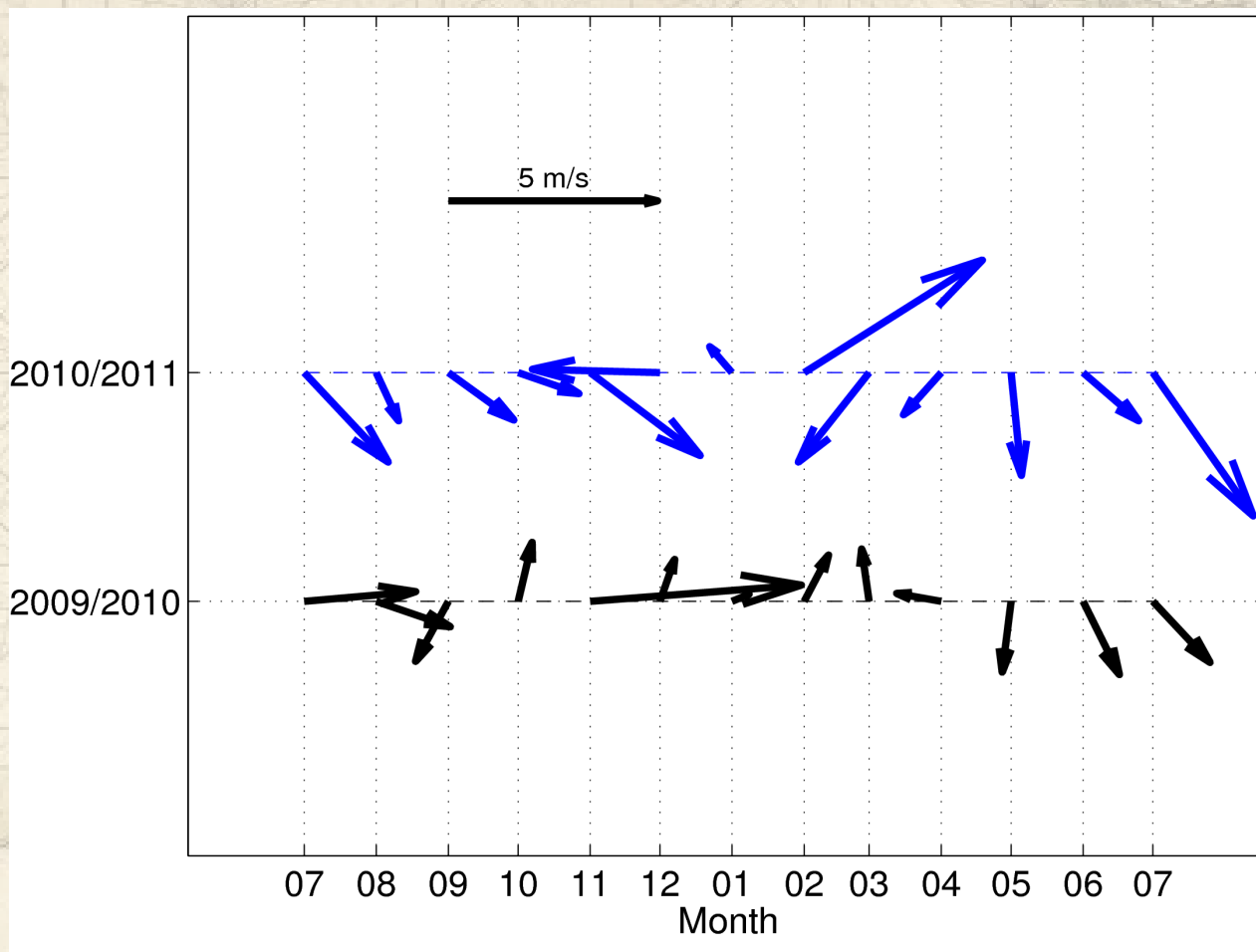
EOF analysis on u, v
=
Eigen values, eigen vector of the
Covariance matrice

Major and minor axis of the
variance ellipse

Along/ cross shore directions



ARPEGE Wind : To study the influence of the wind on the circulation, the winds used are from the ARPEGE numerical weather model from Météo France (*Déqué et al., 1994*). This model releases are 6-hourly sampled.



Winds for years 2009 – 2011

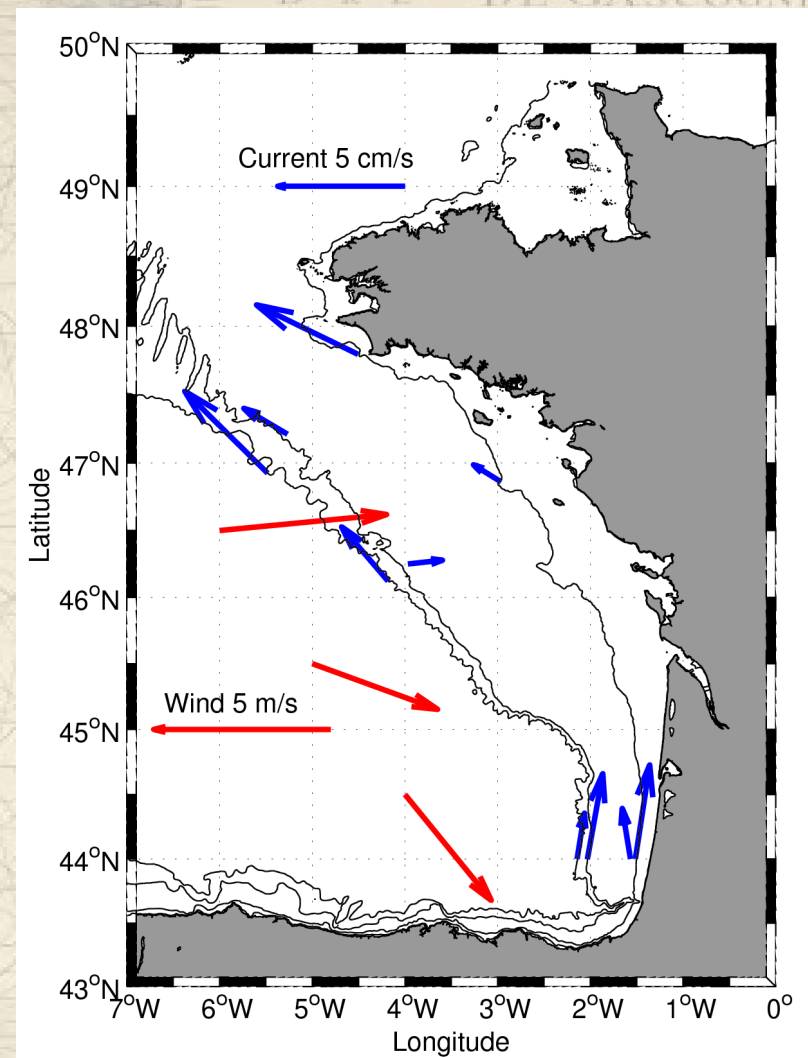


Observed Circulation :

- 1) Mean circulation
- 2) Seasonal circulation
- 3) Weekly averages

Mean circulation :

- Wind :
Eastern Edge of the Anticyclone Azores
+ local effects
Eckman transport -> Equatorward circulation
- Circulation :
Poleward current
Particular behaviour at the Loire river
Strong current at Penmarc'h



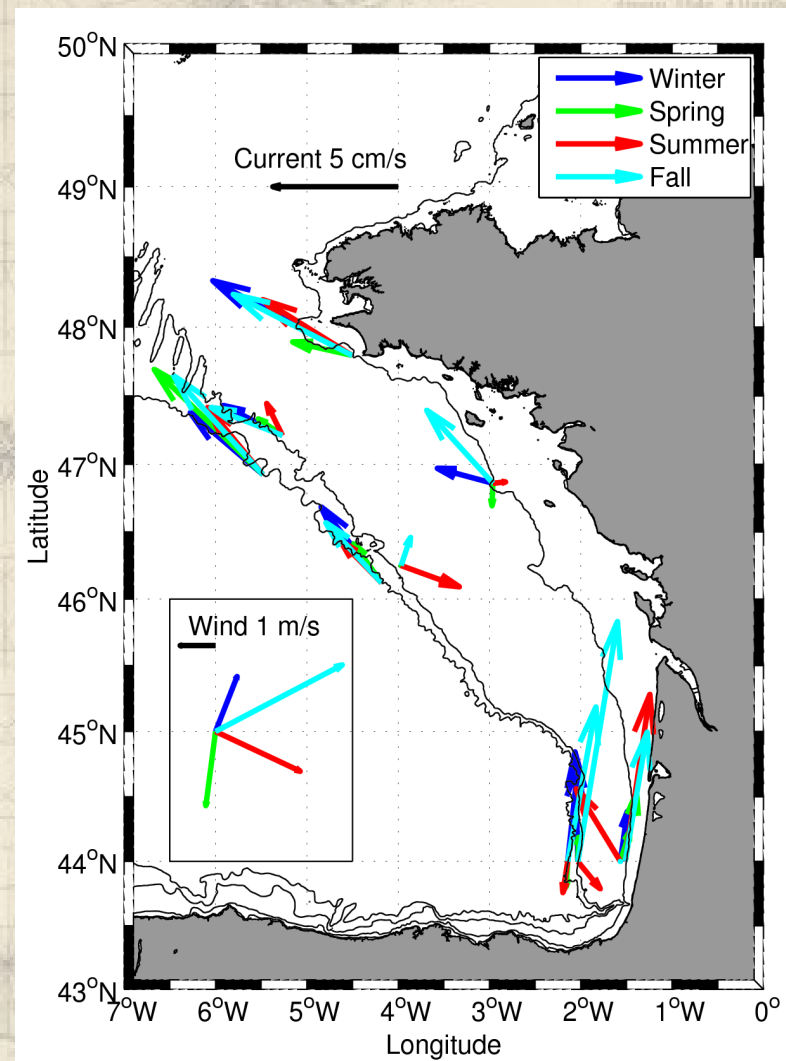
Two years averaged of the vertically averaged currents and winds

Seasonal average :

Winter and Autumn : Strongest Poleward currents associated with northward/northeastward winds.

Summer : Southeastward winds drives equatorward currents in front of the Loire river.

Spring : Weakest currents except on the Armorican slope.



Seasonal average of the vertically averaged currents and winds

Seasonal average :

Vertical Profiles of the seasonal averaged per mooring (cm/s)

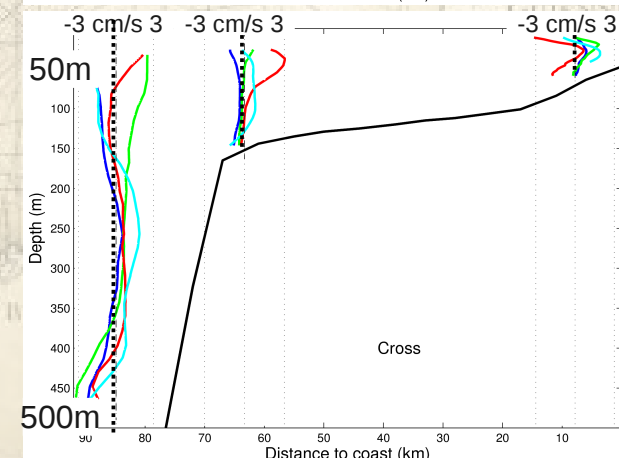
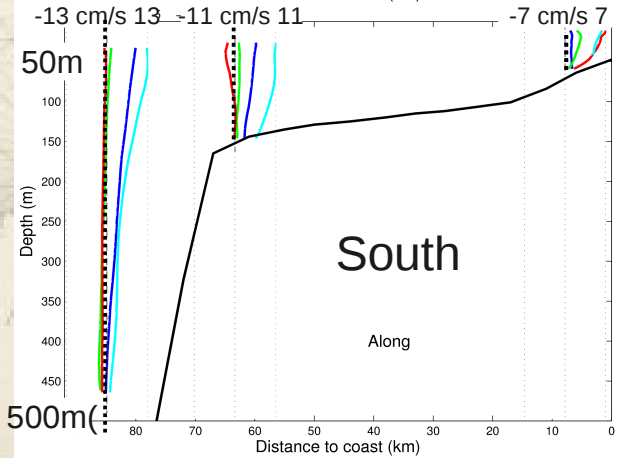
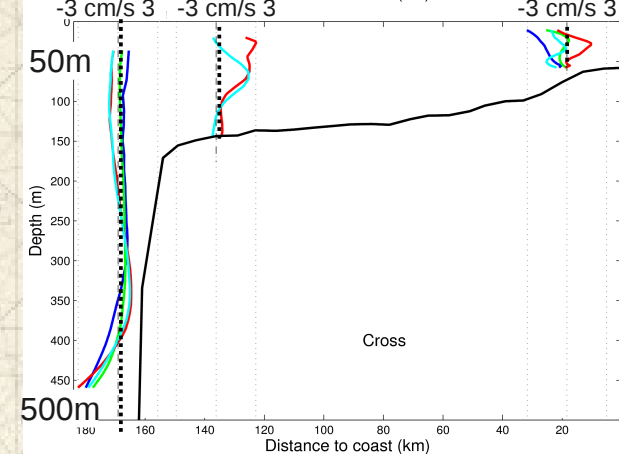
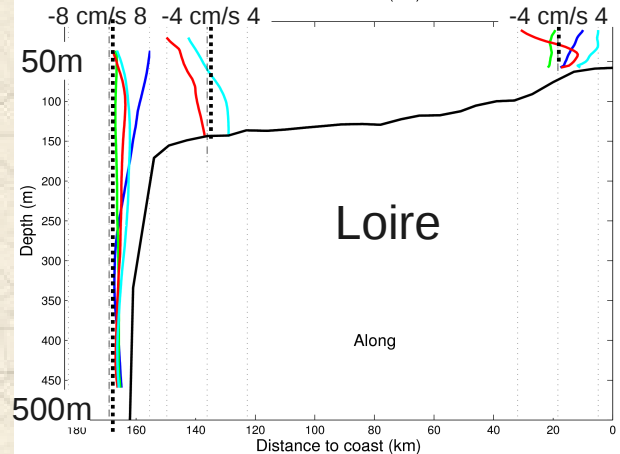
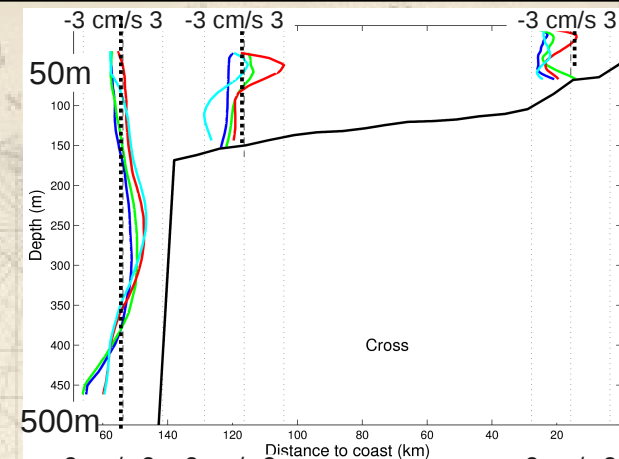
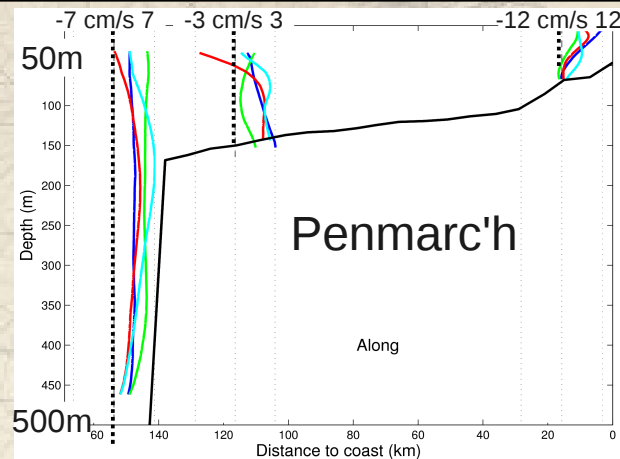
- Slope / shelf circulation separation

Slope :

- Poleward current increasing toward the surface
- Weak cross shore velocity in the interior, increasing downslope at the bottom

Shelf :

- Seasonal Variability :
Vertical shear in summer
- Onslope in the interior
- Downslope at the bottom

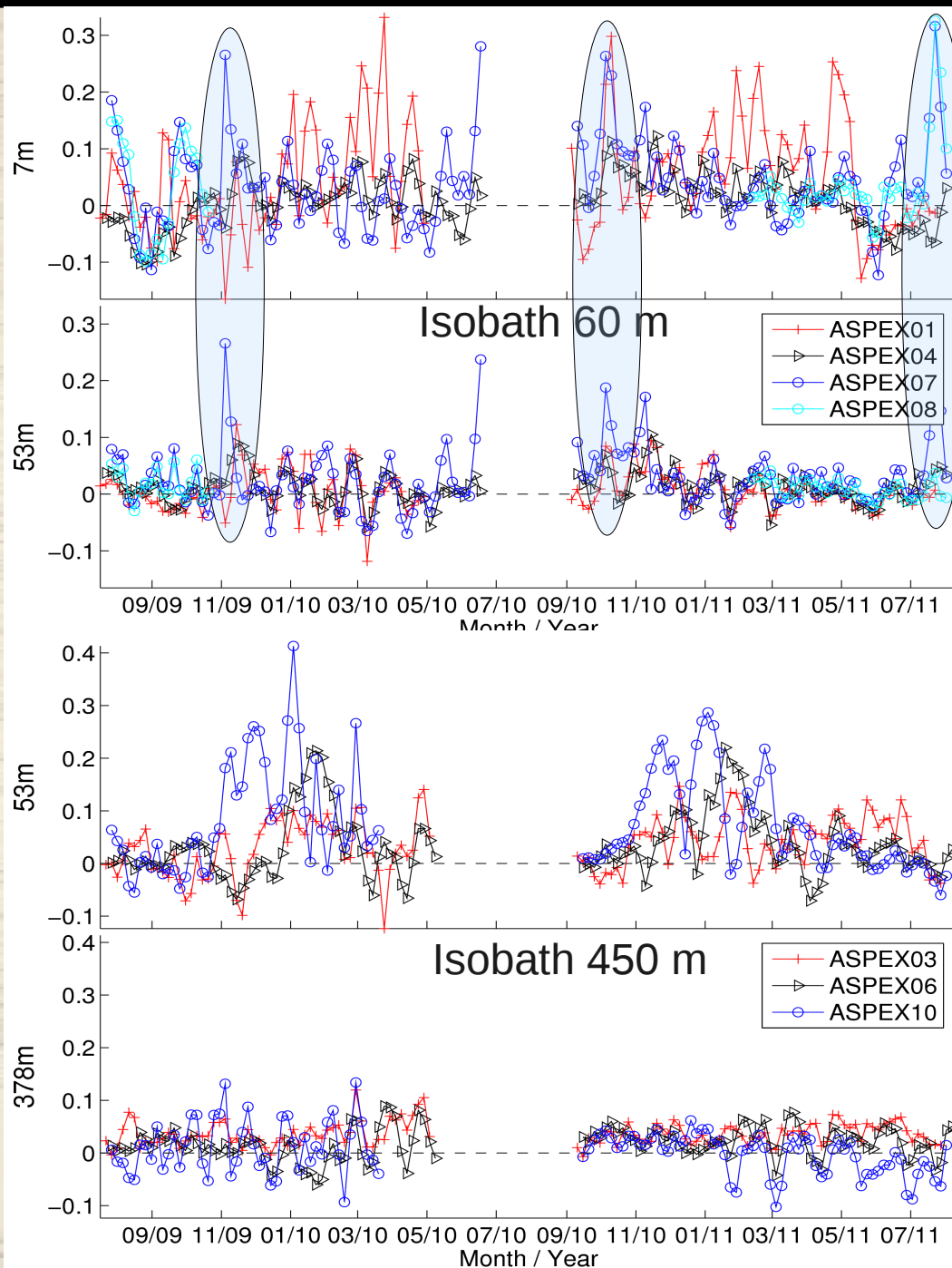


Along Shore Velocities :

Weekly average of the Along shore velocities at the surface and close to the bottom per isobath

Strong current events :

- Isobath 150 m
 Summer/ Autumn at **South** section
 Deep signature

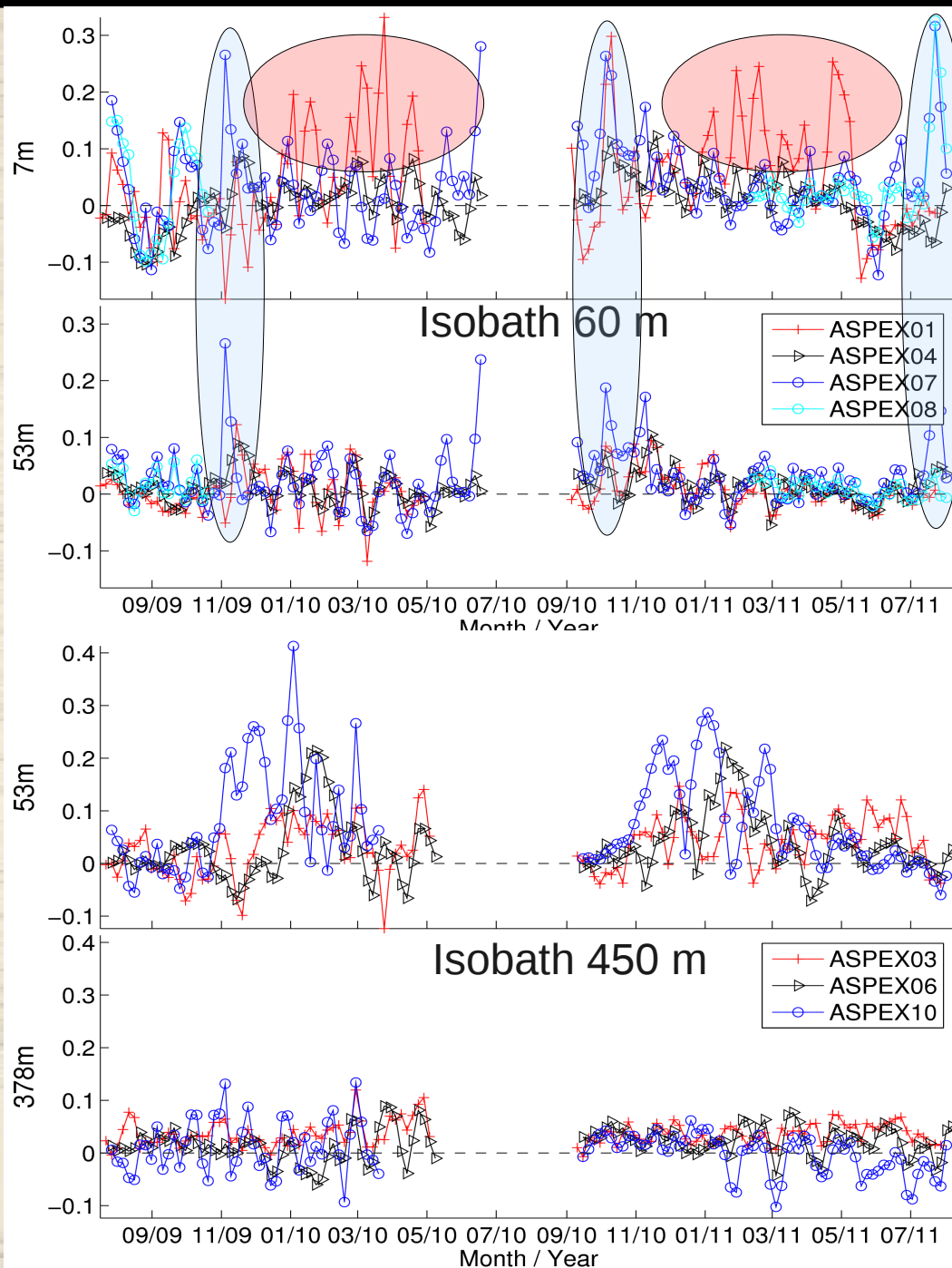


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- Isobath 150 m
 Summer/ Autumn at **South** section
 Deep signature
- Spring/Winter at **Penmarc'h** section
 Surface trapped

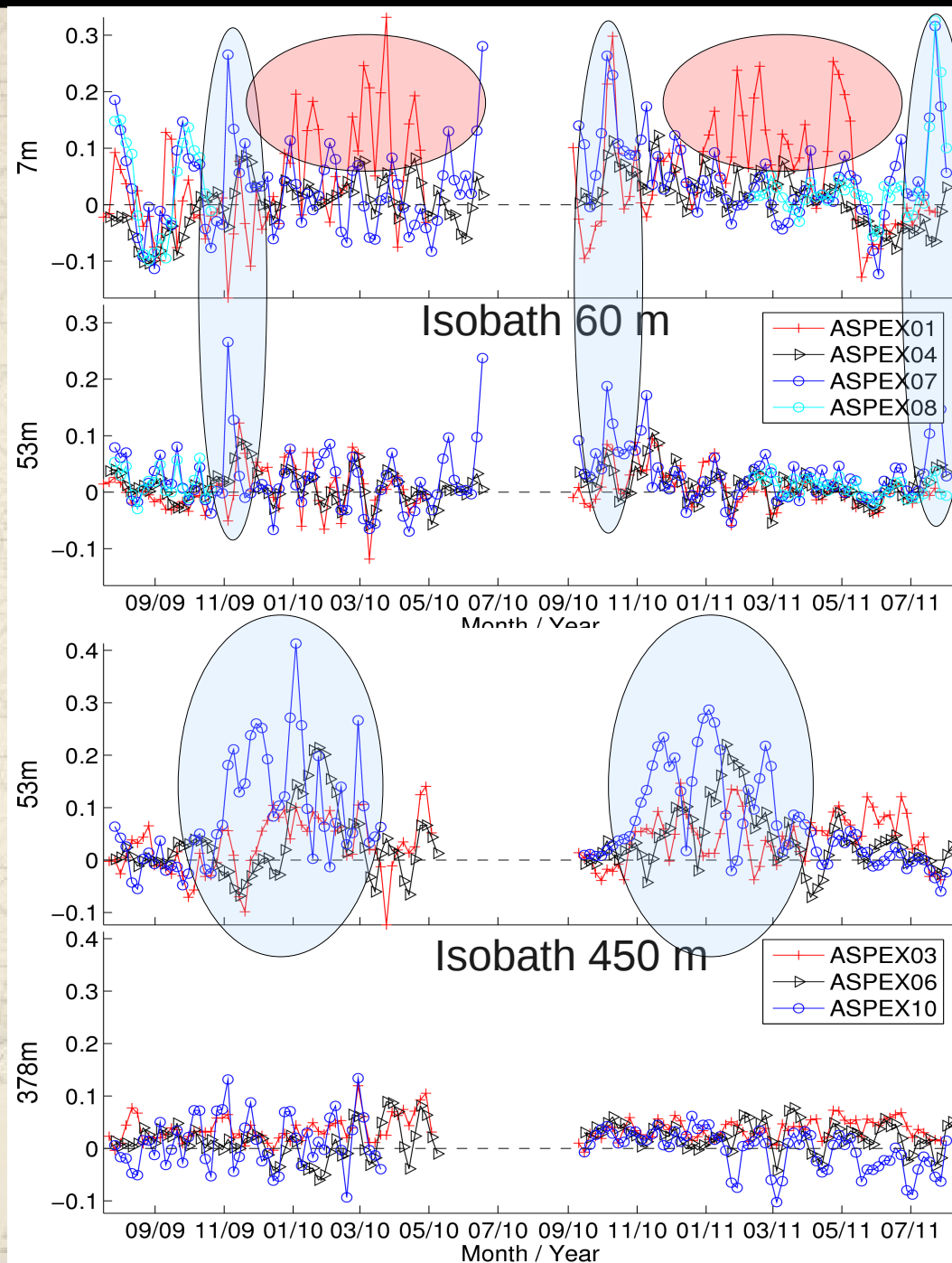


Along Shore Velocities :

Weekly average of the Along shore velocities at the surface and close to the bottom per isobath

Strong current events :

- Isobath 150 m
 Summer/ Autumn at **South** section
 Deep signature
- Spring/Winter at **Penmarc'h** section
 Surface trapped
- Isobath 450 m
 Late Autumn/Winter at **South** section
 ~200 meters deep



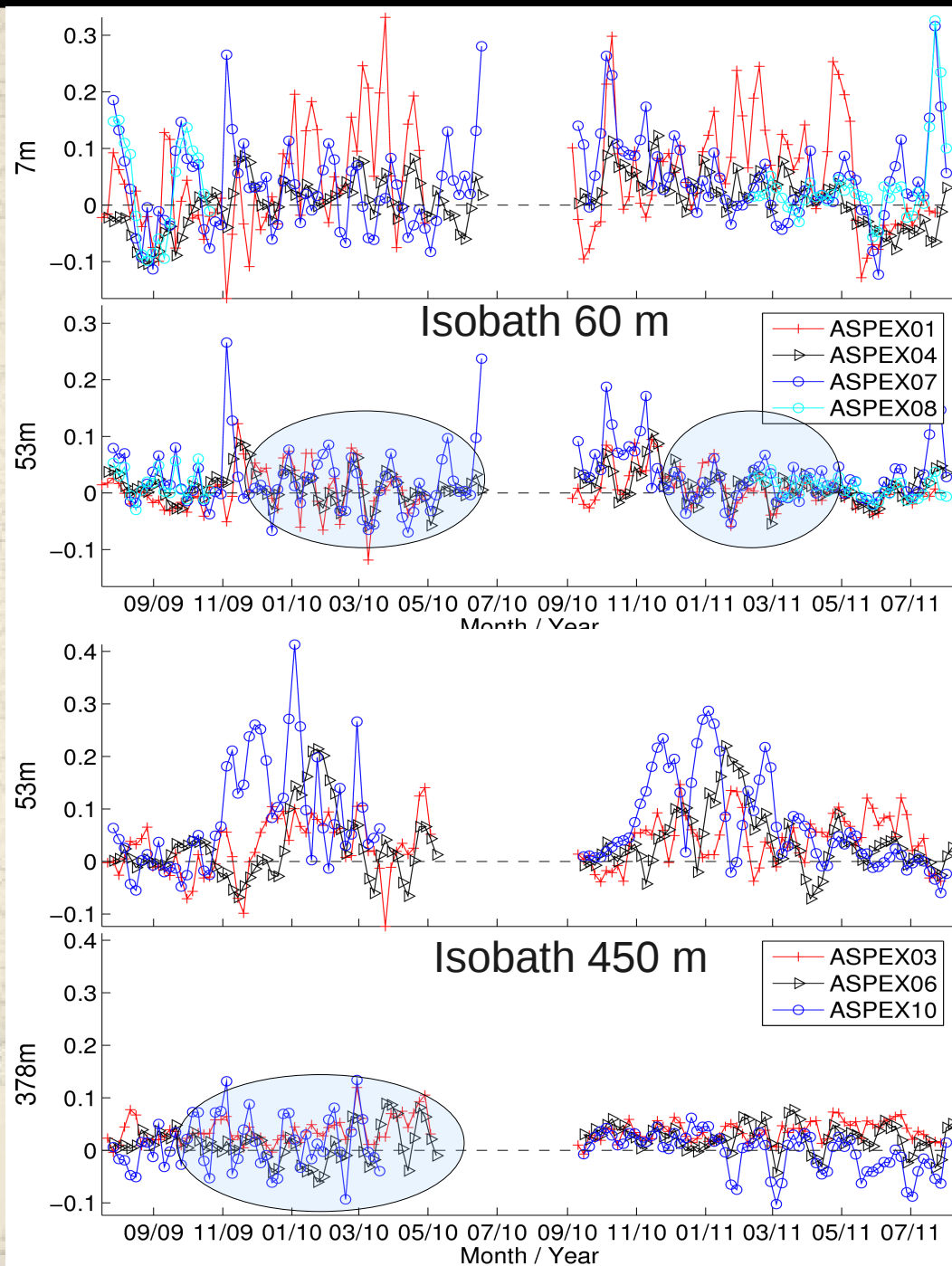
Along Shore Velocities :

Weekly average of the Along shore velocities at the surface and close to the bottom per isobath

Spatial coherence of the circulation :

- at the bottom

Oscillation over all the domain in winter/spring or fast propagation (< a week)

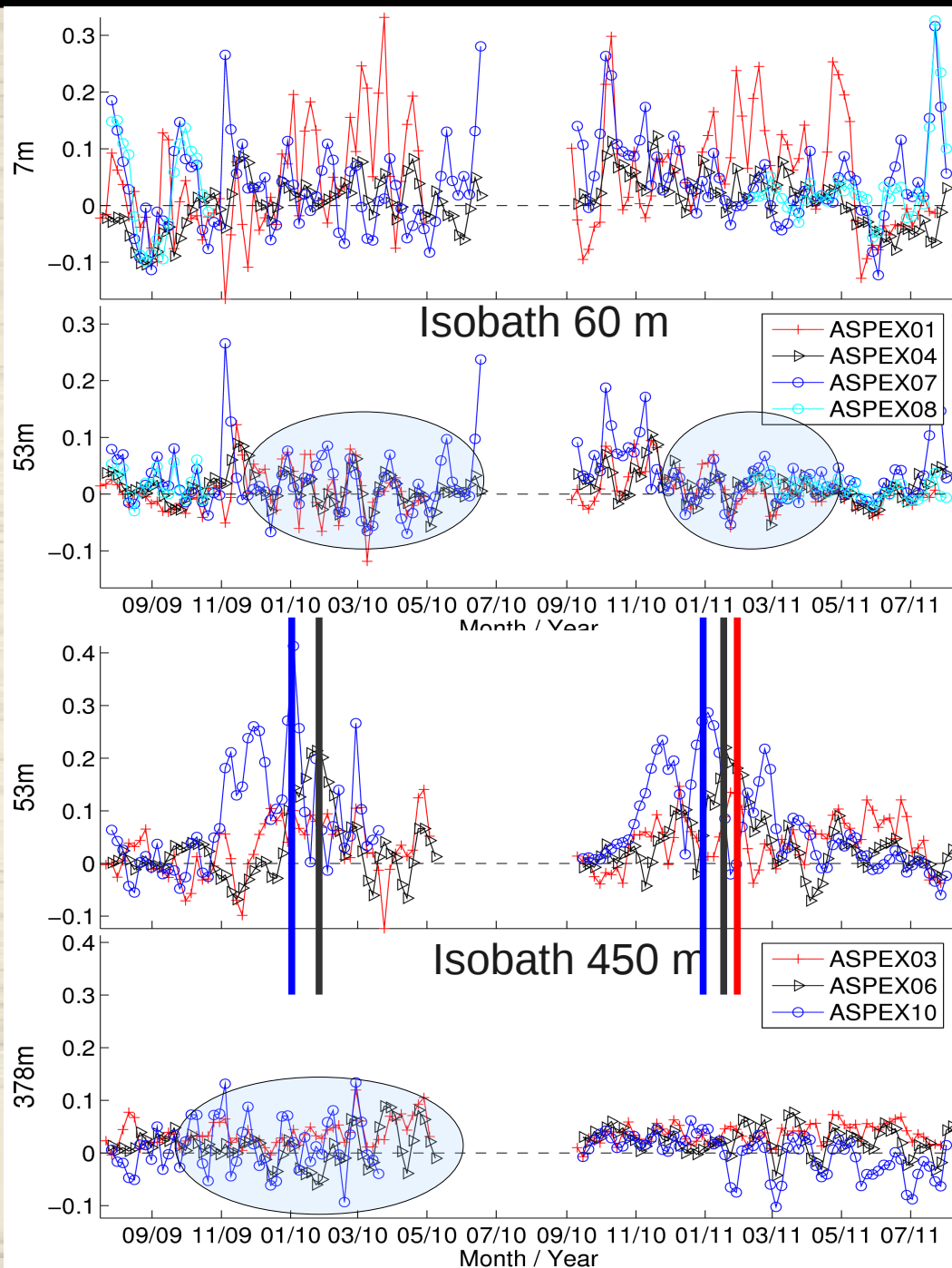


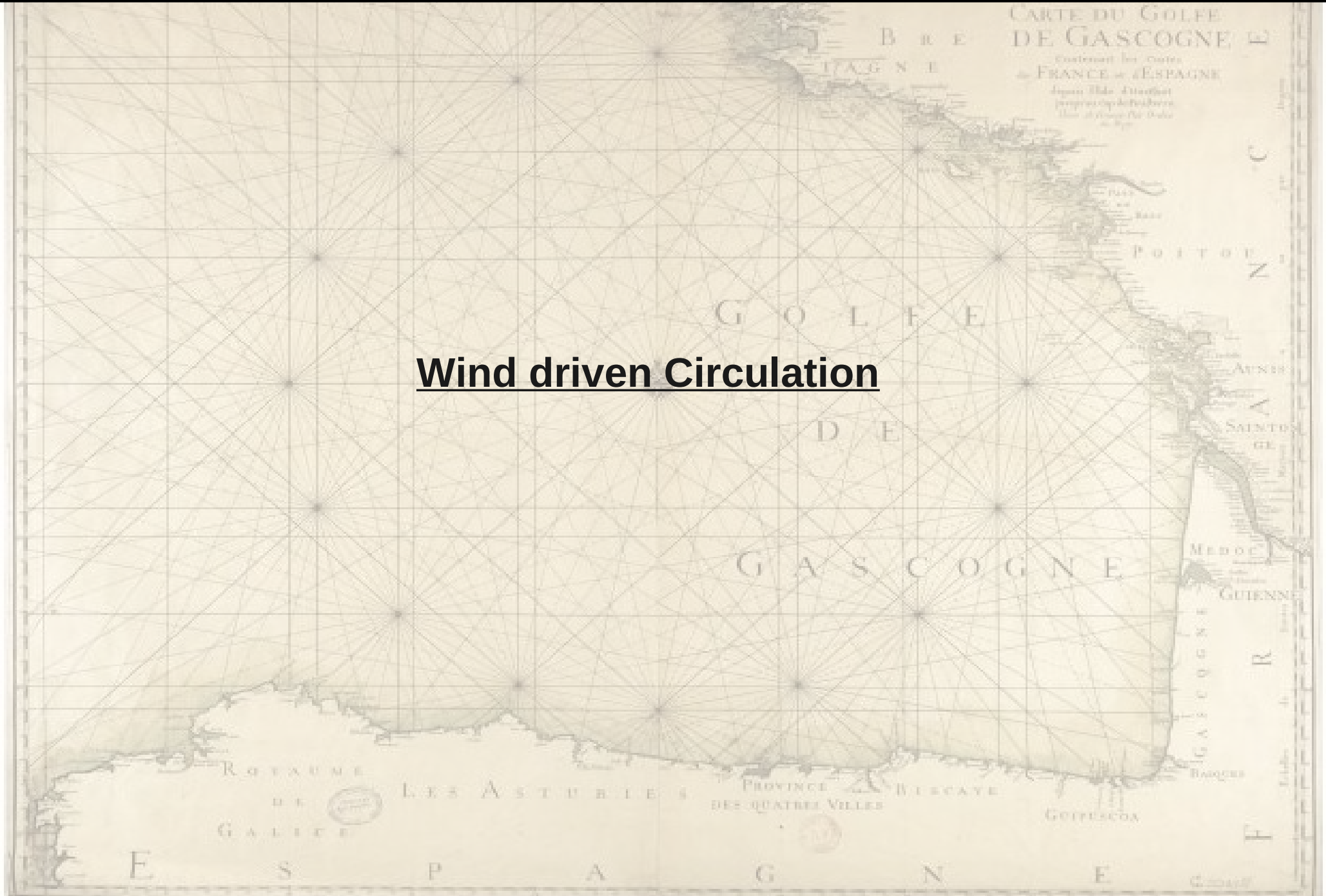
Along Shore Velocities :

Weekly average of the Along shore velocities at the surface and close to the bottom per isobath

Spatial coherence of the circulation :

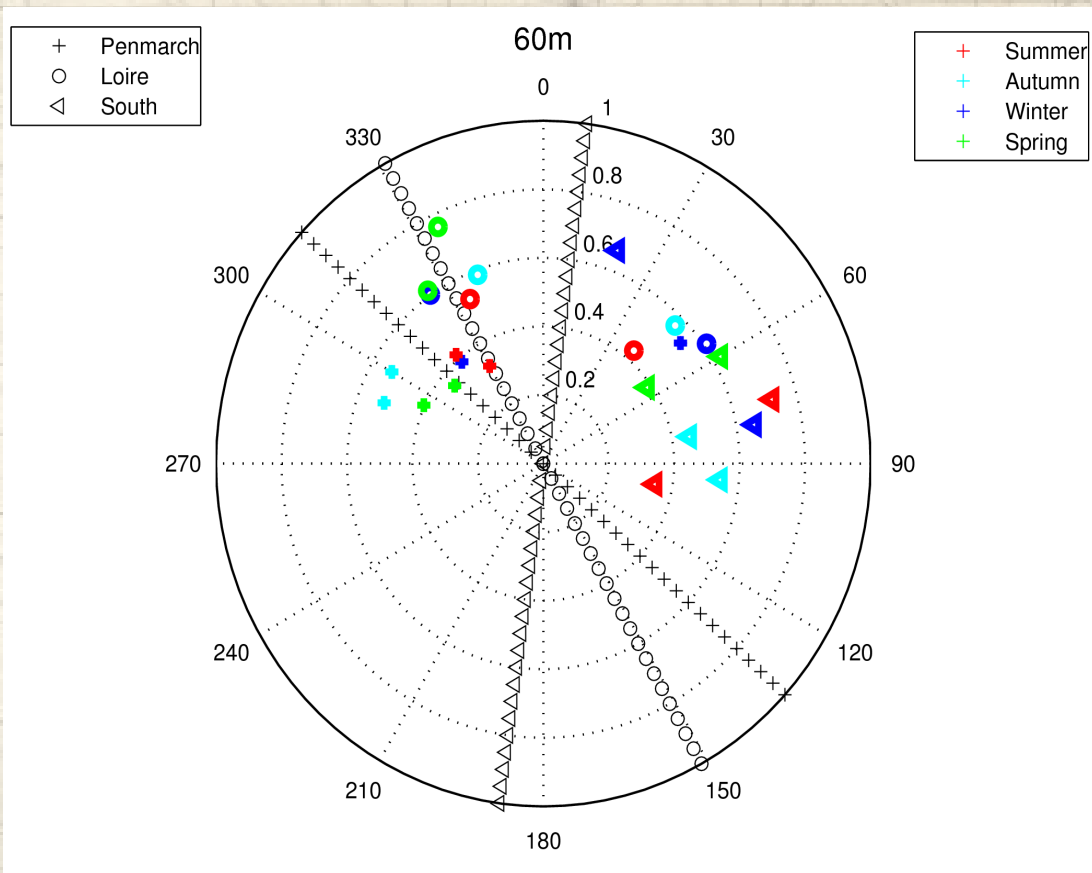
- at the bottom
 Oscillation over all the domain in winter/spring or fast propagation (< a week)
- at the surface (isobath 450m)
 Northward propagation ~ a month





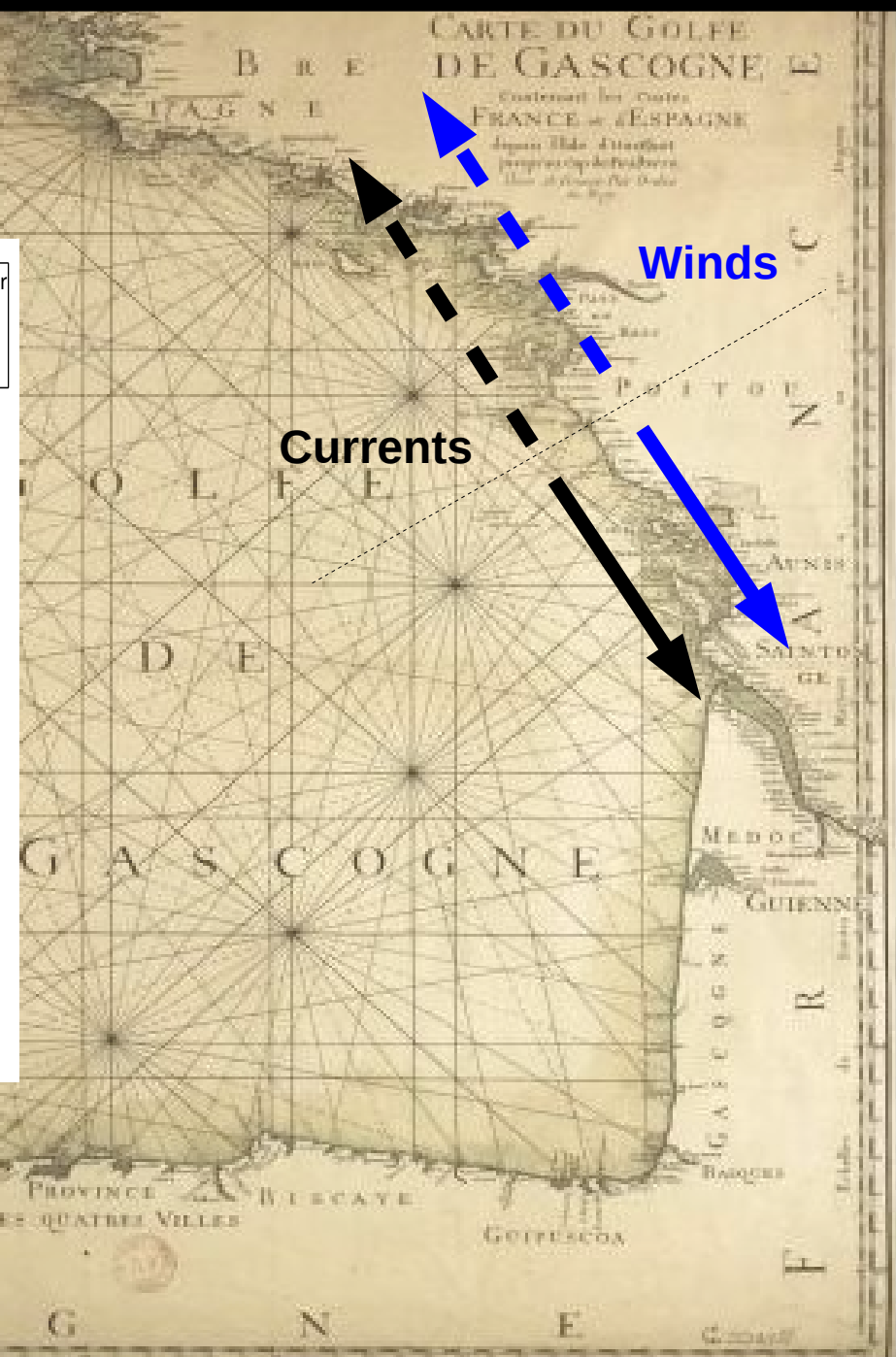
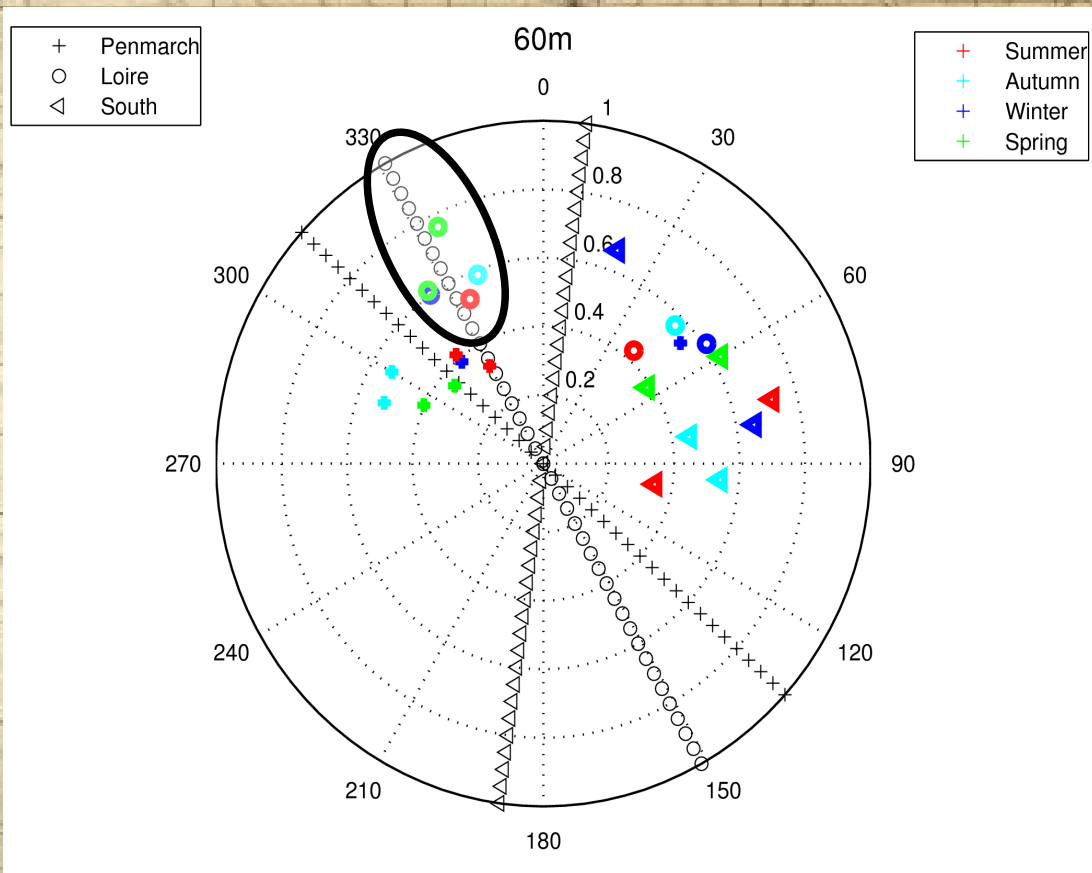
Wind driven Circulation

Wind/ Current correlation :

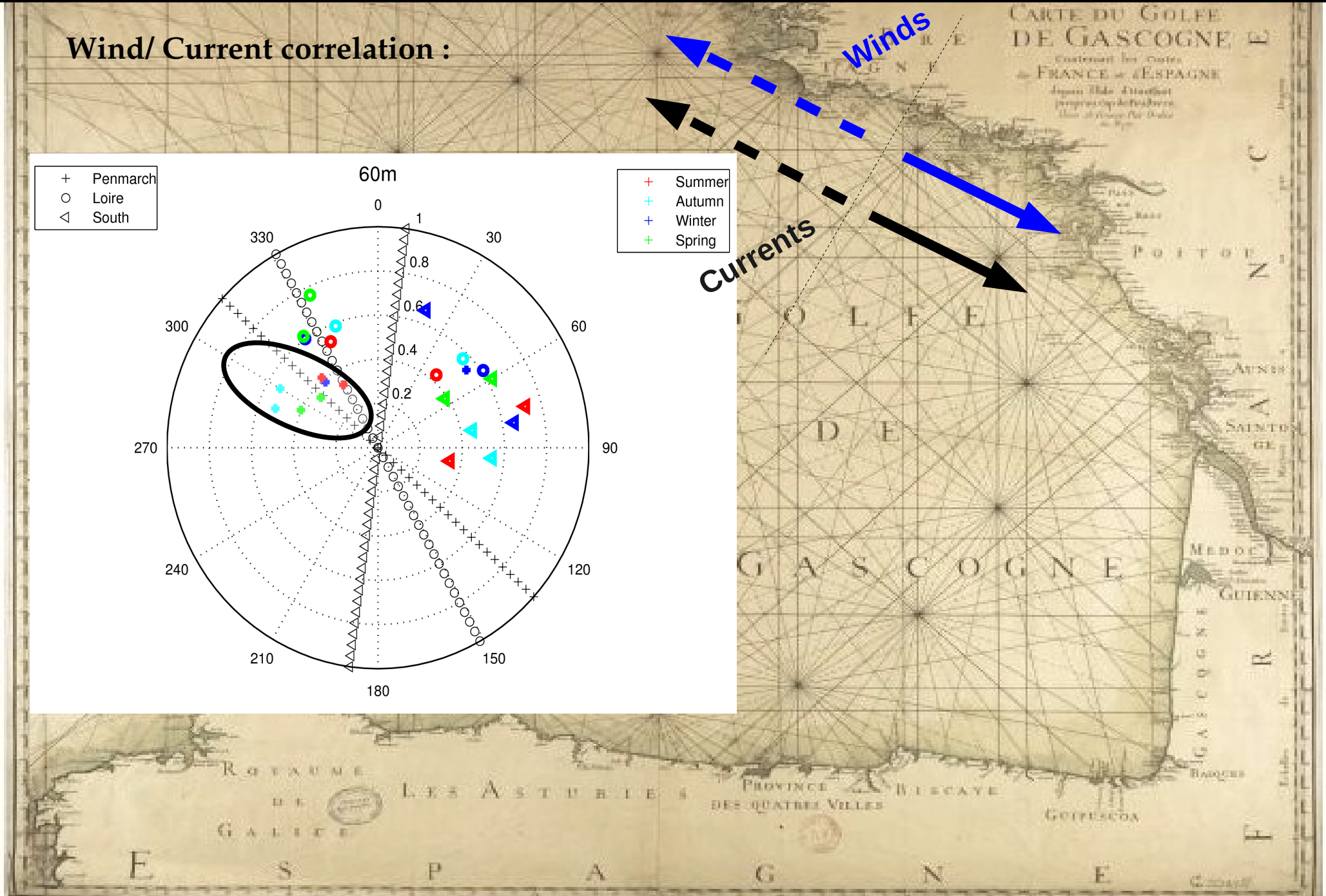
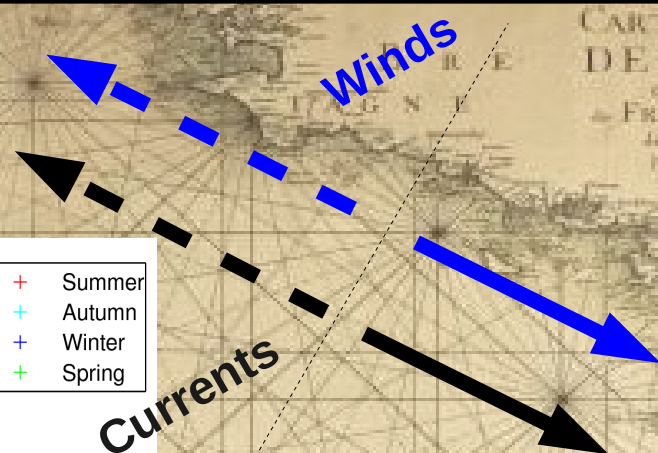
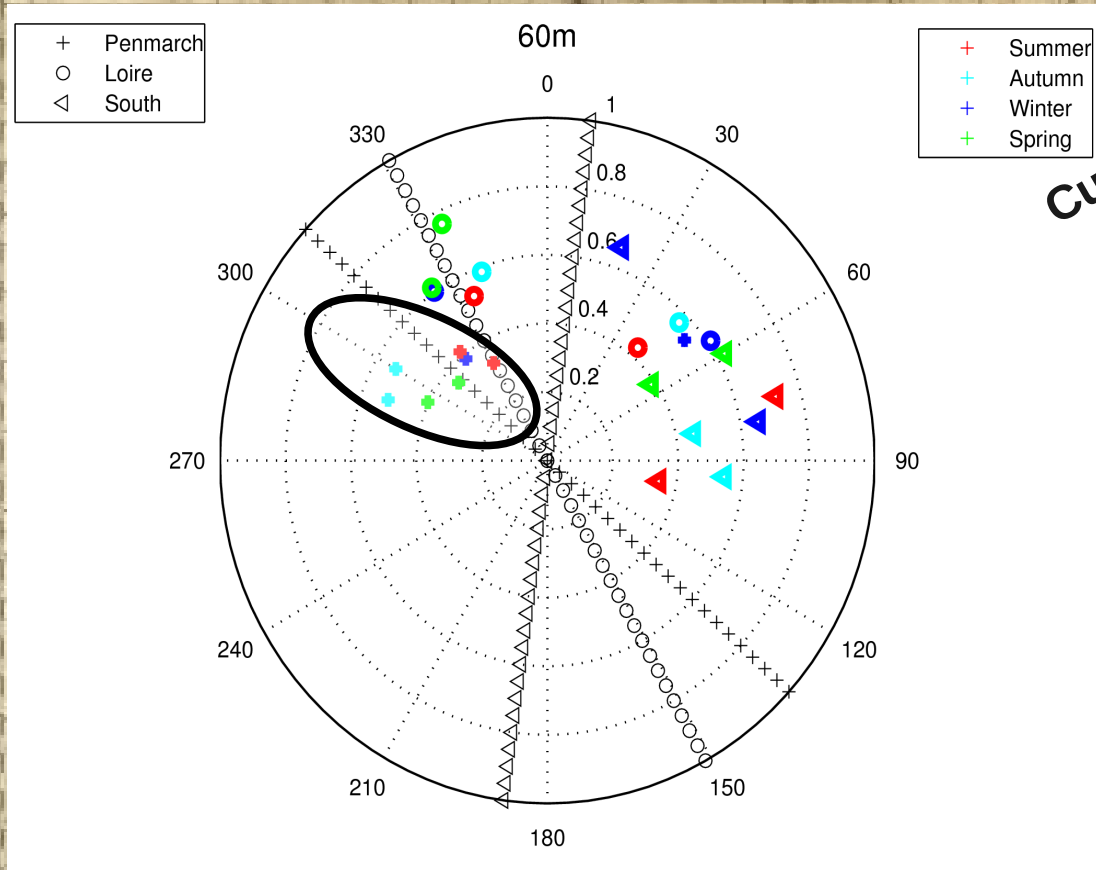


Time lag correlations between along shore currents and oriented winds

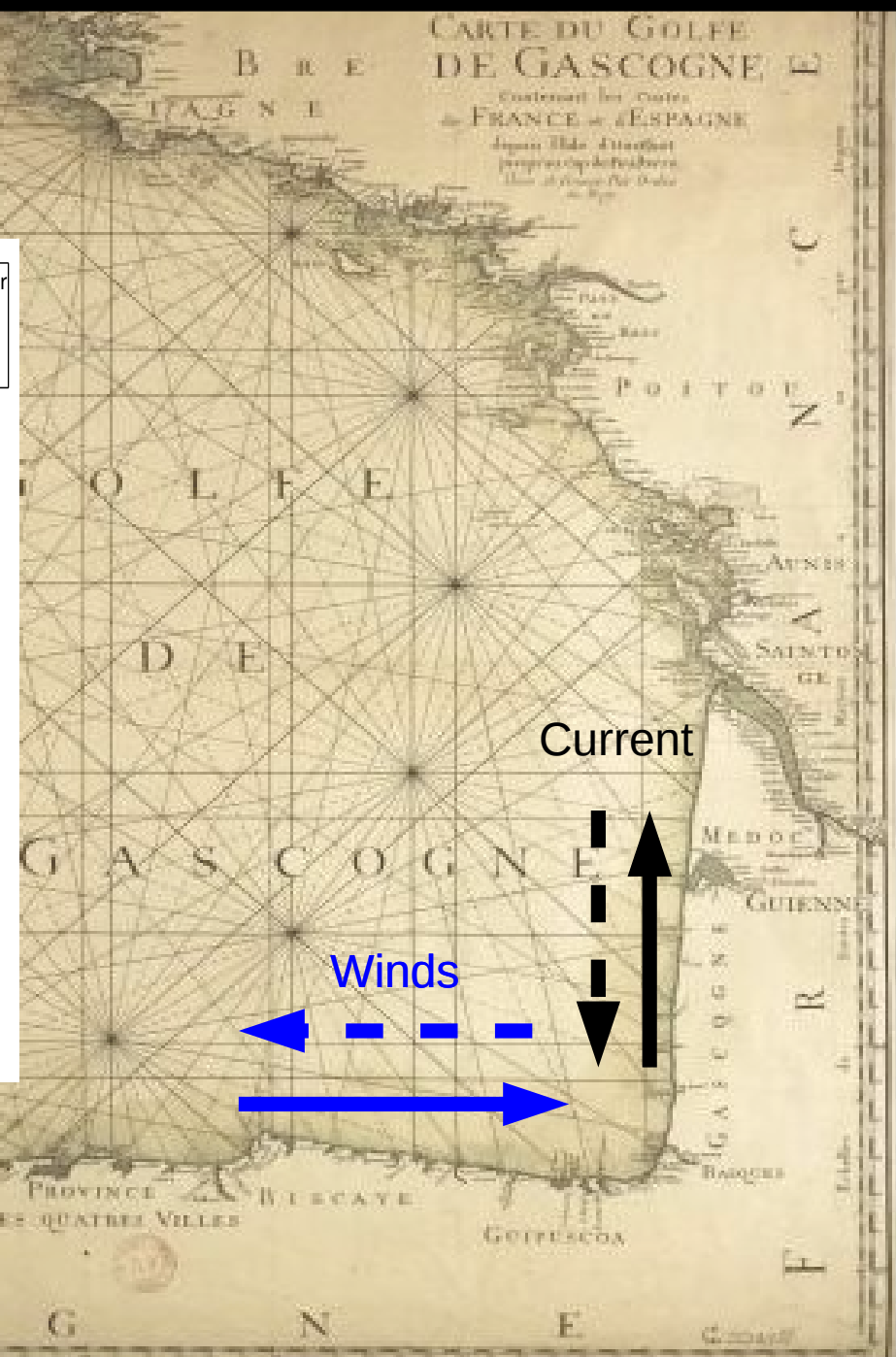
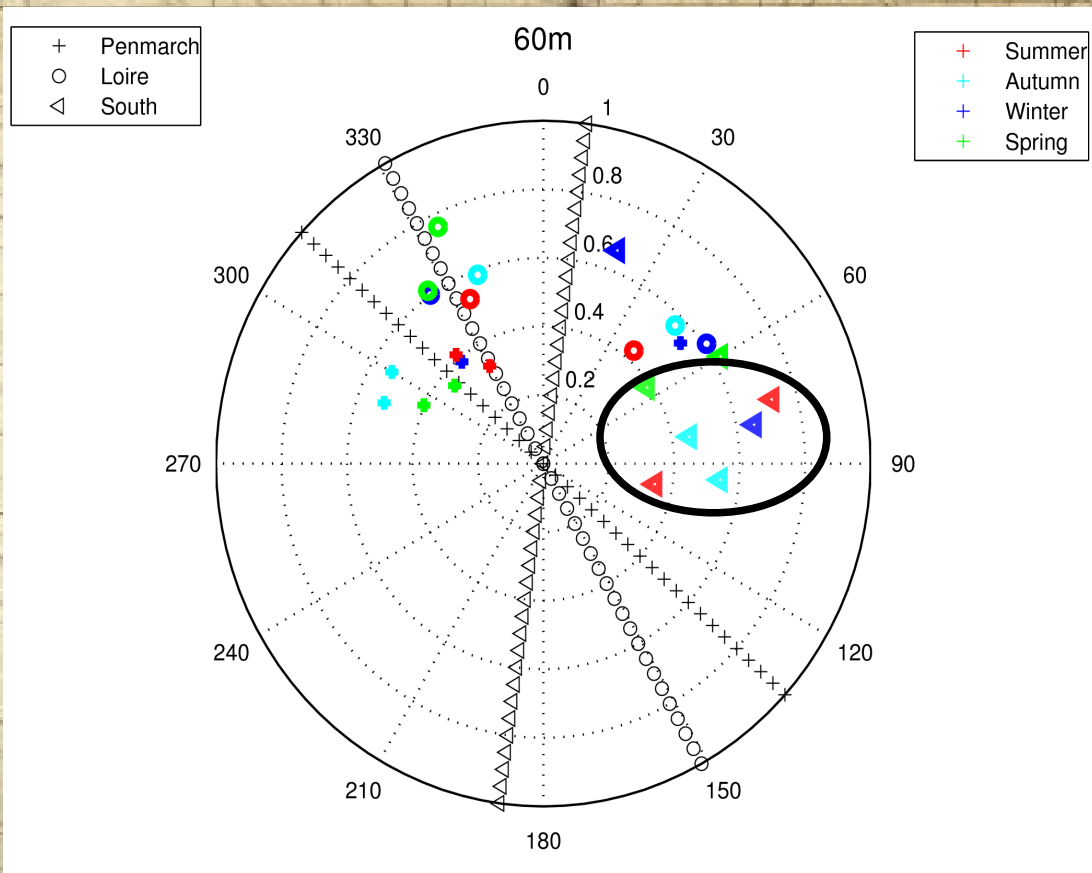
Wind/ Current correlation :



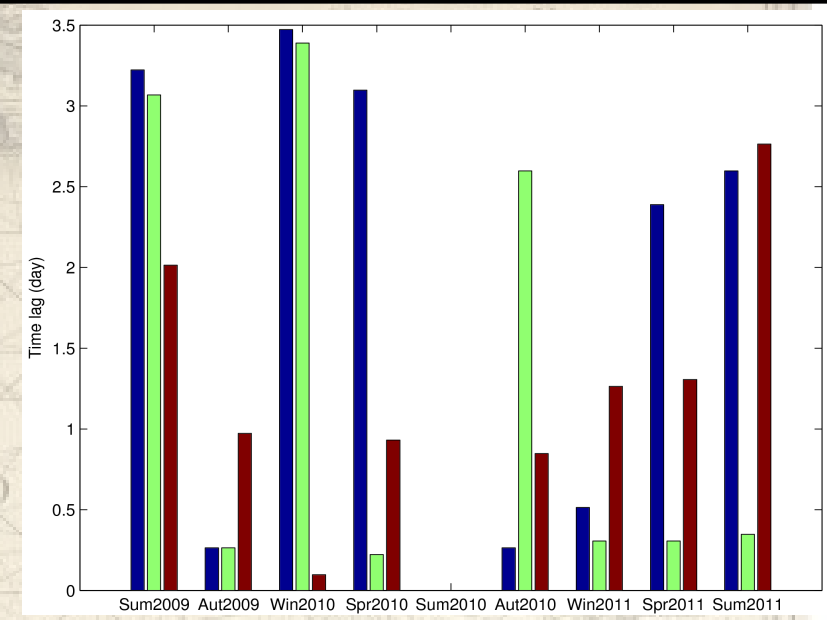
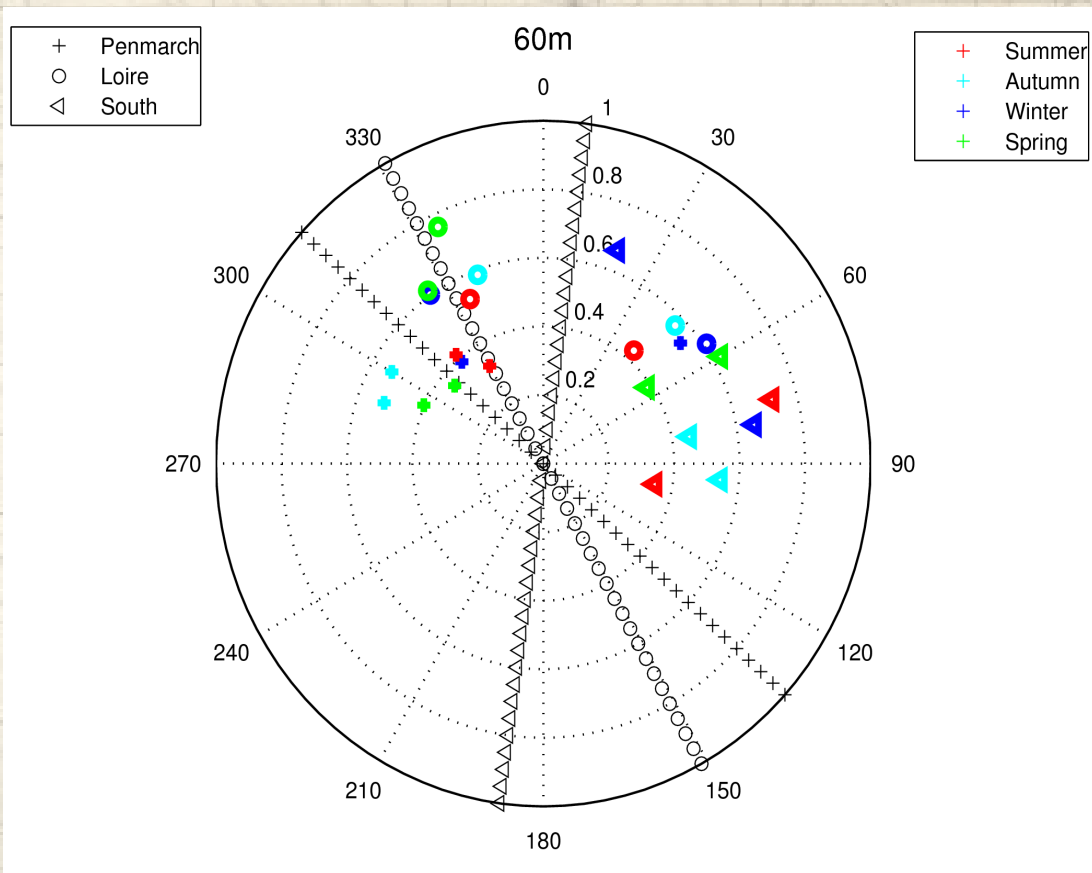
Wind/ Current correlation :



Wind/ Current correlation :



Wind/ Current correlation :



Short time lag = Frictionnal Model

$$v_t + \frac{rv}{H} = \frac{H}{\rho} \nabla_h \tau_{wind}$$

Time lag > a day :
 Remote forcing adjustment
 - Coastal trapped Waves ?

Conclusion:

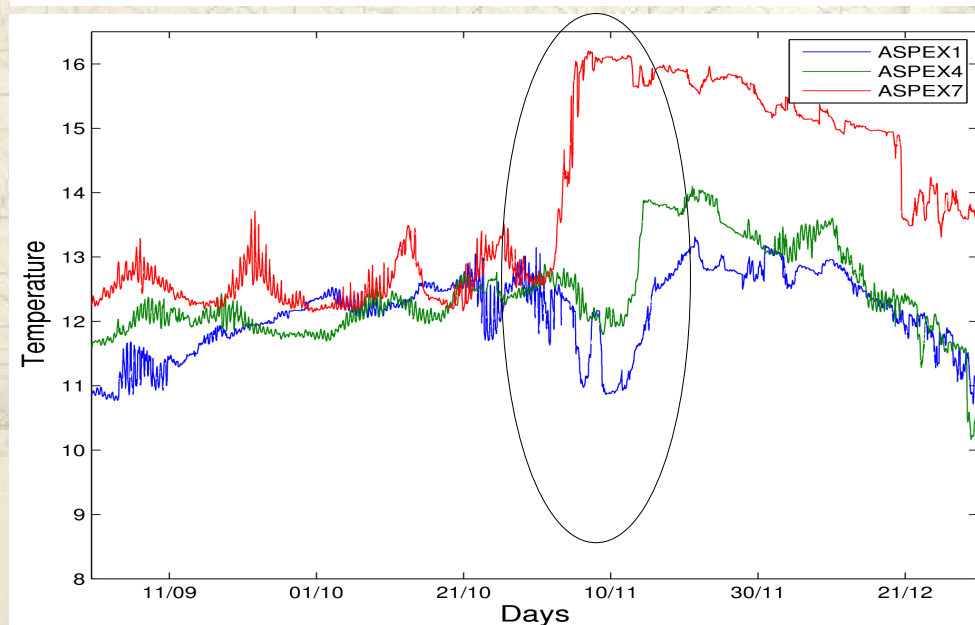
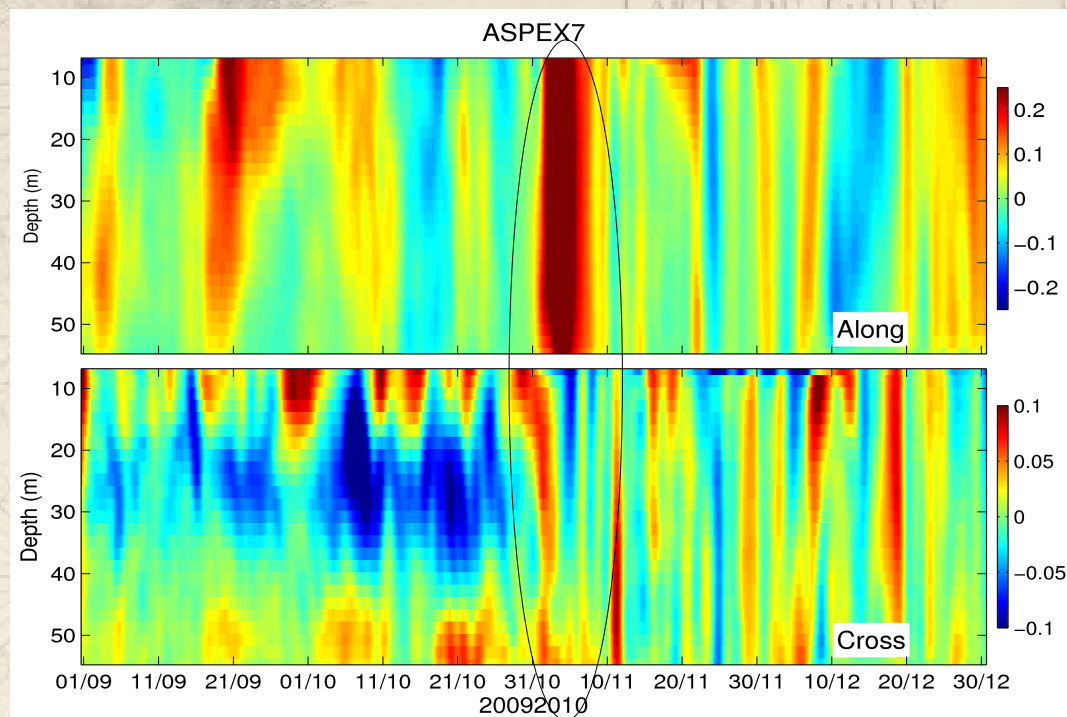
- ASPEX project : Observation of the Shelf/Slope circulation over all the Bay of Biscay for 2 years. It allows for the first time a **quantitative description of the seasonal Bay of Biscay circulation**.
- The circulation is characterized by a **Poleward current** with seasonal and spatial variation. Summer winds drives a mean Equatorward surface trapped flow.
- The circulation in the **middle** of the Bay of Biscay is **driven by the wind....**
 - ... In the **north**, the long time lag correlations would suggest an adjustment to wave propagation and the low correlation suggest some other driven mechanism ...
 - ... In the **south**, the circulation is remotely forced by the wind driven circulation of the North Spanish coast.

Scientific Perspectives : Remote forcing of the Spanish coast wind driven circulation

Strong Poleward current events
occurs in Autumn.

They are associated with an increase
of the bottom temperature about 4°C
with a Northward extension reaching
Penmarc'h.

(Batifoullier et al.2011)



Personal Perspectives





Thanks
for your attention