Surface circulation in the Irise Sea from HFR observations: results & perspectives

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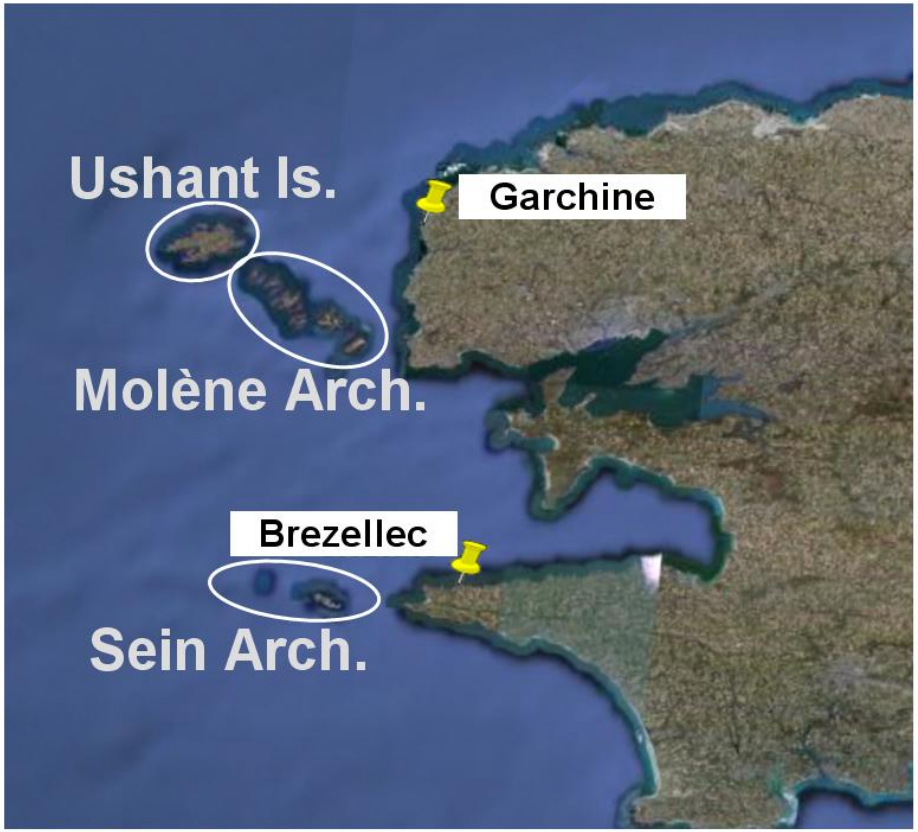
* LSEET

** LOG

***IFREMER

Site and radar implementation

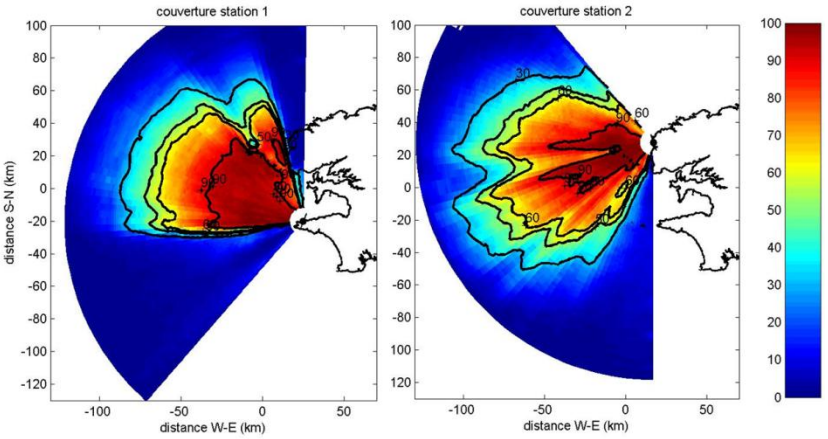


Iroise radars

- 12 MHz
- long time series (from 2006 to date)
- time resolution: 1/3 h
- resolution: 1.5 km along beam

  2 in azimuth

coverage per range pixel %



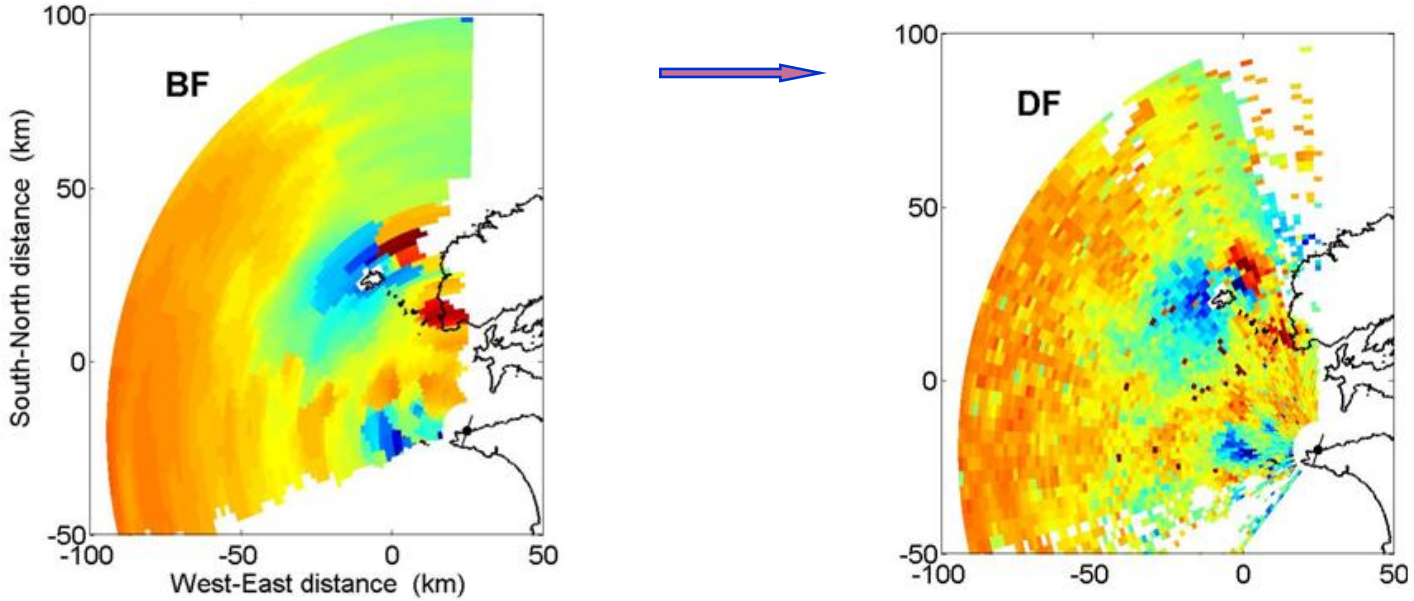
Advanced radar current data

I - MUSIC processing

MUSIC is a method of source direction finding: at a given distance, get azimuth corresponding to a given $V_{Doppler}$

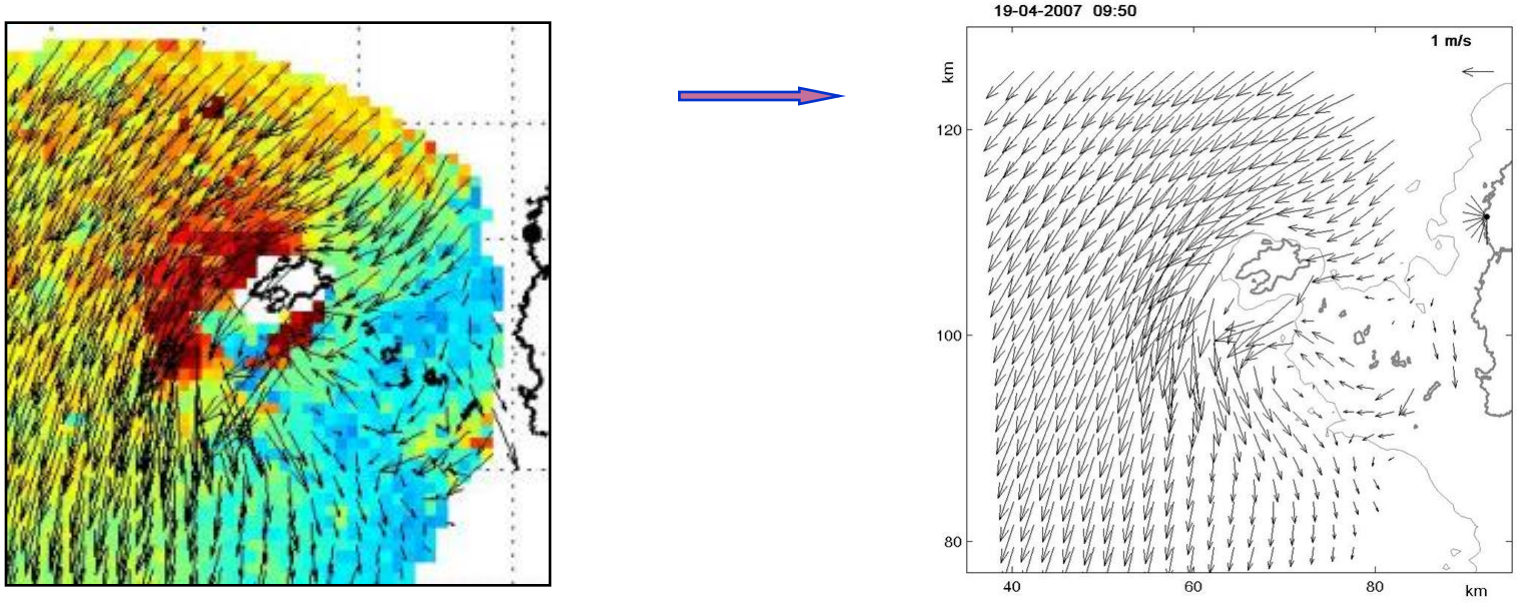
Main advantage : to provides high resolution radial velocity maps, better than traditional beam forming

Outcomes : noise, holes in pixel fields



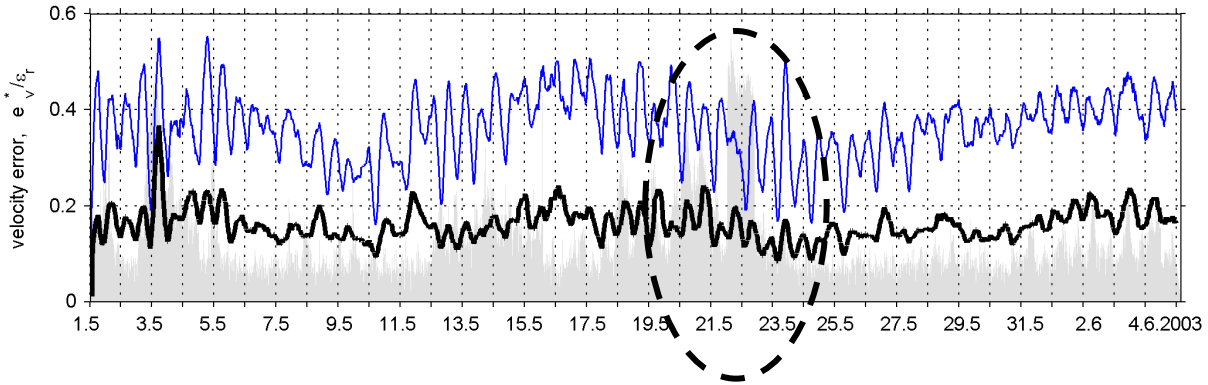
II - Variational interpolation

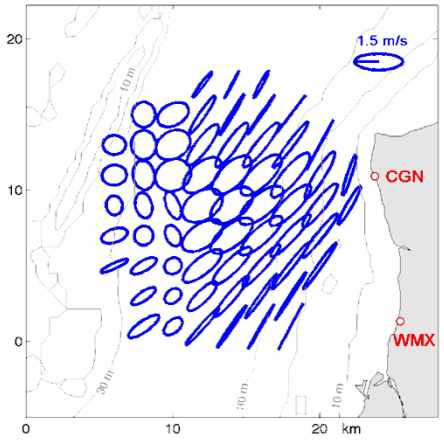
Variational interpolation (2dVar) provides velocity vector maps, gap filling, smoothing, curl and div and interpolation errors

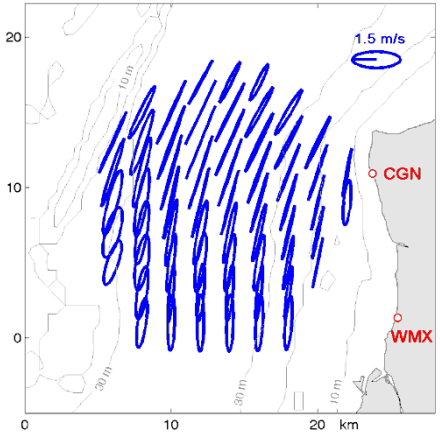


Combined EOF/2dVar technique for vel. interpolation and gap filling

Gray shading: the percentage of gaps in observations. period 21.5-22.5 : only one radar (CGN) was in operation.

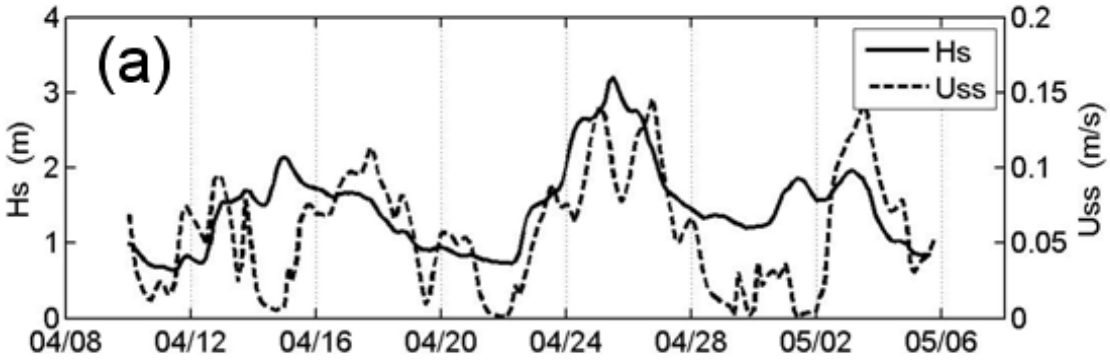


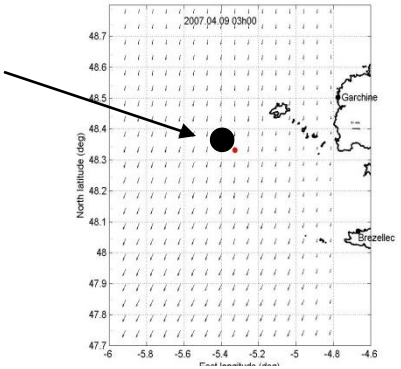


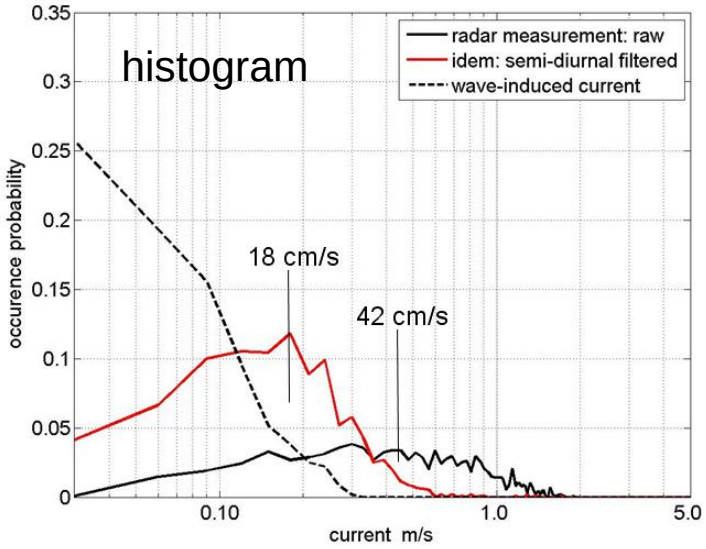


III - Wave influence correction

Wave induced current (U_{ss}) and significant waveheight (H_s) at point



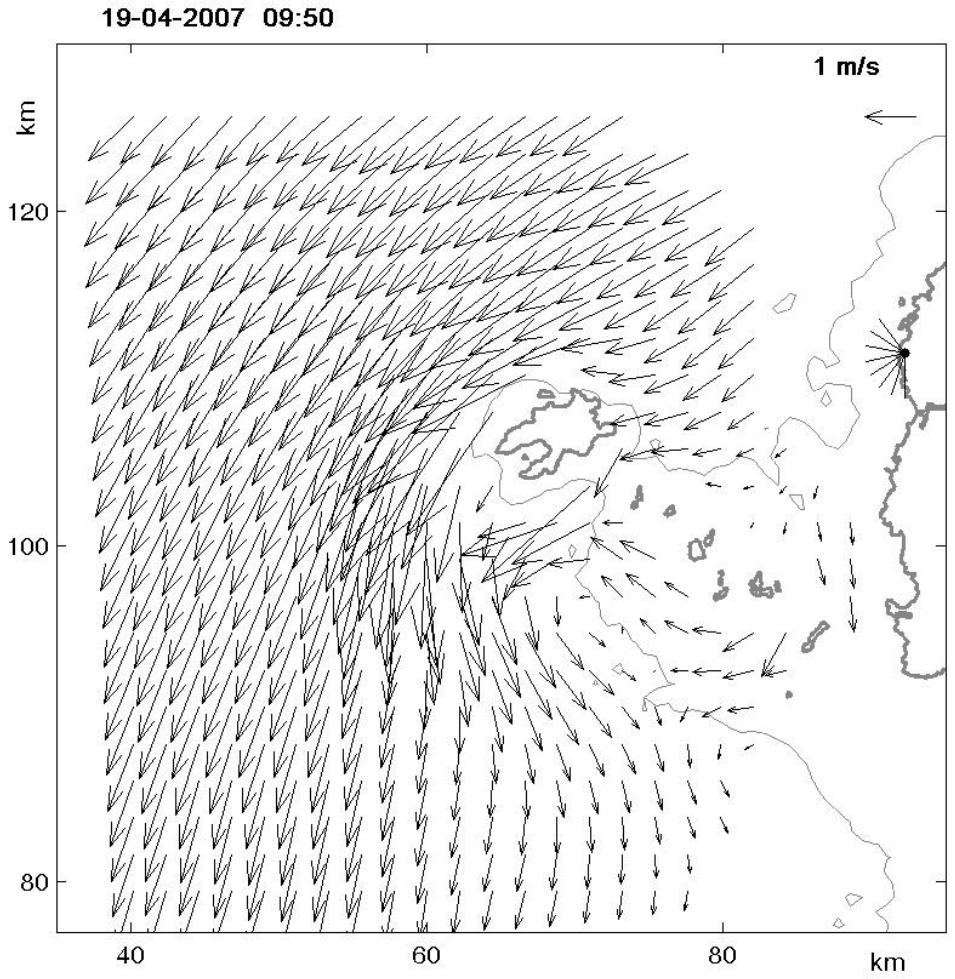




➔ weak but non-negligible contribution of wave-derived surface current for residuals

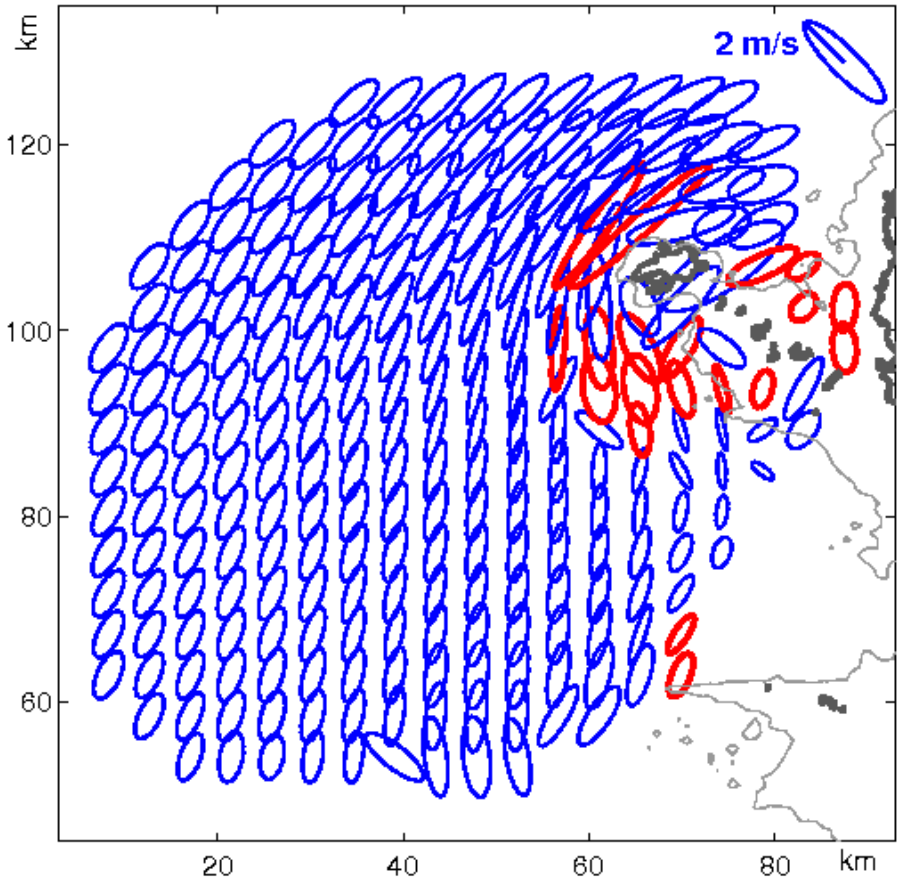
Recent results of circulation in Iroise Sea

int2Dvar maps: one tidal cycle from April 18, 2007: 21h10 to April 19: 09h50



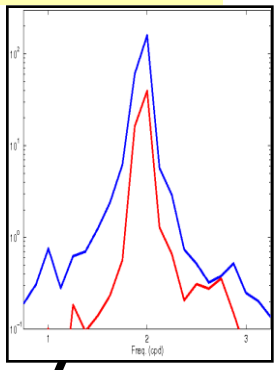
Tidal currents

PCA - derived synthetic ellipses during primary spring tide (7-d averaged)



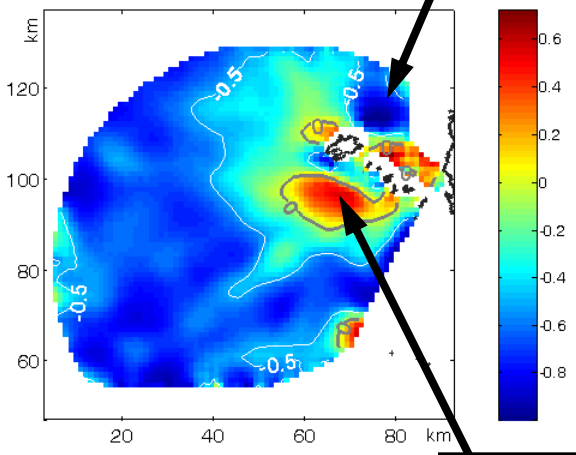
red: ccw rotating current vectors
blue : cw rotating

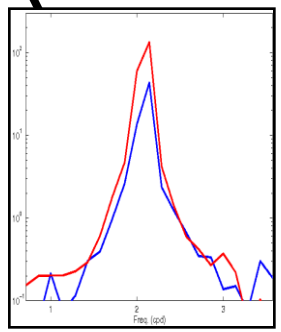
Rotary power spectra



rotary coefficient

$$r = \frac{S^+ - S^-}{S^+ + S^-}$$



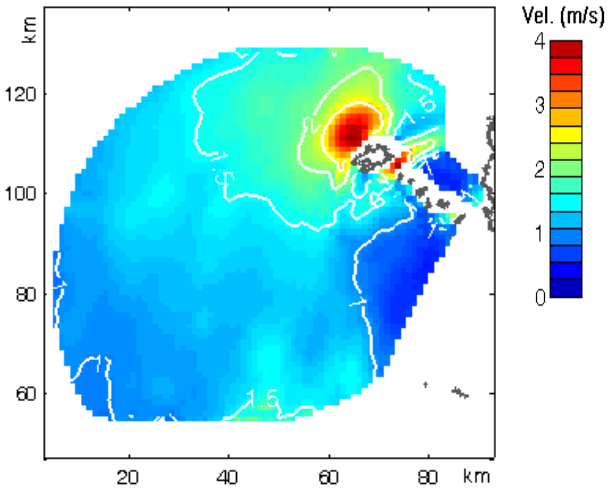


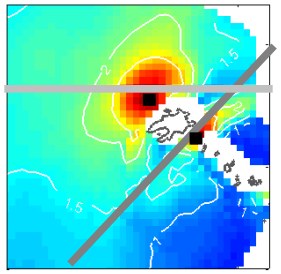
***r* < 0 for cw motion**

***r* > 0 for ccw motion**

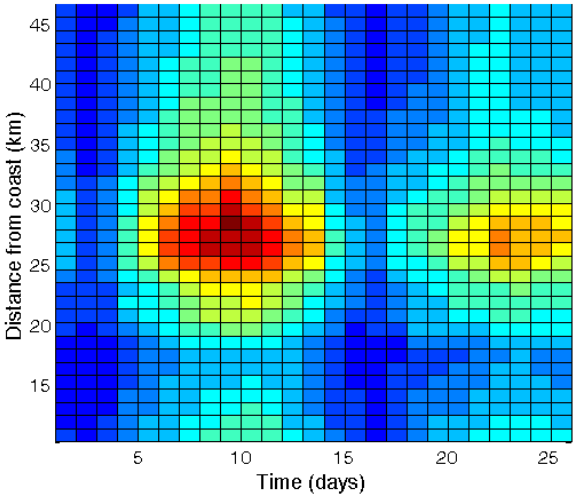
***r* = 0 for unidirectional flow**

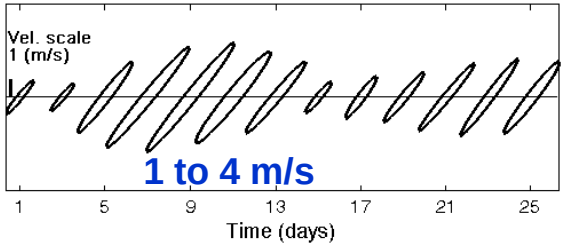
Time/Space variations of the amplitude of tidal currents 10 Apr – 5 May 2007



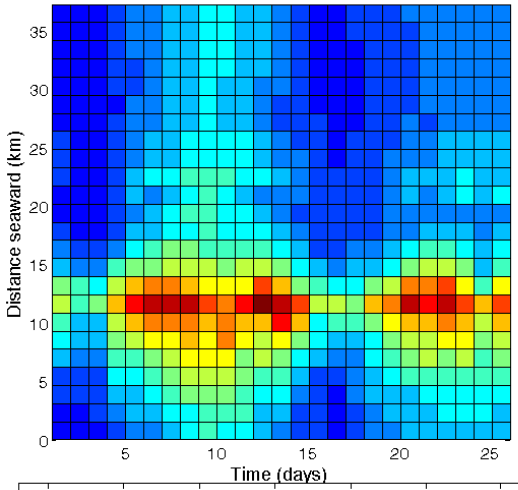


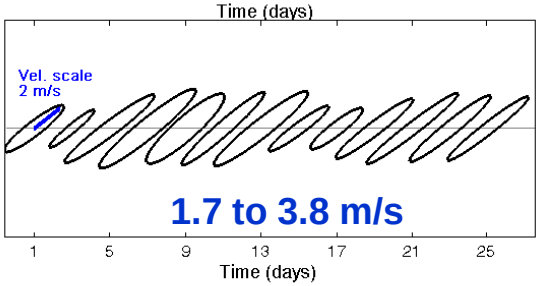
W-E line





SW-NE line





Spatial variability

Max velocity ranges 0.7 to 4 m/s

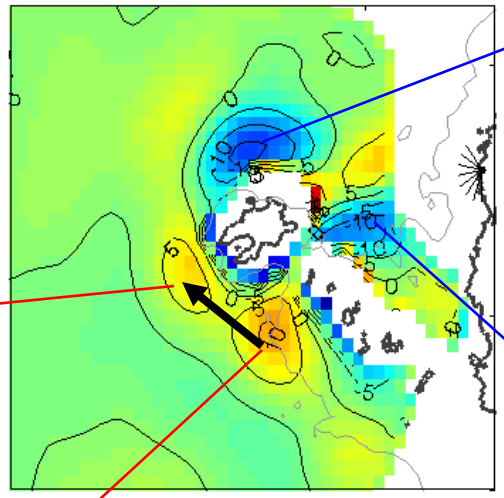
Min velocity ranges from 0.2 to 1.7 m/s

Tidal constit.	M2	S2	N2	M4	MS4	2MN6	M6	2MS6
A: Ushant	1.74	0.92	0.47	0.15	0.16	0.06	0.06	0.08
B: Fromveur	2.09	0.83	0.35	0.12	0.09	0.12	0.16	0.20

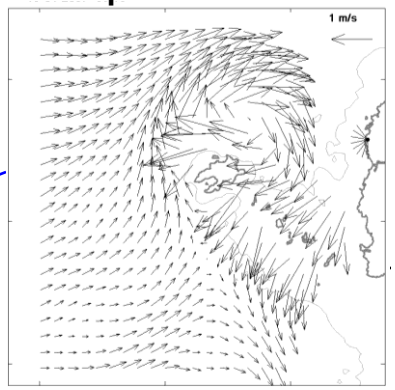
Tidally generated eddies

Flood

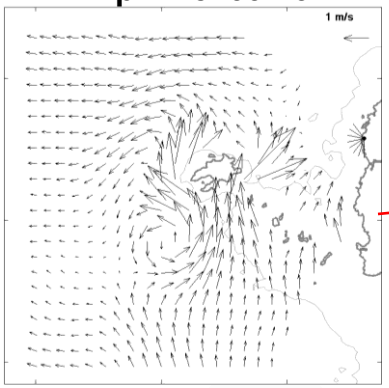
Average vorticity field (25 days)



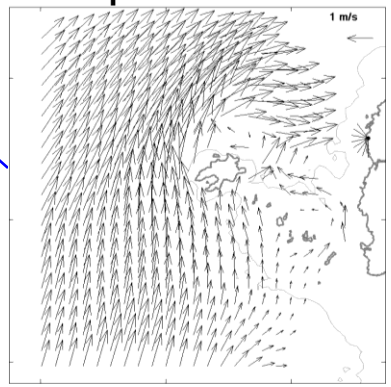
April 19 06:10



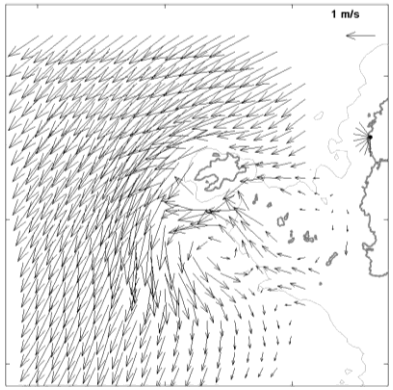
April 19 00:10



April 19 04:10



April 18 22:10

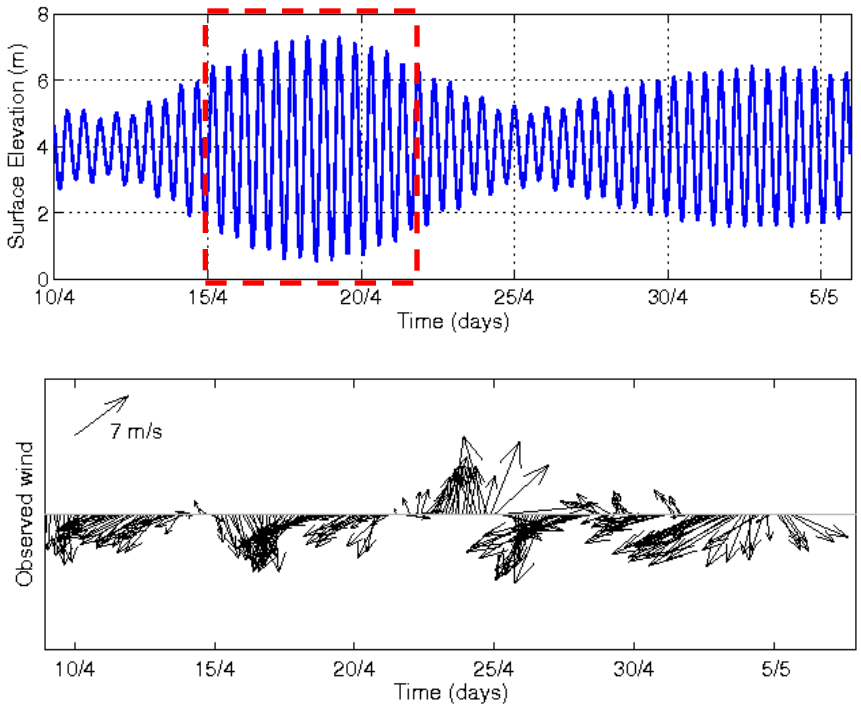


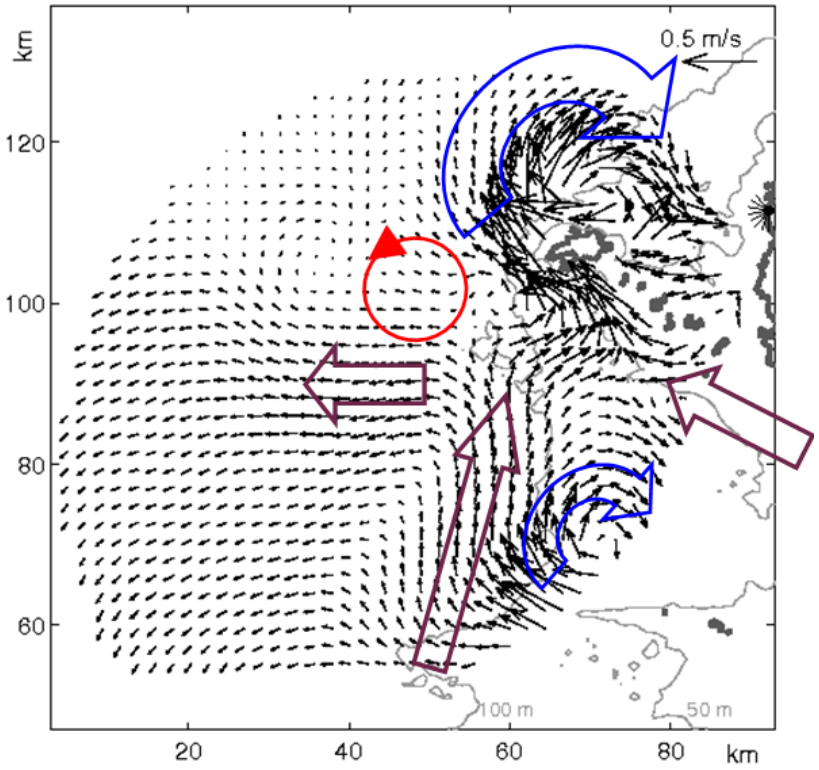
Ebb

- generation by bottom friction
- advection by tidal currents
- time-averaged vorticity of opposite sign appears on both sides of a cape or island

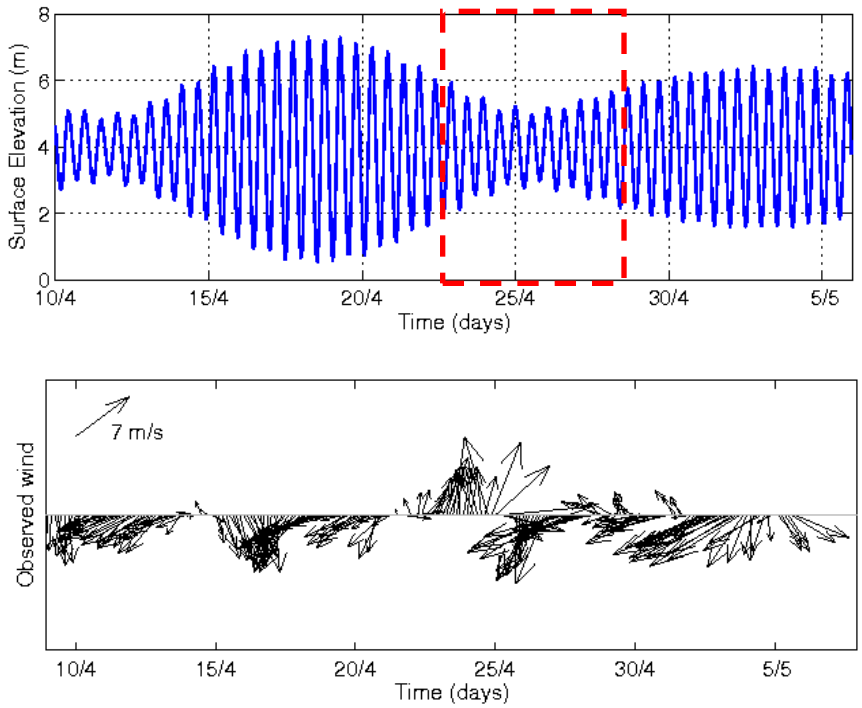
Residual currents

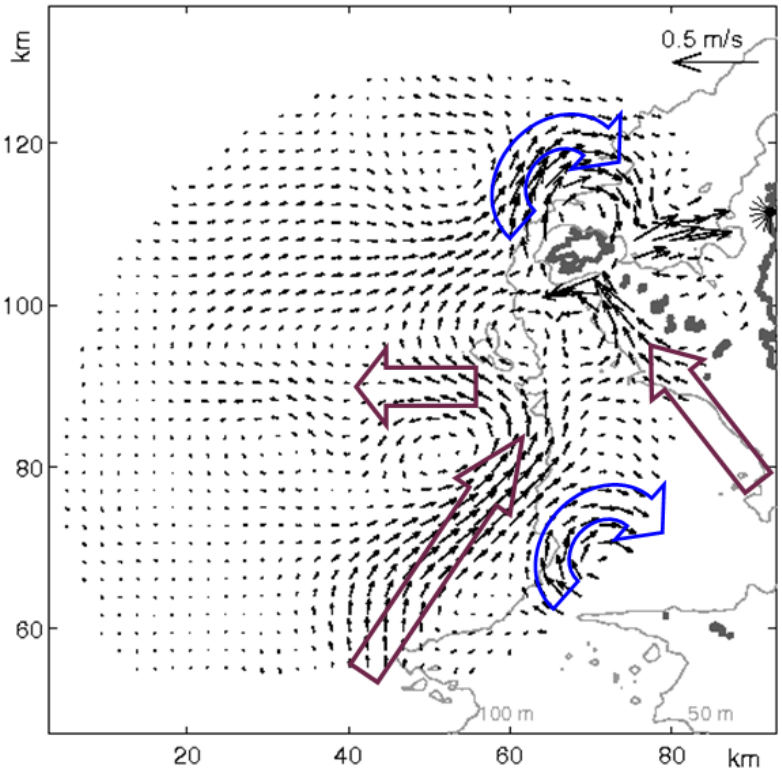
Spring





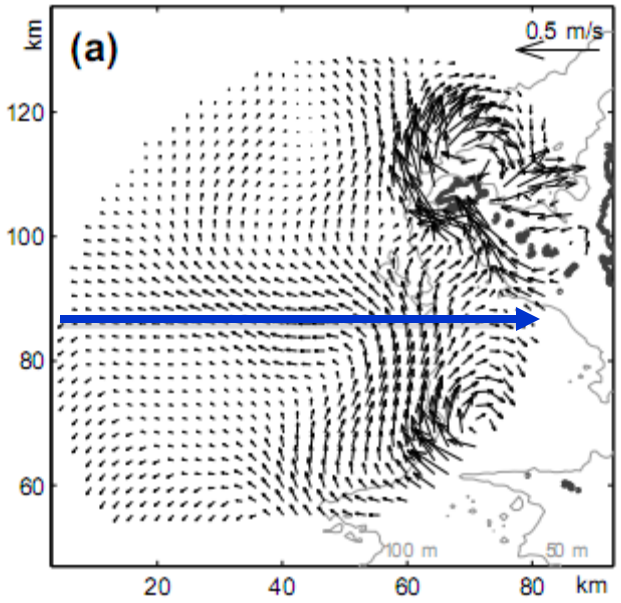
Neap



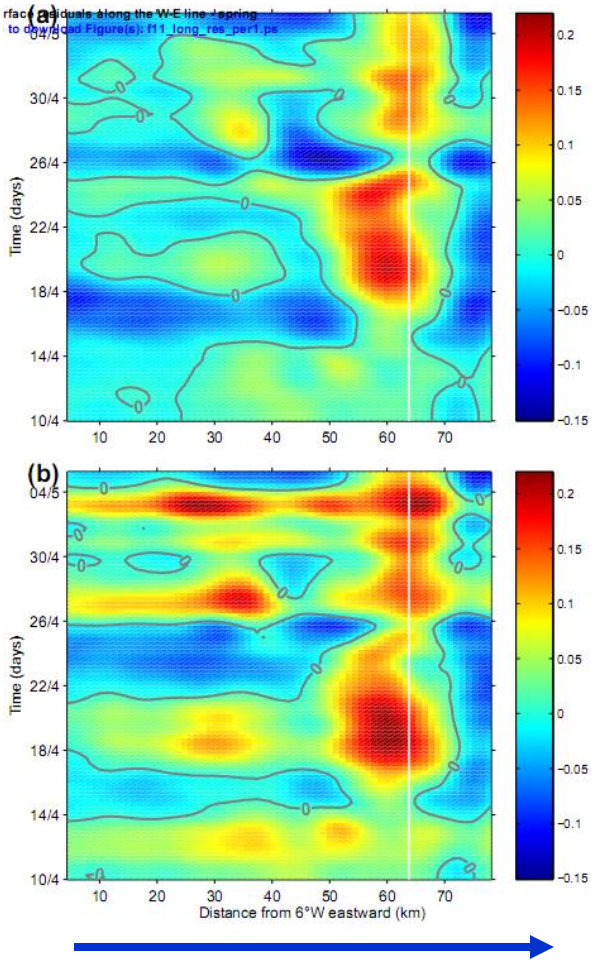


Features:
- high velocity values (up to 0.5 m/s)
- rotational field (permanent eddies)
- control of the RC by bathymetry
- off-shore and near-shore jets
- pronounced fortnightly variability

mid-spring : 10 Apr – 5 May 2007



de-tided current



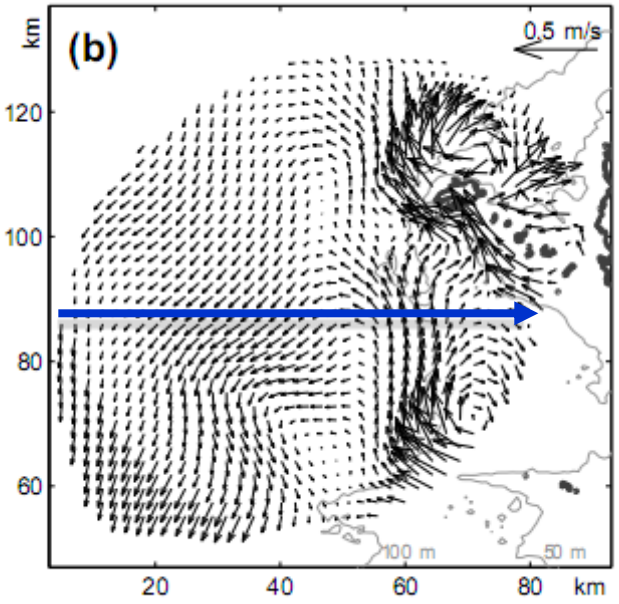
de-tiding: diurnal, semidiurnal, inertial filtering => 1% variability left

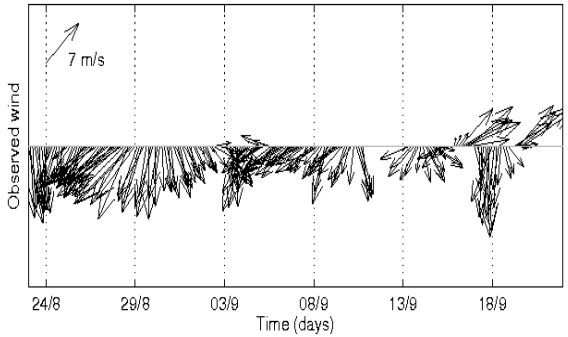
minus wave & wind influence

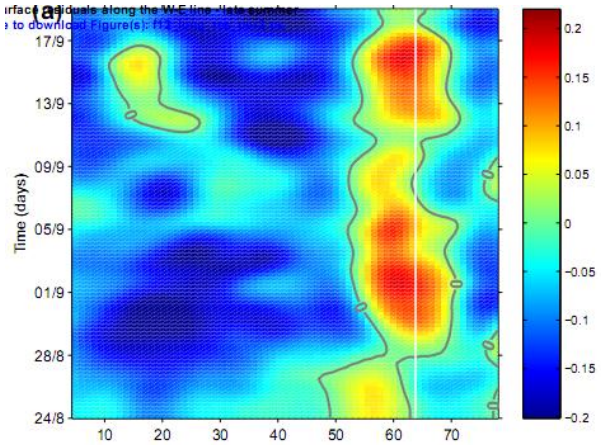
late summer : 24 Aug – 19 Sep 2007

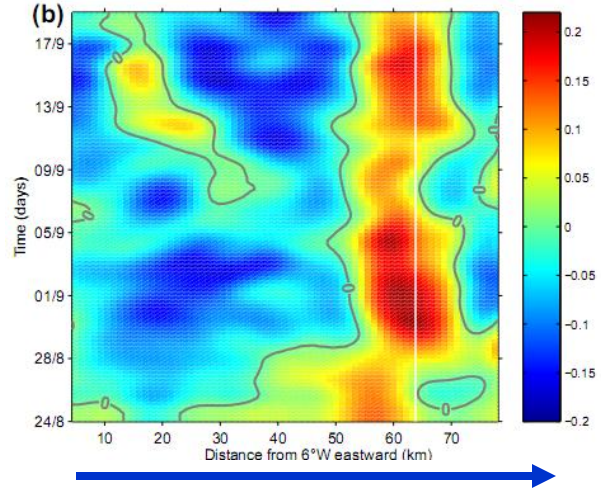
Ushant thermal front

de-tided current

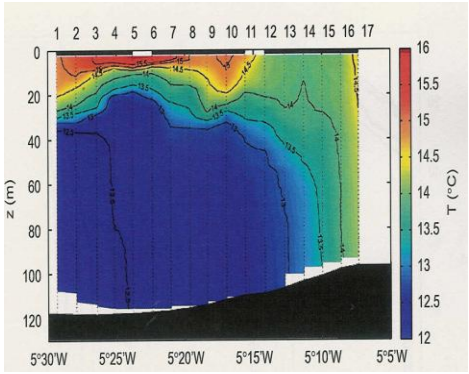




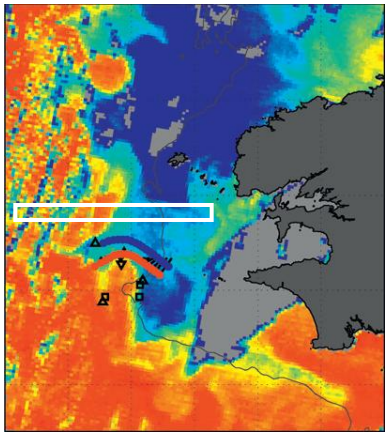




Temp. 48 N section on 14 Sep, 2007 (*Le Boyer et al., CSR 2009*)



SST on 14 Sep 2007 from MODIS



de-tided current minus wave & wind influence

➔ **Signature of the Ushant thermal front**

Paper

Sentchev A., Forget P., Barbin Y., Yaremchuk M. 2010. Surface circulation in the Iroise Sea (W. Brittany) from high resolution HF radar mapping, *J. Marine Systems*, en révision.

Presentations

- Sentchev et al. *EGU 2010*, Vienne May 24-27 2010

- Marié L. et al., *ISOBAY*, IUEM-Brest 3-6 May 2010

- Sentchev A. et al. *Workshop HF Radar Systems for monitoring surface currents*, AZTI, San Sebastian, 28-29 Oct. 2010

- Forget P. et al. *Workshop HF Radar Systems for monitoring surface currents*, AZTI, San Sebastian, 28-29 Oct. 2010

Travail 2011-12

- traitement période hivernale pour compléter la saisonnalité de 2008

- étude combinée radar/modèle de l'activité tourbillonnaire dans la région Ouessant-Molène

- assimilation: calcul des erreurs d'interpolation

- développement d'un prototype de base de données

Nécessité d’alimenter par les mesures radar des bases de données accessibles aux usagers scientifiques (laboratoires, observatoires, programmes).

=> nécessité de définir :

- le produit : composantes radiales, vecteurs, grillage géographique, …

- le niveau de traitement: 2DVar, erreurs, filtrage des vagues, …

- les critères de qualité …

- les questions d’accessibilité, d’hébergement, de gestion

=> **proposition d’une réunion de travail de la communauté**