Inferring surface displacements from hourly SST fields: preliminary results

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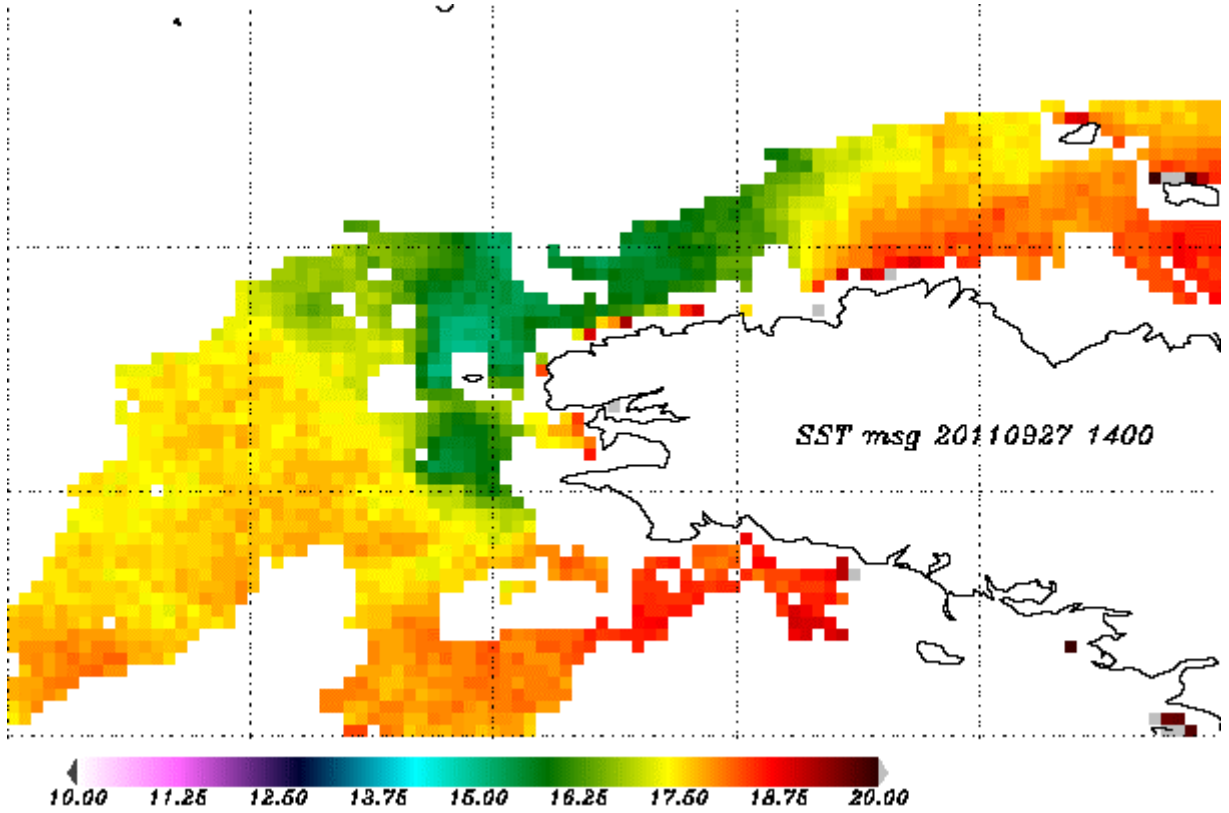
Outline

- Introduction
- Experiment description
- Method
- Results
- Conclusion

Introduction

Can we relate the displacements observed by METEOSAT to the surface currents?



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Preliminary tests

Preliminary tests on one day have shown that:

- The optimal correlation method seems promissing
- With a time interval of 3 hours
- Better results are obtained with SST fields rather than with gradient fields

Experiment description

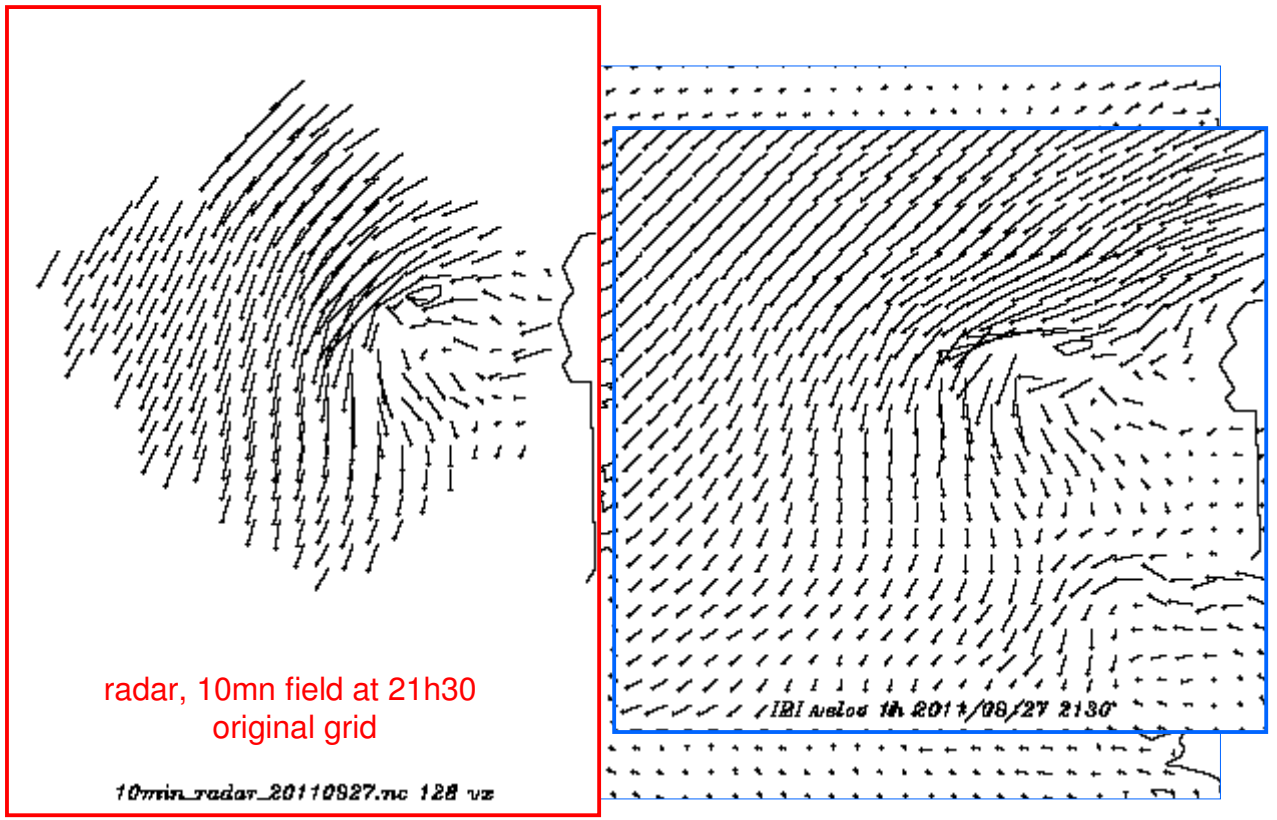
- Study area: 2W – 7W – 47N – 50N
- Period: 30 May 2009 mean tide
  27-28 September 2011 spring tide

- METEOSAT derived SST, 1h, 0.05 degree

- Ocean model IBI outputs: SST, surface current, 1h, ~2km

- Radar measurements: surface current, 15 min, ~2km

Examples of current fields



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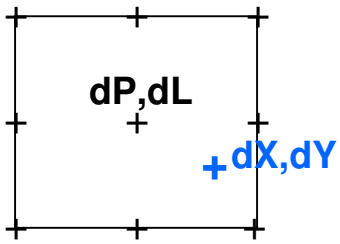
Method: principles

SST field displacement calculated in two steps:

- Optimal correlation
  - Reference box in field 2 NxN pixels, centered at (P,L)
  - Moving box in field 1 +/-5 line or pixel displacement
  - Optimal correlation between moving box and reference box => displacement (dP, dL)

- Calculation in real coordinates
  - Adjustment of a 2 degree polynom to the correlation over the 3x3 box centered at (dP,dL)
  - Polynom maximum => (dX,dY)



Method: processing steps

- Median filter on SST fields — no filter, 2x2, 3x3
- Optimal correlation — NxN box
- Test on displaced SST

  rejection if $\text{mean}(|SST_{disp} - SST_{ref}|) > DT$
- Calculation in real coordinates
- Smoothing velocity vectors (3x3 box)
- Displacements converted into velocity vectors

Tests on IBI SST and Meteosat SST (27 Sept 2011, 20h):

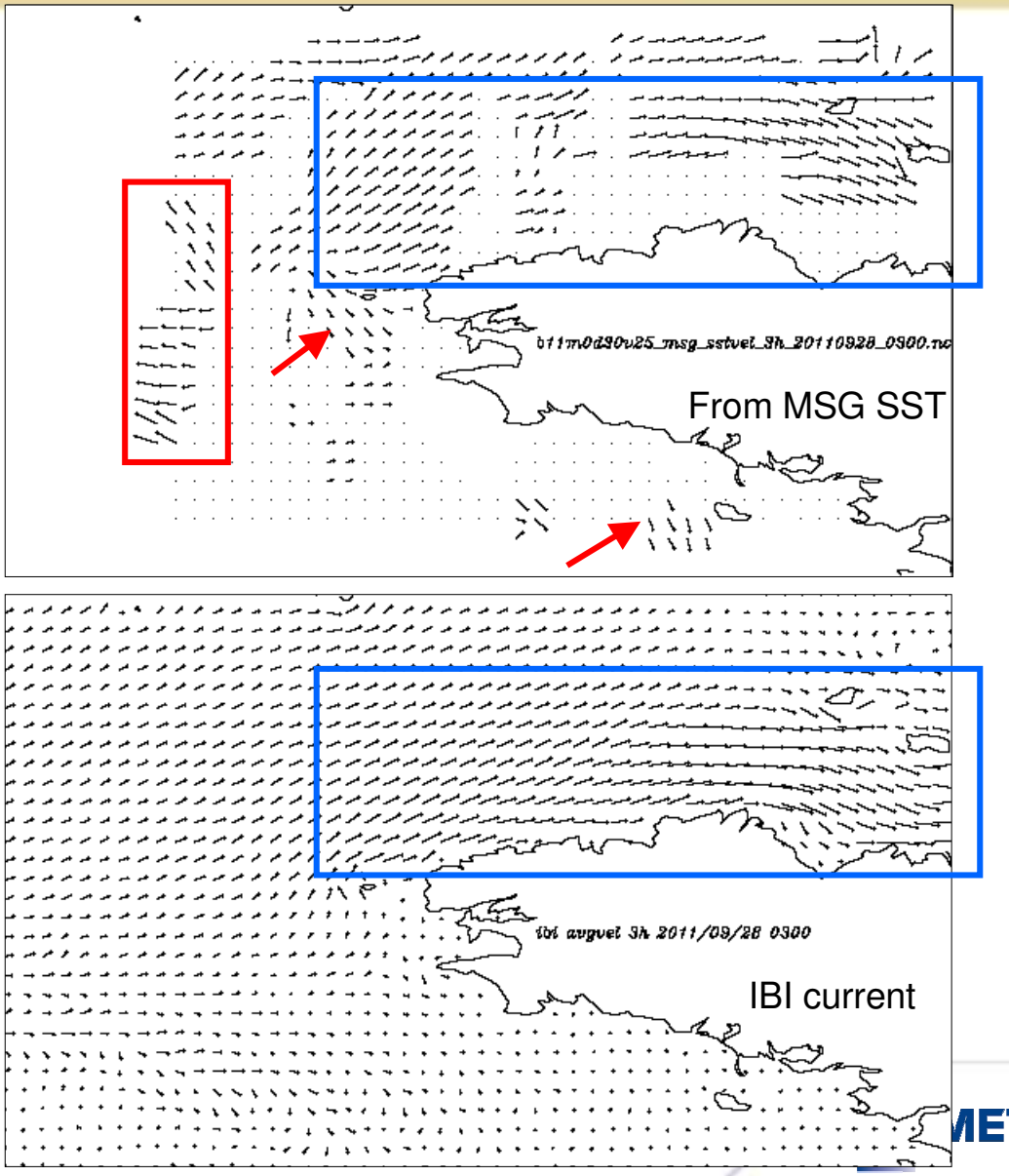
no filter (or median 2) N=11 DT=0.3K

Results

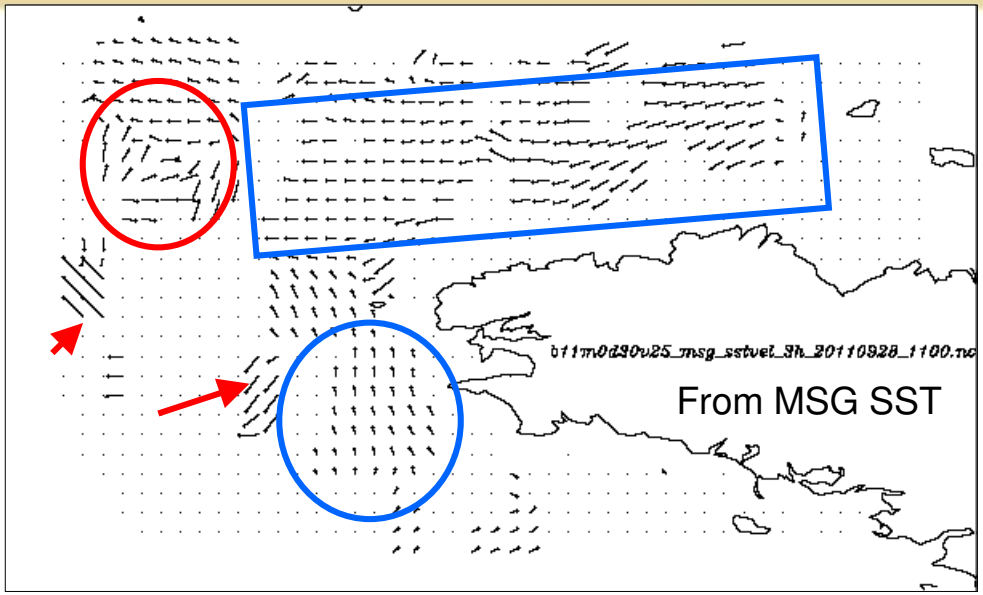
METEOSAT SST derived velocity vectors are compared to:

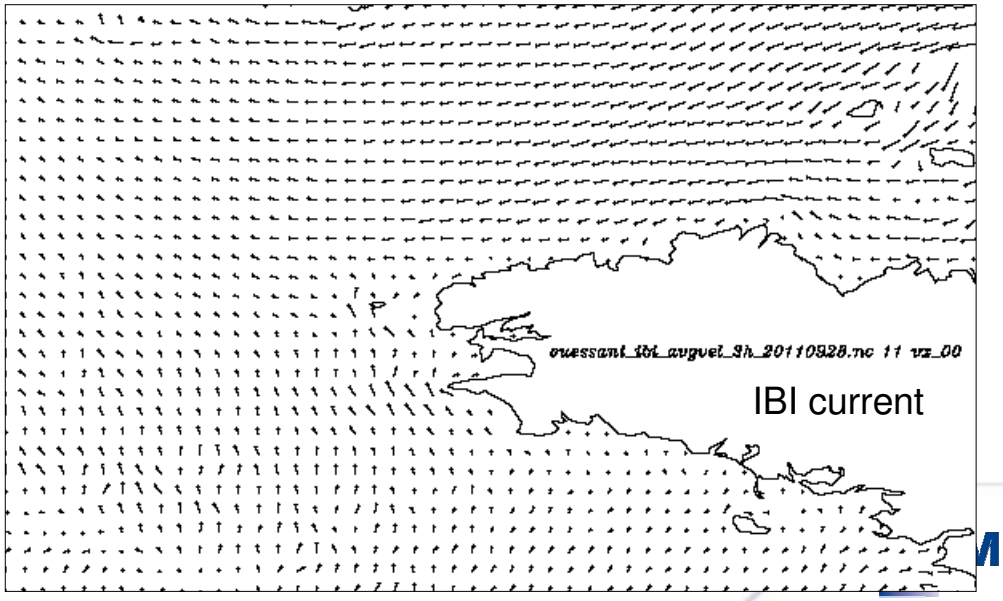
- IBI surface currents on the whole area
- Radar measurements on a limited western sub-area

Velocity vectors on 28 sept 2011 3h-6h

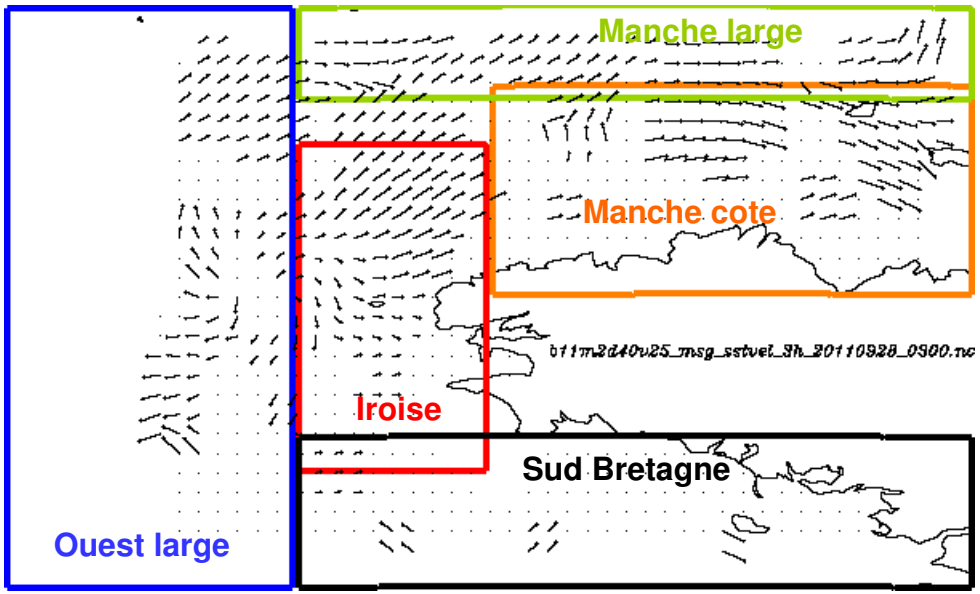


Velocity vectors on 28 sept 2011 11h-14h

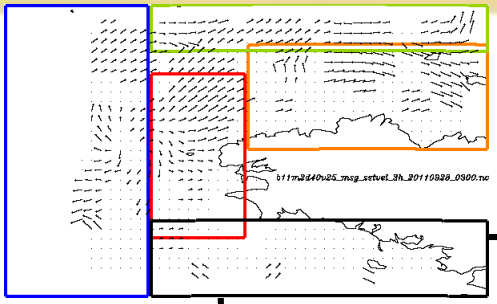




Defining sub-areas



Velocity module statistics METEOSAT / IBI

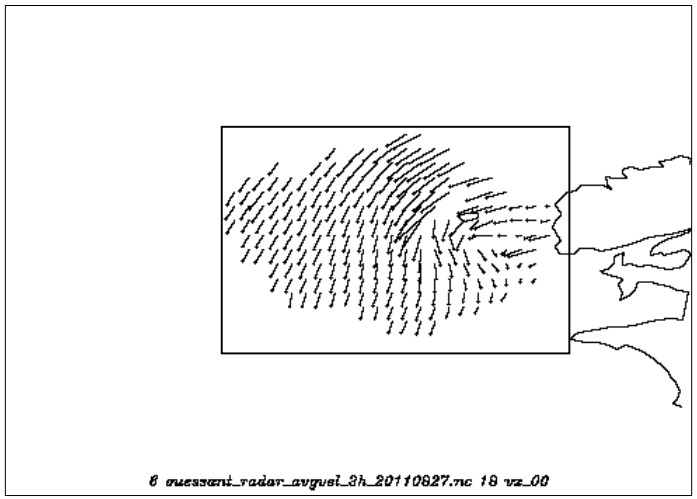


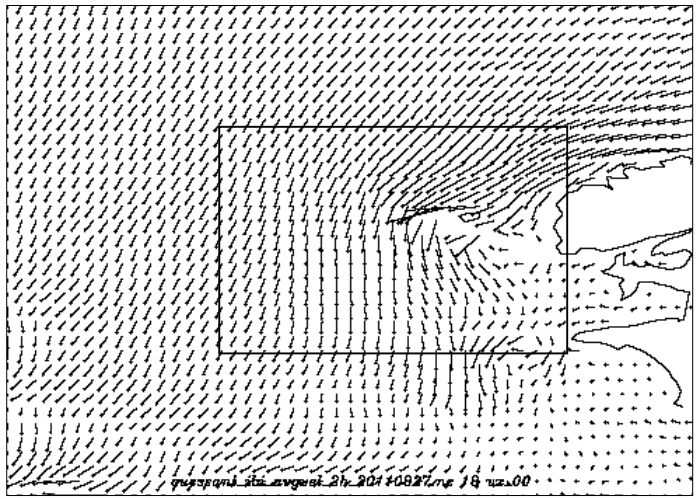
	# cases	bias	sigma	IBI mean	
all area	31948	0.27	0.52	0.75	
Iroise	8657	0.05	0.42	0.81	← OK
Manche cote	9612	0.22	0.49	0.91	← ??
Manche large	5863	0.27	0.45	0.83	← ??
Ouest large	6850	0.47	0.53	0.63	← bad
Sud Bretagne	3993	0.53	0.57	0.33	← bad

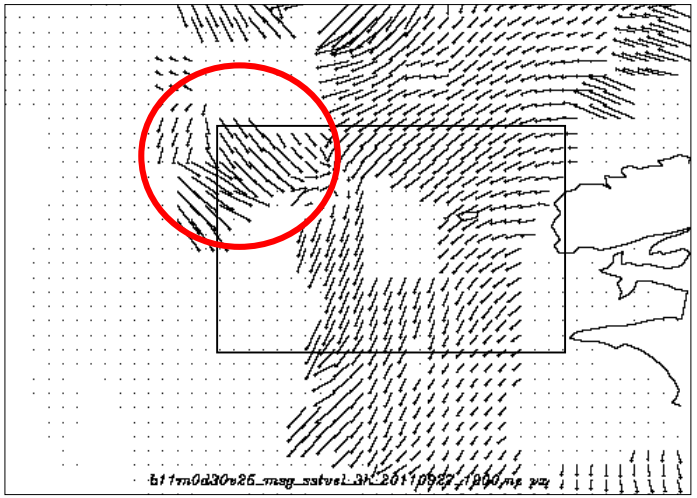
METEOSAT derived velocity vectors compared to IBI currents
Statistics on velocity module, values in m/s, 27 sep 14 h to 28 sep 14h, 2011

Similar results on 30 May 2009 but with lower values

METEOSAT / radar / IBI
Velocity vectors on 27 sept 2011 19h-22h







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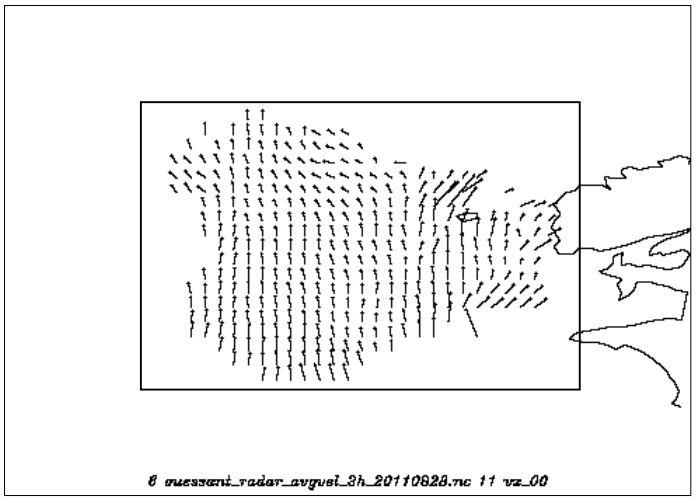
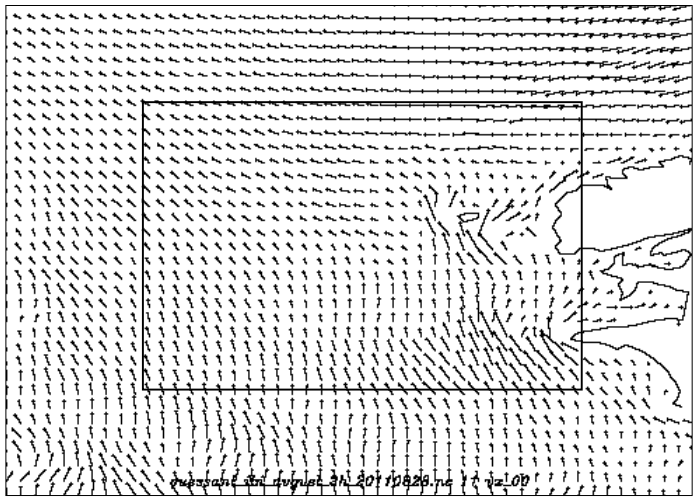
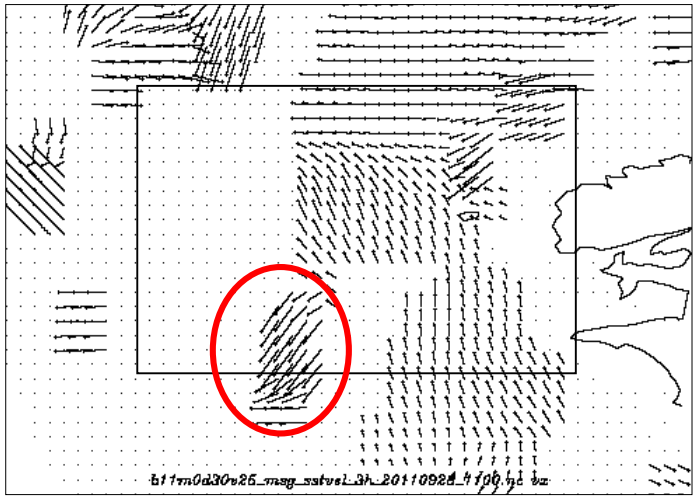
METEOSAT / radar / IBI
Velocity vectors on 28 sept 2011 11h-14h







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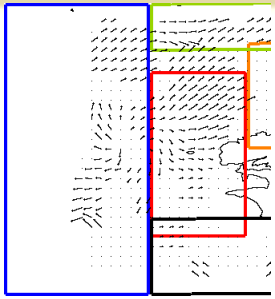
Velocity module statistics METEOSAT / IBI / RADAR

The radar data cover 2 sub-areas, Iroise and Ouest large



	# cases	bias	sigma	mean ref
Iroise				
vs IBI	2173	-0.10	0.48	0.84
vs radar	2173	-0.04	0.46	0.78
Ouest large				
vs IBI	1499	0.33	0.53	0.72
vs radar	1499	0.30	0.55	0.75

METEOSAT derived velocity vectors compared to IBI or radar currents
Statistics on velocity module, values in m/s, 27 sep 14 h to 28 sep 14h, 2011
Statistics calculated on cases available in the 3 data sets

=> close results when comparing METEOSAT to IBI or radar

Conclusion

- An attempt has been made to calculate velocity vectors from METEOSAT SST by optimal correlation
- Reasonable results are obtained in areas with rather strong currents
- Further studies would be needed to, at least, detect and eliminate high errors in areas of weak current