Inferring surface displacements from hourly SST fields: preliminary results

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Outline

- Introduction
- Experiment description
- Method
- Results
- Conclusion
Can we relate the displacements observed by METEOSAT to the surface currents?
Preliminary tests on one day have shown that:

- The optimal correlation method seems promising
- 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

radar, 10mn field at 21h30
original grid
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 \( \text{mean}(|SST_{\text{disp}} - SST_{\text{ref}}|) > DT \)
- 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

From MSG SST

IBI current
Defining sub-areas

- Iroise
- Manche cote
- Manche large
- Sud Bretagne
- Ouest large
**Velocity module statistics METEOSAT / IBI**

<table>
<thead>
<tr>
<th></th>
<th># cases</th>
<th>bias</th>
<th>sigma</th>
<th>IBI mean</th>
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</thead>
<tbody>
<tr>
<td>all area</td>
<td>31948</td>
<td>0.27</td>
<td>0.52</td>
<td>0.75</td>
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<tr>
<td>Iroise</td>
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<td>0.45</td>
<td>0.83</td>
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<tr>
<td>Ouest large</td>
<td>6850</td>
<td>0.47</td>
<td>0.53</td>
<td>0.63</td>
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<tr>
<td>Sud Bretagne</td>
<td>3993</td>
<td>0.53</td>
<td>0.57</td>
<td>0.33</td>
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**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
METEOSAT / radar / IBI
Velocity vectors on 28 sept 2011 11h-14h
The radar data cover 2 sub-areas, Iroise and Ouest large

<table>
<thead>
<tr>
<th></th>
<th># cases</th>
<th>bias</th>
<th>sigma</th>
<th>mean ref</th>
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<tbody>
<tr>
<td><strong>Iroise</strong></td>
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<tr>
<td>vs IBI</td>
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<td>vs radar</td>
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<tr>
<td><strong>Ouest large</strong></td>
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<tr>
<td>vs IBI</td>
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<td>0.72</td>
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<tr>
<td>vs radar</td>
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<td>0.30</td>
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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.