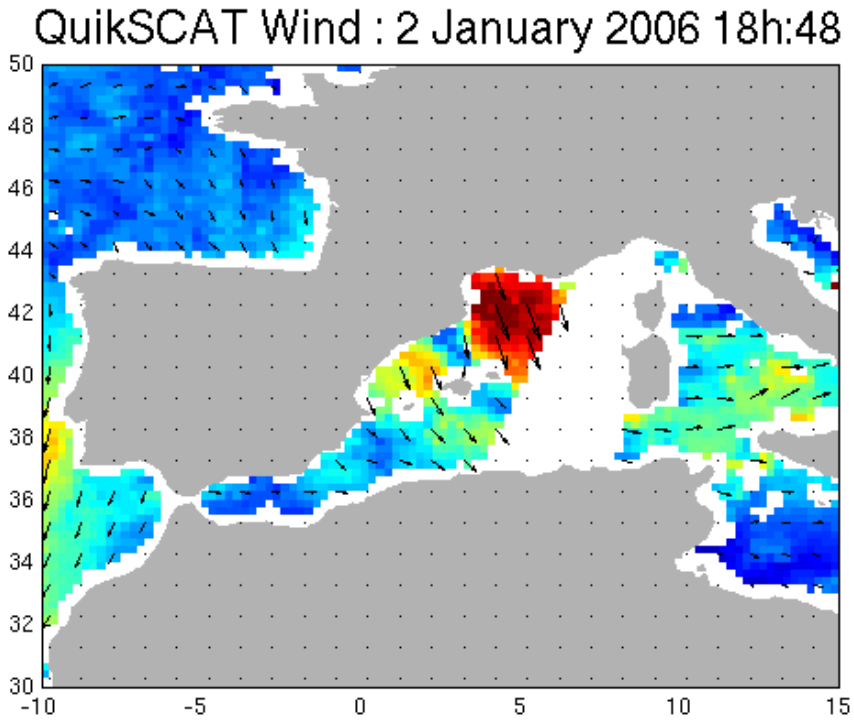
# Synergetic use of scatterometer and synthetic aperture radar wind measurements in coastal areas.

Mohamed Bassam BEN TICHA

IFRERMER

# Scatterometer data

- High temporal resolution: 2 measurements per day taken by QuikScat
- Spatial resolution of 25 km



# Synthetic aperture radars

- High spatial resolution: ~ few hundred of meters

- Temporal resolution: irregular, less than 10 measurements per month generally

# ECMWF analysis

- Spatial resolution: 50 km
- Temporal resolution: 4 analysis per day

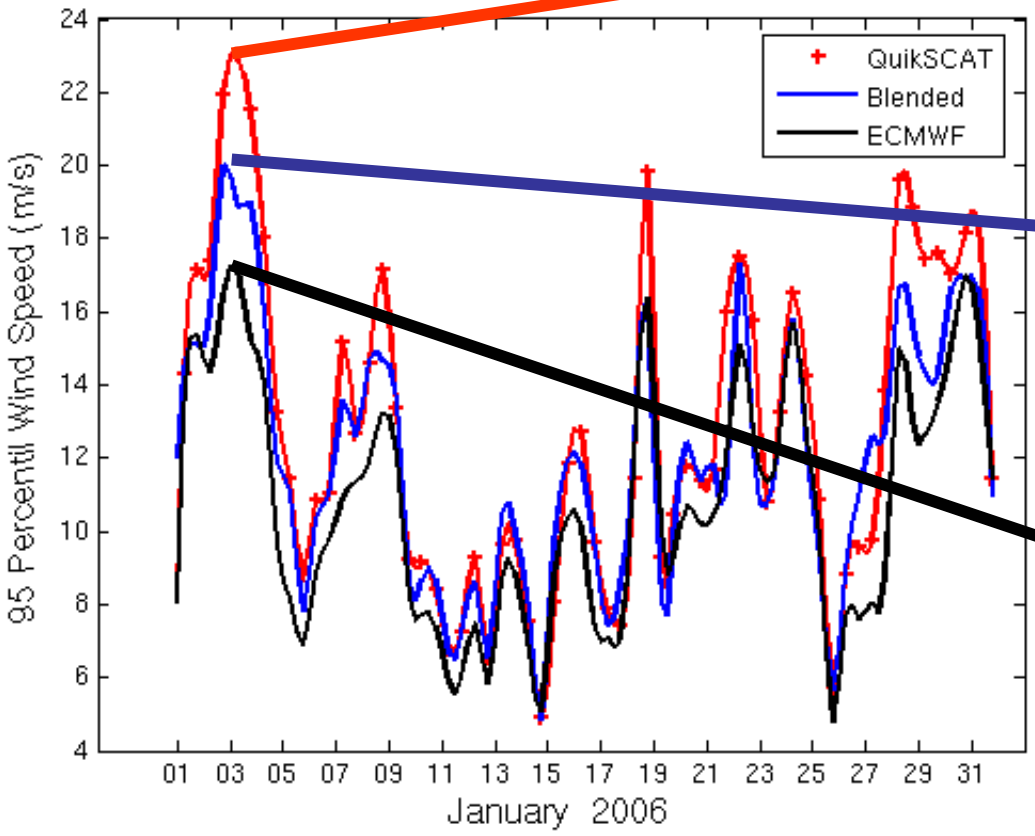
# IFREMER blended wind fields

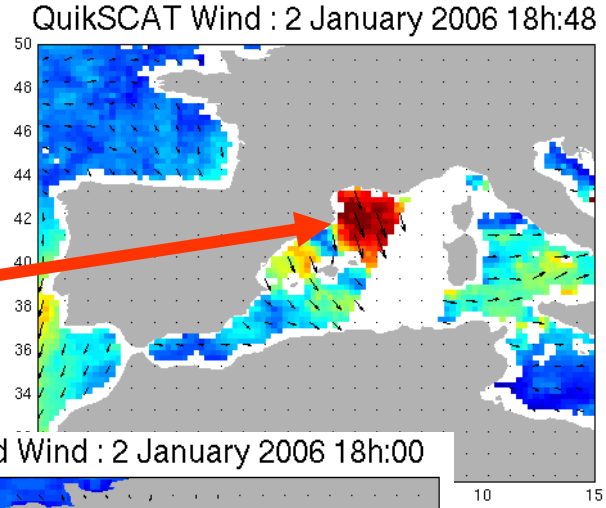
- Resulting from a kriging of scatterometer and radar radiometers wind fields on ECMWF analysis.

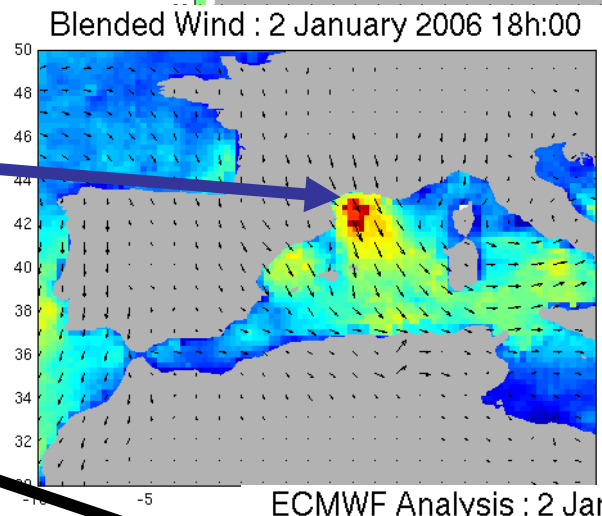
- Spatial resolution: 25 km

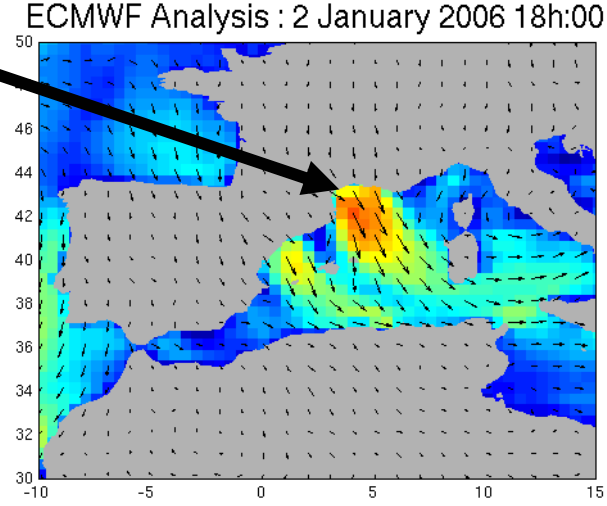
- Temporal resolution: 4 wind fields per day

# Regional Evaluations : High Wind Comparisons

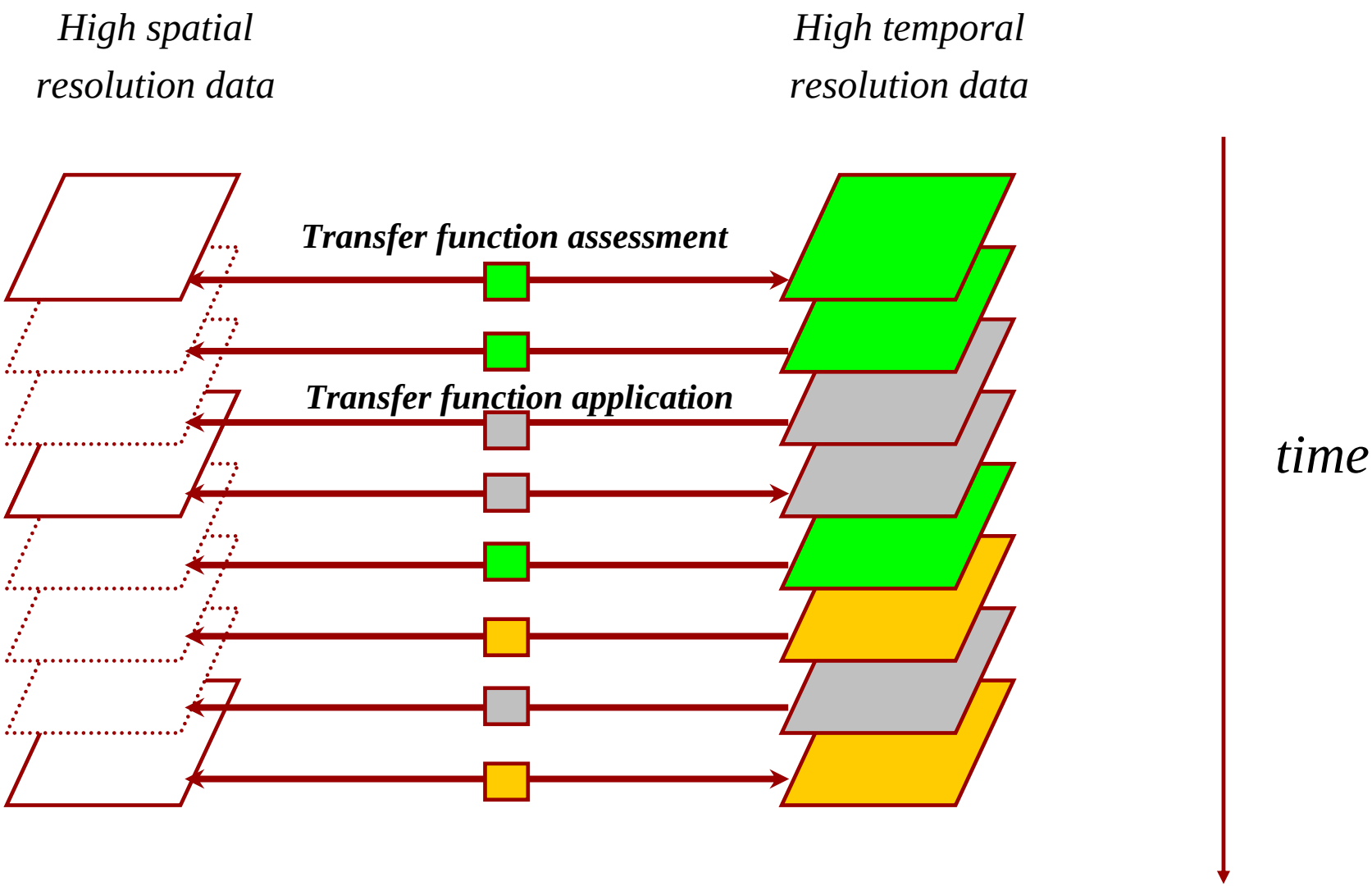


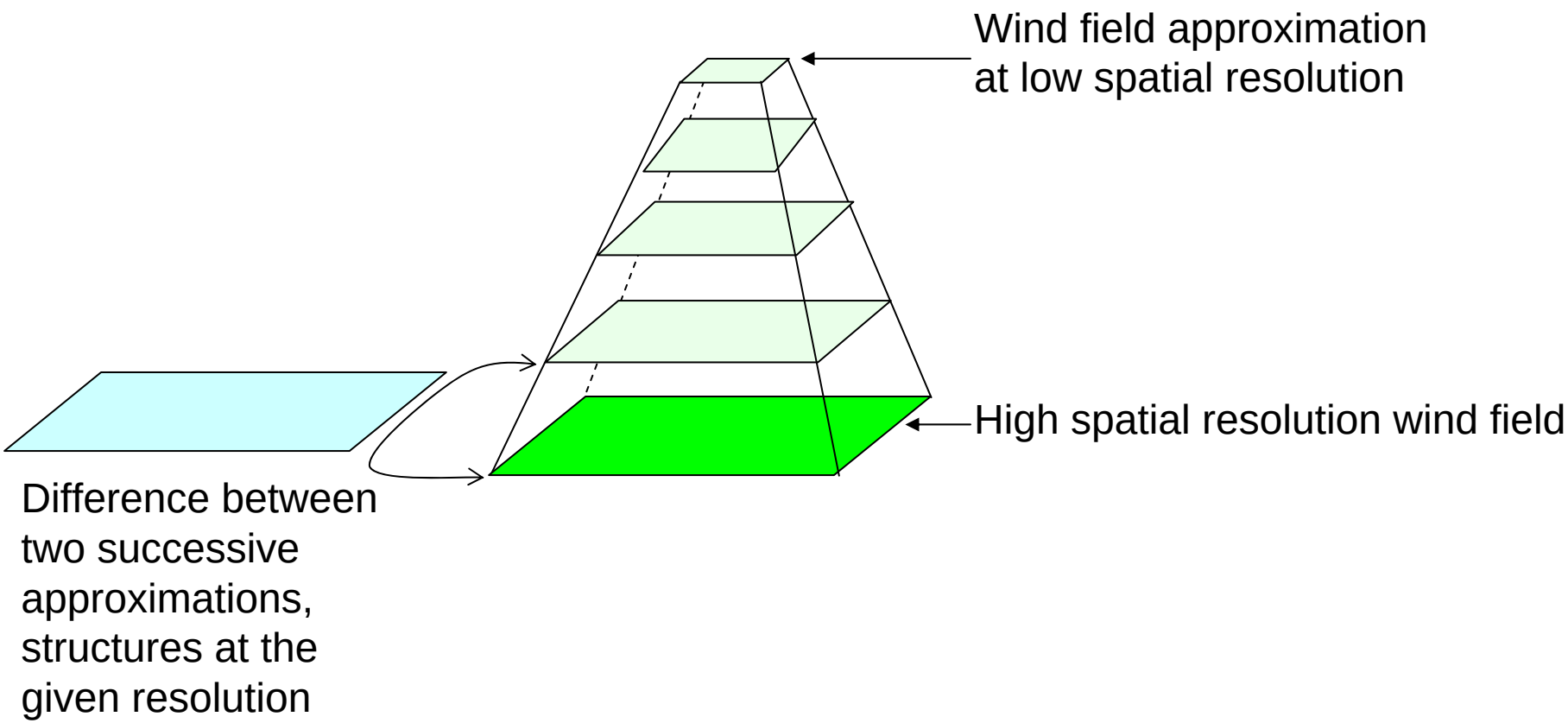



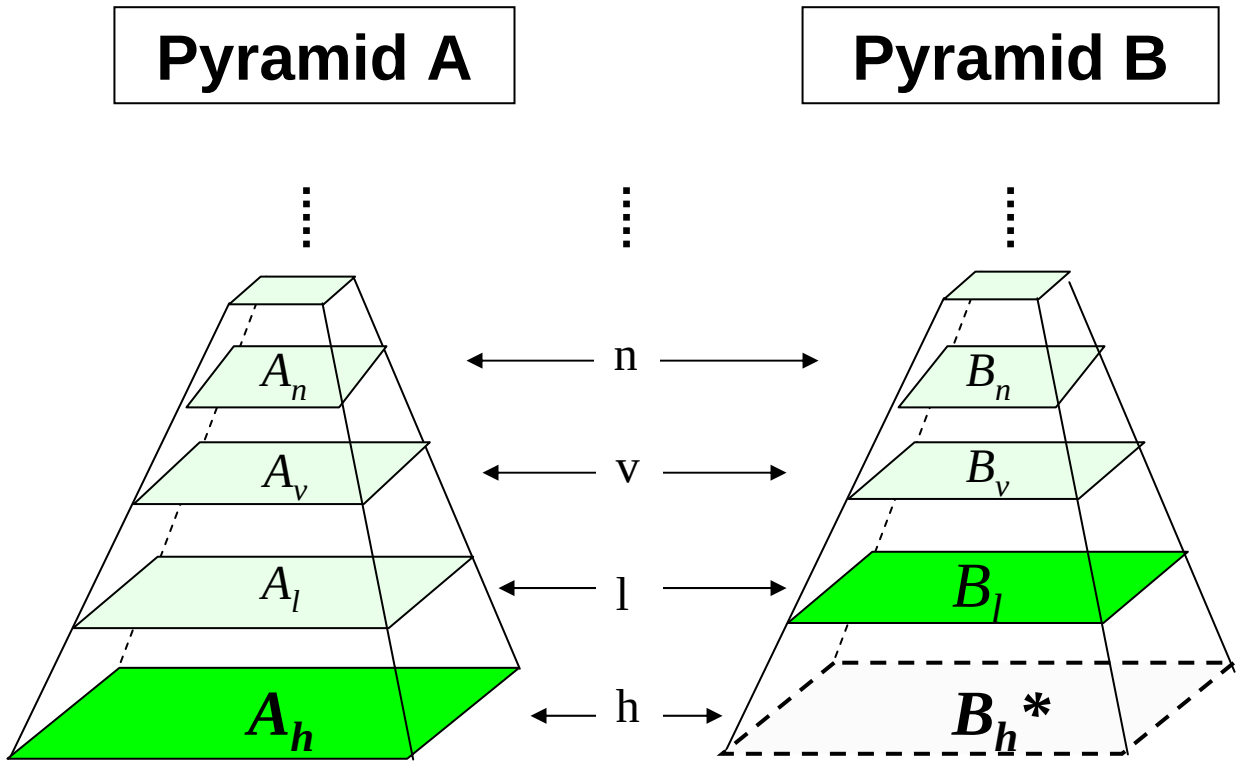
# Data fusion


*High spatial resolution data*
*High temporal resolution data*
***Transfer function assessment***
***Transfer function application***
*time*

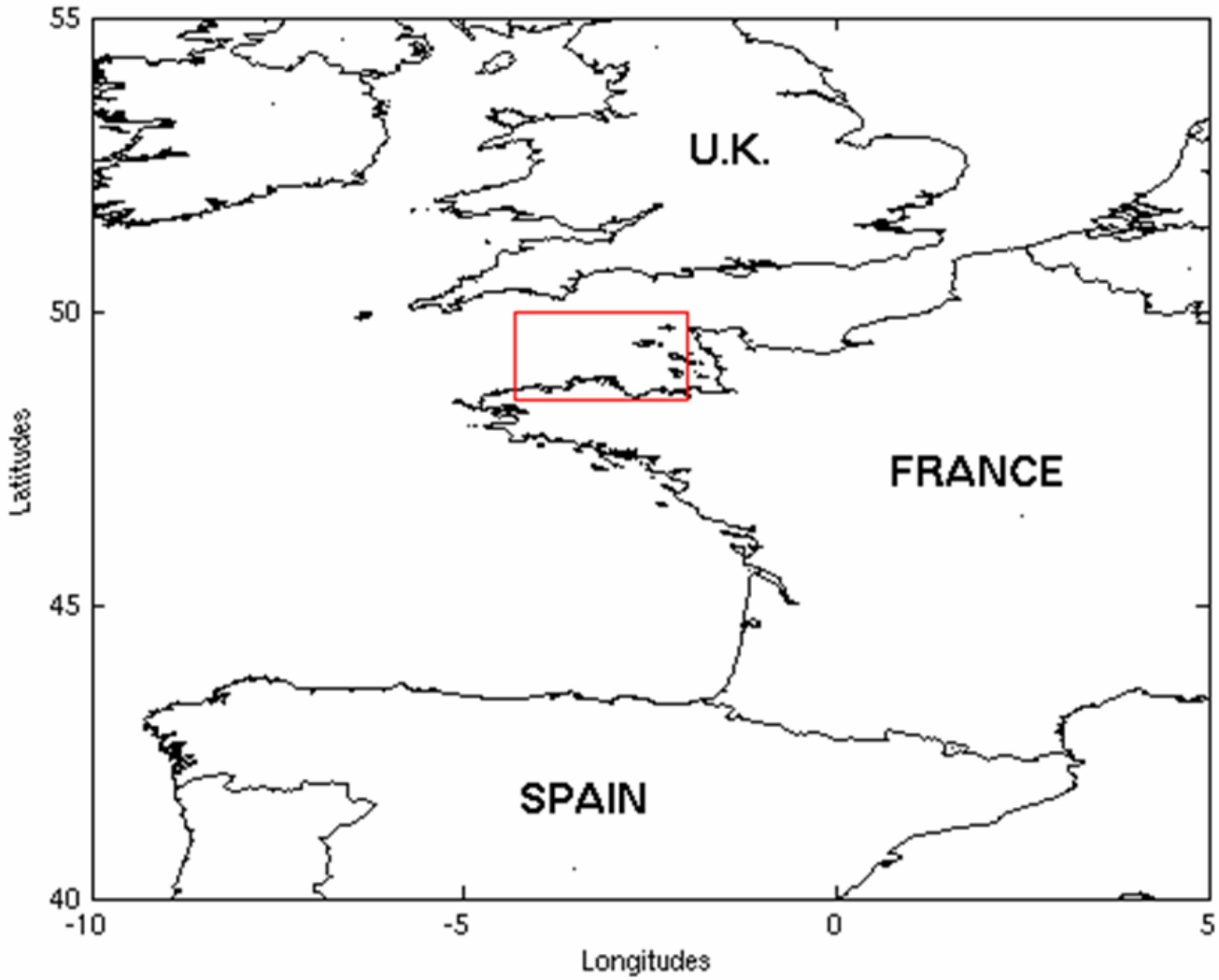
# Transfer function – Multi-scale analysis



# Transfer function



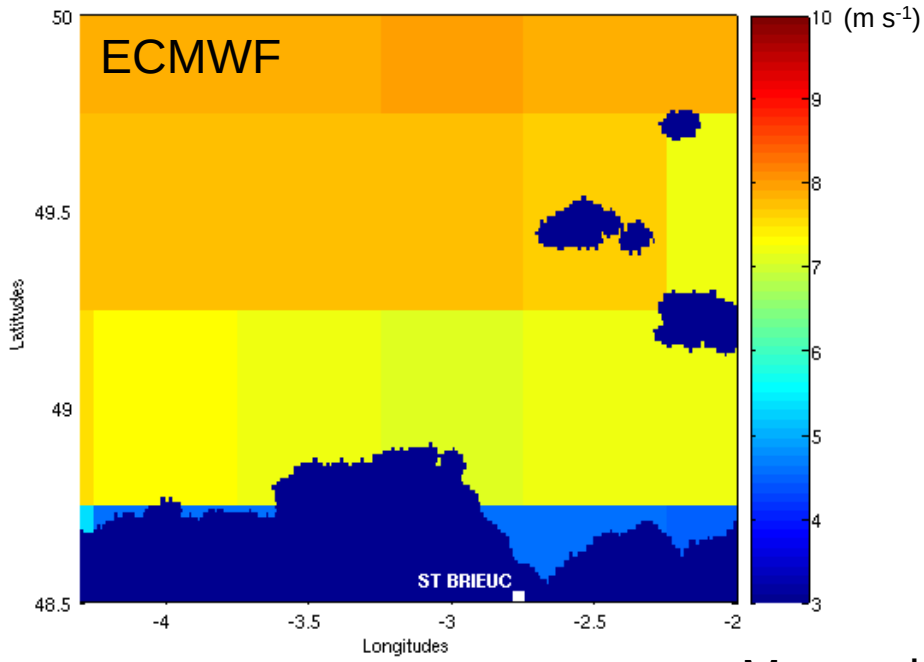
# Study area

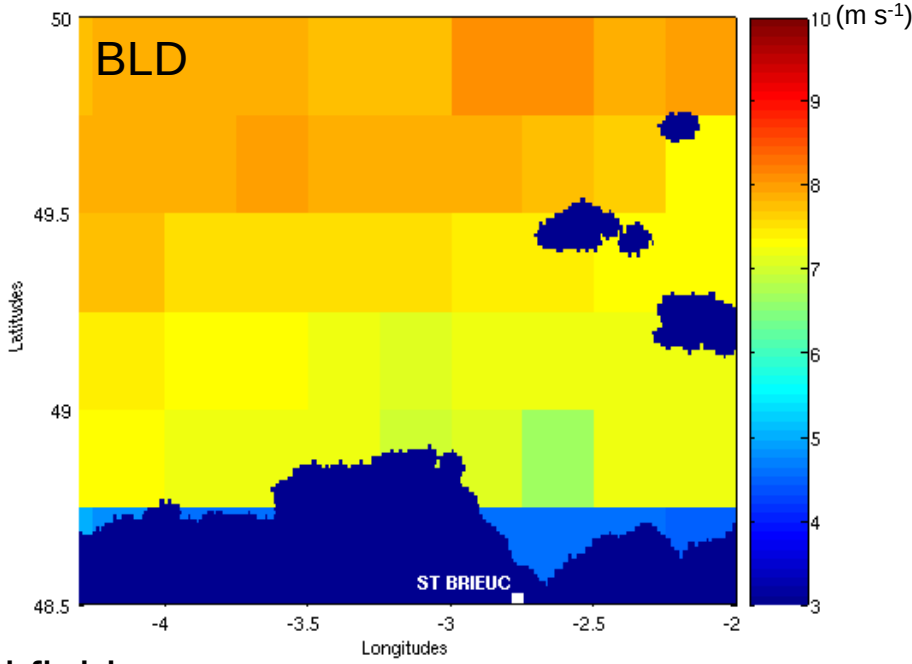


# Available data

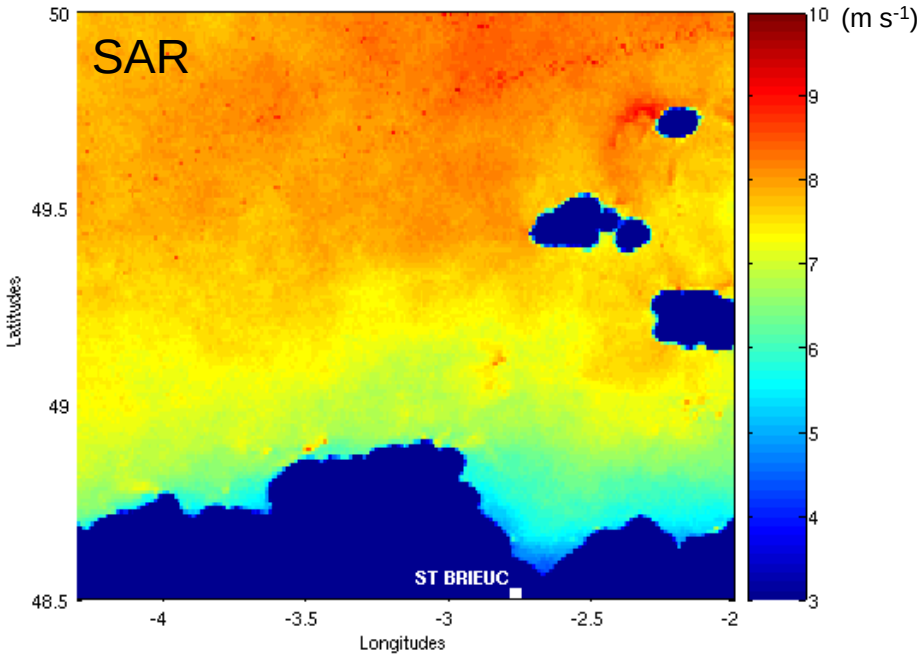
- 45 SAR images acquired by the satellite ENVISAT between October 2007 and June 2008. Source:

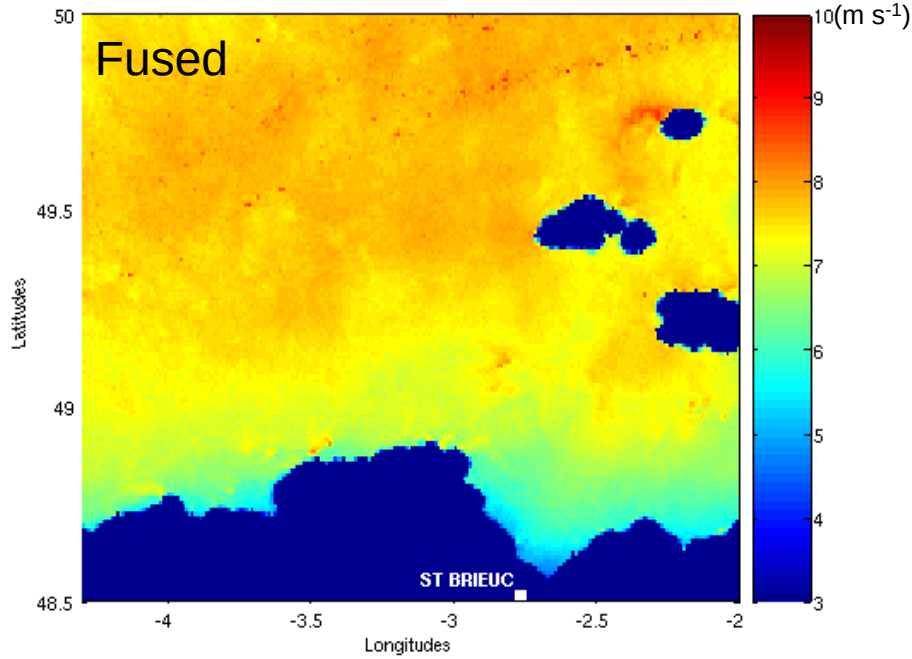
  http://soprano.boost-technologies.com
- From 3 to 6 images per month during this period: a good distribution over the year
- Scatterometer data not available only during two days




Mean wind field



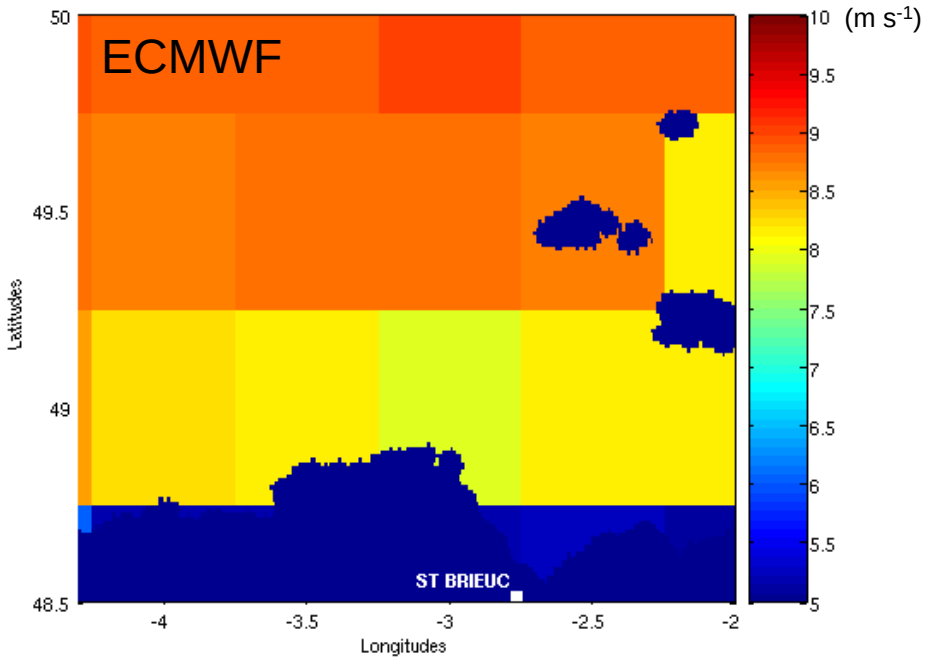
# Distribution de Weibull

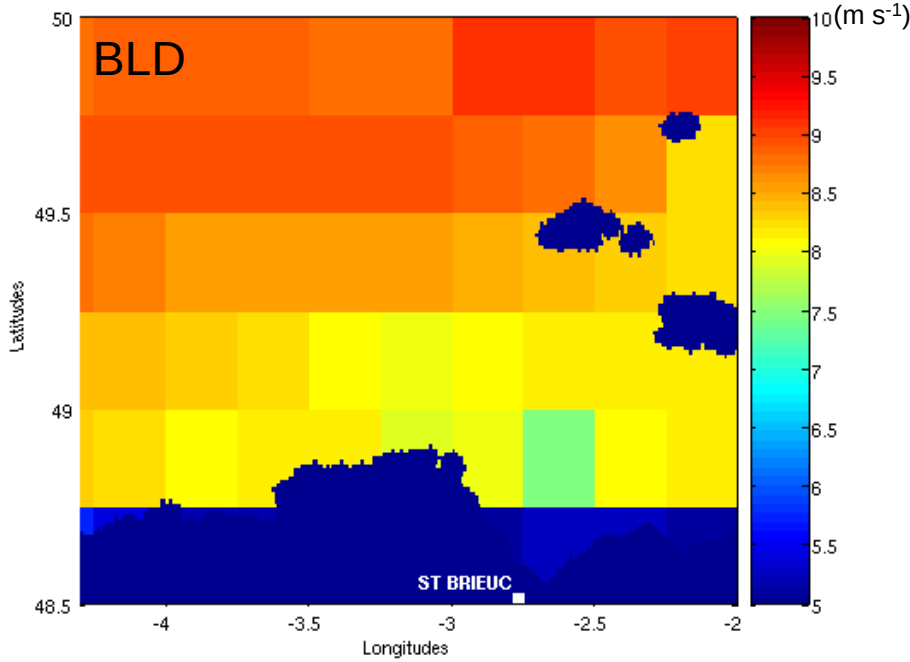
- Weibull probability density function

$$p(v) = \begin{cases} \frac{k}{A}\left(\frac{v}{A}\right)^{k-1} e^{-\left(\frac{v}{A}\right)^{k}} & v > 0 \\ 0 & v \leq 0 \end{cases}$$

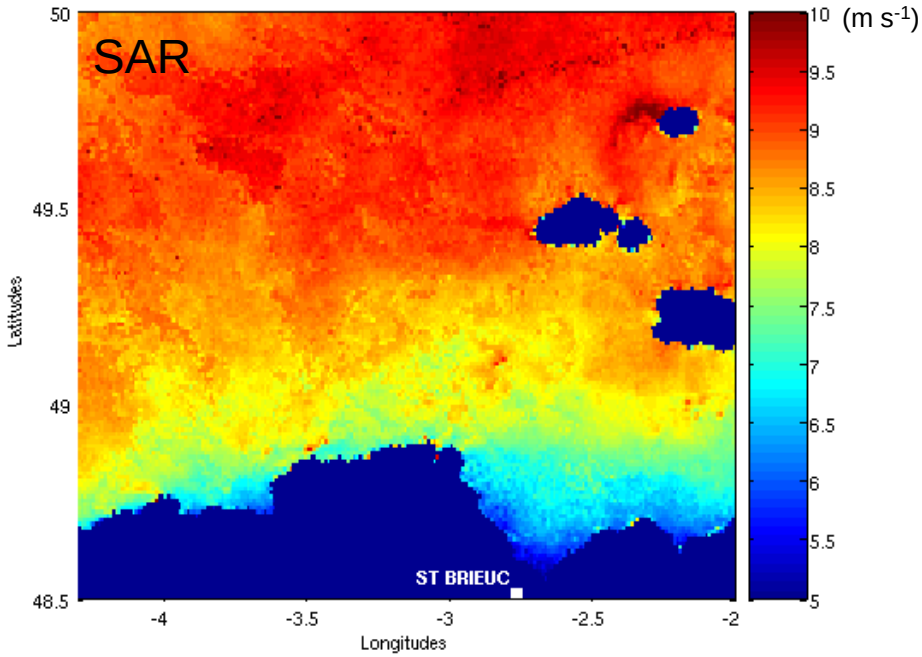
- Mean power density

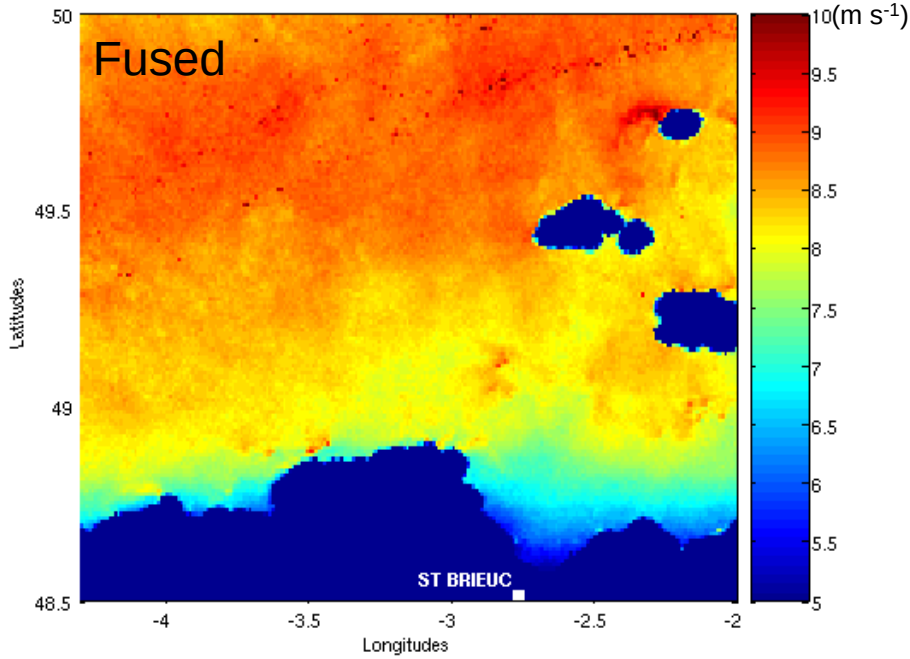
$$\overline{E} = \frac{1}{2}\rho A^3 \Gamma\left(1 + \frac{3}{k}\right)$$

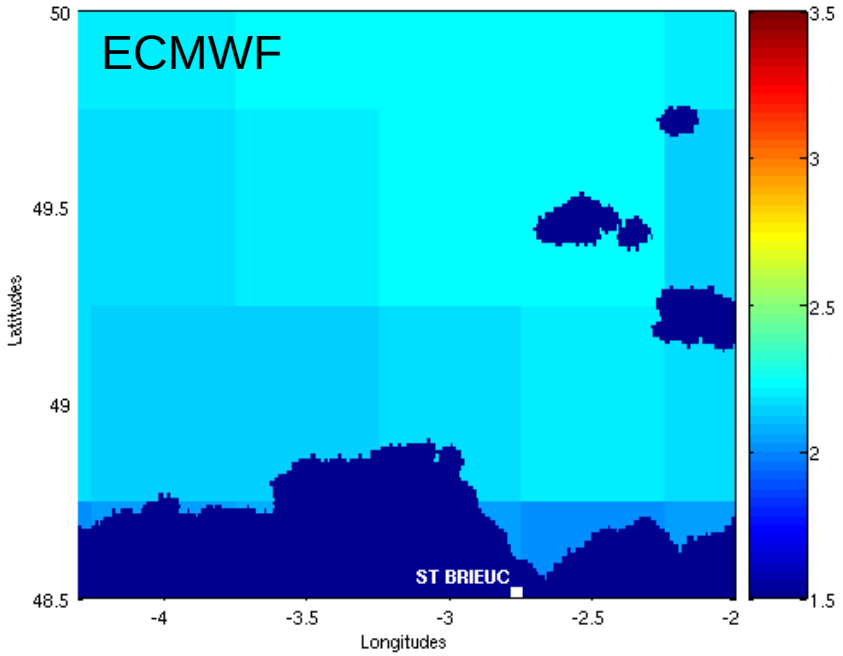


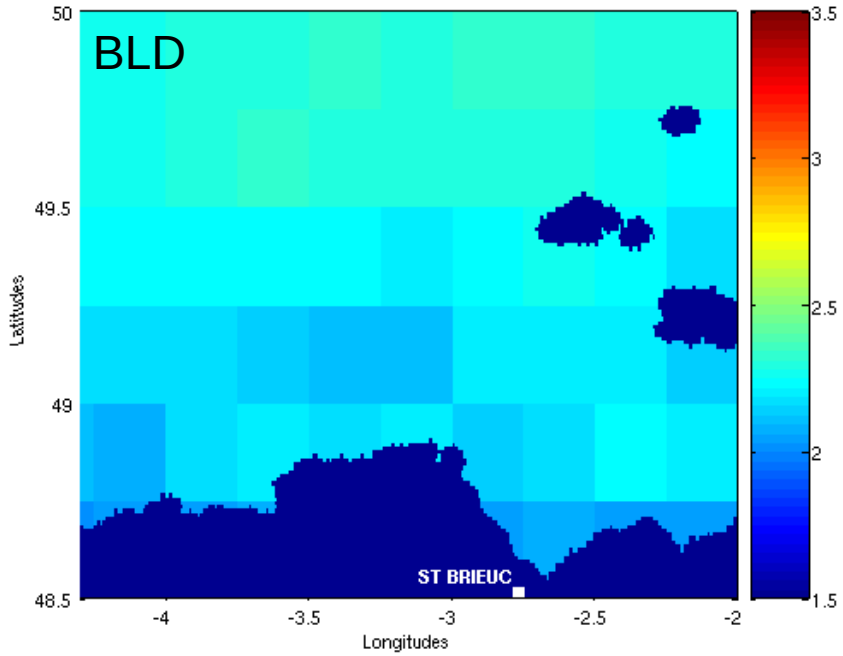




Weibull A parameter

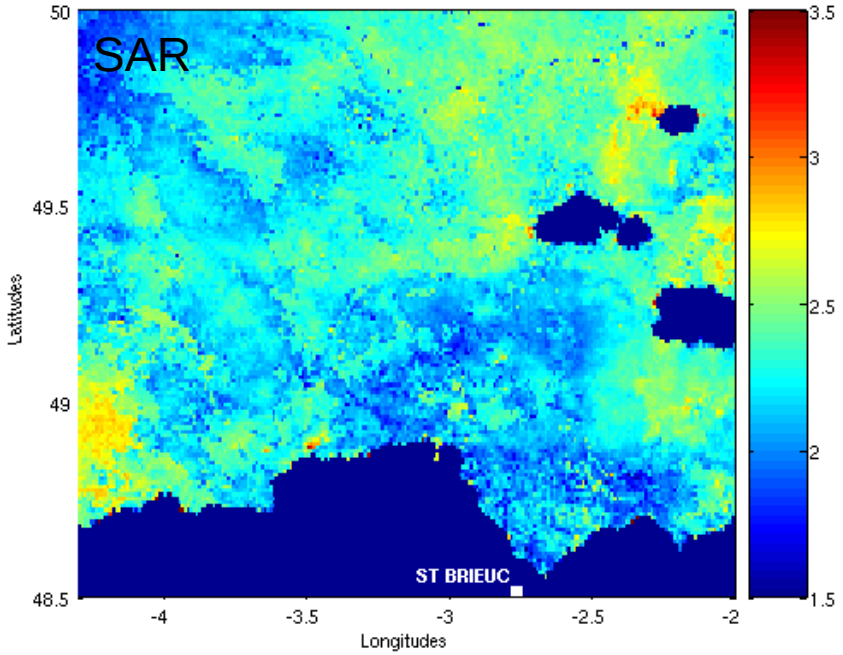


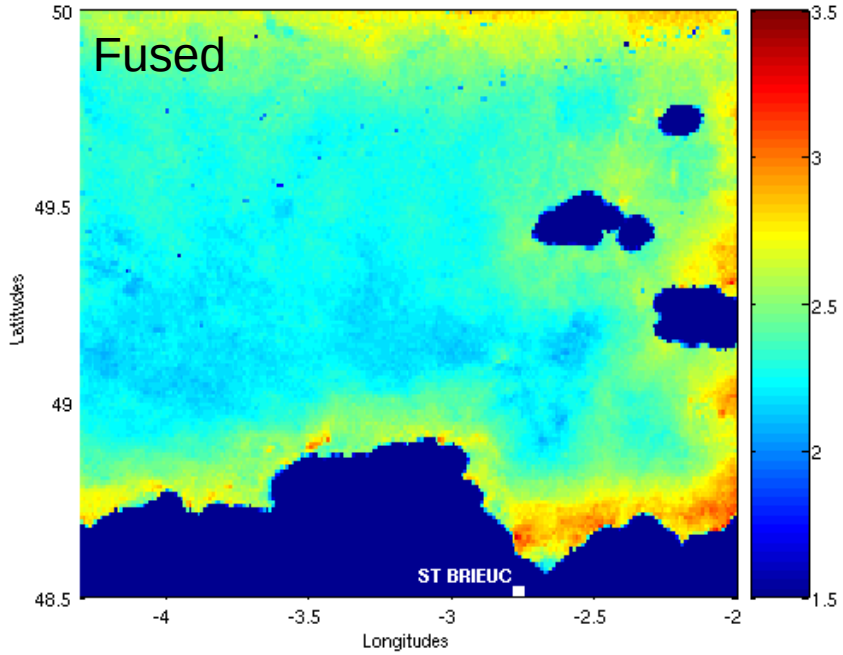





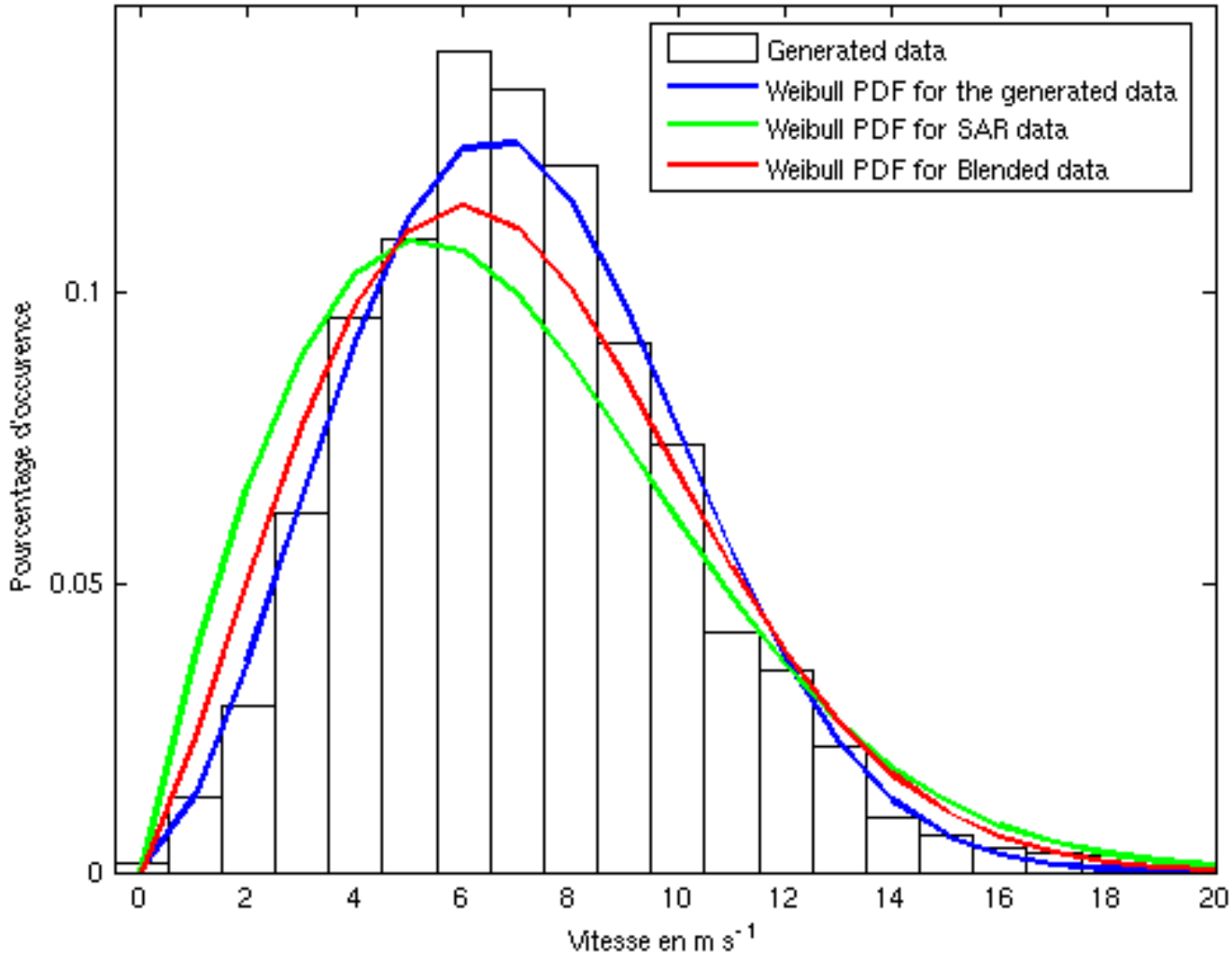



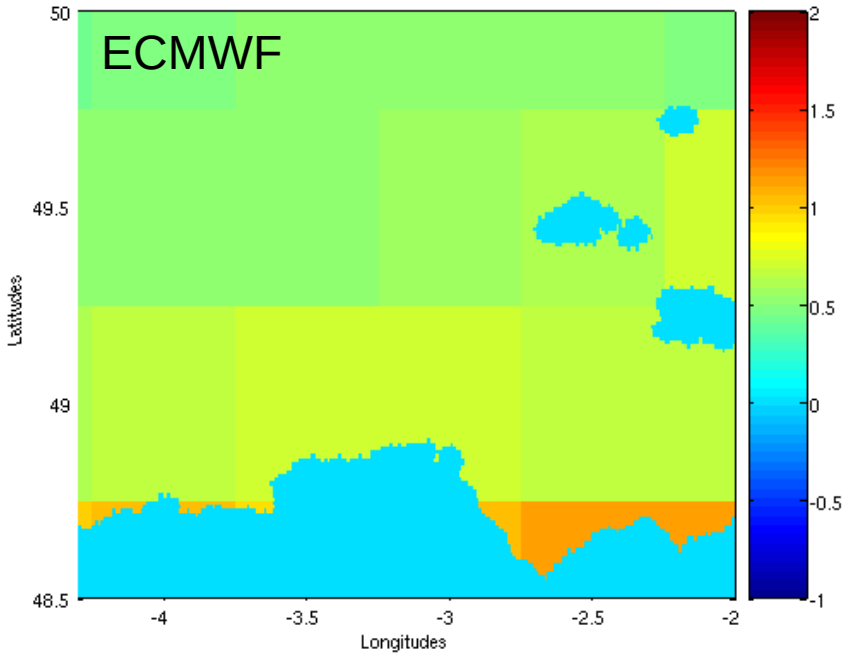

Weibull k parameter



# Weibull distribution

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49
48.5
Latitudes
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Longitudes
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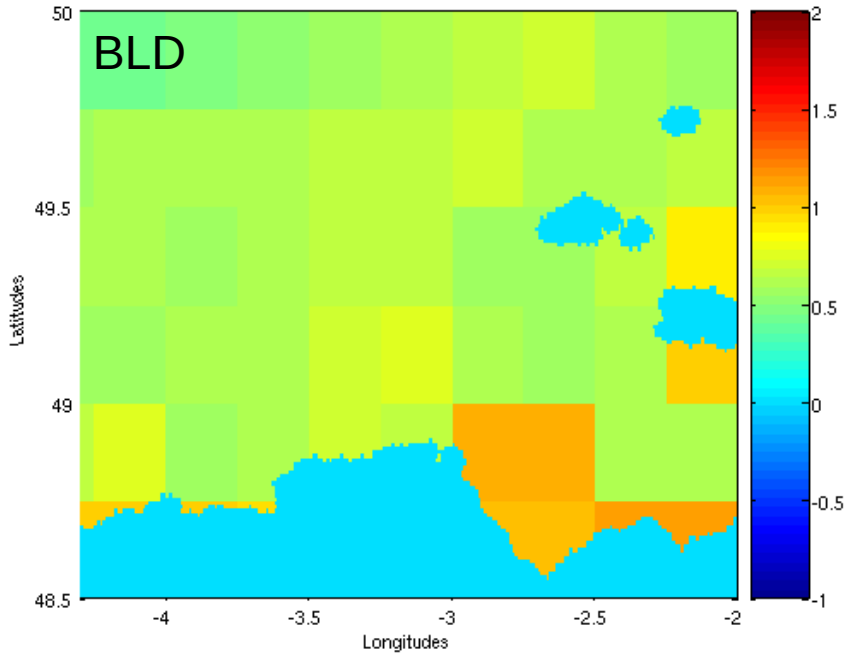
-0.5
-1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Latitudes
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Longitudes
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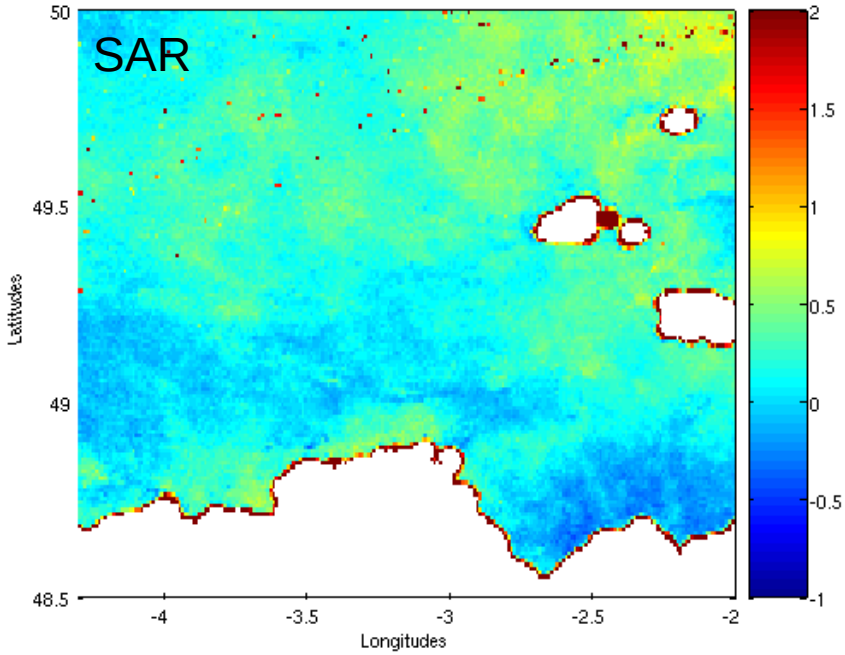
Skewness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Latitudes
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Longitudes
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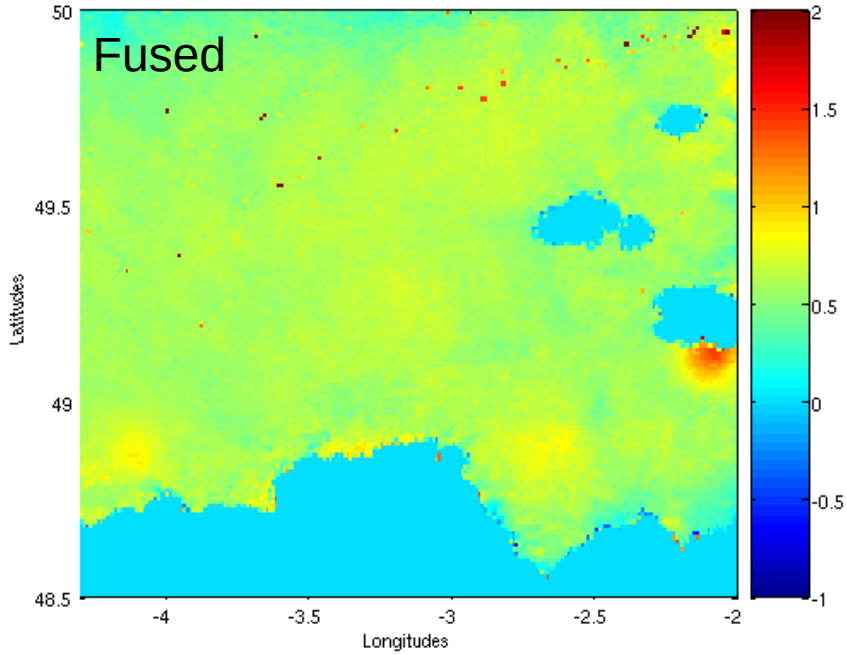
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Latitudes
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Longitudes
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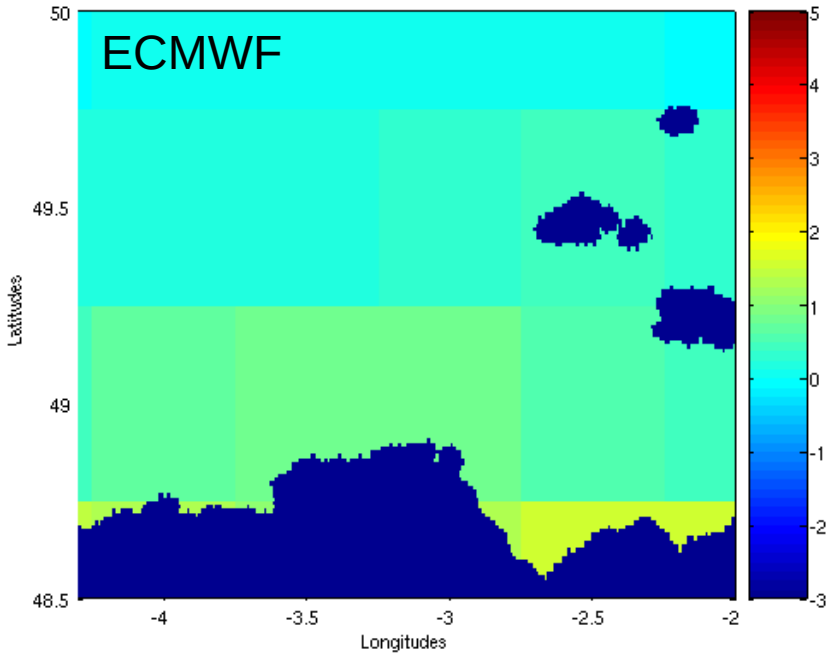
ECMWF
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Latitudes
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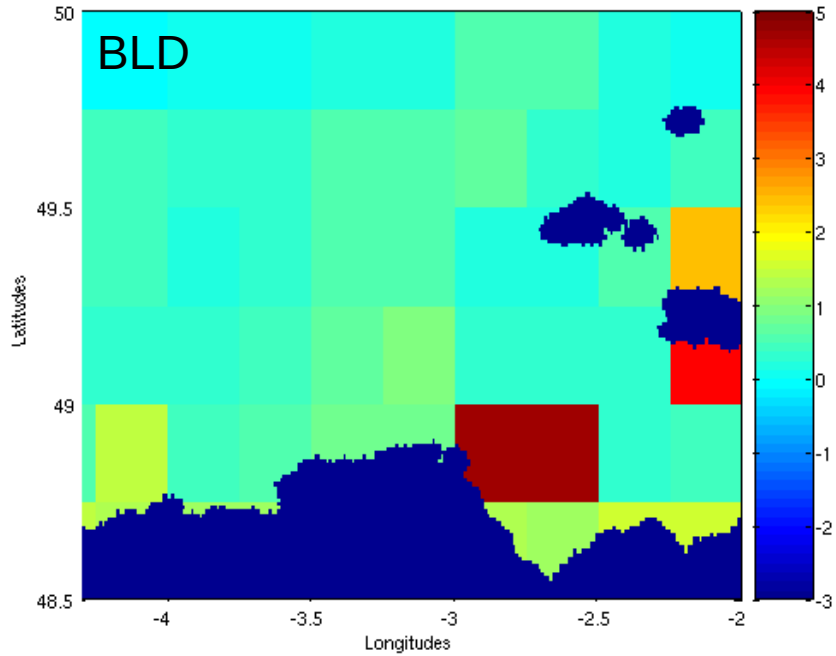
BLD
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Latitudes
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Longitudes
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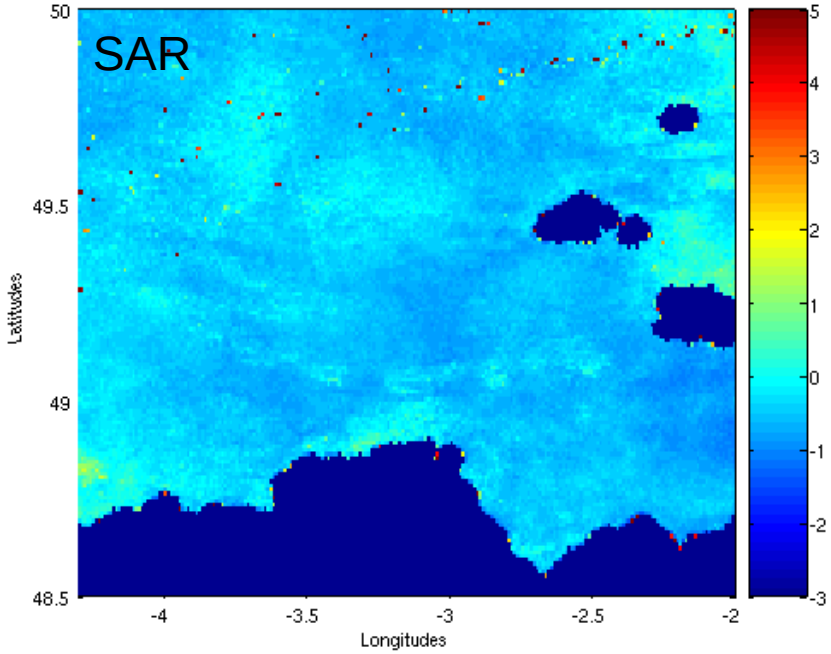
-1
-2
-3

Kurtosis


SAR
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49.5
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48.5
Latitudes
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Longitudes
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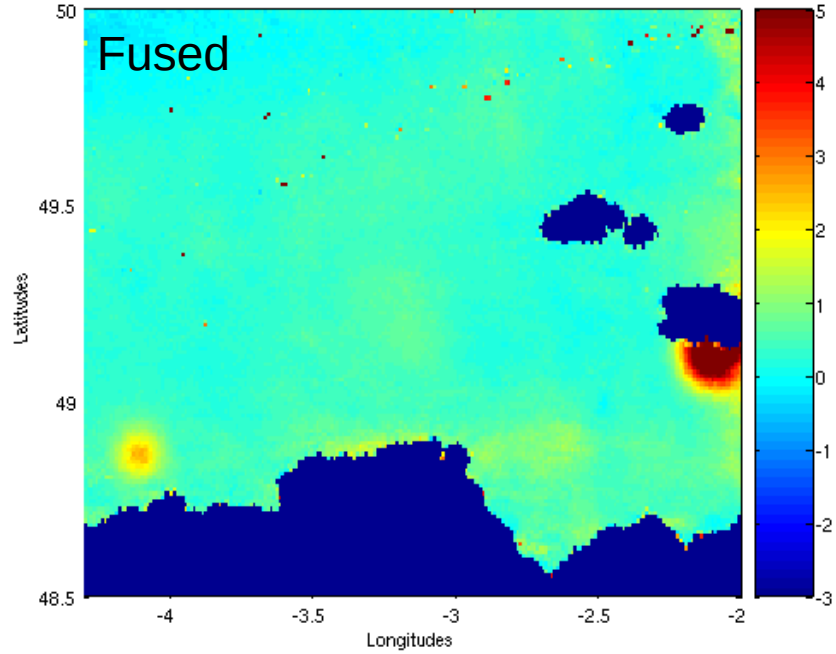
Fused
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Latitudes
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Longitudes
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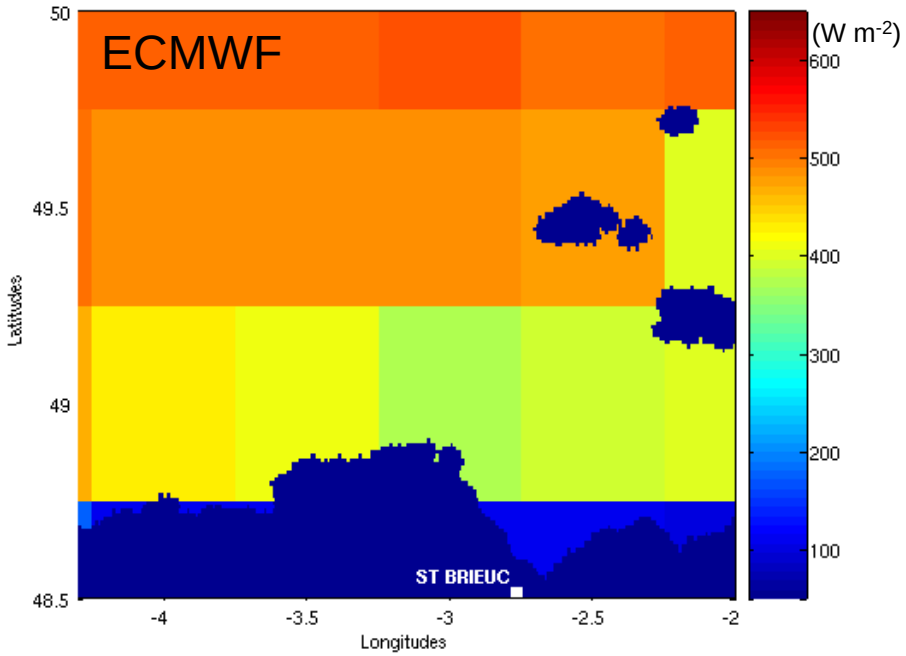
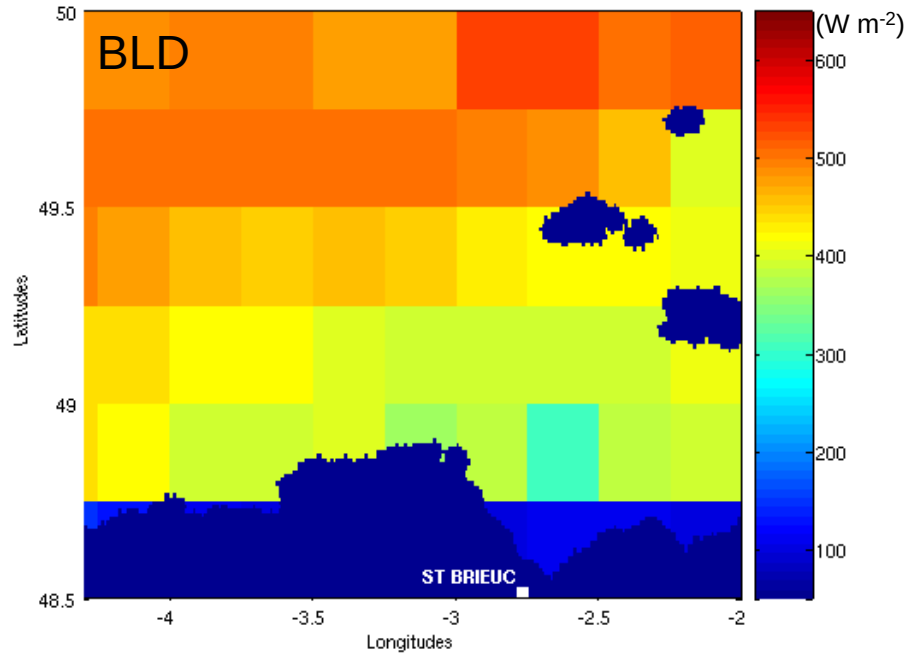
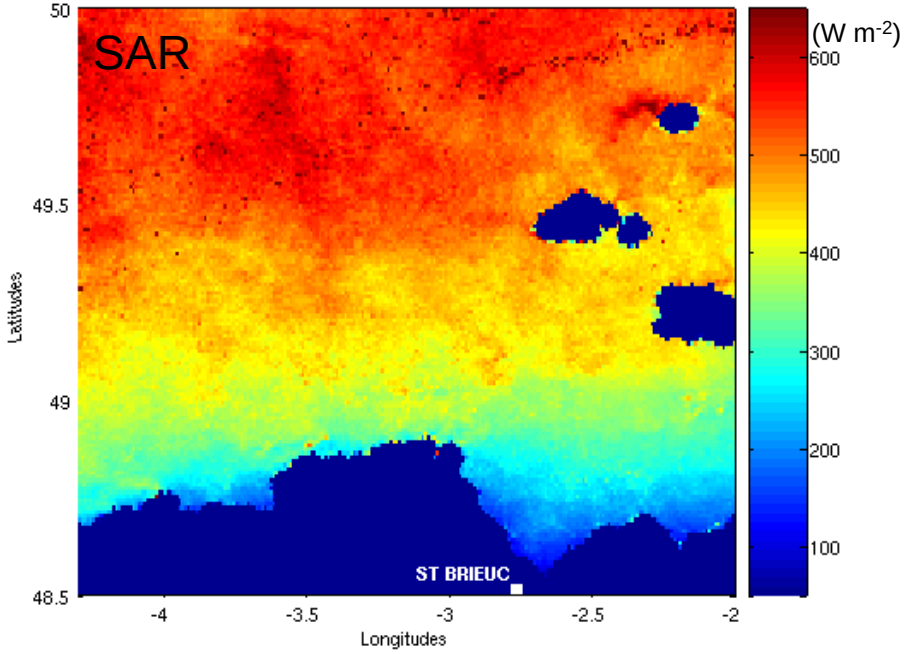
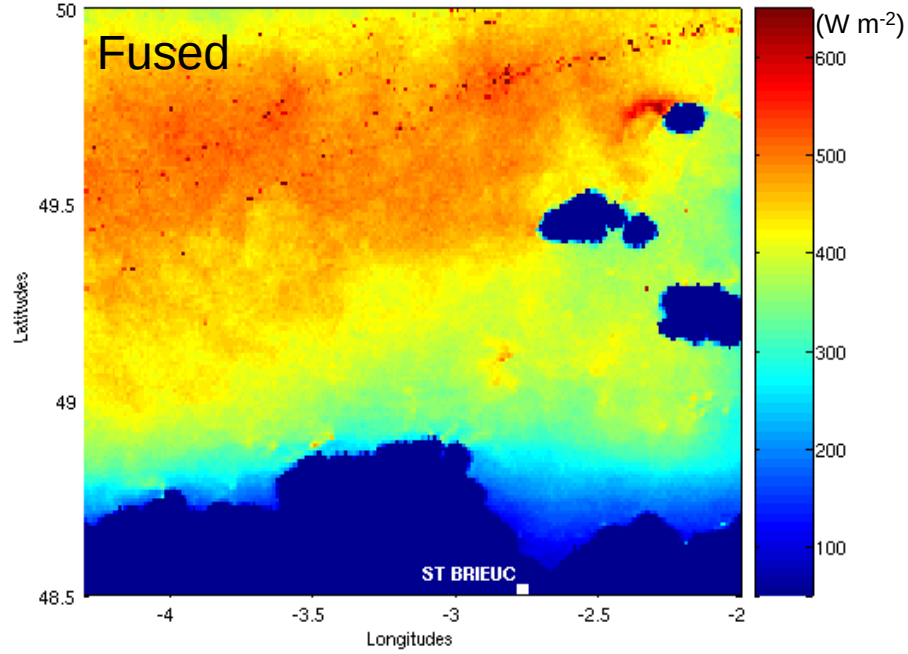


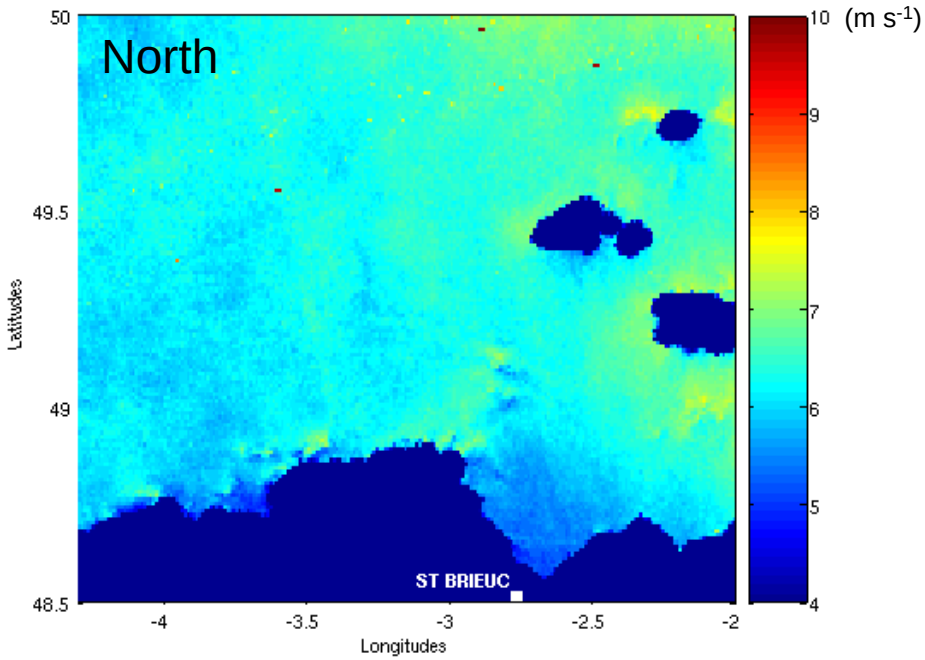

Mean power density

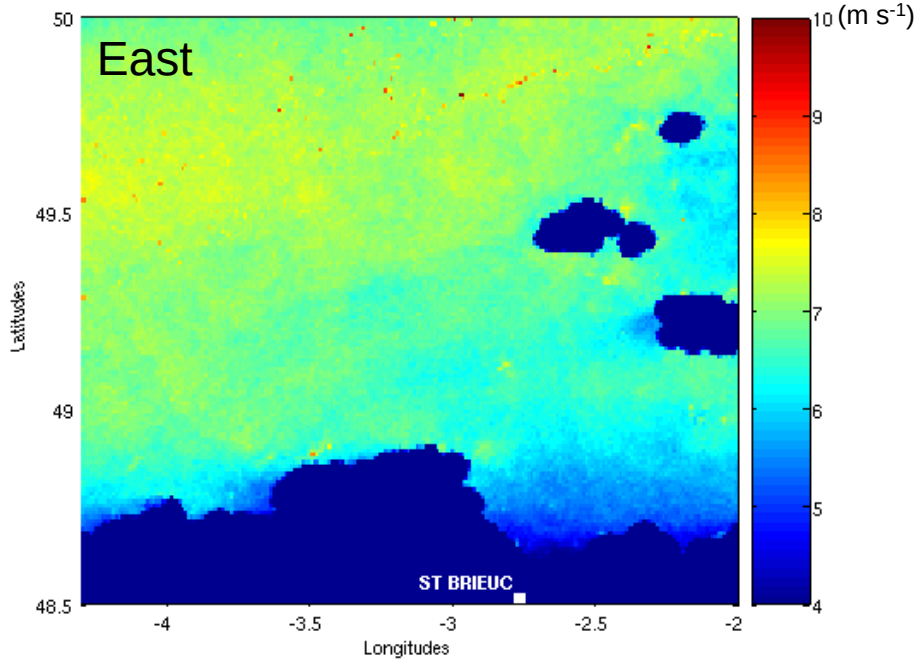


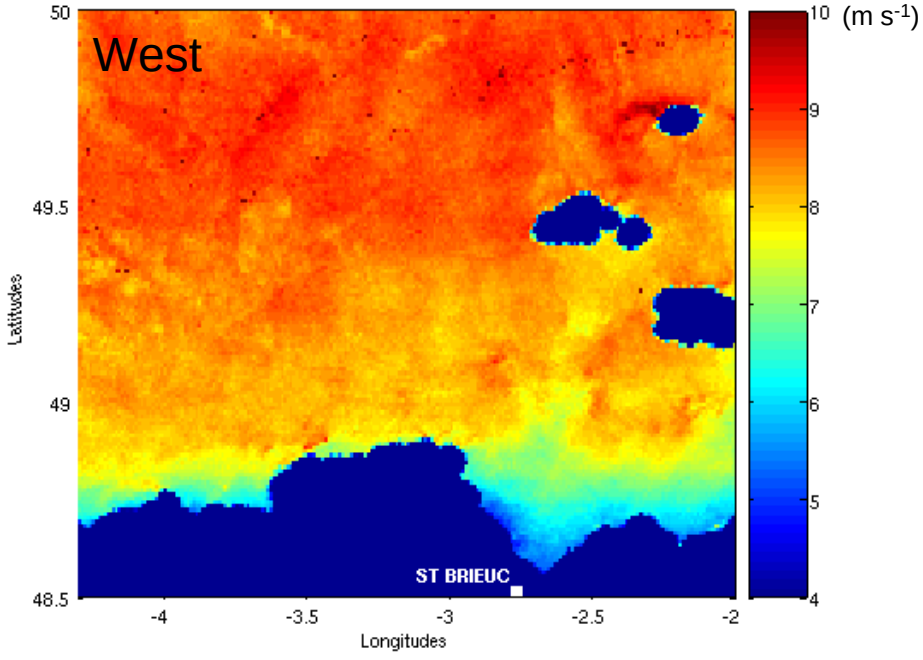



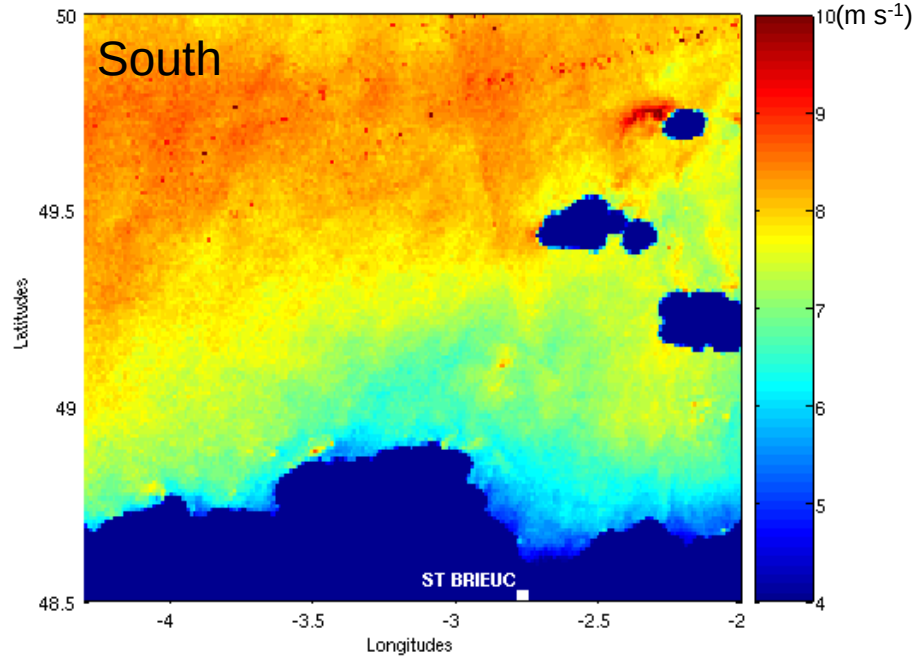
# Evaluation according to wind directions

- For each wind direction, we compute the mean.
- We consider wind bins of 90°
  - North winds: 23 %
  - East winds:  22 %
  - South winds: 18 %
  - West winds:  37 %


North
ST BRIEUC
Latitudes
Longitudes
50
49.5
49
48.5
-4
-3.5
-3
-2.5
-2
10
9
8
7
6
5
4
(m s-1)


East
ST BRIEUC
Latitudes
Longitudes
50
49.5
49
48.5
-4
-3.5
-3
-2.5
-2
10
9
8
7
6
5
4
(m s-1)


West
ST BRIEUC
Latitudes
Longitudes
50
49.5
49
48.5
-4
-3.5
-3
-2.5
-2
10
9
8
7
6
5
4
(m s-1)


South
ST BRIEUC
Latitudes
Longitudes
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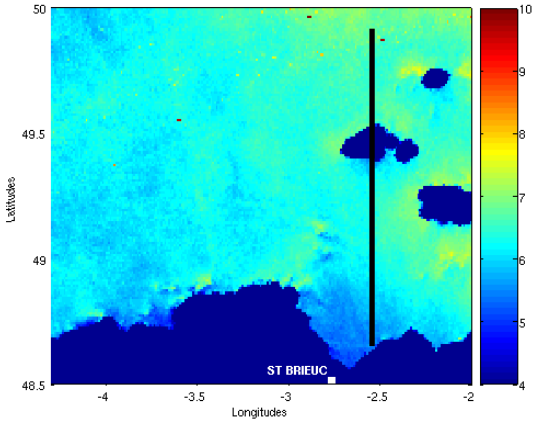
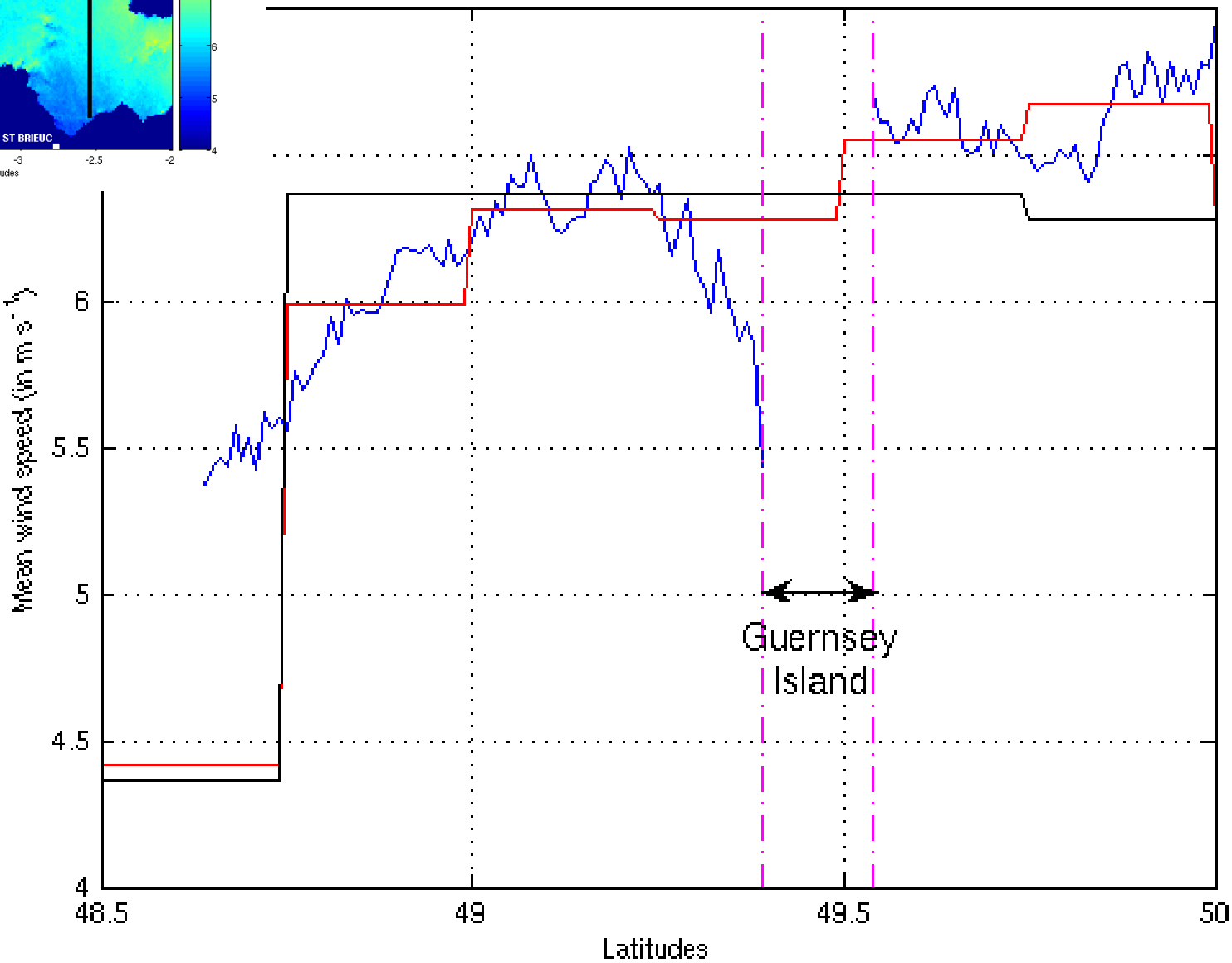
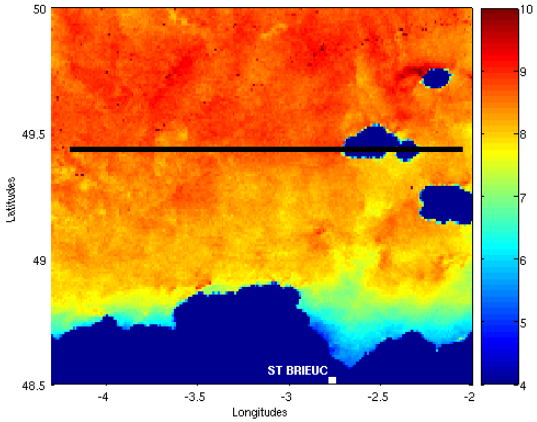
49.5
49
48.5
-4
-3.5
-3
-2.5
-2
10
9
8
7
6
5
4
(m s-1)

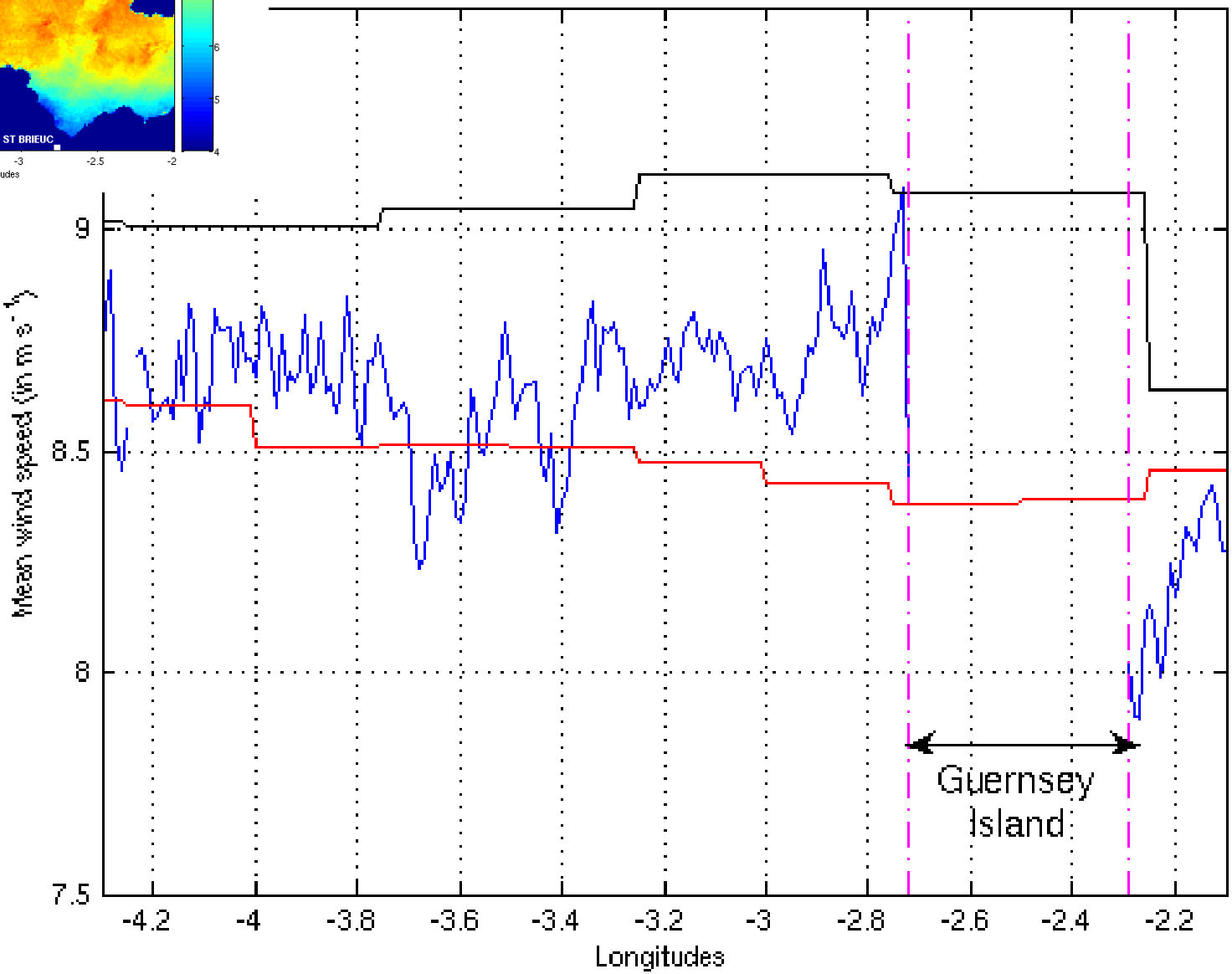
# Winds from the North (23 % of the total)



# Winds from the West (37 % of the total)



# Conclusions

- The statistical proprieties of the wind series generated using the data fusion method are in agreement with those retrieved at lower spatial resolution.
- The spatial resolution improving was qualitatively evaluated.
- The high spatial resolution generated data permits the retrieval of phenomena not retrieved using lower spatial resolution data.
- These results have to be evaluated, by a comparison to *in situ* data or models with similar spatial resolution.