10th International Workshop on Wave Hindcasting and Forecasting

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Freak or high waves?

or

The "*Voyager*" storm in the Mediterranean Sea

Rescue for stricken cruise ship

A cruise liner with 732 people on board - most of them Spanish - has been crippled by a severe storm in the western Mediterranean.

The ship was battered by 10-metre waves

A French-led rescue operation is under way to reach the stricken Voyager, now about 100km (60 miles) from Menorca.

Several people suffered minor injuries and the ship has lost all engine power, a spokesman for its owner, V Ships of Monaco, told the BBC News website.

It was sailing from Sardinia, on a voyage from Tunis to Barcelona.

The spokesman said the crew were battling to restore engine power and a liquefied gas tanker, the Gimi, was on the scene after receiving the distress call.

Battered by storm

A high wave smashing through the windows of the bridge and damaging electronics is thought to have caused the power cut.

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The distress call from the ship said it was taking on water and was in "terrible condition," UK coastguards reported.

They received the message just after 0900 GMT on Monday via the Gimi.

The French coastguards told the BBC that the ship was not on fire and not in danger of sinking.

Two tugs - one Spanish and one French - are travelling to the

Passenger ship Voyager radios SOS in the Mediterranean

February 14, 2005

A passenger ship, the *Voyager* enroute between Spain's Balearic Islands to the Italian island of Sardinia, radioed a distress call earlier today after getting into difficulties in heavy seas.
A huge wave shattered a bridge window,
damaging control systems inside.

The question we are asking is:

“was this an exceptionally high wave, in other words a freak or monster wave, or was it simply a large wave consistent with the local conditions at the time of the accident?”

Methodology :

make the best hindcast

compare with available data

given the local wave condtions, estimate the probability of large waves (see reports)

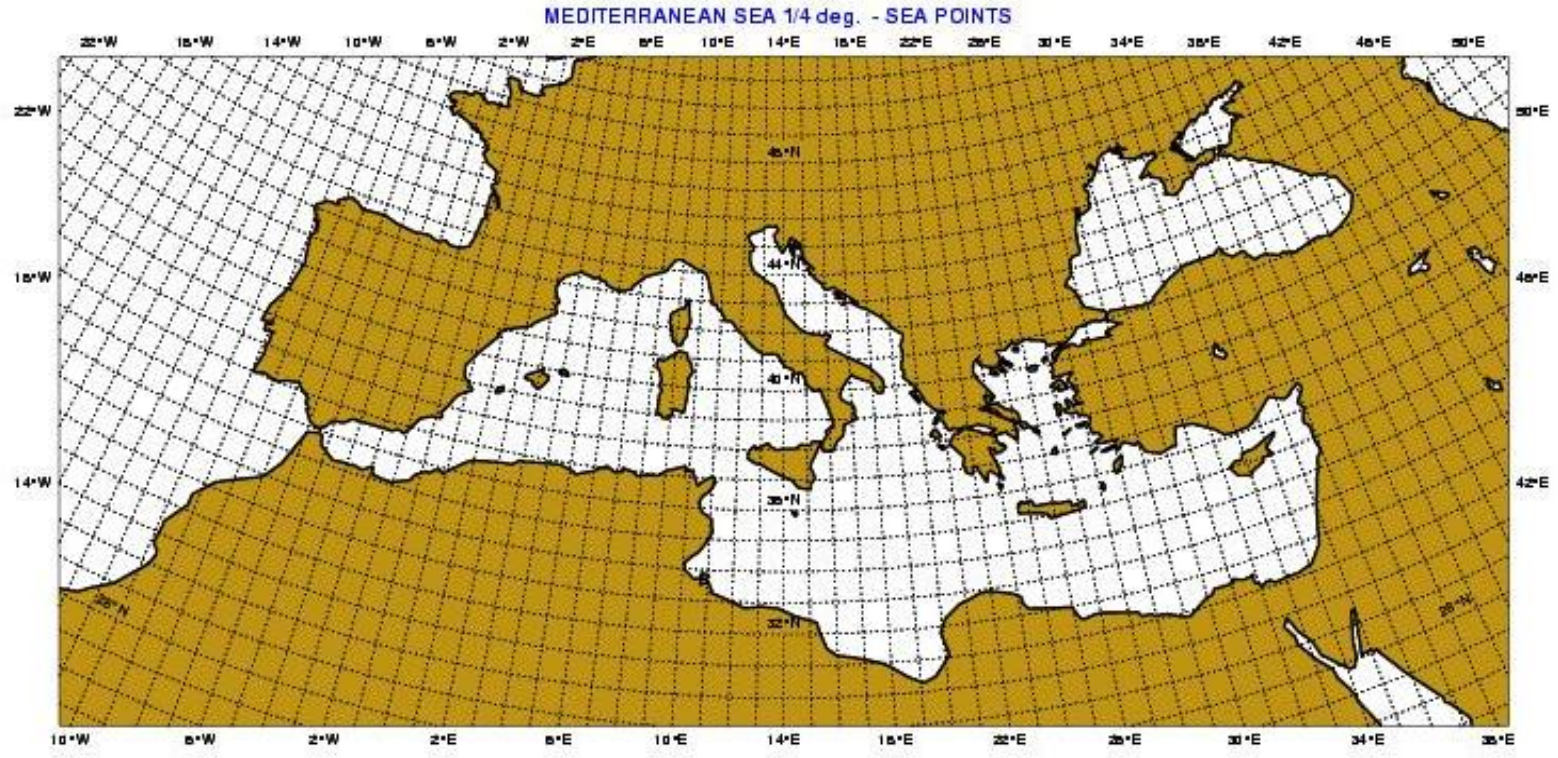
Results :

disappointing: reported waves easily expected

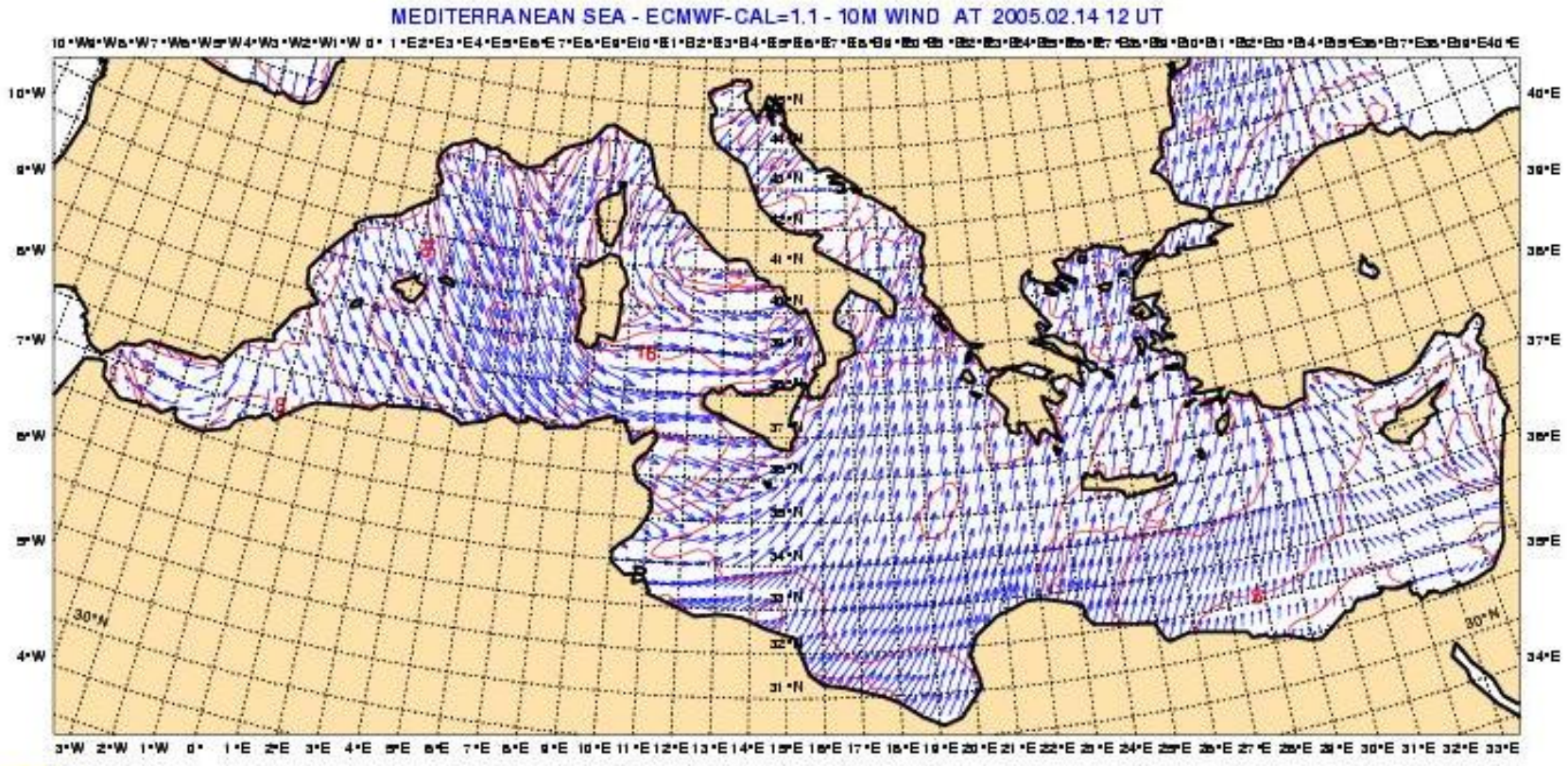
we believe the reports were wrong, and argue what could have actually happened

along the way we have derived some conclusions about the quality of the Jason and QuikSCAT winds in the enclosed seas

the Mediterranean Sea



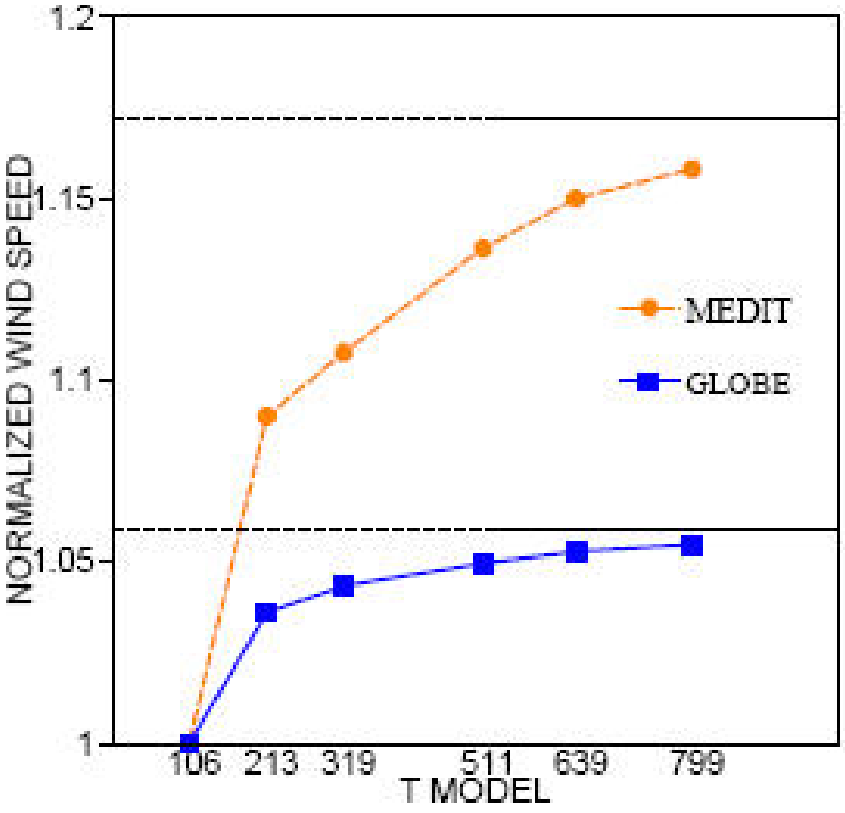
structure of the storm _ 2

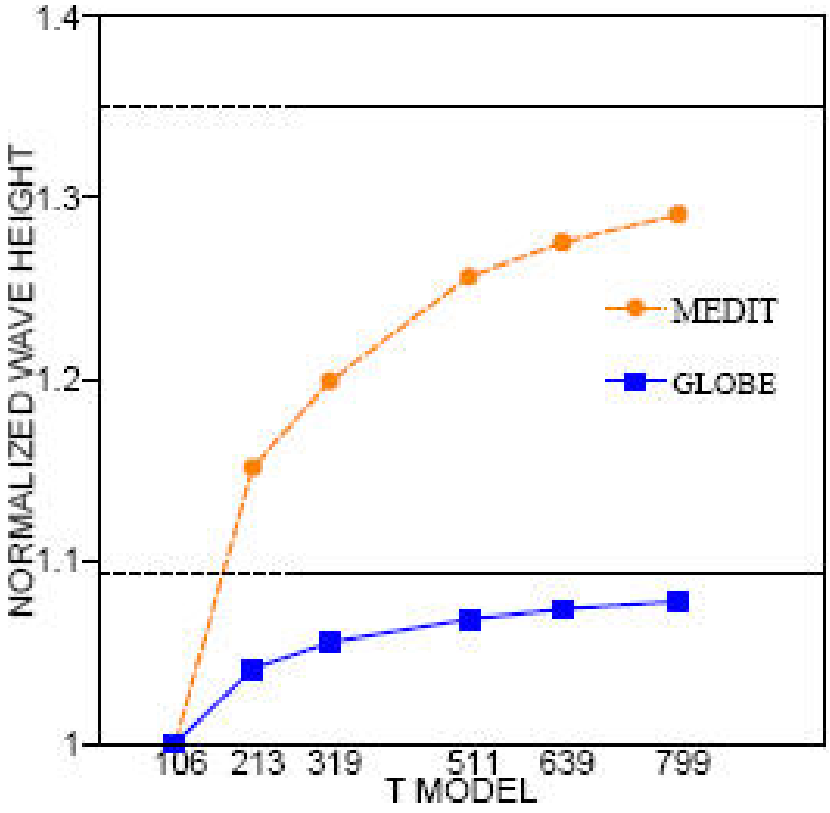


In principle we could use the ECMWF analysis or forecast fields to derive the wind and wave conditions at the ship location

problem:

the T511 ECMWF fields are underestimated in the Mediterranean Sea


1.2
1.15
1.1
1.05
1
NORMALIZED WIND SPEED
MEDIT
GLOBE
106
213
319
511
639
799
T MODEL


1.4
1.3
1.2
1.1
1
NORMALIZED WAVE HEIGHT
MEDIT
GLOBE
106
213
319
511
639
799
T MODEL

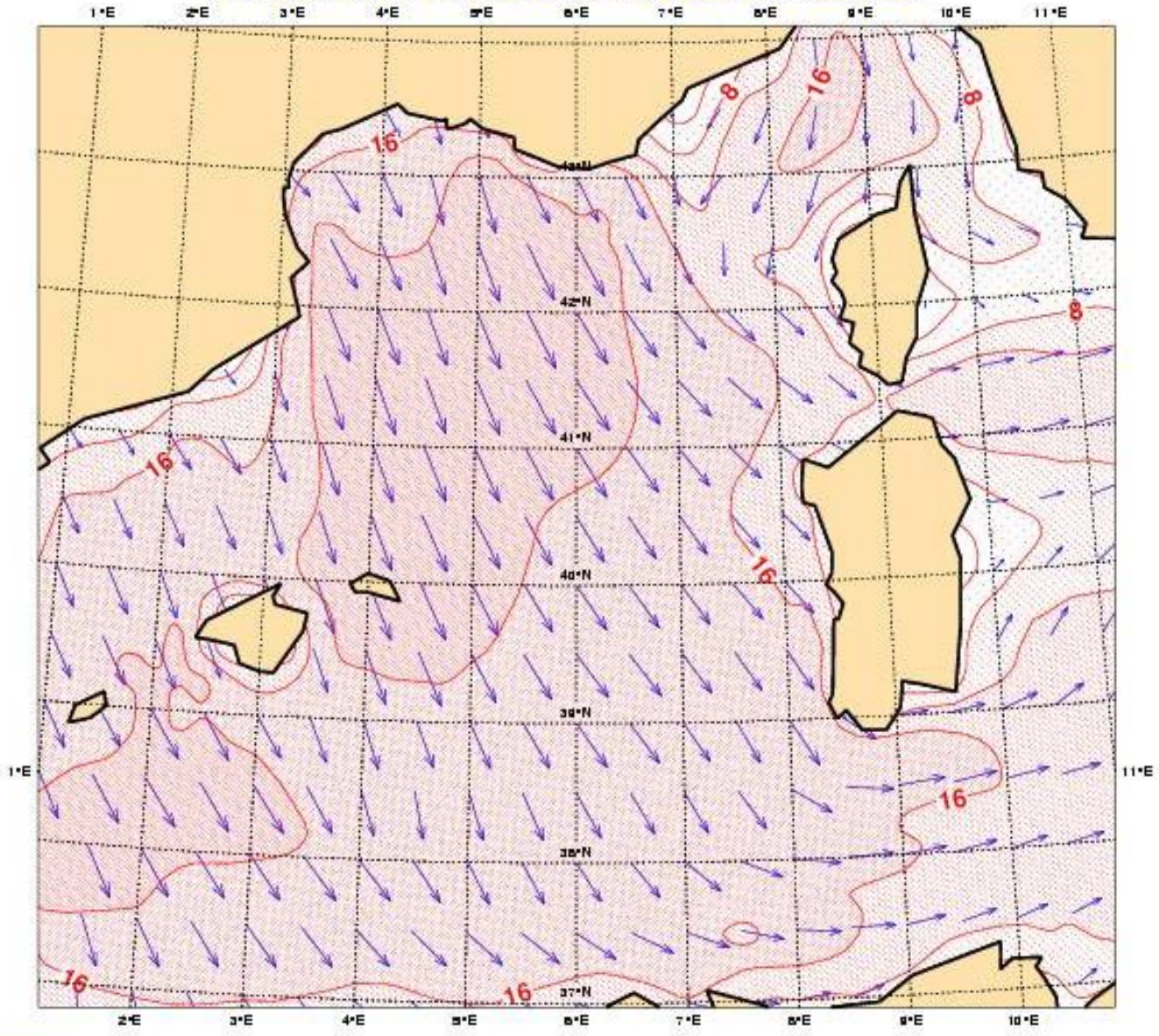
The ECMWF T511 wind speeds are substantially

underestimated in the inner seas, and in particular

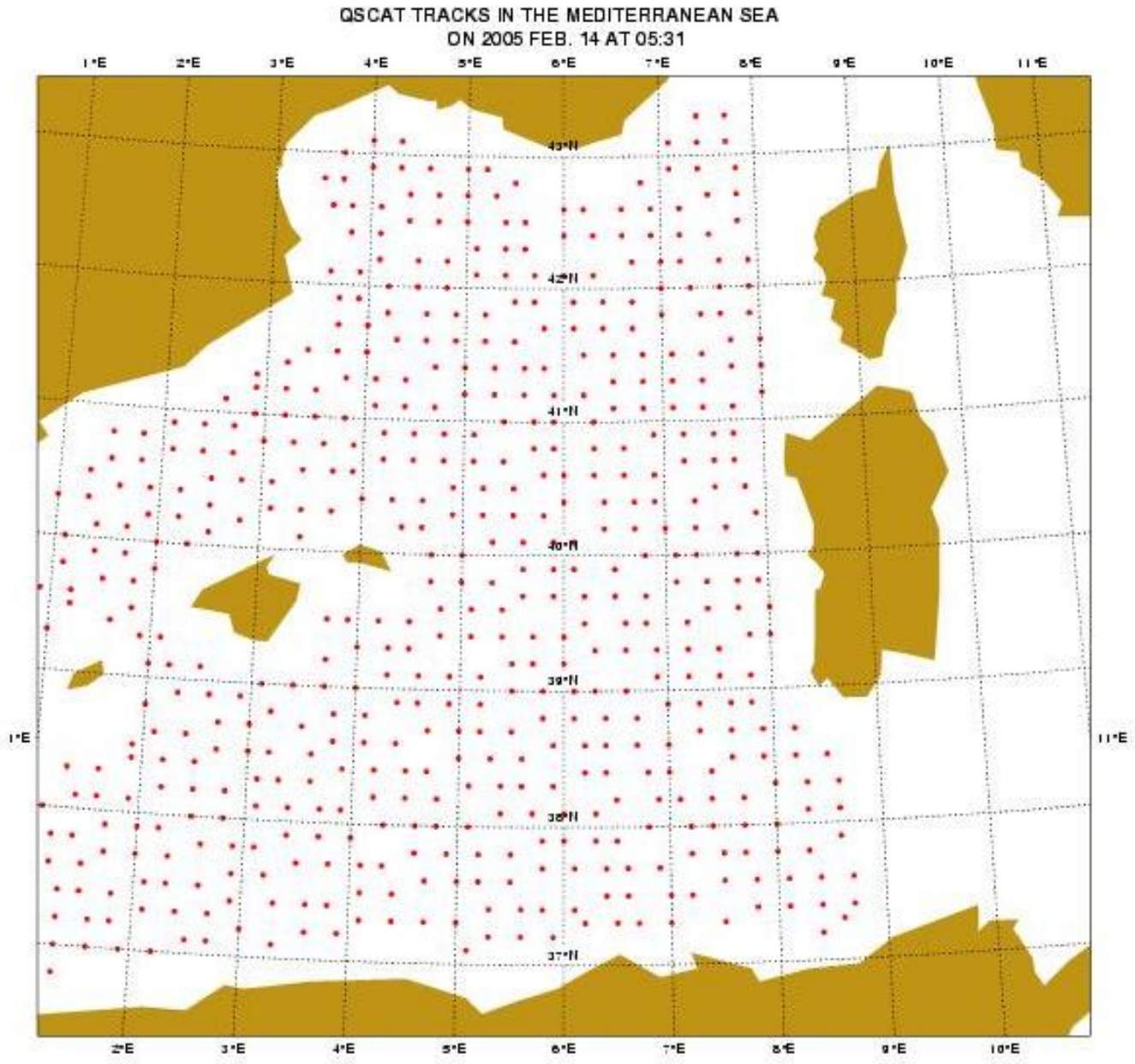
in the Mediterranean Sea

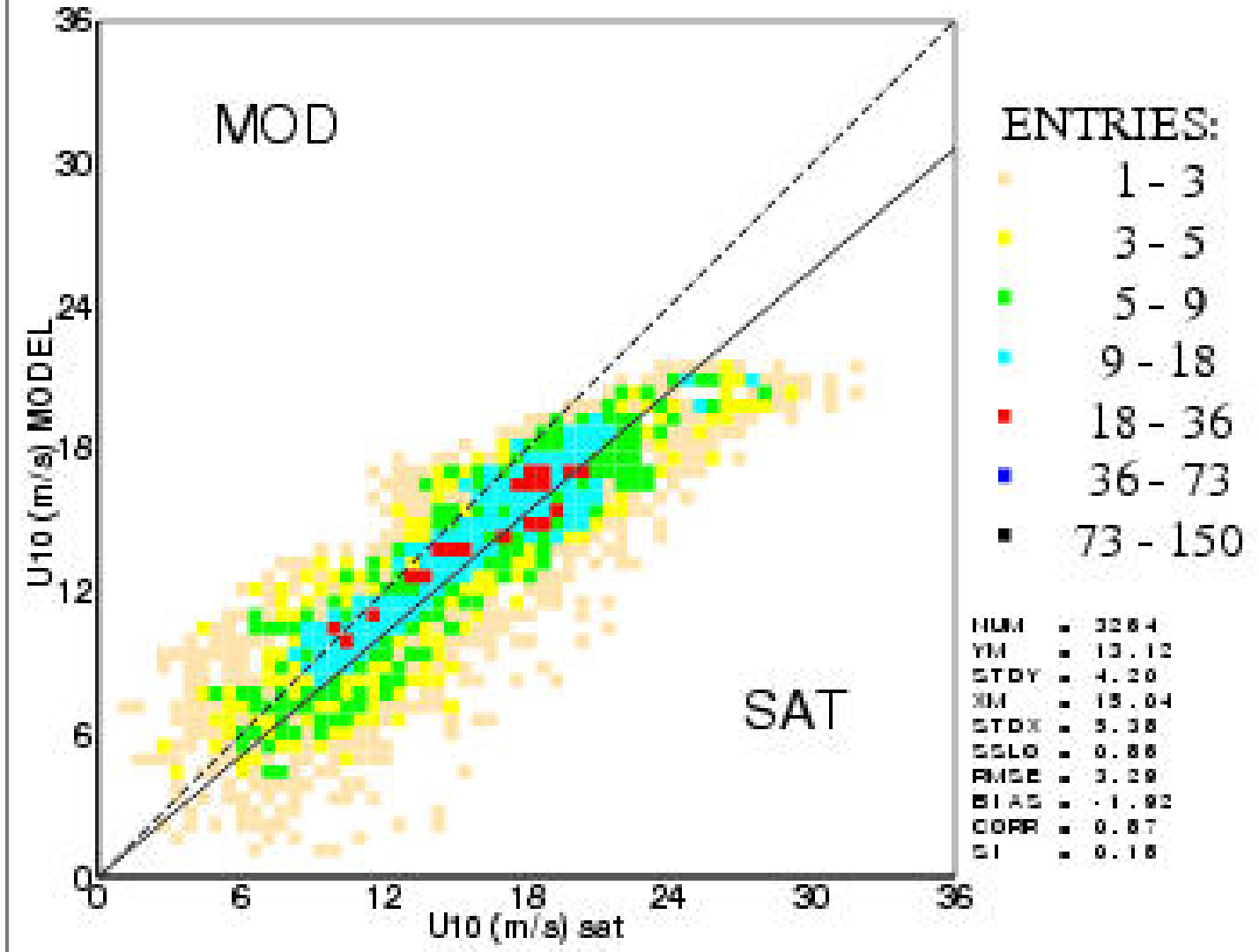
Experiments repeated with T799 (25 km resolution)

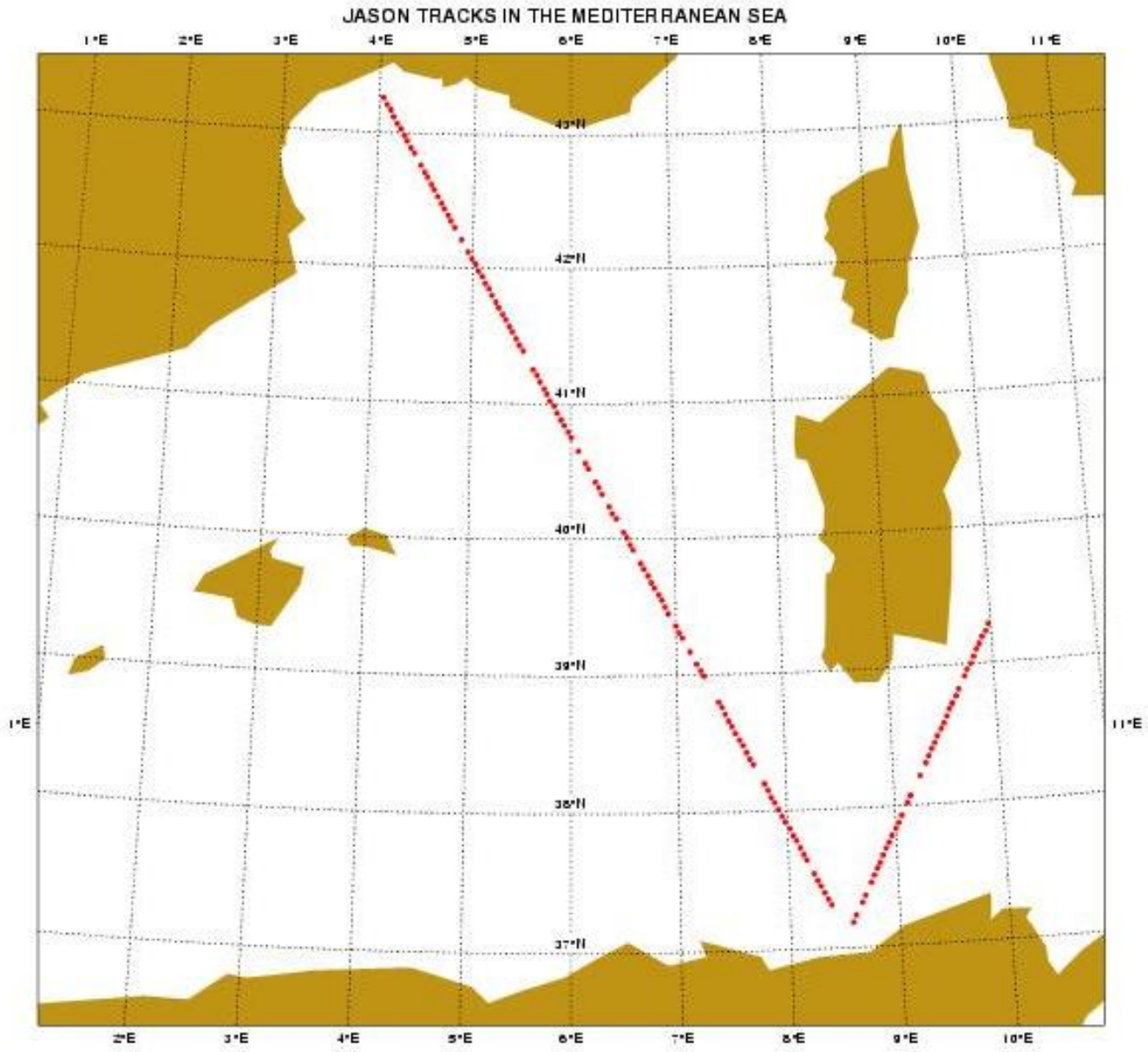
Also COAMPS (FNMOC) winds have been used (0.2^{o})


MEDITERRANEAN SEA - ECMWF-CAL=1.1 - 10M WIND AT 2005.02.14 03 UT
1°E
2°E
3°E
4°E
5°E
6°E
7°E
8°E
9°E
10°E
11°E
42°N
41°N
40°N
39°N
38°N
37°N
8
16

ECMWF 1.1WND


QSCAT TRACKS IN THE MEDITERRANEAN SEA
ON 2005 FEB. 14 AT 05:31
1°E
2°E
3°E
4°E
5°E
6°E
7°E
8°E
9°E
10°E
11°E
43°N
42°N
41°N
40°N
39°N
38°N
37°N

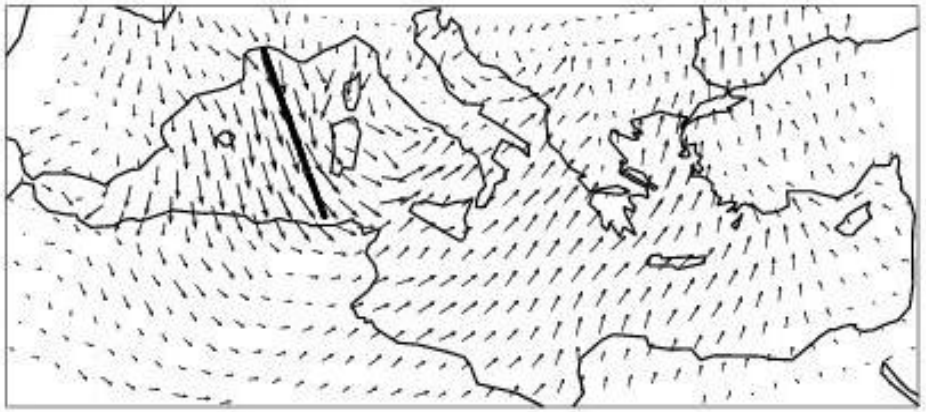

MOD
SAT
ENTRIES:
1 - 3
3 - 5
5 - 9
9 - 18
18 - 36
36 - 73
73 - 150
NUM = 3284
YM = 13.12
STDY = 4.20
XM = 15.04
STDX = 5.38
SSLO = 0.86
RMSE = 3.29
BIAS = -1.92
CORR = 0.87
SI = 0.18
U10 (m/s) MODEL
U10 (m/s) sat
0
6
12
18
24
30
36


JASON TRACKS IN THE MEDITERRANEAN SEA
1°E
2°E
3°E
4°E
5°E
6°E
7°E
8°E
9°E
10°E
11°E
43°N
42°N
41°N
40°N
39°N
38°N
37°N

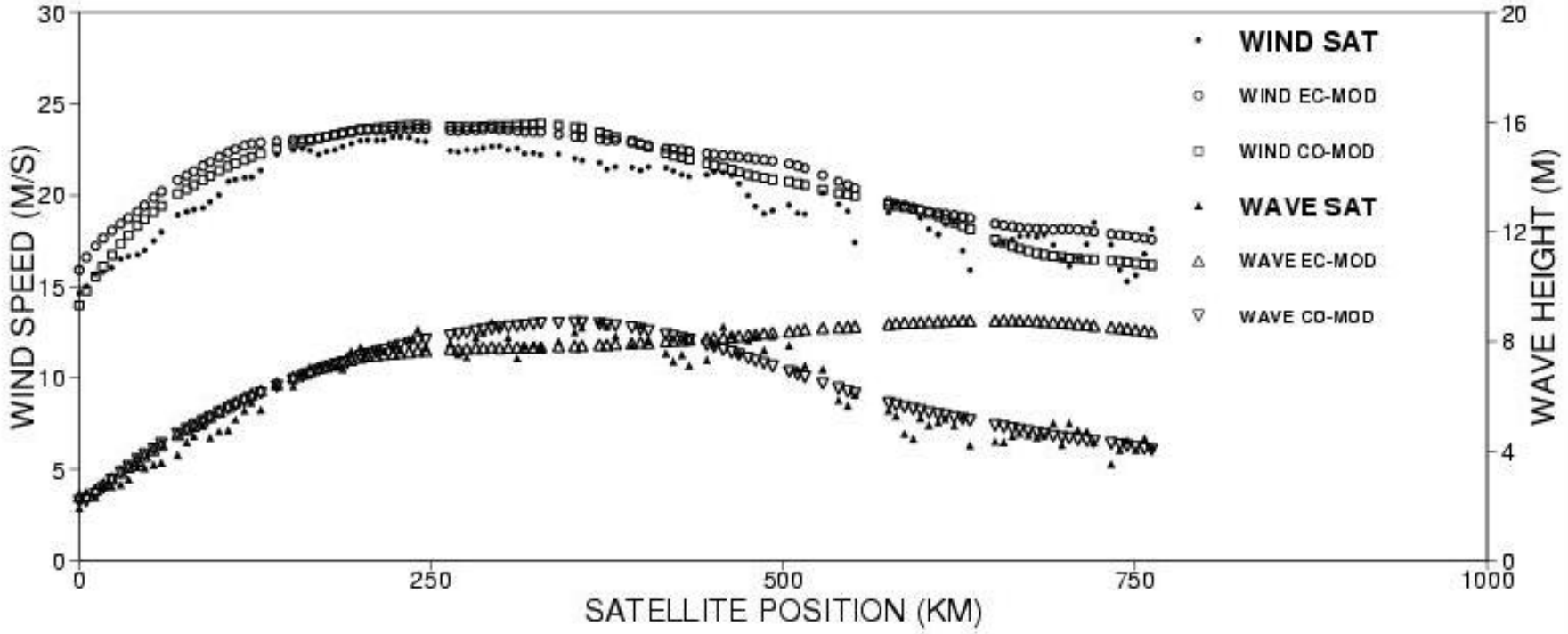
Comparison between ECMWF model winds and QuikSCAT data suggests ECMWF winds need to be increased by 14%

Increasing ECMWF wind speeds by 14% leads to wave heights that are 7% in excess with respect to Jason altimeter data

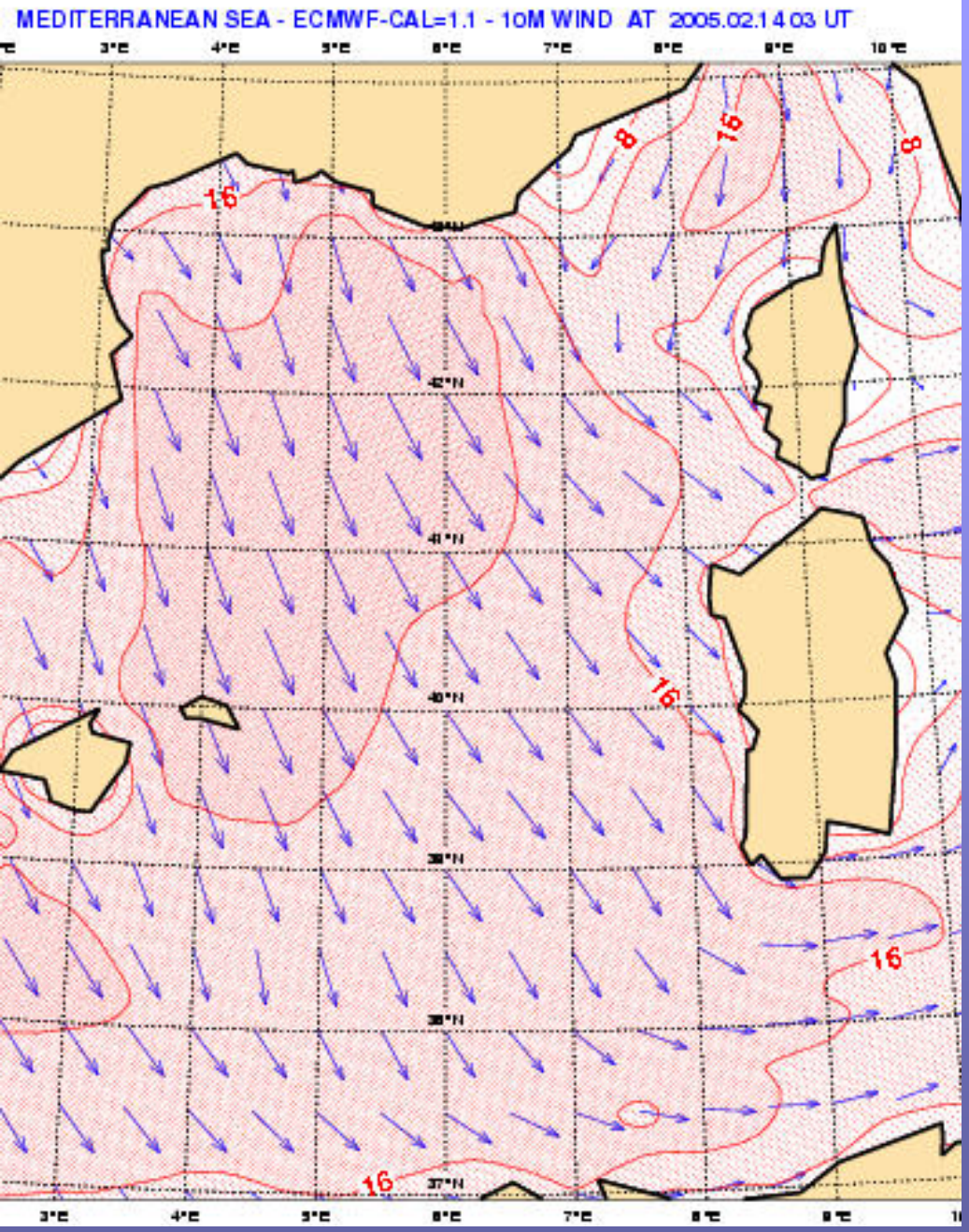
Final choice: increase ECMWF wind speeds by 10% - no increase required for COAMPS wind speeds

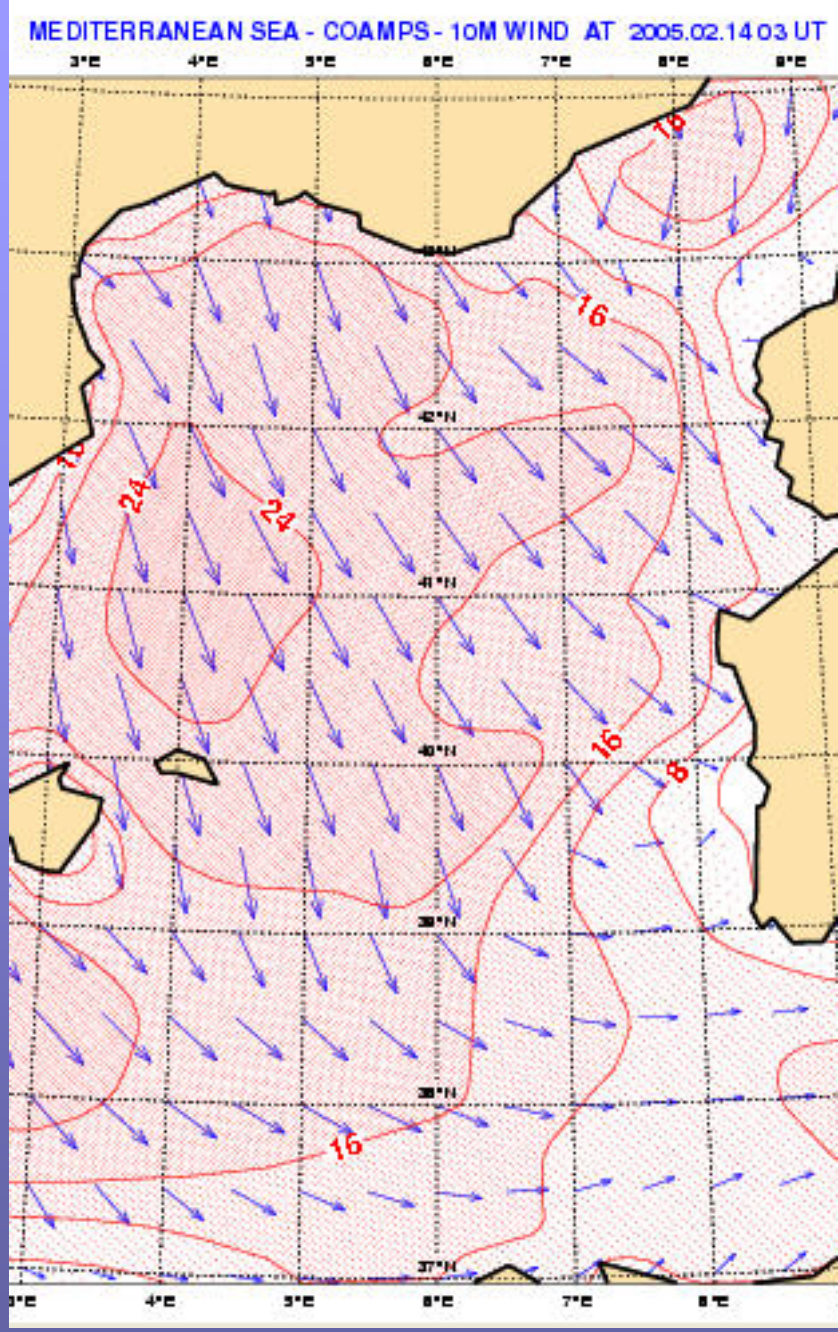


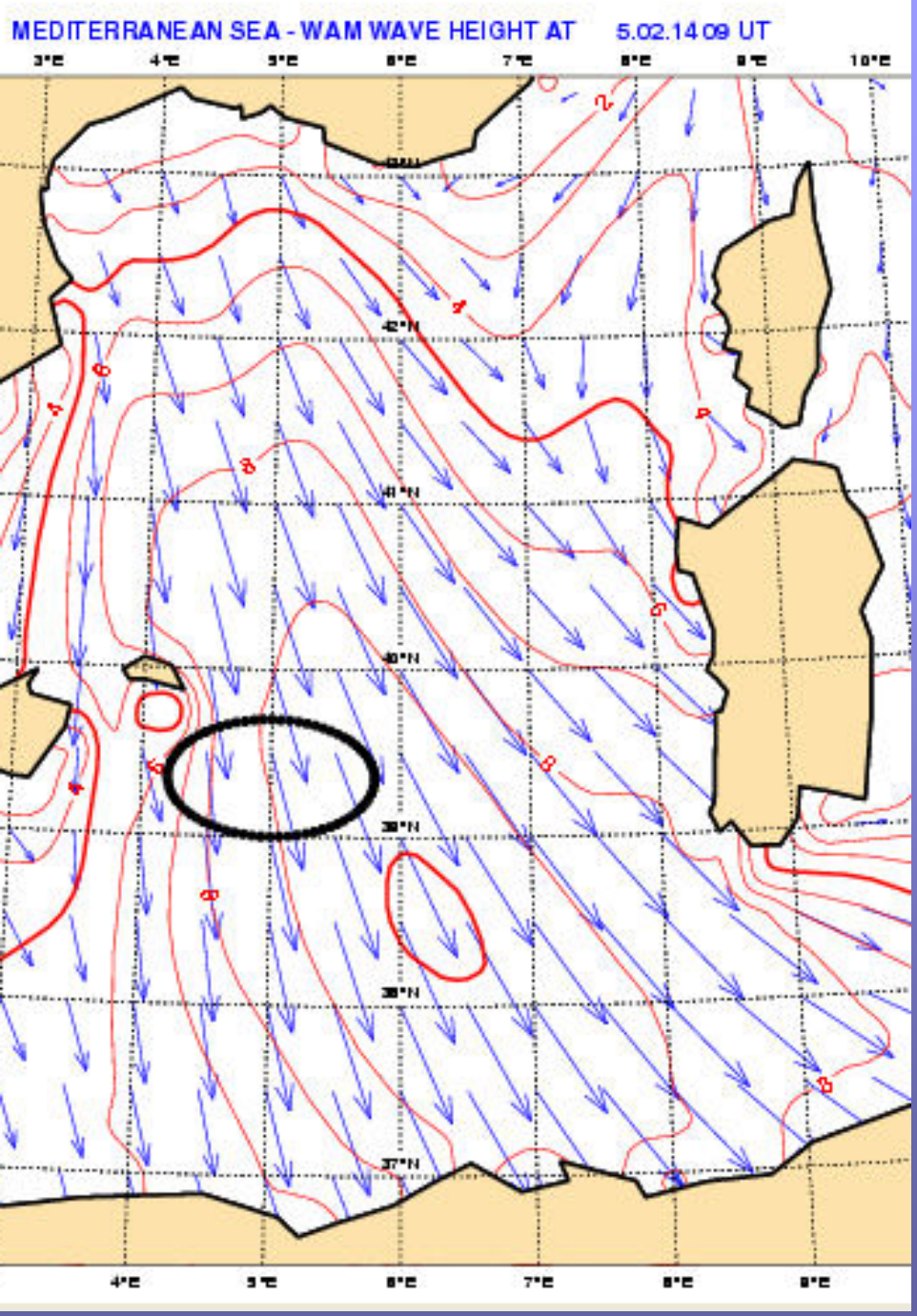
JASON TRACK ON MEDITERRANEAN SEA
DATE: 5 2 14 0828 UT
FIRST POINT (43.30 N , 4.01 E)
LAST POINT (37.31 N , 8.38 E)

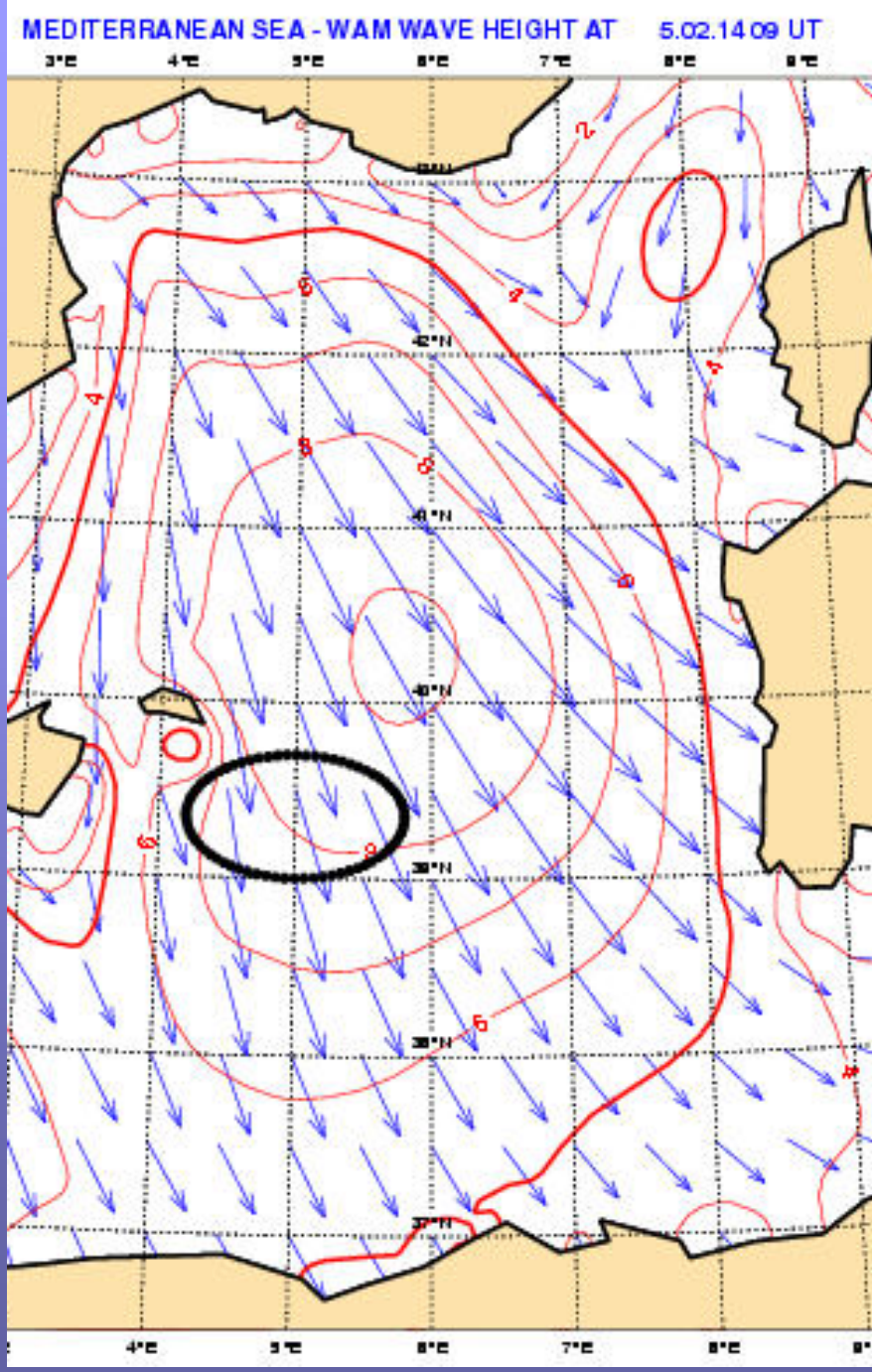


CALIB=1.1


MEDITERRANEAN SEA - ECMWF-CAL=1.1 - 10M WIND AT 2005.02.14 03 UT
16
8
16
8
16
16
16
16


MEDITERRANEAN SEA - COAMPS - 10M WIND AT 2005.02.14 03 UT
16
24
24
16
8
16


MEDITERRANEAN SEA - WAM WAVE HEIGHT AT 5.02.14 09 UT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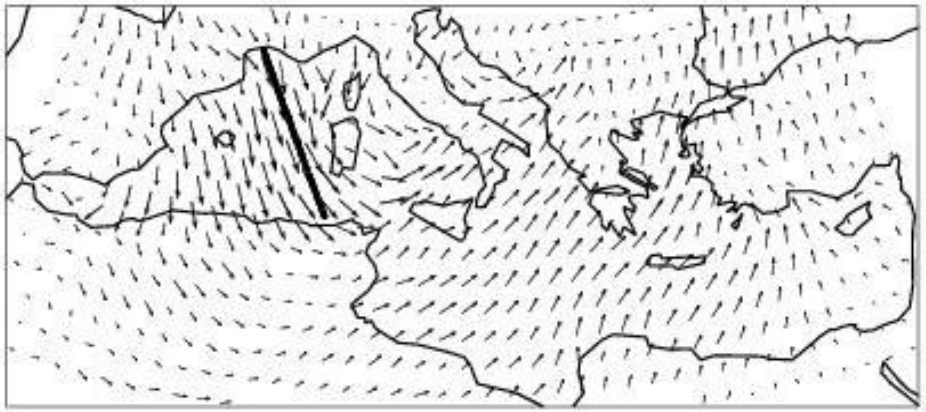

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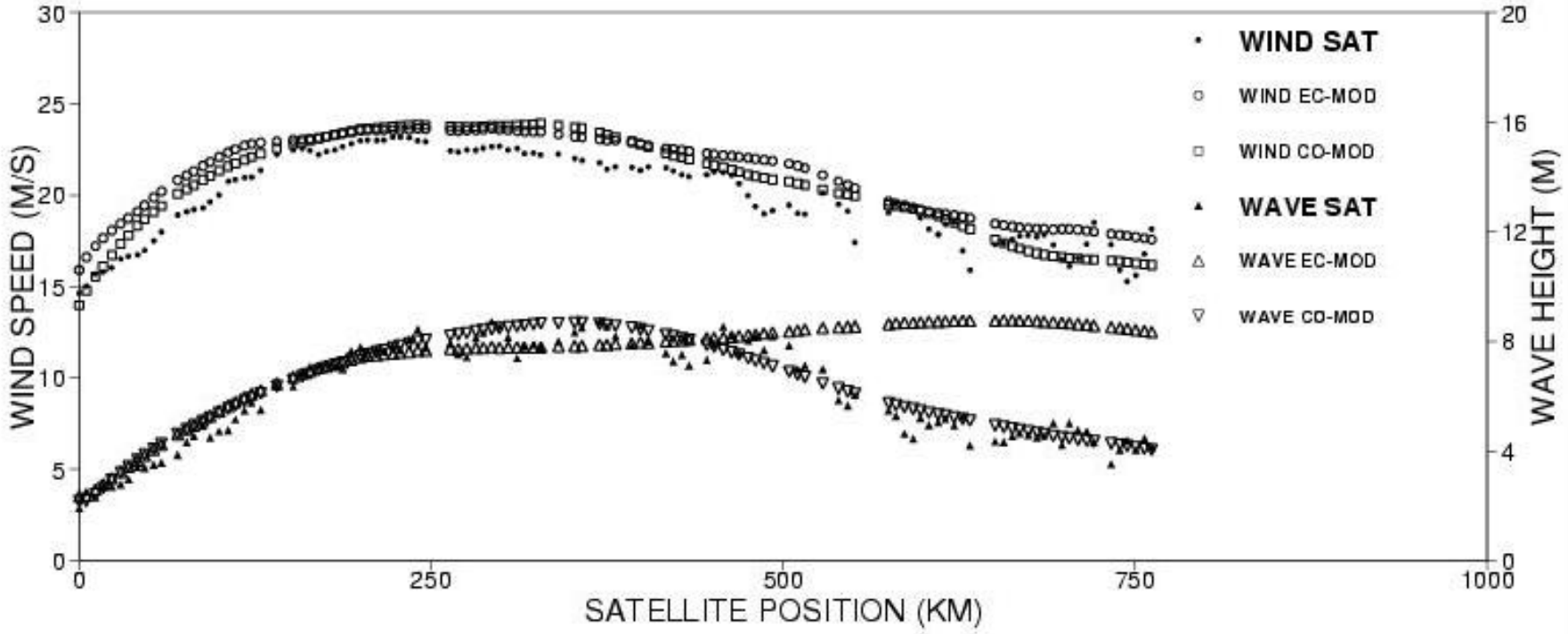


CALIB=1.1

side conclusions:

The Jason wind speeds are slightly underestimated

in the Mediterranean Sea, more in general

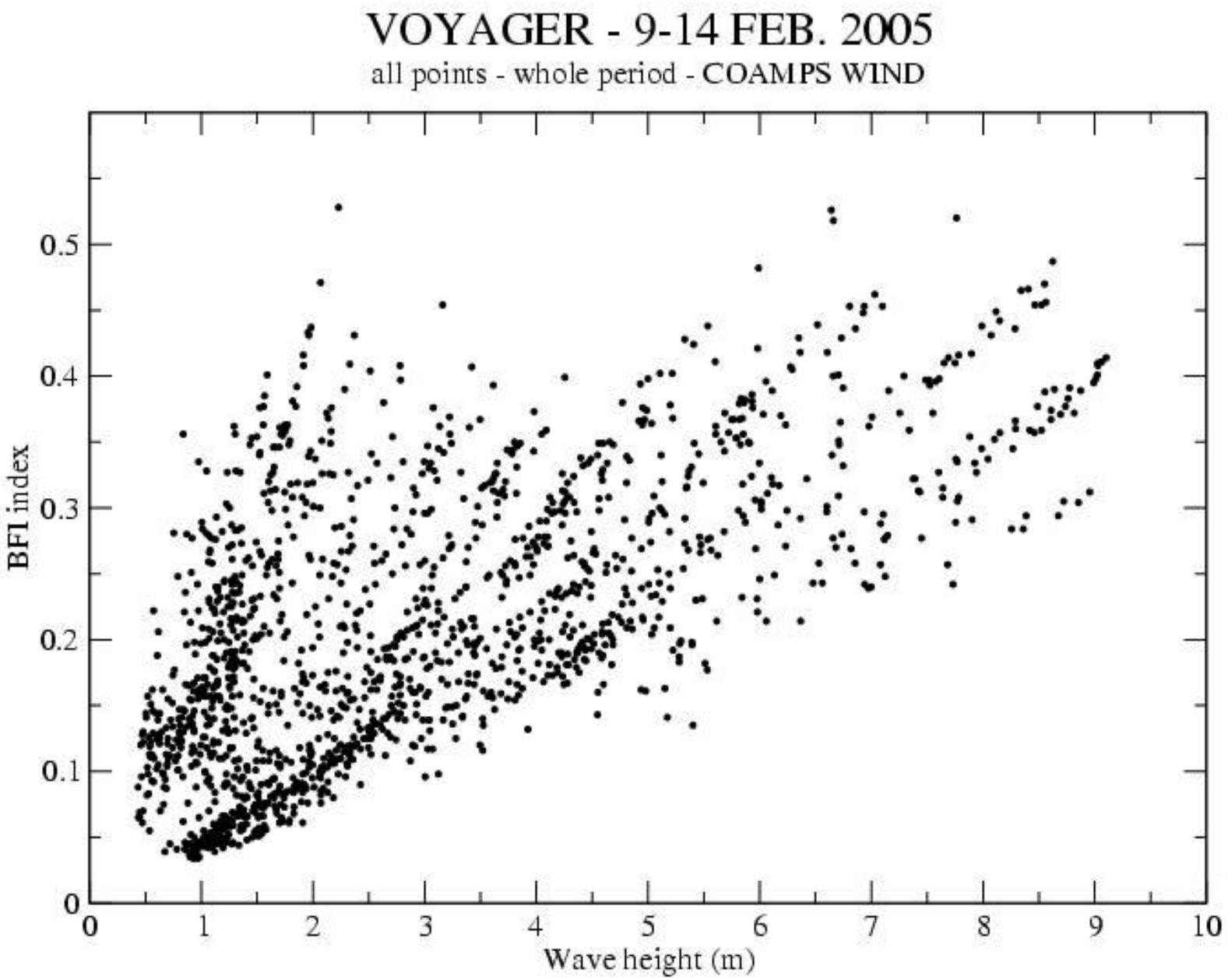
in the enclosed seas –

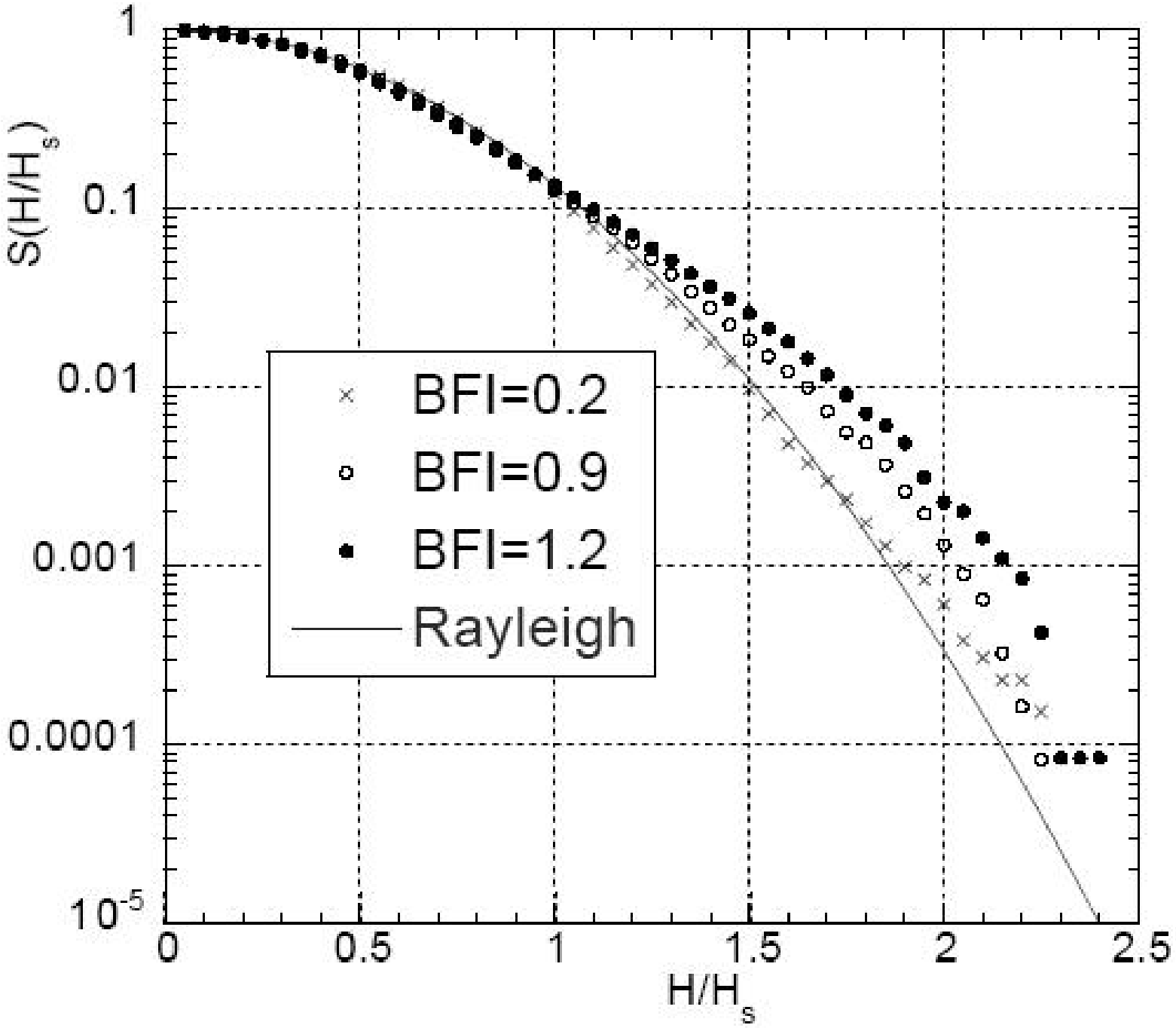
In these same areas the SeaWINDS wind speeds

are slightly overestimated

The Benjamin-Feir index, BFI, is a measure
of the level of nonlinearity present in the system,
hence of the probability of appearance of wave heights
much larger than expected from linear theory –

if BFI < 0.8 the probability of freak waves is low


VOYAGER - 9-14 FEB. 2005
all points - whole period - COAMPS WIND
BFI index
0
0.1
0.2
0.3
0.4
0.5
0
1
2
3
4
5
6
7
8
9
10
Wave height (m)


1
0.1
0.01
0.001
0.0001
10-5
S(H/Hs)
0
0.5
1
1.5
2
2.5
H/Hs
BFI=0.2
BFI=0.9
BFI=1.2
Rayleigh

Hs	8	10	m
H = 14 m	1.75	1.4	times larger
Rayleigh every	500	50	waves
i.e. every	1.5	0.18	hours

Hypothesis:	Hc = 14 m	→	H = 18 m
H = 18 m	2.1	1.8	times larger
Rayleigh every	13000	550	waves
i.e. every	40	2	hours

We have concluded that the wave that hit the ship was not exceptional (i.e. not a historic event) –

rather, it was well within the probabilities connected to the conditions present in the area at the time of the accident

mind you – also the storm was not extreme – it was a very severe mistral storm

mind the wave - questions?