Intercomparison of operational wave forecasting systems against buoys: data from ECMWF, MetOffice, FNMOC, DWD, BoM, and SHOM June 2008 to August 2008

Jean-Raymond Bidlot, European Centre for Medium-range Weather Forecasts, jean.bidlot@ecmwf.int

September 17, 2008

0.1 Forewords

Outputs from different operational forecasting centres are compared to buoy and platform data as broadcasted to the meteorological community via the Global Telecommunication System (GTS). On a monthly basis, data are gathered informally from operational weather services with an interest in wave forecasting (Bidlot and Holt, 2006). The different data sets are subsequently merged and made available to all participating partners for further evaluation. In this documents, examples, in graphical and tabular forms, are shown. These results have been processed at ECMWF and should served as an example to the kind of information that could be obtained from such comparison. No statement of quality, nor reasons why the different systems are performing differently will be given.

0.2 Data

Before using observations for verification, care has to be taken to process the data to remove any erroneous observations and also in order to match the scale of both model and observations. This scale matching is achieved by averaging the hourly data in ± 2 hour time windows centered on the four major synoptic times corresponding to the normal model output times. The original quality control and averaging procedure was discussed in Bidlot *et al.* (2002). It was extended to include platform data as described in Sætra and Bidlot (2004). Note that in this paper we refer to these data as buoy data since most of them are from moored buoys, except if stated otherwise.

The intercomparison relies on the exchange of model output at buoy locations. An agreed upon list of locations is used where observations are known to be available. Because buoy networks are changing with time, as witnessed by a rapid increase in the number of buoys available via the GTS since the mid-nineties, updates to the list have been necessary. Not all participating centres have been able to update their list however. Other participants are only running limited area model(s) or do produce the parameter(s) that can be compared to the buoy data. Because of the limited number of buoys, a fair comparison between the different systems can only be achieved if the same number of buoys and the same number of buoy-model collocations are used.

In this document, data that are common to ECMWF, MetOffice, FNMOC, DWD, BoM, and SHOM are used. The other participants are left blank in the plots below.

References

Bidlot J.-R., D. J. Holmes, P. A. Wittmann, R. Lalbeharry, H. S. Chen, 2002: Intercomparison of the performance of operational ocean wave forecasting systems with buoy data. *Wea. Forecasting*, **17**, 287-310.

Bidlot J.-R. and M.W. Holt, 2006: Verification of operational global and regional wave forecasting systems against measurements from moored buoys. *JCOMM Technical Report*, **30**. WMO/TD-No. 1333.

Sætra, Ø. and J.-R. Bidlot, 2004: On the potential benefit of using probabilistic forecast for waves and marine winds based on the ECMWF ensemble prediction system. *Wea. Forecasting*, **19**, 673-689.

0.3 Results

In the remaining pages, some of the results of the comparison with buoys are presented for all common buoys and for common buoys within a sub-area as displayed by the corresponding maps. Summary forecast scores are shown first, followed by density scatter diagrams with associated statistics for each subarea. Only common data to ECMWF, MetOffice, FNMOC, DWD, BoM, and SHOM are used.

0.3.1 Comparison for all buoys

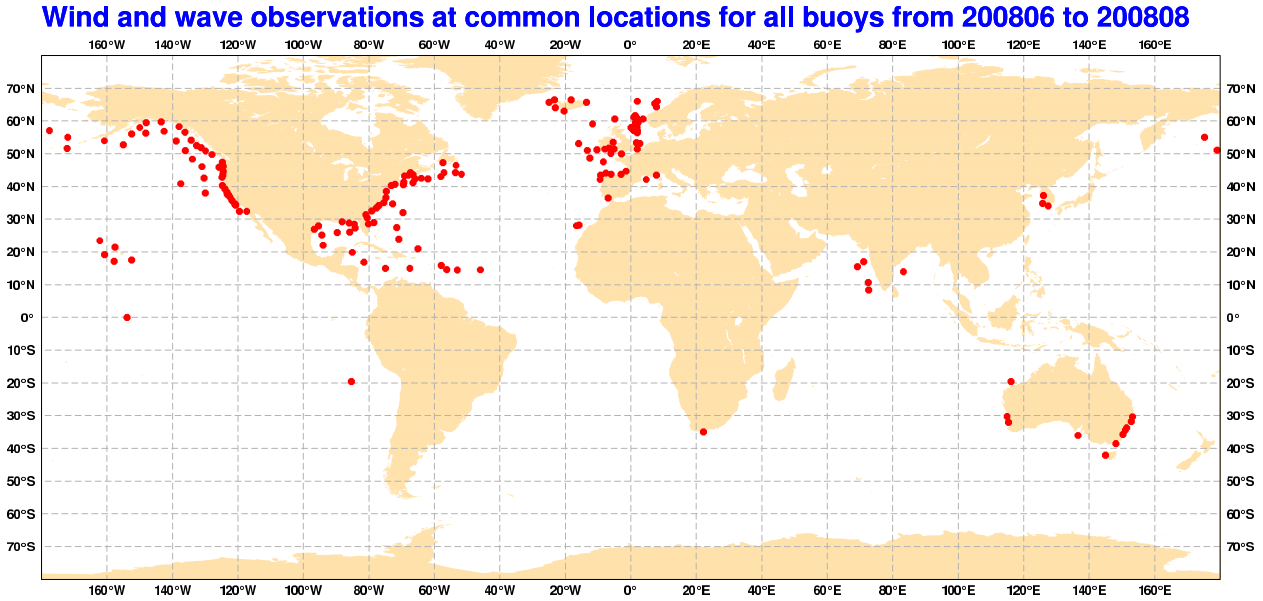
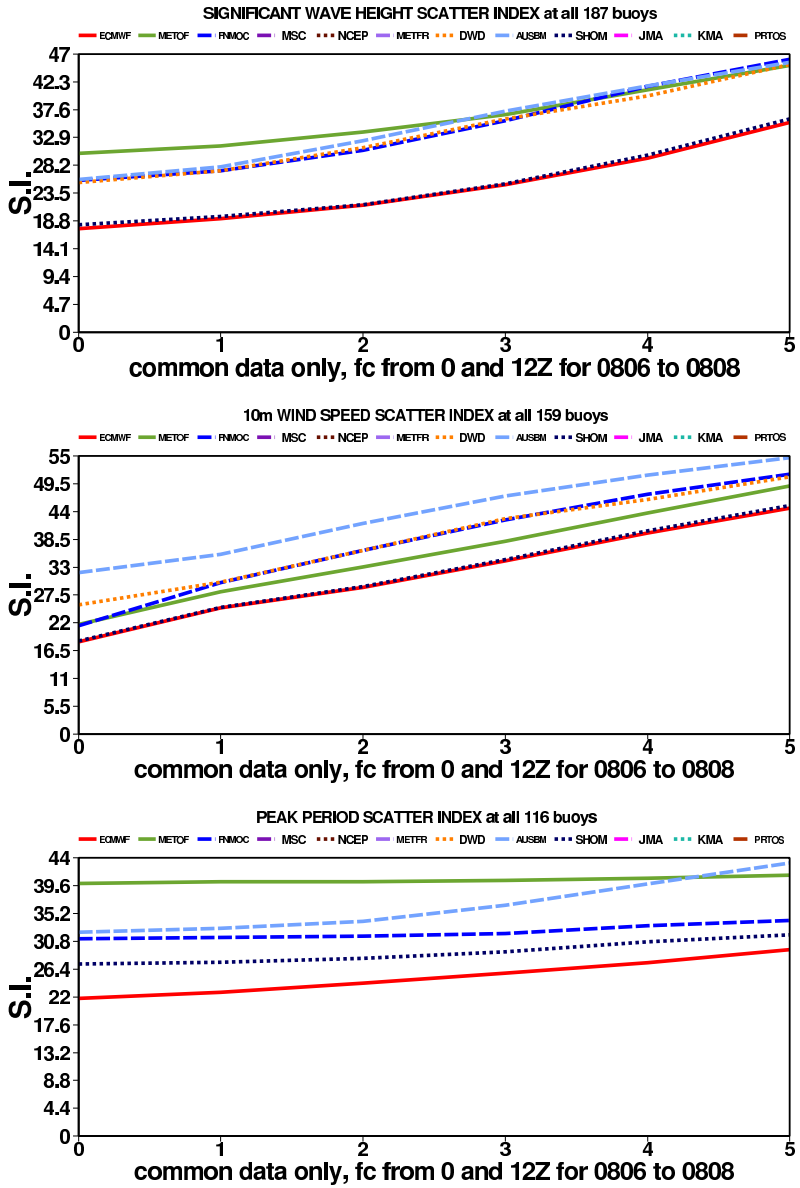
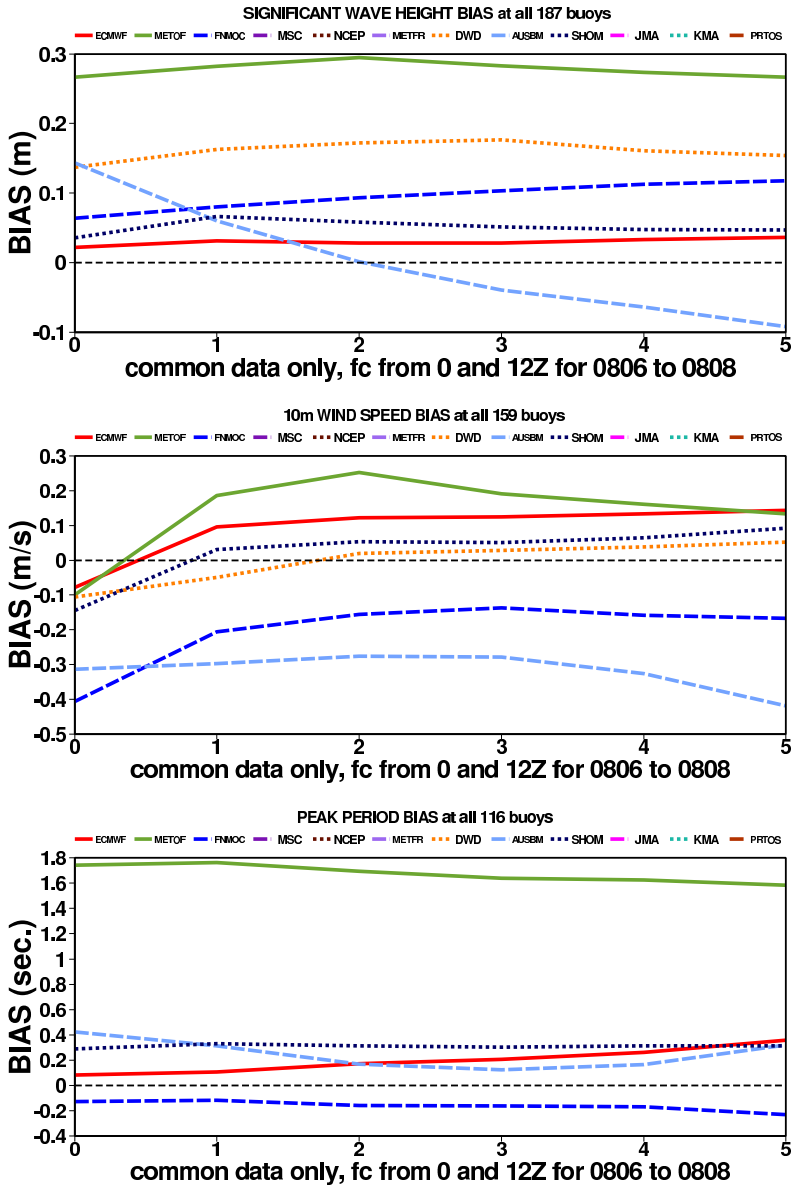


Figure 1: Buoy locations

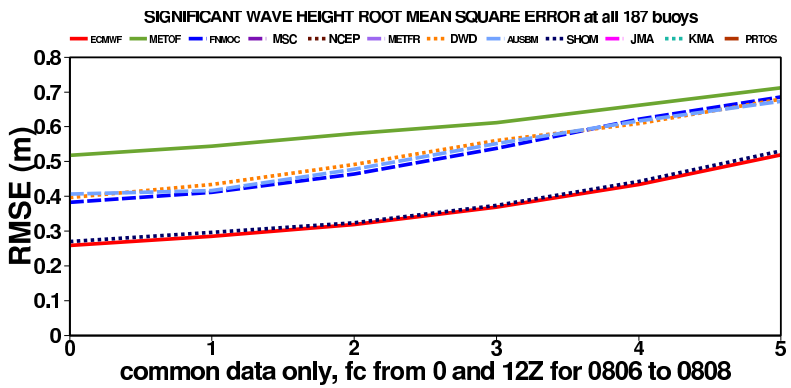


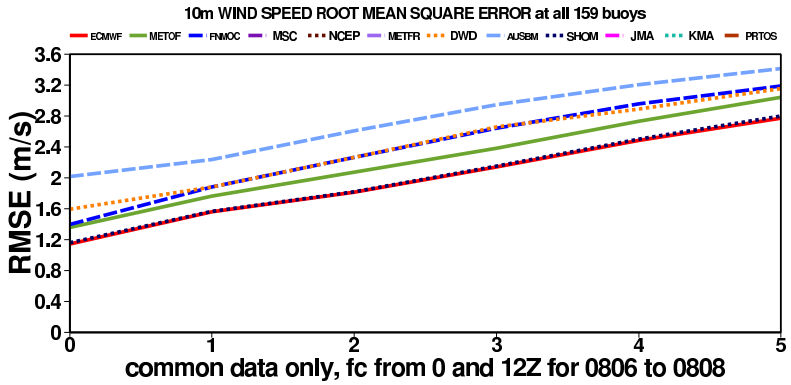
(a) Scatter Index (%)

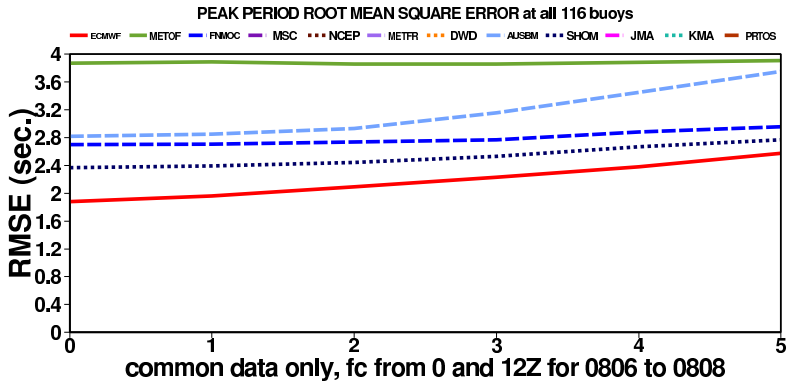


(b) Bias (model-buoy)

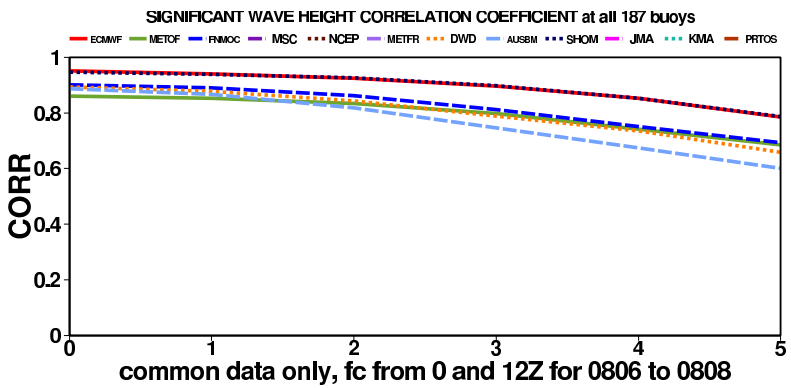
Figure 2: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common all buoys.

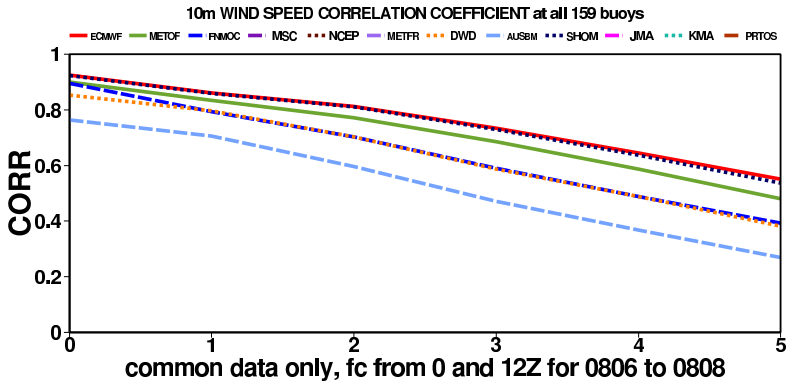


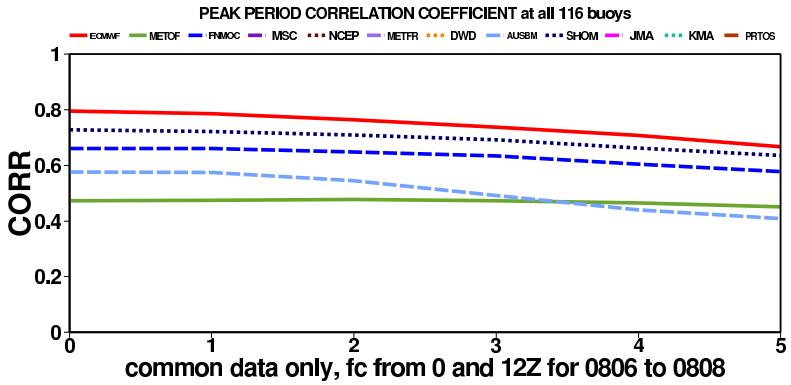




(a) R.M.S.E.

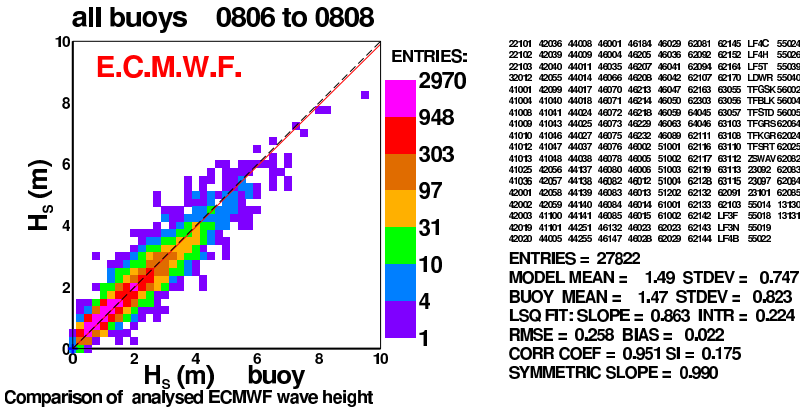




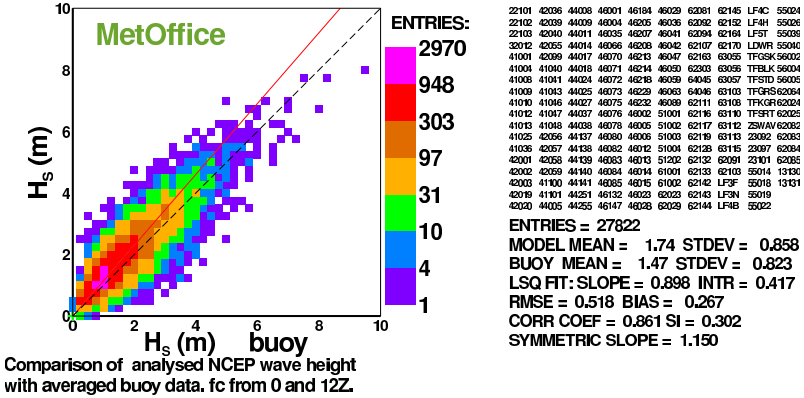


(b) Correlation Coefficient

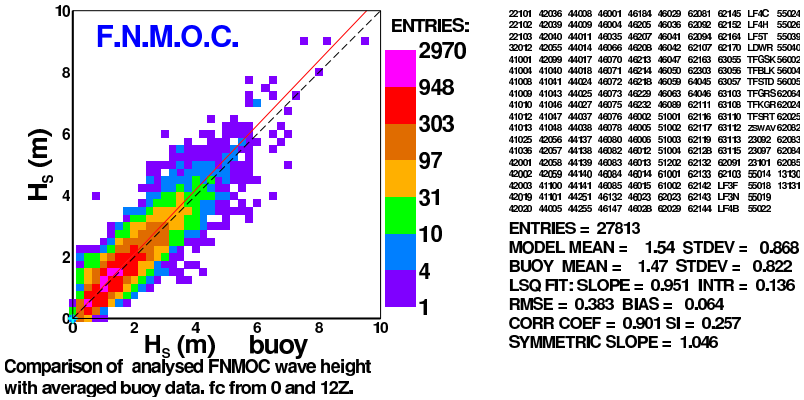
Figure 3: Forecast root mean square error (RMSE) and linear correlation coefficient at common all buoys.



Comparison of analysed ECMWF wave height with averaged buoy data. fc from 0 and 12Z.

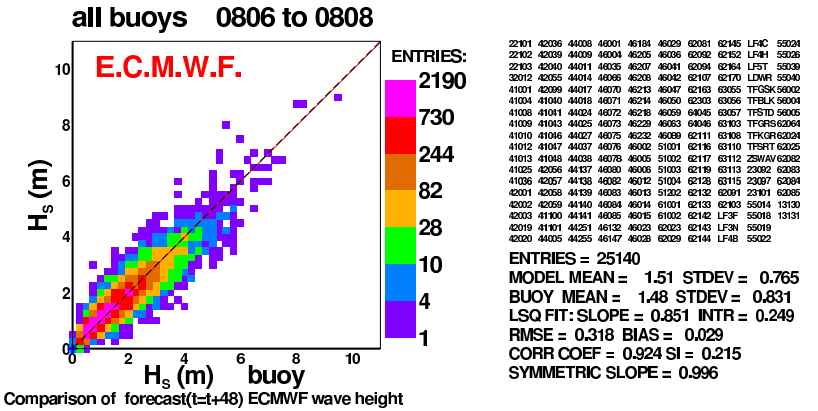


Comparison of analysed NCEP wave height with averaged buoy data. fc from 0 and 12Z.

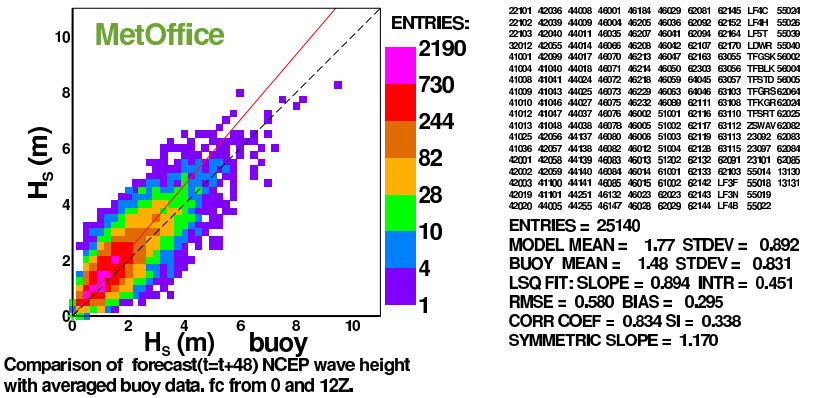


Comparison of analysed FNMOC wave height with averaged buoy data. fc from 0 and 12Z.

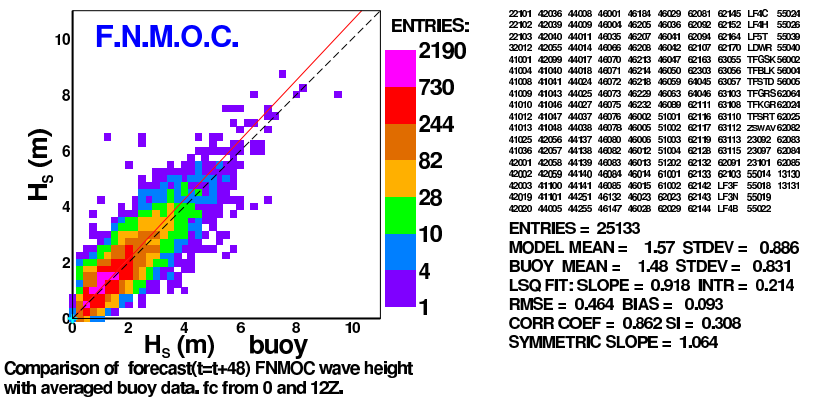
(a) t+0



Comparison of forecast(t=t+48) ECMWF wave height with averaged buoy data. fc from 0 and 12Z.



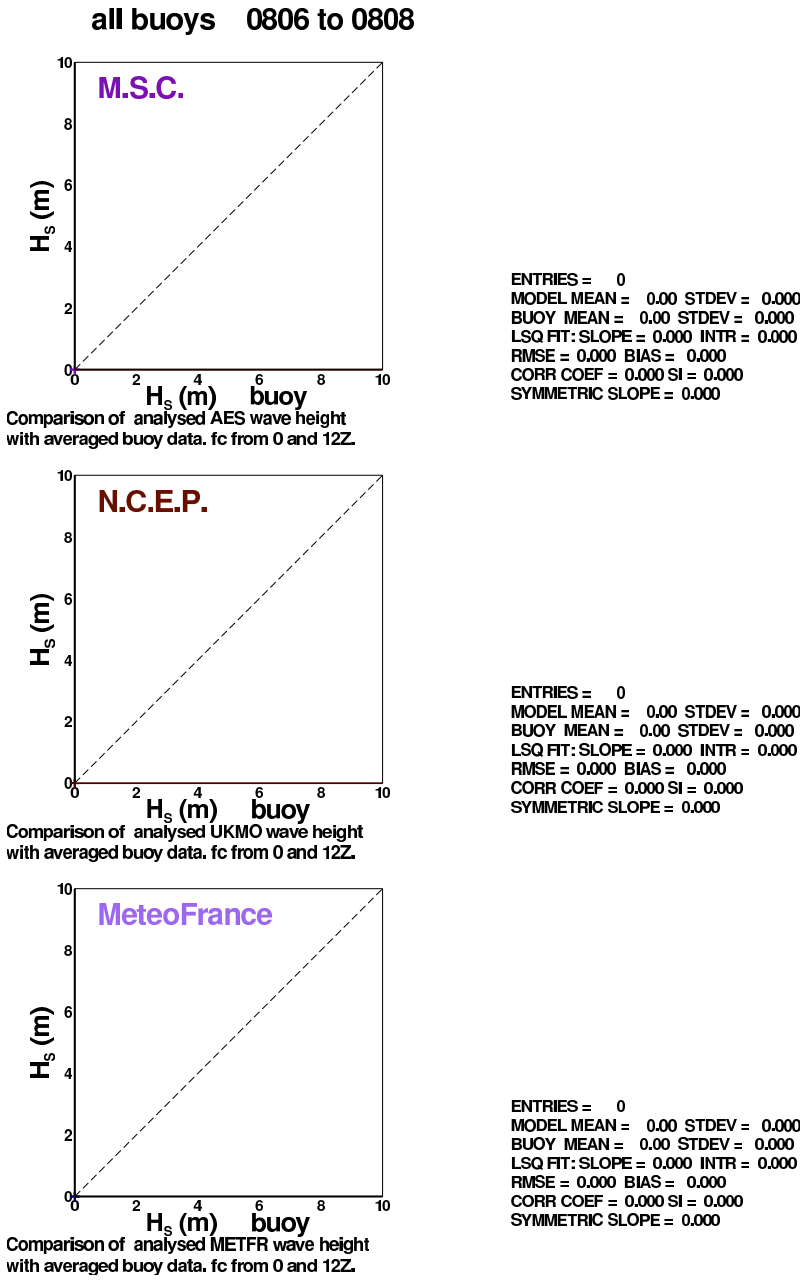
Comparison of forecast(t=t+48) NCEP wave height with averaged buoy data. fc from 0 and 12Z.



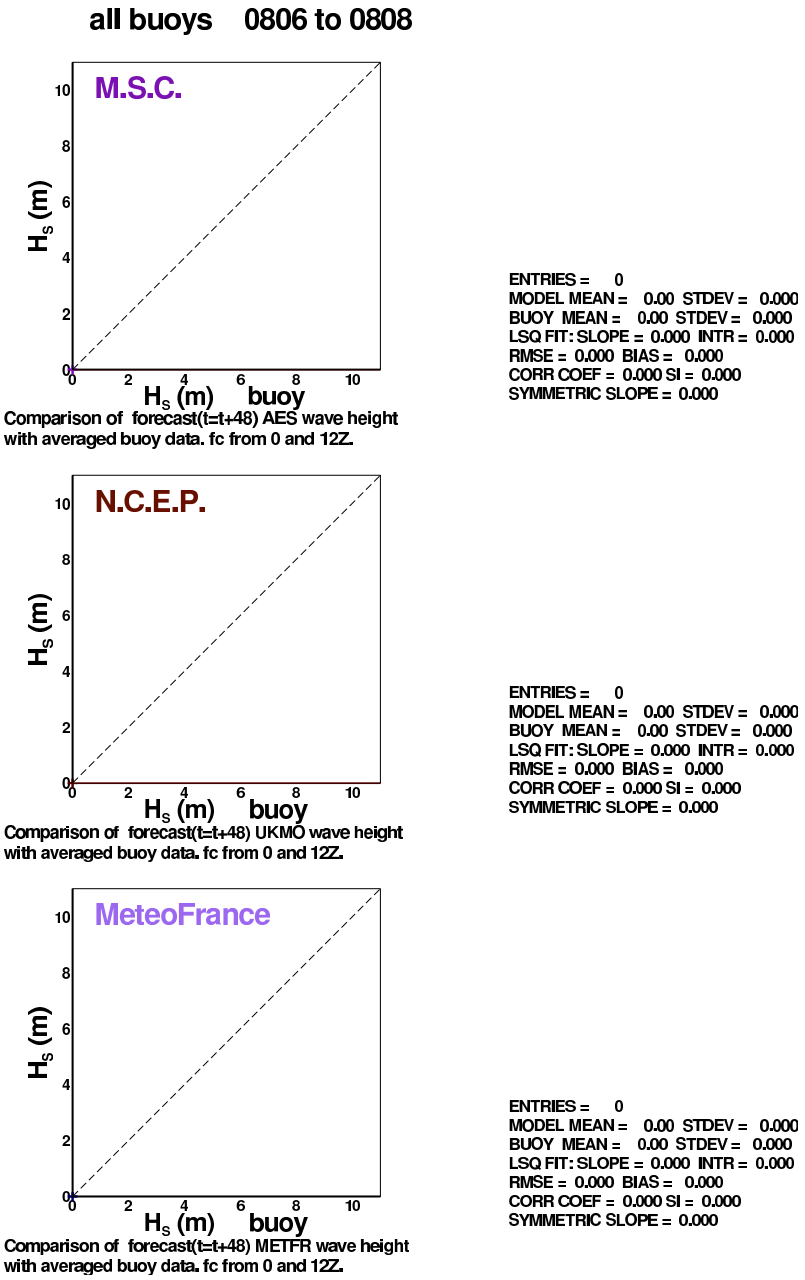
Comparison of forecast(t=t+48) FNMOC wave height with averaged buoy data. fc from 0 and 12Z.

(b) t+48

Figure 4: Scatter diagrams for wave height at step 0 and 48 for the displayed centres at all buoys.

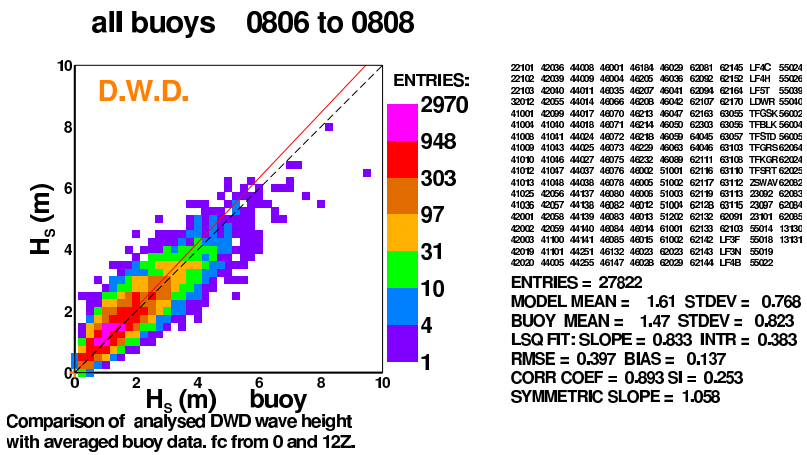


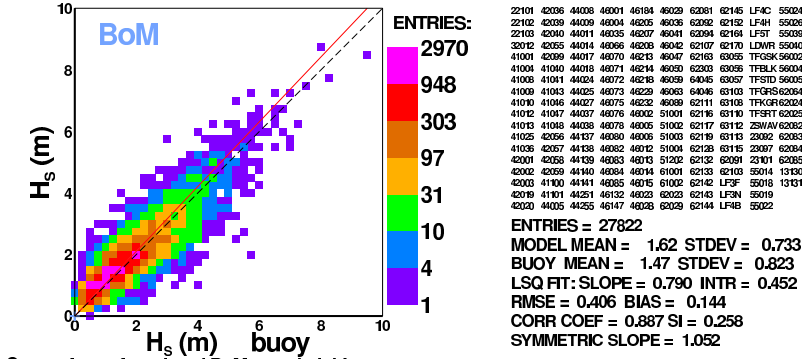
(a) t+0

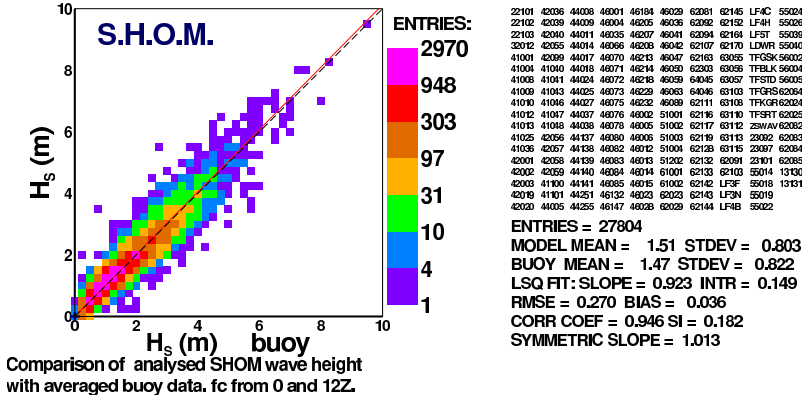


(b) t+48

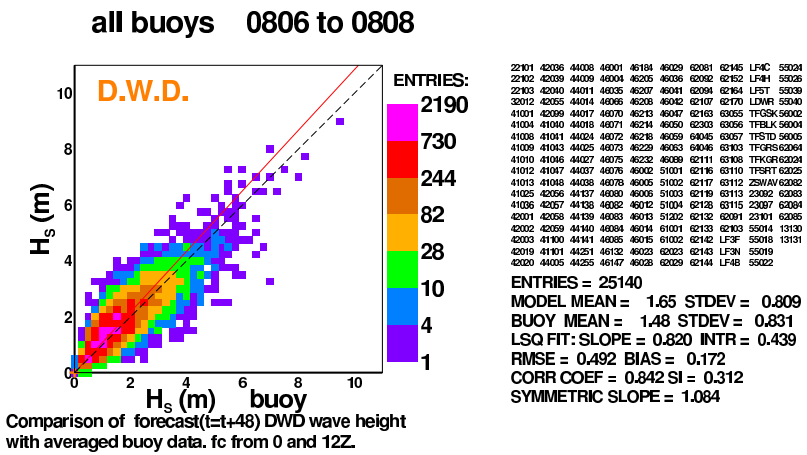
Figure 5: Scatter diagrams for wave height at step 0 and 48 for the displayed centres at all buoys.

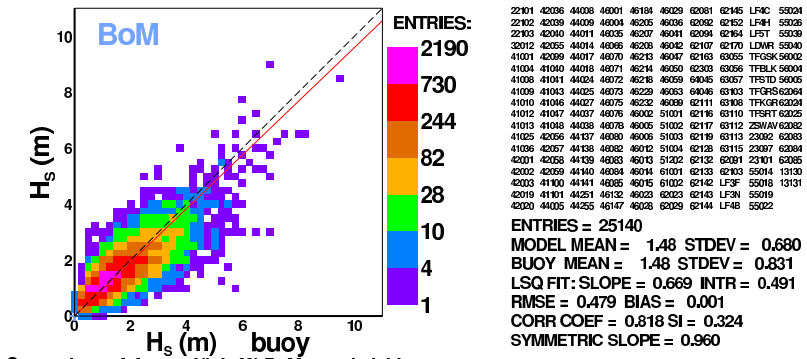


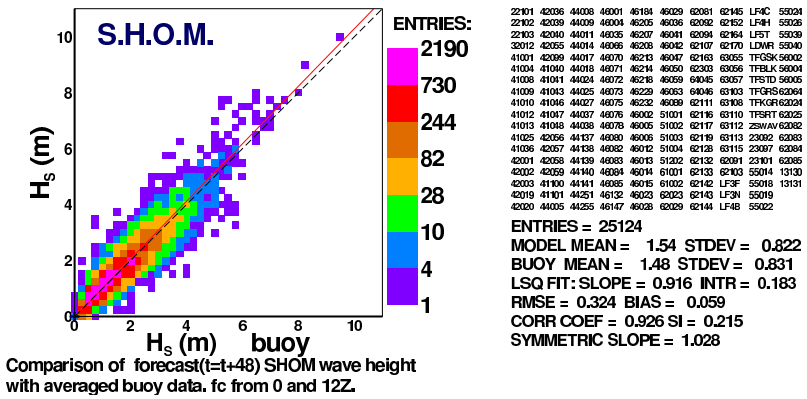




(a) t+0

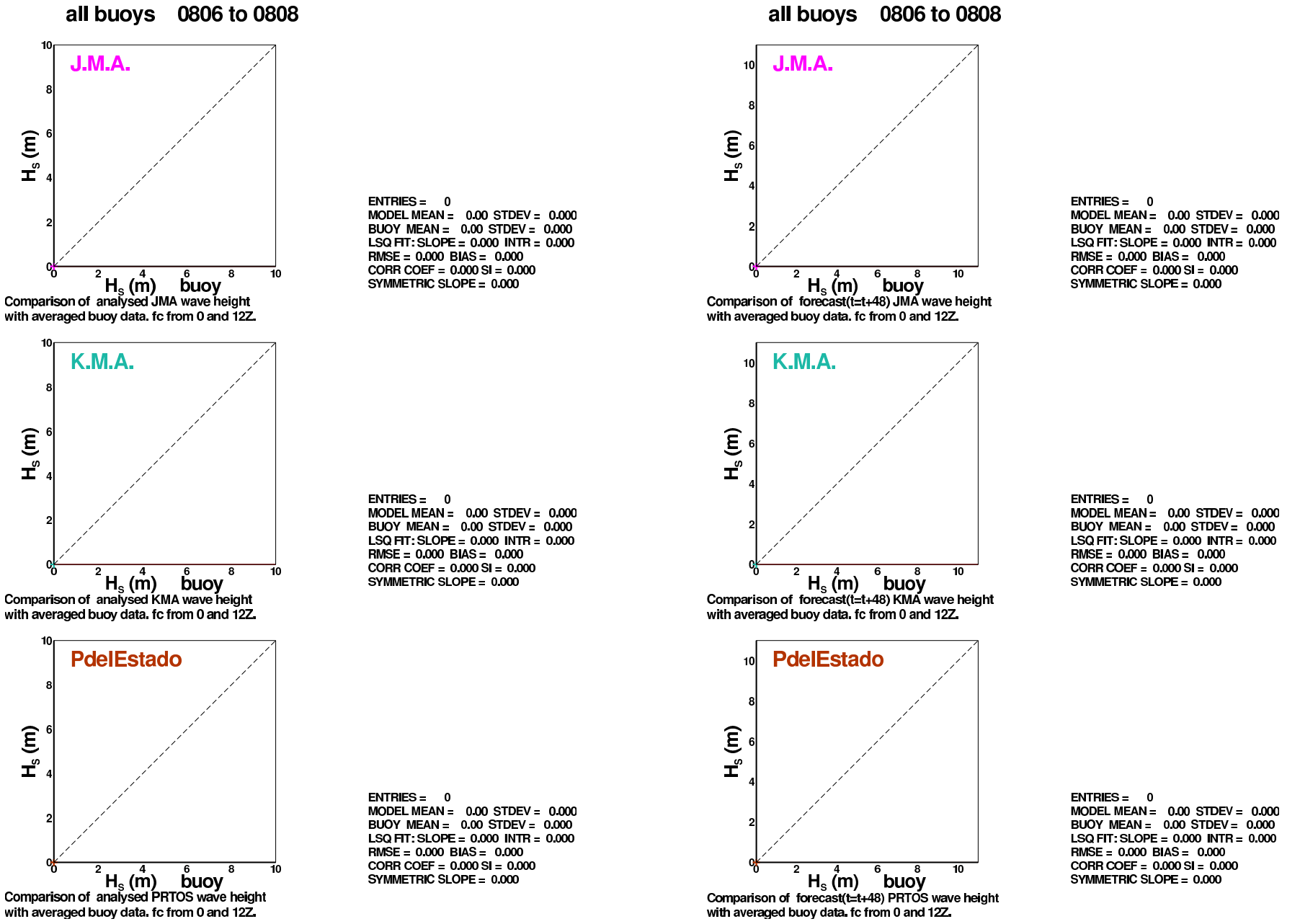






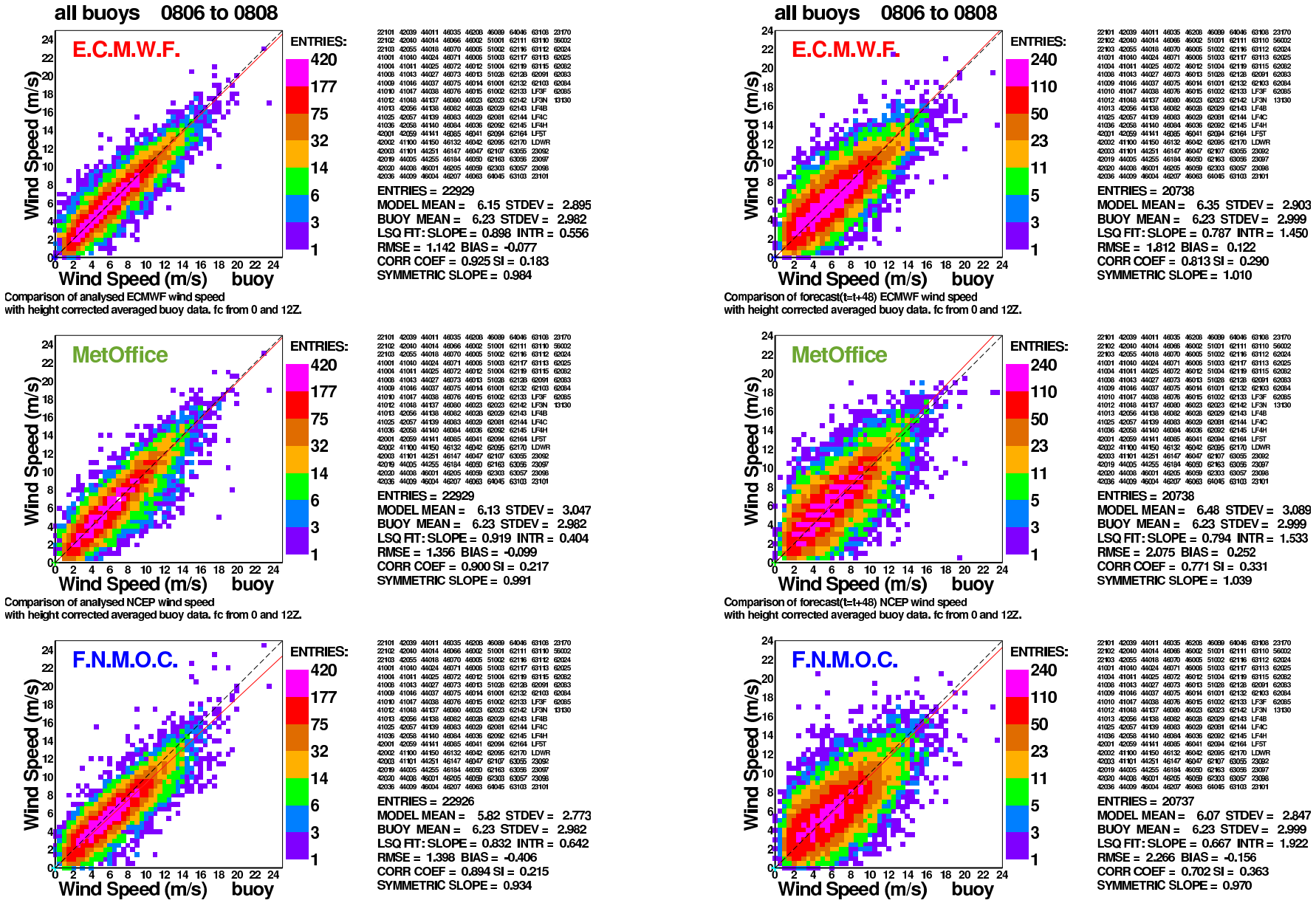
(b) t+48

Figure 6: Scatter diagrams for wave height at step 0 and 48 for the displayed centres at all buoys.



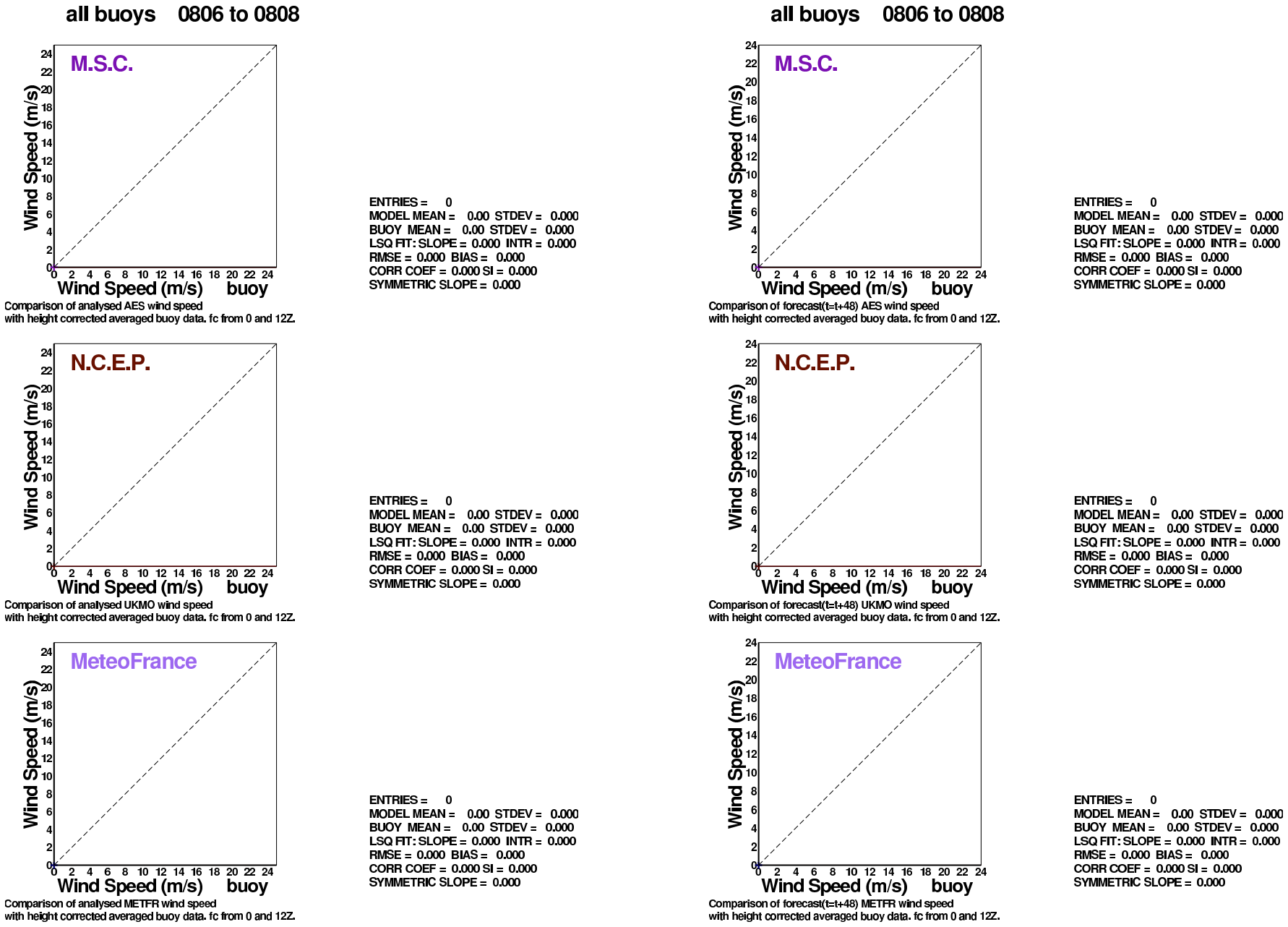
(a) t+0 (b) t+48

Figure 7: Scatter diagrams for wave height at step 0 and 48 for the displayed centres at all buoys.



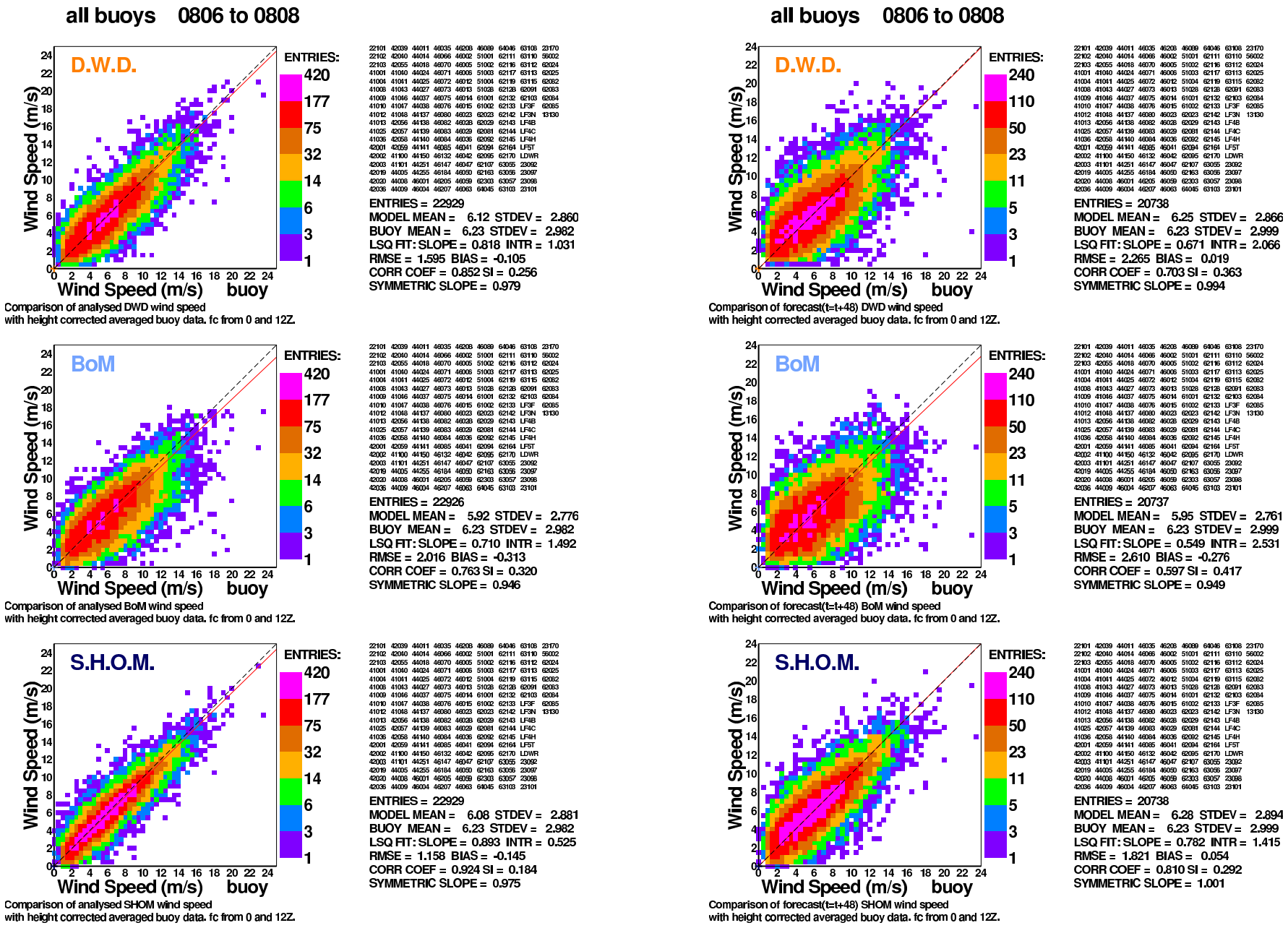
(a) t+0 (b) t+48

Figure 8: Scatter diagrams for wind speed at step 0 and 48 for the displayed centres at all buoys.



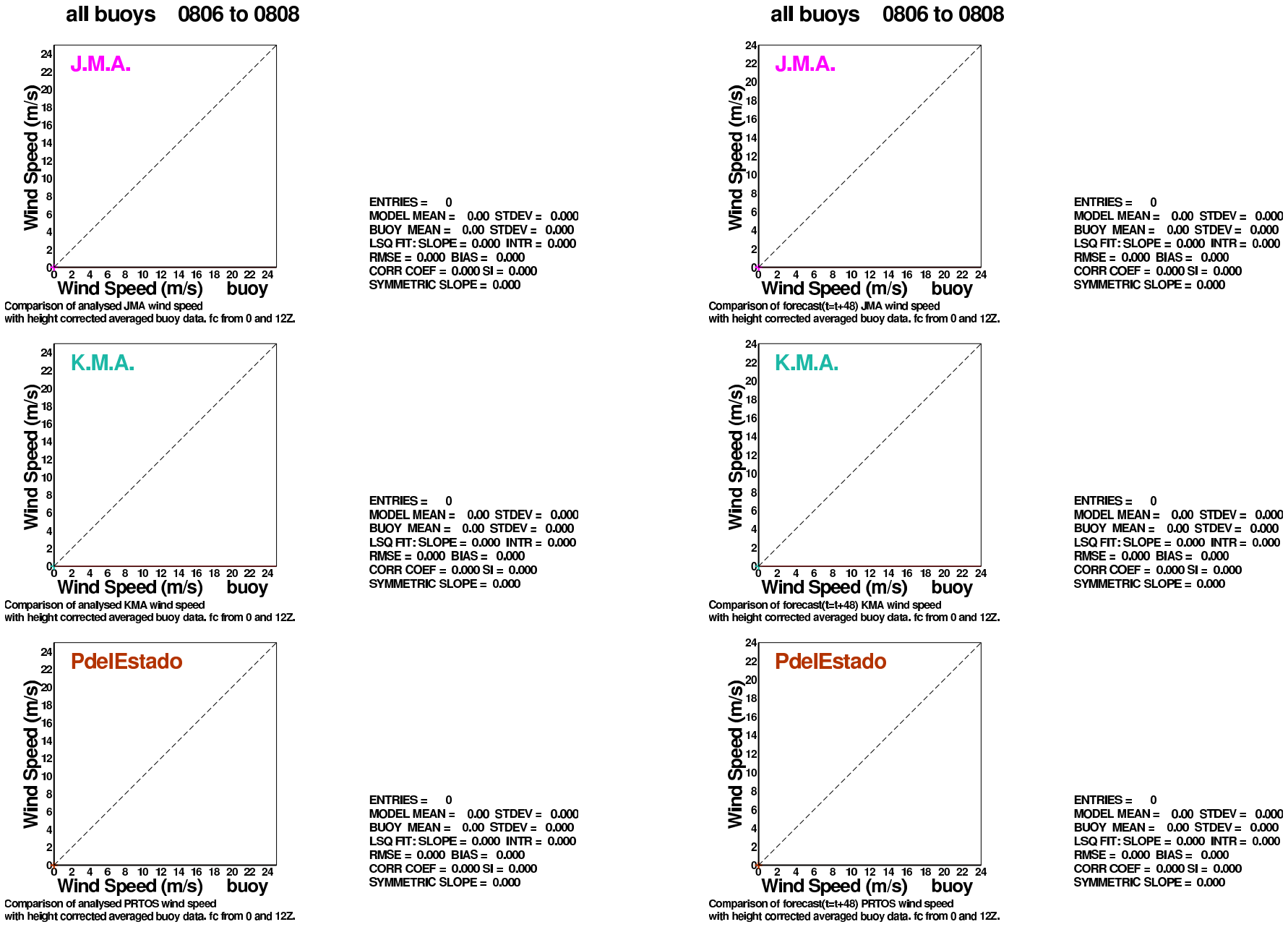
(a) t+0 (b) t+48

Figure 9: Scatter diagrams for wind speed at step 0 and 48 for the displayed centres at all buoys.



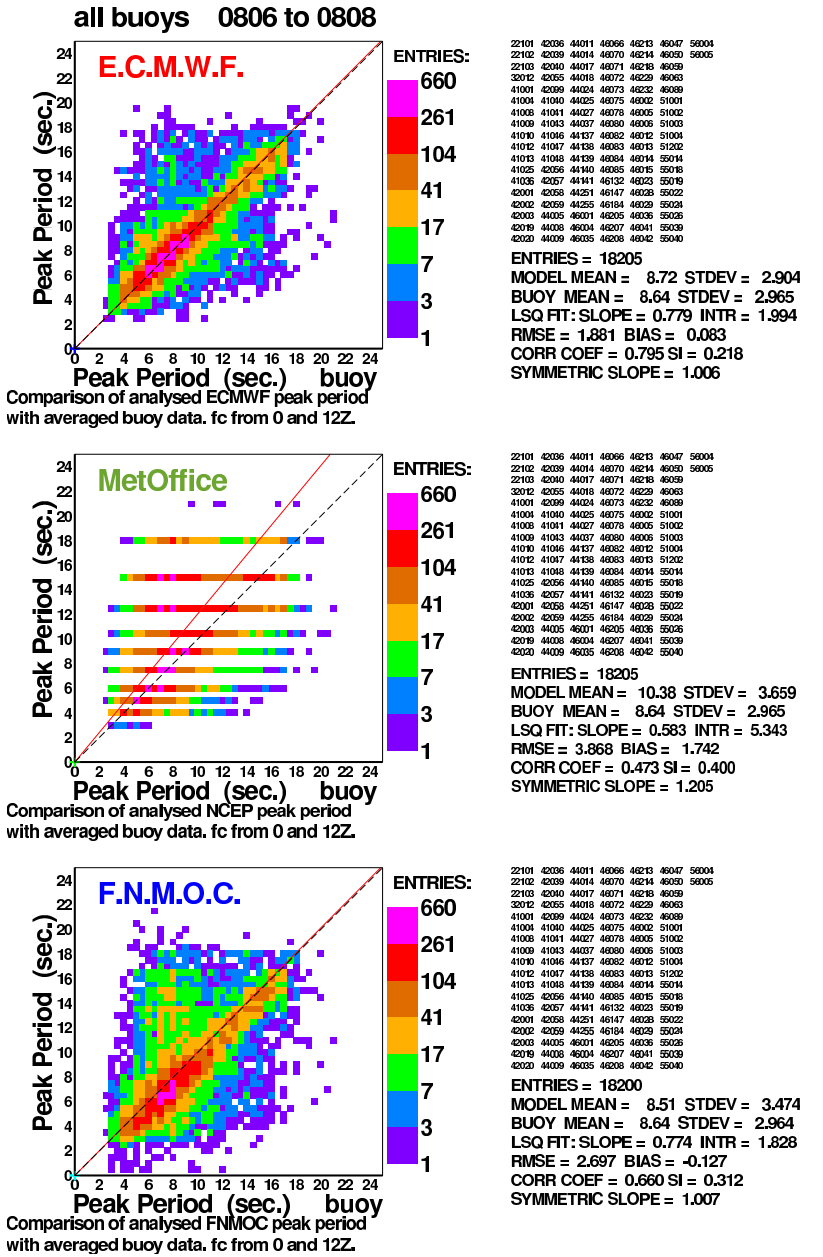
(a) t+0 (b) t+48

Figure 10: Scatter diagrams for wind speed at step 0 and 48 for the displayed centres at all buoys.

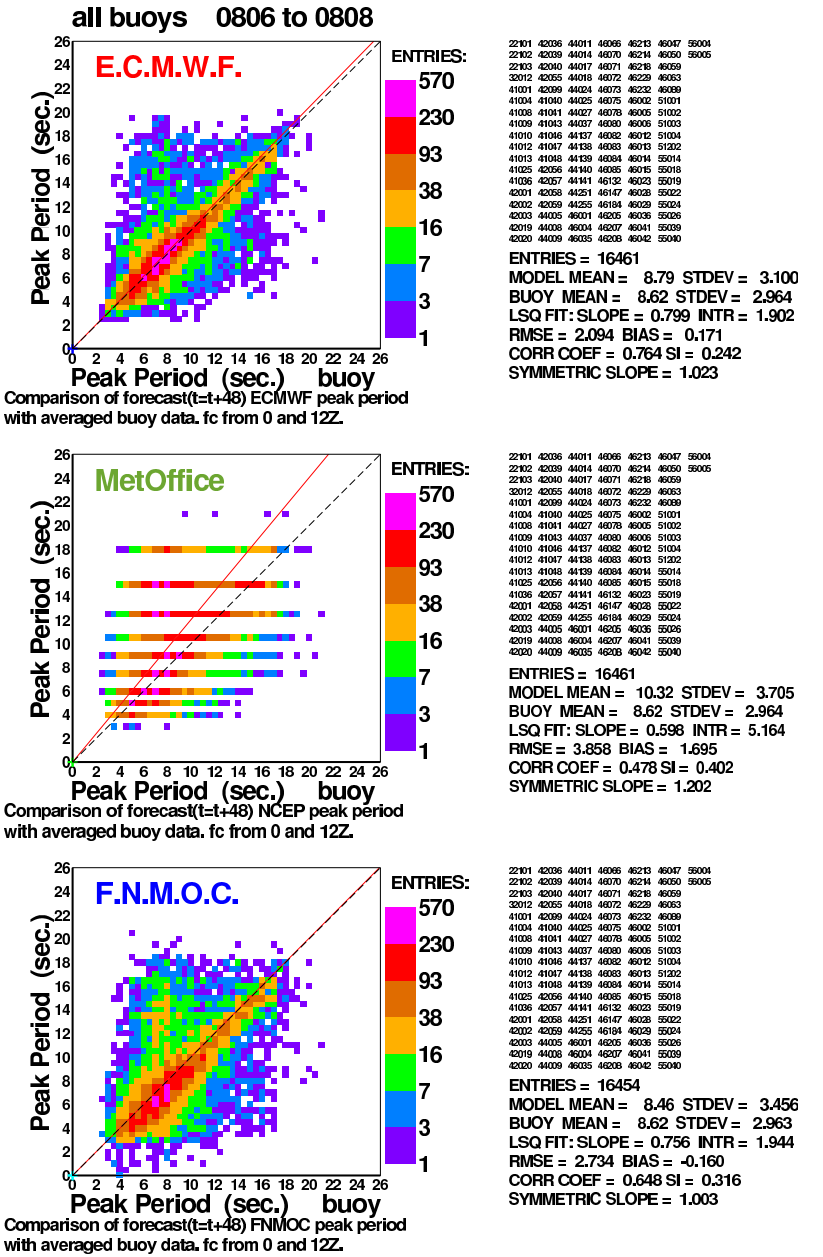


(a) t+0 (b) t+48

Figure 11: Scatter diagrams for wind speed at step 0 and 48 for the displayed centres at all buoys.

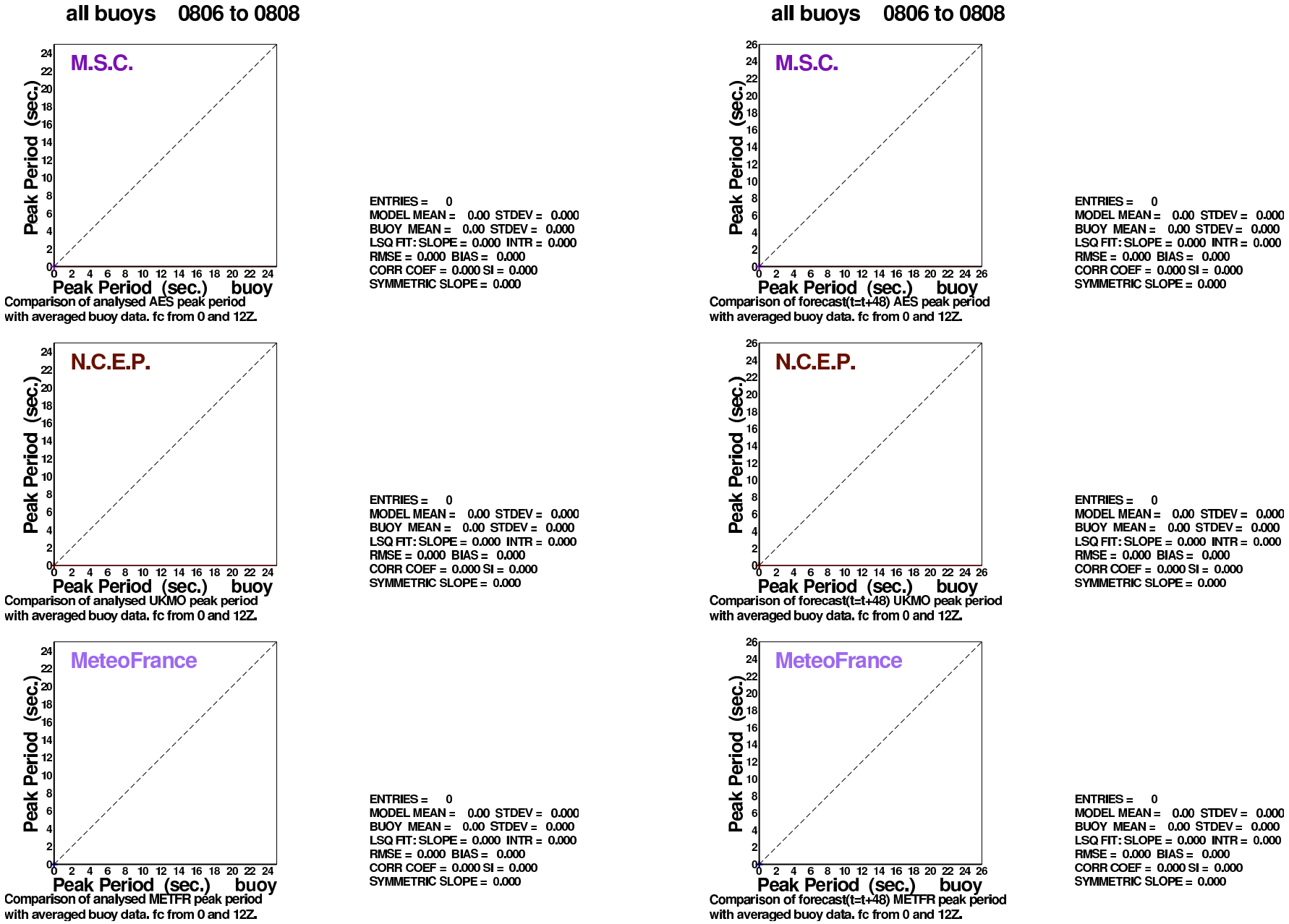


(a) t+0



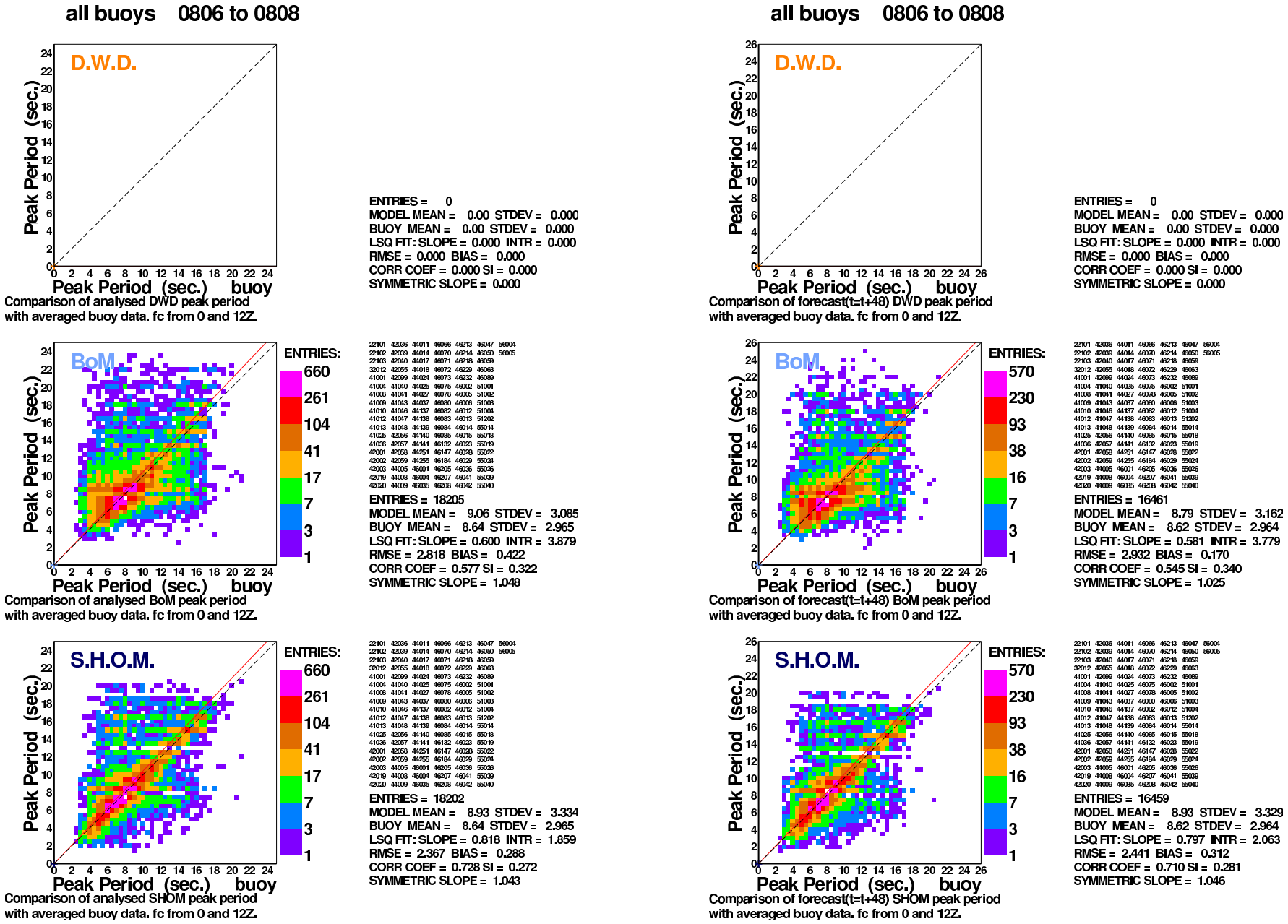
(b) t+48

Figure 12: Scatter diagrams for peak period at step 0 and 48 for the displayed centres at all buoys.



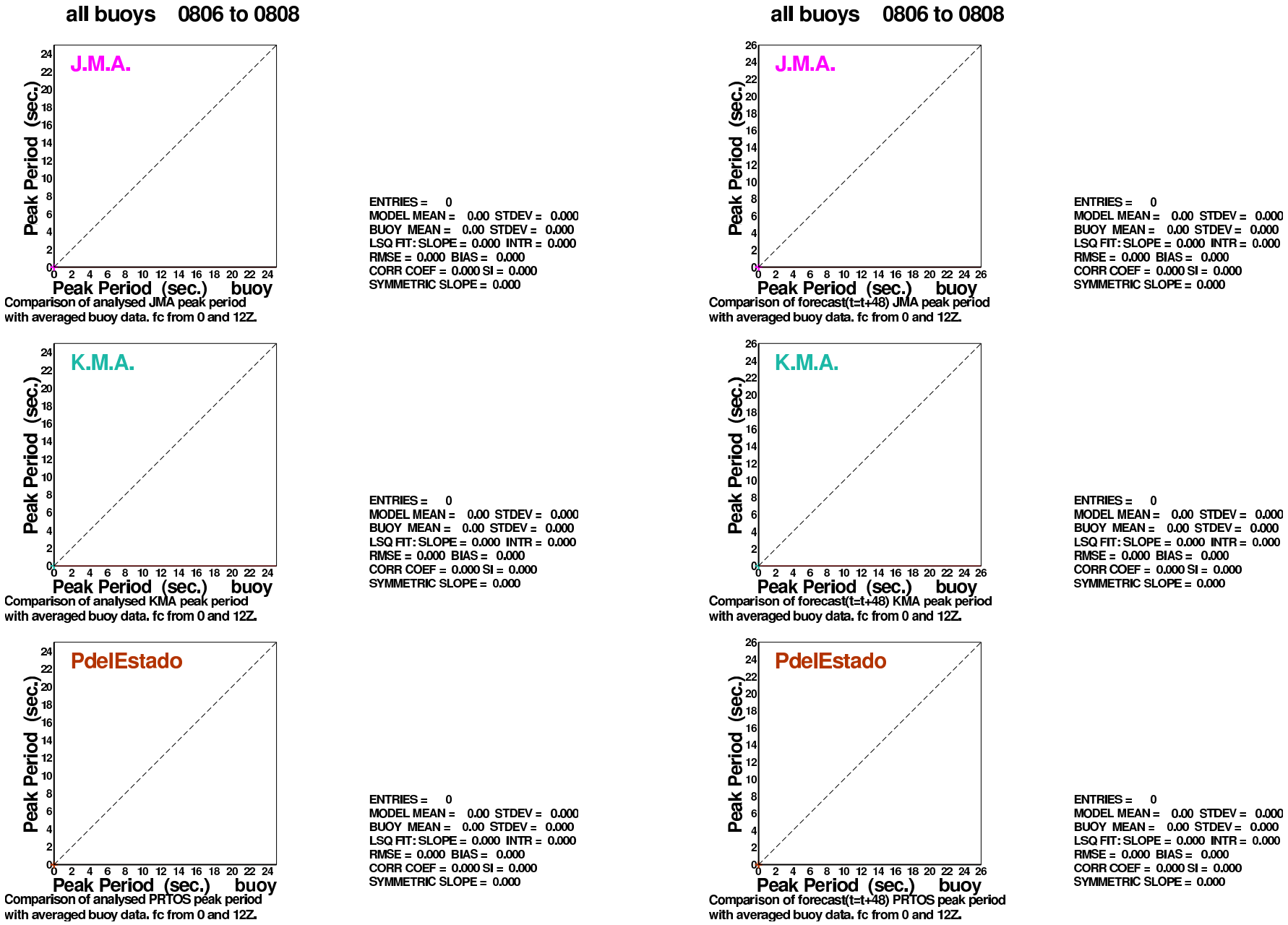
(a) t+0 (b) t+48

Figure 13: Scatter diagrams for peak period at step 0 and 48 for the displayed centres at all buoys.



(a) t+0 (b) t+48

Figure 14: Scatter diagrams for peak period at step 0 and 48 for the displayed centres at all buoys.



(a) t+0 (b) t+48

Figure 15: Scatter diagrams for peak period at step 0 and 48 for the displayed centres at all buoys.

0.3.2 Comparison for Hawaiian buoys

Number of common observations for Hawaiian buoys (HW) from 200806 to 200808 (wind, Hs, Tp)

1	51001	182	182	182	Hawaii North West	4	51004	15	15	15	Hawaii South East
2	51002	181	181	181	Hawaii South West	5	51028	181	0	0	Christmas Island DWA
3	51003	182	182	182	Hawaii West	6	51202	0	179	179	Hawaii Mokapu Point (scripps 098)

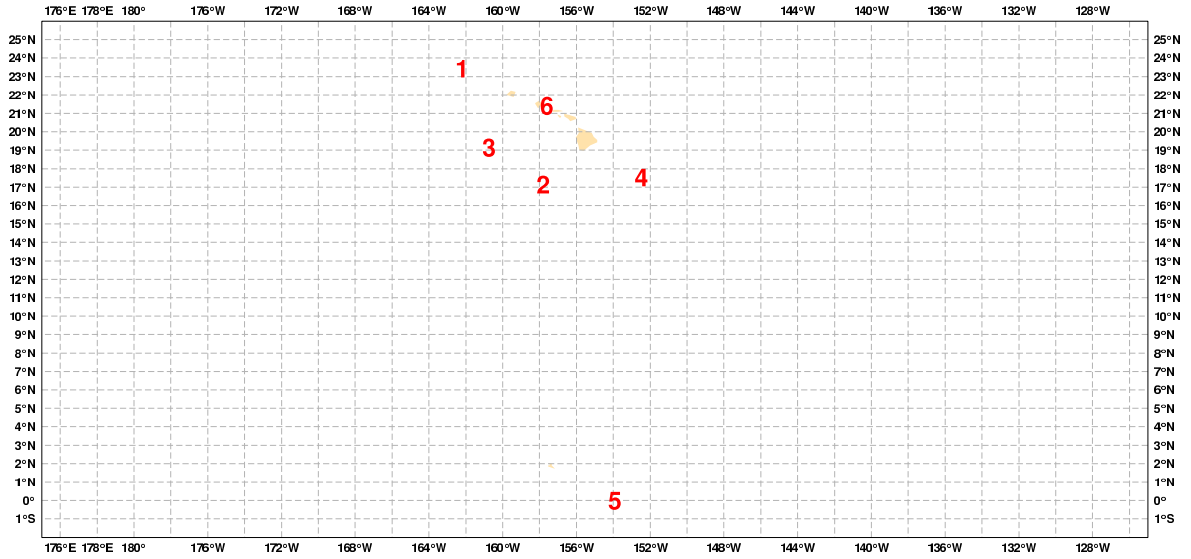
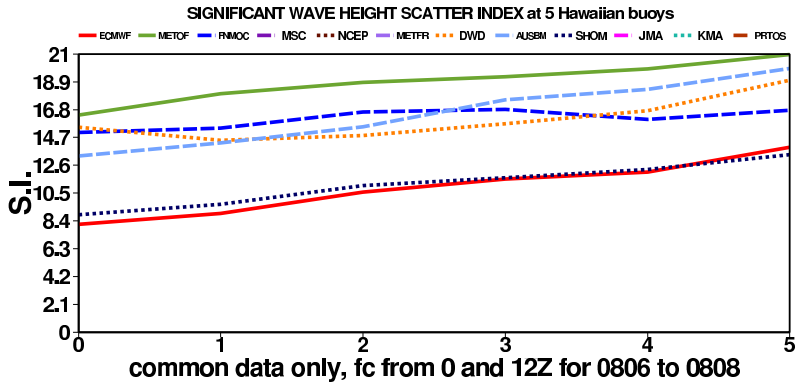
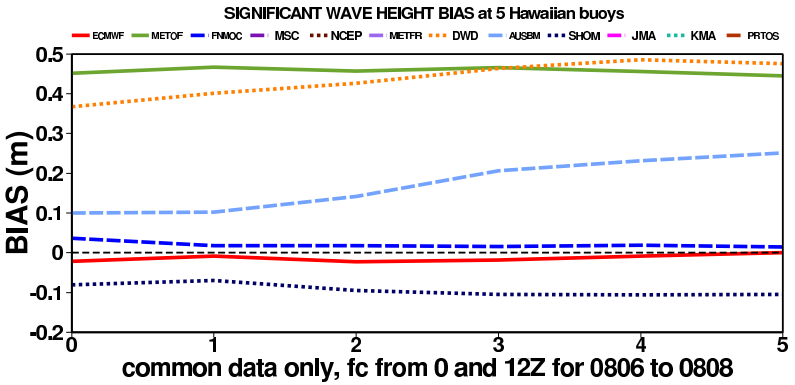
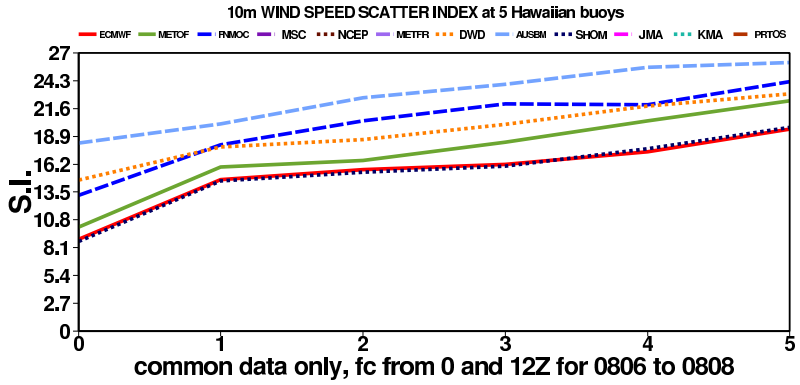
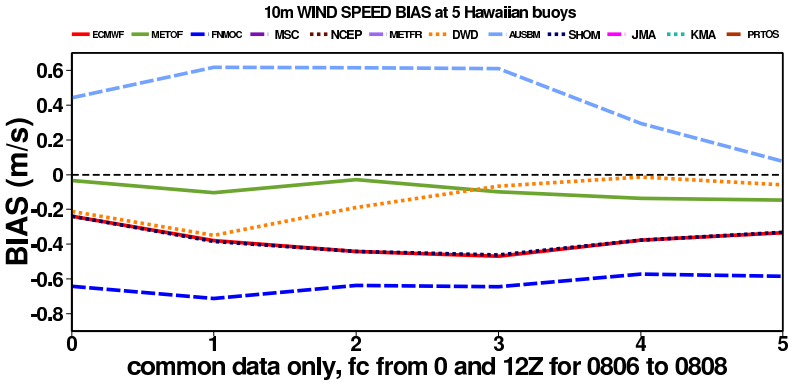


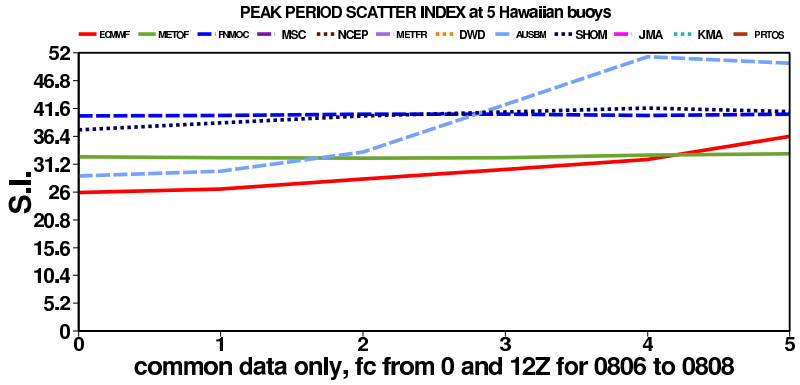
Figure 16: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.

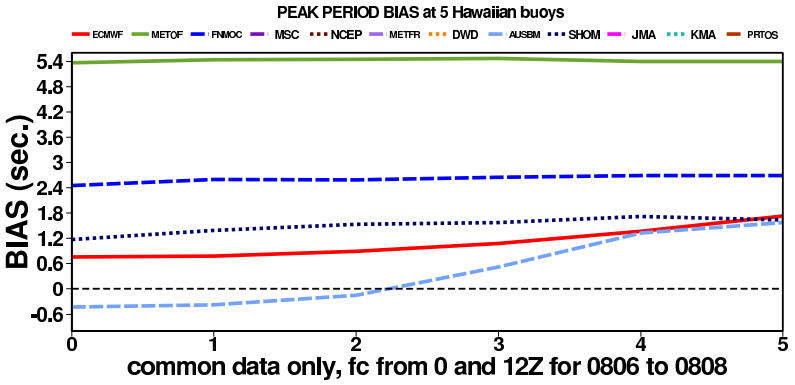








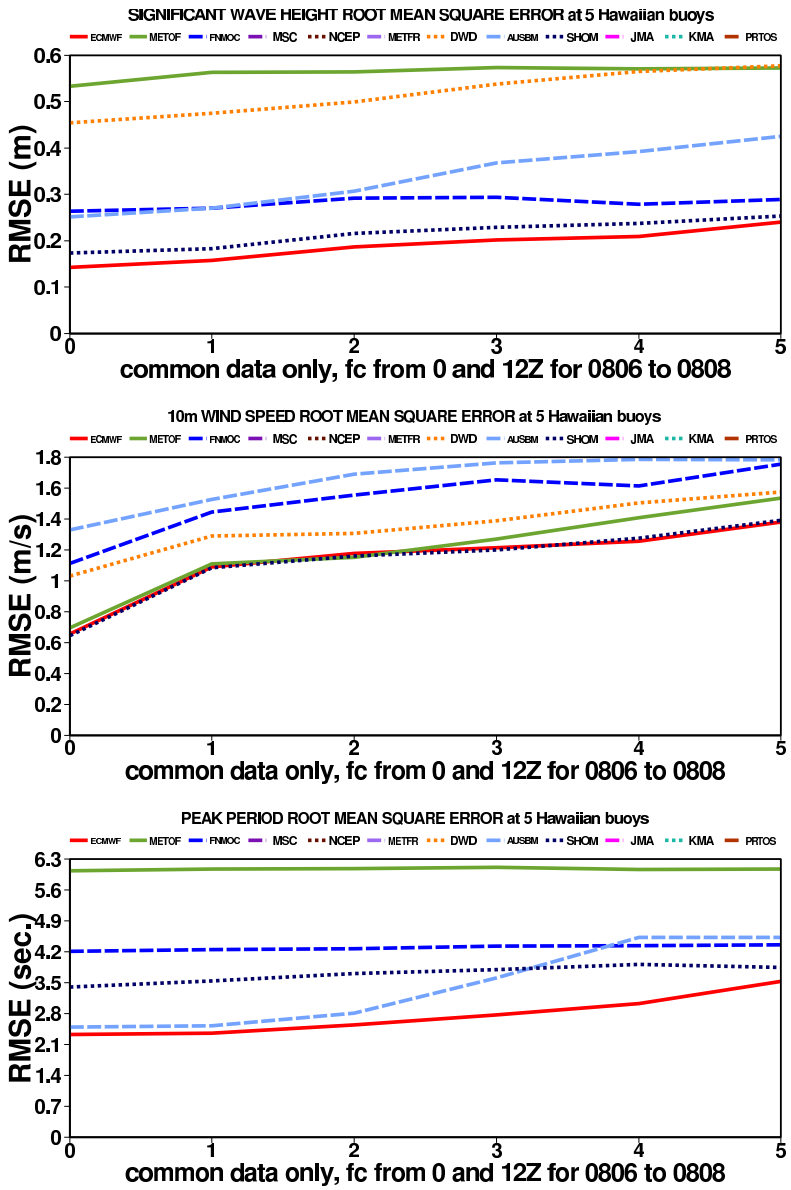




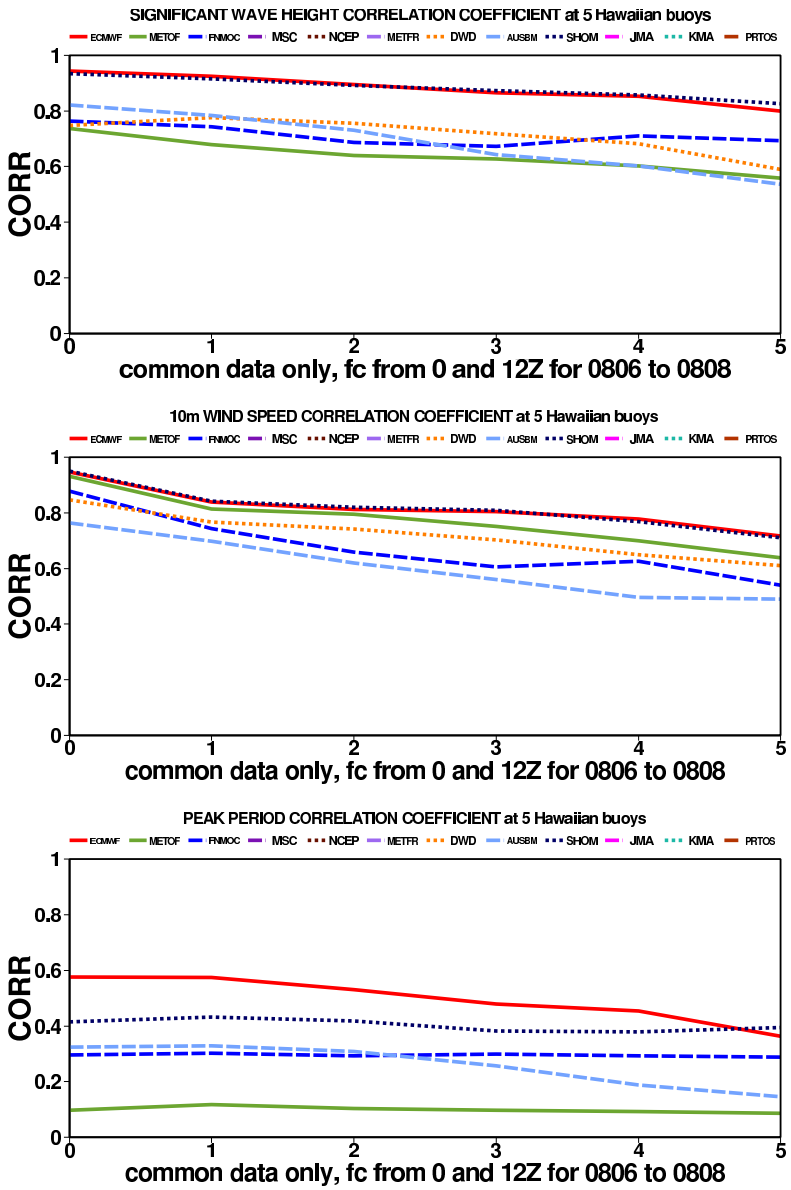
(a) Scatter Index (%)

(b) Bias (model-buoy)

Figure 17: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common Hawaiian buoys.



(a) R.M.S.E.



(b) Correlation Coefficient

Figure 18: Forecast root mean square error (RMSE) and linear correlation coefficient at common Hawaiian buoys.

0.3.3 Comparison for North Pacific buoys

Number of common observations for North Pacific buoys (NPC) from 200806 to 200808 (wind, Hs, Tp)

1	46001	182	182	182	Gulf of Alaska
2	46004	181	181	181	Canada West Coast, Middle Nomad
3	46035	182	181	181	Bering Sea
4	46066	182	181	182	Gulf of Alaska, S Aleutians
5	46070	181	173	173	Southwest Bering Sea
6	46071	165	165	165	North Pacific, Western Aleutians
7	46072	13	182	182	North Pacific, Central Aleutians
8	46073	182	177	177	Southeast Bering Sea
9	46075	60	180	180	North Pacific, Shumagin Islands
10	46076	143	144	0	Gulf of Alaska, Cape Cleare
11	46078	0	178	177	Gulf of Alaska, Albatross Banks
12	46080	65	67	67	Gulf of Alaska, Kennedy Entrance
13	46082	55	56	56	Gulf of Alaska, Cape Suckling
14	46083	148	182	182	Gulf of Alaska, Fairweather Grounds
15	46084	181	182	182	Gulf of Alaska, Cape Edgecumbe
16	46085	178	180	179	Central Gulf of Alaska
17	46132	182	182	182	Canada West Coast, South Brooks
18	46147	182	182	182	Canada West Coast, South Moresby
19	46184	182	182	181	Canada West Coast, North Nomad
20	46205	182	182	182	Canada West Coast, W. Dixon Entrance
21	46207	182	182	182	Canada West Coast, East Dellwood
22	46208	182	182	182	Canada West Coast, West Moresby

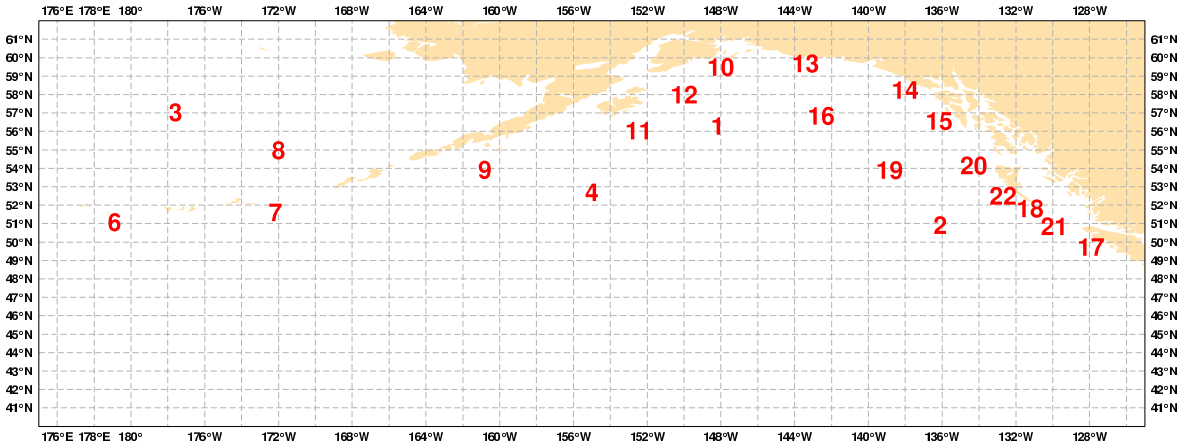
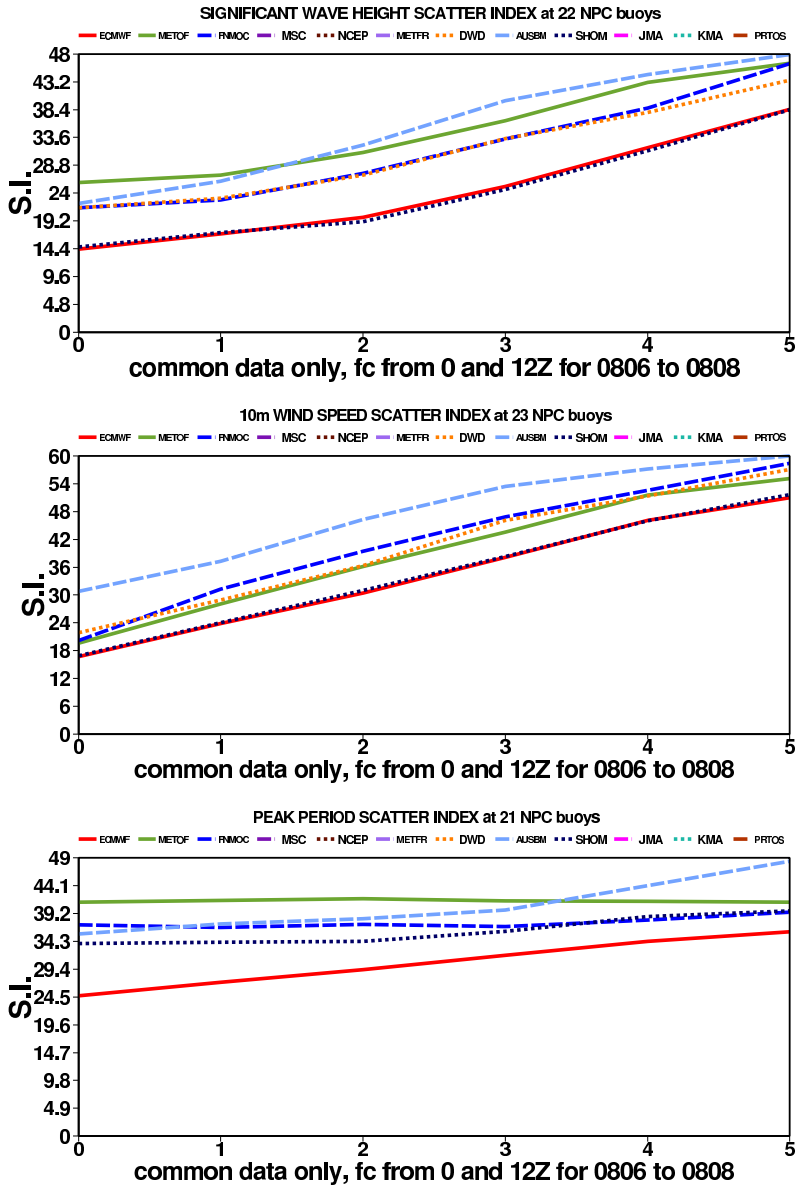
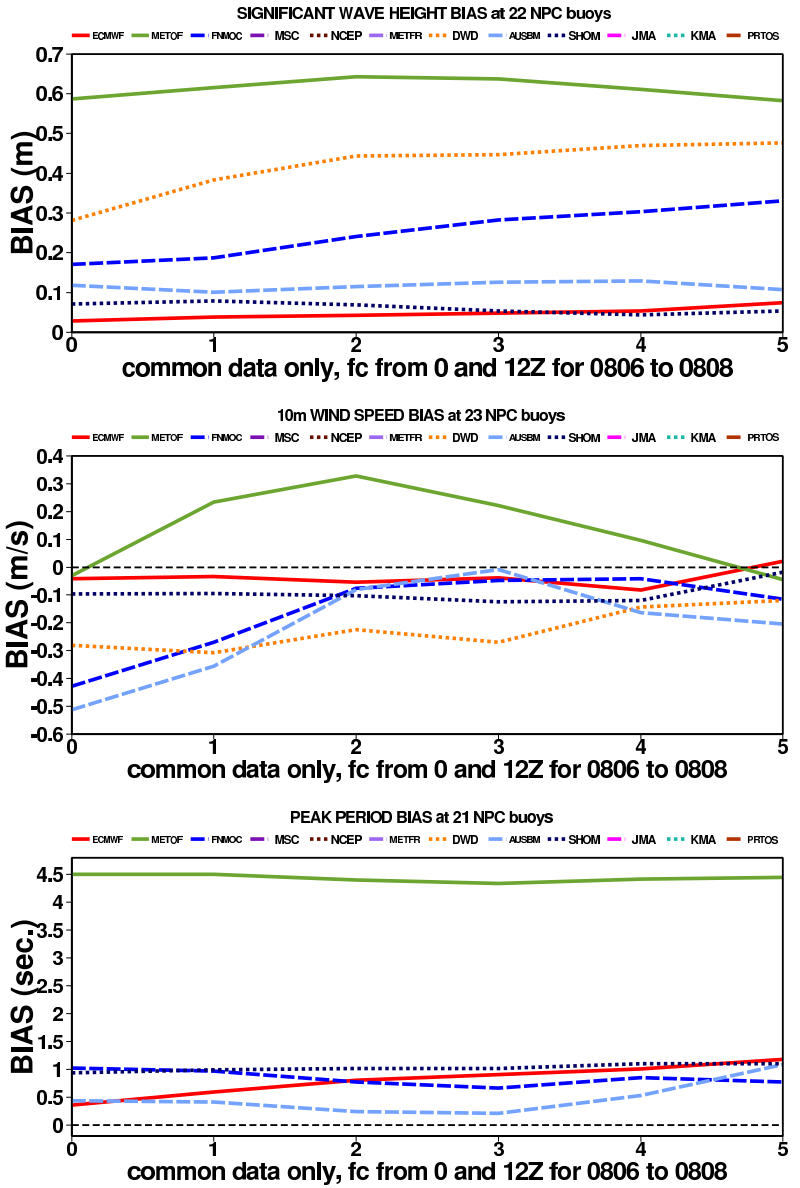


Figure 19: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.

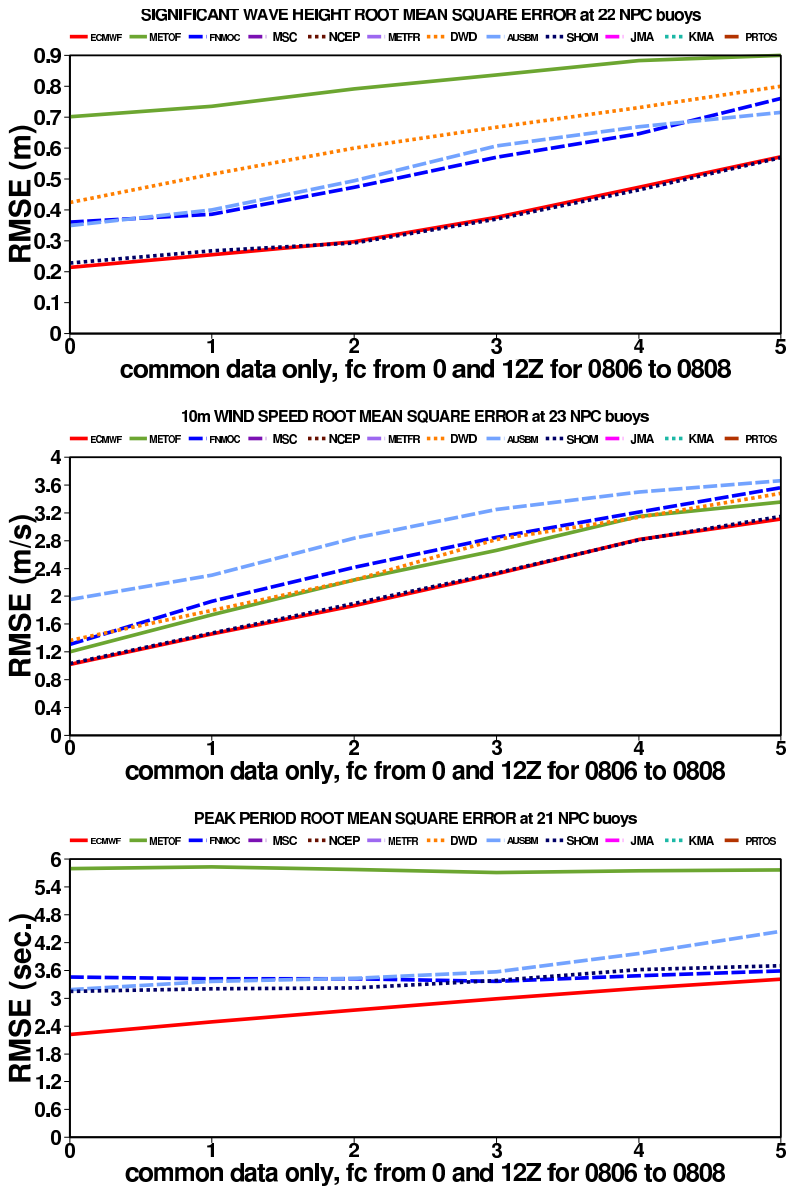


(a) Scatter Index (%)

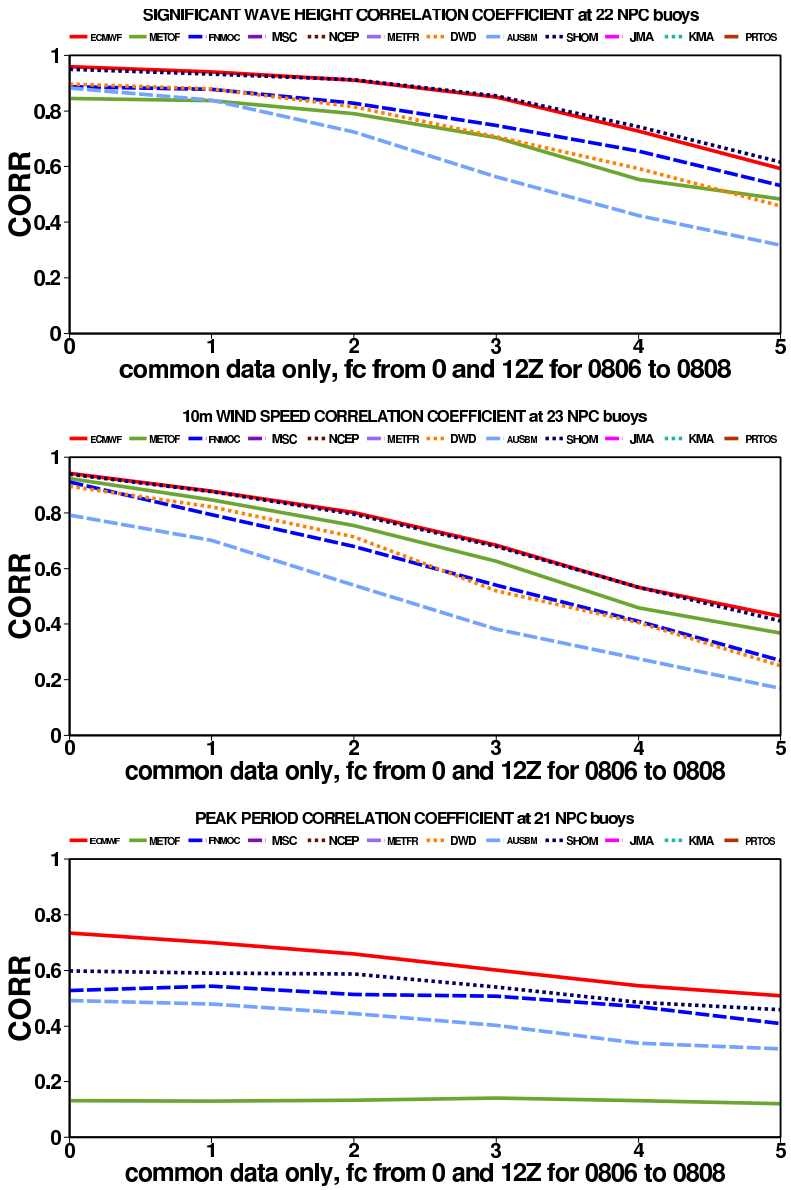


(b) Bias (model-buoy)

Figure 20: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common North Pacific buoys .



(a) R.M.S.E.



(b) Correlation Coefficient

Figure 21: Forecast root mean square error (RMSE) and linear correlation coefficient at common North Pacific buoys .

0.3.4 Comparison for US West Coast buoys

Number of common observations for US West Coast buoys (USWC) from 200806 to 200808 (wind, Hs, Tp)

1	46002	134	135	135	US West Coast,Oregon
2	46005	132	132	132	US North-West Coast, W Astoria
3	46006	17	17	17	US West Coast, SW Astoria
4	46012	170	170	170	US South-West Coast, Half Moon Bay
5	46013	182	182	182	US South-West Coast, Bodega
6	46014	182	182	181	US South-West Coast, Point Arena
7	46015	120	116	116	US West Coast, Port Orford
8	46023	182	182	182	US South-West Coast, Point Arguello
9	46028	182	180	180	US South-West Coast, Cape St Martin
10	46029	182	182	182	US West Coast, Columbia River Bar
11	46036	181	182	181	Canada West Coast, South Nomad
12	46041	168	182	182	US North-West Coast, Cape Elisabeth
13	46042	182	146	145	US South-West Coast, Monterey
14	46047	182	182	182	US South-West Coast, Tanner Banks
15	46050	182	182	182	US West Coast, Yaquina Bay
16	46059	182	182	182	US West Coast, California
17	46063	182	182	182	US West Coast, Pt Conception
18	46089	128	128	128	US West Coast, Tillamook, OR
19	46213	0	182	182	US South-West Coast, Cape Mendocino (scripps 094)
20	46214	0	176	176	US South-West Coast, Point Reyes (scripps 029)
21	46218	0	182	182	US South-West Coast, Harvest (scripps 071)
22	46229	0	182	182	US West Coast, Coos Bay (scripps 126)
23	46232	0	182	181	US South West Coast, Coranado Islands MX (scripps 133)

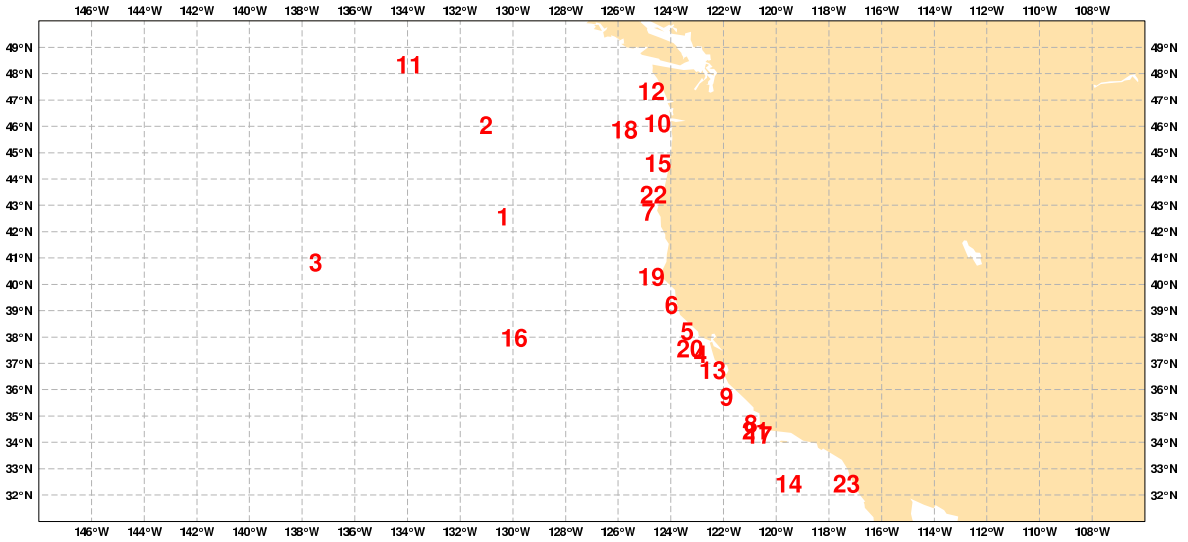
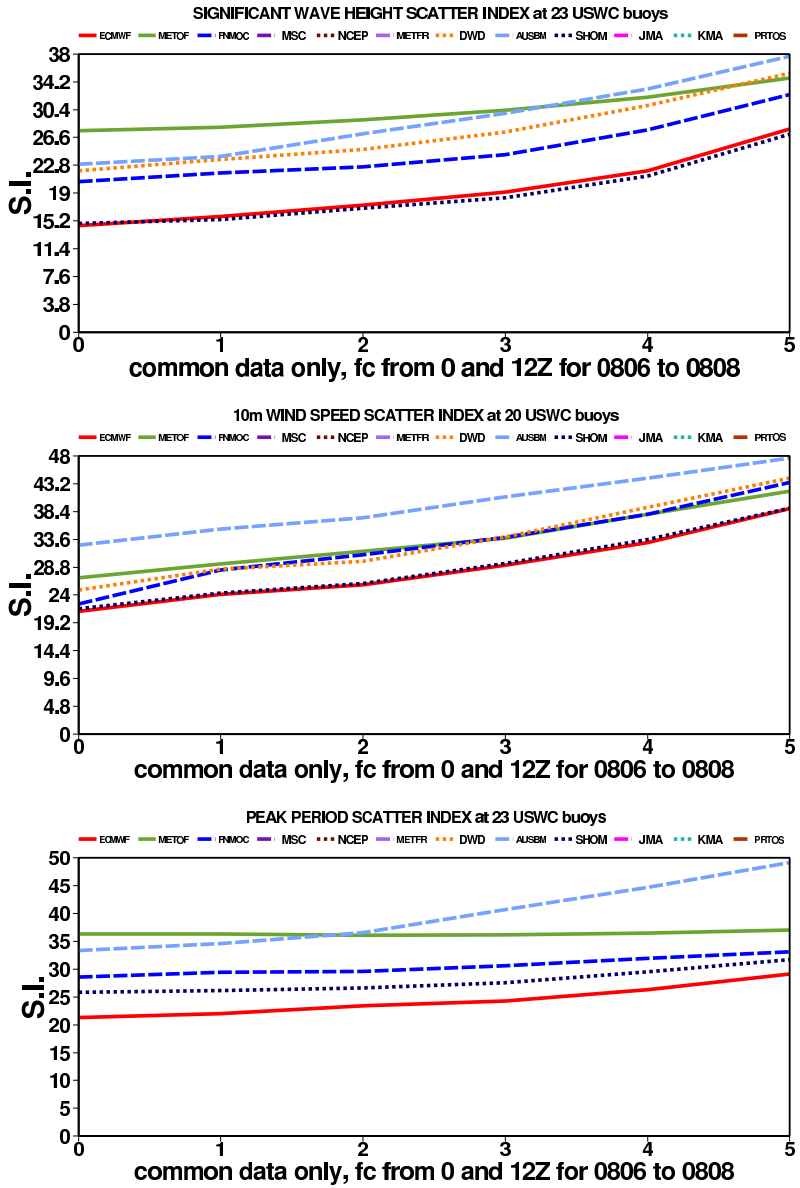
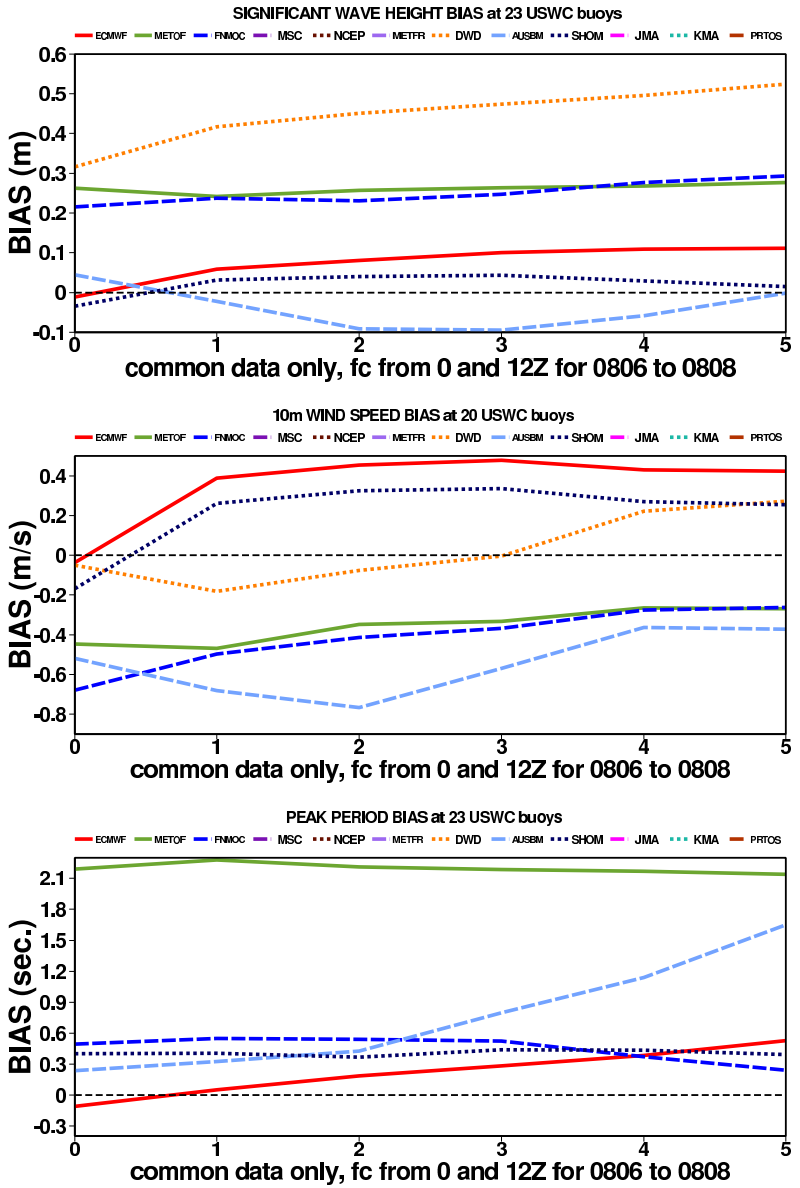


Figure 22: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.

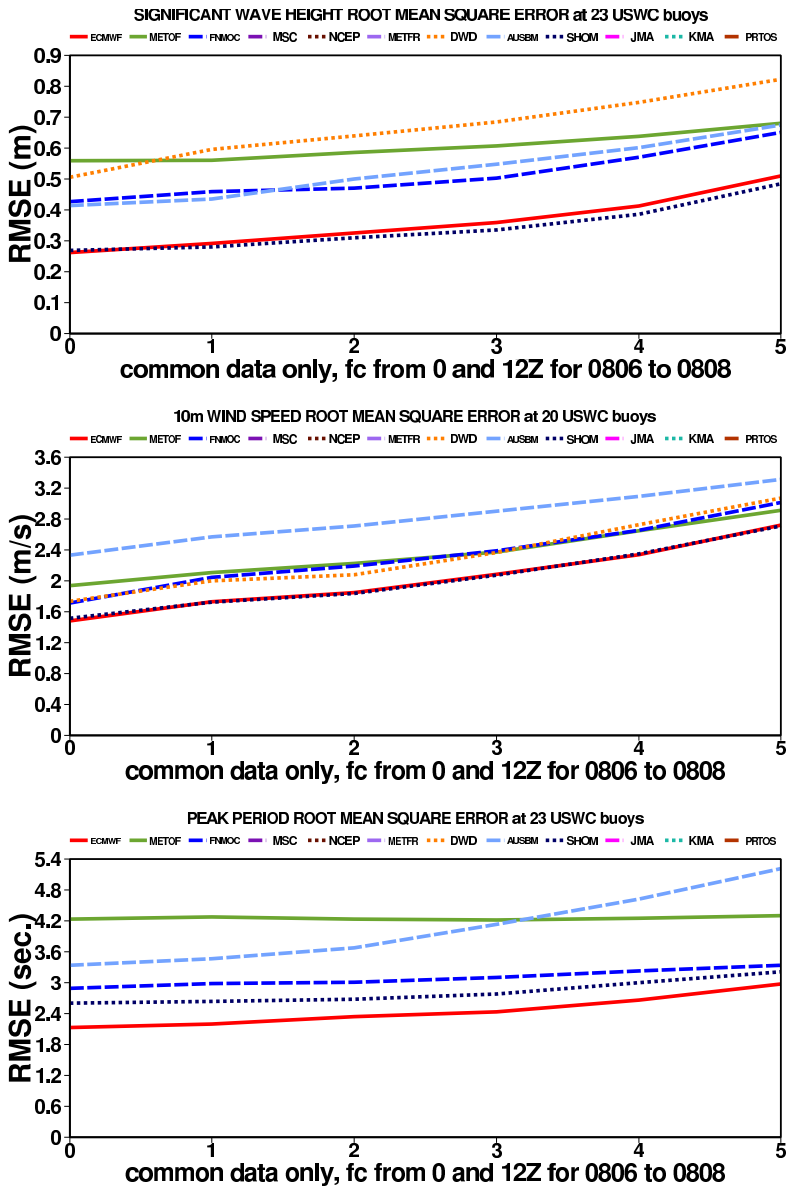


(a) Scatter Index (%)

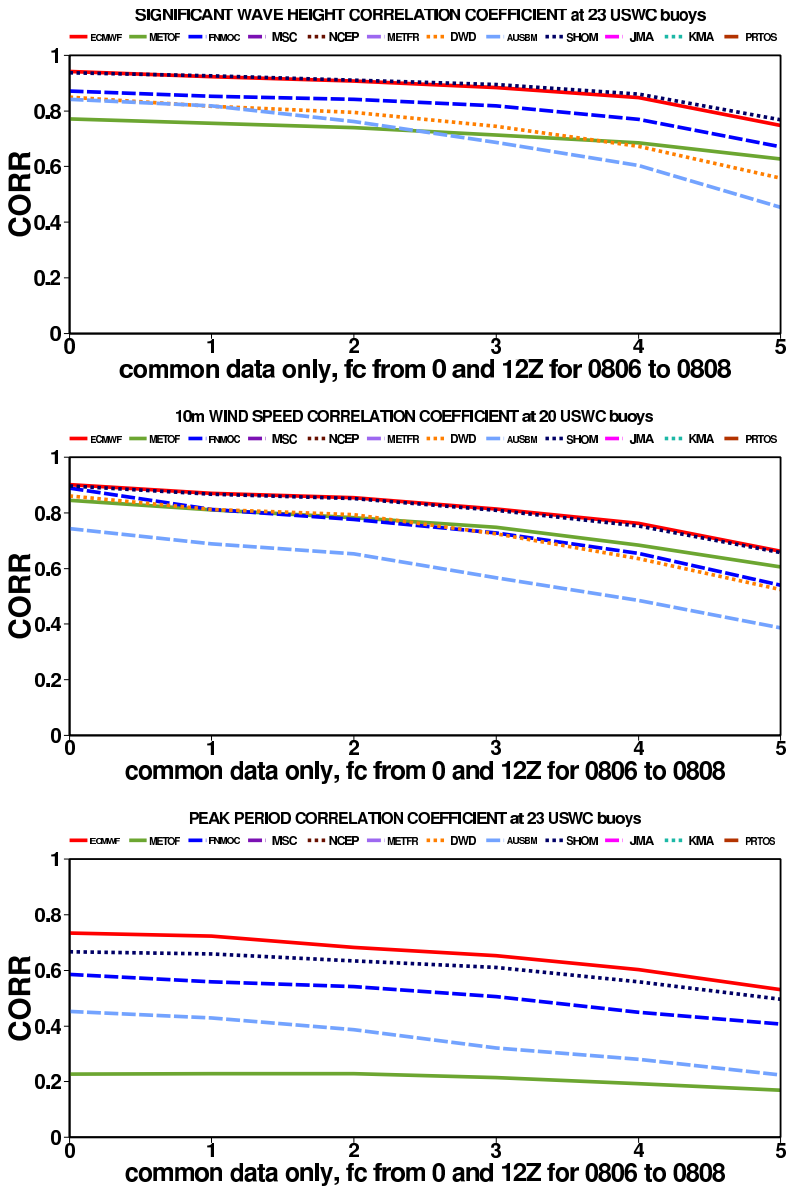


(b) Bias (model-buoy)

Figure 23: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common US West Coast buoys .



(a) R.M.S.E.



(b) Correlation Coefficient

Figure 24: Forecast root mean square error (RMSE) and linear correlation coefficient at common US West Coast buoys .

0.3.5 Comparison for US East Coast buoys

Number of common observations for US East Coast buoys (USEC) from 200806 to 200808 (wind, Hs, Tp)

1	41001	82	82	82	US East Coast, E Hatteras	12	44008	182	182	182	US North-East Coast, Nantucket
2	41004	177	177	177	US South-East Coast, Edisto	13	44009	181	182	182	US North-East Coast, Delaware bay
3	41008	180	180	180	US South-East Coast, Grays reef	14	44011	179	180	180	US North-East Coast, Georges Bank
4	41009	91	126	126	US East Florida , Cape Canaveral	15	44014	120	120	120	US East Coast, Virginia Beach
5	41010	182	182	182	US East Florida , Cape Canaveral East	16	44017	0	182	182	US North-East Coast, Montauk Point
6	41012	181	155	155	US East Florida , St Augustine	17	44018	180	182	182	US North-East Coast, SE Cape Cod
7	41013	182	182	182	US South-East Coast , Frying Pan Shoals	18	44024	181	181	181	US North East Coast, Northeast Channel
8	41025	182	171	171	US East Coast, Diamond Shoals (Red Buoy)	19	44025	182	182	182	US North East Coast, Long Island
9	41036	182	182	182	US East Coast, Onslow Bay offshore	20	44027	182	182	177	US North East Coast, Jonesport
10	41048	182	179	179	W Bermuda	21	44037	181	182	181	US North East Coast, Jordan Basin
11	44005	76	76	76	US North East Coast, Gulf of Maine	22	44038	182	182	0	US North East Coast, Scotian Shelf

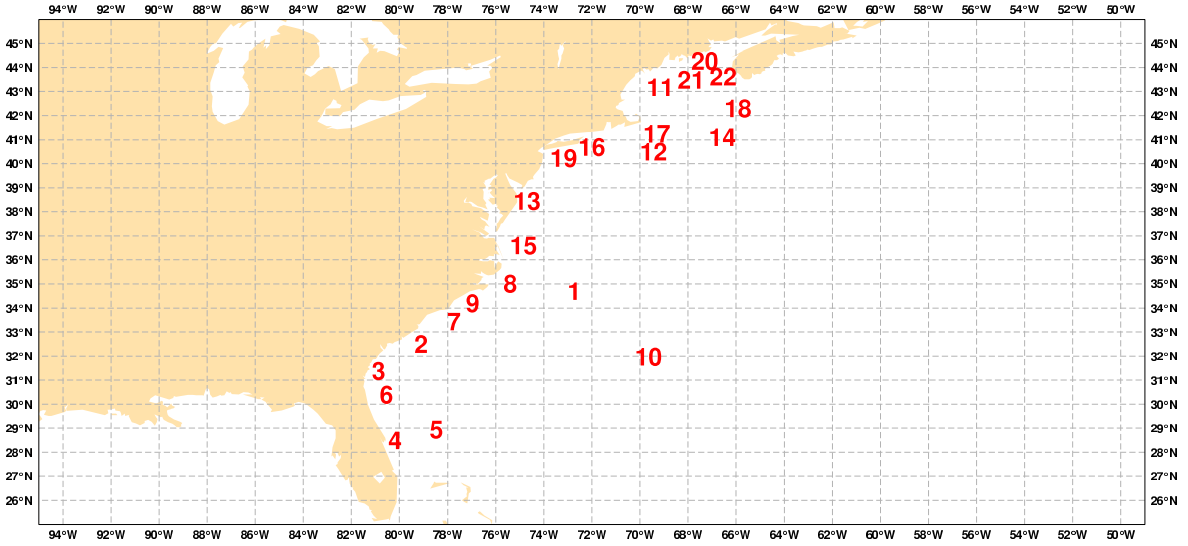
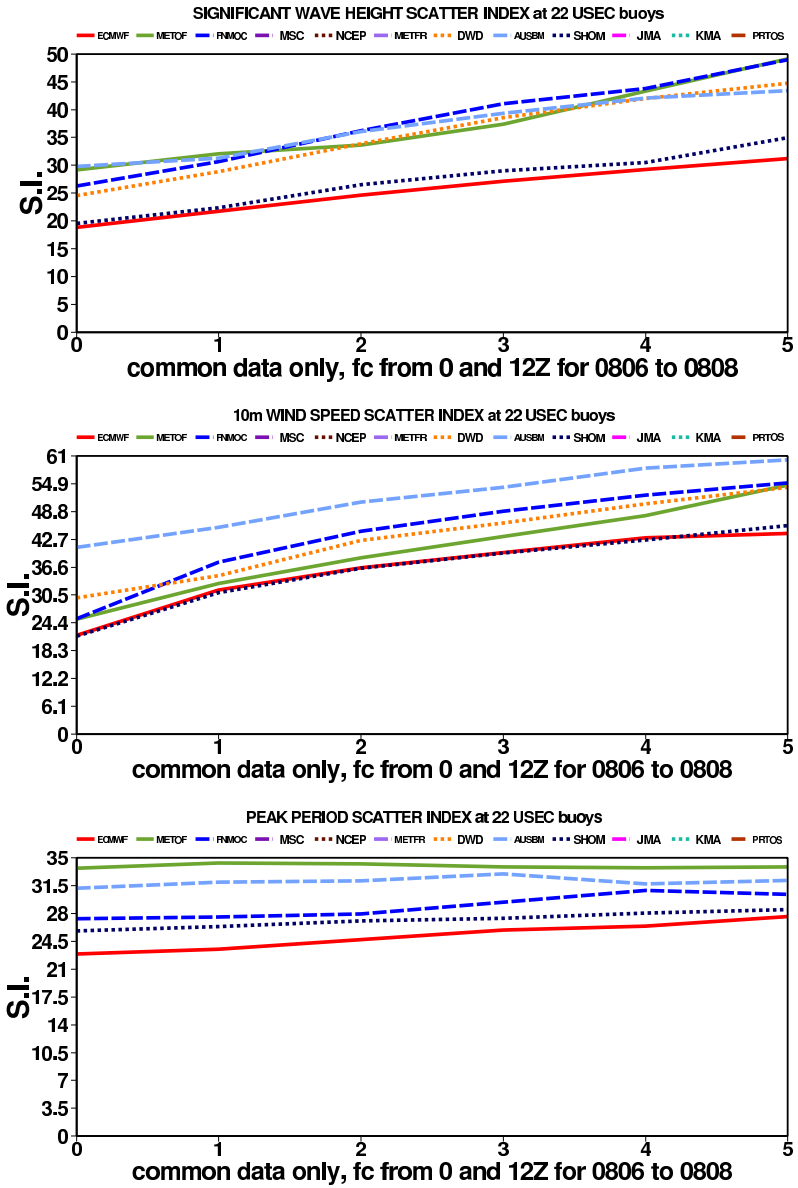
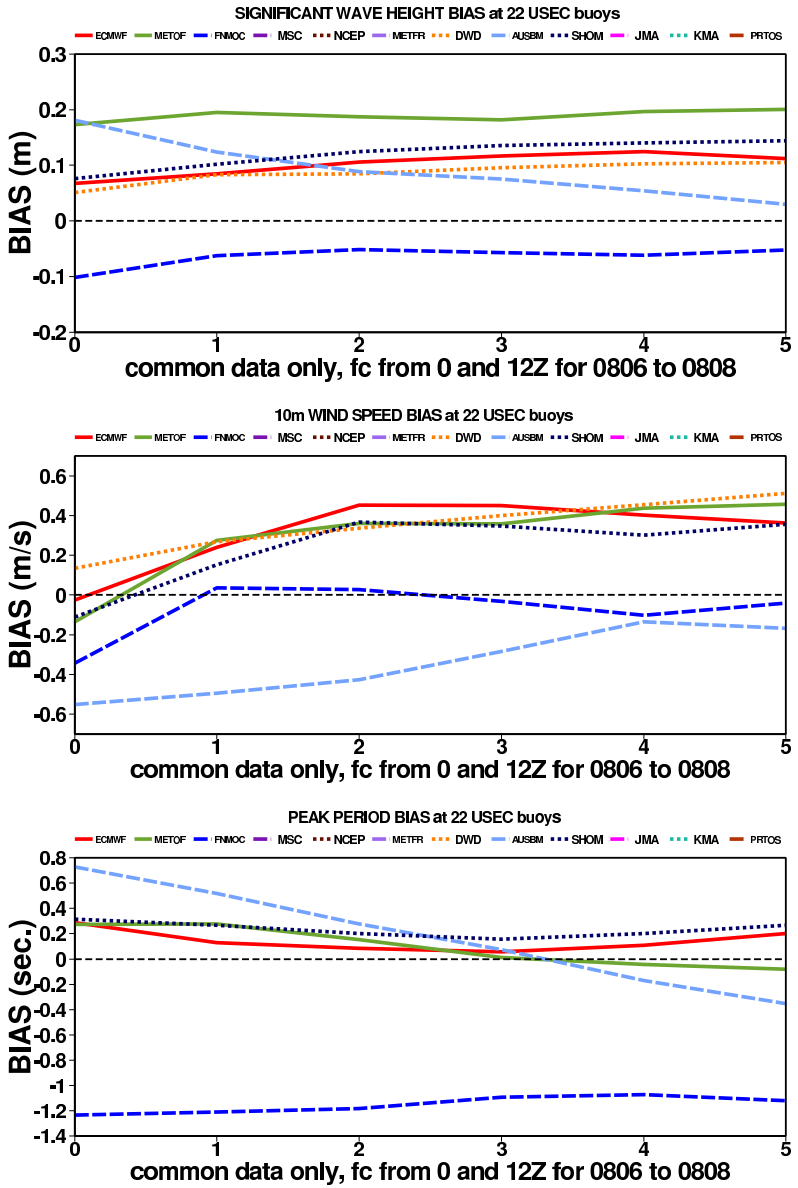


Figure 25: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.

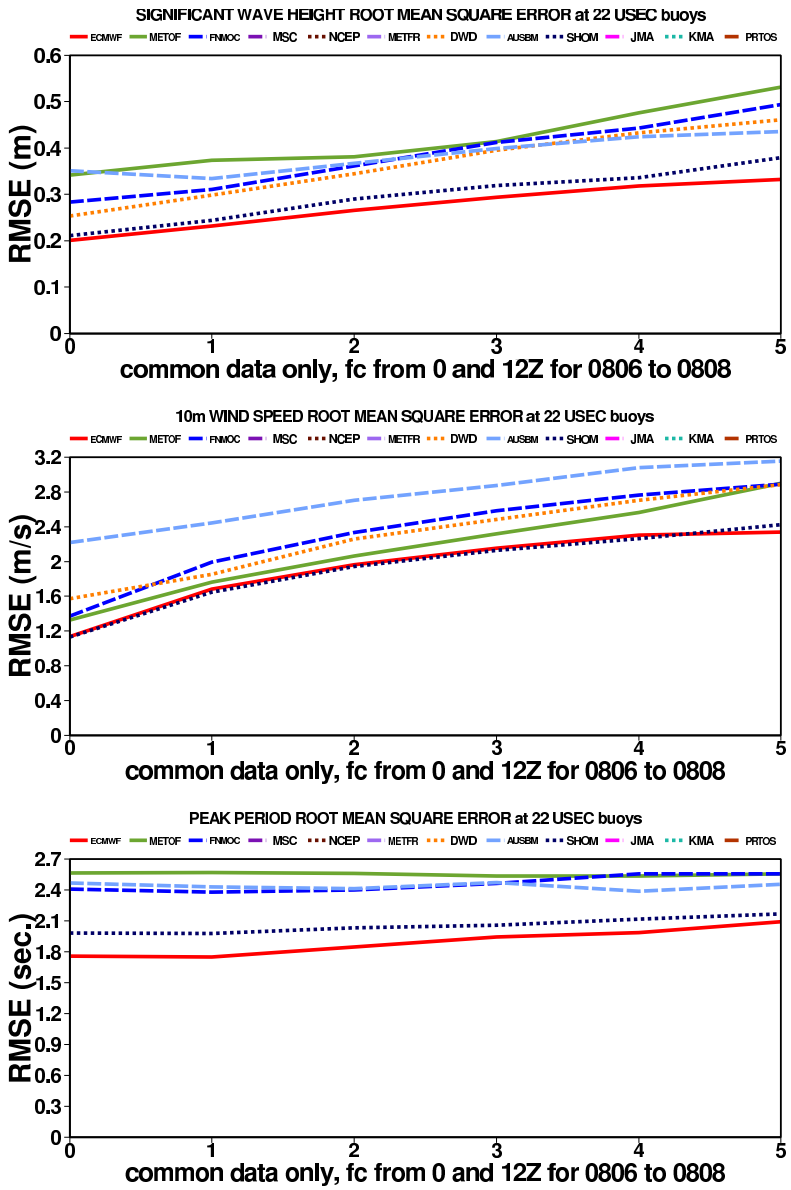


(a) Scatter Index (%)

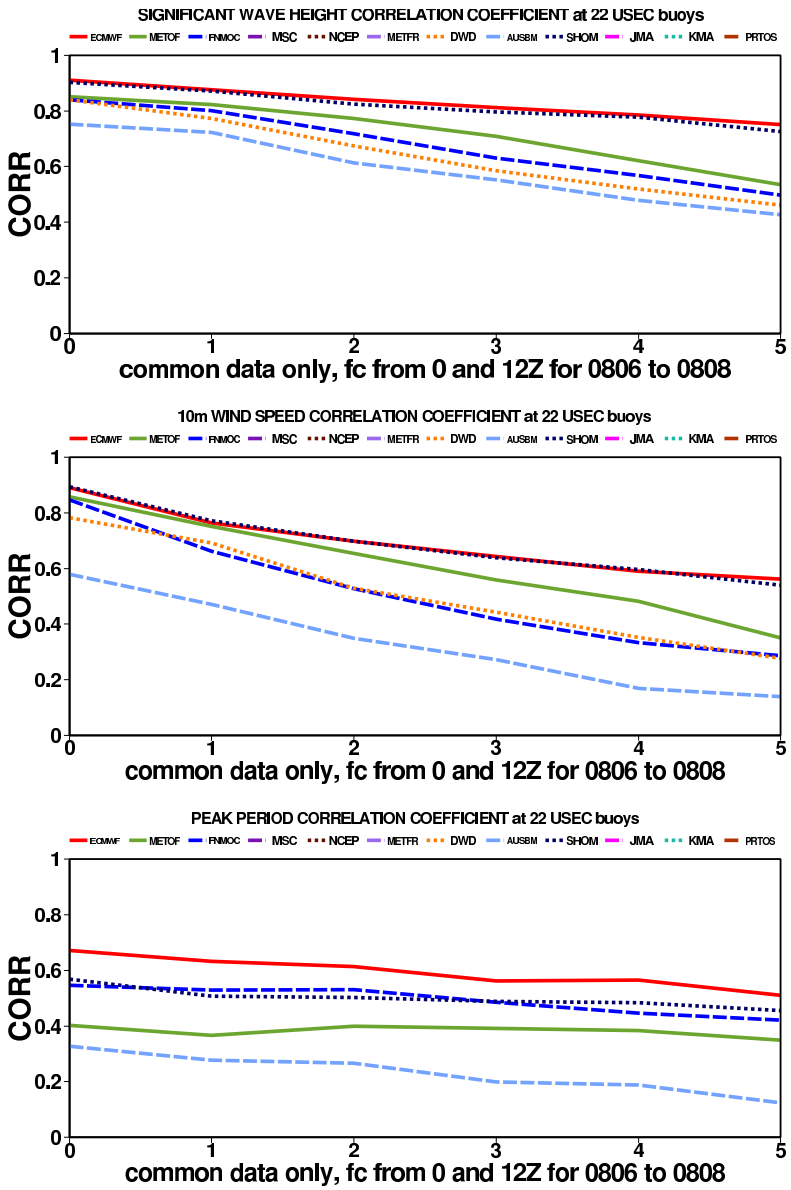


(b) Bias (model-buoy)

Figure 26: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common US East Coast buoys .



(a) R.M.S.E.



(b) Correlation Coefficient

Figure 27: Forecast root mean square error (RMSE) and linear correlation coefficient at common US East Coast buoys .

0.3.6 Comparison for Gulf of Mexico buoys

Number of common observations for Gulf of Mexico buoys (GM) from 200806 to 200808 (wind, Hs, Tp)

1	42001	182	181	174	Mid Gulf of Mexico	6	42036	181	182	165	Gulf of Mexico W Tampa
2	42002	182	178	171	Western Gulf of Mexico	7	42039	181	181	173	Gulf of Mexico Pensacola S
3	42003	180	180	178	East Gulf of Mexico	8	42040	181	182	173	Gulf of Mexico Mobile S
4	42019	182	182	181	Gulf of Mexico Lanelle	9	42055	181	181	178	Bay of Campeche
5	42020	182	182	179	Gulf of Mexico Corpus Christi	10	42099	0	180	173	Gulf Mexico, St Peterburg (scripps 144)

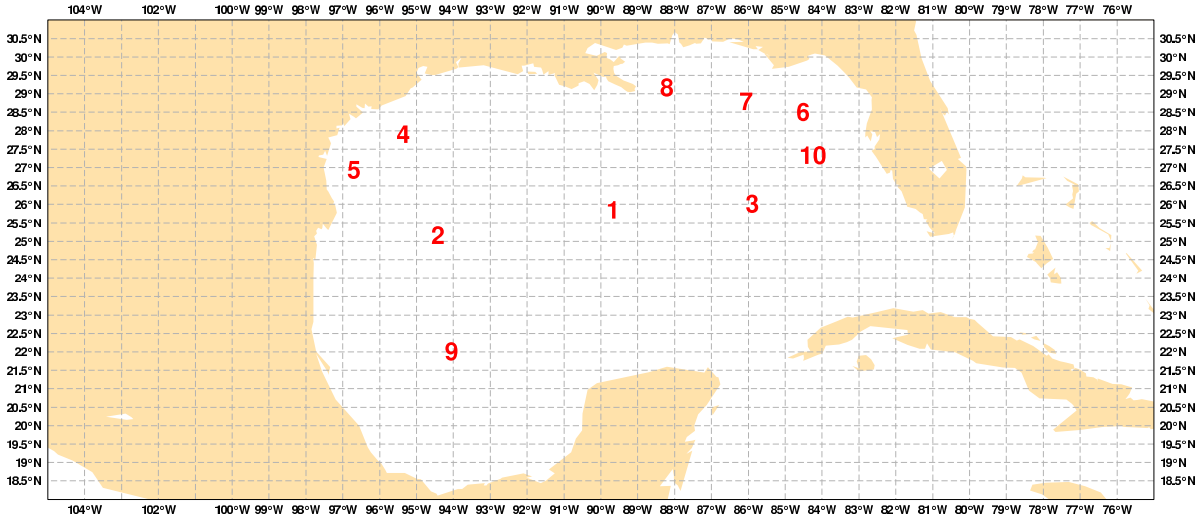
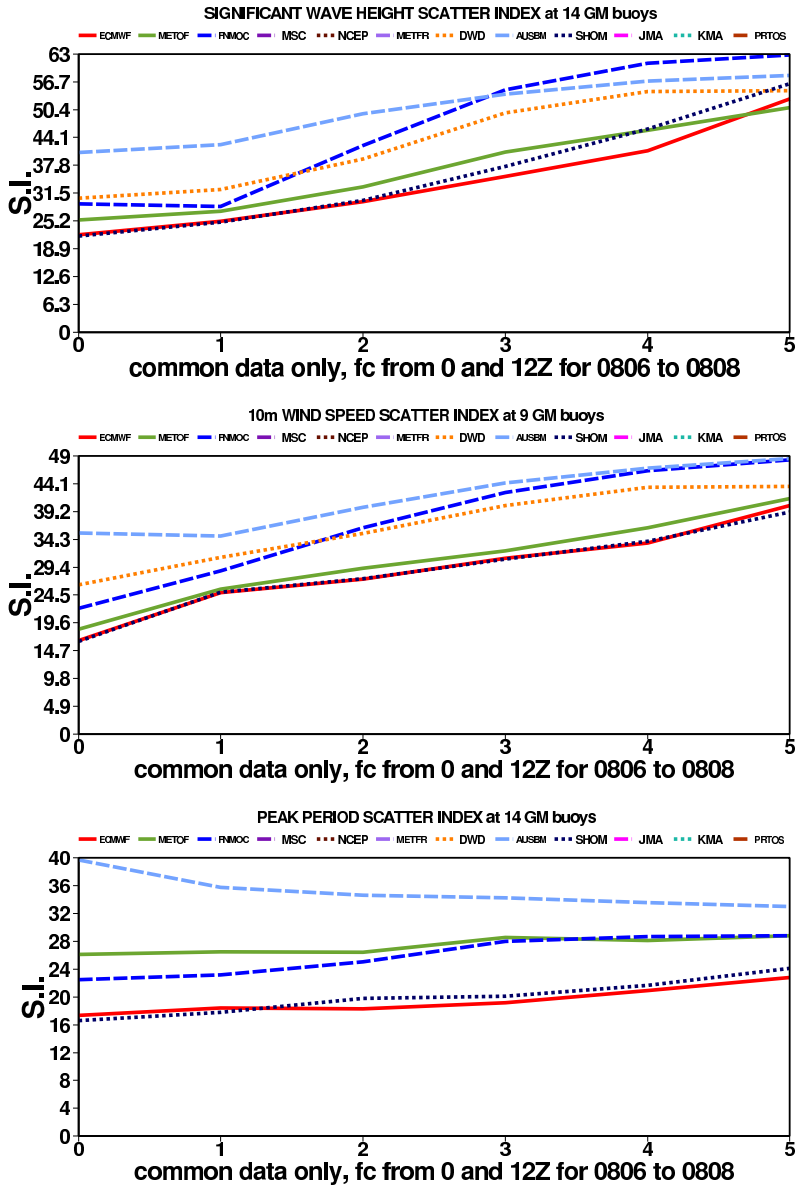
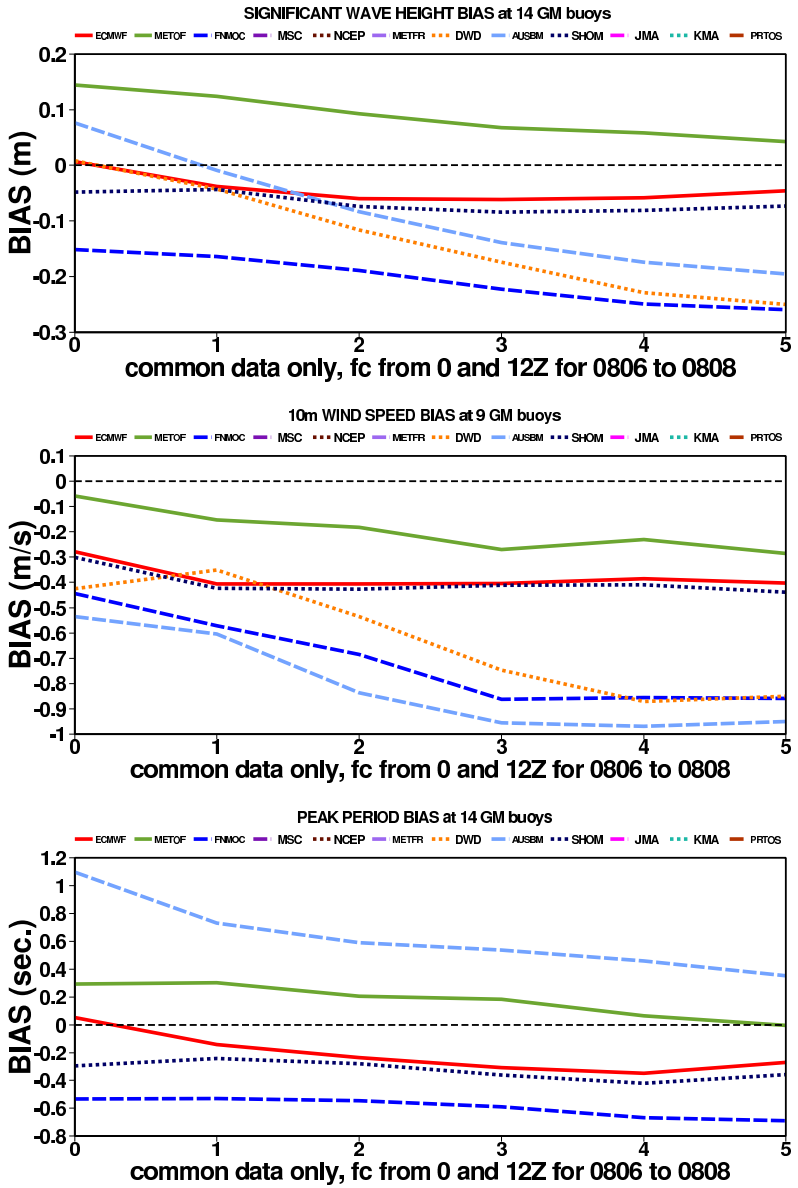


Figure 28: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.

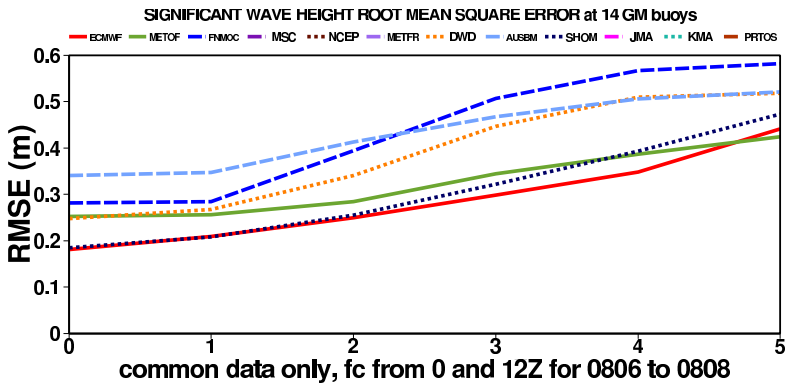


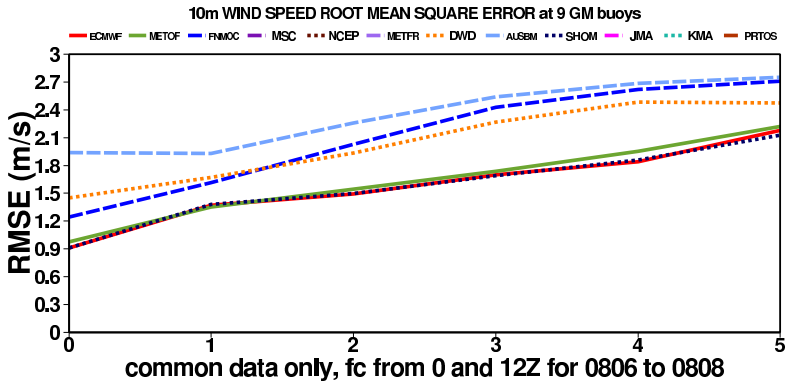
(a) Scatter Index (%)

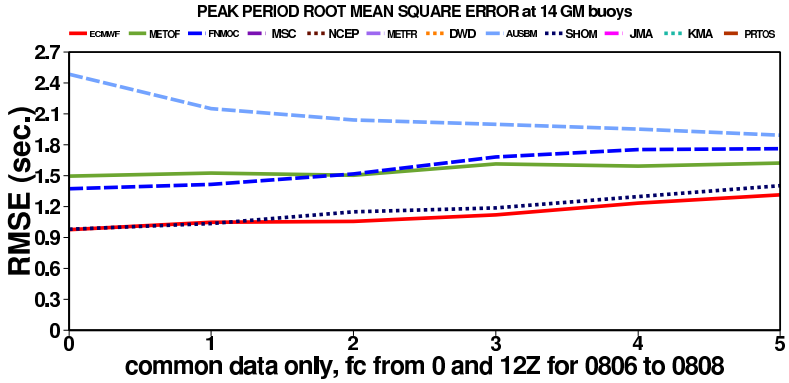


(b) Bias (model-buoy)

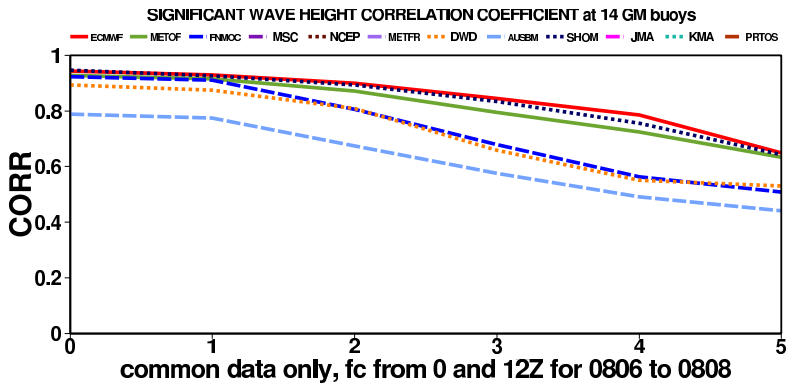
Figure 29: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common Gulf of Mexico buoys .

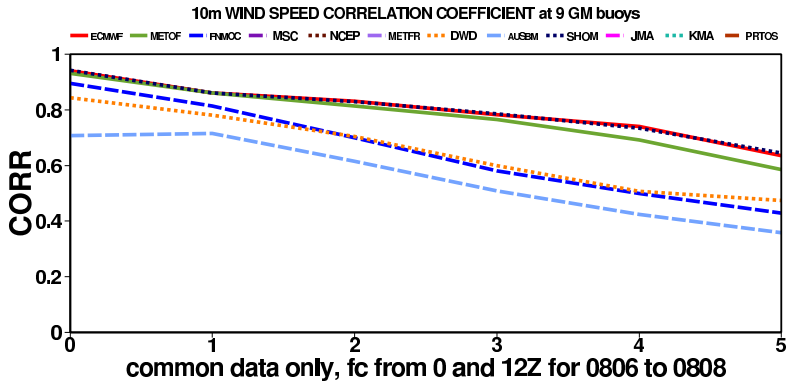


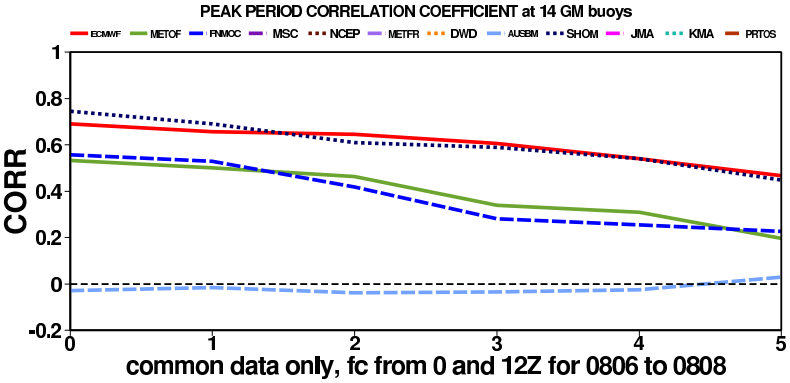




(a) R.M.S.E.







(b) Correlation Coefficient

Figure 30: Forecast root mean square error (RMSE) and linear correlation coefficient at common Gulf of Mexico buoys .

0.3.7 Comparison for Canadian East Coast buoys

Number of common observations for Canadian East Coast buoys (CANEC) from 200806 to 200808 (wind, Hs, Tp)

1	44137	104	180	180	Nova Scotia, East Scotia slope	5	44141	24	177	176	Nova Scotia, Laurentian Fan
2	44138	182	182	182	Newfoundland, SW Grand Bank	6	44150	182	0	0	Nova Scotia, La Have Bank
3	44139	181	180	181	Newfoundland, Banquerau	7	44251	153	153	153	Newfoundland, Nickerson Bank
4	44140	167	17	17	Newfoundland, Tail Of The Bank	8	44255	180	175	175	Newfoundland, NE Bugeo Bank

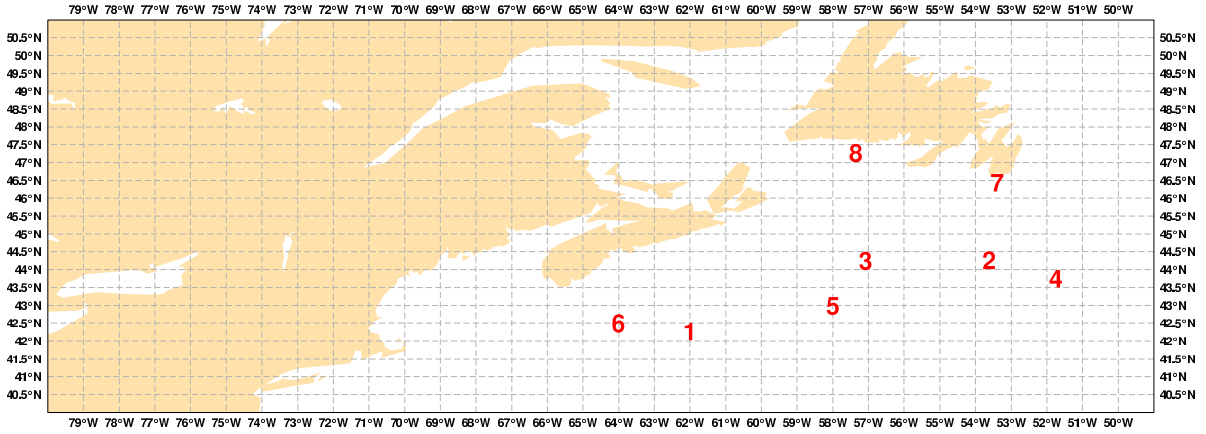
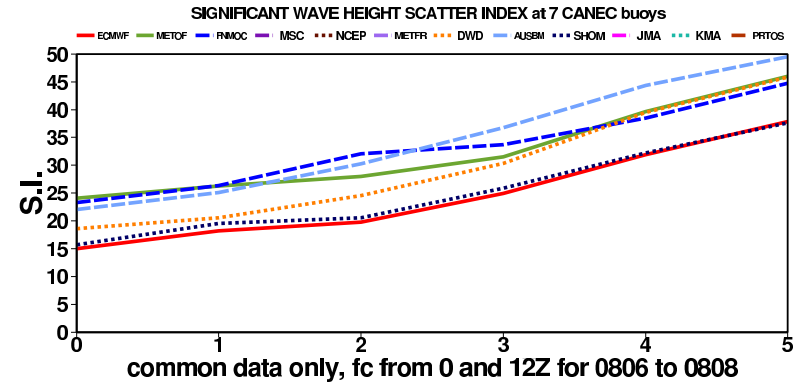
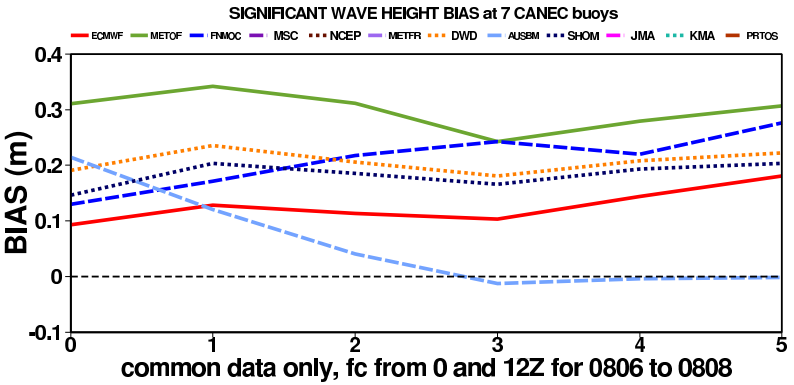
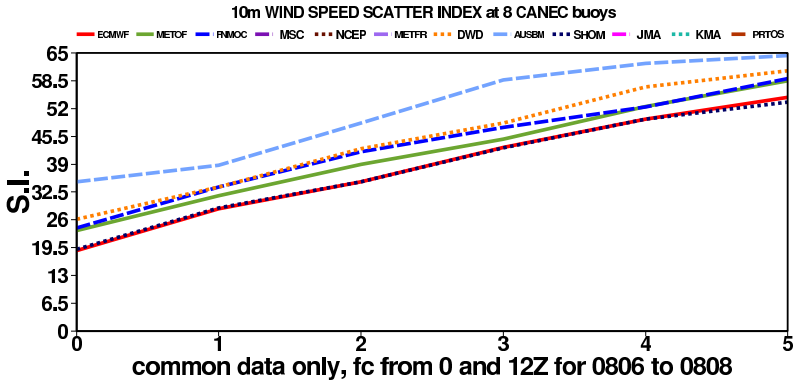
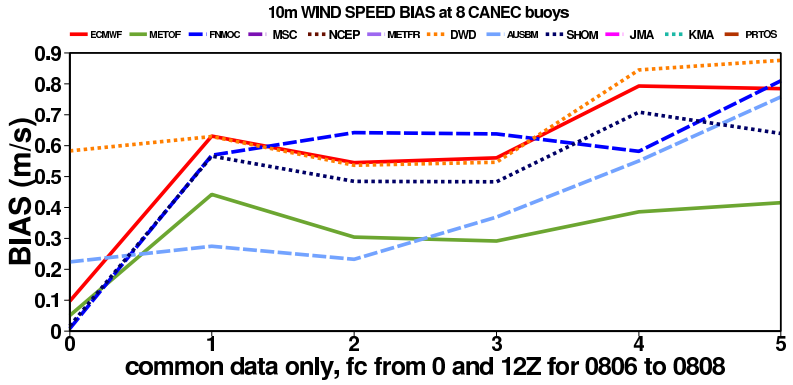


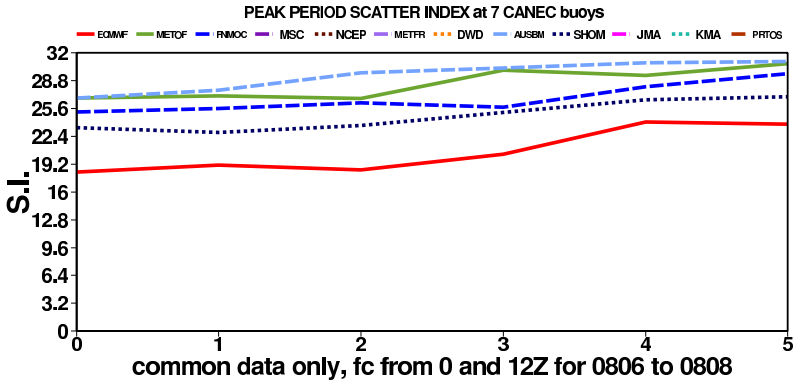
Figure 31: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.

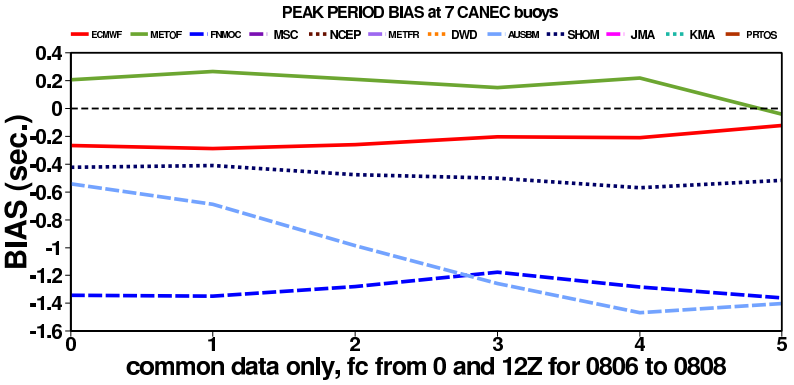








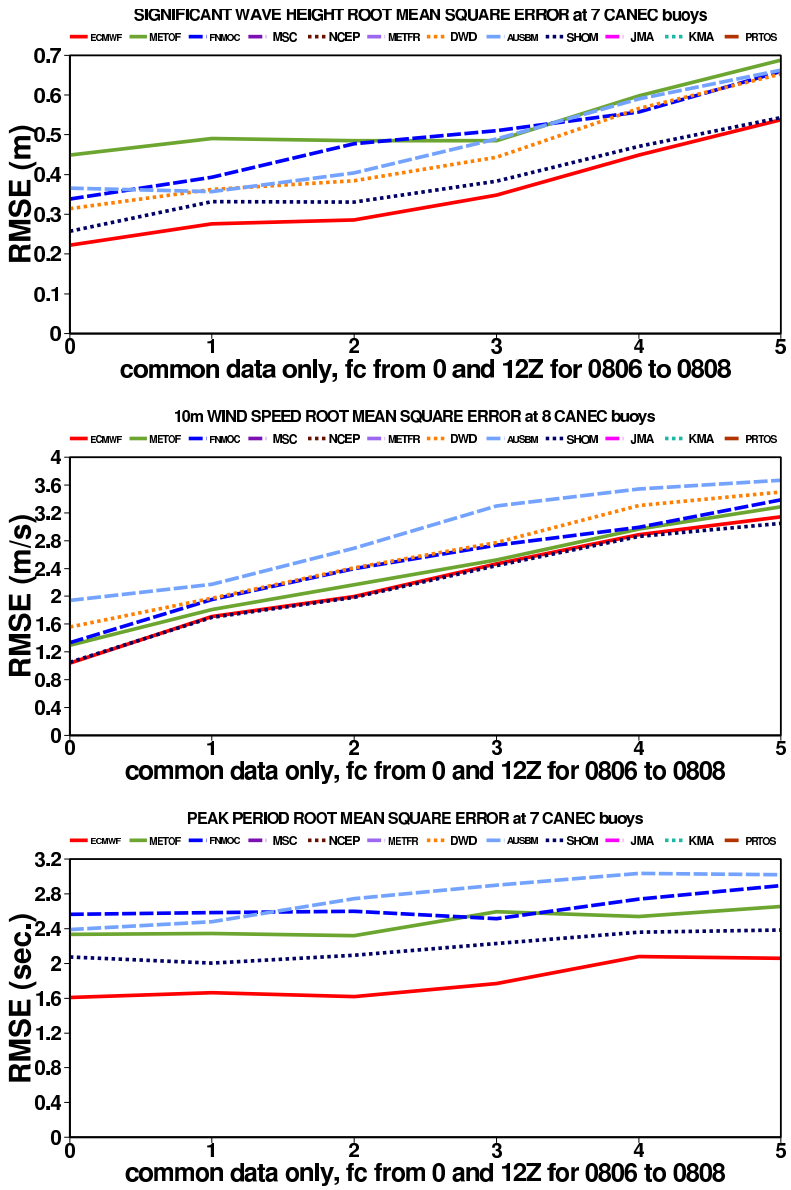




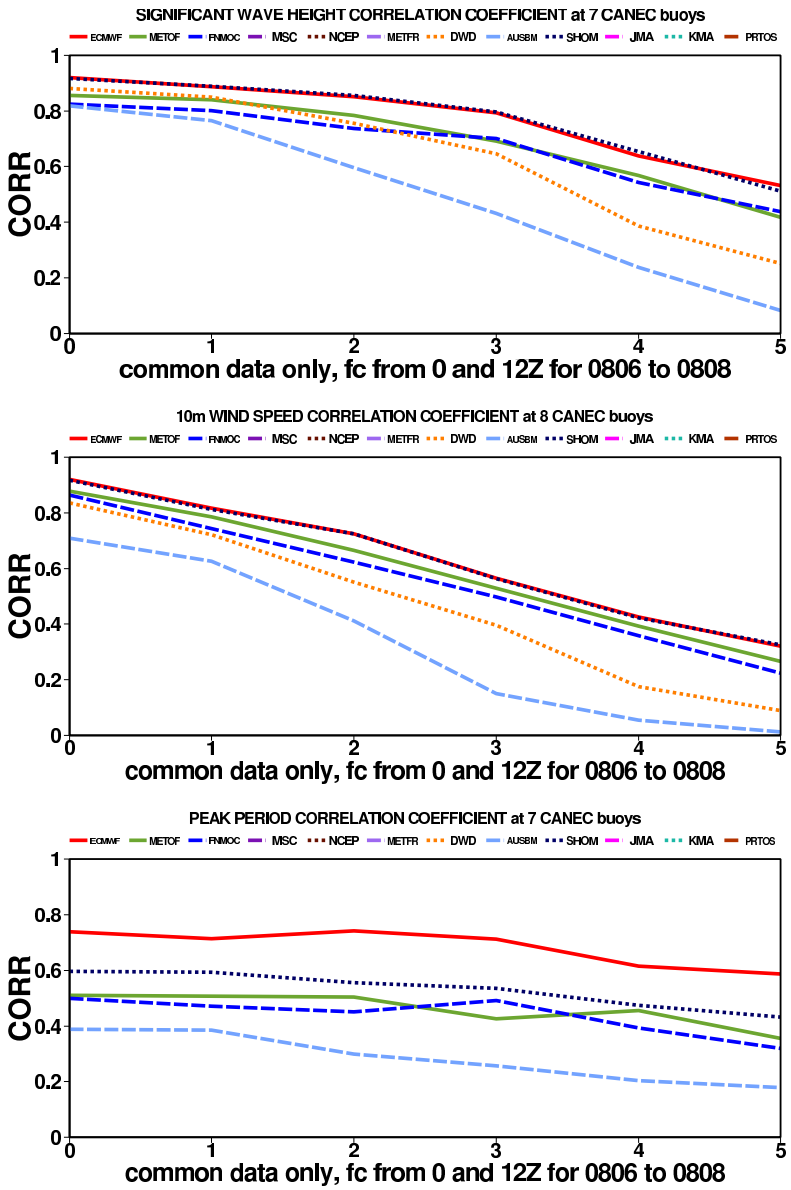
(a) Scatter Index (%)

(b) Bias (model-buoy)

Figure 32: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common Canadian East Coast buoys .



(a) R.M.S.E.



(b) Correlation Coefficient

Figure 33: Forecast root mean square error (RMSE) and linear correlation coefficient at common Canadian East Coast buoys .

0.3.8 Comparison for Caribbean Sea buoys

Number of common observations for Caribbean Sea buoys (CRB) from 200806 to 200808 (wind, Hs, Tp)

1	41040	182	182	182	Tropical Atlantic, West Atlantic
2	41041	182	181	180	Tropical Atlantic, Middle Atlantic
3	41043	177	177	177	South Western Atlantic
4	41046	180	179	180	E Bahamas
5	41047	181	180	181	NE Bahamas
6	41100	179	182	0	French West Indies (Antilles 1)
7	41101	181	181	0	French West Indies (Antilles 2)
8	42056	181	181	182	Yucatan Basin
9	42057	182	182	182	Western Caribbean
10	42058	181	180	180	Central Caribbean
11	42059	181	181	181	Eastern Caribbean

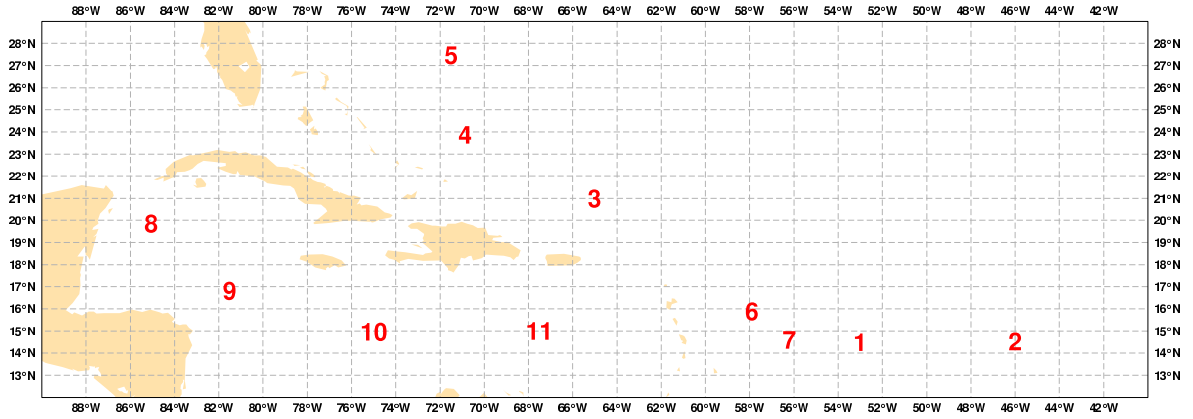
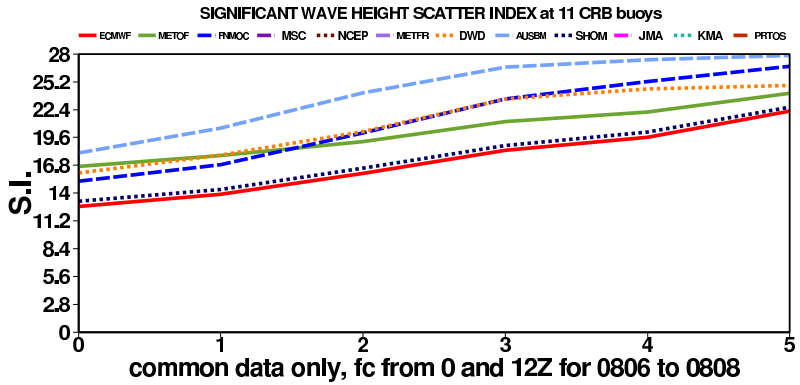
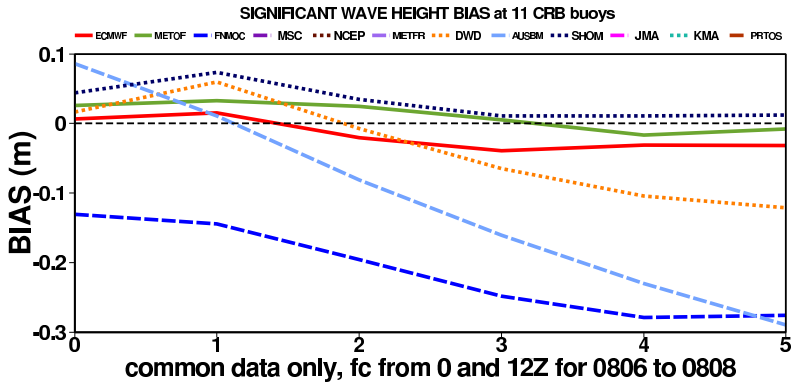
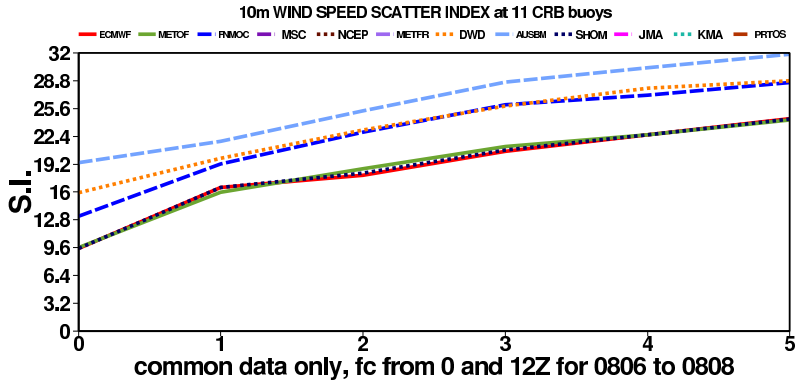
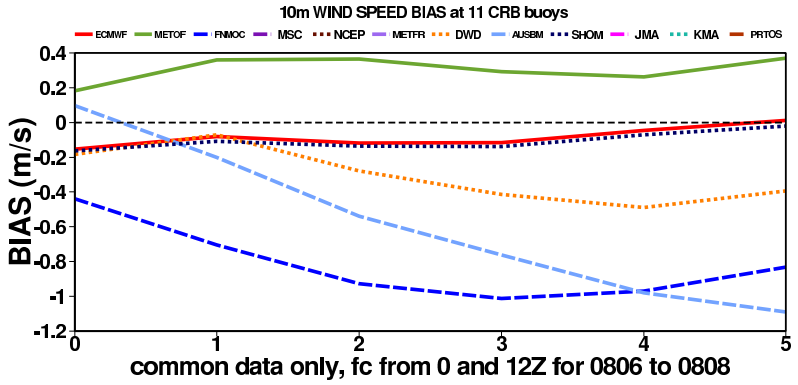


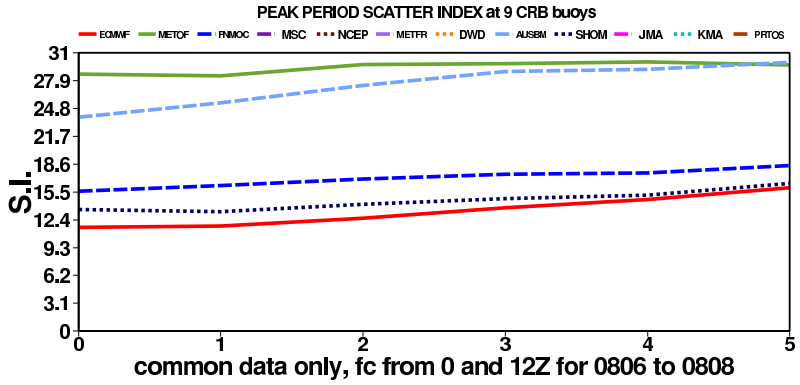
Figure 34: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.

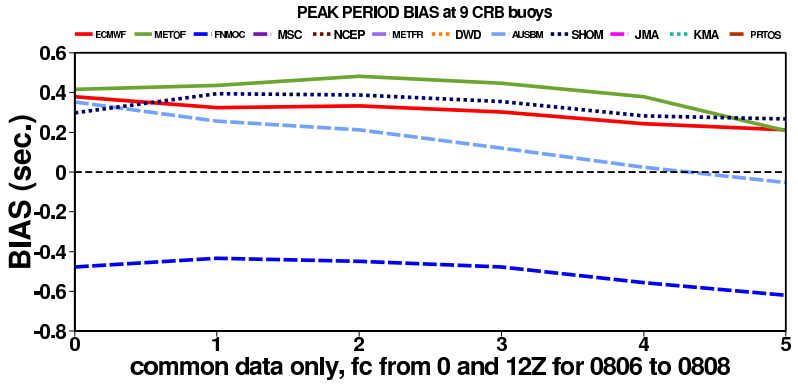








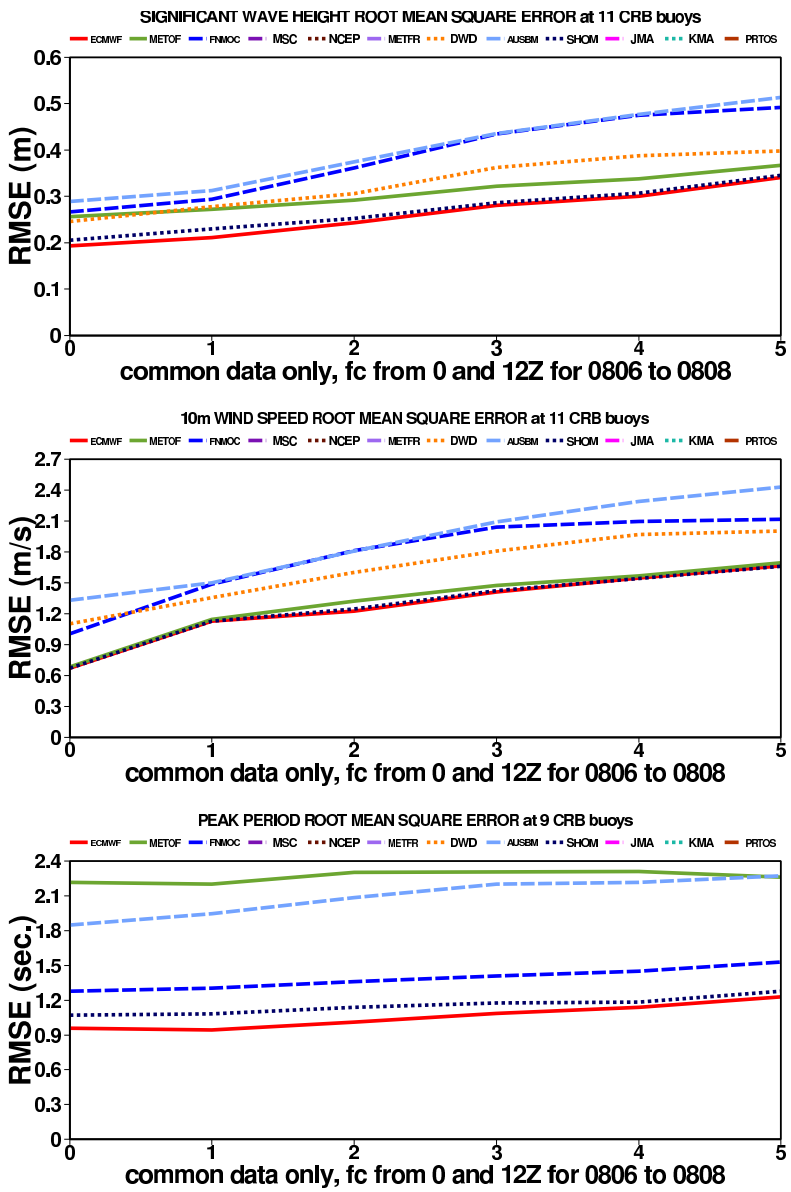




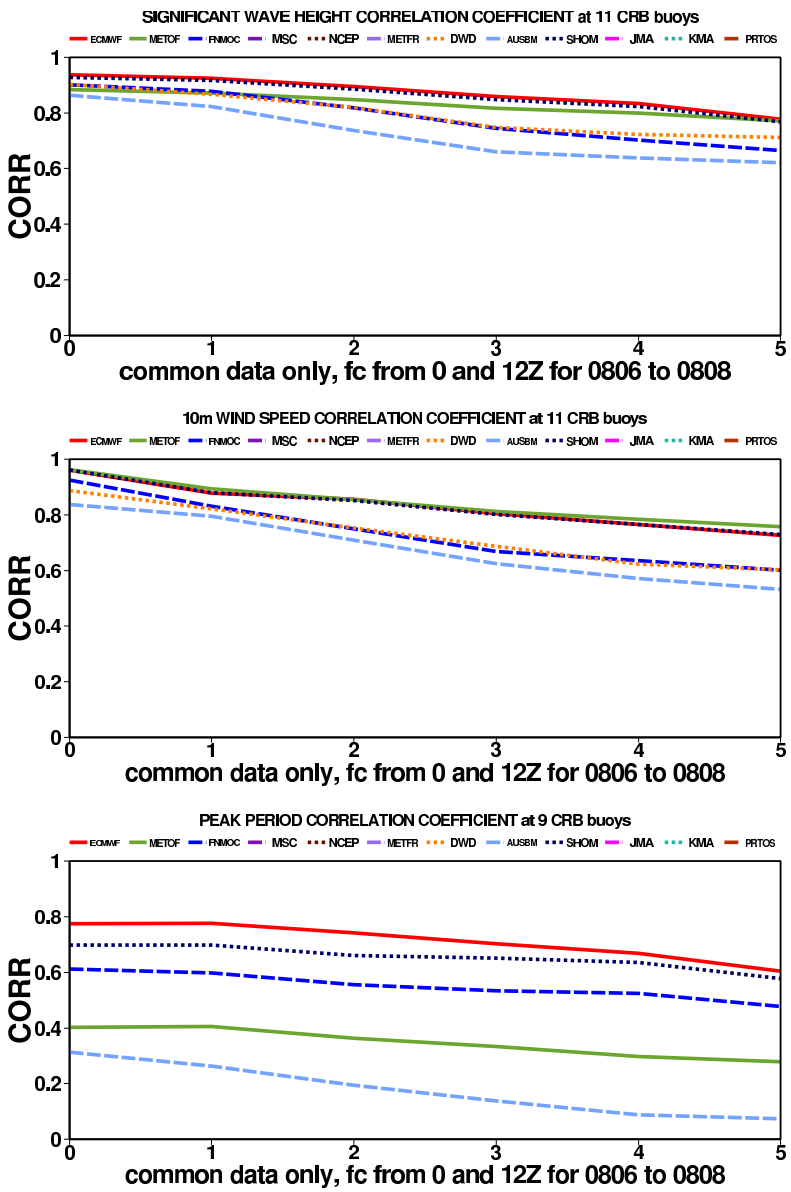
(a) Scatter Index (%)

(b) Bias (model-buoy)

Figure 35: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common Caribbean Sea buoys.



(a) R.M.S.E.



(b) Correlation Coefficient

Figure 36: Forecast root mean square error (RMSE) and linear correlation coefficient at common Caribbean Sea buoys.

0.3.9 Comparison for North East Atlantic buoys

Number of common observations for North East Atlantic buoys (NEATL) from 200806 to 200808 (wind, Hs, Tp)

1	62023	162	163	0	South Ireland, Marathon rig	10	62085	147	168	0	Cadiz (Spain)
2	62024	99	100	0	Bilbao (Spain)	11	62092	8	182	0	South West Ireland (M3), Mizen Head
3	62025	166	169	0	Cabo de Penas (Spain)	12	62094	181	181	0	South Ireland (M5), South East
4	62029	177	181	0	UK Celtic Sea shelf break (K1)	13	62095	122	0	0	West Ireland (M6), West Coast
5	62064	0	95	0	SHOM (Cape Ferret)	14	62107	180	180	0	Isle of Scilly (7 stones)
6	62081	182	182	0	UK East Atlantic (K2)	15	62163	133	182	0	UK Celtic Sea shelf break (Brittany)
7	62082	155	155	0	Estaca de Bares (Spain)	16	62303	179	180	0	Bristol Channel (Pembroke buoy)
8	62083	169	169	0	Villano-Sisargas (Spain)	17	64045	81	178	0	UK North-East Atlantic (K5)
9	62084	167	167	0	Silleiro Spain)	18	64046	173	165	0	UK North-East Atlantic (K7)

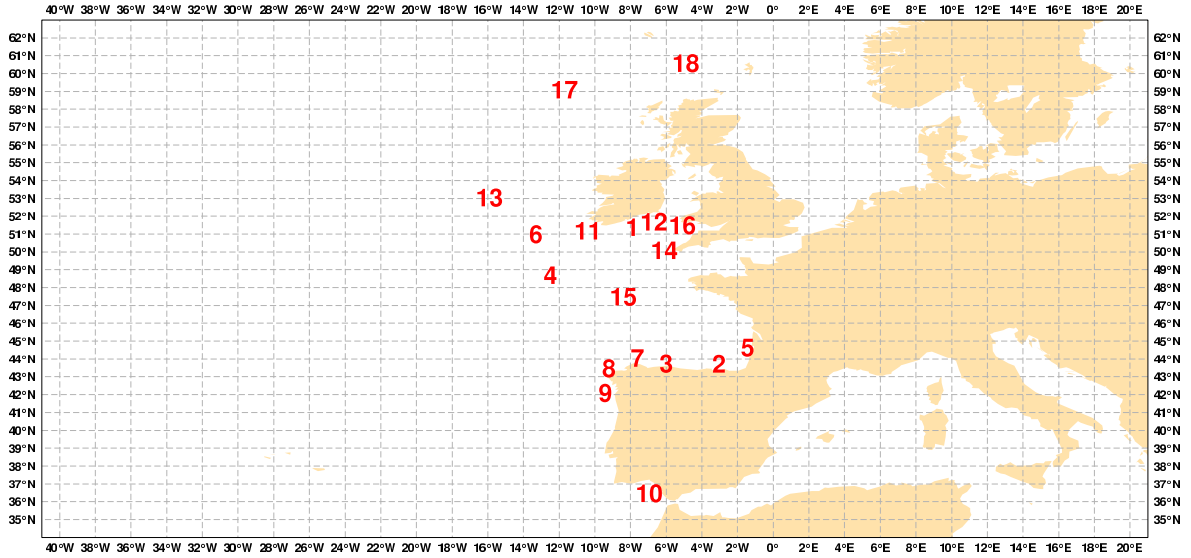
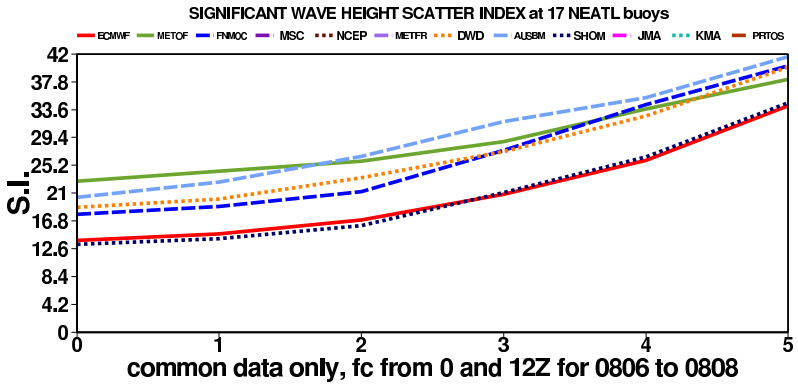
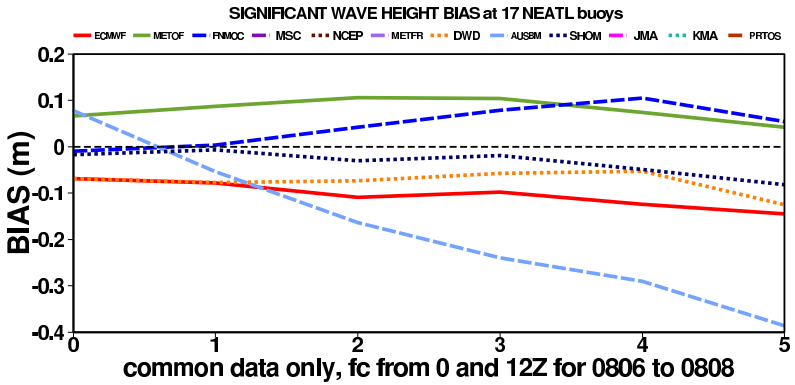
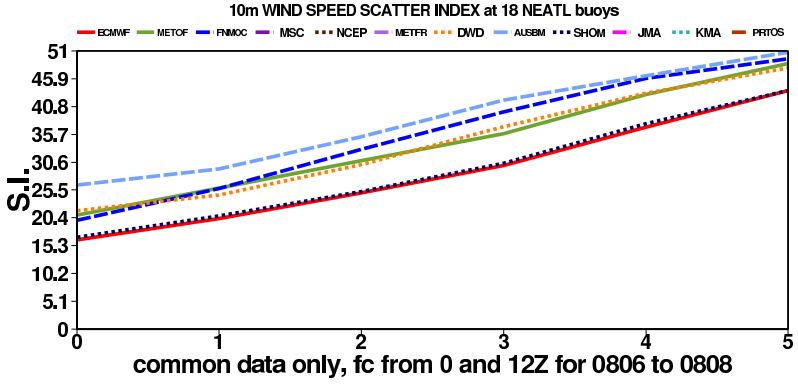
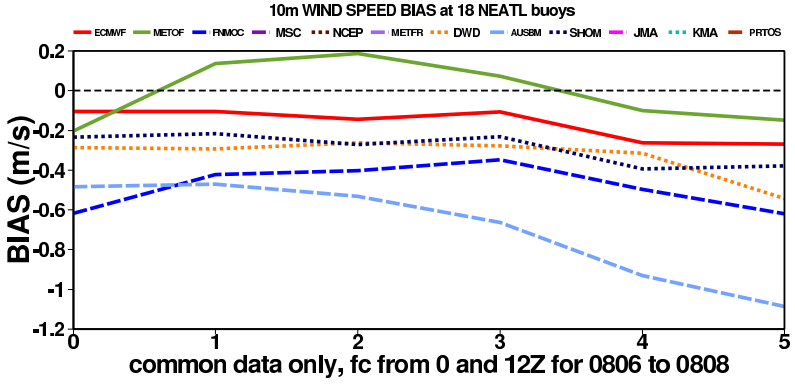


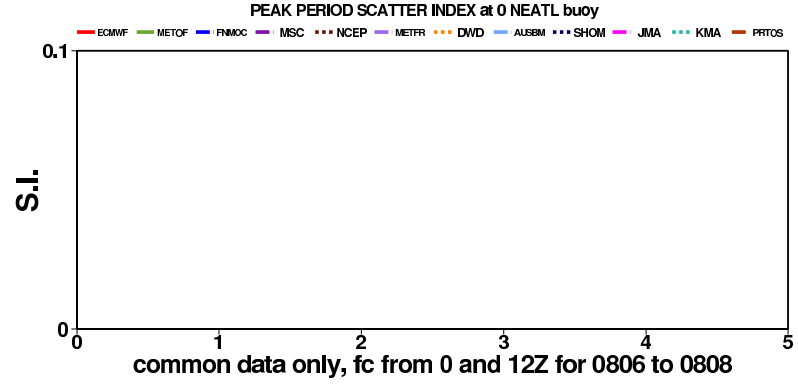
Figure 37: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.

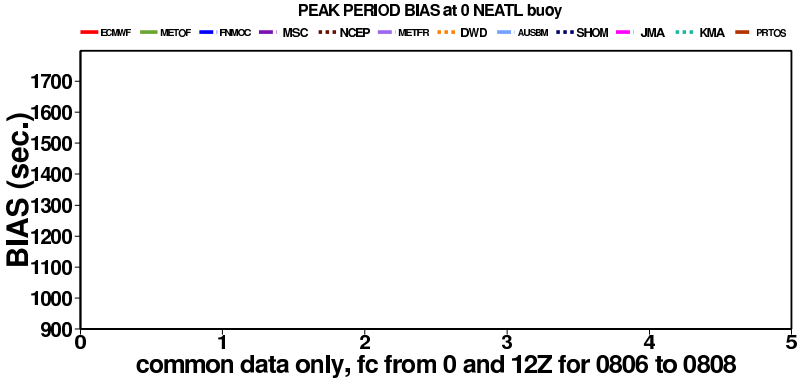








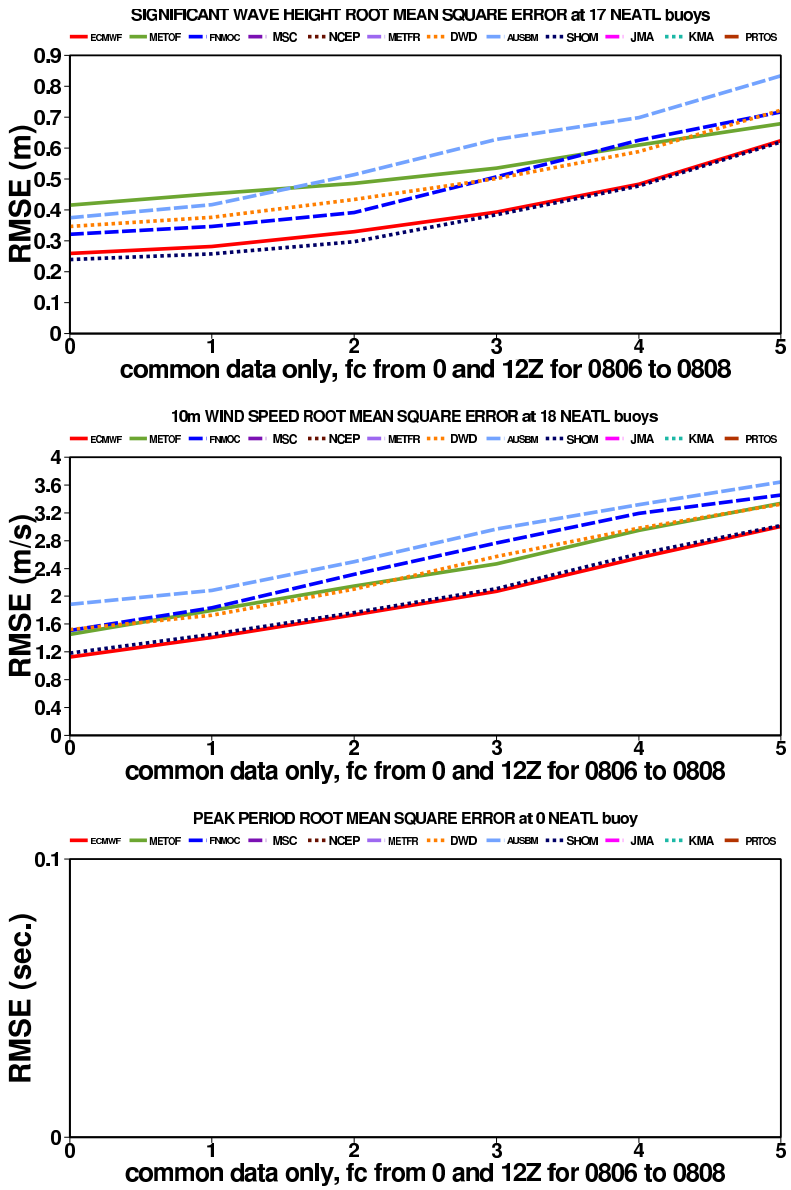




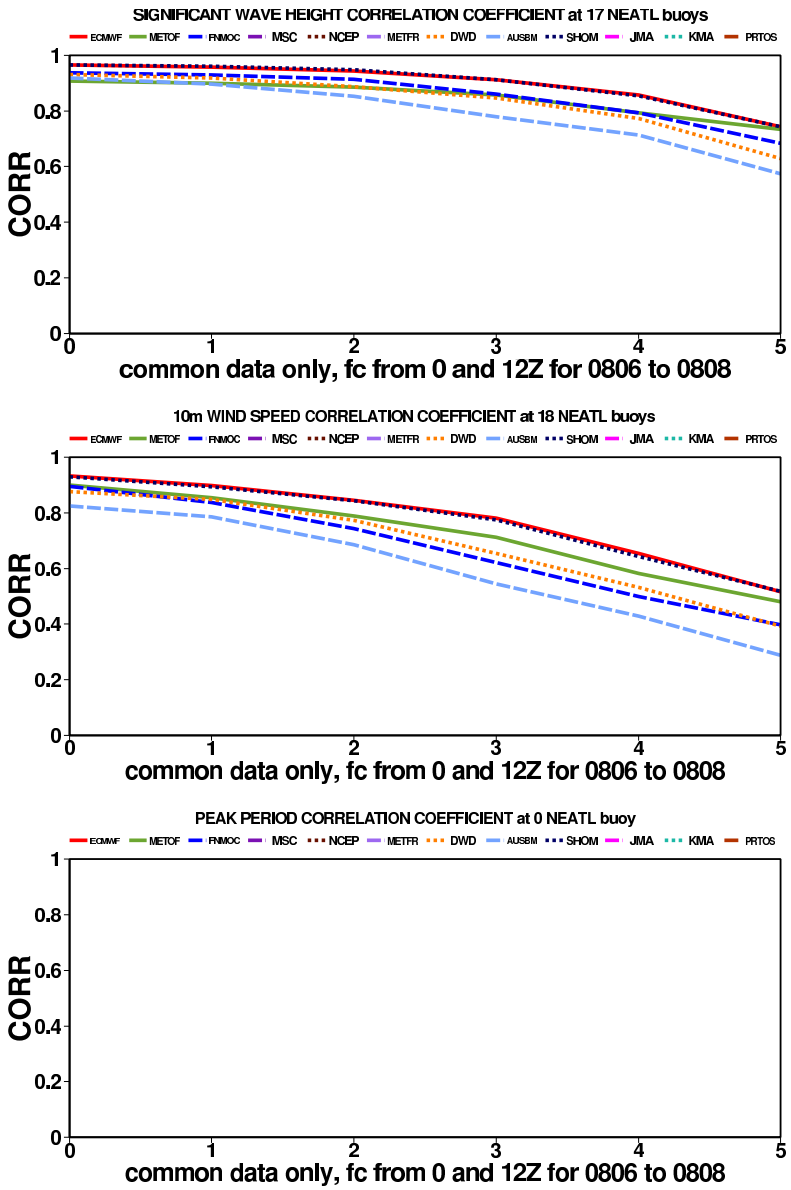
(a) Scatter Index (%)

(b) Bias (model-buoy)

Figure 38: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common North East Atlantic buoys .



(a) R.M.S.E.



(b) Correlation Coefficient

Figure 39: Forecast root mean square error (RMSE) and linear correlation coefficient at common North East Atlantic buoys .

0.3.10 Comparison for North Sea platforms

Number of common observations for North Sea (NSEA) from 200806 to 200808 (wind, Hs, Tp)

1	62111	180	180	0	North Sea (Ivanhoe)
2	62116	156	178	0	North Sea (Nelson)
3	62117	46	64	0	North Sea (??????)
4	62119	132	130	0	North Sea (??????)
5	62128	125	123	0	North Sea (??????)
6	62132	34	34	0	North Sea (Auk A)
7	62133	179	179	0	North Sea (Gannet)
8	62142	180	180	0	North Sea (Leman)
9	62143	177	177	0	North Sea (??????)
10	62144	160	154	0	North Sea (Clipper)
11	62145	180	170	0	North Sea (Sean P)
12	62152	0	178	0	North Sea (??????)
13	62164	64	126	0	North Sea (Anasuria)
14	62170	164	161	0	Channel (F3 light vessel)
15	63055	37	136	0	North Sea shelf break (????????)
16	63056	129	11	0	North Sea shelf break (????????)
17	63057	6	6	0	North Sea shelf break (????????)
18	63103	179	179	0	S Norwegian Sea (North Cormorant)
19	63108	179	179	0	S Norwegian Sea (North Alwyn)
20	63110	89	91	0	North Sea shelf break (?????)
21	63112	175	176	0	North Sea shelf break (????????)
22	63113	57	57	0	North Sea shelf break
23	63115	177	177	0	North Sea shelf break (?????)

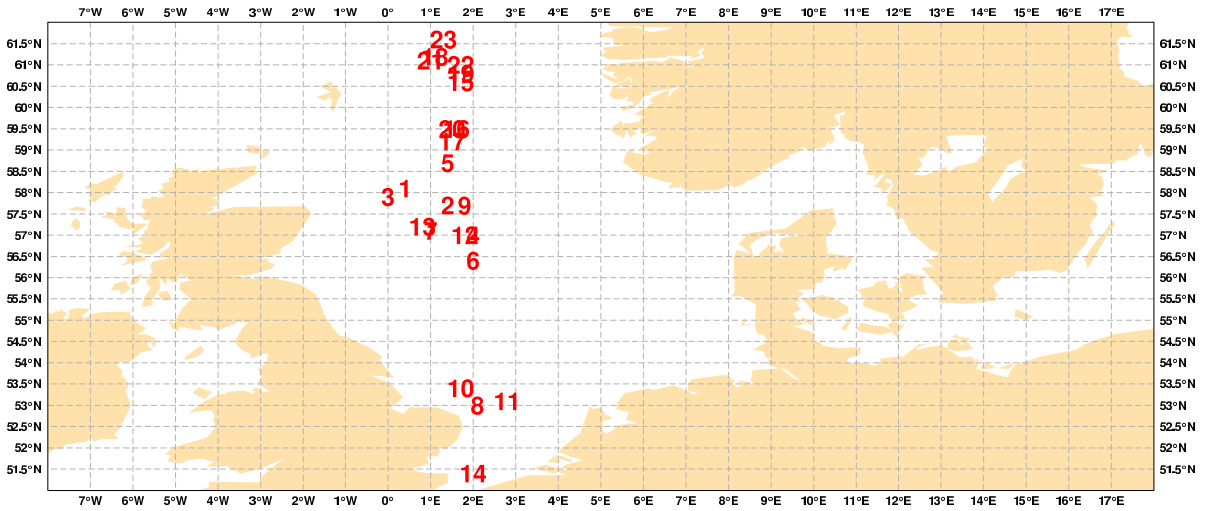
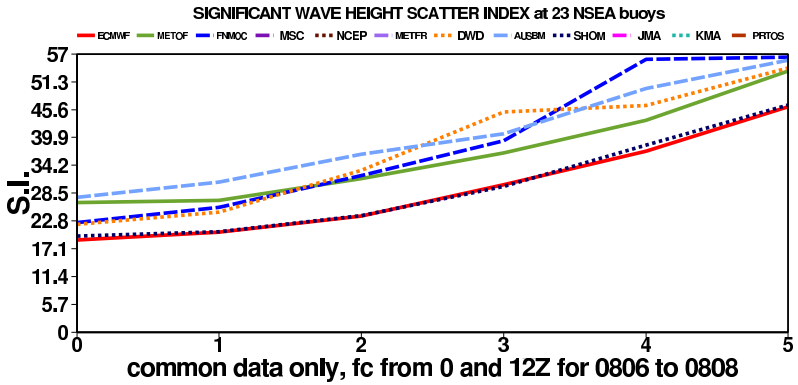
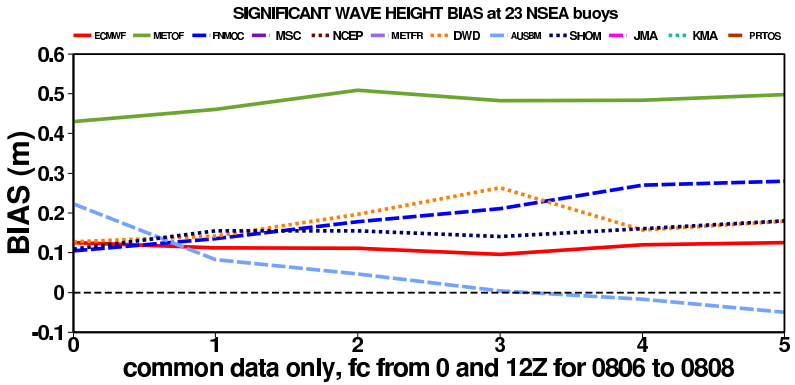
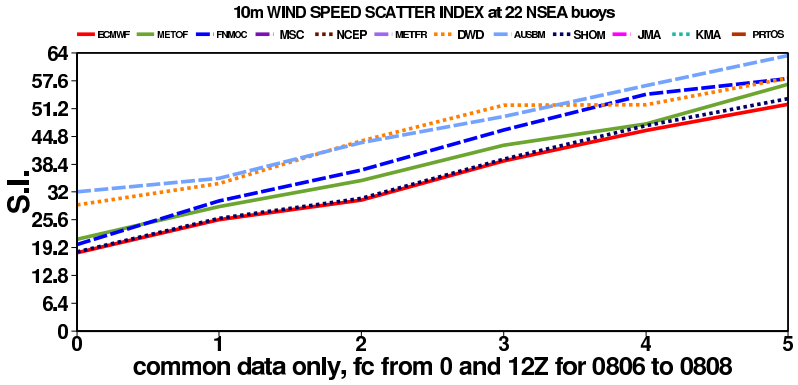
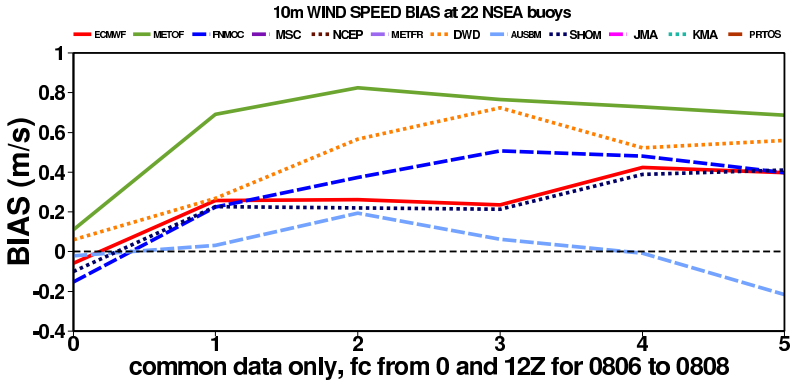


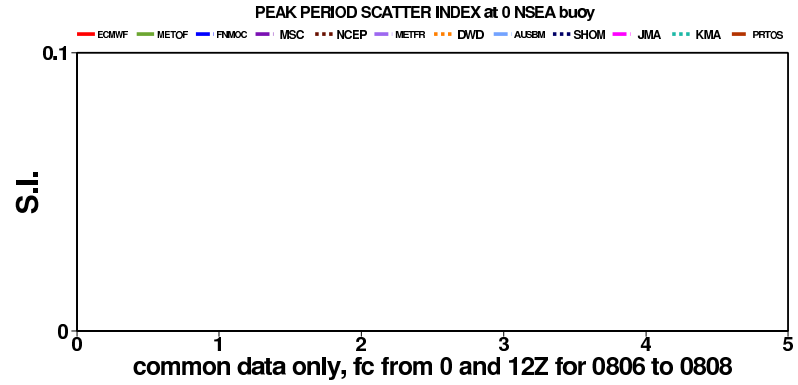
Figure 40: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.

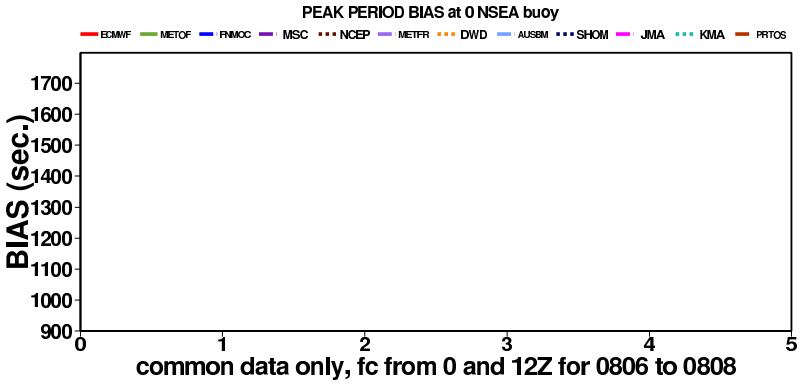








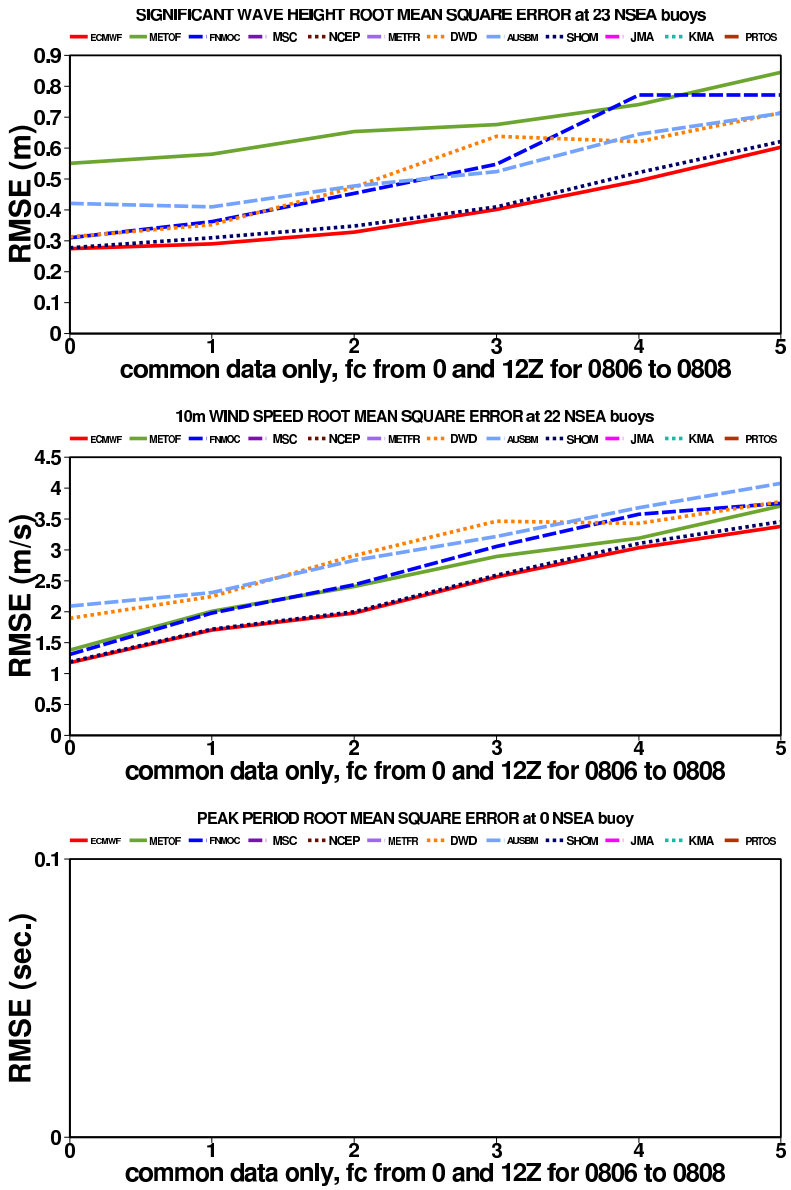




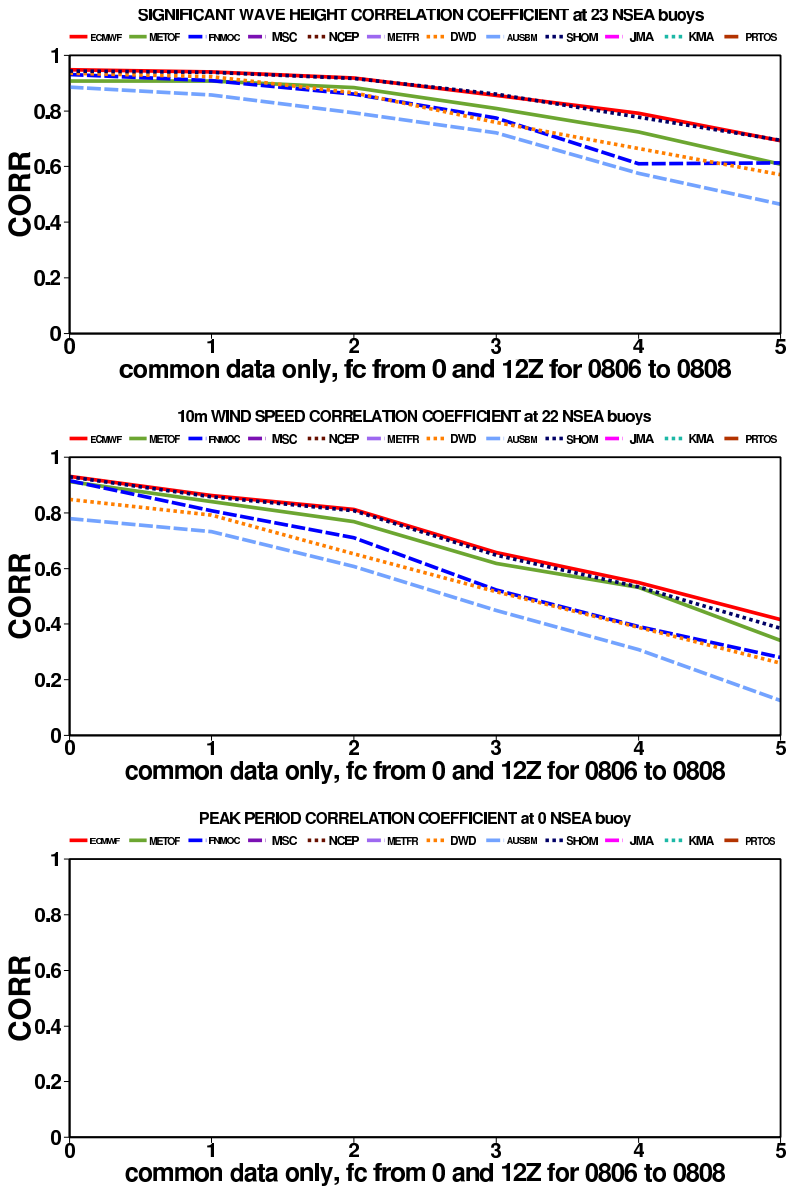
(a) Scatter Index (%)

(b) Bias (model-buoy)

Figure 41: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common North Sea platforms.



(a) R.M.S.E.



(b) Correlation Coefficient

Figure 42: Forecast root mean square error (RMSE) and linear correlation coefficient at common North Sea platforms.

0.3.11 Comparison for Icelandic buoys and Norwegian platforms

Number of common observations for Iceland and Norway (NRDIC) from 200806 to 200808 (wind, Hs, Tp)

1	LDWR	178	178	0	N Norwegian Sea (Mike)
2	LF3F	158	96	0	N Norwegian Sea (Draugen)
3	LF3N	179	169	0	N Norwegian Sea (Heidrun)
4	LF4B	176	93	0	S Norwegian Sea (Troll A)
5	LF4C	169	108	0	North Sea (Sleipner)
6	LF4H	182	182	0	S Norwegian Sea (Heimdal)
7	LF5T	127	55	0	N Norwegian Sea (Norne)

8	TFBLK	0	156	0	West Iceland (Blakksnes)
9	TFGRS	0	151	0	North Iceland (Grimseyjarsund)
10	TFGSK	0	152	0	West Iceland (Gardskagi)
11	TFKGR	0	114	0	East Iceland (Kogur)
12	TFSRT	0	132	0	South Iceland (Surtsey)
13	TFSTD	0	165	0	North West Iceland (Straumnes)

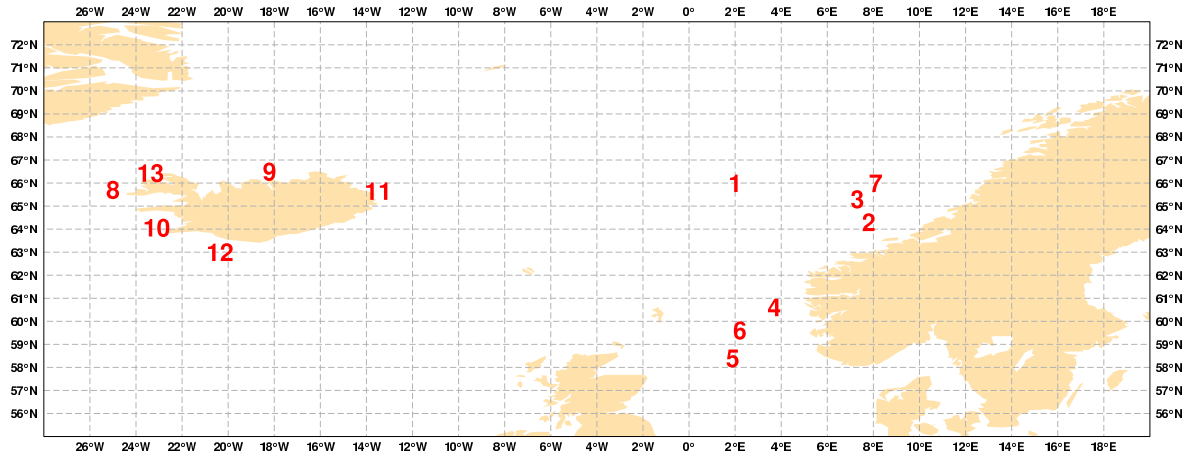
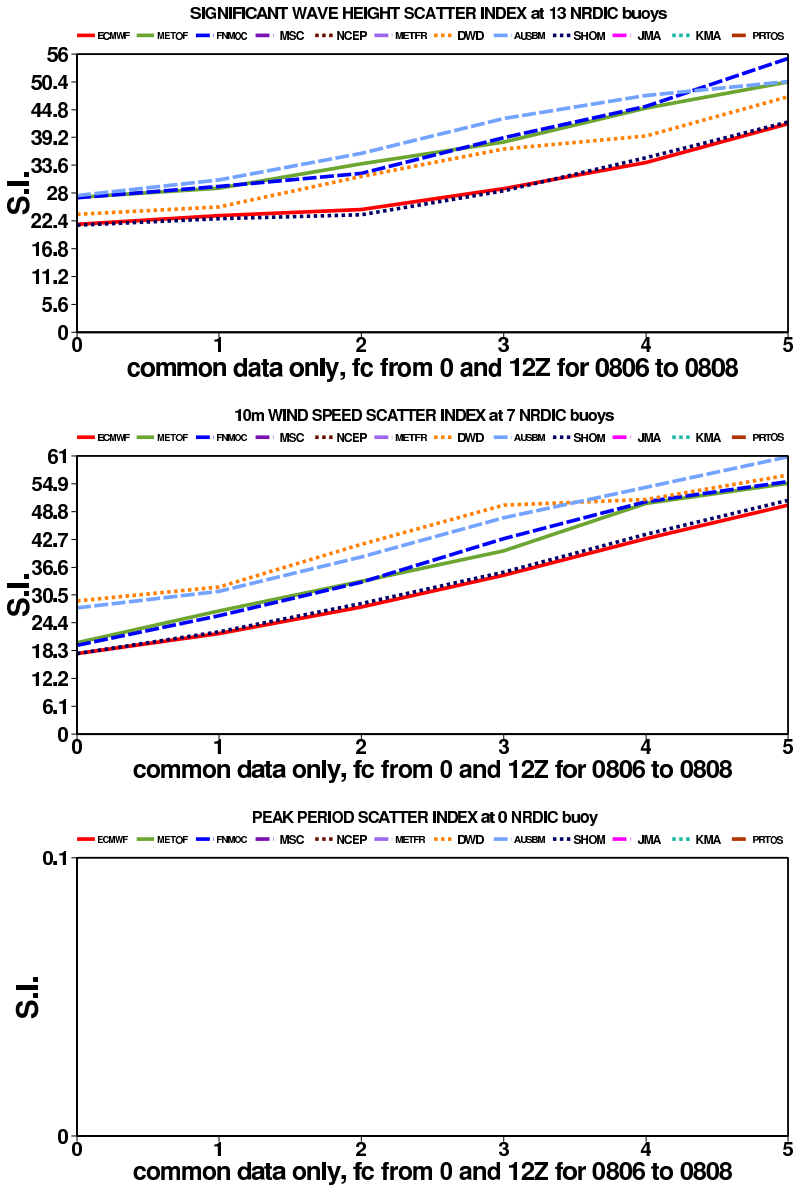
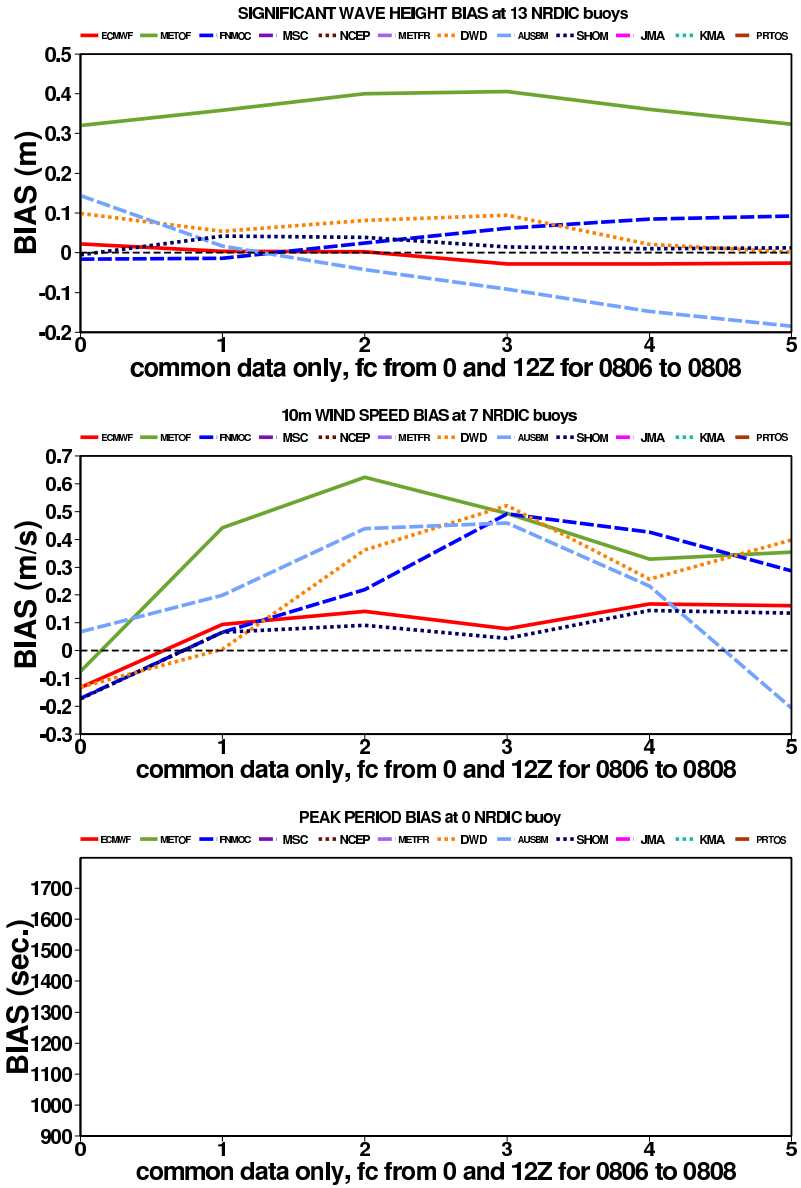


Figure 43: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.

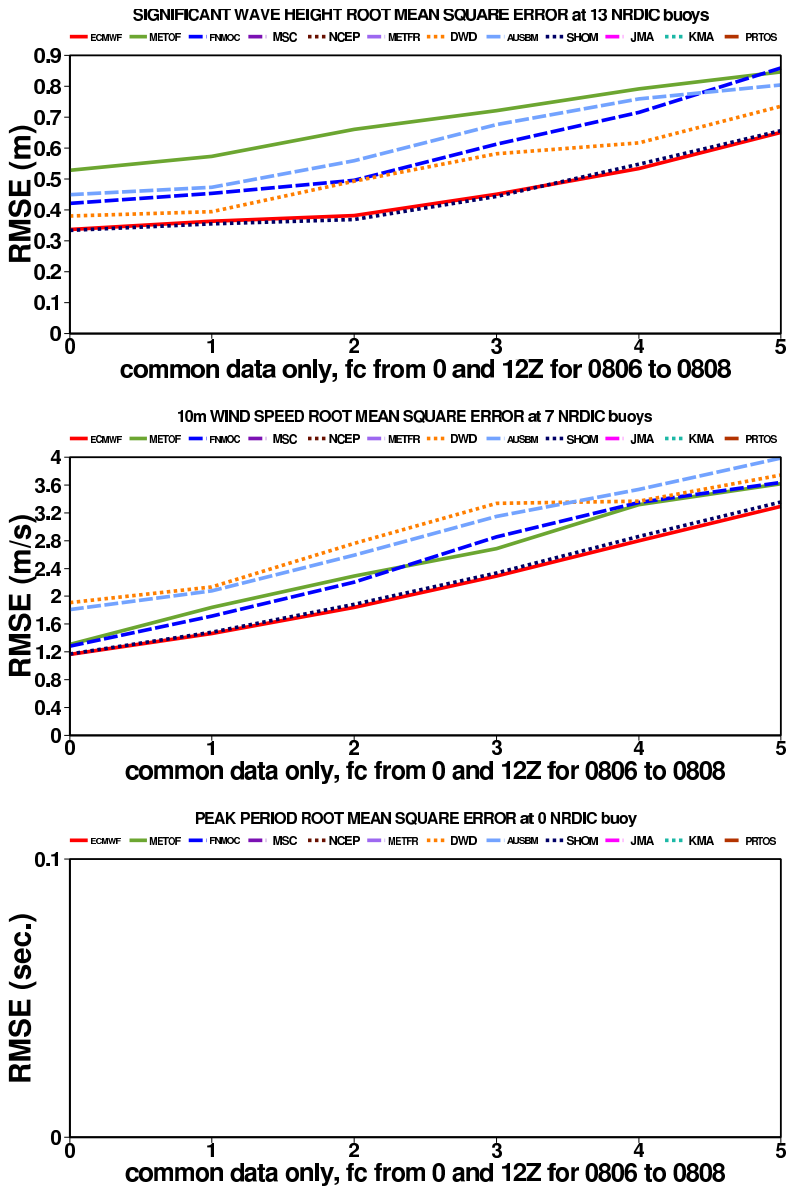


(a) Scatter Index (%)

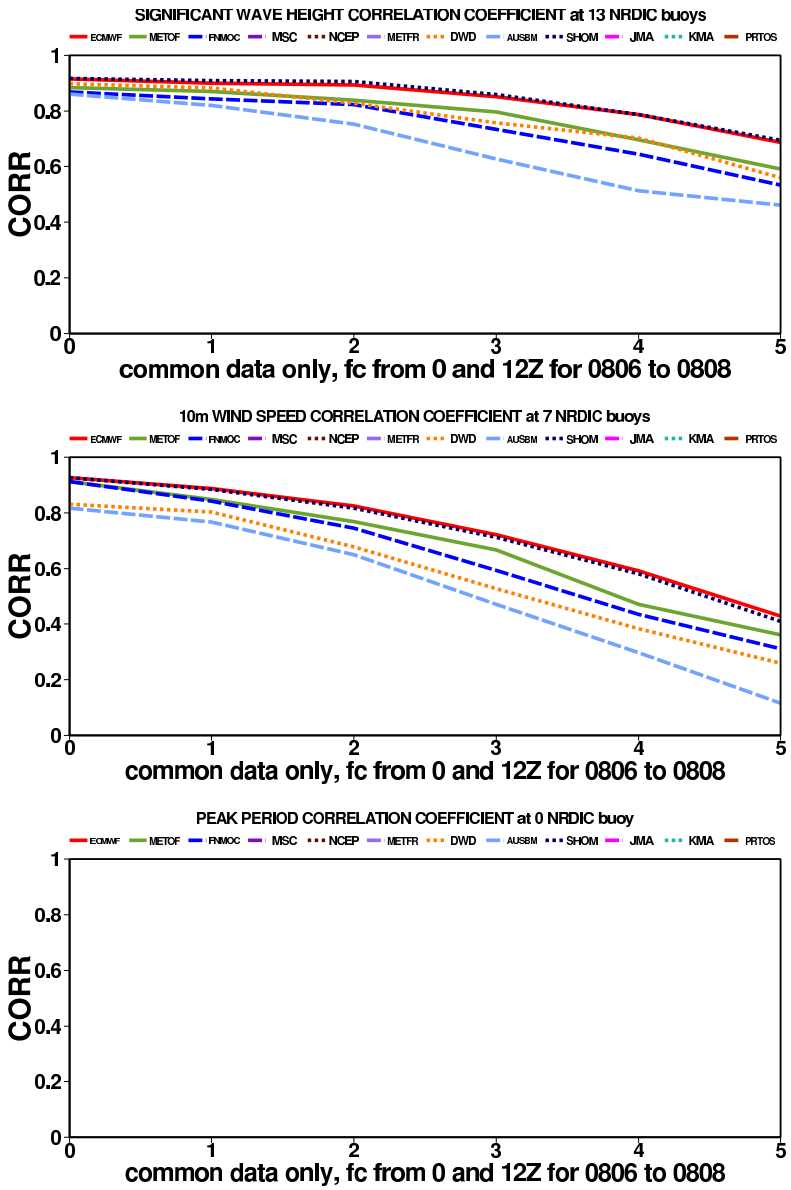


(b) Bias (model-buoy)

Figure 44: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common Icelandic buoys and Norwegian platforms .



(a) R.M.S.E.



(b) Correlation Coefficient

Figure 45: Forecast root mean square error (RMSE) and linear correlation coefficient at common Icelandic buoys and Norwegian platforms .

0.3.12 Comparison for South African platform

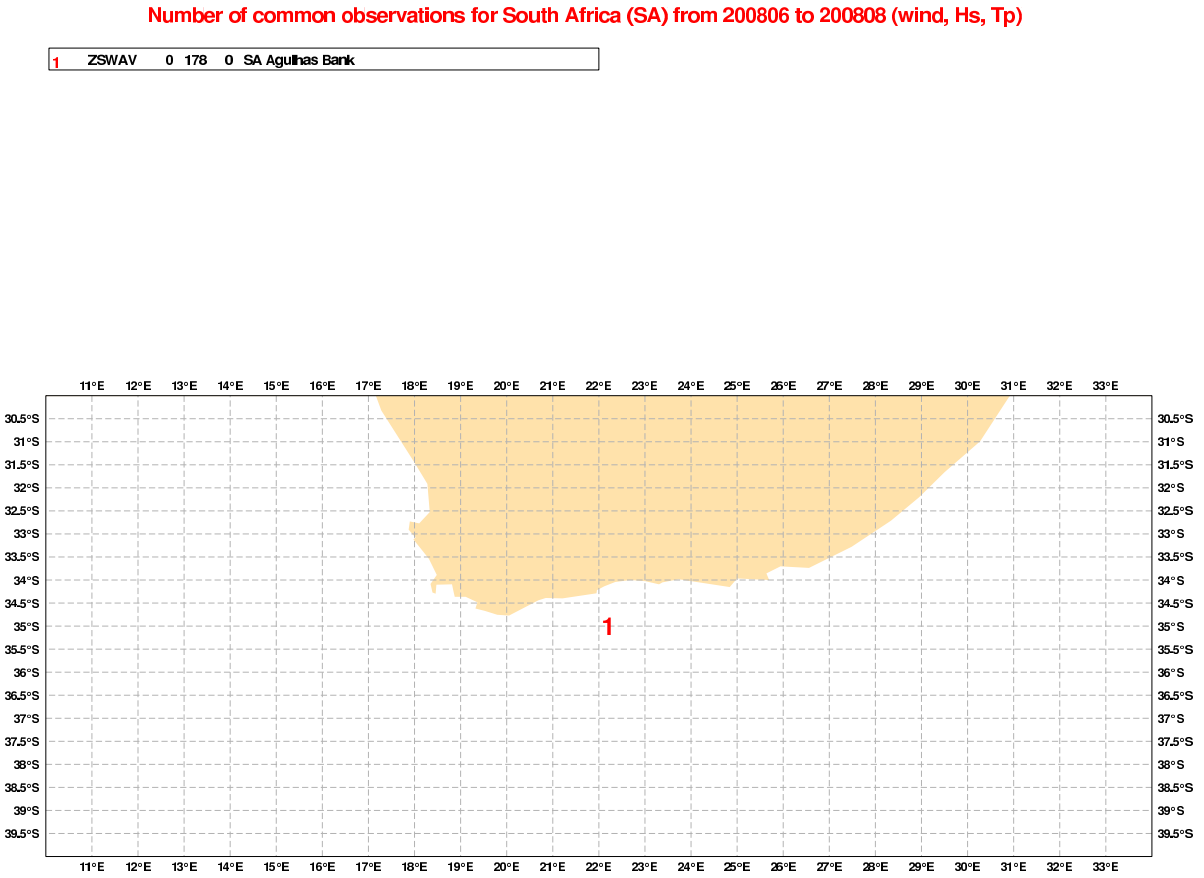
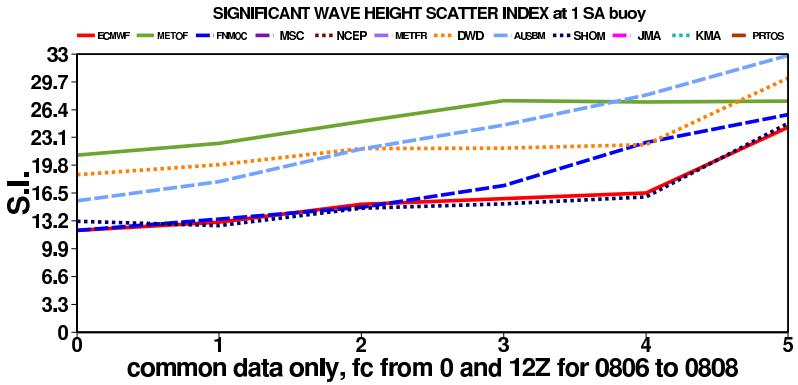
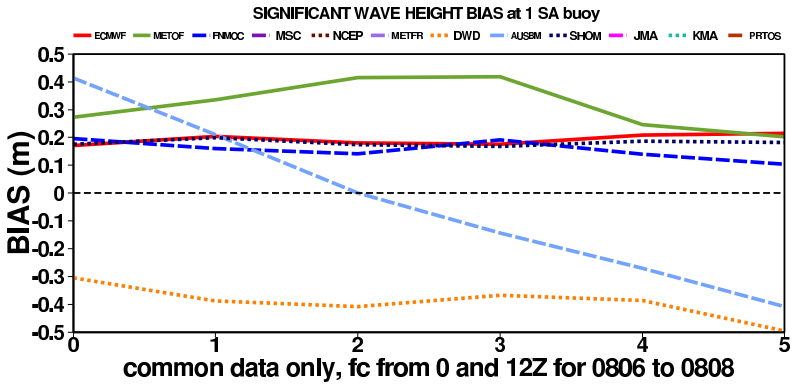
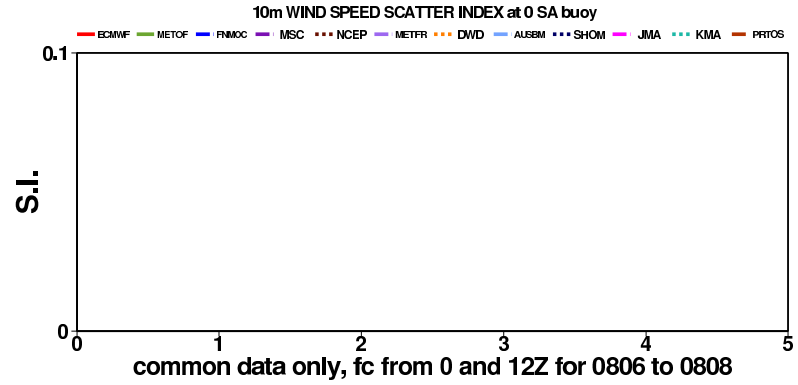
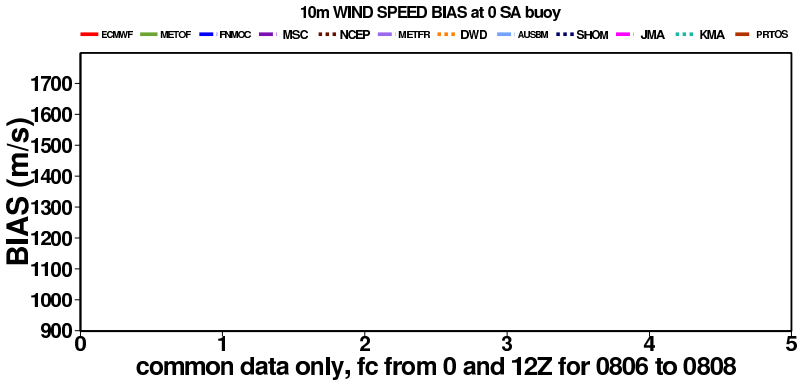


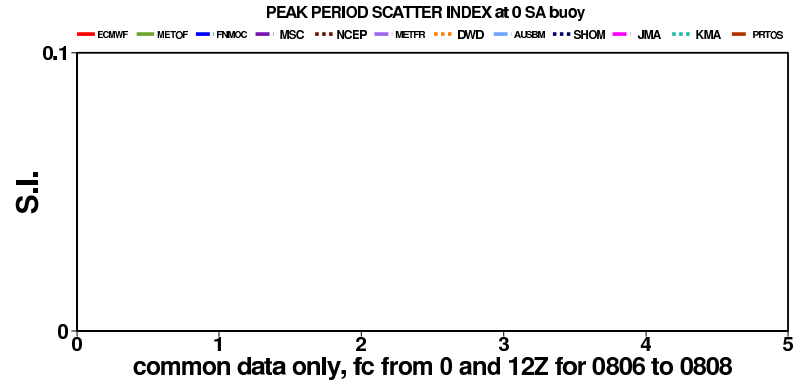
Figure 46: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.

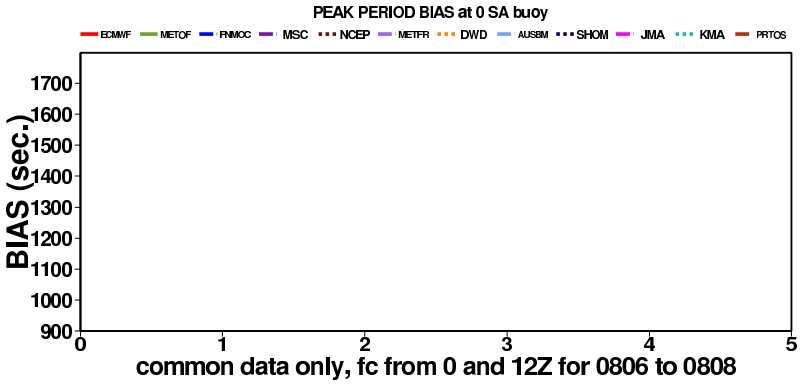








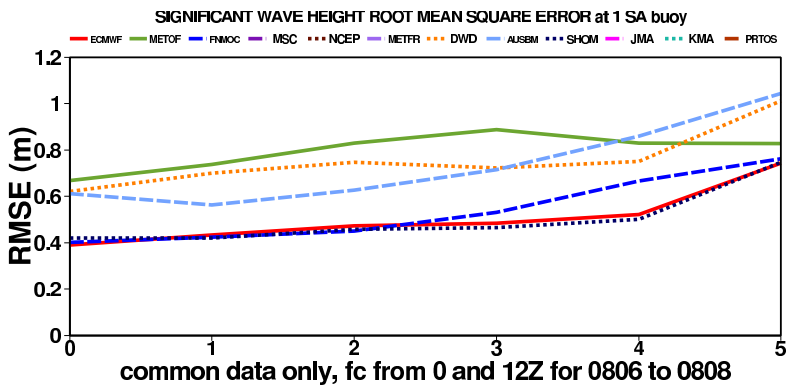


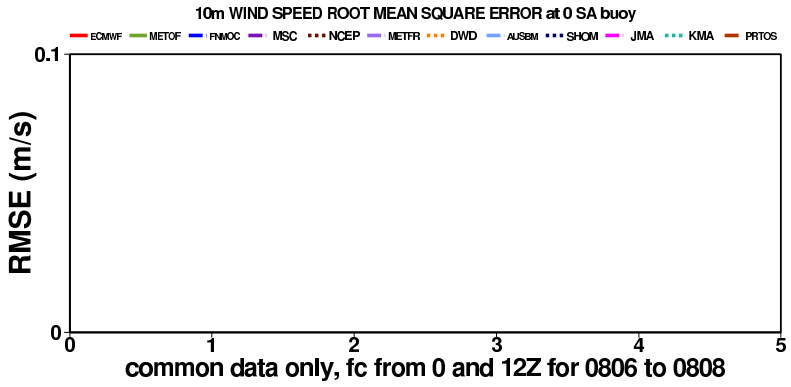


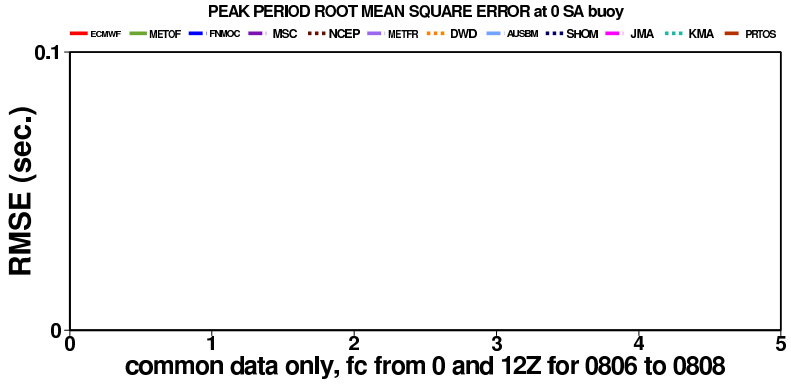
(a) Scatter Index (%)

(b) Bias (model-buoy)

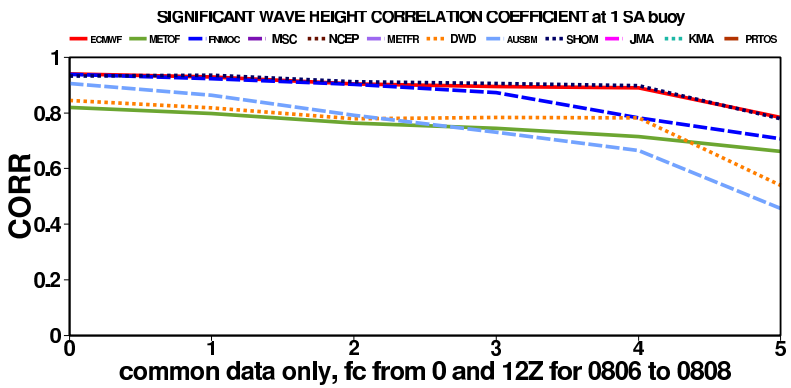
Figure 47: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common South African platform.

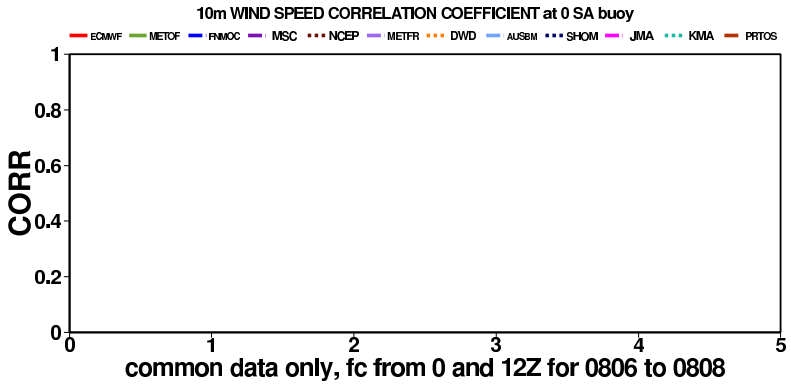


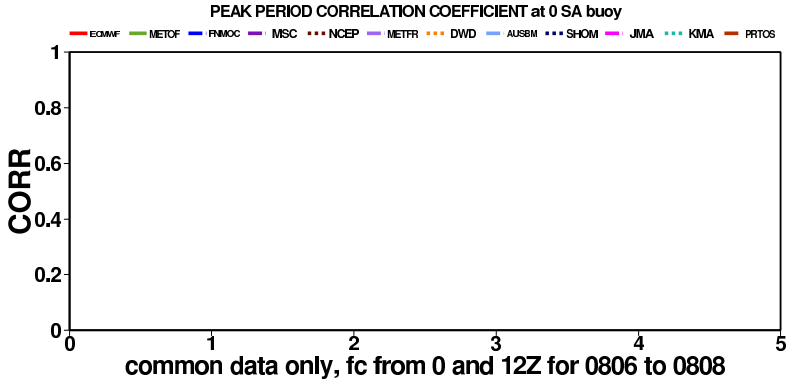




(a) R.M.S.E.







(b) Correlation Coefficient

Figure 48: Forecast root mean square error (RMSE) and linear correlation coefficient at common South African platform.

0.3.13 Comparison for Indian buoys

Number of common observations for India (INDIA) from 200806 to 200808 (wind, Hs, Tp)

1	23092	73	74	0	Arabian Sea	4	23101	22	17	0	Bay of Bengal
2	23097	4	4	0	Arabian Sea	5	23170	26	0	0	Arabian Sea
3	23098	13	0	0	Arabian Sea						

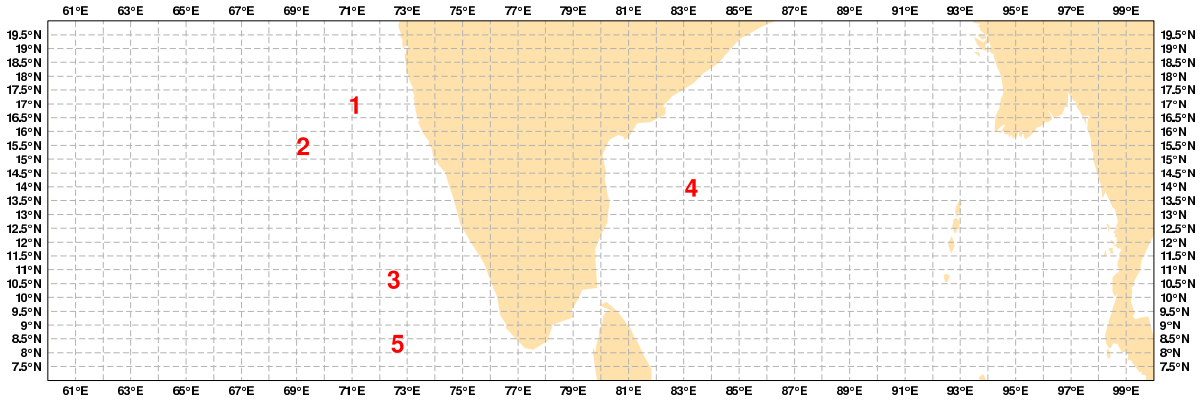
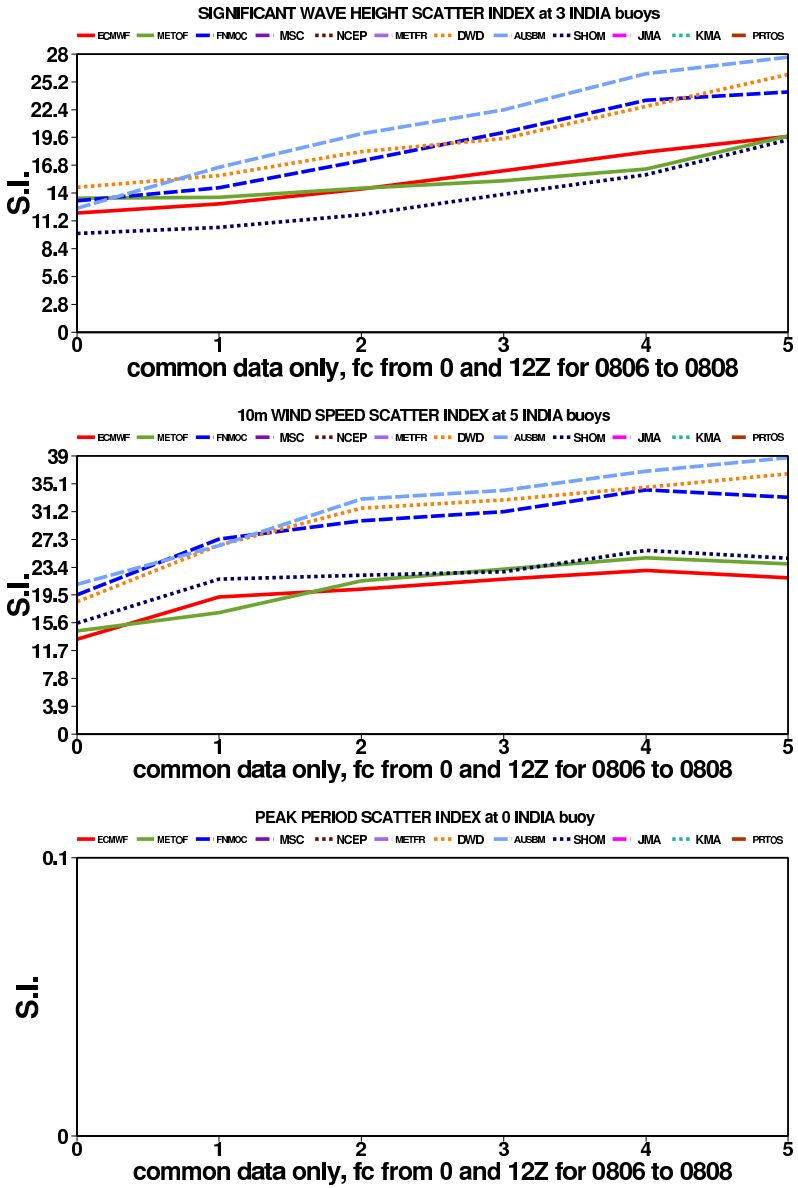
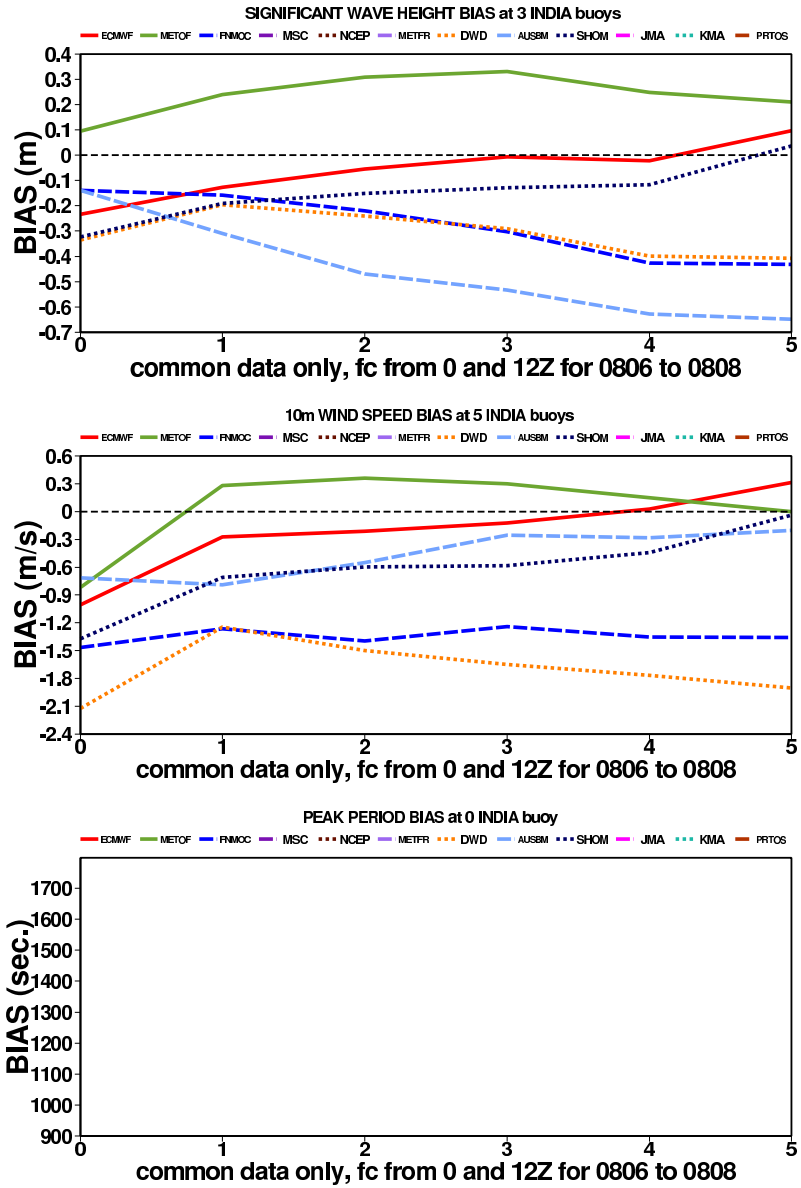


Figure 49: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.

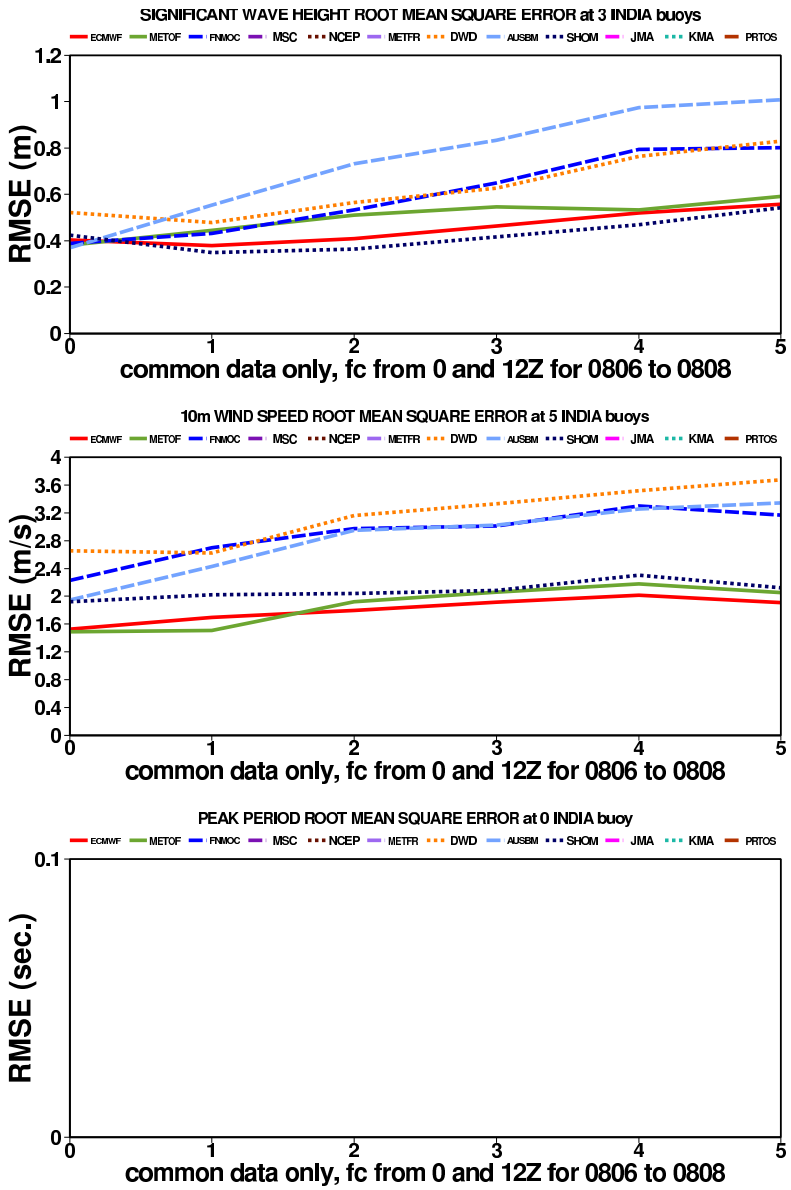


(a) Scatter Index (%)

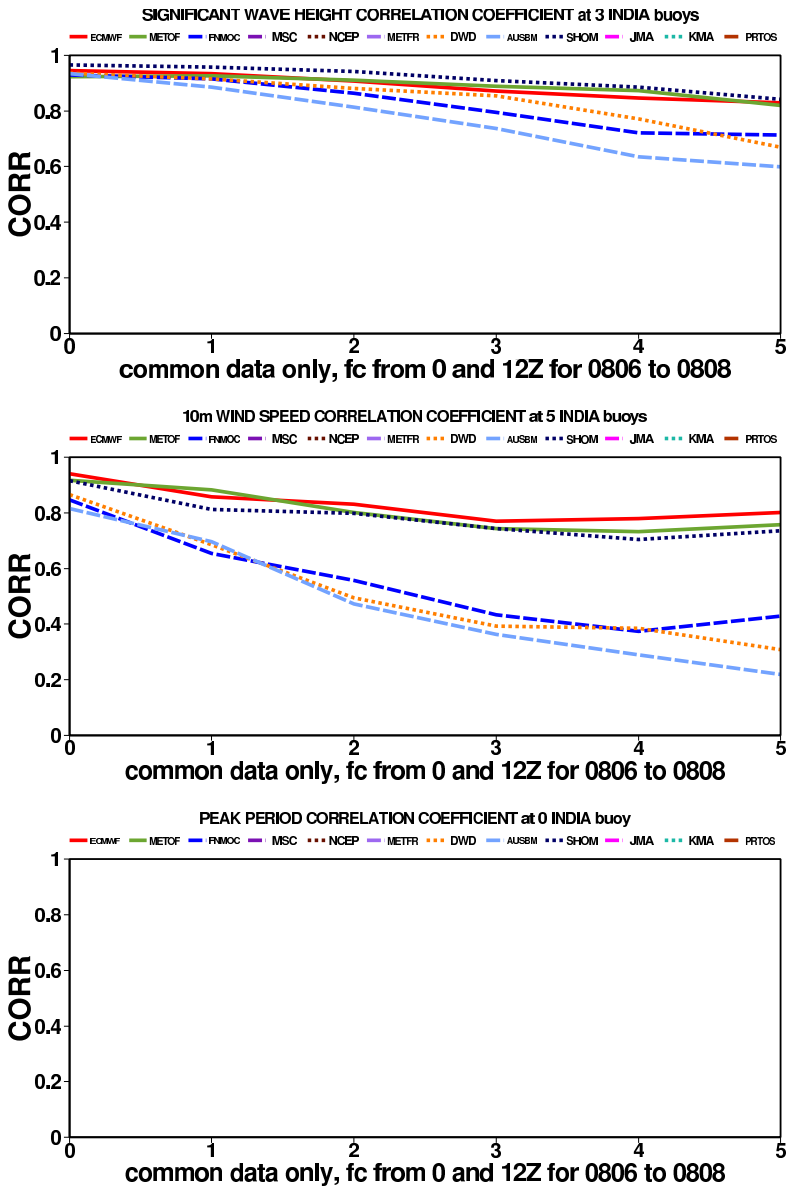


(b) Bias (model-buoy)

Figure 50: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common Indian buoys.



(a) R.M.S.E.



(b) Correlation Coefficient

Figure 51: Forecast root mean square error (RMSE) and linear correlation coefficient at common Indian buoys.

0.3.14 Comparison for Australian South East Coast buoys

Number of common observations for Australian South East Coast (ASEC) from 200806 to 200808 (wind, Hs, Tp)

1	55014	0	150	150	Bateman's Bay	4	55022	0	120	120	Port Kembla
2	55018	0	172	172	Coffs Harbour	5	55024	0	178	178	Sydney
3	55019	0	170	170	Crowdy Head	6	55039	0	182	179	Kingfish B

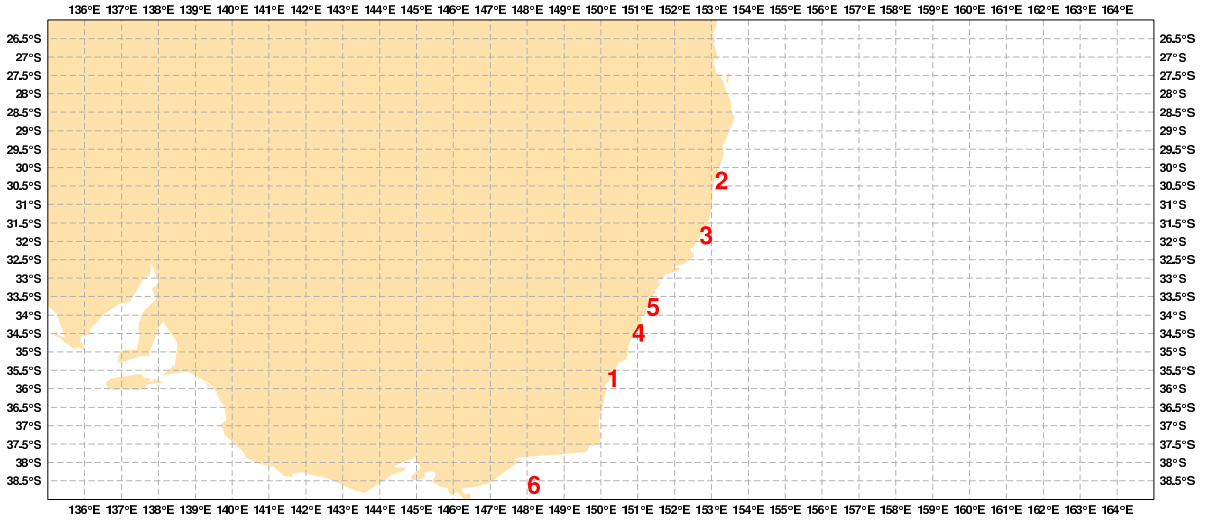
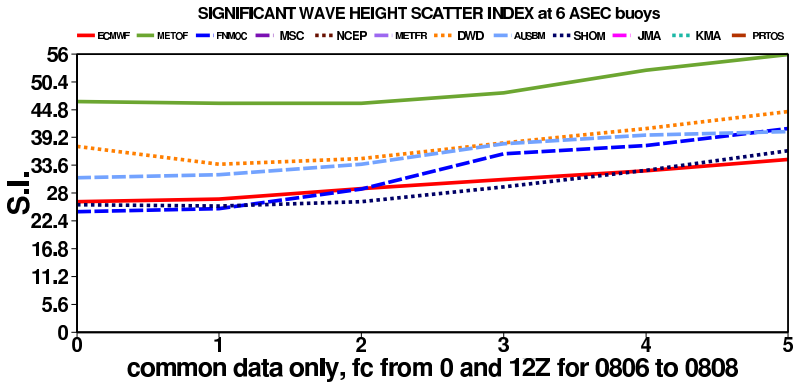
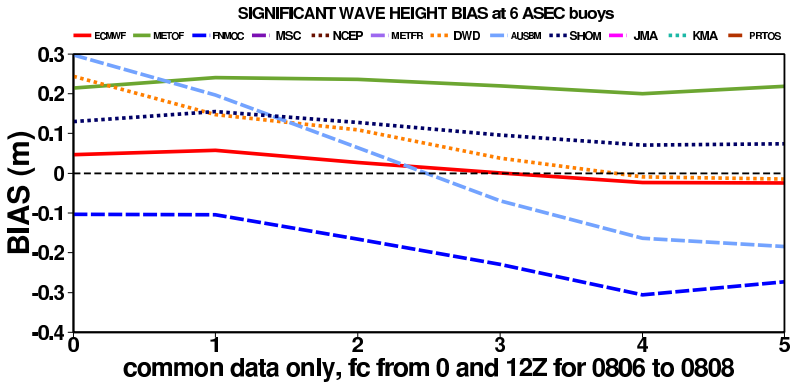
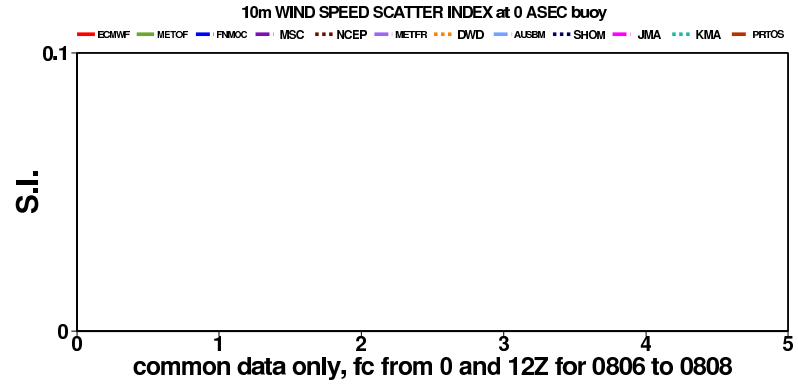
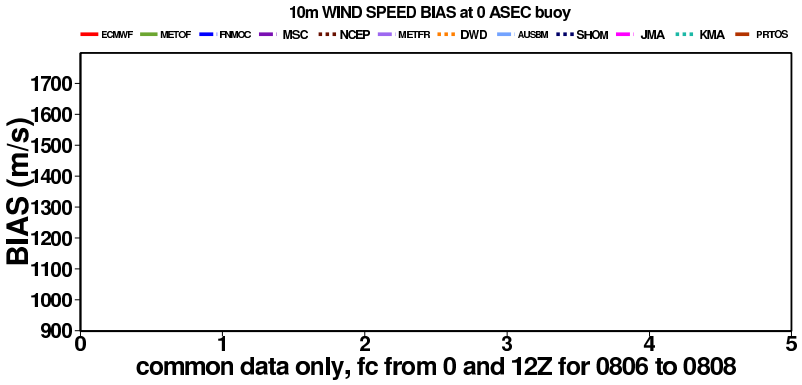


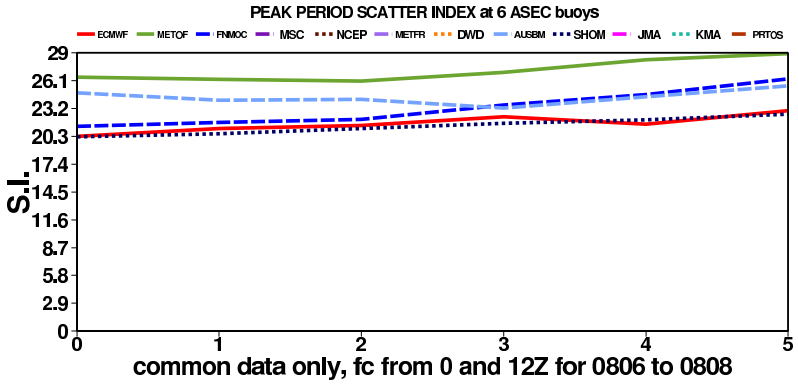
Figure 52: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.



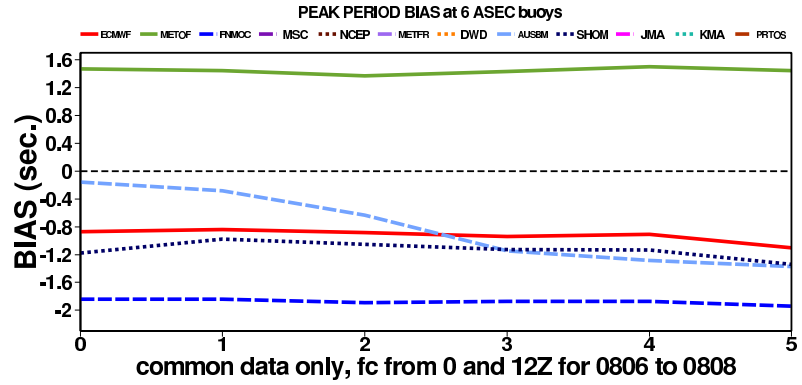






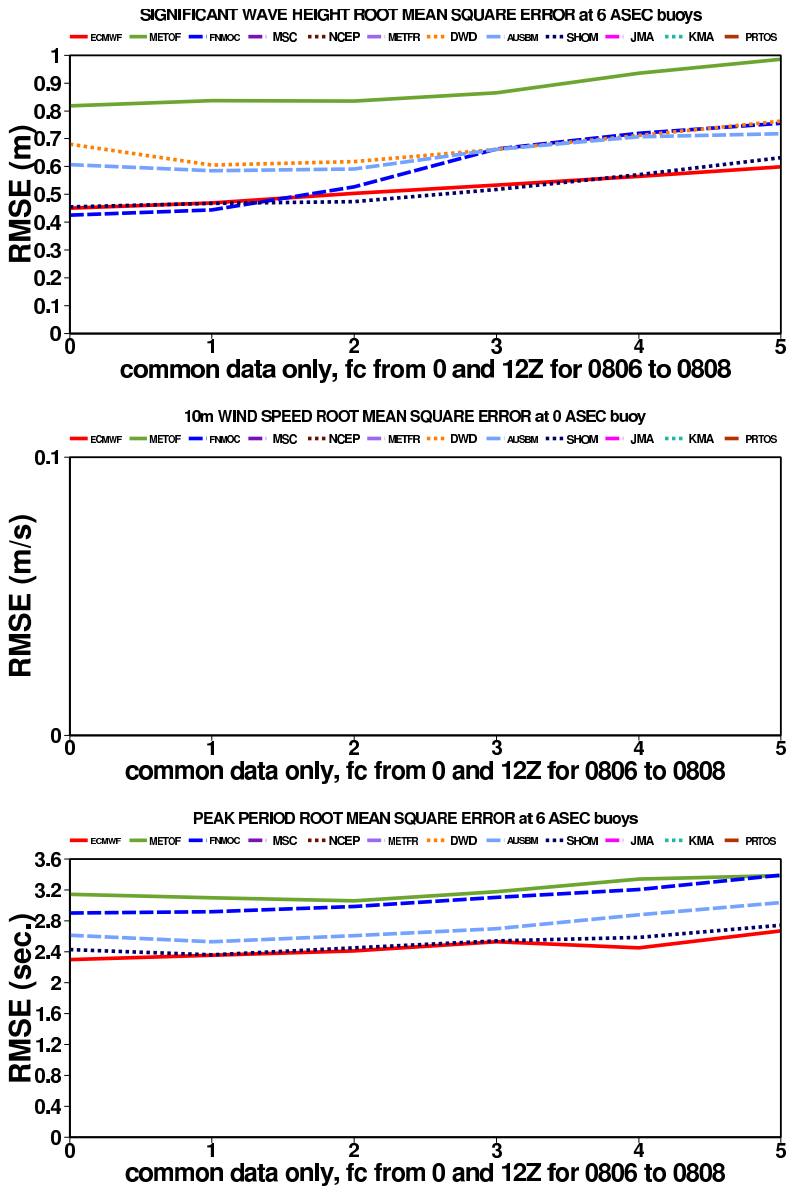


(a) Scatter Index (%)

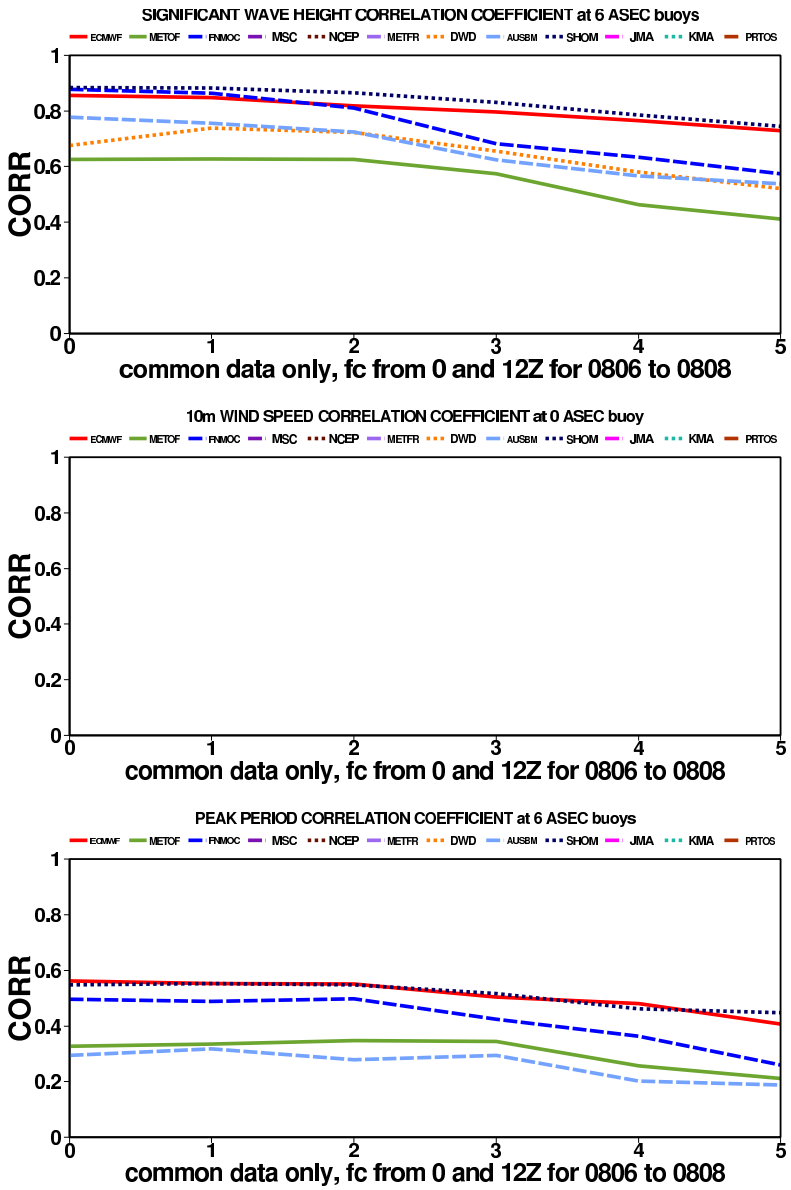


(b) Bias (model-buoy)

Figure 53: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common Australian South East Coast buoys.



(a) R.M.S.E.



(b) Correlation Coefficient

Figure 54: Forecast root mean square error (RMSE) and linear correlation coefficient at common Australian South East Coast buoys.

0.3.15 Comparison for Australian Great Barrier Reef buoys

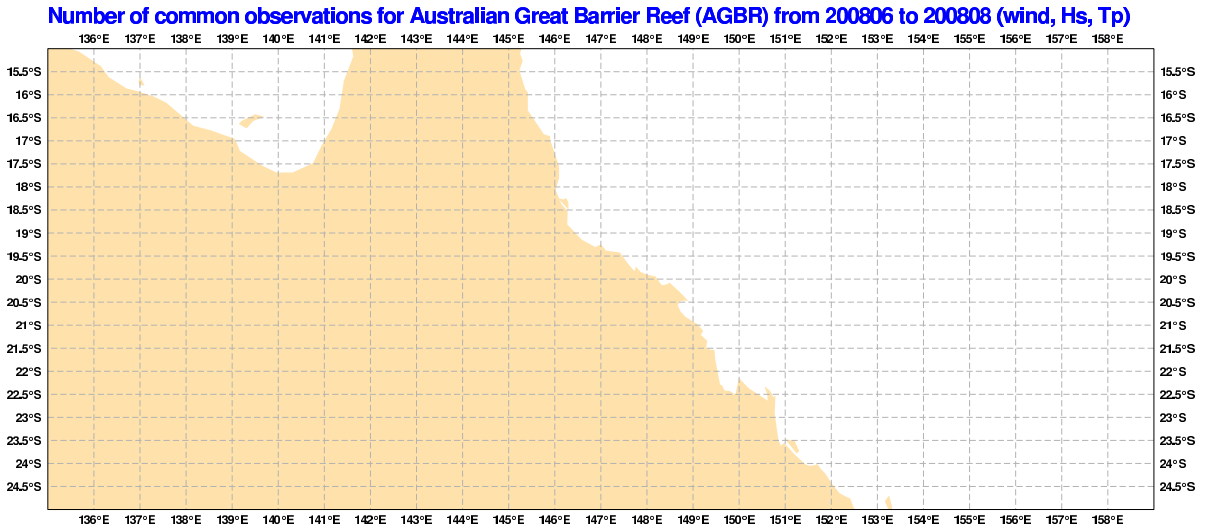
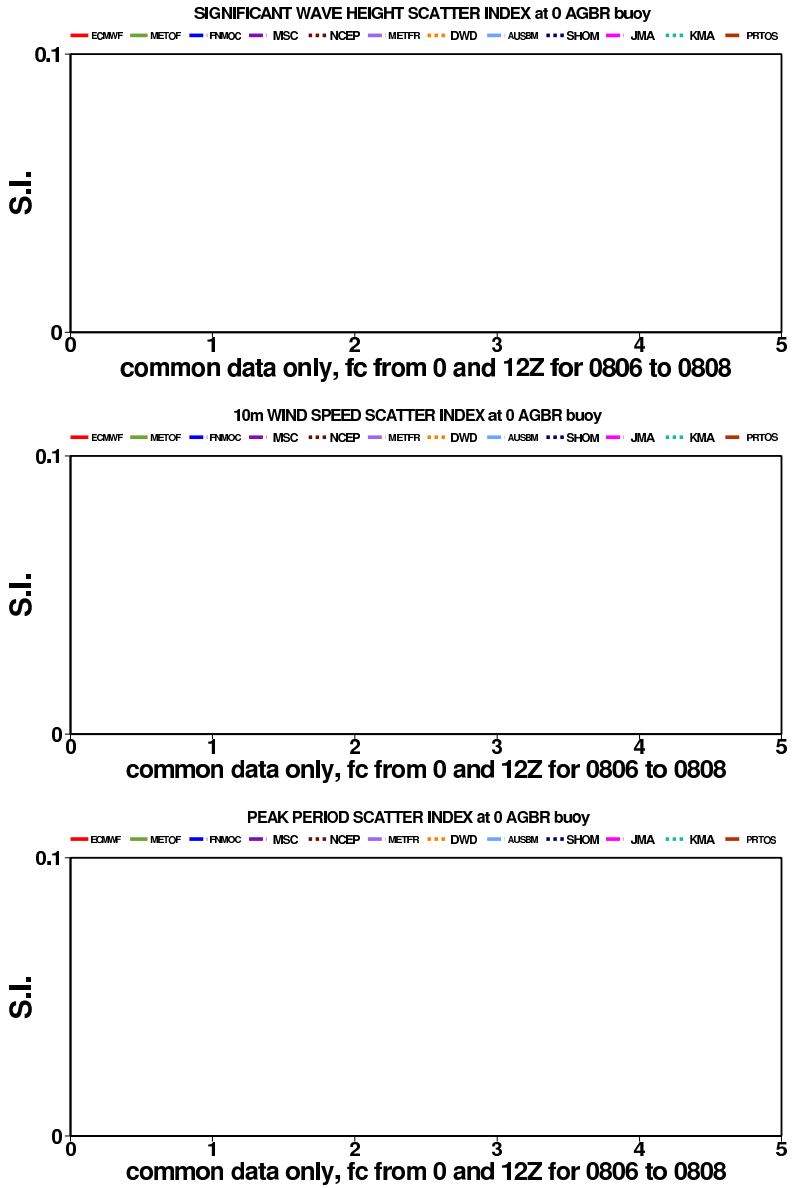
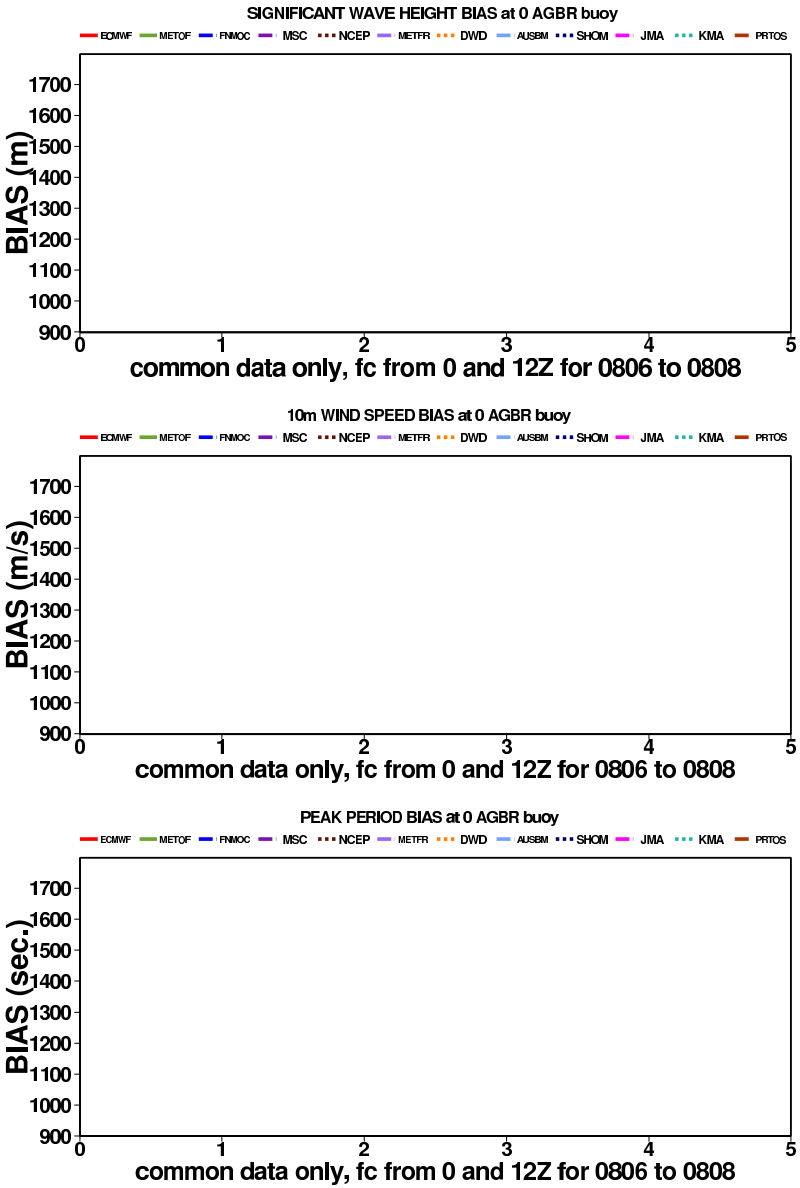


Figure 55: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.

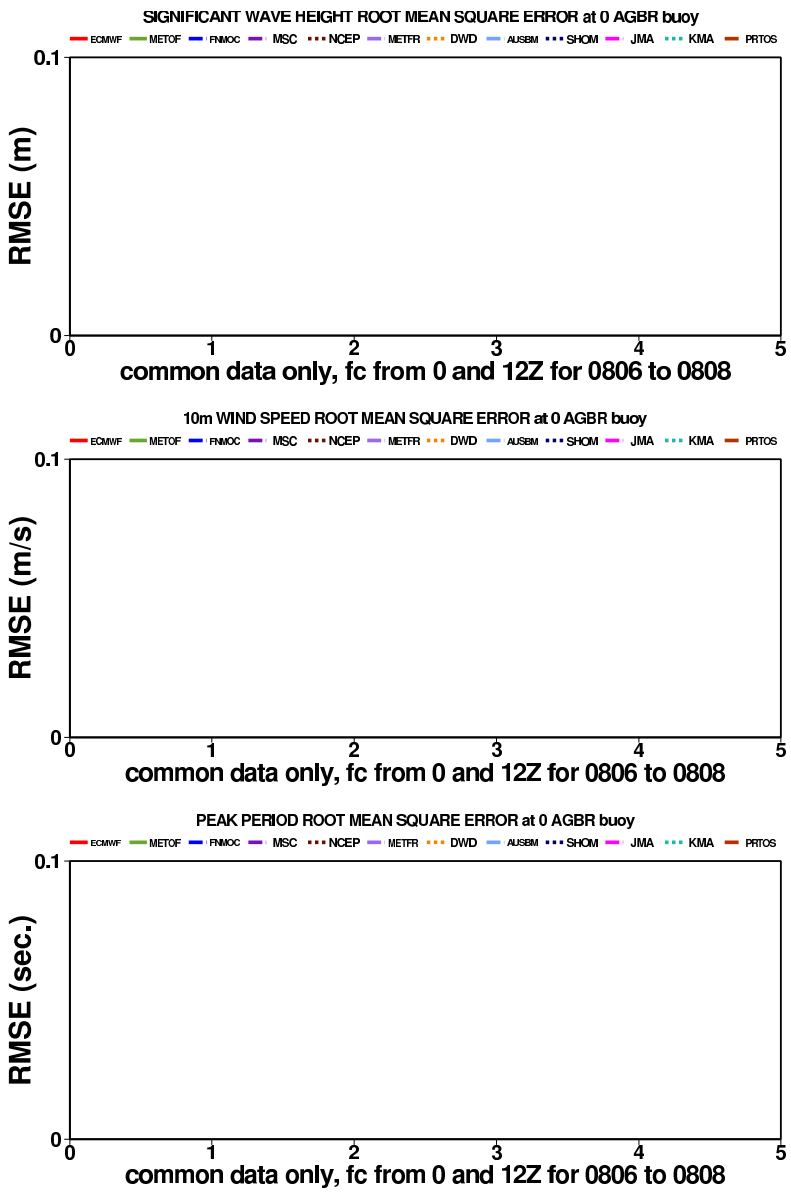


(a) Scatter Index (%)

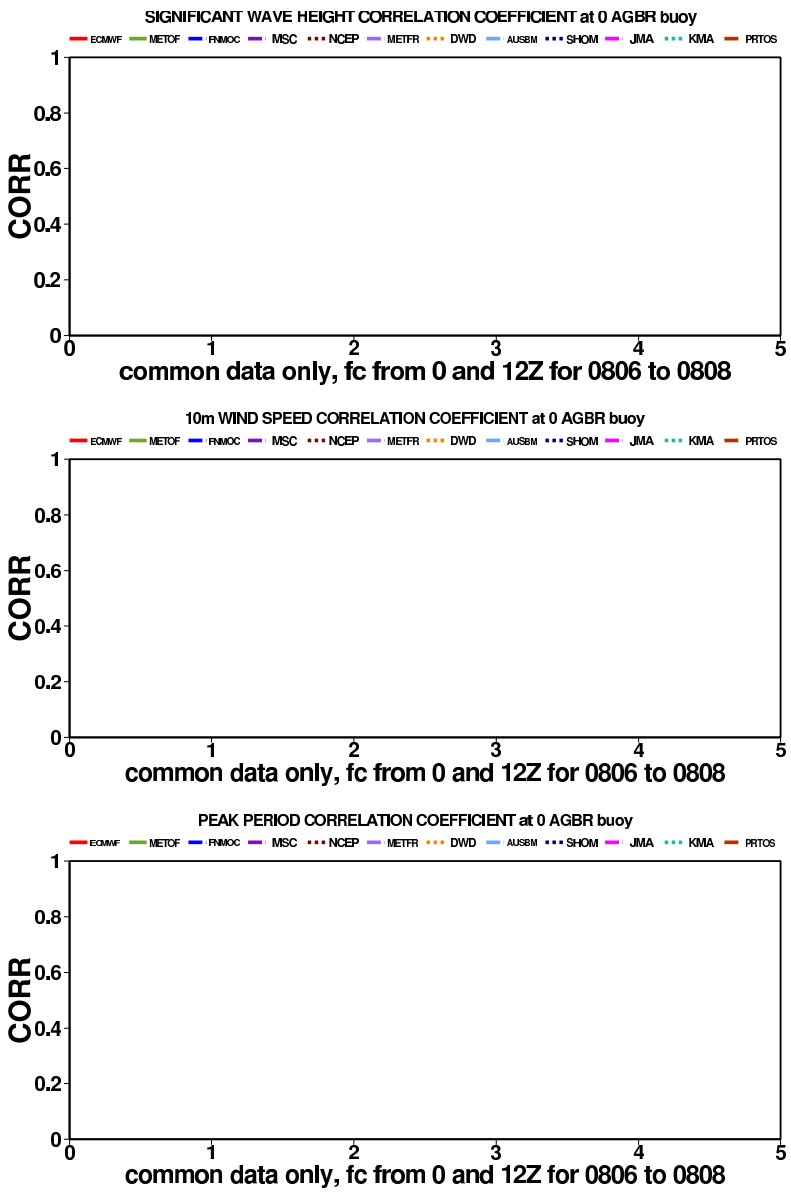


(b) Bias (model-buoy)

Figure 56: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common Australian Great Barrier Reef buoys.



(a) R.M.S.E.



(b) Correlation Coefficient

Figure 57: Forecast root mean square error (RMSE) and linear correlation coefficient at common Australian Great Barrier Reef buoys.

0.3.16 Comparison for Australian South West facing Coast buoys

Number of common observations for Australian South West facing Coast (ASWC) from 200806 to 200808 (wind, Hs, Tp)

1	55026	0	182	182	Strahan	3	56004	0	177	177	Jurien
2	55040	0	182	182	Cape Du Couedic	4	56005	0	175	175	Rottnest Island

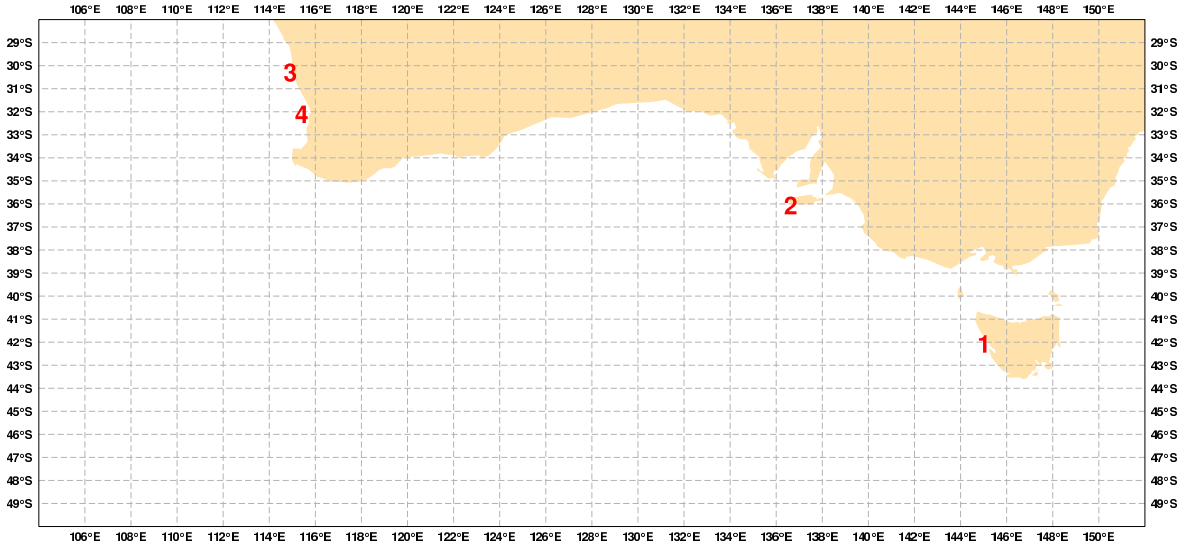
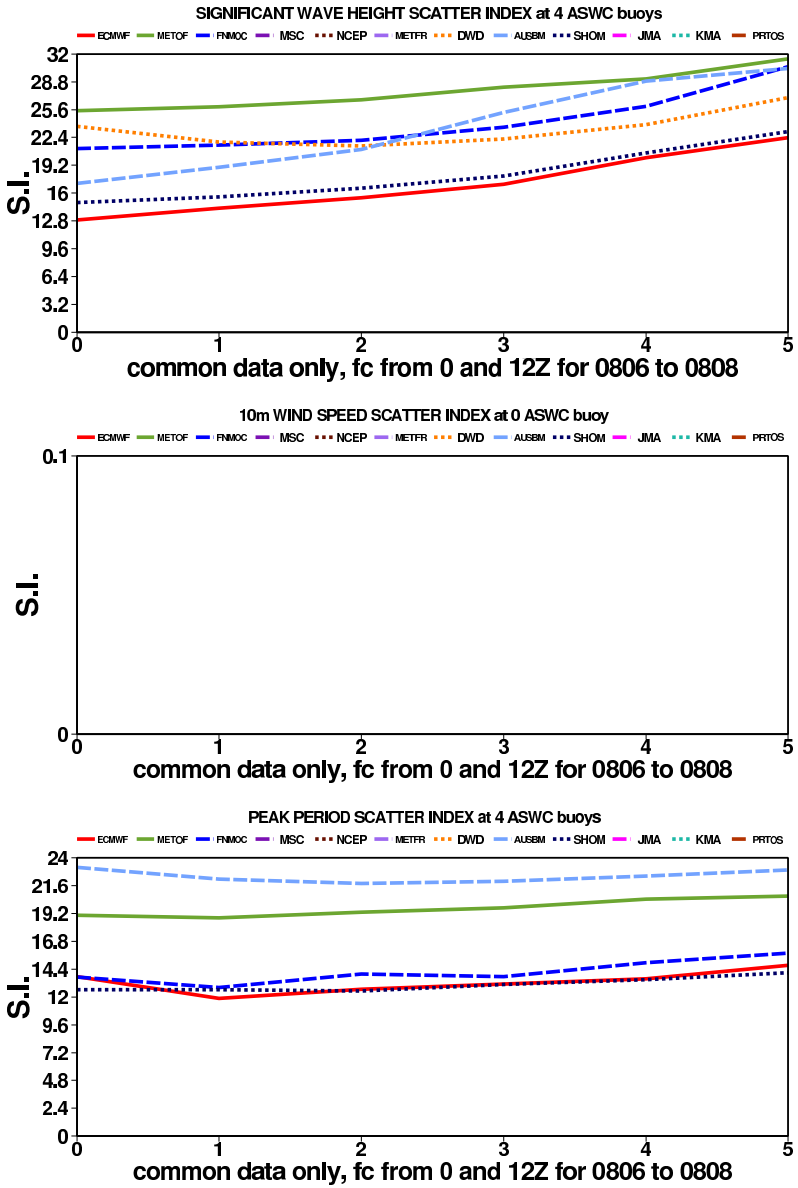
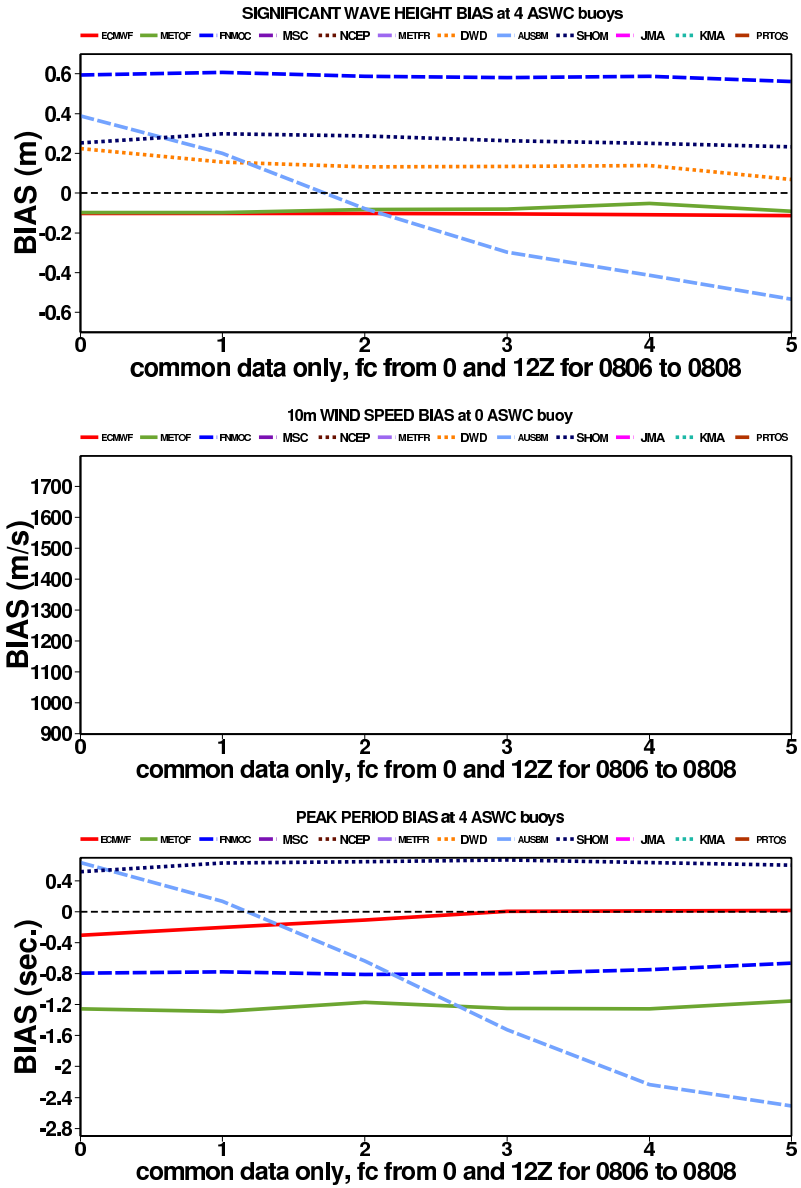


Figure 58: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.

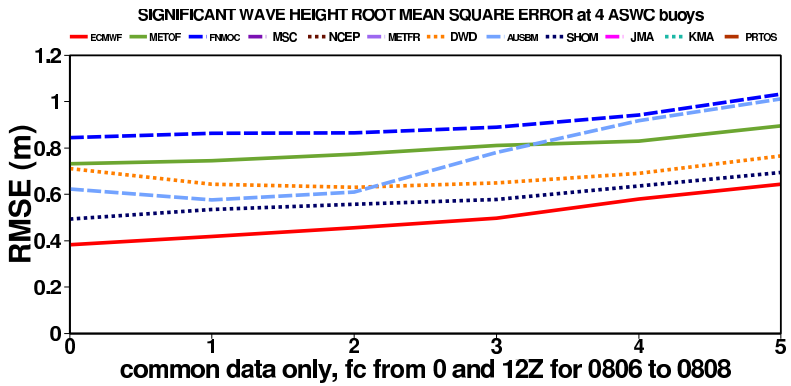


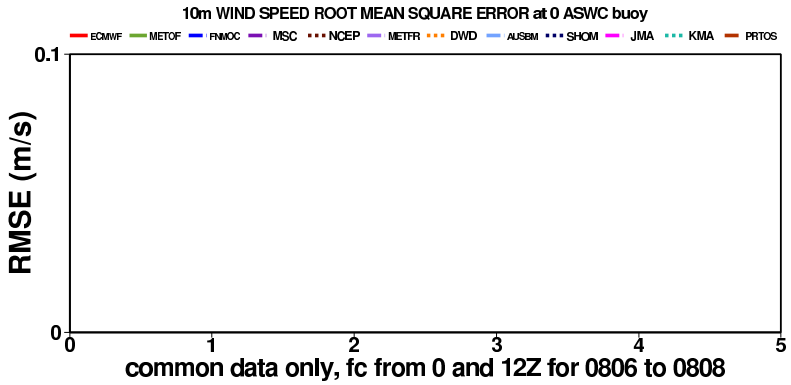
(a) Scatter Index (%)

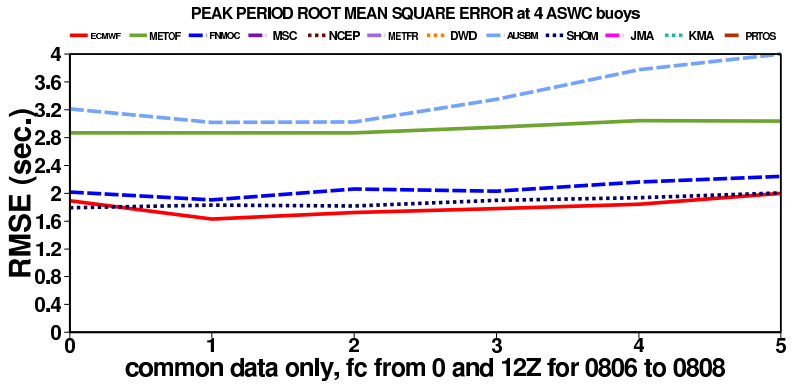


(b) Bias (model-buoy)

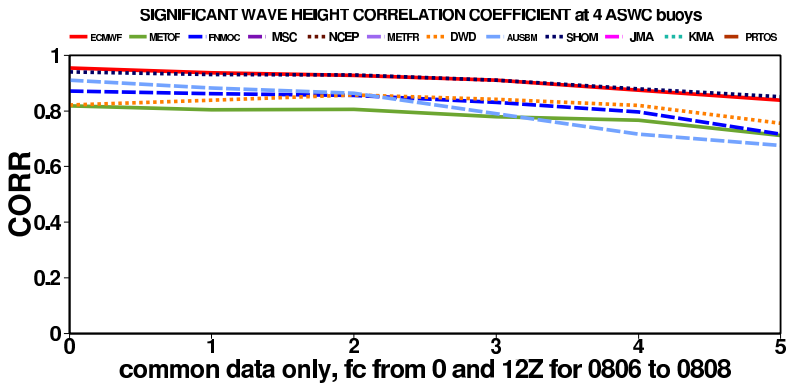
Figure 59: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common Australian South West facing Coast buoys.

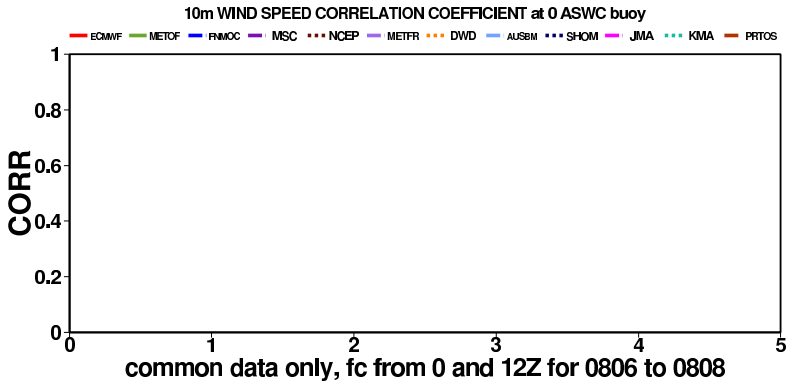


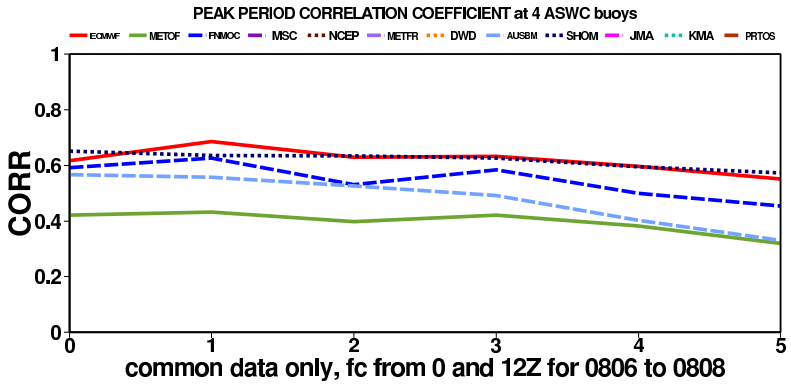




(a) R.M.S.E.







(b) Correlation Coefficient

Figure 60: Forecast root mean square error (RMSE) and linear correlation coefficient at common Australian South West facing Coast buoys.

0.3.17 Comparison for Australian North West Coast buoys

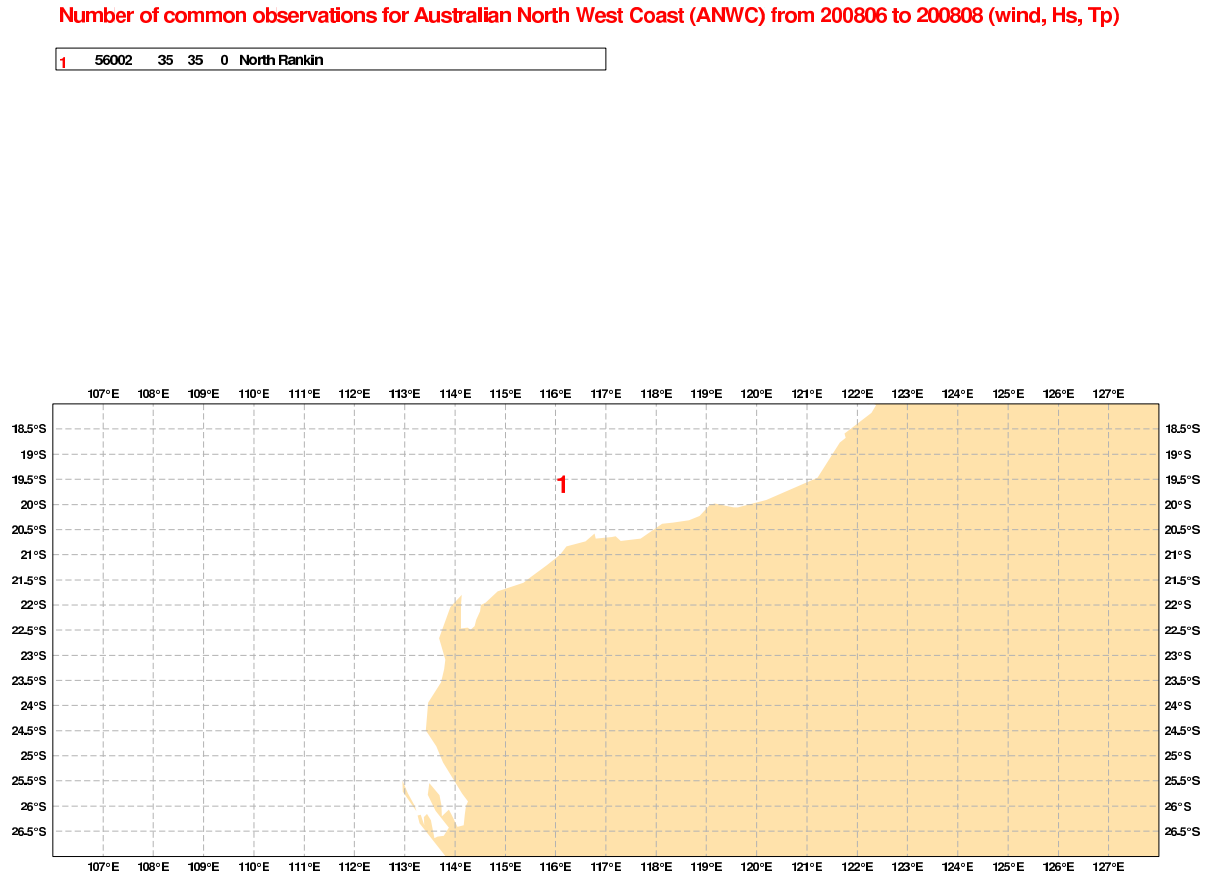
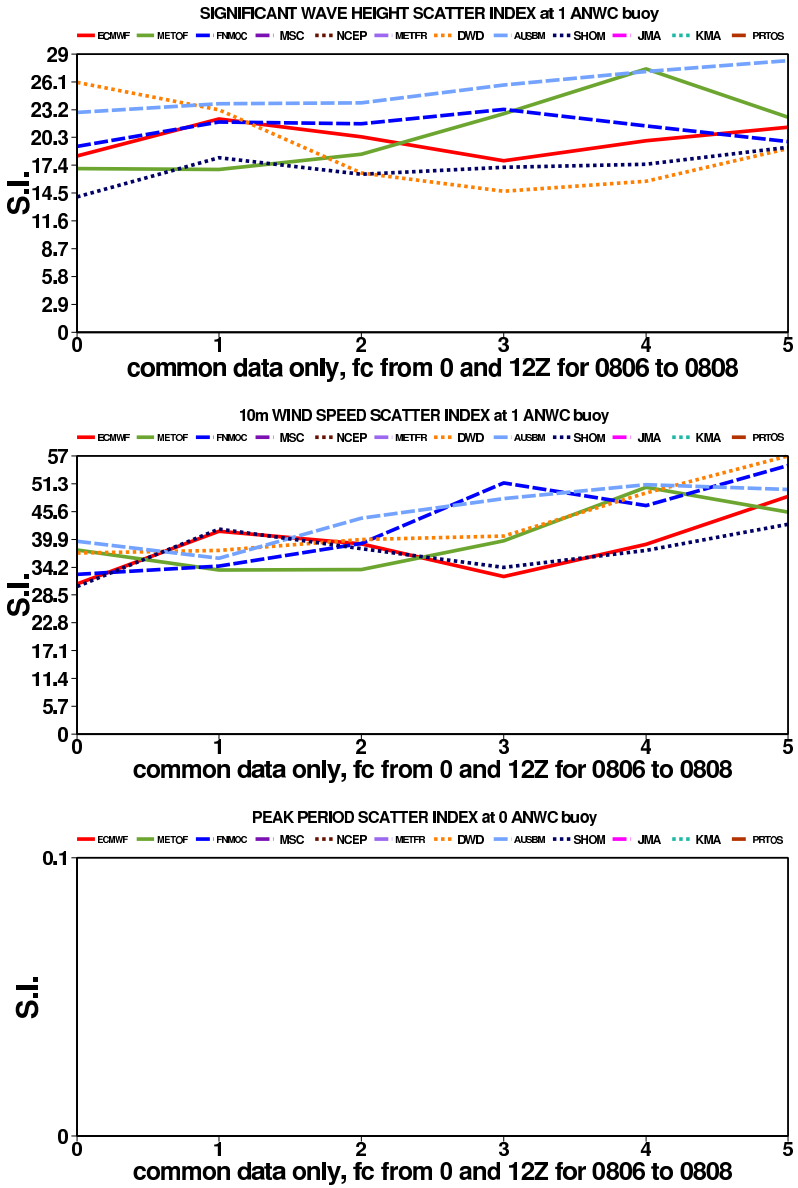
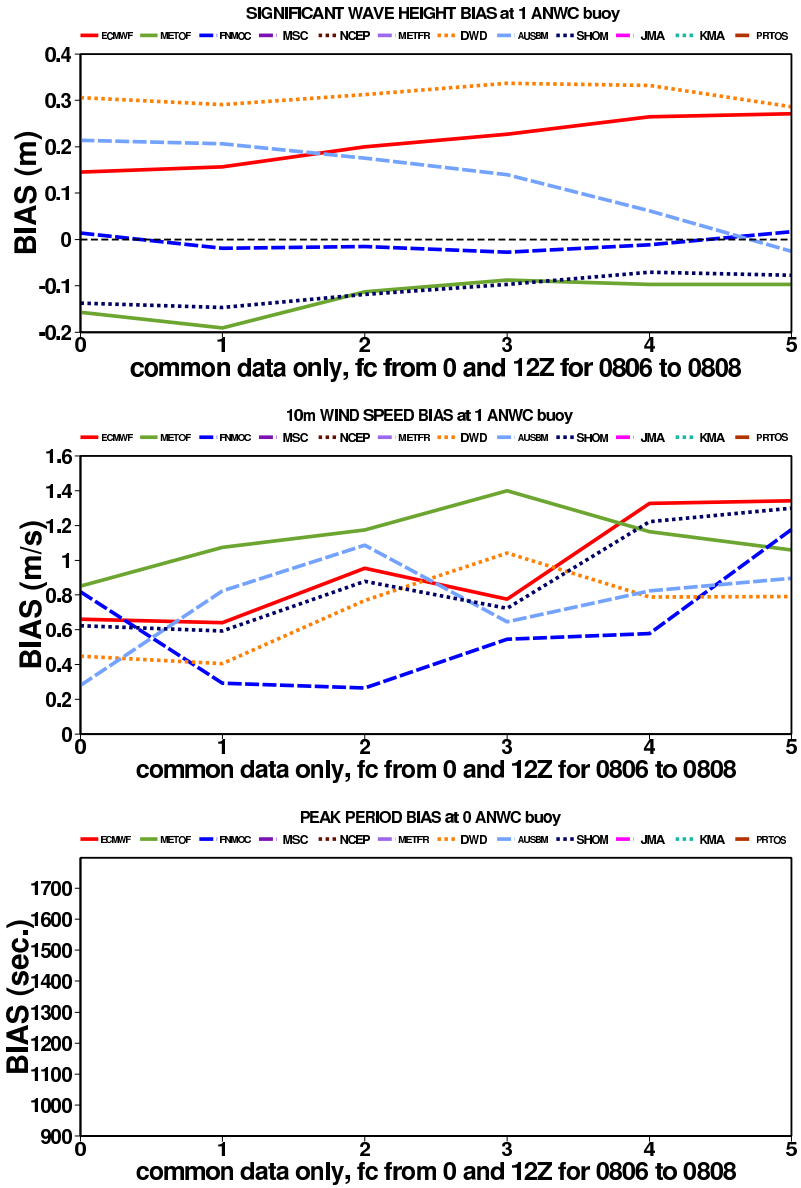


Figure 61: Buoy locations. The numbers in the table following each buoy identifier are the number of collocations between models and buoy wind speed, wave height and peak period.

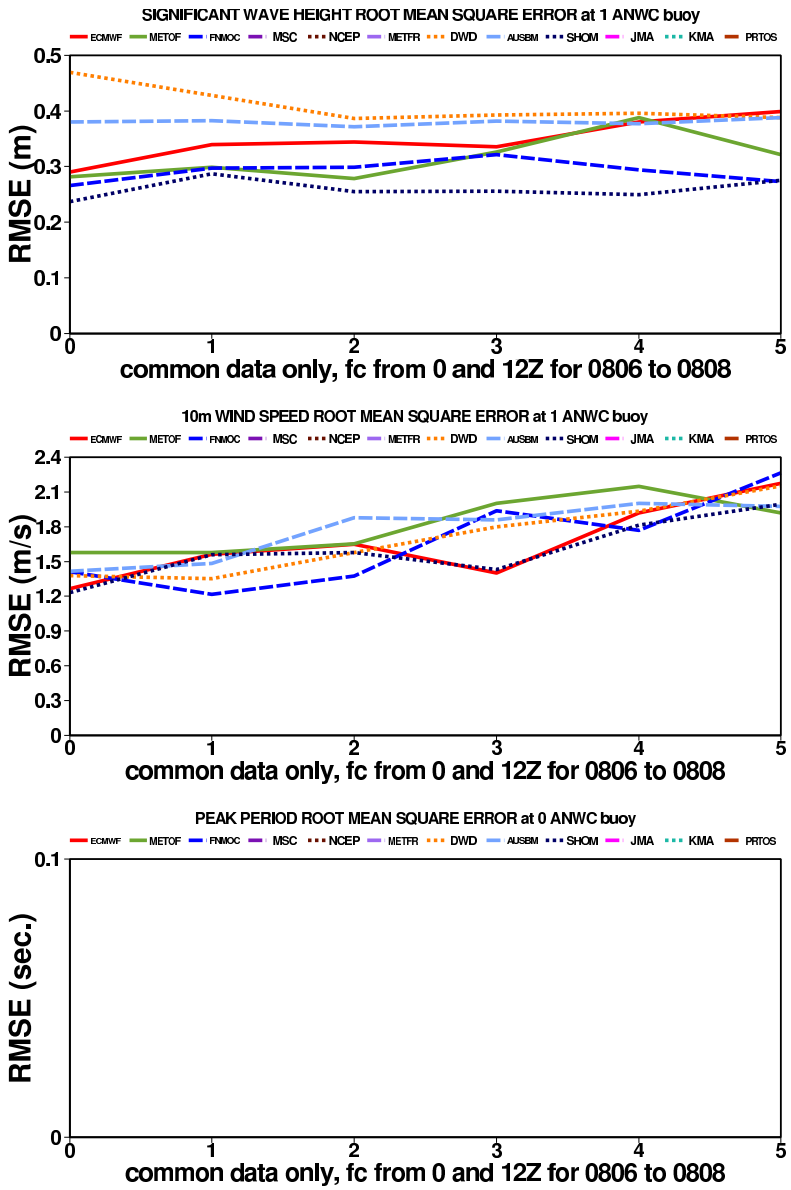


(a) Scatter Index (%)

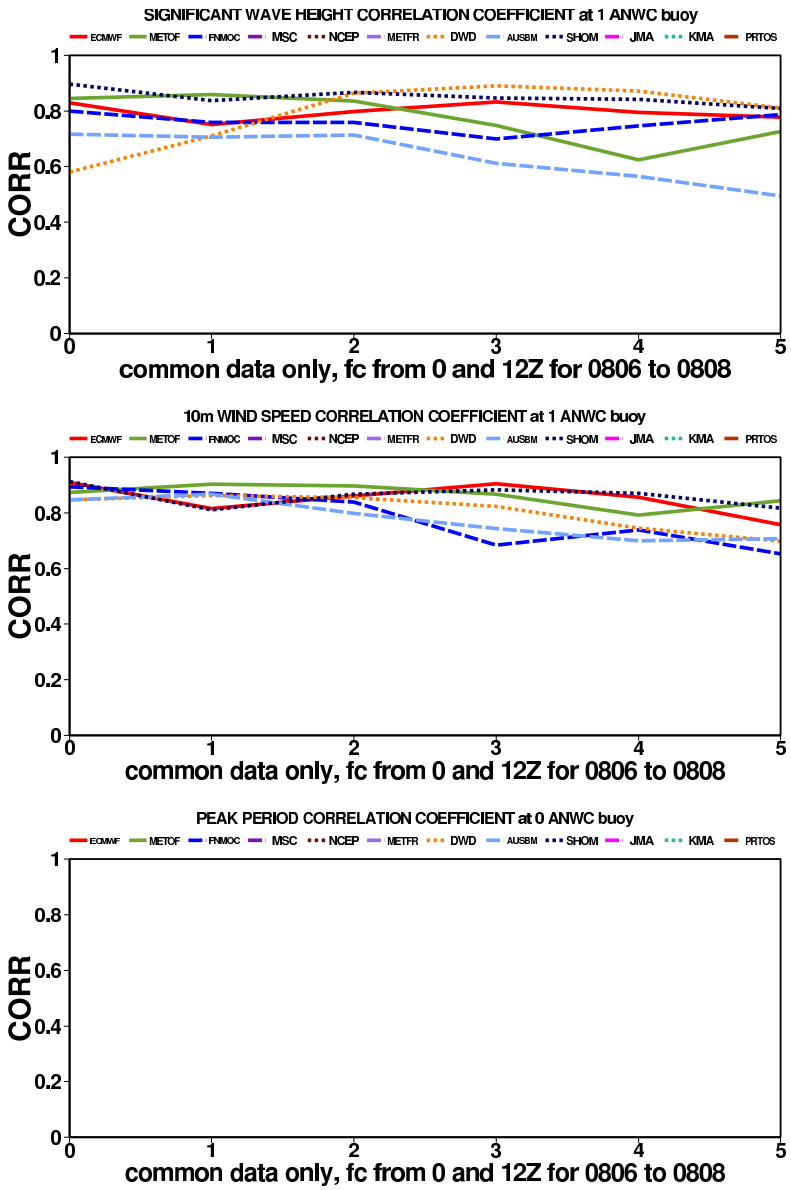


(b) Bias (model-buoy)

Figure 62: Forecast scatter index (standard deviation of the difference normalised by the mean of the observations) and bias (model-buoy) at common Australian North West Coast buoys.



(a) R.M.S.E.



(b) Correlation Coefficient

Figure 63: Forecast root mean square error (RMSE) and linear correlation coefficient at common Australian North West Coast buoys.