

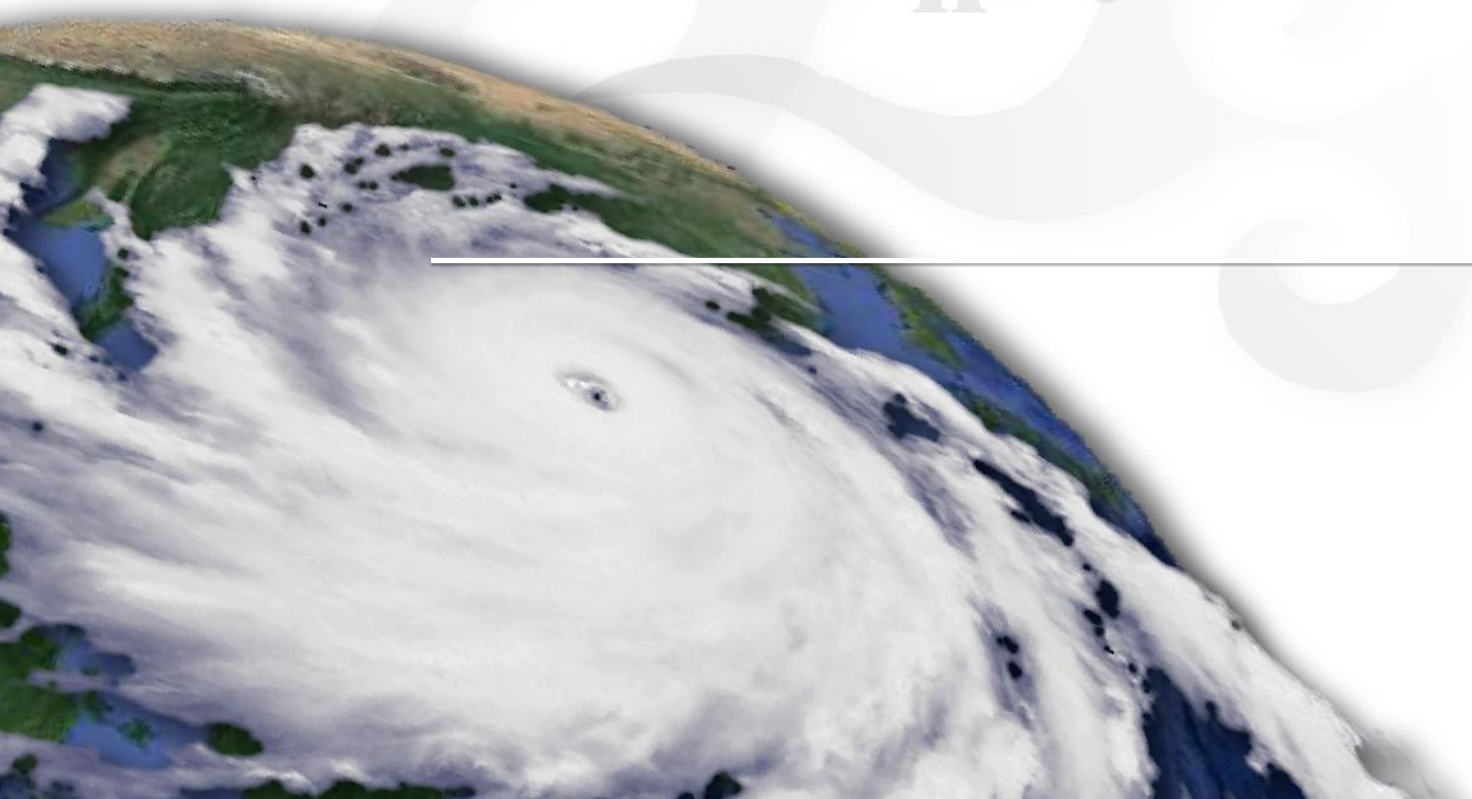


氣象署桃園中程高頻海象雷達資料比對

歐陽頡、尤心瑜

中央氣象署 海氣遙測組

2026.09.03



大綱

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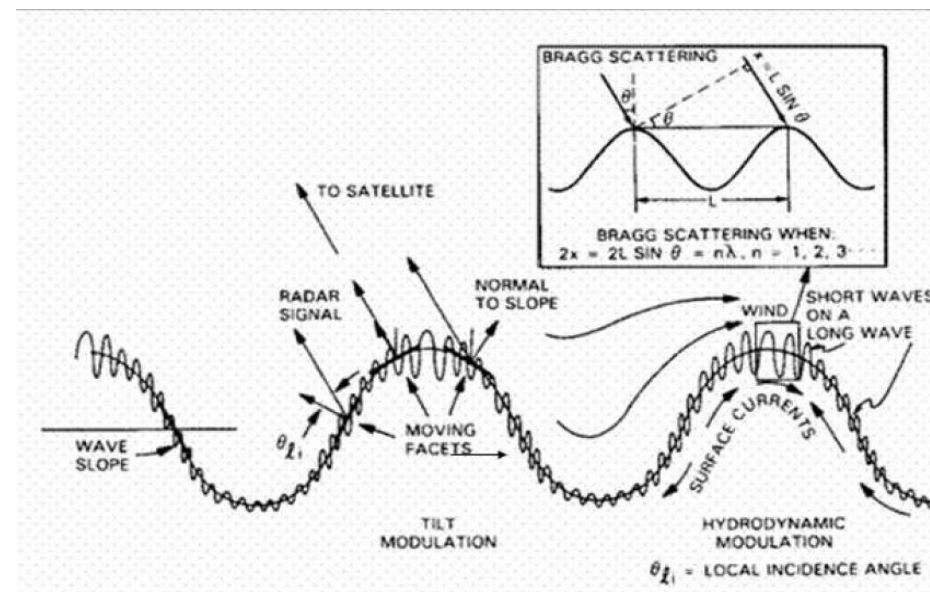
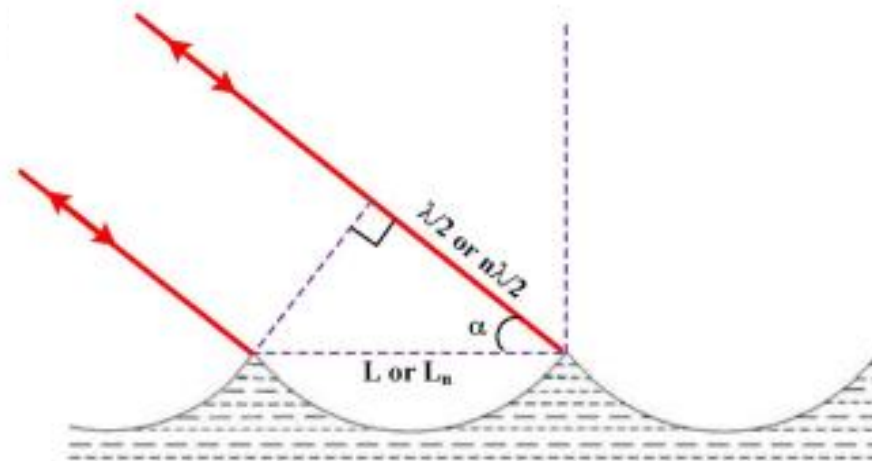
高頻雷達與模式比對結果

5.

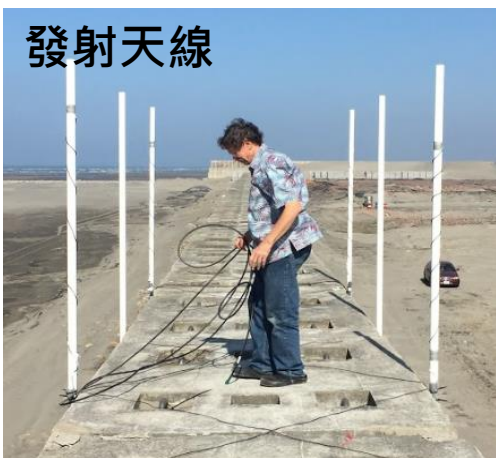
結論

簡介

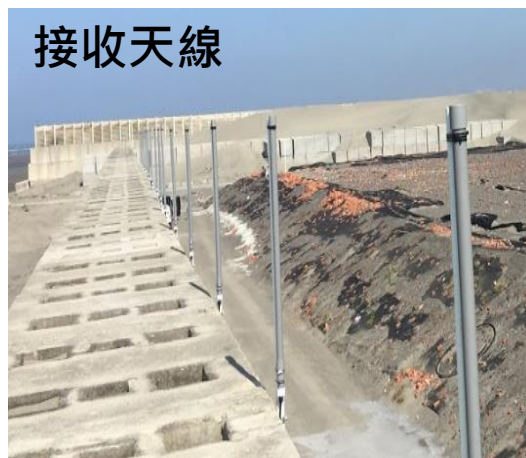
- 中央氣象署於桃園沿岸建置五座**中程高頻海象雷達**，目的為提供大範圍的海象資訊
- 觀測原理：將電磁波發射至海平面，根據接收的回波訊號反演得出海表面流速、波高、週期等海洋參數
- 可作為海域活動安全參考，應用於海上搜救、油汙監測、離岸流或颱風暴潮之預警



發射天線



接收天線

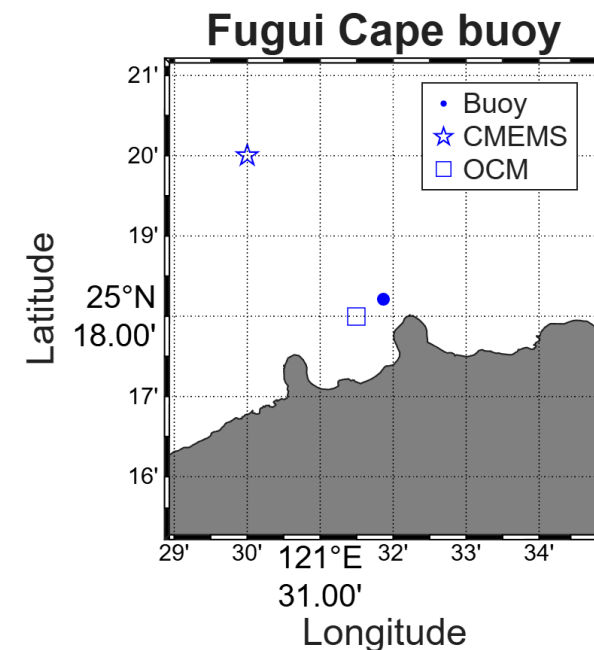
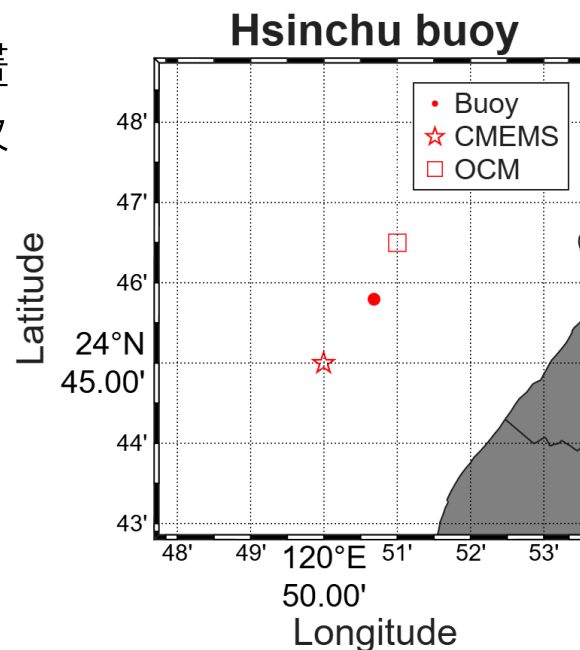
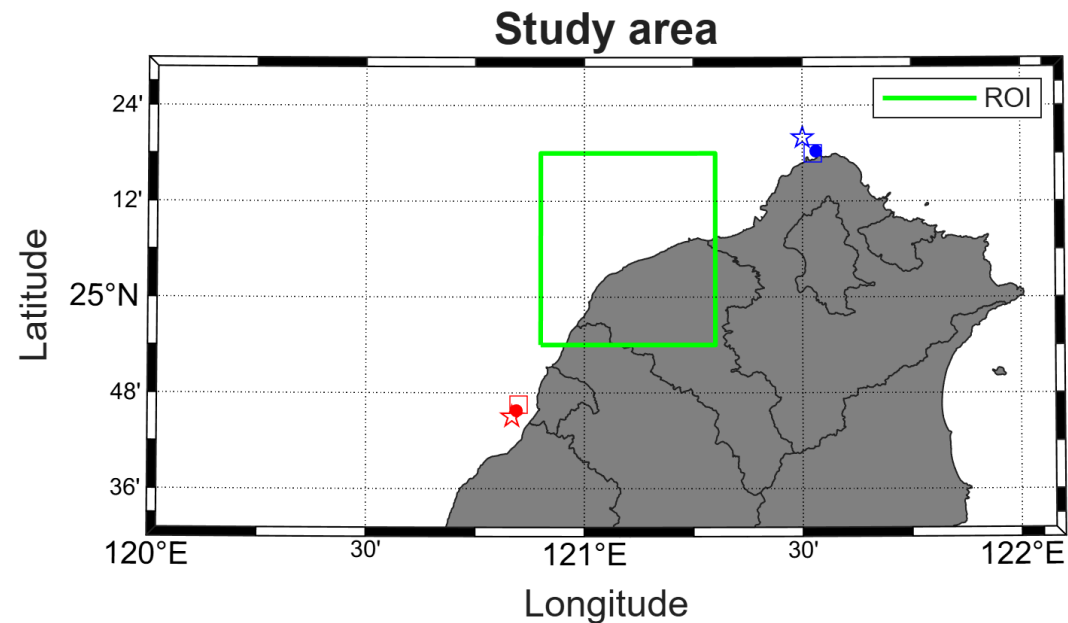


研究方法

• 研究區域

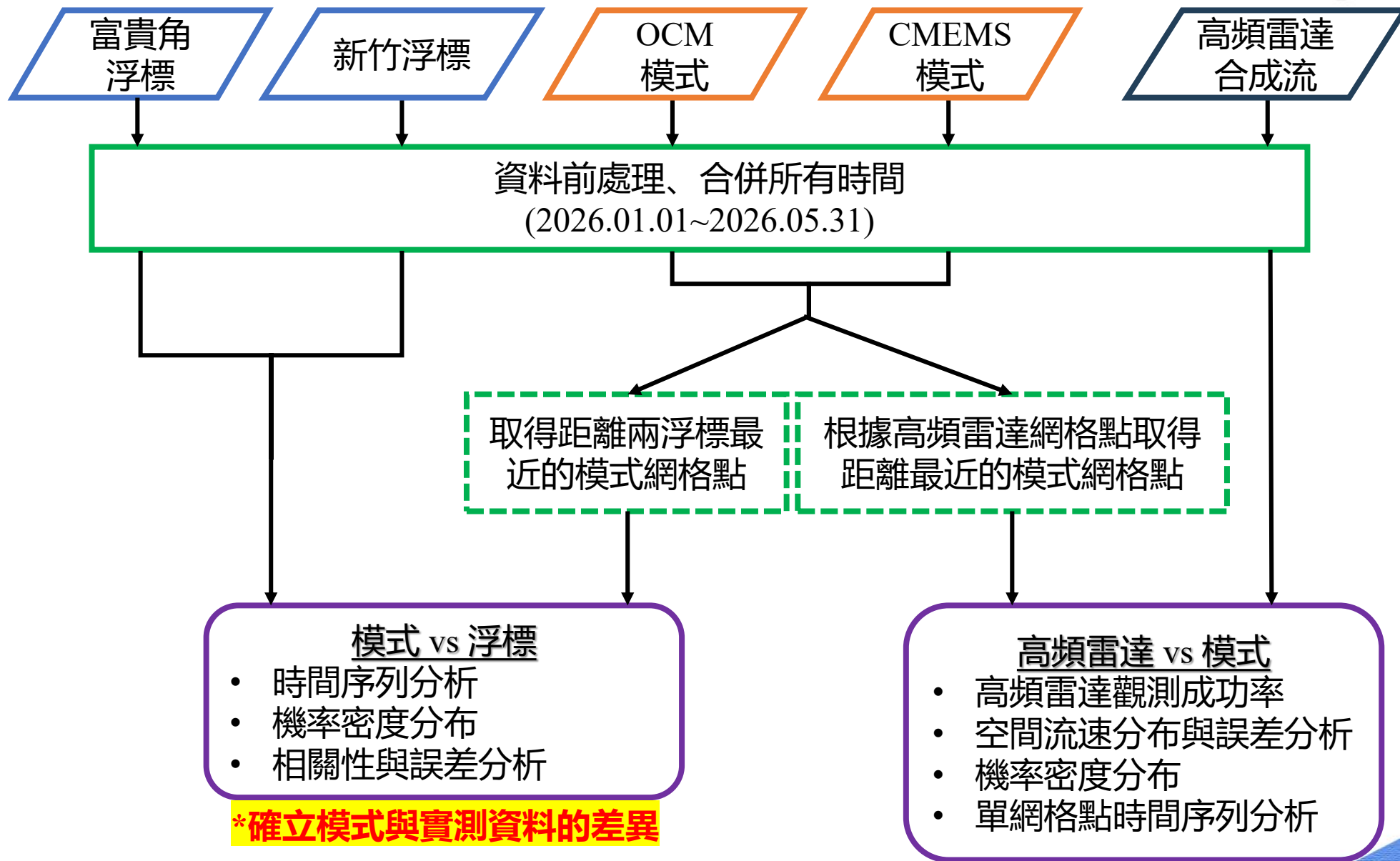
- 時間：2026.01.01~2026.05.31
- 實測資料使用氣象署位於新竹與富貴角海氣象浮標的流速，深度為4 m
- 模式資料使用歐盟哥白尼計畫 (CMEMS) 產品提供的表面流速，以及氣象署的OCM預報模式的表面流速

Model	CMEMS	OCM
Time resolution	1 hour	1 hour
Special resolution	$1/12^{\circ} * 1/12^{\circ}$ (~8 km)	$1/40^{\circ} * 1/40^{\circ}$ (~2.5 km)



研究方法

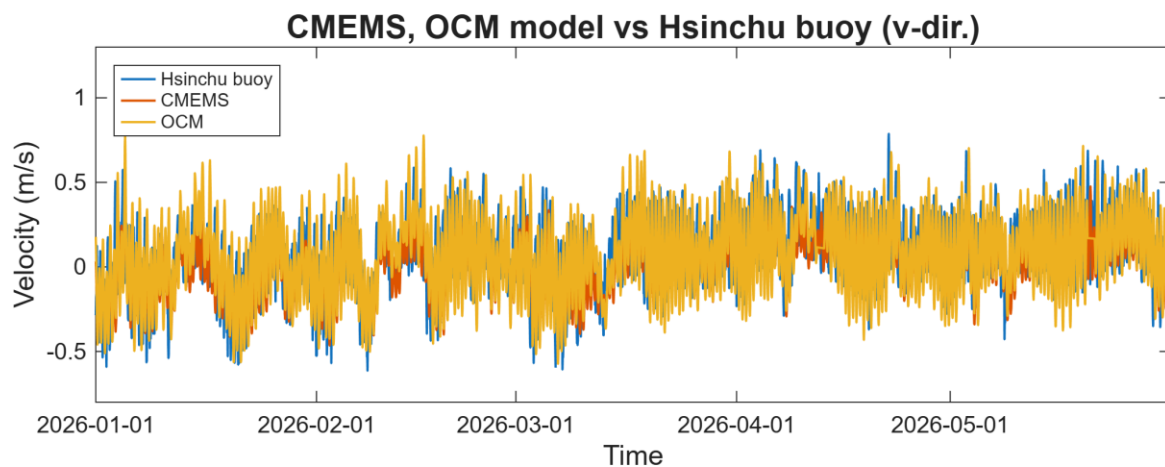
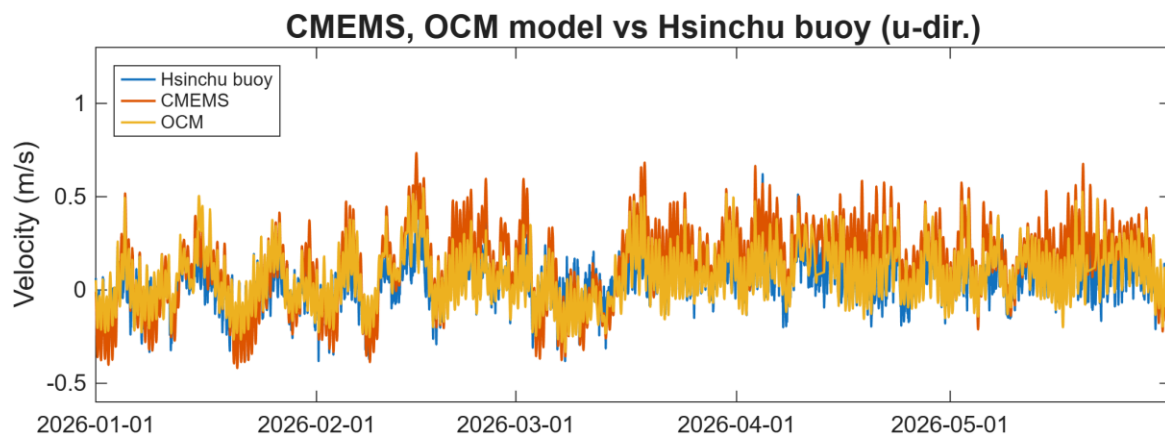
• 架構圖



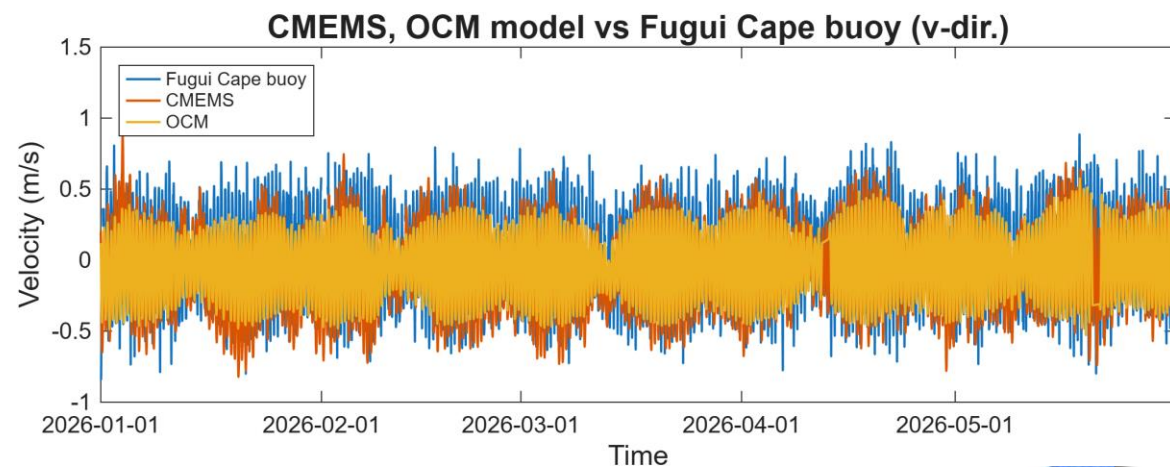
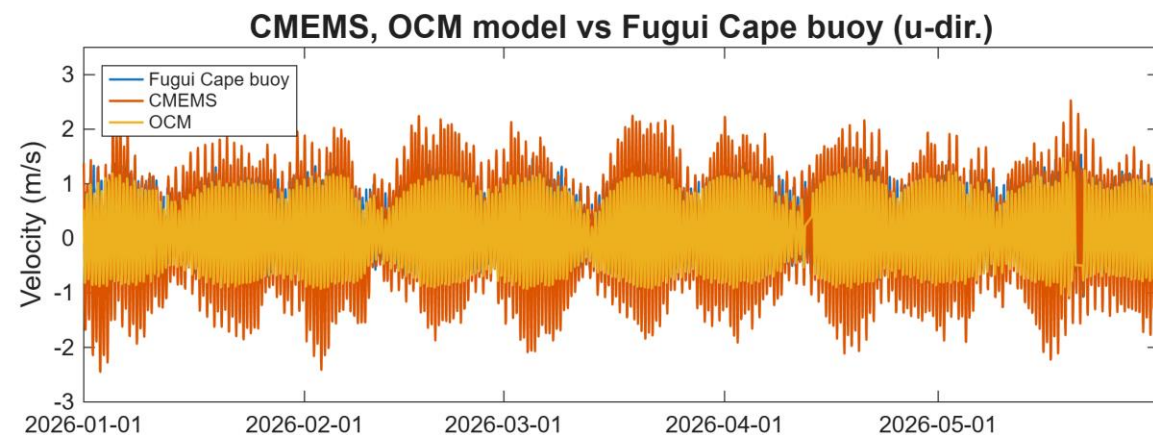
模式與浮標比對結果

- 時間序列

新竹浮標



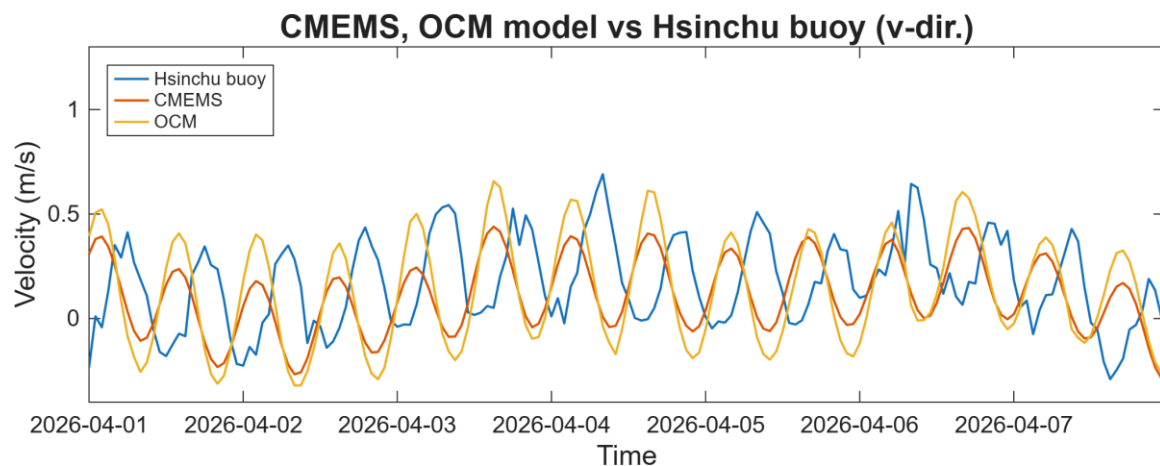
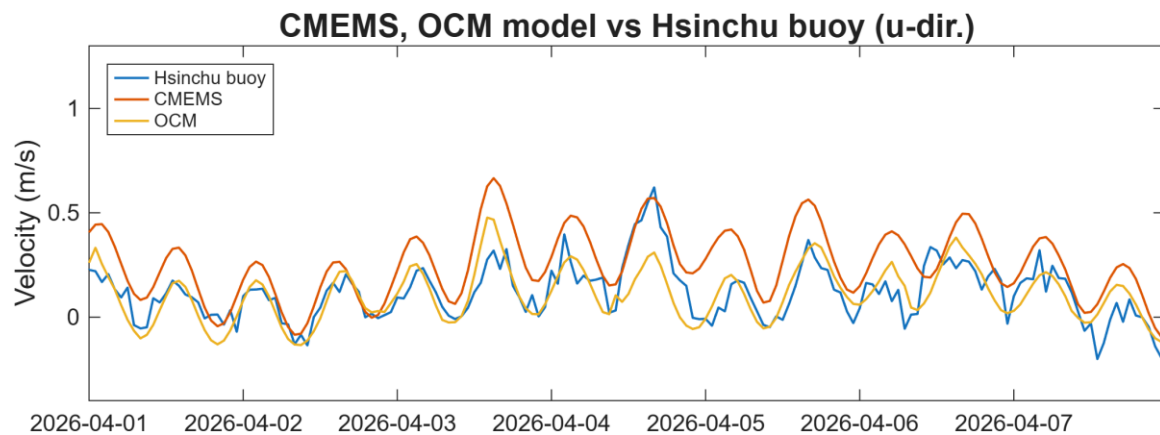
富貴角浮標



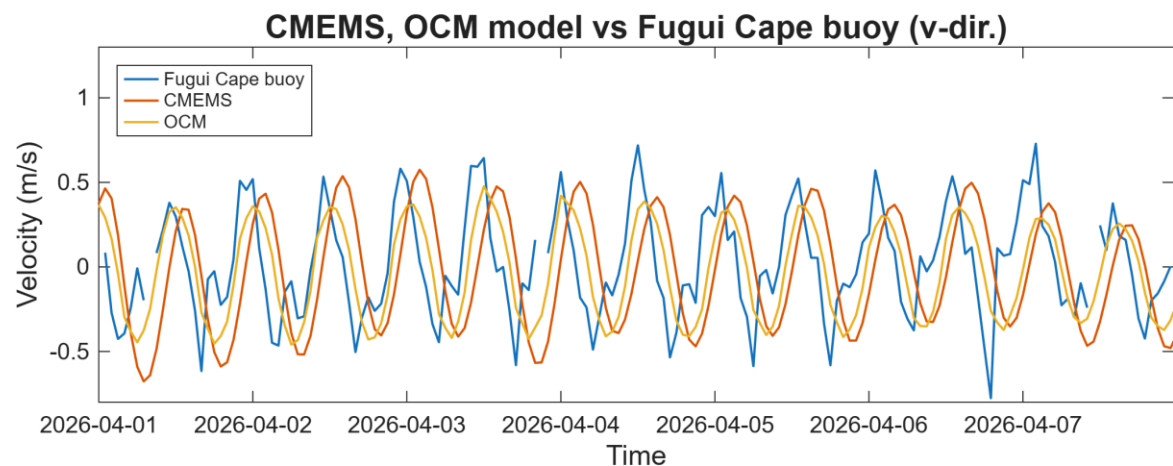
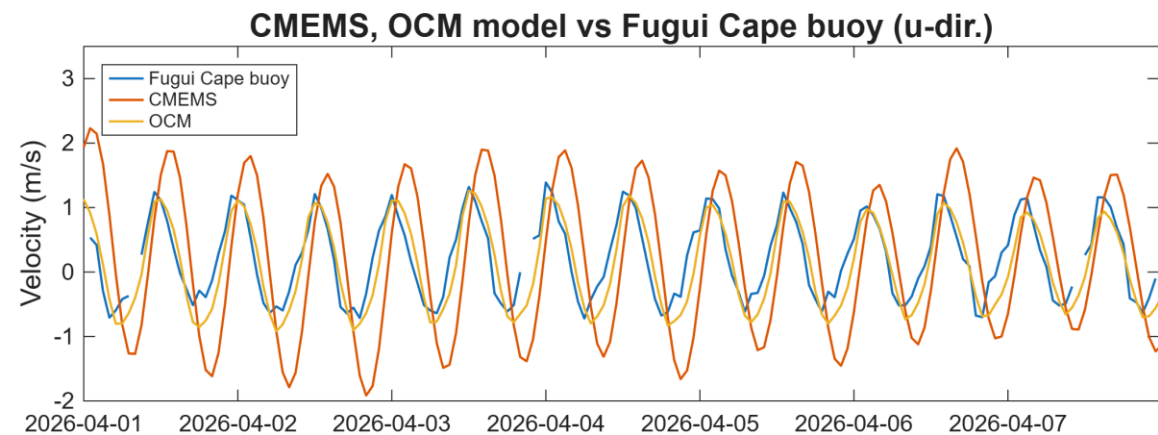
模式與浮標比對結果

- 時間序列 (4/1~4/7)

新竹浮標



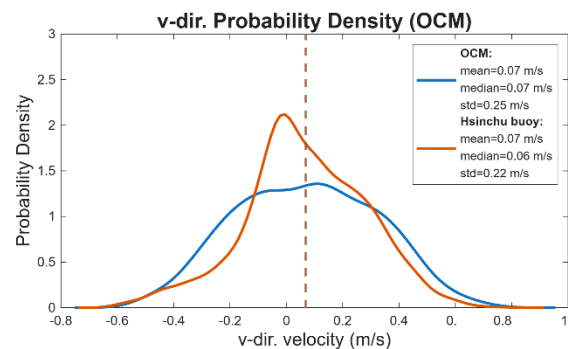
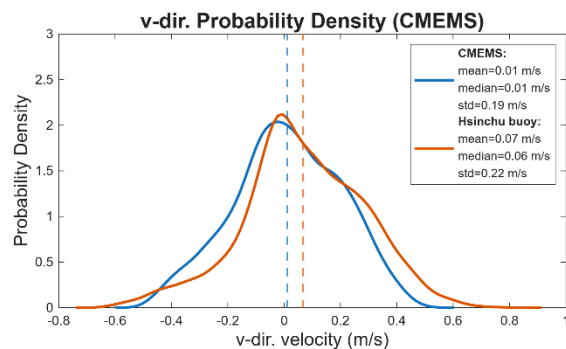
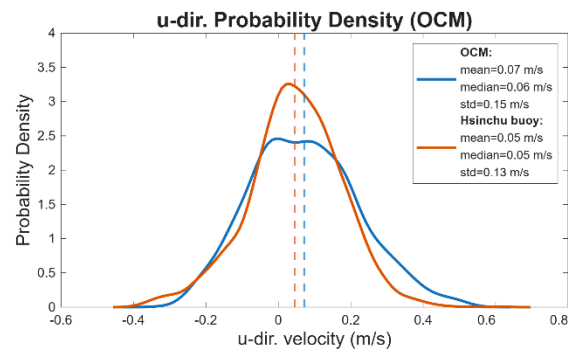
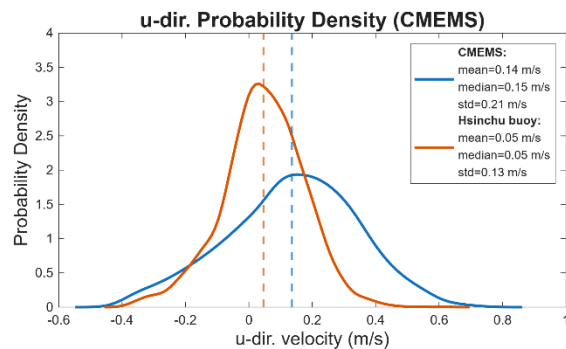
富貴角浮標



模式與浮標比對結果

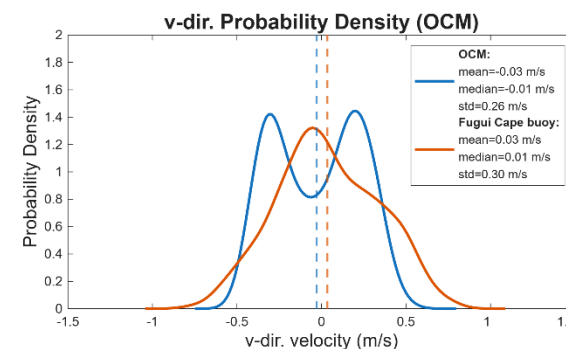
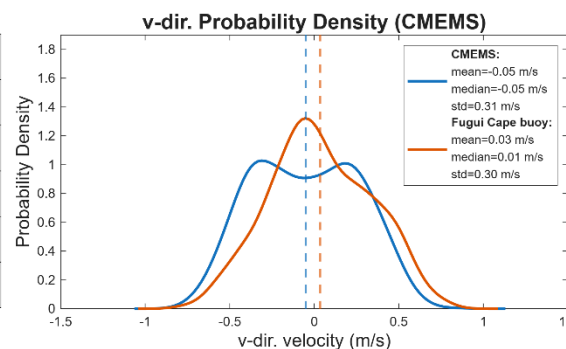
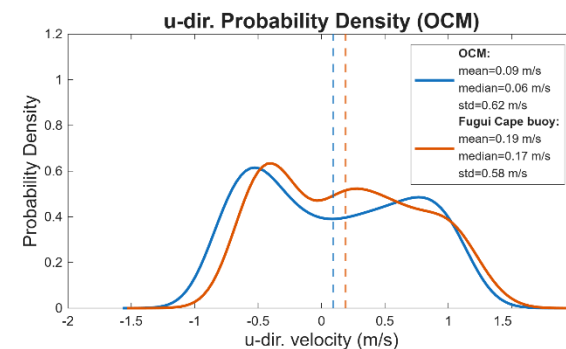
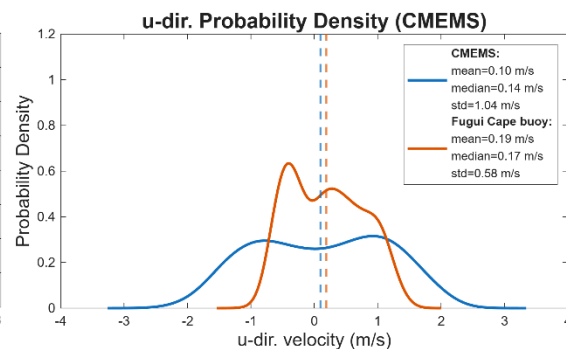
機率密度分布

新竹浮標



	u-dir.			v-dir.		
	Mean	Median	Std.	Mean	Median	Std.
CMEMS	0.14	0.15	0.21	0.01	0.01	0.19
OCM	0.07	0.06	0.15	0.07	0.07	0.25
Hsinchu buoy	0.05	0.05	0.13	0.07	0.06	0.22

富貴角浮標

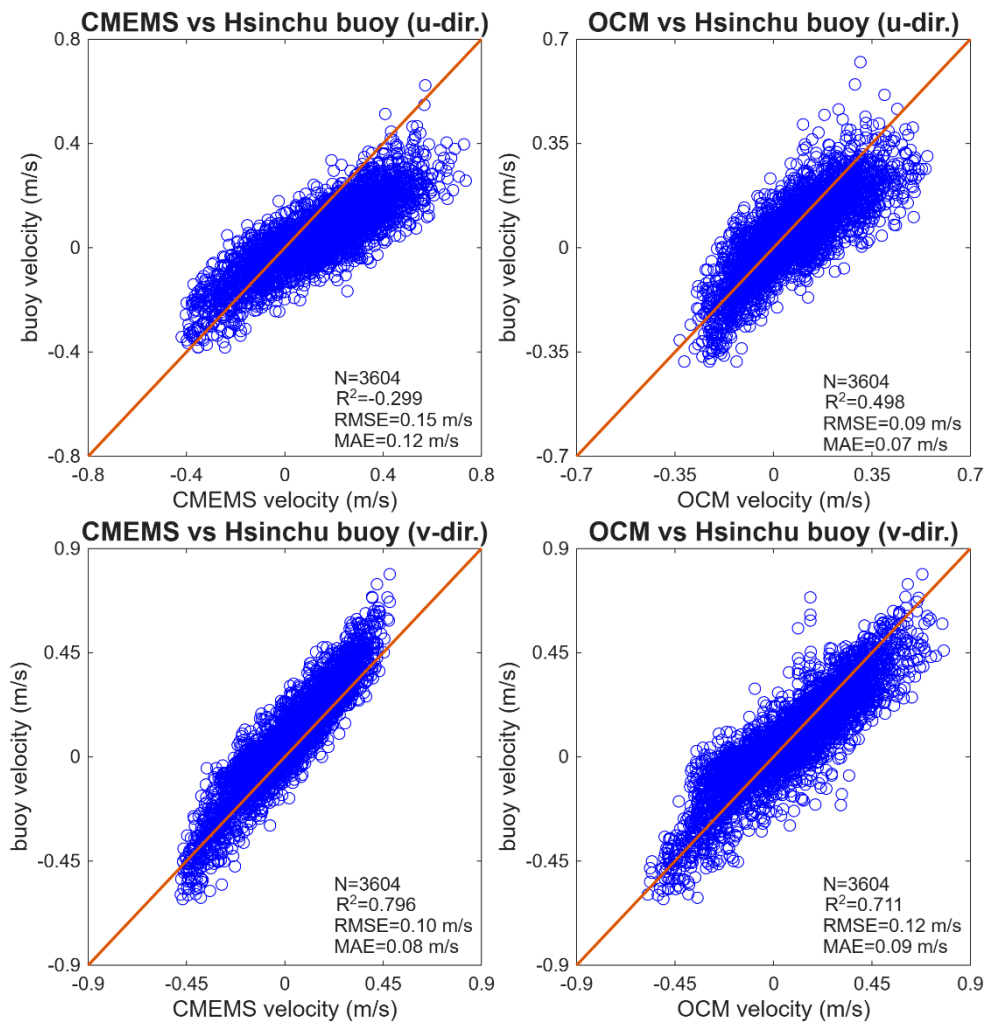


	u-dir.			v-dir.		
	Mean	Median	Std.	Mean	Median	Std.
CMEMS	0.10	0.14	1.04	0.05	0.05	0.31
OCM	0.09	0.06	0.62	0.03	0.01	0.26
Fugui Cape buoy	0.19	0.17	0.58	0.03	0.01	0.30

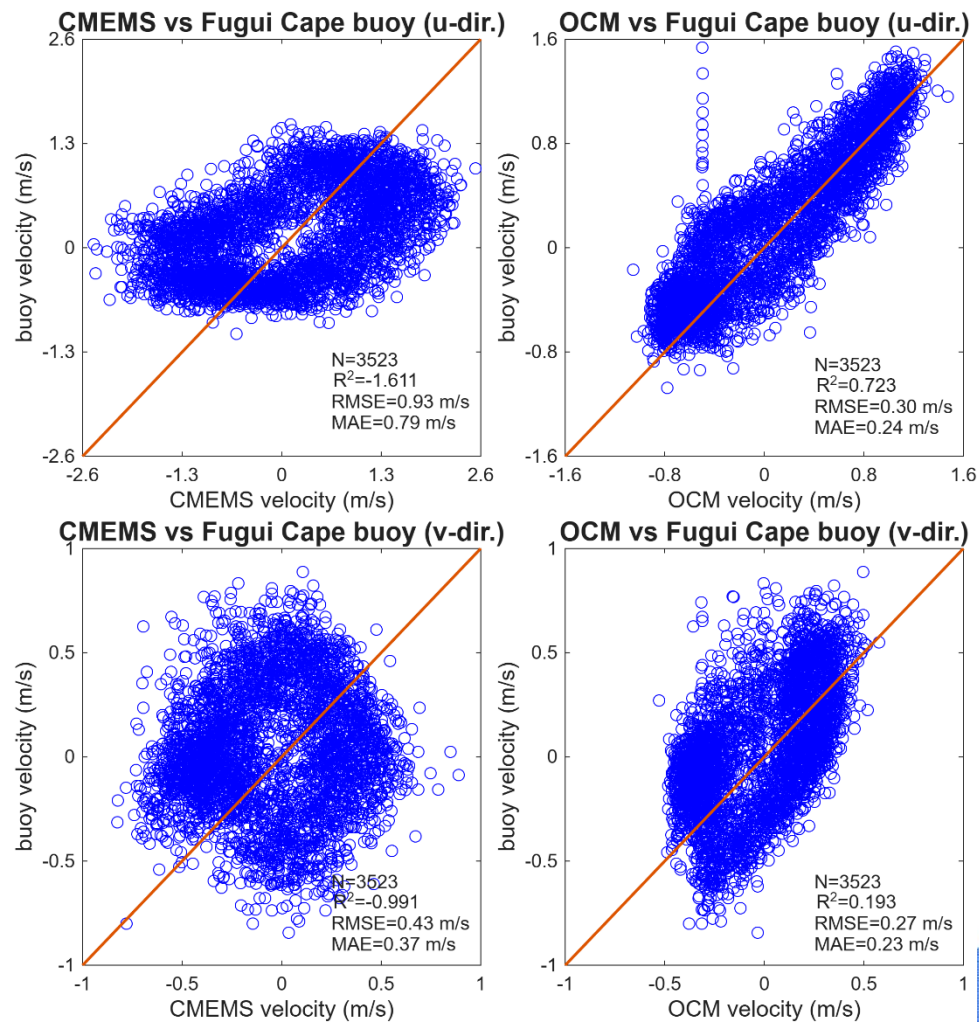
模式與浮標比對結果

• 相關性與誤差分析

新竹浮標



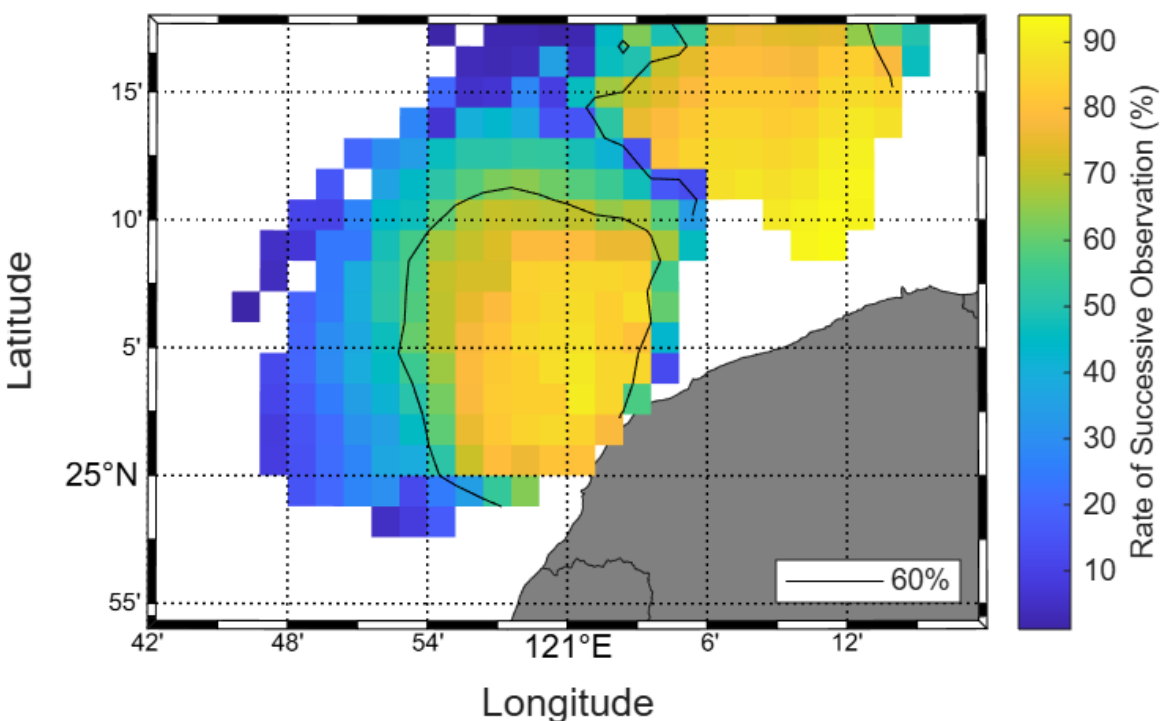
富貴角浮標



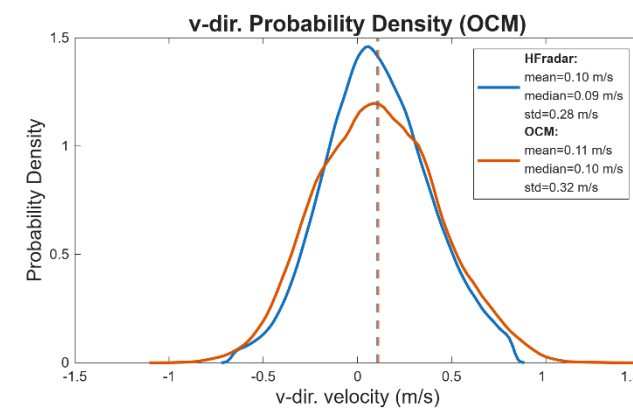
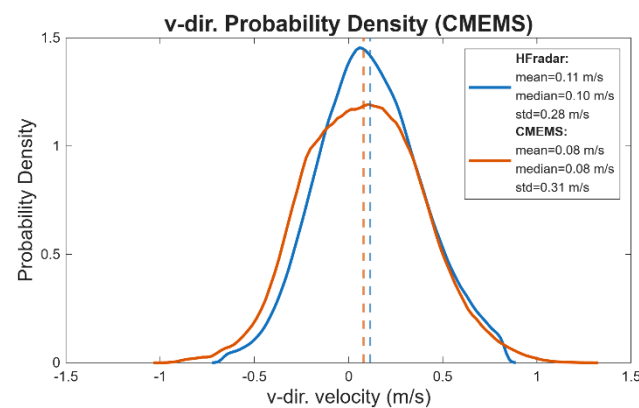
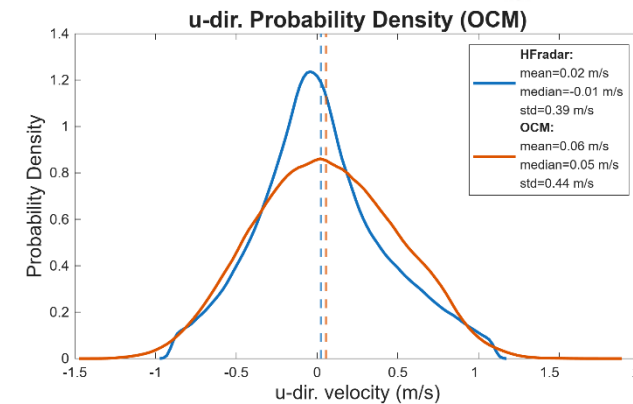
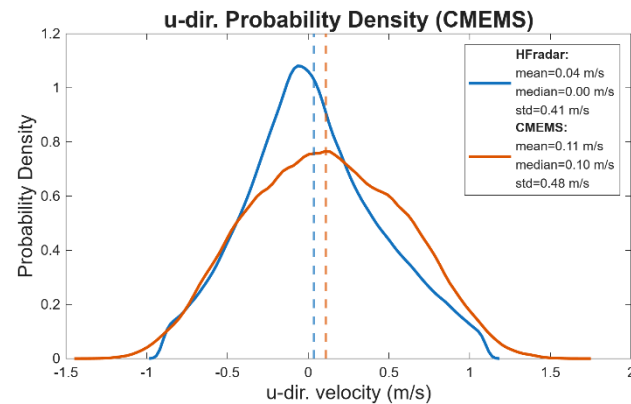
高頻雷達與模式比對結果

- 高頻雷達觀測成功格點
空間分布圖

HFradar Rate of Successive Observation



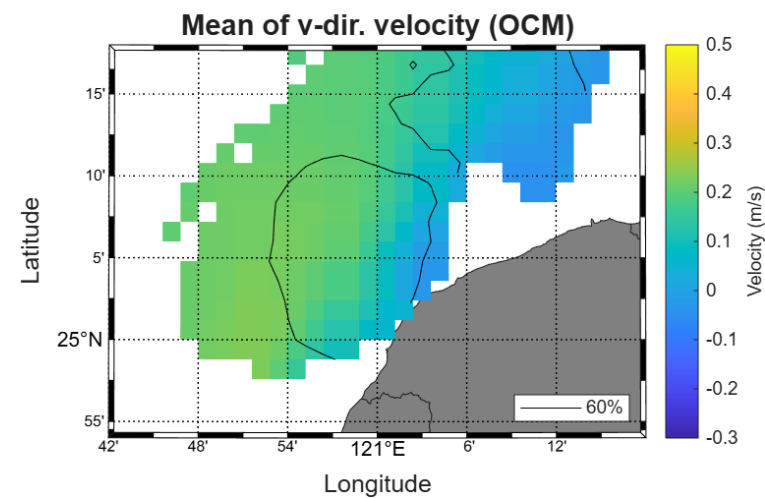
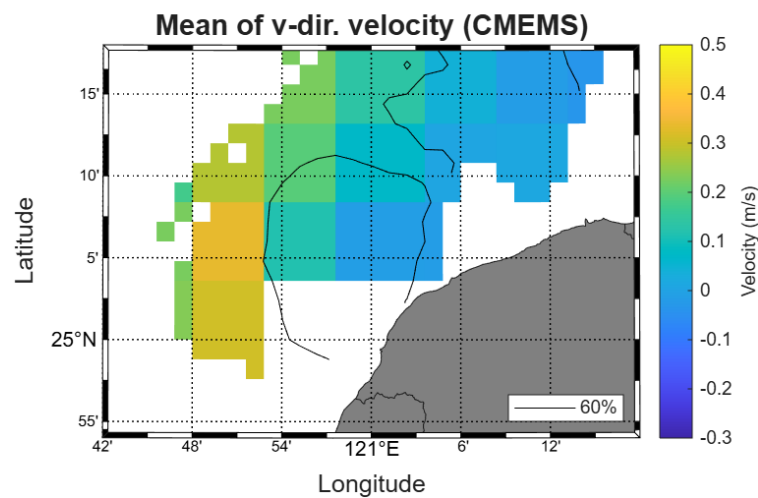
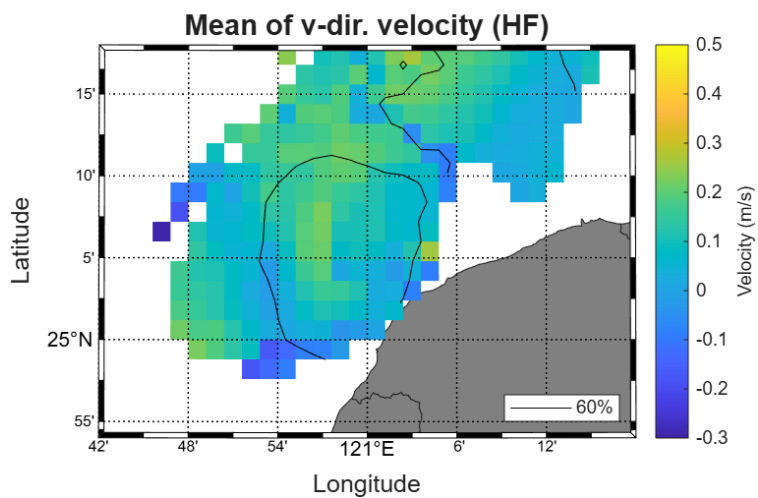
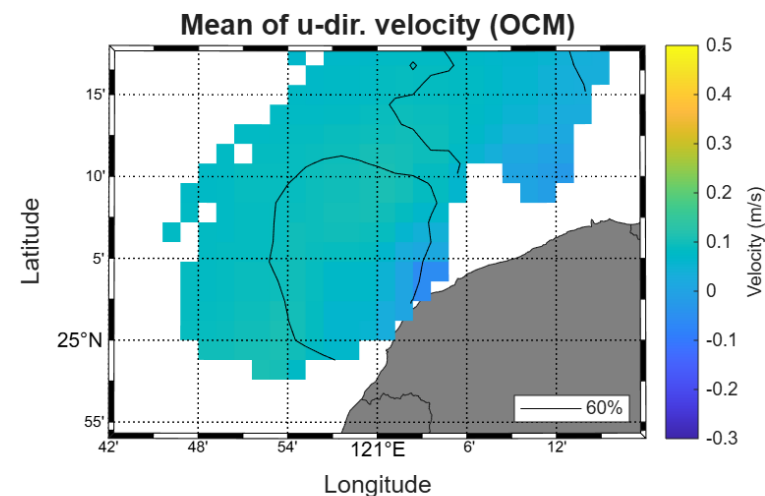
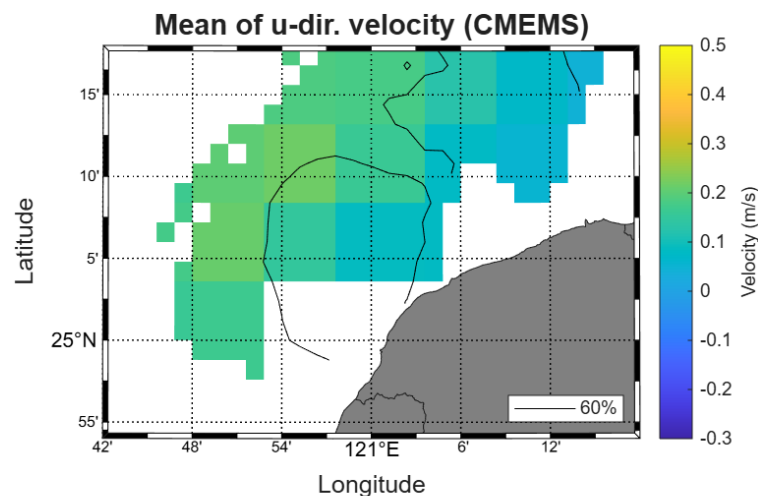
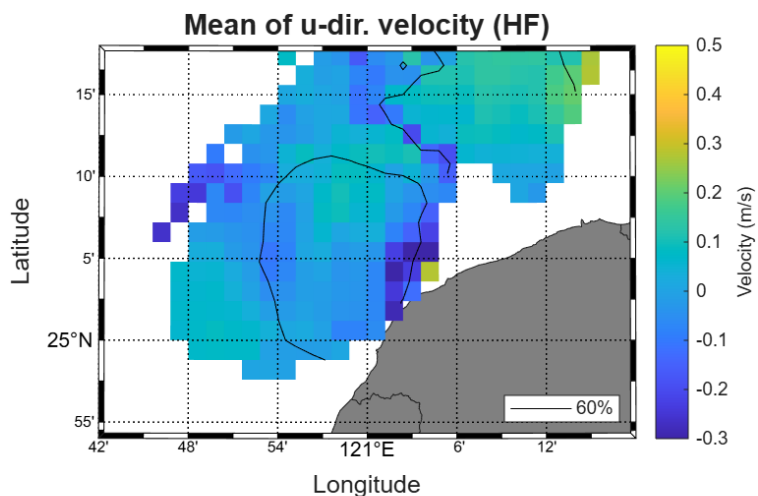
- 機率密度分布



	u-dir.			v-dir.		
	Mean	Median	Std.	Mean	Median	Std.
HFradar	0.04	0.00	0.41	0.11	0.10	0.28
CMEMS	0.11	0.10	0.48	0.08	0.08	0.31
HFradar	0.02	0.01	0.39	0.10	0.09	0.28
OCM	0.06	0.05	0.44	0.11	0.10	0.32

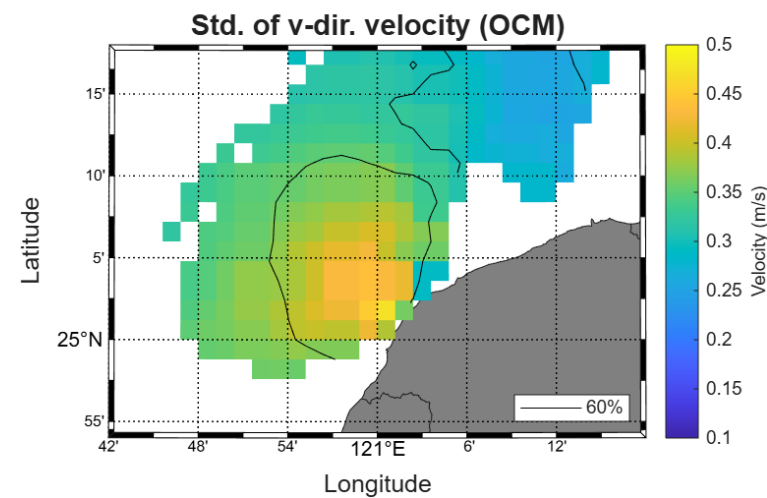
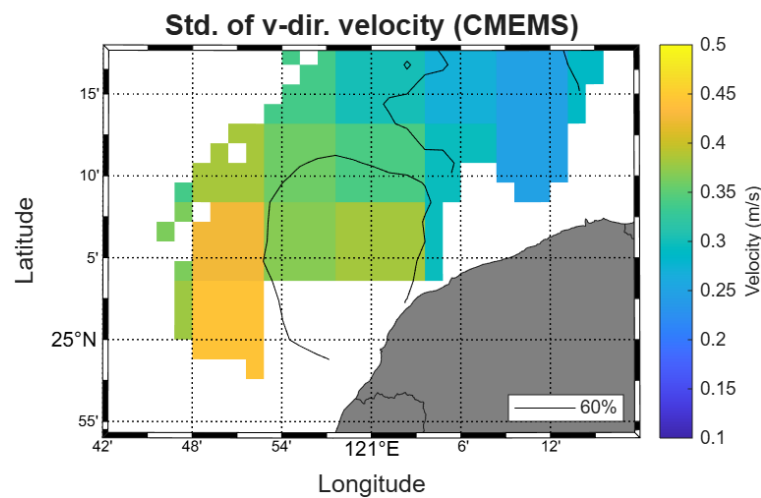
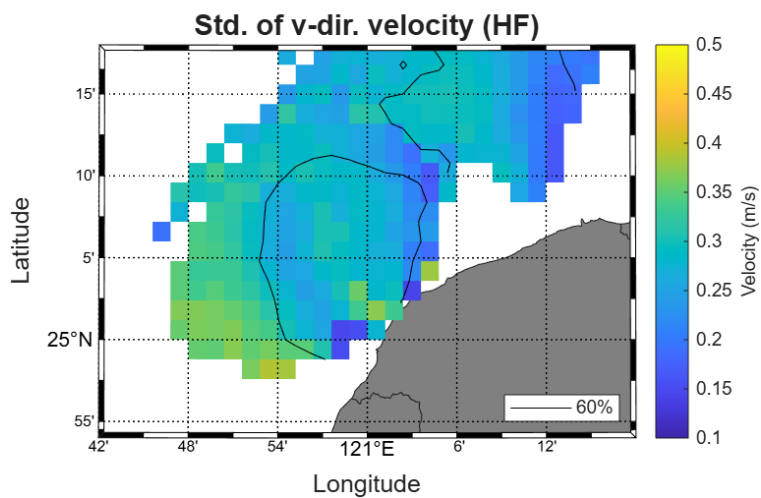
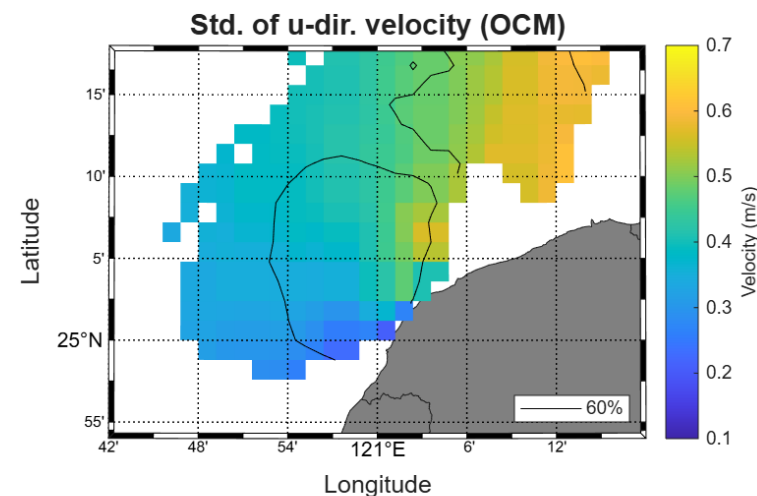
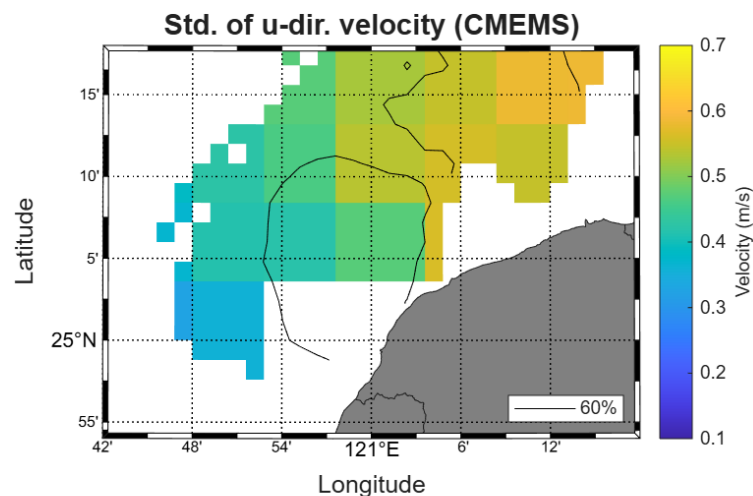
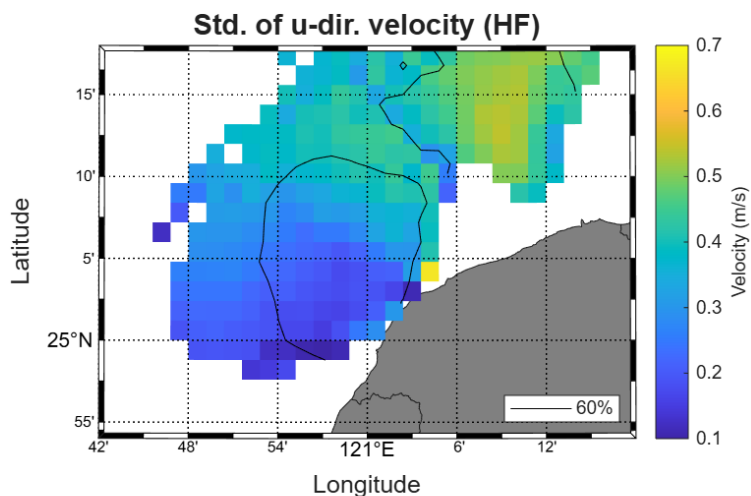
高頻雷達與模式比對結果

- 平均流速空間分布圖



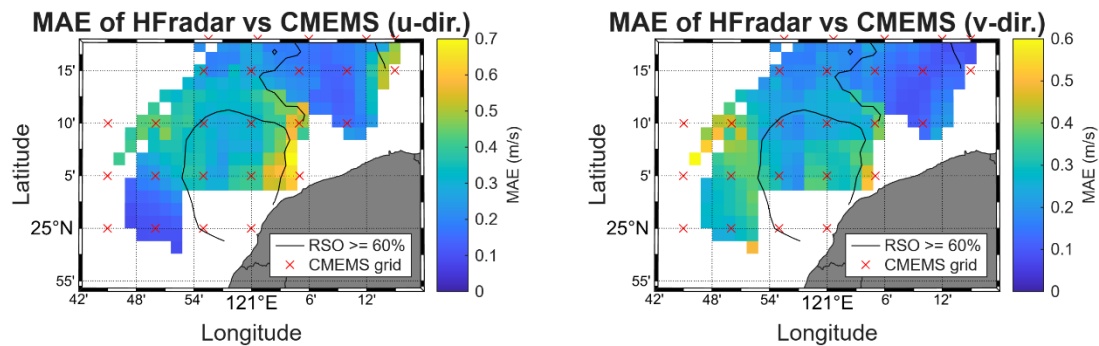
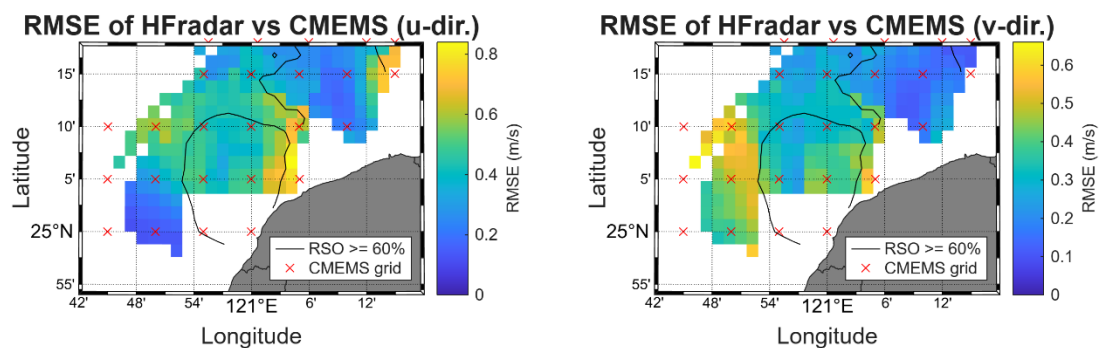
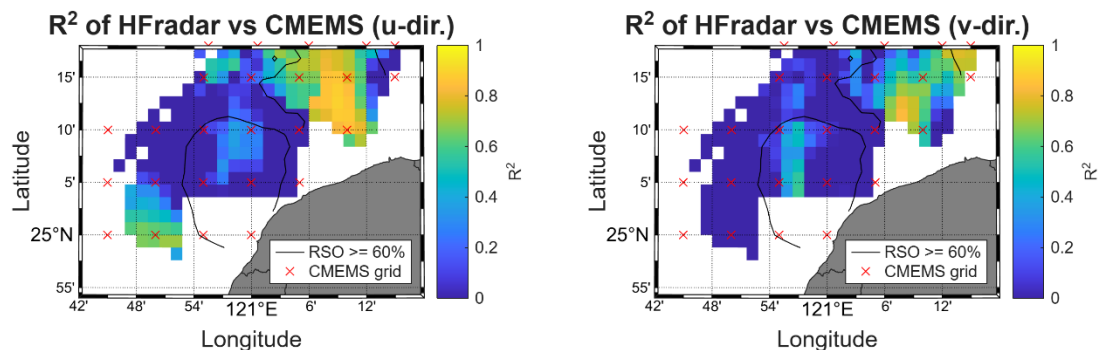
高頻雷達與模式比對結果

- 流速標準差空間分布圖

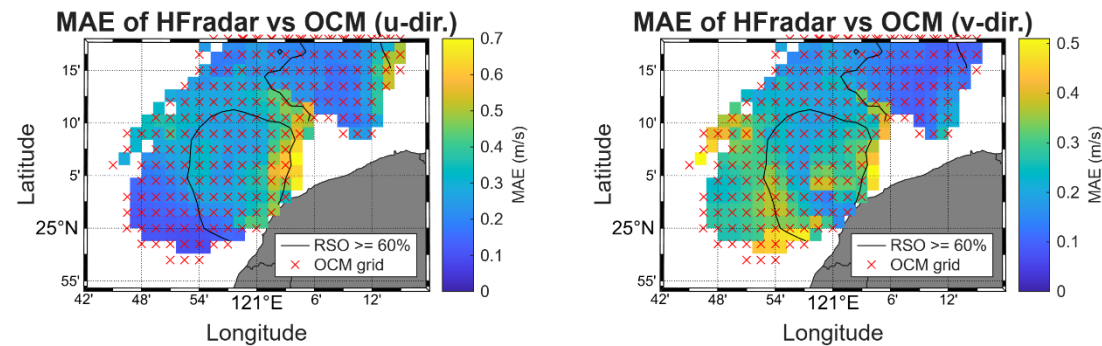
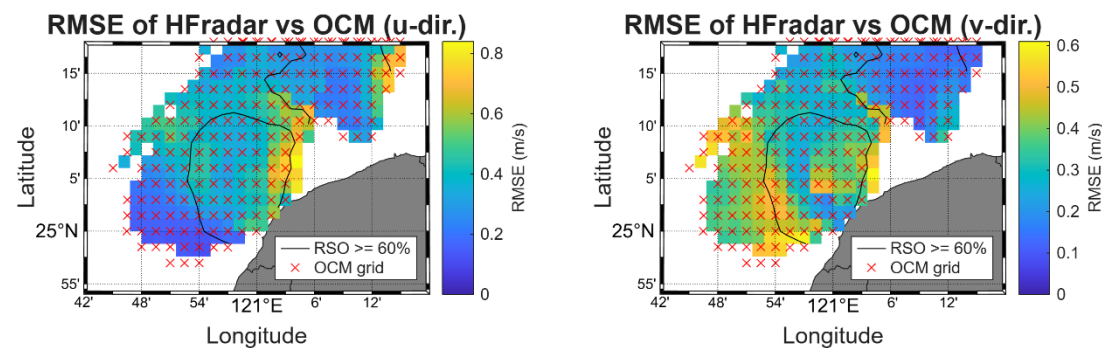
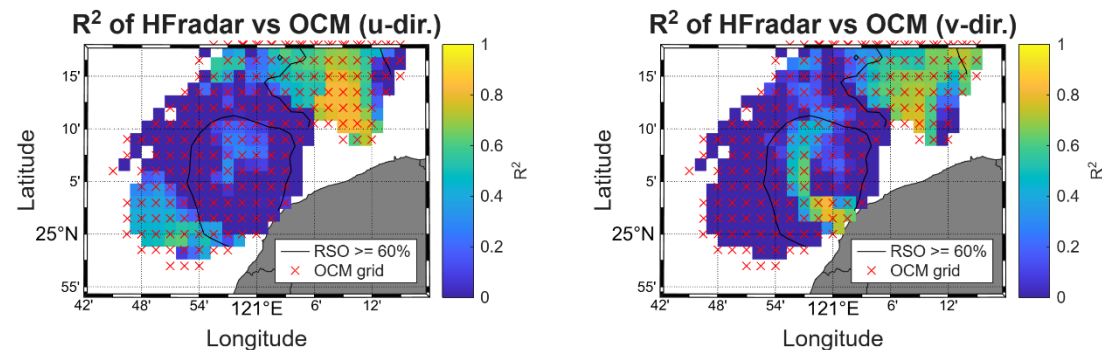


高頻雷達與模式比對結果

• 與CMEMS模式比較之空間分布圖



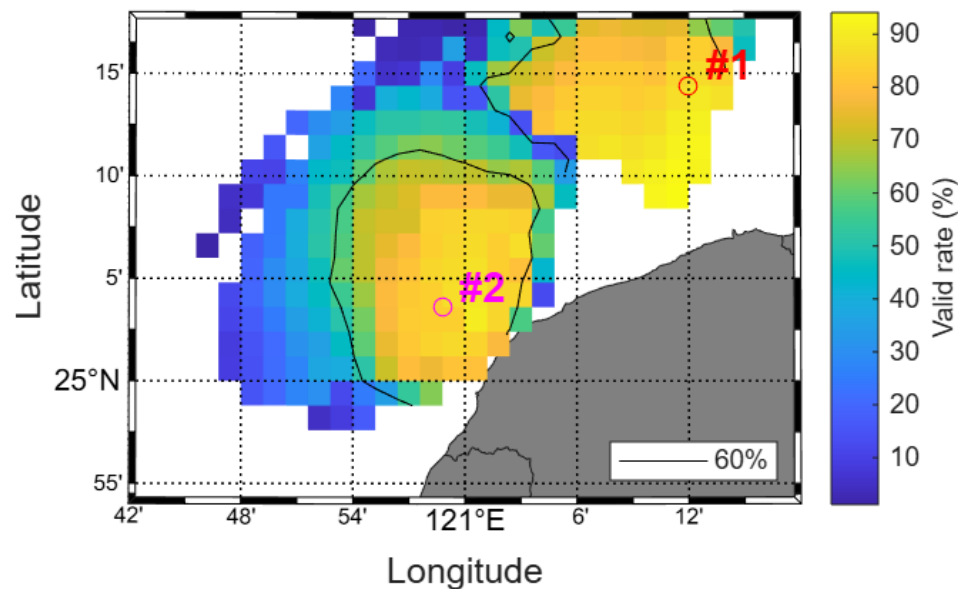
• 與OCM模式比較之空間分布圖



高頻雷達與模式比對結果

- 單一觀測點時間序列

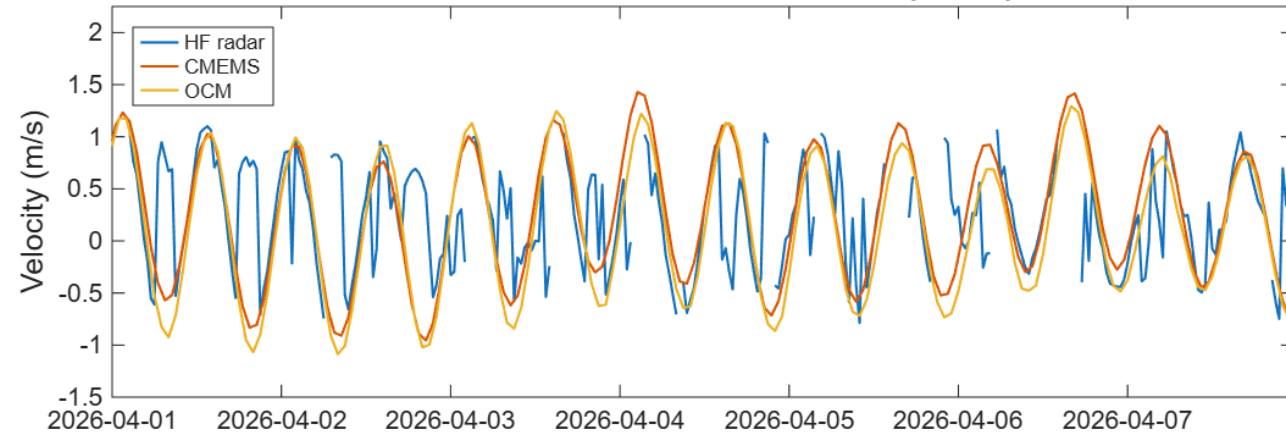
HFradar Rate of Successive Observation



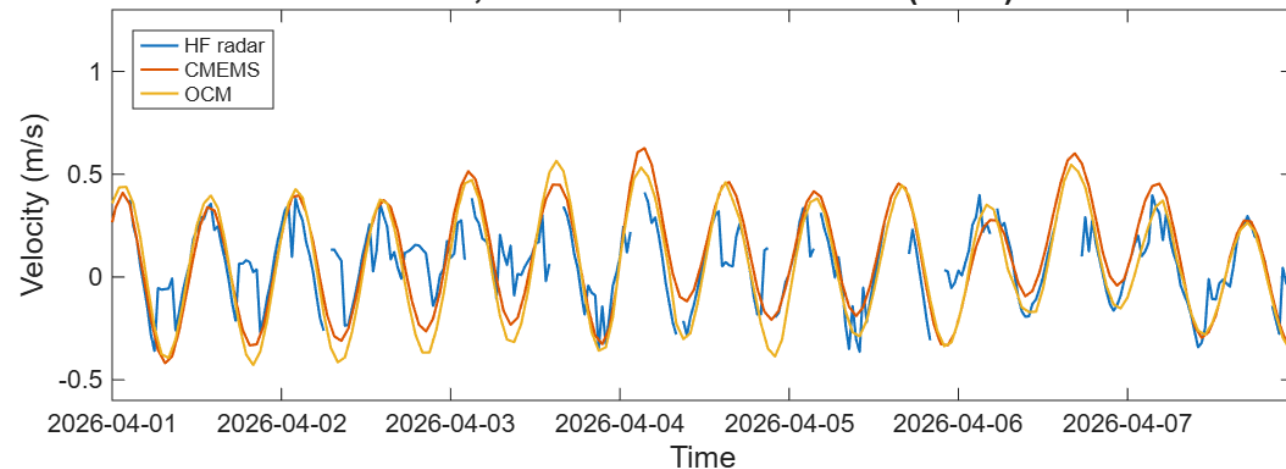
- 誤差分析

#1 u-dir.	Mean	Std.	R^2	RMSE	MAE
HFradar	0.18	0.45	-0.117	0.59	0.37
CMEMS	0.07	0.58			
OCM	0.04	0.59			

CMEMS, OCM model vs HF radar (u-dir.) #1



CMEMS, OCM model vs HF radar (v-dir.) #1

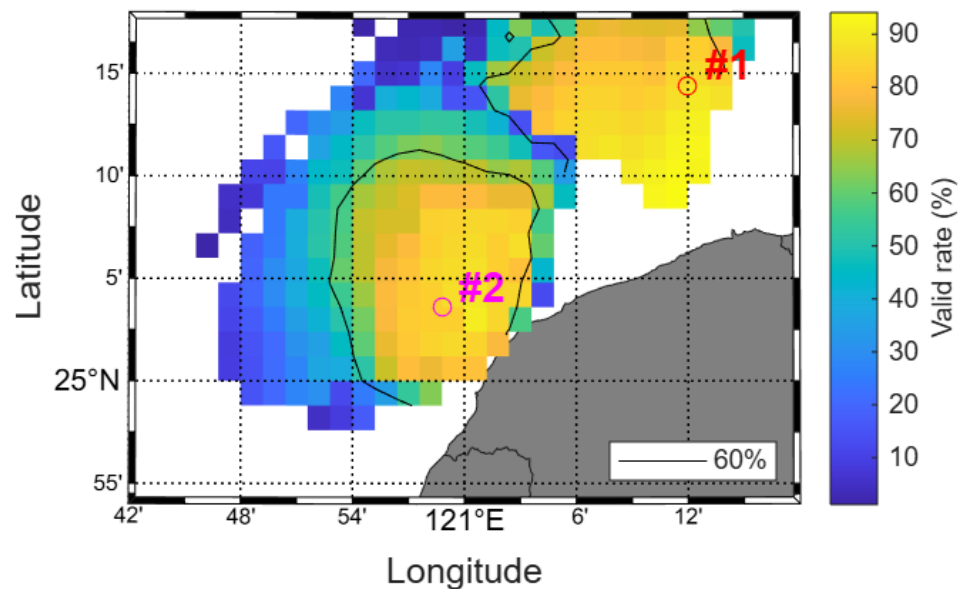


#1 v-dir.	Mean	Std.	R^2	RMSE	MAE
HFradar	0.02	0.18	0.498	0.17	0.12
CMEMS	-0.01	0.25			
OCM	-0.01	0.26			

高頻雷達與模式比對結果

• 單一觀測點時間序列

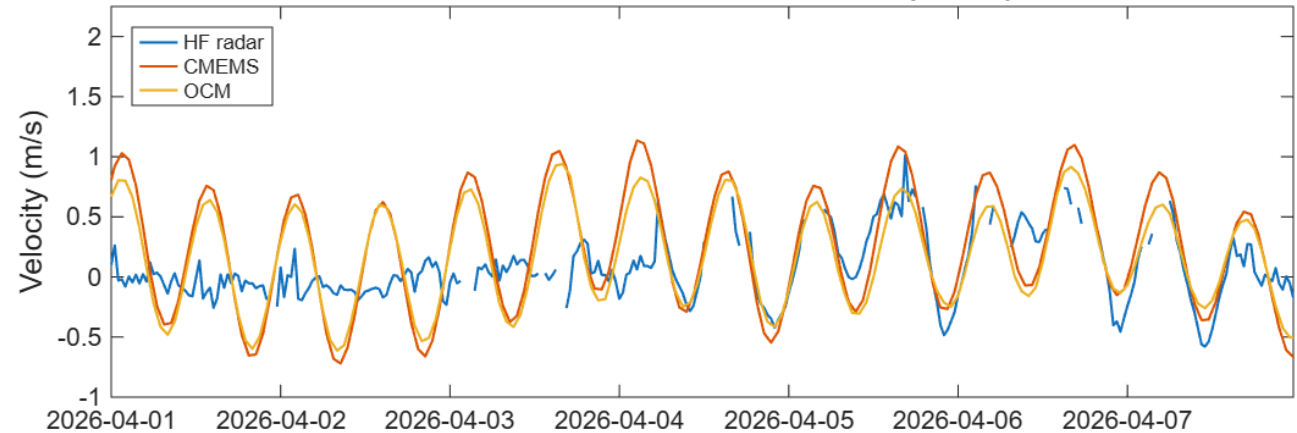
HFradar Rate of Successive Observation



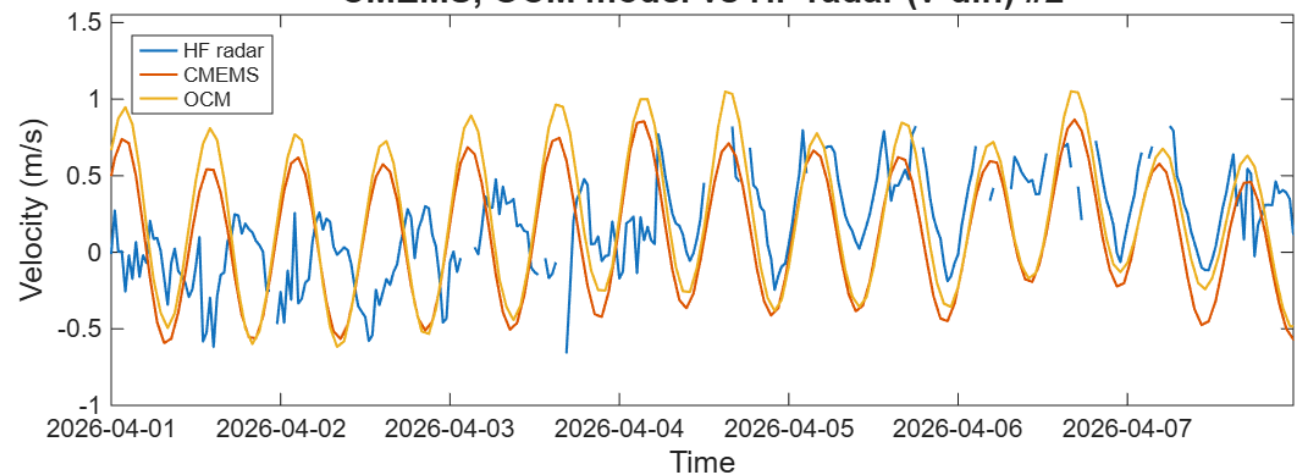
• 誤差分析

#2 u-dir.	Mean	Std.	R^2	RMSE	MAE
HFradar	-0.03	0.18	$\frac{1}{1}$	$\frac{1}{1}$	$\frac{1}{1}$
CMEMS	0.09	0.47			
OCM	0.07	0.40			

CMEMS, OCM model vs HF radar (u-dir.) #2



CMEMS, OCM model vs HF radar (v-dir.) #2



#2 v-dir.	Mean	Std.	R^2	RMSE	MAE
HFradar	0.05	0.28	$\frac{1}{1}$	$\frac{1}{1}$	$\frac{1}{1}$
CMEMS	-0.01	0.38			
OCM	0.13	0.44			

結論

- 模式與浮標比對
 - 與新竹浮標差異約0.1~0.2 m/s，富貴角浮標差異約0.2~1 m/s，顯示模式易受近岸地形影響不易觀測到小範圍的海流變化
- 高頻雷達與模式比對
 - 位於近岸約20公里範圍內觀測成功率可達60%，觀測分布也與模式接近
 - 空間分布上高頻雷達呈現不連續的現象，與模式的差異約0.3~0.8 m/s，且u方向上的平均流速偏低
 - 單一觀測點誤差分析可發現高頻雷達與模式的相關性不佳且空間差異大；時間序列也顯示高頻雷達未貼近模式流速的週期
 - 高頻雷達合成流仍需加強空間連續性品管，未來待流程完整上線後重新比對

謝謝聆聽
敬請指教



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