波浪預報偏差修正之研究

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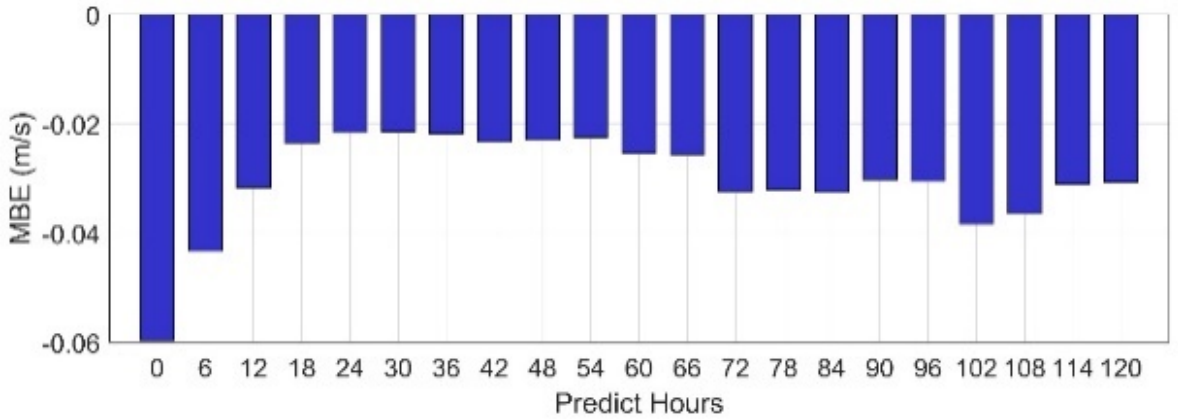
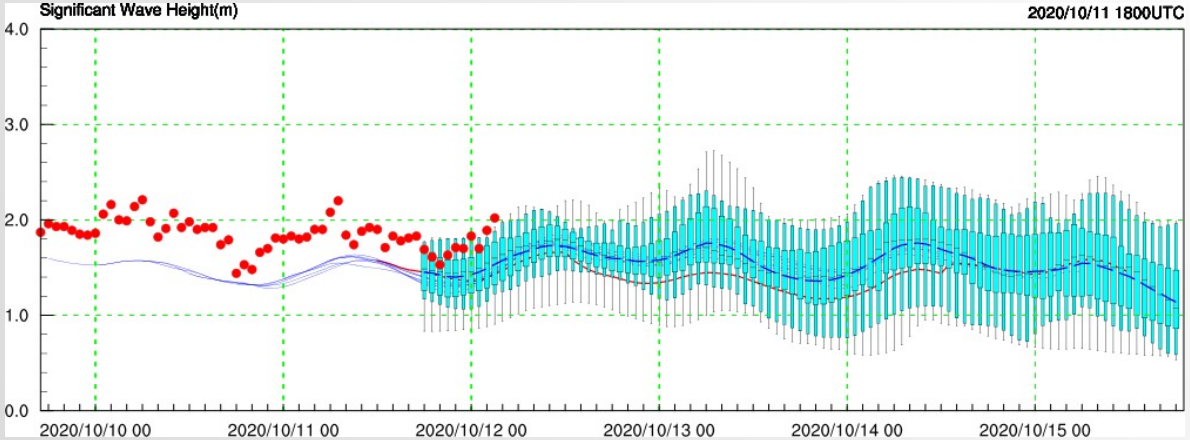
OUTLINE

- Motivations
- Methods
- Results
- Conclusion

MOTIVATIONS





BIAS=Ave. Σ(Model-Observation)

Because of …

- inherent simplifications
- inadequate model physics (parameterizations, assumptions…)
- numerical solution schemes
- Resolution
- insufficient or imperfect calibration datasets
- incorrect boundary forcing data

BIAS Correction (BC)

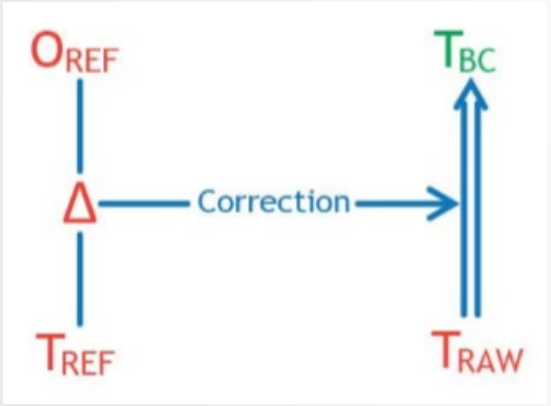
SCENARIOS (BC)

- Hindcast data analysis (how long?)
- Real time analysis
- Future data analysis (e.g. 2040-2050)

- One Variable(univariate)
- More Variables (Bivariate…..) e.g. Hs & Tm

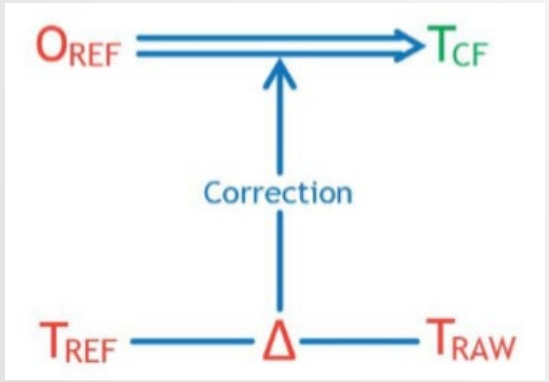
- Point
- Field

1. Nudging



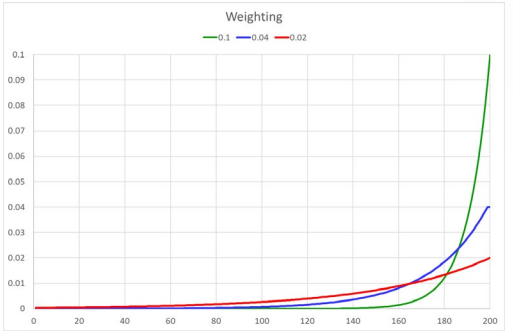
(Hawkins et al., 2013)

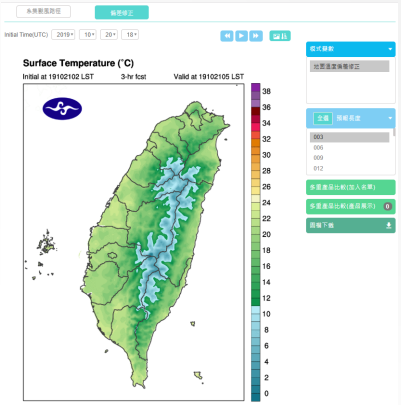
2. Change Factor



(Hawkins et al., 2013)

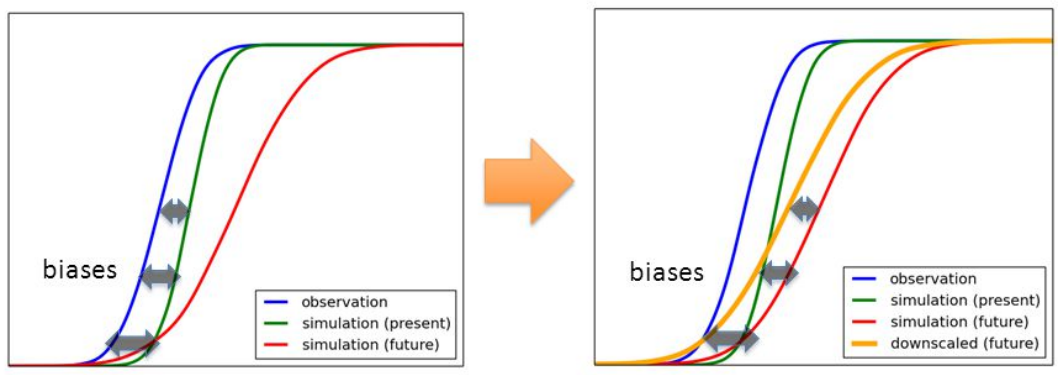
3. decaying average



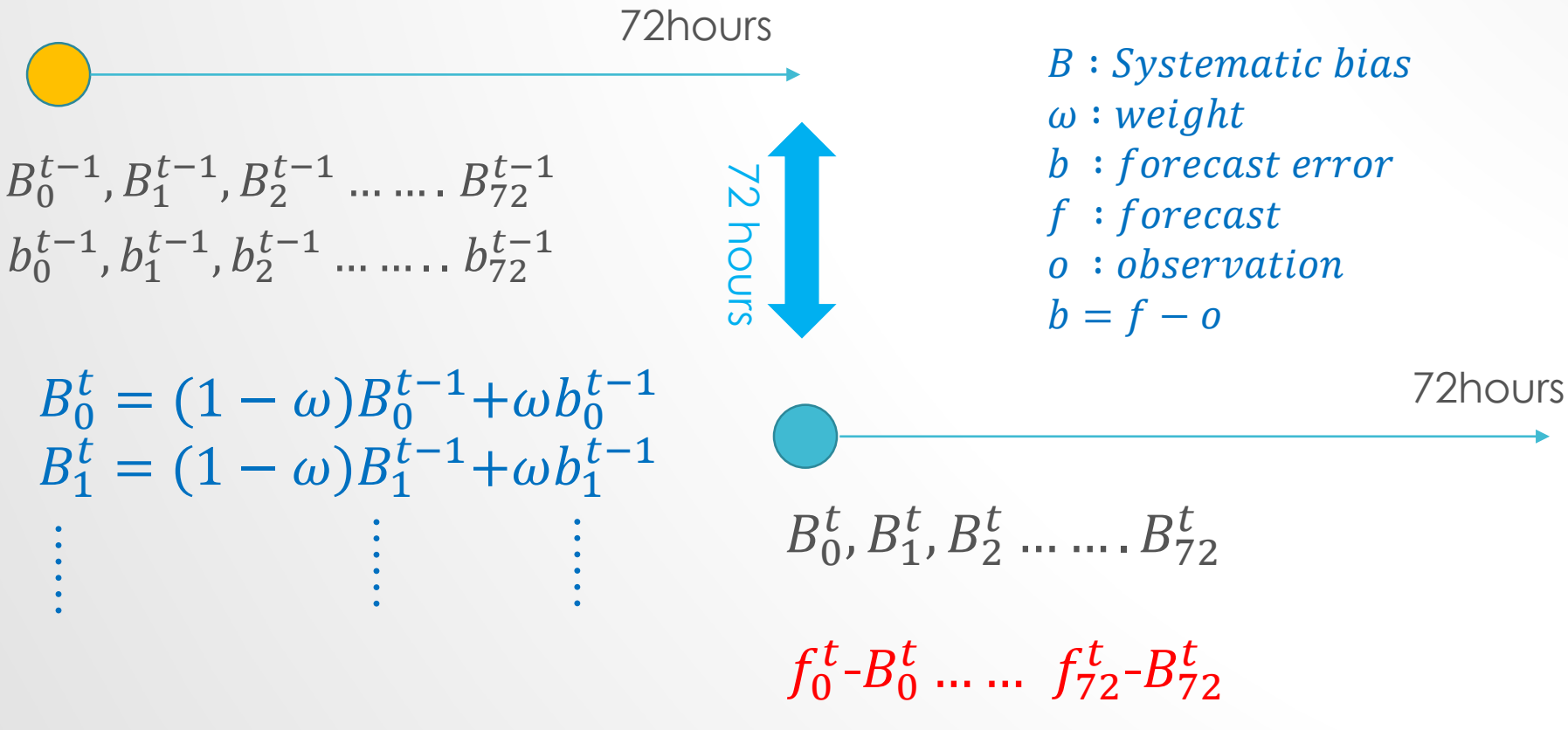


(NCEP & CMC, 2006)

4. Quantile mapping(QM)



DECAYING AVERAGE



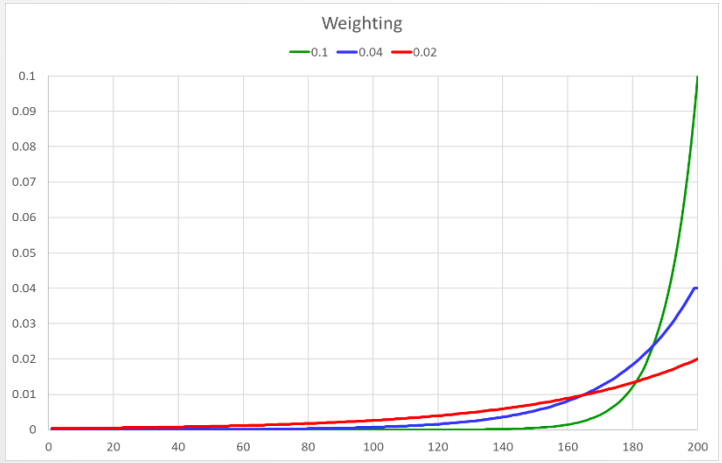
$$B_n^t = (1-\omega)B_n^{t-1} + \omega b_n^{t-1}$$

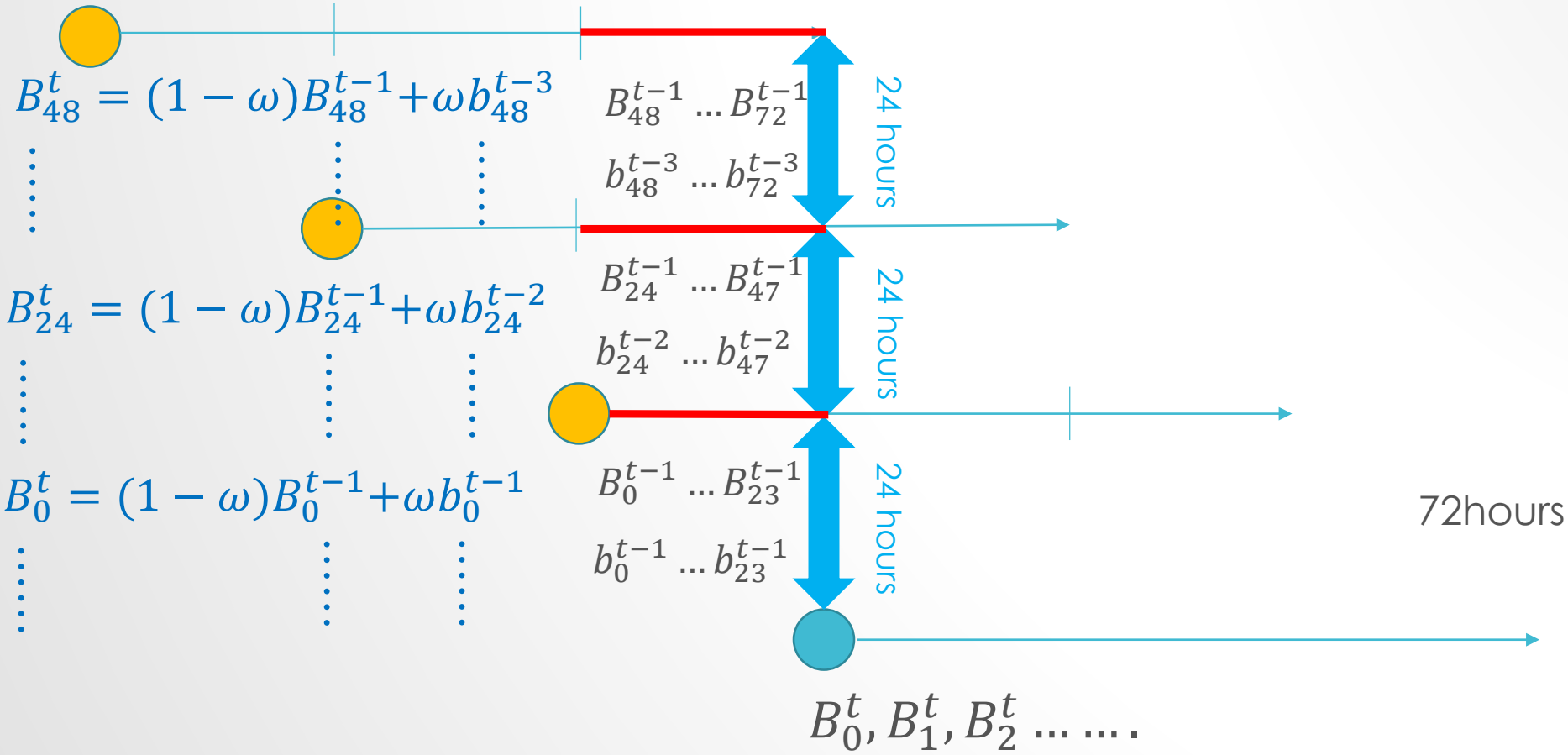
$$B_n^t = (1-\omega)^2 B_n^{t-2} + \omega(1-\omega)b_n^{t-2} + \omega b_n^{t-1}$$

$$B_n^t = (1-\omega)^3 B_n^{t-3} + \omega(1-\omega)^2 b_n^{t-3} + \omega(1-\omega)b_n^{t-2} + \omega b_n^{t-1}$$

可推導至離現在k個預報時段之預報誤差的相關性如下式:

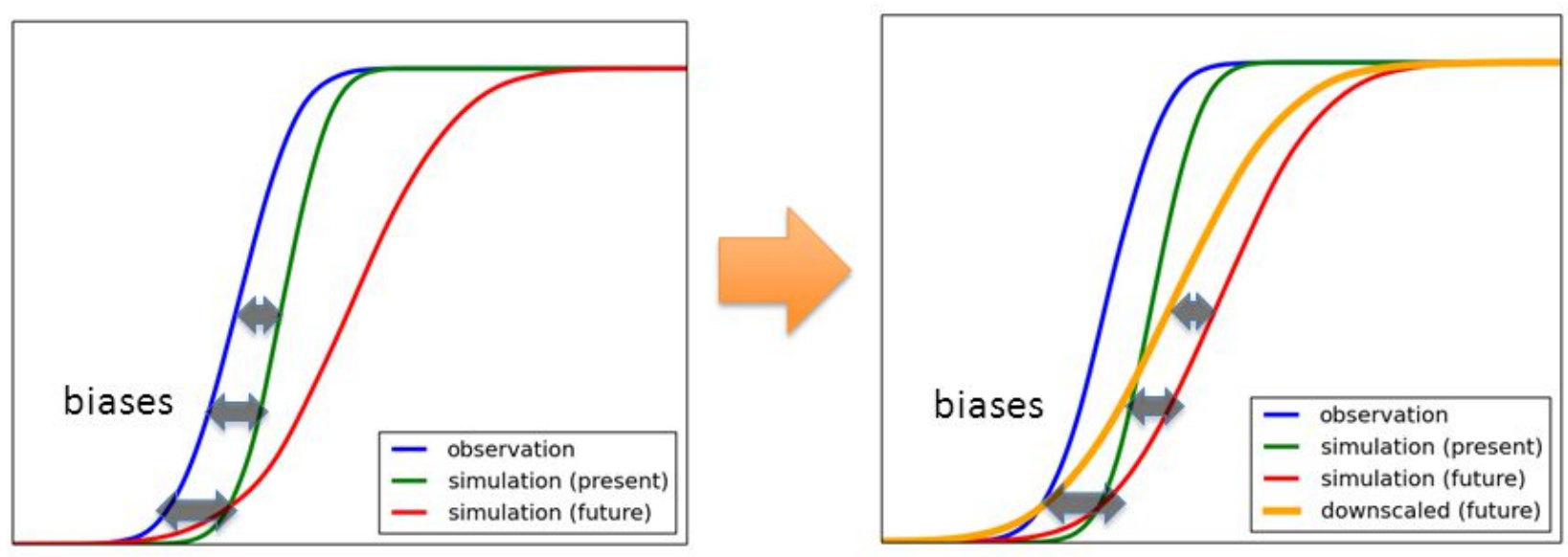
$$B_n^t = \omega(1-\omega)^{k-1} b_n^{t-k} \ldots\ldots + \omega(1-\omega)^2 b_n^{t-3} + \omega(1-\omega)b_n^{t-2} + \omega b_n^{t-1}$$



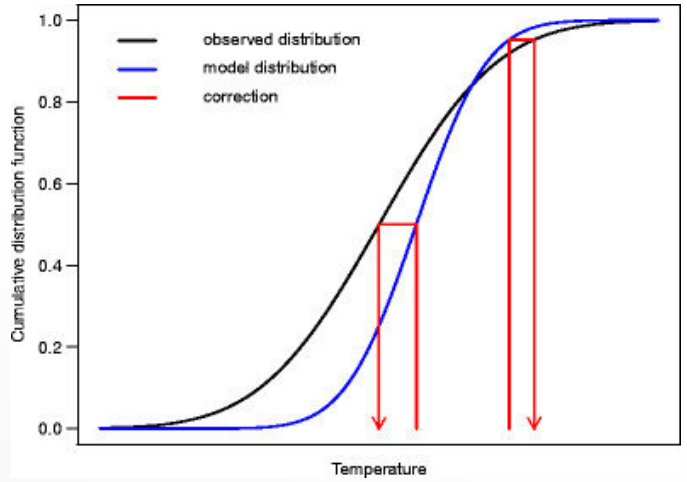

$B_{48}^{t} = (1-\omega)B_{48}^{t-1} + \omega b_{48}^{t-3}$
$B_{24}^{t} = (1-\omega)B_{24}^{t-1} + \omega b_{24}^{t-2}$
$B_{0}^{t} = (1-\omega)B_{0}^{t-1} + \omega b_{0}^{t-1}$
$B_{48}^{t-1} \dots B_{72}^{t-1}$
$b_{48}^{t-3} \dots b_{72}^{t-3}$
$B_{24}^{t-1} \dots B_{47}^{t-1}$
$b_{24}^{t-2} \dots b_{47}^{t-2}$
$B_{0}^{t-1} \dots B_{23}^{t-1}$
$b_{0}^{t-1} \dots b_{23}^{t-1}$
24 hours
24 hours
24 hours
72hours
$B_0^t, B_1^t, B_2^t \dots \dots .$

QUANTILE MAPPING

- To match the CDF(Cumulative Distribution Function) of the model time series to that of a target(observational) time series.

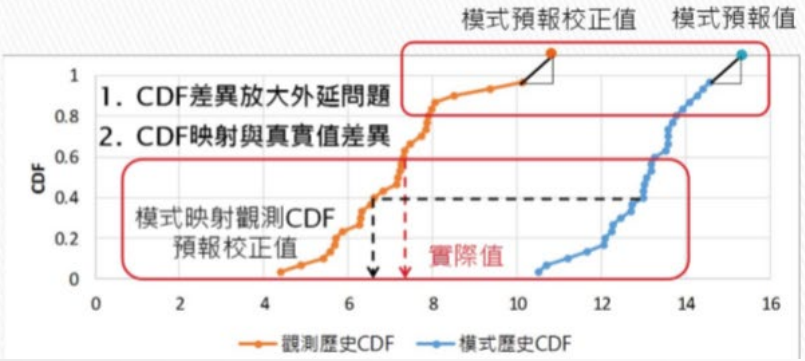


CDF & Inverse CDF

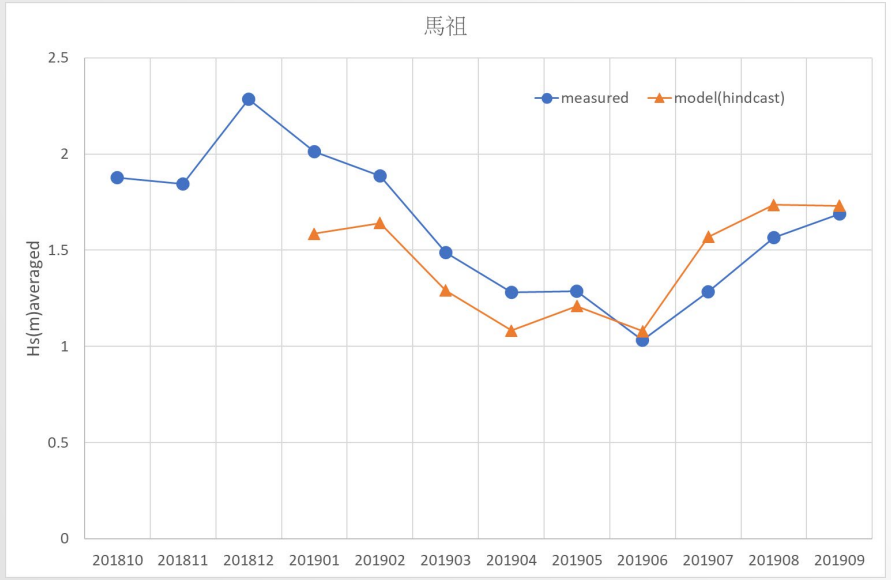


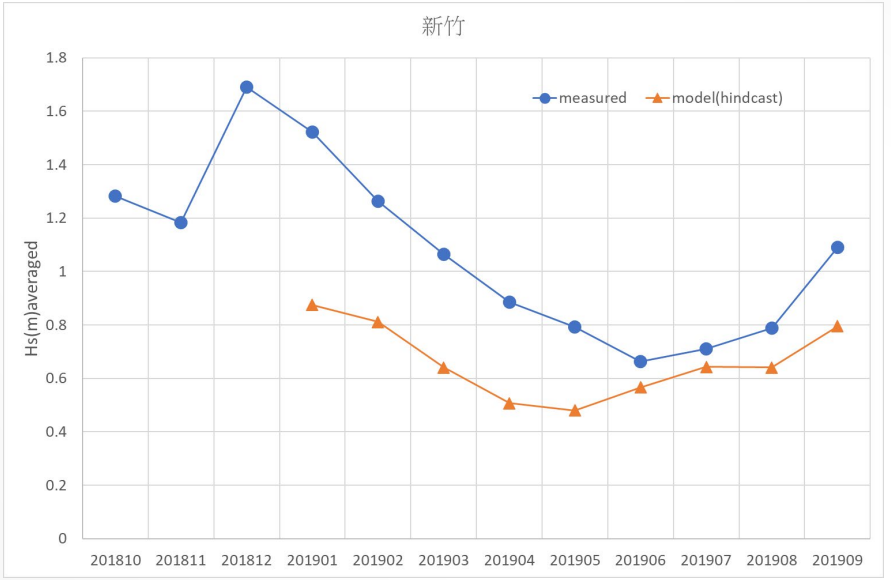
QM誤差來源

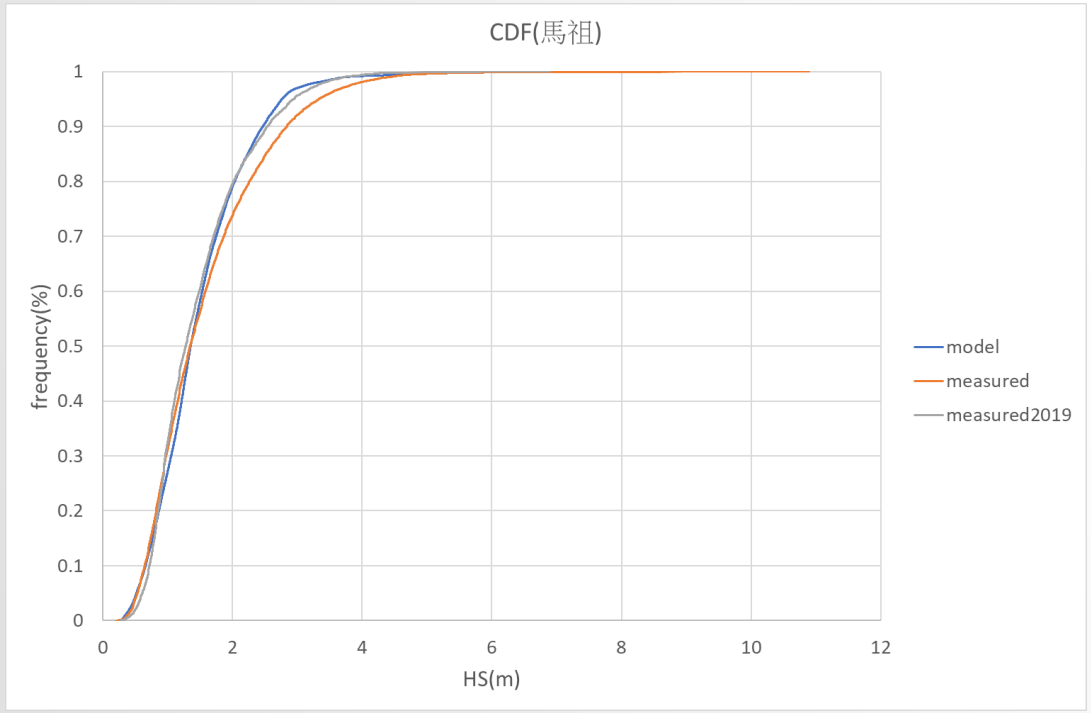
- 樣本數太少建立的CDF函數形狀較不連續，容易產生誤差。
- 當模式預報值落在CDF範圍以外之極值處理。
- CDF函數形狀斜率差異過大，使得分位數即便移動相同百分位，變數變動的幅度卻不同，造成校正誤差。
- 最主要的影響因素為模式的分位數與觀測的分位數之差異。

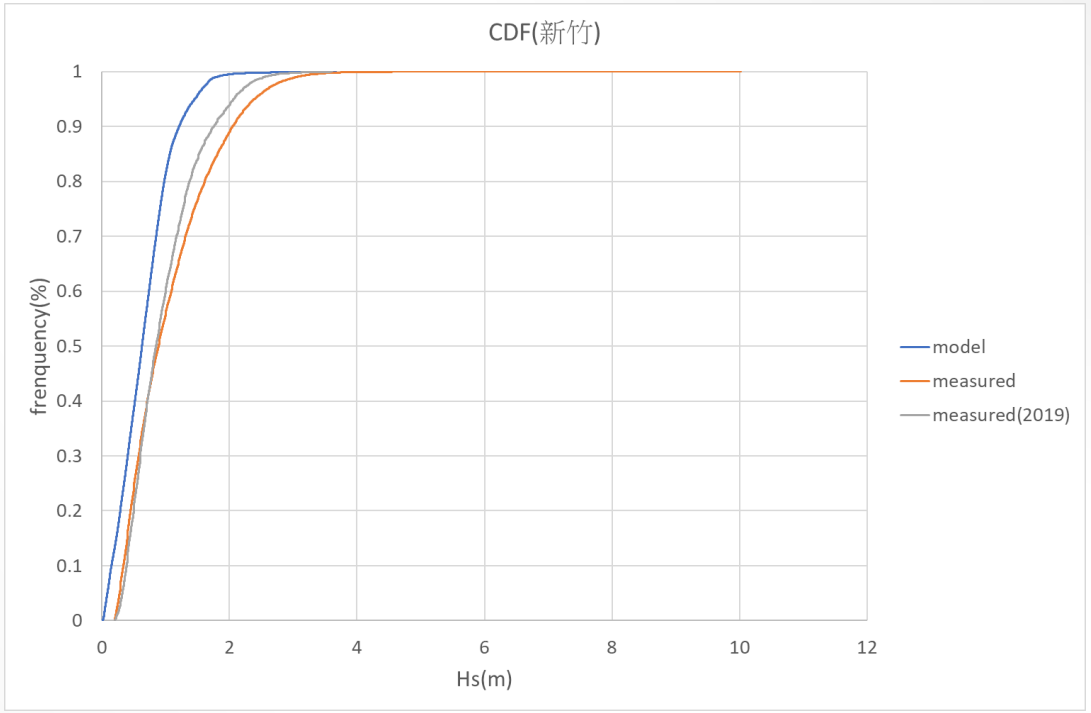



馬祖
新竹

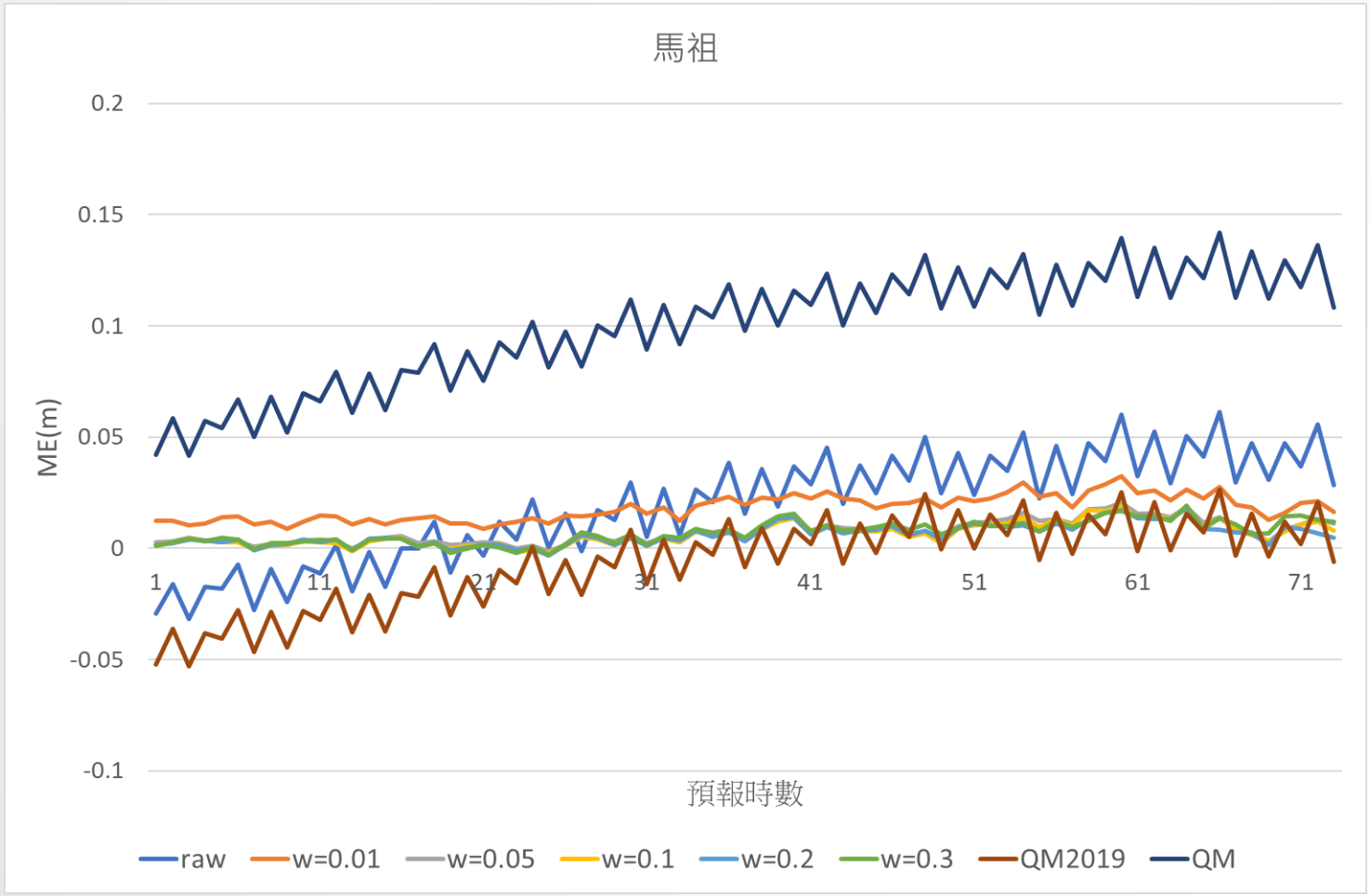

馬祖
measured
model(hindcast)
Hs(m)averaged
2.5
2
1.5
1
0.5
0
201810
201811
201812
201901
201902
201903
201904
201905
201906
201907
201908
201909

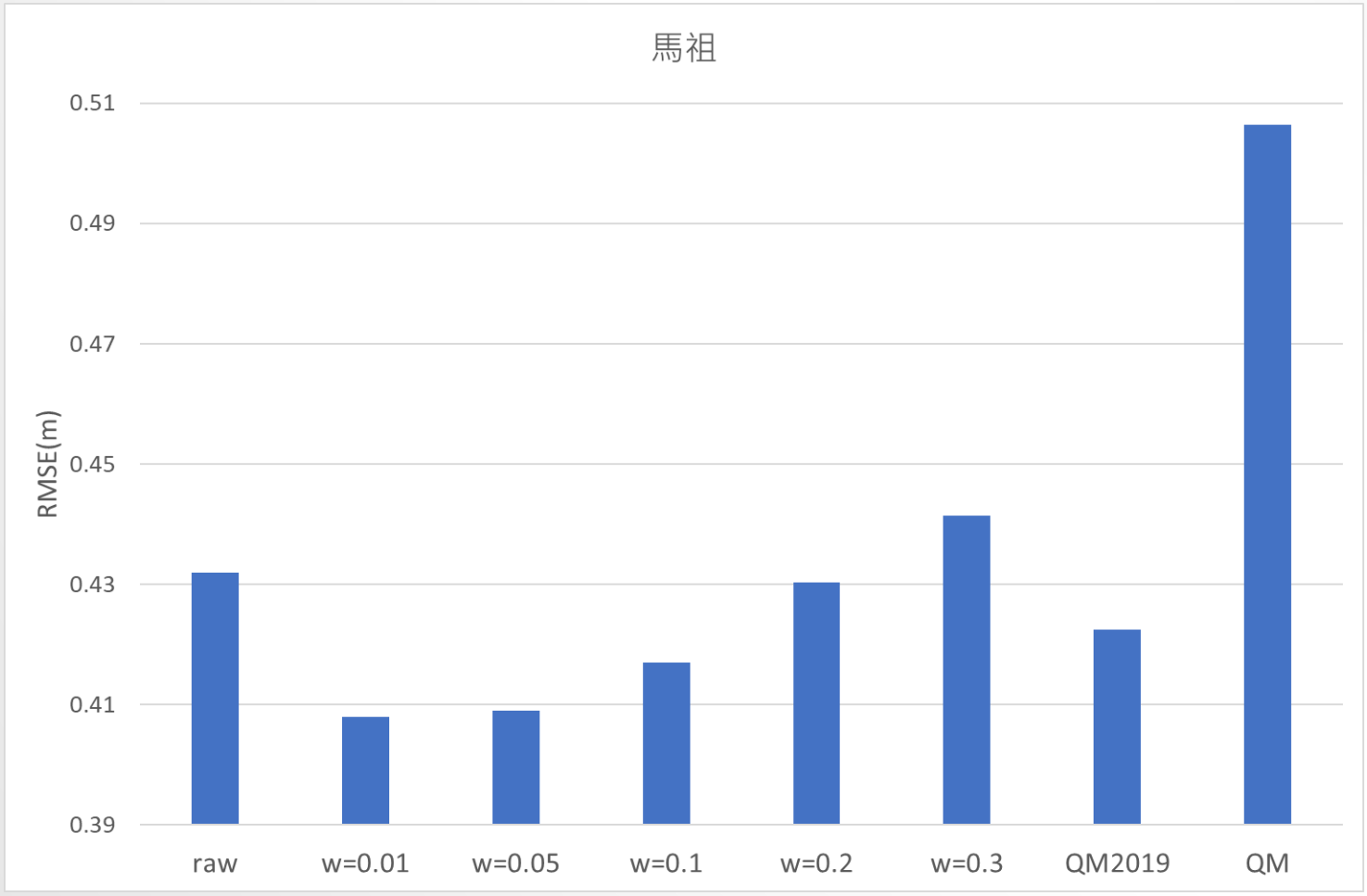

新竹
measured
model(hindcast)
Hs(m)averaged
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
201810
201811
201812
201901
201902
201903
201904
201905
201906
201907
201908
201909

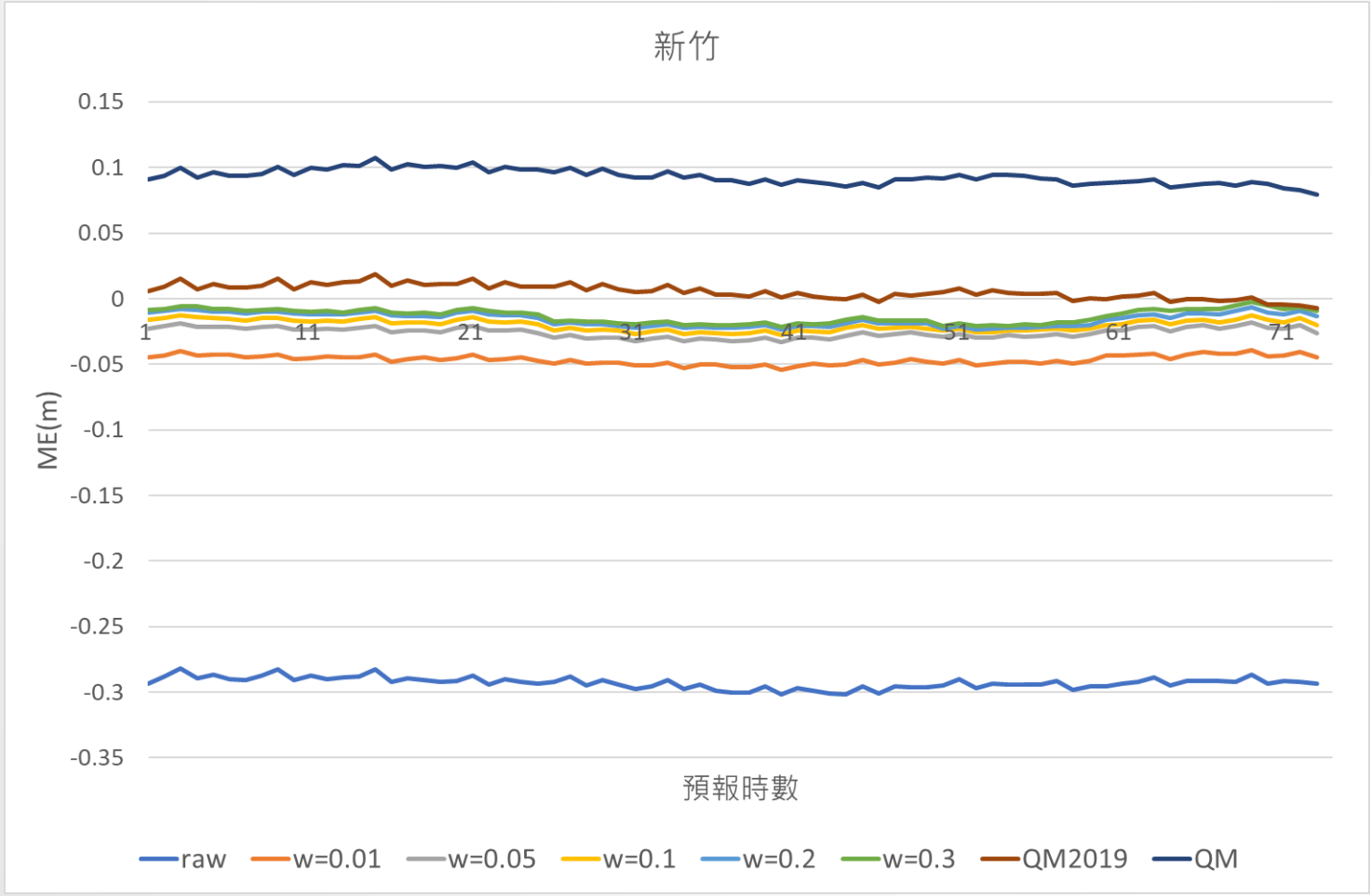


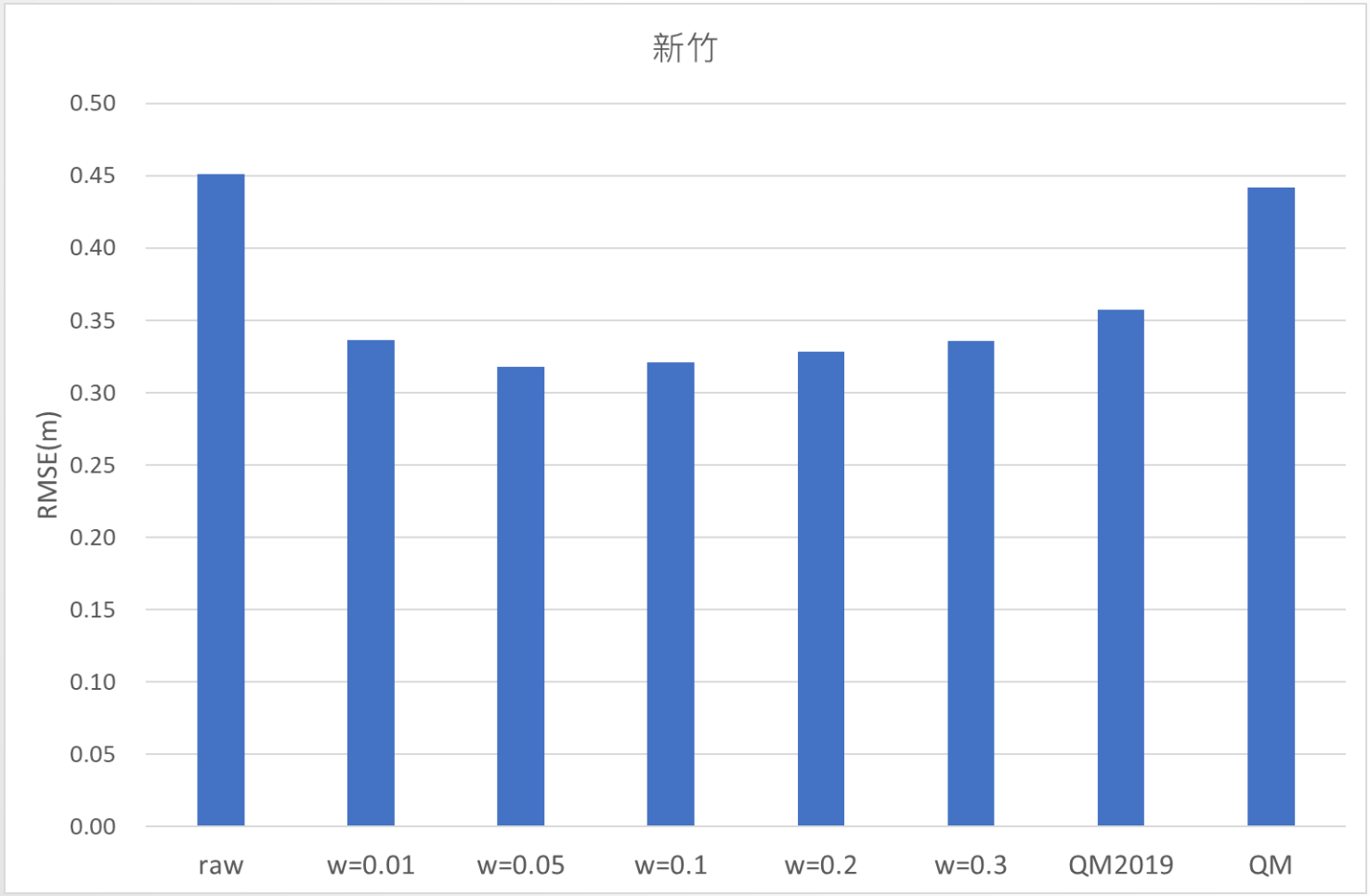


measured(2016~2019/9)
measured2019(2019/1~9)

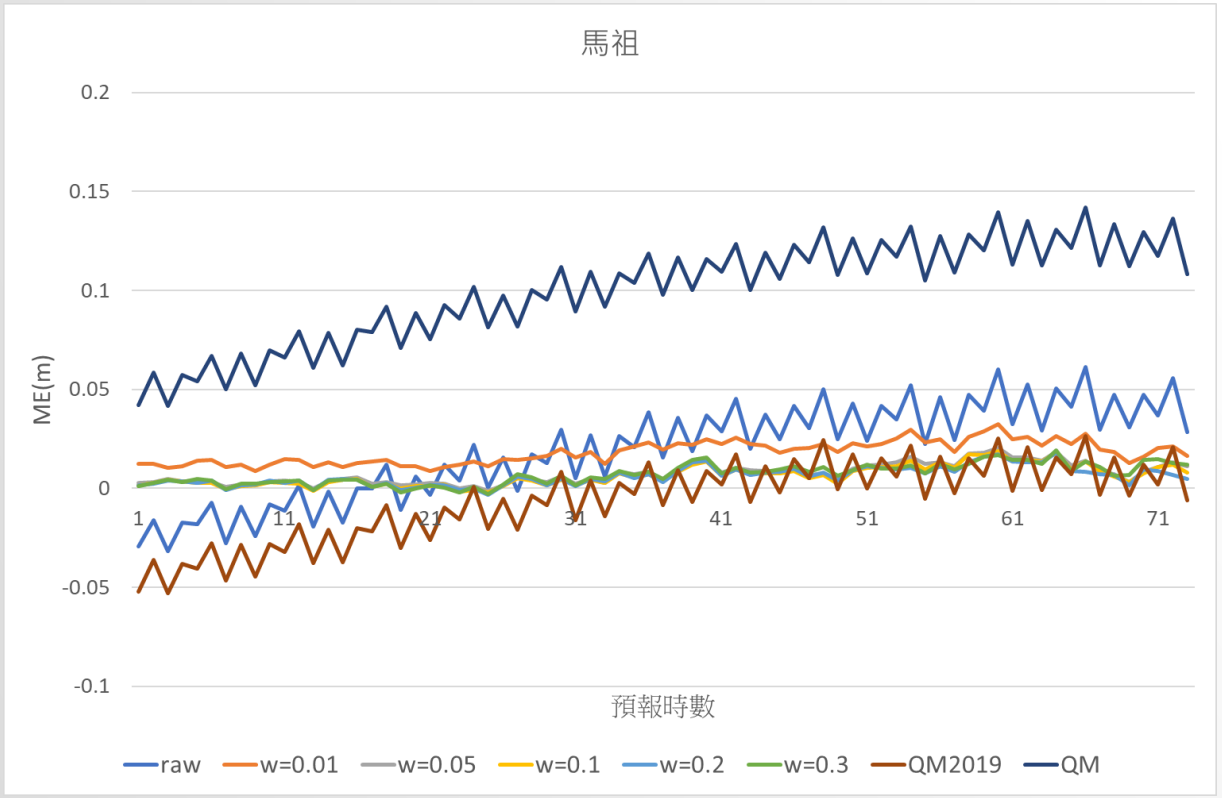

馬祖
0.2
0.15
0.1
0.05
0
-0.05
-0.1
ME(m)
1
11
21
31
41
51
61
71
預報時數
raw
w=0.01
w=0.05
w=0.1
w=0.2
w=0.3
QM2019
QM


馬祖
RMSE(m)
0.51
0.49
0.47
0.45
0.43
0.41
0.39
raw
w=0.01
w=0.05
w=0.1
w=0.2
w=0.3
QM2019
QM

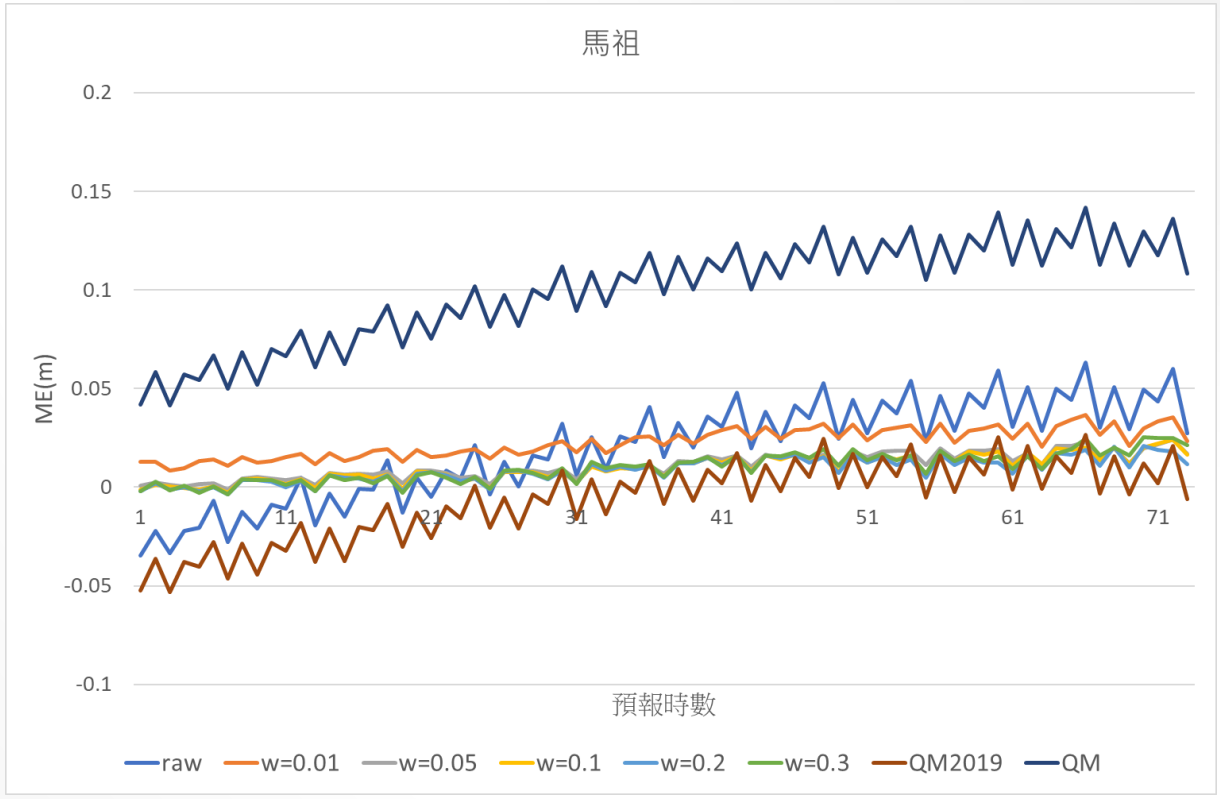

新竹
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
ME(m)
1
11
21
31
41
51
61
71
預報時數
raw
w=0.01
w=0.05
w=0.1
w=0.2
w=0.3
QM2019
QM

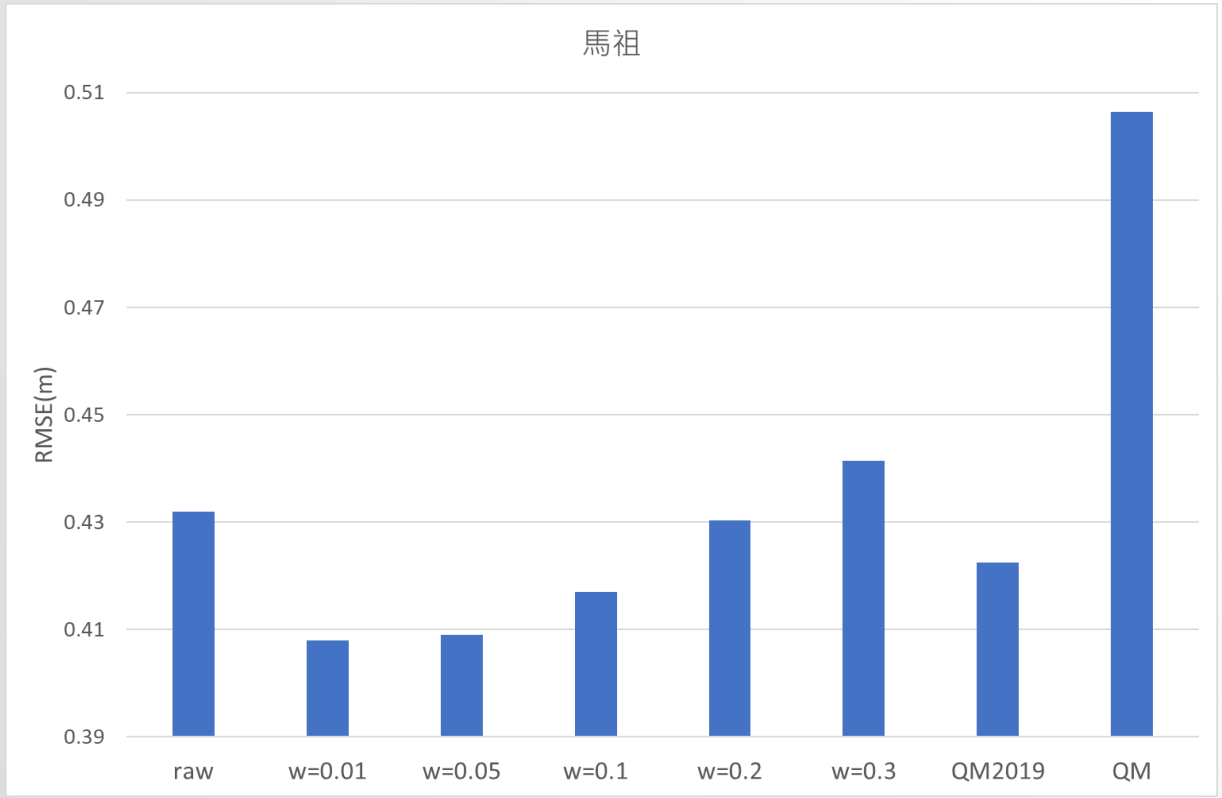

新竹
RMSE(m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
raw
w=0.01
w=0.05
w=0.1
w=0.2
w=0.3
QM2019
QM

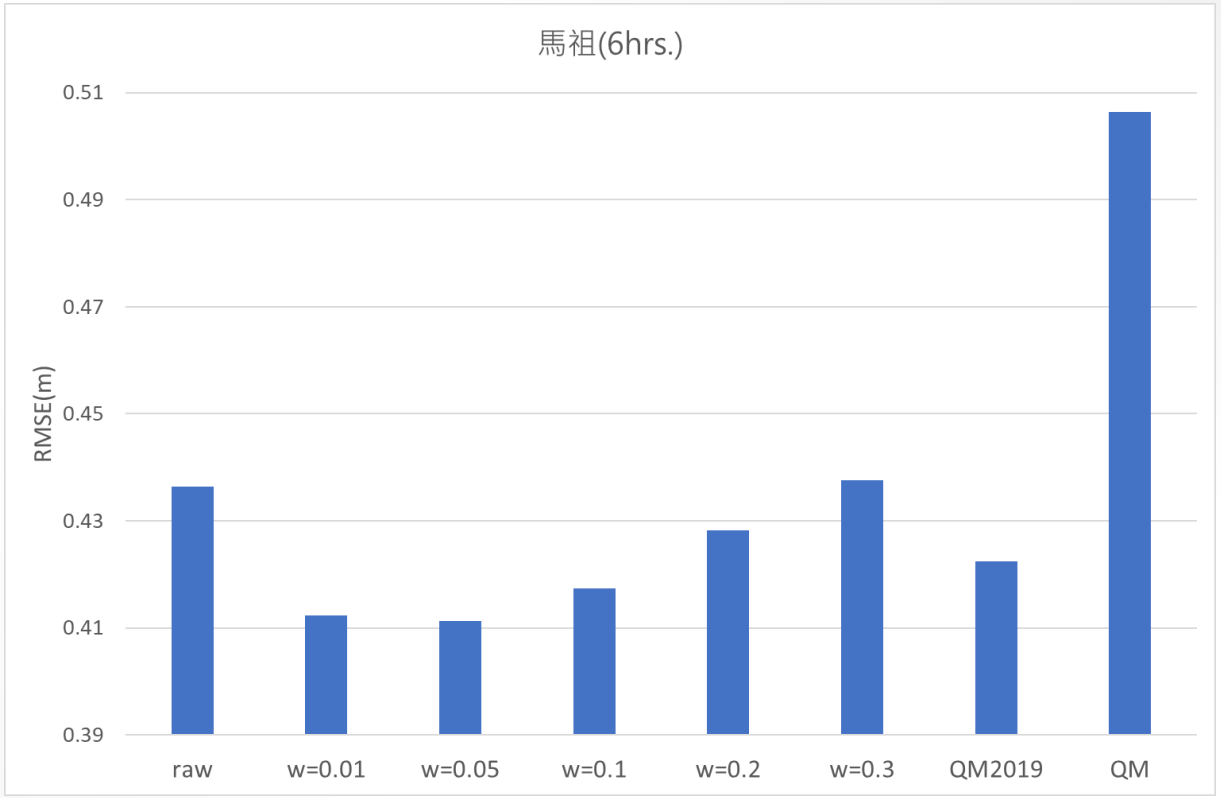
24hrs


馬祖
0.2
0.15
0.1
0.05
0
-0.05
-0.1
ME(m)
1
11
21
31
41
51
61
71
預報時數
raw
w=0.01
w=0.05
w=0.1
w=0.2
w=0.3
QM2019
QM

6hrs


馬祖
0.2
0.15
0.1
0.05
0
-0.05
-0.1
ME(m)
1
11
21
31
41
51
61
71
預報時數
raw
w=0.01
w=0.05
w=0.1
w=0.2
w=0.3
QM2019
QM


馬祖
0.51
0.49
0.47
0.45
0.43
0.41
0.39
RMSE(m)
raw
w=0.01
w=0.05
w=0.1
w=0.2
w=0.3
QM2019
QM


馬祖(6hrs.)
0.51
0.49
0.47
0.45
0.43
0.41
0.39
RMSE(m)
raw
w=0.01
w=0.05
w=0.1
w=0.2
w=0.3
QM2019
QM

CONCLUSION

- Decay average : 除了可以消除BIAS，亦可提高模式的精度(降低RMSE)
- 馬祖站W=0.05(0.019→0.007)，新竹站W=0.2(-0.293→-0.016)可以得到較佳的修正。
- QM:利用同年的觀測資料修正，得到平均BIAS的改善，在馬祖站(0.019→0.006)，新竹站 (-0.293→0.006)，其亦可提高模式的精度，但略低於較使用Decay average法。
- Decay average法需用到過去72小時的預報資料，本研究使用過去24小時的觀測資料，最短可僅使用過去6小時的觀測資料。
- QM需有較Decay average更長時間的觀測資料及模式資料(CDF)。

THANKS FOR YOUR ATTENTION