應用Decaying Average 發展測站即時溫度觀測檢核技術

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簡報大綱

一、緣起與目標

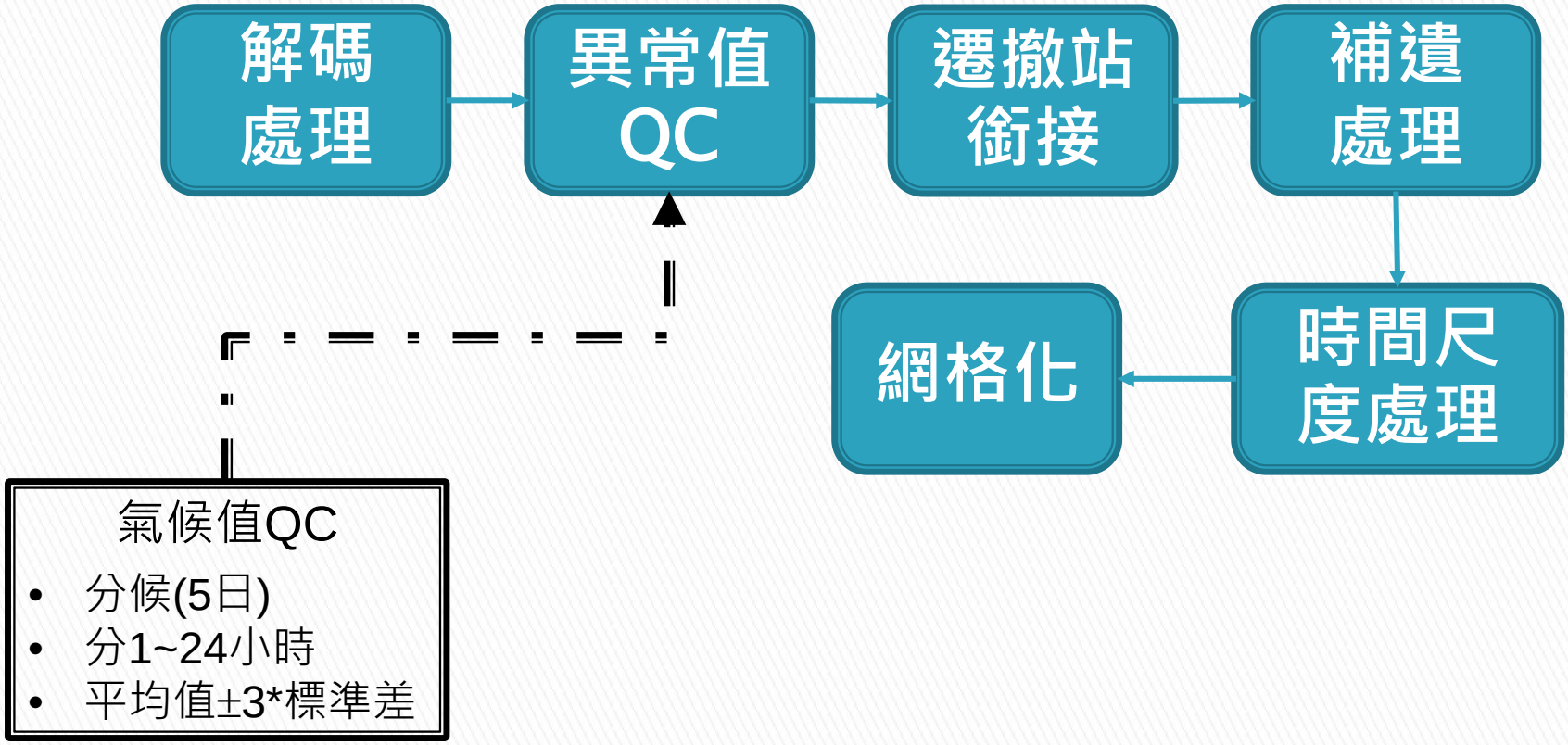
二、測站即時溫度觀測檢核技術

三、檢核結果

四、總結與後續工作

氣候變遷應用服務能力發展計畫

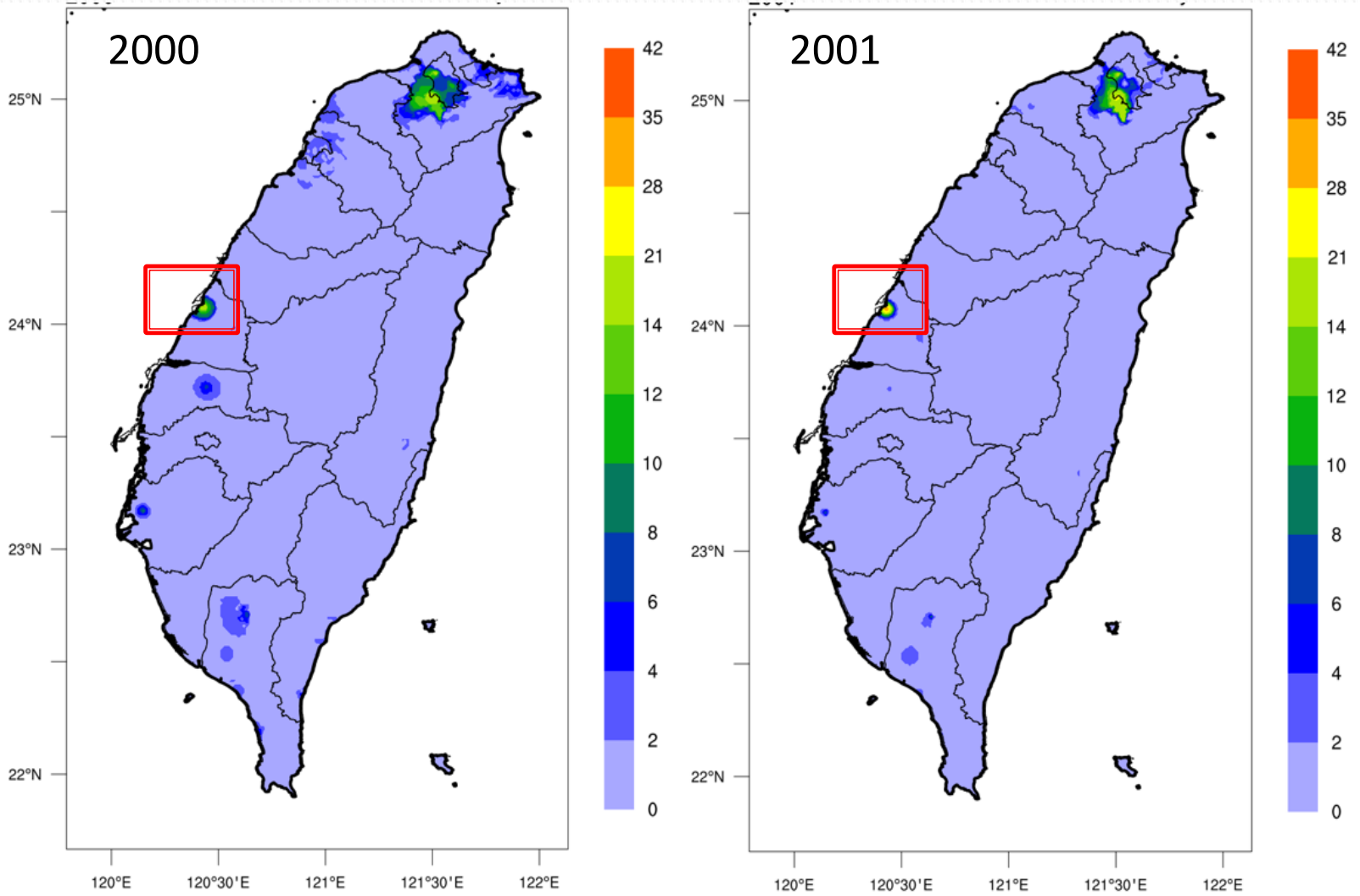
- 氣候資料整集分析系統–測站資料網格化流程



疑似異常溫度觀測

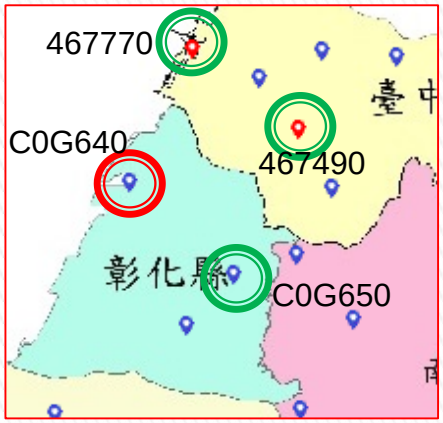
- 一日24小時溫度≥25℃ 且至少1小時≥35℃之日數

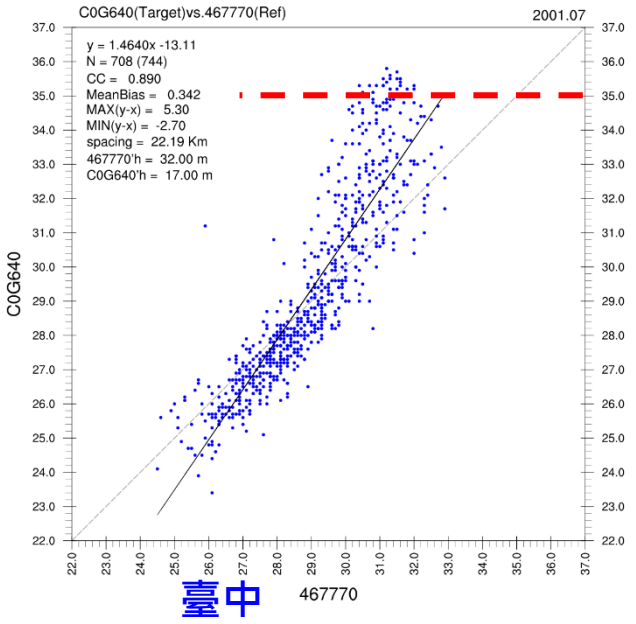
鹿港站
C0G640

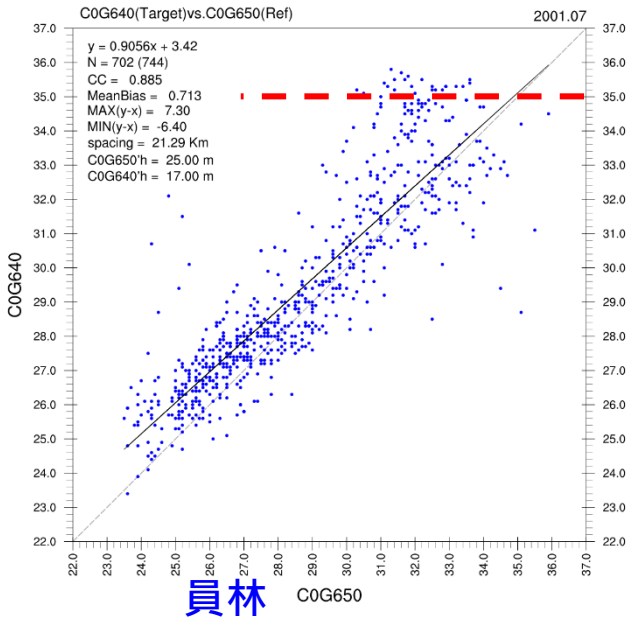


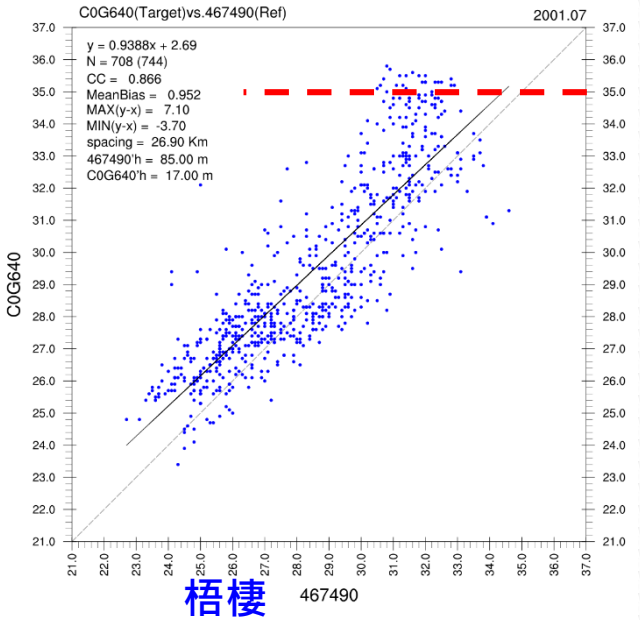
鹿港鄰近站溫度 (1/2)

- 2001年7月



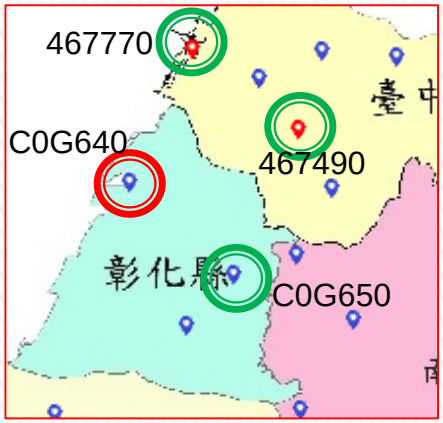


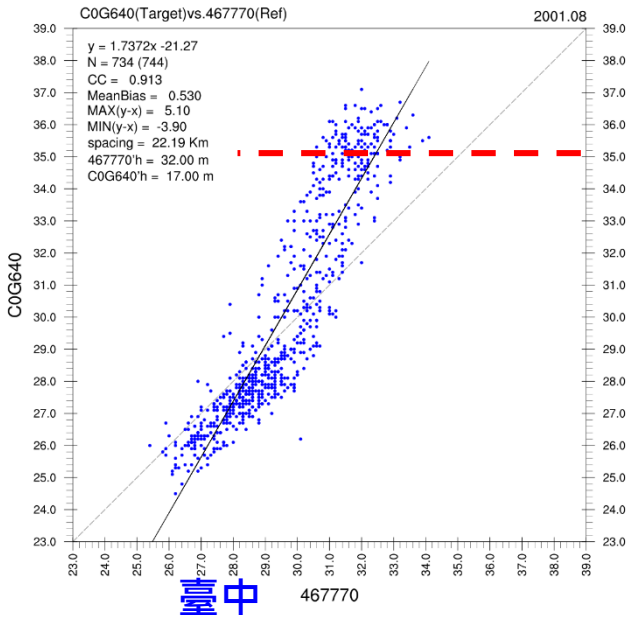


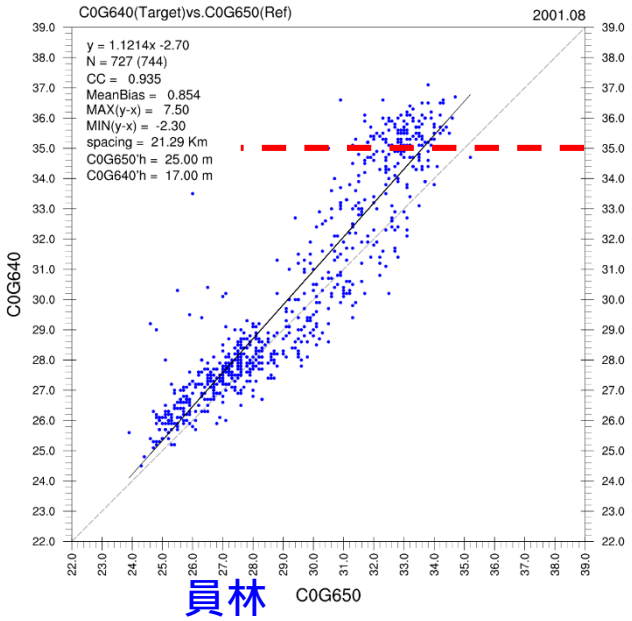


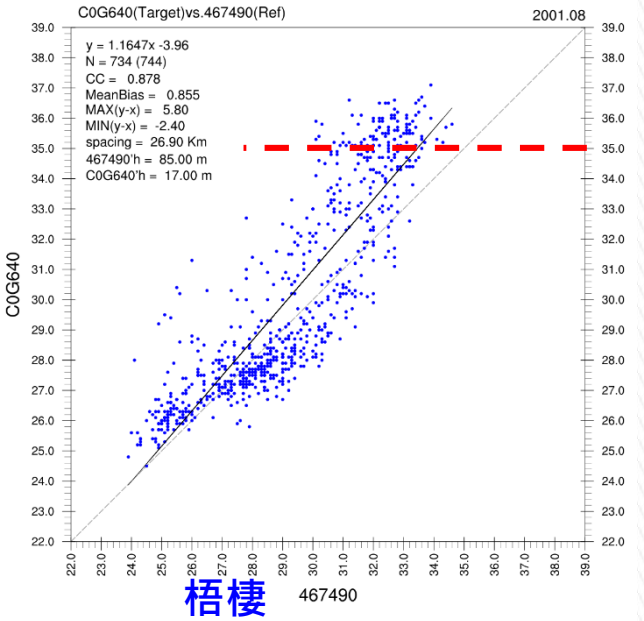
鹿港鄰近站溫度 (2/2)

- 2001年8月







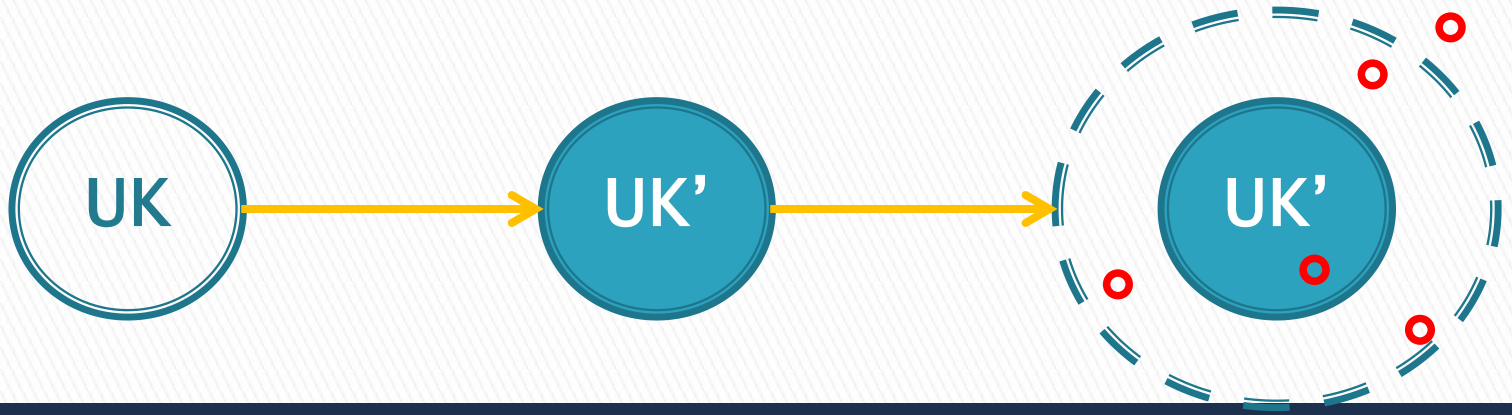


如何提升QC的正確性?

- 觀測結束後立即QC
  - QC方法需輕巧 & 計算快速
- 採用可靠的參考值
  - 透過正確觀測資料組成
  - 需移除系統性偏差
  - 需有估計誤差標準差
- 納入氣象/氣候觀點
  - 日夜差異
  - 季、月、旬、候

即時溫度觀測檢核技術

- 克利金空間內插法
  - 利用當下其他測站的觀測資料
  - 統計理論提供估計誤差標準差
- Decaying Average 校正法
  - 系統性偏差紀錄僅需紀錄於一個數值 -> 輕巧!
  - 三方程，加、減、乘 -> 計算簡易
- 區分月份與1~24小時



DCA 加減乘

t-1 時間點克利金OSSE估計值

t 時間點誤差

t-1 時間點觀測值

$$b_{i,j}(t) = f_{i,j}(t-1) - a_{i,j}(t\text{-}1)$$

權重係數 0.01, 代表考慮
100天前迄今的偏差值

t 時間點系統性偏差 更新

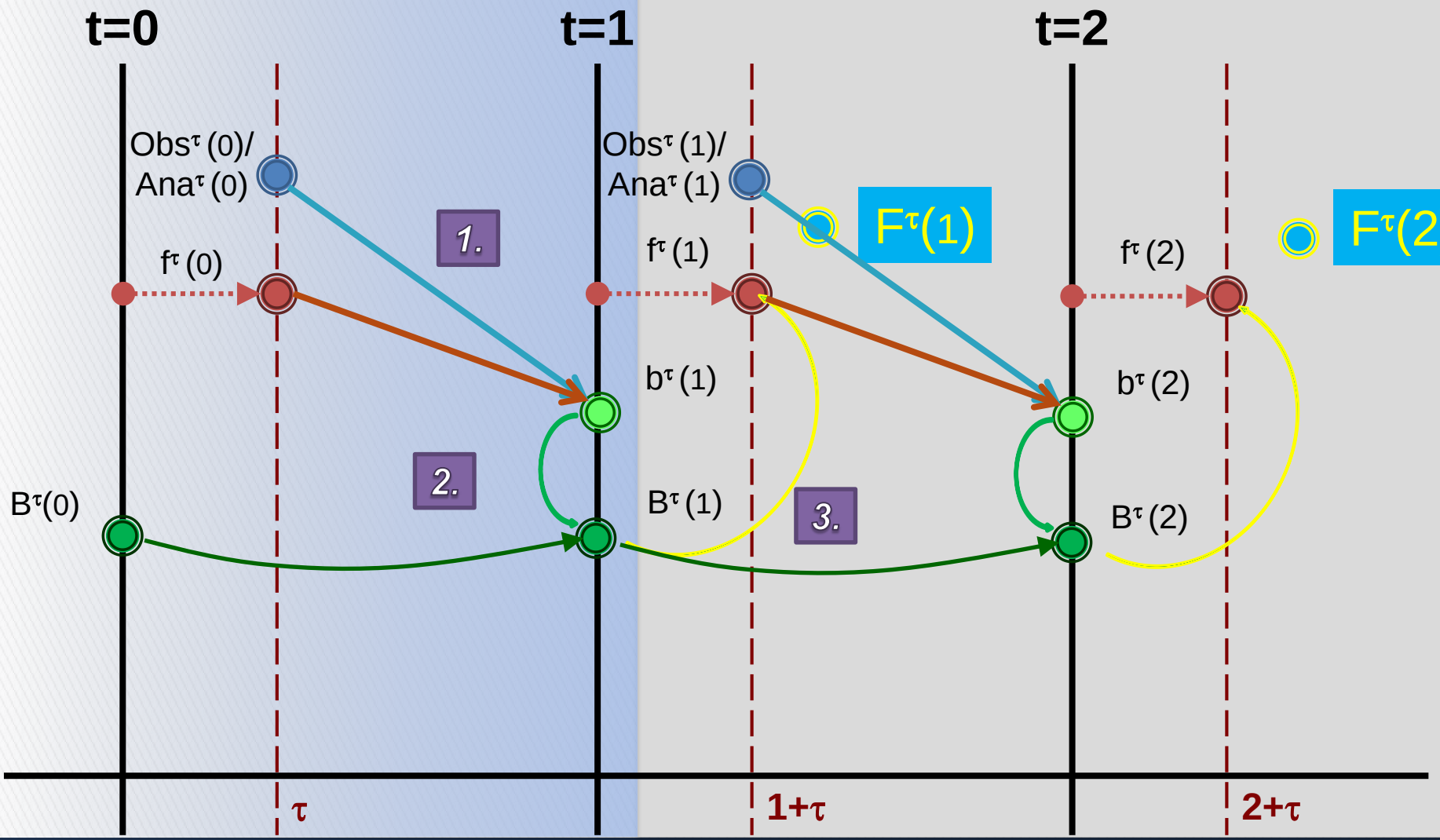
$$B_{i,j}(t) = (1-\omega)\cdot B_{i,j}(t-1) + \omega \cdot b_{i,j}(t)$$

使用1993年開始之溫度時資料
逐步進行系統性偏差估計

t 時間點
克利金OSSE修正估計值

$$F_{i,j}(t) = f_{i,j}(t) - B_{i,j}(t)$$

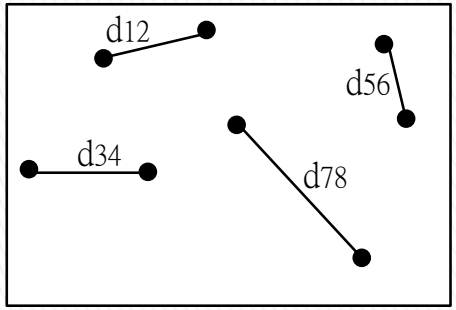
DCA 運作流程


t=0
t=1
t=2
Obsτ (0)/
Anaτ (0)
fτ (0)
1.
2.
Bτ(0)
Obsτ (1)/
Anaτ (1)
fτ (1)
Fτ(1)
bτ (1)
Bτ (1)
3.
fτ (2)
Fτ(2)
bτ (2)
Bτ (2)
τ
1+τ
2+τ

Kriging step by step (1/2)

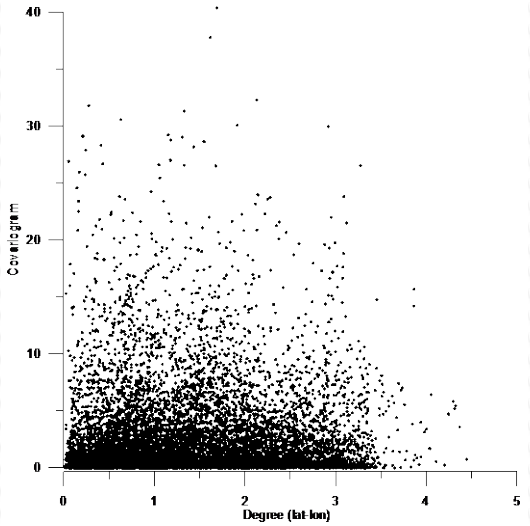
1. Calculate distance between stations

$$d_{12} = |\mathbf{u}_1 - \mathbf{u}_2| = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

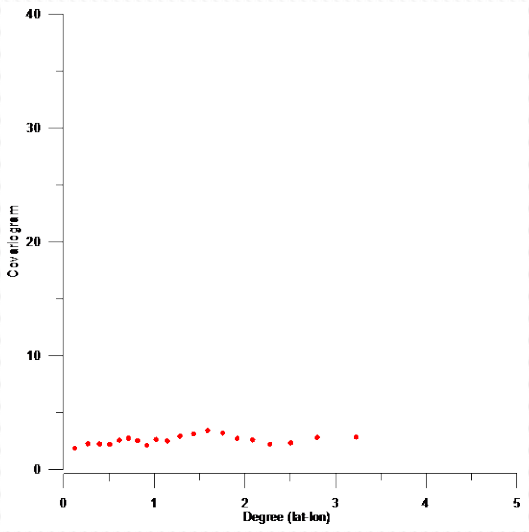


2. Calculate raw variograms

$$\gamma(d_{12}) = \frac{1}{2}[Z(\mathbf{u}_1) - Z(\mathbf{u}_2)]^2$$



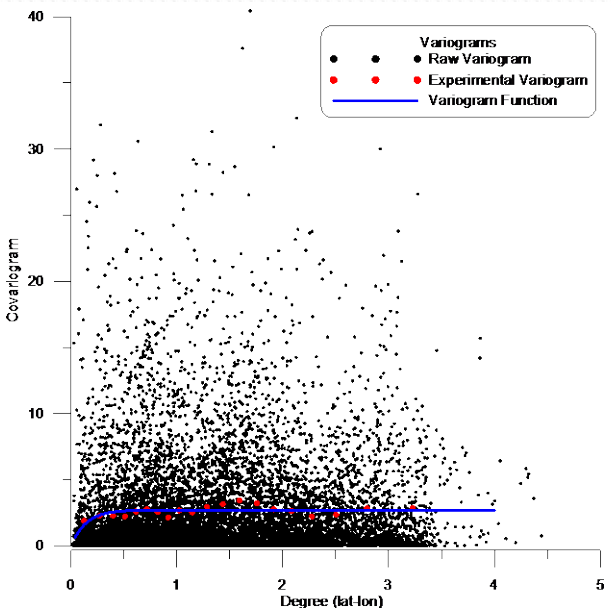
3. Calculate experimental variograms



Kriging step by step (2/2)

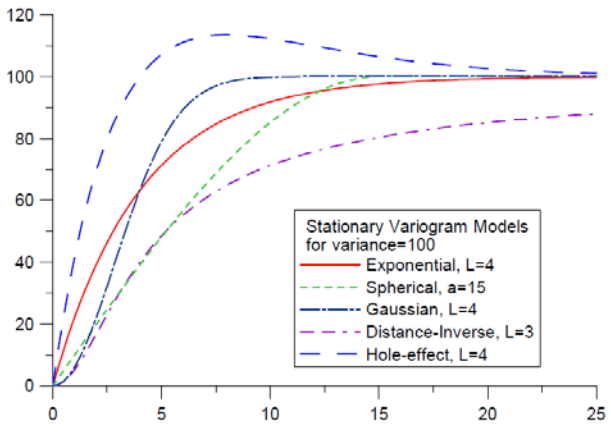
4. Fitting experimental variograms

Exponential model $\gamma(d) = \sigma^2\left[1 - \exp\left(-\frac{d}{L}\right)\right]$



5. Calculate weightings

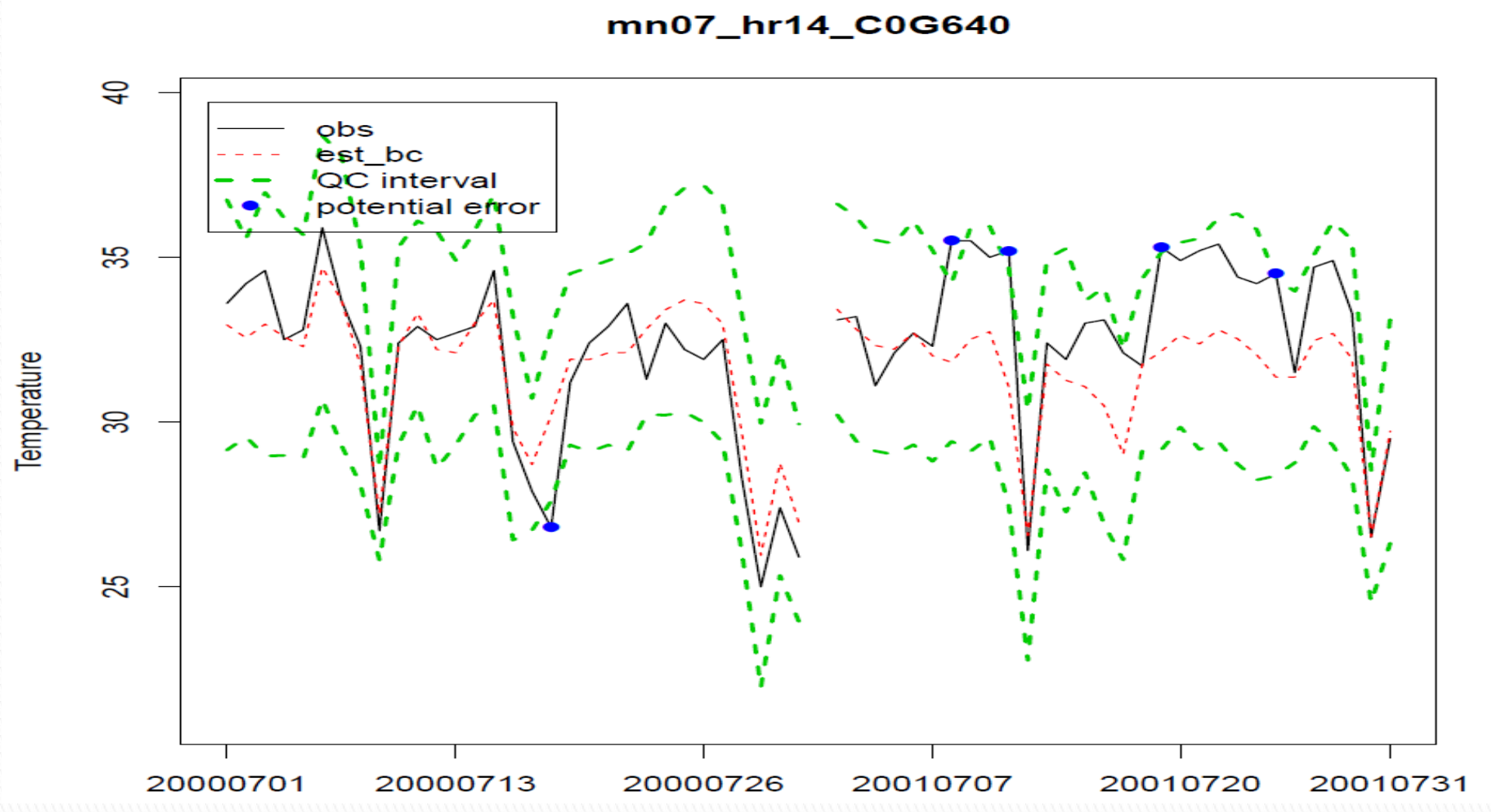
$$\begin{bmatrix} \sigma^2 & c_{12} & \cdots & c_{1n} & 1 \\ c_{21} & \sigma^2 & \cdots & c_{2n} & 1 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ c_{n1} & c_{n2} & \cdots & \sigma^2 & 1 \\ 1 & 1 & \cdots & 1 & 0 \end{bmatrix} \cdot \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \vdots \\ \lambda_n \\ \nu \end{bmatrix} = \begin{bmatrix} c_{01} \\ c_{02} \\ \vdots \\ c_{0n} \\ 1 \end{bmatrix}$$



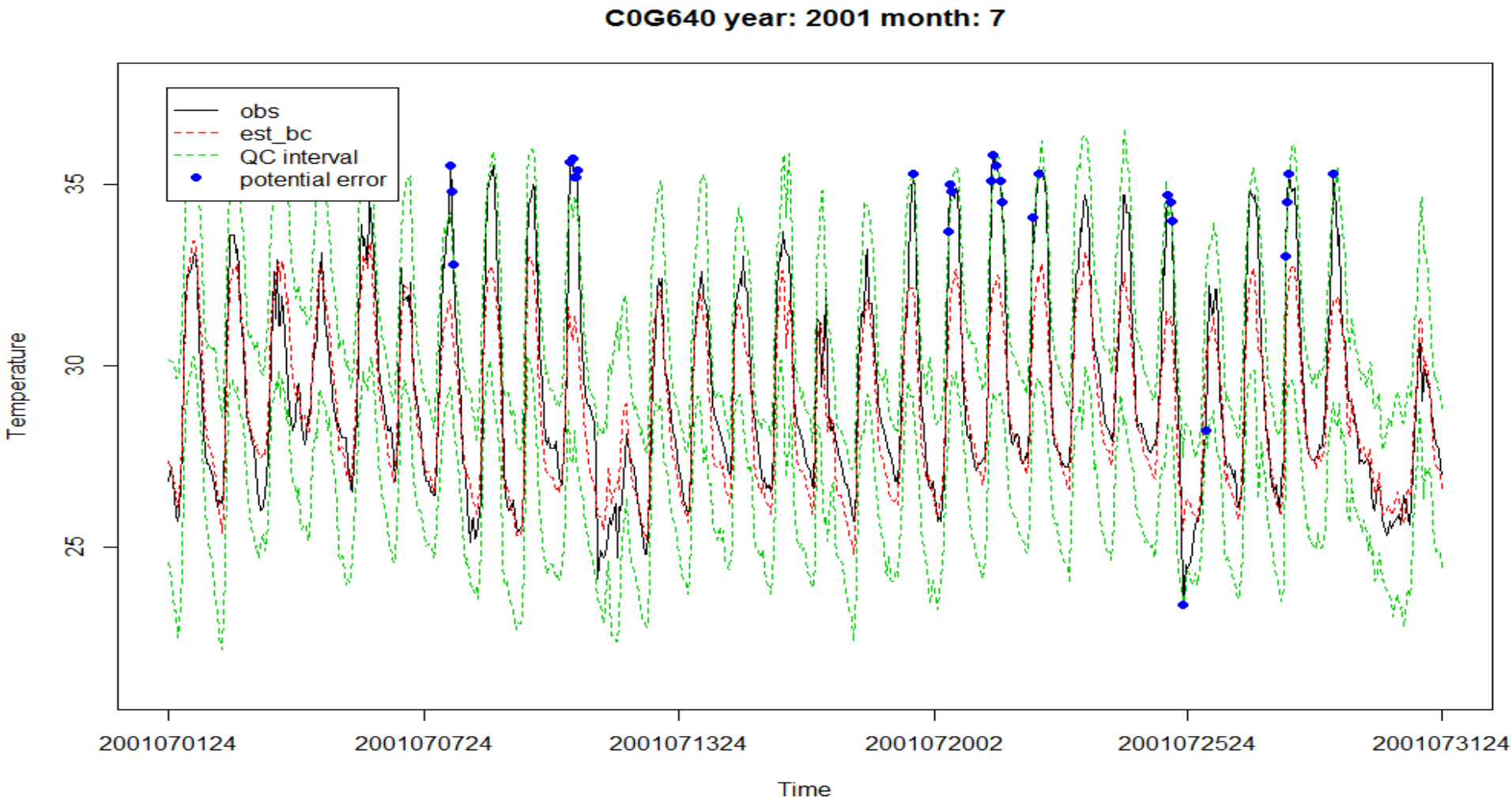
6. Kriging interpolation

$$\hat{z}(\mathbf{u}_0) = \sum_{i=1}^{n} \lambda_i z(\mathbf{u}_i)$$

鹿港站7月14:00檢核結果



2001年7月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obs
est_bc
QC interval
potential error
Temperature
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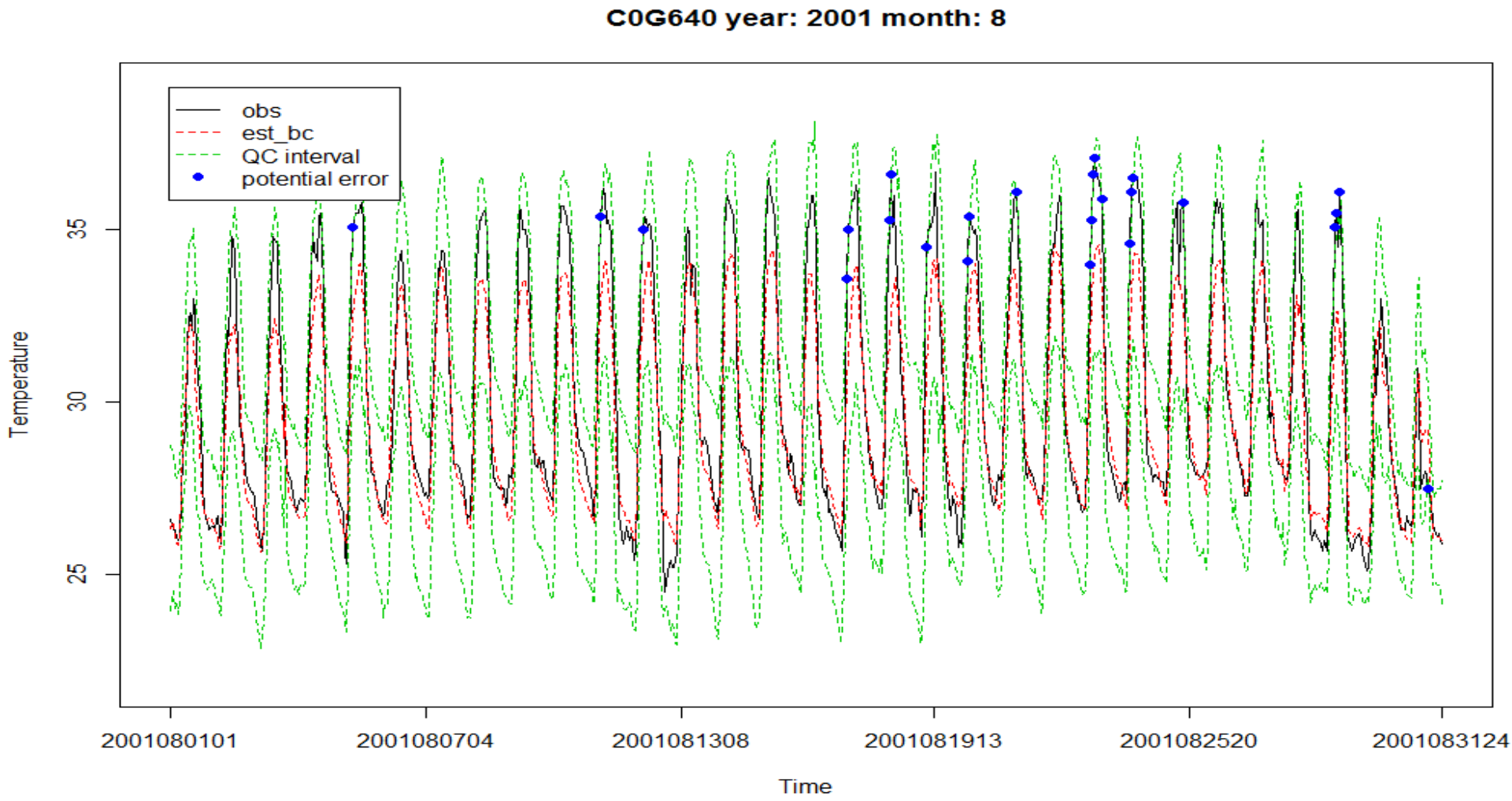
30
35
2001070124
2001070724
2001071324
2001072002
2001072524
2001073124
Time

2001年8月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obs
est_bc
QC interval
potential error
Temperature
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30
35
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2001080704
2001081308
2001081913
2001082520
2001083124
Time

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C0G640	2001072010	33.7	30	29.6	30
C0G640	2001072110	35.1	30.5	30.5	30.5
C0G640	2001072610	28.2	29.2	29.1	28.9
C0G640	2001072810	34.5	30.9	30.5	30.9
C0G640	2001071111	35.6	31.8	31.3	31.6
C0G640	2001072011	35	31	30.5	30.8
C0G640	2001072111	35.8	31.3	31.2	30.8
C0G640	2001072811	35.3	31.2	31.1	31.9
C0G640	2001071112	35.7	31.6	31.5	30.9
C0G640	2001072012	34.8	32.2	30.8	31.8
C0G640	2001072112	35.5	31.4	31.6	31.2
C0G640	2001072212	35.3	31.9	30.9	32.5
C0G640	2001072912	35.3	33.4	31.6	32
C0G640	2001071113	35.2	30.3	32	31.1
C0G640	2001072513	34.7	31	30.2	30.7
C0G640	2000071814	26.8	30.1	29.5	31.3
C0G640	2001070814	35.5	31.7	31.1	31.4
C0G640	2001071114	35.2	31.4	31.3	30.6
C0G640	2001071914	35.3	32.9	30.7	32
C0G640	2001072514	34.5	31.9	30.2	32.3
C0G640	2001070815	34.8	31.7	31.2	31.2
C0G640	2001071115	35.4	31.1	31.6	30.7
C0G640	2001072115	35.1	32	30.8	31.4
C0G640	2001072515	34	31.9	30.2	31
C0G640	2001070816	32.8	31.4	30.6	30.9
C0G640	2001072116	34.5	31.7	30.9	31.5
C0G640	2001072521	23.4	23.6	26.1	24.3
C0G640	2000082304	24.3	25.1	24.8	25.4
C0G640	2000080608	31.4	28.3	28.9	26.8
C0G640	2000080808	31.7	27.9	29.4	27.5
C0G640	2000080908	31.4	28.3	28.8	27.8
C0G640	2000081708	32.4	29.7	29.5	28.3

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C0G640	2000080809	34.2	29.2	30	29.3
C0G640	2000080909	33.2	30.5	29.8	29.4
C0G640	2000081709	33.7	30.8	30.6	29.9
C0G640	2000081909	33.7	30.8	30.4	29.7
C0G640	2000082709	34.1	28	29.6	29.5
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C0G640	2001081909	34.5	31.7	30.5	30.4
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C0G640	2000080610	34.8	31.6	30.6	30.5
C0G640	2000080810	34.4	31.2	30.4	30.4
C0G640	2000081710	34.7	32.6	30.3	31.3
C0G640	2000081810	34.7	32	30.4	31.2
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C0G640	2000082710	34.9	29.7	30.4	30.7
C0G640	2000082810	34.7	29.4	30.2	30
C0G640	2000083010	32.7	25.9	28.1	25.5
C0G640	2001080510	35.1	32.5	30.8	31.6
C0G640	2001081110	35.4	31.9	31.3	32
C0G640	2001081210	35	30.5	30.6	31.3
C0G640	2001081710	35	32.6	30.9	31.7
C0G640	2001081810	35.3	31.4	30.6	30.1
C0G640	2001082010	35.4	32.2	31	30.2
C0G640	2001082310	35.3	33.4	31	31.7
C0G640	2001082410	36.1	33.2	31.1	31.6
C0G640	2001082910	35.1	31.3	31.1	30.9
C0G640	2000080611	35.2	32.1	30.9	30.7
C0G640	2000080811	36	30.8	30.5	31.2

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C0G640	2000082711	36.3	30.9	30.7	30.5
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C0G640	2001082311	36.6	32.3	32.6	32.7
C0G640	2001082411	36.5	34.3	31.5	32.4
C0G640	2001082911	35.5	32.3	30.9	31
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C0G640	2000080812	36	30.7	31	31.2
C0G640	2000080912	35.4	32.4	30.9	32
C0G640	2000081812	36.3	33.8	31.6	32.9
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C0G640	2000082112	36.8	31.5	31.2	32
C0G640	2000082712	35.8	31.6	30.5	31.7
C0G640	2001082312	37.1	33.8	32	33.9
C0G640	2000080813	35.5	31.4	30.9	32.1
C0G640	2000081813	36	33.7	31.2	32.4
C0G640	2000082713	35.6	32.6	31.1	32.7
C0G640	2001082913	36.1	31.7	31	31.3
C0G640	2000080614	34.9	32.1	30.1	31.4
C0G640	2000080814	35.8	32.7	31	32.1
C0G640	2000081714	35.4	32.6	31	32.2
C0G640	2000081814	36.5	32.7	31	32.3
C0G640	2000082314	24.8	24.9	24.7	25.2
C0G640	2000082714	35.9	31.8	31.3	32.4
C0G640	2000080215	32.6	26.5	30.2	26.2
C0G640	2000080615	35.2	31	30.2	31.1
C0G640	2000080715	35.2	32.3	31.3	32
C0G640	2000080815	36.3	32.3	30.5	32.5
C0G640	2000081815	36	32.1	31	32
C0G640	2000081915	36.4	32.8	30.9	32.8
C0G640	2000082015	36	33.6	31.2	32.8

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C0G640	2000080716	35	31.5	30.9	31.5
C0G640	2000080816	36.5	32	30.1	31.6
C0G640	2000081216	33.3	27.8	31.4	25.8
C0G640	2000081716	34.9	32.1	30.2	31.4
C0G640	2000081816	36.5	31.2	30.2	31.4
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C0G640	2001082316	35.9	32.6	32	32.8
C0G640	2001082516	35.8	32.7	31.2	30.3
C0G640	2001083116	27.5	27.6	28.8	27.9
C0G640	2000080217	29.4	24.6	24.5	24.7
C0G640	2000080317	30	26	28.7	27
C0G640	2000080617	33.9	30.4	29.8	30.4
C0G640	2000080717	33.7	31.2	30.6	31
C0G640	2000080817	35.3	31.2	29.9	31.3
C0G640	2000081217	30.6	25.2	27	24.3
C0G640	2000081817	34.8	31.1	29.2	30.8
C0G640	2000081917	34.3	31.6	30	31.2
C0G640	2000080318	28.9	25.8	27.6	26
C0G640	2000080319	27.7	25.5	26.5	26.1

測試總結

- 2000、2001年7 & 8月挑出 131筆疑似異常
  - 降雨中、降雨間歇、即將降雨 5 筆
  - 疑似降雨 1筆 (C0G650降雨中)
  - 資料量 1,488筆，異常率 8.8%
- 2000~2015年挑出 803筆疑似異常
  - 資料量 140,160筆，異常率 0.57%
  - 共花費約 60秒
- 高溫或低溫均可偵錯

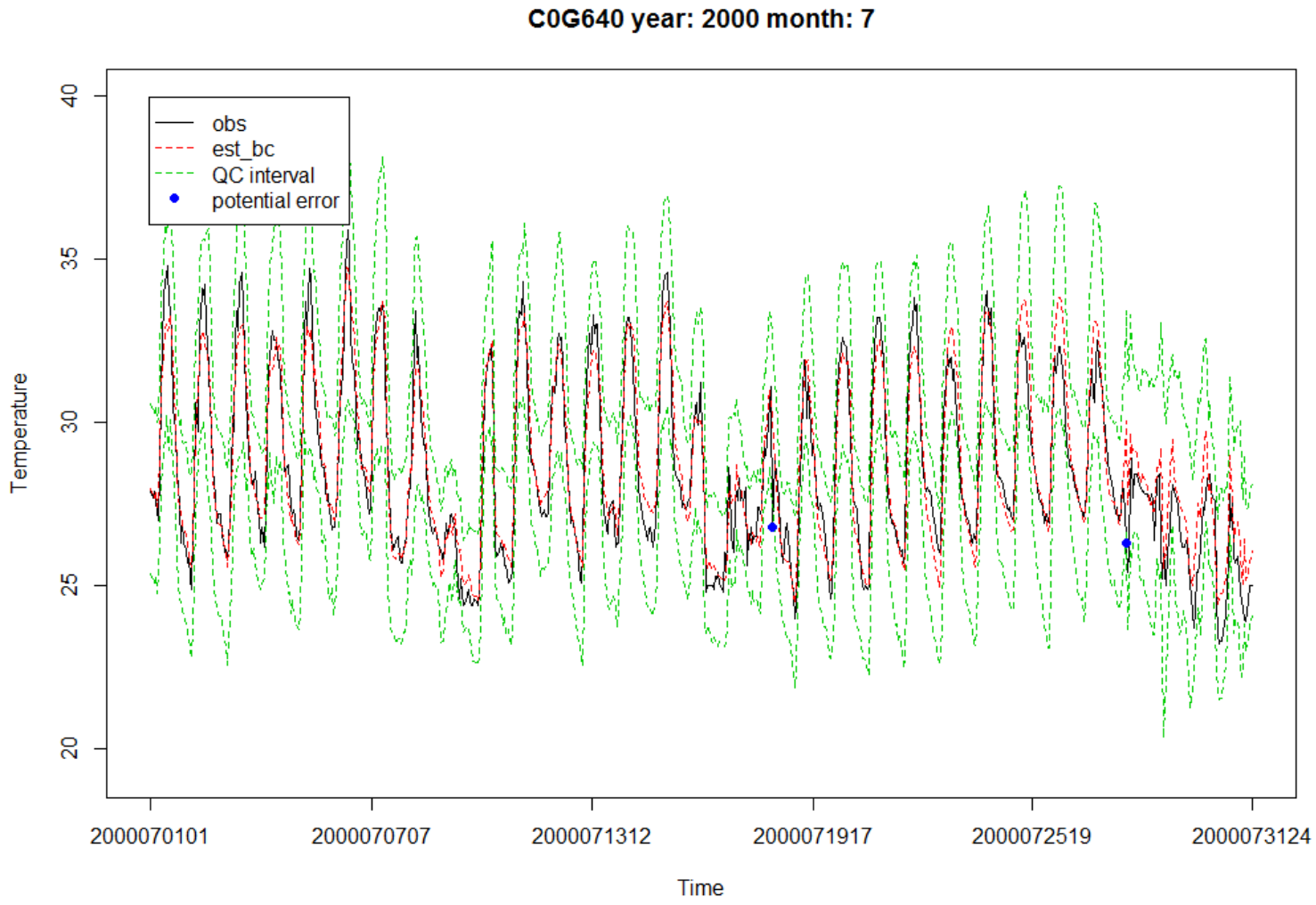
後續工作

- 測試DCA 權重係數敏感度
- 增加排除異常資料污染機制
- 因應即時資料QC，增加判斷：
  - 是否降雨
  - 是否降雨後
- 因應歷史資料QC，增加判斷：
  - 是否降雨
  - 是否降雨後
  - 是否降雨間歇判斷

簡報結束 敬請指教

www.manysplendid.com

2000年7月


C0G640 year: 2000 month: 7
obs
est_bc
QC interval
potential error
Temperature
20
25
30
35
40
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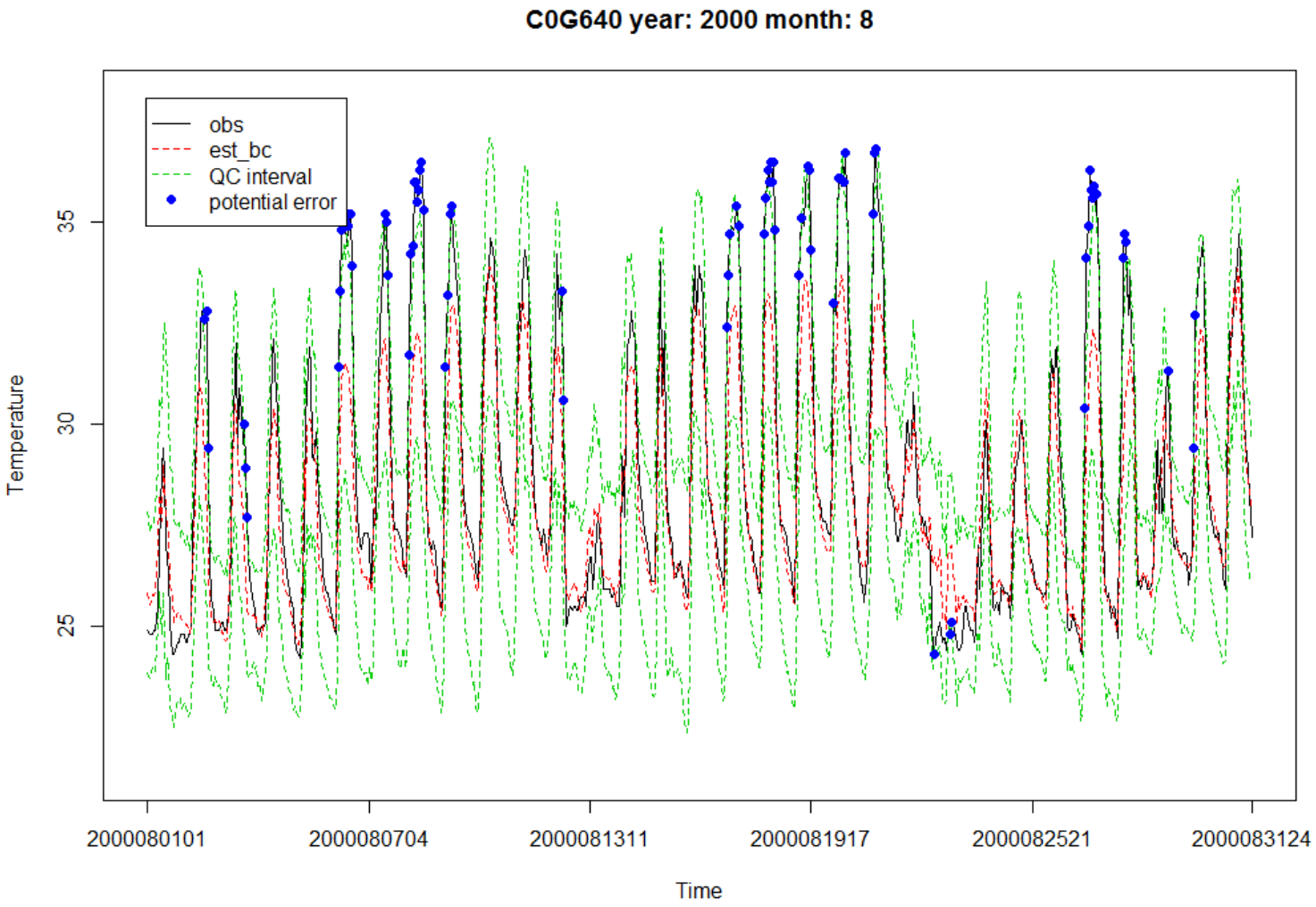
2000073124
Time

2000年8月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est_bc
QC interval
potential error
Temperature
25
30
35
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2000082521
2000083124
Time