透過資料同化分析2024日全食造成之全電子含量下降所需的最少地面站數量

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目錄

研究動機

1. 2024 年 4 月初到德州參與了日蝕觀測等相關一系列活動
2. 我們有整合了一套自己的接收機系統
3. 希望可以不用像美國如此高密度地面站資源也可以重現各種現象
4. 希望我們的接收機製作穩定後，可以搭建自己的觀測網

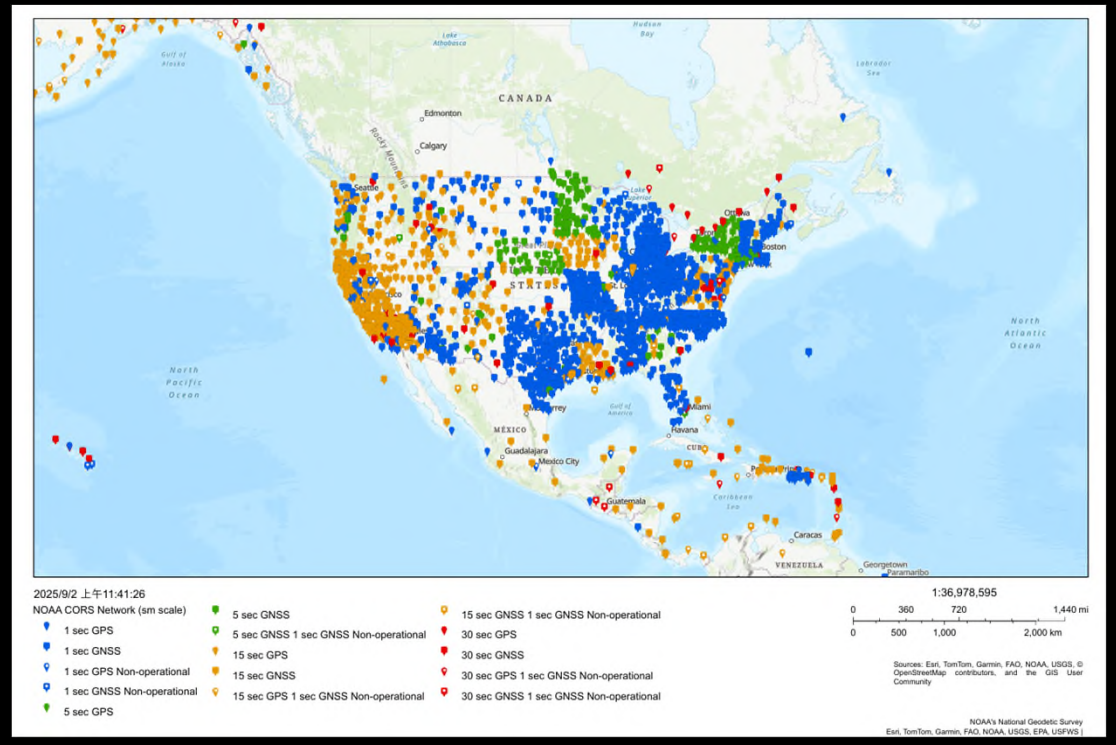
2024 Total Solar Eclipse

The April 8, 2024, total solar eclipse began over the South Pacific Ocean and crossed North America, passing over Mexico, the United States, and Canada.

https://science.nasa.gov/wp-content/uploads/2022/10/eclipse-map-2024-1920-1.png?w=1024&format=webp

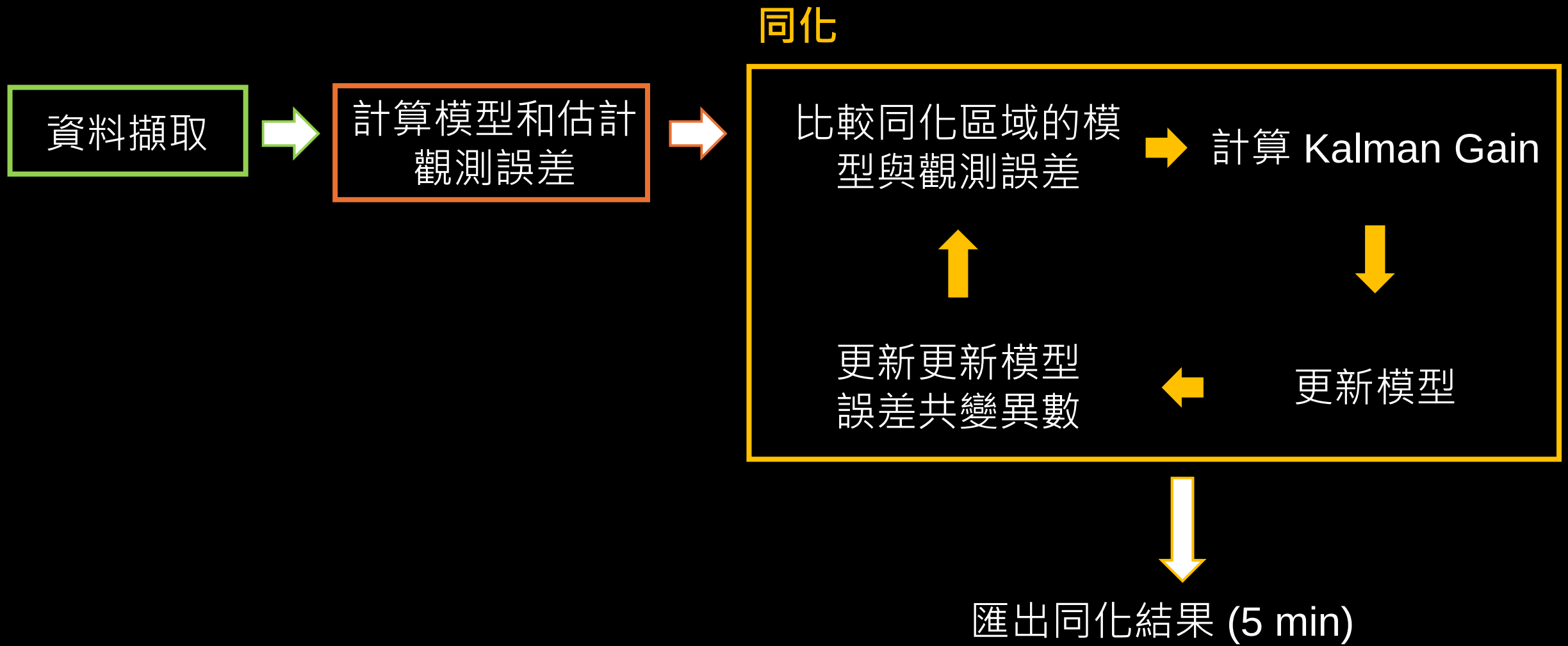
觀測資料

- 背景場: CODE GIM (2024/4/8 1700 UTC)
- 觀測來源: 美國 CORS 地面站 (VTEC)
- 同化時間: 2024/4/8 1800 ~ 2000 UTC



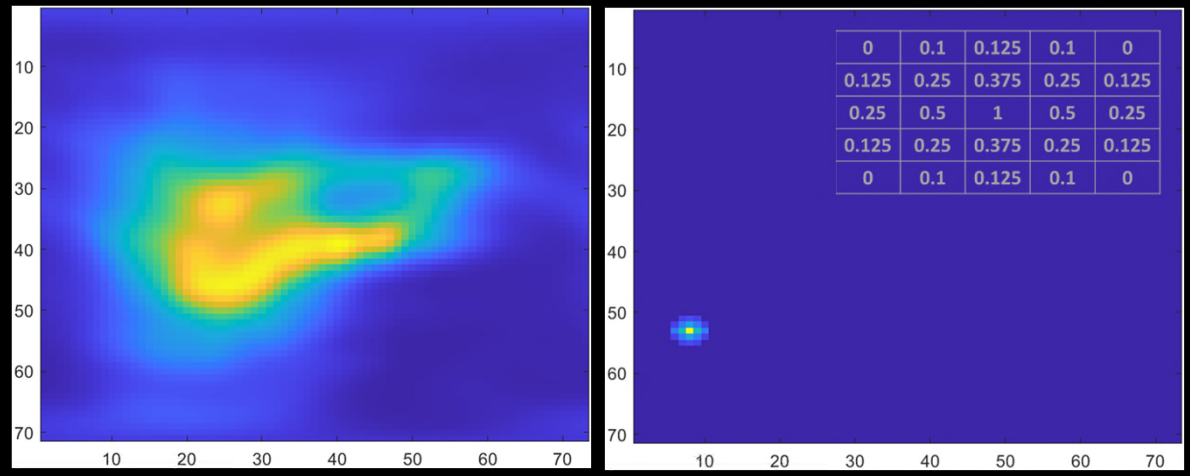
NGS Map

實驗設計

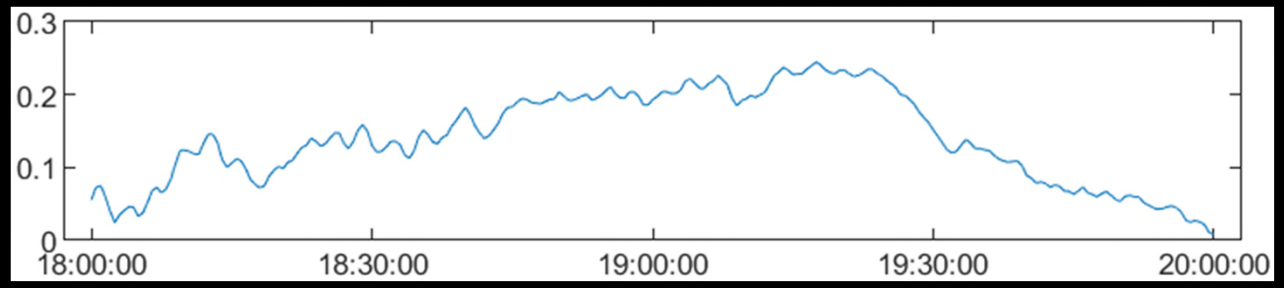

資料擷取
計算模型和估計觀測誤差
同化
比較同化區域的模型與觀測誤差
計算 Kalman Gain
更新模型
更新更新模型誤差共變異數
匯出同化結果 (5 min)

Data assimilation –Covariance

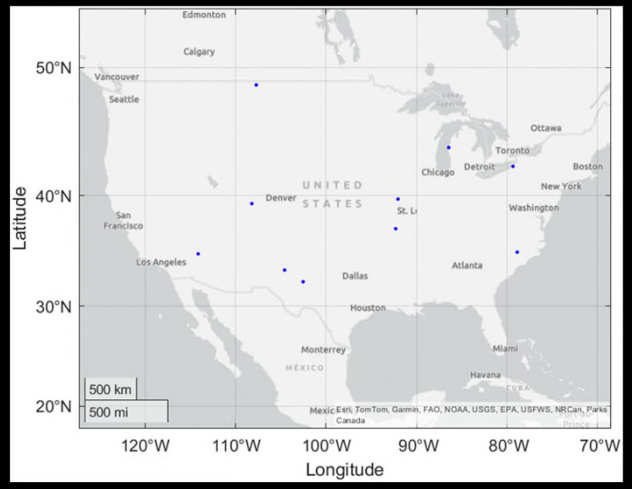
Model error covariance (P):
使用 22 年 (包含太陽極大極小期)
CODE GIM 計算共變異數矩陣

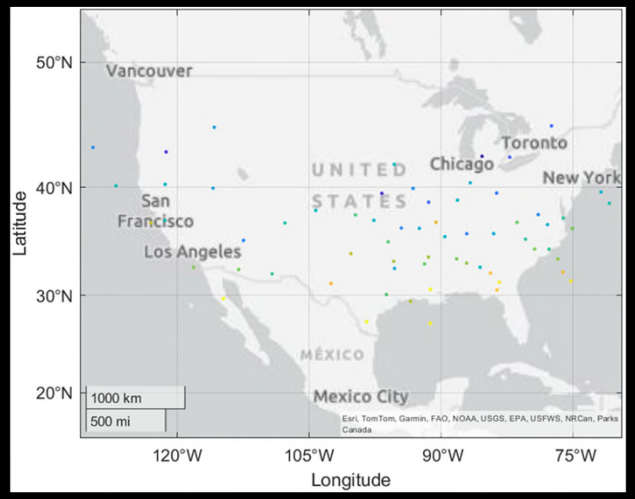


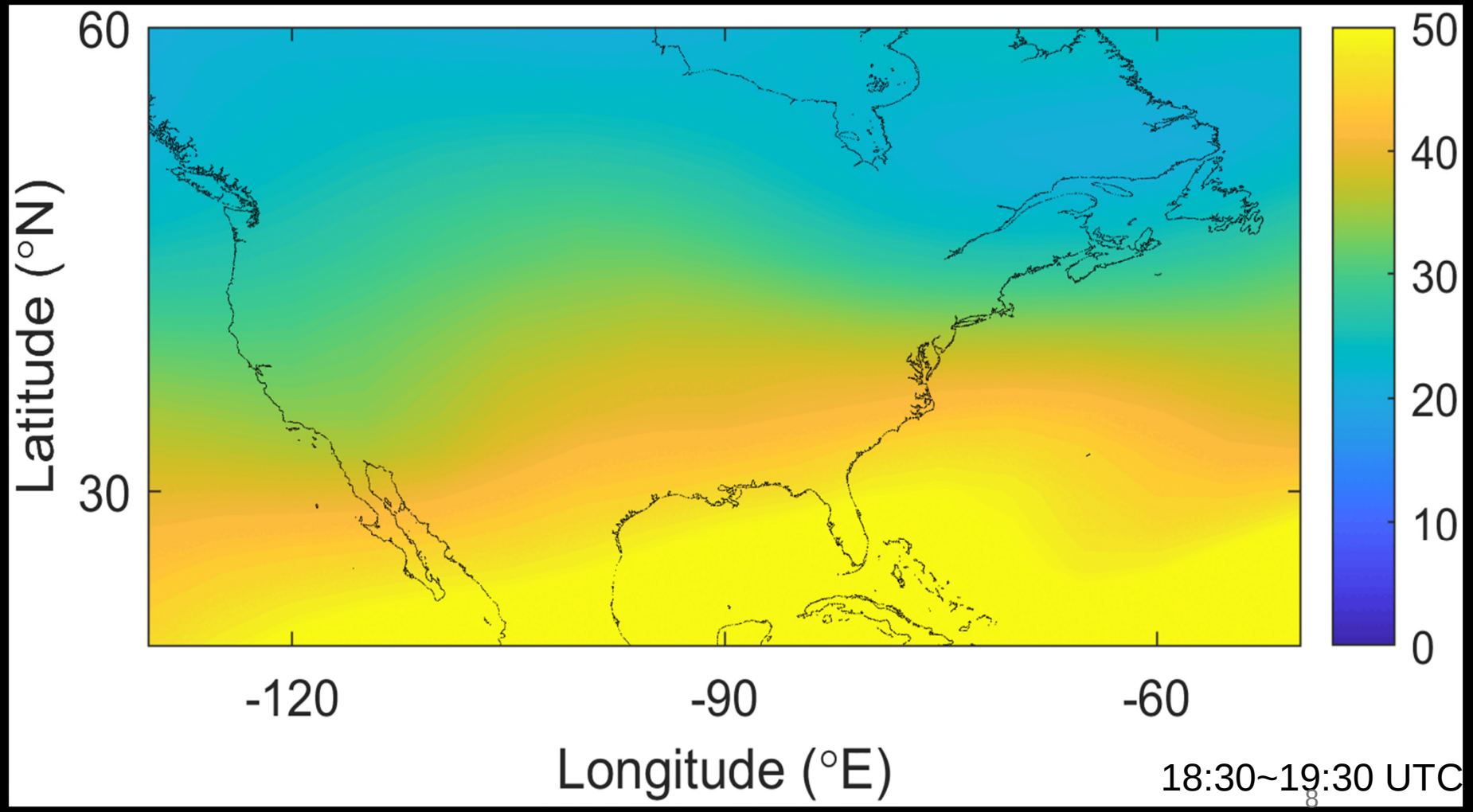
Data error covariance (R):
資料誤差以 2 TECU 為基準，
時序資料標準差作加權。



10 stations

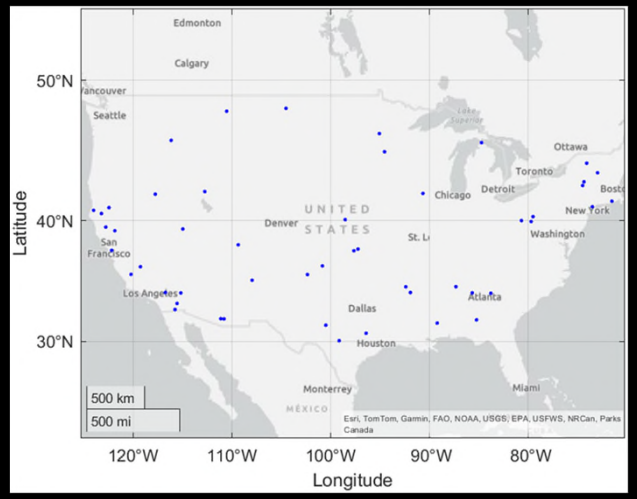


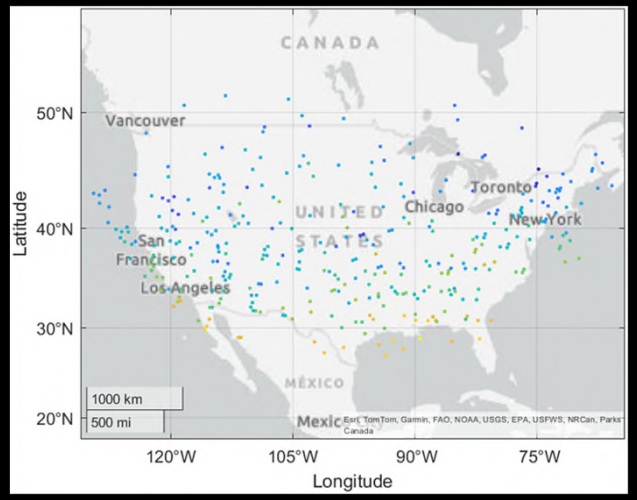


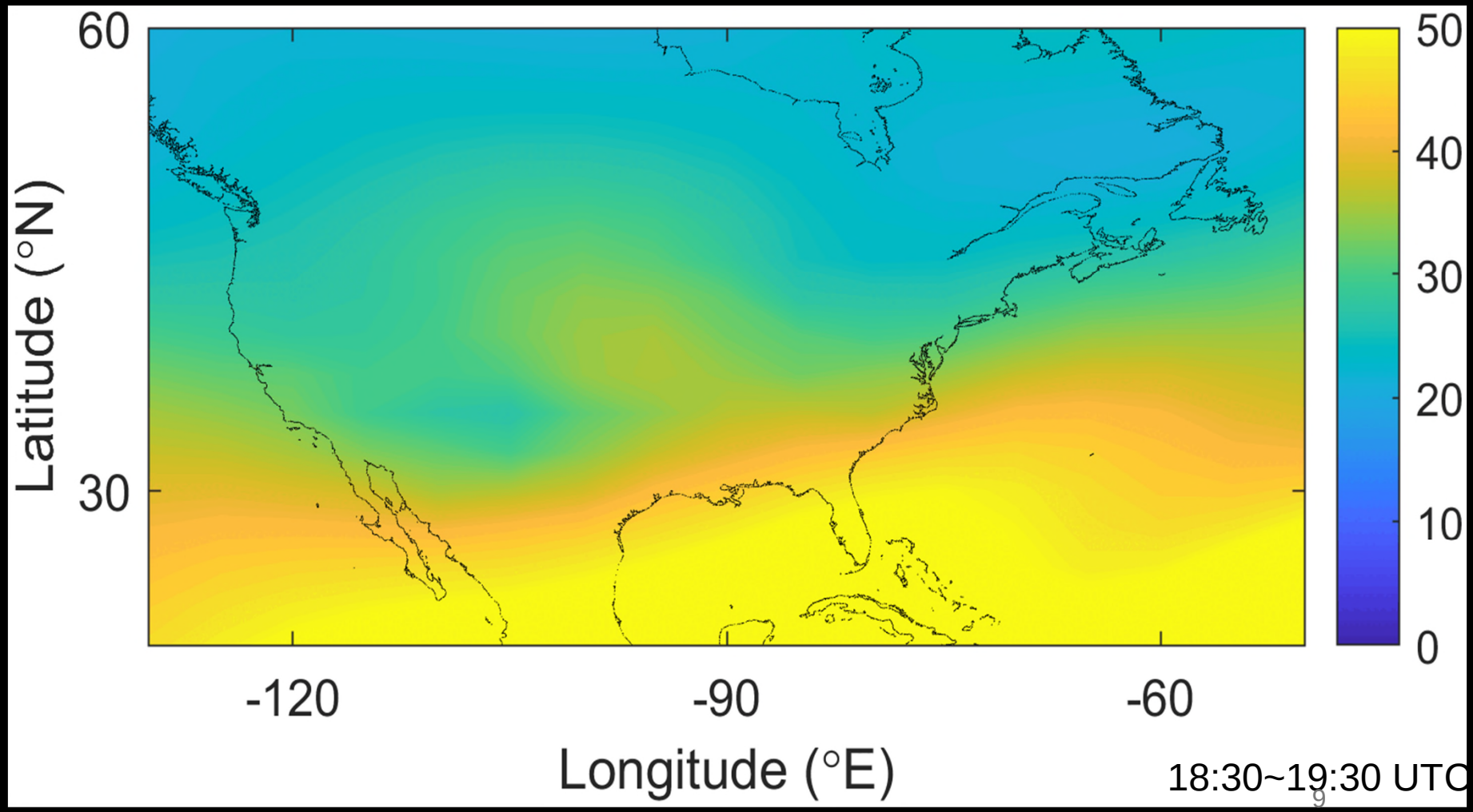


18:30~19:30 UTC

50 stations

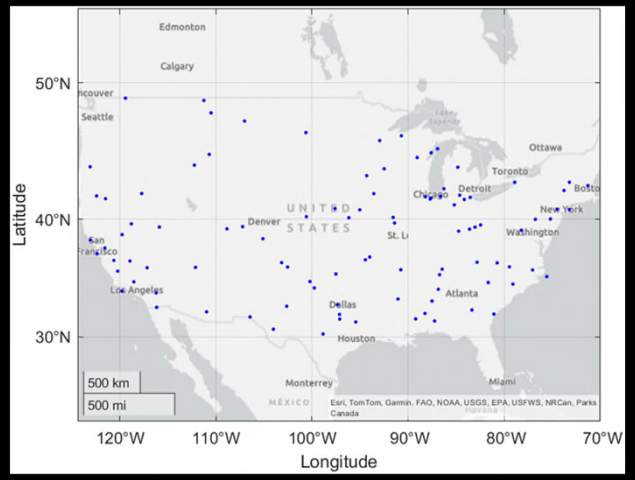


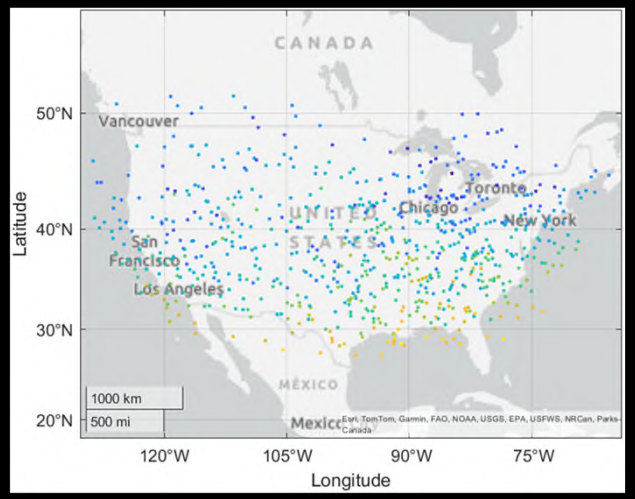


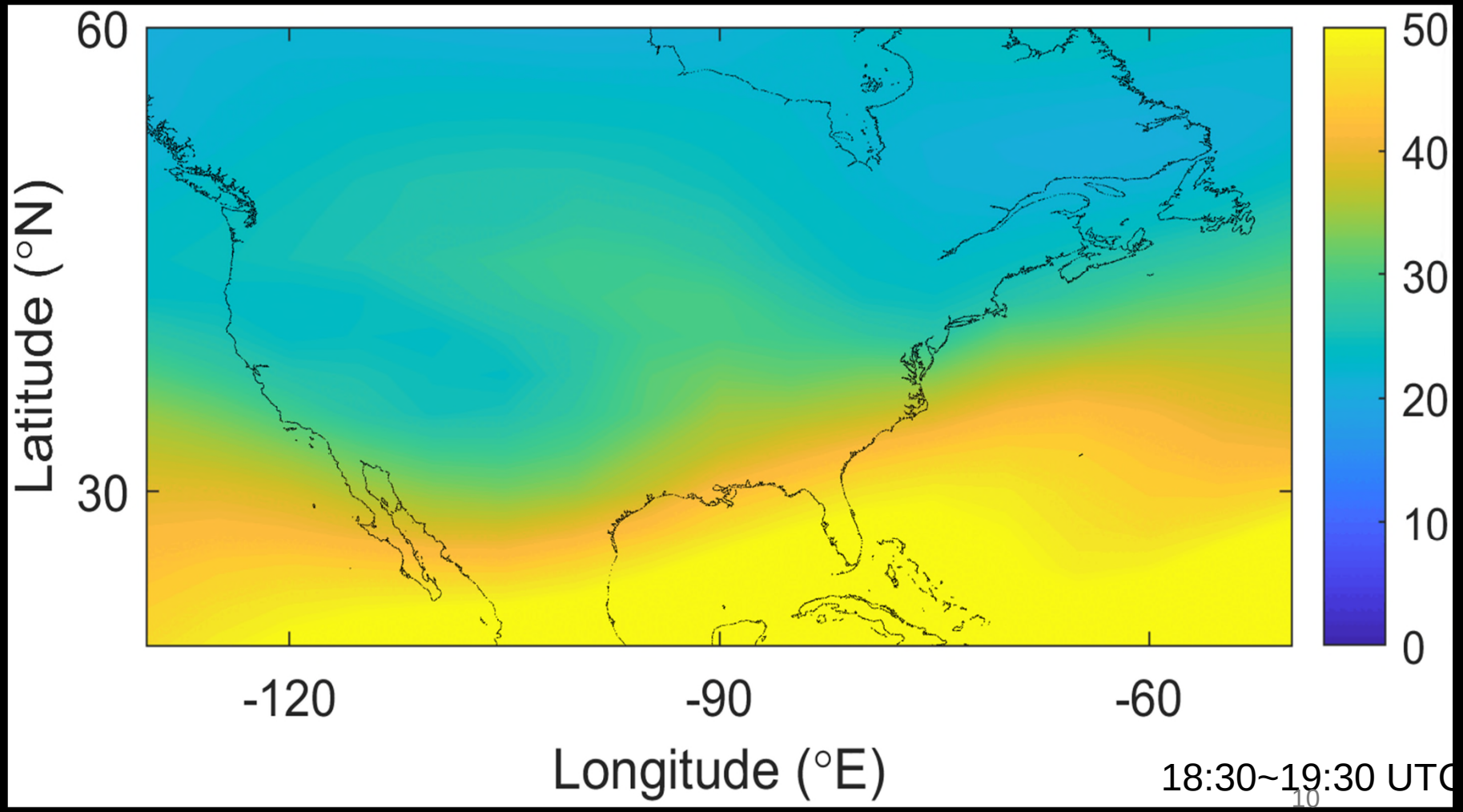


18:30~19:30 UTC

100 stations

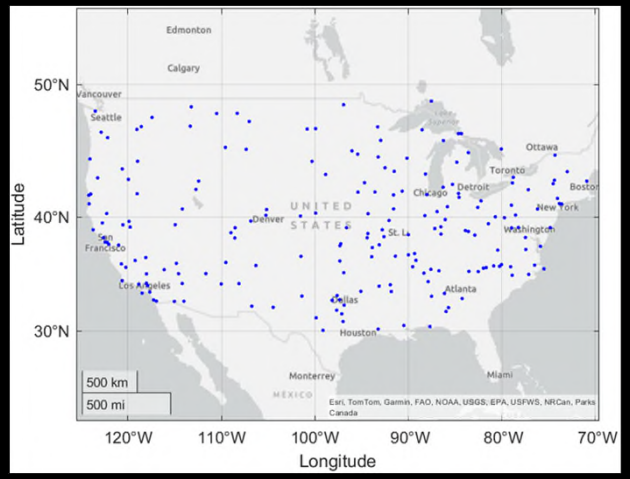


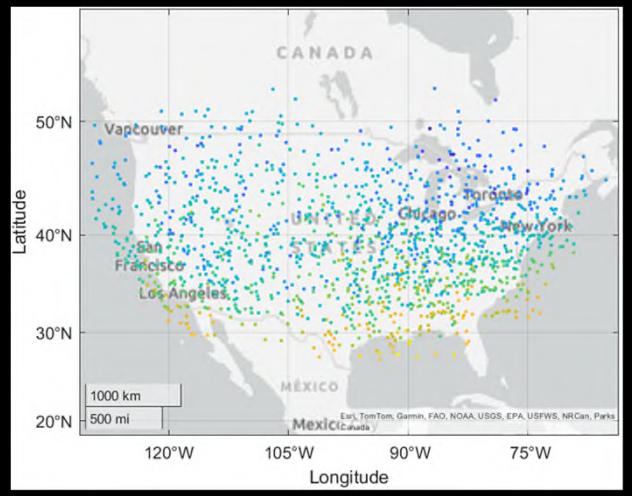


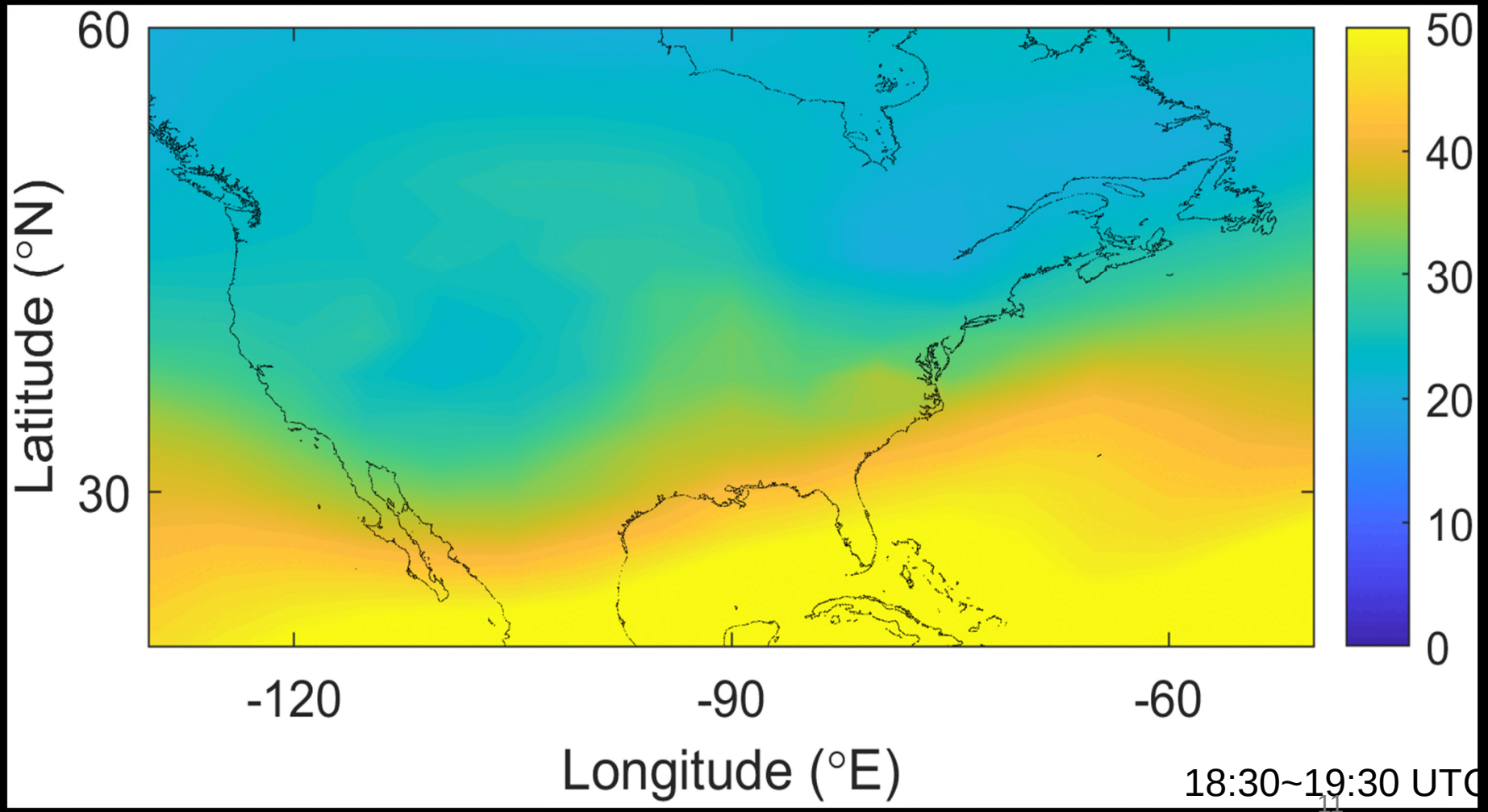


18:30~19:30 UTC

200 stations



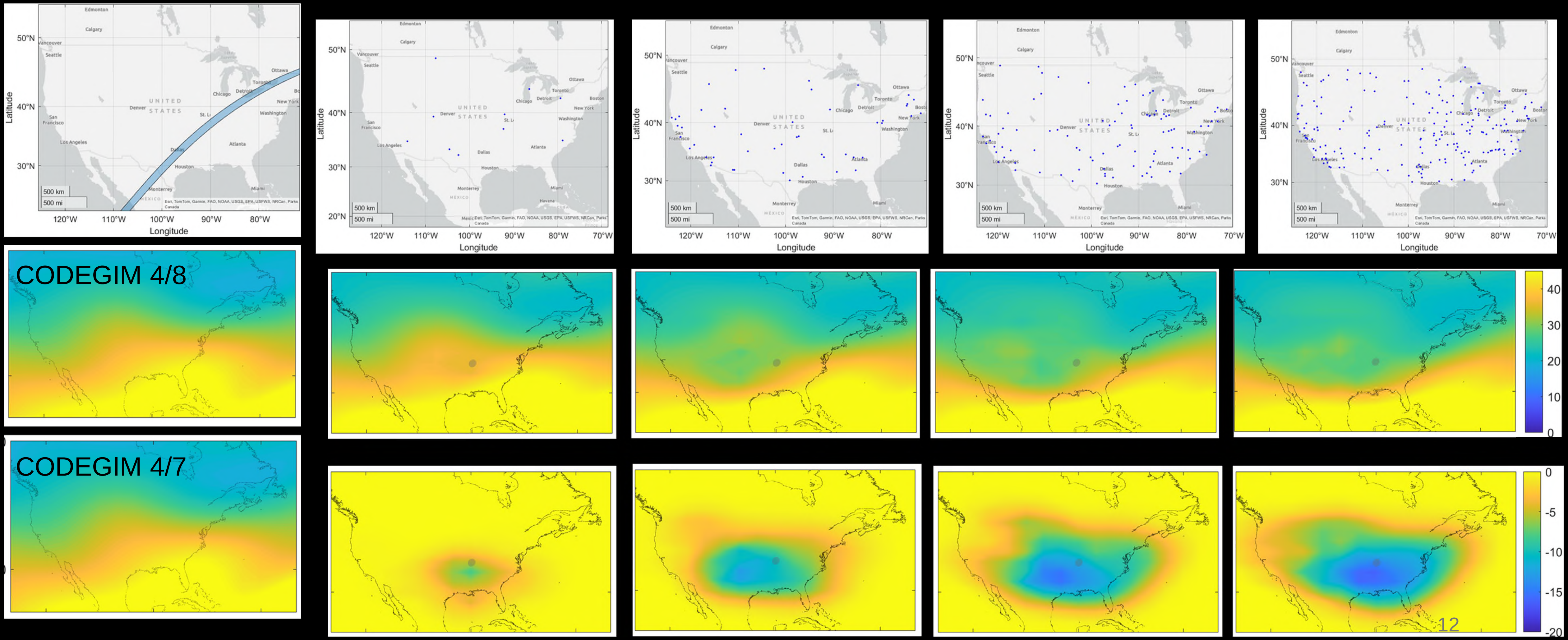




18:30~19:30 UTC

1 小時同化結果

10 Ground stations | 50 Ground stations | 100 Ground stations | 200 Ground stations



結論

- 透過不同數量的地面站資料的同化，我們發現在採用 50 個以上地面站的結果，可以看到日食所造成全電子含量顯著下降的特徵
- 解果顯示全電子含量下降最大的區域，跟全食陰影區有一段時間延遲，也符合實際觀測的結果，進一步驗證此方法的可行性