

土壤分類對土壤資料同化系統 (HRLDAS)之影響

林伯勳、洪景山、蔡雅婷

在土壤的世界

1. 地表的異質性、土壤觀測的缺乏，幾乎難以進行土壤的資料同化
2. 相對來說，地面很多觀測
3. 如果能給定大氣近地面的觀測，如果土壤過程是可信的，那我們可以藉由土壤模式的過程，將近地面的大氣觀測，逐步往土壤擴散，經過一段時間之後，最終我們可以得到土壤的「分析場」。

Rainfall, Psfc, T2m, Q2m, U2m, V2m, Radiation



$$\frac{\partial \theta}{\partial t} = \frac{\partial}{\partial z} \left(D \frac{\partial \theta}{\partial z} \right) + \frac{\partial K}{\partial z} + F_{\theta}$$

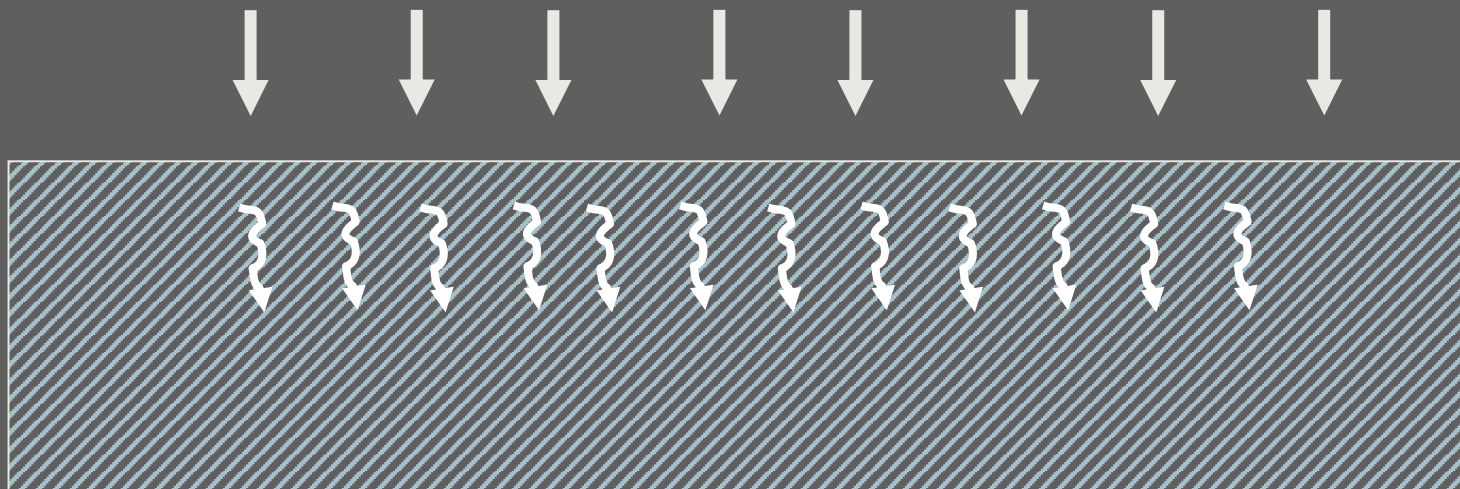
$$C(\theta) \frac{\partial T}{\partial t} = \frac{\partial}{\partial z} \left(K_t(\theta) \frac{\partial T}{\partial z} \right)$$

HRLDAS: High Resolution Land Data Assimilation System

For the HRLDAS system,
Ingest of the hourly atmospheric forcing is required, including

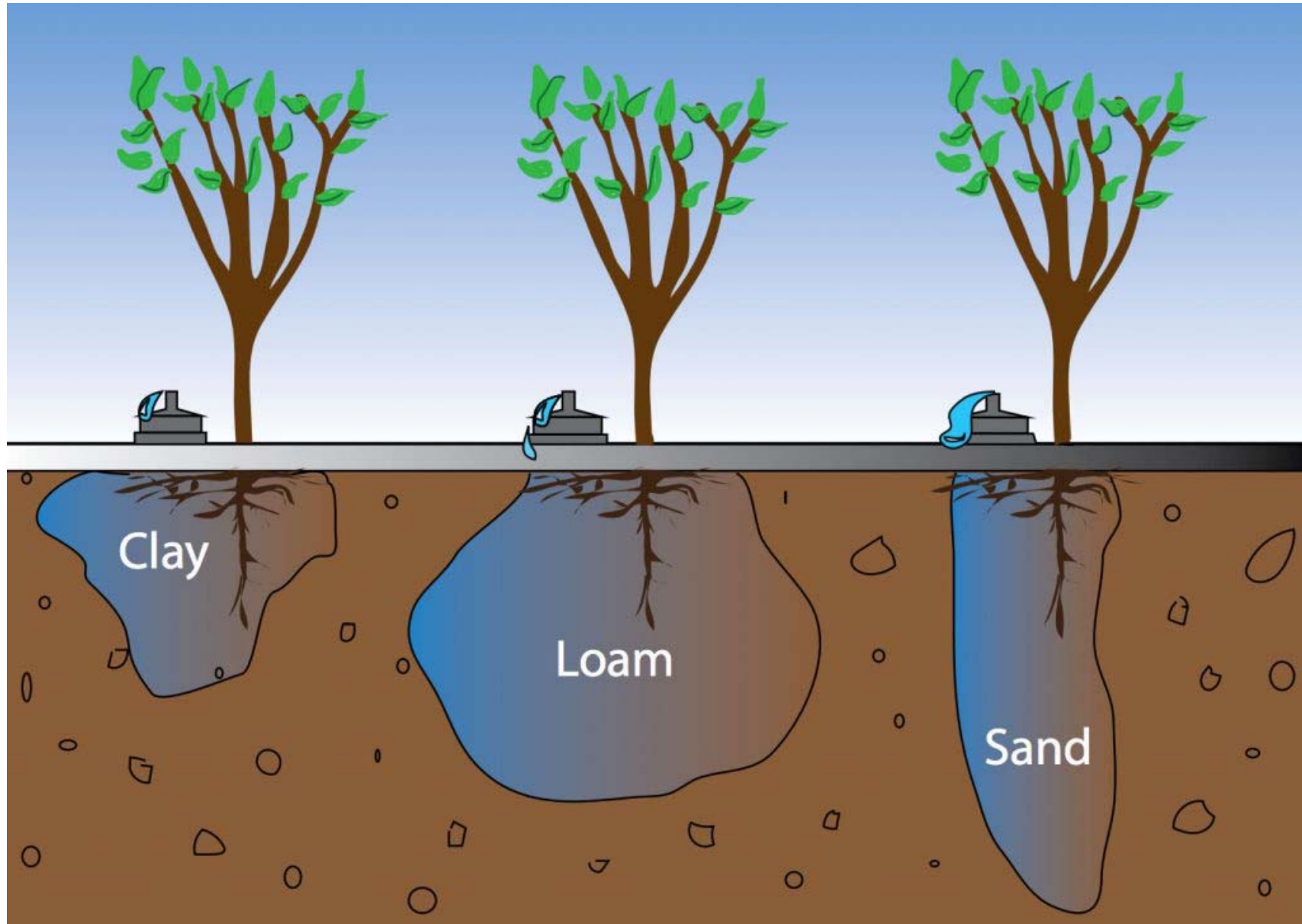
- RAINRATE from QPESUMS
- Psfc, T2m, Q2m, U2m, V2m from WRF fcst
- Radiation from WRF fcst

A long-time spin-up is required to reach an equilibrium state





<https://www.wilsonbrosgardens.com/different-soil-types.html>

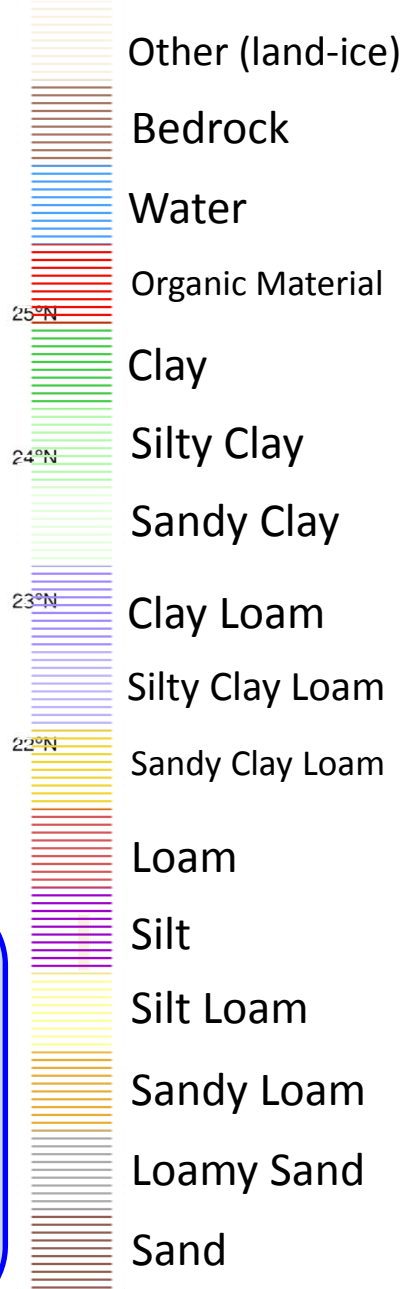
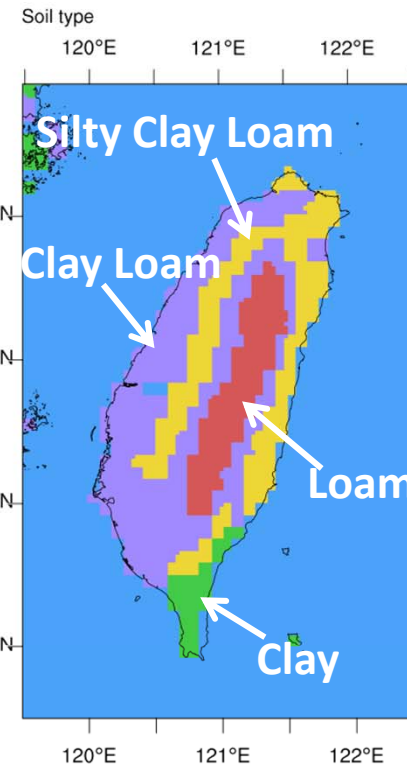
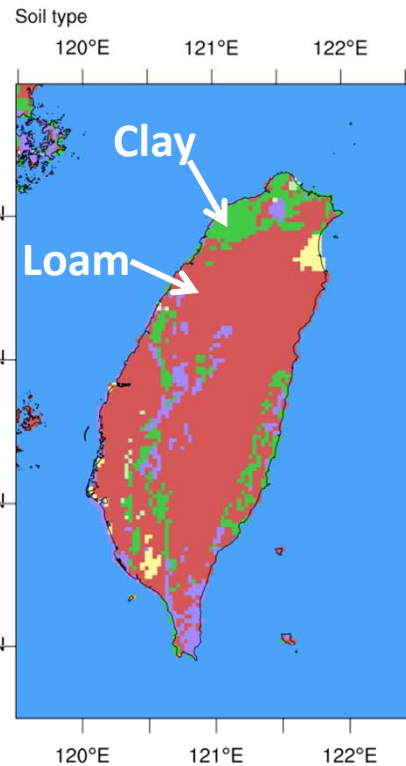
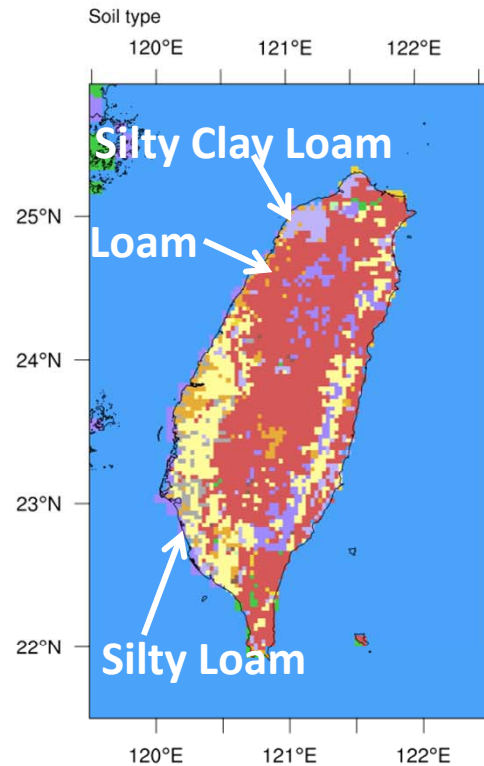


<https://www.dripworks.com/blog/tips-for-gardeners-and-growers-irrigation-tips-for-clay-soil-sandy-soil-and-loam/>

NCU

BNU

USGS



平地：行政院農委會
山區：vector-format
(polygon) data for
1/50000 – 1/25000
soil maps
水平解析度約為1 km
(中央大學鄭芳怡教授提供)

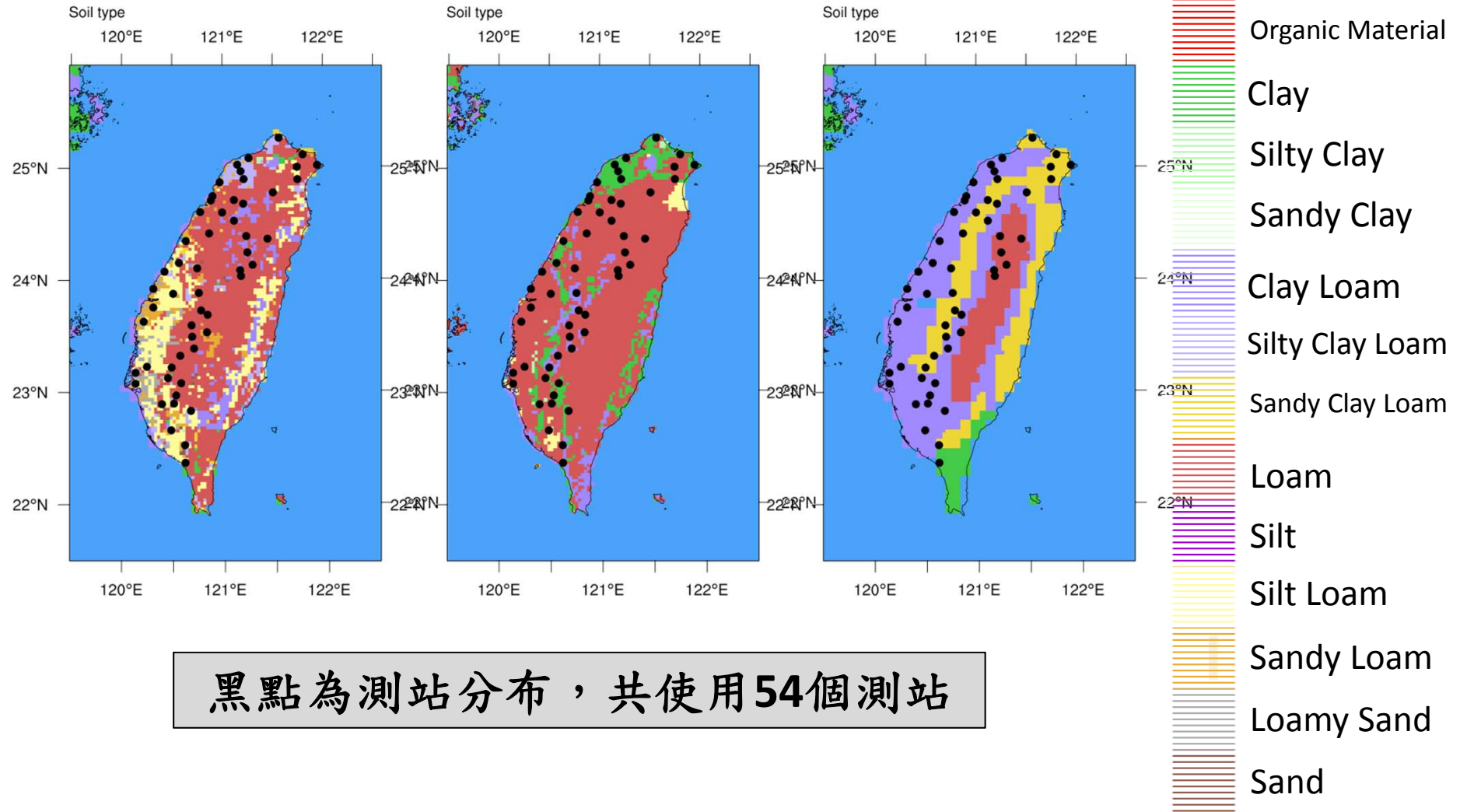
北京師範大學
提供，資料由1：
1000000的Soil
map所產製，
水平解析度約
為1 km。

美國 Food and
Agriculture
Organization (FAO)
所提供，北美以
外地區的水平解
析度為10 km

NCU

BNU

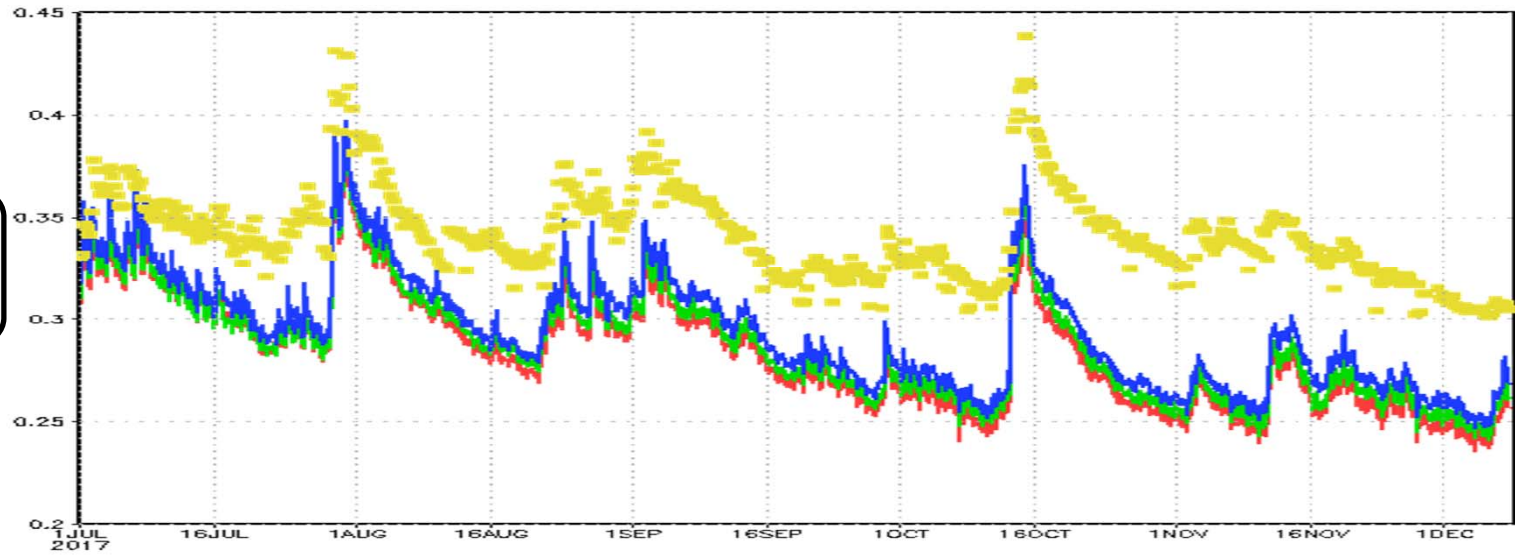
USGS



黑點為測站分布，共使用54個測站

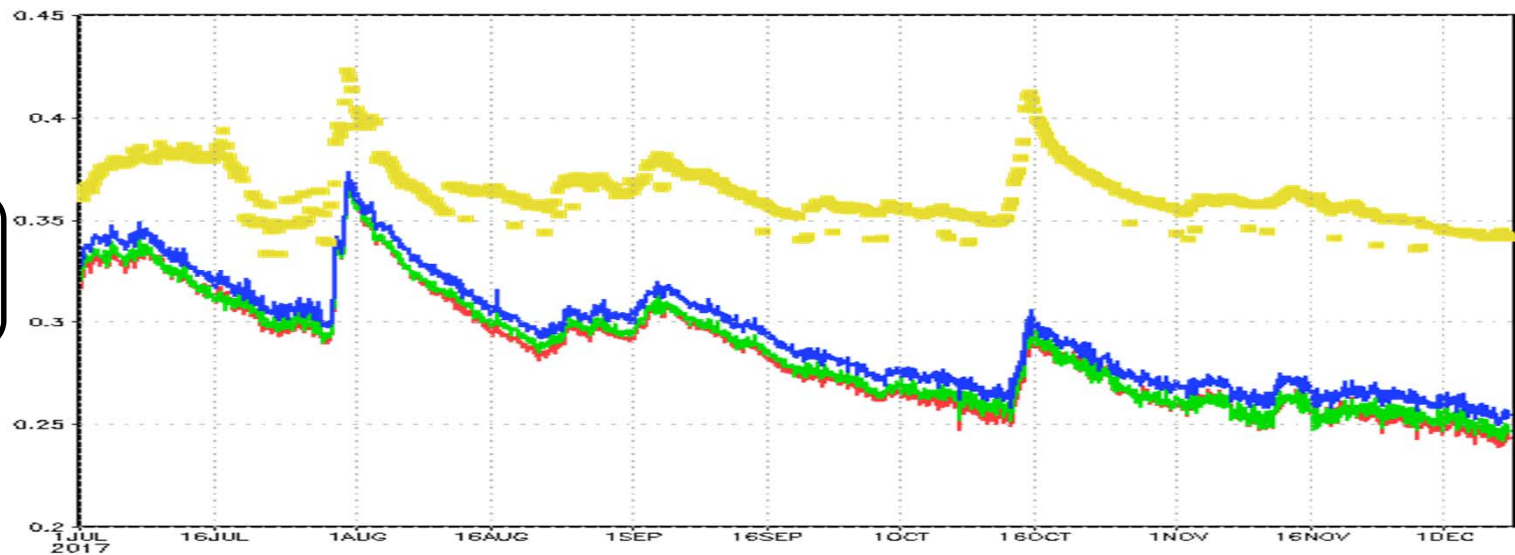
土壤濕度
10 cm

- NCU
- BNU
- USGS
- GFS



2018-09-04-11:17

土壤濕度
100 cm



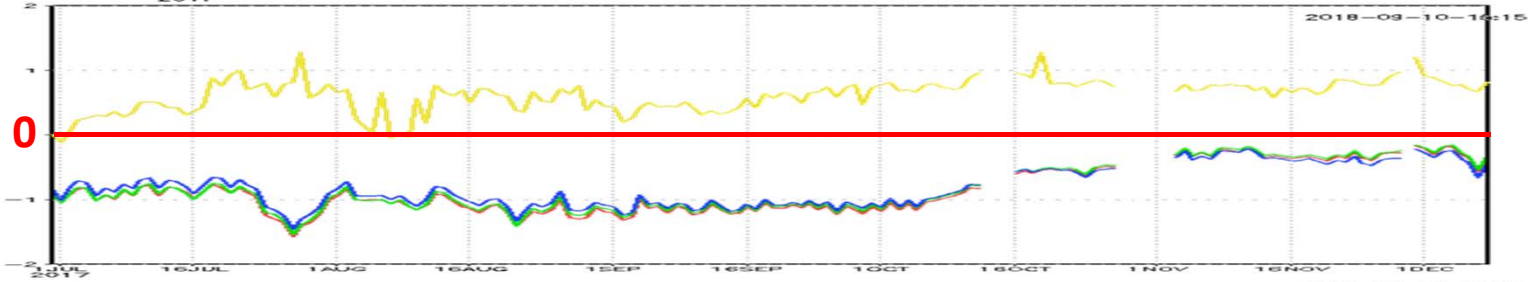
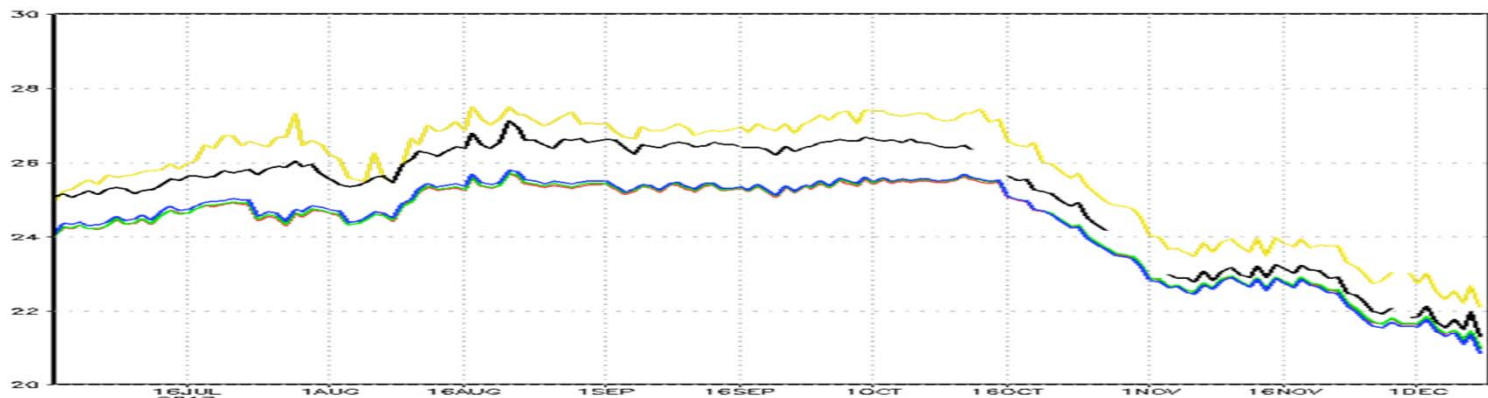
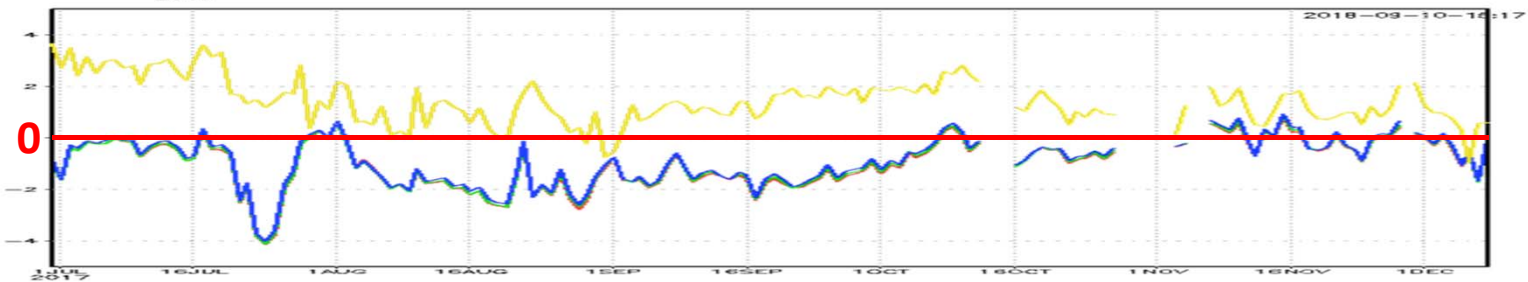
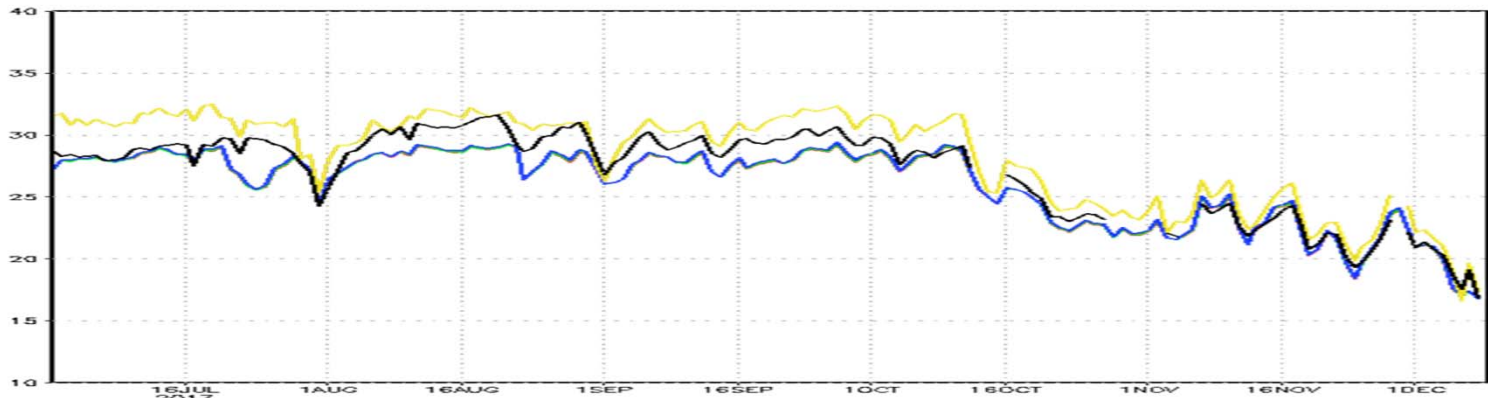
2018-09-04-11:16

Only 14 LST

土壤溫度
10 cm

- NCU
- BNU
- USGS
- GFS
- OBS

土壤溫度
100 cm

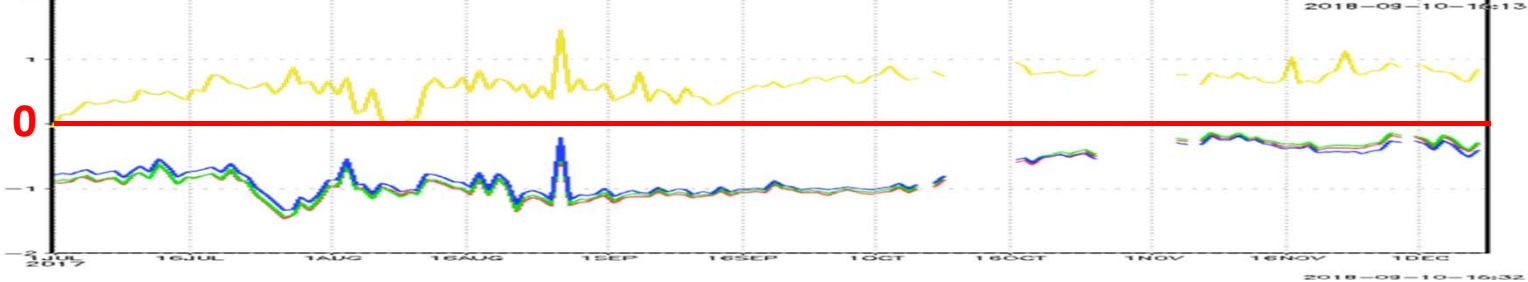
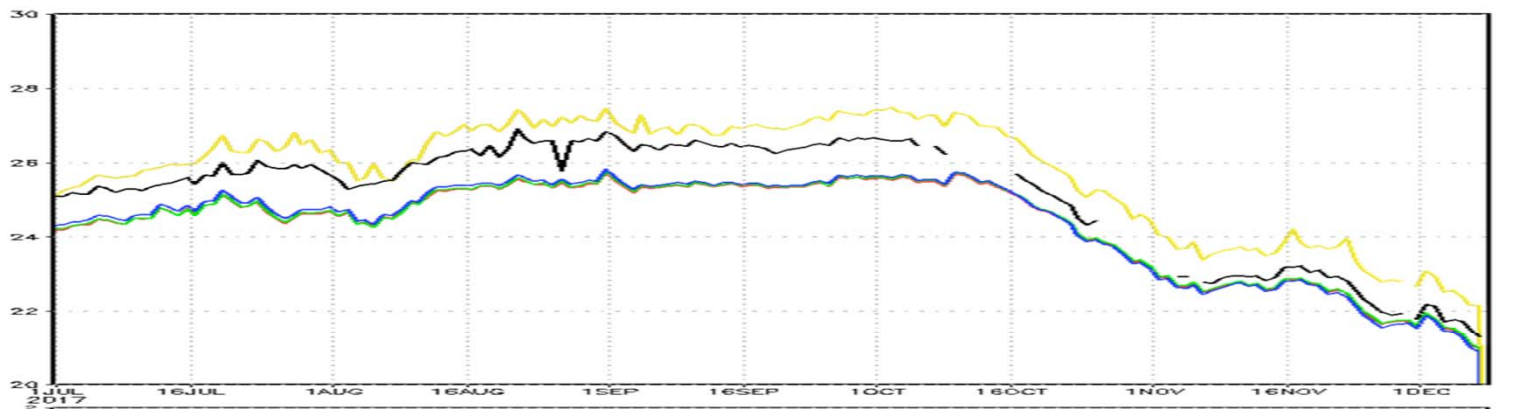
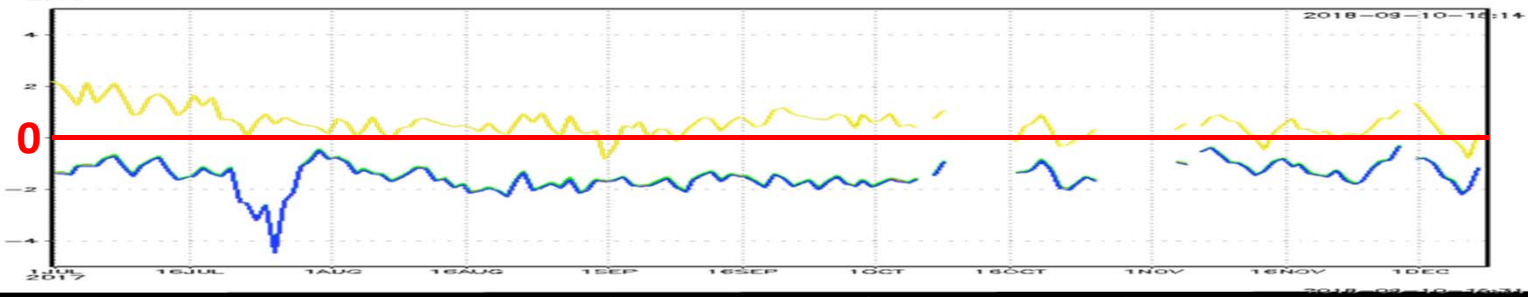
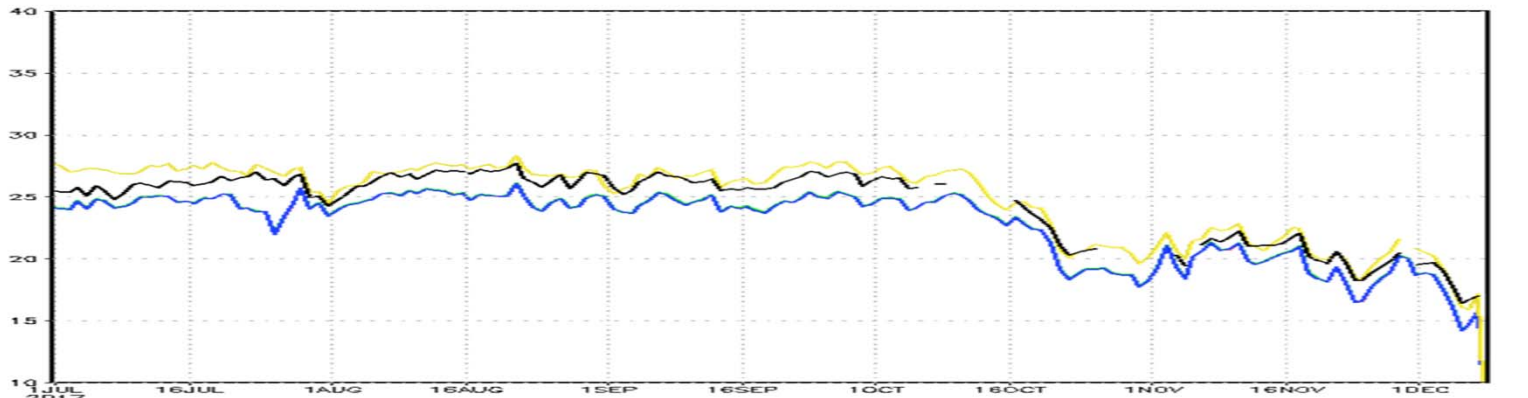


Only 02 LST

土壤溫度
10 cm

- NCU
- BNU
- USGS
- GFS
- OBS

土壤溫度
100 cm



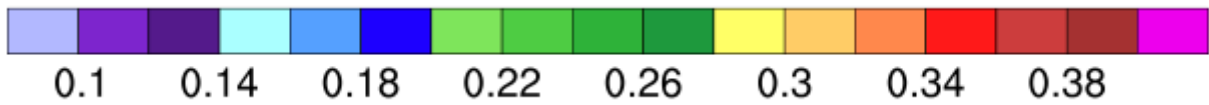
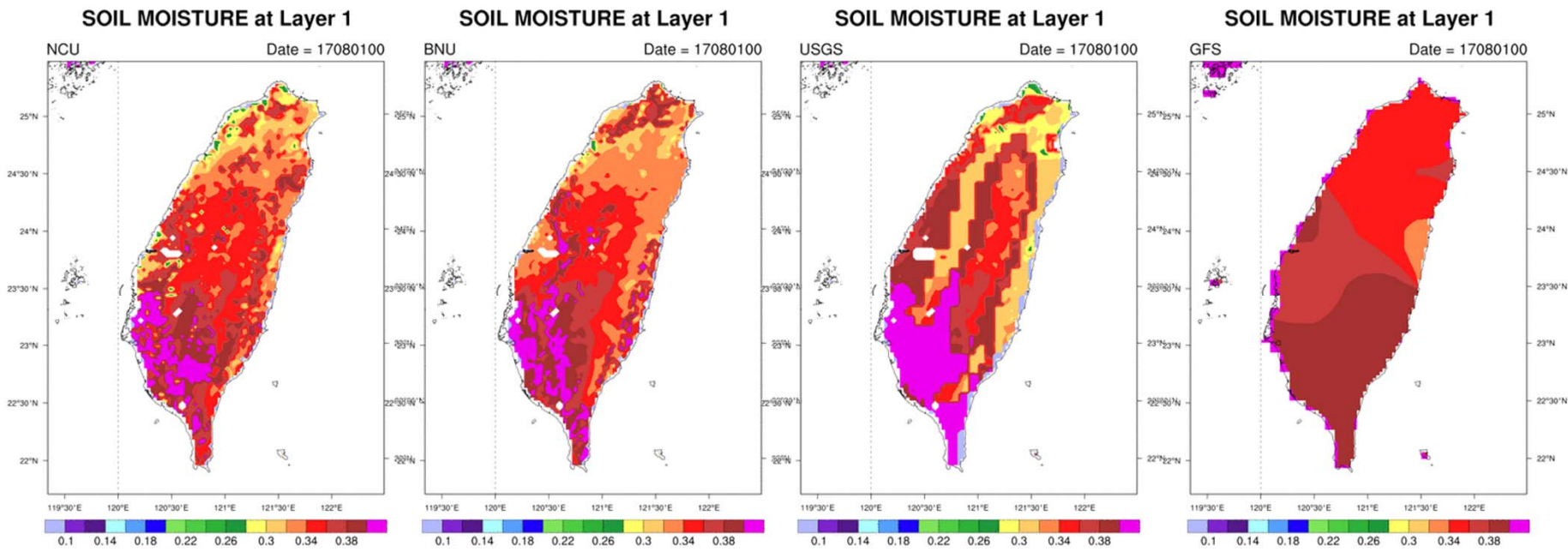
Soil Moisture at Layer 1 (10 cm)

NCU

BNU

USGS

GFS



Soil Moisture at Layer 1 (10 cm) 2017070100~2017120900 (UTC)

NCU

BNU

USGS

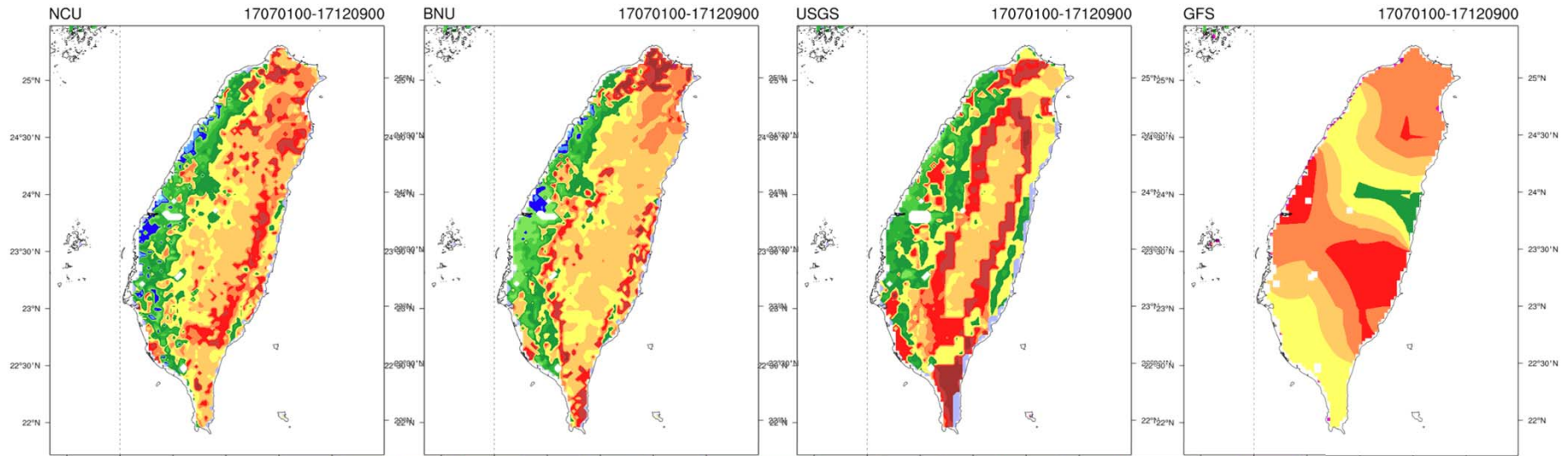
GFS

SOIL MOISTURE at Layer 1

SOIL MOISTURE at Layer 1

SOIL MOISTURE at Layer 1

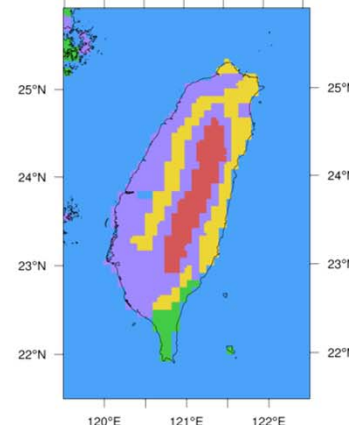
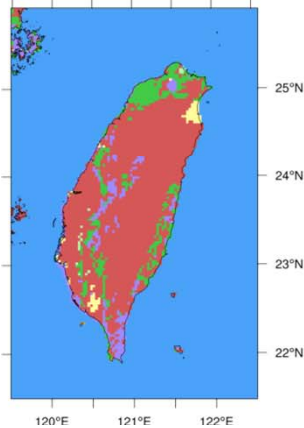
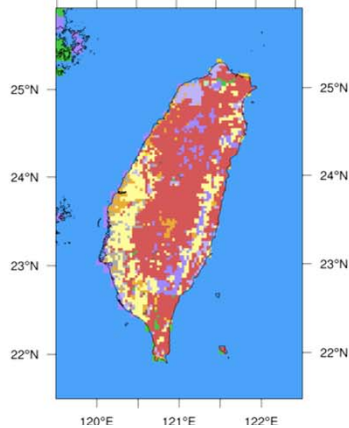
SOIL MOISTURE at Layer 1



Soil type 0.1

Soil type 0.18

Soil type 0.3



Soil Temperature at Layer 1 (10 cm)

NCU

BNU

USGS

GFS

SOIL TEMPERATURE at Layer 1

SOIL TEMPERATURE at Layer 1

SOIL TEMPERATURE at Layer 1

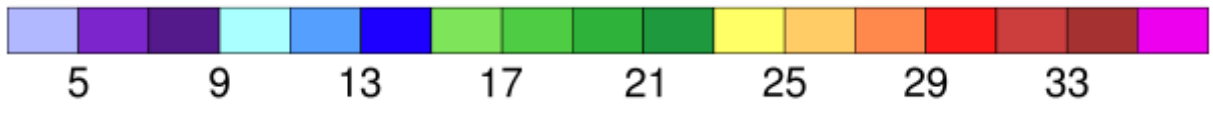
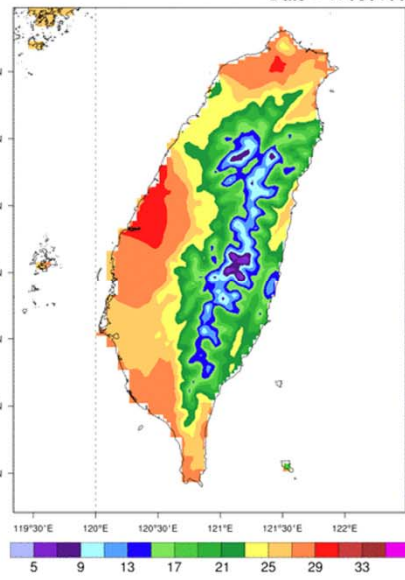
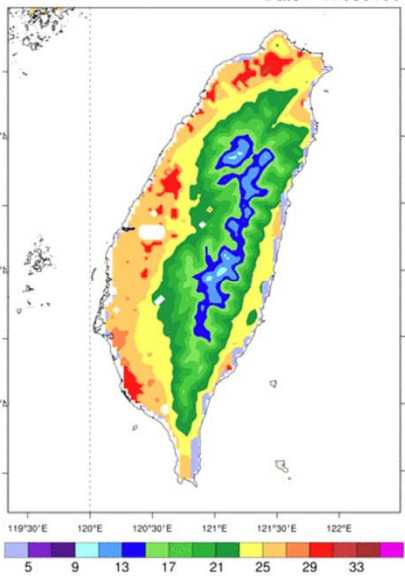
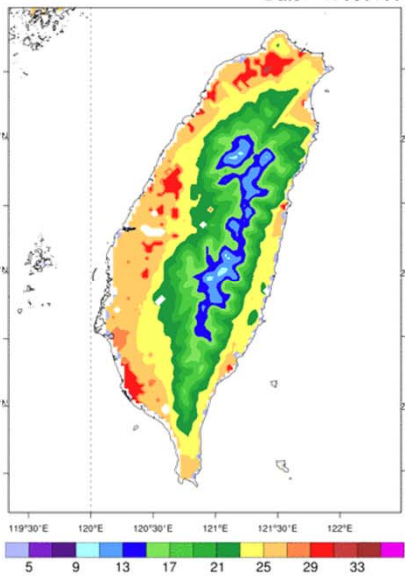
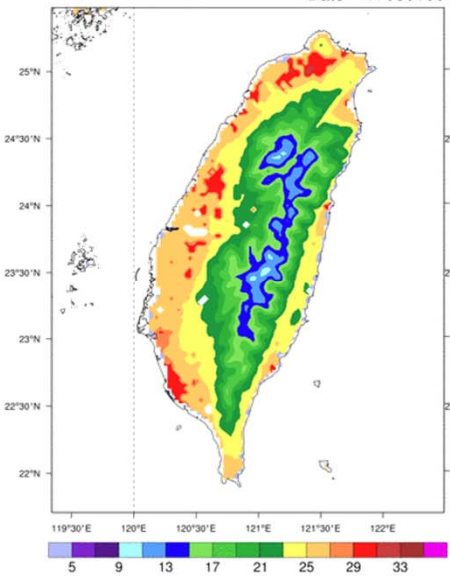
SOIL TEMPERATURE at Layer 1

Date = 17080100

Date = 17080100

Date = 17080100

Date = 17080100



Soil Temperature at Layer 1 (10 cm) 2017070100~2017120900 (UTC)

NCU

BNU

USGS

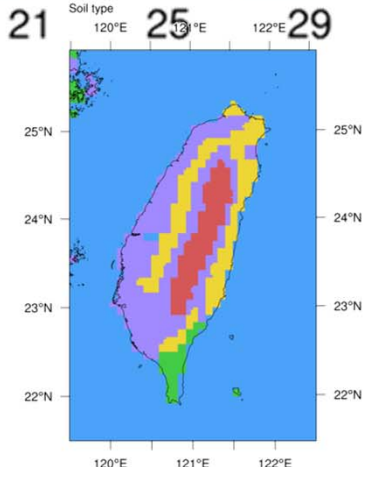
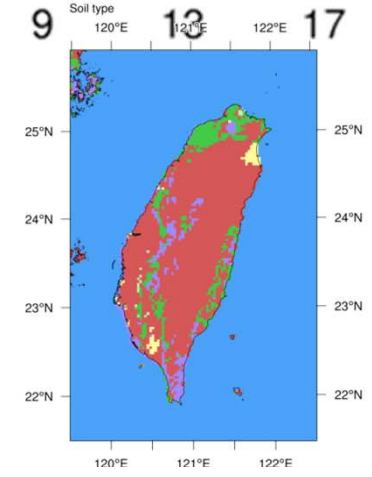
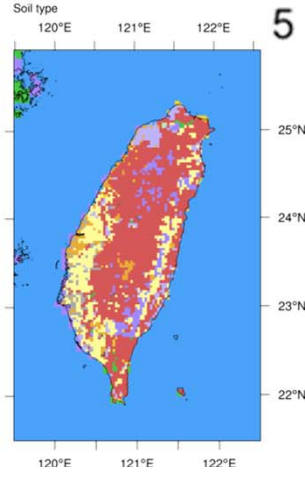
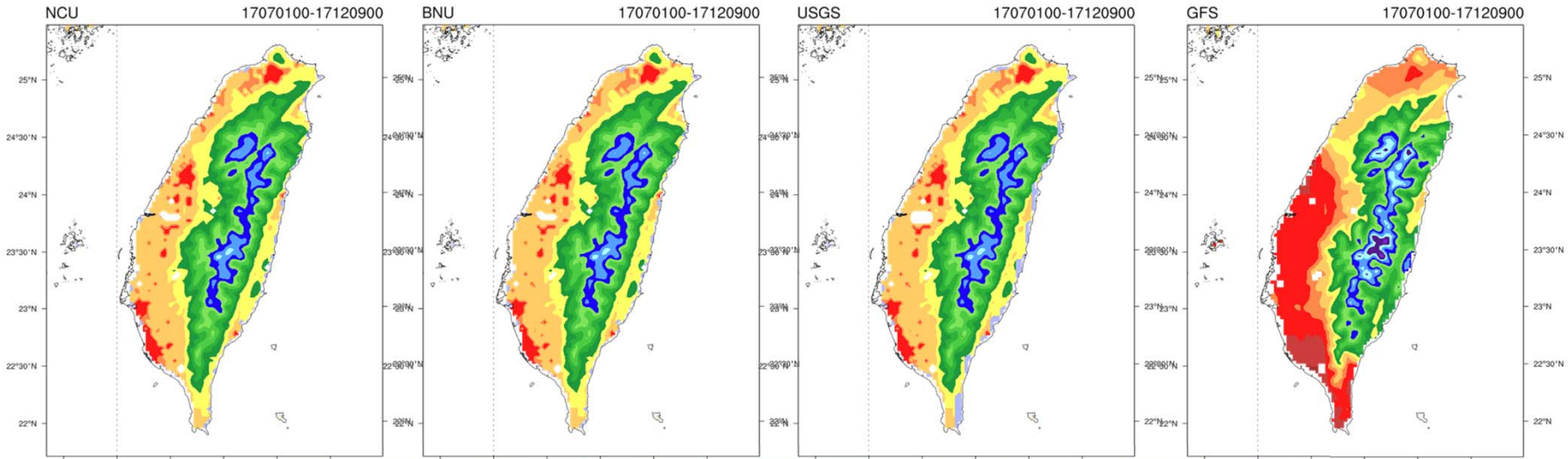
GFS

SOIL TEMPERATURE at Layer 1

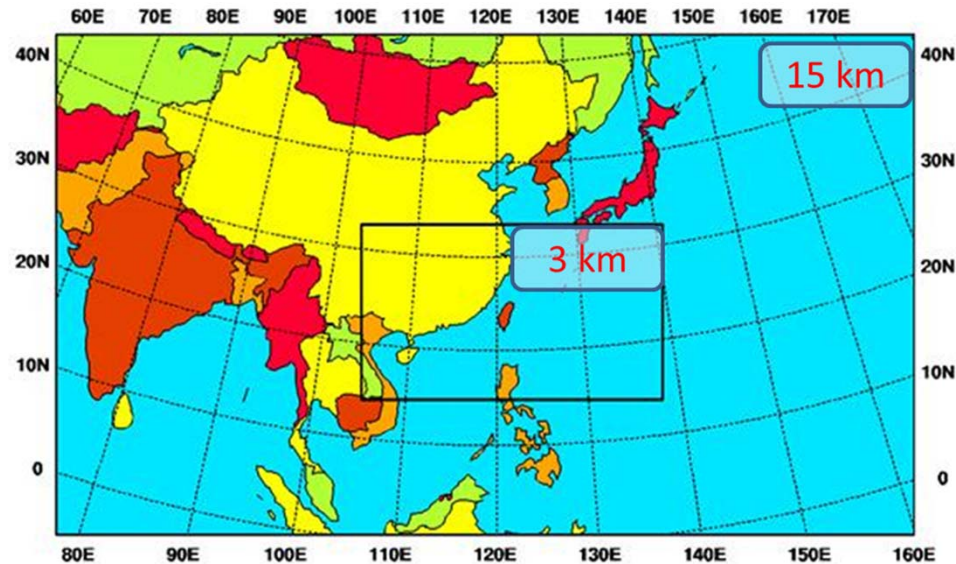
SOIL TEMPERATURE at Layer 1

SOIL TEMPERATURE at Layer 1

SOIL TEMPERATURE at Layer 1



WRF couple HRLDAS



初始時間：2017082400 UTC

模式版本：CWB WRF M04

實驗設計：

WRF_NCU：土壤初始場使用NCU之土壤分析場

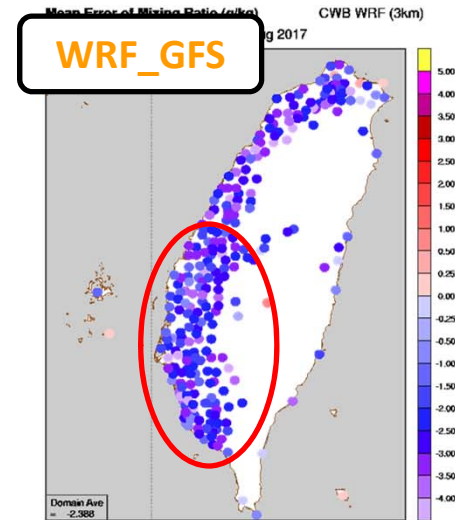
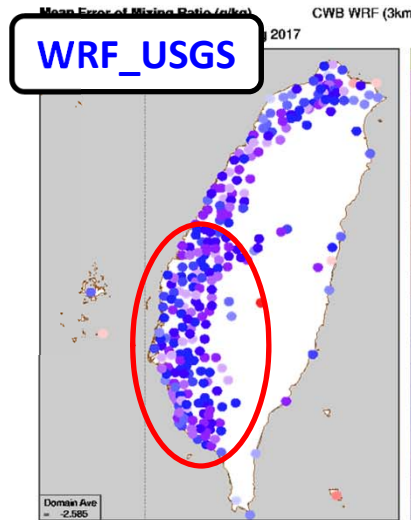
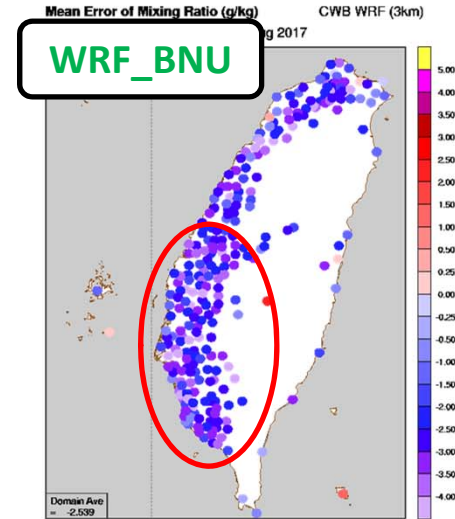
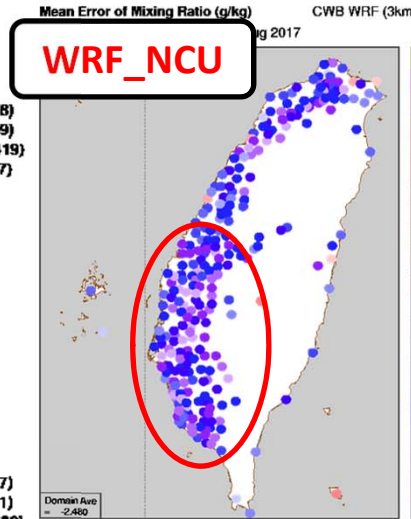
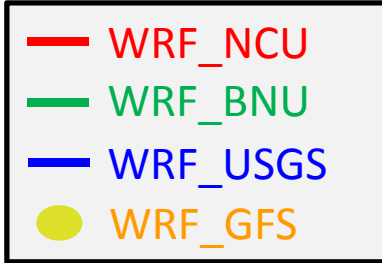
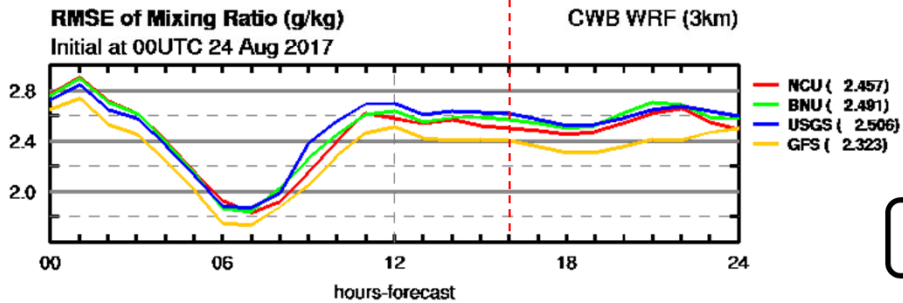
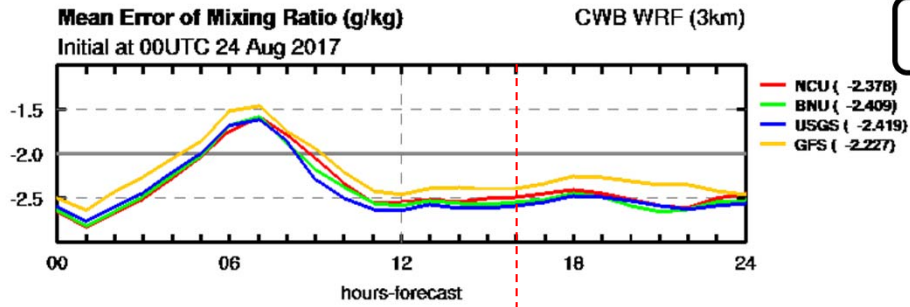
WRF_BNU：土壤初始場使用BNU之土壤分析場

WRF_USGS：土壤初始場使用USGS之土壤分析場

WRF_GFS：土壤初始場使用GFS之土壤分析場

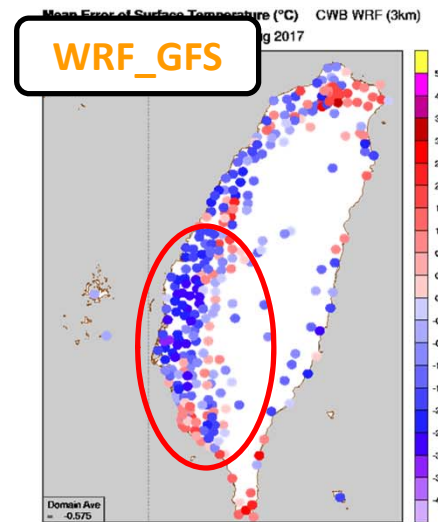
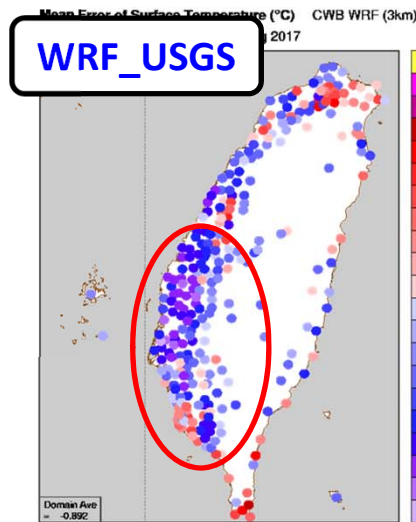
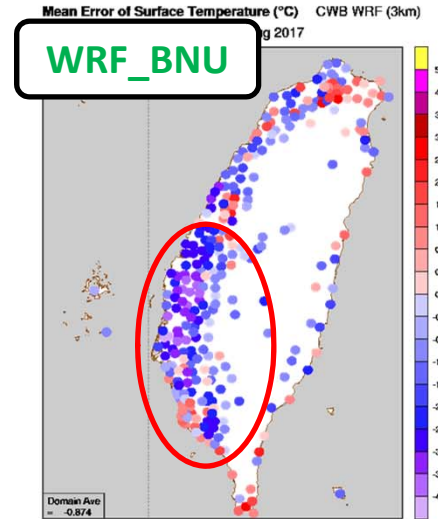
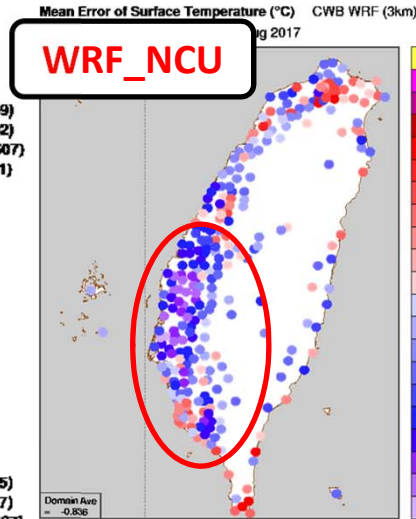
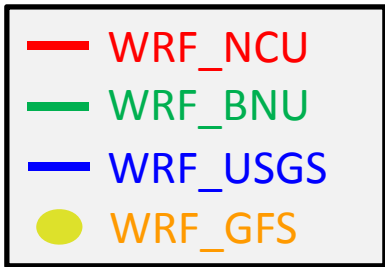
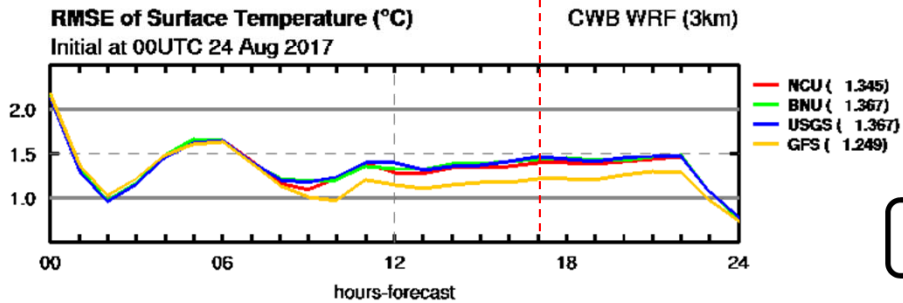
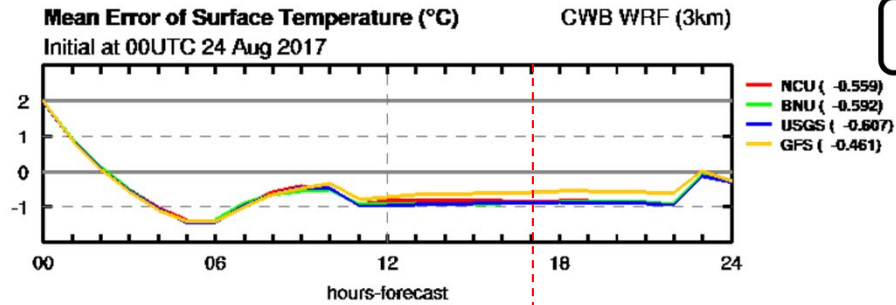
Mixing Ratio at 2 m

Forecast hour = 16
Valid Time = 2017080500 LST



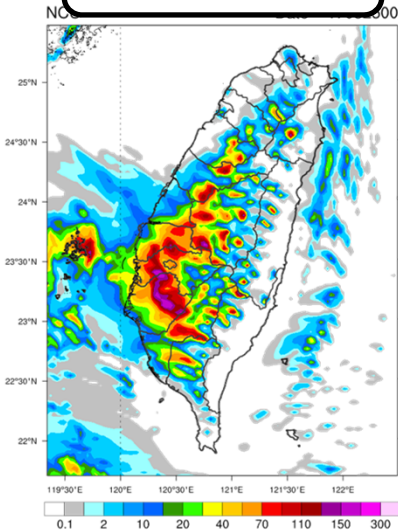
Temperature at 2 m

Forecast hour = 17
Valid Time = 2017080501 LST

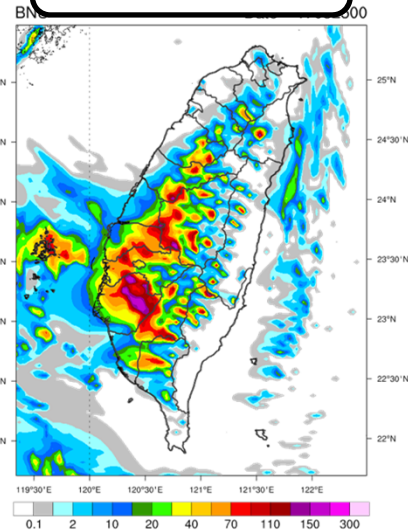


24小時累積降水

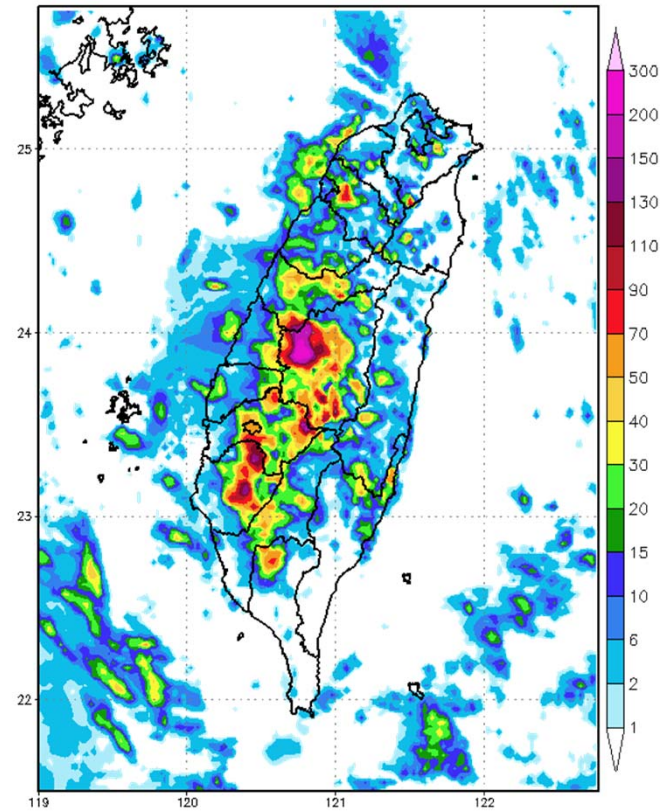
WRF_NCU



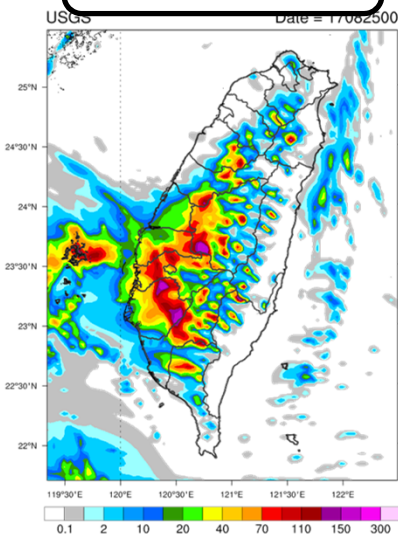
WRF_BNU



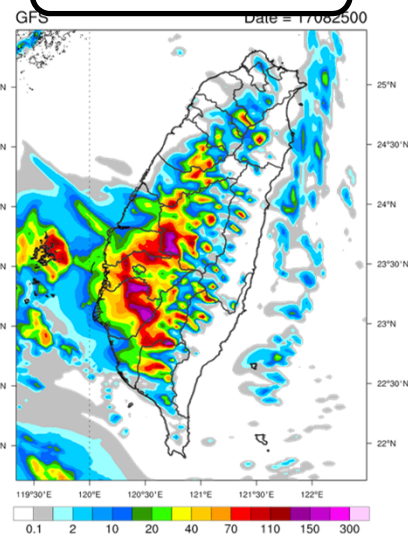
OBS



WRF_USGS



WRF_GFS



結論與未來工作

1. HRLDAS

- 改變HRLDAS的土壤分類資料對土壤濕度的影響較為顯著，對土壤溫度的影響則較不明顯。
- HRLDAS的土壤溫度有冷偏差，尤其在夜晚更為明顯。
- NCU因為土壤的透水性最高，因此其土壤濕度最低，依序為BNU、USGS。
- 與GFS相比，HRLDAS系統的土壤溫度偏低，土壤濕度也偏低。

2. WRF耦合HRLDAS

- WRF耦合HRLDAS的實驗中，使用NCU的土壤分析場，在地面溫度及濕度的預報都可以獲得較好的結果。
- 使用GFS土壤分析場能夠獲得最好的預報結果。

3. 未來工作

- 評估HRLDAS的土壤濕度
- 調整NOAH Land Surface Model及相關參數