

中央氣象局  
土壤資料同化系統之更新

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## 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



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

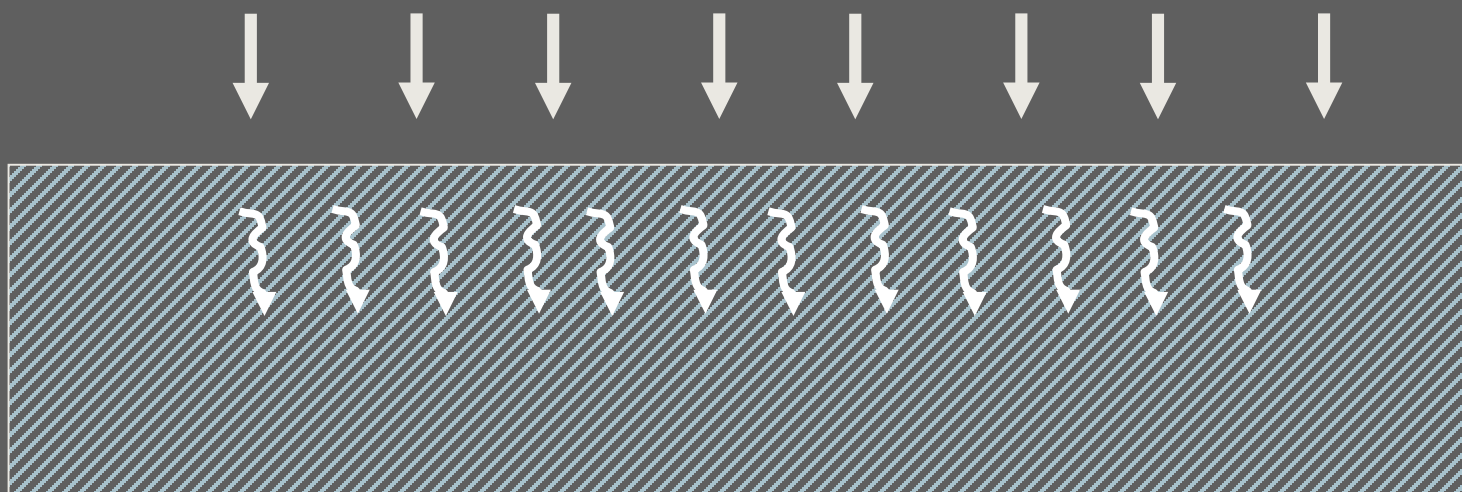
$$C(\theta) \frac{\partial T}{\partial t} = \frac{\partial}{\partial z} \left( K_t(\theta) \frac{\partial T}{\partial z} \right)$$

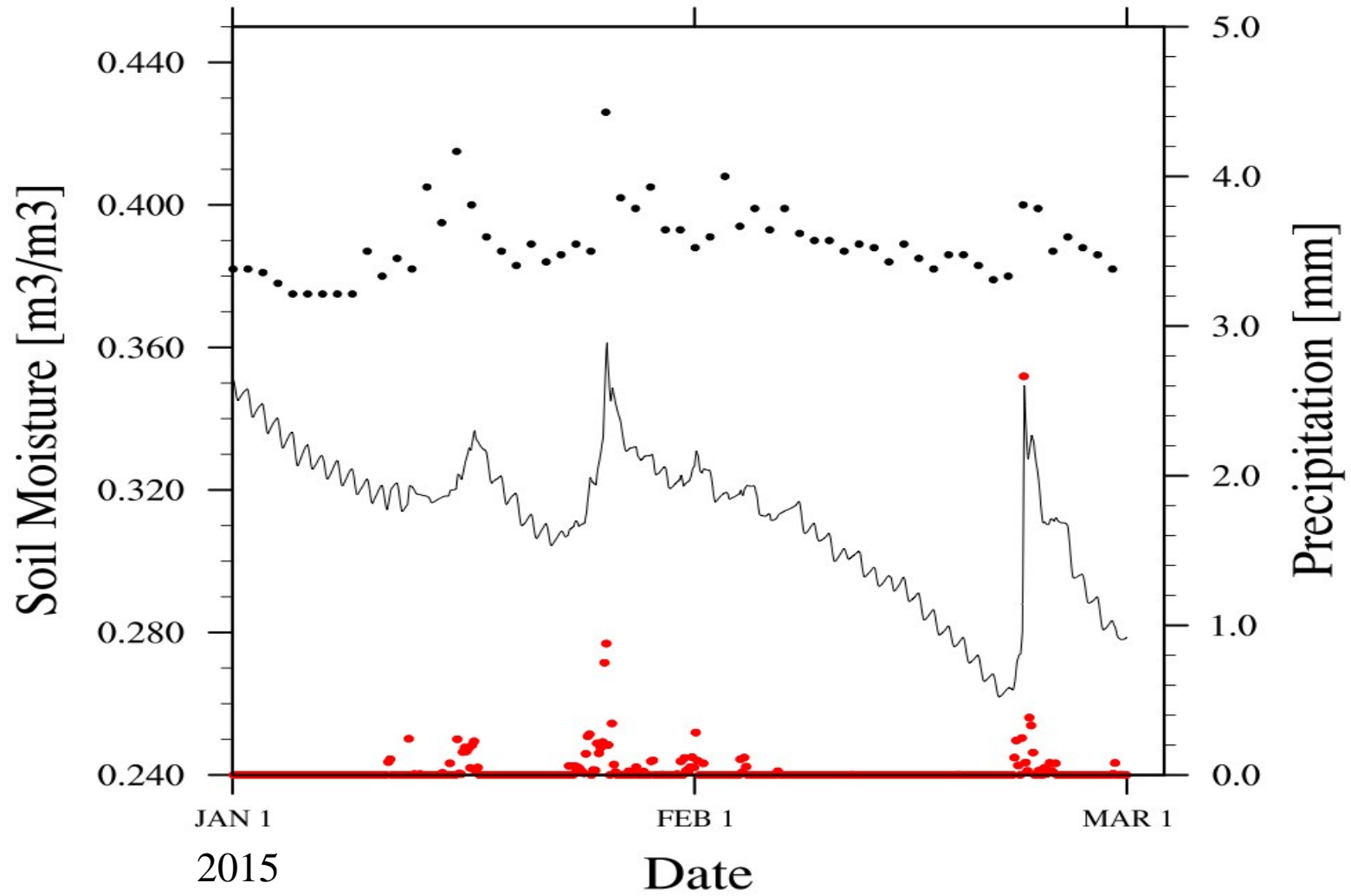
HRLDAS: High Resolution Land Data Assimilation System

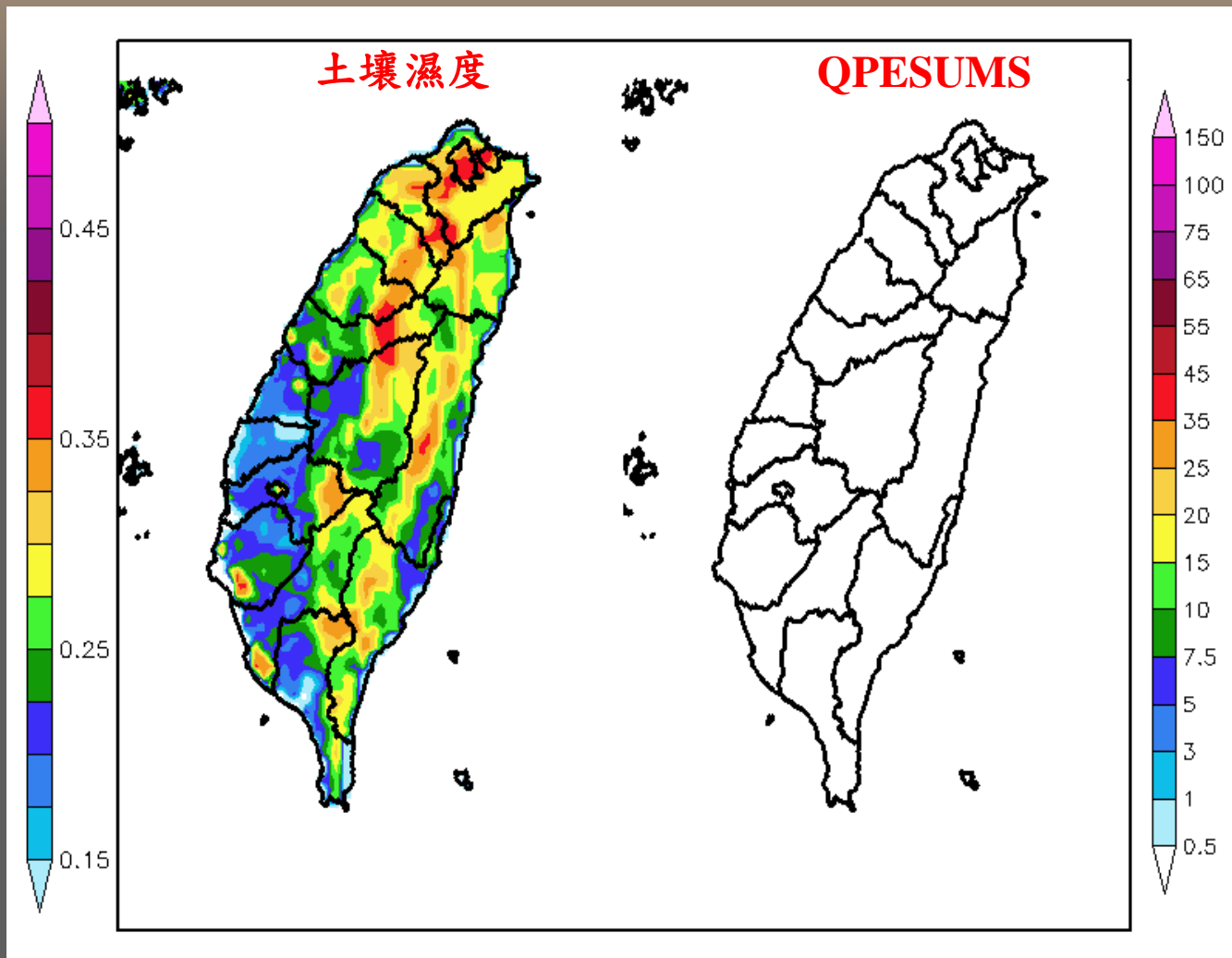
For the HRLDAS system,  
Ingest of the hourly atmospheric forcing is required, including

- 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





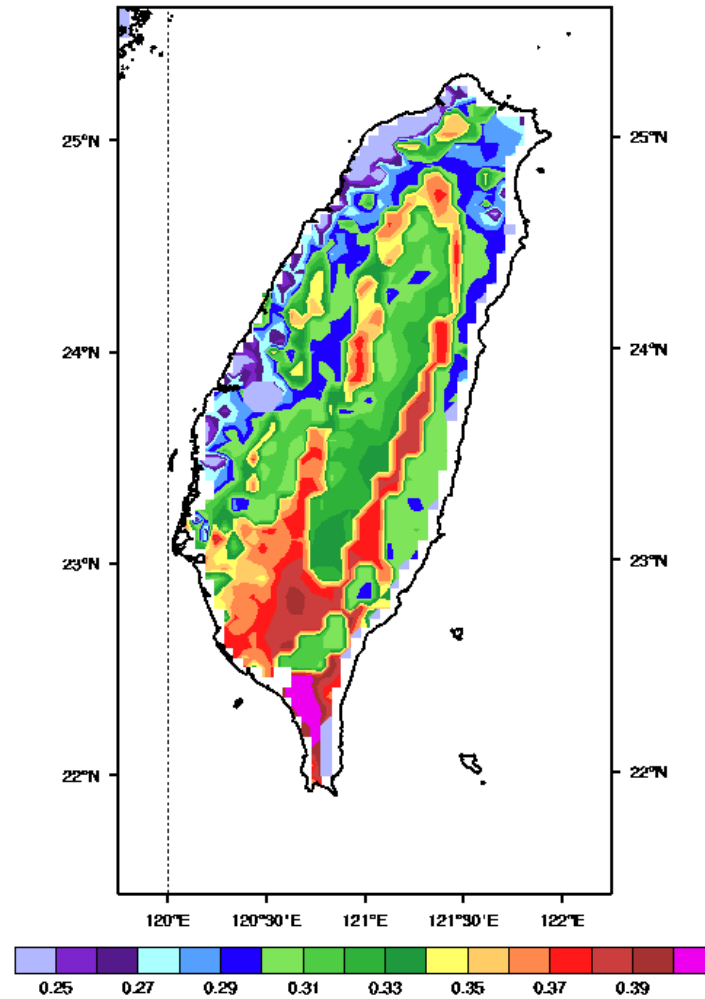


水資源管理的應用  
土石流防災應用  
大氣水氣通量傳送→局部環流

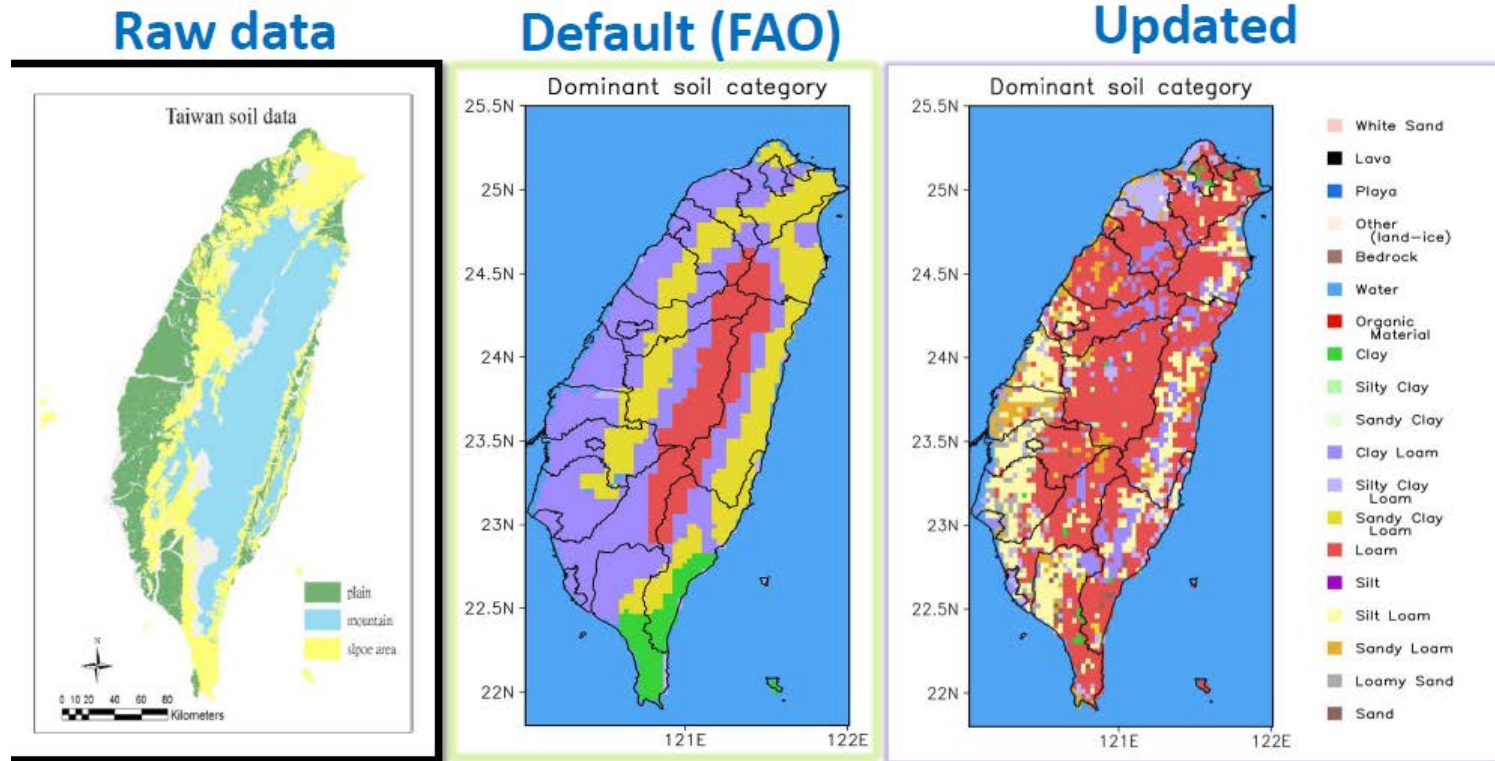
# SOIL MOIS AT LAYER 1

OLD

max=0.419229



# Updated soil textures



平原地區使用行政院農委會的資料

silt loam, loam, loamy sand, sandy loam, sand,  
clay, clay loam, silty clay, silty clay loam

山區及山坡使用vector format(polygon)  
data for 1/25000 soil maps

鄭芳怡、林梓舜，2014

Soil Category	Soil Description	sand	clay	silt	OLD	NEW
1	Sand (砂)	85~100	0~10	0~15	0	2
2	Loamy Sand (壤質砂土)	70~85	10~15	0~30	0	25
3	Sandy Loam (砂壤土)	45~85	0~20	0~50	0	50
4	Silt Loam (粉砂壤土)	0~50	0~25	50~90	0	257
5	Silt (淤泥)	0~20	0~10	90~100	0	0
6	Loam (壤土)	35~50	5~25	30~50	213	826
7	Sandy Clay Loam (沙質粘壤土)	55~80	20~35	0~30	387	3
8	Silty Clay Loam (粉質粘土壤土)	0~20	25~40	40~75	10	62
9	Clay Loam (粘壤土)	20~45	25~40	15~55	638	89
10	Sandy Clay (砂質粘土)	45~65	35~55	0~20	0	0
11	Silty Clay (粉質粘土)	0~20	40~60	40~60	0	0
12	Clay (粘土)	0~45	40~100	0~40	71	5
13	Organic Material (有機物質)				0	0
14	Water (水體)				0	0
15	Bedrock (岩盤)				0	0
16	Other (land-ice)				0	0



# 實驗結果討論

Initial Time at 2016.07.21 00 UTC

Analysis at 2016.08.01 00 ~

2016.09.01 00 UTC

	Resolution	Soil Texture
OLD	5 km	舊版
NEW	5 km	新版
3KM	3 km	新版

# 土壤溫度

OLD SOIL TEXTURE  
V.S.  
NEW SOIL TEXTURE

OLD

2016.08平均

NEW

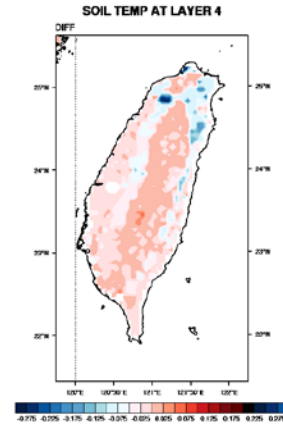
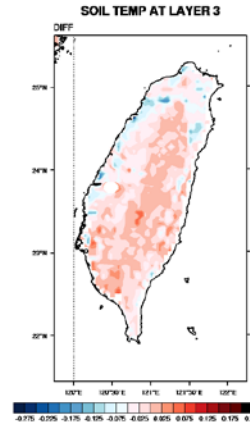
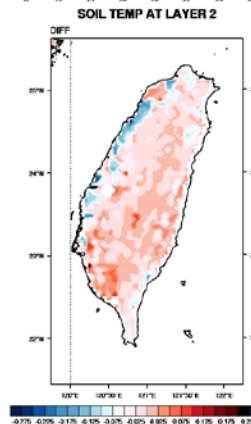
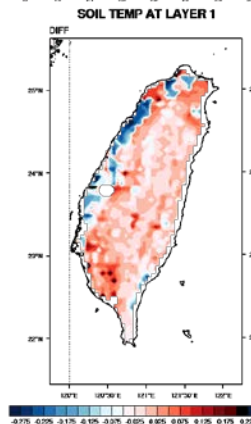
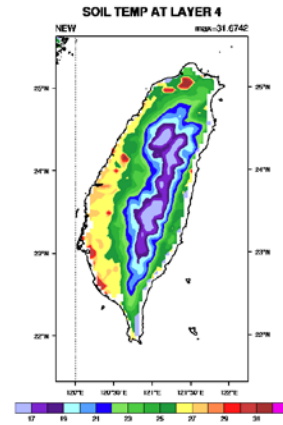
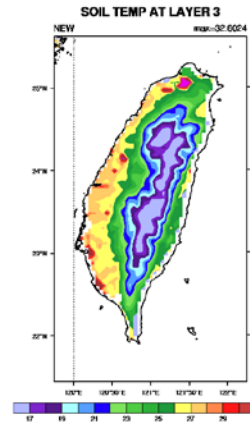
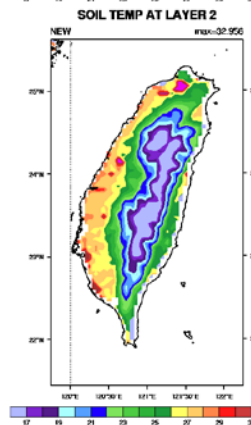
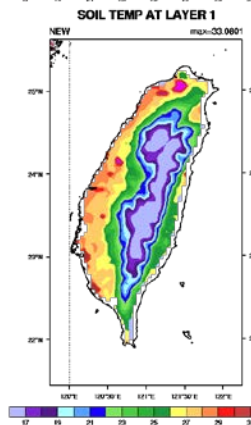
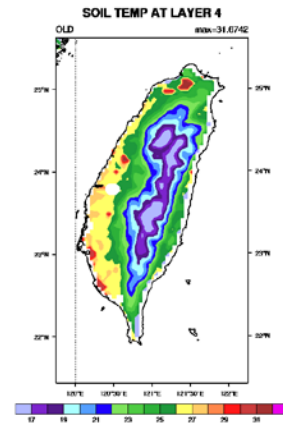
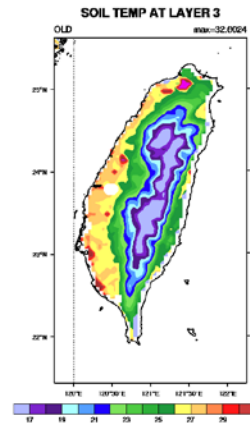
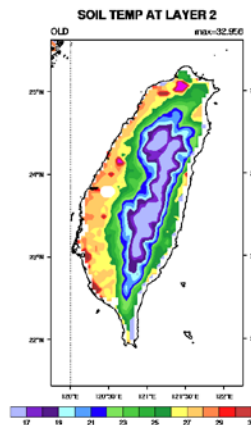
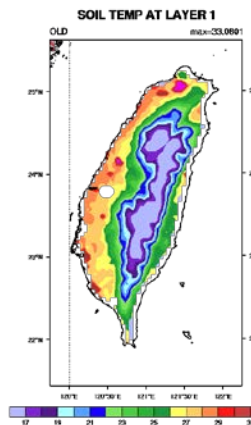
NEW-OLD

Layer 1

Layer 2

Layer 3

Layer 4



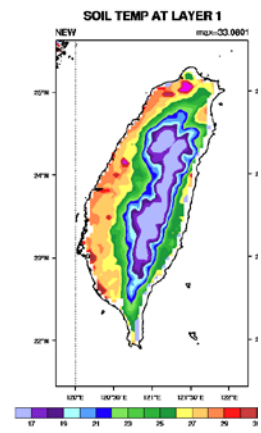
# 土壤溫度

NEW SOIL TEXTURE  
V.S.  
3KM SOIL TEXTURE **NEW**

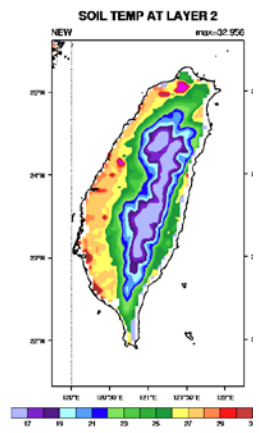
2016.08 平均

**3 KM**

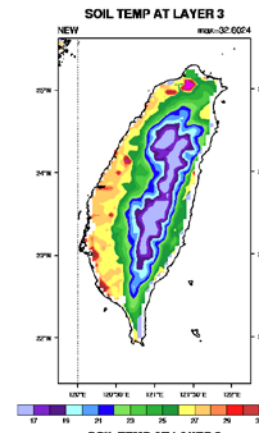
Layer 1



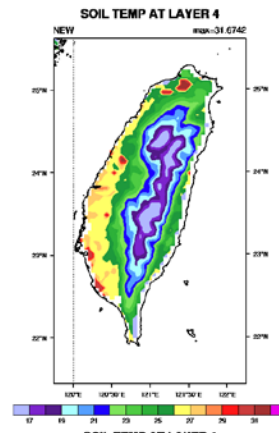
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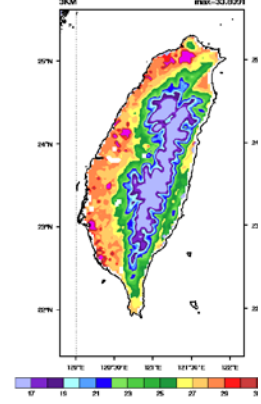
Layer 3



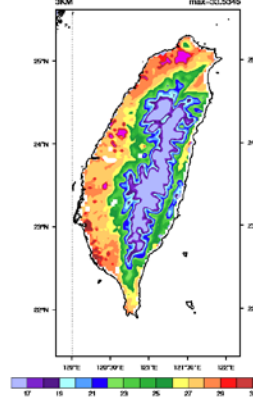
Layer 4



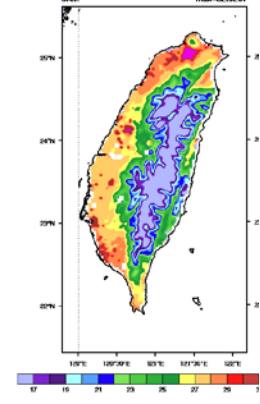
SOIL TEMP AT LAYER 1



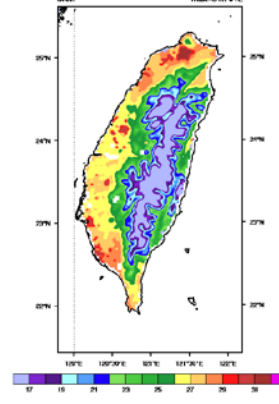
SOIL TEMP AT LAYER 2



SOIL TEMP AT LAYER 3



SOIL TEMP AT LAYER 4



# 土壤濕度

OLD SOIL TEXTURE  
V.S.  
NEW SOIL TEXTURE

OLD

2016.08平均

NEW

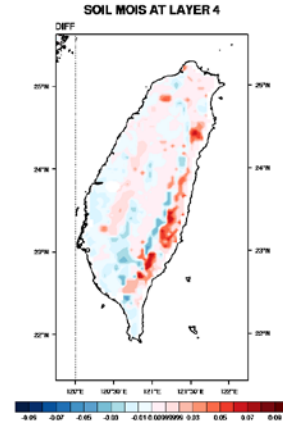
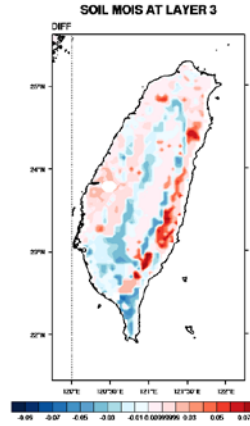
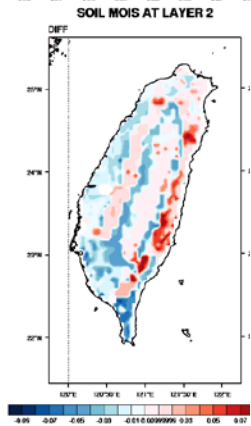
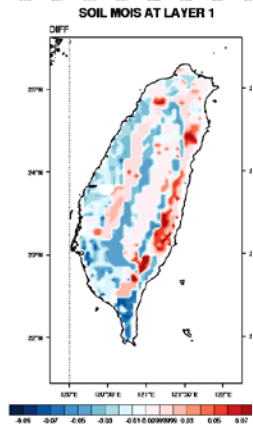
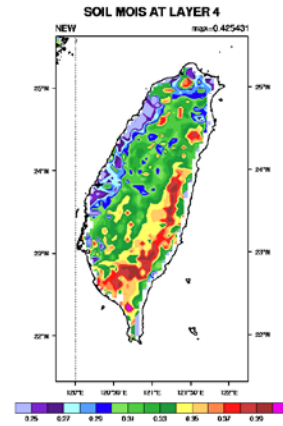
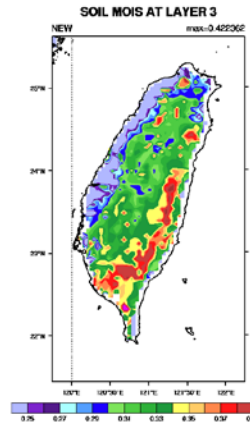
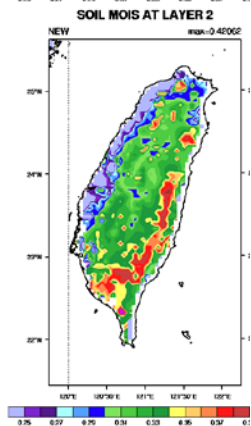
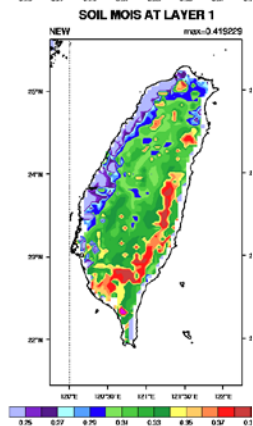
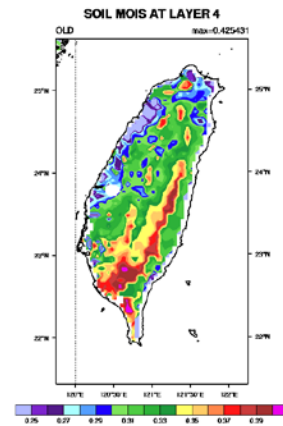
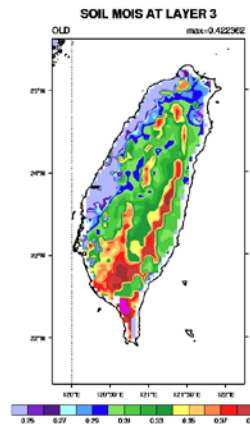
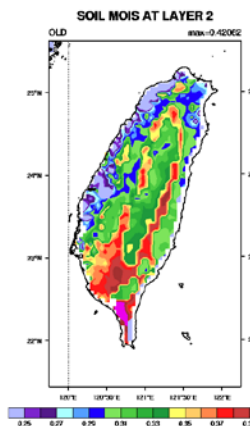
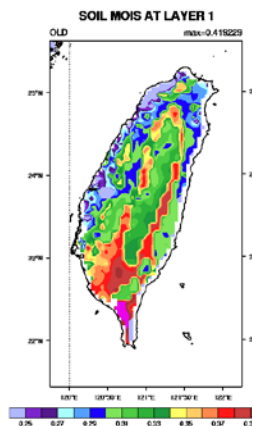
NEW-OLD

Layer 1

Layer 2

Layer 3

Layer 4



# 土壤濕度

NEW SOIL TEXTURE  
V.S.  
3KM SOIL TEXTURE **NEW**

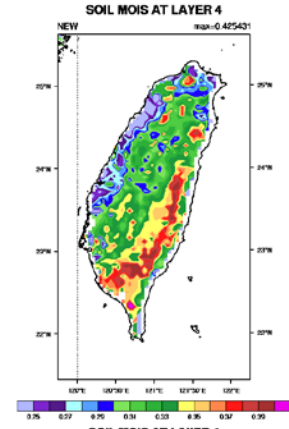
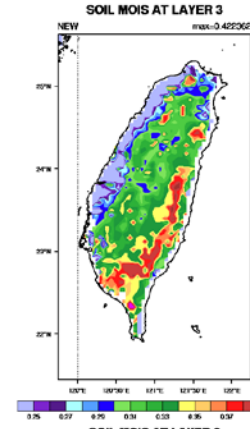
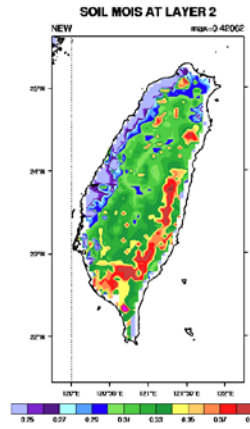
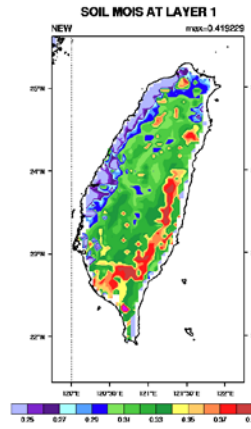
2016.08 平均

Layer 1

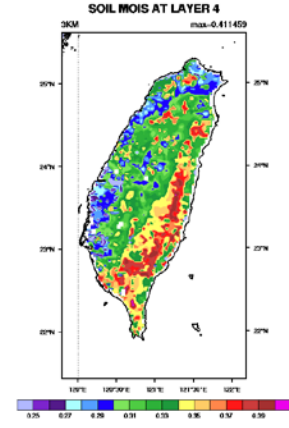
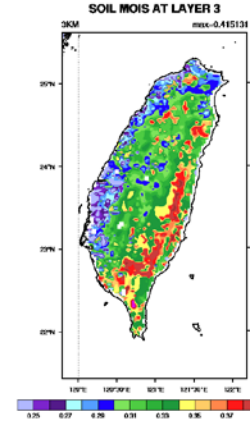
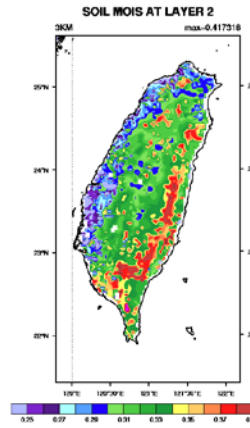
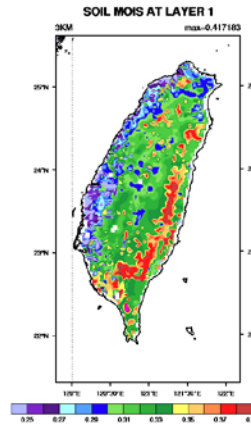
Layer 2

Layer 3

Layer 4

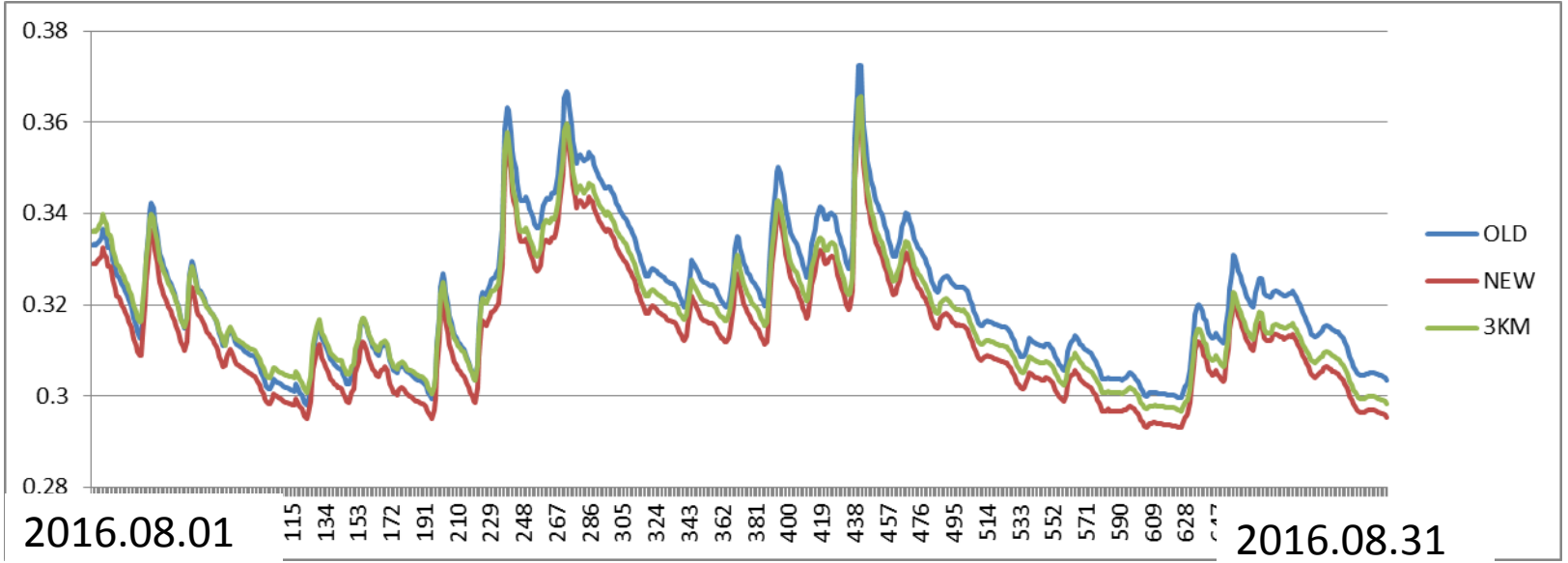


**3 KM**

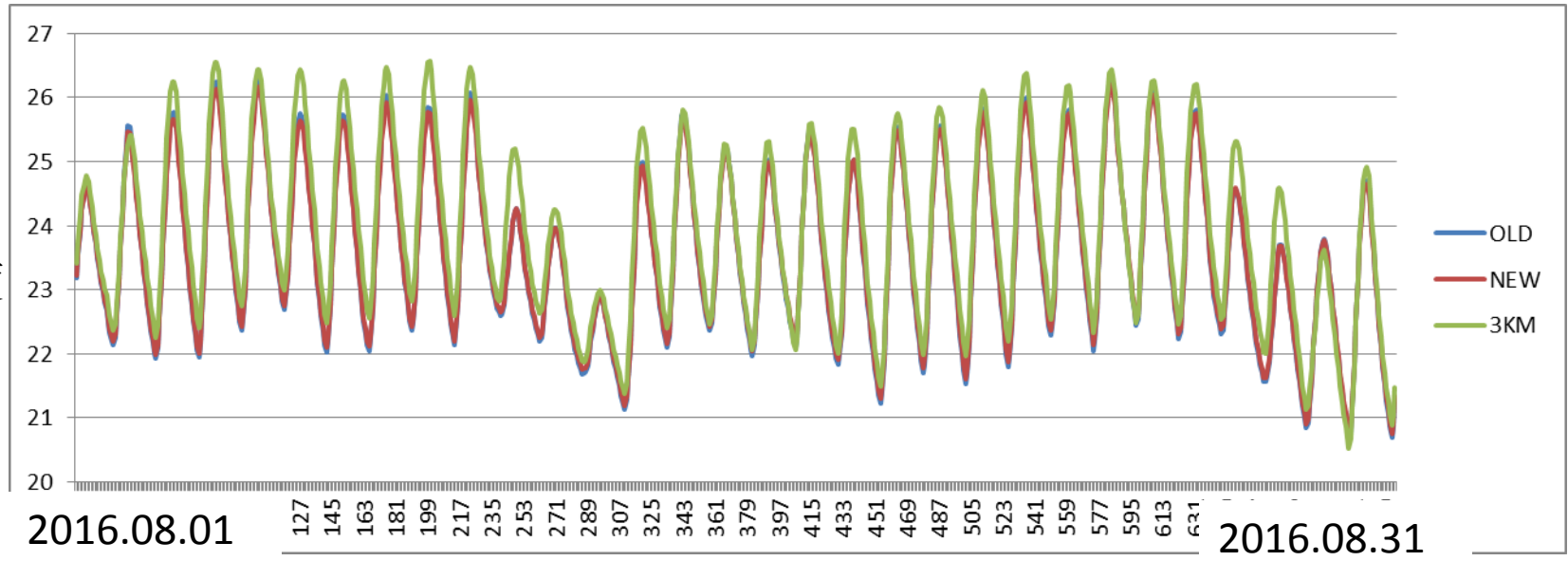


# LAYER 1

土壤濕度



土壤溫度



## 土壤濕度

	OLD	NEW	3KM
LAYER 1	0.321	0.314	0.318
LAYER 2	0.321	0.315	0.319
LAYER 3	0.319	0.314	0.320
LAYER 4	0.319	0.316	0.322

## 土壤溫度

	OLD	NEW	3KM
LAYER 1	23.63	23.64	23.94
LAYER 2	23.59	23.59	23.90
LAYER 3	23.54	23.55	23.85
LAYER 4	23.48	23.48	23.77

# 結論

- 使用新版Soil texture，土壤濕度有變暖的趨勢。
- Soil texture的改變對土壤濕度的影響顯著。從空間平均來看，台灣地區土壤溼度降低。
- 3 km HRLDAS相對於5 km HRLDAS能凸顯更多細節。
- 未來將評估使用新版Soil texture 的HRLDAS (NEW) 及3 km HRLDAS (3KM)對WRF預報的影響。