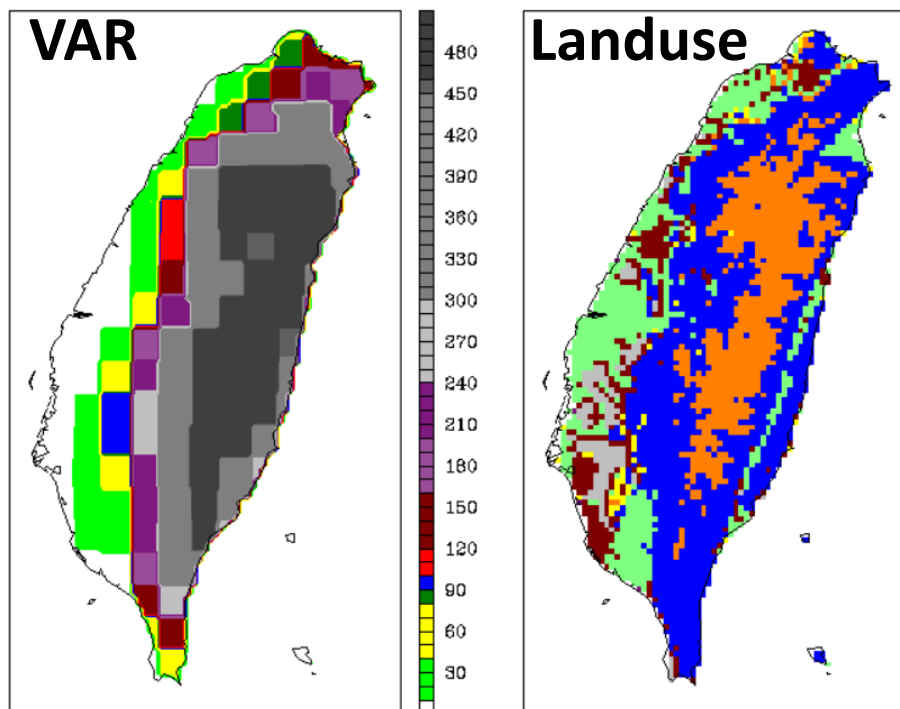


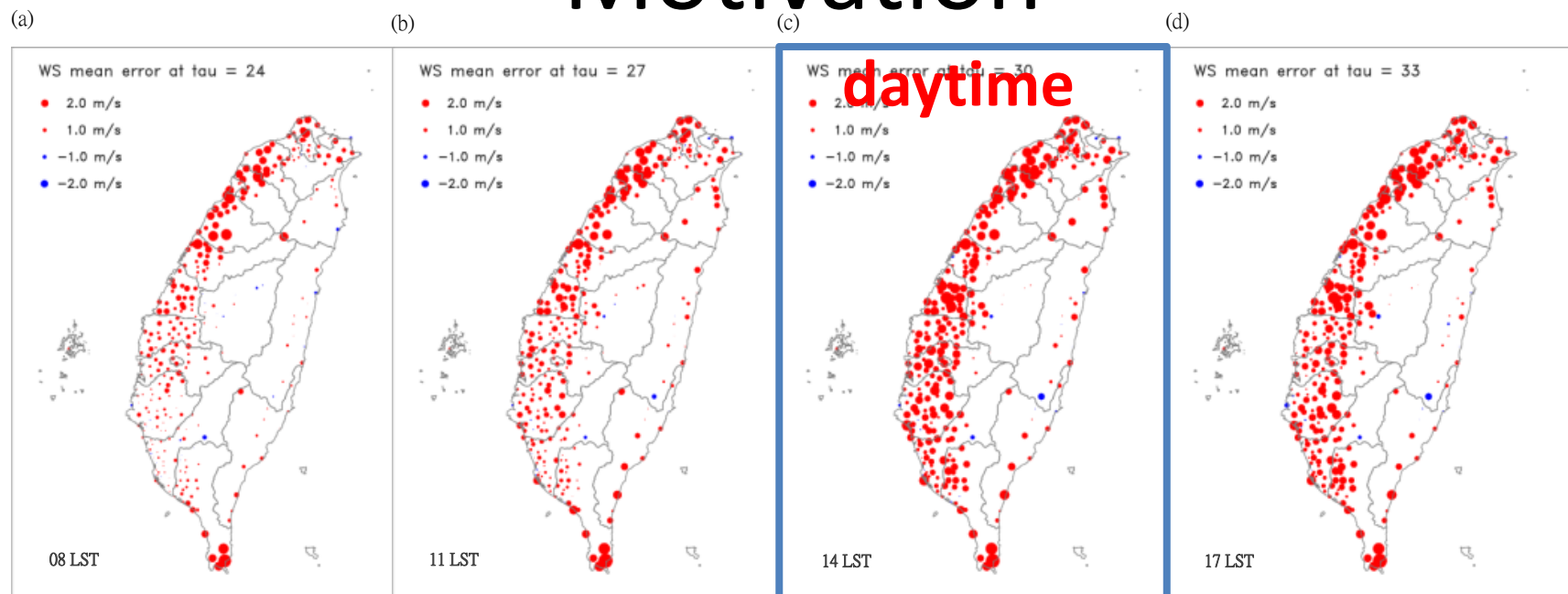
次網格地形暨地表粗糙度對 模式地面風及降水預報之影響

黃小玲、洪景山、陳怡儒
中央氣象局 資訊中心

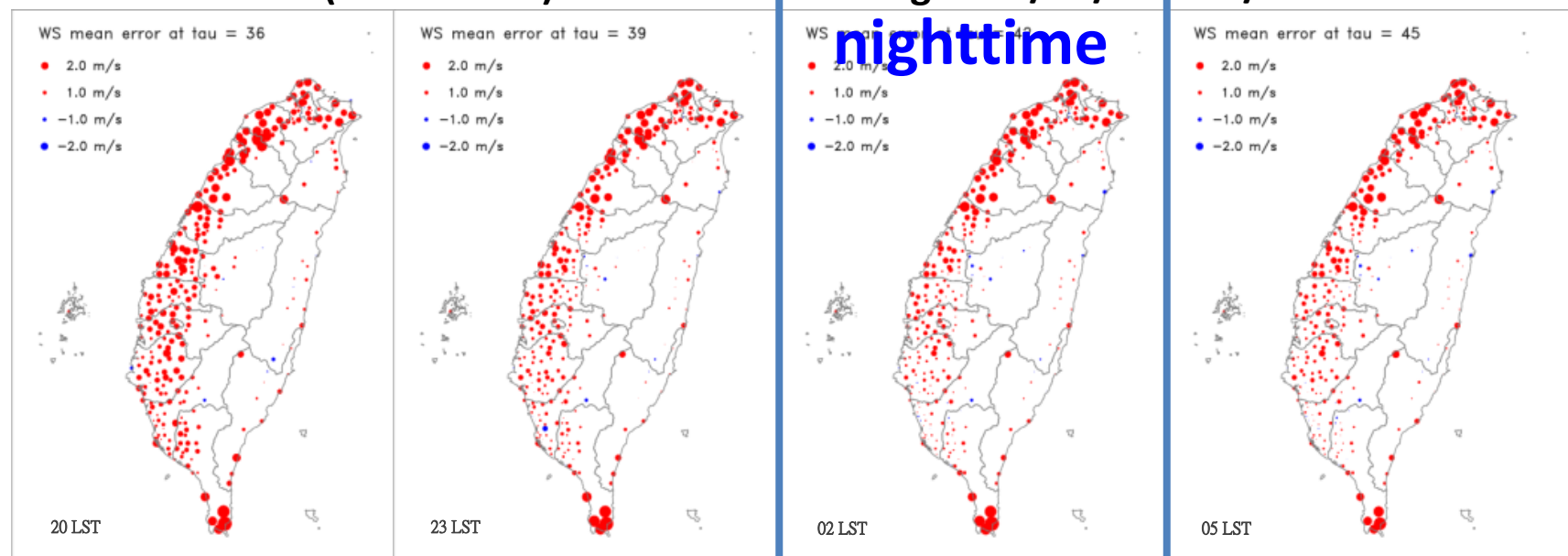
107年天氣分析與預報研討會
2018/09/11 ~ 09/13 @ 台北



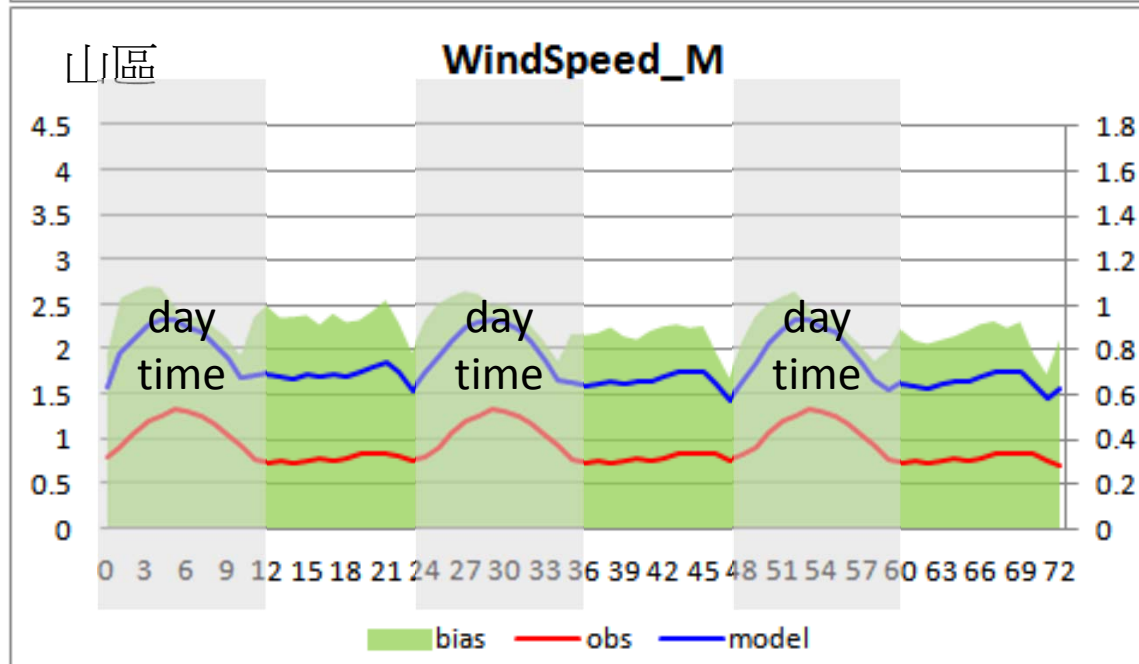
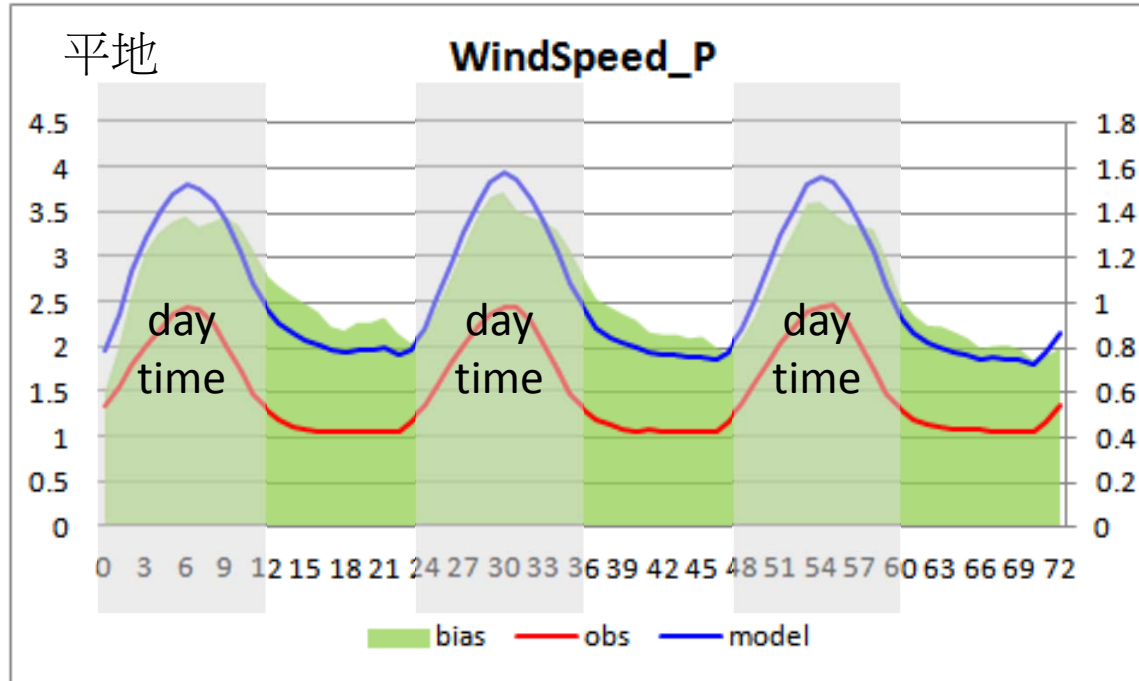
Motivation



(e) **ME (mean error) of 10 m wind during 2017/05/01 to 06/30**

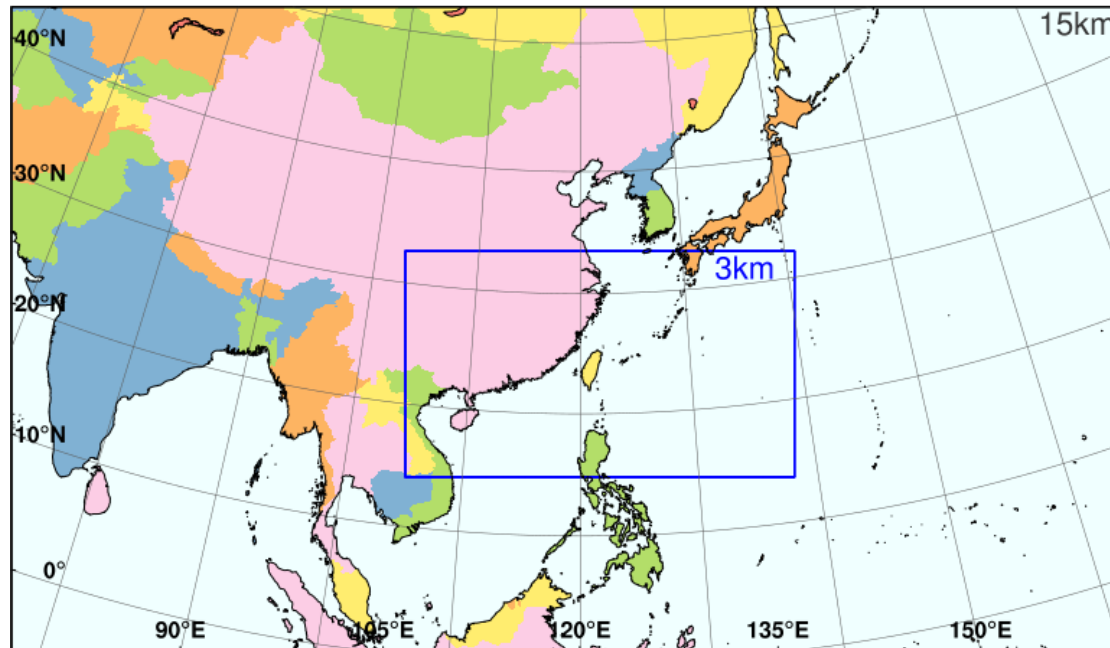


ME of 10 m wind during 2017/05/01 ~ 06/30



Configuration

WRFD Domain



D1: 662*386 (15-km)

D2: 1161*676 (3-km)

52 levels in the vertical

CU: Kain-Fritsch with new trigger function (used @ D1)

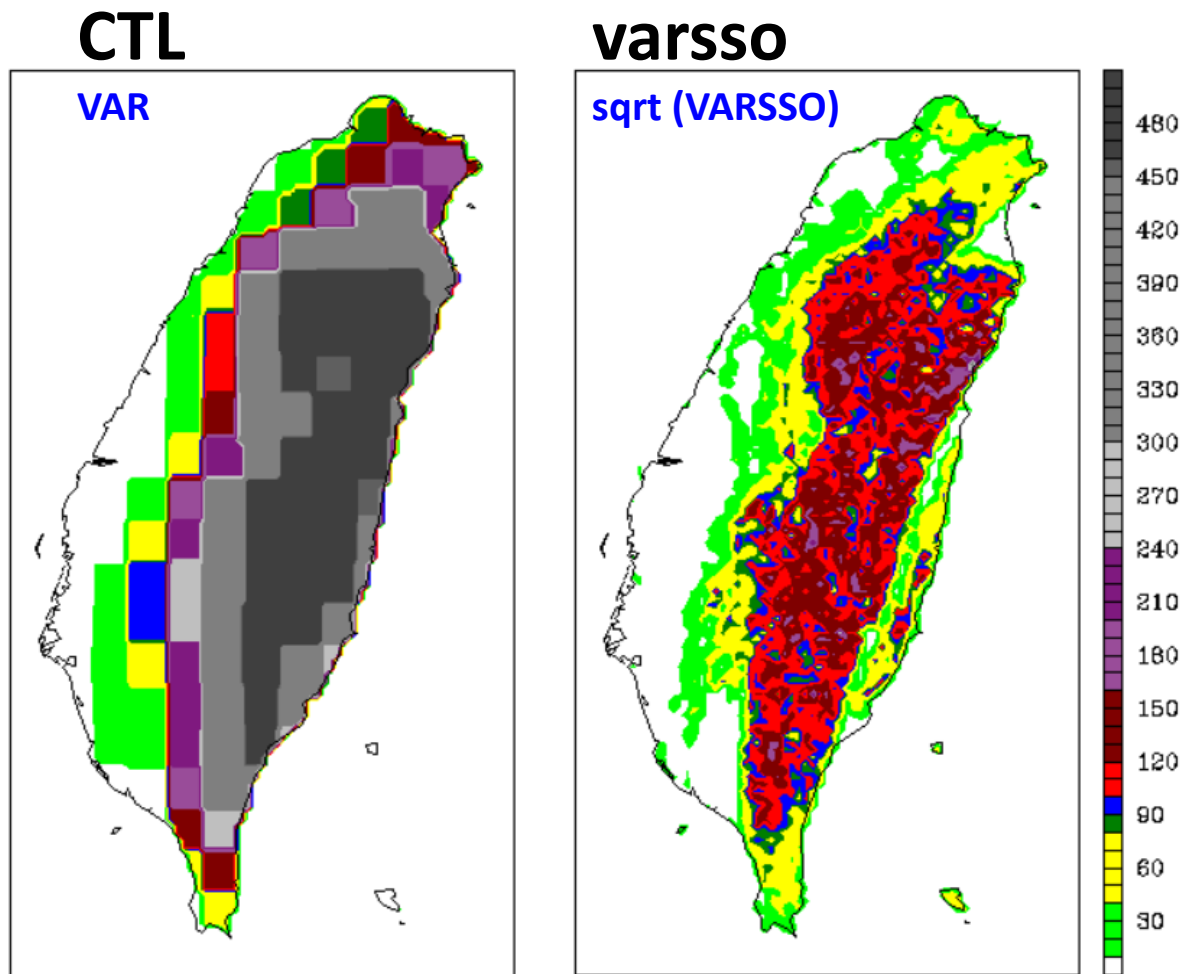
MP: Goddard 6-class

PBL: YSU

Tests	
CTL	topo_wind=2 (VAR; 粗解析之地形方差資料)
crop+0.1	與CTL相同, 但增加crop and roughness
varsso	topo_wind=2 (VARSSO; 高解析之地形方差資料)
topo1 (varsso)	topo_wind=1 (VARSSO; 高解析之地形方差資料)

Surface roughness 實驗

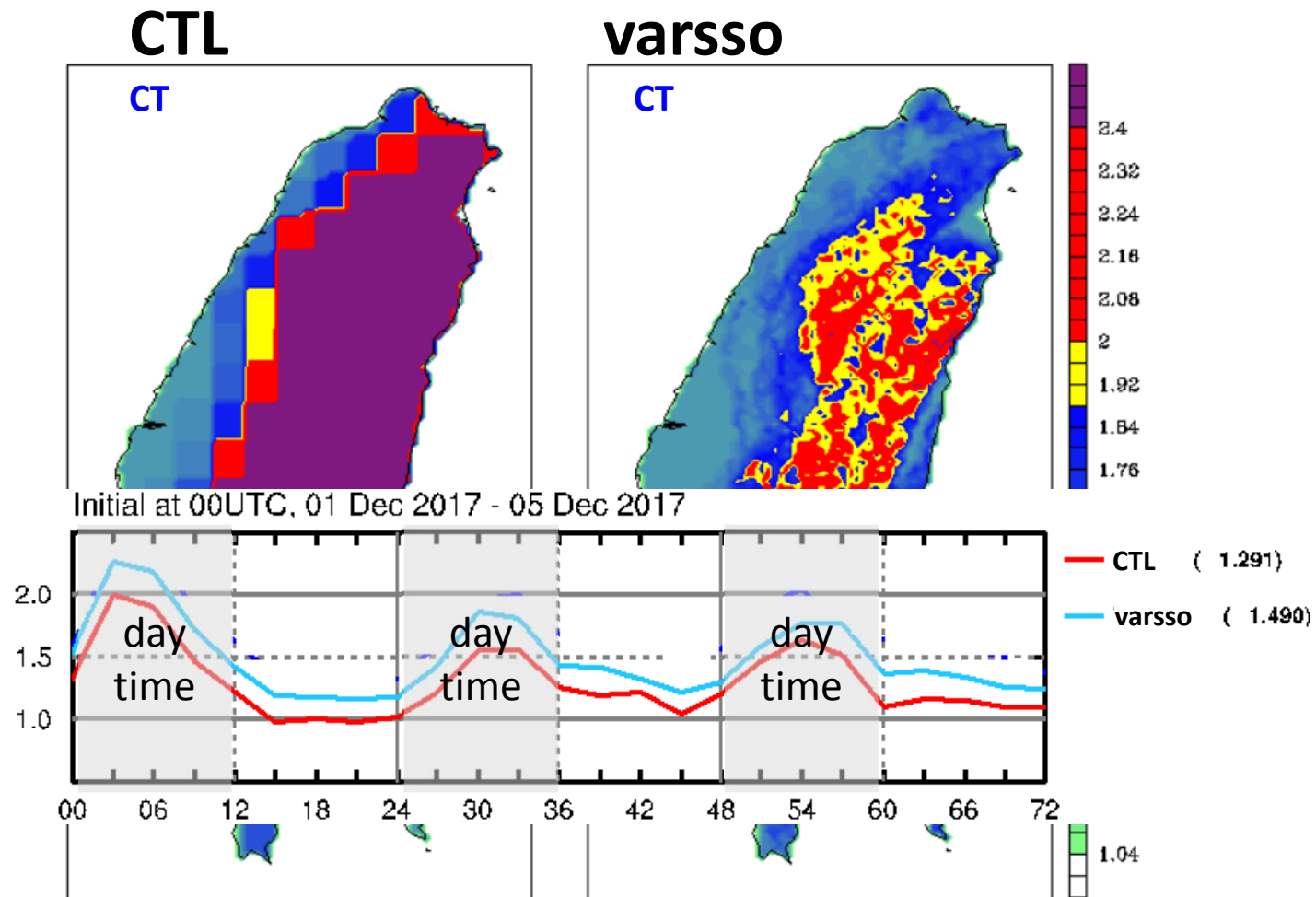
Tests	topo_wind scheme
CTL	topo_wind=2 (VAR; 粗解析之地形方差資料)
varsso	topo_wind=2 (VARSSO; 高解析之地形方差資料)



VAR: orographic variance

VARSSO: variance of subgrid-scale orography

Tests	topo_wind scheme
CTL	topo_wind=2 (VAR; 10 min解析~ 20 km)
varsso	topo_wind=2 (VARSSO; 30 sec解析~ 1 km)



CT: Correction for topography

var= min (1.575, (var*0.4/200.+1.175))
ct= var*var

Tests	topo_wind scheme
topo1 (varsso)	topo_wind=1 (VARSSO; 高解析之地形方差資料)

Topo_wind =1 計算 : (Jimenez and Dudhia, 2012)

$$\Delta^2 h_{i,j} = 0.25(h_{i+1,j} + h_{i,j+1} + h_{i-1,j} + h_{i,j-1} - 4h_{i,j})$$

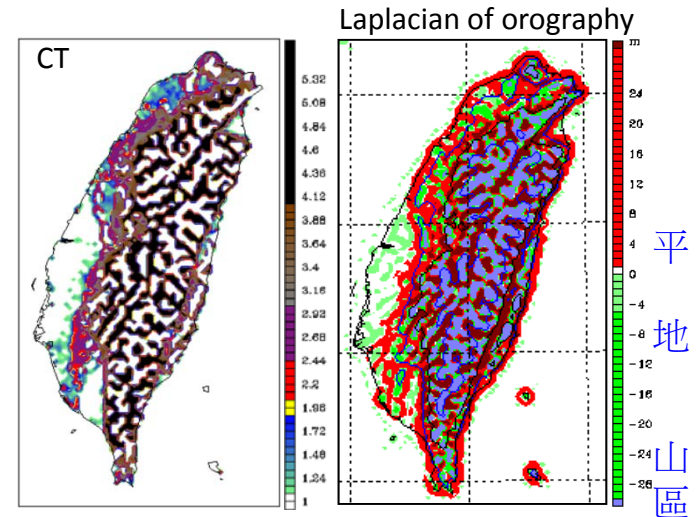
$$\alpha = (\Delta^2 h + 20)/10$$

低地: $\Delta^2 h_{i,j} > 0$; 高地: $\Delta^2 h_{i,j} < 0$

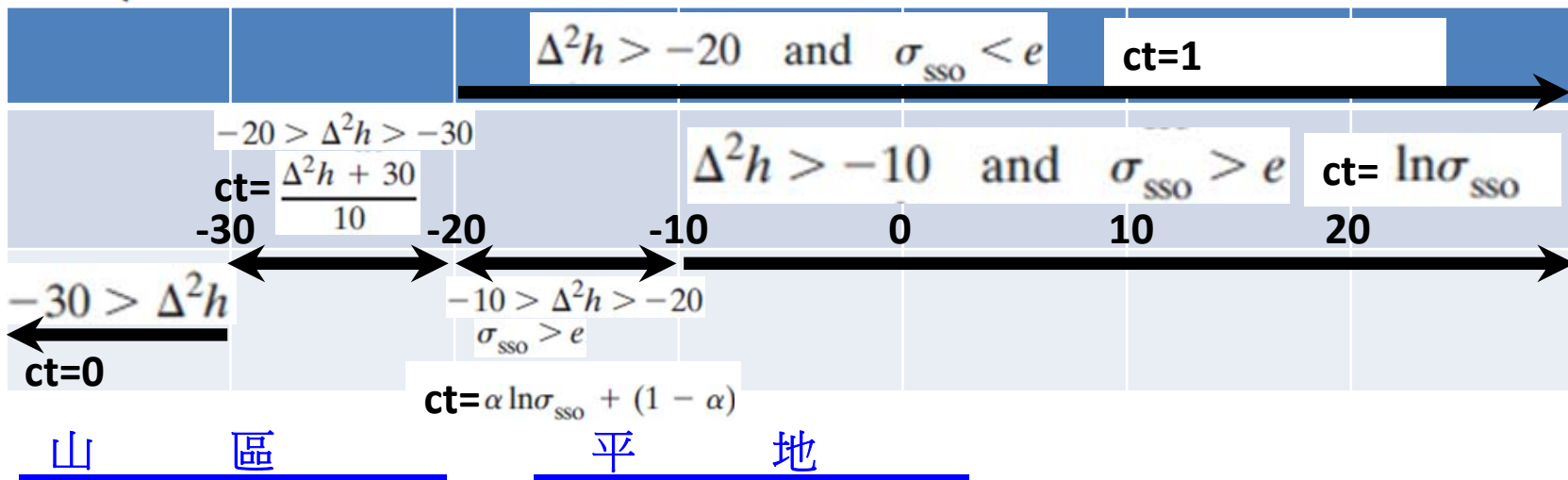
e: the natural logarithm base (2.718)

$\Delta^2 h_{i,j}$: Laplacian of orography

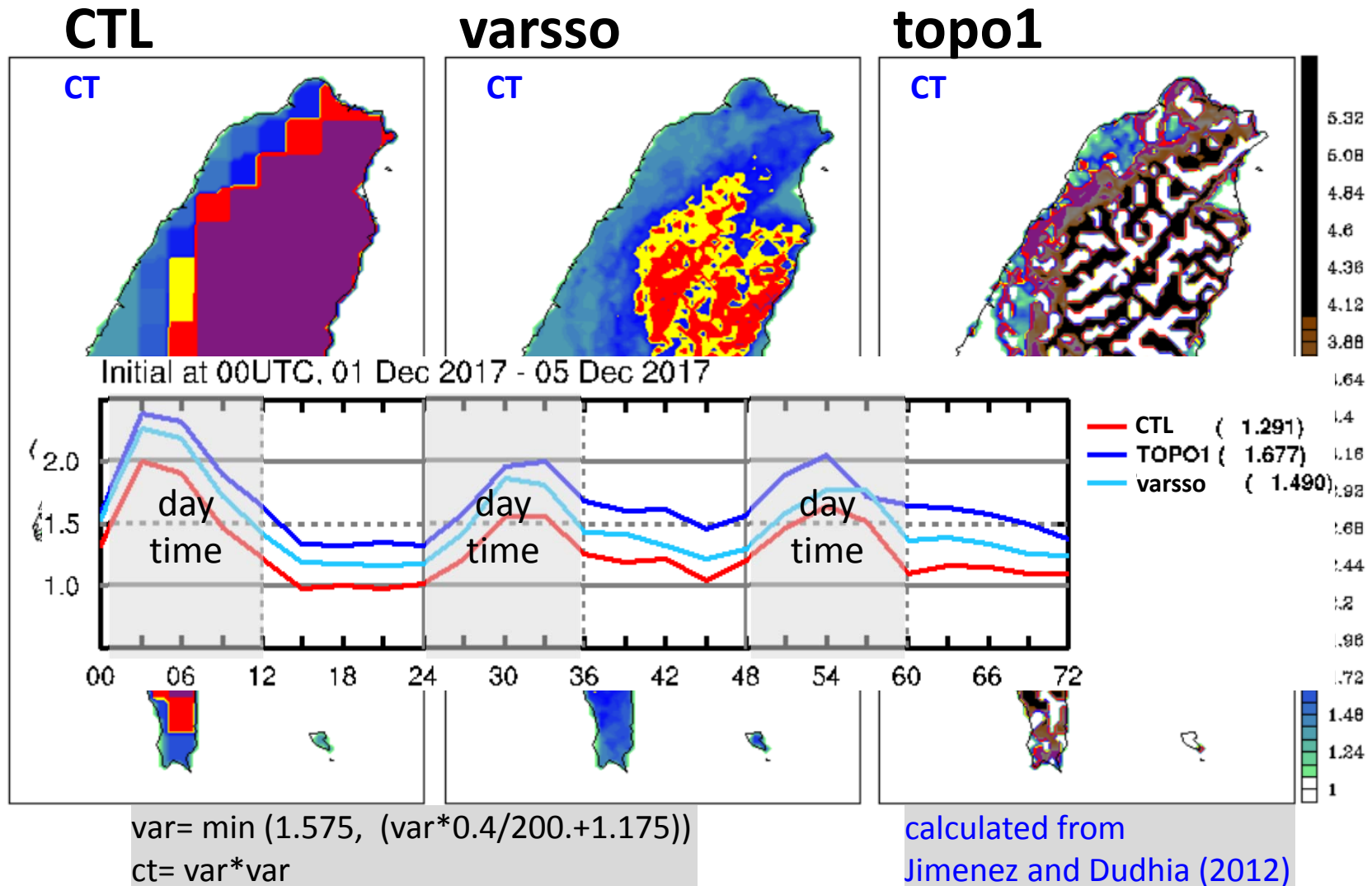
$$c_t = \begin{cases} 1 & \text{平地} & \text{if } \Delta^2 h > -20 \text{ and } \sigma_{SSO} < e \\ \ln \sigma_{SSO} & & \text{if } \Delta^2 h > -10 \text{ and } \sigma_{SSO} > e \\ \alpha \ln \sigma_{SSO} + (1 - \alpha) & & \text{if } -10 > \Delta^2 h > -20 \text{ and } \sigma_{SSO} > e \\ \frac{\Delta^2 h + 30}{10} & \text{山區} & \text{if } -20 > \Delta^2 h > -30 \\ 0 & & \text{if } -30 > \Delta^2 h \end{cases}$$



平地
山區

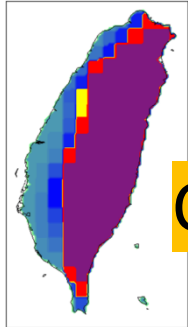


Tests	topo_wind scheme
CTL	topo_wind=2 (VAR; 粗解析之地形方差資料)
varsso	topo_wind=2 (VARSSO; 高解析之地形方差資料)
topo1 (varsso)	topo_wind=1 (VARSSO; 高解析之地形方差資料)

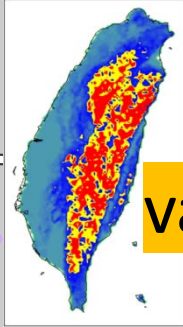
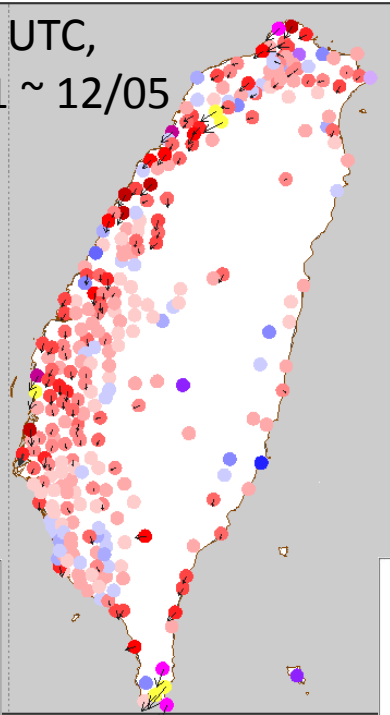


Initial at 00 UTC,
2017/12/01 ~ 12/05

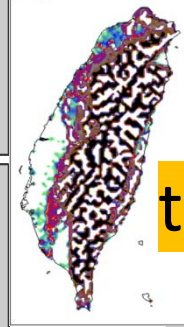
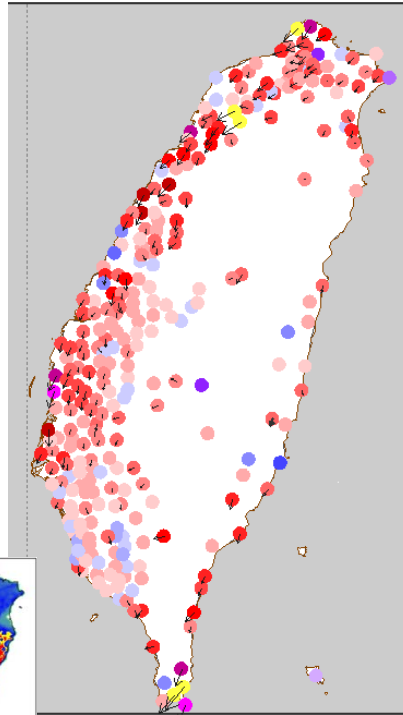
nighttime
(f18)



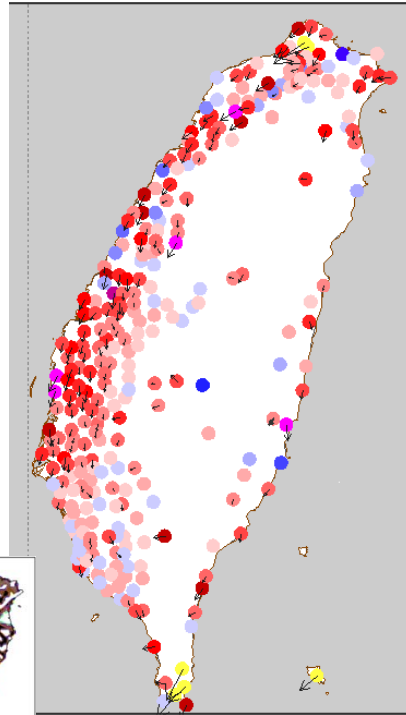
CTL



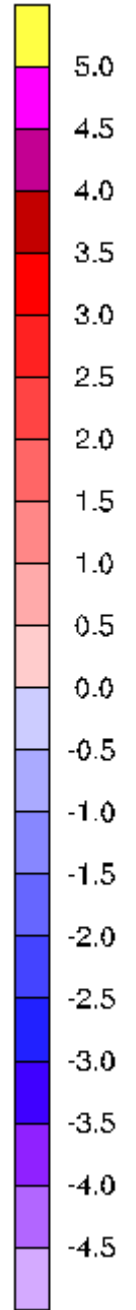
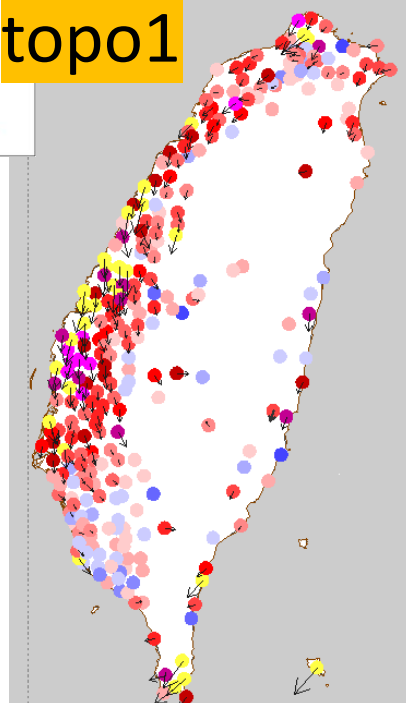
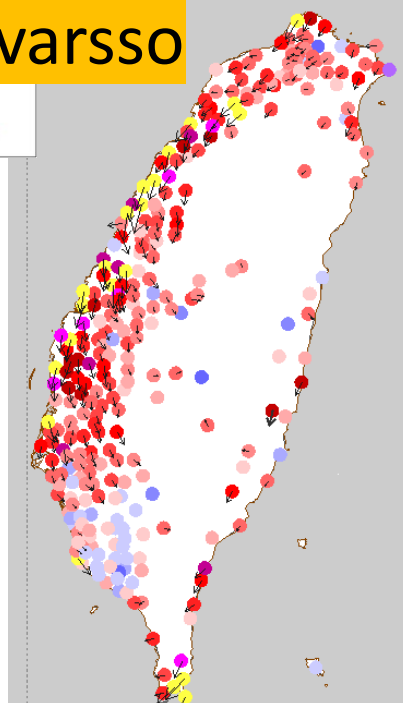
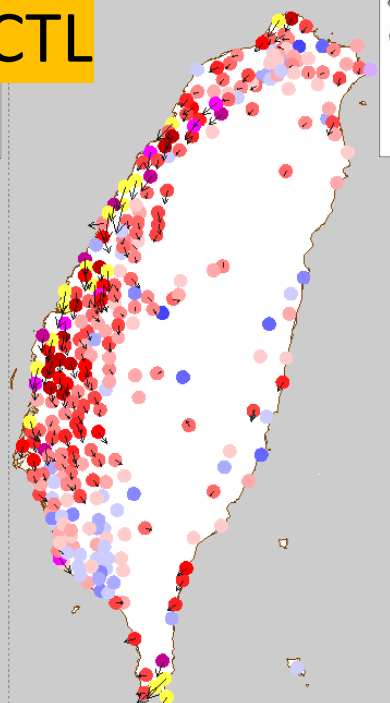
varsso



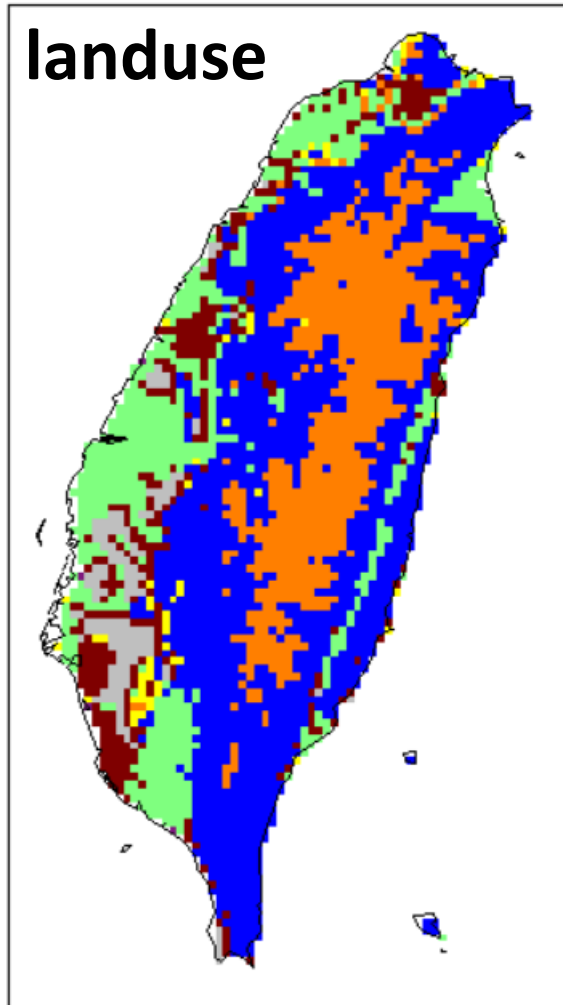
topo1



daytime
(f30)



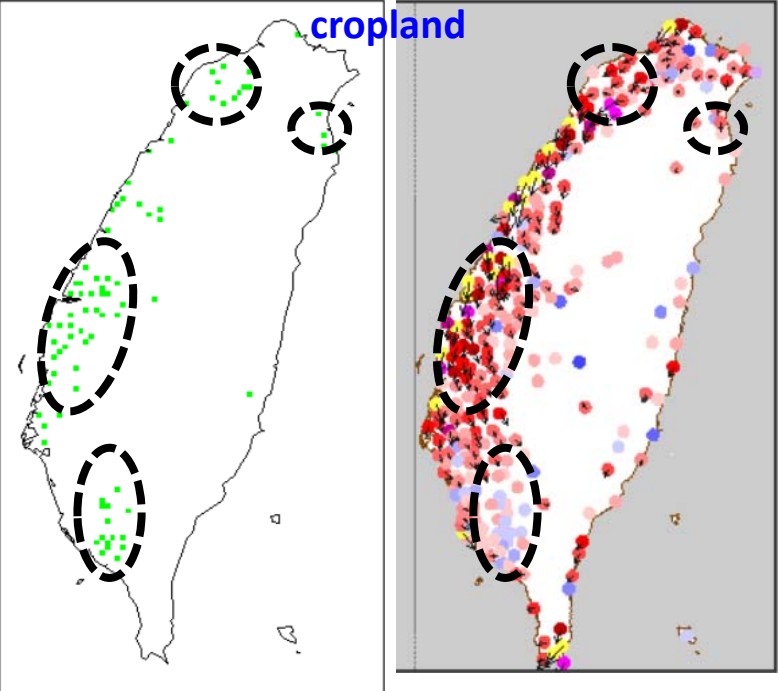
Surface roughness test



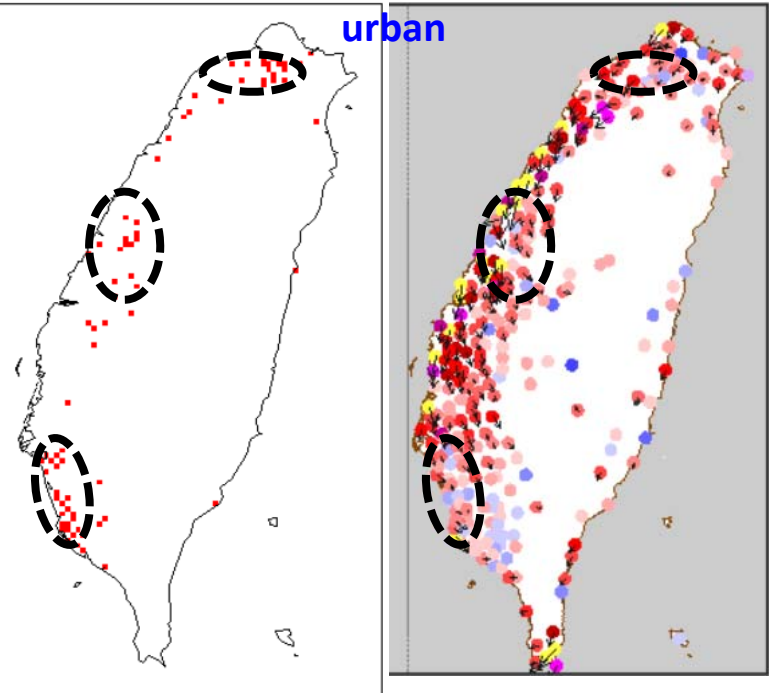
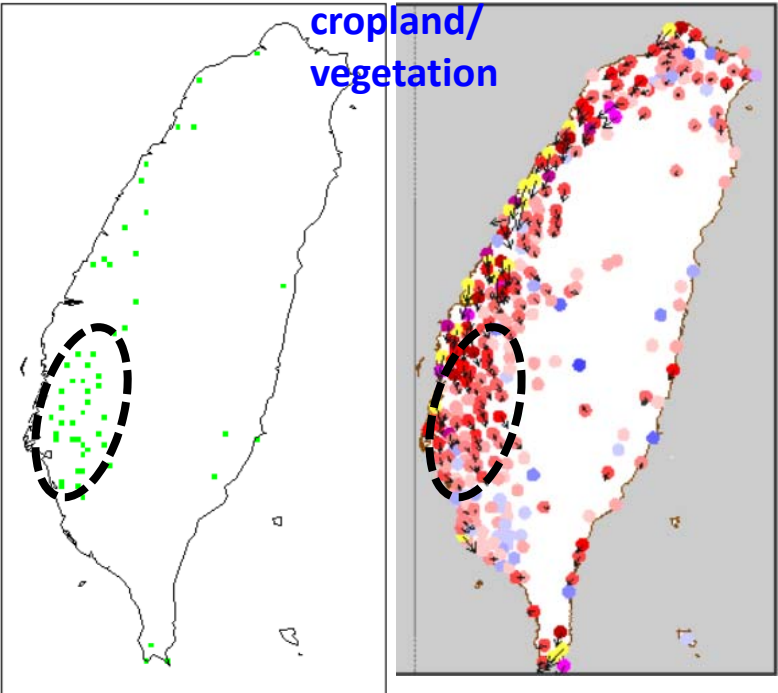
MODIFIED_IGBP_MODIS_NOAH

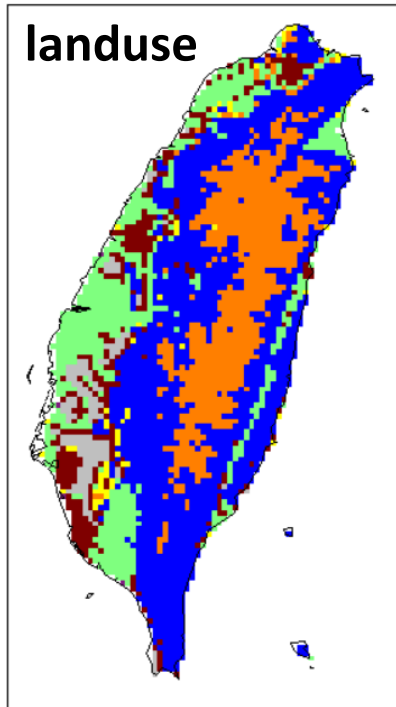
cat	CTL	crop+0.1		
2	0.5	0.5	■	Evergreen Broadleaf Forest
12	0.15	0.25	■	Croplands
13	0.5	0.5	■	Urban and Built-Up
14	0.05	0.05	■	cropland/natural vegetation mosaic

ME of 10 m wind @ daytime of CTL



MODIFIED_IGBP_MODIS_NOAH				
cat	Z0 (surface roughness)	St number (total=316)		
2	0.5	63 (20%)	■	Evergreen Broadleaf Forest
12	0.15	82 (26%)	■	Croplands
13	0.5	80 (25%)	■	Urban and Built-Up
14	0.05	56 (18%)	■	cropland/natural vegetation mosaic



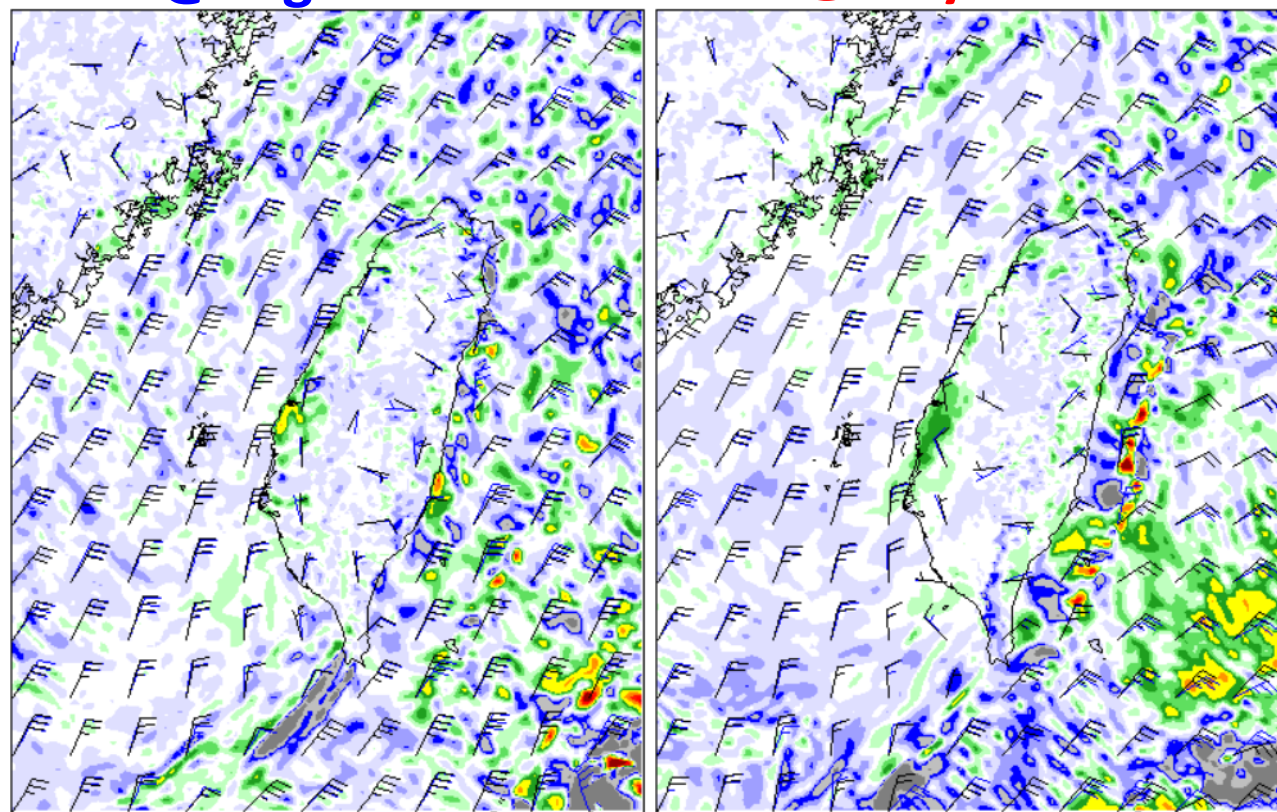


MODIFIED_IGBP_MODIS_NOAH

cat	CTL	crop+0.1	St number (total=316)		
2	0.5	0.5	63 (20%)	■	Evergreen Broadleaf Forest
12	0.15	0.25	82 (26%)	■	Croplands
13	0.5	0.5	80 (25%)	■	Urban and Built-Up
14	0.05	0.05	56 (18%)	■	cropland/natural vegetation mosaic

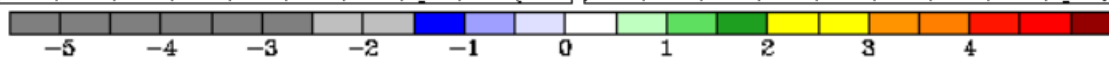
f18 @ nighttime

f30 @ daytime



Difference of
10 m wind

CTL - crop+0.1

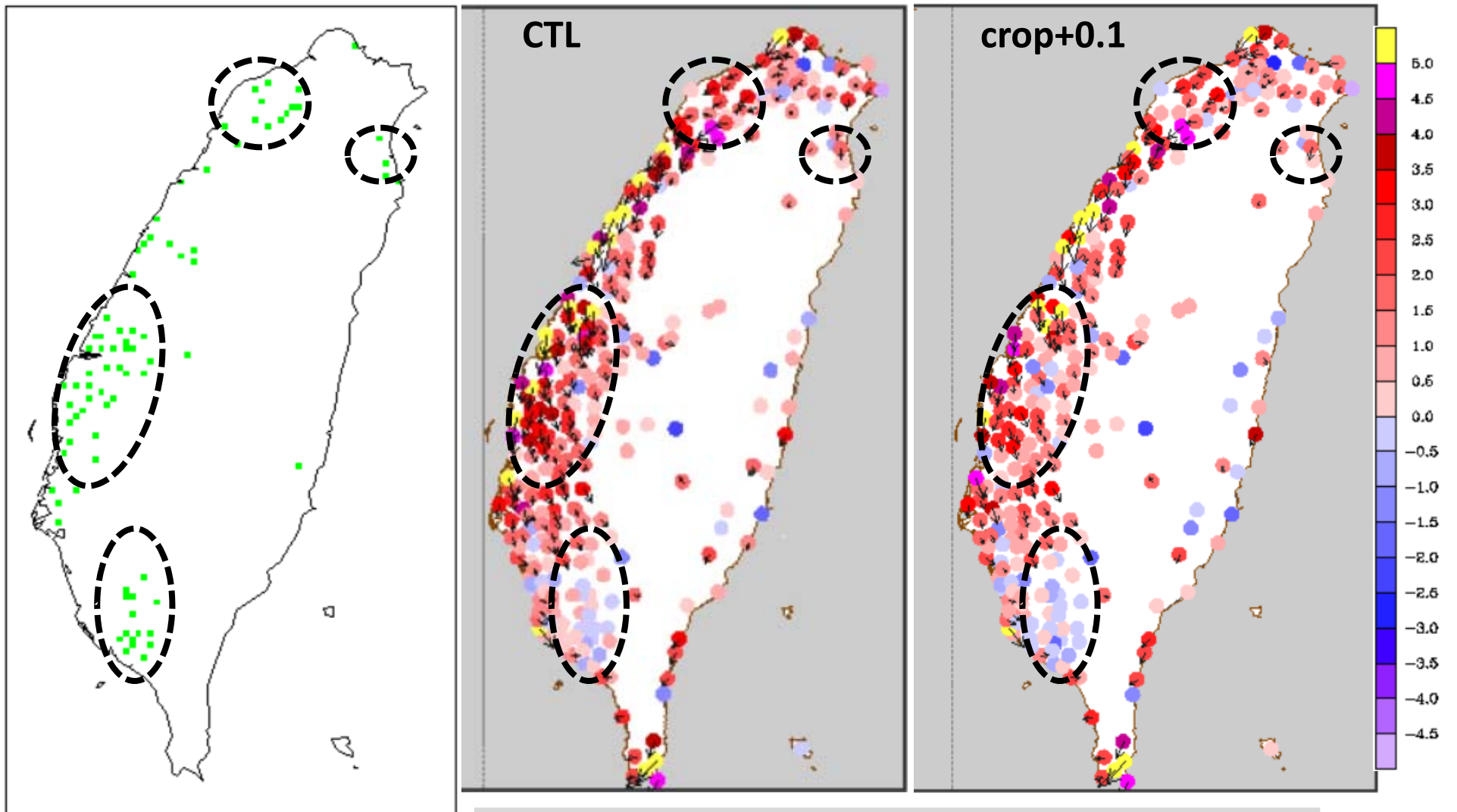


crop+0.1 加速

crop+0.1 減速

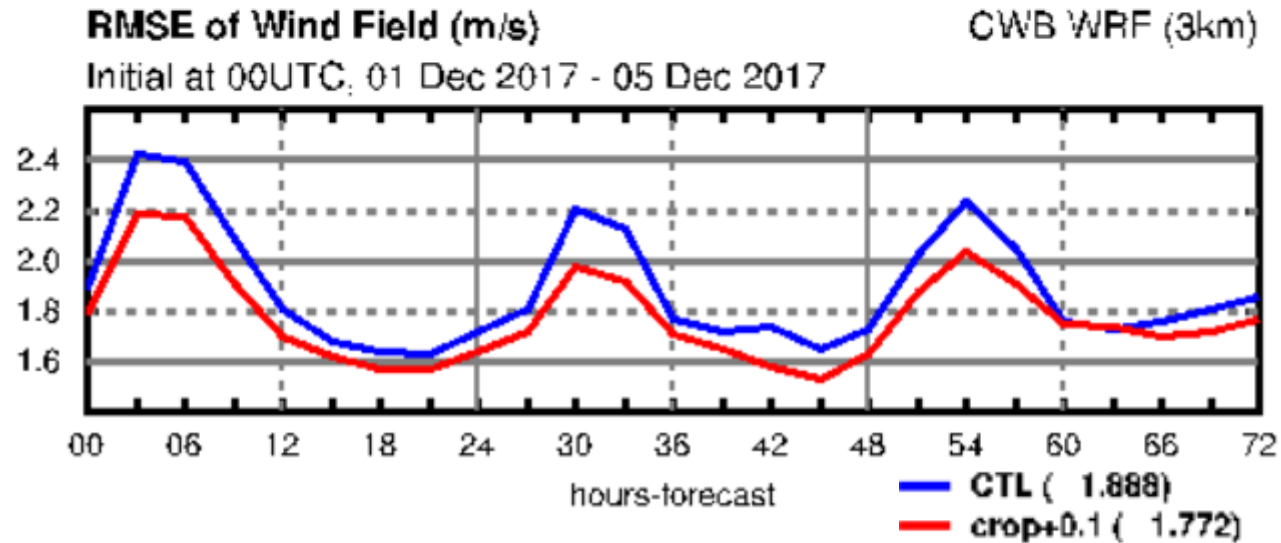
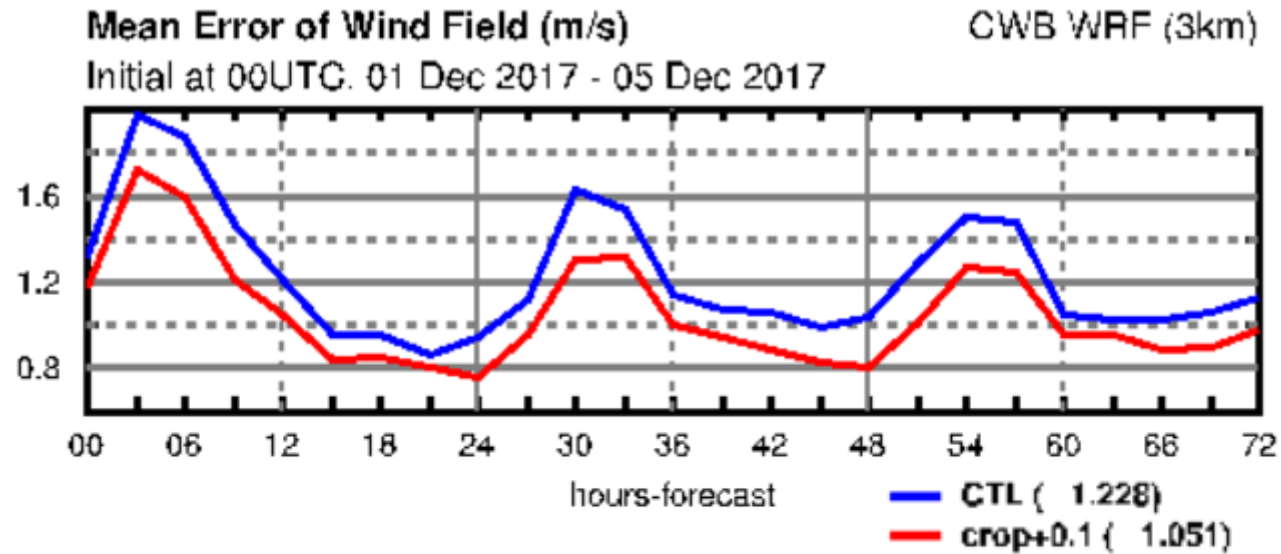
ME of 10 m wind @ daytime of CTL & crop+0.1

cases: initial at 00 UTC 2017/12/01 ~ 12/05



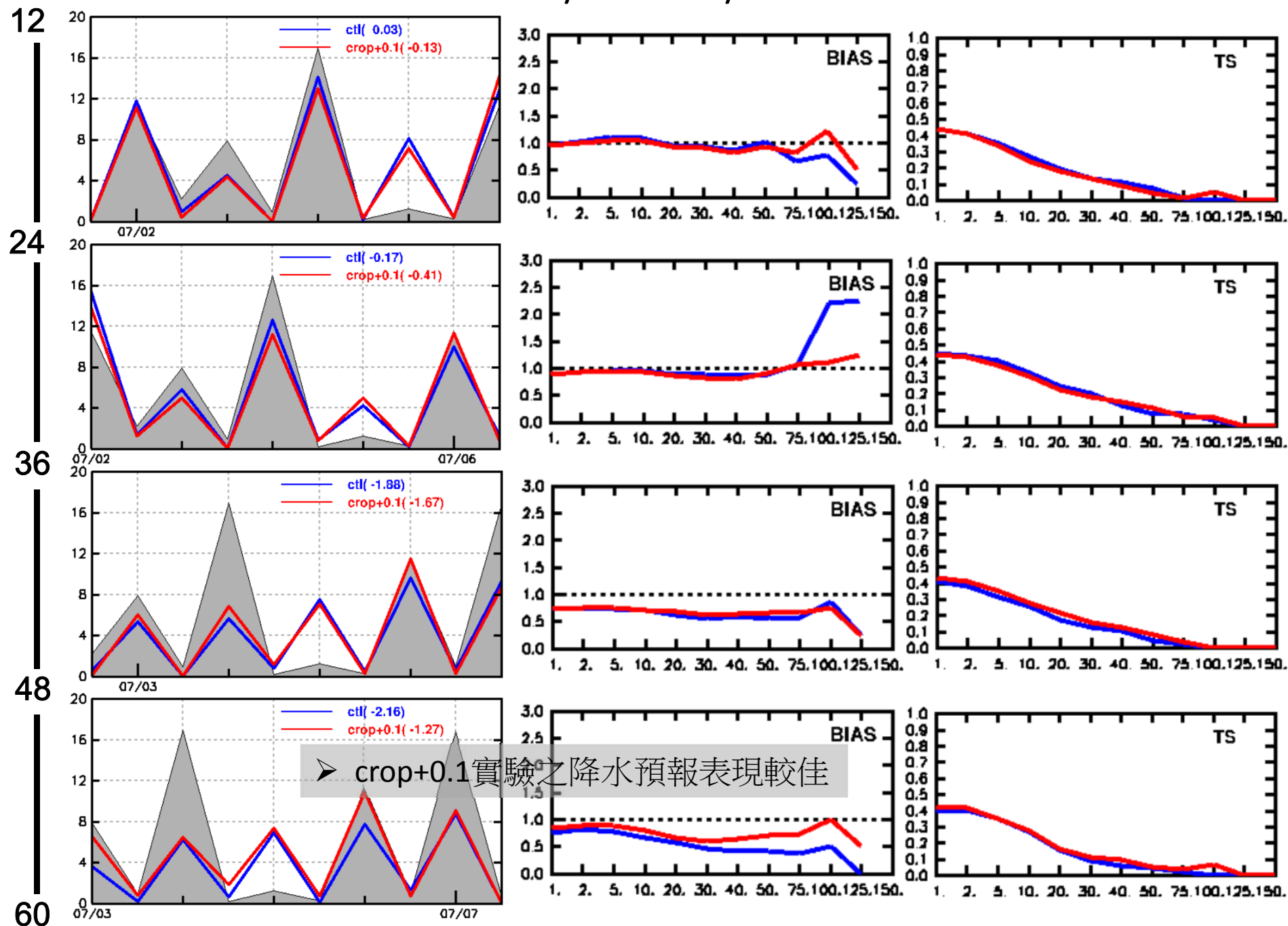
MODIFIED_IGBP_MODIS_NOAH				
cat	CTL	crop+0.1	St number (total=316)	
12	0.15	0.25	82 (26%)	Croplands

cases: initial at 00 UTC 2017/12/01 ~ 12/05



Tau

cases: 07/01 to 07/05



Summary

- 模式預報台灣地區之地面風速普遍呈高估情形，尤其以台灣西部地區之日間高估最為明顯。
- 次網格地形實驗：
 - 台灣西部為平緩地形，地形拖曳力對於模式預報地面風速高估的改善有限。
- Surface roughness實驗：
 - 使用的校驗測站點約有26 %為模式之cropland type，主要分布在雲嘉南平原之風速高報區域。
 - crop+0.1實驗增加農田地表粗糙度，預報地面風速平均較CTL實驗約有0.2 ms⁻¹改善；且午後對流個案之降水預報表現亦較CTL實驗為佳。