準滯留性降水系統與氣候變遷
Quasi-stationary Rainfall Systems and Climate Change

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CASE:612水災

Time :2012/06/12

1.The first time call off school and work because meiyu front

Introduction of this study

Purpose:

We want to know how the future climate change affect the meiyu case (612水災) in the future ?

More precipitation ?

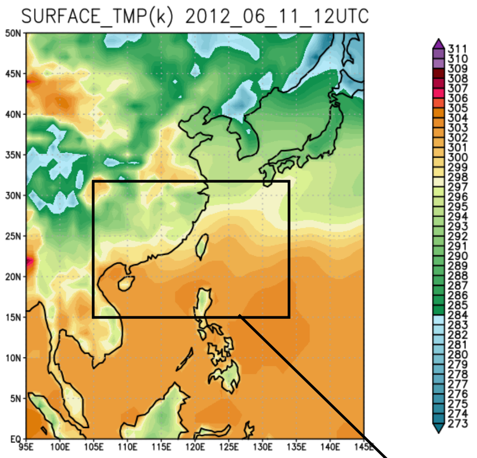
Less precipitation?

meiyu season case
(612水災)

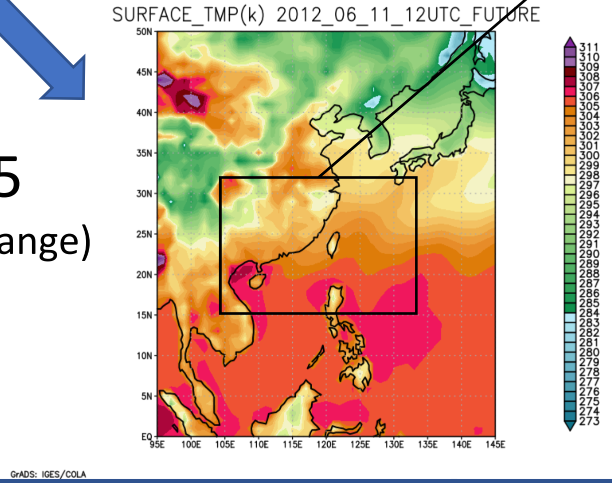
x

+delta rcp8.5
(Future climate change)

Climate now



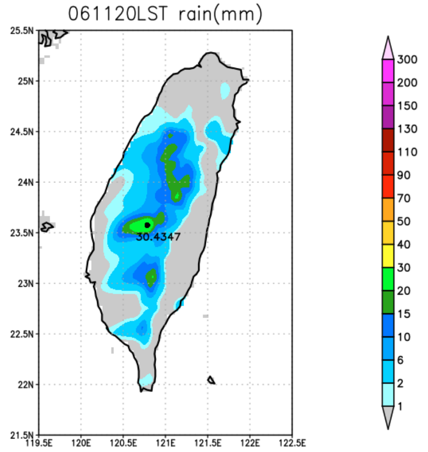
Future climate



CReSS Domain

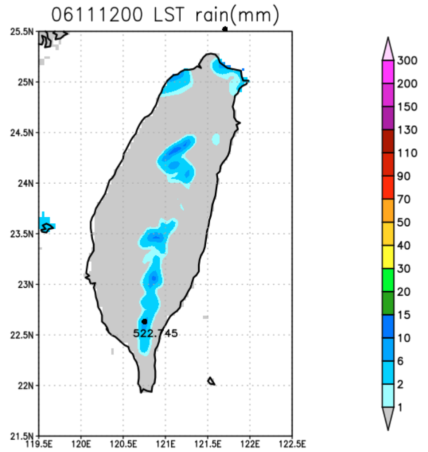
CReSS

Control Experiment(CE)



CReSS

Sensitivity Experiment(SE)



Water budget

DATA introduction-FNL(meiyu case)

Data from :NCEP FNL Operational Model Global Tropospheric Analyses, continuing from July 1999 , 6 hour/per data

Resolution :1 ° X 1 °

Z levels :25levels

TIME:2012/06/09 12UTC~2012/06/13 12UTC

Variables:

Wind (m/s)	Temperature (K)	surface Temperature (K)
RH (%)	Geopotential height (m)	Pressure (hPa)

DATA introduction-Delta(Future climate change value)

Data from :CMIP5 experiment(38models)

Z levels :17levels

Caculate :2081-2100,May-Jun,ave-1981-2000,May-Jun,ave

RCP8.5

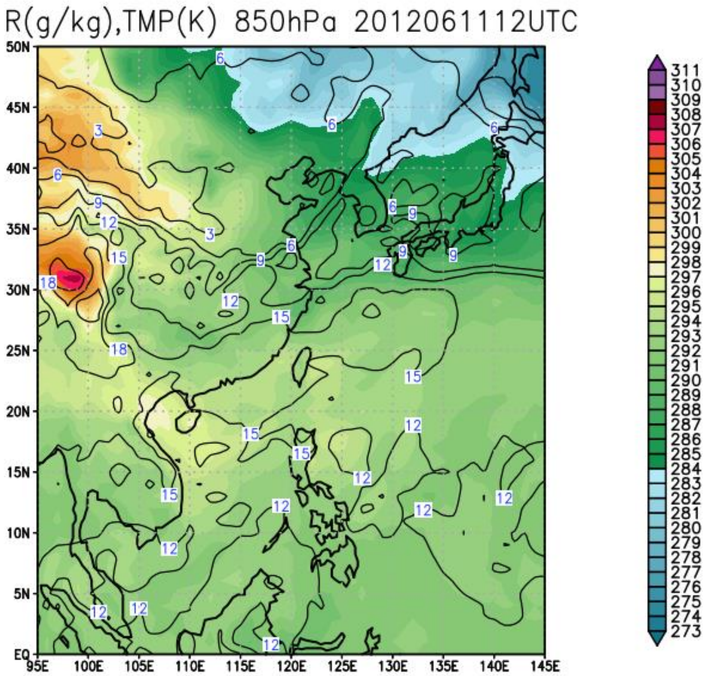
Variables:

Wind (m/s)	Temperature (K)	surface Temperature (K)
specific humidity (kg/kg)	Geopotential height (m)	Pressure (hPa)

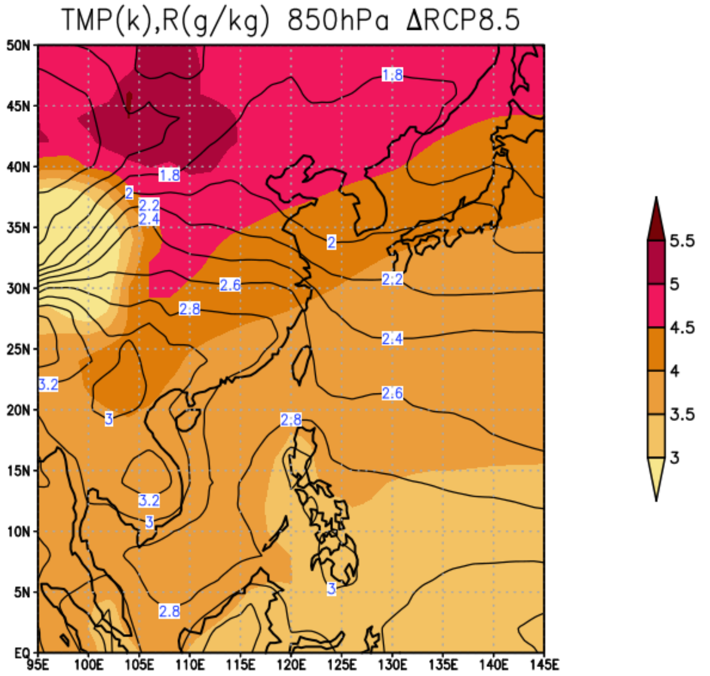
Case

850hPa Temperature,Mixing ratio

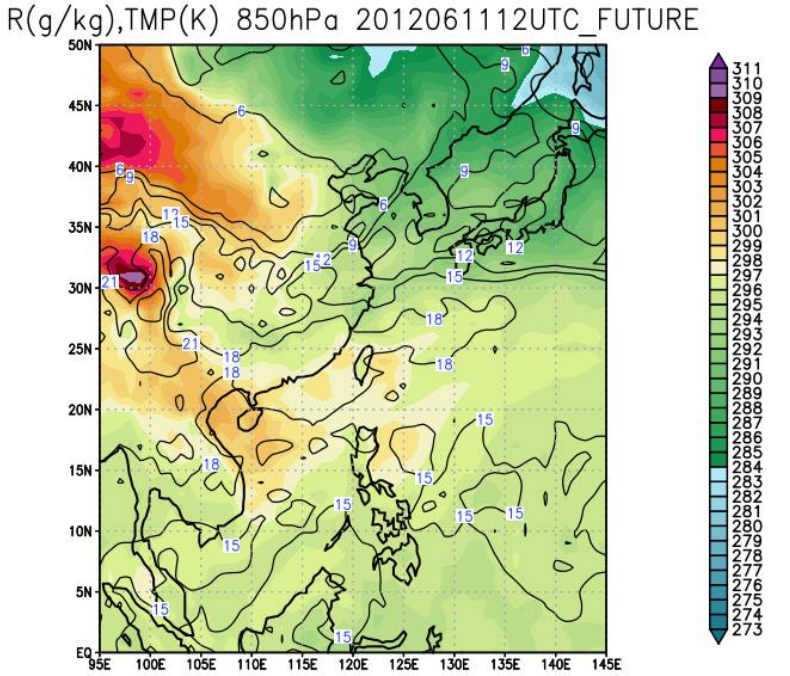
Now (FNL)



DELTA



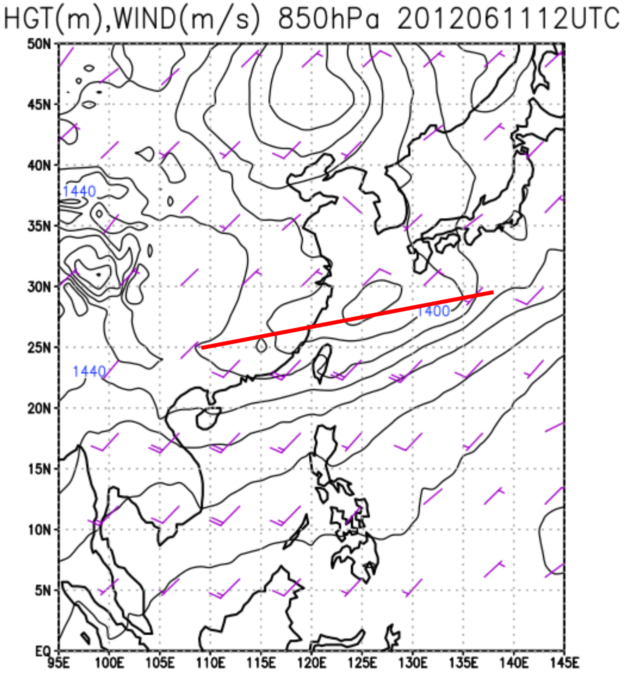
Future (FNL+DELTA)



Contour:mixing ratio	15g/kg	+2.5g/kg	+16%
Shading:temperature	290k	+3.8k	+1.3%

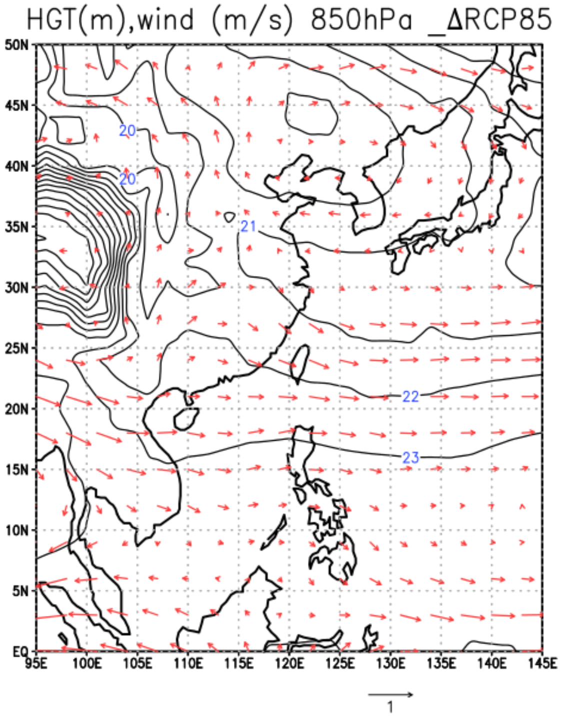
850hPa Wind, Geopotential Height

Now (FNL)



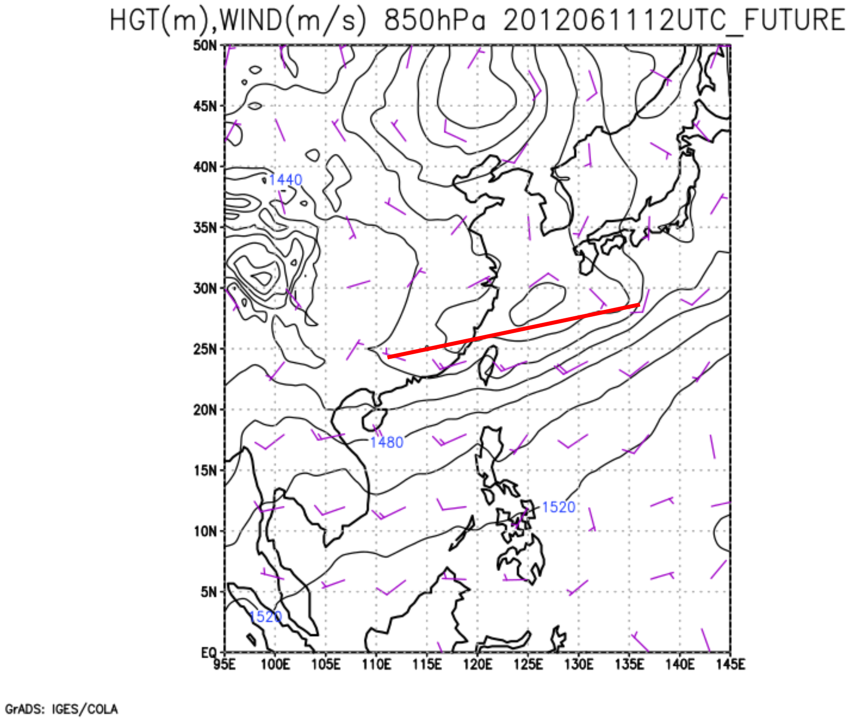
Contour:geopotential height
Barb:wind
Red line:meiyu front

DELTA



west wind increase

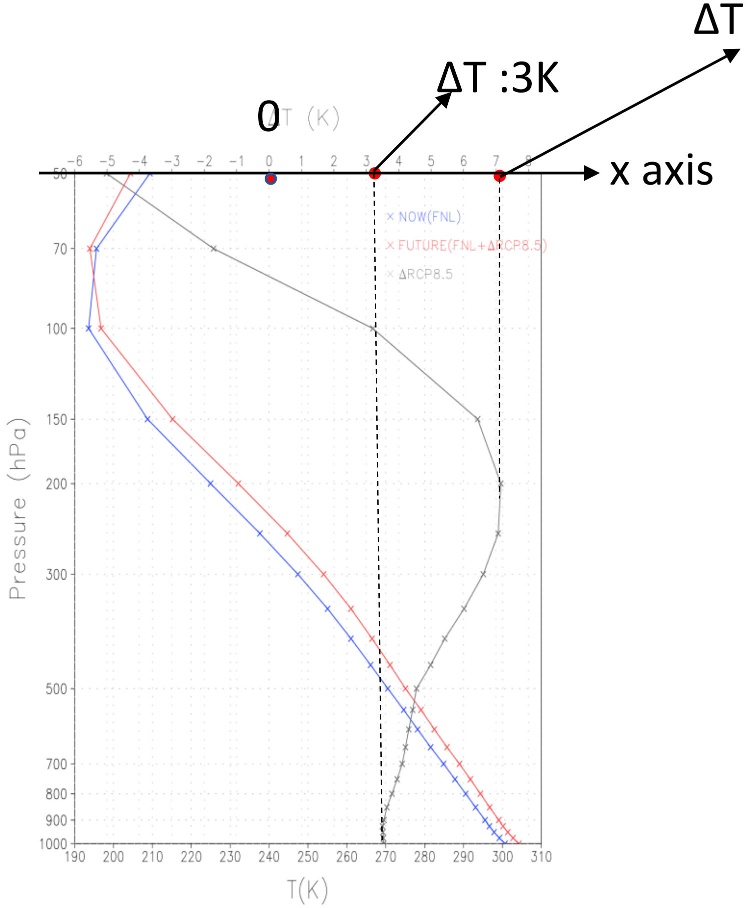
Future (FNL+DELTA)



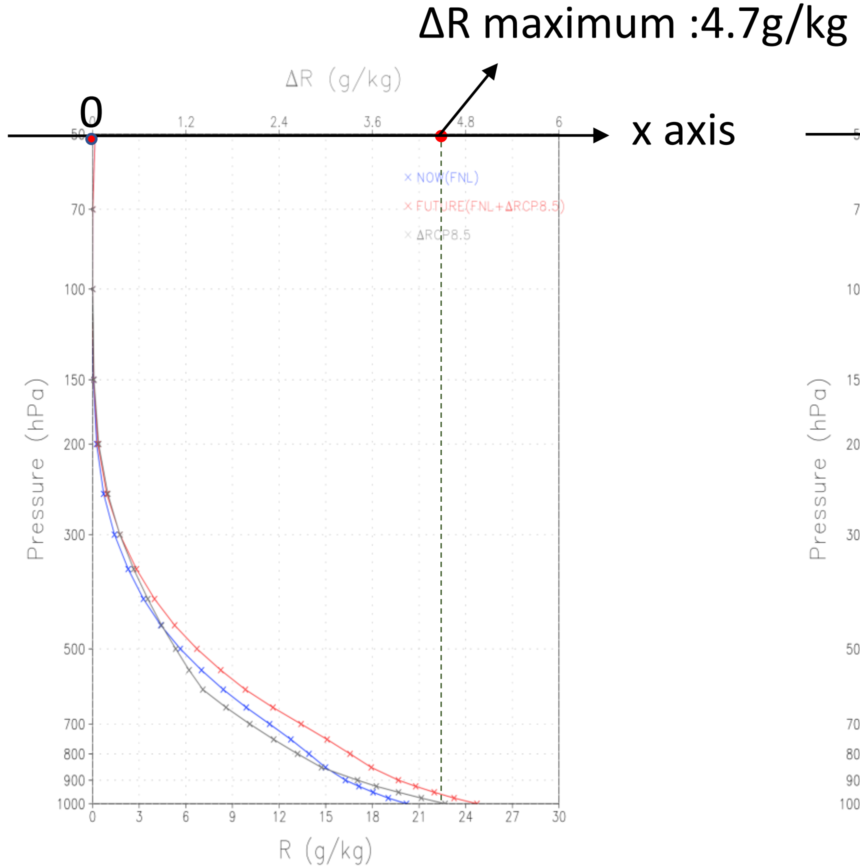
case profile

Blue line:NOW(FNL)
Red line:FUTURE(FNL+ ΔRCP8.5)
Black line:FUTURE change value(ΔRCP8.5)

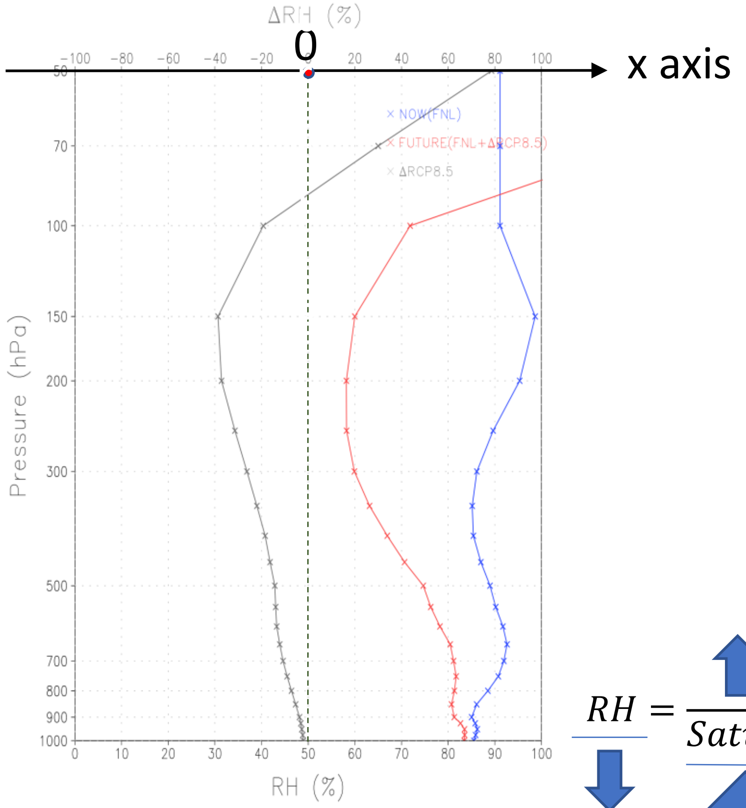
Time ave =06/09/12~06/13/12 UTC
Space ave =Latitude: 21.5 ° ~ 25.5 °
Lontitude: 119.5 ° ~ 122.5 °



Temperature profile



Mixing ratio profile



RH profile

$$RH = \frac{vapour}{Saturated\ vapour}$$

Simulate

CReSS

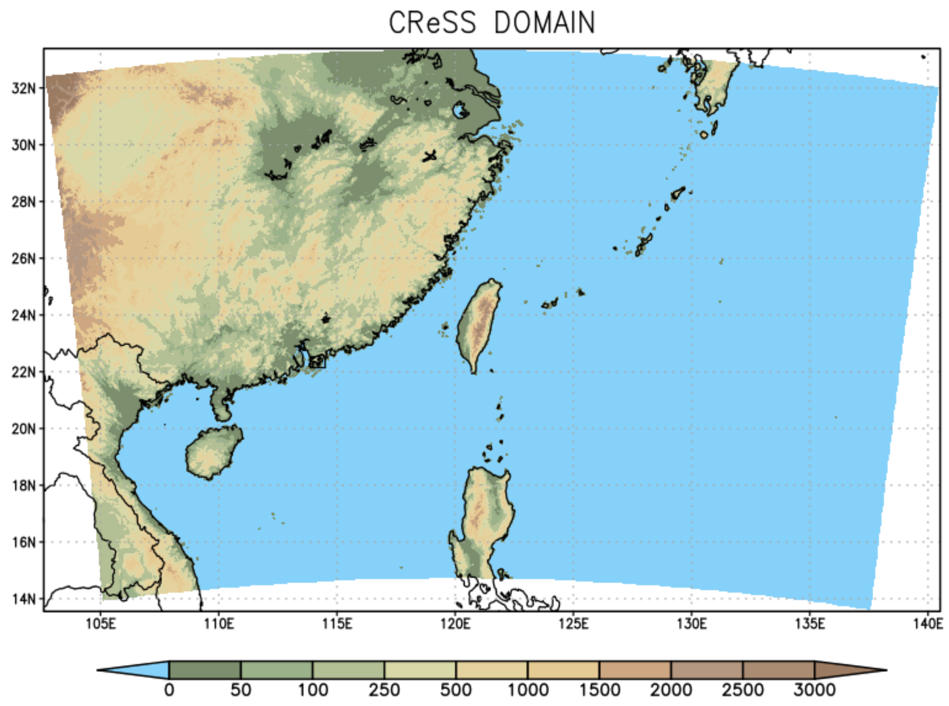
Projection: Lambert conformal conic

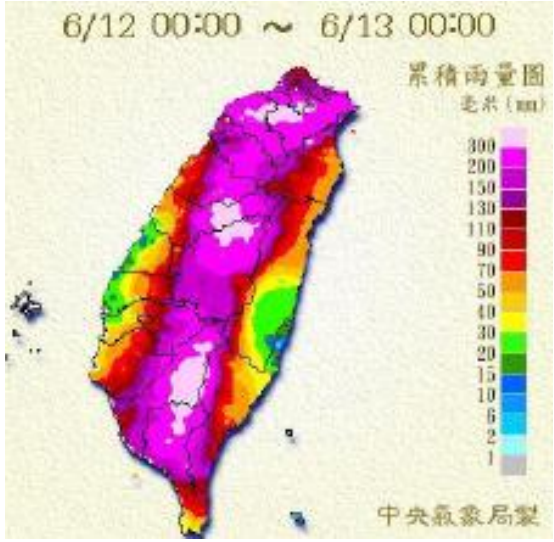
Grid:1152*672

Resolution:3km x 3km

Levels:100-25687m

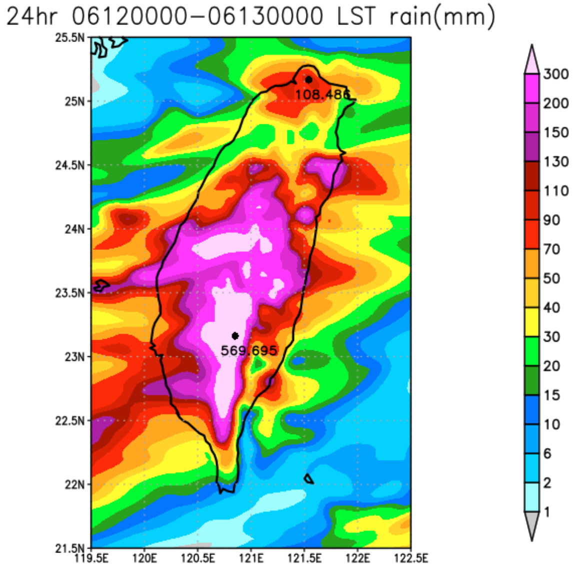
Time:2012/06/09 12UTC-2012/06/13 12UTC





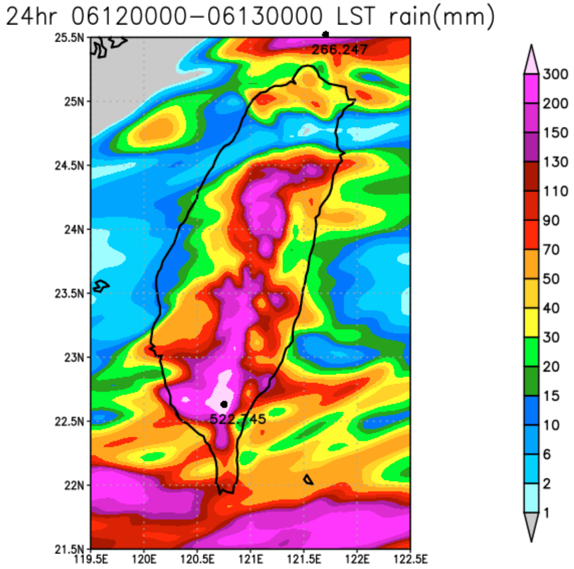
Why precipitation will decrease in the future ?

CE(now)



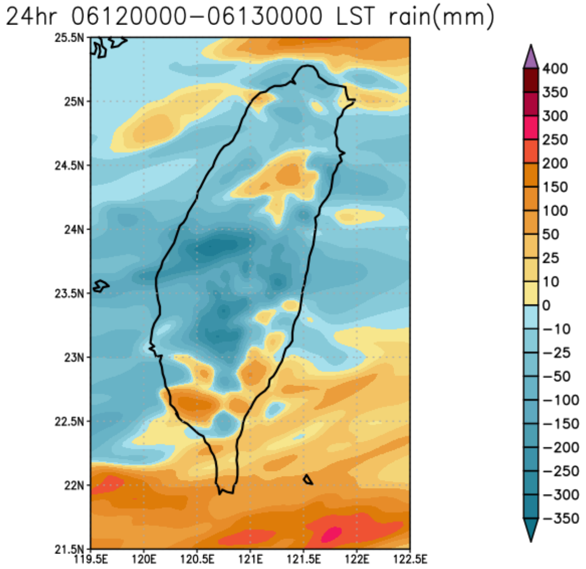
maximum:569mm , Kaohsiung

SE(future)



maximum:522mm , Kaohsiung

SE-CE

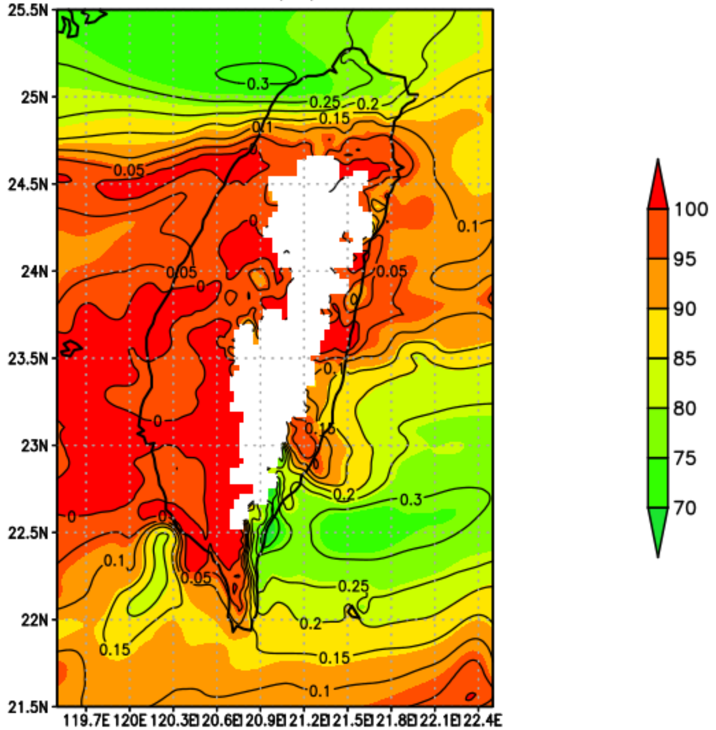


Time=2012061220 lst
lev =2000m

$$RH = \frac{vapour}{Saturated\ vapour}$$

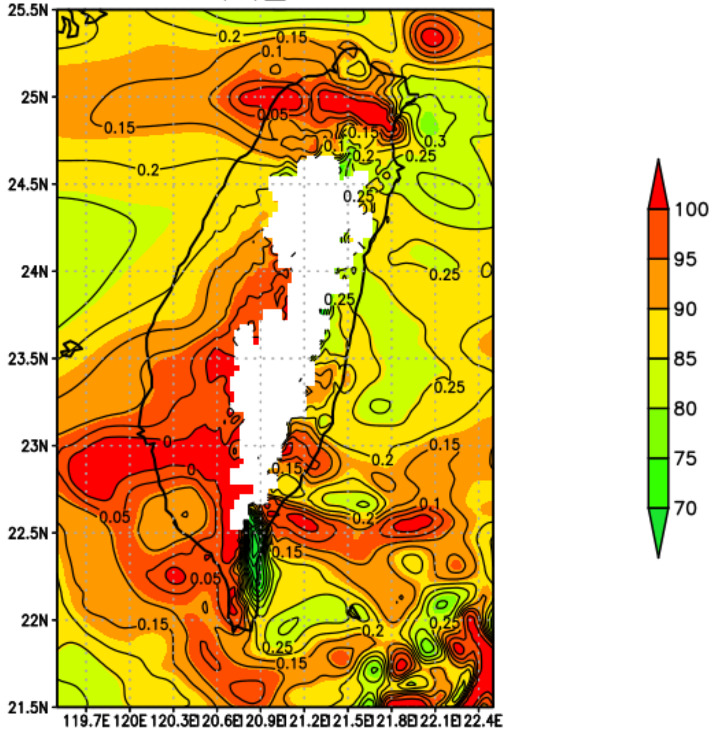
CE

RH(%)



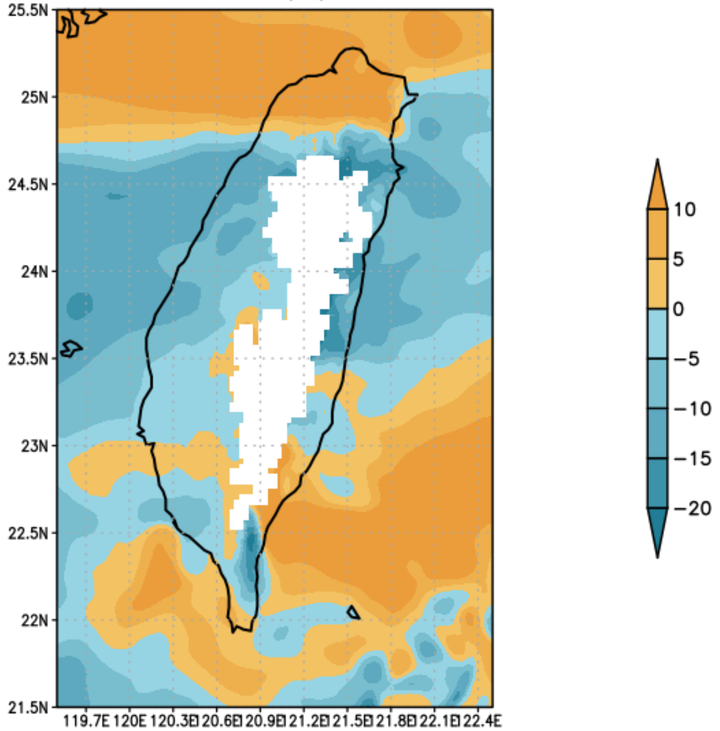
SE

RH(%)_future



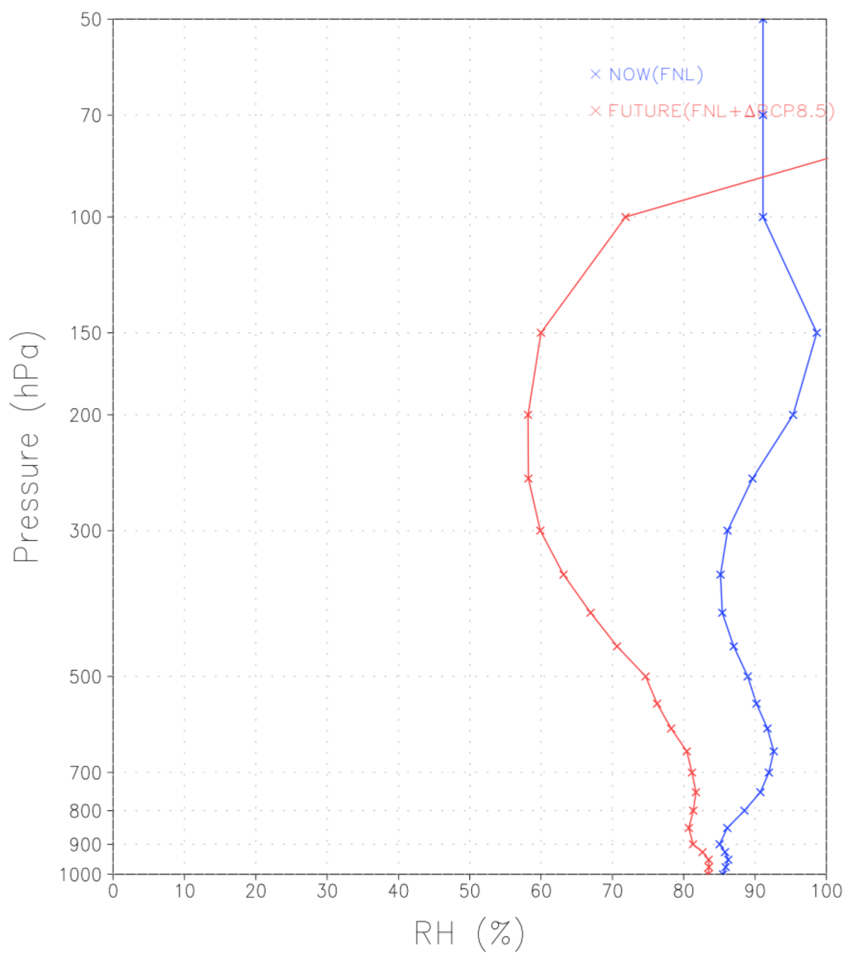
SE-CE

ΔRH(%)

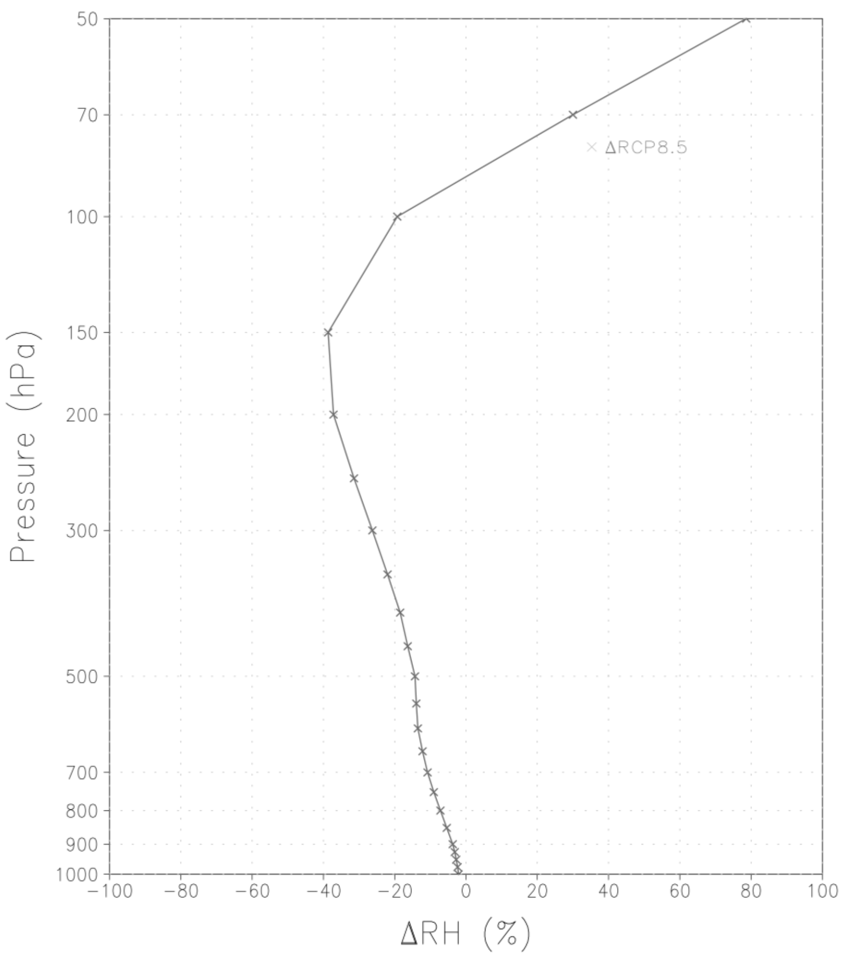


Shaded:RH

RH profile



× NOW(FNL)
× FUTURE(FNL+ΔRCP8.5)
Pressure (hPa)
RH (%)



× ΔRCP8.5
Pressure (hPa)
ΔRH (%)

Water budget

$$P+\frac{\partial}{\partial t}(w_v+w_h)=-\int_0^{\infty}\nabla\cdot(\rho_v V)dz-\int_0^{\infty}\nabla\cdot(\rho_h V)dz+E+R$$

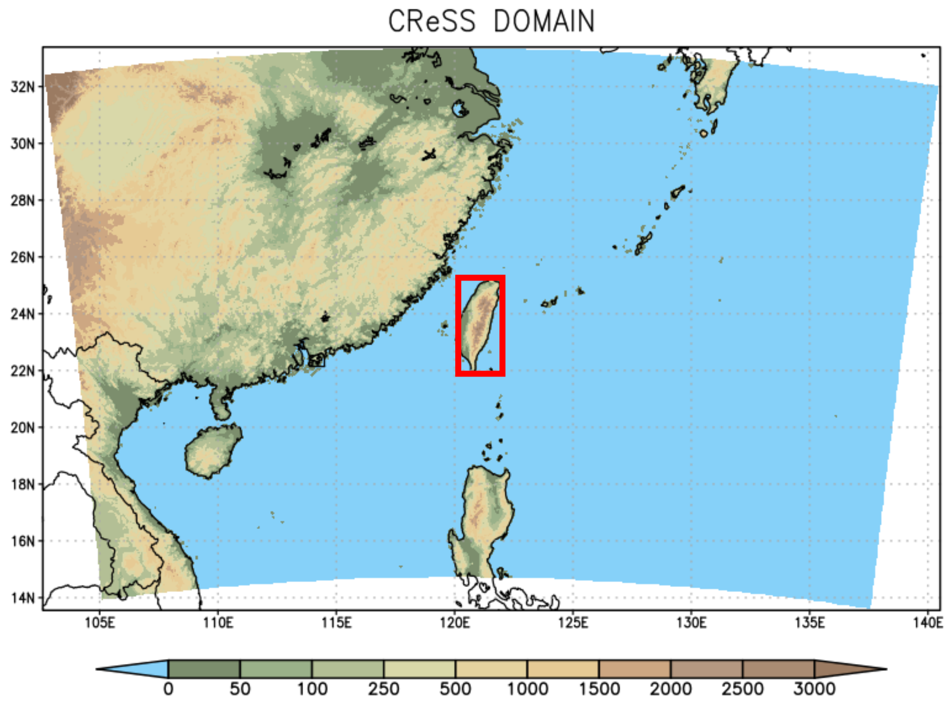
TDC CVF CHF

$$-\int_0^{\infty}\nabla\cdot(\rho_v V)dz=-\int_0^{\infty}\rho_v(\nabla\cdot \mathrm{V})dz-\int_0^{\infty}(\mathrm{V}\cdot\nabla)\rho_v dz$$

CVF CONV ADV

$$-\int_0^{\infty}\rho_v(\nabla\cdot \mathrm{V})dz=\int_0^{5.5km}\rho_v\,dz\cdot-\int_0^{5.5km}(\nabla\cdot V)\,dz$$

CONV $PW_{5.5}$ $IHC_{5.5}$



P = Precipitation

TDC = Tendency of total water content

W_v = Vapour

CVF = Convergence of vapour flux

E = Evaporation

R = Residual

CONV = Convergence of vapour

ADV = Advance of vapour

W_h =Hydrometeors

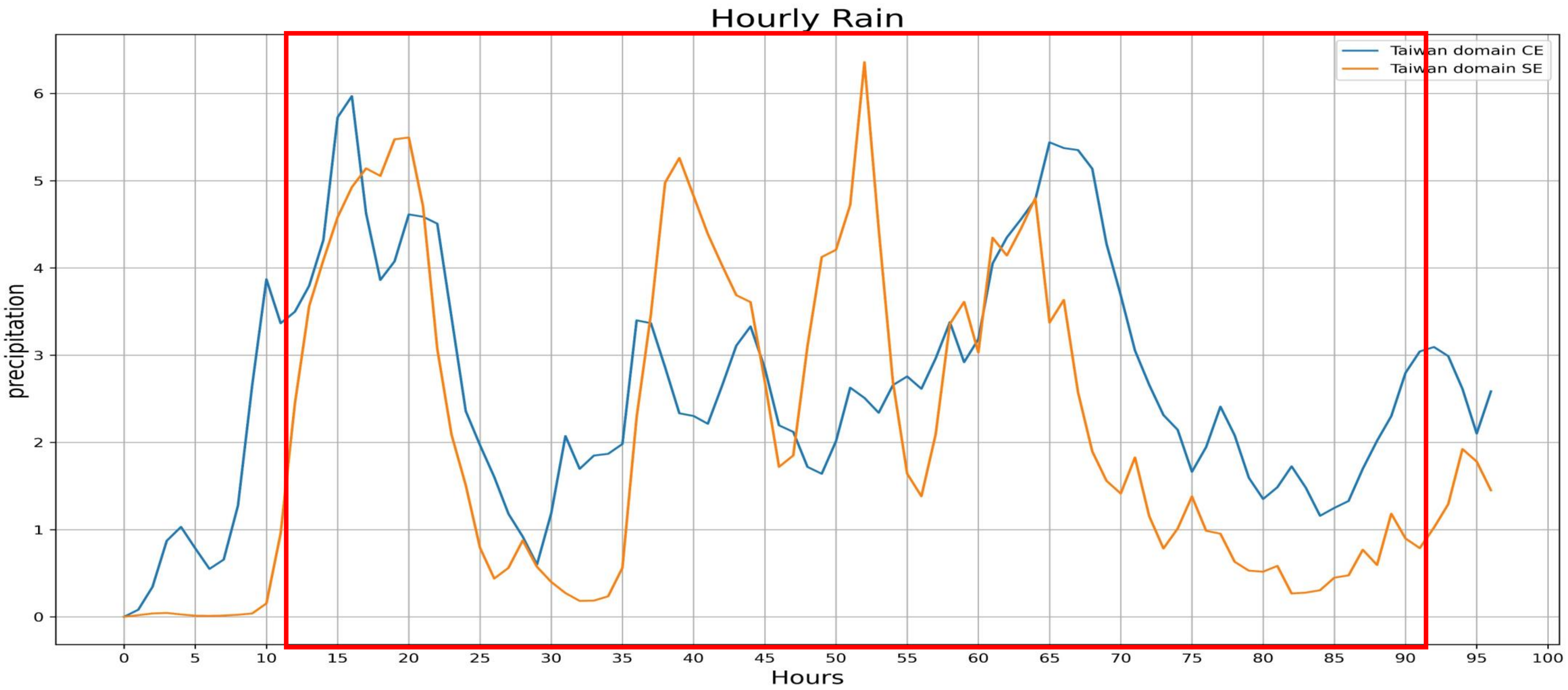
$PW_{5.5}$ = Dencity of vapour

$IHC_{5.5}$ = Convergence of wind

CHF = Convergence of Hydrometeors flux

TrenberthandGuillemot(1995)

Water budget-time domain



Water budget-result

TAIWAN	P	TDC	CVF					CHF	E	R	R/P(%)
			TOTAL	CONV			ADV				
				TOTAL	PW5.5	IHC5.5					
CE	2.83	-0.08	2.03	1.6	51.79	4.58	0.42	0.15	0.12	0.44	15.79
SE	2.41	-0.12	2.15	2.51	64.57	5.91	-0.36	0.07	0.1	-0.04	-1.95
SE-CE	-0.42	-0.04	0.12	0.91	12.78	1.33	-0.78	-0.08	-0.02	-0.48	
SE-CE/CE(%)	-14.8	50	5.9	56.9	24.7	29	-186	-53	-16.7	-109	

P = Precipitation
CVF = Convergence of vapour flux
CHF = Convergence of Hydrometeors flux
TDC = Tendency of total water content
E = Evaporation
R = Residual

Conclusion

- The climate will become warmer and moister in the future.However, the accumulation of precipitation in Taiwan won’t increase in this case

- The accumulation of precipitation in Taiwan won’t increase in this case because the temperature increase make the RH decrease in the future

- The precipitation will be more concentrated in certain areas and certain periods

- From water budget ,we can find that CVF is the most important part in precipitation ,and it will increase 5.9% in the future thanks!