Regional Climate During SCSMEX:Observation VS. Simulation

Pay-Liam Lin[1], Hann-Ming Henry Juang[2],Fun-Cheng Cheng[1], Po-Ling Wu[1], Jhih-Ying Chen[1], Shih-che Lin[1]

[1]Department of Atmospheric Sciences National Central University
Chung-Li, 320
Taiwan
[2]Climate Prediction Center, NCEP,USA

- Examine the RSM's capability with NCEP data.
- Conduct experiments :
  1.Cloud schemes.
  2.Nested strategy.
- Analysis data used : NCEP T62
- Simulation period : May-August,1998
- Horizontal resolution : 30km,90km
- Simulation runs:
  1.Control run and Sensitivity run.
  2.With cloud 3 and cloud 1 scheme.
  3.With nested.

Introduction

- SCSMEX provides an opportunity for mesoscale modeling study.
- NCEP (National Centers for Environmental Prediction) RSM (Regional Spectral Model) has been used by NTU, NCU, CCIT and CWB for SCSMEX simulations.
- Most of the results they showed indicate that there is a problem of less precipitation over southwest ocean of Taiwan extending to SCS.

- The motivation to solve the aforementioned problem is the main theme of this study.
- Since air over the SCSMEX domain may be easily saturated, thus the treatment of the grid-scale precipitation becomes one of the reasonable candidates to be investigated.

The elements of NCEP Regional Spectral Model

- Limited-area Atmospheric Model
- Primitive equations on sigma pressure coordinates
- The perturbation nesting
- Spectral computation
- Hydrostatic or non-hydrostatic systems
- NCEP MRF model physics : radiation, soil model, simple hydrology model, surface, PBL, Gravity-wave drag, grid-scale precipitation, simplified Arakawa and Shubert cumulus parameterization

- An option of prognostic explicit cloud scheme
- Relocatable to any geographical region with polar or Mercator projections
- Portable to any platform with unix as its OS
- International user group

Model physics

- Surface layer : 2-layer soil model with canopy evaporation, snow etc (Pan and Mahrt, BLM 1984, 1987)
- Vertical diffusion : Nonlocal PBL diffusion and improved clear air turbulence (Hong and Pan, MWR 1996)
- Convection : The Simplified Arakawa-Schubert scheme (SAS) Grell (1993), Pan and Wu(1994), Hong and Pan(MWR, 1996, 1998)

- Prognostic cloud scheme : Hong et. al(MWR, 1998)
- Gravity wave drag : Alpert et. al (1988, 1998)
- Radiation : Infrared and solar radiation interaction with clouds

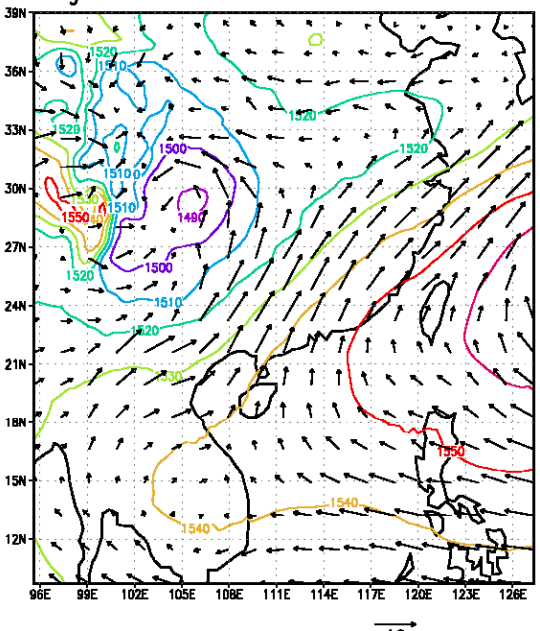
Details of the Model Uniqueness

- Perturbation method
  1. physical decomposition
  2. time-dependent base field
- Spectral computation in perturbation
  1. nonlinear computation

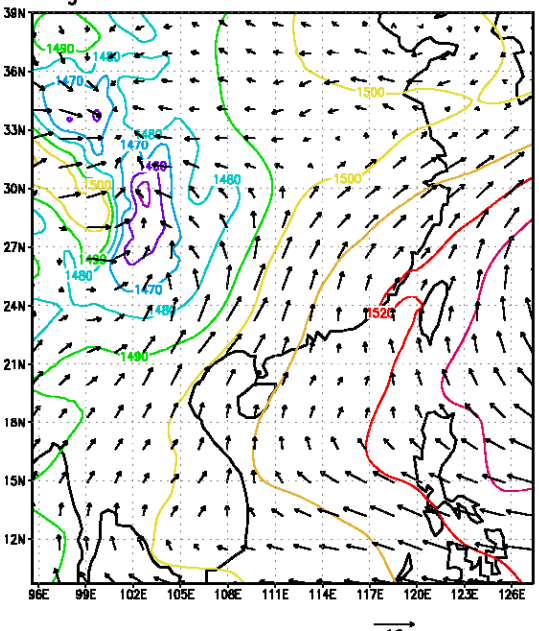
     Total tendency – base tendency
  2. linear computation in perturbation only

- Minimize the lateral boundary forcing
  1. narrow relaxation zone
  2. small relaxation coefficient
  3. for spectral convergence only
- Blending initial lateral boundary terrain
  1. provide mass conservation

A (0501) 850hpa geopotential height & wind field
average before monsoon onset from 0506–0520



B (NCEP) 850hpa geopotential height & wind field
average before monsoon onset from 0506–0520

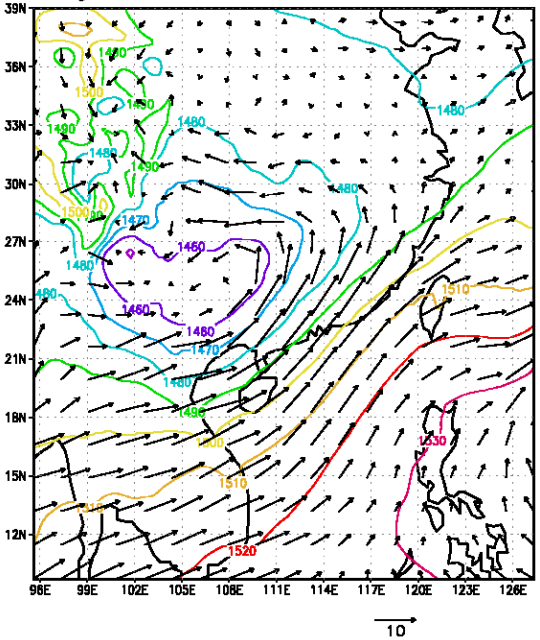


0506-0520

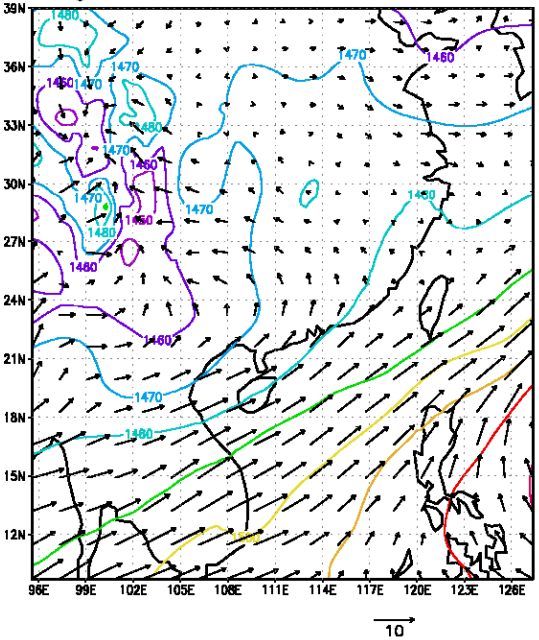
RSM 0501

NCEP R2

C (0501) 850hpa geopotential height & wind field
average after monsoon onset from 0526–0609

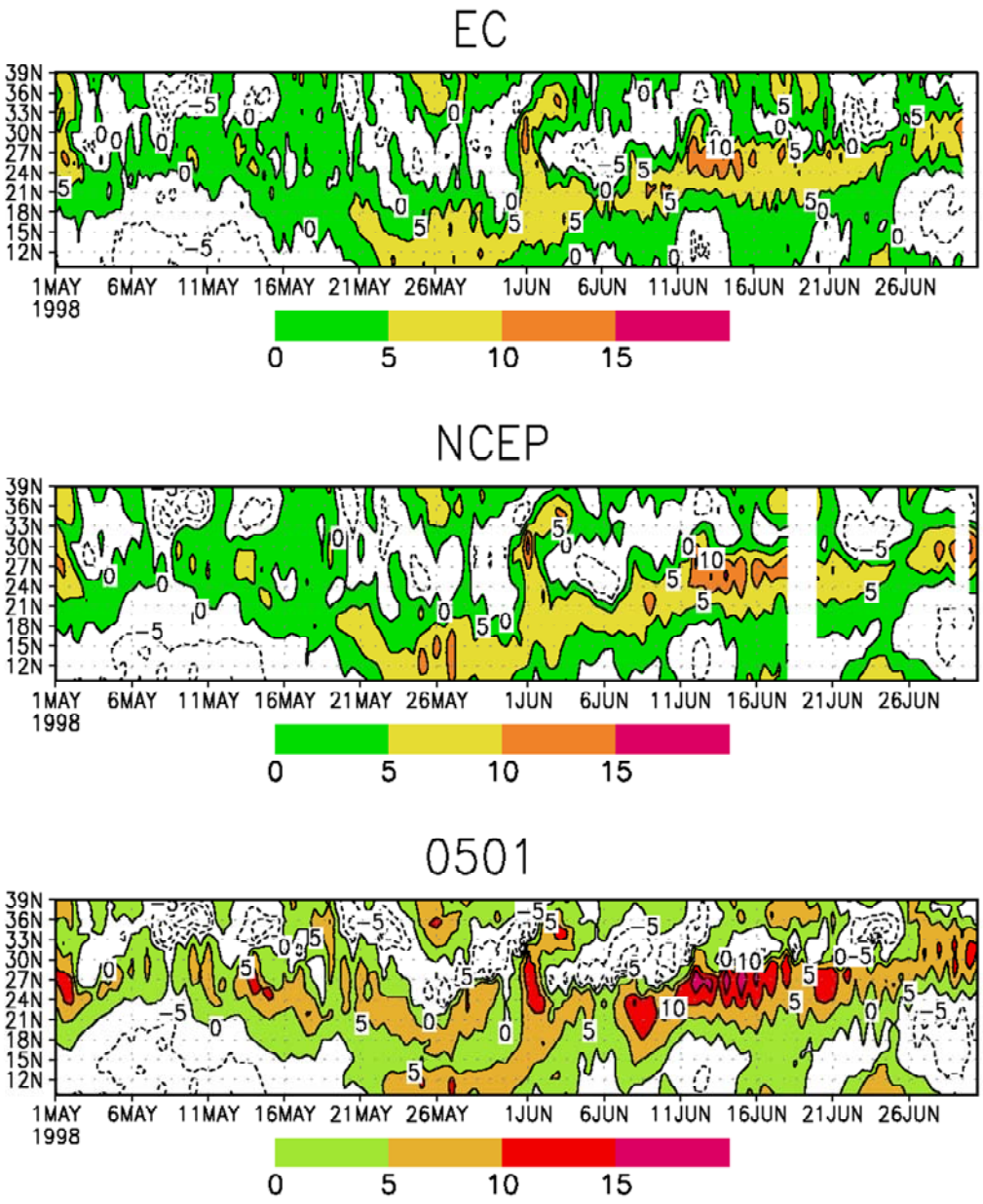


D (NCEP) 850hpa geopotential height & wind field
average after monsoon onset from 0526–0609



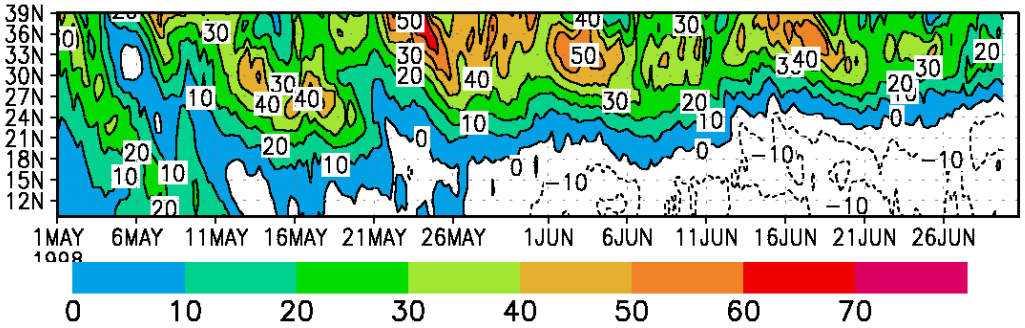
0526-0609

850hPa U (110°E-120°E) from 0501 to 0630

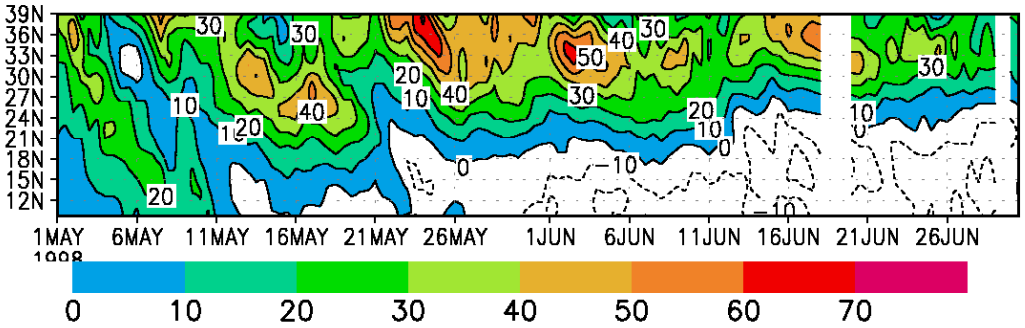


200hPa U (110°E-120°E) from 0501 to 0630

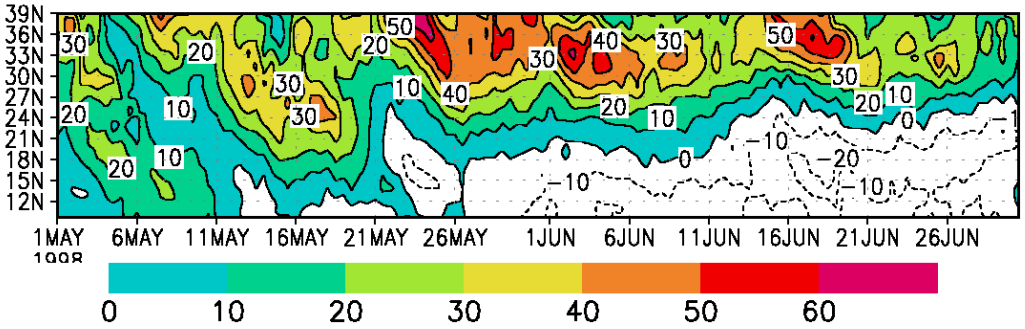
EC



NCEP

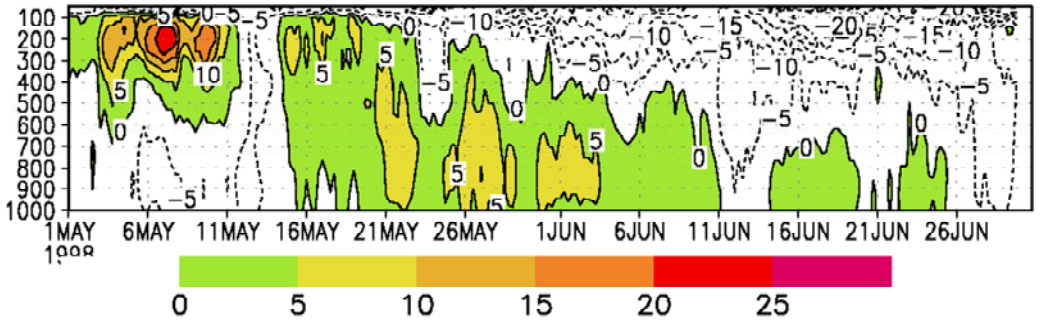


0501



U (110°E-120°E, at 15°N) from 0501 to 0630

EC



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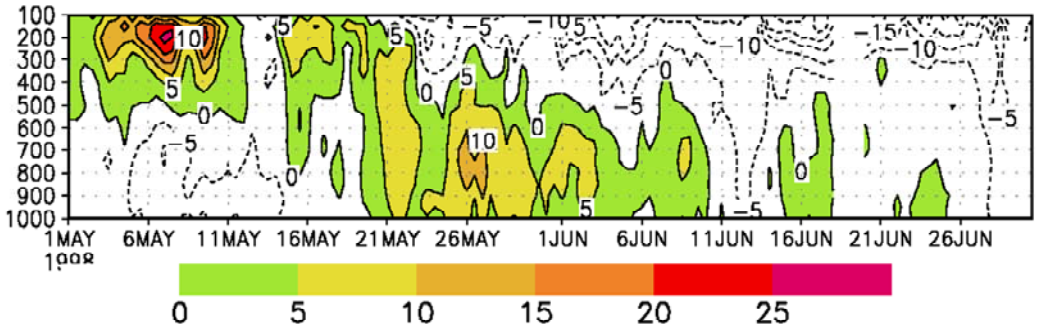
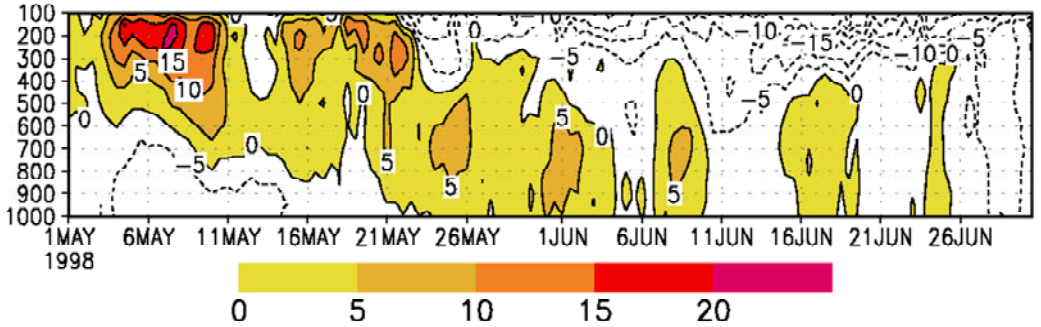
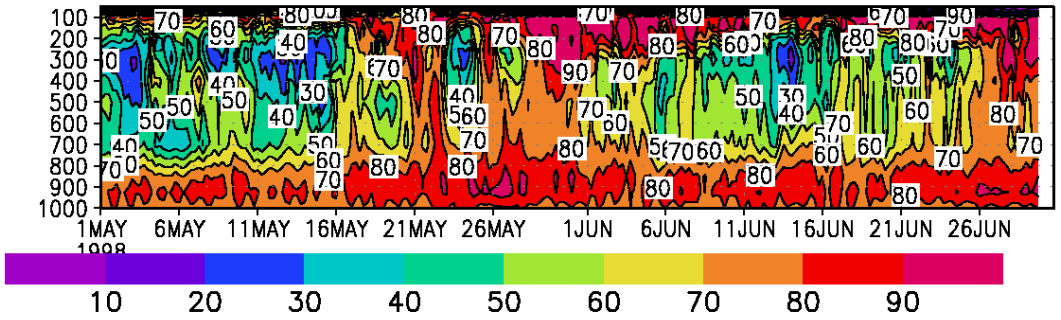


0501

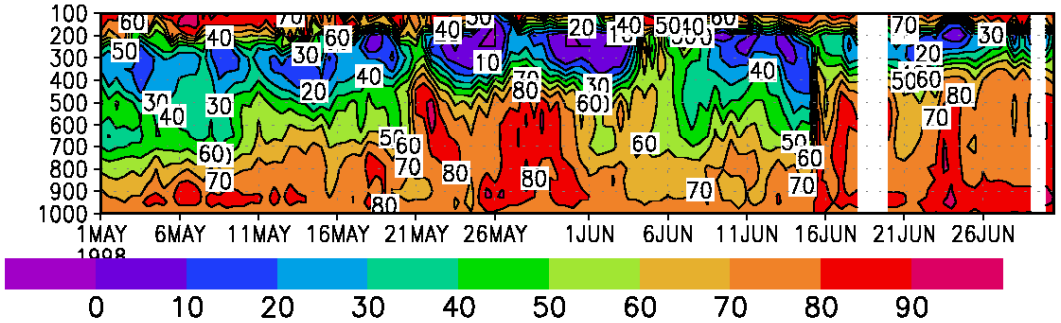


850hPa Relative Humidity (110°E-120°E) from 0501 to 0630

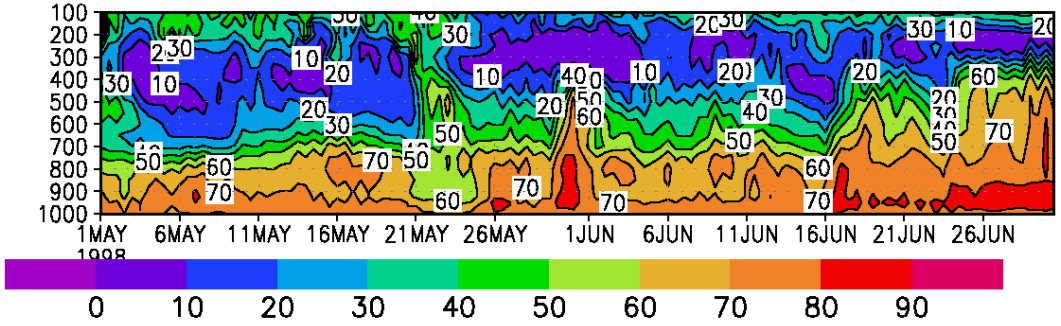
EC



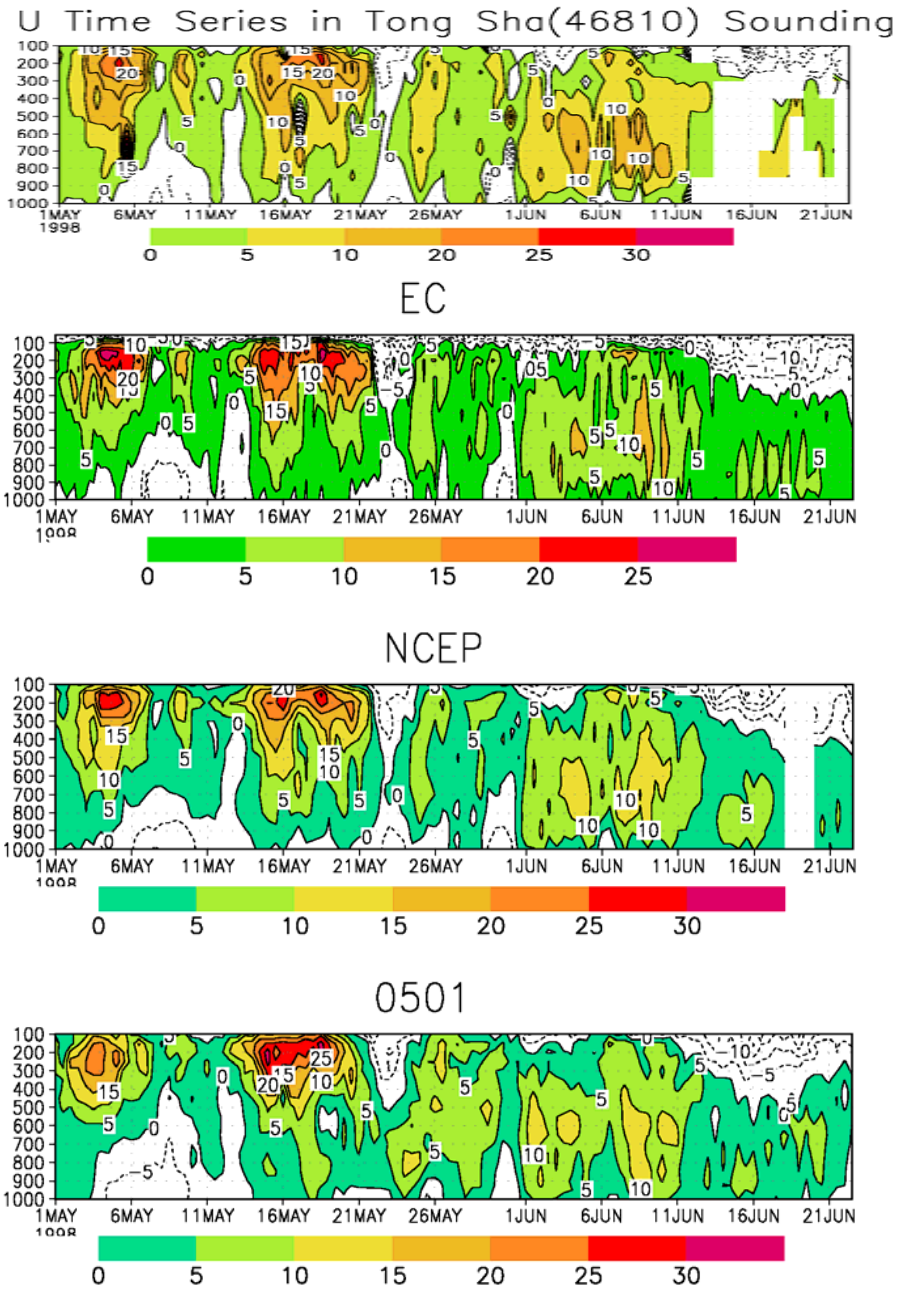
NCEP



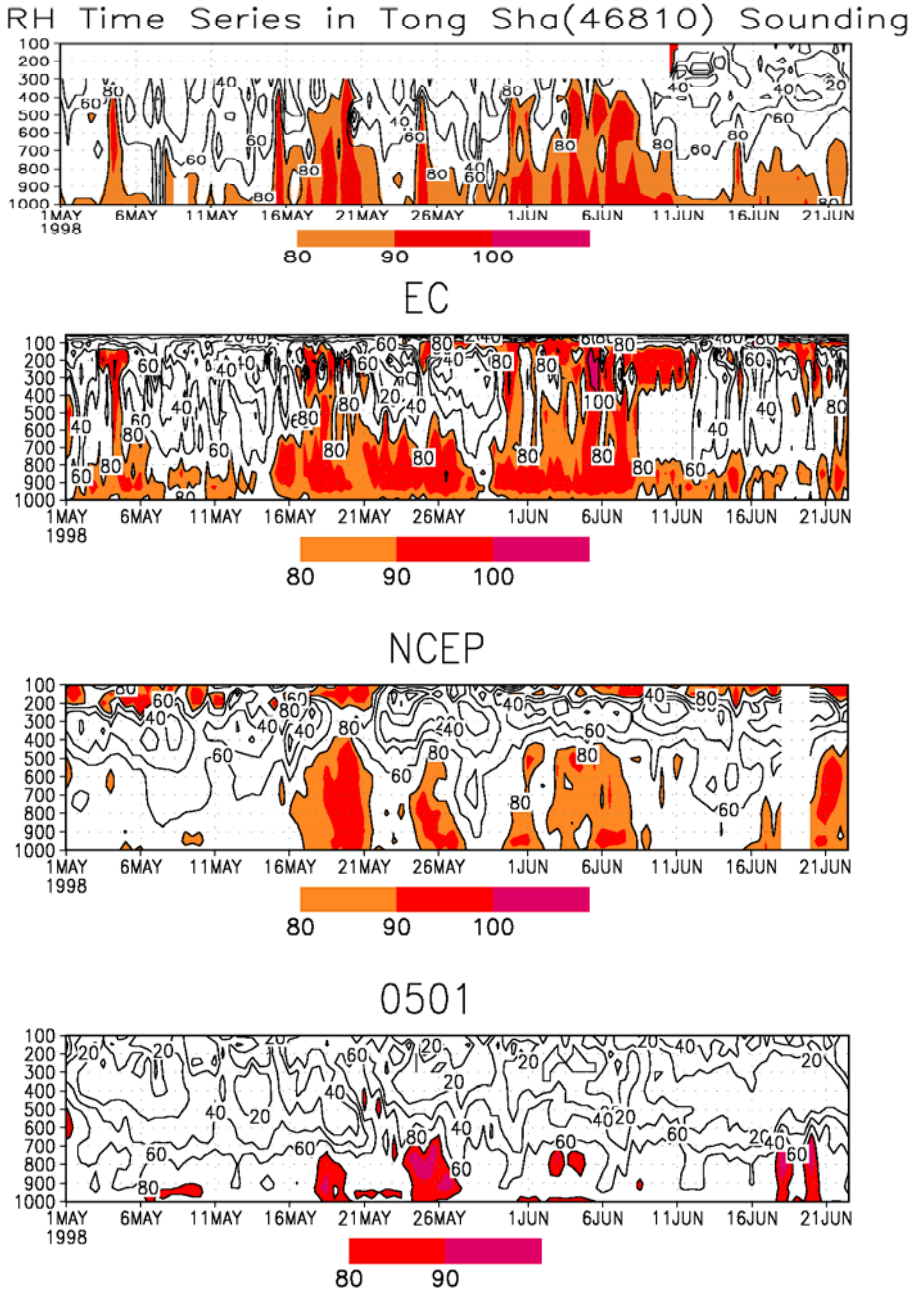
0501

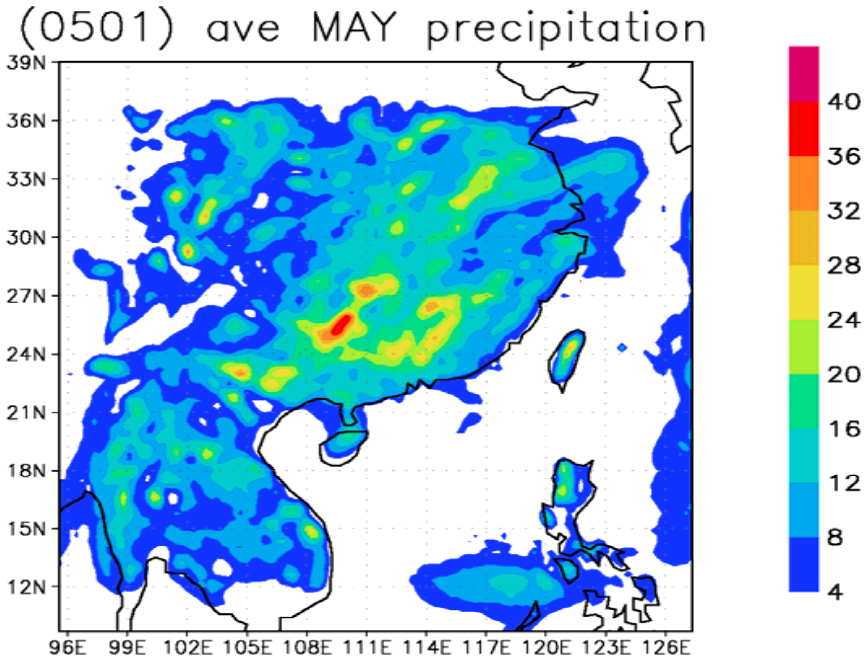


U Time Series in Tong Sha(46810) Sounding



Relative Humidity Time Series in Tong Sha(46810) Sounding




(0501) ave MAY precipitation
39N
36N
33N
30N
27N
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18N
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96E 99E 102E 105E 108E 111E 114E 117E 120E 123E 126E
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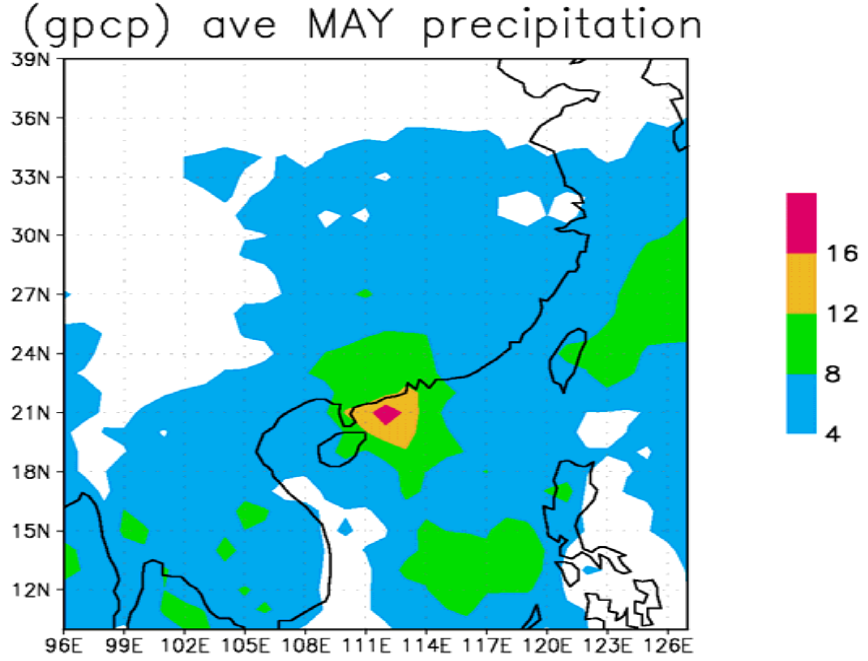
4


(gpcp) ave MAY precipitation
39N
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96E 99E 102E 105E 108E 111E 114E 117E 120E 123E 126E
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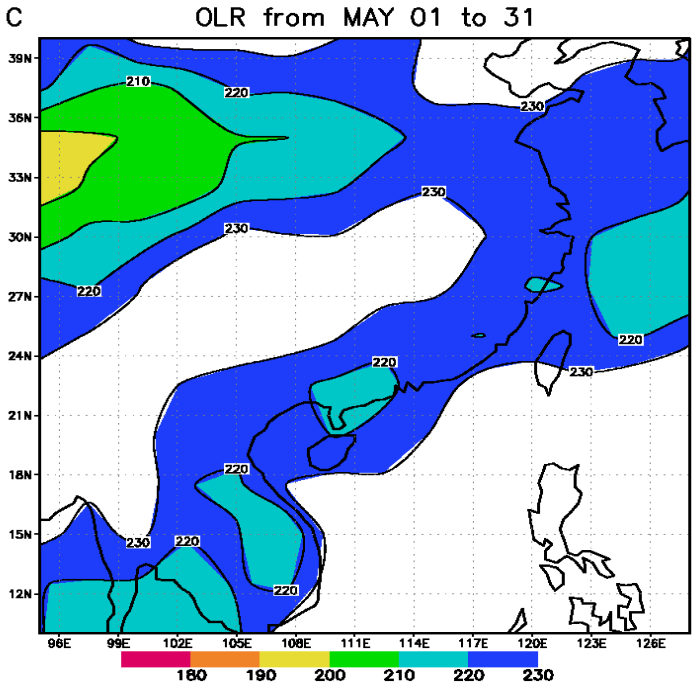
C
OLR from MAY 01 to 31
39N
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96E 99E 102E 105E 108E 111E 114E 117E 120E 123E 126E
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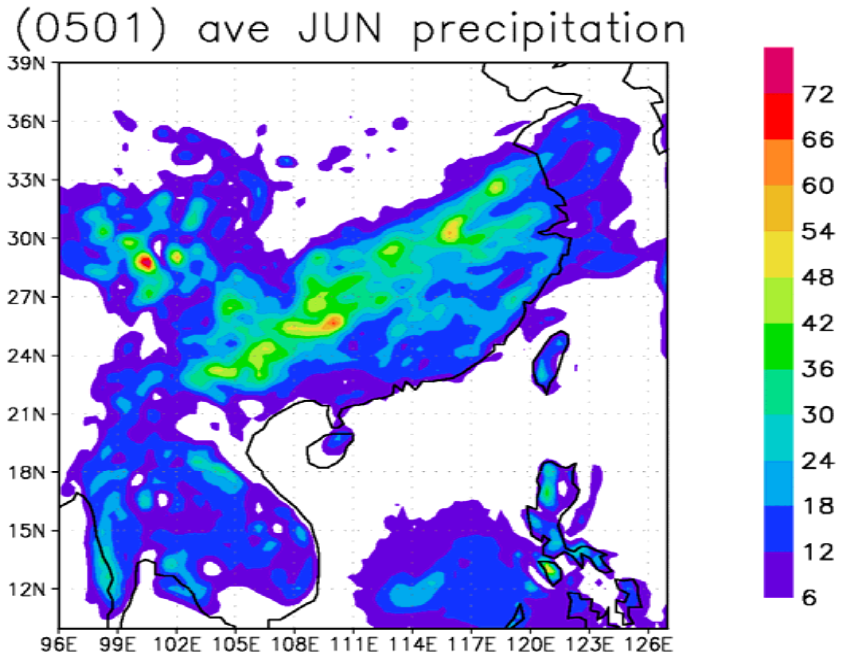
220
230
180 190 200 210 220 230


(0501) ave JUN precipitation
39N
36N
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24N
21N
18N
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96E 99E 102E 105E 108E 111E 114E 117E 120E 123E 126E
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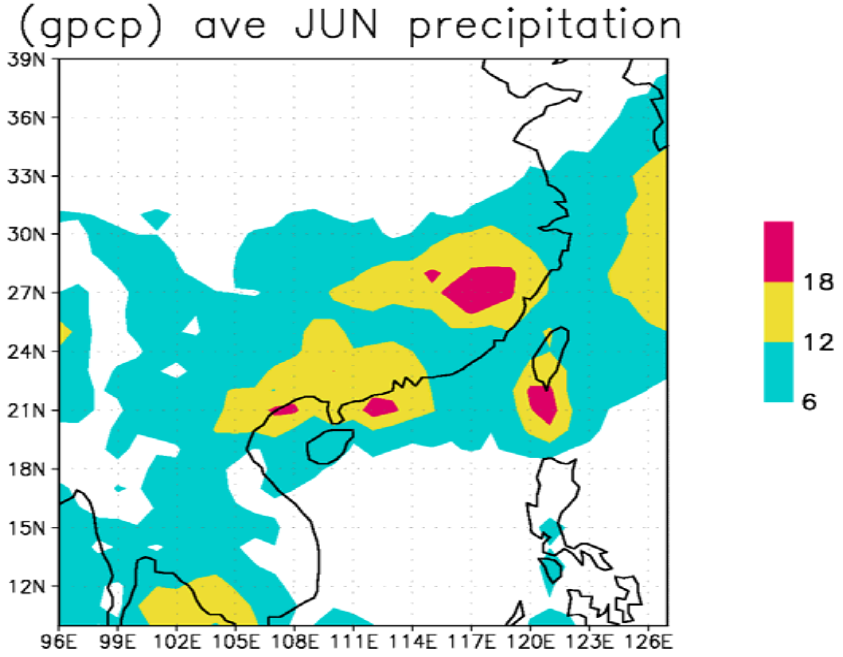
(gpcp) ave JUN precipitation
39N
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96E 99E 102E 105E 108E 111E 114E 117E 120E 123E 126E
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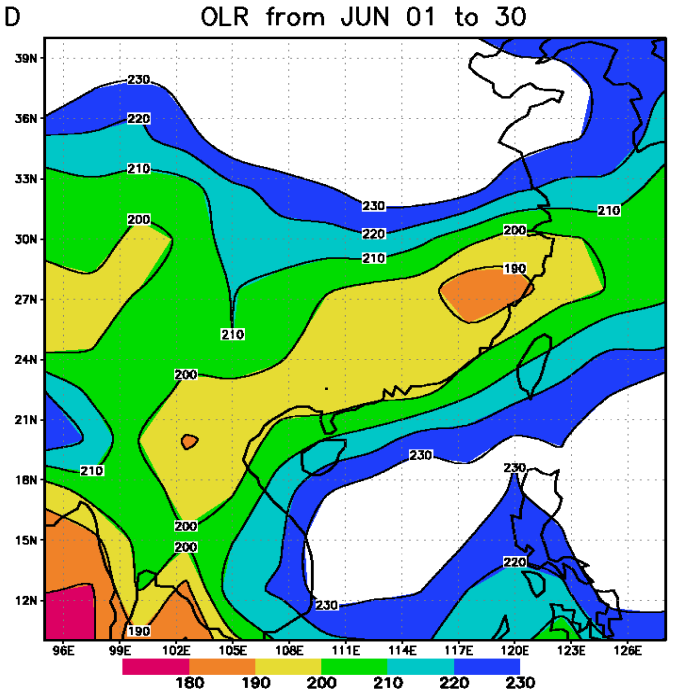
D
OLR from JUN 01 to 30
39N
36N
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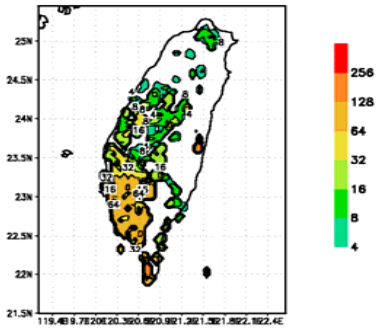
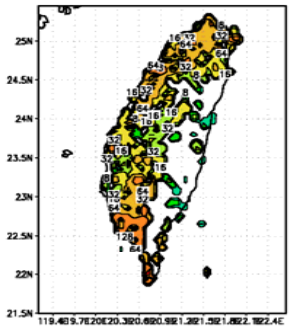
96E 99E 102E 105E 108E 111E 114E 117E 120E 123E 126E
180 190 200 210 220 230

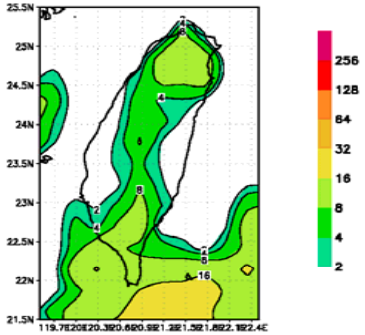
A accumulated rain in 0601



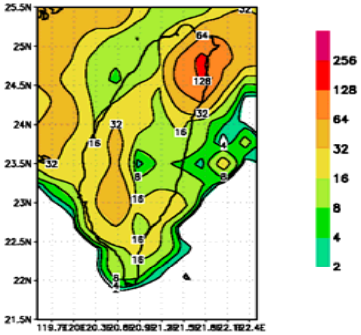
D accumulated rain in 0604



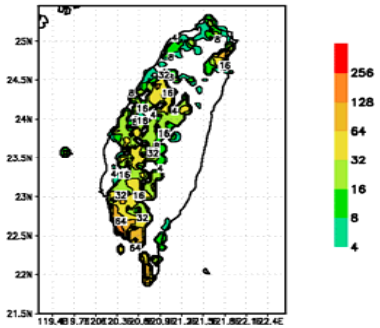
A accumulated rain in 0601



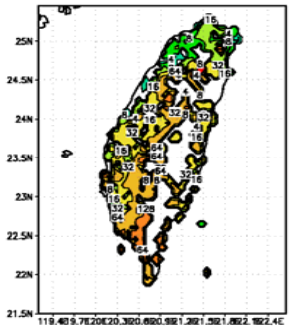
D accumulated rain in 0604



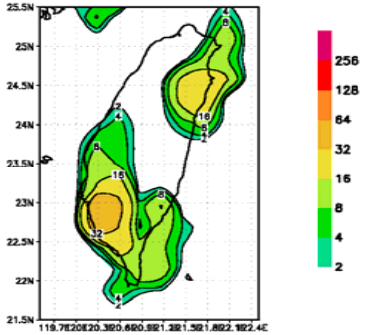
B accumulated rain in 0602



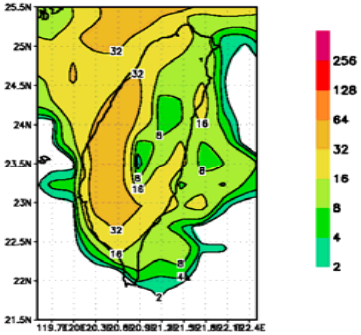
E accumulated rain in 0605



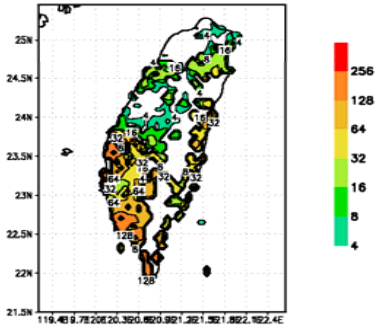
B accumulated rain in 0602



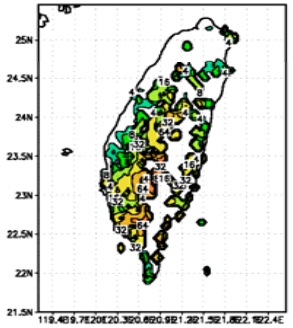
E accumulated rain in 0605



C accumulated rain in 0603



F accumulated rain in 0606



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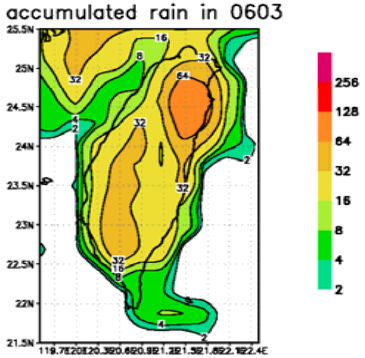
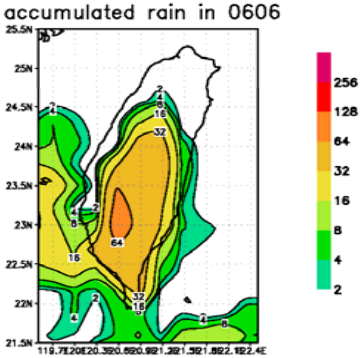
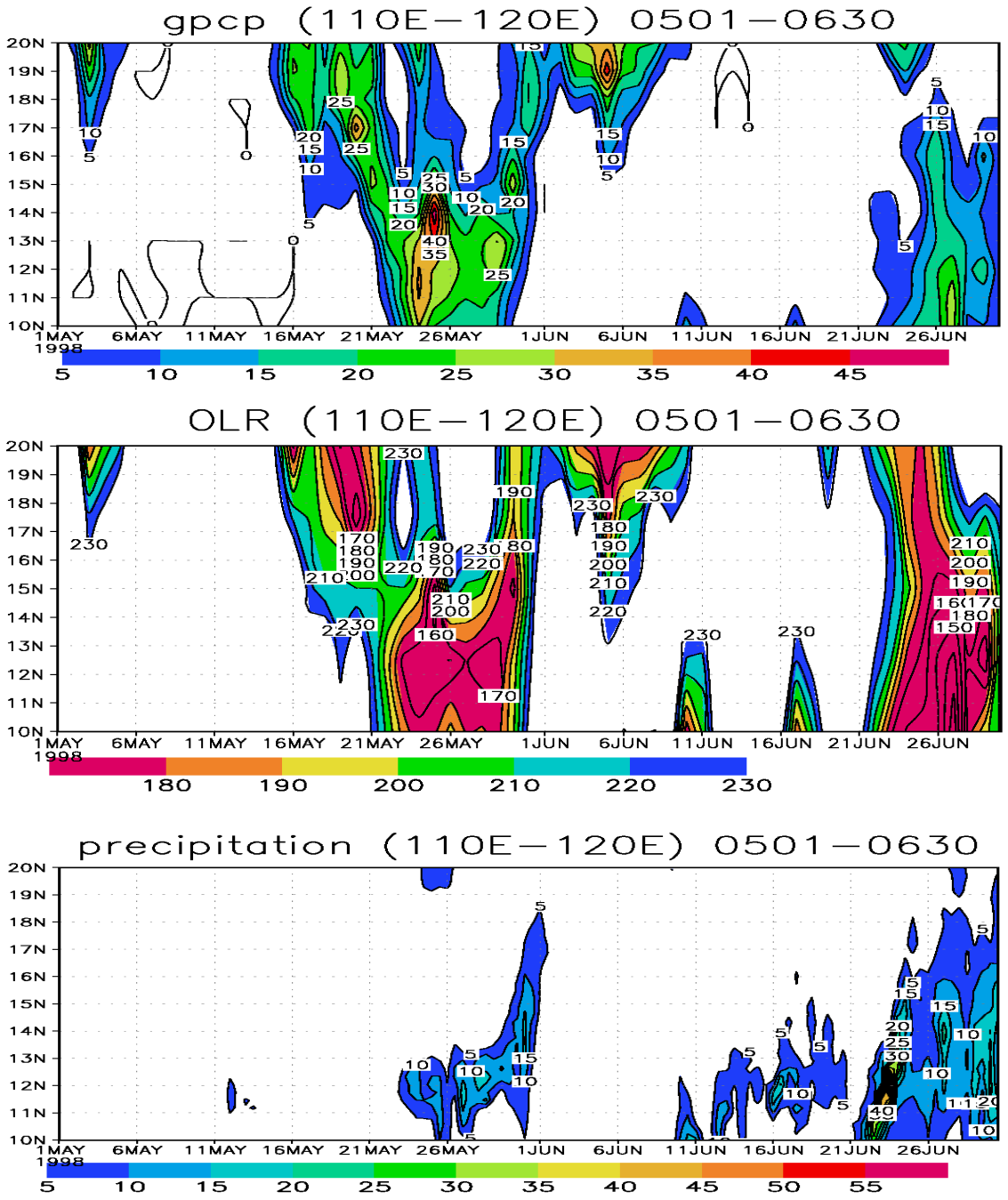


F accumulated rain in 0606



A


gpcp (110E–120E) 0501–0630
20N
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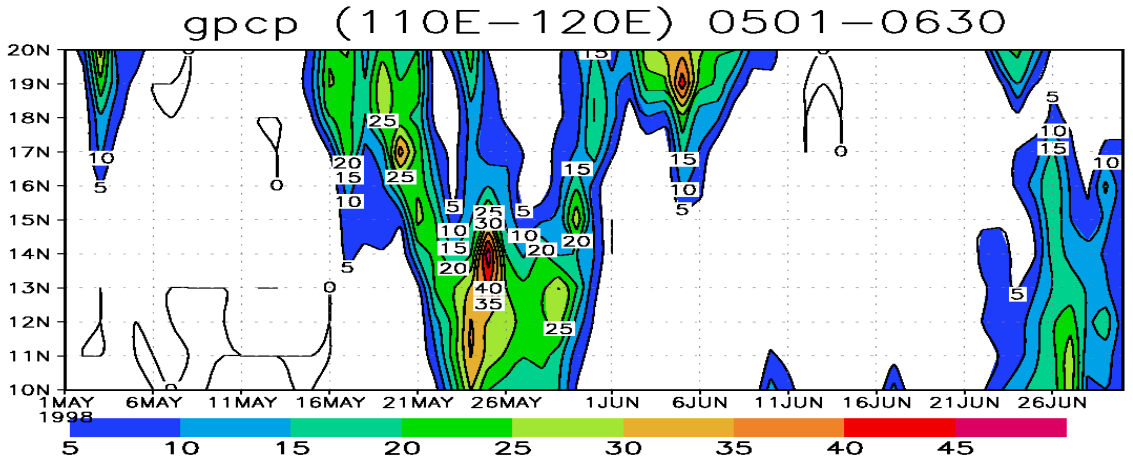
1MAY 6MAY 11MAY 16MAY 21MAY 26MAY 1JUN 6JUN 11JUN 16JUN 21JUN 26JUN
1998
5 10 15 20 25 30 35 40 45
OLR (110E–120E) 0501–0630
180 190 200 210 220 230
precipitation (110E–120E) 0501–0630
5 10 15 20 25 30 35 40 45 50 55

A


gpcp (110E-120E) 0501-0630
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21MAY
26MAY
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6JUN
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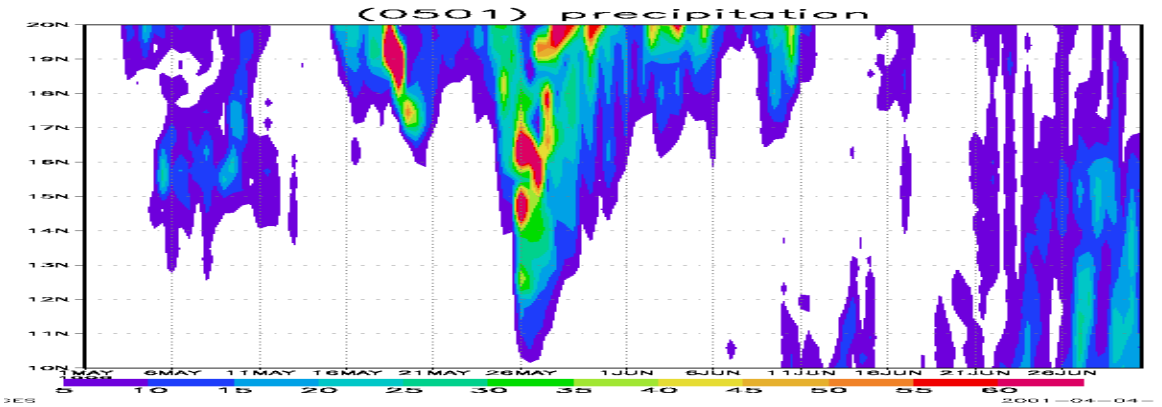
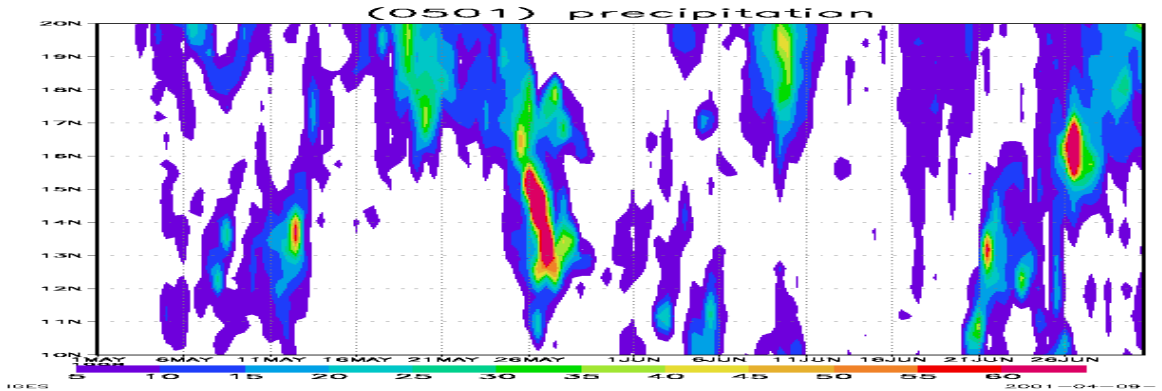
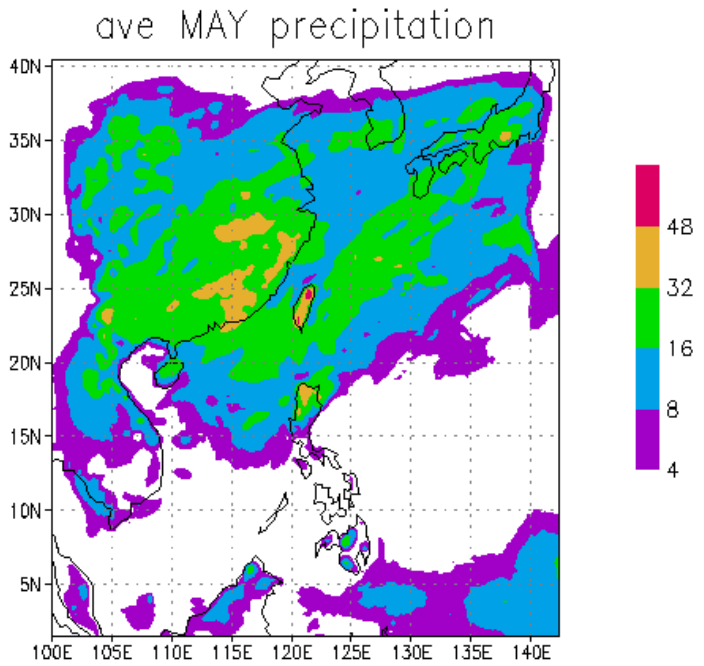
26JUN
5 10 15 20 25 30 35 40 45

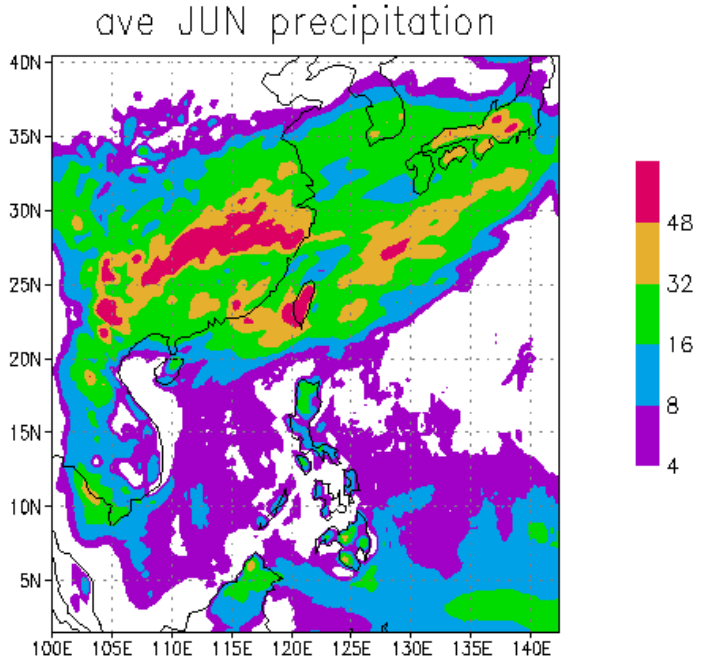

(0501) precipitation
5 10 15 20 25 30 35 40 45 50 55 60

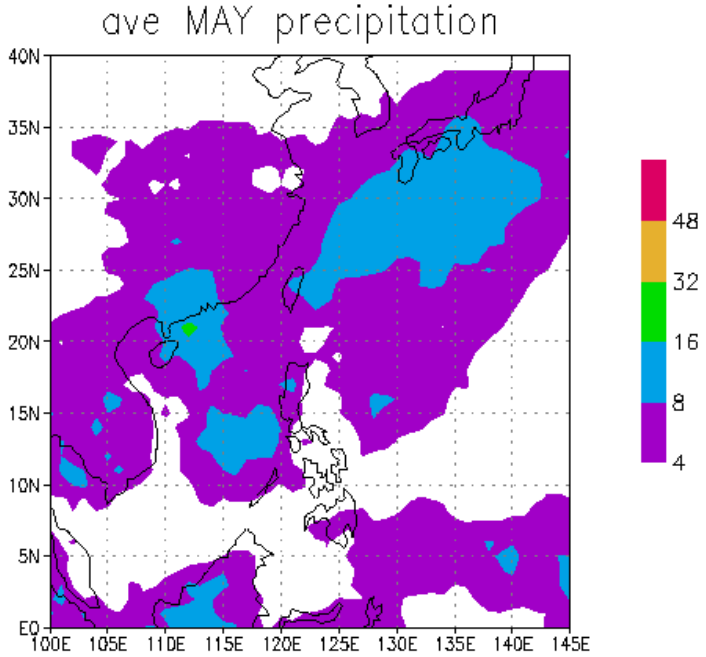
nested


(0501) precipitation
5 10 15 20 25 30 35 40 45 50 55 60

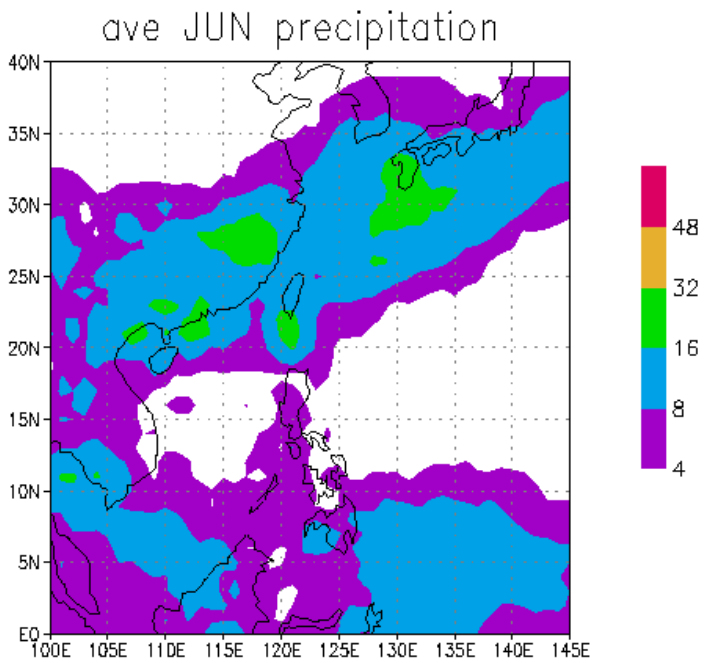


cloud3



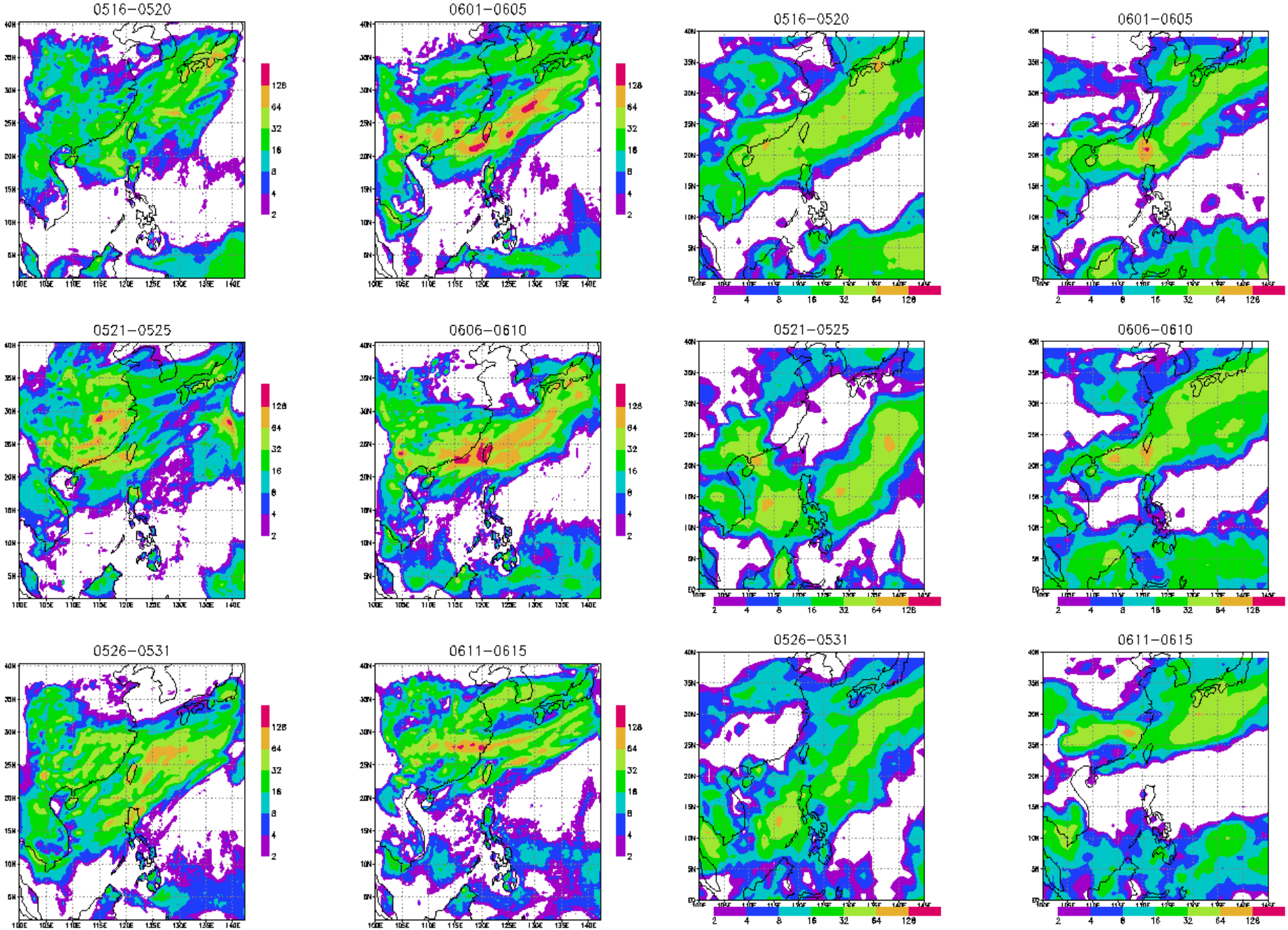


GPCP DATA



RSM cloud3

GPCP



Conclusions

- Overall, the model results are satisfactory in terms of the simulated large scale feature. A discernable bias is found in the simulated too strong subtropic high pressure ridge in the vicinity of Taiwan and the South China Sea area.
- The Monthly accumulated precipitation over the South China Sea area was not reproduced well in the control simulation.
- These discrepancy can be improved with considering more detail cloud process or adopt more suitable domain coverage and improved the nesting strategy.

- From the sensitivity tests, it is found that the spin-up problems introduced by each additional restart is not obvious in RSM. This result suggest the feasibility of dividing long regional climate simulation into a set of short-term ones that could be run in parallel.
- The structure of the regional climate evolution will be investigated in the near future from the diagnostic analysis of the simulation results during SCSMEX.
- RSM simulation:Good for monsoon onset (wind shifting).

- Discernable bias
  1. Strong subtropical high pressure.
  2. Accumulated precipitation.
- How to improve the precipitation simulation?
  1. With nested:not good.
  2. With cloud3:much better.

THE END