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ICTP RegCM4 Tropical Band version

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ICTP RegCM4
Tropical Band version

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Outlines

- Motivation
- Two steps' work
  - Get rid of west and east LBC forcing;
  - Periodic cycle at west and east boundaries.
- Model performance
  - 90x30L18, ~445km "Toy" domain
  - 720x180L18, ~56km domain
  - Parallel efficiency
- Limitation and future work

Motivation

- ~5 yr's plans come true:
  - Non-hydrostatic dynamics
  - Air-Sea Coupling
  - CLM
  - Atmospheric Chemistry
  - Tropical band model
- Relatively easier to implement, but require supercomputer to use it.

Step I: get rid of W/E LBC forcing

- In mod_bdycod.F90, the follow variables should be deleted, all codes which use them need to be modified:
  - **uj1, uj2, ujl, ujlx, vj1, vj2, vjl, vjlx and Feb, Febt, Fwb, Fwbt (F=p, q, t, u, v);**
  - **bdyin.F90, bdyuv.F90, bdyval.F90, nudge.F90, sponge.F90, mod_bdycod.F90, tend.F90; init.F90, spinit.F90, outsav.F90, output.F90**
  - **11 (out of 148) files.**
- ~800 lines have been modified.

Step II: periodic conditions at W/E boundaries

- Periodic cycle = No west/east LBC forcing. The related codes are complex:
  - Arakawa B grid (BATS, Rad. and other physics)
  - Horizontal advection
  - Horizontal diffusion
  - Parallel code implement
  - IO
- ~3500 lines have been modified.
- Basic Rules:
  - Almost all do-loops with jxm1 or jxm2 need modify;
  - No corner points.

Step II: periodic conditions at W/E boundaries

- diffu.F90, diffut.F90, htdiff.F90, splitf.F90, spstep.F90, tend.F90, slice3D.F90, regcm.F90;
- hadv.F90 (hadv_t, hadv_u, hadv_v, hadvqv, hadvqc, hadvch)
- blhnew.F90, chemtap.F90, cumtran.F90, holtbl.F90, inirad.F90, interf.F90, nconvp.F90, vadv.F90;
- mod_aerosol.F90, mod_bats.F90, mod_bdycod.F90, mod_blh_tmp.F90, mod_dust.F90, mod_mainchem.F90, mod_rad.F90, mod_mppio.F90, mod_o3blk.F90, mod_outrad.F90;
- init.F90, initb.F90, grads_stuf.F90, mkfile.F90, output.F90, outsav.F90, outsub.F90, outtap0.F90, outtap.F90, radout.F90, radtap.F90;
- tracbud.F90, conadv.F90, conmas.F90, tracdiag.F90, mod_outprt.F90.

50 (out of 148) files

Domain Configuration

- Two domains:
  - “Toy” domain,90x30,444.79574km
  - High resolution domain, 720x180,55.5994675km
- NORMER, EIN15, OI_WK, June of 1990

“Toy” domain

NORMER, 90x30,444.79574km
EIN15,OI_WK, 1990Jun

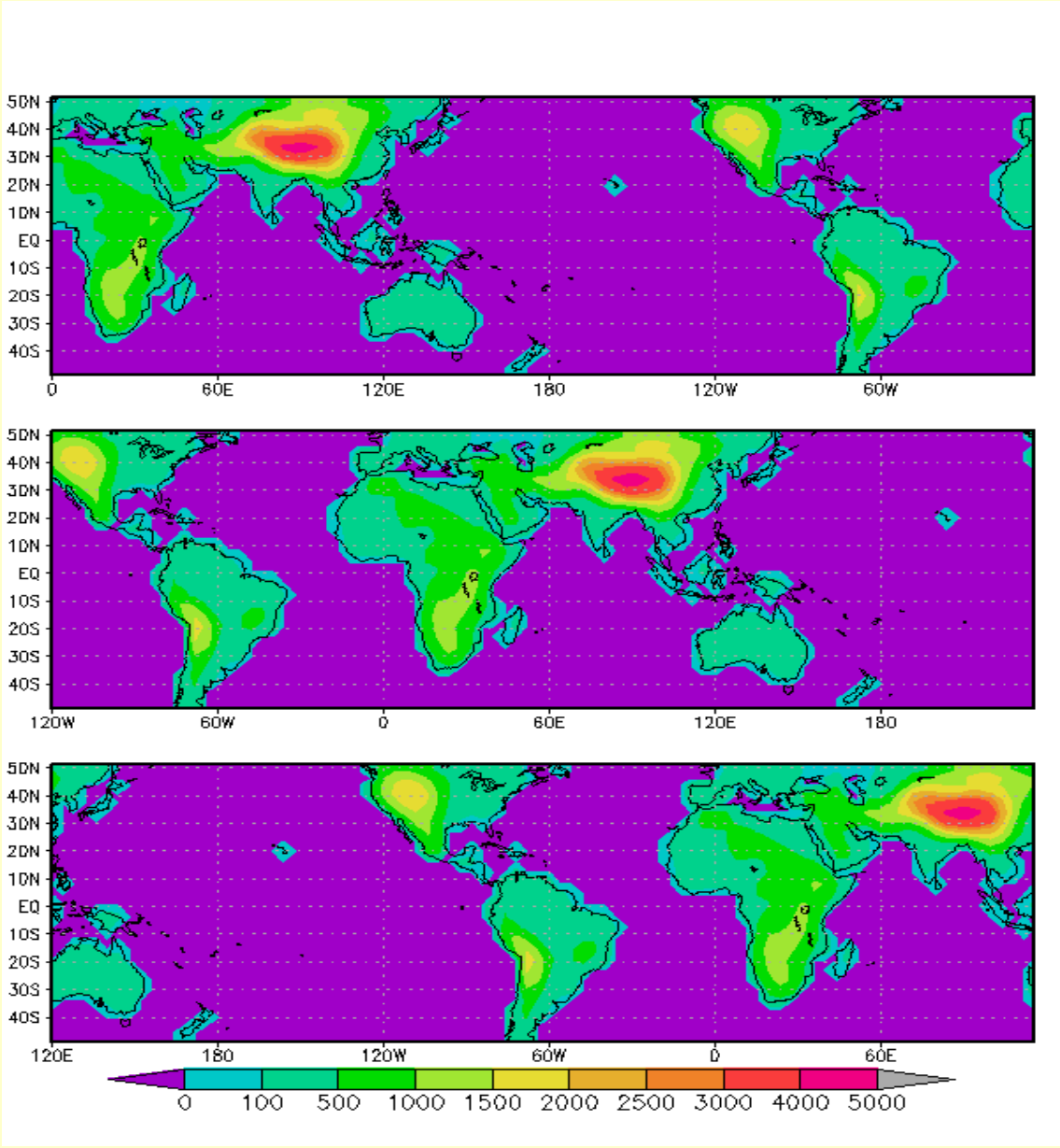
With and without
west/east LBC forcing

With LBC forcing
at E-W boundary

clon: 180

clon: 60E

clon: 60W



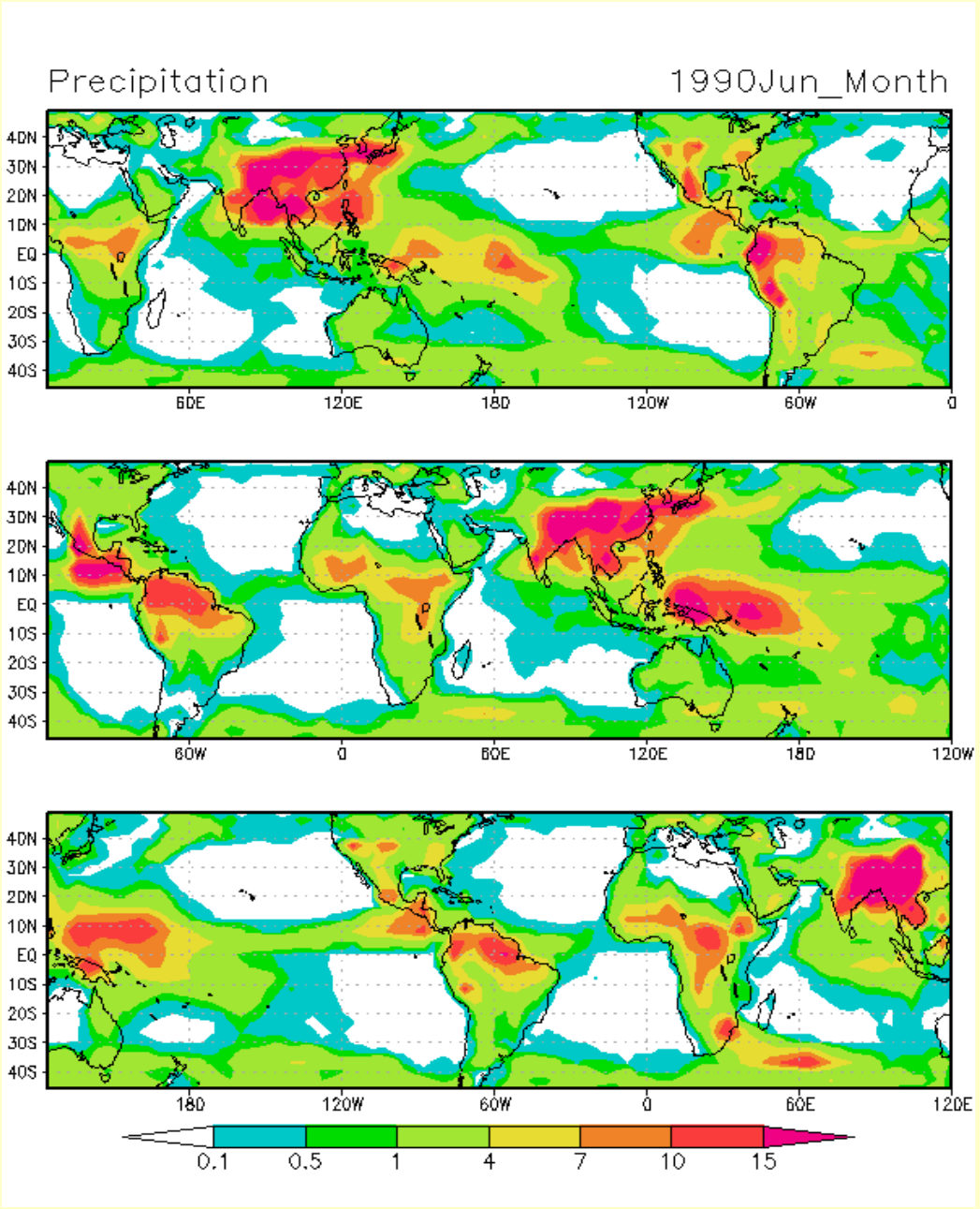
92x30L18

With LBC forcing
at E-W boundary

clon=180

clon=60E

clon=60W



Monthly mean
Precipitation

92x30, 445km

Forced by
ERA-Interim,
1990 June.

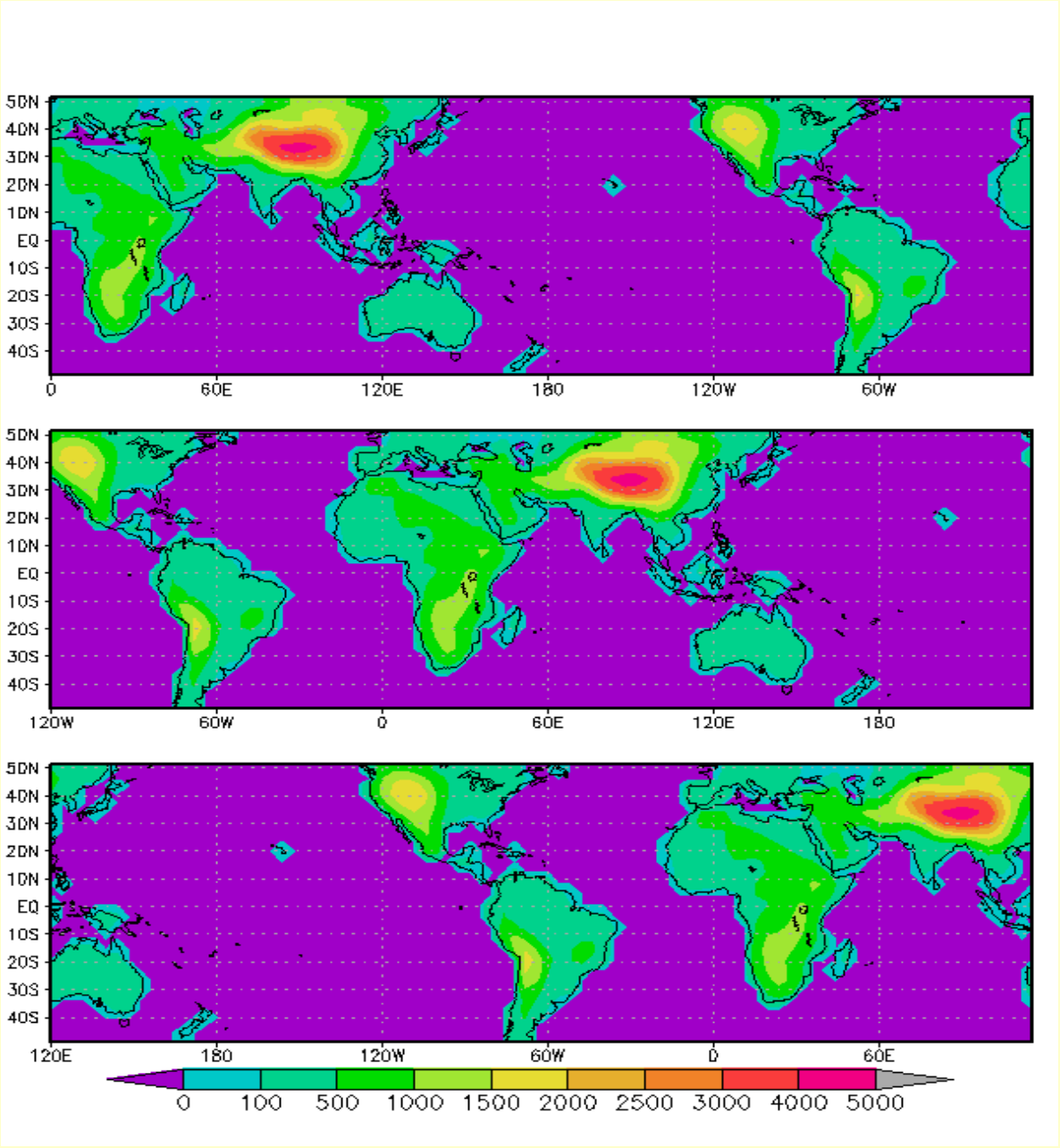
92x30L18

Periodic conditions
at E-W boundary

clon: 180

clon: 60E

clon: 60W



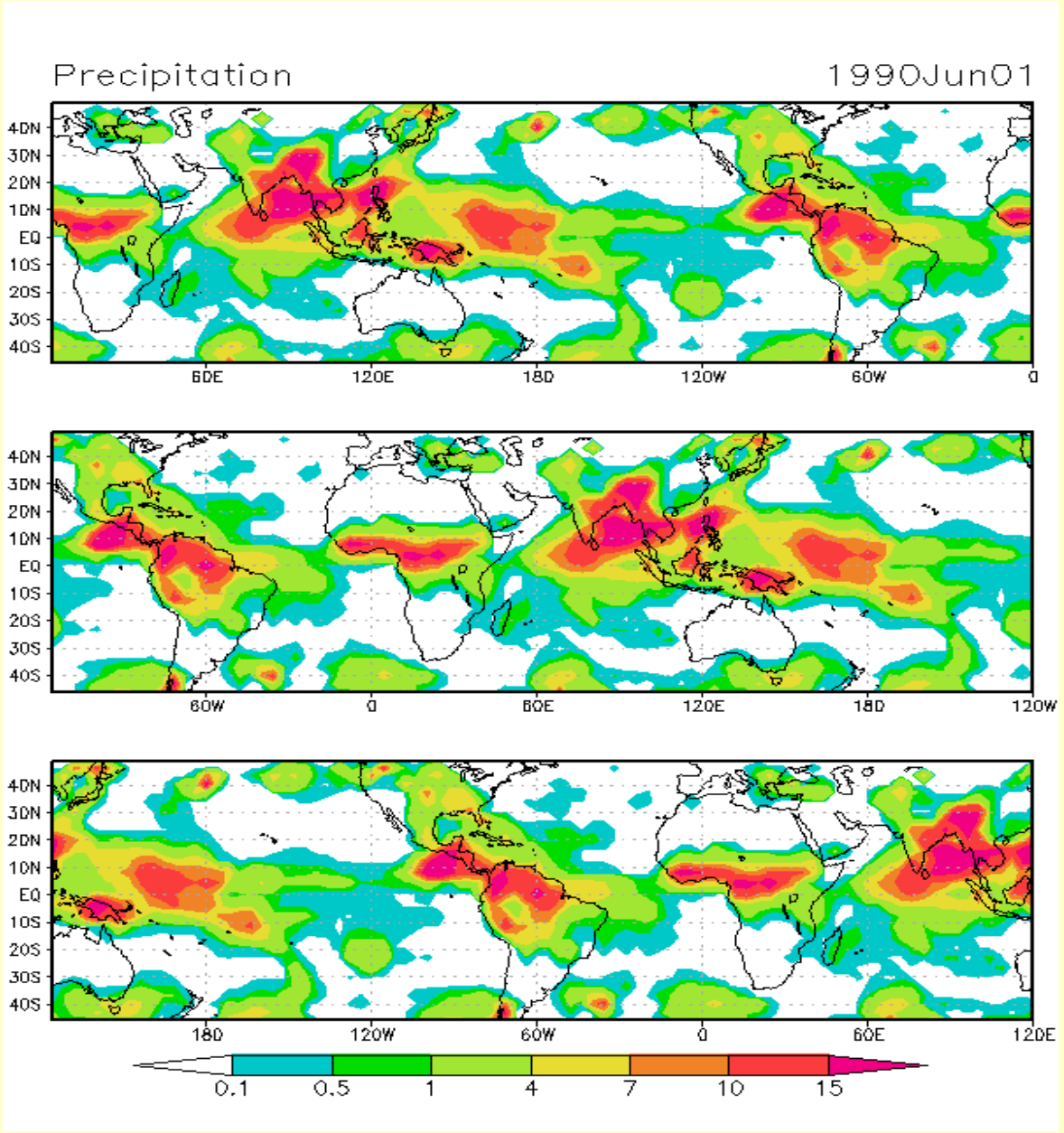
90x30L18

Periodic conditions
at E-W boundary

clon: 180

clon: 60E

clon: 60W

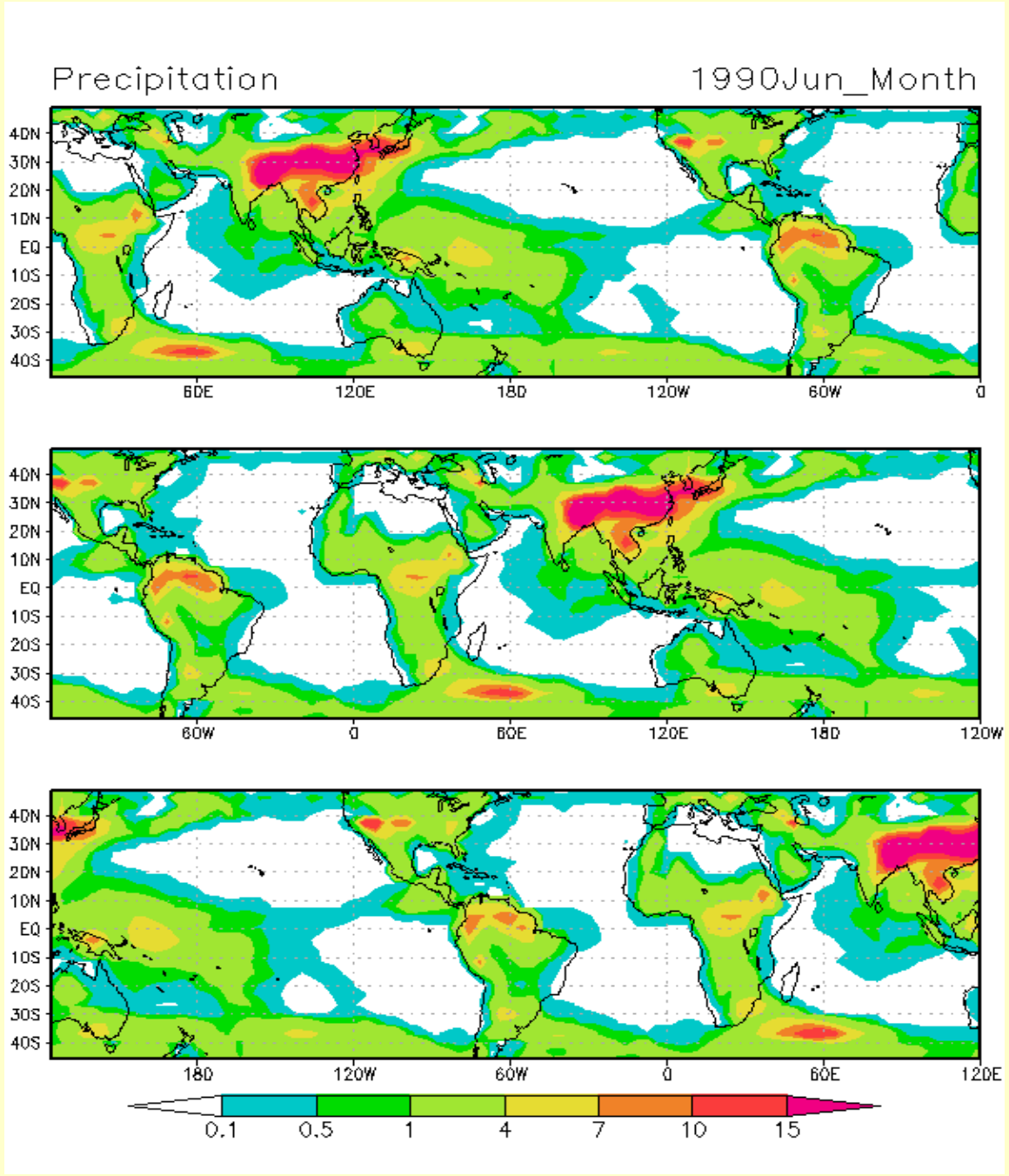


90x30L18

clon=180

clon=60E

clon=60W



Periodic conditions at E-W boundary

Monthly mean Precipitation

90x32, 444km

Forced by ERA-Interim, 1990 June.

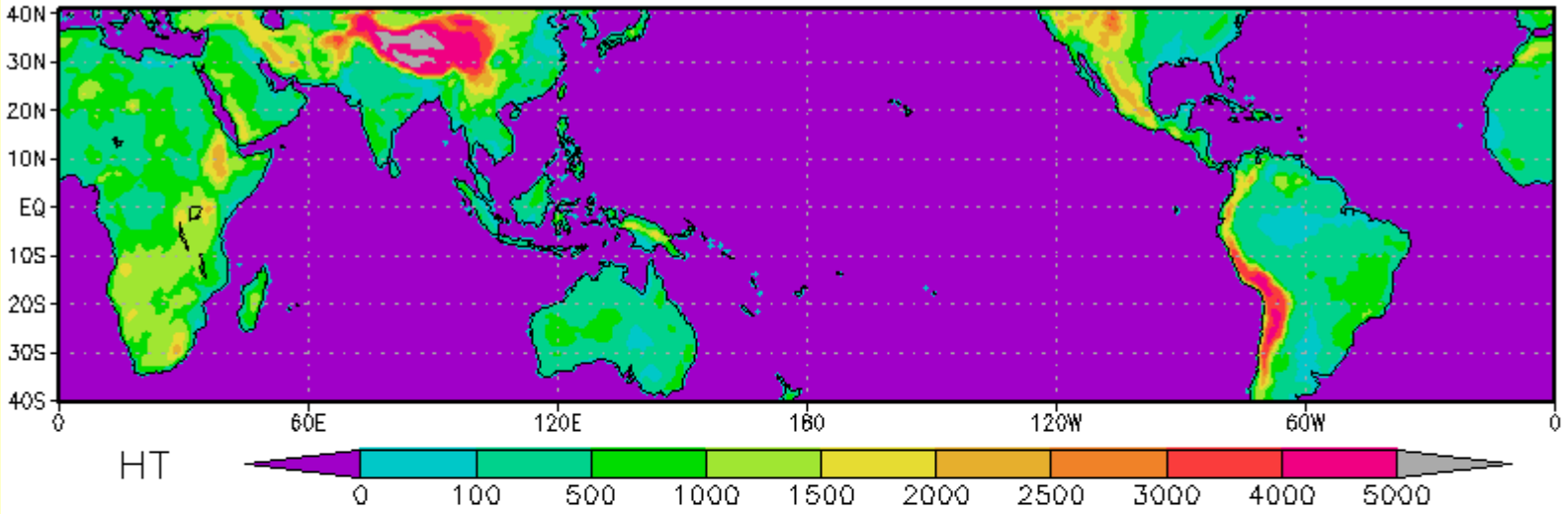
90x30L18

Reasonable resolution domain

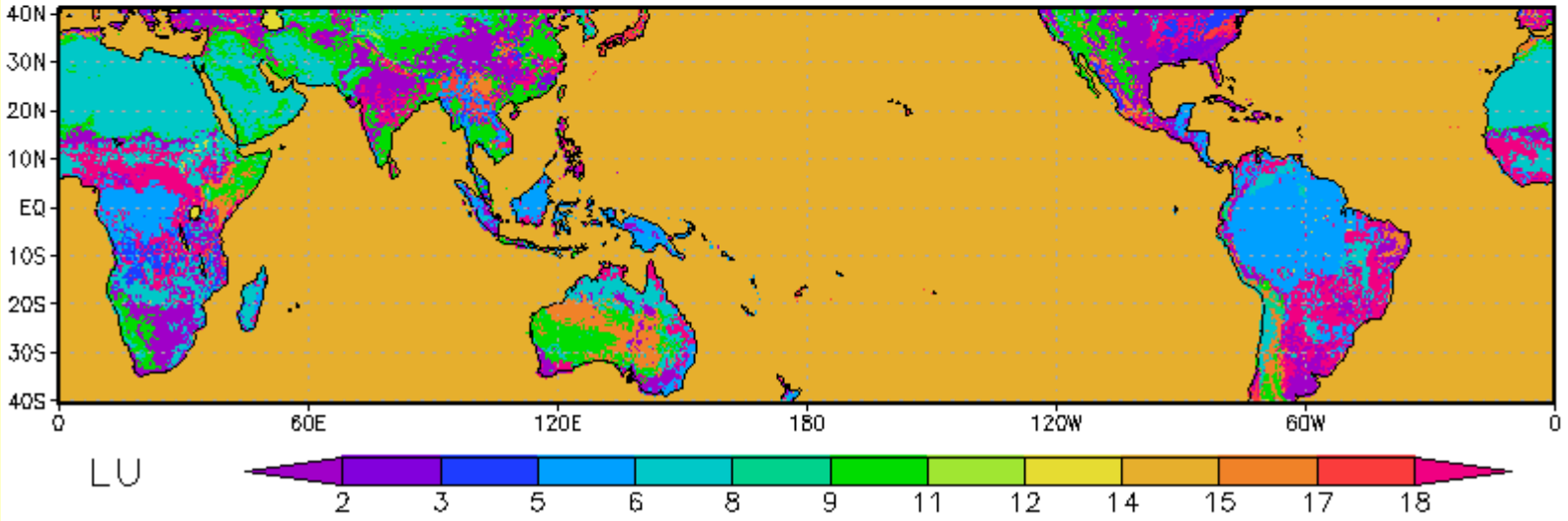
NORMER, 720x180,55.5994675km

EIN15,OI_WK, 1990Jun

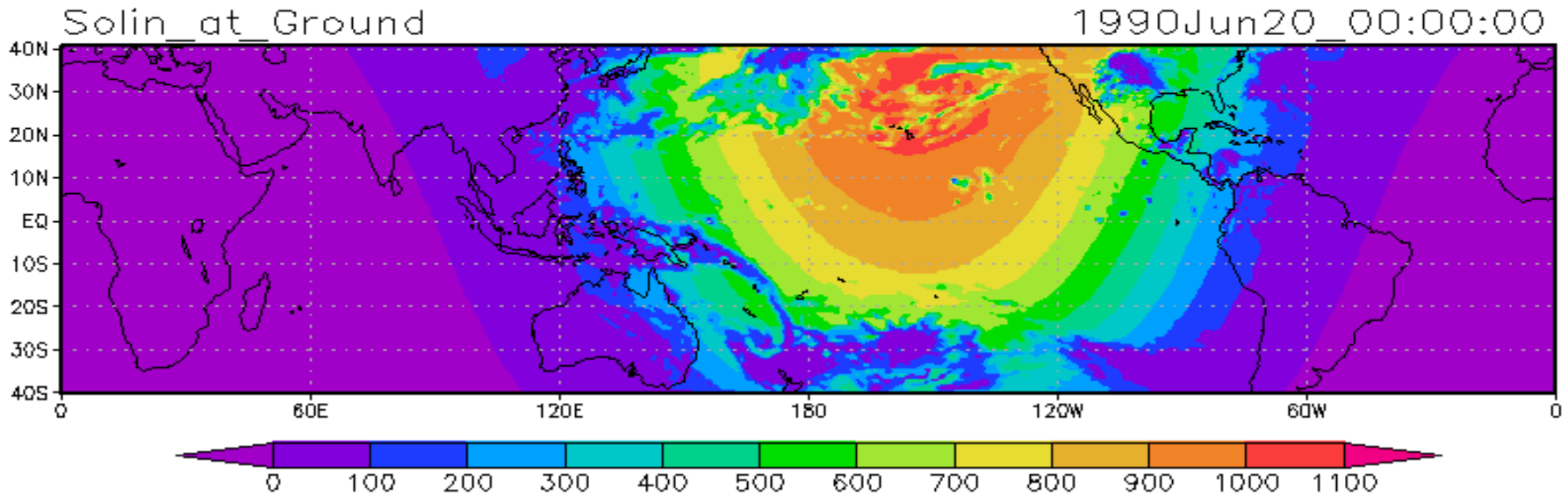
Topography

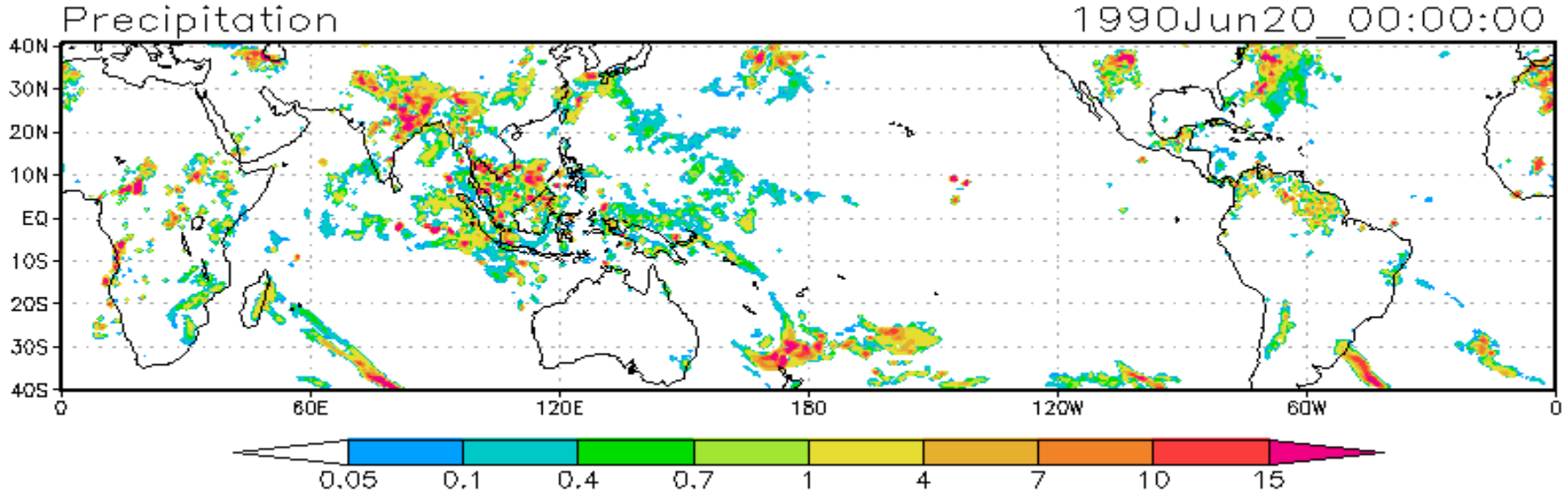


Landuse

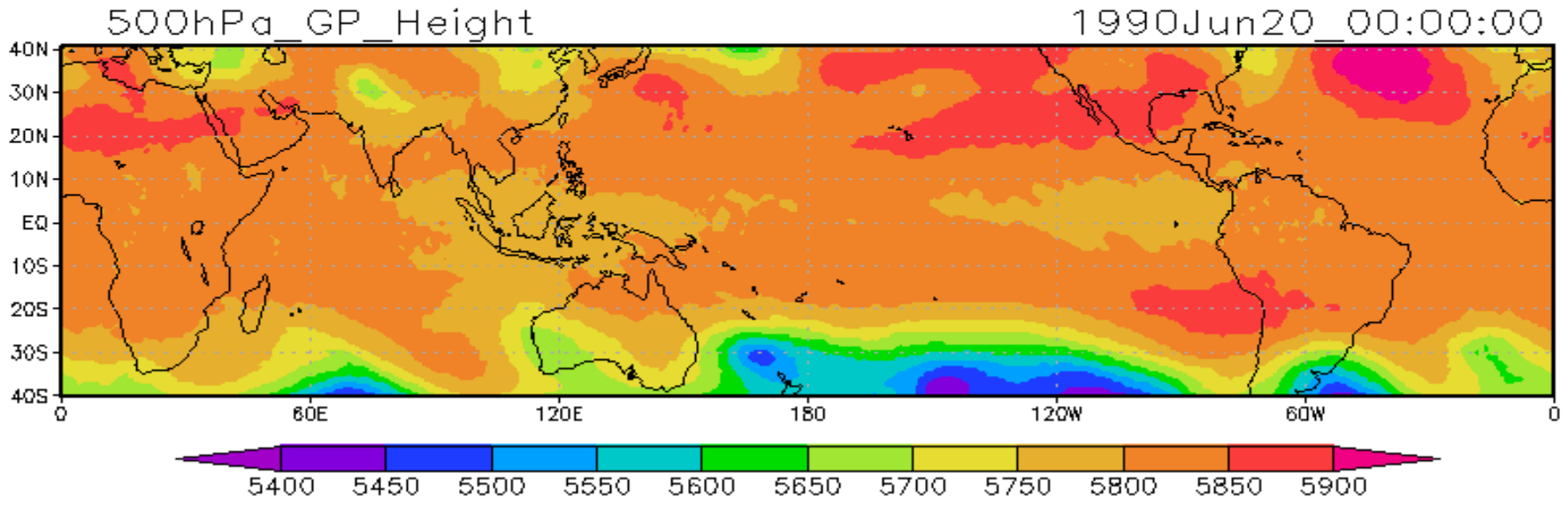


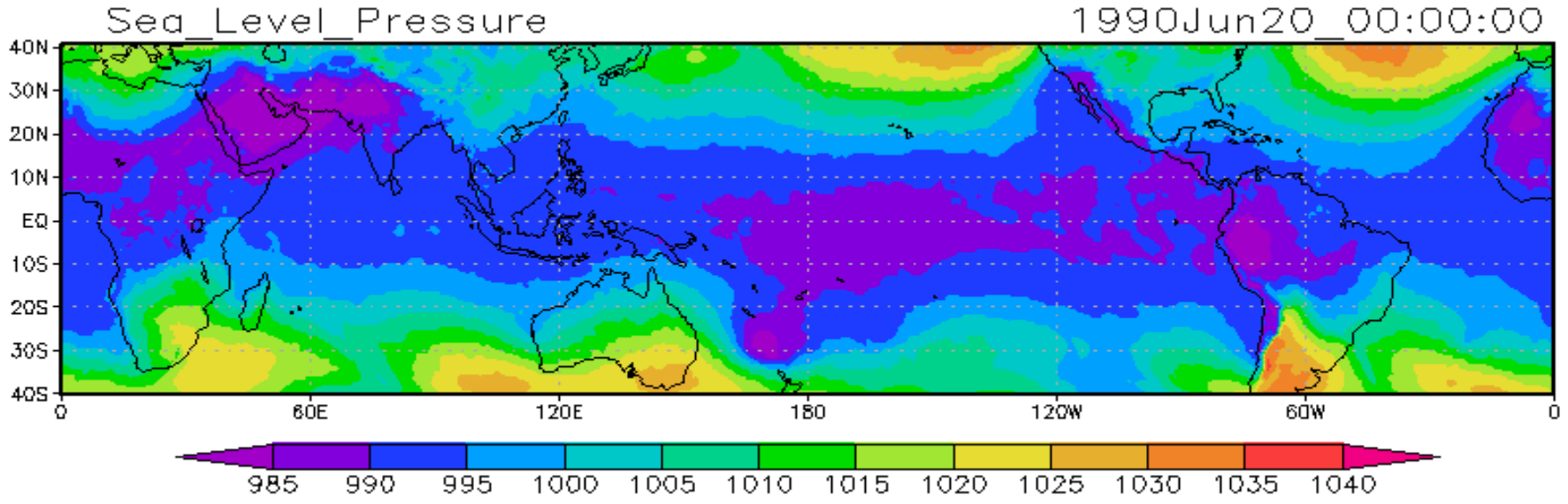
Solar Radiation & precipitation





500hPa height & Sea Level Pressure





Parallel Efficiency

- On my due-core laptop (Mandriva Linux, Intel Fortran 11.1, openmpi 1.4.2), the serial run, parallel run with 1CPU and parallel run with 2 CPU have exactly the same results. For one month integration of the 90x30 domain, the serial run takes **35** minutes, parallel_1CPU takes 35 minutes, and parallel_2CPU takes **23** minutes;
- On SISSA's AMD64 CPU SuperCluster, one month big domain integration takes **1:12:04** by using 80 CPUs, and it takes **2:14:12** by using 40 CPUs, ***two results are exactly the same !!!***

Limitation

- RegCM4 Terrain code need to be modified,
  - If clon=180.0, terrain code works fine;
  - If central longitude is not 180.0, terrain failed to get the right ht, htsd and mask for the whole domain;
- Not sure that CLM works or not, all codes under Main/CLM haven't been touched, parallel efficiency is probably an issue for RegCM4 with CLM.
- In the formal version of RegCM4, the tropical band version will be released as a branch (or by using macro-define control).

Future work

- “A lot of things could be done” (quote from F.G) if there is enough computer resources:
  - Tropical band couple model;
  - LFO and tropical waves simulation;
  - Cyclone simulation,
  - Climate affected by ENSO
  - High performance computing
  - .....