High-resolution results of the GEM Model

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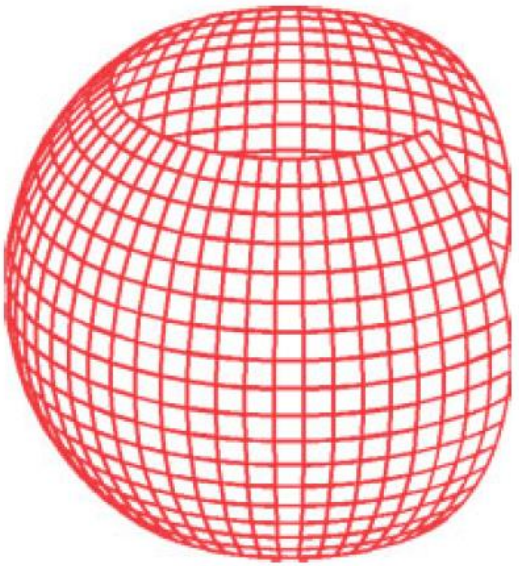
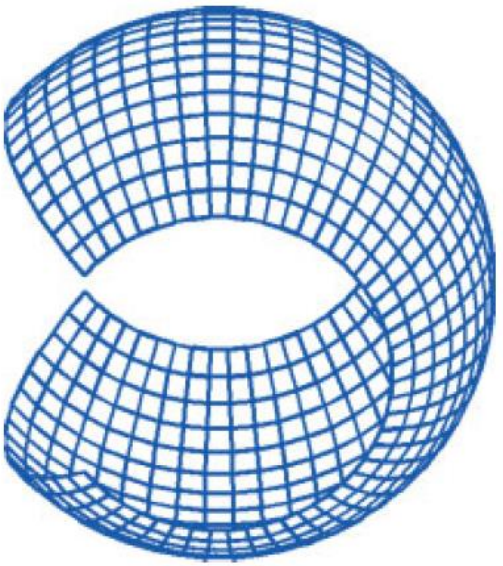
GEM Yin-Yang

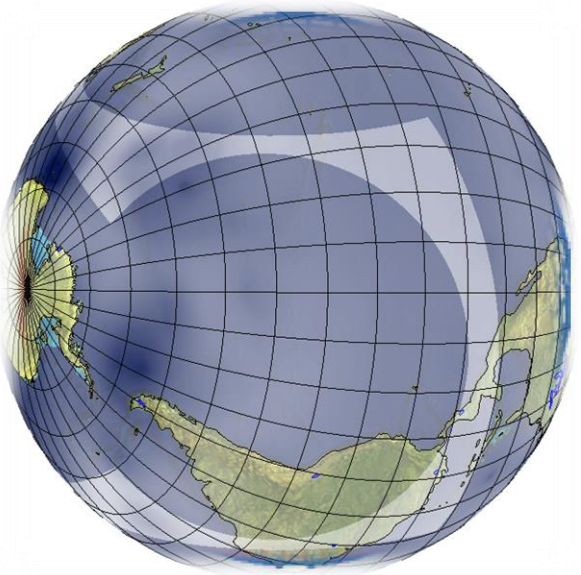
Yin



Yang



Yin-Yang



$$\Omega_1 = \left\{ 45^0 - 3\delta \le \lambda \le 315^o + 3\delta;\ -45^0 - \delta \le \theta \le 45^o + \delta \right\}; \delta = 2^0$$

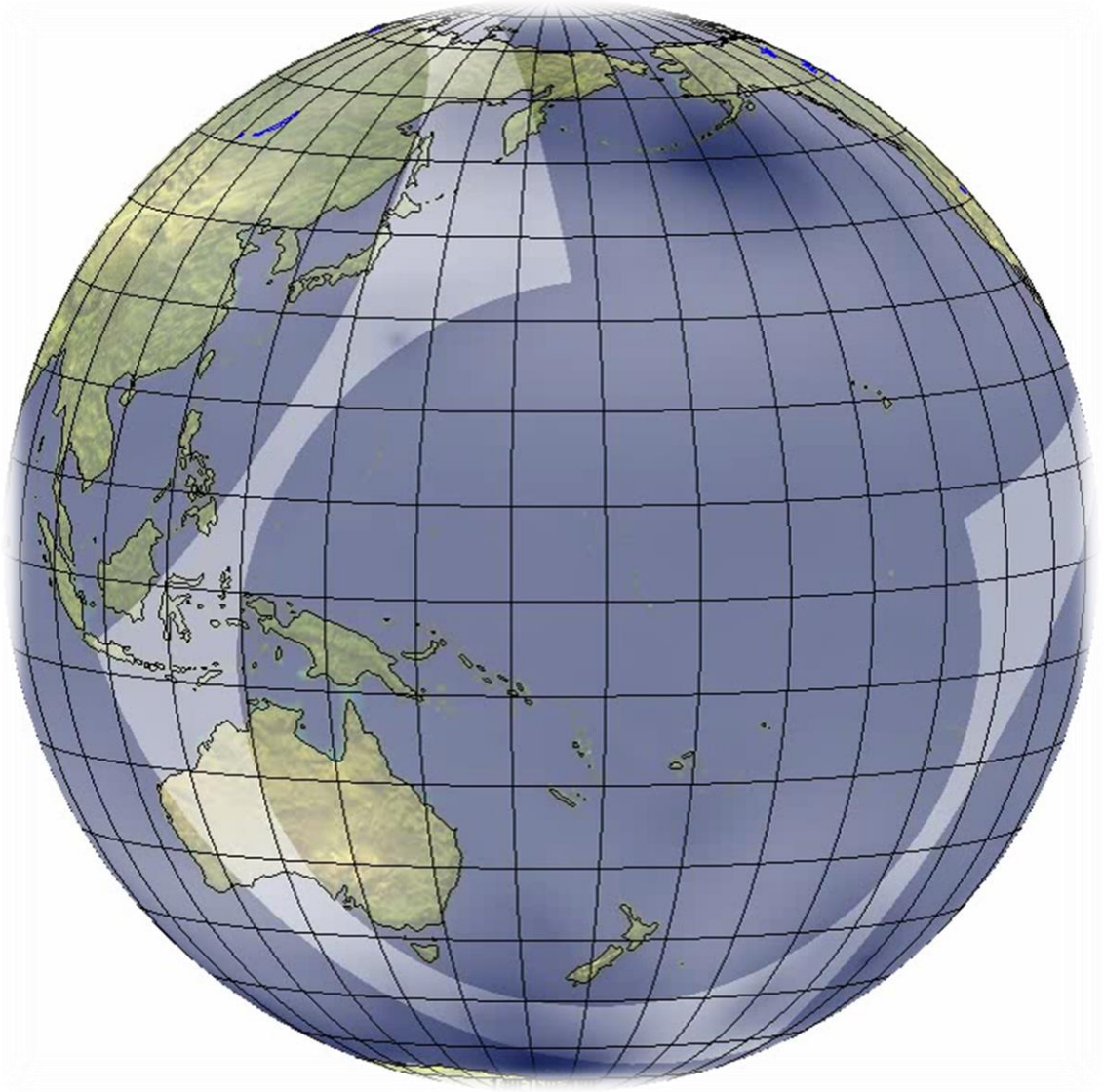
$$\Omega_2 = \Omega_1$$

The global forecast is based on the two-way nesting method between 2-limited area models.

Qaddouri and Lee 2011 Q.J.R.Meteorol.Soc.137:1913-1926

GEM Yin-Yang
Global 25km

GEM LAM
National 2.5km



GEM Model

- Horizontal discretization: Finite differencing on Arakawa-C grid
- Vertical discretization: Charney Phillips grid with a log-like zeta-coordinate
- 2 time-level semi-Lagrangian fully implicit scheme
- The elliptic problem on the Yin-Yang grid is solved by using the Schwarz iterative method
- Full physics
- Explicit horizontal diffusion

GEM scalability on the new supercomputer

790 compute nodes

36 processors / node

Therefore:

Max of 28440 cores available

GEM Yin-Yang Setup for Scalability Tests

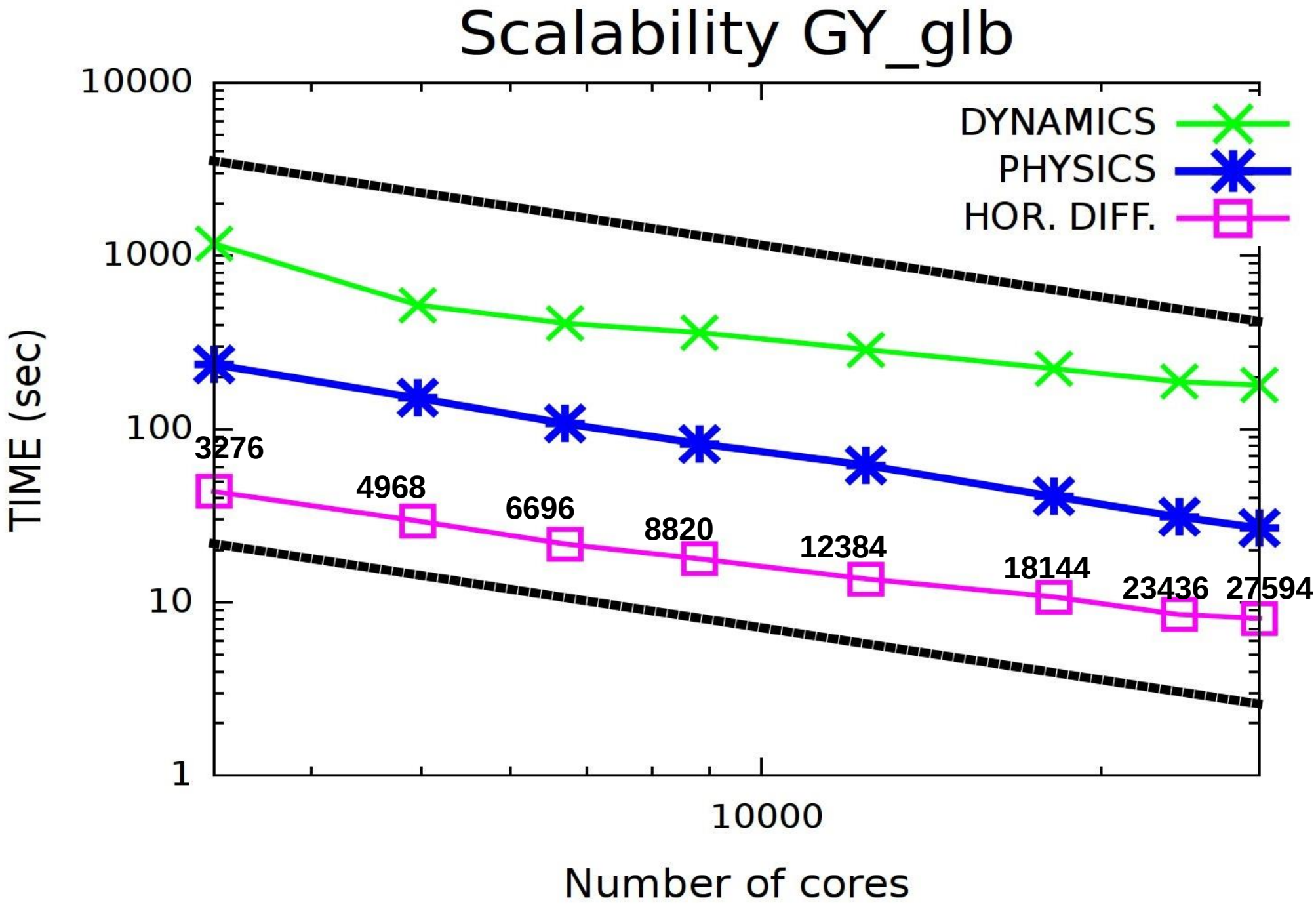
144 Timesteps

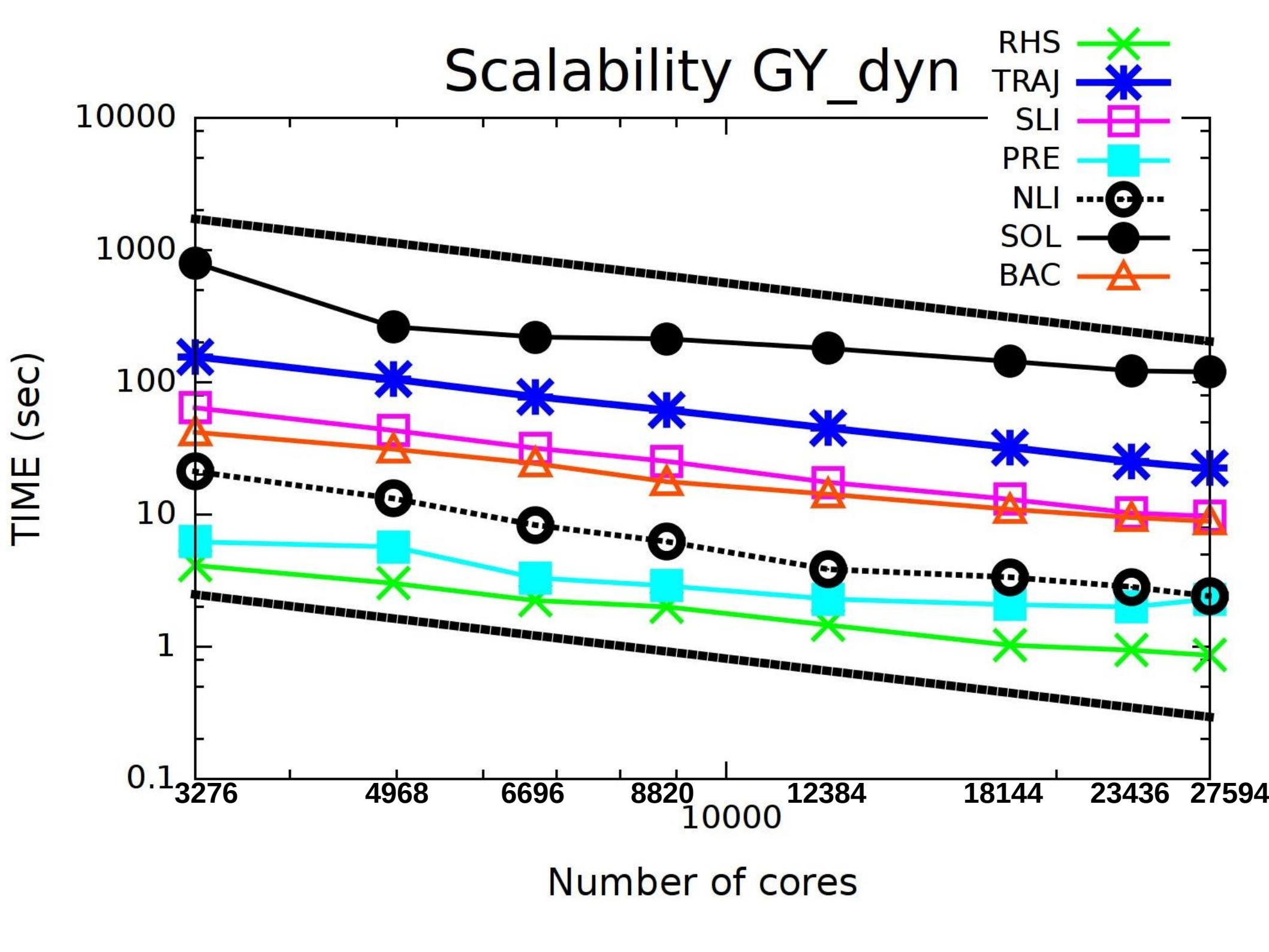
Grid Resolution: .047 degree

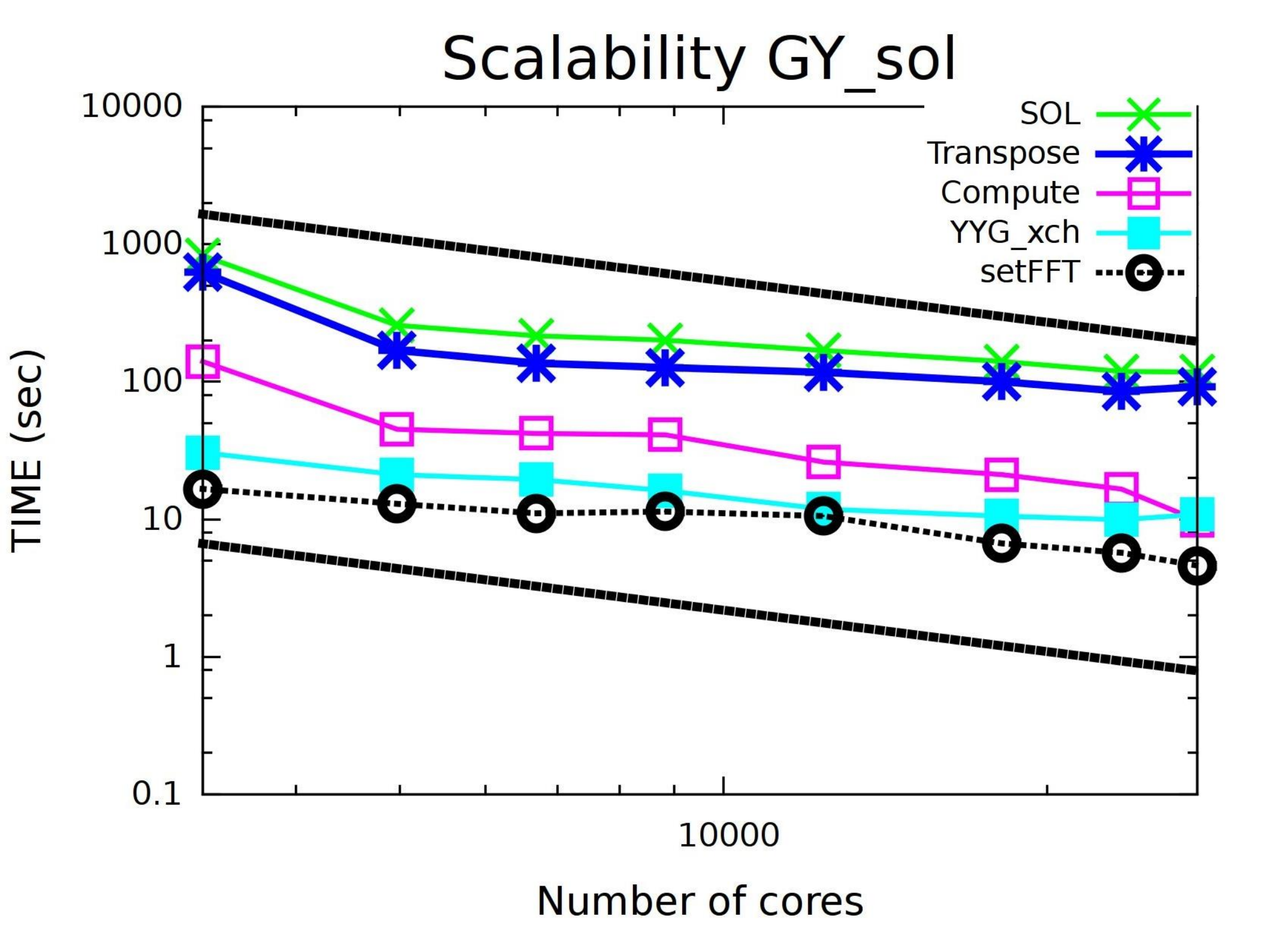
Using between:
3276 to 27594 cores

GEM Yin-Yang grid: Each LAM core: 5999 x 2000 pts

Processor Topology Npex X Npey	Total Nodes used	Total # of CPUs	Local tile size: Ni x Nj	Total CPU time (seconds)
78 x 21	91	3276	77 x 96	1745
92 x 27	138	4968	65 x 75	819
108 x 31	186	6696	55 x 65	646
126 x 35	245	8820	47 x 58	566
144 x 43	344	12384	41 x 47	467
168 x 54	504	18144	35 x 37	381
189 x 62	651	23436	31 x 32	337
189 x 73	767	27594	31 x 27	327


Scalability GY_glb
10000
1000
100
10
1
TIME (sec)
DYNAMICS
PHYSICS
HOR. DIFF.
3276
4968
6696
8820
12384
18144
23436
27594
10000
Number of cores


Scalability GY_dyn
RHS
TRAJ
SLI
PRE
NLI
SOL
BAC
TIME (sec)
10000
1000
100
10
1
0.1
3276
4968
6696
8820
10000
12384
18144
23436
27594
Number of cores


Scalability GY_sol
10000
1000
100
10
1
0.1
TIME (sec)
10000
Number of cores
SOL
Transpose
Compute
YYG_xch
setFFT

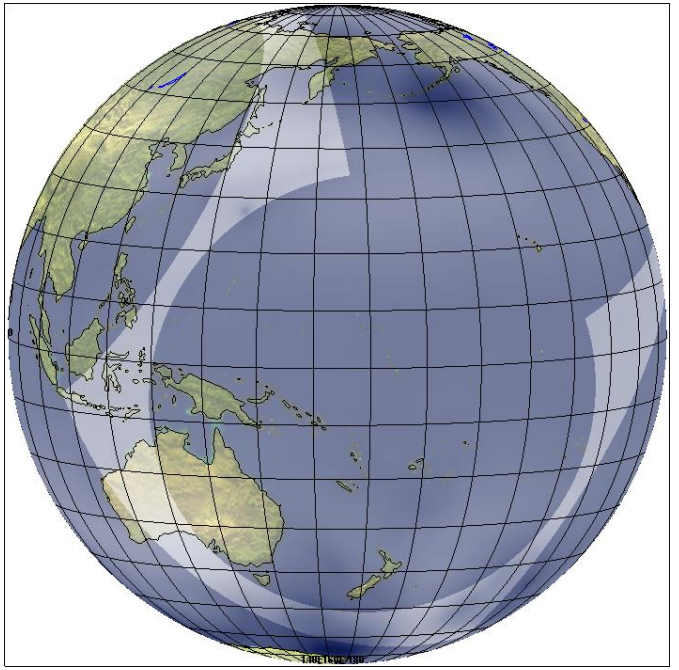
Highest Resolution GEM Yin-Yang run to fit into the new HPC

Grid size of Yin/Yang:

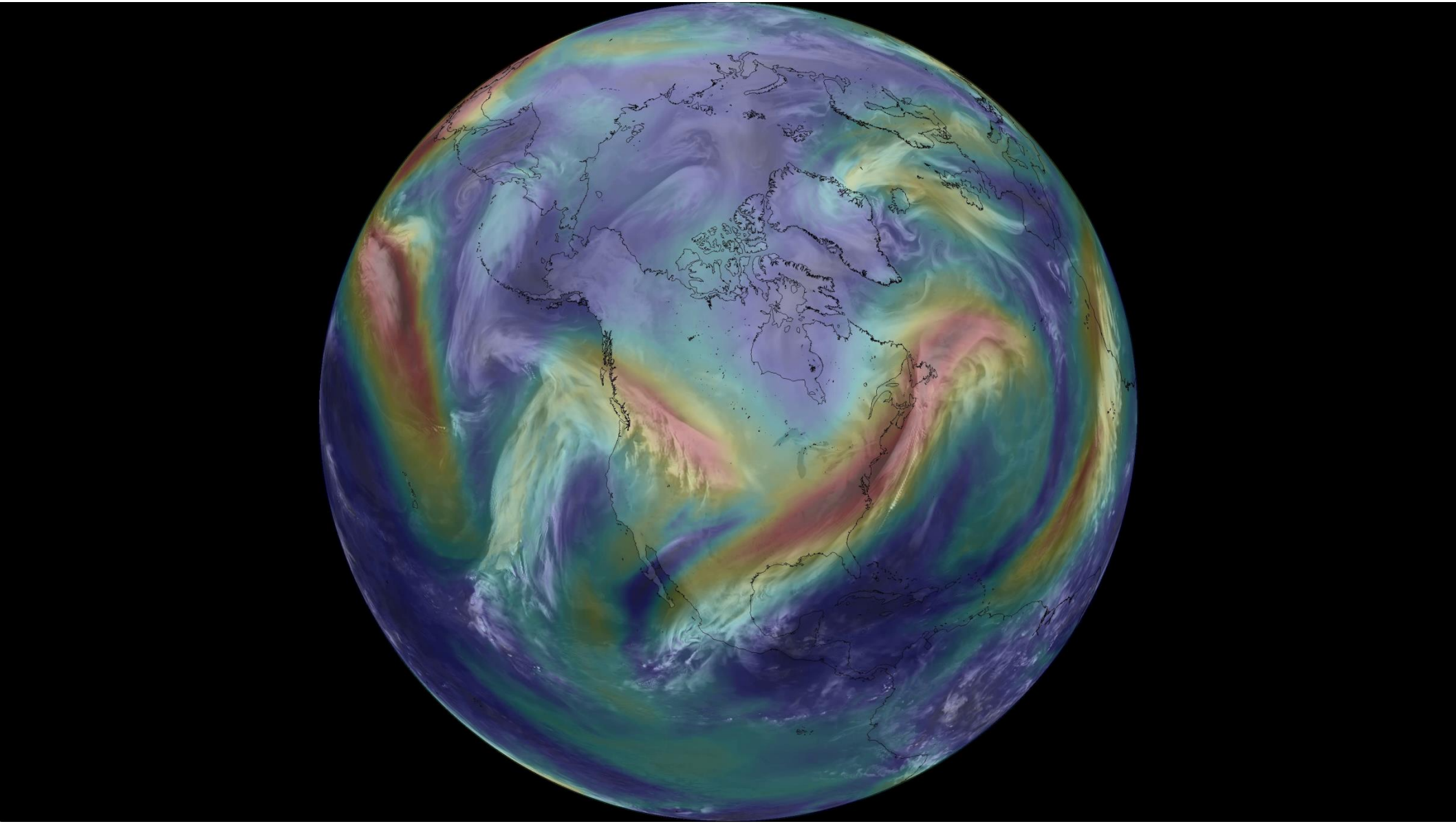
Grd_ni = 10035, Grd_nj=3370

Resolution = 0.0282 degrees (3.1 kms)

- **Alberta clipper : initialized at 1200 UTC 5 January 2015**
- **5 day forecast , time step = 90 sec**
- **Total Wall clock run = 7hrs + 9min**
- **Processor Topology per LAM grid: (279 x 50 x 1)**
- **Total CPUS = 27900 (775 nodes)**



Global Yin-Yang (3.1km) grid, 5 day forecast : 1200 UTC Jan. 5, 2015
(EI) Out-going Infrared energy exiting the atmosphere, (UV) Wind speed



GY_EI+UV_Globe_4K.mp4

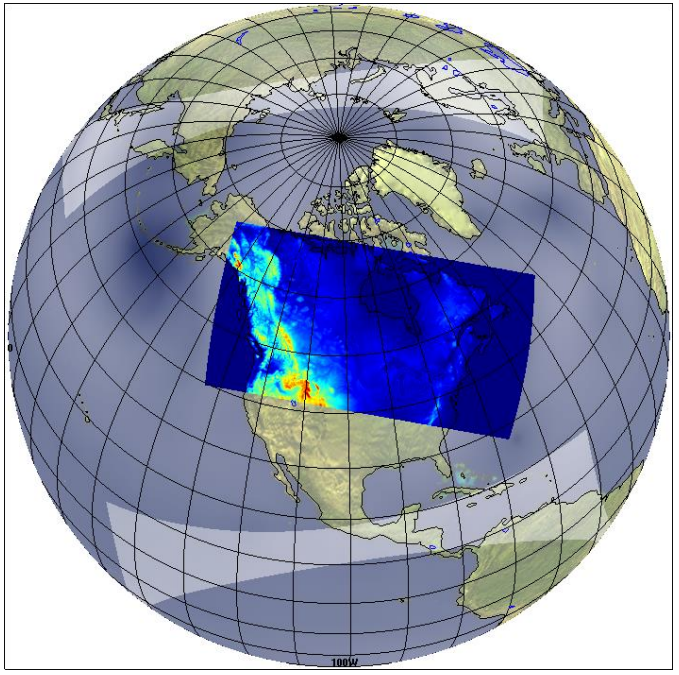
Highest Resolution GEM LAM run to fit into the new HPC

Grid size of LAM:

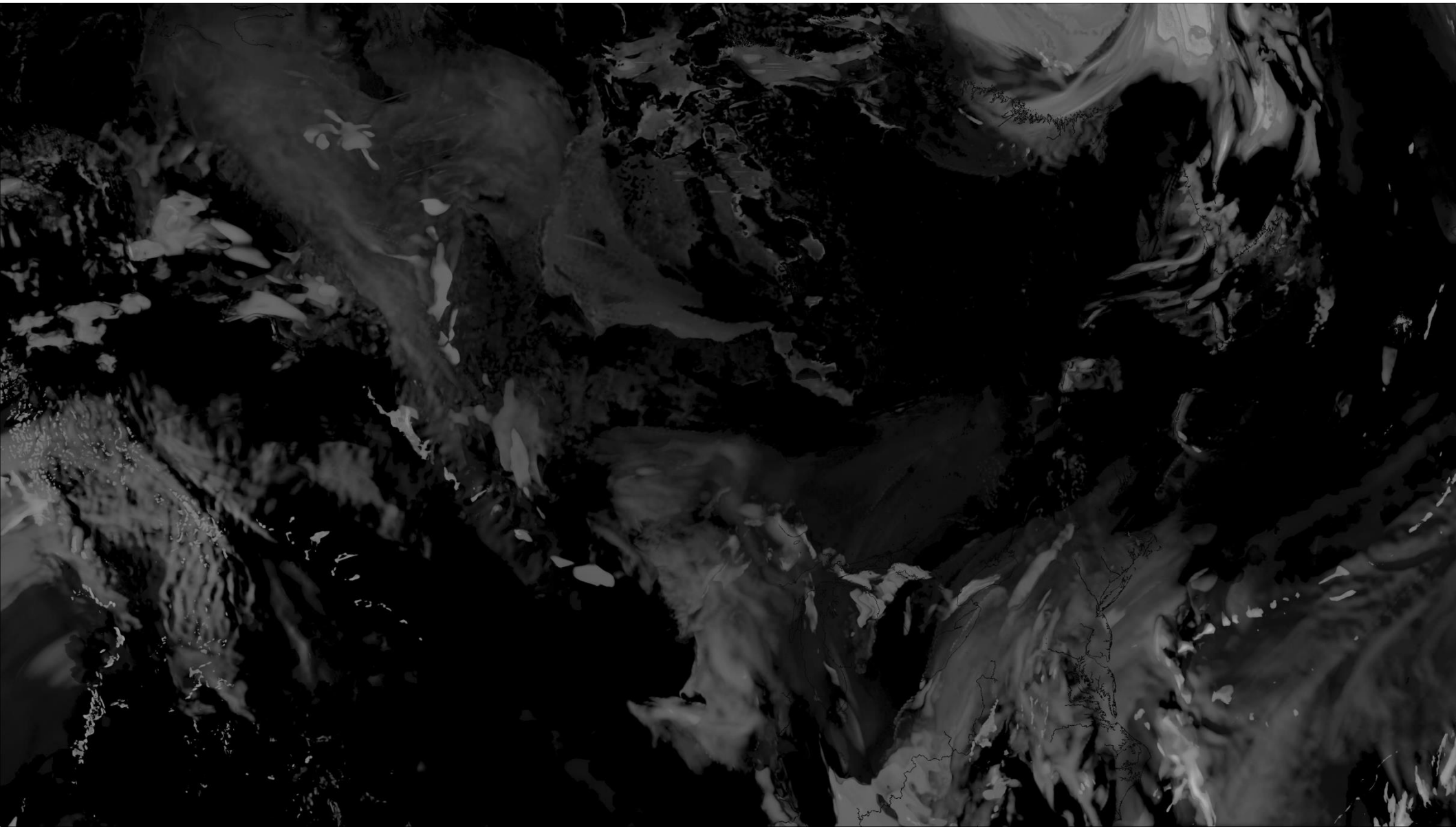
Grd_ni = 12022, Grd_nj=6162

Resolution = 0.00480 degrees (533.33 metres)

- **Alberta Clipper low: initialized at 1200 UTC 26 Jan 2015**
- **48 hour forecast , time step = 12 sec**
- **Wall clock = 16hrs**
- **Processor Topology : (188 x 151 x 1)**
- **Total CPUS = 28388 (789 nodes)**



National LAM grid (533m), 48H forecast : 1200 UTC Jan. 26, 2015
(ZEC) Maximum Equivalent Radar Reflectivity, (PR) 15 min Accumulated Precipitation



LU_ZEC+PR_4K.mp4

Thank-you

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