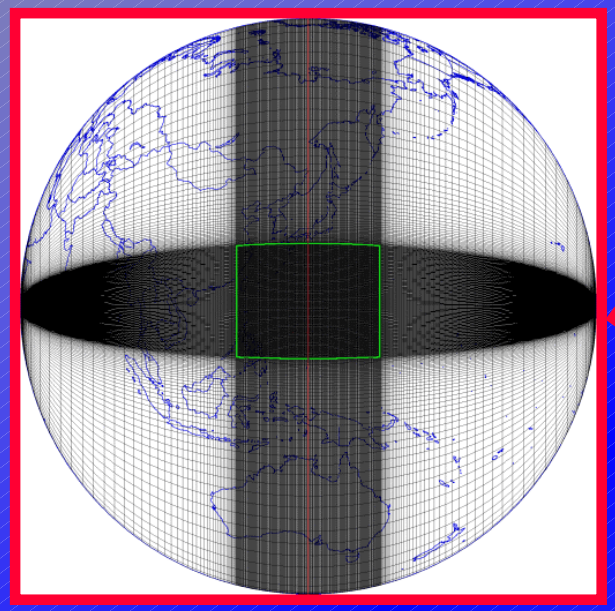
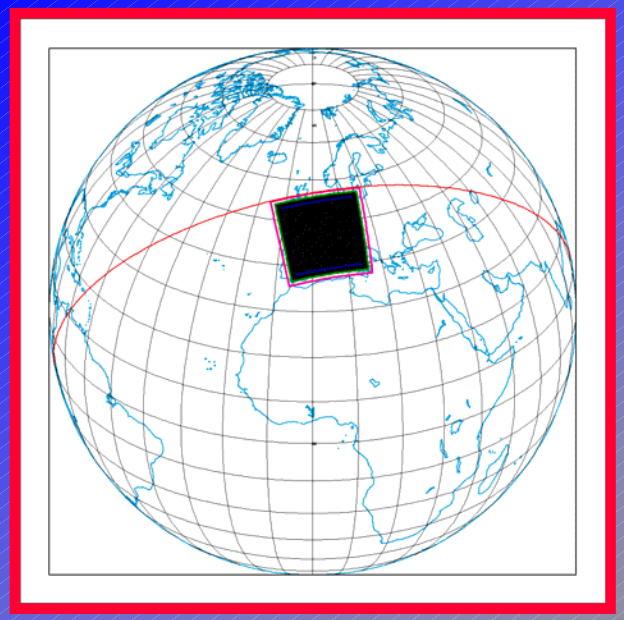
Limited Area Modelling with GEMDM

M. Desgagné, V. Lee

Recherche en Prévision Numérique
Environment Canada - MSC/RPN





RPN

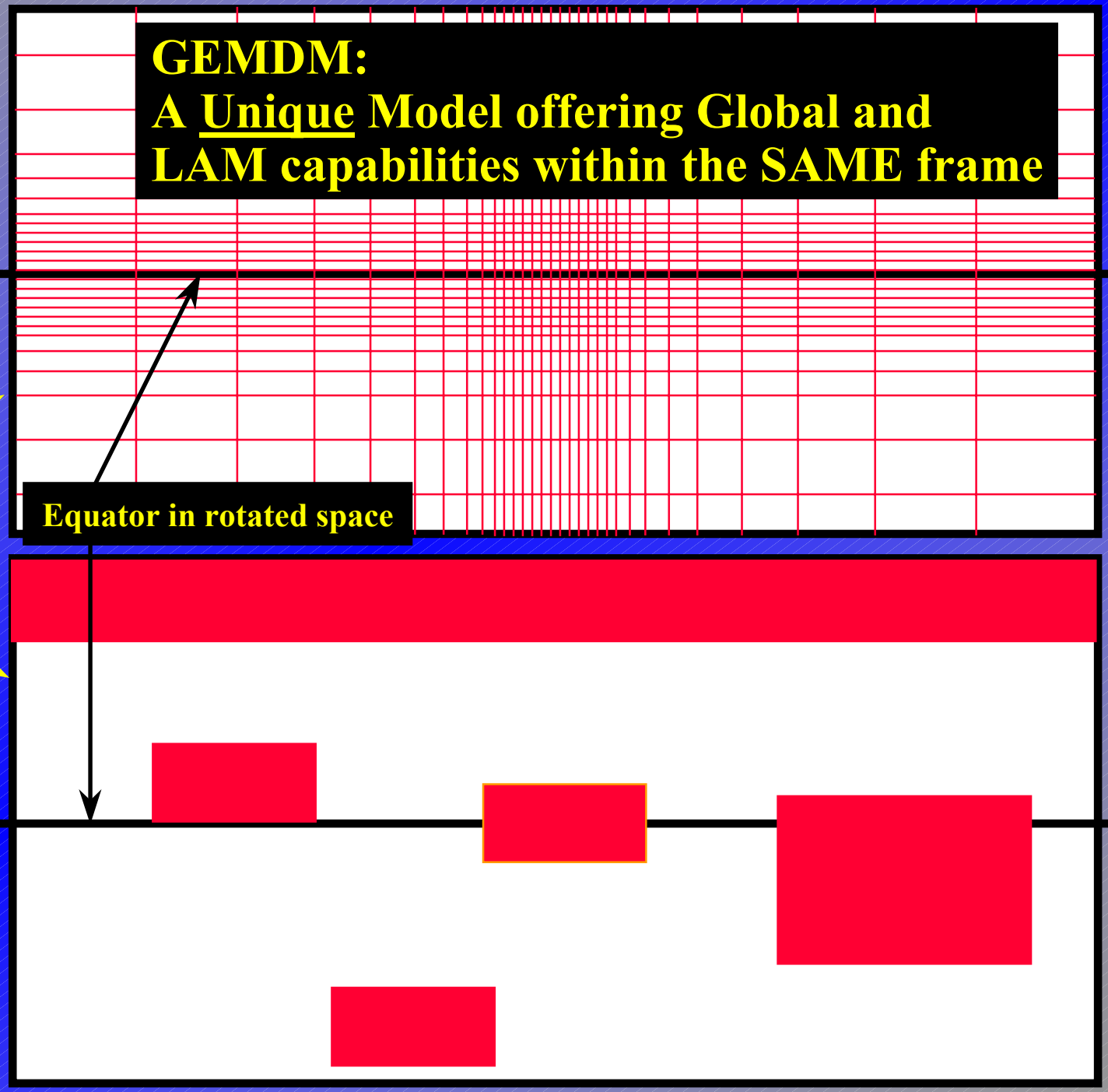
Environment Canada - MSC (formerly AES)

GEMDM:
A Unique Model offering Global and LAM capabilities within the SAME frame

Variable Resolution

Global Domain

LAM

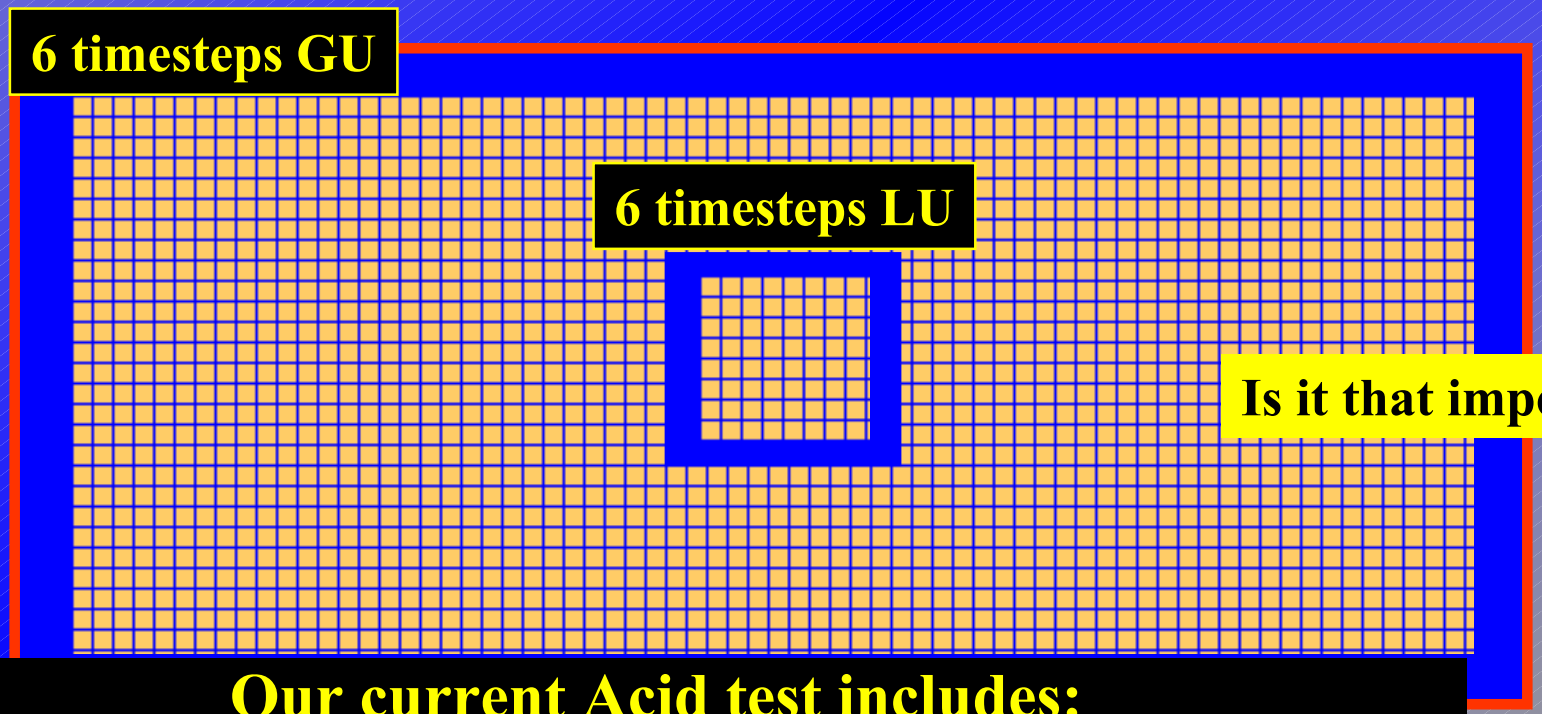


An Acid Test for LAM

Regional Modelling: A Theoretical Discussion

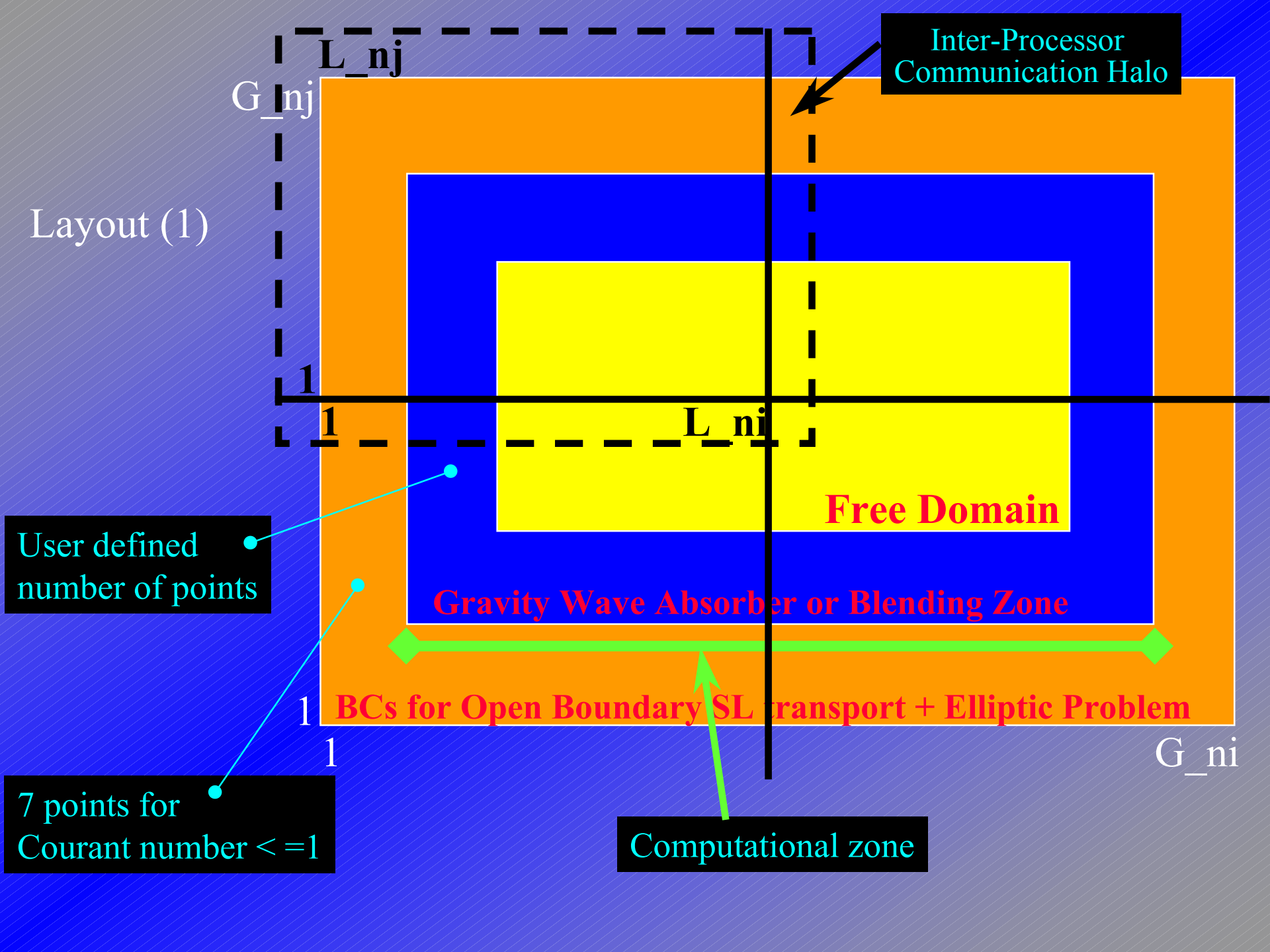
A. Staniforth, 1995 (Meteor. Atmos. Phys.)

At same horizontal and temporal resolution, how well can a LAM reproduce the solution of a large domain on any smaller subdomain

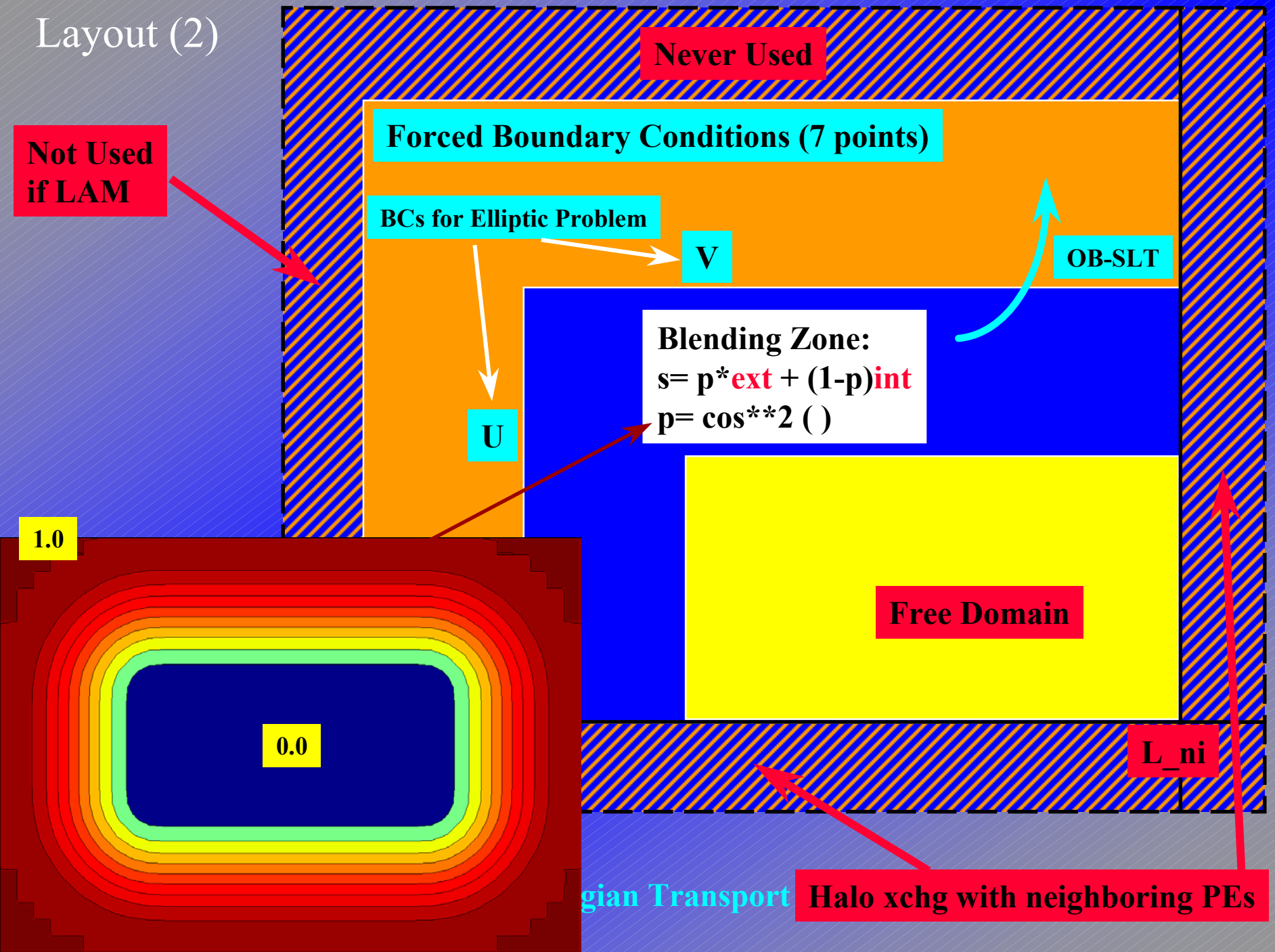


Our current Acid test includes:
The whole diabatic kernel + horizontal diffusion

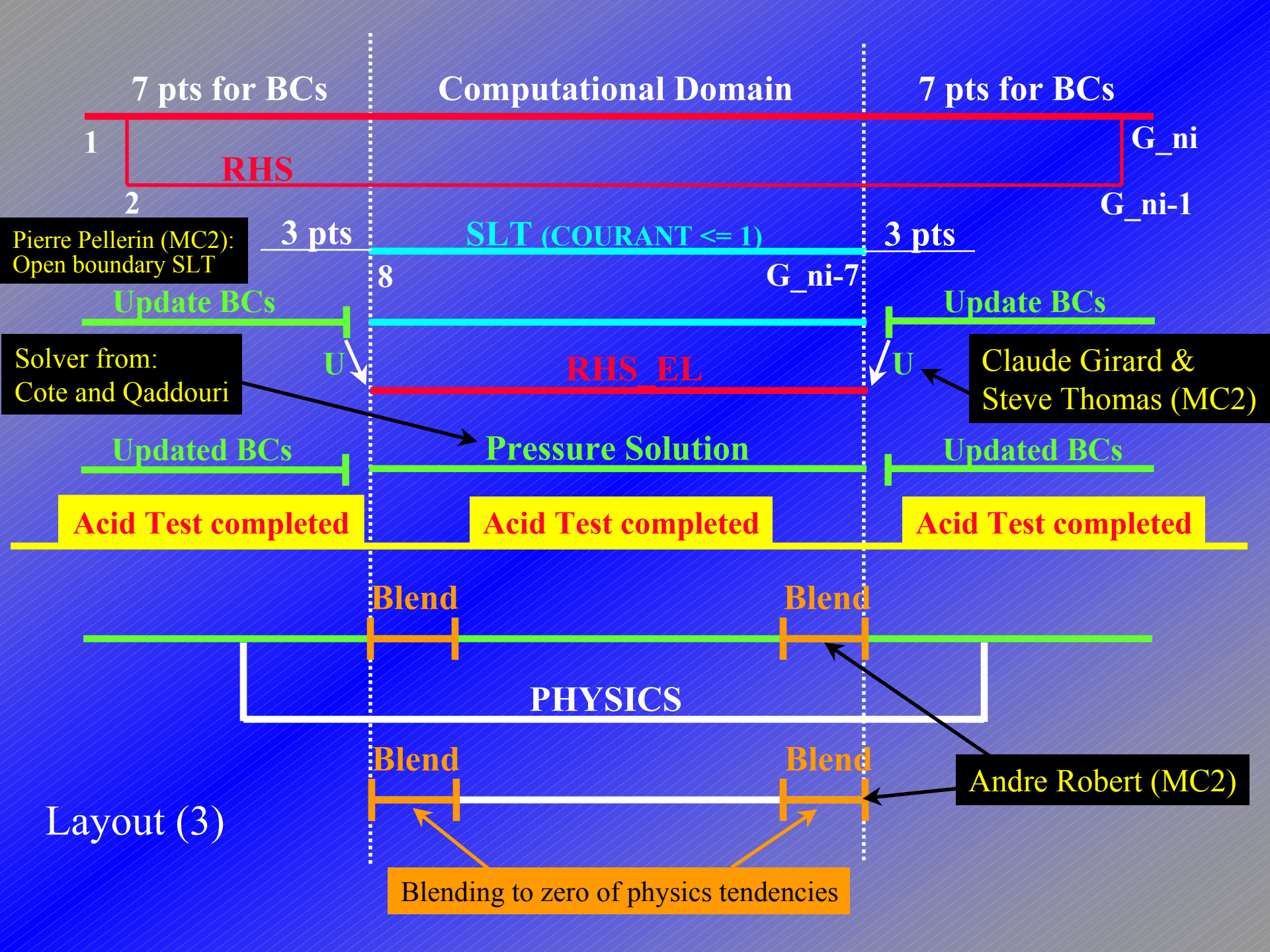
Layout (1)


L_nj
G_nj
Inter-Processor
Communication Halo
1
1
L_ni
Free Domain
User defined
number of points
Gravity Wave Absorber or Blending Zone
1
BCs for Open Boundary SL transport + Elliptic Problem
1
G_ni
7 points for
Courant number < =1
Computational zone

Layout (2)



gian Transport


7 pts for BCs
Computational Domain
7 pts for BCs
1
RHS
G_ni
2
G_ni-1
Pierre Pellerin (MC2):
Open boundary SLT
3 pts
SLT (COURANT <= 1)
3 pts
8
G_ni-7
Update BCs
Update BCs
Solver from:
Cote and Qaddouri
U
RHS_EL
U
Claude Girard &
Steve Thomas (MC2)
Updated BCs
Pressure Solution
Updated BCs
Acid Test completed
Acid Test completed
Acid Test completed
Blend
Blend
PHYSICS
Blend
Blend
Andre Robert (MC2)
Layout (3)
Blending to zero of physics tendencies

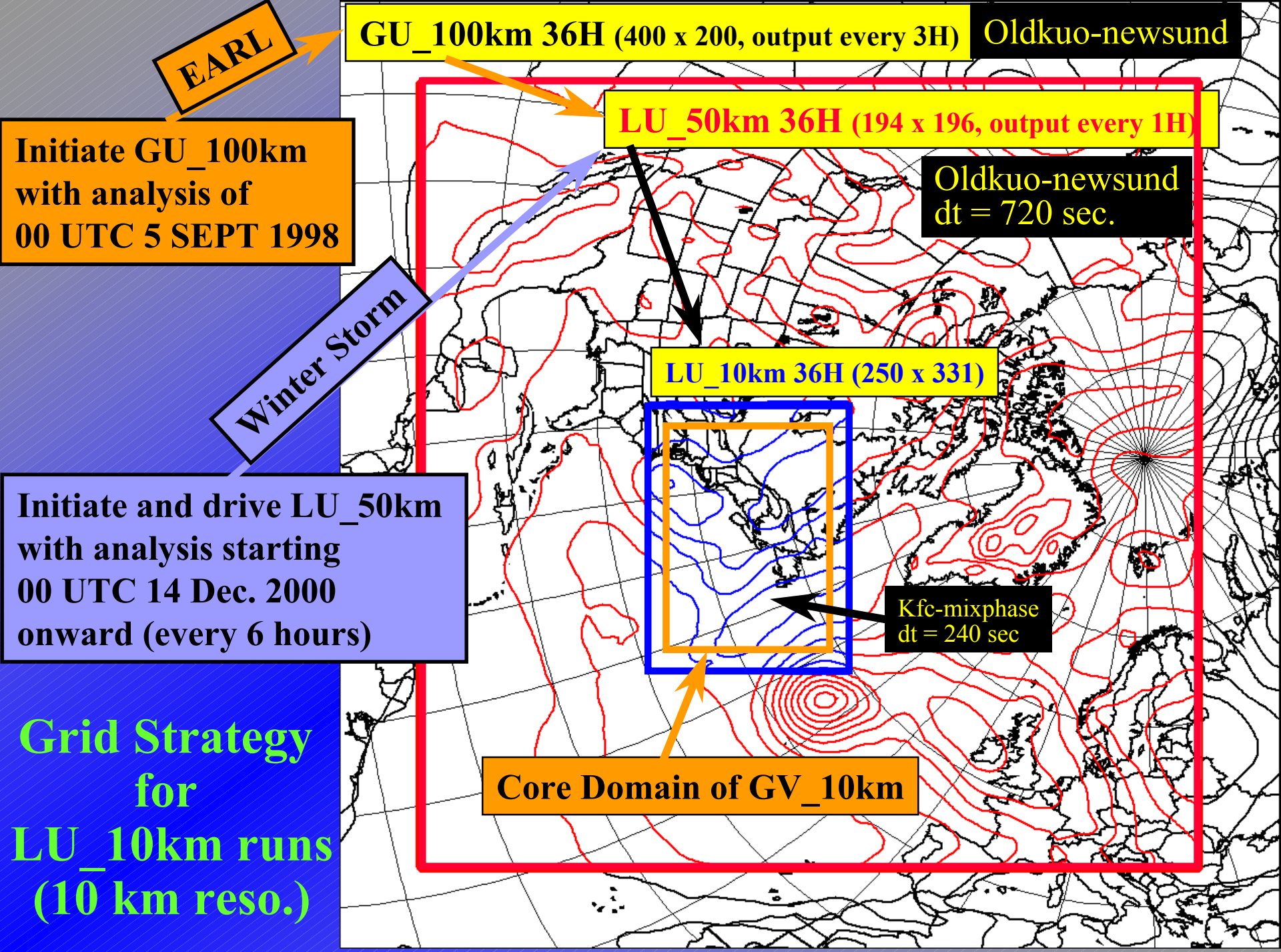
Launching a LAM configuration: user perspective

LAM config

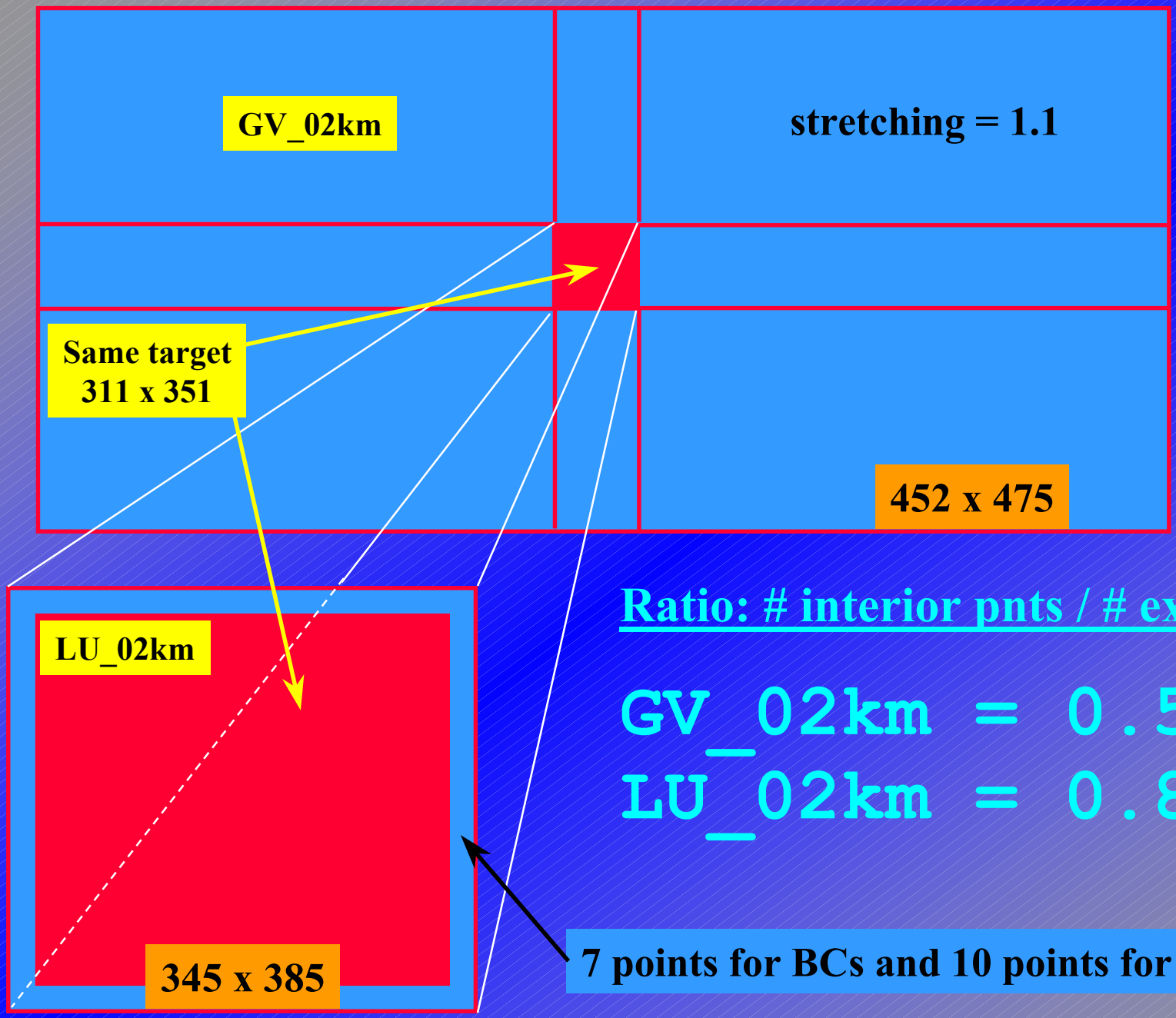
```
&grid
 Grd_typ_S='LU', Grd_ni=250, Grd_nj=331,
 Grd_iref= 125, Grd_jref= 166,
 Grd_latr= 0.  , Grd_lonr= 180.,

 Grd_dx=0.09, Grd_dy=0.09,
 Grd_xlon1=-62., Grd_xlat1=45., Grd_xlon2=100., Grd_xlat2=45.,
 Grd_roule=.true.

&gement
 Pil_runstrt_S = "19980905.000000", Pil_nesdt = 3600
 Hblen_momentx = 10,   Hblen_tx  = 10,
 Hblen_massx   = 10,   Hblen_trx = 10,
```

Variable resolution config

```
&grid
 Grd_typ_S='GV', Grd_ni  = 353, Grd_nj  = 415,
                 Grd_nila= 216, Grd_njla= 297,

 Grd_dx=0.09, Grd_dy=0.09,
 Grd_xlon1=-62., Grd_xlat1=45., Grd_xlon2=100., Grd_xlat2=45.,
 Grd_roule=.true.
```


EARL
GU_100km 36H (400 x 200, output every 3H)
Oldkuo-newsund
Initiate GU_100km
with analysis of
00 UTC 5 SEPT 1998
LU_50km 36H (194 x 196, output every 1H)
Oldkuo-newsund
dt = 720 sec.
Winter Storm
LU_10km 36H (250 x 331)
Initiate and drive LU_50km
with analysis starting
00 UTC 14 Dec. 2000
onward (every 6 hours)
Kfc-mixphase
dt = 240 sec
Core Domain of GV_10km
Grid Strategy
for
LU_10km runs
(10 km reso.)

Timings (1)



Ratio: # interior pnts / # exterior pnts

```
GV_02km = 0.51
LU_02km = 0.86
```

Comparative Timings for 2 km resolution runs on SX6

	345 x 385 1080 steps	345 x 385 2160 steps	338 x 385 1080 steps	452 x 475 1080 steps
	GEM LAM	MC2	GEM FFT-LAM	GEM VAR
CPU (hours)	34.0	28.7	**25.7**	**53.7**
FC (E+12)	**198.2**	**145.7**	119.0	394.8
Gflops/sec	1.6	1.5	**1.3**	**2.06**
Vector length	160	176	153	207
Mem (Gbytes)	11.5	7.4	9.0	11.8

Remaining differences between GEM and MC2

	GEM	MC2
Time discretization	2 time level fully implicit	3 time level semi-implicit
Pressure solver	direct solver on nk planes	iterative fully 3D solver
Vertical coordinate	mass no-staggering	height Charney-Phillips staggering
SLT	1 set of trajectories	3 sets of trajectories
Change grid	mostly cubic	strictly linear
Physics interface	4 basic tendencies + 6 derivates including a heat term on mass fields	4 basic tendencies
Prognostics variables	14: 6 basics + 5 derivates + 3 pertub.	6
Topography	fixed	time dependent at startup

THE END

Thank You !

Environment Canada