



Early Experiences with IBM p775 and ENDGame

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Met Office



IBM p775

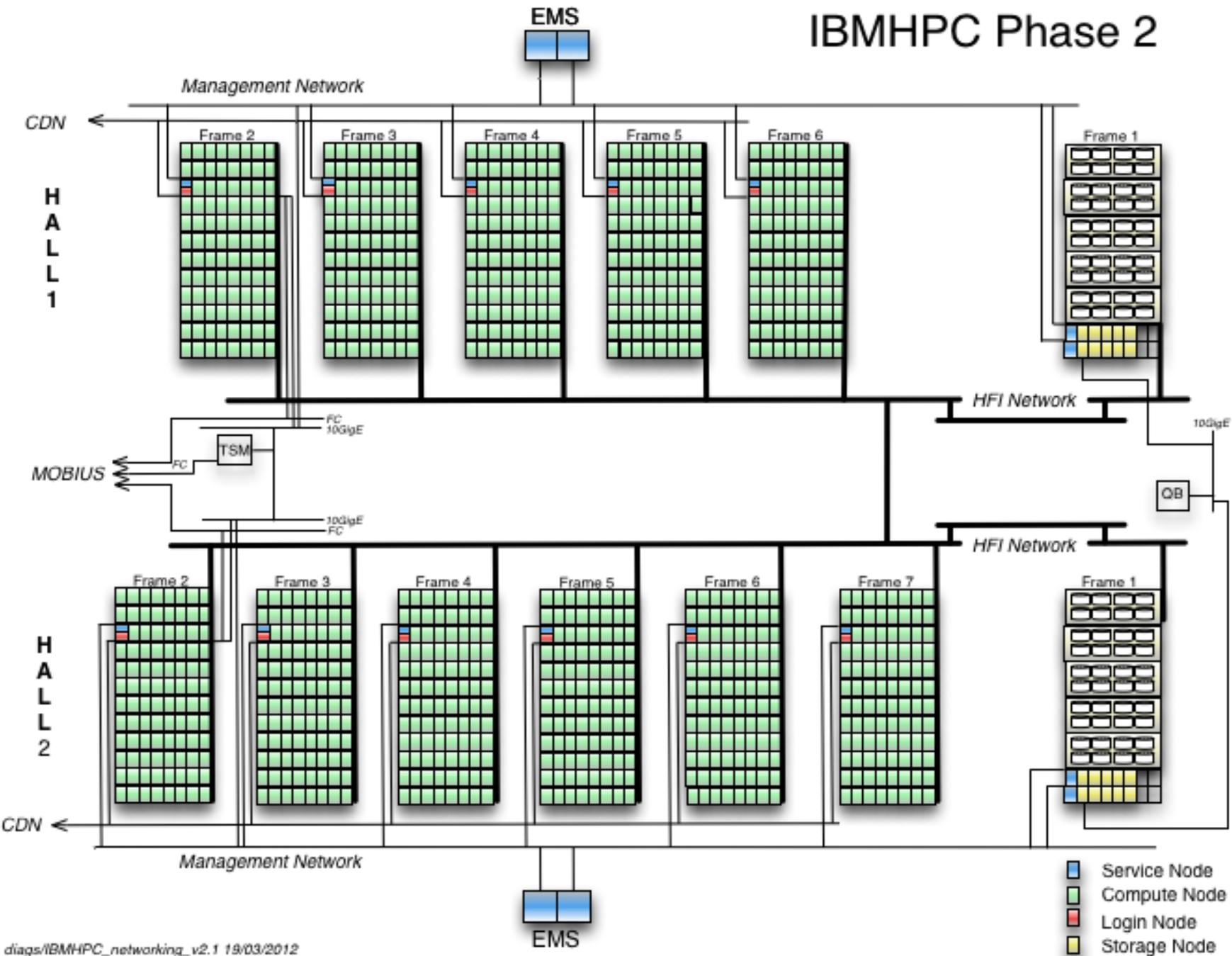


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Facts & Figures

	IBM Power 6 1E+1F+1C	IBM Power7 2E+2F+2C	Factor
<i>Peak Performance per node (GFLOPS)</i>	600	960	1.6
<i>Number of Nodes</i>	247	1216	4.9
<i>Number of Cores</i>	7904	38912	4.9
<i>Total Peak Performance (TFLOPS)</i>	150	1166	7.8
<i>Total Disk (TBytes)</i>	750	1500	2
<i>Disk Performance (GB/s)</i>	24	48	2
<i>Power (Mwatts)</i>	1.2	2.5	2.1
<i>MFLOPS/Watt</i>	96	370	3.9

IBM HPC Phase 2









PS29 v PS30 – 26th April 2012

UM Task	PS29 Power 6	PS30 Power 7	Improvement
QG00 Global	3580	3400	5%
QU00 Gbl Update	530	429	19%
QY00 NAE	856	767	10%
Q403 UK4	1439	1165	19%
QV09 UKV	3874	3292	15%



AQUM Suite

Task	PS29 Power 6	PS30 Power 7
Reconfigure	8:43	3:36
Fieldcalc	28:28	10:26
MakeBC	24:27	9:17
Create Dump	0:59	0:30
UM	48:09	35:08
Archive	0:58	0:19
Total	1hr 58min	0hr 59 min



Acceptance and beyond

- Power 7 clusters accepted - end August 2012
- Operational – 17th September
- Power 6 all powered down by 26th September

- OJEU PIN issued for successor system
- Aiming for operations in 2015

- 2 stage RAPS release
 - 1st N1024 global ENDGame + I/O Server
 - Full set of benchmarks ready for procurement



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Operational Models



Primary NWP Models in Operational Suite: Sep 2012

Global

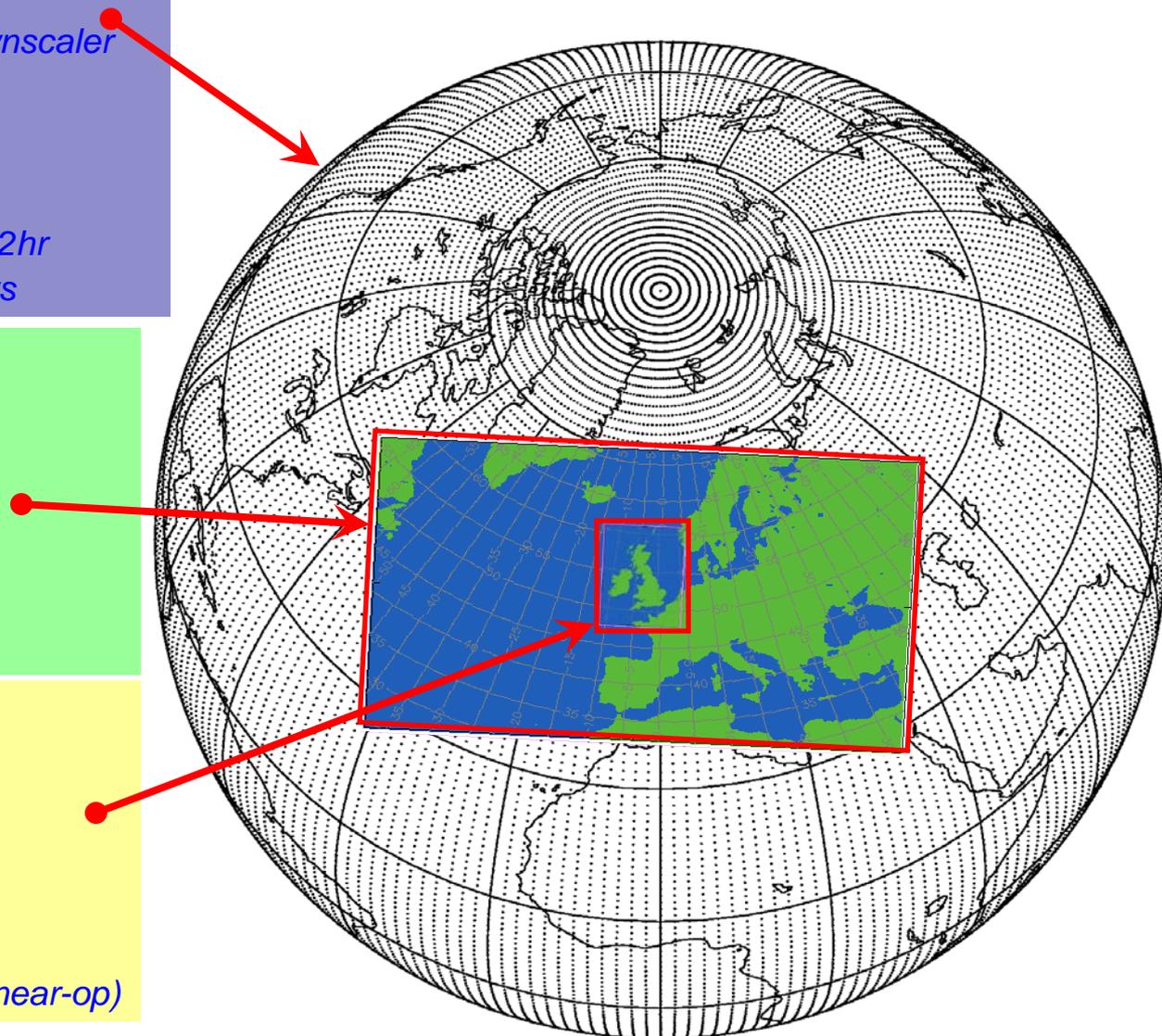
- 25km 70L + UK4 as dynamic downscaler
- with Hybrid 4DVAR at 60km
- 66hr forecast twice/day
- 144hr forecast twice/day
- +12 member EPS - 60km 4x/day 72hr
- & 24 member EPS 2x/day to 15days

NAE

- 12km 70L
- 4DVAR – 24km
- 60hr forecast
- 4 times per day
- +12member EPS at 18km 4x/day

UK-V (& UK-4)

- 1.5km 70L
- 3DVAR (3 hourly)
- 36hr forecast
- 4 times per day
- +12member EPS at 2.2km 4x/day (near-op)





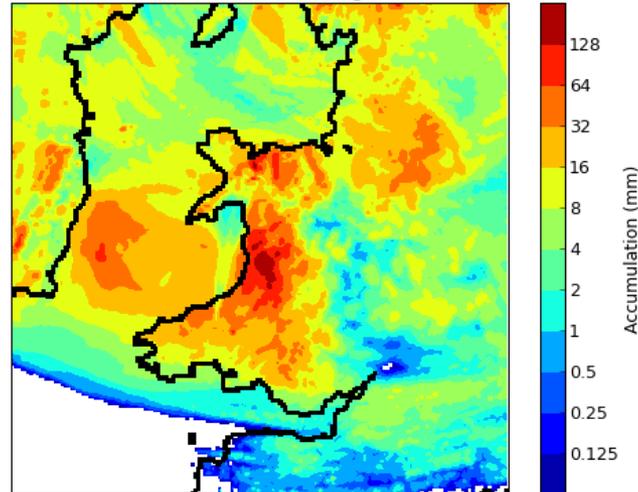
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First Results: 2.2km UK Ensemble

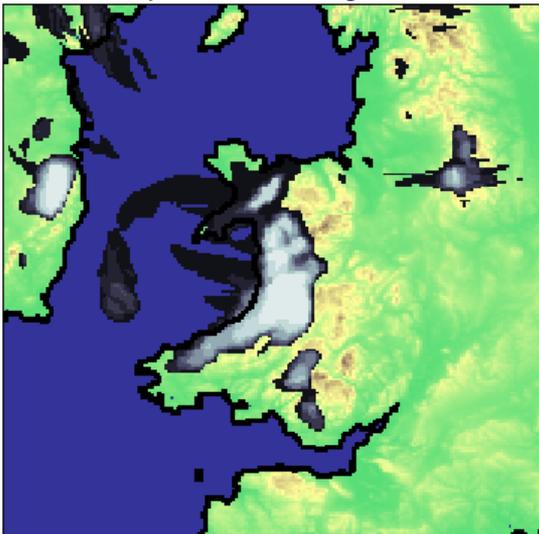
Probability of Exceeding precipitation thresholds

9th Jun 2012

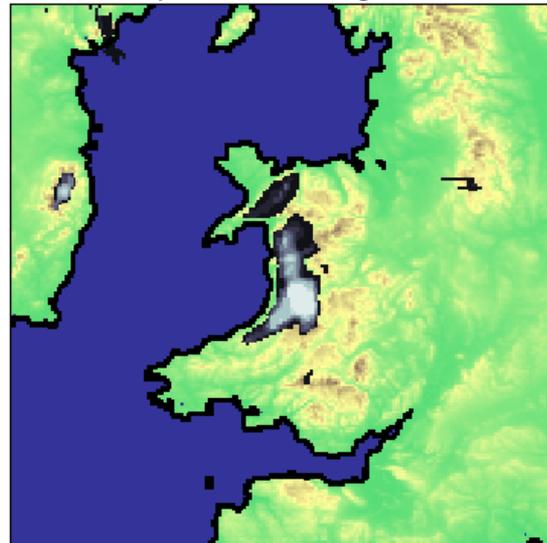
Radar 24 hr Accumulation, ending 08Z 09/06/12



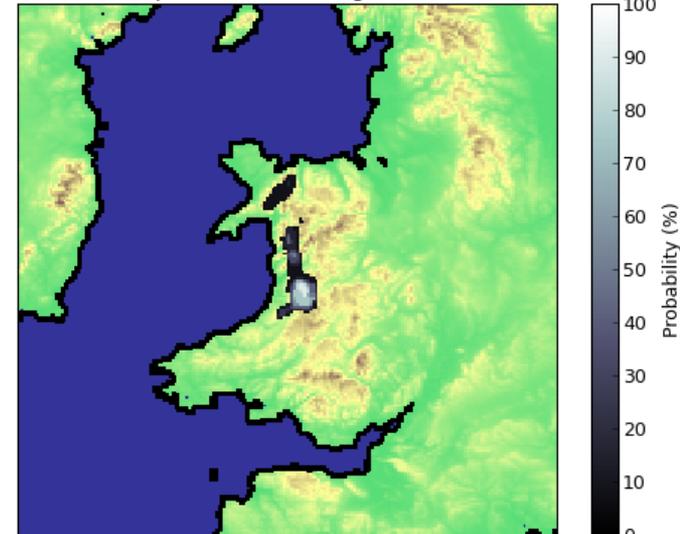
MOGREPS-UK prob. of exceeding 32.0 mm accum.



MOGREPS-UK prob. of exceeding 64.0 mm accum.



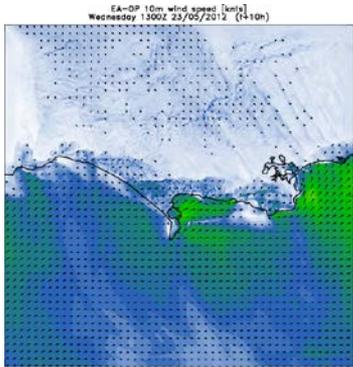
MOGREPS-UK prob. of exceeding 100.0 mm accum.



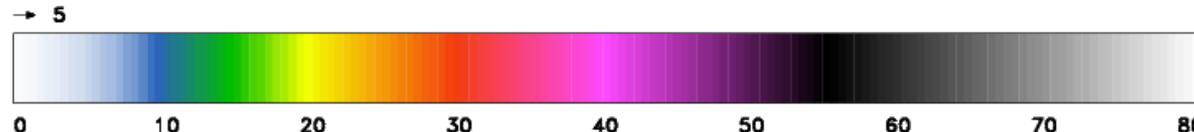
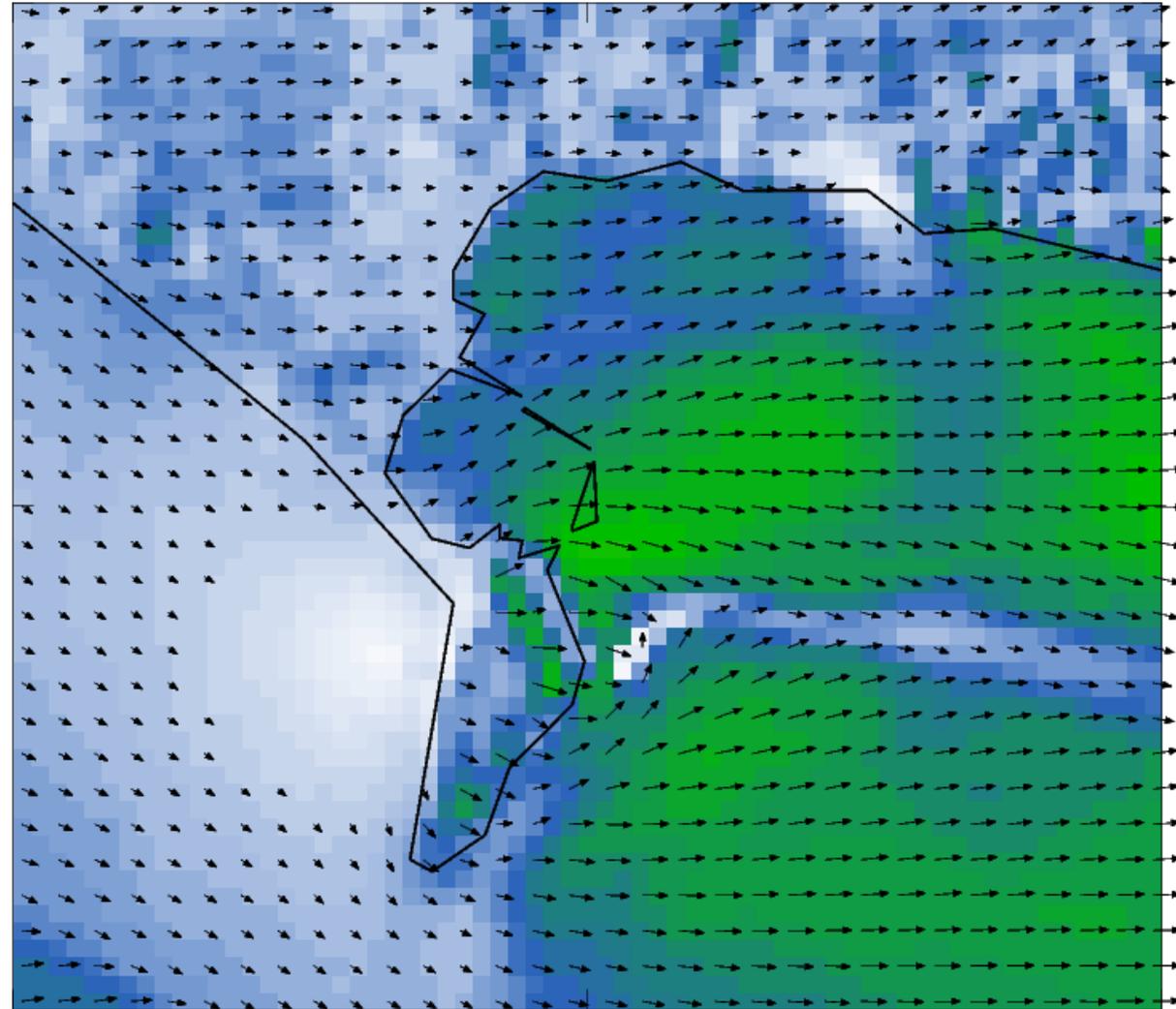


Weymouth Bay 300m - Zoom

- **London 2012** Yachting Support
- **Capability Demonstration**
- **300m** resolution
- **100km*100km** domain
- Plus **250m SWAN** Wave model

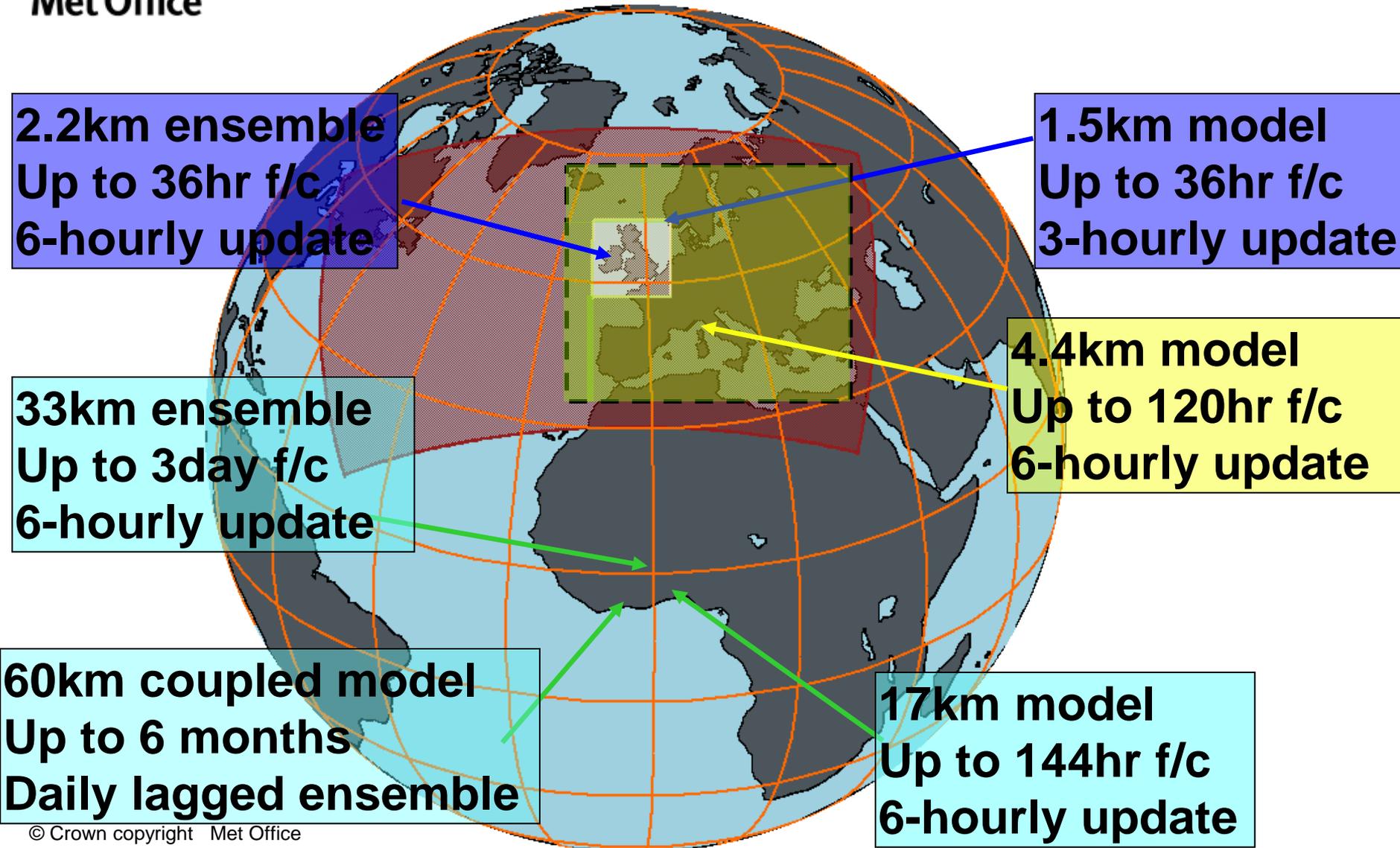


Weymouth 10m wind speed [knts]
Wednesday 1800Z 23/05/2012 (t+15h)





2013 Primary Modelling Suites



2.2km ensemble
Up to 36hr f/c
6-hourly update

1.5km model
Up to 36hr f/c
3-hourly update

33km ensemble
Up to 3day f/c
6-hourly update

4.4km model
Up to 120hr f/c
6-hourly update

60km coupled model
Up to 6 months
Daily lagged ensemble

17km model
Up to 144hr f/c
6-hourly update



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ENDGame



Why ENDGame?

- Build on foundations of New Dynamics
- Aims are:
 - Improved robustness
 - Improved accuracy
 - Maintain/improve conservation
- While maintaining/improving efficiency

⇒ Accuracy/Robustness/Scalability

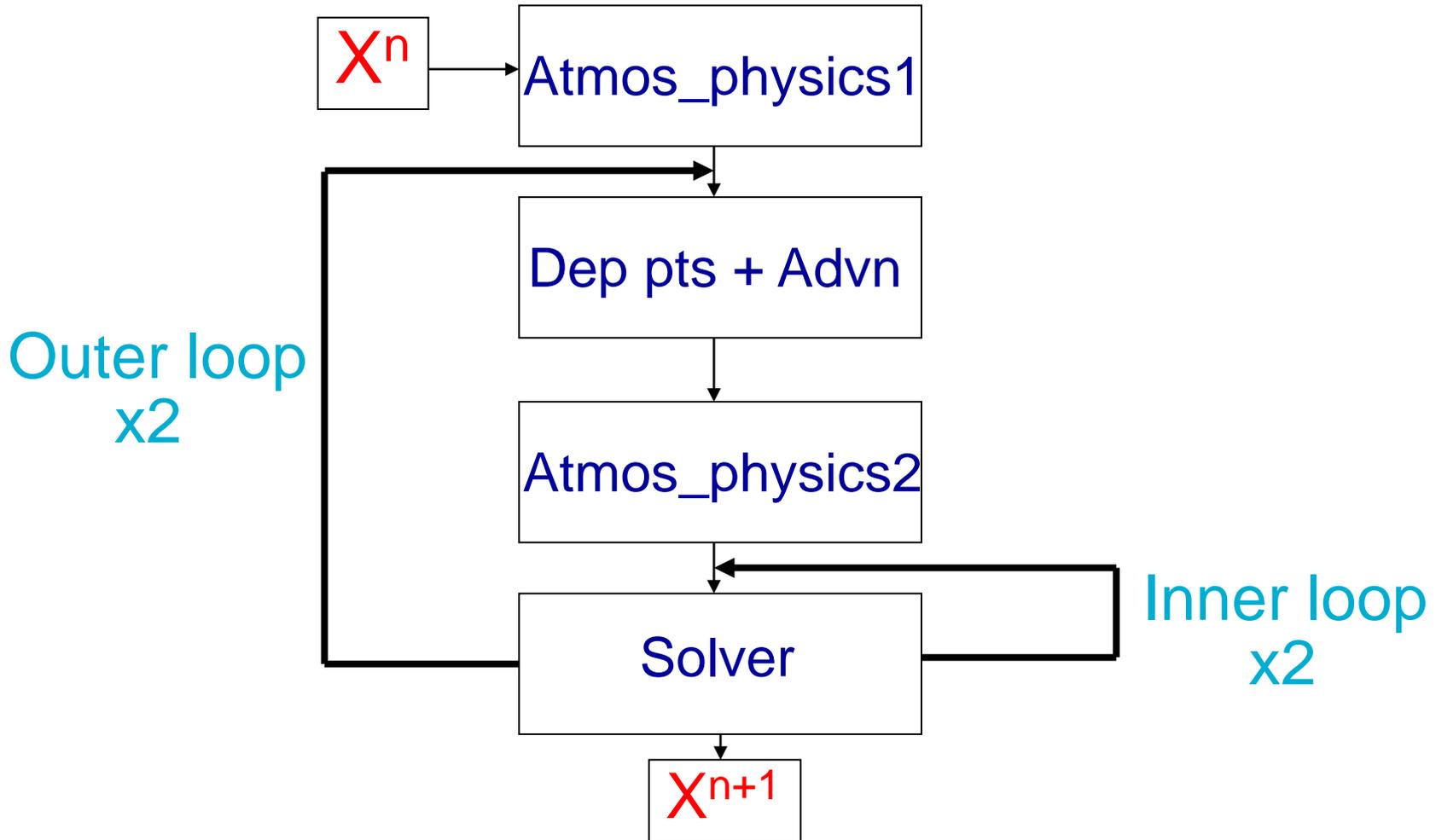


What has *not* changed?

- Evolution of New Dynamics
 - Same equation set & dry variables (θ - π)
 - Same horizontal staggering (Arakawa C-grid)
 - Same vertical staggering (Charney-Phillips)
 - Semi-implicit semi-Lagrangian

- Physics and DA unchanged

Iterative solution





Result of iteration (1)

- Resolves number of New Dynamics issues:
 - Non-interpolating in the vertical for theta advection **Removed**
 - Explicitly handled vertical Coriolis terms **Removed**
 - Extrapolated trajectory calculation **Removed**

⇒ Improved robustness



Result of iteration (2)

- Allows much simpler Helmholtz problem (7 point stencil cf. 45 point)
 - Much simpler (red/black SOR) preconditioner
⇒ greatly reduced communications
- ⇒ Improved scalability



Further Changes

- Same SL advection for all variables
 - Cf. New Dynamics = forms of SL for all, except Eulerian for dry density

⇒ Improved robustness

- Coriolis terms based on mass flux variables
 - improved Rossby mode propagation

⇒ Improved accuracy



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More Changes

- No polar filtering or horizontal diffusion
 - Control near lid and poles achieved by implicit damping of W

⇒ Improved scalability and accuracy

- V-at-poles (cf. u , w and all scalars)
 - Not solving Helmholtz problem at singular point of grid!
 - And improved energy properties

⇒ Improved scalability and accuracy



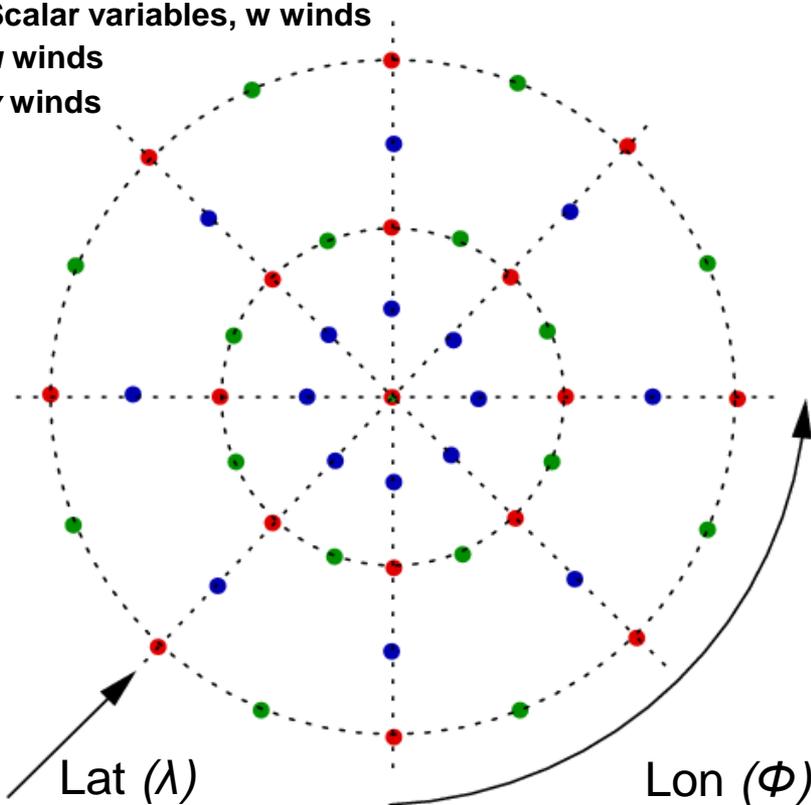
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V vs. U-at-poles

A “trivial” change to model grid!

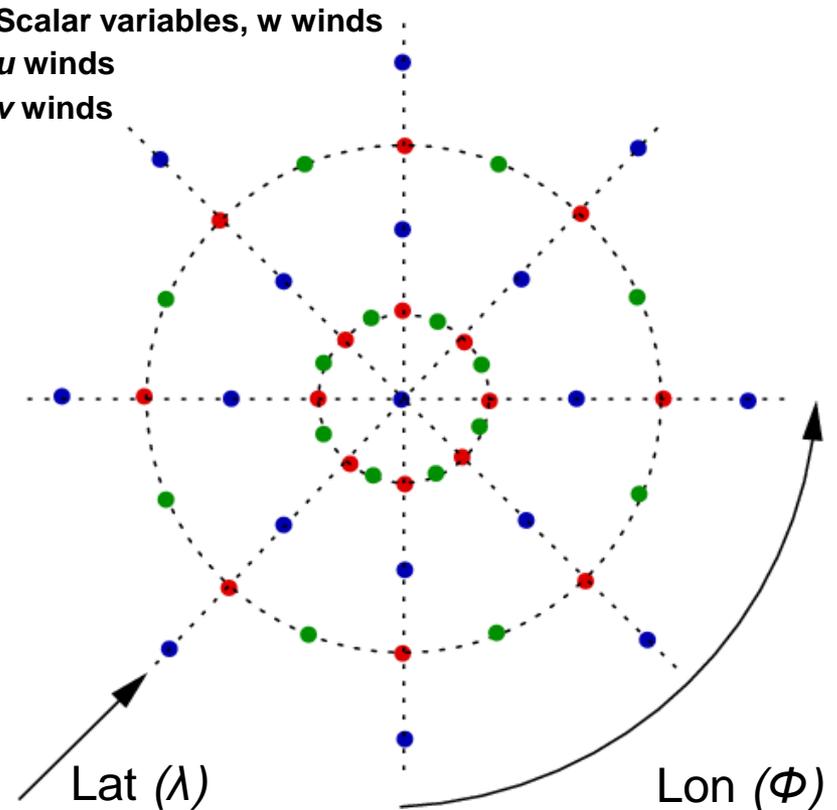
Current “New Dynamics” grid

- Scalar variables, w winds
- u winds
- v winds



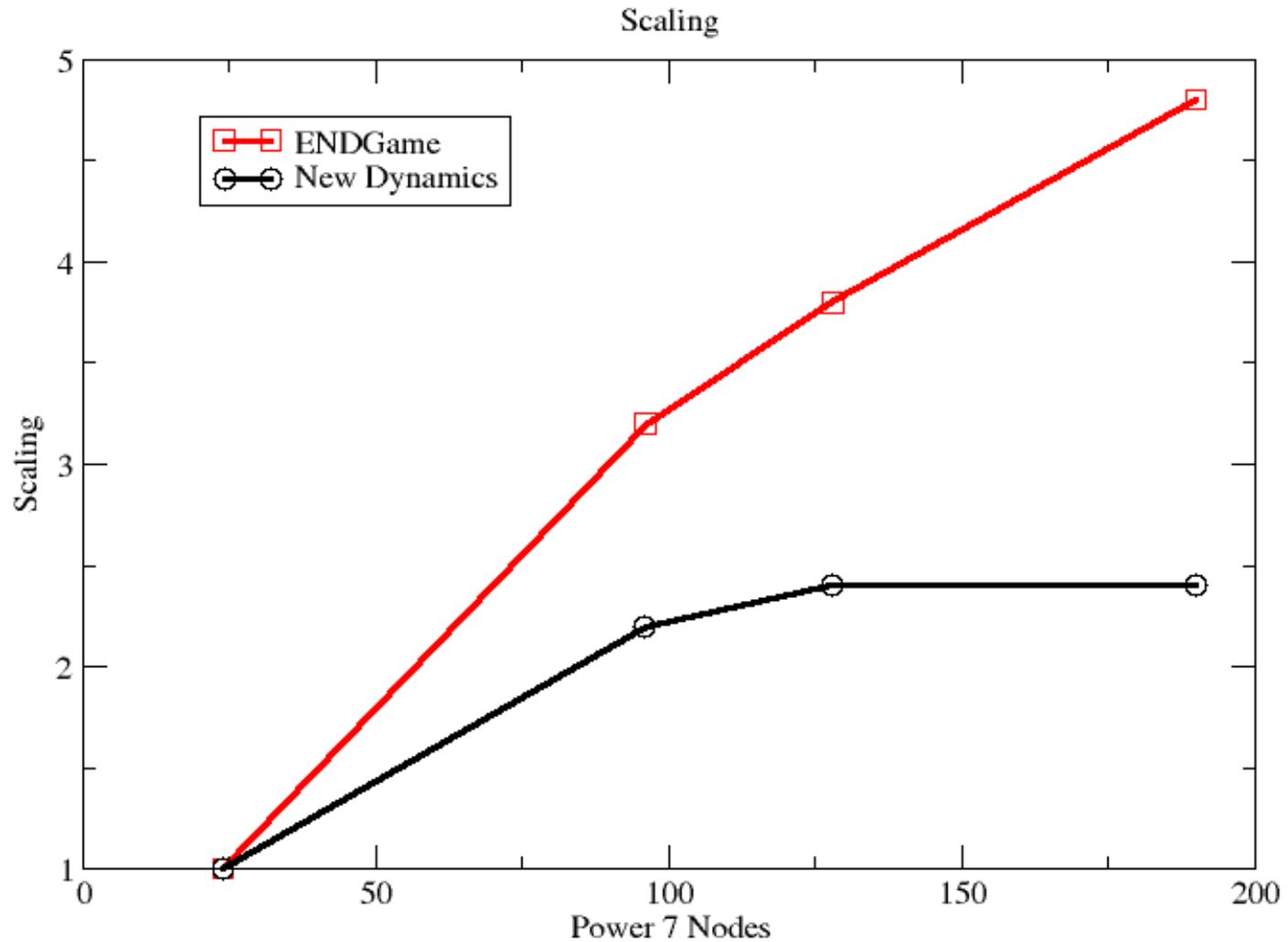
ENDGame grid

- Scalar variables, w winds
- u winds
- v winds



ENDGame scalability

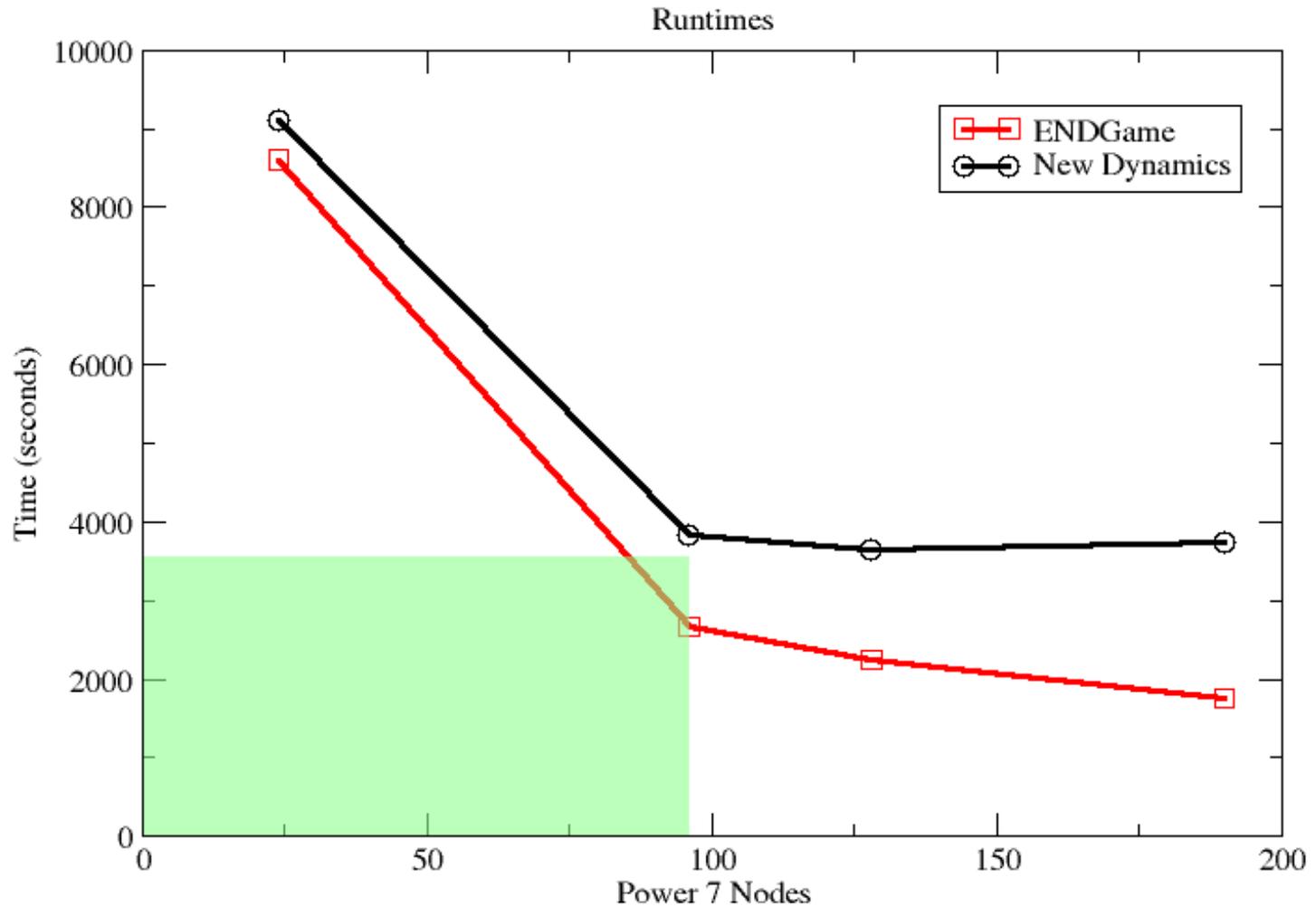
N768 - New Dynamics vs ENDGame





ENDGame Runtimes

N768 - New Dynamics vs ENDGame





Questions and answers