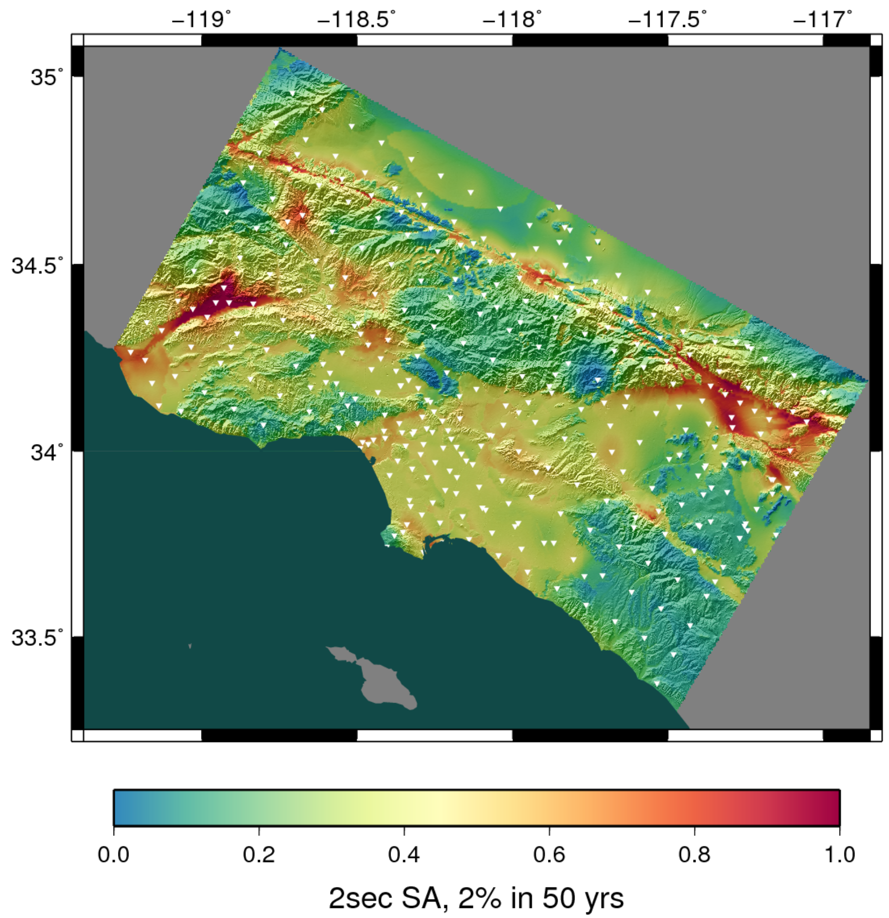
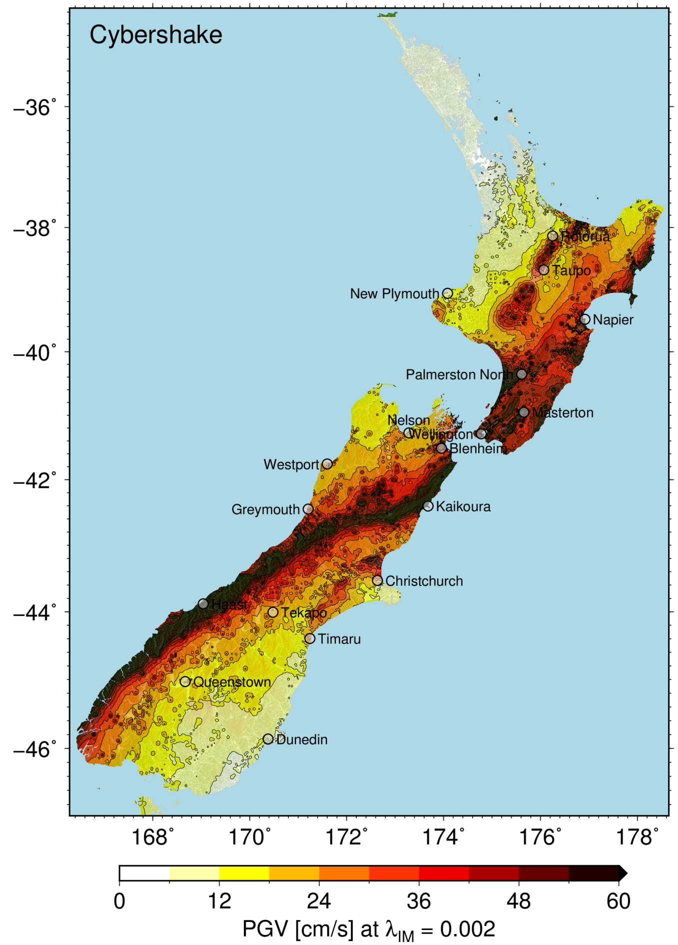
Comparison of SCEC and QuakeCoRE Cybershake





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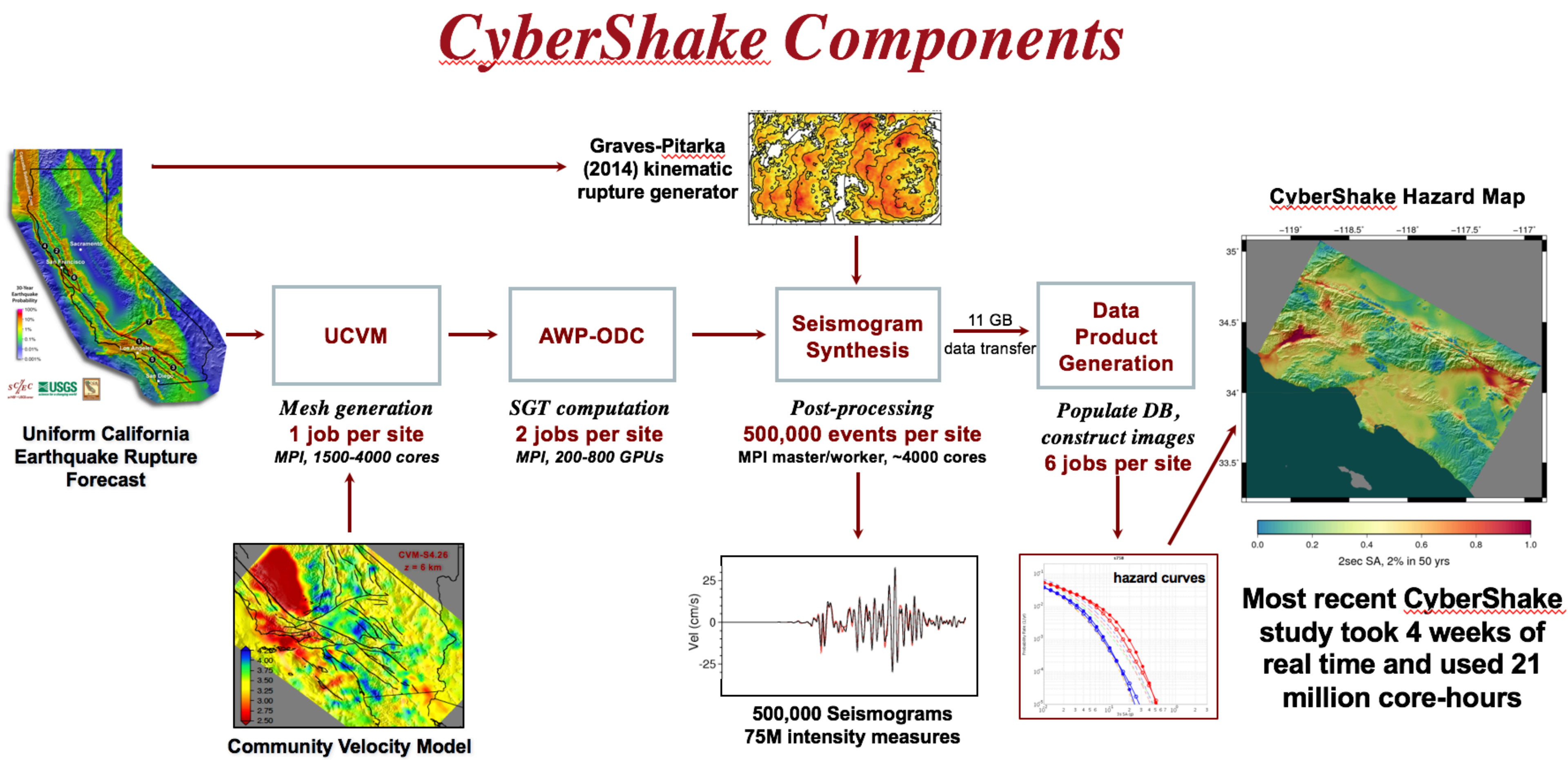
History

- ‘Cybershake’ concept (PSHA using physics-based ground motions) pursued by SCEC since 2007.
  - 14 versions over the past decade
  - Most focus on Sth Cal, but last few versions extended to Central and Nth Cal.
- QuakeCoRE Cybershake v18.5 is first full version (after internal v17.9 and v18.4); Aiming to learn from 10 years of SCEC efforts to set a platform that allows rapid scaling in terms of Cybershake products

Components are similar, computational scale currently 10^2 different!



Simulation details comparison

Detail	SCEC (v17.3/18.3)	QuakeCoRE (v18.5)
Rup generator	Graves and Pitarka (2010, 2015, 2016)	
LF Wave propagation	AWP-ODC (Olsen et al)	EMod3d (Graves et al)
HF simulation	Simplified physics 'stochastic' method	
Number of ruptures	~500,000 (UCERF2 2007)	~3,000 (NZ ERF 2010)
Source uncertainties	Hypocentre (along strike and dip), slip realization	Hypocentre (along strike only), slip realization
Velocity model	3D refined by F3WT	3D
Number of stations	~500 + 800 = 1,300	~20,000
Forward/ reciprosity	Reciprosity (fixed domain)	Forward (domain varies)
Cybershake use focus	Hazard maps only	Site-specific hazard and time series for engineering use
LF/HF transition frequency	1.0Hz	0.25Hz
Number of seismograms	~285M	~60M
Core hours	21M	~0.1M
Archived data	10TB	1TB
Background seismicity	No (for 17.3), Yes (for 18.5)	Yes
Subduction sources?	No	No

Comparison

	SCEC	QuakeCore
Velocity model	UCVM	NZVM
Fault generation	PreAWP code seems to do this	SRF generation
Numerical codes	AWP-ODC-SGT (both for CPU and GPU). They have the choice to run deterministic or stochastic	EMOD3D, runs deterministic and stochastic parts only
Post-processing	- CheckSGT - DirectSynth (https://scec.usc.edu/scecpedia/DirectSynth)	IM post-processing to be ported to run on Mahuika
Indexing	Adding their data to their MySQL DB.	Would be something like preparing the SeisFinder metadata for the version run.
Orchestration	Pegasus	None yet.
Hardware	At least 2 supercomputers are mentioned: - Titan (lots of GPUs) - BlueWater (preferred for PP)	Right now only Kupe. Hoping to use both Maui (numerical simulation) and Mahuika (IO intensive jobs).
File transfer	Globus	SCP or RSYNC. Globus once NeSI proposes that service.
Hazard and deaggregation	OpenSHA based codes.	In-house code, with similar usage as theirs.

Simulation details comparison

- Perceived weaknesses of both:
  - Extent of source uncertainty treatment: Only considering hypocentre location and slip realization
  - Some (limited) validation clearly shows that these uncertainties are insufficent to explain variation between simulations and observation
  - Other uncertainties: Average Vrup; correlation between slip, rake, rise time

Simulation details comparison

- Perceived weaknesses of both:
  - Use of uniform mesh LF computations (Scott mentioned plans to use DG SGT code)
  - Plasticity, frequency-dependent Q
  - Crustal model uncertainties (e.g. Vs pertubations)
  - All of which are important for f>1Hz LF
    - (handling of reciprocity with plasticity)

Predictive capability over time