

An aerial photograph of a city, likely San Francisco, showing a mix of residential and commercial buildings. A large orange banner is overlaid across the middle of the image, containing the title 'ShakeMap Software' in yellow text.

# ShakeMap Software



Kuo-Wan Lin & Bruce Worden  
U. S. Geological Survey, Golden, CO

# Software Overview

- Freely available, open-source package
- A collection of modules written in Perl
- Maps are made with the Generic Mapping Tools
- File format is converted using Imagemagick
- Runtime parameters are stored in MySQL
- ShakeMap Version 3.5 released in 2010
- ShakeMap Version 4.0 in planning stages

# Operating System

- Should run under most UNIX-like systems (but avoid Ubuntu if possible)
- Current development is done/tested under both Fedora Linux/MacOS X
- Testing under Solaris x86 is contributed by Pete Lombard

# Perl and Related Modules

- Perl (>5.8.5 and 5.18.0) should work
- Try to manage Perl modules in a consistent way, CPAN or package manager
- A newer version module does not always work better, DBD::mysql is a common offender

# Generic Mapping Tools (GMT)

- ShakeMap V3.5 supports GMT 4.3, 4.4, and 4.5. GMT 5 is not supported.
- ShakeMap now uses GMT “SI” unit internally instead of “US”
- Don’ t get tripped by .gmtdefaults file
- NetCDF library is needed to run GMT
- gcc 4.x works well in compiling supporting C programs (dist\_rrupt, dist\_rx, and sm\_nearneighbor) for grind, gcc 3.4.x is not recommended

# MySQL Database

- Most versions (4.x, 5.x) should work
- Database administration skills are not required but preferred
- ShakeMap database creation and user privileges
- MariaDB is drop-in replacement on systems that don't support MySQL

# Database Management

- Interaction with the ShakeMap database is usually not required
- ShakeMap database stores event information and run time parameters
- Working directly with the database usually only needed to
  - Unlock/delete entries from run away programs
  - Consolidate run versions and parameters
  - Remove entries of old/broken events
  - Back up database

# Other Utilities and Tools

- Ghostscript
- Imagemagick/Graphicsmagick convert
- C compiler, make
- Subversion
- USGS Metadata Parser (mp)
- ssh, zip, 3-way “merge”



# ShakeMap Installation

- Get Subversion (svn) client if it is not pre-installed
- Use svn to check out the ShakeMap distribution:  
svn checkout <https://vault.gps.caltech.edu/repos/products/shakemap/tags/release-3.5/>  
local\_directory\_name
- Find SoftwareGuide.pdf in the “doc” directory
- Install necessary programs and Perl modules
- Configure and secure the MySQL database
- Configure the ShakeMap programs

# ShakeMap Installation (cont.)

- Configuration files in “config” directory. Most are self-documenting. Set up “mydb.conf” and configs for relevant programs.
- Install Vs30 grid, topography, roads, cities, etc.
- Subversion is used for future updates and bug-fixes – “svn update”
- Developers’/Operators’ Mailing List:  
<https://geohazards.usgs.gov/mailman/listinfo/shake-dev>

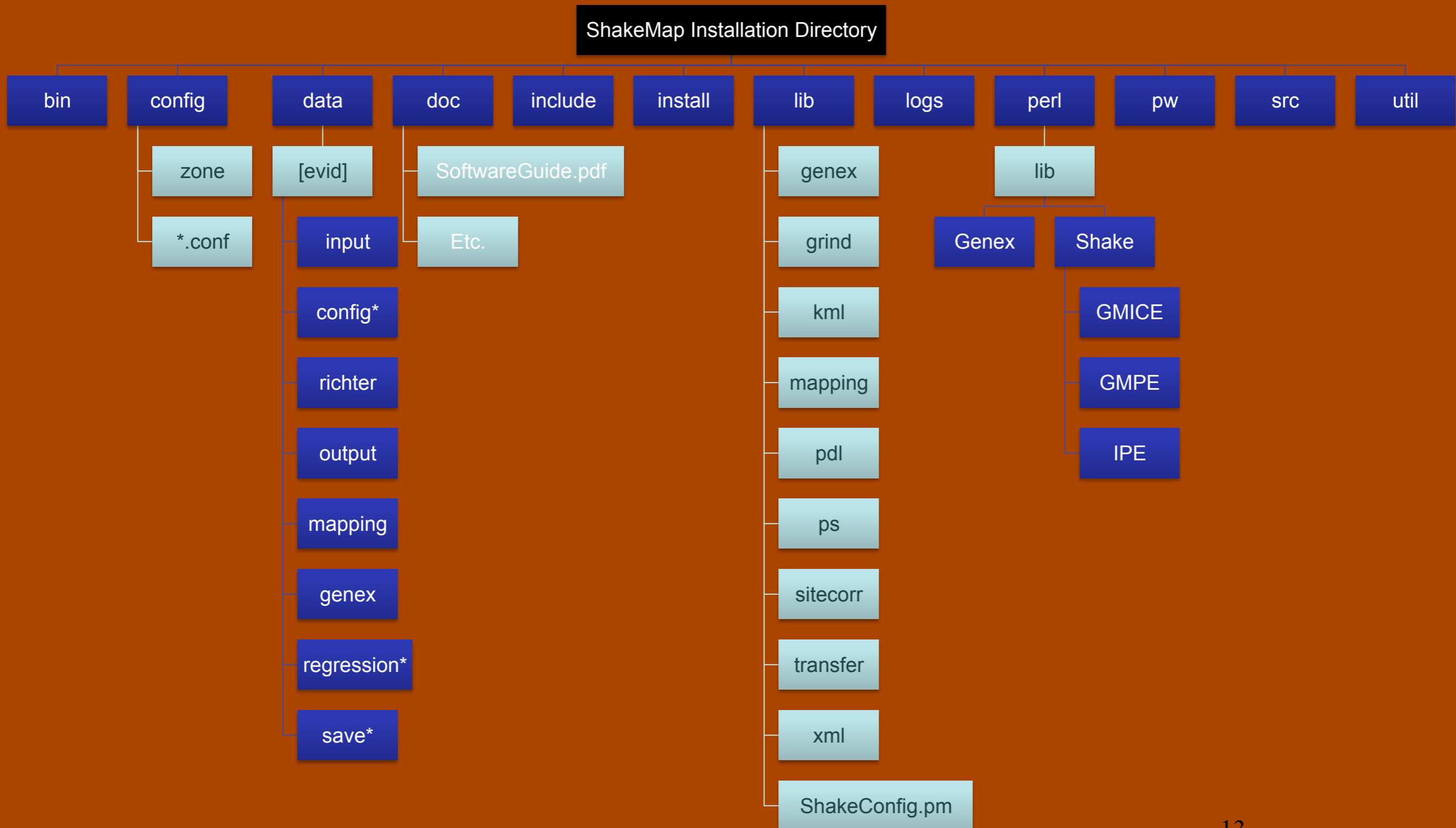
# Customizing ShakeMap

- Code mod
  - Core scripts and modules, advanced users only
  - GMPE/IPE/GMICE
  - Please submit changes back to us for incorporation in the distribution
- Library mod
  - Avoid using default filenames when creating custom library files
  - Topography
  - Vs30 and site amplification
  - Station velocity file

# Customizing ShakeMap

- Library mod
  - Supplemental GIS components, city, highway, fault...
  - Intensity legend postscript for custom MMI regression relation
  - Product list and templates
- Configuration mod
  - List of program runs and sequence
  - Default parameters of run programs
- Importing external data
  - XML, modify existing tools

# ShakeMap Directory Structure



# ShakeMap Run Sequence

**retrieve**

(retrieve.conf)



Extract event and ground-motion data and generate XML input



**grind**

(grind.conf)



Process input ground motion and estimate ground motions in map area



**mapping**

(mapping.conf)



Create postscript GMT maps of computed ground motions



**genex**

(genex.conf)



Convert and generate custom product files for export

# ShakeMap Run Sequence

**print**

(print.conf)

Send plots to various printers

**transfer**

(transfer.conf)

Transfer data files to the web, ftp, and push destinations



**setversion**

Manipulate version information for an event;  
save inputs and outputs

**shakemail**

(shakemail.conf)

Email ShakeMap info to mailing list

**plotregr**

Plot station ground motion parameters and  
regression values

# ShakeMap Event Directory

input

- event.xml, \*\_dat.xml, and \*\_fault.txt input data files.
- Estimate grids (one per metric) in GMT grid format

config\*

- Event specific configuration

richter

- Forward modeling and estimated data files
- rcg contribution and Vs30 grids

output

- Grids and processing information of ground motion estimates

mapping

- Maps and images of computed ground motion parameters

genex

- ftp and web directories for file export

regression\*

- Ground motion parameters and regression plots

save\*

- Version specific configurations and input data



# “mydb.conf”

- Allows ShakeMap programs access to the MySQL database.
- Set up password in “pw/passwords”

# “shake”

- Wrapper program
  - Configuration file “shake.conf”
  - Calls ShakeMap programs in order
  - Extracts runtime options from configuration (1<sup>st</sup> run) or database (subsequent runs)
  - Allows magnitude-dependent options
  - Configure programs to be run:

```
program      : retrieve
program      : grind
program      : tag
program      : mapping
program      : genex
program      : transfer
program      : setversion
program      : shakemail
program      : plotregr
```

# “shake” (cont.)

## Set default runtime options:

```
default_flags : retrieve
default_flags : grind -qtm -xml -noforward -boundcheck -verb
default_flags : mapping -timestamp -itopo -tvmap -pgminten
default_flags : shakemail
default_flags : genex -zip -metadata -shape shape
default_flags : print
default_flags : transfer -www -nofork
default_flags : addon
default_flags : plotregr -lab_dev 6
```

## Set magnitude-dependent runtime options:

```
variable_flags : grind 4.0 6.7 -lonspan 2.5
variable_flags : grind 6.7 7.0 -lonspan 3.0
variable_flags : grind 7.0 7.3 -lonspan 4.0
variable_flags : grind 7.3 7.6 -lonspan 5.0
variable_flags : grind 7.6 7.7 -lonspan 6.0
variable_flags : grind 7.7 9.9 -lonspan 7.0
```

# “shake” (cont.)

- shake.conf flags can be overwritten on the command line
- This provides the user flexibility to change runtime parameters on the fly, without altering the default configuration files
- The last used flags are stored in the mysql database and preserved in future versions of given shakemap ID
- Run programs with “-help” (e.g., “./bin/grind -help”) for available flags

# “shake” (cont.)

Run shake -dryrun to see current options:

```
[igskcicgltgm037:bin] <21> ./shake -event Northridge -dryrun
shake started event Northridge at Thu May 21 10:06:10 2015
/Users/cworden/Unix/ShakeMap/trunk/bin/../../bin/grind -event Northridge -qtm
-xml -noforward -boundcheck -lonspan 3.0 -psa
/Users/cworden/Unix/ShakeMap/trunk/bin/../../bin/tag -event Northridge
/Users/cworden/Unix/ShakeMap/trunk/bin/../../bin/mapping -event Northridge -
timestamp -itopo -tvmap -pgminten
/Users/cworden/Unix/ShakeMap/trunk/bin/../../bin/genex -event Northridge -zip
-metadata -shape shape -shape hazus
/Users/cworden/Unix/ShakeMap/trunk/bin/../../bin/transfer -event Northridge -
www -nofork
/Users/cworden/Unix/ShakeMap/trunk/bin/../../bin/setversion -event Northridge
-savedata
/Users/cworden/Unix/ShakeMap/trunk/bin/../../bin/shakemail -event Northridge
```

# ShakeMap Run Sequence

**retrieve**

(retrieve.conf)



Extract event and ground-motion data and generate XML input



**grind**

(grind.conf)



Process input ground motion and estimate ground motions in map area



**mapping**

(mapping.conf)



Create postscript GMT maps of computed ground motions



**genex**

(genex.conf)



Convert and generate custom product files for export

# “retrieve”

## Another wrapper program

- Calls program(s) that populate the event’s “input” directory
- “event.xml” must exist in the event’s input directory when retrieve returns or shake will terminate
- “\*\_dat.xml” file(s) contain peak ground motions and/or intensities (MMI)
- “\*\_fault.txt” file(s) contain fault coordinates
- “source.txt” can contain values that override or supplement those found in event.xml

# event.xml

```
<earthquake  
  id="200409281715"  
  lat="35.761" lon="-120.307"  
  mag="6.0"  
  year="2004" month="09" day="28" hour="17"  
  minute="15" second="24" timezone="GMT"  
  depth="0.5"  
  type="SS"  
  locstring="Parkfield, California" />
```



# PGM \*\_dat.xml

```
<station code="47179" name="Salinas - City Yard" insttype=""  
  lat="36.671001" lon="-121.641998" source="California Geological  
  Survey" commtype="DIG" netid="CE">  
  <comp name="HNN">  
    <pga value="1.1726" flag="0" />  
    <pgv value="1.5960" flag="0" />  
    <psa03 value="3.1989" flag="0" />  
    <psa10 value="2.4992" flag="0" />  
    <psa30 value="0.7997" flag="0" />  
  </comp>  
  ...  
</station>
```

# Intensity \*\_dat.xml

- netid needs to be one of “DYFI”, “CIIM”, “OBS”, or “INTENSITY”

```
<station code="89101" name="ZIP Code 89101 Las Vegas (Intensity II, 3 responses)" insttype="USGS (Did You Feel It?)" lat="36.172607854" lon="-115.122034043" source="USGS (Did You Feel It?)" netid="DYFI" commttype="USGS (Did You Feel It?)" intensity="2.0">
```

```
<comp name="Intensity Questionnaire">
```

```
<acc value="0.3" />
```

```
<vel value="0.2" />
```

```
</comp>
```

```
</station>
```

# ShakeMap Run Sequence

**retrieve**

(retrieve.conf)



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(grind.conf)



Process input ground motion and estimate ground motions in map area



**mapping**

(mapping.conf)



Create postscript GMT maps of computed ground motions



**genex**

(genex.conf)



Convert and generate custom product files for export

# “grind”

- Processes input files to create interpolated grids of ground motion parameters
- Places products in the “output” directory (some files into “richter” as well)
- “grind.conf” allows operator to specify GMPE, IPE, GMICE, Vs30 file, bias factors, map size, resolution, etc.

# “grind”

## “input”

- event.xml
- \*\_dat.xml
- \*\_fault.xml



## “output”

- <param>.grd\*
- urat\_pga.grd
- grid.xml
- rock\_grid.xml
- uncertainty.xml
- stationlist.xml
- info.xml

## “richter”

- flagged\_stations.txt
- misc. files for internal processes

\*“<param>” = PGA, PGV, PSA03, etc.

# info.xml

- ShakeMap summary file
- Quality control tool
  - Input data
  - Processing parameters
  - Output products and quality measures
- The content will likely be expanded in the future

# info.xml

```
<info evid="Northridge" tags="...">
  <tag name="ShakeMap revision" value="3.5.1388" desc="ShakeMap source code revision number" />
  <tag name="grind_time" value="Mon May 18 16:15:38 PDT 2015" desc="Start time for event processing" />
  <tag name="datafiles" value="dyfi_dat.xml,hist_dat.xml" desc="List of input files" />
  <tag name="src_mech" value="RS" desc="Source mechanism (based on gmpe)" />
  <tag name="faultfiles" value="northridge_fault.txt" desc="Fault file(s)" />
  <tag name="fault_ref" value="" desc="Fault reference(s)" />
  <tag name="Vs30default" value="686" desc="Default Vs30 for 'rock' (m/s)" />
  <tag name="directivity" value="no" desc="Directivity applied (yes|no)" />
  <tag name="median_dist" value="no" desc="Median distance used" />
  <tag name="map_bound" value="-120.035700/-117.035700/32.972500/35.447500" desc="Boundary of event map" />
  <tag name="latspan" value="2.481" desc="latitude span" />
  <tag name="lonspan" value="3.0" desc="longitude span" />
  <tag name="llratio" value="0.827" desc="latspan/lonspan ratio" />
  <tag name="x_grid_interval" value="0.008333333333333333" desc="Grid spacing in longitude (degrees)" />
  <tag name="y_grid_interval" value="0.008333333333333333" desc="Grid spacing in latitude (degrees)" />
  <tag name="site_correction" value="Borcherdt table" desc="Site correction applied (none|disabled|Borcherdt table|
    old-style Borcherdt table|GMPE native" />
  <tag name="sitecorr_table" value="/Users/cworden/Unix/ShakeMap/trunk/bin/./lib/sitecorr/Borcherdt94.dat"
    desc="Borcherdt site amplification table" />
  <tag name="sitecorr_source" value="/Users/cworden/Unix/ShakeMap/trunk/bin/./lib/sitecorr/global_vs30.grd"
    desc="Vs30 site file|&quot;from topography&quot;" />
  <tag name="pgm2mi" value="Shake::GMICE::Wald99 - Wald, et al.; 1999" desc="Ground Motion/Intensity Conversion
    Equation" />
  <tag name="miscale" value="scale_wald99.ps" desc="Intensity Scale" />
  <tag name="mi2pgm" value="Shake::GMICE::Wald99 - Wald, et al.; 1999" desc="Inverse Ground Motion/Intensity
    Conversion Equation" />
  <tag name="GMPE" value="Shake::GMPE::BAo8" desc="GMPE type" />
```

# info.xml (cont.)

```
<tag name="gmroi" value="10k" desc="Ground motion radius of influence (km)" />
<tag name="gmdecay" value="0.5" desc="Ground motion influence decay (fraction of gmroi)" />
<tag name="bias_log_amp" value="yes" desc="Used log amp to compute bias?" />
<tag name="bias_norm" value="l1" desc="Norm of the bias (l1|l2)" />
<tag name="bias_max_range" value="120" desc="Max distance to include station in bias (km)" />
<tag name="bias_min_stations" value="6" desc="Min # of stations necessary to compute bias" />
<tag name="bias_max_mag" value="7.7" desc="Max magnitude to compute bias" />
<tag name="bias_max_bias" value="2.0" desc="Max allowed bias" />
<tag name="bias_min_bias" value="-2.0" desc="Min allowed bias" />
<tag name="outlier_deviation_level" value="6" desc="Outlier level (# of std dev" />
<tag name="outlier_max_mag" value="7.0" desc="Maximum magnitude to flag outliers" />
<tag name="bias" value="0.49 0.04 0.00 0.25 -0.03 " desc="magnitude bias (pga pgv psa03 psa10 psa30 )" />
<tag name="total_flagged_pgm" value="0" desc="Number of stations flagged for PGM bias" />
<tag name="mmi_sitecorr_table" value="/Users/cworden/Unix/ShakeMap/trunk/bin/./data/Northridge/output/
  1jPdvo3qol.grd" desc="MMI site amplification table" />
<tag name="IPE" value="Shake::IPE::DefaultIPE" desc="IPE type" />
<tag name="iroi" value="10k" desc="Intensity observation radius of influence (km)" />
<tag name="idecay" value="0.5" desc="Intensity observation influence decay (fraction of iroi)" />
<tag name="total_flagged_mi" value="0" desc="Number of stations flagged for intensity bias" />
<tag name="mi_bias" value="0.25" desc="magnitude bias for Intensity" />
<tag name="pga_max_grid" value="84.58" desc="Max value of pga in grid" />
<tag name="pgv_max_grid" value="133.55" desc="Max value of pgv in grid" />
<tag name="mi_max_grid" value="9.51" desc="Max value of mi in grid" />
<tag name="psa03_max_grid" value="225.06" desc="Max value of psa03 in grid" />
<tag name="psa10_max_grid" value="156.82" desc="Max value of psa10 in grid" />
<tag name="psa30_max_grid" value="39.82" desc="Max value of psa30 in grid" />
<tag name="pga_max" value="84.58" desc="Max value of pga on land" />
<tag name="pgv_max" value="133.55" desc="Max value of pgv on land" />
```

...



# “grind.conf”

- Format for definition of GMPEs:

```
gmpe : gmpe-module min-mag max-mag [depth-min depth-mag]
```

- Example definition of multiple GMPEs:

```
gmpe: CY08_SMM_CCa1 0.0 5.3 0 9999
```

```
gmpe: CY08 5.3 7.7 0 22
```

```
gmpe: Youngs97_interface 7.7 9.9 0 22
```

```
gmpe: Youngs97_intralab 5.3 7.2 22 50
```

```
gmpe: Youngs97_interface 7.2 9.9 22 50
```

```
gmpe: Youngs97_intralab 5.3 9.9 50 9999
```

# “grind.conf”

## Available GMPEs:

Module Name	Reference	Magnitude Range	Distance Range (km)	Distance Metric	PGV	PSA	Uncertainty Type	Site Term	Mech <sup>4</sup>	Region
AB06_ENA_BC	Atkinson & Boore (2006) <sup>5</sup>	$\geq 4.0$	0 – 1000	$R_{Rup}$	Yes	Yes <sup>6</sup>	Spatially constant <sup>7</sup>	Yes <sup>8</sup>	N/A	Eastern North America
AkkarBommer07	Akkar & Bommer (2007, 2007b)	$5.0 \leq M \leq 7.6$	5 – 100	$R_{Rup}$	Yes	Yes <sup>9</sup>	Spatially constant	Yes <sup>10</sup>	RS, NM, ALL	Europe
ASB13	Akkar, et al. (2013)	$4.0 \leq M \leq 8.0$	0 – 200+	$R_{JB}/R_{Epi}$	Yes	Yes	Spatially constant	Yes	SS, RS, NM	Southern Europe and Middle East
BA08 <sup>11</sup>	Boore & Atkinson (2008)	$3.0 \leq M \leq 8.0$	0 – 200	$R_{JB}$	Yes	Yes	Spatially constant <sup>12</sup>	Yes	SS, RS, NM, ALL	NGA Active Tectonic
BJF97	Boore, Joyner, Fumal (1997)	$5.0 \leq M \leq 7.4$	0 – 80	$R_{JB}$	No <sup>13</sup>	Yes	Spatially constant	Yes	SS, RS, ALL	Western North America
Boatwright03	Boatwright, et al. (2003)	$3.5 \leq M \leq 7.1$	0 – 300	$R_{Hypo}$	Yes	No <sup>14</sup>	Spatially constant	Yes <sup>15</sup>	N/A	Northern California

# “grind.conf”

## Available GMPEs (page 2):

Module Name	Reference	Magnitude Range	Distance Range (km)	Distance Metric	PGV	PSA	Uncertainty Type	Site Term	Mech <sup>4</sup>	Region
CY08 CY08_SMM_CCal CY08_SMM_SCal	Chiou & Youngs (2008), Chiou, et al. (2009)	$3.0 < M \leq 7.7$	0 – 200	$R_{Rup}$ <sup>16</sup>	Yes	Yes	Spatially variable <sup>17</sup>	Yes	SS, RS, NM	NGA Active Tectonic, CA for SMM
Campbell2003	Campbell (2003; 2004)	$\geq 5.0$	0 – 1000	$R_{Rup}$	N&H'82	Yes	Spatially constant <sup>18</sup>	No <sup>19</sup>	N/A	Eastern North America
Garcia05	Garcia et al. (2005)	$5.2 \leq M \leq 7.4$	0 – 400	$R_{Rup}$ $R_{Hypo}$	Yes	Yes	Spatially constant	No	N/A	Mexico intra-slab
HazusPGV	Boore, Joyner, Fumal (1997)	$5.0 \leq M \leq 7.4$	0 – 80	$R_{JB}$	N&H'82 <sup>20</sup>	Yes	Spatially constant	Yes	SS, RS, ALL	Western North America
Kanno2006	Kanno, et al. (2006)	$\geq 5.5$	0 – 500	$R_{Rup}$	Yes	Yes	Spatially constant	Yes	N/A	Subduction, Active Tectonic
MA2005	Motazedian & Atkinson (2005)	$3.0 \leq M \leq 8.0$	2 – 500	$R_{Rup}$	Yes	Yes	Spatially constant	No <sup>21</sup>	N/A	Puerto Rico
PP04	Pankow & Pechmann (2004)	$5.0 \leq M \leq 7.7$	0 – 100	$R_{JB}$	Yes	Yes <sup>22</sup>	Spatially constant	Limited <sup>23</sup>	N/A <sup>24</sup>	Extensional Tectonic
Small	Quitoriano	$3.0 \leq M \leq 5.2$	0 – 200	$R_{JB}$	Yes	Yes	Spatially constant <sup>25</sup>	Yes	N/A	Active Tectonic (CA)

# “grind.conf”

## Available GMPEs (page 3):

Module Name	Reference	Magnitude Range	Distance Range (km)	Distance Metric	PGV	PSA	Uncertainty Type	Site Term	Mech <sup>4</sup>	Region
Youngs97 Youngs97_interface Youngs97_intraslab	Youngs (1997)	$5.2 \leq M \leq 8.0$	0 – 300	$R_{Rup}$	N&H'82	Yes	Spatially constant <sup>26</sup>	No <sup>27</sup>	N/A	Subduction: interface, intraslab <sup>28</sup>
Zhao06 Zhao06_crustal Zhao06_interface Zhao06_intraslab	Zhao, et al. (2006)	$5.0 \leq M \leq 8.3$	0 – 300	$R_{Rup}$	N&H'82	Yes	Spatially constant	Yes <sup>29</sup>	SS, NM, RS <sup>30</sup>	Japan: crustal, interface, slab

# ShakeMap Run Sequence

**retrieve**

(retrieve.conf)



Extract event and ground-motion data and generate XML input



**grind**

(grind.conf)



Process input ground motion and estimate ground motions in map area



**mapping**

(mapping.conf)



Create postscript GMT maps of computed ground motions



**genex**

(genex.conf)

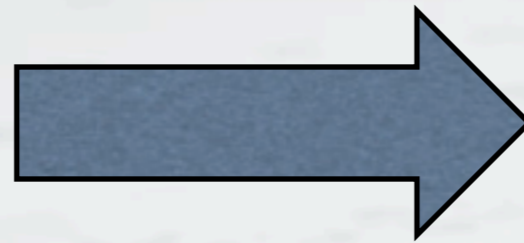


Convert and generate custom product files for export

# “mapping”

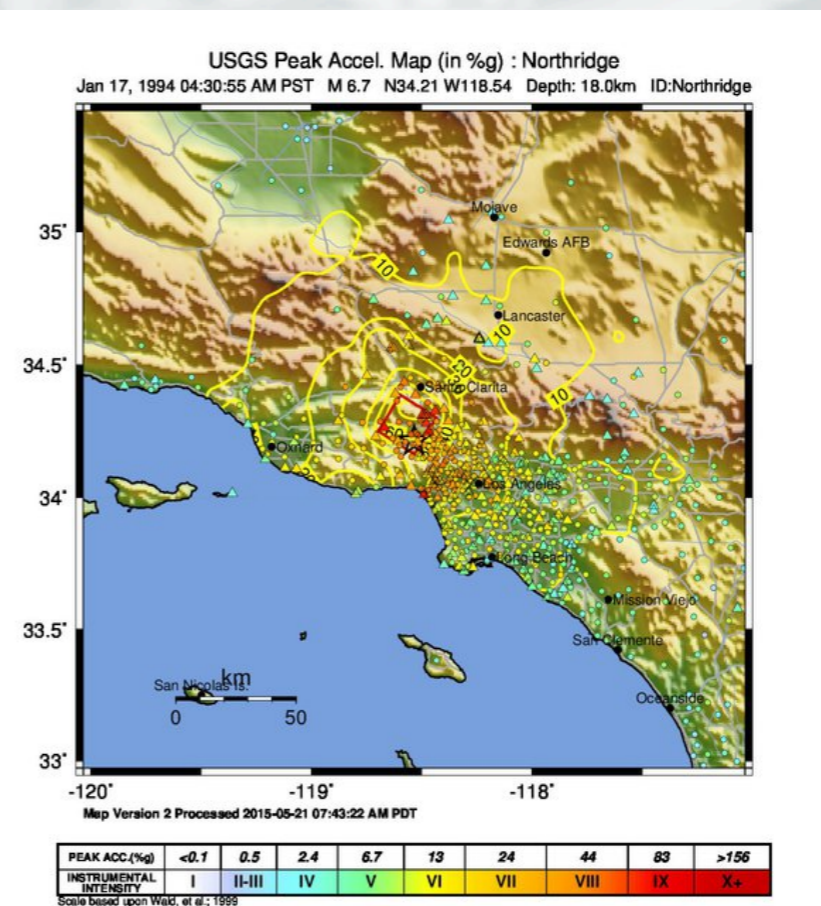
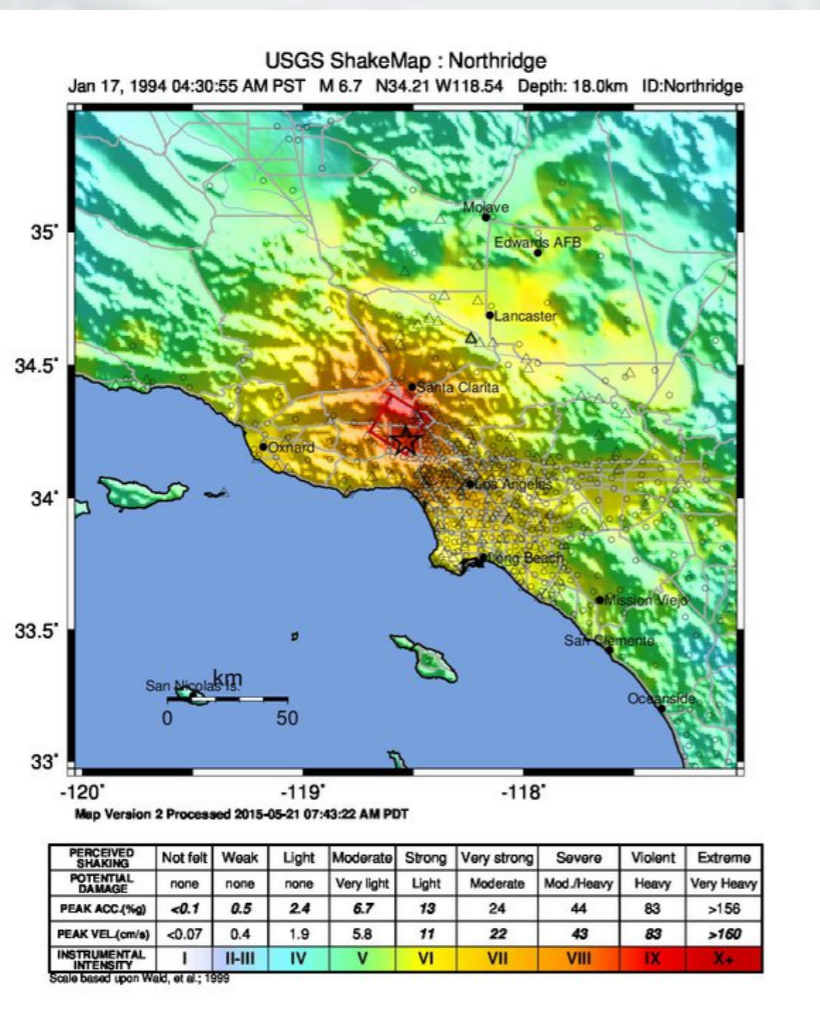
## “output”

- <param>.grd



## “mapping”

- <param>.ps
- ii\_overlay.ps
- tvmap.ps
- cont\_<param>.xyz



# ShakeMap Run Sequence

**retrieve**

(retrieve.conf)



Extract event and ground-motion data and generate XML input



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Process input ground motion and estimate ground motions in map area



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(mapping.conf)



Create postscript GMT maps of computed ground motions



**genex**

(genex.conf)



Convert and generate custom product files for export

# “genex”

## “genex” → GENerate EXport

\*.ps



- \*.jpg (or .png)
- \*.ps.zip

cont\_\*.xyz



- cont\_<param>.json
- cont\_<param>.kmz

\*.grd



- GIS Files
- shape.zip
  - hazus.zip
  - raster.zip

stationlist, fault  
contours, intensity  
overlay, etc.



KML/KMZ for  
Google Earth



# “genex”

- genex also produces the web pages.
- Other products include:
  - Metadata in text, HTML, and XML
  - Stationlist in GeoJSON
  - Compressed (zip) grid XML files

# ShakeMap Run Sequence

**print**

(print.conf)

Send plots to various printers

**transfer**

(transfer.conf)

Transfer data files to the web, ftp, and push destinations



**setversion**

Manipulate version information for an event;  
save inputs and outputs

**shakemail**

(shakemail.conf)

Email ShakeMap info to mailing list

**plotregr**

Plot station ground motion parameters and  
regression values

# “transfer”

transfer moves ShakeMap products to other directories and other machines

- Protocols include:
  - FTP
  - cp/rcp/scp
  - rsync
  - PDL
- Can push individual files or entire directory
- Pushes web pages to web server

# ShakeMap Run Sequence

**print**

(print.conf)

Send plots to various printers

**transfer**

(transfer.conf)

Transfer data files to the web, ftp, and push destinations



**setversion**

Manipulate version information for an event;  
save inputs and outputs

**shakemail**

(shakemail.conf)

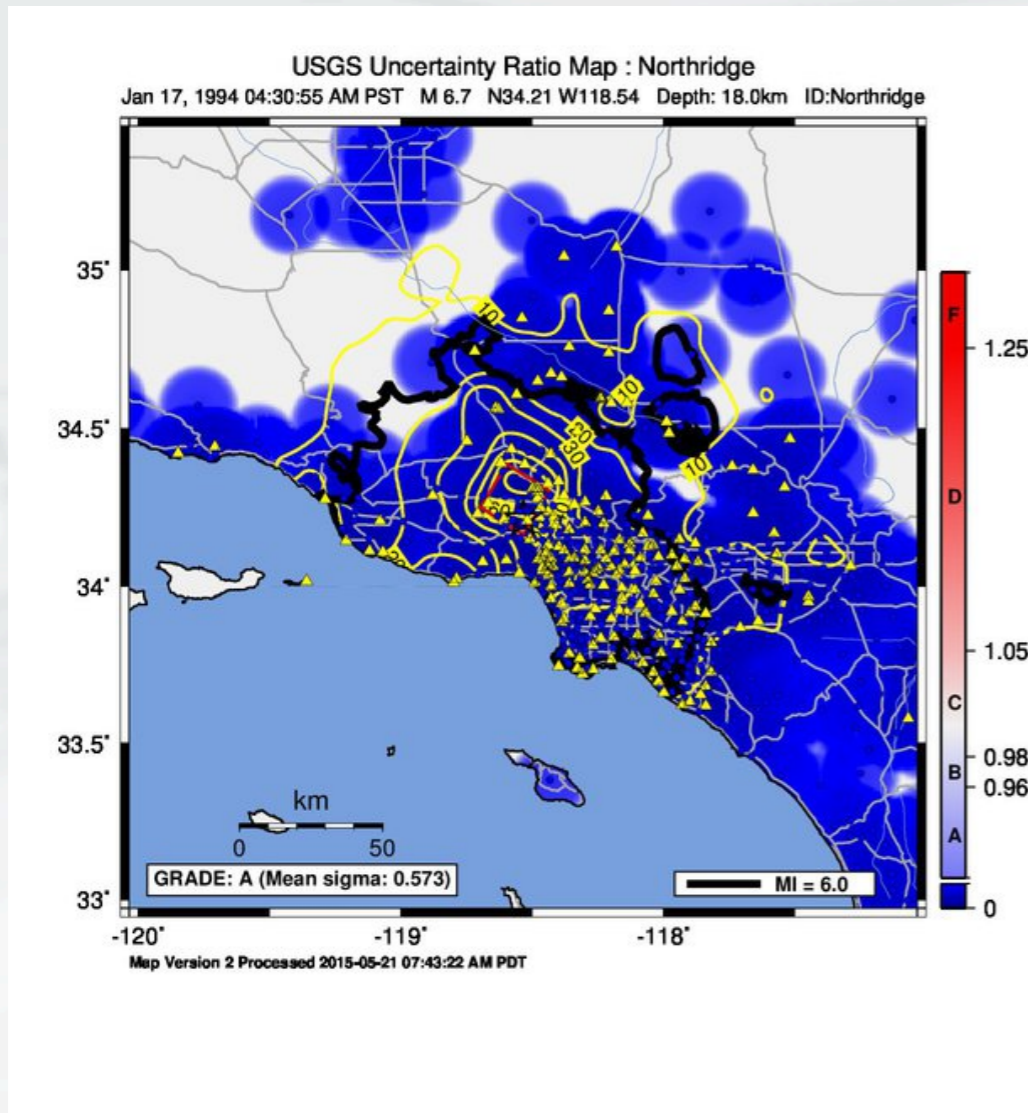
Email ShakeMap info to mailing list

**plotregr**

Plot station ground motion parameters and  
regression values

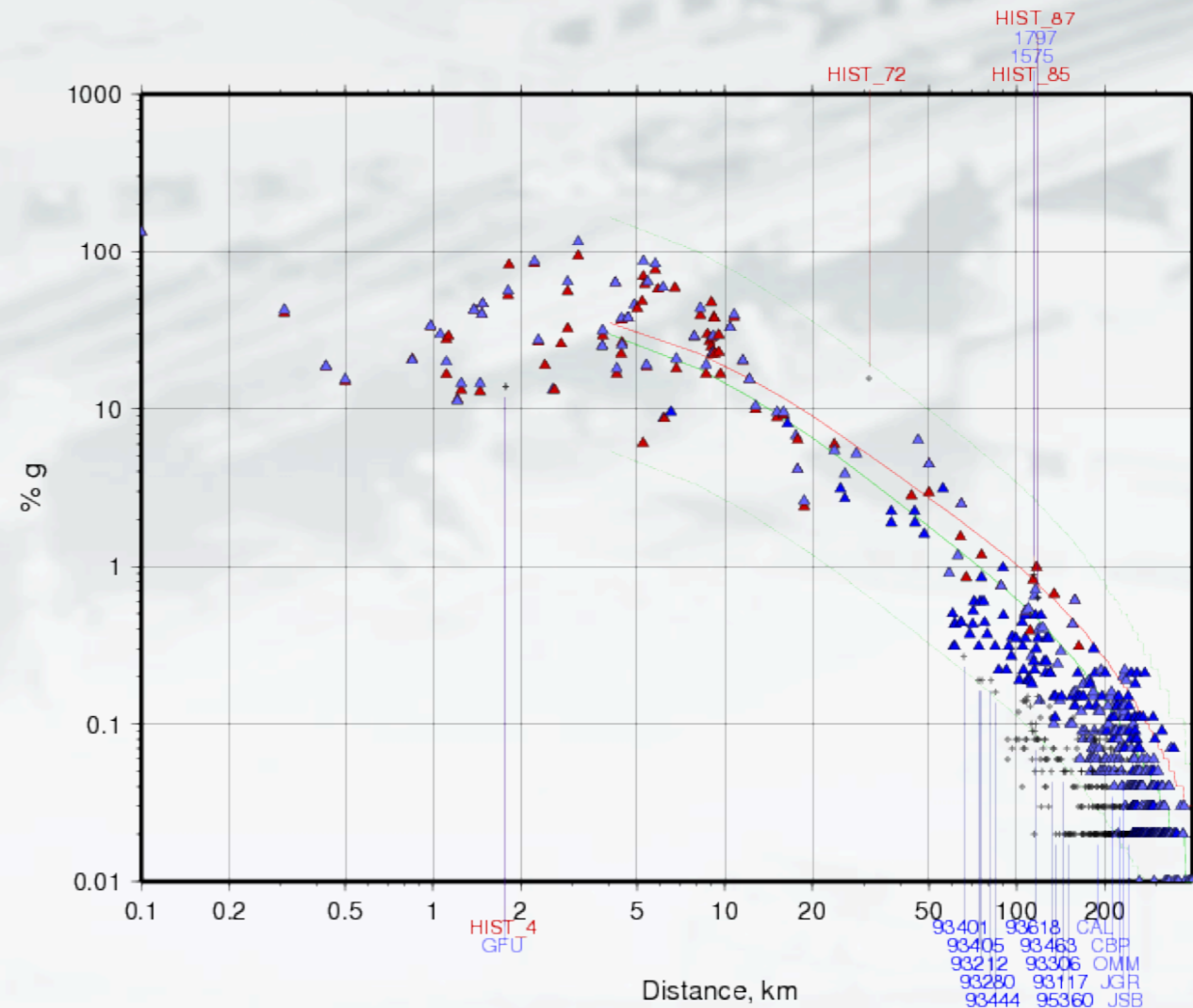
# Processing-Related Products

## Standard deviation plots for PGA



## GMPE Plots with “plotregr”

USGS Peak Acceleration (in %g) Epicenter: Parkfield, California  
Tue Sep 28, 2004 11:15:24 AM MDT M 6.0 N35.76 W120.31 Depth: 0.5km ID:200409281715

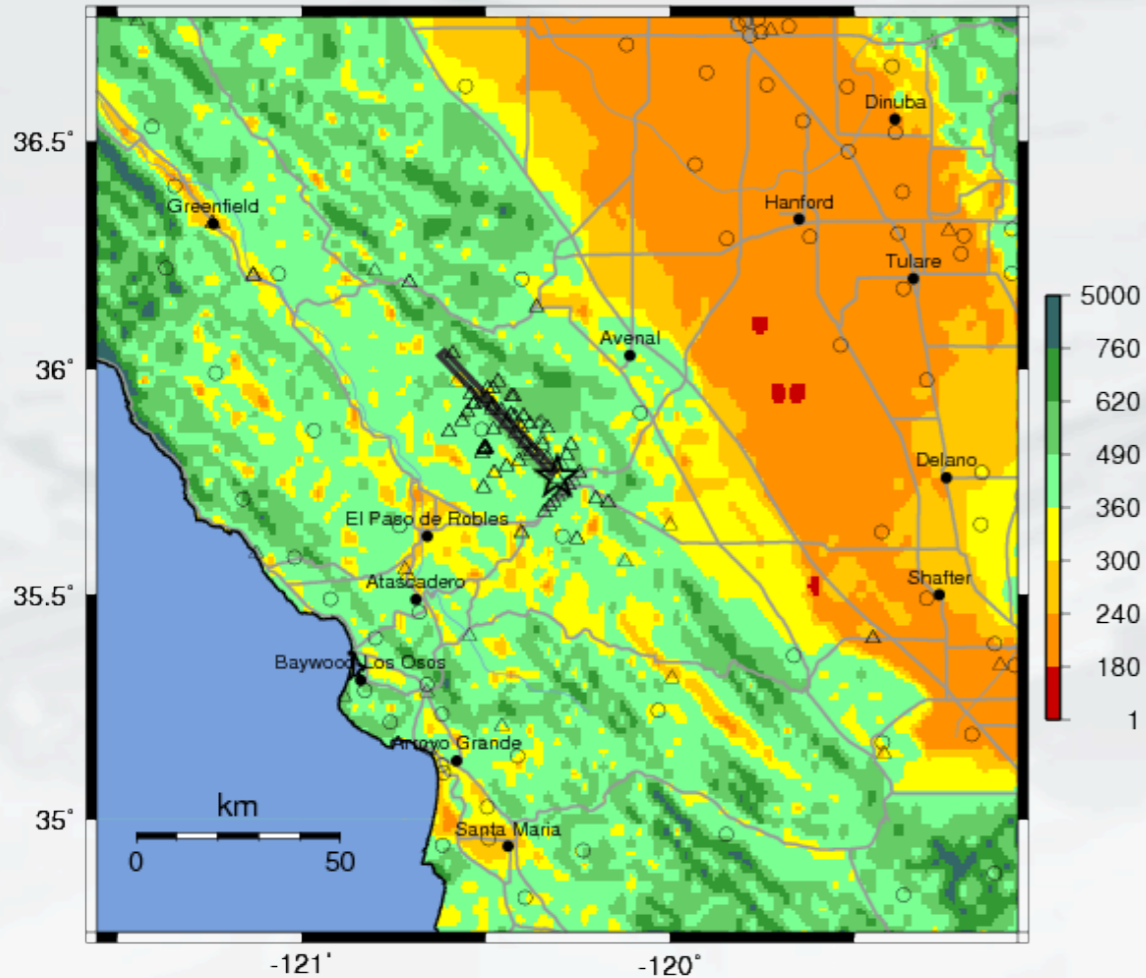


# Processing-Related Products

## Vs30 plot with plot\_vs30

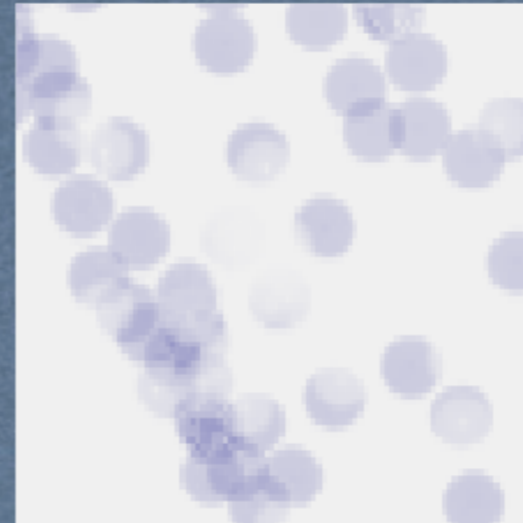
USGS VS30 map (in m/s) : Parkfield, California

Tue Sep 28, 2004 17:15:24 GMT M 6.0 N35.76 W120.31 Depth: 0.5km ID:200409281715

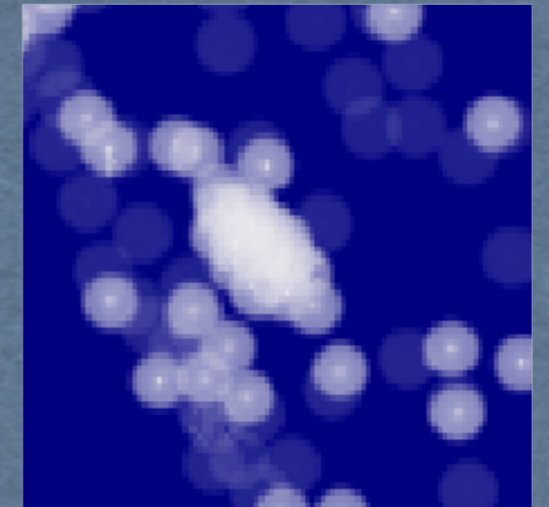


## Relative contribution grids with “grind -rcg”

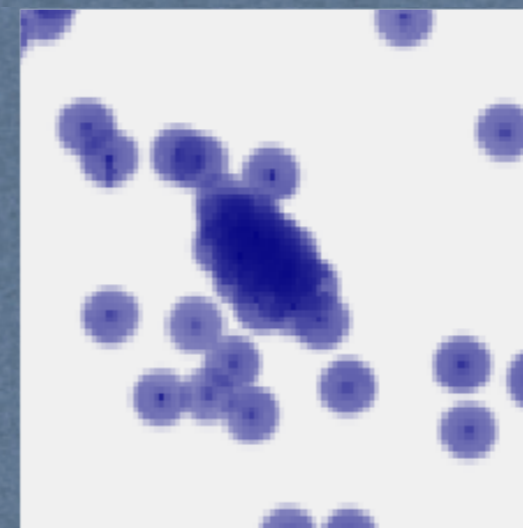
### Conversion



### GMPE



### Observation



Weights:  
Blue=1  
White=0

# Scenario ShakeMap

- Create “<shake\_home>/data/<evid\_se>/directory
- Populate the “input” directory with
  - “event.xml”
  - “\*\_dat.xml”
  - “\_fault.txt”
- Optionally provide ground motion estimates as GMT .grd files (“<param>\_estimates.grd” and “<param>\_sd.grd”)

# Adding Finite Faults

- Addition of finite faults can greatly improve the quality of ShakeMap outputs
- Finite faults can be defined in a simple file, such as:
  - Filename is: `<event id>/input/<fault name>_fault.txt`
  - Finite faults have a 3<sup>rd</sup> dimension (e.g., a dipping plane)
  - The format of the fault file is a polygon defined as:  
`<lat> <lon> <depth> :`

```
34.315 -118.421    5.000
34.401 -118.587    5.000
34.261 -118.693   20.427
34.175 -118.527   20.427
34.315 -118.421    5.000
```



# Advanced Topics

- “zone\_config” allows for region-specific config files, zoneconfig2 goes even further
- Automating processing with “queue”
- Customizing programs in src/xml to produce ShakeMap input XML from user’s source data
- Versioning

# Thanks!

Email: [cbworden@usgs.gov](mailto:cbworden@usgs.gov)