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# scisola

automatic moment tensor solution for SeisComP3

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#### overview

#### (1) introduction

- (2) software tools used
- (3) architecture
- (4) flowchart
- (5) case study
- (6) screenshots
- (7) manual example
- (8) future improvements
- (9) installation
- (10) links & more



#### moment tensors

 moment tensors are important for studies like shakemap generation, tsunami warnings, ground motion evaluation and more

• importance of automatic, quick and reliable moment tensor solution

# scis la

- open-source python based software
- user friendly GUI

supports:

- automatic Moment Tensor calculation of events provided by SeisComP3 in real-time
- easy solution overview
- quick solution revision
- extensive configuration

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#### SeisComP3

- likely the most widely distributed software package for seismological purposes
- v evolved within approximately the last 10 years
- its use ranges from pure acquisition or real-time data exchange over Internet to a fully featured real-time earthquake monitoring
- provides real-time waveform data through Seedlink protocol



- ISOLA is a package of Fortran and Matlab code (by J. Zahradnik and E. Sokos)
- Matlab code is used for preparing input data and plotting results while FORTRAN for basic calculations. GMT is also used for preparing plots and displaying the results
- ✓ first version was released in 2004
- has been used as a routine MT analysis software in various labs, e.g. Univ. Patras, NOA –GI, Greece (reporting to EMSC)
- currently ~ 150 registered users
- ✓ seminars on ISOLA use: Costa Rica 2012, Colombia 2014, Brazilia 2014

#### ISOLA

ISOLA moment tensor algorithm:

- point source iterative deconvolution method
- full wavefield is taken into account
- discrete wavenumber method for local or regional distances
- moment tensor is found by least-square minimization of misfit between observed and synthetic waveforms
- position and time of centroid is optimized through grid search

more info in Sokos & Zahradnik, 2008 and Sokos & Zahradnik, 2013

#### ISOLA

			Crusta	l model definiti	on			
	Crustal mode		stal model	Albania model				
	Depth (km)	Vp	Vs (km/sec)	Density (g/cm^3)	Qp	Qs		
1.	0	5.12	2.876	2.724	300	300	Save	
2.	2	5.33	2.994	2.766	300	300		
3.	4	5.52	3.101	2.804	300	300	Load	
4.	6	5.62	3.157	2.824	300	300		
5.	8	5.82	3.27	2.864	300	300	Plot	
6.	10	6.05	3.399	2.91	300	300		
7.	15	6.25	3.511	2.95	300	300	Calculate Density	
8.	20	6.39	3.59	2.978	300	300		
9.	30	6.5	3.652	3	300	300	Use Vp/Vs	
10.	40	8	4.494	3.3	1000	1000	1.78	
11.								
12.								
13.								
14.								
15.							i	

GUI example: ISOLA tool for creating crustal model



- ObsPy is an open-source Python framework for processing seismological data
- provides parsers for common file formats, clients to access data centers and seismological signal processing routines which allow the manipulation of seismological time series
- provides reading and writing data SEED/MiniSEED and Dataless SEED, XML-SEED,
   GSE2 and SAC, filtering, instrument simulation, triggering, and plotting
- supports retrieving data from ArcLink or a SeisHub database
- can access to the actual time series directly, allowing the use of powerful numerical array-programming modules like NumPy or SciPy
- results can be visualized using modules such as matplotlib or MayaVi (3D)

# matplotlib

- matplotlib is a python 2D plotting library
- produces publication quality figures in a variety of hardcopy
   formats and interactive environments across platforms
- can be used in python scripts, the python and ipython shell (like MATLAB or Mathematica), web application servers and six graphical user interface toolkits
- generates plots, histograms, power spectra, bar charts, errorcharts, scatterplots, etc, with just a few lines of code

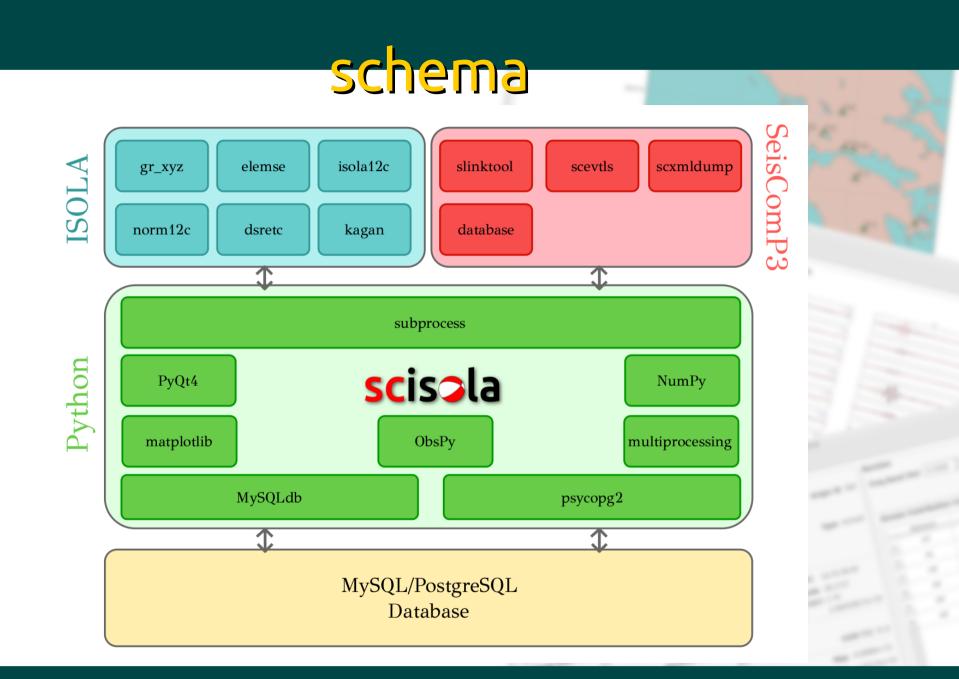
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# libraries

ObsPy	used for seismological calculations e.g. signal filtering		
matplotib	used mostly for plots		
Numpy	used for math calculations		
PyQt4	used for GUI		
subprocess	used for wrapping SeisComP3 and ISOLA		
multiprocessing	used for parallelizing calculations		
MySQLdb/psycopg2	used for MySQL/PostgreSQL database manipulation		



#### structure

scisola consists of three packages in two layers:

lib (2nd layer -blue box-)

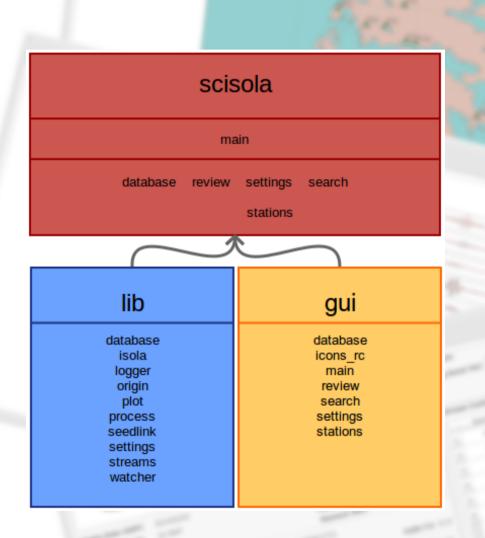
*includes all necessary files to implement all the needed functions and algorithms, -logic- of scisola* 

gui (2nd layer -yellow box-)

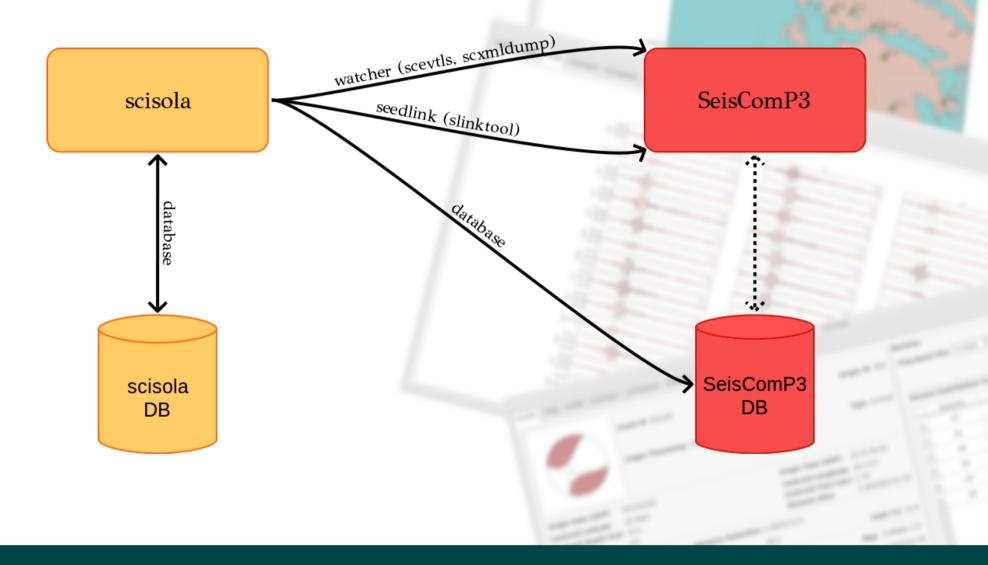
includes all necessary files of GUI

scisola (1st layer -red box-)

an abstract layer/package that connects the lib and gui packages



#### SeisComP3 connectivity



# SeisComP3 connectivity

lib/database.py	handles the Stations and Streams information provided by SeisComP3
lib/seedlink.py	use of slinktool in order to retrieve the corresponding waveforms
lib/watcher.py	use of scevtls and scxmldump in order to watch SeisComP3 for new events in real-time and for retrieving the corresponding event and origin information respectively

#### database

the scisola database is used for:

- saving and editing station and stream information retrieved from the SeisComP3 software
- saving the earthquake event information and the MT calculation including the streams contributing to the inversion
- saving the extensive configuration of scisola settings

#### database

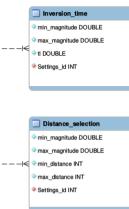
it consists of ten tables, which can be classified in three categories:

- Stations (<u>tables</u>: *Station, Stream*)
- Settings (<u>tables</u>: Settings, Distance\_selection, Inversion\_time, Inversion\_frequency)
- Event (<u>tables</u>: Event, Origin, Moment\_Tensor, Stream\_Contribution)

#### database

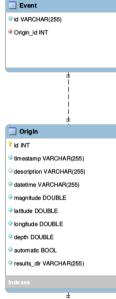
Station id INTEGER(11) code CHAR(8) network CHAR(8) description VARCHAR(80) latitude DOUBLE Iongitude DOUBLE elevation DOUBLE priority INTEGER(11) Stream id INTEGER(11) Station\_id INTEGER(11) code CHAR(3) azimuth DOUBLE dip DOUBLE gain\_sensor DOUBLE gain\_datalogger DOUBLE norm\_factor DOUBLE nzeros TINYINT zeros\_content BLOB npoles TINYINT poles\_content BLOB priority INTEGER(11)

Settings id INT timestamp TIMESTAMP center\_latitude DOUBLE center\_longitude DOUBLE distance\_range INT magnitude\_threshold DOUBLE min sectors INT stations\_per\_sector INT sources INT source step INT clipping\_threshold DOUBLE time\_grid\_start INT time\_grid\_step INT time\_grid\_end INT watch\_interval INT process\_delay INT process\_timeout INT crustal\_model\_path VARCHAR(255) output\_dir VARCHAR(255) isola\_path VARCHAR(255) sc3\_path VARCHAR(255) sc3\_scevtls VARCHAR(255) sc3\_scxmldump VARCHAR(255) seedlink\_path VARCHAR(255) seedlink\_host VARCHAR(255) seedlink\_port INT



#### 

Settings\_id INT



#### Stream\_Contribution

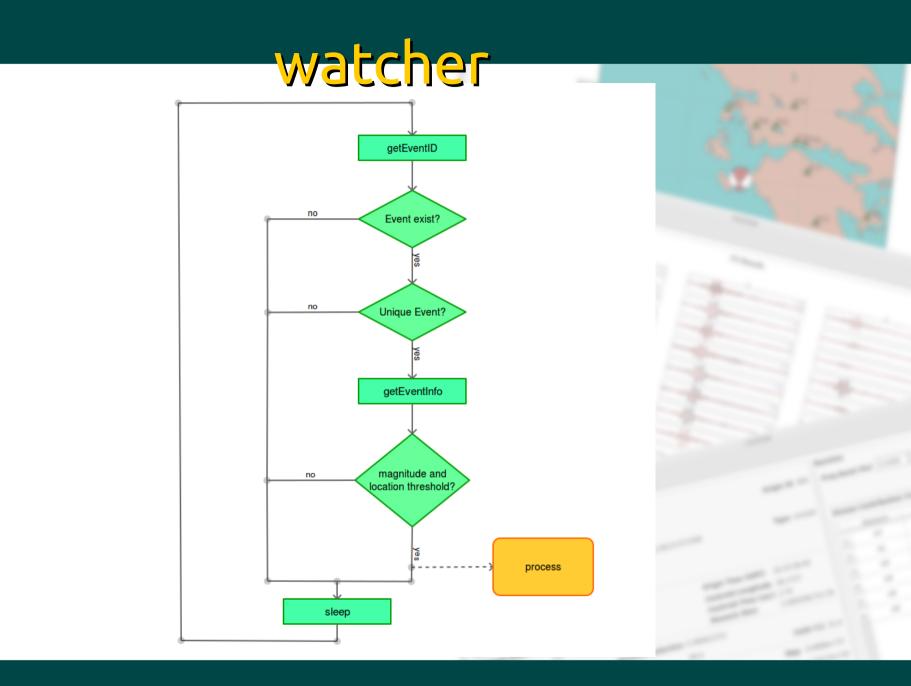
- stream StationCode CHAR(8)
- streamCode CHAR(3)
- var\_reduction DOUBLE
   mseed\_path VARCHAR(255)
- Origin\_id INT

Moment\_Tensor cent\_shift INT cent\_time DOUBLE cent latitude DOUBLE cent\_longitude DOUBLE cent\_depth DOUBLE correlation DOUBLE var reduction DOUBLE mw DOUBLE mrr DOUBLE mtt DOUBLE mpp DOUBLE mrt DOUBLE mrp DOUBLE mtp DOUBLE vol DOUBLE dc DOUBLE clvd DOUBLE mo DOUBLE strike DOUBLE dip DOUBLE rake DOUBLE strike\_2 DOUBLE dip\_2 DOUBLE rake\_2 DOUBLE p\_azm DOUBLE p\_plunge DOUBLE t azm DOUBLE t\_plunge DOUBLE b\_azm DOUBLE b\_plunge DOUBLE minSV DOUBLE maxSV DOUBLE CN DOUBLE stVar DOUBLE fmVar DOUBLE frequency\_1 DOUBLE frequency\_2 DOUBLE frequency\_3 DOUBLE frequency\_4 DOUBLE Origin\_id INT

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#### automatic procedure bad station data station selection station data origin triggering correction based on distance filtering result inversion Green's functions station selection plotting computation computation based on azimuth

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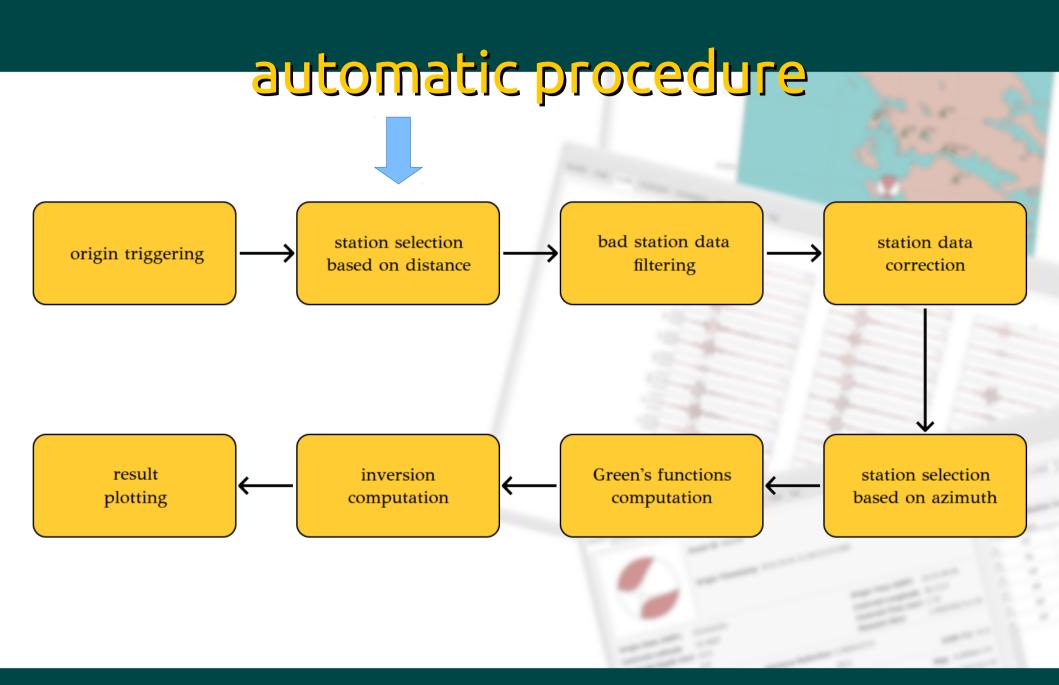
# origin triggering

• automatic mode

watch SeisComP3 through scevtls retrieve origin's info through scxmldump

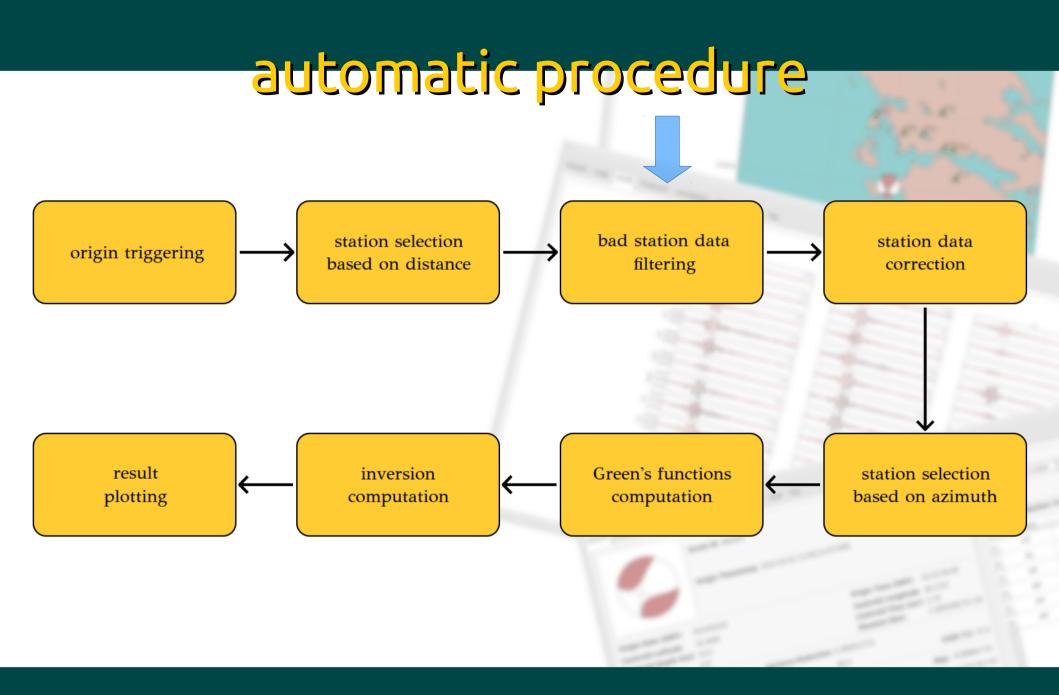
• manual mode

execution through python script (mostly for testing purposes)



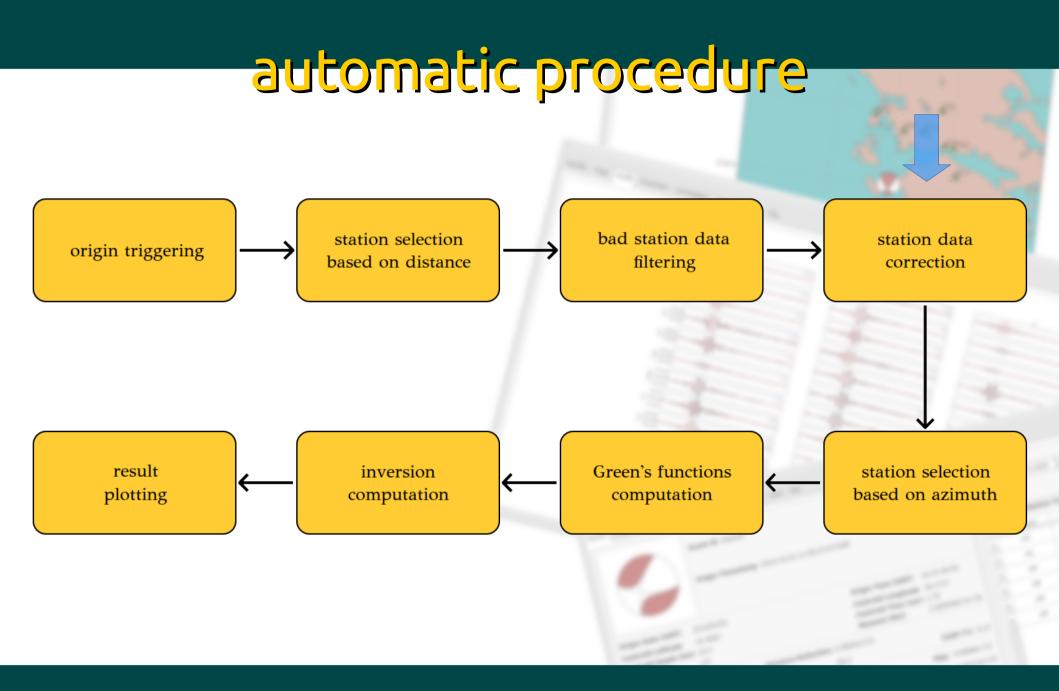
#### station selection based on distance

- retrieves Stations/Streams Info from scisola database
- filters Stations/Streams by certain type (e.g. HHN, HNE)
- removes Blacklisted Stations/Streams defined by the user
- calculates distance and azimuth of stations according to epicenter
- ✓ selects Stations/Streams according to "distance rule", defined by the user (e.g. 3.5 ≤ mw ≤ 4.5 → 20 ≤ distance ≤ 100 km)



### bad station data filtering

- removes unavailable stations/streams according to seedlink
- retrieves records from seedlink in mseed format
- removes stations/streams with gaps
- removes stations/streams with clipping

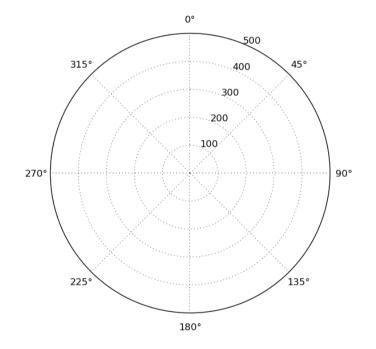


### station data correction

- rotates stations/streams automatically
- corrects stations/streams data
  - removes instrumental effect
  - aligns according to origin time
  - cuts to predefined duration
  - resamples

#### automatic procedure bad station data station selection station data origin triggering correction based on distance filtering result inversion Green's functions station selection based on azimuth plotting computation computation

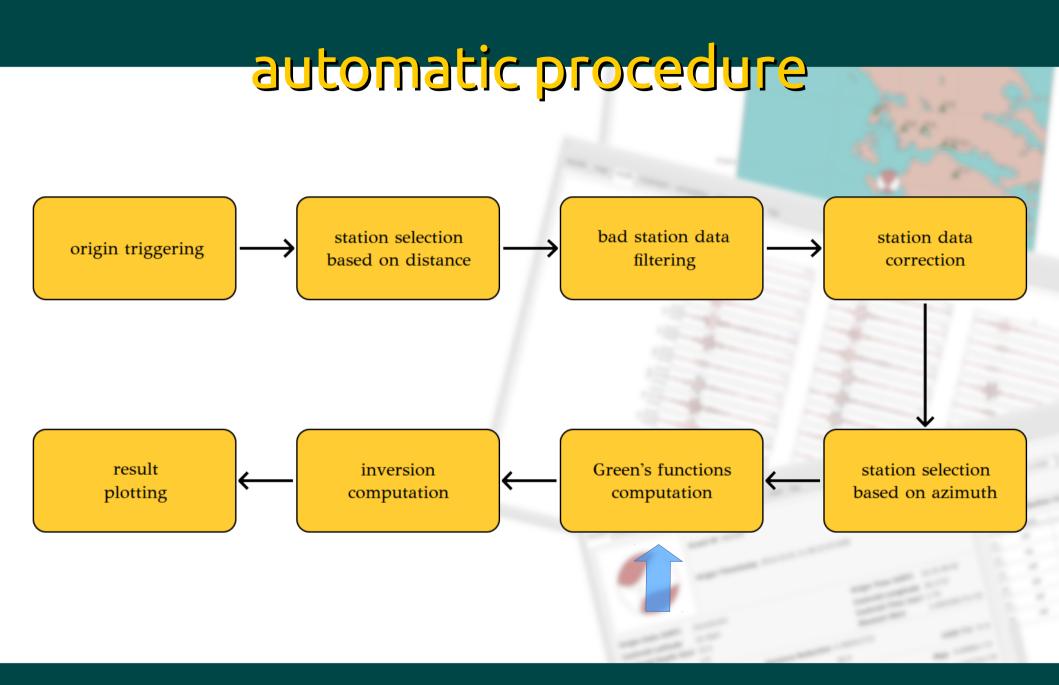
#### station selection based on azimuth



 station distribution according to epicenter location

8 sectors, each of 45°

- minimum number of sectors defined by the user
- maximum stations per sector defined by the user
- stations' order based on priority and minimum distance from epicenter



### Green's functions computation

- single 1D crustal model defined by the user
- computation of elementary seismograms (delta time function)
- time window length of inversion procedure (tl) is defined by
   the user according to "tl rule"
   (e.g. 3.5 ≤ mw ≤ 4.5 → tl = 327.68 sec)
- centroid horizontal position fixed at epicenter location while centroid depth is grid searched
- the number of trial sources above and below automatic depth estimation is defined by the user

#### automatic procedure bad station data station selection station data origin triggering correction based on distance filtering result inversion Green's functions station selection plotting computation computation based on azimuth

## inversion computation

- source inversion predefined to deviatoric type
- r inversion frequency band is defined by the user according to "frequency rule"
   (e.g. 3.5 ≤ mw ≤ 4.5 → frequencies = [0.04, 0.05, 0.08, 0.09] Hz)
- time grid search for centroid time is defined by the user

#### automatic procedure bad station data station selection station data origin triggering correction based on distance filtering result inversion Green's functions station selection plotting computation computation based on azimuth

## result plotting

- generates text files with results and the final focal mechanism
- generates a map containing the epicenter location and contributing stations' location
- generates observed and synthetic waveforms plot
- generates correlation plots
   i.e. focal mechanism at each space and time position overlaid above the correlation contours
- generates contributing streams plot
- saves results to scisola database

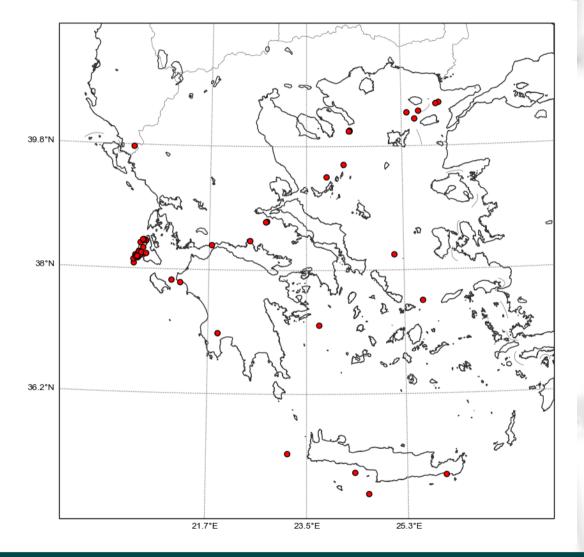
### revise procedure

- user can manually remove streams that have been selected by the automatic procedure from the inversion
- user can change inversion frequencies

### overview

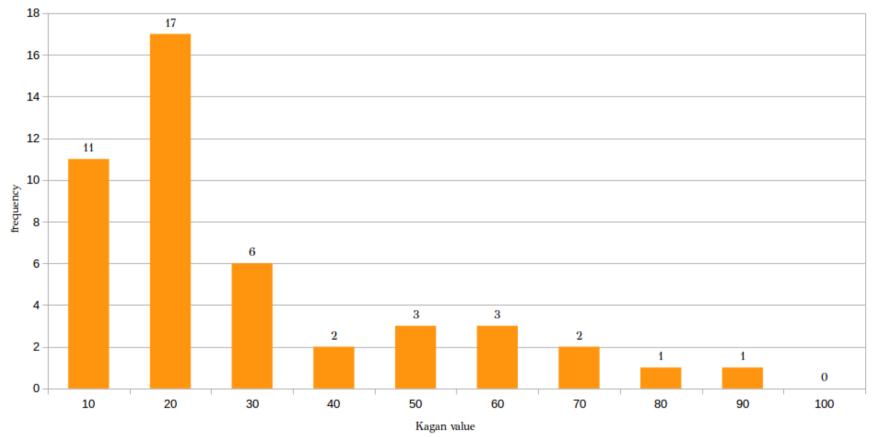
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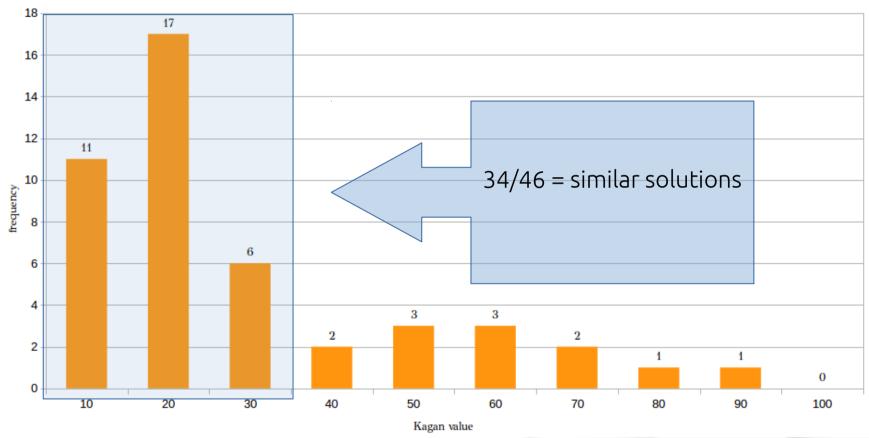


- comparison of 46 manual MT solutions by GI-NOA, with 46 automatic by scisola
- comparison using the Kagan angle metric
- locations  $\rightarrow$  red dots

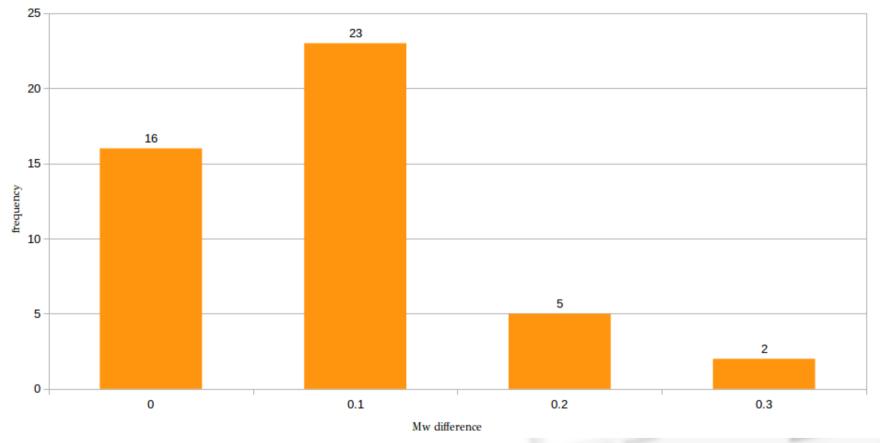
Kagan Value



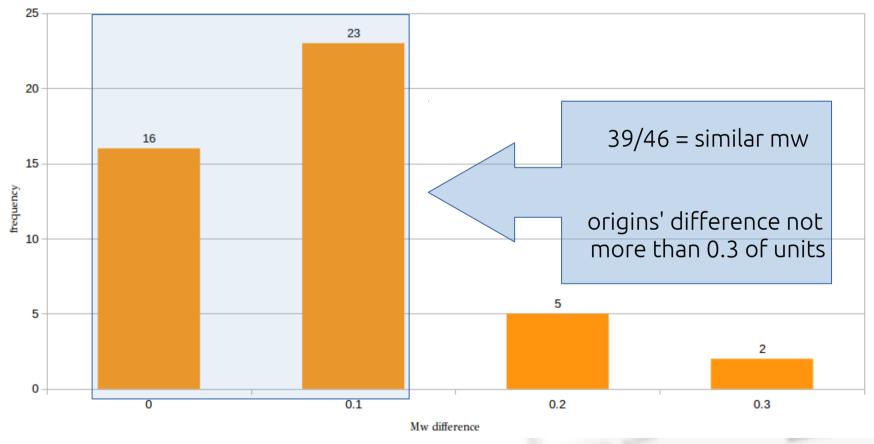
#### Kagan Value



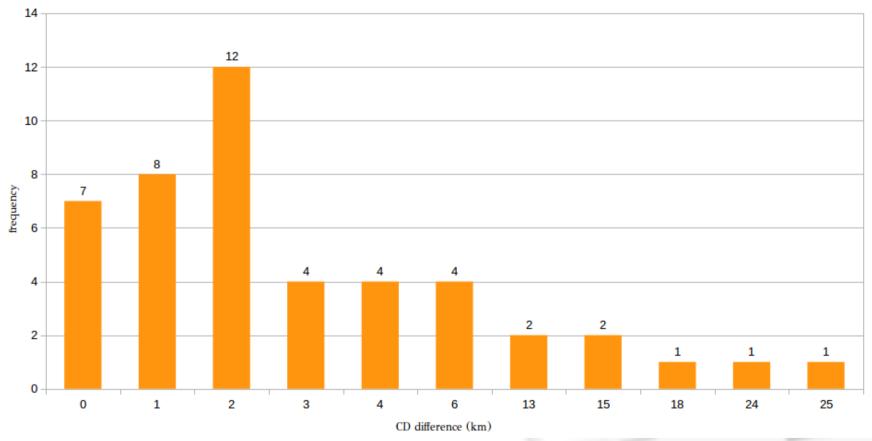
#### Mw Difference



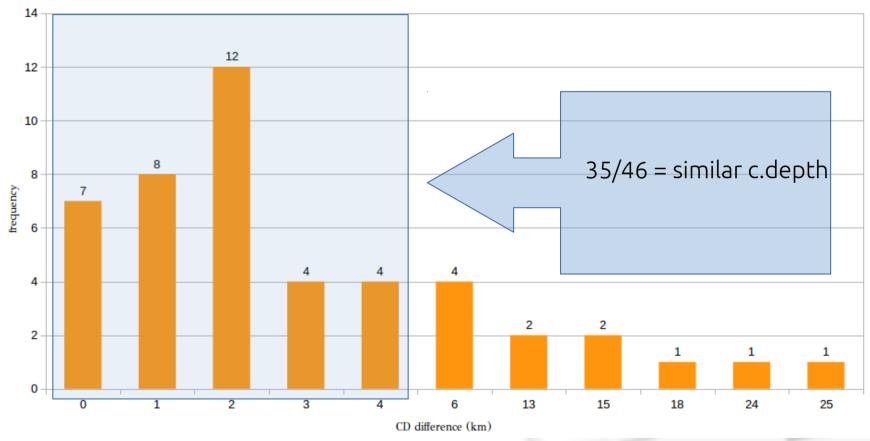
#### Mw Difference



Centroid Depth Difference



#### Centroid Depth Difference



results:

- automatic Vs manual 74% similar solutions
- automatic MTs recognize the size and depth of the seismic source with adequate accuracy a few minutes after the event. Important for quick estimation of ground motions or tsunami hazard
- r average time of the automatic procedure is
   ≈ 5 minutes
- quick revision, in just a few minutes, provides highly accurate solutions

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## login screen

~	database configuration ×					
SC	isola					
50						
scisola S	eisComP3					
type	MySQL &					
user	root					
password	****					
host	localhost					
port	3306					
database	scisola					
status:						
	✓ apply					

• scisola DB (MySQL)

 SeisComP3 DB (MySQL/PostgreSQL)

## login screen

Ŧ		database configuration	×	
	cci	sola		
1	SCI			
	scisola S	eisComP3	databas	se
	type	MySQL	×	
	user	root		
	password	****		
	host	localhost		
	port	3306		
	database	scisola		
s	tatus:			
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		💙 apply		

- scisola DB (MySQL)
- SeisComP3 DB (MySQL/PostgreSQL)

## login screen

→ database configuration ×         ×		
• •		
scisola		
scisola SeisComP3		
type MySQL		
user root		
password ****		
host localhost remote loc	gin eg. 192.168.1.2	
port 3306		
database scisola		
status:		
✓ apply		

scisola

datetime	latitude	longitude	depth	mw	mo	type	id
2014/05/24 09:25:01.00	40.2857	25.4032	8	6.6	7.61214e+18	revised	359
2014/02/09 08:22:58.00	38.1752	20.3675	27	4.8	1.92161e+16	revised	358
2014/02/09 08:22:58.00	38.1752	20.3675	31	4.8	1.80111e+16	revised	357
2014/02/01 16:33:38.00	38.1727	20.3687	10	4.9	2.48455e+16	revised	356
2014/01/31 12:45:40.00	38.418	20.4677	6	4.5	5.60425e+15	revised	355
2014/01/02 05:29:21.00	35.0563	24.366	36	4.2	2.19752e+15	automatic	354
2014/01/11 04:12:56.00	37.8433	21.0142	5	4.9	2.17839e+16	automatic	353
2014/01/26 13:55:43.00	38.219	20.5322	8	6	1.29597e+18	automatic	352
2014/01/26 14:59:25.00	38.303	20.4753	10	4.3	3.18839e+15	automatic	351
2014/01/26 18:45:08.00	38.2282	20.4138	8	5.3	8.54745e+16	automatic	350
2014/01/26 19:03:07.00	38.1873	20.4177	11	4.3	3.30883e+15	automatic	349
2014/01/26 19:12:04.00	38.2408	20.4002	2	4.5	5.50082e+15	automatic	348
2014/01/26 21:15:34.00	38.1337	20.3002	12	4.6	9.73414e+15	automatic	347
2014/01/26 23:06:55.00	38.2398	20.4297	6	4.2	2.62028e+15	automatic	346
2014/01/27 13:05:50.00	38.2308	20.4403	3	4.5	7.36782e+15	automatic	345
2014/01/27 15:39:34.00	38.3748	20.4222	7	4.3	2.83447e+15	automatic	344
2014/01/28 05:12:53.00	38.2083	20.3817	10	4.2	2.16889e+15	automatic	343
2014/01/28 22:22:37.00	38.4037	20.4885	5	4.3	3.07107e+15	automatic	342

scisola

datetime	latitude	longitude	depth	mw	mo	type	id
2014/05/24 05:25:02:00	main tab	S 25.4032	8	6.6	7.61214e+18	revised	359
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## scisola

main buttons

datetime	latitude	longitude	depth	mw	mo	type	id
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2014/01/28 22:22:37.00	38.4037	20.4885	5	4.3	3.07107e+15	automatic	342

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S	<b>ciso</b> l	ิล		latest	20 origins				
origins	datetime	latitude	longitude	depth	mw	mo	type	id	â
	2014/05/24 09:25:01.00	40.2857	25.4032	8	6.6	7.61214e+18	revised	359	
log	2014/02/09 08:22:58.00	38.1752	20.3675	27	4.8	1.92161e+16	revised	358	
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	2014/01/26 13:55:43.00	38.219	20.5322	8	6	1.29597e+18	automatic	352	
	2014/01/26 14:59:25.00	38.303	20.4753	10	4.3	3.18839e+15	automatic	351	
	2014/01/26 18:45:08.00	38.2282	20.4138	8	5.3	8.54745e+16	automatic	350	
	2014/01/26 19:03:07.00	38.1873	20.4177	11	4.3	3.30883e+15	automatic	349	
	2014/01/26 19:12:04.00	38.2408	20.4002	2	4.5	5.50082e+15	automatic	348	
	2014/01/26 21:15:34.00	38.1337	20.3002	12	4.6	9.73414e+15	automatic	347	
	2014/01/26 23:06:55.00	38.2398	20.4297	6	4.2	2.62028e+15	automatic	346	
	2014/01/27 13:05:50.00	38.2308	20.4403	3	4.5	7.36782e+15	automatic	345	TU
	2014/01/27 15:39:34.00	38.3748	20.4222	7	4.3	2.83447e+15	automatic	344	
	2014/01/28 05:12:53.00	38.2083	20.3817	10	4.2	2.16889e+15	automatic	343	
	2014/01/28 22:22:37.00	38.4037	20.4885	5	4.3	3.07107e+15	automatic	342	



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## scisola

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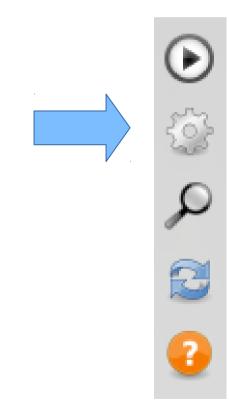
origins 2014-07-31 23:49:47,866 INFO - Settings successfully applied. 2014-07-29 00:48:12,649 INFO - Stoping watcher... 2014-07-29 00:48:09,404 INFO - Starting watcher ... 2014-07-25 12:05:09,595 INFO - Revised procedure finished successfully ... 2014-07-25 12:02:09,668 INFO - Starting revised procedure for origin id: 318... 2014-07-19 18:38:25,250 INFO - Revised procedure finished successfully ... 2014-07-19 18:36:34,848 INFO - Starting revised procedure for origin id: 357... 2014-07-19 18:30:43,847 INFO - Revised procedure finished successfully ... 2014-07-19 18:28:46,498 INFO - Starting revised procedure for origin id: 331... 2014-07-19 18:21:58,527 INFO - Revised procedure finished successfully... 2014-07-19 18:20:06,428 INFO - Starting revised procedure for origin\_id: 336... 2014-07-19 18:07:53,931 INFO - Revised procedure finished successfully ...

## main buttons



- start/stop watcher
- settings screen
- search screen
- update latest 20 origins
- about screen

## main buttons



- start/stop watcher
- settings screen
- search screen
- update latest 20 origins
- about screen

stations inversion watch	er settings			
Location's restriction				Magnitude's restriction
center longitude		center latitude 38.0	distance range (km)	min magnitude 3.5 J
Distance selection				
	magnitude min 0.0 ) max 0.0 )	distance (km) min 0 1 max 0	<pre>3.5 &lt;= magnitude &lt;= 4.0 and 10 &lt;= distance &lt;= 100 4.1 &lt;= magnitude &lt;= 4.5 and 50 &lt;= distance &lt;= 150 4.6 &lt;= magnitude &lt;= 5.0 and 80 &lt;= distance &lt;= 200 5.1 &lt;= magnitude &lt;= 5.5 and 90 &lt;= distance &lt;= 250 5.6 &lt;= magnitude &lt;= 6.0 and 110 &lt;= distance &lt;= 500 6.1 &lt;= magnitude &lt;= 12.0 and 330 &lt;= distance &lt;= 1000</pre>	
Azimuthal selection			Stations	
number of sectors stations per sector		1         ↓           3         ↓		
	Last change	5: 2014-07-31 20:49:46	✓ apply	

-		Settings	- + 3
stations inversion watcher settings	settings tabs		
Location's restriction			Magnitude's restriction
center longitude 22.0	center latitude 38.0		distance range (km) min magnitude 3.5
Distance selection magnitude min 0.0 1 max 0.0 1	distance (km) min 0 1 max 0	,	3.5 <= magnitude <= 4.0 and 10 <= distance <= 100 4.1 <= magnitude <= 4.5 and 50 <= distance <= 150 4.6 <= magnitude <= 5.0 and 80 <= distance <= 200 5.1 <= magnitude <= 5.5 and 90 <= distance <= 250 5.6 <= magnitude <= 6.0 and 110 <= distance <= 500 6.1 <= magnitude <= 12.0 and 330 <= distance <= 1000
Azimuthal selection number of sectors stations per sector	13	▲ ● ●	Stations       edit database
Last change	es: 2014-07-31 20:49:46		✓ apply

stations inversion wat	cher settings	
Location's restriction		Magnitude's restriction
center longitude	distance rules	distance range (km) 1000 (1) min magnitude 3.5 (1)
Distance selection		3.5 <= magnitude <= 4.0 and 10 <= distance <= 100
	magnitudedistance (km)min0.0min0max0.0max0	4.1 <= magnitude <= 4.5 and 50 <= distance <= 150 4.6 <= magnitude <= 5.0 and 80 <= distance <= 200 5.1 <= magnitude <= 5.5 and 90 <= distance <= 250 5.6 <= magnitude <= 6.0 and 110 <= distance <= 500 6.1 <= magnitude <= 12.0 and 330 <= distance <= 1000
Azimuthal selection		Stations
number of sectors stations per sector	1 * 3	
	Last changes: 2014-07-31 20:49:46	✓ apply

stations inversion wat	cher settings		
Location's restriction			Magnitude's restriction
center longitude	center latitude 38.0		distance range (km) min magnitude 3.5
Distance selection			
Distance selection	magnitudedistance (km)min0.0 1min0<1max0.0 1max0<1	-	<pre>3.5 &lt;= magnitude &lt;= 4.0 and 10 &lt;= distance &lt;= 100 4.1 &lt;= magnitude &lt;= 4.5 and 50 &lt;= distance &lt;= 150 4.6 &lt;= magnitude &lt;= 5.0 and 80 &lt;= distance &lt;= 200 5.1 &lt;= magnitude &lt;= 5.5 and 90 &lt;= distance &lt;= 250 5.6 &lt;= magnitude &lt;= 6.0 and 110 &lt;= distance &lt;= 500 6.1 &lt;= magnitude &lt;= 12.0 and 330 &lt;= distance &lt;= 1000</pre>
	azimuthal rules		
Azimuthal selection		. St	edit database
number of sectors stations per sector	3	¢	
	Last changes: 2014-07-31 20:49:46		✓ apply

stations inversion watcher s	settings				
Location's restriction					Magnitude's restriction
center longitude 22.0		center latitude 38.0		distance range (km)	min magnitude 3.5
Distance selection					
mi		distance (km) min 0 1 max 0	4.1 <= magnitude <= 4 4.6 <= magnitude <= 5 5.1 <= magnitude <= 5 5.6 <= magnitude <= 6	4.0 and 10 <= distance <= 100 4.5 and 50 <= distance <= 150 5.0 and 80 <= distance <= 200 5.5 and 90 <= distance <= 250 6.0 and 110 <= distance <= 500 12.0 and 330 <= distance <= 1000	
				edit scisola stations	
Azimuthal selection			Stations	edit database	
number of sectors stations per sector		1         ▲           3         ↓			
-	Last changes	: 2014-07-31 20:49:46	✓ apply		

stations inversion watcher settings		
Centroid depth	Green's functions c	onfiguration
number of sources	20	Clipping threshold
step search (km)	2	Time grid search
Crustal model		start -75 end 75
crustal model path /home/nikos/Dropbox/mas	ter_thesis/version/scisola-1.0/crustal.dat	step search 2
Inversion time magnitude min 0.0 1 max 0.0 1	tl (sec) 16.384 ▲	3.5 <= magnitude <= 5.5 and tl = 327.68 5.6 <= magnitude <= 12.0 and tl = 409.6 Image: the second
Inversion frequency magnitude frequencies ( min 0.0 1 max 0.0 1	Hz) 0.0000 0 0.0000 0 0.0000 0	<ul> <li>5.6 &lt;= magnitude &lt;= 6.0 and frequencies = [0.02, 0.03, 0.06, 0.07]</li> <li>6.1 &lt;= magnitude &lt;= 12.0 and frequencies = [0.001, 0.005, 0.01, 0.02]</li> <li>3.5 &lt;= magnitude &lt;= 4.2 and frequencies = [0.06, 0.07, 0.09, 0.1]</li> <li>4.3 &lt;= magnitude &lt;= 5.5 and frequencies = [0.04, 0.05, 0.08, 0.09]</li> </ul>
Last ch	anges: 2014-07-31 20:49:46	✓ apply

stations inversion watcher settings		
Centroid depth		Data clipping
number of sources	20	clipping threshold 0.80
step search (km)	2	Time grid search
Crustal model		start -75
		end 75
crustal model path /home/nikos/Dropbox/master_th	esis/version/scisola-1.0/crustal.dat	step search 2
Inversion time magnitude min 0.0 1 max 0.0 1	tl (sec)	3.5 <       = magnitude <= 5.5 and tl = 327.68         5.6 <       = magnitude <= 12.0 and tl = 409.6
Inversion frequency magnitude frequencies (Hz) min 0.0 1 0.000 1 0.000 max 0.0 1	00 0 0.0000 0.0000	5.6 <= magnitude <= 6.0 and frequencies = [0.02, 0.03, 0.06, 0.07] 6.1 <= magnitude <= 12.0 and frequencies = [0.001, 0.005, 0.01, 0.02] 3.5 <= magnitude <= 4.2 and frequencies = [0.06, 0.07, 0.09, 0.1] 4.3 <= magnitude <= 5.5 and frequencies = [0.04, 0.05, 0.08, 0.09]
Last changes	: 2014-07-31 20:49:46	✓ apply



stations inversion watcher settings	
check interval (sec)	60
process triggering delay (sec)	0
process timeout (sec)	3600



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stations inversion watcher settings			
	watcher configuration		
check interval (sec)		60 Ĵ	
process triggering delay (sec)		0	]
process timeout (sec)		3600	



stations inve	rsion watcher	settings								
scisola										
results folder	/home/nikos/I	Desktop/out						browse		
scisola data	abase		C update database			🗌 reset				
SeisComP3										
SeisComP3 p	ath /home/nik	/home/nikos/Programs/seiscomp3_exp/bin/seiscomp								
scevtls path	scevtls	scevtls								
scxmldump p	oath scxmldum	scxmldump								
slinktool		path     slinktool       host     83.212.117.71								
ISOLA										
ISOLA path	/home/nikos/Dro	opbox/master_the	is/version/scisola-1.0/ISOLA					browse		
		Last ch	anges: 2014-07-31 20:49:46		✓ apply					

stations inversion	ion watcher settings	
scisola		
results folder //	/home/nikos/Desktop/out	📕 browse
scisola databa		
	C update database         import streamsefrom	15C3
SeisComP3		
SeisComP3 path	th /home/nikos/Programs/seiscomp3_exp/bin/seiscomp	J browse
scevtls path	scevtls	J browse
scxmldump path	th scxmldump	J browse
	path Slinktool	🛃 browse
slinktool	host 83.212.117.71	port 18000
ISOLA		
ISOLA path /hor	home/nikos/Dropbox/master_thesis/version/scisola-1.0/ISOLA	J browse
	Last changes: 2014-07-31 20:49:46	

	network 🔺	station	stream	latitude	longitude	station_priority	stream_priority	azimuth	dip	sensor_gain	datalogger_gain	normalization_fac
531	HP	LTK	HHN	38.0228	22.9673	5	7	0.0	0.0	6000.0	399998.4	571508000.0
532	HP	LTK	HHZ	38.0228	22.9673	5	7	0.0	-90.0	6000.0	399998.4	571508000.0
533	HP	ZKS	HHE	37.696	20.785	5	7	90.0	0.0	1201.0	399998.4	1703690000.0
534	HP	ZKS	HHN	37.696	20.785	5	7	0.0	0.0	1201.0	399998.4	1703690000.0
535	HP	ZKS	HHZ	37.696	20.785	5	7	0.0	-90.0	1201.0	399998.4	1703690000.0
536	HP	SGD	HHE	39.612	20.234	5	7	90.0	0.0	2000.0	399998.4	98533.4
537	HP	SGD	HHN	39.612	20.234	5	7	0.0	0.0	2000.0	399998.4	98533.4
538	HP	SGD	HHZ	39.612	20.234	5	7	0.0	-90.0	2000.0	399998.4	98533.4
539	HP	AXS	HHE	38.1962	21.3763	5	7	90.0	0.0	2000.0	999996.0	98533.4
540	HP	AXS	HHN	38.1962	21.3763	5	7	0.0	0.0	2000.0	999996.0	98533.4
541	HP	AXS	HHZ	38.1962	21.3763	5	7	0.0	-90.0	2000.0	999996.0	98533.4
542	HP	GUR	HHE	37.9363	22.3423	5	7	90.0	0.0	1500.0	999996.0	1.0
543	HP	GUR	HHN	37.9363	22.3423	5	7	0.0	0.0	1500.0	999996.0	1.0
544	HP	GUR	HHZ	37.9363	22.3423	5	7	0.0	-90.0	1500.0	999996.0	1.0
545	HP	RGA	HHE	39.3212	20.3544	5	7	90.0	0.0	2000.0	303030.3	98533.4
546	HP	RGA	HHN	39.3212	20.3544	5	7	0.0	0.0	2000.0	303030.3	98533.4
547	HP	RGA	HHZ	39.3212	20.3544	5	7	0.0	-90.0	2000.0	303030.3	98533.4
548	HP	DSL	HHE	39.1338	21.0964	5	7	90.0	0.0	2000.0	303030.3	98533.4
549	HP	DSL	HHN	39.1338	21.0964	5	7	0.0	0.0	2000.0	303030.3	98533.4
						_	_					

# settings screen

							tations		cl	ick to ed	it 📃	
	network 🔺	station	stream	latitude	longitude	station_priority	stream_priority	azimuth	dip	sensor_gain	datalogger_gain	normalization_fact
531	HP	LTK	HHN	38.0228	22.9673	5	7	0.0	0.0	6000.0	399998.4	571508000.0
532	HP	LTK	HHZ	38.0228	22.9673	5	7	0.0	-90.0	6000.0	399998.4	571508000.0
533	HP	ZKS	HHE	37.696	20.785	5	7	90.0	0.0	1201.0	399998.4	1703690000.0
534	HP	ZKS	HHN	37.696	20.785	5	7	0.0	0.0	1201.0	399998.4	1703690000.0
535	HP	ZKS	HHZ	37.696	20.785	5	7	0.0	-90.0	1201.0	399998.4	1703690000.0
536	HP	SGD	HHE	39.612	20.234	5	7	90.0	0.0	2000.0	399998.4	98533.4
537	HP	SGD	HHN	39.612	20.234	5	7	0.0	0.0	2000.0	399998.4	98533.4
538	HP	SGD	HHZ	39.612	20.234	5	7	0.0	-90.0	2000.0	399998.4	98533.4
539	HP	AXS	HHE	38.1962	21.3763	5	7	90.0	0.0	2000.0	999996.0	98533.4
540	HP	AXS	HHN	38.1962	21.3763	5	7	0.0	0.0	2000.0	999996.0	98533.4
541	HP	AXS	HHZ	38.1962	21.3763	5	7	0.0	-90.0	2000.0	999996.0	98533.4
542	HP	GUR	HHE	37.9363	22.3423	5	7	90.0	0.0	1500.0	999996.0	1.0
543	HP	GUR	HHN	37.9363	22.3423	5	7	0.0	0.0	1500.0	999996.0	1.0
544	HP	GUR	HHZ	37.9363	22.3423	5	7	0.0	-90.0	1500.0	999996.0	1.0
545	HP	RGA	HHE	39.3212	20.3544	5	7	90.0	0.0	2000.0	303030.3	98533.4
546	HP	RGA	HHN	39.3212	20.3544	5	7	0.0	0.0	2000.0	303030.3	98533.4
547	HP	RGA	HHZ	39.3212	20.3544	5	7	0.0	-90.0	2000.0	303030.3	98533.4
548	HP	DSL	HHE	39.1338	21.0964	5	7	90.0	0.0	2000.0	303030.3	98533.4
549	HP	DSL	HHN	39.1338	21.0964	5	7	0.0	0.0	2000.0	303030.3	98533.4
						_						

# main screen

scisola

datetime	latitude	longitude	depth	mw	mo	type	id
2014/05/24 09:25:01.00	40.2857	25.4032	8	6.6	7.61214e+18	revised	359
2014/02/09 08:22:58.00	38.1752	20.3675	27	4.8	1.92161e+16	revised	358
2014/02/09 08:22:58.00	38.1752	20.3675	31	4.8	1.80111e+16	revised	357
2014/02/01 16:33:38.00	38.1727	20.3687	10	4.9	2.48455e+16	revised	356
2014/01/31 12:45:40.00	38.418	20.4677	6	4.5	5.60425e+15	revised	355
2014/01/02 05:29:21.00	35.0563	24.366	36	4.2	2.19752e+15	automatic	354
2014/01/11 04:12:56.00	37.8433	21.0142	5	4.9	2.17839e+16	automatic	353
2014/01/26 13:55:43.00	38.219	20.5322	8	6	1.29597e+18	automatic	352
2014/01/26 14:59:25.00	38.303	20.4753	10	4.3	3.18839e+15	automatic	351
2014/01/26 18:45:08.00	38.2282	20.4138	8	5.3	8.54745e+16	automatic	350
2014/01/26 19:03:07.00	38.1873	20.4177	11	4.3	3.30883e+15	automatic	349
2014/01/26 19:12:04.00	38.2408	20.4002	2	4.5	5.50082e+15	automatic	348
2014/01/26 21:15:34.00	38.1337	20.3002	12	4.6	9.73414e+15	automatic	347
2014/01/26 23:06:55.00	38.2398	20.4297	6	4.2	2.62028e+15	automatic	346
2014/01/27 13:05:50.00	38.2308	20.4403	3	4.5	7.36782e+15	automatic	345
2014/01/27 15:39:34.00	38.3748	20.4222	7	4.3	2.83447e+15	automatic	344
2014/01/28 05:12:53.00	38.2083	20.3817	10	4.2	2.16889e+15	automatic	343
2014/01/28 22:22:37.00	38.4037	20.4885	5	4.3	3.07107e+15	automatic	342

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# Main Screen

	d		double cli	ck to review	v		
datetime	latitude	longitude	depth	mw	mo	type	id
2014/05/24 09:25:01.00	40.2857	25.4032	8	6.6	7.61214e+18	revised	359
2014/02/09 08:22:58.00	38.1752	20.3675	27	4.8	1.92161e+16	revised	358
2014/02/09 08:22:58.00	38.1752	20.3675	31	4.8	1.80111e+16	revised	357
2014/02/01 16:33:38.00	38.1727	20.3687	10	4.9	2.48455e+16	revised	356
2014/01/31 12:45:40.00	38.418	20.4677	6	4.5	5.60425e+15	revised	355
2014/01/02 05:29:21.00	35.0563	24.366	36	4.2	2.19752e+15	automatic	354
2014/01/11 04:12:56.00	37.8433	21.0142	5	4.9	2.17839e+16	automatic	353
2014/01/26 13:55:43.00	38.219	20.5322	8	6	1.29597e+18	automatic	352
2014/01/26 14:59:25.00	38.303	20.4753	10	4.3	3.18839e+15	automatic	351
2014/01/26 18:45:08.00	38.2282	20.4138	8	5.3	8.54745e+16	automatic	350
2014/01/26 19:03:07.00	38.1873	20.4177	11	4.3	3.30883e+15	automatic	349
2014/01/26 19:12:04.00	38.2408	20.4002	2	4.5	5.50082e+15	automatic	348
2014/01/26 21:15:34.00	38.1337	20.3002	12	4.6	9.73414e+15	automatic	347
2014/01/26 23:06:55.00	38.2398	20.4297	6	4.2	2.62028e+15	automatic	346
2014/01/27 13:05:50.00	38.2308	20.4403	3	4.5	7.36782e+15	automatic	345
2014/01/27 15:39:34.00	38.3748	20.4222	7	4.3	2.83447e+15	automatic	344
2014/01/28 05:12:53.00	38.2083	20.3817	10	4.2	2.16889e+15	automatic	343
2014/01/28 22:22:37.00	38,4037	20.4885	5	4.3	3.07107e+15	automatic	342

review

results map misfit inversion correlation streams text log Revision Event ID dataset Origin ID 360 Freg Band (Hz) 0.0400 0.0500 ^ \_ and 0.0800 0.0900 • tapered tapered Origin Timestamp 2014-10-01 11:58:23.071589 Type revised Stream Contribution (variance reduction per component) Network Station Ν Е Ζ 1 HT LKD2 0.67 0.91 -0.45 Origin Date (GMT) 2014/02/01 Origin Time (GMT) 16:33:38.00 2 HL RLS 0.82 0.29 -0.57 Centroid Longitude 20.3687 Centroid Latitude 38.1727 3 HP PVO 0.47 0.65 0.13 Centroid Depth (km) 10.0 Centroid Time (sec) 2.76 Mw 4.9 Moment (Nm) 2.48454817e+16 4 HP DRO 0.81 -0.62 -3.93 5 HP AMT -1.2 0.46 0.3 Correlation 0.773009 Variance Reduction 0.380912721 VOL (%) -0.0 DC (%) 68.4 CLVD (%) 31.6 6 HP ANX -1.02 0.49 0.95 Mtt 1.83137e+16 Mrr -8.4149e+15 Mpp -9.8988e+15 Mrt -2.0432e+15 Mrp 7.5847e+15 Mtp 1.74213e+16 NP1 NP2 Strike 203.0 105.0 Dip 71.0 68.0 Rake -157.0 -19.0 Azimuth Plunge **P-axis** 65.0 28.0 T-axis 334.0 2.0 / revise 🗌 all 🗎 delete **B**-axis 239.0 61.0 Min Singular Value 6.64989791e-16 Max Singular Value 1.22019617e-15 Condition Number 1.83490968 STVAR 0.2 **FMVAR** 11.9491111111

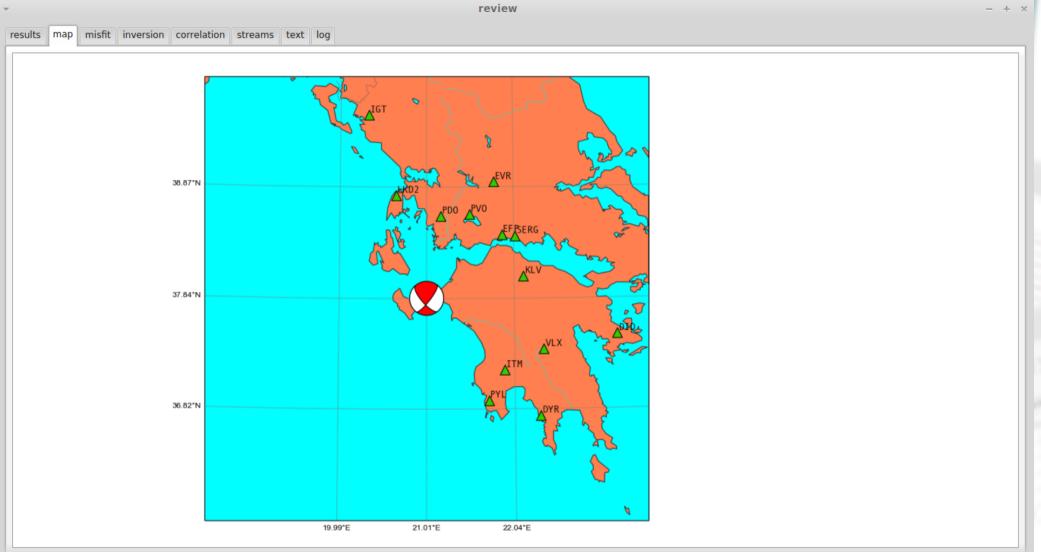
- + >

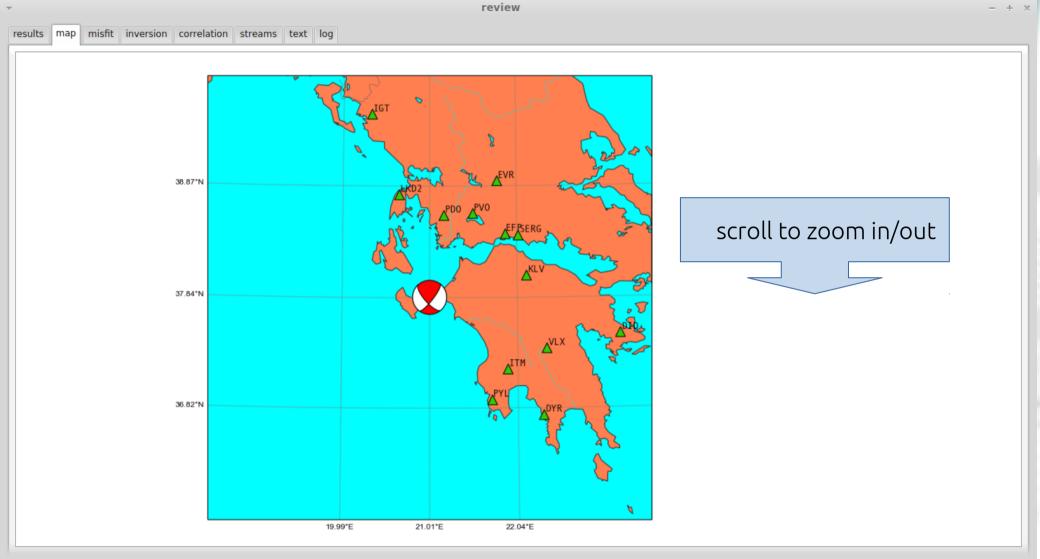
			review						- +
results map misfit inversion corr	relation streams text log	с геч	view tabs						
				Revisio	on				
Event ID	o dataset		Origin ID 360	Freq	Band (Hz) 0.0	400 1 -	0.0500 🕽 an	d 0.0800 1	- 0.0900
				-		tapered			pered
	imestamp 2014-10-01 11:58:23.03	71590	Type revised						
	mestamp 2014-10-01 11.56.25.0	1203	iype revised	Strea	am Contributio	n (variance red	uction per comp	onent)	
					Network	Station	Ν	E	Z
				1	HT	LKD2	0.67	0.91	-0.45
Origin Date (GMT) 2014/02/01		Origin Time (GMT)		2	HL	RLS	0.82	0.29	-0.57
Centroid Longitude 20.3687 Centroid Depth (km) 10.0		Centroid Latitude Centroid Time (sec)	38.1727	3	HP	PVO	0.47	0.13	0.65
Mw 4.9		Moment (Nm)	2.48454817e+16	4	HP	DRO	0.81	-0.62	-3.93
Correlation 0.773009	Variance Reduction 0.3809	12721		5	HP	AMT	-1.2	0.46	0.3
<b>VOL (%)</b> -0.0	<b>DC (%)</b> 68.4		CLVD (%) 31.6	6	HP	ANX	-1.02	0.49	0.95
Mrr -8.4149e+15	Mtt 1.83137e+16	1	Mpp -9.8988e+15						
Mrt -2.0432e+15	Mrp 7.5847e+15	1	Mtp 1.74213e+16						
	NP1	NP2							
Strike	203.0	105.0							
Dip	71.0	68.0							
Rake	-157.0	-19.0							
	Azimuth	Plunge							
P-axis	65.0	28.0							
T-axis	334.0	2.0			all	🔒 delete		🗸 revise	
B-axis	239.0	61.0							
Min Singular Value 6.64989791e-10	6 Max Singular Value 1.220196	17e-15 Condition Nu	mber 1.83490968						
<b>STVAR</b> 0.2	FMVAR 11.94911	11111							

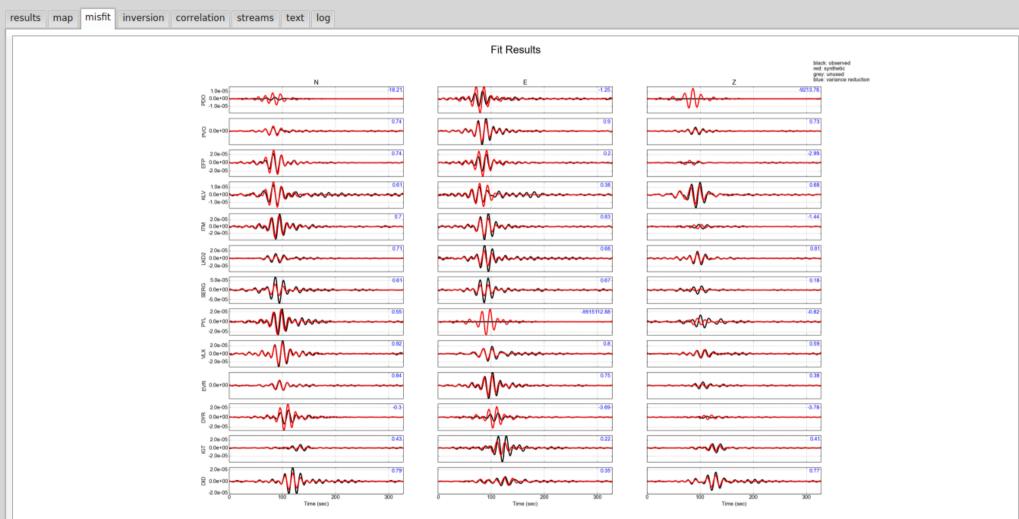
			ew so	-			revisio	n	
			review						-
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[				Re	evision				
Ev	ent ID dataset		Origin ID 360	F	req Band (Hz) 0.0	400 🕽 -	0.0500 🗊 an	d 0.0800 🕽	- 0.0900
						tapered		ta	pered
Or	igin Timestamp 2014-10-	01 11:58:23.071589	Type revised						
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					Network	Station	N	E	Z
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igin Date (GMT) 2014/02		_	MT) 16:33:38.00		2 HL	RLS	0.82	0.29	-0.57
ntroid Longitude 20.368 ntroid Depth (km) 10.0		Centroid Latitu Centroid Time			3 HP	PVO	0.47	0.13	0.65
w 4.9		Moment (Nm)	2.48454817e+16		4 HP	DRO	0.81	-0.62	-3.93
orrelation 0.773009	Variance Red	uction 0.380912721			5 HP	AMT	-1.2	0.46	0.3
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rt -2.0432e+15	Mrp 7.584	7e+15	Mtp 1.74213e+16						
	NP1	NP2							
rike	203.0	105.0							
р	71.0	68.0							
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review

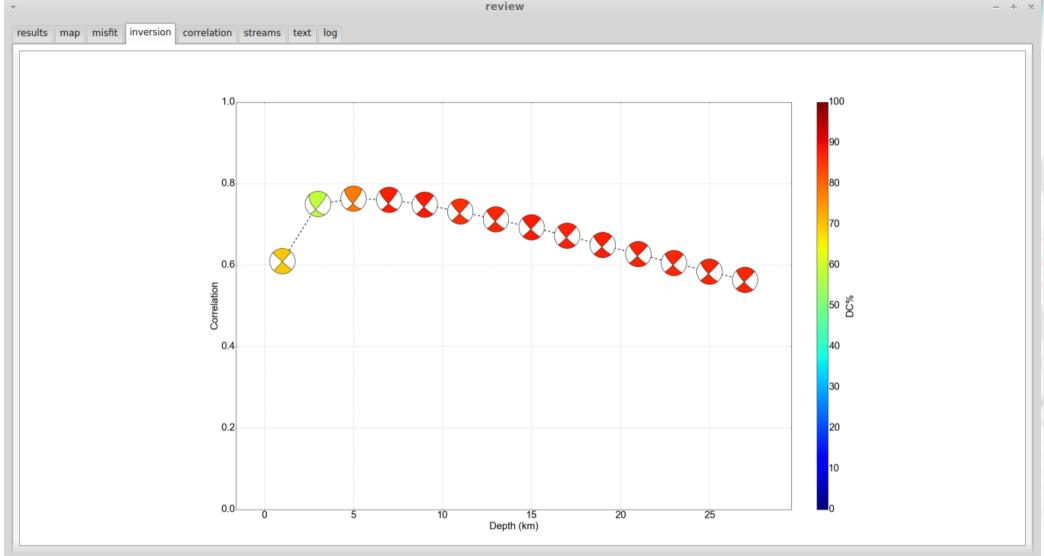
results map misfit inversion correlation streams text log Revision Event ID dataset Origin ID 360 Freg Band (Hz) 0.0400 0.0500 ^ \_ and 0.0800 0.0900 1 tapered tapered Origin Timestamp 2014-10-01 11:58:23.071589 Type revised Stream Contribution (variance reduction per component) Network Station Ν Е Ζ 1 HT LKD2 0.67 0.91 -0.45 Origin Date (GMT) 2014/02/01 Origin Time (GMT) 16:33:38.00 2 HL RLS 0.82 0.29 -0.57 Centroid Longitude 20.3687 Centroid Latitude 38.1727 3 HP PVO 0.47 0.65 0.13 Centroid Depth (km) 10.0 Centroid Time (sec) 2.76 Mw 4.9 Moment (Nm) 2.48454817e+16 4 HP DRO 0.81 -0.62 -3.93 5 HP AMT -1.2 0.46 0.3 Correlation 0.773009 Variance Reduction 0.380912721 VOL (%) -0.0 DC (%) 68.4 CLVD (%) 31.6 6 HP ANX -1.02 0.49 0.95 Mtt 1.83137e+16 Mrr -8.4149e+15 Mpp -9.8988e+15 Mrt -2.0432e+15 Mrp 7.5847e+15 Mtp 1.74213e+16 delete origin NP1 NP2 Strike 203.0 105.0 Dip 71.0 68.0 Rake -157.0 -19.0 Azimuth Plunge **P-axis** 65.0 28.0 T-axis 334.0 2.0 / revise 🗌 all 🗎 delete **B**-axis 239.0 61.0 Min Singular Value 6.64989791e-16 Max Singular Value 1.22019617e-15 Condition Number 1.83490968 STVAR 0.2 **FMVAR** 11.9491111111

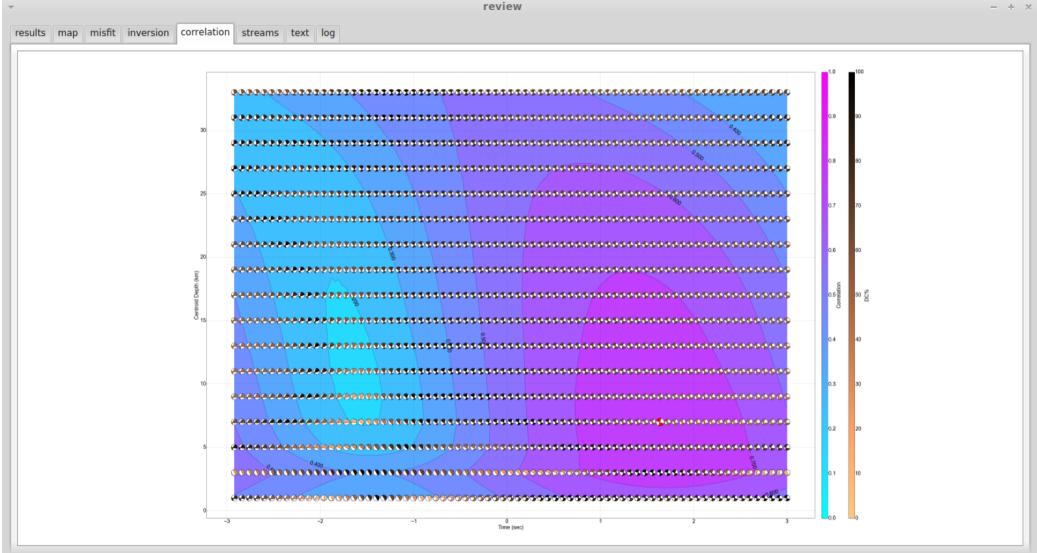






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	Mw: 4.9					
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	Stations N	E	Z			
	HP.PDO	-18.21		-9213.76		
	HP.PVO			0.73		
	HP.EFP			-2.99		
	HL.KLV		0.38	0.68		
	HL.ITM			-1.44		
	HT.LKD2		0.68	0.81		
	HP.SERG	0.61	0.67	0.18		
	HP.PYL	0.55	-9915112	.88	-0.82	
	HP.VLX	0.92	0.8	0.59		
	HL.EVR	0.84	0.75	0.38		
	HP.DYR	-0.3	-3.69	-3.78		
	HT.IGT	0.43	0.22	0.41		
	HP.DID	0.79	0.35	0.77		
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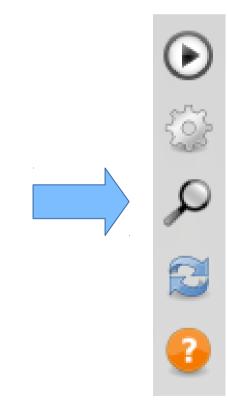
review

results map misfit inversion correlation streams text log

2014-07-17 18:32:01,339 INFO - Working directory is set to: /home/nikos/Desktop/out/20140111\_041256000000/20140717\_153201332480

2014-07-17 18:32:01,340 INFO - Origin's parameters: datetime: 2014/01/11 04:12:56.00 latitude: 37.8433 longitude: 21.0142 magnitude: 4.7 depth: 7 timestamp: 2014-07-17 15:32:01.332480 event id: dataset 2014-07-17 18:32:01,340 INFO - Settings's parameters: time grid step: 2 distance range: 1000 time grid end: 75 stations per sector: 3 sources: 20 clipping threshold: 0.8 seedlink host: 83.212.117.71 sc3 path: /home/nikos/Programs/seiscomp3 exp/bin/seiscomp source step: 2 sc3 scxmldump: scxmldump process timeout: 3600 inversion\_time: [[3.5, 5.5, 327.68], [5.6, 12.0, 409.6]] id: 1 crustal model path: /home/nikos/Dropbox/master thesis/version/scisola-1.0/crustal.dat output dir: /home/nikos/Desktop/out center latitude: 38.0 time grid start: -75 min sectors: 1 timestamp: 2014-07-17 09:57:09 process delay: 0 seedlink port: 18000 distance\_selection: [[3.5, 4.0, 10, 100], [4.1, 4.5, 50, 150], [4.6, 5.0, 80, 200], [5.1, 5.5, 90, 250], [5.6, 6.0, 110, 500], [6.1, 12.0, 330, 1000]] sc3 scevtls: scevtls watch interval: 60 isola path: /home/nikos/Dropbox/master thesis/version/scisola-1.0/ISOLA magnitude threshold: 3.5 center\_longitude: 22.0

# main buttons



- start/stop watcher
- settings screen
- search screen
- update latest 20 origins
- about screen

### search screen

· sea	rch ×	
SCISOL	9	
From	2014/07/31 20:53:18.113 🔻	
То	2014/07/31 20:53:18.113 🔻	
<mark>, ₽</mark> se	arch	

### shows origins defined by datetime (GMT) range

# main screen

# scisola

searched origins

<u>ک</u>

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6								
origins	datetime	latitude	longitude	depth	mw	mo	type	id
ð	2014/05/24 09:25:01.00	40.2857	25.4032	8	6.6	7.61214e+18	revised	359
<u>fo</u>	2014/02/09 08:22:58.00	38.1752	20.3675	27	4.8	1.92161e+16	revised	358
	2014/02/09 08:22:58.00	38.1752	20.3675	31	4.8	1.80111e+16	revised	357
	2014/02/01 16:33:38.00	38.1727	20.3687	10	4.9	2.48455e+16	revised	356
	2014/01/31 12:45:40.00	38.418	20.4677	6	4.5	5.60425e+15	revised	355
	2014/01/02 05:29:21.00	35.0563	24.366	36	4.2	2.19752e+15	automatic	354
	2014/01/11 04:12:56.00	37.8433	21.0142	5	4.9	2.17839e+16	automatic	353
	2014/01/26 13:55:43.00	38.219	20.5322	8	6	1.29597e+18	automatic	352
	2014/01/26 14:59:25.00	38.303	20.4753	10	4.3	3.18839e+15	automatic	351
	2014/01/26 18:45:08.00	38.2282	20.4138	8	5.3	8.54745e+16	automatic	350
	2014/01/26 19:03:07.00	38.1873	20.4177	11	4.3	3.30883e+15	automatic	349
	2014/01/26 19:12:04.00	38.2408	20.4002	2	4.5	5.50082e+15	automatic	348
	2014/01/26 21:15:34.00	38.1337	20.3002	12	4.6	9.73414e+15	automatic	347
	2014/01/26 23:06:55.00	38.2398	20.4297	6	4.2	2.62028e+15	automatic	346
	2014/01/27 13:05:50.00	38.2308	20.4403	3	4.5	7.36782e+15	automatic	345
	2014/01/27 15:39:34.00	38.3748	20.4222	7	4.3	2.83447e+15	automatic	344
	2014/01/28 05:12:53.00	38.2083	20.3817	10	4.2	2.16889e+15	automatic	343
	2014/01/28 22:22:37.00	38.4037	20.4885	5	4.3	3.07107e+15	automatic	342

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- (10) links & more



### manual example

*# import the necessary scisola modules* import src.lib.origin as origin import src.lib.database as database import src.lib.settings as settings import src.lib.process as process

# creates an Origin object
# fill with the desired values
# the attributes of the Origin object can be found at (scisola/src/lib/origin.py)
orig = origin.Origin()
orig.datetime = "2015/11/08 09:21:41.00"
orig.magnitude = round(3.9,1) # must be no more than 1 decimal
orig.longitude = 21.747
orig.latitude = 38.3568
orig.depth = int(7) # must be integer
orig.event\_id = "test" # the id provided by seiscomp3 or anything you want

### manual example

# creates a Database object # fill with the desired values # the attributes of the Database object can be found at (scisola/src/lib/database.py) db = database.Database() db.password = "password"

# creates a Settings object
sett = settings.Settings()
# retrieves configuration from database
sett = db.loadSettings(sett)

# by-passing database values by filling desired variables # the attributes of the Settings object can be found at (scisola/src/lib/settings.py) # e.g. # setting different results folder than the one provided by the database

sett.output\_dir = '/home/user/myoutput' # (example)

### manual example

# creates a Process Object for calculating # fill with the desired values # the attributes of the Process object can be found at (scisola/src/lib/process.py) # if for example provide a station\_list, it calculates a revise procedure, if however station\_list is empty, it calculates an automatic procedure. By default, is empty # if for example save2DB is False, it won't store the results to scisola database # check (scisola/src/lib/process.py) for more info and options p = process.Process(origin=orig, settings=sett, db\_scisola=db, save2DB=True, delay=0) # starting MT calculation p.start()

*# run from terminal: python example.py* 

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# future improvements

- advanced methods and artificial intelligence techniques for stations/streams selection
- advanced signal processing methods to be applied to seismic waveforms (to avoid various problems e.g. disturbances, noise and data transmission problems)
   e.g.: Vackář, J. et al, (2014) "Automated detection of disturbances in seismic records; MouseTrap code"
- multiple or 3D crustal models based on earthquake's location
- search of centroid in 3D grid surrounding hypocenter
- pre-calculated Green's functions (for faster performance)
- optimization of inversion, by re-calculating inversion according to streams' correlation
- improved GUI interaction with user
- upgraded configuration and overview info according to user's needs
- save results to SeisComP3

# future improvements

Event ID         dataset.         Origin ID 360         Revision           Origin Date (GMT)         2014/02/08         Origin Time (GMT)         2014/02/08         Origin Time (GMT)         16:33:38.00           Centroid Latitude         20.3687         Centroid Longitude         38.1727         HP         PVO           Centroid Latitude         20.3687         Centroid Longitude         38.1727         HP         PVO           Mer         4.9         Moment (Nm)         2.49454817±160         HP         DRO           VoL (%)         0.0         DC (%)         68.4         CLVD (%)         31.6         HP         ANT           Mrr -8.4149e+15         Mrt 1.831370         Immediate means (means (marks) (mins)	
Origin Timestamp         2014-10-01         11:50:23.071599         Type         revised           Origin Date (GMT)         2014/02/01         Origin Time (GMT)         06:33:38.00           Centroid Latitude         20.687         Centroid Longitude         38.1727           Centroid Depth (km)         10.0         Centroid Time (sec)         2.76           Mw         4.9         Moment (Nm)         2.48454817e+16           Cerrelation         0.773009         Variance Reduction         0.300312721           VOL (%)         0.0         DC (%)         68.4         CLVD (%)         31.6           Mrr         8.4149e+15         Mtt         1.83137e         Imm         Imm           Mrt         2.0632e+15         Mrp         7.5647         Immediate (mediate) (modeled (m)	
Origin Date (GMT)         2014/02/01         Origin Time (GMT)         16:33:38.00           Centroid Latitude         20.5687         Centroid Longitude         38.1727           Centroid Depth (km)         10.0         Centroid Time (sec)         2.75           Mw         4.9         Moment (Nm)         2.48454817c+16           Cerrelation         0.773009         Variance Reduction         0.300912721           VOL (%)         0.0         DC (%)         68.4         CLVD (%)         31.6           Mrr         -8.4149c+15         Mtt         1.83137c         Imp         AMT           Mrt         -2.0632e+15         Mrp         7.547         Imp         Max	
Origin Date (GMT)         2014/02/01         Origin Time (GMT)         16:33:38.00         2         HL         RLS           Centroid Latitude         20.3687         Centroid Longitude         38.1727         3         HP         PVO           Centroid Depth (km)         10.0         Centroid Time (sec)         2.76         MP         PVO           Mw         4.9         Moment (Nm)         2.48454817±16         4         HP         DRO           Cerrelation         0.773009         Variasce Reduction         0.300312721         6         HP         AMT           VOL (%)         0.0         DC (%)         6E.4         CLVD (%)         31.6         6         HP         AMT           Mrr         -8.4149c+15         Mtt         1.83137c         memory and instance (memory an	
Centroid Latitude         20.3687         Centroid Longitude         38.1727           Centroid Depth (km)         10.0         Centroid Time (sec)         2.75           Mw         4.9         Moment (Nm)         2.48454817e+16         3         HP         PVO           Correlation         0.773009         Variance Reduction         0.300912721         4         HP         DRO           VOL (%)         0.0         DC (%)         68.4         CLVD (%)         31.6         6         HP         AMT           Mrr         -8.4149e+15         Mtt         1.83137e	
Centroid Depth (km) 10.0         Centroid Time (sec) 2.76         3         HP         PVO           Mw         4.9         Moment (Nm) 2.48454817±16         4         HP         DRO           Correlation 0.773000         Variasce Reduction 0.300312721         5         HP         AMT           VOL (%)         0.0         DC (%)         6E.4         CLVD (%) 31.6         6         HP         AMT           Mrr -8.4149c+15         Mtt 1.83137c	
Mw         4.9         Moment (Nm)         2.48454817e+16         4         HP         DRO           Correlation         0.773000         Variance Reduction         0.300312721         5         HP         AMT           VOL (%)         0.0         DC (%)         6E.4         CLVD (%)         31.6         6         HP         ANX           Mrr         -8.4145e+15         Mtt         1.81137e         Immediate         Immediat         Immediate         Immed	
VOL (%)         0.0         DC (%)         68.4         CLVD (%)         31.6         6         HP         ANX           Mrr : 8.4149x+15         Mtt 1.811370	
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0.2 FMVAR NP2 NP2 NP2	
Pip 1.4 040 take 13.50 - 14.6	

- remote/online control via smartphone or tablet
- implementation into the cloud

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# dependencies

- Python
- Python libraries:
  - > PyQt4
  - > ObsPy
  - > matplotlib
  - numpy
  - > MySQLdb
  - > psycopg2
  - > mpl\_toolkits
- gfortran
- MySQL/PostgreSQL

(tested on 2.7.4)

(tested on 4.8.4) (tested on 0.8.4) (tested on 1.3.1) (tested on 1.7.1) (tested on 1.2.3) (tested on 2.5.1)

(tested on 4.7.3) (tested on 5.5.34/9.1)



- i. download scisola from github repository (https://github.com/nikosT/scisola/)
- ii. compile the ISOLA source code by running the compile.sh script *(using gfortran)*
- iii.insert the scisola database to MySQL
- iv.run in shell: python scisola.py
  - (a simple Ubuntu based installation script is provided)

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### links

- scisola website (Nikolaos Triantafyllis) http://students.ceid.upatras.gr/~triantafyl/scisola/
- source code https://github.com/nikosT/scisola/
- extensive description & user guide http://students.ceid.upatras.gr/~triantafyl/scisola/master\_thesis.pdf
- mailing list to subscribe send a blank e-mail to: scisola+subscribe@googlegroups.com
- ISOLA code (*Jiri Zahradnik and Efthimios Sokos*) http://seismo.geology.upatras.gr/isola/index.html

### <mark>more</mark>

- publications:
- 2015 Triantafyllis, N., Sokos, E., Ilias, A., & Zahradník, J. (2015). Scisola: Automatic Moment Tensor Solution for SeisComP3.
   submitted for publication at Seismological Research Letters (Electronic Seismologist)
- 2014 Triantafyllis, N., Sokos, E., & Ilias, A. (2014). Scisola: Automatic Moment Tensor Solution for SeisComP3.

presented at 34th General Assembly of the European Seismological Commission (24-29 August 2014)

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