Introduction to the key features of SeisComP3

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August 10, 2015

Outline

1 GEMPA

2 SeisComP
- Overview
- BMKG, Jarkarta/Indonesia
- Architecture
- Modules
- GUIs

GEMPA - short introduction

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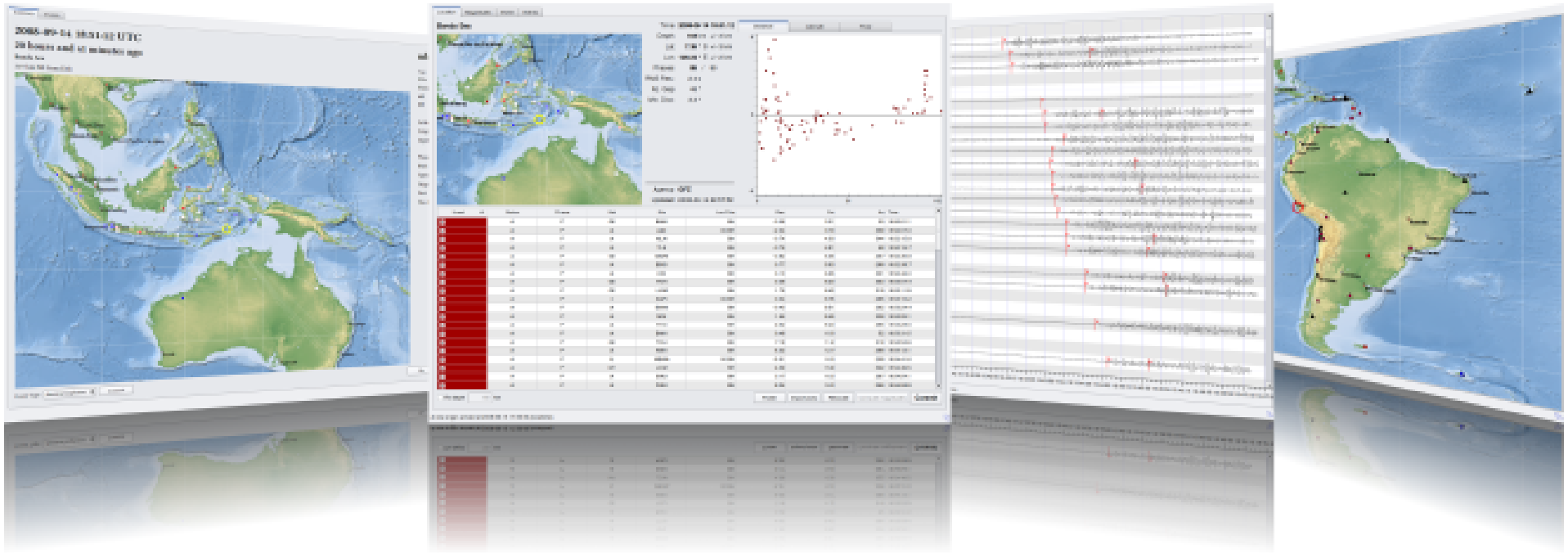
- Commercial spin-off of GFZ Potsdam
- 9 employees (2 seismologists, 4 software engineers, 2 system administrators, 1 web developer
- Offering solutions for tsunami early warning, local earthquake and geothermal monitoring
- Customers are tsunami warning centers, earthquake services and energy industry



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- Software package handling
  - acquisition
  - archiving
  - processing
  - analysis
  - quality control

  of seismological data
- Graphical user interfaces for
  - visualization of waveforms and station status
  - event visualization
  - state-of-health monitoring
  - manual analysis
- Emphasis on simplicity and speed
- Developed in the context of tsunami warning

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- Originally designed as acquisition and archiving software for GEOFON[1]
- **2001** SeedLink as core acquisition protocol and software becomes a de-facto standard in Europe
- **2003** Development of simple automatic analysis tools (after Algerian earthquake)
- **2005**
  - global associator/locator
  - interactive analysis using Seismic Handler (SeisComP2)
  - ArcLink server as distributed waveform and meta-data server

[1] http://geofon.gfz-potsdam.de

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- **2006** Development of the 3rd generation of SeisComP within GITEWS project
- **2007** Installation at BMKG, Jakarta/Indonesia in May 2007
- **2008** Major release SeisComP3 *Barcelona* (first public release)
- **2009** Major release SeisComP3 *Erice*
- **2010** Major release SeisComP3 *Potsdam*
- **2011** Major release SeisComP3 *Zurich*
- **2012** Major release SeisComP3 *Seattle*
- **2014** Major release SeisComP3 *Jakarta*
  Completely open source!

SeisComP World-wide Distribution

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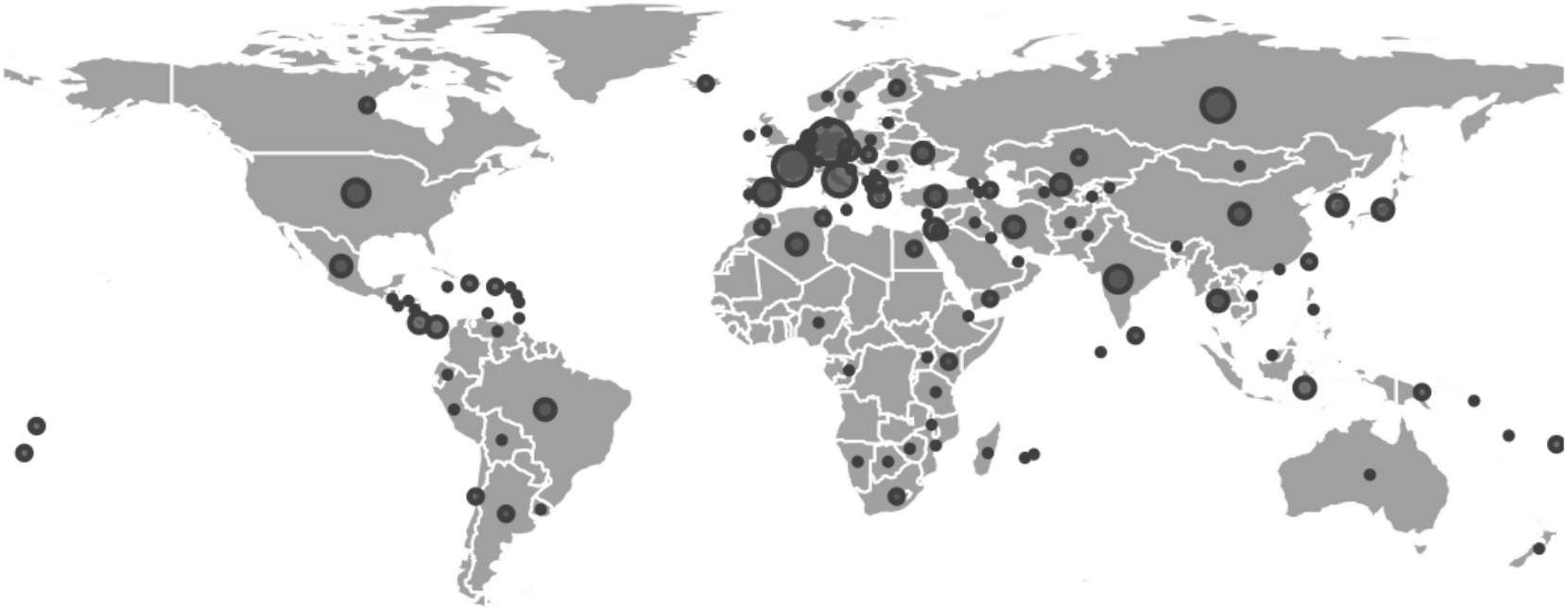

World-wide SeisComP installations (last updated March, 2014)

30 tsunami warning centers

50 earthquake monitoring centers

60 universities

50 research centers

10 commercial companies

25 CTBTO NDC using it in daily operation

SeisComP Main Features

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- Distributed processing
- SeedLink for data acquisition
- SeisComP3XML, a branch of QuakeML[2] for database schema and communication protocol
- Automatic 2 level P- and S-picker (STA/LTA and AIC)
- Automatic location modules supporting different velocity models and locators
- Magnitudes: MLv, ML, Md, mb, mB, Mw(mB), Mwp, Mw(Mwp), Mjma, Ms(BB)
- Graphical user interfaces
  - Real-time traces
  - Network/station status
  - Event visualization
  - Event and waveform analysis
  - State-of-health monitoring
  - Data quality monitoring

[2] http://www.quakeml.org

- Use of de-facto standards for waveform and parameter exchange (QuakeML, SeedLink, ArcLink, FDSN web services)
- Interprocess communication between modules builds on TCP/IP
- Database support for MYSQL, SQLite3, PostgreSQL
- Scripting interface for Python

SeisComP3 at BMKG, Jakarta/Indonesia

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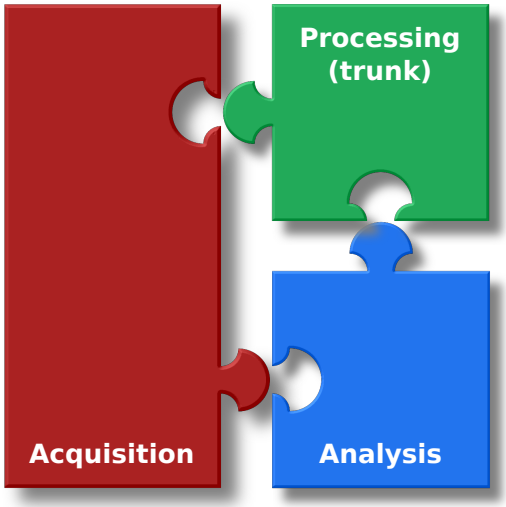
Operator's desk with a 4 monitor system connected to the processing server (new warning room)



Retrieves waveform data from remote stations, archives it and delivers it to clients on request
Modules: **SeedLink**, **slarchive** and **ArcLink**

Processes waveform data automatically and emits derived parameters such as picks, amplitudes, magnitudes, hypocenters and events
Modules: **scmaster**, **scautoloc**, **scautopick**, **scamp**, **scmag** and **scevent**

Provides graphical user interfaces to analyse and verify results and waveforms interactively either in realtime or as post event analysis
Modules: **scrttv**, **scmv**, **scolv** and **scesv**

SeisComP3 components

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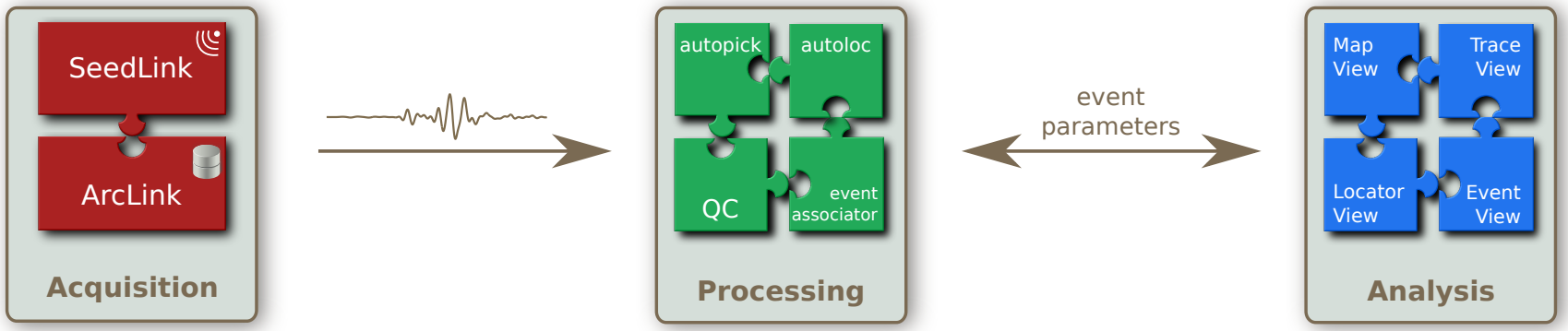
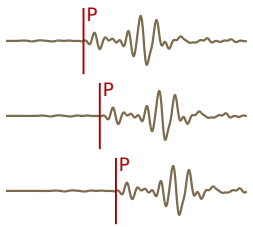
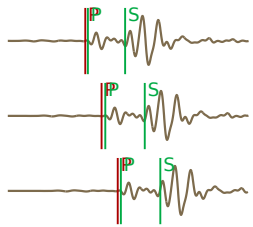




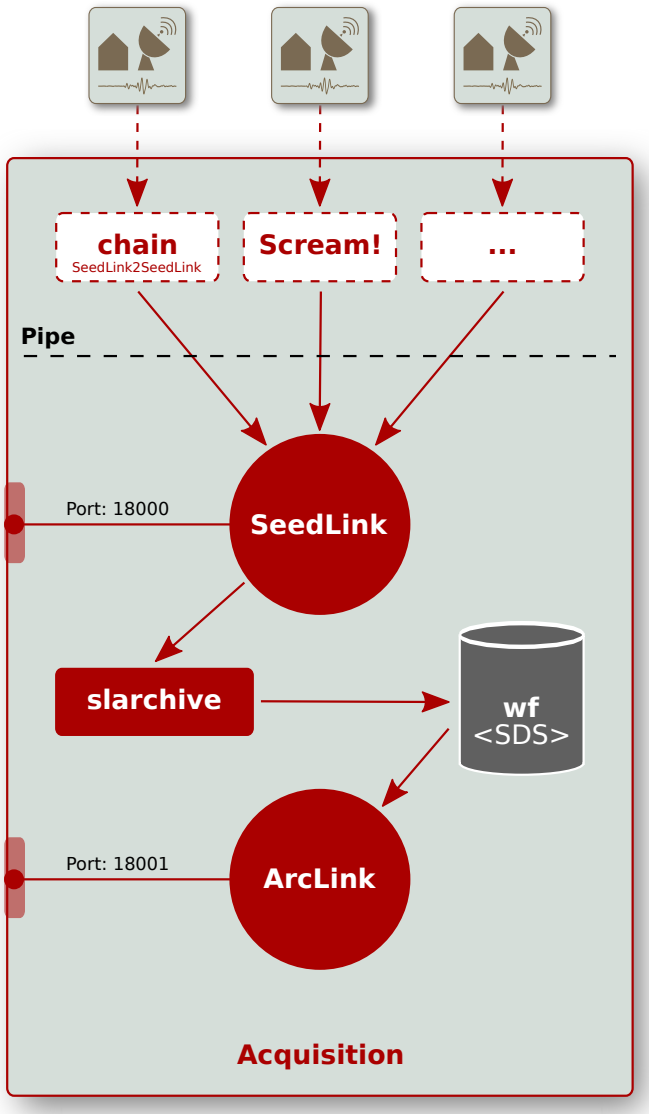


M 3.5

M 3.4

Event

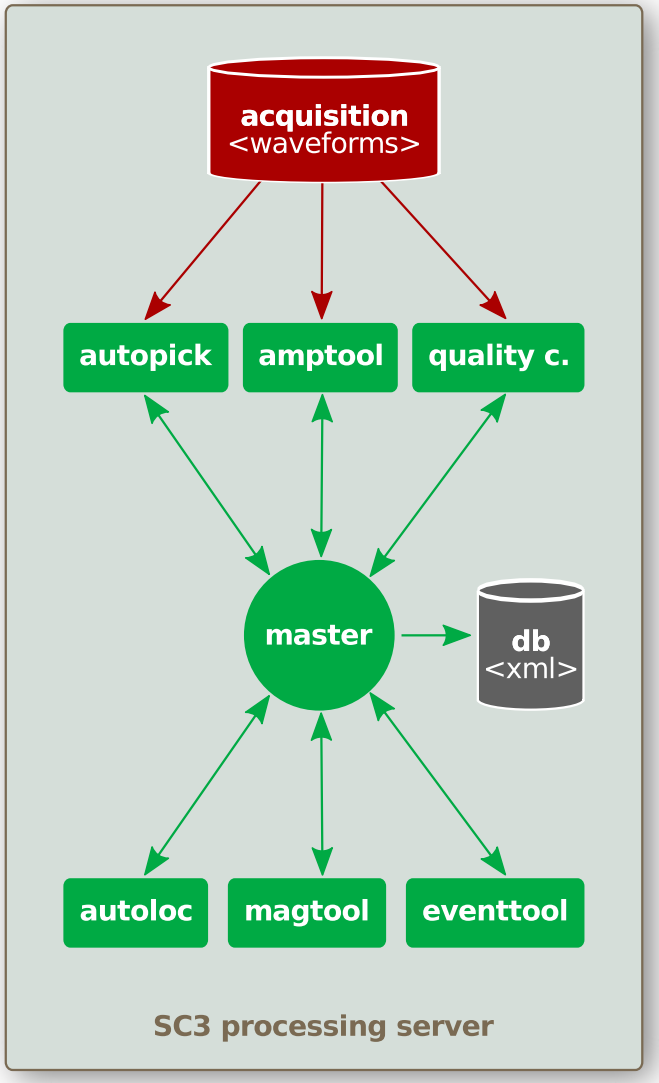
M 3.5 (A)
M 3.4 (M)



SeedLink collects waveform data from stations through plugins. Many plugins for various digitizers are available. **SeedLink** is a TCP server and delivers TCP data streams to remote clients on port 18000 (configurable).

slarchive stores the waveforms in an archive (SDS structure).

ArcLink provides the archived data as a TCP server to local/remote clients on port 18001 (configurable).

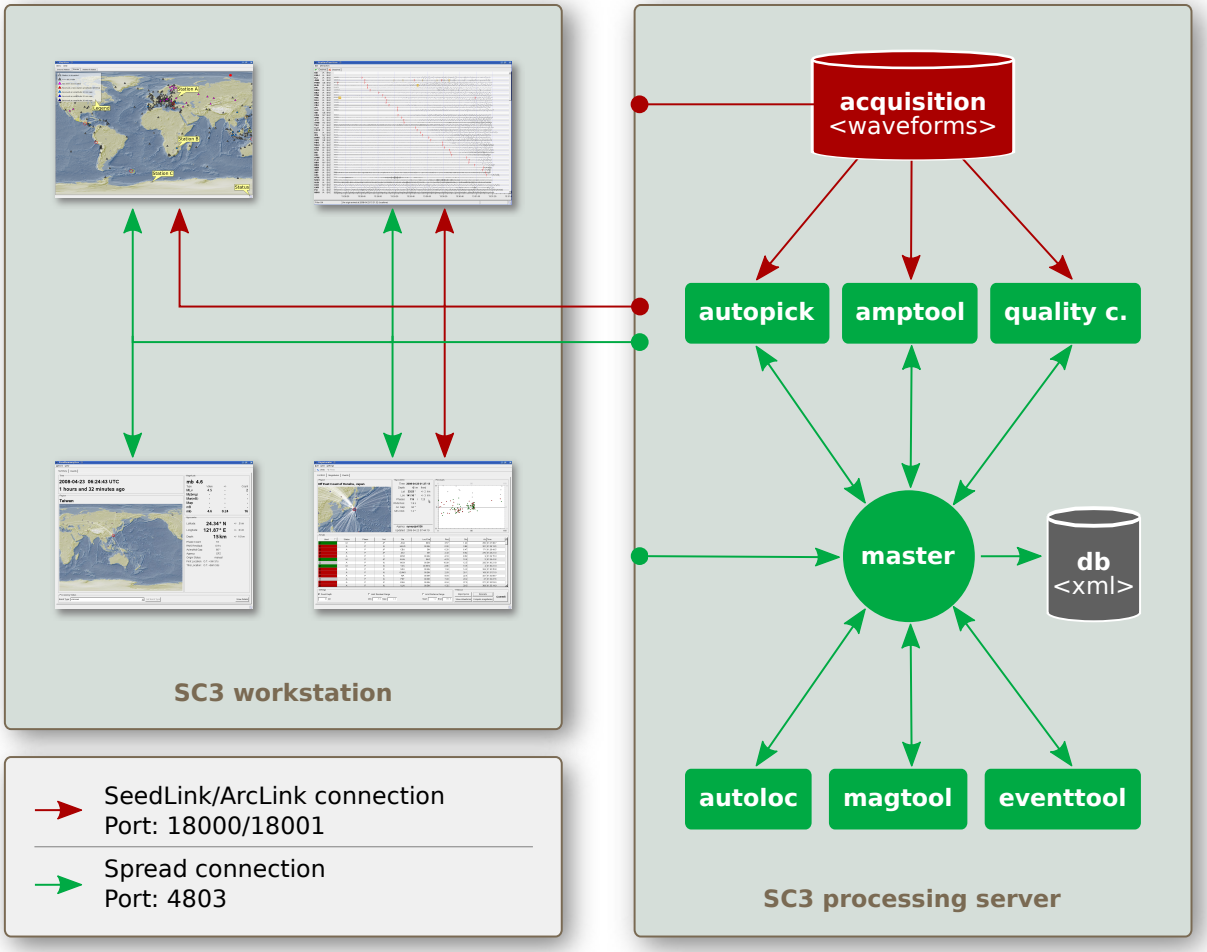


Waveform server provides real time data with SeedLink and archived data with ArcLink

Master is messaging server[a] which handles meta data exchange between SC3 modules and stores objects in a database. Connections are excepted from TCP clients on port 4803.

EventTool associates origins (locations) to events and chooses the best location and magnitude among all candidates

[a] based on Spread toolkit ▸ http://www.spread.org



Automatic and interactive system each running on a dedicated computer. Both systems are connected to the same messaging and waveform server.

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Name	Description
seedlink	Real time data acquisition
slinktool	SeedLink query interface
slarchive	Storing waveform data in SDS structure
arclink	Retrieval of archived waveform data
arclinktool	ArcLink query interface

SeisComP3 processing modules

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Name	Description
scmaster	TCP/IP messaging server
scautopick	Automatic P detector/picker
scautoloc	Automatic locator
screloc	Automatic relocator
scamp	Amplitude calculation
scmag	Magnitude calculation
scevent	Event associator
scqc	Quality parameters of waveforms
scevtlog	Logging of event states
scdb	Database storage of parametric data
scvoice	Acoustic alerts
scalert	Custom alarms

Name	Description
scrttv	Real time trace view
scmv	Map view showing the overall situation
scolv	Revision of processing results and manual picker
scesv	Event summary view
scqcv	Waveform quality view
scheli	Helicorder plots

Name	Description
scconfig	GUI for configuration of SeisComP3
wsfdsn	FDSN webservice implementation
import_inv	Wrapper for inventory converter
inv2dlsv	Inventory to dataless Seed converter
invextr	Extracts or removes networks, stations or channels from an inventory XML file
scinv	Inventory XML merger
stationconf	Station metadata configurator (the old way)
scsohlog	State-of-health logging
scchkcfg	Checks seiscomp configuration for case-sensivity issues
scdispatch	Sends simple SeisComP3 objects

Name	Description
scart	Export/import waveforms from/into archive
scbulletin	Create event bulletins
scmm	Message and performance monitor
scevtls	List available events
scevtstreams	Extract stream information from events
scimex	Import/export for earthquake parameters
scimport	Message relaying
scm	state-of-health monitor
scxmldump	Dumping event parameters to XML
sczip	SeisComP3 file (de)compressor

Name	Description
css2inv	Converts station information from the IDC schema to SeisComP3 XML
inv2css	Converts station information from SeisComP3 XML to the IDC schema
css2proc	Converts IDC results to SeisComP3 XML
proc2css	Converts SeisComP3 results to IDC schema

SeisComP3 commercial addons

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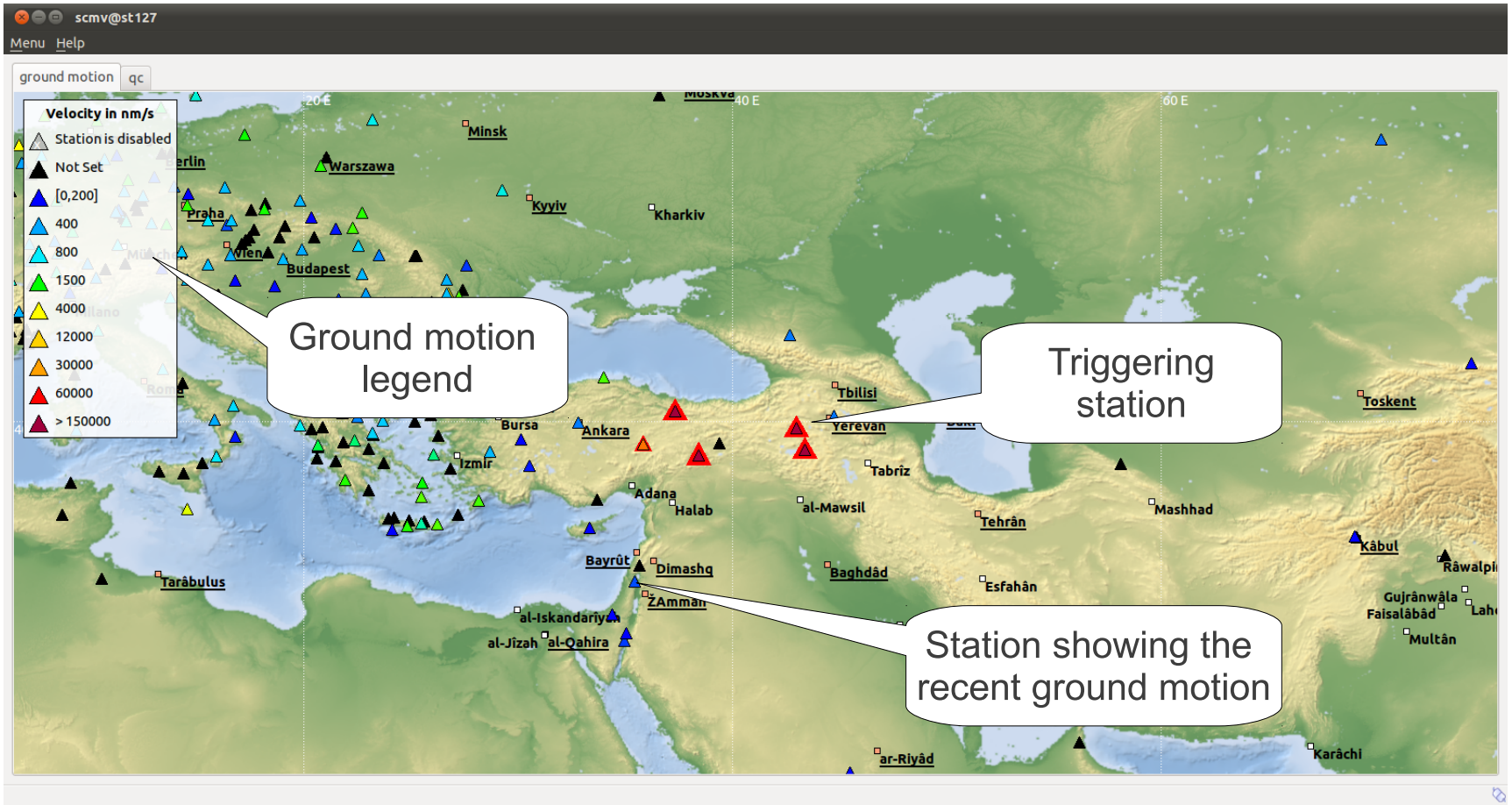
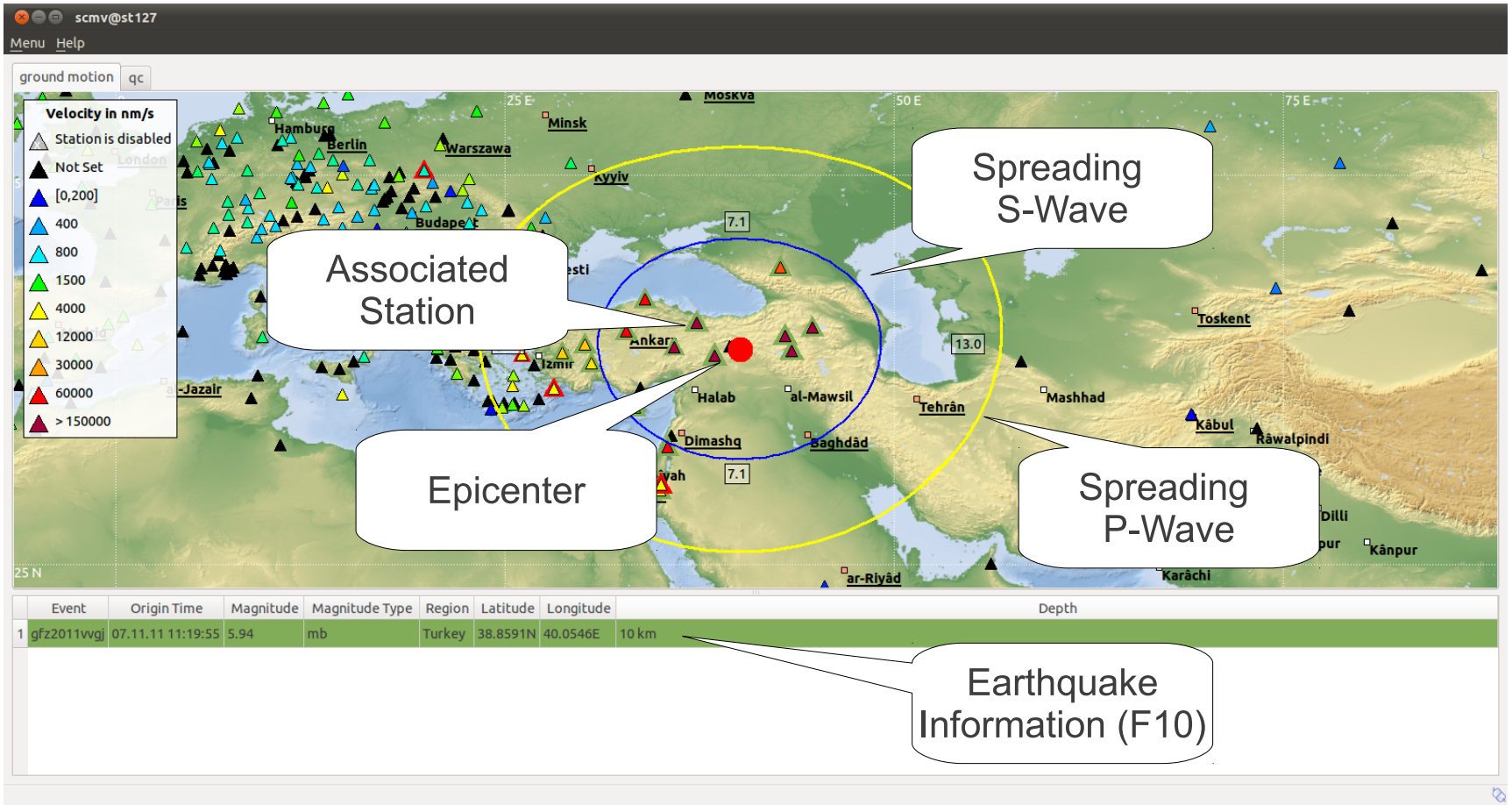
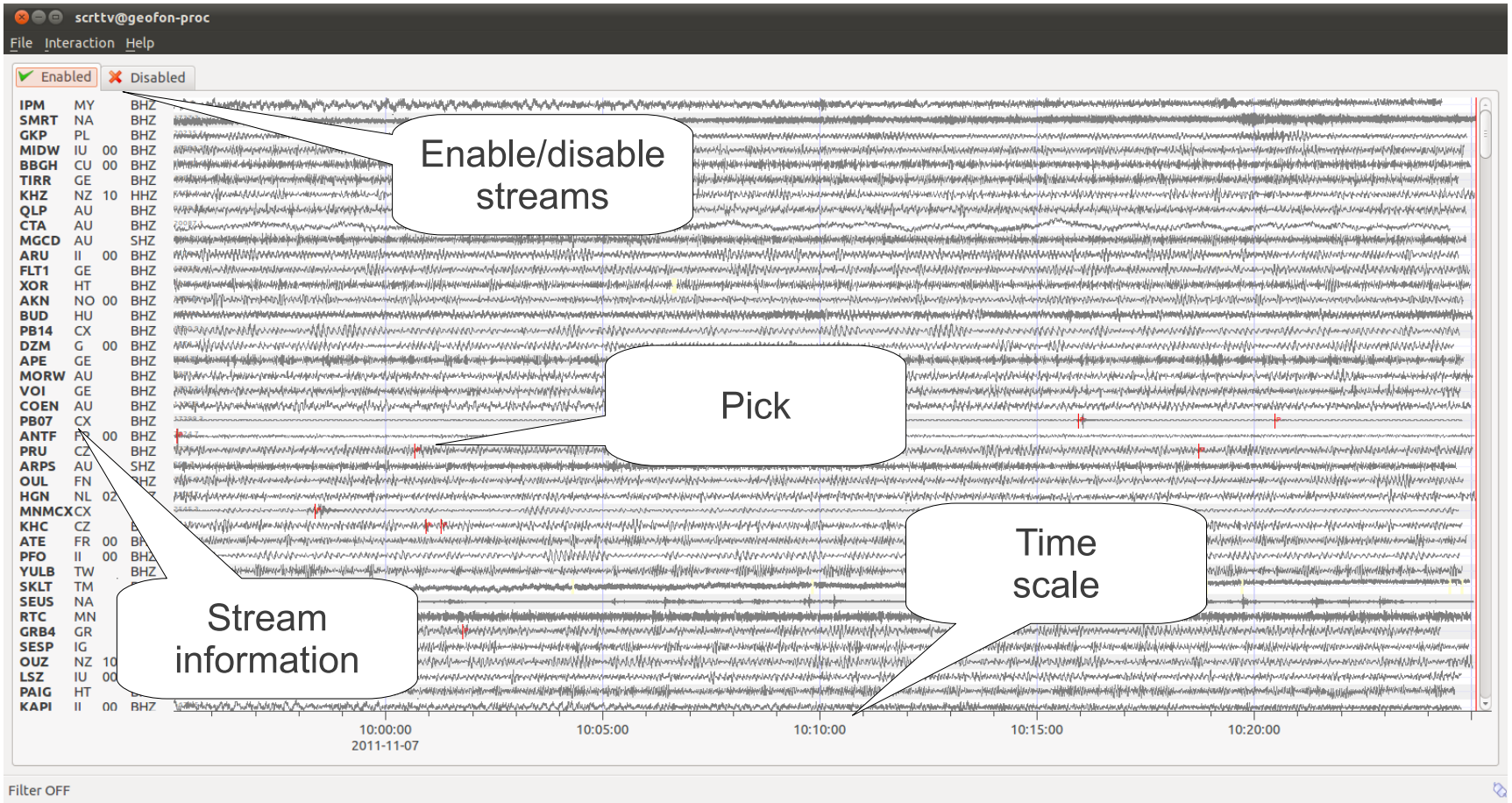
Name	Description
CAPS	Multi format acquisition server
GDS with GIS	Dissemination server with image generator
QuakeLink	Real-time event information streaming
scanloc	Cluster search based locator using P- and S-phases
ccloc	Crosscorrelation locator (alpha version)
sceval	Origin evaluator based on station distribution comparison
VORTEX	Volcano monitoring supporting RSAM and SSAM
automt/mtv	Automatic and interactive moment tensor calculation
WEBGUIs	Browser based GUIs replacing scrttv, scmtv, scesv, scolv
SMP	Station metadata portal
SMGUI	Strong motion GUI
WebConfig	Browser based version of scconfig

Name	Description
scrttv	Real time trace view
scmv	Map view showing the overall situation
scolv	Revision of processing results and manual picker
scesv	Event summary view


scmv@st127
Menu Help
ground motion
qc
Velocity in nm/s
Station is disabled
Not Set
[0,200]
400
800
1500
4000
12000
30000
60000
> 150000
Ground motion legend
Triggering station
Station showing the recent ground motion
Minsk
Warszawa
Kyyiv
Kharkiv
Praha
Wien
Budapest
Tbilisi
Yerevan
Toskent
Bursa
Ankara
İzmir
Tabriz
Adana
Halab
al-Mawsil
Mashhad
Tehrân
Kâbul
Bayrût
Dimashq
Baghdâd
Esfahân
Tarâbulus
Gujrânwâla
Faisalâbâd
Multân
al-Iskandariyah
al-Jizah
al-Qahira
ZAmman
ar-Riyâd
Karâchi


scmv@st127
Menu Help
ground motion
qc
Velocity in nm/s
Station is disabled
Not Set
[0,200]
400
800
1500
4000
12000
30000
60000
> 150000
Associated Station
Spreading S-Wave
Epicenter
Spreading P-Wave
Earthquake Information (F10)
Event
Origin Time
Magnitude
Magnitude Type
Region
Latitude
Longitude
Depth
1
gfz2011vvgj
07.11.11 11:19:55
5.94
mb
Turkey
38.8591N
40.0546E
10 km


scrttv@geofon-proc
File Interaction Help
Enabled
Disabled
Enable/disable streams
Pick
Time scale
Stream information
10:00:00
2011-11-07
10:05:00
10:10:00
10:15:00
10:20:00
Filter OFF

SeisComP3 TraceView

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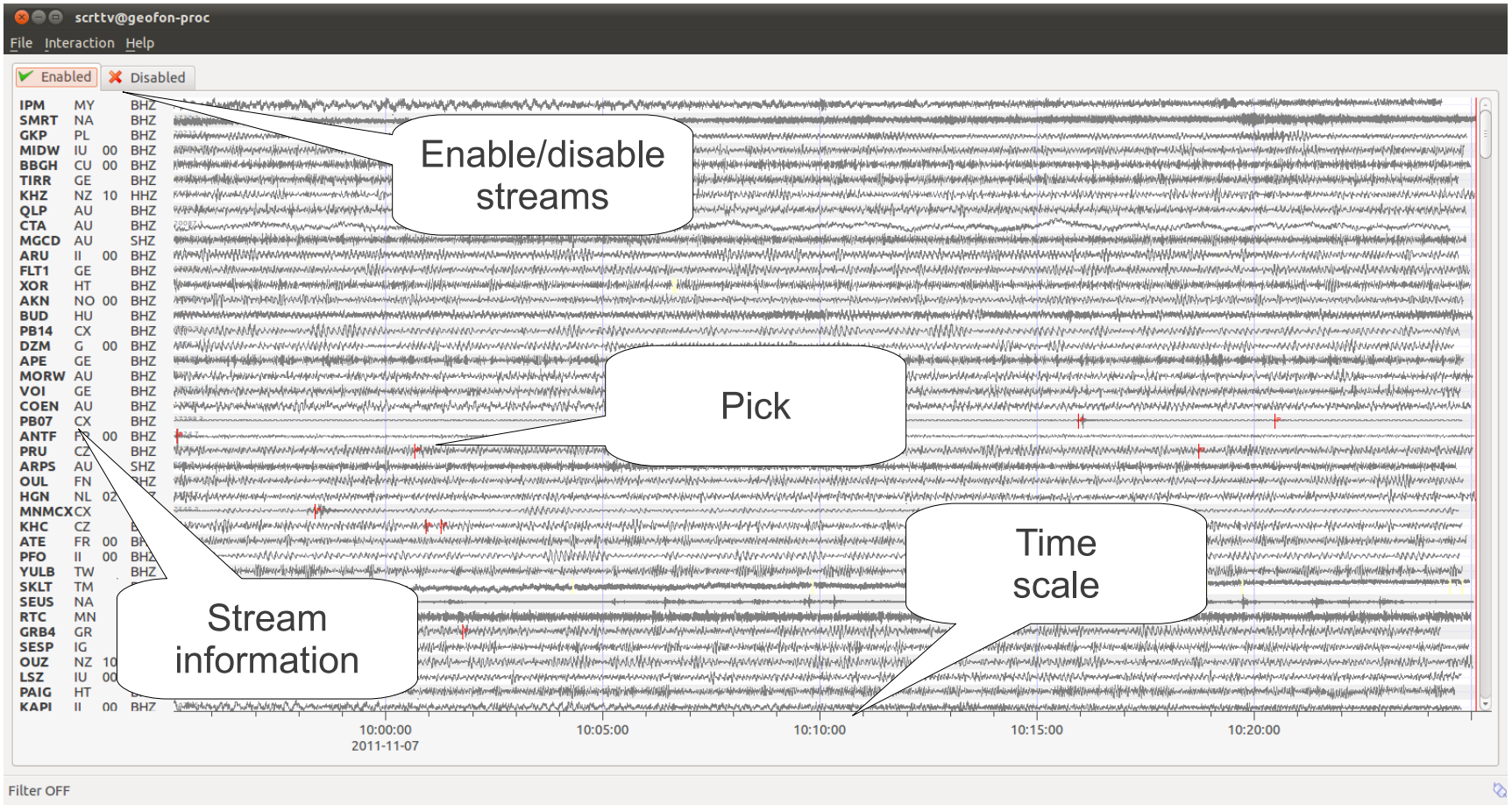

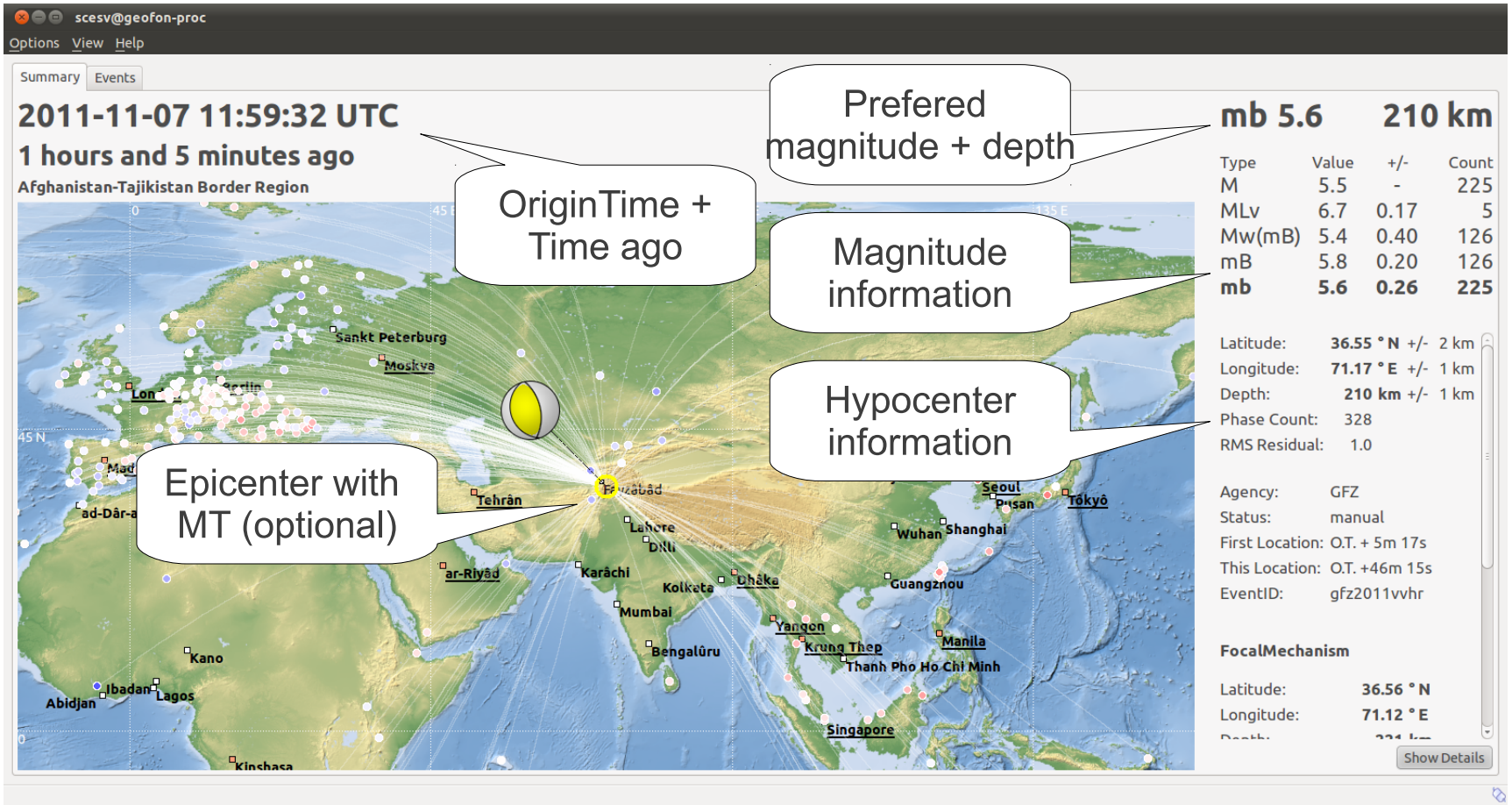
scesv@geofon-proc
Options View Help
Summary Events
2011-11-07 11:59:32 UTC
1 hours and 5 minutes ago
Afghanistan-Tajikistan Border Region
Prefered magnitude + depth
OriginTime + Time ago
Magnitude information
Hypocenter information
Epicenter with MT (optional)
mb 5.6 210 km
Type Value +/- Count
M 5.5 - 225
MLv 6.7 0.17 5
Mw(mB) 5.4 0.40 126
mB 5.8 0.20 126
mb 5.6 0.26 225
Latitude: 36.55 °N +/- 2 km
Longitude: 71.17 °E +/- 1 km
Depth: 210 km +/- 1 km
Phase Count: 328
RMS Residual: 1.0
Agency: GFZ
Status: manual
First Location: O.T. + 5m 17s
This Location: O.T. +46m 15s
EventID: gfz2011vvhr
FocalMechanism
Latitude: 36.56 °N
Longitude: 71.12 °E
Show Details
Sankt Peterburg
Moskva
Tehrân
Lahore
Dilli
Karâchi
Kolkata
Dhâka
Mumbai
Bengalûru
Wuhan
Shanghai
Guangznou
Seoul
Pusan
Tôkyô
Yangon
Krung Thep
Thanh Pho Ho Chi Minh
Manila
Singapore
Kano
Ibadan
Lagos
Abidjan
Kinshasa
ar-Riyâd

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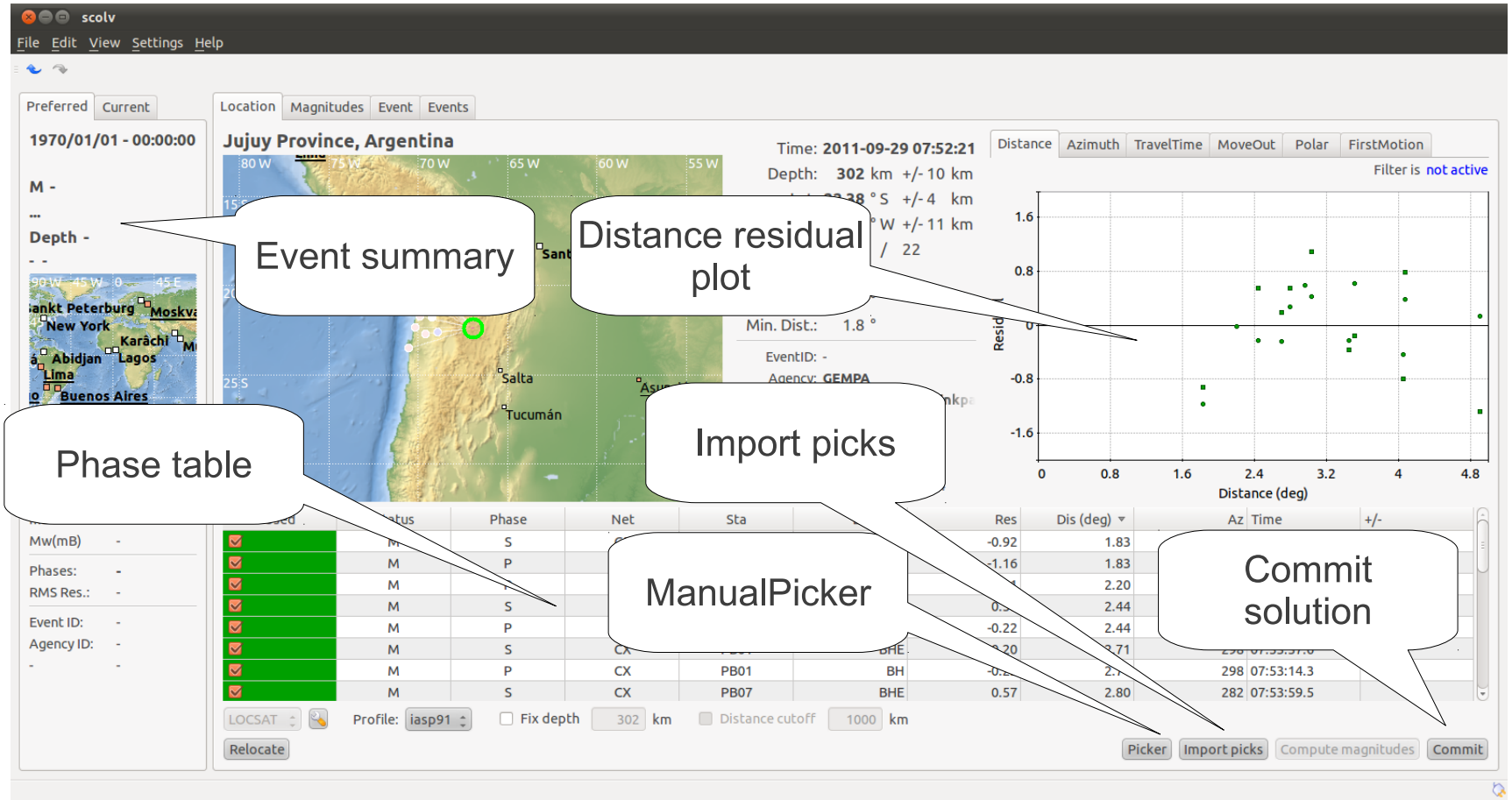
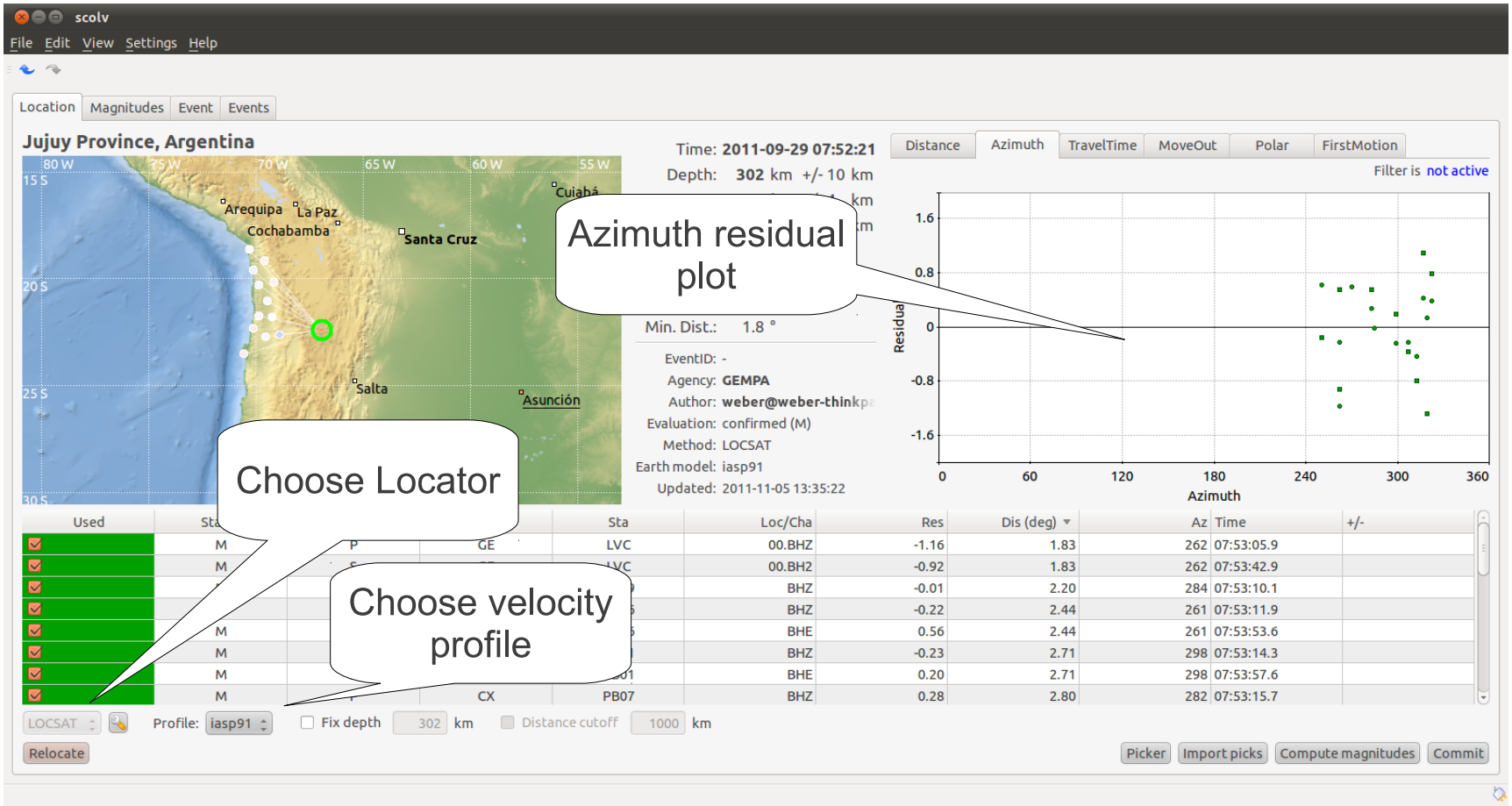

scolv
File Edit View Settings Help
Preferred Current
Location Magnitudes Event Events
Jujuy Province, Argentina
Time: 2011-09-29 07:52:21
Depth: 302 km +/- 10 km
Min. Dist.: 1.8 °
EventID: -
Agency: GEMPA
Distance Azimuth TravelTime MoveOut Polar FirstMotion
Filter is not active
Distance (deg)
Phase Net Sta Res Dis (deg) Az Time +/-
Mw(mB) -
Phases: -
RMS Res.: -
Event ID: -
Agency ID: -
LOCSAT Profile: iasp91 Fix depth 302 km Distance cutoff 1000 km
Relocate
Picker Import picks Compute magnitudes Commit
Event summary
Distance residual plot
Phase table
Import picks
ManualPicker
Commit solution


scolv
File Edit View Settings Help
Location Magnitudes Event Events
Jujuy Province, Argentina
Arequipa
La Paz
Cochabamba
Santa Cruz
Cuiabá
Salta
Asunción
Time: 2011-09-29 07:52:21
Depth: 302 km +/- 10 km
Min. Dist.: 1.8 °
EventID: -
Agency: GEMPA
Author: weber@weber-thinkp
Evaluation: confirmed (M)
Method: LOCSAT
Earth model: iasp91
Updated: 2011-11-05 13:35:22
Distance Azimuth TravelTime MoveOut Polar FirstMotion
Filter is not active
Residua
Azimuth
Azimuth residual plot
Choose Locator
Choose velocity profile
Used Sta Loc/Cha Res Dis (deg) Az Time +/-
LVC 00.BHZ -1.16 1.83 262 07:53:05.9
LVC 00.BH2 -0.92 1.83 262 07:53:42.9
BHZ -0.01 2.20 284 07:53:10.1
BHZ -0.22 2.44 261 07:53:11.9
BHE 0.56 2.44 261 07:53:53.6
BHZ -0.23 2.71 298 07:53:14.3
BHE 0.20 2.71 298 07:53:57.6
CX PB07 BHZ 0.28 2.80 282 07:53:15.7
LOCSAT Profile: iasp91 Fix depth 302 km Distance cutoff 1000 km
Relocate
Picker Import picks Compute magnitudes Commit

SeisComP3 OriginLocatorView

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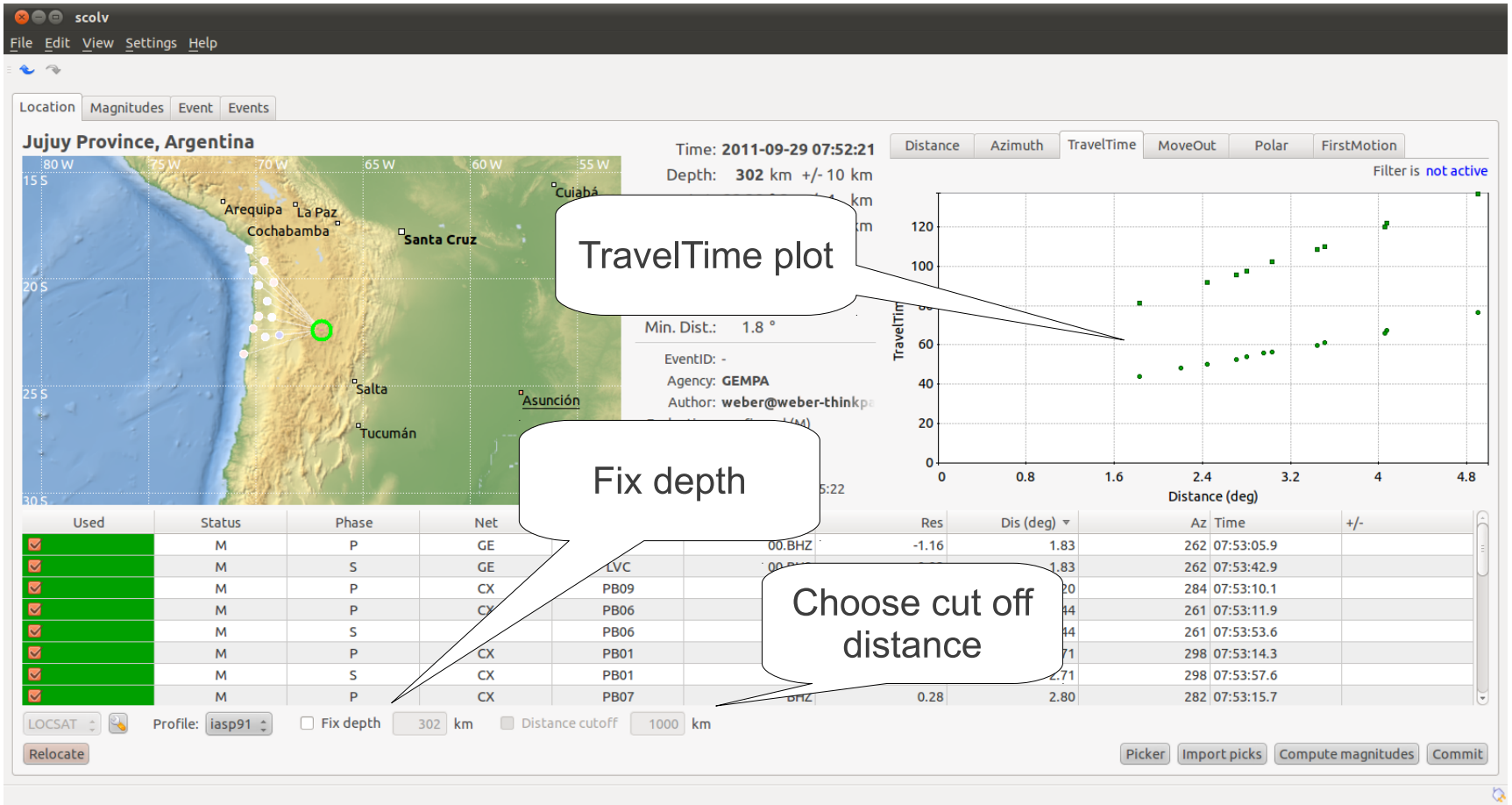
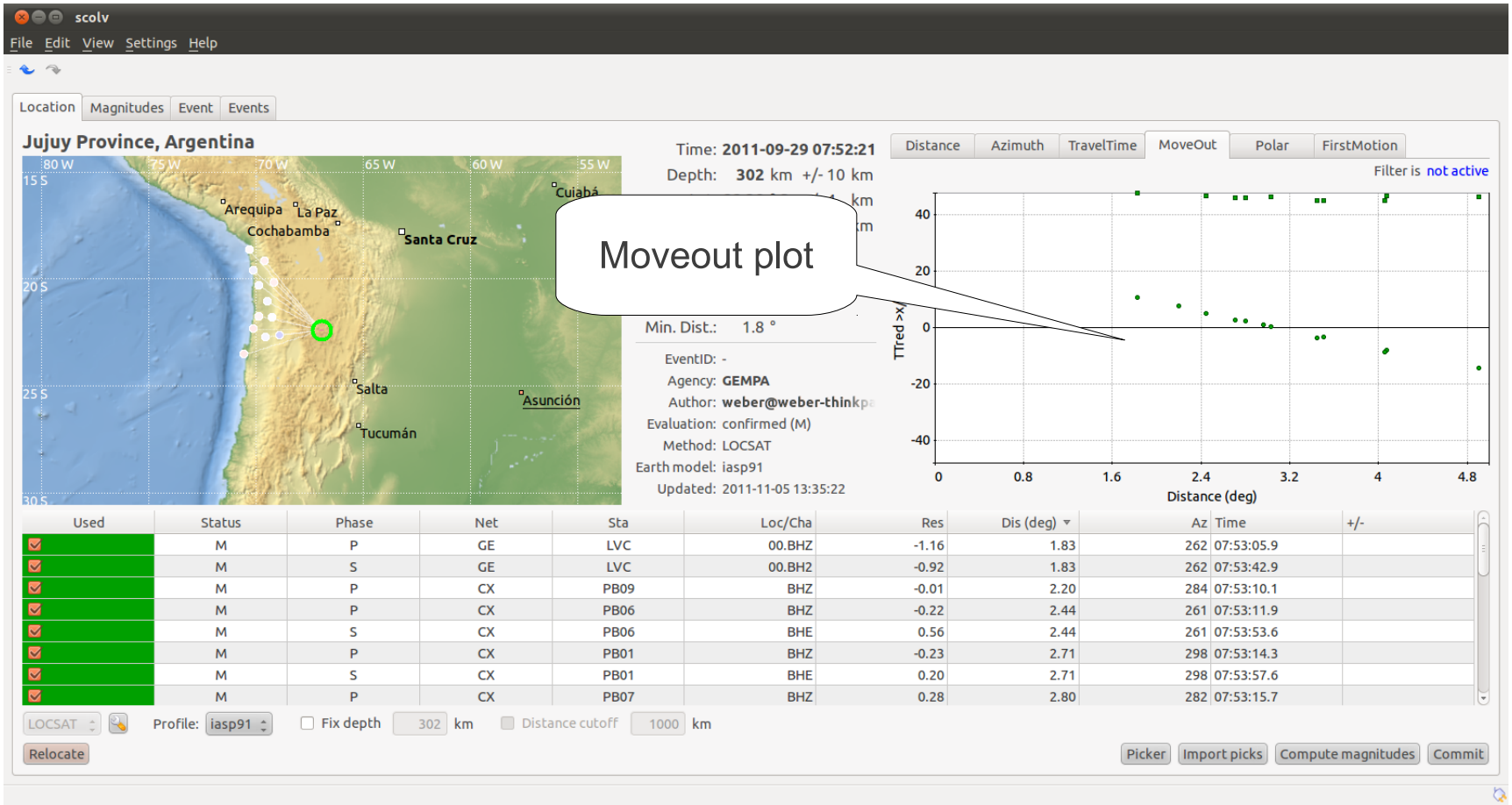
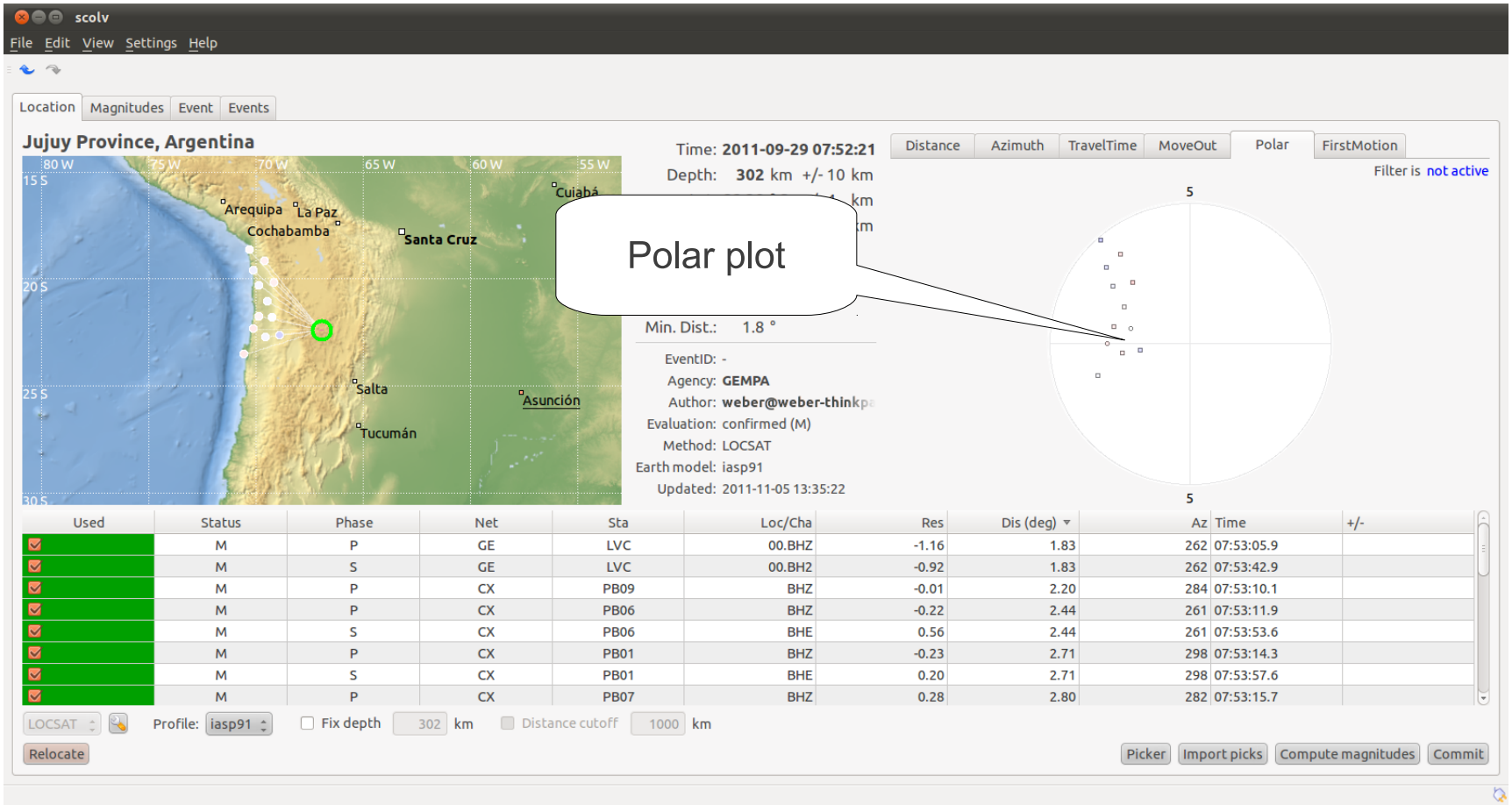
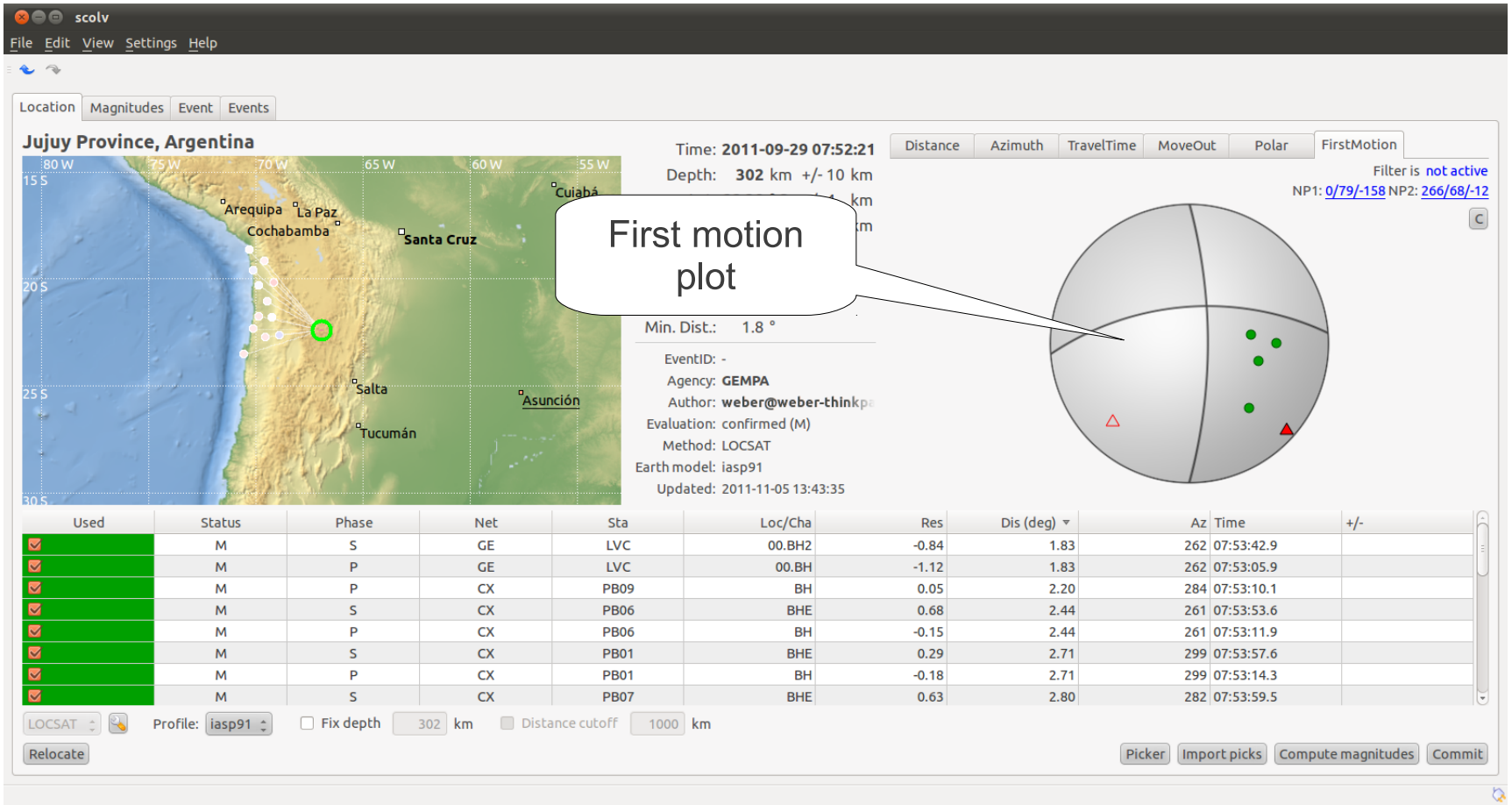


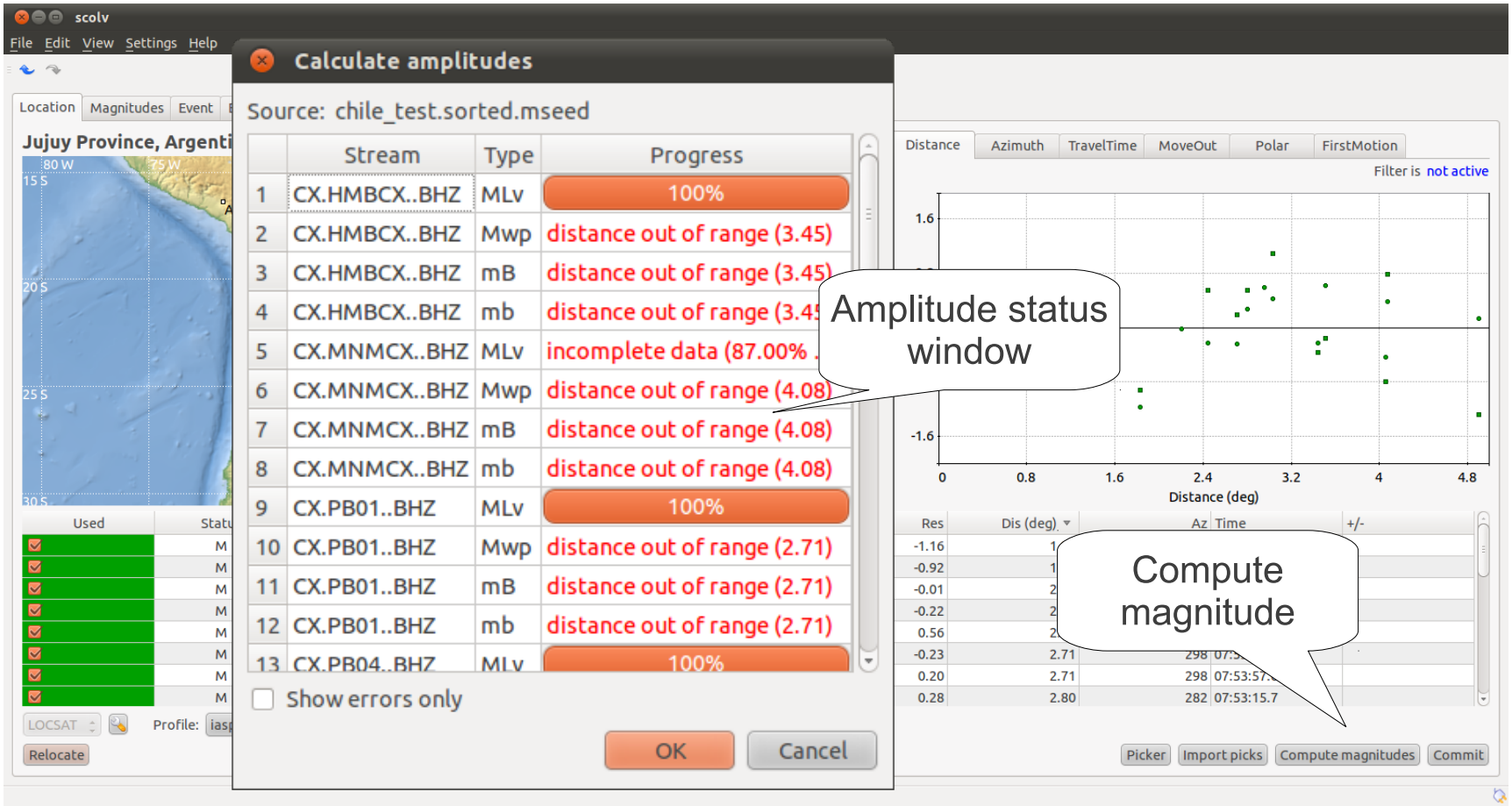

scolv
File Edit View Settings Help
Location Magnitudes Event Events
Jujuy Province, Argentina
Arequipa
La Paz
Cochabamba
Santa Cruz
Cuiabá
Salta
Asunción
Tucumán
Time: 2011-09-29 07:52:21
Depth: 302 km +/- 10 km
Min. Dist.: 1.8 °
EventID: -
Agency: GEMPA
Author: weber@weber-thinkp
Evaluation: confirmed (M)
Method: LOCSAT
Earth model: iasp91
Updated: 2011-11-05 13:35:22
Moveout plot
Distance Azimuth TravelTime MoveOut Polar FirstMotion
Filter is not active
TTred >x
Distance (deg)
Used Status Phase Net Sta Loc/Cha Res Dis (deg) Az Time +/-
M P GE LVC 00.BHZ -1.16 1.83 262 07:53:05.9
M S GE LVC 00.BH2 -0.92 1.83 262 07:53:42.9
M P CX PB09 BHZ -0.01 2.20 284 07:53:10.1
M P CX PB06 BHZ -0.22 2.44 261 07:53:11.9
M S CX PB06 BHE 0.56 2.44 261 07:53:53.6
M P CX PB01 BHZ -0.23 2.71 298 07:53:14.3
M S CX PB01 BHE 0.20 2.71 298 07:53:57.6
M P CX PB07 BHZ 0.28 2.80 282 07:53:15.7
LOCSAT Profile: iasp91 Fix depth 302 km Distance cutoff 1000 km
Relocate
Picker Import picks Compute magnitudes Commit

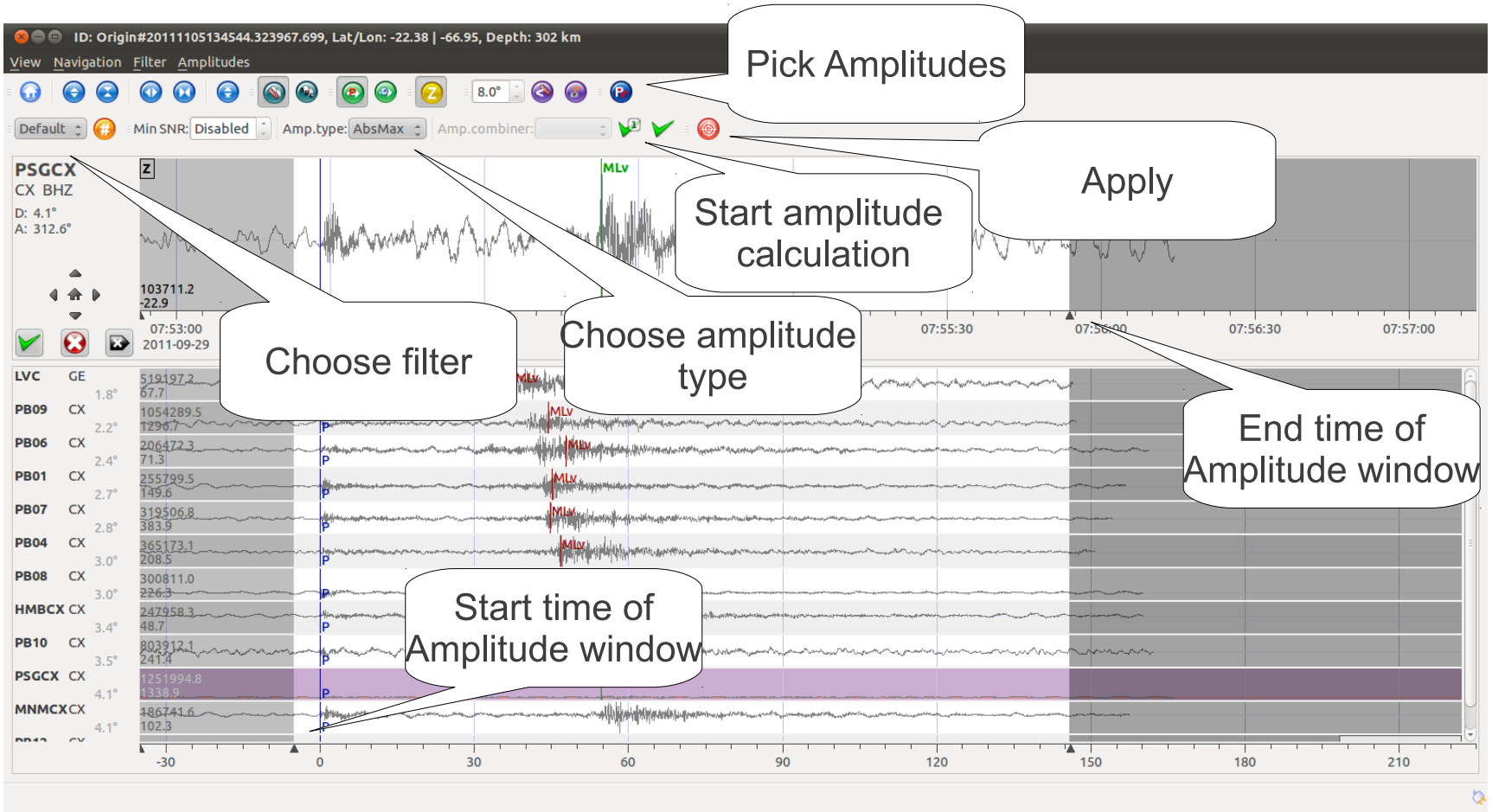

scolv
File Edit View Settings Help
Location Magnitudes Event Events
Jujuy Province, Argentina
Arequipa
La Paz
Cochabamba
Santa Cruz
Cuiabá
Salta
Asunción
Tucumán
Time: 2011-09-29 07:52:21
Depth: 302 km +/- 10 km
Min. Dist.: 1.8 °
EventID: -
Agency: GEMPA
Author: weber@weber-thinkp
Evaluation: confirmed (M)
Method: LOCSAT
Earth model: iasp91
Updated: 2011-11-05 13:35:22
Distance Azimuth TravelTime MoveOut Polar FirstMotion
Filter is not active
Polar plot
Used Status Phase Net Sta Loc/Cha Res Dis (deg) Az Time +/-
M P GE LVC 00.BHZ -1.16 1.83 262 07:53:05.9
M S GE LVC 00.BH2 -0.92 1.83 262 07:53:42.9
M P CX PB09 BHZ -0.01 2.20 284 07:53:10.1
M P CX PB06 BHZ -0.22 2.44 261 07:53:11.9
M S CX PB06 BHE 0.56 2.44 261 07:53:53.6
M P CX PB01 BHZ -0.23 2.71 298 07:53:14.3
M S CX PB01 BHE 0.20 2.71 298 07:53:57.6
M P CX PB07 BHZ 0.28 2.80 282 07:53:15.7
LOCSAT Profile: iasp91 Fix depth 302 km Distance cutoff 1000 km
Relocate
Picker Import picks Compute magnitudes Commit

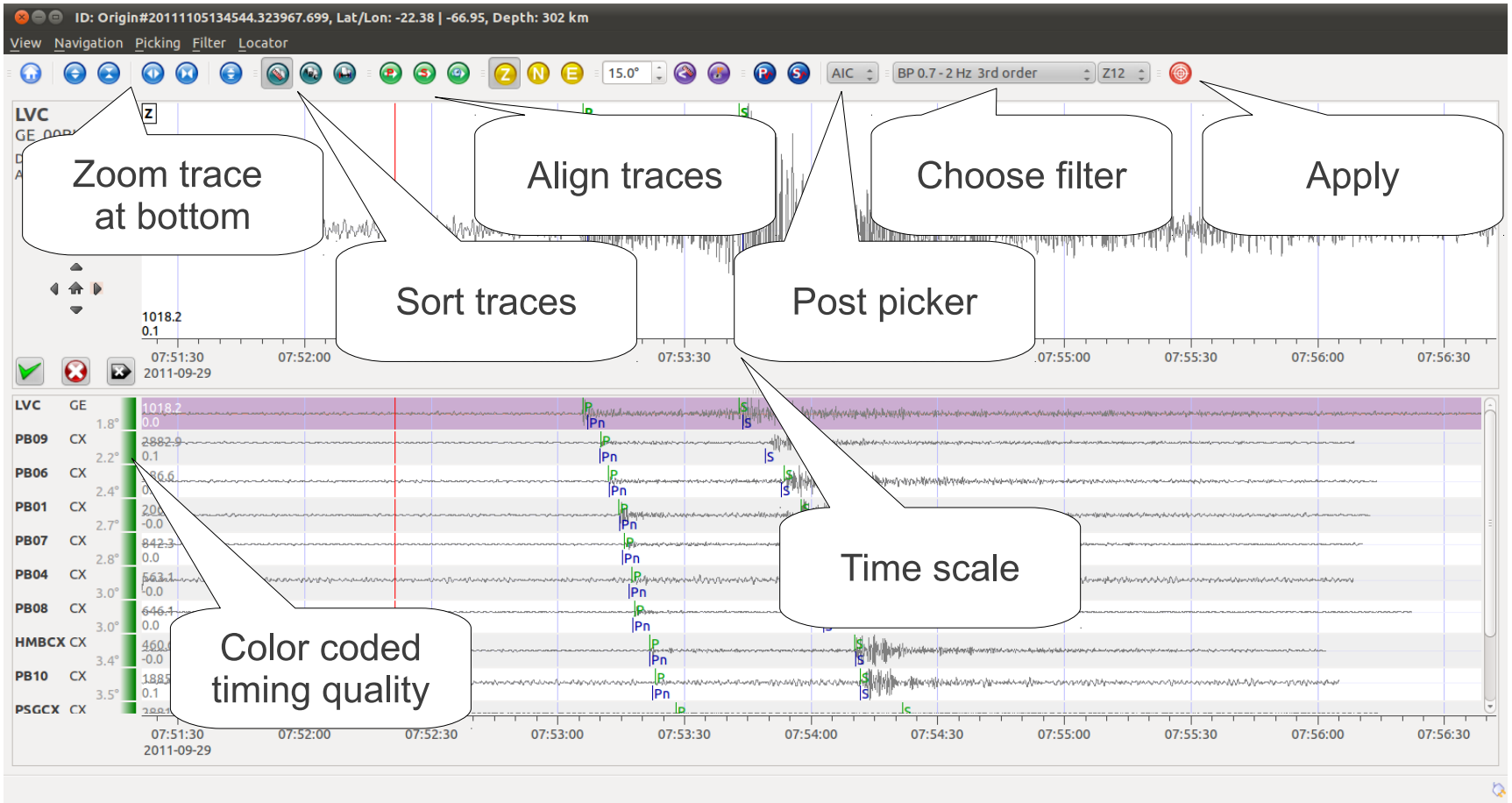

scolv
File Edit View Settings Help
Location Magnitudes Event Events
Jujuy Province, Argentina
80 W 75 W 70 W 65 W 60 W 55 W
15 S
20 S
25 S
30 S
Arequipa
La Paz
Cochabamba
Santa Cruz
Cuiabá
Salta
Asunción
Tucumán
Time: 2011-09-29 07:52:21
Depth: 302 km +/- 10 km
Min. Dist.: 1.8 °
EventID: -
Agency: GEMPA
Author: weber@weber-thinkp
Evaluation: confirmed (M)
Method: LOCSAT
Earth model: iasp91
Updated: 2011-11-05 13:43:35
First motion plot
Distance Azimuth TravelTime MoveOut Polar FirstMotion
Filter is not active
NP1: 0/79/-158 NP2: 266/68/-12
C
Used Status Phase Net Sta Loc/Cha Res Dis (deg) Az Time +/-
M S GE LVC 00.BH2 -0.84 1.83 262 07:53:42.9
M P GE LVC 00.BH -1.12 1.83 262 07:53:05.9
M P CX PB09 BH 0.05 2.20 284 07:53:10.1
M S CX PB06 BHE 0.68 2.44 261 07:53:53.6
M P CX PB06 BH -0.15 2.44 261 07:53:11.9
M S CX PB01 BHE 0.29 2.71 299 07:53:57.6
M P CX PB01 BH -0.18 2.71 299 07:53:14.3
M S CX PB07 BHE 0.63 2.80 282 07:53:59.5
LOCSAT Profile: iasp91 Fix depth 302 km Distance cutoff 1000 km
Relocate
Picker Import picks Compute magnitudes Commit

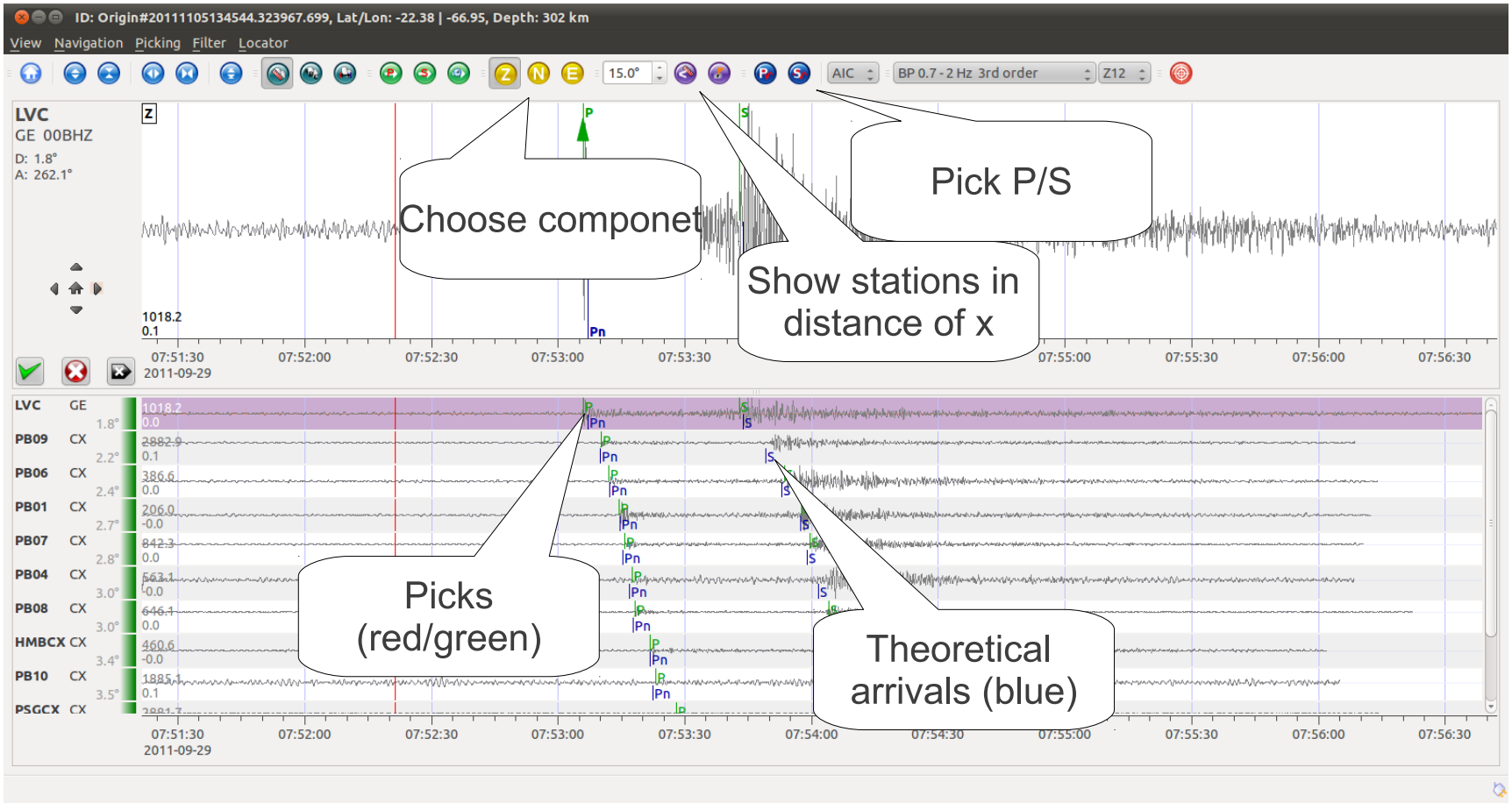
SeisComP3 OriginLocatorView

gempa




ID: Origin#20111105134544.323967.699, Lat/Lon: -22.38 | -66.95, Depth: 302 km
View Navigation Filter Amplitudes
Default
Min SNR: Disabled
Amp.type: AbsMax
Amp.combiner:
Pick Amplitudes
Apply
Start amplitude calculation
Choose filter
Choose amplitude type
End time of Amplitude window
Start time of Amplitude window
PSGCX
CX BHZ
D: 4.1°
A: 312.6°
07:53:00
2011-09-29
07:55:30
07:56:00
07:56:30
07:57:00
LVC GE
PB09 CX
PB06 CX
PB01 CX
PB07 CX
PB04 CX
PB08 CX
HMBCX CX
PB10 CX
PSGCX CX
MNMCX CX
-30
0
30
60
90
120
150
180
210


ID: Origin#20111105134544.323967.699, Lat/Lon: -22.38 | -66.95, Depth: 302 km
View Navigation Picking Filter Locator
Zoom trace at bottom
Align traces
Choose filter
Apply
Sort traces
Post picker
Time scale
Color coded timing quality
LVC GE
PB09 CX
PB06 CX
PB01 CX
PB07 CX
PB04 CX
PB08 CX
HMBCX CX
PB10 CX
PSGCX CX
07:51:30
2011-09-29
07:52:00
07:52:30
07:53:00
07:53:30
07:54:00
07:54:30
07:55:00
07:55:30
07:56:00
07:56:30


ID: Origin#20111105134544.323967.699, Lat/Lon: -22.38 | -66.95, Depth: 302 km
View Navigation Picking Filter Locator
LVC
GE 00BHZ
D: 1.8°
A: 262.1°
Choose componet
Pick P/S
Show stations in distance of x
Picks (red/green)
Theoretical arrivals (blue)
07:51:30
2011-09-29
07:52:00
07:52:30
07:53:00
07:53:30
07:54:00
07:54:30
07:55:00
07:55:30
07:56:00
07:56:30

More information

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http://www.seiscomp3.org