ISOLA training course, Brasilia 2020

Title of the course:
"Waveform Inversion for Moment Tensor – ISOLA Course"
(part of the University of Brasilia/2020 Winter Couse (V))

Dates: Nov. 16 to 20, 2020

Lecturers for *morning* sessions:
1. Prof. J. Zahradnik (JZ), Charles University, Prague, Czech Republic <jz@karel.troja.mff.cuni.cz>

2. Prof. E. Sokos (ES), University of Patras, Greece <esokos@upatras.gr>

Assistants for *afternoon* sessions:
3. Dr. Ronnie Quintero (Universidade Nacional de Costa Rica) <rquinter@una.cr>
4. Dr. JuanM Gómez (Universidad Autonoma do México) <gomez@geociencias.unam.mx>
5.Dr.Patrica Pedraza(Rede Sismológica Nacional de Bogota) <patriciapedrazag@gmail.com>
6. Dr. Silvina Nascif Suvire (University of San Juan, Argentina) <nacif.silvina@gmail.com>
7. Dr. Silvana Spagnotto (University of São Luiz, Argentina) <pampa113@gmail.com>
8. Dr. Celeste Bolani (University of La Plata, Argentina) <bollini@fcaglp.unlp.edu.ar>
9. Dr. O'Leary Matos (Centro de Estudos Sismológico de Cuba) <oleary@cenais.cu>
10. Dr. Fábio Dias (National Observatory, Brazil) <fabioludias@gmail.com>
11. Dr. Juraci Mario de Carvalho (Brasilia University, Brazil) <juraci@unb.br>
12. Dr. Lucas Vieira Barros (Brasilia University, Brazil) <lucas@unb.br>

Day 1 morning
Schedule:

Day 1 morning
ES and JZ: Short introductory overview of various ISOLA applications.

JZ: Necessary knowledge of seismic instruments (broad-band velocity and strong-motion acceleration recording, poles & zero files, instrumental disturbances).

ES: ISOLA installation and presentation of ISOLA tools for conversion of waveforms into internal ISOLA-ascii format, conversion of the IRIS RESP and SAC-PZ files into internal ISOLA pz-files, instrumental correction of records, recognizing disturbed records for their removal. Seismic instruments; arquivos PZs; disturbances (mouse); Instalação e apresentação das ferramentas do isola; etc.

Day 2 morning

JZ: Necessary knowledge of seismic waves and sources (Green's tensor, moment tensor, elementary moment tensors, synthetic seismograms, forward and inverse problem, correlation between real and synthetic seismograms, variance reduction, condition number).

ES: Presentation of ISOLA tools for set up of velocity models, station selection, start time, origin time, inverted time-window length, trial seismic sources, and first simple calculations of Green functions and inversions of records.

Day 3 morning

JZ: Point sources and multiple-point sources (hypocenter and centroid, grid search, choosing proper frequency range, station-dependent frequency ranges, concept of “subevents”).

ES: Presentation of ISOLA tools for correlation diagrams, grid search in space and time. Iterative deconvolution. More complex examples of a Mw6+ event.

Day 4 morning

JZ: Full and deviatoric moment tensors (MT decomposition, the double-couple and non-double-couple part), source-type plots, concept of uncertainty using covariance matrices.

ES: Presentation of ISOLA tools for jackknife tests, inversion with uncertainty assessment, forward modeling tool.

Day 5 morning

JZ: Problems of small earthquakes (noise, need of combining waveform inversion with first-motion polarities, concept of waveform envelopes and shits).

ES: Presentation of ISOLA tools for Cyclic Scanning of Polarity Solutions (CSPS) method, and the tools for envelope inversion.

Comments and recommendations

1. Subdivisions of the tasks between ES and JZ is just tentative.

2. Tools will be explained on two examples, initially prepared for the 2018 course in Cuba, updated for 2020, because for both examples the lecturers have prepared detailed users' guides. The guides will be distributed in advance, so that students could print them. In the morning sessions, they will primarily watch the lecturer, and make their remarks on the printed guides. Due to online education, students will not replicate the examples on their computers during morning sessions (in contrast to previous courses).

3. The afternoon training, in smaller groups, under supervisions of the assistants, will have two parts. In the first part, students will replicate the examples form the morning session on their computers. In the second part, students will go through examples prepared by the assistants.

Prerequesits: Basics of Seismology (types of seismic waves, velocity models, location of hypocenter, seismic instruments, seismograms, noise and signal), Basics of Mechanics of continuous (displacement vector, stress and strain tensors), Basics of Signal processing (filtering , data differentiation and integration). Basic computer skills with directories and files, and with running Matlab codes.
Advanced (but strongly welcomed): Software SeisGram2K of A. Lomax, Basic Fourier spectral analysis (convolution, delta function, differentiation and integration in time and spectral domain), Basics of Wave propagation and Source physics (Green's tensor, Moment tensor), Seismic data formats (mainly SAC), Instrument response function (poles, zeros, IRIS data formats RESP and SAC-PZ). Matlab, GMT (V 4 - 5), SeisGram2K and Emap must be installed.