ICTP DIPLOMA PROGRAMME IN EARTH SYSTEM PHYSICS 2014-15

SYLLABUS

OBSERVATIONAL AND COMPUTATIONAL SEISMOLOGY
[12 lectures: 18 hours] - M. Guidarelli

1. Fundamentals of Seismology

What is seismology? Branches of seismology. Spectrum of seismic waves. Historical development of seismology. Earthquakes. Elastic moduli and body waves. P-waves, S-waves and their velocity. Surface waves. Surface wave dispersion.

2. Earth structure and seismic phases - Seismogram interpretation

Origin time, arrival time and travel time. Seismic rays, travel times amplitudes and phases. Hypocentre and epicenter. Local, regional and teleseismic earthquakes. Refraction, reflection and conversion of waves at boundaries. Seismic phases at different distance ranges. Seismogram analysis and travel time curves. Phase picking and first arrival polarities. Determination of structure (introduction). Global earth models.

3. Earthquake location

Manual location. Single station location. Multiple station location. Wadati diagram. Manual location and computer location. Earthquake location: general problem and generalize inverse. Location by iterative methods. Relative location methods. Joint hypocenter location. Double difference earthquake location.

4. Intensity and magnitude measurements

Parameters which characterize size and strength of seismic sources: intensity, magnitude seismic moment. Magnitude determination: magnitude scales for local events; common teleseismic magnitude scales. Complementary magnitude scales.

5. Earthquakes and seismometry

Elastic rebound theory. Fault geometry and basic types of faulting. First motions and body wave radiation patterns. Focal mechanism determination. Focal mechanisms from first motions. Inversion of amplitudes and first arrival polarities. Moment tensor inversion. Seismogram modeling.

6. Surfave waves

Origin. Dispersion and polarization. Crustal surface waves and guided waves. Normal modes. Surfave wave dispersion measurement: theoretical aspects and practical measurement with computer programs.. Frequency-time analysis (FTAN).

7. Earth structure

Inversion of seismic data for determination of Earth structure. Refraction seismology. Reflection seismology. Body waves travel time studies. Inversion of surface wave dispersion.

7. **Seismic tomography**
   Seismic tomography: body wave tomography; surface wave tomography. Ambient noise analysis and tomography. Other methodologies for the study of Earth structure.

8. **Seismic data analysis**
   Seismic data formats and digital waveform data. Software for seismic data analysis. Data analysis and seismogram interpretation: problems and caveats. Criteria and parameters for for routine seismogram analysis. Software for routine seismological analysis (Seisan, SAC) with computer based lectures. Software installation and usage.

9. **Geophysical inverse theory**
   Geophysical inverse theory. Parameter estimation and inverse problems. Forward problems and inverse problems. Linear inverse problems: discrete problems, continuous problems. Equi-determined, over-determined and under-determined problems. Least square inverse.