SC-C Earthquake Source Physics

SCC-0 Earthquake Source Physics (posters)

MOMENT TENSOR INVERSION WITH A MINIMUM OF DATA - NEW INSIGHT INTO THE STRESS FIELD OF EASTERN AFRICA

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Little is known about the stress regime in Eastern Africa, primarily due to a lack of earthquake source mechanism information. However, Eastern Africa is a zone of moderate seismicity and source mechanisms can be determined by using regional moment tensor inversion.
The World Stress Map (WSM) extracts stress data mostly from earthquake focal mechanisms. The WSM routinely uses solutions provided globally by the CMT group in Harvard and on a regional scale by several other institutions. The Eastern African Rift System is a region of active tectonics and thus of special interest for the WSM. CMT solutions are calculated teleseismically for events in Eastern Africa down to about mb 5.0. So only a few stronger earthquakes are used to determine stress directions. Presently there are 11 broadband seismometers recording the seismicity in central and southern Africa continuously. By the use of these stations we determine focal mechanisms of light earthquakes by moment tensor inversion. This decreases the magnitude threshold for source mechanisms to around mb 4.5 in a region where source-receiver distances are predominately up to 10°.
We discuss the limits of moment tensor inversion in regions with sparse data and show our source mechanism results of several light earthquakes. We discuss error estimations and reliability of the used moment tensors. Finally the result of a regional stress inversion is presented.

SEISMIC SOURCE DIRECTIVITY FROM DOPPLER EFFECT ANALYSIS, PART I: THEORY

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The directivity effects, a characteristic of finiteness seismic sources, are generated by the rupture in preferential directions. Those effects are manifested through different cadencies in the seismological measures from azimuthally distributed stations. The apparent durations are expressed as (e.g. Aki and Richards, 1980),

$$t_c(.\ ) = \frac{L}{v_r} - \frac{L}{c}\cos. \qquad (1)$$

where L, v, c and ??are, respectively, the fault length, the rupture velocity, the wave velocity and the angle between rupture direction and ray. This time duration can be measured directly from waveform or indirectly from Relative Source Time Function (RSTF). Equation (1) is deduced from a simple source model (Haskell model) that considers unidirectional uniform rupture propagation and a homogeneous elastic isotropic media. If we consider a more general propagation model, with spherical concentric layers, we obtain

$$t_c(.\ ,p) = \frac{L}{v_r} - \frac{pL}{R_T\cos.} \qquad (2)$$

where p is the ray parameter and the earth radius.
Similar equation can be obtained through physical considerations about a model composed by a sequence of subevents unilaterally distributed along a line (Doppler Effect). Based on the same considerations we can do a more detailed analysis through

$$\tau_j(.\ ,p) = \tau_0(1 - \frac{p_j}{R_T} v_{rH}\cos._j) \qquad (3)$$

where is the time interval between 2 identified pulses in the rupture referential and j indicate the number of station.
Based on this theory, we have developed a computational code DIRDOP (DIRectivity DOPpler effect) which determines the rupture direction and velocity from pulse durations observed in waveforms or RSTF.
We used this code to analyse recent major seismic events including the unilateral 23 June, 1999 Arequipa (Peru, Mw=8.2) earthquake and the bilateral 21 May 2003 Boumerdes (Algeria, Mw=6.7) earthquake amongst others. The results are similar to those obtained by other methods.

SEISMIC SOURCE DIRECTIVITY FROM DOPPLER EFFECT ANALYSIS, PART II: APLICATION TO THE ZEMMOURI-BOUMERDES (ALGERIA) EARTHQUAKE OF MAY 21ST, 2003, Mw=6.8g

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On May 21, 2003, the Eastern part of Algiers was struck by an earthquake (Mw=6.8) that injured 11.455 people and caused serious damage in cities close the hypocenter.
The purpose of this work is to analyse the rupture directivity of this event using a Doppler Effect approach. The inversion method developed (DIRDOP) (Caldeira et al., 2004) allows an estimation of the rupture direction and velocity from a collection of time pulses, extracted from body waveforms or a relative source time function (RSTF). This seismic data has been downloaded from the IRIS consortium and has a reasonable azimuthal coverage. We have used 30 teleseismic broadband body wave data and 6 relative RSTF obtained from the deconvolution in the time domain (Borges, 2003) using the synthetic Green functions. These are calculated using the Haskell propagator matrix.
The results show a bilateral rupture in the E-W direction. In the first 5 seconds the rupture propagates from the epicentre toward the East (N87ºE +-13º) with an average velocity of 2.9 0.31km/s. In the last 10 seconds the rupture propagates with the same velocity but in the opposite direction (S84W+- 14º). Both results are coherent with the focal mechanism (strike=64º, dip=50º, rake=83º) and the seismic source obtained elsewhere (Bezzeghoud et al., 2004).

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SOURCE TIME FUNCTION AND SOURCE PARAMETERS OF SEISMIC EVENTS AT RUDNA COPPER MINE, POLAND

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The source time function of 43 seismic events from Rudna copper mine was retrieved using empirical Green's function deconvolution technique in the frequency and time domain. The moment magnitude of analyzed events ranged from 2.1 to 3.6. For the empirical Green's function, we have selected events from the same area of the mine with a similar source mechanism and in the magnitude range from 1.5 to 2.7. The relative source time function was retrieved from the records of a number of