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Large-scale shear velocity structure of the upper mantle beneath Africa and surrounding regions

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The automated multimode waveform inversion technique developed by Lebedev et al. (2005) was applied to available data of broadband stations in Africa and surrounding regions.
It performs a fitting of the complete waveform starting from the S-wave onset to the surface wave. Assuming the location and focal mechanism of a considered earthquake as known, the first basic step is to consider each available seismogram separately and to find the velocity perturbations that can explain the filtered seismogram best. In a second step, each velocity perturbations serves as a linear constraint in an inversion for a 3D S-wave velocity model of the upper mantle.

We collected data for the years from 1990 to 2006 from all permanent stations for which data were available via the data centers of ORFEUS, GEOFON and IRIS, and from others that build the Virtual European Seismological Network (VEBSN) as well as all available African stations. Just recently we were also able to add the data recorded by the temporary broadband EGELADOS network in the southern Aegean. This represents a huge dataset with all available stations in Africa and surroundings regions.

The resulting models exhibit an overwhelming structural detail in relation to the size of the region considered in the inversion. They are to our knowledge the most detailed models of shear wave velocity currently available for the African upper mantle and surroundings. Most prominent features are an extremely sharp demarcation of the Dead Sea Rift System. Narrow high velocity regions follow the Hellenic arc and the Ionian trench toward the north. Low velocity zones are found at depths around 150 km in the Middle East region. The hotspots in North Africa are also clearly imaged.