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New temporary broadband stations in the larger Mediterranean region

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Project MIDSEA [Present Situation - midsea - Data Assembly] - Scientific goals [Motivation - Realization] - References

Project MIDSEA

Present situation

The present coverage of the Mediterranean region with broadband seismic stations is the result of individual efforts of many countries (figure 1). Well spread throughout the Mediterranean region are the stations from the Italian MedNet. The German Geofon is well present in the eastern Mediterranean and is expanding in the western Mediterranean. Four American GSN stations extend from the western end of the Eurasia-Africa plate boundary at the Azores to the eastern end in Turkey. The global Geoscope network also has three stations in the region and the region hosts another dozen of local and national broadband stations and networks. The ORFEUS European-Mediterranean seismic station inventory for the region reflects this mosaic of stations. For furthering our geophysical knowledge about this plate boundary region we are interested in quality data from these seismic stations in the band between 0.01 and 10 Hz. This band provides key information about upper mantle structure and about the source mechanisms of intermediate and large events in the region. All presently existing stations of this mosaic that have the capacity to produce quality data in this broad frequency band are plotted together in figure 1 (triangles). The availability of data from these stations is variable. Some managers of telemetered stations/networks in this mosaic make their data available through Spyder®. A more common way is to request the data of both telemetered and non-telemetered stations/networks at the managing authority's internet site. A widely used automated mechanism for such data requests is AutoDRM. Numerous variants of requesting data over the interenet exist, such as access through World Wide Web forms (e.g. SPEED, WILBER), FTP, Gopher or E-mail (e.g. Breq-fast). Most of these data request mechanisms provide the requesting party with data in SEED Volumes. When the data is not available in SEED format, software to read the particular data format is generally freely available or provided with the requested data. Retrieving, processing and making available seismological data is a labor intensive process. Data from stations/networks that are in an experimental stage or that are managed by understaffed offices do not become available for analysis for long periods of time. ORFEUS data center provides a great service to the seismological community by activating the various data request mechanisms to assemble data sets of significant earthquakes in the European Mediterranean region. ORFEUS also provides help in data processing and quality control for the above mentioned understaffed or experimental networks. When ORFEUS has assembled all available data for a particular time period a CDROM is produced for distribution among seismologists. In the time between the significant earthquakes and the production of the CDROM the assembled data sets are available through their web site. While assembled data sets with as dense a coverage in certain parts of the Mediterranean region as the large number of stations (fig 1) suggests are becoming available though the data services just described, data from possible new stations are needed to fill up the few remaining gaps in data coverage of the larger Mediterranean region.

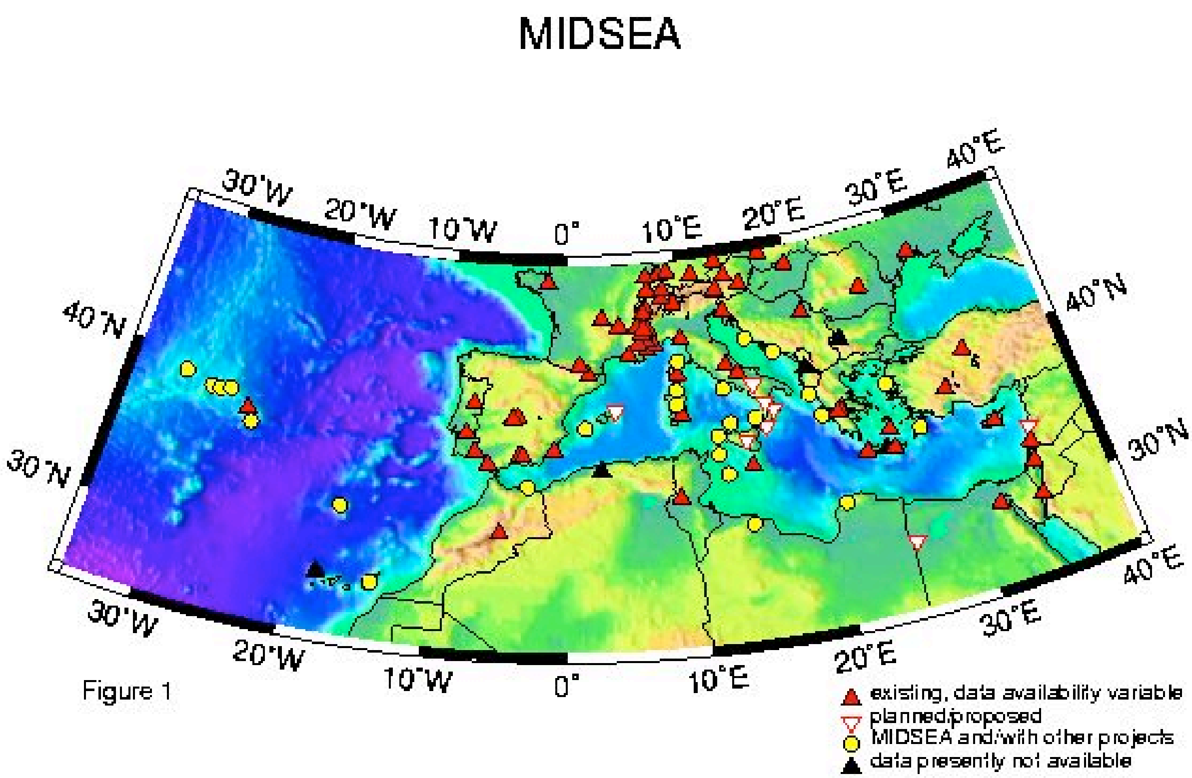

Fig 1. Existing and planned stations in and around the Mediterranean

MIDSEA

To date, studies of upper mantle structure have been relatively poorly resolved in large parts of the Mediterranean region due to sparse station coverage in important parts such as the Mediterranean Sea itself. To optimize the station coverage in this broad frequency band of interest we have initiated the project MIDSEA, Mantle Investigation of the Deep Suture between Europe and Africa. MIDSEA proposes the installation of additional broadband stations in key locations, which are mostly islands, in the Mediterranean Sea. The proposed locations are plotted in figure 1 (yellow circles). The ETH part in MIDSEA will consist of a dozen or half seismic stations each consisting of an STS2 seismometer and a MARS88 data logger. The UNSA part consists of Guralp CMG3 and STS2 seismometers and Agecodagis data loggers. The ING part consists of Guralp CMG3 seismometers and RefTek data loggers. For the proposed locations in Greece we have received a positive answer for collaboration from seismologists of the University of Athens. Our major collaborators in Croatia are seismologists of University of Zagreb. Two stations are scheduled to be installed on Croatian islands in March 1999. A meeting to discuss possible sites in Lybia has been scheduled with the general director of the Libyan Center for Remote Sensing and Space Sciences. Corsica already has one stations of the TGRS-Nice and a second is scheduled for installation in February 1999. Installations on Sardinia and the other Italian islands (e.g. Ustica, Panarea, Filicudi) are atill being planned. We collaborate with Geofon seismologists on plans for installation on Ibiza and in Melilla. Geofon has scheduled the installation of a station on Menorca and plans to install a stations in Melilla sometime in 2000. Until then MISDEA will provide the instrumentation for the latter site. Seismologists on the Canary Islands have worked to revive the GSN station TBT, and have provided significant information about a possible installation on a more easterly island of the group. Seismologists of DASE (Departement d'Analyse et de Surveillance de l'Environnement) in France and of the Univeristy of Lisbon are running an LDG station on Madeira of which they are making the data available. Last, but not least, a group of seismologists of the University of Lisbon, the Carnegie Institution of Washington and IPG in Paris are discussing the possibilities of installation several broadband stations on the Azores islands. Such an installation would overlap in time with MIDSEA and the data of the projects together enable a study of the Eurasia-Africa plate boundary further west than was previously possible.

Fig 2. Wielandt-Streckeissen STS-2 seismometer

Data assembly

The timing of MIDSEA as a means to fill in gaps in broadband data coverage in the larger Mediterranean region is good in view of the present broadband station coverage, which is better than ever and, together with current plans for new installations, covers the land masses very well. By the year 2000 it will be possible, in principle, to assemble *one* broadband data set out of the mosaic of individual broadband stations and networks in the larger Mediterranean region. This data set will have optimal station coverage for what would be possible using land stations. Better coverage could be achieved in the future by combining land data with data from Ocean Bottom Seismometers. An amalgamated data set of land seismograms might actually come to exist if as many as possible broadband station and network managers make their data available as timely as possible. We look forward to working towards this goal with the ORFEUS data center.

Summary of scientific goals of MIDSEA

Motivation

The plate boundary region between Africa and Eurasia is unusual on account of it being a zone of slow convergence between continents. This leads to complex deformational patterns at the surface and an equally complex structure of the underlying upper mantle, as evidenced for the Mediterranean region by the work of, for example, Panza (1985), Snieder (1988), Nolet (1990), Spakman et al. (1993), De Jonge et al. (1994), Zielhuis and Nolet (1994), Marquering et al. (1996), Yegorova et al. (1997). In project MIDSEA we wish to study of the upper mantle structure in the entire Africa-Eurasia plate-boundary region in improved detail using surface and body waves to improve the geodynamic understanding of the area as well as to characterize the deformational and thermal consequences of this long-term, slow convergence. We plan to use the data from the optimized station coverage to image the 3-dimensional (3-D) *S*-velocity structure and radial anisotropy using surface wave tomography and to characterize the transverse anisotropy and discontinuity structure using body waves.

Realization

The 3-D imaging and the measuring of radial anisotropy will be based on partitioned waveform inversion (Nolet, 1990; Van der Lee and Nolet, 1997) of regional fundamental and higher mode Rayleigh and Love waves. The characterization of transverse anisotropy will be based on the analysis of teleseismic *SKS* wave splitting measurements (Silver and Chan, 1991), and discontinuity structure on receiver function type analyses (Ammon et al., 1990; Van der Lee et al., 1994; Bostock, 1996; Vinnik et. al, 1997; Estabrook, 1996; Bethoux et al., 1999; Kosarev et al., 1999). Moreover, increased availability of Mediterranean data together with better knowledge on Mediterranean uppermost mantle structure allows a more accurate determination of source mechanisms of Mediterranean earthquakes as well as the determination of source mechanisms of smaller magnitude events in the region (Giardini et al., 1993a, 1993b).

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