

Orfeus FDSN Report 2004

Introduction.

ORFEUS is the European non-profit organization that aims at coordinating and promoting digital, broadband seismology in Europe. The Orfeus Data Center (ODC) is the European Regional Data Center for high-quality waveform data from stations in the European-Mediterranean region and is a collaborative effort of research institutes and observatories in the region. In this report we present the current status and progress at Orfeus.

The ODC gathers broadband (BB) data from observatories in the region, performs quality control and makes the data available to the global seismological community, mainly for research. To facilitate this ORFEUS is actively involved in coordination, funding, communication, web and workshop activities.

Broadband stations in Europe.

European-Mediterranean countries have been, and still are, rapidly upgrading their stations by installing high-quality broadband seismic instrumentation. This resulted in currently more than 400 broadband permanent stations that are operated by about 50 networks and observatories in the region. In order to keep a homogeneous overview ORFEUS Working Group 1 maintains a database with detailed information of these stations (see Figure 5). ORFEUS goal is to archive most of this waveform data in a standardized format (SEED) and make the data accessible to the seismological community.

Data gathering (from off-line to on-line procedures)

So far the ODC has been successful in archiving event data of most existing BB stations in Europe using off-line data gathering (tapes, CDs, etc) and manual quality control procedures. The last few years the ODC has been implementing on-line data gathering and automatic data quality procedures in order to cope with the exponentially increasing amount of digital broadband data (see Figure 2). The on-line data gathering has been realized within the EC funded MEREDIAN project (Contract EVR1-CT-2000-40007) in which the ODC and 17 national observatories have successfully implemented the required real-time data exchange infrastructure in Europe resulting in the Virtual European Broadband Seismic Network (VEBSN, van Eck et al., 2004). The ODC is presently merging its existing automatic quality control procedures with new tools and the real-time data processing system. The goal is to optimize the archiving and quality control procedure.

Virtual European Broadband Seismic Network (VEBSN)

The VEBSN combines two major project objectives: 1) rapidly provide high quality data to the research community and 2) automate central data collection and archiving procedures. The result is a virtual European network with a high potential for innovative research. The VEBSN has an important role in redefining the automated data management procedures at the ODC. The VEBSN collects (near) real time data, locates and quantifies important seismic events and stores the event waveform data in a publicly accessible repository (an example of data in this repository for the Morocco February 24, 2004 event is shown in Figure 4). The VEBSN also facilitates rapid centralized data exchange between European observatories and the IRIS-DMC through the Orfeus export server. As of September 2004 the VEBSN is comprised of more than 115 stations in and around Europe (Figure 3).

The data gathered by the VEBSN provides opportunities for rapid secondary products. For example, the VEBSN currently provides rapid accurate locations of large to medium sized earthquakes, complete with automatic picks and magnitude estimates, to the EMSC and observatories in the region. The EMSC combines the VEBSN picks with additional data picks to produce an improved location and magnitude estimate with a certain delay. Also, the event waveform data are used for routine rapid moment tensor determinations (e.g. the geophysics group of the Technical University of Zürich, ETHZ, Switzerland and the National Geophysical Institute, INGV, in Rome, Italy).

Seedlink developments

In Europe the GFZ group in Potsdam started the development of a simple real-time data exchange protocol: Seedlink (Hanka et al, 2000). This development was recognized by Orfeus to play an important part is giving real-time access to European stations and new plug-ins for different data recorders were developed at the ODC. Seedlink is now widely used also outside Europe. For detailed developments see <http://orfeus.knmi.nl/meredian/seiscomp>.

Orfeus Data Center archive

The ODC archives primarily waveform data of global events ($M \geq 5.5$) and regional events ($M \geq 5.0$) in SEED format and are made available through the Internet (WWW and FTP), email (AutoDRM) and on CD's or DVD's after basic quality control procedures have been applied. These quality procedures check whether all relevant and correct information (instrument response, station and event information, data description, etc.) is available and the data is not distorted or contaminated with noise, etc. The obtained quality-controlled products are so-called "ODC-volumes".

Currently, the ODC also offers rapid products that have not yet passed a quality control. Event data selected out of the VEBSN data are archived in the POND (Pool Of Networked Data) is available through WILBERII. Continuous data is stored in SEED on RAID systems and additional tape back-ups that are stored outside the ORFEUS host building. This double archiving system provides an automatic backup for European observatories that submit data to the ODC. The continuous data is also available from our processing system up to 30 days after it has been collected. The currently (nearly) completed data management structure is shown in Figure 1.

NetDC and WebDC

In 2004 the NetDC software was (again) implemented at the ODC and a connection to part of the ODC waveform data was realized. Real-time data from the POND is available. Discussions are going on how to organize the data exchange between NetDC nodes. A recent GEOFON development (**WebDC**) is in development as a continuation of NetDC. Orfeus has an active interest in this development. For more info: http://www.gfz-potsdam.de/geofon/new/web_dc.html

Data availability

Broadband event waveform data from stations in the European-Mediterranean area is available from ORFEUS in many different forms as illustrated in Table 1

Table 1. Data availability at Orfeus Data Center

Type of data	Continuous BB data European-Mediterranean stations	Event BB data European-Mediterranean stations M > 4.4 Euro-Med region events M > 4.9 global event	
	Real-time data 30 days to present	POND data 1."5-min" products 2."full events May 2002-present	ODC-volumes QC full event data 1988-1996 intermediate products 1997-2001
Access			
Web	-	WILBERII	WILBER
FTP	-	orfeus.knmi.nl	orfeus.knmi.nl
e-mail	rtautodrm@orfeus.knmi.nl	NetDC	autodrm@knmi.nl
On-line	On request	-	-

Orfeus web site: <http://orfeus.knmi.nl>

Data and web pages access statistics.

Figure 6 provides an overview of the statistics for data retrieval e.g. through the new WILBERII interface, giving access to POND data, and direct FTP access to the same data. Figure 7 provides an overview of the web page statistics for the ORFEUS web site. NetDC statistics are not yet available and the same applies to (rt)autodrm statistics. Orfeus also directly delivers real-time data to other data centers. E.g. three stations (HGN,FUORN & SENIN) provide their data in

real-time to IRIS. For the year 2004 (up to August 31) the data volume for these stations is 5.5 Gb.

ORFEUS Web-site developments

The current set-up of the Orfeus Web site needs revision and therefore a completely new structure is being designed. A first prototype of the new structure was developed summer 2004 and is planned to become operational later this year.

ORFEUS coordinating activities

Workshops organized through ORFEUS (2002-2003)

- '*Real-time data exchange within Europe*' (Barcelona, 2002)
[EMICES, ORFEUS WG1]
- '*Installation and operation of broadband seismograph stations*' (Istanbul, 2002)
[Kandilli, ORFEUS WG2, UNESCO]
- '*Distributed, Object Oriented Computing for Seismology*' (Athens, 2003)
[EMICES, ORFEUS WG4]
- '*Seismic hazard analysis and data exchange in the Mediterranean region*' (Nicosia, 2003)
[EMICES, USGS, UNESCO].

Three workshops were funded by project EMICES (contract EVK2-CT-2001-80002)
Proceedings (presentations, documents, software) are available on CDROM from ORFEUS

On-going projects and proposals

ORFEUS is coordinating two EC-projects:

- European-Mediterranean Infrastructure Coordination for Earthquake Seismology (EMICES) EC-contract EVK2-CT-2001-80002. Period: 2002-2004
<http://orfeus.knmi.nl/emices/>
- Mediterranean-European Rapid Earthquake Data Information and Archiving Network (MEREDIAN). EC-contract: EVR1-CT-2000-40007. Period: 2000-2005.
<http://orfeus.knmi.nl/meredian/>

Proposals:

- Network of Research Infrastructures for European Seismology (NERIES) 42 European participants. ORFEUS coordinator. FP6 'Support for Research Infrastructures'. Status rejected 2003, prepared for new submission 2004/2005.
- Earthquake monitoring in Support of Disaster Preparedness in South-Eastern Europe. EMSC and ORFEUS coordinators on behalf of DPPI partners. DPPI Stability Pact for south Eastern Europe. Status 2004: pending, basis for proposals to many different funding agencies.

Working Groups

- WG 1: 'Seismograph broadband station and siting standards'
(Chair: Josep Vila, Barcelona) <http://orfeus.knmi.nl/working.groups/wg1/wg1.html>
- WG 2: 'Technical support group for broadband seismometer users'
(Chair: Damiano Pesaresi, Rome) <http://orfeus.knmi.nl/working.groups/wg2/>
- WG 3: Mobile (broadband) stations'
(Chair: Paul Denton, Leicester) <http://orfeus.knmi.nl/working.grpoups/wg3/>
- WG 4: Seismological Software'
(Chair: Manfred Baer) <http://orfeus.knmi.nl/working.grpoups/wg3/>

References

Hanka, W. A. Heinloo and K-H. Jaeckel, 2000, Networked Seismographs: GEOFON Real-time Data Distribution. ORFEUS newsletter: <http://orfeus.knmi.nl/newsletter/vol2no3/geofon.html>

Van Eck, T., C. Trabant, B. Dost, W. Hanka and D. Giardini, 2004, Setting Up a Virtual Broadband Seismograph Network Across Europe, EOS 85-13.

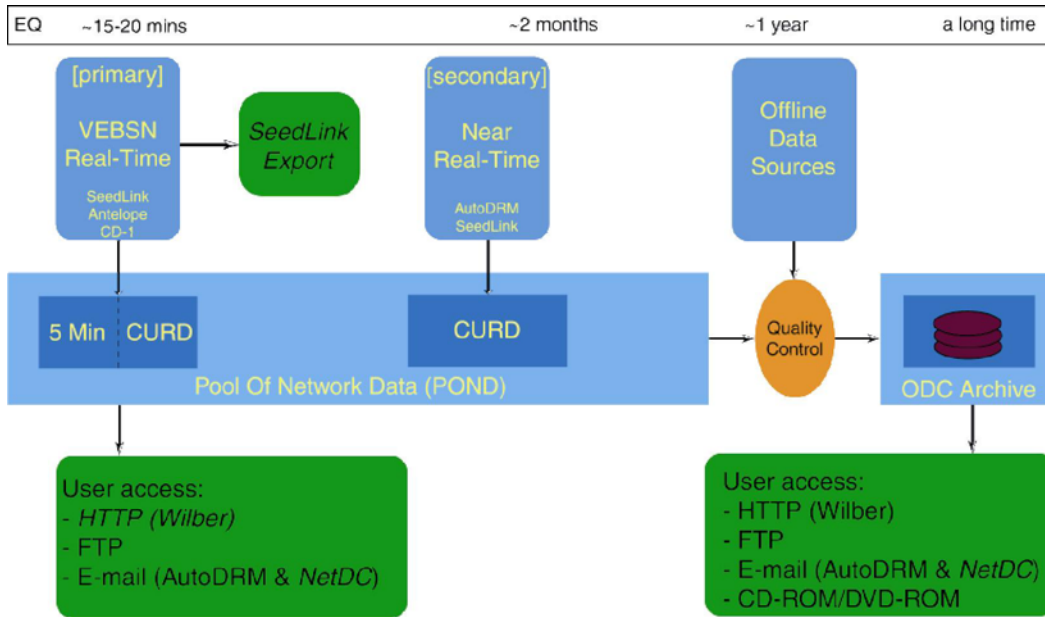


Figure 1. A schematic overview of the data management currently existing and being completed at Orfeus Data Center. Data inflow is either on-line in (near) real time or off-line. For efficiency reasons the goal is to minimize the off-line data gathering and make the VEBSN the major data gathering procedure. The Quality Controlled Event Data archive is the final database specifically for research.

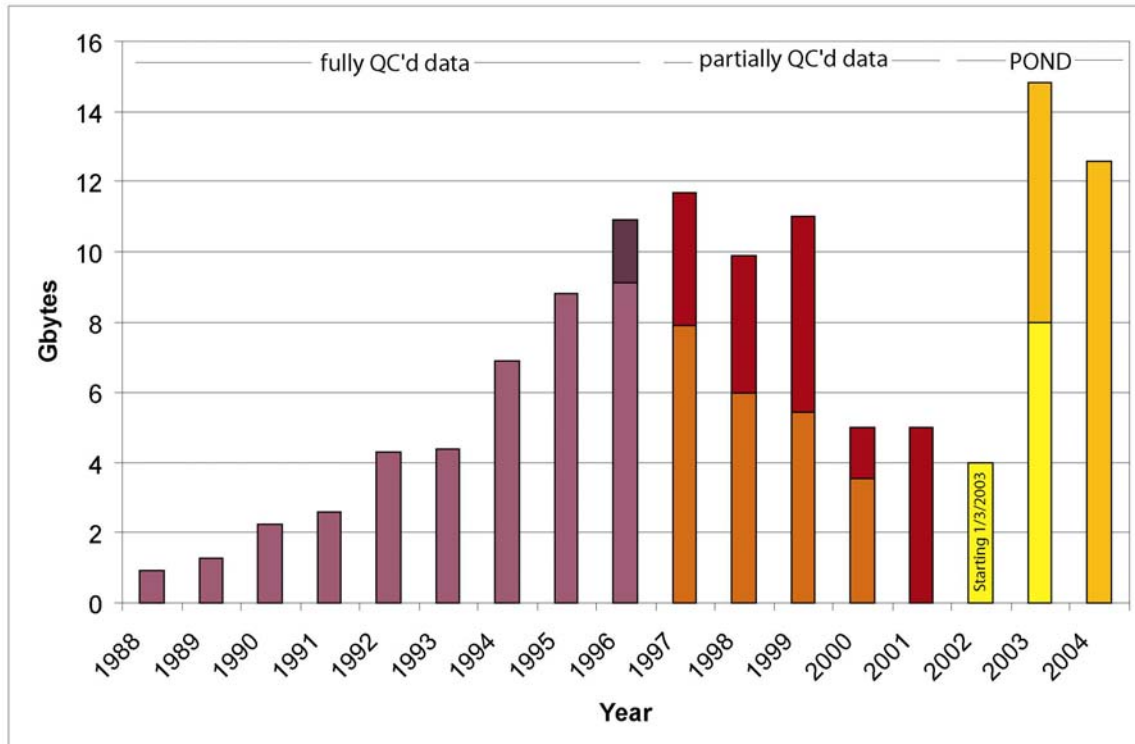


Figure 2. Data archiving progress. Bars indicate the event data available at the Orfeus Data Center. The darker tinted parts of the bars indicate the data added after June 2003. Data from 1988-1996 has been Quality Controlled. For data from 1997-1998 only sporadic stations have to be controlled. Quality Control is in progress for the period 1999-2000. We expect still more data for the years 1998-2004. For the period 1998-2002 archiving is done with off-line data gathering methods. Since 2003 the data gathering is mainly on-line and in real-time.

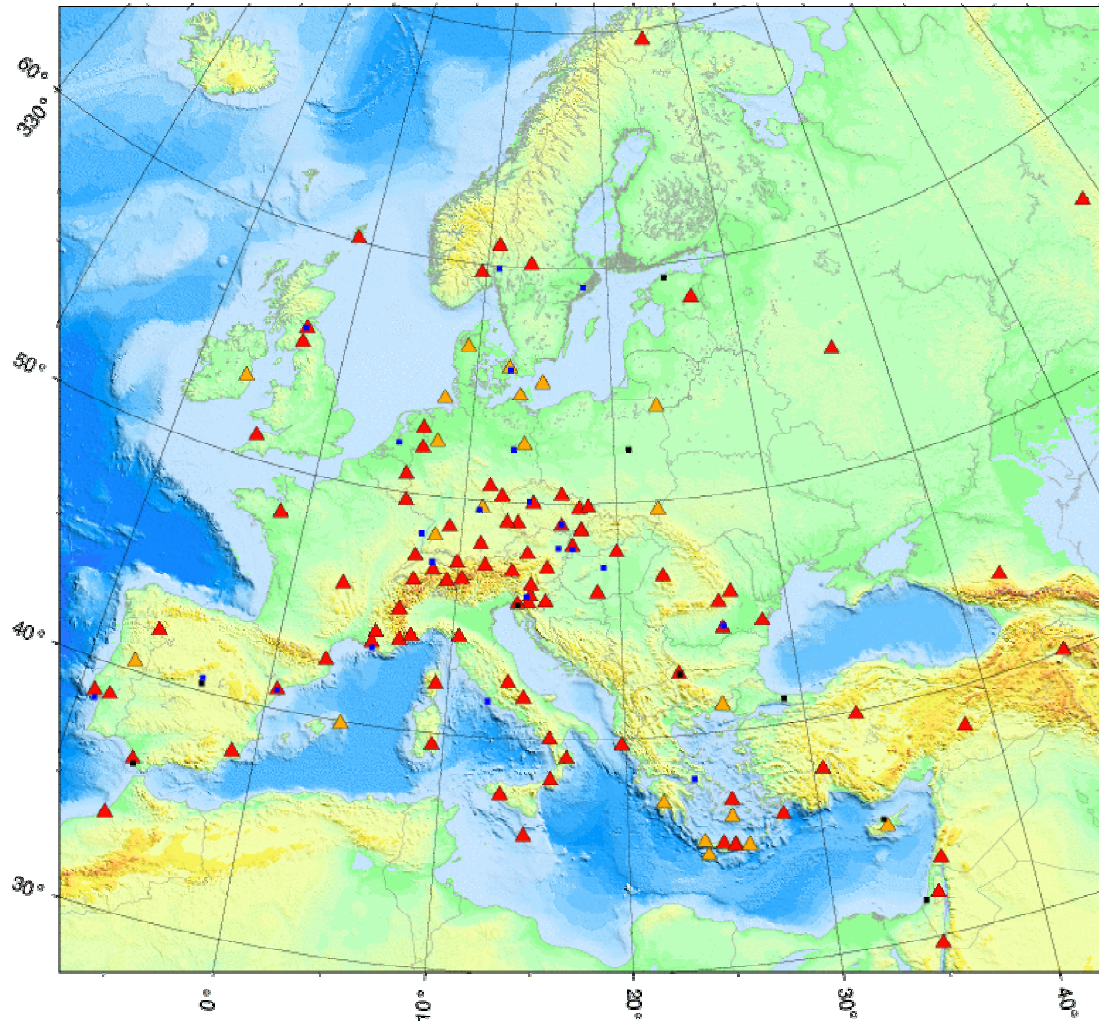


Figure 3. The Virtual European Broadband Seismic Network (VEBSN) as of 31 August 2004 (116 stations). The VEBSN also contains a number of stations outside the presented frame, among others in Canary Islands and the Cape Verde. Red triangles represent stations that contribute data within minutes, Orange triangles represents stations that transfer data every 1-60 minutes. Blue squares are participating observatories/institutes. The VEBSN is a product of EC-project MEREDIAN (Contract EVR1-CT-2000-40007) and is operated by ORFEUS.

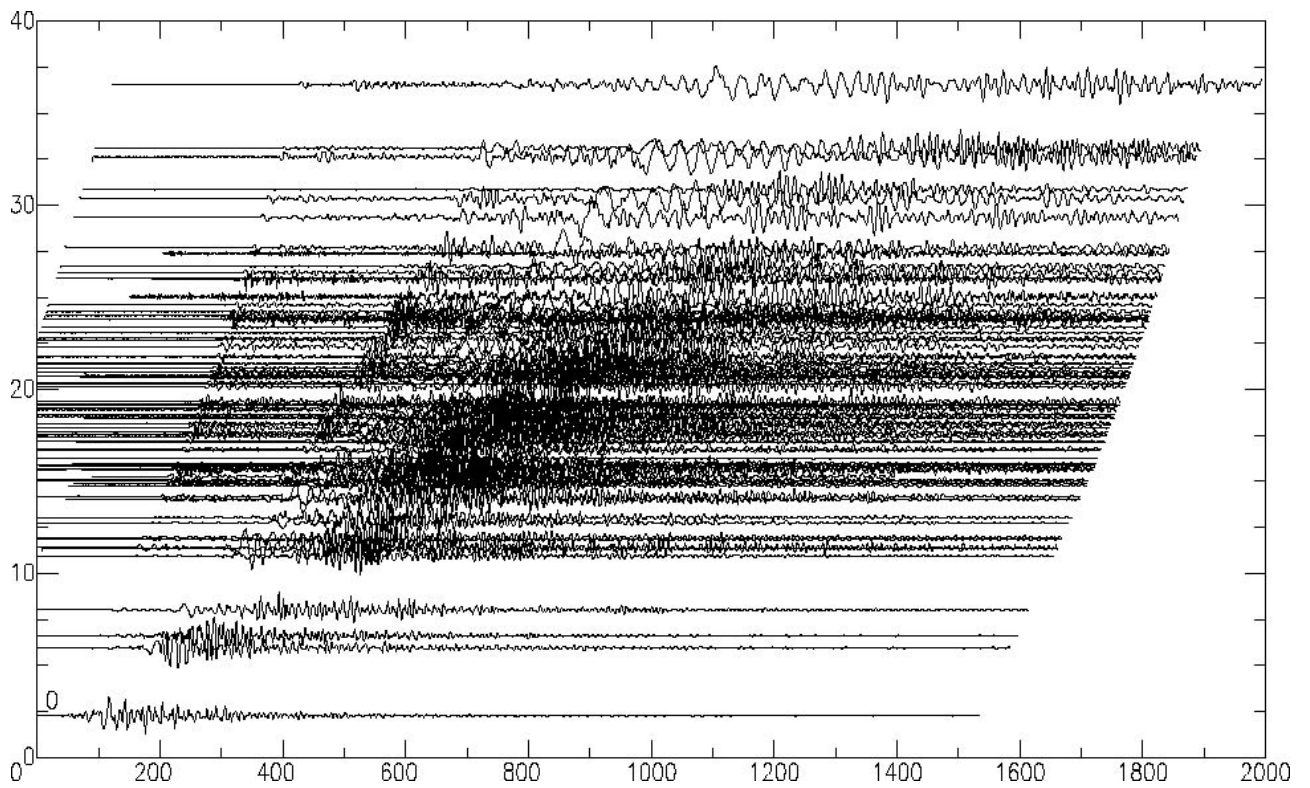


Figure 4. Example of VEBSN data. Event record section for the Morocco earthquake ($M = 6.4$ February 24, 2004) as available from the POND created by the VEBSN within a few hours after the event. Such data is available through WILBERII, ftp and AutoDRM at Orfeus Data Centre (<http://orfeus.knmi.nl>). Available formats are SEED, miniSEED, SAC.

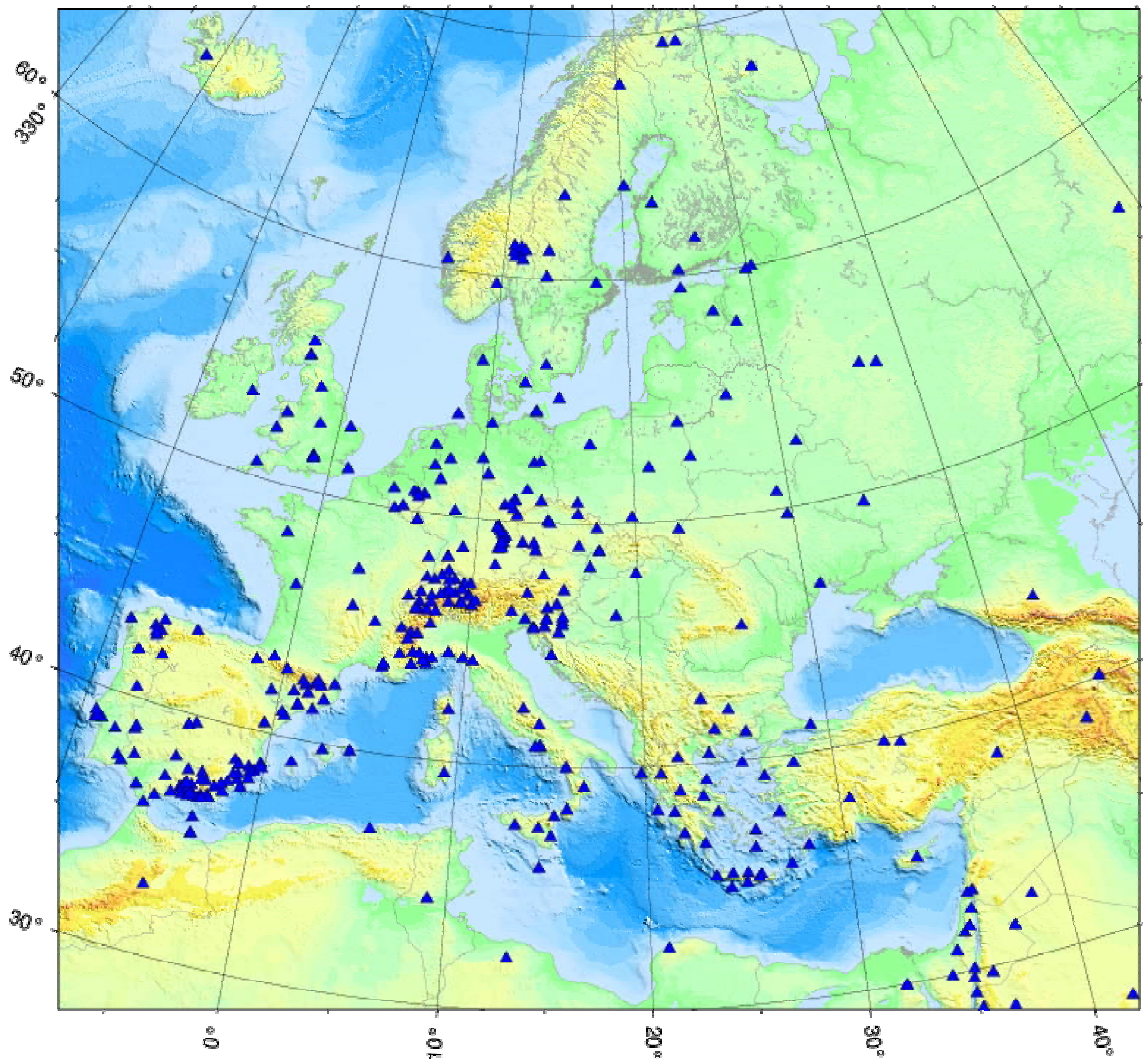


Figure 5. Broadband stations in Europe and surroundings as of January 1, 2004, as obtained from the station database at ORFEUS WG1. ORFEUS Working Group 1 maintains a database with extensive information about broadband stations in Europe and its surroundings. This database is available on <http://orfeus.knmi.nl>.

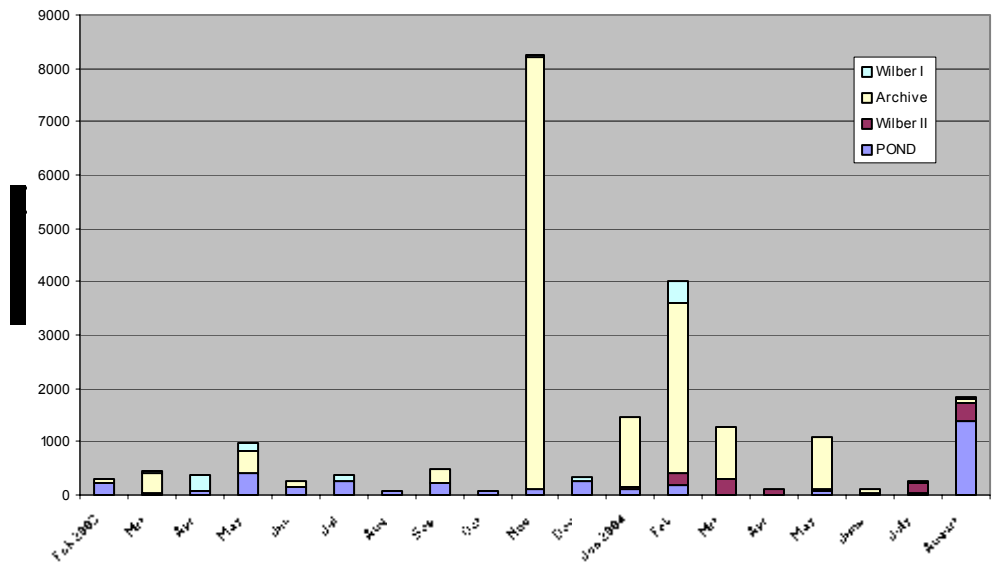


Figure 6. ODC data retrieval statistics for February 2003 – August 2004.

ORFEUS web access (April 1999 - July 2003)

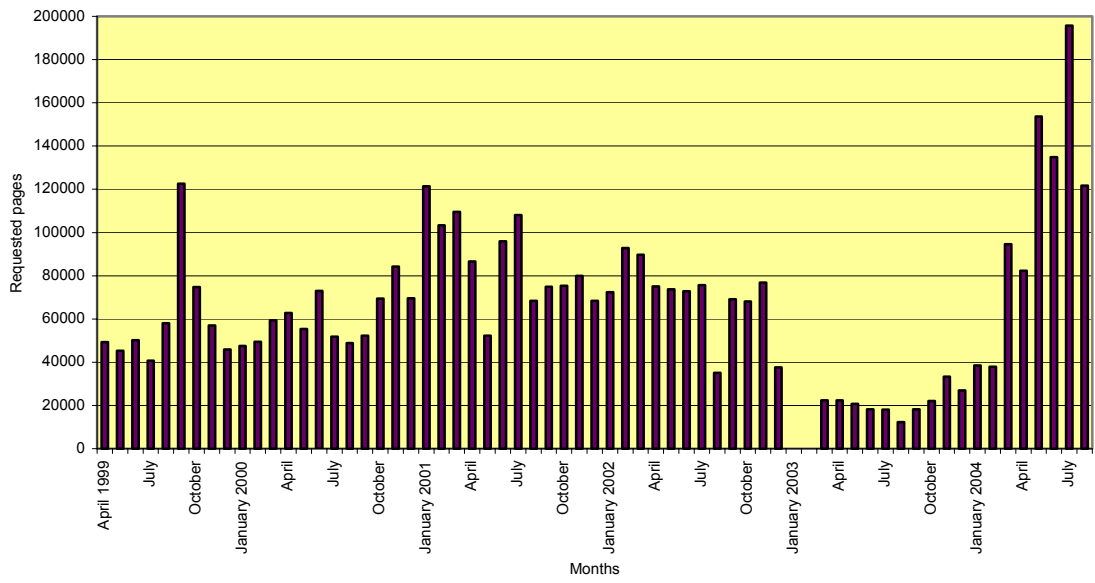


Figure 7. ORFEUS web access March 2003 – August 2004. Known robot traffic has been excluded from the statistics.