



Recommendation 864 (1979)¹

Earthquake prediction

Parliamentary Assembly

1. Expressing its deep sympathy for the victims of the recent earthquake disaster in Yugoslavia ;
2. Noting that 2 000 million of the world's population live in earthquake-prone areas and that in Europe alone this century earthquakes have accounted for over 130 000 deaths ;
3. Having regard to the proceedings of the European Seminar on Earthquake Prediction held in Strasbourg from 5 to 7 March 1979 by the Council of Europe and the European Space Agency ;
4. Welcoming the work done in this field by UNESCO, and in particular the organisation of the International Symposium on Earthquake Prediction held in Paris from 2 to 6 April 1979, to which the results of the European Seminar were presented ;
5. Noting that combined satellite and ground-based prediction techniques have a definite potential for saving lives in earthquake-prone countries ;
6. Welcoming the proposal made by the seminar for a concerted European research programme on earthquake prediction, to be prepared within the framework of the Assembly's "Exercise in Scientific Co-operation" by its Working Party on Geodynamics, in consultation with the European Space Agency, the European Seismological Commission, the European Mediterranean Seismological Centre and the European Association of Remote-Sensing Laboratories ;
7. Resolving to support the implementation of this proposal by setting up within the framework of its "Exercise in Scientific Co-operation" a European Association for Earthquake Prediction, on the model of the European Association of Remote-Sensing Laboratories which it established in 1977 in conjunction with the Commission of the European Communities and the European Space Agency ;
8. Noting the special importance of continuous seismic surveillance in regions of high seismic activity such as the Upper Rhine Graben area where extra risks are involved due to the presence of nuclear power plants, and that proper surveillance in this area depends on special radio links for transmitting seismic data across frontiers,
9. Recommends that the Committee of Ministers :
 - 9.1. request the governments of member states to ask the appropriate authorities in their countries :
 - a. to support the proposal, appended hereto, of the Strasbourg Seminar for a concerted European research programme on earthquake prediction, and
 - b. to examine and report on how this programme should be staffed and funded ;
 - 9.2. invite the European Space Agency and the Commission of the European Communities, given the probability that more earthquake disasters will occur within their geographical areas, to encourage and accord priority to the implementation of this proposal ;

1. Assembly debate on 11 May 1979 (8th Sitting) (see [Doc. 4332](#), report of the Committee on Science and Technology). Text adopted by the Assembly on 11 May 1979 (8th Sitting).



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9.3. invite the Government of the Federal Republic of Germany to draw the attention of the Deutsche Bundespost to the need for maintaining the allocation of appropriate radio frequencies for the transmission of seismic data in the Upper Rhine Graben region.

Appendix

Proposal for a European Programme of Earthquake Prediction Research

Conclusions adopted at the Seminar for the Definition of a European Research Programme for Earthquake Prediction jointly organised by the European Space Agency and the Parliamentary Assembly of the Council of Europe

Following the motion for a resolution (Doc. 4237) of the Parliamentary Assembly of the Council of Europe, a Seminar for the Definition of a European Programme for Earthquake Prediction Research was jointly organised by the European Space Agency and the Parliamentary Assembly of the Council of Europe in Strasbourg (5-7 March 1979).

About forty scientists and representatives of interested organisations from ten European countries discussed the subject in much detail, reviewed the activities in earthquake research and submitted a programme proposal which was approved by the meeting.

The proposed European programme aims at the prediction of earthquakes using ground-based and space techniques combined with modern communication capabilities. In this research programme methods will have to be developed which will permit us to systematically search for, identify and monitor changes in the physical state of the earth that are precursory to earthquakes. It is hoped that these methods can be used to forecast earthquakes, thereby helping to mitigate disasters caused by them.

The proposed programme calls for a concerted European effort. It also provides the framework for national, bilateral and interdisciplinary projects which are already under way or in the planning stage.

The territory of Europe is heavily affected by the presence of the Alpine-Mediterranean seismic belt which covers a broad area extending from the Near East through the Eastern Mediterranean and Aegean region, the Balkan and Apennine peninsulas, the Sicilian-Calabrian arc, and the Iberian Peninsula to the Azores Islands. In addition, the dispersed intra-plate seismic activity has to be taken into account where, in a densely-populated continent like Europe, even moderately-sized earthquakes could cause substantial loss of life and property. The seismic regions described above are associated with different tectonic processes and, therefore, will in turn have an impact on the type of instrumentation and methodology to be applied.

The countries most threatened by earthquakes, those which have suffered great loss of life and property in the past, are Turkey, Cyprus, Greece, Romania, Yugoslavia, Italy, Malta, Spain, Portugal and Iceland, some of which have already offered their help for intensified European studies in their homelands.

The programme presented follows a four-phase plan, which should start immediately with a "preparatory phase" (for a period of two or three years), followed by a "testing and evaluation phase" and a "pre-operation phase", leading to the establishment of an "operational system" before the end of this century.

The proposal comprises activities in the following areas :

- ground-based systems,*
- seismotectonic evaluation,*
- field work,*
- space systems and satellite missions,*
- communication systems for data collection and distribution,*
- data centre(s),*
- organisational arrangements.*

The attached table, which outlines the general structure of the programme, indicates specific activities for the "preparatory phase".

The ground-based systems should provide well-defined geophysical, geodetic and astronomical parameters relevant to the problem in question, possibly supplemented by geochemical and other data. About 150 fixed "key stations" with appropriate instrumentation are envisaged, to be arranged in clusters in the active areas mentioned. A number of "mobile stations" should be available which can be placed in potential seismogenic areas.

The design and development of low-cost instrumentation should be encouraged. For these developments, financial support from national funding agencies has to be secured. The specification of sensitivity, precision, long-term stability and environmental effects on the various sensors is a prerequisite.

Seismotectonic evaluation is a complementary approach to the monitoring of earthquakes. By enabling a comparison of seismic data and relevant geological or structural data (especially neotectonics and interpretation of satellite imagery), seismotectonic maps make it possible to define seismogenic zones more precisely. It is recommended to join efforts between European countries in order to adjust and complete existing documents, already available or still in progress, especially along country borders.

Extensive field work will be required in the areas selected for detailed earthquake prediction studies. These research activities will include investigations of the historical and current seismicity, mapping of tectonic features and lithospheric structure with the aim of facilitating the selection of suitable sites for the ground-based systems. The combination of seismological observations with geological and structural data (for example, as obtained by satellite imagery) will help to outline seismogenic sources more precisely and, in addition, will make it possible to produce a new seismotectonic map of Europe.

A pre-processing of data in the field areas will be necessary to cut down on the amount of data to be transmitted to the data centre(s).

The proposed space systems comprise :

satellite and aircraft imagery

laser ranging<ATTfleche>ground-to-satellite - <ATTfleche>satellite-to-ground - and, to be added at a later stage,

satellite-assisted VLBI

satellite-to-satellite tracking - (with the aim of obtaining the fine structure of the gravity field).

Under the heading of satellite missions, future geostationary satellites should be equipped with a system capable of transmitting geophysical data relevant to earthquake prediction.

For the communication systems, various technical solutions should be studied, which are presently available or under discussion. There are some non-technical aspects which have to be considered in this context :

- a. legal problems (such as the use and allocation of frequencies, etc.),²
- b. costs of operation.

With regard to the data centres, there has been agreement that the European Mediterranean Seismological Centre (EMSC), which has been operating in Strasbourg since 1976 under the auspices of the European Seismological Commission, should act as the central data-handling agency in the proposed European programme of earthquake prediction research. In this data centre, the received data will have to be stored, analysed and interpreted. A special evaluation group will be in charge of making decisions after careful assessment of the information collected. All data in this programme will be subject to an open exchange. For this initial phase, additional staff are needed for the centre. It is foreseen that the data centre will grow considerably during the later phases of the programme and, therefore, a new structure is needed for the centre. The new structure will have to be studied carefully. There should be modern receiving and processing facilities at the centre. For its operation- i.e. communication systems, storage, retrieval, analysis, interpretation and distribution of data, and the necessary research- the centre should be properly staffed. For comparison, it should be mentioned that centres of this kind are already in operation in countries already engaged in earthquake prediction research, such as Japan, USA, USSR, and the People's Republic of China, each of them having a staff of several hundred persons. There is confidence that a similar European Centre is needed for a concentrated effort in earthquake prediction research.

In a future system, where satellites will be used to broadcast data to such a centre, it would be an advantage if more sub-centres would come into existence, receive directly the required data, and share the scientific evaluation.

2. An imminent administrative problem has been identified leading to the possible discontinuation of an already existing regional surveillance network (in the Rhine Valley area). The meeting recommends therefore that a corresponding request is submitted by the Council of Europe to the appropriate authorities of the countries concerned.

Organisational arrangements. It is recommended that for the present the Working Party on Geodynamics of the Council of Europe, in consultation with the European Space Agency, the European Seismological Commission and the European Mediterranean Seismological Centre, should act as the preliminary co-ordinating body. In order to facilitate the anticipated close co-operation it is suggested that a "European Association for Earthquake Prediction" (EAEP) be formed, which is seen as a loosely organised group of interested institutions in Europe actively engaged in earthquake prediction research, eventually growing into a fully-fledged organisation responsible for the entire programme. This association will have to appoint the special evaluation group in the data

centre. Intergovernmental status may well be preferable for this organisation in the long term in view of the anticipated financial support by all European countries. On a global and continental scale, close international cooperation should be sought and special efforts should be made to secure effective coordination.

Programme	Preparation	Testing and evaluation	Pre-operation	Operational services
Time scale	1980 1981 1982	1983 1984 1985 1986	1987 1988 1989	1990 1991
Ground systems	Preparation Testing	Evaluation Operational		
Field work and mapping	Preparation Site selection	Testing and evaluation several sites	Pre-operational seismotectonic map of Europe	Complete network operational (150 sites)
Space systems	Feasibility studies	Design, development and testing	Operational	
Satellite missions	Mission definition	Conceptual studies of geostationary and multi-disciplinary satellites	Mission implementation	
Communication systems	Preparation and tests using Argos and Meteosat	Pre-operational		
Data centre	Preparation Strasbourg EMSC	Testing Preparation European Association for Earthquake Prediction (EAEP){	Operational	Dedicated network European Earthquake Monitoring and Prediction Centre (EEMAPC)

Conclusions

In conclusion, it can be stated that the seminar convened by the Council of Europe and the European Space Agency has achieved its objectives. The major issues under discussion have been incorporated in the proposal presented. It is recommended that the dialogue initiated at this seminar be continued in the near future, possibly in connection with the forthcoming sixth meeting of the European Geophysical Society in Vienna, 11-14 September 1979, in order to implement the proposed plan of action.