Working group on the future role of the ISC

Report to the ISC Governing Council, July 1995

Preamble

At its meeting on January 9 1994 the Governing Council of the International Seismological Centre created a Working Group to consider the future role and function of the ISC. The Working Group has solicited opinions from members of the Governing Council, with the request that they also convey the solicitation to other interested parties. Some 23 replies were received in response to the solicitation and these were carefully considered by the Working Group. The Working Group met in Newbury in August 1994 and as part of its deliberations invited the senior ISC staff members to outline their views as to the future role and function of the ISC. The Appendix gives the membership of the Working Group and a list of those from whom letters were received. In interpreting its terms of reference, the Working Group has assumed that its recommendations should not involve expansion of the responsibilities of the ISC that would require a substantial increase in the operating budget. This report summarises recommendations of the Working Group.

Introduction

The ISC has an essential and continuing role to collect, archive, analyse and disseminate global earthquake information. Such information is a prerequisite for many applications, such as hazard assessment, tectonic studies, nuclear arms non-proliferation monitoring, determination of Earth structure and studies of the earthquake source process. The work of the ISC is widely admired and appreciated. Its role of collection and dissemination of data give to the ISC a central role which is not duplicated by any other organization. Its establishment as an operational international non-governmental organization, with global membership, make it unique in seismology. While dependent collectively upon the bodies that submit data, the ISC is not, and should not be dependent upon any other individual organization. We believe that such independence is important and that it must be strengthened. In looking to the future we do not see a need to redefine the basic mission of the ISC, which will be as relevant in the future as it has been in the past. This mission, as defined in the ISC's *Working Statutes*, is as follows:

(a) *To collect seismogram readings from station networks throughout the world in cooperation with other seismological data centres and seismological organizations;*

(b) *To edit and preserve the readings for analysis in computer-readable form;*

(c) *To compute focal coordinates and magnitudes for each event for which adequate data are available and to publish monthly a bulletin containing the fullest possible listing of original data and parameters derived therefrom;*

(d) *To prepare and publish a regional catalogue of earthquakes;*

(e) *To undertake such research and developments as may be relevant to improving the execution of the above-mentioned tasks, and are within the terms of these statutes;*

(f) *To provide such other services to institutions or to individual scientists and engineers throughout the world as are compatible with the execution of the above-mentioned tasks, and with the data and facilities available within the Centre;*

(g) *To undertake such other relevant activities as may be approved by the Governing Council on its own motion or on the recommendation of the Executive Committee.*

While the fundamental role of the ISC does not need to change, it is necessary to reinterpret this role in the light of the advances which have taken place in computing power, in data storage technology and in computer networking. On the one hand these advances should make the work of the ISC easier. For example, the ready availability of large amounts of disk storage should make it possible for the ISC to keep much more of its data, perhaps all its data, online. The cost of the computer hardware needed to accomplish a given task has greatly diminished. On the other hand, the new technology leads to new demands. In general there will be less call for earthquake data in the form of printed bulletins and more need for the distribution of data in a variety of electronic forms, including remote access to data via the Internet. This, we believe, should lead to a change of emphasis in which the ISC becomes less a publishing house for printed bulletins and more an online resource, generating the Bulletin as one of its products.

Advances in computing also have relevance to the *analysis* carried out at the ISC. The ease with which large amounts of data can be displayed on a workstation should make it possible to make the event review and reassociation tasks interactive and more rapid. Once the data are online it is possible to envisage that the entire catalogue could be reanalysed in the event that a new model or a new location algorithm is adopted.

The ISC has a dual role as, on the one hand, a *data centre* and on the other an *analysis centre*. As a data centre the ISC should aim to be the definitive source for earthquake data, other than seismograms – a seismological hub, collecting data from all seismological observatories and agencies and dispatching subsets of the data in response to requests from scientists. As an analysis centre it should aim to provide the definitive global hypocentral catalogue.

The functions envisaged in this report will take a number of years to put in place, and their implementation is likely to be a step-by-step process requiring, at each step, that short term *targets* be defined; the definition of such targets will be guided by the overall vision of the ISC's role. It is hoped that this report can serve (*i*) to help to define the overall vision – the long term objectives, (*ii*) to identify certain immediate steps which can be taken – the short term targets (*iii*) to suggest procedures by which development targets can be defined and met in the future.

General Recommendations

We believe that it is *essential* that the ISC be able to renew itself in response to new possibilities that present themselves in the form of advances in computing and networking. As an institution having responsibility for earthquake information the ISC cannot afford

to ignore the explosion in 'information technology' and, in particular, in the Internet which has radically changed the practice of information exchange. This carries the implication that a certain amount of staff time, and a certain amount of money will need to be allocated to what may be termed *development* of the ISC's programmes. We believe that the amounts of time and money needed to begin on the proposed developments can be made available within the ISC's current resources.

Development is not a one-time event, and in general a mechanism needs to be established whereby changes can be initiated and carried through in a timely way. Change is usually incremental and, initially at least, experimental and exploratory in nature; in order to provide freedom of action we recommend that a fund be set aside from the budget, to be expended at the discretion of the Director, in consultation with the Executive Committee Chairman, in furthering the development of new systems at the Centre. Let us call it a *Development Fund*. We hope by this recommendation to provide a degree of flexibility that will make it unnecessary for all items of expenditure on computer equipment, for example, to be planned many months in advance or for specific quotations always to be brought to the Executive Committee. Subject to budgetary constraints, allocations to this fund should be made from time to time at the recommendation of the Executive Committee. We recommend that the Executive Committee considers such allocations at each of its meetings and defines the goals towards which such development activity should be targeted. That is, the Executive Committee should agree on *development targets*. A report should be made by the Director to the following meeting of the Executive Committee on progress towards the stated targets. Recommendations for current *development targets* (T1-3) are made below.

The need to accommodate and to take advantage of technological advances also should be taken into account in making appointments at the Centre. We recommend that the potential ability of a candidate for appointment to contribute to the development of new systems at the Centre should be a factor of significance in the selection procedure.

As a further general recommendation, we believe that the development of a close association with an active seismological research institution would be highly beneficial to the evolution of the Centre.

The ISC as a Data Centre

As a Data Centre, the role of the ISC should be to archive earthquake data, excluding waveforms, and to satisfy user requests, either for the complete archive or for a selected time interval and selected record types – e.g. hypocentres determined by various agencies, phase records, macroseismic records, etc.. These functions could be carried out without any analysis or reassociation on the part of the ISC. The ISC would not have responsibility for the quality of these data. Each record would have a reference to the responsible agency. Since this aspect of the work does not require analysis, data could be made available without significant delay. Thus a scientist could request data for a recent time interval and receive the data currently available. This service would, for example, cater to scientists wishing to study recent aftershock sequences using their own location algorithms, or using hypocentral parameters reported by the contributing agencies. If the ISC were to receive the data generated under GSETT initiative, information could be made available very

soon after the event. The ISC has requested from the GSETT group the phase data and locations to be obtained by the International Data Centre, with the potential objective of making these data available to the seismological community.

There will also be a need to accommodate a variety of different kinds earthquake data – for example the macroseismic earthquake records which it is proposed to generate under the GSHAP programme. By adopting a sufficiently general data structure the ISC can become very flexible in the form of the data it retains and distributes. We believe that the ISC should be in a position to act as a repository and archive for all kinds of data relating to earthquakes. In addition, the ISC should maintain more complete station information, including instrument type and response parameters, activity history, contact address and e-mail address for data requests.

We recommend that, in the longer term, the ISC develop the capability of maintaining information on the availability and mode of access of digital seismograms residing at other institutions, such as the FDSN Data Archive, or with station or local network operators.

In the near term we propose that ISC should generate and make available a "raw" data stream, consisting of time-ordered phase records and interleaved agency event reports and ISC solutions. Flags should be used to indicate associations determined by the reporting agencies, and by the ISC when appropriate. These data should be made available in a timely way (i.e. soon after the data are received), in order that recent events may be studied by interested seismologists.

The ISC as an analysis centre

The ISC should continue its present role of assembly, association, hypocentre estimation and generation of bulletins of hypocentral and associated phase information. Such analysis would take place, as now, some 2 years after real time, in order to ensure that the most complete data set is used.

However, we are very much aware of the great and increasing load on the ISC staff in processing and reviewing such large numbers of events which, for example, exceeded 6,200 in May 1993, with some 180,000 readings. We propose, therefore, that the ISC does not attempt to analyse events below certain magnitude thresholds. The thresholds will need to be determined on a regional basis, since small events in regions of low seismicity will be of much greater interest than small events in highly active regions. In general we believe that the thresholds should be in the magnitude range from 3.0 to 4.0.

Taking advantage of the capabilities of modern workstations the ISC should seek to make more of its event processing operations interactive. In particular, the event review stage should be set up in such a way that phase deletions, reassociations etc. can be carried out, and solutions recomputed online. Moreover, we believe that by program modification it should be possible for a significant number of errors currently requiring intervention by a seismologist, to be detected and corrected automatically.

By rejecting small events and by taking steps to make the procedures more automatic and more interactive it should be possible to bring the work load to a manageable level, within current resources. Naturally this is essential if there is to be scope for the ISC's programmes to be enhanced.

The Working Group did not give detailed consideration to the question of possible adoption of new travel time tables, or other algorithmic changes, believing this to be an issue for the Executive Committee and the Governing Council, and not having great influence on the broader aspects of the ISC's future role. Furthermore, before making such changes it would be desirable to first develop the capability of reanalysing the entire catalogue, in order to maintain the homogeneity of the ISC hypocentre data set. However, we do make the recommendation that additional phases be used in ISC location procedures; in particular, S and PKP.

Computer environment

The functions envisaged will require a new computer environment at the ISC. Since other recommendations are dependent upon computational changes, we identify this as an area in need of immediate action.

It is our view that the aims will be most readily achieved by moving to a network of UNIX workstations, connected to the Internet. The full implementations of such a change may require a significant one-time effort to raise funds through grant applications for hardware and, possibly, for the support of additional temporary personnel. In the near term, however, it is necessary to gain experience with the UNIX environment and to port current programs to a UNIX workstation platform. To this end we strongly recommend that a single workstation be purchased. This system should be equipped with a DAT or Exabyte tape drive, a large magnetic disk (e.g. 2GB), Internet connection and laser printer. We believe that this should be considered a matter of urgency. Members of the working group expressed willingness to be of assistance in designing and developing such a system and in porting programs and data. The specifications of the development system were discussed by the working group, but the detailed configuration should be worked out by the ISC staff in consultation with the Executive Committee chairman and others they may wish to consult. Thus we recommend the following as current *development targets*:

(T1) Acquisition of a suitably equipped UNIX work station with Internet connection.

(T2) Porting of current analysis and editing programs.

(T3) Experimental automatic processing of data requests submitted by electronic mail or via anonymous-ftp.

As an initial allocation to the *Development Fund* we recommend the sum of £20,000, to be found from ISC's current funds.

Summary Recommendations

- ISC continues to operate as the primary archive for global phase and earthquake information, excluding seismograms;
- ISC extends its role by including other kinds of earthquake information in its archives and by developing new tools to collect and disseminate information via the Internet;

- ISC continues to produce a homogeneous catalogue of global seismicity;
- ISC implements a procedure whereby specific *development targets* are defined and reviewed by the Executive Committee; at the present time we recommend the following development targets: (T1) Acquisition of a suitably equipped UNIX work station with Internet connection; (T2) Porting of current analysis and editing programs; (T3) Experimental automatic processing of data requests submitted by electronic mail or via anonymous-ftp.

Appendix

Membership of the Working Group.

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