ANNALI DI GEOFISICA, VOL. XXXVI, N. 3-4, June-July 1993

Technical guidelines for global seismic hazard assessment

Peter Basham [1] **and Domenico Giardini** [2]
([1]) *Geological Survey of Canada, Ottawa, Canada*
([2]) *Istituto Nazionale di Geofisica, Roma, Italia*

Abstract
We present a compilation of the twenty recommendations proposed for the implementation of the Global Seismic Hazard Assessment Program, endorsed in the UN/IDNDR framework, and approved by the second GSHAP Steering Committee meeting (Mexico, April 1993). The goal of this document is to promote a common methodology under GSHAP to deal with the four basic elements of hazard assessment: earthquake catalogues and associated data bases, seismotectonics and earthquake source zones, strong seismic ground motion and seismic hazard computation.

1. Introduction

The proposal by the International Lithosphere Program for a Global Seismic Hazard Assessment Program (GSHAP) has been endorsed as an international demonstration project by the Scientific and Technical Committee of the UN's International Decade for Natural Disasters Reduction.

To provide a framework for GSHAP, representatives of 27 countries and most of the international and regional agencies involved in seismic hazard assessment were invited to a technical planning meeting in Rome, 1-3 June 1992. The purpose of this meeting was to verify the consensus of the scientific community on the need for GSHAP and to define the program goals and specifications. To develop a common methodology for seismic hazard assessment under GSHAP, four internationally recognized scientists were asked to provide recommendations at the Rome technical planning meeting on the four basic elements of hazard assessment: earthquake catalogues and associated data bases (A. Johnston); seismotectonics and earthquake source zones (R. Muir-Wood); strong seismic ground motion (D. Boore); and seismic hazard computation (R. McGuire). A volume of proceedings, in press in the summer of 1993 (Giardini and Basham, 1993), contains the detailed reports presented in Rome and the technical guidelines (Johnston and Halchuk, 1993; Muir-Wood, 1993; Boore and Ambraseys, 1993; McGuire, 1993). Working groups were formed at the technical planning meeting on each of the four basic elements, chaired by the theme leaders, to assess the recommendations for GSHAP implementation in the wide variety of conditions found around the globe.

Additional invited contributions to the technical planning meeting were on the important aspects of analysing historical earthquake data (Guidoboni and Stucchi, 1993), and on the results that have been achieved under the three ILP Theme II projects: world stress map (Zoback, 1993); world map of active faults (Trifonov and Machette, 1993); and paleoseismicity of the late Holocene (Pantosti and Yeats, 1993).

The four theme leaders were then asked by the GSHAP Steering Committee to consider the results of the Rome working groups, the information provided under these special themes, and their general experience from contacts around the globe, and prepare specific recommendations on the technical guidelines to be adopted by GSHAP for consideration at the second GSHAP Steering Committee meeting, held in Mexico in April 1993. The following is a compilation of the twenty recommendations (R) as accepted by the Committee.

2. Earthquake catalogues and data bases

The GSHAP Steering Committee, at its first meeting in Rome, recommended that the initial work at the Regional Centres be focused on the improvement of the earthquake catalogues, an activity that is needed in all regions and one that could begin even before full funding has been established. In addition, it is generally recognized that there is a need for the development of more complete global earthquake catalogues to serve as reference standards.

Specific recommendations on the catalogues and data bases are as follows:

R.1

Seismicity data should be considered in three time-period categories:

1) 1964-present, modern instrumental data is available from the International Seismological Centre (ISC) data base; numerous catalogues and data bases have been compiled at regional, national and local scale; Harvard Centroid-Moment Tensor solutions (CMT) are available from 1977 to present;

2) 1900-1963, early instrumental data; main data sources are ISS, BCIS and Gutenberg and Richter (1954); principal information will often be non-instrumental;

3) Pre-1900, pre-instrumental; data sources will be historical and macroseismic only.

R.2

For the modern instrumental data the ISC catalogue should be the default. That is, ISC hypocentral parameters will be used for 1964 to the present unless substituted or augmented with better local and/or regional data, which in some cases might be macroseismic. However, there are three important problems with ISC data to consider:

a) many ISC focal depths based on depth phases will need critical reappraisal;

b) as the ISC did not adopt surface-wave magnitudes until 1978, the PDE (NEIC) values will be adopted for 1968-1978;

c) the ISC computed M_S with no depth restriction from January 1978 to June 1981; for events at depths greater than 60-70 km these magnitudes are invalid.

As the ISC is considering the adoption of new location and quantification procedures and data formats for its future operation, it is recommended that the ISC be asked:

a) to consider these recommendations;

b) to adopt newly available travel times and new location procedures in agreement with NEIC and the IASPEI Commission on Practice;

c) to re-evaluate its catalogue from 1964 following these same procedures.

R.3

For the early instrumental era, a significant effort is justified to improve the existing data banks. This should include, but need not be restricted to:

a) merger of the event phase data present in the ISS and BCIS data bases;

b) recomputation of hypocentres using these data and modern techniques, including the newly-adopted travel-time tables;

c) compilation of instrumental data for the period 1890-1913 from all available sources, particularly in those regions where larger events in this time period may be important to the earthquake history.

Activities a) and b) are being undertaken jointly by USGS and UNAM as a two-year GSHAP special project. It is recommended that the technical procedures followed in the re-locations using the BCIS and ISS data be consistent with those adopted by ISC, so as to create for the first time a uniform global instrumental earthquake catalogue.

R.4

For the pre-instrumental, historical era, it is recognized that it will be beyond the general scope of GSHAP to compile and analyse/reanalyse historical earthquakes on a global scale.

Each Regional Centre, however, will establish a regional catalogue of historical seismicity, focusing reanalysis efforts on the larger events important to an understanding of the earthquake history. The merger of the regional historical catalogues will allow, for the first time, the compilation of a uniform global historical earthquake catalogue.

R.5
The earthquake size descriptor for the GSHAP seismicity data base – instrumental and historical, global and regional – will be the moment magnitude M as defined by Hanks and Kanamori (1979). Because seismic moment M_0 will be available for only a small fraction (<5%) of the total data base, a moment magnitude must be estimated from the available instrumental or macroseismic data. The regressions on magnitude and/or isoseismal area to estimate M should be developed on a regional basis by each Regional Centre. An example of the hierarchy of estimation methods for M for earthquakes in stable continental regions is given in Appendix A. Calibration events for use in the regressions should be treated as events of special interest by the Regional Centres and receive the most thorough data compilation and analysis.

R.6
The minimum magnitude for the global seismicity data base will vary by region. Stable intraplate regions should have a lower minimum magnitude threshold than active intraplate or plate boundary zones. Selection of minimum magnitude threshold should be made by the Regional Centres, and in no case should it be higher than $M = 5$. Minimum magnitude is closely tied to the problem of estimating levels of completeness for the data base. Both will vary temporally and spatially; their specification on a global scale will be a major undertaking that will require close coordination and guidance at the Steering Committee level.

R.7
Even though most deep earthquakes and oceanic ridge and transform earthquakes pose negligible risk, the GSHAP is a unique undertaking and its goals should extend beyond the immediate (and highest priority) objective of quantifying seismic hazard globally. An earthquake catalogue that is truly global will have a lasting scientific value and should be a goal of GSHAP. It is recommended that Regional Centres expand their efforts in establishing high-quality earthquake catalogues to the entire geographical extent of their regions.

R.8
A standard data file format is needed for each earthquake in the GSHAP seismicity data base. For ease of use in a variety of computers, the recommended file format is 80 columns, with flag entries to other supplementary files. The recommended format that allows for the different data requirements of the three data eras, modern instrumental, early instrumental and pre-instrumental, is described in Appendix B.

3. Seismotectonics and earthquake source zones

A key component of seismic hazard assessment is the creation of the seismic source model, which demands translating seismotectonic information into a spatial approximation of earthquake localization and recurrence. The whole process of collecting and analysing seismotectonic knowledge has to be explicit so that it becomes possible to question on what basis judgements were made in the construction of the seismic source model (Muir-Wood, 1993).

Specific recommendations on the compilation and interpretation of the seismotectonic information are as follows:

R.9
Each Regional Centre should identify a key individual with a background in neotectonics, geodynamics and earthquake geology well aware of the published information and its limitations, who will have the task of assembling and critically reviewing all of the relevant information.

R.10
The Regional Centres should take advantage of all information available from the ILP Theme II projects on Contemporary Dynamics

and Deep Processes. The project on the world stress map has been completed, as described by Zoback (1992). The status of the projects on the world map of active faults and paleoseismicity of the late Holocene, is described by Trifonov and Machette (1993) and by Pantosti and Yeats (1993), respectively. Regional Centres should maintain contact with the latter project leaders to keep apprised of progress.

R.11
Each Regional Centre should undertake a review to explore the depth and reliability of seismotectonic knowledge in its region. The results of the review would be used to determine the uncertainties inherent in the seismic estimates, and to define future research objectives. A review can be undertaken through the pursuit of answers to a series of questions:

a) What is the degree to which geological deformation and earthquake sources can readily be mapped at surface outcrop?

b) How intensively have active faults or fault scarps been searched for? How many of these have been investigated and dated in natural and artificial exposures?

c) Is there an alternative mean of assessing regional deformation rates based on plate tectonics or geodetic information?

d) What is the level of geological analysis of recent deformation?

e) How does historical moment release compare with the rate of regional deformation estimated from plate boundary constructs and geological evidence?

f) Is there a scientific consensus as to the current seismotectonic state?

R.12
The results of the seismotectonic compilation should be summarized into a single report with maps, review articles and reference lists. A common style should be adopted and the set of seismotectonic chapter headings could be as follows:

1) regional crustal and tectonic structure;

2) regional deformation rates and styles;

3) regional rates of seismicity;

4) the locations and style of the principal faults controlling the deformation;

5) the recurrence intervals of major fault rupture events and dates of the last episode of fault movement in different parts of the region;

6) evidence for spatio-temporal variations in earthquake activity.

R.13
Using all of the available seismotectonic information, earthquake source zones will be designated for the region. Faults would be specified by geometry (in three dimensions), sense of slip, segmentation, and a function describing rupture length or area as a function of magnitude. If faults cannot be identified, the locations of possible earthquakes must be represented with areal sources within which earthquake characteristics are designated to be uniform. For each seismic source, fault or area, the earthquake recurrence model must be specified.

4. Strong seismic ground motion

The third main element required for seismic hazard assessment is the designation of the strong ground motion estimation equations, specifying the strong ground motion as a function of earthquake size (M) and hypocentral distance. These equations have been developed for only a few regions of the world. Obtaining realistic estimates of strong ground motions in all regions is a major challenge that must be met if GSHAP is to be a success (Boore and Ambraseys, 1993).

Specific recommendations on strong ground seismic motions are as follows:

R.14
It is recognized that some existing hazard assessments are based on qualitative estimates of earthquake effects such as intensity, and used for official national zoning maps. However, for a uniform application throughout all regions under GSHAP, it is recommended that quantitative ground motion parameters such as peak ground acceleration, peak ground velocity and spectral velocity for specified damping and structural frequencies be employed. As

there is no accepted worldwide standard concerning the parameters used to quantify and display seismic hazard, it is recommended that the views of the international earthquake engineering community be sought on the question of the set of strong ground motion parameters that should be used in the GSHAP hazard estimates. Dr. Giuseppe Grandori, a member of the GSHAP Steering Committee, has agreed to consult the earthquake engineering community on this question and report their views by early 1994.

R.15
Each Regional Centre should evaluate all ground motion studies done in the region, including studies done by seismological observatories for purposes of magnitude estimation at regional distances, for they can be used to obtain the attenuation of ground motion with distance.

R.16
Lacking any studies of ground motion attenuation and source scaling in the region or sufficient ground motion data to obtain new regressions, then studies from other parts of the world must be used. It is recommended that a thorough review of ground motion predictions throughout the world be conducted as a GSHAP special program by a small team of international experts, with attention paid to the geophysical and geological parameters that might control the rate of attenuation and the scaling of motions with source size. Although primary attention should be given to empirical studies, almost certainly theoretical considerations will prove to be essential. An attempt should be made to minimize the number of generic tectonic regimes and earth structures; a few, ranging from Precambrian shield to subduction regions, is probably sufficient. Dr. D. Boore of the United States Geological Survey has agreed to head a small international team to undertake this review.

R.17
On a regional basis, GSHAP will initially be computing ground shaking hazard for rock sites. The program does not encompass microzonation studies or the assessment of the response of soils on a site-specific basis. However, where deep soils have a wide areal extent and will have a significant influence on the shaking hazard, they must be taken into account for GSHAP products to be useful. Therefore, Regional Centres should compile a map or data base of surficial geology where deep soils have a wide extent in the inhabited portions of the region. Initially, such a map or data base may simply lump the surficial geology into «rock» and «soil» categories, but it will be important to have better-defined soil profiles in areas where the response of the soil may be significant in altering the hazard.

R.18
The process of converting descriptions of near-surface geology into variations of ground motion is not standardized, although many building codes have foundation factors that modify rock motions for different types and depths of soil columns. It is recommended that a global survey of such procedures be done as a GSHAP special program (by the same international team of R.16), resulting in recommendations for translating geological descriptions of soil profiles into ground motion variations.

5. Computation of seismic hazard

The GSHAP Steering Committee recognizes that countries around the world employ different hazard computation methods for the development of national seismic zoning regulations. GSHAP does not wish to, and in fact cannot, dictate methodology that may differ from well-established practice in developed countries. The intent of GSHAP is to provide a common methodology that may be applied throughout an entire GSHAP region (and when compiled together, to build a common global hazard base), and, where needed, to provide a well-accepted methodology to countries where such practices are poorly developed or non-existent.

R.19
It is recommended that a probabilistic seismic hazard computation of the type introduced by Cornell (1968) be adopted for global application in the GSHAP framework.

6. Software tools for hazard computations

For the development of seismic hazard products to work efficiently, the primary effort of the geoscientists at the Regional Centres and in each country should be on evaluating data and making interpretations, not on developing software for evaluations and interpretations.

R.20
It is recommended that a comprehensive package of software be developed under the guidance of the GSHAP Coordinating Centre and made available to the Regional Centres and the working groups in each country. The software package should contain the following modules:

a) *Catalogue manipulation*. The earthquake catalogues are the fundamental data base for earthquake hazard analysis and deserve the closest scrutiny. This software module will provide a capability to perform two major functions: 1) process catalogues of different formats, eliminate duplicates and produce a master catalogue in the recommended format (R.8); and 2) convert all seismic size estimates to moment magnitude (R.5), assigning uncertainties to these estimates. Commercial data base software will be evaluated for this purpose.

b) *Plotting module*. This module will enable: 1) plotting of epicentres from the master catalogue on a geographical base of land masses and political boundaries; 2) the interactive display and analysis of all areal geological and tectonic data bases available in digital form; and 3) the display of contoured seismic hazard maps and associated uncertainty. Commercial GIS software will be evaluated for this purpose.

c) *Recurrence parameter estimation*. From the master catalogue, and using the geometry of the seismic source zones, this module will assemble earthquake counts by magnitude range and year, from which periods of complete reporting can be estimated. The module would estimate rates of activity and b-values for each source zone using a maximum likelihood procedure such as that developed by Weichert (1980).

d) *Hazard computation*. The Coordinating Centre will undertake a review of a variety of Cornell-type hazard computation codes in use in agencies around the world and make a decision on the code appropriate to GSHAP purposes. This code will calculate hazard for a grid of sites; have the capability of weighting different seismic sources and ground motion equations; and produce a mean hazard result, with uncertainty, in terms of both probabilities of exceedence for several ground motion amplitudes and specific amplitudes corresponding to selected probabilities.

REFERENCES

BOORE, D. AND N. AMBRASEYS (1993): Some notes concerning prediction of ground motion for GSHAP, in *GSHAP Technical Planning Volume*, edited by D. GIARDINI and P.W. BASHAM, *Ann. Geofis.*, **36** (n. 3-4), 169-180.

CORNELL, C.A. (1968): Engineering seismic risk analysis, *Bull. Seismol. Soc. Am.*, **58**, 1583-1606.

GIARDINI, D. and P.W. BASHAM (1993): *GSHAP Technical Planning Volume*, *Ann. Geofis.*, **36** (n. 3-4).

GUIDOBONI, E. and M. STUCCHI (1993): The contribution of historical records of earthquakes to the evaluation of seismic hazard, in *GSHAP Technical Planning Volume*, edited by D. GIARDINI and P.W. BASHAM, *Ann. Geofis.*, **36** (n. 3-4), 201-215.

GUTENBERG, B. and C.F. RICHTER (1954): Seismicity of the Earth and Associated Phenomena, 2nd ed., Princeton University Press, Princeton, New Jersey, pp. 310.

HANKS, T.C. and H. KANAMORI (1979): A moment magnitude scale, *J. Geophys. Res.*, **84**, 2348-2350.

JOHNSTON, A. and S. HALCHUK (1993): The seismicity data base for the Global Seismic Hazard Assessment Program, in *GSHAP Technical Planning Volume*, ed-

ited by D. GIARDINI and P.W. BASHAM, *Ann. Geofis.*, **36** (n. 3-4), 133-151.
MCGUIRE, R.K. (1993): Computations of seismic hazard, in *GSHAP Technical Planning Volume*, edited by D. GIARDINI and P.W. BASHAM, *Ann. Geofis.*, **36** (n. 3-4), 181-200.
MUIR-WOOD, R. (1993): From global seismotectonics to global seismic hazard, in *GSHAP Technical Planning Volume*, edited by D. GIARDINI and P.W. BASHAM *Ann. Geofis.*, **36** (n. 3-4), 153-168.
PANTOSTI, D. and R. YEATS (1993): Paleoseismology of great earthquakes of the late Holocene, in *GSHAP Technical Planning Volume*, edited by D. GIARDINI and P.W. BASHAM, *Ann. Geofis.*, **36** (n. 3-4), 237-257.
TRIFONOV, V. and M.N. MACHETTE (1993): The World Map of Major Active Faults Project, in *GSHAP Technical Planning Volume*, edited by D. GIARDINI and P.W. BASHAM, *Ann. Geofis.*, **36** (n. 3-4), 225-236.
WEICHERT, D.H. (1980): Estimation of the earthquake recurrence parameters for unequal observation periods for different magnitudes, *Bull. Seismol. Soc. Am.*, **70**, 1337-1346.
ZOBACK, M.L. (1992): First and second order patterns of tectonic stress: The World Stress Map Project, *J. Geophys. Res.*, **97**, 11703-11728.
ZOBACK, M.L. (1993): Utilizing *in-situ* stress data for seismic hazard assessment; the World Stress Map Project's contribution to GSHAP, in *GSHAP Technical Planning Volume*, edited by D. GIARDINI and P.W. BASHAM, *Ann. Geofis.*, **36** (n. 3-4), 217-224.

Appendix A. Hierarchy of estimation methods for moment magnitude.

Johnston and Halchuk (1993) have established a hierarchy of estimation methods for determining moment magnitude *M* for earthquakes in stable continental plate interiors, where any method takes precedence over all those below it:

1) *M* derived directly from the seismic moment M_0;
2) *M* estimated from standard teleseismic magnitudes;
3) *M* estimated from measured isoseismal areas;
4) *M* estimated from regional or non-standard instrumental magnitudes;
5) *M* estimated from quoted intensity areas, radii or magnitudes;
6) *M* estimated from number of recording stations;
7) *M* estimated from epicentral intensity;
8) *M* assigned by judgement.

Johnston and Halchuk provide more details within each of these eight categories, including estimates of uncertainty on the derived M. This hierarchy has been derived for stable continental plate interiors and may not apply in exactly the same order in other seismotectonic environments such as tectonically active intraplate zones and plate boundary zones; the hierarchy and associated regressions to estimate *M* will need to be developed by each Regional Centre in accordance with its seismotectonic environments.

Appendix B. The GSHAP primary seismicity data file format.

INTRODUCTORY REMARKS

1) For reasons elaborated in the text, the recommended format for the GSHAP seismicity data file is standard Fortran, 80 characters (columns) length. It is recognized that many modern data bases have much more sophisticated and complex formatting. However, for global use in the widest possible variety of computing environments, this format is unrivaled. Data complexity, ambiguity, and multiple values are accomodated through flags to detailed supplementary files. Moreover, the 80-character format is more than adequate to fulfill the requirements of a wide spectrum of seismic hazard analytical applications.

2) A guiding principle for the data file was that the same format must serve for every earthquake, whether it occurred in: a) the pre-instrumental era (pre-twentieth century); b) the early instrumental era (~1900-1963), or the modern instrumental era (1964-present). This was considered essential for a homogeneous seismicity catalogue, which in turn is a primary requirement of seismic hazard analysis. Although the primary data file for the three eras is standardized, the flagged supplementary files will be different (see *comment*, columns 75-80).

3) Each event in the catalogue will be assigned a single size descriptor. The GSHAP Steering Committee has adopted moment magnitude (M_w or M) as that descriptor. Since only a small percentage of earthquakes have a measured seismic moment, a hierarchy of regression methods has been designed to estimate M_w from other magnitudes or intensity data (see *comment*, columns 54-60 and Appendix A). All original magnitude or intensity data will be retained in secondary data files, keyed by flags in the primary file.

Other details concerning specific entries in the data file are found in *comments* following the column number in the format description below.

GSHAP - Primary Data Record
80 columns, Fortran format

1	A1	record type:	M	modern instrumental
			I	all instrumental
			K	all macroseismic
			B	mixed

Comment allows the catalogue to be easily sorted for instrumental or historical subsets.

2-4	I3	Flinn-Engdahl Region number
5-6	A2	country/ocean code-2-letter I.D.

Comment many hazard assessments will be at the national level. This field allows the easy sorting by country.

6-10	I5	year-negative is BC
11-12	I2	month
13-14	I2	day
15-16	I2	hour
17-18	I2	minute
19-21	F3.1	second
22-27	F6.3	latitude (decimal degrees; south is –)
28-34	F7.3	longitude (decimal degrees; west is –)
35-38	I4	epicenter source reference number

Comment the source reference number for the epicenter (also col. 43-46 for depth, and 61-64 for moment magnitude) will specify the primary source for the data. Often this will be just primary agencies such as ISC, NEIC, EMSC, ISS, etc., but it is anticipated that many of the primary data sources, especially for historical data will be from the literature. The I4 field will allow up to 9999 entries in the GSHAP source bibliography.

39	A1	epicenter descriptor	T	teleseismic instrumental
			C	centroid
			R	regional instrumental
			L	local instrumental
			M	macroseismic

40-42	I3	hypocentral depth (nearest km)		
43-46	I4	depth source reference number		
47	A1	depth descriptor	L	local network solution
			T	teleseismic/regional
			P	depth phases
			W	waveform modelling or inversion
			M	macroseismic
			R	restricted
48-51	F4.2	log(M_o)	M_o in dyne-cm	

Comment this will be a measured quantity only for events with directly determined M_o; otherwise it is obtained from regressions on the other parameters listed in col. 54-60. Dyne-cm are used to conform to the Hanks and Kanamori definition of moment magnitude.

52-53 F2.1 moment magnitude (Hanks and Kanamori, 1979)

54-60 A7 M_w calculation/quality category: list in priority order all that are applicable up to maximum of 7.

A	instrumental (seismic) M_o
B	M_o from field/geodetic observations
C	teleseismic M_s and m_b available
D	teleseismic M_s only
E	teleseismic m_b only
F	instrumental m_{bLg}
G	M_{GR} (Gutenberg and Richter 54); not class «d»
H	isoseismal contour areas-regression to M_o
I	direct M_L-log(M_o) regression
J	regional m_b, M_s (non-ISC/NEIS)
K	M_L regressed to m_b/M_s, then to M_o
L	M_{GR} class «d» (Gutenberg and Richter 54)
M	M_w from number of recording stations
N	M_w from quoted isoseismal areas/radii
O	M_w from intensity-based m_b, M_s, m_{bLg}
P	M_w from I_o (epicentral/maximum I)
Q	M_w assigned by judgement

Comment these columns detail the number of ways of estimating M_o. For events with abundant data, the number may exceed the allotted 7 columns in which case only the highest priority 7 are listed. If less than 7 methods are used, the remaining columns are blank.

61-64	I4	M_w primary data source reference number		
65	A1	event type	I	independent (mainshock)
			A	aftershock
			F	foreshock
			S	swarm
			D	doublet
			T	triplet
			R	induced: reservoir
			M	induced: mining/wells
			B	rockburst

Comment allows the catalogue to be sorted for independent events only, which is often desirable or necessary in hazard calculations. This will place the responsibility for identification of dependent and induced events with the Regional Centres. The classification allows for «quasi-independent» doublets, triplets, or swarms.

66-68	F3.1	max/epicentral intensity (allows half-values)		
69	A1	intensity scale	M	MMI
			K	MSK
			C	MCS
			R	RF
			J	Japanese
			O	other
70-74	A5	associated phenomena:	T	tsunami
			C	casualties
			D	damage
			F	felt
			S	seiche
			L	liquefaction
			A	landslides
			E	earthquake lights
			F	surface faulting
			X	surface deformation

Flags to Other Additional / Secondary Record Files
– 0 indicates that no additional/secondary files exist

75	I1	# of additional/secondary epicenter, depth, and other instrumental data records
76	I1	# of additional/secondary magnitude records
77	I1	# of focal mechanism/moment tensor records
78	I1	# of source parameter records
79	I1	# of isoseismal data records
80	I1	# of comment records

Comment the detailed formats of these supplementary records will be determined following a six-month trial evaluation of the GSHAP data formats — both primary and supplementary — at the Regional Centres. This evaluation period will allow the twin requirements of comprehensiveness and flexibility of the data base to be best achieved. After the test period the GSHAP Steering Committee will evaluate the results and formally adopt the final primary and supplementary data file formats.