

PROGRESS REPORT 2009

IASPEI Commission on Seismological Observation and Interpretation (CoSOI)

Working Group (WG) on Magnitudes

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INTRODUCTION

The Working Group on Magnitudes (*Magnitude WG*) of the International Association of Seismology and Physics of the Earth's Interior (IASPEI) Commission on Seismological Observation and Interpretation (CoSOI) was established to recommend standard procedures for making measurements from digital data to be used in calculating several widely used types of earthquake magnitude.

ACCOMPLISHMENTS AS OF JANUARY 2009

Acceptance of Standard Procedures by CoSOI

At the 2005 IASPEI meeting in Santiago, Chile, we proposed standard procedures for M_L , two types of M_S , m_b , m_B , $m_b(L_g)$, and M_W . The procedures were accepted by the CoSOI at the 2005 meeting and are now called the IASPEI Standard Procedures for Magnitude Determination. The IASPEI Standard Procedures may be viewed on-line at the IASPEI web-site (http://www.iaspei.org/commissions/CSOI/Summary_of_WG_recommendations.pdf).

Advertising the Standard Procedures for Magnitude Determination

The International Seismological Centre (ISC) has notified the seismological community of its intent to implement the IASPEI Standard Procedures.

Papers published by WG members that report detailed studies of IASPEI magnitudes and their relation to other magnitudes.

Peter Bormann, Ruifeng Liu, Xiao Ren, Rudolf Gutdeutsch, Diethelm Kaiser, and Silvia Castellaro (2007). Chinese National Network Magnitudes, Their Relation to NEIC Magnitudes, and Recommendations for New IASPEI Magnitude Standards: Bulletin of the Seismological Society of America, v. 97, p. 114-127.

Peter Bormann and Joachim Saul (2008). The New IASPEI Standard Broadband Magnitude m_B : Seismological Research Letters, v. 79, p. 698 – 705.

Peter Bormann, Ruifeng Liu, Zhiguo Xu, Kexin Ren, Liwen Zhang, and Siegfried Wendt (2009). First Application of the New IASPEI Teleseismic Magnitude Standards to Date of the China National Seismographic Network: Bulletin of the Seismological Society of America, v. 99, in press.

Peter Bormann and Joachim Saul (2009). Earthquake magnitude, in: Encyclopedia of Complexity and Systems Science, edited by A. Meyers, Springer, Heidelberg (in press).

Adoption of IASPEI Standard Procedures by the USGS/NEIC, ISC, and other agencies

The IASPEI-recommended formula for M_w has been adopted by the USGS/NEIC and the Global Centroid Moment Tensor project.

The ISC has announced its intention to implement the IASPEI Standard Procedures and has developed standardized phase identifiers for contributed amplitudes that are measured with the IASPEI Standard Procedures. The ISC announcement may be viewed at “<http://www.isc.ac.uk/doc/analysis/2006p03/magletter.html>”.

The USGS/NEIC is committed to following the IASPEI Standard Procedures and has been testing an automatic implementation of the IASPEI Standard Procedures for over two years but has not made a general public announcement and does not yet include the magnitudes in its routine data products. The USGS/NEIC anticipates using some of the IASPEI magnitudes in their routine products beginning in 2009.

Detailed comparison of m_b procedures at the USGS/NEIC and the ISC has provided an example of the kind of discrepancy in magnitudes that can develop between agencies even when the agencies believe they are following the same standard procedure. For some years, it has been recognized that the m_b values computed by the ISC are slightly but systematically less than those computed by the USGS/NEIC. Utsu(2002) estimated the discrepancy to be about 0.05 magnitude units. Upon investigation, it appears that, early in the computer age, the USGS/NEIC and the ISC settled upon two slightly different digital representations of the PZ magnitude calibration terms of Gutenberg and Richter (1956), which were for most focal depths originally presented only in graphical form. The slightly different calibration terms have been used ever since. From a reconnaissance of data, it seems likely that much of the discrepancy between the USGS/NEIC and ISC magnitudes can be accounted for by the slight differences between the magnitude calibration terms used at the two agencies, although both agencies are using what are nominally “Gutenberg and Richter” calibration terms. At the minimum, the issue of USGS/NEIC m_b versus ISC m_b illustrates the need to compare magnitude procedures to the level of individual station data in order to feel confident that systematic discrepancies between magnitudes do not reflect arbitrary differences in procedure.

WORKING GROUP GOALS, 2009 – 2011

Adoption of IASPEI Standard Procedures by the International Data Centre (IDC) of the United Nations Comprehensive Nuclear Test Ban Organization

In 2003, the WG received assurances from the then director of the IDC that the IDC would be willing to compute m_b according to the IASPEI Standard Procedure, in addition to computing its own m_b . This would enable the IDC data to be more useful to the international earthquake hazards community. We have had to re-establish communication with IDC and hope that we can make progress on this issue in the next two years.

Compilation of sample data-sets and special study data-sets

The Magnitude WG has recognized the value of having sample sets of digital seismographic data that could be used by seismological centers to test their implementations of the IASPEI Standard Procedures. In addition, at the 2005 IASPEI

meeting it was proposed that the Magnitude WG help organize an international observational period for collecting magnitude data, but this effort never got underway.

For the intermediate future, we will concentrate on a more sharply defined approach. We will accept the offer of several members of the group (Bormann, Klinge, and Saul) to compile a set of 50-100 representative broadband records to constitute a test data-set that could be used by agencies to test their implementations of the IASPEI Standard Procedures.

More complete on-line documentation of magnitude procedures by seismological observatories

From the beginning, the WG has emphasized the importance of documentation of magnitude procedures. In early 2007, the International Seismological Centre invited agencies to answer a questionnaire to document their magnitude procedures, and, by mid-2007, six agencies had done so. The answered questionnaires may still be viewed at the ISC web-site (http://www.isc.ac.uk/services/magnitude/mag_info.html), but the documentation project has stagnated, and many important agencies are not represented.

It is essential to restart the documentation process. From the response to the initial documentation effort, it seems evident that parts of the documentation questionnaire were ambiguous. Prior to restarting the documentation, it will be necessary to revise these parts of the questionnaire.

FUTURE NEED FOR A MAGNITUDE WORKING GROUP AFTER 2011

On the basis of experience to date, we anticipate a continuing need for the Magnitude WG after 2011. New magnitude types are continually being introduced to take advantage of modern digital instrumentation and to address special needs that may not be met by traditional magnitude types. Some of the new magnitude-types are special purpose magnitudes that will be used only within single agencies and that therefore do not require standardization. Others of the magnitude-types are likely to be widely used. When two or more agencies are publishing magnitudes that are identified with the same nomenclature, there may be a need for standardization. Another reason for maintenance of the WG is that, even for the magnitudes already covered by Standard Procedures, experience with implementation of the Standard Procedures may reveal biases arising from differences in details that the WG did not recognize as important when the Standard Procedures were defined. A continuing Magnitude WG is desirable in order to have a mechanism for additional standardizing of details in magnitude computation procedures.