DOCUMENTATION OF STATION/AGENCY MAGNITUDE PROCEDURES

(Modified from the SUMMARY OF IASPEI MAGNITUDE WORKING GROUP RECOMMENDATIONS ON DETERMINING EARTHQUAKE MAGNITUDES FROM DIGITAL DATA, updated version 2011; see http://www.iaspei.org/commissions/CSOI/Summary_WG-Recommendations_20110909.pdf)

This document is to outline the procedures adopted by seismological agencies to compute magnitudes of seismic events.

Agency Name:
Zentralanstalt für Meteorolgie und Geodynamik
ZAMG
Network Code OE

Please list the magnitudes computed and corresponding phase type analyzed in the table below (example provided). Add as many rows as required.

Magnitude type (nomenclature used at the agency)	Full name	Wave type analyzed
mb	body-wave magnitude	P-waves
ml	local Magnitude	S-Waves
ms	surface wave magnitude	Surface-Waves

For each magnitude type computed at the agency, please specify:

1. The equations that are used for calculating each magnitude type and
a: specify if distance is measured as epicentral distance or hypocentral distance;
b: specify the distance range for which the equation is applied;
c: specify restrictions on hypocentral focal-depth, if any.

mb -0.104 + log10(amp) + 1.66 * log10(delta) – velocity amplitude
ml   -0.304 + log10(amp) + 1.66 * log10(delta) – velocity amplitude
ms   0.52   + log10(amp) + 1.66 * log10(delta) – velocity amplitude

for all magnitudes:
  a) epicentral distance is used
  b) all distances, but one station in Austria with a SNR > 2 is needed
  c) no restrictions on the focal depth
  d) amplitudes are measured on VELOVITY traces, unit is nm/s

2. Is any signal-to-noise ratio criterion applied to the analyzed signal?

Yes – a minimum SNR of 2.0 is required

3. Specify the software used (such as SeisComp, Antelope, Seismic Handler, Seisan, SAC, in-house developed programs) to perform the analyses for magnitude computation.

Antelope – selfwritten magnitude module "Mampmag"

4. If the agency is computing magnitudes not based on some amplitude/period measurement (e.g., moment magnitude Mw) please summarize the details of the technique used. For example, is Mw obtained with a centroid moment tensor, W-phase and/or spectral fitting technique?

The amplitudes are measured on filtered VELOCITY amplitudes (mn/s)

5. Other restrictions on the calculation of a specific magnitude. For example, is the magnitude measured only for earthquakes of a certain size, as defined by an independent measure of earthquake size? Also, are specific magnitudes computed only for seismic events occurring in specific areas?

Magnitudes are computed only on stations in Austria, this limits the magnitude measurements to events in the vicinity of Austria

Detailed questions on the magnitudes based on amplitude/period measurements:

6. How the network (event) magnitude and corresponding uncertainty is obtained? For example, is the network magnitude an arithmetic/trimmed mean, median value of the single station magnitudes?

Mean magnitude based on amplitudes measured as peak2peak/2

7. Units of the reported amplitudes. Specify if amplitudes are reported in units of trace-amplitude motion instead of ground motion.

Nm/s – only broadband velocity traces are used

8. Time-window in which the amplitude measurement is made for the phase type analyzed. For example, for body wave magnitudes, is the time window a flexible time-interval between the P onset and the PP onset or a fixed time window after the first P onset (e.g. 5 s, 10 s or other)? Similarly, for the surface wave magnitudes, is the time window considered a time-interval spanned by waves having group-velocities between, e.g., 3.2 and 4.0 km/s or is always the maximum velocity amplitude, respectively (A/T)max in the whole surface-wave train in a wide range of periods be measured? If so, give the range of periods.

mb – P onset time ± (time window from P to S onset)/4

ml – S onset time ± (time window from P to S onset)/2

ms – (P onset time + deltakm / 4) ± (time window from P to S
        this is roughly surface wave onset time

9. Orientation of seismograph (horizontal or vertical) from which the measurement is made. For example, is Ms computed using both horizontal and vertical components? Specify also if, as for example might be the case for ML, data from each of the two horizontal components at a single station are used, are data from each component treated as a se parate observation in the network magnitude computation, or are the two components first averaged into a station magnitude, which is then treated as a single observation in the network magnitude computation?

mb: vertical component
ml: horizontal components – maximum magnitude from 2 channels
ms: horizonal components – maximum magnitude from 2 channels

10. Describe the amplitude-response, filter characteristics, or transfer-function of the seismograph or simulated seismograph through which the amplitude measurement is made. For example, is the IASPEI recommended standard Wood-Anderson seismometer simulation filter with the parameters according to Uhrhammer and Collins (1990) used to compute ML?

Measurements are all from STS2 or STS2.5 broadband instruments.
mb: Butterworth bandpass 5 pole 1.0 Hz to 10 Hz
ml: Butterworth bandpass 3 pole 0.6 Hz to   3 Hz
ms: Butterworth highpass 5 pole 0.01 Hz

11. Details of measuring amplitude:

   a: For example, does the amplitude correspond to 0.5*(peak-to-trough amplitude), where "peak-to-trough amplitude" corresponds to difference between a maximum positive excursion and a maximum negative excursion of the trace, or is the amplitude instead measured as the maximum absolute excursion from the "zero" position of the seismograph trace?

   b: for example, if the amplitude corresponds to 0.5*(peak-to-trough amplitude), are the "peak" and "trough" respectively the absolute maximum and absolute minimum values of the entire wave-group, or are they the adjacent peak and trough corresponding to the maximum trace excursion that is associated with a single zero-crossing?

   c: for example, are displacement amplitude(A) and period(T) measured at the time of maximum A or at the time of the maximum of the quotient (A/T)?

   amplitude is measured as peak-to-peak/2 . Peaks are global minimum and maximum over whole time-window described in 8

12. Details of measuring period. For example, is it the time between the neighboring peaks, respectively troughs or twice the time span measured between the largest peak and adjacent trough at which the double amplitude has been measured?

Periods are not taken into account for magnitude measurement.

13. To what part of a phase the amplitude-measurement time refers. For example, is the amplitude-measurement time the time of the zero-crossing associated with a peak-to-adjacent trough measurement or is it the time of an absolute maximum or absolute minimum?

   The amplitude measurements are currently not reported. Time is internally recorded as time of absolute peak.

Finally, please add publications as well as internal reports or web links that can be quoted to describe the magnitude procedures adopted at the agency and/or any other relevant information which may not have been included in the questions above.

   Antelope manpage Mampmag.3p