IUGG 2007 – ASI009-4
International Union of Geodesy and Geophysics, XXIV General Assembly, 2-13 July 2007, Perugia, Italy

Comparisons of Inclination-only Statistical Methods

Levi, S
Shaul_Levi@msn.com
College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, OR 97331 United States

Arason, P
arason@vedur.is
The Icelandic Meteorological Office, Bustadavegi 9, IS-150 Reykjavik, Iceland

Paleomagnetic data from borecores often lack declinations, and the arithmetic means of inclination-only data are known to introduce a shallowing bias. Several methods have been proposed to estimate unbiased means of the inclination along with measures of the precision. Using maximum likelihood estimates, we were able to derive a robust technique of inclination-only statistics for the mean inclination and precision parameter, without making the assumptions and approximations of previous methods. Our method is described by Arason and Levi at the 2007 IUGG meeting. To assess the reliability and accuracy of our method, we generated random Fisher-distributed data sets and used seven methods to estimate mean inclinations and precision parameters. We used true inclination values of 0, 10, ..., 80, and 90 degrees; true precision parameters of 10, 20, 40, and 100; the sample number in each data set was 5, 10, 20, and 100. For each combination, we generated one thousand random Fisher-distributed data sets, and for these 160 000 data sets we calculated the true Fisher mean, also using declinations. For inclination-only data the mean was calculated using the following methods: Arithmetic mean; Kono (1980); McFadden-Reid (1982), using both their original and modified methods; Enkin-Watson (1996) Gaussian-estimates; finally, we obtained maximum likelihood estimates by our new robust technique. In many cases the estimates provided by the previous methods are significantly displaced from the true peak of the likelihood function to systematically shallower inclinations, especially for steep and dispersed data. It appears that the mean inclination estimates of the original McFadden-Reid statistics, still used by some paleomagnetists, is nearly identical to the arithmetic mean, and, in our opinion this method should be abandoned. Comparisons of the results of the various methods is very favourable to our new maximum likelihood method. On average, it gives the most reliable estimates and the mean inclination estimates are the least biased toward shallow values. Further information on our inclination-only analysis can be obtained from: http://www.vedur.is/~arason/paleomag