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On statistical paleomagnetic field modeling

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In a series of papers inspired by that of Hulot and Le Mouël (PEPI, 82, 167-183, 1994), we have investigated the possibility of developing a fully consistent statistical approach to paleomagnetic field modeling, based on the concept of a Giant Gaussian Process (GGP) first introduced by Constable and Parker (JGR, 93, 11569-11581, 1988). We first showed that a rigorous forward approach could be designed that exactly tests any given GGP model against any (assumed perfect) data set, both globally and regionally (Khokhlov et al., GJI, 145, 157-171, 2001). More recently, we have been able to test in many details the whole GGP concept, by analyzing series derived from numerical dynamo simulations (Bouligand et al., in revision). Although the GGP concept does not appear to be completely compatible with the behavior of the field produced by such numerical dynamos, it clearly appears that to first order, an empirical approach based on a GGP approach can indeed be used. This prompted us to further refine the forward approach of Khokhlov et al. (2001) to also account for possible errors in the data sets to be tested against GGP models. It appears that this refined forward approach leads to very encouraging results. It is highly sensitive and makes it possible to show that 1) only a few of the GGP models proposed so far to describe the field over the past 5 Myr can be made compatible with the data, and 2) that this is possible only when the errors assumed in the data are precisely of the order published in the data basis.