Inference of the earth's magnetic field from surface directional data

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We discuss the possibility of developing from the distributions of the virtual geomagnetic poles (VGPs) and the distribution of the equatorial virtual poles (EVPs) constraints that can be used in constructing geomagnetic field model from the directional data. We first discuss analytic definitions of the VGPs and the EVPs and their distributions on a sphere. We then relate the distributions of the VGPs and the EVPs to the spherical harmonic contents of the vector field whose directions on the sphere generate the given distributions of the VGPs and EVPs. We suggest that given the directional data on the earth surface, the geomagnetic field can be inverted, apart from a multiplicative constant, by minimizing 2-norms of functional which relate the density functions of the VGPs and EVPs distributions to geomagnetic field on the surface. We further suggest that a type of "time-averaged geomagnetic field model" can be defined by using total distributions of the VGPs and the EVPs observed over a period time as the observables. This type of "the time averaged model" is worthy investigation, because it yields the aspects of the time-averaged dynamic behaviors of the geomagnetic field different from that of widely used "the time averaged model" defined by using mean directions as observables, which is obtained by vector summation of the directions at each site.