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A New Verifiable Measure of Centennial Geomagnetic Activity: Modifying the K Index Method for Hourly Data

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The K indices have long been the most important way to estimate geomagnetic activity. However, they have some basic and practical problems which restrict the reliability and applicability of these indices especially for long-term (centennial) studies. Here we discuss these problems, modify the K method and construct a new, straightforward, easily verifiable and homogeneous index, the so called Ah index, which is based on digital, hourly data and is dedicated for centennial studies. We study the centennial change in geomagnetic activity using the new indices at six long-term stations. At all six stations geomagnetic activity has increased during the last century. However, the amount of centennial increase varies greatly with latitude, being largest at high latitudes, smaller at low latitudes and, unexpectedly, smallest at mid-latitudes. While the centennial increase in the aa index is roughly twice larger than in the Ah index at mid-latitudes, comparison with the Ap index verifies that the scaling of the aa index was erroneously modified by a few nT in late 1950s. The Ah index correlates very well with the Ap index, better than the aa index and much better than the alternative, not-K based IHV index. Local Ah indices also include a similar diurnal variation of geomagnetic activity as local K/ak indices. While the local Ah indices can be used to extend the local K/ak indices, the global Ah index offers the most reliable extension of the Ap index by 30 years, and is recommended to use in centennial studies of geomagnetic activity instead of aa or IHV indices.