We study the spatial distribution of geomagnetic activity in 1966-2009 with local geomagnetic activity indices at 27 magnetic observatories. Using the principal component analysis method we find that more than 97% of the variance in annually averaged geomagnetic activity can be described by the two first principal components. The first component describes the evolution of the global geomagnetic activity, and has excellent correlation with, e.g., the Kp/Ap index. The second component describes the leading pattern by which the spatial distribution of geomagnetic activity deviates from the global average. We show that the second component is highly correlated with the relative (annual) fraction of high-speed streams (HSS) in solar wind. The spatial distribution of the second mode has a high maximum at auroral latitudes, a local minimum at subauroral latitudes and a low maximum at mid-latitudes. We show that this distribution is related to the difference in the average location and intensity between CME and HSS-related substorms. These results demonstrate that the local indices of geomagnetic activity over a spatially extended network can provide useful, quantitative information about the solar wind that is lost when using only global indices.