Global land surface climate analysis based on the calculation of a modified Bowen ratio

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A modified Bowen ratio (BRm), the sign of which was determined by the direction of the surface sensible heat flux, was used to represent the major divisions in climate across the globe and the usefulness of this approach was evaluated. Five reanalysis datasets and the results of one off-line land surface model were investigated. We divided the global continents into five major BRm zones using the climatological means of the sensible and latent heat fluxes during the period 1980-2010: extremely cold, extremely wet, semi-wet, semi-arid and extremely arid. These zones had BRm ranges of (-infinit, 0), (0, 0.5), (0.5, 2), (2, 10) and (10, +infinit), respectively. The climatological mean distribution of the Bowen ratio zones corresponded well with the Köppen-like climate classification, and it reflected well the seasonal variation for each subdivisions of climate classification. The features of climate change over the mean climatological BRm zones were also investigated. In addition to giving a map-like classification of climate, the BRm also reflects temporal variations in different climatic zones based on land surface processes. An investigation of the coverage of the BRm zones showed that the extremely wet and extremely arid regions expanded, whereas a reduction in area was seen for the semi-wet and semi-arid regions in the boreal spring during the time period 1980-2010. This indicates that the arid regions may have become drier and the wet regions wetter over this period of time.

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