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Methods of comparing fire danger indices

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Fire danger indices are generally formulated using current or forecasted weather data, and sometimes include other factors such as vegetation types, fuel loads or geographical factors. A plethora of indices have been developed, often for quite specific locations or circumstances. In both the USA and Europe, efforts are underway to develop methods of determining the 'best' index for particular regions or purposes. Given the potential importance of fire danger indices as public warning systems and operational fire management aids, a poor choice of index could contribute to disastrous consequences. Combined with the climate-change driven risk of increased fire activity in areas formerly unaccustomed to fires, this recognition of the importance of accurate indices has lead to the creation of a range of proposed fire index comparators. The comparison of fire danger indices is not trivial and the performance of indices should be tested according to the highest standards. Different indices may be discreet or continuous, may produce data across different ranges or follow different distributions in their frequency analysis histograms. Plotting the frequency distribution of index values of the course of one or several years may result in any conceivable distribution pattern, depending largely on the mathematical formulation of the index.

Various authors have proposed comparators and demonstrated different responses of indices to their tests, but rarely has much effort been put into demonstrating the validity of the comparators themselves. This paper compares four hypothetical fire danger indices, three of which are simple mathematical transformations of each other. It is thus reasonable to suppose that any valid method of comparing them should rank them as equally useful, otherwise the comparison method may be ranking indices differently simply because the indices have different frequency distributions. We present a demonstration that many of the published comparators are sensitive to the different frequency distributions that may be inherent in different indices, and we outline a non-parametric method that may be useful in future work.

The non-parametric method presented is robust to differences in index frequency distribution. The method gives a two-part descriptor of fire indices that may help to differentiate index performance, based on the slope of the ranked fire-day percentiles and the 'y' intercept of that slope. The daily values for each index (including both fire-days and nonfire-days) are converted to percentiles, and those index percentiles for fire-days are ranked from lowest to highest. Plotting these on the 'y' axis and with the 'x' axis indicating the rank, we obtain a curve of points. Considering that on this plot an index composed of many random numbers would have a slope of 1.0 and an intercept of zero while a mythical 'perfect' index would have a slope approaching zero and an intercept approaching 100, these two parameters together may usefully describe the performance of fire indices.

Although substantial work remains to be done on determining acceptable methods for comparing fire indices, we establish here that commonly used parametric methods may potentially produce spurious results. The proposed two-part non-parametric comparator certainly requires a great deal more investigation to determine its worth, but this will be effort better spent than continuing with comparators that are demonstrably suspect.