



Temporal scaling behavior of forest and urban fires

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It has been found that many natural systems are characterized by scaling behavior. In such systems natural factors dominate the event dynamics. Forest fires in different countries have been found to exhibit frequency-size power law over many orders of magnitude and with similar value of parameters. But in countries with high population density such as China and Japan, more than 95% of the forest fire disasters are caused by human activities. Furthermore, with the development of society, the wildland-urban interface (WUI) area is becoming more and more populated, and the forest fire is much connected with urban fire. Therefore exploring the scaling behavior of fires dominated by human-related factors is very challenging. The present paper explores the temporal scaling behavior of forest fires and urban fires in Japan with mathematical methods. Two factors, Allan factor (AF) and Fano factor (FF) are used to investigate time-scaling of fire systems. It is found that the FF for both forest fires and urban fires increases linearly in log-log scales, and this indicates that it behaves as a power-law for all the investigated timescales. From the AF plot a 7 days cycle is found, which indicates a weekly cycle. This may be caused by human activities which has a weekly periodicity because on weekends people usually have more outdoor activities, which may cause more hidden trouble of fire disasters. Our findings point out that although the human factors are the main cause, both the forest fires and urban fires exhibit time-scaling behavior. At the same time, the scaling exponents for urban fires are larger than forest fires, signifying a more intense clustering. The reason may be that fires are affected not only by weather condition, but also by human activities, which play a more important role for urban fires than forest fires and have a power law distribution and scaling behavior. Then some work is done to the relative humidity. Similar distribution law characterizes the relative humidity. The AF plot and FF plot of relative humidity validate the existence of a strong link between weather and fires, and it is very likely that the daily humidity cycle determines the daily fire periodicity.