RESEARCH BRIEF

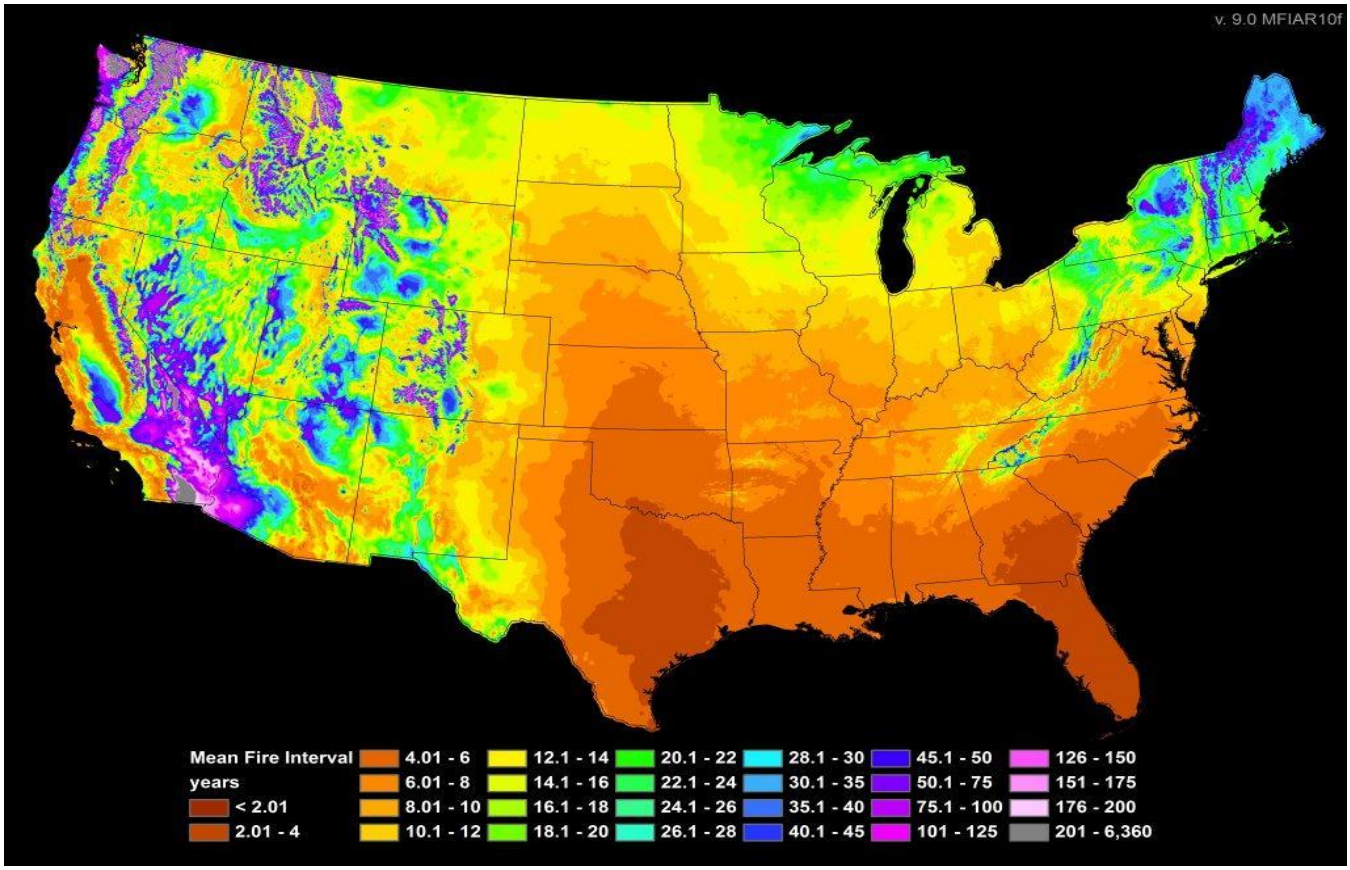
Predicting fire frequency with chemistry and climate

Richard P. Guyette, Michael C. Stambaugh, Daniel C. Dey, and Rose-Marie Muzika, Ecosystems (2012) 15: 322-335

In this paper Dr. Richard Guyette and co-authors present a model which uses theories and data in physical chemistry, ecosystem ecology, and climatology to predict fire frequency. Fire frequency data provides important information regarding past and future management and restoration. Additionally, this fire frequency data aids in assessing carbon emissions, fire-vegetation feedbacks and alternate stable states, and potential climate change effects on wildfires. Historical fire frequency information is often supplied by charcoal and tree-ring based fire-scar studies, though the resources necessary for such studies are not available at most sites. This study provides needed information regarding climate influence on fire frequency for ecosystems which lack empirical fire regime information.

The model described in this study, referred to as the Physical Chemistry Fire Frequency Model (PC2FM), utilizes mean maximum temperature, precipitation, and the partial pressure of oxygen to estimate mean fire intervals (MFI). The model is inspired by Arrhenius' equation, which is a fundamental rate equation in physical chemistry. The authors state that "Faced with the problems and effects of wildland fire, it is easy to overlook that fire is fundamentally a chemical reaction".

The PC2FM is calibrated with historical fire frequency information from 170 sites in North America. It purposely excludes topographic, vegetative, and ignition source variables. In doing so, the authors note that though fine-scale accuracy is reduced, it allows the model to be applied to broader spatial and temporal scales. MFI estimates derived from the PC2FM using PRISM climate data were mapped in the ArcGIS software environment. The authors suggest that the resulting map can aid in the understanding of fire's historical role at many locations, which otherwise would have no local or historical fire frequency information.



Mapped estimates of historic mean fire intervals for the period 1650-1850 CE using the physical chemistry of climate.