

## Introduction

Wildland fires are one of the most devastating and terrifying forces of nature. They are unpredictable and most of the time uncontrollable. They draw strength from the wind, and are particularly devastating in areas prone to drought. Old growth forest stands can be consumed in minutes leaving nothing but skeletal remains. Or the fire may leave the tree canopies untouched, but scour the forest floor consuming understory vegetation. Fires fill the sky with heat and gloom, raining ashes and brands of fire for miles. In a matter of hours wildland fires can change entire landscapes. While their effects are mostly destructive they also help with regeneration of forests and other ecosystems. Low-intensity fire can clear dangerously accumulating underbrush and duff preventing catastrophic crown fires, and allowing seeds of the sun-loving trees to germinate. Health and survival of such ecosystems as mixed conifer forest with giant sequoia and ponderosa pine or chaparral with various *Ceanothus* species depend on the re-occurrence of fires.

In North America the area and intensity of wildland fire has been growing alarmingly during the past decade. Our choice of the word “alarmingly” is deliberate. During the past 10 years almost every year has seen an increase in total numbers of wildfires and the surface area burned over the previous year. Correspondingly, each year has cost the United States federal, state and local governments more than during the previous one. This experience is also true for Australia, Europe and Asia. Increasingly scientists and land managers are viewing this as a global change in wildland fire. It is not only that fires are increasing in number. It is rather that the nature of wildland fire is changing. Over 90% of the area burned in North America in the past five fire seasons has been consumed by only 1% of the fires. This data demonstrates that a few large fires are burning over larger areas. Additionally, the intensity and spread rates of these fires are often beyond the accepted fire indices used by forest managers to describe fire danger and intensity. These huge fires that burn for weeks over whole landscapes have been given a new name – they are called MegaFires, a name that has frightening implications for managing forests in decades to come.

It is the role of the International Union of Forest Research Organizations (IUFRO) to be the champion of forests, squaring off against even the most difficult problems, using scientific exchange and cooperative research as its main tools. In September of 2006 the IUFRO Research Group 7.01 “Impacts of Air Pollution and Climate Change on Forest Ecosystems” held a meeting in Riverside, California, to discuss wildland fire and its role in the atmospheric environment. At the meeting a select group of distinguished scientists and resource managers was called together to share information and research concerning wildland fire. A challenging theme of the meeting was the feedback between wildfire and the Earth’s climate system. This theme was additionally explored while considering the effects of air pollution on forest fire fuels and the effects of wildland fire smoke on air quality. Several ideas arose that are of note. First, that MegaFires are a result of primarily short-term climate fluctuations, often termed climate variability. This variability, combined with the effects of past management practices which tend to increase fuel loading in forest systems, has made these dramatically large and intense fires possible. Secondly, air pollution in the form of elevated ground-level ozone and atmospheric nitrogen deposition has been a contributing factor to MegaFires in areas of North America. Finally, wildland fire smoke is becoming an increasingly significant health hazard. Managing and regulating smoke, however, has only been successfully applied to small prescribed fires. At present there are neither techniques nor regulations to manage smoke hazards from MegaFires. These fires have potential to adversely affect the health of millions of people through smoke exposure at concentrations far beyond air quality regulatory standards.

The purpose of this book is to provide a deeper understanding of wildland fires and air quality by exploring their unknowns, paradoxes and challenges. In the book the reader will find the knowledge offered at that unique international conference. The book is purposed as a practical walk along a scientific path to new comprehension, leading from facts to reasoning, understanding, and finally, it is hoped – to action. In the first section of the book the basics of wildland fires and resulting emissions are presented from the perspective of changing global climate, air quality impairment and effects on environment and human health and security. In the second section, effects of wildland fires on air quality, visibility and human health in various regions of the Earth are discussed. The third section of the book deals with complex issues of the ecological impacts of fires and air pollution in forests and chaparral in North America. The fourth section discusses various management issues facing land and fire managers which are related to wildfires, use of prescribed fires and air

quality. This section also presents various models and modeling systems used for describing fire dangers and behavior as well as smoke and air pollution predictions applied in the risk assessment analysis. Finally, the book concludes with a series of expert recommendations for wildland fire and atmospheric research both in North America and internationally.

The ancients viewed fire as one of the four elements or elementals of which all things, animate and inanimate, were composed. It was in the balance of the four elementals of earth, air, water and fire that life was possible. As you read this written record of the important IUFRO meeting it encapsulates, the authors hope that you will find both a balance of essential elements and a sure guide to their understanding. Through science modern man has increased his understanding from four ancient elementals to modern physics, from an Earth-centric cosmos to a new understanding of the Universe as a Multiverse. Now as we face a new era in wildland fire, the era of the MegaFire, we apply our best science as a world-embracing partnership under the banner of the IUFRO. By such humble yet hopeful steps we try to unravel various wildland fire enigmas and paradoxes strand by strand.

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