Case Study: Analysis of Weather Conditions and Smoke for 2002 Biscuit Fire in Southwest Oregon

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Abstract

A series of lightning storms ignited five fires in the Siskiyou Mountains in Southwest Oregon starting on July 13, 2002. Within days the fires joined together. The fire burned for two months across almost half a million acres of wildland and communities. Estimated cost to control and suppress the fire amounted to $150 million and a work force of more than 7,000 people constructed over 400 miles of fireline in order to control and suppress the fire. An analysis of the weather conditions and the smoke emissions from the Biscuit Fire was performed in a two-phase case study research. First, a meteorological reconstruction of the weather observed during the fire event was accomplished. This analysis took into consideration available synoptic analyses, mesoscale meteorological data, and on-site meteorological observations during the fire. Second, a re-creation analysis of the smoke behavior, emissions and effects was performed through the use of the BlueSky Smoke Modeling Framework and the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) dispersion model. The first phase analysis included collecting detailed information regarding the fire location, fire progression, and growth, enabling the creation of two different ignition pattern scenarios. The detailed fire progression analysis was used as input to BlueSky, to investigate how greater detailed fire ignition and progression information impacts smoke concentrations near-surface and aloft. This analysis is intended to clarify the variability and uncertainty in emissions impacts resulting from uncertainty in input variables and model assumptions. Results will aid managers on the planning of strategies to protect health, life and properties.

More Information

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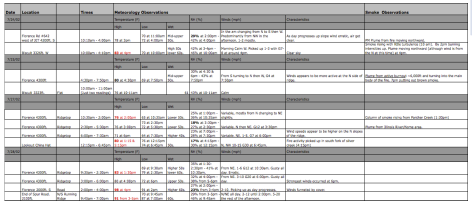
Phase I: Fire Behavior and Meteorological Data

Table 1: Meteorological information including temperature, relative humidity, and wind speed and direction, collected from the original weather observations saved at the National Archives in Seattle, WA. Inversion presence and lifting times, fire behavior characteristics, and smoke visibility observations were compiled as well.



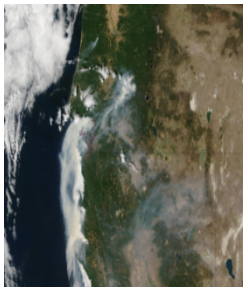
Meteorological Observations compiled from the National Archives.

July 29th, 2002	July 30th, 2002	August 7th, 2002	August 11th, 2002
• 40,000 acres	• 70,000 acres	• 52,000 acres	• 42,601 acres
• High T 99°F	• High T 98°F	• High T 84°F	• High T 99°F
• Low RH 17%	• Low RH 18%	• Low RH 8%	• Low RH 14%
• Winds NNE Ave 5.2mph Max 18mph	• Winds NNE Ave 4.5mph Max 17mph	• Winds NNE Ave 4.2mph Max 18mph	• Winds NE Ave 3.5mph Max 16mph

Meteorological data from dates with larger burn area growth.

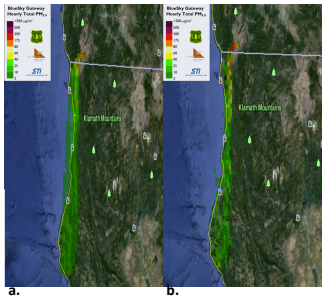
Table 2: Critical dates for fire behavior determined by the information gathered from the US Forest Service Chronology of the Biscuit Fire and Fire Behavior Report. Critical dates are establish as those with largest burn area growth. Remote Automated Weather Station (RAWS) information from the Illinois Valley Airport, Oregon, compiled for the critical dates.

Phase II: Smoke Behavior



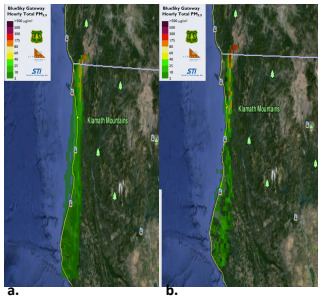
MODIS Satellite Image Aug 18, 2002

Figure 1: Moderate Resolution Imaging Spectroradiometer (MODIS) image acquired by the Terra satellite on August 18, 2002. Observe the thick smoke plume form the Biscuit fire moving southward, impacting communities along the California west coast.



a. b.
BlueSky Output Individual Fires Aug 18, 2002

Figure 2: BlueSky output of 1-hr average $PM_{2.5}$ concentrations; a. aloft (500m), b. near surface (50m). Meteorological input from the MM5 12km resolution model, and fire location input specifying the progress and development of five fires joining together, as time progresses, into the Biscuit Fire.



a. b.
BlueSky Output One Fire Aug 18, 2002

Figure 3: BlueSky output 1-hr average $PM_{2.5}$ concentrations; a. aloft (500m), b. near surface (50m). Meteorological input from the MM5 12km resolution model, and fire location input with one fire location as the fire burn area increases in the Biscuit Fire.

Discussion

•**Reconstruction of weather observed** – Meteorological reconstruction of the weather observed during the fire event took into consideration available synoptic analyses, mesoscale meteorological data, and on-site meteorological observations during the fire. Critical dates of fire behavior were established by this reconstruction.

•**Smoke emissions and transport recreation** – The detailed information regarding the fire location, fire progression, and growth, enabled the creation of two different ignition pattern scenarios, which were used as input to BlueSky, to investigate how greater detailed fire ignition and progression information impacts smoke concentrations near-surface and aloft. The scenario 1 includes five fires ignited at five different locations, joining together by August 7th, 2002; while scenario 2 includes one fire ignited at a specific location, according to the Progression Report.
For each ignition pattern scenario BlueSky with the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) dispersion model, was run to obtain the 1-hr average PM2.5 concentration near the surface, up to 50m, and aloft, up to 500m. With the Fuel Characteristic Classification System (FCCS) the Douglas-fir- Madrone / Tanoak forest was establish as fuel loading.

•**Variability and uncertainty in emission impact** – This analysis intended to clarify the variability and uncertainty in emissions impacts resulting from uncertainty in input variables and model assumptions.

Figure 4: Rogue River-Siskiyou National Forest, on August 2012. Effects of the Biscuit fire on the wilderness area shown after ten years of the fire occurrence.