# JFSP Research Needs Worksheet
## Prescribed Fire Smoke Models

**Topic**: Prescribed fire is a widely used management tool for natural resource managers, wildfire mitigation and agricultural operations in the U.S. South. Smoke emitted from prescribed fire is often one of the greatest concerns to prescribed fire managers due to the potential for smoke to negatively impact roadways, communities, and other smoke sensitive areas. Existing smoke models are often regarded by the fire management community as lacking in the spatial and temporal resolution sufficient for decision support, especially regarding surface impacts on smoke sensitive areas. New smoke models are needed that can forecast day and night-time production of low-buoyancy smoke associated with light fuels, smoldering combustion, relatively moist fuel, and small prescribed fires characteristic of those conducted in the South (Hiers et al. 2020).

**Science Maturity**: Existing research on this topic has resulted in the development of several management tools that have made progress towards addressing the smoke modeling needs of prescribed burners. VSmoke-GIS and VSmokeWeb (Lavdas, 1996) are Gaussian plume models (Lavdas, 1986) that are still regularly used by the prescribed fire community. PB-Piedmont was developed nearly 20 years ago to model down-slope night-time smoke movement in complex terrain (Achtemeier, 2000). Recent reviews have summarized many of the current efforts in prescribed fire smoke modeling (Goodrick et al. 2012).

**Research Needs/Questions**:
- Development of smoke models appropriate for predicting smoke production, relative concentration and movement from relatively low-energy prescribed burns from a variety of fuel models.
- Development of web-based or mobile device capable smoke models that can forecast potential smoke accumulation and impacts to roadways and low-lying areas.
- Models need to be sensitive to real-time meteorological inputs and forecasts but also flexible to allow models to be run as scenarios for prescribed fire planning.

**Audiences and Products**: Based on the maturity category above, identify anticipated appropriate outcomes and targeted users, for example:
1. Smoke models for forecasting the day and night-time movement of smoke from low-buoyancy prescribed fires
2. Training resources and science delivery tools to support adaption by the diversity of prescribed fire managers across the U.S.

**References**:

Achtemeier, Gary L. 2000. PB-Piedmont: A numerical model for predicting the movement of biological material near the ground at night. In: Proceedings of the 24th conference on agricultural and forest meteorology; 14-18 August 2000; Davis, CA. Boston, MA: American Meteorology Society: 178-179.

Goodrick Scott L., Achtemeier G. L., Larkin N. K., Liu Y., Strand T. M. 2012. Modelling smoke transport from wildland fires: a review. *International Journal of Wildland Fire* 22, 83-94.

Hiers, J.K., O'Brien, J.J., Varner, J.M. et al. 2020. Prescribed fire science: the case for a refined research agenda. *Fire Ecol* 16, 11. https://doi.org/10.1186/s42408-020-0070-8

Lavdas LG 1986. An Atmospheric Dispersion Index for Prescribed Burning. USDA Forest Service, Southeastern Forest Experiment Station, Research Paper SE-256. (Macon, GA)

Lavdas LG 1996. Program VSMOKE – user's manual. USDA Forest Service, Southeastern Forest Experiment Station, General Technical Report SRS-6. (Macon GA)

**Originator**: This topic was identified by the Southern Fire Exchange Leadership Team based on quantitative and qualitative feedback recorded in the 2017 and 2019 Southern Fire Exchange regional end-user surveys and evaluations. Qualitative feedback was also provided by members of the Southern Fire Exchange Advisory Board, collaborators and partnering organizations.