

Projecting the impact of climate change on southern forest fire regimes

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Introduction and motivation

- **Economic losses:** In 2011, Texas had the worst fire season in the state's history: Over 1.6 Mha of forest land and 3000+ homes destroyed. The Georgia bay complex fires of 2007 were the state's largest wildfire in recorded history, with around \$54 million lost in timber value.
- **Better prescribed fire management:** Prescribed burning is the most commonly used tool for fuel management in the south. For example, an average of 14% of the total 14.7 million acres of forest land in Florida is treated by prescribed burning. It is important to consider the types of fuel present while estimating the potential for achieving management goals through the burn treatment (Marshall *et al.* 2008).
- **Fires reduce the carbon sequestration potential:** Currently, southeast forests annually sequester up to 13% of the regional greenhouse gas emissions. Frequent wildfires can reduce this amount considerably.

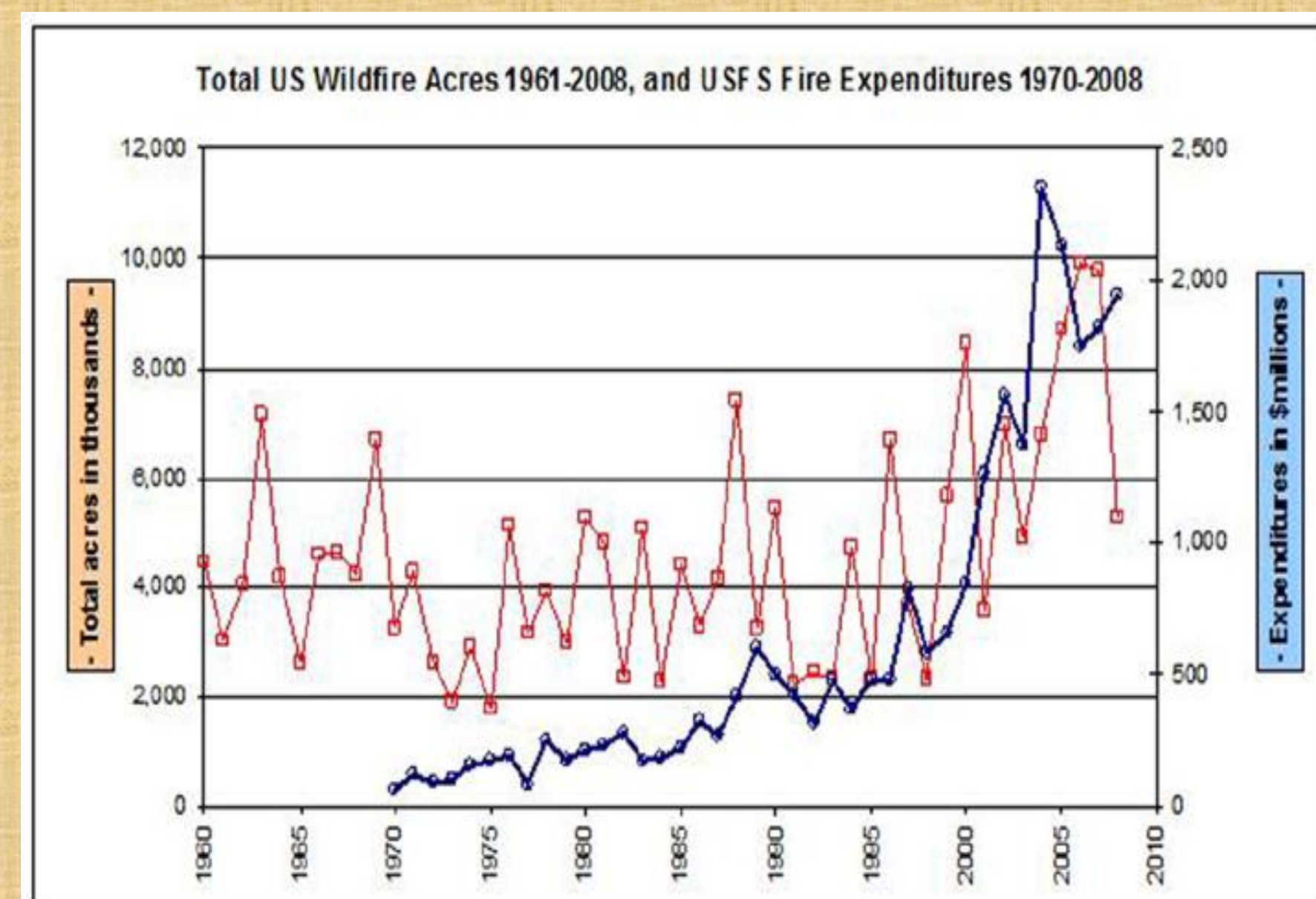


Fig 1: Trends in area burnt and related expenditure in the US (ref: <http://westinstenv.org/sosf/2009/06/30/is-there-a-forest-fire-climate-connection/>)

Previous studies

1. **Wear and Greis (2011):** An extensive work that looked at projecting the evolution of fire potential in Southeast USA, done as part of the Southern forest futures project. There, they improved on the well-known Keetch-Byram Drought Index (KBDI).
2. **Erdody *et al.* (2010):** This work describes how LIDAR can be used to sense fuel load, in mixed pine and conifer forests of Washington state. For example, they could estimate the available canopy fuel (Mg/ha) with a R^2 value of 88%, and canopy bulk density (kg/m^2) was estimated with a R^2 value of 84%.
3. **Westerling *et al.* (2011):** Downscaled results from 3 GCMs were used to project occurrence of large fires in the Yellowstone region, for 1951–2099.

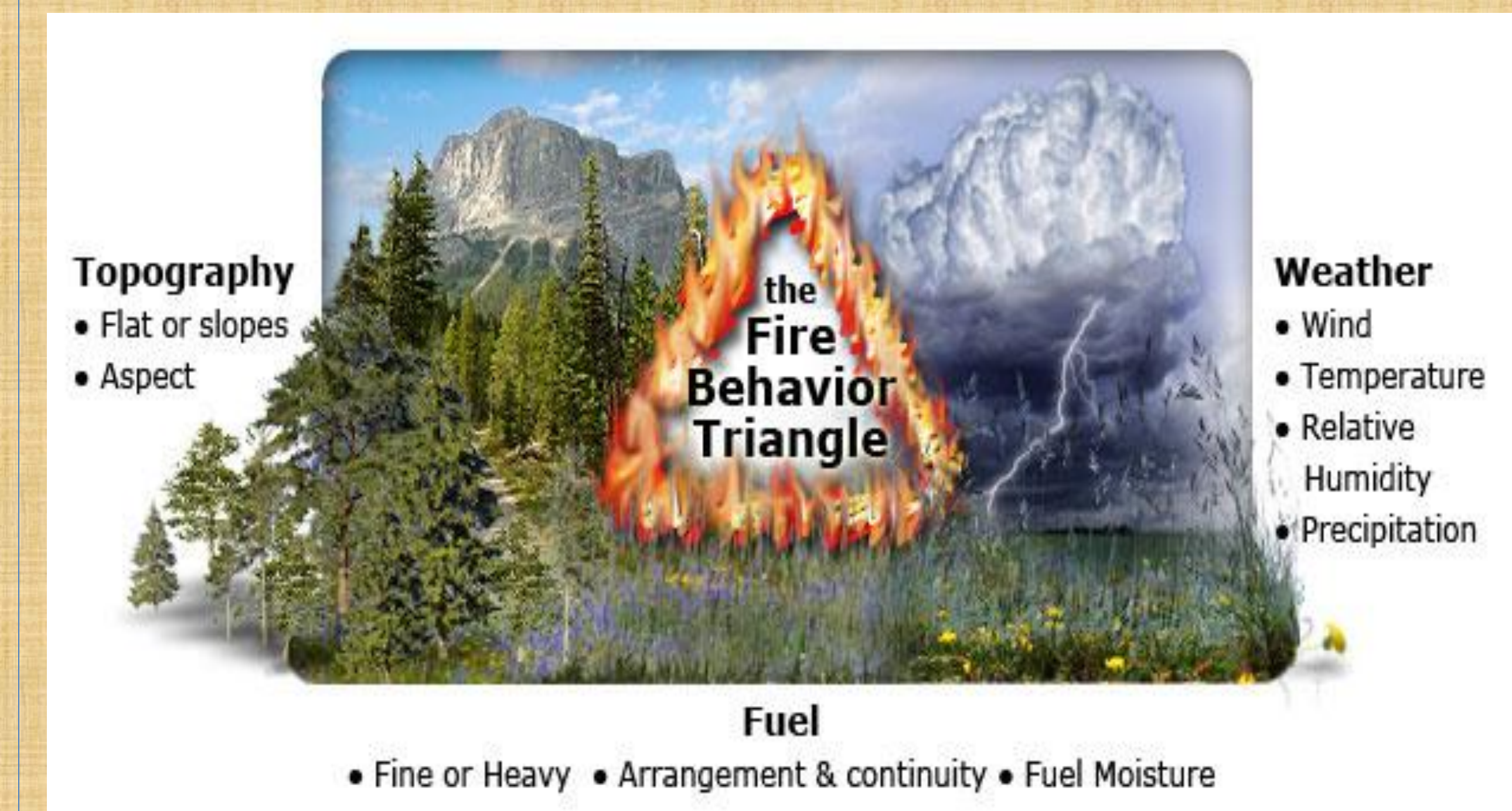


Fig 2: Components of the *fire triangle*. The interaction with fire and climate (weather) can be seen here (ref: <http://www.rvmagonline.com>)

Research objectives and plan of work

1. **To enhance current remote sensing methods for characterization of fuel loads in managed loblolly pine systems:** Our main focus would be on using LIDAR-based systems, which have great potential for characterizing fuel loads, especially in the understory (Erdody *et al.* 2010, Mutlu *et al.* 2008). We plan to use LIDAR data collected over loblolly pine plots established by the Forest Inventory and Analysis National Program (FIA 2012). These plots have *in situ* estimates of fuel loads, thus giving us the ability to find a statistical relation between LIDAR signatures and fuel loads. This exercise would also help us establish a good baseline fuel load (for current conditions), over the Southeast.
2. **To identify the relations between fuel load and management practices, in such plantations:** We plan to use the methods developed from our work on objective 1 to quantify fuel loads across various industry stands, with known management practices. This would allow us to understand and describe the statistical relation between the current fuel load and previous management practices followed, for a stand (see fig. 3, top part). Further, this would help us identify the management practices that are ideal for reducing fuel loads, in such stands.
3. **To project future fuel load trajectories in the face of climate change:** First, we plan to formulate a statistical relation that helps us to estimate fuel load using the various stand-level parameters projected by 3PG (fig 3, bottom). This would help us build an extended version of 3PG, that also projects fuel load into the future. This version can be calibrated and checked using the baseline fuel load, described above. This extended model can then be used to project fuel loads for the future, using projected climate parameters (from GCMs).

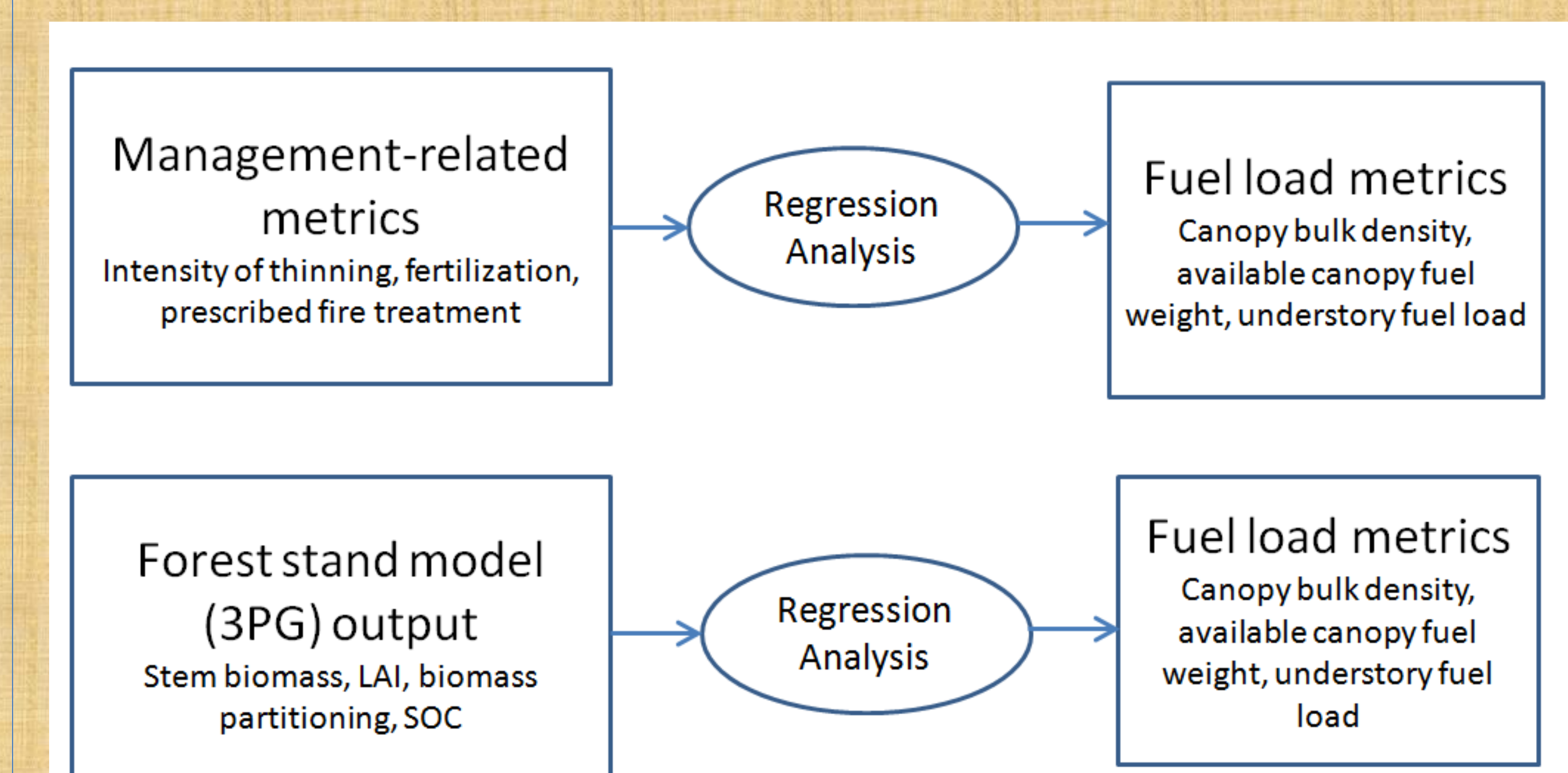


Fig 3: Schematic representation of statistical relations we plan to derive for fuel load. We plan to derive these relations in objectives 2 and 3

Selected references

1. Erdody T. L. and Moskal, L. M. (2010) "Fusion of LiDAR and imagery for estimating forest canopy fuels", *Remote Sensing of Environment*, 114, pp. 725-737.
2. Wear D.N. and Greis J. G. (2011) "The Southern Forest Futures Project: Summary Report". Available at the Southern Forest Futures Project website.
3. Marshall D.J. *et al.* (2008) "Synthesis of knowledge of hazardous fuels management in loblolly pine forests", US Forest service General Technical Report SRS-110
3. Westerling A.L. *et al.* (2011) "Continued warming could transform Greater Yellowstone fire regimes by mid-21st century", *Proc. Nat. Acad. Sciences (PNAS)* vol. 108, no. 32