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MACHINE LEARNING IN COUPLED WILDFIRE-WATER SUPPLY RISK ASSESSMENT: DATA SCIENCE TOOLKIT

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Scope

We develop a data analysis framework based on Machine Learning and spatial models, in order to measure wildland fire impacts on water yields across the United States. We initiated this national scale research in response to increasing concerns about fire impacts on potable water, and the need to untangle the simultaneous effects of climate change and land cover change.

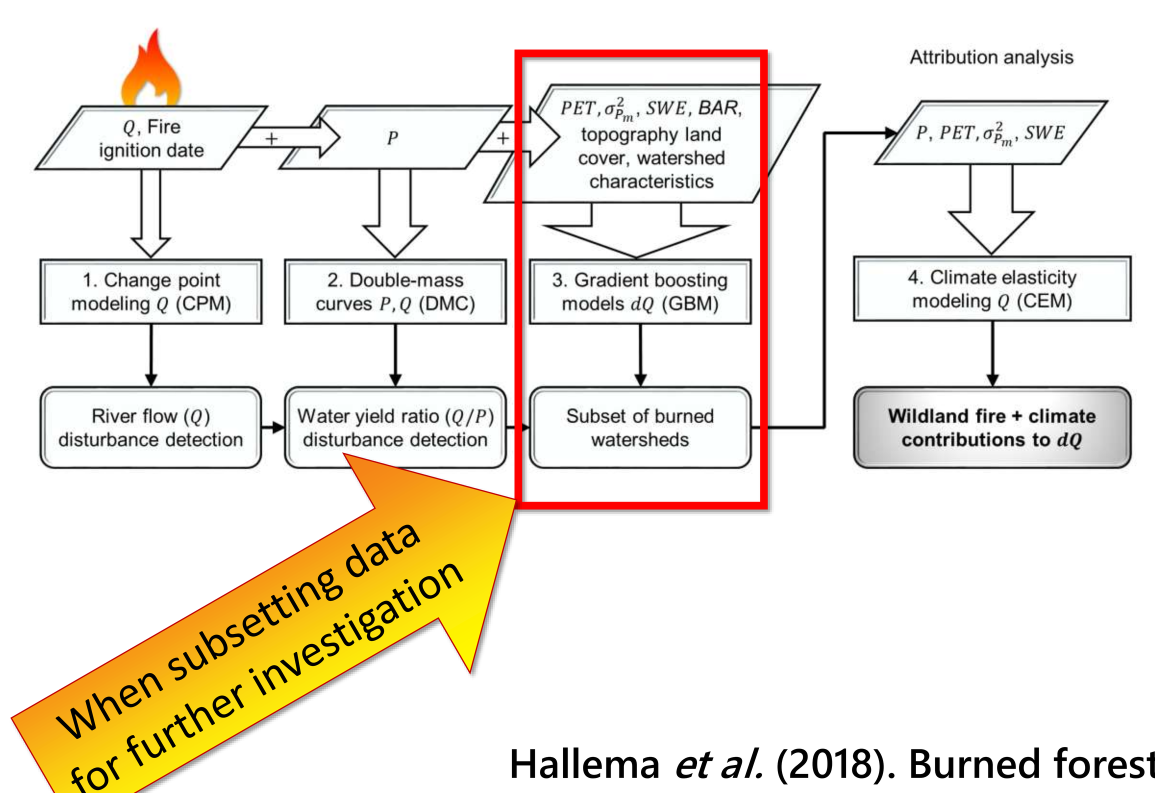
MACHINE LEARNING

- Construction of algorithms that learn from data
- Formalized by Arthur Samuel in 1959:

"it can learn to [play chess] in a remarkably short period of time (8 or 10 hours of machine-playing time)"

Samuel, A. L. (1959). Some studies in machine learning using the game of checkers. IBM Journal of Research and Development, 3(3), 210-229.

Where Machine Learning fits within the work flow



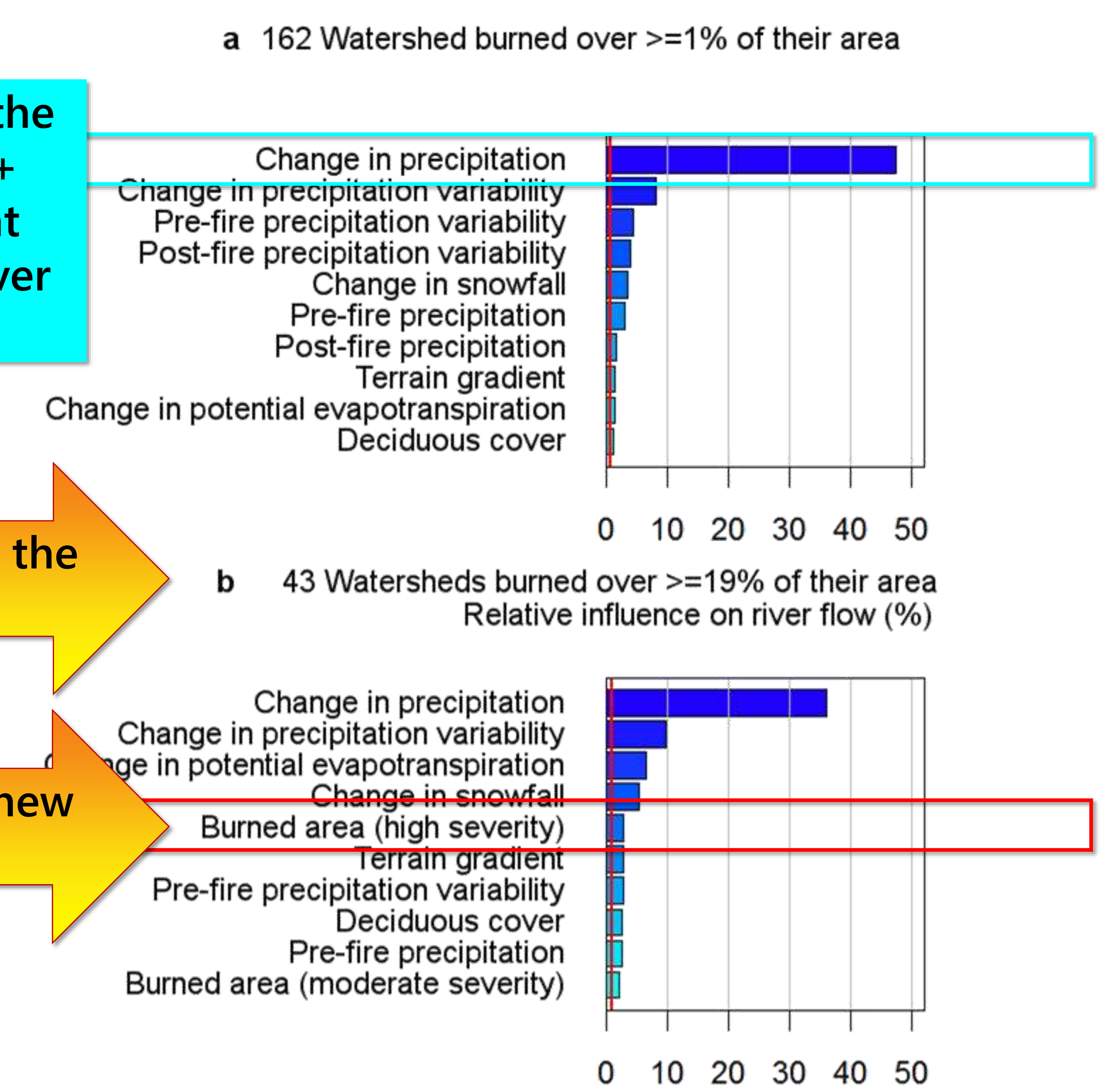
Machine Learning helps to:

1. Identify influential variables we do not (yet) understand
2. Detect environmental thresholds
3. Extract maximum information from data
4. Formulate hypotheses regarding burn impacts on water yields

Once we know the key variables + thresholds that affect annual river flow...

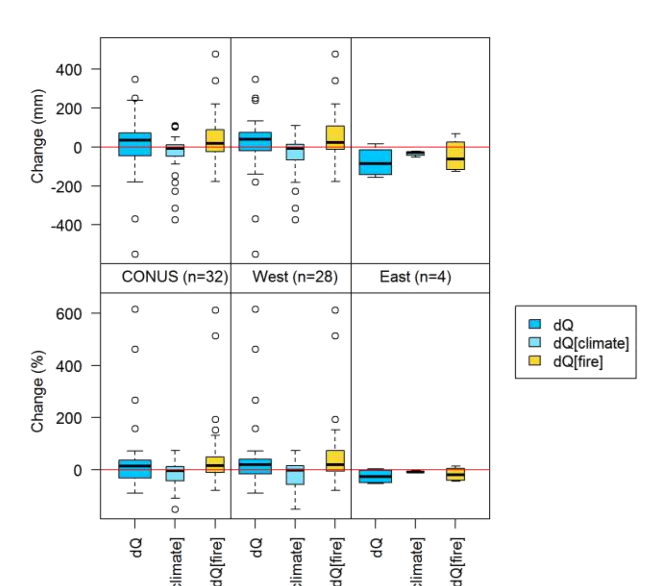
...we can subset the data...

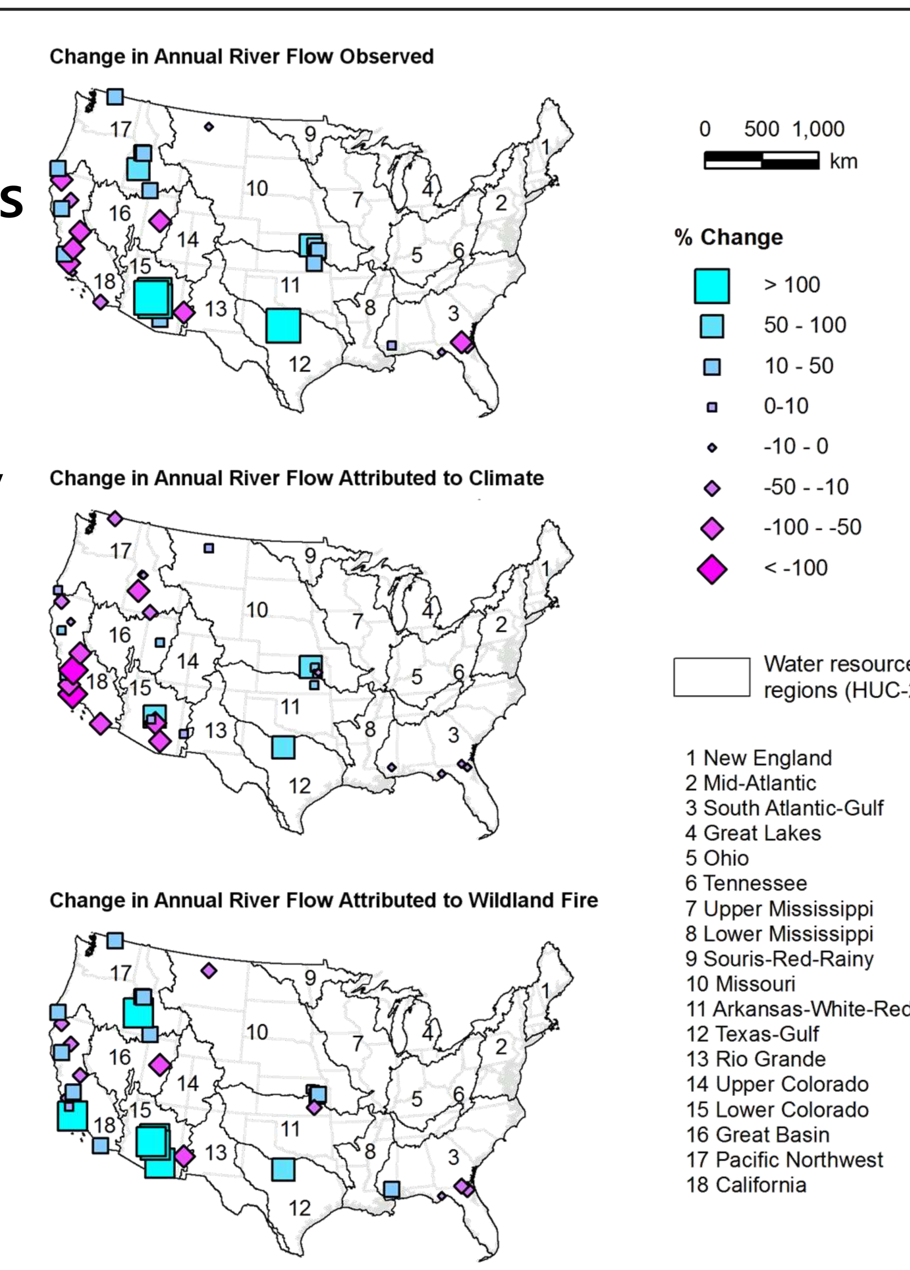
...and discover new thresholds



Wildland fire impacts on observed annual water yields

- Observed postfire river flow increased by +43.3% on average (median +14.0%)
- But because precipitation generally declined, true wildfire impact was +57.5% (median +14.6%).

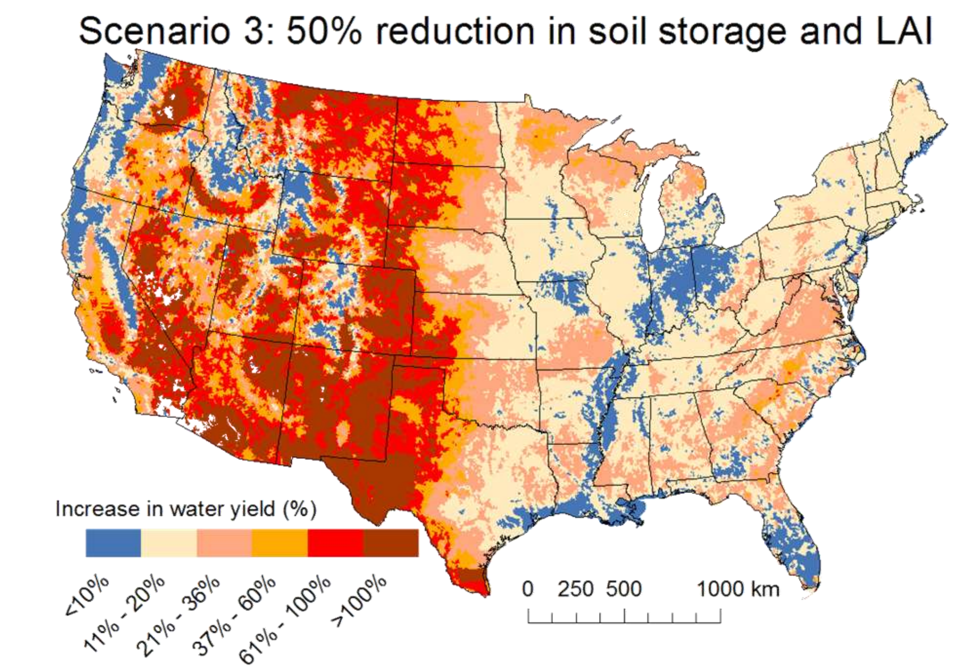


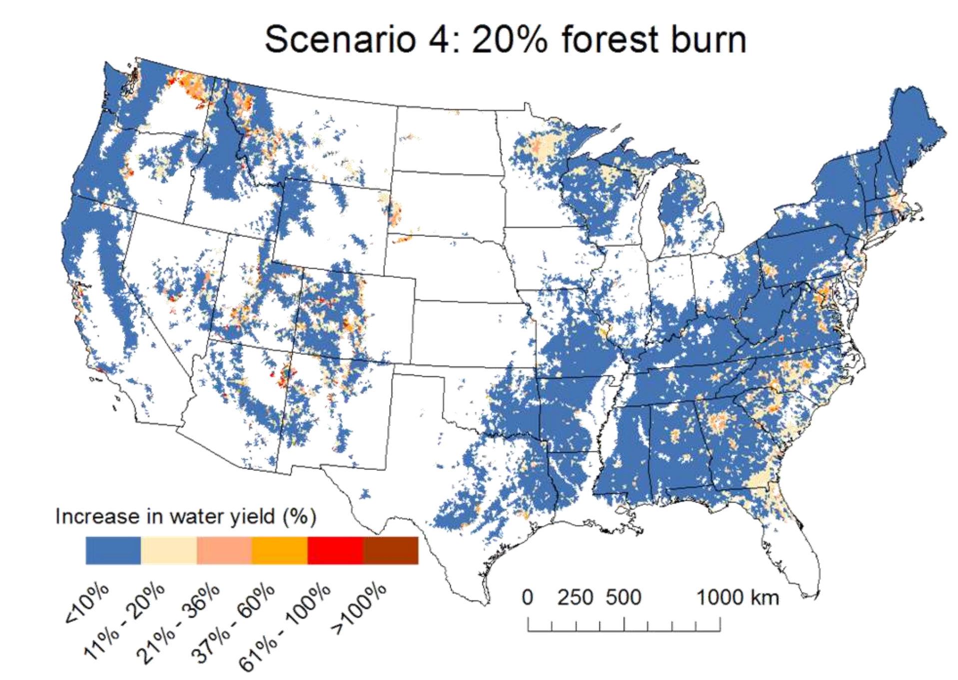


Use influential variables to assess potential wildland fire impacts on annual water yield 2001-2010

- WaSSI Water Supply Stress Index model
- 88,000 subwatersheds in the Contiguous United States

$$Water\ yield = Precipitation - Evapotranspiration$$





Highlights

- Combine data analytics with hydrological models to estimate true disturbance impact
- Regions with large potential increases in total annual water yield (+10% to +50%): mid to high elevation forests in northeast Washington, in northwestern Montana, central Minnesota, southern Utah, Colorado, and South Dakota, and coastal forests in Georgia and northern Florida

Hallema *et al.* (2018). Burned forests impact water supplies. *Nature Communications* 9:1307

JOINT FIRE SCIENCE PROGRAM