

Fire Structure, Real Plumes, and Models

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Conceptual progression of complexity

How many plumes?

Atmospheric models, resolution, parameterizations

Near-field vs. far-field

Key concerns













Complicating factors

- Wind vs heat output
- Vertical and horizontal wind shear (subscale?)
- Canopy impact on turbulence and vertical movement
- Burning area geometry



Fire geometry: single vs. multiple convective cores

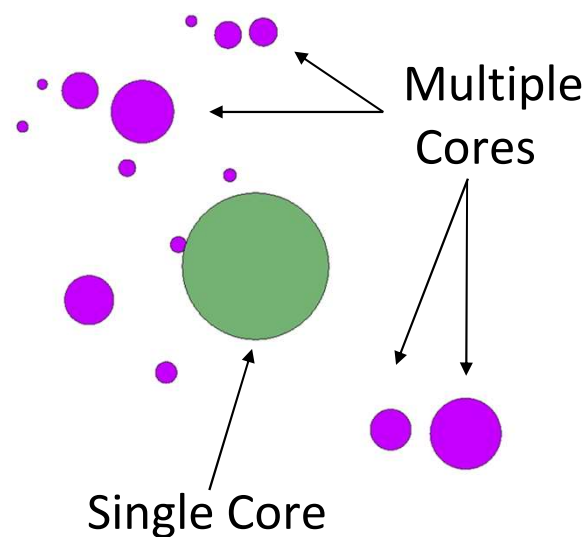
Single core representation minimizes entrainment, may increase plume top

Rice Ridge Fire Sept 2, 2017

Growth on Sept 2
~5700 hectare



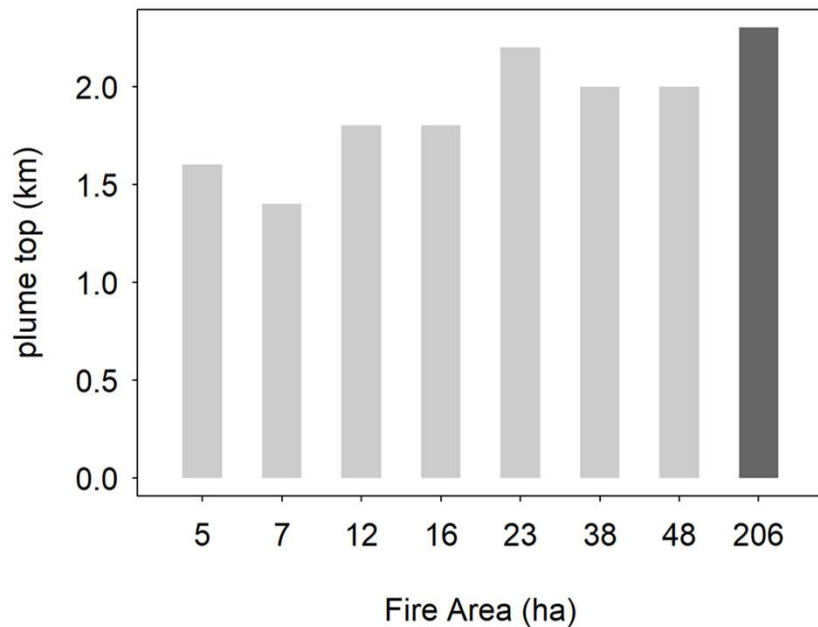
Representation for
Plume Model



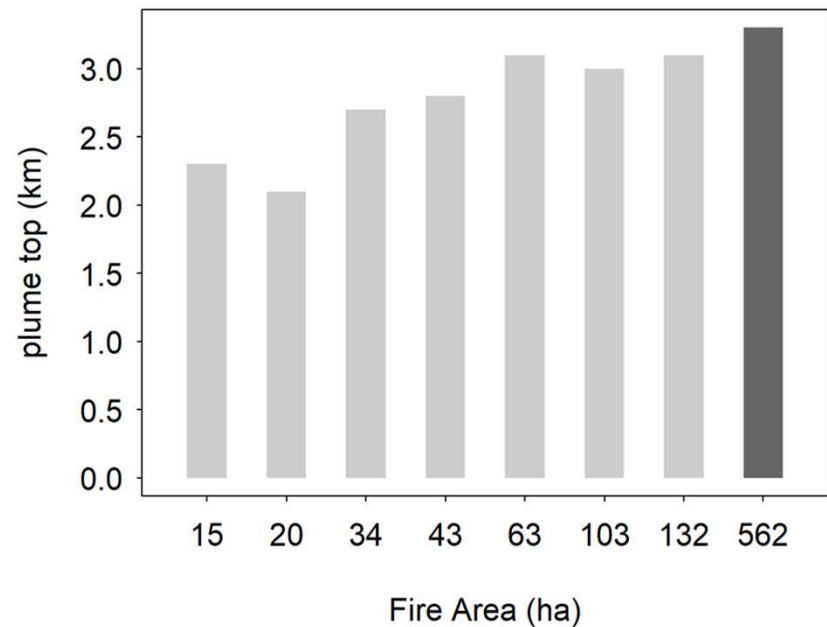
Impact of using multiple cores – Rice Ridge Fire

Dark gray = single plume, light gray = multiple plumes

Sept 2, 2017 13:00 LT



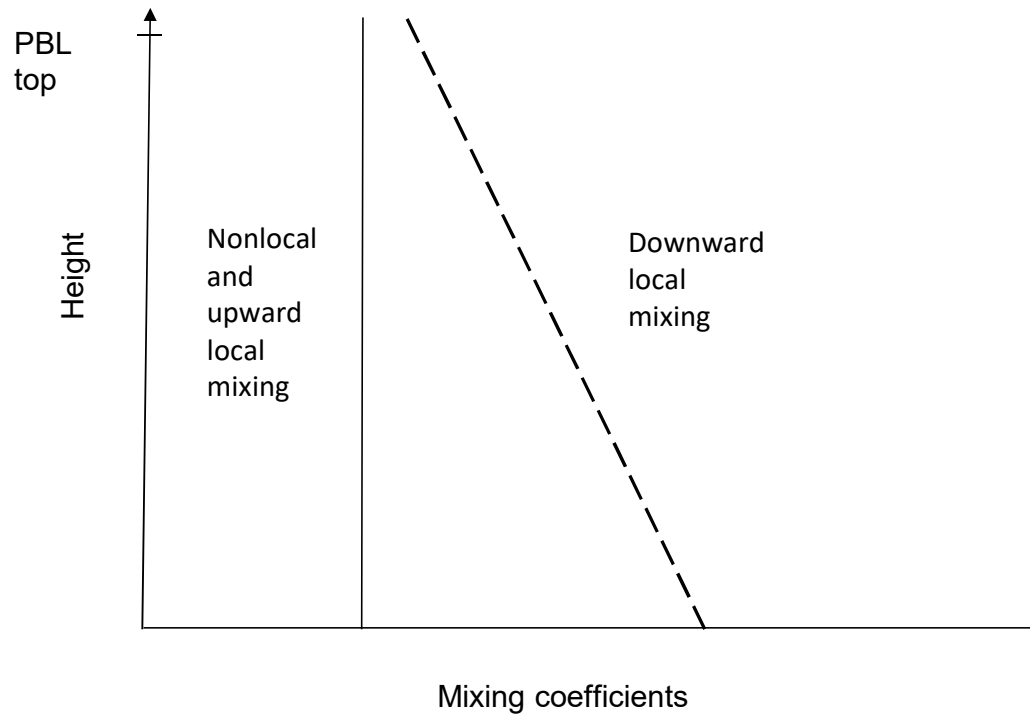
Sept 2, 2017 17:00 LT



For these fire sizes and heat flux:

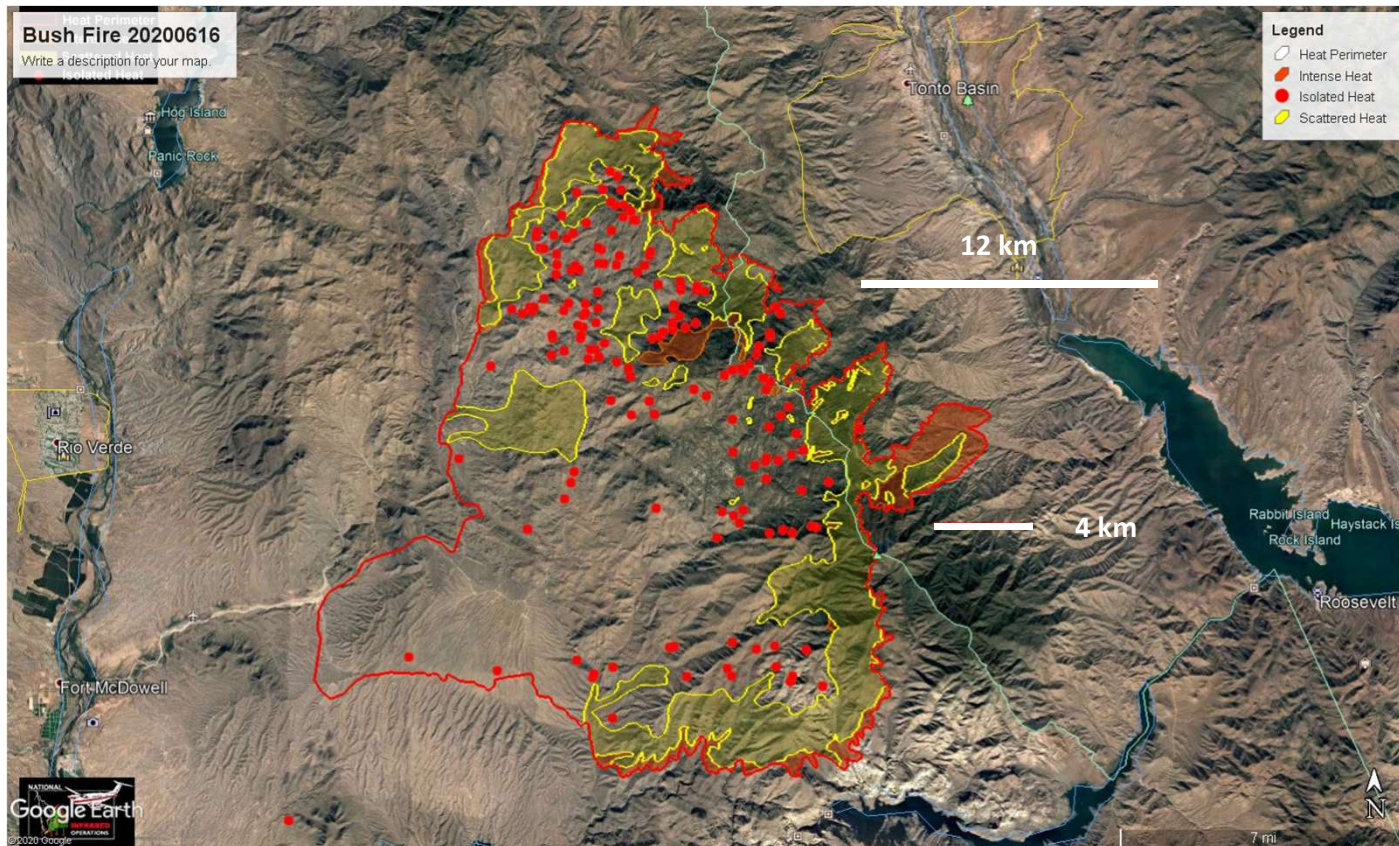
Environmental conditions may be controlling factor on plume top

PBL parameterized mixing

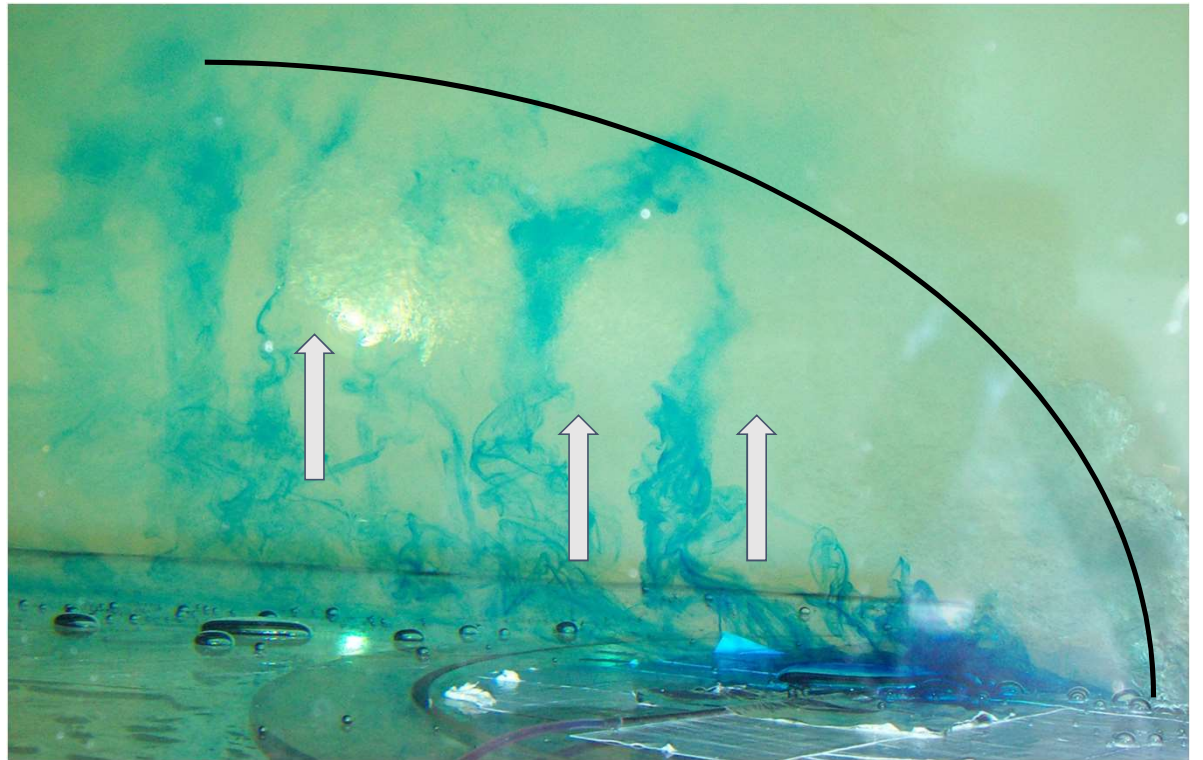


Conceptual profiles of mixing coefficients for ACM2 PBL scheme, Pleim (2007)

Plume << model grid cell



Near field vs far field



Questions to ask

- Is the mathematical model I'm using really the model for the plume I'm modeling?
- Is the atmospheric model PBL parameterization scheme consistent with the plume model?
- Is the fire area much smaller than the area of the atmospheric model grid cell?
- How do we model the plumes from fires with burning areas comparable to the atmospheric model resolution?
- Do the engineering model assumptions violate the atmospheric model parameterization assumptions?

Literature cited

Pleim JE, 2007. A combined local and nonlocal closure model for the atmospheric boundary layer: Part I model description and testing. *J. Appl. Meteor. Climatol.* **46**, 1383–1395, doi:10.1175/JAM2539.1

Urbanski et al., 2020. IAWF International Smoke Symposium III, April 23, 2020.