Organic Vapor Condensation in Pyro-cumulonimbus Outflow Explains Large Stratospheric Smoke Mass Injection and Thickly Coated Black Carbon

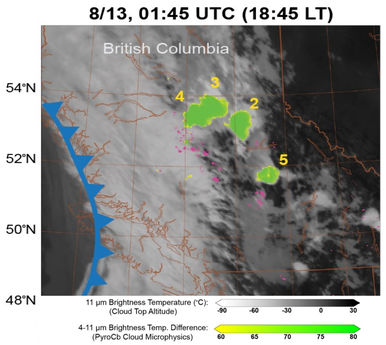
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D. Peterson | *Naval Research Laboratory Monterrey CA* S. Guimond | *University of Maryland, Baltimore*

LDRD LABORATORY DIRECTED RESEARCH & DEVELOPMENT

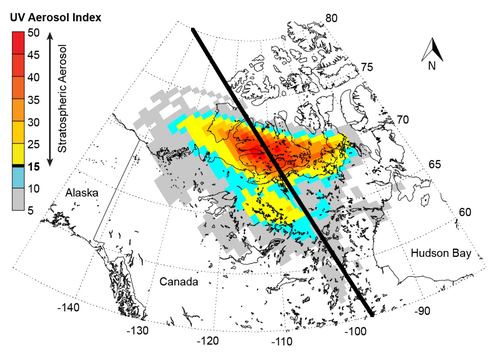
Pyrocumulonimbus stratospheric smoke mass injection >> fuel based estimate

Observations of the 2017 PyroCb show stratospheric penetration and large mass injection (0.2 Tg) over British Columbia (BC17). The dynamical, micro-physical and chemical mechanisms of the BC17 injection are unclear.

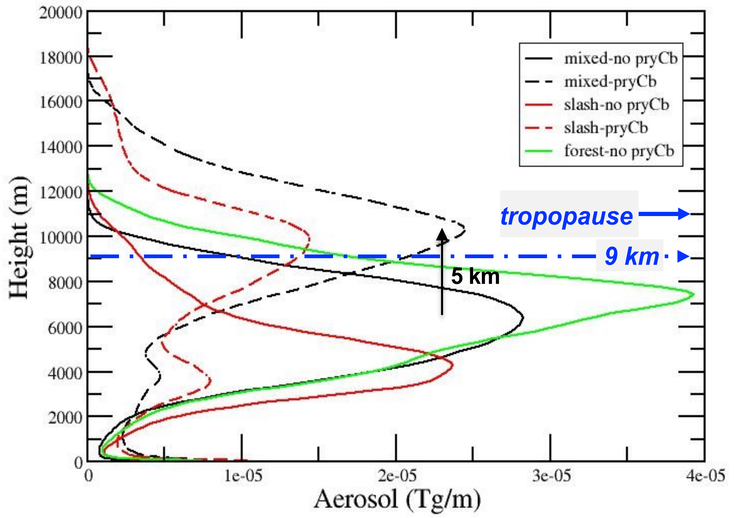
GOES (4, 11 μ)



OMPS (UV-AI)

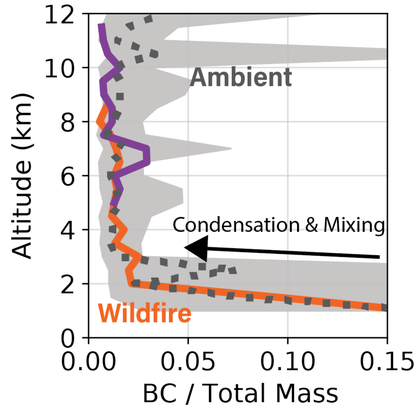


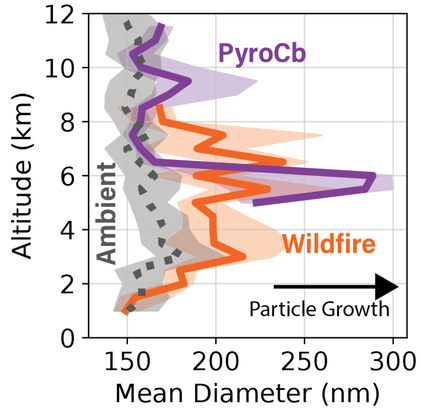
LES(HIGRAD) Plume Model: Bark Beetle Slash Piles and Aerosol-Cloud Physics

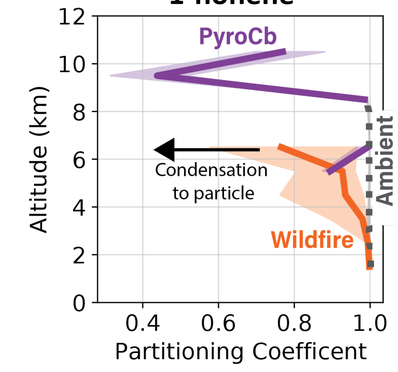


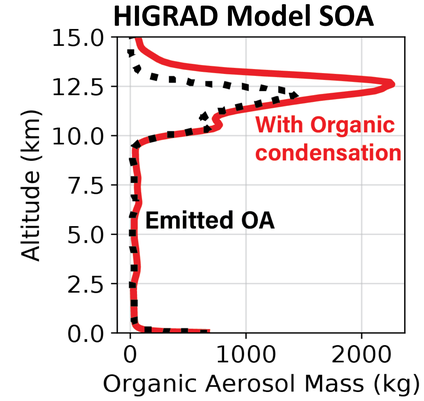
PyroCbs (dash) push aerosols to higher altitudes (solid) by greater buoyancy (slash pile) and ice/warm clouds (latent heat).

In situ synthesis (FIREX-AQ): BC falls, SOA and coatings grow in updrafts





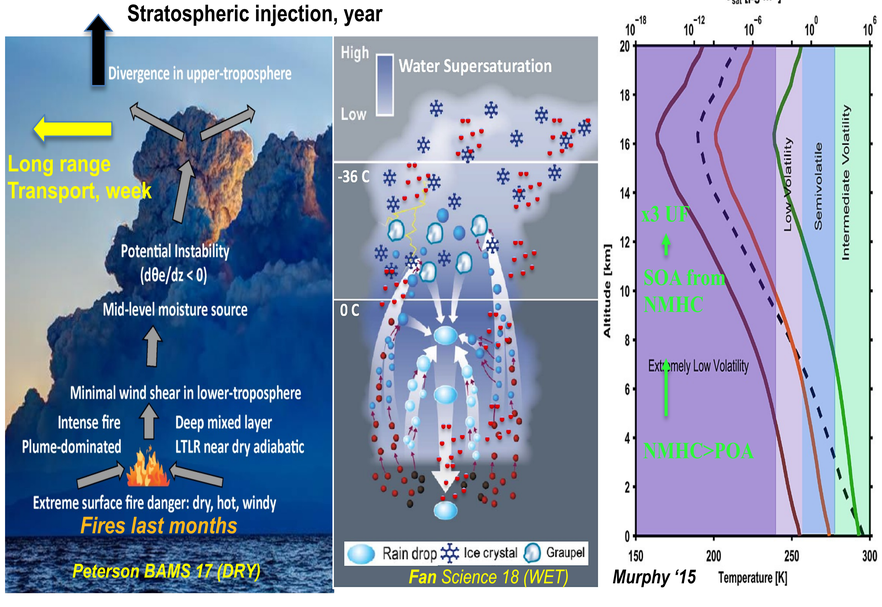




Evidence from FIREX-AQ See EGU21-13143, Benedict et al.

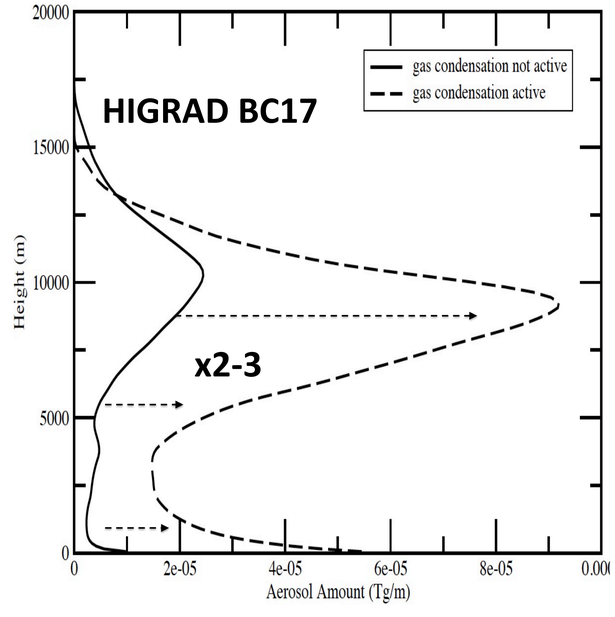
MODELS INFORMED BY OBSERVATIONS

PyroCb: Dynamics **Aerosol Microphysics** **Chemistry**



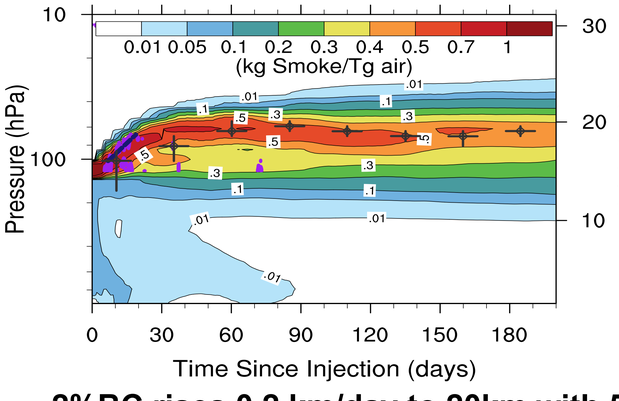
How was PyroCb smoke lofted into stratosphere?
- Why was smoke mass higher than what fuel loads suggest?
- What do *in situ BC* fraction and coating thickness reveal?

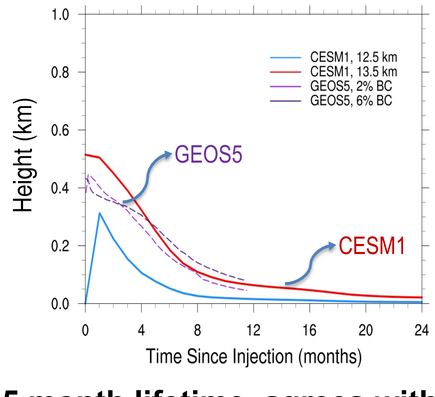
Secondary Organic Aerosol from Condensation of Volatile Organic



VOC SOAs increases mass x2-3 to 0.3 Tg

Stratospheric Smoke Self Lofting and Lifetime (CESM/GEOS5) Simulations





2%BC rises 0.2 km/day to 20km with 5 month lifetime, agrees with data. More %BC lofts higher lasts longer, sensitive to plume height

Los Alamos NATIONAL LABORATORY