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What drives increased evaporation at cloud top in polluted stratocumulus clouds?

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Observations and simulations show that an increase in aerosol concentration typically leads to an increase in liquid water path in precipitating stratocumulus clouds due to precipitation suppression, but once precipitation is fully suppressed, further increases in aerosol concentration typically lead to a reduction in liquid water path due to enhanced evaporation at cloud top. The increased evaporation is typically attributed directly to the presence of smaller, more numerous cloud droplets. However, observations suggest that the evaporation rate is primarily controlled by the entrainment mixing rate rather than the droplet properties at the tops of stratocumulus clouds. As such, aerosol-induced changes to droplet properties should not directly lead to faster evaporation. Our simulations suggest instead that the smaller, more numerous droplets enhance the cloud top maximum radiative cooling rate, which in turn increases the entrainment rate and speeds evaporation. Our results highlight that unlike integrated radiative cooling, maximum radiative cooling continues to increase with increasing liquid water path and remains sensitive to droplet properties at high liquid water path. As such, the role of radiation in driving aerosol-cloud interactions may need additional consideration in the future.