Wet Removal of Soluble Trace Gases in Deep Convective Clouds: New WRF-Chem Developments

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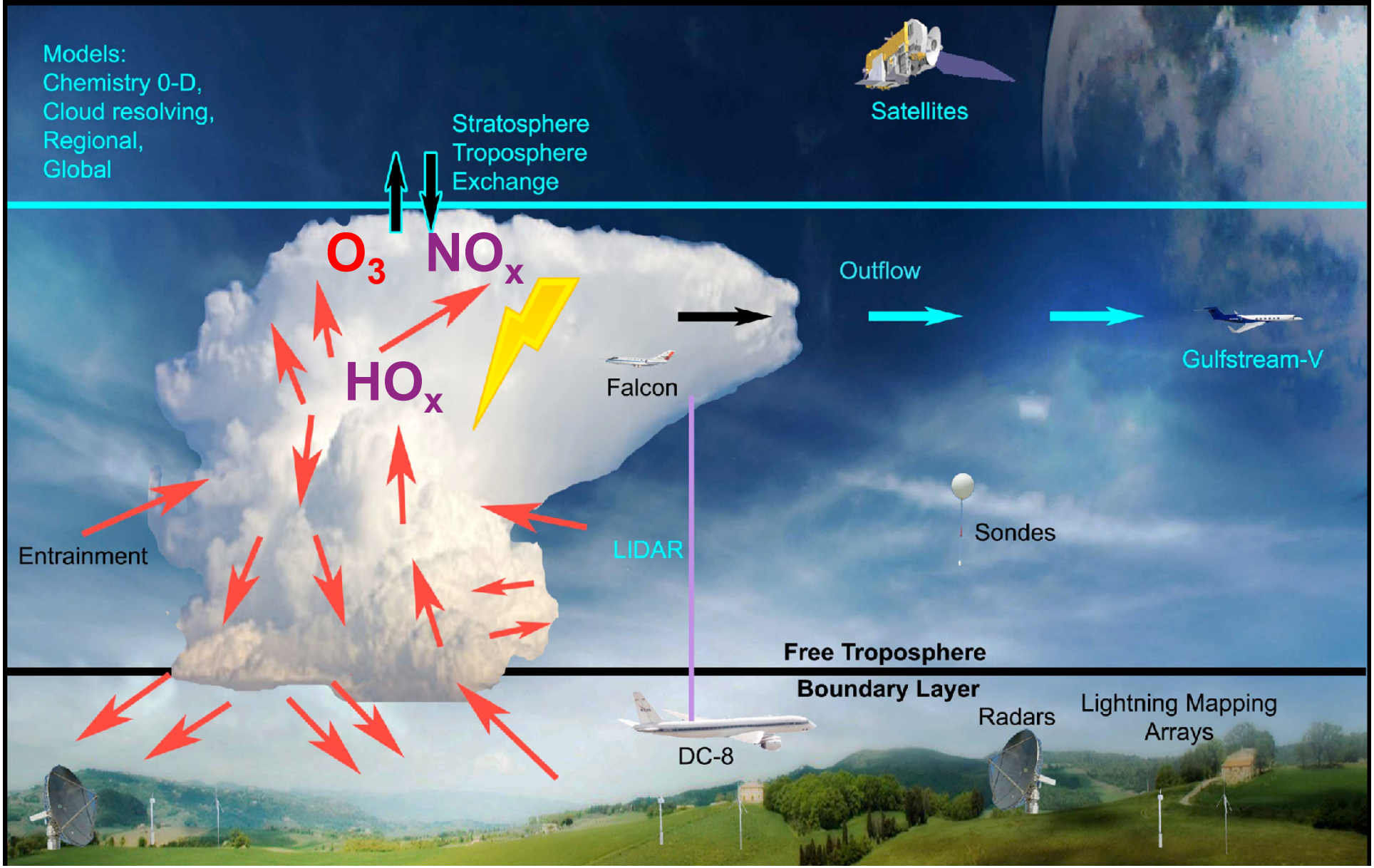
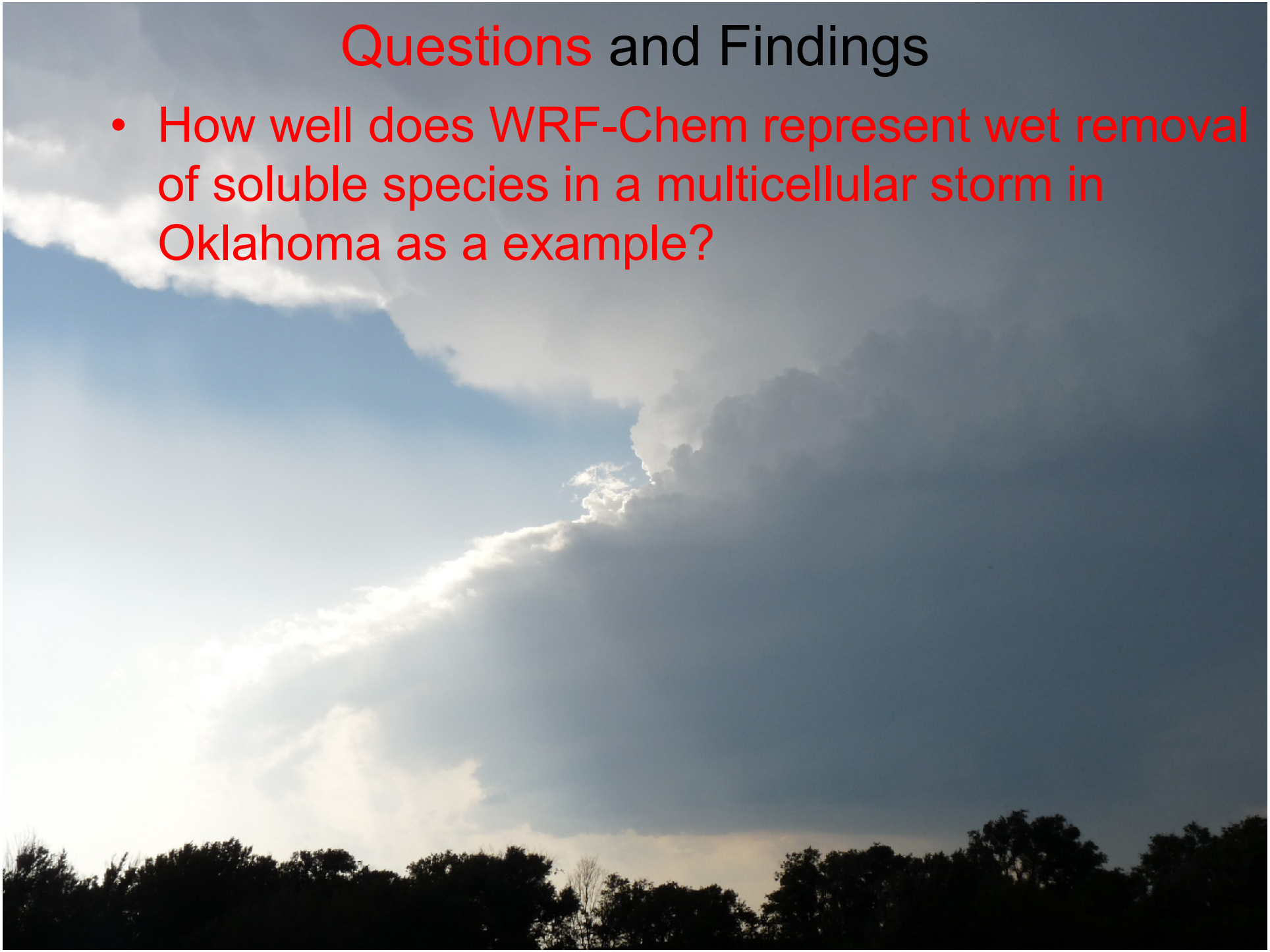
O_3 formation in UT controlled by HO_x and NO_x; many HO_x precursors are soluble





Questions and Findings

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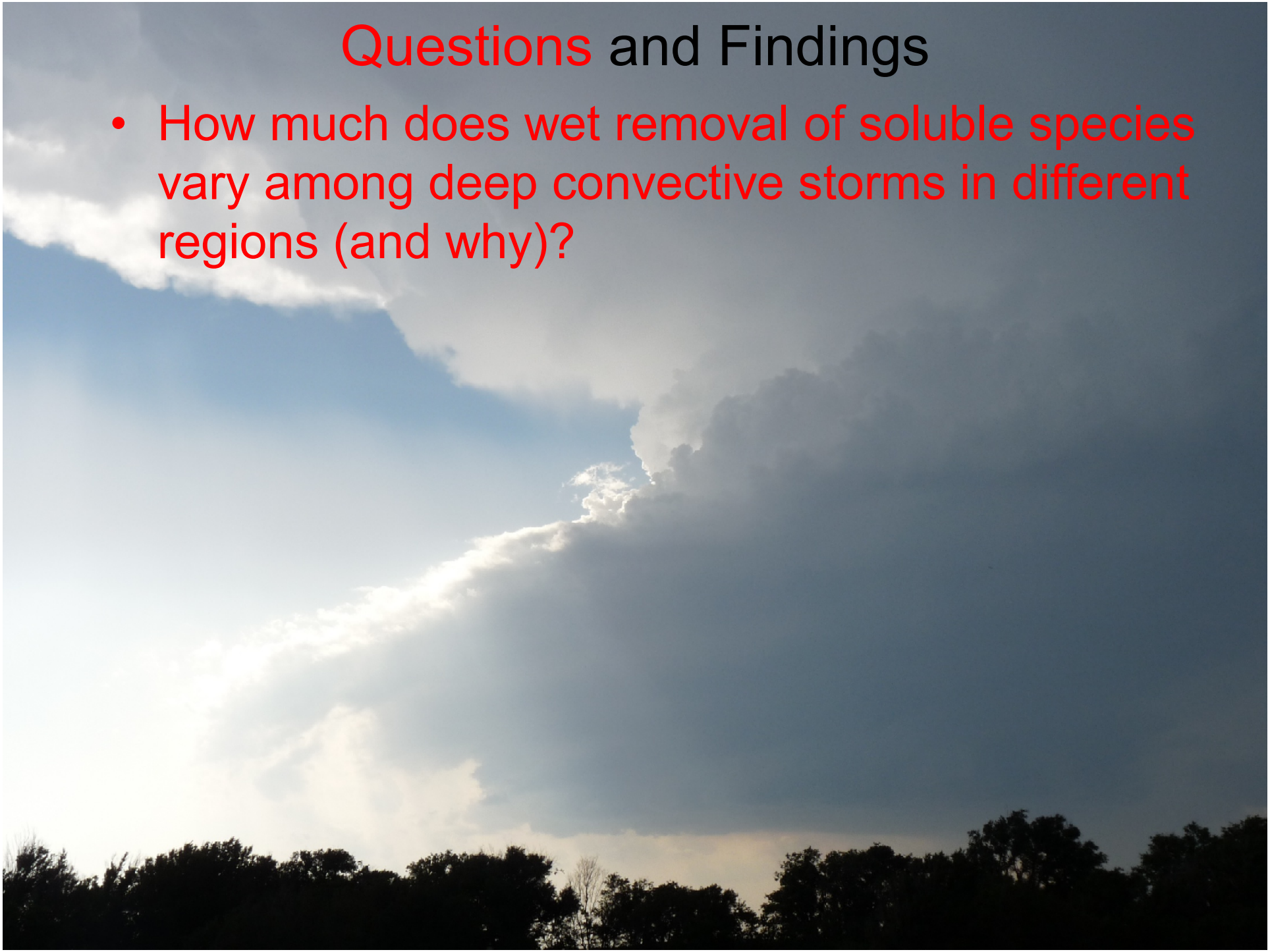
    - Inflow tracers confirm boundary layer region sampled by aircraft is entrained by model storm
    - Adding variable ice retention, WRF-Chem represents wet removal in an Oklahoma multicellular storm



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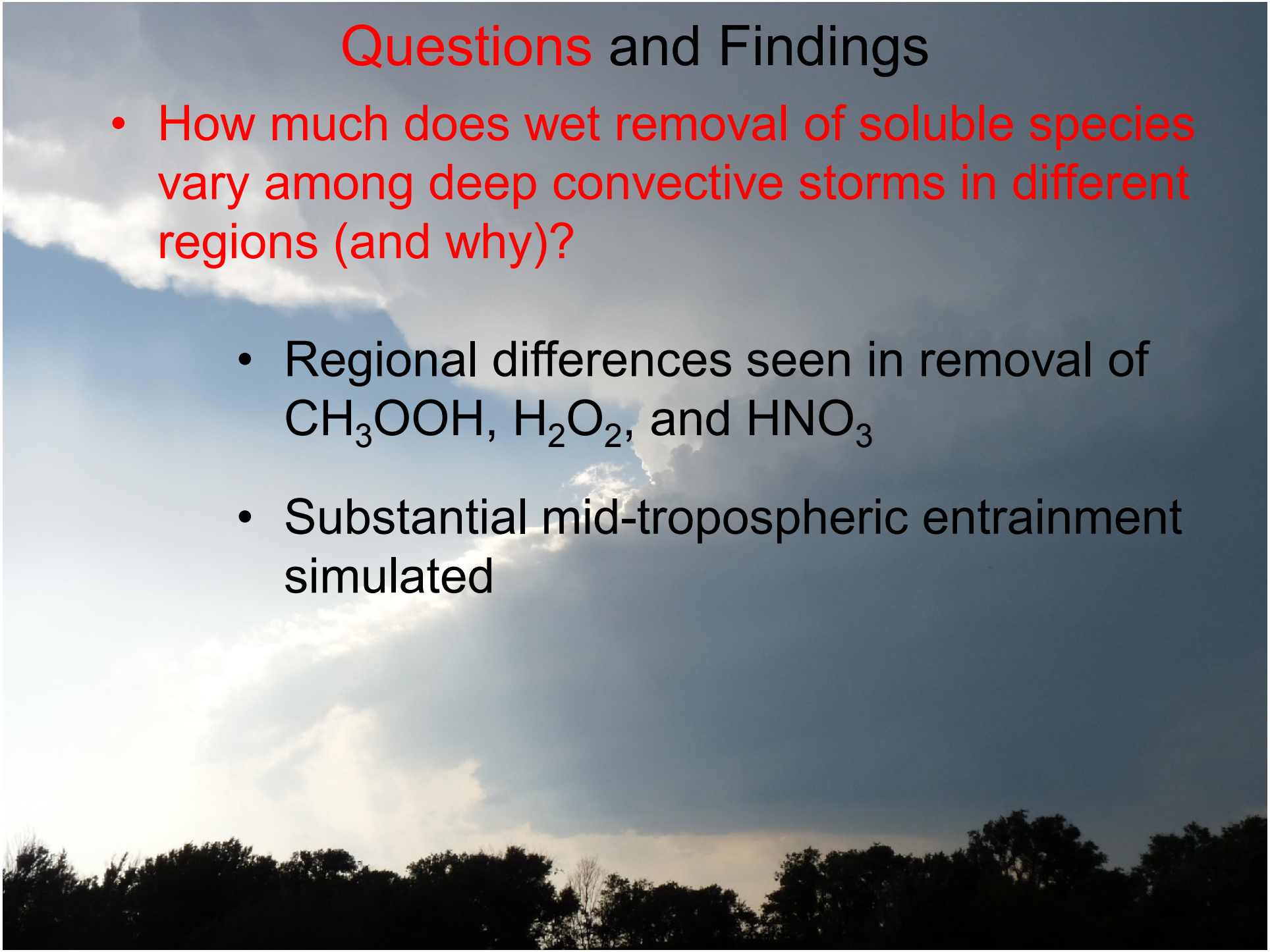
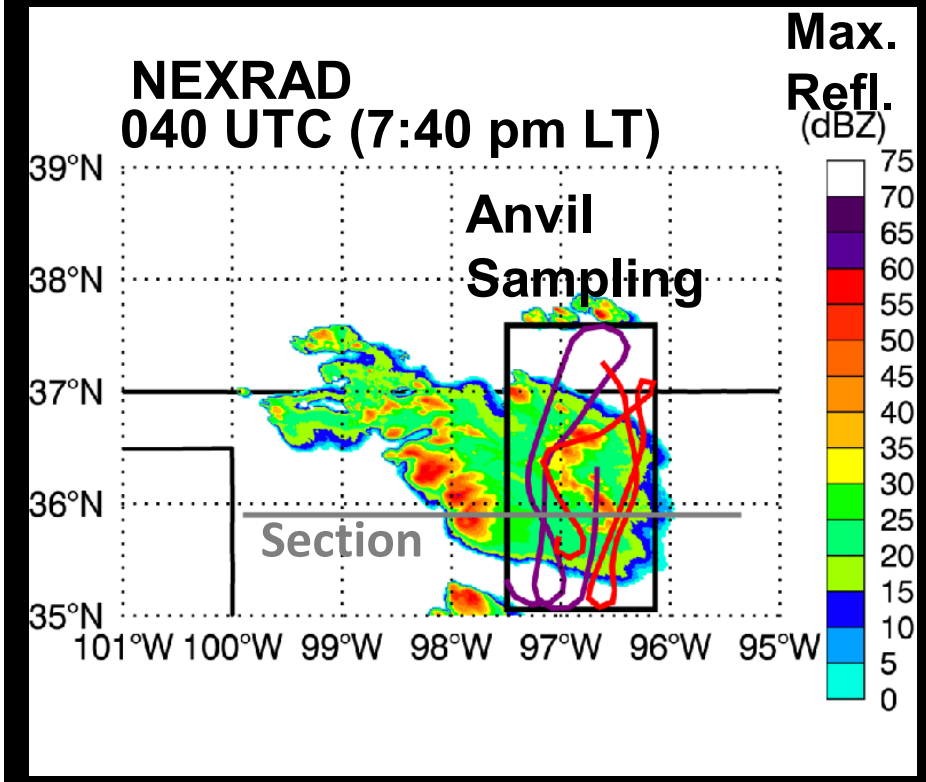


Questions and Findings

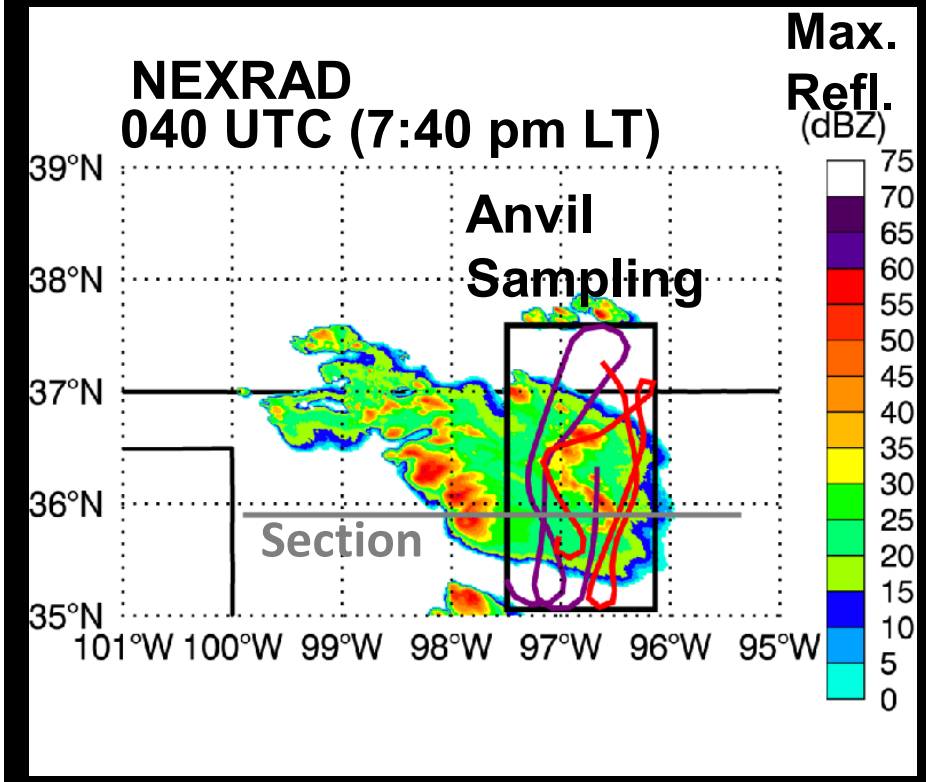
- How much does wet removal of soluble species vary among deep convective storms in different regions (and why)?
  - Regional differences seen in removal of CH_3OOH, H_2O_2, and HNO_3
  - Substantial mid-tropospheric entrainment simulated

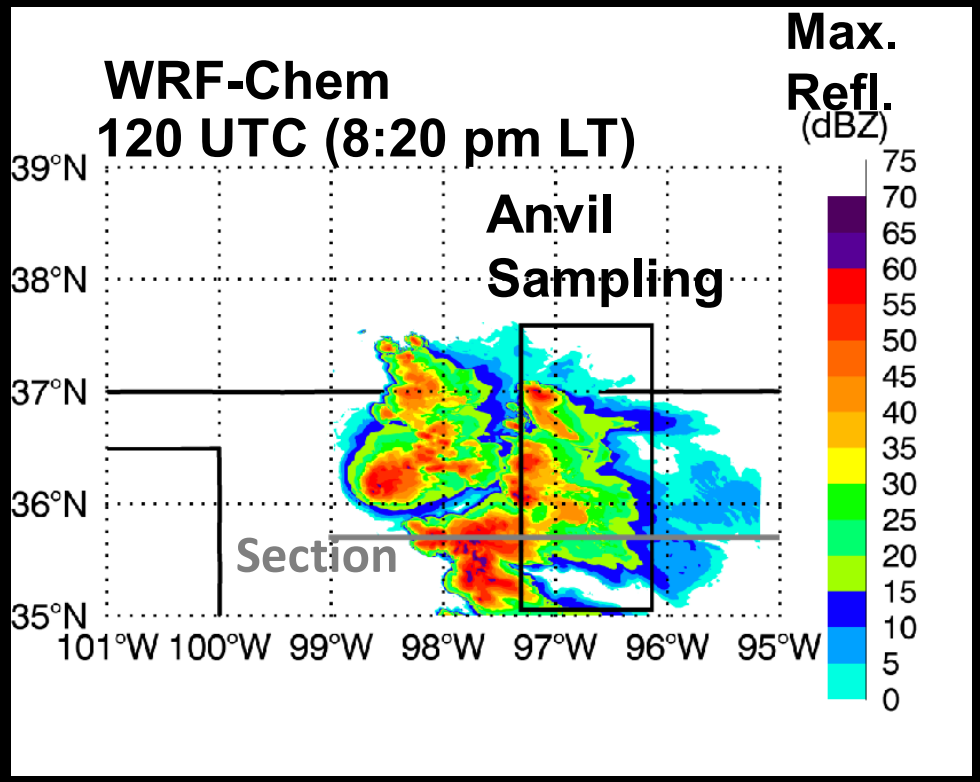
Good Inflow and Outflow Observations Taken During DC3 of May 29, 2012 Multicellular Storm in Oklahoma



Bela et al. (2015), in prep.

High-Resolution WRF-Chem Simulates Location and Structure of DC3 May 29, 2012 Oklahoma Storm





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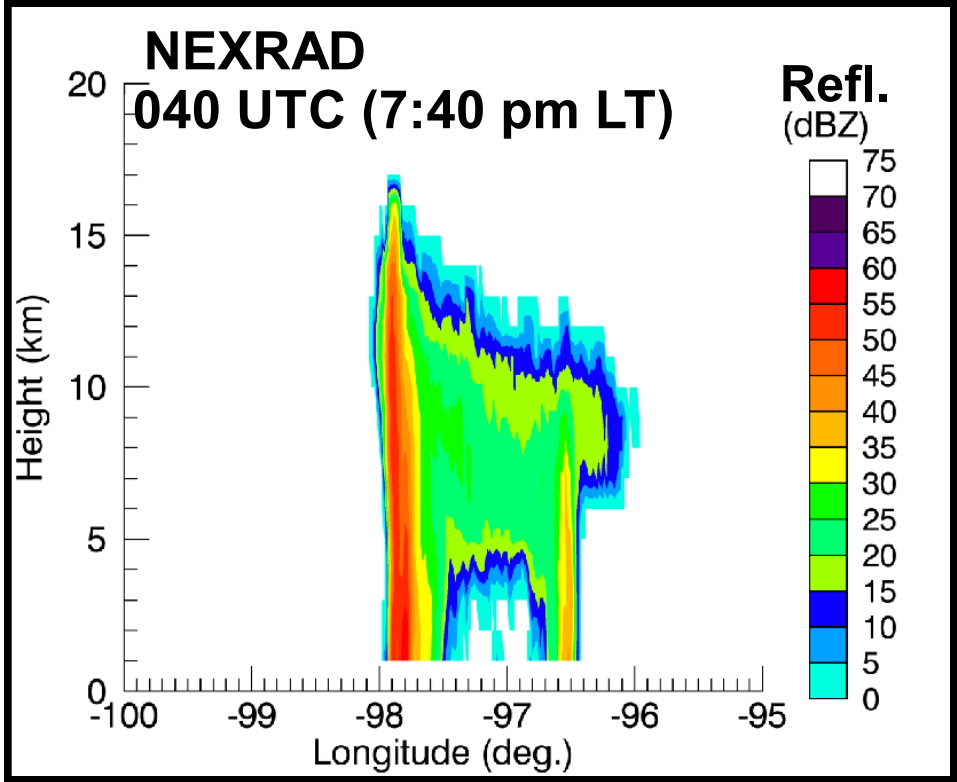
Good Observations Taken of Vertical Structure of DC3 May 29, 2012 Oklahoma Storm



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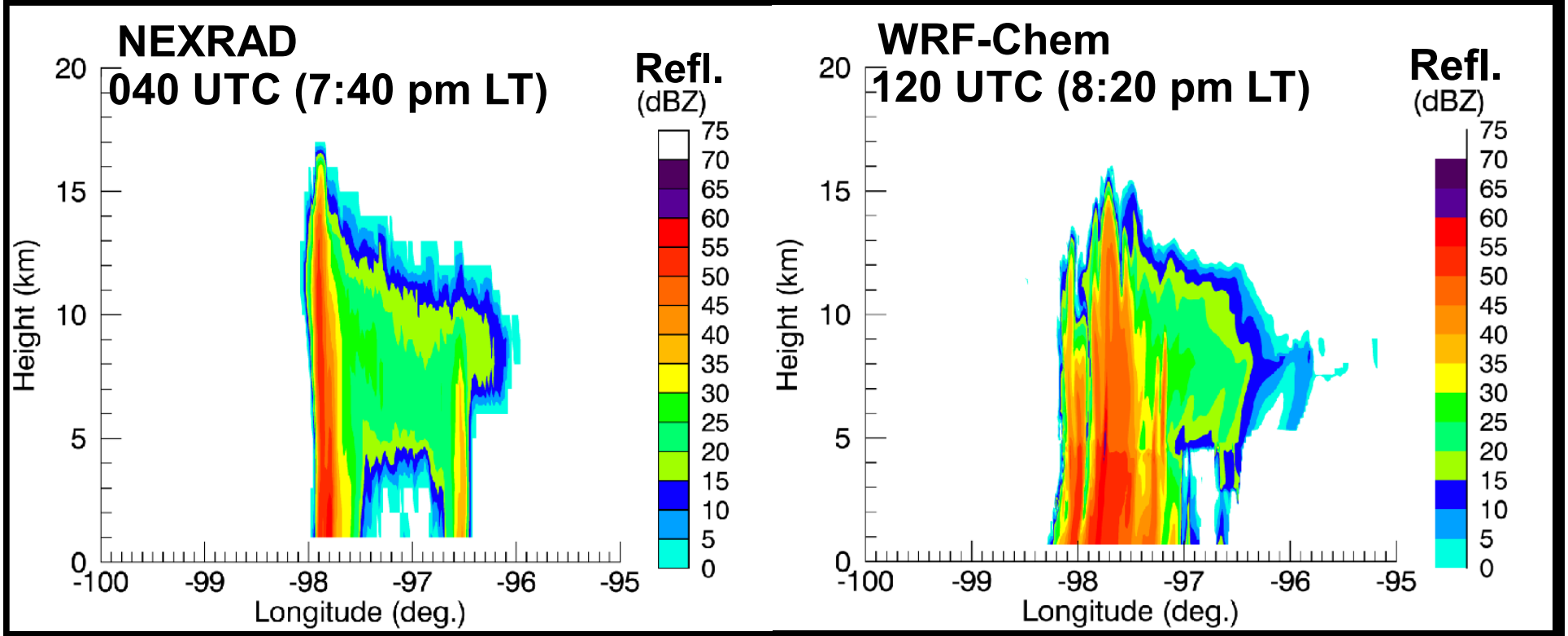
WRF-Chem Represents Vertical Structure of DC3 May 29, 2012 Oklahoma Storm



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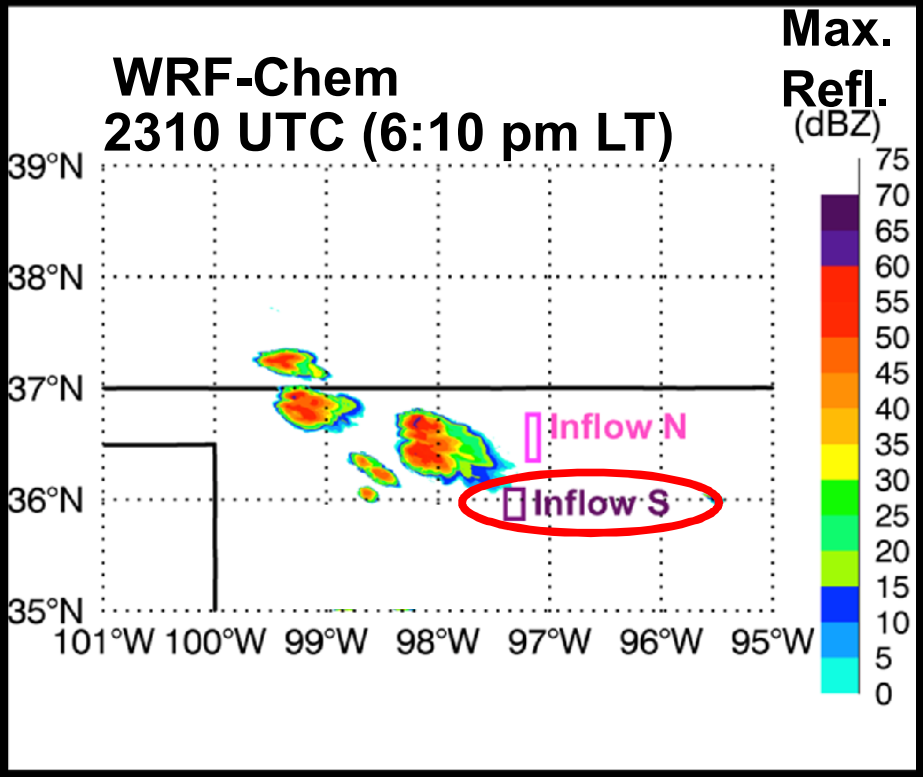
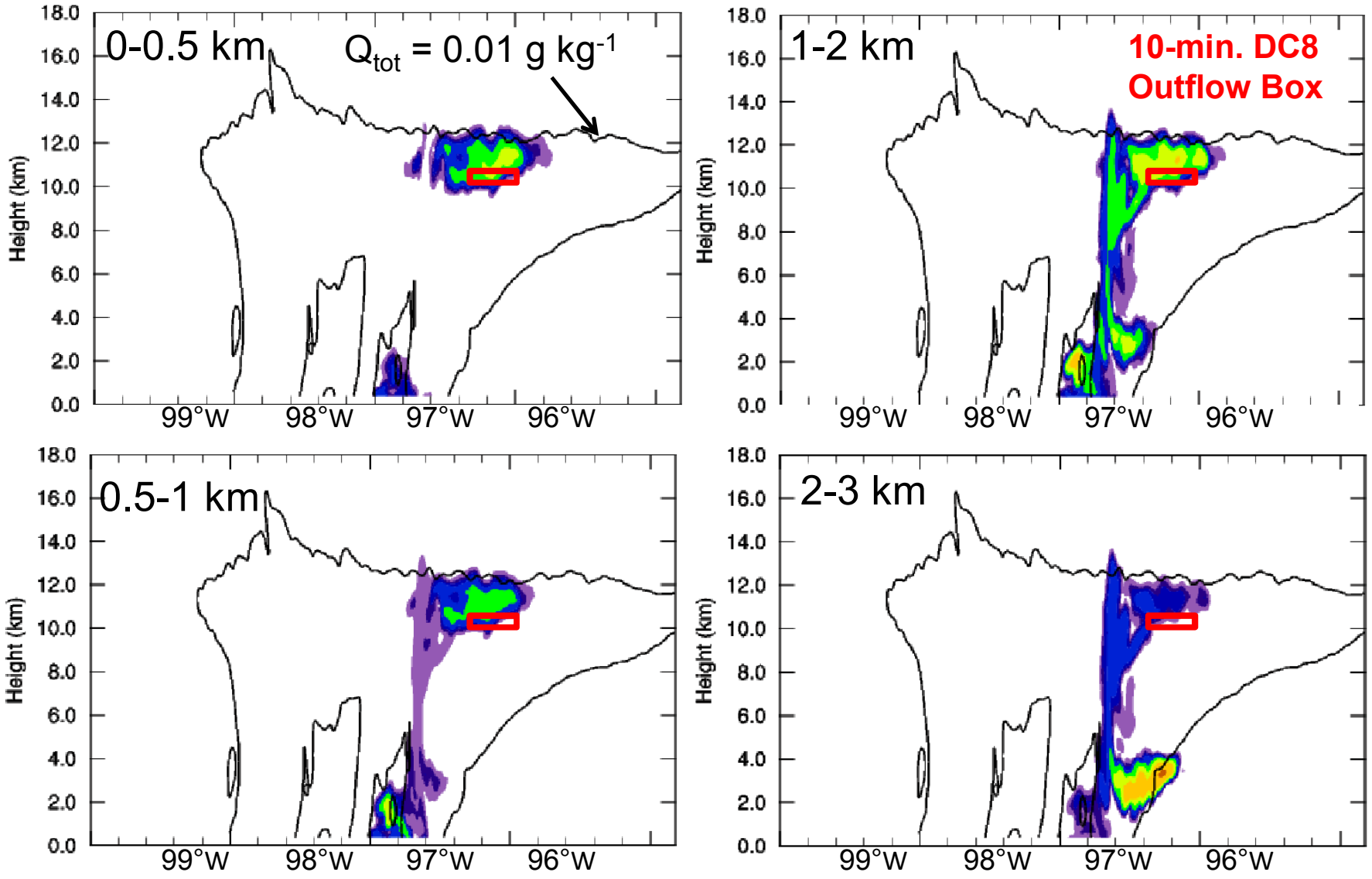
Inflow Tracers Confirm Southern Boundary Layer Sampling Region Entrained by Model Storm



Tracer value indicates fraction of air originating from given region and altitude



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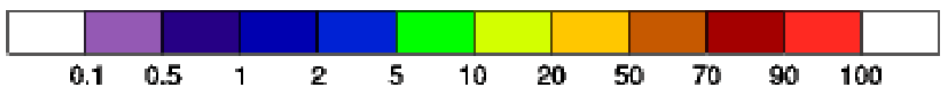
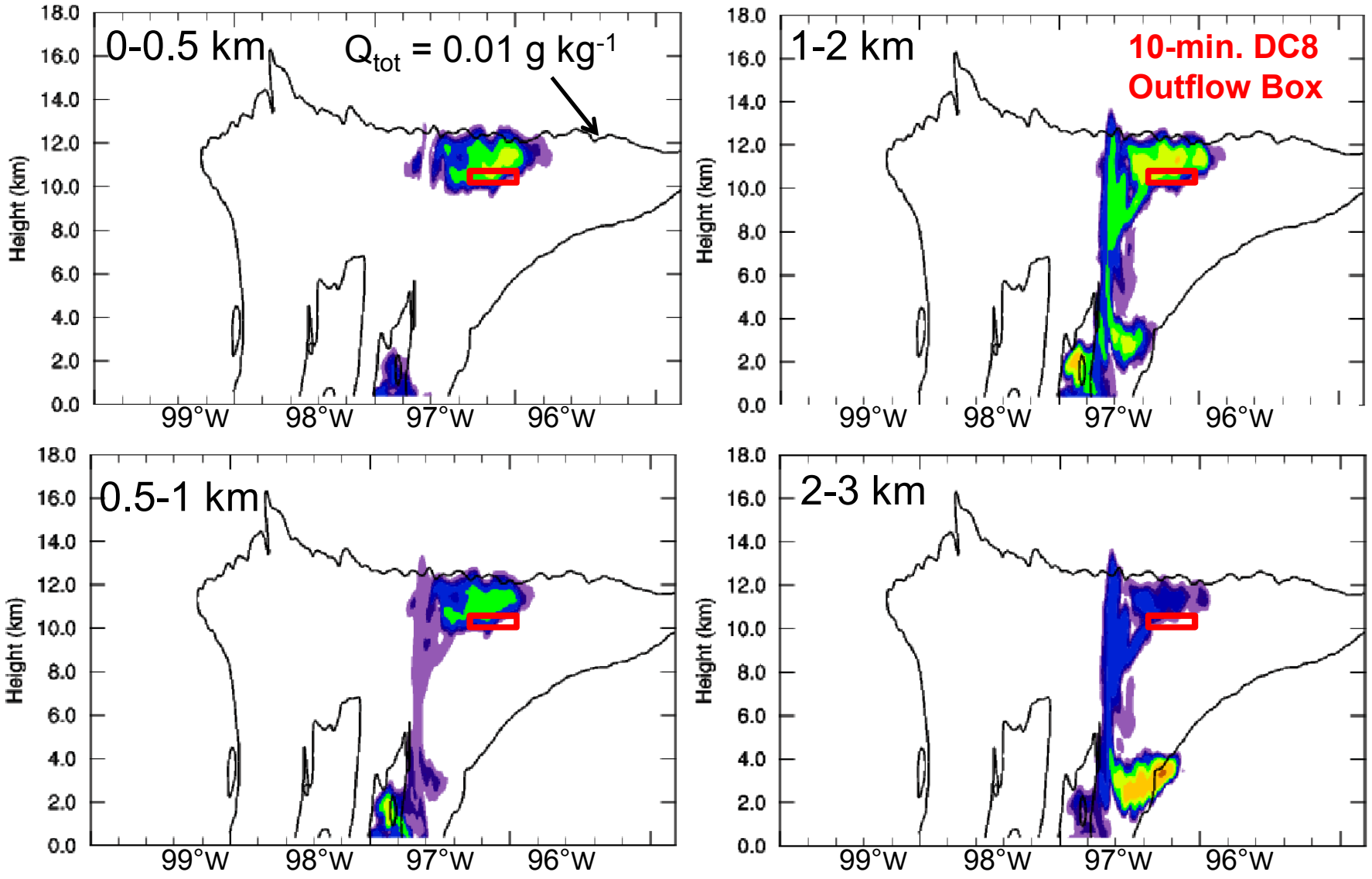


%

Highest fraction of inflow air in core originates from 1-2 km a.g.l.



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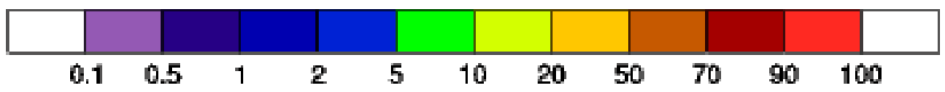
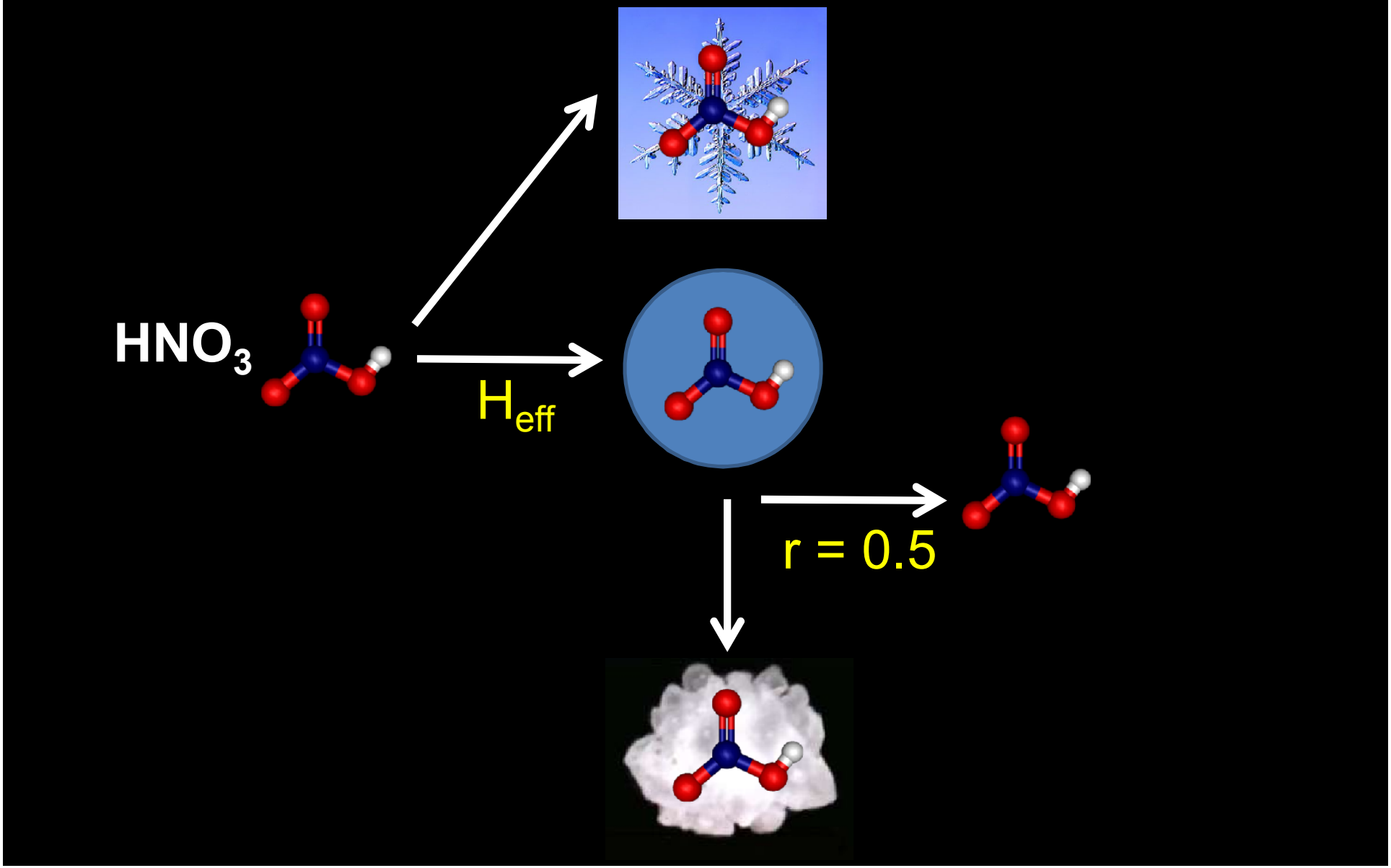


%

WRF-Chem Wet Scavenging Scheme Assumes 50% of HNO_3 Retained in Ice



All Other Species Completely Ejected to Gas Phase When Cloud Water Freezes

H_2O_2

H_{eff}

r = 0

WRF-Chem Sensitivity Simulations Constrain Ice Retention Fractions

5 Simulations:

No scavenging

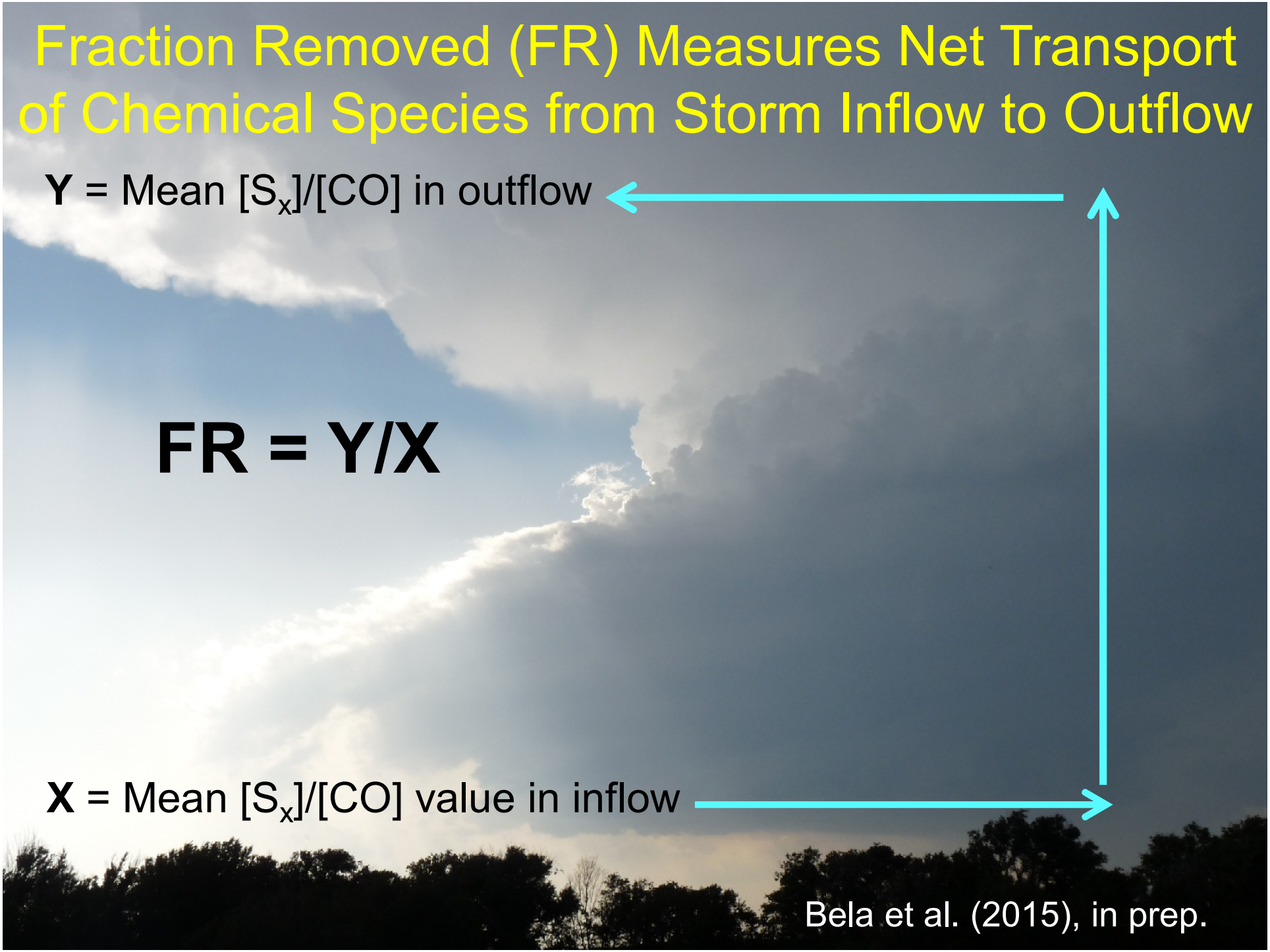
r = 0 all species

r = 0.5 all species

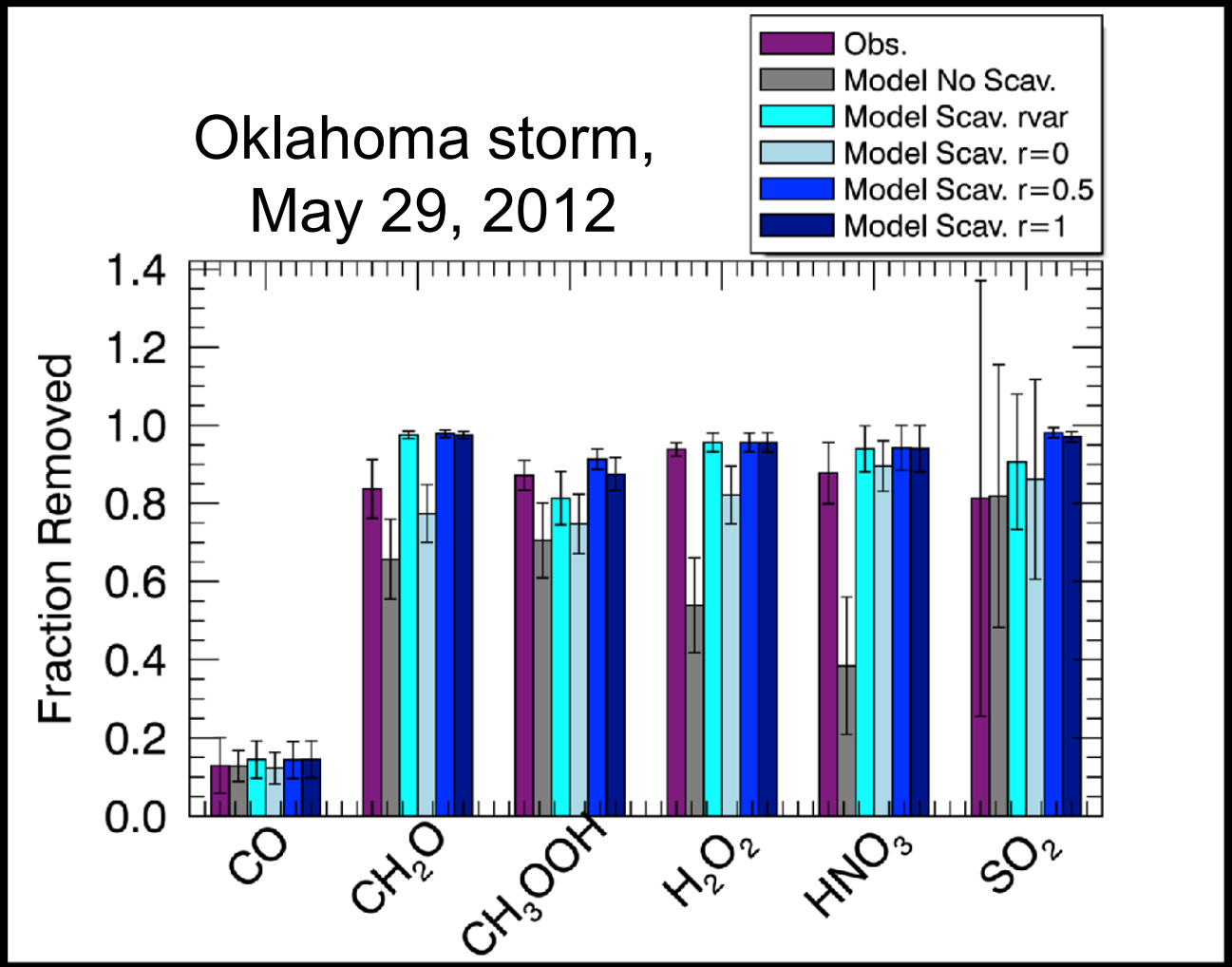
r = 1 all species

r varies by species

Bela et al. (2015), in prep.


Fraction Removed (FR) Measures Net Transport of Chemical Species from Storm Inflow to Outflow
Y = Mean [Sx]/[CO] in outflow
FR = Y/X
X = Mean [Sx]/[CO] value in inflow
Bela et al. (2015), in prep.

Fractions Removed Vary Among Species and Are Affected by Ice Retention Fraction



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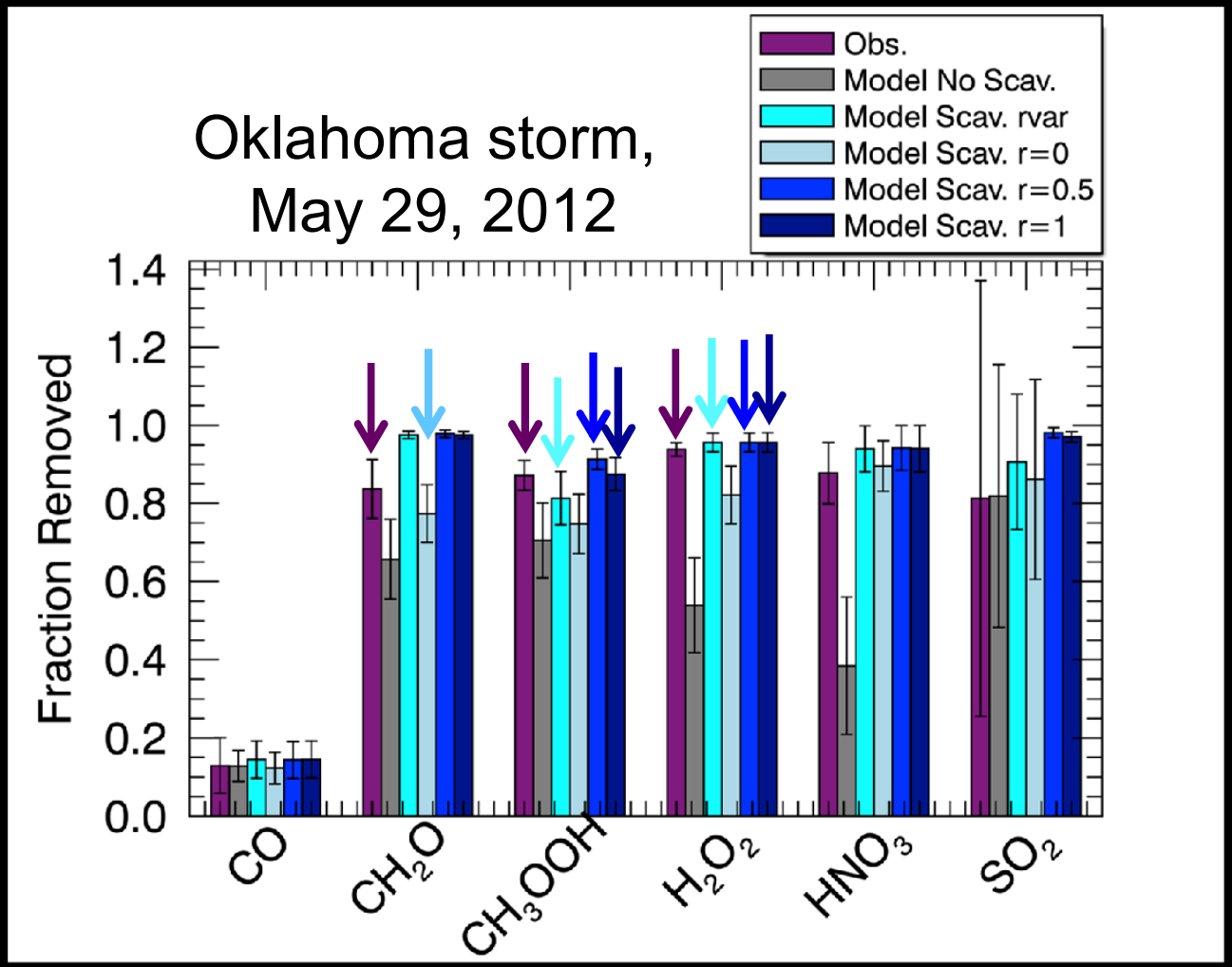
	r_f
CH_2O	0
CH_3OOH	0.02-1
H_2O_2	0.5-1



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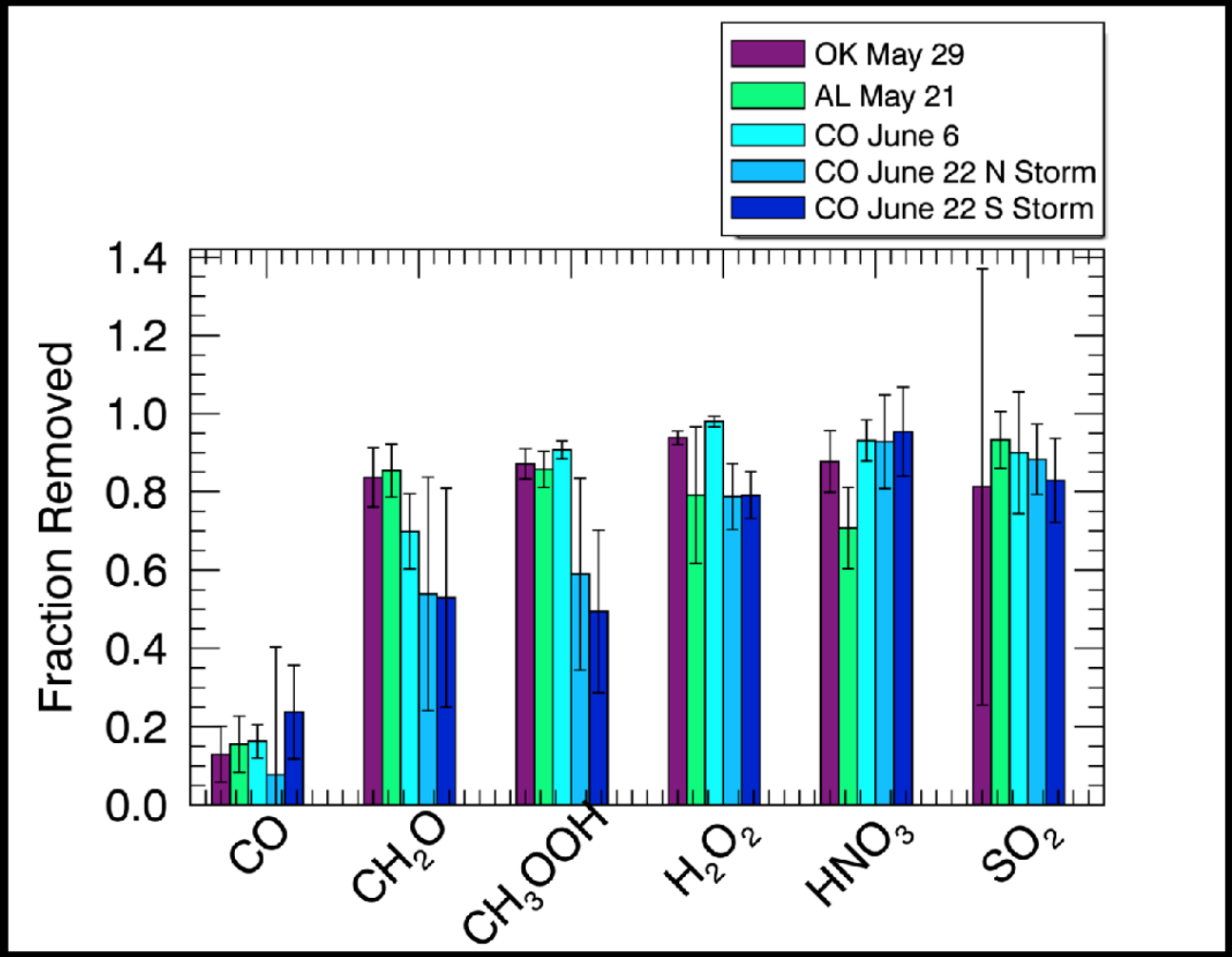
Fractions Removed Vary Among Different Storm Types



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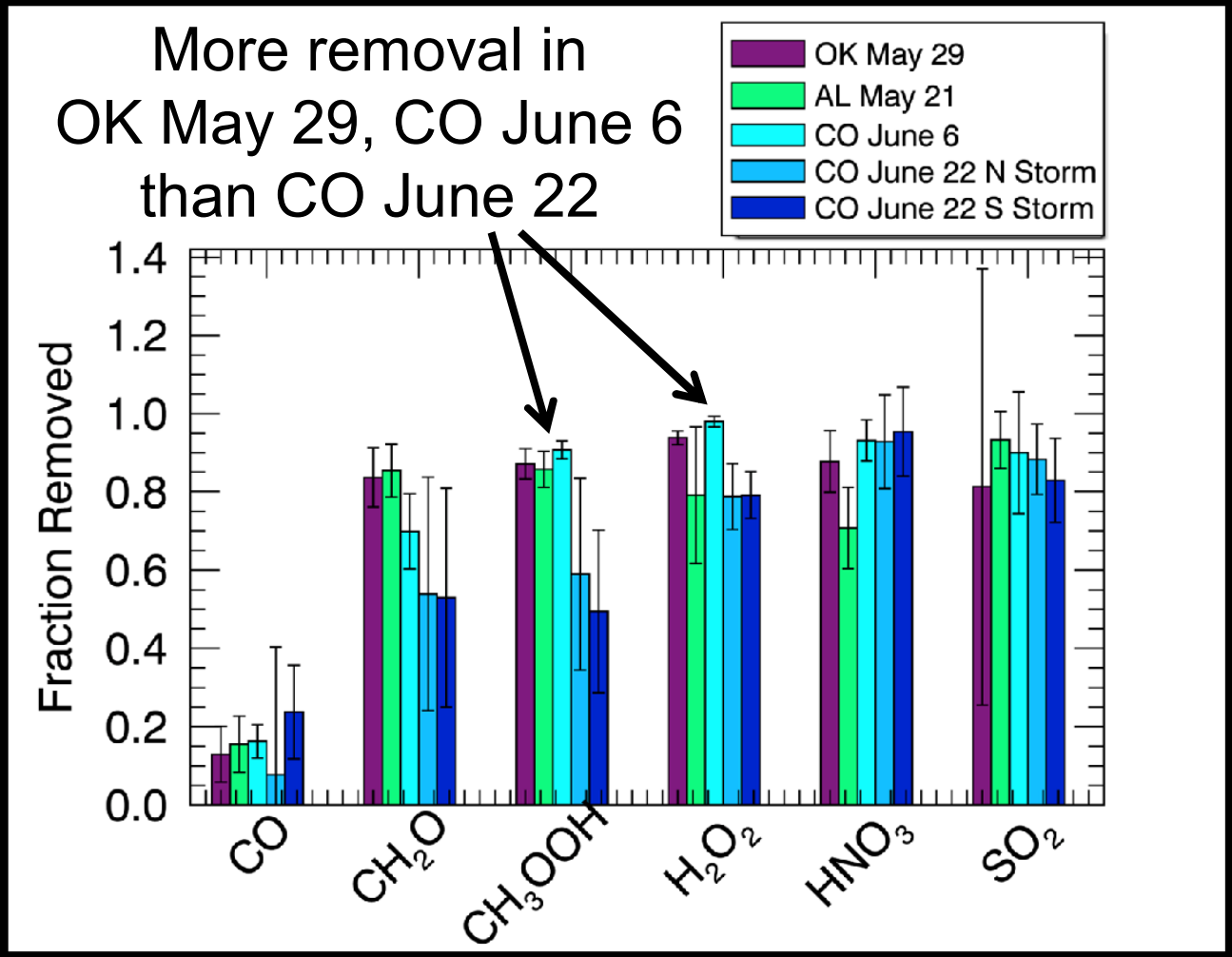

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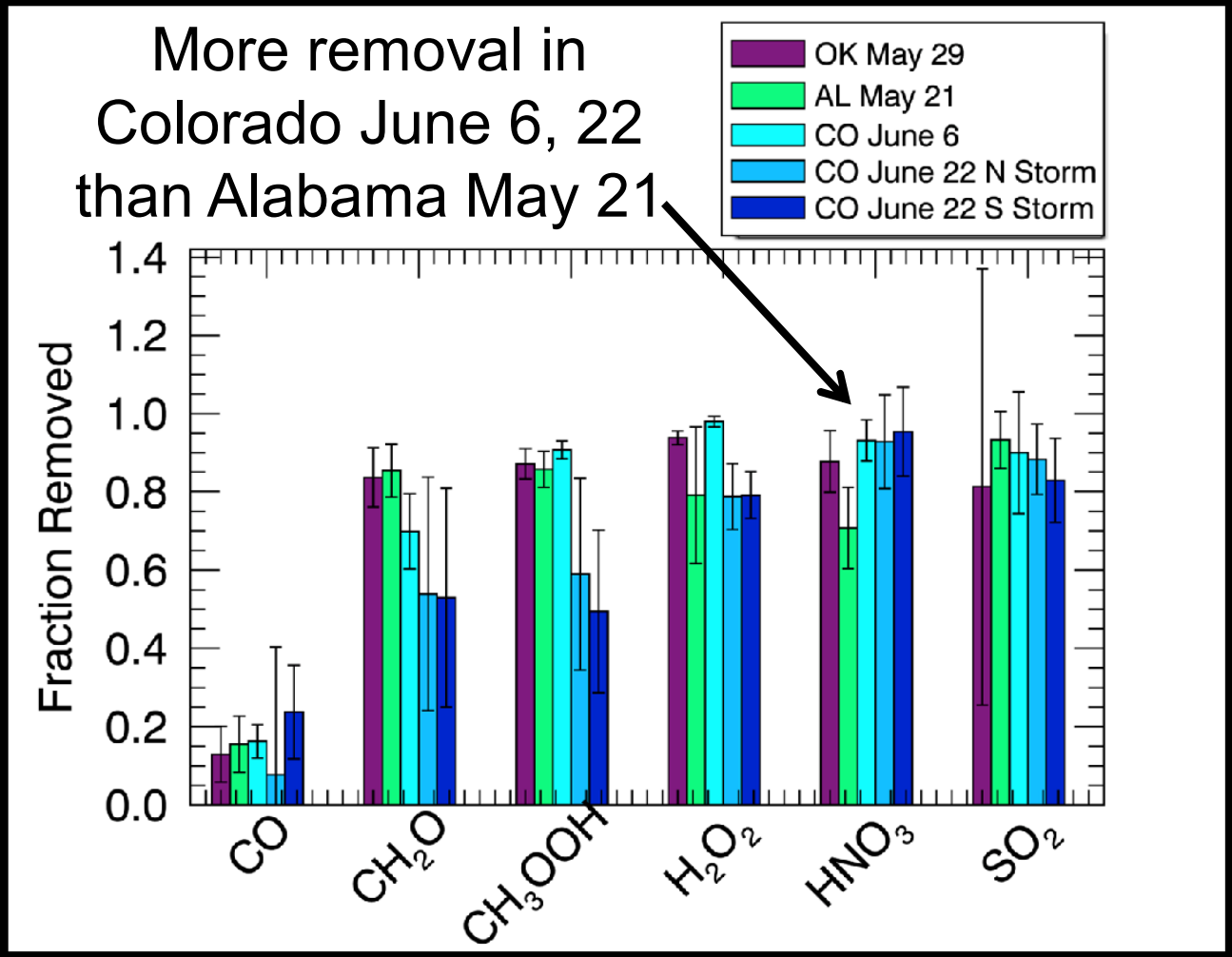

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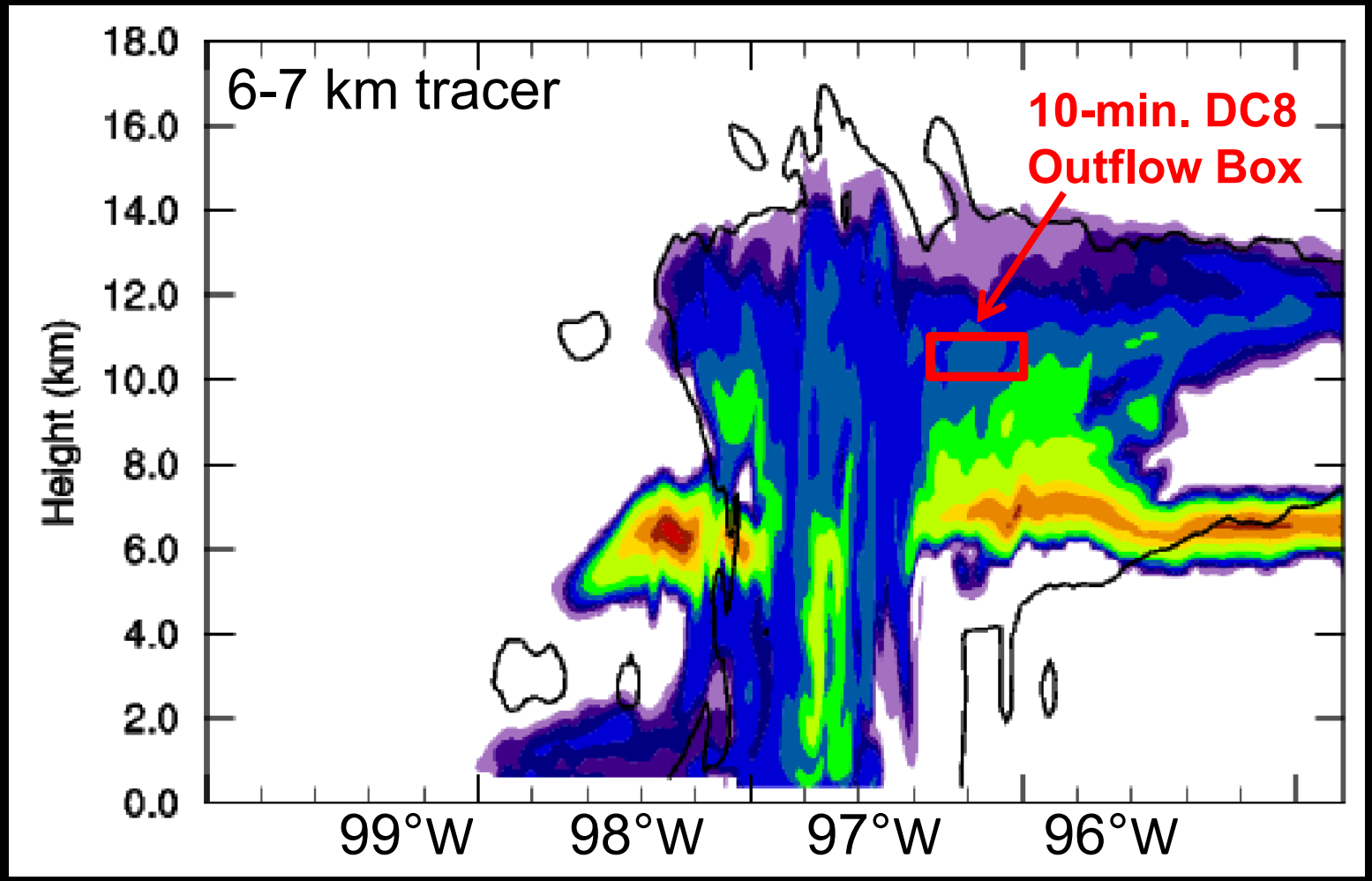
Anvil Sampling Region Is Also Affected by Entrainment of Free- and Upper-Tropospheric Air



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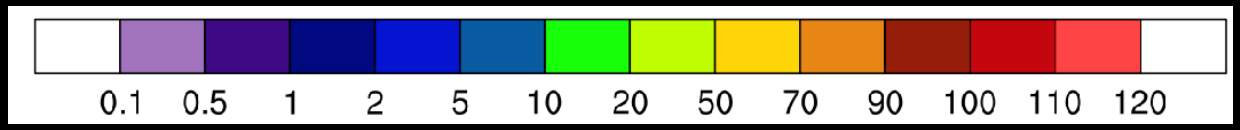
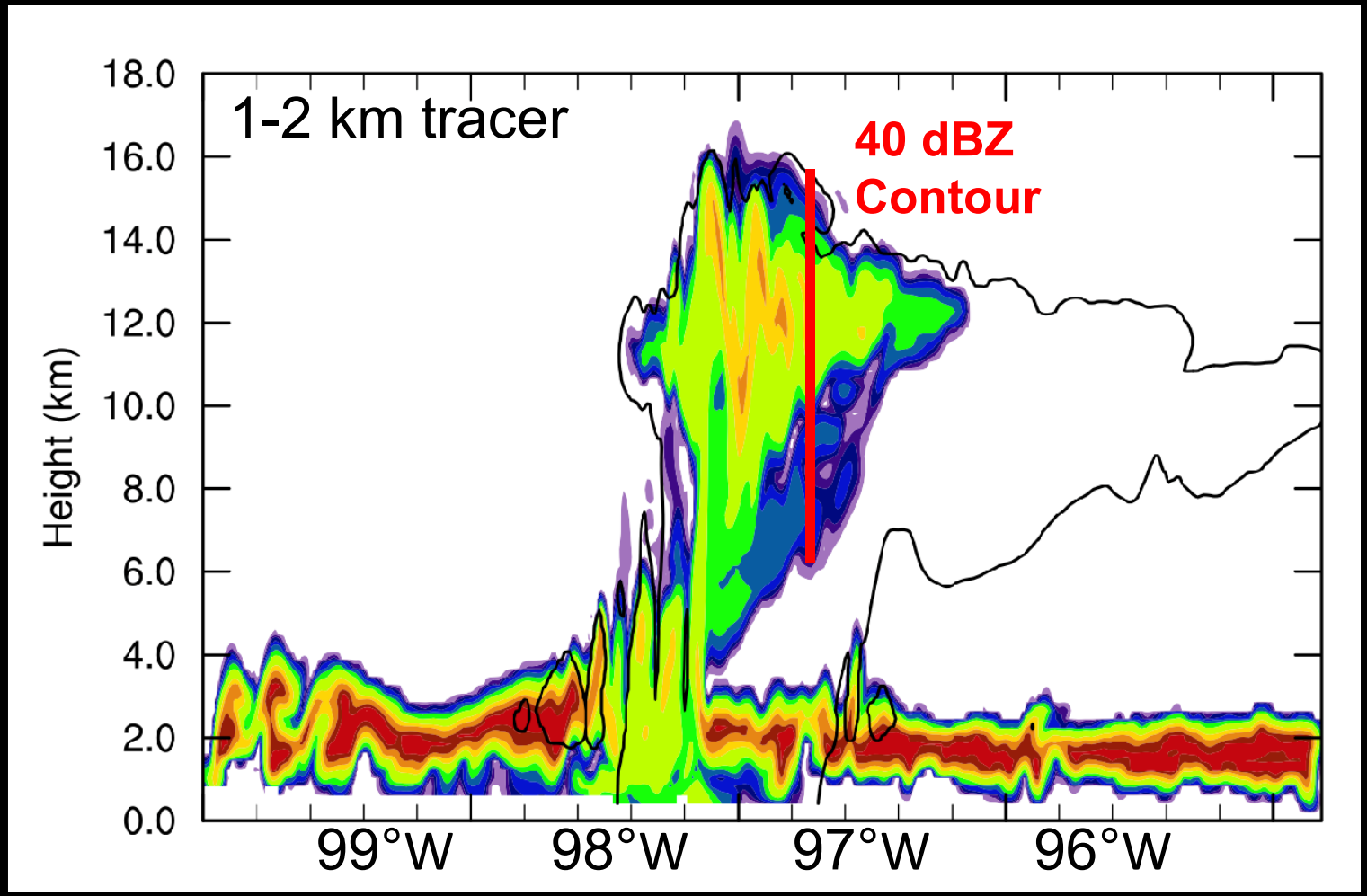


%

However, Up to 80% of Air in Core Originates from 1-2 km a.g.l.



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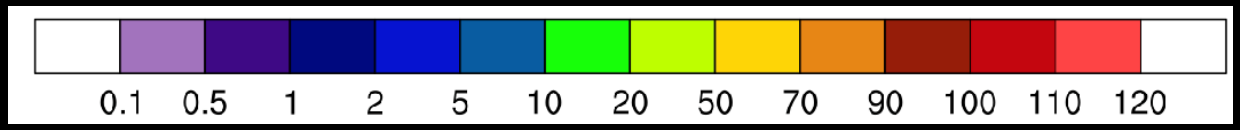
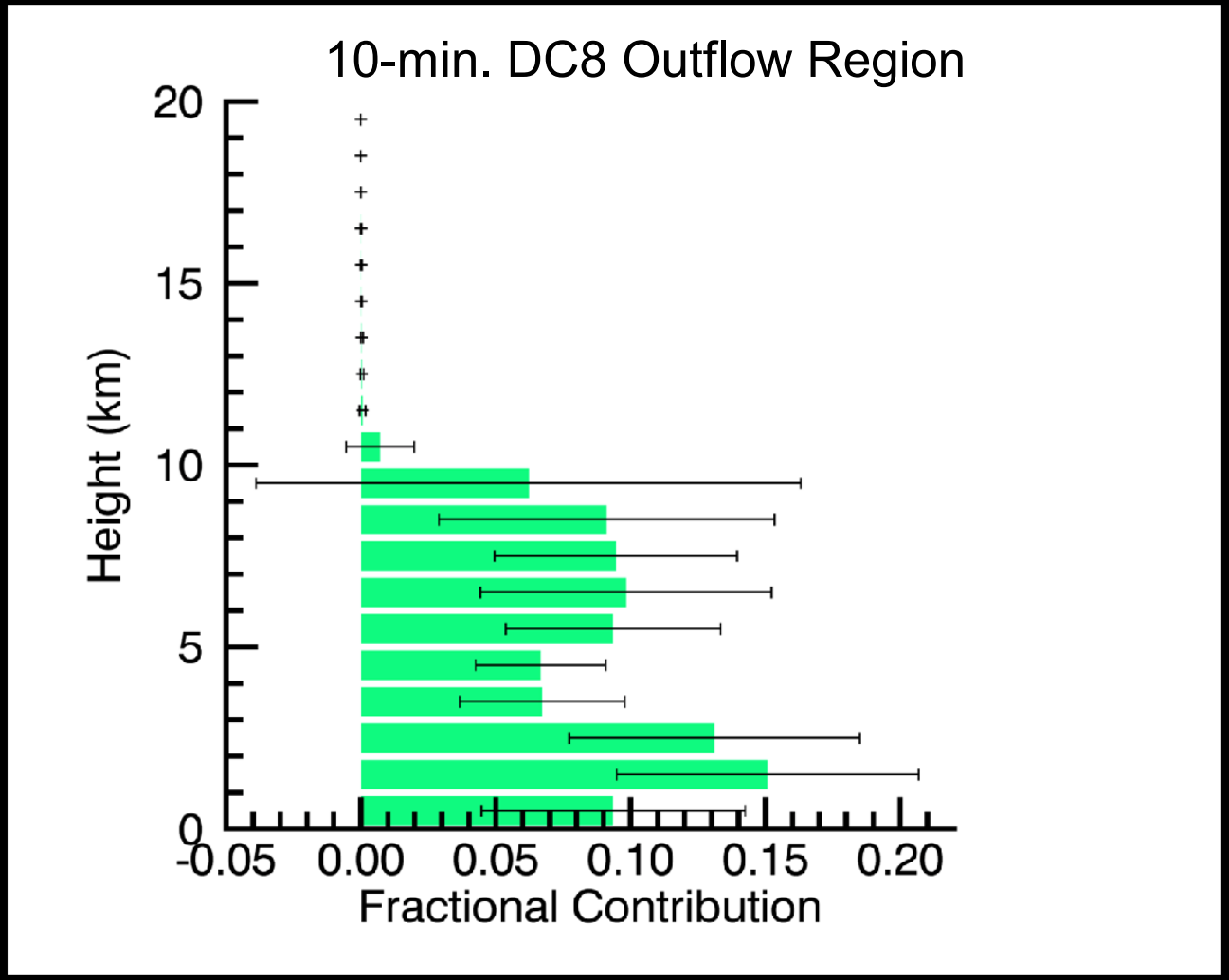


%

Air in Anvil Sampling Region Originates from All Levels



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Conclusions

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