Improved Dust Aerosol Physics for V2

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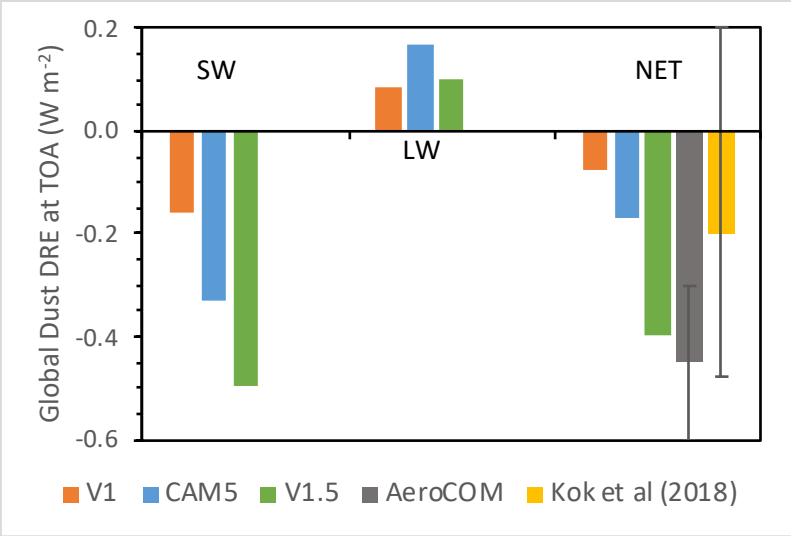
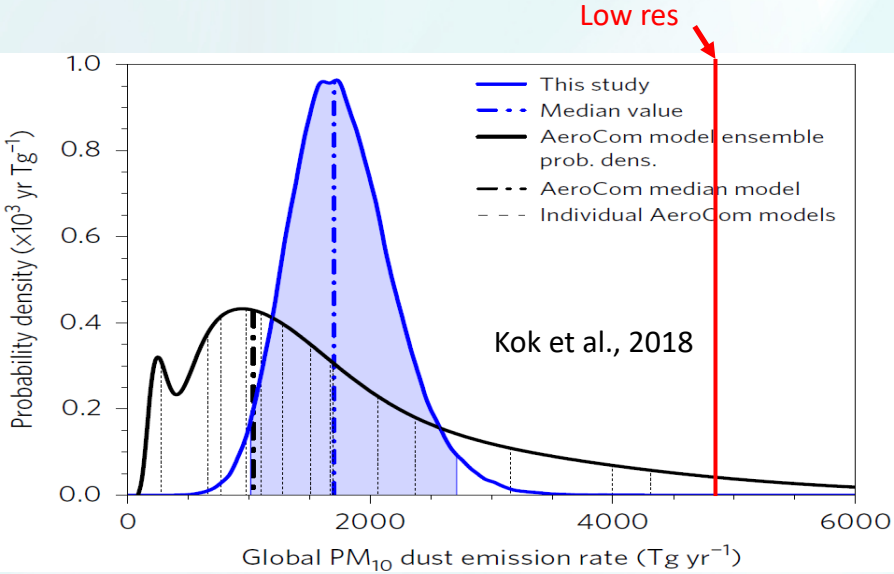
Issues in V1: (1) fine-size bias; (2) too absorbing in SW; (3) deposition is too high
These biases -> direct radiative effect (DRE) by dust is -0.08 Wm^{-2}, warmer than the multi-model median





Feature	What improvement for V2 (status)	Readiness
Size distribution at emission (same as in CAM6)	• More coarse particles (evaluated) -> larger LW warming • Water cycle responses (major changes not expected)	ready
Shortwave refractive index	• Less SW absorption (evaluated) -> larger SW cooling • Net TOA DRE = -0.4 Wm^{-2} vs -0.08 Wm^{-2} with V1	ready

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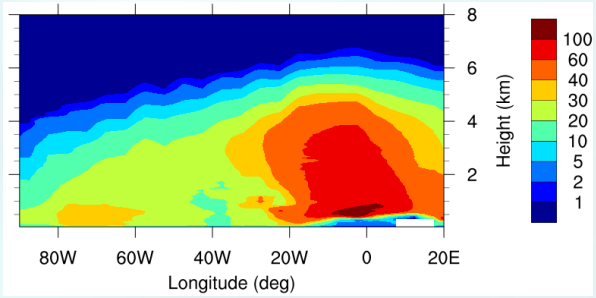
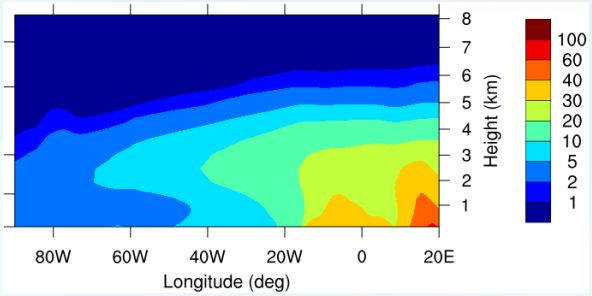
Dust plume height is underestimated -> underestimation of dust longwave warming

JJA: Dust Extinction averaged over North Africa and Atlantic (0-35°N)

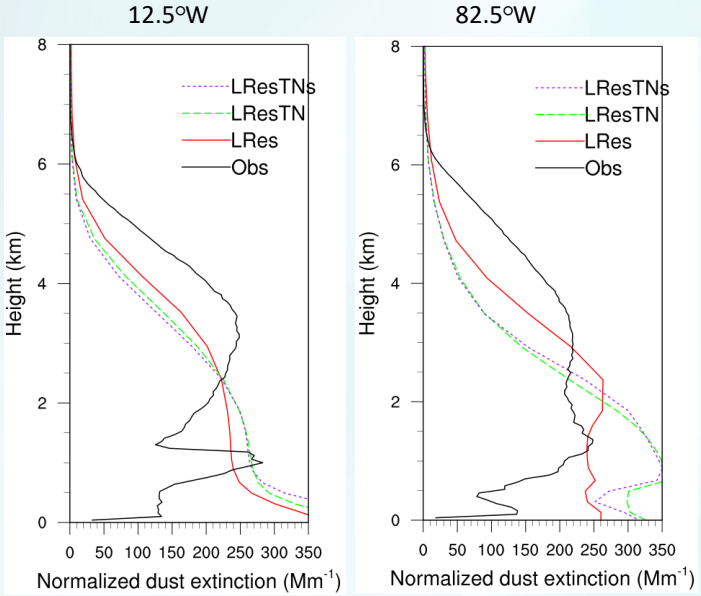
CALIOP Satellite obs



V1



Normalized vertical profiles



Feature	What improvement for V2 (status)	Readiness
Emission height	• Address the over-deposition bias (testing) • Higher dust layer • Larger LW warming from 0.1 Wm^{-2} ->Water cycle responses	1-3 months

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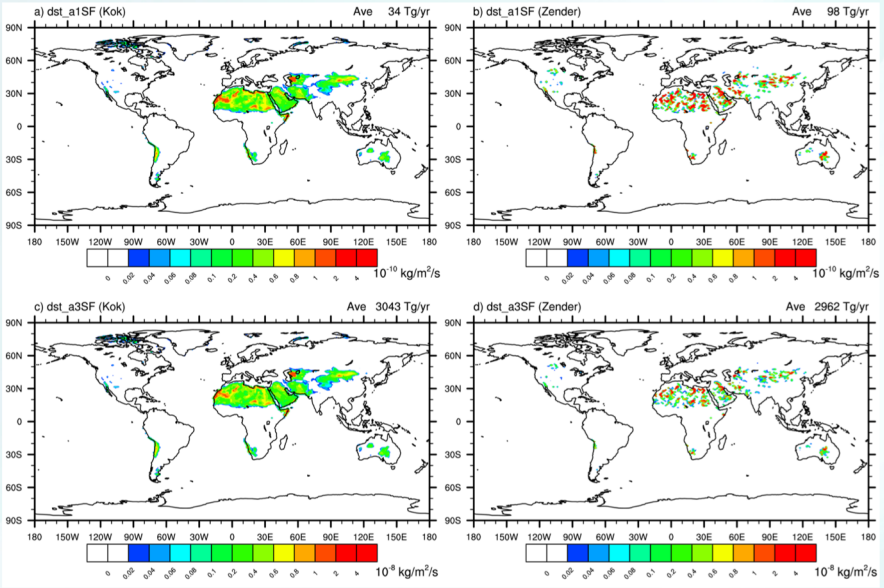
Dust emission flux $\phi_d = C_{tune} S F_d$

	V1	New
Soil erodibility	S Empirical map (lat, lon)	Calculated in F_d
Flux per eroding area per time	F_d Depends on soil threshold velocity	F_d Strongly depends on soil threshold velocity (soil moisture; aggregation)
Climate regime	Current	Sensitive to predicted soil state
High-lat dust	little	Comparable to recent obs

New V1



Feature	What improvement for V2 (status)	Readiness
New emission scheme (Kok et al., 2014)	• Time-varying soil erodibility (testing)-> dust aerosol climate sensitivity • High-latitude dust -> Arctic IN source • Enhanced climate-dust feedback in coupled runs (unknown)	3-6 months