



Attribution of Surface Radiation Biases in NWP and Climate Models near the US Southern Great Plains

Kwinten Van Weverberg, Cyril Morcrette, Hsi-Yen Ma, J. Petch, S.A. Klein, C. Zhang, S. Xie, Q. Tang, W.I. Gustafson Jr., Y. Qian, L.K. Berg, Y. Liu, M. Huang, M. Ahlgrim, R. Forbes, E. Bazile, R. Roehrig, J. Cole, W. Merryfield, W.-S. Lee, F. Cheruy, L. Mellul, Y.-C. Wang, K. Johnson, M. Khaiyer

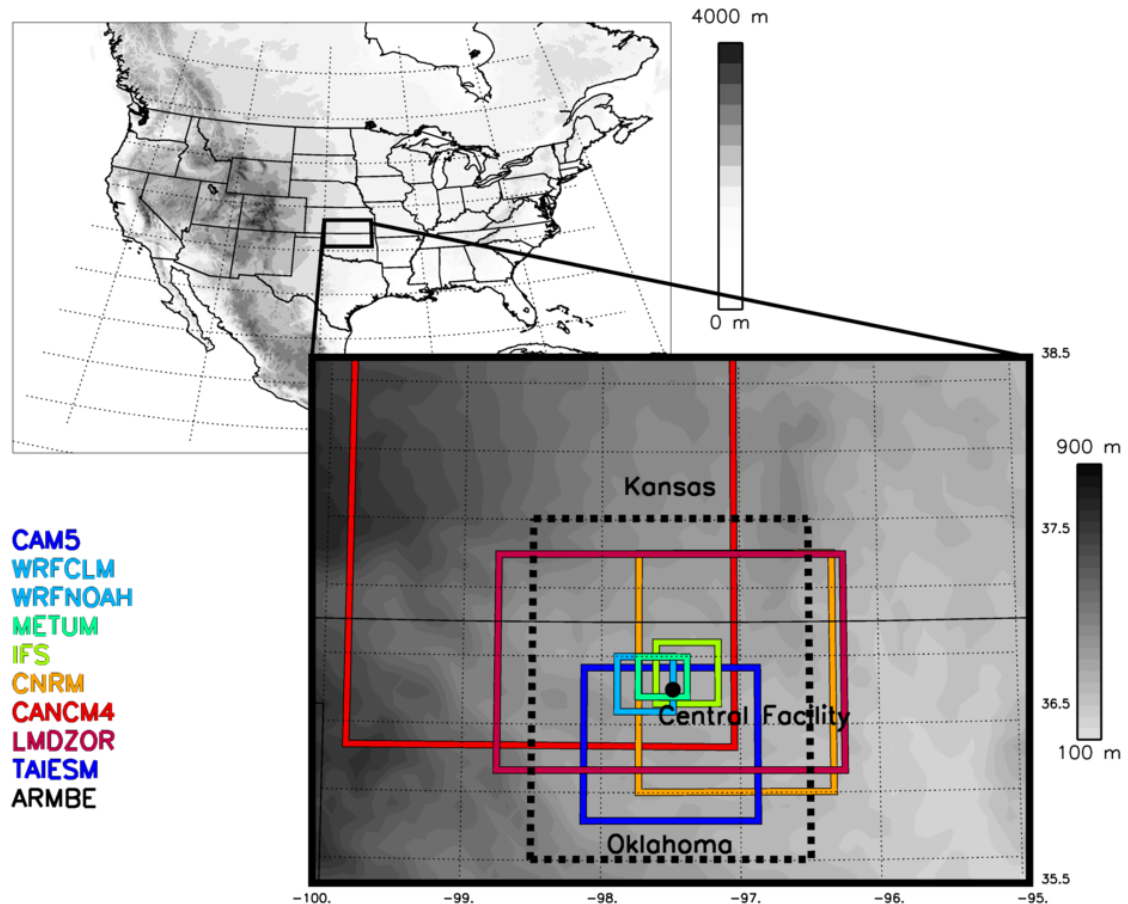


CAUSES Breakout
2018 ARM/ASR PI Meeting
21 March 2018, Tysons, VA



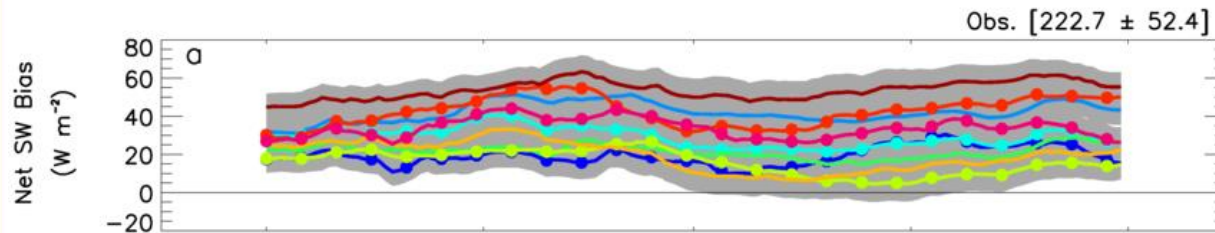
CAUSES: Radiation Attribution

Clouds Above the US and Errors at the Surface



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Clouds Above the US and Errors at the Surface



Net SW

IWV

Cloud

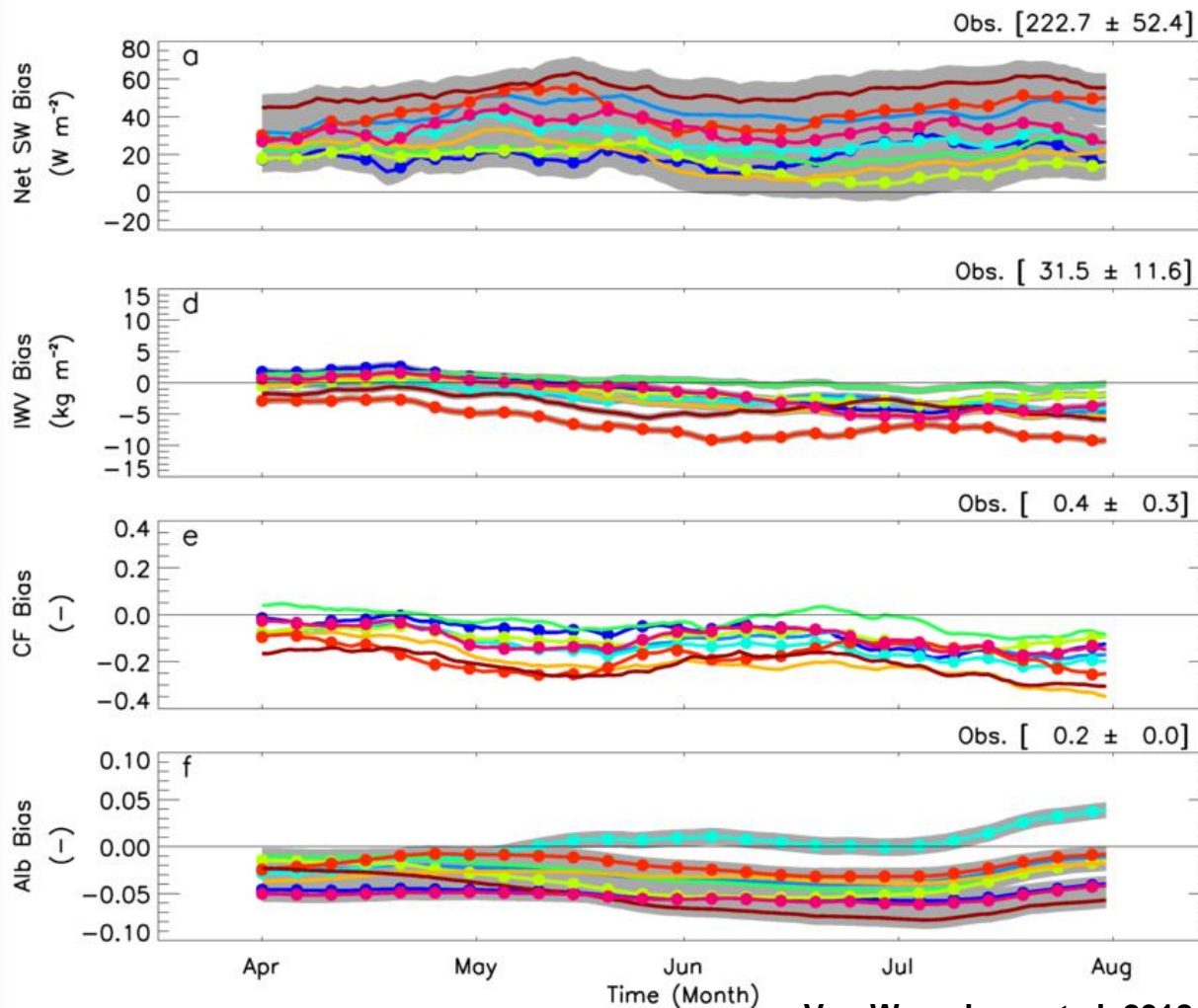
Albedo

WRFCLM
METUM
CNRM
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CAM5
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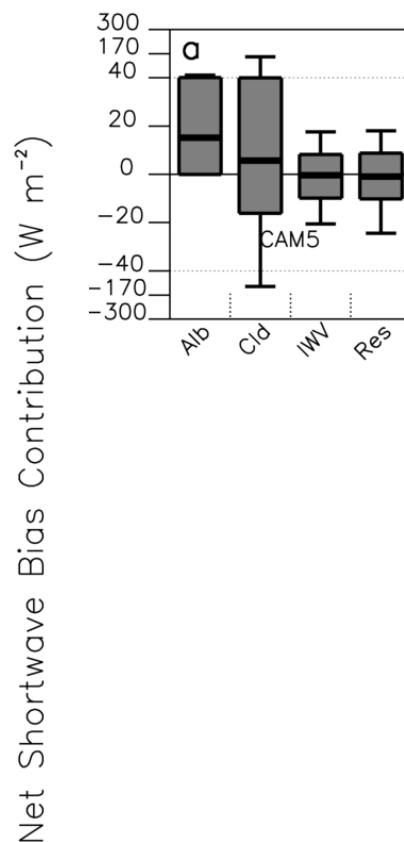
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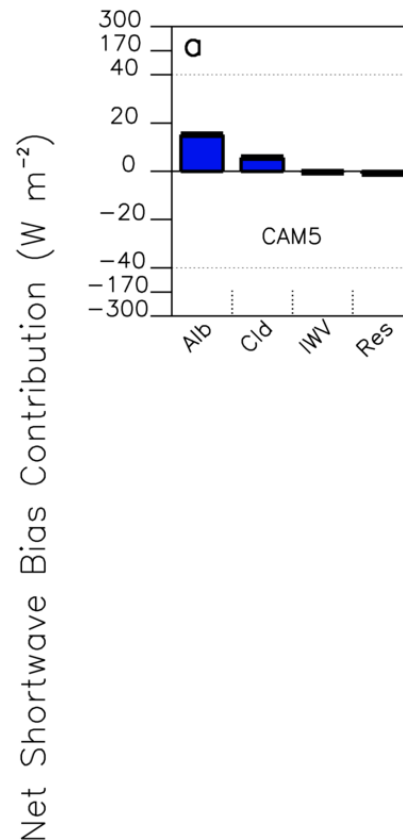
CAUSES: Radiation Attribution

Attribution of Shortwave bias to surf albedo, clouds and IWV



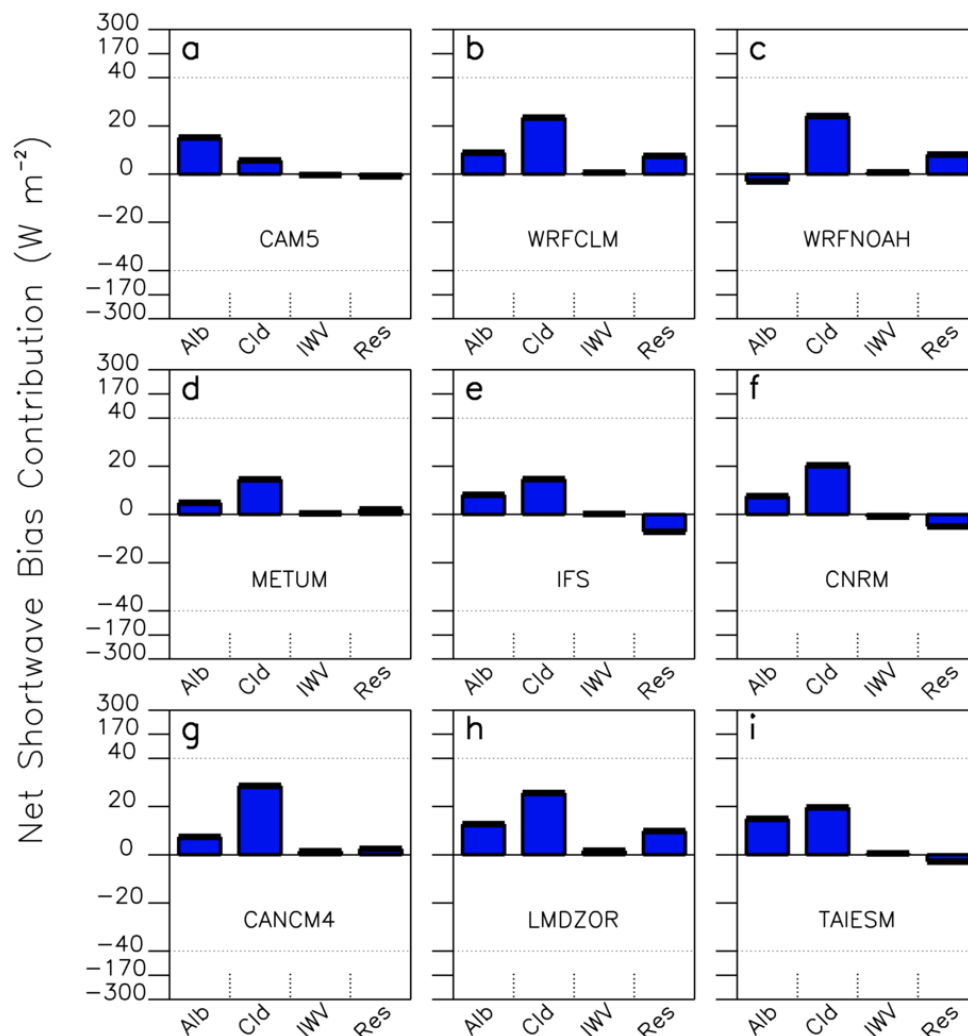
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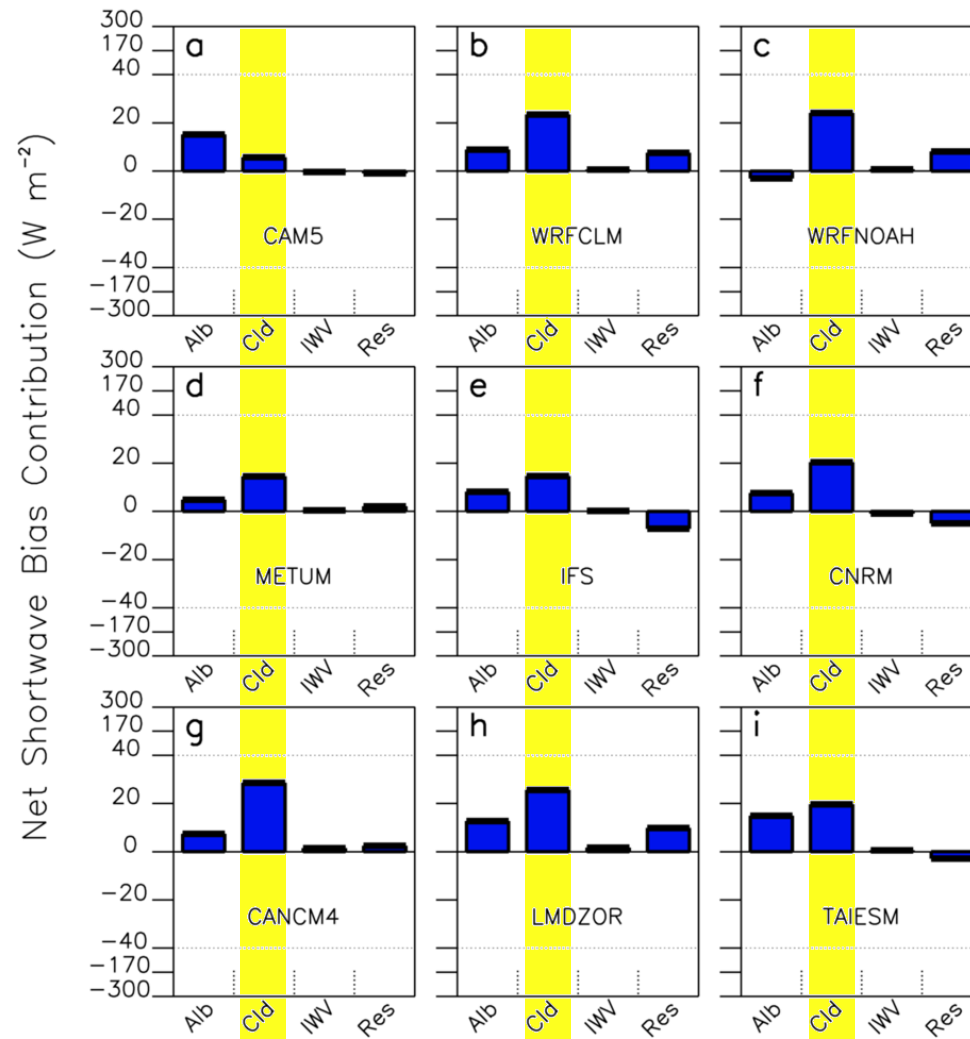
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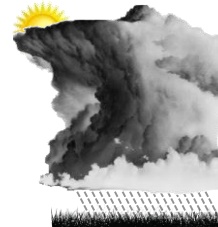
CAUSES: Radiation Attribution

Radiation Attribution: Clouds dominate



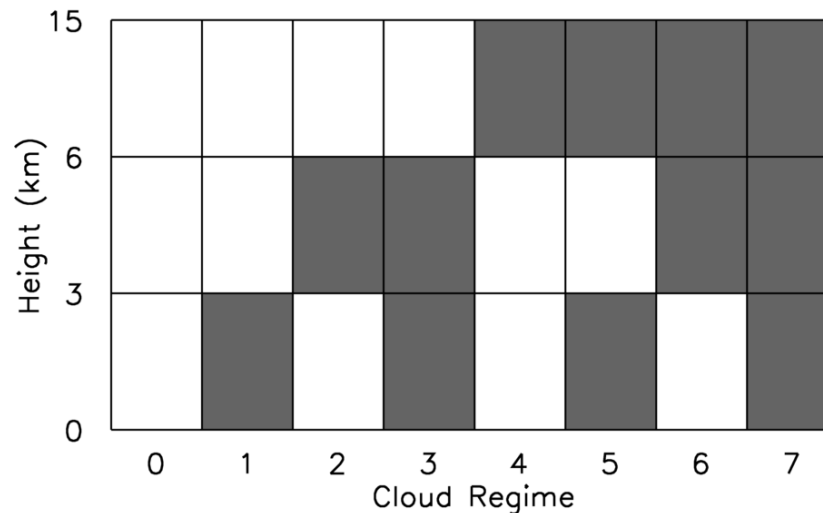
CAUSES: Cloud Regime Definition

Which cloud regimes are responsible for this bias?



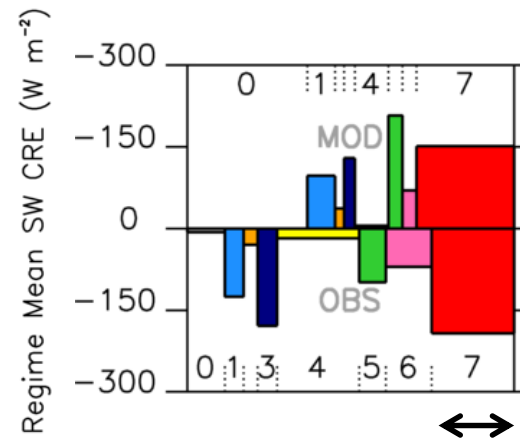
?

Cloud regimes, based on cloud occurrence at three levels of the atmosphere (Obs from ARSCL-Value Added Product)



CAUSES: Cloud Regime Analysis

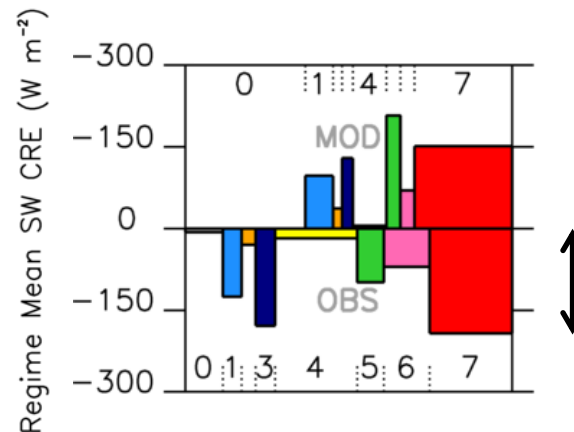
Composite cloud-related radiation bias into cloud regimes



Width of the bars: Frequency of occurrence of regime

CAUSES: Cloud Regime Analysis

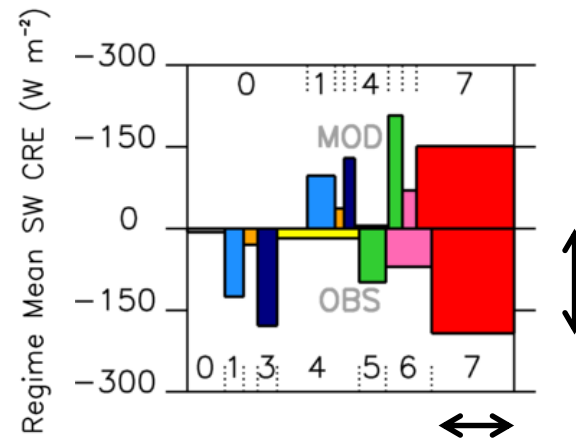
Composite cloud-related radiation bias into cloud regimes



Width of the bars: Frequency of occurrence of regime
Height of the bars: Mean cloud radiative effect

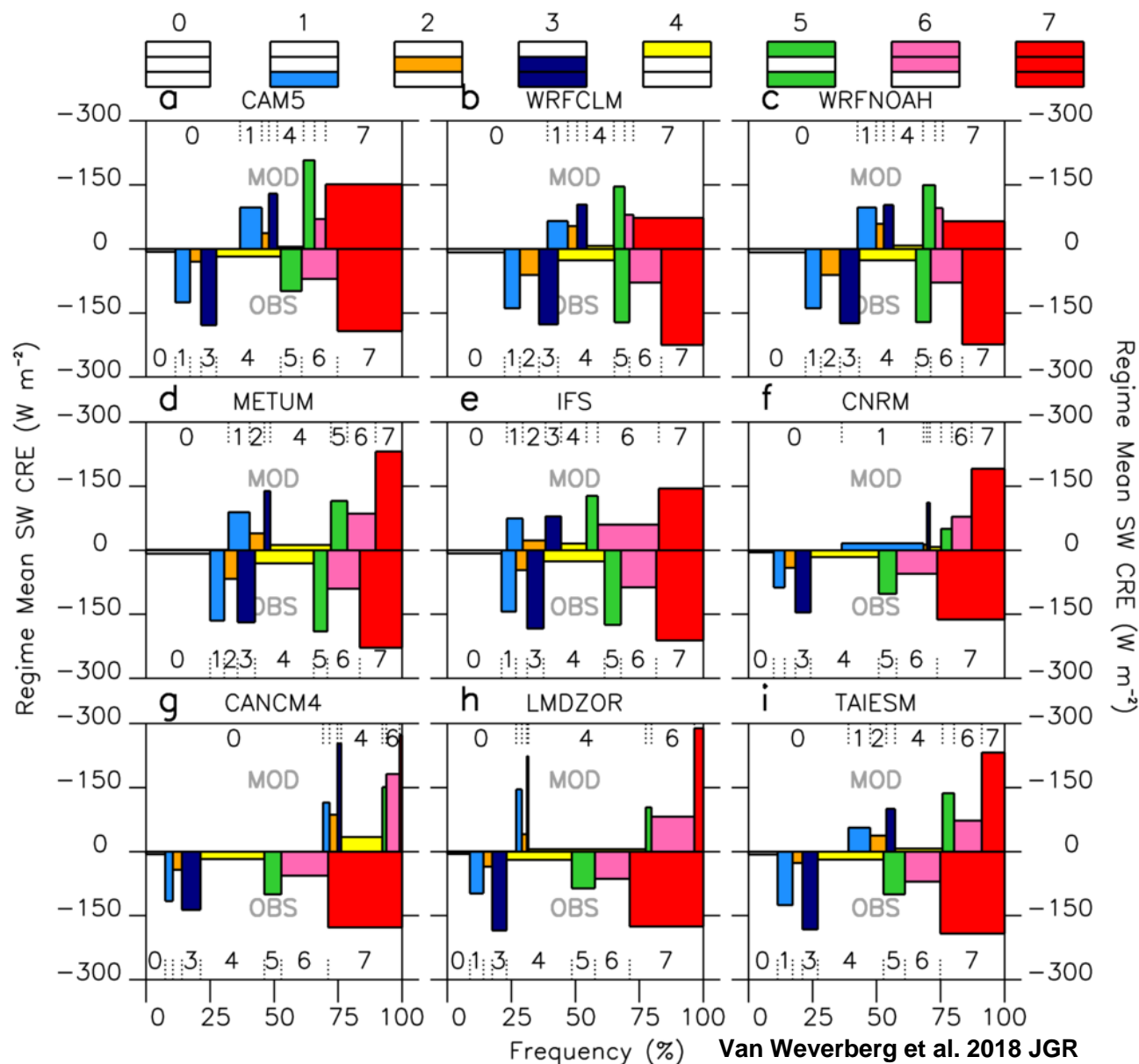
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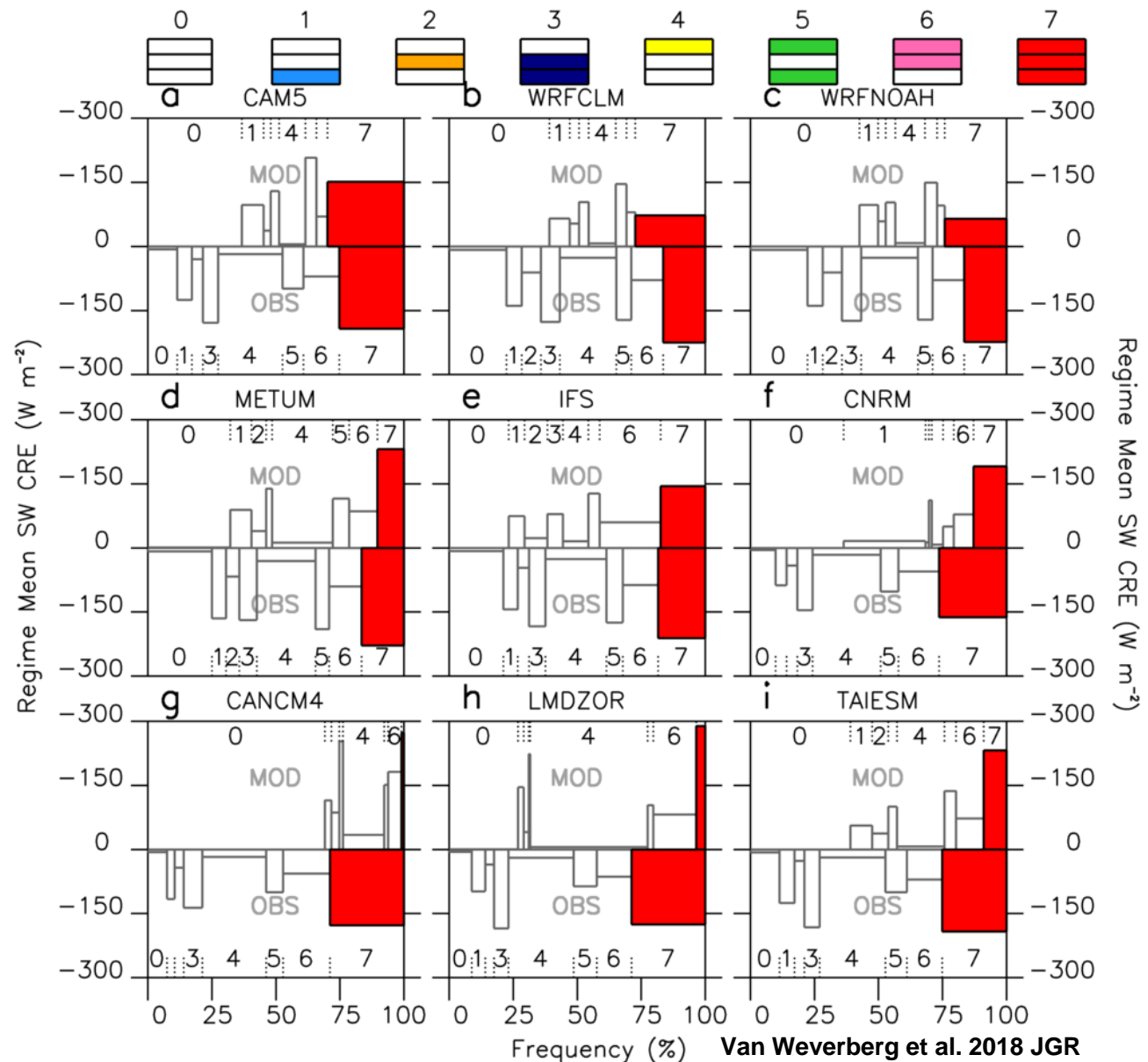


Width of the bars: Frequency of occurrence of regime
 Height of the bars: Mean cloud radiative effect of regime
 Surface area: Total cloud radiative effect of regime

CAUSES: Cloud Regime Analysis



CAUSES: Cloud Regime Analysis



CAUSES: Cloud Regime Analysis

→ Deep cloud regime problematic in most models, due to:

- Too small SW cloud radiative effect or
- Too small frequency

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→ Deep cloud regime problematic in most models, due to:

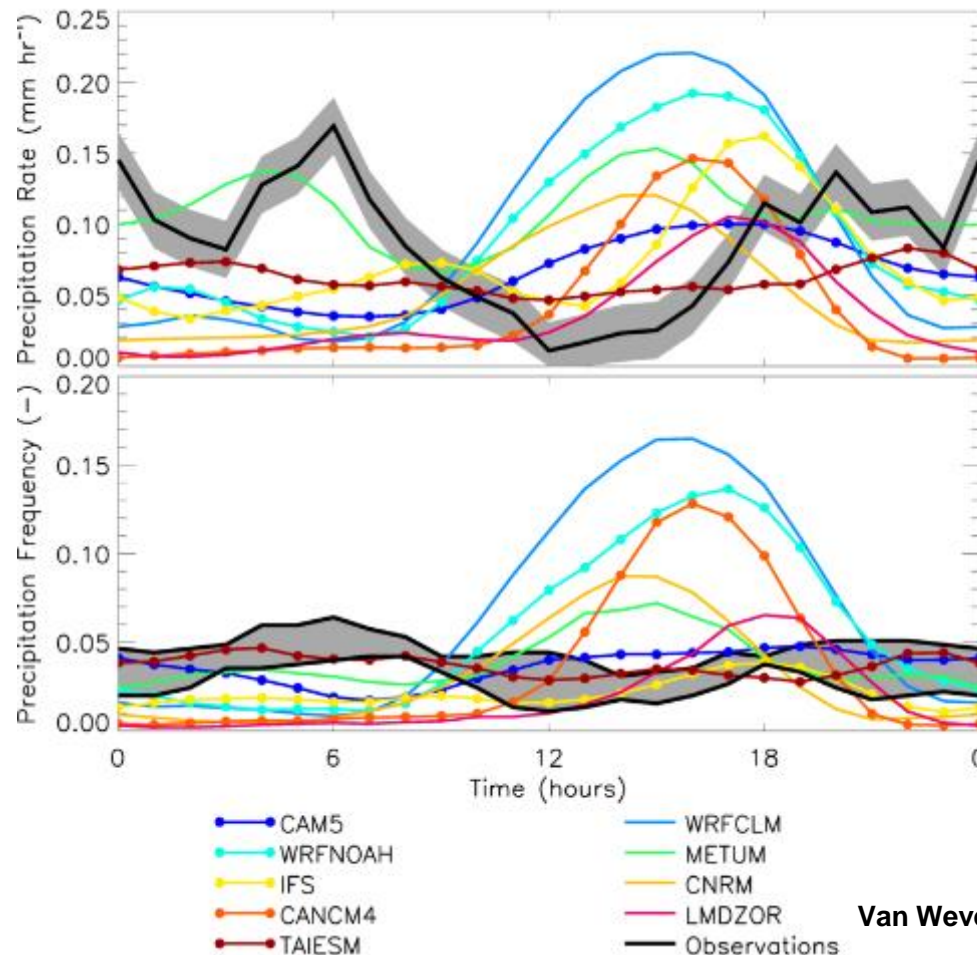
- Too small SW cloud radiative effect or
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→ Suppressed convective activity during daytime?

CAUSES: Surface Rain Analysis

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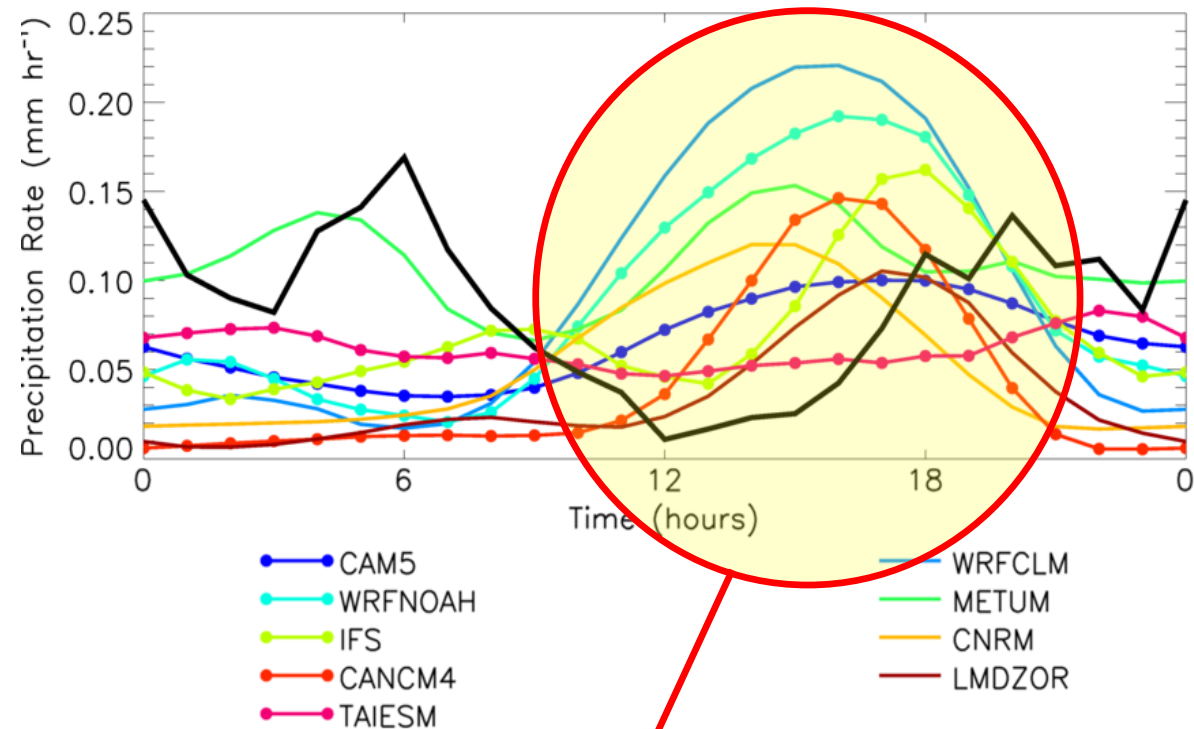
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CAUSES: Surface Rain Analysis

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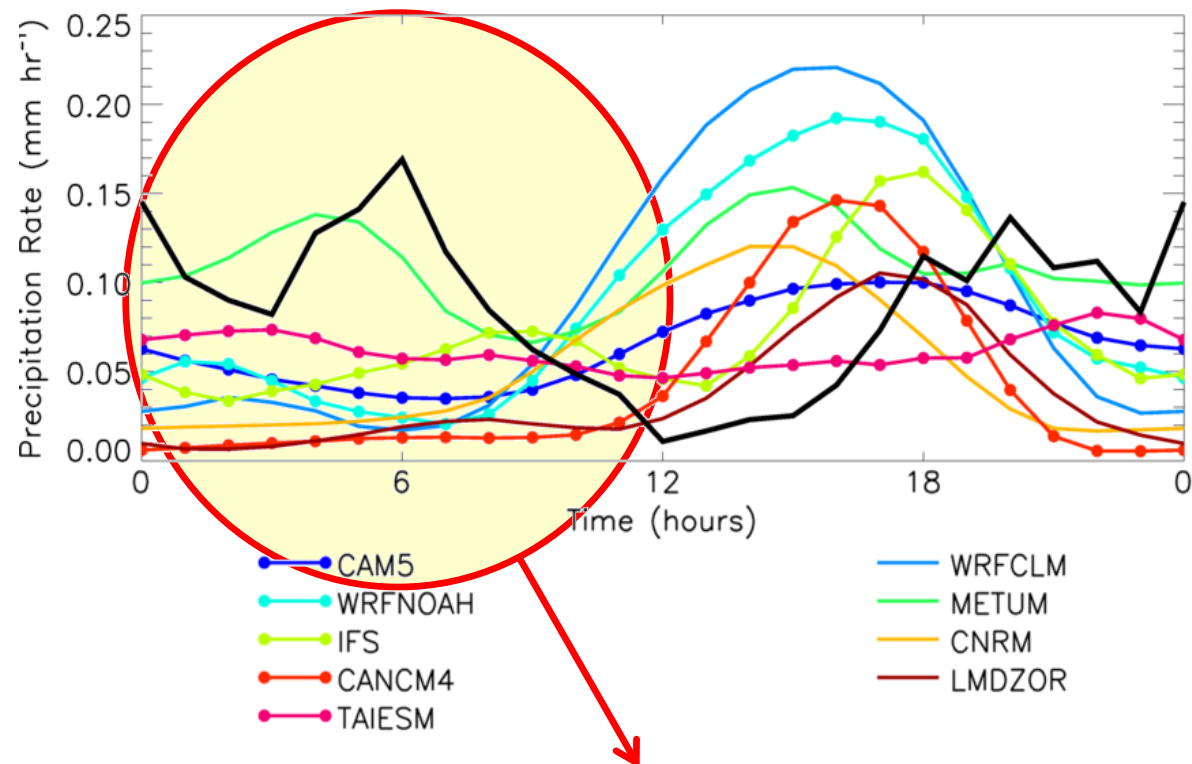


Most models are actually too wet in the afternoon

CAUSES: Surface Rain Analysis

→ Deep cloud regime problematic in most models.

→ Suppressed convective activity during daytime?



... but miss the nocturnal elevated storms

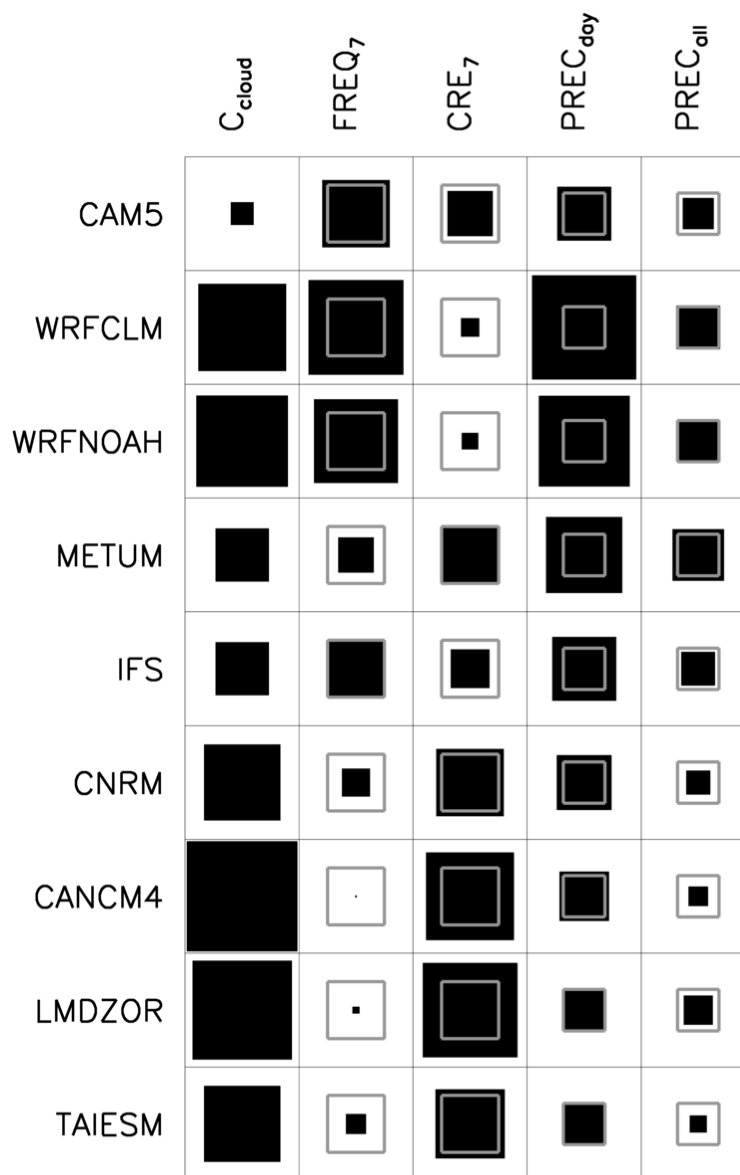
Recommendations to developers

- All models suffer from excess shortwave at the surface
- Mainly because of too infrequent or too transparent deep cloud
- Daytime precipitation rates/frequency actually overestimated, so not an issue of insufficient convective triggering

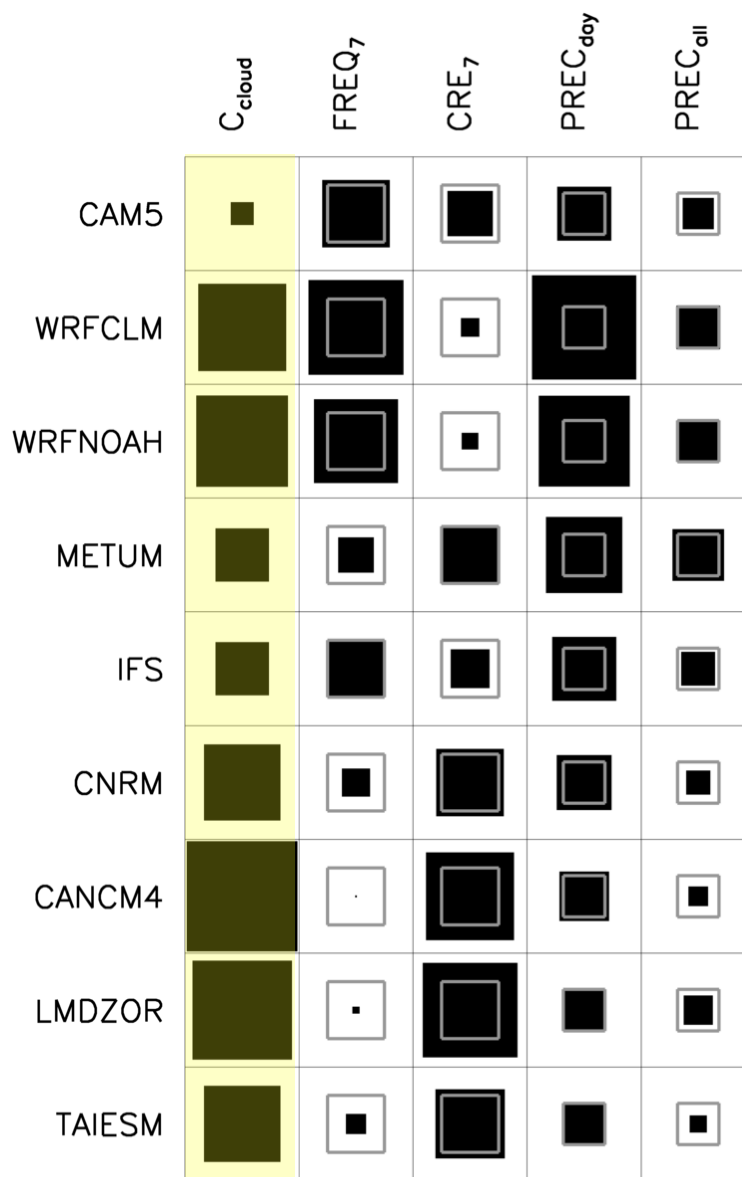
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- Mainly because of too infrequent or too transparent deep cloud
- Daytime precipitation rates/frequency actually overestimated, so not an issue of insufficient convective triggering
- Possibly need to tune down precipitation efficiencies in midlatitudes to retain more cloud aloft and reduce rain rates
- Needs to be concerted with better captured elevated nocturnal convection, otherwise too dry overall, leading to too small evaporative fraction and maintaining or enhancing the warm bias

CAUSES: Summary
















































CAUSES: Summary

































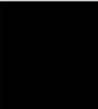














- All models suffer from cloud-related radiation bias
- Main contribution from deep clouds (regime 7)

CAUSES: Summary

	C_{cloud}	FREQ_7	CRE_7	PREC_{day}	PREC_{all}
CAM5					
WRFCLM					
WRFNOAH					
METUM					
IFS					
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







































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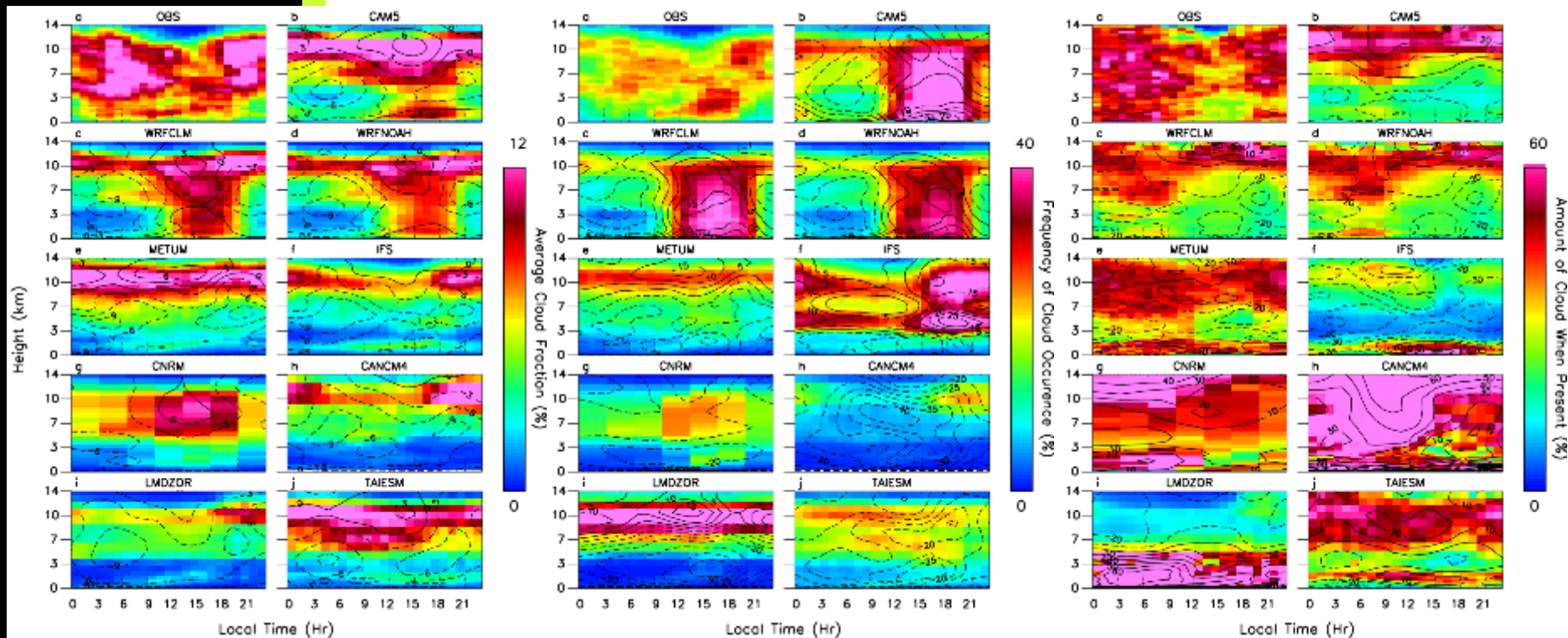
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- Models too wet during daytime
- ... but since nocturnal elevated storms are missing, too dry overall

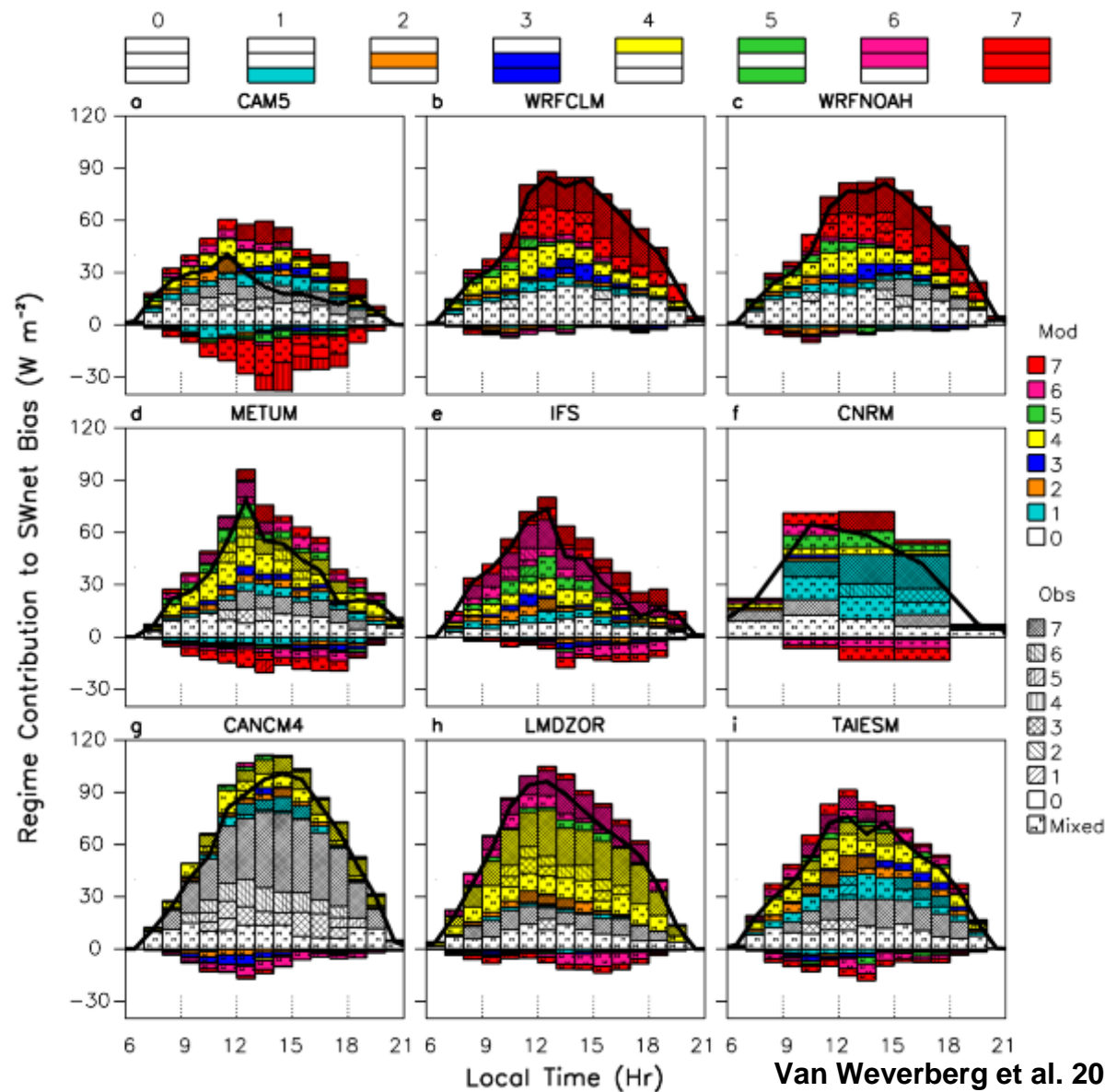
Questions?



CAUSES: Summary



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CAUSES: Summary

