Comparing GFDL GCM Model Output with ARM CMBE Dataset: *Diurnal Cycle*

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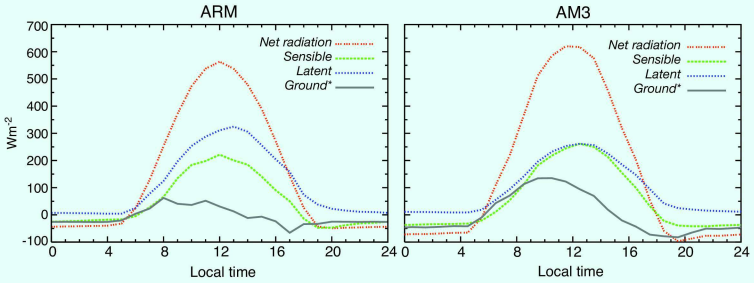
Introduction

- *ARM CMBE (Climate Modeling Best Estimate) is a dataset designed to facilitate the evaluation of climate models with ARM observations.*
- *We evaluate the climatology of a recent prototype version of GFDL AM3 (c48_am3p5-gamma-B6).*
- *AM3 was modified to enable direct output of composite diurnal cycles.*
- *Focus on summer time (June-July-August) diurnal cycle at the SGP site.*

Surface Fluxes



- *Net shortwave radiation is too large in AM3, mainly due to incoming shortwave but also albedo.*
- *Daytime ground flux (computed here as a residual) is much larger in AM3 than observations.*
- *AM3 appears too dry: sensible flux is too large and latent heat flux too small.*

Surface Energy Budget (Wm^{-2}, positive down)

	ARM	AM3
Shortwave down	273.0	293.3
Shortwave up	-56.5	-47.9
Longwave down	397.5	410
Longwave up	-458.6	-496.5
Albedo	0.21	0.16

	ARM	AM3
Net Shortwave	216.5	245.4
Net longwave	-61.1	-86.5
Net radiation	155.4	158.9
Sensible	-48.4	-59.0
Latent	-113.8	-97.4

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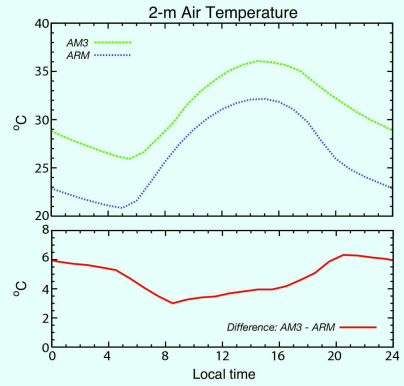
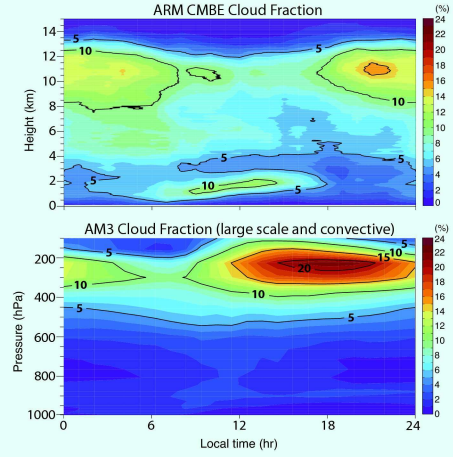
Near Surface Temperature



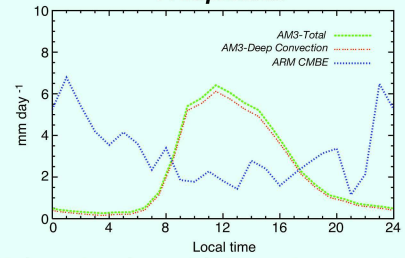
- *AM3 exhibits a large positive temperature bias, as large as 6°C at night.*

Cloud Amount



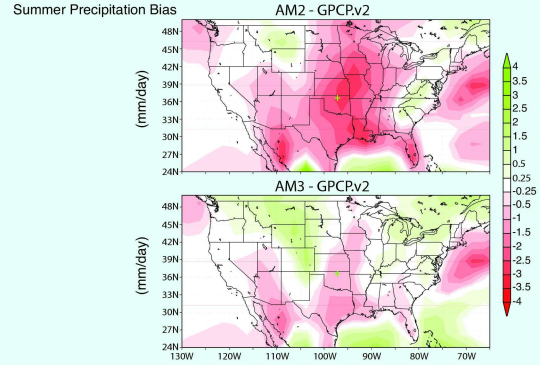
- *ARM observations show mid-day shallow clouds with cloud fraction up to 10%.*
- *Shallow clouds are absent from AM3. Their absence may partly explain the over estimation of shortwave reaching the surface.*

Precipitation



- *ARM observations show a nighttime maximum precipitation.*
- *AM3 is almost perfectly out of phase.*
- *Virtually all summer precipitation in AM3 is from deep convection.*
- *Deep convection is strongly influenced by daytime surface heating through its CAPE relaxation closure.*

Comparison with AM2 *[Klein et al. (2006), GRL, L18805]*



- *Dry bias in summertime precipitation is reduced in AM3 compared to AM2.*
- *Despite precipitation improvement, AM3 - like AM2 - suffers from a dry bias in surface fluxes.*
- *Diurnal cycle of precipitation is not realistic in both AM2 and AM3.*

Conclusions

- *Large positive 2-m temperature bias in AM3. Probable causes:*
  - *incoming shortwave is too large due to lack of daytime shallow convection shading,*
  - *albedo is too low,*
  - *soil is too dry.*
- *Diurnal cycle of precipitation is out of phase in AM3:*
  - *CAPE relaxation closure links daytime surface heating to convective activity too strongly.*