Recent Progress Related to CLM at the University of Arizona

Land-Atmosphere-Ocean Interaction (LAOI) Group
Mark Decker
Xubin Zeng
Zhou Wang
Koichi Sakaguchi
Brad Christofferson

Summary of CLM progress at UA presented in 2008 CLM and CCSM meetings (preliminarily implemented in CLM4.0)

a) revised form of Richards equation (Zeng and Decker 2009, J. Hydromet, published)

b) minor inconsistency in computing soil ice fractions (Decker and Zeng 2009, JAMES, accepted with minor revision)

c) improved treatment of ground evaporation (Sakaguchi and Zeng 2009, JGR, published)

d) vertical snow burial fraction (A.H. Wang and Zeng 2009, Adv. Atmos. Sci., in press)

e) convergence of roughness length with LAI (Zeng and A.H. Wang 2007, J. Hydromet.)

New progress for 2009

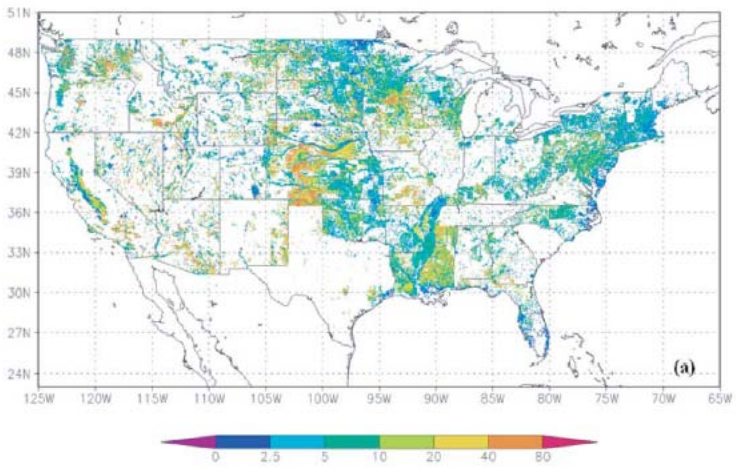
a) Evaluation of CLM3.5, CLM3.5+DZ, and CLM4.0 using new data (Decker and Zeng 2009, JAMES, accepted with minor revision)
   -------CLM4.0 not in this paper
   -------Thanks to Dave Lawrence and Keith Oleson for CLM4.0 output

b) comparison of numerical solutions of Richards equation (Decker and Zeng 2009, in preparation)

c) intercomparison of snow fraction and albedo in four land models (Z. Wang and Zeng 2009, J. Appl. Meteor. Clim., accepted with minor revision)

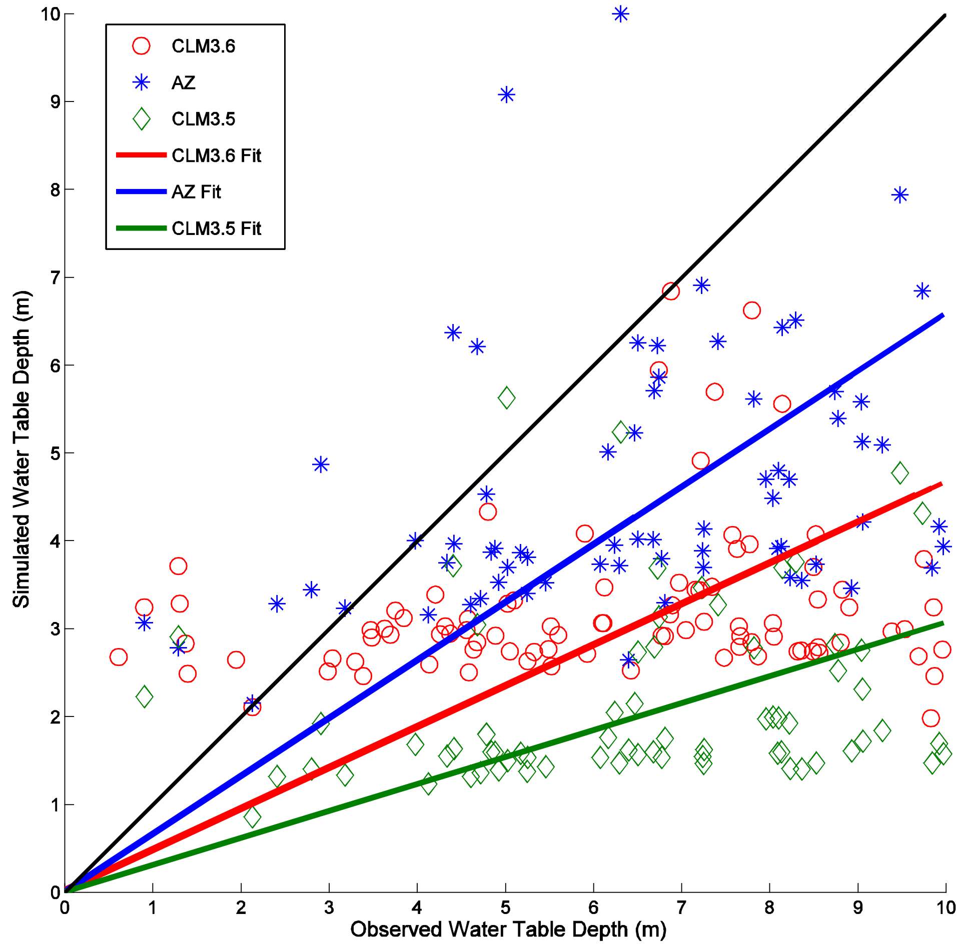
d) Amazon-MIP (Christoffersen et al. 2009, in preparation)

Comparison of Z_{wtd} Obs



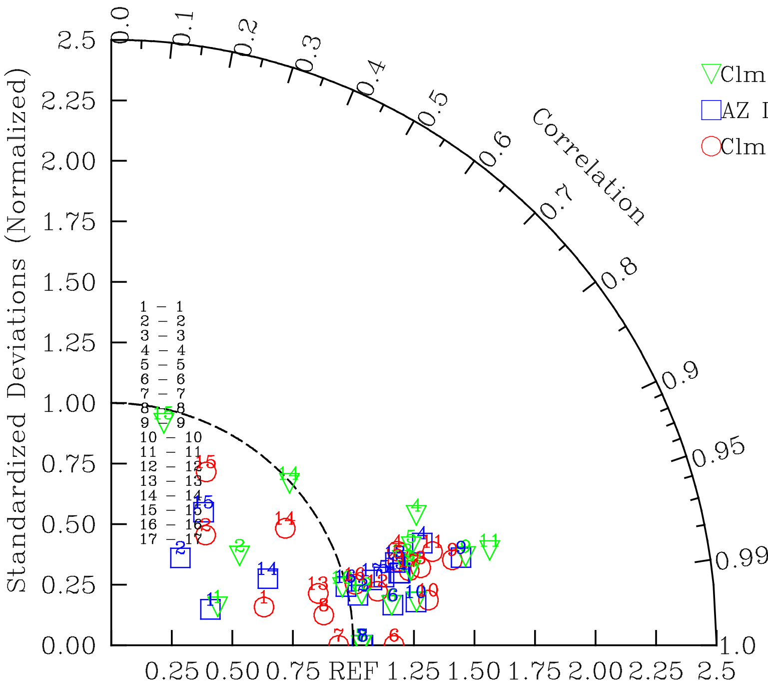
Miguez-Macho et al. (2008)

USGS in situ climatological water table observations (~ 550,000)

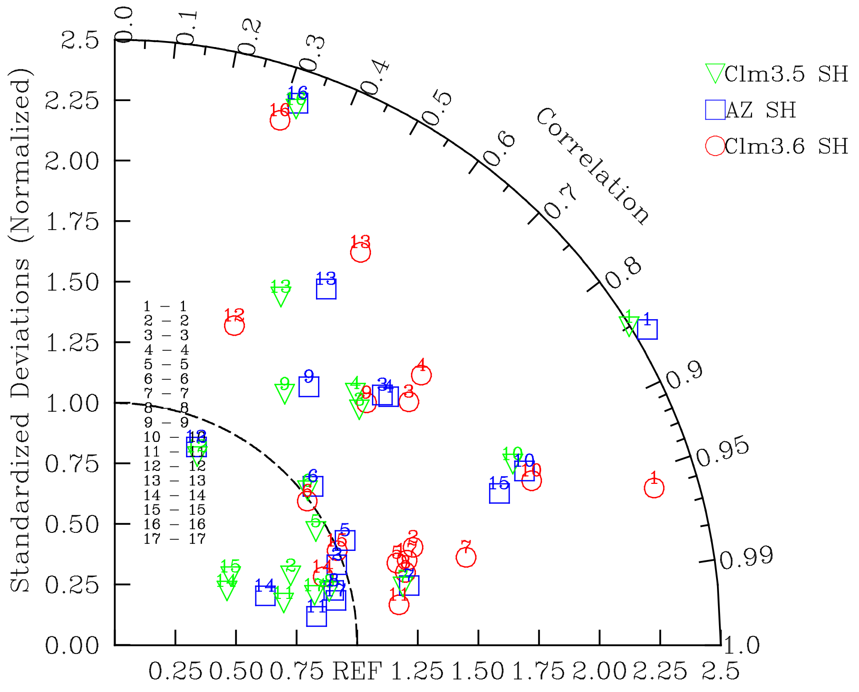


Comparison with Ameriflux Observations

Latent Heat Flux



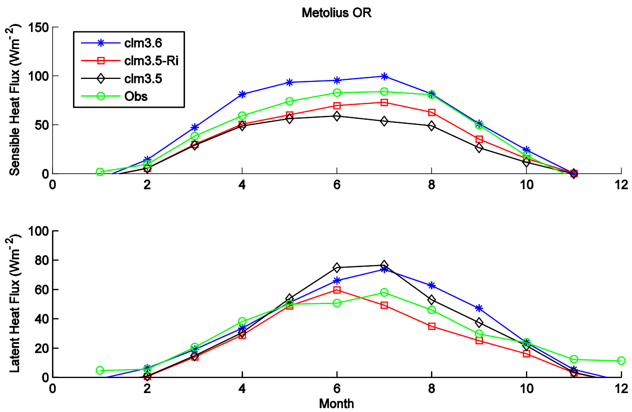
Sensible Heat Flux

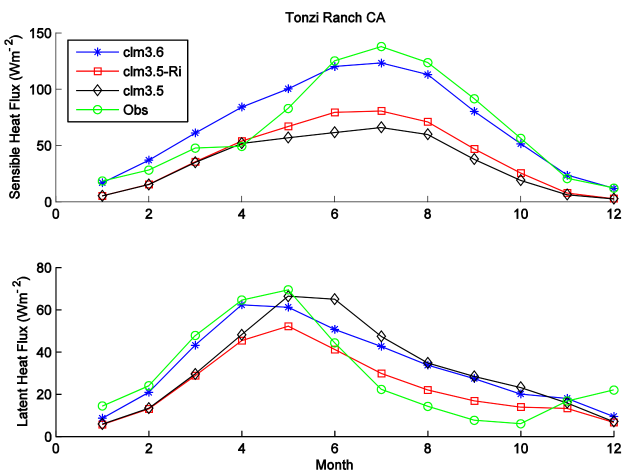


Observations from 17 Tower with > 4 Years of data

Note: Compared Mean Monthly Annual Cycle (grid box vs point obs)

Comparison with Ameriflux Observations (cont.)





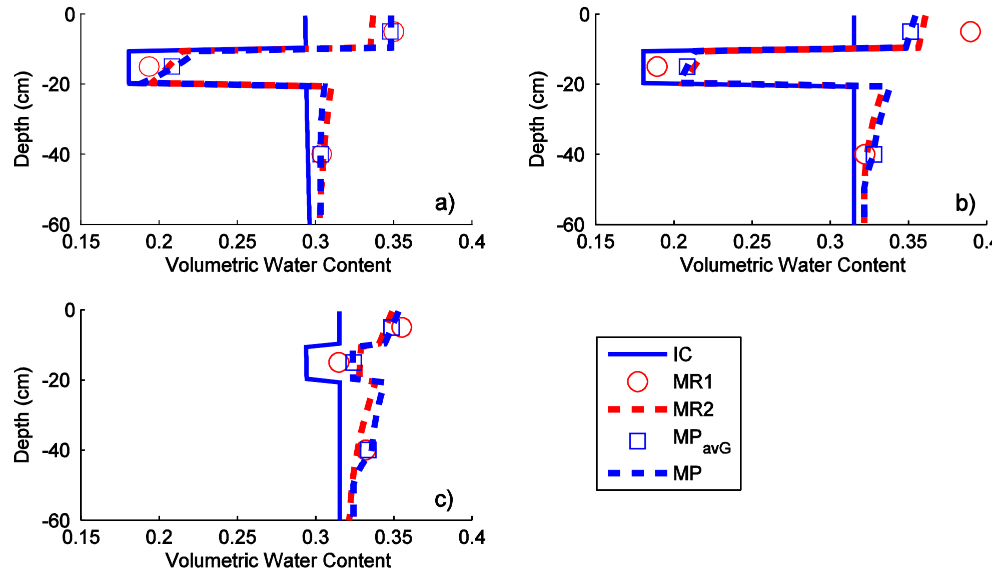
	State	CLM3.5	AZ	CLM3.6	CLM3.5	AZ	CLM3.6
1	AK	27.18	27.95	21.87	12.76	13.41	13.28
2	CA	12.17	10.82	15.31	20.17	26.94	25.09
3	IL	13.98	15.01	14.97	12.86	11.56	14.31
4	FL	18.89	18.74	20.89	14.39	12.35	10.61
5	MT	11.74	10.15	8.82	11.61	7.75	9.62
6	MA	16.11	13.47	20.1	6.37	6.54	5.99
7	ME	6.1	6.54	14.93	3.21	3.27	3.04
8	ME	7.69	7.54	11.23	2.46	2.46	4.65
9	FL	22.07	22.32	20.56	12.99	12.69	11.82
10	WI	14.02	14.38	14.16	10.06	9.93	11.59
11	OR	12.49	6.91	9.15	13.11	6.75	10.74
12	IN	22.48	23.36	23.92	7.65	7.78	9.26
13	FL	23.5	23.7	26.02	10.41	10.04	7.45
14	CA	26.16	19.63	14.21	15.44	9.82	11.88
15	CA	24.4	17.82	16.38	27.81	19	21.45
16	CA	27.26	27.48	26.78	8.61	8.53	8.53
17	WA	9.76	6.86	15.19	7.4	5.24	6.98
	Average	**17.41**	**16.04**	**17.32**	**11.61**	**10.24**	**10.96**

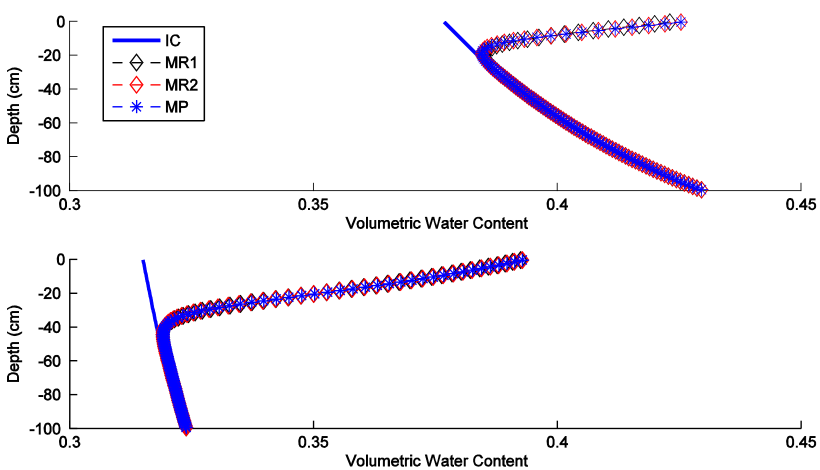
Sensible Heat   Latent Heat

Intercomparison of Numerical Solutions for Richards Eqn.

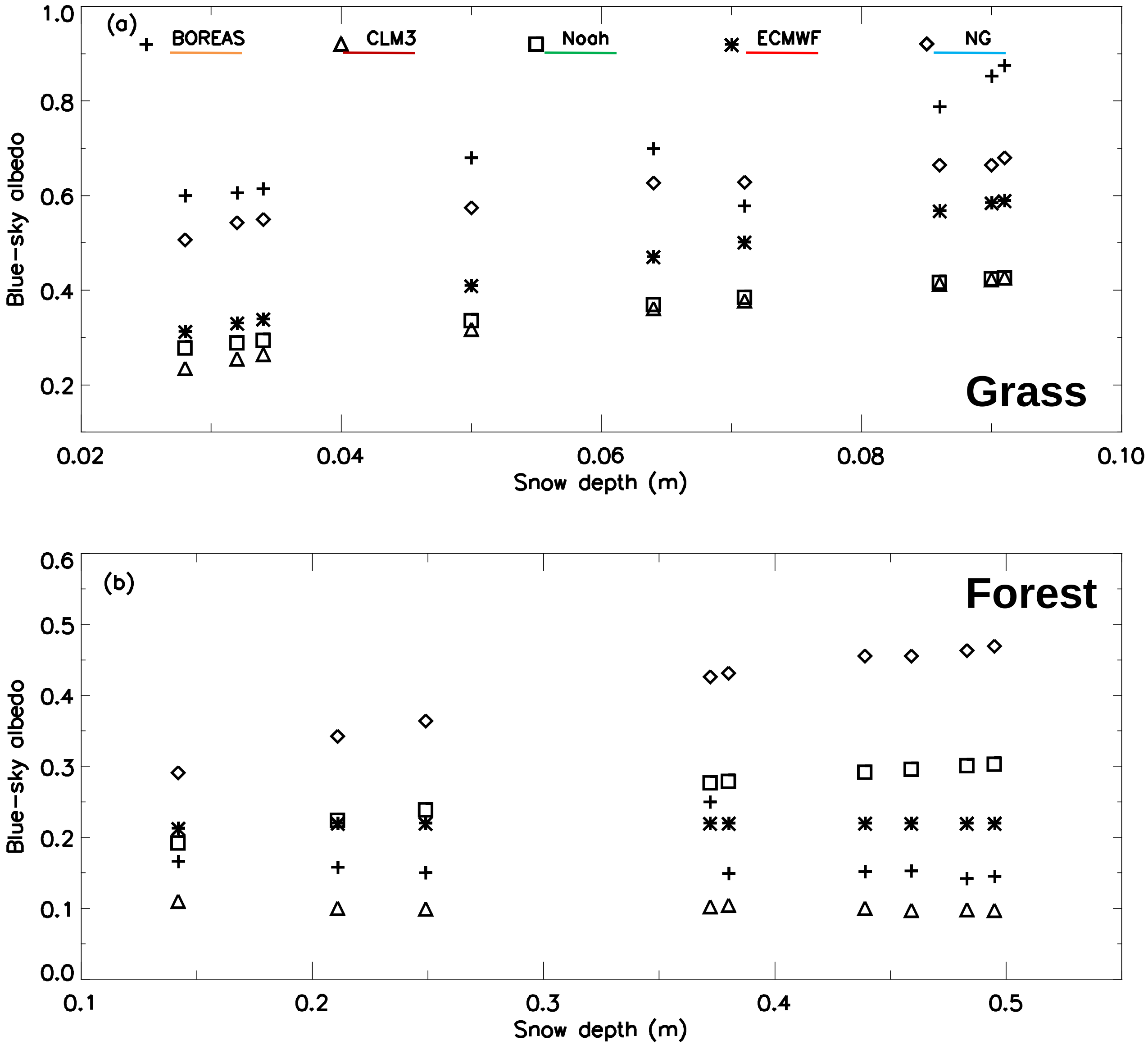
Compare Method Utilized by Ground water Community with CLM

Main Difference: Linearization versus Iteratiations



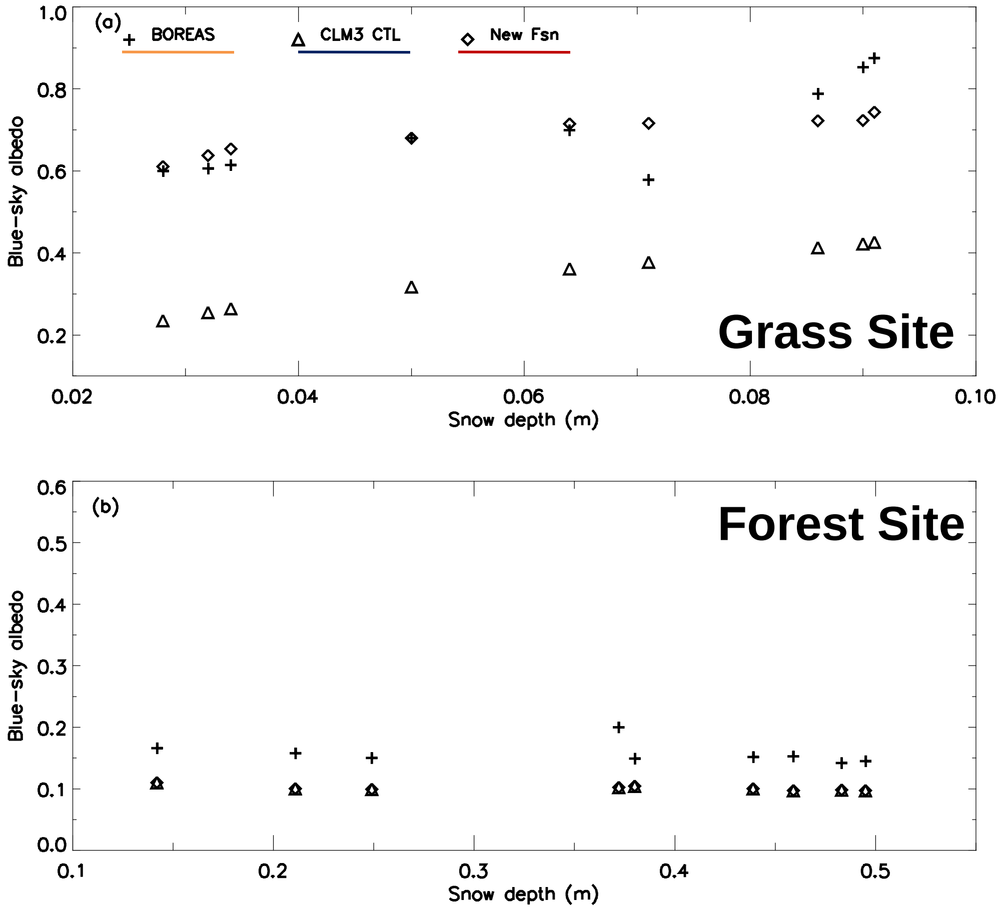


Comparison of daily averaged blue-sky albedos



Comparison of daily averaged blue-sky albedos from CLM3, Noah, NG, and ECMWF with the multi-year BOREAS data (from 1994 to 1996) on the days with snow on the ground but without snowfall or snowmelt.

Sensitivity of CLM3 snow-covered surface albedo



AZ Formulation

$$f_{sno} = \frac{z_{sn}}{z_{0m,g} + z_{sn}}$$

CLM3 Formulation

$$f_{sno} = \frac{z_{sn}}{10\, z_{0m,g} + z_{sn}}$$

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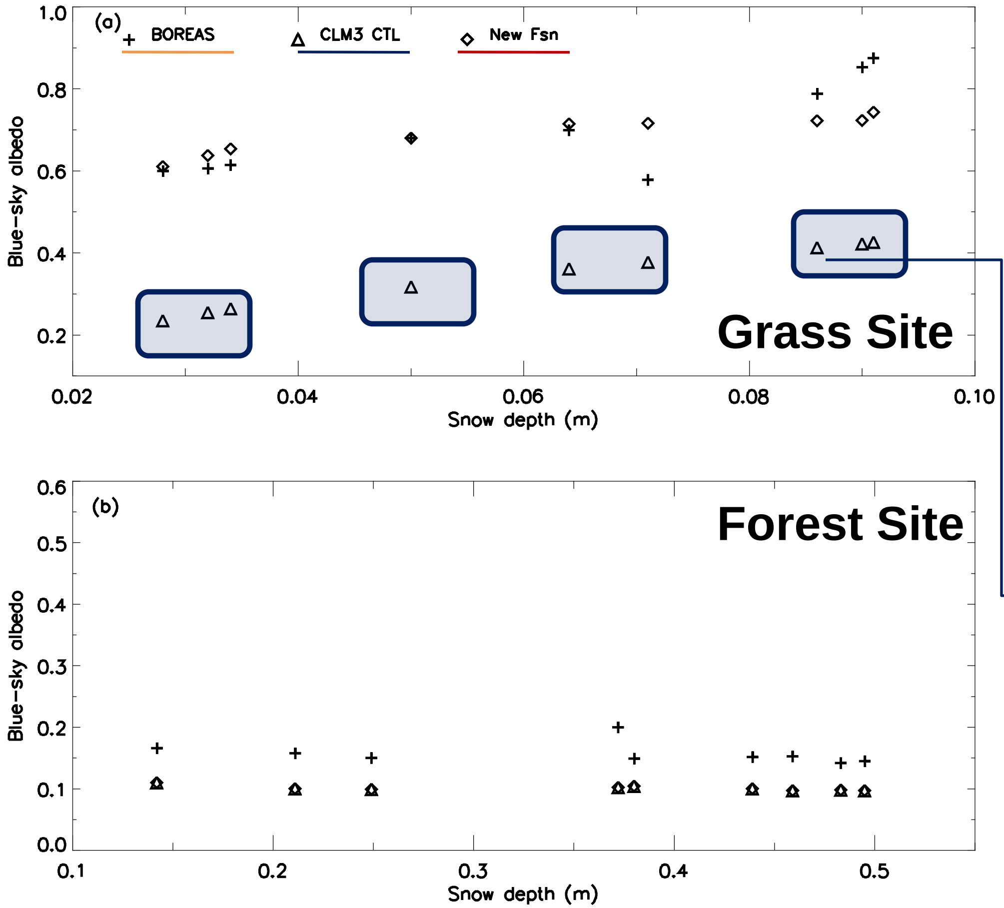

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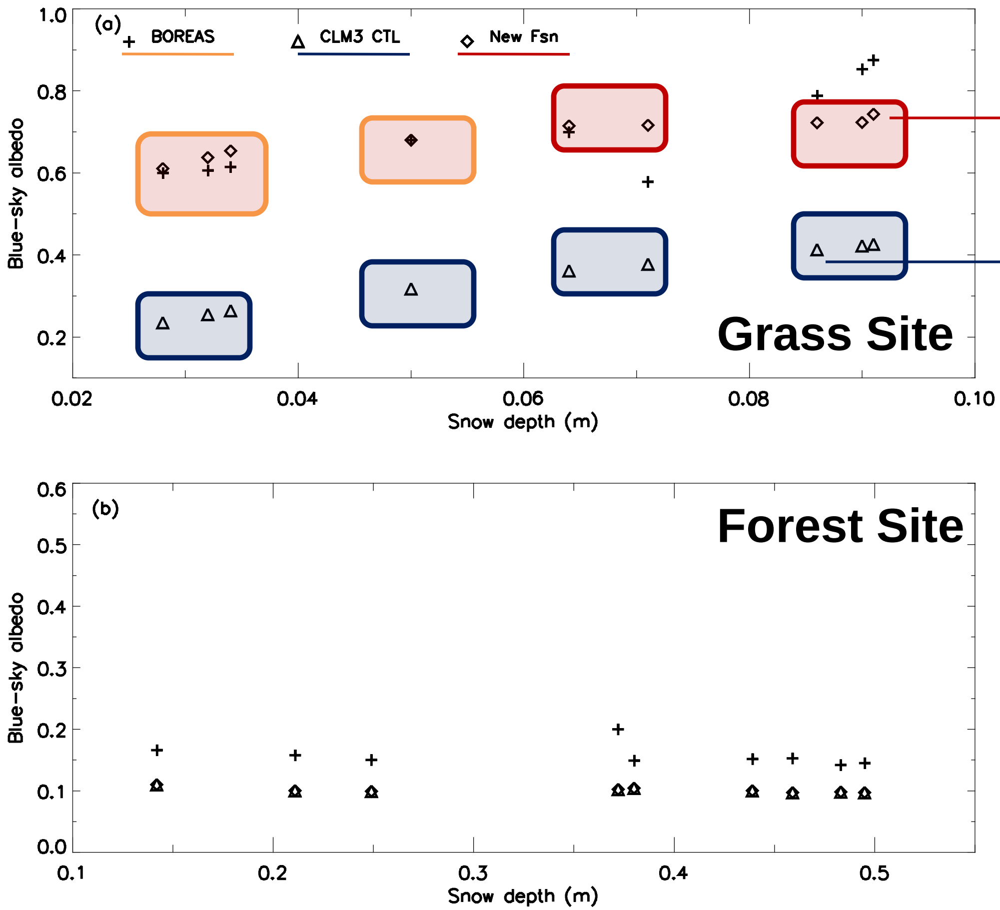

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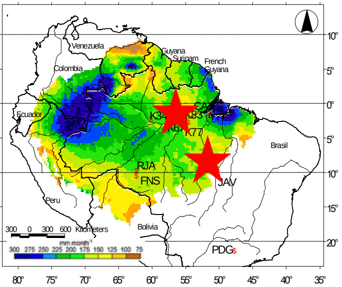


Seasonal Water Balance and Evapotranspiration Of CLM3.5 from LBA-MIP

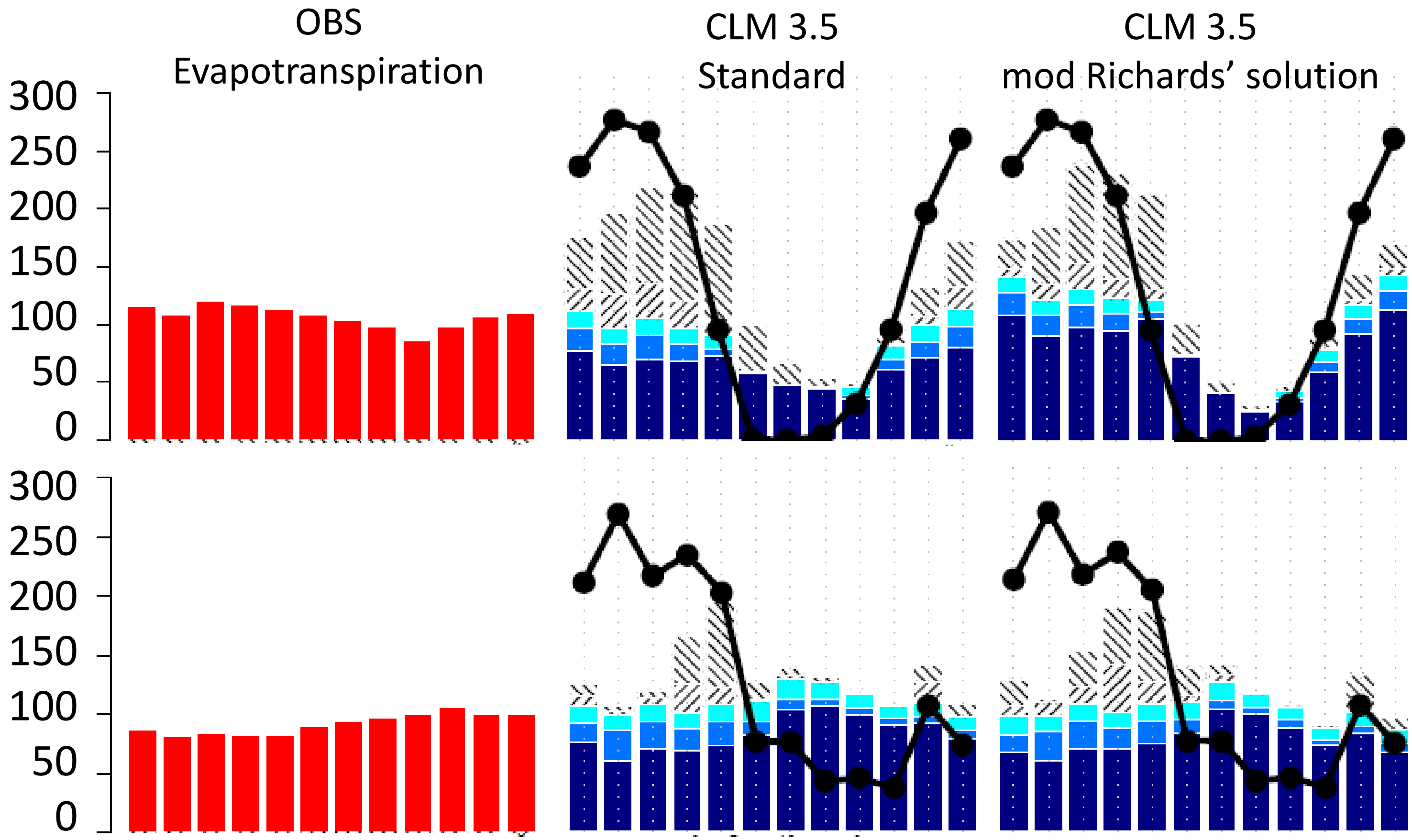
(all values in mm/month)

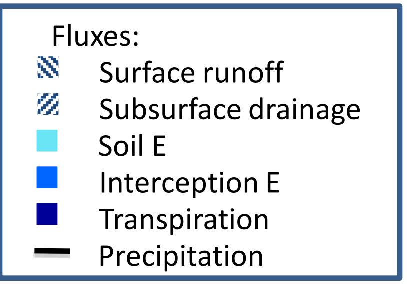
Bananal Island

(southern seasonally flooded deciduous forest)

Tapajós km67

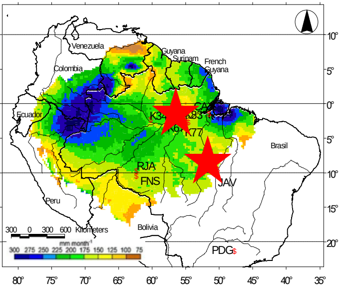
(equatorial moist evergreen forest)





Seasonal timecourse of ET at equatorial site in good agreement with OBS

Dry season ET is depressed in the model for the southern deciduous forest site (Bananal) compared to OBS



Seasonal Gross Photosynthesis and Carbon Balance Of CLM3.5 from LBA-MIP

(all values in Mg/ha/month)

OBS | CLM 3.5 DGVM Standard | CLM 3.5 DGVM mod Richards' solution

Bananal Island
(southern seasonally flooded deciduous forest)

Tapajós km67
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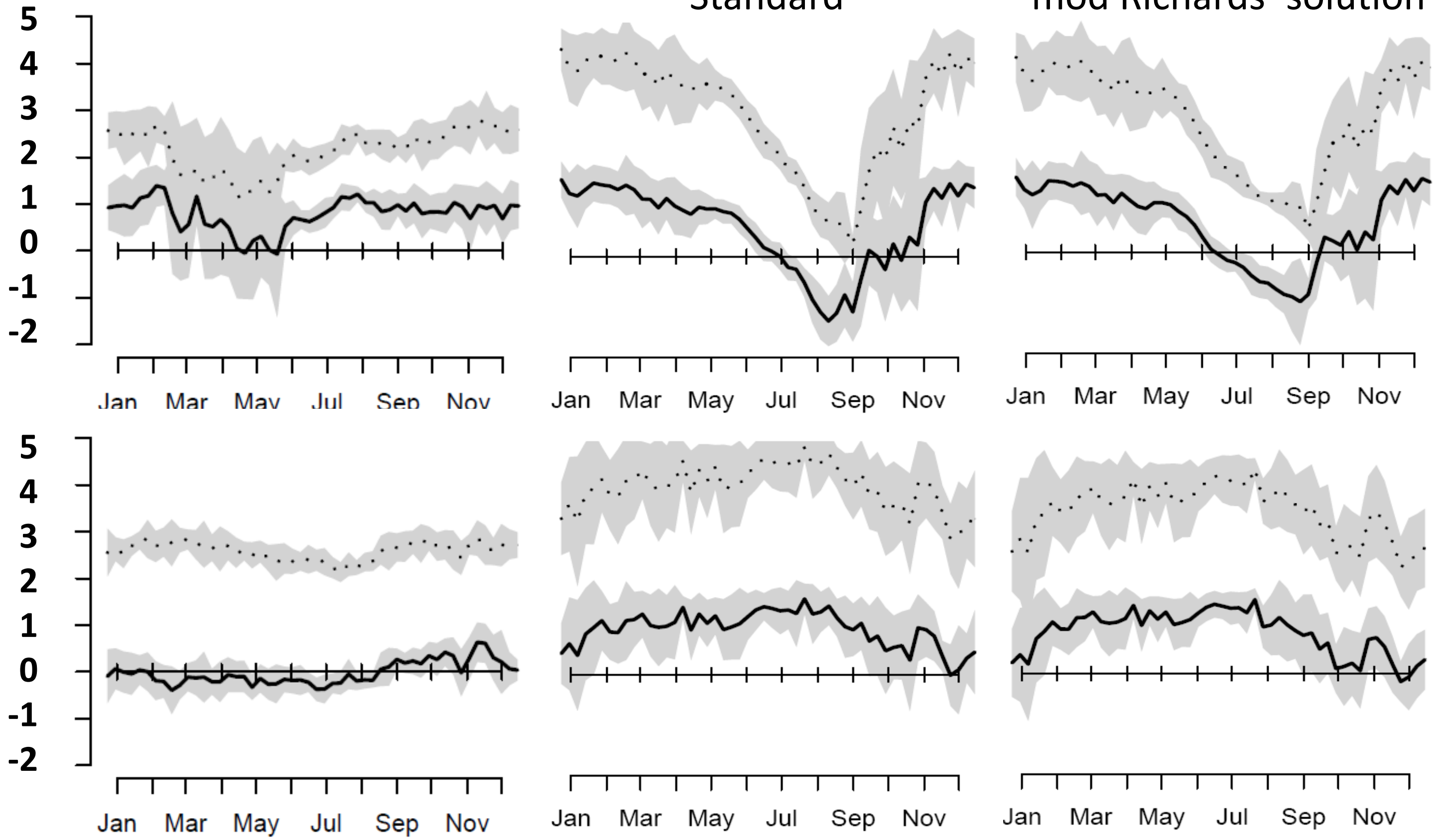

········ GEP (Gross Ecosystem Productivity)

——— NEP (Net Ecosystem Productivity)

OBS: CLM-DGVM soil carbon & respiration is low; both sites predicted to be net sinks for carbon.

CLM-DGVM overestimates observed GEP as well as its seasonal variability at both sites.