Role of Moist convection in the Amazon Basin

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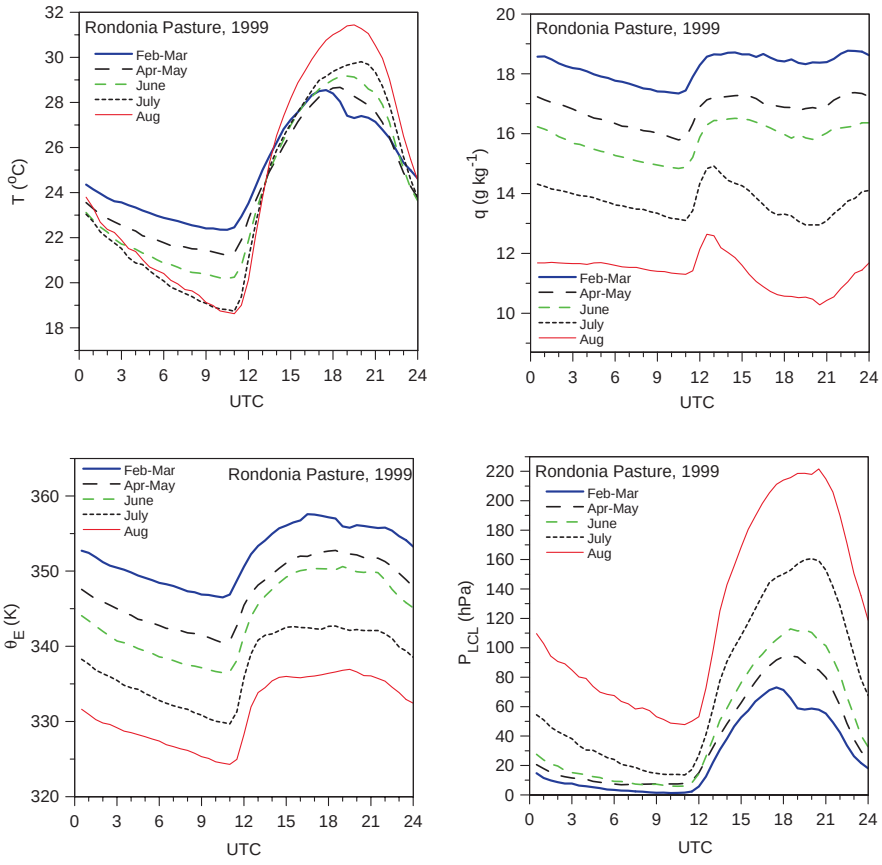
1) Seasonal Cycle

Humidity, clouds, convection, and precipitation not temperature



Diurnal cycle of surface thermodynamics from "Wet to Dry season" for Abracos pasture tower in Rondonia for 1999. [data from von Randow/Manzi]

Change in organization/type of convection between wet and dry seasons
Coupled to flow regime; 'continental' aerosols

Expect valuable data from RaCCI/LBA this Fall
Issue: Radar

2) WETAMC data issues

"Calibration and correction of LBA/TRMM Abracos pasture site merged dataset" – Betts et al., 2002

The major problem in the tropics is humidity measurement:

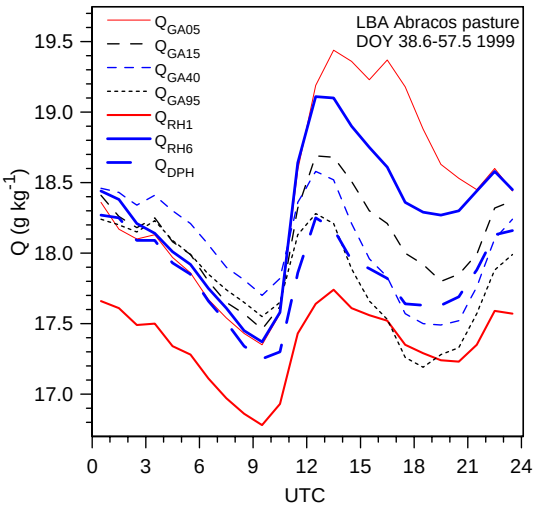


Figure 2. Diurnal cycle of mixing ratio, Q, from 4 GA levels, 2 RH-probes and DPH.

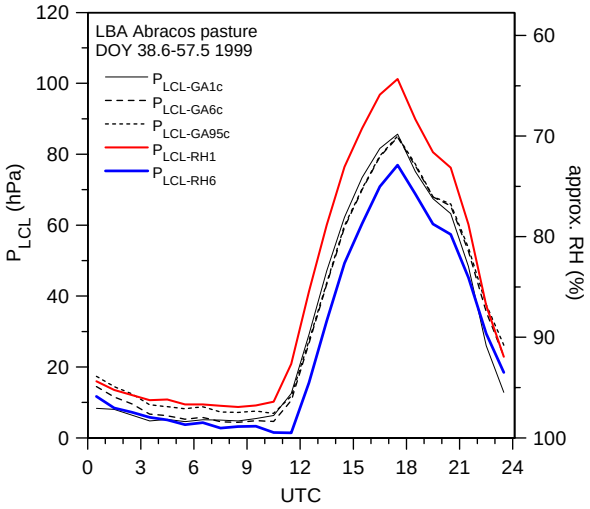


Figure 3. Comparison of mean diurnal cycle of P_{LCL} from GA (corrected) and RH-probes (uncorrected).

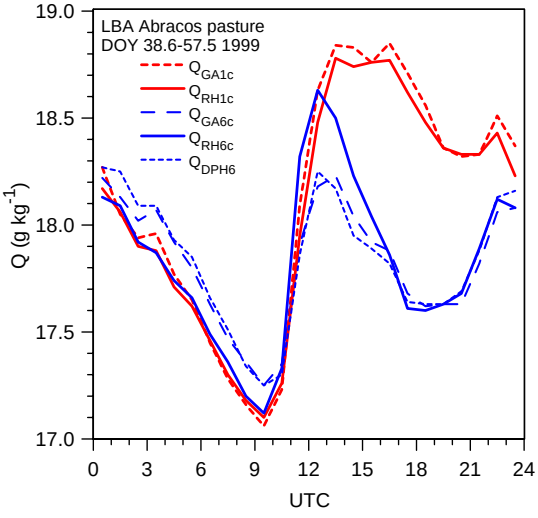


Figure 4. Comparison of corrected mean diurnal cycles of Q at two levels.

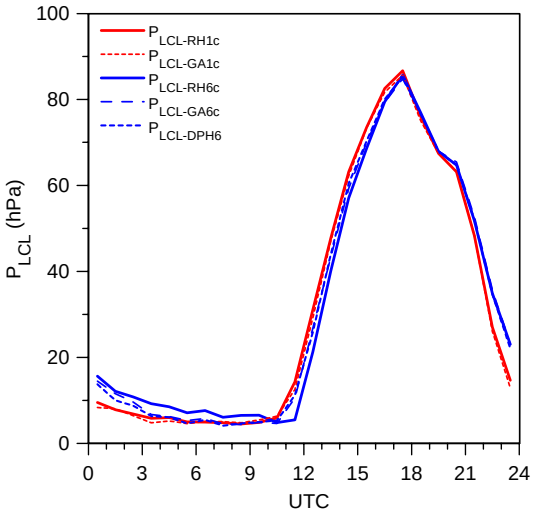


Figure 5. As Figure 4 for corrected P_{LCL}.

Achieved close to ± 1% in RH, ± 3 hPa in LCL

3) Data matters because of fundamental modeling problem

– Moist convection and atmospheric dynamics tightly coupled in the tropics
– Climate and forecast models: Convection parameterized
– Only in small domains in nested high-resolution models can convection be represented explicitly, but coarsely [eg P. SilvaDias]

– Parameterized convection — sub-models and closures not adequate
– Result is that it is uncertain whether tropical flow is correct.

– not a new issue: been on agenda since GATE in 1974.

Model validation needs good data on small scale, mesoscale and scale of Amazon to resolve flow fields

4) Example : ECMWF model diurnal cycle error

Betts, A. K. and C. Jakob, 2002, Study of diurnal cycle of convective precipitation over Amazonia using a single column model. J. Geophys. Res., in revision.

ECMWF model has error in diurnal cycle of precipitation

Model omega field has clear diurnal cycle with morning subsidence and evening ascent: but is it right?

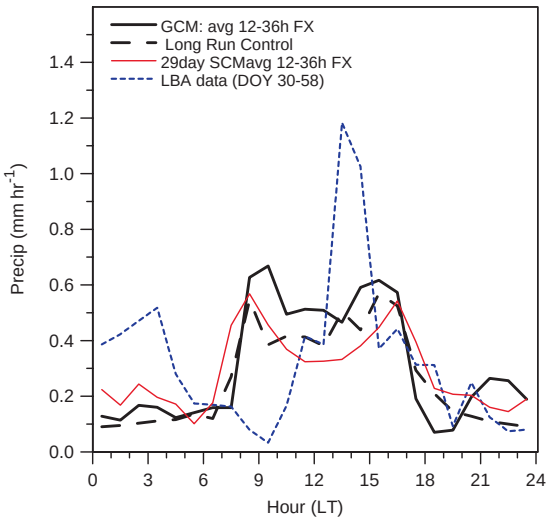


Figure 7 29-day mean diurnal cycle of precipitation from short term forecasts, long run, and SCM runs using large-scale forcing from the 3-D model.

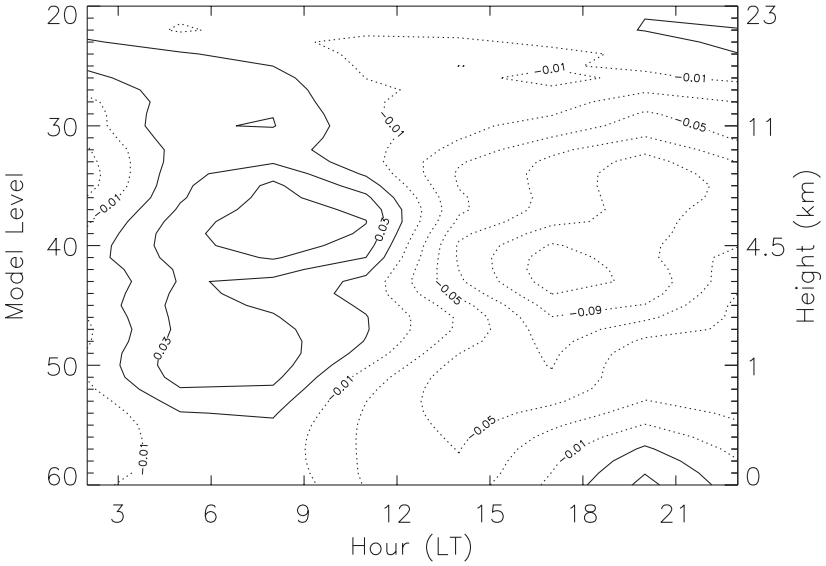


Figure 6. Mean diurnal cycle of omega field for 29-day average from short term forecasts.

– we failed to solve "parameterization of convection" problem [so far]

Can 'large-scale' and convection be "uncoupled"?

Development path unclear in terms of present parametric framework.

Is large-scale omega forcing wrong? We don't know

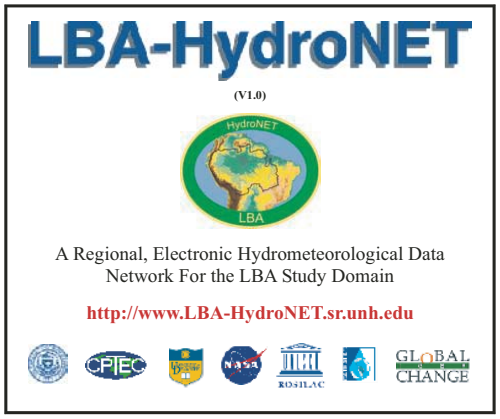
Is convective parameterization wrong? We think so, but both diurnal phase of omega in 3D and precip in 3D and 1D have proved rather insensitive to parameterization in its present formulation

Radiation diurnal phase interaction important to climate:
Climate "SW cloud feedback" is a diurnal problem

5) Global Hydrometeorology from models

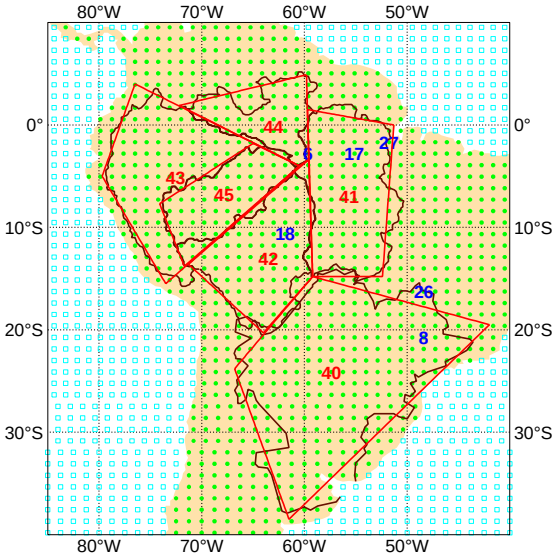
– How well can we model precipitation, evaporation and runoff for large river basins in
a) In forecast models, and analyses (global/regional) ?
b) In climate models?

– Validation critical:



– ERA40 basin budgets

– How good are they?

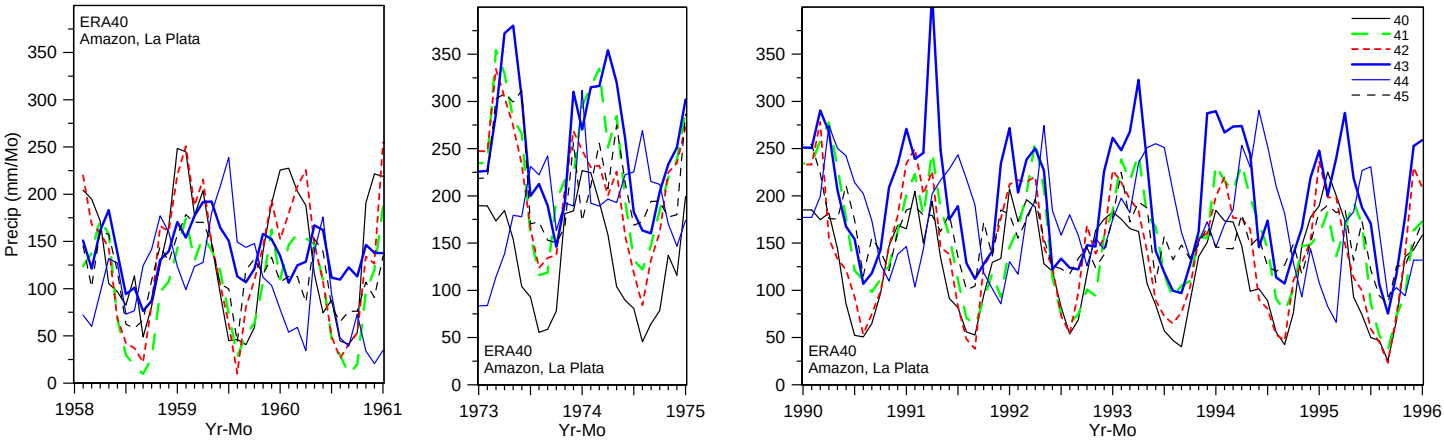


6) In Tropics, satellite data have large impact on global analyses

Amazon and LaPlata basin precipitation for 3 satellite Eras

Summary: @SUM Field: = precip [12-24FX]
Rows: Year* Columns: Basin*

	40	41	42	43	44	45	
	LaPlata	Tapajos+	Madiera	Solimoes	Negro	Purus+	
1958	1639	1092	1491	1554	1363	1411	
1959	1615	1314	1660	1816	1712	1521	No satellite data
1960	1668	1224	1553	1567	806	1233	
1973	1683	2787	2678	3091	2246	2683	
1974	1492	2714	2274	3064	2406	2536	VTPR data
1975	1484	2362	1993	3099	1937	2002	
1990	1516	2106	1801	2418	2255	2093	
1991	1530	1684	1784	2526	1982	1904	Microwave data
1992	1648	1699	1836	2202	2045	1766	
1993	1399	2013	1657	2397	2342	1920	
1994	1470	1892	1636	2369	2247	1743	
1995	1393	1528	1538	2294	1677	1738	
12-yr avg	1544	1868	1825	2367	1919	1879	



Amazon "trends" related to satellite data, not climate drift....

– parts of ERA40 will be rerun with different satellite data assimilation

Progress but many challenges remain

– we need to stay the course

Continue to collect, correct and assemble datasets:

– these will be a legacy for years to come

Continue to work on model validation and development on all scales

Continue to educate students and hand on expertise to the next generation, who will have to solve the issues we fail to resolve.