Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2019-12-RC2, 2019

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Land–atmosphere interactions in the tropics" *by* Pierre Gentine et al.

Anonymous Referee #2

Received and published: 1 April 2019

Review of "Land-Atmosphere Interactions in the tropics"

The authors present new perspectives based on recent literature, emphasizing the role of surface radiation in biosphere-atmosphere interactions and the water cycle. This is a much needed shift in focus toward (shallower) clouds and aerosols and their coupling to the surface water balance. A central part of this coupling, and a focus of the review, is on transpiration and its connection to clouds and aerosols via surface radiation and photosynthesis. These are important yet often overlooked topics for a wide range of current research problems from Earth system modeling to monitoring changes in the water cycle. The review gives a balanced discussion of observations, theory, and modeling, including new techniques to constrain the photosynthesis-water cycle connection from observations. Thus I believe this review will be a valuable contribution.

There are some relatively minor edits and clarifications needed, along with a few sug-

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gestions below.

Some of section 4 on WTG approximation could be put into a broader context as a way to study multiscale interactions by parameterizing the larger scales. The discussion of the literature on WTG certainly raises awareness of the challenges in linking the larger and smaller scales and provides a way to gain understanding. The motivation for thinking about nonlocal coupling could be clarified slightly, since I don't think the authors are arguing for nonlocal coupling as being dominant over or even separate from the other. For feedbacks, it seems less clear a priori which scales should be most important for future change in the water cycle; and from a model development perspective, the unknown still centers largely on local or subgrid scale processes (e.g. the diurnal cycle of clouds), although the interactions of the 'nonlocal' and 'local' processes are certainly part of that unknown. It seems the challenge is to make progress on modeling the multiscale and multicomponent system, and in gaining some understanding (and capability of observing) the overall behaviors of the complex system related to water cycle extremes. This sort of discussion would help wrap up the review in the conclusions.

Technical comments/clarifications:

133 their initiation [and] the role of surface [processes]

201 – A little more background on the WECANN product would be helpful, specifically what other observations it uses besides SIF in deriving the surface fluxes (if any).

203 plausible interannual [variability]

231 'The distinction between shallow and deep convection remains elusive' - Elusive may not be the right word; perhaps 'imprecise', 'subjective', or 'contextual' would work better

277 Fix citation: {Lintner:2017gm}. 299 One key concept in tropical climate is the Weak Temperature Gradient (WTG) - This could be set up a bit more with another sentence or two, depending on page limits. 310 - "In addition it is relatively straightforward" - nec-

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essary? 326 as discussed in Section XX. 335 ‘upscale to larger scale.’ - Redundant?

“In what follows, we evaluate climatologies of evapotranspiration” - Maybe give some idea of what the reader should expect to learn?

Fig. 4 "over the wet part of the Amazon (top left), the Savanna region of Brazil (top right), " - Some readers may confuse the titles Amazon (wet) and Amazon (dry) for wet and dry seasons as opposed to regions. Perhaps replace with Amazon (rainforest) / Amazon (Savanna) or Amazon (rainforest) / Amazon (Cerrado), and then in the caption make the connection between those regions and wet vs dry climates.

347 – Perhaps be more specific to ET components here “canopy evaporation (of intercepted rain)”

Fig. 5 Could you set the aspect ratio of the panels to make this less stretched out and easier to read? i.e., make the axes labels consistent and crop the ocean regions. I recommend stacking all the panels vertically so that panel 3 has the same longitude axis as the seasonal plots. That way we get a clear picture of how variable the SE Asian/Indonesian region is due to the topography (as noted in the text).

Fig. 5 could be better integrated with the text - perhaps add references around line 367 ‘the topography and the distribution of island land masses leads to strong local variability [Fig. 5e]’

392-395 – “The seasonal pattern of ET resembles GPP...” - this section could use minor editing by breaking up the sentences and expanding to be more specific and clear.

389 "regions (Figure 5). GPP is maximized during the wet season in South America, as GPP is" - The text moves on to GPP without much transition here; perhaps add a transition sentence.

404 It would help to define “moist static energy flux” as LH+SH 419 I assume references for ‘why do most contemporary land-surface models incorrectly represent the wettest rainforest GPP and ET...” are in the prior sections? If so it may help to add a link here

to refer readers back to the introduction.

422 You may mean that capturing this accurately will require better understanding? 430 remove “because” in “because relative humidity is high...” 454 “build up of water stress in the soil-plant continuum” - it may help to introduce the water potential terminology a bit earlier here, since it appears in the next paragraph anyway. That terminology may help to clarify this sentence.

476 Fix “also known as...” 476 Regarding midday depression, there are some references on this for tropical forests (Malhi et al., 1998; Williams et al., 1998; Harris et al., 2004).

492 “We suggest that the most critical land-atmosphere feedbacks...” - It would help to specify this a bit, as to whether it is critical for understanding, addressing ESM water cycle deficiencies, modeling dynamic vegetation in a changing climate, etc. . .

510 longwave cooling? 512 generates dew or forms dew

548 - “As such the radiation feedback. . . may systematically impact clearings and deforested regions”. I suggest expanding and editing this sentence to reflect the three ideas it contains. The first is that transpiration is able to buffer the dry season effects in these regions, stabilizing ET, so that the feedback loop involving precipitation and ET is weakened. Thus, the impact of the dry season on ET (and hence clouds) is strongest in mesoscale clearings and deforested regions. In addition, the feedback of shallower clouds and surface radiation may be more important than the feedback of deeper clouds and precipitation.

564 - Here and in a few other places there is some discussion on respiration, in which the link to the water cycle may be lost for some readers as it is not as clear as for photosynthesis. Consider clarifying those connections.

605 “outweigh” 613 “increased lifetime” 618 “depending on the Amazonia site, from rather pristine...” ? 628 dynamics that drive

631 “the transition from turbulent clear convective conditions to shallow cloudy maybe modified in the future” - Do you mean changes in the frequency of the transition or nature of the transition?

640 – the discussion on Maritime continent biomass burning is nice for geographical balance and is an outcome of precipitation deficits tied to El Nino. The carbon cycle impact of the burning is discussed in the review, but do you think it also has impacts on the water cycle that could be discussed here?

Figure 16 caption – could use a little more information on what increasing/decreasing regime mean

751 ‘reduced feedback strength’ - reduced relative to what?

References Malhi Y., A. D. Nobre, J. Grace, B. Kruijt, M. G. P. Pereira, A. Culf, S. Scott, Carbon dioxide transfer over a Central Amazonian rain forest. Journal of Geophysical Research-Atmospheres 103, 31593-31612 (1998); published online EpubDec 27 (10.1029/98jd02647).

Harris P. P., C. Huntingford, P. M. Cox, J. H. C. Gash, Y. Malhi, Effect of soil moisture on canopy conductance of Amazonian rainforest. Agricultural and Forest Meteorology 122, 215-227 (2004); published online EpubApr 20 (10.1016/j.agrformet.2003.09.006).

Williams M., Y. Malhi, A. D. Nobre, E. B. Rastetter, J. Grace, M. G. P. Pereira, Seasonal variation in net carbon exchange and evapotranspiration in a Brazilian rain forest: a modelling analysis. Plant Cell and Environment 21, 953-968 (1998); published online EpubOct (10.1046/j.1365-3040.1998.00339.x).

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