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Hydrology and Earth System Sciences
Discussions

Interactive comment on "The role of Amazon Basin moisture on the atmospheric branch of the hydrological cycle: a Lagrangian analysis" *by* A. Drumond et al.

Anonymous Referee #2

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In this manuscript the authors use the FLEXPART Lagrangian model to evaluate the regions that contribute to precipitation to the Amazon River basin (backward trajectory analysis). In addition, the authors evaluate the regions that receive moisture from the Amazon River basin (forward trajectory analysis). They find an interesting climatology, where the Northern Tropical Atlantic contributes to the Amazon during the Austral Summer, while the Southern Tropical Atlantic complements the moisture sources during the rest of the year. The authors also find that the Amazon basin is an important contributor to La Plata during September to March. The authors then relate their moisture source analysis to ENSO variability. The manuscript is well written, but there are many scat-

tered grammatical mistakes – please have the entire paper read by a native speaker. Overall, this is an interesting manuscript, with valuable results – however, there is a general weakness in the way that the results are interpreted and this must be revised for me to recommend publication.

Major Concerns

1a) There is a lack of a rigorous interpretation of the results in light of large-scale circulation patterns and previous results in the literature. This is true in the climatological analysis, but particularly in the interpretation of El Nino and La Nina. As it stands right now, the authors are showing the reader their results without a physical interpretation. For example, the "Walker Circulation", a critical physical mechanism to explain their findings with respect to ENSO analysis, is not mentioned anywhere in the manuscript. In particular, the decrease in the transport from NA to the Amazon during El Niño is related to the weakening of the Atlantic Walker circulation and the increase in the transport towards La Plata coincides with a stronger subtropical jet during El Niño. See for example

Kousky et al, 1984, A review of the Southern Oscillation: oceanic-atmospheric circulation changes and related rainfall anomalies, Tellus, 36A, 490-504.

Ropelewski and Halpert, 1987, Global and Regional Scale Precipitation Patterns Associated with the El Niño/Southern Oscillation. Monthly Weather Review, 115, 1606-1626.

General features of the climate of La Plata (see e.g. line 20, page 1031) and the corresponding variability associated with ENSO. See for example Garreaud et al. 2009, Present-day South American Climate, Paleo3, 281, 180-195.

1b) Related to my concern above, there are several key papers that the authors have not mentioned in their background section. This tells me that the authors must first go through some fundamental reading of the papers that have studied this issue, so

that they can show their true (very interesting) contributions to the field. For example, there is one study that quantifies the exchanges of moisture between the Amazon and other sources. In that study, annual cycles and inter-annual time series for a period of $\sim$ 25 years is available for comparison and further analysis. See Dirmeyer and Brubaker, 2007. Characterization of the Global Hydrological Cycle from a Back-Trajectory Analysis of Atmospheric Water Vapor. Journal of Hydrometeorology, 8, 20-37

2a) The FLEXPART results are unique in this type of literature because they don't actually quantify mass (as for example the quasi-isentropic back trajectory algorithm). The results are difficult to interpret because you are showing maps of E-P. In particular, Figure 2b shows negative values of (E-P) associated to NA: does this mean that moisture is transported from the Amazon to NA or that moisture coming from the eastern Atlantic is lost in NA before reaching the Amazon? The authors clearly state that NA is not a source for the Amazon during June to September, which suggests that Figure 2b should be interpreted as follows: moisture coming from other places to the Amazon is lost in NA during June to September. It would be helpful for the reader to state this clearly (e.g. near line 12, page 1030), and clarify what this other sources are.

In general, in your Data and methods please be clearer about the following aspects - In the back trajectory analysis, what does negative E-P indicate? - In the forward trajectory analysis, what does positive E-P indicate? - If I understand correctly, you are doing BOTH forward and backward analysis. . .correct? If so, paragraph 10 and 15 are misleading, because you say "A forward analysis may identify all trajectories. . .." But you never actually say that you did both.

2b) Related to my concern above, when looking at figures 2b and 4b, the units on the y axis are (E-P)*100 mm/day. This means that you are getting peak values of around .025 mm/day for these source regions. . ..can we interpret these as mass? They seem awfully low. Please interpret these physically.

3) Figure 4b is presented in a very strange way (focusing on points of inflection, as opposed to the seasons where there is large or small contribution), also, paragraphs 20 is very awkward. I think that after the authors have read the references mentioned above they can say a bit more about this point.

4) In many cases the figures are presented for all months of the year, but there is minimal discussion. The authors should either a) remove the panels that are not discussed b) include a discussion of every panel or c) not show every month, but a subset (one in each season). In any case, please discuss all figures/panels that are presented.

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