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Earth System Dynamics
Discussions

Interactive comment on "Evaluation of the Moisture Sources in two Extreme Landfalling Atmospheric River Events using an Eulerian WRF-Tracers tool" *by* Jorge Eiras-Barca et al.

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General Comments

Eiras-Barca et al., develop a 3D tracer tool to track moisture origins for atmospheric river events. The tool itself is novel, although the findings are limited to two extreme events. The paper is well written however, there are a number of errors in the composition. Acronyms are defined repeatedly and are interchangeably used with full versions. There are also grammatical errors, which I have highlighted in the supplement. Some figures can be combined or entirely eliminated.

Regarding the content, with some clarifications the paper will be suitable for publication in ESD. Two points of concern are 1) the impact of excluding water vapor from the nudging scheme and 2) the discrepancy between WRF and observational precipitation in mountainous regions. It would be useful if the authors include a few lines regarding the local antecedent conditions for both events (i.e. soil moisture, snowpack) and the potential influence of these conditions on the partition of tropic versus local moisture originations. With two case studies, it is clear that this manuscript is more than just a methods paper for the new tracer tool. However, more emphasis should be placed on the novelty and distinction of this tool in comparison to other approaches like FLEXPART. Lastly, the conclusions should be stated more precisely.

I would encourage the authors to submit a follow-up paper once the tool has been widely implemented. It would be a valuable contribution to the scientific community to better understand how variations in moisture origins may impact AR events and vice versa. Some examples for comparisons, landfalling vs. non-landfalling, role of antecedent conditions, extreme vs. non-extreme events etc.

Specific Comments

Page 1, Line 13: "mean water vapor transport (IVT) of" Mean integrated water vapor transport.

Page 1, Line 17-18: "Between 3 and 5 ARs can be found per hemisphere at any given time," The 3-5 ARs in each hemisphere at any given time statistic is from Zhu and Newell 1998 not Guan and Waliser 2015.

Page 2, Line 16: Tropical moisture exports acronym defined as TME, but not used again in the text.

Page 2, Line 21: "Ramos et al. (2016) used the FLEXible PARTicle dispersion model (FLEXPART) to show that both tropical and local sources of moisture are present in AR landfall events for different European latitudes." Can the authors provide a better

distinction between the advantages/disadvantages of the Ramos et al 2016 Lagrangian tool versus the newly presented WRF-Tracer tool?

Page 3, Figure 1: “Source Era-In”, use proper reference to ERA-Iterim. It is not intuitive which event is associated with the names “Great Coast Gale” and “Great Storm”. I would stick with Pacific and Atlantic.

Page 3, Line 4: “This manuscript is organized as follows. Section 2 describes the applied data and methods, the results and discussion are presented in section 3 and we summarize our conclusions in section 4.” Unnecessary description of paper outline.

Page 3, Line 7: Interchangeably using United States and U.S.

Page 3, Line: 11: How does Figure 1.a. (a snapshot in time) demonstrate the rapid development?

Page 4, Figure 2: All panels of this figure are repeated elsewhere in the manuscript, it should be removed.

Page 4, Line 1: “Regarding the alleged role of the atmospheric river in the fast deepening of the cyclone -35 mb in 24 hours- (Figure 1, b), Shutts (1990) showed the key role played by the latent heat release in the storm formation.” Sentence is hard to follow, try rewording.

Page 4, Lines 7-9: “For the Pacific case, the WRF horizontal resolution is 15 km and the vertical column is divided into 40 levels. For the Atlantic simulation, grid spacing is 20 km in the horizontal and there are 50 vertical levels.” Why use different resolutions?

Page 4, Line 10: Water Vapor Tracer (WVT) tool defined with acronym, but not used again.

Page 4, Lines 11-19: YSU, WSMC6, RRTM, ECMWF and ERA all undefined acronyms.

Page 4, Line 7, 14: “We use the Weather Research and Forecasting Model ” “Spectral nudging has been applied” Make sure to use consistent verb tenses, present and past

tense are used interchangeably.

Page 4, Line 21: “Water vapor is not nudged, and given that the subject of this study is moisture transport and precipitation, we focus validations on these two variables” This sentence dismisses the nudging of water vapor since moisture transport and precipitation are used for validation. The statement makes it seem as though precipitation and moisture transport are not functions of water vapor. This should be further clarified and supported.

Page 5, Figure 3: Can you provide a difference map between the WRF simulation and observations for both locations? Not required in the text, but for this review.

Page 5, Line 5: “[FigVALQ],” Figure 4?

Page 5, line 8-9 and Figure 3: The overestimation of precipitation for the west coast event which is pronounced over high topography is concerning. Especially as the focus of this paper is moisture sources and differentiating between topic/subtropic and local origin. This is not to say that the observations are entirely accurate but do you have any supporting information to better clarify the amplified orographic enhancement? How will this potentially effect results?

Page 6, Figure 4: Same as Figure 3, provide a difference map.

Page 7, Figure 5: What do the labels of “Domain CS1”and “Domain CS2” mean? Again, avoid identifying the events by vague names of Great Coast Gale and Great Storm, use Pacific and Atlantic.

Page 7, Equation 1: Meridonial component of IVT? Incorrect formulation.

Page 7, Lines 8-9: “Figure 6 shows the three-dimensional distribution of water vapor mixing ratio (a), and tracer water vapor mixing ratio (b) for the event in the Pacific that made landfall along the U.S. West Coast on December 3, 2007.” Date of landfall already mentioned in methods. Also West Coast alternates between being capitalized and not capitalized throughout the text.

Page 8, Line 12: “The main goal of Figures 6 and 7 is the visual depiction of the total and tracer moisture.” Should not have to state this.

Page 8, Lines 13-21: This paragraph explaining Figure 1 should be moved to the methodology section where the figure was originally introduced and detailed.

Page 8, Line 22: The formatting of the names for the two events should be consistent, keeping it as the Pacific and Atlantic events is detailed enough. The inclusion of the dates is unnecessary.

Page 8, Line 30: “In the October 1987 Atlantic case, we also see a clear plume where tropical water vapor accounts for more than 80What is the explanation for the cause of rapid decrease?

Page 8, Line 34-35: “. . .there is evidence that the maximum of tropical moisture does not necessarily coincide with the low-level jet (LLJ), which is the maximum in wind speed at lower levels.” Citation?

Page 9, Figure 6: The addition of lat/lon labels would make the figure and the point made on Page 8 line 5 more obvious. Also “d) Vertical cross sections of (d).” should be “sections of (b)”

Page 9, Line 1: Where is Figure 8d? Perhaps you meant 10d.

Page 11: Consider combining Figures 8 and 9.

Page 12, Figure 10: Define TCS. Axis labels of km cut off.

Page 12, Line 4: ““the Great Coast Gale of December, 2007”” Date not previously included in the quotes.

Page 13, Lines 5-7: “The Pacific event shows a more intense connection with tropical regions; therefore, the percentage of tropical precipitation for this event is higher and peaks at around 85These two main conclusions should be reworded.

Page 13, Line 8: “in terms of heavy precipitation” In terms of? Or chosen because of the subsequent heavy precipitation.

Page 14, Lines 7-9: “It is widely accepted in the literature that the bulk of moisture in ARs is primarily advected within the LLJ of extratropical cyclones but in light of our results we suggest that further discussion is necessary for this matter.” This is not a very effective concluding sentence, should be reworded.

Page 16, Figure A2: Labels of LLJ missing. European not capitalized, however this event was not previously described as the “European case”.

Page 20, Line 4: Partial citation.

Technical Corrections

See supplement.

Please also note the supplement to this comment:
https://www.earth-syst-dynam-discuss.net/esd-2017-63/esd-2017-63-RC2-supplement.pdf

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