EGU23-3606, updated on 20 Apr 2024
https://doi.org/10.5194/egusphere-egu23-3606
EGU General Assembly 2023

Estimating the origin of precipitation: uncertainties associated with atmospheric moisture tracking models

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Precipitation is the largest freshwater flux that enables life on land. However, climate change is projected to increase the frequency and intensity of extreme precipitation events, which often culminate in droughts and floods with devastating impacts on humanity and the environment. To better understand the dynamics of precipitation in a changing climate, recent studies aimed to unravel the interaction between evaporation and precipitation. To do so, atmospheric moisture tracking models have often been employed to determine the origins of precipitation and establish source–sink relationships. However, due to the lack of sufficient and accurate observations to evaluate these models, their estimated source regions of precipitation often remain unvalidated. Nonetheless, the number of studies using such models is increasing, even if only a few have addressed associated uncertainties and even fewer employed multiple models.

Here, we advocate the need for moisture tracking model intercomparisons to advance this field of study. Therefore, we provide an overview of models and methods that track moisture through the atmosphere and determine the origins of precipitation. Further, we highlight conceptual differences between these models and demystify assumptions hidden in the analysis of source regions. Using selected case studies, we illustrate the uncertainty associated with the origin of precipitation and highlight the need for coordinated model comparisons using multiple models. Finally, we present our plans to engage with the entire moisture tracking community to collaborate on prospective model intercomparison studies. Through these efforts, we wish to raise awareness about the uncertainties inherent in moisture tracking approaches and achieve a better understanding of the drivers of precipitation in a changing climate.