

Reexamining the Nonlinear Moisture-Precipitation Relationship over the Tropical Oceans

Stephanie Rushley¹, Daehyun Kim¹, Chris Bretherton¹, and Min-Seop Ahn^{1, 2} ¹University of Washington, ²Chonnam National University

Research Question: How do updated precipitation estimates from the Special Sensor Microwave Imager (SSM/I) alter the moisture-precipitation relationship?

Objective: The goal of this study is to accurately estimate the nonlinear relationship between moisture and precipitation over the tropical oceans. Additionally, we evaluate the moisture-precipitation relationship in climate models.

Analysis: Using precipitation (P) and precipitable water ($\langle q \rangle$) from SSM/I Satellites and saturation specific humidity ($\langle q_s \rangle$) from ERA Interim reanalysis temperature, we examine the relationship between column relative humidity ($CRH = \langle q \rangle / \langle q_s \rangle$) and precipitation over the tropical oceans. We fit an exponential curve of the form $P = P_r \exp(a_d CRH)$ to the SSM/I Version 5 and Version 7 data and 28 CMIP5 models. We use the exponential fits to find the coefficients P_r and a_d of the nonlinear fit.

Findings: The nonlinear fit between moisture and precipitation in Version 7 has a more gradual increase in precipitation with moisture, and shows a significantly lower amount of precipitation. CMIP5 models tend to have too much precipitation at low moisture and too little at high moisture.

Significance: The rate at which precipitation increases with moisture is lower than previously thought, which alters the amount of precipitation that can remove moisture from the column. Many models do not accurately represent the moisture-precipitation relationship, which has implications for convection parameterization in models.

Broad Impact: We suggest that the updated exponential fit from Version 7 should be used in future studies of the tropics.

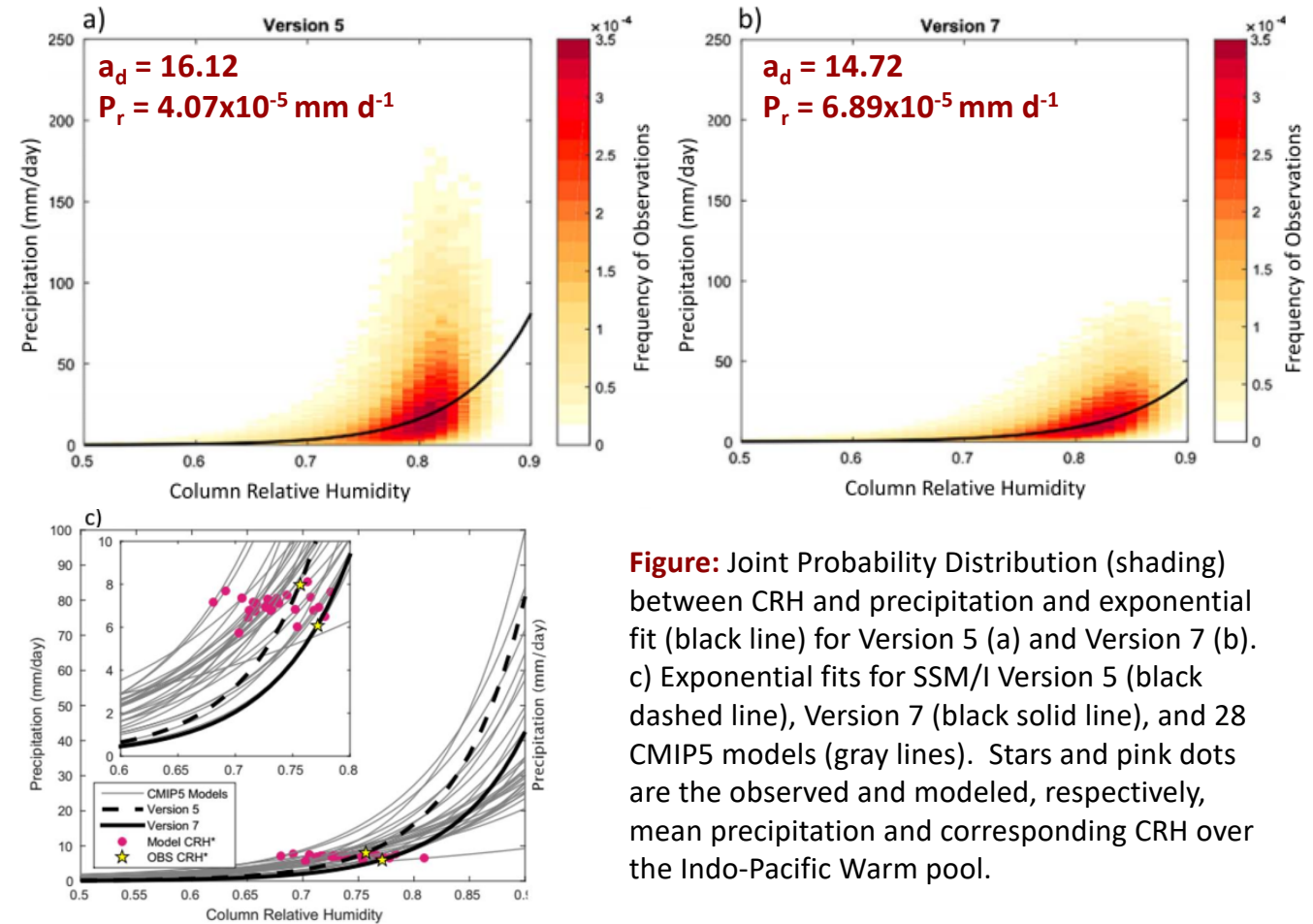


Figure: Joint Probability Distribution (shading) between CRH and precipitation and exponential fit (black line) for Version 5 (a) and Version 7 (b). c) Exponential fits for SSM/I Version 5 (black dashed line), Version 7 (black solid line), and 28 CMIP5 models (gray lines). Stars and pink dots are the observed and modeled, respectively, mean precipitation and corresponding CRH over the Indo-Pacific Warm pool.

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