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# Radiative cooling by clouds affects the precipitation - temperature scaling derived from observations

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One direct effect of climate warming on hydrology is the increase in moisture holding capacity of atmosphere at the rate of 7%/°C as suggested by the Clausius Clapeyron equation. Extreme precipitation largely depends on the amount of precipitable water in the atmospheric column and is thus expected to scale with temperature at the same rate. Observations, however, show significant variability in precipitation - temperature scaling rates, with negative scaling dominating in the tropical regions. These scaling relationships assume a one way causality, i.e. temperature is independent of precipitation. However, we show here that temperatures strongly co-vary with precipitation through the effect that clouds have on surface radiation. The presence of clouds associated with precipitation events result in lower solar isolation at the surface, further leading to reduced temperatures. This induces a two-way causality and thus temperature is no longer independent of precipitation. To remove this cooling effect of clouds, we used a surface energy balance model with a thermodynamic constraint to derive clear sky temperatures during precipitation events. We then show using observations from India, that extreme precipitation scaled with clear sky temperatures shows an increase consistent with the CC rate. On contrary, the negative scaling obtained using observed temperatures misrepresent the precipitation response to warming as a result of the co-variation with the cloud radiative effect. Our findings reveal that scaling relationships not only show how precipitation changes with temperature but also how atmospheric conditions associated with precipitation affect temperature. Thus, this covariation needs to be taken into account when using observations to derive scaling relationships that are then used to infer the extreme precipitation response to climate change.