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Quantifying Human Impact to the Rainfall Extremes Associated with Tropical Cyclone

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More than 2000 mm rainfall occurred over southern Taiwan when a category 1 Typhoon Morakot pass through Taiwan in early August 2009. Entire village and hundred of people were buried by massive mudslides induced by record-breaking precipitation. Whether the past anthropogenic warming played a significant role in such extreme event remained very controversial. On one hand, people argue it's nearly impossible to attribute an individual extreme event to global warming. On the other hand, the increase of heavy rainfall is consistent with the expected effects of climate change on tropical cyclone. To diagnose possible anthropogenic contributions to the odds of such heavy rainfall associated with Typhoon Morakot, we adapt an existing probabilistic event attribution framework to simulate a 'world that was' and compare it with an alternative condition, 'world that might have been' that removed the historical anthropogenic drivers of climate. One limitation for applying such approach to high-impact weather system is that it will require models capable of capturing the essential processes lead to the studied extremes. Using a cloud system resolving model that can properly simulate the complicated interactions between tropical cyclone, large-scale background, topography, we first perform the ensemble 'world that was' simulations using high resolution ECMWF YOTC analysis. We then rerun the simulation with adjusted the analysis to 'world that might have been conditions' by removing the regional atmospheric and oceanic forcing due to human influences estimated from the CMIP5 model ensemble mean conditions between all forcing and natural forcing only historical runs. Thus our findings are highly conditional on the driving analysis and adjustments therein, but the setup allows us to elucidate possible contribution of anthropogenic forcing to changes in the likelihood of heavy rainfall associated Typhoon Morakot in early August 2009. Also large ensemble members with initial condition perturbations are created to quantify uncertainty in the probability event attribution framework and enable the risk assessment. Different aspects of typhoon associated rainfall extremes will be examined.