The influence of historical warming on the extreme flooding event due to Typhoon Vamco (2020) in the Philippines

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In November 2020, Typhoon (TY) Vamco (locally named Ulysses) made landfall on the main island of Luzon. It brought intense rainfall resulting in widespread flooding which affected 5.2 million people, 111 casualties, and damage costs in excess of USD 418 million, making it the 7th costliest typhoon in the Philippines. Its thermodynamic characteristic from radiosonde observations show that while the convective available potential energy (CAPE) was not abnormally high during its closest passage, the saturated layer from 850 to 600 hPa height had a lapse rate larger than moist-adiabat. Also, high precipitable water of up to 70.3 mm and high relative humidity (RH) from ground to 400 hPa likely explain the heavy rainfall associated with TY Vamco. Global warming has exerted profound effects on weather patterns around the globe. Consequently, the impact of TY Vamco was used as an example of climate change in the local popular media. In this study, we investigated the influence of historical warming on the rainfall characteristics of TY Vamco using the Weather Research and Forecasting model. The pseudo-global warming method was applied using 40-year regression of sea surface temperature (SST), as well as temperature and RH profiles from the JRA-55 reanalysis data. Three model runs were produced: (1) control run, (2) regressed SST run, and (3) regressed SST, temperature and RH profile run, or the GW run. We then used the modelled rainfall in simulating the river discharge of the Cagayan River in Cagayan Valley, northern Philippines, where river height exceeded 13 m in certain sections, using a calibrated Rainfall-Runoff-Inundation (RRI) model. The SST run had 16.7% lower river discharge compared to the control run, while the GW run only had 0.8% discharge reduction relative to the control. In terms of inundation area, the GW and SST runs had lower 1-6 m flood area coverage of 3.6% and 16.9%, respectively. Results show that historical warming of SST yields higher present-day rainfall, but current drier mid-tropospheric conditions compensated this historical warming.

Keywords: the Philippines, typhoon, global warming, WRF model, RRI model

