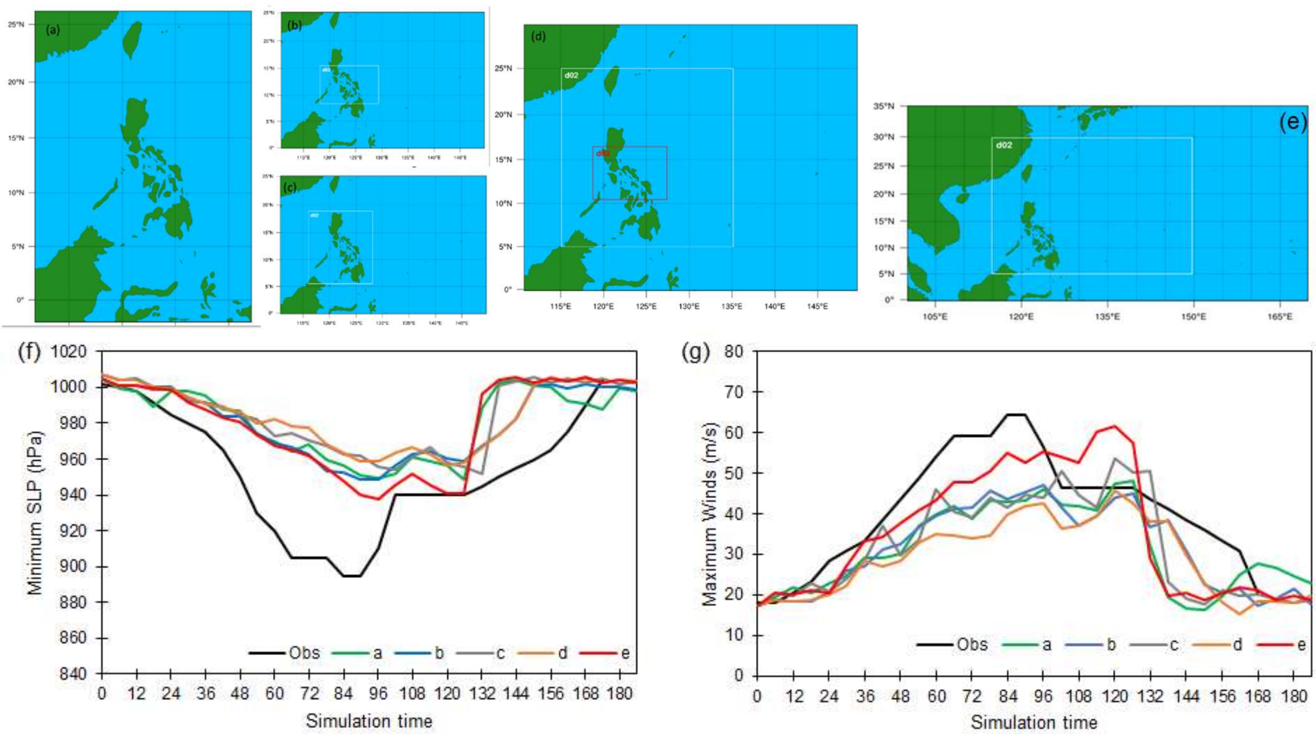
Supplement of the response to comments of Reviewers on

Sensitivity of simulating Typhoon Haiyan (2013) using WRF: the role of cumulus convection, surface flux parameterizations, spectral nudging, and initial and boundary conditions

Delfino et. al.

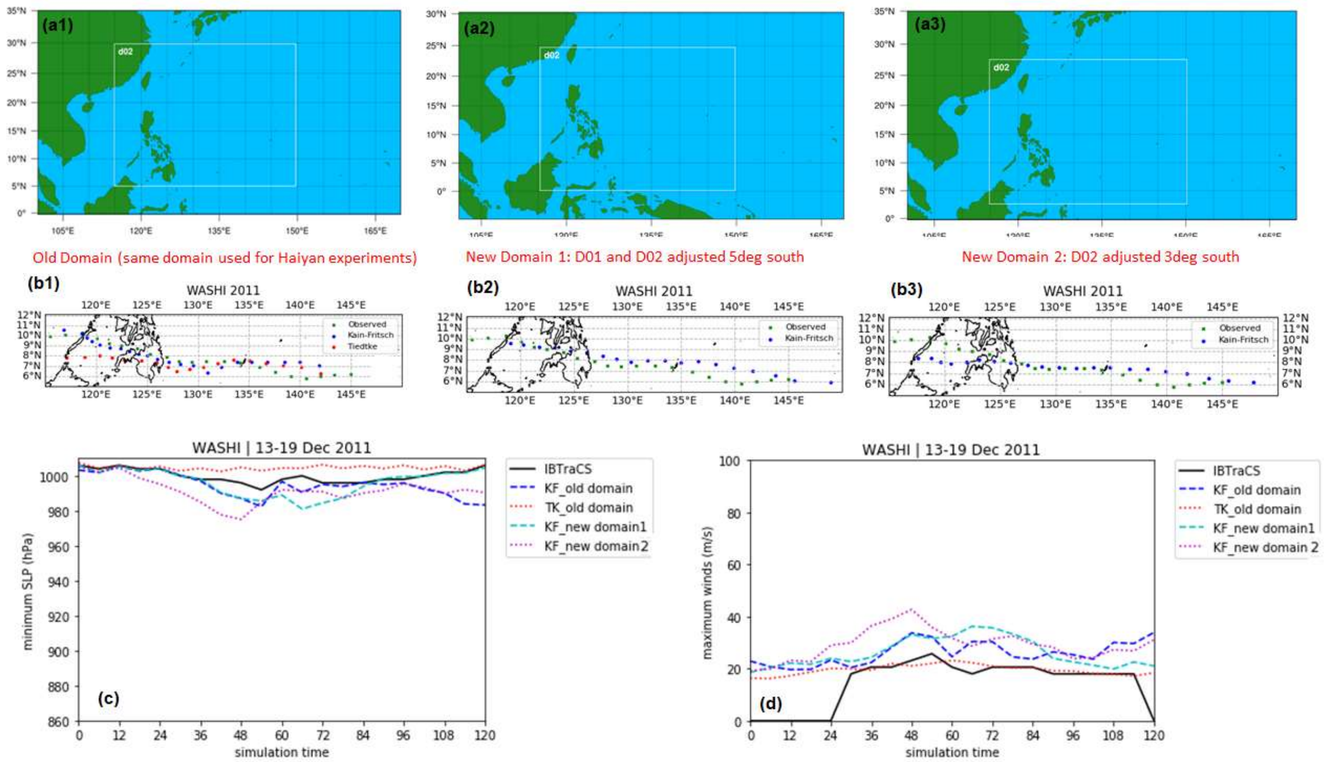
This supplement contains figures to support responses to comments of Anonymous Referee #1&2.

The overall approach of this study is to have a common domain for multiple TC cases in this region (other TC cases not included in this paper, but are the focus of a follow-on paper, about to be submitted) to understand and have a more general set of conclusions on the response of TCs to future warming. Initial simulations have been done to check model performance using different domain configurations and horizontal resolution i.e. (a) single domain (at 12km horizontal resolution); (b) two domains (at 12 and 4km horizontal resolution); (c) same as (b) but with bigger inner domain; (d) three domains (12, 4 and 1.3km horizontal resolution); and (e) two domains (25,5km) horizontal resolution. Domain configuration (e) was used for the sensitivity experiments which simulated the lowest minimum sea level pressure and maximum winds, and in consideration of computing resources and other TC cases that were simulated in the project.



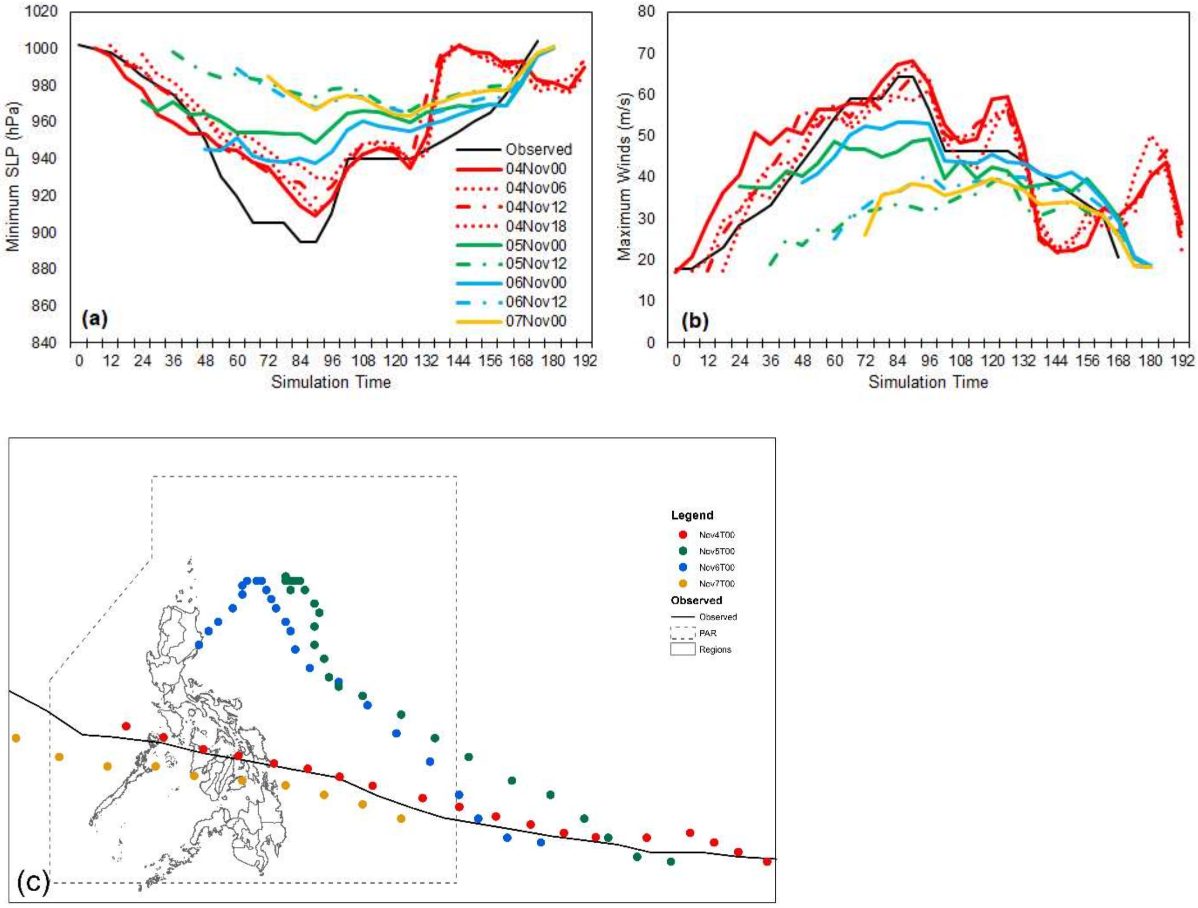
Supplementary Figure 1a: Different domain set-up (a-e) for experiments looking at different domain configurations for Typhoon Haiyan with the corresponding simulated minimum sea level pressure (f) and maximum winds (g) for each domain set-up.

We also conducted several sensitivity experiments on different domain configurations and specific experiments with adjusted southern boundaries were also conducted (but for a different TC case that tracked further south) and it was found that the current domain configuration was optimal in terms of simulated tracks and intensity.



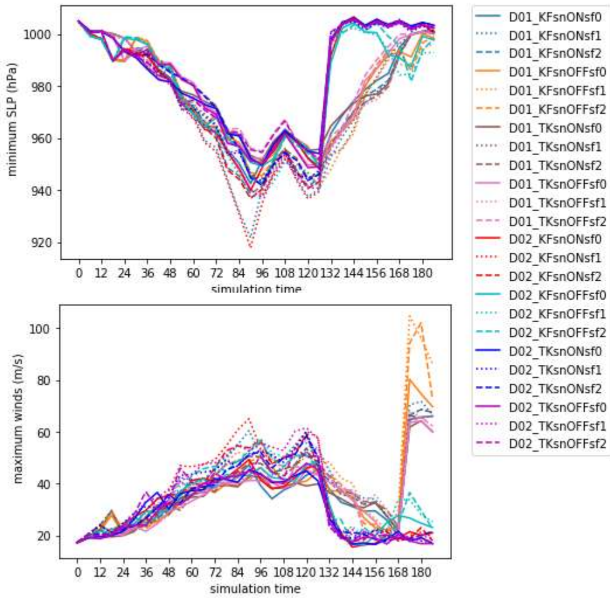
Supplementary Figure 2b: Different domain set-up (a1, a2, a3), corresponding simulated tracks (b1,b2,b3), simulated minimum sea level pressure (c) and maximum winds (d) for experiments looking at the impacts of the southern boundary for a TC case (Washi, December 2011) that tracked south of Haiyan.

Experiments with different lead times have been conducted prior to the selection of 04 Nov 00 UTC as the initial time (longer lead-time). Other experiments include 04 Nov 06, 12, 18 UTC; 05 Nov 00, 12 UTC; 06 Nov 00, 12 UTC; and results of these experiments showed that this chosen initial time with longer lead-time is able to simulate the observed track and intensity better than later times.

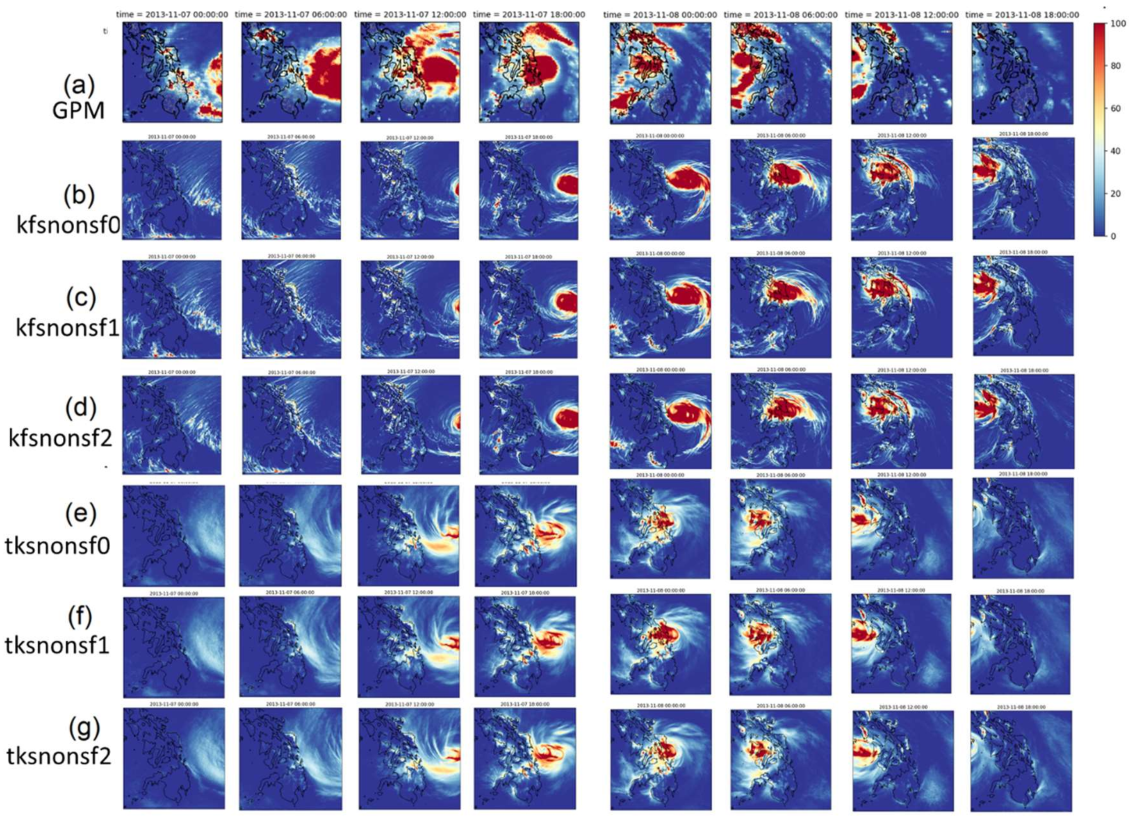


Supplementary Figure 3: Time series of (a) minimum sea level pressure in hPa and (b) maximum winds in ms-1 for the sensitivity experiments with different initial times, including the simulated tracks (c) for the experiments initialized at 04 Nov 00UTC, 05 Nov 00UTC, 06 Nov 00UTC, and 07 Nov 00UTC.

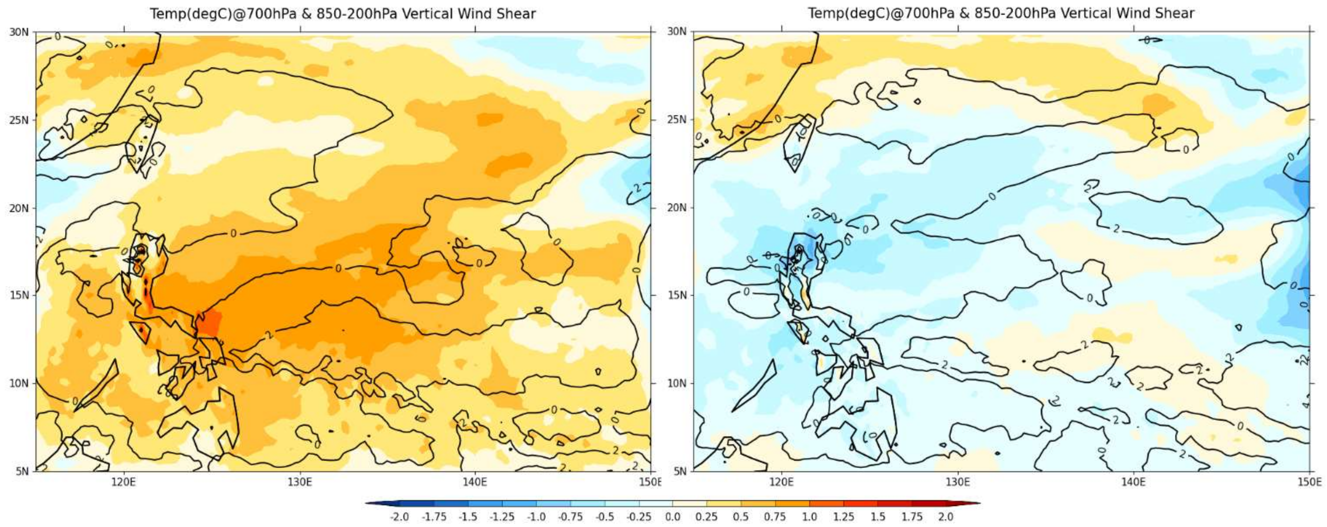
There is no difference in the simulated intensity (MSLP = 1005hPa; max winds = 17 m/s) at t=0 (04 Nov 00 UTC) for both mother/outer domain (D01) and child/inner domain (D02) for all sensitivity experiments and small differences up to t=12.



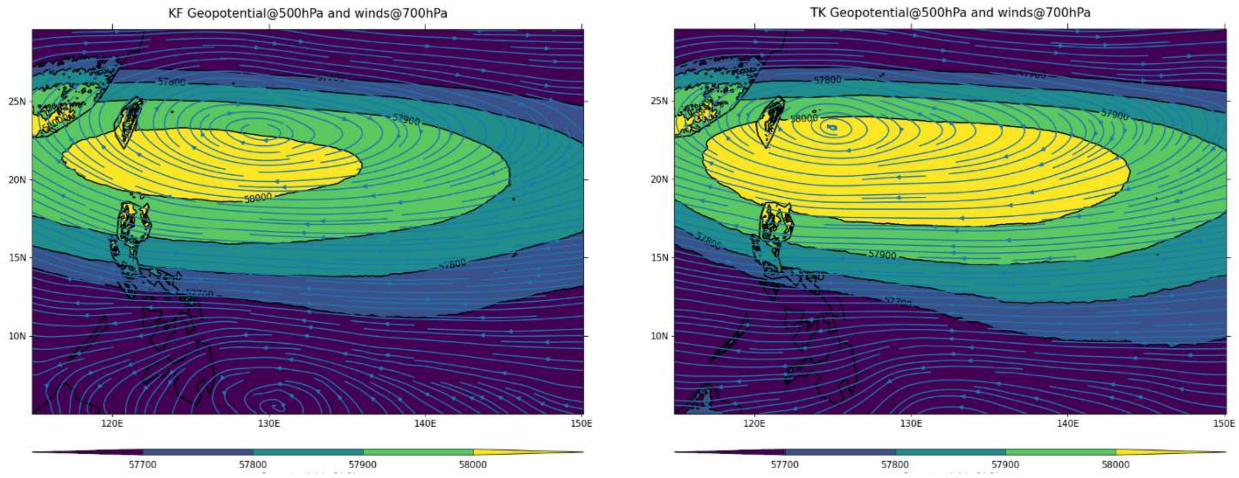
Supplementary Figure 4: Time series of simulated 6-hourly (a) minimum sea level pressure in hPa and (b) maximum winds in ms-1 for the sensitivity experiments from 04 Nov 00 UTC (t=0) to 11 Nov 18 UTC (t=186) from the mother/outer domain (D01) and child/inner domain (D02) for all sensitivity experiments.



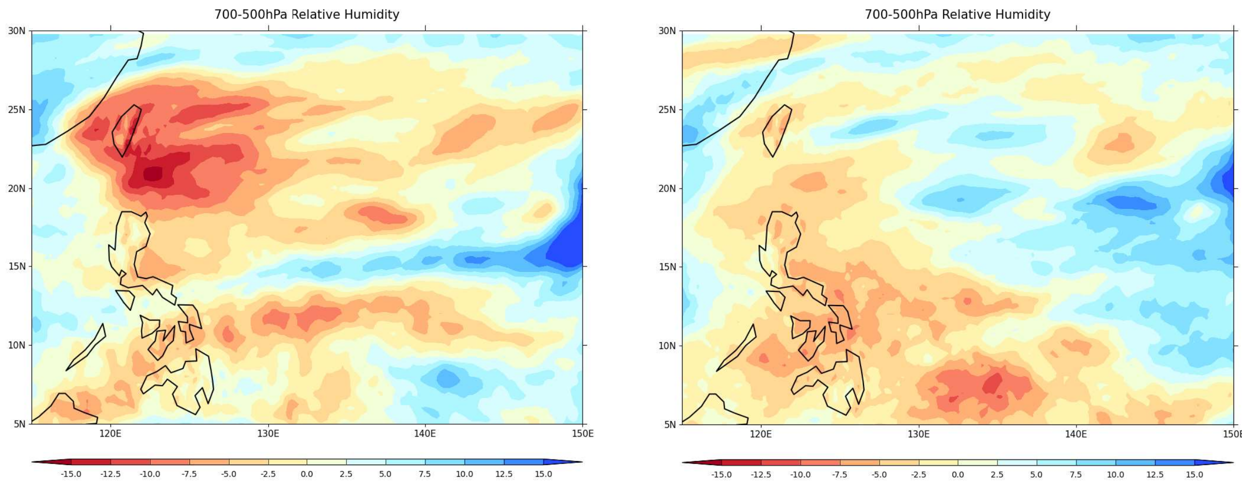
Supplementary Figure 5: Spatial patterns of rainfall (in mm) every 6-hours from 00 UTC 7 Nov 2013 to 18 UTC 8 Nov 2013 (a) GPM, and the different simulations WITH nudging using (b,c,d) KF with sf0, s1,sf2 respectively, and (e,f,g) TK with sf0, sf1, sf2 respectively.



Supplementary Figure 6: The average difference of the simulated temperature (in degree Celsius) at 700hPa (contour) and deep vertical wind shear averaged over the entire period of the simulation with (a) KF and (b) TK temperature and winds from ERA5. The 6-hourly WRF output was interpolated to the coarser 6-hourly ERA5 grid using First-order Conservative Remapping through CDO remapcon function. CDO code available at https://code.mpimet.mpg.de/projects/cdo/



Supplementary Figure 7: Average Geopotential height at 500hPa in geopotential meters (shaded contour lines) and winds (streamlines) at 700hPa averaged over the entire period of the simulation with (a) KF and (b) TK.



Supplementary Figure 8: The average difference of the simulated Mid-tropospheric (700-500hPa) Relative Humidity averaged over the entire period of the simulation with (a) KF and (b) TK from ERA5.