ATSC 507

HW 2 WRF Simulation(s)

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Weather Research Forecast model (WRF-ARW) has a variety of Planetary Boundary Layer (PBL) schemes which aim to parameterize complex dynamics and physics that occur within the lowermost portion of the earth's atmosphere. The use of parameterization schemes allows for models to be run at relatively fast computational speeds that make WRF-ARW adequate for operational weather forecasts. The default "CONUS" in the WRF-ARW calls a PBL scheme: *Mellor-Yamada-Janjic (Eta) TKE scheme* and surface layer option: *Monin-Obukhov (Janjic Eta) Similarity scheme.* For a simple comparison to the default scheme or "Base" scheme, the Yonsei University (YSU) PBL scheme and surface-layer option *Monin-Obukhov Similarity scheme* were used to model the same forecast period. The forecast period of choice was an extreme wind event that affected the Southern Coast of British Columbia, Canada on December 20th, 2018.

For this study, four forecast variables are used to compare the two PBL schemes. Figures 1-8 illustrate the spatial variance of two-meter Relative Humidity (%), two-meter Temperature (deg C) Mean Sea Level Pressure (MSLP) (hPa) and 10-meter Wind Speed/Direction (ms^-1) at varied times of the forecast period. In the initial time of 2018-12-20 00:00Z you can see that the two PBL schemes are all ready producing different results for all four forecast variables. Looking at the Relative Humidity (most apparent in the **RH Diff(YSU_BASE)** map) that the YSU scheme forecasts lower relative humidity values as compared to the Base schemes throughout most of the forecast domain (Fig1-4). From the Temperature, the YSU scheme appears to resolve the PBL in the complex terrain better than the Base scheme. This is said because in areas of complex terrain you see far more well-defined valleys and mountain tops. However, and a big however that is just a theory because we are not comparing against observational data (just model to model) thus we have no truth in what really occurred. MSLP behaves similarly in both PBL schemes though the Base scheme forecasted slightly lower pressures (~2 hPa) than the YSU scheme. Of note, the variance in the MSLP becomes more pronounced the further into the forecast period. This comes as no surprise and can be explained by the butterfly effect in that "is the sensitive dependence on initial conditions in which a small change in one state of a deterministic nonlinear system can result in large differences in a later state" Boeing, G. (2016). Thus small changes in how the MSLP is calculated at the initial time to lead to (not huge in this case) but a large difference the further into the forecast period. The Wind Speed and direction varified pretty well between the two PBL schemes until then end when YSU forecasted stronger wind speeds affecting the Southern Coast of BC than the Base PBL scheme. Seeing how each PBL scheme affects the forecast involves the question of which scheme is best to use? Further research is needed to draw any conclusion.

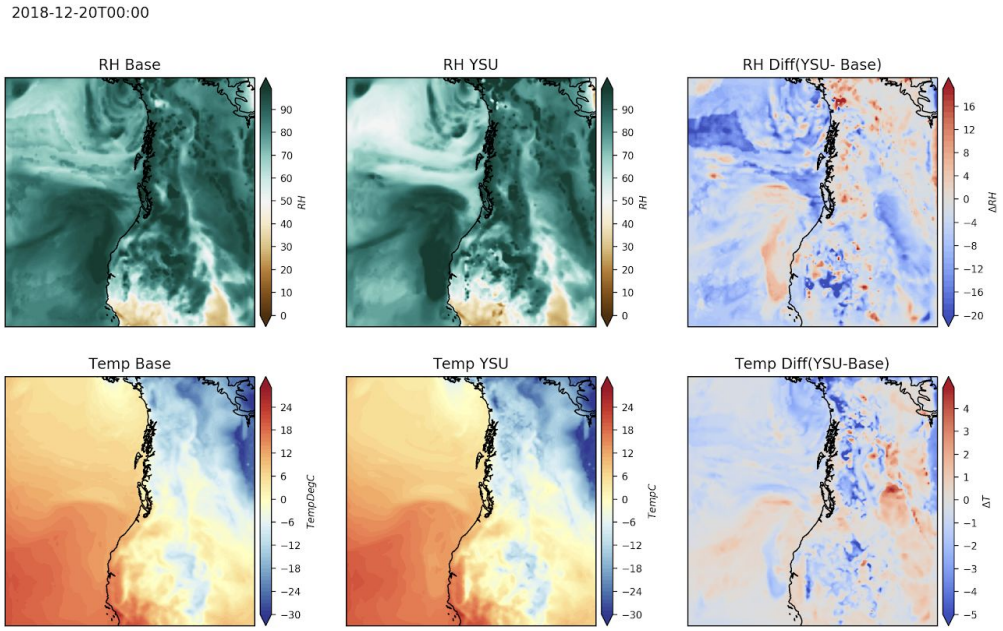

Figure 1

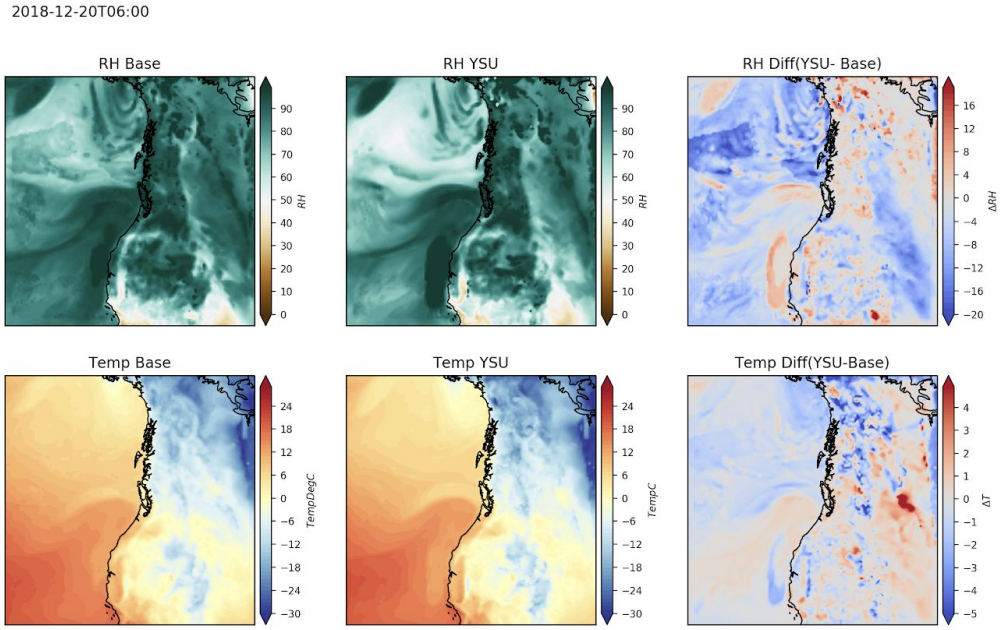

Figure 2

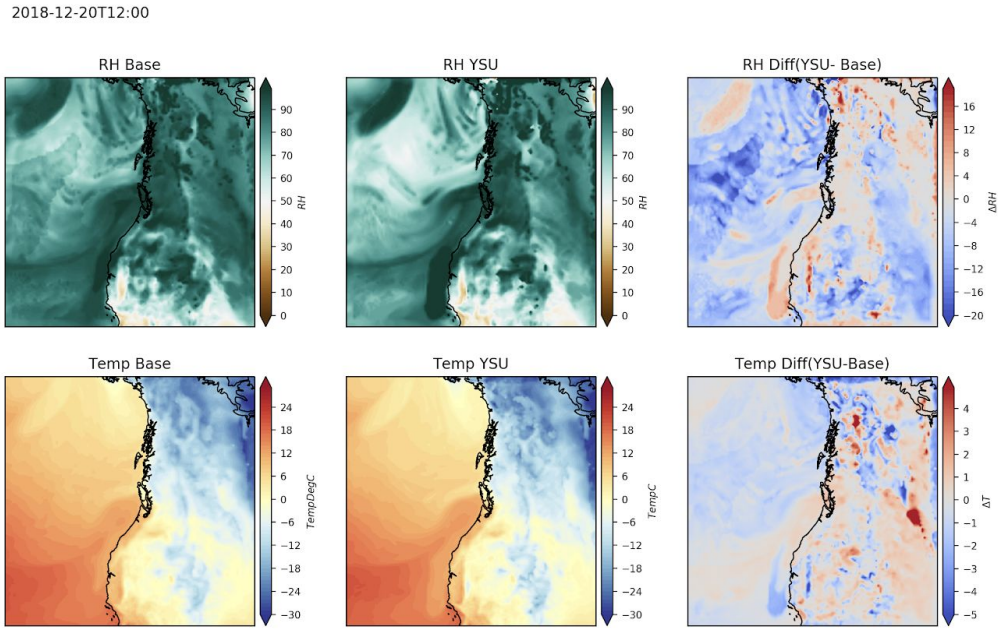

Figure 3

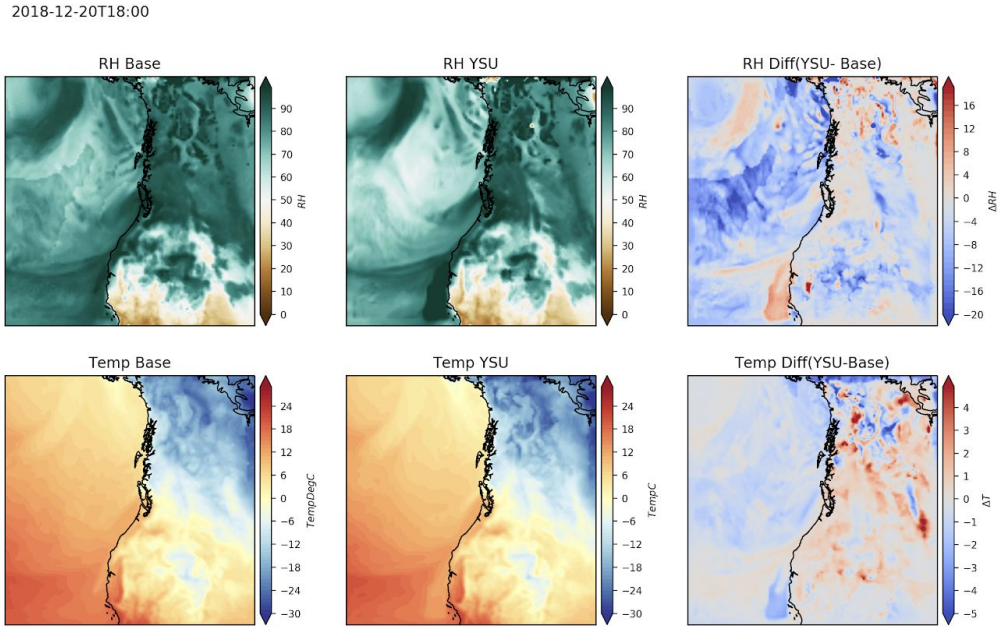

Figure 4

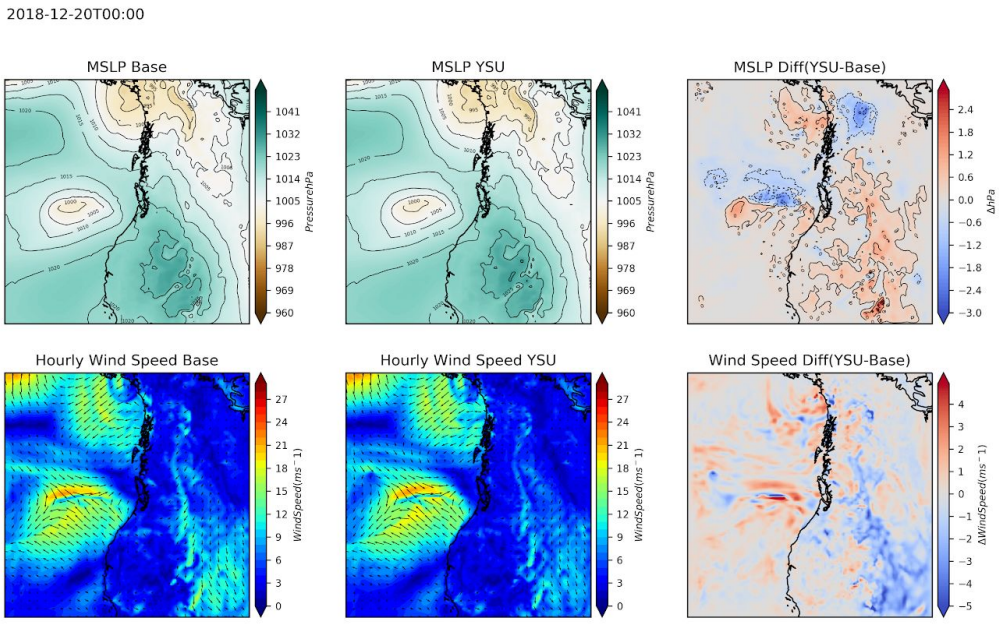

Figure 5

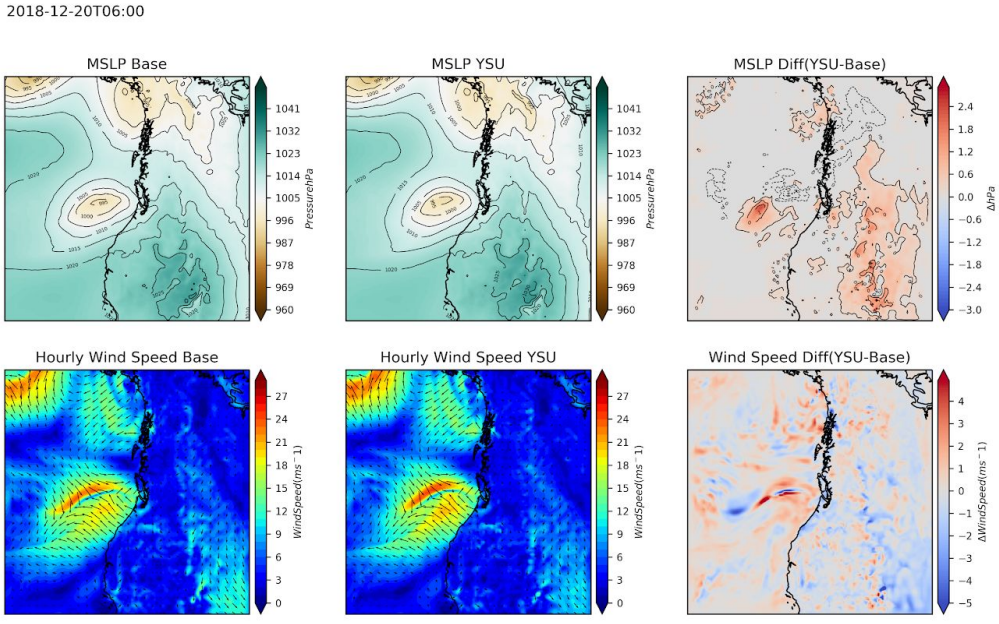

Figure 6

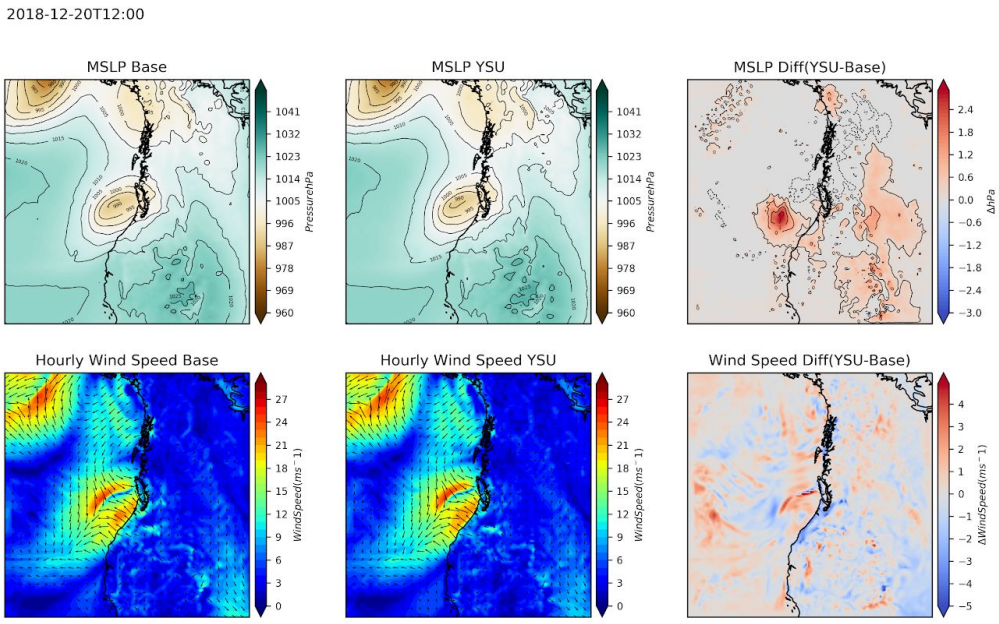

Figure 7

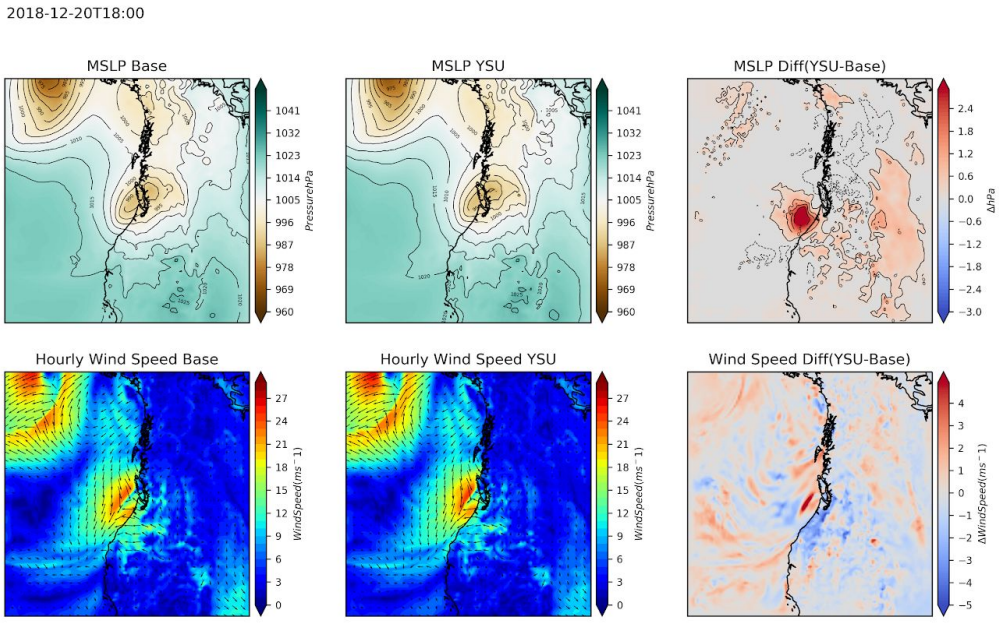

Figure 8