**NWP WRF assignment**

**January 2020**

**Eve Wicksteed**

**WRF Comparison of Two Planetary Boundary Layer (PBL) Schemes**

I use the MYNN2 PBL scheme, along with the appropriate surface layer physics scheme (sf\_sfclay\_physics 5) to run WRF and compare it to the tutorial case where we use the default CONUS settings: MYJ PBL scheme.

I look at various standard variables: precipitation, temperature, wind, and surface pressure to compare the results.

I have generated two plots for each different run at every time step of the simulation, which ran from 18 December 2018 to 22 December 2018 with an hourly time step. Select plots are available in the table below. The plots show certain times for the tutorial case (left, using the MYJ PBL scheme) and my specific case (right, using the MYNN PBL scheme). The dates and times are show in the table. The two plots show 4 different variables: the first and smaller plot shows accumulated precipitation, and the second, larger plot shows 2m temperature (shaded contouring), wind vectors (arrows), and mean sea level pressure (MSLP; black contours). I have plotted accumulated precipitation (from 18/12/2018 00:00) in order to see the variable over the whole time period. I have made sure to have the same ranges for both simulations when plotting the variables so that it is possible to visibly compare the figures.

There is also a plot for each run of hourly precipitation at one time step at the bottom of the report.

The full WRF run was from 18 December 2018 to 22 December 2018; however, I have chosen to only look at data between 19 and 21 December, when the storm was at its strongest.

There are not very noticeable differences between the two runs with different PBL schemes. The main visible differences are in the precipitation field. There are also some slight differences in the surface pressure fields.

The difference is precipitation is visible in its location. In the top left corner of the domain the MYJ scheme has less precipitation and more areas with no precipitation when compared to the MYNN simulation. In general it looks like the MYNN scheme simulates more precipitation as it also has more accumulation over land on the right hand side of the domain. The differences are more evident earlier on in the simulation and the simulations look more similar at the last time step I compare (21 December 2018 – 11am). The locations of the scattered precipitation cells on the right hand side of the domain are quite different at many of the time steps in the model.

The wind vectors look fairly similar between the two PBL scheme runs. There may be small differences between the two, likely stemming from a difference in the pressure fields, but it’s hard to seem them.

The pressure field also doesn’t look too different, however there looks like a difference starting at 8pm on December 20, where the MYNN scheme run shows the high pressure centre over Vancouver strengthening more than the one in the MYJ run. There are also a few differences in the location of the pressure centres and contours, specifically in the last three images (20 Dec - 8pm, 21 Dec - 5am, 21 Dec - 11am).

It is also hard to see any temperature differences between the two runs. Perhaps the only visible difference is that the temperatures in the MYJ run look a bit cooler than in the MYNN run (more darker shades of blue).

Overall it’s hard to visibly see differences between the runs, but quantitative metrics would make it easier to see the differences.

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| **PBL scheme**  **Time** | **MYJ** | **MYNN** |
| **19 December 2018** | | |
| **12:00** | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-19-12-00_MYJ.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYJ_IDV:image_5_2018_12_19_12_00_00Z.jpg | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-19-12-00_MYNN.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYNN_IDV:image_83_2018_12_19_12_00_00Z.jpg |
| **15:00** | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-19-15-00_MYJ.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYJ_IDV:image_8_2018_12_19_15_00_00Z.jpg | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-19-15-00_MYNN.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYNN_IDV:image_86_2018_12_19_15_00_00Z.jpg |
| **18:00** | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-19-18-00_MYJ.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYJ_IDV:image_11_2018_12_19_18_00_00Z.jpg | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-19-18-00_MYNN.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYNN_IDV:image_89_2018_12_19_18_00_00Z.jpg |
| **20 December 2018** | | |
| **01:00** | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-20-01-00_MYJ.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYJ_IDV:image_18_2018_12_20_01_00_00Z.jpg | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-20-01-00_MYNN.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYNN_IDV:image_96_2018_12_20_01_00_00Z.jpg |
| **08:00** | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-20-08-00_MYJ.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYJ_IDV:image_25_2018_12_20_08_00_00Z.jpg | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-20-08-00_MYNN.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYNN_IDV:image_103_2018_12_20_08_00_00Z.jpg |
| **20:00** | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-20-20-00_MYJ.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYJ_IDV:image_37_2018_12_20_20_00_00Z.jpg | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-20-20-00_MYNN.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYNN_IDV:image_115_2018_12_20_20_00_00Z.jpg |
| **21 December 2018** | | |
| **05:00** | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-21-05-00_MYJ.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYJ_IDV:image_46_2018_12_21_05_00_00Z.jpg | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-21-05-00_MYNN.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYNN_IDV:image_124_2018_12_21_05_00_00Z.jpg |
| **11:00** | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-21-11-00_MYJ.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYJ_IDV:image_51_2018_12_21_10_00_00Z.jpg | Macintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:figs:2018-12-21-11-00_MYNN.pngMacintosh HD:Users:ewicksteed:Documents:Eve:NWP:wrf_HW:IDV:MYNN_IDV:image_129_2018_12_21_10_00_00Z.jpg |

**Figure 1:** Comparison of two WRF runs with different PBL schemes. The first and smaller plot shows accumulated precipitation, and the second, larger plot shows 2m temperature (shaded contouring), wind vectors (arrows), and mean sea level pressure (MSLP; black contours).

The following two images show hourly precipitation for 5am on 21 December 2018. There a slight differences in the shapes of the rain bands and the amount of precipitation. The MYNN run has a thinner rain band with higher precipitation values. The MYJ run has thicker rain bands with lower precipitation amounts. However, the top left hand rain bands are fairly similar in both runs.

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| **21 December 2018 5am** | |
| **MYJ** | **MYNN** |
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**Figure 2:** Comparison of two WRF runs with different PBL schemes. The plots show hourly precipitation at 5am on 21 December 2018.