

# IDV Instructions for WRFV4

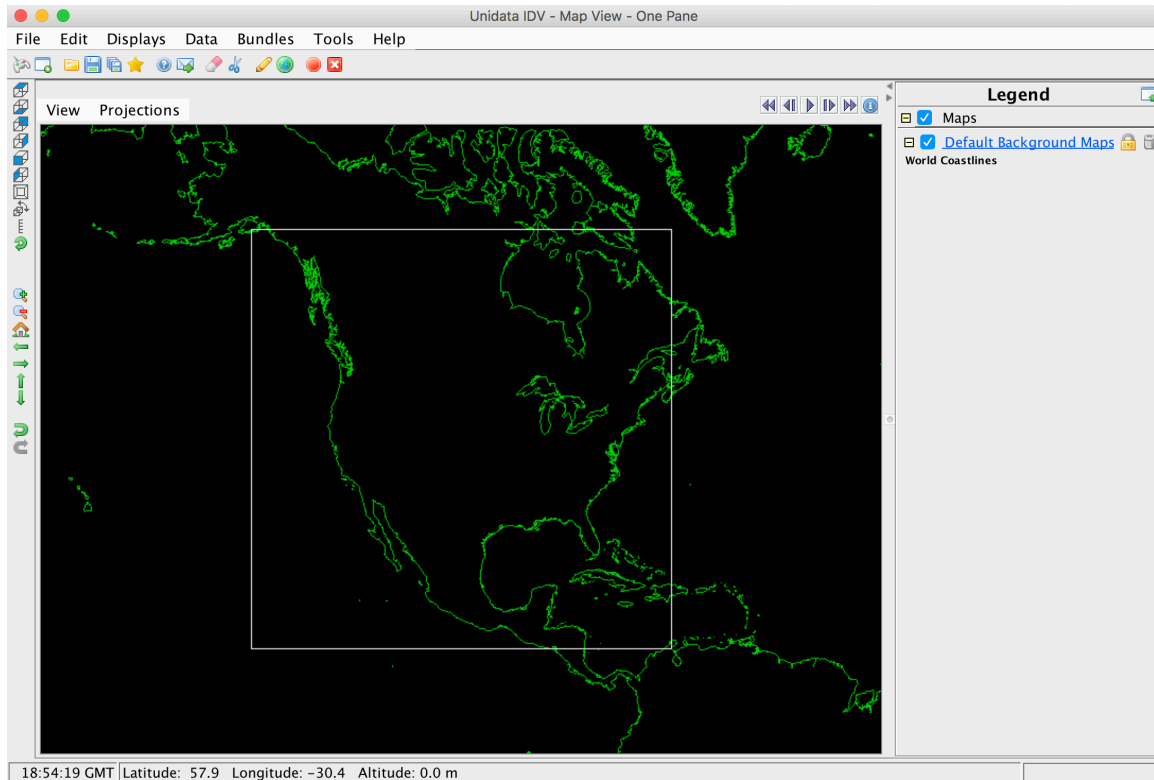
Updated: January 2023

## Preliminaries

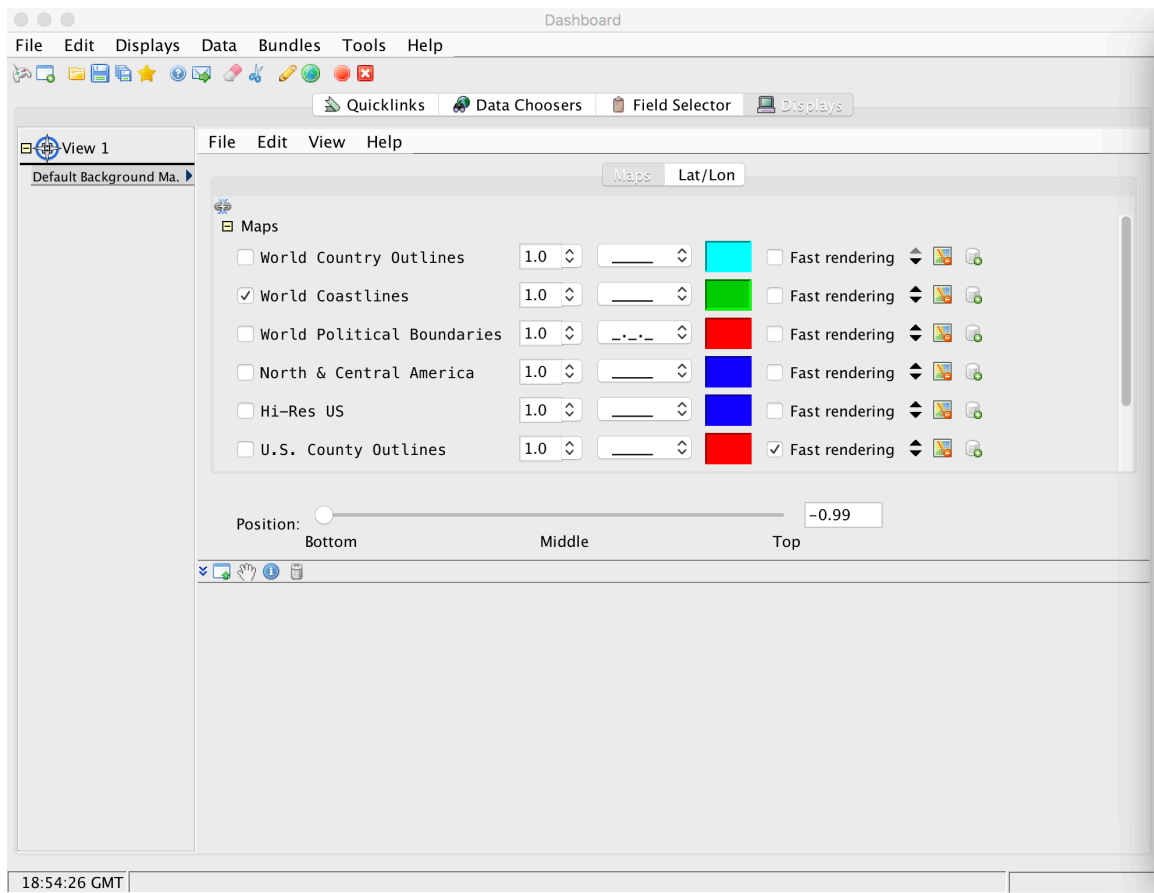
- Ensure that you've downloaded the required sample wrfout files to your laptop
  - `mkdir wrfouts_original`
  - `cd wrfouts_original`
  - `scp`  
`username@optimum.eos.ubc.ca:/data/rstull/shared/ATSC507/WRF/wrfout_d01_2018-12-20* .`
    - All on one line
  - `scp`  
`username@optimum.eos.ubc.ca:/data/rstull/shared/ATSC507/WRF/wrfout_d01_2018-12-21* .`
    - All on one line
  
  - Total: 2.8 GB
- Download IDV and install onto your computer
  - <https://www.unidata.ucar.edu/downloads/idv/current/index.jsp>

## IDV Basics

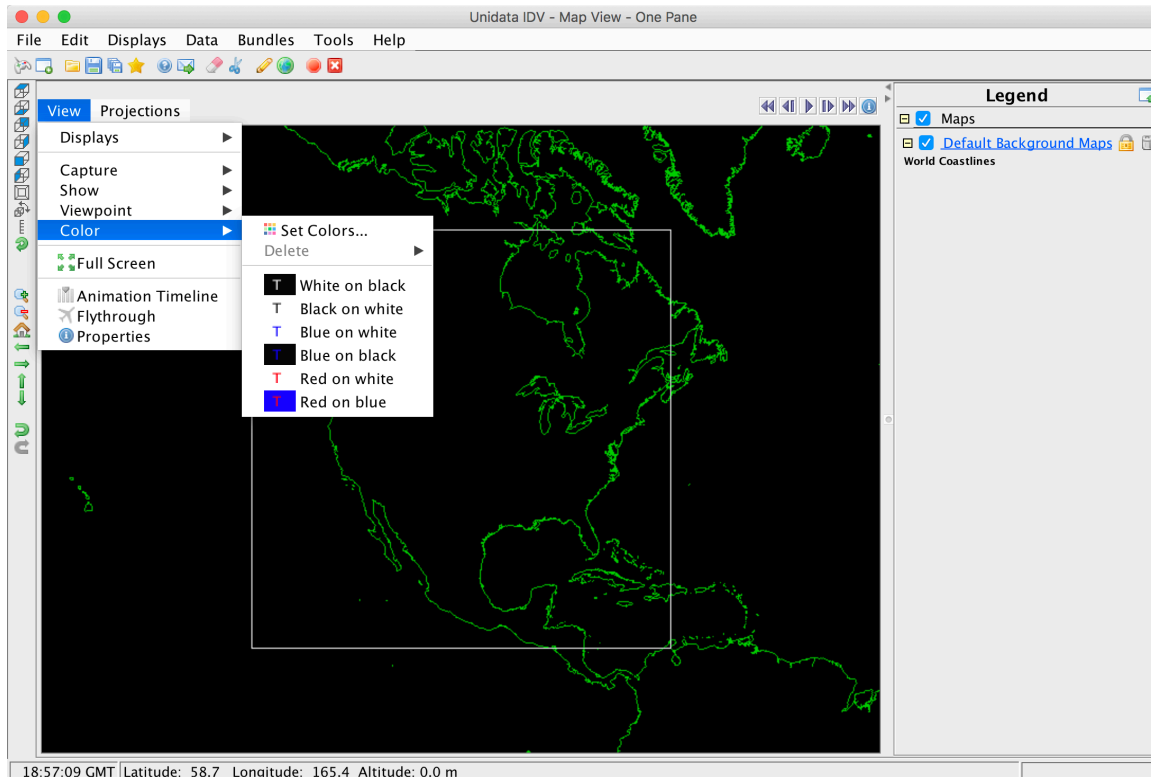
- When you first open up IDV, you should see two windows pop up:



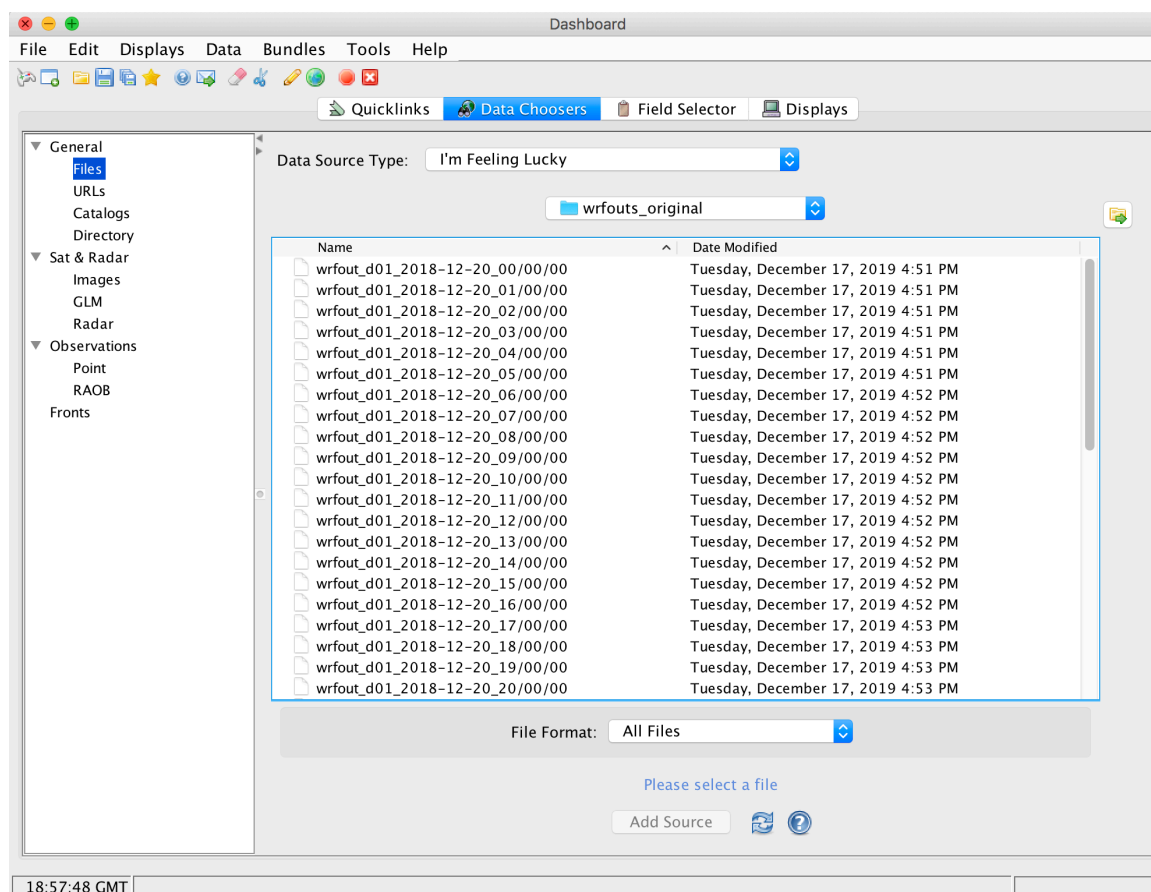
- This is the Map View, and will show the bulk of the plots you make



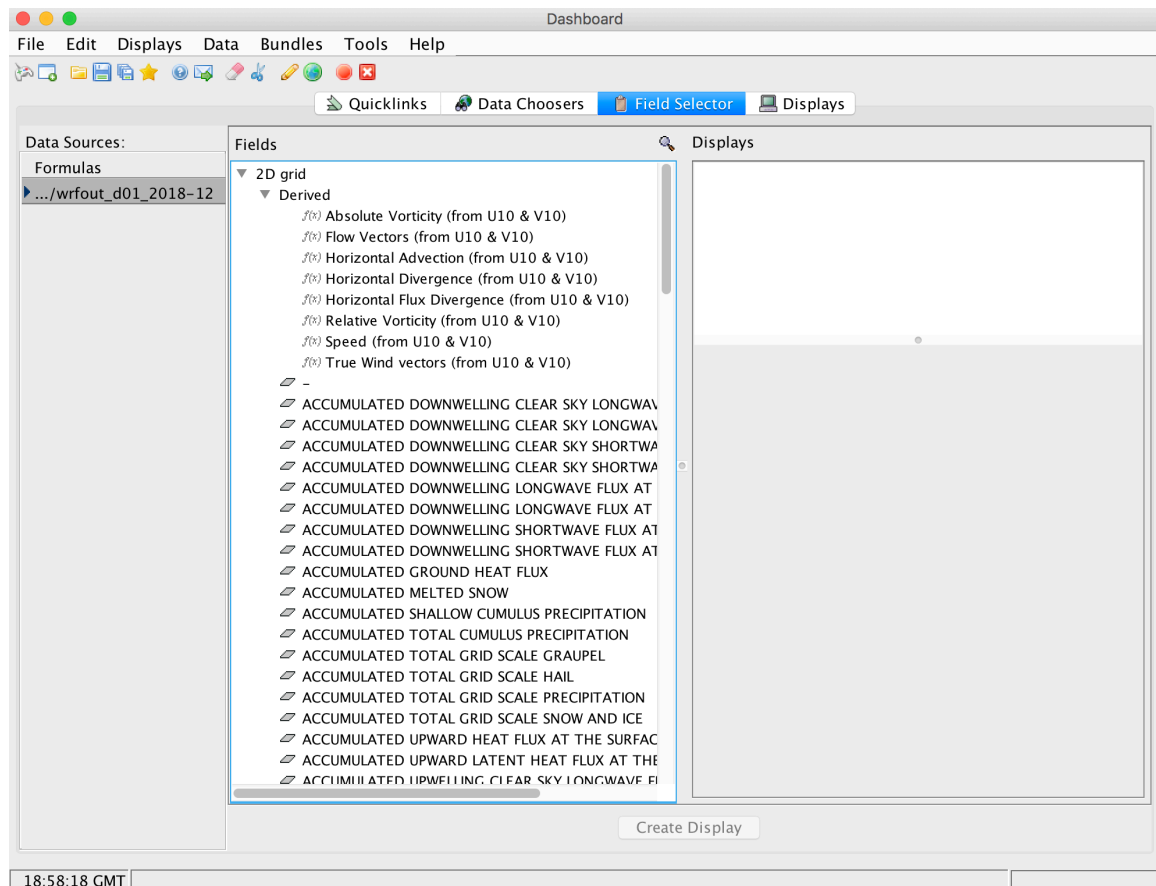
- This is the Dashboard. This window provides most of the settings for the plots you'd make in the Map View



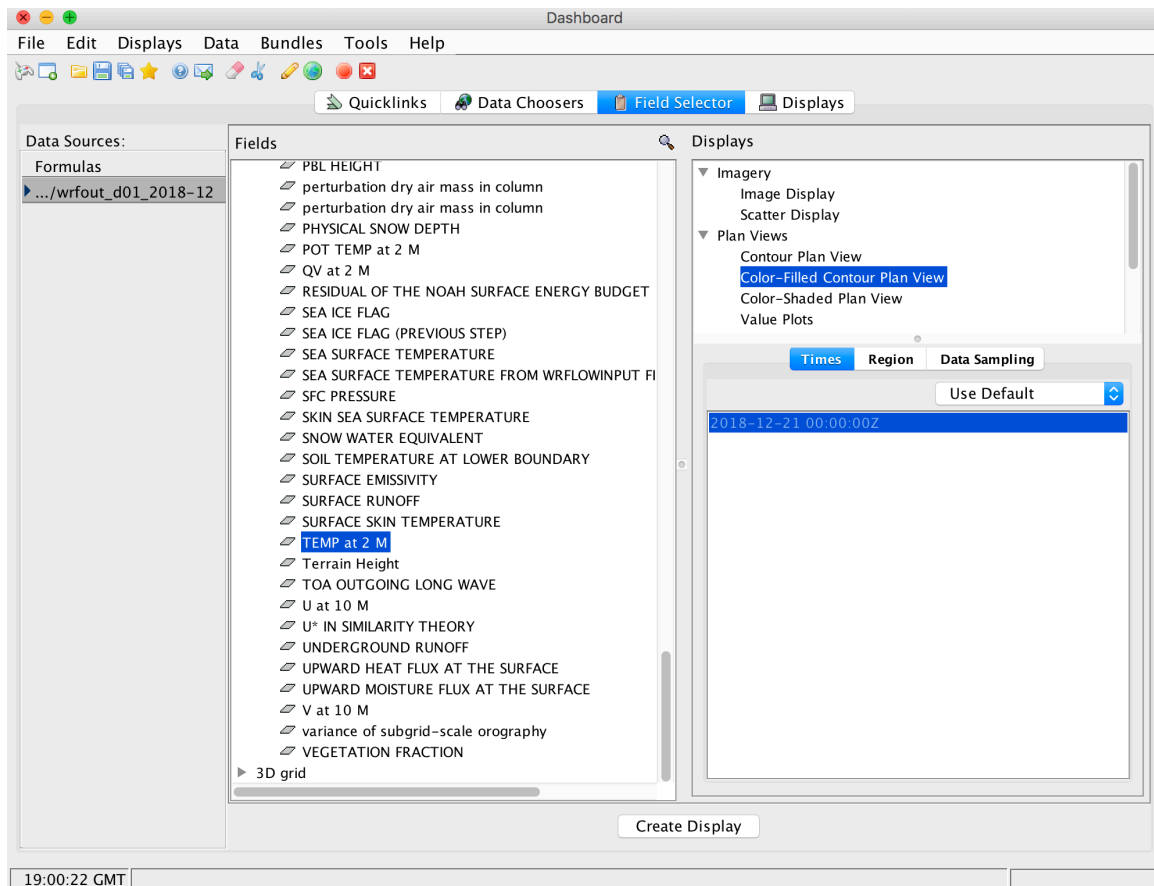
- The black background isn't that great to work with, so let's give the Map View a white ocean background
  - "View" > "Color" > "Blue on white"



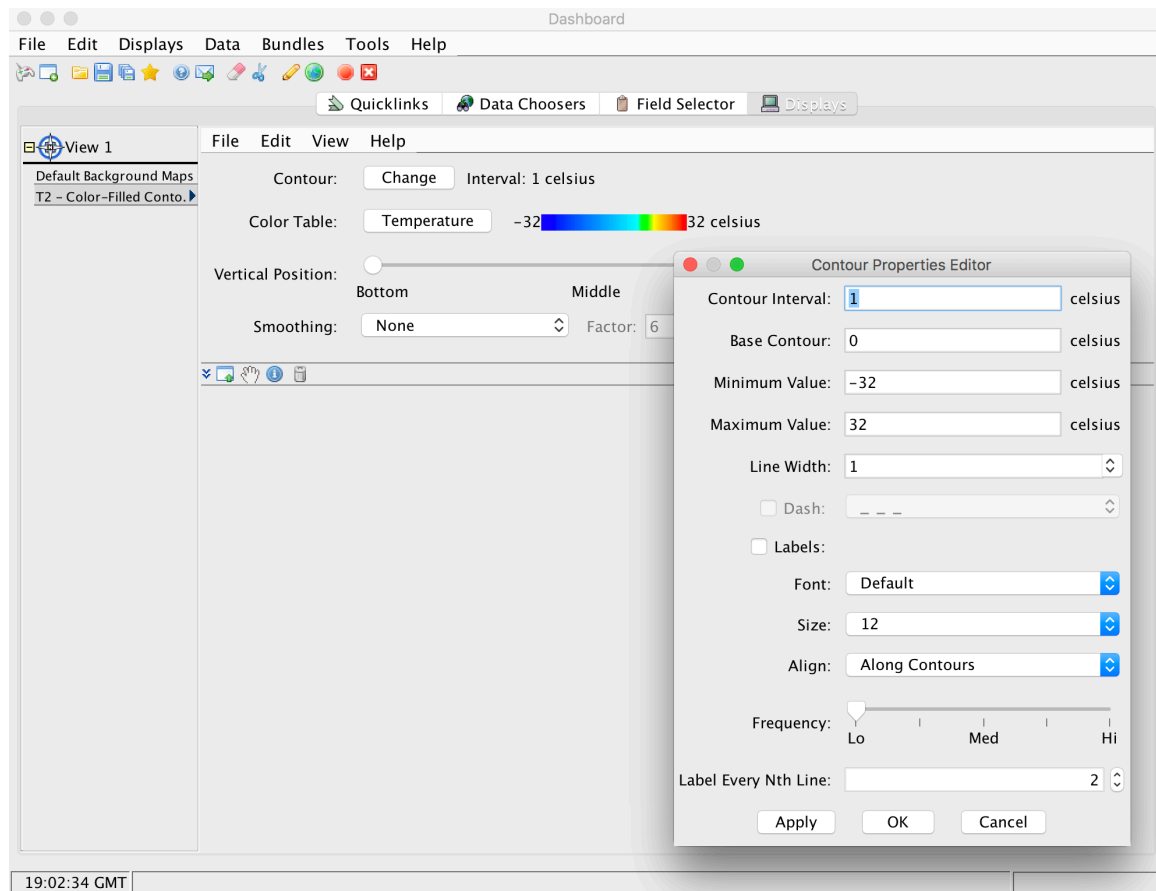
- Now on the dash board, click “Data Choosers”
- Navigate to where your wrfout files are stored, and click on the file wrfout\_d01\_2018-12-21\_00:00:00
- Click “Add Source”, and hit OK when prompted



- You should then be taken to the “Field Selector” tab. You will see 2D grid and 3D grid as options
- Click the arrow next to 2D grid. You will see a whole bunch of raw 2D fields available, as well another arrow for Derived fields

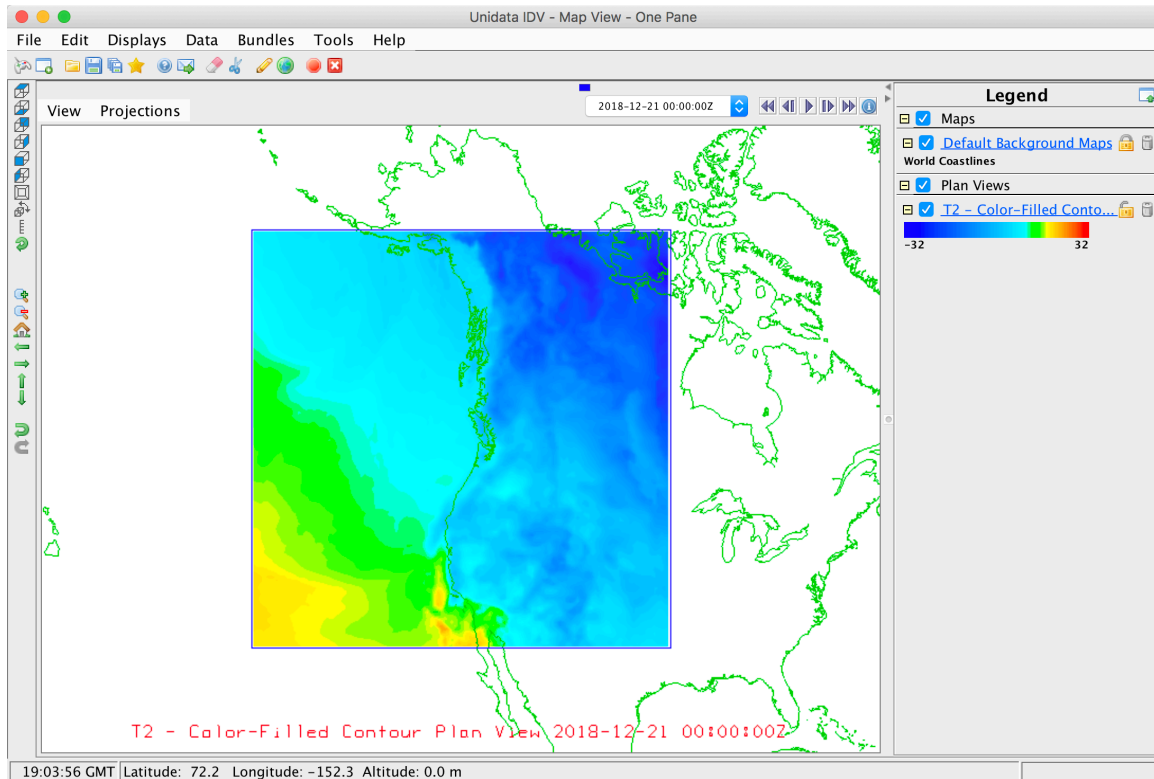


- Let's start simple with 2-m temperature. Click "TEMP at 2 M", then under "Plan Views" choose "Color-Filled Contour Plan View"
- At the bottom, click "Create Display"

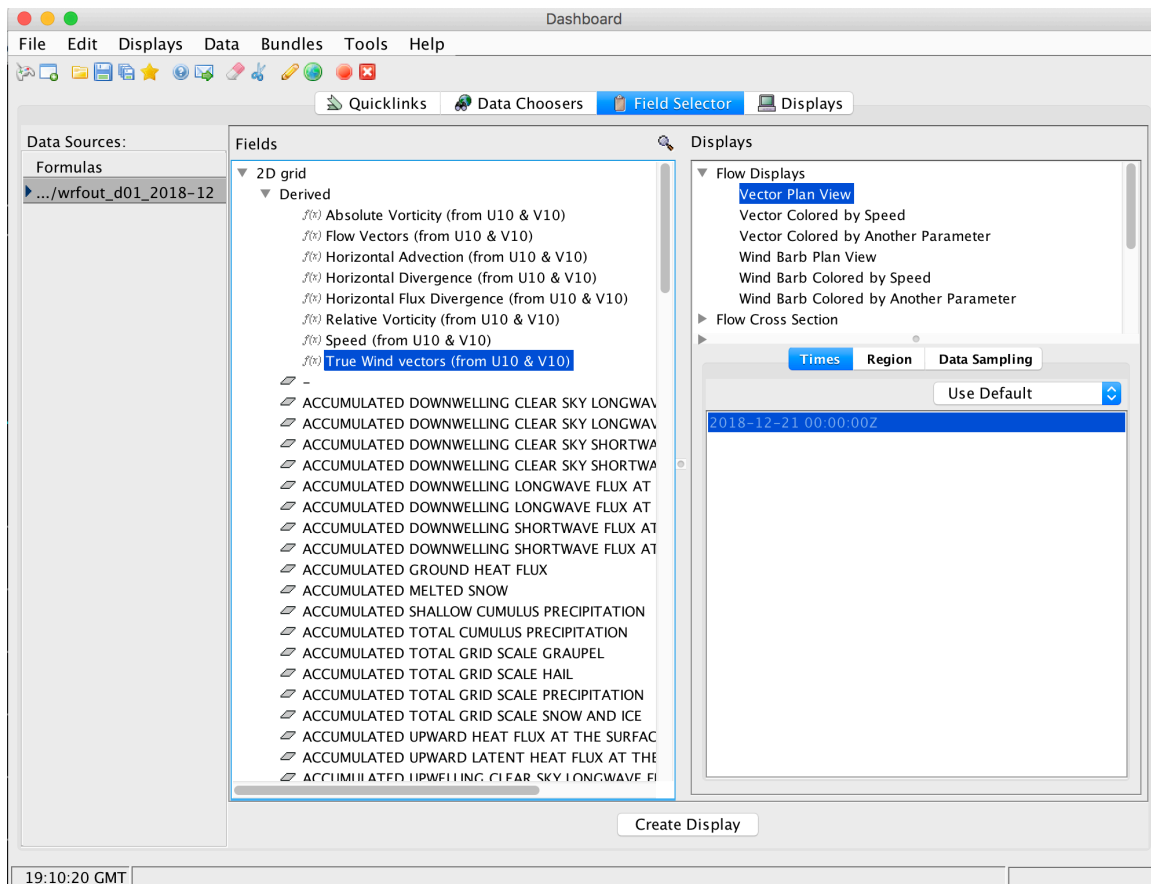


- You should see a plot created in Map View, but we can make it a whole lot nicer
- On your Dashboard, under the “Displays” tab, “Change” the contour settings with the same settings as what you see above
- For “Temperature” next to “Color Table”, change the range from -32 and 32, as seen above

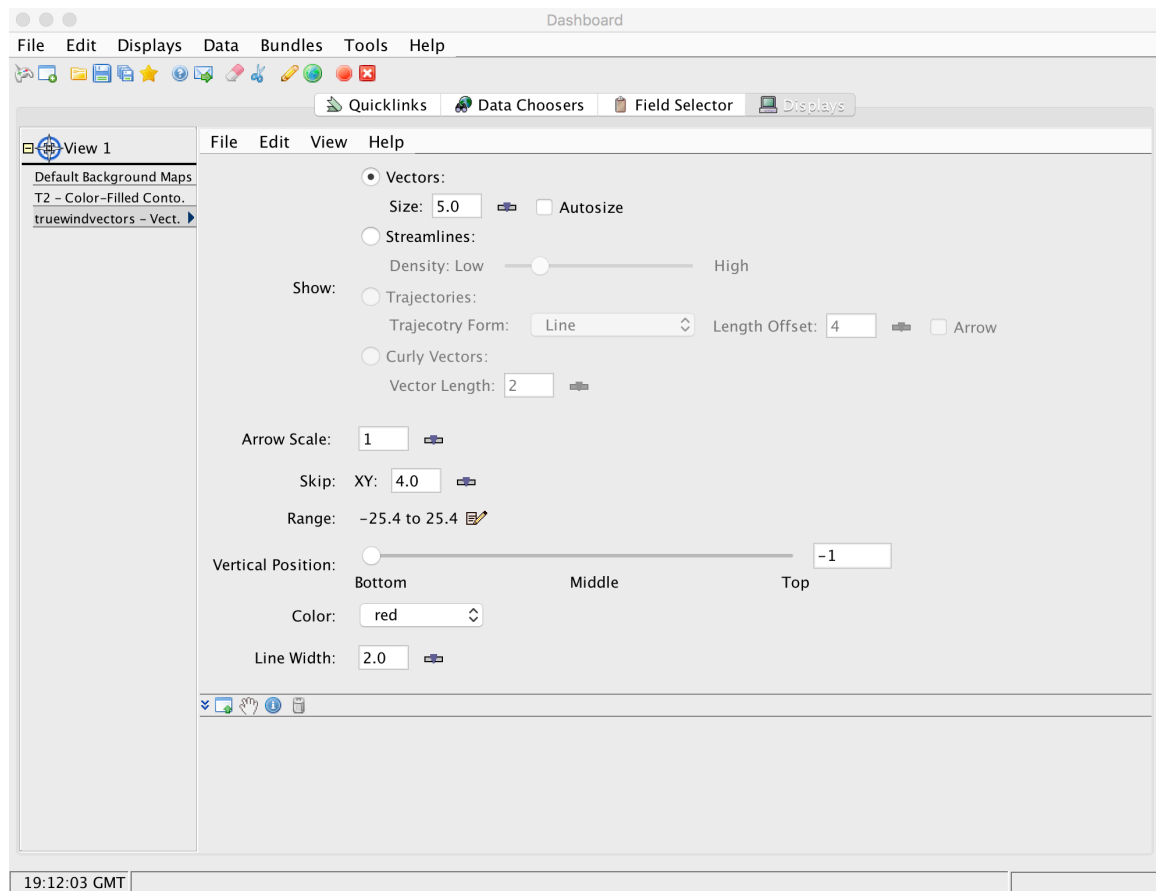




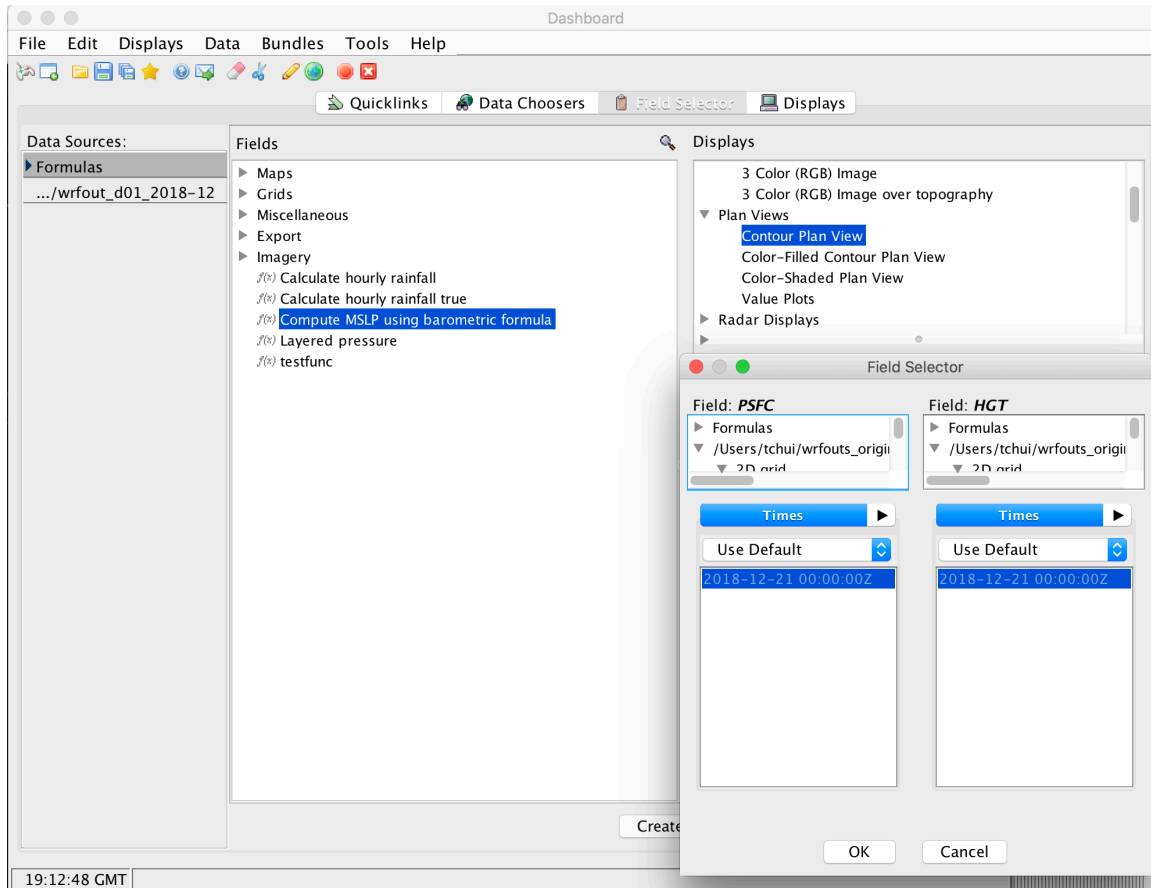
- Your Map View should now look something like this, with much finer contours than before
- Note that the plot is rotated from the map we saw from the beginning; that's because we're plotting using the domain's projection (polar stereographic)



- Now let's add some wind vectors to the plot
- Under "Field Selector" on your Dashboard, click the arrow next to "Derived", and choose "True Wind vectors (from U10 & V10)"
- Choose "Vector Plan View", and then "Create Display"



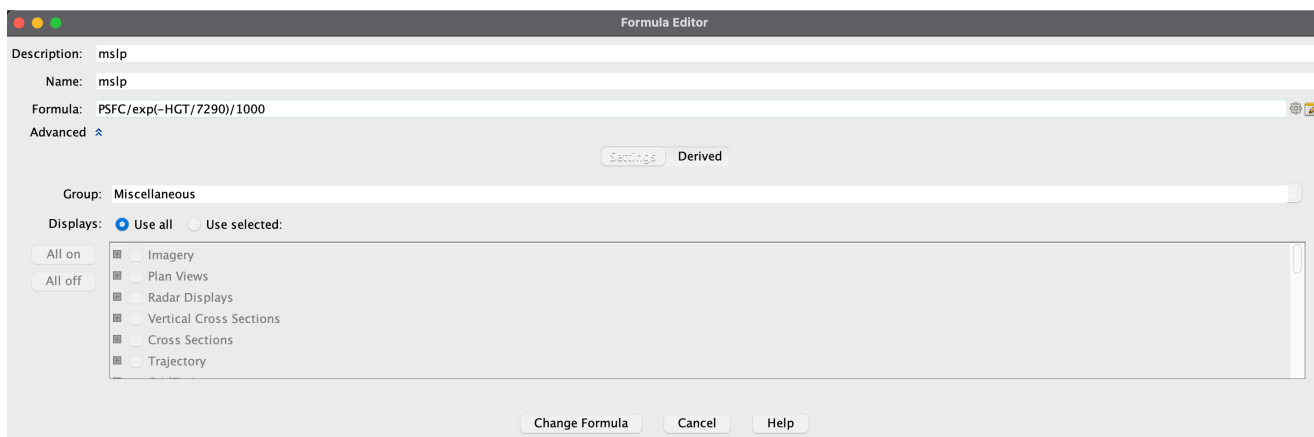
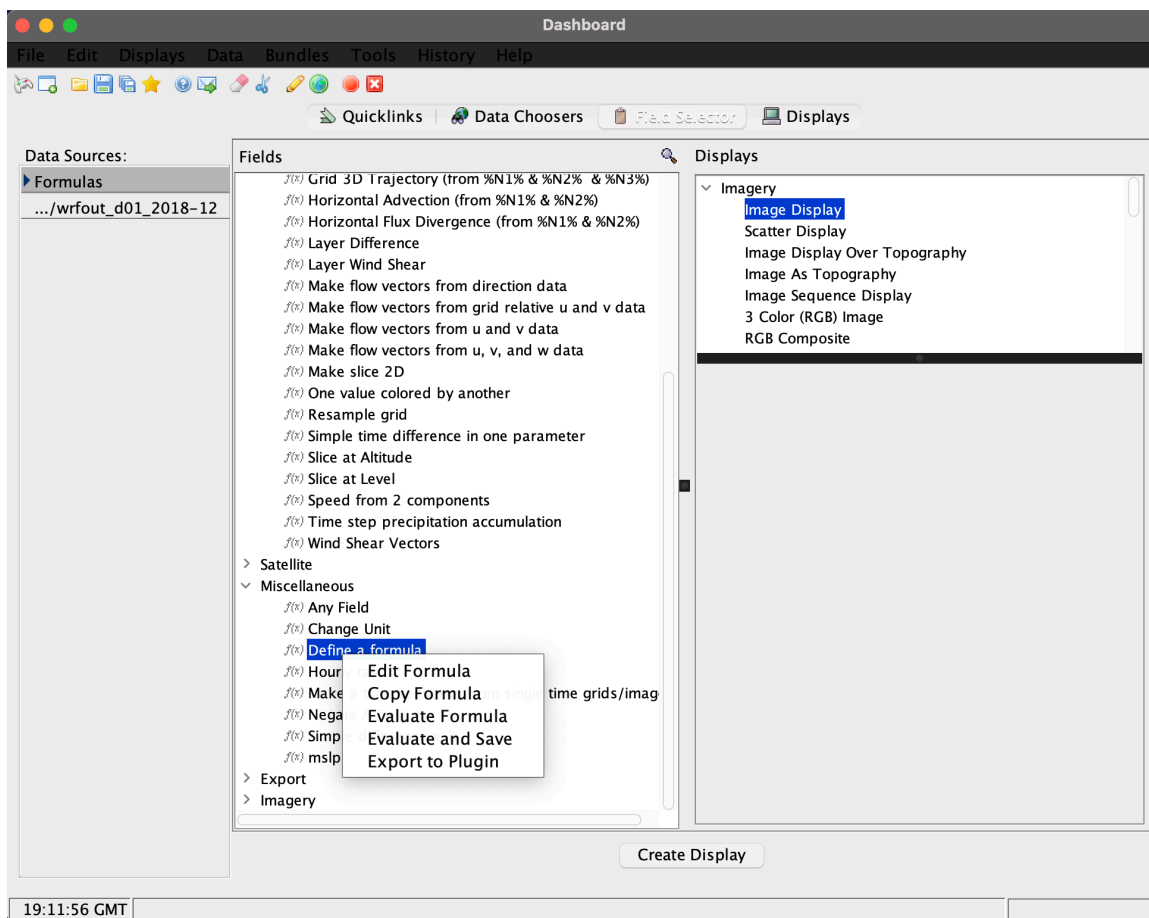
- The vectors in Map View should be barely visible. We can fix that under the “Displays” tab on your Dashboard
- Firstly, we don’t need one vector for each grid point, that’s just too much. Next to “Skip”, change “XY:” to 4.0
  - This plots one vector for every 4<sup>th</sup> grid point
- We can make the vectors bigger by changing “Size:” to 5.0
- ...and make the arrows thicker by changing “Line Width:” to 2.0
- Finally, let’s change the “Color” of the arrows to red
- Your vectors should now show up much nicer on the Map View, but let’s plot one final thing before seeing it again



- We want to plot MSLP, but MSLP is not a raw model field, nor is it automatically derived in IDV
- **\*\*\* The workflow to compute MSLP is different depending on your IDV version\*\*\***

### **COMPUTE MSLP - OLDER VERSIONS OF IDV**

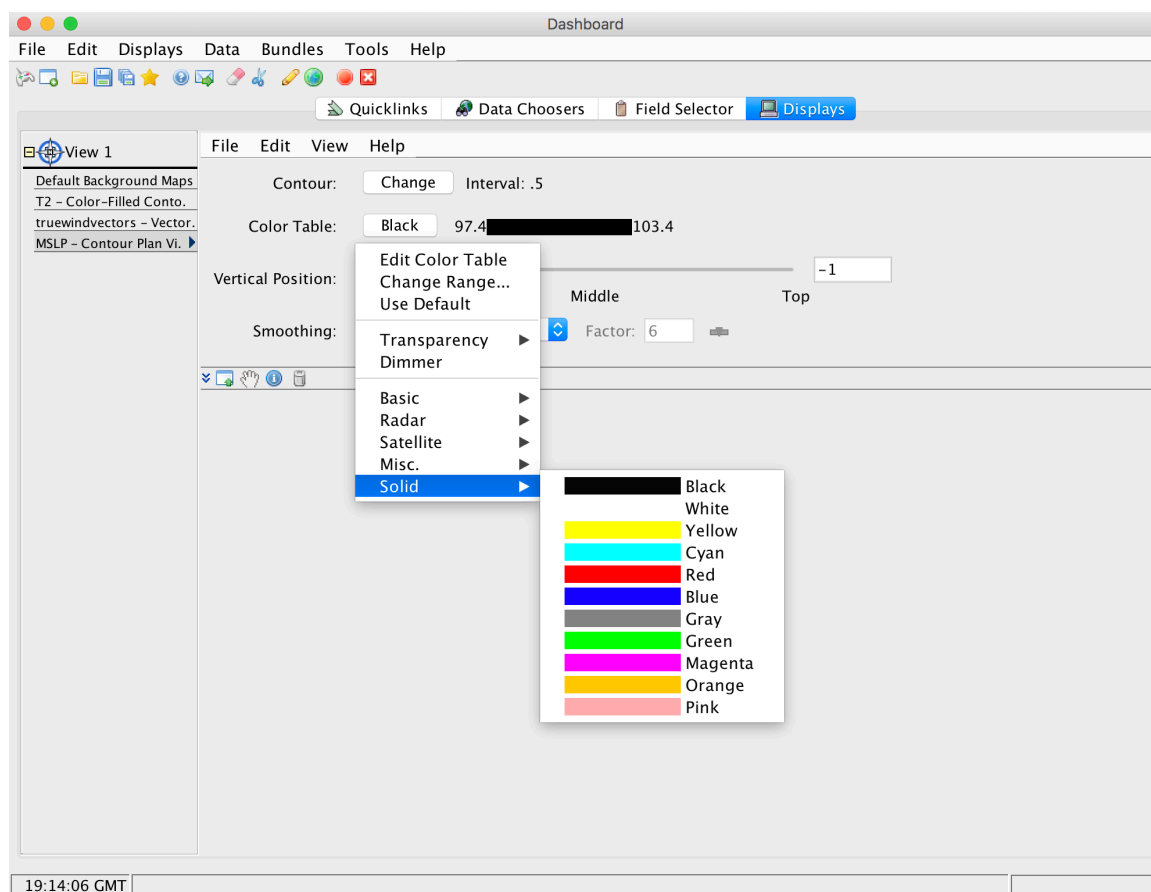
- On the very left of your Dashboard, you should see a “Formulas” tab. Click it, and look under the “Imagery” option in the “Fields” panel
- You should see “Compute MSLP using barometric formula”. This is an example formula that IDV has pre-made. You can create your own Formula to derive your own variables (we’ll do this with precipitation later).
- Choose it, then choose “Contour Plan View”.
- “Create Display”, then hit “OK” for all options. You will notice that you’re deriving MSLP from PSFC (surface pressure) and HGT (terrain height)



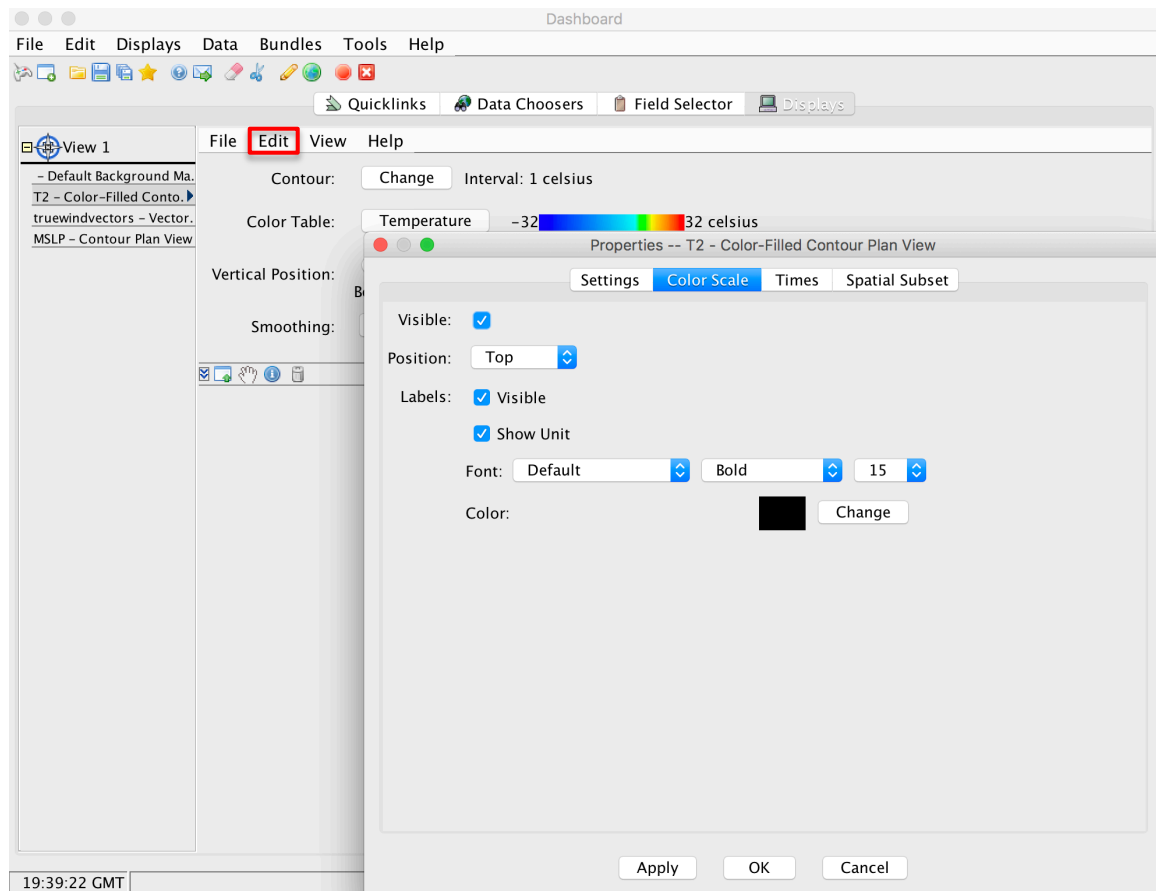
## **COMPUTING MSLP - NEWER VERSIONS OF IDV (6.0+)**

- On the very left of your Dashboard, you should see a “Formulas” tab. Click it, and look under the “**Miscellaneous**” option in the “Fields” panel
- You should see “Define a formula.” Right-click, and choose “Copy Formula.”

- In the Formula Editor, change the Description and Name fields to “mslp.” Then, insert the formula into the Formula box as follows:
  - $PSFC/\exp(-HGT/7290)/1000$
  - This will compute the mean sea level pressure in kPa, assuming a dry and isothermal atmosphere
- Click “Change Formula”.
- Now choose “mslp” in the Fields panel (under “Miscellaneous”), then choose “Contour Plan View”.
- “Create Display”, then hit “OK” for all options. You will notice that you’re deriving MSLP from PSFC (surface pressure) and HGT (terrain height)

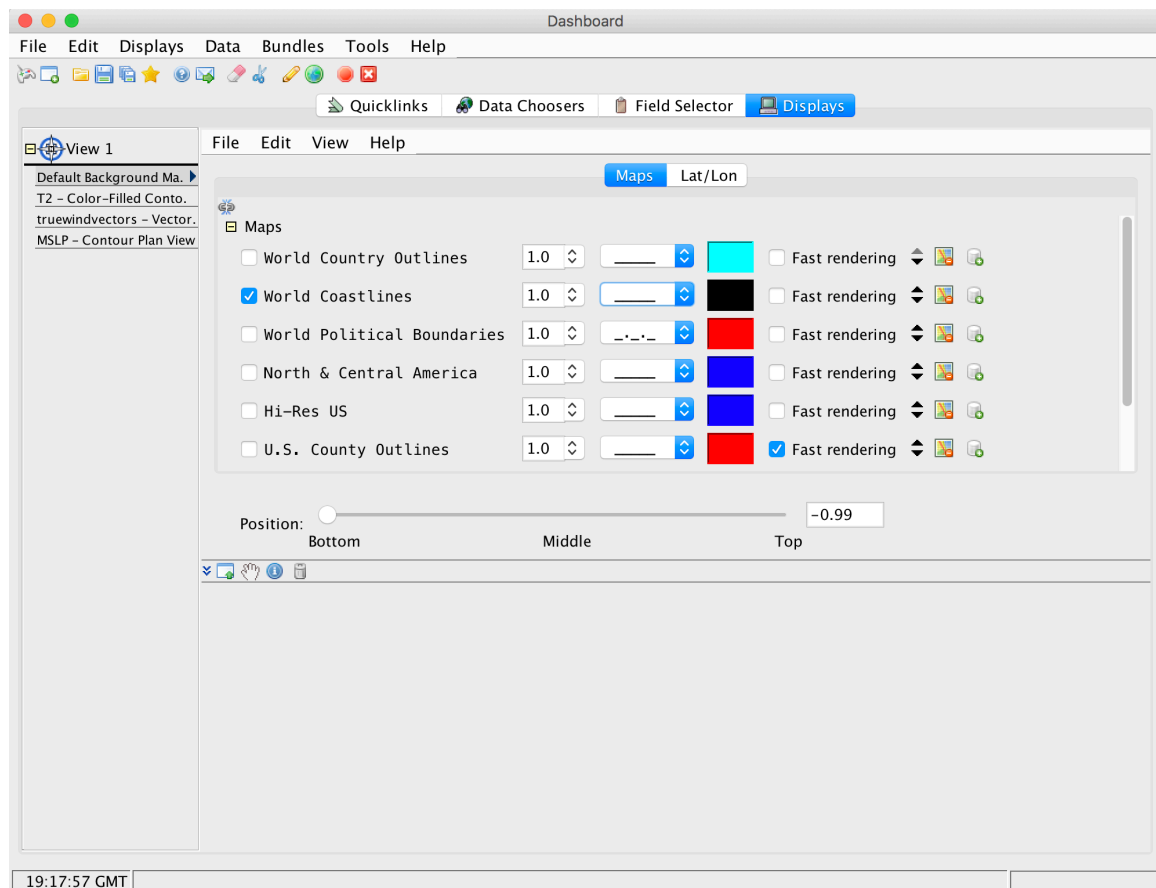


- Again, the default plot will look ugly and be barely visible
- Under the “Displays” tab, change the contour interval to 0.5
- Under “Color Table”, choose “Solid” > “Black”
  - This enforces a single color for all contours; better, since temperature is already color-filled contours

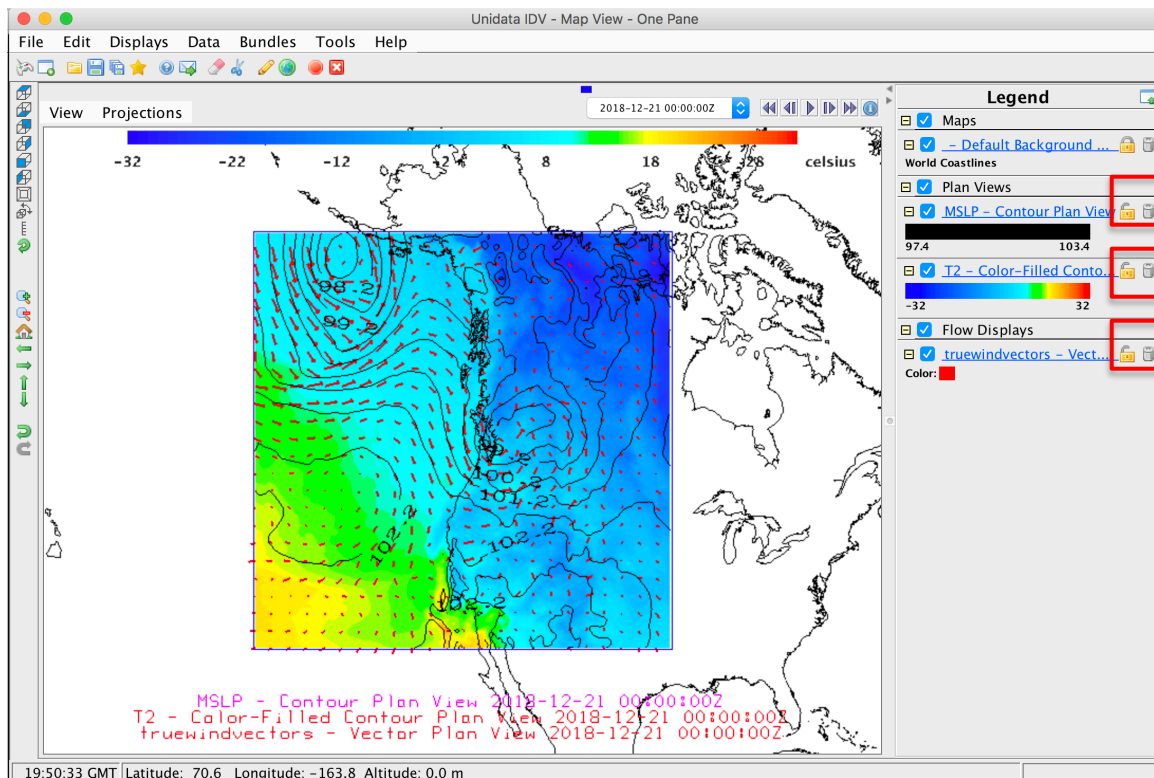


- Before we finalize our plot, let's add a colorbar for our temperature contours as well
- On the left, under "View 1", choose "T2 - Color-Filled Contour"
- Click the "Edit" button marked by the red box in the image above, and choose "Properties"
- Click the "Color Scale" tab. Check "Visible" and "Show Unit". Change the Position to "Top"
- Change the font color to black, make it bold, and increase its font size to 15

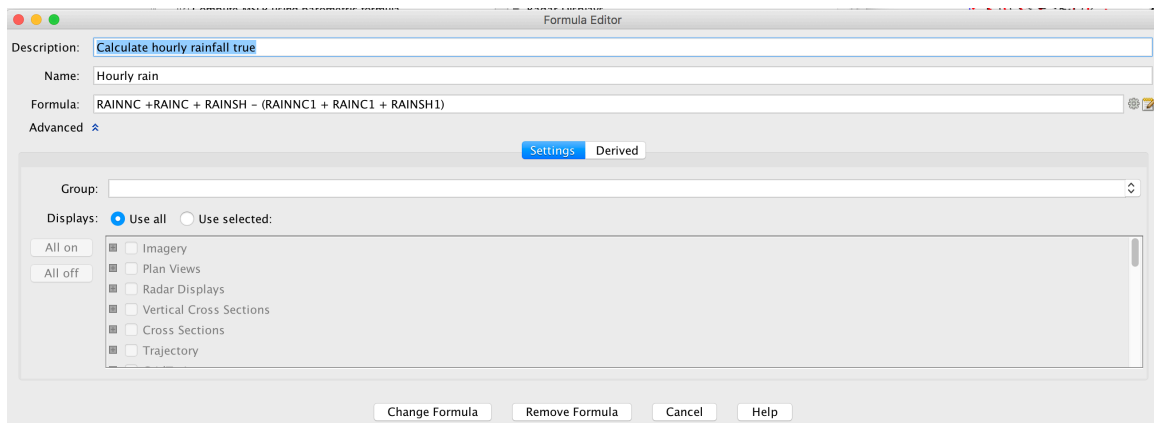




- One last thing: because the coastline colors are green by default, it makes the continent difficult to see underneath the temperature contours
- In the “Displays” tab, choose “Default Background Map” on the left under “View 1”
- For the color box next to “World Coastlines”, change to black



- And there you have it! A plot of MSLP, 2-m temperature and 10-m wind vectors all on one panel, with a temperature colorbar placed at the top. Not the prettiest plot in the world, but it works.
- Congrats on making your first 2D contour plot in IDV!
- Feel free to make this plot with other times as well, or explore other 2D fields.
- Once you're done, you can click the trash cans highlighted by the red boxes above to get rid of the layers; keep the Default Background map

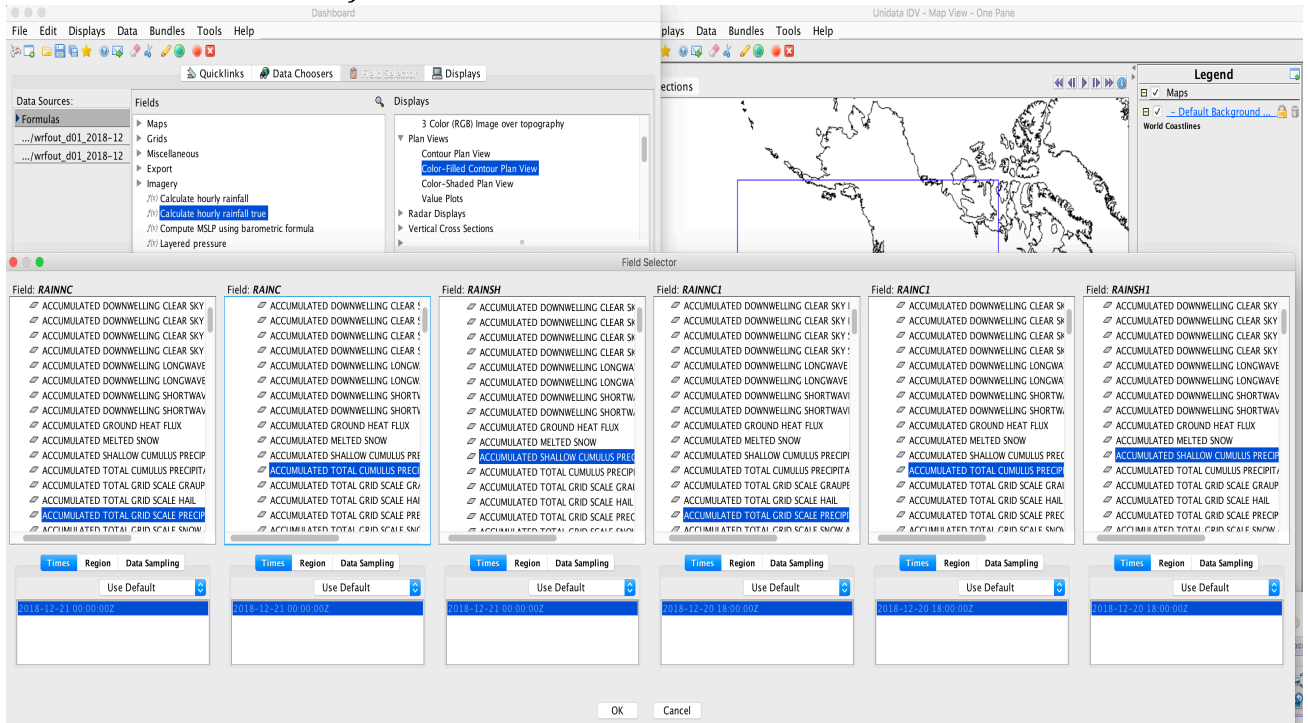


- Now, we want create an accumulated precipitation plot.
- Precipitation in wrfout files is accumulated from the very first wrfout file; hence, to plot hourly or 3-hourly or 6-hourly precipitation, we need to do some simple subtraction
- Precipitation is also divided into three main variables: RAINNC (grid-scale precipitation, computed from the microphysics scheme), RAINC (cumulus precipitation, computed from the cumulus scheme), RAINSH (shallow cumulus precipitation, computed from the shallow cumulus scheme, if applicable)
  - Accumulated precipitation between current time and some previous time =  $(RAINNC + RAINC + RAINSH)_{\text{current time}} - (RAINNC + RAINC + RAINSH)_{\text{previous time}}$
  - None of our files should have a shallow cumulus scheme turned on, so RAINSH should be uniformly 0, but we'll pretend that it's on anyway for our calculations
- On your Dashboard, go back to "Field Selector" > "Formulas"

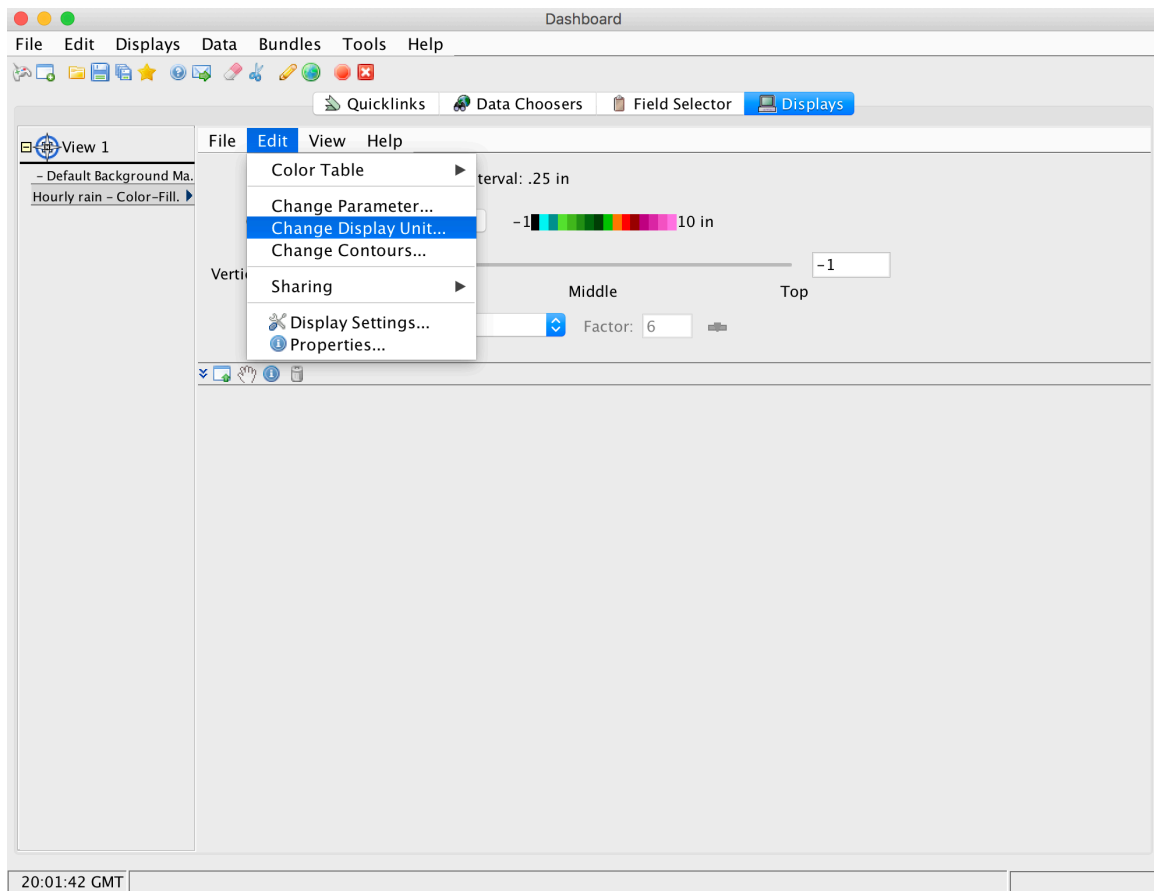
Right-click on "Calculate hourly rainfall" (**OLDER VERSIONS OF IDV**)/"Define a formula" (**NEWER VERSIONS OF IDV**) and choose "Copy Formula"

- "Calculate hourly rainfall" does add up RAINNC + RAINC + RAINSH, but does not subtract from some previous time; hence, it's actually the total accumulated precipitation up to that point
- We need to do the subtraction ourselves
- Change the Description and Formula to what you see in the image above

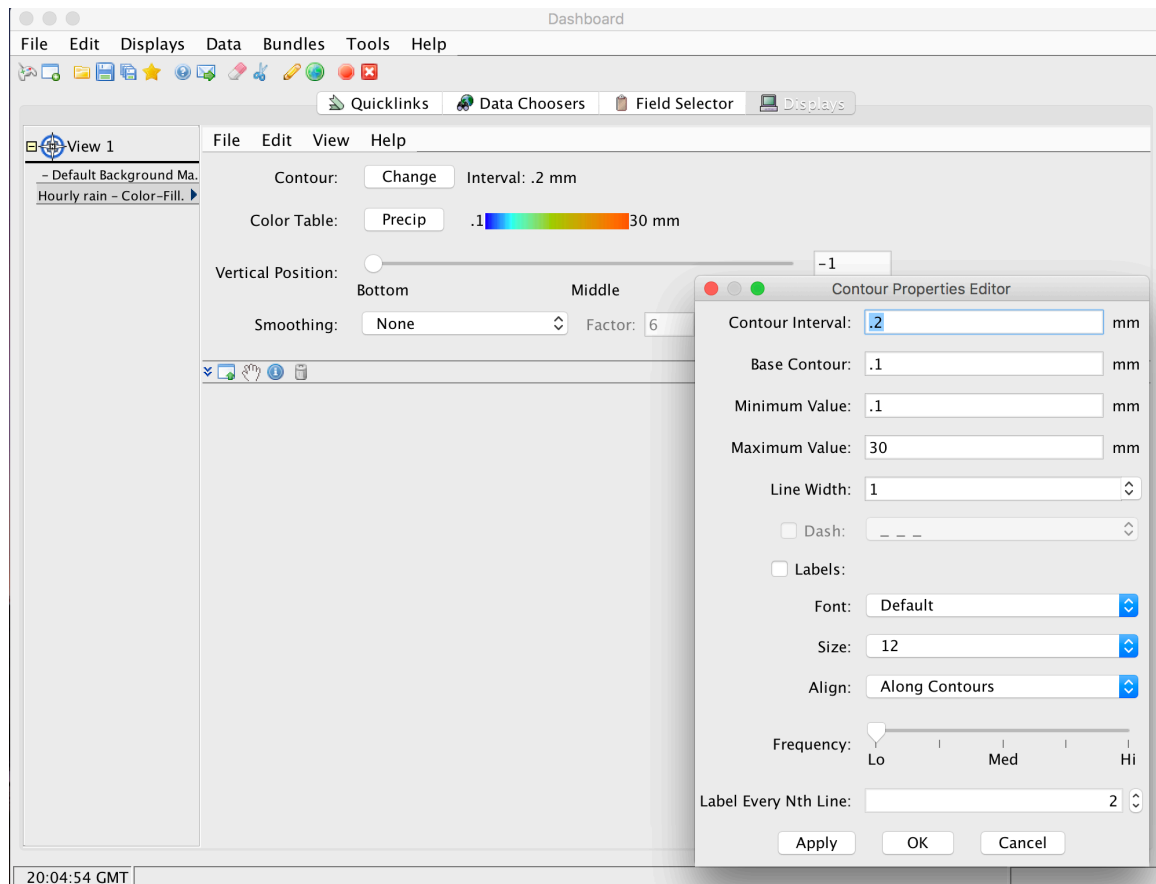
- Formula = RAINNC + RAINC + RAINSH - (RAINNC1 + RAINC1 + RAINSH1)



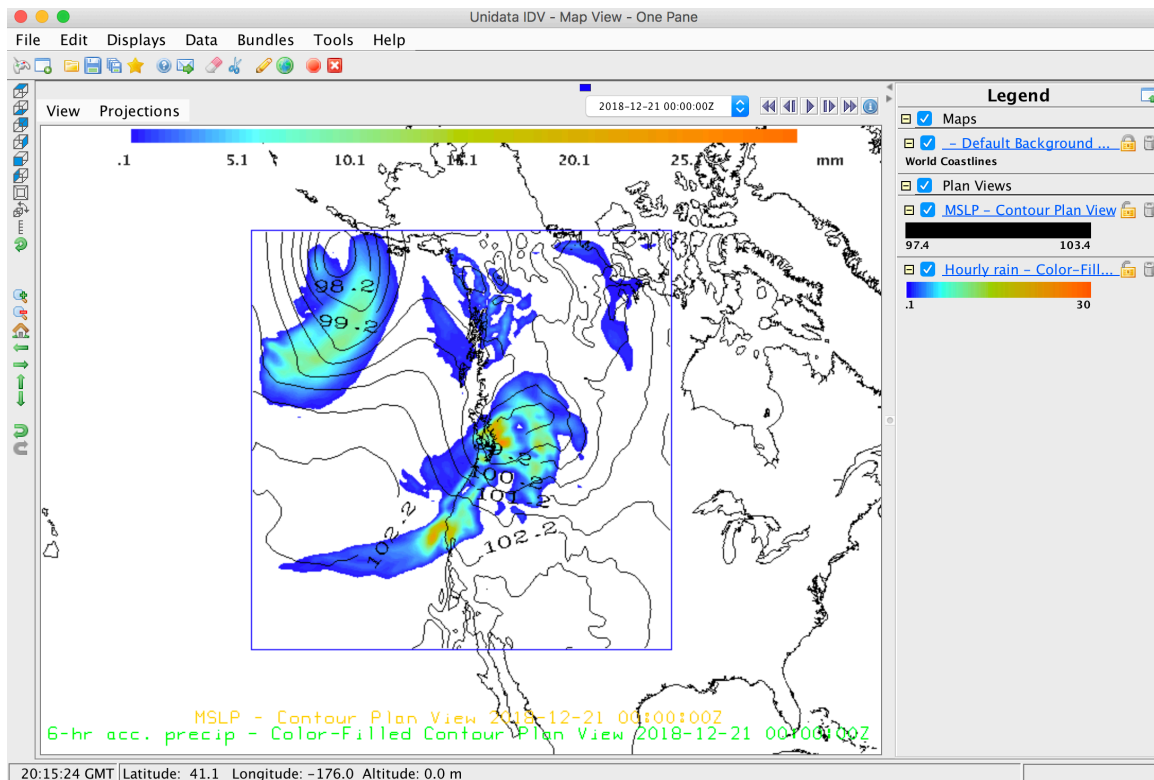
- **Go back to Data Choosers, and load out wrfout\_d01\_2018-12-20\_18:00:00, so that we can make a 6-hour accumulated precipitation plot**
- Now in Formulas, choose your newly created Formula “Calculate hourly rainfall rate”, and select “Color-Filled Contour Plan View”
- Manually select the correct fields for the current time (wrfout\_d01\_2018-12-21\_00:00:00 → ACCUMULATED TOTAL GRID SCALE PRECIPITATION, ACCUMULATED TOTAL CUMULUS PRECIPITATION, ACCUMULATED SHALLOW CUMULUS PRECIPITATION) as well as for the previous time (wrfout\_d01\_2018-12-20\_18:00:00, same fields)



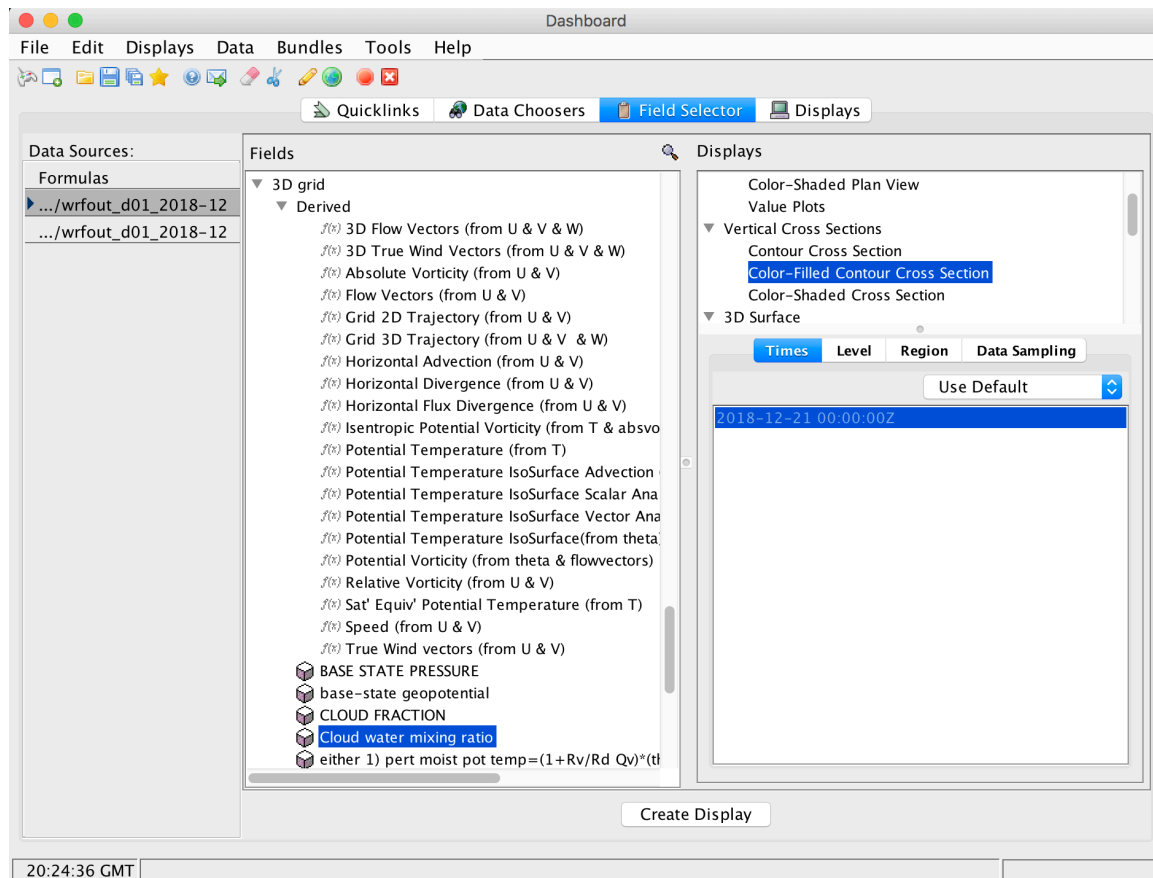
- The produced plot will look ugly, and have the wrong units. Change the units on your Dashboard > Displays > Edit > Change Display unit, to mm



- Also change the contour intervals and color table as seen above
- Instead of using the default color table, choose Basic > Precip
- Finally, add in the MSLP contours we saw in the previous finished plot (do the same as you did before), and add in a colorbar for the accumulated precipitation plot
  - You can change the label name from “Hourly rain” or whatever to something more appropriate like “6-hr acc. precip” under “Edit” > “Properties”, in the same window that you toggled colorbar options

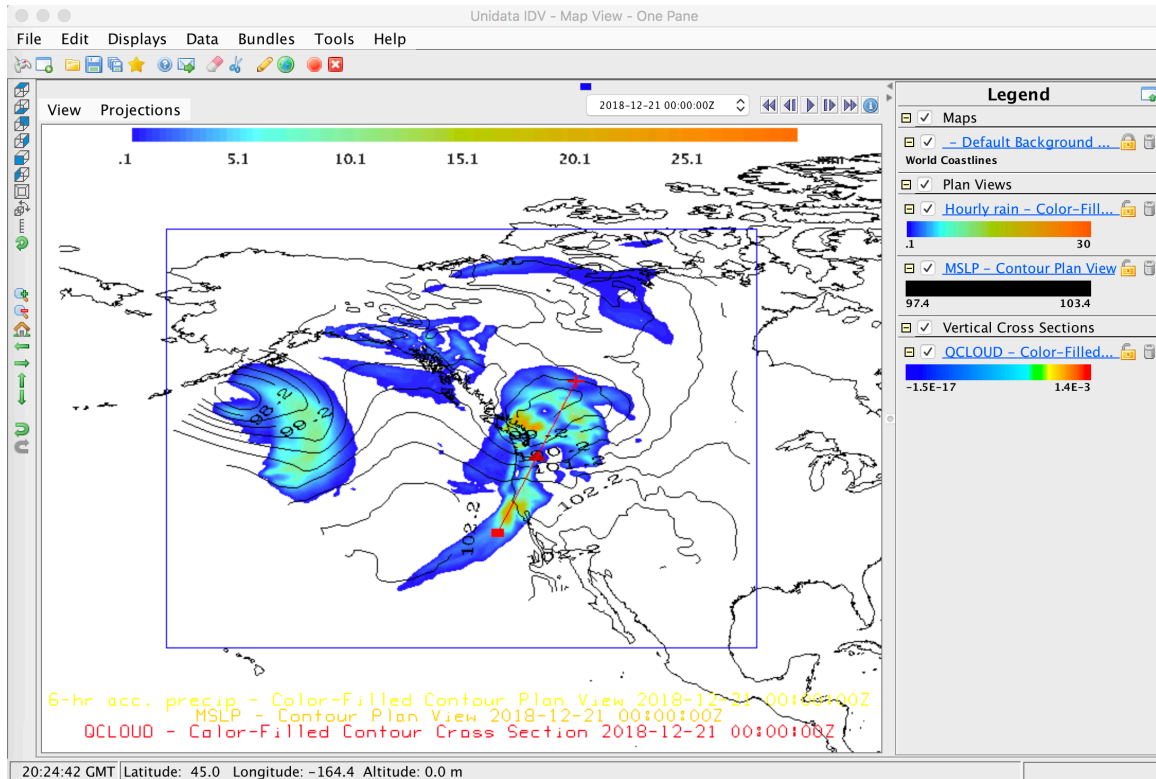


- ...and there you have it! Doesn't look half bad! You can clearly make out the frontal precip bands for the system contacting the coast.

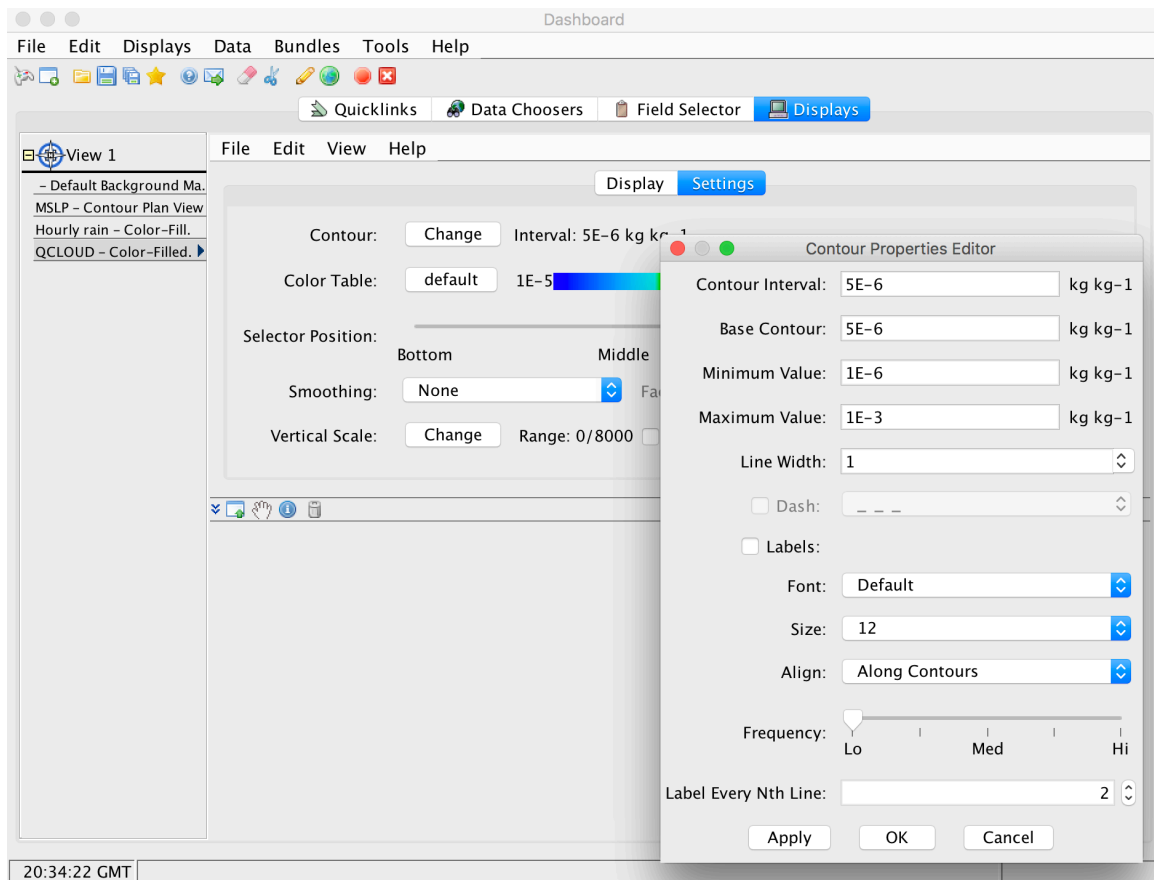


- One last thing, let's add in a cross section of cloud water mixing ratio
- "Field Selector" > "3D grid" > "Cloud water mixing ratio"
- Choose "Vertical Cross Sections" > "Color-Filled Contour Cross Section"

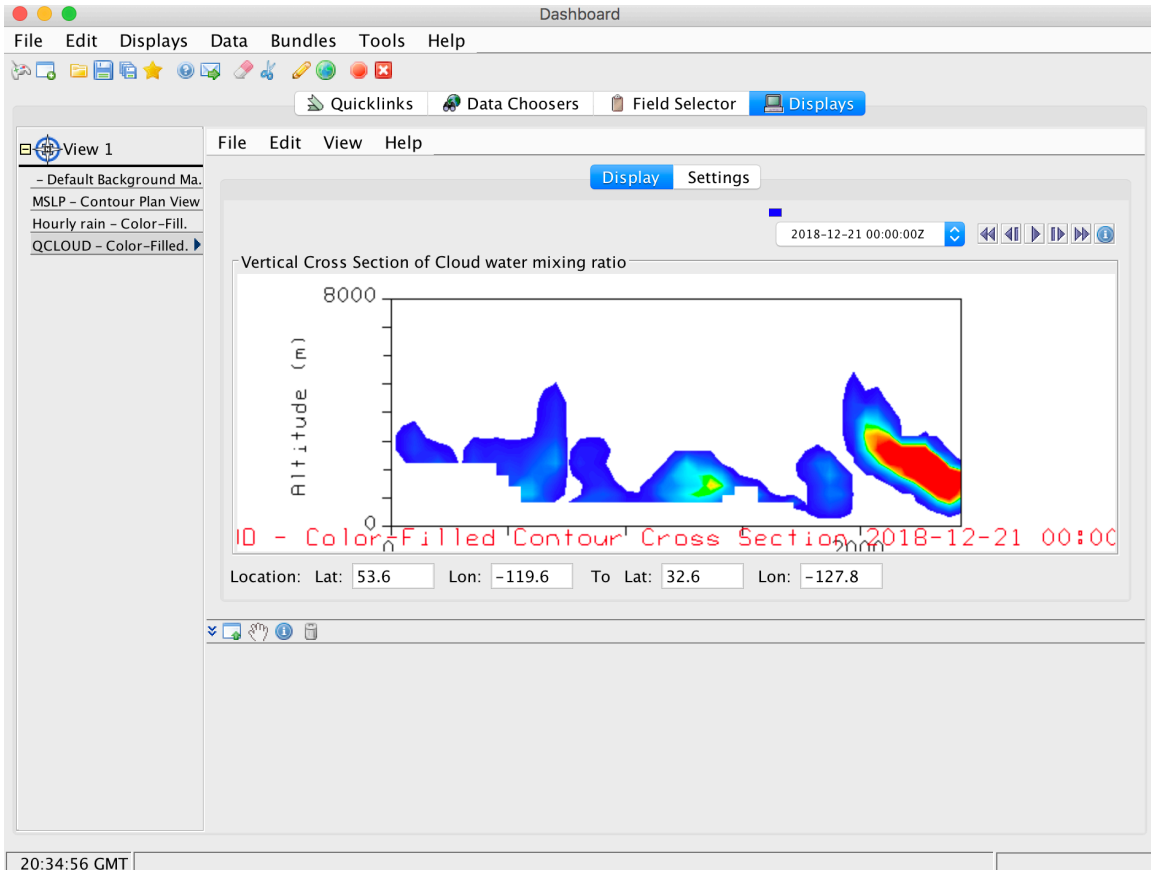




- You should see a transect show up in your Map View. The “+” corresponds to the left side of your cross-section, the triangle the centre, and the square the right



- In the “Settings” tab under “Displays” on your Dashboard, change the contour settings as shown above
- Also note that the vertical scale has been changed to 0 to 8000 m



- If done correctly, under the “Display” tab on your Dashboard, you should see a cross-section that looks something like what you see here
- Note the deep, cloudy air next to the square (right side of transect), corresponding to the cold front of the storm
- Feel free to play around with the transect, by moving it around, lengthening it, rotating it, etc.