(65-240329-B) **Visualizing GML's Model and Observation Data Products**

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According to Mark Subbarao from the NASA Scientific Visualization Studio, "The pace of scientific discovery is accelerating, and the public is being flooded with new information. Visualization is perhaps the best way to make sense of this complexity and to appreciate the connectedness and beauty of our natural world." A lot of truth is said with the quote, but there's also a lot of hidden complexities that need to be addressed to wrangle this influx of "big data" into visualizations that help produce valuable insights for end users. To contrast, 2-D visualizations are much simpler to create than their 3-D counterparts, which are in turn easier to create than their 4-D counterparts. The main reason for this is that for each dimension you add to a visualization you add complexity to generating an image/gif/video for that visualization. This in turn makes "big data" analysis/visualization workflows harder, and more upfront setup is necessary, but with the use of tools like Xarray, Dask, Linux piping, and Python IO buffers, great speed ups can be attained when creating a gif/video using ffmpeg. With this advanced set of tools, I was able to make 3-D/4-D visualizations of atmospheric CO2 from CarbonTracker, and atmospheric CH4, and its isotopic signature (d13C-CH4) from CarbonTracker-CH4. I also used this code to create a video of atmospheric CH4 to be displayed on Science on a Sphere as well as create a gif of the atmospheric CO2 dataset. Therefore, my code is versatile. One major lesson I've learned is that datasets with a higher spatial/temporal resolution require a bit more work to get working than their counterparts, and if improperly managed can lead to unexpectedly long execution times. In addition, gifs/videos are great intermediary visualization mediums, but with Nvidia's up-and-coming or recently released visualization tool, stunning 4-D visualizations can be made and then showcased on GML's websites or the U.S. GHG Center's website. With further development, these visualizations can also be experienced in the palm of a person's hand via an augmented/virtual reality capable device anywhere in the world with an internet connection, thereby helping to bring NOAA/GML datasets from a research centric role into an operational centric role and helping the public gain valuable insights about our changing planet.

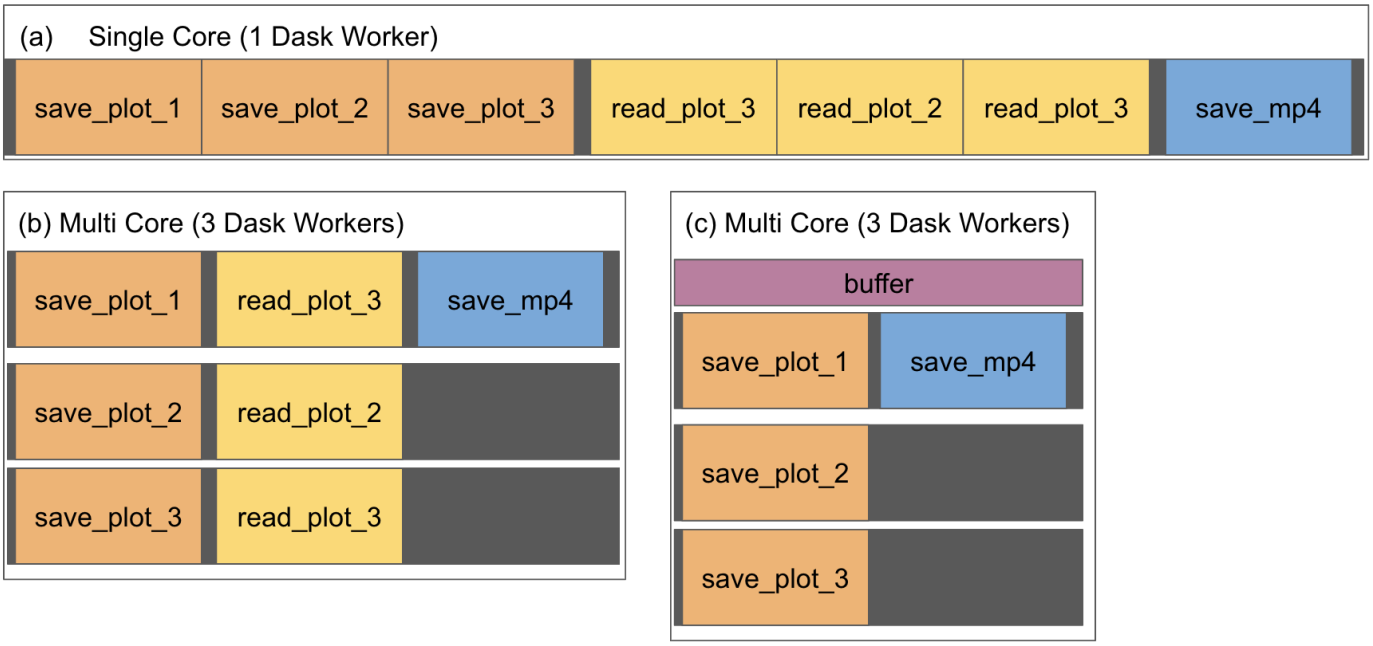

Figure 1. Figure 1 shows a very basic comparison between sequential and parallel workflow runtimes using Dask workers for creating a visualization video.