## Exercises - GEO4902-01 - General modeling concepts

**The assignment is due by Wednesday, Sep. 16, 2021**

***[Save google-collab as jupyter notebook, with your name in the filename, and upload on canvas]***

### Exercise 01b - Compare forecasts of global and regional forecast system:

**Use:**

<https://colab.research.google.com/github/maltemuellerm/GEO4902_2021/blob/main/01/Weather_Forecasts_GlobalVSregional.ipynb>

This script plots the precipitation forecast of the regional model (AROME MetCoOp) and global model ECMWF, for the extreme precipitation event which occurred in 2014. More information on this event can be found here: <https://www.nrk.no/emne/oktoberflaumen-2014-1.12012052>

1. Explore the convective and large-scale precipitation in the ECMWF model system.
2. Zoom into the west coast system. Plot as maps and point forecasts (e.g. for Flåm) What are the differences between the models, and what might be a major reason for the differences in the precipitation maps?
3. Plot also temperature and winds of the two model forecasting systems. Compare, interpret, and describe your findings.

You shall also access the forecasts of the Polar Low from February 4, 2020 from the global ECMWF system:

1. Modify the code, so that the files for February 04 are read in. Compare the forecasts of the two forecasting systems as maps and point-forecasts. What are the main differences and what could be the cause for it?

Reflection Notes from students 2022:

#### What did you learn?

Thru this exersice the learning outcome is mostly coding. How and espesially where to make my own code more effective when selecting variables for one or more locations. I didnt have enough time to figure it out in this exersice, but this was a big eyeopener for me. The focus on two different weather forecast systems was interesting, and also see the differences hands on was very informative, which include resolution on the systems, and also the point forecast that differed alot. Learning to use cartopy (for the first time) was interesting, and more intuitive than basemap i think.

#### What was difficult?

The code. It is for me really difficult to understand the code when not used to code weather data, even if it is only plotting data on a map. Understanding what the projections does, and how and why arome and ecifs are on different spaced grids. Basically it is more of the understanding to handle this differences that is difficult, and understand how to solve this. Most of the time consumed on this exersice are discussing coding errors and googling what the error means (maybe it is more common than i think). Because of the time spent on handeling error in my code, it might be too short time to acually connect the assignment outcome to the lectures, maybe?

#### What went well?

After struggling with all code issues, i think the plots became nice, and of coarse fixing errors are helpful to understand problems. Discussing these problems/coding errors with other students also enhance the learning and understanding. I will for sure use more for loop in the plotting to minimize the code.

#### What was surprising?

The most surprising thing was probably the time spent on the code. Next, the differences in the point forcasts. Because the grid resolution in the ECMWF are almost 10 times larger than the Arome the point forcast differences was much bigger than i initially thought. In some way i could look like two completly different places. Since they choose the nearest gridpoint values it basically is?

#### What elements will you take with you and use next time?

Next time handeling the coding would go faster and next time the data assimilation assignment i will have more time for the theory behind. Then its much easier to connect the code and figures to what we do in the lectures.

#### Where would you like to get some more input?

Coding is always good. Espesially how to get exactly the data we need, and not use much time calculating and plotting data which are never shown in the acual plot (im not sure, but my code use quite some time to finish). Also, more understanding (maybe a go-thru) cartopy and how to set up and plot data on different projection maps etc.... That would be very useful.

#### Summary

It was a very interesting and motivating assignment, and how to plot your own weather forcast. The hands-on pyhton was very useful!

What did I learn?

- The resolution of your weather forecast needs to have quite a high resolution to

be able to account for convective precipitation (non-hydrostatic processes in

general).

- How barbs work and how to plot a location on the map.

What was difficult?

- It took quite some time getting comfortable with the code, and some parts are

still not 100% clear (for instance how these cartopy projection functions work).

- Using barbs went well with the winds in arome but were a real struggle using the

ecifs ones.

- Understanding why the AROME MetCoOp provided so low values of

accumulated precipitation point forecast compared to the ECMWF-IFS.

What went well?

- The point forecasts of precipitation, temperature and wind speed, and the map

forecasts of precipitation and temperature went relatively well.

What was surprising?

- That the values of accumulated precipitation on the point forecast were so low in

relation to the ECMWF-IFS ones.

What elements will you take with you and use next time?

- How regional forecasting systems works in relation to global ones.

- I hope that many aspects of the code are possible to bring along for the upcoming

exercises.

Where would you like to get some more input?

- More information about exactly why there is this surprising difference between

the AROME and ECMWF-IFS point forecast for accumulated precipitation.

First I struggled a lot with setting up the environment and installing all the packages that are necessary. This took me 3 days which gave me a little bit of stress to get the exercise done on time, but it worked out. I learned how to change the script to get the right data and the asked outcomes and how you can interpret it. I also learned how big the difference is between a regional and a global model so the resolution is an important factor.

For me it was difficult to put the air pressure on a map with the two different datasets. My result is something weird and I don’t think it’s right. Also the air temperature of 4 february 2020 differed a lot between the two models. The regional model even had temperatures of -24°C and I don’t know what went wrong there because I did the exact same as the script.

I really like that there is a script available with the code that is necessary to do the exercise and that we have the possible solution of the previous exercise. But sometimes I still don’t know what we exactly have to do. For example: Explore the convective and large-scale precipitation, I didn’t know if we just had to look around the dataset or if we had to do something with the code. Also Zoom into the west coast system, I think it was already zoomed in in the west coast so I just put the coordinates of Bergen but I don’t know if this was the purpose. But it was already more clear than the first exercise and I think it is really interesting.

Throughout the exercise the main focus was the comparison between the two models with different resolution. This is something that has been mentioned in the lectures, but the exercise gave a better practical understanding of the different concepts. For example, the consequence of advection or no advection of the precipitation when the systems hits the shore.

Further, it was interesting to see how much details that disappears in a low resolution model. One can think that 9 km is not that much, but the model was for example not able to detect the impact of altitude and topography in fjords/valley systems. Even though I knew that the model was general I thought that it was going to consider more than an almost linear increase in altitude towards high elevation areas like for example Hardangervidda.

Other than the models themselves, I had to get familiar with a new way to plot maps, and all that follows. I did not be the most clever one and look for example on how to plot barbs in the example solution from exercise 1a. But on the other hand the struggle on the barb plotting, projections and so on gave me a better understanding on how the cartopy and netcdf files are build up. So even though it took quite some time I am grateful for this extra learning and hope that it will help me while using these again later on.

For further learning I would like to learn more about how the different models create their point forecasts. Here I tried to read a bit, but I would like to get a better understanding of the subject.

## Reflection Note how you worked with the exercise.

In case of ECMWF I checked youtube channel<https://www.youtube.com/watch?v=sVvtlAT4quo&t=231s&ab_channel=ECMWF>. I also checked other videos to learn more about their system. I have saved the ECMWF file and tried to explore it in their tool I installed metview but it failed to open the file.(it hanged)

With jupyter part I worked on exercise by checking documentation of cartopy and basemap, wich in many cases was waste of time. I think they are not well documented (together with matplotlib). They all wrap each other, but the documentation is mostly "textual" without enough eg. of class diagrams, so i found it pretty confusing to figure out which data is needed to wich plot. In case of winds I did not find them useful at all. I also googled a lot, but found not much help. I did not know there there was possible sollution from last exercise, I find it very useful but I get to know it exists too late.

## What did you learn?

I think it very good to compare 2 diffent forecast for exactly same date and same region and exlore the differences. I liked examples about polar low and

## What was difficult?

Plotting winds as barbs or quiver was extremely confusing. Even when I have figured out basic quiver functionality, I still found it extremely confusing - esp because AROME and ECMWIF have different organisation of lons and lats and different form of presenting winds. One attempt even crashed my notebook. In case of ECMWIF I could not even found the coordinate system of the forecast.

## What went well?

Plotting temperatures.

## What was surprising?

When I looked at solved exerise - pressure processing was suprising. I will need to dig deeper into this. Diffrences between forecasts. I think it would be even more interesting if we would plot the forecast from arome and ecmwf for a given point and compare it with observation. Probably the observations are also somwhere on threads, but it would took me too much time to figure it out.

## What elements will you take with you and use next time?

I know more where data is located, so far I knew that thredds server exist, but I was not exploring it (only using it to get the wave bouys data). What was also interesting is to have some orinetation in how the forecast files are organized. Its not that easy to figure out just by reading the documentation (eg. the scope of arome, or difference between arome and arome arcic). Probably pressure and wind plotting, but once I will master it.

## Where would you like to get some more input?

I would like to get more inforamtion about forecast coord and then plot coordinate systems. In case of cartopy I found this video which was extremely helpful<https://www.youtube.com/watch?v=TE4uXbkHK_Y&t=4283s&ab_channel=Enthought> I would also like to know about winds plotting. I found winds in ECMWF confusing.