COVID-19 Forecast Similarity Analysis

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Examples of forecasts and Cramer distances - US National

The plots show the distances between the ensemble and UMass-MechBayes at two different forecast dates. We can see that lower approximated CD values indicates more similarity between the two forecasts - as the plots of the predictive quantiles on forecast date 2021-04-05 shows a lot of overlap. On the other hand, the plots of the predictive quantiles on forecast date 2021-08-02 shows less overlap accompanying by higher approximated CD values.

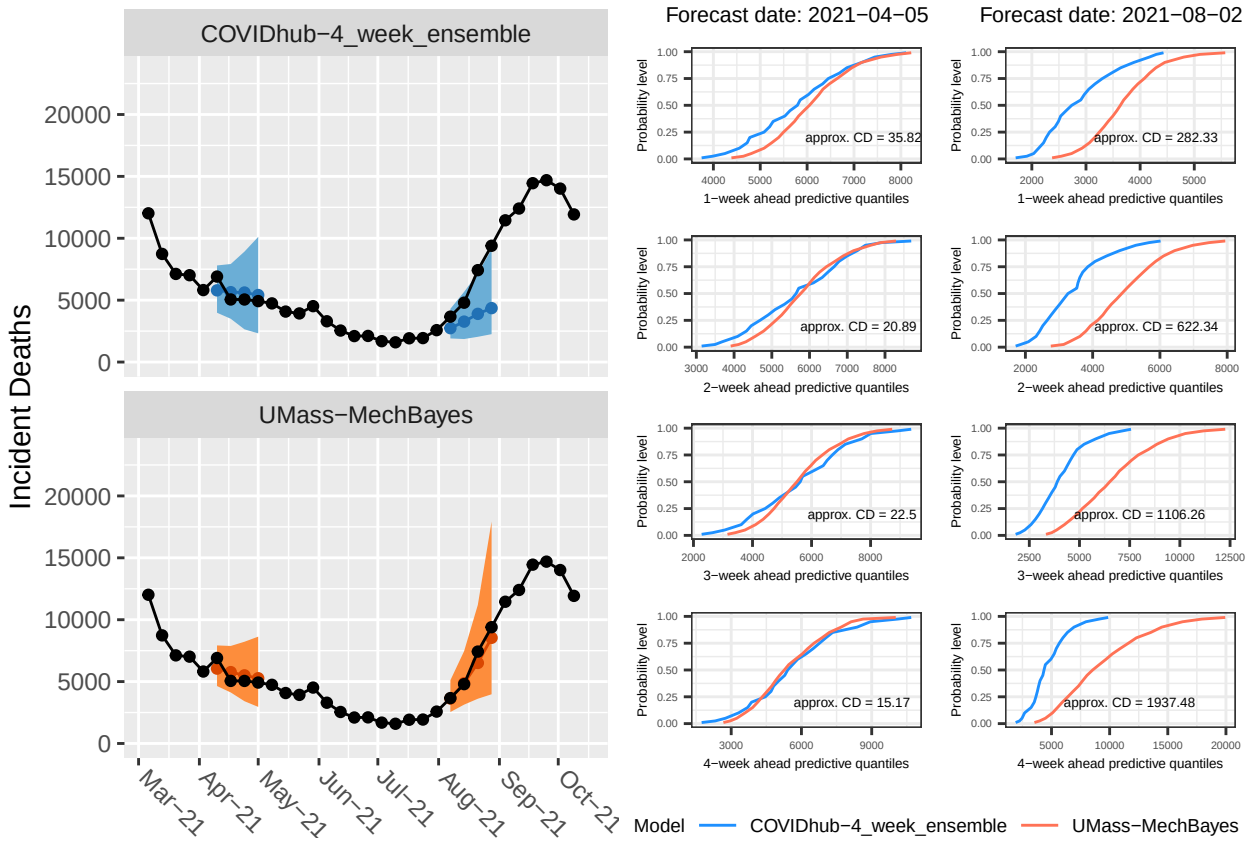


Figure 1: COVID-19 deaths forecasts (left) and all predictive quantiles (right)

Distance/dissimilarity as a signal of a change in trends

We are interested in looking at an dissimilarity measure across dates to see if we see any trends prior to a change/an increase in observed incident deaths.

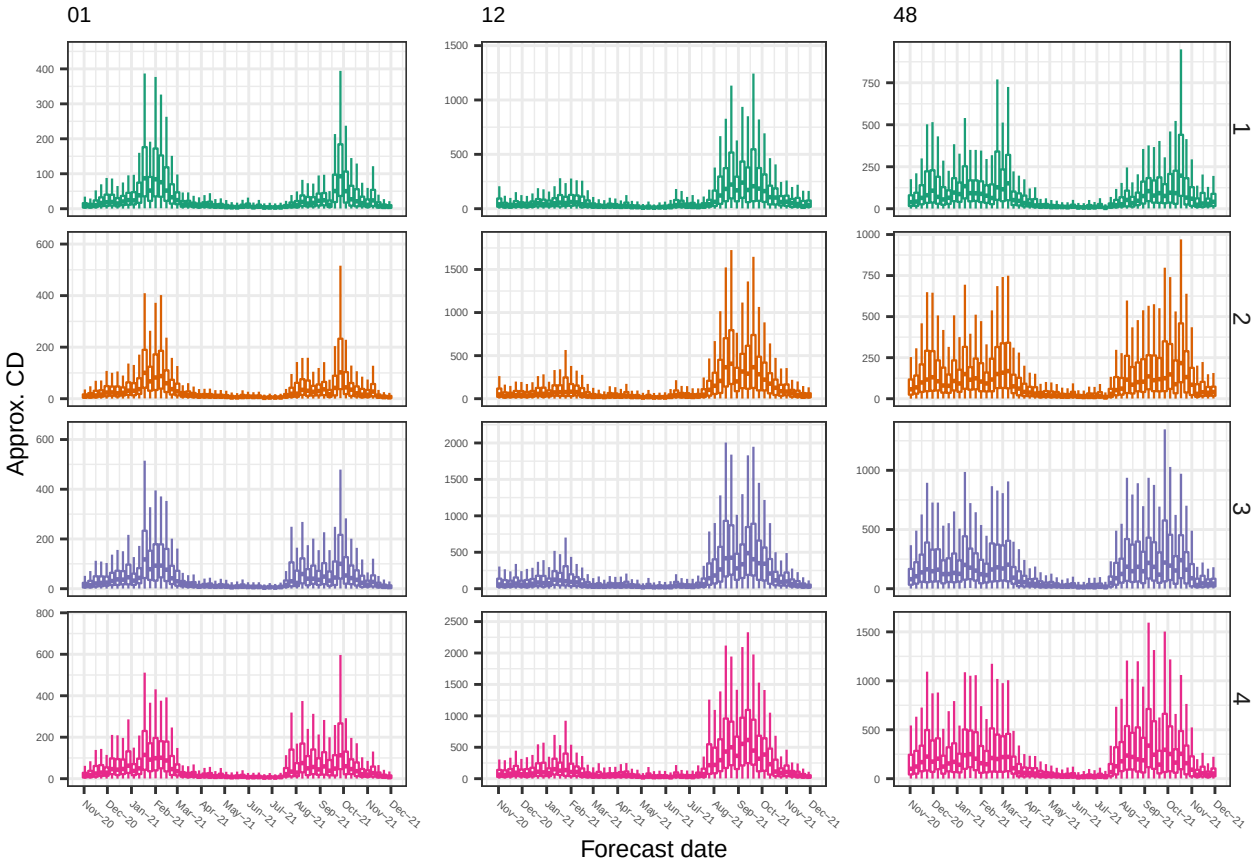


Figure 2: Boxplots of approximated Cramer distnaces - plots exclude outliers. The plots exclude the outliers.

Cross correlations

Cross correlations of median approx. CDs and incident deaths are calculated. Since the autocorrelation could result in spurious correlations between the two, cross correlations of pre-whiten median approx. CDs and incident deaths are also calculated. There are other possible approaches to "de-trend".

Forecast inclusion criteria

- Forecast date: 20 weeks before the peak in the winter 2020 and the peak in the fall 2021 for each location
- Model: all models submitted on a particular date
- Horizon: 2 and 4
- Probability levels: All
- Locations: 28 locations excluding US and other states with no distinct peak or incorrigible data abnormality in 2021

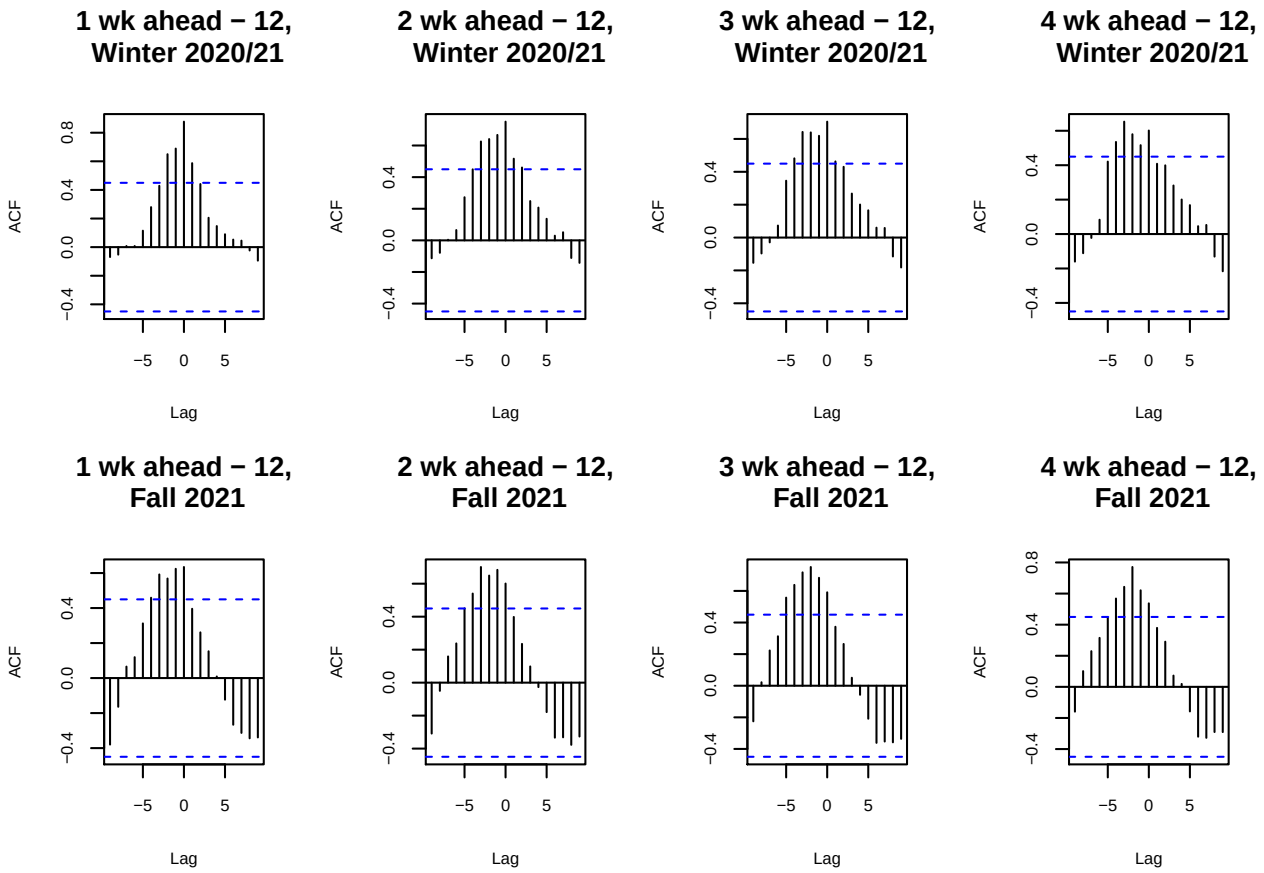


Figure 3: Example CCF plots for 2 and 4 wk ahead horizons. The two dashed lines are the confidence intervals based on 20 observations

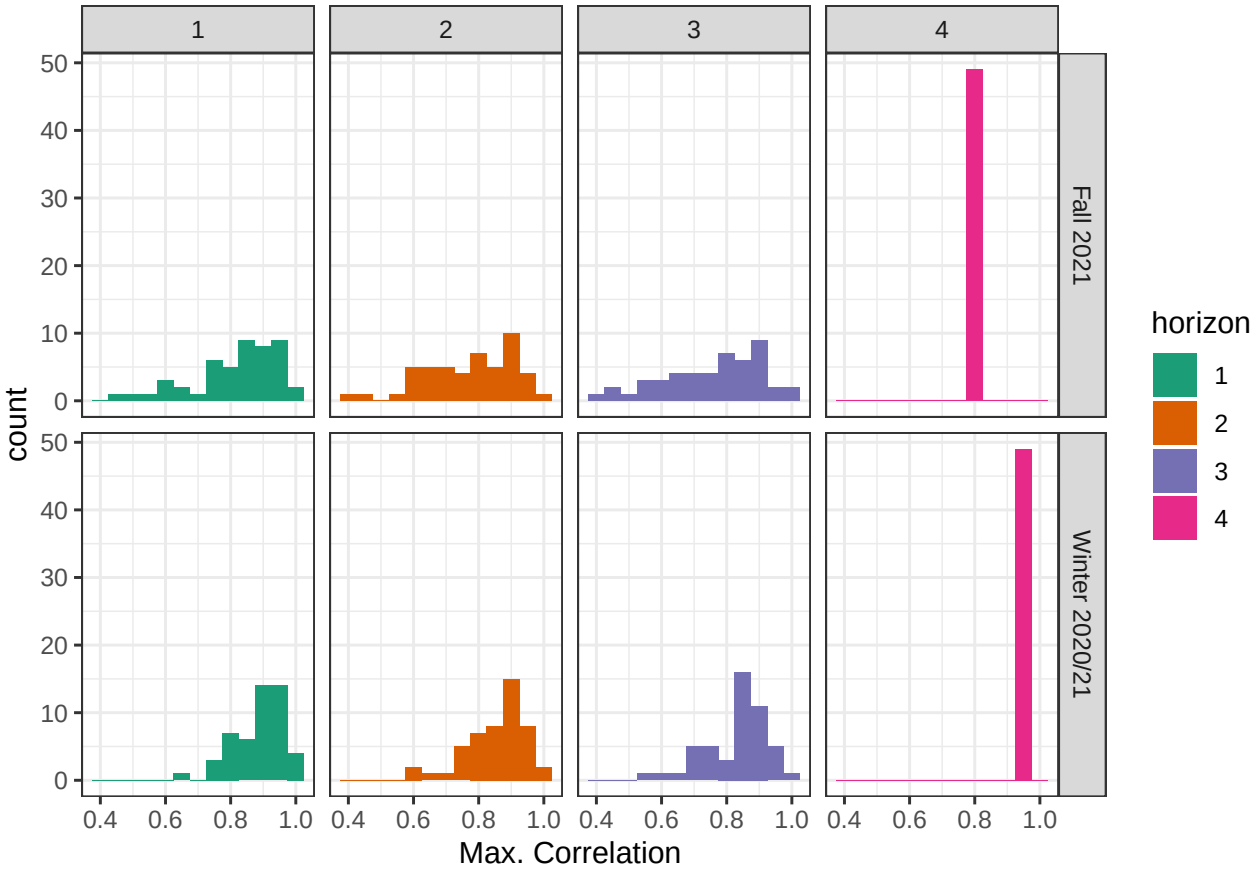


Figure 4: Distribution of max. correlations by horizon and time

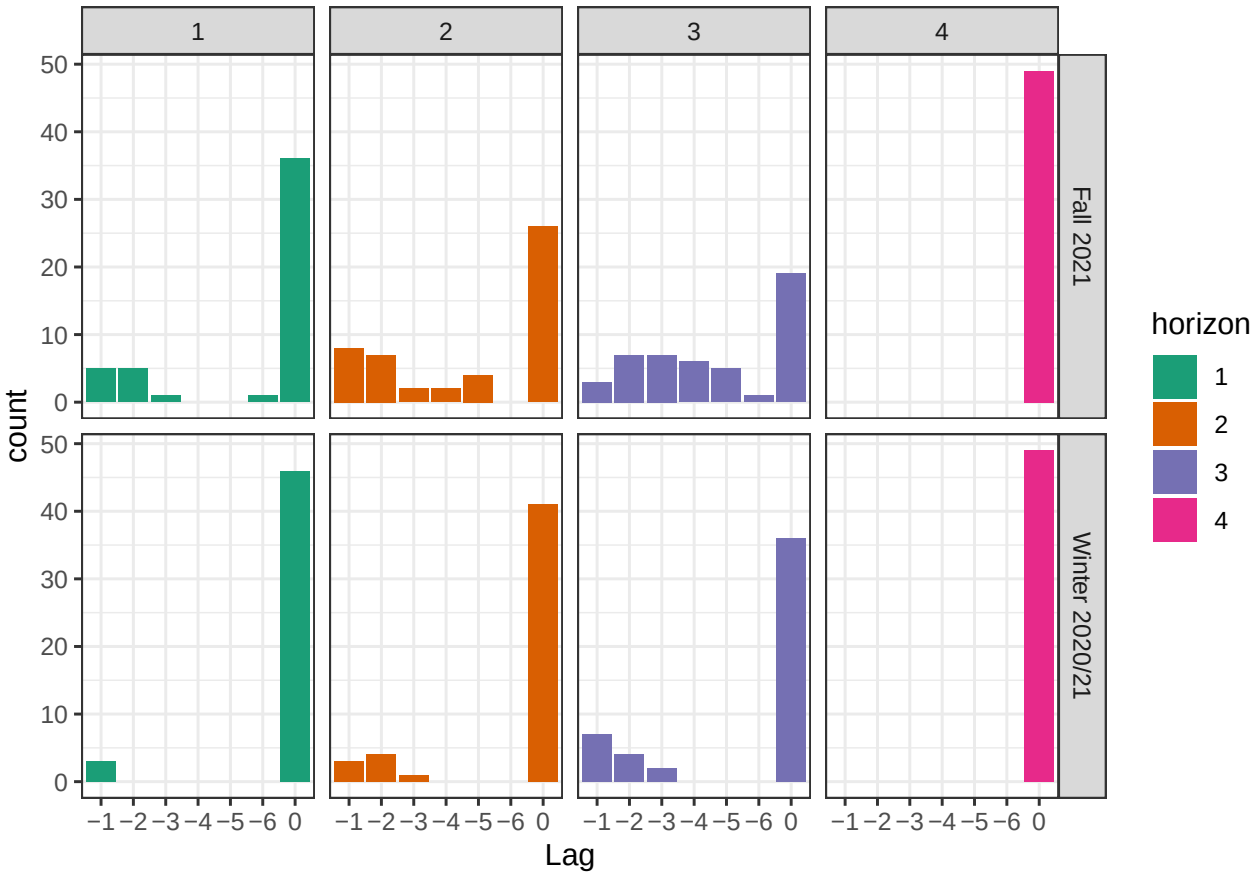


Figure 5: Count of lags of max. cross-correlations

Statistically significant cross correlations

For each of 28 locations and each horizon, I selected the maximum cross correlations among the statistically significant cross correlations. For most locations, 4 wk approx. CD seems to be a leading indicator and 2 wk approx. CD seems to both lead and lag (or have lag of 0). Location and horizon combinations with no statistically significant cross correlations are not included. Note that this is done based on pre-whitened cross correlations, but using the unprocessed CDs and deaths should yield similar results based on the booklet of CCFs.

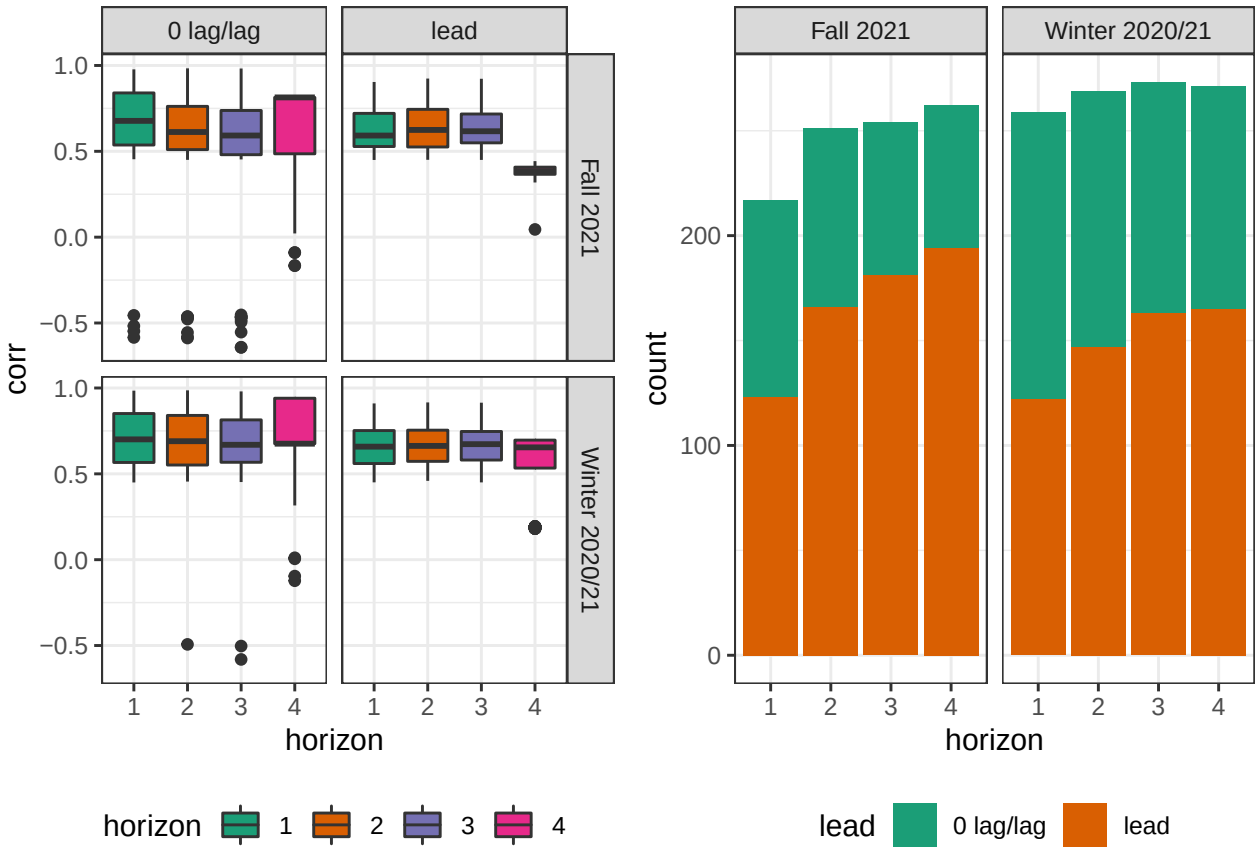


Figure 6: Statistically significant cross correlations

Similarity by type

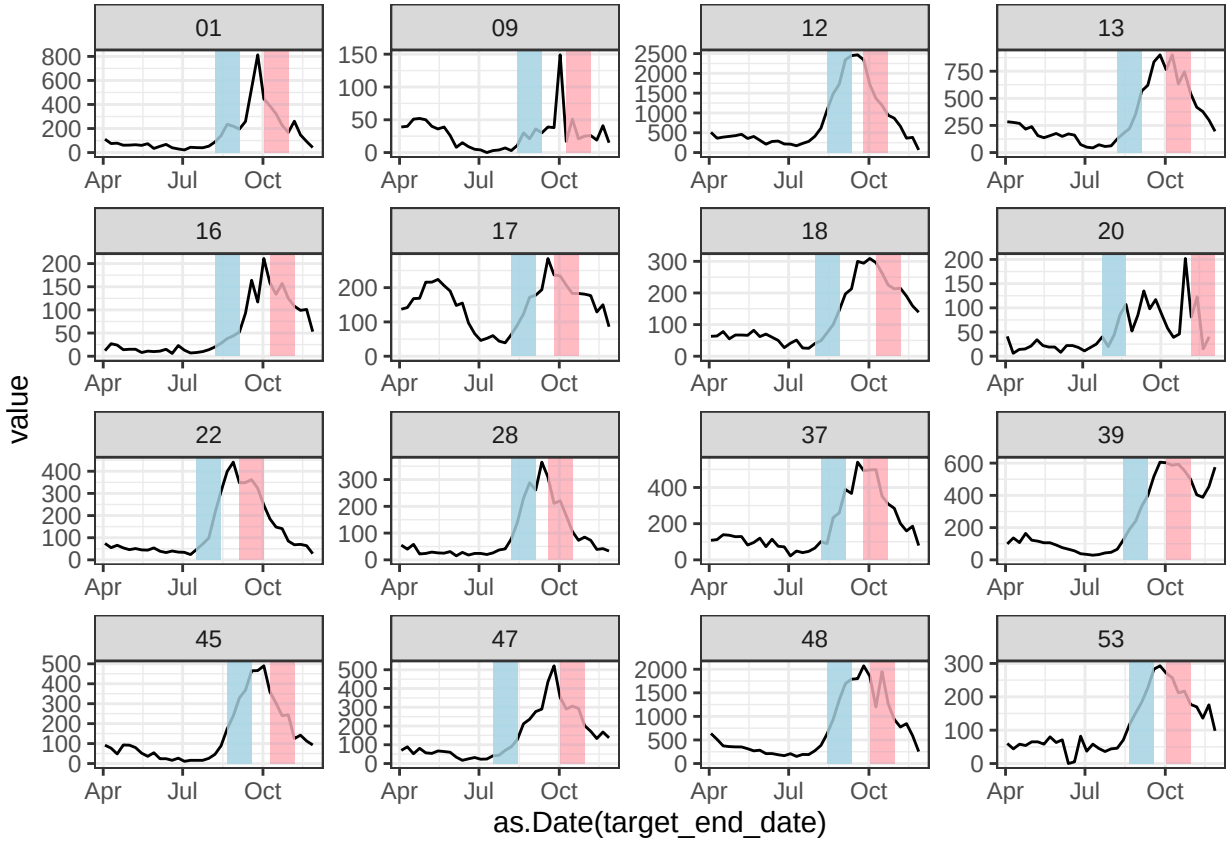
The models are selected based on their submission on the date designated as the moment of change dates and the number of submissions overall during 2021. We have 6 stats/ML models and 6 mechanistic models. Model included in the analysis are:

```
FALSE              model_abbr             type
FALSE 1      BPagano.RtDriven      mechanistic
FALSE 2 CovidAnalytics.DELPHI      mechanistic
FALSE 3             CU.select      mechanistic
FALSE 4           Karlen.pypm      mechanistic
FALSE 5    Microsoft.DeepSTIA data_adaptive/ML
FALSE 6      MOBS.GLEAM_COVID      mechanistic
FALSE 7            MUNI.ARIMA data_adaptive/ML
```

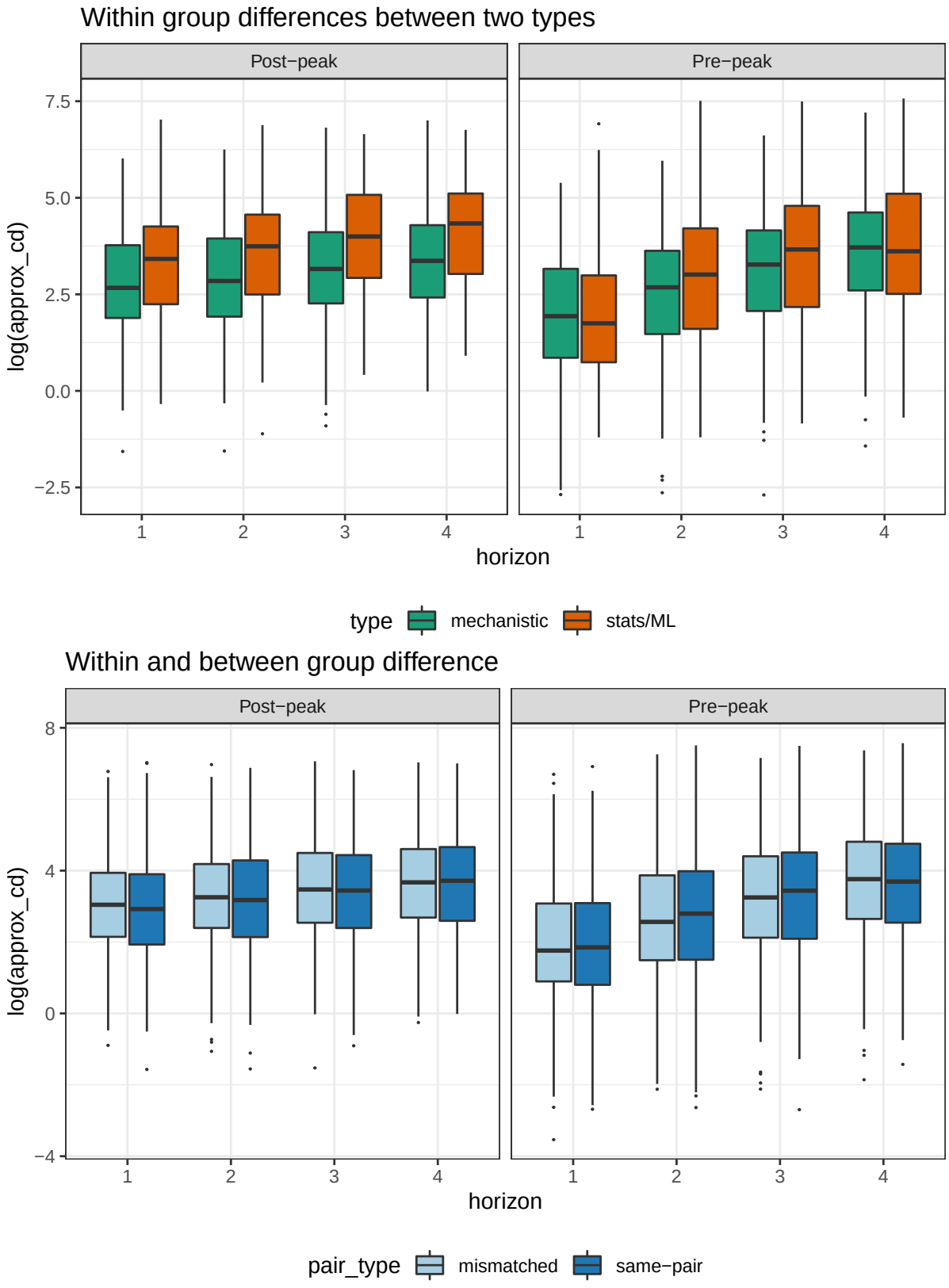
```
FALSE 8    RobertWalraven.ESG data_adaptive/ML
FALSE 9        USC.SI_kJalpha data_adaptive/ML
```

Moment of change before and after the summer/fall 2021 wave of incident deaths

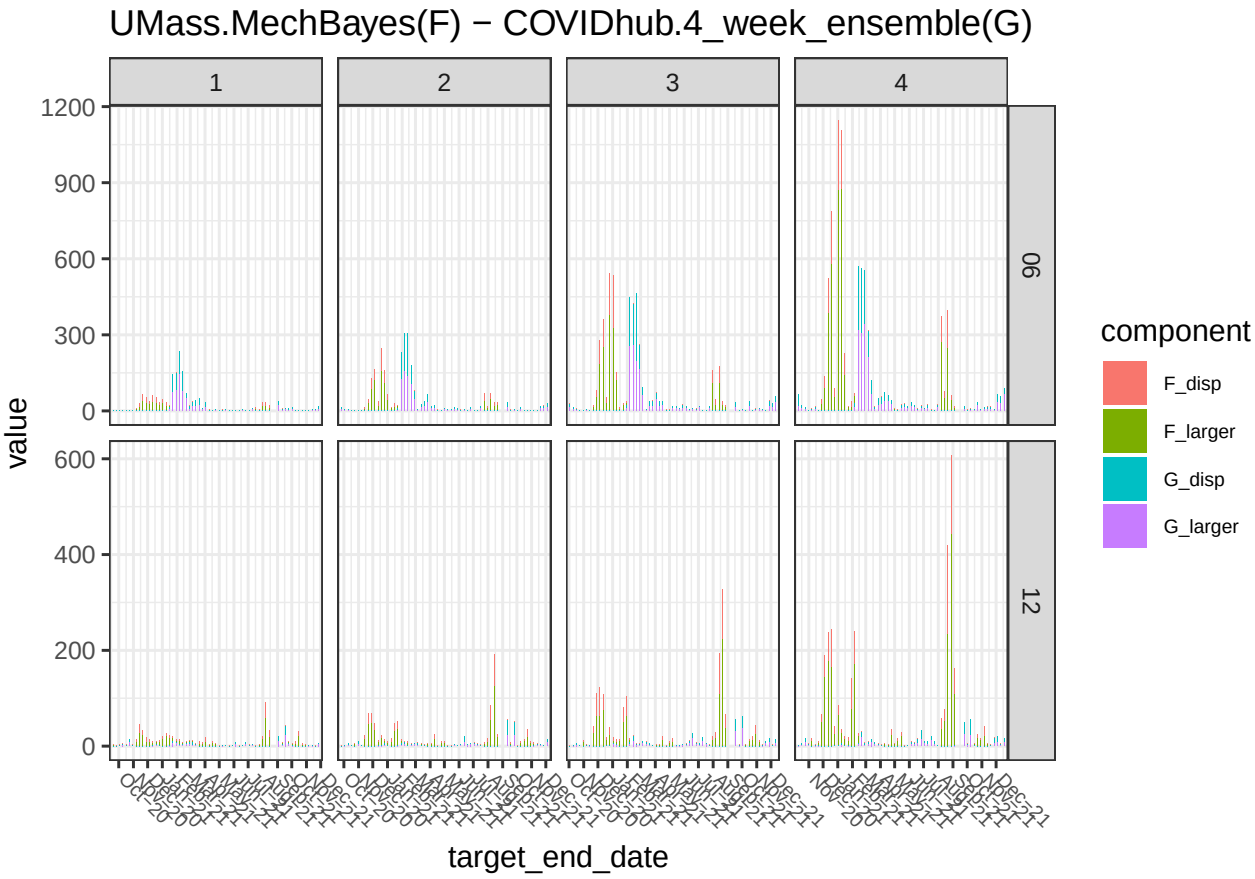
Below are the plots of incident deaths in 12 locations that experienced a noticeable summer wave in 2021 (they are selected based on objective criteria - I will add them here later). The shaded portions show the target end dates (we only test the first and the last dates of the portion) selected for testing.

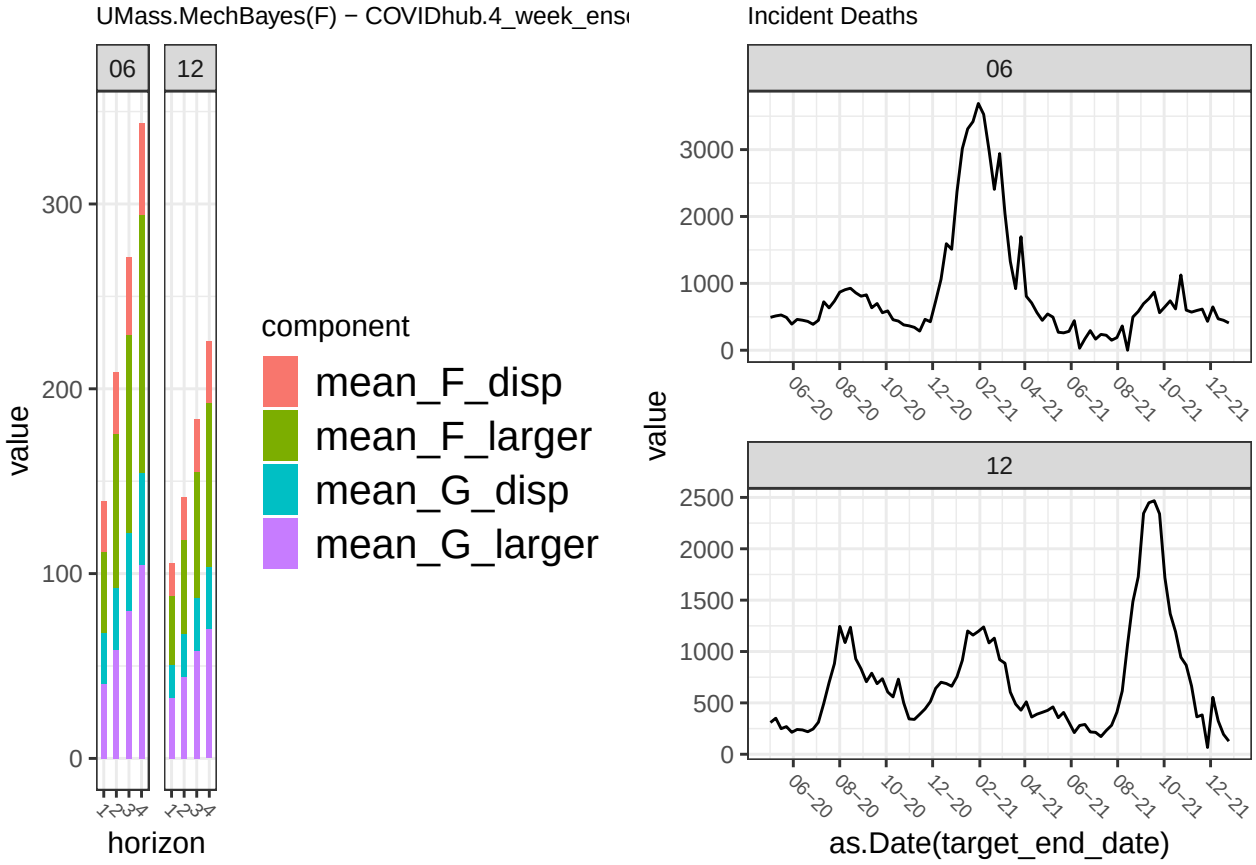


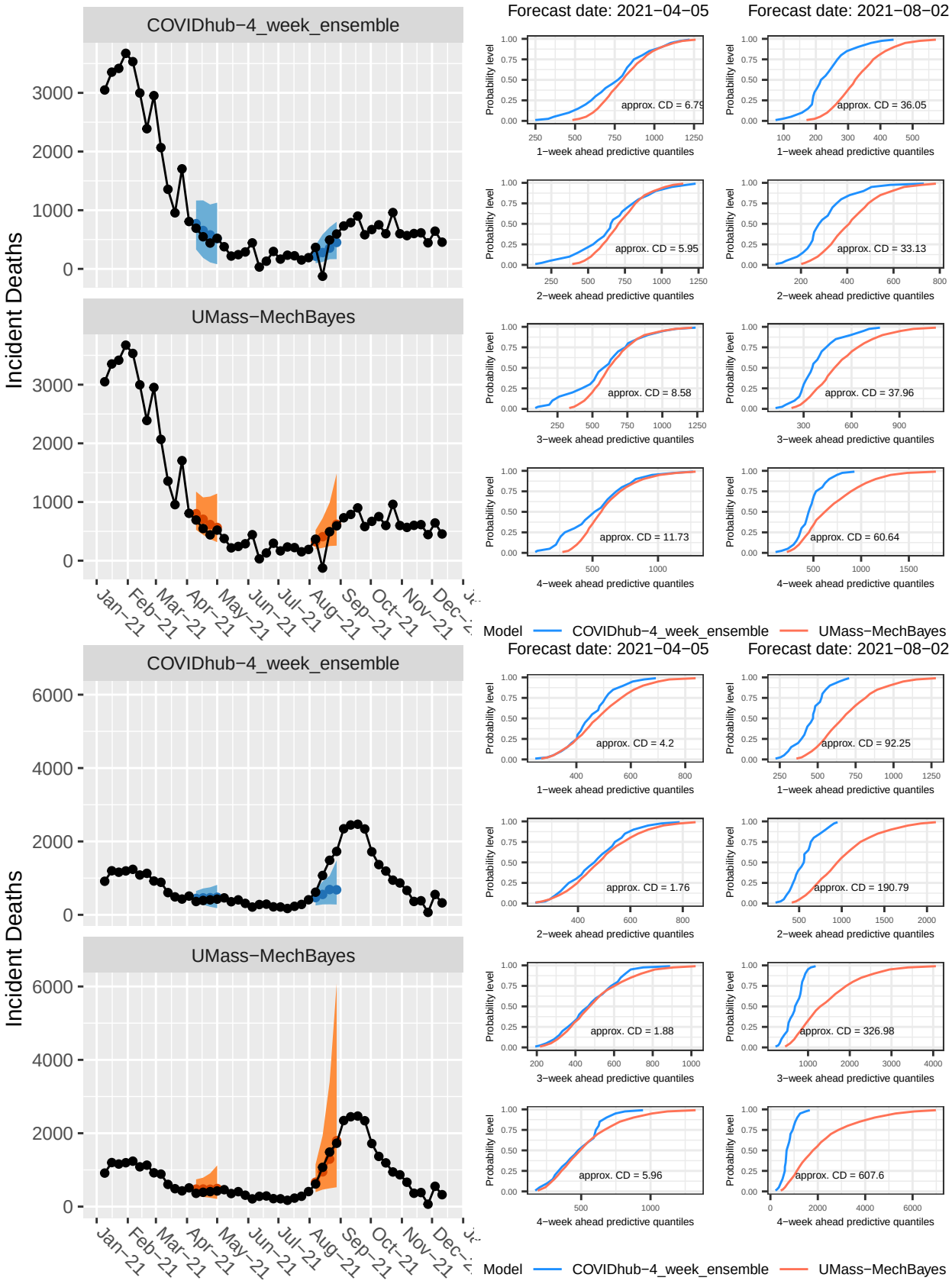
Boxplots of log-transformed approx. CDs by categories



Decomposition by group




UMass.MechBayes(F) − COVIDhub.4_week_ens
06
12
300
200
100
0
value
1
2
3
4
horizon
component
mean_F_disp
mean_F_larger
mean_G_disp
mean_G_larger
Incident Deaths
06
12
3000
2000
1000
0
2500
2000
1500
1000
500
0
value
06–20
08–20
10–20
12–20
02–21
04–21
06–21
08–21
10–21
12–21
as.Date(target_end_date)



- MechBayes often having larger right shift in distribution compared to the ensemble in both locations,

but around Jan-Feb 2021, the ensemble has larger right shift.

- The large relative dispersion of MechBayes in Aug 2021 agrees with what we see when we plot a forecast for that date.
- The benefit of this stack plots is that it gives a good summary of comparison between the two models across multiple time points without having to plots all the forecast dates.