Temperature Forecast Analysis for Summer 2020-21

June 2021

A report assessing the forecast accuracy of AEMO's operational weather providers in the National Electricity Market from 1 December 2020 to 31 March 2021

Important notice

PURPOSE

This report has been prepared to:

- Give the weather providers used by Operational Forecasting an insight into their comparative temperature forecast performance in the NEM during the 2020-21 summer period.
- Give any intending weather providers information to assess the relative performance of their forecasts.
- Contribute to ongoing discussion and improvement within AEMO and the energy industry.

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GLOSSARY

Term	Description
Dry-bulb temperature	The temperature of air measured by a thermometer freely exposed to the air but shielded from radiation and moisture.
Electricity demand (Operational demand)	The sum of scheduled, semi-scheduled, and significant non-scheduled generation connected to the National Electricity Market.
Rolling forecast horizon	A forecast that is always created X hours ahead of the actual observation. For example, for a 4-hour-ahead rolling forecast horizon, the observation at 12:00 pm was forecast at 8:00 am, and the observation at 4:00 pm was forecast at 12:00 pm.
Forecast error (°C)	Forecast temperature minus actual temperature
Mean Absolute Error (MAE)	The calculated average of the absolute (unsigned) forecast error. Mean absolute error is only used in reference to temperature forecast error (°C) in this paper.
Accuracy vs. precision	Accuracy refers to the closeness of an actual temperature measurement to the forecast value. Precision is the frequency at which a forecast error is reproduced. Therefore, a set of forecast outcomes could be precise in that its errors fall within a narrow range, and a set of forecast outcomes are both accurate and precise when that small range of errors are close to the actual measurement.

Executive summary

This report examines the temperature forecast performance of AEMO's three weather service providers in the National Electricity Market (NEM) from 1 December 2020 to 31 March 2021. This report aims to highlight the differences in forecasting performance between summer 2019-20 and 2020-21, while also drawing new performance insights from the summer 2020-21 period. This is part of a catalogue of biannual *Temperature Forecast Analysis* reports available on the AEMO website for summer and winter periods since 2018[1].

This report studies temperature forecast accuracy and precision at the 4-, 24-, and 72-hour ahead (HA) rolling forecast horizons.

The weather stations analysed in this report are Adelaide West Terrace (South Australia), Archerfield Airport (Queensland), Bankstown Airport (New South Wales), Hobart Airport (Tasmania), Melbourne Airport (AP) (Victoria), Melbourne Olympic Park (OP) (Victoria), and Penrith Lakes (New South Wales). These weather stations have the largest influence on demand forecasts for their respective NEM region.

The key findings from the analysis were:

- Despite Provider A observing a greater year-on-year improvement in forecast performance than Providers B and C, Provider A remained the lowest performing provider for all three forecast time horizons.
- Consistent with the previous summer period, Provider C produced more precise and accurate temperature forecasts than Providers A and B at the 4HA time horizon for all weather stations, except Adelaide West Terrace.
- All three providers continued to find forecasting temperatures at Adelaide West Terrace more challenging than at the other weather stations, despite Providers A and B observing a clear improvement in forecast precision.
- Provider B's forecast performance at Adelaide West Terrace across all time horizons was on par with Provider C, which was the highest performer during the previous summer.
- Provider B's overall forecast precision was consistent with the previous summer period, however the performance spread between weather stations was much smaller.
- Performance improved for all providers for the top 10% of temperatures, with Provider B delivering the greatest improvement year-on-year. This was aided by lower 90th percentile temperatures at all studied stations this summer (average reduction of 1.2°C).
- In forecasting hotter temperatures, Provider A had improved forecast precision at all weather stations except Archerfield, and especially at Adelaide West Terrace and Bankstown Airport.
- Provider A continued to produce higher forecast error in the middle of the day between 10:00 and 20:00 than Providers B and C; this has not changed from the previous year.
- Typically, Providers B and C had lower forecast errors in the middle of the day at 24HA, and occasionally at 72HA, than Provider A did at 4HA.

This report discusses a Victorian case study into the temperature forecast response to an earlier-than-expected cool change on Monday 25 January 2021. This highlighted the importance of capturing unforeseen weather changes into intraday temperature forecasts for the purposes of demand forecasting.

This analysis will be used by AEMO to aid operational decision-making and will be shared with weather providers to draw attention to potential areas of improvement. AEMO is continuing to work with the weather forecasting industry on developing weather forecast products tailored for the energy industry as well as addressing the key challenges identified in this report.

[1] At https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/operational-forecasting/load-forecasting-in-pre-dispatch-and-stpasa.

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1. Introduction

This report examines the temperature forecast accuracy of AEMO's three weather service providers in the National Electricity Market (NEM) from 1 December 2020 to 31 March 2021[2]. This report aims to highlight the differences in forecasting performance between summer 2019-20 and 2020-21, while also drawing new performance insight from the summer 2020-21 period. This is part of a catalogue of biannual *Temperature Forecast Analysis* reports available on the AEMO website for summer and winter periods since 2018.

This report has been prepared as a resource for weather service providers to benchmark their forecast performance, and as a discussion and ongoing improvement piece within AEMO and the energy industry. It also includes a case study day to demonstrate how temperature forecasts are linked to the operational challenges faced by AEMO during the summer 2020-21 period.

The weather stations analysed in this report are Adelaide West Terrace (South Australia), Archerfield Airport (Queensland), Bankstown Airport (New South Wales), Hobart Airport (Tasmania), Melbourne Airport (AP) (Victoria), Melbourne Olympic Park (OP) (Victoria), and Penrith Lakes (New South Wales). These weather stations have the largest influence on demand forecasts for their respective NEM region.

Demand sensitivity to temperature

The performance of a temperature forecast must be understood with reference to its operational impact on electricity demand. That is, it is most important for providers to produce accurate and precise temperature forecasts when:

- demand is high,
- reserves are low, or
- a small change in temperature results in a large change in demand.

These conditions are often encountered on hot summer days, meaning it is important to produce accurate and precise temperature forecasts on these days. In addition, electricity demand in each NEM region has different temperature sensitivity (see Figure 1)[3].

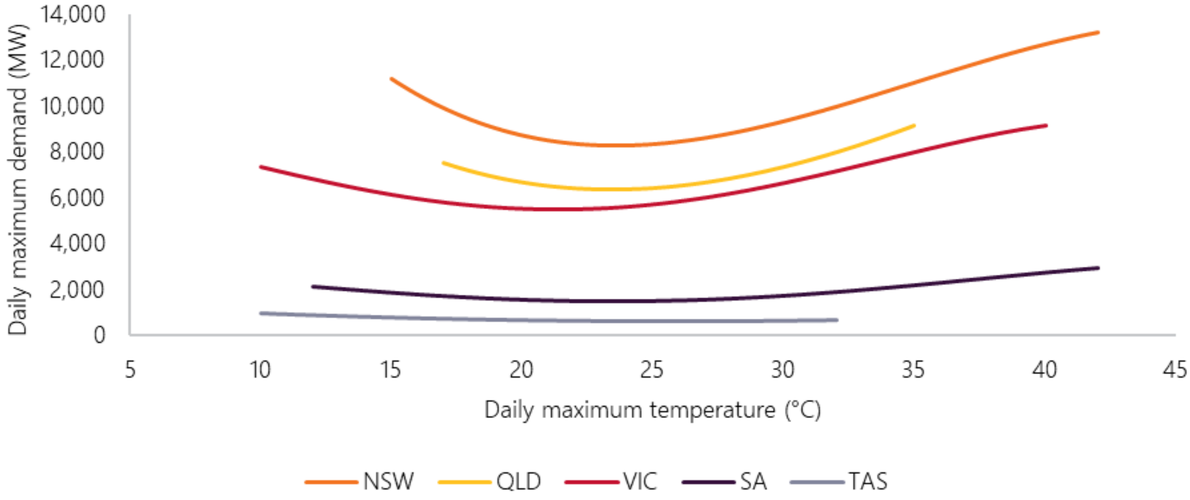
Figure 1 illustrates that:

- At 30°C, an accurate temperature forecast for New South Wales is more critical than for Tasmania.
- All regions except Tasmania have notable temperature sensitivity on hot summer days, exceeding their temperature sensitivity on cool winter days.
- If the actual temperature is 35°C but the forecast was 30°C, the demand will be approximately:
  - 1,800 megawatts (MW) higher than forecast in Queensland;
  - 1,700 MW higher than forecast in New South Wales;
  - 1,300 MW higher than forecast in Victoria; and
  - 500 MW higher than forecast in South Australia.

[2] All analysis refers to time in Australian Eastern Standard Time (AEST).

[3] Figure 1 and Figure 2 used the relationship of maximum daily dry bulb temperature values with maximum daily native demand on weekdays (excluding public holidays) during 1 Jan 2017 to 31 Mar 2020. The temperature readings were taken from the primary weather station for demand forecasting in each region during that period (New South Wales – Bankstown Airport, Queensland – Archerfield, Victoria – Melbourne Olympic Park, South Australia – Kent Town, Tasmania – Hobart Airport). This analysis was not extended to include 2020-21 data as to not introduce the demand impacts of COVID-19 restrictions.

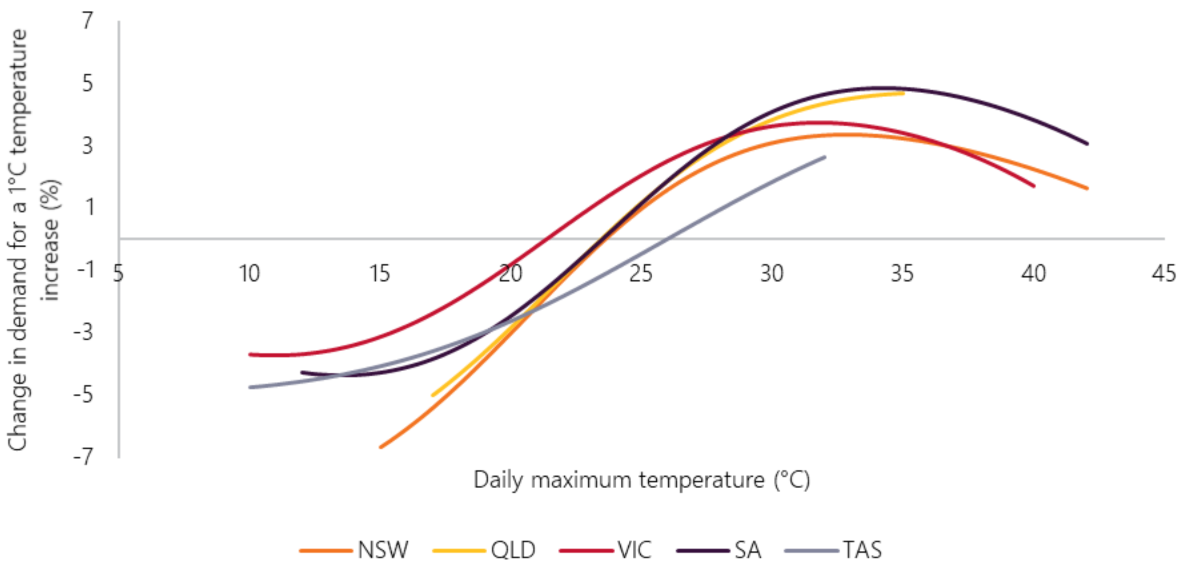
Figure 1 **Weekday maximum daily demand (excluding major industrial loads) versus temperature in each NEM region**



It should be noted that a 100 MW demand forecasting error in New South Wales normally does not create the same operational challenges as the same error in South Australia. Since each region has limited local generation and interconnector capacity, percentage changes in demand must be understood in conjunction with absolute demand changes. Figure 2 illustrates the percentage change in demand if the actual temperature is 1°C higher than the forecast temperature. Key findings from Figure 2 include:

- In most regions during summer, demand is most sensitive to temperatures between 32°C and 35°C. This makes temperature forecasts critical at or above these temperatures because demand is both high and sensitive.
- South Australia and Queensland have the highest temperature sensitivity, at up to 5% per 1°C during summer.
- Even considering proportionality, Tasmania demand has comparatively low temperature sensitivity.
- Towards 40°C, demand sensitivity reduces, since by this stage most cooling devices that can be switched on, are switched on. Accurate temperature forecasting is still critical at these temperatures because demands are very high (as shown in Figure 1).

Figure 2 **Percentage change of demand of each NEM region from a 1°C under-forecasting error**



2. Summer forecast performance

This section contains a selection of temperature forecasting performance insights for summer 2020-21 in the NEM. Results supporting major insights are included in the main report, with additional results included in appendices A1 and A2.

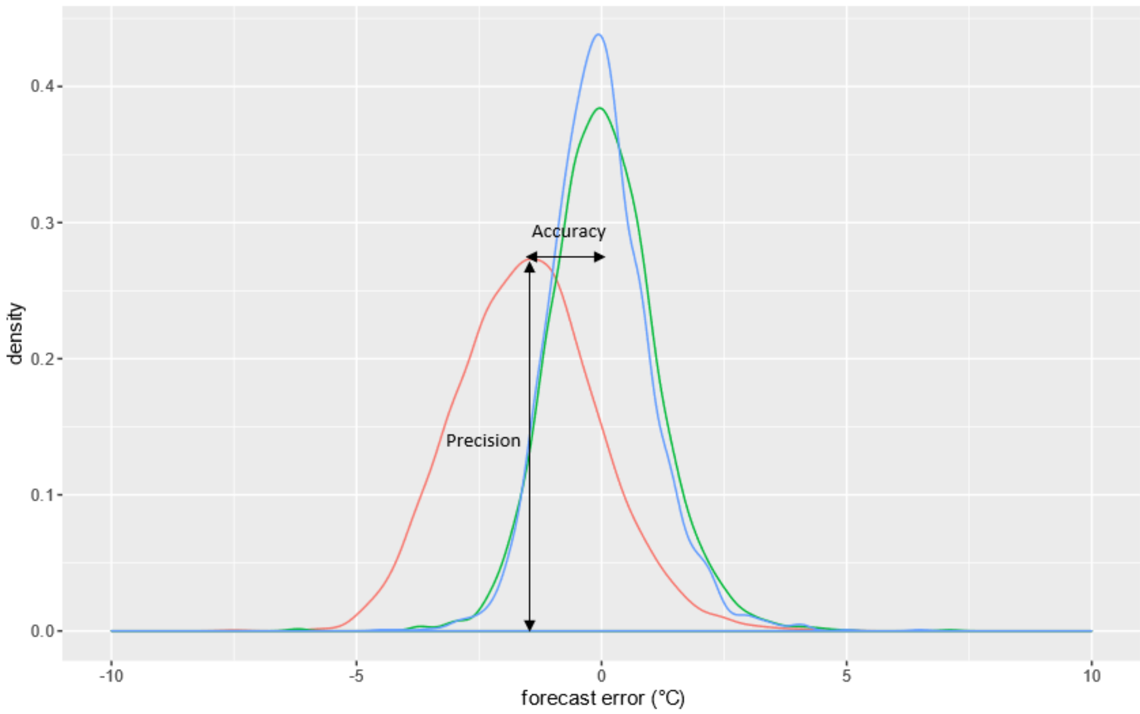
This report studies temperature forecast performance at the 4-, 24-, and 72-hour ahead (HA) rolling forecast horizons.

Many of the results in this section and in Appendix A1 are displayed as error density plots like Figure 3 shown below. These figures can be interpreted as follows:

- The x-axis shows forecast error. Positive values indicate over-forecasting (the forecast temperature exceeded the actual temperature), and negative values indicate under-forecasting (the forecast temperature was lower than the actual temperature).
- The y-axis shows error density. This reflects the relative rate of a forecast error occurring. For each forecast error, the error density will be between 0 and 1, and the area under each curve equates to 1.
- The height of the error density peak captures the level of forecast precision. The higher the peak, the greater the forecast precision and the smaller the expected deviation from the level of error. In Figure 3, the forecast distribution in blue has the highest precision and the forecast distribution in red has the lowest precision.
- The position of the peak with respect to a forecast error of zero captures the forecast accuracy. The further the peak is from zero error, the lower the accuracy, and the larger the tendency for over- or under-forecasting on average. In Figure 3, the forecast distribution in red is less accurate than the forecast distributions in green and blue.

Appendix A2 contains intraday mean absolute error (MAE) profiles for weather stations not explicitly featured in the main report. Forecasts are provided for each hour of the day and for each provider.

Figure 3 Accuracy and precision in the error density plot



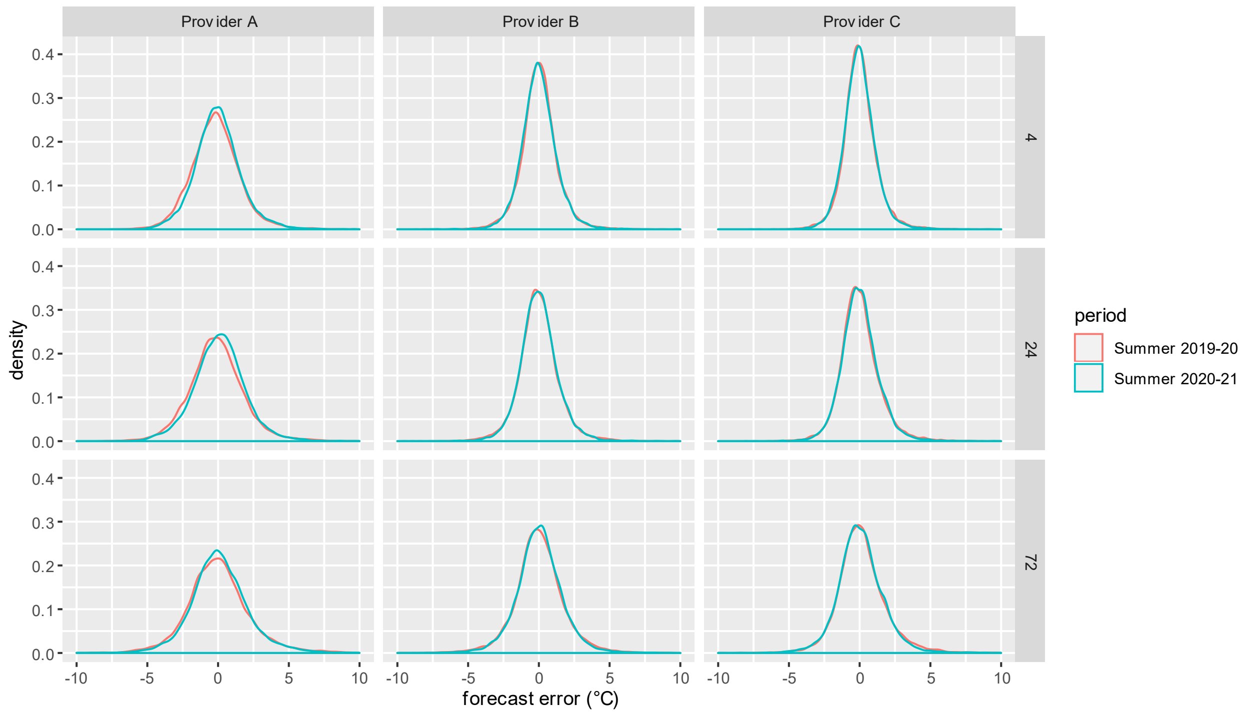
2.1 Overall performance

Summer 2020-21 was heavily influenced by the effect of the La Niña, which delivered Australia its wettest summer in four years and the first cooler-than-average summer in nine years based on daytime temperatures[4]. The cooler conditions were mostly seen in the national maximum temperatures, which were 0.28°C below the long-term average, made up of South Australia (-0.48°C), Victoria (-0.34°C), New South Wales (-0.19°C) and Tasmania (-0.15°C). Queensland was the only NEM region to see an increase in average maximum temperature (+0.46°C) after an abnormally warm and dry summer.

Figure 4 and Figure 5 show the performance comparison of 2019-20 and 2020-21 summer periods across all studied weather stations for Providers A, B, and C. Insights include:

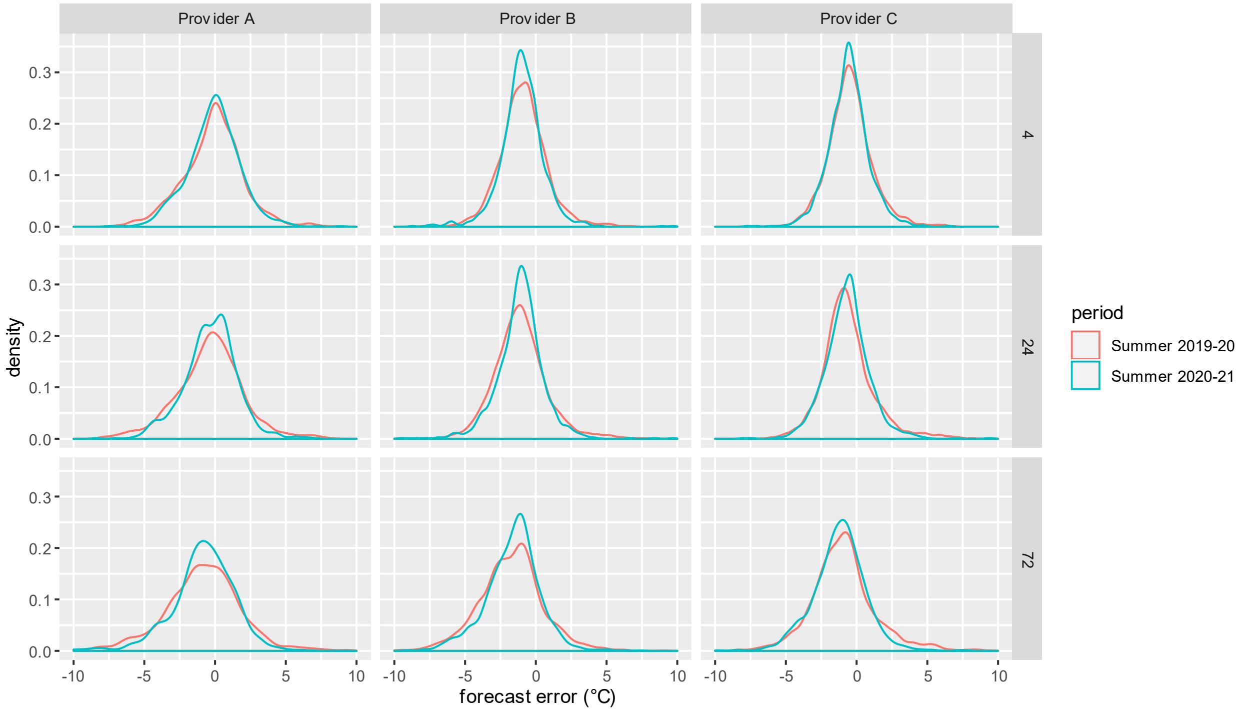
- Provider A remained the lowest performing provider across all forecast horizons, but overall accuracy and precision improved more for Provider A than Providers B and C.
- In summer 2020-21, Provider A's performance was closest to Providers B and C at the 72HA time horizon, but their performance did not improve as much as Providers B and C as the forecast time horizon decreased.
- Performance improved for all providers for the top 10% of temperatures, with Provider B delivering the greatest improvement year-on-year. This was aided by lower 90th percentile temperatures at all studied stations this summer (average reduction of 1.2°C).
- Provider A continued to forecast high temperatures with the highest accuracy but the lowest precision. Providers B and C produced more precise forecasts at high temperatures, but they were less accurate, tending to under-forecast more often.

Figure 4 Summer performance comparison across all weather stations (2019-20 and 2020-21)



[4] Source: Bureau of Meteorology (BOM), Australia in summer 2020–21, at http://www.bom.gov.au/climate/current/season/aus/summary.shtml.

Figure 5 Summer performance comparison across all weather stations (2019-20 and 2020-21), top 10% of temperatures



2.2 Temperature forecast precision at Adelaide West Terrace

Consistent with the previous summer, all three providers continued to find forecasting temperatures at Adelaide West Terrace more challenging than at the other weather stations examined.

Figure 6 shows that Provider A continued to produce the least precise temperature forecasts at Adelaide West Terrace relative to its forecasts at other weather stations, despite observing a slight improvement compared to summer 2019-20. This improvement in forecast precision helped close the forecast precision gap that was observed between Adelaide West Terrace and the other weather stations. As shown in Figure 7, Provider A's forecasts at Adelaide West Terrace for hot temperatures observed a significant increase in precision and were close to the most precise forecasts of any weather station.

Figure 8 and Figure 9 show that Providers B and C produced the second least precise temperature forecasts at Adelaide West Terrace relative to their forecasts at other weather stations, only slightly better than their forecasts at Penrith Lakes. Compared to summer 2019-20, Provider B observed a significant improvement in precision at Adelaide West Terrace. This improvement was not matched by Provider C, and led to Provider B's temperature forecast performance across all three forecast horizons being on par with Provider C, which had clearly outperformed the others in the summer 2019-20 period (see Figure 10). For hot temperatures, Provider B overtook Provider C to provide the most precise forecasts across all three forecast horizons in summer 2020-21, as shown in Figure 11.

Figure 6 All weather stations, Provider A, all summer temperatures 2019-20 and 2020-21, 24HA

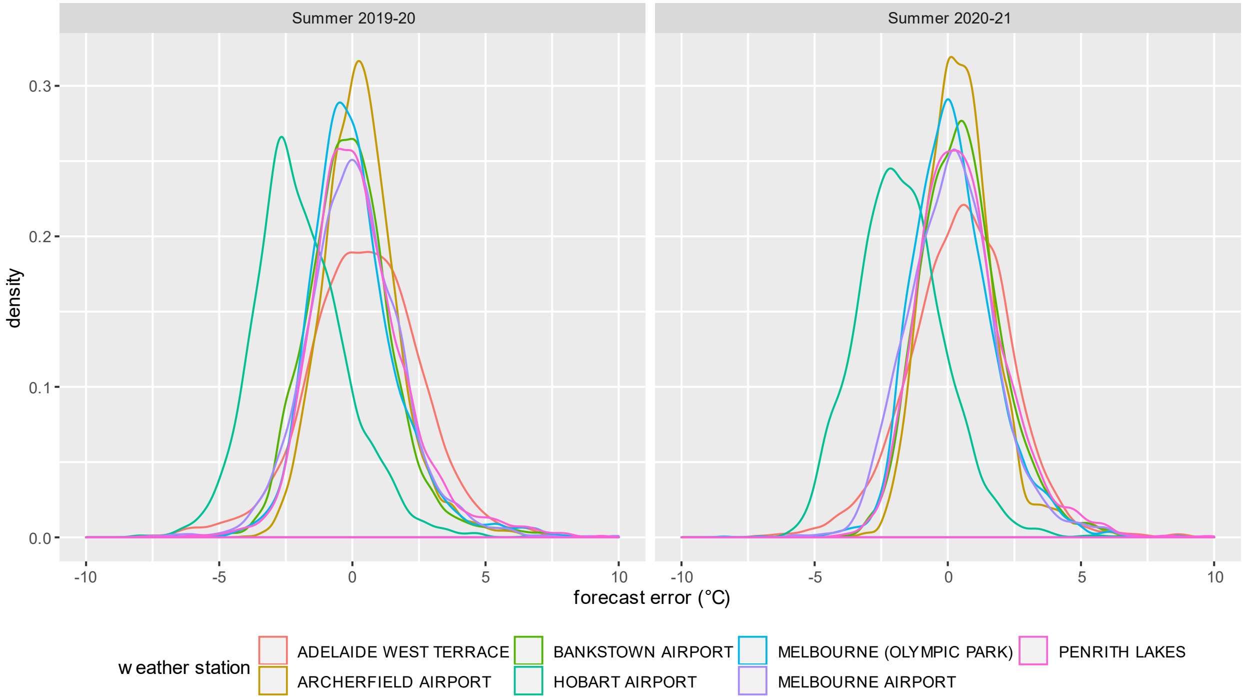


Figure 7 All weather stations, Provider A, top 10% summer temperatures 2019-20 and 2020-21, 24HA

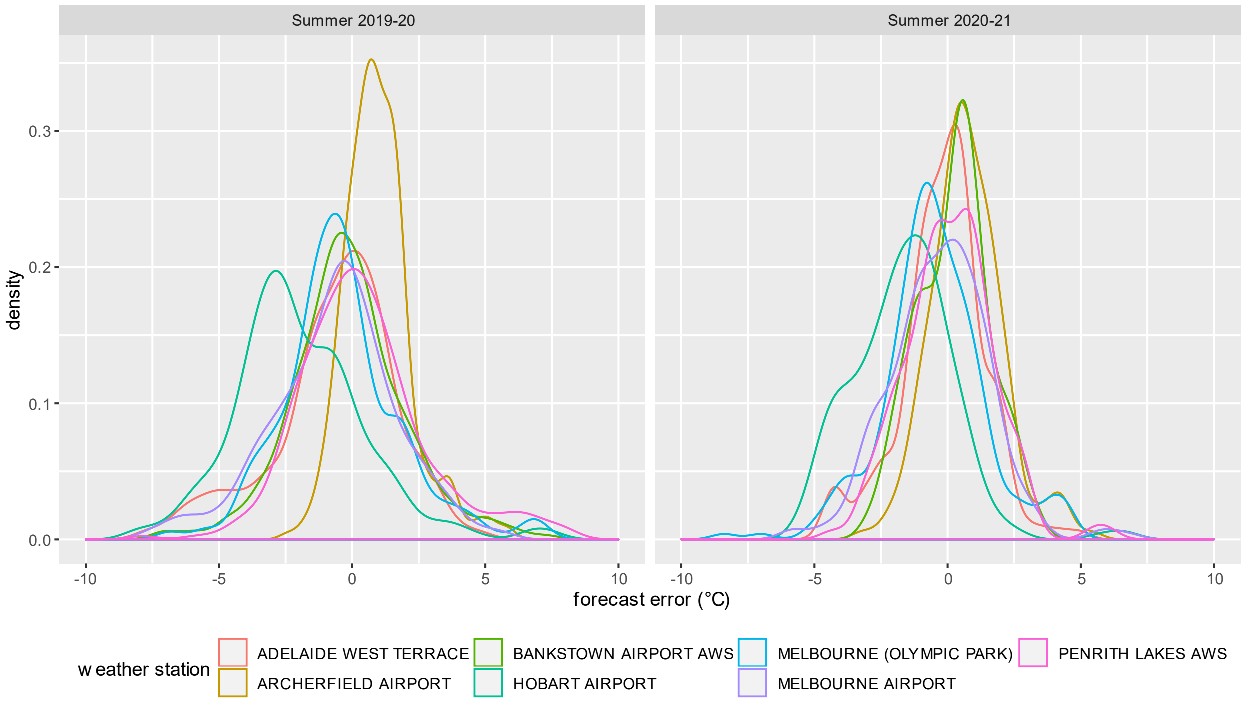


Figure 8 All weather stations, Provider B, all summer temperatures 2019-20 and 2020-21, 24HA

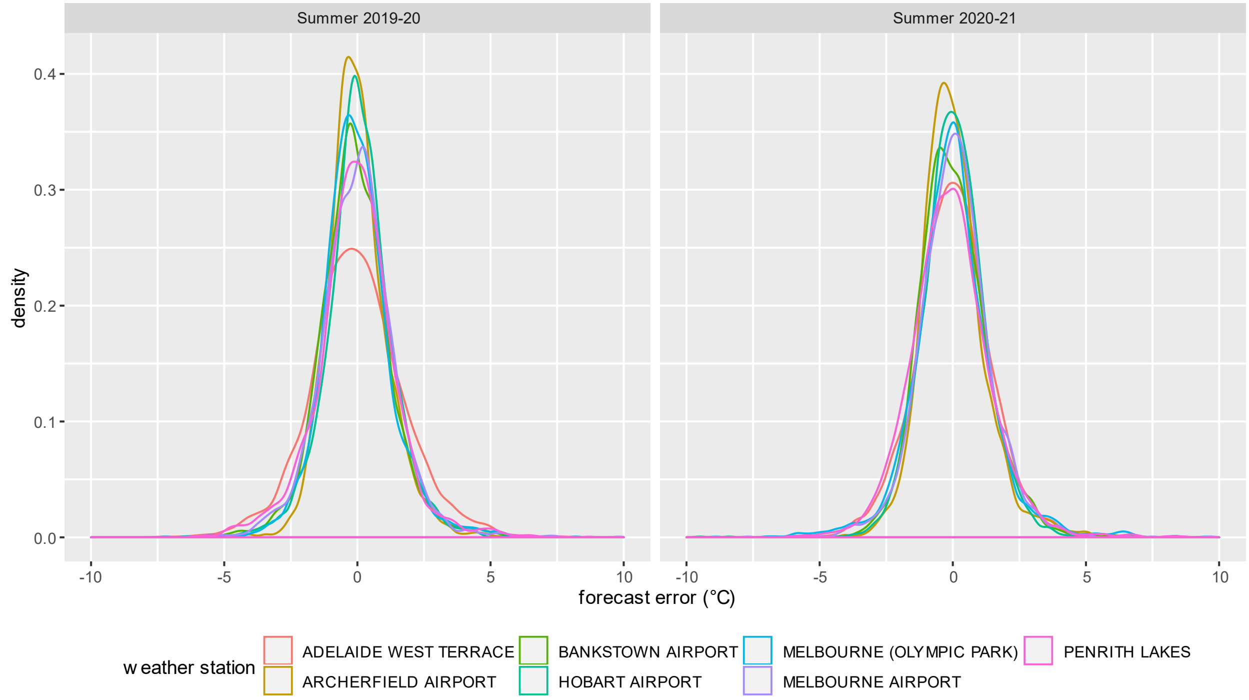


Figure 9 All weather stations, Provider C, all summer temperatures 2019-20 and 2020-21, 24HA

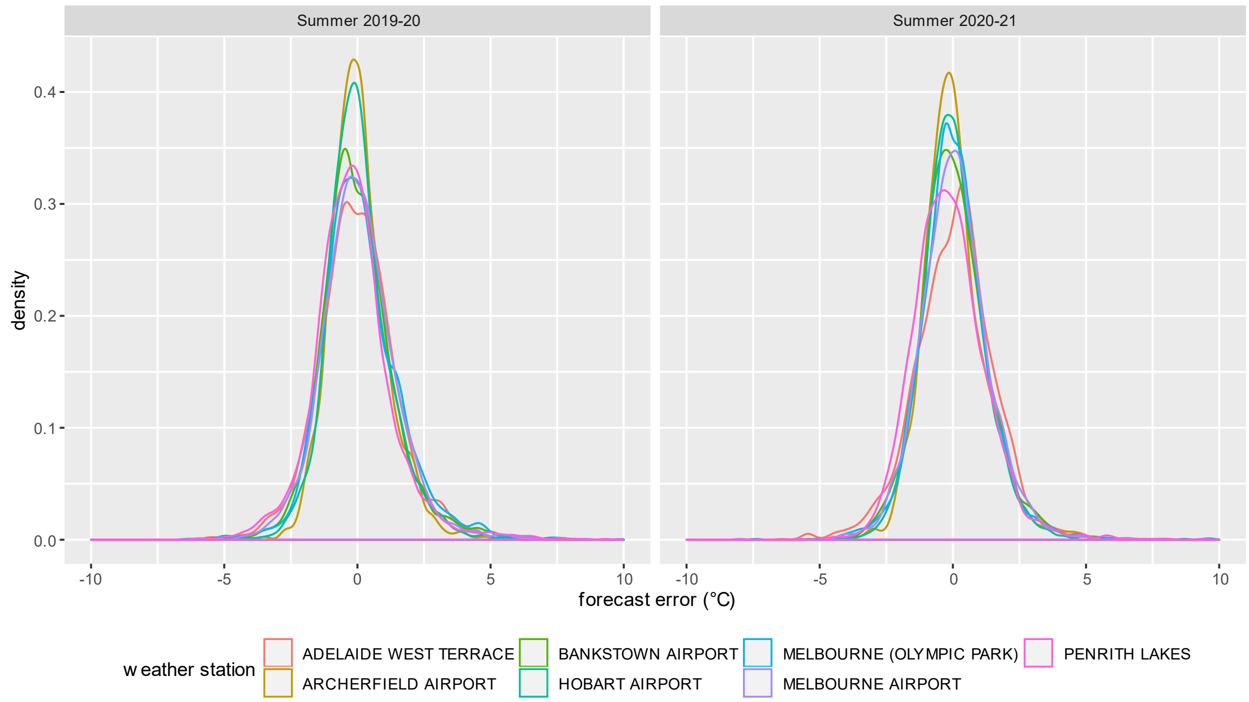


Figure 10 Adelaide West Terrace, all providers, all summer temperatures 2019-20 and 2020-21, all time horizons

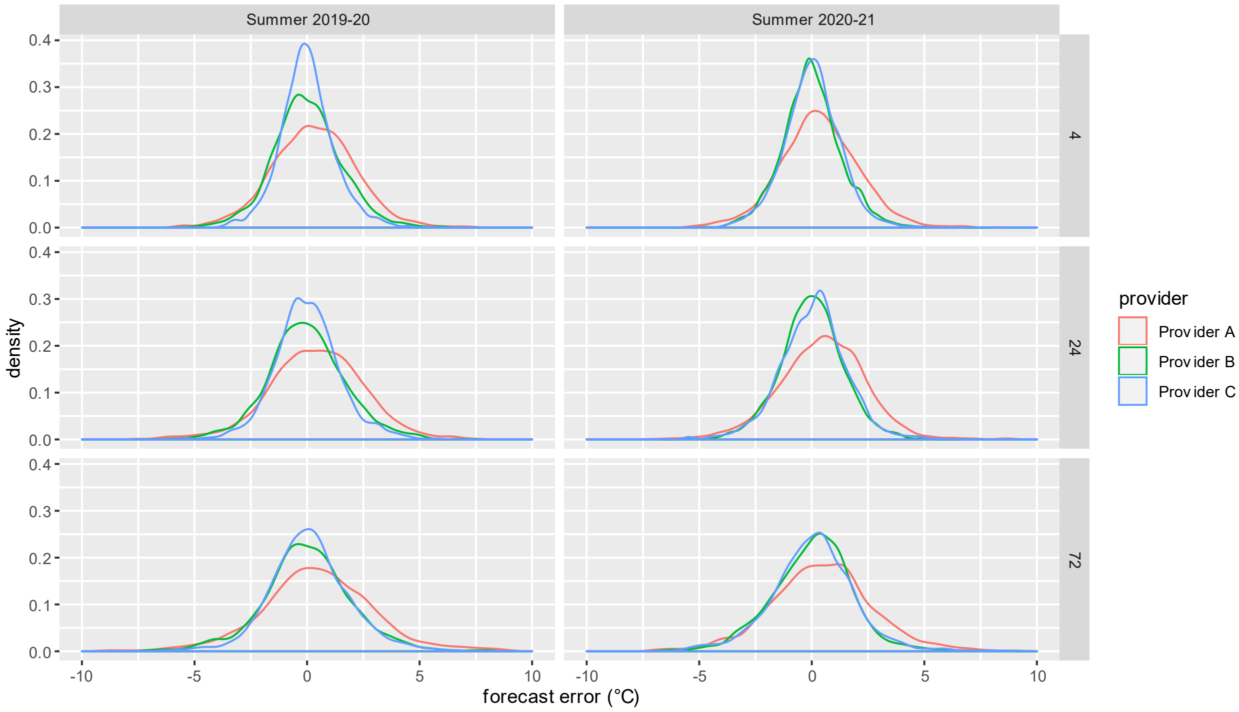
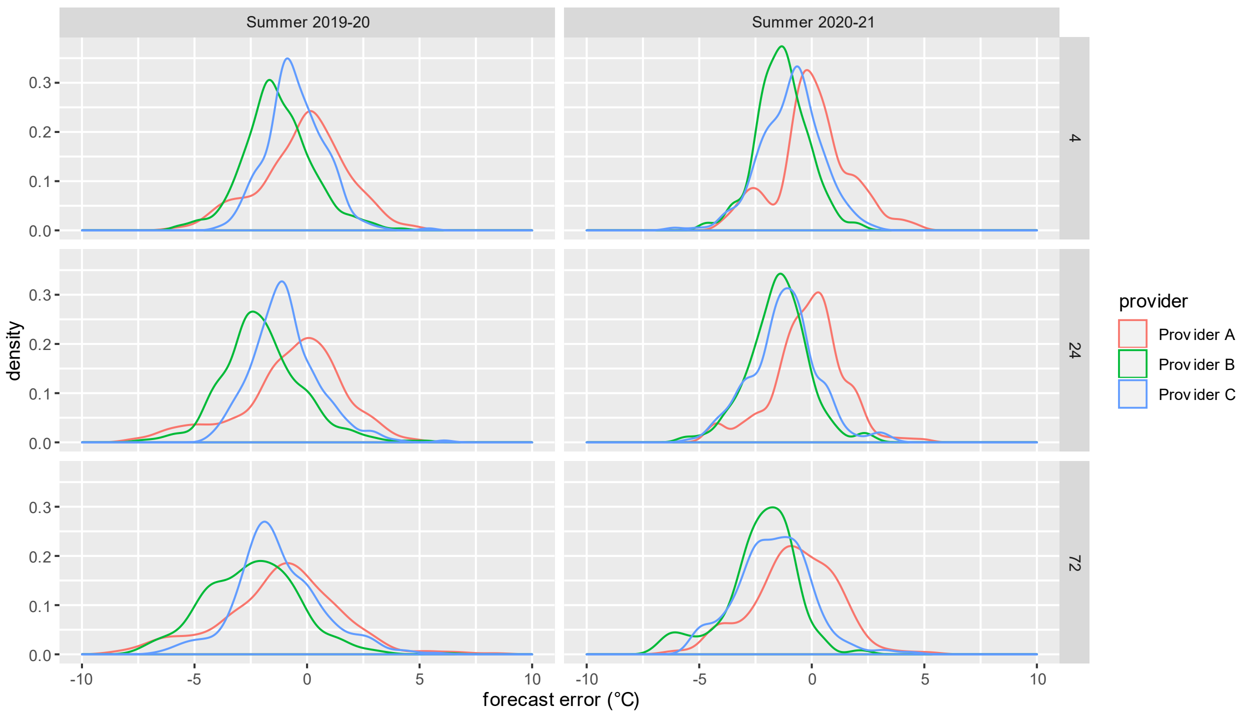


Figure 11 Adelaide West Terrace, all providers, top 10% summer temperatures 2019-20 and 2020-21, all time horizons



2.3 Greatest overall performance improvement by Provider A

As shown in Figure 4, Provider A observed a greater performance improvement than Providers B and C in summer 2020-21, when compared to the previous summer period.

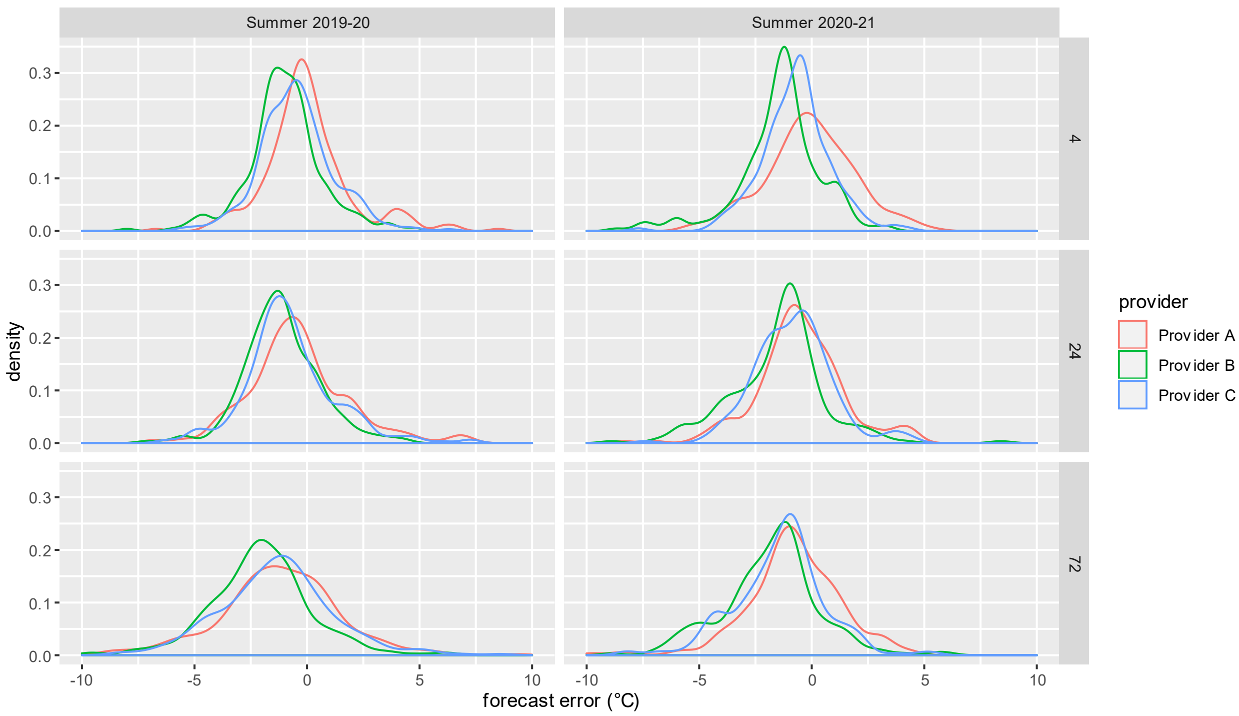
In forecasting hotter temperatures at 24HA, Provider A showed improved forecast precision at all weather stations except Archerfield, and especially at Adelaide West Terrace and Bankstown Airport (see Figure 7).

Figure 12 shows that for the top 10% of temperatures in summer 2019-20, Provider A had the best forecast accuracy and precision at the 4HA time horizon at Melbourne Olympic Park. During the 2020-21 summer period, Provider A observed a reduction in forecast precision at this weather station and delivered the least precise forecasts at the 4HA time horizon. Despite this, Provider A continued to produce the most accurate forecasts at the 4HA time horizon.

Provider A's forecast performance at Hobart Airport remained noticeably less accurate than at the other weather stations. Figure 6 shows that temperature at Hobart Airport were under-forecasted by approximately 2.5°C on average.

After summer 2020-21, AEMO worked with Provider A on its initiatives to uplift its temperature forecast feeds for all weather stations. After switching to a more accurate combination of forecast models, Provider A has reported a steady improvement in performance, including a correction to the persistent under-forecasting at Hobart Airport. It is expected these performance improvements will be reflected in future *Temperature Forecast Analysis* reports.

Figure 12 Melbourne OP, all providers, top 10% summer temperatures 2019-20 and 2020-21, all time horizons



2.4 Provider B and forecast precision

Provider B's overall forecast precision was consistent with the previous summer period, however the performance spread between weather stations was much smaller (see Figure 8). This was due to a significant improvement in temperature forecast precision at Adelaide West Terrace and a slight reduction in forecast precision for Archerfield Airport and Hobart Airport.

For the top 10% of summer temperatures, improvement in temperature forecast precision was observed at all weather stations, and especially at Adelaide West Terrace and Bankstown Airport (see Figure 11 and Figure 14).

When forecasting the top 10% of summer temperatures:

- At Archerfield Airport, Provider B overtook Provider C in producing the most precise temperature forecasts at the 24HA and 72HA time horizons (see Figure 13).
- At Bankstown Airport, Provider B saw a significant improvement in the precision of its 4HA forecasts and recorded the most precise forecasts for all forecast horizons.

Figure 13 Archerfield Airport, all providers, top 10% summer temperatures 2019-20 and 2020-21, all time horizons

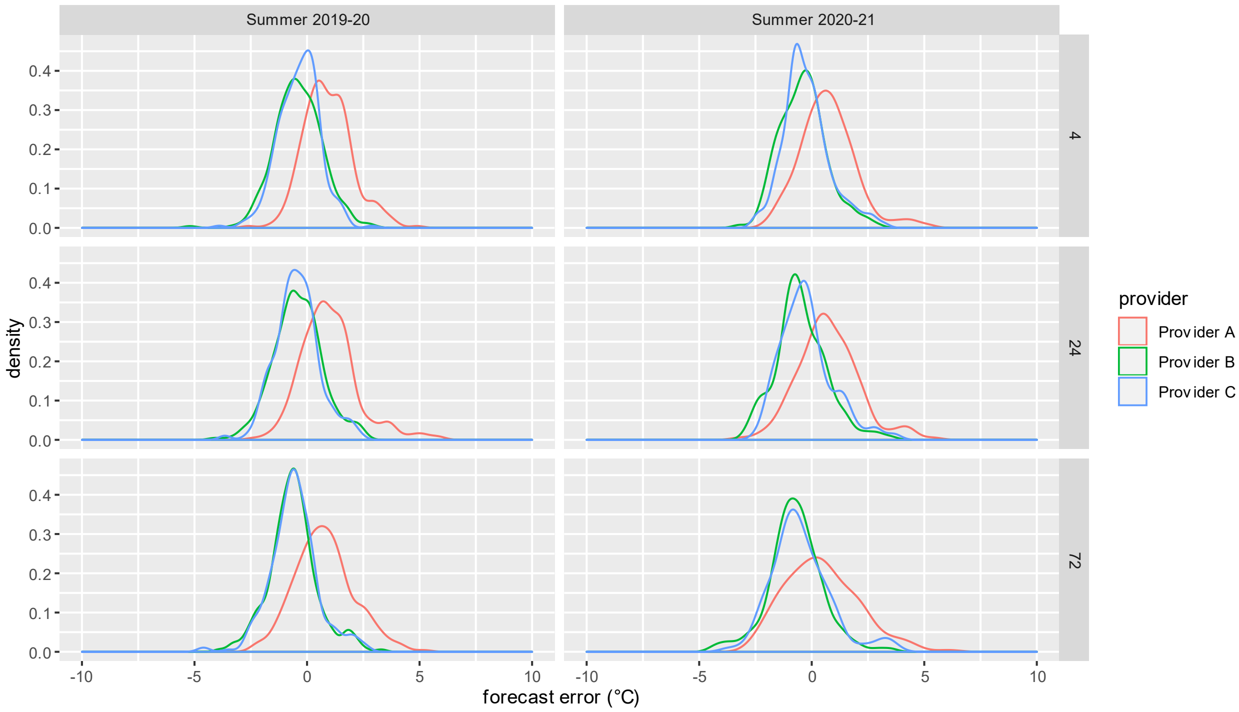
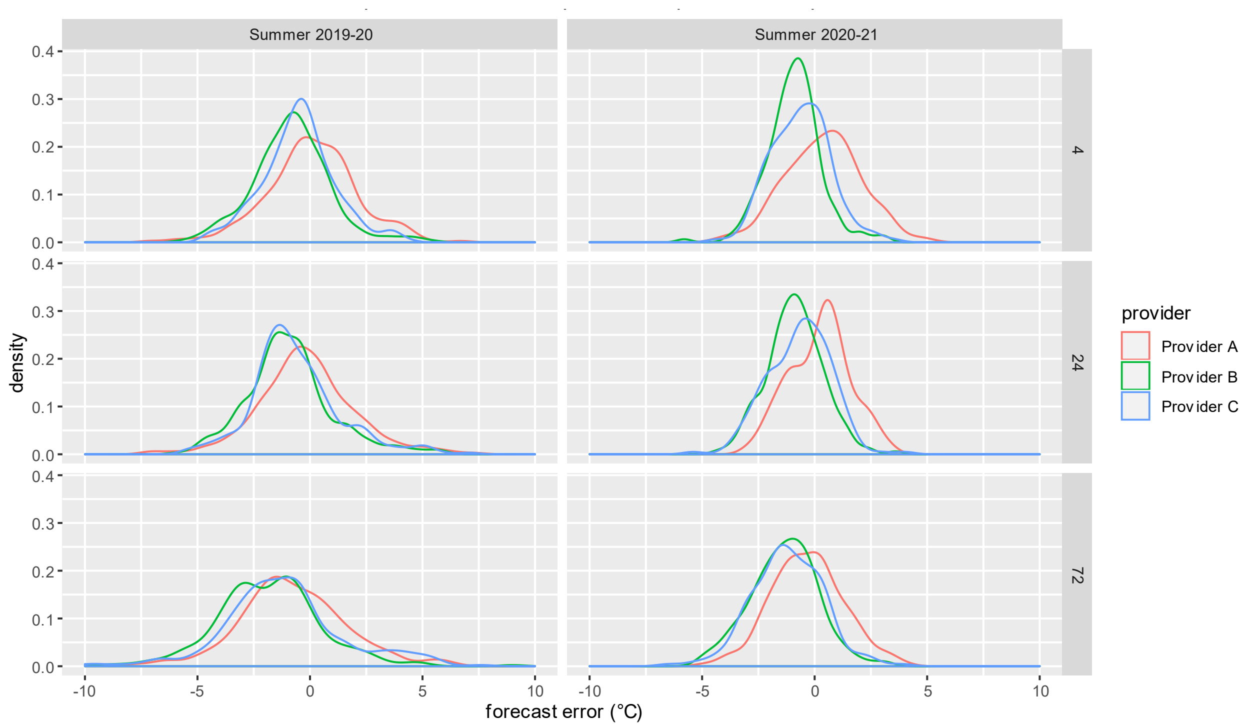


Figure 14 Bankstown Airport, all providers, top 10% summer temperatures 2019-20 and 2020-21, all time horizons



2.5 Provider C had the best performance at the 4HA and 24HA time horizons

Consistent with the previous summer period, Provider C produced more precise and accurate temperature forecasts than Providers A and B at the 4HA time horizon, at all weather stations except Adelaide West Terrace. Provider C's forecast precision slightly worsened at the 4HA and 24HA time horizons at Adelaide West Terrace, while Provider B's forecast precision significantly improved. This resulted in Providers B and C producing equally precise forecasts at this weather station, where previously Provider C was better (see Figure 10). At Melbourne OP, Provider C observed an improvement in its 4HA and 24HA forecast precision and overtook Provider B to deliver the most precise temperature forecasts for this weather station in summer 2020-21 (see Figure 15).

Provider C's performance in forecasting hot summer temperatures improved at several weather stations:

- After an improvement in forecast accuracy, Provider C became the most accurate forecaster at Bankstown Airport at the 4HA and 24HA time horizons (see Figure 14).
- At Melbourne Airport, Provider C improved its forecast accuracy and precision, allowing it to extend its performance lead at the 4HA time horizon (see Figure 16).
- At Penrith Lakes, Provider C's significant improvement in forecast precision for the 4HA and 24HA time horizons resulted in it overtaking Provider B to produce the most precise forecasts for these time horizons (see Figure 17).

Figure 15 Melbourne OP, all providers, all summer temperatures 2019-20 and 2020-21, all time horizons

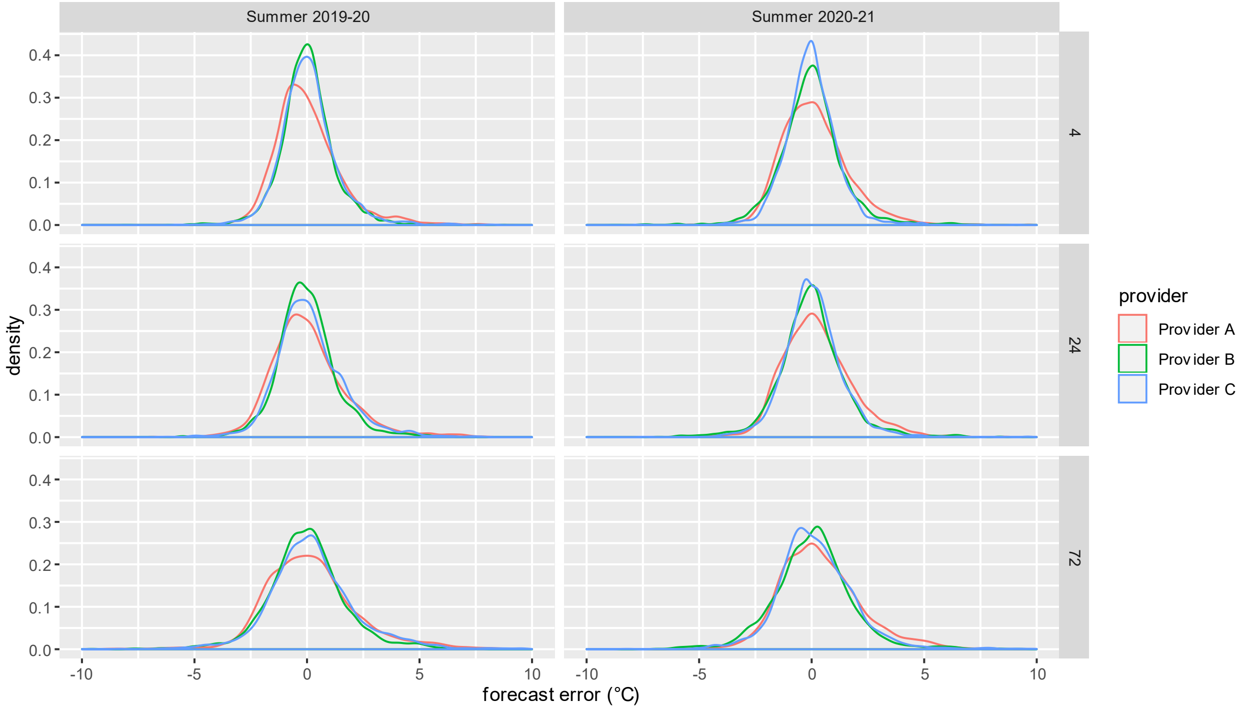


Figure 16 Melbourne AP, all providers, top 10% summer temperatures 2019-20 and 2020-21, all time horizons

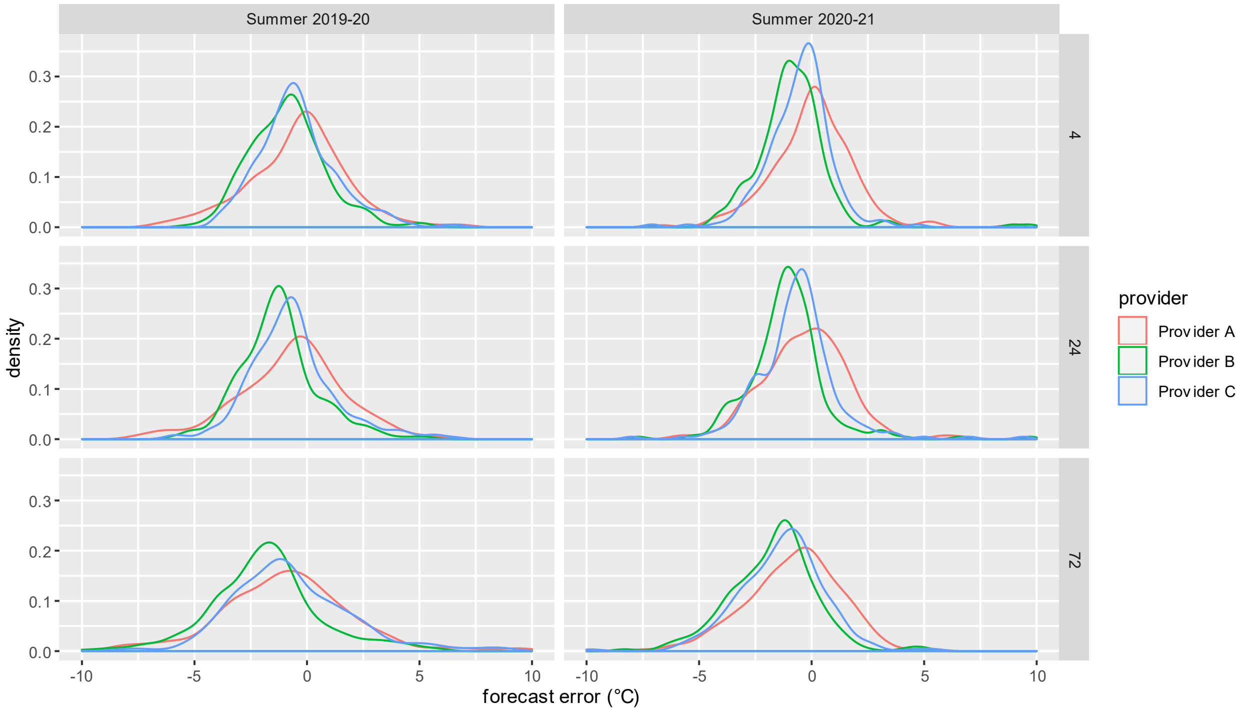
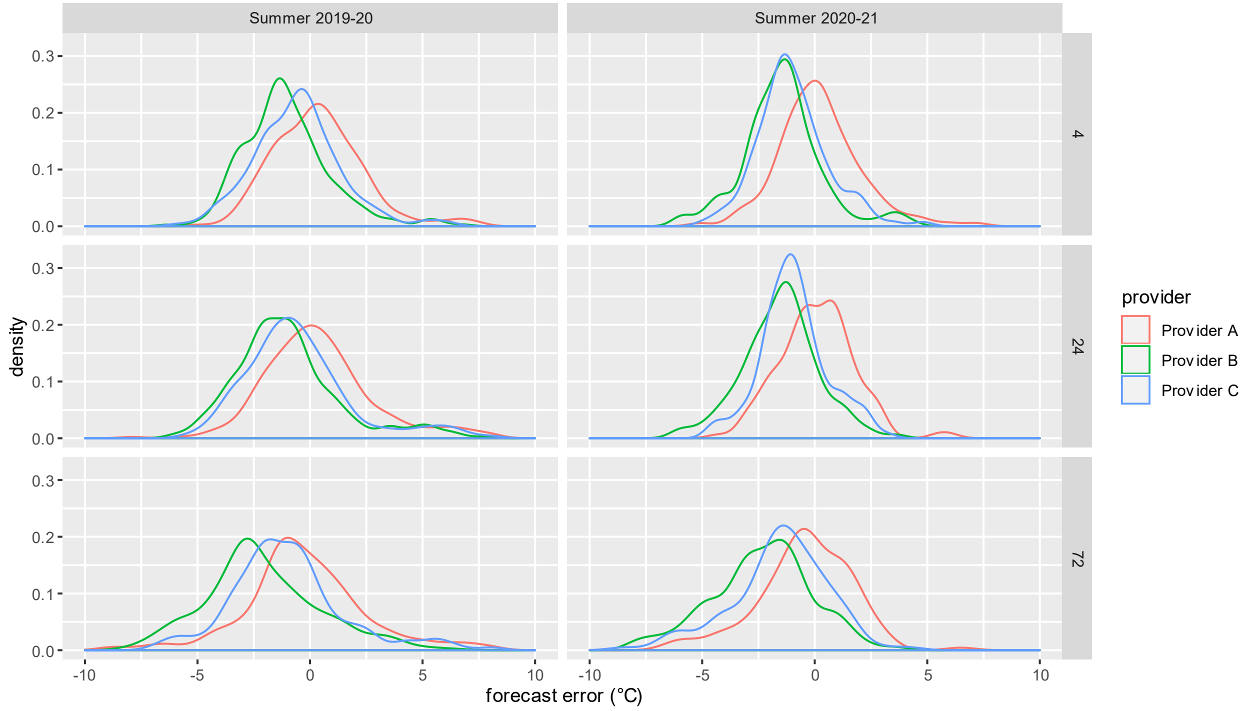


Figure 17 Penrith Lakes, all providers, top 10% summer temperatures 2019-20 and 2020-21, all time horizons



2.6 Intraday insights

These insights were derived from the Intraday Mean Absolute Error (MAE) profiles, which can be found in Appendix A2. Key insights from the data include:

- Provider A continued to produce much higher forecast errors in the middle of the day between 10:00 and 20:00 than Providers B and C, and this has not changed from the previous year.
- Typically, Providers B and C had better forecast error performance in the middle of the day at 24HA and occasionally at 72HA than Provider A does at 4HA (see Figure 18 and Figure 19 as examples).
- At Adelaide West Terrace, Provider B's forecast error improved and was on par with Provider C for all periods of the day (see Figure 18).
- At Bankstown Airport, Providers B and C improved their forecast error during midday for all forecast horizons, especially 72HA (see Figure 19).

Figure 18 Adelaide West Terrace, intraday MAE profile, all providers, summer 2019-20 and 2020-21, all time horizons[5]

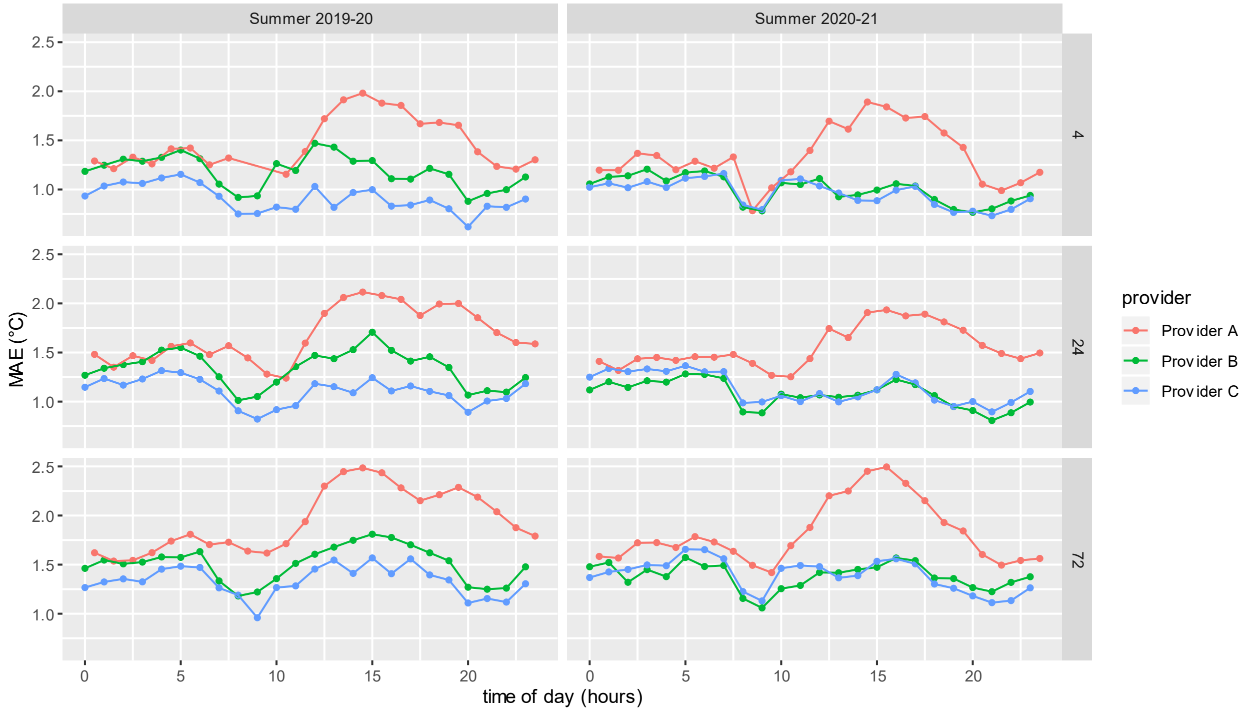
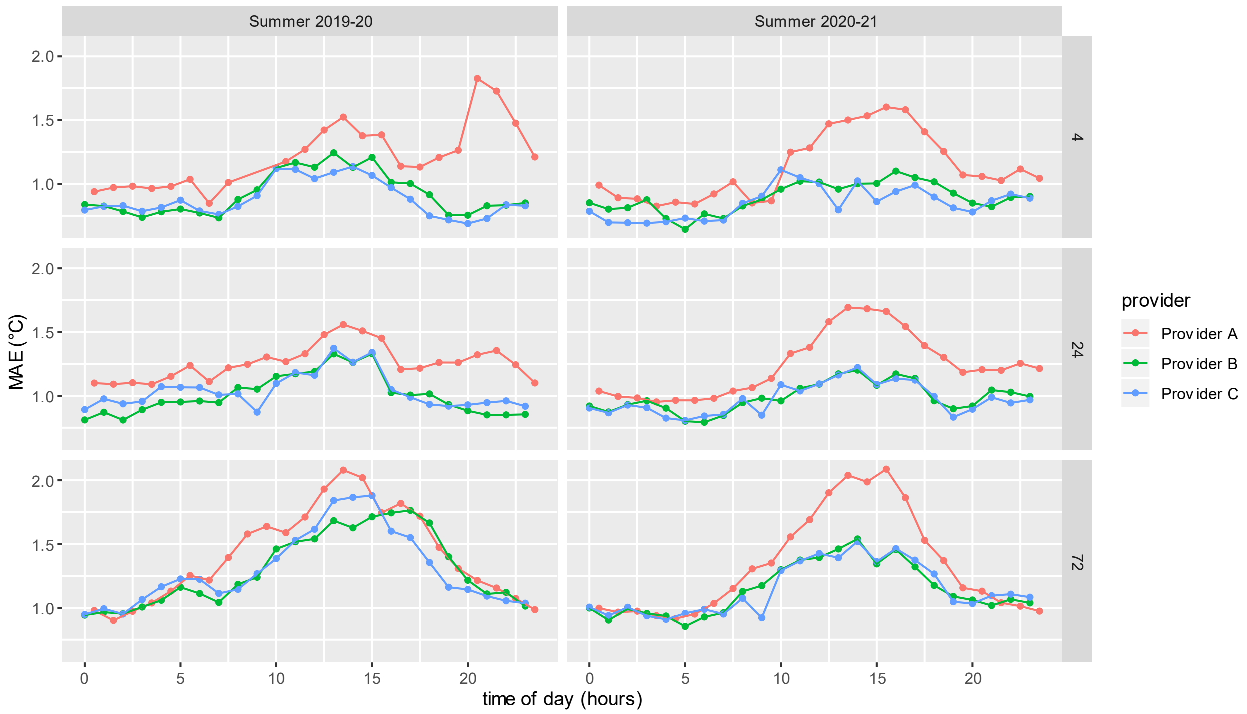


Figure 19 Bankstown Airport, intraday MAE profile, all providers, summer 2019-20 and 2020-21, all time horizons



[5] The forecast intervals for Provider A are between hours (e.g. 00:30 and 15:30) while Providers B and C are on the hour (e.g. 01:00 and 15:00). This explains the offset in data points in the intraday MAE profiles in Section 2.6 and Appendix A2 and Provider A forecast data in Figure 20.

3. Case study: Monday 25 January 2021 in Victoria

This case study explores the temperature forecasts of an abrupt cool change that occurred in Melbourne on Monday 25 January 2021, and the subsequent impacts this had on intraday demand forecasting.

Temperature forecasts

A hot northerly wind established over Melbourne from Thursday 21 January 2021. Extreme hot days were forecast for Sunday 24 January and Monday 25 January, with expected temperatures 10°C above average. Temperatures in Melbourne were forecast to peak near 40°C on Monday 25 January, ahead of a significant cool change at approximately 16:00 (AEST). This cool change was expected to drop temperatures by more than 10°C within an hour.

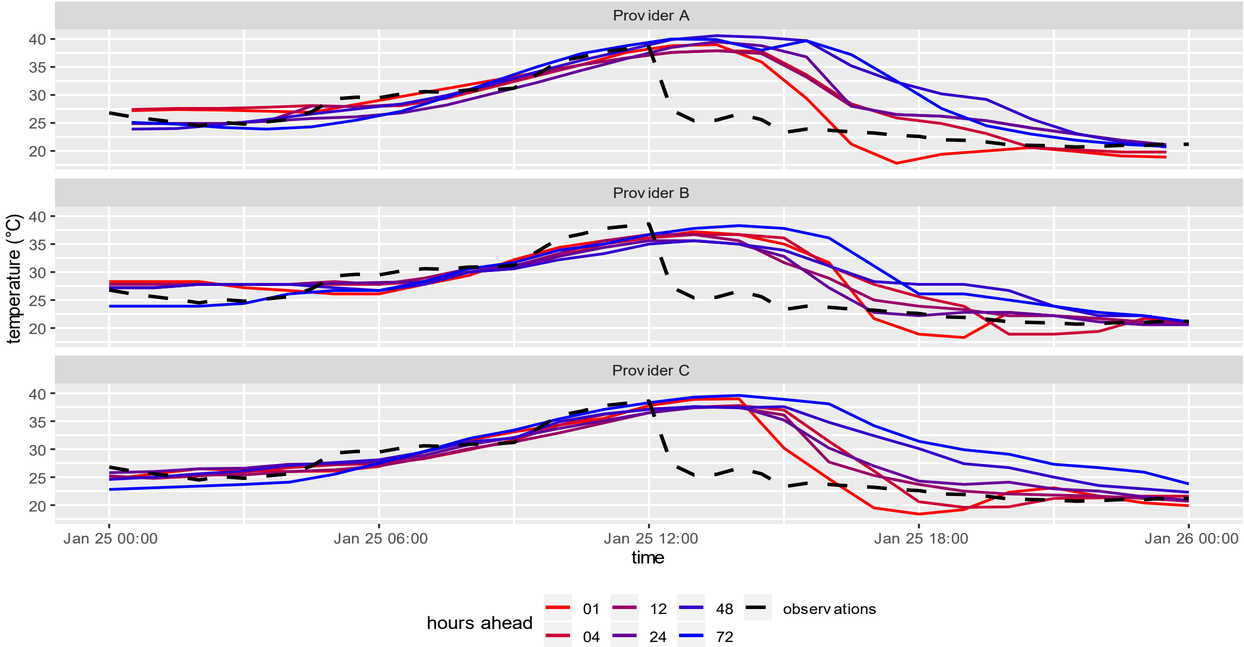
Leading into Monday, there was uncertainty around the exact timing of the cool change, with some weather models suggesting it would arrive during the late morning and others suggesting later in the afternoon. On the day, some models also indicated some pre-cooling ahead of the front which could limit heating potential.

Temperature outcomes

Overnight temperatures at Melbourne Olympic Park (OP) on Monday 25 January were near day-ahead forecasts before ramping steeply from 09:00 toward their peak at 12:00 ahead of the strong cold front. The front arrived approximately four hours earlier than beginning-of-day forecasts and had the effect of reducing Melbourne temperatures by 13°C in one hour.

Figure 20 illustrates how Providers A, B, and C had significantly over-forecast temperatures at Melbourne OP after the abrupt cool change, which persisted even at the one hour ahead forecast horizon. Providers A and C had forecast temperatures reasonably well at the time of peak; but Provider B forecast relatively lower temperatures from 09:00, resulting in relatively less over-forecasting deviations after the cool change moved through.

Figure 20 Forecast temperatures at multiple horizons against actual temperatures for each provider on Monday, 25 January 2021, at Melbourne OP



Intraday demand forecast impacts

The shape of the Victorian day-ahead demand forecast was driven by the day-ahead temperature feeds, with demand expected to ramp steeply during the morning hours before peaking at 8,850MW at 15:30 in line with the anticipated cool change. On the day, the earlier-than-expected cool change resulted in demand peaking much earlier, with 8,400MW observed at 12:30 (see Figure 21 below). After peaking, the actual demand ramped down quickly with falling temperatures causing large intraday forecast deviations.

To understand the impact this event had on intraday demand forecast deviations, the two largest drivers of the demand forecast on the day first need to be understood:

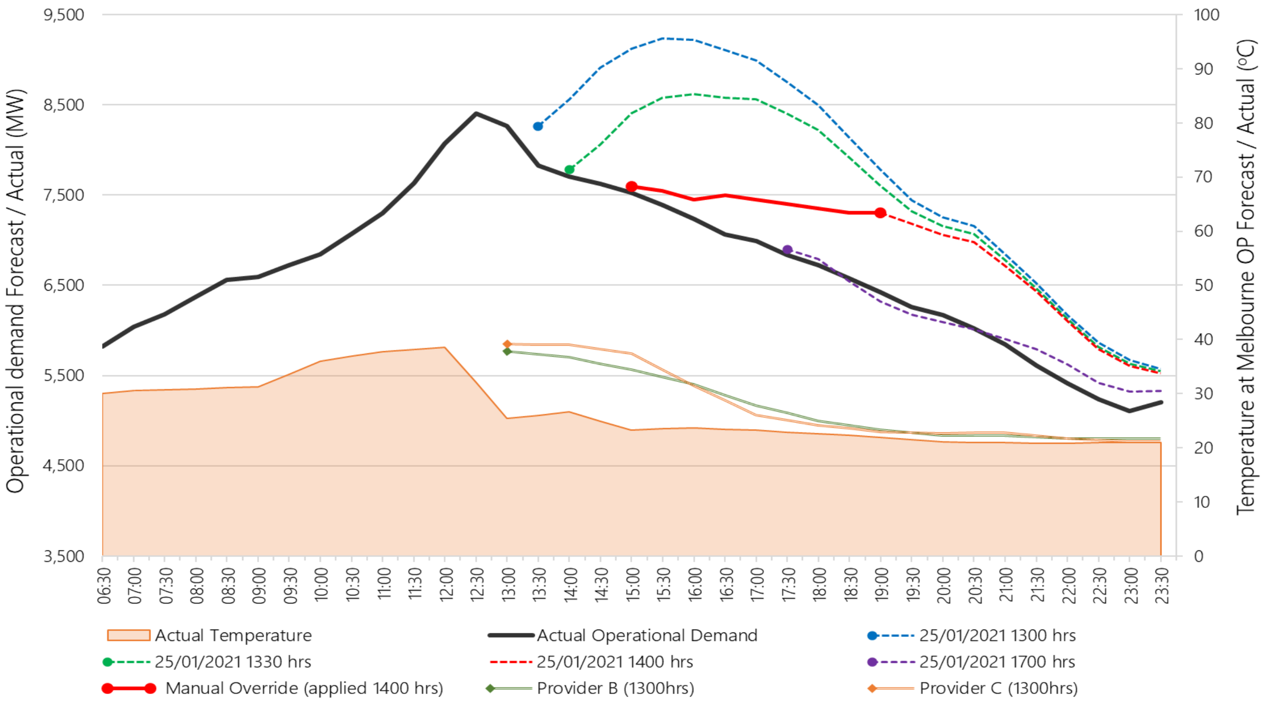
1. **Actual demand** – recently measured loads are fed into the model and drive the demand forecast in the near term (up to two hours ahead). These provide a reference points for the level and ramp of the load for the forecast to launch from.
2. **Temperature feeds** – temperature forecast feeds drive the demand forecast at horizons greater than two hours ahead. Demand will change proportionally with changing temperature feeds.

After the cool change arrived, the demand forecast dropped in the near term, in line with decreasing actual loads. The demand forecast beyond this, however, remained elevated, as temperature forecasts did not update to reflect cooler conditions for the remainder of the day.

This discrepancy created the operational challenge illustrated by Figure 21:

- The demand forecasts generated at 13:00 and 13:30 had lower initial demand due to decreasing actual load, but peaked at higher demand due to temperature forecasts not reflecting that the cool change had occurred at 12:00, as shown by Providers B and C's 13:00 forecast run.
- A manual override was applied to the demand forecast generated at 14:00 for the intervals 14:30 to 19:00 (inclusive) to correct for the temperature over-forecasting. This override lowered the baseline demand forecast by approximately 1,000MW.
- From 17:00, more than four hours after the cool change arrived, temperature forecasts reflected the cooler conditions, which improved the baseline demand forecast. This allowed the manual override of the demand forecast to be released.

Figure 21 Operational demand and temperature forecasts at specific run times against actuals, Victoria, 25 January 2021



Intraday temperature forecast initiatives

This case study demonstrates the impact on demand forecasting when intraday temperature feeds do not reflect unforeseen changes in the weather. Prior to manual intervention, temperature forecasts were driving an unreasonably high demand forecast for the remainder of the day.

AEMO is working actively with the weather service industry to increase model update frequency and ensure recent observations are better incorporated into intraday weather forecasts (Nowcasting project[6]). These initiatives will increase the adaptability and flexibility of these models and reduce the requirement for manual intervention of demand forecasts.

[6] For more information on the Nowcasting project, see https://arena.gov.au/projects/gridded-renewables-nowcasting-demonstration-over-south-australia/.

4. Conclusions

The results and insights presented in this report supplement the findings of previous *Temperature Forecast Analysis* reports and will continue to aid operational forecasting and decision making at AEMO. This report will be shared with current and intending weather service providers to draw attention to potential areas of improvement and help assist in baselining performance.

The key findings of this report include:

- Despite Provider A observing a greater year-on-year improvement in forecast performance than Providers B and C across all weather stations, Provider A remained the lowest performing provider for all three forecast time horizons.
- Performance improved for all providers for the top 10% of temperatures, with Provider B achieving the greatest improvement year-on-year. This was aided by lower 90th percentile temperatures at all studied stations this summer (average reduction of 1.2°C).
- Consistent with the previous summer period, Provider C produced more precise and accurate temperature forecasts than Providers A and B at the 4HA time horizon, at all weather stations except Adelaide West Terrace.
- All three providers continued to find forecasting temperatures at Adelaide West Terrace more challenging than at the other weather stations, despite Providers A and B observing a clear improvement in forecast precision.

In addition, this report aims to contribute to ongoing discussion and improvement within AEMO and across the wider weather and energy industry.

In 2021, AEMO is continuing to work with the weather forecasting industry to ensure weather forecast tools are developed for the purposes of energy forecasting. Initiatives include:

- Redevelopment of AEMO's Projected Assessment of System Adequacy (PASA) to be probabilistic and include weather uncertainty margins in reserve calculations.
- Continuing to work with Solcast, Weatherzone, and Tesla on the ARENA-funded Nowcasting project to improve near-term weather forecasts in the 0-6 hour-ahead forecast horizon[7].
- Continued collaboration with AEMO's weather service providers to develop weather forecasts designed for the energy industry.
- Increasing the number of weather station observations available to AEMO's Demand Forecasting System. This will assist with tracking weather systems such as cold fronts and thunderstorms to better inform their impact on demand.

The next *Temperature Forecast Analysis* report will focus on winter 2021 and will be published toward the end of this year.

[7] For more information on the Nowcasting project, see https://arena.gov.au/projects/gridded-renewables-nowcasting-demonstration-over-south-australia/.

A1. Error density plots

A1.1 Station comparison by provider

Figure 22 All weather stations, Provider B, top 10% summer temperatures 2019-20 and 2020-21, 24HA

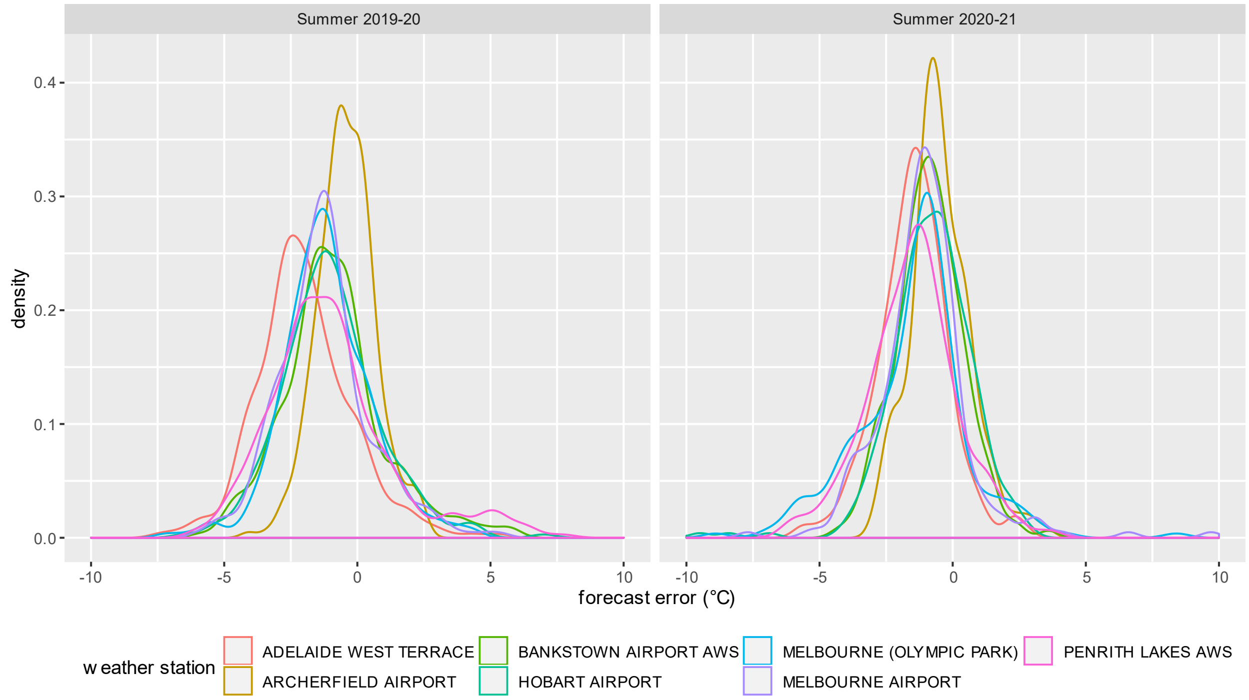
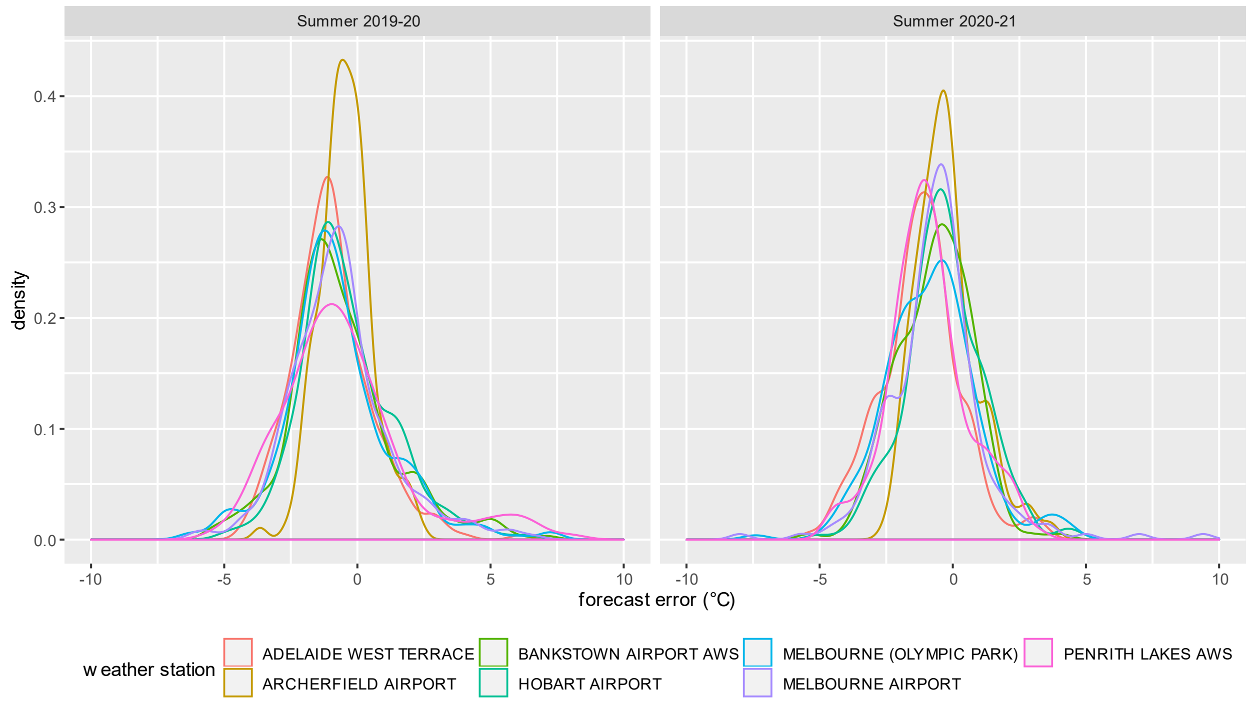


Figure 23 All weather stations, Provider C, top 10% summer temperatures 2019-20 and 2020-21, 24HA



A1.2 Provider comparison by weather station

Figure 24 Archerfield Airport, all providers, all summer temperatures 2019-20 and 2020-21, all time horizons

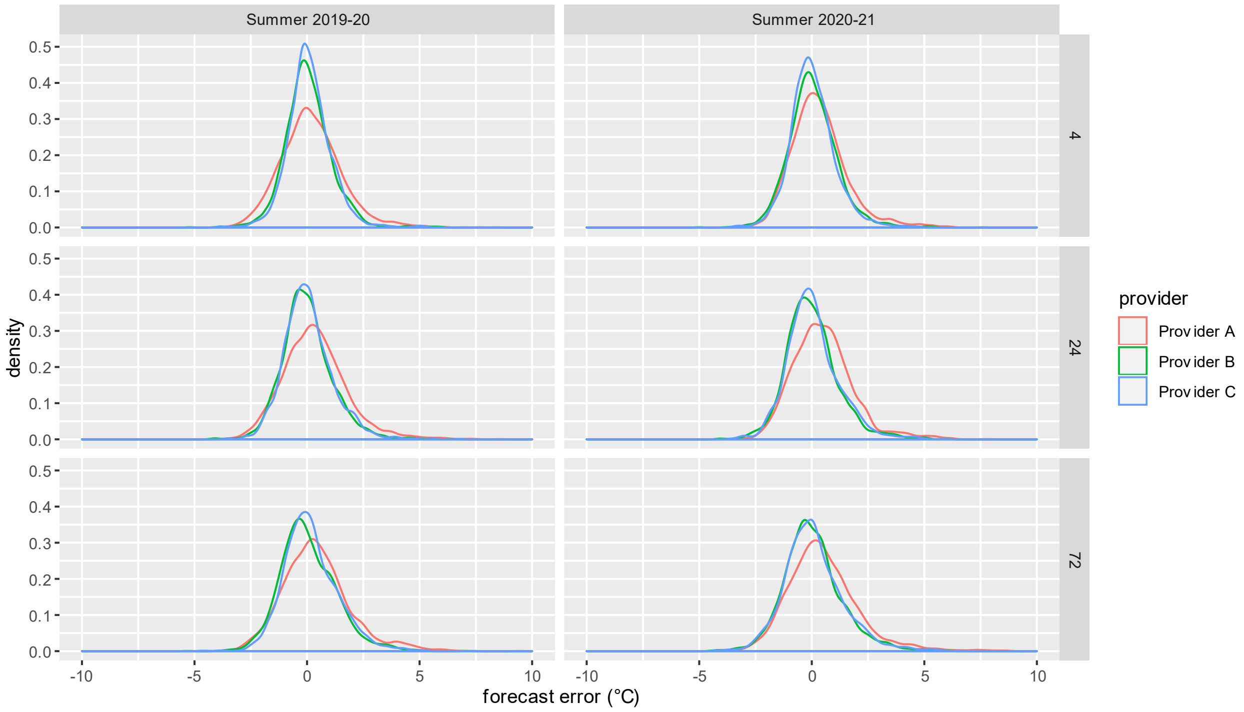


Figure 25 Bankstown Airport, all providers, all summer temperatures 2019-20 and 2020-21, all time horizons

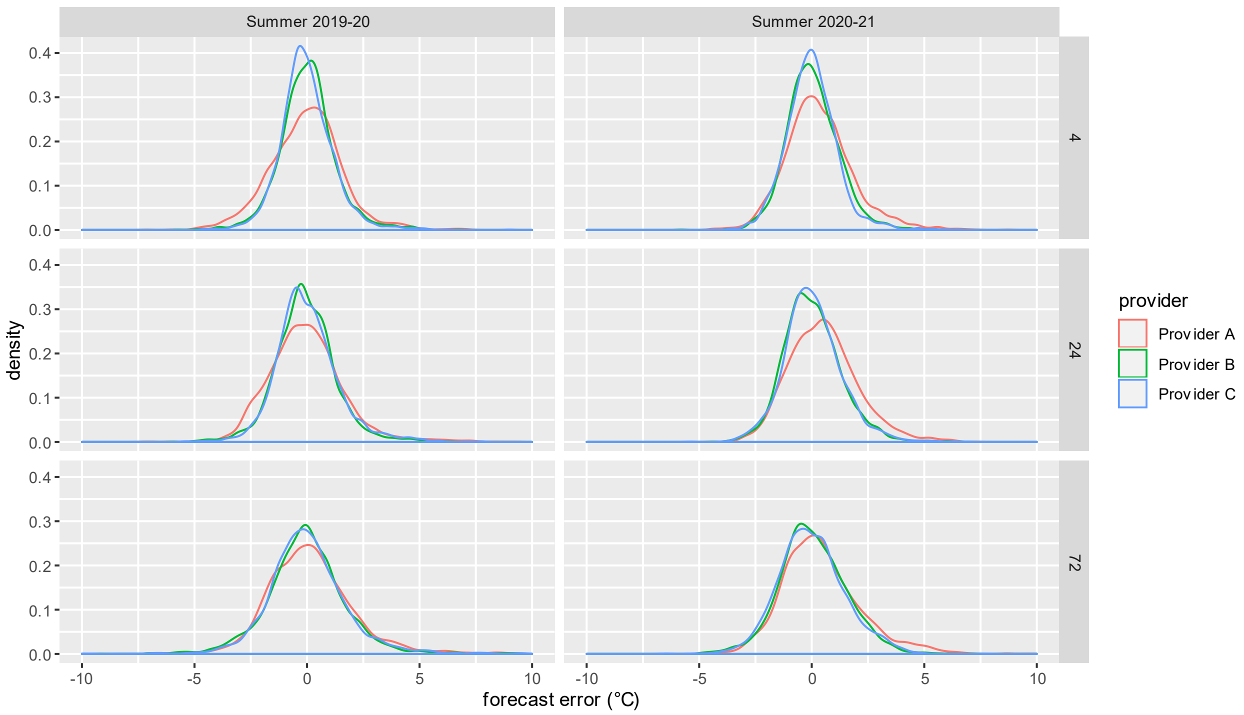


Figure 26 Hobart Airport, all providers, all summer temperatures 2019-20 and 2020-21, all time horizons

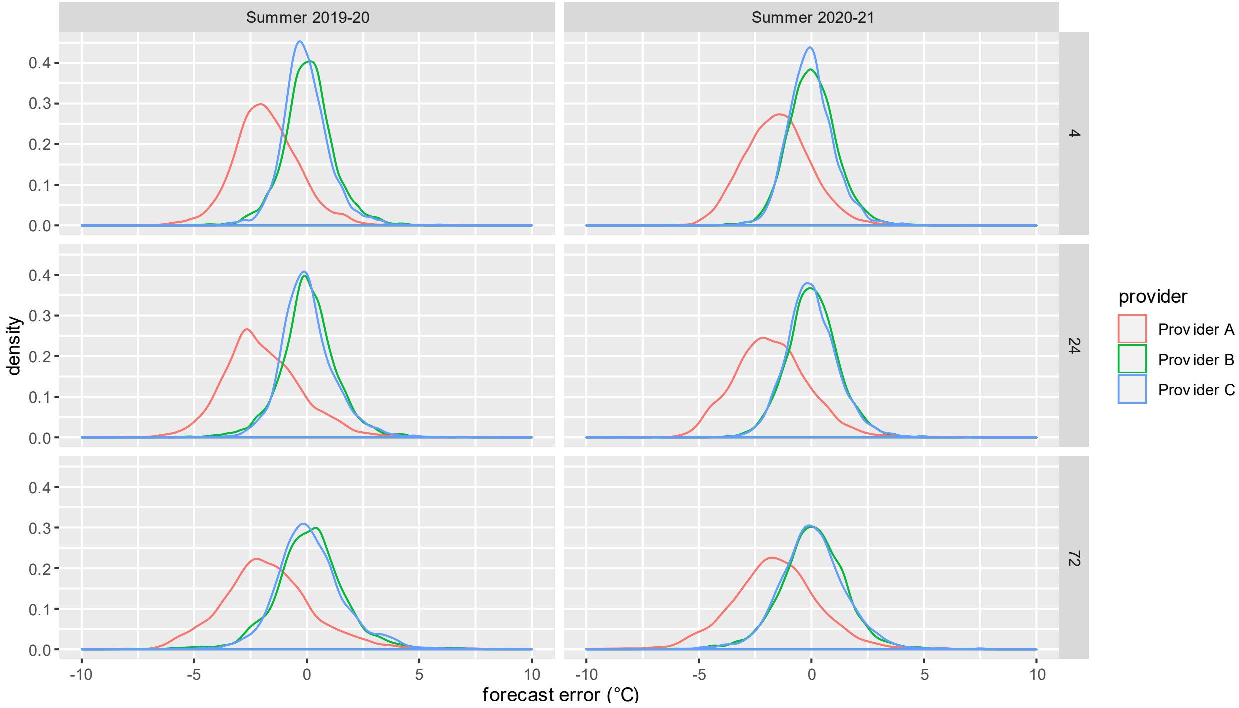


Figure 27 Hobart Airport, all providers, top 10% summer temperatures 2019-20 and 2020-21, all time horizons

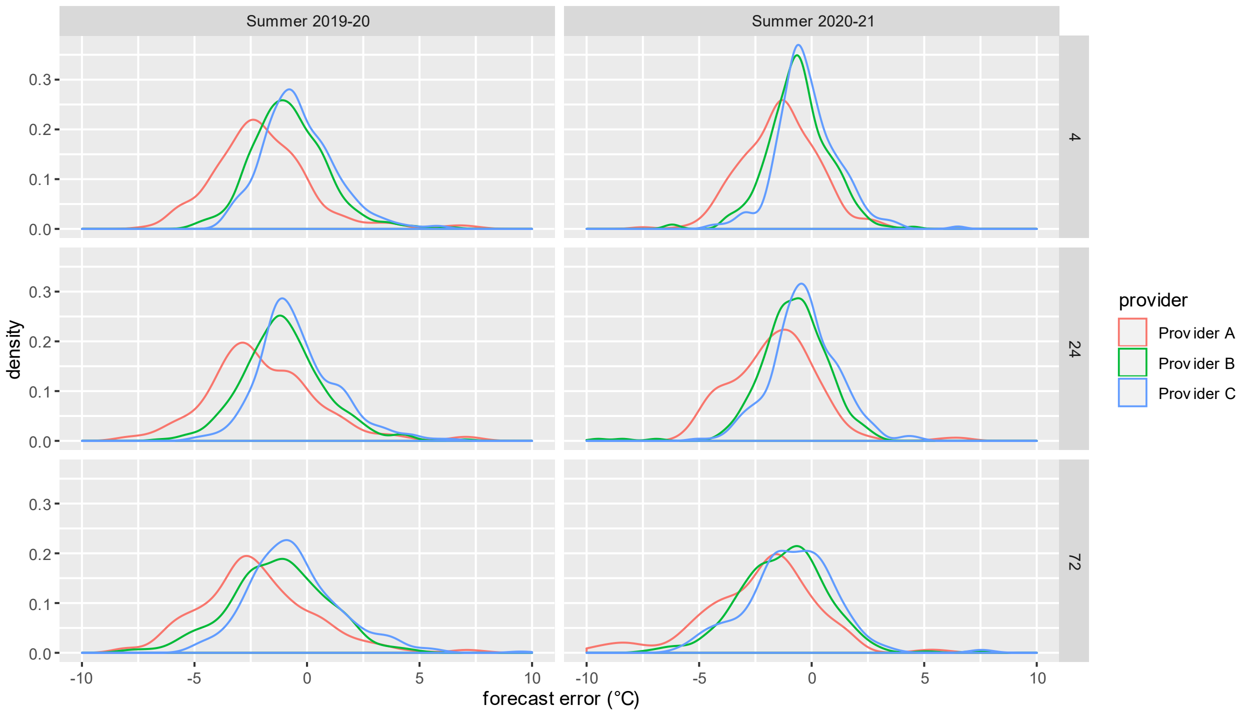


Figure 28 Melbourne AP, all providers, all summer temperatures 2019-20 and 2020-21, all time horizons

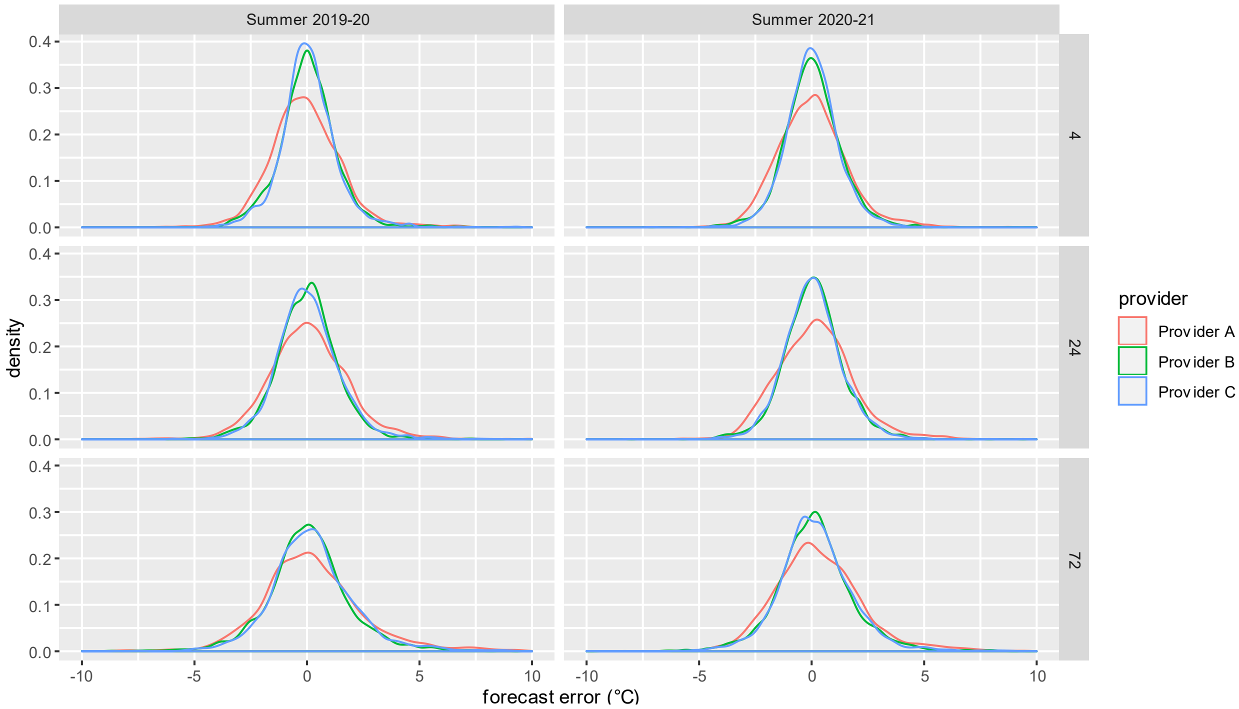
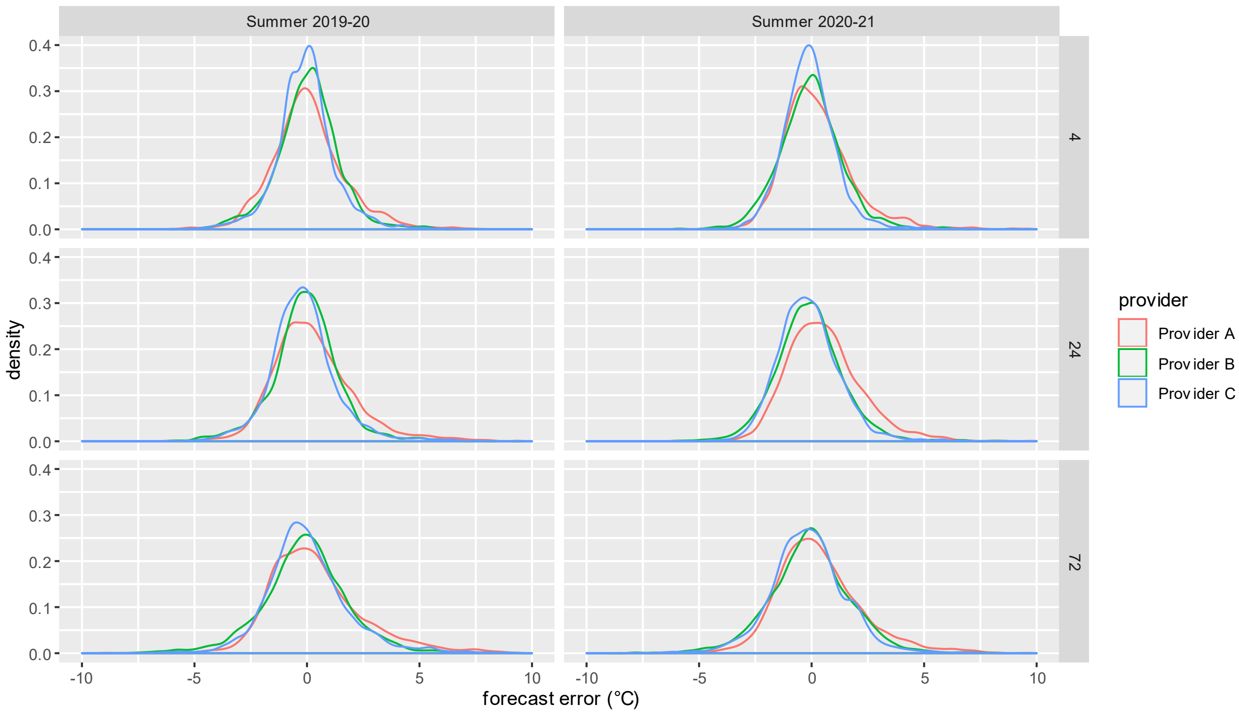


Figure 29 Penrith Lakes, all providers, all summer temperatures 2019-20 and 2020-21, all time horizons



A2. Intraday MAE profiles

Figure 30 Archerfield Airport, intraday MAE profile, all providers, summer 2019-20 and 2020-21, all time horizons

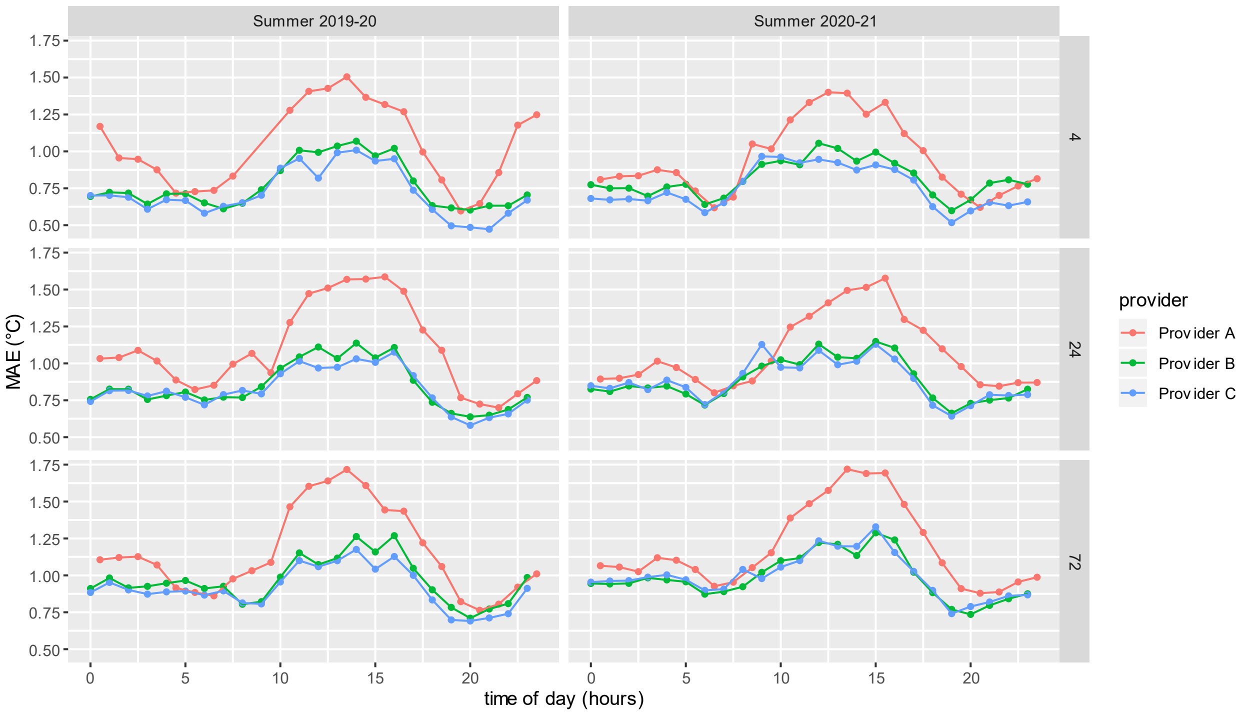


Figure 31 Hobart Airport, intraday MAE profile, all providers, summer 2019-20 and 2020-21, all time horizons

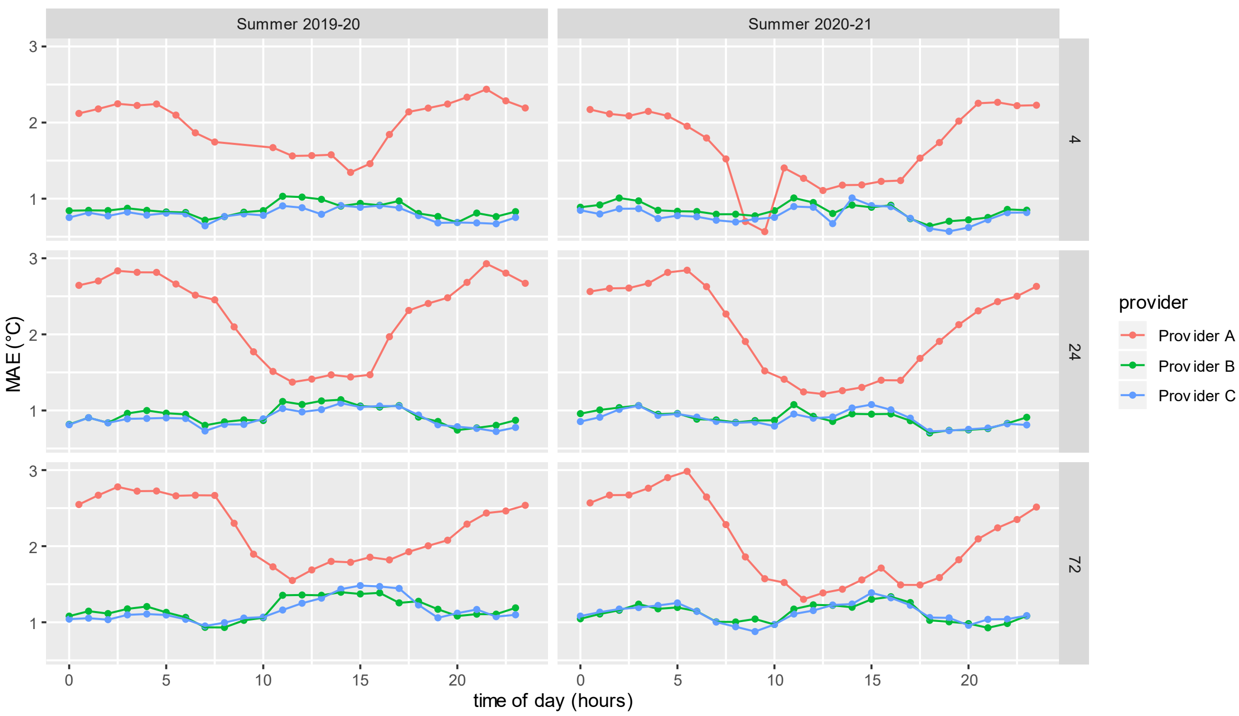


Figure 32 Melbourne OP, intraday MAE profile, all providers, summer 2019-20 and 2020-21, all time horizons

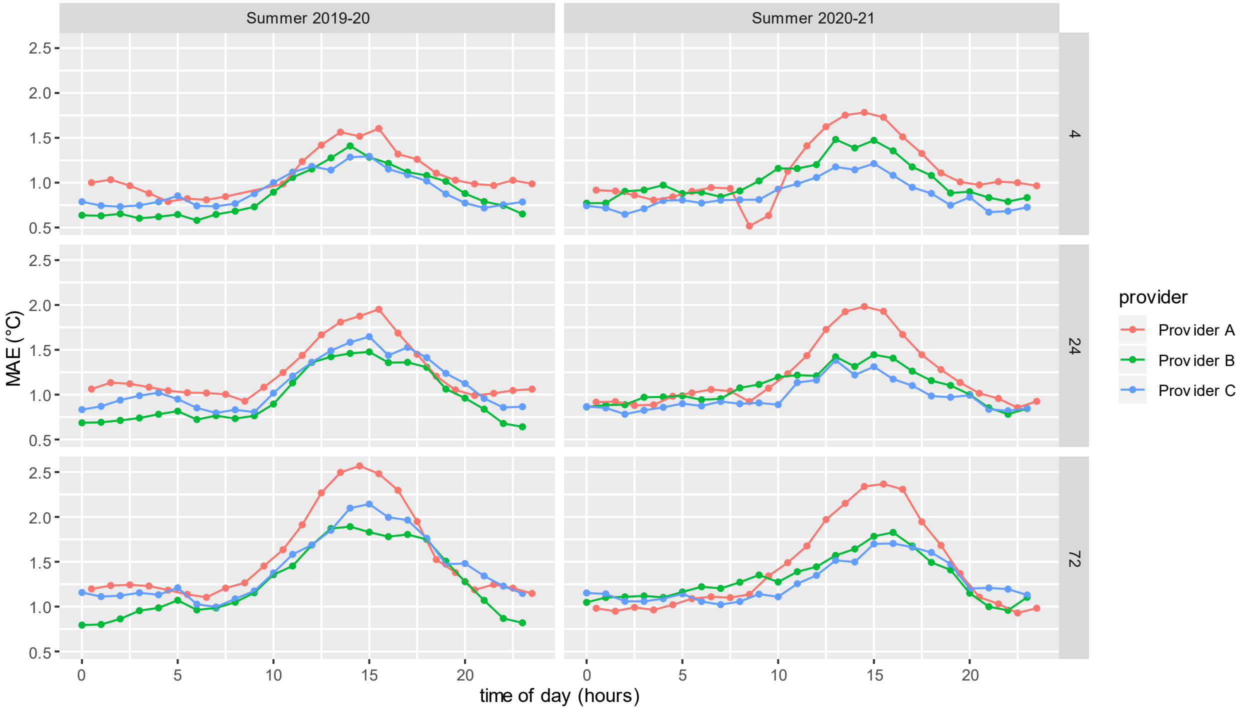


Figure 33 Melbourne AP, intraday MAE profile, all providers, summer 2019-20 and 2020-21, all time horizons

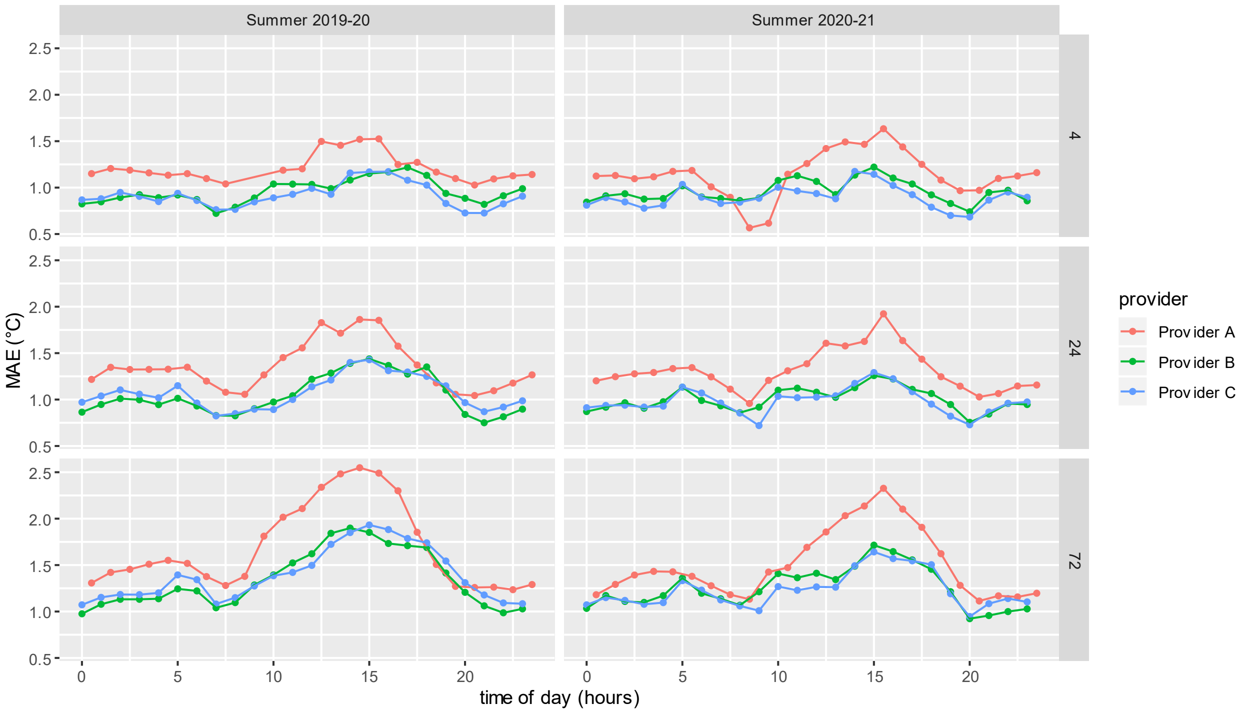


Figure 34 Penrith Lakes, intraday MAE profile, all providers, summer 2019-20 and 2020-21, all time horizons