Estimated evapotranspiration for the Victorian Water Accounts 2021-22

Introduction

Evapotranspiration is the sum of transpiration by plants plus evaporation from soil, open water surfaces and the wet surfaces of plants soon after rainfall. This appendix presents modelled basin estimates of evapotranspiration for 2021-22.

The evapotranspiration and rainfall estimates reported in this appendix have been calculated by the Bureau of Meteorology using the Australian Landscape Water Balance model (AWRA-L) [1].

The AWRA-L evapotranspiration output used is "E_{tot}" — the modelled landscape actual evapotranspiration, or the total evapotranspiration from vegetation, soil and groundwater.

The adoption of AWRA-L outputs to report on evapotranspiration and rainfall for 2021-22 follows the method used since the 2019-20 Victorian Water Accounts. Prior to 2019-20, previous editions of the Victorian Water Accounts used evapotranspiration estimates based on results from the SoilFlux model, a one-dimensional water balance model. The 2019-20 Victorian Water Accounts documented a comparison of the new and old methods and reported that there was no obvious negative or positive bias when comparing the data.

The AWRA-L approach was adopted due to the availability and ease of use of AWRA-L model outputs, as well as the quality of the documentation that the Bureau of Meteorology provides to support the Australian Landscape Water Balance model.

More information on AWRA-L is available at https://awo.bom.gov.au/about/overview

Evapotranspiration in 2021-22

Evapotranspiration amounts vary considerably across Victoria depending on a range of factors including rainfall conditions and land cover. Averaged across Victoria as a whole, evapotranspiration in 2021-22 was estimated to be 620 mm, which is about 11% above the long-term average calculated based on a post-1975 historic climate reference period. This relatively high evapotranspiration occurred due to the wet conditions in 2021-22, with annual rainfall 15% above the statewide long-term average.

Modelled estimates of basin evapotranspiration are presented in Figure A-1. Evapotranspiration is presented in terms of millimetres per unit area, to allow for direct comparison between basins of different sizes.

Figure A-1 shows that the estimated river basin scale annual evapotranspiration in 2021-22 was generally high, with most Victorian basins experiencing evapotranspiration at or above the long-term average conditions. The 2021-22 annual evapotranspiration for Millicent Coast, Glenelg River and Portland Coast basins was consistent with long term average conditions, which is lower than the annual evapotranspiration in other Victorian basins for this reporting period. This is due to annual rainfall being at or below the long-term average in these basins. Annual evapotranspiration was more than 20% above the long-term average conditions in the Broken, Kiewa and Tambo River basins. In these river basins, the 2021-22 annual rainfall was more than average, including 45% above average in the Tambo.

Figure A-2 shows the annual rainfall for Victoria's river basins. In general, 2021-22 was a wet year with rainfall exceeding the long-term average conditions in most river basins. The Glenelg, Portland and Hopkins were the only river basins to experience below average rainfall in 2021-22, however all were within 3% of the long-term average. In contrast, the 2021-22 rainfall in the Tambo, Snowy and East Gippsland basins was more than 40% above the long-term average. The driest river basins are found in the northwest while the alpine catchments of the northeast and southeast receive the most rainfall.

Figure A-3 shows evapotranspiration as a proportion of rainfall in Victoria's basins. Averaged across the State in 2021-22, the proportion of evapotranspiration to rainfall was lower than the long-term average. This is consistent with above-average rainfall generally being observed.

[1] https://awo.bom.gov.au/assets/notes/publications/AWRALv6_Model_Description_Report.pdf

Figure A-1 Modelled evapotranspiration per unit area

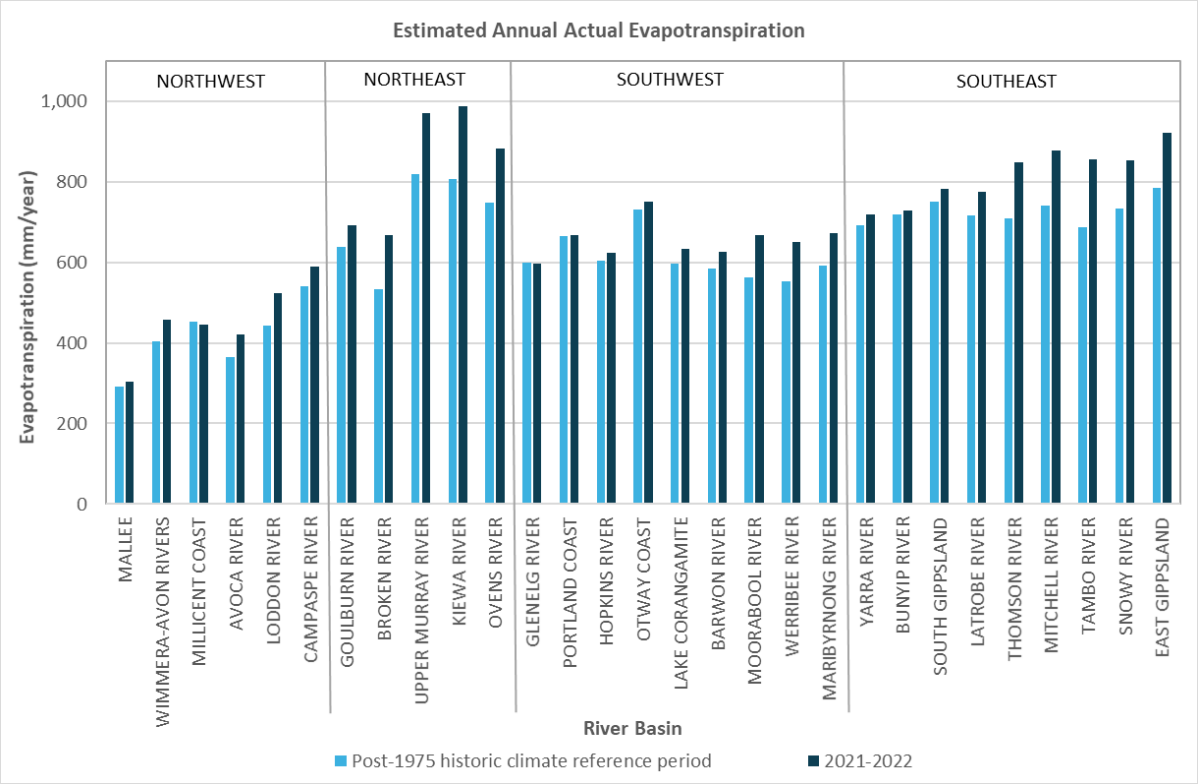


Figure A-2 Annual rainfall

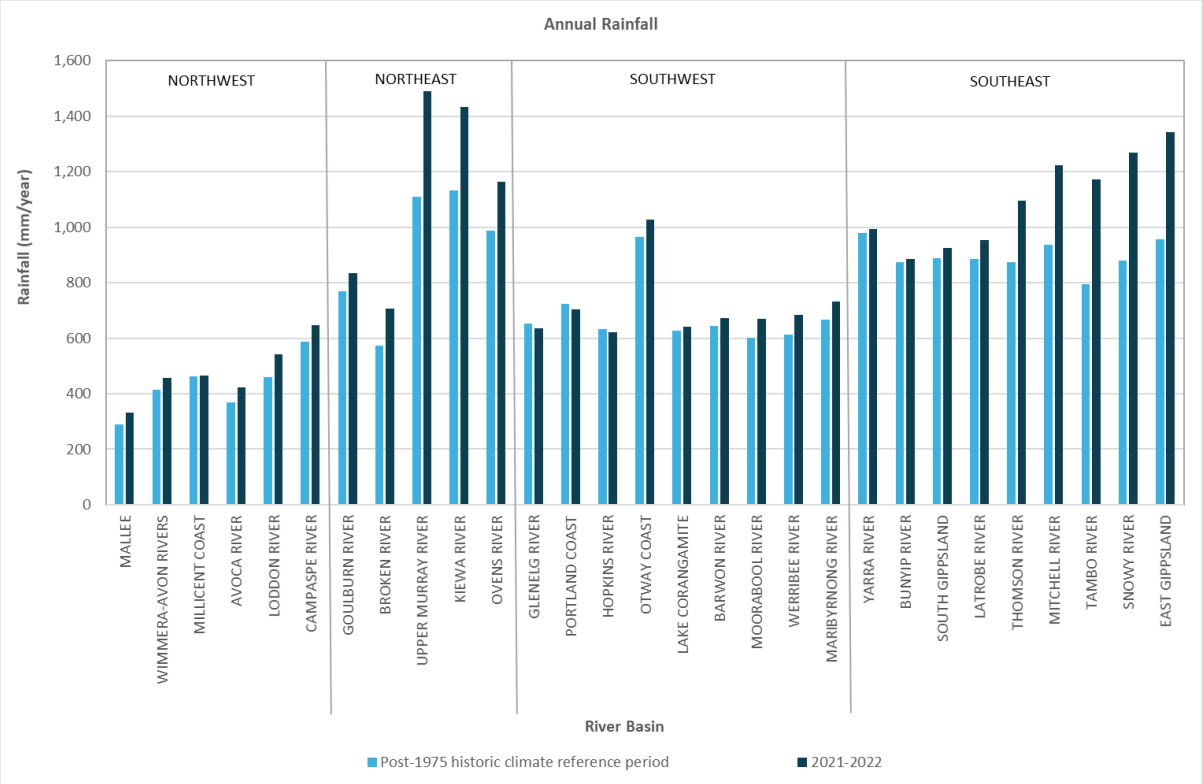
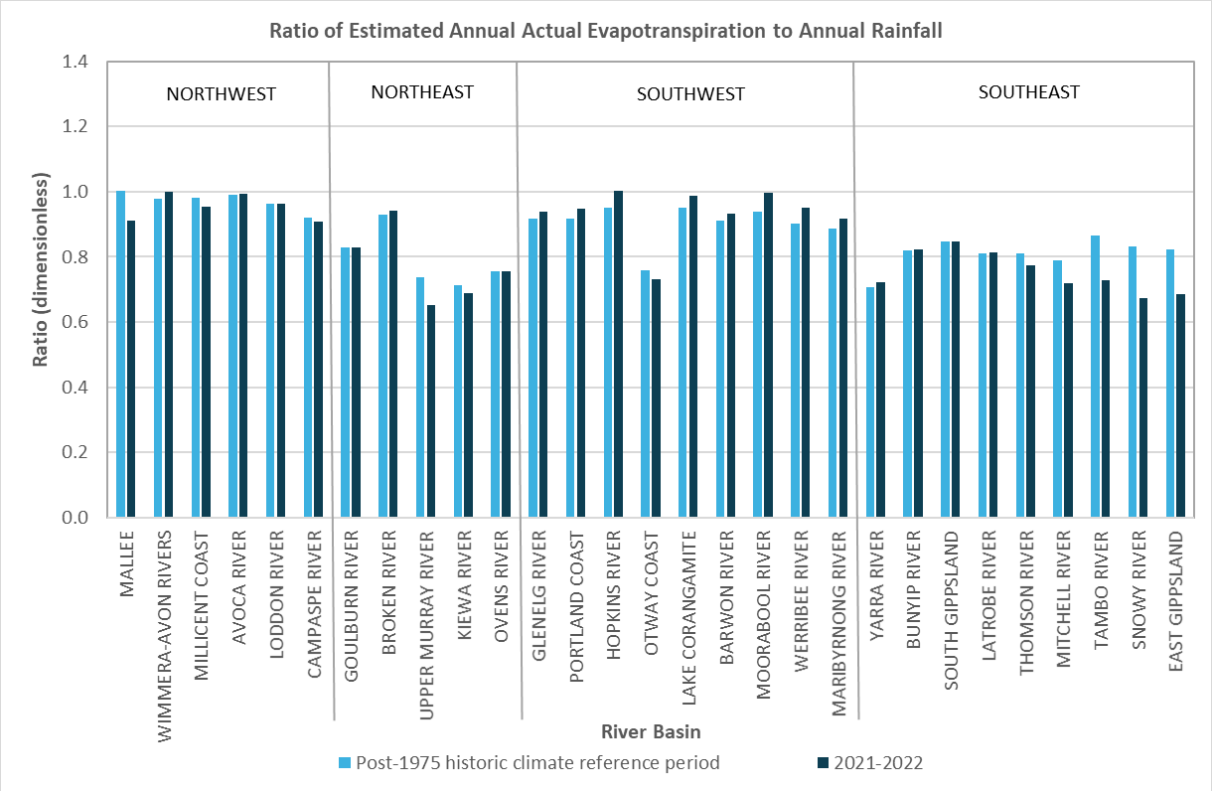


Figure A-3 Modelled evapotranspiration as a percentage of rainfall



North-east Victoria (Goulburn to Upper Murray basins)

All basins in the north-east of Victoria were relatively wet in 2021-22, with annual rainfall ranging from 8-34% above long-term average conditions. Consequently, the estimates of evapotranspiration were above average for all north-eastern basins (9-25% above long-term average evapotranspiration). The estimated evapotranspiration ranged from 670 mm in the Broken basin to 990 mm in the Kiewa basin (Figure A-1). This is an increase in evapotranspiration in all north-eastern basins compared to the previous reporting period (2020-21).

In 2021-22 evapotranspiration as a proportion of rainfall in the north-eastern basins was generally close to or below the long-term average. The Broken basin was estimated to have the north-east's highest evapotranspiration as a proportion of rainfall — 94% compared to the long-term average of 93% — and the lowest was in the Upper Murray basin: 65%, compared to the long-term average of 74% (Figure A-3).

South-eastern Victoria (East Gippsland to Yarra basins)

It was a wet year in south-eastern Victoria; rainfall in 2021-22 was above average by 1-47%. The basins in the far east received the most rainfall relative to the long-term annual average, with the Tambo basin receiving 47% more than the long-term average. Similarly, the estimated evapotranspiration rates were higher than average, ranging from between 1-24% above the long-term average (Figure A-1). The estimated evapotranspiration ranged from 710 mm in the Yarra basin to 920 mm in the East Gippsland basin. With the exception of the Bunyip and Yarra basins, the evapotranspiration in the south-eastern river basins increased compared to the previous reporting period (2020-21).

In 2021-22, evapotranspiration as a proportion of rainfall was close to or below average across all south-eastern basins. The South Gippsland basin was estimated to have the south-east's highest evapotranspiration as a proportion of rainfall — 85%, which is consistent with the long-term average — and the lowest was in the Snowy basin: 67%, compared to the long-term average of 83% (Figure A-3).

South-western Victoria (Maribyrnong to Glenelg basins)

Rainfall over south-western Victoria in 2021-22 was generally close to or greater than the long-term average. The Glenelg and Hopkins River basins and the Portland Coast basin were exceptions which received rainfall less than 3% below the long-term average. Rainfall in the other south-western basins was between 2-12% more than average. The estimated evapotranspiration was greater than the average for all south-west basins, up to 18% above average for the Werribee and Moorabool River basins (Figure A-1). The 2021-22 estimated evapotranspiration values ranged from 600 mm in the Glenelg basin to 750 mm in the Otway Coast basin. The Werribee, Moorabool and Maribyrnong river basins had increased evapotranspiration compared to last year.

In 2021-22, evapotranspiration as a proportion of rainfall in the south-western basins was generally greater than the long-term average. Both the Hopkins and Moorabool basins had evaporation equal to rainfall in 2021-22 (ratio of one in Figure A-), which is greater than the long-term average for these basins and the largest ratios of the south-western basins. The 2021-22 ratios were also greater than the long--term average for the Lake Corangamite, Barwon, Werribee and Maribyrnong basins. The Otway Coast basin had the lowest ratio in the south-west: 73% compared to the long-term average of 76%. This was the only south-western basin where the 2021-22 ratio of evapotranspiration as a proportion of rainfall was below average (Figure A-3).

North-western Victoria (Mallee to Campaspe basins)

2021-22 was wet in the north-west, with annual rainfall totals above the long-term average conditions for all basins in the region. Consequently, evapotranspiration was also close to or above the long-term average for these basins. The Millicent Coast basin annual evaporation this year was slightly lower than the long-term average while all other basins were 4-18% above the long-term average. The estimated evapotranspiration ranged from 300 mm in the Mallee basin to 590 mm in the Campaspe basin (Figure A-1), which reflects an increase in all basins compared to last year.

In 2021-22, evapotranspiration as a proportion of rainfall for most of the north-western basins was generally close to the long-term average. The Mallee basin was the exception to this: at 91%, the recent evaporation as a proportion of rainfall was the lowest for the region and was also 9% below the long-term average. All other basins were +/- 3% of the long-term conditions. The Wimmera-Avon and Avoca basins both had evapotranspiration equal to rainfall in 2021-22 (ratio of one), the highest ratio in the north-west for this year. (Figure A-3).

Key assumptions and data limitations

The estimates of evapotranspiration presented in this appendix are based on results from the Bureau of Meteorology's Australian Landscape Water Balance model (AWRA-L)[2].

[2] Information about the assumptions of the AWRA-L model can be found in Frost et al. (2016): https://awo.bom.gov.au/assets/notes/publications/AWRALv6_Model_Description_Report.pdf

Modelling evapotranspiration requires many approximations and assumptions that qualify the accuracy of the estimates. Major assumptions and limitations of the method used to derive the above estimates of evapotranspiration include:

- representing the landscape as only two land use types: shallow and deep-rooted vegetation
- not explicitly accounting for actual evapotranspiration in urban, rocky or irrigated areas, or over reservoirs and lakes

This modelling approach and associated uncertainties mean that the estimated evapotranspiration reported here may differ from the water balance estimates reported for each basin in other sections of the Victorian Water Account. Readers should interpret the data with care.

The basin areas used to report evapotranspiration estimates are slightly different to those used for reporting in the surface water local water reports. In the surface water local reports, the Murray basin captures information about Murray River irrigation districts in the Mallee, Avoca, Loddon, Campaspe, Goulburn and Broken basins. For evapotranspiration reporting, these irrigation districts are included within their host river basin (for example, the Mildura Irrigation District is in the Mallee basin). However, as noted above, the evapotranspiration estimates do not account for water applied by irrigation.