Estimated evapotranspiration for the Victorian Water Accounts 2022-23

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 estimates of evapotranspiration for 2022-23.

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 2022-23 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 2022-23

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 2022–23 was estimated to be 686 mm, which is about 22% 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 2022–23, with annual rainfall 34% 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 2022–23 was generally high, with all Victorian basins experiencing evapotranspiration above the long-term average conditions. Annual evapotranspiration was at least 19% above the long-term average conditions in all northern Victorian, and also in several of the south-west basins including in the Glenelg, Portland Coast, Hopkins, Lake Corangamite and Moorabool river basins. This is due to annual rainfall being above the long-term average in all basins, including being more than 50% above average in the Mallee, Campaspe, Loddon and Avoca River catchments. While still above average, the south-east of the state experienced evapotranspiration conditions closer to the long-term average conditions. The lowest estimated annual evapotranspiration relative to the long-term average occurred in the South Gippsland basin where evapotranspiration was 7% above the long-term average.

Figure A-2 shows the annual rainfall for Victoria's river basins. Rainfall exceeded the long-term average conditions in all river basins during 2022–23. Although 2021–22 was also a relatively wet year, the Glenelg, Portland and Hopkins basins experienced below average rainfall during that reporting period. Particularly high annual rainfall relative to the long-term average can be seen in the north-east and north-west catchments in 2022–23. These basins exceed the long-term average rainfall by values of between 37% in the Goulburn and up to 61% in the Mallee. This corresponds with a number of major Victorian floods during late 2022.

[1] Frost, A. J., and Shokri, A., (2021) The Australian Landscape Water Balance model (AWRA-L v7). Technical Description of the Australian Water Resources Assessment Landscape model version 7. Bureau of Meteorology Technical Report. https://awo.bom.gov.au/assets/notes/publications/AWRA-Lv7_Model_Description_Report.pdf

Figure A-3 shows evapotranspiration as a proportion of rainfall in Victoria's basins. Averaged across the State in 2022–23, the proportion of evapotranspiration to rainfall was lower than the long-term average. This is consistent with above-average rainfall during 2022-23.

Figure A-1 Modelled evapotranspiration per unit area

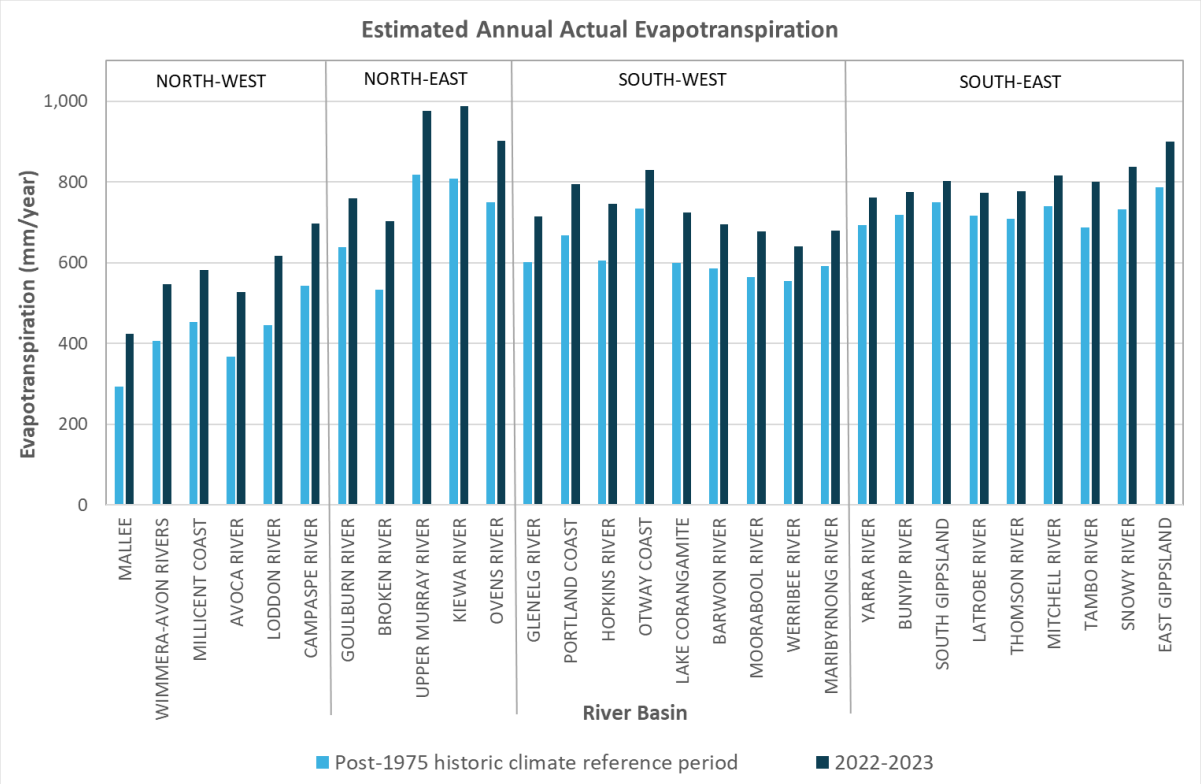


Figure A-2 Annual rainfall

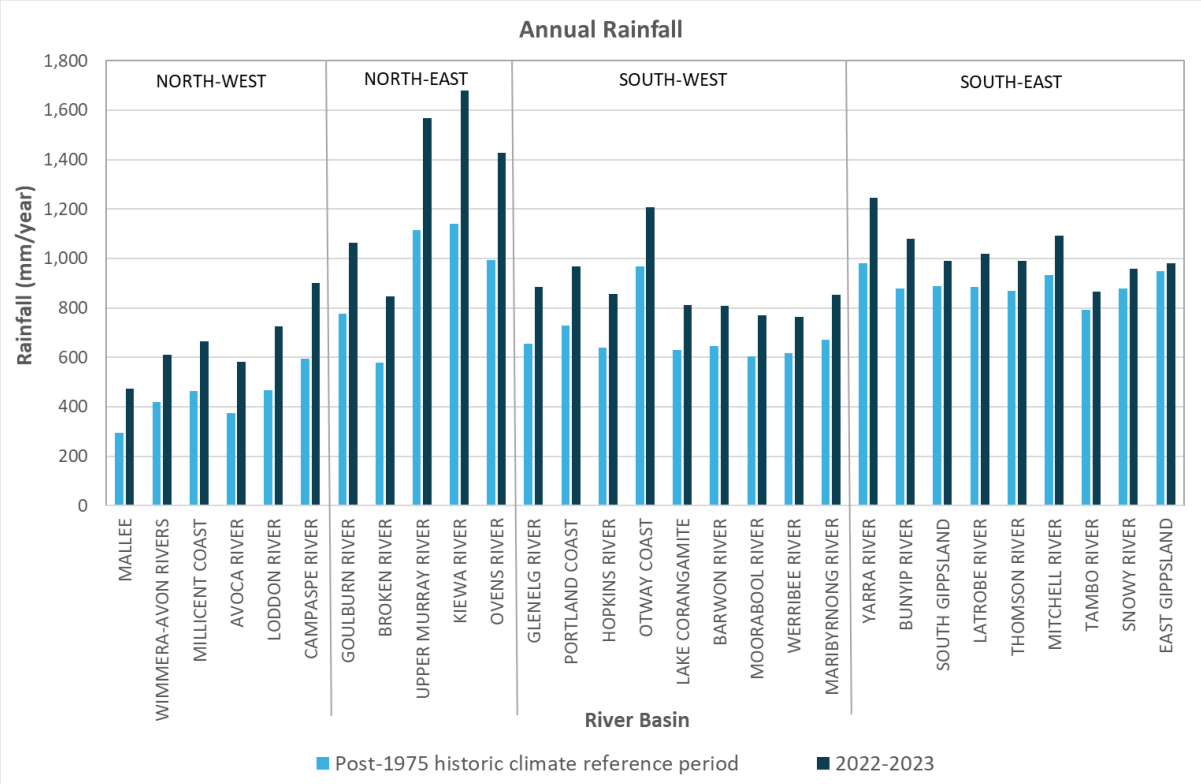
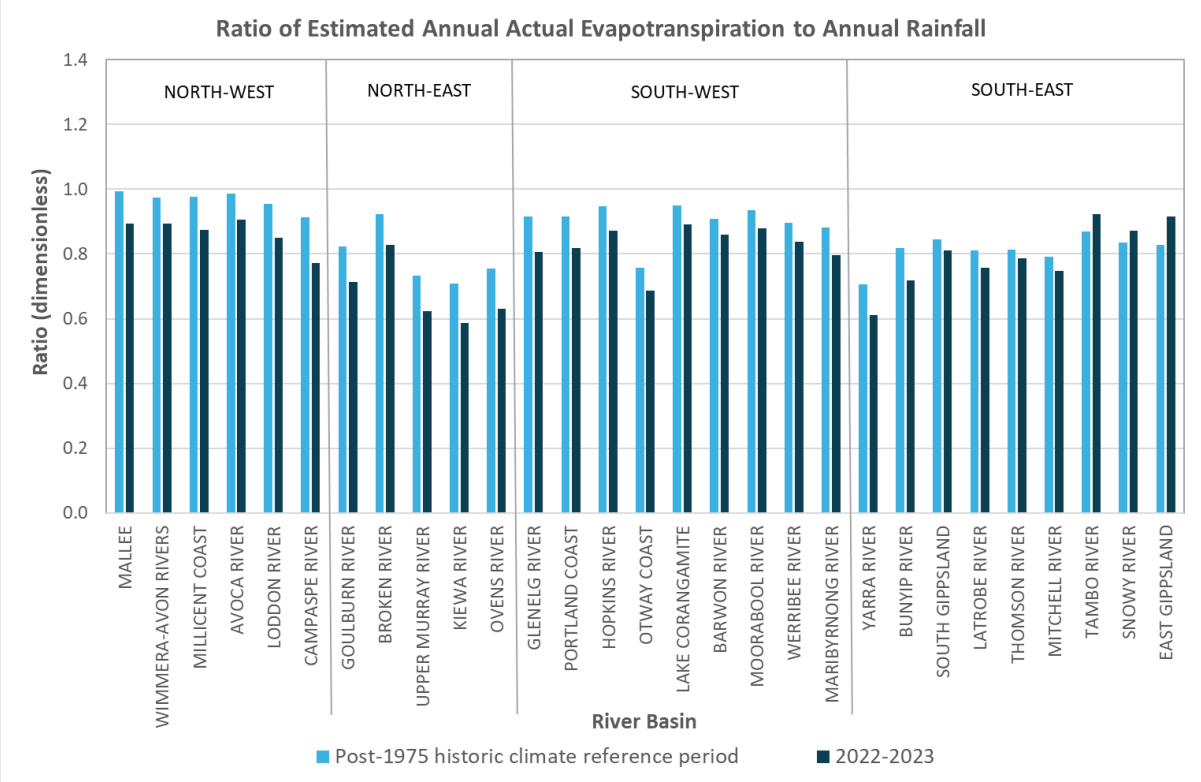


Figure A-3 Modelled evapotranspiration as a percentage of rainfall



North-east Victoria (Goulburn to Upper Murray basins)

All basins in the north-east of Victoria were very wet in 2022–23, with annual rainfall ranging from 37-47% above long-term average conditions (Figure A-2). Consequently, the estimates of evapotranspiration were above average for all north-eastern basins (19-32% above long-term average evapotranspiration). The estimated evapotranspiration ranged from 700 mm in the Broken basin to 990 mm in the Kiewa basin (Figure A-1). Other than the Kiewa basin which was equivalent to 2021–22, an increase in evapotranspiration was exhibited in all other north-eastern basins in 2022–23 compared to the previous reporting period of 2021–22.

In 2022–23 evapotranspiration as a proportion of rainfall in the north-eastern basins was below the long-term average. The Broken basin was estimated to have the north-east's highest evapotranspiration as a proportion of rainfall — 83% compared to the long-term average of 92% — and the lowest was in the Kiewa basin: 59%, compared to the long-term average of 71% (Figure A-3).

South-eastern Victoria (East Gippsland to Yarra basins)

Rainfall in south-eastern Victoria in 2022–23 was above average by 3-27%. The Yarra basin received the most rainfall relative to the long-term average (Figure A-2), with annual rainfall relative to the long-term average tending to decrease for more easterly basins. This is the reverse to the wet conditions experienced in the 2021–22 reporting period, when greater increases in rainfall occurred relative to the long-term conditions in the far eastern river basins. Similarly, the estimated evapotranspiration rates were higher than average, ranging from between 7-16% above the long-term average (Figure A-1). The estimated evapotranspiration ranged from 760 mm in the Yarra basin to 900 mm in the East Gippsland basin. The modelled evapotranspiration increased in the Yarra, Bunyip and South Gippsland basins compared to the 2021–22 reporting period, whereas other south-eastern basins show declines since last year.

In 2022–23 evapotranspiration as a proportion of rainfall reflected the transition in conditions from west to east; the Tambo, Snowy and East Gippsland basins all experienced above average values of evapotranspiration as a proportion of rainfall, whereas the other basins were close to or below average. The Tambo and East Gippsland basins were estimated to have the south-east's highest evapotranspiration as a proportion of rainfall — both 92% compared to the long-term average of 87% and 83% respectively — and the lowest was in the Yarra basin: 61%, compared to the long-term average of 71% (Figure A-3).

South-western Victoria (Maribyrnong to Glenelg basins)

Rainfall over south-western Victoria in 2022–23 was greater than the long-term average, with basins receiving between 24-35% more than average (Figure A-2). The estimated evapotranspiration was also greater than the long-term average for all south-west basins, with up to 23% above average for Hopkins River and 21% for Lake Corangamite basin (Figure A-1). The 2022–23 estimated evapotranspiration values ranged from 640 mm in the Werribee basin to 830 mm in the Otway Coast basin. With the exception of the Werribee River all basins experienced an increase in evapotranspiration from last reporting period.

In 2022–23, evapotranspiration as a proportion of rainfall in all the south-western basins was less than the long-term average (Figure A-3). The Otway Coast basin had the lowest ratio of evapotranspiration as a proportion of rainfall in the south-west with 69% compared to the long-term average of 76%. The highest ratio of evapotranspiration as a proportion of rainfall was Lake Corangamite with 89%.

North-western Victoria (Mallee to Campaspe basins)

2022–23 was wet in the north-west, with annual rainfall totals above the long-term average conditions by 43-61% for all basins in the region (Figure A-2). Consequently, evapotranspiration was also above the long-term average for these basins by at least 28% (Figure A-1). The estimated evapotranspiration ranged from 420 mm in the Mallee basin to 700 mm in the Campaspe basin, which reflects an increase in all basins compared to last year.

In 2022–23, evapotranspiration as a proportion of rainfall for the north-western basins was less than the long-term average, with the greatest difference of -14% in the Campaspe basin (Figure A-3). The lowest ratio of evapotranspiration to rainfall was Campaspe with 77% compared to the long-term average of 91%. The greatest ratio in the north-west was Avoca River basin with 91% compared to the long-term average of 99%.

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].

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:

[2] Information about the assumptions of the AWRA-L model can be found in Frost, A. J., and Shokri, A., (2021): https://awo.bom.gov.au/assets/notes/publications/AWRA-Lv7_Model_Description_Report.pdf

- Representing the landscape as only three land use types: shallow and deep-rooted vegetation, and impervious surfaces (urban areas and rocky outcrops). The latter landscape type was added in AWRA version 7.
- Not explicitly accounting for actual evapotranspiration in 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 Accounts. Additionally, version updates made by the Bureau of Meteorology to the AWRA model may make it difficult to directly compare evapotranspiration estimates reported in the Victorian Water Accounts from year to year. 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 Victorian Water Accounts' 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.