Introduction

This portable document format (PDF) file provides supplemental information for U.S. Geological Survey Scientific Investigations Report by Asquith and Roussel (2009) (the Report) and is available from the Web site listed in the "References" section. The purpose of this PDF file is to document the spatial distribution of residuals for two weighted-least squares, multi-linear regression analyses for each of nine recurrence intervals of annual peak streamflow. The residuals are depicted in the nine figures 1B–1 through 1B–9 for the 2-, 5-, 10-, 25-, 50-, 100-, 200-, 250-, and 500-year equations, respectively of this PDF. Each figure is comprised of a left-hand (A) and right-hand (B) plot.

The residuals were derived from the R environment for statistical computing (R Development Core Team, 2008) and are plotted in geographic coordinates using the plotting features provided by the R environment. (In particular, the color transparency of PDF version 1.4 and greater is used.)

The A plot of each figure depicts the magnitude (and sign) of the residual for the indicated recurrence interval from the first-regression analysis (see table 2 of the Report). The residual is computed as the observed value minus the fitted value from the regression equation. The B plot of each figure depicts the residual after application of the Ω parameter ("OmegaEM parameter") in the second-regression analysis (see table 3 of the Report).

Color is an important attribute of the plots. The grey symbols represent stations for which the magnitude of the residual is less than $0.15\log_{10}$(cubic feet per second). Red and blue are assigned to residuals based on the sign and the residual magnitude (absolute value of residual) being greater than $0.15\log_{10}$(cubic feet per second). Specifically, red depicts a negative residual or a case of under prediction by the regional equation for a given station. Whereas, blue depicts a positive residual or a case of over prediction by the regional equation for a given station.

Successive inspection of the A plots by recurrence interval shows that a belt (band or region) of under prediction exists from central north Texas through central Texas and curves towards the west in south central Texas. Similarly, a region of over prediction exists in east Texas. Less clear patterns exist elsewhere in the study area.

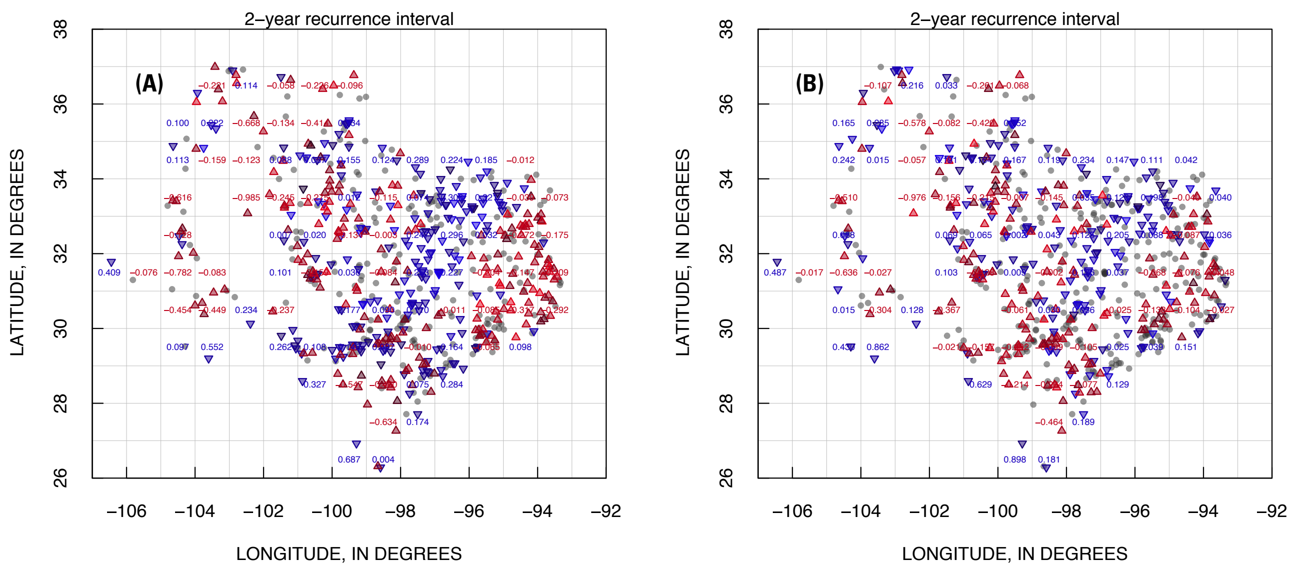
Within each 1-degree quadrangle of latitude and longitude, the median residual for all stations within the quadrangle is plotted in the color corresponding to the sign of the residual. These values are critically important for the estimation of the Ω parameter as described in the Report. Specifically, the graph A in figure 1B–3 for the 10-year recurrence interval was selected as the basis for estimation of the Ω parameter as described in the Report.

After application of the Ω parameter in the second-regression analysis (see table 3 of the Report), the B plots of figures 1B–1 through 1B–9 were generated. Although the Ω parameter might not be optimal because the values are based on interpretations described in Asquith and Roussel (2009), inspection of the B plots shows a marked reduction in spatial structure of the residuals and a general lowering of median residual magnitude by quadrangle throughout the study area. The regression diagnostics of residual standard error and, in particular, the PRESS statistic, in table 3 of the Report show substantial reduction from those in table 2 of the Report. The reduction shows that the Ω parameter enhances the regression analysis described in the Report.

References

Asquith, W.H., and Roussel, M.C., 2009, Regression equations for estimation of annual peak-streamflow frequency for undeveloped watersheds in Texas using an L-moment-based, PRESS-minimized, residual-adjusted approach: U.S. Geological Survey Scientific Investigations Report 2009–5087, 48 p. [http://pubs.usgs.gov/sir/2007/5087]

R Development Core Team, 2008, R—A language and environment for statistical computing: Vienna, Austria, R Foundation for Statistical Computing, ISBN 3–900051–07–0, http://www.R-project.org



EXPLANATION

0.862 Median residual (under prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

▽ Residual (under prediction) for indicated recurrence interval is > 0.15 base-10 logarithm(cubic feet per second)

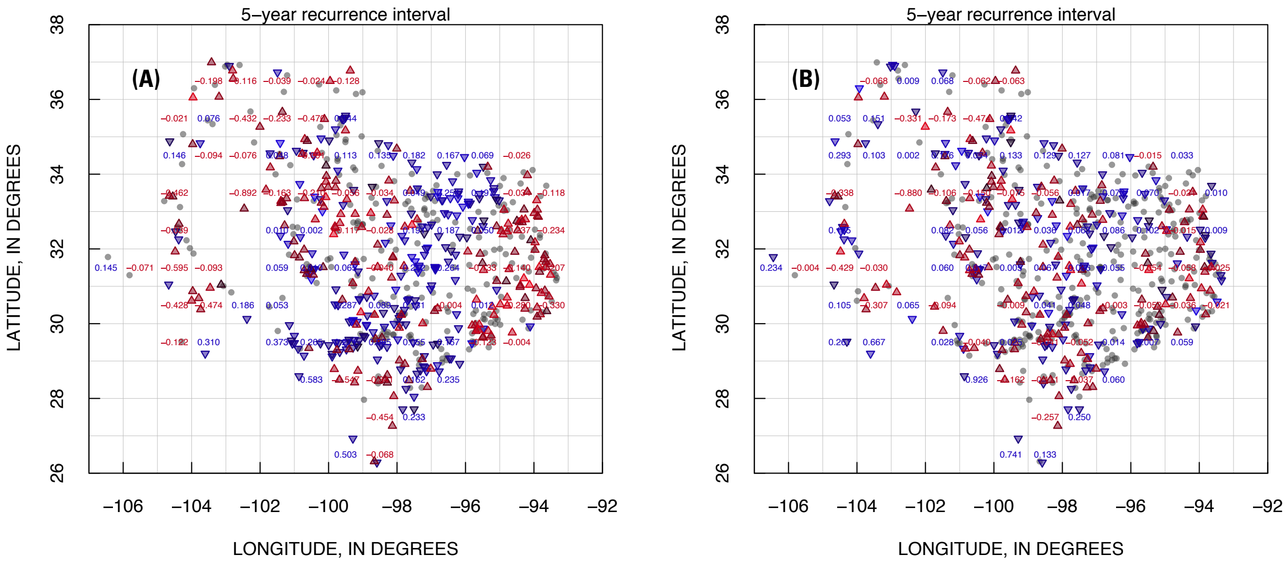
● Magnitude of residual for indicated recurrence interval is < 0.15 base-10 logarithm(cubic feet per second)

△ Residual (over prediction) for indicated recurrence interval is < -0.15 base-10 logarithm(cubic feet per second)

−0.976 Median residual (over prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

Note: color intensity (darkness) increases with increasing magnitude of the residual.

Figure 1B–1. Comparison of residuals for 2-year recurrence interval for weighted-least squares, multi-linear regression (left, A) using drainage area, dimensionless main channel slope, mean annual precipitation and regression (right, B) using same three variables and OmegaEM parameter as described in Asquith and Roussel (2009).



EXPLANATION

0.862 Median residual (under prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

▽ Residual (under prediction) for indicated recurrence interval is > 0.15 base-10 logarithm(cubic feet per second)

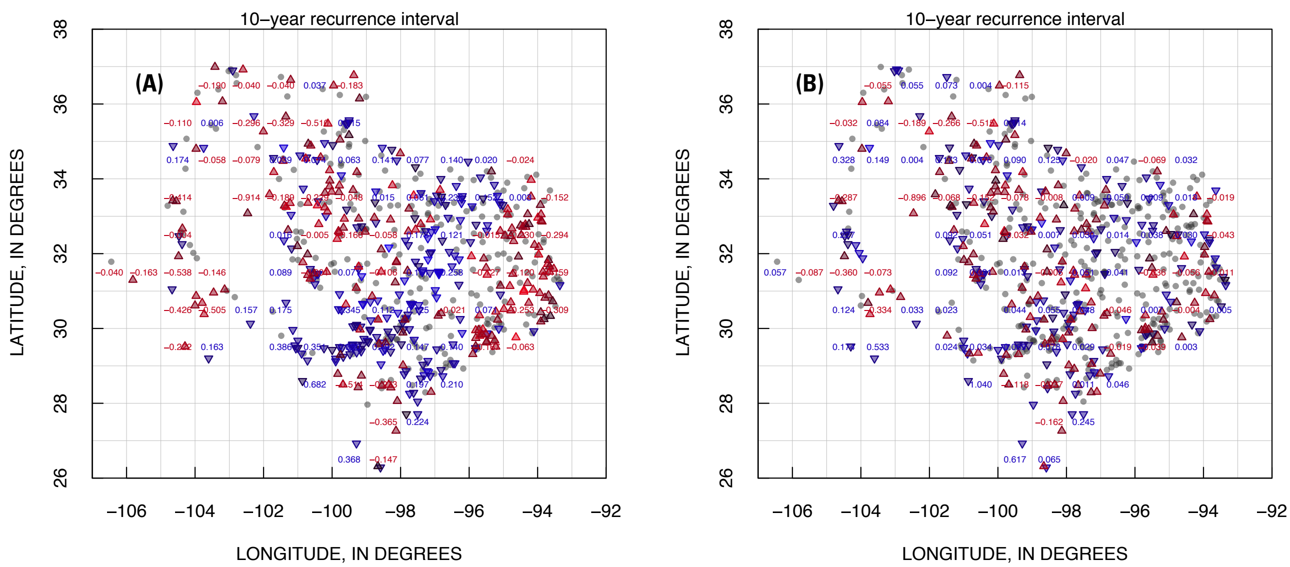
● Magnitude of residual for indicated recurrence interval is < 0.15 base-10 logarithm(cubic feet per second)

△ Residual (over prediction) for indicated recurrence interval is < -0.15 base-10 logarithm(cubic feet per second)

−0.976 Median residual (over prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

Note: color intensity (darkness) increases
with increasing magnitude of the residual.

Figure 1B–2. Comparison of residuals for 5-year recurrence interval for weighted-least squares, multi-linear regression (left, A) using drainage area, dimensionless main channel slope, mean annual precipitation and regression (right, B) using same three variables and OmegaEM parameter as described in Asquith and Roussel (2009).



EXPLANATION

0.862 Median residual (under prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

▽ Residual (under prediction) for indicated recurrence interval is > 0.15 base-10 logarithm(cubic feet per second)

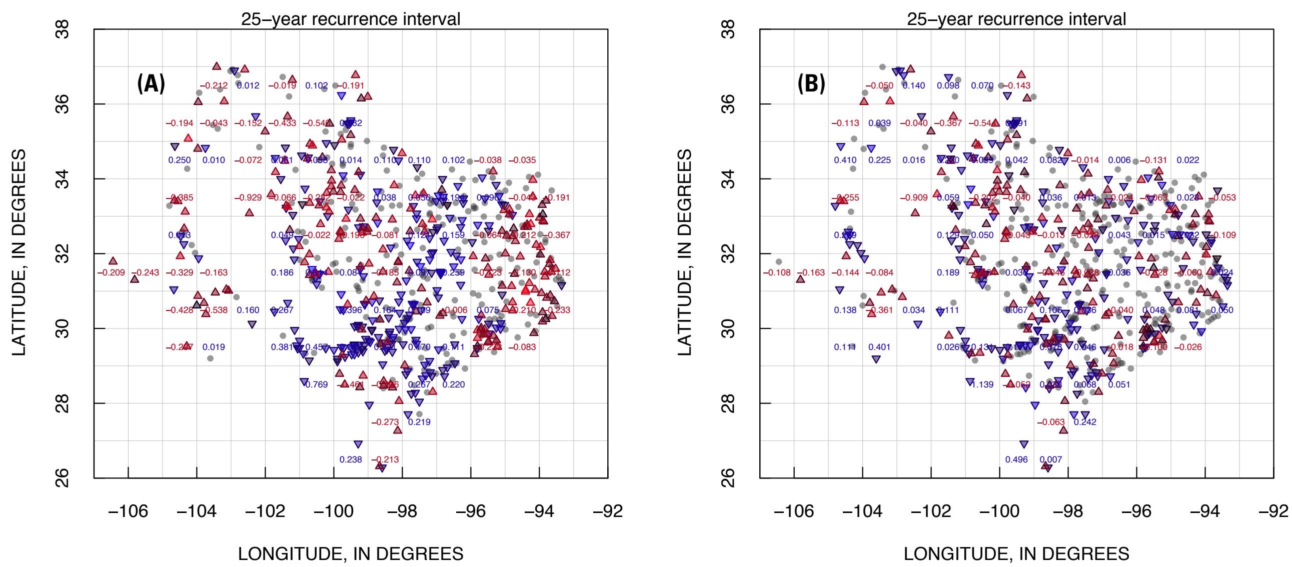
● Magnitude of residual for indicated recurrence interval is < 0.15 base-10 logarithm(cubic feet per second)

△ Residual (over prediction) for indicated recurrence interval is < -0.15 base-10 logarithm(cubic feet per second)

–0.976 Median residual (over prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

Note: color intensity (darkness) increases
with increasing magnitude of the residual.

Figure 1B–3. Comparison of residuals for 10-year recurrence interval for weighted-least squares, multi-linear regression (left, A) using drainage area, dimensionless main channel slope, mean annual precipitation and regression (right, B) using same three variables and OmegaEM parameter as described in Asquith and Roussel (2009).



EXPLANATION

0.862 Median residual (under prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

Residual (under prediction) for indicated recurrence interval is > 0.15 base-10 logarithm(cubic feet per second)

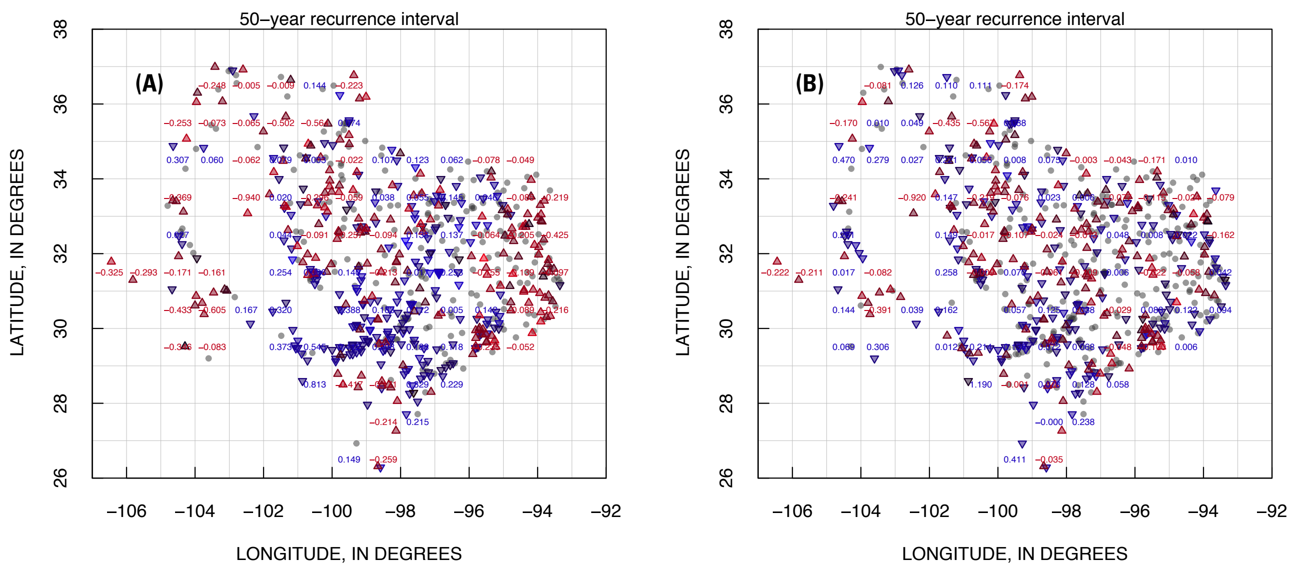
Magnitude of residual for indicated recurrence interval is < 0.15 base-10 logarithm(cubic feet per second)

Residual (over prediction) for indicated recurrence interval is < -0.15 base-10 logarithm(cubic feet per second)

−0.976 Median residual (over prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

Note: color intensity (darkness) increases with increasing magnitude of the residual.

Figure 1B–4. Comparison of residuals for 25-year recurrence interval for weighted-least squares, multi-linear regression (left, A) using drainage area, dimensionless main channel slope, mean annual precipitation and regression (right, B) using same three variables and OmegaEM parameter as described in Asquith and Roussel (2009).



EXPLANATION

0.862 Median residual (under prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

▽ Residual (under prediction) for indicated recurrence interval is > 0.15 base-10 logarithm(cubic feet per second)

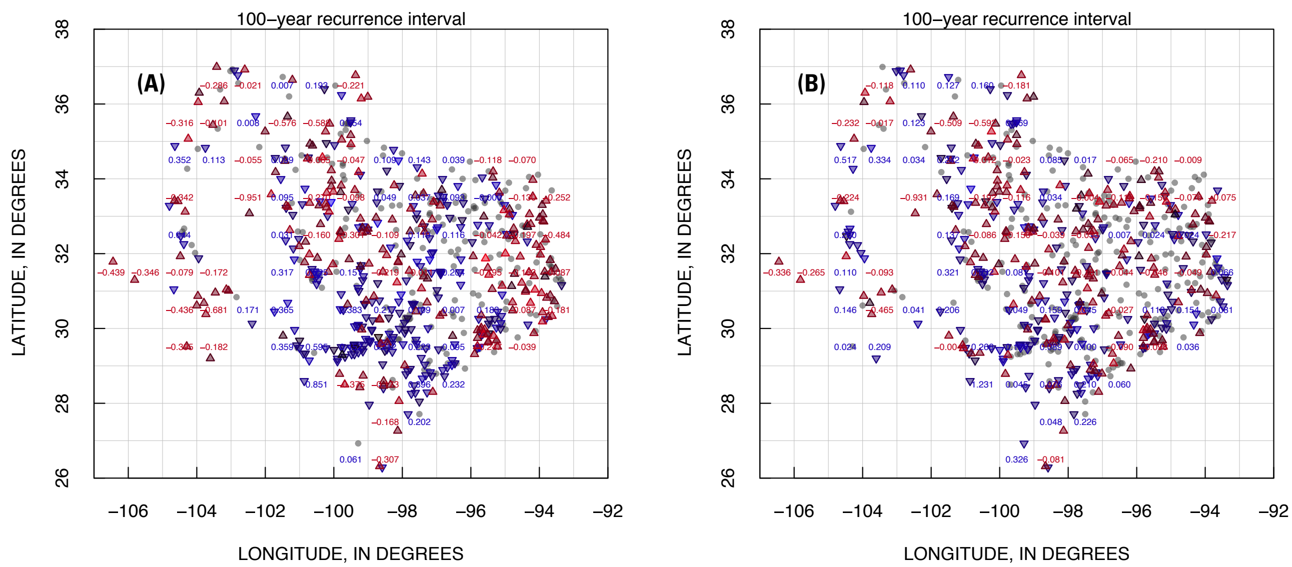
● Magnitude of residual for indicated recurrence interval is < 0.15 base-10 logarithm(cubic feet per second)

△ Residual (over prediction) for indicated recurrence interval is < -0.15 base-10 logarithm(cubic feet per second)

−0.976 Median residual (over prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

Note: color intensity (darkness) increases
with increasing magnitude of the residual.

Figure 1B–5. Comparison of residuals for 50-year recurrence interval for weighted-least squares, multi-linear regression (left, A) using drainage area, dimensionless main channel slope, mean annual precipitation and regression (right, B) using same three variables and OmegaEM parameter as described in Asquith and Roussel (2009).



EXPLANATION

0.862 Median residual (under prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

▽ Residual (under prediction) for indicated recurrence interval is > 0.15 base-10 logarithm(cubic feet per second)

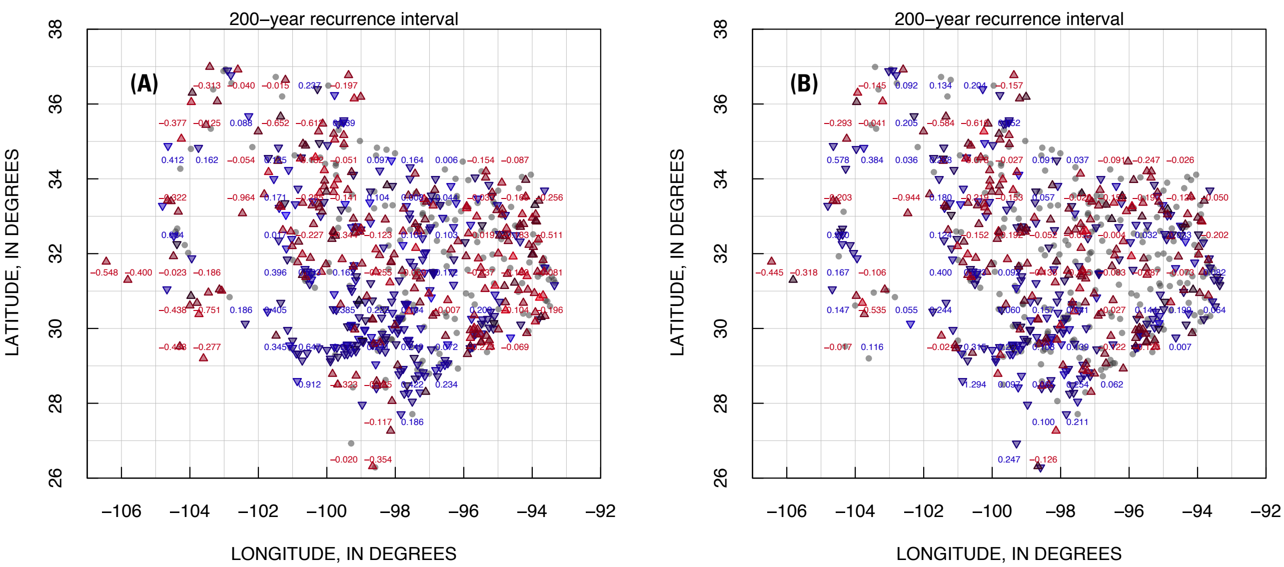
● Magnitude of residual for indicated recurrence interval is < 0.15 base-10 logarithm(cubic feet per second)

△ Residual (over prediction) for indicated recurrence interval is < -0.15 base-10 logarithm(cubic feet per second)

−0.976 Median residual (over prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

Note: color intensity (darkness) increases
with increasing magnitude of the residual.

Figure 1B–6. Comparison of residuals for 100-year recurrence interval for weighted-least squares, multi-linear regression (left, A) using drainage area, dimensionless main channel slope, mean annual precipitation and regression (right, B) using same three variables and OmegaEM parameter as described in Asquith and Roussel (2009).



EXPLANATION

0.862 Median residual (under prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

▽ Residual (under prediction) for indicated recurrence interval is > 0.15 base-10 logarithm(cubic feet per second)

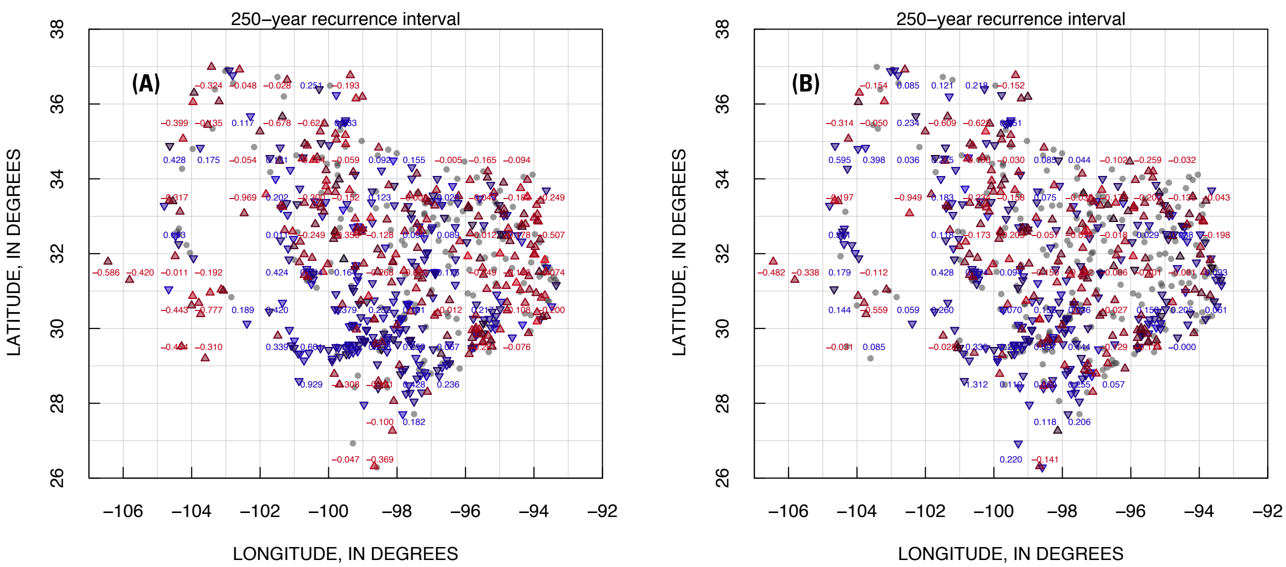
● Magnitude of residual for indicated recurrence interval is < 0.15 base-10 logarithm(cubic feet per second)

△ Residual (over prediction) for indicated recurrence interval is < -0.15 base-10 logarithm(cubic feet per second)

–0.976 Median residual (over prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

Note: color intensity (darkness) increases
with increasing magnitude of the residual.

Figure 1B–7. Comparison of residuals for 200-year recurrence interval for weighted-least squares, multi-linear regression (left, A) using drainage area, dimensionless main channel slope, mean annual precipitation and regression (right, B) using same three variables and OmegaEM parameter as described in Asquith and Roussel (2009).



EXPLANATION

0.862 Median residual (under prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

Residual (under prediction) for indicated recurrence interval is > 0.15 base-10 logarithm(cubic feet per second)

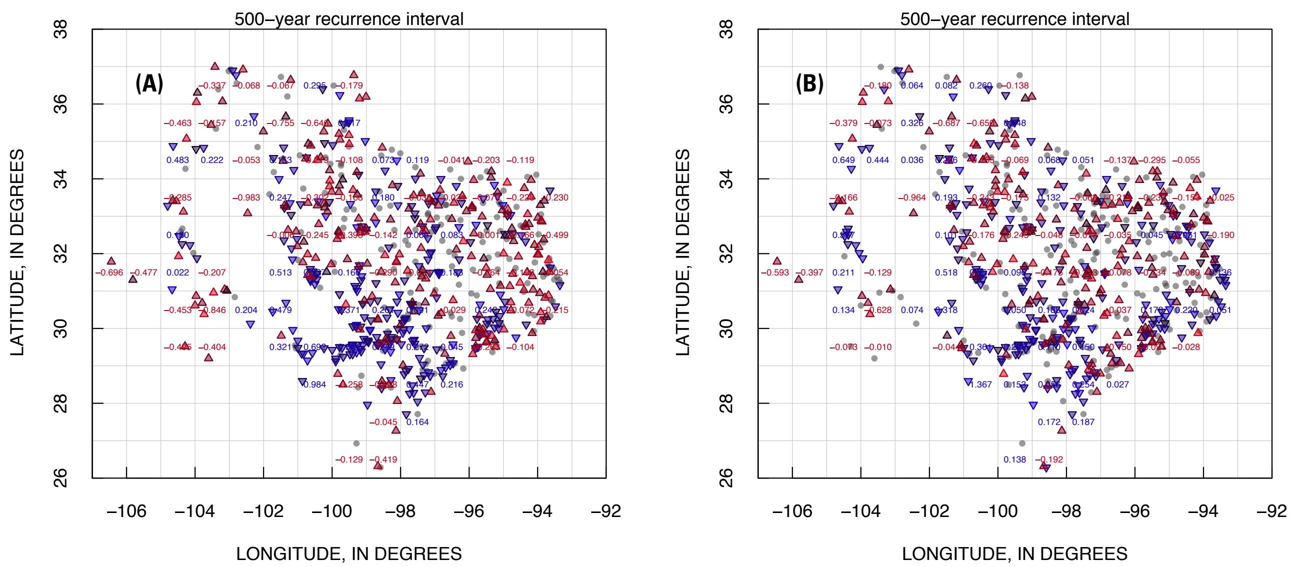
Magnitude of residual for indicated recurrence interval is < 0.15 base-10 logarithm(cubic feet per second)

Residual (over prediction) for indicated recurrence interval is < -0.15 base-10 logarithm(cubic feet per second)

−0.976 Median residual (over prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

Note: color intensity (darkness) increases
with increasing magnitude of the residual.

Figure 1B–8. Comparison of residuals for 250-year recurrence interval for weighted-least squares, multi-linear regression (left, A) using drainage area, dimensionless main channel slope, mean annual precipitation and regression (right, B) using same three variables and OmegaEM parameter as described in Asquith and Roussel (2009).



EXPLANATION

0.862 Median residual (under prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

Residual (under prediction) for indicated recurrence interval is > 0.15 base-10 logarithm(cubic feet per second)

Magnitude of residual for indicated recurrence interval is < 0.15 base-10 logarithm(cubic feet per second)

Residual (over prediction) for indicated recurrence interval is < -0.15 base-10 logarithm(cubic feet per second)

–0.976 Median residual (over prediction) for 1-degree quadrangle for indicated recurrence interval in base-10 logarithm(cubic feet per second)

Note: color intensity (darkness) increases with increasing magnitude of the residual.

Figure 1B–9. Comparison of residuals for 500-year recurrence interval for weighted-least squares, multi-linear regression (left, A) using drainage area, dimensionless main channel slope, mean annual precipitation and regression (right, B) using same three variables and OmegaEM parameter as described in Asquith and Roussel (2009).