

Supporting Information for “In Search of The Optimal Atmospheric River Index for US Precipitation: A Multifactorial Analysis”

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Introduction

This supporting information provides supplementary figures showing, for the West Coast and the Midwest AR indices from January 1980 to June 2017, the coarse-grain *AR Related Precipitation* and *Precision* values, fine-grain event-average precipitation rate distributions, and the distributions of surface areas swept by AR events. The West-Coast region is further divided into Northwest and Southwest regions, and the respective event-accumulated precipitation over unit area swept by ARs are shown. In addition,

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West-Coast or Midwest AR event-accumulated precipitation over unit area in (1) January 1981–December 1998 and (2) January 1999–December 2016 are shown, with or without being conditional on the season.

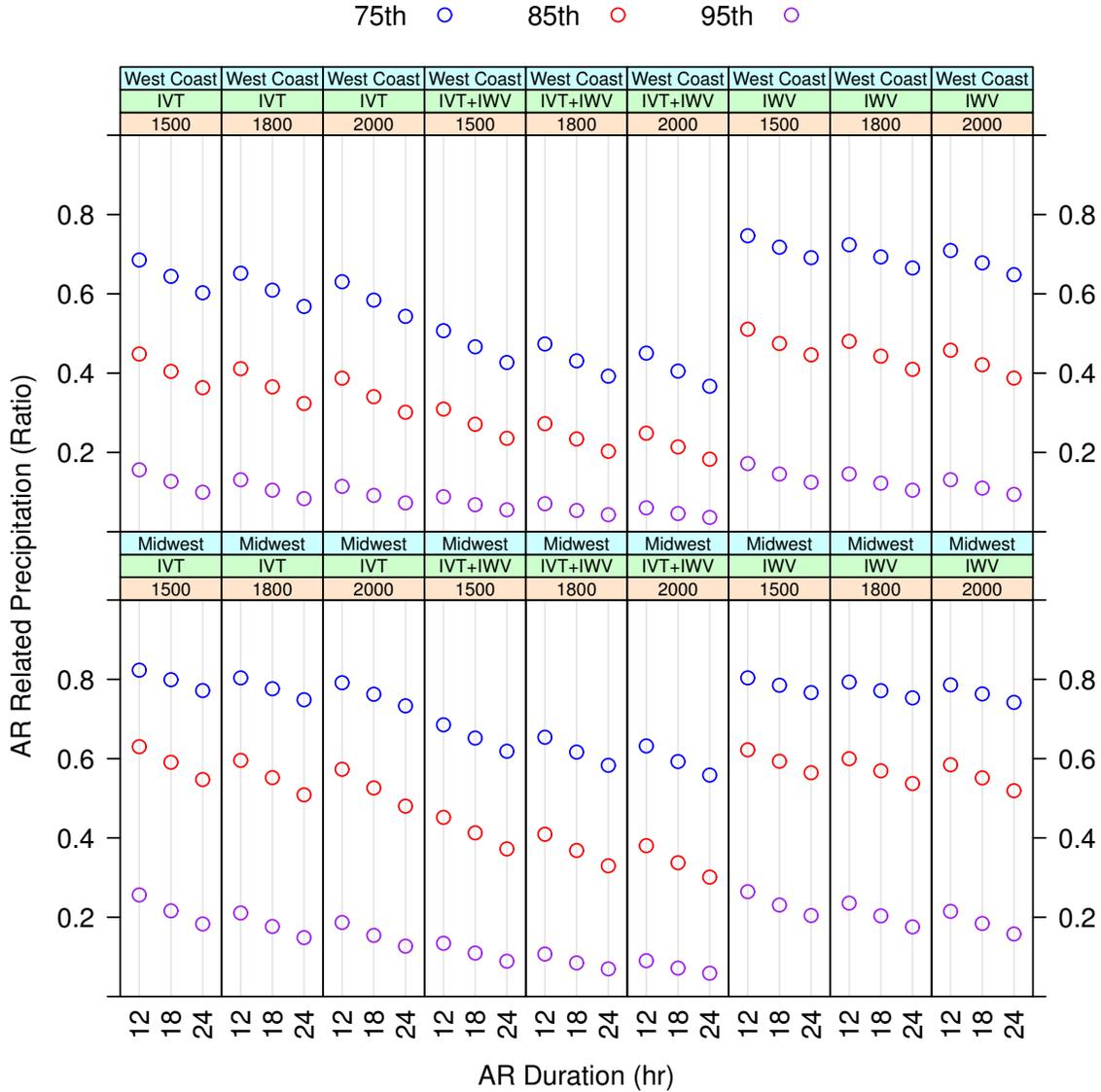


Figure S1. Dotplots of coarse-grain *AR Related Precipitation* calculated for 81 West-Coast (top-row) and 81 Midwest (bottom-row) AR indices. The fraction of total days with precipitation attributable to identified ARs (in ratio) are plotted on each panel, conditional on 18 combinations of regions (West Coast or Midwest), moisture fields (*IVT*, *IWV*, or *IVT+IWV*), and AR length criteria (1500, 1800, or 2000 km). The results are 18 packets, or subsets, of values. Each packet has 9 paired values of *AR Related Precipitation* in the *y*-axis and one of the AR persistent duration thresholds (12, 18, or 24 hours along the *x*-axis), grouped with color by climatological thresholds (75th, 85th, or 95th percentiles).

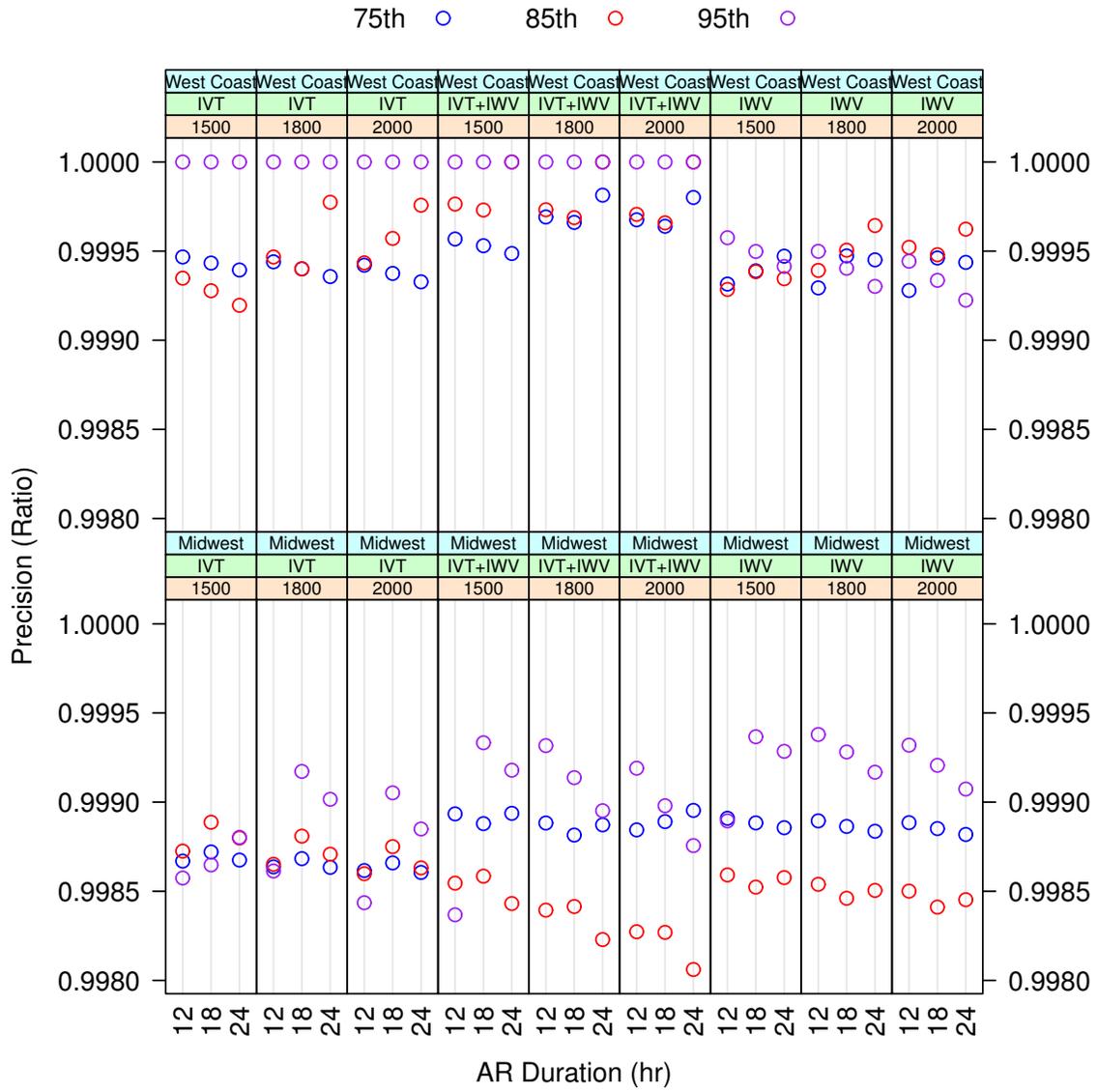


Figure S2. Similar to Figure S1, but for Precision.

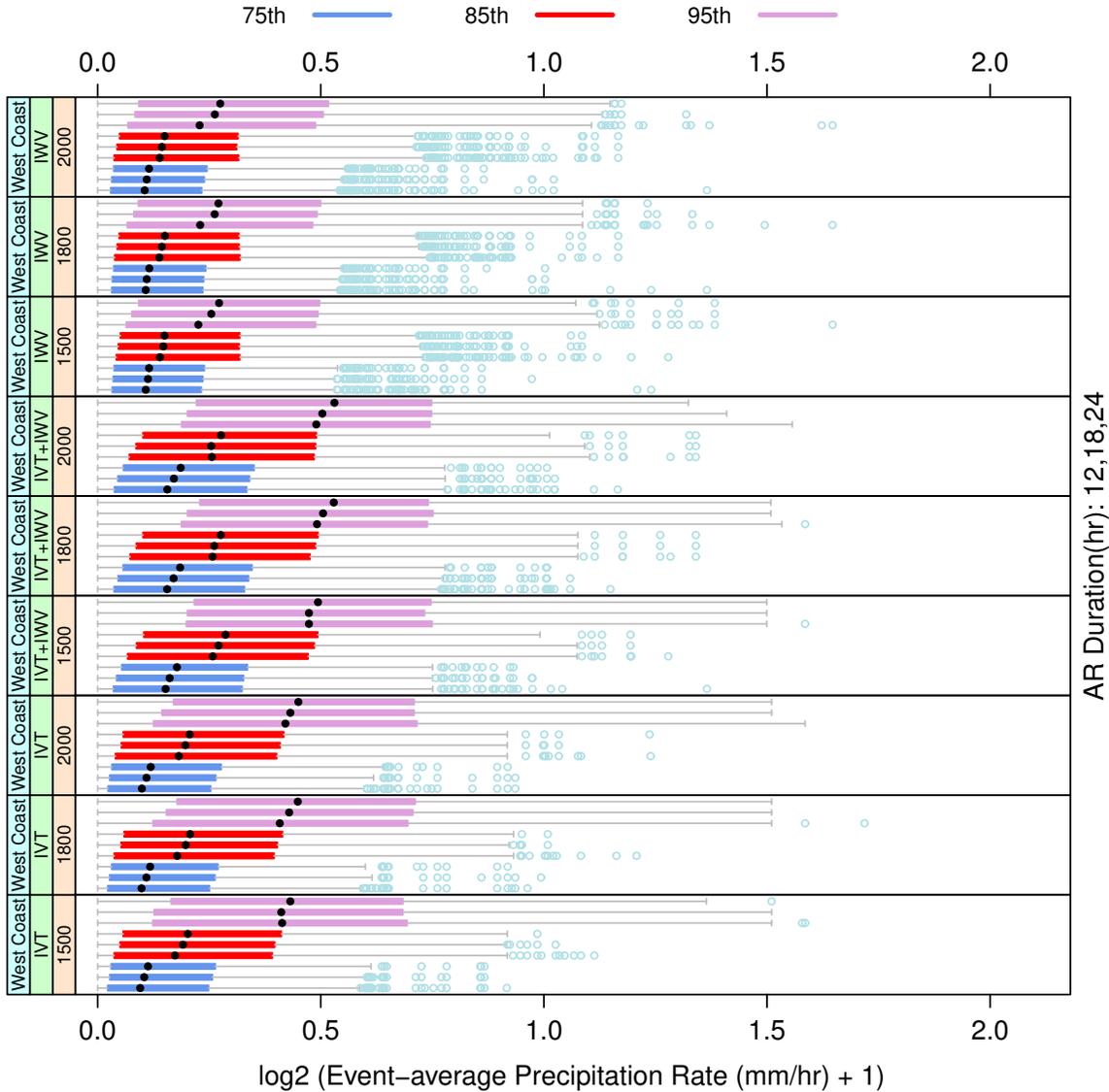


Figure S3. Based on the West Coast AR indices, boxplots of base-2 logarithmic transformation of event-average precipitation rate plus 1 (in mm hr^{-1}) over unit area. Each figure has nine packets from combinations of three moisture (*IVT*, *IWW*, or *IVT + IWW*) and three AR length criteria (1500, 1800, or 2000 km). Each packet has nine boxplots grouped by color into three levels of climatological thresholds (75th, 85th, or 95th percentile). Within each triplet, from bottom to top, the persistent duration thresholds increase from 12, 18, to 24 hours. Each boxplot includes the colored box spanning from Q1 to Q3 of the distribution, a black dot marking the median, and the whiskers are marked in grey. The whiskers extend to the most extreme data point that is no more than 1.5 times the length of the box (IQR) away from the box. Any data points outside the whiskers are marked as potential outliers in light blue.

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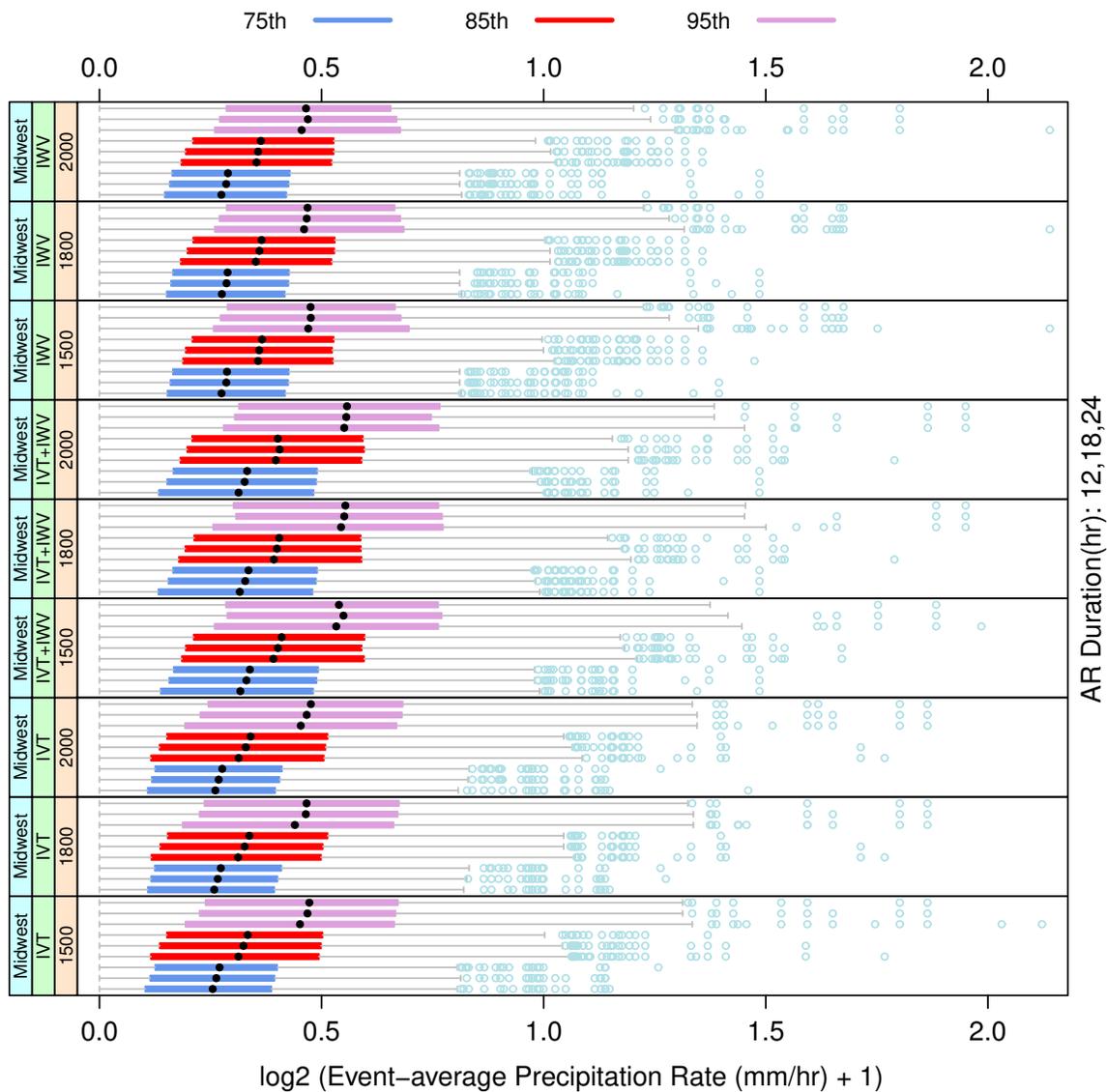


Figure S4. Similar to Figure S3, but based on the Midwest AR indices.

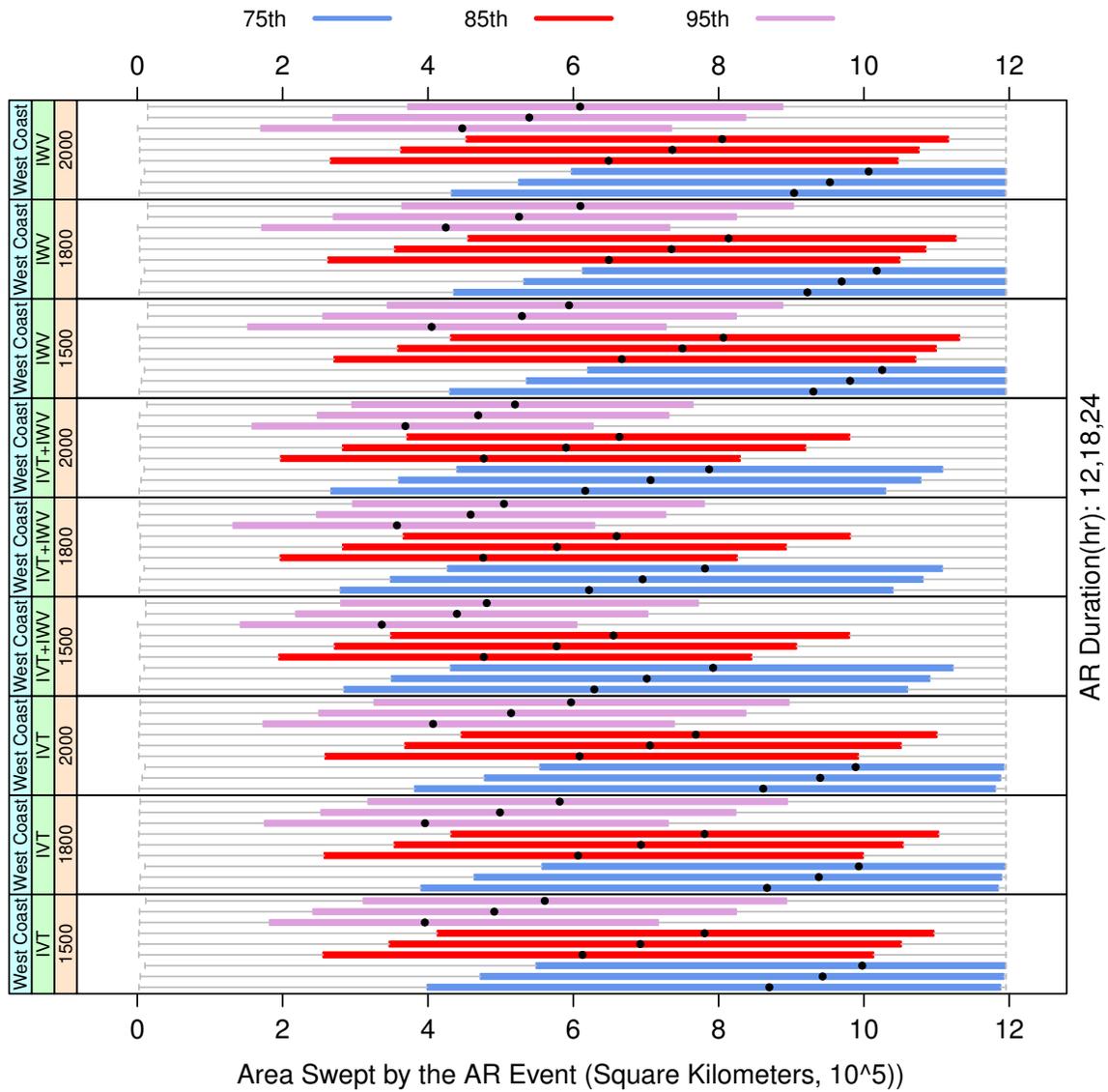


Figure S5. Similar to Figure S3, but for boxplots of surface area (in 10^5 km^2) swept by the detected ARs for each AR event for the West Coast. Each figure has nine packets from combinations of three moisture (*IWT*, *IWW*, or *IWT + IWW*) and three AR length criteria (1500, 1800, or 2000 km). Each packet has nine boxplots grouped by color into three levels of climatological thresholds (75th, 85th, or 95th percentile). Within each triplet, from bottom to top, the persistent duration thresholds increase from 12, 18, to 24 hours.

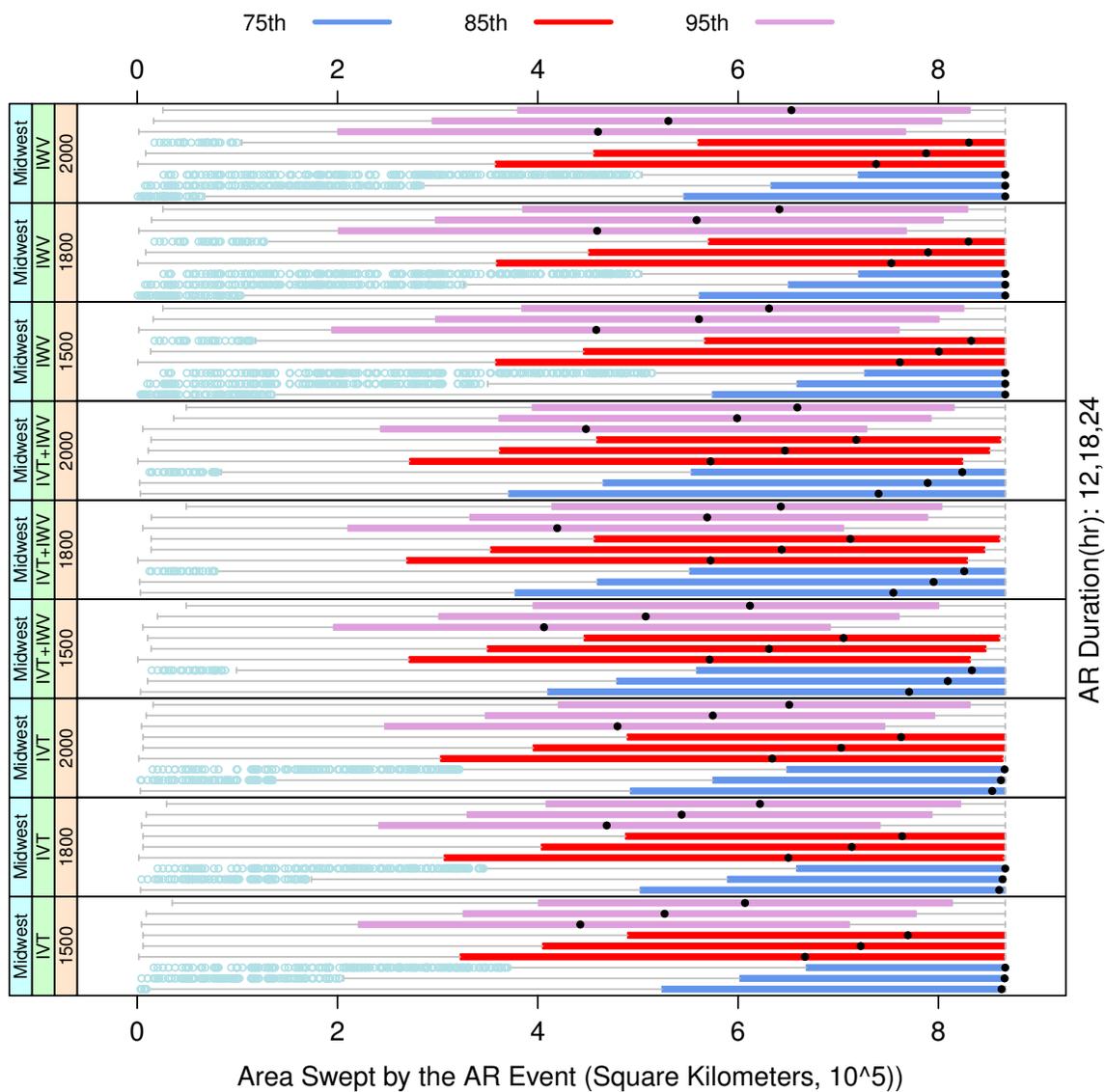


Figure S6. Similar to Figure S5, but for the Midwest.

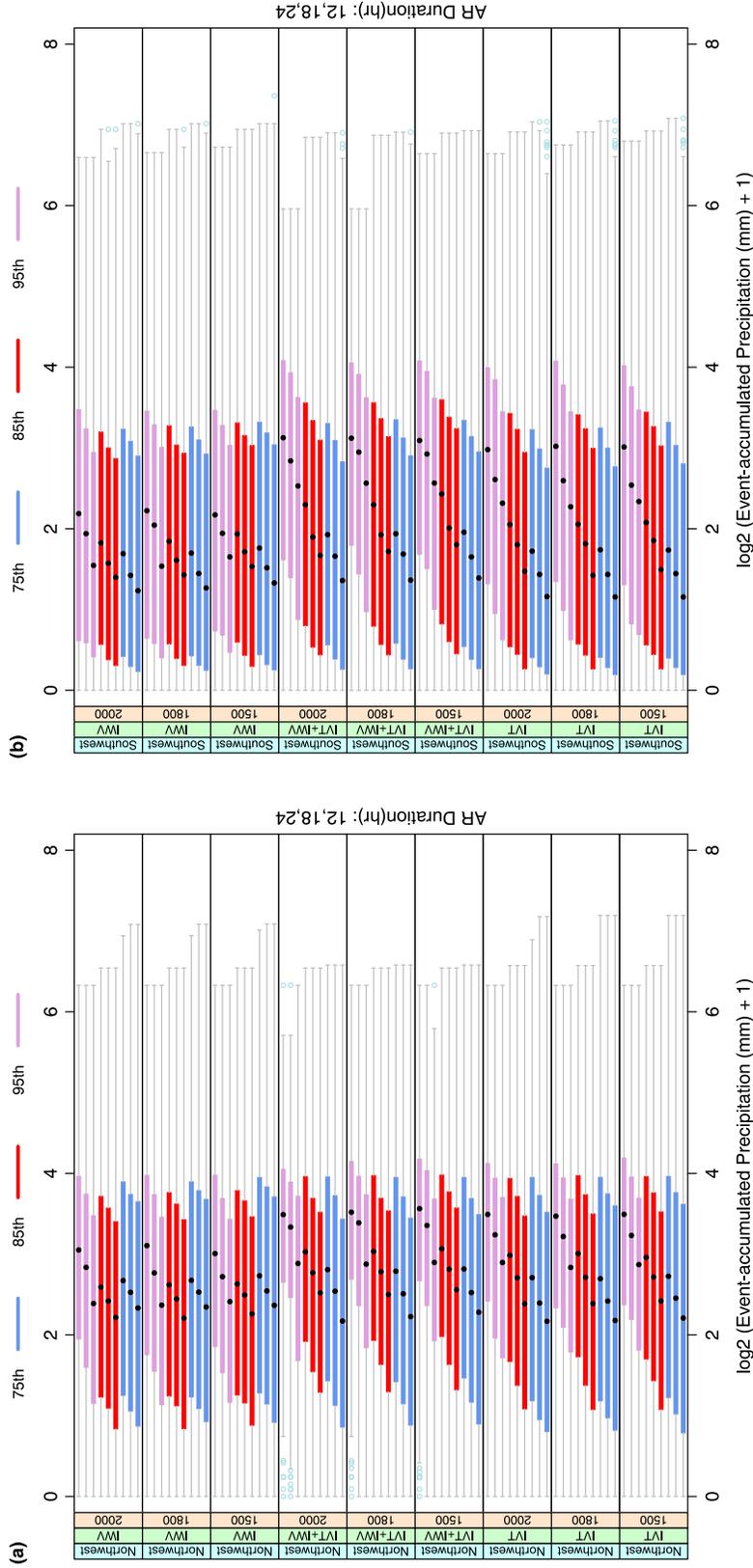


Figure S7. Boxplots of event-accumulated precipitation (mm), plus 1, over unit area swept by AR in the (a) Northwest and (b) Southwest regions. The results are base-2 logarithmic transformation of the original values plus 1, and are conditional on nine combinations of moisture fields (*IVT*, *IWV*, or *IVT + IWV*) and AR length criteria (1500, 1800, or 2000 km). Each resultant packet has nine boxplots grouped by color into three levels of climatological thresholds (75th, 85th, or 95th percentile). Within each triplet, from bottom to top, the persistent duration thresholds increase from 12, 18, to 24 hours.

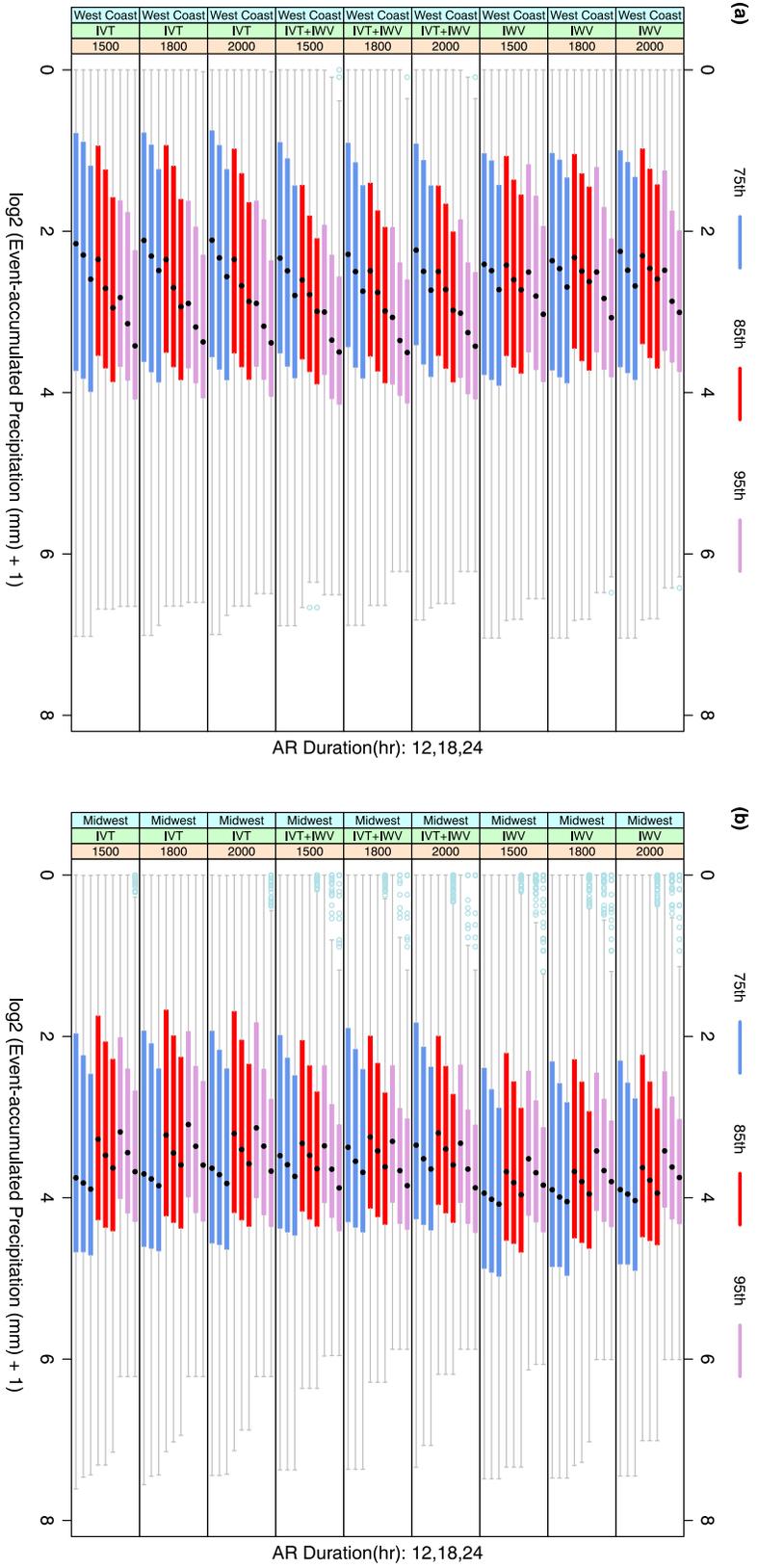


Figure S8. Boxplots of event-accumulated precipitation (mm) over unit area swept by ARs in the (a) West Coast and

(b) Midwest during the first period (January 1981–December 1998). The results are base-2 logarithmic transformation of the original values plus 1, and are conditional on nine combinations of moisture fields (IVT , IWV , or $IVT + IWV$) and AR length criteria (1500, 1800, or 2000 km). Each resultant packet has nine boxplots grouped by color into three levels of climatological thresholds (75th, 85th, or 95th percentile). Within each triplet, from bottom to top, the persistent duration thresholds increase from 12, 18, to 24 hours.

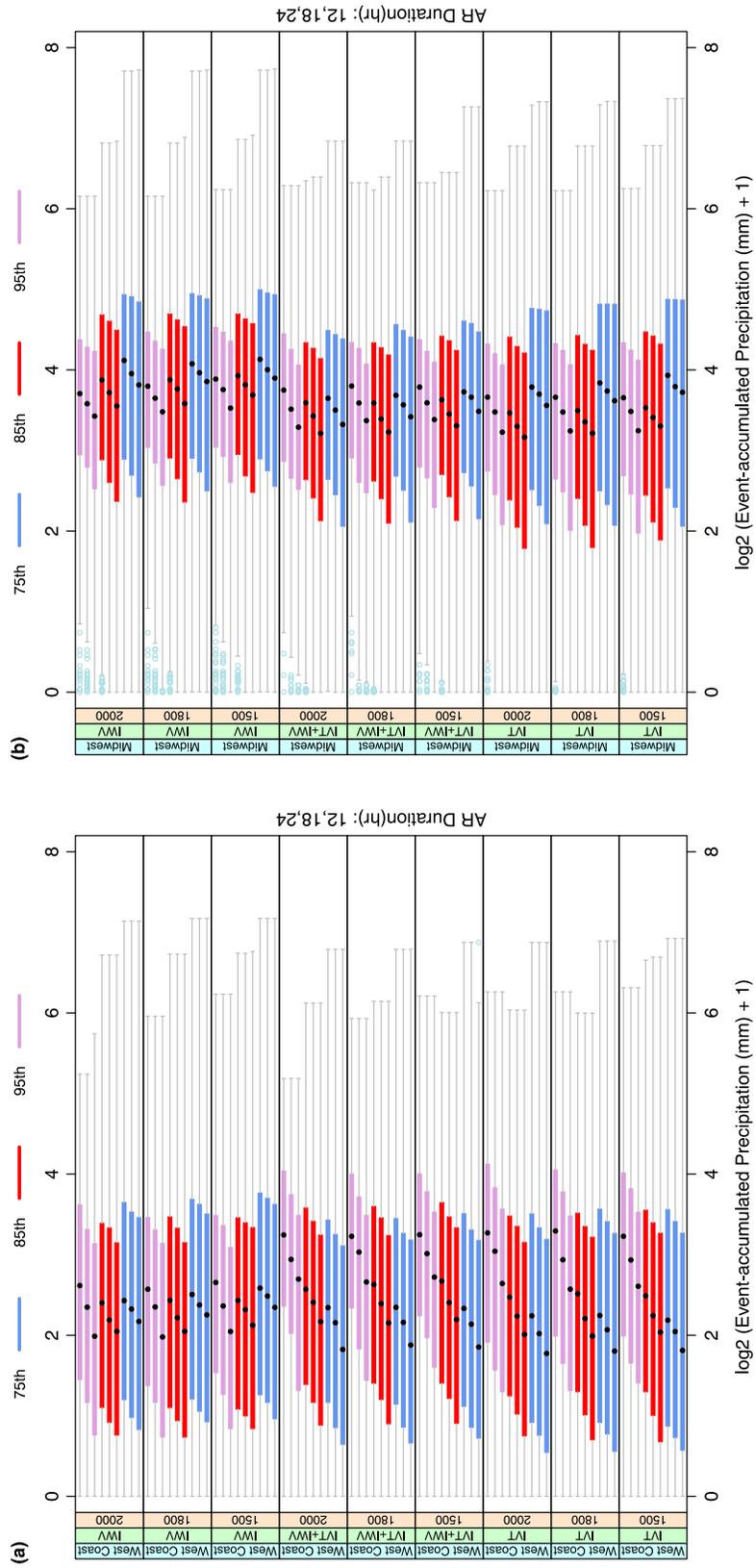


Figure S9. Similar to Figure S8, but for the second period (January 1999–December 2016).

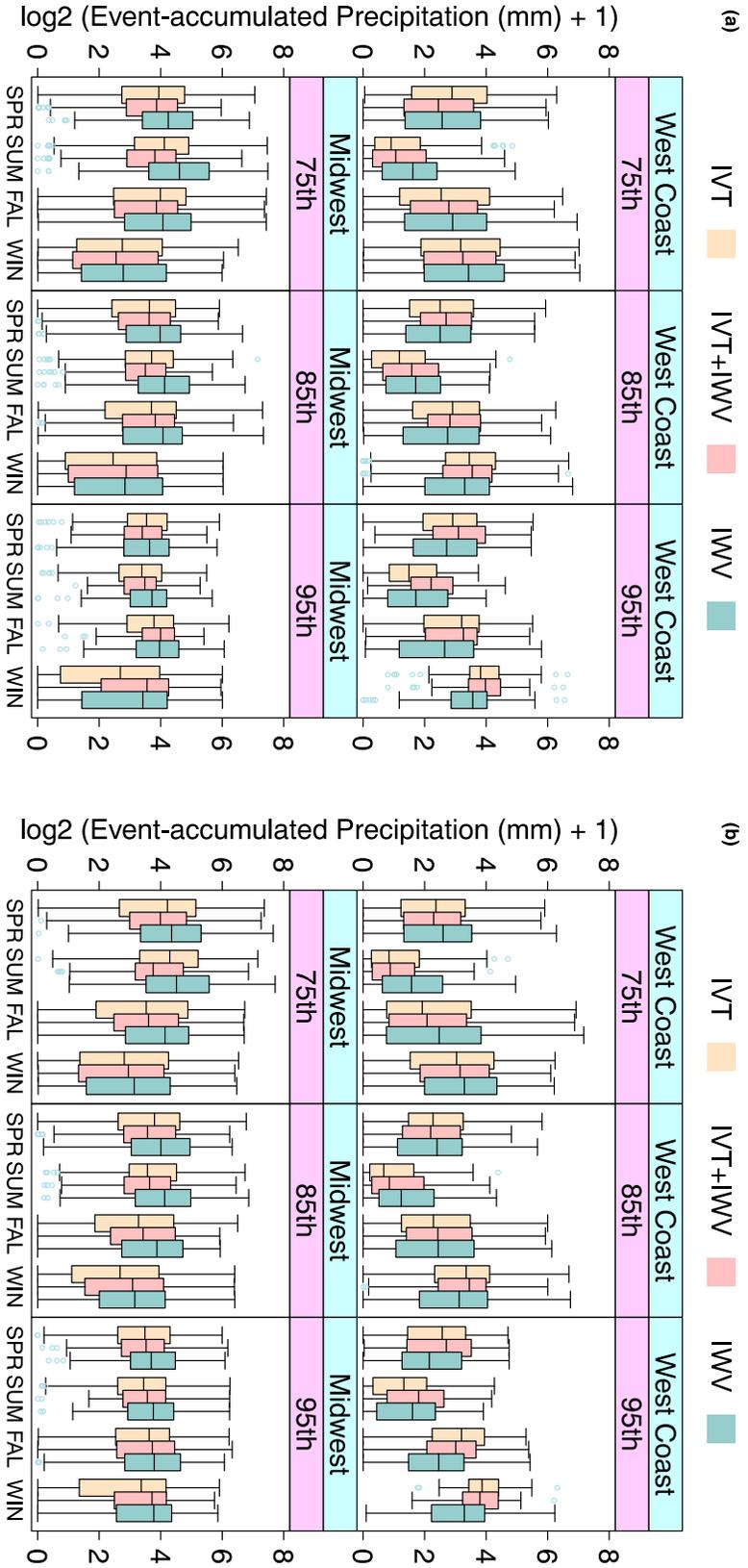


Figure S10. Boxplots of base-2 logarithmic transformation of event-accumulated precipitation (mm), plus 1, over unit area swept by AR in West Coast and Midwest during (a) the first period (January 1981–December 1998) and (b) the second period (January 1999–December 2016) in different seasons—spring (SPR: March–May), summer (SUM: June–August), fall (FAL: September–November), and winter (WIN: December–February)—according to *IVT*, *IVT* + *IWV*, and *IWV*-based AR indices with the 1500-km length and 18-hr persistent duration criteria, labeled as climate threshold in percentile 75th, 85th, or 95th in the purple box.