

1 Supplementary figures for

2 “*Tide-Surge Interaction near Singapore and Malaysia using a Semi-*
3 *empirical Model*”

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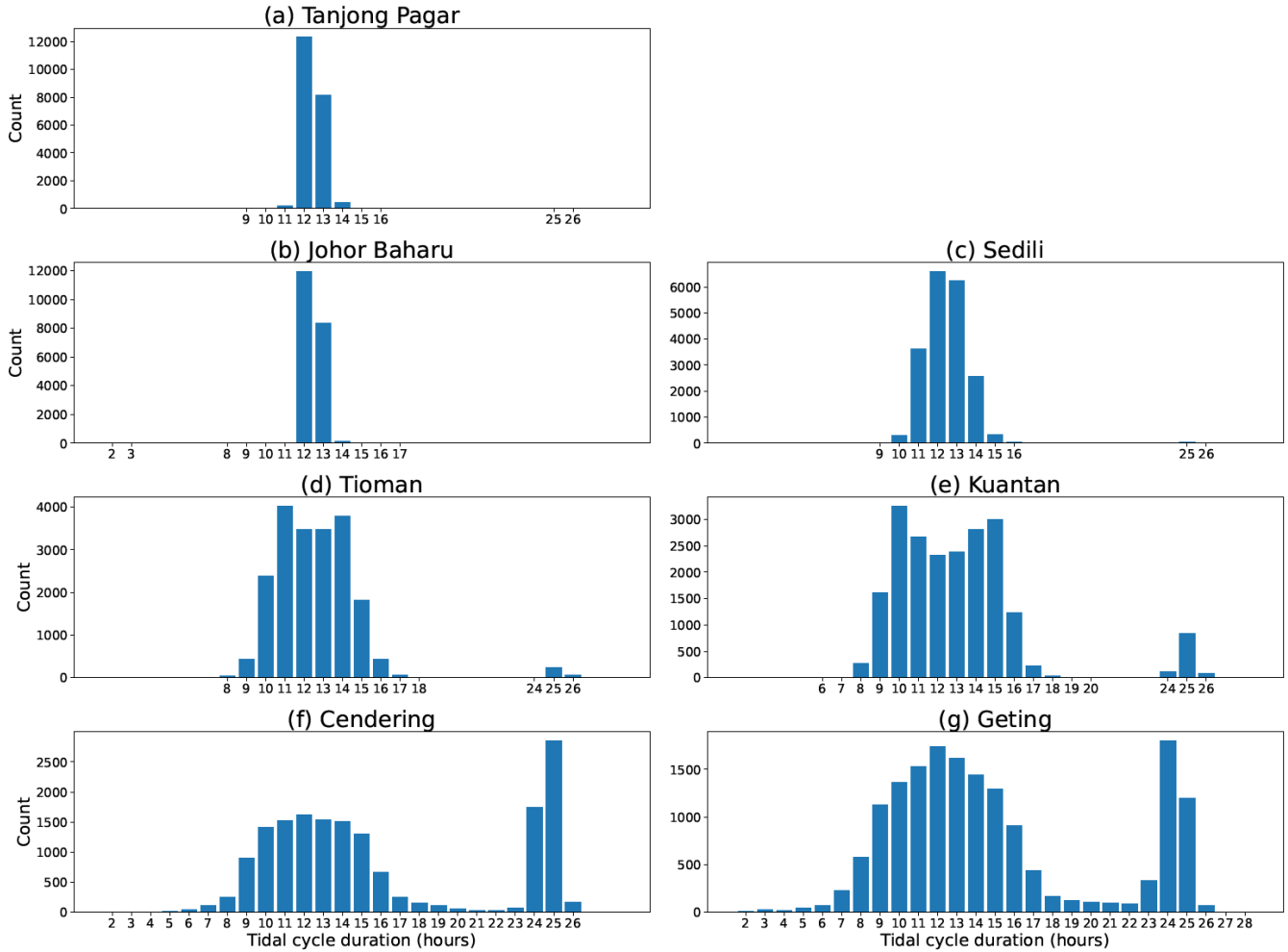
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10 Technology (TU Delft), The Netherlands

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Distribution of tidal cycle duration

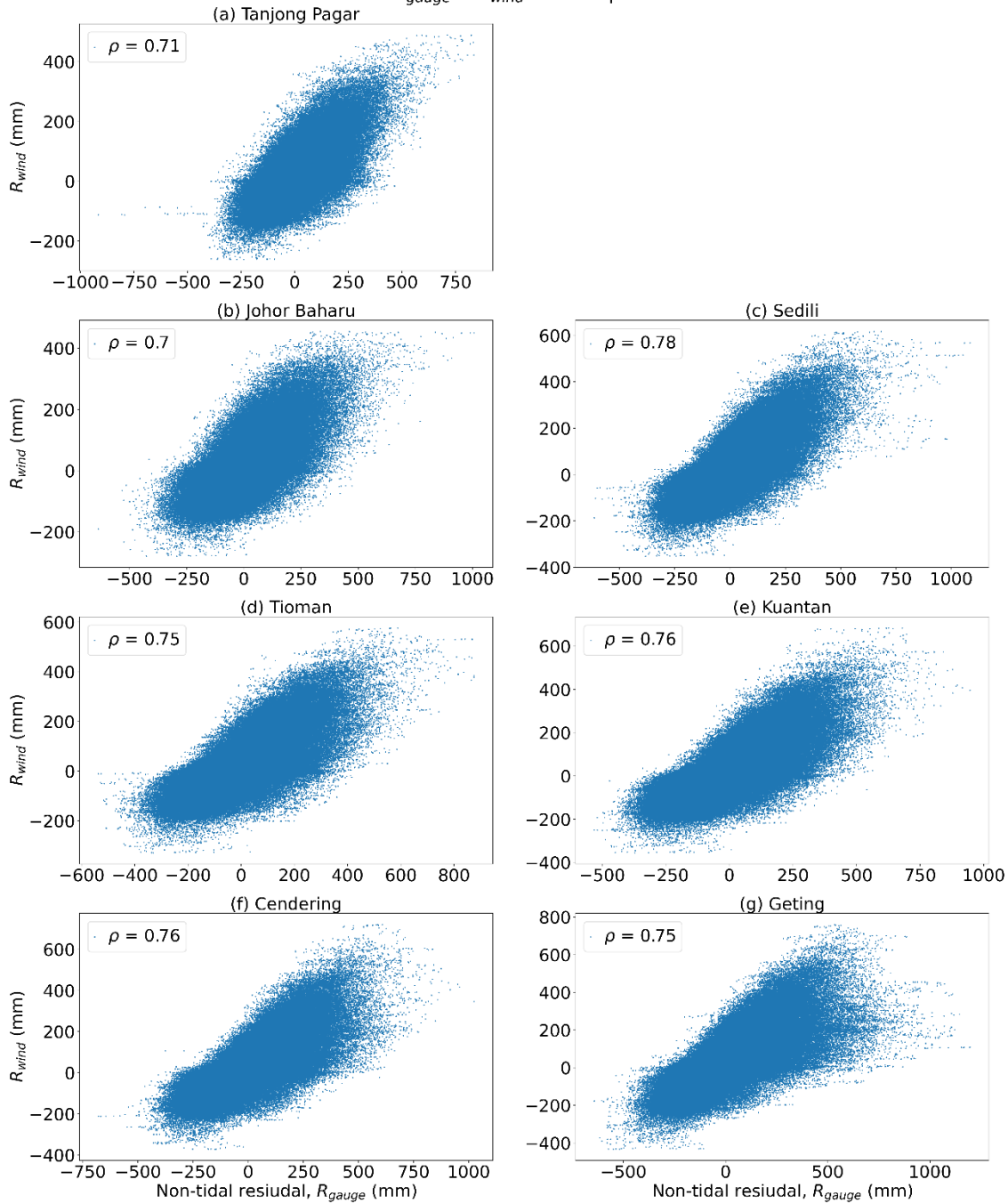


13

14 **Figure S1: Histogram of the duration of tidal cycles at each tide gauge location. Tidal cycles are defined as the duration from one**
 15 **local minima in the hourly tidal level to the observation immediately preceding the next local minima (Sect. 2.2). Tidal cycles at**
 16 **Tanjung Pagar and Johor Baharu are often 12–13 hours long, while the tidal cycles at the other locations are less consistent.**

17

$R_{gauge} - R_{wind}$ scatter plot

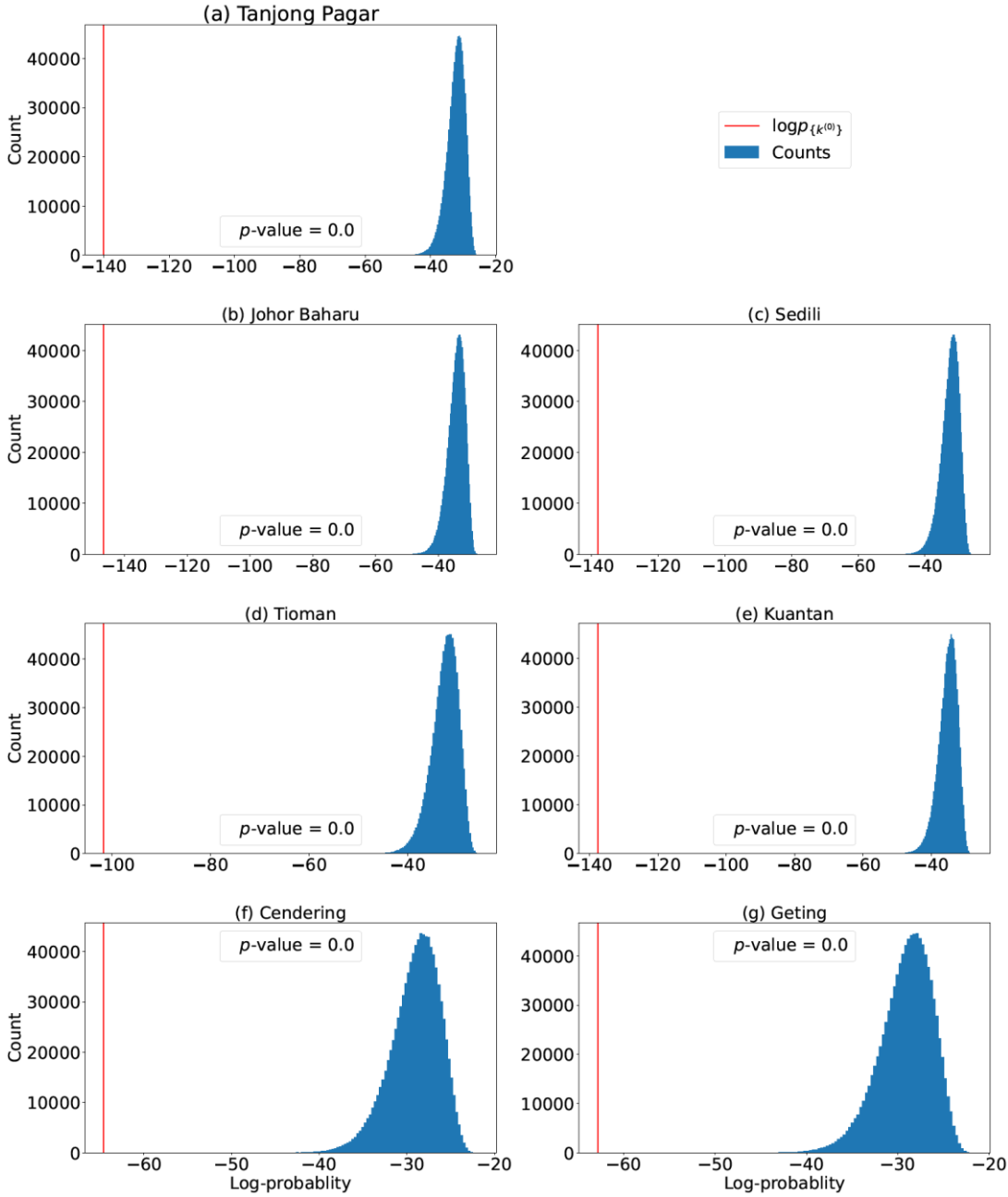


18

19 **Figure S2: Scatter plots between non-tidal residuals, R_{gauge} and R_{wind} at each tide-gauge location. The correlation coefficients of**
20 **0.7–0.8 corresponds to a coefficient of determination of 0.5–0.6.**

21

Distribution of bootstrap sample log-probability

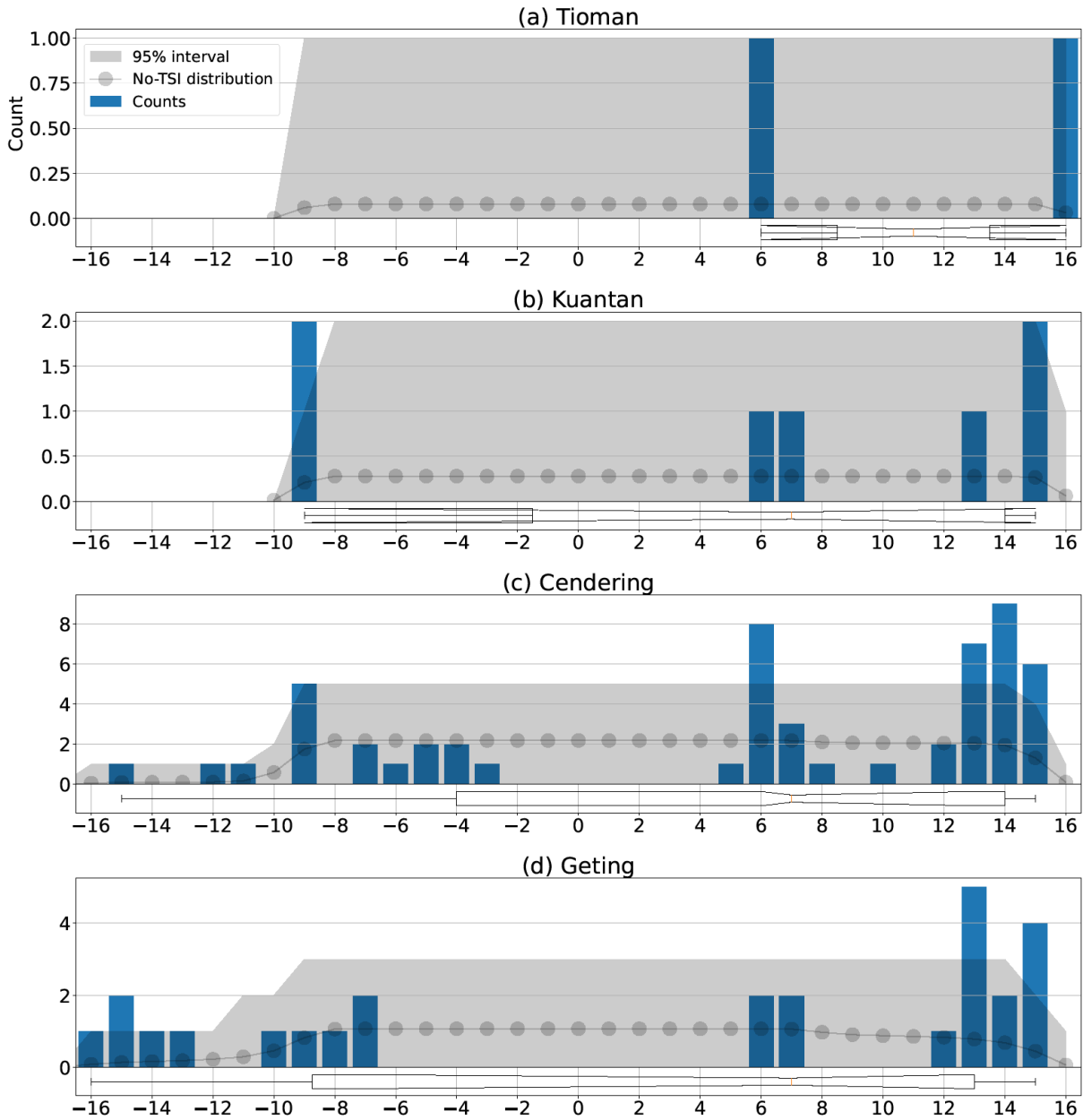


22

23 **Figure S3: Histogram of 1,000,000 log-probabilities of obtaining a randomly generated bootstrap sample from the normalized No-**
 24 **TSI distribution p_h of R_{gauge} during semidiurnal tidal cycles. Red vertical lines indicate $\log p_{\{k^{(0)}\}}$, the log-probabilities of obtaining**
 25 **the frequency distribution $k^{(0)}$ from p_h . p -values are obtained by taking the quantile of the $\log p_{\{k^{(0)}\}}$ within the 1,000,000 log-**
 26 **probabilities of bootstrap samples.**

27

Number of extremes found at x hours from nearest tidal high water

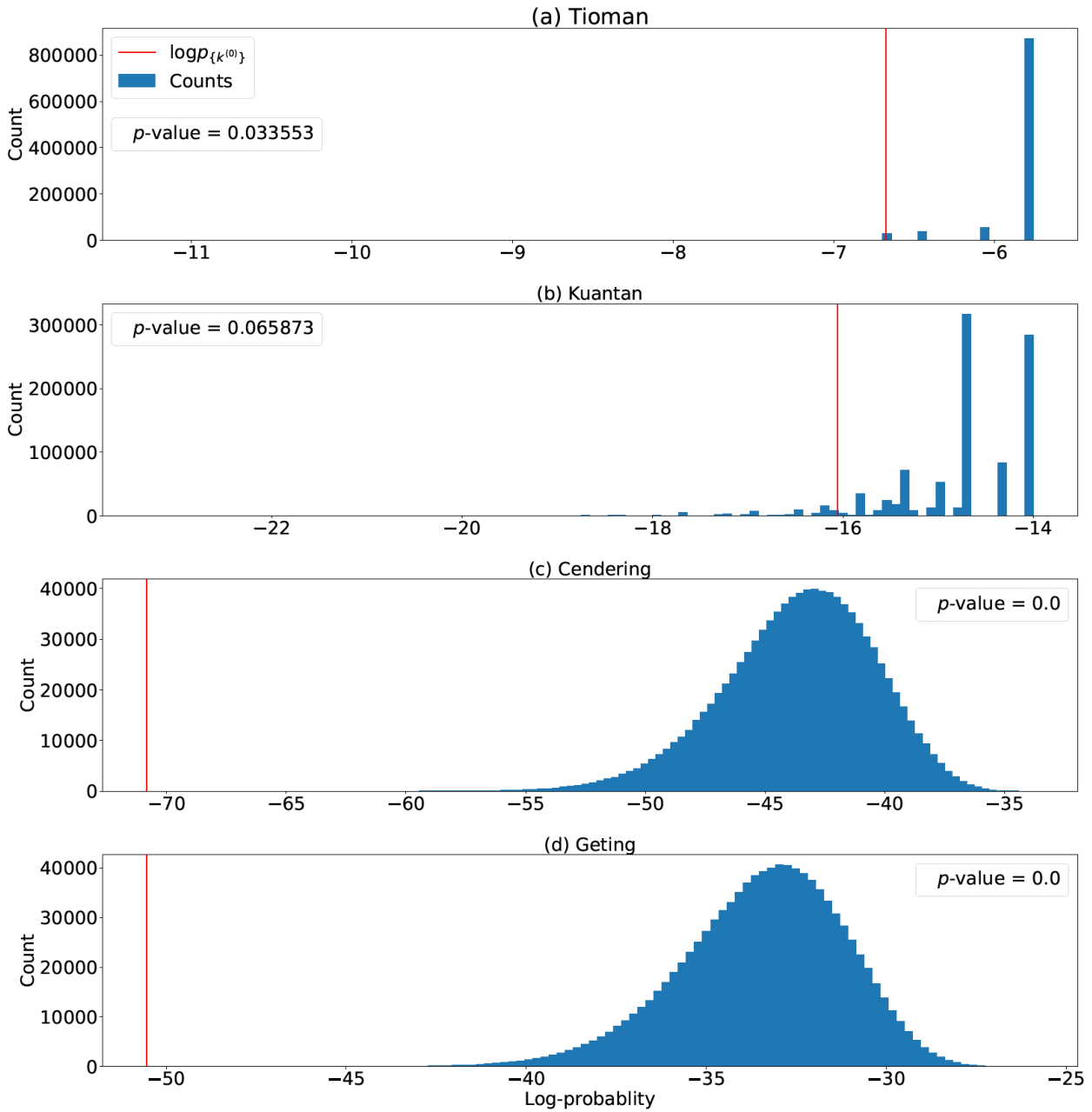


28

29 **Figure S4:** The frequency distribution for extreme values of R_{gauge} and the No-TSI distribution during diurnal tidal cycles,
 30 truncated at ± 16 hours from tidal high water. The frequency distribution is compared to the No-TSI distribution to determine the
 31 presence of tide-surge interaction. Summary statistics of the frequency distribution are shown using the horizontal notched box plot,
 32 where orange lines indicate the medians, notches indicate the 95% confidence interval of the medians, notched rectangles indicate
 33 the interquartile range (IQR), whiskers indicate a range that extends up to $1.5 \times \text{IQR}$ from the limits of the IQR, and black circles (if
 34 present) indicate outliers outside this range.

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Distribution of bootstrap sample log-probability

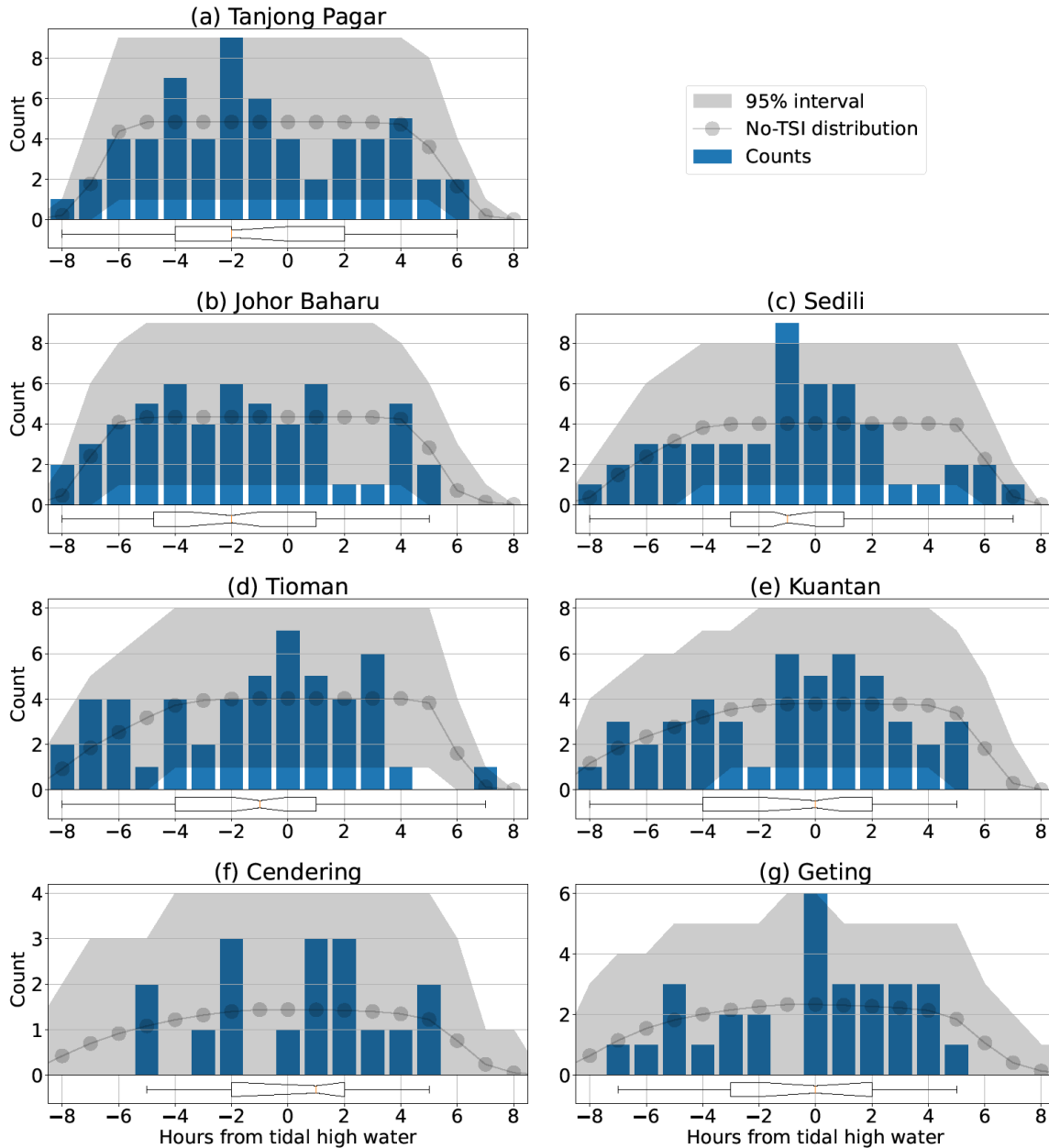


36

37 **Figure S5: Histogram of 1,000,000 log-probabilities of obtaining a randomly generated bootstrap sample from the normalized No-**
 38 **TSI distribution p_h of R_{gauge} during diurnal tidal cycles. Red vertical lines indicate $\log p_{\{k^{(0)}\}}$, the log-probabilities of obtaining the**
 39 **frequency distribution $k^{(0)}$ from p_h . p -values are obtained by taking the quantile of the $\log p_{\{k^{(0)}\}}$ within the 1,000,000 log-**
 40 **probabilities of bootstrap samples.**

41

Number of R_{wind} extremes found at x hours from nearest tidal high water

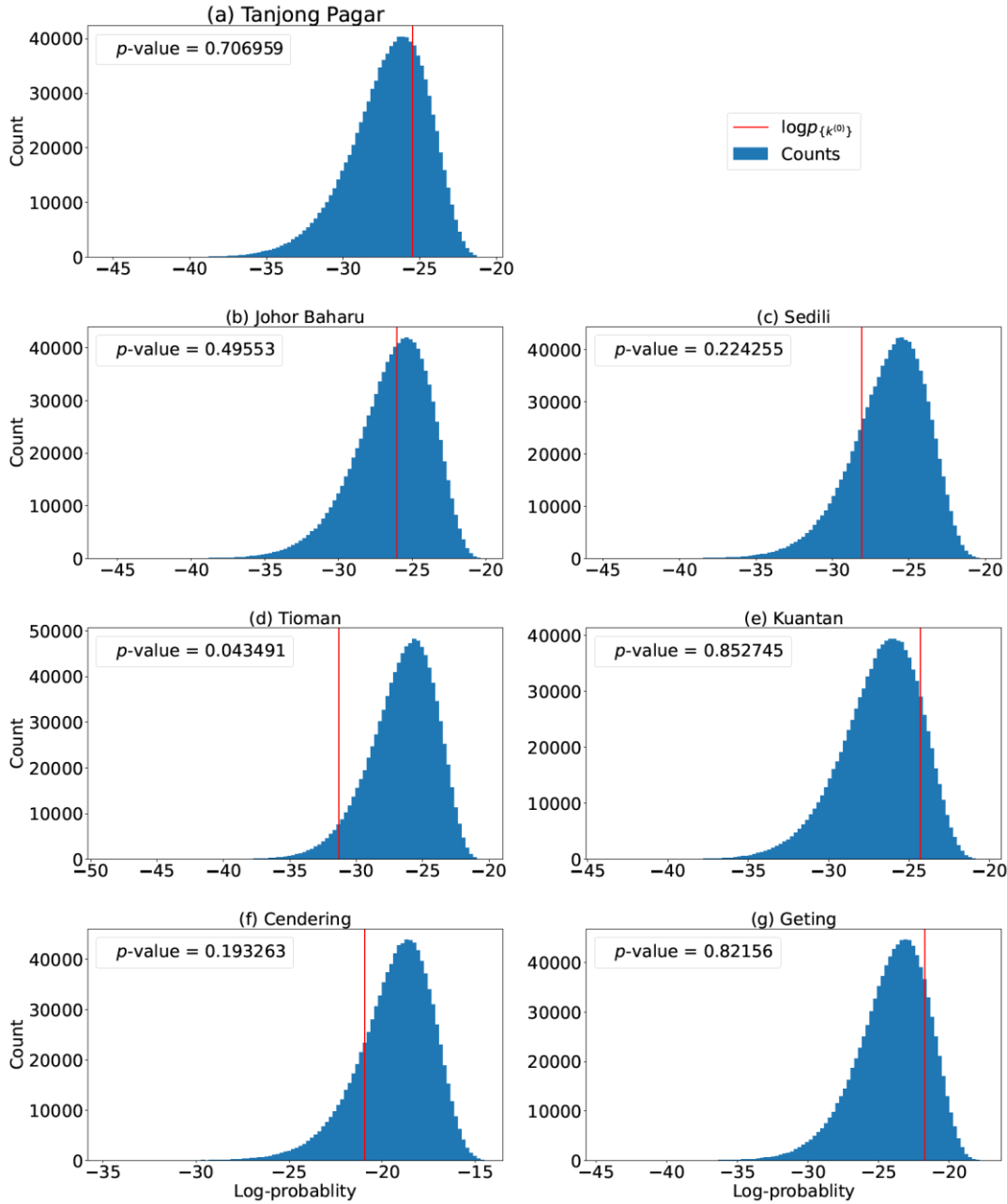


42

43 **Figure S6:** The frequency distribution for extreme values of R_{wind} and the No-TSI distribution during semidiurnal tidal cycles,
 44 truncated at ± 8 hours from tidal high water. The frequency distribution is compared to the No-TSI distribution to determine the
 45 presence of tide-surge interaction. Summary statistics of the frequency distribution are shown using the horizontal notched box plot,
 46 where orange lines indicate the medians, notches indicate the 95% confidence interval of the medians, notched rectangles indicate
 47 the interquartile range (IQR), whiskers indicate a range that extends up to $1.5 \times \text{IQR}$ from the limits of the IQR, and black circles (if
 48 present) indicate outliers outside this range.

49

Distribution of bootstrap sample log-probability

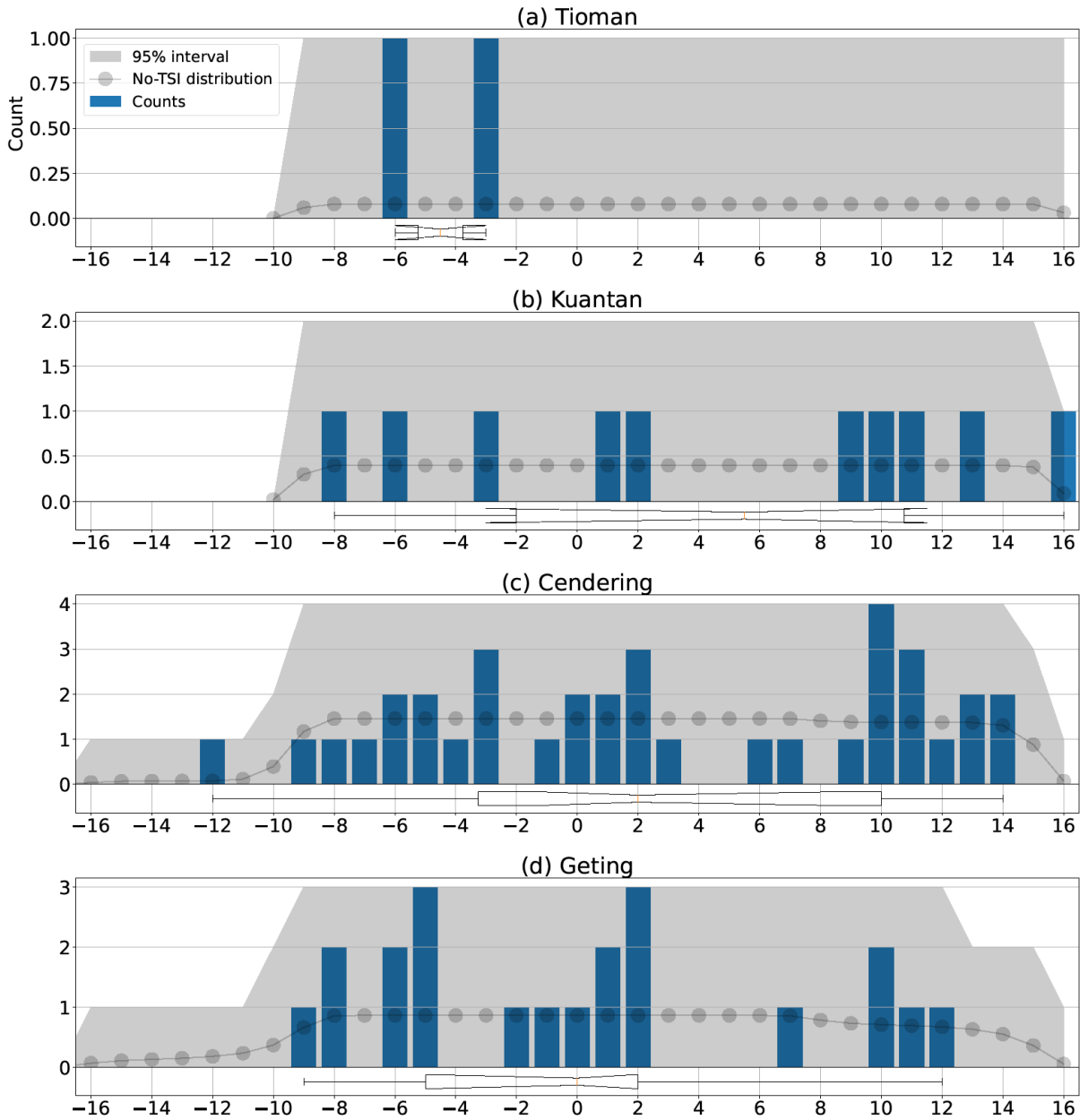


50

51 **Figure S7: Histogram of 1,000,000 log-probabilities of obtaining a randomly generated bootstrap sample from the normalized No-**
 52 **TSI distribution p_h of R_{wind} during semidiurnal tidal cycles. Red vertical lines indicate $\log p_{\{k^{(0)}}}$, the log-probabilities of obtaining**
 53 **the frequency distribution $k^{(0)}$ from p_h . p -values are obtained by taking the quantile of the $\log p_{\{k^{(0)}}}$ within the 1,000,000 log-**
 54 **probabilities of bootstrap samples.**

55

Number of R_{wind} extremes found at x hours from nearest tidal high water

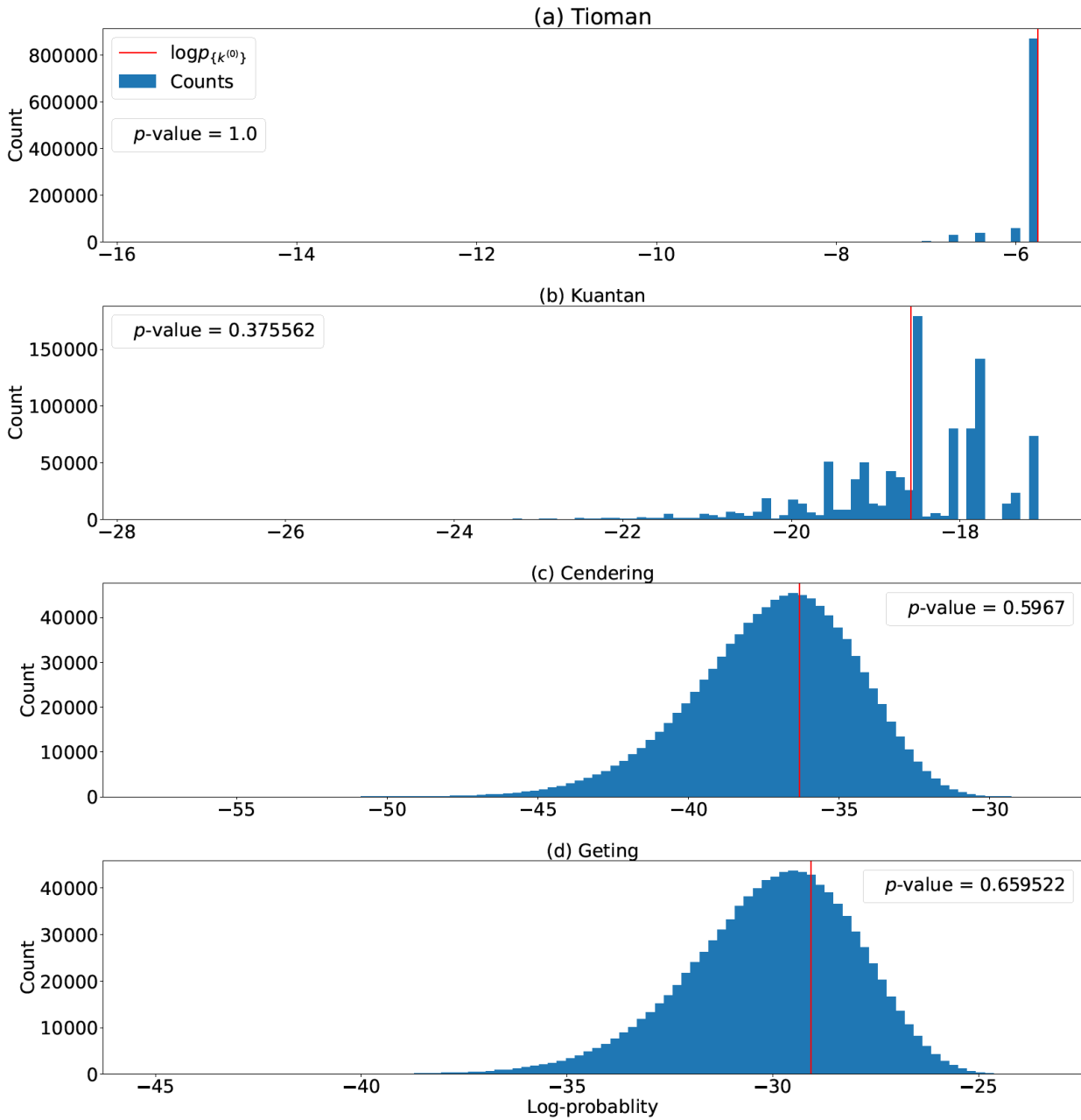


56

57 **Figure S8:** The frequency distribution for extreme values of R_{wind} and the No-TSI distribution during diurnal tidal cycles, truncated
 58 at ± 16 hours from tidal high water. The frequency distribution is compared to the No-TSI distribution to determine the presence
 59 of tide-surge interaction. Summary statistics of the frequency distribution are shown using the horizontal notched box plot, where
 60 orange lines indicate the medians, notches indicate the 95% confidence interval of the medians, notched rectangles indicate the
 61 interquartile range (IQR), whiskers indicate a range that extends up to $1.5 \times IQR$ from the limits of the IQR, and black circles (if
 62 present) indicate outliers outside this range.

63

Distribution of bootstrap sample log-probability

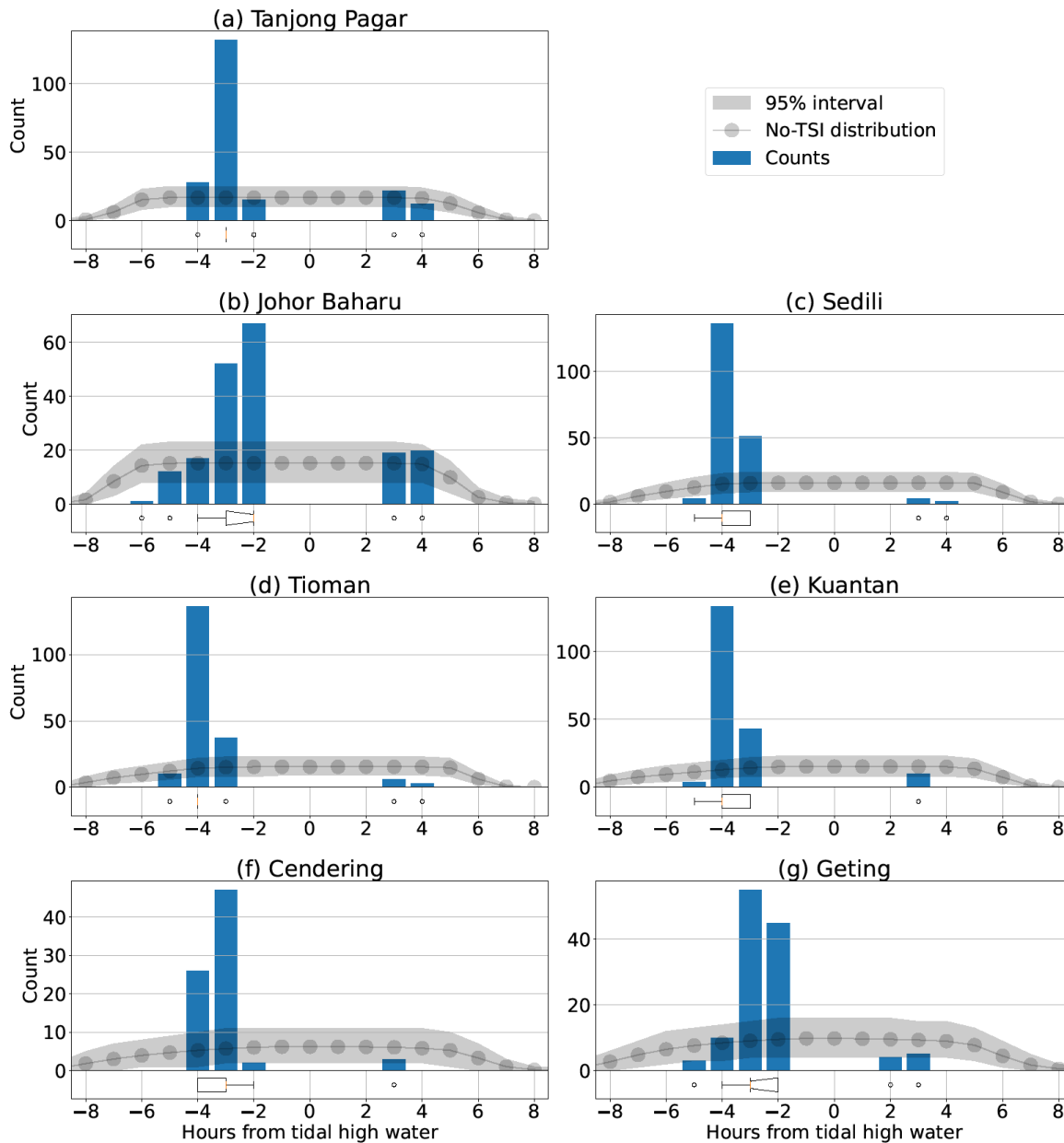


64

65 **Figure S9: Histogram of 1,000,000 log-probabilities of obtaining a randomly generated bootstrap sample from the normalized No-**
 66 **TSI distribution p_h of R_{wind} during diurnal tidal cycles. Red vertical lines indicate $\log p_{\{k^{(0)}\}}$, the log-probabilities of obtaining the**
 67 **frequency distribution $k^{(0)}$ from p_h . p -values are obtained by taking the quantile of the $\log p_{\{k^{(0)}\}}$ within the 1,000,000 log-**
 68 **probabilities of bootstrap samples.**

69

Number of R_{phase} extremes found at x hours from nearest tidal high water

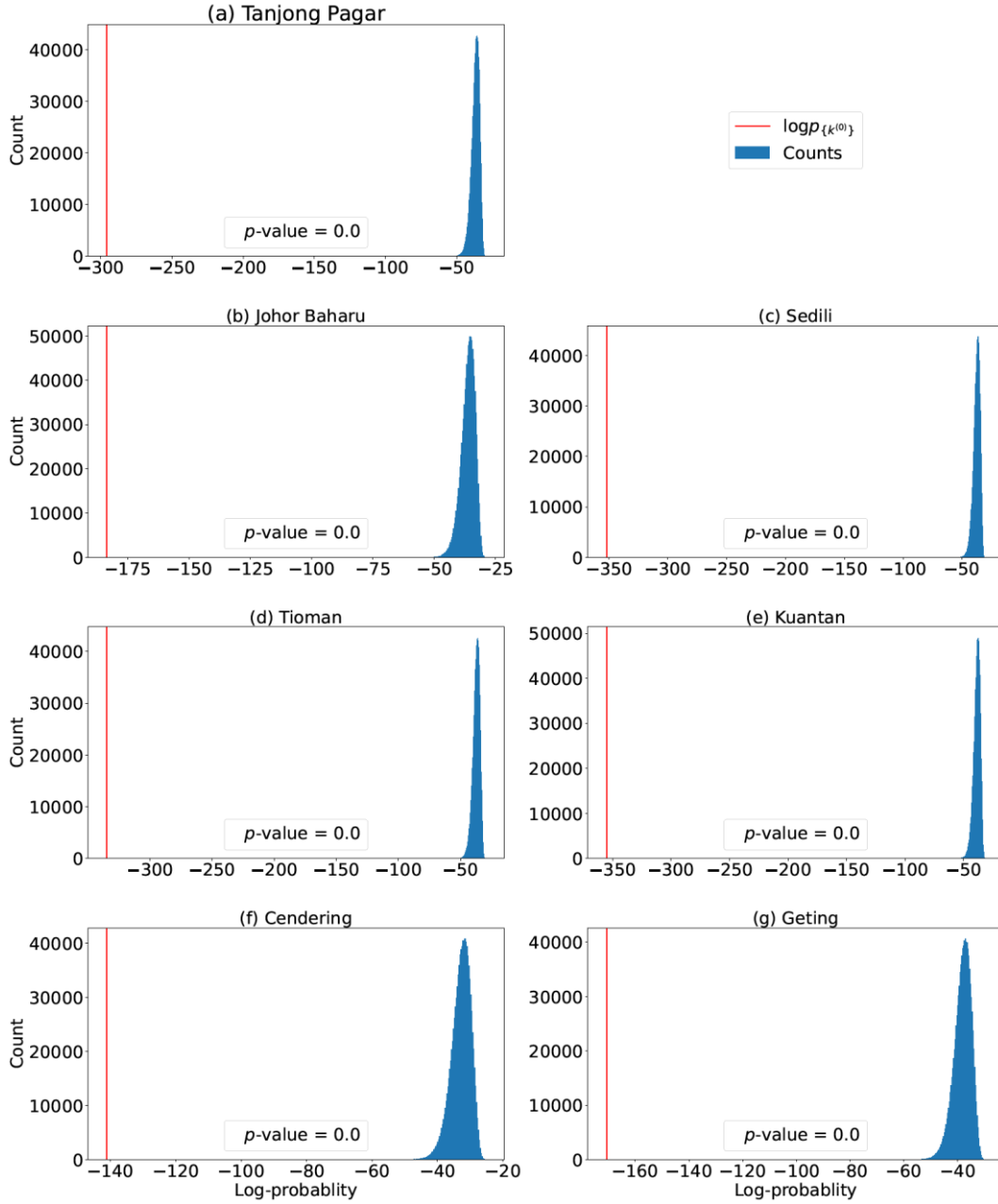


70

71 **Figure S10: The frequency distribution for extreme values of R_{phase} and the No-TSI distribution during semidiurnal tidal cycles,**
 72 **truncated at ± 8 hours from tidal high water. The frequency distribution is compared to the No-TSI distribution to determine the**
 73 **presence of tide-surge interaction. Summary statistics of the frequency distribution are shown using the horizontal notched box plot,**
 74 **where orange lines indicate the medians, notches indicate the 95% confidence interval of the medians, notched rectangles indicate**
 75 **the interquartile range (IQR), whiskers indicate a range that extends up to $1.5 \times \text{IQR}$ from the limits of the IQR, and black circles (if**
 76 **present) indicate outliers outside this range.**

77

Distribution of bootstrap sample log-probability

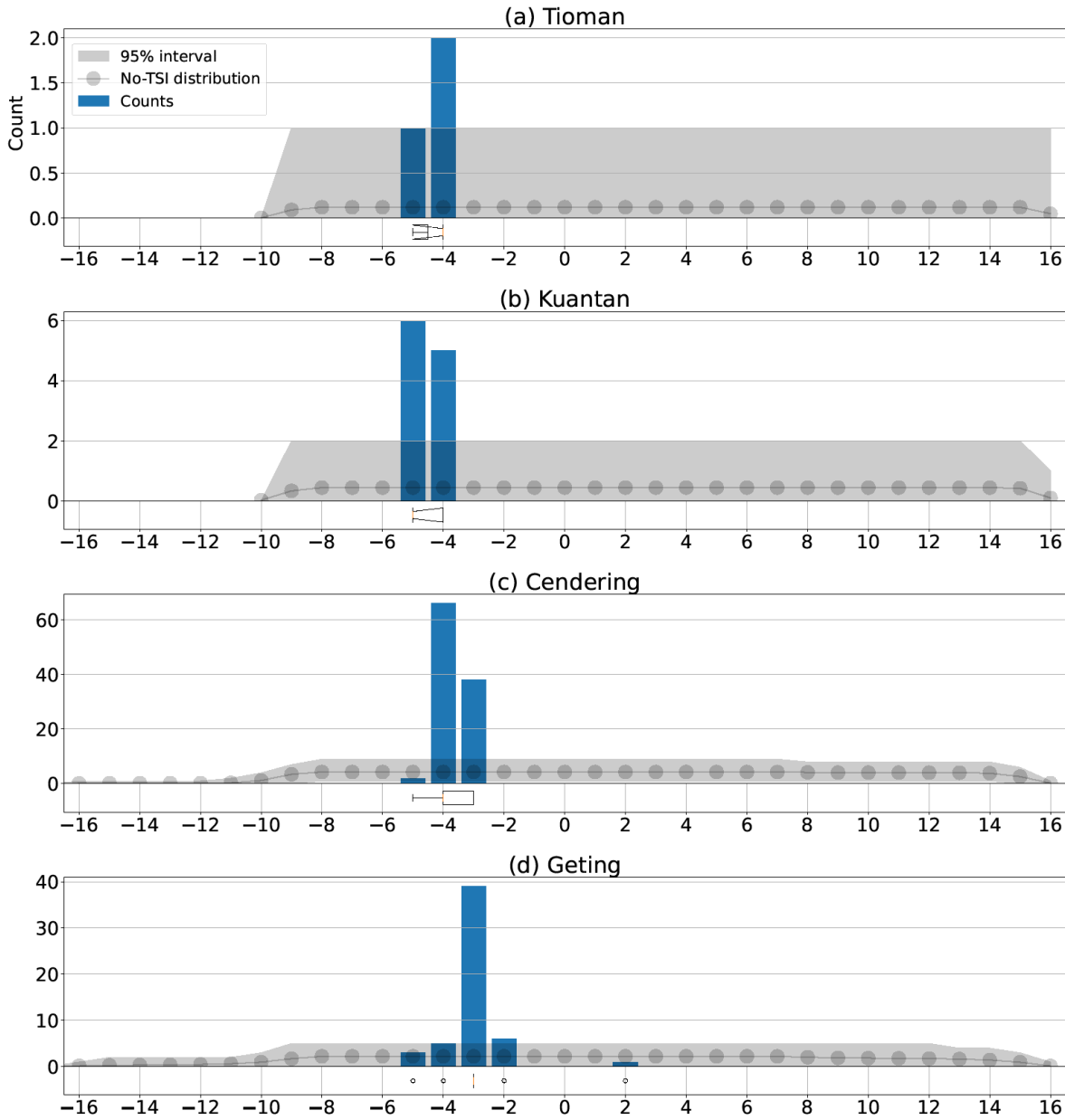


78

79 **Figure S11: Histogram of 1,000,000 log-probabilities of obtaining a randomly generated bootstrap sample from the normalized No-**
 80 **TSI distribution p_h of R_{phase} during semidiurnal tidal cycles. Red vertical lines indicate $\log p_{\{k^{(0)}\}}$, the log-probabilities of obtaining**
 81 **the frequency distribution $k^{(0)}$ from p_h . p -values are obtained by taking the quantile of the $\log p_{\{k^{(0)}\}}$ within the 1,000,000 log-**
 82 **probabilities of bootstrap samples.**

83

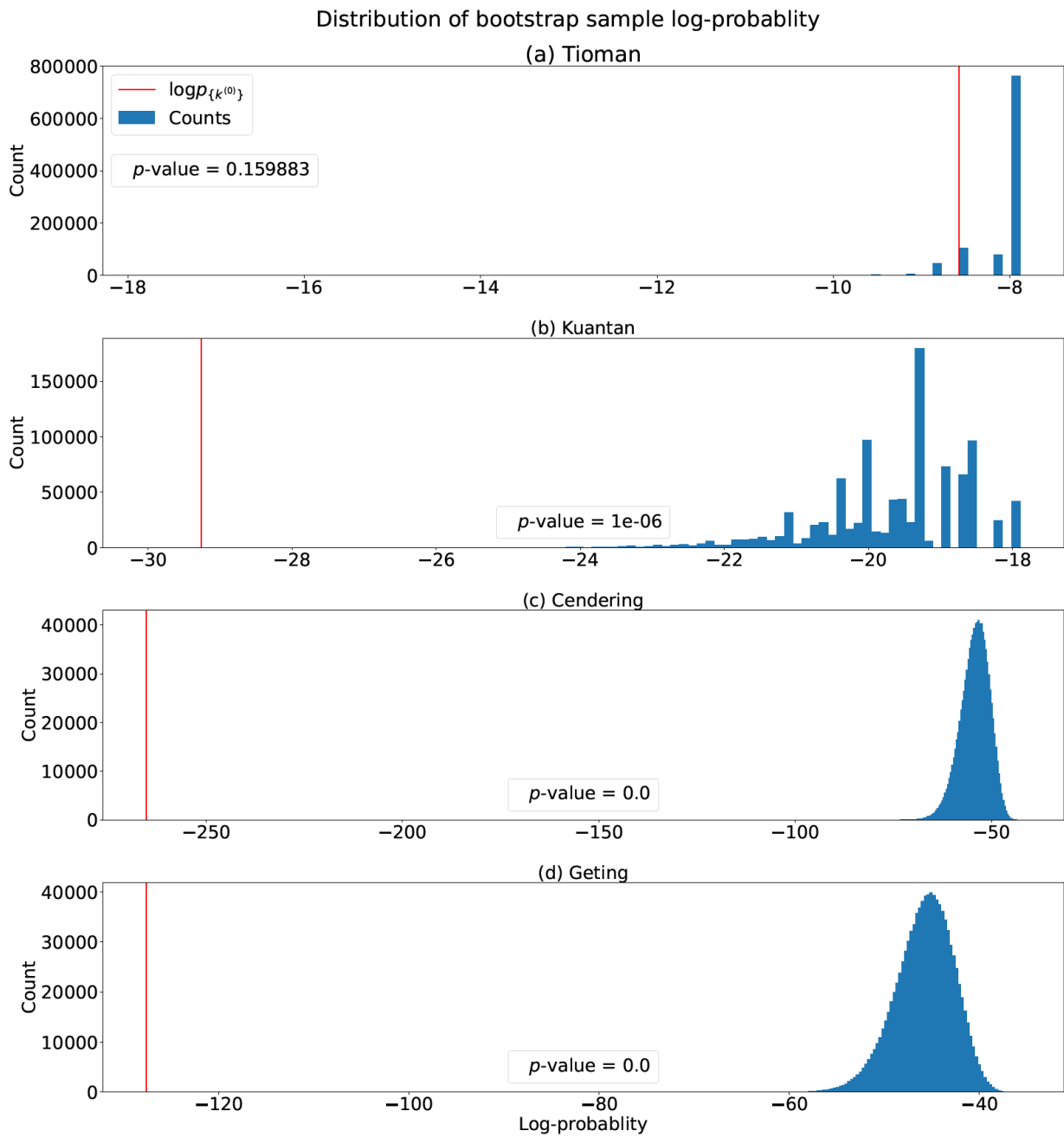
Number of R_{phase} extremes found at x hours from nearest tidal high water



84

85 **Figure S12: The frequency distribution for extreme values of R_{phase} and the No-TSI distribution during diurnal tidal cycles,**
 86 **truncated at ± 16 hours from tidal high water. The frequency distribution is compared to the No-TSI distribution to determine the**
 87 **presence of tide-surge interaction. Summary statistics of the frequency distribution are shown using the horizontal notched box plot,**
 88 **where orange lines indicate the medians, notches indicate the 95% confidence interval of the medians, notched rectangles indicate**
 89 **the interquartile range (IQR), whiskers indicate a range that extends up to $1.5 \times IQR$ from the limits of the IQR, and black circles (if**
 90 **present) indicate outliers outside this range.**

91

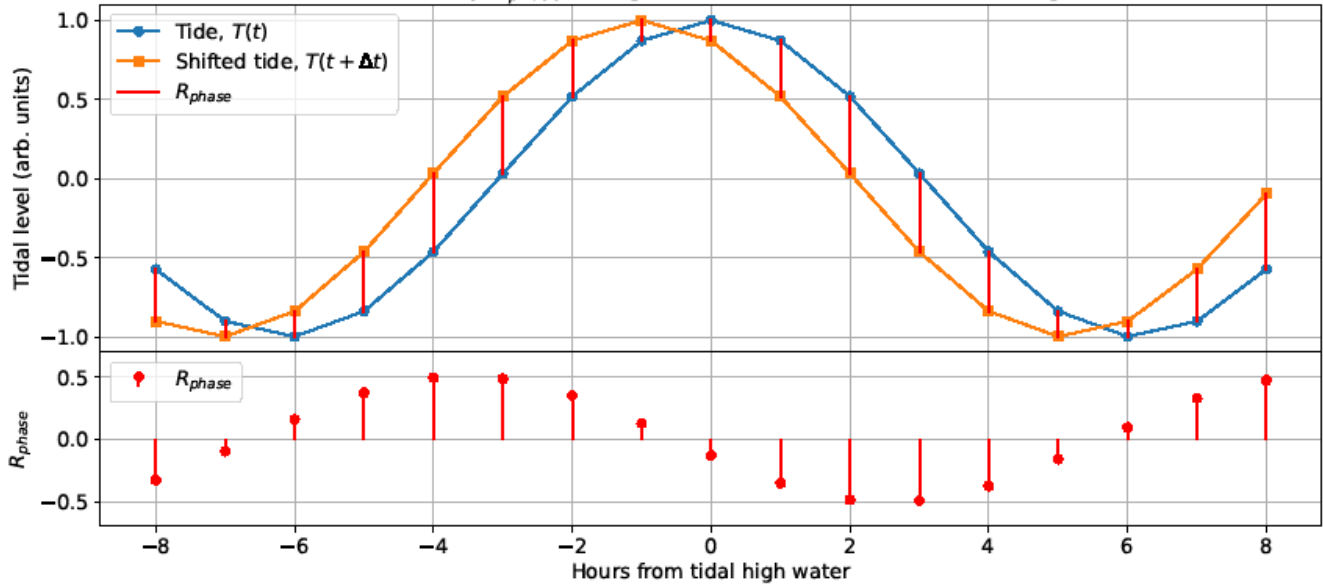


92

93 **Figure S13: Histogram of 1,000,000 log-probabilities of obtaining a randomly generated bootstrap sample from the normalized No-**
 94 **TSI distribution p_h of R_{phase} during diurnal tidal cycles. Red vertical lines indicate $\log p_{\{k^{(0)}\}}$, the log-probabilities of obtaining the**
 95 **frequency distribution $k^{(0)}$ from p_h . p -values are obtained by taking the quantile of the $\log p_{\{k^{(0)}\}}$ within the 1,000,000 log-**
 96 **probabilities of bootstrap samples.**

97

Illustration of why R_{phase} is largest at 3 and 4 hours from tidal high water

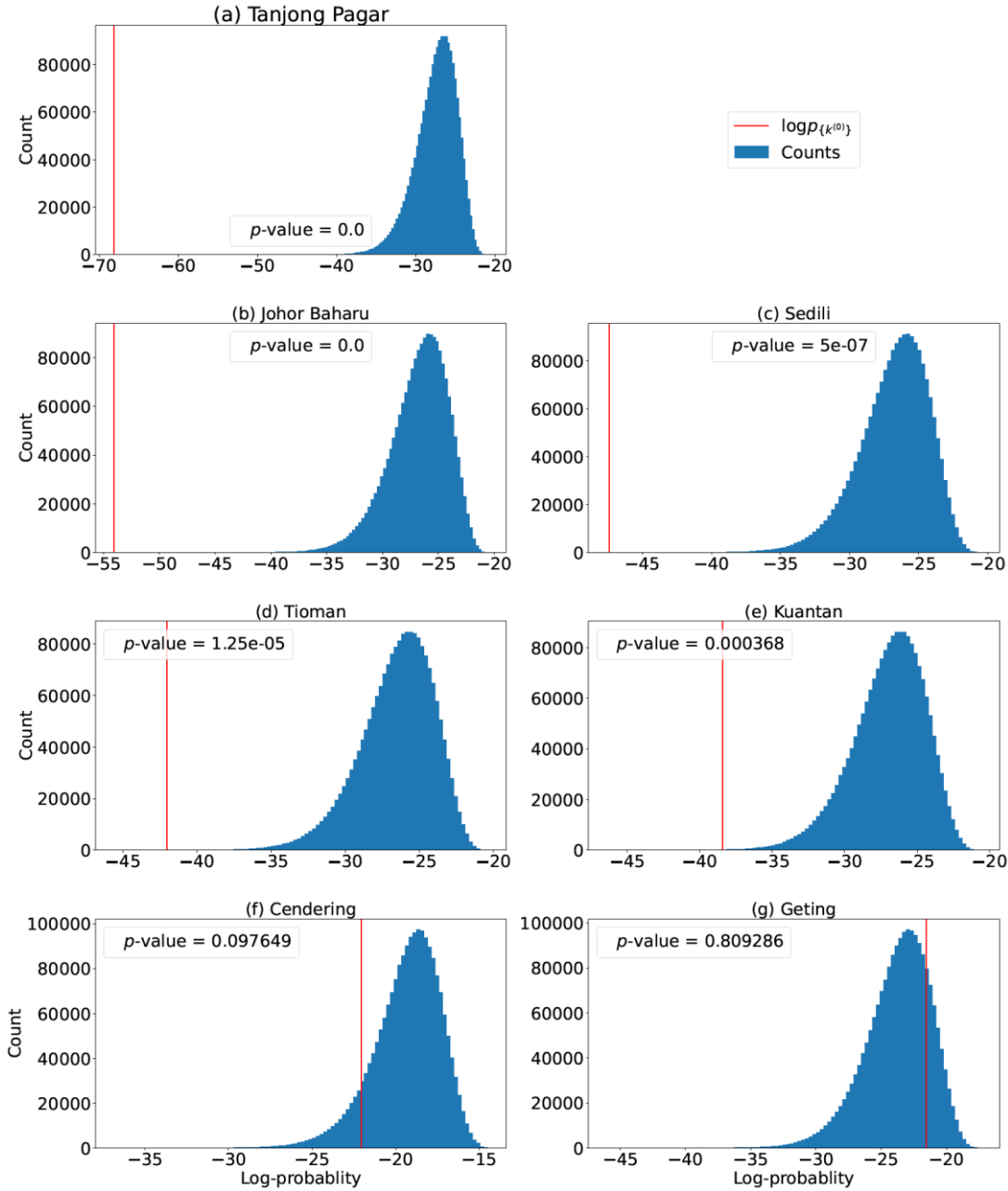


98

99 **Figure S14: The greatest vertical difference between two identical but slightly horizontally-displaced functions are near where the**
100 **function has the steepest gradient. For semidiurnal tides, this corresponds to 3–4 hours from HW. Magnitude of the horizontal**
101 **displacement is an arbitrary amount and exaggerated for the purpose of illustration.**

102

Distribution of bootstrap sample log-probability

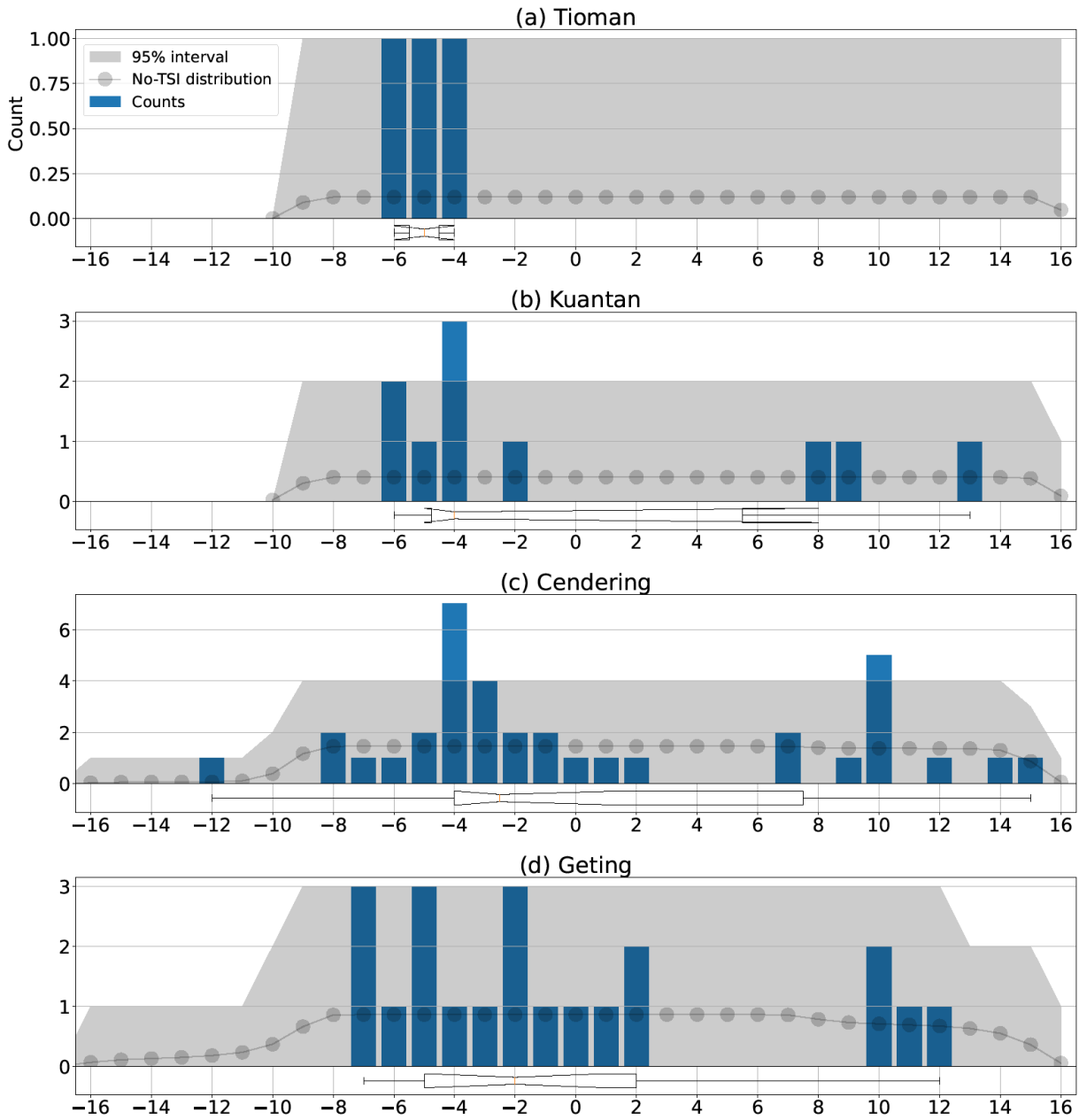


103

104 **Figure S15: Histogram of 1,000,000 log-probabilities of obtaining a randomly generated bootstrap sample from the normalized No-**
 105 **TSI distribution p_h of R_{sum} during semidiurnal tidal cycles. Red vertical lines indicate $\log p_{\{k^{(0)}\}}$, the log-probabilities of obtaining**
 106 **the frequency distribution $k^{(0)}$ from p_h . p -values are obtained by taking the quantile of the $\log p_{\{k^{(0)}\}}$ within the 1,000,000 log-**
 107 **probabilities of bootstrap samples.**

108

Number of R_{phase} extremes found at x hours from nearest tidal high water

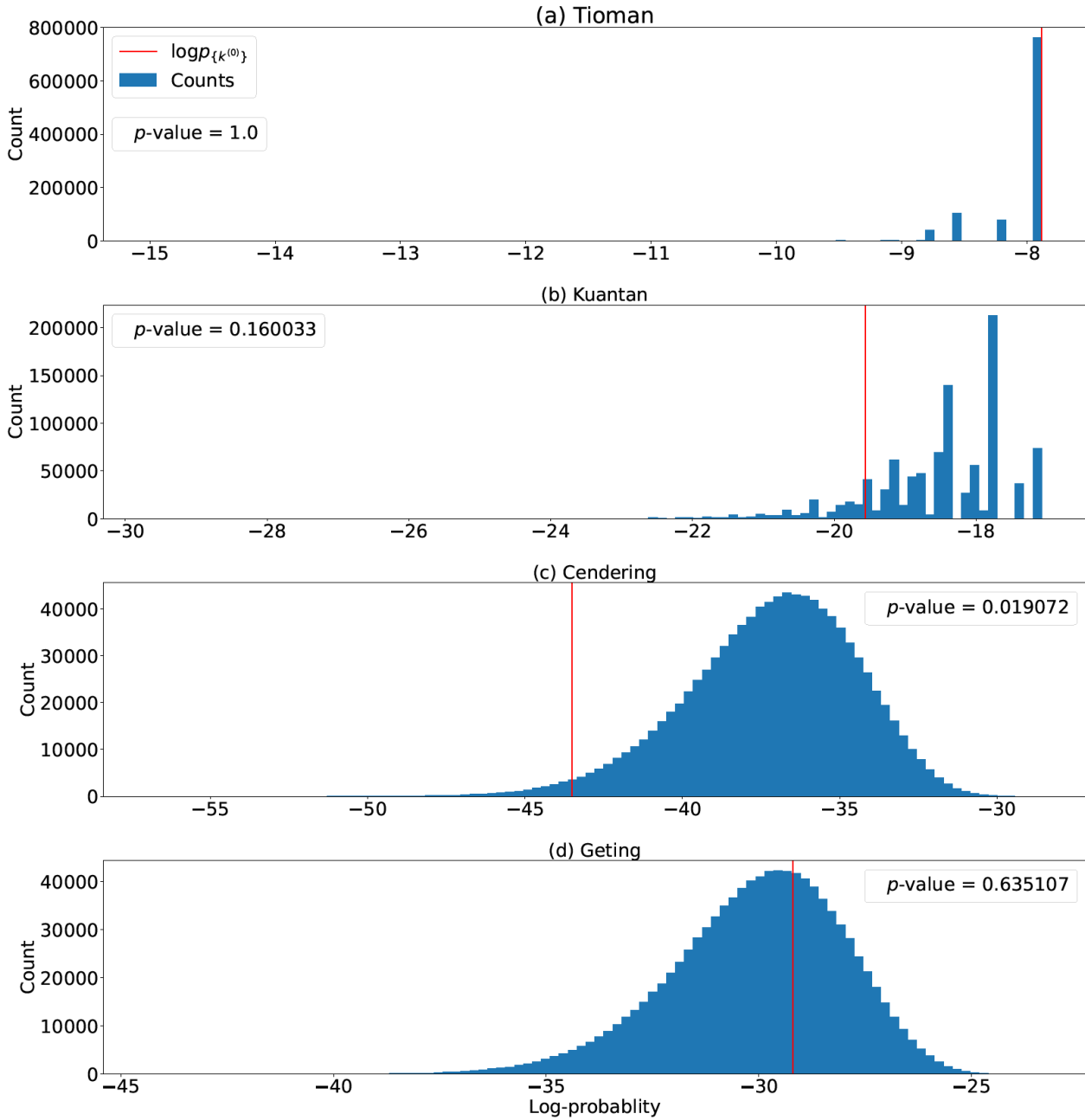


109

110 **Figure S16: The frequency distribution for extreme values of R_{sum} and the No-TSI distribution during diurnal tidal cycles, truncated**
 111 **at ± 16 hours from tidal high water. The frequency distribution is compared to the No-TSI distribution to determine the presence**
 112 **of tide-surge interaction. Summary statistics of the frequency distribution are shown using the horizontal notched box plot, where**
 113 **orange lines indicate the medians, notches indicate the 95% confidence interval of the medians, notched rectangles indicate the**
 114 **interquartile range (IQR), whiskers indicate a range that extends up to $1.5 \times IQR$ from the limits of the IQR, and black circles (if**
 115 **present) indicate outliers outside this range.**

116

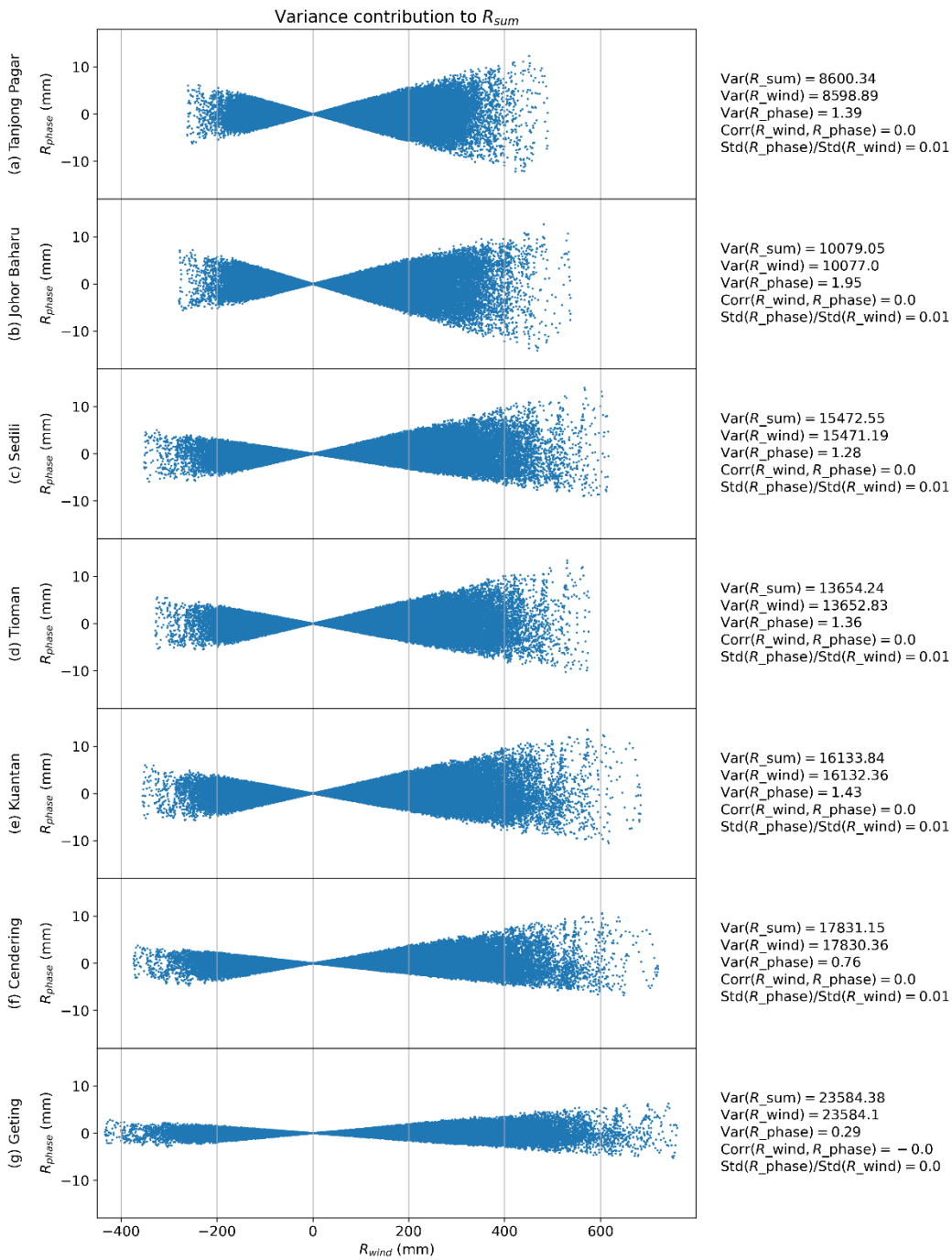
Distribution of bootstrap sample log-probability



117

118 **Figure S17: Histogram of 1,000,000 log-probabilities of obtaining a randomly generated bootstrap sample from the normalized No-**
 119 **TSI distribution p_h of R_{sum} during diurnal tidal cycles. Red vertical lines indicate $\log p_{\{k^{(0)}\}}$, the log-probabilities of obtaining the**
 120 **frequency distribution $k^{(0)}$ from p_h . p -values are obtained by taking the quantile of the $\log p_{\{k^{(0)}\}}$ within the 1,000,000 log-**
 121 **probabilities of bootstrap samples.**

122



123

124 **Figure S18: Scatter plots between R_{wind} and R_{phase} at each tide gauge location and how they contribute to R_{sum} . Values of -0.0 is**
 125 **a small negative value below -0.05 .**

126