

Joint Occurrence of Extreme Rainfall and Storm Surge along the Croatian Coast:

Exploring Seasonal Variations

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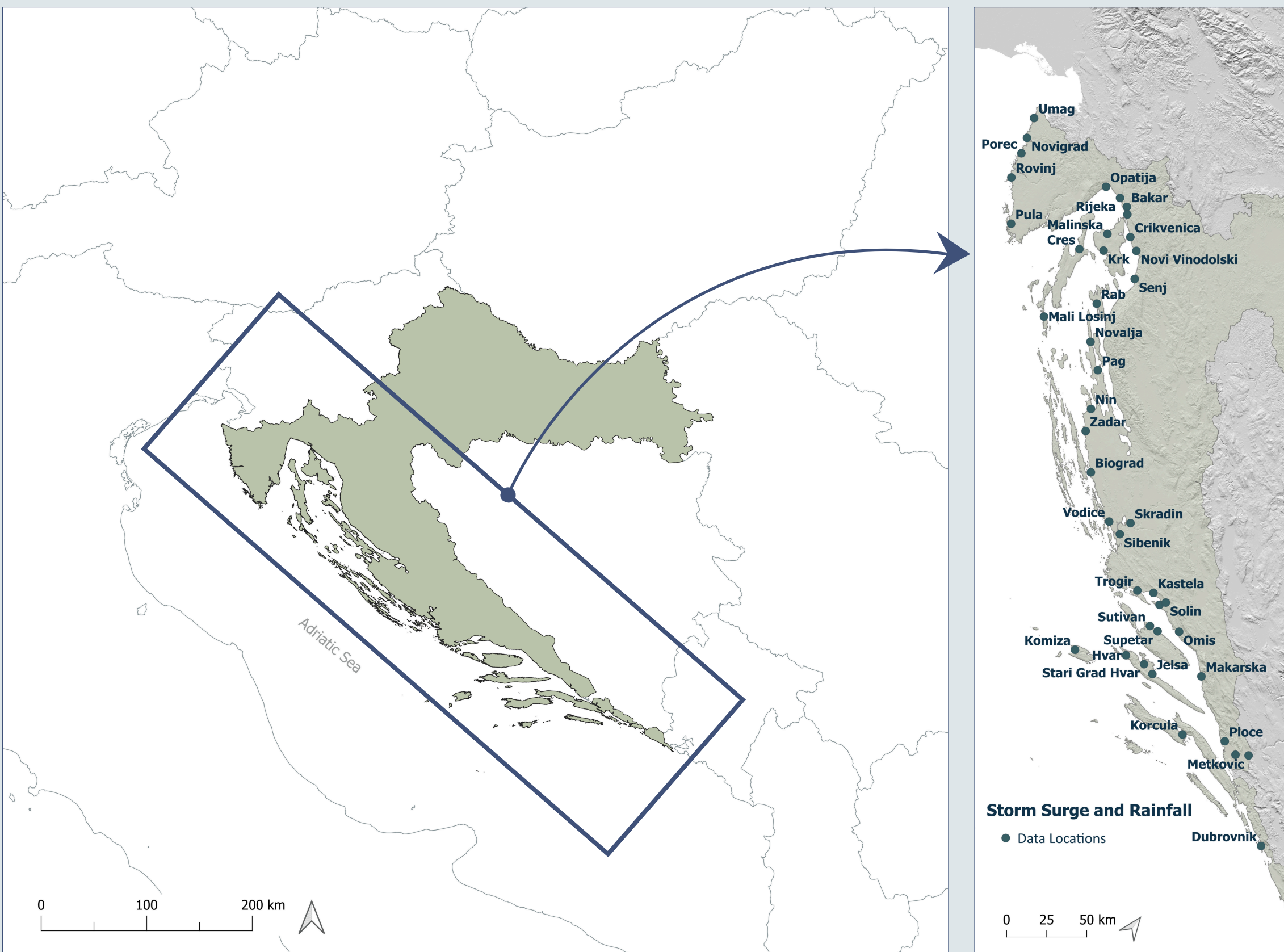
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MOTIVATION

- The simultaneous or consecutive occurrence of two or more flood drivers can lead to an event known as **compound flooding (CF)**.
- In Croatia, CF caused by the co-occurrence of **high river discharges** and **storm surges** is the **only combination** of CF drivers investigated to date, **while others remain unexplored**.
- This study aims to address this gap by conducting **further research on CF in Croatia**.
- High storm surges and heavy rainfall are flood drivers that often originate from the same weather system, so **neglecting their seasonality** can lead to a significant **underestimation of dependency** and **CF potential**.
- With its pronounced seasonality, the Croatian coast is an excellent example for investigating the **seasonal correlation** and **co-occurrence of storm surges and rainfall**.

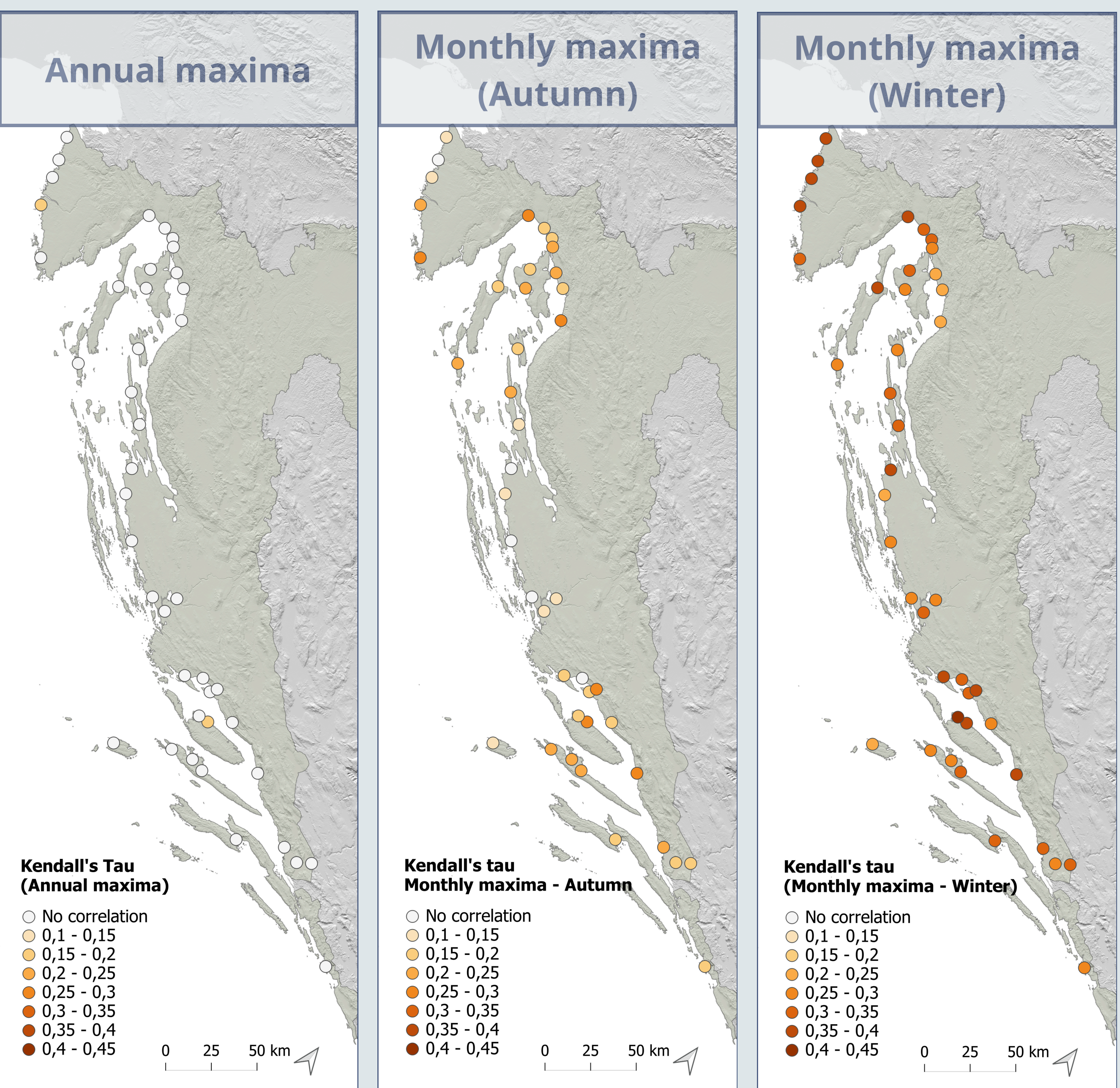
STUDY AREA: Croatian coast (42 locations)



- Rainfall data:** Rain gauge stations - daily timeseries.
- Storm Surge data:** Coastal Extremes in the Mediterranean Sea reanalysis (CoExMed) corrected by tide gauge data - hourly timeseries.

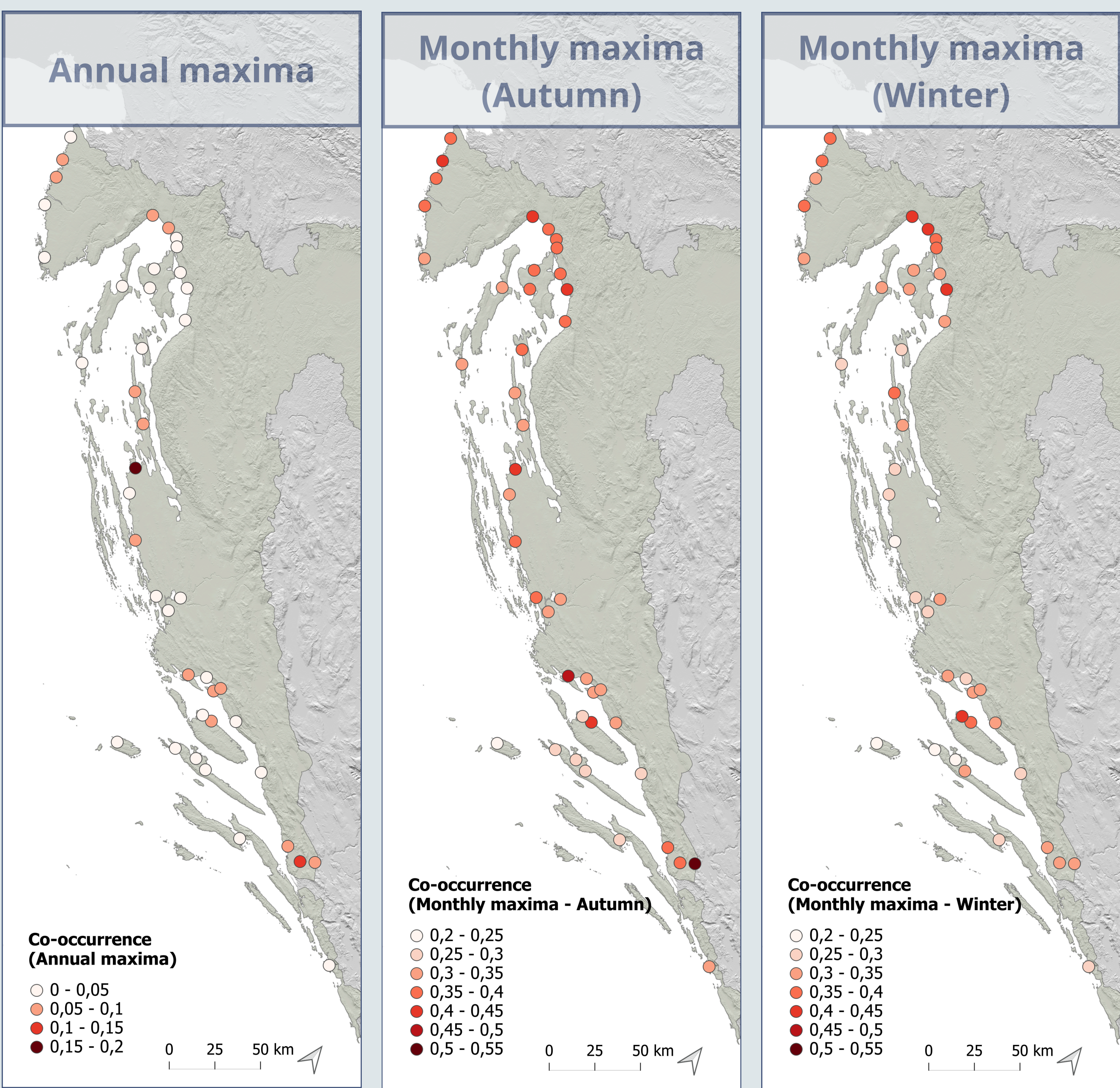
RESULTS & DISCUSSION

CORRELATION



- The **correlation (Kendall's tau)** for the annual maxima pairs of storm surge and rainfall is **only statistically significant at a few locations**.
- The **inclusion of seasonality shows a clear increase in dependency** at many locations, especially in the winter, when all locations exhibit significant correlation.
- Stronger correlations are observed in the northern and southern parts of the Croatian coast**, indicating areas with a higher potential for compound flooding.

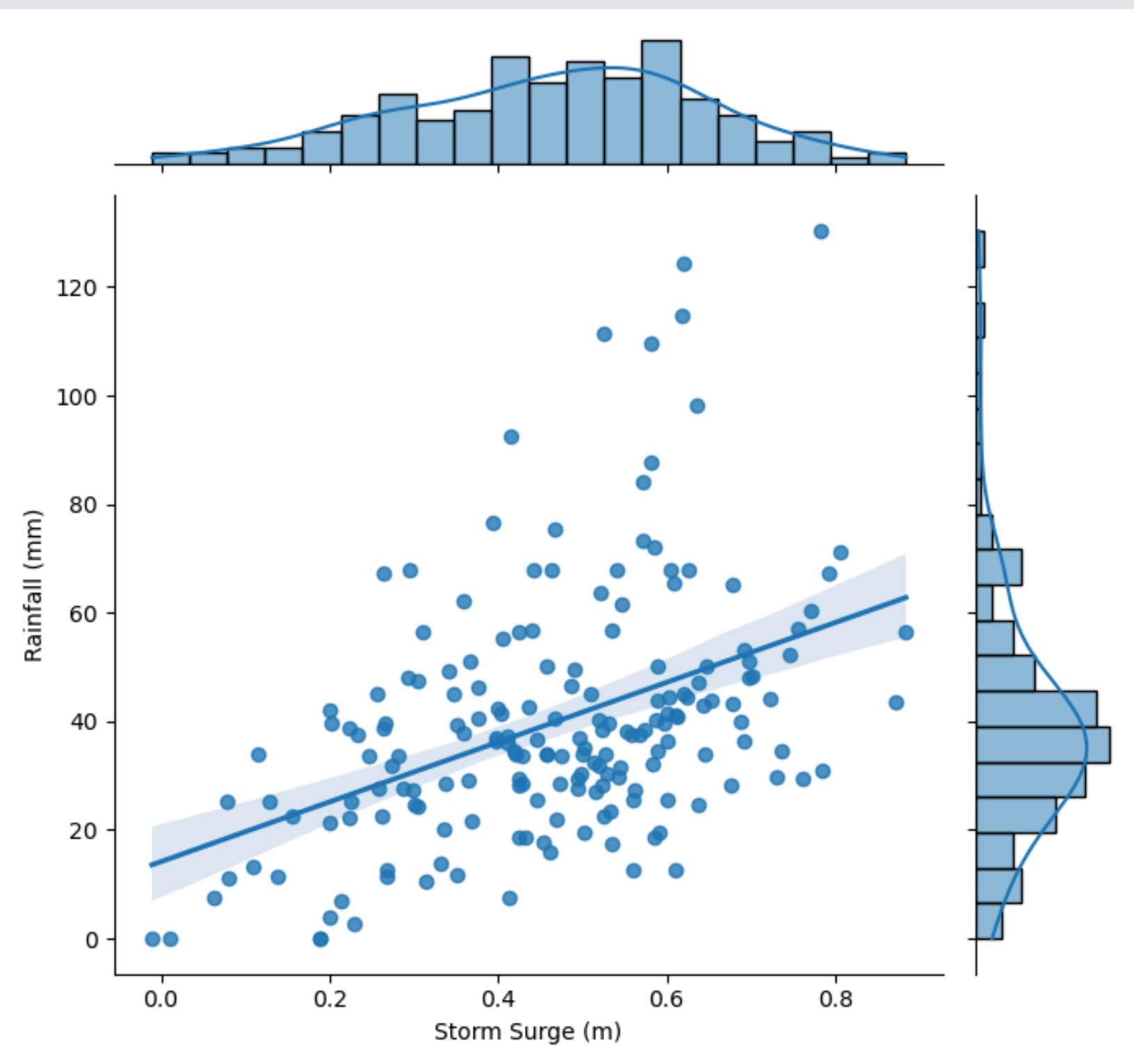
CO-OCCURRENCE



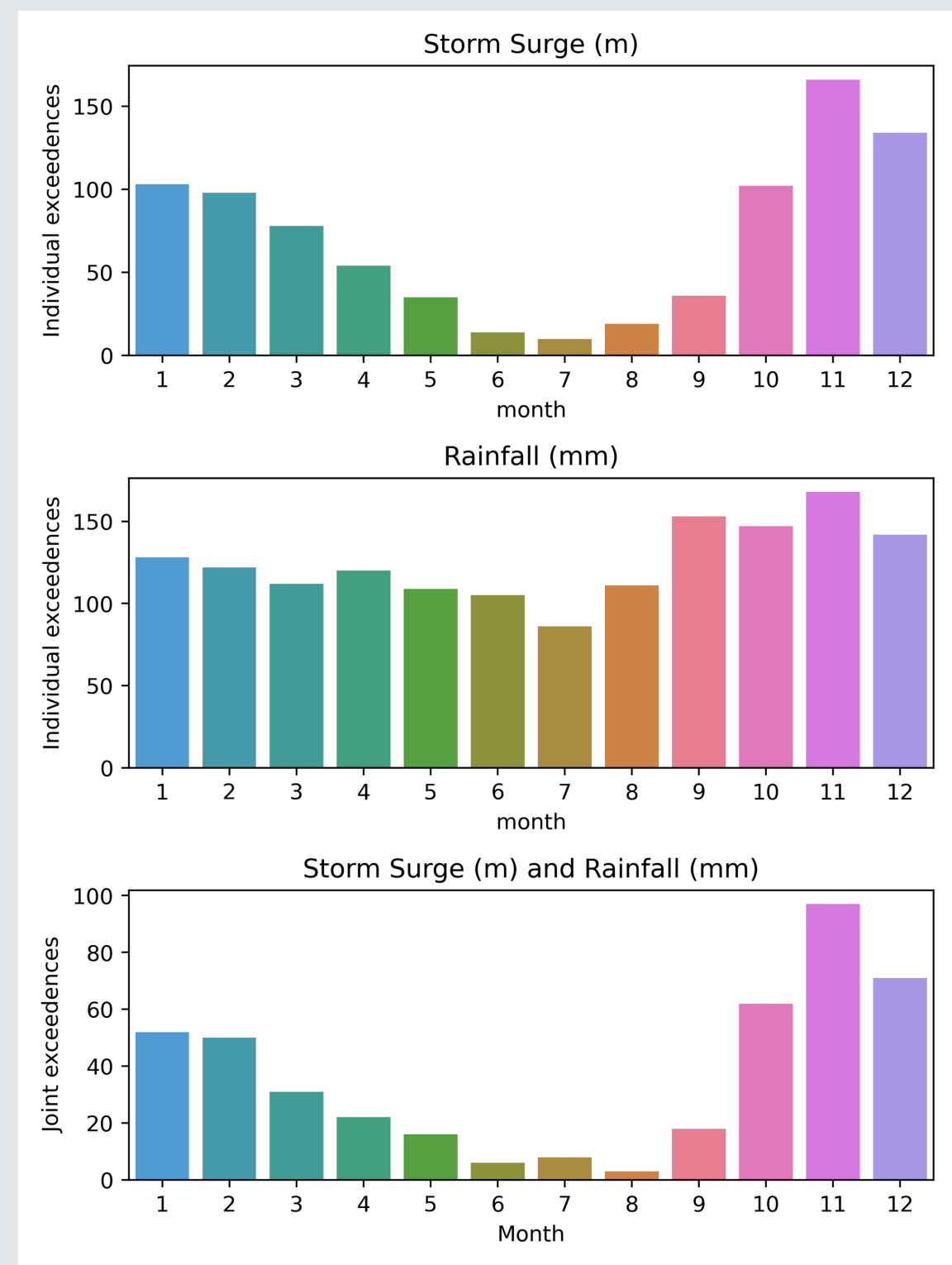
- The **co-occurrence of annual maxima of extreme rainfall and storm surges** is notably lower than in the seasonal analysis.
- For the Croatian coast, **co-occurrence is more frequent in certain seasons, especially in winter**.
- The **northern part of the Croatian coast shows a stronger co-occurrence for annual maxima**, but the seasonal analysis shows an additional increase.
- Although **the correlation is higher in the winter season**, **the co-occurrence rate is higher in autumn**.

METHODOLOGY

CORRELATION



CO-OCCURRENCE



FUTURE STEPS

- Fitting and selecting the copula model
- Calculating the joint return period for rainfall 10-yr return period and storm surge 10-yr return period

TAKE HOME MESSAGES

- Seasonality is important:** Neglecting seasonality can lead to an underestimation of flood impacts and risks.
- Correlation and co-occurrence:** Both correlation and co-occurrence metrics are essential for a comprehensive understanding of CF dynamics. While correlations peak in winter, co-occurrence rates are higher in autumn, highlighting the importance of using both metrics to capture seasonal variations.

