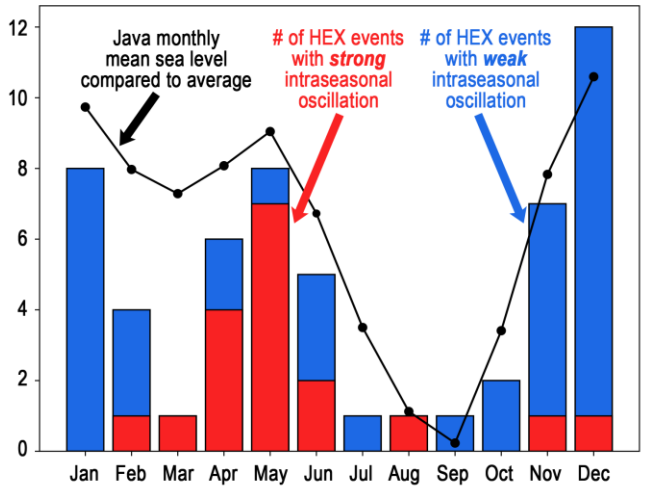
Atmospheric Oscillations Leading to Sea Level Extremes

Quantifying the roles of intraseasonal oscillations and their interplay with global sea level rise may be a critical first step for successful mitigation of disastrous coastal flooding events.

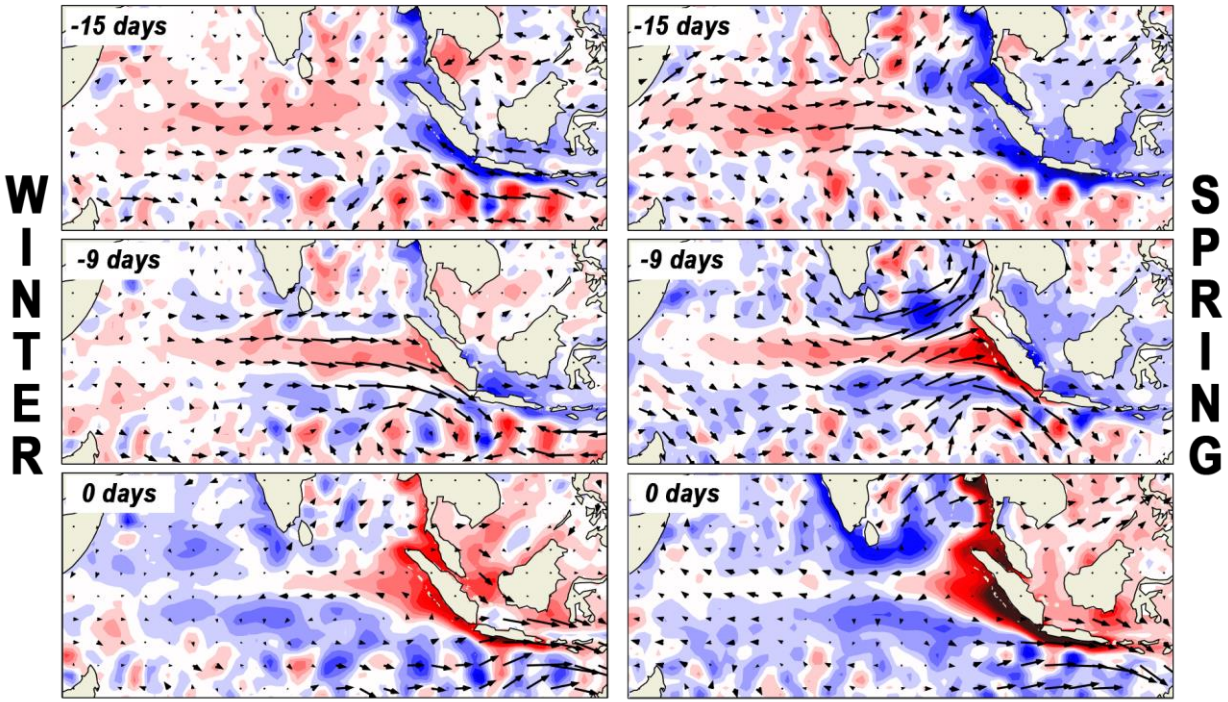
Sea level is rising around the globe but the risk of damage varies from place to place. For example, some coastal communities are especially vulnerable to ***sea surface height extreme (HEX) events***. **Our first-ever study quantifies the role of atmospheric *intraseasonal oscillations (ISOs)* – particularly the Madden-Julian Oscillation (MJO) – in causing HEX events along the Indonesian coast.**

We identified 56 HEX events from 1993 to 2022. Most occurred during winter and spring, seasons when the mean seasonal cycle of Java sea level anomaly is higher. Color-coding of the bar graphs indicates whether HEX events occurred **during strong ISOs** or **during weak ISOs**.



The patterns are surprising since MJOs are often considered to be strongest during winter. **In fact, 12 of the 18 HEX events associated with strong ISOs occurred during spring while only 2 of the 18 occurred during winter**.

Comparing winter and spring (maps at upper right), it is clear that **spring MJOs have stronger atmospheric convection in the eastern equatorial Indian Ocean, greater east-blowing winds over the entire equatorial Indian Ocean, and larger sea level anomalies along the southern coast of Java.**



*Days leading up to 12 HEX events that co-occurred with MJOs during **winter (left)** and **spring (right)**. **Red is higher-than-normal sea level** and **blue is lower-than-normal** sea level. Vectors indicate winds.*

Our results arise from the fact that during spring, strong atmospheric intraseasonal convections are located in the eastern equatorial Indian Ocean and are more symmetric around the equator, which drive stronger basin-wide eastward winds across the entire equatorial Indian Ocean. By contrast, the winter MJOs' convection center moves to south of the equator, which does not drive as strong and basin-wide eastward winds at the equator as in spring.

Kamp, W., Han, W., Zhang, L., Kido, S., and McCreary, J. (2024) ***Tropical Atmospheric Intraseasonal Oscillations Leading to Sea Level Extremes in Coastal Indonesia during Recent Decades*** , J. Clim., 37, 2867-2880, doi: 10.1175/JCLI-D-23-0374.s1

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