Southeast Asian Monsoon Index for Its Monitoring and Prediction

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Southeast Asian Monsoon – where?

- Two 'monsoon periods'
  - Northeast/boreal winter
  - Southwest/boreal summer

- Focus on 10 countries:
  - Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Viet Nam

SW Monsoon Wetter during Jun-Aug

NE Monsoon Wetter during Dec-Feb

JJA - DJF Climatology, CHIRPS
Reference Period: 1981 - 2010

Anomaly (mm/day)
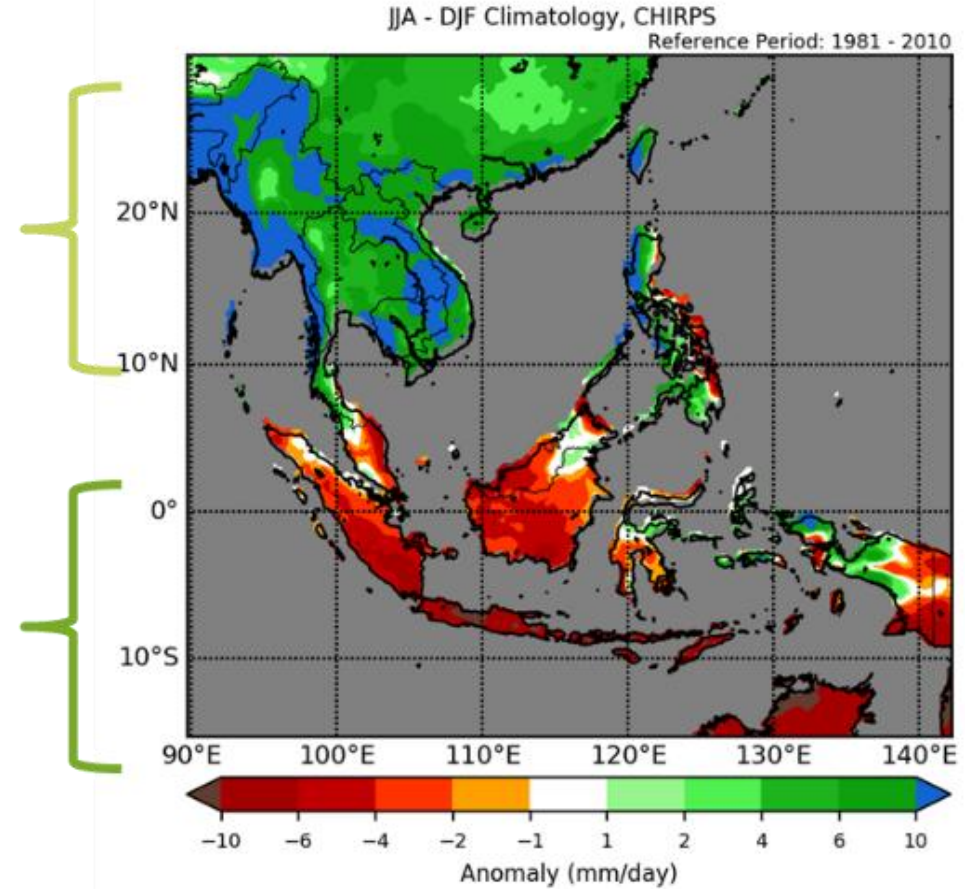
Southeast Asian Monsoon – why?

To have a regionally coherent 'language' for monsoon, onset, strength, termination within the region:
- Subseasonal and seasonal (including monitoring):
  - ASEAN Climate Outlook Forum
  - Southeast Asia Regional Climate Centre Network
- Climate change projections

Not to replace national definitions
- Definitions tied to user requirements and local conditions

Southeast Asian Monsoon – what to use?

<u>Variables used in previous studies/national definitions:</u>
- Rainfall
- Wind (different levels)
- OLR
- Precipitable Water
- And combinations of above

<u>What the index needs to be able to do:</u>

- Monitored in real time

- Capture gradual onset/termination within the region

- Long homogeneous record (study past change, understanding decadal variability, seasonal variability)

- Captured by GCMs (future studies/climate change, or seasonal models)
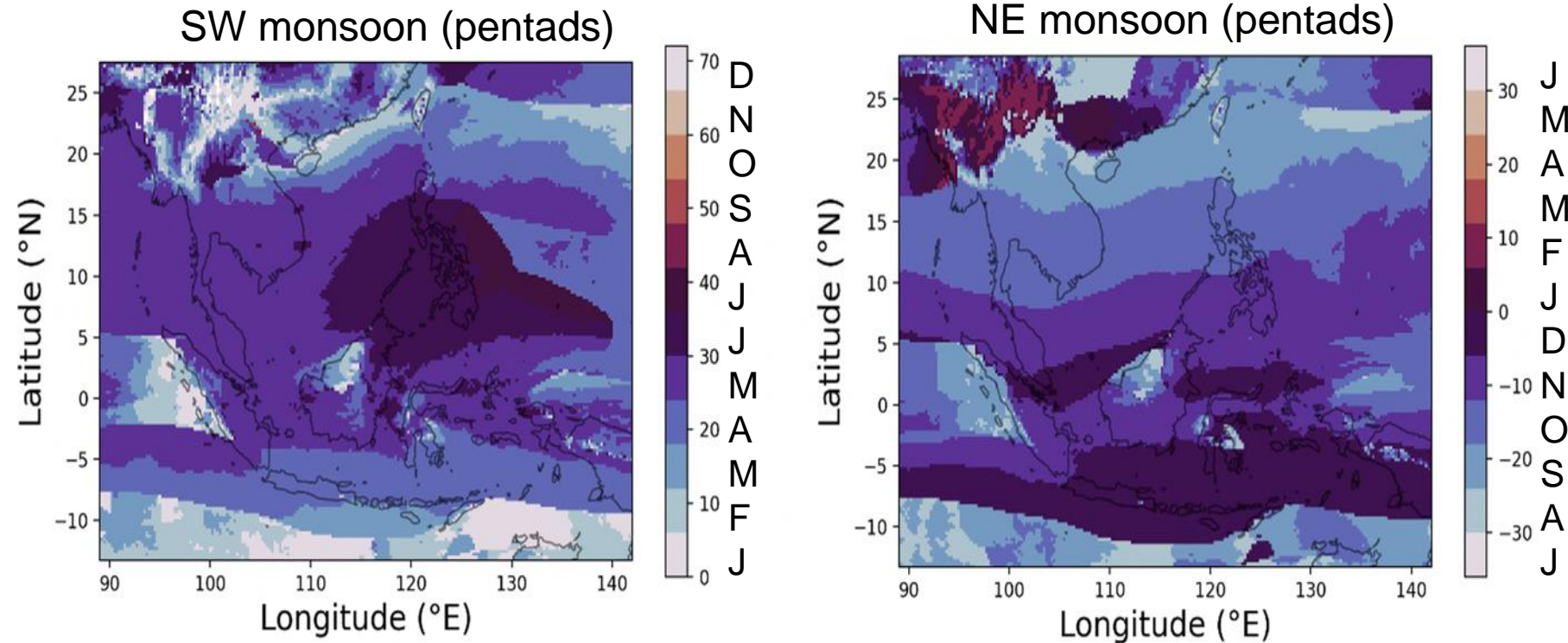
Southeast Asian Monsoon – what we did

- Using ERA5 850hPa winds

- Steps:
  1. Turn dataset into 'pentads'
  2. Find peak wind speak for each season (NE/SW) based on 1991 – 2020 climatology
  3. Apply correction to account for winds not 180degrees apart
  4. For each pentad, find strength of the wind in the direction of corrected peak monsoon = monsoon index

Peak winds in the climatology (1991 – 2020) : NE monsoon (blue) SW monsoon (red)
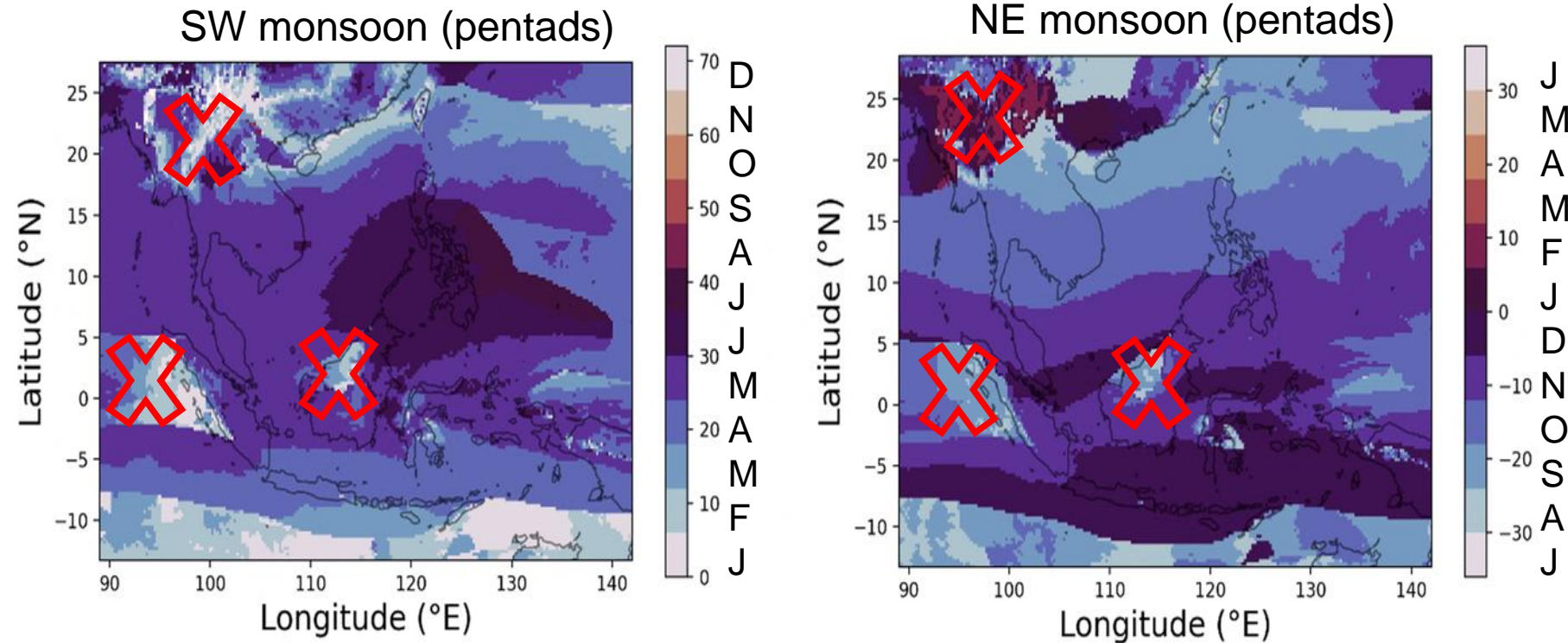
Southeast Asian Monsoon average onset
1991 - 2020
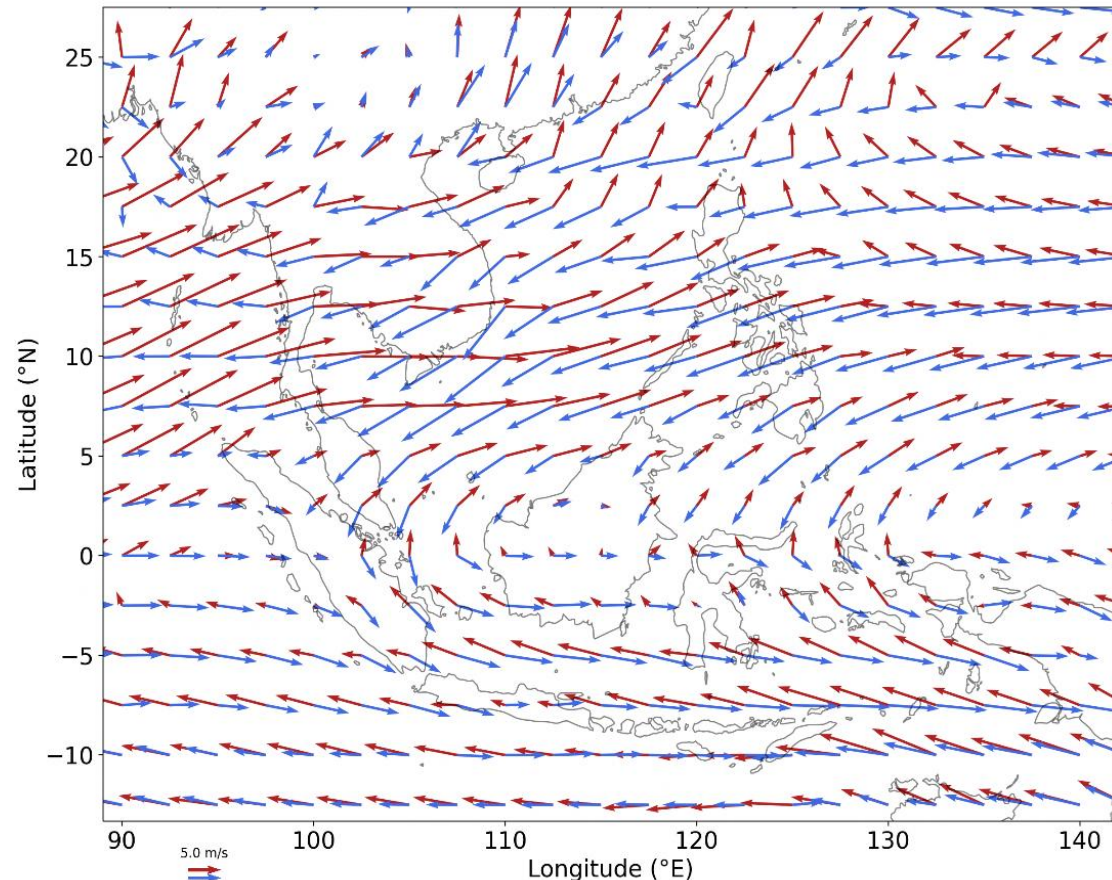
SW monsoon (pentads)

NE monsoon (pentads)

Preliminary definition: >0.4 for 3 consecutive pentads (~15 days)

- SW monsoon (right): South to north (in the west) then east

- NE Monsoon (left): North to south (more general apart from equator)

Southeast Asian Monsoon average onset
1991 - 2020

SW monsoon (pentads)

NE monsoon (pentads)

- Some regions no clear onset:
  - Parts of equator: west of Sumatra, parts of Borneo
  - N Mainland Southeast Asia (SW), NW Mainland Southeast Asia (NW)

>> Further development of classification of peak winds helps with some of these regions

Comparison of two years

2019

- Strong positive IOD in the second half of the year

- Weak/borderline El Nino at the start of the year

Impacts:

- Drought in Indonesia Jun –Aug affecting 1.3M people

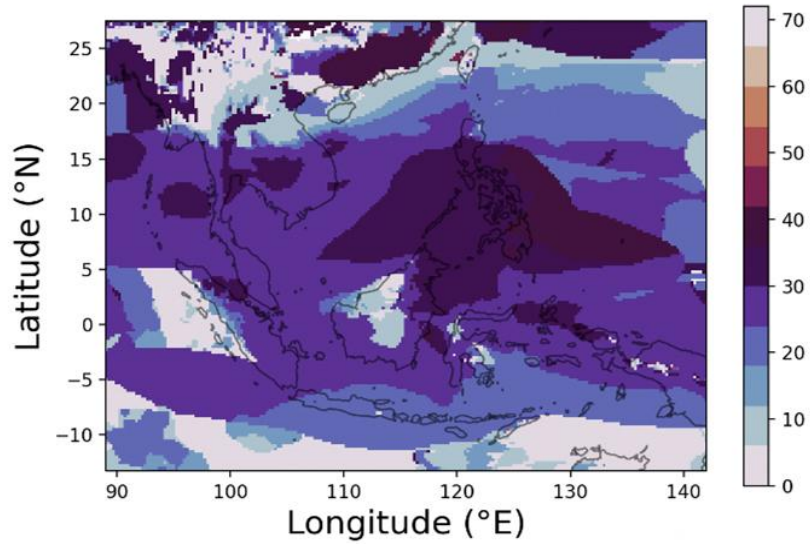- Fewer people affected by floods during Apr/May in Indonesia (compared to 2022) - ADINet

2022

- La Niña event from late 2021 – early 2023

- Negative IOD in the second half of the year

Impacts:

- Malaysia, flooding and second largest landslide (December)

- More people displaced during Nov/Dec due to floods in Indonesia (compared to 2019) -ADINet
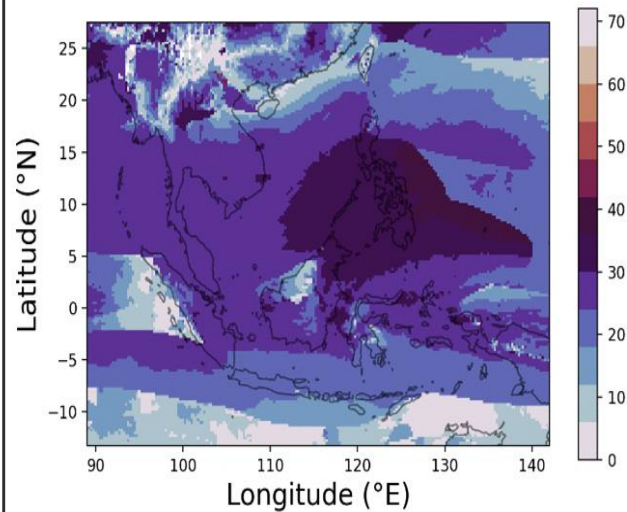
2019

- Near average (within two pentads) for most

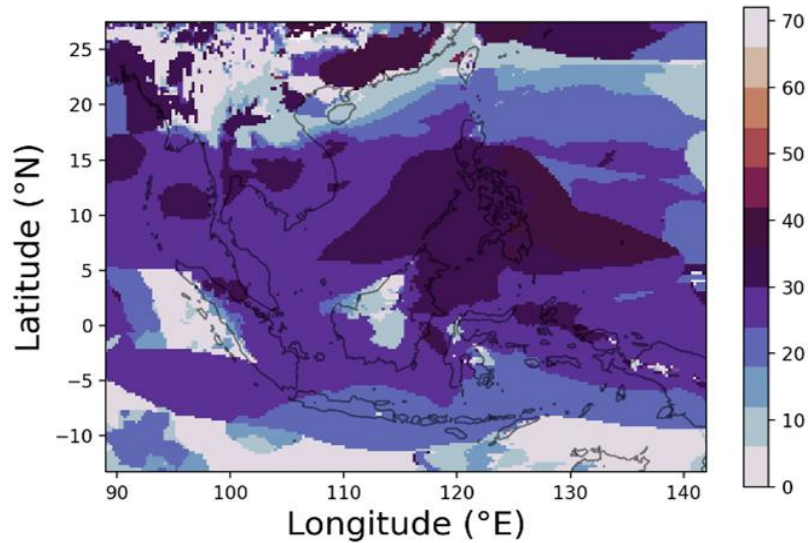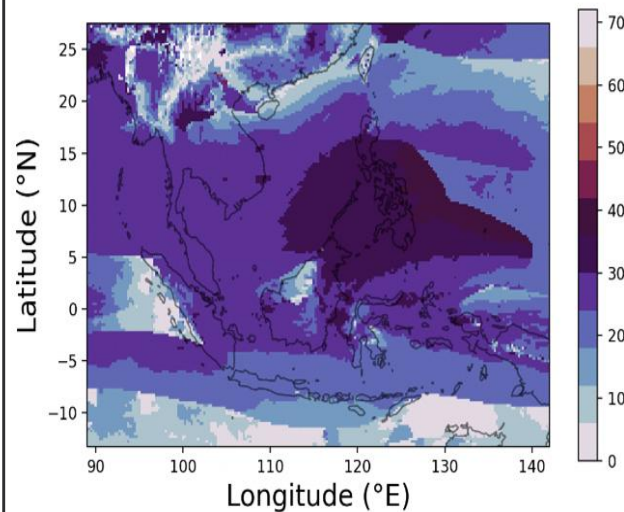- Few locations with later start in Mainland Southeast Asia, including Bangkok.

>> in line with neutral ENSO, IOD conditions

SW monsoon onset

Climatology
1991 – 2020

SW monsoon onset

2019

- Near average (within two pentads) for most

- Few locations with later start in Mainland Southeast Asia, including Bangkok.

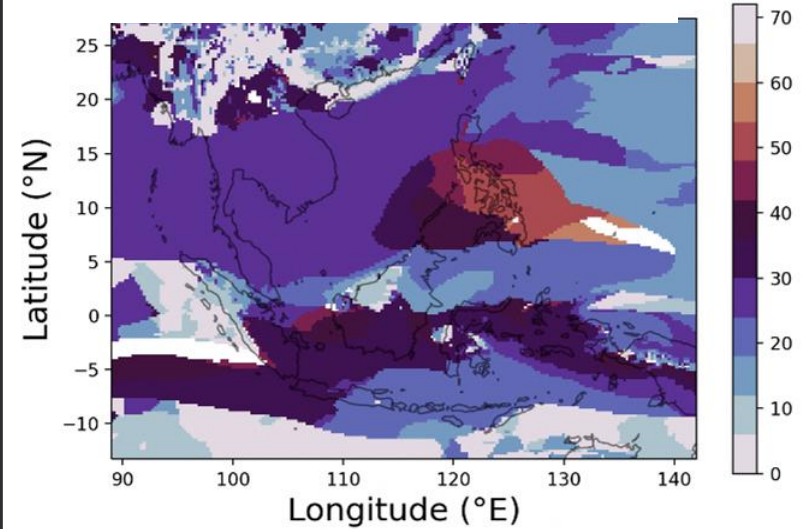>> in line with neutral ENSO, IOD conditions
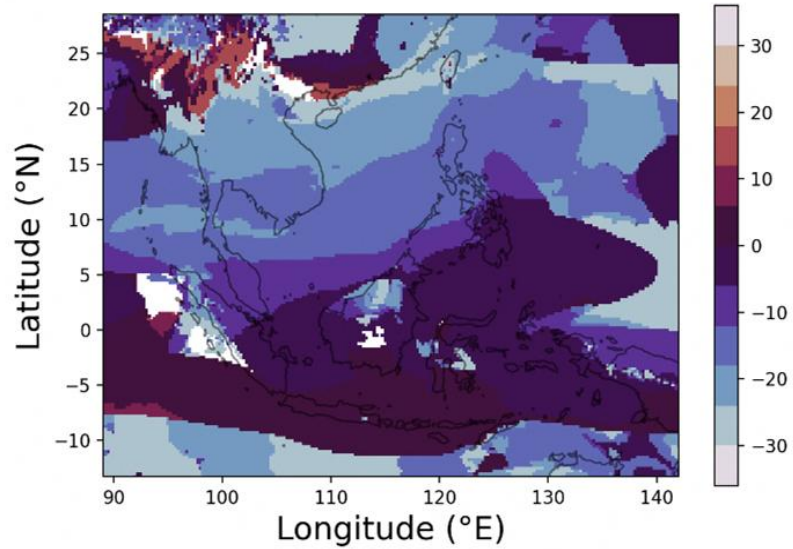
Climatology 1991 – 2020

2022

- Near average for Mainland Southeast Asia

- Later for much of the Maritime Continent, although a few locations around the equator were earlier

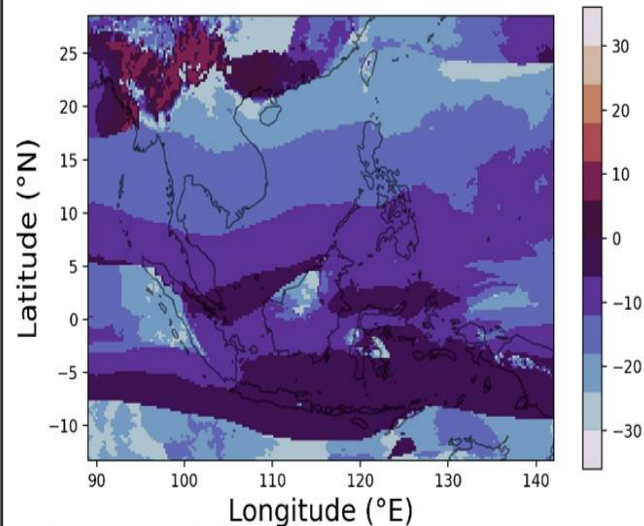>> later onset in Maritime Continent in line with La Niña conditions

2019

NE monsoon onset

Climatology
1991 – 2020

- Later start south of the equator

- Rest of the region near-average
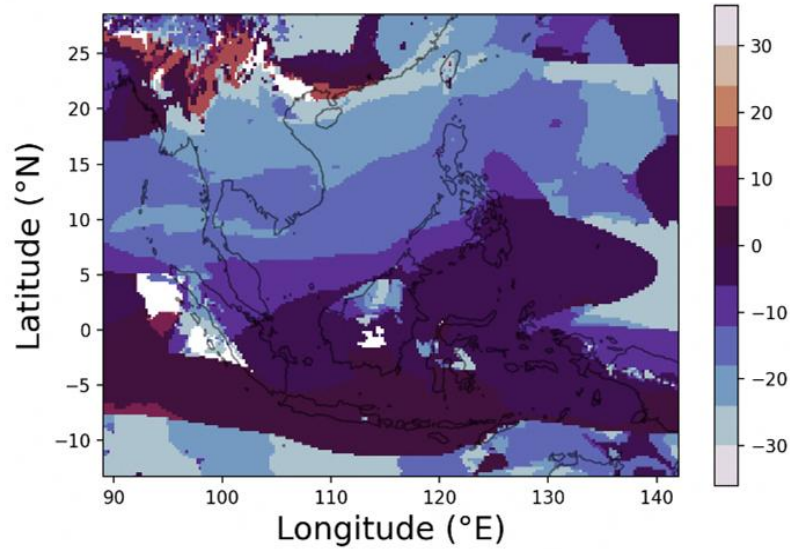
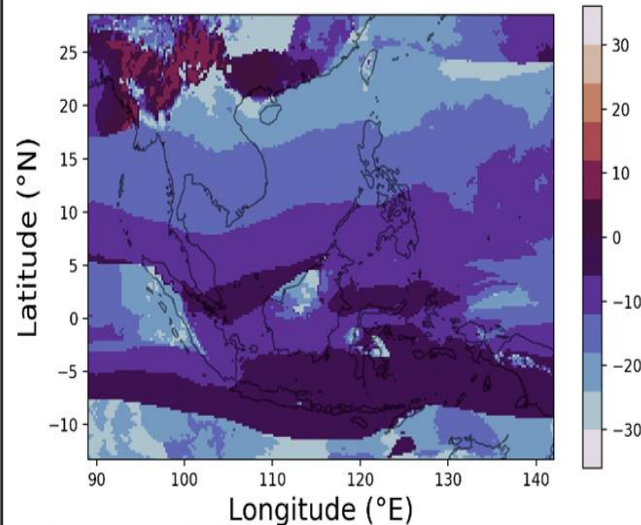>> in line with strong positive IOD

NE monsoon onset

2019

- Later start south of the equator

- Rest of the region near-average
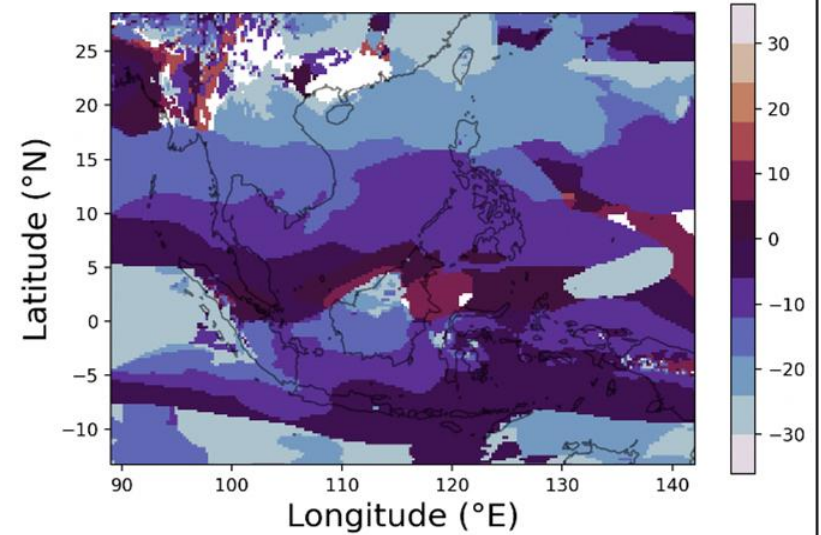
>> in line with strong positive IOD

Climatology 1991 – 2020

2022

- Earlier start south of the equator

- Near average for Mainland Southeast Asia

>> Earlier onset south of the equator in line with La Niña event

Duration at select locations

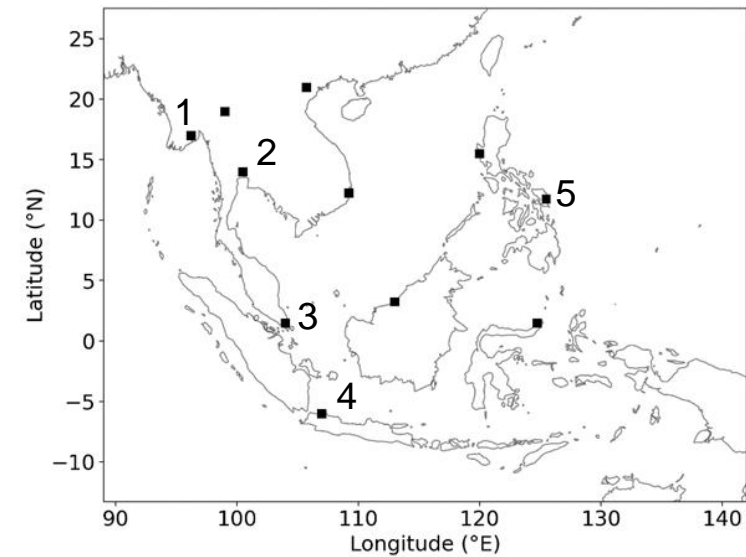Duration (number of pentads between onset and termination)

Southwest monsoon:

- Jakarta has earliest onset - longest duration (longer in 2019 than 2022)
- Borogan has latest onset - shortest duration

Northwest monsoon:

- Earlier onset - longer duration

Duration SW + NE ~ 41 - 62 pentads, with 10 - 33 pentads with 'inter-monsoon' periods

	SW monsoon			NE monsoon		
	1991-2020	2019	2022	1991-2020	2019	2022
1. Yangon	26.5	27	26	15	**18**	**24**
2. Bangkok	25	**20**	27	22.5	**32**	**32**
3. Singapore	35	**39**	**45**	22	**29**	**13**
4. Jakarta	40.5	**44**	**26**	21.5	**15**	**24**
5. Borogan	16	**19**	**4**	36	**37**	**30**

Summary & Next Steps

- New monsoon definition to capture Northeast and Southwest Monsoon periods in Southeast Asia

- Definition captures onset for much of the regions
  - Although there are some locations for which it doesn't work (particularly along the equator)

- Comparison of 2019 and 2022 show some of the characteristics of delayed/earlier onset as expected based on ENSO and IOD

Next steps:

- Development of more objective criteria for peak winds
  - Work led by Donaldi Permana

- Discuss during upcoming ASEANCOF

- Assess the predictability of the monsoon index

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Thank you for your attention