Southeast Asia Regional Case Study: Predicting extreme rainfall in two monsoon seasons

Follow ASMC on LinkedIn: https://www.linkedin.com/company/asean-specialised-meteorological-centre/

Thea Turkington and Raizan Rahmat

Online Training Workshop on Subseasonal to Seasonal (S2S) Prediction of Monsoons

2 Nov 2021

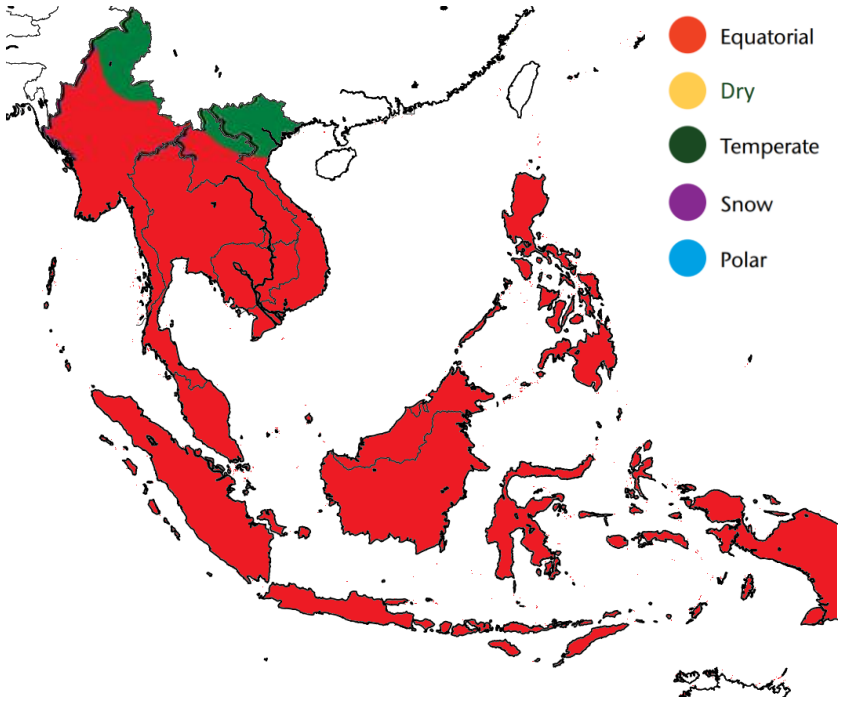
This session

- You will have a go at predicting where disasters may occur in Southeast Asia due to extreme rainfall at subseasonal timescale
  - At Week 3 & Week 1 lead time

Outline:

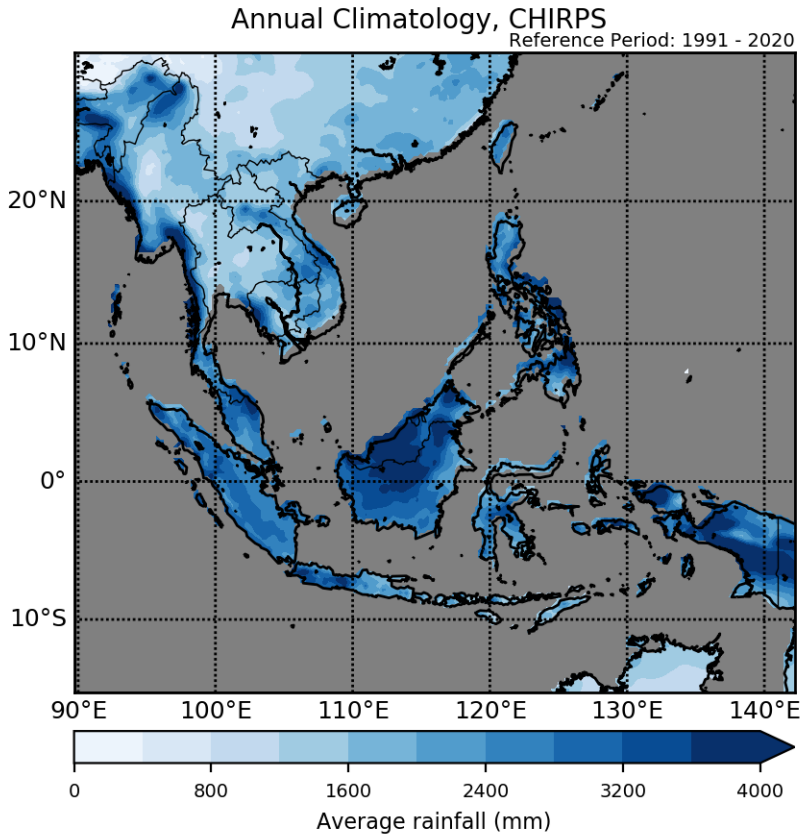
- Overview of Southeast Asia & two monsoon seasons
- Two case studies

Welcome to Southeast Asia



- Majority of the region experience equatorial/tropical climate (except for north): average temperature of 18°C or higher year-round.

Welcome to Southeast Asia

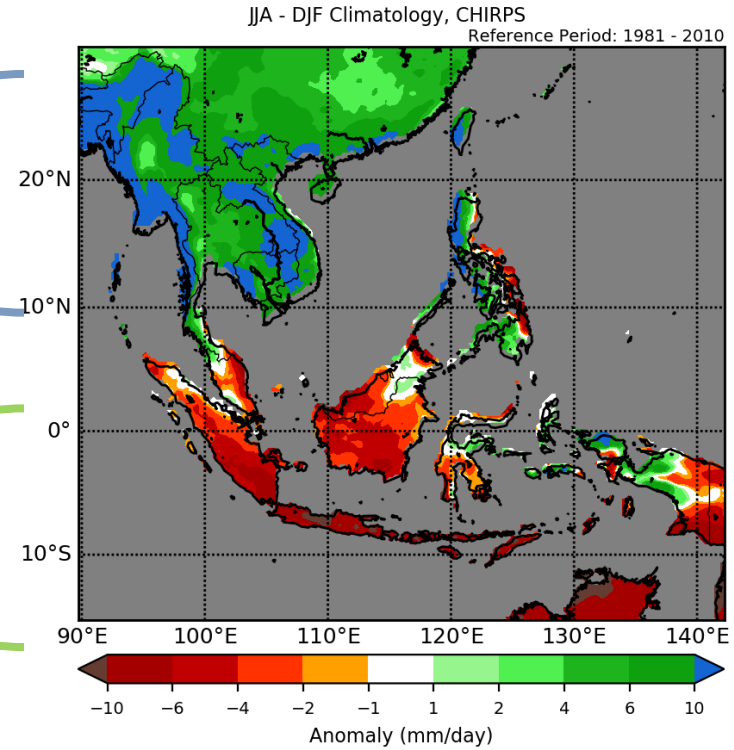


- Majority of the region experience equatorial/tropical climate (except for north): average temperature of 18°C or higher year-round.
- Annual rainfall between 800 – 3000mm+

Welcome to Southeast Asia

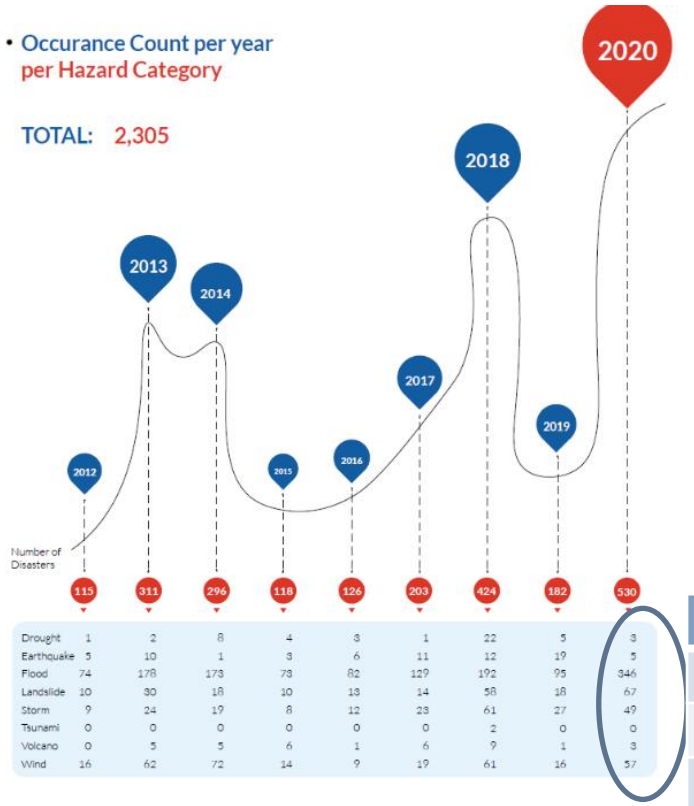
SW Monsoon: Wetter during Jun-Aug

NE Monsoon: Wetter during Dec-Feb



- Majority of the region experience equatorial/tropical climate (except for north): average temperature of 18°C or higher year-round.
- Annual rainfall between 800 – 3000mm+
- Two monsoon seasons: NE/SW Monsoon

Welcome to Southeast Asia



	2012	2013	2014	2015	2016	2017	2018	2019	2020
Drought	1	2	8	4	3	1	22	5	3
Earthquake	5	10	1	3	6	11	12	19	5
Flood	74	178	173	73	82	129	192	95	346
Landslide	10	30	18	10	13	14	58	18	67
Storm	9	24	19	8	12	23	61	27	49
Tsunami	0	0	0	0	0	0	2	0	0
Volcano	0	5	5	6	1	6	9	1	3
Wind	16	62	72	14	9	19	61	16	57

Number of Disasters – The AHA Centre Annual Report 2020
https://ahacentre.org/publication/annual-report-2020/

	2020
Drought	3
Earthquake	5
Flood	346
Landslide	67
Storm	49
Tsunami	0
Volcano	3
Wind	57

- Majority of the region experience equatorial/tropical climate (except for north): average temperature of 18°C or higher year-round.
- Annual rainfall between 800 – 3000mm+
- Two monsoon seasons: NE/SW Monsoon
- High exposure hydro-meteorological hazards

Northeast Monsoon

- Gradually sets in from October
- Usually transitions from March

Northern (dry)	Southern (wet)
Drought	Heavy rainfall
Fires/transboundary haze	Monsoon surges (cold surges)
Tropical cyclone activity*	Tropical cyclone activity

* BoB typically only until Dec

Southwest Monsoon

- Gradually sets in from May
- Usually transitions from October

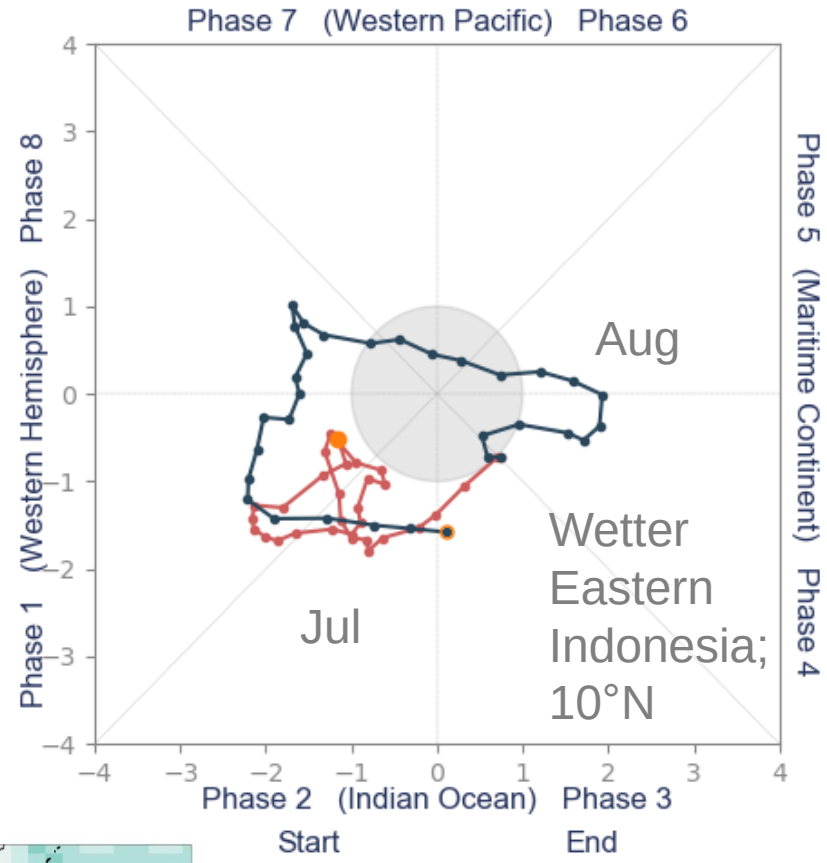
Northern (wet)	Southern (dry)
Heavy rainfall	Drought
Tropical cyclone activity	Fires/transboundary haze

Case study SW monsoon

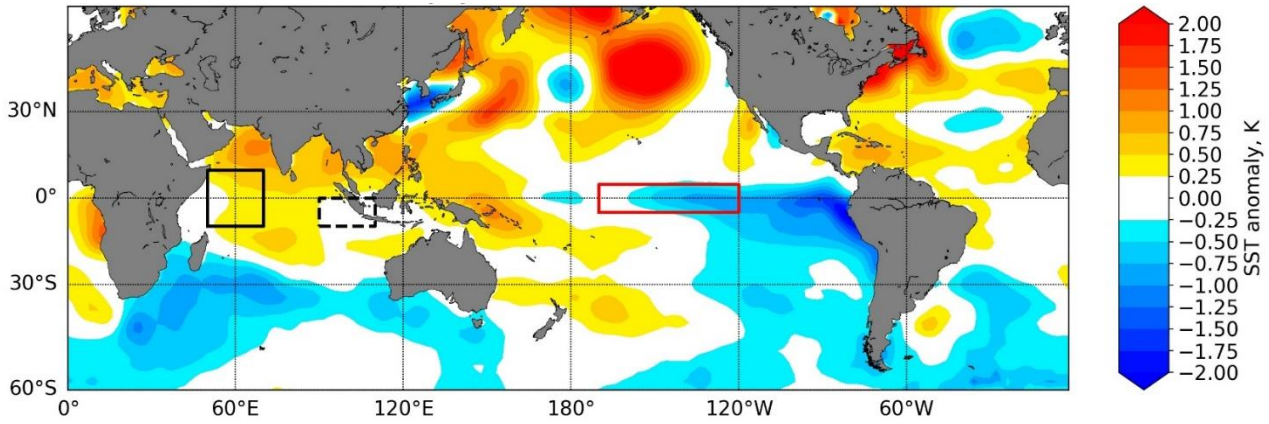
- Target week: 27 July to 2 August 2020

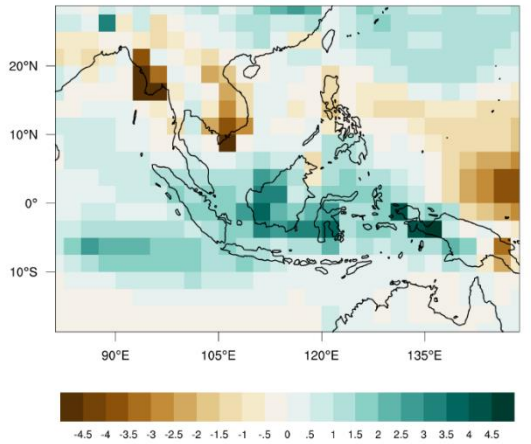
Developing La Niña event in the Pacific,
Warm SSTs Bay of Bengal, South China Sea
MJO Phases 2 - 4

RMM Index



SST Anomalies, July 2020 (ERSSTv5)

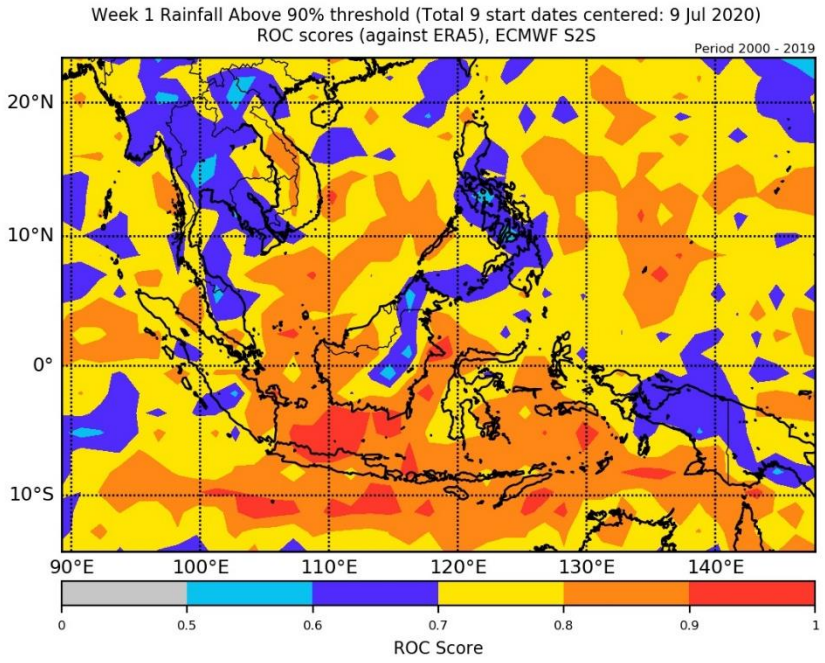




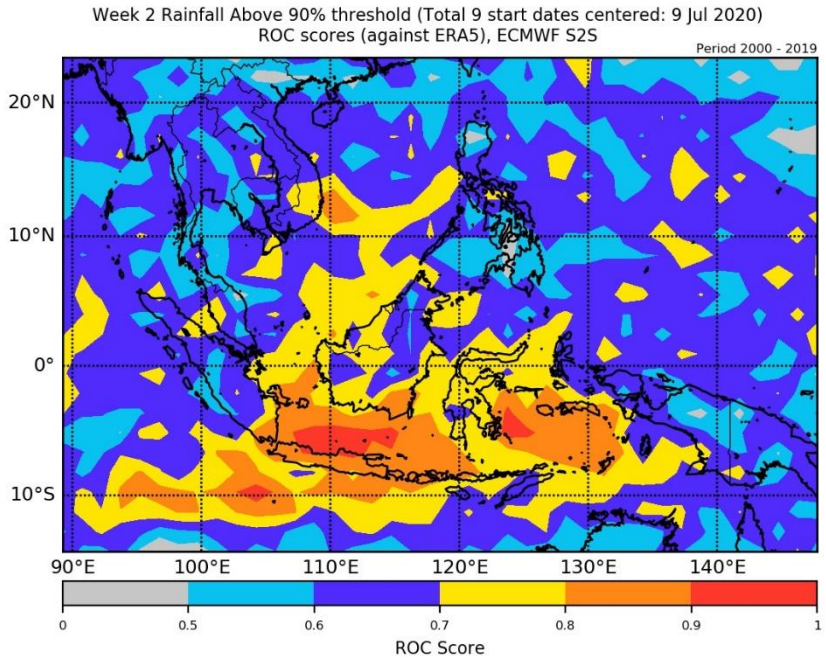
Rainfall anomaly composite La Niña -JJA

Hindcast skill

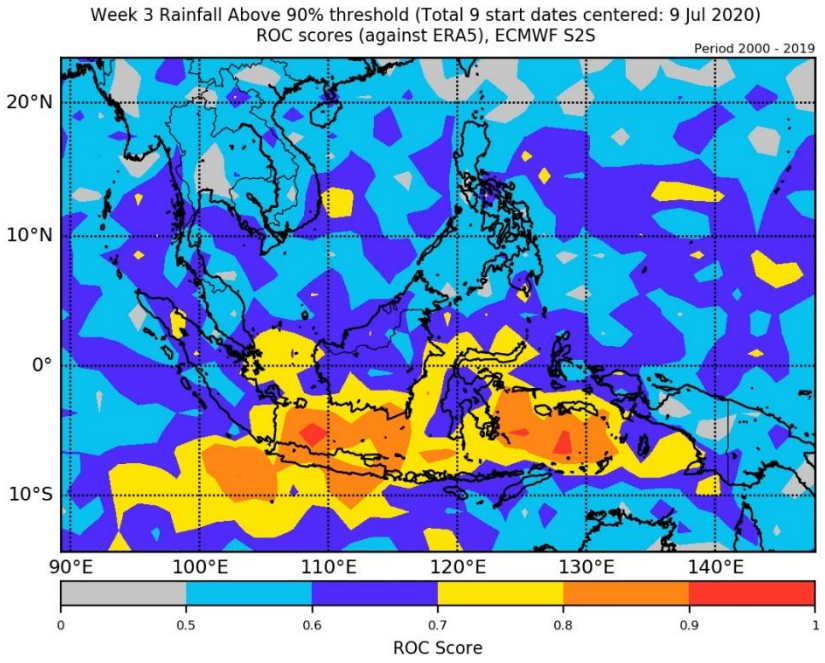
Week 1
Days 5 – 11



Week 2
Days 12 – 18

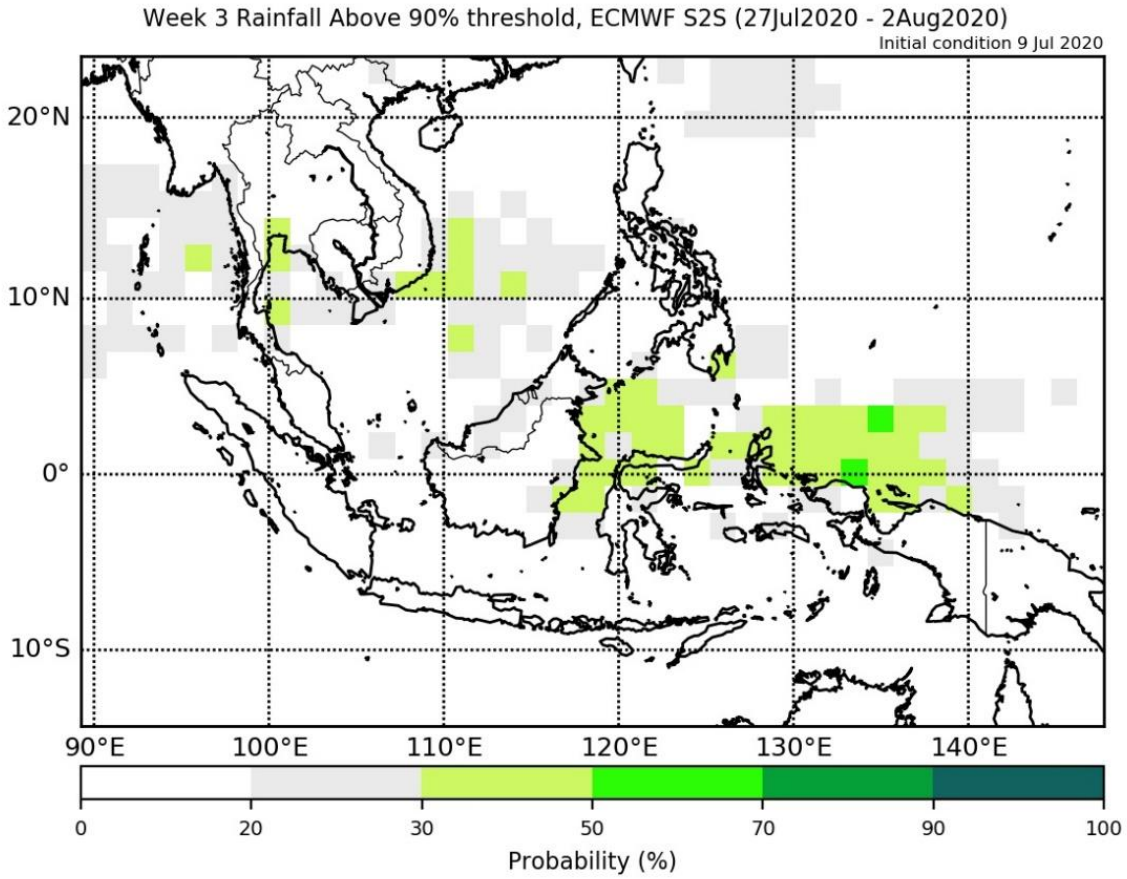


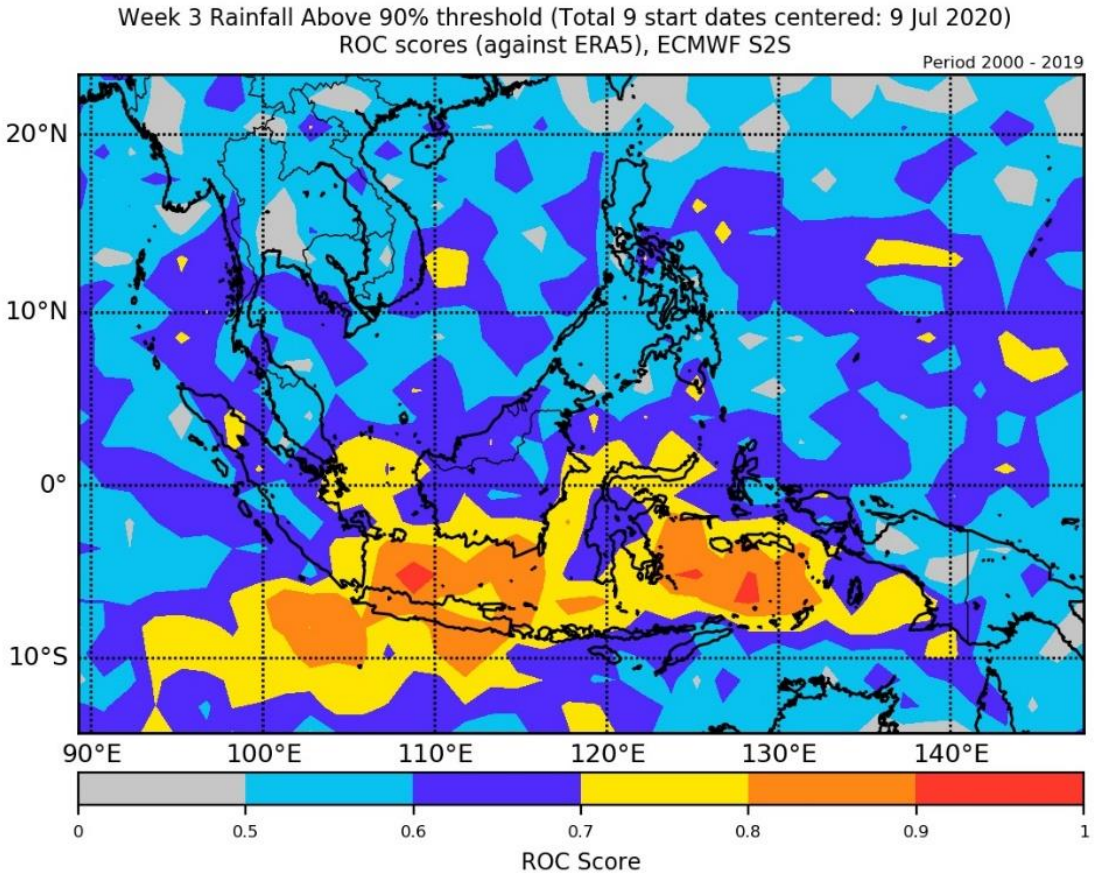
Week 3
Days 19 – 25



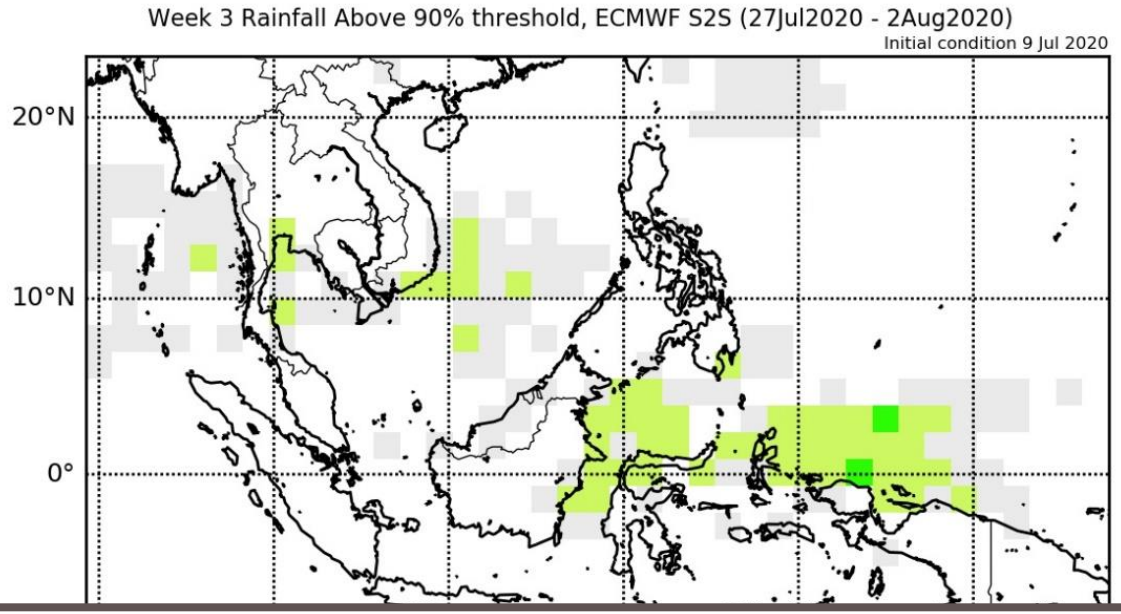
ROC Score for the 90th percentile

Outlook – where would you indicate an increased chance of heavy rainfall leading to a disaster?





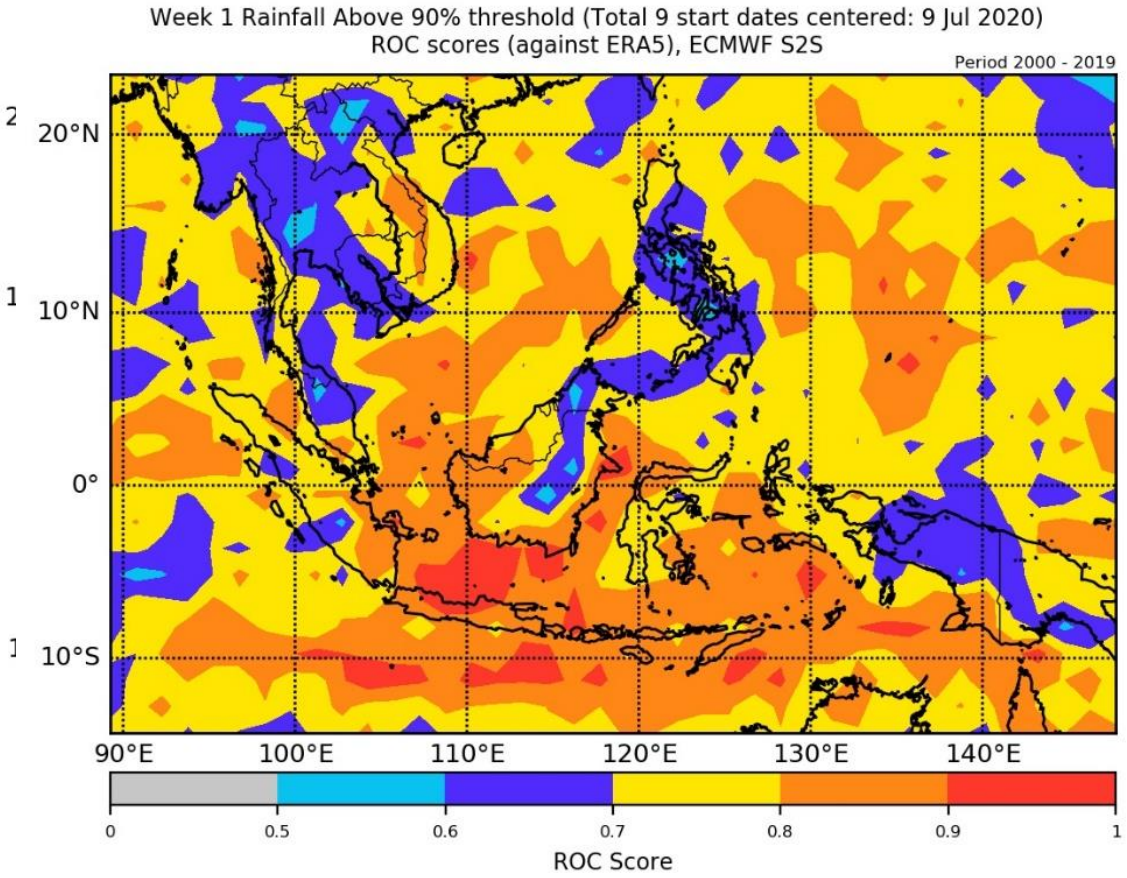
Outlook

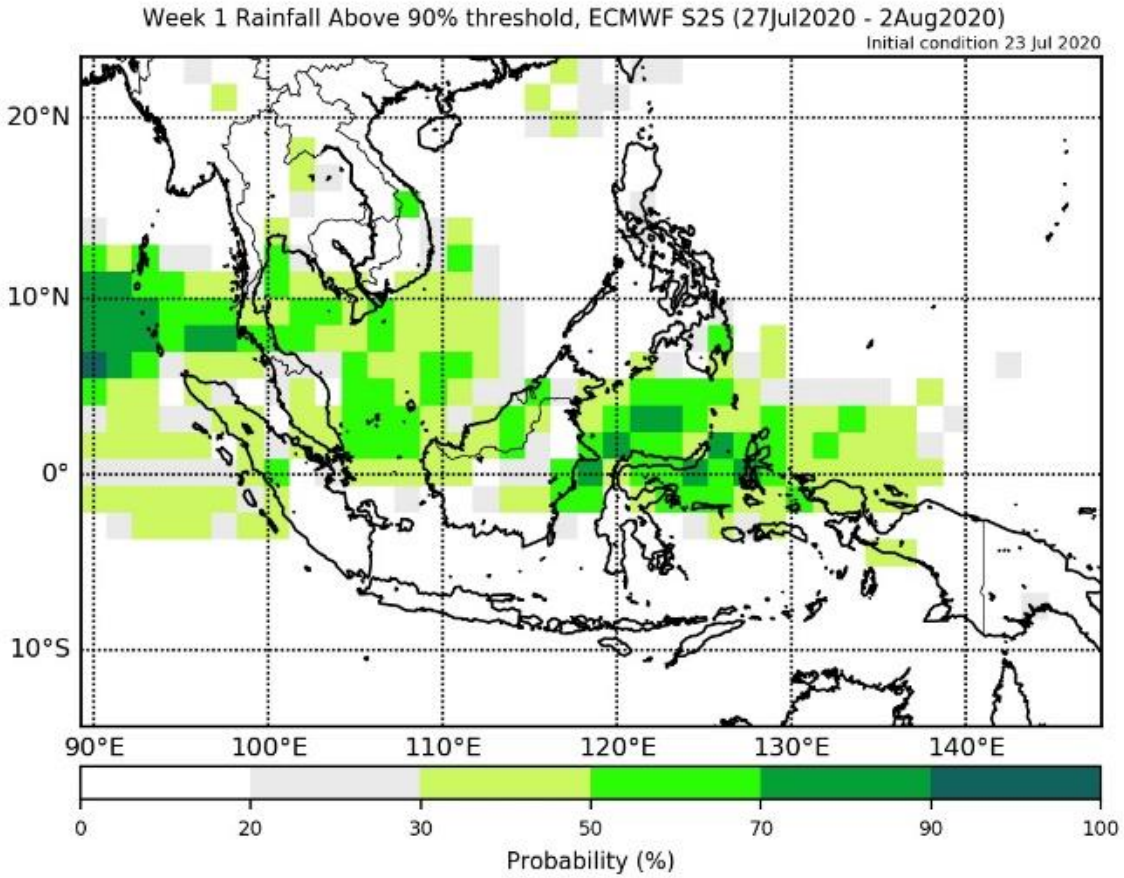


Outlook provided 13 July:

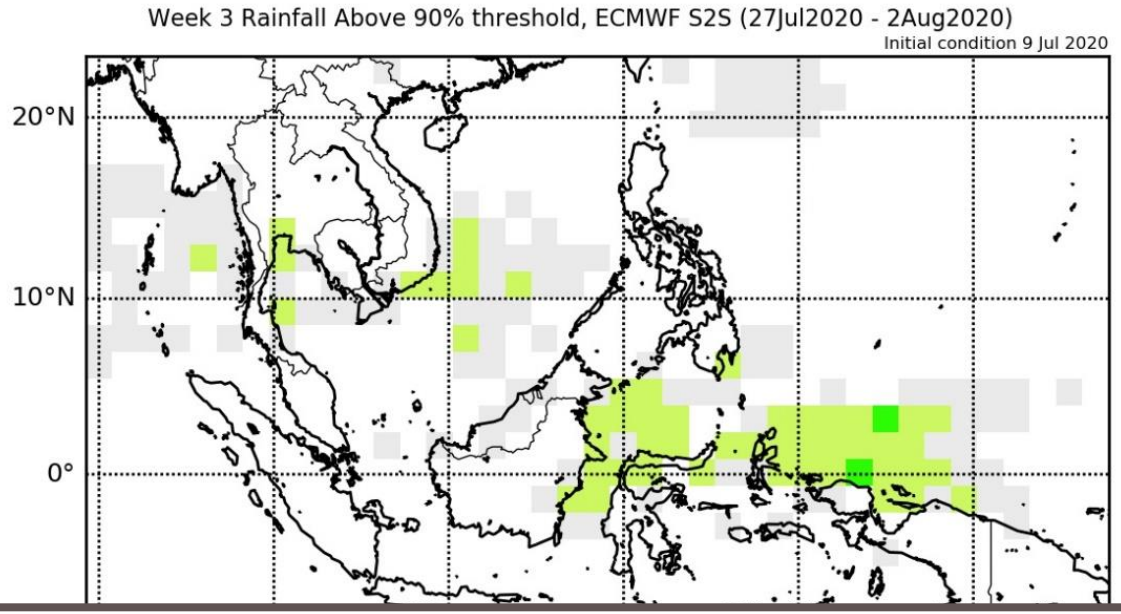
- For Week 3 (27/07-02/08), there is a small increase in chance of very heavy rainfall in eastern Indonesia (northern Sulawesi to northern Papua)

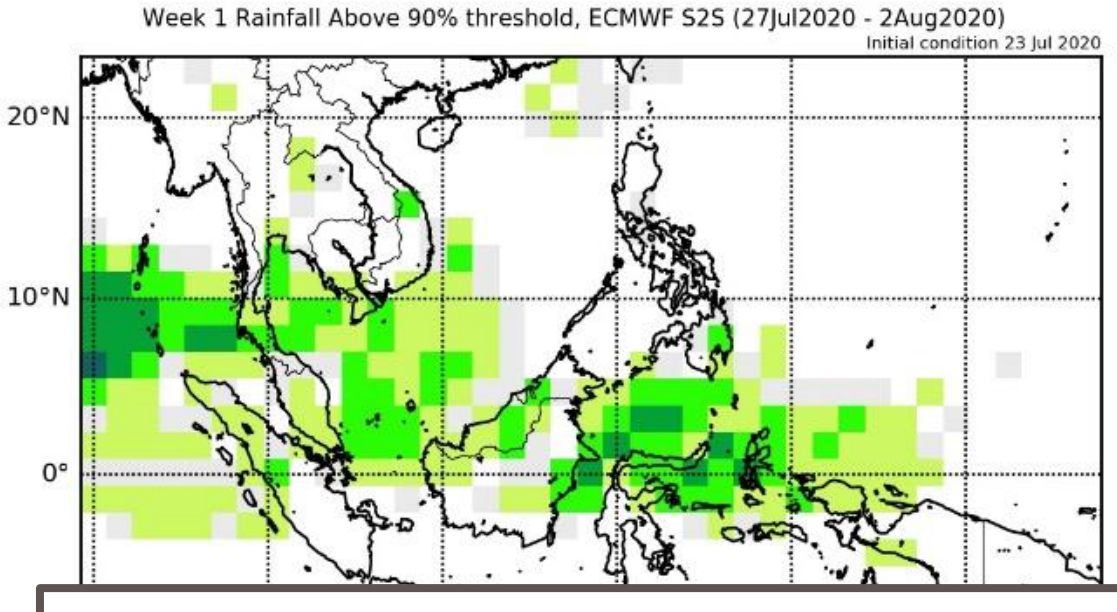
Outlook – where would you indicate an increased chance of heavy rainfall leading to a disaster?





Outlook





Outlook provided 13 July:

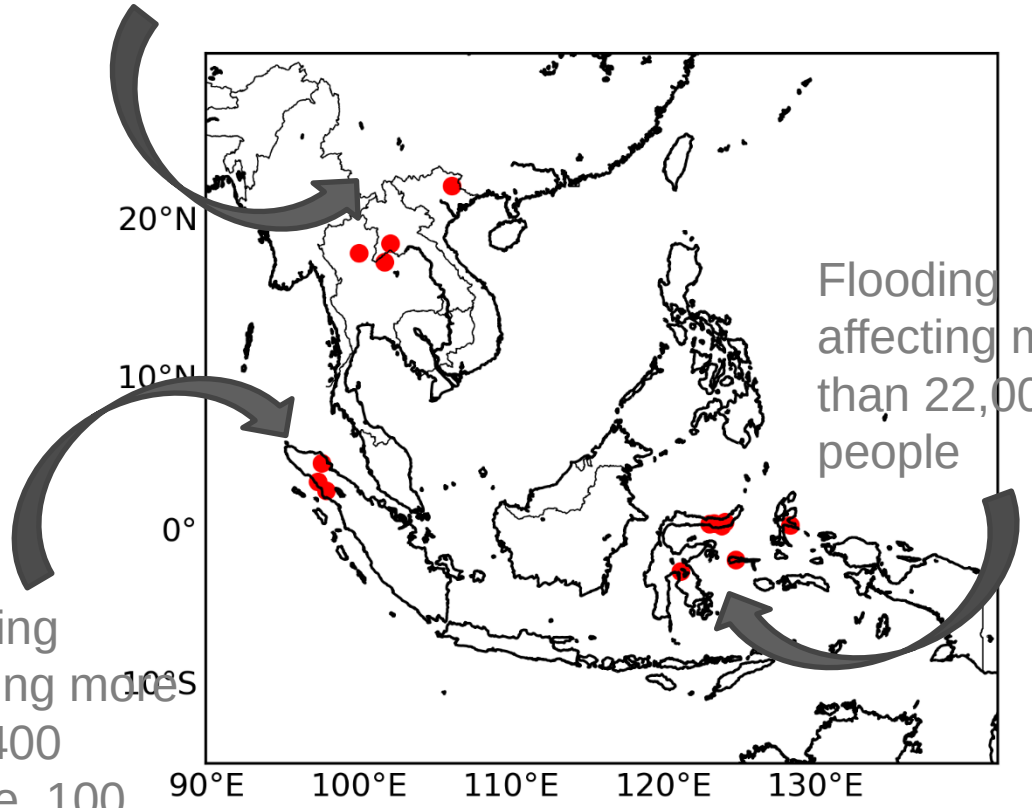
- For Week 3 (27/07-02/08), there is a small increase in chance of very heavy rainfall in eastern Indonesia (northern Sulawesi to northern Papua)

Outlook provided 27 July:

- For Week 1 (27/07-02/08), there is a moderate increase in chance of very heavy rainfall in eastern Indonesia (northern Sulawesi to west Papua); small increase for southern Thailand

27 July – 2 August 2020

Flooding, landslides, mudslides; affecting more than 100,000 people; associated with TS Sinlaku

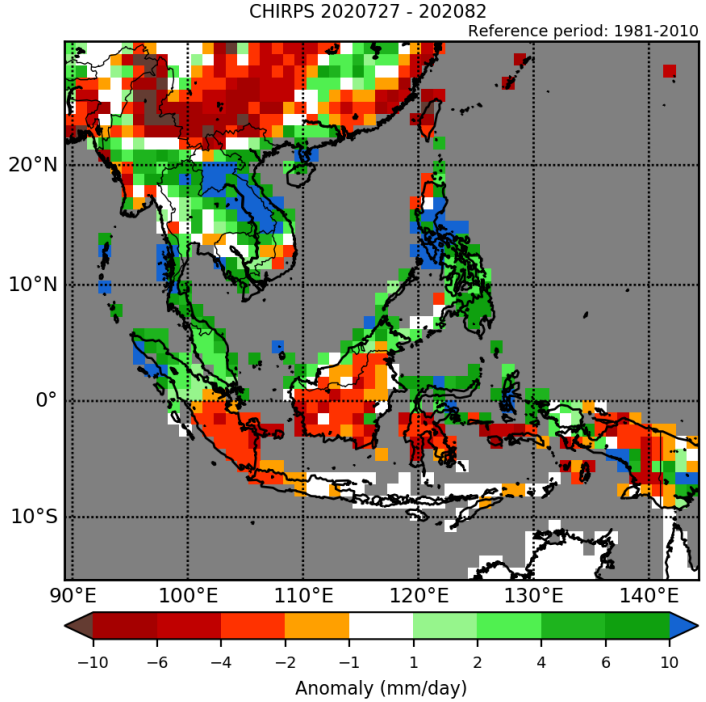


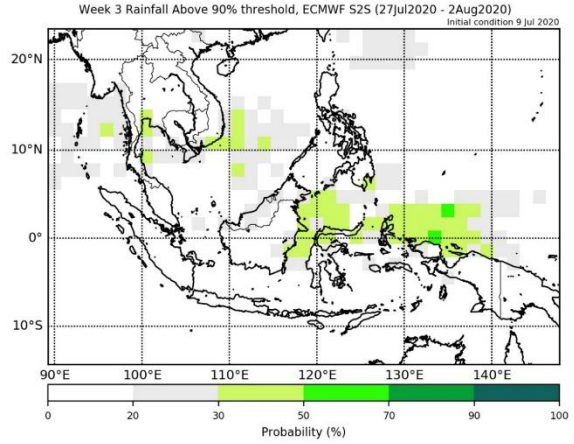
Flooding affecting more than 22,000 people

Flooding affecting more than 400 people, 100 houses submerged

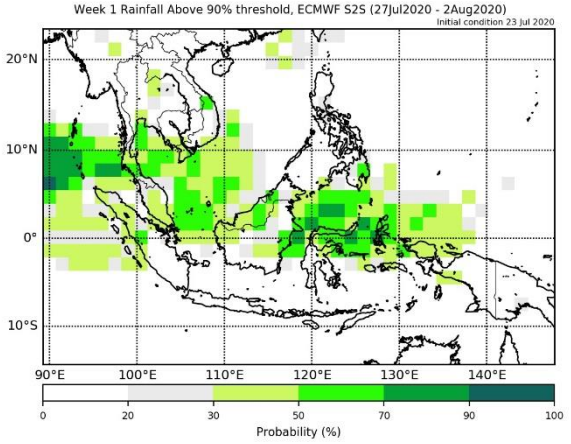
Reports from ADINet

adinet.ahacentre.org





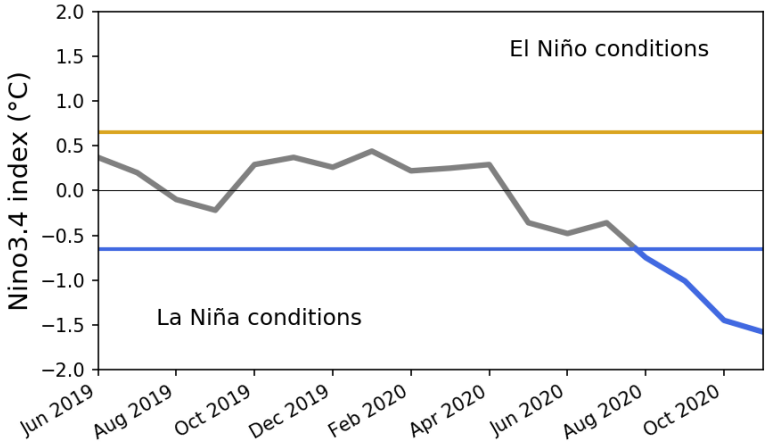
Week 3

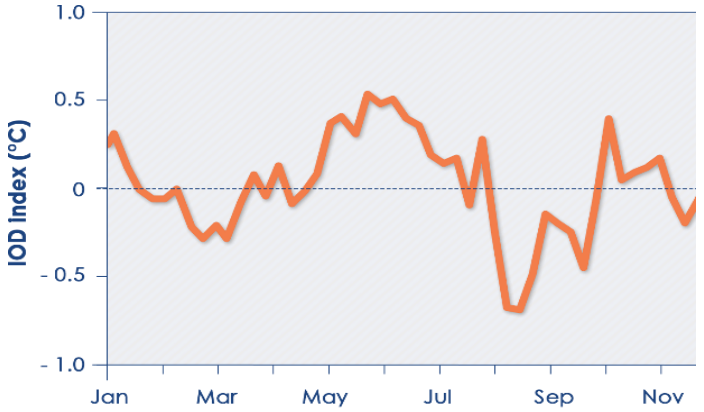


Week 1

Fast-forward: August to November 2020

- La Niña event became established, peaking October/November
- Indian Ocean Dipole generally neutral
- MJO Phases 5-7 in October, Phases 8 – 2 in November
- …..



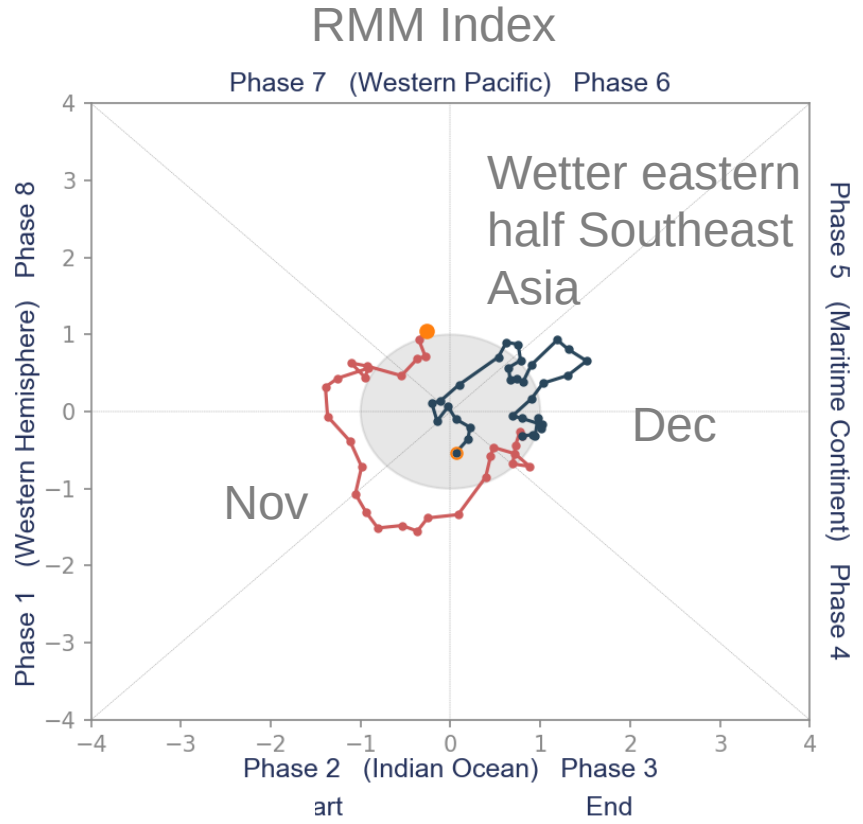


Case study NE Monsoon

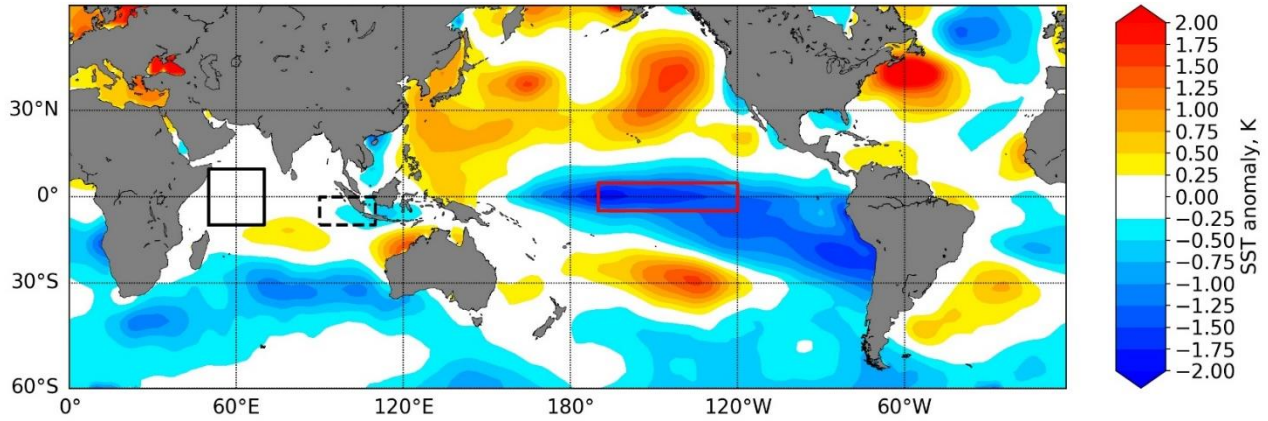
Target week: **14 – 20 December 2020**

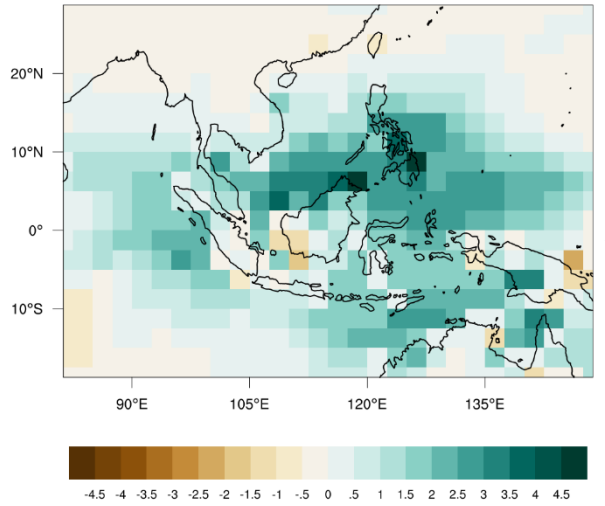
December:

- La Niña event
- Cooler SSTs around Southeast Asia



SST Anomalies, December 2020 (ERSSTv5)

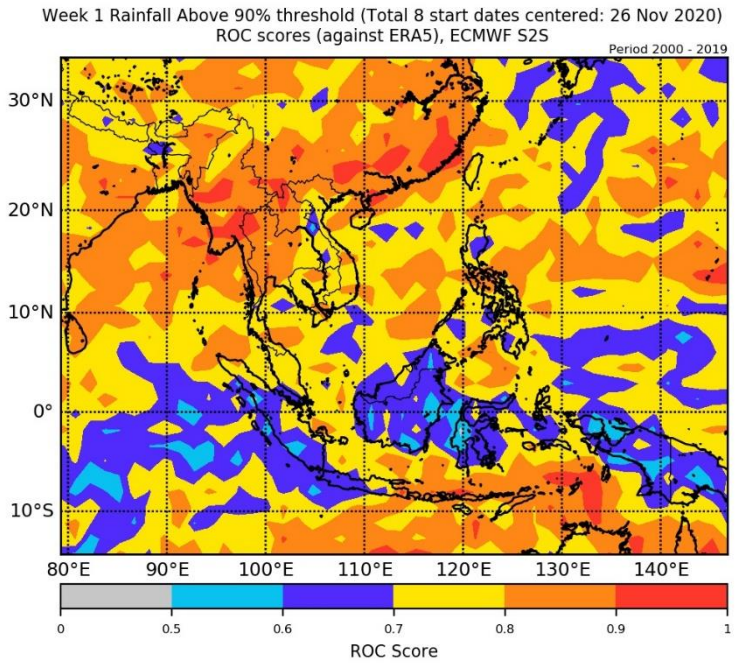




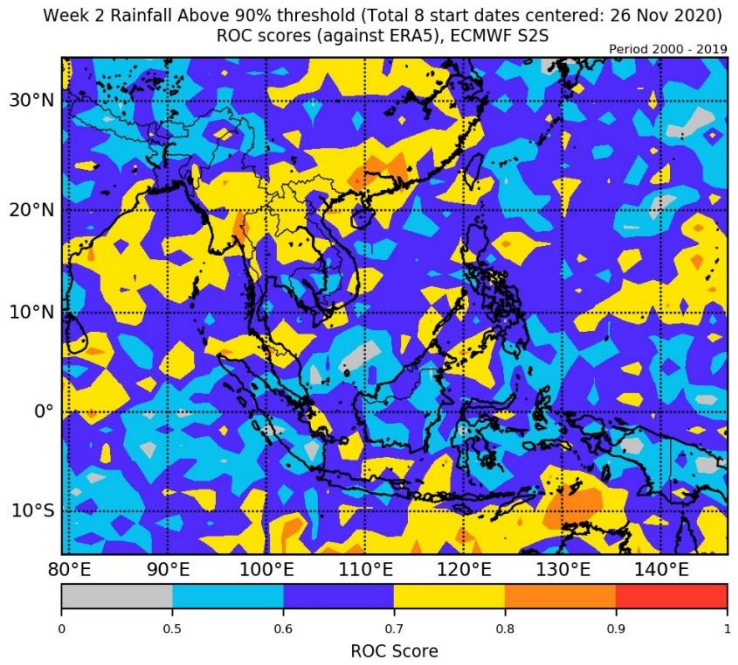
Rainfall anomaly composite La Niña -DJF

Hindcast skill

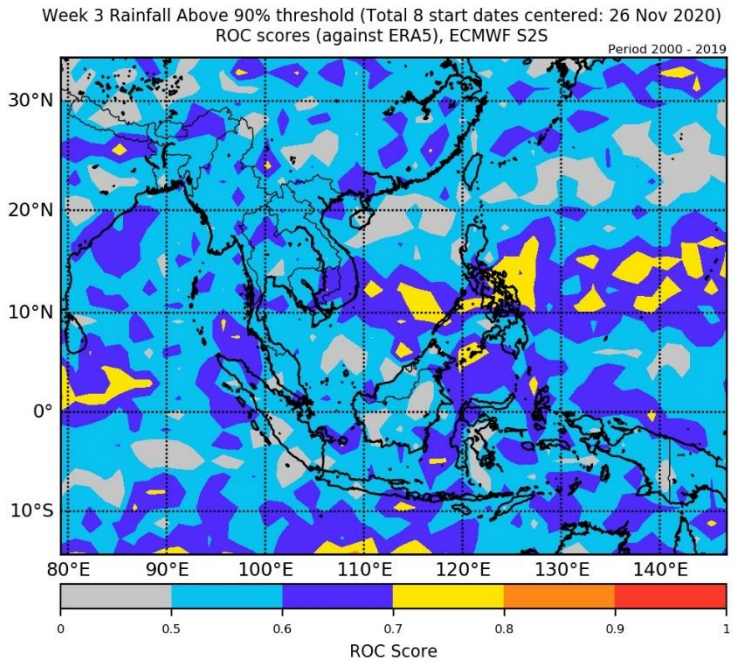
Week 1
Days 5 – 11



Week 2
Days 12 – 18

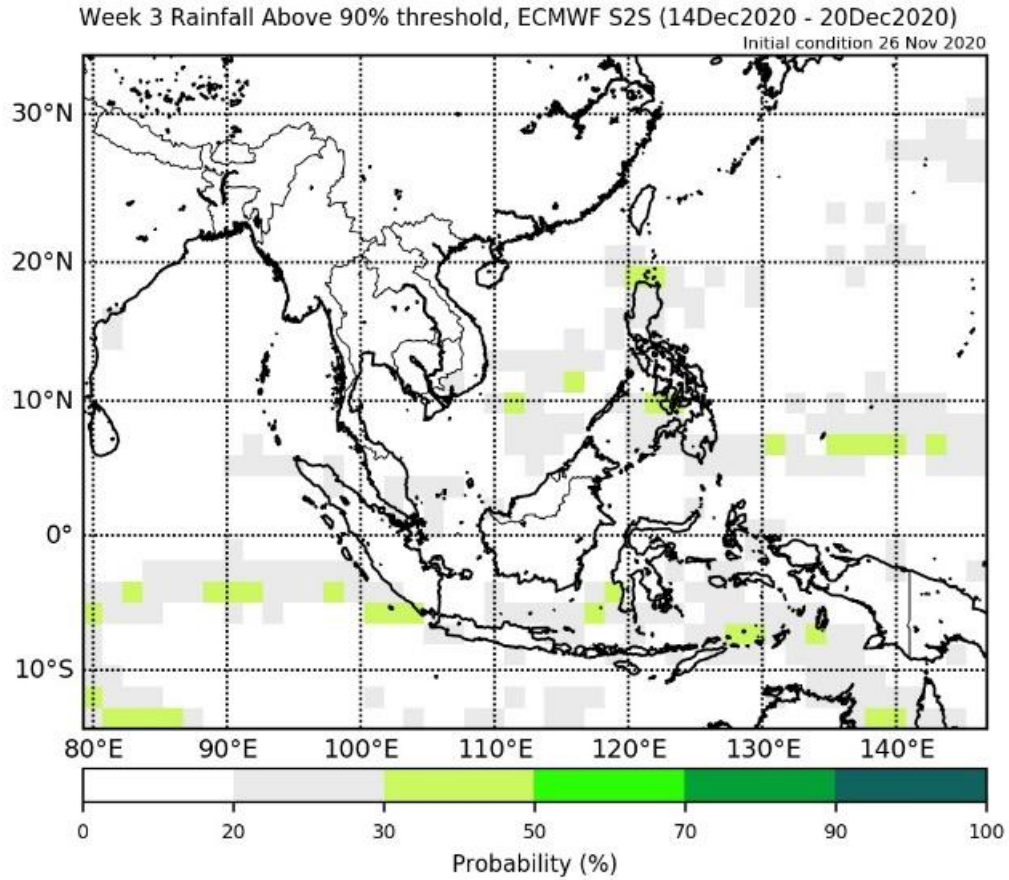


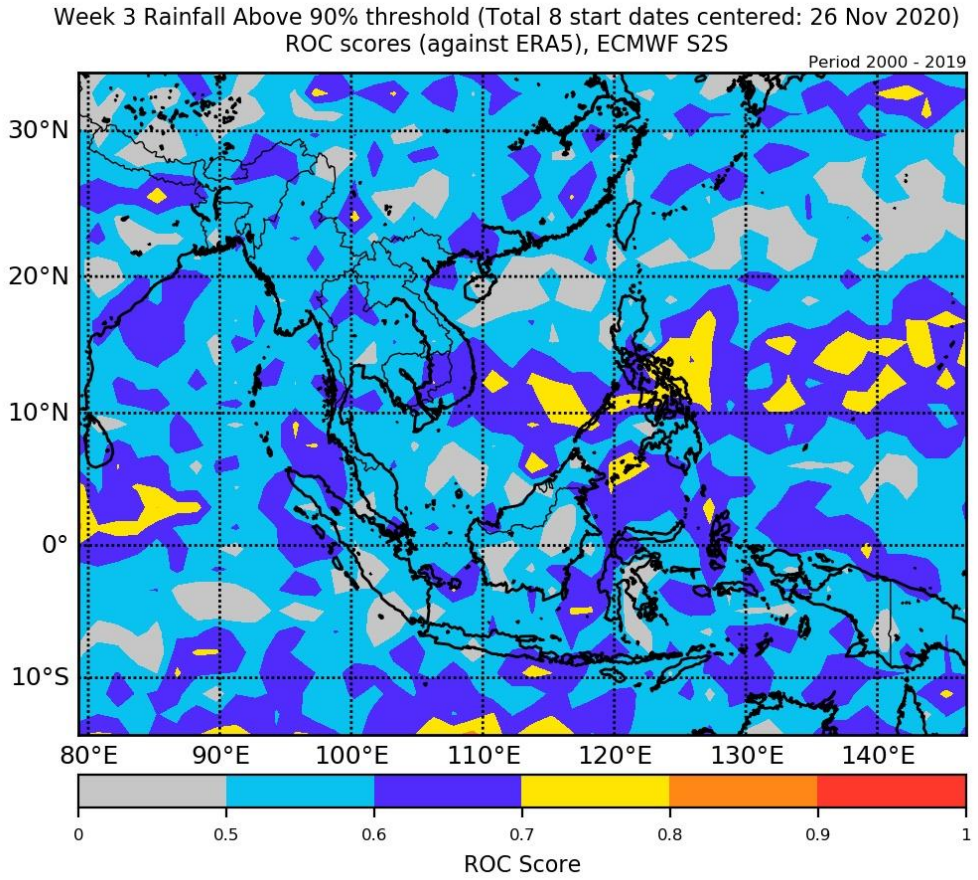
Week 3
Days 19 – 25



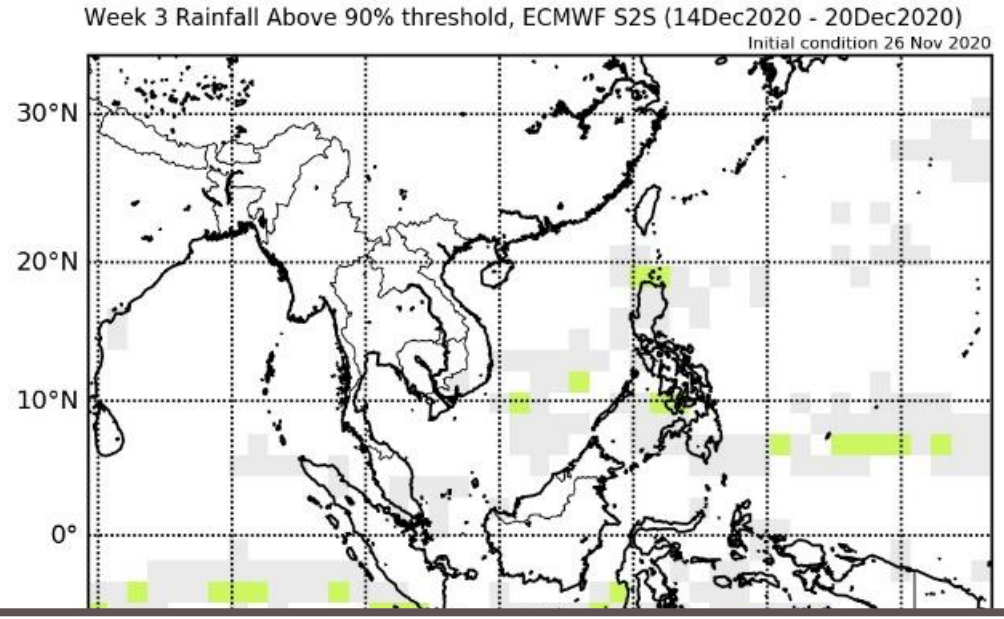
ROC Score for the 90th percentile

Outlook – where would you indicate an increased chance of heavy rainfall leading to a disaster?





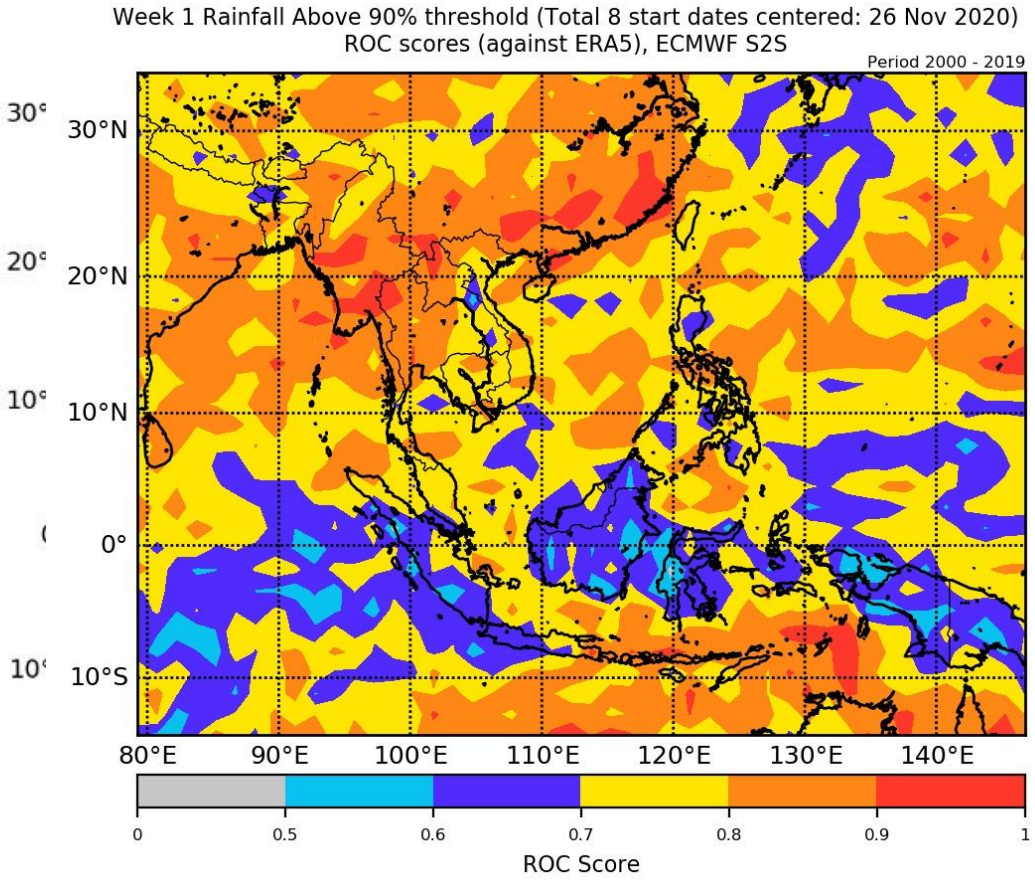
Outlook

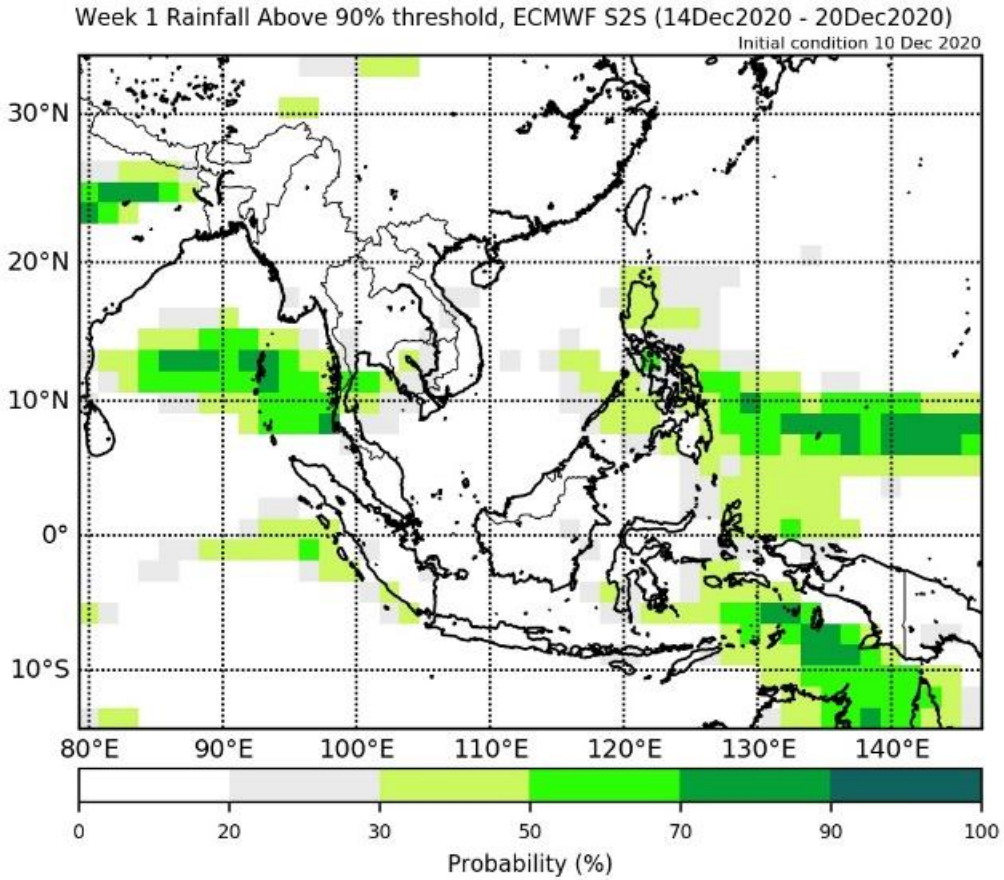


Outlook provided 30 November:

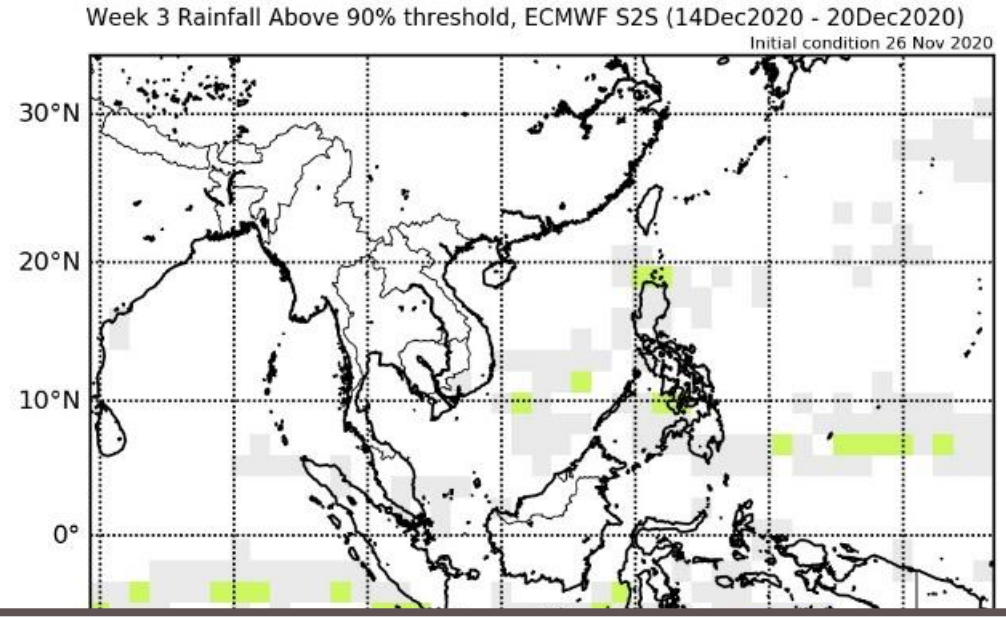
- For Week 3 (14/12-20/12), there is a small increase in chance of very heavy rainfall over the Philippines, and southern Indonesia.

Outlook – where would you indicate an increased chance of heavy rainfall leading to a disaster?



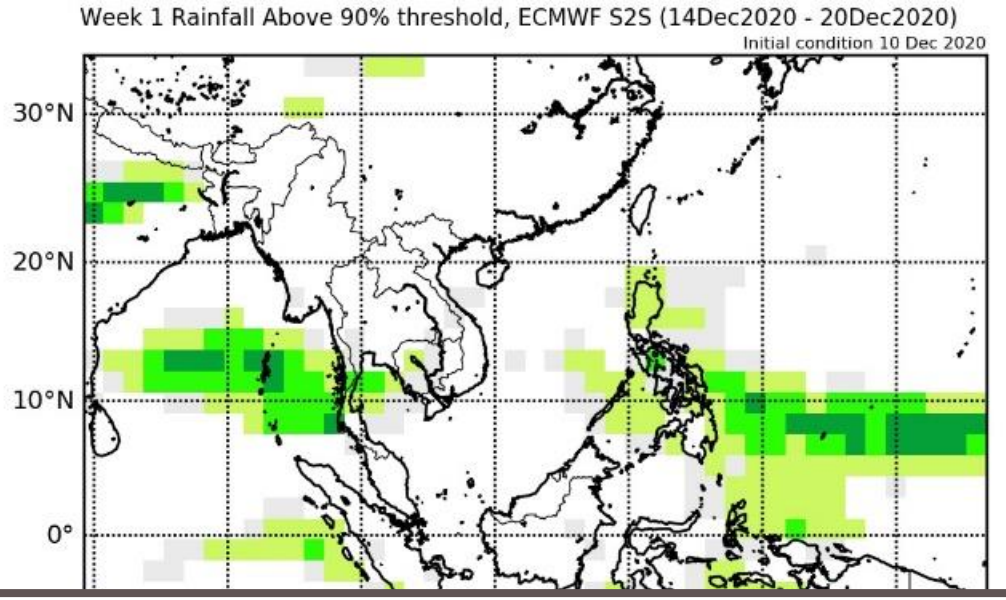


Outlook



Outlook provided 30 November:

- For Week 3 (14/12-20/12), there is a small increase in chance of very heavy rainfall over the Philippines, and southern Indonesia.

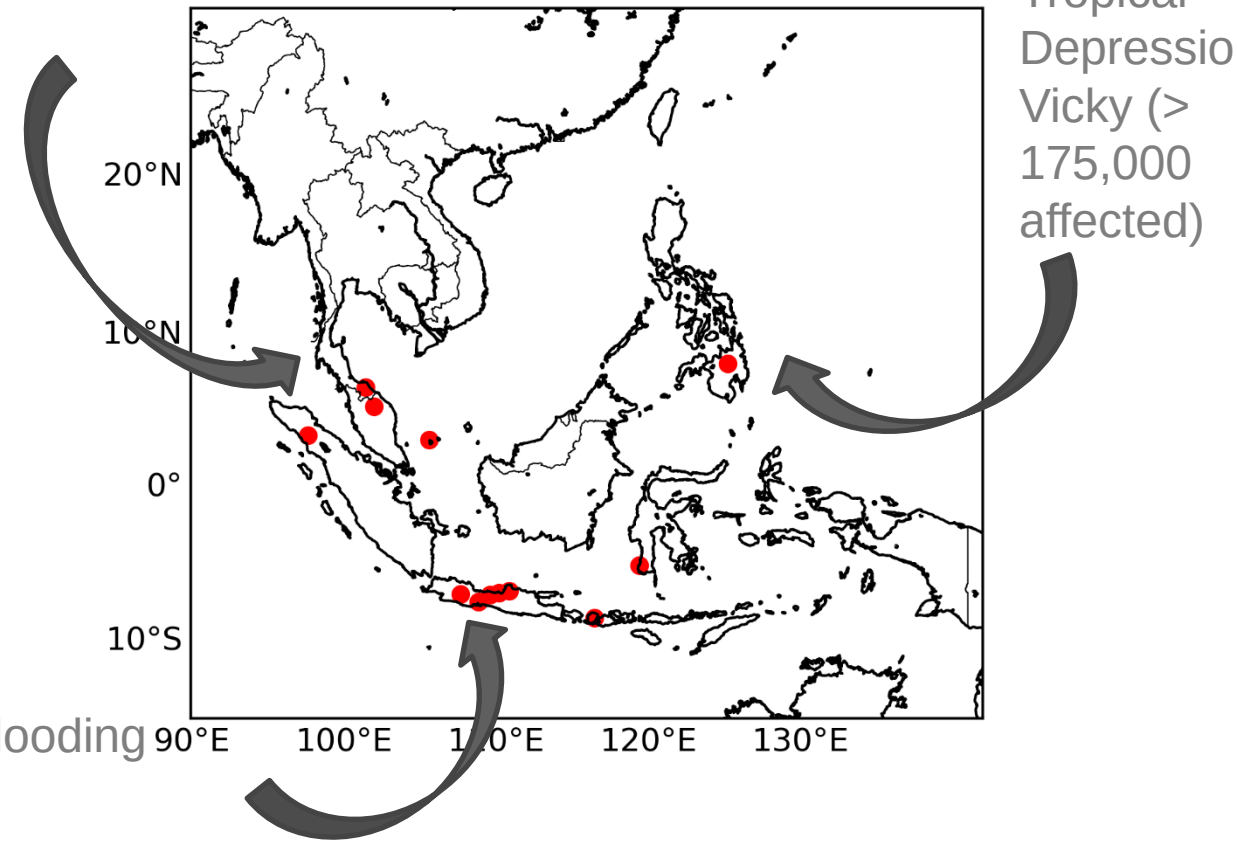


Outlook provided 14 December:

- For Week 1 (14/12-20/12), The Philippines, central and southern Viet Nam, southern Thailand, southern Myanmar and southeastern parts of the Maritime Continent

14 – 20 December 2020

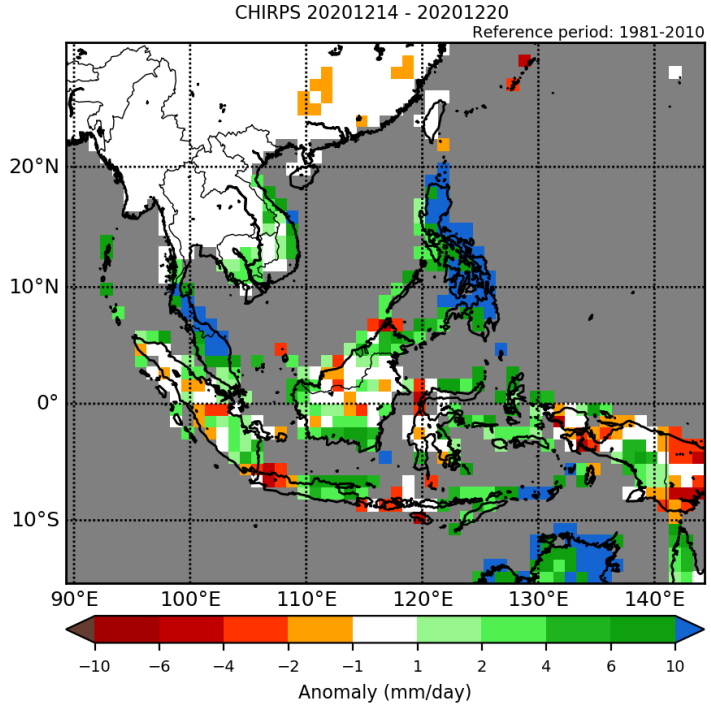
Strong NE monsoon surge,
>40,000 people affected

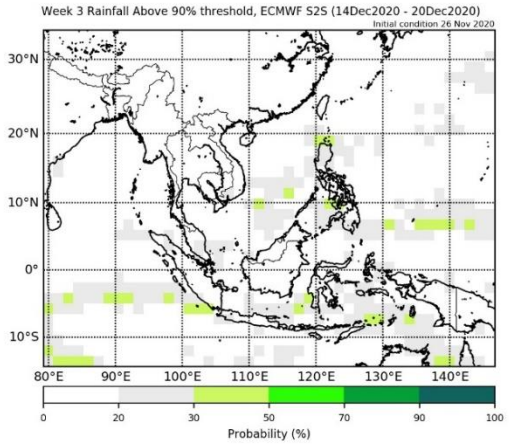


Tropical Depression Vicky (> 175,000 affected)

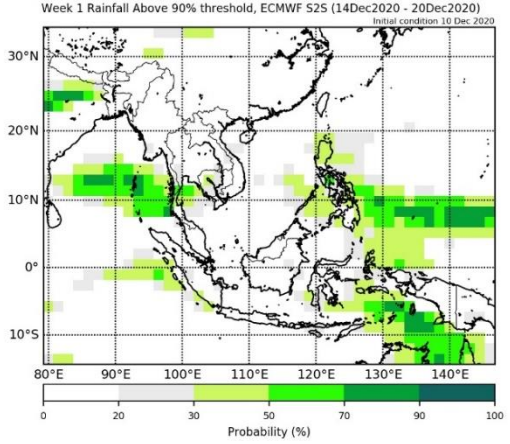
Flooding

Reports from ADINet
adinet.ahacentre.org





Week 3



Week 1

Summary

- A lot of information to take in – both as a forecaster, and as a user.
- Model skill depends on lead time, location, time of year, sources of predictability:
  - Southeast Asia has some of the highest skill, but still can miss events.
  - In places where lower skill, can use a lower threshold where there is more skill (but trade-off: increase hits can increase false alarms)
  - Can also try Model Output Statistics/other calibration

Important to develop product with users to have something that is useful:

- Identifying actions that can be taken at the S2S timescale
- Developing products to support this (considering misses/false alarms/hits).