WWRP Warning Value Chain Project

Warning Chain Database questionnaire

I. Purpose

Please use this form to record as much information as possible on the end-to-end warning chain for a hazardous weather event. This information will:

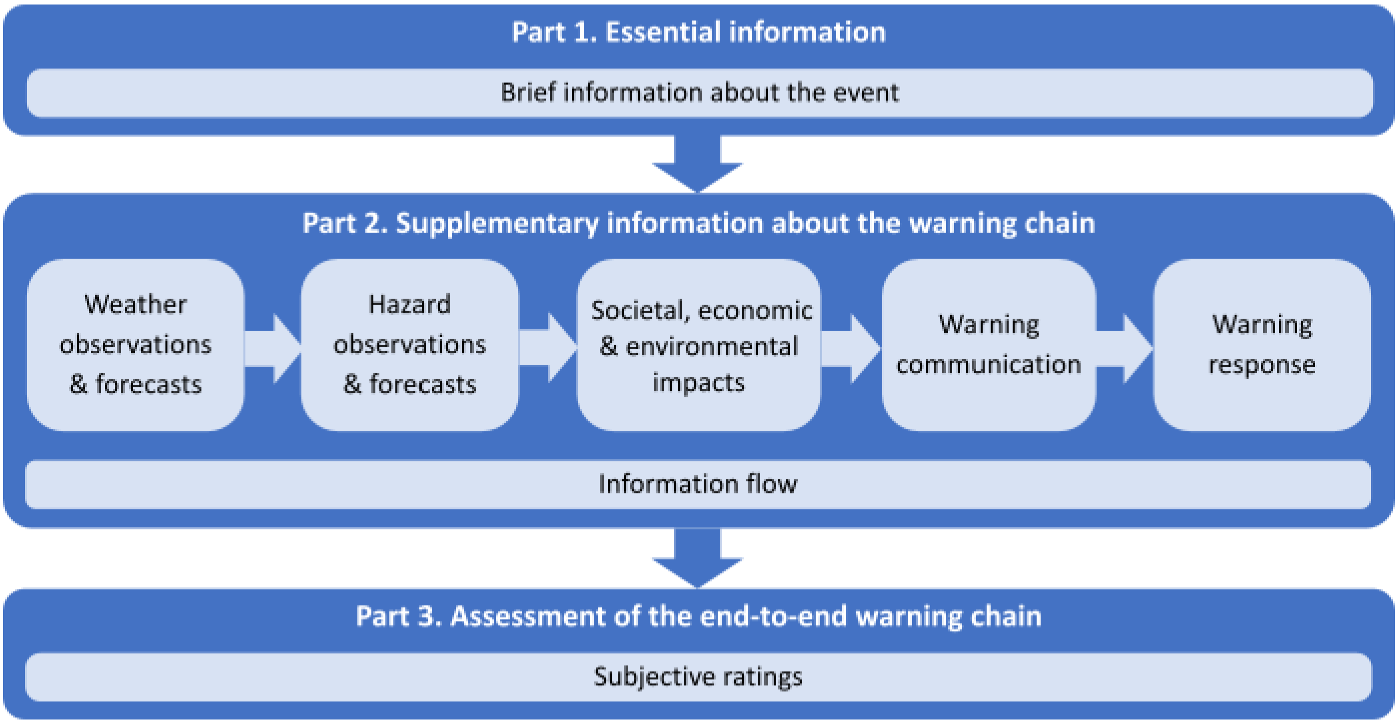
- add to a global database of hazardous weather events with rich information covering the many components of the warning value chain
- enable case studies and cross-cutting analysis of end-to-end warning value chains, from simple to complex, to understand effective practices.

The warning value chain database tries not to duplicate data collected in databases for other purposes. This template provides for a comprehensive picture of the information flow, decision making and response during a high impact weather event.

More information about the WWRP Warning Value Chain Project can be found at http://hiweather.net/Lists/130.html.

II. Structure and format

The form consists of three main parts.



Part 1. The **essential information table** requests brief facts about a particular event, such as what happened, when, where, impacts and responses. This information will help users to filter events. Please provide numerical and short text entries. Links to other databases and catalogues (e.g., ECMWF Severe Event Catalogue, EM-DAT, DesInventar, etc.) about this event should be provided.

Part 2. The second part requests **supplementary information** about different stages in the warning value chain. This more detailed information and analysis about the weather, the hazards, the impacts, the

warning communication and warning response will help users understand what was unique about the warning chain for this event. The guidelines are just suggestions, they are not exhaustive.
Information here might include:

- Graphics (for example, forecast charts, reanalysis maps, warning graphics, photos of impacts, etc.)
- Videos (for example, from social media, weather service outlooks, etc.)
- Free-form text (for example, description of meteorology, selected extracts from reports, data analysis, tables, etc.)
- Links (e.g., to other databases/catalogues, external reports, media, etc.)

Note:

⇒ Part 2 is optional, provide what you feel able to.

⇒ Each section has an "additional analysis" where you can add further information not covered by the items in the template.

⇒ Try to keep your entries brief and include references and links (URLs) to where additional information can be found.

⇒ Many people may contribute information on this event. Where you disagree try to provide evidence to support your position.

⇒ You can acknowledge contributors that provided you with information for the template at the end of the template before Annex 1. This is optional.

<u>Part 3.</u> The subjective assessment asks contributors to rate the effectiveness of the individual elements of the end-to-end warning chain, and its overall effectiveness, on a scale of 1 (poor) to 5 (excellent). This may assist users of the database in choosing cases and performing meta-analysis (recognising the large variability in contributor' judgments).

III. Tips

- Detailed instructions, explanations and examples about the data asked for are provided in the dedicated Guidance document (link to document on VC webpage).
- The Value Chain Glossary provides a common terminology. Use the names of hazard types listed in *Annex 1* of the template or this guide.
- A series of prompts (i) in this template provide some quick information to assist with entering the required data. Simply put your cursor over the information symbol i and text should pop up next to it (ignore the “Ctrl+click to follow link” instruction). *Note, that this feature is only available in the Microsoft Word App, not in the SharePoint or Google Drive browser page.* Consult the Guidance document instead if this feature does not work for you.
- It is not anticipated that a single person can fill in the entire template. Rather, we encourage to share the template with colleagues who can provide information.
- See HERE for a worked example of the template.

Part 1. Essential information

Editors (Name & Institute)	*Brian Golding, Met Office*

HIGH IMPACT WEATHER EVENT	
Unique identifier i	
Name of event	Tropical Cyclone Seroja
When did it happen i?	3-4 April 2021
Where did it happen i?	East Nusa Tenggara province, Indonesia
WHAT HAPPENED – WEATHER, HAZARDS, IMPACTS, WARNINGS, RESPONSES	
Weather event type/system that caused hazards i *Refer to Annex 1*	Tropical Cyclone
If possible, provide more detail about weather observations & forecasts (*link to page*)	
Hazards that caused the main impacts i *Refer to Annex* 1	Flood, Landslide, Rock Fall
Classify hazard in regard to the location's climatology i	Strongest TC to hit Indonesia since 2008. Head of BMKG suggested abnormally high SST (30C rather than 26C) to blame for impacts.
If possible, provide more detail about hazard observations and forecasts (*link to page*)	
What were the main direct impacts i?	Deaths, Displacement, Infrastructure & property damage, Crop loss
Economic damage in USD i	$235.7M in Indonesia (Wikipedia)
Fatalities	226 in Indonesia, 41 in East Timor (EM-DAT)
If possible, provide more detail about impact observations and forecast (*link to page)*	
Main warnings issued i	TC warning issued after main impacts
Who issued the warnings? i	BMKG
If possible, provide more detail about the warnings and communication (*link to page*)	
Main responses to warnings i	None
If possible, provide more detail about responses to warnings (*link to page*)	
Links to other databases *(ECMWF catalogue of severe events, WMO CHE, DesInventar, EM-DAT, GLIDE, etc.)* https://confluence.ecmwf.int/display/FCST/Severe+Event+Catalogue	ECMWF event database: https://confluence.ecmwf.int/display/FCST/202104+-+Rainfall+-+Indonesia

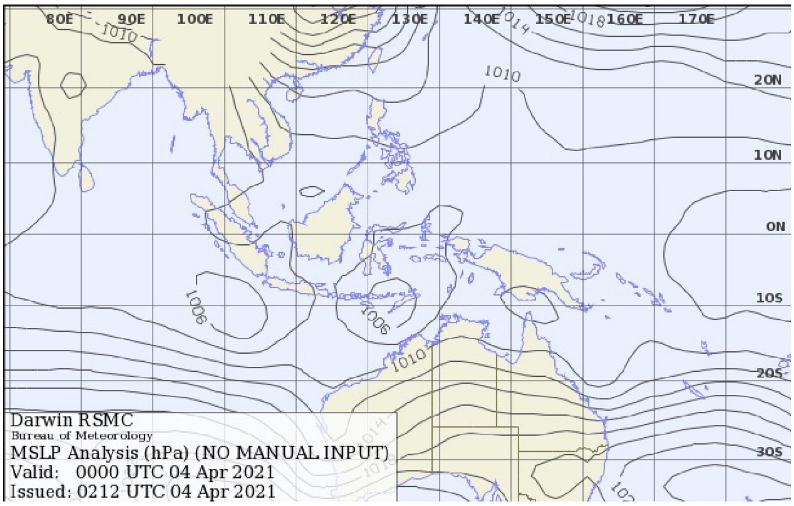
Part 2a. Supplementary information about weather

Wherever possible, please include references to information you provide!

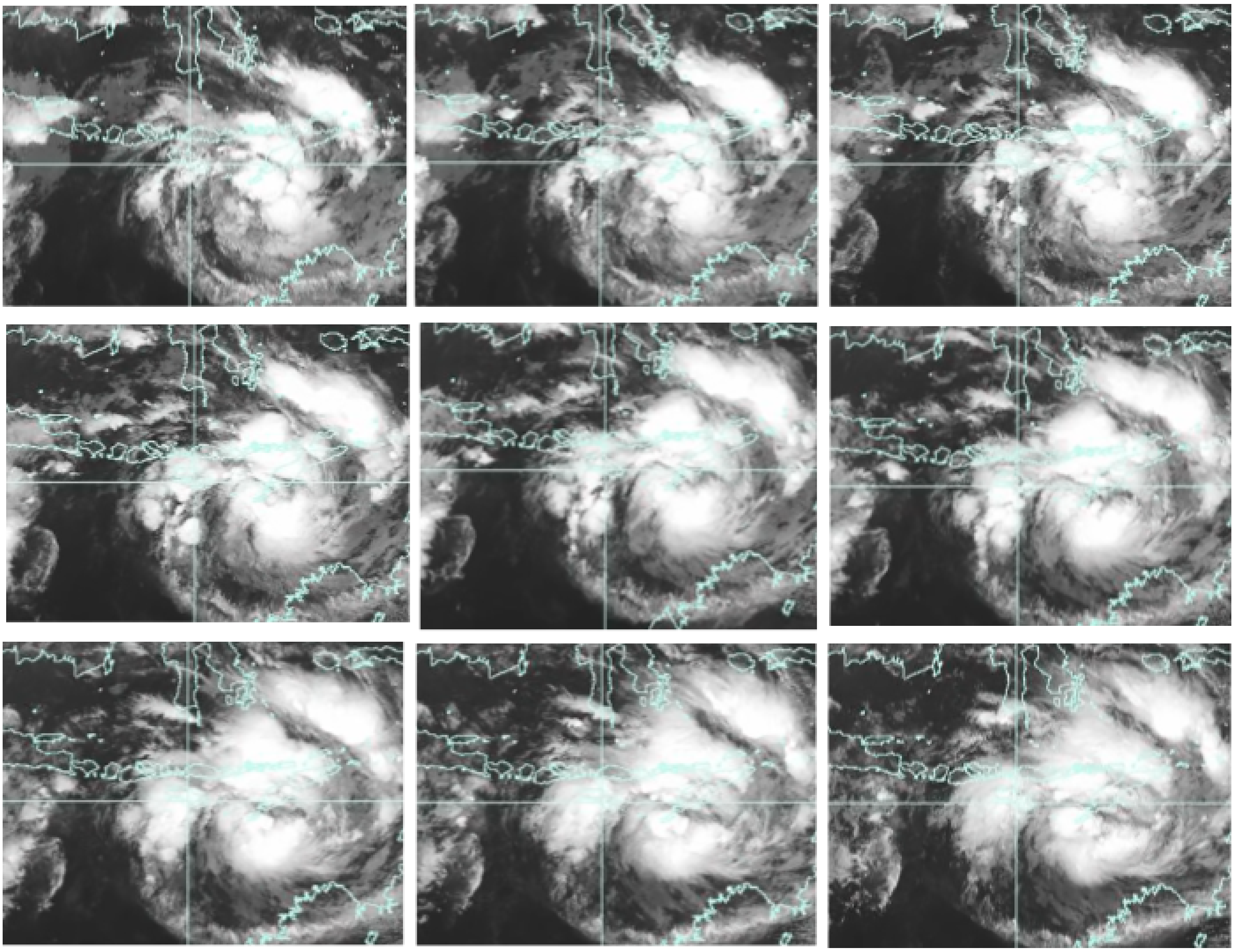
Editors (Name & Institute): Brian Golding

Meteorological overview:

On 29 March, the BoM began to mention that Tropical Low 22U was developing to the south of Timor. BMKG identified TD99S in this area on 2nd April. By 3 April, the tropical low fully developed as it was within an active trough. The low was located in a generally favourable environment with deep moisture, low vertical wind shear, and defined outflow. The low drifted close to the coast of Timor very slowly with persistent spiralling bands of convection occupying the storm's circulation, producing prolific rainfall in the surrounding regions on 3–4 April. At this time, the low pressure system was located inside the Area of Responsibility (AoR) of TCWC Jakarta. By the early morning of 4 April, the presentation of its structure had improved with spiral bands of deep convection and tight curvature at its centre. Although there were fluctuations in central convection, a favourable environment of deep moisture, low vertical wind shear, and good outflow meant further development of the system was expected. Meanwhile, the Joint Typhoon Warning Center(JTWC) issued their first warning on the storm as *Tropical Cyclone 26S* at 15:00 on UTC 4April. The tropical low slowly gained strength, intensifying to a Category 1 tropical cyclone, and was given the name *Seroja* by the Tropical Cyclone Warning Centre (TCWC) Jakarta at 20:00 UTC on 4 April, about 95 km (60 mi) north-northwest of Rote Island. (Wikipedia)

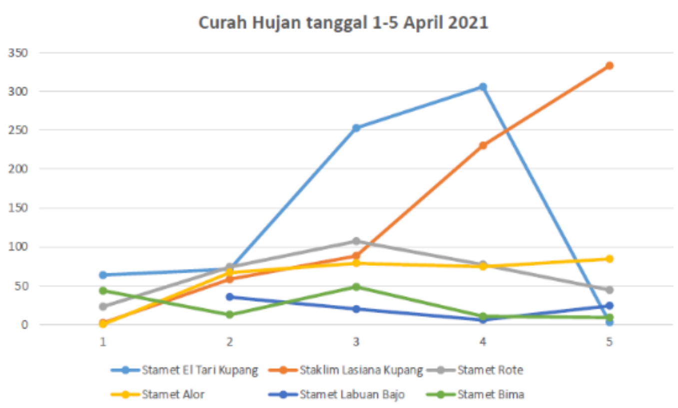


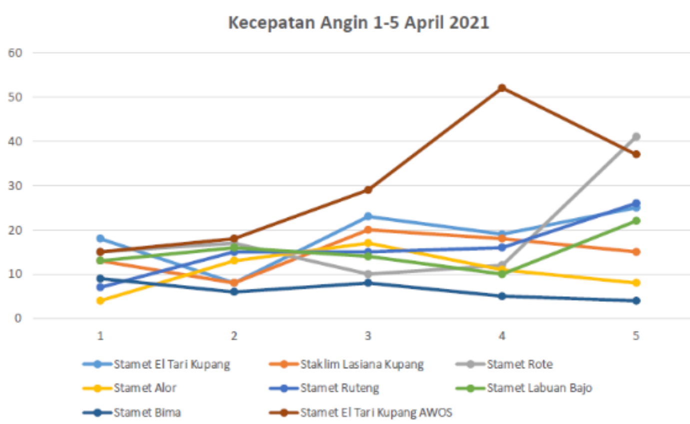
The satellite sequence shows intense convection developing over Timor at the centre of the TD, and along several spiral bands associated with it, from mid-evening. The whole system is quasi-stationary at this time. The band lying along the East Flores islands remains there until dawn, by which time the cloud appears to be dissipating.



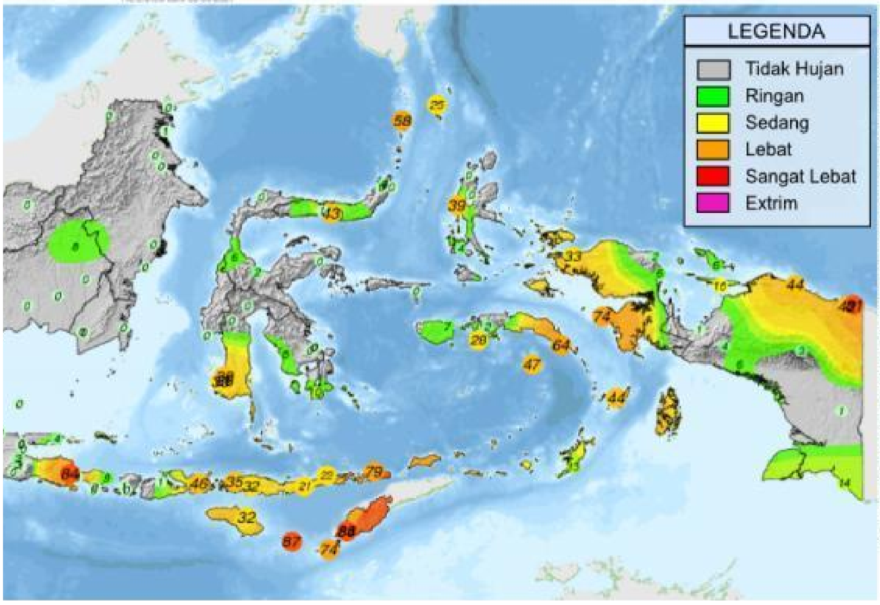
Himawari IR sequence 1500 – 2300UTC (2200 – 0600 WIB, ~2300-0700 Local)

Weather observations and analyses Station observations of rainfall (curah hujan) in mm/day and wind (kecepatan angin) in knots. Alor is the only station representative of the Flores islands where most of the fatalities occurred. Kupang is the main city on Timor and was closest to the cyclone.



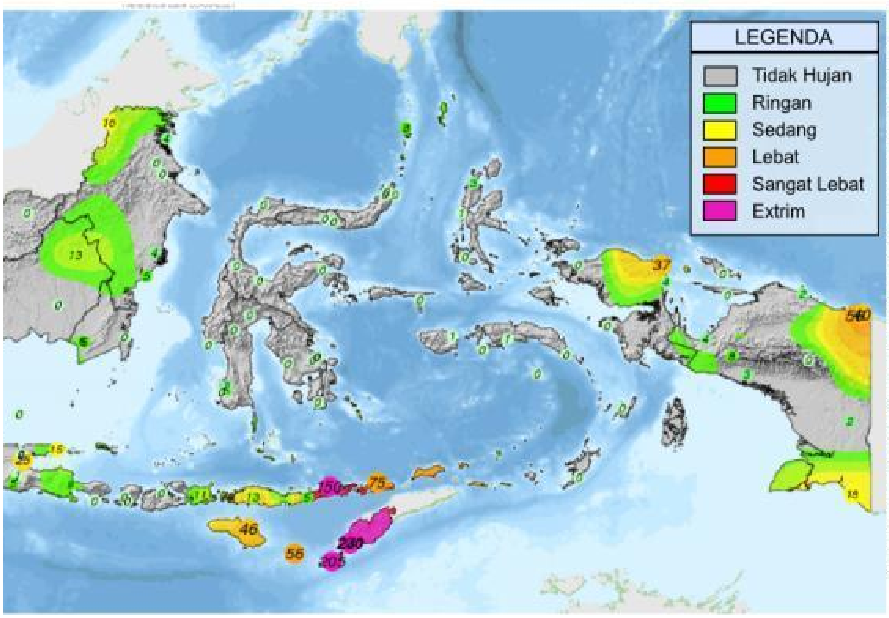


02 April 2021 pukul 07.00 WIB s/d 03 April 2021 pukul 07.00 WIB



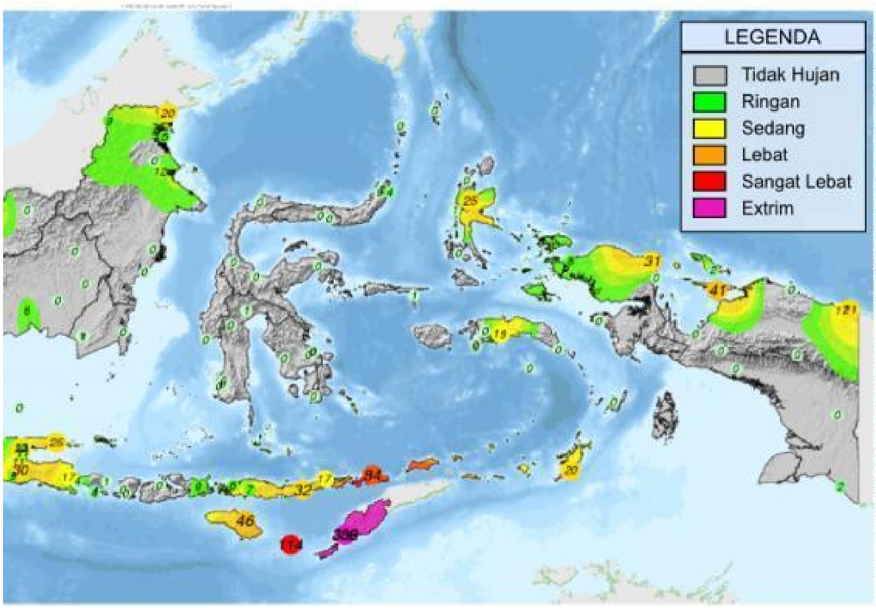
STATION	24hRR
Stasiun Klimatologi Kupang	88.4
Stasiun Meteorologi Tardamu	87.0
Stasiun Meteorologi Eltari	84.0
Stasiun Meteorologi Banyuwangi	83.9
Stasiun Meteorologi Dok Ii Jayapura	81.4
Stasiun Meteorologi Soekarno Hatta	79.0
Stasiun Meteorologi Mali	79.0
Stasiun Meteorologi Maritim Serang	77.8
Stasiun Geofisika Lampung Utara	75.8
Stasiun Meteorologi Torea	74.0
Stasiun Meteorologi David Constatijn Saudale	74.0
Stasiun Meteorologi Kemayoran	73.4
Stasiun Meteorologi Budiarto	71.0
Stasiun Meteorologi Geser	63.8
Stasiun Geofisika Tangerang	63.0
Stasiun Meteorologi Naha	58.1
Atang Sanjaya Bogor	58.0
Stasiun Meteorologi Bandaneira	47.0
Stasiun Meteorologi Maritim Tanjung Priok	46.0
Stasiun Klimatologi Tangerang Selatan	45.8
Stasiun Meteorologi Sultan Muhammad Salahuddin	45.8
Stasiun Meteorologi Radin Inten Ii	45.0
Halim Pk	45.0
Stasiun Meteorologi Sultan Iskandar Muda	45.0
Stasiun Meteorologi Karel Sadsuitubun	44.0

03 April 2021 pukul 07.00 WIB s/d 04 April 2021 pukul 07.00 WIB



STATION	24hRR
Stasiun Meteorologi Eltari	241.0
Stasiun Klimatologi Kupang	230.2
Stasiun Meteorologi David Constatijn Saudale	205.0
Stasiun Meteorologi Gewayantana	150.0
Stasiun Meteorologi Mali	75.0
Stasiun Meteorologi Tardamu	56.2
Stasiun Meteorologi Sentani	56.0
Stasiun Meteorologi Umbu Mehang Kunda	46.2
Stasiun Meteorologi Binaka	45.8
Stasiun Klimatologi Tangerang Selatan	43.6
Stasiun Meteorologi Dok Ii Jayapura	40.1
Stasiun Meteorologi Rendani	37.0
Stasiun Meteorologi Minangkabau	35.4
Stasiun Meteorologi Hang Nadim	35.0
Stasiun Meteorologi Cut Nyak Dhien Nagan Raya	33.8
Stasiun Geofisika Deli Serdang	28.5
Stasiun Meteorologi Raja Haji Abdullah	27.5
Stasiun Meteorologi Juanda	25.0
Stasiun Meteorologi Depati Amir	25.0
Stasiun Meteorologi Raja Haji Fisabilillah	20.0
Stasiun Klimatologi Bangka Tengah	19.4
Stasiun Meteorologi Sultan Syarif Kasim Ii	18.8
Stasiun Meteorologi Fl Tobing	18.1
Stasiun Meteorologi Mopah	18.0
Stasiun Meteorologi Yuvai Semaring	16.0

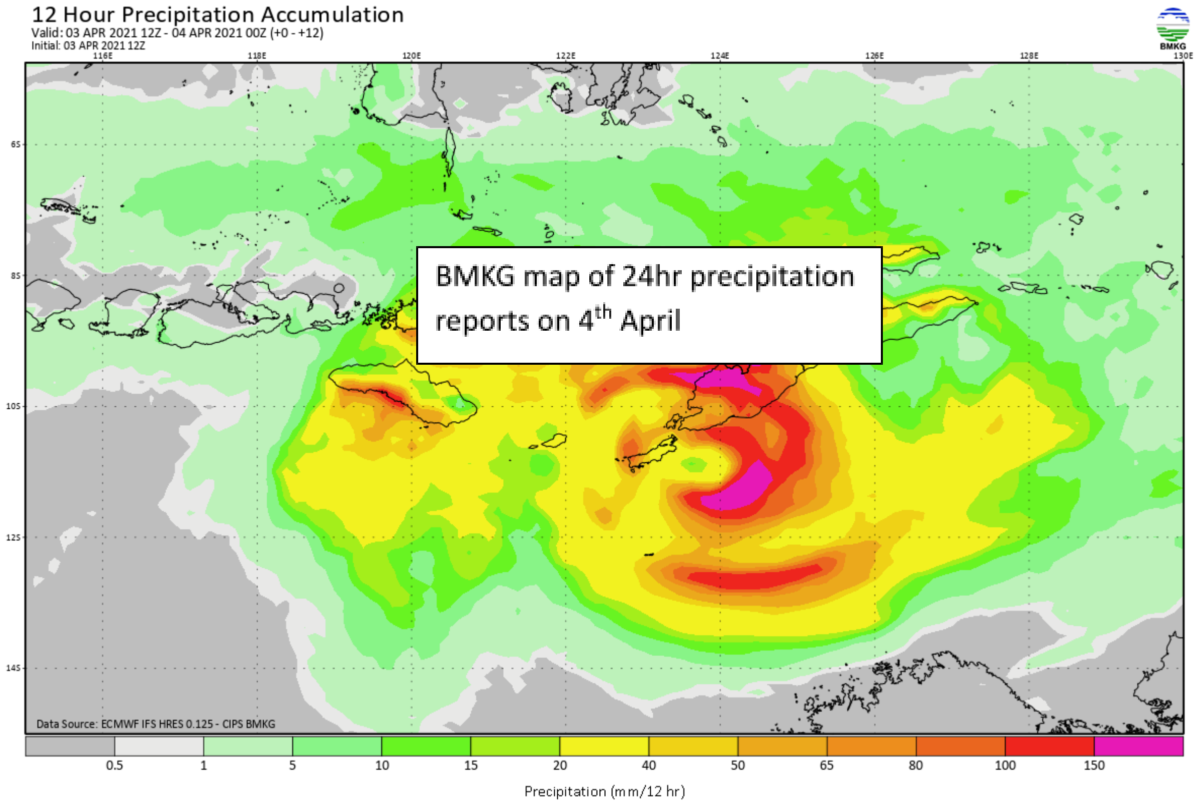
04 April 2021 pukul 07.00 WIB s/d 05 April 2021 pukul 07.00 WIB



STATION	24hRR
Stasiun Klimatologi Kupang	332.1
Stasiun Meteorologi Eltari	306.0
Stasiun Meteorologi Tardamu	113.5
Stasiun Klimatologi Mempawah	97.0
Stasiun Meteorologi Mali	84.0
Stasiun Meteorologi Malikussaleh	51.1
Stasiun Meteorologi Umbu Mehang Kunda	46.0
Stasiun Meteorologi Tunggul Wulung	43.0
Stasiun Meteorologi Sudjarwo Tjondro Negoro	41.0
Madiun/Iswahyud	33.5
Surakarta/Adisum	33.0
Stasiun Meteorologi Fransiskus Xaverius Seda	32.0
Stasiun Meteorologi Rendani	30.9
Malang/Abdul (Af	29.8
Stasiun Geofisika Sleman	29.5
Stasiun Meteorologi Kalianget	25.3
Kau	24.6
Stasiun Meteorologi Perak I	22.2
Stasiun Meteorologi Dok Ii Jayapura	21.4
Stasiun Meteorologi Susilo	20.5
Stasiun Meteorologi Mathilda Batlayeri	20.0
Stasiun Meteorologi Nunukan	20.0
Stasiun Meteorologi Amahai	19.0
Stasiun Meteorologi Gewayantana	17.0
Stasiun Meteorologi Banyuwangi	17.0

Daily rainfall totals for 2-4 April from BMKG. Note the significant totals on 2nd ahead of the main event on 3-4 April.

According to the AHA Centre situation report, the rainfall lasted for about 9 hours. The most representative report for the Flores islands is Gawayantana, with 22mm on 2nd, 150mm on 3rd and 17mm on 4th. While 50mm/hr is not unusual for a tropical thunderstorm, 150mm in 9 hours is extreme even by tropical standards. A report in the Guardian from a correspondent in Bali dated 10th April quoted a Kupang resident saying the storm started there at about midnight local time on 4th April and lasted until day-break. If the total of 230mm on 3rd for Kupang all fell in that 6 hours it is even more remarkable – and the data for 5th April indicate that another 330mm followed during the next day.



The EC 12-hour accumulation from 12UTC 3rd to 00UTC 4th (above) appears to capture the overall nature of the initial event in the early hours of 4th April, local time. Comparison with the Himawari images suggests that it has the whole system a little too far south (by perhaps as much as 100km). The southerly winds to the west of the TC centre produced the modest totals on Sunda and Bima, while the West to NW winds along the Flores Islands produced the high totals on their northern slopes, particularly on Adonara. The main rain bands on the northeastern flank of the TC produced the extreme totals over Timor – which continued into the 4th April.

How did the observed weather relate to climatology and/or previous extreme events?

The eastern islands of Indonesia are affected by the northeast monsoon with a rainy season December to March. Average rainfall in Kupang is 234mm in March and 65mm in April. Siswanto et al (**https://doi.org/10.1002/joc.4548**) carried out an extreme value analysis of Jakarta rainfall in the western part of Indonesia and found no occurrences of more than 300mm/day in a record from 1900. Shorter records from Ende and Bima indicate a large variation in monthly rainfall during the wetter months, probably related to exposure to the northeast monsoon winds, but even in the wetter Bima, the wettest monthly total is only slightly over 300mm. While tropical cyclones are rather rare over Indonesia – it is generally reckoned to be too close to the equator - tropical depressions that evolve into TCs are more common, affecting Indonesia twice a year on average, and often producing damaging rainfall. There are few records of rainfall associated with these, but up to 400mm in a day has been recorded. See below for extreme impacts.

Special/non-traditional observational data used in the weather forecast or assimilated into NWP None known

Weather models

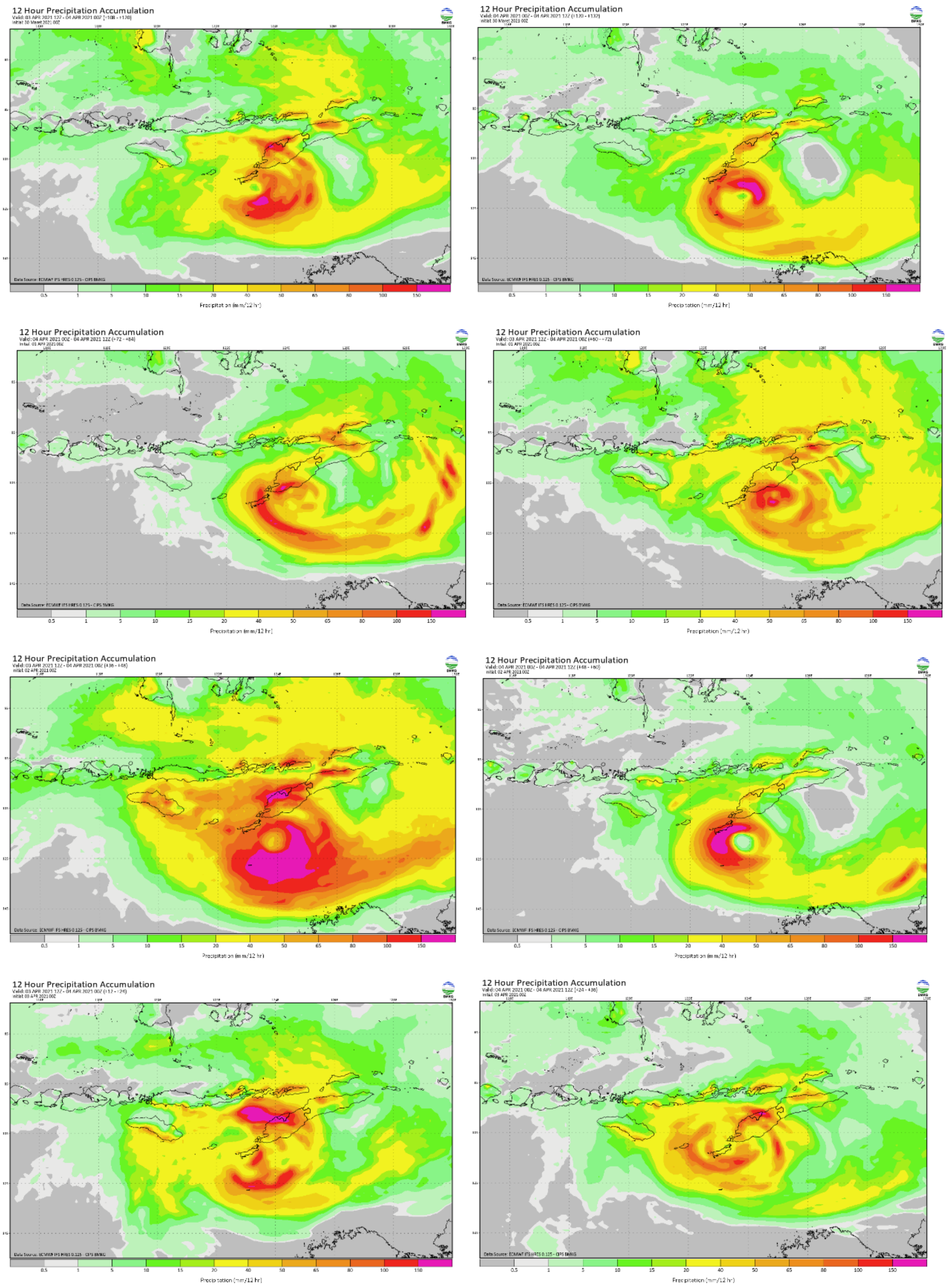
(Info on operational NWP systems: http://wgne.meteoinfo.ru/nwp-systems-wgne-table/wgne-table/)

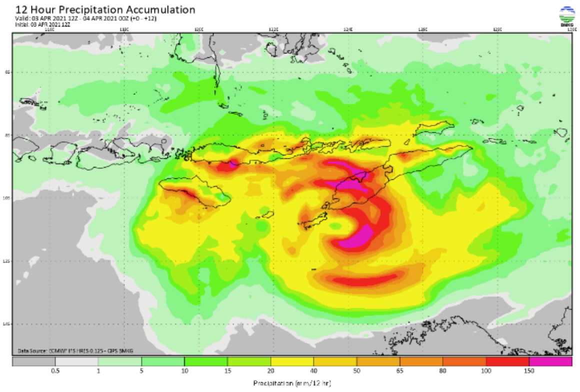
Name	Horizontal resolution	Ensemble size	Forecast length

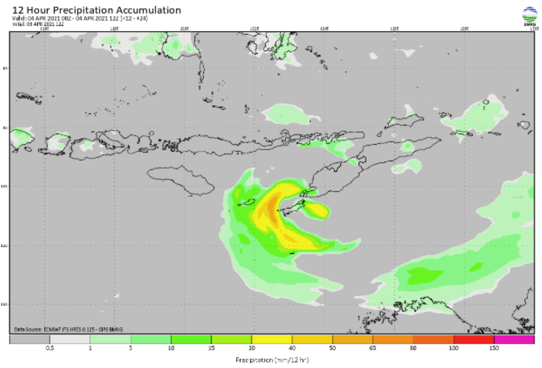
ECMWF HIRes			
ECMWF EPS			
UM regional EPS	8.8km & 4.4km		

Post-processing/calibration applied to weather model output None

Deterministic weather forecast outputs and examples

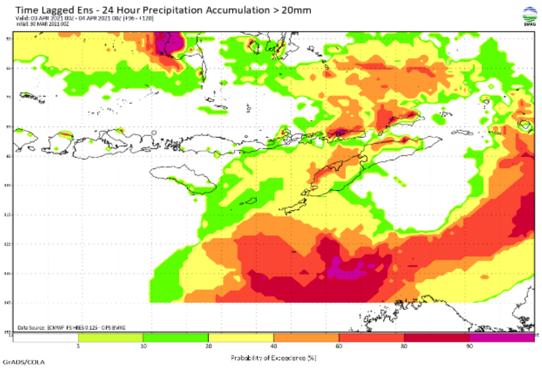


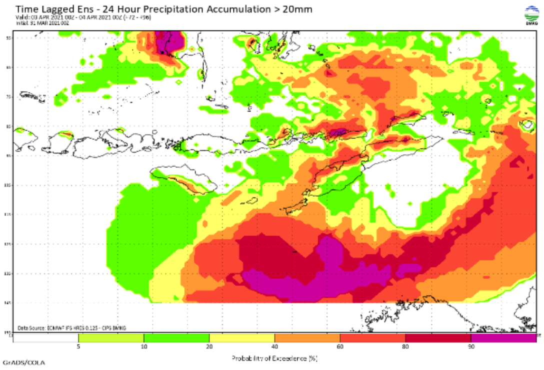


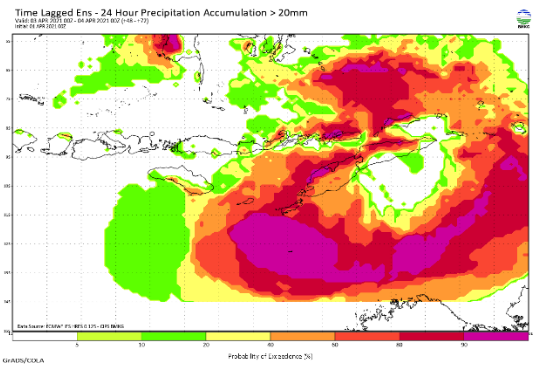


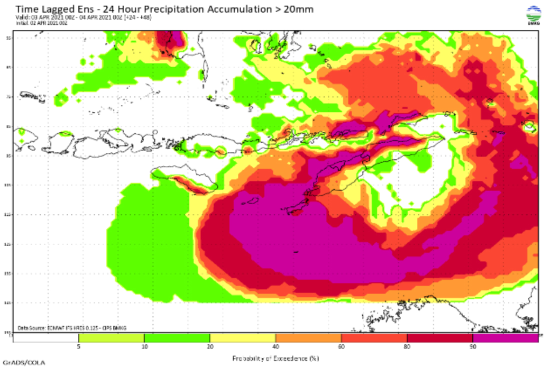
As shown above, the EC position forecasts of the centre of the TC were remarkably consistent, at least from 1st April. However, the rainfall forecasts show substantial day-to-day variability.

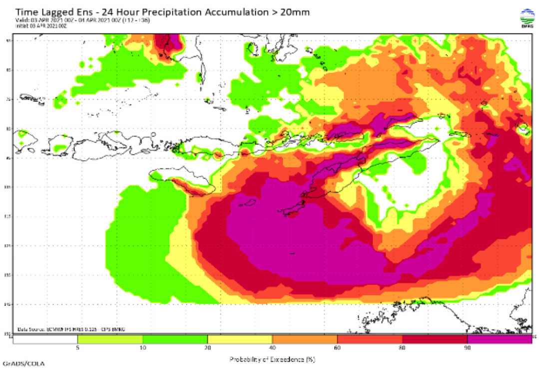
Ensemble/probabilistic weather forecast outputs and examples

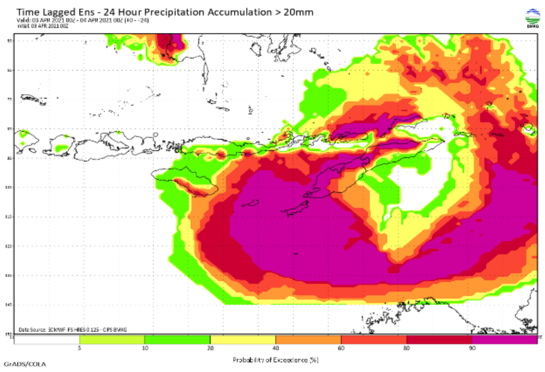






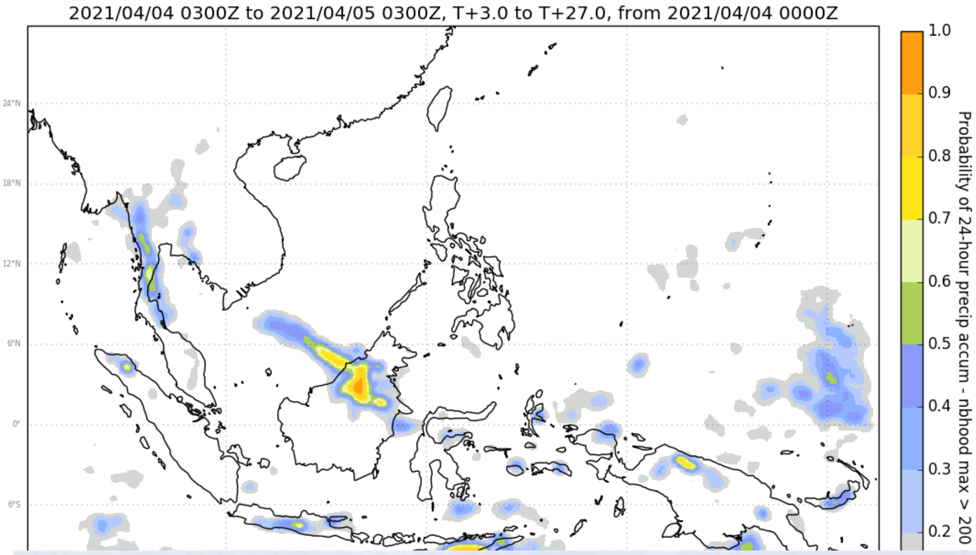






The probabilities of exceeding 20mm in a day show good consistency but there is only a weak signal in the probabilities of more than 50mm. Along with the deterministic forecast amounts, this should have been sufficient for a warning both for Timor and for the coastal areas of the Flores Islands.

For the extreme rain in Kupang, the EC forecasts of 24-hour precipitation for 4th April show a consistent story from the ensemble (blue box & whisker) increasing to about half the observed amount (green star) in the final forecast. By contrast, the HiRes (red dots) shows enormous run-to-run variability, but a much more accurate final run. The ensemble mean exceeds the model climate extremum (black triangle) in the final run.



Data from the Met Office 8.8km regional EPS for this area are available for 4th April showing substantial probabilities of more than 200mm on Timor (below)

Interpretation/guidance for forecast users

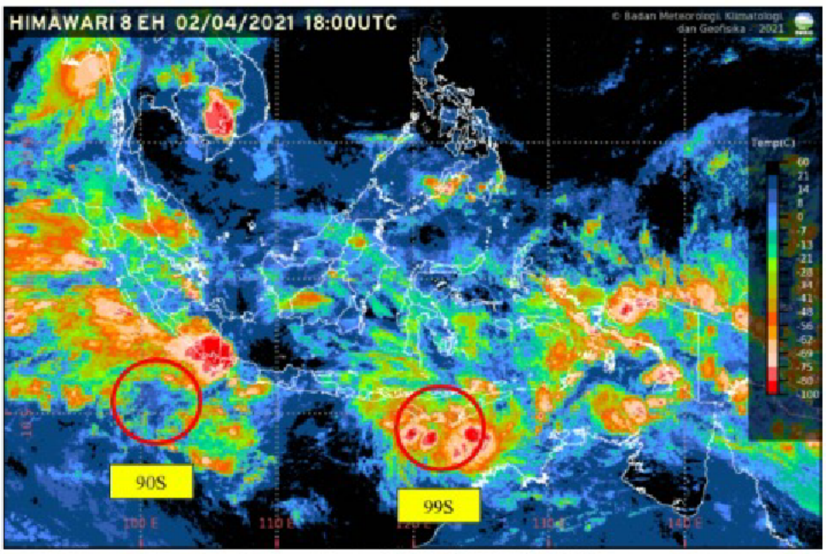
Tropical Cyclone "Seeds" formation bulletin issued 0100 3 April (Local) by TCWC Jakarta.

BADAN METEOROLOGI KLIMATOLOGI DAN GEOFISIKA

Jl. Angkasa I No. 2, Kemayoran, Jakarta 10720 Telp. : (021) 4246321 Fax. : (021) 4246703
P.O. Box 3540 Jkt, Website : http://www.bmkg.go.id

BMKG

Analisis Bibit Siklon Tropis di dalam wilayah AoR TCWC Jakarta
Tanggal 02 April 2021 Pukul 18 UTC



Gambar: Citra Satelit 3 April 2021 01.00 WIB

Bibit Siklon Tropis di wilayah Tanggung Jawab TCWC Jakarta :

1. **99S. INVEST.25kts-1003mb -10.4S-122.2E(AoR)**
2. **90S. INVEST. 20kts-1004mb-9.1S-103.5E(AoR)**

1. Bibit Siklon 99S

Bibit siklon 99S terpantau bergerak ke arah selatan tenggara, saat ini berada di Laut Sawu bagian selatan berbatasan dengan Laut Timor, selatan Pulau Rote, tepatnya pusat sistem berada di sekitar 11.3LS – 122.7BT, dengan kecepatan angin maksimum sistem 20-25 knot terutama di kuadran bagian timur. Tekanan yang terpantau ada di kisaran 1000 mb. Identifikasi suspect area menunjukkan sirkulasi angin terpantau di lapisan bawah hingga menengah (850-500 mb). dari citra satelit Himawari-8 kanal infra merah menunjukkan keberadaan deep convective yang persisten dalam 12 jam terakhir. Kondisi lingkungan lainnya yang lebih luas menunjukkan MJO sedang aktif di wilayah Indonesia, didukung aktifnya gelombang equatorial lainnya (Low dan ER). Berdasarkan angin 850 mb menunjukkan suplai angin dari barat dan utara masuk ke dalam sistem, angin lapisan atas (200 mb) di wilayah bibit menunjukkan < 20 knot, sehar vertikal yang lemah (5-15 knot) dengan shear tendency 24 jam terakhir lemah, upper divergence cukup kuat

What was the level of agreement between the different forecasts?

How reliable and accurate were weather forecasts?

When was the potential event first detected in the models?

The general nature of the development was well captured by the EC forecast from 30^{th} March.

Additional analysis i

Successes/issues/challenges experienced? i

Part 2b. Supplementary information about hazards

Wherever possible, please include references to information you provide!

Editors (Name & Institute):

Brief overview of the hazard event(s)

The main hazards were flash floods, landslides, soil liquefaction, a rockfall. The initial events that caused most impact occurred in the early hours of April 4th (estimated ~6am, local time – ~23 UTC).

Hazard observations and analyses.

How did the hazard(s) relate to climatology?

Flash floods and landslides are common in Indonesia. It is not clear how extreme the floods were. The rivers are small, short and steep and there are no records available.

How was the hazard(s) made worse by pre-existing conditions?

The event happened at the end of the rainy season, so the ground was saturated. There were flash floods reported on 1st April. It is not clear whether the locations overlapped, but they may have done.

Observational data used in the hazard forecast or assimilated into the hazard model None

Hazard prediction models/tools None known

Name	Resolution	Ensemble size	Forecast length

Deterministic hazard forecast outputs and examples

Ensemble/probabilistic hazard forecast outputs and examples i

How reliable and accurate were the hazard forecasts? i

What was the trigger used to classify the event as hazardous and start the warning process? Designation of the TC by Darwin followed by Jakarta. By this time the main impacts in the Flores islands had already happened.

Additional analysis i

Successes/issues/challenges experienced? i

Part 2c. Supplementary information about impacts

Wherever possible, please include references to information you provide!

Editors (Name & Institute):

Brief overview of the impact(s)

Media reports identified the following locations of serious impacts:

There are several versions of the impact statistics for Indonesia. The final numbers announced by the BNPB were 181 dead and 45 missing. EM-DAT combines those to give a death toll of 226. The initial BNPB release gave 129 injured, but the EM-DAT figure is 21, suggesting that some of the increasing death toll was of injured who didn't survive. EM-DAT gives the number of affected as 509,604, a much larger number than initial BNPB estimates of 2,019 households/ 13,226 people. EM-DAT quotes a cost of $240M. the initial BNPB damage estimates were 688 houses heavily damaged, 272 moderately, 154 slightly and 1992 affected. They also estimated 24 businesses destroyed and 87 affected. 15 bridges were reported as destroyed. However, Antara on 14th suggested there were only 9 bridges lost. The biggest city in the region is Kupang, population ~450,000. Many of the displaced were here but only 6 people died.

At least another 41 died and 143,670 displaced in East Timor (EM-DAT).

AHA Centre Situation report 14-4-21: TC Seroja brought flood/flash-floods, strong winds, and landslides in the region especially in East Nusa Tenggara and West Nusa Tenggara. Heavy rain lasting about nine hours caused dams in four sub-districts to overflow, inundating houses and ricefields. The BNPB reported that as many as 509,604 persons were affected by TC 26S(SEROJA), with 11,406 people displaced, 181 deaths, 271 injuries, 45 missing persons while 66,036 houses were reportedly damaged in East Nusa Tenggara and West Nusa Tenggara (as of 12 April, 23.30 WIB)

Electricity was cut widely and was expected to be out for at least a month in parts of Timor. Communications lines were also cut. Crops were widely destroyed raising fears of a food shortage and prompting panic buying. Aid supplies were flown in to prevent this. Looting was reported, so while women and children stayed at rest centres, the men returned home to maintain security (Guardian 10th April)

Bridges and roads connecting to Flores Island and Adonara Island were destroyed. The banks of two rivers in Ende district burst, killing two people and resulting in extensive flooding. Dozens of homes were buried under mudslides in the village of Lamenele on Adonara island. 14 villages on Lembata Island were hit by flash flooding as a result of runoff of volcanic material erupted from Mount Ile Lewotolok during the previous November. A local chief in East Flores reported that hundreds of hectares of crops were destroyed. Dozens of farm animals were also reportedly swept away by flash floods. A majority of casualties in East Flores were from the Nelelamadike village in Adonara Island after a massive rockslide struck the village killing 55, of whom 15 were children. More than 600 residents of the village were left homeless. (Wikipedia)

Observed health impacts

Observed property and business impacts

Observed critical infrastructure damage and service disruption

Environmental damage observed

Impact prediction models/tools i

Name	**Method**
None known	

Impact forecast outputs and examples

Comparison of predicted and actual impacts i **-**

Informal rules/tools used to identify impacts i -

Who and what were exposed to the hazards, when, for how long and why?

In the Flores islands, the exposure was mainly in small villages that were devastated either by the water itself (flash flood) or by mud or, in one case, by a rockfall from a previous volcanic eruption.

Out of those exposed, who and what were vulnerable to the hazards and why?

Additional analysis

In the EM-DAT record from 2000, previous weather-related disasters with more than 200 dead/missing in Indonesia have occurred in: 2001, 2003, 2006,2010, 2019. These were all flood-related. The worst was in 2010 when 290 were killed. We may estimate therefore that this was a ~20% per year event for the whole of Indonesia (an area ~half that of Europe) – much less likely in this particular region. This was the worst event in the East Timor record from 2000 – but the statistics are less reliable for that country.

Successes/issues/challenges experienced? i

Part 2d. Supplementary information about warning communication

Wherever possible, please include references to information you provide!

Editors (Name & Institute):

Brief overview of the communication "story"

(Jakarta Post 30th November 2020) Following the eruption of Mt Ile Lewotolok, local villages within 4km of the mountain were advised to take precautions during heavy rain.

(Antares 25th March) BMKG forecast that Nusa Tenggara would start its dry season in April.

BMKG highlighted the likely development of a TC from March 29th.

(Antares March 30th) BMKG forecast heavy rain with lightning and strong winds across much of Indonesia on their website. Any regional detail is not quoted.

BMKG warned of coastal flooding from storm surge and heavy rainfall during April 1st-3rd on Saturday April 3rd (Antares April 4th)

On Sunday afternoon, April 4th, BMKG released the status of potential heavy rain for the impact of flood / flash, NTT was on alert status (CNN Indonesia April 5th)

Some residents used traditional means to warn people, with reports of mosques using loudspeakers and church bells to warn of imminent danger. (Straits Times April 9th)

Antara reported that during an online limited meeting on the disaster from the Merdeka Palace, Jakarta, on 6th April, President Jokowi remarked that all regional leaders and the public should be able to access and monitor the weather forecast issued by the BMKG – suggesting that the warnings were not issued to these groups.

Straits Times (April 9th) reported that there were no warnings issued, quoting local residents in the affected areas. However, we must be cautious in accepting this, as there are always some who claim this after any disaster.

What information was provided to emergency responders, government and other stakeholders about the hazard and its possible impact, and by whom?

BMKG warning on 3rd April: in addition, the threat of rob (storm tide?) looms large over the coast of Sumba Island and Sabu Island and Raijua Island. Hadi noted that this condition could have an impact by disrupting transportation around the port and coast, the activities of salt farmers and inland fish, as well as loading and unloading activities at the port.

Public warnings in detail i

Warning name	Warning lead time	Issued by	Warning area	Type of warning	Did it include safety advice?	Scaled	Channel	Warning frequency
		BMKG		Severe weather warning			Press release	
TC Seroja	0	BMKG		TC warning			Text	

Warning outputs and examples

Was uncertainty included in the warning? If so, how? No

Were communication systems in place and operating effectively?

Were warning messages received and understood by the public? How did you know?

Were the needs of specific communities and populations addressed? If so, how? No.

Additional analysis i

Communication success/issues/challenges experienced i

Part 2e. Supplementary information about responses to warnings

Wherever possible, please include references to information you provide!

Editors (Name & Institute):

Brief overview of the response to the hazard by emergency services and other partners

A state of emergency was declared on 6th April, 2 days after the main impact. The head of BPBD in East Nusa Tenggara was removed from office for his slow response (Kompas 9th April).

What were the main response actions by the public to the warnings?

None

Institutional responses i

Response actions	Taken by whom	When taken	On the basis of what information?	Benefit (if any)	Cost

How did the overall response to this event compare to similar previous events?

How knowledgeable was the community about the hazard?

Reference to variable preparedness depending on whether floods had happened recently.

Were disaster preparedness and response plans in place and used?

Reference to use of church bells to alert people to evacuate to high ground.

What capacity did the community have to respond to warnings?

In the rural communities, response was to move to high ground.

Additional analysis i

Success/issues/challenges experienced i

Part 2f. Analysis of the warning chain

Information flow through the warning chain

Warning chain	Was this produced? (yes/no)	Was all necessary input information available? (yes/no)	Commentary: Was the forecast complete? what input information was missing? Who could have provided it?
Weather forecast	Yes	No	
Hazard forecast	Yes	Yes	Warning was of coastal flooding – implied main risk was from storm tide and waves, though rain was mentioned. Flash flooding needed highly local rainfall forecast, plus antecedent hydrology. No mention of landslides or rockfalls. The volcanic rock precursor could have been identified.
Impacts forecast	No		
Warning	Yes	No	Coastal flooding
Response	No	No	

Tools and operational workflows for sharing information between partners. Not known

How were social media data used in the warning chain? Not known

Evidence that warning chain was effective in reducing fatalities, injuries, damage, and/or disruption? Very little?

What were the strongest links in the warning chain?

What were the weakest links in the warning chain? Individual impacts were unpredictable with current capabilities.

What procedures were used to identify lessons learned from the event? i None known.

If known, how did lessons learnt from previous events contribute to greater warning success for this event? No evidence.

Additional analysis

Part 3. Assessment of the end-to-end warning chain

Assessor (Name & Institute) (optional):
Profession:
Please rate your level of expertise on a scale of 1 (no expertise) to 5 (established expert) for:

Weather: 5

Hazard: 5

Impact: 4

Warning/communication: 3

Response: 2

High-impact weather event evaluation: 4

HOW SUCCESSFUL WERE THE FORECASTS, WARNINGS AND RESPONSES?

How well was the event observed? *Scale of 1 (poor) to 5 (excellent) 3*
Reason for this rating TC was well observed from space. Surface conditions based on few reports. Precipitation based on 1 radar and ~3 gauge locations – inadequate for the complex topography.

How well was the weather forecast? *Scale of 1 (poor) to 5 (excellent) 3*
Reason for this rating The formation of the TC was forecast several days ahead. However, the rainfall forecast for the critical period varied substantially from run to run up to the last minute.

How well were the hazards forecast? *Scale of 1 (poor) to 5 (excellent) 1*
Reason for this rating There were no hazard forecasts.

How well were the impacts predicted? *Scale of 1 (poor) to 5 (excellent) 1*
Reason for this rating There were no impact forecasts.

How well were warnings communicated? *Scale of 1 (poor) to 5 (excellent) 1*
Reason for this rating No public warning was issued. The forecasts may have been used by BNPB for readiness.

How well were the warnings used? *Scale of 1 (poor) to 5 (excellent) 1*
Reason for this rating Initial response appears to have been quite fast, suggesting readiness. However, the level of damage made access a problem.

How well did the entire warning chain perform overall? *Scale of 1 (poor) to 5 (excellent) 1*

Thank you very much for contributing to the WWRP Warning Value Chain Project database!

Acknowledgements (e.g., information providers) i

Annex 1: *Weather system and hazard types based on pre-defined hazards in the Sendai Framework Monitor*

a) Weather system types

- Blizzard
- High pressure system
- Convective storm
- Cyclone surge
- Cyclonic rain
- Cyclonic wind
- Derecho
- Extra-tropical storm
- Extreme temperature
- Fog
- Rain
- Snow
- Tornado
- Tropical cyclone

b) Hazard types

- Coastal erosion
- Coastal flood
- Cold wave
- Dust
- Fire
- Flash flood
- Flood
- Fog
- Freak waves
- Freeze
- Frost
- Hail
- Heat wave
- Ice
- Lightning
- Riverine flood
- Snow
- wind
- Wave action
- Wildfire

<table>
<tr><th colspan="2">Weather (system) types</th><th colspan="4">Hazard types</th></tr>
<tr><td>Type</td><td>Sub-type</td><td>Type</td><td>Sub-type I</td><td colspan="2">Sub-type II</td></tr>
<tr><td colspan="2" rowspan="3">Tropical storm/cyclone</td><td>Rain</td><td>Flood</td><td colspan="2">Riverine flood, coastal flood, flash flood</td></tr>
<tr><td rowspan="2">Wind</td><td>Wave action/ storm surge/ freak waves</td><td colspan="2">Coastal erosion</td></tr>
<tr><td colspan="2">Dust</td><td rowspan="2">Dust</td></tr>
<tr><td rowspan="2">Convective storm</td><td>Tornado</td><td>Lightning</td><td>Fire</td><td>Urban fire, wildfire</td></tr>
<tr><td>Derecho</td><td colspan="4" rowspan="2">Hail</td></tr>
<tr><td rowspan="3">Extratropical storm</td><td>Cyclonic storm</td></tr>
<tr><td rowspan="2">Blizzard</td><td rowspan="2">Snow</td><td colspan="3">Avalanche</td></tr>
<tr><td colspan="3">Snow drift</td></tr>
</table>

<table>
<tr><td rowspan="2">High pressure system</td><td rowspan="2">Extreme temperatures</td><td>Cold wave</td><td>Freeze, frost, ice</td></tr>
<tr><td colspan="2">Heat wave</td></tr>
<tr><td>Fog</td><td colspan="3">Fog</td></tr>
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