Climate is what you used to expect, extreme weather is what you get!

My Climate Risk Interdisciplinary Reading Group (MCRILG)

13 July 2026

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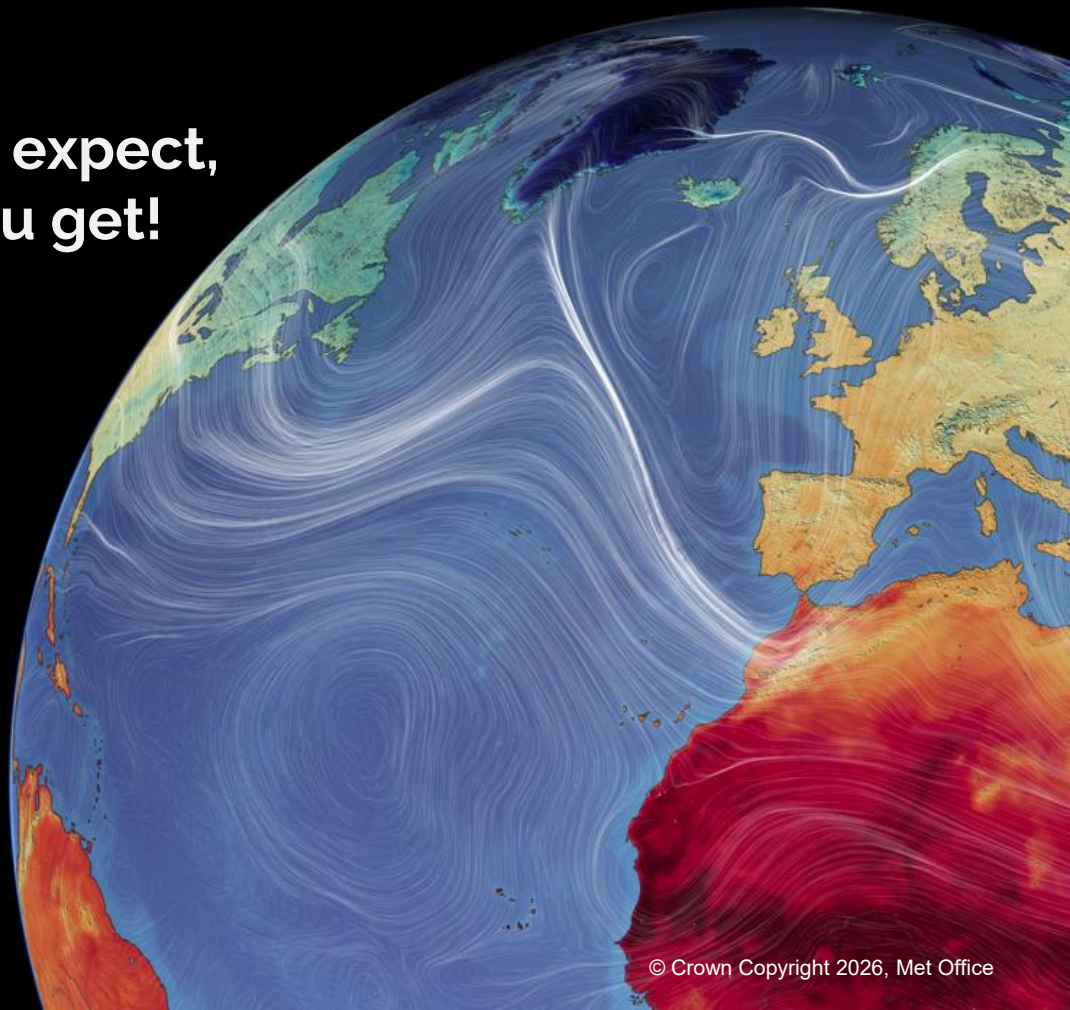

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Outline

- Background & context
- Focus paper: Potter et al. (2025) Research gaps and challenges for impact-based forecasts and warnings
- Bridging impact-based weather & climate services

Met Office University of BRISTOL

Undergraduate in meteorology from University of Reading, with year in Oklahoma

PhD from the LSE working with Lloyd's of London insurance

Postdoc at the University of Cape Town, South Africa

Met Office Senior Scientist, and later Science Manager in International Climate Services

Joint role at the University of Bristol through Met Office Academic Partnership (MOAP)

WCSSP South Africa Lead Scientist

IPCC WGI AR7 Lead author Ch10: Climate Information & Services

2003 2007 2011 2015 2021 2023 2025

CLIMATE SERVICES

INFORMATION IN CONTEXT

Climate services involve the provision of climate information in such a way as to assist decision-making. The service includes appropriate engagement from users and providers, is based on scientifically credible information and expertise, has an effective access mechanism and responds to user needs (Hewitt et al., 2012).

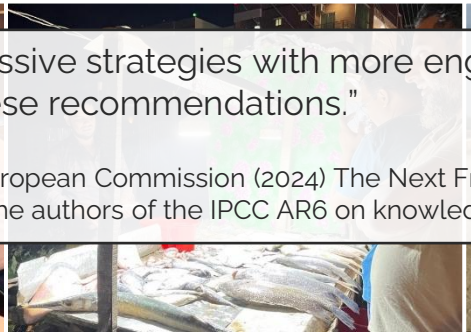
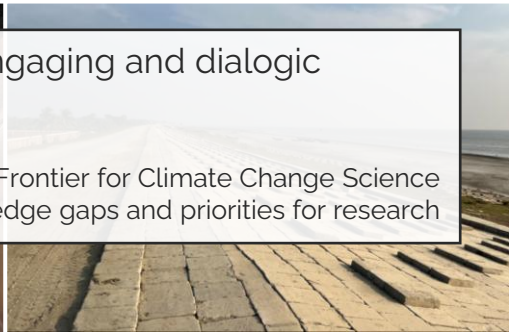
"Integrating social science is no panacea for demand-driven climate services, but it is certainly a prerequisite."

Findlater et al., (2021) Nature Climate Change,
Climate services promise better decisions but mainly focus on delivering better data

"The science of communication suggests replacing passive strategies with more engaging and dialogic approaches. Research is required to operationalise these recommendations."

European Commission (2024) The Next Frontier for Climate Change Science
Insights from the authors of the IPCC AR6 on knowledge gaps and priorities for research



CO-PRODUCTION

FIGURE A: The building blocks of co-production *(Adapted from Carter et al 2019)*

FIGURE B: Ten principles for good co-production *(Adapted from Carter, et al 2019)*

Carter, S., Steynor, A., Vincent, K., Visman, E. (2026) 'Co-production of African weather and climate services'. Third edition. Exeter: Weather and Climate Information Services for Africa

Met Office University of BRISTOL

"The need for climate services to inform decision-making has never been greater." (WMO, 2024)

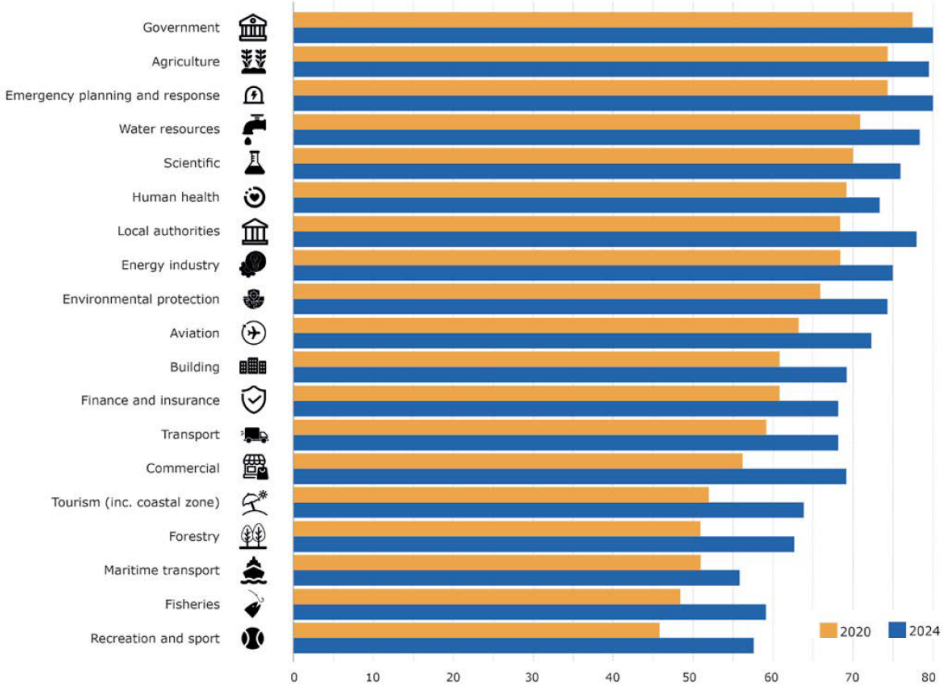
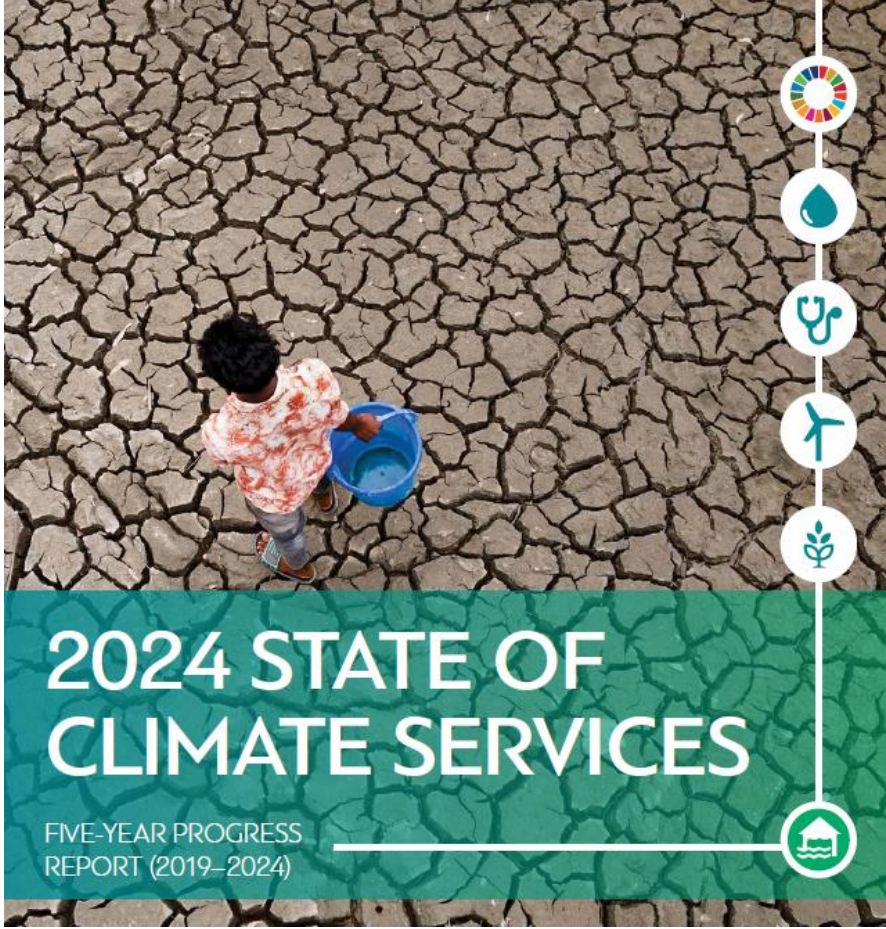


Figure 18. Number of NMHSs that provide climate services, per sector



WORLD METEOROLOGICAL ORGANIZATION

GFCS GLOBAL FRAMEWORK FOR CLIMATE SERVICES

Met Office

Focus paper

ELSEVIER

International Journal of Disaster Risk Reduction

Volume 118, 15 February 2025, 105234

Research gaps and challenges for impact-based forecasts and warnings: Results of international workshops for High Impact Weather in 2022

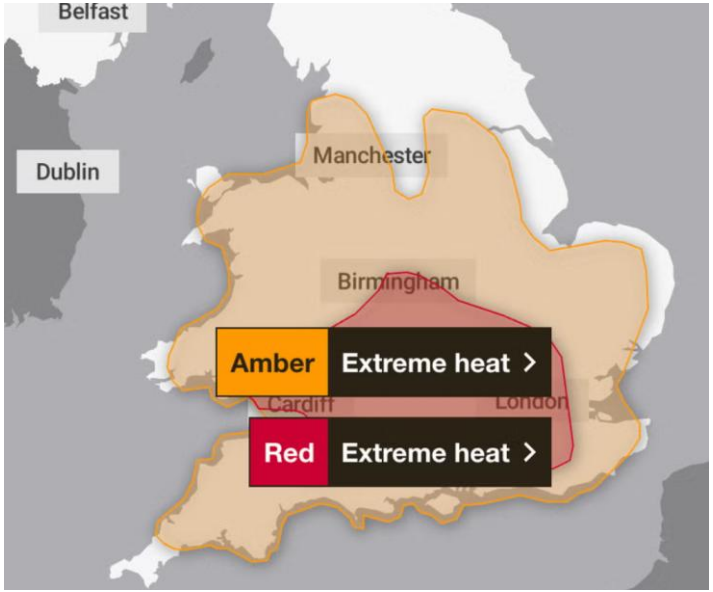
Sally H. Potter [a], Thomas Kox [b], Brian Mills [c], Andrea Taylor [d], Joanne Robbins [e], Carolina Cerrudo [f], Faye Wyatt [e], Sara Harrison [a], Brian Golding [e], Will Lang [e], Adam J.L. Harris [g], Rainer Kaltenberger [h], Stefan Kienberger [i], Harold Brooks [j], Andrew Tupper [k]

England set a new national record for June daily maximum temperature. A provisional high of **37.7°C** was recorded at Lingwood, Strumpshaw Hill on 26 June, surpassing the previous record of 35.6°C set at Southampton in June 1976.

Wales also experienced exceptional heat, with **35.9°C** recorded at Cardiff Bute Park on 25 June, breaking the previous June record of 33.7°C set in 2000.

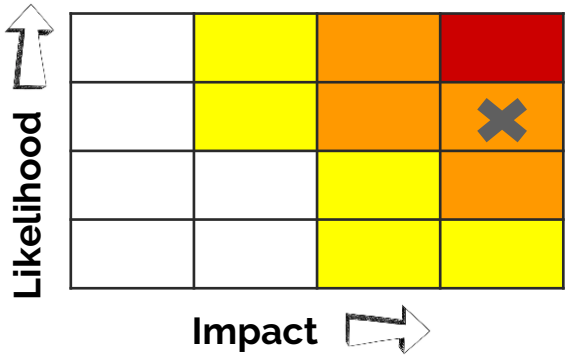
The UK and Wales saw a **new record overnight temperature**, with **23.5°C** recorded at Cardiff Bute Park on 25 June, surpassing the previous record of 20.0°C set in 2023.

https://www.metoffice.gov.uk/blog/2026/june-2026-heatwave-a-recap-of-the-temperature-records



"As temperatures soared in recent days across the British capital—home to around 9 million people—the service said ambulance crews responded to a **record 642 Category 1 calls** on Wednesday."

https://phys.org/news/2026-06-uk-june.html



Impact-based forecasting (IBF):

“considers the vulnerability of people and property to the weather and warns of the associated impacts, as well as the likelihood of them occurring”

Met Office website

Impact tables are used by the Met Office for its National Severe Weather Warning Service.

Right - example for “Impacts resulting from snow”.

- Tables are not exhaustive.
- They do not include secondary or downstream impacts.
- The level of impacts can be affected by previous weather and climate conditions, as well as non-climate factors (e.g., conflict and economy).

Very Low	Low	Medium	High
A few transport routes affected.	Some transport routes and travel services affected. Some journeys require longer travel times.	Transport routes and travel services affected. Longer journey times expected. Some stranded vehicles and passengers, with disruption to rail, road and air services. Interruptions to power and/or other utilities and services. Some rural communities temporarily inaccessible due to deep snow or snow drifts.	Transport routes and travel services affected for a prolonged period. Long travel delays. Large numbers of stranded vehicles and passengers with widespread disruption to rail, road and air services. Widespread and prolonged interruptions to power and/or other utilities and services. Rural communities cut off for a prolonged period, perhaps several days, due to deep snow or snow drifts.

KEY POINTS

Motivation

- UN motivated for “Early Warning for All” in 2022 calling for everyone in the world to be protected from natural hazards through early warnings by 2027
- Learning from insights developed in the High Impact (Weather (HIWeather) research project under the WMO World Weather Research Programme
- Summary and synthesis of discussions on key gaps, challenges and opportunities for enhanced impact-based forecasts and warnings (IBFWs) supporting early action, taken from a series of global interactive workshops in 2022 involving 350 people

KEY POINTS

Findings

- Eleven themes identified after analysing data from workshop, using thematic coding of workshop outputs

Communication and uncertainty

Measures and success

Responsibility

Tailoring

Evaluation and verification

Scale and resolution

Cost and feasibility

Interoperability

Multi-hazard complexity

Knowledge translation

Input variables

KEY POINTS

Responsibility

- "We often hear NMHSs say 'we're not allowed to do impact-based forecasting' because the responsibility for impacts and response lies elsewhere." (W3-GC-02)

- Solutions offered by participants to address responsibility challenges included adopting a co-production framework in which multiple agencies representing several lines of authority would be co-located.

KEY POINTS

Communication and uncertainty

- "How do you deal with low probability but [very] high impact events being seen as providers of data not knowing what they are talking about? This is made worse when you have multiple large scale hazards." (W3-GC-28)
- Participant comments touched on whether and how probabilistic information should be communicated.
- A further challenge is how to communicate risks and impacts in a changing climate, "When people may never have experienced anything like it before." (W2-GC-17)

Met Office

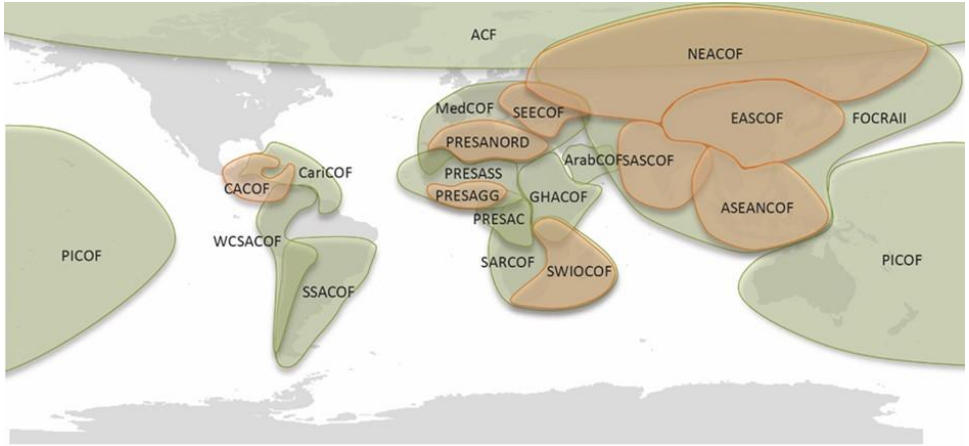
SIMBOL – Seasonal IMpact-Based OutLooks

Learning from the development of impact-based severe weather warnings to enhance seasonal climate services

MOTIVATION

Regional and National Climate Outlook Forums issue seasonal climate outlooks and discuss the implications for key sectors and livelihoods.

Images right: 21 RCOFs around the world – WMO

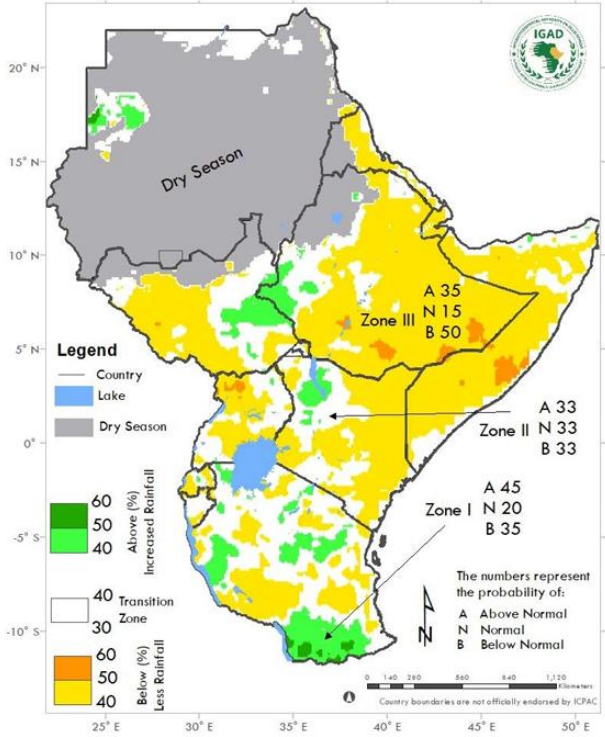


Progress has been made in model-based probabilistic seasonal forecasting. Yet it is the **impacts of weather during and throughout the season** that affects people and ecosystems.

The challenge is to translate seasonal outlooks into ***probabilistic impact-based seasonal outlooks*** and advisories. At present, seasonal outlooks place too much emphasis on the “most likely” outcome.

GHACOF-63 seasonal outlook

Rainfall Probabilistic Forecast March - May 2023



"Dry conditions highly likely to continue over the Horn of Africa during the March to May 2023 rainfall season"

Reliefweb, Feb 2023

KENYA

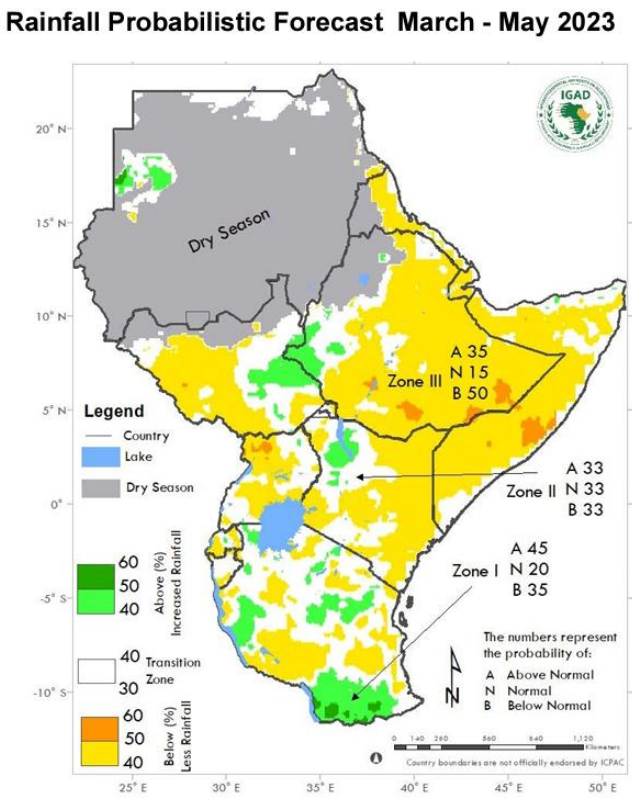
Disaster Risk Management

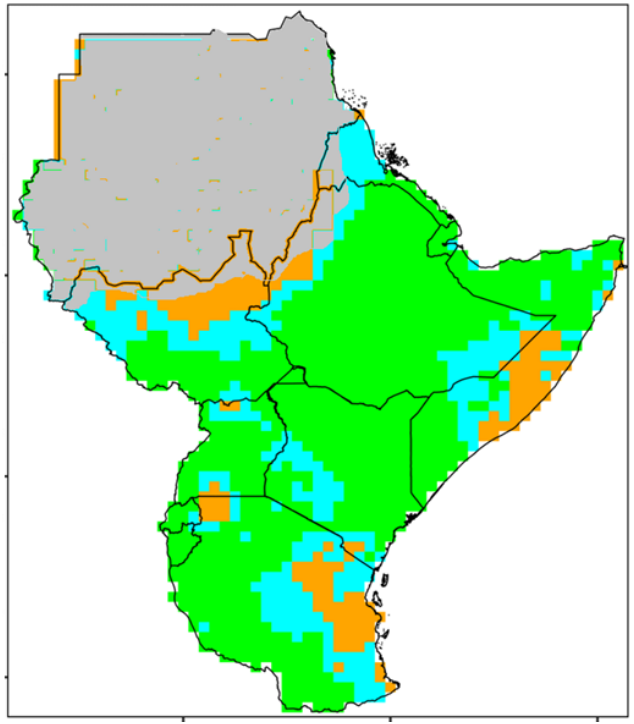
Increase in the number of people in need of humanitarian/food aid from current 4.3M people. Heat stress likely to impact human, wild and domestic animals. Water scarcity for communities and wildlife. School drop-outs expected to increase in drought affected areas.

Advisory

- Continue/enhance relief food distributions and cash transfers.
- Distribute animal feeds and encourage animal off-take.
- Encourage water trucking and rehabilitate water sources.
- Enhance school feeding programs.
- Disseminate climate information and create awareness to support decision making.

GHACOF-63 seasonal outlook verification





Wetter
Average
Drier

ICPAC Regional verification MAM 2023
https://www.icpac.net/documents/757/MAM_Verification.pdf

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Phase 1

PREPARATION

Phase 2

CO-CREATION

Phase 3

COMMUNICATION & EVALUATION

Example: Groundwater in Somalia

Phase 1
PREPARATION

Phase 2
CO-CREATION

Phase 3
COMMUNICATION
& EVALUATION

SIMBOL approach

STEP 1: Define the seasonal variable, impact and region of interest

Total seasonal rainfall (March to May) impacts on groundwater availability in Somalia

STEP 2: Define likelihood thresholds

High	≥ 70 %
Medium	35 – 65 %
Low	15 – 30 %
Very Low	≤ 10 %

STEP 3: Define impact categories and co-develop impact table

Minimal	Minor	Significant	Severe
Groundwater levels are healthy, within normal range. Good availability.	Groundwater levels are lower than normal. Reduced availability in some places.	Groundwater levels are very low. Limited availability across the region. Shallow wells and boreholes are dry.	Groundwater levels are exceptionally low. No availability across the region. All wells and boreholes dry.

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SIMBOL approach

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Phase 1
PREPARATION

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CO-CREATION

Phase 3
COMMUNICATION & EVALUATION

SIMBOL approach

STEP 4: Articulate standard advisories for each risk level

Risk advisory levels	
Very low risk	Level 0
Low risk	Level 1
Moderate risk	Level 2
High risk	Level 3

Examples:

- Monitor water sources continuously.
- Increase community awareness on water saving and water quality.
- Enhance water harvesting and conservation and prepare for water conflict resolution plan.
- Preposition safe drinking water, mobile clinics, cash grants, and humanitarian assistance.

Phase 1
PREPARATION

Phase 2
CO-CREATION

Phase 3
COMMUNICATION
& EVALUATION

SIMBOL approach

Step 5: Assign impacts and their severity to each outcome

Prior to the release of the seasonal outlook, co-production sessions take place across sectors (e.g., water & energy, health, agriculture & food security).

Phase 1
PREPARATION

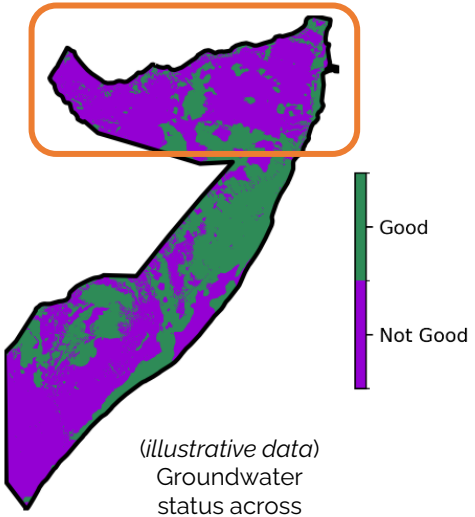
Phase 2
CO-CREATION

Phase 3
COMMUNICATION & EVALUATION

SIMBOL approach

Step 5: Assign impacts and their severity to each outcome

None	Minimal	Minor	Significant	Severe
Groundwater levels are healthy, within normal range. Good availability.	Groundwater levels are healthy but at the bottom of the range of normal levels. Adequate availability.	Groundwater levels are lower than normal. Reduced availability in some places.	Groundwater levels are very low. Limited availability across the region. Shallow wells and boreholes are dry.	Groundwater levels are exceptionally low. No availability across the region. All wells and boreholes dry.
	Above normal rainfall	Near normal rainfall		Below normal rainfall



(*illustrative data*) Groundwater status across Somalia

Phase 1
PREPARATION

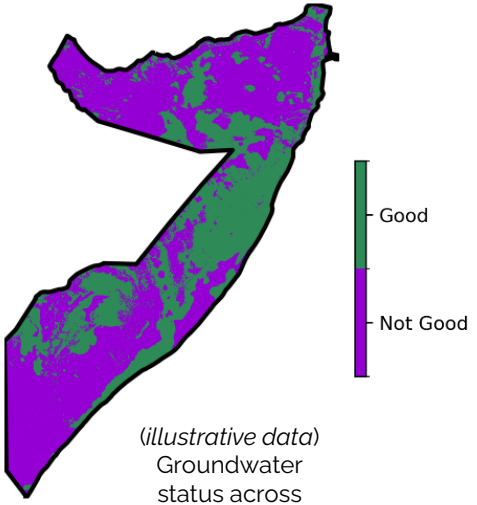
Phase 2
CO-CREATION

Phase 3
COMMUNICATION
& EVALUATION

SIMBOL approach

Step 5: Assign impacts and their severity to each outcome

Region	Below-normal	Near-normal	Above-normal
Northern Somalia	severe	minor	minimal
Central Somalia	minor	minimal	minimal
Southern Somalia	severe	minor	minimal



(*illustrative data*) Groundwater status across Somalia

Phase 1
PREPARATION

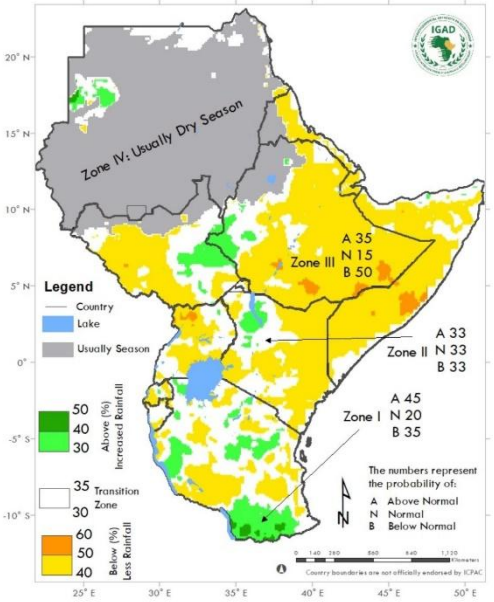
Phase 2
CO-CREATION

Phase 3
COMMUNICATION & EVALUATION

SIMBOL approach

Step 6: Incorporating likelihoods to create impact-based outlook

Region	Below-normal	Near-normal	Above-normal
Northern Somalia	50%	15%	35%
Central Somalia	50%	15%	35%
Southern Somalia	50%	15%	35%



Phase 1
PREPARATION

Phase 2
CO-CREATION

Phase 3
COMMUNICATION
& EVALUATION

SIMBOL approach

Step 6: Incorporating likelihoods to create impact-based outlook

Likelihood	None / Minimal	Minor	Significant	Severe
High (≥ 70 %)				
Medium (35 – 65 %)	**Above normal rainfall**			**Below normal rainfall**
Low (15 – 30 %)		**Near normal rainfall**		
Very Low (≤ 10 %)				
	Impact			

Northern Somalia

Phase 1
PREPARATION

Phase 2
CO-CREATION

Phase 3
COMMUNICATION
& EVALUATION

SIMBOL approach

Step 6: Incorporating likelihoods to create impact-based outlook

Likelihood	None / Minimal	Minor	Significant	Severe
High (≥ 70 %)				
Medium (35 – 65 %)	**Above or near normal rainfall**	**Below normal rainfall**		
Low (15 – 30 %)				
Very Low (≤ 10 %)				

Impact

Central Somalia

Phase 1
PREPARATION

Phase 2
CO-CREATION

Phase 3
COMMUNICATION
& EVALUATION

SIMBOL approach

Step 6: Incorporating likelihoods to create impact-based outlook

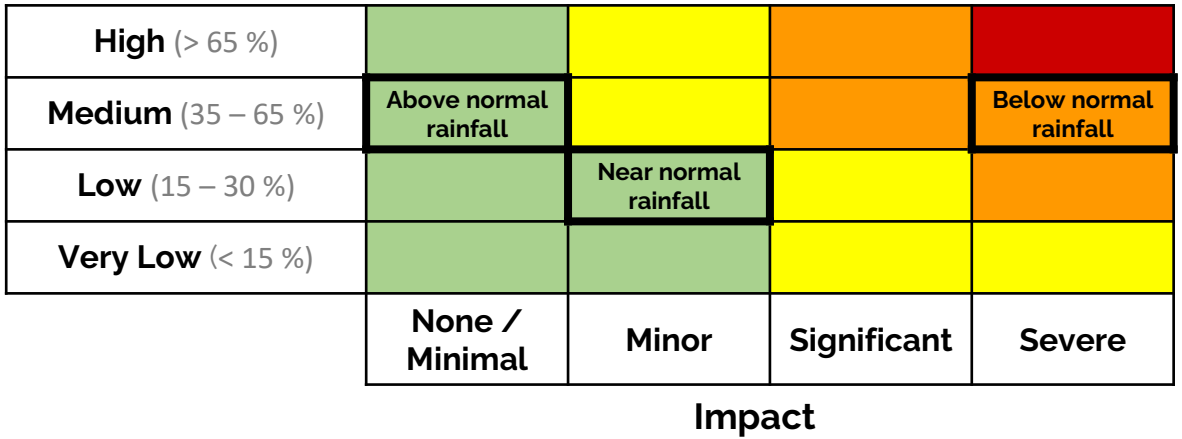
Likelihood	None / Minimal	Minor	Significant	Severe
High (≥ 70 %)				
Medium (35 – 65 %)	**Above normal rainfall**			**Below normal rainfall**
Low (15 – 30 %)		**Near normal rainfall**		
Very Low (≤ 10 %)				
	Impact			

Southern Somalia

Sensitivity testing

Existing example for northern Somalia

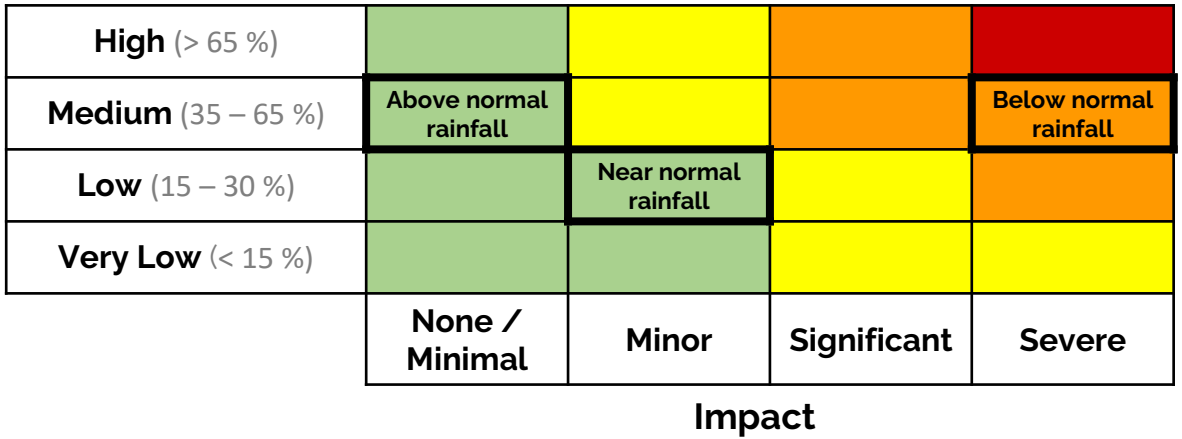
	Below Normal	Near Normal	Above Normal
Impact	Severe	Minor	Minimal
Likelihood	**50%**	15%	35%



Sensitivity testing

Likelihoods of below normal and above normal switched

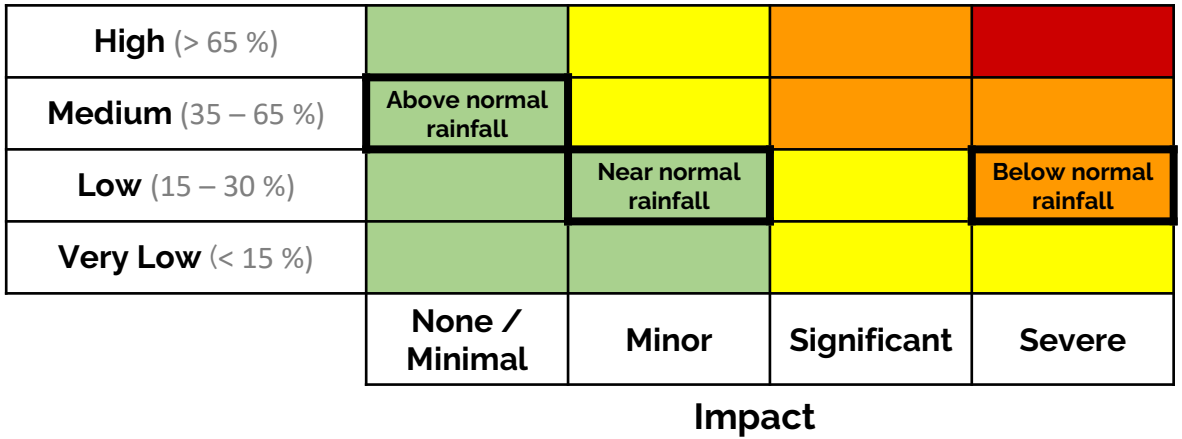
	Below Normal	Near Normal	Above Normal
Impact	Severe	Minor	Minimal
Likelihood	35%	15%	**50%**



Sensitivity testing

Reduced chance of below normal

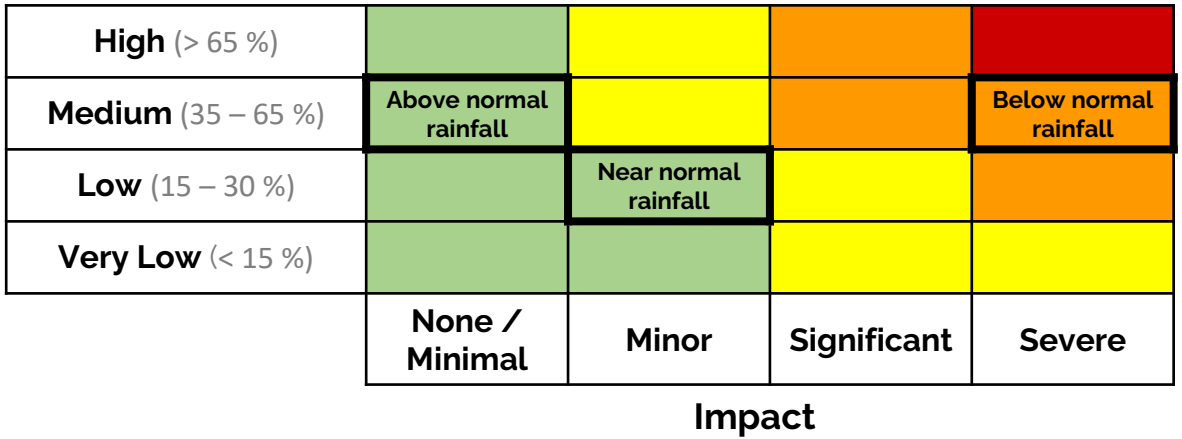
	Below Normal	Near Normal	Above Normal
Impact	Severe	Minor	Minimal
Likelihood	20%	30%	**50%**



Sensitivity testing

Existing example for northern Somalia

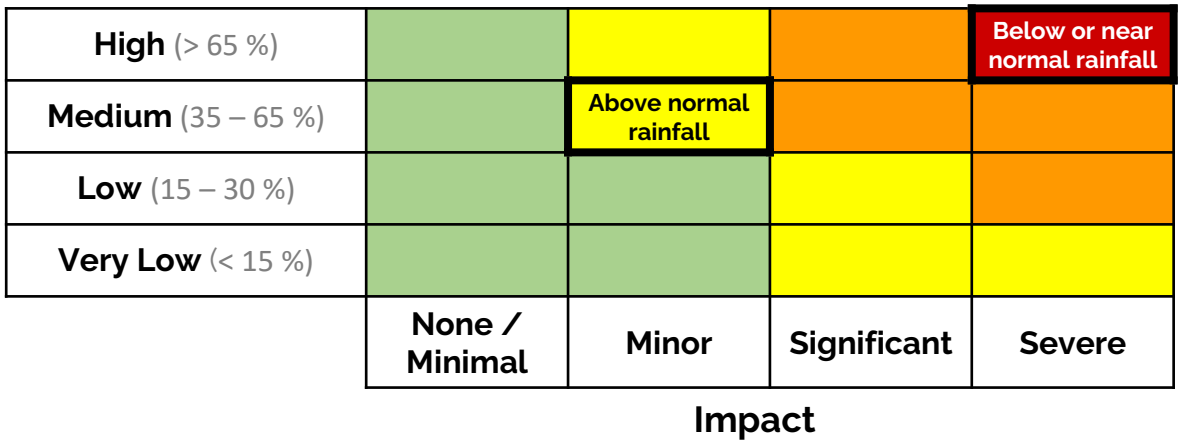
	Below Normal	Near Normal	Above Normal
Impact	Severe	Minor	Minimal
Likelihood	**50%**	15%	35%



Sensitivity testing

*The coming season follows **successive drought seasons***

	Below Normal	Near Normal	Above Normal
Impact	**Severe**	**Severe**	Minor
Likelihood	**50%**	**15%**	35%



Phase 1
PREPARATION

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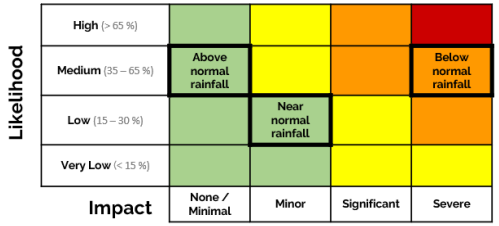
SIMBOL approach

Step 7: Extract risk level and agree advisory actions



Northern Somalia

Risk advisory

MEDIUM RISK

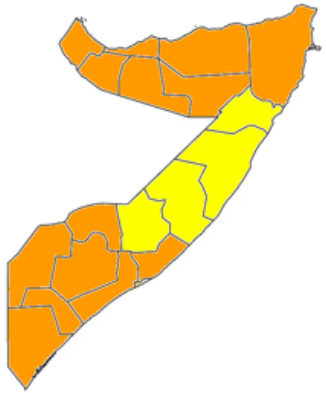
Medium likelihood of exceptionally low availability across the country

Actions Level 2

- Seek national response to provide access to water to vulnerable groups
- Prepare water conflict resolution plans for communities already exposed to poor groundwater availability
- Monitor water sources continuously
- Enhance community awareness and promote locally-led action plans

SIMBOL approach

Step 8: Communicate outlooks and issue warnings



Northern Somalia – MODERATE RISK

Medium likelihood of severe impacts on groundwater

Central Somalia - LOW RISK

Medium likelihood of minor impacts on groundwater

Southern Somalia – MODERATE RISK

Medium likelihood of severe impacts on groundwater

Step 9: Evaluate and learn

Feedback from participants:

"It's designed for advisories, good to make it simple, downscale the language."

"A subset of impacts may be appropriate, but not all would be (too complex)."

Value of SIMBOL Approach

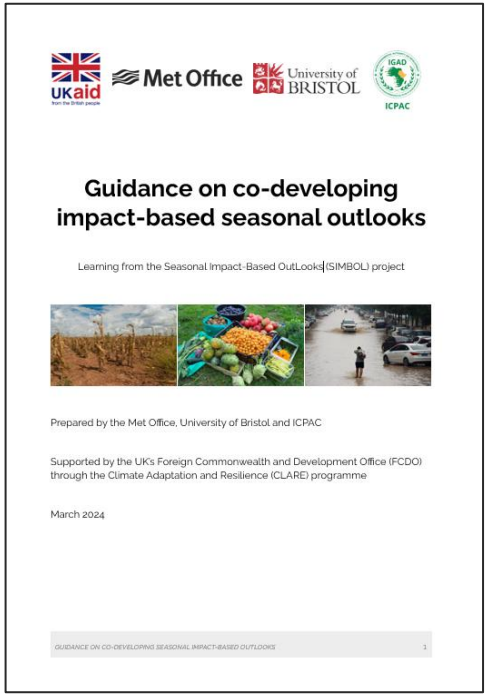
1. **Maintaining probabilistic information** improving the way we communicate the range of potential impacts associated with seasonal outlooks

2. **Capturing high impact, low likelihood outcomes** preventing too much focus on most likely outcomes, when lower likelihood outcomes would be more impactful

3. **Dealing with low skill** providing a method for communicating seasonal outlooks and advisories even with limited model skill

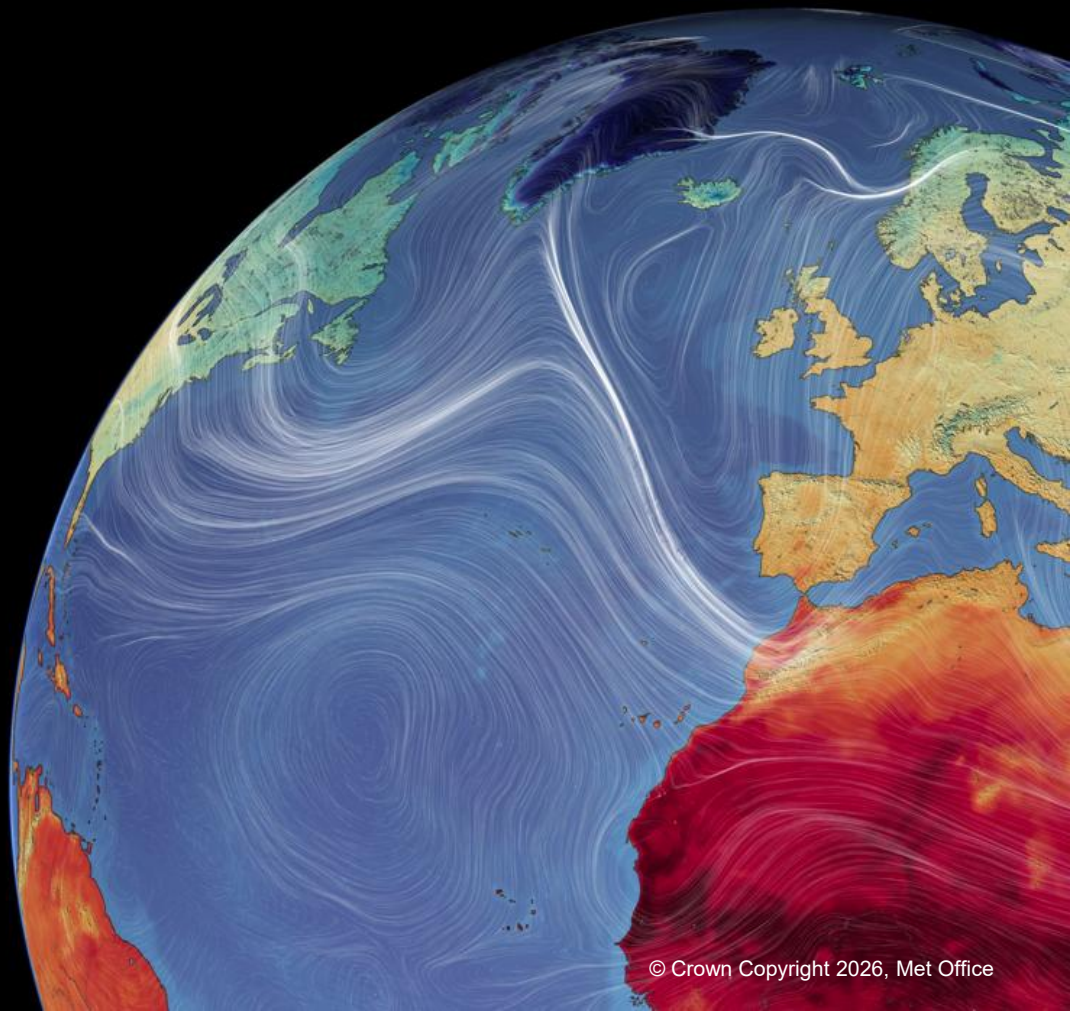
   "The low skill in the Long rains has the potential to erode the public trust thereby reducing the uptake of the early warning information, reduce preparedness to the extreme events" Gudoshava et al., 2024

4. **A standardised methodology** that can be applied across regions, countries, hazards and sectors.



Daron et al., (2025) SIMBOL: A method to co-produce impact-based seasonal outlooks. *Climate Services*

Thanks for listening!



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