

 CLIMATE SERVICES · WATER RESOURCES

From Climate Prediction to Risk Management

A Multi-Timescale Approach to Climate Services with a Focus on Water Resources

WEEKLY | MONTHLY | SEASONAL | MULTI-YEAR | 20-YEAR OUTLOOK

The Decision Challenge

Making better decisions when the future is uncertain



Will rainfall be above or below normal?



How may drought or flood risk evolve?



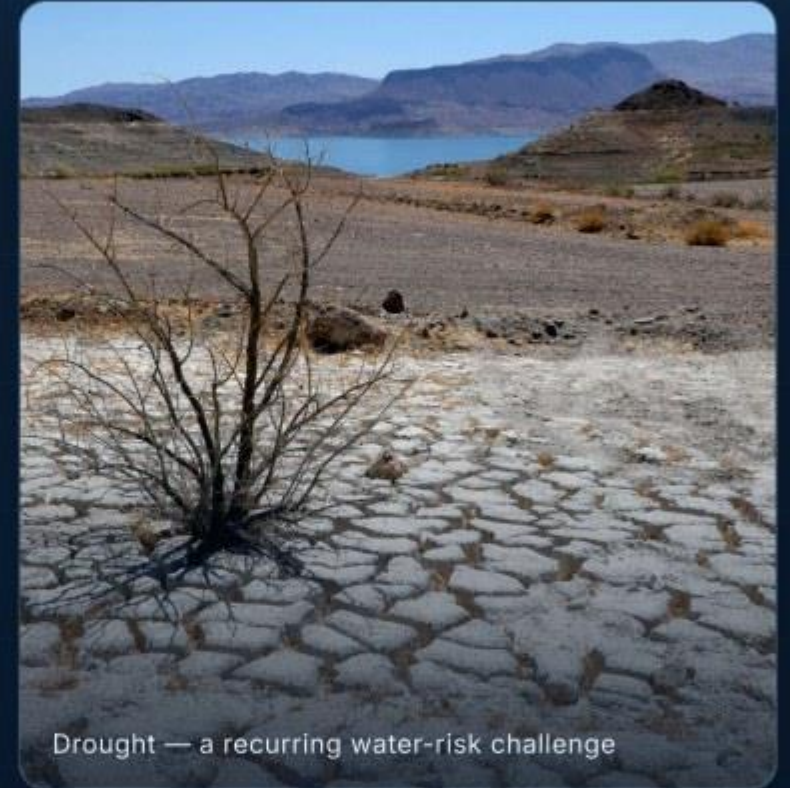
How much water may be available in the coming months and seasons?



Should reservoir operation, irrigation or cropping plans be adjusted?



What information is needed for longer-term adaptation and infrastructure?



Drought — a recurring water-risk challenge

We cannot eliminate uncertainty — but we can improve decisions under uncertainty.

From Weather to Climate Prediction

Different horizons answer different questions



Forecast / Prediction ≠ Projection ≠ Scenario

Longer horizons require explicit treatment of uncertainty and plausible futures.





One climate system — seen from orbit

One Climate System — Multiple Decision Horizons

	WEEKLY	Operational decisions
	MONTHLY	Short-term planning
	SEASONAL	Water & agricultural planning
	MULTI-YEAR	Strategic planning
	20-YEAR	Adaptation & infrastructure

— Different decisions require different time horizons.

WMO Perspective on Climate Prediction

A continuum of operational prediction across multiple time scales



Climate prediction becomes decision-relevant when uncertainty is quantified, communicated and translated into usable information.



From Climate Prediction to Climate Services

Turning prediction into decision-relevant information



The same forecast can become different services for different users.



Water manager



Agriculture



Energy



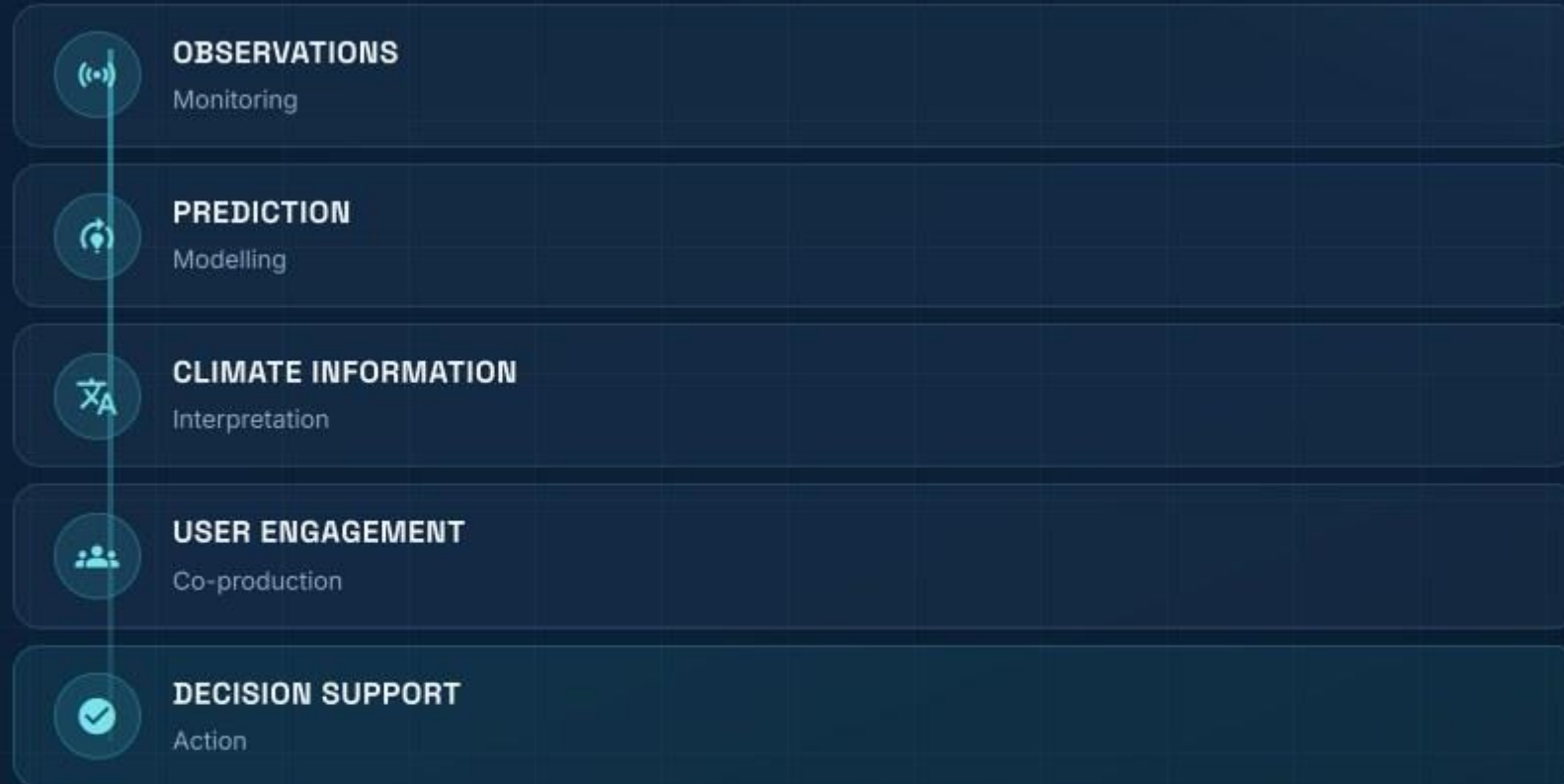
Disaster risk



Environment

The Climate Service Value Chain

The user should shape the service — not simply receive the final product



ITERATIVE LOOP



Observations begin at the ground station

● Co-production

● Communication

● Verification

● Feedback

A successful climate service is an iterative learning system.

From Climate Prediction to Risk Management

Prediction is one input to risk — not the risk assessment itself

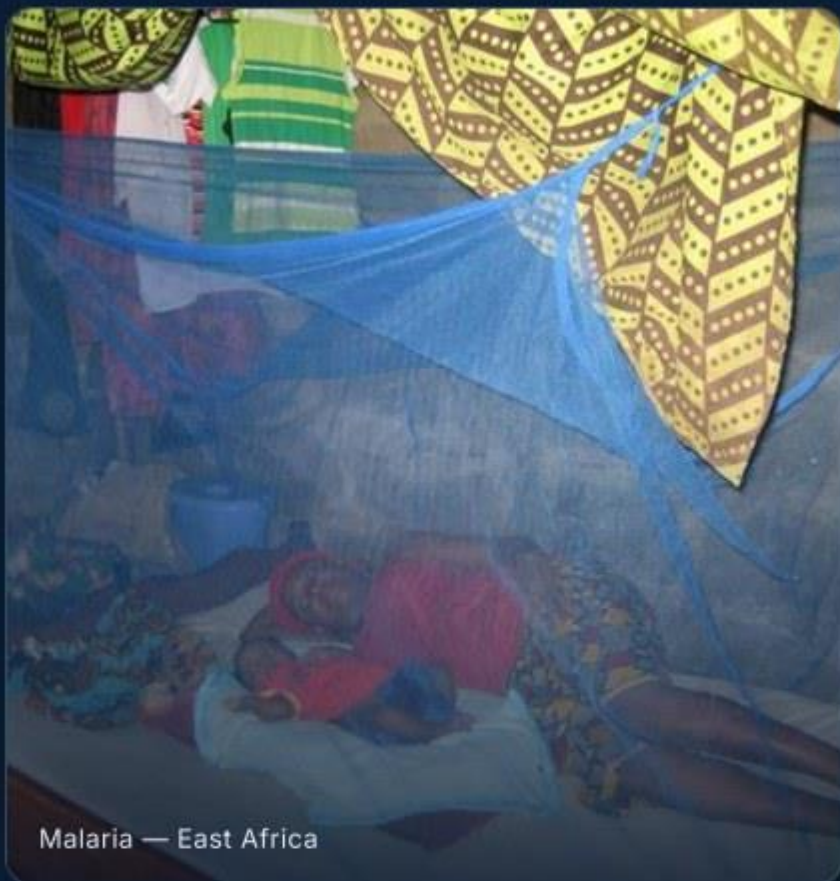


Forecast → Risk information → Decision → Action

The background of this section is an aerial photograph of a residential area that has been severely flooded. Houses and streets are partially submerged in brown water. The text 'Forecast → Risk information → Decision → Action' is overlaid in white on this image.

The objective is not certainty; it is risk-informed action.

Case Study (Public Health & Climate):



Malaria — East Africa

Integrating Seasonal Forecasts into Public Health: A Case Study

Objective: Demonstrating the impact of seasonal rainfall prediction on vector-borne disease control.

Case Example: Predicting Malaria outbreaks in East Africa using S2S (Sub-seasonal to Seasonal) forecasting.

Actionable Insights:

Pre-season: If high rainfall is predicted 3 months in advance, prepositioning medical supplies (antimalarials, nets).

During-season: Targeted vector control (spraying) before the peak of transmission.

30% Result: A 30% reduction in mortality rates compared to reactive approaches.

Takeaway: Climate information acts as an early warning system for health infrastructure.

Climate Prediction for Water Resources

Water is the central application — but not the only one



Water availability

Reservoir inflow, runoff, storage



Drought management

Early awareness, preparedness



Flood risk

Rainfall and hydrological risk



Water allocation

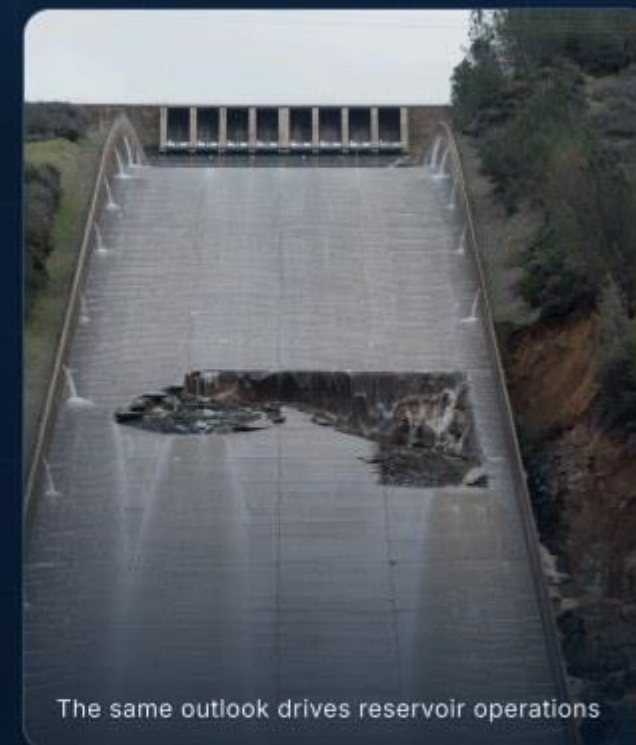
Agriculture, environment, industry



The Same Information — Different Decisions

One forecast — many sectoral decisions

Sector	Climate information	Potential decision
 Water	Rainfall, temperature, runoff	Reservoir & allocation
 Agriculture	Rainfall, heat, drought	Crop & irrigation planning
 Energy	Temperature, precipitation	Demand & resource planning
 Disaster risk	Extremes & anomalies	Early action
 Environment	Variability & trends	Adaptation planning
 Infrastructure	Extremes & long-term change	Design & resilience



The same outlook drives reservoir operations

What Can We Learn from International Practice?

From global climate services to operational applications



WMO

Global framework & standards



Copernicus

Operational climate information



**National & regional
services**

Sector-specific products

Common lesson: prediction must be connected to users, decisions and measurable value

From global coordination and prediction systems to operational climate services and sector-specific applications..

WMO	Copernicus C3S	ECMWF	European Climate Services
Global Framework	Operational Climate Services	Prediction & Modelling	Impact & Adaptation

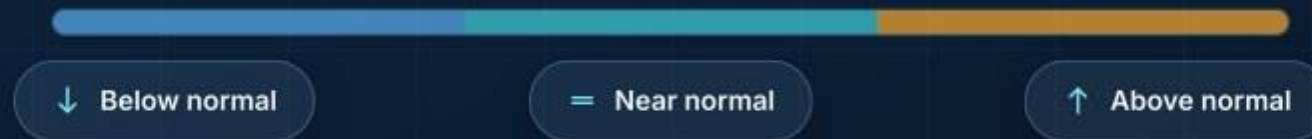


Global practice — one connected planet

Seasonal Forecasting: From Probability to Action



Seasonal forecasts are probabilistic — they describe a **shift in likelihood**, not a deterministic daily sequence.



Managing Uncertainty — Not Hiding It



Illustrative probabilities — not an actual forecast

Uncertainty is not a weakness of climate prediction; it is part of the information.

— OUR CAPACITY

Our Multi-Timescale Climate Prediction Capacity

Our capabilities within the broader WMO-style prediction and climate service framework



WEEKLY

Operational



MONTHLY

Planning



SEASONAL

Sectoral



MULTI-YEAR

Strategic



20-YEAR OUTLOOK

Adaptation

Statistical

Dynamical

AI / Machine Learning

Ensemble / Hybrid Approaches

A portfolio of prediction products for different decision horizons.

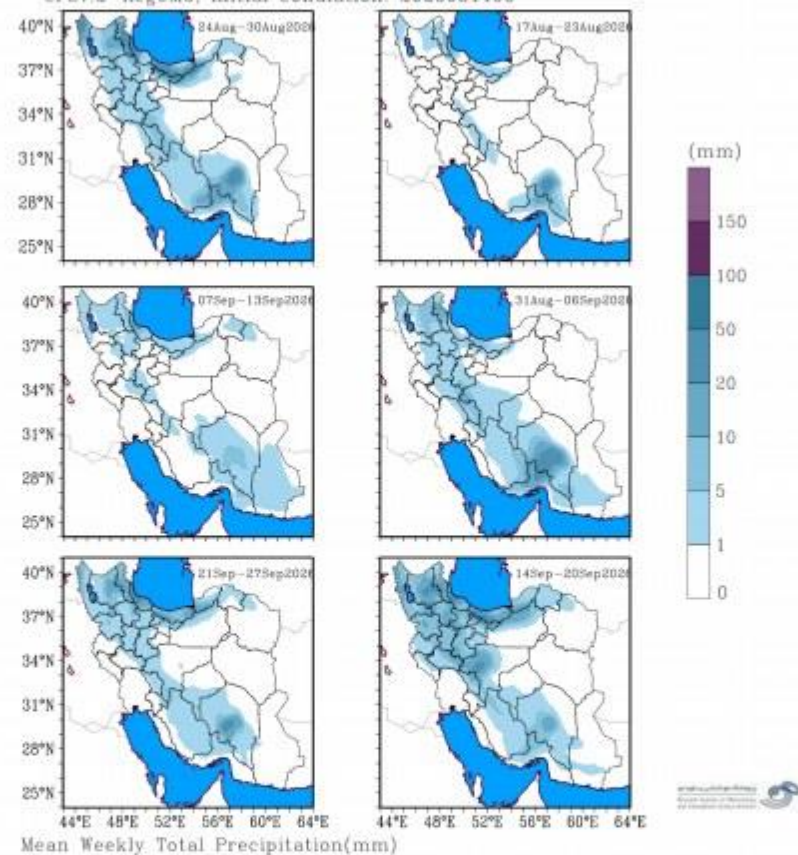
Our Weekly Climate Prediction

Operational outlook for Iran and RCC West Asia



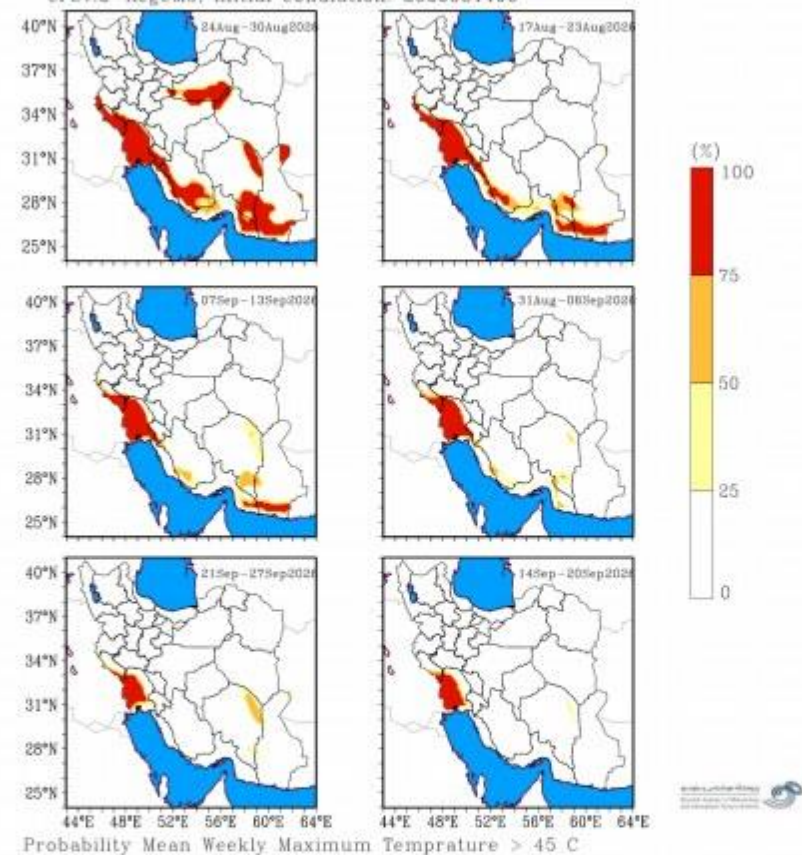
From model ensembles to a weekly, decision-relevant climate outlook.

Climatological Research Institute (CRI) Weekly Prediction
CFSv2-RegCM5, Initial condition: 2026081400



Mean Weekly Total Precipitation (mm) — 6-week outlook

Climatological Research Institute (CRI) Weekly Prediction
CFSv2-RegCM5, Initial condition: 2026081400



Probability of Mean Weekly Maximum Temperature > 45 °C

The “Forecast-to-Action” Pipeline



DATA INTEGRATION LAYER

Combining meteorological inputs (SST, soil moisture) with socioeconomic vulnerability indices.



TRANSLATIONAL LAYER

Raw Forecast Data → Risk Assessment Models.

Risk Assessment → Threshold Identification (Trigger points for mobilization).



OPERATIONAL IMPLEMENTATION

If probability > 70%: **Activate “Early Action” protocols.**

If probability 40–70%: Increase monitoring.



FEEDBACK LOOP: Continuous evaluation of forecast accuracy to refine future threshold triggers.

Our Monthly Climate Prediction

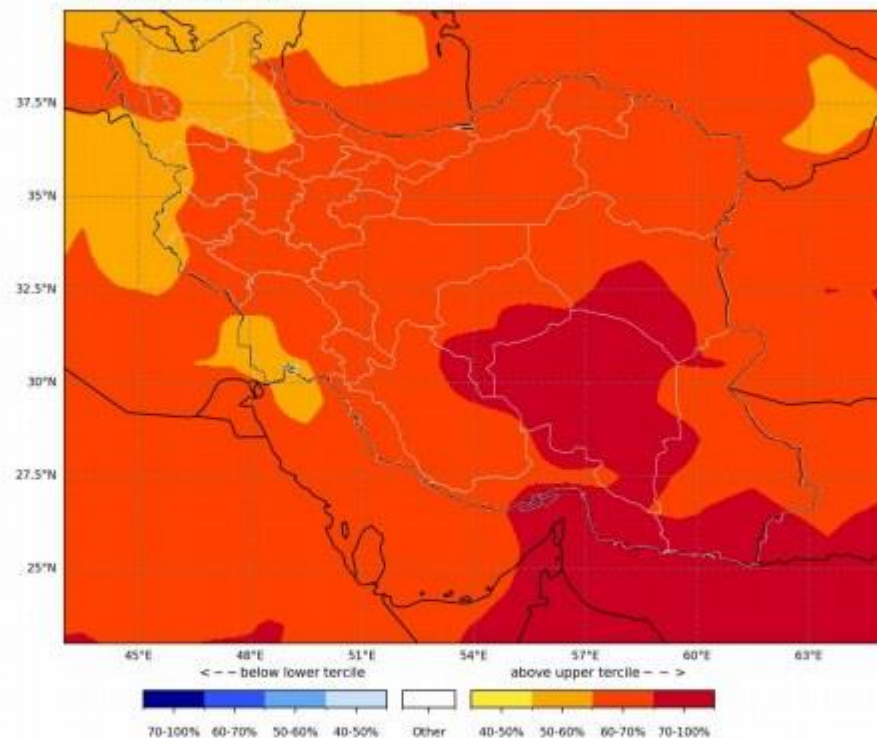
A longer planning horizon based on dynamic downscaling



Monthly prediction extends the planning horizon while retaining operational relevance.

RIMAS/CRI: Multi-Model seasonal forecast (Unweighted Mean)
Prob(most likely category of 2m temperature)
Jan 2027

Nominal forecast start: 01/08/26

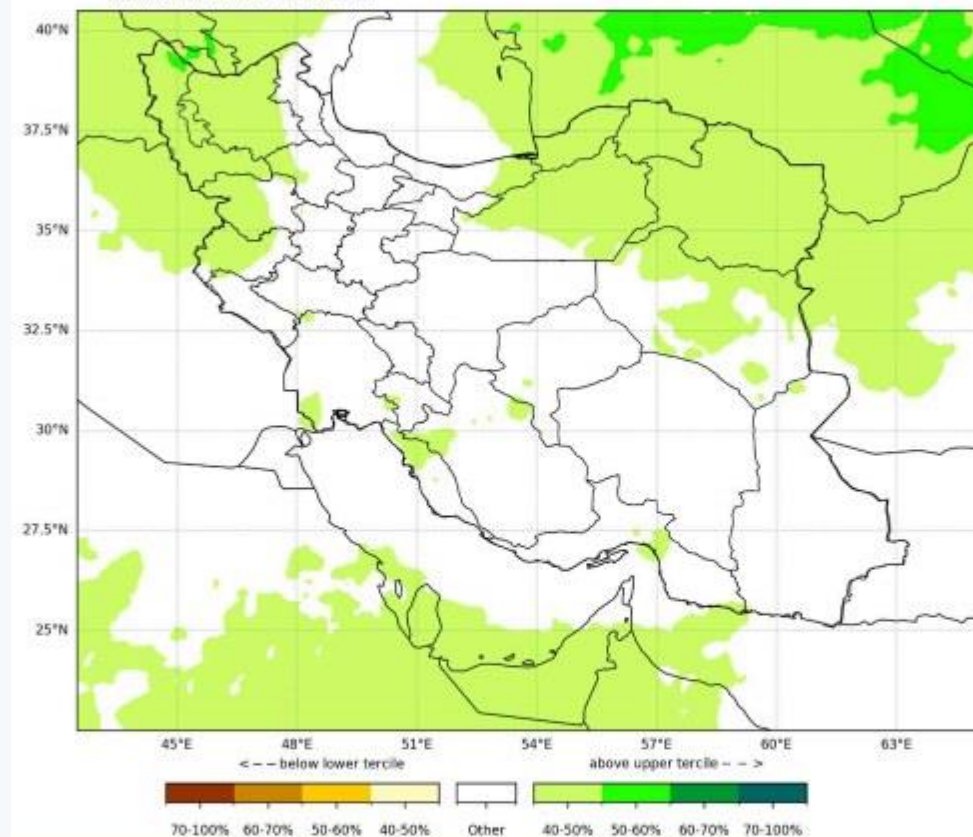


Probability of most likely category of 2m temperature — Jan 2027

RIMAS/CRI: Multi-model seasonal forecast
Prob(most likely category of precipitation)
Jan 2027

Nominal forecast start: 01/08/26

Jan 2027



Probability of most likely category of precipitation — Jan 2027

Our Seasonal Climate Prediction

Seasonal outlooks as probabilistic information for planning



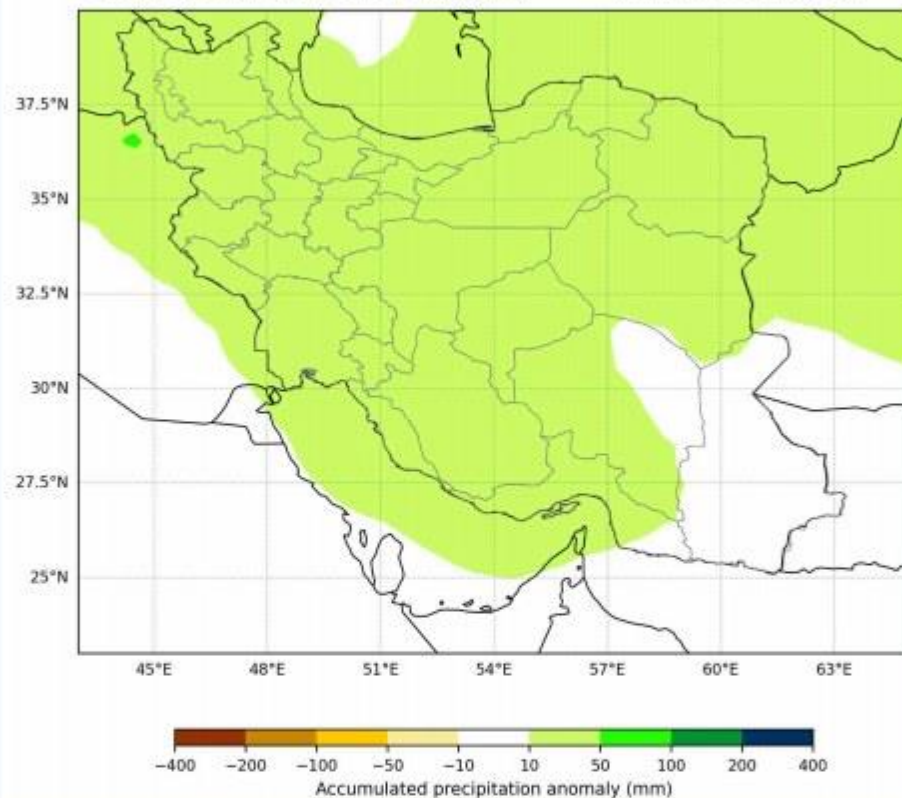
From seasonal ensembles to water & agricultural planning decisions.

RIMAS/CRI: Multi-model seasonal forecast
(ECMWF/Meteo-France/CMCC/DWD/NCEP/ECCC/BOM)

NOV-DEC-JAN 2026/27

Accumulated precipitation anomaly (mm)

Nominal forecast start: 01/08/26



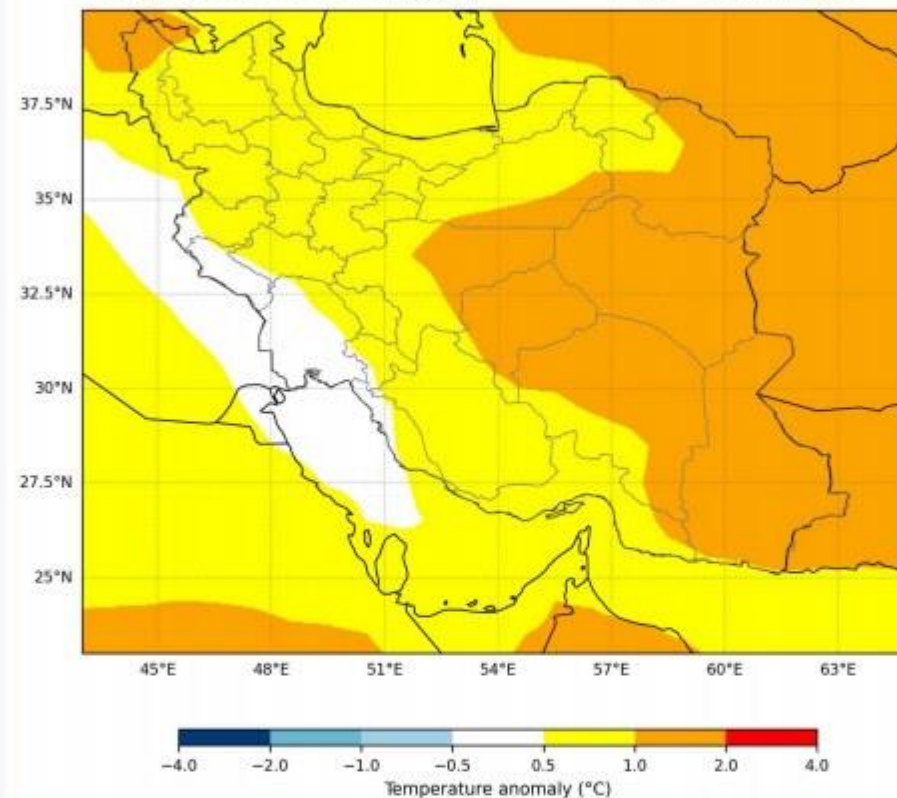
Accumulated precipitation anomaly (mm) — Nominal forecast start: 01/08/26

RIMAS/CRI: Multi-model seasonal forecast
(ECMWF/Meteo-France/CMCC/DWD/NCEP/ECCC/BOM)

NOV-DEC-JAN 2026/27

Mean 2m temperature anomaly (°C)

Nominal forecast start: 01/08/26



Mean 2m temperature anomaly (°C) — Nominal forecast start: 01/08/26

Our Decadal Climate Outlook

Long-term information for adaptation and strategic planning



10-YEAR HORIZON

Decadal / long-term planning information



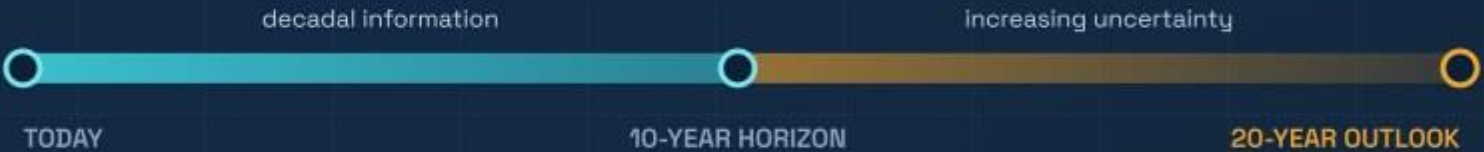
POTENTIAL USE

- Infrastructure
- Water strategy
- Agricultural adaptation



KEY PRINCIPLE

Scenarios + uncertainty rather than deterministic point forecasts



Long-horizon climate information



This slide should be populated with the methodology and results of our 20-year product.

The uploaded source describes weekly, monthly and seasonal products; it does not specify the 20-year methodology.

Decadal Prediction

Decadal Prediction

- 1-10 year climate predictions based on realistic **atmospheric and oceanic initial conditions**
- Latest model initialization: **November 2024**
- **Variables: Temperature & Precipitation**

Improving Prediction Skill

- First-order bias correction using **GPCC** and **ERA5**
- Significant improvement in precipitation prediction skill up to **~8 years**
- Increasing uncertainty beyond 8 years

SKILL & UNCERTAINTY — SCHEMATIC



Key Outlook for Iran

- **Overall tendency toward above-normal precipitation**
- HadGEM: stronger, more concentrated increases in western & southwestern Iran
- EC-Earth: milder but more widespread increases

From Prediction to Preparedness

- Bridging weather forecasting and long-term climate projections
- **Supporting climate-informed planning, water management & adaptation**



Initial conditions: ocean + ice + atmosphere

Looking Beyond the Next Season

20-year climate outlooks for strategic planning

Q1



What may change?

Q2



What is uncertain?

Q3



What risks may emerge?

Q4

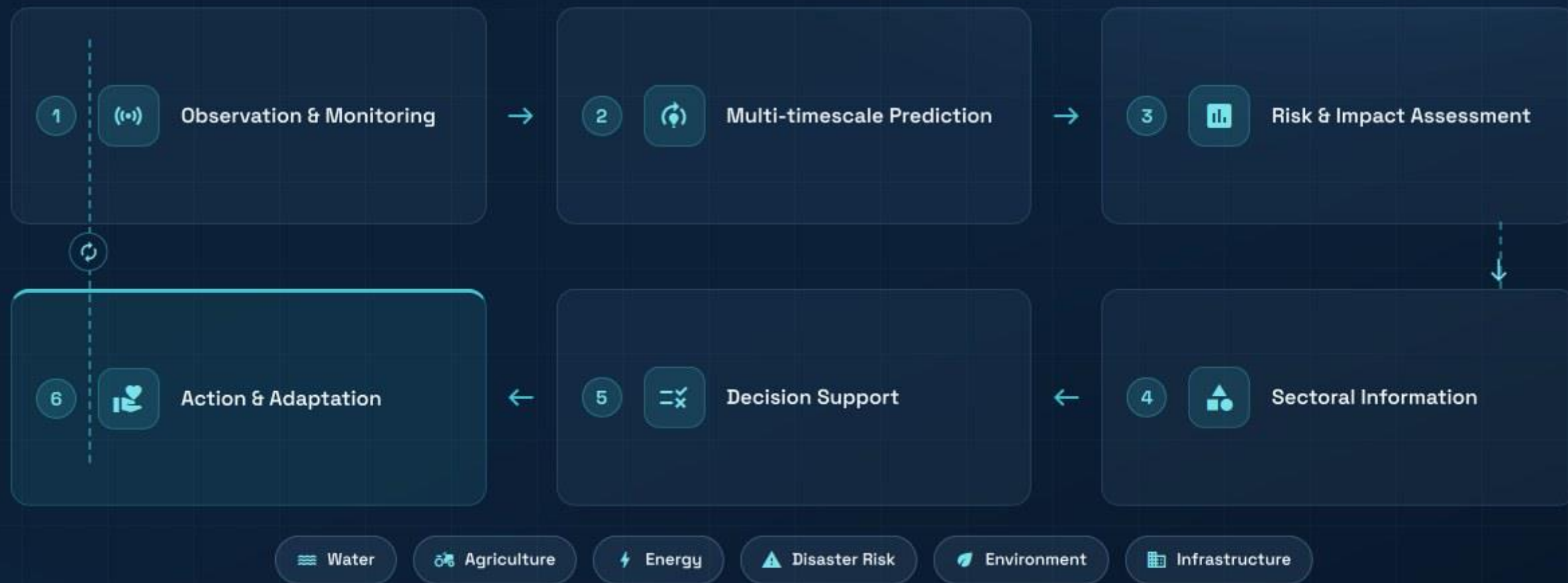


What adaptation options
are robust?

Use long-term information to explore **plausible futures** — not to imply certainty.

Prediction $\neq$ Projection $\neq$ Scenario

An Integrated Climate Risk Management Framework



Verification & user feedback create a continuous learning loop.

Bridging the Gap: The Future of Crisis Management

Interdisciplinary Collaboration: Moving beyond siloed departments; meteorologists and crisis managers must share a common “operating language.”

Key Challenges to Address:



Communication:

Presenting probabilistic forecasts in a way that is actionable for policy-makers.



Trust:

Building confidence in long-term models through transparent verification processes.

The Paradigm Shift



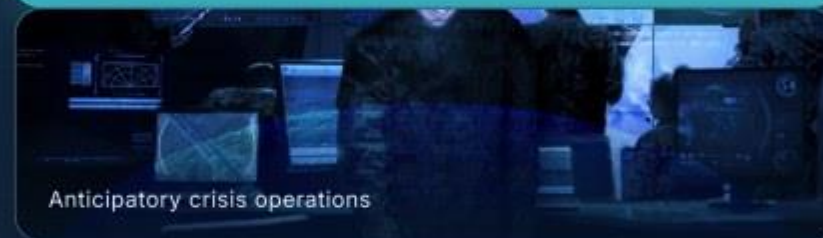
“Disaster Response”

(Reactive)



“Risk Management”

(Proactive/Anticipatory)



Anticipatory crisis operations

Closing Statement: “Seasonal forecasting is not just about predicting the weather; it is about saving lives through timely, evidence-based preparation.”

From Prediction Products to Climate Services

What strengthens the next generation of applications?



Prediction Products



Climate Services



Improve prediction skill

01

Better data, models, ensembles and verification

01



Improve communication

02

Clear probabilities, uncertainty and thresholds

02



Strengthen user engagement

03

Products designed around real decisions

03



Connect forecasts to decisions

04

Risk indicators, scenarios and decision-support tools

04

— SUMMARY

Key Messages

- 01 Climate prediction is a decision-support tool.
- 02 Different decisions require different time scales.
- 03 Uncertainty should be communicated — not ignored.
- 04 Water is a central application, but the framework is cross-sectoral.
- 05 The future is not only about better forecasts, but better climate services.

From Prediction



to Preparedness



to Resilience