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# AMOC Collapse Risk: 59% Weakening by 2100 Could Devastate India's Monsoon

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# AMOC Collapse Risk: 59% Weakening by 2100 Could Devastate India's Monsoon

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## WHY IN NEWS

New scientific research published in May 2026 warns that the **Atlantic Meridional Overturning Circulation (AMOC)** — the ocean’s global heat redistribution engine — could weaken by **up to 59% by 2100**, more than three times worse than the previous dominant estimate of 15%. The finding has alarmed scientists because even a 15% weakening was projected to cause significant disruptions to the **Indian Summer Monsoon**. A 59% weakening would be catastrophic for South Asian weather patterns, agriculture, and food security. This comes as the **India Meteorological Department (IMD)** has already forecast a **below-normal 2026 southwest monsoon** at 90–95% of the Long Period Average (LPA).

## WHAT IS AMOC?

The **Atlantic Meridional Overturning Circulation (AMOC)** is a large system of ocean currents — sometimes called the “global conveyor belt” — that circulates water throughout the world’s oceans and plays a critical role in regulating Earth’s climate.

### How It Works

STAGE	PROCESS
<b>1. Surface flow northward</b>	Warm, salty surface water flows north through the Atlantic toward the Arctic/sub-polar region
<b>2. Cooling and sinking</b>	In the North Atlantic, the water cools, becomes denser, and sinks to the deep ocean
<b>3. Deep water return</b>	Cold, dense deep water flows southward at depth
<b>4. Upwelling</b>	The deep water gradually rises (upwells) in other ocean basins and returns to the surface

AMOC is driven by **thermohaline circulation** — differences in **temperature** (thermo) and **salinity** (haline) that determine water density. It transports roughly **1.3 petawatts** of heat northward — comparable to 1.3 million large power plants.

### Why Is AMOC Weakening?

Climate change is destabilising AMOC through two mechanisms:

- 1 **Arctic ice melt** releases large volumes of **freshwater** into the North Atlantic. Freshwater is less dense than salt water, preventing the normal sinking of surface water that drives the circulation.
- 2 **Warming oceans** reduce the temperature differential that drives density-driven circulation.

Satellite data and oceanographic buoy arrays (the **RAPID array** since 2004) have confirmed AMOC is already at its weakest in at least 1,000 years.

## THE 59% WEAKENING PROJECTION

Previous IPCC reports projected AMOC would weaken by approximately **15%** by 2100 under high-emissions scenarios. The new 2026 research (peer-reviewed, published in a leading oceanography journal) uses updated ice sheet melting models incorporating **Greenland** and **Antarctic** ice loss rates observed since 2019. Their revised projections:

SCENARIO	AMOC CHANGE BY 2100
Previous (IPCC AR6) high-emissions	~15% weakening
New (2026) high-emissions model	~59% weakening
Tippling point (complete collapse)	Possible if warming exceeds 1.6°C–2°C above pre-industrial

A complete AMOC collapse (not yet likely in the 21st century but not ruled out) would trigger a **rapid drop** of 5–10°C in Western Europe while other regions face severe disruptions.

## IMPACT ON INDIA'S MONSOON

The **Indian Summer Monsoon** (June–September) is fundamentally a product of differential heating between the Indian Ocean and the Asian landmass. AMOC's influence on the monsoon operates through the following pathways:

### 1. Southward Shift of the Inter-Tropical Convergence Zone (ITCZ)

AMOC carries heat northward; when it weakens, the Northern Hemisphere cools relative to the Southern Hemisphere. This **asymmetry pushes the ITCZ southward** — pulling the monsoon rain belt away from India.

### 2. Intensification of La Niña/El Niño Extremes

AMOC weakening disrupts sea surface temperature patterns in the Pacific, making **El Niño events more frequent and intense**. Strong El Niño years are already correlated with weak Indian monsoons.

### 3. Reduced Arabian Sea Warming

AMOC influences Atlantic SSTs, which in turn affect Indian Ocean heat content via atmospheric teleconnections. Less heat transport means cooler Arabian Sea SSTs — weakening the low-pressure gradient that drives monsoon winds.

### 4. Monsoon Variability Increase

Even without a reduction in total monsoon rainfall, AMOC weakening increases **year-to-year variability** — more droughts and more flood years, less predictable onset and withdrawal.

## INDIA'S VULNERABILITY

SECTOR	EXPOSURE TO MONSOON DISRUPTION
<b>Agriculture</b>	~55% of crop area is rain-fed; kharif crops (rice, maize, pulses) directly dependent on June–September rains
<b>Groundwater</b>	Monsoon recharges 45% of India's groundwater; 60% of irrigation depends on groundwater
<b>Hydropower</b>	River-dependent projects (Bhakra, Hirakud, Tehri) require adequate monsoon inflows
<b>Drinking water</b>	600+ million people in rural India depend on monsoon-fed water bodies
<b>GDP</b>	Agriculture contributes ~15–18% of GDP; a 10% monsoon deficit causes ~2% GDP contraction historically

### IMD's 2026 Monsoon Forecast (Already Concerning)

The IMD forecast for the 2026 Southwest Monsoon season (June–September) is **below normal** — 90–95% of the Long Period Average (LPA of 87 cm). This is independent of AMOC but adds urgency.

## AMOC AND INDIA'S CLIMATE POLICY IMPERATIVES

India's NDC (Nationally Determined Contribution) under the Paris Agreement targets **net-zero by 2070** and commits to reducing **emissions intensity** of GDP by 45% from 2005 levels by 2030. However, AMOC weakening is primarily driven by **global** cumulative emissions — especially from developed nations historically. This creates a **climate justice dimension**: India bears **disproportionate** consequences of a phenomenon to which it has historically contributed least.

India is actively pursuing:

- **Mission LiFE** (Lifestyle for Environment) – behavioural change
- **National Action Plan on Climate Change (NAPCC)** – 8 national missions including **National Water Mission**
- **State Action Plans on Climate Change (SAPCC)** – state-level adaptation

## UPSC RELEVANCE

*AMOC (Atlantic Meridional Overturning Circulation); thermohaline circulation; ITCZ (Inter-Tropical Convergence Zone); RAPID array (ocean monitoring); IMD 2026 monsoon forecast – below normal (90–95% LPA); El Niño–monsoon link; India’s NDC (net-zero 2070); Paris Agreement; NAPCC; Mission LiFE*

*Indian monsoon mechanism; climate change impact on Indian agriculture and water security; thermohaline circulation and global climate regulation*

*Climate change and India’s vulnerability; India’s climate commitments under Paris Agreement; climate justice and historical responsibility; food security; water management; Himalayan glaciers and river systems under climate stress*

*“The greatest threats to India’s security in the 21st century will not come from borders but from a destabilising climate.”*

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AMOC: Atlantic Meridional Overturning Circulation; ocean's thermohaline conveyor belt; redistributes ~1.3 petawatts of heat northward

New research (May 2026): AMOC could weaken 59% by 2100; vs earlier IPCC estimate of ~15%

Mechanism: Arctic freshwater from melting ice → reduces salinity → prevents deep water formation → slows circulation

RAPID Array: Continuous AMOC monitoring array across Atlantic at 26°N; operational since 2004

ITCZ: Inter-Tropical Convergence Zone; monsoon belt; shifts southward if Northern Hemisphere cools

India monsoon: June–September (SW monsoon); ~87 cm LPA over 50-year average

IMD 2026 forecast: Below normal (90–95% of LPA)

El Niño link: Warm Pacific SSTs suppress Indian monsoon; AMOC weakening intensifies El Niño frequency

55% of India's crop area is rain-fed; 45% of groundwater recharged by monsoon

India's NDC: Net-zero by 2070; emissions intensity –45% from 2005 by 2030

NAPCC: 8 national missions; includes National Water Mission, National Mission for Sustaining Himalayan Ecosystem

Paris Agreement Article 2: Limit warming to 1.5°C above pre-industrial levels

Sources: [Business Today — AMOC and Indian monsoon](#) , [Insights on India — AMOC](#) ,  
[MIT Climate Portal — AMOC collapse probability](#)

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