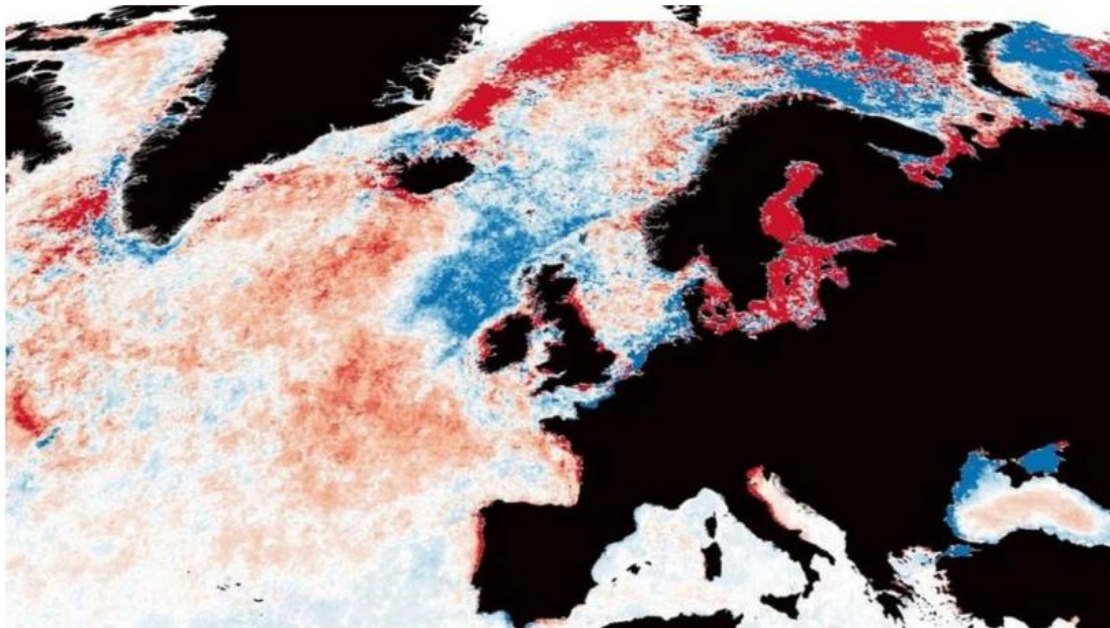


CONCEPTS

Global oceans are darkening, disrupting life beneath the surface: Study

Study by Plymouth researchers shows 21 per cent of the ocean has dimmed in two decades, endangering life dependent on natural light.

By: [Science Desk](#) 6 min read New Delhi Updated: Jun 14, 2025 09:10 AM IST



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WORLD

Infographic: How Iran used Strait of Hormuz to choke oil and gas supply after Israel-US attacks



Global Ocean Darkening

- A new study seems to suggest that more than one-fifth of the global ocean has considerably darkened in the last two decades.
- This alarming state of the oceans has been brought to light by the study, Darkening of the Global Ocean, conducted by researchers from University of Plymouth.



Southern Ocean carbon 'anomaly' reveals what models can still miss

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For nearly two decades, computer models said stronger westerly winds and more greenhouse gases in the atmosphere would pump more carbon-rich deep water up towards the Southern Ocean's surface, which would release carbon dioxide into the air. Yet new data has found the exact opposite has happened

Published - December 22, 2025 06:00 am IST - BENGALURU

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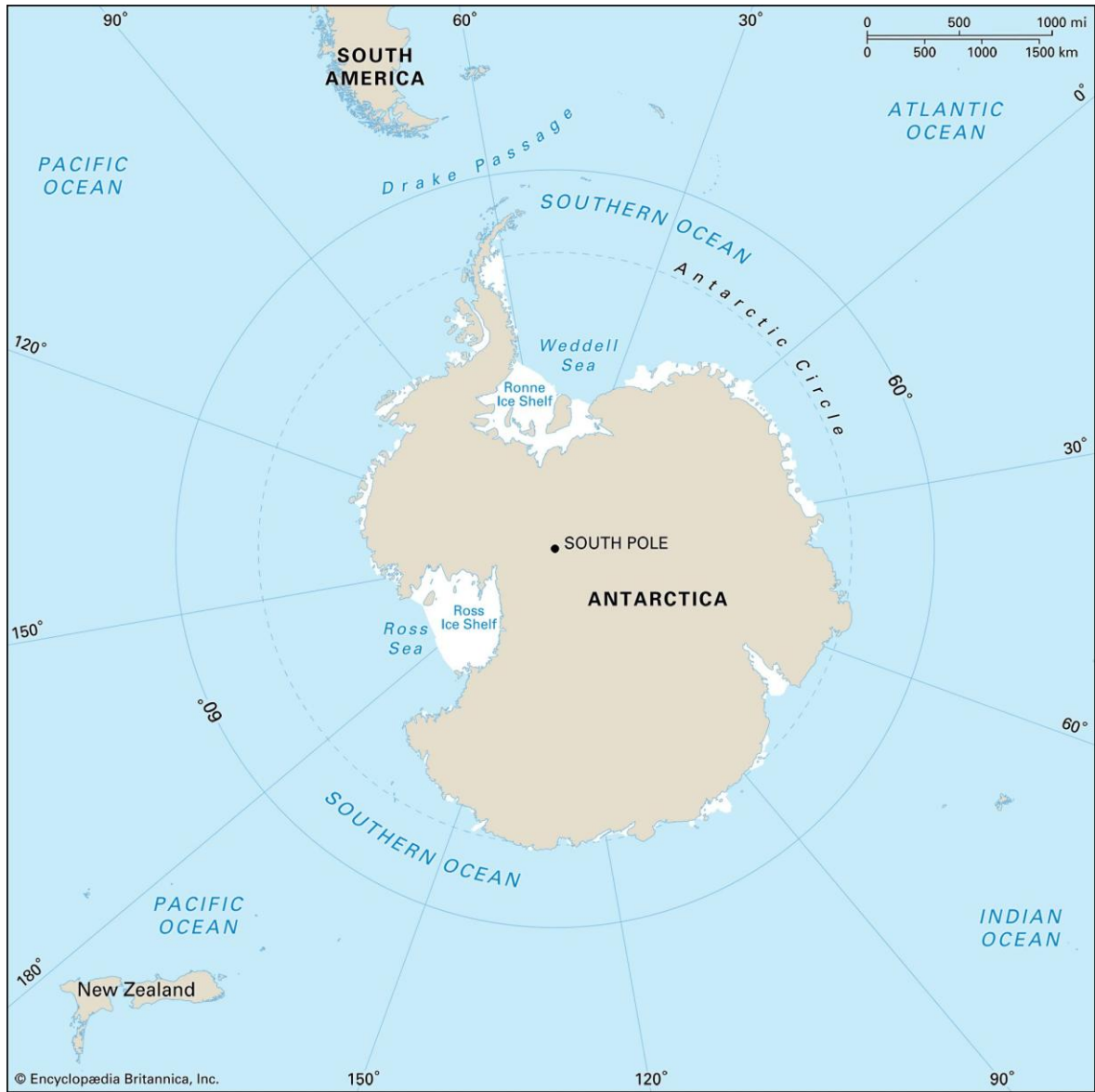


Southern Ocean carbon 'anomaly'



- Climate models predicted stronger westerly winds would increase upwelling of deep, carbon-rich waters in the Southern Ocean, releasing more CO₂ to the atmosphere and weakening its carbon sink. However, observations since the early 2000s show the ocean continues to **absorb more CO₂**.
- This occurs because **freshwater from rainfall, melting Antarctic ice, and sea ice** has strengthened **stratification**.
- The lighter freshwater layer prevents vertical mixing, keeping carbon-rich deep waters **100–200 m below the surface** and trapping the carbon.





Atmospheric River

- A large part of the United States witnessed heavy rain, strong winds and severe thunderstorms due to a type of storm known as an atmospheric river
- Atmospheric rivers are a narrow, fast-moving band of moisture and wind – like rivers in the sky – that transport large amounts of water vapour. While they are an essential source of rainfall, they can lead to flooding, trigger mudslides and result in loss of life and property damage.



The science behind atmospheric rivers

An atmospheric river (AR) is a flowing column of condensed water vapor in the atmosphere responsible for producing significant levels of rain and snow, especially in the Western United States. When ARs move inland and sweep over the mountains, the water vapor rises and cools to create heavy precipitation. Though many ARs are weak systems that simply provide beneficial rain or snow, some of the larger, more powerful ARs can create extreme rainfall and floods capable of disrupting travel, inducing mudslides and causing catastrophic damage to life and property. Visit www.research.noaa.gov to learn more.

A strong AR transports an amount of water vapor roughly equivalent to 7.5–15 times the average flow of water at the mouth of the Mississippi River.

ARs are a primary feature in the entire global water cycle and are tied closely to both water supply and flood risks, particularly in the Western U.S.

On average, about 30–50% of annual precipitation on the West Coast occurs in just a few AR events and contributes to the water supply — and flooding risk.

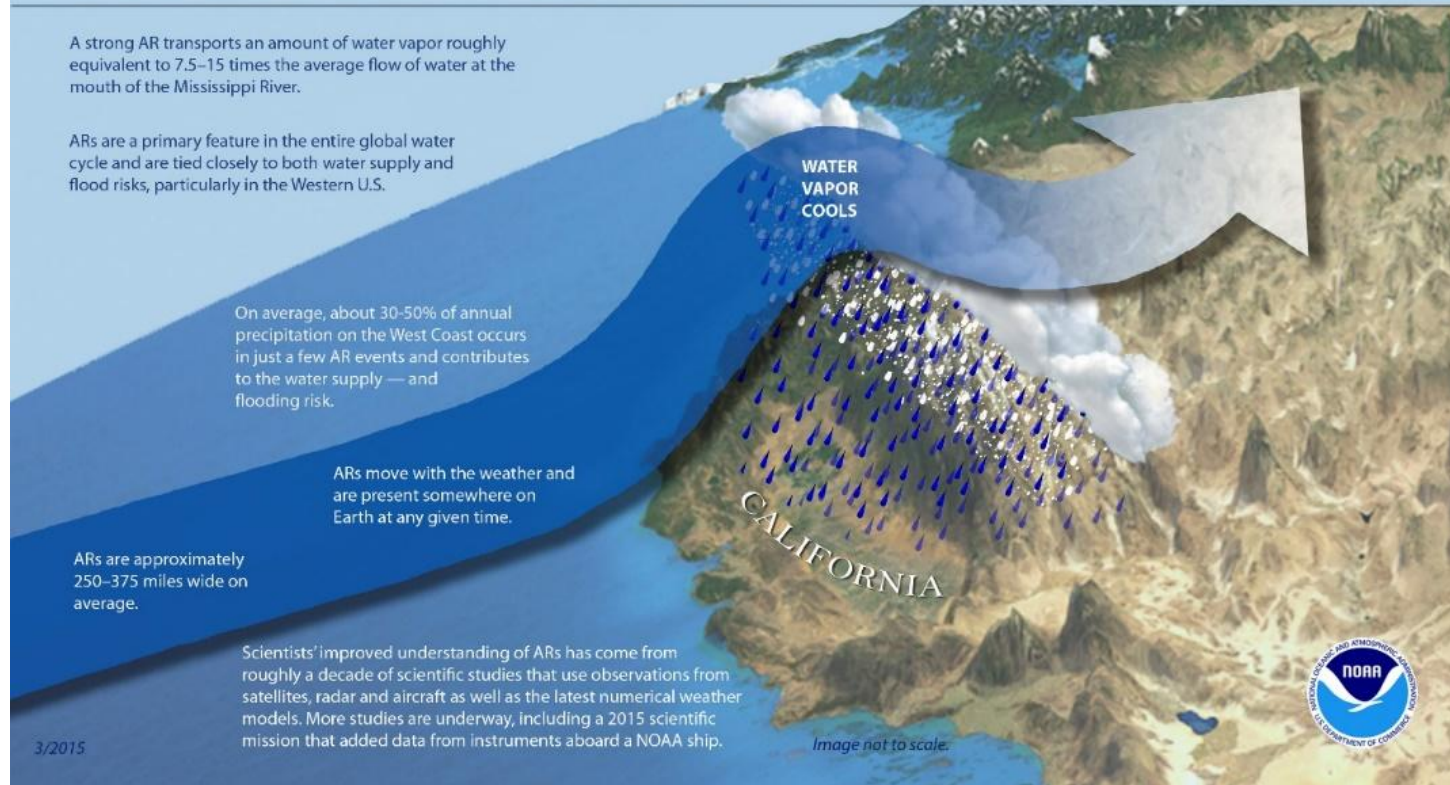
ARs move with the weather and are present somewhere on Earth at any given time.

ARs are approximately 250–375 miles wide on average.

Scientists' improved understanding of ARs has come from roughly a decade of scientific studies that use observations from satellites, radar and aircraft as well as the latest numerical weather models. More studies are underway, including a 2015 scientific mission that added data from instruments aboard a NOAA ship.

Image not to scale.

3/2015

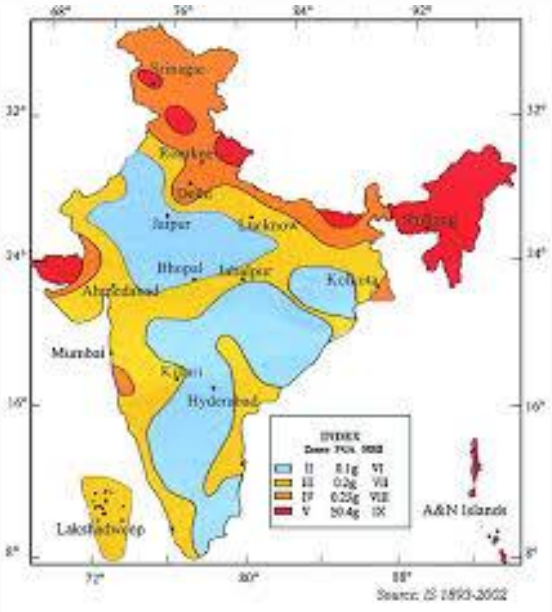
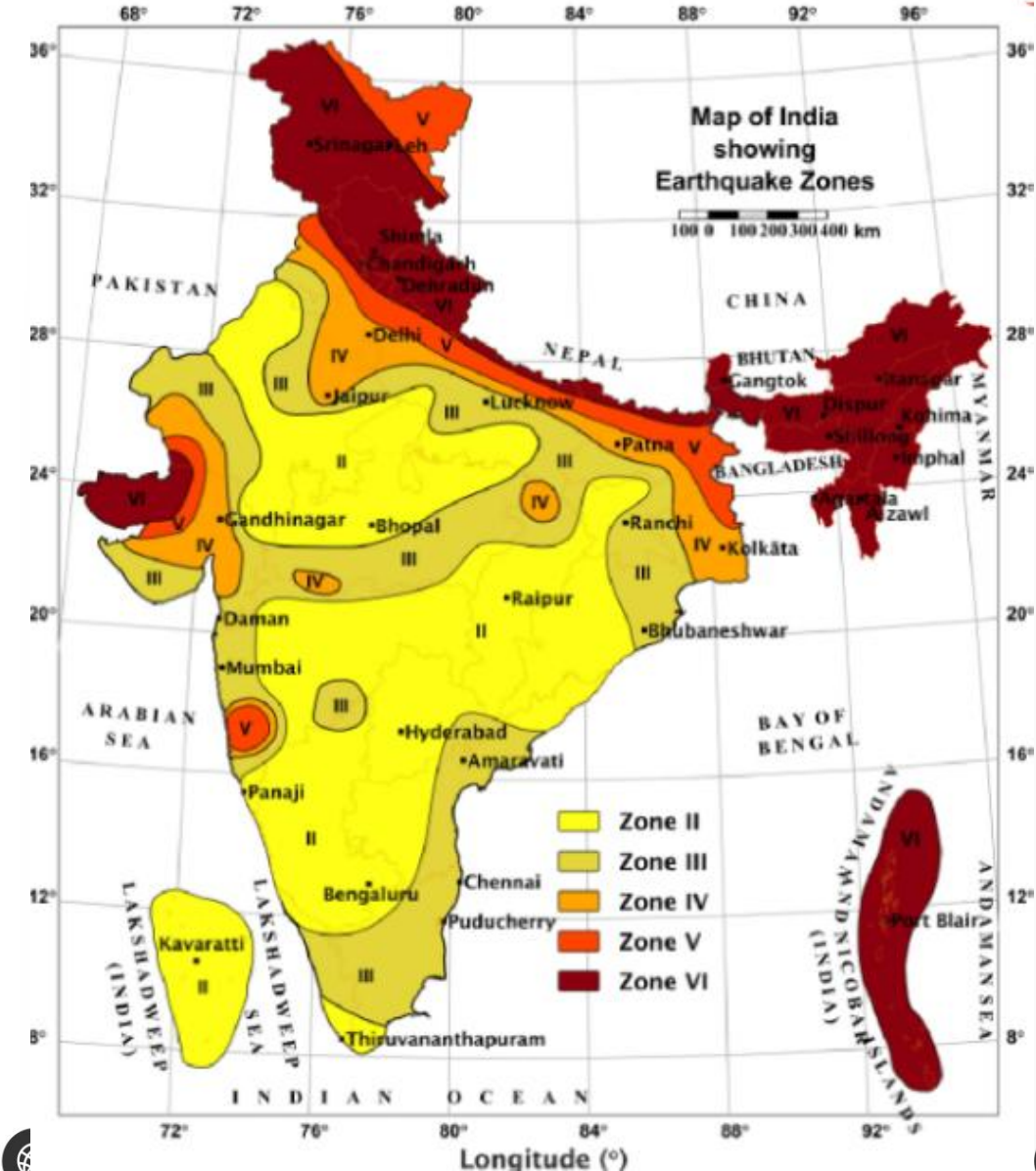


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New Earthquake Map of India



New Earthquake Map of India

- The Bureau of Indian Standards (BIS) has released an updated seismic zonation map under the **revised Earthquake Design Code 2025 (IS 1893)**.
- This revision significantly alters India's earthquake risk assessment by introducing a **new highest-risk Zone VI**, primarily covering the Himalayan region.

Key Changes in the Updated Seismic Zonation Map

- **Introduction of Zone VI**
 - A new **highest seismic hazard category (Zone VI)** has been introduced.
 - The **entire Himalayan belt (Jammu & Kashmir to Arunachal Pradesh)** has been placed in this zone due to its extreme tectonic vulnerability.
- **Expansion of Earthquake-Prone Area**
 - Earlier **59% of India's landmass** was classified as earthquake-prone.
 - The updated map places **61% of the landmass (housing ~75% population)** under **moderate-to-high seismic hazard zones**.
- **Reclassification of Himalayan Region**
 - Previously divided between **Zone IV and Zone V**.
 - Now unified under **Zone VI** acknowledging widespread seismic risk.
- **Boundary Rule**
 - Cities located on boundaries of two zones will **automatically be classified under the higher risk zone**.



Africa heading for a continental breakup

- Africa is undergoing a slow geological transformation that may eventually divide the continent into two separate landmasses.

Role of Plate Tectonics

- The foundation for this projection lies in the theory of plate tectonics, which demonstrates that the arrangement of Earth's continents has never been fixed. Over millions or even billions of years, large tectonic plates have fractured and drifted apart, forming new areas of oceanic crust through a process called seafloor spreading.





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100 villages to be tsunami-ready

What is Tsunami Ready?

- The UNESCO-IOC Tsunami Ready Recognition Programme (TRRP) is an international community-based effort to bolster risk prevention and mitigation across global coastal zones.
- It aims to build tsunami resilience through awareness and preparedness strategies that will protect life, livelihoods and property from tsunamis.



Communities at risk

Millions of people living in coastal communities around the world live in constant danger of being struck by tsunamis.



Warning and emergency management agencies

National and local authorities play a key role in helping communities prepare for and react.



Government authorities

National and local administrations should include tsunami-risk mitigation in their development programmes and agendas.



Community leaders and the public

Individuals with a strong influence over the general population should help get key messages across.

Methodology

This voluntary, performance-based community recognition programme is a collaborative effort to meet a standard level of tsunami preparedness.

12 indicators have been conceived to provide a consistent evaluation standard. All must be met to gain the recognition, which is renewable every four years.

Assessment

1. Tsunami hazard zones are mapped and designated.
 2. The number of people at risk in the tsunami hazard zone is estimated.
 3. Economic, infrastructural, political, and social resources are identified.
-

Response

9. A community tsunami emergency response plan is approved.
10. The capacity to manage emergency response operations during a tsunami is in place.
11. Redundant and reliable means to timely receive 24-hour official tsunami alerts are in place.
12. Redundant and reliable means to timely disseminate 24-hour official tsunami alerts to the public are in place.

Preparedness

4. Easily understood tsunami evacuation maps are approved.
5. Tsunami information including signage is publicly displayed.
6. Outreach and public awareness and education resources are available and distributed.
7. Outreach or educational activities are held at least three times a year.
8. A community tsunami exercise is conducted at least every two years.

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India's Coastline expansion

PARLIAMENT QUESTION: Coastline of the Country

Posted On: 04 DEC 2025 5:08PM by PIB Delhi

The length of India's coastline of 7516.6 km has been re-assessed to 11098.81 km by National Hydrographic Office (NHO) in coordination with Survey of India (SoI) as per the latest terms of references provided by National Security Council Secretariat (NSCS). The updated measurements were carried out using modern GIS software and high-resolution data of High-Water Line (HWL) based on latest surveys thereby capturing more intricate details. Coastal Protection and Development Advisory Committee (CPDAC) accepted the revised coastline length of India after obtaining concurrence from all coastal States/UTs. Based on the report published by Survey of India, the revised length of coastline was promulgated by Ministry of Ports Shipping and Waterways (MoPSW) circular dated 29th April 2025. Accordingly, the state wise length of the coastline of India has changed and the details have been given in the table below. In view of the revision of the length of coastline across the country, the length of Andhra Pradesh's coastline has become third in position.



Length of Coastline of India

The State-wise/UT-wise 'Length of Coastline of India' are hereby mentioned below.

Sl.No.	State/Union Territory	Coastline length (in Km)
1.	Gujarat	2,340.62
2.	Maharashtra	877.97
3.	Goa	193.95
4.	Karnataka	343.30
5.	Kerala	600.15
6.	Tamil Nadu	1,068.69
7.	Andhra Pradesh	1,053.07
8.	Odisha	574.71
9.	West Bengal	721.02
10.	Daman & Diu	54.38
11.	Pondicherry	42.65
12.	Lakshadweep Islands	144.80
13.	Andaman & Nicobar Islands	3,083.50
Total Length of Coastline of India		11,098.81

MHA: India's recalculated coastline up 48% in 53 years

Umamaheswara Rao / TNN / Updated: Jan 4, 2025, 04:22 IST



India's coastline has significantly expanded from 7,516km in 1970 to 11,098km in 2023-24, driven by new measurement methodologies. Gujarat and Bengal saw the most growth, while Puducherry's coastline shrank. The recalculations reflect advances in accurately measuring coastline features, boosting economic prospere ... [Read More](#)

From 7,516 kms to 11,098 kms: India's coastline expands by 47.6% in over 50 years, reveals MHA report



Sl. No.	STATES & UT	NHO & SOI (1970) data	Re-verified length of coastline
1	GUJARAT	1214.70	2340.62
2	MAHARASTRA	652.60	877.97
3	GOA	101.00	193.95
4	KARNATAKA	280.00	343.3
5	KERALA	569.70	600.15
6	TAMIL NADU	906.90	1068.69
7	ANDHRA PRADESH	973.70	1053.07
8	ODISHA	476.40	574.71
9	WEST BENGAL	157.50	721.02
10	DAMAN & DIU	42.50	54.38
11	PONDICHERRY, KARAIKAL, YANAM & MAHE	47.60	42.65
12	LAKSHADEEP & MINICOY ISLANDS	132.00	144.80
13	A & N ISLANDS	1962.00	3083.50
TOTAL (Km)		7516.60	11098.81

Coastal Security

India's Coastline

3.40 India has a coastline of 7516.6 km (under review for >11,000 km) bordering the mainland and the islands in Bay of Bengal in the East, the Indian Ocean on the South and the Arabian Sea on the West. There are nine States viz. Gujarat, Maharashtra, Goa,

Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Odisha and West Bengal and four Union Territories viz. Daman & Diu, Lakshadweep, Puducherry and Andaman & Nicobar Islands situated on the coast. The revision of the length of the coastline is owing to use of new Terms of References for computing India's maritime parameter established by NMSC for measuring coastline.

of Home Affairs

MHA: India's recalculated coastline up 48% in 53 years

Umamaheswara Rao / TNN / Updated: Jan 4, 2025, 04:22 IST



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721km. Nationally, the coastline increase compared to 1970 data stands at 47.6%. This major upward revision of coastline length across nine states and UTs is attributed primarily to using a new methodology to measure India's maritime parameter, as established by the National Maritime Security Coordinator.

Unlike older methods that relied on straight-line distance measurements, the scientifically updated approach incorporates the measurement of complex coastal formations such as bays, estuaries, inlets, and other geomorphological features.

According to experts, this refined methodology provides a more precise representation of the true length of the coastline, capturing its dynamic and heterogeneous characteristics. Coastline data from 1970, as reported by the National Hydrographic Office and Survey of India, was based on the measurement techniques and technologies available at the time.



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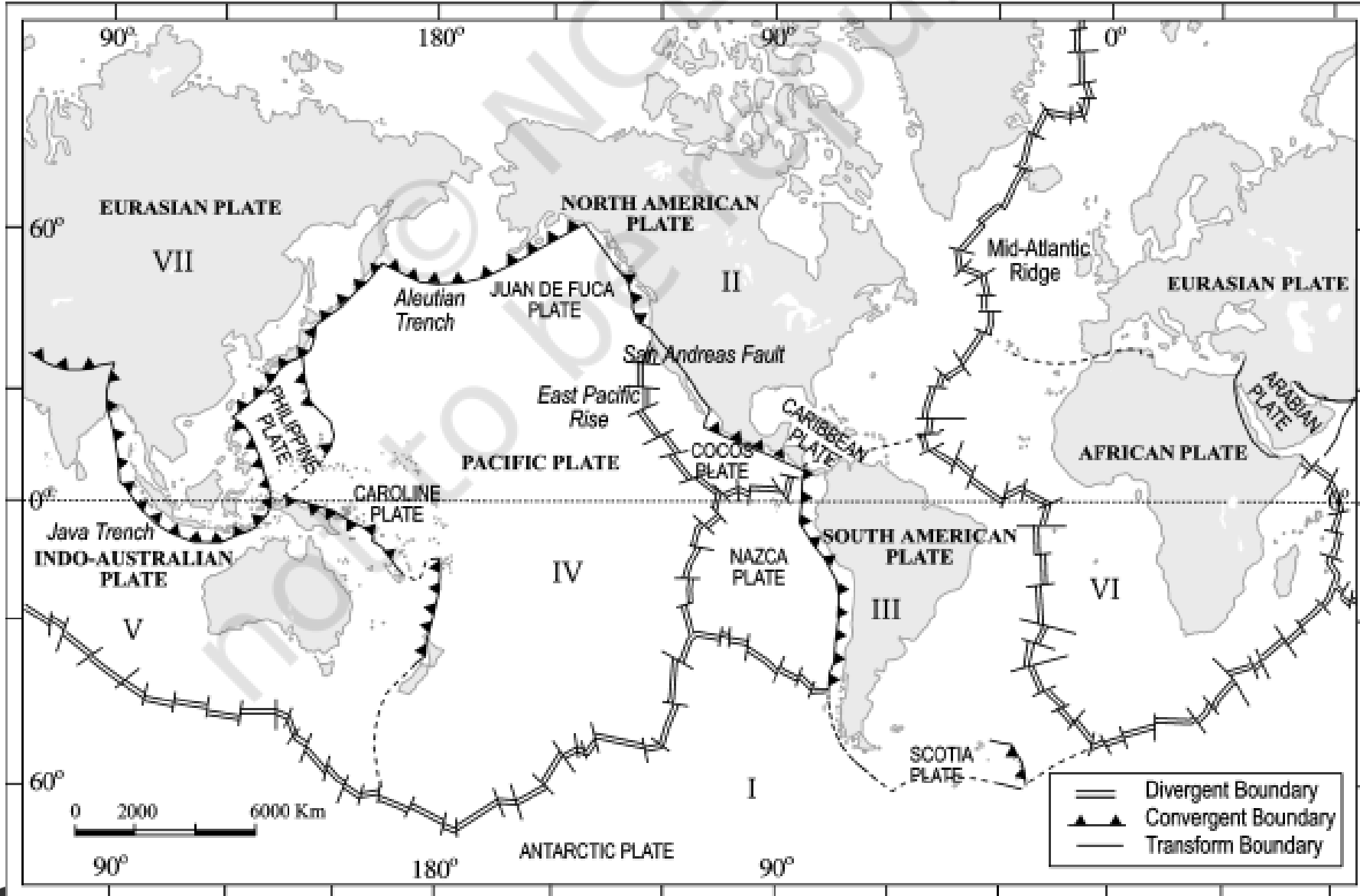
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Mount Ibu Eruption

Active volcanoes around the Indonesian archipelago: Sulawesi and North Maluku area



Source: NOAA *Caused fatality, damage, tsunami, or quake, with volcanic explosivity index of 6 or larger



Mount Semeru

Indonesia : eruption of Mount Semeru



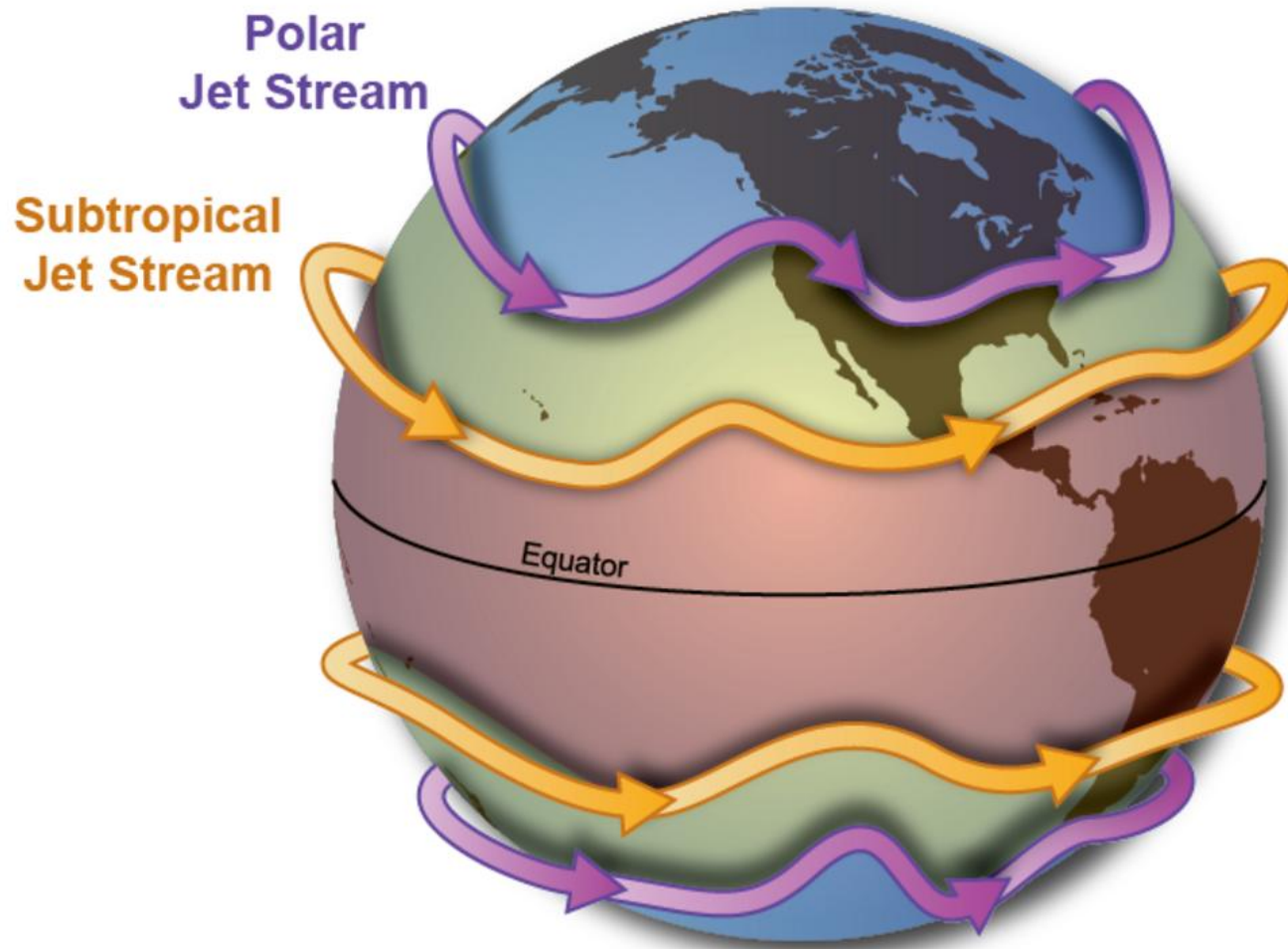
Omega Block

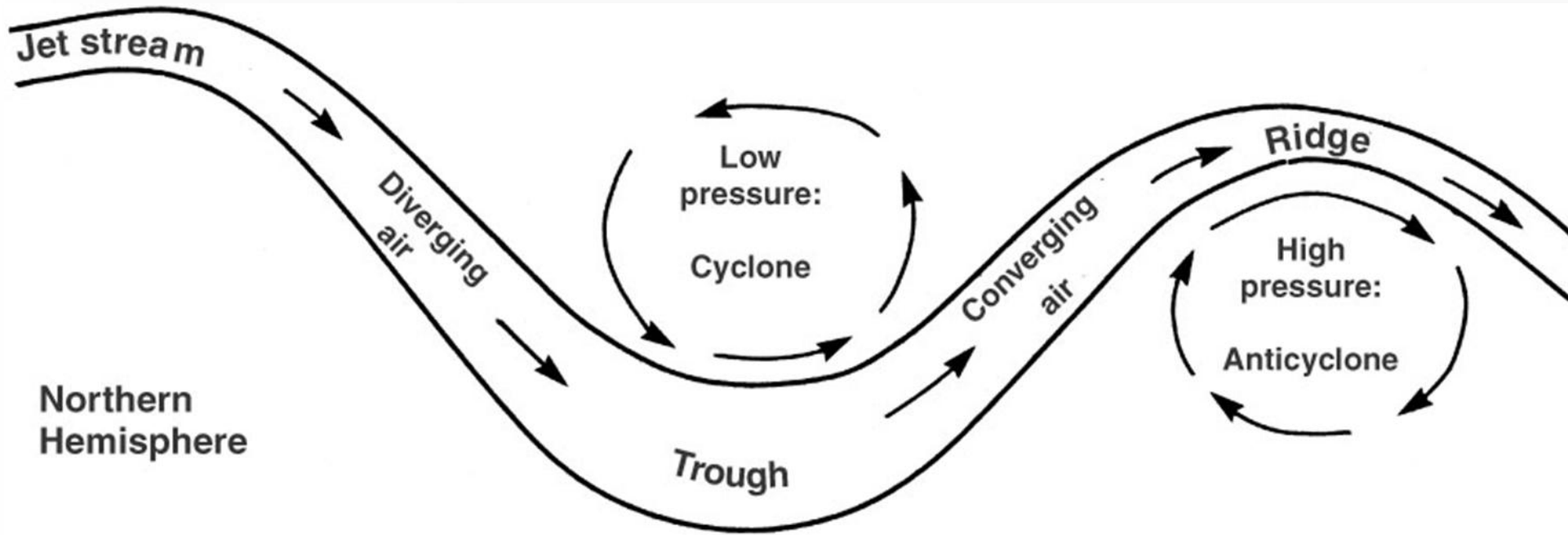
Omega Block

- Omega blocks get their name because the upper air pattern looks like the Greek letter omega (Ω).
- Omega blocks are a combination of **two cutoff lows with one blocking high sandwiched between them.**
- Because of their size, Omega blocks are often quite persistent and can lead to flooding and drought conditions, depending upon the location under the pattern.
- Cooler temperatures and precipitation accompany the lows, while warm and clear conditions prevail under the high.

Note - **Blocking patterns** occurs when centers of high pressure and/or low pressure set up over a region in such a way that they prevent other weather systems from moving through.







OMEGA BLOCK

WHAT IT MEANS

JET STREAM



LARGE, PERSISTENT &
CAN LEAD TO DROUGHTS

Heat Dome

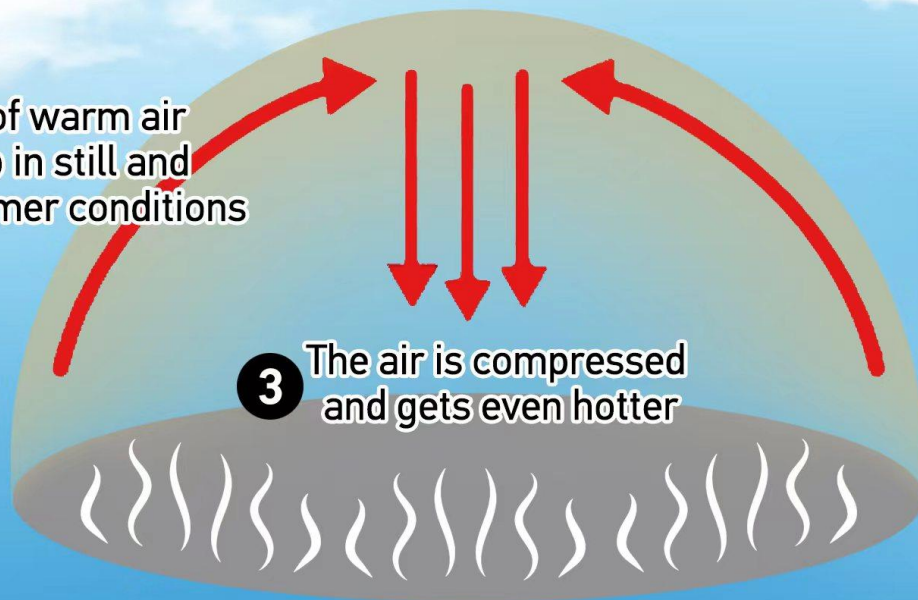
- A heat dome is formed when an area of high pressure in the atmosphere remains over the same region for a prolonged period of time, acting like a lid on a pot.
- As a result, hot air is caught underneath the pressure system – and cool air cannot enter – creating the aptly named heat dome.
- The “dome” is created because the air can’t escape. Then, temperatures keep warming, often to uncomfortable or even dangerous levels.
- The weather phenomena also suppress cloud cover and rainfall, which further exacerbates the high temperatures they bring. That’s because sunlight can hit the Earth’s surface more easily.

How a heat dome forms

2 High pressure in the atmosphere pushes the warm air down

1 A mass of warm air builds up in still and dry summer conditions

3 The air is compressed and gets even hotter



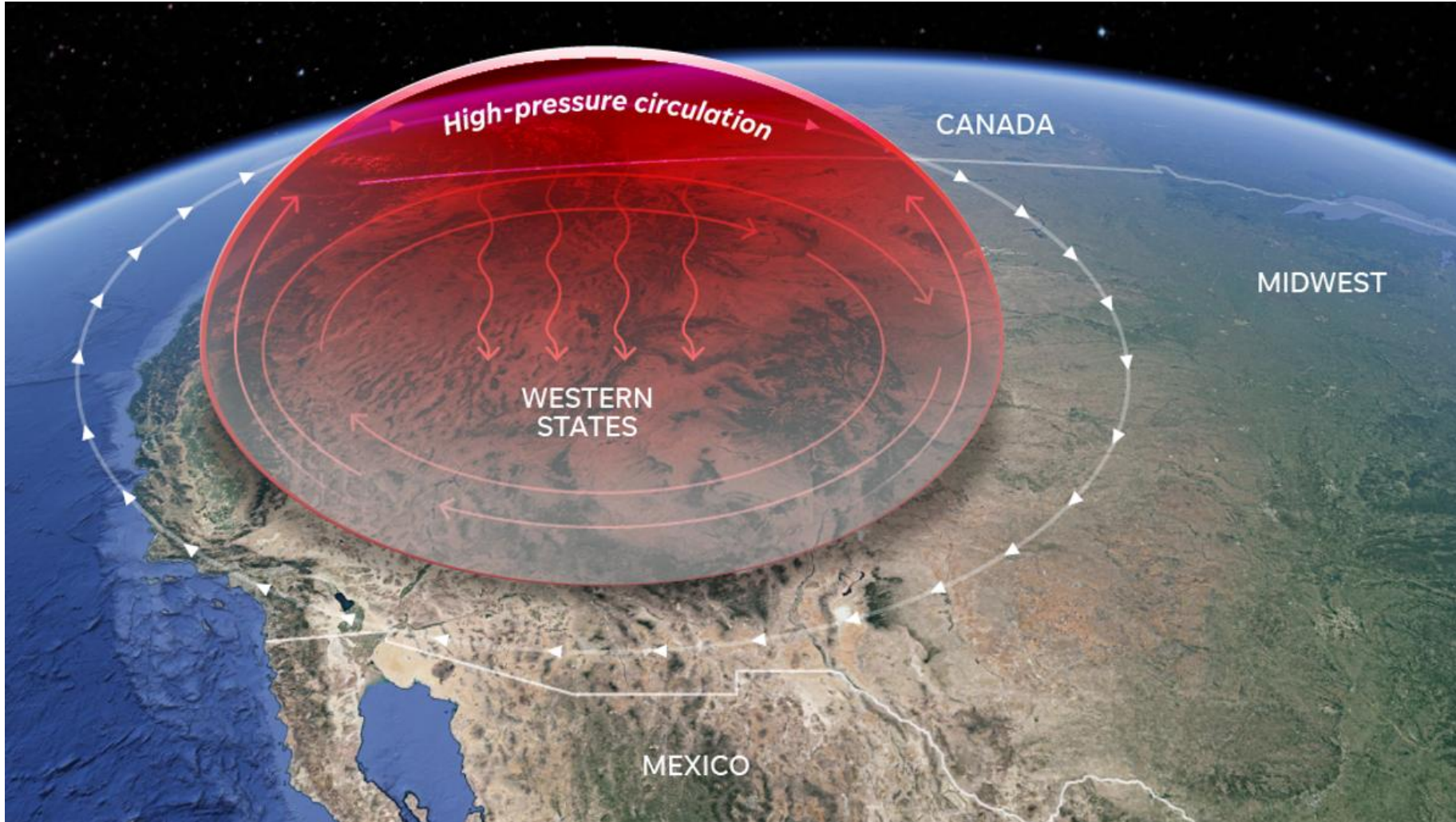
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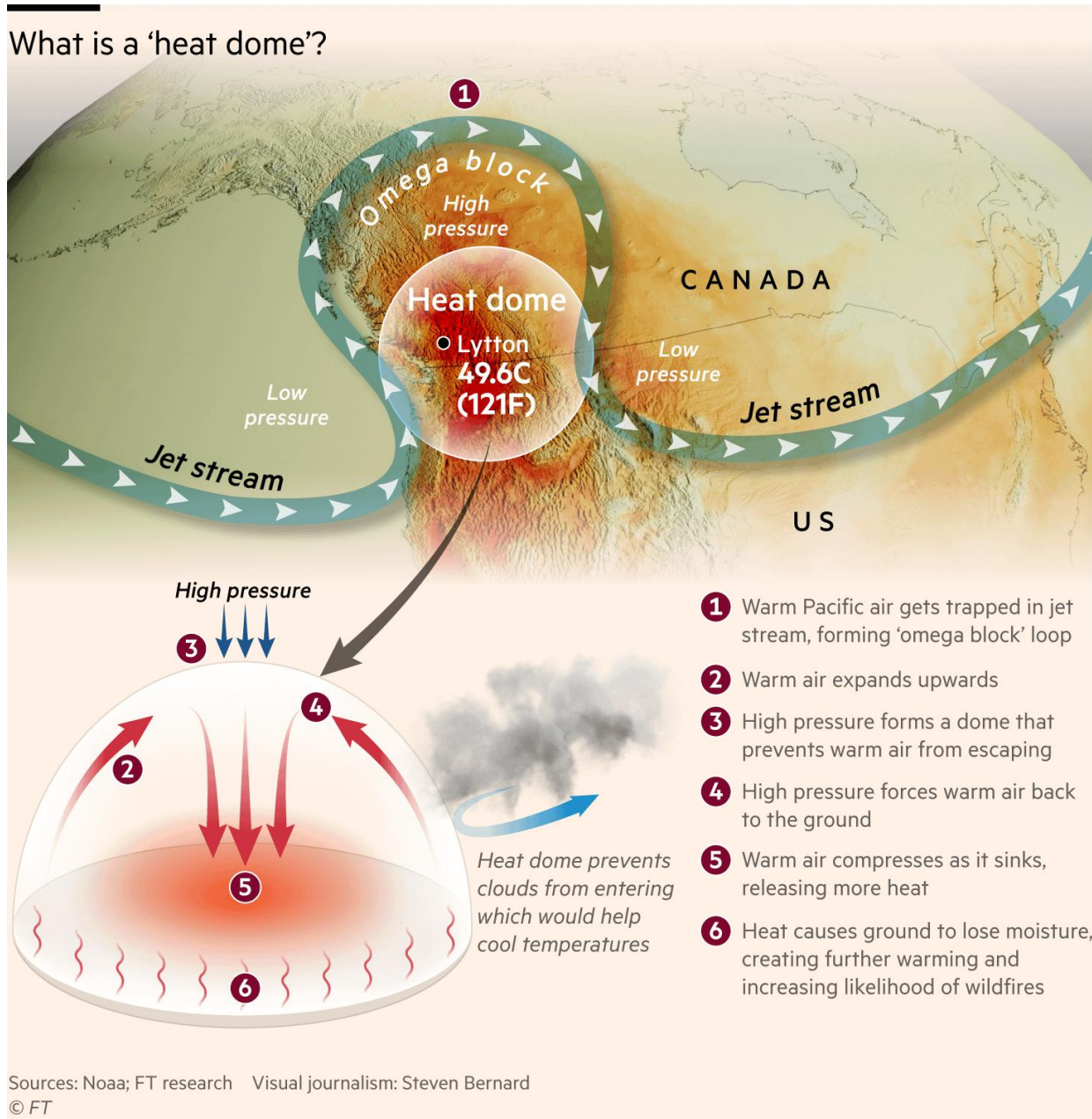
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What is a 'heat dome'?



Sources: NOAA; FT research Visual journalism: Steven Bernard

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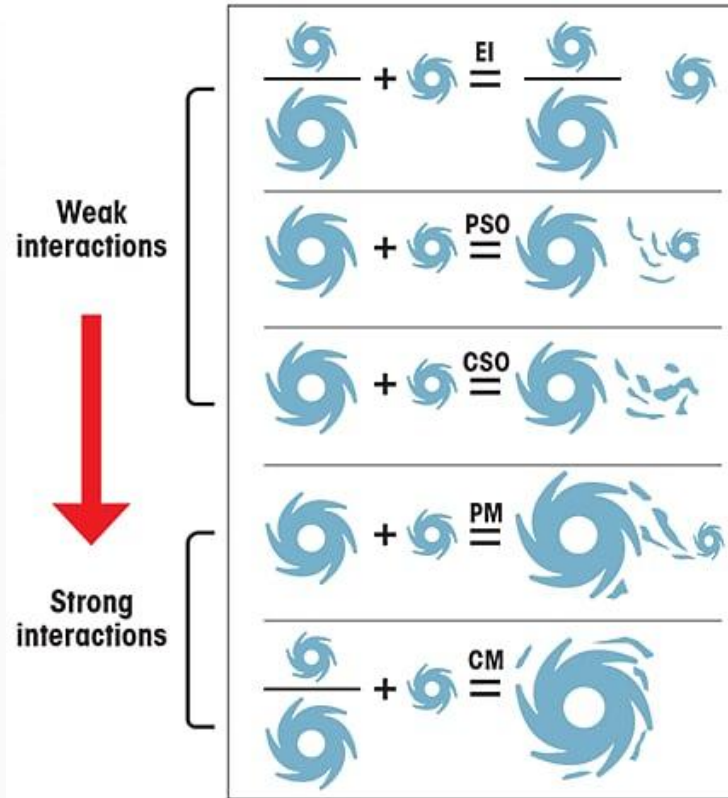
Fujiwhara Effect

Fujiwhara Effect

- The Fujiwhara Effect (also named as the Fujiwhara interaction or the binary interaction) is an interesting natural phenomenon that takes place when two nearby hurricanes or **cyclonic vortices** interact with each other.
- The Fujiwhara Effect was first described by a Japanese meteorologist, Dr. Sakuhei Fujiwhara in 1921. The phenomenon was thus named after him.
- Binary interaction of smaller circulations can cause the development of a larger cyclone or cause two cyclones to merge into one.



Additional Information



Elastic Interaction (EI): Interaction of vortices (storms) of same or different sizes, resulting in changes only in the direction of motion. This is the most commonly seen interaction

Partial Straining-Out (PSO): Interaction of vortices of unequal sizes. Part of the smaller vortex lost to the atmosphere.

Complete Straining-Out (CSO): Interaction of vortices of unequal sizes. The smaller vortex completely lost to the atmosphere

Partial Merger (PM): Interaction of vortices of unequal sizes
Part of the smaller vortex merged to the bigger vortex

Complete Merger (CM): Interaction of vortices of same or different sizes, resulting in complete merger of both the storms

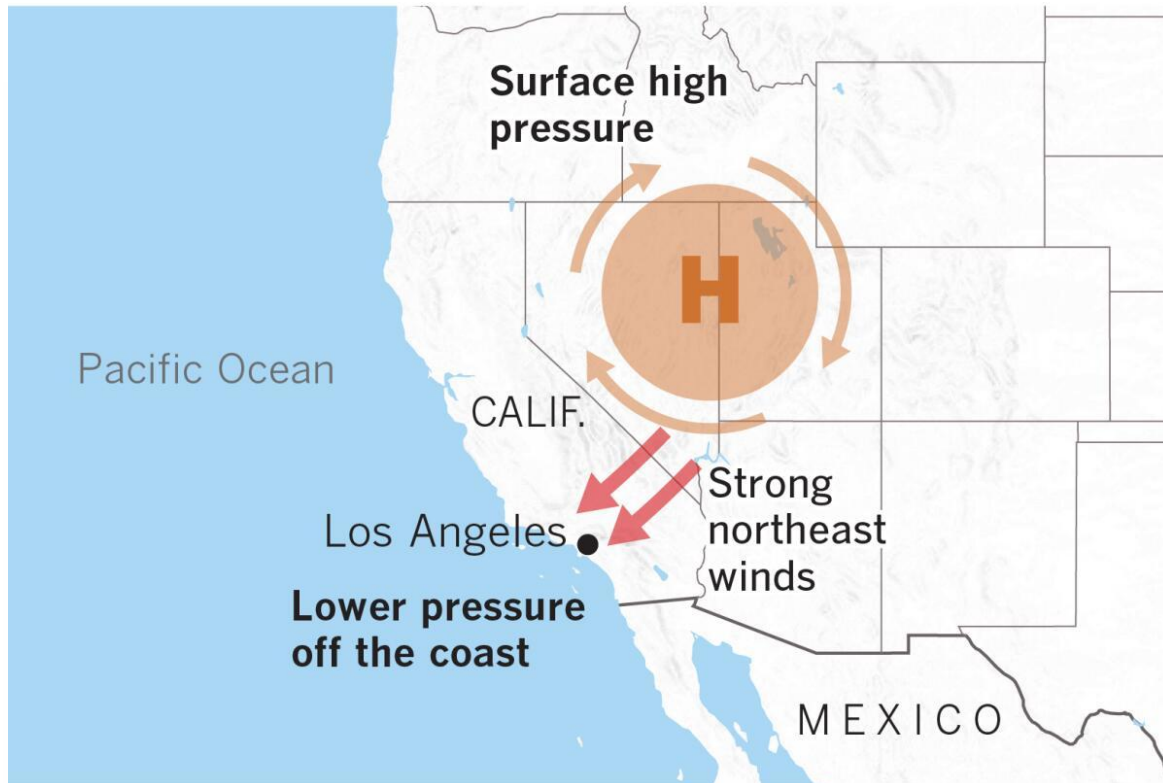
Additional Information

- There are five different ways in which Fujiwhara Effect can take place. The first is elastic interaction in which only the direction of motion of the storms changes and is the most common case. These are also the cases that are difficult to assess and need closer examination.
- The second is partial straining out in which a part of the smaller storm is lost to the atmosphere.
- The third is complete straining out in which the smaller storm is completely lost to the atmosphere. The straining out does not happen for storms of equal strengths.
- The fourth type is partial merger in which the smaller storm merges into the bigger one and the fifth is complete merger which takes places between two storms of similar strength.



California Wildfires : Santa Ana Winds

Santa Ana winds





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Santa Ana winds blow when area between the Rocky Mountains and Sierra Nevada (a mountain range in the Western United States) – and the pressure is low over California's coast.

Santa Ana winds usually occur from October to January. “Winter weather patterns allow high pressure to build near the surface of the Great Basin, which then interacts with low-pressure air over the Pacific,”



- The difference in pressure triggers the movement of powerful winds from the Basin's inland deserts, east and north of Southern California, over the mountains toward the Pacific Ocean.
- As the wind comes down the mountains, it compresses and heats up. The wind's humidity also drops, sometimes to less than 20% or even less than 10%.
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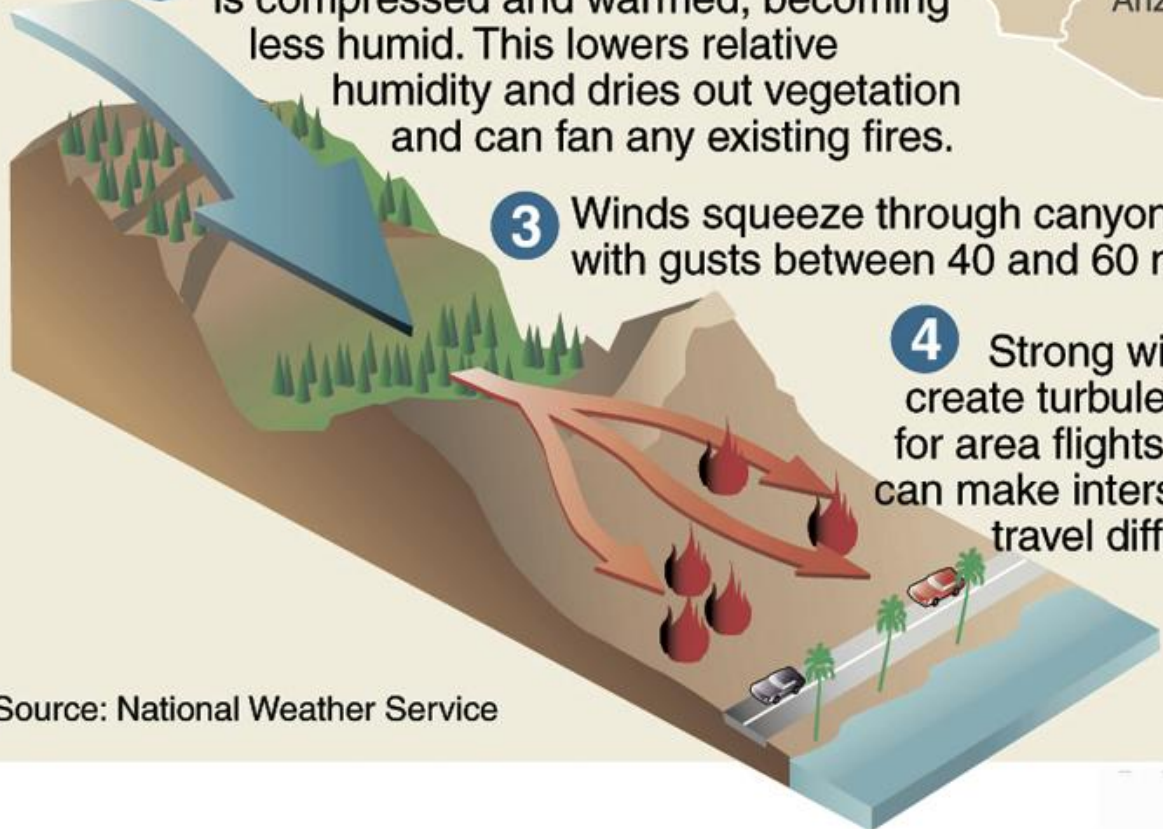
Santa Ana winds

In addition to increasing the threat of wildfires, Santa Ana winds can cause trouble for drivers and pilots in Southern California.

1 Desert winds originate from a clockwise flow of air around a high-pressure system east of the Sierras.



2 Air extends from the mountains, and is compressed and warmed, becoming less humid. This lowers relative humidity and dries out vegetation and can fan any existing fires.



3 Winds squeeze through canyons with gusts between 40 and 60 m.p.h.

4 Strong winds create turbulence for area flights and can make interstate travel difficult.

Source: National Weather Service

- As the wind comes down the mountains, it compresses and heats up.
- The wind's humidity also drops, sometimes to less than 20% or even less than 10%.
- The extremely low moisture turns vegetation dry, making it ready to burn.
- This process helped fuel the flames in Malibu.

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