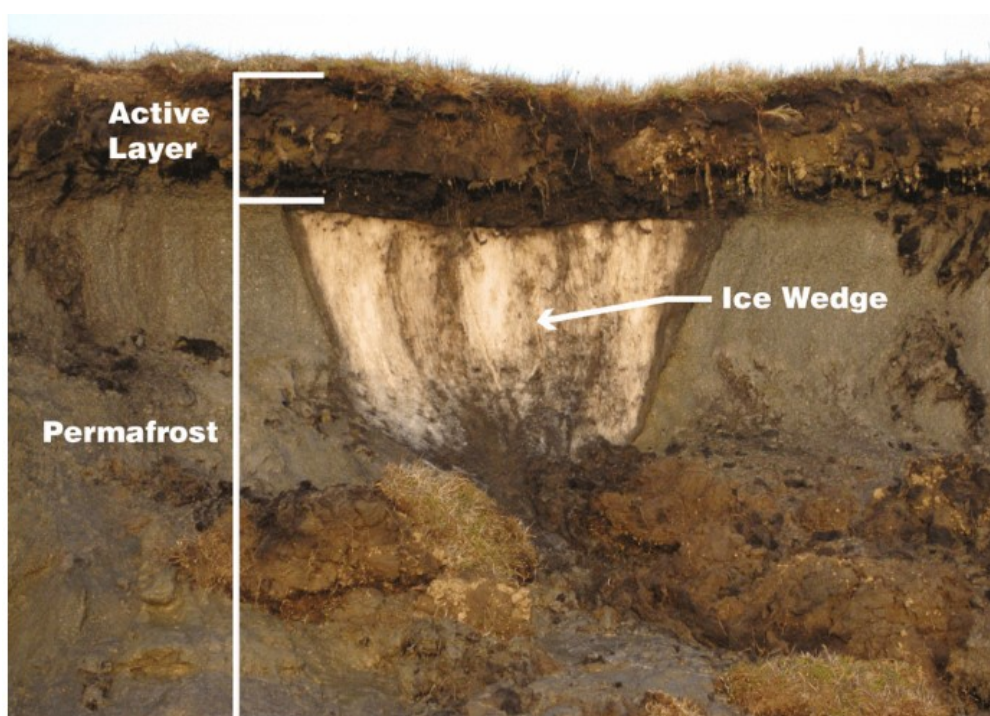


## UPSC Daily Current Affairs | Prelim Bits 23-08-2024

### Toxic mercury in Arctic's permafrost

*As the Arctic's permafrost thaws in a warming climate, an enormous amount of toxic mercury is being released into the environment.*

- **Permafrost** - They are any ground that remains completely frozen 32°F (0°C) or colder—for at least two years straight.
- Permafrost is made of a combination of soil, rocks and sand that are held together by ice.
- These are most common in regions with high mountains and in Earth's higher latitudes—near the North and South Poles.



- **Active layer** - It is the top layer of the permafrost that does not stay frozen all year.
- It thaws during the warm summer months and freezes again in the fall.
- **Permafrost Thawing** - As Earth's climate warms, the ice inside the permafrost melts, leaving behind water and soil.
- **Mercury Bomb** - A significant amount of total mercury (THg) is liberated from permafrost during glacial erosion in Arctic.
- Abrupt thawing events can rapidly mobilise metres-thick deposits of

sediment, potentially releasing large mercury.

- The mercury content was generally higher in sediment, with finer rather than coarser grains
- **Thaw slumps** - It is a type of landslide that occurs in the terrestrial Arctic's permafrost region.
- Thaw slumps adjacent rivers around the arctic region - Mackenzie river, Yukon and Koyukuk rivers, elevate suspended particulate mercury contents downstream.
- Most mercury eroded from the banks during river migration is redeposited with sediments.
- **Arctic Mercury** - Mercury is a global environmental contaminant with both natural sources and sources associated with human activities.
- Much of the mercury contaminating the Arctic is a result of transport by ***air and ocean pathways*** from sources outside of the Arctic.
- Over **98%** of atmospheric mercury is emitted outside the region and is transported to the Arctic via long-range air and ocean transport.
- **Impact** - People and wildlife living in the Arctic are some of the most exposed human populations globally to mercury.
- Mercury is a ***neurotoxin*** that can cause serious harm to the brain and nervous system, particularly when it accumulates in the food chain.
- Many indigenous communities, including Alaskan communities, rely on subsistence fishing and have disproportionately elevated blood mercury levels linked to dietary exposure.

## References

[Down to Earth |Toxic mercury trapped in Arctic's permafrost](#)

## Kodaikanal Tower Tunnel Telescope

*Scientists have discovered a new method to explore the Sun's secrets by studying magnetic fields at different layers of its atmosphere using data from the Kodaikanal Tower Tunnel Telescope.*

Aspect	Details
Origins and Evolution	• Established in 1899 as the Madras Observatory and later renamed as Kodaikanal Solar Observatory.
Location	• Tamil Nadu
Operator	• Indian Institute of Astrophysics (IIA)

<b>Significance and Legacy</b>	<ul style="list-style-type: none"> <li>• One of the oldest solar observatories globally.</li> <li>• Maintains a 1250-year collection of solar observations.</li> <li>• Plays a crucial role in tracking the Sun's activity over time.</li> <li>• Known for the discovery of the <b><i>Evershed Effect in 1909.</i></b></li> </ul>
<b>Primary Use</b>	<ul style="list-style-type: none"> <li>• Observations and measurements of the Sun's magnetic fields</li> <li>• Tracks the Sun's magnetic field and its evolution.</li> <li>• Observes solar activity cycles, with the 25<sup>th</sup> cycle expected to peak in 2024-2025.</li> <li>• Provides data on sunspots, solar flares, and coronal mass ejections (CMEs).</li> </ul>
<b>Environment</b>	<ul style="list-style-type: none"> <li>• Situated at an altitude of 2,500 meters.</li> <li>• Ideal for solar observations with over 220 days of clear skies.</li> <li>• Low dust pollution and low atmospheric turbulence enhance observation quality.</li> </ul>
<b>Telescope Infrastructure</b>	<ul style="list-style-type: none"> <li>• Houses 7 telescopes for solar observations.</li> <li>• Key telescopes include Spectro Heliogram Telescope, Twin Telescope, Kodai Tower Tunnel Telescope, H-Alpha Telescope, and others.</li> <li>• The 8-inch telescope is used for night sky observations.</li> </ul>
<b>Telescope Type</b>	<ul style="list-style-type: none"> <li>• Coelostat-based telescope system with a 3-mirror setup.</li> </ul>
<b>Mirror Configuration</b>	<ul style="list-style-type: none"> <li>• <b>Primary Mirror (M1)</b> - Tracks the Sun.</li> <li>• <b>Secondary Mirror (M2)</b>-Redirects sunlight downwards.</li> <li>• <b>Tertiary Mirror (M3)</b>- Makes the beam horizontal.</li> </ul>
<b>Focusing System</b>	<ul style="list-style-type: none"> <li>• Achromatic doublet (38cm aperture, f/96) focuses the Sun's image.</li> </ul>
<b>Image Scale</b>	<ul style="list-style-type: none"> <li>• 5.5 arcsec per mm.</li> </ul>
<b>Key Spectral Lines Used</b>	<ul style="list-style-type: none"> <li>• <b>Hydrogen-alpha (H<math>\alpha</math>) line-</b> 6562.8 Å</li> <li>• <b>Calcium II line-</b> 8662 Å</li> </ul>
<b>Purpose of Spectral Lines</b>	<ul style="list-style-type: none"> <li>• Inference of magnetic field stratification at different atmospheric heights.</li> </ul>
<b>Strategic and Geopolitical Importance</b>	<ul style="list-style-type: none"> <li>• Studying solar eruptions critical to protect satellites, power grids, and communication networks.</li> <li>• Helps predict and prepare for space weather events that could have global impacts.</li> </ul>

## References

1. [PIB | Kodaikanal Tower Tunnel Telescope](#)
2. [India Today | Kodaikanal Tower Tunnel Telescope](#)

## Island of Madeira

*Wildfires in Madeira have endangered world-heritage forests and stranded tourists, with nearly 6% of the island's total area burned.*



Aspect	Details
Location	<ul style="list-style-type: none"><li>• Madeira is a Portuguese island located in the North Atlantic Ocean, part of the Madeira Archipelago.</li><li>• It comprises the volcanic islands of Madeira, Desertas, and the Porto Santo.</li><li>• The Portuguese archipelago of Madeira is located to the west of Morocco and to the southwest of the Portuguese capital of Lisbon.</li></ul>
Region	<ul style="list-style-type: none"><li>• Iberian Peninsula (Spain and Portugal).</li></ul>
Capital	<ul style="list-style-type: none"><li>• Funchal.</li></ul>

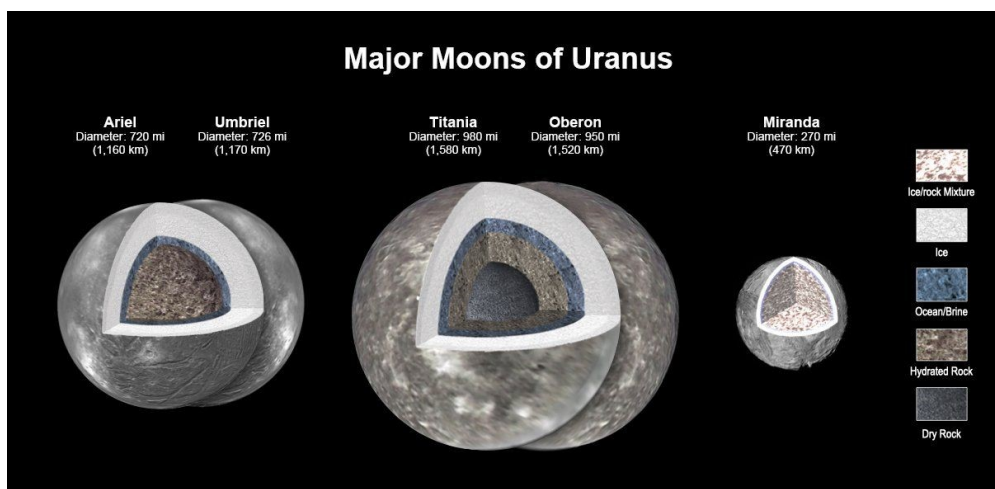
<b>Geography</b>	• Madeira is the top of a massive, submerged shield volcano rising about 6 km from the ocean floor.
<b>Area</b>	• Madeira is the largest and most populous island of the Madeira Archipelago.
<b>Tourism</b>	• A highly popular tourist destination, known for its landscapes, wine, and mild climate.
<b>Natural Heritage</b>	• Home to the largest surviving laurel forests ( <i>Laurus nobilis</i> ) in the world, a UNESCO World Heritage Site.

## Reference

[Down to Earth | Island of Madeira](#)

## Underground Ocean on Ariel

*The scientists using the James Webb Space Telescope have detected carbon dioxide ice on Uranus' moon Ariel, marking a key discovery in the search for water in the solar system.*



- Scientists working on the “Moons of Uranus” project has been closely studying 4 specific moons orbiting Uranus in order to find traces of ammonia, organic molecules, water, or carbon dioxide ice.
- They found that carbon dioxide ice was present on the surface of Uranus’ moon called Ariel.
- **Potential Underground Ocean-** The presence of ***carbon dioxide ice*** on Ariel suggests there may be a ***liquid ocean beneath its surface***.
- **Possible Chemical Processes-** The underground ocean may be releasing carbon dioxide through chemical processes, which then escapes to the surface via ice cracks.
- Another theory suggests that Uranus' magnetic field could be ***breaking***

### **down molecules to generate carbon dioxide.**

- **Additional Findings-** Carbon monoxide and traces of carbonates were also found on Ariel's surface. Carbonates are typically formed when water interacts with rocks.
- **Significance-** Underground oceans are considered important in the **search for extra-terrestrial life**, as they may harbour or sustain life.

## **Ariel**

- Ariel, second nearest of the five major moons of Uranus.
- **Size-** It has a diameter of about 1,158 kilometres.
- It is the fourth-largest of Uranus' moons.
- **Discovery-** It was discovered in 1851 by William Lassell
- Other major discovery on Ariel was conducted by the Voyager 2 spacecraft in January, 1986.
- **Voyager 2-** The primary source of information about Ariel comes from the Voyager 2 flyby in 1986.
- The spacecraft provided detailed images and data about its surface and features.
- **Surface-** Ariel's surface is characterized by a mix of bright, young surfaces and older, heavily cratered areas.
- **Internal Structure-** The moon is composed mainly of water ice and rocky material, with its internal structure possibly consisting of a silicate core surrounded by an icy mantle.
- **Magnetic Field-** Ariel does not have a significant magnetic field of its own.

## **References**

1. [India Express | underground ocean on Uranus' moon](#)
2. [Brittanica | Ariel](#)

## **JUICE probe**

*European scientists were due to attempt a first in orbital gymnastics tapping into the gravity of the earth.*

- **JUICE probe-** The Jupiter Icy Moons Explorer (JUICE) probe.
- It is a **European Space Agency (ESA) mission** designed to explore Jupiter and its 3 large moons i.e. **Callisto, Europa, and Ganymede.**
- **Launched in** - April, 2023, aboard an Ariane 5 rocket from the Guiana Space Centre.
- **Goals**
  - **Exploring the moons** - Create detailed maps of the moons' surfaces,

analyze the water bodies beneath them, and characterize them as planetary objects and potential habitats

- **Studying Jupiter** - Monitor Jupiter's magnetic, radiation, and plasma environment, and understand its origin, history, and evolution
- **Searching for life** - Investigate the possibility of life in space by studying the moons' subsurface oceans, which are believed to have conditions that could support life.

## Gravity assist

- It is a technique where a spacecraft brushes past a planet or moon, using its ***gravity to alter speed or trajectory***.
- Scientists will tapping into the gravity of the earth to guide the JUICE probe towards Jupiter in the ***first-ever double slingshot manoeuvre***.
- In a novel double manoeuvre, the JUICE probe will first use the gravity of the moon to swing towards the earth on exactly the right trajectory.
- If successful, it will put JUICE on course to reach Jupiter and its 3 large ocean-bearing moons - Callisto, Europa and Ganymede in 2031 with the help of three further single gravity assists
  - Venus in 2025, and then
  - The earth again in 2026 and 2029.

## References

1. [The Hindu | Juice Probe](#)
2. [ESA | Juice spacecraft specs](#)

