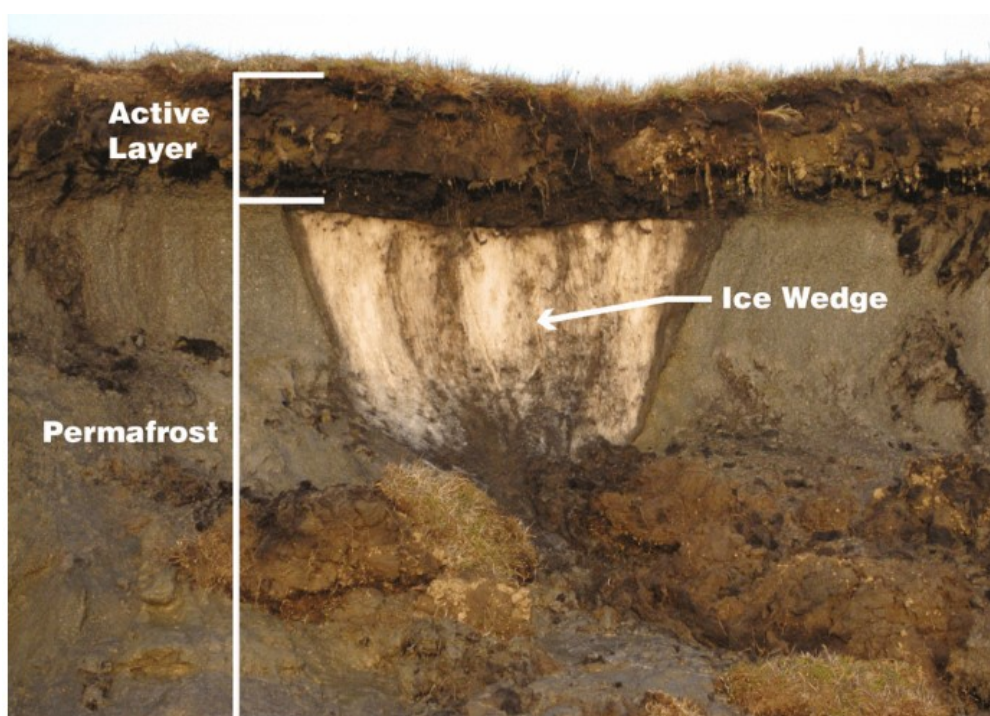


UPSC Daily Current Affairs | Prelim Bits 23-08-2024

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) |

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

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

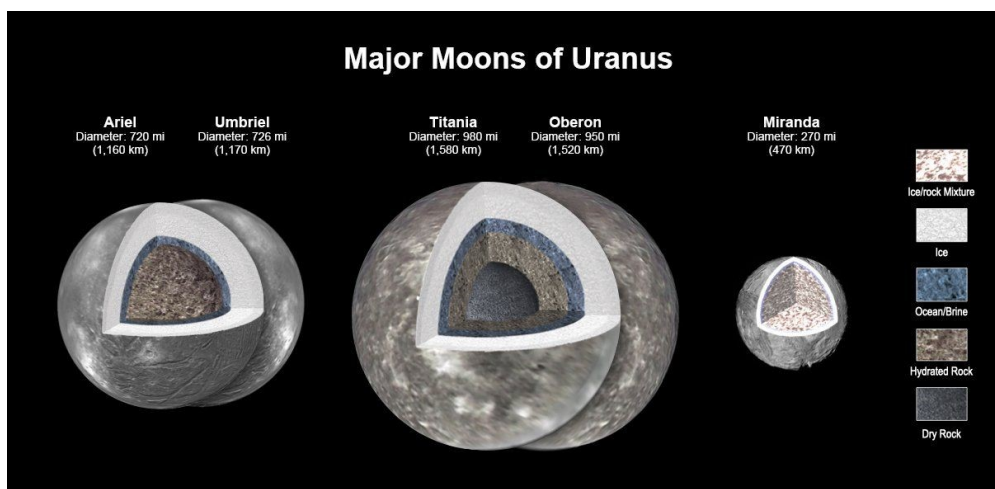
| | |
|-------------------------|--|
| Geography | • Madeira is the top of a massive, submerged shield volcano rising about 6 km from the ocean floor. |
| Area | • Madeira is the largest and most populous island of the Madeira Archipelago. |
| Tourism | • A highly popular tourist destination, known for its landscapes, wine, and mild climate. |
| Natural Heritage | • 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](#)

