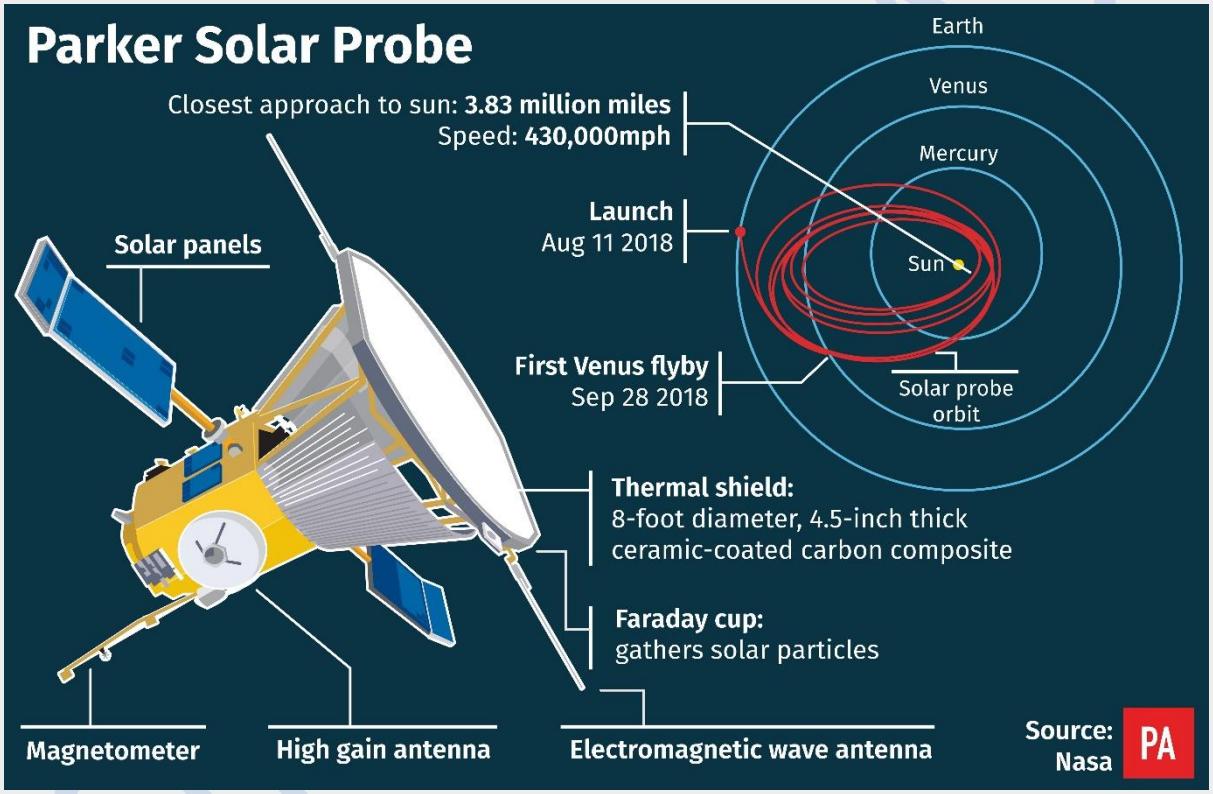
1. Parker Solar Probe

Why in News?

Among the various places humans have aspired to visit in the solar system, the sun remains the most foreboding. NASA's Parker Solar Probe arrived within 6.1 million km of the star's surface. This is a short distance to be from the sun: no spacecraft has ever made such a close approach. Even the Parker Solar Probe took seven years to get here.

The probe is making regular attempts to arrive within 6 million km of Sun's surface.



Naming of Probe

Around six decades ago, a scientist named Eugene Parker predicted the existence of the solar wind: a stream of charged particles flowing out from the sun in all directions. NASA named the Parker Solar Probe in his honour.

Launch

The probe was launched on board a Delta IV rocket from Cape Canaveral in Florida in August 2018. Once in space, the probe's maximum speed was an astounding 692,000 km/hr.

Shield

To protect against the sun's intense heat, the probe has an 8-foot-wide, 4.5-inch thick carbon-carbon composite material shield that can withstand up to 1,370° C while weighing only 73 kg. This shield was built by researchers at the Johns Hopkins Applied Physics Laboratory. It

consists of a carbon composite foam sandwiched between two carbon plates. Its sun-facing side is coated with white ceramic paint to reflect as much sunlight as possible instead of absorbing it.

Just a few metres behind the shield, in its shadow, the ambient temperature drops to 29º C, allowing the probe's scientific instruments to operate without special provisions to maintain the temperature.

Solar powered
The probe also has two sets of solar power arrays: one in the shield's shadow that supplies power to the instruments and the other on the sun-facing side, which uses a special fluid pump to cool itself while powering the probe during its close approaches.

Moving around Sun
Curiously, the first obstacle to the mission's success wasn't the sun's heat but its gravity. Since the probe flew through space at a very high speed, it had to decelerate significantly as it got close to the sun. If it didn't, the sun's gravity would have encouraged it to dive right into the star.

The probe used the combined gravitational forces of the earth and Venus to slowly spiral closer to the sun's surface.

Instruments on board
The probe has four scientific instruments: FIELDS, Integrated Science Investigation of the Sun (ISoIS), Wide-Field Imager (WISPR), and Solar Wind Electrons Alphas and Protons (SWEAP). FIELDS measures the electric and magnetic fields of the sun's atmosphere; ISoIS observes the energetic particles that cause solar storms while SWEAP records their properties; and WISPR takes pictures as it passes through the corona.

Relevance: GS Prelims; Science & Technology
Source: Indian Express

2. Why Naini Lake is seeing record-low water levels this year

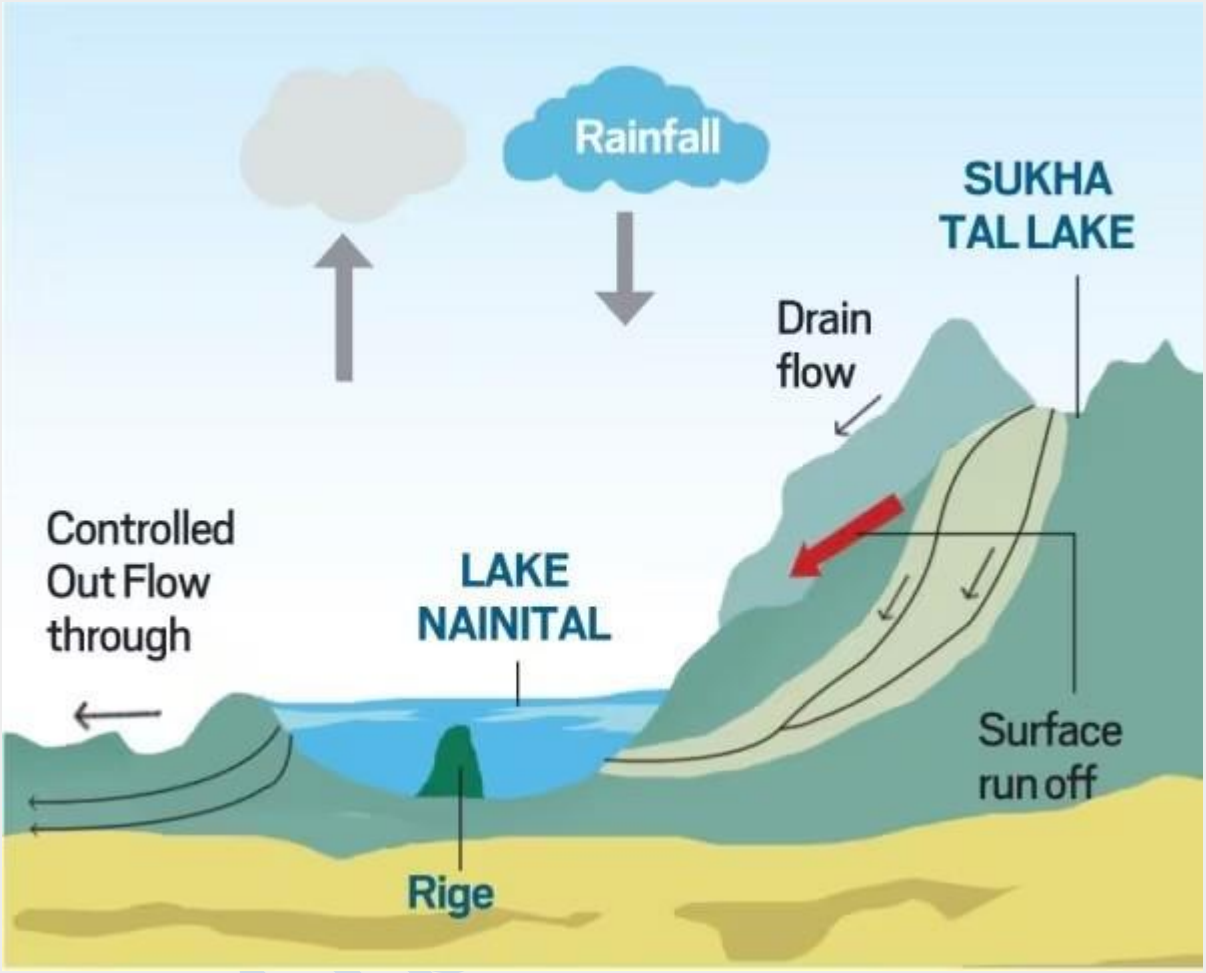
Why in News?
The Naini Lake, one of Nainital's key attractions, has recorded fall in water level. This has sparked concerns over drinking water scarcity ahead of the summer season. The Uttarakhand Jal Sansthan extracts 10 million litres everyday from the lake to supply drinking water to the city.

For many years now, alarm bells have been sounded about the lake's depleting water levels. This time, a decrease in snowfall and rainfall in the winter months has played a role, compounded by long-term issues surrounding the lake's upkeep.

Central to Nainital

The Naini Lake is a natural kidney-shaped lake in the heart of Nainital, surrounded by seven hills. It is said that English businessman P Barron chanced upon it around the mid-19th Century, spurring the town's development as a hill station for the British.

Nearly,76% of the city's water demand was met by the Naini Lake in 2024.



Reasons behind falling levels

Pressure from an increasing population, the increase in tourist activity, and commercialisation of nearby areas have impacted its health.

There are other civic issues also. For instance, pollution from the discharge of untreated wastewater, improper disposal of solid waste, and inadequate sewer systems causing sewage to overflow into stormwater drains, which ultimately discharge into the Naini Lake.

Climate change has a bearing on prevailing weather patterns. Annual mean temperatures in Uttarakhand have increased by nearly 1.5 degrees Celsius between 1970 and 2022. Experts say the warming is affecting rainfall and snowfall.

Also, Enhancing siltation, dumping debris in Sukhatal Lake, which is a major aquifer recharge area for Naini Lake, is fall in water level of Naini lake.

Efforts to Save lake

Several petitions have been filed concerning the lake, with one of the earliest going to the Supreme Court in 1993. The court held that projects of commercial complexes should be banned in Nainital. However, construction had not stopped.

Homestays have been permitted, and almost every third house is a homestay. Construction has been done on wetlands as well. Water is stored in wetlands for six months and serves as an important source for the lake during the lean period.

Relevance: GS Prelims; Environment
Source: Indian Express

3. Who are the members of the Arctic Council? Why has the Arctic region become an area of interest now?

Why in News?

International observers have raised concerns about escalating tensions in the Arctic, warning that if left unchecked, they could eventually spark conflict in the region.

What is happening?

The Arctic, the northernmost area of the planet, has remained largely isolated for centuries. However, as climate change accelerates the melting of ice caps, new strategic opportunities are emerging for global powers. Beneath the frozen landscape lie untapped reserves of natural resources such as fossil fuels, rare earth elements, phosphates, and copper as well as lucrative fishing grounds.

Most of these resources are currently inaccessible due to the year-round ice barrier, but as climate change destroys the Arctic environment, these resources and nearby trade routes will become increasingly viable.

Unlike the Antarctic, which is demilitarised and environmentally protected by a dedicated international treaty, the Arctic lacks similar legal safeguards and is primarily governed by the UN Convention on the Law of the Sea (UNCLOS). This allows nations to claim territories in the region and deploy military infrastructure. In recent years, overlapping maritime claims and military posturing have exacerbated tensions.

Who is in control?

The various islands and coastal areas in the Arctic are controlled by eight countries — Canada, Denmark (through Greenland), Finland, Iceland, Norway, Russia, Sweden, and the U.S. Together, these nations form the Arctic Council, an international body tasked with protecting the environment, conducting scientific research, and safeguarding the interests of indigenous peoples in the region. These nations exercise sovereignty over the Arctic land and can also exploit resources within their Exclusive Economic Zones (EEZs). The waters between these territories fall under international jurisdiction, ensuring freedom of navigation.

According to UNCLOS, nations can extend their claims to the seabed beyond the 200-nautical-mile EEZ if they can prove that the area is a natural prolongation of their continental shelf.

Canada, Denmark, and Russia have all submitted overlapping claims to the Arctic seabed to the UN Commission on the Limits of the Continental Shelf. Despite these territorial declarations, infrastructure in the Arctic remains underdeveloped, with only a few operational ports along the coast. Among the Arctic Council members, Russia is the only country with a significant fleet of icebreakers, including one which is nuclear-powered, capable of navigating through the region's treacherous sea ice.

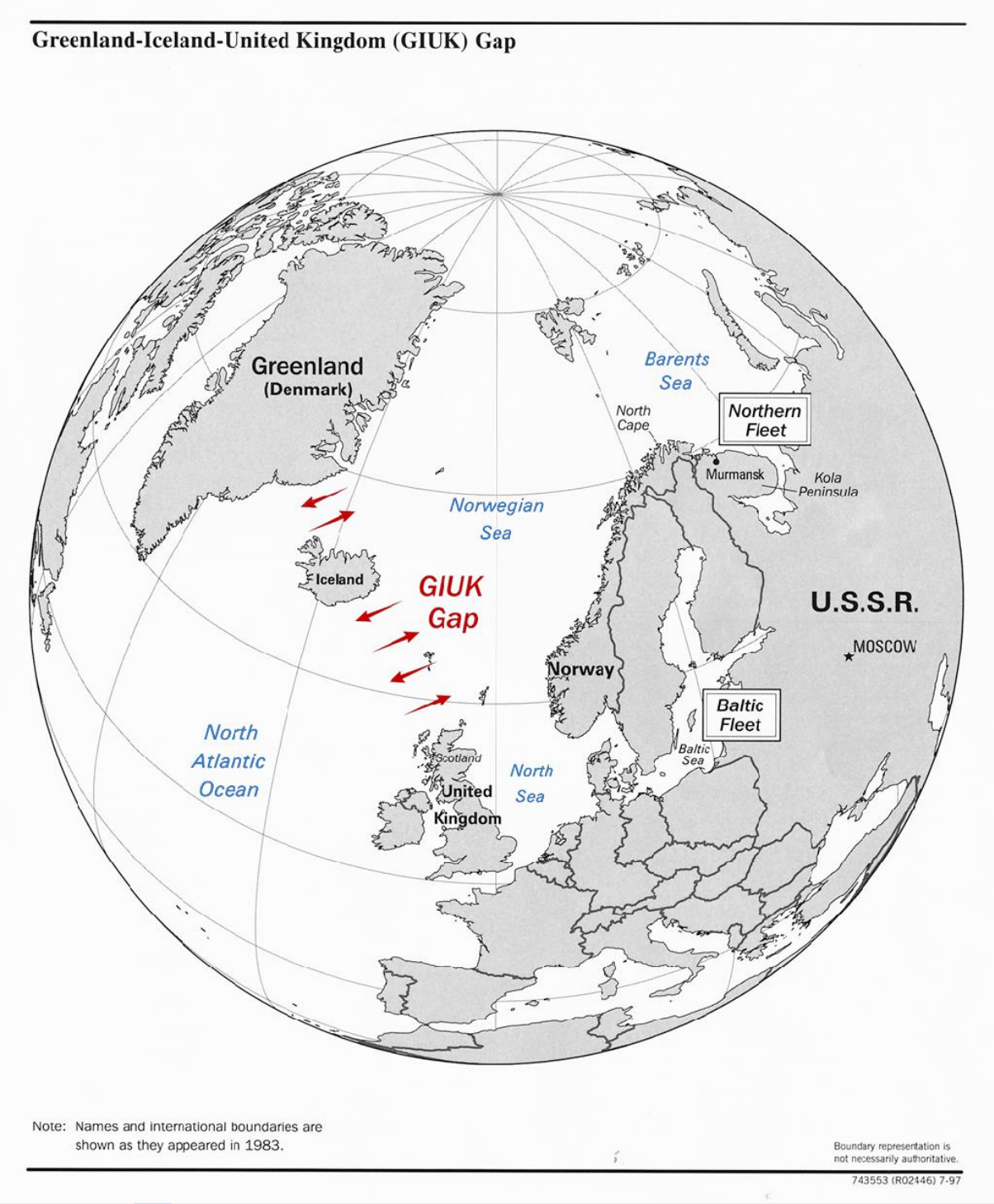
Where do the tensions arise?

For months, news headlines have reported on U.S. President Donald Trump's renewed interest in acquiring Greenland from Denmark. He has described the world's largest island as a matter of " national security" and has questioned the legitimacy of Denmark's sovereignty over the territory. Greenland, which has been under Danish control for over 300 years, also hosts the U.S. Pituffik military base. In January, following Mr. Trump's renewed interest, Denmark's prime minster Mette Frederiksen has pledged to bolster Greenland's security and embarked on a tour of European capitals to seek support from allies.

Additionally, tensions between the U.S. and Canada have risen following Mr. Trump's controversial comments about annexing Canada. Both nations have long disputed the status of the Northwest Passage, a potential Arctic shipping route that winds through Canada's Arctic Archipelago. Canada considers the passage part of its internal waters, granting it control over navigation, while Washington insists it falls under international jurisdiction, which means that any nation has freedom of navigation in the Passage.

Concerns over potential conflict also extend to Russia and the remaining Arctic Council members. These members, apart from Russia, all belong to NATO. Since the Russian invasion of Ukraine, relations within the Council have become increasingly strained. Russian officials have suggested that Norway's Arctic island of Svalbard should fall under Russian control. Meanwhile, observer states of the Arctic Council, including India, are closely monitoring developments.

The U.K., for instance, has repeatedly mphasized the strategic importance of the Greenland-Iceland-U.K. (GIUK) gap, a critical choke point for NATO's naval defences. This passage is the only feasible route for Russian submarines attempting to access the Atlantic to potentially disrupt NATO shipping in case of conflict, making it a focal point of Western military planning.



Why does the Arctic matter so much?

Aside from ongoing resource extraction, interest in the Arctic surged following a 2009 U.S. Geological Survey report estimating that the region holds 13% of the world's undiscovered oil reserves and 30% of its untapped natural gas reserves. Most of these resources lie beneath the seabed, making maritime claims highly significant. Greenland also harbours some of the world's richest deposits of rare earth elements, which drew significant investment interest from Chinese companies in the early 2020s. However, many of these projects were later suspended due to environmental concerns or U.S. political pressure.

The melting of Arctic sea ice has also prompted interest into the opening of new commercial trade routes. The Northeast Passage, which runs along Russia's Arctic coast, is particularly critical for Chinese trade. This route, stretching from the Bering Strait to Norway, could reduce the maritime distance between East Asia and Europe by approximately 8,000 kilometres compared to the traditional route through the Suez Canal. Navigating commercial shipping through this passage could save Beijing billions in transportation costs. However, the so-called Polar Silk Road would require Russia to grant Chinese ships access to its Arctic ports, a prospect Moscow has so far approached with caution.

What lies ahead?

Aside from political declarations and territorial claims, some nations have taken concrete steps to assert their Arctic ambitions. In 2007, Russia sent the MIR-1 submarine to the North Pole to plant a Russian flag on the seabed beneath the Arctic ice cap — a symbolic demonstration of its presence and capabilities. Moscow has also maintained a number of military bases in the Arctic, most of them dating back to the Soviet era. In 2022, it conducted joint naval exercises with Beijing in the East China Sea, which indicated strategic implications for Arctic security.

China has also steadily become more vocal about its Arctic interests, declaring itself a 'Near-Arctic State' in 2018 and planning the construction of its first nuclear-powered icebreaker. Since Sweden and Finland joined NATO following Russia's invasion of Ukraine, the alliance has intensified its military presence in the region, including large-scale exercises near the Russian border in Finland in 2024. Analysts have pointed out NATO's limited operational capabilities in the Arctic, raising concerns about strategic imbalances. As temperatures continue to rise, tensions in the melting Arctic may soon reach a boiling point.

Relevance: GS Prelims & Mains Paper II; International Relations
Source: The Hindu