



SPACE

CAPSULE

Part 1

(June-November 2019)



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Moon's Aitken Crater

- **Why in news?**
 - Scientists have observed an unusual anomaly in the south pole of the moon-Aitken basin.
- **What is the Aitken Basin?**
 - Aitken Basin is the largest preserved impact crater of the solar system.
 - The massive subsurface has a deposit of a dense material which is assumed to be a metal.
 - The metal supposedly came from the crashed asteroid and it sank to the mantle of the moon and now sinks to the core

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○ It is also assumed to be a concentration of dense oxides which is related to the last stage of lunar magma ocean solidification.	
● How did the scientists find this out?	
○ It was done by scientists at NASA through their GRAIL (Gravity Recovery and interior laboratory) and LRO (Lunar Reconnaissance Orbiter)	
● What is the GRAIL?	
○ GRAIL, initiated by NASA's Discovery Program in 2011, is concerned with the visualization of the internal structure of the moon using high-quality gravitational field studies.	
○ GRAIL mission has placed two identical spacecraft namely, Ebb and Flow around the moon in respective orbits.	
● What is LRO?	
○ NASA's moon mission in operation since 2009.	

- It is concerned with the quest for ice and water on the poles of the moon that could dominantly reside in shadowed craters.

Chandrayaan II

- Mineralogical and elemental study of the lunar surface will be undertaken by it, also to figure out the signatures of hydroxyl and water ice on the moon.
- It is a part of India's PLANEX (Planetary Science

Mission moon 2.0 A look at the four key components of Chandrayaan 2 – launcher, orbiter, lander and rover

Launcher – GSLV Mk-III | It will carry Chandrayaan 2 to its designated orbit. This three-stage vehicle is India's most powerful launcher to date, and is capable of launching 4-tonne class of satellites to the Geosynchronous Transfer Orbit

ORBITER



Weight: 2,379 kg
Power generation capability: 1,000 W
Capable of communicating with the Indian Deep Space Network at Byalalu and the Vikram lander. It will be placed in a 100X100 km lunar polar orbit

LANDER – VIKRAM



Weight: 1,471 kg
Power generation capability: 650 W
Named after Vikram Sarabhai, the Father of the Indian space programme, it is designed to function for one lunar day, equivalent to about 14 earth days

ROVER – PRAGYAN



Weight: 27 kg
Power generation capability: 50 W
This 6-wheeled robotic vehicle can travel up to 500 m and uses solar energy for its functioning. It can communicate only with the lander

SOURCE: ISRO

● Why in news?

- Recently launched by ISRO, Chandrayaan II will be India's second mission to the moon.

● Specifics of the mission

- One of its major aims is to explore the moon's south pole region. The project aims at getting a better understanding of the origin of the Moon and its history through topographical studies and mineralogical analysis

and exploration) mission.

- Its three components include an orbiter, rover (Pragyan) and lander (Vikram).
- It is placed at an altitude of 100kms above the moon's surface where the basic changes would take place as the lander separates from the orbiter and allows a soft landing which is its unique characteristic.
- Its launch vehicle is GSLV Mk-III which was designed with a primary aim to launch

communication satellites and to launch satellites in the geostationary orbit.

- It can carry a payload of 8000 kgs to LEO and 4000 kgs to GTO.
- GSLV has two solid motor strap ons, the core stage of liquid propellant and the cryogenic stage.
- **Other info**
- India became the fourth country to land a spacecraft on the moon's south pole
- The south pole of the moon remains unexplored as compared to the other regions due to moon axis and due to a phenomenon called tidal locking.
- Among the other challenges facing Chandrayaan are communication, landing and trajectory.
- Why the south side of the moon is so important and not properly explored?
- Due to the moon's axis, few regions on the south pole remains forever dark especially the craters and have higher chances of containing water.
- Because of the axis ' weak angular tilt (1.54-degree tilt relative to Earth's 23.5 degrees), the bottom of the polar craters of stay under shadows forever. Hence the temperature remains frigid at the poles, hitting as low as -248 degrees Celsius. That makes it among the lowest Solar System temperatures. The sunlight strikes in the polar regions at very low angles and thus the craters might never have received sunlight, thus increasing the chances of ice being present on such surfaces.

Indian Space Station

- **Why in news?**
- India plans to have its own space station launched by 2030.
- **What is the space station?**
- It is basically a spacecraft which is habitable by humans who are crewmembers.
- Countries such as the United States, Russia, and China have already developed their presence in space and the ISS (International Space Station) is the only and largest fully functioning human-made space station.
- **What is India's plan?**
- India intends to carry out microgravity experiments.

- It will be an extension of the ambitious Gaganyaan mission in India and should be capable of hosting astronauts for about 20 days.
- It will be placed at an altitude of 400 kms around the earth. Space docking or Spadex technology which is already being tested in ISRO will be used.
- It helps to gather information and provides a platform for greater scientific study and many of these features.

Spectrum Roentgen Gamma Telescope

- **Why in news?**
- A team of German Russian scientists has begun the Spectrum Roentgen Gamma Telescope.
- **What is the use of this?**
- It aims at creating a 3D X-ray map of the entire universe.
- It also aims at unveiling hidden black holes, dark energy and stars.
- The period is set for 4 years where it will be 8 times surveying the sky and monitoring the above-listed elements.
- **What's unique about this?**
- It uses hard X-ray(X-rays with high photon energies (above 5–10 keV) are called hard X-rays.)to map the universe. Due to their penetrating ability hard X-rays are widely used to image the inside of visually opaque objects.
- Dark matter will be traced by this.
- It has no role to play on the gamma radiation.
- X-Ray was also used earlier but it didn't do exactly what this project intends to do.

Methane on Mars

- **Why in news?**
- NASA's Curiosity rover has discovered high quantities of methane in Mars ' air leading to speculation as to whether life exists on or below Mars.
- Later it was discovered that the levels had fallen back to normal.
- **What is Methane?**
- Methane on earth is a natural gas, created primarily by biological and natural processes.

- It is produced by microbes living in the underground and in the digestive system of animals like cows. It also occurs in natural formations like rocks, springs, and others. It is a result of the chemical reactions at low temperatures between carbon and hydrogen atoms.
- It is a short-lived element on earth. It is one of the 6 greenhouse gases covered under the Kyoto protocol under UNFCCC.
- **More news**
- Scientists are yet to figure out the source of it and its effects on mars. This shift in gas intensity results from the Martian Plume, whose causes are still undetected by the scientists.

RISAT 2B

- **Why in news?**
- ISRO successfully launched RISAT 2B, from Sriharikota which is PSLV C46 radar imaging satellite.

All-season satellite

RISAT-2B is a radar imaging earth observation satellite developed by ISRO

Key features

Lift-off weight | 615 kg

Altitude | 557 km

Payload | X-Band radar

Inclination | 37 degrees

Mission life | 5 years

Applications



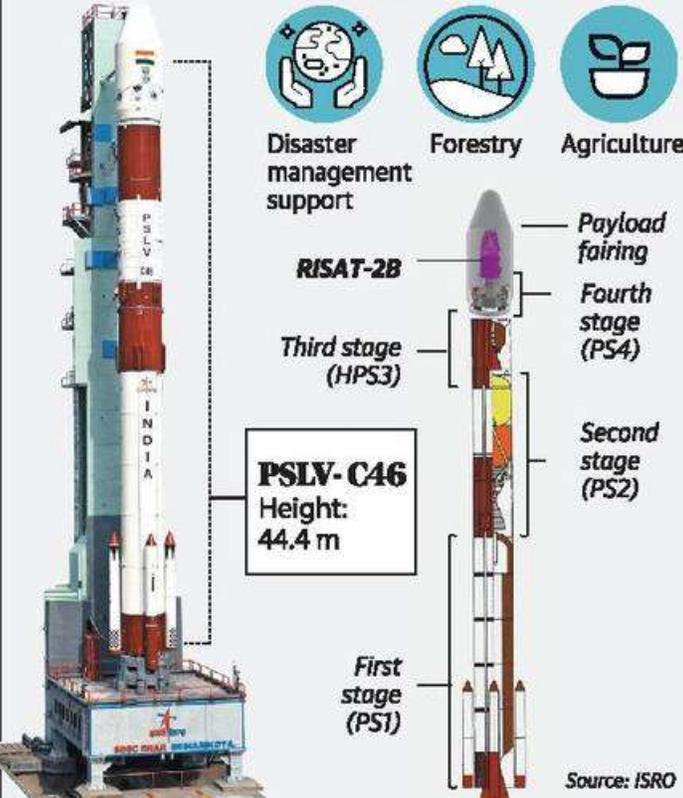
Disaster management support



Forestry



Agriculture



Source: ISRO

- **What is RISAT 2B?**
- This is the 4th one in the RISAT series.
- It was placed in a 555kms orbit with a 37-degree inclination toward the equator.
- Its main usage is for military and general surveillance purposes.
- It is also used in support for agriculture, forestry, environment and disaster management.
- It is primarily used for earth observation and is fitted with synthetic aperture radar that will take pictures in cloudy weather as well as at night and day.
- PSLV C46 is its launch vehicle.

MANAV: Human Atlas Initiative

• Why in news?

MANAV is an initiative by the Department of Biotechnology to launch a human atlas designed to improve knowledge of human physiology.

• More info

- It is a project funded by DBT and Persistent Systems a biotechnology company. This project aims to create a database network of all tissues within the human body from the resources available.
- It involves scientific skill development, science outreach and others. It aims at getting better insights about human physiology through mapping, develop disease models, and analyse drugs and other things. Students from different fields like those linked to sciences will participate in this.
- This will be an important platform as it will explore the avenue where there less exploration and will impact positively on the academics of the students, researches for study and drug development.
- It will enable understanding human physiology in two conditions, namely, normal and disease conditions.
- The project will be executed by the Indian Institute of Science Education and Research (IISER) an autonomous organization under MHRD and the National Center for Cell Sciences (NCCS) autonomous organization under DBT, Ministry of S&T.

Gaganyaan

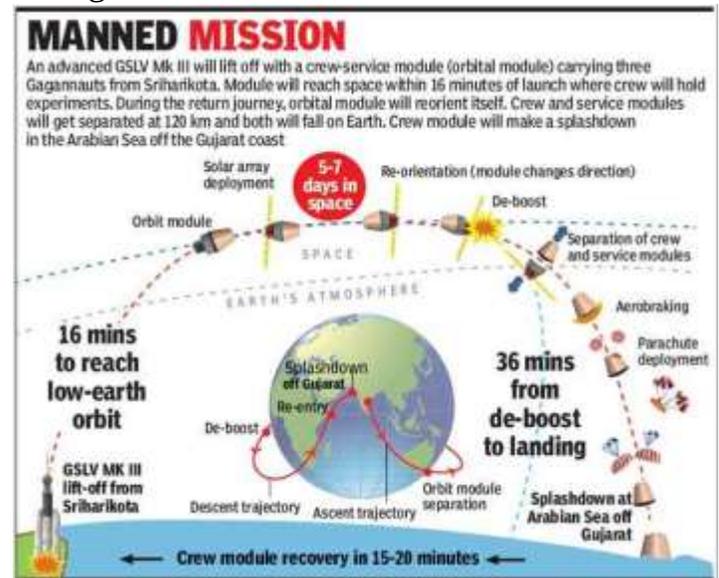
• Why in news?

- India is all set to begin its ambitious Gaganyaan mission which would send Indian astronauts into space.

• More about the mission

- It aims at sending three flights into the orbit where 1 will be manned and other 2 will be unmanned.
- The spacecraft will have 3 astronauts and will be referred to as an orbital module; its payload consists of 2 important module, the crew module consisting of human beings and service

module consisting of two liquid-propellant engines.



- It will be present at the lower earth orbit at an altitude of 300-400kms from the earth for about 5-7 days.
- Its launch vehicle will be GSLV MkIII which is a heavy-lift launch vehicle and a vital part of the mission.
- Research has started with respect to the mission and studies have been performed such as pad abort tests.
- The mission is to cost around Rs. 10000 crores.
- This will be India's first time via its own spacecraft to take its people into space.

Punch Mission

• Why in news?

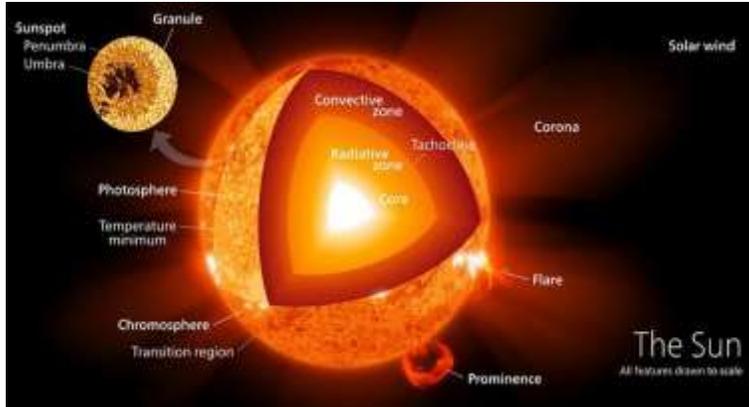
- Dipankar Banerjee, an Indian solar physicist, has been named a co-investigator of the Punch Mission at NASA.

• More about the mission

- It stands for Polarimeter to Unify the Corona and Heliosphere.
- It will be launched in 2022.
- It is concerned with understanding the transition of particles from the corona of the sun through the solar winds which fill the interplanetary space.
- The microsats have been used here to orbit the earth and the study corona and the atmosphere of the sun.

- It will also track the solar wind and coronal mass ejections that influence the space atmosphere.
- India is expected to join this mission with its own Aditya L1 built for the same purposes.

Regions of sun



- Corona- Outermost region of the sun.
- Coronal mass ejections are the plasmas of enormous energy that gets thrown out of the atmosphere of the Sun and influence the weather events in space.
- Solar winds are the constant streams of solar material that flows of the sun.

X 57 Maxwell

● Why in news?

- It is NASA's first-ever all-electric aircraft, its development began way back in 2015.
- It is intended to demonstrate the technology to reduce fuel use, emissions, and noise.

● Specifications

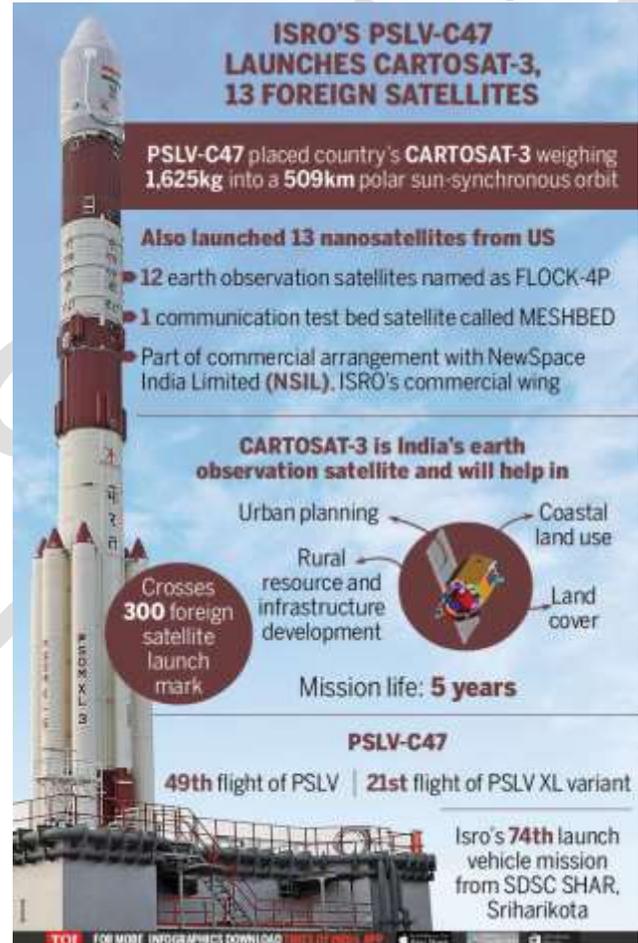
- The two largest of 14 electric motors that propel the plane are powered by lithium-ion batteries that are specially designed.-
- It will be the first crewed X-plane to be developed in two decades.
- The lift propellers will be activated for take-off and landings, but retract during the flight's cruise phase.
- Today, electric motor systems are more lightweight than internal combustion engines with fewer moving parts, they are much easier to maintain and weigh much less, consuming less energy to travel.
- They also are quieter than conventional engines.

- It seems a great accomplishment to inculcate this technology in flying and needs to be emulated in larger scales.

PSLV C47 and CARTOSAT 3

● Why in news?

- ISRO recently launched CARTOSAT 3, along with other nanosatellites, to be placed in orbit.

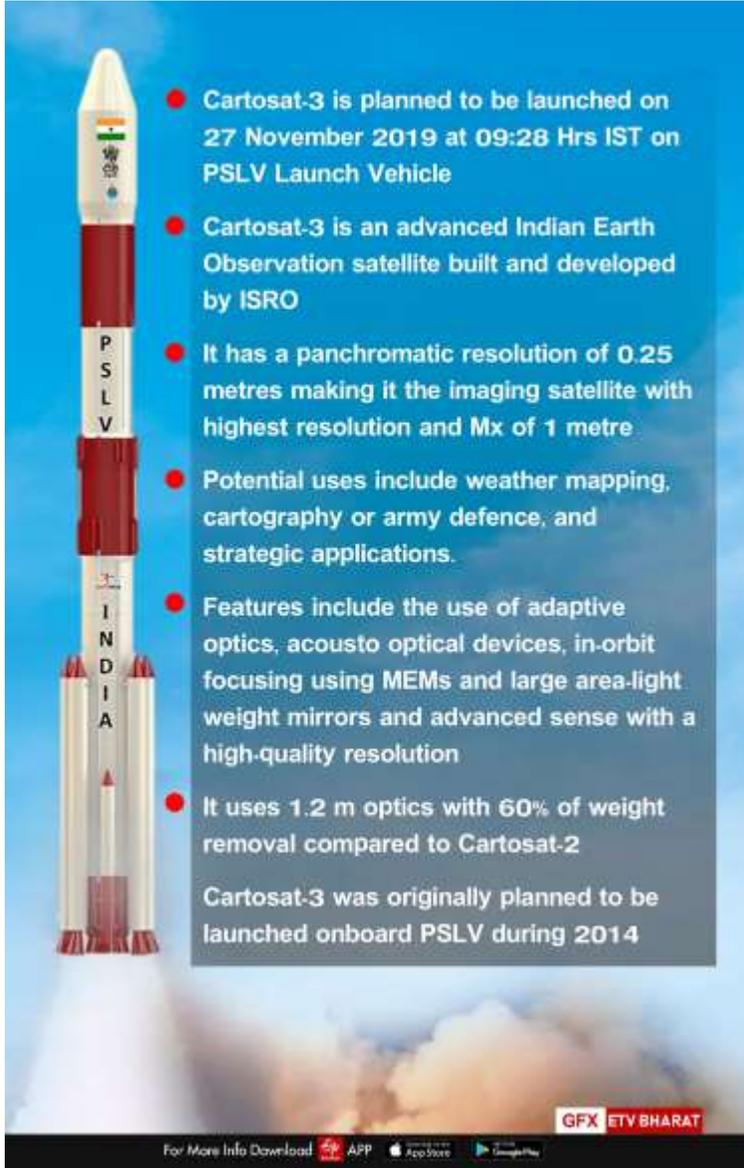


● PSLV C47

- Polar Satellite Launch Vehicle is an ISRO's expendable launch system, which has been developed indigenously.
- It comes in the category of medium-lift launchers and can reach up to various orbits, including the Geosynchronous Transfer Orbit, Lower Earth Orbit, and Polar Sun Synchronous Orbit.
- All of PSLV's activities are managed by Satish Dhawan Space Centre, Sriharikota.

● CARTOSAT 3

- It is an advanced earth observation satellite of the third generation with high-resolution imaging capability.



The infographic shows the PSLV launch vehicle with the Cartosat-3 satellite attached. The satellite is a small, white, cylindrical object with a red and white striped body. The PSLV is a tall, white, cylindrical rocket with four boosters. The text on the infographic provides details about the satellite and its launch.

- Cartosat-3 is planned to be launched on 27 November 2019 at 09:28 Hrs IST on PSLV Launch Vehicle
- Cartosat-3 is an advanced Indian Earth Observation satellite built and developed by ISRO
- It has a panchromatic resolution of 0.25 metres making it the imaging satellite with highest resolution and Mx of 1 metre
- Potential uses include weather mapping, cartography or army defence, and strategic applications.
- Features include the use of adaptive optics, acousto optical devices, in-orbit focusing using MEMs and large area-light weight mirrors and advanced sense with a high-quality resolution
- It uses 1.2 m optics with 60% of weight removal compared to Cartosat-2

Cartosat-3 was originally planned to be launched onboard PSLV during 2014

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- It is developed to replace the IRS series.
- It will be set at an inclination of 97.5 degrees in a 509 km orbit.
- Till date, eight Cartosats have been launched by ISRO.
- Cartosat-3 has a panchromatic resolution of 0.25 metres making it the imaging satellite with highest resolution and Mx of 1 metre with a high-quality resolution, which is a major improvement from the previous payloads in the Cartosat series.

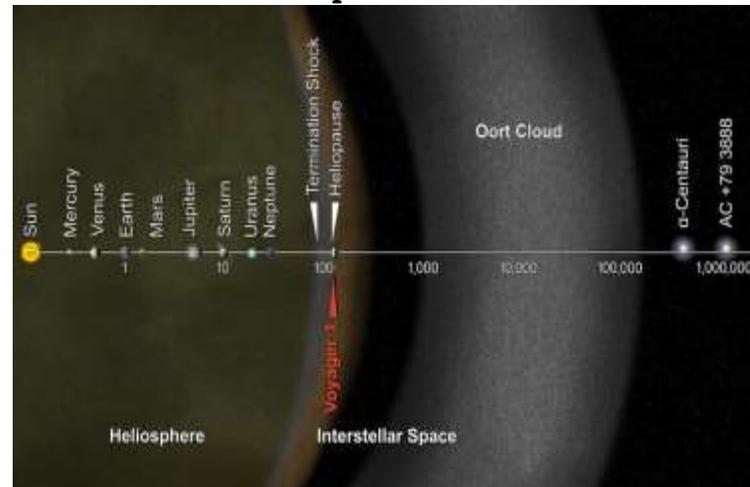
- It is used for various purposes like cartography, mapping, locating water resources, rural resource development and so on.

Voyager 2

Why in news?

- Voyager 2 has now penetrated away from the solar system into interstellar space.
- The mission**
- The Voyager mission was launched in the 1970s, and NASA's probes were intended only to explore the outer planets.
- Voyager 2 departed Earth on 5 September 1977, a few days after Voyager 1 and left our solar system in 2013.
- The mission objective of the Voyager Interstellar Mission (VIM) is to extend the NASA exploration of the solar system beyond the neighbourhood of the outer planets to the outer limits of the Sun's sphere of influence, and possibly beyond.
- They are said to be the successors of Pioneer series.
- Voyager 2 is the only probe ever to study Neptune and Uranus during planetary flybys.
- It is the second man-made object to leave our planet after Voyager 1, which is 6 years ahead of it.
- Voyager 2 is the only spacecraft to have visited all four gas giant planets Jupiter, Saturn, Uranus and Neptune — and discovered 16 moons.

What is interstellar space?

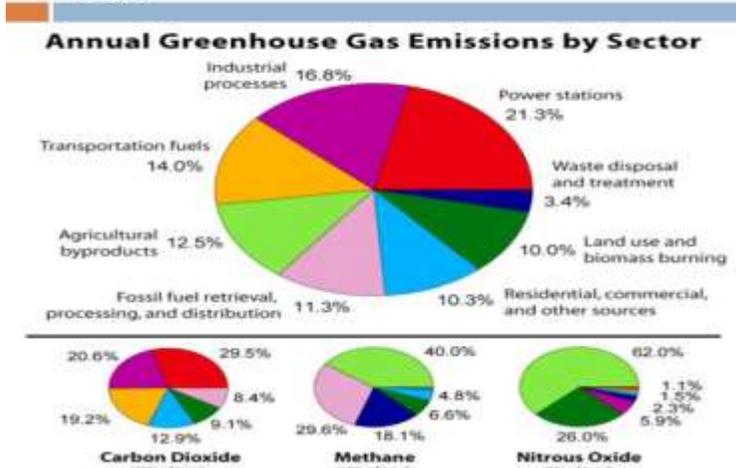


- In astronomy, the interstellar medium is the matter and radiation that exists in the space between the star systems in a galaxy

Sentinel-3 World Fire Atlas

- **Why in news?**
- That is ESA's new innovation
- **What is it about?**
- The Sentinel-3 World Fires Atlas Prototype product has been developed by the European Space Agency.
- It uses a method that enables it to identify all active fires at night.
- The sensors on satellites measure thermal infrared radiation to take the temperature of Earth's land surfaces. This information is used to detect and monitor the heat emitted by the fires.
- The Atlas uses the satellite data to plot the number of fires occurring monthly.
- It will help in Quantifying and monitoring fires which helps in the study of climate.

Annual Greenhouse gas emission by sector



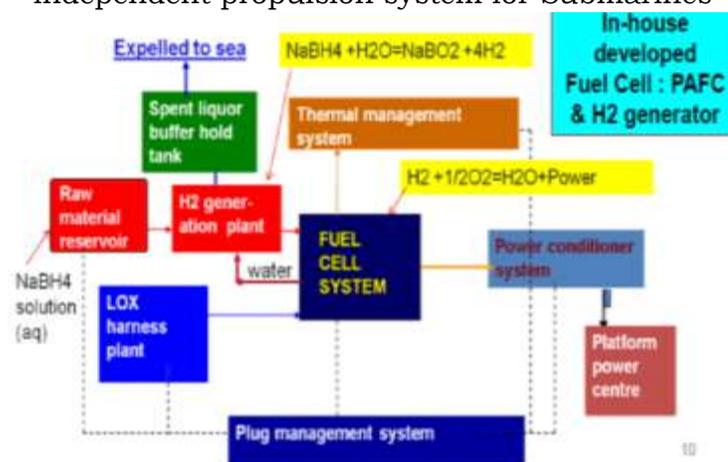
- Forest fires have a significant impact on global ozone pollution, with the burning of wood adding to the global greenhouse gas budgets, including carbon dioxide.

Space Internet or Space-based internet

- **Why in news?**
- It is SpaceX's new innovation under its network project Starlink.
- **What is this new project?**
- E Starlink network is one of several ongoing efforts to begin beaming out space-based data signals.
- Under the project, the company intends to evolve into a constellation of nearly 12,000 satellites to provide low-cost and reliable space-based Internet services to the world.
- The project launched in 2015, now has 122 orbiting satellites.
- The project ensures that reliable and uninterrupted Internet services are universally available in every part of the globe.
- The existing conventional methods of internet access have not been able to reach all locations, so this space-based tech will be able to solve this problem and provide a network to all.
- Lower Earth orbit has been preferred over the geostationary orbit as this area is far away and latency problems would arise.

Air independent propulsion system

- **Why in news?**
- DRDO has successfully tested the Air independent propulsion system for Submarines



- **What is this system?**

- It is any technology that allows the operation of a non-nuclear submarine without exposure to atmospheric oxygen (by surfacing or using a snorkel).
- It augments or replaces the diesel-electric propulsion system of non-nuclear vessels.
- The fuel cell air-independent propulsion converts chemical energy from fuel cell into electricity through a chemical reaction of positively charged hydrogen ions with oxygen or other oxidizing agents.
- It is based on the combustion of stored oxygen and ethanol to augment battery-powered propulsion.
- AIP increases stealth by allowing a submarine to generate electricity for operation and battery charging and propulsion while being completely submerged.
- The Non-nuclear submarines running on this can be virtually silent.

Deep Carbon Observatory

- **Why in news?**

- The recent report shows some important findings
- **What are the findings saying?**
- Less than one per cent of the planet's carbon is found above surface.
- The majority of the carbon—about 1.85 billion gigatons—is contained in the crust and mantle of the earth.
- The carbon that is found in the oceans, the land and the atmosphere, for the most part, appears to be disturbed by human activity.
- Human greenhouse gas emissions are a hundred times higher than all the volcanoes on Earth.
- Every year, human activity contributes around 10 gigatons of CO₂ to the atmosphere. Natural geological processes underground, for comparison, release about 10 times less of the global warming gas.
- Carbon dioxide emissions into the atmosphere and oceans from volcanoes account for about 280 to 360 million tonnes.

- Burning fossil fuels, deforestation and other human activities add to the environment between 40 and 100 times the volume of CO₂.

- **What is this DCO?**

- It is a global community of more than 1000 scientists on a ten-year quest to understand Earth's carbon concentrations, trends, processes and origins.
- As carbon is a vital element both positively and negatively, it becomes important to be studied

NASA ICON Mission

- **Why in news?**

- National Aeronautics and Space Administration (NASA) has deployed an ICON satellite to detect dynamic regions in the Ionosphere of the Earth.

- **What's the mission about?**

- The ICON satellite will study the Earth's Ionosphere. It includes different layers of the uppermost atmosphere where free electrons flow freely and are vital for understanding the composition of the atmosphere on earth.
- The ICON mission is the 39th successful launch and satellite deployment by Pegasus rocket and is operated by the University of California. It is equipped with 780-watt solar arrays to power the instruments.

Earth's Atmospheric Layers:



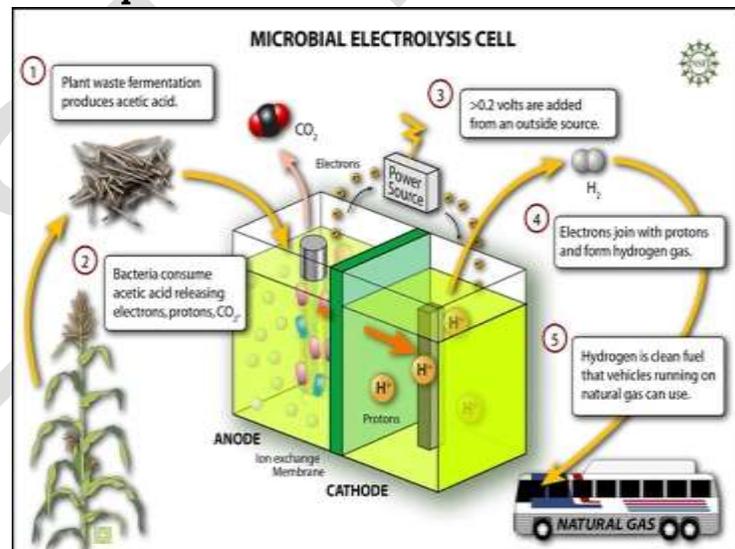
- **Troposphere:** It starts at the Earth's surface and extends 8 to 14.5 kilometres high (5 to 9 miles). This part of the atmosphere is densest. Almost all-weather phenomenon's take place in this region.
- **Stratosphere:** It starts just above the troposphere and extends to 50 kilometres (31 miles) high. The ozone layer, which absorbs and scatters the solar ultraviolet radiation, is in this layer.
- **Mesosphere:** The mesosphere starts just above the stratosphere and extends to 85 kilometres (53 miles) high. Meteors burn up in this layer.
- **Thermosphere:** It starts just above the mesosphere and extends to 600 kilometres (372 miles) high. Aurora and satellites occur in this layer.
- **Ionosphere:** It is an abundant layer of electrons and ionized atoms and molecules that stretches from about 48 kilometres (30 miles) above the surface to the edge of space at about 965 km (600 mi), overlapping into the mesosphere and thermosphere. This dynamic region grows and shrinks based on solar conditions and divides further into the sub-regions: D, E and F; based on what wavelength of solar radiation is absorbed. The ionosphere is a critical link in the

chain of Sun-Earth interactions. This region is what makes radio communications possible.

- **Exosphere:** This is the upper limit of our atmosphere. It extends from the top of the thermosphere up to 10,000 km (6,200 mi).

Microbial Fuel Cell

- **Why in news?**
 - These fuel cells installed in a London zoo have generated **botanical selfie** for the first time ever.
- **What is this?**
 - A device that converts chemical energy to electrical energy by the action of microorganisms.
- **The process**



- The plants produce sugar and oxygen from water and CO_2 (photosynthesis) under sunlight
- These sugars do not remain in the leaves, but are transported throughout the plant to the stem and roots.
- Some of these sugars are excreted by the roots as a waste product from the plant. Soil microorganisms break this down further, releasing energy. This energy is captured using an anode (minus) and a cathode (plus) and charge a supercapacitor. When the supercapacitor is full, the power is discharged and a photo is taken.
- Unlike solar panels, plants may thrive in the shade, shifting naturally in place to optimize the absorbing capacity of sunlight.

The Copernicus Programme

- **Why in news?**
- Data from the Copernicus Sentinel 3 project with regard to wildfires have been documented and put forward.
- **What is this programme?**
 - Copernicus is basically an Earth observation programme.
 - This seeks to provide accurate, timely and usable data for improving environmental management, recognizing and mitigating the impact of climate change and maintaining civil safety
 - Copernicus is the new name for the Global Monitoring for Environment and Security programme, previously known as GMES.
 - This initiative is headed by the European Commission (EC) in partnership with the European Space Agency (ESA).
- **The Sentinel**
 - ESA is developing a new family of satellites, called Sentinels, specifically for the operational needs of the Copernicus programme. The Sentinels will provide a specific set of observations, beginning with the radar images of all-weather, day and night.
 - Monitoring wildfires as part of earth observation is absolutely vital as it leads to several issues such as emissions and others.

Aditya L1 Mission

The daring Aditya L1 solar mission
India's Aditya-L1 mission aims to put 1,500-kg heavy class satellite into halo orbit around Lagrangian point L1, a point between Sun and Earth about 1.5 million km from Earth.

ISRO is set to launch first solar mission Aditya-L1 in 2019 to study sun.

Mission cost: ₹2.35 crore for the financial year 2016-17

The satellite will be programmed to orbit L1 point and image sun's magnetic field from space for very first time in world.

Objectives of mission

- > Study dynamic nature of sun's outer most layers, the corona and the chromosphere, and collect data about Coronal Mass Ejections.
- > Study on origin of solar storms and their path through the interplanetary space from the Sun to the Earth.

sources: Science, The Hindu, ISRO, Planetary Society

- **Why in news?**
 - ISRO's next ambitious programme prepares to be launched by April 2020.
- **What is this mission?**
 - It is India's first solar mission as India has never tried to reach the sun earlier.
 - It will study the outermost layer of the sun, the corona and chromosphere, and collect data on coronal mass ejection, which will also provide information for prediction of space weather.
 - The data from Aditya mission will be immensely helpful in discriminating between different models for the origin of solar storms and also for constraining how the storms evolve and what path they take through interplanetary space from the Sun to the Earth.
- **What is L1?**

- To get the best science from the sky, continuous observation is favoured without occultation or eclipses and thus, the satellite Aditya L1 will be put in the halo orbit around the sun-earth system's Lagrangian point 1 (L1).
- Lagrangian points are the locations in space where the combined gravitational pull of two large masses roughly balances each other. Any small mass placed at that location will remain at constant distances relative to the large masses. There are five such points in the Sun-Earth system and they are denoted as L1, L2, L3, L4 and L5. A halo orbit is a periodic three-dimensional orbit near the L1, L2 or L3.

Space situational awareness and management centre

- **Why in news?**
 - The foundation for this centre has been laid in Bengaluru by ISRO.
- **The place**
 - ISRO has developed a Space Situational Awareness and Management Directorate to protect highly valued space assets from near approaches and collisions with space debris. To carry out systematically all activities related to SSAM, a control centre is being established at Bengaluru.
 - The control centre would host a range of activities related to protecting Indian space assets against inactive satellites, pieces of orbiting objects, near-earth asteroids and adverse weather conditions in space.
 - It would also assimilate the tracking data of inactive satellites from indigenous observation facilities and generates useful information from bare observations through analysis.
 - It is important because of the rise of man-made space debris and the increased threat of collision with operating spacecraft.
 - Article IX of the Outer Space Treaty asserts states that the presence of debris in outer space can arguably be considered as "harmful contamination" of this zone and, therefore, states parties to the Outer Space Treaty must adopt appropriate measures, which may include active debris removal, to mitigate them

Interplanetary Pollution

- **Why in news?**
 - Israel's Beresheet spacecraft tried to land on the moon but crashed on the surface. This very aircraft was carrying many items in it including many specimens of Tardigrade (in dehydrated form).
- **What are these?**
 - The tardigrade is one of the strongest and most durable creatures on Earth, also known as water bears, and can only be seen under a microscope
 - Half a millimetre long, it is essentially a water-dweller but also inhabits land and, a 2008 study found, can survive in the cold vacuum of outer space.
The tardigrade can endure extreme hot and cold temperature levels. They themselves expel water from their bodies and set off a mechanism to protect their cells, and can still revive if placed in water later. The organism on rehydration is known for "coming back to life."-
 - The tardigrade derives its name from the fact that it looks like an eight-legged bear, with a mouth that can project out like a tongue. A tardigrade typically eats fluids, using its claws and mouth to tear open plant and animal cells, so that it can suck nutrients out of them.
- **What is the concern?**
 - The question is did the thousands of dehydrated tardigrades on Beresheet survive the crash? And if they did, are they now living on the Moon?
 - As they were all in dehydrated state, the chances of them surviving only depends on them finding water source or liquid source.
 - Even if they find one, their survival will be tough, according to scientists. Scientists have yet to find any evidence that the moon ever hosted living organisms (other than visiting astronauts and microbial hitchhikers from Earth) that could be threatened by microscopic invaders. However, contamination could carry serious consequences for missions to planets where life might yet be found.
 - There is already a fairly large amount of debris left by astronauts from obsolete spacecraft and

trash. As more missions are planned to the moon, eventually with human passengers and perhaps even settlements, we must learn to clean up as we go along. Otherwise, we are going to have the sort of crisis that we are seeing on Earth with the outcry about environmental damage from plastics.

FEDOR (Final Experimental Demonstration Object Research)

- **Why in news?**

- FEDOR is a life-size humanoid robot launched into space by Russia.

- **What's more?**

- The spaceship carries a humanoid robot of life size that will spend 10 days studying how to support astronauts on the International Space Station.- FEDOR, which stands for Final Experimental Demonstration Object Research, the Skybot F-850 is the first humanoid robot to be sent to space by Russia.
- FEDOR, who is the size of an adult and can emulate movements of the human body, has apparently embraced his mission, describing himself as "an assistant to the ISS crew". Fedor is defined as potentially useful for work in high radiation, demining and difficult rescue missions on Earth.
- Fedor is not the first robot to go into space. In 2011, NASA sent up Robonaut 2 followed by Japan in 2013.

Magnetospheric multi scale mission

- **Why in news?**

- The Magnetospheric Multiscale Mission (MMS) recently used high-resolution instruments to perform the first precise measurements of an interplanetary shock.

- **What is this mission?**

- NASA's MMS investigates how the Sun's and Earth's magnetic fields connect and disconnect, explosively transferring energy from one to the other in a process that is important at the Sun,

other planets, and everywhere in the universe, known as magnetic reconnection.

- Reconnection limits the performance of fusion reactors and is the final governor of geospace weather that affects modern technological systems such as telecommunications networks, GPS navigation, and electrical power grids.
- For the first time, MMS shows the small-scale three-dimensional structure and dynamics of an elusively thin and fast-moving field of electron diffusion. It does this in both of the key reconnection regions near Earth, where the most energetic events originate.
- By observing magnetic reconnection in nature, MMS provides access to predictive knowledge of a universal process that is the final governor of space weather, affecting modern technological systems such as communications networks, GPS navigation, and electrical power grids. MMS will develop expertise, methods and technologies relevant to future space weather missions and space weather forecasting for the future growth and development. MMS sensors will measure charged particle velocities, as well as electric and magnetic fields, with unprecedented (milliseconds) time resolution and accuracy needed to capture the elusively thin and fast-moving electron diffusion region.

Kepler Space Telescope

- **Why in news?**

- NASA's Kepler Telescope was instrumental in discovering many exoplanets, and did a fairly good job

- **Kepler Space Telescope**

- Scientists have discovered more than 100 new exoplanets using NASA Kepler Space telescope data and ground-based observatories. The diverse planets are expected to play a large role in developing the research field of exoplanets and life in the Universe.
- The Kepler Space Telescope has been officially retired by NASA. Its successor space telescope, called TESS, has already started collecting data.
- The Kepler mission, launched in 2009, is specifically designed to explore our Milky Way galaxy region to find hundreds of Earth-sized

and smaller planets in or near the habitable area and estimate the fraction of the hundreds of billions of stars in our galaxy that may have these planets.

Lunar evacuation system

- **Why in news?**
 - NASA successfully tested the assembly of the Lunar Evacuation system for its future mission to Moon in 2024.
- **The system**
 - LESA developed by the European Space Agency (ESA), is a pyramid-like structure used for rescuing an injured astronaut on the lunar surface.
 - Astronauts could not carry their fallen crewmate over their shoulder while wearing a heavy extravehicular activity (EVA) suit as they tend to get injured easily.
 - LESA enables an astronaut to lift their crewmate onto a mobile stretcher in less than 10 minutes, before carrying them to the safety of a nearby pressurized lander.
 - LESA can be operated by a single astronaut to rescue a fallen colleague. It helps an astronaut to lift their crewmate in less than 10 minutes onto a mobile stretcher before moving them to a nearby pressurized lander's safety.

Spitzer Space Telescope

- **Why in news?**
 - After 16 years of its exploration Spitzer Telescope is going to be shut down by NASA.
- **What is this telescope?**
 - NASA's Spitzer Space Telescope was launched in 2003 to study the universe in the infrared.
 - It is the last mission of the NASA Great Observatories program, which saw four specialized telescopes which are used for various electromagnetic radiations like visible light (Hubble, still operational), gamma-rays (Compton Gamma-Ray Observatory, no longer operational) and X-rays (the Chandra X-Ray Observatory, still operational.)
 - Spitzer's highly sensitive instruments allow scientists to peer into cosmic regions that are

hidden from optical telescopes, including dusty stellar nurseries, the centres of galaxies, and newly forming planetary systems.

- Spitzer's infrared eyes also allows astronomers see cooler objects in space, like failed stars (brown dwarfs), extrasolar planets, giant molecular clouds, and organic molecules that may hold the secret to life on other planets.

Planet Saturn

- **Why in news?**
 - The discovery of Saturn's 20 new moons made it the planet with the highest number of moons, which is 82.
- **Saturn - Key facts**
 - Saturn is the sixth planet from the sun, with the largest planetary rings in the Solar System.
 - It is the second-largest planet after Jupiter.
 - It has a diameter of 120.536 km or 74.897 mi, almost 9.5 times bigger than the diameter of Earth and a surface area about 83 times greater.
 - The rings of Saturn are the most extensive of any other planet. This rings can't be seen with the unaided eye. Generally, only 3 rings can be seen by regular telescopes, powerful telescopes can view 8 rings and when the spacecraft Cassini orbited Saturn, it counted well above 30 rings. It is important to understand that these rings are actually countless since they are comprised of millions of generally small rocks creating illusions of ring systems.
 - Saturn has the lowest density of all the planets.
 - Though it doesn't have a solid surface, being enveloped in swirling gases and liquids deeper down, it is believed that Saturn has a core much smaller than Jupiter, almost twice the size of Earth - comprised mostly of metals like iron and nickel surrounded by rocky material, and other compounds, solidified by the intense pressure and heat.
 - The largest moon of Saturn is named Titan. It is the second-largest moon in the Solar System after the Ganymede satellite of Jupiter. Titan is even larger than Mercury, a planet.
 - Though the potential for life is zero for Saturn, many of its moons such as Titan or Enceladus,

have internal oceans that could possibly hold life.

- Saturn – also nicknamed the “Ringed Planet”

GEMINI (Gagan Enabled Mariner’s Instrument for Navigation and Information)

● Why in news?

- The Union Ministry of Earth Sciences has launched its GEMINI system.

● What is GEMINI?

SAFE AT SEA	
<p>HOW IT WORKS</p> <ul style="list-style-type: none"> > Gemini, a soap-box size device fitted to fishing boats, will have a receiver > Servers in INCOIS, Hyderabad, will receive data on various ocean parameters including sea surface temperature, currents and wind speed and direction > A suite of numerical models is run to generate forecast on daily weather, disaster warning for cyclone and tsunami and potential fishing zones (PFZ) > The forecast is transmitted to Gemini device receiver through Gagan (GPS Aided Geo Augmented Navigation) satellite system, linked to GSAT-8, GSAT-10 and GSAT-15 	<p>Gagan is used by Airports Authority of India for aircraft landing and takeoff. INCOIS has tied up with AAI to use the technology for its Gemini device</p> <p>> Gemini sends the information to a mobile application downloaded by fishermen through Bluetooth, in all regional languages</p> <p>> PFZ forecast is sent three days in advance and alerts on weather systems are sent once every hour</p>



- It is a device developed to effectively disseminate emergency information and communication to fishermen on Ocean States Forecasting and Mapping of Potential Fishing Zones (PFZ).
- Ocean States Forecast provides accurate information about the oceans which includes the forecasts related to winds, waves, ocean currents, water temperature, etc. PFZ provide information about the probable locations of fish aggregation in the seas to the fishermen.
- GEMINI is a portable receiver that is linked to ISRO-satellites. With this device, the fishermen outside the signal range of their phone companies can get warnings and alerts, as the

device can send signals up to 300 nautical miles.

It will facilitate satellite-based communication that will be highly useful while dealing with cyclones, high waves, and tsunamis.

- Indian National Centre for Ocean Information Services (INCOIS) in collaboration with the Airports Authority of India utilized the GAGAN (GPS Aided Geo Augmented Navigation) satellite while developing the GEMINI device.
- GAGAN was developed by ISRO and the Airports Authority of India. It is India's first satellite-based global positioning system that relies on ISRO's GSAT satellites. The drawback of this device is that it only allows one-way communication, meaning it can't be used by fishermen to make calls. Also, it is relatively expensive for the average fisherman.

Fermi Gamma Ray Telescope

● Why in news?

- NASA's space telescope Fermi Gamma-ray has identified the farthest gamma-ray blazars that are a type of galaxy whose intense emissions are powered by super-sized black holes.

● The telescope

- NASA's Fermi Gamma-ray Space Telescope is a powerful space observatory that opens a wide window on the universe it was launched in 2008.
- Gamma rays are the highest-energy form of light, and the gamma-ray is spectacularly different from the one we perceive with our own eyes.
- It aims to provide more information with regards to phenomenon like quasars, black holes, blazars etc.
- More technically, Fermi observes light in the photon energy range of 8 keV to greater than 300 GeV. An electronvolt is a unit of energy close to that of visible light; Fermi observes photons with energy levels thousands to hundreds of billions of times greater than what the unaided eye can see.

Blazars

- Blazars are among the brightest objects in the universe thanks to emissions powered by supersized black holes. The most distant of the newly discovered blazars started to emit their light when the universe was just 1.4 billion years old. Previously, the most distant blazars detected by Fermi emitted their light when the universe was about 2.1 billion years old.
- Blazars are similar to all active galaxies, acquiring energy from matter falling toward a central supermassive black hole. A small part of this infalling material becomes redirected into a pair of particle jets, which blast outward in opposite directions at nearly the speed of light.

Ploonet

- **Why in news?**
- These are new celestial bodies that have been defined by the astronomers
- **What are ploonets?**
- Ploonets are orphaned moons that have escaped the bonds of their planetary parents.
- Planet + moon = Ploonet.
- The researchers explain that the angular momentum between the planet and its moon results in the moon escaping the gravitational pull of its parent.
- A new study suggests that the moons of gas-giant exoplanets may break away into their own orbits.
- As the gas giants move inward toward their suns, the orbits of their moons are often disrupted, according to new computer models.
- The scientists believe that these bodies will exist around their host stars in solitary orbits and could even be detected in observations from past and present exoplanet-hunting surveys, such as Kepler and TESS.

Cosmic rays and global warming

- **Why in news?**

- The cosmic rays affect the earth's climate by creating low-cloud cover, according to a study published in the journal Scientific Reports.
- **What are cosmic rays?**
- Cosmic rays are fragments of atoms that rain from outside the solar system on Earth. Most cosmic rays are nuclei of the atom: most are nuclei of hydrogen, others are nuclei of helium, and the others are heavier elements.
- Cosmic rays travel at the speed of light and in satellites and other devices have been responsible for electronics issues.
- **How do they impact earth's climate?**
- According to scientists: Cosmic rays will influence the earth's climate by raising the coverage of clouds and creating a "umbrella effect."
- **What is Umbrella Effect?**
- In this case Umbrella effect refers to the cooling of earth, as cosmic rays increase low level clouds which blocks the sunlight thereby acting as an Umbrella.
- Cosmic rays beaming down from space often contribute to cloud formation, in addition to atmospheric temperature and the amount of water vapor in the air.
- So, this study provides an opportunity to rethink the impact of clouds on climate. As galactic cosmic rays increase, low clouds do so, and when cosmic rays decrease clouds do similarly, climate warming can be caused by a opposite-umbrella effect.
- Previously, the Intergovernmental Panel on Climate Change addressed the effect of cloud cover on climate but due to insufficient physical knowledge, this phenomenon has never been included in climate forecasts.
- Therefore, understanding the role of cosmic rays in global warming might be relevant with the increase in climate change events.

Spektr-RG

- **Why in news?**

- Russia has launched the Spektr space telescope along with Germany.
- **What is this mission?**
- This mission is vested with the responsibility of observation of outer galaxies, other celestial objects and so on.
- A joint project between the Russian Space Agency, Roscosmos, and the German Space Agency, DLR, is the Spektrum-Röntgen-Gamma mission, also known as Spektr-RG.
- Spektr-RG is positioned in space in the orbit called a Lagrange point (L2) where the gravitational forces of two large objects, the sun and the planet, balance each other out in this case.
- It will perform observations with low fuel usage.
- It is expected the spacecraft will find 100,000 galaxy clusters, 3 million supermassive black holes, tens of thousands of star-forming galaxies, plasma activity, and many more object types.
- The observatory includes two X-ray mirror telescopes, called ART-XC and eROSITA.
- Spektr-RG's key objective will be to investigate the mysterious cosmic components known as 'dark matter' and 'dark energy'.