

UPSC 2018 Mains Test Series

Test 10- GS Comprehensive Test 1 Geography Answers

1. Write an explanatory note on Gravity Recovery and Climate Experiment.

The Gravity Recovery and Climate Experiment (GRACE) was a joint mission of NASA and the German Aerospace Center that lasted from 2002 to 2017.

- ✓ The two GRACE satellites -GRACE-1 and GRACE-2 - were launched in 2002.
- ✓ GRACE consisted of two identical spacecraft that were flying about 220 kilometers apart in a polar orbit 500 kilometers above Earth. GRACE mapped Earth's gravity field by making accurate measurements of the distance between the two satellites, using GPS and a microwave ranging system. It provided scientists from all over the world with an efficient and cost-effective way to map Earth's gravity field with unprecedented accuracy.
- ✓ Twin satellites took detailed measurements of Earth's gravity field anomalies and their data transformed scientists' view of how water moved and was stored around the planet.
- ✓ By measuring gravity anomalies, GRACE showed how mass is distributed around the planet and how it varies over time.
- ✓ The data gathered from the satellites proved to be an important tool for studying Earth's ocean, geology, and climate.

{Additional information –

Recently, NASA announced to launch two new satellite missions and conduct an array of field research in 2018 to enhance the understanding of Earth's ice sheets, glaciers, sea ice, snow cover and permafrost.

These missions come at a time when decades of observations from the ground, air and space have revealed signs of change in the frozen regions of Earth, called the 'cryosphere'.

Highlights of new mission:

- ✓ The mission called the Gravity Recovery and Climate Experiment Follow-On (GRACE-FO) mission would be launched by NASA along with the German Research Centre for Geosciences.
- ✓ Under it, twin satellites will be launched to continue the original GRACE mission's legacy of tracking fluctuations in Earth's gravity field in order to detect changes in mass, including the mass of ice sheets and aquifers.
- ✓ Following this, NASA would be launching the Ice, Cloud, and land Elevation Satellite-2 (ICESat-2), which will use a highly advanced laser instrument to measure the changing elevation of ice around the world, providing a view of the height of Earth's ice with greater detail than previously possible.
- ✓ The missions will also make other key observations such as, the GRACE-FO will measure groundwater reserves and deep ocean currents and ICESat-2 will measure sea ice thickness and vegetation height.

Significance

According to NASA Research, the permafrost is melting at faster rates now than before.

The changes in the cryosphere, which often occur in the remote regions, have shown impact on people all around the world like sea level rise affects coastlines globally and melting of snowpack affects billions of people who rely on the water.

Diminishing sea ice that covers the Arctic Ocean plays a significant role in Earth's climate and weather patterns.}

2. What do you mean by greenhouse earth, icehouse earth and hothouse earth phenomena?

Throughout the Phanerozoic history of the Earth (i.e. past 500 million years), the planet's climate has been fluctuating between two dominant climate states: the greenhouse Earth and the icehouse Earth.

A greenhouse Earth is a period in which there are no continental glaciers whatsoever on the planet, the levels of carbon dioxide and other GHGs are high, and sea surface temperatures (SSTs) range from 28 °C in the tropics to 0 °C in the polar regions. Tectonic movements, producing more CO₂ and heating up the Earth's atmosphere are considered as reasons for greenhouse earth.

An "icehouse Earth" is the earth as it experiences an ice age. Unlike a greenhouse Earth, an icehouse Earth has ice sheets present, and these sheets wax and wane throughout times known as glacial periods and interglacial periods. During an icehouse Earth, GHGs tend to be less abundant, and temperatures tend to be cooler globally. The Earth is currently in an icehouse stage, as ice sheets are present on both poles and glacial periods have occurred at regular intervals over the past million years.

Greenhouse and icehouse earth are natural phenomena whereas scientists believe that we are on the verge of hothouse earth phenomena that is the outcome of human actions. Due to increase in concentrations of various GHGs temperatures are rising rapidly compared to pre-industrial levels and be higher by 4-5 degrees Celsius compared to it.

3. Discuss how data from Indian Remote Sensing satellites are used for various applications of resources survey and management under the National Natural Resources Management System.

NNRMS is an integrated natural resource management system of India which aggregates the data about natural resources from the remote sensing satellites and other conventional techniques.

One of the important elements of this management system is the National Resource Information Systems which acts as feeder information system to the larger information system of the Government, which includes socioeconomic information and models.

Synergy Study Point

NNRMS carries out the following tasks:

- ✓ Forest/vegetation type and grassland mapping
- ✓ Monitoring of forest encroachment and shifting cultivation Forest fire surveillance
- ✓ Mapping and monitoring of biosphere reserves
- ✓ Eco-system management related studies for environmentally fragile/sensitive regions like the Himalayas, Western Ghats etc.
- ✓ Development of Environment/Forest Resources Information System (ERIS/FRIS)
- ✓ Establishment of State Forest Data Management Centres, with linkages to National System
- ✓ Fuel wood resources assessment
- ✓ Environmental Impact Assessment (EIA) involving land, water and air pollution
- ✓ Environmental hazard related studies (land slide, volcano, earthquake)
- ✓ Mapping/monitoring of Coastal Regulation Zone/coastal areas, etc.

NNRMS helps in:

- ✓ Identifying zones which could yield ground water and the suitable locations for recharging water
- ✓ Monitoring command areas.
- ✓ Estimating crop areas and yields
- ✓ Assessing deforestation
- ✓ Mapping urban areas for planning purposes
- ✓ Delineating ocean areas with higher fish catch potential and
- ✓ Monitoring of environment and scene specific spot imagery
- ✓ Training educationists about GIS technologies.

The agency has executed several projects under National mapping missions wherein mapping and inventory of forests, wastelands, land use, surface water-bodies, wetlands, coastal land use, ground-water targets, urban land use etc. have provided the basis for managing these resources to the different ministries and users.

4. Recently the European Space Agency's Swarm Mission revealed that Earth has an additional magnetic field. Write a brief note about it and also examine the role of earth's existing magnetic field on human lives and biodiversity.

Swarm is the fifth Earth Explorer mission approved in ESA's Living Planet Programme. The objective of the Swarm mission is to provide the best-ever survey of the geomagnetic field and its temporal evolution as well as the electric field in the atmosphere using a constellation of 3 identical satellites carrying sophisticated magnetometers and electric field instruments.

Synergy Study Point

The European Space Agency's 4-year long Swarm Mission revealed that Earth has an additional magnetic field. While the magnetic field is created largely by Earth's molten iron core, other factors, like magnetised rocks in the crust and the flow of the ocean also affect the field.

When salty ocean water flows through Earth's magnetic field, an electric current is generated, and this, in turn, induces a magnetic signal. However, the field generated by tides is tiny and extremely difficult to measure -- but Swarm has done just this in remarkable detail. It's a really tiny magnetic field. It's about 2-2.5 nanotesla at satellite altitude, which is about 20,000 times weaker than Earth's global magnetic field.

These satellites show details of the steady swell of a magnetic field produced by the ocean's tides. The discovery is believed to be a big help in building better models around global warming.

Since oceans absorb heat from the air, tracking how this heat is being distributed and stored, particularly at depth, is important for understanding our changing climate. In addition, because this tidal magnetic signal also induces a weak magnetic response deep under the seabed, these results will be used to learn more about the electrical properties of Earth's lithosphere and upper mantle.

Role of Earth magnetic field

Without Earth's magnetic field, solar winds — streams of electrically charged particles that flow from the sun — would strip away the planet's atmosphere and oceans. As such, Earth's magnetic field helped to make life on the planet possible

The Earth's magnetic field serves to deflect most of the solar wind, whose charged particles would otherwise strip away the ozone layer that protects the Earth from harmful ultraviolet radiation.

Earth's magnetic field is vital for keeping our atmosphere in place. Mars lost its atmosphere because it lost its magnetic field. This proves the efficacy of Earth's magnetic field in deflecting the solar wind and protecting our atmosphere.

Without our magnetic field all the water on our planet would have evaporated and life wouldn't have survived and thrived in the way it is doing now.

Animals including birds and turtles can detect the Earth's magnetic field, and use the field to navigate during migration. Disablement of the magnetosphere would interrupt whale navigation and bird flight.

So no magnetic field means no atmosphere, no oxygen, no water and no life!

5. India has written to Food and Agriculture Organisation (FAO) of the UN proposing declaration of year 2019 as “International Year of Millets”. Which are the important millets of India? Where and how they are grown in different parts of the country?

Such declaration will raise awareness about millets among consumers, policy makers, industry and R&D sector. Promotion of production and consumption of millets through conscious efforts at global level is likely to contribute substantially in the fight against targeted hunger and mitigate the effect of climate change in long run. Popularizing millets would benefit future generations of farmers as well as consumers.

Millet is a common term to categorize small-seeded grasses that are often termed nutri-cereals or dryland-cereals. The millets commonly grown in India include:

- ✓ bajra (pearl millet),
- ✓ jowar (sorghum),
- ✓ ragi (finger millet),
- ✓ barri (proso/common millet),
- ✓ jhangora (barnyard millet),
- ✓ kangni (foxtail/ Italian millet),
- ✓ kodra (kodo millet) etc

Millets are generally grown as mixed crops in regions of low rainfall, the other crop grown with them being usually one of the legumes. Most of the millets grown in our country are of short duration, taking, three to four months from sowing to harvesting. About 30 million acres in India fall under millets.

Sorghum: Jowar

- ✓ India is among the leading producer
- ✓ Total area 42.6 million acres producing 7.4 million tonnes.
- ✓ Mainly a crop of plains, and is grown as both kharif and rabi.
- ✓ Uttar Pradesh, Punjab, Madhya Pradesh, Chhattisgarh, Andhra Pradesh, Maharashtra and Rajasthan.

Pearl Millet: Bajra

- ✓ Total area under the crop is 29.2 million acres producing about three million tonnes.

Synergy Study Point

- ✓ It is suited to regions of low rainfall, and can be grown even in tracts which receive only 51 to 60 cm of rainfall. It is seldom grown in areas where the rainfall is heavier than about 10.5 cm annually.
- ✓ It is chiefly cultivated in Uttar Pradesh, Punjab, Andhra Pradesh, Tamil Nadu, Rajasthan, Maharashtra and Gujarat.
- ✓ In India the crop is grown mainly in kharif.

Ragi (finger millet)

- ✓ 3rd most imp millet of India with 5.9 million acres and the annual production of about 1.9 million tonnes.
- ✓ About 75% of the area under the crop lies in south India. It is also grown to a limited extent, in the hilly tracts of northern India.
- ✓ It is cultivated as a food crop in Andhra Pradesh, Tamil Nadu, Karnataka, Orissa, Bihar, Uttar Pradesh and Maharashtra.
- ✓ It is one of the hardiest crops suited for dry farming. It can grow under conditions of very low rainfall, land can withstand very severe drought.
- ✓ It can be grown as dry crop as well as under irrigation.
- ✓ Unlike other crops, both the plants and grain remain free from pests and diseases. Ragi grain can be stored for many years even up to 50 years without damage, if kept away from moisture.
- ✓ In India, Ragi is sown in the kharif. In Andhra Pradesh and Tamil Nadu, sowing and harvesting continue almost throughout the year.

Millets offer nutrition, resilience, income and livelihood for farmers even in difficult times. They have multiple untapped uses such as food, feed, fodder, biofuels and brewing. Therefore, millets are Smart Food as they are Good for You, Good for the Farmer and Good for the Planet.

6. What is El Nino? How does it appear? Bring out the relationship between El Nino and Indian Monsoon. (15 marks; 250 words)

El Nino is an intermittent disruption of the climate system centered in the equatorial Pacific that has effects on short-term climate around the Pacific basin. It is a temporary warm current that replaces the cold Peruvian (Humboldt) current after cycle of every 3 – 7 years.

Appearance –

Synergy Study Point

Under "normal" conditions the easterly trade winds, driven by the pressure difference between the eastern Pacific high and the western Pacific low and blowing toward the equator, push warm water toward the equator and across the Pacific Ocean toward Australia and Indonesia. This causes a pool of warm water to form near the equator in the western Pacific.

During El Nino periods there is a weakening of the easterly trade winds and the warm waters of the western Pacific are pushed toward the east. This movement of warm water towards the coast of South America is termed as El Nino.

Impact on Monsoon -

- ✓ El Nino and Indian monsoon are inversely related.
- ✓ The most prominent droughts in India have been El Nino droughts.
- ✓ It is believed that weakening of Walker Circulation during El Nino is the reason for weakening of monsoon.

But there is no general rule that whenever there is El Nino, monsoon gets affected. Consider the following example:

In 1997, even before the monsoon began, waters of the equatorial Pacific Ocean had warmed sharply, leading to one of the most powerful El Nino events in the last century. As such a phenomenon typically suppresses monsoon rains over India, a severe drought was widely predicted. As it turned out, the monsoon that year ended with above average rains. Just five years later, in 2002, a moderate El Nino unexpectedly wrecked the monsoon and produced a massive drought. Rainfall data for 126 years indicates that the odds of a drought jump to over 40 per cent when there is an El Nino.