



# Astronomical Grand Cycles

[Source: DTE](#)

## Why in News?

A recent study published in the journal *Nature Communications* has found evidence of erosion in the deep sea linking **astronomical grand cycles** with the **orbits of Earth and Mars**, and [global warming or cooling](#).

## What are the Key Findings of the Study?

- **Astronomical Grand Cycles:**
  - Geological sedimentary evidence in the deep sea has revealed a newly discovered **2.4-million-year cycle, known as "astronomical grand cycles,"** linked with the orbits of Earth and Mars.
  - The cycle influences **global warming or cooling trends** and has been detected through **erosion patterns in deep-sea sedimentary data.**
- **Connection Between Mars' Orbit and Earth's Climate:**
  - The **gravity fields of planets in the solar system** interfere with each other, leading to changes in their **orbital eccentricity (how circular their orbits are).**
    - The interaction between Earth and Mars' orbits causes variations in the **amount of [solar radiation](#) received by Earth,** resulting in **cycles of warming and cooling over 2.4 million years.**
- **Impact on Climate and Ocean Circulation:**
  - The vigorous deep-sea circulation driven by **eddies (a circular current of water)** during warmer cycles could potentially **prevent ocean stagnation,** even if the [Atlantic Meridional Overturning Circulation \(AMOC\)](#) **slows or stops functioning.**
    - AMOC is a large system of ocean currents that carry warm water from the tropics northwards into the North Atlantic.
  - Deep ocean eddies could help provide oxygen to the deep ocean and draw carbon dioxide from the **atmosphere** into the ocean in a warmer world.
    - Intense deep-ocean eddies, described as giant whirlpools, play a vital role in **ocean circulation dynamics,** these sit at depths of 3,000 to 6,500 meters and where sunlight doesn't penetrate.
    - These **eddies contribute to seafloor erosion** and the formation of large sediment accumulations known as **contourites,** resembling snowdrifts in their structure.
- **Future Research Directions:**
  - The team plans to gather more data showcasing cycles driven by Earth-Mars interaction, further exploring the dynamics of Earth's climate fluctuations over millions of years.

## What are Astronomical Cycles?

- Astronomical cycles refer to **periodic variations in the Earth's orbit and orientation towards the Sun** that impact the amount of solar radiation received by our planet over long periods.
  - These cycles are caused by the **gravitational forces between the Earth, Sun, and other planets** in the solar system.

- These cycles were first theorised by **Serbian scientist Milutin Milankovitch** in the 1920s to explain the cyclical patterns of [ice ages](#) on Earth also called **Milankovitch cycles, or Milankovitch oscillations.**
  - **Some key astronomical cycles include**
    - **Eccentricity** (100,000 years) - Changes in the elliptical shape of Earth's orbit around the Sun.
    - **Obliquity** (41,000 years) - Variations in the tilt of Earth's axis relative to its orbital plane.
    - **Precession** (23,000 years) - The shifting orientation of **Earth's axis over time.**

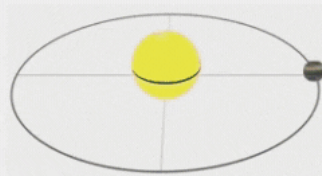
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## THE THREE MILANKOVITCH CYCLES

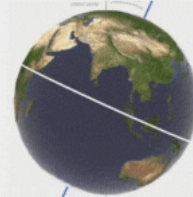
**CHANGES IN AXIAL PRESSION (WOBBLE) IN A 26,000-YEAR CYCLE**



**CHANGES IN ECCENTRICITY (ORBIT SHAPE) IN A 100,000-YEAR CYCLE**



**CHANGES IN OBLIQUITY (TILT) IN A 41,000-YEAR CYCLE**



## What are the Other Astronomical Influences on Earth's Climate?

- **Sunspot Activity:**
  - [Sunspots](#) are **dark and cooler patches on the sun** that increase and decrease in a cyclical manner.
    - The number and intensity of sunspots increase and decrease in a cyclical pattern, typically over an **11-year solar cycle.**
  - According to some meteorologists, **higher sunspot activity** and numbers are associated with:
    - **Cooler and wetter weather patterns on Earth** and increased storminess and cloud cover.
    - Conversely, periods with **fewer sunspots** are linked to **Warmer and drier** conditions globally.
  - However, these **correlations between sunspot activity and specific weather patterns are not consistently** supported by statistically significant evidence.
- **Galactic Cosmic Rays:**
  - Some studies suggest that increased [cosmic ray flux from our galaxy](#) could influence cloud formation on Earth, potentially leading to cooling effects.
    - However, the magnitude of this effect and the mechanisms involved **are still subjects of ongoing research.**
- **Asteroid/Comet Impacts:**
  - Major [asteroid or comet](#) impacts on Earth, while extremely rare, can inject **massive amounts of dust and gasses** into the atmosphere, leading to temporary cooling periods.
  - The [Cretaceous-Paleogene extinction \(caused extinction of dinosaurs\)](#) around 66 million years ago is thought to have been caused in part by an asteroid impact and associated climate changes.

## UPSC Civil Services Examination Previous Year Question (PYQ)

### Prelims

**Q. Variations in the length of daytime and nighttime from season to season are due to (2013)**

- (a) the earth's rotation on its axis
- (b) the earth's revolution around the sun in an elliptical manner
- (c) the latitudinal position of the place
- (d) revolution of the earth on a tilted axis

**Ans: (d)**

PDF Reference URL: <https://www.drishtiias.com/printpdf/astronomical-grand-cycles>

