GEO ENGINEERING IDEA: DIAMONDS IN THE SKY, COOLING THE EARTH

GS3: S&T

Context:

SPRAYING MILLIONS of tonnes of diamond dust in the upper atmosphere could be an effective way of cooling down the Earth and fixing the problem of global warming, a new study has concluded.

Solar Radiation Management (SRM)

- Several other materials including **compounds of sulphur, calcium, aluminium, and silicon**, have been suggested previously for this same job.
- The essential idea is to scatter material that can reflect solar radiation back to space—and not allow it to reach Earth—there by cooling down the planet.
- According to the new study, diamonds can be more effective in doing this job compared to any other material considered previously.
- ('Microphysical Interactions Determine the Effectiveness of Solar Radiation Modification via Stratospheric Solid Particle Injection') **Such solutions, called ' geoengineering', or more specifically, solar radiation management (SRM)**,
- With this same intention, **the installation of space based mirrors** has also been assessed.

Hotter and hotter

- Measures to slow or halt global warming have been extremely inadequate.
- Not only have global temperatures continued to rise, even the emissions of greenhouse gases, the main reason for the warming, have not been curbed.
- Global temperatures are already about 1.2 degrees Celsius higher than pre-industrial times (1850-1900 period), and 2023 was as much as 1.45 degrees Celsius warmer.
- There is no way that the world can keep this rise to **under 1.5 degrees Celsius**, which was one of the targets mentioned in **the Paris Agreement**.
- In theory, this is still possible— but the bare minimum for achieving this target requires the world to **cut emissions by at least 43% by 2030 from the 2019 levels**.
- All ongoing and promised actions in this regard are, however, likely to result in a re**duction of just 2% by 2030**.

Geo-engineering

- Geo engineering refers to any large-scale attempt to alter the Earth's natural climate system to counter the adverse effects of global warming.
- **Solar radiation management (SRM)**, in which certain materials are proposed to be deployed in space to reflect the rays of the Sun and prevent them from reaching Earth, is one of two broad geo engineering options being explored.
- The other is **carbon dioxide removal (CDR) technologies**, which includes various carbon capture and sequestration (CCS) methods.
- Both SRM and CDR are seen as having the potential to offer quick fixes to either reduce emissions or lower temperatures, but neither option has been proven to be viable yet.
- Carbon dioxide emitted by industry or power generating plants is sought to be 'captured' at source, and deposited deep below the Earth's surface in suitable geo logical formations for long term storage.
- Since carbon dioxide is not released in the atmosphere, there is a reduction in overall emissions.
- Some solutions involve the use of 'captured' carbon as an input for other industrial processes (carbon capture and utilisation, or CCU); in others, a part of the carbon dioxide is utilized and the rest stored underground (carbon capture, utilization and storage, or CCUS).
- There are also direct air capture (DAC) methods that seek to use large 'artificial trees' to suck carbon dioxide from ambient air and direct it to storage or utilization sites.
- Since these methods can potentially eliminate carbon dioxide accumulated over the years, the benefit sare larger compared to CCS. Some experimental projects are trying out these technologies, but the challenges are formidable.

Mimicking volcanoes:

- ✓ SRM is the most ambitious, and potentially most rewarding, form of geoengineering.
- ✓ It is inspired by volcanic eruptions, in which large amounts of sulphur dioxide combines with water vapour to form suphate particles that reflect sunlight back to space.
- ✓ The massive eruptions from Mt Pinatubo in the Philippines in 1991 are supposed to have brought down the Earth's temperature by 0.5 degrees Celsius that year.
- ✓ Scientists trying to mimic this process artificially have explored the capabilities of several materials, including sulphur dioxide, calcium carbonate, and sodium chloride.
- ✓ Diamonds have been talked about, too.
- ✓ The new study compared seven compounds and found diamond to be the most effective.
- ✓ But to achieve a temperature reduction of 1.6 degrees Celsius, about 5 million tonnes of diamond dust would need to be sprayed in the upper atmosphere every year.

Challenges/concerns:

- **Technology and costs:** SRM options obviously face massive challenges **of technology and costs**.
- **Manipulating natural processes** on a large scale can have unintended and unforeseen consequences, including disrupting global and regional weather patterns and rainfall distribution.
- **Impact on biodiversity:** Altering natural sunlight can impact **agriculture, vegetation, and biodiversity**.
- **Practically not feasible**: it might be technically possible to deploy CCS technologies, it may not be feasible or practical to rely on them to achieve climate objectives.
- The study calculated that emission path ways that required the world to put up to 20 billion tonnes of carbon dioxide underground by 2050 could cost at least $ 30 trillion more than the path ways in which only about 5 billion tonnes have to be stored.
- Besides, enough safe underground sites for storing such huge amounts of CO2 may not be available. That said, CCS options are considered almost unavoidable now.
- There are no scenarios for the world to achieve the 1.5-degree or 2-degree Celsius targets that do not require contribution from CCS and CDR technologies