



Impact of Ground Water Extraction on Earth's Spin

Why in News?

A recent study published in **Geophysical Research Letters** has shed light on the significant impact of [Groundwater Extraction](#) on Earth's Rotational Axis and its contribution to global sea-level rise.

- Researchers analyzed changes in the drift of Earth's rotational pole and water movement — first, by accounting for **just ice sheets and Glaciers** and then by adding different groundwater redistribution scenarios.

What are the Factors Affecting Earth's Rotation?

- Factors contributing to polar motion include **Weather, Seasonal Changes, the molten Core, and powerful Hurricanes**.
 - Polar motion is the **movement of the Earth's rotational axis** relative to its crust, reflecting the influence of the material exchange and mass redistribution of each layer of the Earth on the Earth's rotation axis.
 - Generally, polar motion is caused by changes in the **hydrosphere, atmosphere, oceans, or solid Earth**.
- Earth's Geographic North and South Poles are where its **axis intersects the surface**; however, they are not fixed. The axis and hence the poles **fluctuate due to variations in the Earth's mass distribution**.
- In the past, the poles' drift was only caused by natural forces like ocean currents and the convection of heated rock deep beneath the Earth.
- But the new research **pitched the redistribution of groundwater as the primary culprit** for the drift.
 - Water's role in altering the Earth's rotation was discovered in 2016, and until now, the contribution of **groundwater to drifts has been unexplored**.

What are the Key Findings of the Study?

- **Earth's Tilt:**
 - Groundwater pumping has tilted Earth nearly **80 centimeters east between 1993 and 2010 alone**.
 - The water circulated across the planet **determines how mass is distributed**.
 - Between **1993 and 2010, people pumped 2,150 gigatons of groundwater**, or more than 6 millimeters of sea level increase.
- **Impact on Polar Drift:**
 - Excessive groundwater pumping has caused **the Earth's pole to drift at a rate of 4.36 centimeters per year between 1993 and 2010**, making it the climate-related factor with the greatest impact on polar motion.
 - Redistributing water from the **mid-latitudes significantly influences polar drift**; therefore, the location of redistribution determines polar drift.
 - During the study period, most redistribution occurred in western North America and northwestern India — both located at mid-latitudes.
- **Impact of Groundwater Pumping on Sea-Level Rise:**
 - Groundwater pumping contributed to a **sea-level rise of 6.24 mm** during the mentioned

period.

- Pumping from mid latitude areas, such as northwest India and western North America, has the **most substantial influence on Earth's axis drift.**

- **Impact of Polar Drift:**

- The rotational pole normally **changes by several metres within about a year**, so changes due to groundwater pumping **don't run the risk of shifting seasons.**
- But on geologic time scales, **polar drift can have an impact on climate.**

- **Recommendations:**

- Attempts to slow groundwater depletion rates, especially in those sensitive regions, **can theoretically alter the change in drift**, but only if such conservation approaches are sustained for decades.

What is the Significance of the Study?

- The findings emphasize the **need to address groundwater depletion** and its consequences on a global scale.
- This finding underscores the importance of considering groundwater depletion as a crucial factor in analyzing Earth's rotational dynamics and rising sea levels.

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