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Q8

How does the cryosphere affect global climate?

UPSC Civil Services Mains 2017 · GS I · 10 marks · Geophysical Phenomena

Important Geophysical phenomena such as earthquakes, tsunami, volcanic activity, cyclone etc., geographical features and their location-changes in critical geographical features (including water-bodies and ice-caps) and in flora and fauna and the effects of such changes.

Core demand of the question

- How does the cryosphere affect global climate?
- Cover albedo, ice sheets, sea ice, glaciers, permafrost, and sea level
- Keep the explanation within a 10-mark length

Revision summary

Snow and sea ice raise planetary albedo and keep the energy budget cooler.

Loss of ice darkens the surface and adds a warming feedback.

Ice sheets control sea level; glaciers control seasonal river water.

Freshwater input can alter ocean circulation.

Permafrost thaw can release greenhouse gases and extend the warming.

Flow diagram

Cryosphere -> High albedo

Cryosphere -> Ice sheets sea level

Cryosphere -> Permafrost carbon

High albedo -> Global climate

Ice sheets sea level -> Global climate

Permafrost carbon -> Global climate

Conclusion

- **Treat the cryosphere as both a thermometer and an engine:** it records warming and it drives further warming through albedo and carbon.
- Link polar ice, Himalayan snow, and permafrost in one answer so global climate is not reduced to **Arctic sea ice** alone.

The cryosphere cools the planet by reflecting light, stores carbon in frozen ground, and sets the long-term water level of the oceans. As it shrinks, those controls weaken, so global climate becomes warmer, wetter in some belts, and more unstable at the coasts.

Facts & figures

Albedo feedback

Ice reflects sunlight; melt exposes darker surfaces that absorb more heat.

Greenland and Antarctica

Continental ice sheets whose melt is the main long-term driver of global sea-level rise.

Arctic sea ice

Frozen seawater that affects heat exchange and does not itself raise sea level when it melts.

Permafrost carbon

Frozen soils that can emit CO₂ and methane after thaw.

Himalayan cryosphere

Snow and glaciers that help seasonality of South Asian rivers.

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