Biomass Satellite Mission

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Biomass Satellite Mission: A Landmark in Space-Based Forest Monitoring

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Context

- Forest ecosystems are a cornerstone of Earth's environmental stability. They cover about **31% of the planet's land surface** and store more than **80% of terrestrial above-ground biomass carbon**.
- Forests play a key role in the **global carbon cycle** by absorbing atmospheric carbon dioxide (CO_2) and storing it in the form of **biomass**. However, due to activities such as **deforestation**, **forest degradation**, and **climate change**, forest health and carbon storage capacity are under threat.
- Accurate, large-scale, and consistent **global biomass data** are crucial for:
    - Climate modelling
    - Emissions accounting
    - Sustainable forest management
    - Biodiversity conservation
- Until now, satellite missions had limited capability in **penetrating dense forest canopies** to assess carbon storage. In this context, the **European Space Agency (ESA)** has developed the **Biomass satellite mission**, a pioneering effort to address this gap.

Key Features of the Biomass Satellite Mission

- **Launching Agency**: European Space Agency (ESA)
- **Launch Vehicle**: **Vega-C** rocket
- **Launch Site**: **Europe's Spaceport in French Guiana**
- **Orbit Type**: **Sun-Synchronous Orbit (SSO)** at an altitude of **666 km**
    - Ensures consistent lighting conditions and repeatable observations.
- **Primary Instrument**:
    - World's first space-based satellite to use a **P-band Synthetic Aperture Radar (SAR)**.
    - The **P-band (435 MHz)** radar wavelength is uniquely capable of penetrating dense vegetation layers.
    - Captures detailed data from **tree trunks, branches, and stems** — areas where **90% of forest biomass carbon is stored**.
- **Mission Duration**: **5 years**
- **Data Output**:
    - Generation of high-resolution **3D maps** of forest biomass.
    - Annual biomass change estimates across global forests.

Scientific and Technological Significance

- **Breakthrough in Canopy Penetration**:
    - Previous radar and optical satellites were hindered by **cloud cover**, especially in tropical regions.

- The **Biomass satellite's P-band radar** can operate under **all weather conditions**, day or night.

- **Global Biomass Assessment**:
  - Will cover regions such as the **Amazon, Congo Basin, Southeast Asia**, and **forests of the Indian subcontinent**.
  - Offers a uniform, comparable global database on **above-ground biomass (AGB)**.

- **Carbon Stock Monitoring**:
  - Enables accurate estimation of **carbon fluxes** — emissions and removals due to land use.
  - A critical input for **carbon trading**, **REDD+ accounting**, and **climate finance mechanisms**.

Environmental and Climate Relevance

- Forests absorb approximately **2.6 billion tonnes of CO_2 per year**. Disturbances such as deforestation lead to massive carbon release.

- ESA's Biomass mission will:
  - Help identify **carbon hotspots**
  - Detect regions undergoing **deforestation or regeneration**
  - Track forest degradation that is often invisible to conventional satellites

- Directly supports climate objectives under:
  - **United Nations Framework Convention on Climate Change (UNFCCC)**
  - **Paris Agreement** and its **Global Stocktake process**

- **SDG 13** (Climate Action) and **SDG 15** (Life on Land)

Geopolitical and Policy Significance

- **Developing countries** often lack infrastructure to conduct comprehensive forest assessments.
- Biomass data will be made **freely available**, offering a significant boost to nations in:
  - South America
  - Central Africa
  - Southeast Asia
  - Indian subcontinent
- Supports:
  - **Transparency** and **accountability** in global climate governance
  - **Evidence-based policymaking** for sustainable land use
  - Implementation of mechanisms like **REDD+**, **carbon offsets**, and **ecosystem valuation**

Relevance for India and the Global South

- **India's forests**, covering about **24.6% of its land area**, are crucial for climate resilience, biodiversity, and livelihoods.
- Biomass data will:
  - Complement national efforts under **Green India Mission**, **CAMPA**, and **State of Forest Reports**

- Assist in identifying **forest degradation zones**
- Help in monitoring **carbon sequestration targets** under India's **Updated NDCs (2022)**

Conclusion

ESA's *Biomass* satellite marks a watershed moment in the use of **space technology for environmental sustainability**. By providing globally consistent, high-quality data on forest biomass, it will enable more informed decisions in **climate policy, forest management, and ecological conservation**. The mission reaffirms how technological innovation can serve as a powerful tool for **climate justice**, especially for the **developing world**.