Statement by the Committee on Earth Observation Satellites (CEOS) and the Coordination Group for Meteorological Satellites (CGMS) on Progress in Supporting UNFCCC Needs for Global Observations

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The United Kingdom, on behalf of the Committee on Earth Observation Satellites (CEOS) and the Coordination Group for Meteorological Satellites (CGMS) is pleased to provide this annual update to the 61st session of the Subsidiary Body for Scientific and Technological Advice (SBSTA), describing the role of satellite observations in supporting the United Nations Framework Convention on Climate Change (UNFCCC).

CEOS and CGMS coordinate civilian satellite observations that advance knowledge of Earth's environment. The organisations are composed of 64 Member Agencies and Associates, and 16 Member Agencies, respectively. The Joint CEOS-CGMS Working Group on Climate addresses the satellite observation and associated activity needs identified by the Global Climate Observing System (GCOS).

Sustained and systematic satellite observations have been transformative in our ability to monitor and understand climate change and inform sound policy. For example, nearly half of the conclusions in the Sixth Assessment Report (2023) of the Intergovernmental Panel on Climate Change were based on satellite data[1]. Below we outline six key areas where satellites have significantly advanced climate knowledge.

1. **Measurements of Greenhouse Gases**: Over the past two decades, satellite advances have enabled high resolution measurements of carbon dioxide, methane, and other greenhouse gases (GHGs), improving our understanding of their sources and sinks. This supports the Conference of the Parties' invitation on actions to reduce methane emissions by 2030, also identified in the Global Methane Pledge, by enabling remote detection of major methane leaks from oil and gas facilities worldwide. Satellite results are now communicated to facility operators via the International Methane Emissions Observatory (IMEO) of the United Nations Environment Programme (UNEP). The data also support estimating global carbon budgets and the effectiveness of emission reduction initiatives.

2. **Changes in Land Cover and Use:** Recent guidelines[2] from the Intergovernmental Panel on Climate Change noted significant advances in the use of satellite data for monitoring land use and land cover change. This capability is used to generate and monitor forest activity data, including deforestation and forest degradation information. Satellite data are also used to develop country GHG inventories that support some developing countries without a long history of national forest inventory measurements.

3. **Global Temperature Trends**: Satellite measurements play a key role in monitoring global temperature trends. These data provide gapless global coverage and bridge sparse ground-based observations. The 45-year era of continuous satellite observations has enabled quantification of long-term trends, regional variations, and identification of urban heat island effects and marine heat waves. Such information is fundamental for climate modelling and for assessing the impacts of temperature changes on ecosystems and human societies.

4. **Melting Polar Ice and Sea Level Rise**: Satellites provide unique insights into the changes of polar ice sheets, glaciers, and sea ice extent. They detected the accelerated melting of polar ice sheets and a corresponding rise in global sea levels. They similarly revealed the alarming losses in Greenland's ice sheet. These data are

[1] As assessed by data references.

[2] https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories

essential for predicting future sea level rise, evaluating coastal vulnerability, and informing adaptation strategies.

5. Extreme Events: Satellites increasingly enable near-continuous monitoring, prediction and impact assessment of environmental extremes such as hurricanes and typhoons, heatwaves, wildfires, floods and droughts. For example, long-term satellite imagery revealed that the population exposed to floods has increased by 20% globally since 2000[3]. Satellites also revealed that widespread severe smoke pollution over the United States in 2023 came from Canadian wildfires in what was, by far, Canada's most destructive wildfire season ever recorded. Advanced technologies have also advanced our understanding of storm intensification, rainfall patterns, and the impact of climate change on the frequency and severity of extreme events.

6. Ocean Health and Acidification: Satellites have long provided data on ocean temperature, salinity, currents, and phytoplankton distribution. These are important for understanding ocean circulation patterns, marine ecosystem dynamics, and ocean acidification trends, and are critical to assessing the health of marine environments and their role in the global carbon cycle.

These are a few of the innumerable climate advances enabled by satellite observations. Just as impressively, the rate of technical innovation with satellites and their data continues to grow, enabled by space hardware miniaturisation, cloud processing and data access, artificial intelligence, and the growth of commercial satellite partners. The Agencies are carefully evaluating and responsibly leveraging these and other changes.

However, just as satellite capabilities grow, so do the needs of users, revealing limitations in the current satellite and data delivery framework. For example, in addition to the recurring Global Stocktakes supporting Paris Agreement goals, new initiatives such as the World Meteorological Organization's (WMO's) Global Greenhouse Gas Watch and UNEP's IMEO require fast, sustained and systematic access to satellite data. Accordingly, our Agencies are actively transitioning GHG research capabilities into sustained monitoring systems.

The Agencies are also working to better assess and deliver the data-derived information needed by policy- and decision-makers. Already agencies are engaging Parties and other users in compiling lessons-learned from the first Global Stocktake. By improving information products and capacity-building activities, we anticipate satellite observations will become increasingly integral to the success of UNFCCC's initiatives.

Nevertheless, the Agencies depend greatly on partnering with other organisations, such as the Group on Earth Observations, WMO and GCOS, and UNFCCC Parties themselves. Parties can help by continuing an international focus on sustaining satellite observations, and advancing national GHG emission Measurement, Reporting and Verification systems that leverage satellite data.

Even with the advances noted above, the Earth system remains highly under-sampled given its size, complexity and the accelerating change. Today's environmental models and predictive systems depend greatly on sustained and comprehensive measurements. The Agencies are committed to providing the data and information underpinning their success, but require continuing political and policy support to do so.

The past decade has seen remarkable advancements in satellite remote sensing capabilities, significantly enhancing our understanding of climate change and its impacts on Earth's systems. These scientific discoveries underscore the indispensable role of satellite observations in global climate monitoring efforts. As we look ahead, international collaboration and continued investment in satellite-based Earth observation systems are essential to furthering our knowledge and effectively addressing the challenges of climate change.

[3] https://www.nature.com/articles/s41586-021-03695-w

CEOS and CGMS Agencies

Agence Gabonaise d'Études et d'Observations Spatiales (AGEOS), Gabon
Agencia Espacial Mexicana (AEM), Mexico
Agensi Angkasa Negara (ANGKASA), Malaysia
Agenzia Spaziale Italiana (ASI), Italy
Australian Bureau of Meteorology (BoM)
Belgian Federal Science Policy Office (BELSPO)
Canada Centre for Mapping and Earth Observation (CCMEO)
Canadian Space Agency (CSA)
Centre National d'Etudes Spatiales (CNES), France*
Centro para Desarrollo Tecnológico Industrial (CDTI), Spain
China Center for Resources Satellite Data and Applications (CRESDA)
China National Space Administration (CNSA)**
Chinese Academy of Space Technology (CAST)
Comisión Nacional de Actividades Espaciales (CONAE), Argentina
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia
Council for Scientific and Industrial Research (CSIR) South Africa
Crown Research Institute (CRI), New Zealand
Deutsches Zentrum für Luft---und Raumfahrt (DLR), Germany
Earth System Science Organisation (ESSO), India
Environment and Climate Change Canada (ECCC), Canada
European Centre for Medium-Range Weather Forecasts (ECMWF)
European Commission (EC)
European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)*
European Space Agency (ESA)*
Geo---Informatics and Space Technology Development Agency (GISTDA), Thailand
Geoscience Australia (GA)
Global Climate Observing System (GCOS)
Global Geodetic Observing System (GGOS)
Global Ocean Observing System (GOOS)
Global Terrestrial Observing System (GTOS)
International Science Council (ISC)
International Geosphere-Biosphere Programme (IGBP)
India Meteorological Department (IMD)**
Indian Space Research Organisation (ISRO)*
Instituto Nacional de Pesquisas Espaciais (INPE), Brazil
Intergovernmental Oceanographic Commission (IOC)*
International Ocean Colour Coordinating Group (IOCCG)
International Society of Photogrammetry and Remote Sensing (ISPRS)
Japan Meteorological Agency (JMA)**
Korea Aerospace Research Institute (KARI)
Korea Meteorological Administration (KMA)*
Ministry of Education, Culture, Sports, Science and Technology (MEXT)/Japan Aerospace Exploration Agency (JAXA)*
National Aeronautics and Space Administration (NASA), USA*
National Institute of Environmental Research (NIER), Korea
National Oceanic and Atmospheric Administration (NOAA), USA*
National Remote Sensing Center of China (NRSCC)
National Satellite Meteorological Center (NSMC)/China Meteorological Administration (CMA)*
National Space Agency of Ukraine (NSAU)
National Space Research Agency of Nigeria (NASRDA)
Netherlands Space Office (NSO)
Norwegian Space Agency (NOSA)
Polish Space Agency (Poland)
Portuguese Space Agency (Portugal Space), Portugal
Russian Federal Service for Hydrometeorology and Environmental Monitoring (ROSHYDROMET)*
Russian Federal Space Agency (ROSCOSMOS)*
Scientific and Technological Research Council of Turkey (TÜBITAK---Uzay)
South African National Space Agency (SANSA)
Swedish National Space Agency (SNSA)
United Arab Emirates Space Agency (UAESA)
United Kingdom Space Agency (UKSA)
United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)
United Nations Educational, Scientific and Cultural Organization (UNESCO)
United Nations Environment Programme (UNEP)
United Nations Food and Agriculture Organization (FAO)
United Nations Office for Outer Space Affairs (UNOOSA)
United States Geological Survey (USGS)
Vietnam Academy of Science and Technology (VAST)
World Climate Research Programme (WCRP)
World Meteorological Organization (WMO)

***Denotes Agencies being Member of both CEOS and CGMS. **Denotes only CGMS Agencies.**