

IAF EARTH OBSERVATIONS COMMITTEE (EOC)

1. Introduction/Summary

The global satellite industry is booming and dominating the rapidly expanding space economy. For 2023 and beyond, the second main driver of that growth, after mobile communications, lies on the increasing need for Earth observation (EO) services: from optical imagery to synthetic aperture radar able to penetrate cloud cover and see through darkness and weather. Beyond routine demand for EO data, the ongoing war in Ukraine is also spurring more adoption of commercial Earth observation, including optical, synthetic aperture radar, radio frequency monitoring, multispectral and hyperspectral data. All in all, the EO market is predicted to reach \$13.6 billion by 2030. EO is more than just pictures from space. AI can examine this massive amount of data collected by EO constellations and reveal insights from methods such as geospatial analytics – satellite-based mapping and surveying techniques, to analyze the Earth system and human societies. Geospatial technology is used in everything from resource and supply chain management to urban planning and development.

2. Latest Developments

MTG-I1, the first EUMETSAT and ESA's Meteosat Third Generation satellites launch from Kourou in December 2022. The **MTG program** is a collaborative venture between the European Space Agency (ESA) and EUMETSAT to ensure the continuity of high-resolution weather monitoring to 2040 and beyond. **MTG-I1** is built by Thales Alenia Space in cooperation with OHB. The MTG satellites will operate in geostationary orbit, and have a lifespan of 8.5 years. MTG-I1, designed to improve weather forecasting in Europe and Africa as a follow-on to the Meteosat Second Generation (MSG) series is set to start operation in 2023. It will be joined by three other imaging satellites (MTG-I) and two sounding satellites (MTG-S) between 2024 and 2033. Operated by Eumetsat, this geostationary

constellation marks a significant improvement in our ability to track extreme meteorological events.

The Surface Water Ocean Topography (SWOT) mission launched on December 2022. The **SWOT** (Surface Water and Ocean Topography) is a joint mission of CNES and NASA, with contributions from the Canadian Space Agency (CSA) and the United Kingdom Space Agency (UKSA). Thales Alenia Space is the main industrial partner for this mission. It features unprecedented innovations, especially a disruptive technology, wide-swath interferometry, using the KaRIn instrument designed by NASA's Jet Propulsion Laboratory (JPL). CNES and Thales Alenia Space designed and built the radio-frequency system KaRin. SWOT will also carry a Nadir payload, comprising the same instruments as on Jason satellites, including the Poseidon dual-frequency altimeter built by Thales Alenia Space, the Doris precision orbit-determination system from Thales, the Advanced Microwave Radiometer (AMR), the GPS Payload (GPSP) and the Laser Retro-reflector Array (LRA) from JPL. SWOT's ocean topography mission will help scientists analyze and understand the impact of coastal circulation on marine life, ecosystems, water quality and energy transfers, resulting in more accurate modelling of ocean/atmosphere interactions. The hydrology mission will evaluate the level of continental bodies of water, water storage changes in humid areas, lakes and reservoirs, and flow rates in rivers.

Turkish satellite IMECE was launched on 15 April 2023 on Space X Transporter -7 mission. IMECE is a Turkish earth observation satellite, developed by Tubitak, to obtain sub-meter resolution images with its own electro-optical camera to establish the infrastructure required for domestic development. The IMECE Satellite Project, supported by the Scientific and Technological Research Council of Turkey (TÜBİTAK), started in January 2017. It has a mass of 800 kg.

Joint Polar Satellite Systems second satellite (JPSS-2) was launched on Nov 2022. The satellite was renamed NOAA-21 and will work together with its sister satellites, Sumi NPP and NOAA-20, to provide weather and climate measurements for numerical weather prediction.

OceanSat-3 from ISRO launched aboard a PSLV rocket on Nov 2022. Oceansat-3 carries an ocean colour monitor, a scatterometer and a sea surface temperature monitor and the second Advanced Data Collection System 4 (Argos-4) payload from CNES.

China launches second classified Gaofen-13 remote sensing satellite. The optical remote sensing satellite is a high-orbit, high-resolution Earth observation technology satellite part of the civilian China High-resolution Earth Observation System (CHEOS). Land surveys, crop yield estimation, environmental governance, meteorological early warning and forecasting, as well as comprehensive disaster prevention and mitigation are noted as the main uses of the satellite. CHEOS comprise optical, multispectral, hyperspectral and synthetic aperture radar satellites.

Maxar signed contract with satellite imagery startup Umbra and collaborates with Guyana Ministry of Natural Resources. The partnership will allow Maxar to directly task Umbra's satellites and integrate synthetic aperture radar (SAR) data into its portfolio of Earth intelligence products and services. Maxar has agreements with third-party SAR providers, including Capella Space and Iceye, but it chose Umbra for a dedicated partnership because the company's high-resolution SAR better complements Maxar's high-resolution optical imagery. Umbra, based in Santa Barbara, California, has five satellites in orbit. Under the contract, Maxar will have assured access to the next two, satellites six and seven. Umbra said it plans to launch a total of 24 satellites. Maxar will collaborate with Guyana Ministry of Natural Resources (MNR) to provide the nation with environmental monitoring services for both offshore and terrestrial applications. Guyana's Environmental Protection Agency (EPA) will utilize Maxar's Crow's Nest Maritime Monitoring and Security products to support offshore petroleum monitoring. Also included in the agreement, the Guyana Forestry Commission will combine several Maxar capabilities to track illegal deforestation, protect mangroves and safeguard the country's biodiversity.

Planet Labs, a wholly owned subsidiary of Planet Labs Federal, will work directly with the National Reconnaissance Office (NRO) to explore how Planet's hyperspectral capabilities align with the agency's national space security architecture together with Planet's existing and planned future commercial

capabilities with Tanager, a hyperspectral constellation designed as part of a first-of-its-kind public-private partnership with the Carbon Mapper Coalition, with capabilities to detect greenhouse gas (GHG) emissions, such as methane, as well as other environmental applications. The highly sensitive payload, developed in partnership with NASA JPL, will also be able to support a number of additional use cases beyond methane.

Other, The ESA GHGSAT three satellites (C6/C7/C8), for greenhouse gas monitoring, successful launch of on Space-X Transporter-7 in April. The SAR Small Satellite: Capella and UMBRA SAR satellite launched in March and April 2023 on Space-X Transporter-7.

3. Breakthroughs

IRIDE will feature a hybrid constellation of different satellites with dedicated EO sensors. IRIDE is a government project funded by Italy's National Recovery and Resilience Plan (PNRR), managed by ESA in conjunction with the Italian space agency ASI. Scheduled for completion by 2026, this end-to-end system comprises a series of low Earth orbit (LEO) satellite sub-constellations, ground infrastructures (downstream) and services dedicated to Italian public administration. This innovative new constellation, based on a number of different sensing instruments and technologies, will range from microwave radar imaging to optical sensors at various spatial resolutions and in different frequency ranges, and also feature sophisticated operating modes to support high revisit rates. Its data can be integrated with that from other existing or future programs and infrastructure, including COSMO-SkyMed, Second Generation and PRISMA, as well as Copernicus. By integrating national and European assets, the IRIDE system will provide valuable data not only to researchers studying the evolution of the environmental conditions of Italy but also to the Civil Protection and other Public administrations to counter hydrogeological instability and fires, protect coasts, monitor critical infrastructures, air quality and weather conditions and will provide analytical data for the development of commercial applications by start-ups, small and medium-sized enterprises and industries in the geospatial sector.

Thales Alenia Space will supply a first batch of six IRIDE small satellites with synthetic aperture radars (SAR) and one satellite based on optical technology. Both the radar and optical satellites are built on the modular NIMBUS (New Italian Micro Bus) platform, weighing about 170 kilograms. The NIMBUS can be produced rapidly and is designed for high-revisit and high-capacity constellations. The optical payload is being developed by the Italian companies Media

Lario and TSD-space. Thales Alenia Space is leading a feasibility study for the PRISMA Second Generation (PSG) hyperspectral Earth observation system including Leonardo, Telespazio, e-Geos and SITAEL. Thales Alenia Space is responsible for the system design and satellite build to support the development of applications like the monitoring of natural resources and atmosphere; regional development and environmental risks. Thales Alenia Space is developing the South Korean 425 radar system that will be launched within 2023. These high-resolution SAR satellites are being developed by a consortium consisting of Korean Aerospace Industries (KAI) and Hanwha Systems Corp with Thales Alenia Space providing the SAR payload. Within Copernicus Expansion missions, Thales Alenia Space contributes to five of the six new missions, three as prime contractor (CIMR, ROSE-L, CHIME) and two as payload supplier (CO2M, CRISTAL). These new satellites will be used to measure the atmospheric carbon dioxide (CO2) produced by human activity, monitor sea ice thickness and overlying snow depth, provide improved services for sustainable agriculture and biodiversity management, observe ocean behaviour, and support precision agriculture and food security.

Maxar unveils 30-centimeter global basemap. Maxar Technologies unveiled an updated version of its popular global basemap. The new basemap, includes global imagery with a resolution of 30-centimeters per pixel. In contrast, Maxar’s previous basemap, which underpins many mapping applications, offers 50-centimeter resolution worldwide and 30-centimeter resolution for select cities.

NRO announces its latest bid for commercial Earth observation. On April 2023, the NRO announced its latest bid for commercial Earth observation. The subject of the fourth focus area of the Strategic Commercial Enhancements Broad Agency Announcement will be innovative electro-optical capabilities. In a request for proposals scheduled to be released in the fall, NRO will invite U.S. companies and foreign-owned companies with U.S. subsidiaries to share information on new sensors, innovative ways of processing data and constellations.

Maxar, Planet and BlackSky are working to expand their offerings beyond optical imagery. All three companies are dominant in optical satellite imaging and are looking to capture a broader spectrum of data from space. They are now expanding into novel sensor phenomenologies — such as radar (Maxar partnership with Umbra), radio frequency (Maxar) and hyperspectral (Planet & Blacksky) — in response to the growing demand for more intricate multi-sensor intelligence.

4. Action plan for the year

The IAF Earth Observation Committee looks forward to a robust series of sessions at IAC 2023 in Baku, Azerbaijan. For the first time, the IAF Earth Observation Symposium is going to be composed of 7 sessions, which is a testament to the high interest and quality during the Congress. Given the growing number of submissions, the EOC will aim again to better tailor and distribute abstracts per session while looking at creative ways to provide opportunities. EOC will continue to support its Subcommittee GEOSS. In Baku, a Special Session is sponsored on wildfires, and a Highlight Lecture on the results of the IAF Global Space Conference on Climate Change (GLOC 2023) with plans to support the IAF in carrying the GLOC results to the GEO Ministerial and COP 28. For proposal of Satellite Earth Observation Oriented Highlight Lectures, Plenaries and Special Sessions for IAC 2024, GEOSS is preparing for further cooperation with Young Professionals and continued support IAF participation in GEO.

The IAF Global Space Conference on Climate Change (GLOC 2023) is a landmark for the year where several EOC members have been part of the Organizing Committee. The Conference focused on the theme **“Fire and Ice – Space for Climate Action”** and addressed various topics of interest in relation to space and climate change including:

- Climate change impacts on the environment
- Applications and services driven by climate change
- Impacts of a changing climate on policy and law
- Commercial opportunities created by a changing climate
- Present and future international collaboration on space missions related to climate change
- Social, communications, economic and cultural dimensions of environmental change