# AC-VC#22 / ACSG Joint Meeting 2026 Summary

The 22nd meeting of the CEOS Atmospheric Composition Virtual Constellation (AC-VC) took place on 1-4 June 2026 at the Space Research Organisation Netherlands (SRON) in Leiden in The Netherlands. The meeting was held jointly with the CEOS Working Group on Calibration & Validation (WGCV) / Atmospheric Composition Subgroup (ACSG) and was co-hosted by SRON and the European Space Agency (ESA). The meeting was attended by 118 participants in total (58 in person).

The meeting covered sessions on the Geostationary Atmospheric Composition Constellation expansion, air quality, water vapour, Cal/Val for the constellations, fire & smoke, and greenhouse gases. The sessions were convened and chaired by K. Emma Knowland (NASA), Shobha Kondragunta (NOAA), Jean-Christopher Lambert (BIRA-IASB), Jochen Landgraf (SRON), Diego Loyola (DLR), Yasjka Meijer (ESA), Charles Miller (NASA), Ali Omar (NASA), Hiroshi Tanimoto (NIES), and Ben Veihelmann (ESA).

## 1. Geostationary Atmospheric Composition Constellation Expansion

A new AC-VC whitepaper advocates for the 'Expansion of the Geostationary Atmospheric Composition Constellation', aiming for an hourly observation capability with global coverage. The manuscript is in its consolidation phase; it is anticipated to be presented to the Strategic Implementation Team (CEOS-SIT) in Fall 2026. The need for hourly air quality observations was presented, highlighting areas not covered by the current constellation of geostationary atmospheric composition sensors. Mission concepts were identified that would expand this constellation and help fill the gaps: MEASMA would cover the Middle East and Africa. GEMS-2, a follow-up mission to the Korean GEMS mission, would safeguard continued coverage of East and South Asia. Sensors on highly elliptical orbits considered by Canada would ensure coverage of North America, even reaching higher latitudes, in a post-TEMPO era. Continued operations of S5P in parallel with S5 would ensure at least two daily overpasses at different local times globally, including areas not covered by geostationary spectrometers (see also Section 7). Additionally, there was discussion to consider a constellation of multiple (about a dozen) Low Earth Orbit (LEO) satellites and to conduct trade studies comparing them with the six-satellite GEO constellation.

## 2. Air Quality

The session covered updates on missions in operation and planned missions with a focus on air quality. The Sentinel-4 (S4), Sentinel-5 (S5), IRS, IASI-NG launched in summer 2025 are in commissioning and received attention. The importance of continued operations of the S5P mission with TROPOMI on board was highlighted and a recommendation was formulated by the AC-VC community (Section 7). An $NO_2$ algorithm intercomparison was proposed in which several different retrieval algorithms (from GEMS, TEMPO, S4, S5, and S5, …) are applied on a selected Level-1b data set. This study would be technically supported by NOAA.

## 3. Water Vapour

Triggered by the CEOS SIT Chair Priority #1 on water ("Water Planet: Seeing Earth's Water from Space", see CEOS Workplan 2026-2028) a session on the total column water vapour products of the Vis and SWIR spectrometers was held. The various products were presented and their complementarity to the infra-red water vapour profile information was highlighted. It was concluded that, at present, the water vapour products from the Vis and SWIR spectrometers are not fully exploited; efforts are needed to showcase their added value and systematic use in different applications including the generation of long-term climate data records (under programs like ESA CCI+ and NASA MEaSUREs), the contribution to international framework studies like the GEWEX Water Vapor Assessments, and the validation of atmospheric composition models (CAMS, GEOS-CF, etc.).

## 4. Cal/Val for the Constellations

The WGCV-ACSG convened a Cal/Val session dedicated to specific needs of the AC-VC constellations. After an update on WGCV activities and on atmospheric composition Cal/Val, vicarious calibration and calibration validation for UV-Vis-NIR and SWIR-NIR sounders were presented, including updates on JAXA/VICAL, DLR/TROPOMI, GSICS, and the CEOS FRMsat initiative. Presentations of the RadCalNet and HYPERNETS radiometric calibration networks were followed by a discussion on their potential use for atmospheric composition sounders, leading to the recommendation to collect needs of the AC-VC constellations for further instrument development and network expansion of RadCalNet, HYPERNETS and the future TIRCALNET. Lessons learnt from the second exercise of the CEOS-FRM Maturity Assessment framework were discussed, highlighting the need to work more systematically on representativeness issues and to harmonize validation practices and metrics across the constellations. A novel approach to the validation of volcanic $SO_2$ fluxes was introduced. Cal/Val requirements expressed in the CEOS-CGMS GHG roadmap and recent experience with facility-scale missions (Copernicus Contributing Missions, GHGSat and many others) advocates for further development of the CEOS GHG Portal as a sustainable central facility to announce future AirCore campaigns and controlled release experiments, as well as to facilitate access to their data. The session concluded with the evaluation of achievements and remaining challenges regarding the eight recommendations formulated in the CEOS white paper on the Geo-AQ constellation validation needs.

## 5. Fire & Smoke

A session on fires and smoke was held to bring together the space assets for observing such events from space. The session is linked to the CEOS SIT Chair Priority #2 on resilience ("Connected Data for Community Resilience", see CEOS workplan 2026-2028), and the new subgroup on wildfires of the Land Surface Imaging Virtual Constellation (LSI-VC). AC-VC efforts focussing on the observation of fire emissions and smoke plumes are complementary to the work by the LSI-VC.

## 6. Greenhouse Gases

The final day of the AC-VC-22 was devoted to presentations on current and future Greenhouse Gasses (GHG) satellite missions, calibration/validation activities, and best practices for

emissions estimation. The GHG virtual constellation continues to grow while the original members, GOSAT and OCO-2, remain in good health and delivering high-quality data. The arrival of Sentinel-5 transitions methane total column measurements to an operational status while new plume measurements with 30-100 m spatial resolution are redefining state-of-the-art. Modeling, validation networks, fiducial standard measurement challenges are other essential elements of the GHG observing and analysis system.

# 7. Recommendation by AC-VC on S5P

The AC-VC community recommends extending the Copernicus Sentinel-5 Precursor (S5P) mission with the TROPOMI instrument on board as long as possible, aiming at operations until 2035 for the following reasons:

**1. S5P is in excellent condition and fit for another 10 years:** The satellite and its payload are in excellent condition such that the mission can provide high quality data for another 10 more years up to 2035, including margins for a controlled re-entry of the satellite.

**2. S5P is the standard for the CEOS Air Quality constellation:** From low Earth orbit, TROPOMI observations overlap with geostationary observations from Sentinel-4 (Europe), GEMS (Asia) and TEMPO (North America), together forming the CEOS virtual constellation for air quality. Currently, S5P data serve as the 'travelling standard' for establishing and verifying mutual consistency of the geostationary sensor data. In the future, S5 will also provide this function, though experience shows that it may take several years for a new sensor to establish the required data quality.

**3. S5P contributes to diurnal variability observation worldwide:** Continued operations of S5P in parallel with S5 are needed to ensure at least two daily overpasses at different local times in areas not covered by geostationary spectrometers. S5P flies in an early afternoon orbit (13:30 LT), while S5 passes in the morning (9:30 LT). The afternoon orbit benefits from higher solar elevation angles, providing better spatial coverage over the winter hemisphere (such as Northern Europe in winter), and a more developed boundary layer. The morning orbit offers reduced cloudiness over specific regions. Two combined overpasses increase the chance of cloud-free observations, which is essential for e.g. methane observations.

**4. S5P extends the long-term afternoon data record:** With an extension of S5P to 2035, the OMI (Dutch-Finnish instrument aboard NASA EOS/Aura) and S5P will provide a continuous data record in the early afternoon orbit of more than 30 years for several key atmospheric constituents, including ozone, nitrogen dioxide and sulfur dioxide. This long-term record is important for the scientific analysis of trends in climate and air quality and for evaluating the effect of policies.

**5. S5P offers higher spatial resolution than S4 and S5:** High spatial resolution is key for accurate emission quantification and to avoid cloud contamination. The spatial resolution of TROPOMI is more than 2.5 times better compared to S5 for the UV-VIS bands ($NO_2$, $SO_2$, $O_3$) and 1.3 times better for the SWIR ($CH_4$, CO); it is more than 3 times better compared to S4 at 45°N for the UV-VIS bands ($NO_2$, $SO_2$, $O_3$), with S4 having a much higher revisit time.

**6. S5P is an important reference for commissioning and verifying S5 and CO2M:** For the commissioning and verification of S5/UVNS and later CO2M, at least two years of temporal overlap with the routine operations phase of the respective missions with S5P are needed. Of particular importance is a high level of mutual consistency of the methane data records from S5P, S5 and CO2M.