ACCOMC 2026 — Conference Scientific Summary Report

Atmospheric Composition and Chemistry Observations and Modelling Conference 2026
Incorporating the Kennaook / Cape Grim Annual Science Meeting (50th Anniversary)
18–20 November 2026 · Tall Timbers Hotel, Smithton, Tasmania & Online



ACCOMC 2026 & Kennaook / Cape Grim 50th Anniversary participants at Tall Timbers Hotel, Smithton (20 Nov 2026).

1. Executive Summary

ACCOMC 2026 marked a landmark milestone: **50 years of continuous atmospheric composition measurements at the Kennaook / Cape Grim Baseline Air Pollution Station (1976–2026)**. Hosted at Tall Timbers Hotel in Smithton, Tasmania (with hybrid Zoom participation), the conference opened with an Acknowledgement of Country by Sally Taylor (Chair, CSIRO Victorian Indigenous Engagement Committee) and welcoming remarks from station manager Sarah Prior (BOM), followed by **54 oral presentations across 10 scientific sessions** and **6 poster presentations** over three days.

Across the programme, speakers paired 50-year retrospective syntheses—spanning greenhouse gases, halocarbons, Antarctic ice/firn archives, stratospheric ozone, and aerosol optical depth—with major methodological and observational **novelties**:

- First integrated science results from the **18-month CAPE-k and Coast-k Southern Ocean aerosol–cloud campaigns**.
- Multi-tracer, **emissions-free hydroxyl radical (OH) anomaly reconstructions** and **micro-radiocarbon (14CO / $^{14}CH_4$) constraints** on oxidative capacity and fossil methane.
- Next-generation **satellite and ground-based methane flux inversions** (MethaneSAT, GOES geostationary plume imaging, TROPOMI/IASI, and EM27/Sun networks).
- Portable **radon calibration transfer standards (T-Rex)**, **PDD vs. RGA hydrogen detector** benchmarks, and simplified **peak-height CRDS CH_4 isotopologue calibration** achieving GGMT compatibility.
- Multi-day **SAPPHIRE chamber** bushfire smoke aging experiments, **ASPECT peat burning** emission factors, and **200+ km persistence** of volatile phenols affecting wine taint.
- Forward-looking **2050 urban air quality projections** showing NOx-to-biogenic VOC regime shifts, **data centre diesel/HFC emission inventories**, and **multi-pollutant health indices**.

2. Attendee Summary

The conference brought together **84 unique registered attendees** from **32 unique affiliations** across **7 countries**, with strong in-person engagement alongside international online participation.

Attendance Mode

Mode	Attendees	Share
In-person	70	83.3%
Online	14	16.7%
Total Registered	**84**	**100%**

Sector Breakdown

Sector	Attendees	Share	Organisations Represented
Research Institutes	37	44.0%	7 (CSIRO, ANSTO, NIMS, Earth Sciences NZ, PTB, FZ Jülich, AWRI)
Academia	32	38.1%	15 (UOW, Melbourne, UTAS, MIT, QUT, Adelaide, Auckland, Swinburne, RMIT, USQ, Minnesota, Rochester, CU Boulder, UEA, SNU)
Government & Public Sector	11	13.1%	7 (BoM, EPA Tas, NSW EPA, AAPP, NOAA GML, DWD, WMO)
Industry & NGO	2	2.4%	2 (Mote Measurement Networks, SARAD GmbH)
Other (Retired / Independent)	2	2.4%	1
Total	**84**	**100%**	**32**

Countries Represented (7)

Country	Attendees
Australia	**64**
United States	**7**
Germany	**4**
New Zealand	**4**
South Korea	**3**
Switzerland	**1**
United Kingdom	**1**

3. Scientific Topics & Novelties by Session

Session 1 — WMO GAW & Kennaook / Cape Grim 50th Anniversary

- **Global & Historical Foundations:** Sergi Moreno Valero (WMO) outlined the Global Atmosphere Watch (GAW) framework across greenhouse gases, reactive gases, aerosols, ozone, and UV. Paul Fraser (CSIRO) traced 50 years of Cape Grim GHG and CFC measurements since 1976, while David Etheridge (CSIRO/UTAS) reviewed pre-industrial Law Dome ice and firn records—noting the **novel transition of CSIRO's ice-core gas capability to a new IMAS/UTAS centre**.
- **50-Year AOD Reassessment:** Stephen R. Wilson (UOW) presented a nearly 50-year reanalysis of Cape Grim aerosol optical depth (AOD), showing how site relocation in 1997 and instrumental calibration challenges left ~1/3 of legacy data requiring contamination filtering and uncertainties exceeding the ±0.01 target.

Session 2 — Southern Ocean Aerosols, Marine Atmosphere & CAPE-k Campaign

- **CAPE-k & Coast-k Synthesis:** Ruhi Humphries (CSIRO) introduced the 18-month CAPE-k and Coast-k campaigns targeting Southern Ocean aerosol–cloud–precipitation interactions. Melita Keywood (CSIRO) revealed stark contrasts between **winter 2024 and winter 2025**, with winter 2025 exhibiting a deeper, more convective boundary layer and higher cloud-ice fractions.
- **New Sulfur & Smoke Insights:** Jakob Boyd Pernov (QUT) showed non-baseline air dominated 65% of CAPE-k observations and confirmed **particle-to-gas MSA evaporation at low relative humidity** as an active Southern Ocean source. Deepa Roy (UOW) used multi-instrument observations (including ToF-ACSM) to derive trace-gas emission factors for transported wildfire plumes in May 2024 and Feb 2025.
- **IGAC Origins & Sea-Ice DMS:** Ian Galbally (CSIRO, replacing David Corporal) presented archival research on *The Genesis of IGAC* (1983–1990). Alanah Chapman (Melbourne) showed that adding **Antarctic sea-ice DMS** emissions improves Southern Ocean CCN representation in ACCESS, though it currently introduces a mid-latitude negative radiation bias.

Session 3 — Stratospheric Ozone, Halocarbons & Global Budgets

- **Carbon Budget & Synthetic GHGs:** Roger Francey demonstrated how Cape Grim baseline CO_2 records capture inter-hemispheric fossil-fuel transport anomalies (e.g., GFC period). Cathy Trudinger (CSIRO) contrasted top-down inverse estimates with Australia's bottom-up synthetic GHG inventory, highlighting rising **SO_2F_2** (unregulated under Montreal/Kigali) and challenges in quantifying SF_6 and NF_3.
- **Ozone Recovery & East Asian Halocarbons:** Paul Krummel (CSIRO) reported that the **2026 Antarctic ozone hole** reached 27 million km² (7th largest area) yet showed only average depletion depth. Matt Tully (BoM) analysed the **1955–2025 Melbourne Dobson record** (+0.3 DU/yr recovery and ~50% QBO variance). David Oram (UEA) presented new East/Southeast Asian flask networks (Taiwan, Vietnam, Malaysia) tracking HFOs and short-lived chlorinated compounds, with plans for a **new long-term site in Vietnam**.

Session 4 — Aerosol–Cloud Interactions, High-Latitude Modelling & Global Observatories

- **High-Resolution Southern Ocean Modelling:** Matt Woodhouse (CSIRO) demonstrated ACCESS-NRI regional modelling for marine cloud brightening; **Jason** (PhD) tested marine INP parameterisations; Sonya Fiddes (UTAS) applied **RAL 3.3** to CAPE-k, identifying primary marine organic overcorrections in aerosol size distributions.
- **Global Observatories & Sediments:** Alan Griffiths (ANSTO) showed Macquarie Island lake-sediment mercury increases (3–4×) cannot be explained by wind speed alone, pointing to **seabird bio-transport**. Dagmar Kubistin (DWD) highlighted Hohenpeißenberg drought–carbon feedbacks within ICOS/ACTRIS, and Sang-Woo Kim (SNU) documented **two-decade declines in black and brown carbon at Gosan (South Korea)** driven by Chinese air-quality policies.

Session 5 — Hydroxyl Radical (OH), Firn Air & Isotopic Tracers

- **Stable Pre-Industrial to Modern OH:** Peter D. Neff (Univ. Minnesota) used Law Dome ^{14}CO and CO_2 to show Southern Hemisphere OH remained stable across the industrial era.
- **Novel OH & Fossil Methane Constraints:** Lee Murray (Univ. Rochester) used a global ^{14}CO inverse framework and found **lower OH in 2024 vs. 2021**, contributing to recent methane growth. Michael Dyonisius (CU Boulder) used atmospheric $^{14}CH_4$ to confirm higher fossil methane emissions (including the post-2010 trend). Steve Montzka (NOAA) analysed global halocarbon constraints, while **Luke Western (MIT)** introduced a **novel emissions-free method** deriving hemispheric OH anomalies from short-term loss variability in HFCs and methyl chloroform. Andrew Smith (ANSTO) showcased **micro-radiocarbon AMS** capabilities supporting upcoming Greenland ^{14}CO reconstructions (**Fetch4**).

Session 6 — Atmospheric Instrumentation, Calibration Standards & Remote Sensing

- **Stratospheric Dichloromethane & CRDS Corrections:** Johannes Laube (FZJ, rescheduled to Session 6) combined Cape Grim Air Archive data with **balloon-borne AirCore** profiles to track stratospheric CH2Cl2 buildup. Ann Stavert (CSIRO) presented an automated water-vapour control system for CRDS water-correction validation.
- **Novel Calibration & Detector Benchmarks:** David Griffith (UOW) showed a **peak-height-only Picarro CH_4 isotopologue calibration** method that brings optical analysers within WMO GGMT IRMS compatibility goals. Hasan Nawaz (UOW) validated **TROPOMI and IASI** tropospheric CO_2/CH_4 against AU/NZ EM27/Sun networks. Scott Chambers (ANSTO) unveiled **T-Rex**, a **portable radon calibration transfer standard** harmonising European networks. Blagoj Mitrevski (CSIRO) presented a 10-year Cape Grim comparison showing **PDD detectors outperform RGA** for H_2 linearity, precision, and maintenance.

Session 7 — Methane & Regional Emissions: Plumes, Facilities & Inversions

- **Multi-Platform & Satellite Inversions:** Jhonathan Ramirez Gamboa (CSIRO) presented mobile-trailer and stationary network inversions at Melbourne's Western Treatment Plant (evaluating Carbon Mapper multi-source plume detection). Ida Jandl (Melbourne) constrained NSW coal-mine methane inversions with satellite data, while Mackenzie Purtill-Wright (UOW) designed an EM27/Sun network for the Hunter Valley.
- **MethaneSAT & Geostationary Plumes:** Kirstin Gerrand (Earth Sciences NZ) demonstrated **MethaneSAT** inversions for NZ agricultural methane (showing sensitivity to diurnal cycles and NZCSM meteorology). Leigh Fleming (Earth Sciences NZ) reviewed the 4-site CarbonWatch Auckland network. **Timothy Bedin (CSIRO)** tested **GOES geostationary satellite imaging** for high-temporal-resolution methane plumes, noting detection limits in lower-emitting Australian facilities.

Session 8 — Biomass Burning, Smoke Chemistry & Fire Plumes

- **Chamber Aging & Peat Emissions:** Max Desservettaz (UOW) presented multi-day daytime/nighttime **SAPPHIRE chamber** aging of synthetic Australian bushfire VOC mixtures, observing a transition from VOC-limited to NOx-limited ozone regimes. **Clare Murphy (UOW)** reported early findings from the 4-week **ASPECT Tasmanian peat-burning campaign**, showing ash-layer trapping of $PM_{2.5}$ and distinct toxic gas ratios across WA, K'gari, and Tasmanian peats.
- **Wine Taint & Forecasting:** Mango Parker (AWRI) showed that guaiacol/cresol uptake in grapes varies independently of $PM_{2.5}$, while **Aiko Jackson (Adelaide)** demonstrated at Cape Grim that **guaiacol persists up to 10 hours and >200 km** downwind. Fabienne Reisen (CSIRO) evaluated the **AQFX Rapid Update Cycle (RUC)** smoke forecast, and Luba Volkova (Melbourne) highlighted the need for improved **coarse woody debris fuel-load maps**.

Session 9 — Regional Aerosols, Marine Atmosphere & Southern Ocean

- **10-Year Shipborne Synthesis:** Salvatore Sodano (UTAS/IMAS) compiled **19 Southern Ocean voyages (2015–2025)** into the first unified particle number size distribution dataset (with exhaust-plume filtering).

- **Single-Particle Microscopy & Optical Optimisations:** Robert Deas (Auckland/Mote) used **X-ray Fluorescence Microscopy (XFM) + machine learning** to show **~40% of urban sea-salt particles in Auckland carry anthropogenic pollutants**. Hamesh Patel (Mote) developed a tracer-correlation (NO_X, PM_1) **aethalometer optimisation** for NZ black/brown carbon source apportionment. Robert Ryan (Melbourne) reviewed **25 years of Australian AEROSPAN AOD**, finding stable trends nationwide (slight dry-season/overall decrease at Jabiru) and strong MERRA-2 agreement vs. MODIS discrepancies.

Session 10 — Urban Air Quality, Emissions & Health Impacts

- **2050 Urban Chemistry Shifts:** Kathryn Emmerson (CSIRO) modelled Australian cities in 2050 (MOZART-T1 under SSP1-2.6 and SSP3-7.0), finding **ozone increases in Sydney despite NOx cuts** due to biogenic eucalypt VOCs and shifts from OH toward HO_2/RO_2.
- **Multi-Pollutant Health & Data Centres:** Simon William Mkasimongwa (Melbourne) introduced a **Multiple Pollutant Air Quality Health Index** ($PM_{2.5}$, PM_{10}, NO_2, O_3), showing many "low-risk" single-pollutant days are actually moderate-risk. **Robert Ryan (Melbourne)** presented **novel estimates of data centre air pollution risks** in Victoria (diesel generator NOx and HFC refrigerants), showing Tier 4 standards substantially curb suburban NOx spikes. Diego Roberto Rojas Neisa (Melbourne) presented early WRF-Chem urban sensitivity runs using local climate zones and Geoscience Australia DEMs.

4. Identified Gaps in Knowledge & Future Priorities

Across presentations, Q&A discussions, and online Zoom chats, the community identified the following key scientific and operational gaps:

1. **Southern Ocean Model–Observation Discrepancies & INP/Organics Physics:**

- Despite filling major observational gaps through CAPE-k, Coast-k, and 19 ship voyages, regional and global models still struggle with aerosol size distributions, primary marine organics overcorrections, SST-dependent sea-spray fluxes, and mid-latitude radiation biases when adding sea-ice DMS (requiring improved INP parameterisations and full aerosol-enabled NWP testing).

2. **OH Variability, Oxidant Coupling & Inversion Priors:**

- Full-chemistry models overly buffer OH, underestimating spatial, seasonal, and inter-annual OH variability seen in ^{14}CO and multi-halocarbon inversions. The roles of **halogens, NOx, HCHO, and HONO** in OH errors, and the impact of replacing TRANSCOM OH priors with ^{14}CO-derived OH fields in CH_4 inversions, remain open questions.
- Radiomethane ($^{14}CH_4$) modelling still needs to reconcile small- vs. large-sample offsets and better represent lag-time distributions between agricultural vs. wetland biogenic sources.

3. **Unregulated & Emerging Trace Gases / Regional Monitoring Gaps:**

- Rising **SO_2F_2** emissions (not covered by Montreal/Kigali), difficulty constraining SF_6/NF_3, and reliance on a single Cape Grim site for Australian top-down HFC estimates (rather than species-specific national inventory modelling and multi-site Australian measurements) remain key policy/science gaps.
- Additional long-term halocarbon monitoring in Southeast Asia (e.g., Vietnam) is needed to constrain regional emissions.

4. **Satellite, AOD & Calibration Harmonisation:**

- Systematic discrepancies persist between **AEROSPAN ground AOD, AERONET algorithms, and MODIS satellite retrievals** under low pristine background AOD (including water-vapour channel effects), while legacy Cape Grim AOD records suffer calibration uncertainties beyond ±0.01.
- Step-changes following calibration/target tank swaps (seen at Cape Grim and CarbonWatch Auckland) and a ~1–1.5‰ round-robin offset in CH_4 isotopes require wider adoption of unified calibration transfer standards.
- Geostationary satellites (GOES) cannot yet resolve smaller Australian methane plumes due to spectral overlap, and MethaneSAT inversions require better **agricultural diurnal emission cycles**.

5. **Bushfire Smoke Profiles, Fuel Loads & Agricultural/Health Impacts:**

- Realistic Australian bushfire **VOC emission profiles** (including coarse woody debris fuel-load maps and fuel-moisture effects) are lacking for chamber and AQFX forecasting models.
- $PM_{2.5}$ is an unreliable proxy for volatile phenols causing **wine smoke taint**, and guaiacol persists far longer (>10 h, >200 km) than previously assumed.

6. **Urban Air Quality, Emerging Sources & Health Communication:**

- Global inventories (e.g., EDGAR) poorly capture Australian urban nighttime NO_2/SO_2/PM; future 2050 chemistry models need state-specific anthropogenic VOC controls alongside biogenic eucalypt emissions.
- **Data centre diesel-generator testing schedules and HFC mixes** represent an unquantified, rapidly growing urban emission source.
- Single-pollutant air quality indices underestimate cumulative health risk, underscoring the need to adopt **multi-pollutant health indices** and investigate sub-threshold health impacts.