

EUFAR Expert Working Groups

Gas-Phase Chemistry workshop

*Munich, Germany
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Participants:

Hans Schlager (DLR), Helmut Ziereis (DLR), Jonathan Williams (MPI-Mainz), Wolfgang Junkermann (IMK-IFU, Garmisch), Andreas Hofzumahaus (KFA-Juelich), Heiner Geiss (KFA-Juelich), Steve Arnold (ULeeds), Alex Parker (ULeicester), Jim McQuaid (ULeeds), Frank Flocke (NCAR), Daniel D. Riemer (UMiami) and Teresa Campos (NCAR).

Since this meeting Agnes Borbon from the Ancellet group (LISA, Paris) has kindly agreed to join the group, until this point there was a clear gap in over coverage of the key European groups.

The meeting aimed to bring a community of users and instrument specialists together, in addition Steve Arnold (ULeeds) attended as a data user. Good interactions between the data users and the data providers is essential to generation of good research output (peer reviews articles etc...) In addition funding was provided for representatives of the US airborne chemistry community which was most welcome.

We identified the key areas which gas phase measurements can be used to address....

- large scale transport
- source appropriation for global tropospheric composition
 - large scale biosphere / ocean - atmosphere exchange
 - large scale BL-FT exchange
 - megacity impacts
 - Biomass burning plume evolution / impacts
 - convection
 - UT/LS chemistry – ozone/water budgets
 - cirrus clouds and halogens
- climate-air quality issues
- satellite validation
- cloud chemistry
- boundary layer chemistry/fluxes
- stratospheric chemistry/physics

Discussions were held with regards to which measurements are presently available (not specific to an aircraft platform or institution) and where the gaps in our capabilities currently exist.

It was recognised that a relatively small number of species on the whole are measured well on board all aircraft such as carbon monoxide, water and ozone. However even these species are still difficult to determine throughout a normal science mission how are they affected by changes in altitude (differential pressure btwn cabin and static) and changes in relative humidity and cloud penetration (this was to be discussed but time precluded this). The instrumentation for the determination of these species appear to be relatively robust in turns and manoeuvres. They are the most important of ALL

chemical measurements made onboard aircraft, they do tend to be considered as being routine, but does this lead to complacency? Is a routine measurement really routine? Maintaining these measurements and their precision and accuracy is a non-trivial task. Can they be improved? In particular ozone suffers from lack of temporal resolution in standard UV photometric methods.

It was agreed that the remaining atmospheric species are less well covered. The following list is based upon an original drawn up by Frank Flocke for the meeting and was then discussed within the group with additional parameters and comments being added.

- Increased temporal resolution of VOC, NMHC, Alkyl nitrates
- Formaldehyde (HCHO) – routine measurements are not sensitive or fast enough to this key species.
- Speciated peroxy radicals
- Speciated organic peroxides – again generally reported as ‘sum of all organic peroxides’
- Nitroaromatics
- Sub-ppt halogen oxides
- Heavily oxidised organics e.g. organic acids
- Terpenoid species
- Nitrous acid - both fast and sensitive
- Secondary sulfur species
- Isotopic ratios for CO, CO₂, VOC, H₂O

This list is NOT exclusive, there are many other measurements but these were the key ones identified.

The measurement of a large number of these species is made more challenging due to transmission difficulties between the ambient air external to the aircraft and the instrument in the cabin. These ‘sticky’ compounds include hydrogen peroxide and higher peroxides, nitric acid, ammonia and many large 2O₂, HNO₃, NH₃, Terpenoids, large VOC

Another major item discussed was the real lack of joined up intercomparisons and how we can address this:

They are all too often an after thought when planning joint aircraft projects, but without confidence in the measurements we are making are we failing to do the best quality science?

We NEED:

- Intercomparisons over larger ranges of conditions
- Good and effective problem resolution after intercomparisons
- Dedicated and focused intercomparison missions not just a low-importance flight to fit into a research program.

It was felt that conventional field projects funded by national research councils and the European Union never permit sufficient time for good, robust intercomparisons to be conducted. National research funding bodies would be almost impossible to co-ordinate proposal submission so EUFAR was identified as the best mechanism of gaining funds for a solid joined up program of intercomparison missions.

The meeting included a presentation by Helmut Ziereis on the new HALO (High Altitude and Long Range Research) aircraft currently being developed for the German research community, it will replace the D-20 Falcon which has served them very well for over 20 years. The HALO source aircraft (Gulfstream G550) is very similar to the new US HIAPER aircraft which flew its first scientific sorties earlier this year, it will provide at twice as much usable cabinspace as the D-20 Falcon aircraft. Driven by user requests, HALO will have an operation ceiling of over 50,000 ft, a range in excess of 8,000 km and capable of carrying a payload of 3,000 kg. The current timeline shows flight testing to begin 2008 with first demonstration science flights in 2009. A very exciting prospect for airborne science for not just Germany but the whole European community. Following the presentation the group was given a tour of the green aircraft which had recently arrived at RUAG whose facility is adjacent to DLR in Oberpfaffenhofen. RUAG are heavily involved in the modifications along with the Gulfstream Corporation.

<http://www.halo.dlr.de/>



Advice to users (data/other scientists)

Awareness of uncertainties within aircraft data – ASK!
Read the header contained with the data
Sharing tools & wrappers

Advice to aircraft and instrument operators

Honesty! details in data header - flags
Data files include REAL uncertainties
European Data protocol – incorporation into data merges.....
Automation – Miniaturisation
Communications (surface-to-air)
Update EUFAR instrumentation database (<http://www.eufar.net>) only the instrument scientists can comment of the status, detection limits, operational ceiling etc.....

Advice to funding agency

Intercomparisons – critical to quality of science we are generating.
We can't rely upon individual research councils to fund a collaborative intercomparison
EUFAR to provide infrastructure WITH funding for a dedicated intercomparison project, this should include participation from US groups/aircraft. (ACCENT already has a system in place)

More for EUFAR Office

List instrument types by SPECIES (VOC/NO_y, oxidants/CO&CO₂..... 8 or so species types)
Where instrumentation not available in EU maybe list US instruments
Clarity – who to contact?? Include instrument web page where appropriate.
Update current webpages
Add links to US urls
Flight planning infrastructure (cf. JOSS) – Pan-european system.
Flight planning logistics, RDF flight planning systems?
Accessibility of data, data tools, on-line merges? EUFAR Data management group?