Unmanned aerial systems (UAS) in atmospheric research

WG3: High resolution 3D atmospheric measurements by UAS

Deliverables, status and discussion

Presenting: Joan Cuxart

Active groups in different participant countries: Norway, Germany, UK, France, Spain, Italy, Finland, Switzerland, ...

Important points in the MoU

• Development and test of UAS fight strategies for temporally
and spatially highly resolved atmospheric measurements.

 ==> done by members during experimental work, collaborative effort in BLLAST
and other smaller campaigns

• Selection of the appropriate sites for relevant atmospheric analysis.

==> Activities made in Lannemezan (CNRS), Lindenberg (DWD), Arctic and
Antarctic sites, plus locally oriented work in participating countries

• Compilation of a database on UAS measurements in the atmospheric
boundary layer for the validation of corresponding fne-scale numerical
simulations.

==> Members report campaigns and generated databases in the COST ES-0802
website. There are also specif c websites (like BLLAST's) which are linked to it.

Background issues (MoU)

*Improvement of the understanding of atmospheric boundary layer processes.

==> Activities made essentially dealing with:
   * ABL processes (stable, convective, heterogeneities, transitions)
   * Wind power oriented research
   * Atmospheric Chemistry

•Improvement of prediction and monitoring of airborne pollution.

==> Modelling has been made prior and after main campaigns

•Monitoring and improvement of the understanding of the effects of global warming on the atmospheric boundary layer

==> No reported activity on this action yet, probably because it is too early.

Scientific Issues (as listed in the MoU)

a) Boundary layer turbulence
==>RPAs initially intended for it, new RPAs generally aim to include the necessary instrumentation (fast responding sensors). Work progressing at a good pace.

b) Verification of remotely sensed (sodar, large aperture scintillometer) turbulence and fine structure parameters with in-situ measured data:
==> Activities proceeding regularly

c) The entrainment zone and the capping inversion of the ABL:
==> scientific subject in BLLAST and Lindenberg activities

Scientific Issues (as listed in the MoU)

d) The stable boundary layer (SBL) and the nocturnal ABL
==> This includes now transitions and heterogeneities: hot topic in polar and mid latitude research with RPAs

e) The polar boundary layer:
==> much activity going on both in the Antarctic and the Arctic areas

f) Atmospheric pollution issues:
==> RPAs have been developed recently that are able to carry the heavier payloads that this activity requires. Development of sensors.

WG3 Scientif c work plan – methods and means

* 3D atmospheric data sets related to different specif c research requirements.

==> in production, continuously

* focus on the application of UAS and the related requirements concerning mission planning and f ight strategies to optimise sensing.

==> good interaction between data producers (RPAs operators) and users (atmospheric science researchers, including modelers)

* Close cooperation with the community of numerical atmospheric modelling (f ne-scale and large eddy simulations (LES))

==>**Models help planning f ights.**
Flights help plan, initiatize and validate models

Initially planned activities

* During each of the years 2 and 3 a tailored measurement campaign will be organized by the Action at advanced ABL measurement sites and potentially at existing instrumented sites in Polar Regions

==> OK

*An own conference, or a specific conference session at one of the large international meteorological conferences, will be scheduled for year 4 to present the activities and results of the Action in condensed form to a broad scientific audience.

==> OK: Scientific workshops in Cambridge(10) and Cyprus (11),
1st ISARRA conference (13) and a Session at EGU (13)

D1: Compilation of a 3D atmospheric database available for process studies and for the validation of fine-scale numerical simulation

*List of past UAS campaigns incl platform, location, maximum altitude, time, number of flights, instruments, parameters measured, PI, contacts.

*Could be meta-database, i.e. consisting of web links to avoid duplication of data storage;

*Add information about sensors in development to ensure future scientist can contact PI for information

D2: Flight strategies for optimising data gathering by single and co-operative UAS

* Wind power
* Atmospheric chemistry
* ABL physical processes

task distributed among participants with coordinators

D3: Development of data analysis tools for registering and fusing data gathered from multiple UAS)

So far only a few successful flights with multiple UAS (Paparazzi can deal with several UAV; stacked Manta flights; BLLAST campaign)

Semi-continuous operation of SUMO and multicopters (only battery recharge between flights)

High resolution numerical modelling in progress

Assimilation of UAS data into numerical model