COST Action ES0802

Unmanned aerial systems (UAS) in atmospheric research

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SUMO – Small Unmanned Meteorological Observer

wingspan: 80 cm
length: 75 cm
weight: 580 g

electric powered, motor time per flight: ≈25 min

maximum ascent rate: 15 m/s
average ascent rate: 7-10 m/s

maximum air speed: 35 m/s
average air speed: 12-18 m/s

maximum altitude above ground: 3.5-(6) km

Autonomous flight capability; designed to be operated as recoverable radiosonde for atmospheric boundary layer research

Main Objective

The main objective of the proposed action is the coordination of ongoing and the conception of future research on the development and application of unmanned aerial systems (UAS) to provide a cost-efficient, trans-boundary method for the monitoring of the atmospheric boundary layer and the underlying surface of the Earth.

We decided during the Action KO meeting to focus on UAS with a weight below 150 kg (regulated by national CAAs, not by ICAO directly)

UAS systems for atmospheric research operated in the US

Altair Predator B

Global Hawk

ws: 3 m wgt: 14 kg

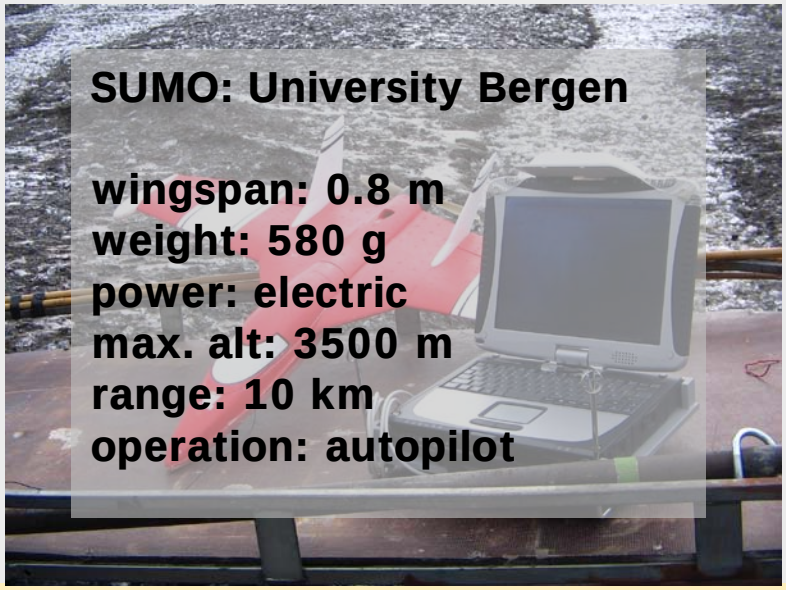
Aerosonde

Global Observer

ws: 18 m wgt: 30 kg

Zephyr

Unmanned aerial systems in atmospheric research



Motivation

Focus on the atmospheric boundary layer

- easily accessible for UAS
- directly related to human life and activity and our perception of weather, climate, pollution etc.
- majority of exchange processes of energy and matter (heat, moisture, trace gases, momentum) take place here
- these processes have to be parameterized within the numerical models used e.g. for weather forecast and climate simulations
- main portion of uncertainty resulting from numerical atmospheric modeling can be attributed to the insufficient representation of BL exchange
- the BL in high latitudes is expected to show faster and larger response to climate change than in other regions

Motivation

A survey of recent research in meteorology/climatology identifies specific observational requirements for the future:

- need for cost-efficient environmental monitoring tools with focus on the atmospheric boundary layer (ABL)
- close the observational gap between routine ground based and satellite measurements
- to provide 4D meteorological data with high spatial and temporal resolution for the validation of fine-scale of numerical simulations and the test and improvement of the underlying BL parameterization schemes
- enable long-term monitoring with respect to climate change issues
- get better access to data in harsh/dangerous/hazardous environments

UAS are the most promising approach, no realistic alternatives available in the near future

WG 1 – UA systems

main tasks:

- survey of airframes and basic components with emphasis on atmospheric research capabilities
- conception and development of prototypes for a fleet of UAS of different size, complexity, and operation range with respect to specific observational requirements
- development of ground station technique and software towards user friendly solutions operable by atmospheric scientists
- adaptation of ground station hardware and flight management software for cooperative UAS missions

main deliverables:

- database on available airframes and related components
- novel airframe configurations by the use of latest advances in composite materials and aerodynamics
- standardized airframes
- standardized data link techniques/protocols for telemetry, mission management and measurement data transfer

WG 2 – UAS sensors for atmospheric research

main tasks:

- survey of sensors applicable for UAS
  - standard measurements (temperature, humidity, pressure, wind)
  - turbulence measurements (momentum, sensible and latent heat)
  - non-standard measurements (cloud microphysics, aerosols, trace gases)
- development/improvement of various methods to determine the wind vector along the flight path of the UAS
- definition of standard calibration procedures and development of mobile calibration units

main deliverables:

- database on meteorological sensors for UAS use
- recommendations for standard sensors
- standard calibration units/methods

WG 3 – High resolution 3D atmospheric measurements

main tasks:

- selection of appropriate sites and situations for relevant atmospheric analysis (in close cooperation with the modeling community)
- development and test of flight strategies for single and co-operative UAS missions
- compilation of a database on UAS measurements in the atmospheric boundary layer (measurements, data analysis, quality control)
- development and application of standardized measurement routines and data analysis tools
- scientific evaluation/interpretation of the corresponding data sets

main deliverables:

- high resolution 3D (4D) atmospheric database available for process studies and model validation
- catalogue on optimized flight strategies by single and co-operative UAS
- standardized measurement methods and data analysis tools

WG 3 - Scientific focus

Based on the potential of UAS systems the following scientific problems have been identified to be addressed during the action:

- boundary layer turbulence (anisotropy, non-stationarity, inhomogeneity)
- the entrainment zone and capping inversion of the ABL
- the stable and nocturnal boundary layer
- the polar boundary layer (marginal ice zone)
- atmospheric pollution issues (dispersion modeling)

WG 4 – UAS operation

main tasks:

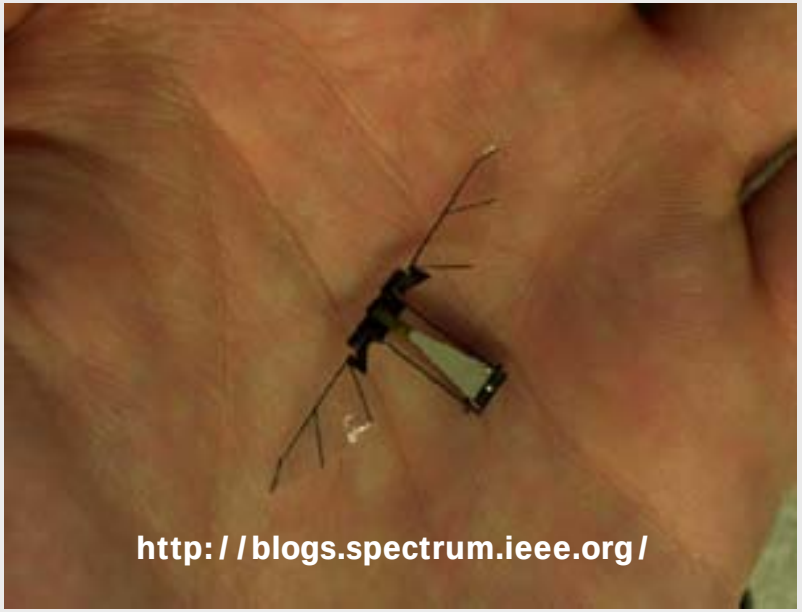
- assessment of current legal conditions in the different European countries
- coordination/cooperation of ongoing legal initiatives in Europe and USA for the application of autonomous flying UAS
- working towards national and transnational authorities involved in air traffic control

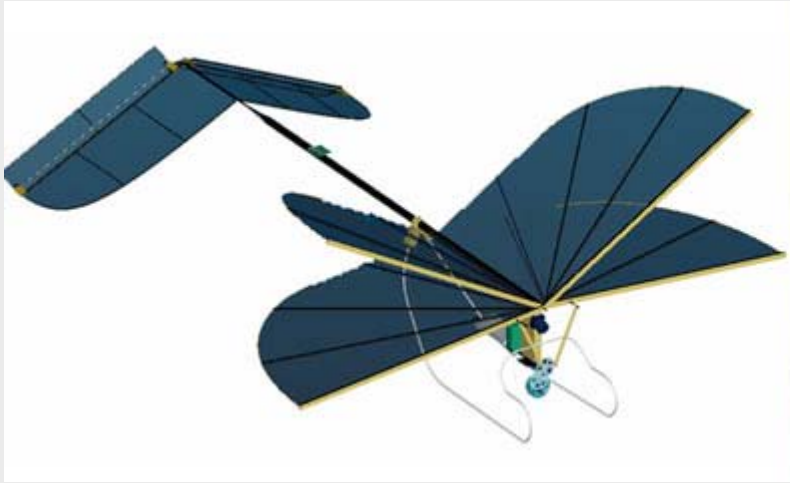
- identification of particular requirements for UAS operation under specific dangerous or hazardous environments

main deliverables:

- legal study documentation
- UAS safety report
- catalogue of security procedures
- training standards for UAV operators
- recommendations for UAV operation in hazardous environments

The future of UAS ?





http://www.delfly.nl/DelFlyI/index2.php?menu_sel=home

Participating countries

Status May 03, 2009:

- 14 countries confirmed (Cyprus, France, Germany, Norway, Poland, Spain, Switzerland, United Kingdom, Denmark, Finland, Belgium, Iceland, Ireland, Israel)

- informal contacts (Italy, Netherlands, Sweden, USA, Canada)

Vision

Establishment of a robust and efficient European network in UAS use for atmospheric research

Design of/input for future scientific Work Programs and Project Calls

Going for ”real money” in particular from EU