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Definition of small-scale atmospheric turbulence.

Flows, circulations and associated fluctuations of thermodynamical and microphysical fields in scales smaller than 10m.

Applications of small scale measurements:

- cloud physics (dynamics/microphysics, collisions, entrainment, warm rain formation, large supercooled droplets-icing);
- boundary layer measurements;

- dissipation of pollutants;
- turbulence and turbulent mixing processes in the free atmosphere;
- extreme events, intermittency;
- multiscale measurements: possibility to cover wide range of scales;
- aerosol particle formation:
- telecommunication links (variability of refractivity and transmissivity due to turbulence)

Presentations:

Haman, Krzysztof	Ultra Fast thermometer UFT and other fast sensors developed at UW
Struś, Bożena	Presentation of UFT
Nacass, Philippe	Fast Anemometer Thermometer and the Fast Refractomer Hygrometer
Hacker, Jorg	High altitude turbulence measurements with the BAT-Probe.
Hacker, Jorg	Comparisons between the BAT-Probe and a Rosemount 858 turbulence probe .
Hacker, Jorg	The Egrett as high altitude research platform.
Strunin, Mikhail	Aircraft observations of the atmospheric boundary layer structure over non-homogeneous terrain in vicinity of Yakutsk City (Western Siberia) in April - June 2000. Aircraft instruments and review of results.
Siebert, Holger	Turbulence Measurements Using a Tethered Balloon in Clouds
Brown, Phil	Plans for the development of a turbulent air motion sensing system on the FAAM BAe146 aircraft.
Malinowski, Szymon	Needs for high-resolution measurements of atmospheric phenomena.
Brenguier, Jean-Louis	Droplet spatial distribution at the microscale as observed with the Fast-FSSP
Duroure, Christophe	Distribution of hydrometeors measured with nephelometer, FSSP and 2DC probes.
Mezrin, Mikhail	The contribution of different scales to integral moisture transport. Experience from CAO Iliushin 18.
Yorish, Svyatoslav	Turbulence experiments in high Reynolds numbers atmospheric flows

Aircraft sensors allowing for spatial resolution better than 10m, recommended for the small scale measurements:

Turbulent velocities:
BAT probe (~50Hz)(ref.),
AUSAT (sampling 1024Hz, after filtering at 48Hz, possible 100Hz, logitudional component only);
Helipod (ref.) 5-hole,
Experimental hot wire probes;
Ultrasonic and hot wire sensing from instrumented airship and/or tethered baloon (ref.)

Temperature: UFT-B, UFT-F, UFT-D (10kHz, ref),
Thermocouple, (ref)
AUSAT (1kHz, ref.)

Humidity:
fast refractometer hygrometer (prototype), CAO humidity ACH&UVH(ref),
Lyman-a,

potential use of infrared,
TDL +20Hz,

Liquid Water:
PVM (1kHz, ref),
fast UW-LWC to be tested more in high LWC conditions

Microphysics:
Fast FSSP (droplet size and interarrival time, ref.).
FSSP's 2DC probe,
Nephelometer,

HIGH ACCURACY POSITIONING, ALTITUDE
Other platforms:
Slow aircraft

Recommendations for users:
No standard instruments, most require operation and maintenance by the developers, some require specific data acquisition systems, highly demanding in terms of maintenance and labor, recommendef for situations where small scale processes may play important role,.
Consider use of tethered balloon platform or slowly flying aircraft.

Recommendations for the aircraft operators:
Desired low operational speed to achieve good spatial resolutions,
Desired close collocation of the sensors, alignment , possibilty to record output on the independent DAS, high quality signal cabling shielded from the high-frequency electrical noise, protection during take-off /landing, vibrations.

Recommendations for developers:
Consider propose the standard: PMS canisters? PMS mounting system?
Consider development of the probe allowing for measurements of multiple parameters in well-localized small sampling volume.

Recommendations for funding agencies:
Measurements of the small-scale (below 1m) turbulent velocities in free atmosphere and in clouds can be done with new generations of sensors. Small scale measurements are useful for applications mentioned above (up).

> There is a lot of ambiguities and ucertainities concerning small scale turbulence in clouds and the free atmosphere (JLB, JFG, SPM, others). The following processes, in which small scale turbulence may play an important role still require experimental investigations:

1) entrainment and mixing in clouds, both convective and stratiform clouds (especially stratocumulus) and the following evaporation of cloud particles;
2) spatial distribution of cloud particles;
3) entrainment on the top of PBL,
4) breaking of gravity waves in the free atmosphere,
5) turbulent mixing

all above

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