STSM Scientific Report

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The COST STSM in the framework of the field campaign 'Boundary-Layer Late Afternoon and Sunset Turbulence' (BLLAST) is part of the COST Action ES 0802. This Action coordinates and conceives future research on the development and application of unmanned aerial systems (UAS) as a cost-efficient, trans-boundary method for the monitoring of the atmospheric boundary layer and the underlying surface of the Earth.
The project BLLAST is an international intent to investigate the decay of the well-mixed convective boundary layer during midday to a residual layer and a stably-stratified surface layer in the late afternoon. In contrast to the morning transition which is well investigated the decay of the PBL in the afternoon is rarely understood. The according field campaign to the project was a perfect opportunity for several member groups of the COST Action ES 0802 to contribute to a well organized campaign with a lot of partners performing meteorological measurements (see Figure 1). The UAS together with surface measurements are an ideal combination to analyse the decay of the convective boundary layer in the late afternoon and to compare the results with previous large eddy simulation (LES) studies.
Sabrina Martin is working since 2008 at the Institute of Aerospace Systems of the Technische Universität Braunschweig. One of her main tasks is to operate the Mini Meteorological Aerial System (M²AV). Sabrina has gained considerable experience with the measurement system and its data during several campaigns.
For the BLLAST campaign the measurements of the M²AV were an essential contribution to collect data of temperature and the three-dimensional wind vector close to the surface and over longer distances to calculate the vertical sensible heat flux. Besides the interest in the scientific results, also comparison between measurements of several UAS operated at the same time and under comparable circumstances is one output of the campaign. Since the UAS system SUMO (Small Unmanned Meteorological Observer) was operating a new turbulence probe during the BLLAST campaign, comparing the turbulence data of SUMO and the M²AV is very important. The joint measurements provide more simultaneous turbulence data and therefore new insights in the turbulent structure of the atmospheric boundary layer.
For the Braunschweig group a comparison between data of the M²AV and the manned aircraft Piper Aztec from SAFIRE is also of high concern. During the campaign flights were performed alternately between manned and unmanned aircraft over the same area. Other flight strategies involved flights of manned and unmanned aircraft performed at the same time but several kilometers apart from each other. Table 1 provides an overview on the performed measurement flights of the M²AV during BLLAST.
Within the next year all data measured during the campaign will be analysed. Each participant has access to all data sets to use the variety of high quality data. A large number of publications regarding the boundary-layer late afternoon and sunset transition is aspired, so that future collaboration between the participating groups is ensured.
The data analysis is done at the moment. Figure 2 and 3 show first results. As an example, the Product of measured temperature and vertical wind subtracted by the linear trend is plotted over the geographical longitude in Figure 2. The data was collected during horizontal flight legs at different altitudes on 02 July 2011 between 14:30 and 14:50 UTC, south of the meteorological observatory in Lannemezan. The heterogeneous surface seems to highly influence this vertical transport of heat. There also seem to be strong single events of vertical transport of heat like it appears at 0.368° geographical longitude at 250 m agl. It needs to be analysed if such events appear frequently and how strong these events are. A vertical profile of temperature is plotted in Figure 3. This data was collected

during the night time flight on 02 July 2011. A strong temperature inversion of 6 K was observed between the surface (660 m above sea level, asl) and 740 m. The height of the inversion layer at 740 m asl can nicely be identified.

Table 1: Overview on the performed measurement flights of the M²AV during the BLLAST campaign.

Date	**Takeoff** in UTC	**Duration** in min	**Altitudes** in m agl
30.06.11	17:22	40	200, 400
30.06.11	18:44	30	200, 400
01.07.11	14:27	10	300
01.07.11	18:47	30	200, 250, 300
02.07.11	14:19	45	200, 250, 300
02.07.11	16:27	25	200, 250, 300
02.07.11	18:13	40	200, 250, 300
02.07.11	20:20	45	150, 200, 250
05.07.11	12:25	45	200, 250, 300
05.07.11	14:25	25	250, 325, 400
05.07.11	15:40	40	250, 325, 375, 400, 375, 500
05.07.11	17:10	45	250, 375, 500
05.07.11	18:30	45	250, 375, 500

Figure 1: The unmanned aerial vehicles M²AV, SUMO and MASC, which were operated intensively during the BLLAST campaign.

Figure 2: First results: The Product of measured temperature and vertical wind subtracted by the linear trend is plotted over the geographical longitude. The data was collected during a flight on 02 July 2011 between 14:30 and 14:50 UTC, south of the meteorological observatory in Lannemezan.

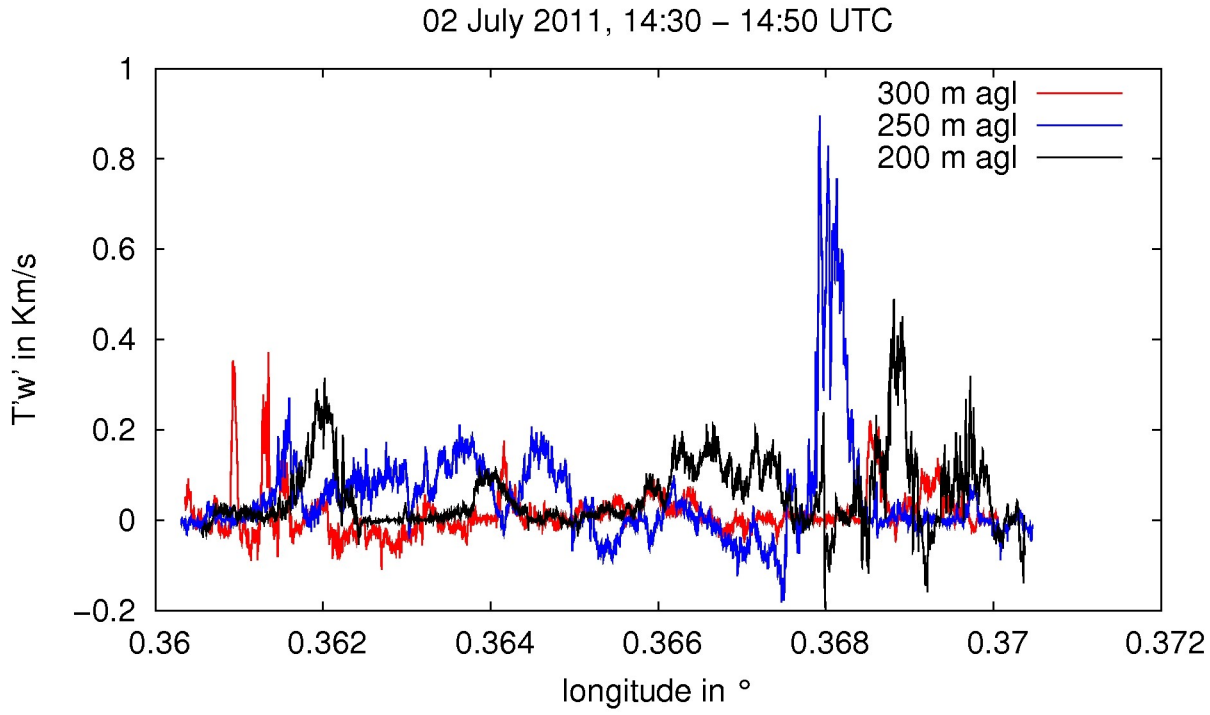

Figure 3: First results: Temperature profile measuerd on 02 July 2011 at 21:00 UTC, south of the meteorological observatory in Lannemezan.