Report on the InGos TNA Campaign at Sodankylä, Finland

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This report intends to give an overview of the field work performed by the Belgian Institute for Space Aeronomy (BIRA-IASB) at the InGos TNA campaign during 19 – 25 June 2015 in Sodanlykä, Finland. The BIRA-IASB team members participating in the field campaign were Martine De Mazière, Mahesh Kumar Sha and Zhou Minqiang along with their subcontractor Florin Mingireanu and Aurel Chirila from Romania.

The main objective of taking part in this field campaign was to test an automatic retrieval system for high altitude payloads such as an aircore. The system designed to achieve this task is a flying wing glider system, developed by our subcontractors Florin Mingreanu and his colleagues from the Romanian Space Agency, which is steered automatically to return back to the launch point. The wing glider system is launched from ground using hydrogen or helium filled balloon capable of carrying a payload up to 30 – 32 km of altitude. Once the intended height is reached, the flying wing is commanded to separate from the balloon using a hot-wire cut down system. After the cut-off from the balloon, the wing starts to glide to the position of the launch site.

During the campaign, two flying wing glider systems were intended to be tested: (i) a 1.4 m wingspan flying wing – designed as a test flight vehicle and (ii) a 1.75 m wingspan flying wing – designed to carry an aircore (approx. weight of 3kg) as a payload. Due to the aviation law restrictions, the 1.75 m wingspan (6.95 kg weight without the aircore) could not be flown without a transponder. The high altitude gliding wing system is an innovative new project and the aviation law restrictions became clear quite late. It was not possible to find an adequate transponder during the short campaign period. However, the smaller wing (1.4 m wingspan weighing 3 kg) was under the limit of the flight restrictions (max. 6 kg allowed without transponder) and hence it was allowed to fly. It has an identical system to the large wing and uses a similar aerodynamic design. Three flights from low altitude to high altitude were performed. The first flight was performed with the cut-down of the flying wing from the balloon at 700 m altitude. As intended, the flying wing flew back automatically to the launch point. The flight demonstrated the functionality of the automatic return, tracking system and cut-down mechanism for the system. The second flight was performed to 10380 m altitude where the wing drifted to a horizontal distance of 18.7 km. The cut-down was initiated from the ground and the wing returned automatically back to the launch point within 60 minutes. The third flight was performed to 26022 m altitude where the wing drifted to a horizontal distance of 32.4 km away from the launch point. The gliding system worked perfectly and the wing landed back to the start point in 1 hour 40 minutes after the cut-down. The campaign was successful in terms of testing the concept of the general wing system by testing the smaller wing.

The second contribution to the campaign was the participation with the EM27/SUN spectrometer measurements. This was a collaborative work between BIRA-IASB and the Karlsruhe Institute of Technology (KIT). The EM27/SUN spectrometer was provided by KIT. It is a low cost, robust and mobile FTIR spectrometer, which measures the column-averaged abundances of CO2, CH4, H2O and O2 from ground. The measurements can be compared with the collocated existing on-site TCCON station, which also measures the column-averaged abundances of CO2, CH4, H2O and O2 in addition to other species. The CO2, CH4 and H2O profiles from the aircore flights performed during the campaign and the TCCON measurements will be helpful to validate the EM27/SUN measurements in artic conditions. The weather conditions during the campaign were quite good. The EM27/SUN performed measurements whenever there was sun and this also included the collocated measurements together with the aircore launches.



Figure 1: smaller wing 1.4 m wingspan; smaller wing during flight; larger wing 1.75 m wingspan


Figure 2: EM27/SUN spectrometer; EM27/SUN and aircore launch