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THE MWP- HIMALAYA RESEARCH EXPEDITION - CHALLENGES, OBJECTIVES AND THE FIRST SCIENTIFIC RESULTS OF THIS OUTSTANDING AIRBORNE MEASUREMENT CAMPAIGN IN NEPAL

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Abstract

The main objective of the Mountain Wave Project (MWP/OSTIV) is the turbulence research and forecast, in particular the spatial extension and classification of the mountain-related rotor-wave turbulence. The integration of new scientific partners in regard of the airborne measurement campaign in Nepal significantly enhanced the overall depth of the GEO-research and the high altitude physiology of the MWP. The challenge in January 2014 was flying with two motor gliders over unknown highly mountain terrain and the exploration of the diurnal wind and lift systems. Based of developed forecasts with a high-resolution non-hydrostatical weather model (2.8km) combined with turbulence parameters (Eddy Dissipation Rate, Turbulent Kinetic Energy), pioneer flights with this type of aircraft were safety achieved over the Himalayas up to the Mt. Everest. The used aircraft Stemme S 10 VTX of the Aachen University of applied sciences is a touring glider and combines the advantages of powered flying including the distribution of electrical power (1,5 kW, 24 V) permanent for the measuring equipment and safety reasons on one side and excellent gliding performance in the gliding mode on the other side. Two wing pods carry up to 100 kg additional measuring equipment without any loss of handling performance. The ambitioned avionics was very helpful for all tasks including the outstanding ferry flights from Germany to Nepal and the return. This aircraft can be used for many purposes like atmospheric measurements, structure, aero elastics, flight performances, human factors in all altitudes up to FL 300 ore even more.
The German Aerospace Center (DLR) tested an aerial camera system to generate detailed 3D-models of scanned areas. The camera was developed to be operated under challenging environmental conditions which are found combined in the Himalayas (air pressure, temperature, strong light contrasts etc.). Never before, digital aerial imagery was taken in this region. First results confirm that using a motor glider it is possible to operate such aerial camera systems under difficult conditions. Up to now areas like the Kali Gandaki gorge, old town of Kathmandu, Khumbu glacier and the Mount Everest were translated into virtual 3D-models with ground resolutions of 15 to 30 cm. Thus, by monitoring glacier change a data base can be set up which can be helpful to draw conclusions regarding global warming. Further, prediction of flood impacts can be improved by more detailed flood simulation and natural or cultural heritage can be documented in a larger scale. ICIMOD and KIT intend to establish an airborne research facility in Nepal based on existing small aircraft in Nepal. The MWP was used evaluate the possibility and limits to use such aircraft (SERA' s) for future air quality research in Nepal which is especially impacted by particulate matter both from local emissions and long range transport from India. The development of mitigation strategies to reduce air pollution problems requires detailed knowledge major sources for air pollution and of regional transport phenomena. Airborne investigations are currently the most promising tools for such investigations. A small set of instruments to characterize fine and ultra fine particulate matter was installed on one of the two Stemma motorized gliders. Four flight missions were flow from Pokhara into the high Himalayas, into Katmandu valley and the Nepalese Ganges plain measuring the vertical distribution of particulate matter and their optical properties for source apportionment. Results of these flights serve as a base for a larger airborne field campaign in the next dry season, 2014/2015.
The objective of the medical part of the study which was under responsibility of the group around Carla Ledderhos from the German Air Force Center of Aerospace Medicine (GAF CAM) was to answer the question whether an early detection of oxygen deficiency is possible also under these extreme conditions (low barometric pressure, extreme temperatures and turbulences, oxygen deficiency) as they could be expected during high

altitude flights performed in the Himalayan region. In addition, the frequency of failures of in flight pulse oximetry measurements at different measurement places should be examined in order to determine the point optimal for such measurements. And last but not least the pilots should receive a feedback about their management of oxygen substitution while performing high altitude flights. The data obtained during those high altitude flights suggest, that the pulse oximetry used, was suitable for the detection of an oxygen deficiency in flight even under those extreme conditions experienced. The likelihood of failures of in flight measurements was biggest at the sternum whereas the forehead turned out to be the optimal point for measurements of oxygen saturation under these conditions. And last but not least it turned out that the oxygen management in flight, especially during the Mount Everest flight, was satisfying. There were only negligible decreases of short durations to values below 88% SaO2. The team of pilots and scientists taking part in the Mountain Wave Project (MWP) demonstrated their understanding of complex atmospheric processes with safety flights over the Himalayas and ferry flights of over proximally 10.000km. After the successfully repatriation of aircrafts and equipment to Germany end of spring 2014 the team and all scientific partners are in a phase of data evaluation now.

Keywords: Mountain Wave Project, Himalaya, Mt. Everest, turbulence, gravity waves, trajectory, 3D-model, aerial camera, glacier monitoring, digital terrain model, air pollution, pulse oximetry, oxygen saturation, Research aircraft, touring motor-glider, measuring flights, DLR, Aachen university of applied sciences, German Aerospace Center, OSTIV

A GAME THEORY ANALYSIS OF SALPLANE RACING

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Abstract

The sport of soaring allows pilots a multitude of decisions that influence the outcome of a competition. From how fast to fly, what altitude to enter and exit thermals, and who to fly with, each pilot can create a strategy to best fit his skill set and yield the best chance of victory. This paper examines and groups these tactical decisions into two overarching strategies: conservative flying and aggressive flying.

To examine the strengths and weaknesses of these strategies, a model was developed using the results from an eight day Standard Class competition. Using IGC Flight Replay software, the flight logs from each pilot were examined to classify of each flight into one of the two strategies, thus yielding two data sets (one per strategy) of the flight scores from the competition. The sets of flight scores were then used to simulate competitions lasting a various number of days via MATLAB software.

Through simulation of single and multiple day competitions, these strategies are examined to determine which situations yield the best result for each strategy. As will be shown, the aggressive strategy has a greater chance of winning a single day competition than does the conservative strategy. Interestingly, as the number of days of the competition increase, the conservative strategy becomes increasingly likely to obtain a high place.

Keywords: Simulation of competitions, conservative strategy.