

Long Duration Flights of Balloons for the Study of Stratospheric Chemistry in the Frame of the TARANIS Project

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In the frame of the satellite TARANIS satellite project dedicated to the study of the Transient Luminous Events above storms, stratospheric balloon instruments can be used for the determination of stratospheric ozone and nitrogen chemistry perturbations induced by these high energy phenomena.

Obviously, it is difficult to know in advance when such phenomena can occur and then to be ready for opportune launching of a conventional stratospheric balloon. Then, we propose to use long duration balloons that can be flown in the lower and middle stratosphere for more than one week. Open stratospheric balloons could be used for such purpose. Some tests have shown that these balloons could stay several days in the middle stratosphere (around an altitude of 30 km) and can carry heavy gondolas, typically up to 200 kg. Such balloons can flow over large storms and cloud expanses without any risk. We propose to use such balloons with gondolas carrying different kinds of instruments. Ozone and NO₂ measurements can be conducted using remote sensing techniques, using Moon and Sun as light source (SALOMON-type instrument). The integrated path length of the measurements is between tens and few hundreds of km. Following the motion of the balloon (driven by winds) and the motion of the Moon and Sun, a significant part of the stratosphere above the balloon float altitude can be sampled. On the other hand, the estimation of the position of the NO₂ enhancements cannot be accurately determined. The second technique involves in situ measurements (SPIRIT-type instrument) by an open cell and infra red tuneable diodes. In this case, the location and altitude of the enhancements can be accurately determined, as well as the absolute values of the species concentrations. On the other hand, the probability of detection is smaller than with remote sensing techniques. Finally, instruments dedicated to the detection of atmospheric “terrestrial gamma ray flashes (TGF)” and to the TLE (cameras or photometers) can be also implanted onboard the gondolas.

All these instruments could be implanted in the same gondola. The flights could be conducted at equatorial latitudes at periods of the year close to equinoxes and solstices, when the speed of the stratospheric winds is low. In this case, the balloons can stay above the cloud expanses all along the flights, thus maximizing the probability of the detection of the high energy phenomena and of their consequences.