Figure 2. Vertical profile of the operations area.

During take-off, the RPA reached an altitude not greater than 4000 ft to proceed to the transition corridor where it climbed gradually until reaching 7000 ft before enter the working area. At the entry point of the working area the RPA reached its final altitude (8000 ft). The manned aircraft followed the same procedure to reach the working area. In fact, during the initial climb and transition through the corridor, both the manned aircraft and the RPA flew at same altitude in parallel to perform a calibration of altitude sensors and guarantee that vertical separation was maintained during the scenario execution inside the working area.

A very important aspect for defining the exercises and for guaranteeing safety of the lives and properties on ground was the definition of crash sites/recovery areas. These areas were selected based on the study of the ground settlements and the capability of the RPA to descend once the parachute has been deployed. The selected crash sites were selected based on the absence of population and buildings, and considering the RPA capability for gliding from different points inside the working area assuming that the RPA starts gliding at mid altitude inside the hexahedron defining the working area. Moreover, these areas had a radius of 500m.

In order to emulate as much as possible a usual controlled airspace and to provide proper air traffic services, several fictitious fixed points and airways were defined as shown in Figure 3.

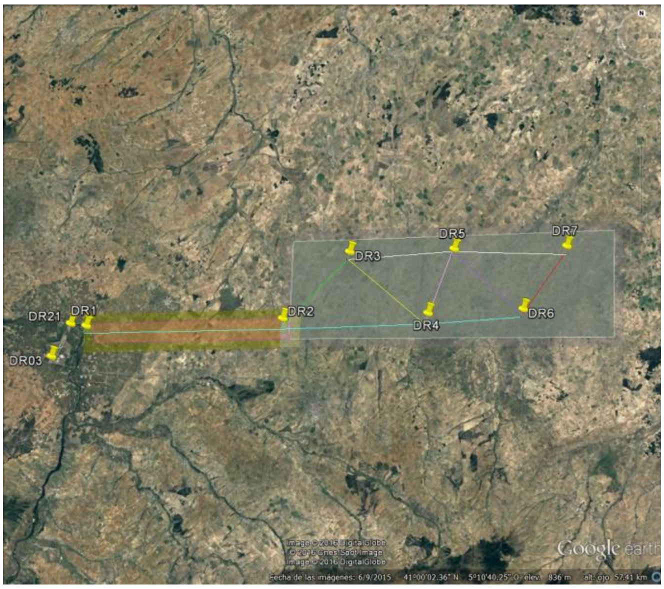

Figure 3. Fixed points and airways.

III. PLATFORMS AND SYSTEMS

Two types of platforms were used in the DEMORPAS flights: one RPAS and one manned aircraft. Both are owned by INTA.

The RPAS used was ALO (Avión Ligero de Observación or Light Observation Aircraft). ALO was integrally developed by INTA and it is used as a test bed platform as well as proposed to be used in some missions of the Spanish Army. ALO is close to mid-range class I small RPAS providing real time reconnaissance, surveillance and target visible and infrared images by means of a gyro-stabilized mini dome on board the air vehicle. ALO is commanded and controlled from the Remote Pilot Station (RPS), where also the images gathered by sensors are presented to the operator. The RPA flies a previously planned mission, except when any modification to the trajectory is needed. At any moment, the Remote Pilot can take over control of the RPA, through the automatic or semiautomatic modes available in the RPS, to modify the trajectory according to the objectives of the flight.

ALO's most important parameters are:

- Maximum take-off weight: 60 kg
- Wingspan: 3.84 m
- Length: 2.35 m
- Maximum Speed: 180 km/h
- Cruising speed: 150 km/h
- Climbing speed: 5 m/s
- Service ceiling: 14000 ft.
- Range: 100 km (LOS)
- Endurance: more than 5 hours (depending on payload)
- Take-off distance: 120 m
- Landing distance: 160 m

ALO also has some take-off limitations related to the atmospheric conditions:

- Maximum wind: 7 m/s
- Maximum wind gusts: 3 m/s
- Maximum lateral wind: <= 4 m/s
- Clouds ceiling: <<250 m

Figure 4. ALO RPA together with its RPS.