
# FLIGHT PLANNING

## Objectives of this unit

- ✓ Know the existence of different types of operation and types of navigation with UAVs.
- ✓ Learn about atmospheric pressures and their use.
- ✓ Identify the key parts of a flight plan.
- ✓ Remember the importance of flight dynamics, and the need for continuous supervision.

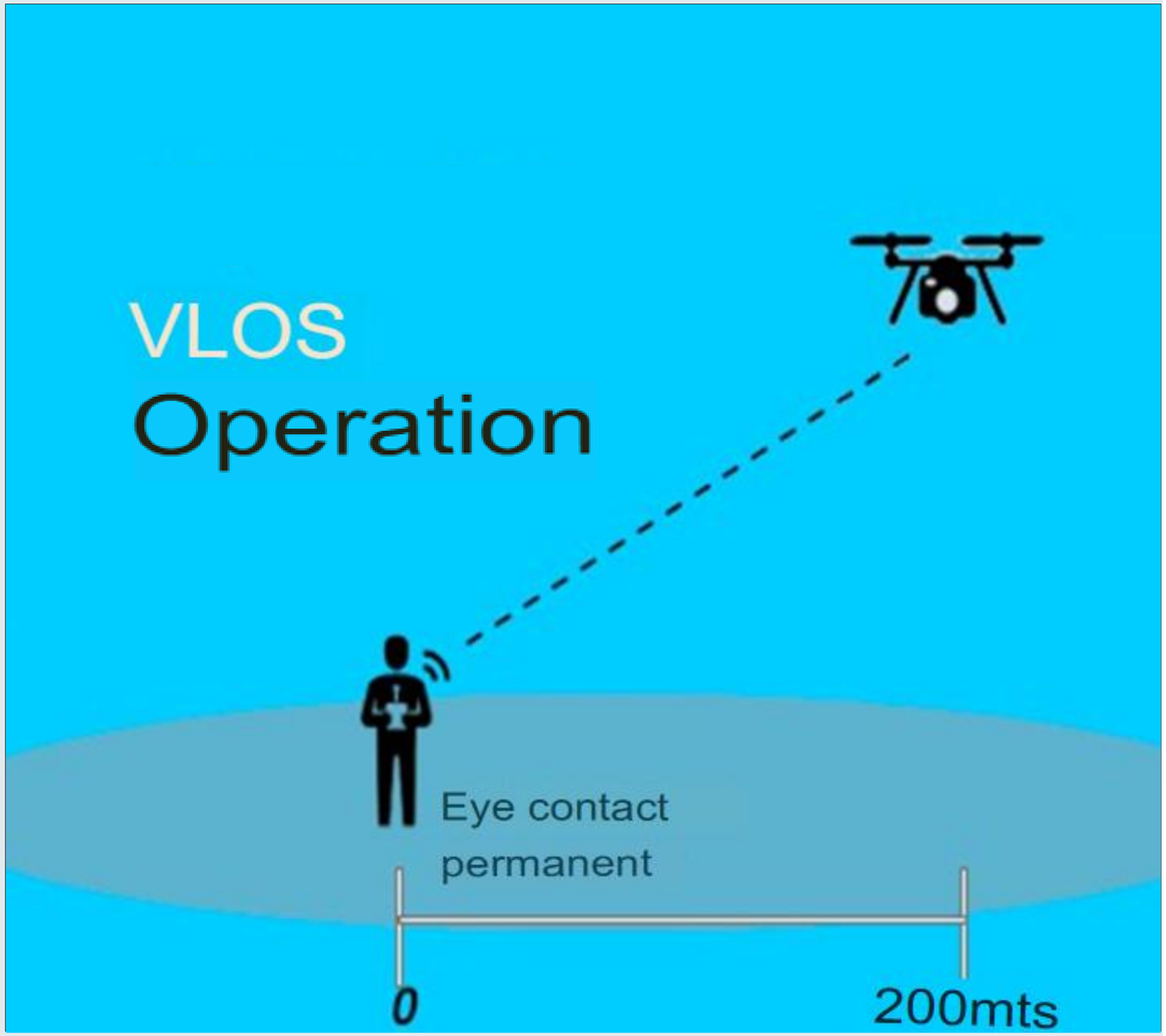
# Introduction

- VLOS, EVLOS and BVLOS.
- Dead reckoning and GPS.
- NOTAMs and NOTAMs UAS
- Altimetry adjustment.
- Flight plan, communications and security separations.
- Flight planning.
- Hypothetical example of a flight planning.

# Types of operations

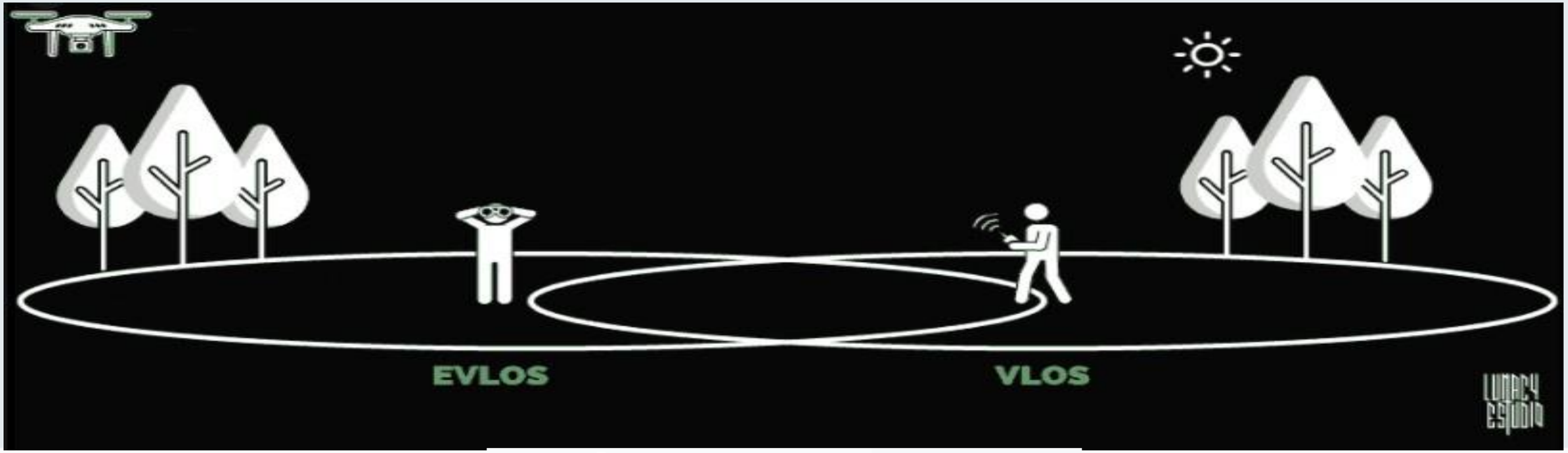
## Line Sight Operation (VLOS):

During this flight operation, the pilot-in-command must maintain visual contact with the model aircraft at all times, up to a maximum horizontal distance of 200 meters, and without assistance from other members of the remote crew.



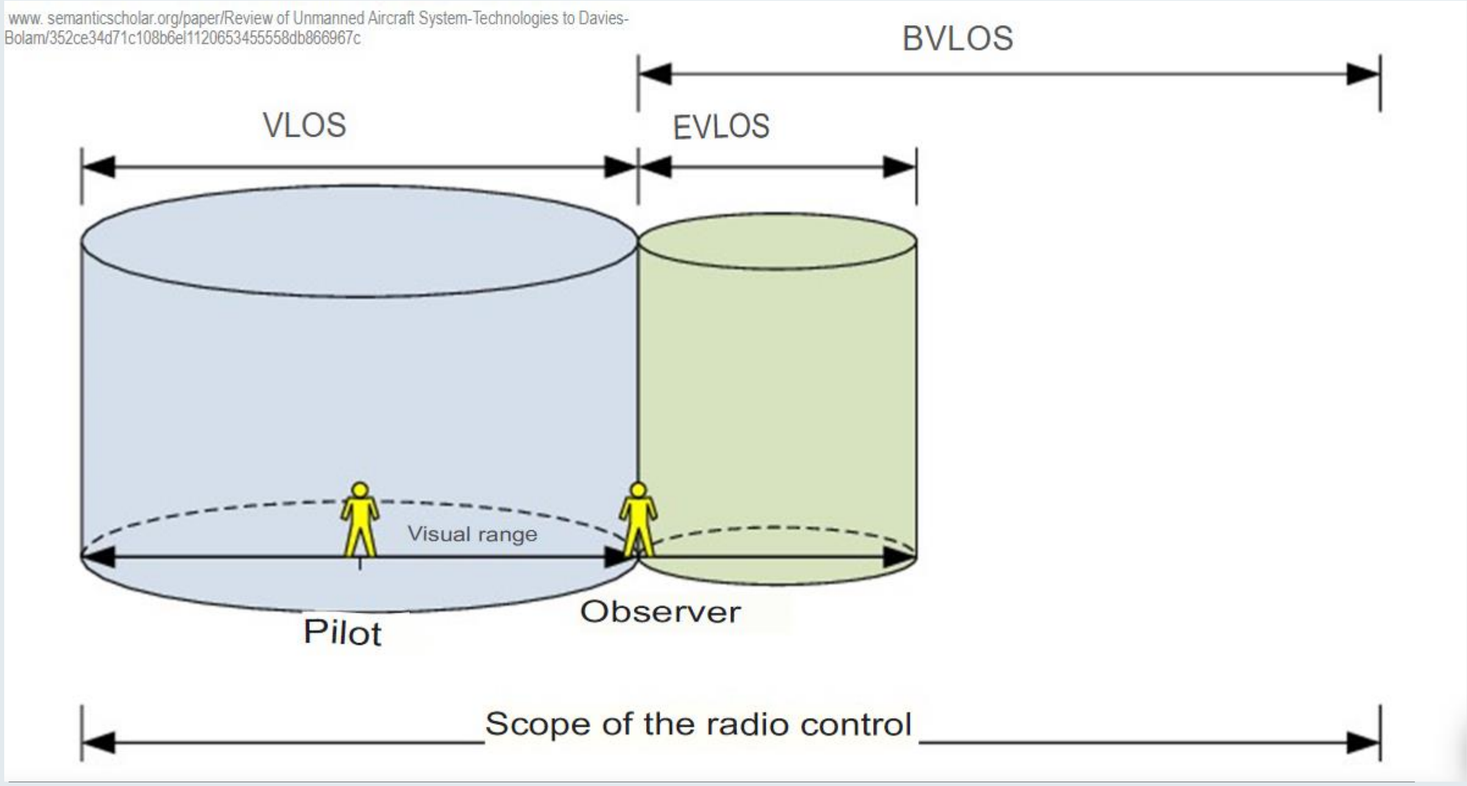
# Types of operations

**Operation with Increased Visual Range (EVLOS):** This type of operation requires the presence of qualified observers and in radio contact with the pilot in command.



# Types of operations

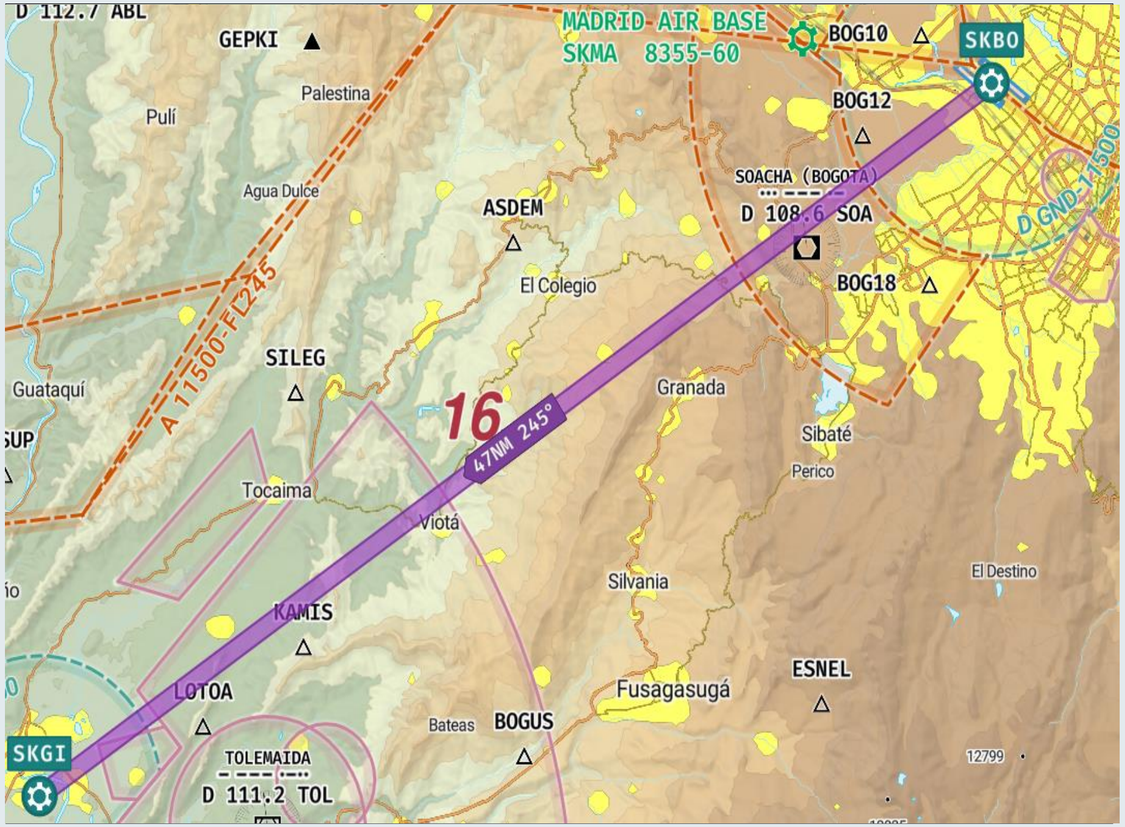
➢**Non-Line-of-Sight Operation (BVLOS):** In this type of operation, the pilot operates without direct visual contact with the UAV. They require special authorization from ANAC.



# Types of Navigation

➢ <u>Dead reckoning (DR):</u>

It is the method of navigating from one place to another using calculations of time, speed, course, and distance.Visual references such as villages, rivers, railways, etc. are used to check the accuracy of the calculations and the correct flight path.




HKVIP SKBO — SKGI 0200 03/30

SkyVector Aeronautical Charts

Block Time: IN: OUT: TOTAL:

Flight Time: ON: OFF: TOTAL:

Fuel Totals: START: REMAIN: USED:

Planned Route

Squawk Code

Clearance

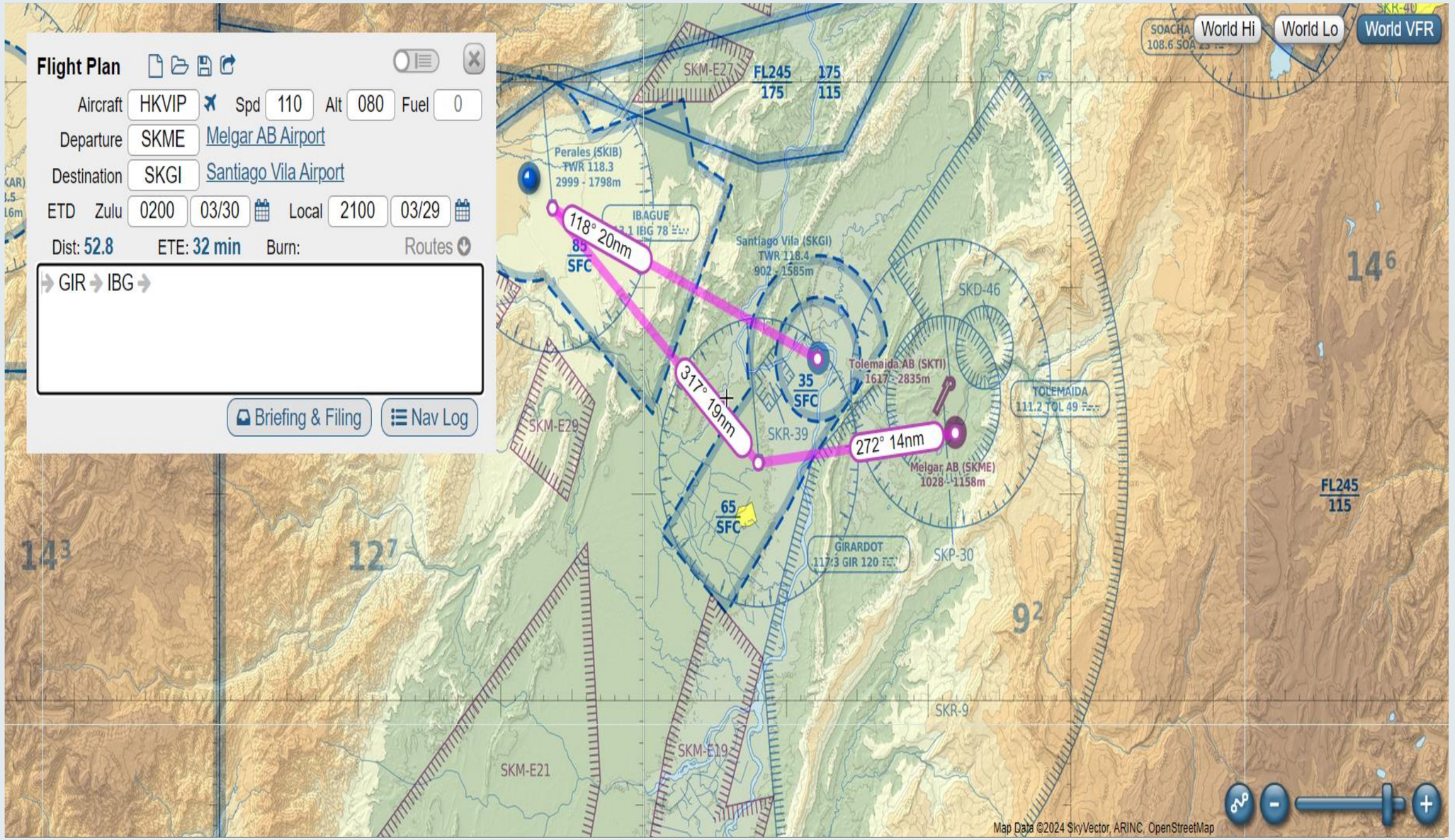
| Waypoint | Route Altitude | wDir wSpd Temp (dev) | TAS | Track WCA | TH Var | MH | GS | Dist | ETE ETO | ATE ATO | Fuel EFR | Fuel AFR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SKBO N 04°42.10' W 074°08.82' | | | | | | | | | | | | |
| | ⊕ | 155° 1 | 114 | 237° | 237° | 245° | 114 | 0.9 | 0.5 | | 0.0 | |
| TOC N 04°41.63' W 074°09.53' | ↗ | 12°C (+14°) | | -0° | +8° | | | | 0.5 | | 0.0 | |
| | ⊕ | 169° 1 | 110 | 237° | 237° | 245° | 110 | 33.5 | 18 | | 0.0 | |
| TOD N 04°23.24' W 074°37.61' | 8000 | 13°C (+14°) | | -0° | +8° | | | | 19 | | 0.0 | |
| | ⊕ | 182° 1 | 113 | 237° | 236° | 245° | 113 | 12.1 | 6.9 | | 0.0 | |
| SKGI N 04°16.58' W 074°47.77' | ↘ | 14°C (+14°) | | -0° | +8° | | | | 26 | | 0.0 | |

# Types of Navigation

**Using a global positioning system (GPS):**

In this case, navigation is carried out with the help of an on-board computer, motion and rotation sensors (accelerometers and gyroscopes), and finally a GPS that will communicate with at least 3 satellites to triangulate the position of the UAV on planet earth. With all this information, the computer shows on a map the location of the device and the data of speed, direction and direction, and height.

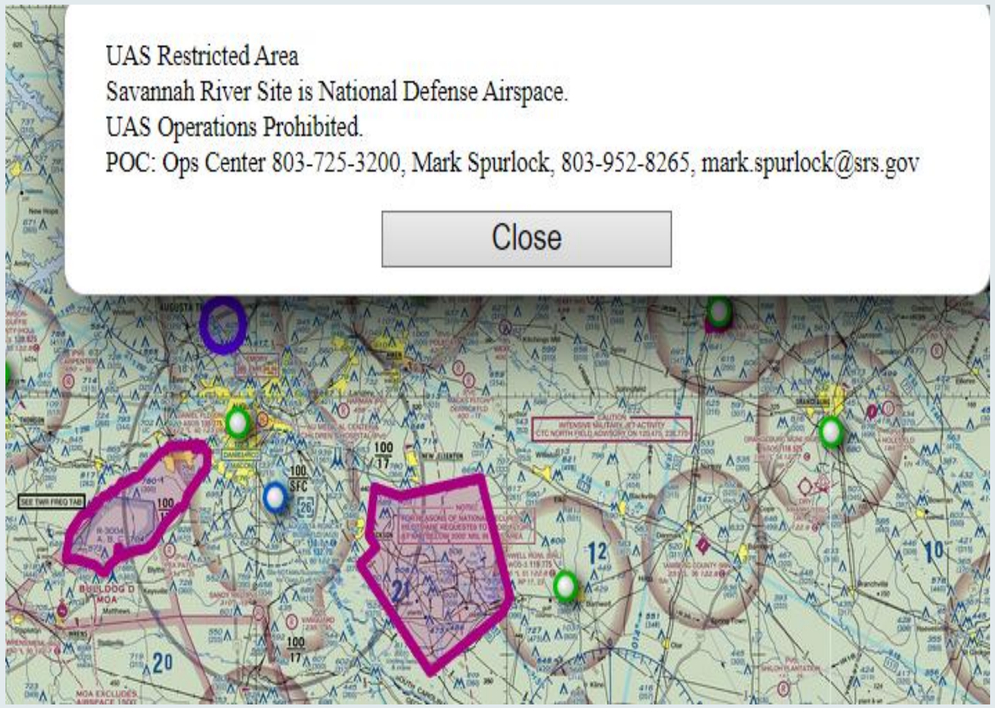
# Types of Navigation



## Temporary Notices and Restrictions

- **Notices to Airmen (NOTAM):** They contain important temporary information for the flight operation, from the establishment or change of an aeronautical facility, service, procedure or hazard.

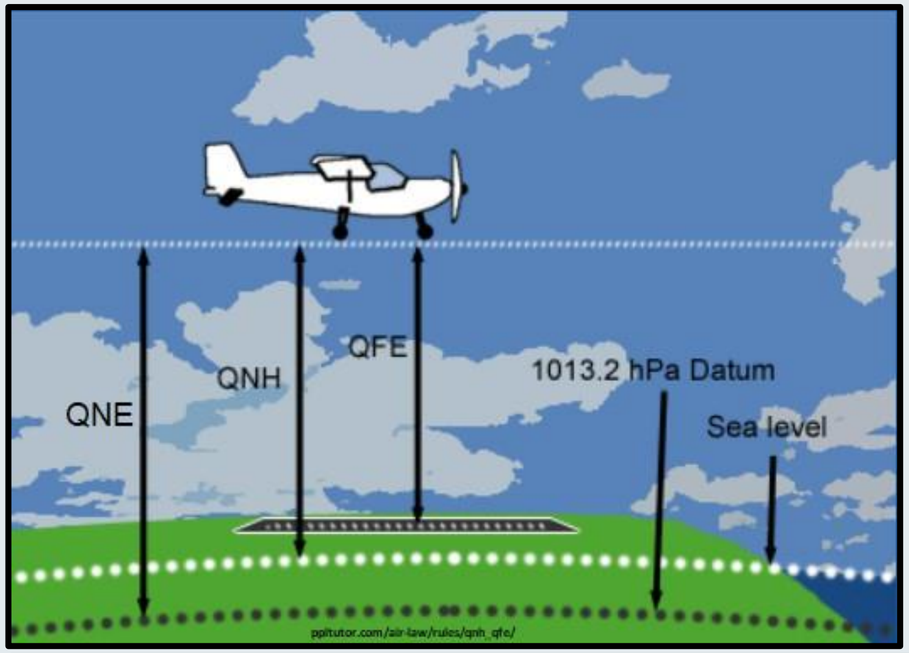
- **UAV Trade Notices (NOTAM UAS):** These are notices that inform about the performance of UAV or SVANT flights.

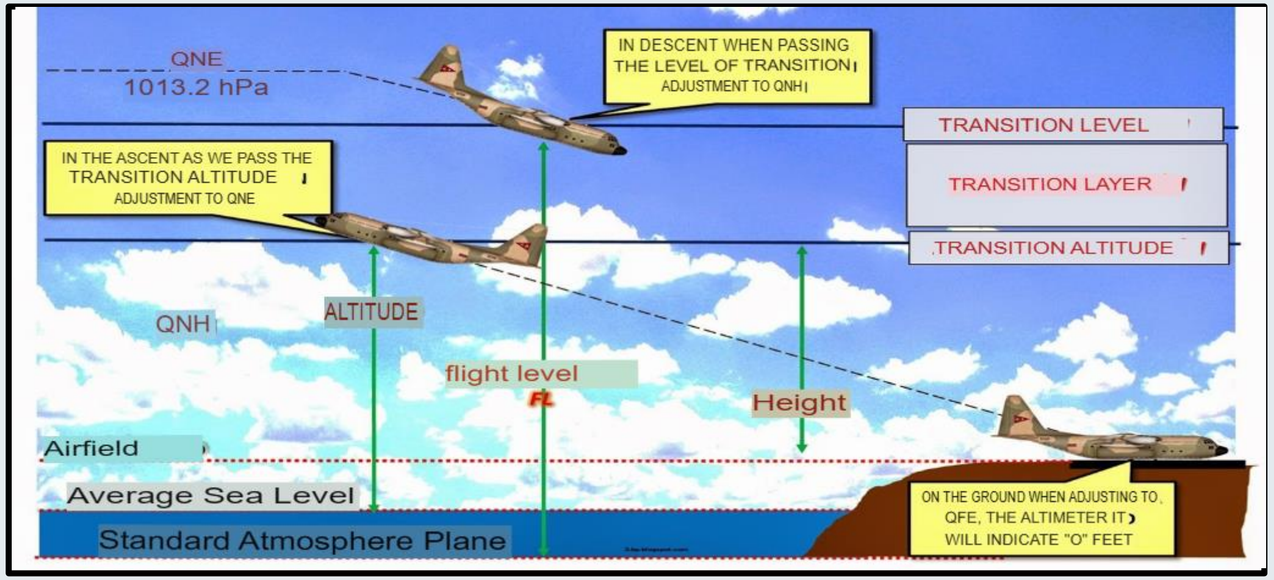


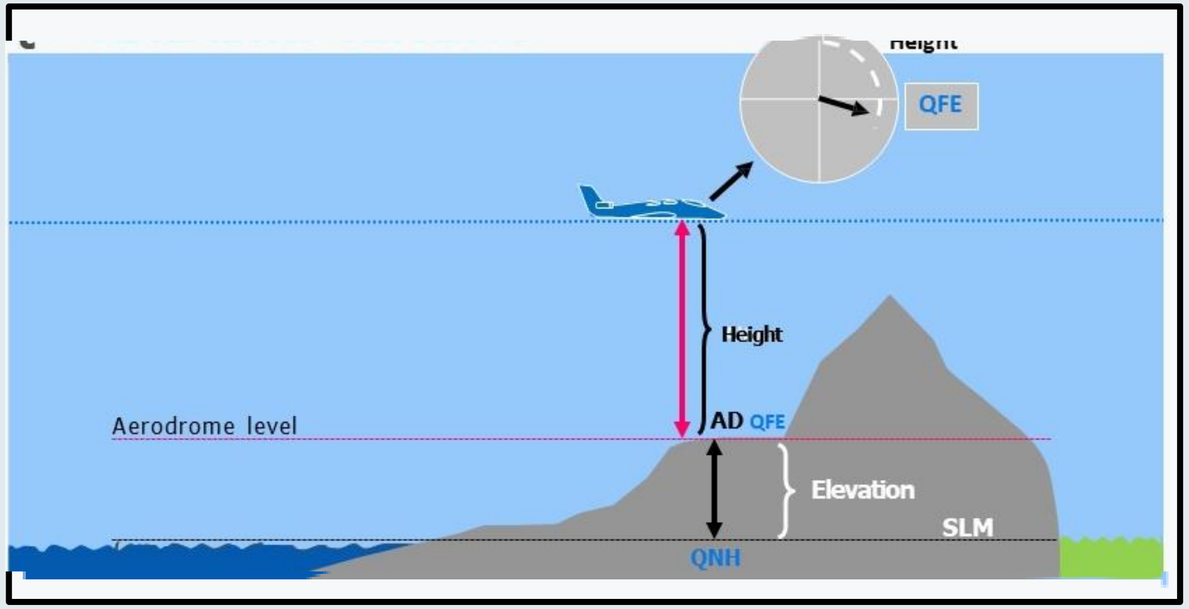


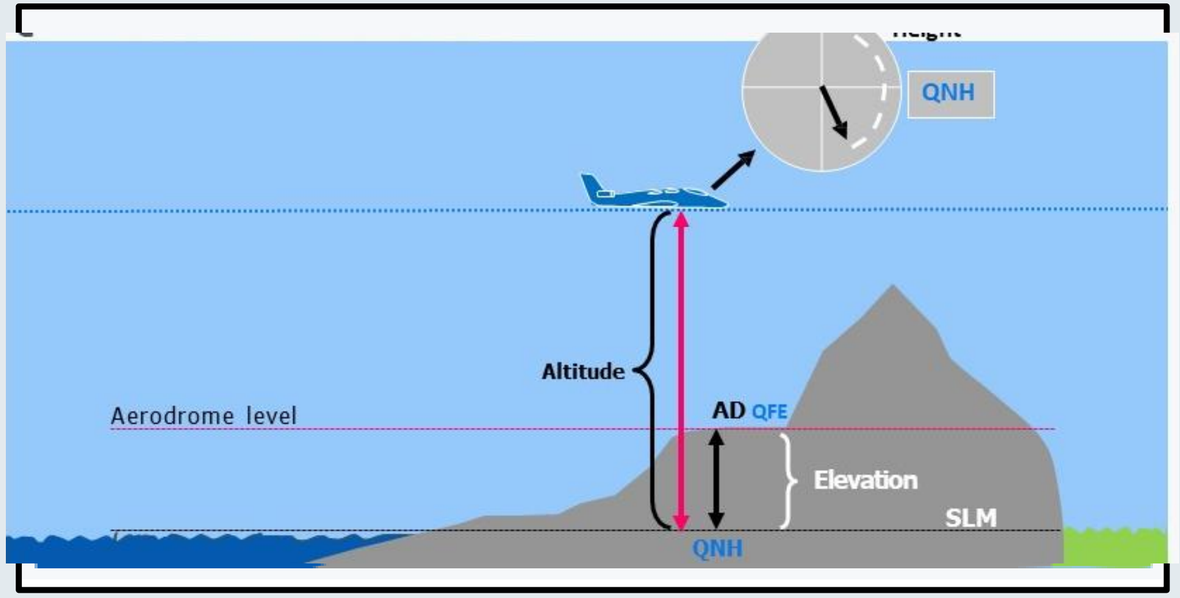
*Fuente de ambas clases de NOTAM: ais.anac.gov.ar/notam*

# Altimeter adjustment



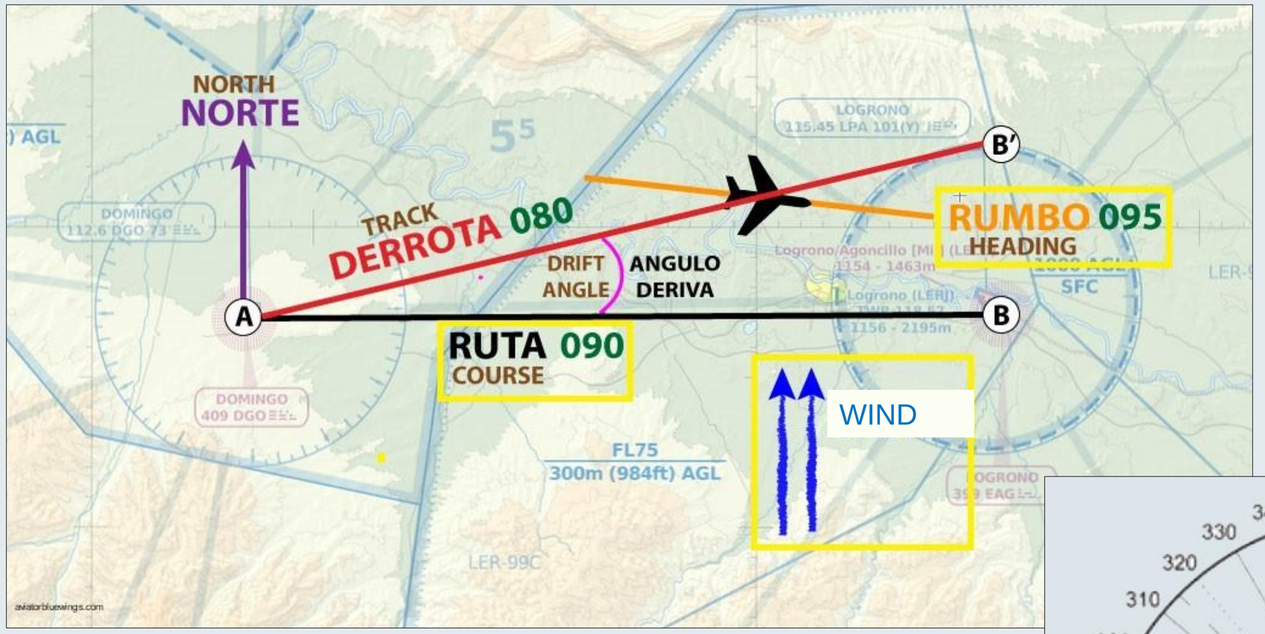



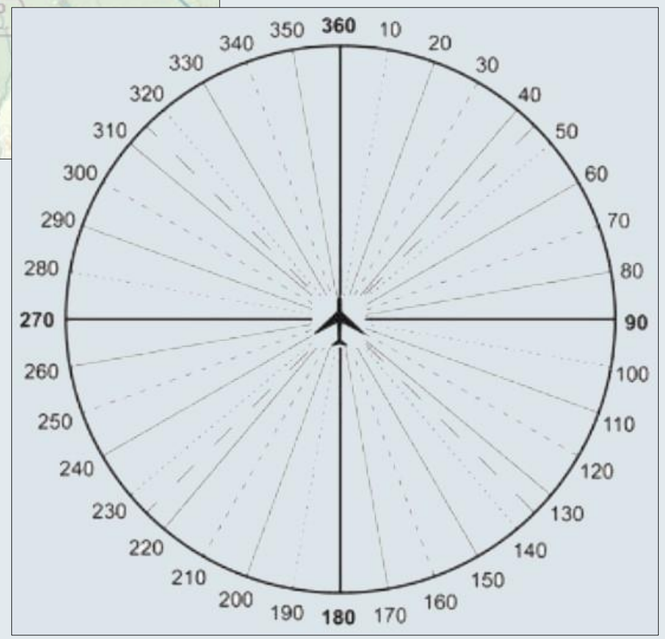
# Planning: Pre-flight

Preparation of the flight plan:

✓**Curse and heading:**

- Distance:
- Velocity:
- Time:
- Operating Height:
- Fuel consumption:



# Planificación: Pre-vuelo

Preparation of the flight plan:

✓Course and heading:

✓**Distance:**

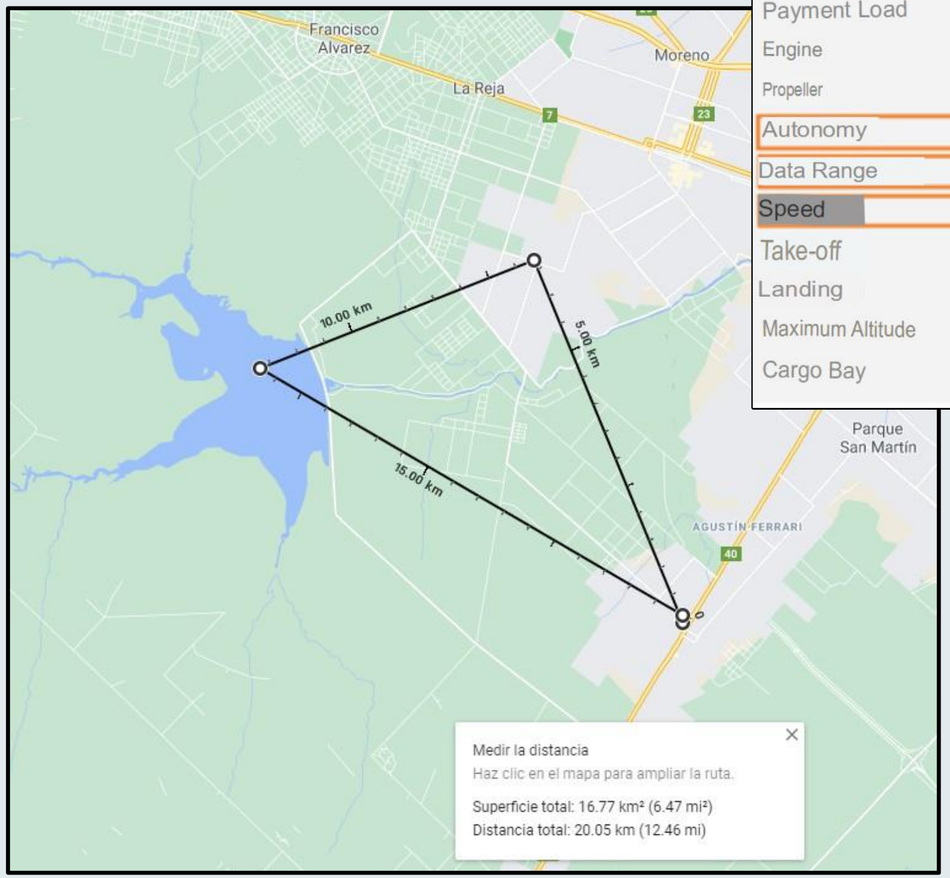
✓**Velocity:**

✓**Time:**

✓**Operating Height:**

✓**Fuel consumption:**

$$\frac{\text{DISTANCE}}{\text{VELOCITY}} \times 60 = \text{TIME}$$




| Benefits | |
|---|---|
| Wingspan | 3600mm |
| Length | 2488mm |
| MTOW | 28kg |
| Empty weight | 20kg |
| Weight in flight | 25kg |
| Payment Load | 5-8kg (depending on the amount of fuel) |
| Engine | 61cc, two-stroke cylinder bike |
| Propeller | 22x8 |
| Autonomy | 3h |
| Data Range | Up to 100km. Ask about the different possible configurations. |
| Speed | 50-120km/h |
| Take-off | 50m track at full load |
| Landing | 70m track |
| Maximum Altitude | 3500m |
| Cargo Bay | 25x23x55cm (33 liters) |


EXAMPLE:

$$\frac{20\text{Km} \times 60}{100\text{Km/h}} = 12\text{min}$$

# Planificación: Pre-vuelo

Preparation of the flight plan:

✓Course and heading:

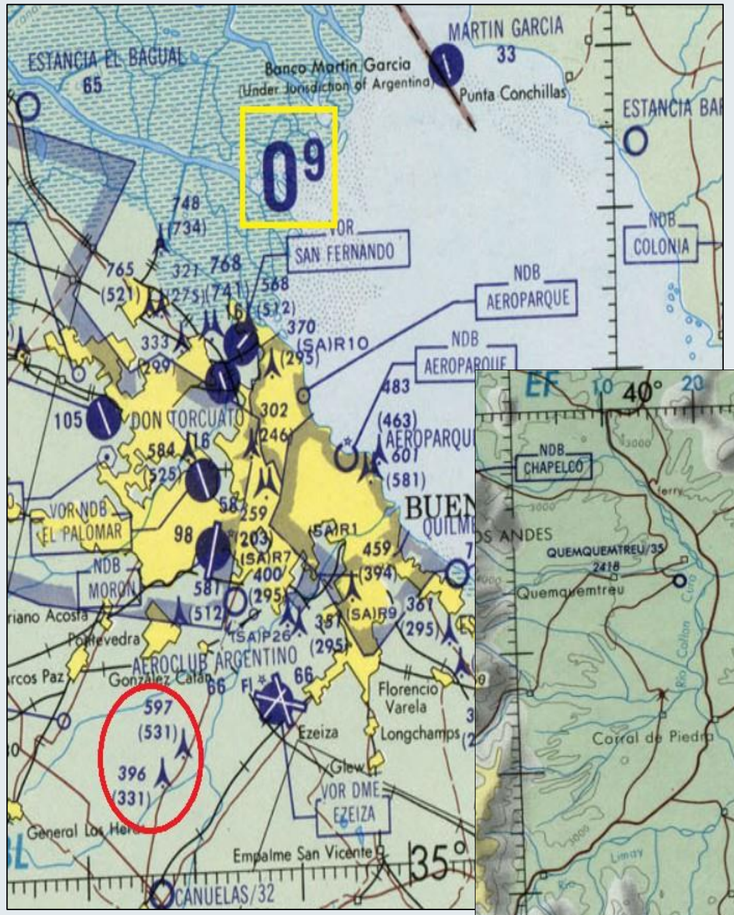
✓**Distance:**

✓**Velocity:**

✓**Time:**

✓**Operating Height:**

✓**Fuel consumption:**

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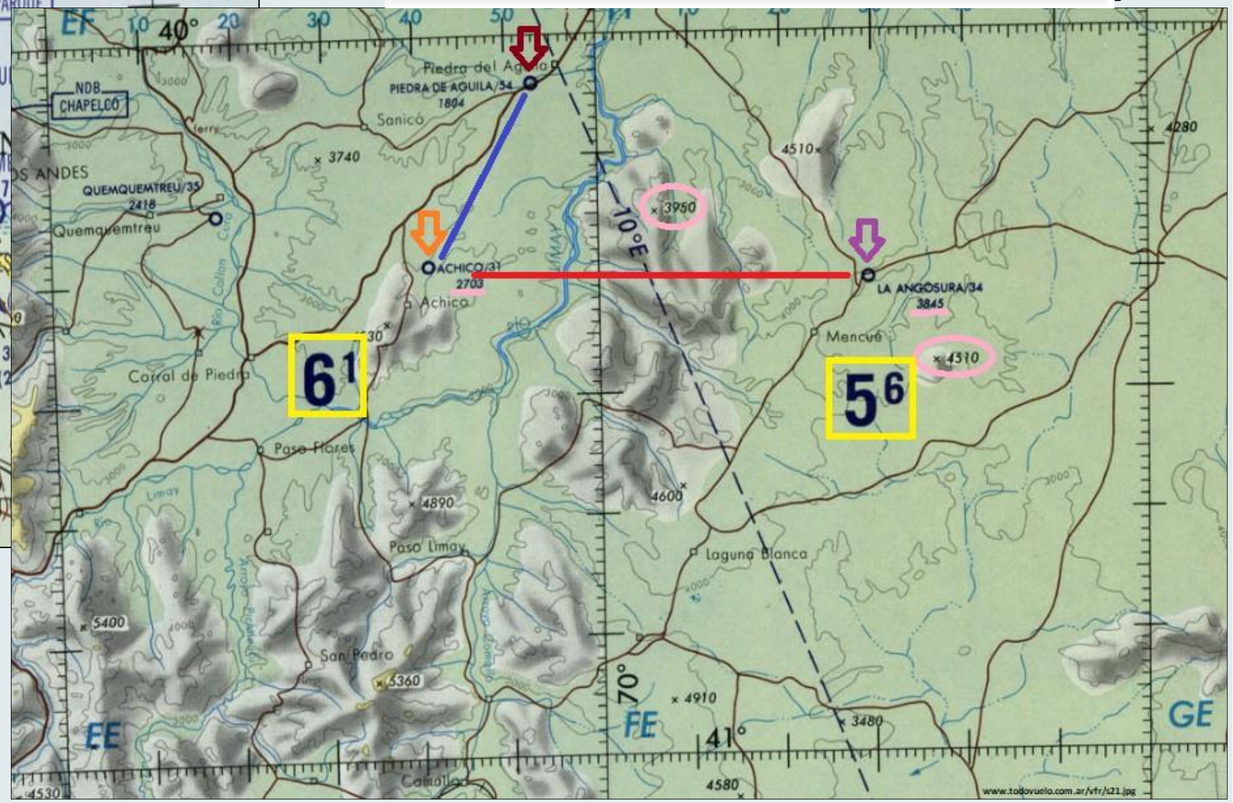

# Planificación: Pre-vuelo

Preparation of the flight plan:

✓Course and heading:

✓**Distance:**

✓**Velocity:**

✓**Time:**

✓**Operating Height:**

✓**Fuel consumption:**

CONDITIONS:
2650 Pounds
Recommended Lean Mixture

**CRUISE PERFORMANCE**

**PRESSURE ALTITUDE 2000 FEET**

| RPM | 20°C BELOW STANDARD TEMP -9°C KTAS | 20°C BELOW STANDARD TEMP -9°C GPH | STANDARD TEMPERATURE 11°C KTAS | STANDARD TEMPERATURE 11°C GPH | 20°C ABOVE STANDARD TEMP 31°C KTAS | 20°C ABOVE STANDARD TEMP 31°C GPH |
|---|---|---|---|---|---|---|
| 2500 | 130 | 10.3 | 131 | 9.9 | 132 | 9.6 |
| 2400 | 128 | 9.9 | 129 | 9.6 | 130 | 9.3 |
| 2300 | 123 | 9.0 | 123 | 8.7 | 123 | 8.5 |
| 2200 | 117 | 8.2 | 116 | 7.9 | 116 | 7.7 |
| 2100 | 105 | 6.9 | 103 | 6.7 | 101 | 6.6 |

Figure 5-7. Cruise Performance(Sheet 1 of 6)

| Benefits | |
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## Planning: Flight Plan Presentation (FPL)

The presentation of the FPL will be made as established by the present regulations.

Some steps could be:

- Have all the corresponding documentation.
- Have route planning and UAV weight and balance calculation.
- Check NOTAMs and UAS NOTAMs.
- Check weather conditions.
- Establish contact and coordinate the operation with air traffic control units, EANA, ANAC, municipalities, etc.

# Planning: FPL Dynamics

**Operation supervision:**

The person responsible for the operation of the model aircraft will be the remote pilot in charge of it. However, it may share responsibilities for the operation with: the observer, the operator and/or the owner.

Supervision in UAV equipment will normally be done through visual contact with the device and/or through the cameras it has, as well as with the use of mobile devices that allow the location, flight data and status of the equipment in flight to be seen on a map.

Conditions in flight, or en route, are dynamic. The weather could deteriorate, fuel consumption (electric or gasoline) could exceed what was calculated, as well as the operating time could be extended due to wind, air traffic conditions or abnormal situations at the destination. Therefore, monitoring parameters, re-calculating times and consumption, as well as planning contingency areas or emergency landing zones are critical in the safe operation of a UAV. Especially for medium or long-haul flights.

At the end of the operation, we must notify, if applicable, the control unit of the completion of our flight.

It is also good practice to write down the final data on time, distance, average speeds and consumption.

This will allow us to track the performance of our model aircraft in more detail, as well as calculate discrepancies for future planning.

# Planning

In the following example we will see in a practical way a hypothetical planning case, in it, a multirotor that will navigate using GPS references, but with visual checks as in DR navigation:

| ROTARY WING - C-CLASS - BVLOS | OPERATION DATA | UAV LIMITS |
|---|---|---|
| Take-off weight | 10kg | MCTOW = 14.5kg |
| Center of Gravity (CG) | 25,6 | Between 24 and 27 |
| Payload: Weight and Type of cargo | 2kg. Medicines (non-flammable and liquid) | |
| | | |
| Room temperature | 20°C | Between -10°C and +40°C |
| Wind in height | Blowing against: from 300° to 2,000mts/h | 30,000mts/h |
| | | |
| Take-off and landing distance | | |
| Vr/V1 / Vx / Vy / Best Glide / Minimum Sink | | |
| | | |
| Distance to the unloading area | 4.000mts | Max range = 7,000mts |
| Cruising speed | 22,000mts/h - 2,000mts/h (wind) = 20,000mts/h | Maximum = 45,000mts/h |
| Total flight time | 15 min | With maximum load = 25 min |
| Flight altitude (to be flown with QNH: 1.010hPa) | 600mts (2,000ft approx. ) | 4.000mts |
| Course and course | North-West: 300° both | |
| | | |
| Rate of climb and its horizontal speed | 200mts per min / 10km/h | 300mts per min / 15km/h |
| Rate of descent and its horizontal speed | 120mts per min / 15km/h | 180mts per min / 18km/h |
| Time of ascent / flight/ descent | 3 min / 7 min / 5 min | |
| Distance covered in: ascent / flight / descent | 500mts / 2.250mts / 1.250mts | |
| | | |
| Control points | Pond / Gated community / Football stadium | |
| Time to the control points | 3 min / 7 min / 5 min | |
| | | |
| Electricity consumption | Estimated: 3,500mA | Capacity = 5,700mAh |

# THANKS

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