UAVs for Volcanic Sampling

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WHY VOLCANIC SAMPLING?

- Volcanoes' plume poses a danger to people and airplanes
- The gas and rock particles constantly move in currently poorly predictable ways.

Figure 1. Plume of Volcán Reventador. 2002

- Planes engines are destroyed by the debris expelled by volcanoes
- The plume grounds flights through large airspaces due to its variable nature

Figure 2. British Airways engine after a run in with a volcanic ash plume. 1982

OUR UAVS

Using off the shelf components and low power, low cost MEMS based sensors allows:

- Cheaper, less prohibitive planes
- Multiple planes to be deployed to collect simultaneous samples
- Losing a unit without compromising the mission

Using multiple UAVs requires a communication framework

- Xbee-PRO Series 2 radios using ZigBee (IEEE 802.15.4) networking protocol
- Create our own script to control planes location
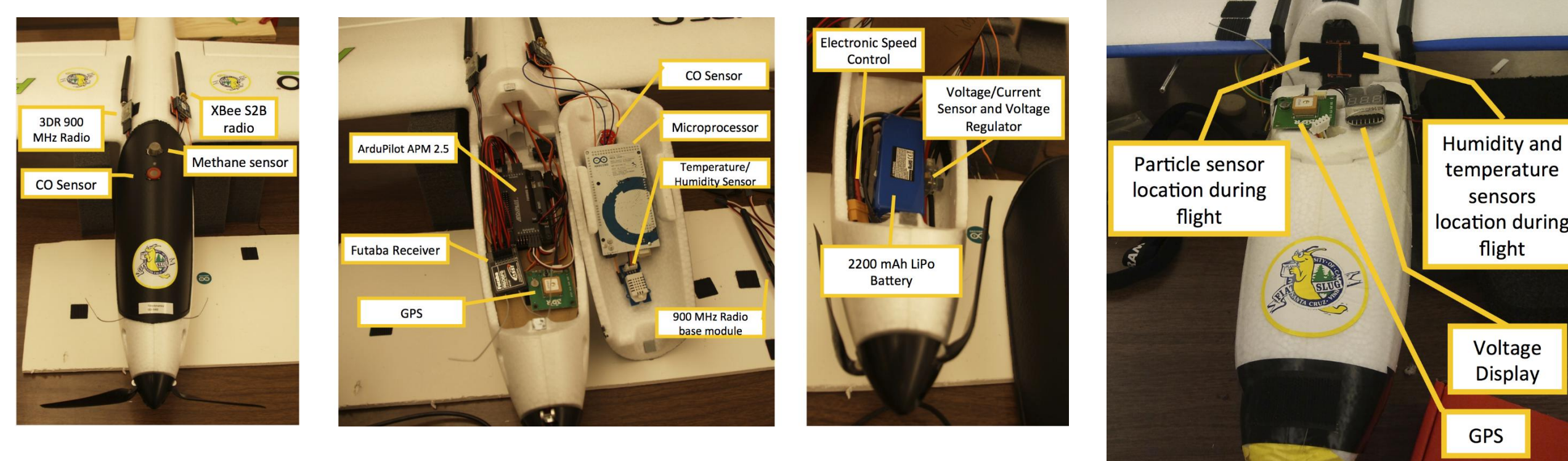
MISSION PLANNING

Finding the perfect point for the relay plane

1. Create circles for the range of each communication point

2. Find the intersections of all the circles

4. Average the points

3. Remove any that do not fall on or in every circle
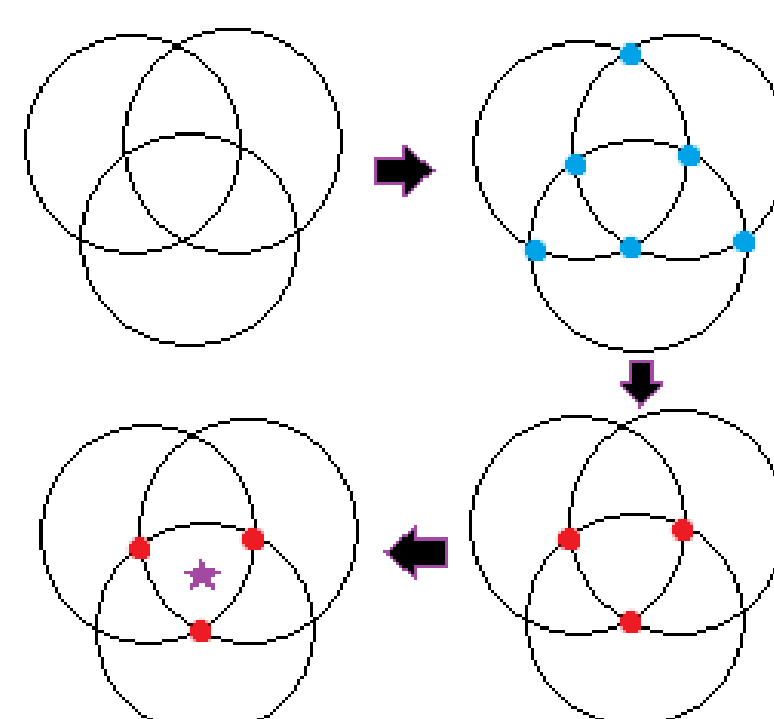
Missions are scripted using python and can perform any reasonable planned course.

The placement of the relay plane is calculated during the mission
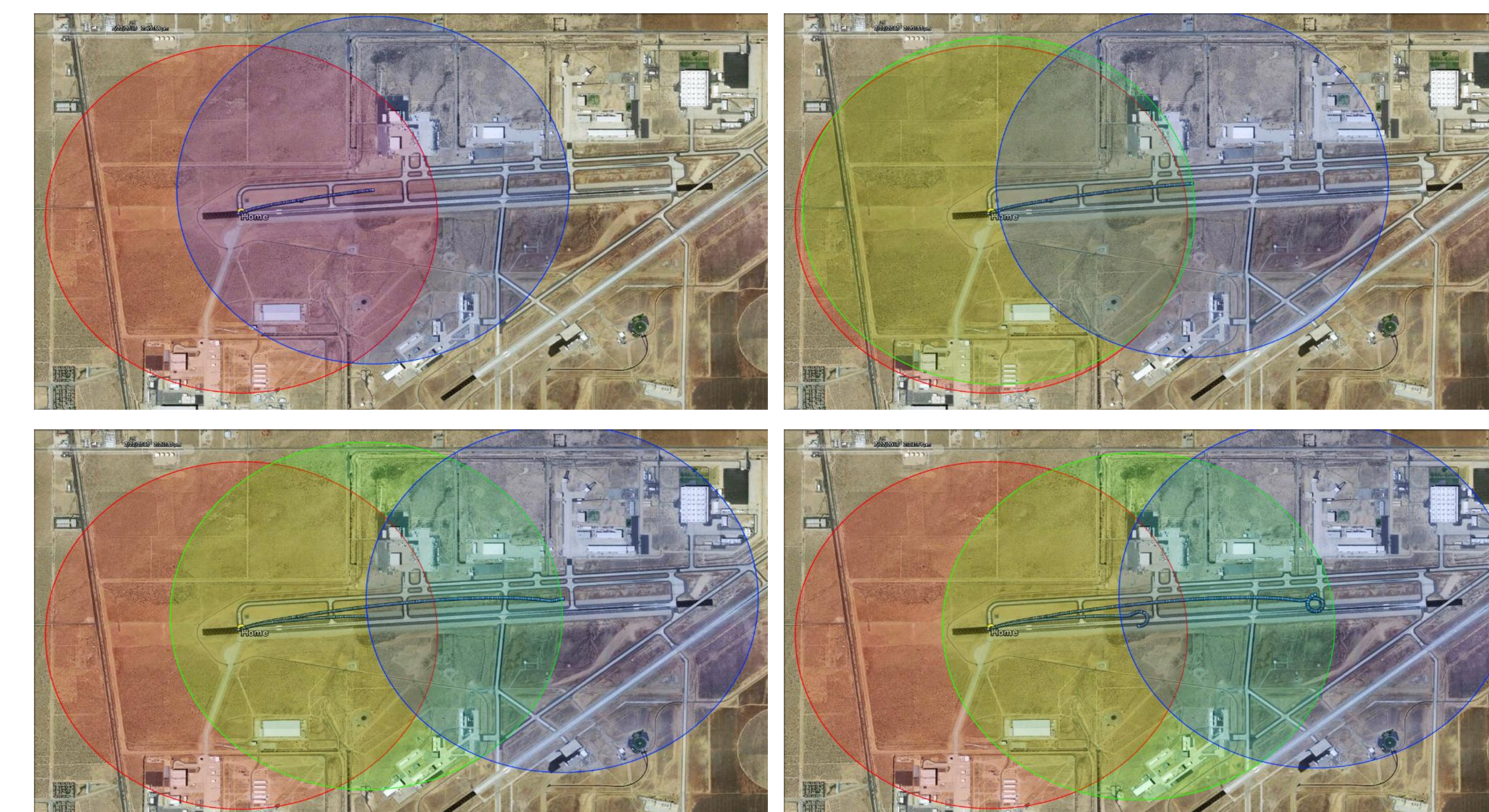
SIMULATION

- Ardupilot (our auto-pilot) is connected
- Mission Planner[4] directs the autopilot and simulation
- XPlane10 simulates the flight and provides feedback to the autopilot


- Multi-plane simulations can be run with multiple computers
- Allows testing of built mission scenarios

RESULTS

- Transmission ranges during flight of home (red), the mission plane (blue), and the relay plane (green).
- The relay plane is sent just as the mission plane leaves the Home stations transmission range.
- The mission plane can always communicate with the Home station.

Distance between Planes
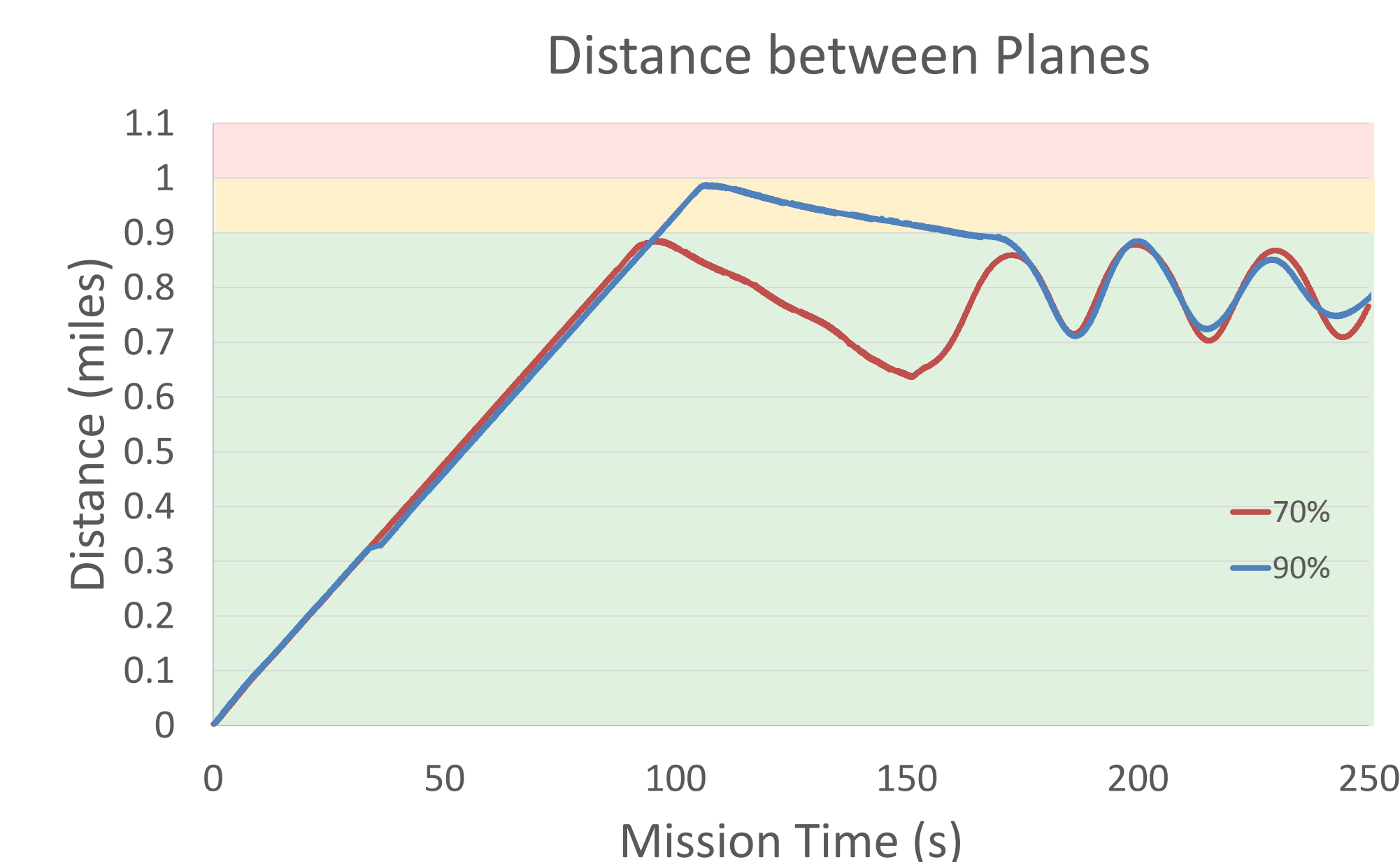
How close to the edge of the home base's communication range do we let the mission plane get to before launching the relay plane?

- Sending the relay plane as late as possible allows power to be saved.
- Launching when the mission plane is at 70% of the transmission range ensures the plane will not be out of the safe zone.
- Launching at 90the relay plane into the uncertain transmission range, .9 - 1.0 miles