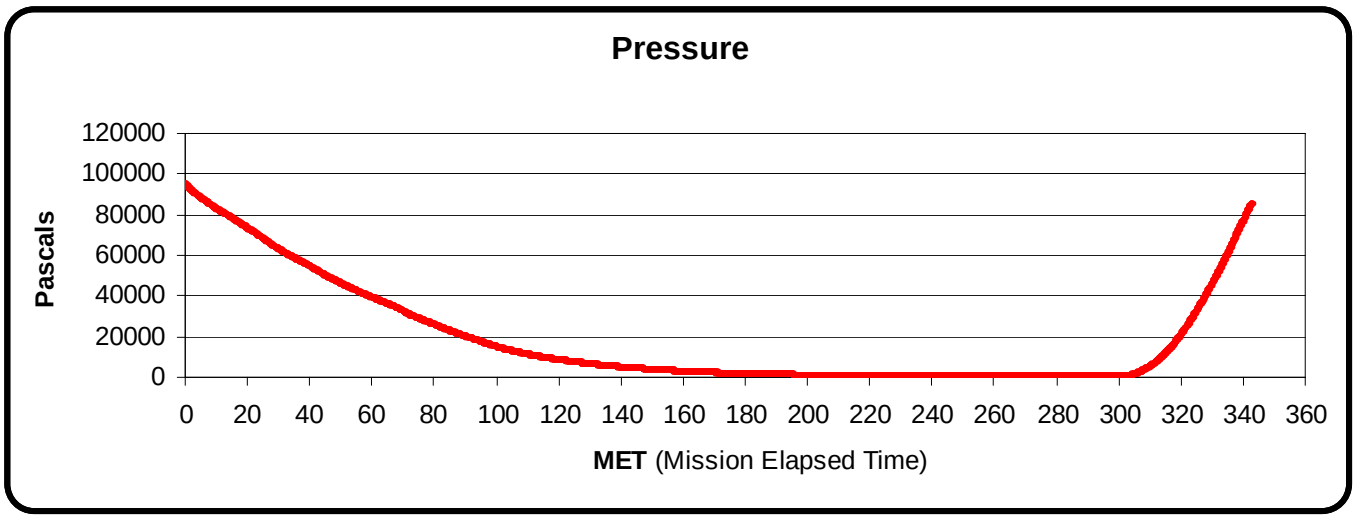
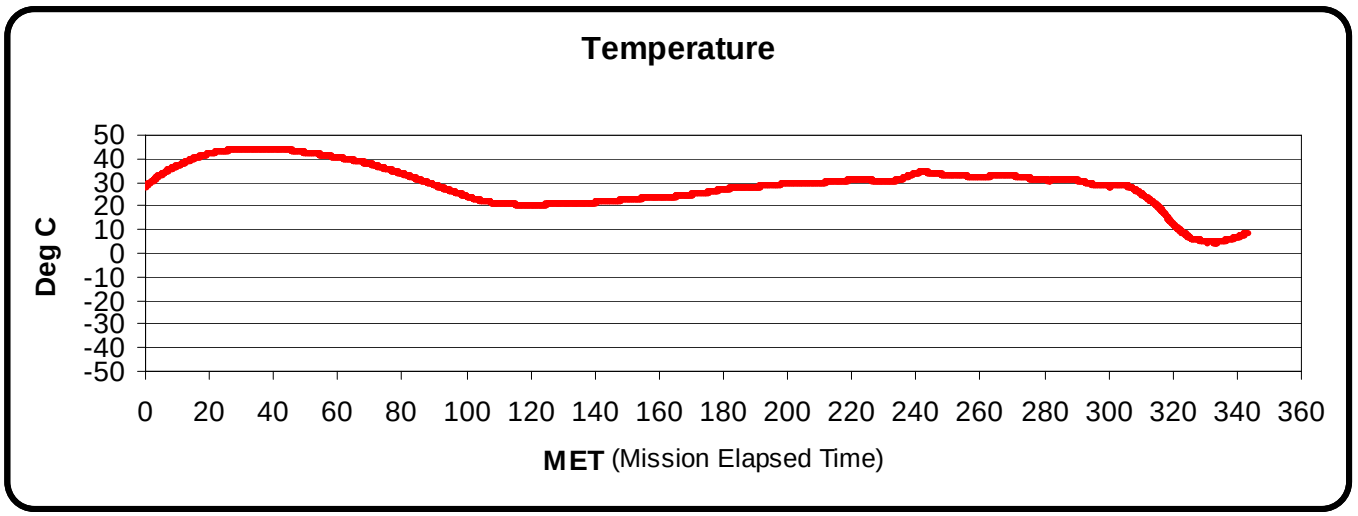
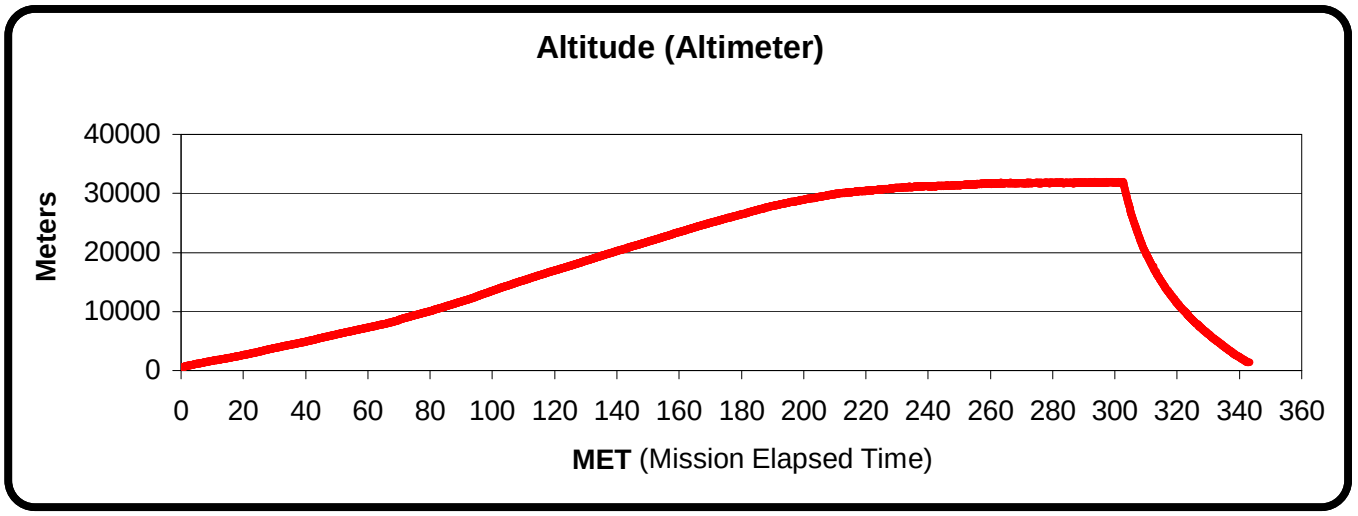
High Altitude Science

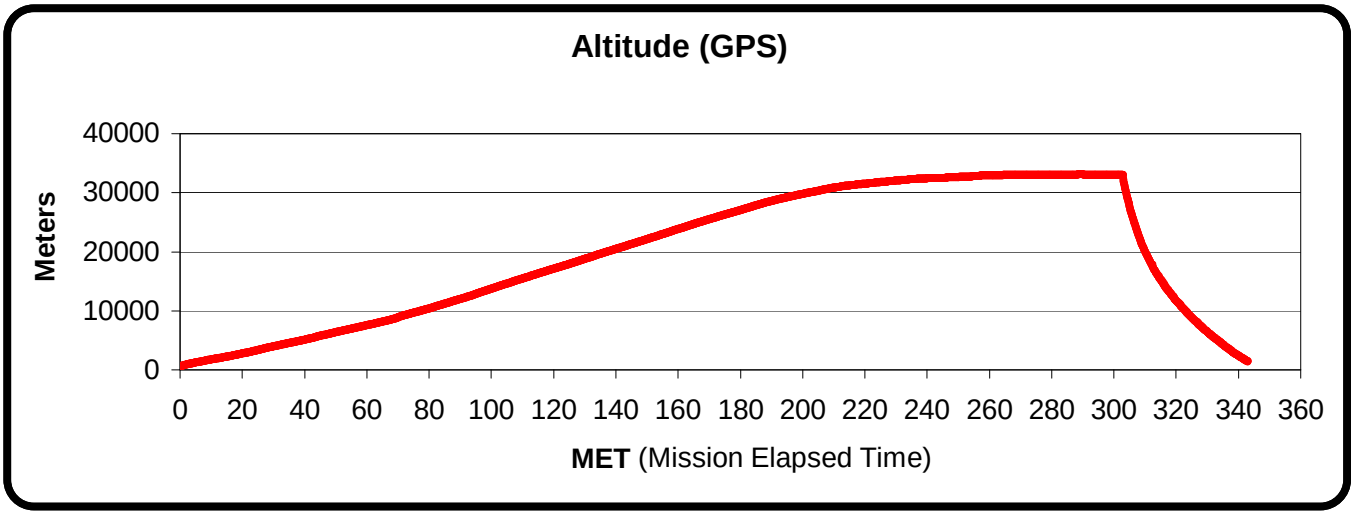
SWISS-STRATO-2
Flight Data Analysis

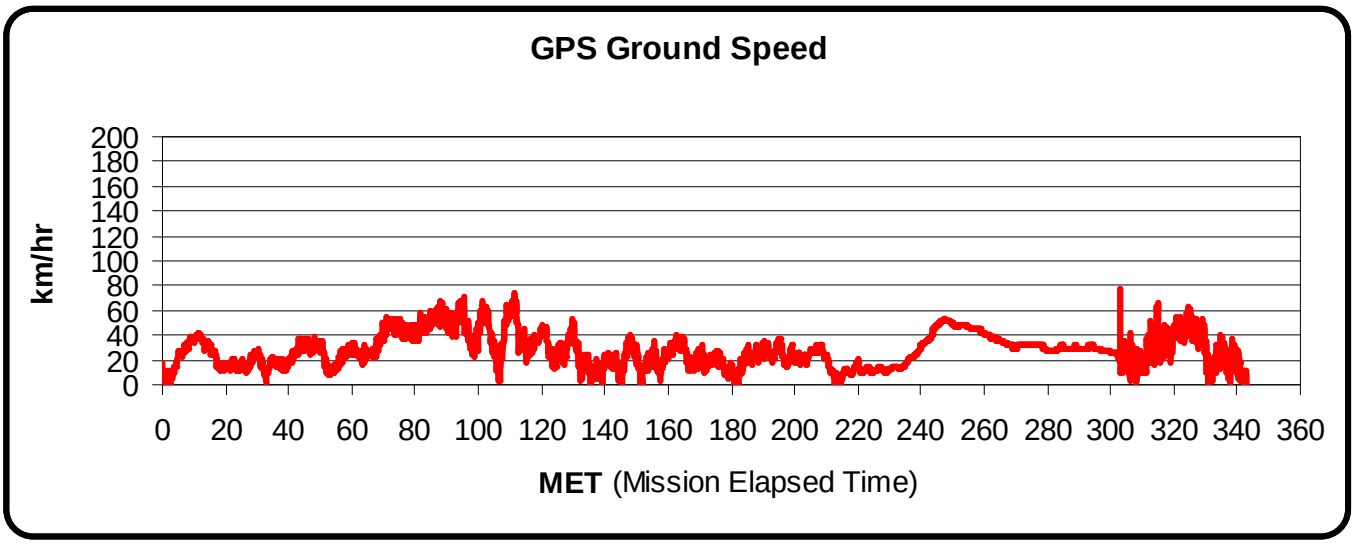
Launch Coordinates	**46.66877/ 5.40034**	
Landing Coordinates	**46.39767 / 6.87472**	
Launch Date	**04/14/13**	
Launch Time	**11:38:18**	**Zulu**
Ascent Duration	**302.6**	**min**
Descent Duration	**40.4**	**min**
Total Flight Duration	**343.0**	**min**
Launch Altitude	**618**	**m**
Burst Altitude	**33,127**	**m**
Inicial Rate of Climb	**107**	**m/s**
Max Ground Speed	**78**	**km/h**

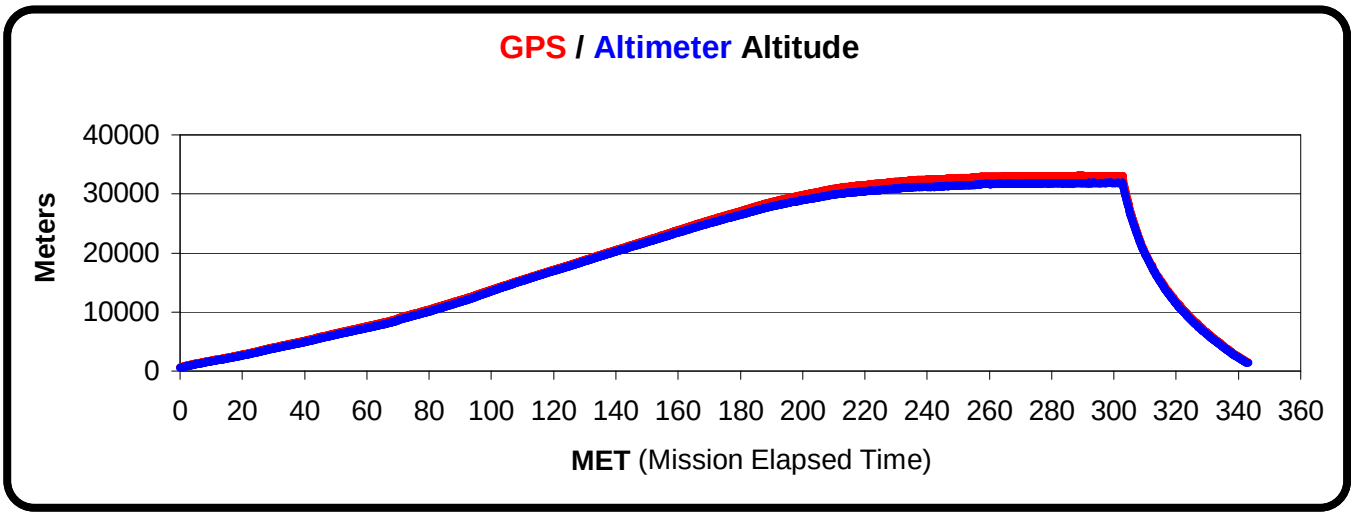












GPS vs. Altimeter Altitude

GPS Altitude is the actual elevation above sea level as read by your GPS receiver module. Altimeter Altitude is the elevation above the standard datum air-pressure plane of 1013.25 milibars / 29.92" Hg as read by your pressure sensor. Depending on the weather, these two elevations can differ significantly.

Our Earth's Atmosphere

As your payload flies to the edge of space, it travels through two major layers in our earth's atmosphere: the troposphere and stratosphere. The layer directly above the surface of the earth is known as the troposphere. This layer extends from the ground to an altitude of anywhere between 9,000m / 29500ft and 17,000m / 29,500ft. The layer directly above the troposphere is the stratosphere. The stratosphere extends from the troposphere to an altitude of approximately 50,000m / 165,000ft. The boundary between the troposphere and stratosphere is known as the tropopause. This boundary is clearly visible just by glancing at your plots if you know what to look for, but first let's talk about our atmosphere's temperature profile.

The troposphere is heated by the surface of the earth; the further you get from the surface of the earth, the colder it gets. The temperature in the stratosphere does the exact opposite, it increases with height. This is due to increased absorption of ultraviolet radiation by the ozone layer. Ozone (O_3) is broken down into atomic (O) and diatomic (O_2) oxygen by radiation from the sun. When the atomic and diatomic oxygen combine back into ozone, heat is produced (exothermic reaction). Thus lethal energy from the sun is converted into harmless heat energy high up in our atmosphere using ozone! This is just one of many vital defense mechanisms in our atmosphere that harbors life on our planet.

Now that you understand one of the major differences between the troposphere and stratosphere, the point where your payload traverses from the troposphere to the stratosphere should be easy to identify. Notice that about halfway through the ascent, the temperature starts to increase with altitude. This occurs at roughly 12,000m / 39,000ft.

Looking closely at your data, you will also notice that the point where the temperature is coldest is also typically the point where the GPS ground speed is greatest. Jet streams typically reside right at the boundary between the troposphere and stratosphere. Here are some other interesting facts about this unique boundary in our atmosphere:

- Engines operate more efficiently at colder temperatures. If possible, commercial airliners prefer to fly at the same altitude as the tropopause to cut down on fuel consumption and emissions.
- The temperature gradient inversion between the troposphere and stratosphere suppresses air currents. Passengers experience less turbulence when pilots choose to fly at this altitude.
- Sometimes you can actually see the boundary between the troposphere and stratosphere from the ground. Because the temperature inversions in our atmosphere suppress air currents, even the most powerful storms struggle to break into the stratosphere. This is why large thunderstorms typically have a flat-top anvil shape.
- Secondary temperature inversions can also form at lower altitudes and cause unique weather patterns. Your temperature data should clearly indicate if one exists during your flight. These are rare. High Altitude Science has only seen this twice.