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Floaters, Early Bursts and Ice Lakes

There are three major ways in which a weather balloon sounding won't go according to plan, and they can all be avoided with a fundamental awareness of what weather balloons experience while they rise through the atmosphere.

But first, ideal performance looks like this:
1. The proper balloon is selected for the payload weight, target burst altitude and ascent rate.
2. The balloon is carefully handled, inflated and tied off.
3. The balloon has a nice, round shape at release. Teardrop shapes are typical and expected for very heavy payloads.
4. There is an average 5m/s ascent rate throughout the entire sounding.
5. There is a simultaneous, shattering burst of the balloon at its maximum achievable altitude.

To avoid subpar performance, you should be aware of three ways in which balloons will be limited in their performance potential and the steps you should take to avoid them.

I. Floaters: Floaters are balloons that do not ascend at a steady rate throughout their entire flight, or are released with an ascent rate that is too low. Balloons without enough lifting gas will not continue to rise vertically and reach their burst altitude. Instead, at some point they will begin to float laterally with the winds. Floaters will usually stay aloft until the balloon leaks enough lifting gas to slowly descend, or they will degrade in UV light enough that the latex tears. In both cases, your balloon and payload may be hundreds or thousands of miles away.

To avoid floaters, stick to 5m/s + ascent rates, make sure the balloon's body is never torn or poked at ground level before release, and ensure that your balloon neck is completely tied-off.

II. Early Bursts: Early Bursts include any time a balloon bursts or tears before it has reached an expected and realistic burst window based on your payload, lifting gas and accent rate.

Early bursts happen primarily for four reasons:
1. Mishandling of the balloon during inflation or release.
2. Selecting a balloon too small to handle the expansion of your lifting gas necessary for your payload mass.
3. Using balloon grade (not Ultra High Purity) or otherwise diluted helium.
4. An ascent rate that is too high or too low.

Weather balloons burst because the lifting gas trapped inside of them expands as the surrounding atmospheric pressure drops. Therefore, the volume of lifting gas used during inflation directly translates to how much physical space is allowed for the lifting gas to fill at altitude. Although our balloons stretch substantially, there is a physical limit to every balloon's expansion as it rises. For maximum altitude, your goal is to hit that limit every time.

III. Ice Lakes: Ice Lakes are probably the most misunderstood phenomena in atmospheric ballooning, but their formation should always be taken into consideration. Ice Lakes are the collection of ice on the apex (top) of the balloon during ascent. Liquid water gathered on the apex of the balloon can depress the top of the balloon into a dimple or bowl, and freeze once the balloon reaches extremely cold temperatures.

An ice lake on the top of the balloon has three major impacts on the balloon's performance:
1. The added weight of water will translate into additional payload at altitude, slightly reducing your ascent rate and starting a small feedback loop where even more moisture gathers.
2. The depression of the water and ice will reduce the overall modulus (stiffness/ roundness) of your balloon, reducing the maximum internal volume of the balloon before burst.
3. The ice will eventually cause a stress point on the apex of the balloon, resulting in a tearing of the latex instead of a shattering burst.

Here is why ice lakes are misunderstood: you cannot see or measure them. Your payload, and any associated camera equipment is suspended from the bottom of the balloon. It cannot record the gathering of moisture on the apex. When your payload returns to the ground, there is no ice present. However, there may be signs: If your balloon tore instead of bursting, especially at a lower altitude than expected, an ice lake almost certainly formed. Once your balloon and payload return (and if you recover them very quickly,) they may be soaked in liquid water.

Ice lakes can form on balloons released in the tropics, arctic, desert and everywhere in between. Even if you can't see a cloud in the sky, there is the very real possibility of an ice lake forming on the balloon and limiting its performance if precautions are not taken.

There are two ways to reduce the risk of an ice lake from forming:
1. Always release a balloon with an ascent rate of 5m/s+ which allows for the necessary shedding of moisture as the balloon rises.
2. Always release a balloon with a normal "roundness" to ensure that a dimple or bowl is not present at the apex. (For larger balloons, this may mean you need more payload mass and corresponding lifting gas to ensure that the balloon's shape is proper at release. There is such a thing as a payload that is too light for some of our largest balloons.)

Kaymont TX-Series balloons are specifically designed to shed moisture while rising through the atmosphere. TX balloons contain moisture shedding compounds in the latex, and are high modulus which preserves their round shape. With a proper ascent rate, these balloons significantly reduce or eliminate the risk of an ice lake forming on your balloon.

It should be noted that ice lakes can form even when all proper procedures are followed, and this is just the nature of stratospheric ballooning. This does not mean there was a defect in the balloon's design, or that a burst calculator was wrong, or that your launch crew made any mistakes. It just means that our atmosphere is a complex and difficult place to operate. Being aware of the unique ways balloons behave in flight is a huge step towards ensuring a successful mission.