Coordinate Calculator Instructions

1. Open the 2 files called “1 Bufkit Data Collector” and “2 Coordinate Predictor”.
2. In the Bufkit Data Collector, go the red “Data” tab and change the 4-digit Site ID to “KRAP”. If you can’t select it, click the “Enable Content” button at the top of the page, and then change the ID.
3. Make sure the small dot next to ISU is filled in, and click “Load Data”. Click “OK” on any prompts it gives you. This may take up to 60 seconds. Numbers will populate the colored chart when it is done.
4. On the “Current” tab of the Coordinate Predictor, make sure the data in the E and F columns are correct. N is the # of moles of buoyant gas, m is the mass of the balloon, gas, parachute, and payload in kg, and CD is the coefficient of drag of the balloon. The CD should always be 0.5, unless the balloon is no longer spherical, and if your balloon isn’t spherical, you’re doing something wrong.
5. In Cell C2 of Sheet 1 of the Coordinate Predictor, input the date and time that you wish to predict for, in the format YYMMDD/TIME, in Mountain Time. For example, if you wish to predict the landing coordinates for a launch occurring at 5:00 AM April 9 2016, then you would put 160409/0500 into C2. Note – the Data Collector has a maximum range of ≈3 days.
6. Click the URL in D4 at the top of the CC. This will open the Google Maps page that will have the landing site pinpointed.
7. Please calculate responsibly.

A Basic Outline

1. When “Load Data” is pressed, the BDC fetches data from Iowa State University. The data that we care about is stored in the NAM-Buf tab. It is organized by hour; the data for each hour contains the projected wind speed and direction, as well as temperature and pressure, at various altitudes at that time.
2. The Coordinate Predictor pulls this information from the NAM-Buf tab by searching for the timestamp that is entered into cell C2 in the “Current” tab. The timestamp is stored at the top of each hourly data chunk in the NAM-Buf I column. Once the Coordinate Predictor has found the correct timestamp, it copies over the data below it into the “Data” tab.
3. The Coordinate Predictor uses the temperature and pressure data to calculate air density at each altitude. This is factored into the ascent velocity at each altitude provided by data points from Bufkit. The CP then divides the difference in altitude data points by the ascent velocity at the lower altitude to get a fairly accurate time spent between each altitude data point.
4. The CP also estimates the descent velocity by taking an assumed initial descent velocity and multiplying it by the ratio of the ascent velocity at the target altitude to the ascent velocity at the ground. I personally don’t know why or how this works; this formula was provided by Dr. Smith. Using this descent velocity, the Excel sheet also finds the time spent at each altitude while descending.
5. The CP then finds the North-South and East-West displacement of the balloon by multiplying the total time spent at each altitude by the components of the wind speed at that altitude. It is assumed that the balloon has no horizontal velocity relative to the wind.
6. The CP then adds up all the separate displacements to find the overall displacement and adds this to the coordinates of the launching area; these are assumed to be 44.075821, -103.286556, aka the Stevens High School football field. If you’re launching from somewhere else, just change the first number in cells E9 and E10 to the correct coordinate values.
7. Once the CP has the projected landing coordinates, it converts them into degrees, minutes, and seconds using some equations down around D66, then plugs these values into a URL equation so that the hyperlink in cell D1 marks the correct spot in Google Maps.

Corrections: The data in the BDC has a max altitude which varies from 30000 m to 33000 m. To account for this the Coordinate Predictor assumes a maximum altitude of 33000 m, aka about 110000 ft. It estimates wind speed and time spent at the altitude above Bufkit’s max recorded altitude, and figures this extra displacement into the total. This occurs around D82; if you think your balloon will pop higher or lower than this, just change the “33000” in D83 to your projected max altitude in meters.

Other Notes: The times in the NAM\_Buf tab are in Mountain Time, while the altitudes are from sea-level.

If you have any questions, contact me at [gspahn1999@gmail.com](mailto:gspahn1999@gmail.com)

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