

Balloon Prediction User Manual

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Balloon Prediction is a software package created at NOAA for forecasting weather balloon trajectories and landing locations. It shows the resulting path on a map and offers Google Earth KML files for 3D viewing. This program has been used to reliably predict balloon paths at NOAA and other scientific and educational institutions since 2007. Note that Balloon Prediction is for Windows (XP or higher), and requires the .NET Framework version 4.0 or higher.

Quick Start Guide

- Enter your launch site information (lat/lon/elevation).
- From the “Default Rise Rates” list, choose “Bursting Balloon, Slow” for most flights.
- Set the date/hour of launch (it can forecast up to a week ahead for GFS predictions)
- Press “Make Prediction: GFS Model” and wait until the data download and calculations are complete. The map is updated automatically when done.

Calculation Setup

After starting the program, Balloon Prediction shows the “Options” tab:

Figure 1: Options tab, with many setup fields.

Flight Coordinates and Information

The screenshot shows a form titled "Flight Coordinates and Information" with several input fields and buttons. A red box highlights the "Launch Latitude", "Launch Longitude", and "Launch Elevation" fields. A dark blue box highlights the "Balloon Ceiling" and "Est. Landing Elevation" fields. A green box highlights the "Site Name (Optional)" field and the "Add Default" and "Remove Default" buttons. A purple box highlights the "Make a Reverse Prediction" checkbox. A light blue box highlights the "UWYO Sounding Wind Data Site" section, which includes a "Closest Site" dropdown menu showing "DENVER/STAPLETON".

Figure 2: Flight Coordinates and Information fields, required to initialize the trajectory calculation.

Start by entering your launch site's information (Figure 2, red area). The latitude and longitude should be where the balloon is released, ideally with 5 or more decimal places. The launch elevation should also be entered (use Google Earth or a GPS at the launch site).

Next enter some approximations about the flight (Figure 2, dark blue area). The "Balloon Ceiling" is an estimate of the balloon's burst/turn altitude (typically around 30000 m above sea level for a 1500 g balloon with a ~2000 g payload). The "Est. Landing Elevation" is an approximate landing altitude at which to stop calculating the balloon trajectory. Use Google Earth to help determine average altitude in typical landing regions for use in this field.

You can optionally enter a name under "Site Name (Optional)" and press "Add Default" (Figure 2, green areas). This will save your launch information in a list under "Default Launch Sites". In the future, you can choose your launch site from this list instead of re-entering the information.

The "Make a Reverse Prediction" check box (Figure 2, purple area) can be ignored for most flights. Checking it will assume you're entering in a desired landing location, and the program will calculate where to launch from. This is useful for instruments that need to compare descent data to ground-based measurements at a known facility, or for easier recovery at a desired region.

As the launch latitude/longitude are entered (or selected from the default list of launch sites), a matching radiosonde sounding site is selected and shown under "UWYO Sounding Wind Data Site" (Figure 2, light blue area). This radiosonde site is used only with the "Actual Winds" predictions. If desired, it can be changed by clicking on the large "Closest Site: xxx" button.

Rise Rate Calculation

The screenshot shows a form titled "Rise Rate Calculation" with two tables: "Ascent" and "Descent". The "Ascent" table has columns for "Altitude [m]" and "Rise Rate [m/s]". The "Descent" table has columns for "Altitude [m]" and "Fall Rate [m/s]". A blue box highlights the "Rise Rate Name (Optional)" field, which contains the text "Valved Balloon". Below the tables are "Add Default" and "Remove Default" buttons, and a dropdown menu for "Default Rise Rates" with the option "Load Default Rise Rates...".

Ascent		Descent	
Altitude [m]	Rise Rate [m/s]	Altitude [m]	Fall Rate [m/s]
2000.00	5.90	2000.00	-4.28
3000.00	6.26	3000.00	-4.46
4000.00	6.46	4000.00	-4.22
5000.00	6.39	5000.00	-3.21
6000.00	6.52	6000.00	2.70

Figure 3: Rise Rate Calculation, used to tweak the trajectory calculation for specific balloon configurations.

Rise rates tables are used to calculate the balloon trajectory from the model winds or radiosonde sounding data. There are several default sets of ascent/descent rates available from a list (Figure 3, blue area), or they can be entered in manually if known from existing flight data (Figure 3, red area). By default, the NOAA “Valved Balloon” rise rates are chosen, but for flights with bursting balloons a different set of rates should be chosen (“Bursting Balloon, Slow” works well for typical launches). Any custom rise rates in the tables can be saved as a new default item in the list using “Add Default”. Make sure that descent rise rates are negative. During trajectory calculation, rise rates will be interpolated from this table (clamped to the upper and lower altitude values if they are inside of the balloon ceiling and est. landing elevation bounds).

Date/Time and Time Zone

Prediction Date/Hour
Time Zone: **(UTC-07:00) Mountain Time (US_Canada)**
Select System Time Zone... [Use Current Time Zone]
Prediction Date: Monday, January 25, 2016 [Mountain Standard Time]
Prediction Hour: 17 [Mountain Standard Time]
Prediction Date/Time UTC: Tuesday, 26 January 2016 at hour 00

Figure 4: Date/Time and Time Zone setup fields. Can be set for real-time, forecast, or historical data.

The time zone for the prediction is automatically chosen when entering in the launch lat/lon. It can also be specified manually using the “Select System Time Zone” field.

Choose a prediction date and hour in the selected time zone using the remaining fields. Note that the NOAA GFS model (for “GFS Model” predictions) only updates every 3 hours, and the closest dataset is chosen. The UWYO/NWS radiosonde launches (for “Actual Winds” predictions) typically happen 2-4 times daily, at standard intervals (usually at hours 0, 6, 12, and 18 UTC).

Starting Prediction Calculation

Get Extra GFS Data for Plotting
Make Prediction: GFS Model **Make Prediction: Actual Winds**

Figure 5: Buttons to start prediction calculation.

There are two types of predictions available, “GFS Model” and “Actual Winds” using NOAA forecast model winds or real-time radiosonde sounding data, respectively.

GFS Model predictions use the NOAA Global Forecast System model to forecast wind conditions up to a week ahead, and store historical winds for a few months back. This type of predictions is preferred for most situations, as forecasting is useful and the results have proven accurate up to a couple days in the future. Checking “Get Extra GFS Data for Plotting” will retrieve temperature, humidity, and ozone forecast data along with the winds and create plots under the “Extra Plots” tab.

Actual Winds predictions use the closest matching UWYO/NWS radiosonde sounding data. These are for real-time predictions (run immediately before the flight) or long-term historical data. But since radiosondes are launched sparsely (both in location and times/day), it is often better to use GFS Model predictions to get a more-accurate matching dataset.

Balloon Trajectory Map

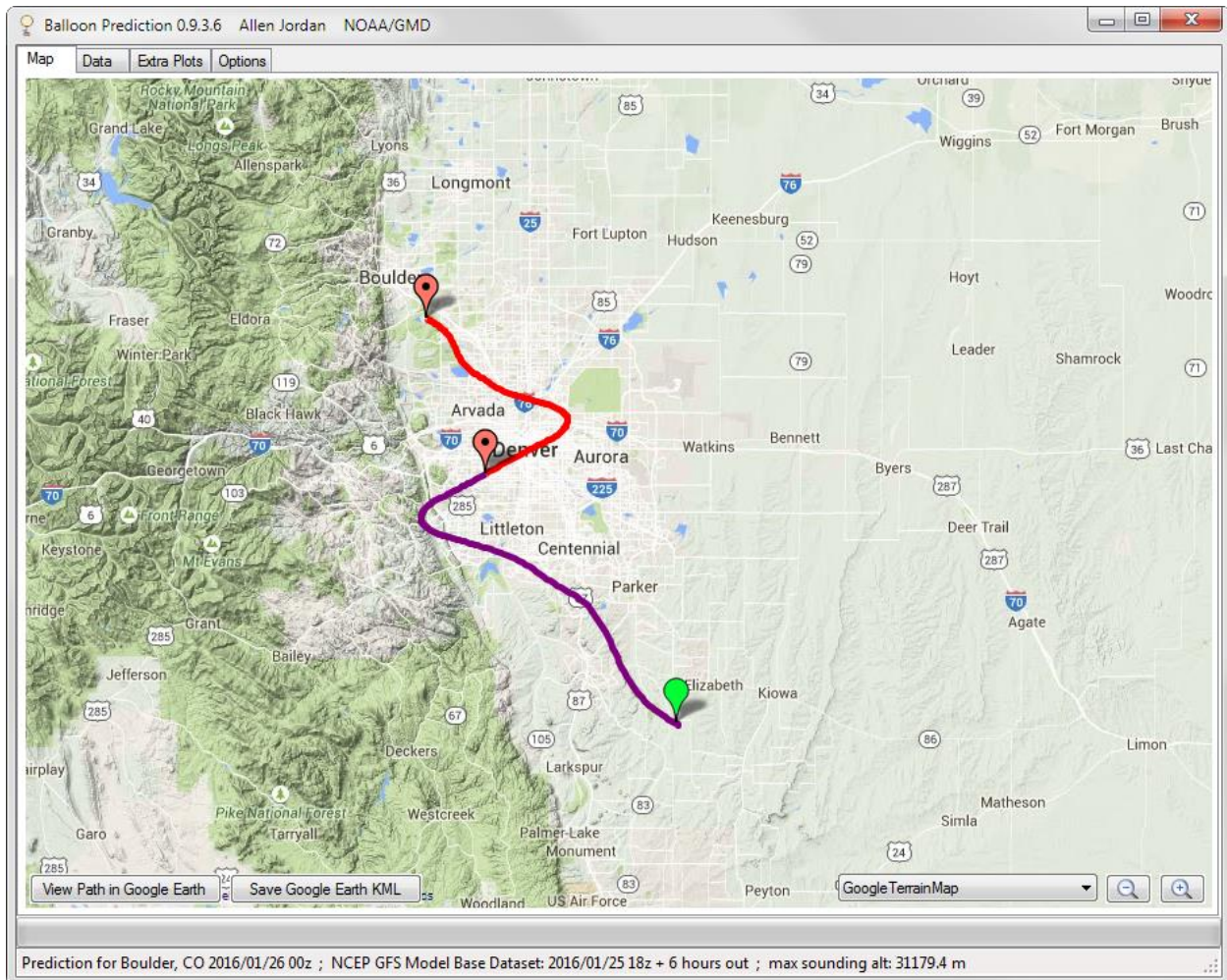


Figure 6: Trajectory mapping.

The calculated balloon trajectory is shown on a map when complete. Choose the map type using the list on the lower-right. Drag or scroll with the mouse to manipulate the map, or use the +/- buttons on the lower-right. Click "View Path in Google Earth" to show the 3D trajectory (if Google Earth is installed). It is even possible to view multiple calculated trajectories using google earth:

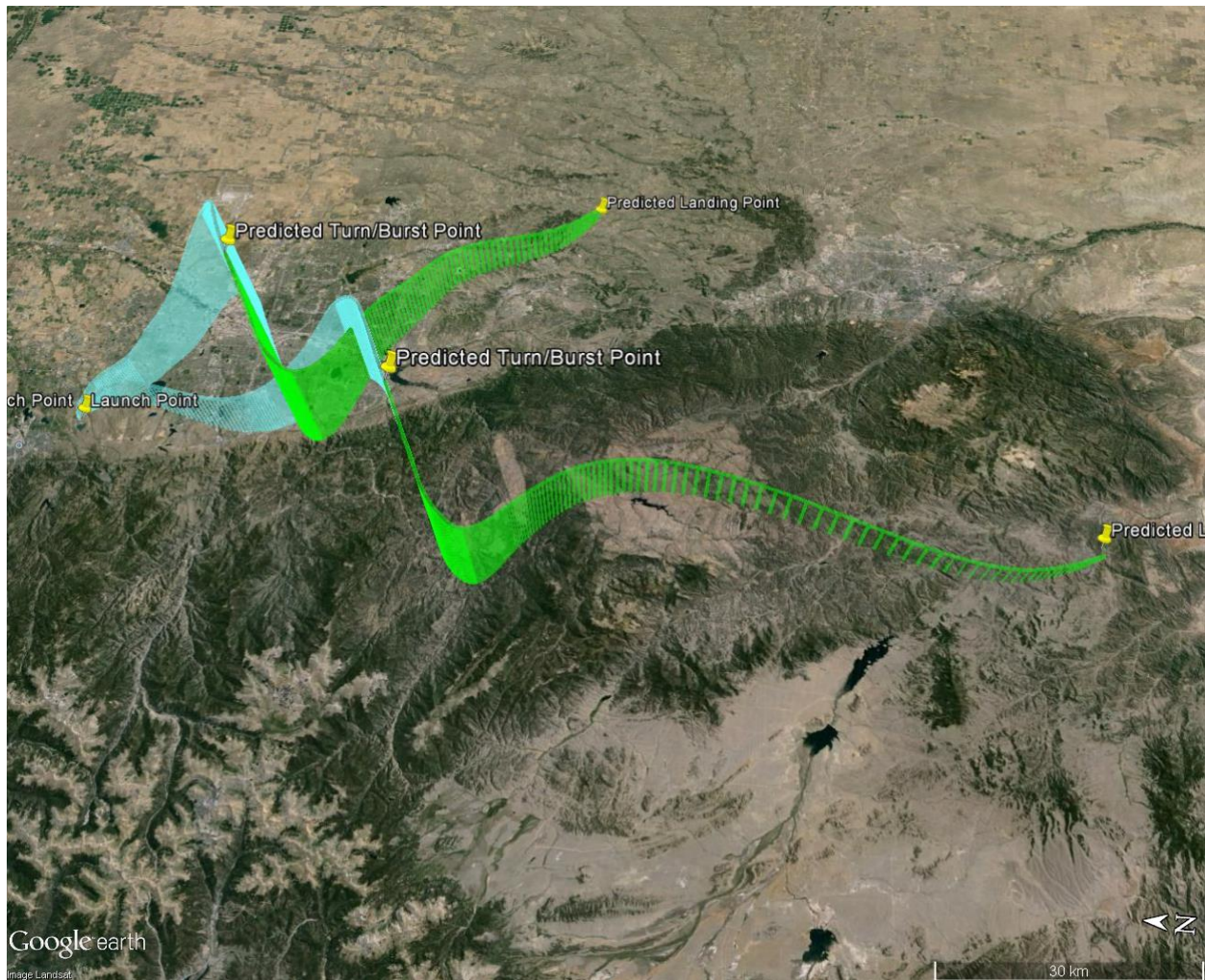


Figure 7: Google Earth 3D trajectory viewing.

The “Save Google Earth KML” button will save the 3d trajectory file for later viewing.

Disclaimer: The availability of these tools to the general public does not condone attempts to recover balloon payloads that land on private property, government property, or hazardous locations. Predicted trajectories and landing zones are only approximate, therefore active tracking is required to accurately locate launched payloads.