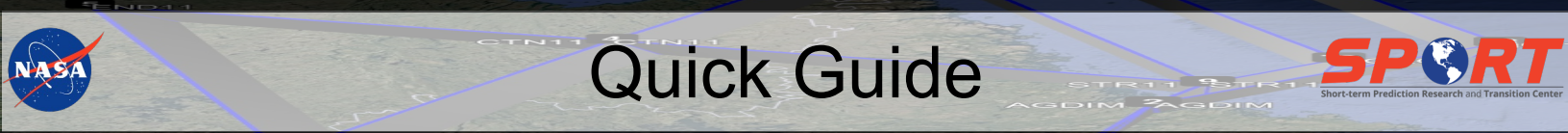
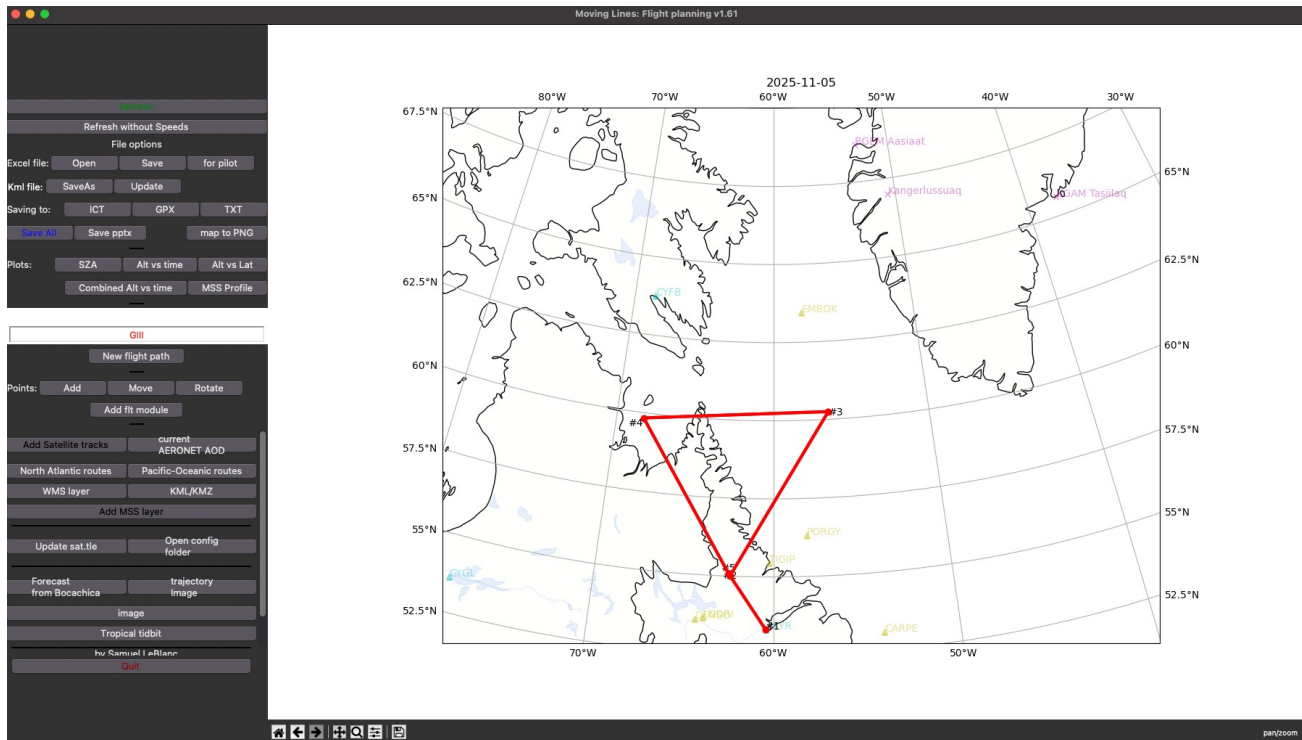


Moving lines: A Research Flight Planning Tool



Quick Guide

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What is “Moving lines?”

Moving lines is an open-source research flight planning tool built in Python, developed by Samuel LeBlanc at NASA Ames. *Moving lines* displays an interactive map with easy-to-select waypoints that is connected to a Microsoft Excel spreadsheet, automating flight time calculations.

Additional Features

Moving lines features the ability to include pre-planned flight modules and overlay satellite overflights and track predictions, AERONET AOD, airspaces, Web Map Services, model outputs, and more. Additionally, the program supports saving a flight plan in several common data formats, such as .xlsx, .kml, Foreflight (for pilots) and .pptx.

Getting Started

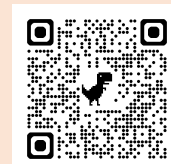
A quick start of *Moving lines* using default settings is straightforward:

1. Select the mapping profile, which defaults to most recent campaign. Here, you can change the map boundaries, take-off time, UTC offset, and map projection.
2. Allow about 30 seconds for the program to load.
3. Enter the date of planned flight in the dialog box, following the format of yyyy-mm-dd.
4. Wait for map to initialize and Excel spreadsheet to load.
5. Move the cursor over the map to refresh it.
6. Create and move points by clicking, or by manually entering their lat/lon in the open Excel.
7. Once finished, save all the figures and files by either selecting each point, or by pressing the 'saveall' button

Limitations

- **Microsoft Excel and Python:** *Moving lines* requires an active installation of both Python 3.9 and Microsoft Excel.
- **Mission Specific Aircraft:** *Moving lines* comes with parameterization for several common NASA research aircraft, but additional aircraft can be configured in the config files.
- **Each Waypoint Must Be Planned:** This also includes altitude changes.
- **Turns Appear as Acute Corners:** Real flight paths include curved turns that must be factored into planning.

Scan the QR code to go
the *Moving lines*
GitHub repo



<https://github.com/samuelleblanc/fp>

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Quick Guide



Examples of common uses and important notes:

Shown here are common uses of **Moving lines** that would be expected during flight planning.

1 All about points.
How to add them, how to move them, how to remove them.

2 Adding figures, model data, satellite tracks, and images.
How to layer these types of graphical information alongside a flight plan, as well as how to visualize satellite tracks.

3 Saving, exporting, and opening flight plans.
How to save a flight plan, export the information for sharing, and opening previous flight plans.

Helpful Tips

- Mousing over the map or hitting the green 'Refresh' will sync the map and Excel files.
- From left to right, the icons on the bottom nav bar are: home screen (first image seen), previous view, next view, pan, zoom, subplots properties, save map.
- You can adjust waypoint timing by changing the takeoff time in the spreadsheet.
- Once you make a new flight path (for different aircrafts or alternate options), switch between them using the named buttons above "New flight path."

1

To create/add a point:
Three methods: Click the map where you want a point OR press the "add" button and follow the prompts OR manually add the lat/lon in the Excel file.
To move/rotate point(s):
Three methods: Click a point and drag OR press the "move" or "rotate" button and follow the prompts OR manually edit the lat/lon in the Excel file.
To remove a point:
Delete the relevant line in the Excel file then sync the map.

WP	Lat [°-90]	Lon [°-180]	Speed [m/s]	delay [min]	Altitude [ft]	CumLegT [hh:mm]	UTC [hh:mm]	LocalT [hh:mm]	LegT [hh:mm]	Dist [km]	CumDist [km]	Dist [nm]	CumDist [nm]	Speed [kt]	Altitude [ft]	SA [deg]	AZI [deg]	Bearing [deg]	ClimbT [min]	Comments	WP names	11/6/25	NURTURE2026	Created with moving_lines v1.61
1	53.31916667	-60.42583333	150.5	0	49	00:00	12:00	08:00	00:00	0	0	0	0	292.5	0.1608	84.4	127	55.201	0					
2	55.77021071	-53.68566885	206	0	12000	00:56	12:56	08:56	00:56	513	513.346	277	277.186	400.4	39.37	77.8	145	323.35	24.749					
3	58.77601585	-58.1074855	231	0	12000	01:27	13:27	09:27	00:30	427	940.684	231	507.932	449	39.37	79.4	149	319.63	0					

This is what the waypoints look like in the Excel file that **Moving lines** creates. Note the space for dedicated waypoint names, and comments. Flight time is indicated with 'CumLegT' or cumulative Leg Time.

2

Adding layers:

- "WMS Layer" will allow you to choose from several publicly available atmospheric model variables (temp, cloud cover, etc.).
- "MSS models" are bespoke model layers from Mission Support Services.
- Images from other sources (local, TropicalTidbits, etc.) can be loaded via options found in the blue box.
- Satellite tracks can be loaded via the button in the red box.

The websites that WMS and MSS pull from can be edited in the WMS.txt and MSS.txt files found in the **Moving lines** installation directory.

3

Saving / Exporting:

- Clicking "Save All" will create all figures (seen next to "Plots:") and save them.
- "Save ptxt" will create a slideshow with preset maps, displays, and a summary of waypoints with comments for context.
- Pressing "Open" allows you to open a previous flight plan using that plan's Excel file. You may need to click "Refresh."
- Save early and save often!