

GOMECH fitting tool V 01 **(Gaussian Observational Model for Edge to Center Heterogeneity)**

Below are instructions for the GOMECH analysis tool. This tool is intended for use in analyses of crosswind heterogeneity studies. The tool uses a GOMECH fit to produce plume width and center metrics of a short-lived compound relative to a long-lived tracer. GOMECH is explained in detail in the accompanied manuscript Decker et al. ES&T 2021.

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If GOMECH and this tool are useful in your analysis, then please cite Decker et al. 2021 ES&T (doi to be included upon acceptance).

The procedure included within this Igor experiment contains the function *GOMECH_Analysis(wLL, wSL, vCenter_Guess, sPlot)* which is a simple tool to run a GOMECH analysis.

The required inputs include

wLL: a wave of a long-lived compound

wSL: a wave of a short-lived compound

vCenter_Guess: a variable containing the initial guess of the plume center of the short-lived compound relative to the width of the long-lived compound. This value is usually 0 for compounds with plume centers aligned with the tracer or 1-3 for unaligned compounds. Guessing 0.5 can help if you are unsure.

sPlot: a string indicating whether to plot the results (“Plot”), or not (anything else).

Also included are four example horizontal crosswind transects taken from the FIREX-AQ 2019 campaign. All data are from the same transect taken between 8/8/2019 01:58:35 UTC and 8/8/2019 02:01:12 from the NASA DC-8 aircraft. These include CO measurements, our long-lived compound, as well as O₃, HONO, j_{HONO}, and maleic anhydride. Detailed information on these measurements is included in the accompanied manuscript.

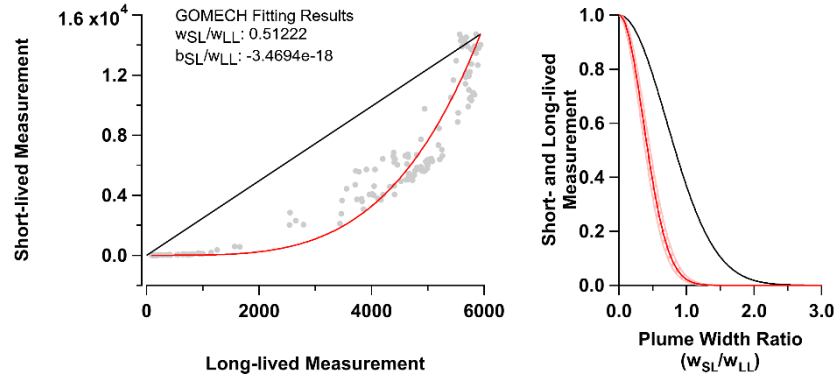
The command line includes the *GOMECH_Analysis* function filled in for these four examples. You can copy and paste each one into the command line to see the examples plotted. Two of these examples are shown on the following page.

HONO

This is an example of a compound narrower than the tracer compound CO. As such, we guess 0 for the plume center and we want to plot, so we indicate "Plot".

GOMECH_Analysis(CO_Plume, HONO_Plume, 0, "Plot")

The results are shown below.



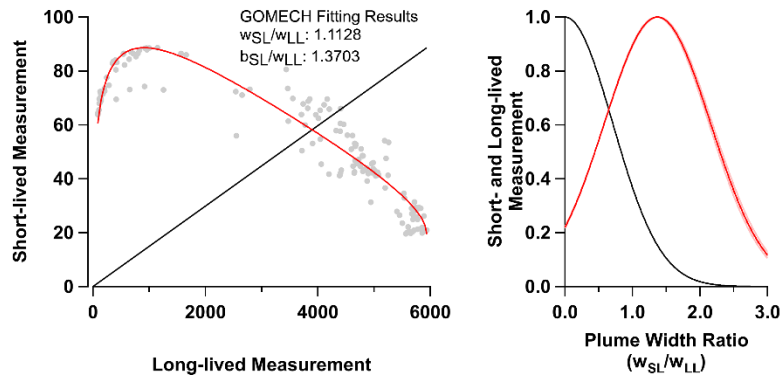
On the left are the observations (grey markers), a 1:1 line for reference (black) and the GOMECH fit (red). The axes take on the units of the compounds. In this case, pptv for HONO and ppbv for CO. On the right is the resulting Gaussian shape from the GOMECH fit (red) bounded by a hashed area that indicates the area of fit uncertainty only. Also shown is a standard Gaussian (black) with width 1 for reference.

All relevant waves and results are also saved under the "GOMECH" folder under the "HONO_Plume" folder. A new folder is created, by the name of the short-lived compound, for each analysis.

GOMECH suggests that the plume width ratio is about 0.51 and the plume center ratio is essentially 0 (a very small number).

O₃

This is an example of a compound with a plume center shifted relative to CO. As such, we guess 1 for the plume center. You can try other guesses and notice the large fit uncertainties that result.



Try the other examples and notice that not all compounds work well with the GOMECH fit. Many of the potential reasons for this are discussed in the accompanied manuscript.