Megasquirt

EFI Analytics

Data driven Tuning using ScatterPlots

MegaMeet 2013

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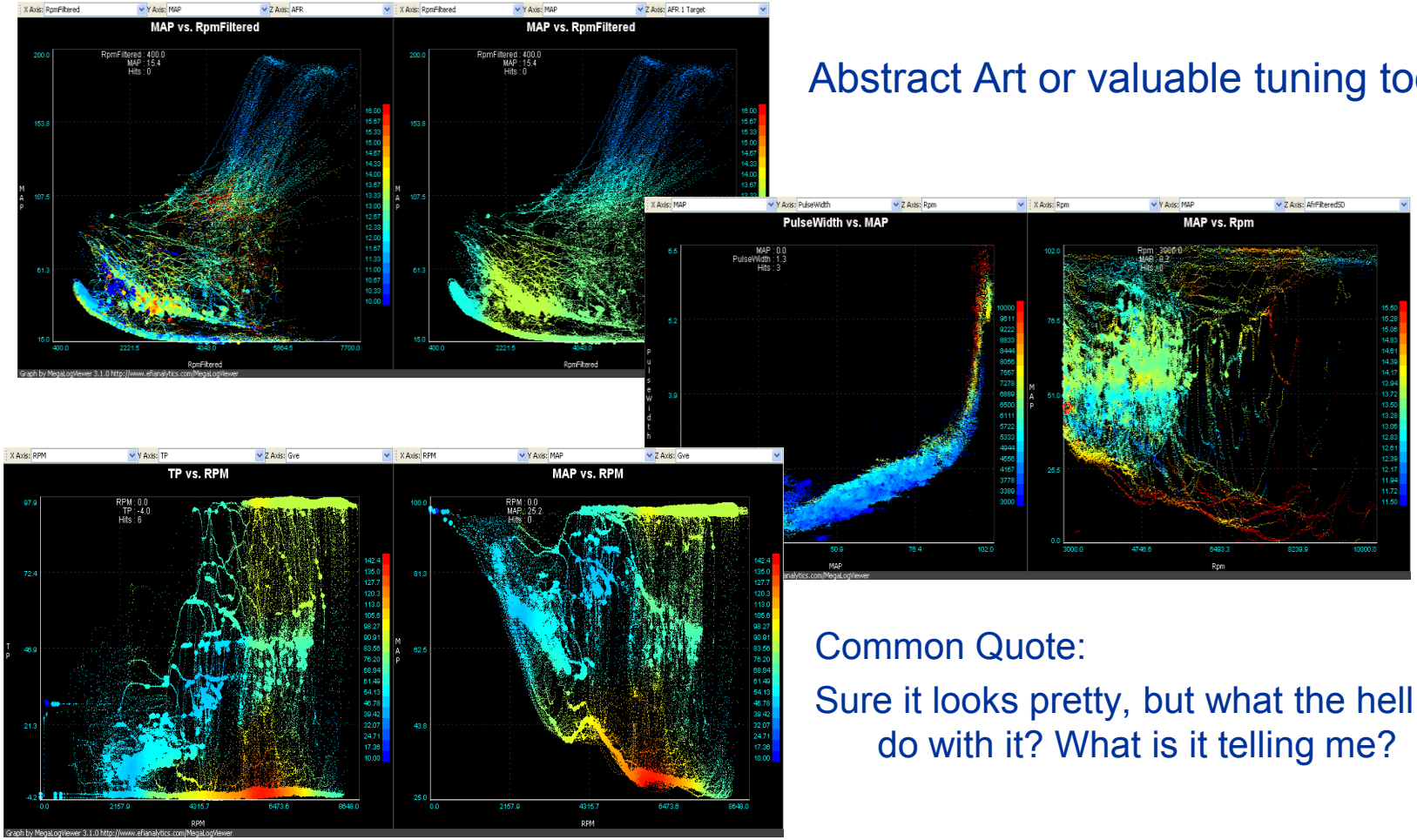
April 20, 2013

MegaLogViewer Scatter Plots



Abstract Art or valuable tuning tool?

Common Quote:

Sure it looks pretty, but what the hell do I do with it? What is it telling me?

MegaLogViewer Scatter Plots

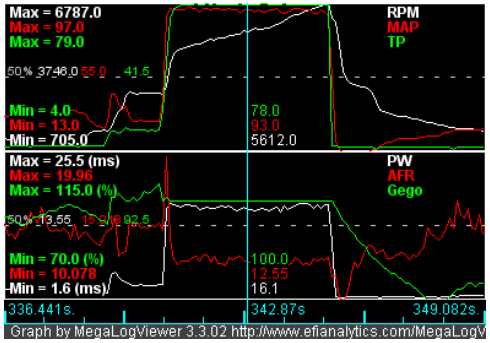
Overview: Scatter Plot graph are commonly used for statistical and data analysis to identity correlations

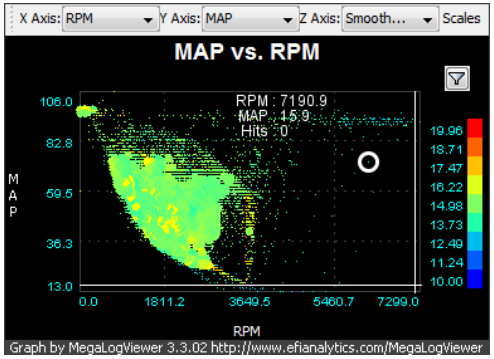
MegaLogViewer Scatter Plots were designed for Tuning

- •Handles high data volumes
- •3 Axis view
- •Custom Calculated Fields to combine and manipulate
- •**Data Filtering!!!**

Common Belief – For tuning high data rates are very important.
FALSE – for most tuning slow data rates will work fine as long as each record is well correlated and you have sufficient time to collect data. More data is better with Scatter Plots, not necessarily faster data.

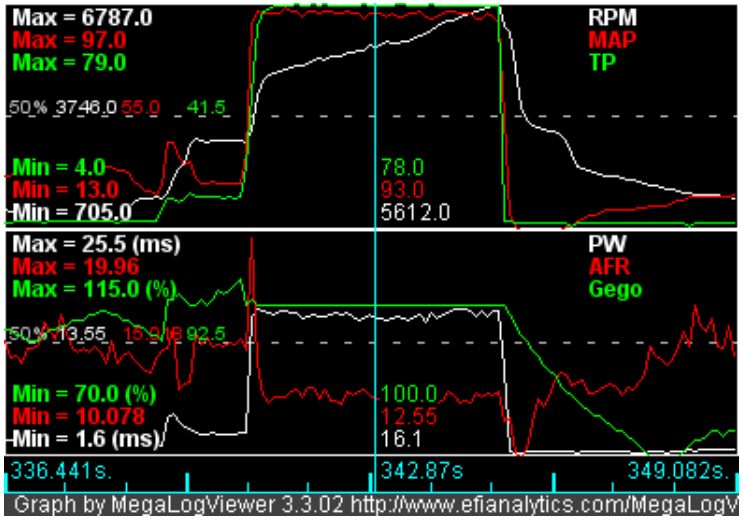
Normal log viewing work great for viewing specific details, but you can only see so much data at once. Using scatter plots you can view thousands of records or hours of data in 1 view to quickly get a big picture view.

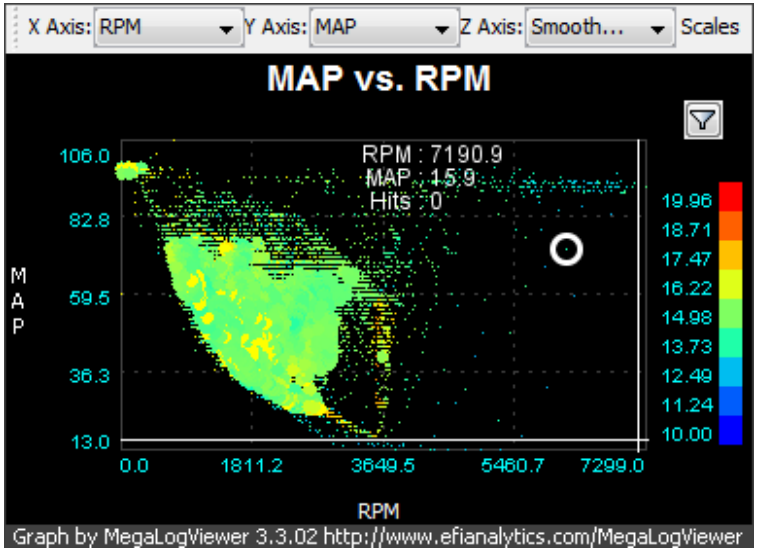




MegaLogViewer Scatter Plots

When a scatter plot over a traditional graph?





- View many fields at once

- Step through record by record to see specifically what was happening at any point in time.

- Can see that at this specific point in time the RPM=5612, MAP=93 kPa, AFR is 12.55:1 and Ego Cor is 100

- Difficult to realize the impact of conditions not happening at other points in time are having on the viewed fields

- 3 Fields at a time

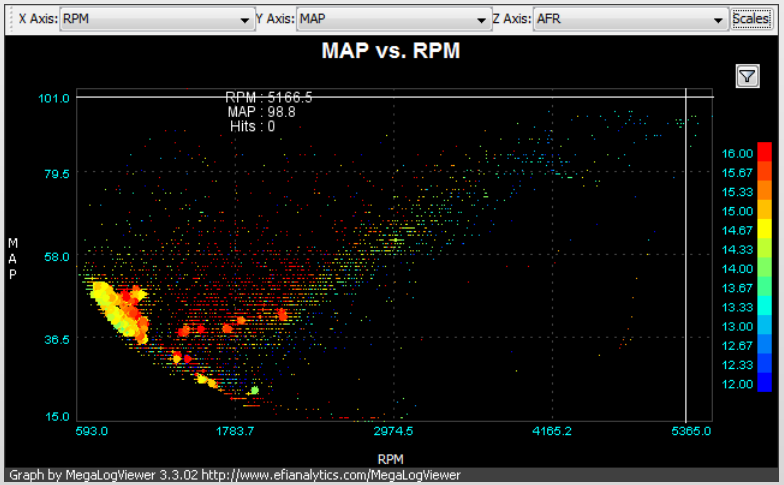
- Full picture view as if it is your Speed density VE Table. X Axis:RPM, Y Axis: MAP, Z Axis:AFR

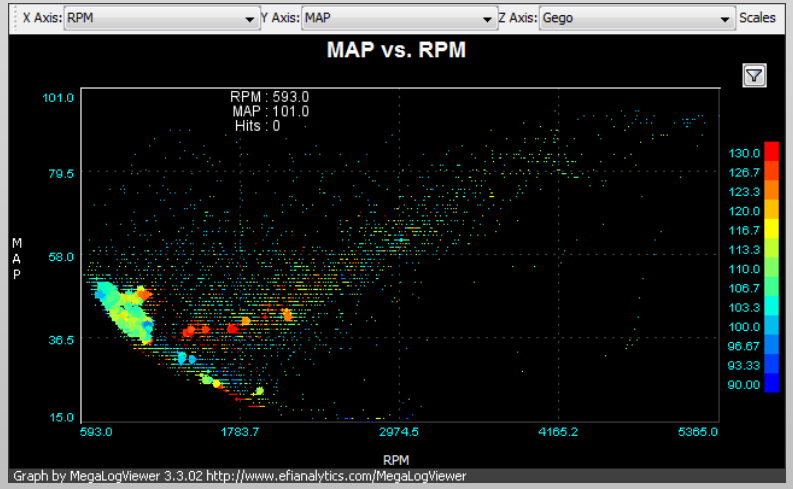
- Notice the Yellow spots, they quickly reveal areas of the VE Table where it is running over 16:1. This is a trend over a large amount of data, not a specific point.

- Can peel back the layers with filters to see what conditions may be effecting the view. AE, Warmup.

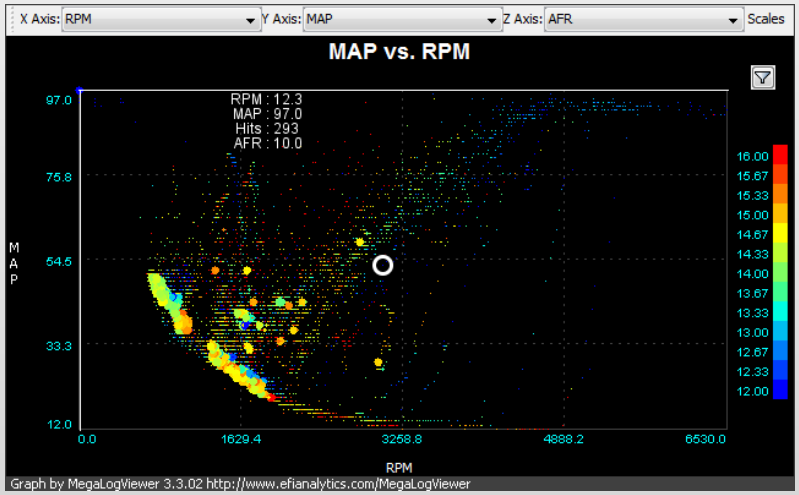
Viewing like a VE Table

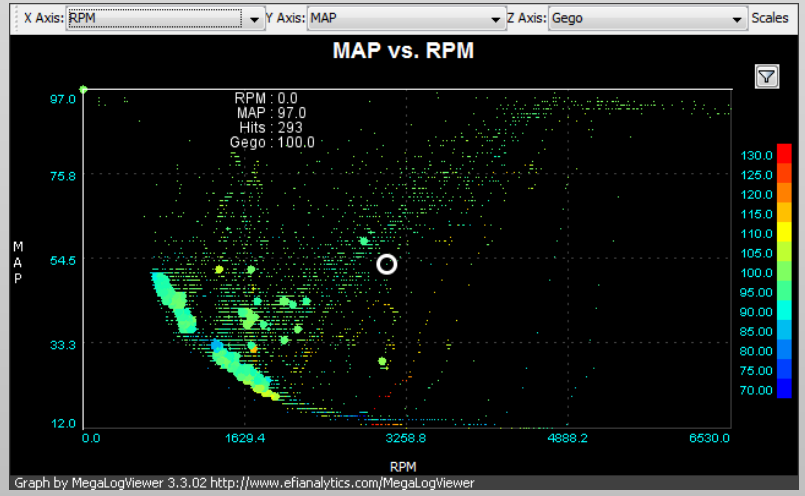
Table Generator



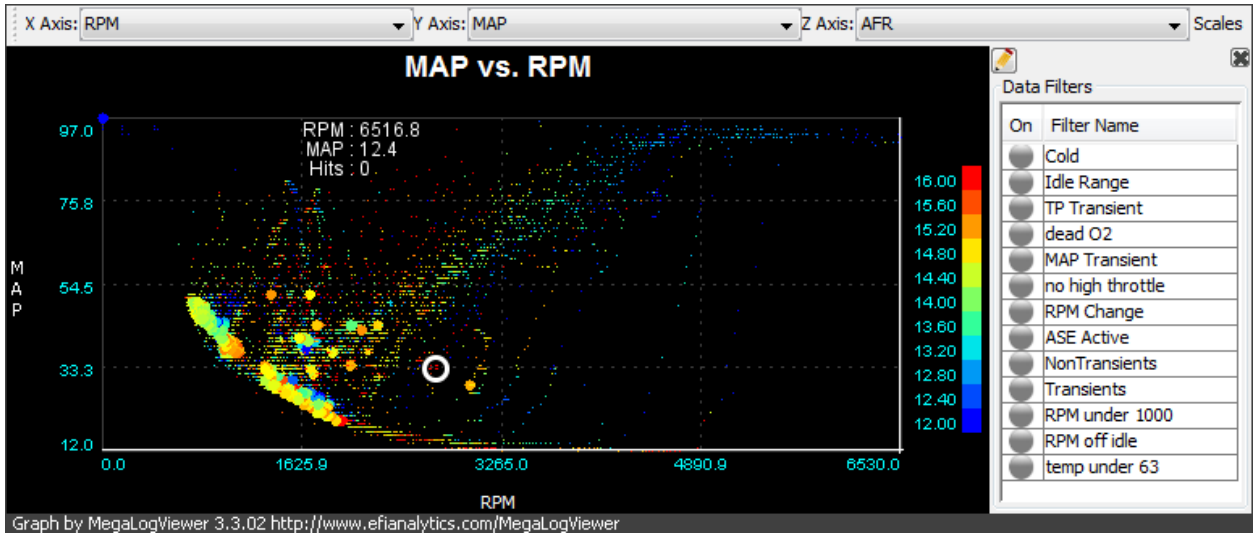


After Tuning

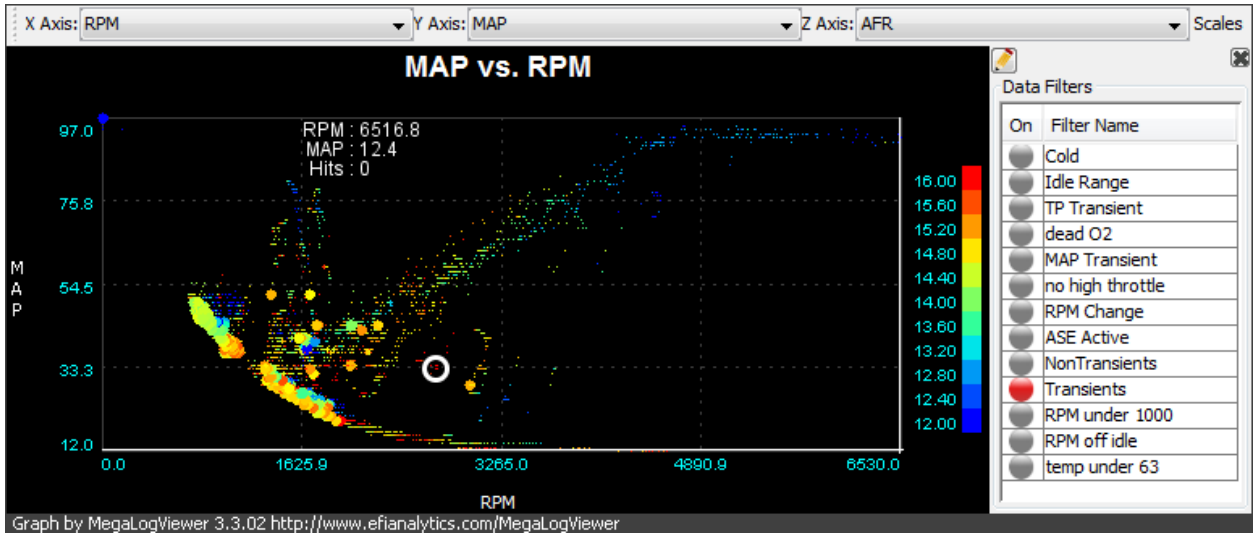




Viewing like a VE Table



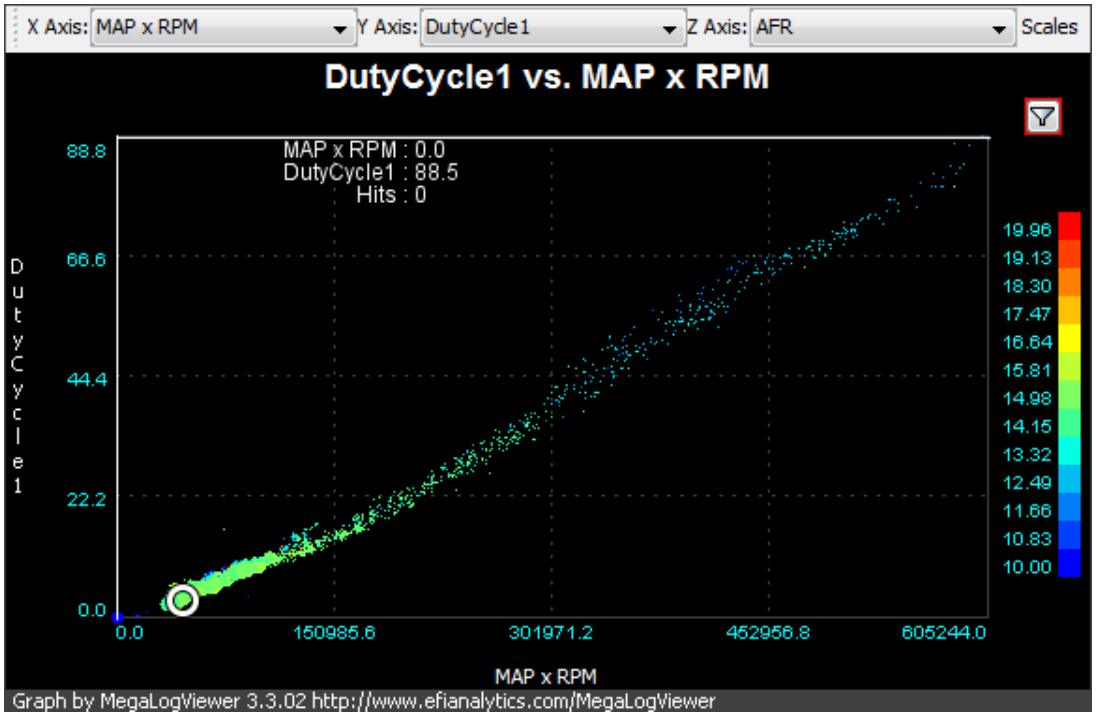
This tuned view still show numerous read areas.
Why?



Activate the Transient Filter, notice how many disappear.

Quick View of Tune

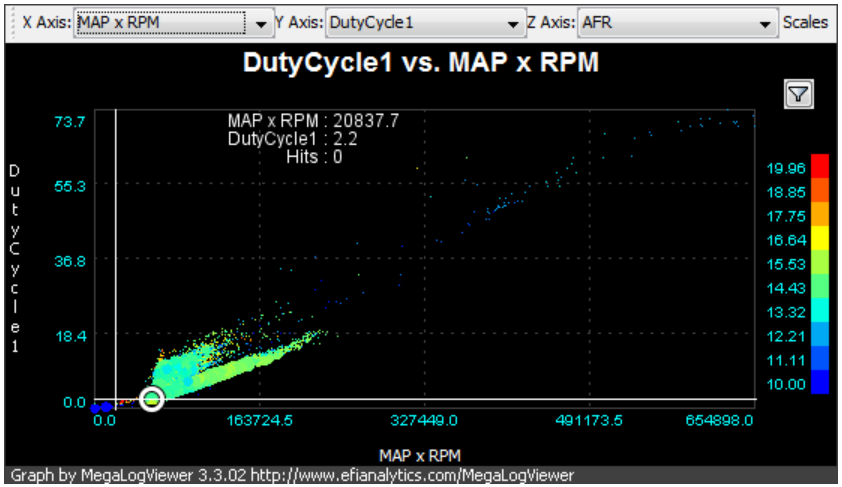
Calculated Field MAPxRPM vs DutyCycle – gives tight correlation on a well tuned engine.

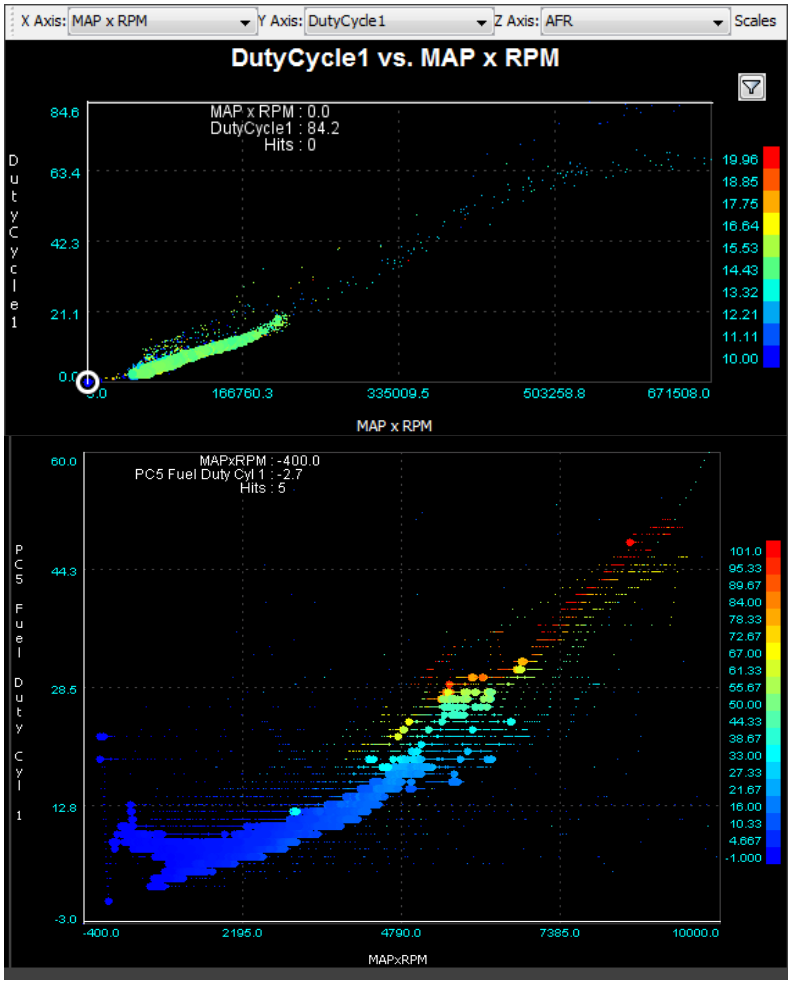


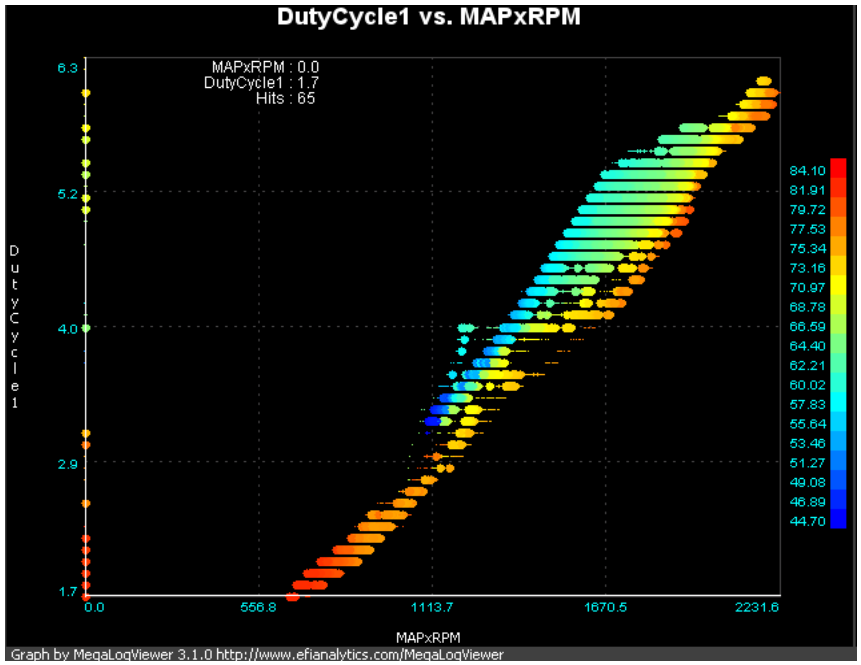
So what?
- MAPxRPM is just that: [MAP] * [RPM]
- Compare to DutyCycle or MAF on the Y Axis

This is really fast way to spot a rough tune or better, where the problems are, one quick view.

Rough Tunes







Various logs displaying MAP x RPM vs DutyCycle where it does not draw a corelated line

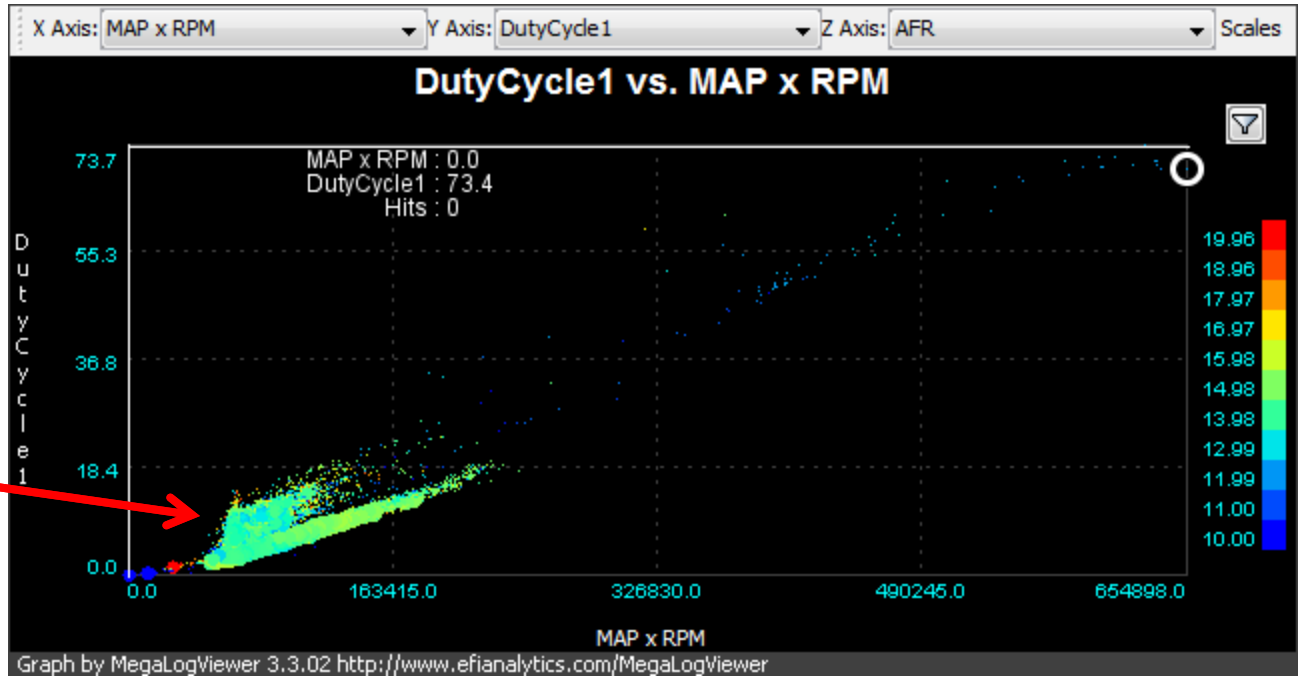
Quick View of Tune

Not showing a clear correlation.

Why?

What looks wrong?

What is causing this hump?



Let's look at this log in MegaLogViewer.
- Bring up the Scatter Graph MAPxRPM vs DutyCycle1
- The Dead O2 Filter removes some records in the hump, but an insignificant number.
- Click on the hump
- Switch to normal log viewing
- Observe what is happening on many of those records.

The scatter plot showed there was a problem and where to looks. The normal log shows specifics.

Warmup Enrichment tuning with Scatter Plots

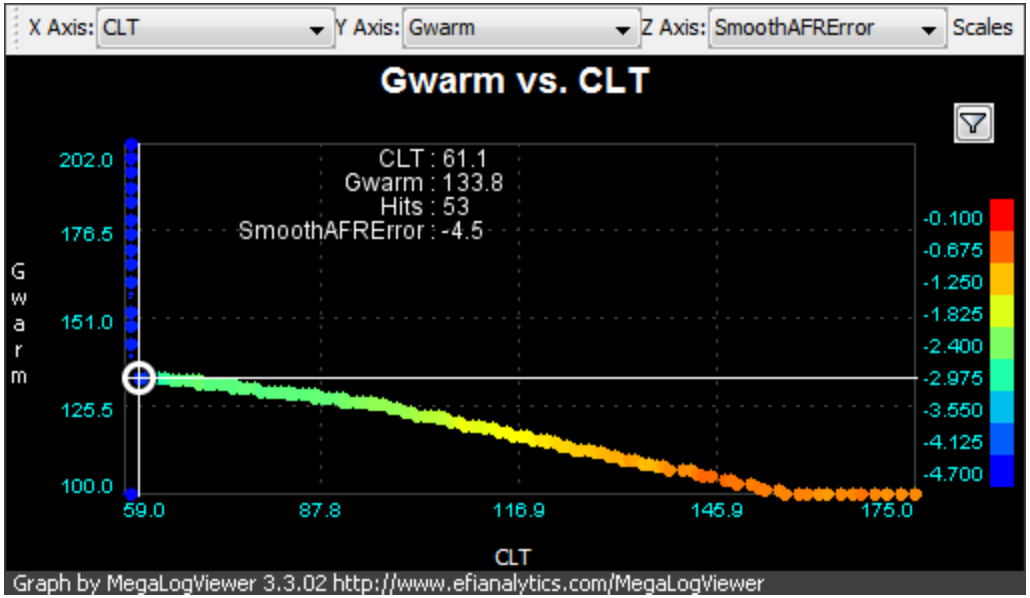
WUE with Scatter Plots

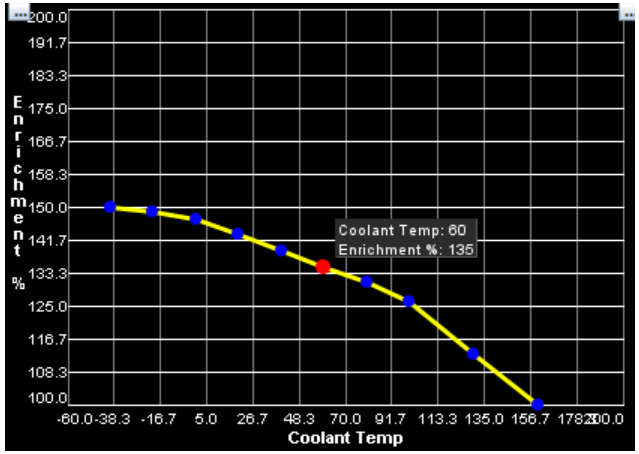
Real World Sample Usage:
Correcting Warmup Enrichment with Scatter Plots

CLT vs Gwarm with SmoothAFR for the Z Axis color
•Regenerate the Warmup Curve as it was set in TunerStudio
•Notice the Z Axis color that shows how far from target AFR it was at each temperature.

SmoothAFRError? What is that?
Custom Field explained on next slide

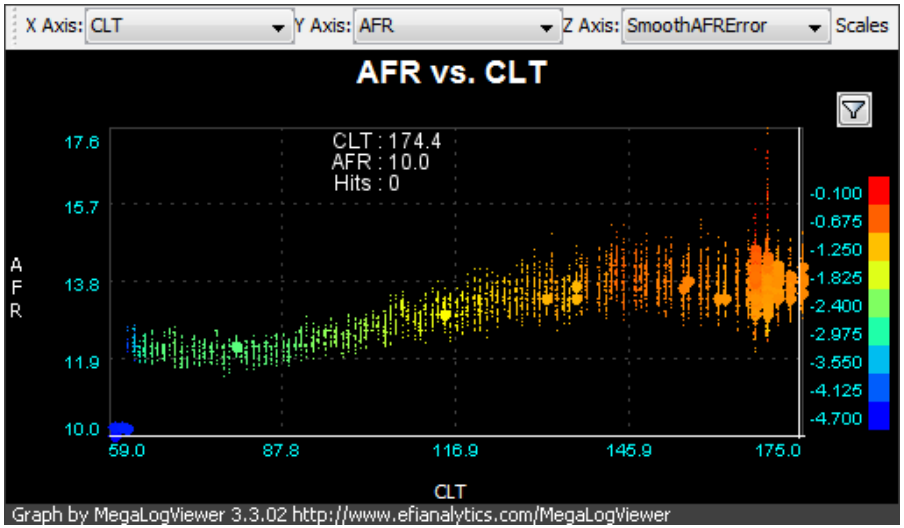
Test Subject: 1989 Corvette
•422 cid
•Mild Solid Roller cam
•220 cc AFR heads
•MS1 running MS1 Extra 29y3
•60-2 Trigger Wheel, Wasted Spark

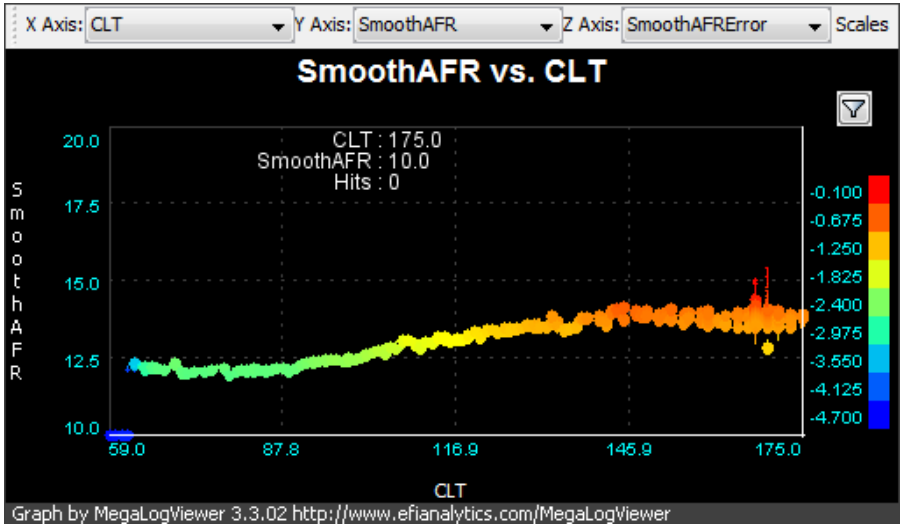




Custom Fields and Functions

Custom Fields: Smoothing and more.





Let's take a step back and look at AFR Smoothing.

Compare CLT vs AFR to CLT vs SmoothAFR

Calculated Field:
Field Name: SmoothAFR
Formula: SmoothBasic([AFR], 20)

For most tuning, smoothing is only over 3-5 records, with Warmup, 20-50 can work well.

Calculated Field:
Field Name: SmoothAFRError
Formula: SmoothBasic([AFR]-14.7, 20)

MS2 and MS3 provide the target AFR for more accurate results. With MS1 either use straight Stoich or a formula to derive your target AFR.

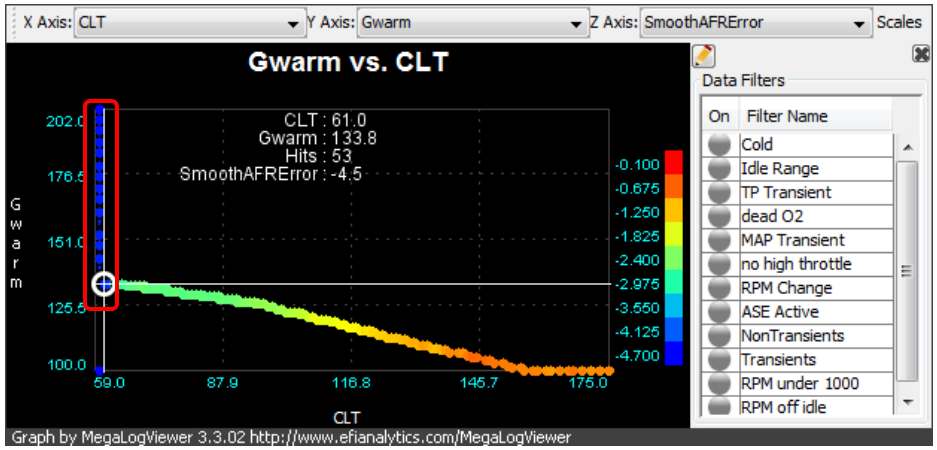
Check in MLV Help for full list of supported functions and usage:
SmoothBasic()
SmoothFiltered()
aerodynamicDragHp()
rollingDragHp()
accelHp()

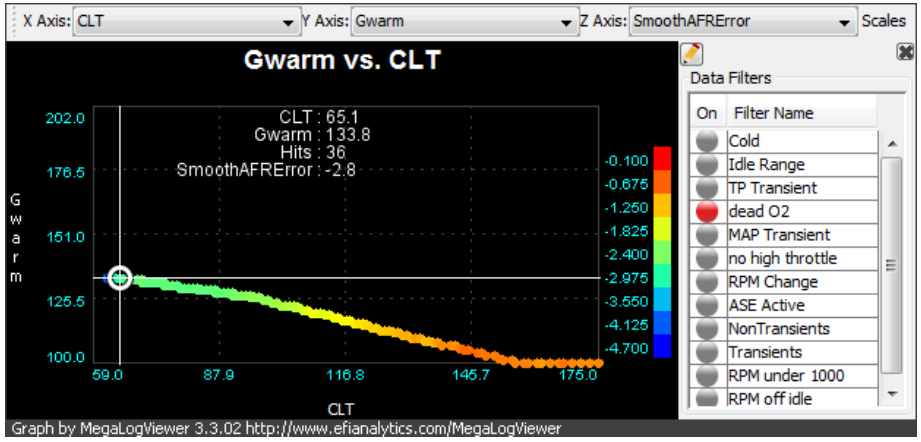
And all the standard functions: sin, cos, floor, ceil, round, pow, abs, etc…

Scatter Plot Filters

Filtering:

Back to our CLT vs Gwarm with SmoothAFR for the Z Axis color





Filters can quickly remove anomalous data, or help to find the cause of that data.

Notice the blue dots up the left axis of top picture. Activate the dead O2 Filter to remove in picture 2.

Now you know you would want to filter that data from any formulas that it would skew the results.

Dead O2 Filter expression with Innovate 10:1-20:1:
[Field.AFR] < 10.3

Numerous built in Filters where you can see the expressions used:

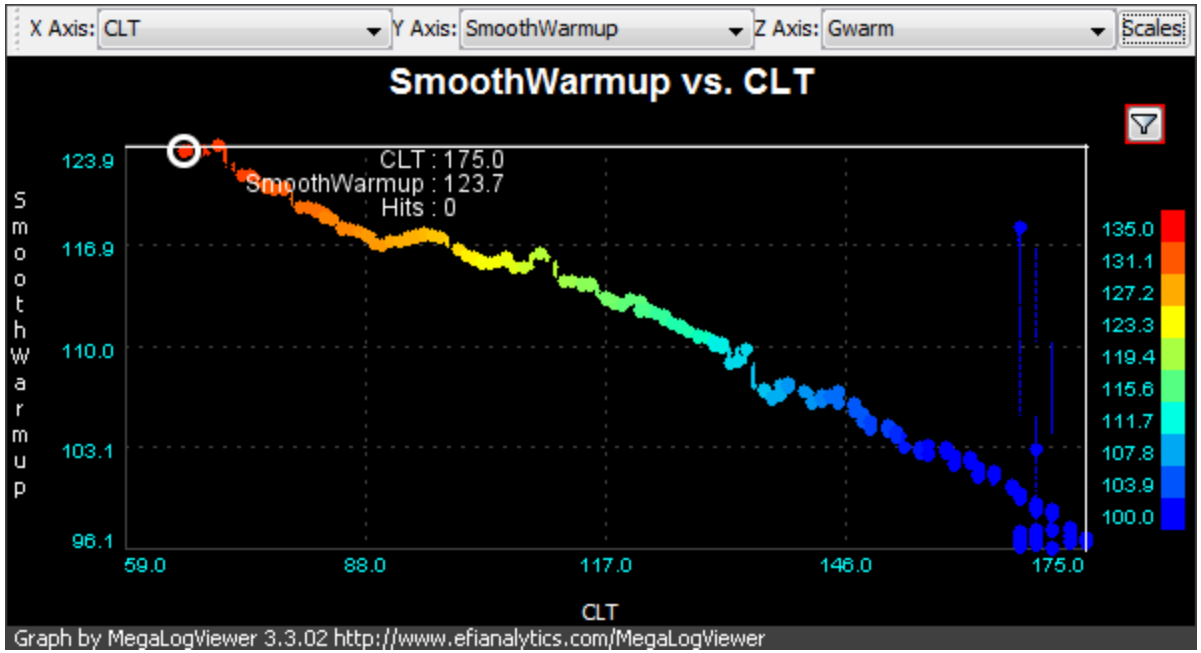
TP Transient: (abs([Field.TP] - [TP-4]) > 3)
ASE Active: [Engine] | 4 == [Engine]

MAP Transients:
(abs([Field.MAP] - [MAP-4]) > ([Field.MAP] * 0.15))

These transient filters are built in and available for use after install.

Solving WUE

Not only can you view what the warmup curve looked like, but you can generate the “Right” answer for it.



Note the Z Axis color illustrates the original Warm up enrichment value.

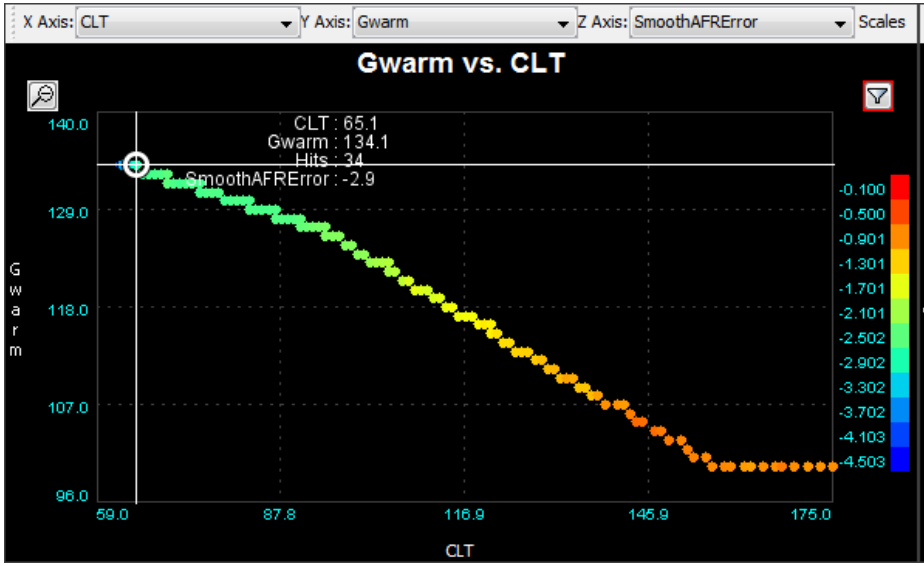
The X & Y Axis show the desirable value.

This car was running needlessly rich.

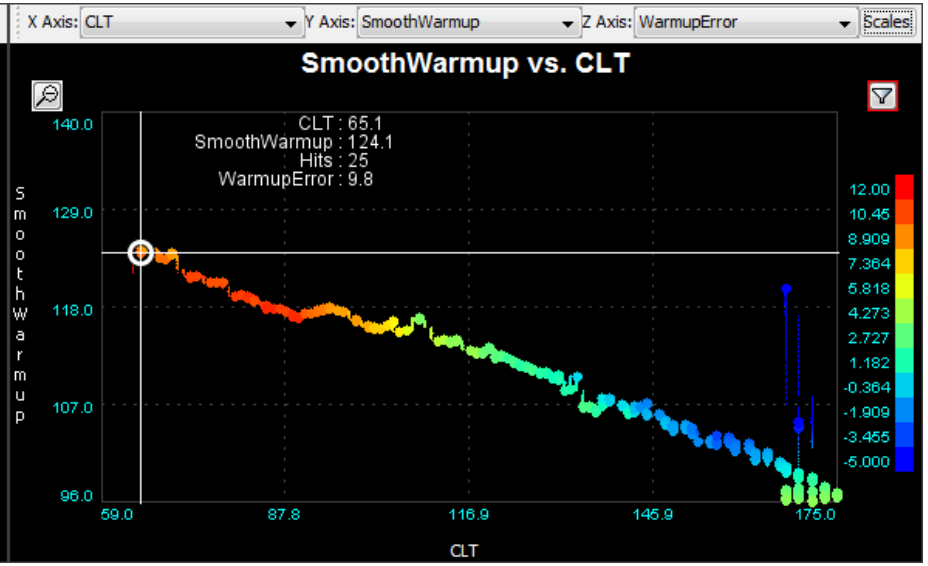
How?? Where did the new curve come from?
Desired Warm up for a single point would be:
Desired Warmup = [Gwarm] * ([Gego]/100) * ([AFR]/[targetAFR])
Add Smoothing:
Desired Warmup = [Gwarm] * (SmoothBasic([Gego], 20)/100) * (SmoothBasic([AFR], 20)/[targetAFR])

Solving WUE

Before



Recommended



- Original Warmup Enrichment off by -12 to +5 Percent, easily seen here. (Z Axis on Right)
- Now simply enter these values back into TunerStudio.

A couple Custom fields and knowing what to display, the correct WUE inputs are suddenly apparent.