Trend Analysis Software.

Adrian Johnson
Senior Operations Technician
Diamond Light Source

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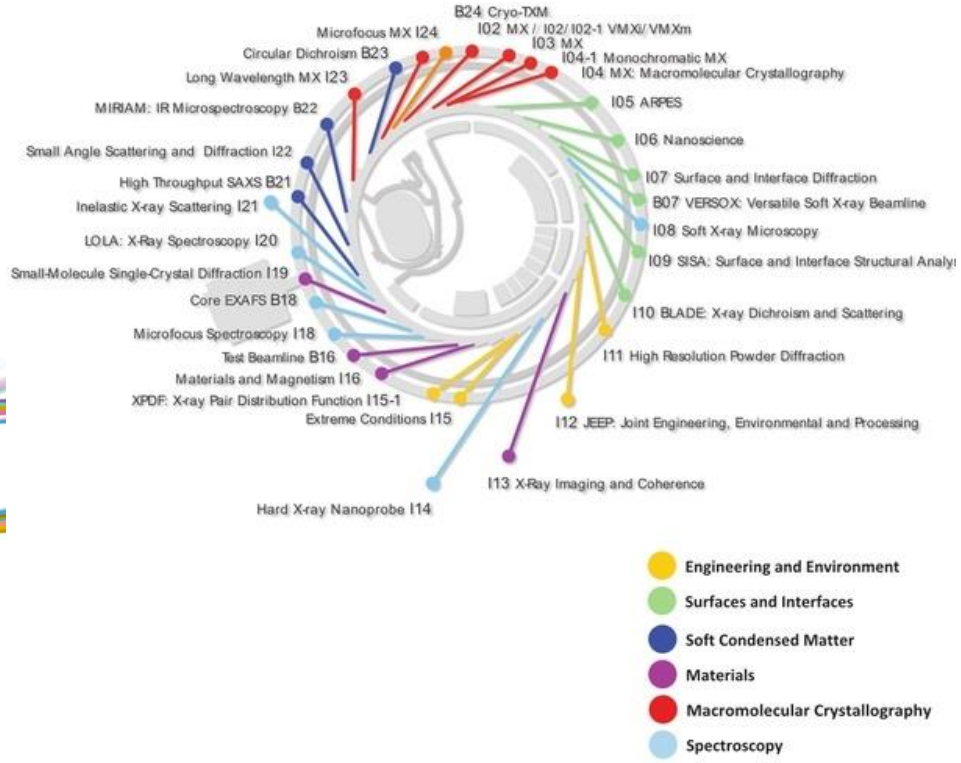
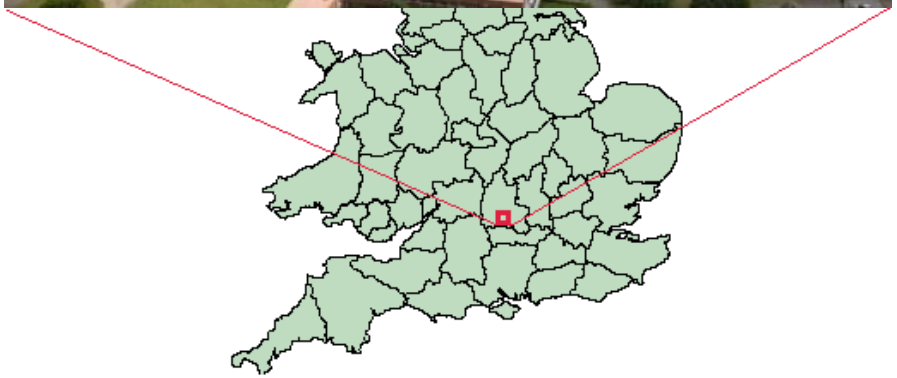
Overview of Diamond

- 3rd Generation Light Source.
- Opened for Users in 2007.
- Currently 26 operational Beamlines.
- 4 Beamlines currently under construction.
- Total of 32 Beamlines by 2017.





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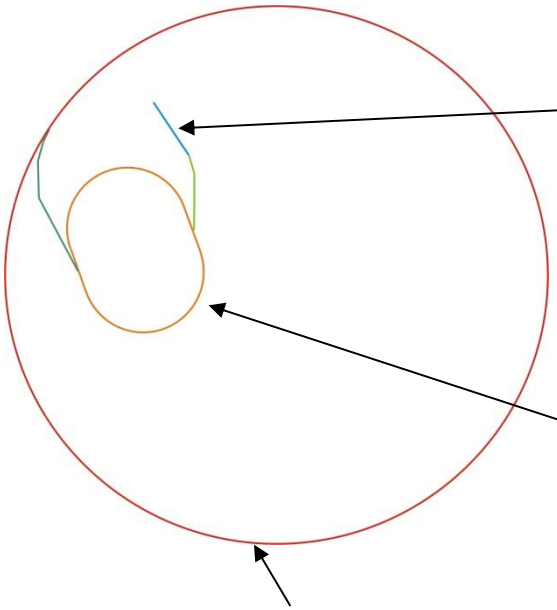
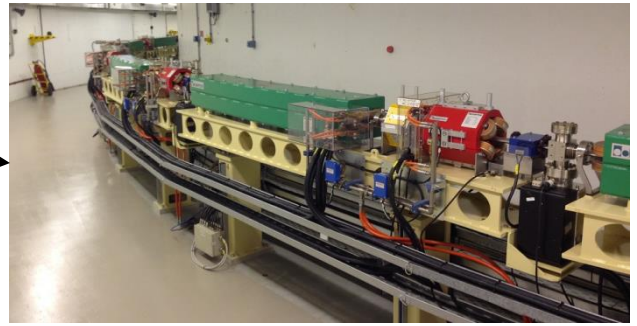
Overview of Diamond Accelerators



100MeV Linac

3GeV Booster



3GeV Storage Ring

- 561.6m Circumference.
- 300mA stored beam.
- Running in Top up (10min cycles).

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Archive Data Available

- Diamond uses EPICS Control System & Data Archive.
- Over 110,000 Process Variables (PV's) are Archived.
- Not all of them are of interest.
- Interested in things such as;
  - Water Flows,
  - Temperatures,
  - Pressures,
  - Voltages,
  - Currents,
  - Beam Diagnostics.

Archive Data Available

- Just looking at Storage Ring Temperatures, as an example.
  - Approx. 1300 temperature pvs are Archived.
    - 336 Water Temperatures
    - 360 Vessel Temperatures
    - 288 PLC Temperatures
    - 192 Vessel Thermocouples
    - 96 Control Cabin Temperatures
    - 24 Tunnel Air Temperatures ⟶

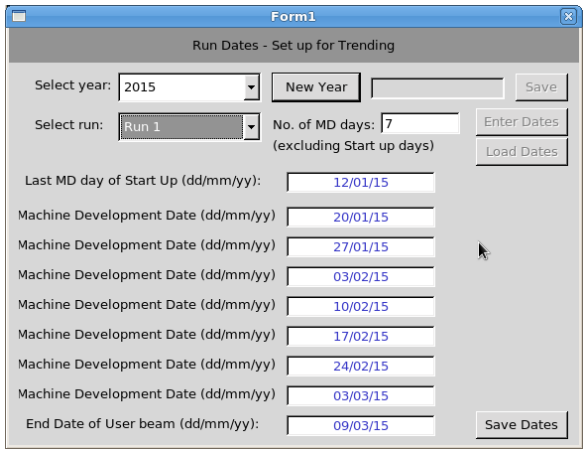
  - Using Archive viewer to examine 1300 PVs is impractical.
  - Using a system that rolls this data up into 6 displays, much easier and quicker.

Trend Analysis Software

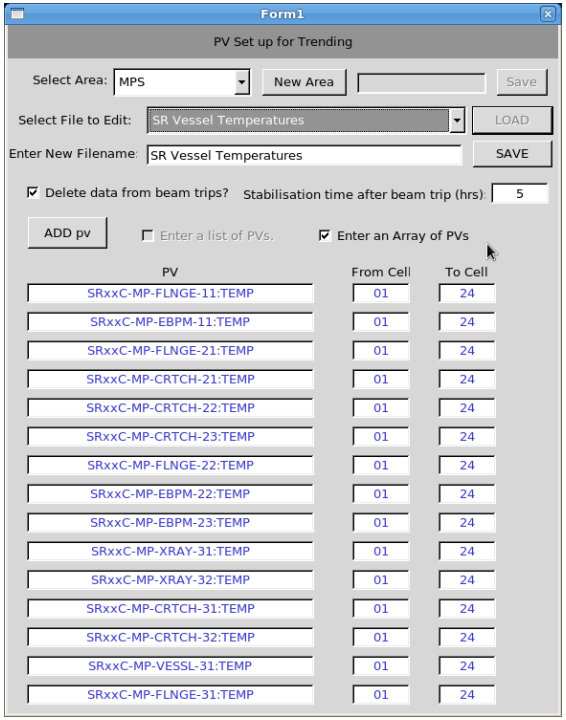
- Software Overview.
  - Provide early indication/warning of potential problems.
  - Read archive data on weekly basis
    - Beam conditions tend to change weekly.
  - Provide indication of:
    - Rising / Falling trends,
    - ‘Out of character’ data.
  - Requests 250 data points per pv.
    - Number actually returned depends on archiving method
  - Takes ~30s to retrieve data for ~300 pvs.
  - Written in python.

Trend Analysis Software

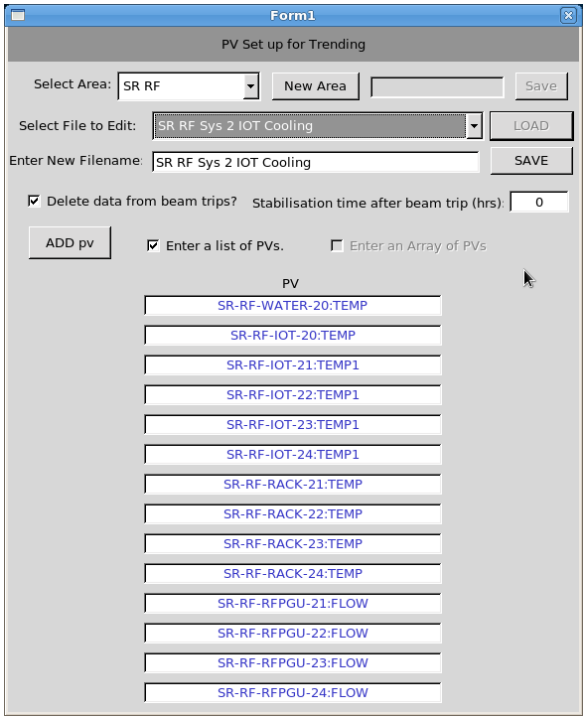
- Set-up GUIs



PV Array



PV List



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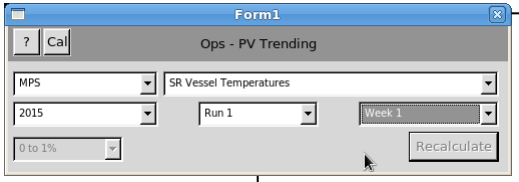
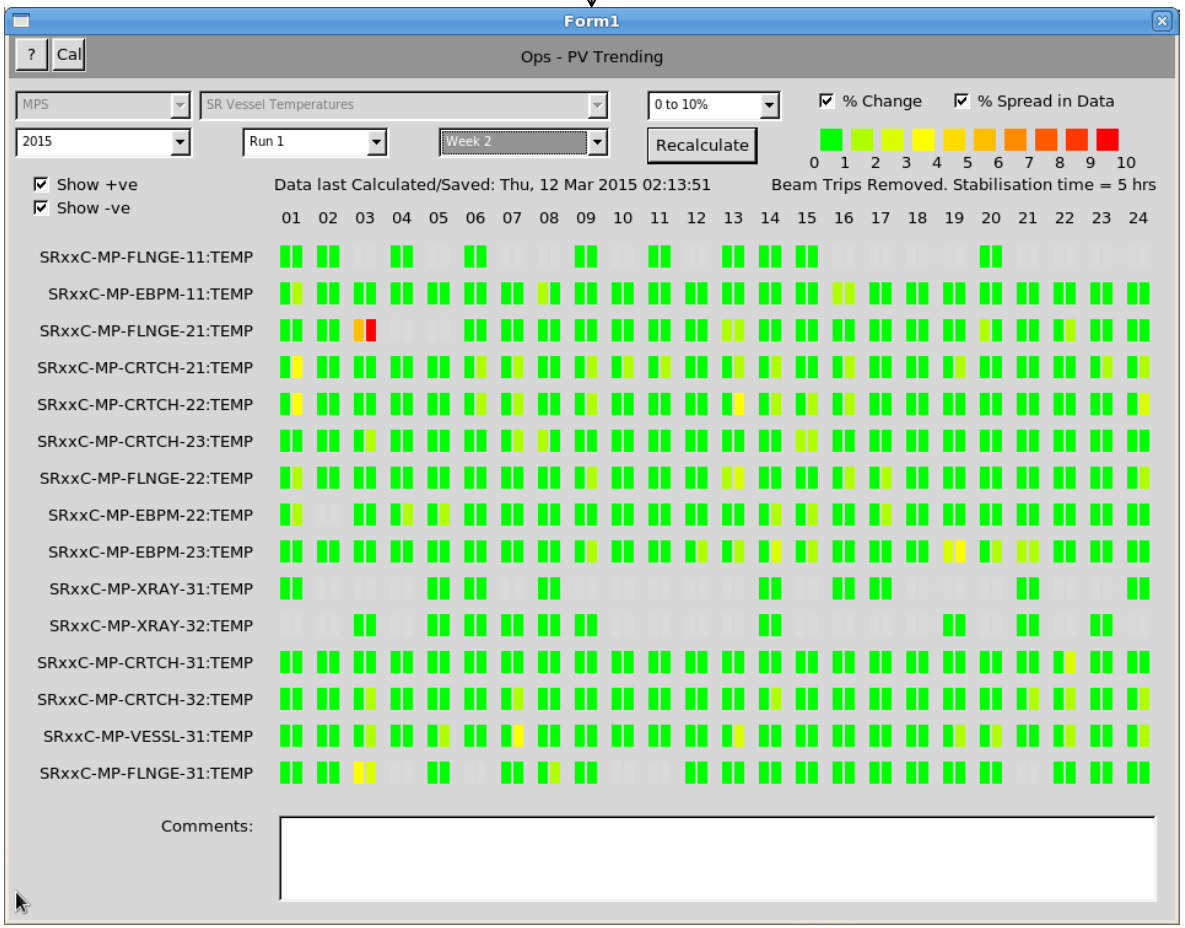
Trend Analysis Software

- Main GUI



PV Array



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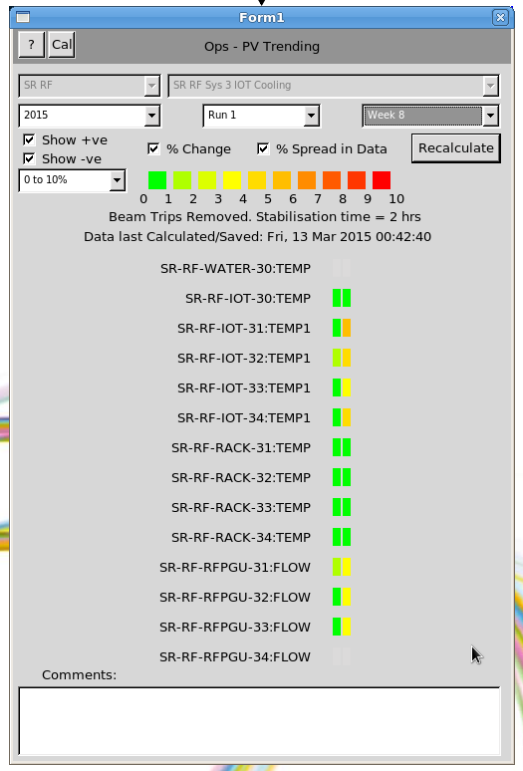
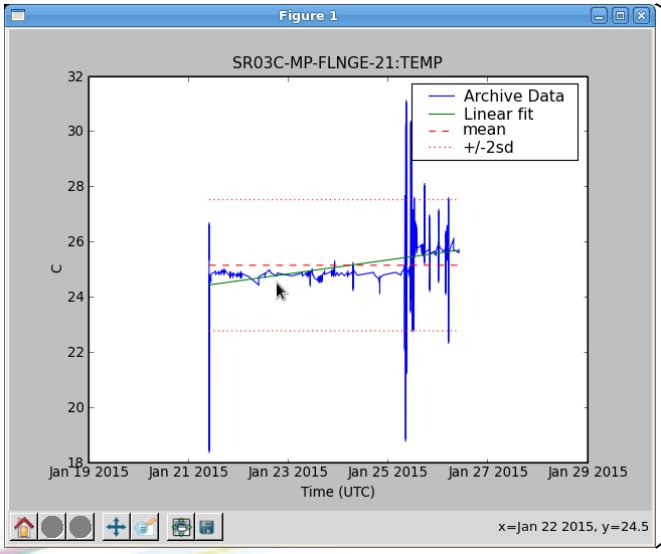
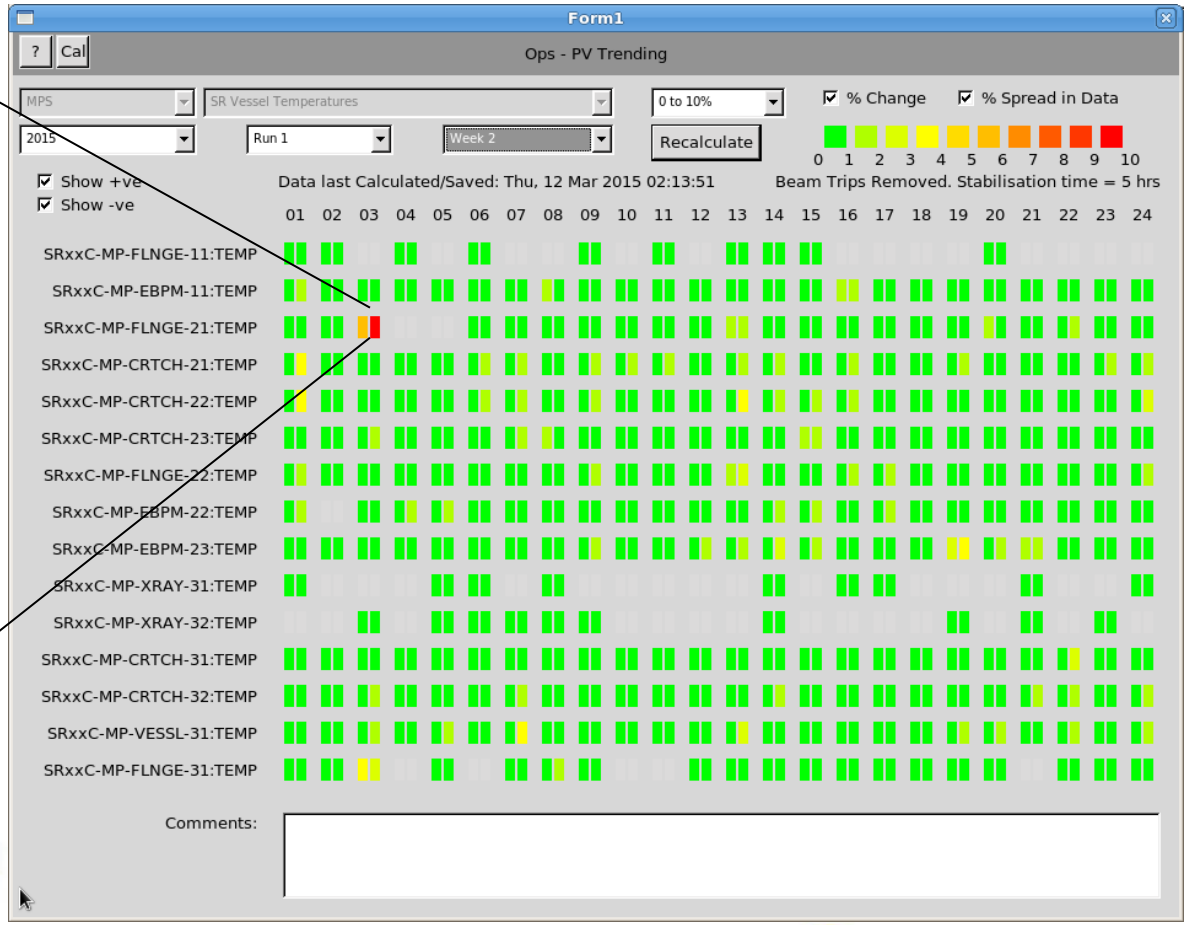


Trend Analysis Software

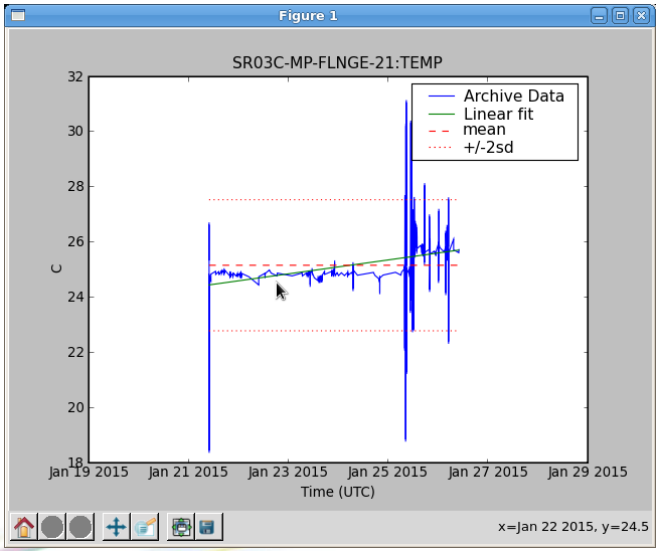
- Clicking on an Indicator opens Archive data for that one PV

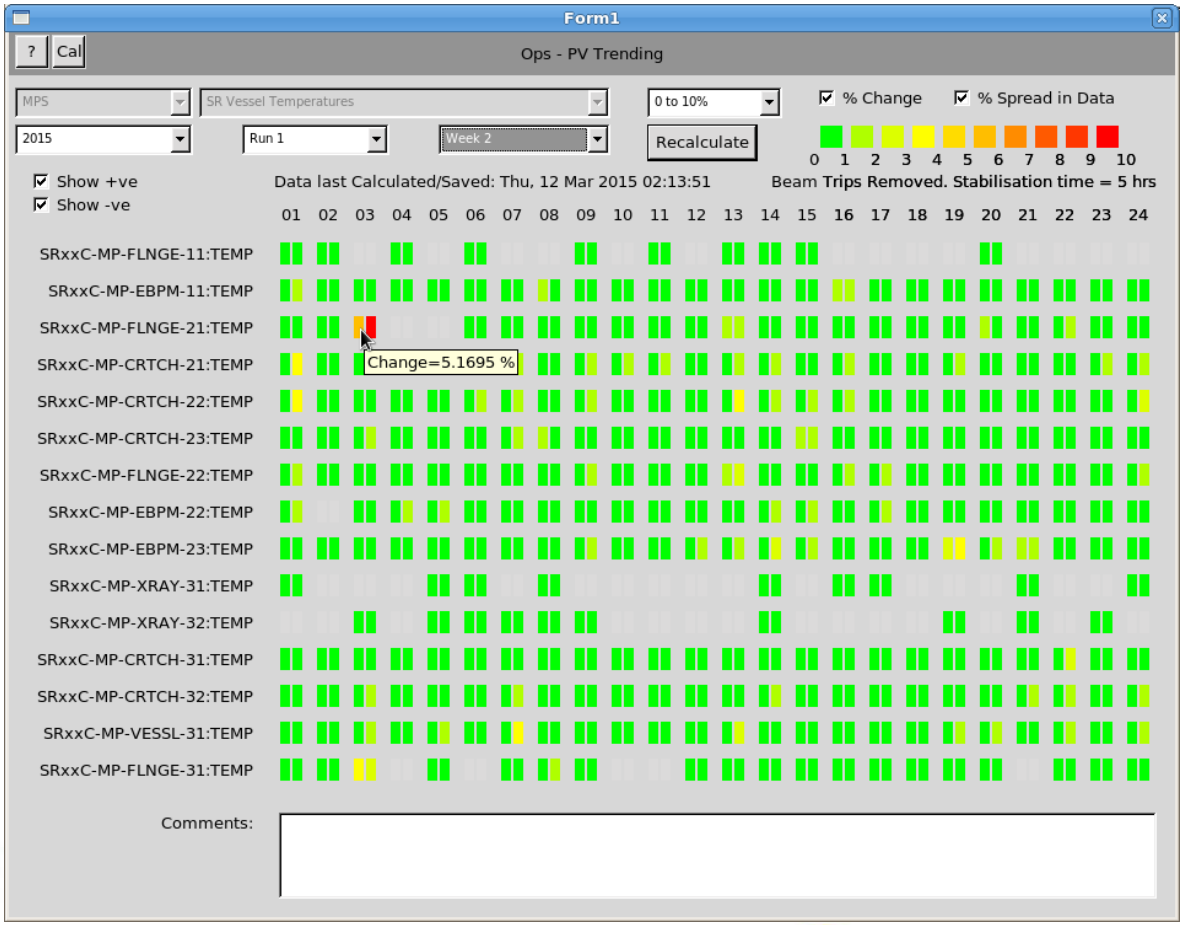




Trend Analysis Software

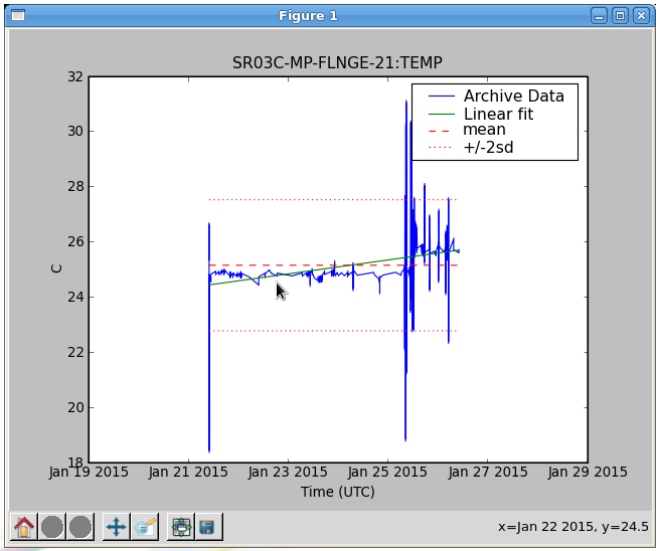
- Mouseover Left Indicator Shows % Change of linear fit



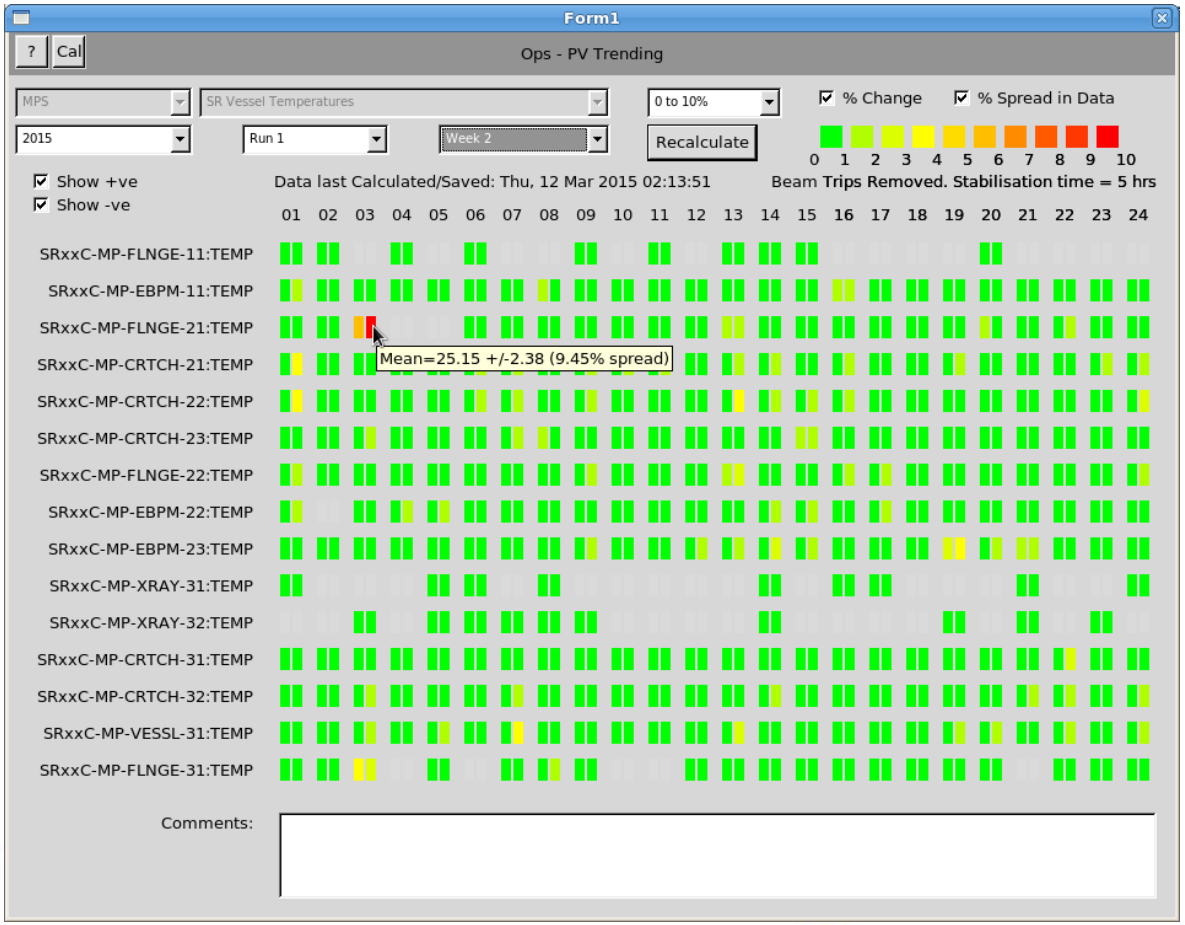


Trend Analysis Software

- Mouseover Right Indicator Shows % Spread in data

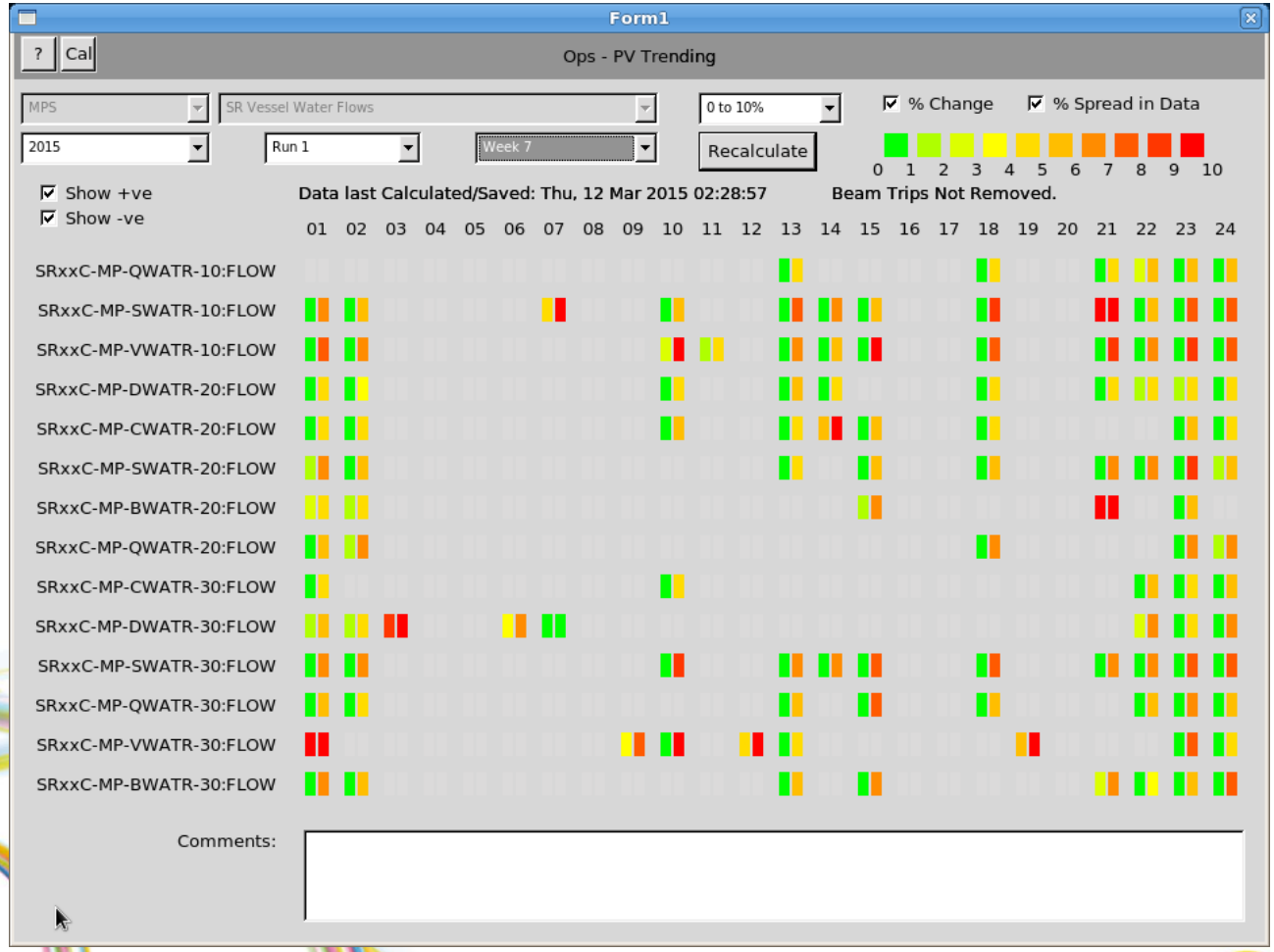


SR03C-MP-FLNGE-21:TEMP
HIHI = 50.0 ºC
HIGH = 40.0 ºC
LOW = 10.0 ºC
LOLO = 0.0 ºC



Trend Analysis Software

- Not always as obvious as previous example.

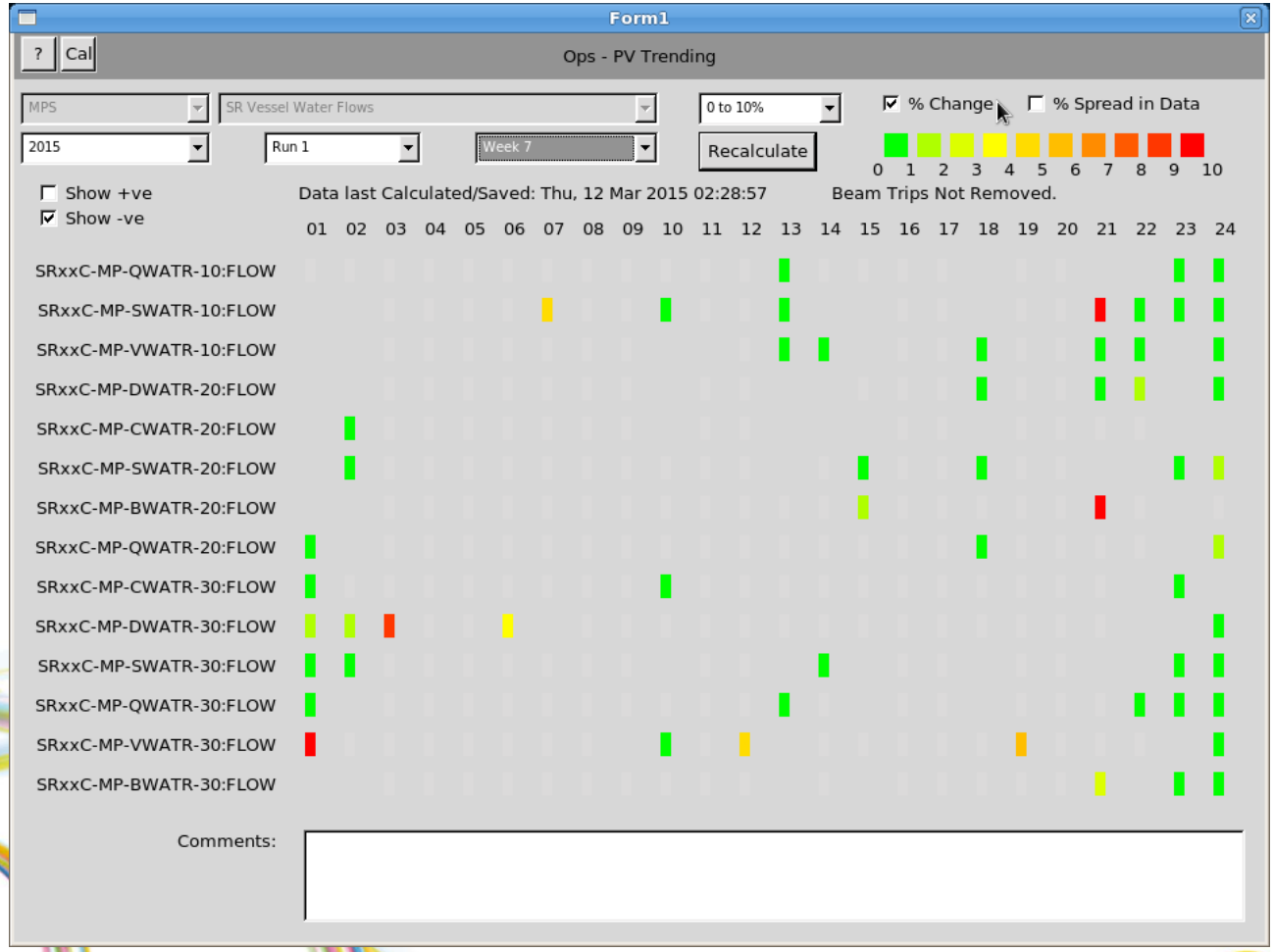


Trend Analysis Software

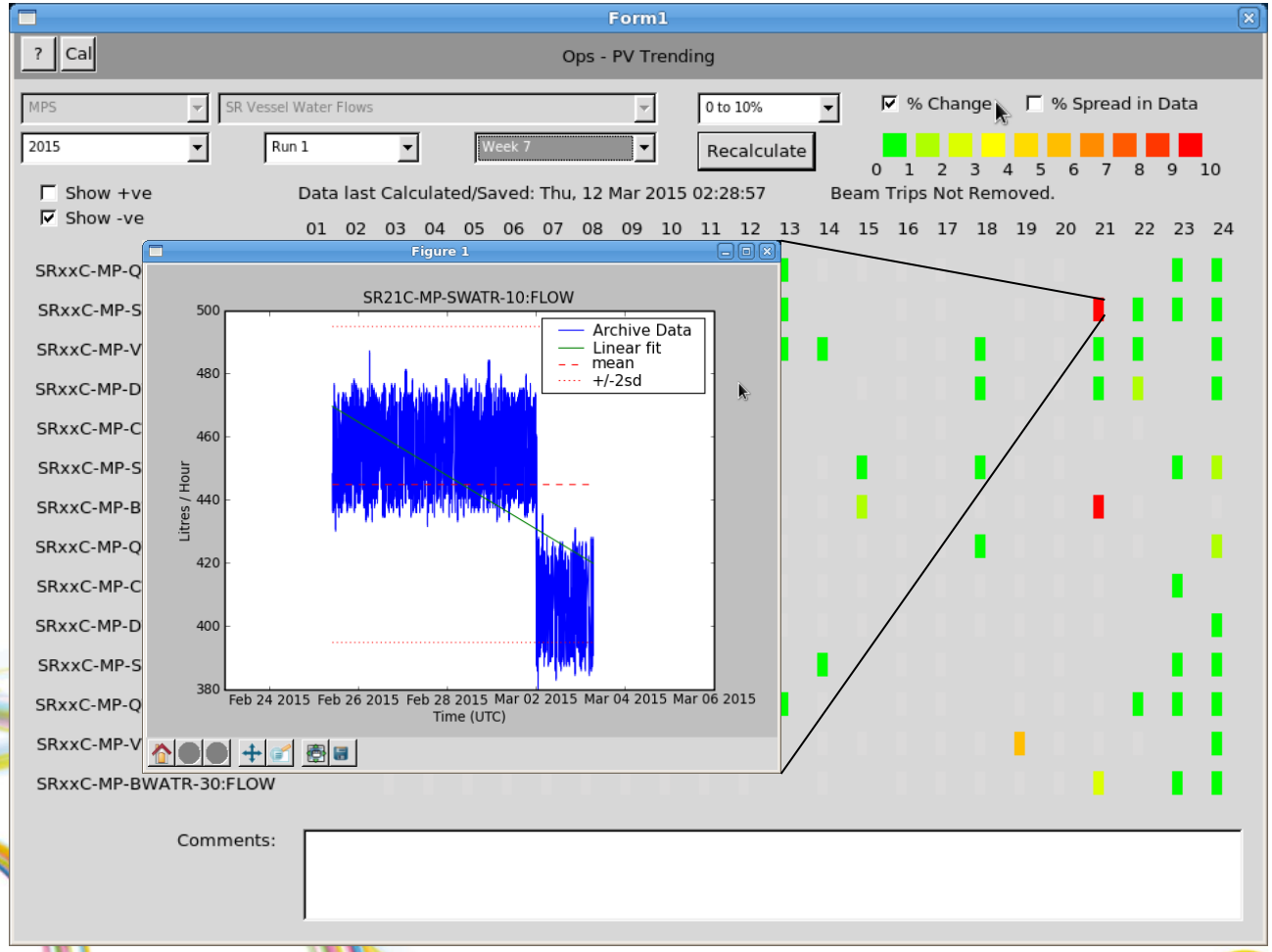
- Hide increasing % change.

Trend Analysis Software

- Hide % spread.



Trend Analysis Software

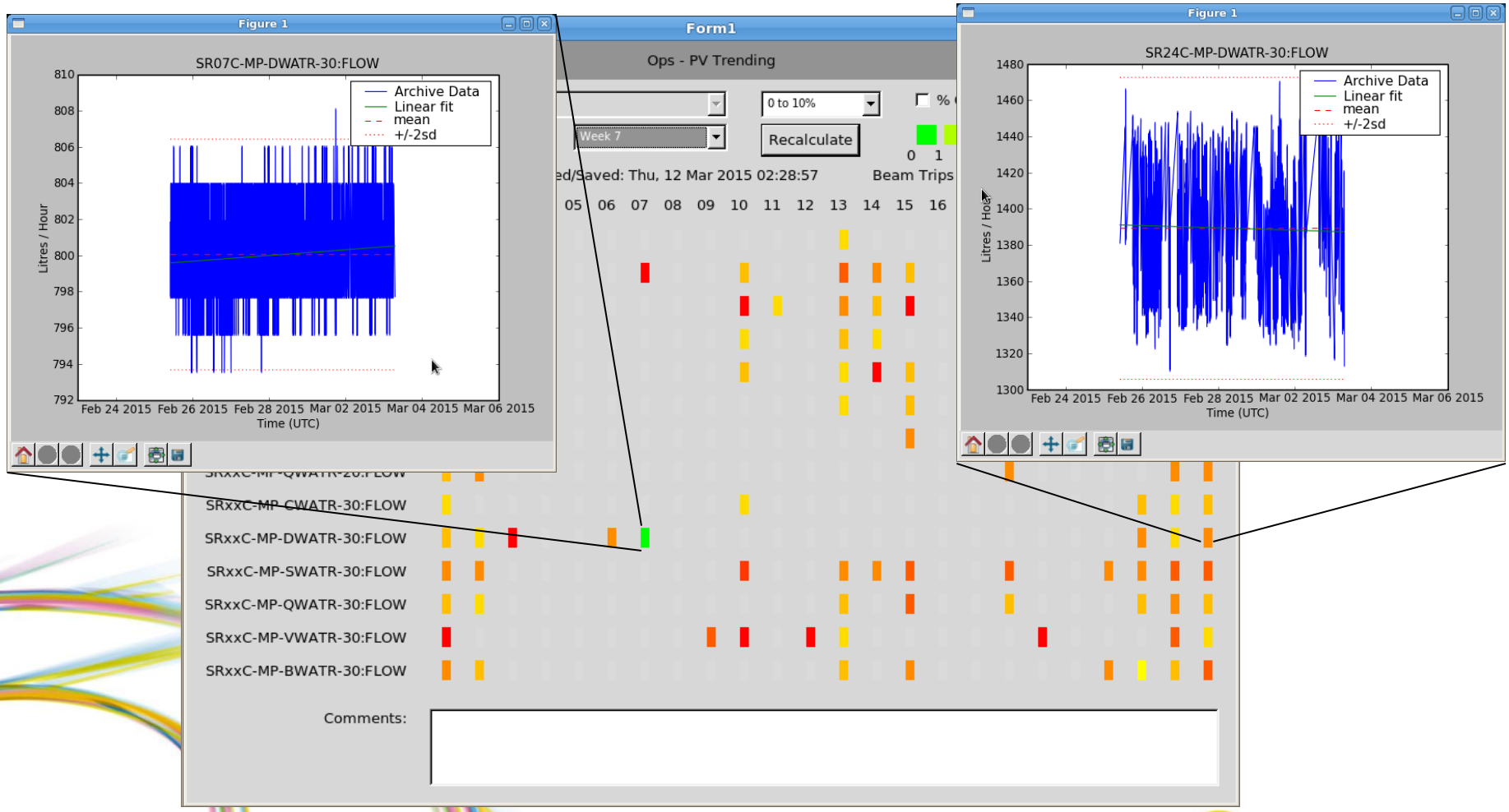


Trend Analysis Software

- Show % Spread only.

Trend Analysis Software

- Show % Spread only.



Where Next

- Currently the analysis is done manually on Sun or Mon
  - To gather enough data during the week.
  - Repairs / further investigation can be done during Machine Development Tuesdays.
  - Only gets done by One Operator,
    - Depending on shift patterns / leave it might not get done.
- Write a script only ‘gui-less’ version that is scheduled to run every Monday morning.
  - E-mail results for further investigation.

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Summary

- The trend analysis software enables large arrays of archive data to be assessed:
  - Quickly,
  - For rising / falling trends,
  - For noisy / failing / failed sensors.

- Thereby providing early indication of potential problems.