

# Data visualization with the Grafana platform at HZDR



S. E. Müller

*FWCC & FWK*

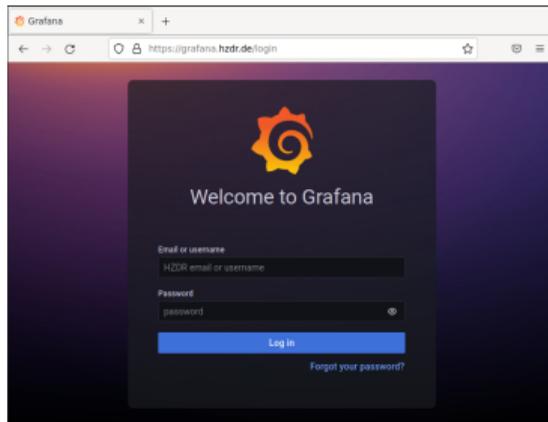
FWK Tutorial,  
*November 26, 2024*

DRESDEN  
concept



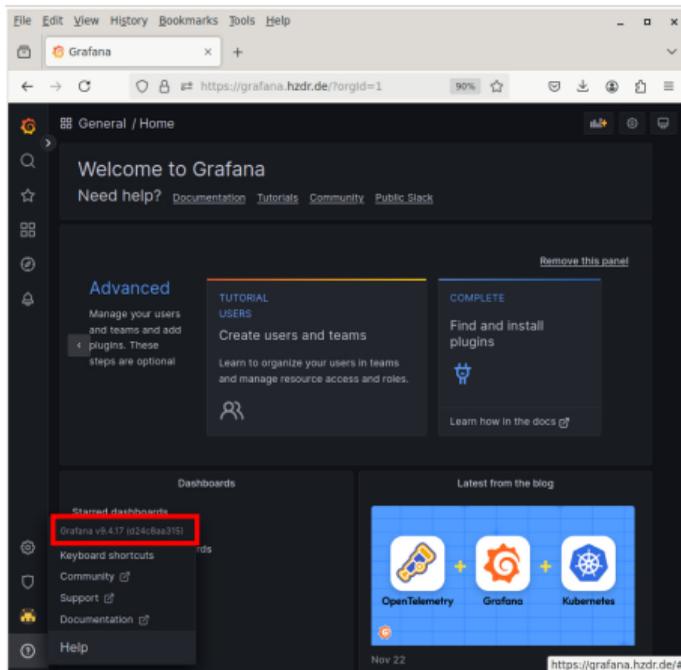
**HZDR**  
HELMHOLTZ ZENTRUM  
DRESDEN ROSSENDORF

- **Grafana** is a platform which allows (among other things) to visualize time-series data
  - developed by Grafana Labs
  - <https://grafana.com>
  - <https://github.com/grafana/grafana>
- **HZDR** hosts the Open Source version of **Grafana** under <https://grafana.hzdr.de>
  - interfaced with LDAP (log in with your HZDR account)
  - accessible from inside HZDR (behind the firewall)

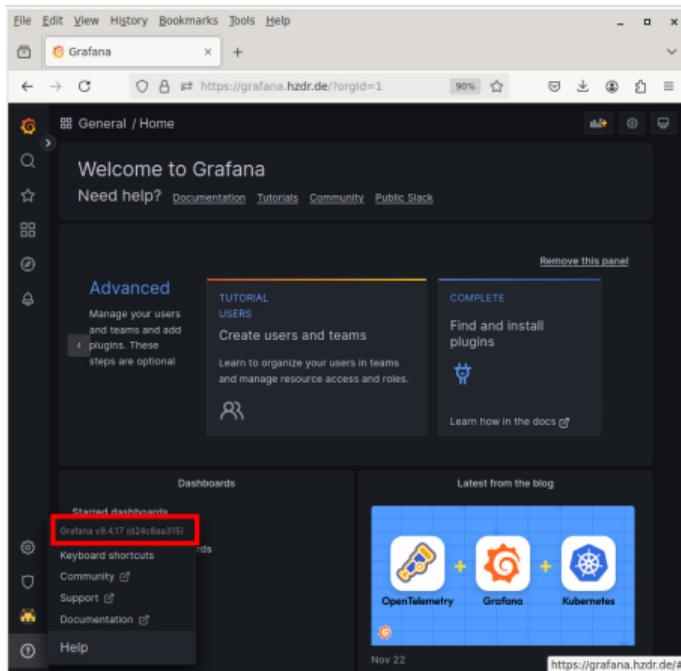




- Currently, we are running version 9.4.17:



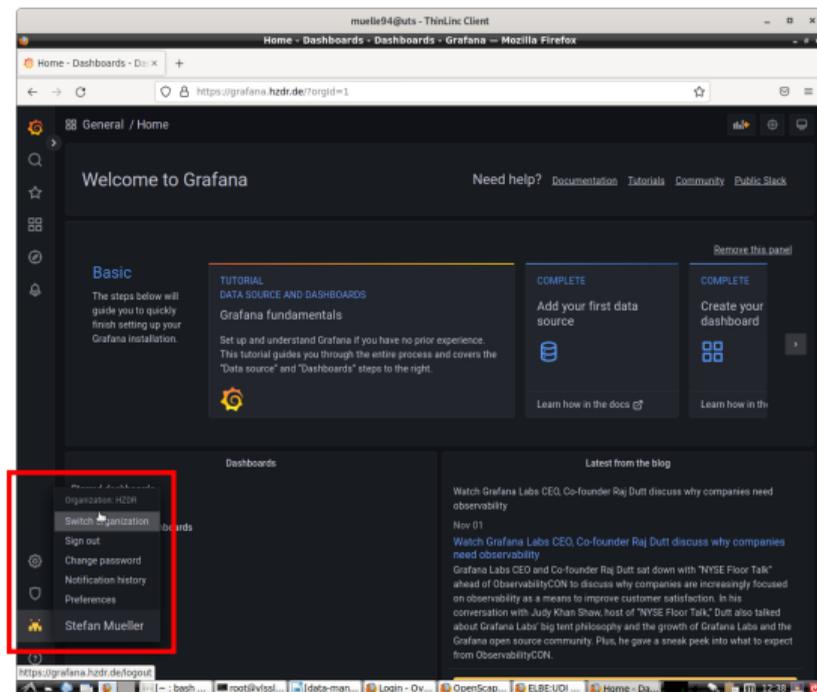
- Currently, we are running version 9.4.17:



- Latest **Grafana** version is 11.3
  - need to understand breaking changes before updating

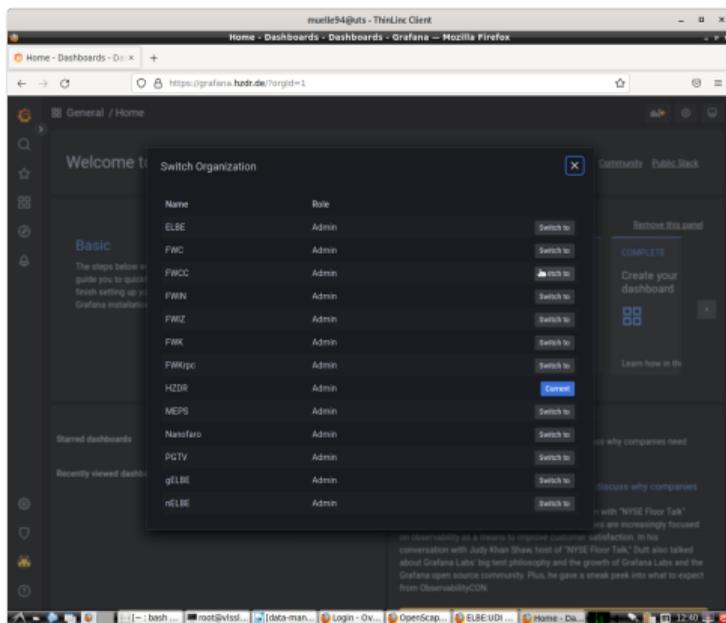
# Organizations

In **Grafana**, users are grouped in “*Organizations*”. New users are automatically added to the *Organization* “HZDR”. *Organization* admins can add users to their *Organization*. Switching *Organizations* is done by clicking on the User icon in the lower left and choosing “Switch Organization”:



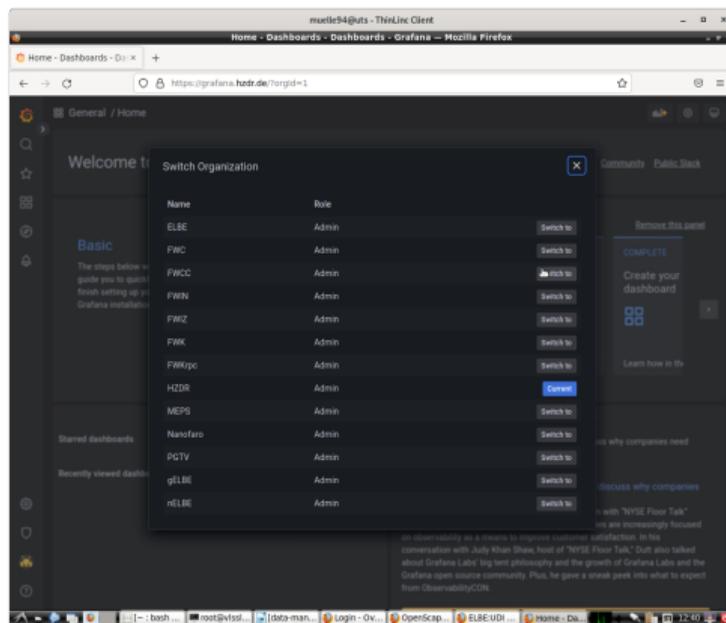
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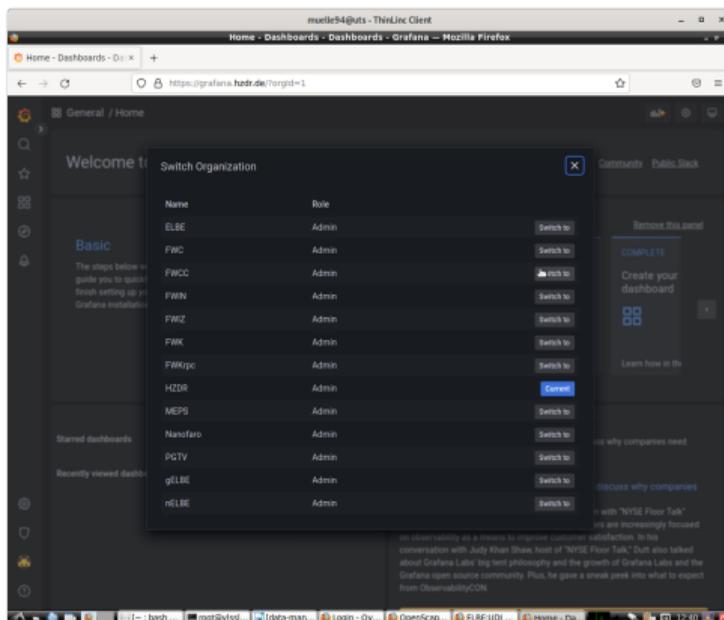
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If you need a new organization to be set up for you, please contact  
**Oliver Knodel** or **Stefan Müller**

# Organizations

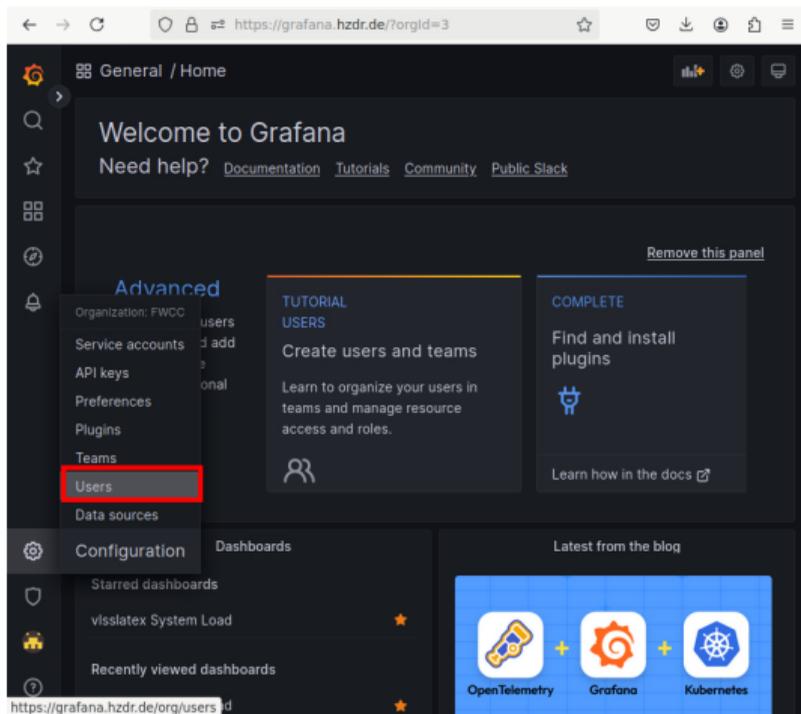
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**Grafana** now also allows to group a set of users with the same permission sets into **Teams** within organizations.

# How-To: Adding users to organizations

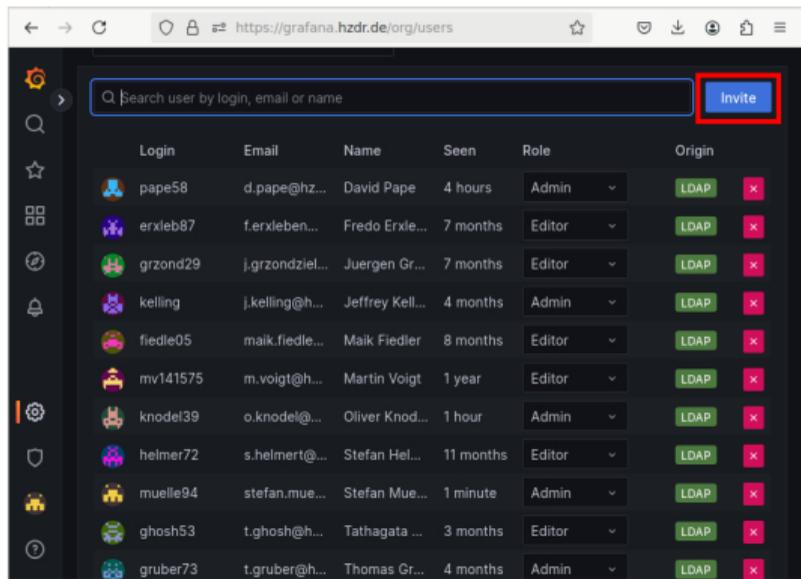
**Organization** admins can add new users to their organization:



Select **Users** from the **Configuration** menu in the lower left.

# How-To: Adding users to organizations

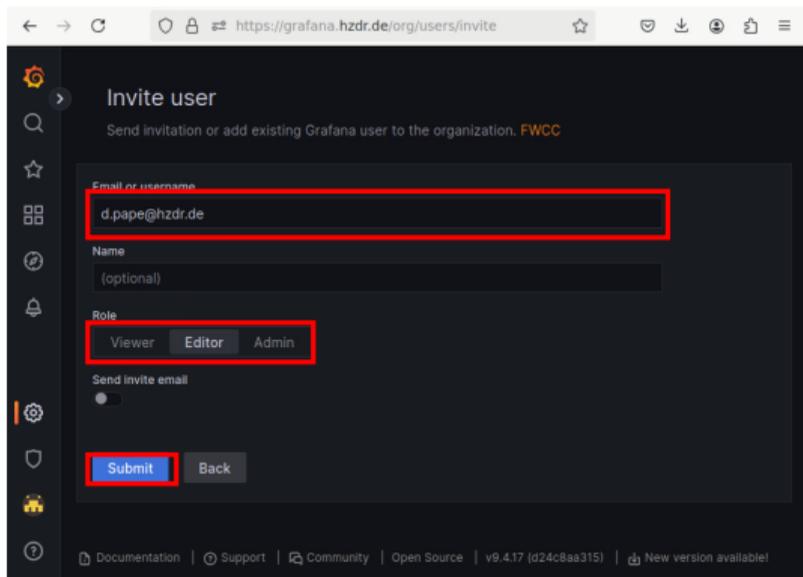
**Organization** admins can add new users to their organization:



Click the **Invite** button (email field can be left blank).

# How-To: Adding users to organizations

**Organization** admins can add new users to their organization:



The screenshot shows the 'Invite user' form in the Grafana web interface. The browser address bar shows 'https://grafana.hzdr.de/org/users/invite'. The form title is 'Invite user' with a subtitle 'Send invitation or add existing Grafana user to the organization, FWCC'. The form contains the following fields and controls:

- Email or username:** A text input field containing 'd.pape@hzdr.de', highlighted with a red box.
- Name:** A text input field with '(optional)' below it.
- Role:** A selection area with three buttons: 'Viewer', 'Editor', and 'Admin'. The 'Editor' button is highlighted with a red box.
- Send invite email:** A toggle switch currently turned off.
- Submit:** A blue button highlighted with a red box.
- Back:** A grey button.

At the bottom of the page, there is a footer with links for 'Documentation', 'Support', 'Community', 'Open Source', version 'v9.4.17 (d24c8aa315)', and a 'New version available!' notification.

Insert the email-address or HZDR username, chose a **role** and click the **Submit** button (switch off “Send invite email”).

- User needs to be registered in **Grafana**'s user list - needs to login before

## Where is the data?

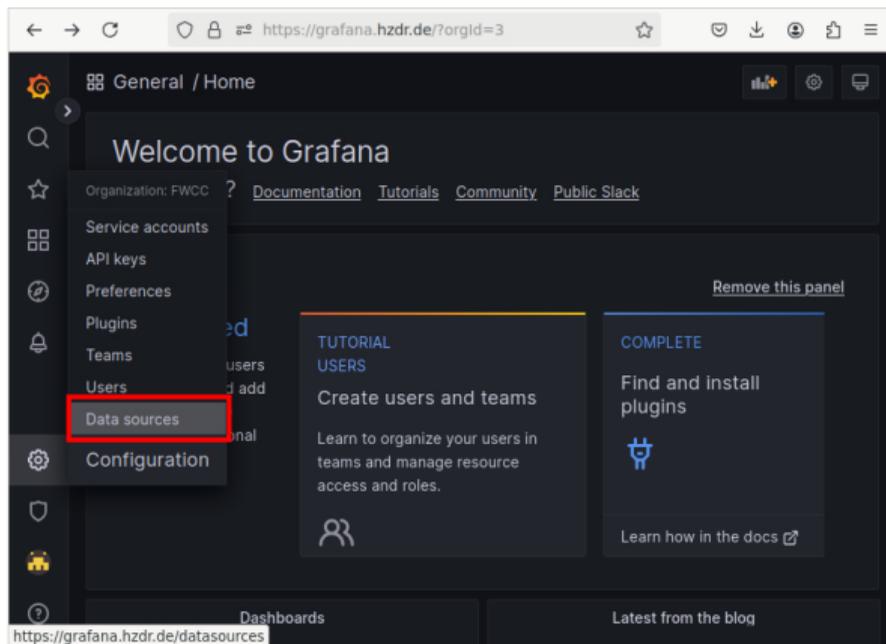
**Grafana** only displays the data, but does not store it. Most of the displayed data resides on a virtual machine hosting a **InfluxDB** time-series database.

- **InfluxDB** provides an efficient data transfer to **Grafana**
- Data can be pushed to the database using
  - Python scripts
  - LabView VIs
  - c++
  - **Telegraf** agent
  - ...
- API is provided
- Installed on a virtual machine in the computing center (v1.8.10 version)
  - v2.7.4 used exclusively by ELBE - concepts are different, not sure about scalability
- InfluxDB key concepts are nicely explained [here](#) (v.1.8)
- InfluxDB databases can be connected as “*data sources*” in **Grafana** to feed your dashboards

Please contact [Oliver Knodel](#) or [Stefan Müller](#) if you would like to store data in our **InfluxDB**.

# How-To: Add a data source

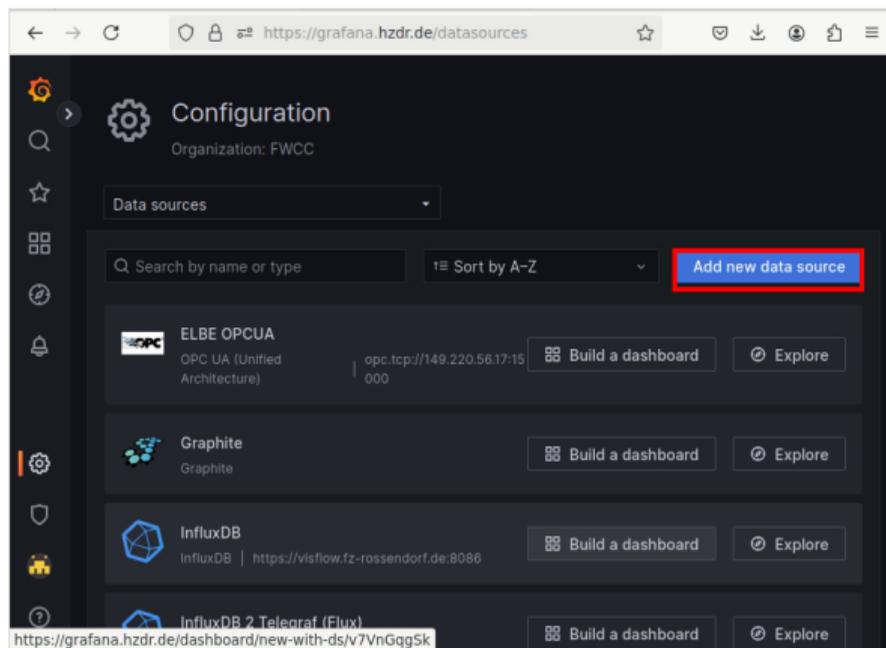
**Data sources** can be added on a “per organization” level by **organization** admins:



Select **Data sources** from the **Configuration** menu in the lower left.

# How-To: Add a data source

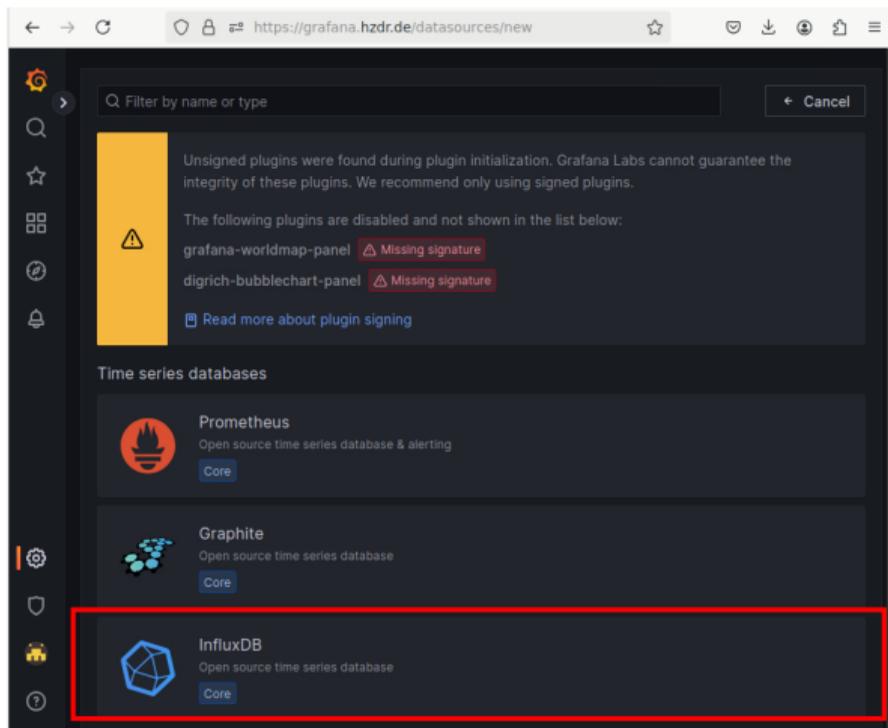
**Data sources** can be added on a “per organization” level by **organization** admins:



Click **Add new data source**.

# How-To: Add a data source

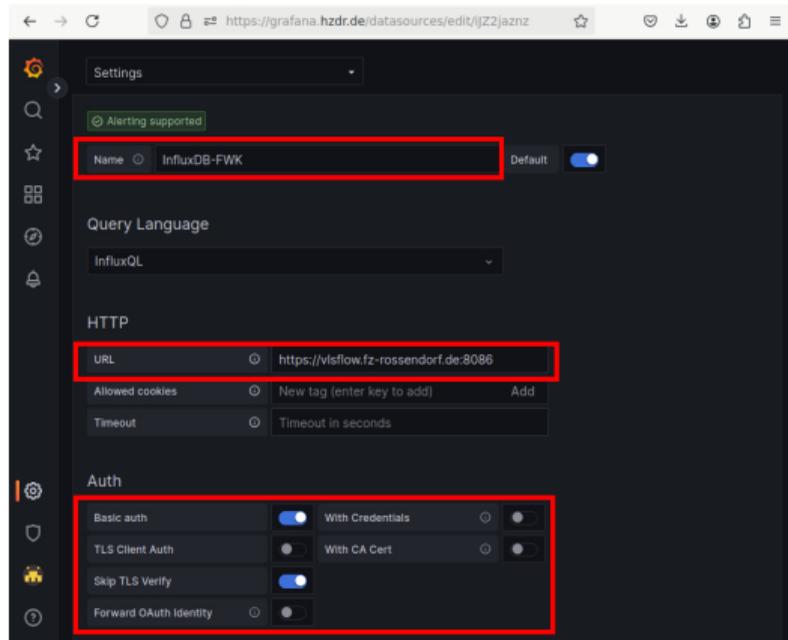
**Data sources** can be added on a “per organization” level by **organization** admins:



Select **InfluxDB**.

# How-To: Add a data source

**Data sources** can be added on a “per organization” level by **organization** admins:



Specify a name, give the URL `https://vlsflow.fz-rossendorf.de:8086`, and select **Basic Auth** and **Skip TLS verify**.

# How-To: Add a data source

**Data sources** can be added on a “per organization” level by **organization** admins:

The screenshot shows the Grafana interface for configuring a data source. The URL in the browser is `https://grafana.hzdr.de/datasources/edit/jj2jajnz`. The page is divided into several sections:

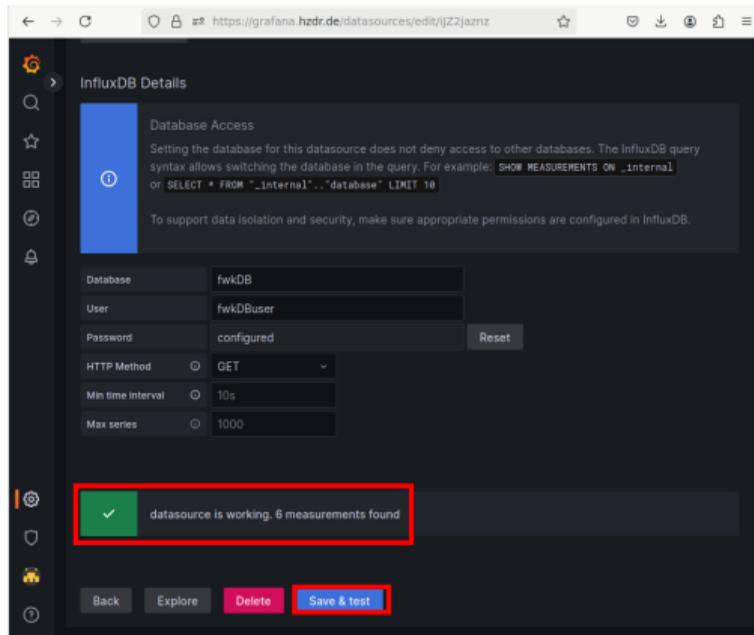
- Basic Auth Details:** A table with two rows: 'User' with value 'fwkDBuser' and 'Password' with value 'configured'. A 'Reset' button is to the right.
- Custom HTTP Headers:** A section with a '+ Add header' button.
- InfluxDB Details:** A section with a blue header and a 'Database Access' sub-section. Below this, there are fields for 'Database' (fwkDB), 'User' (fwkDBuser), 'Password' (configured), and 'HTTP Method' (GET). A 'Reset' button is to the right of the 'Password' field.
- Other fields:** 'Min time interval' (10s) and 'Max series' (1000).

At the bottom, there are buttons for 'Back', 'Explore', 'Delete', and 'Save & test'.

Give username and password for your **InfluxDB** access (twice!), and the name of your database in **InfluxDB**.

# How-To: Add a data source

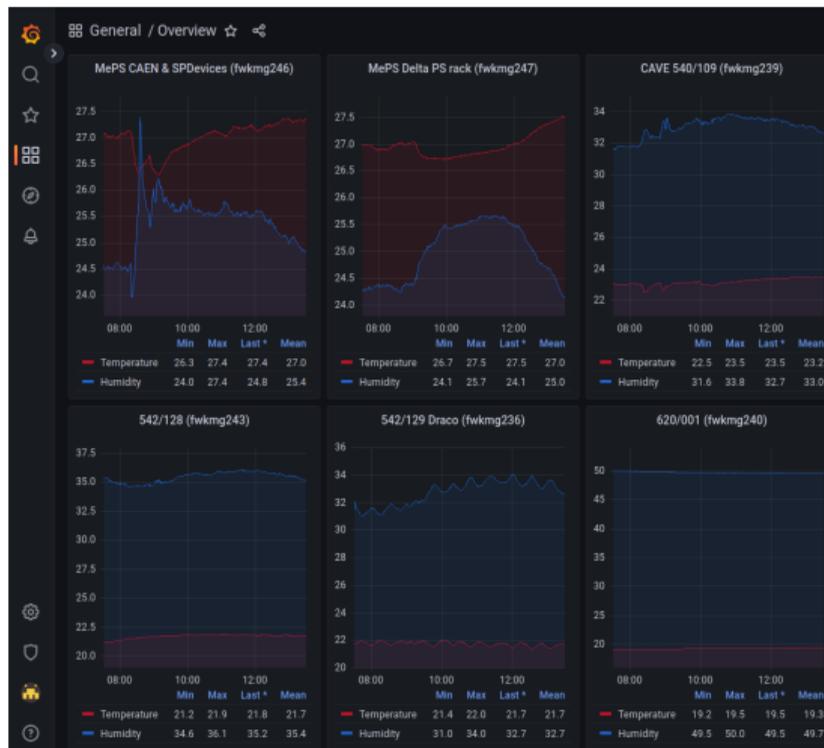
**Data sources** can be added on a “per organization” level by **organization** admins:



Click **Save & test**. You should get a message whether the connection to the database is working.

# Dashboards - examples

**Grafana** displays data on dashboards which consist of several panels:



Humidity and temperature logging by FWK

# Dashboards - examples

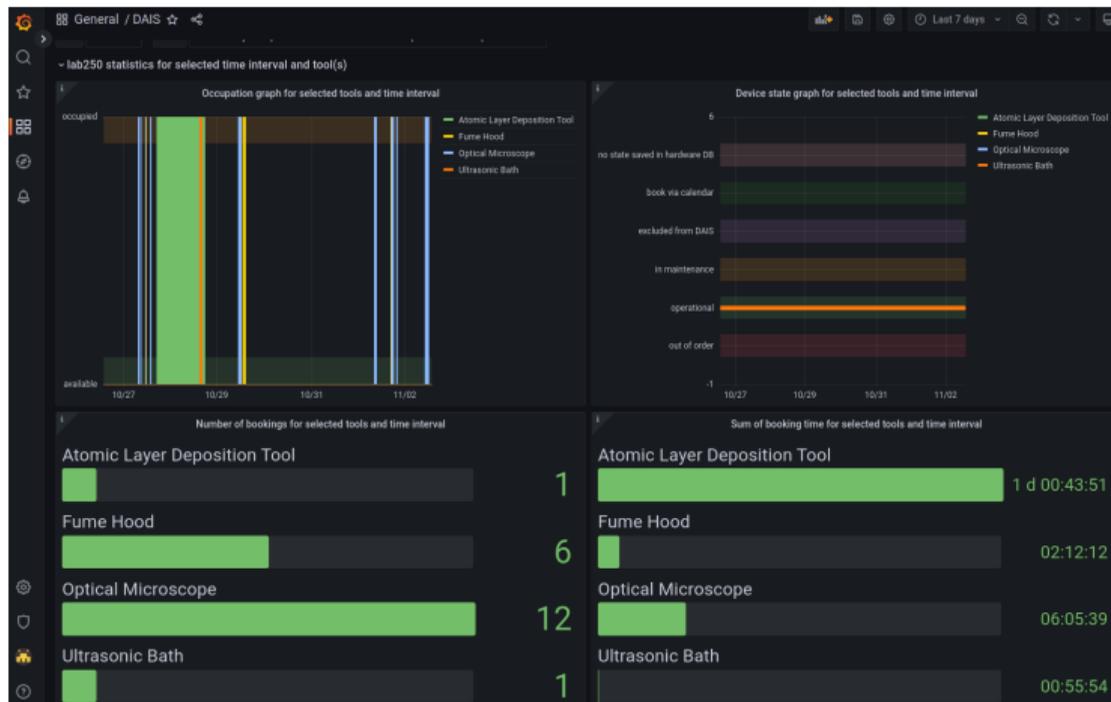
**Grafana** displays data on dashboards which consist of several panels:



Cryocompressor logging by K. Lenz (FWIN)

# Dashboards - examples

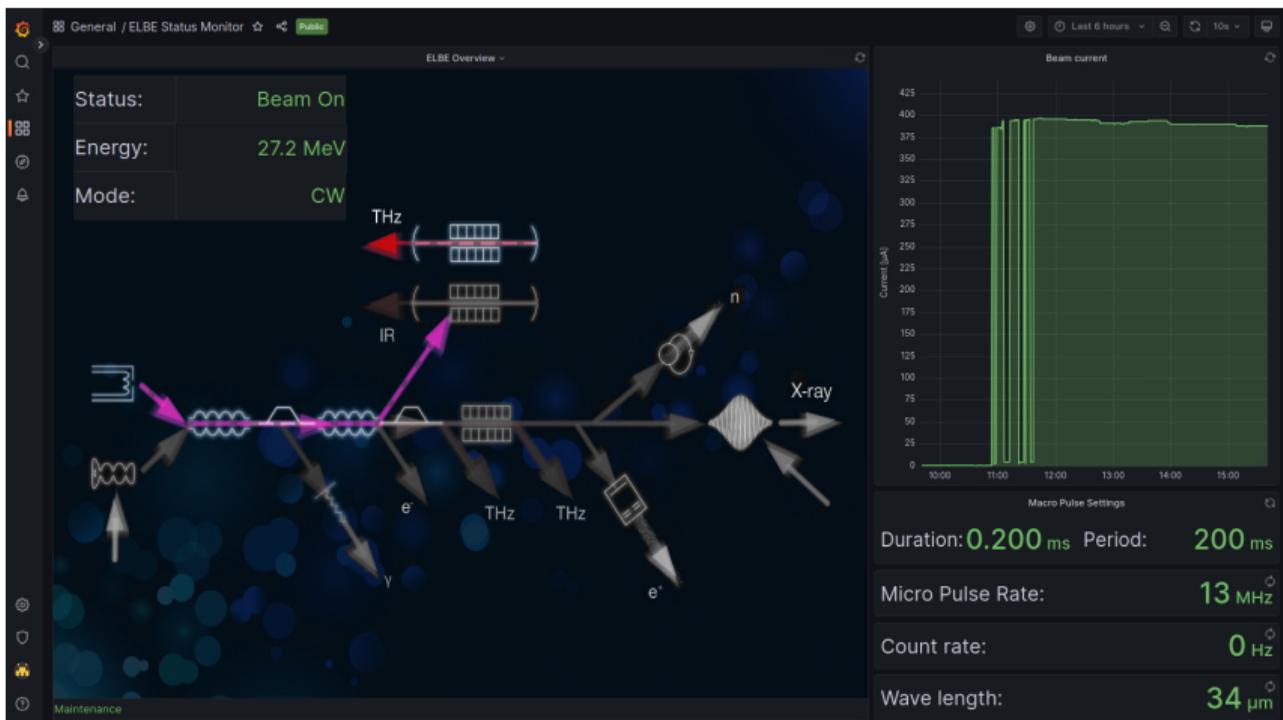
**Grafana** displays data on dashboards which consist of several panels:



Device Activity Information System (DAIS) dashboard by T. Schönherr (FWIO)

# Dashboards - examples

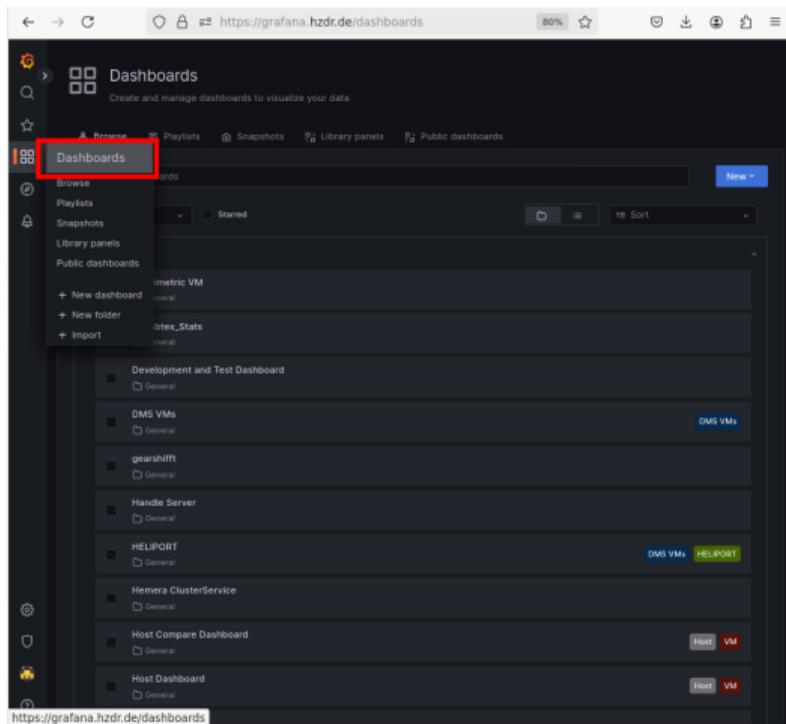
**Grafana** displays data on dashboards which consist of several panels:



ELBE Status Monitor dashboard by K. Zenker (FWKE)

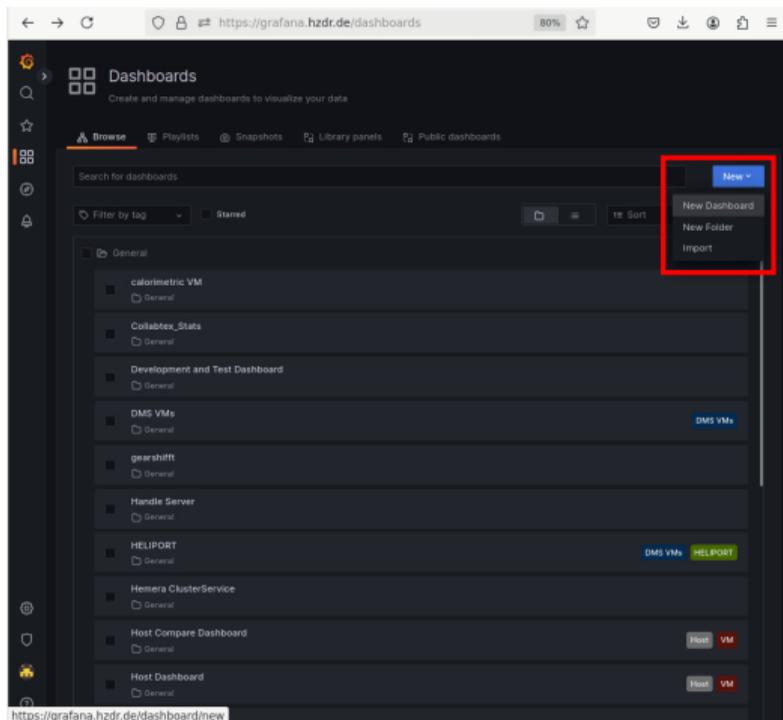
# How-To: Set up a dashboard

Click the **Dashboards**-symbol to go to the *Dashboard*-menu:



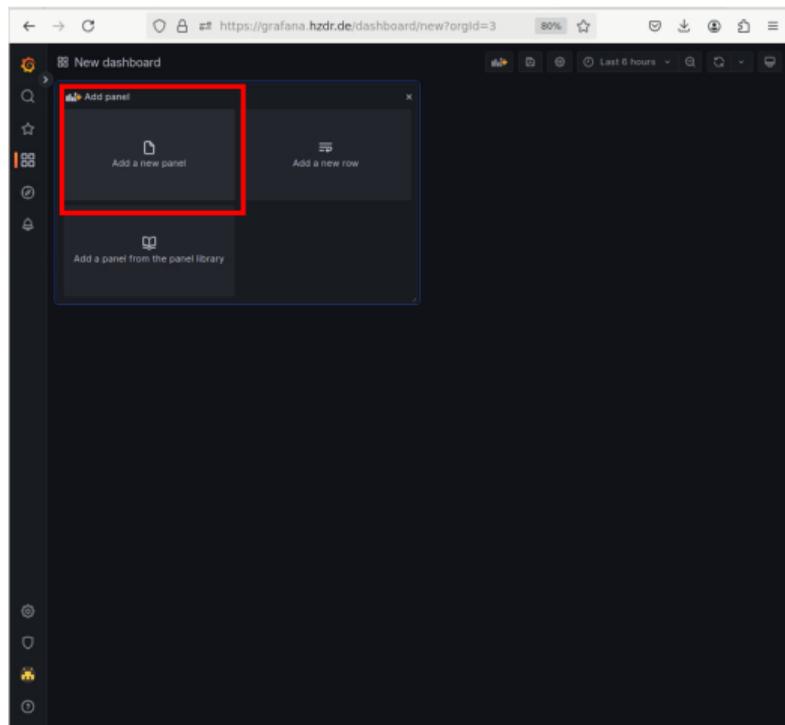
# How-To: Set up a dashboard

Click the **New**-symbol and select *New dashboard*:



# How-To: Set up a dashboard

Select *Add a new panel*:



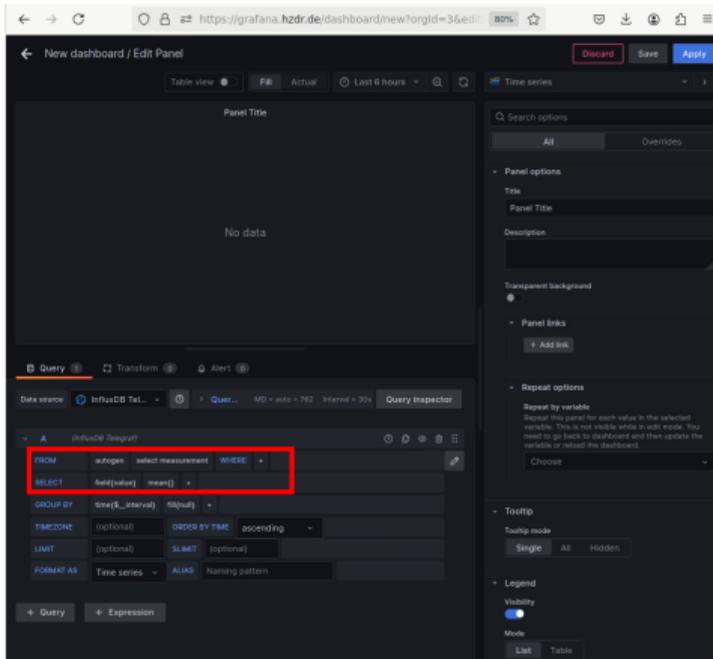
# How-To: Set up a dashboard

Choose your data source:

The screenshot shows the Grafana interface for creating a new dashboard panel. The browser address bar indicates the URL: <https://grafana.hzdr.de/dashboard/new?orgId=36edit>. The main panel area is currently empty, displaying "No data". Below the panel, the "Query" editor is active, showing a "Data source" dropdown menu. This menu is open, displaying a list of data sources: InfluxDB Tel..., ELBE OPCUA, Graphite, InfluxDB, InfluxDB 2: Telegraf (Flux), InfluxDB Telegraf (default), InfluxDB Test Instance, InfluxDB-1, InfluxDB-clusterService, InfluxDB-Collabtex Stats, InfluxDB-Heliport Stats, and InfluxDB-Rodare Stats. The "InfluxDB" option is highlighted with a red box. The right-hand sidebar contains various configuration options for the panel, including "Search options", "Panel options", "Transparent background", "Panel links", "Repeat options", "Tooltip", and "Legend".

# How-To: Set up a dashboard

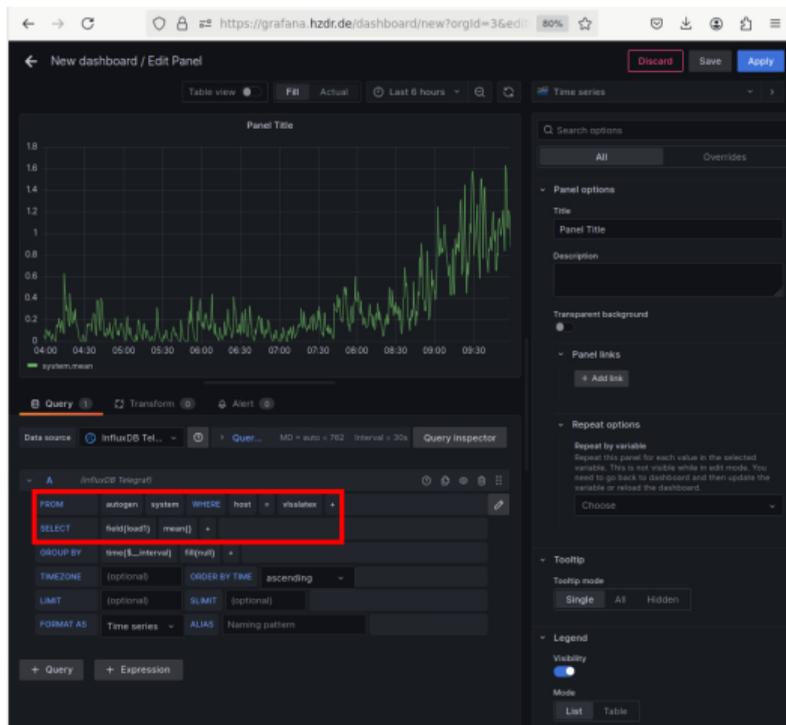
Configure your “*FROM*” and “*SELECT*” fields by clicking on them (does not work if data-source is configured with **InfluxDB**’s “*FLUX*” language):



- “*field(value)*” is a placeholder - if you have a field called “value” in your measurement, you have to explicitly select it
- “*\$\_interval*” is a default variable optimizing the graph layout

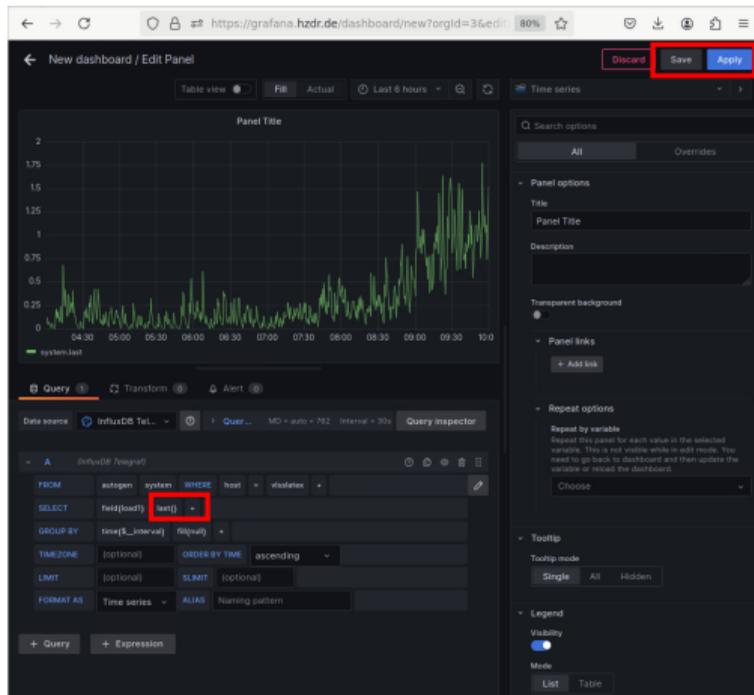
# How-To: Set up a dashboard

Result:



# How-To: Set up a dashboard

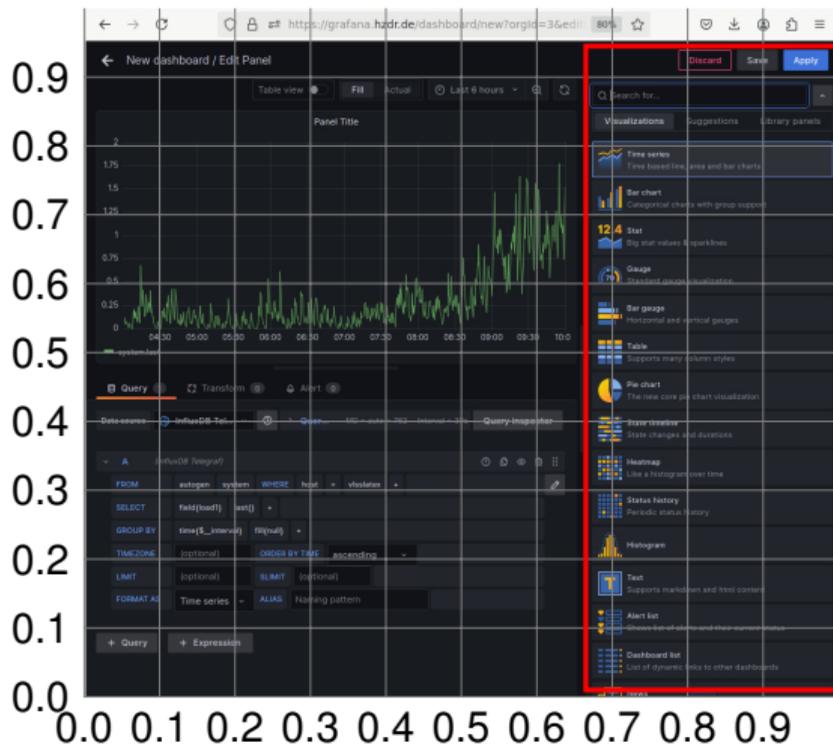
Other than “*mean()*”, many different aggregation states can be selected, often “*last()*” is useful:



Click “*Apply*” to apply the changes to your dashboard, and “*Save*” to save it

# How-To: Set up a dashboard

Other than “*Time series*”, many different visualization modes can be chosen:



# How-To: Set up a dashboard

And many things to configure for the panel:

The screenshot displays the Grafana dashboard configuration interface. The main panel shows a time series plot with green data points and lines, titled "Panel Title". The x-axis represents time from 04:30 to 10:00, and the y-axis represents values from 0 to 2. Below the plot is a query editor with the following SQL query:

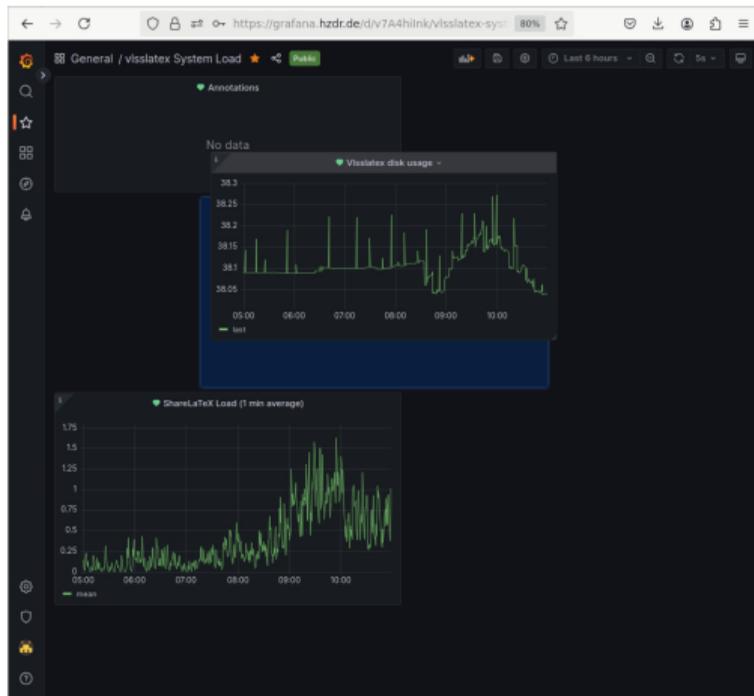
```
FROM astegan system WHERE host = 'vstalon'  
SELECT field(host) len()  
GROUP BY time($__interval) fill(null)  
TIMEZONE (optional) ORDER BY TIME ascending  
LIMIT (optional) SLIMIT (optional)  
FORMAT AS Time series ALIAS Naming pattern
```

The right sidebar shows the configuration options for the "Time series" panel, which are highlighted with a red border. The "Time series" section includes:

- Buttons: Discard, Save, Apply
- Search options: All, Overrides
- Line width: Slider from 0 to 10, set to 1
- Fill opacity: Slider from 0 to 100, set to 25
- Gradient mode: None, Opacity, Hue, Scheme
- Line style: Solid, Dash, Dots
- Connect null values: Never, Always, Threshold
- Show points: Auto, Always, Never
- Point size: Slider from 1 to 20, set to 7
- Stack series: Off, Normal, 100%
- Standard options: Unit (Choose), Min (Leave empty to calculate based on all values, auto), Max

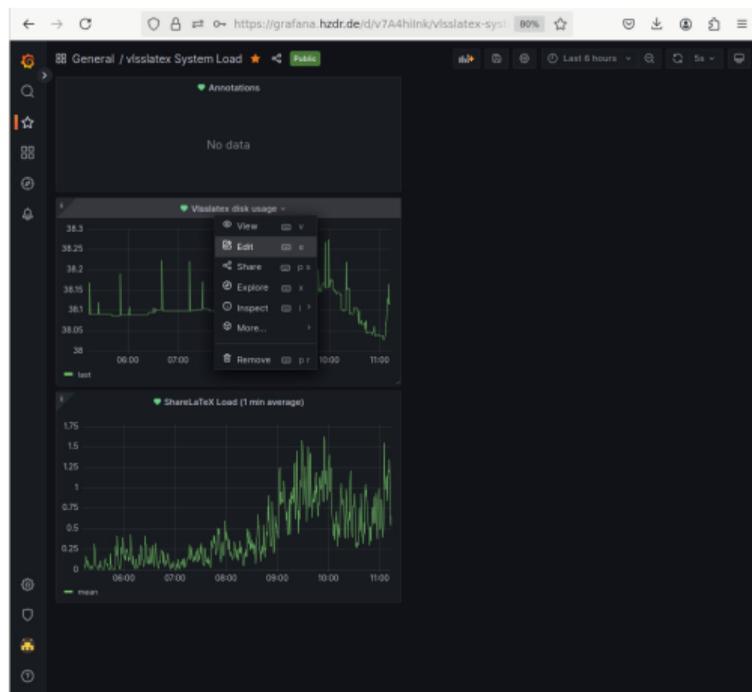
# How-To: Set up a dashboard

Add more panels to the dashboard, grab with mouse to arrange:



# How-To: Set up a dashboard

Dashboards can be edited by clicking next to the title:

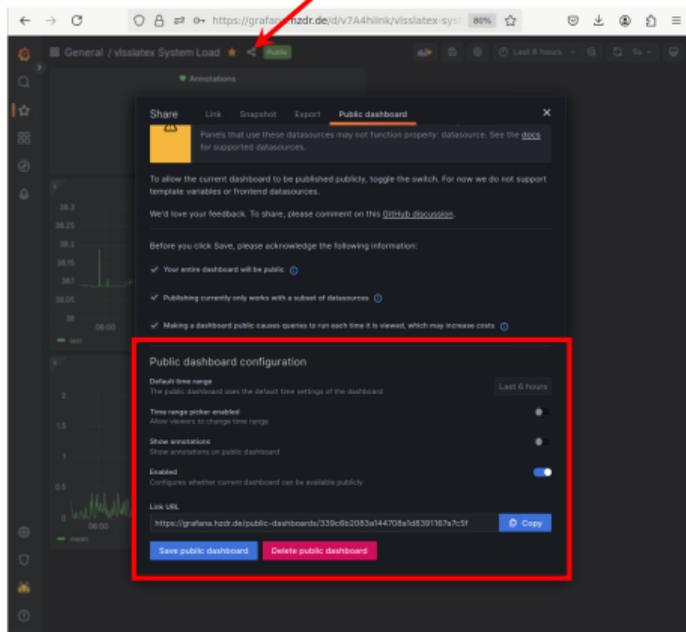


# Public dashboards

Dashboards can be made public so that users can access them without logging in:

- currently only from inside HZDR (Firewall)
- not possible for all kinds of dashboards

click here

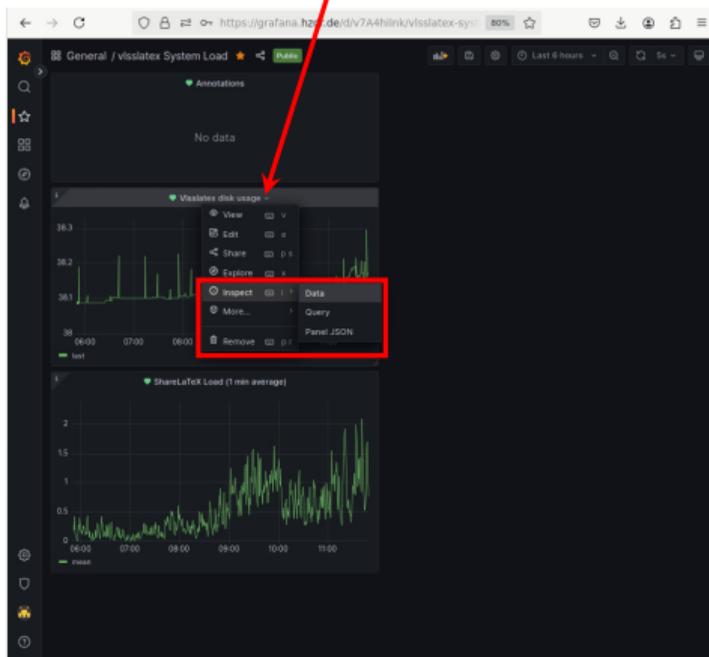


Refresh time and time range are taken from default values of original dashboard.

# Extracting data from dashboards

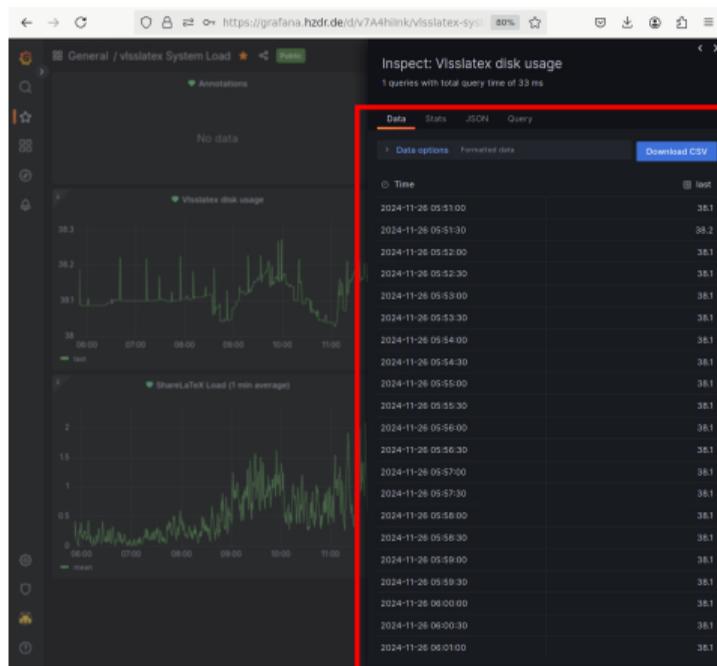
Data can be extracted from dashboards as csv-file:

click here



# Extracting data from dashboards

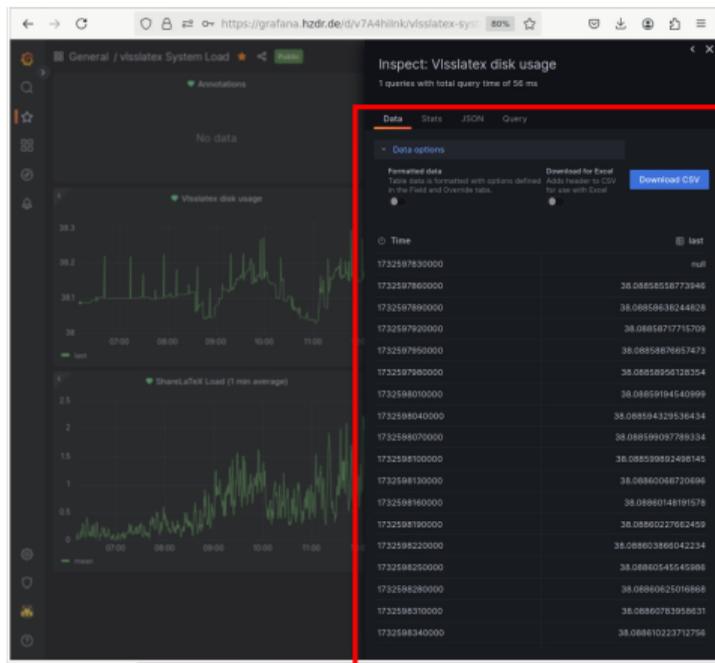
Data can be extracted from dashboards as csv-file:



Click "Download CSV" to obtain the file.

# Extracting data from dashboards

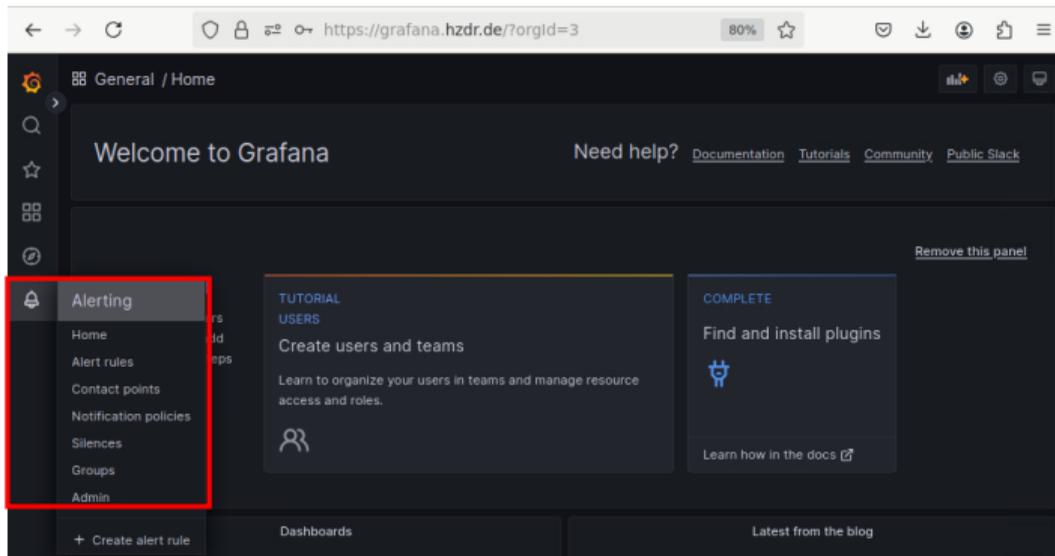
Data can be extracted from dashboards as csv-file:



Data format can be changed.

# Alerts

**Grafana** allows to set up alert rules - upon certain conditions, a notification is sent to a contact point.



Click the **Alerting**-symbol to go to the *Alerting*-menu

# Alerts

**Grafana** allows to set up alert rules - upon certain conditions, a notification is sent to a contact point.

The screenshot displays the Grafana Alerting dashboard. At the top, the browser address bar shows the URL `https://grafana.hzdr.de/alerting/home`. The main header includes the 'Alerting' title and a navigation menu with options: Home, Alert rules, Contact points, Notification policies, Silences, Groups, and Admin. The dashboard is divided into several sections:

- Alert rules:** A card with the description 'Define the condition that must be met before an alert rule fires' and a link to 'Manage alert rules'.
- Contact points:** A card with the description 'Configure who receives notifications and how they are sent' and a link to 'Manage contact points'.
- Notification policies:** A card with the description 'Configure how firing alert instances are routed to contact points' and a link to 'Manage notification policies'.
- How it works:** A section explaining the alerting process with three diagrams: 'Alert rule' (querying data), 'Alert instances' (listing servers like Server 01-05), and 'Notification policy' (routing to a contact point).
- Get started:** A section with a list of steps: 'Create an alert rule by adding queries and expressions from multiple data sources', 'Add labels to your alert rules to connect them to notification policies', 'Configure contact points to define where to send your notifications to', and 'Configure notification policies to route your alert instances to contact points'. It includes a link to 'Read more in the Docs'.
- Alerting in Grafana video:** A video player showing a presentation slide titled 'Alerting in Grafana' by Gille Meij.

# How-To: Define a contact point

Go to the *Contact points* panel and click “+Add contact point”:

Alerting

Learn about problems in your systems moments after they occur

Home Alert rules **Contact points** Notification policies Silences Groups Admin

Choose Alertmanager

Grafana

Contact points

Define where notifications are sent, for example, email or Slack.

+ Add contact point

Contact point name	Type	Health	Actions
Telegram Oll	Telegram	OK	ⓘ ⚙
smueller	Email	OK	ⓘ ⚙
Knodel	Email	OK	ⓘ ⚙
autogen-contact-point-default		No attempts	ⓘ ⚙
Pape	Email	No attempts	ⓘ ⚙

Notification templates

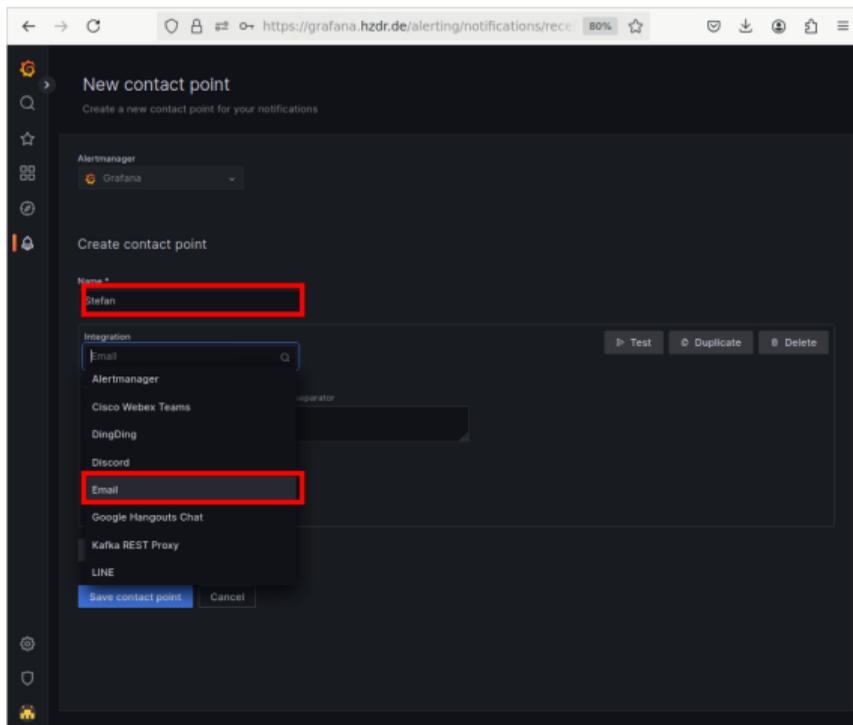
Create notification templates to customize your notifications.

+ Add template

Template	Actions
No templates defined.	

# How-To: Define a contact point

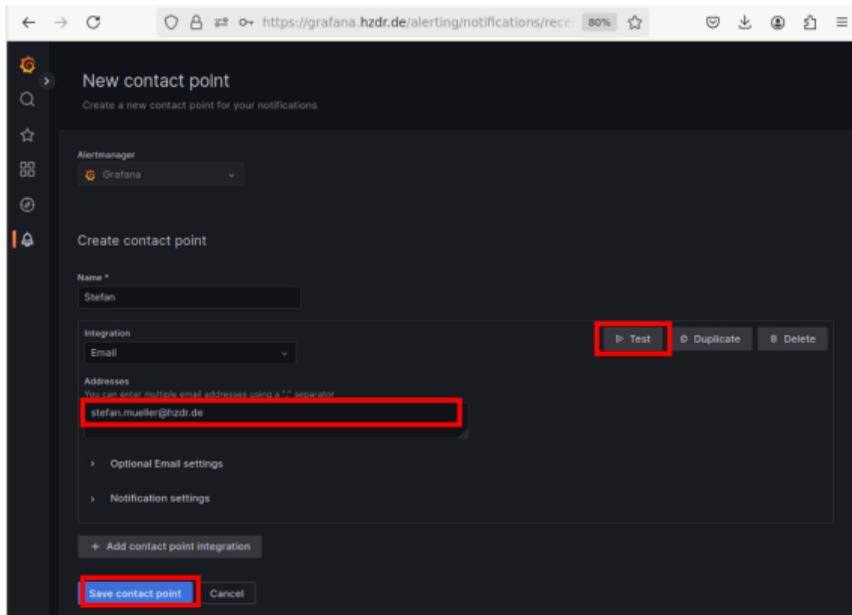
Go to the *Contact points* panel and click “+Add contact point”:



Give a name, and select “*Email*” from the many options in the list.

# How-To: Define a contact point

Go to the *Contact points* panel and click “+Add contact point”:



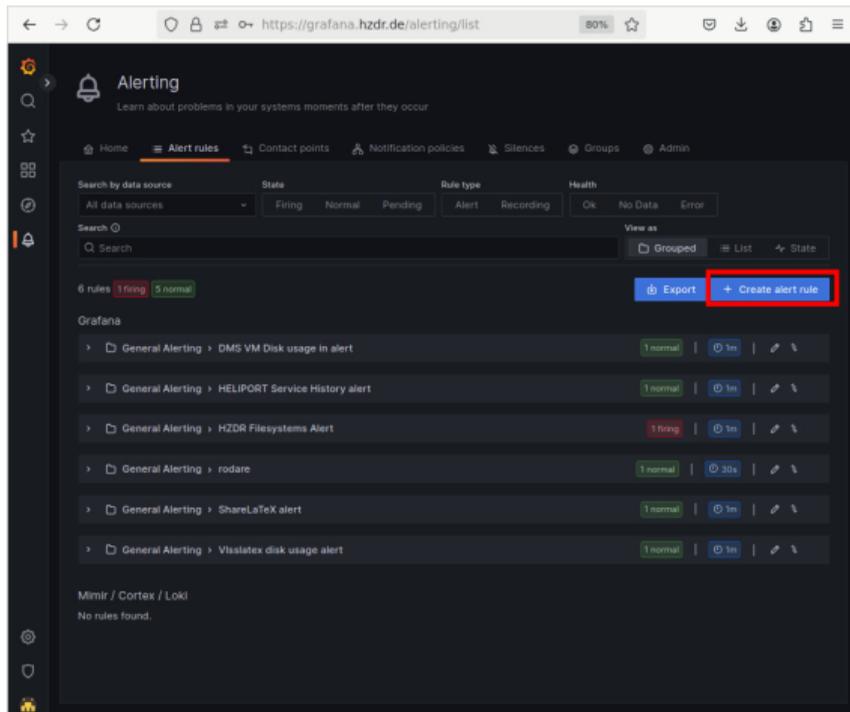
The screenshot shows the 'New contact point' form in the Grafana Alertmanager interface. The form is titled 'New contact point' and includes the following fields and actions:

- Name \***: A text input field containing 'Stefan'.
- Integration**: A dropdown menu set to 'Email'. To its right are three buttons: 'Test' (highlighted with a red box), 'Duplicate', and 'Delete'.
- Addresses**: A section with a sub-header 'New contact points email addresses using a "\*" separator'. Below it is a text input field containing 'stefan.mueller@hzdr.de', which is highlighted with a red box.
- Optional Email settings**: A collapsed section.
- Notification settings**: A collapsed section.
- + Add contact point integration**: A button to add more integrations.
- Save contact point**: A button at the bottom left, highlighted with a red box.
- Cancel**: A button at the bottom right.

Give email address(es), eventually click “Test”, and then “Save contact point”.

# How-To: Create an alert rule

Go to the “Alert rules” panel and click “+Create alert rule”:



The screenshot shows the Grafana Alerting interface. The browser address bar displays `https://grafana.hzdr.de/alerting/list`. The main heading is "Alerting" with the subtitle "Learn about problems in your systems moments after they occur". The navigation menu includes "Home", "Alert rules", "Contact points", "Notification policies", "Silences", "Groups", and "Admin". The "Alert rules" panel is active, showing a search bar, a "View as" dropdown set to "Grouped", and a "State" dropdown. Below the search bar, it indicates "6 rules: 1 firing, 5 normal". A red box highlights the "+ Create alert rule" button. The list of alert rules includes:

- General Alerting > DMS VM Disk usage In alert (1 normal, 0 1m)
- General Alerting > HELIPORT Service History alert (1 normal, 0 1m)
- General Alerting > HZDR Filesystems Alert (1 firing, 0 1m)
- General Alerting > rodare (1 normal, 0 30s)
- General Alerting > ShareLaTeX alert (1 normal, 0 1m)
- General Alerting > Vistatex disk usage alert (1 normal, 0 1m)

At the bottom, it shows "Mimir / Cortex / Loki" and "No rules found."

# How-To: Create an alert rule

Go to the “Alert rules” panel and click “+Create alert rule”:

The screenshot shows the Grafana alerting configuration page. The browser address bar indicates the URL: `https://grafana.hzdr.de/alerting/new?returnTo=%2F...`. The interface is divided into two main steps:

- 1 Set an alert rule name**: The "Rule name" field contains the text "My Alert", which is highlighted with a red rectangular box.
- 2 Set a query and alert condition**: This section offers three options for the alert condition:
  - Grafana managed alert** (selected): Supports multiple data sources of any kind. Transform data with expressions. A note below states: "You do not appear to have any compatible datasources."
  - Mimir or Loki alert**: Use a Mimir, Loki or Cortex datasource. Expressions are not supported.
  - Mimir or Loki recording rule**: Precompute expressions. Should be combined with an alert rule.A note at the bottom of this section reads: "Select 'Grafana managed' unless you have a Mimir, Loki or Cortex data source with the Ruler API enabled."

Below the alert condition options, a query editor is visible, highlighted with a red rectangular box. It shows a query for the "InfluxDB Tele..." data source with the following configuration:

- Time range: `now-1m to now`
- Max data points: `43,200`
- Query: `FROM autogen system WHERE host = vislatex +`
- SELECT: `field(load) mean() +`
- GROUP BY: `time($__interval) fill(null) +`
- TIMEZONE: `(optional)`
- ORDER BY TIME: `ascending`
- LIMIT: `(optional)`
- FORMAT AS: `Time series`
- ALIAS: `Naming pattern`

Name the alert and define query(ies) for variable(s).

# How-To: Create an alert rule

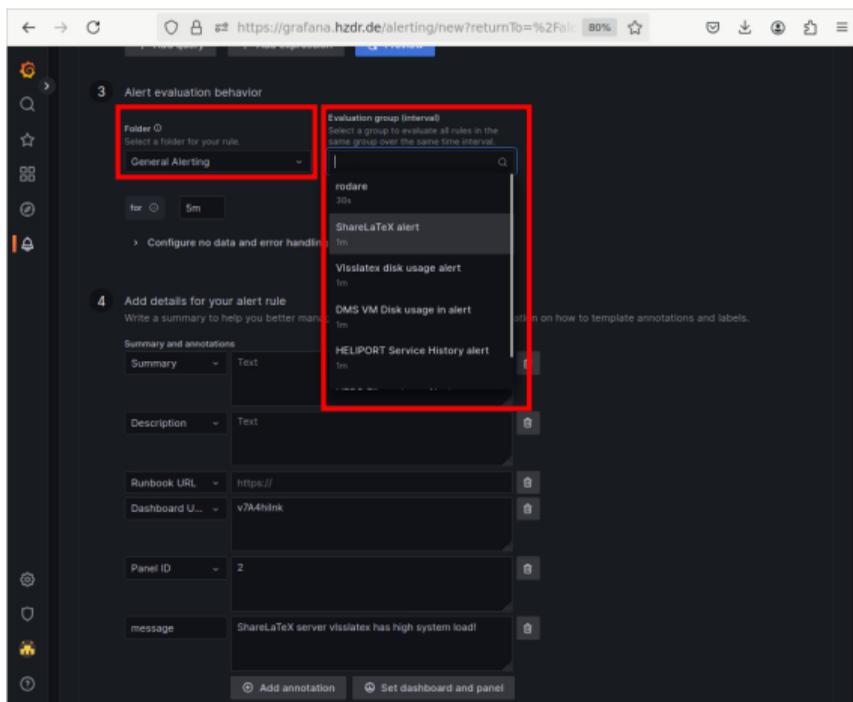
Go to the “Alert rules” panel and click “+Create alert rule”:

The screenshot shows the Grafana alerting configuration page. The main query is: `FROM autogen system WHERE host = 'visolates'`. The query is formatted as a 'Time series'. A red box highlights the 'Classic conditions' section, which is currently empty. Below it, a 'Make this the alert condition' button is visible. The interface also shows a 'Preview' button and options to 'Add query' or 'Add expression'.

Add an expression, switch it to “Classical expression” and apply it to query **A**.  
- Click “*Make this the alert condition*”

# How-To: Create an alert rule

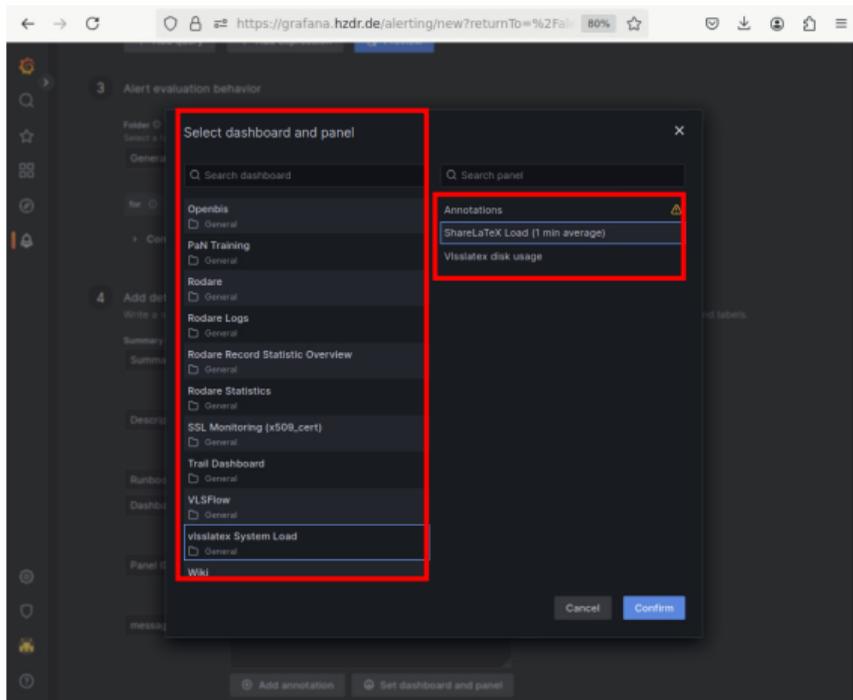
Go to the “Alert rules” panel and click “+Create alert rule”:



Choose a folder for the rule, and select group with defined time interval.

# How-To: Create an alert rule

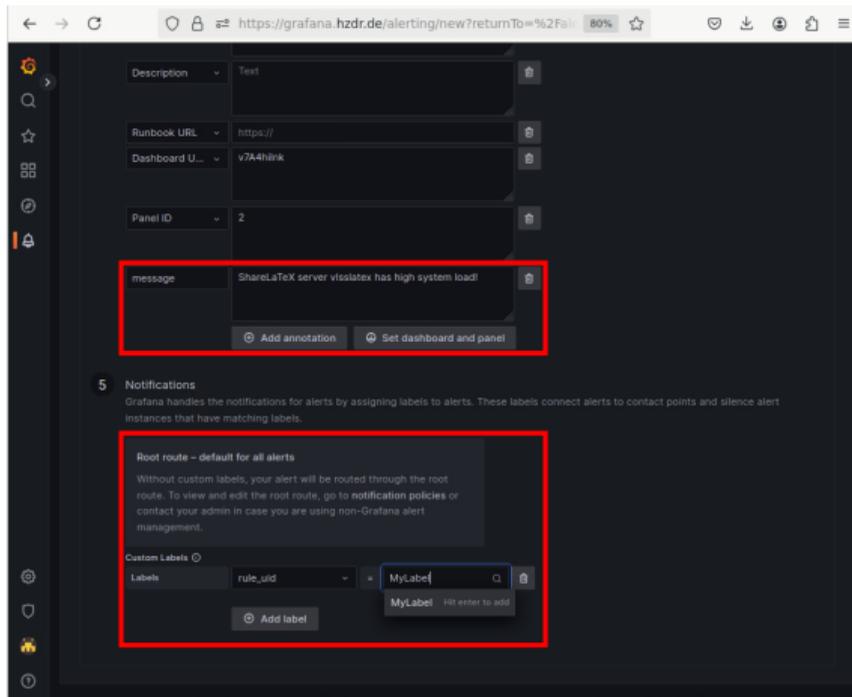
Go to the “Alert rules” panel and click “+Create alert rule”:



Select the dashboard and the corresponding dashboard panel.

# How-To: Create an alert rule

Go to the “Alert rules” panel and click “+Create alert rule”:

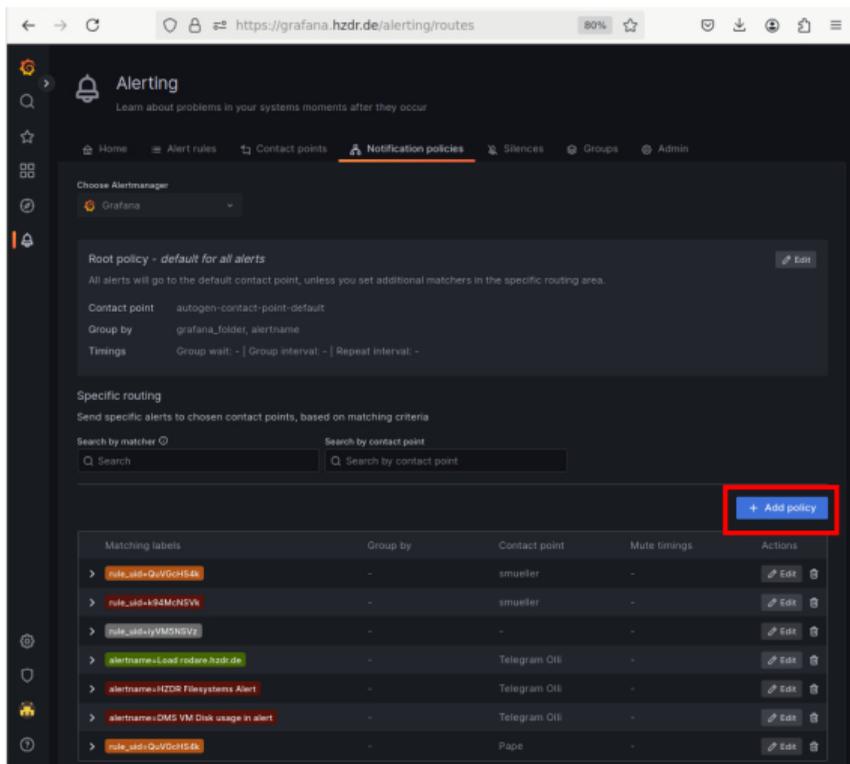


Add an annotation as “*message*”, and define a custom label.

- The alert rule is now created, next we need to define the notification policy

# How-To: Create a notification policy

Go to the “*Notification policy*” panel and click “+Add policy”:

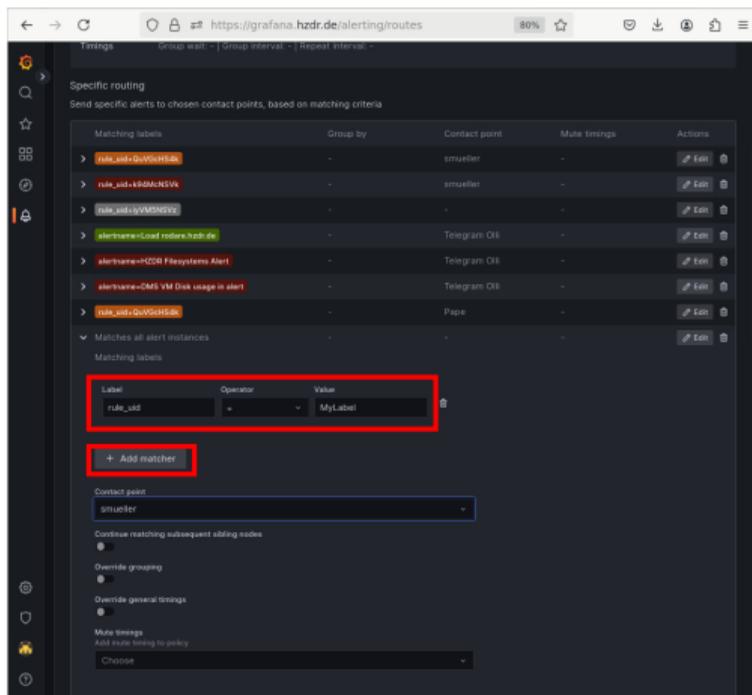


The screenshot shows the Grafana Alerting interface. The top navigation bar includes 'Home', 'Alert rules', 'Contact points', 'Notification policies' (selected), 'Silences', 'Groups', and 'Admin'. The 'Notification policies' section is active, showing a 'Choose Alertmanager' dropdown set to 'Grafana'. Below this is the 'Root policy - default for all alerts' section, which includes details for 'Contact point', 'Group by', and 'Timings'. The 'Specific routing' section is also visible, with search filters for 'Search by matcher' and 'Search by contact point'. A table of existing notification policies is shown at the bottom, with columns for 'Matching labels', 'Group by', 'Contact point', 'Mute timings', and 'Actions'. A red box highlights the '+ Add policy' button in the top right corner of the table.

Matching labels	Group by	Contact point	Mute timings	Actions
> rule_id=k9vGcH54k	-	smueler	-	Edit Delete
> rule_id=k94McNSVx	-	smueler	-	Edit Delete
> rule_id=yVM5NSVZ	-	-	-	Edit Delete
> alertname=Load rodare hzdr.de	-	Telegram Oti	-	Edit Delete
> alertname=HZDR Filesystems Alert	-	Telegram Oti	-	Edit Delete
> alertname=CMS VM Disk usage in alert	-	Telegram Oti	-	Edit Delete
> rule_id=k9vGcH54k	-	Page	-	Edit Delete

# How-To: Create a notification policy

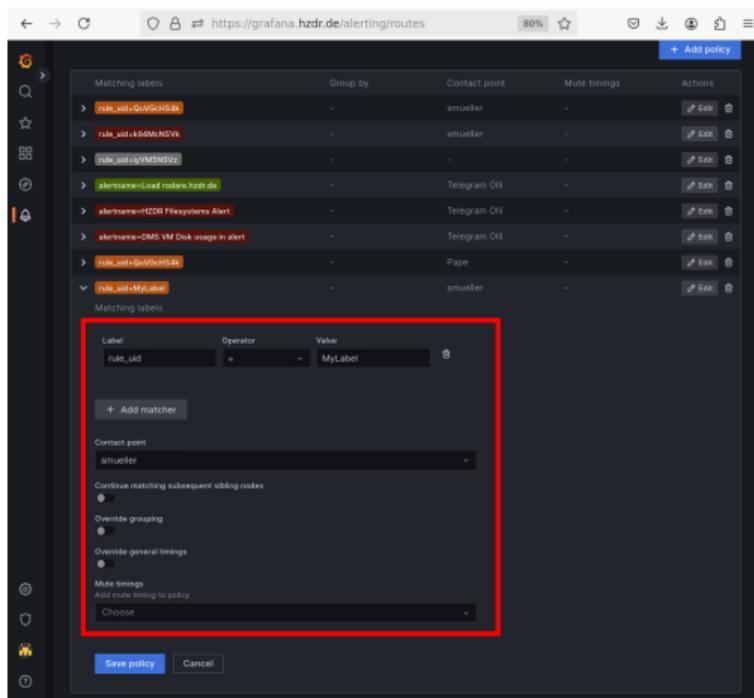
Go to the “*Notification policy*” panel and click “+Add policy”:



Select previously defined contact point, and click on "+Add matcher"  
- match to previously defined label

# How-To: Create a notification policy

Go to the “*Notification policy*” panel and click “+Add policy”:



After clicking on “*Submit policy*”, our new policy is now visible in the list of policies.  
- and should be active now

# Summary:

- The **Grafana** platform is an established tool to visualize data in your browser (mostly time-based data)
  - Ideal for “Slow-Control”-data used for monitoring environmental conditions, device status, etc.
- **HZDR** hosts the Open Source version of **Grafana** at <https://grafana.hzdr.de>
  - Currently v9.4.17
- The corresponding data can be conveniently stored in **HZDR's InfluxDB** time-series database
  - Please contact **Oliver Knodel** ([o.knodel@hzdr.de](mailto:o.knodel@hzdr.de)) or **Stefan Müller** ([stefan.mueller@hzdr.de](mailto:stefan.mueller@hzdr.de)) for more information on using the **InfluxDB** at **HZDR**
- I gave a brief introduction to
  - **Organizations** in **Grafana** and how to add users
  - **Datasources** and how to add them
  - **Dashboards** and how to set up a simple dashboards, make it public and extract its data
  - **Alerts** and how to set them up (Uff!)
- How to go continue from here?