

DWD Radar Monitoring with Grafana



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Radar system and data monitoring has become an essential part of the radar network at DWD to ensure high availability of meteorological data. To process and visualize the large amount of data, an open-source visualization and analytics software is used – Grafana®.

The continuous display of the BITE data as time series is a helpful analysis tool for an early detection of critical radar system states. This can be used to initiate of preventive maintenance measures. The setup of notifications and annotations are implemented to notify the second-level support in case of critical system states. In addition to monitoring the hardware, Grafana is also used to for verifying the data quality by displaying e.g. the ZDR offset or comparing radar data with additional sensors.

Data integration

As shown in Figure 1, the data source used for Grafana is InfluxDB, as it is optimized for fast, high-availability storage and retrieval of time series data. Two query languages can be selected: InfluxQL or Flux.

Flux overcomes some limitations of InfluxQL and is recommended for more complex queries. For example, filtering or math functions can be applied across measurements, which helps to visualize desired data and allows for more refined alerting rules. The update rate for sending BITE data and monitoring products is currently set to 5 minutes in order to synchronize with the radar scan schedule at DWD. It is planned to increase the update rate for better monitoring options and faster reaction times in case of alerts.

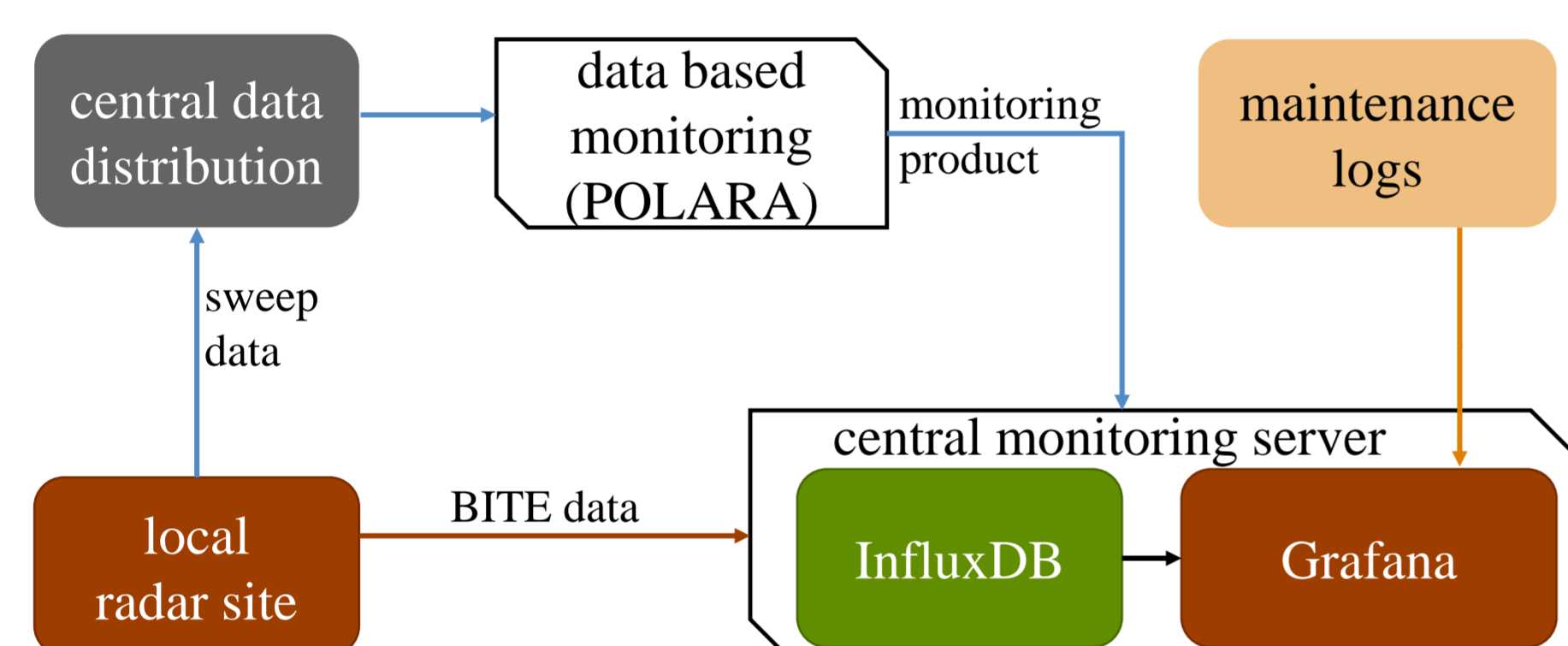


Fig. 1: General scheme of the monitoring dataflow. The BITE data is directly sent to the central monitoring server by each radar site every 5 minutes. Monitoring products displayed in Grafana first run through central processing. The maintenance logs are not stored in InfluxDB but sent directly to Grafana.

Visualization of data quality & BITE data

Variables are an important tool to display large amounts of data in a well-structured way. The dashboards used at DWD mostly have a radar site variable to make a quick preselection. It is also possible to use select individual BITE items which then can be compared among the 17+1 radar sites.

In parallel to hardware monitoring, separate dashboards for data quality are set up (Fig. 3 a). For example, these include ZDR offsets derived from the birdbath scan or angle bias calculated by solar encounter.

In addition to the already integrated visualization options (time series, heatmaps, histograms, etc.), plugins offer a good way of displaying the data accordingly. A more advanced plugin is "Flowchart" (Fig. 3 b) which can be used to display complex diagrams (using draw.io) and connect it with your data. For example, animations can be set up for certain events, which quickly indicate irregularities.

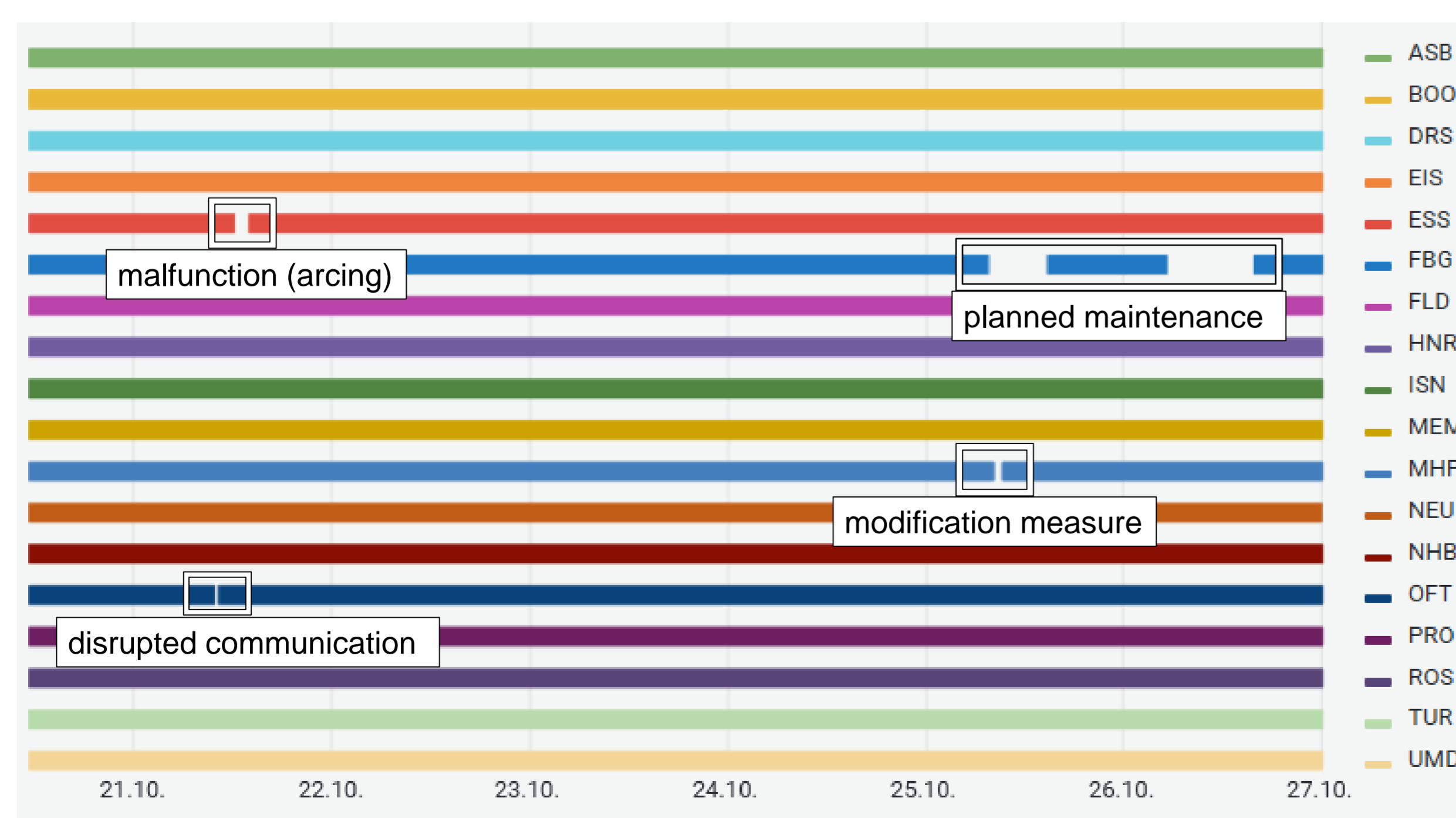


Fig. 2: Timeline of available data. Shown is a simple overview of BITE data availability for each radar site. Gaps in the timeline indicate outages or maintenance. Such a representation can be well combined with annotations.

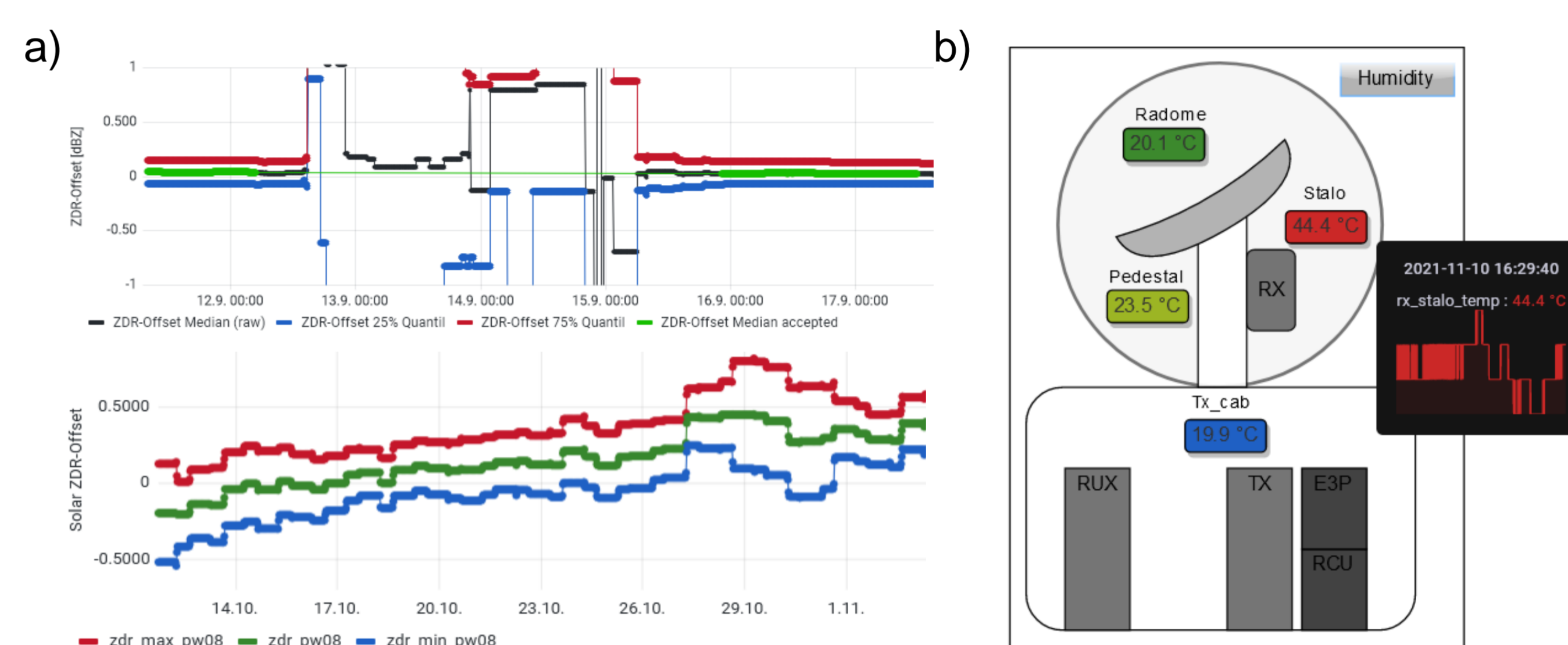


Fig. 3: In addition to BITE data, data quality is also monitored. The figure on the left shows a section of the ZDR dashboard. On the right side the plugin "Flowchart" is used to assign elements from draw.io to a database query. In this simple case, the last value of temperature sensors are shown and automatically colored. It can be hovered over the value to get more information (black box).

Grafana alerting

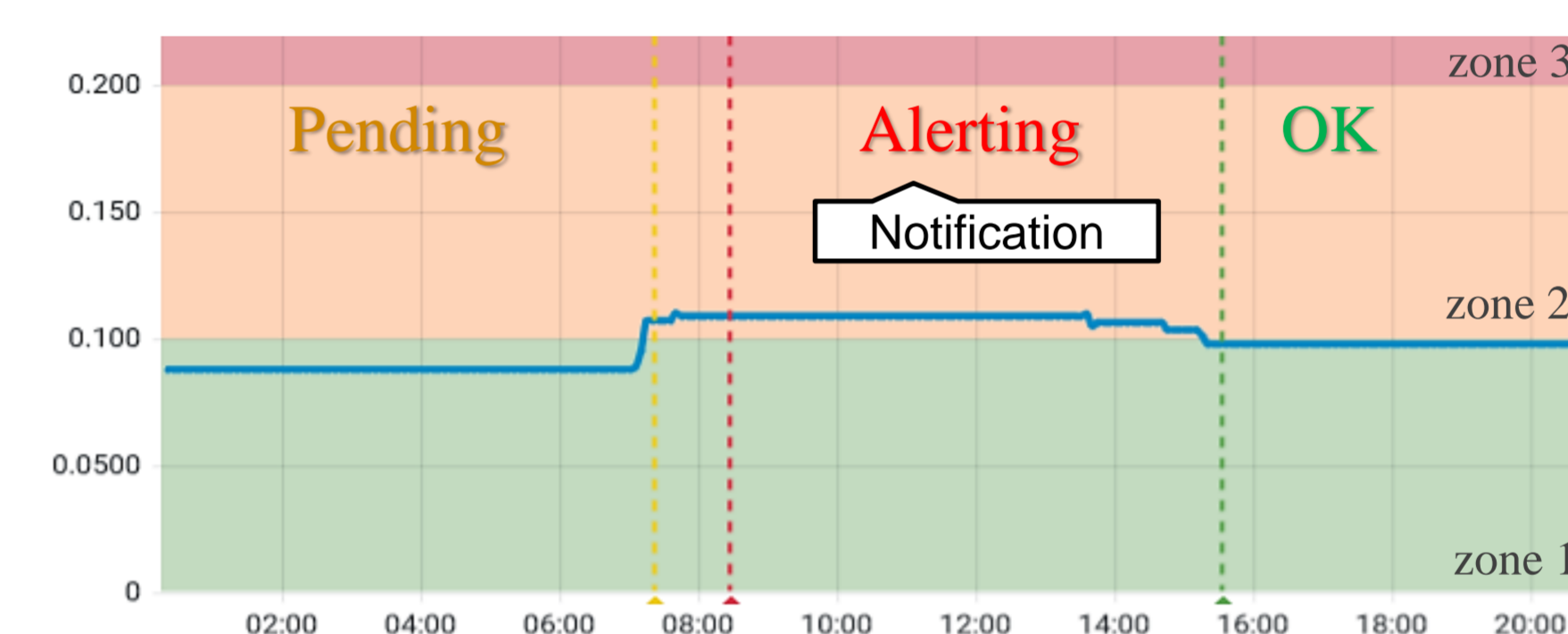


Fig. 4: Visualization of triggered alerts. When a defined threshold is exceeded, the status "Pending" is applied (yellow line). Once the alert rule has been firing for more than the configured duration, then the status is changed to "Alerting". The same duration is required to return to the status "OK". Unfortunately, it is currently not possible to differentiate between more than one threshold or area, so two rules must be created for both zone 2 and zone 3.

Alerts help to monitor key points by setting threshold values. By setting up notification channels, the responsible person is contacted when the threshold values are exceeded.

The alert settings must be adapted to the corresponding BITE item. Frequency and the duration of the exceedance should be selected differently for each data field (e.g. temperatures, voltages or statuses).

Unfortunately, a combination of variables and alerts is currently not implemented in Grafana. Setting up many alerts via the graphical interface can therefore be time-consuming, so creating the rules via the JSON model can be worthwhile.

Another disadvantage is that it is not possible to distinguish between warnings and critical errors within one rule (see Figure 4: zone 2 & 3).

Outlook: maintenance annotations

Through annotations a better context can be created in the data visualization (see Figure 5). Therefore, the goal is to mirror the entries from the maintenance log into Grafana using a Python script. The set tags allow filtering by e.g. radar site or cause.

A further step would be to integrate log files from the radar software into Grafana using Loki™.

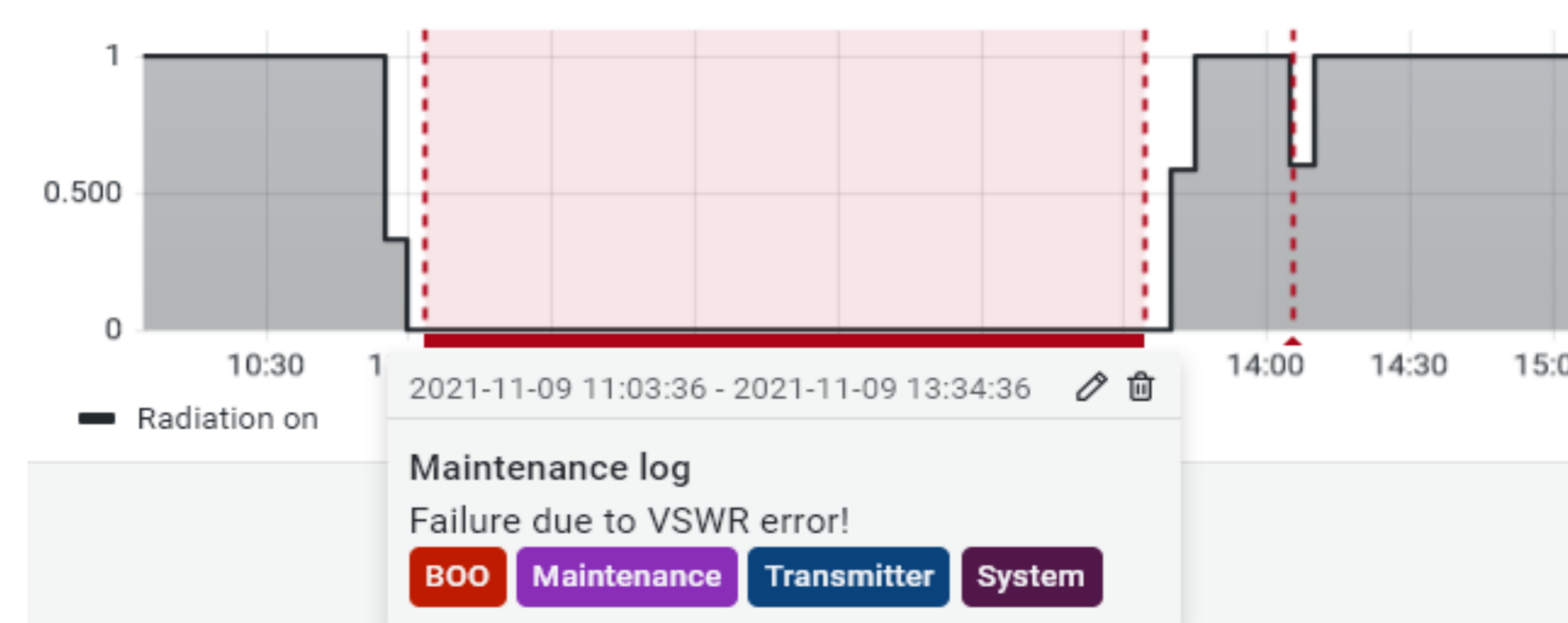


Fig. 5: Annotations provide a way to mark points on the graph. Hovering over an annotation displays the event description and event tags. For example, maintenance can be marked in terms of time. Furthermore failures can be logged together with their causes, so that correlations can be traced easier at a later stage.

