

UNLEASH INSIGHTS

Earth Intelligence at Eurac Research

Private Research Centre Eurac, located in South Tyrol / Italy plays an important role monitoring the alpine regions in times of climate change. The understanding of substantial environmental mechanisms and corresponding climate and disaster risks represent the main focus of Eurac's research activities. The Institute for Earth Observation has developed visionary data analysis and management methods. In this context, the rasdaman datacube technology provides a valuable component for the processing of complex interferometric Sentinel-1 imagery and long time series of MODIS, Landsat and Sentinel-2 products. Additionally, the Big Data Server was complemented with advanced frontends for simplifying server requests and comparative analytics: CubeR and Mona-Lisa-R.

eurac
research | Sentinel Alpine
Observatory

„rasdaman's multi-dimensional arrays enormously help organizing huge datasets.“

Alexander Jacob

Advanced Computing for Earth Observation
Eurac Research Institute for Earth Observation

Climate change is one of the greatest challenges of our time. Especially mountain regions are severely affected by global warming making cryosphere monitoring increasingly important nowadays. Earth observation from Space has opened up new perspectives for environmental research. The Institute for Earth Observation integrates remote sensing techniques with interdisciplinary approaches to monitor and understand key environmental dynamics in mountain regions and related climate and disaster risks. For understanding our ecosystem's development it is relevant to gain insights into the

glacier and snowmelt quantity as well as further vegetation and environmental analytics.

For scientists, the primary source of data is satellite imagery provided through ESA's Copernicus program which is co-financed by the European Commission. Both optical and radar data are managed in the rasdaman database for easier access by combining thousands of scenes into few cubes. "Not everyone needs to be a data scientist at rasdaman to pull information out of thousands of pieces of data", says group leader Alexander Jacob.

later. Since 2021, Eurac Research has been operating the rasdaman Big Data Server exclusively in the enterprise edition.

Due to different research approaches, the applied methodology of data analysis and storage must also meet a wide variety of requirement profiles. "We are pretty hardcore users of rasdaman and every now and again have new questions and challenges. We are very satisfied, not the least because we always have had smooth exchange. We were always able to solve problems because we received reliable feedback",

"CubeR offers a convenient possibility of exploring the rasdaman environment and embedding information directly into the scientific analysis."

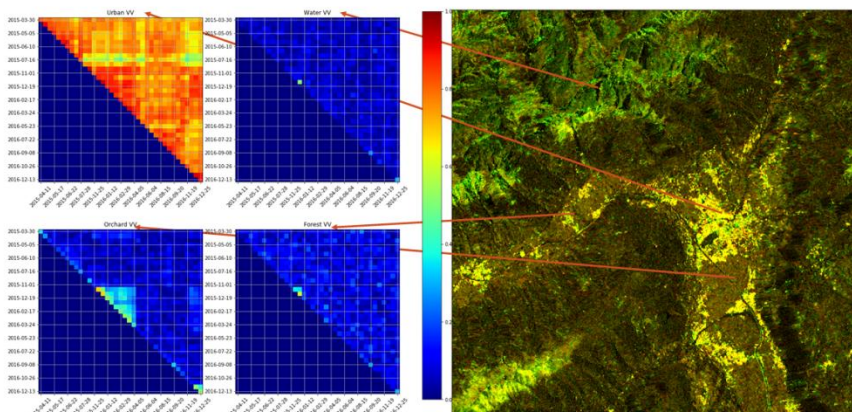
Dr. Mattia Rossi

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ions is the R package CubeR. It was implemented under the leadership of Mattia Rossi who used the rasdaman-based infrastructure to handle large amounts of data as part of his PhD thesis. Rossi's work addressed the observation of alpine grasslands at various scales, from local to Alps-wide. In order to work efficiently, he linked diverse databases with different OGC standards using R. It was advantageous that Sentinel time series were already available in rasdaman, which allowed Rossi to directly retrieve vegetation indices, for example.

This is now also possible via R. "We wrote the R package to simplify queries to rasdaman. In addition to WCPS or rasql, the user can now send queries on geo datacubes using the R programming

Compressing information from more than 500 images into one figure:



Extracting 2-dimensional temporal coherence planes from 4-dimensional data cubes for selected pixels of different land cover type.

Average Sentinel-1 coherence amplitude over 2 years derived from 4-dimensional data cube selecting only the shortest temporal baseline.

Compressed information of more than 500 images in one data cube.

Since 2016 the rasdaman data cube engine is in use at the institute. After testing the open source community version first, the commercial enterprise edition was purchased just one and a half years

emphasizes Jacob.

CubeR

Over time the team has implemented several add-on packages for specific user groups. One of these extens-

language", Jacob says. CubeR interacts with the rasdaman server via the WCS standard. 2-D time slices can be obtained as R objects as well as 1-D time series, for example the history of individual pixels.

WCPS allows formulating more complex analytics and data fusion. For example, an R prototype function allows "band ratios" such as vegetation or snow index to be calculated in the rasdaman backend, i.e. close to the data, for direct download.

In addition, routines can be easily created that extract overview information (e.g., providers, coverages) and coverage-specific metadata (e.g., acquisition times, extent, coordinate system, etc.).

Mona-Lisa-R

The Mona-Lisa-R package was developed to perform comparative analyses. One example is landslide monitoring. Avalanches and landslides occur regularly in the mountainous regions of South Tyrol due to the steep slopes. Interferometry on radar data is used to monitor the movements of the Earth surface. For a more detailed analysis, other sources are added, too, such as satellite, meteorological and sensor data. "We can access satellite data in the data cubes with our packages but we can also relate other data to the data cube via one or two lines of code using R", Rossi explains.

"That way we can compare station data with the data we have at the same location in

„Lots of packages in R ease requesting and formatting the response via the rasdaman API substantially.“

Dr. Mattia Rossi

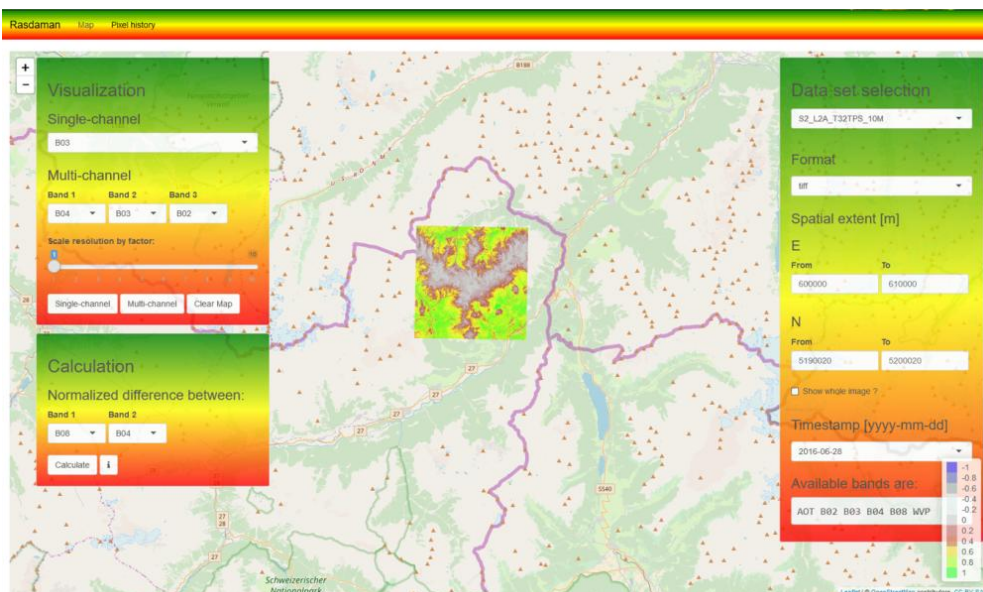
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the data cube and see if there are any correlations."

The Institute for Earth Observation provides snow mapping for the entire Alpine region; up-to-date maps of snow cover are produced daily.

The team works closely with local authorities, such as the hydrographic service, providing up-to-date information on snowmelt. The water discharge is an indicator to control the energy production by hydropower in South Tyrol.

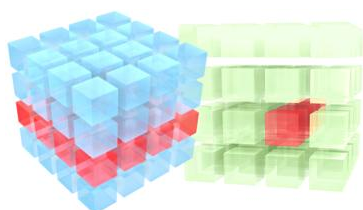
"When the meltwater comes down the mountains you have to know when and how much water is coming, when the turbines have to start and how much power can be generated and when," Jacob says.



R-Shiny as a graphical interface for using CubeR and rasdaman.

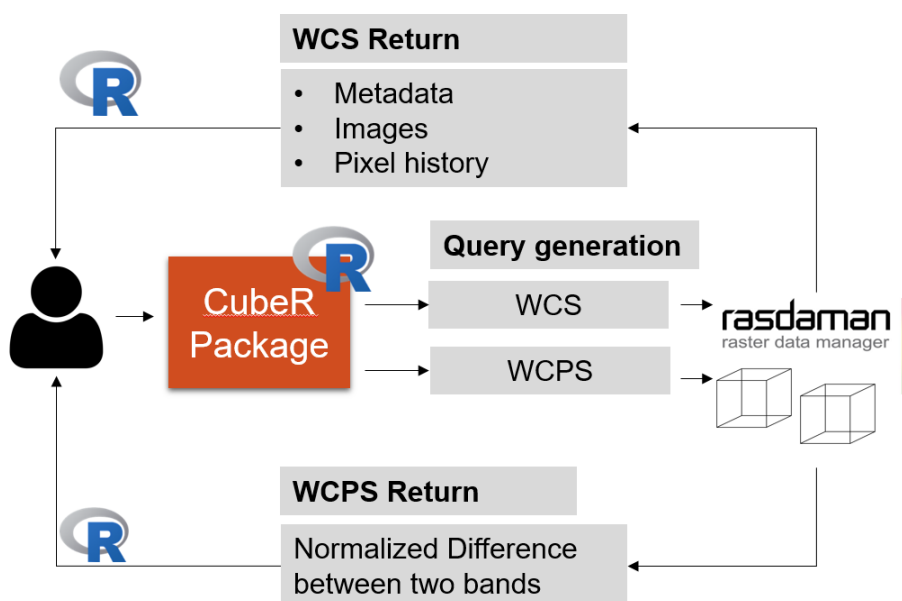
Another important area of work for the team is the analysis and classification of forest damage caused by storms is

The monitoring of droughts and dry spells has led to co-operation with local insurance companies; for them this data is an important source of information.



Pheno Camps

Pheno Camps is an experimental approach combining satellite data with camera and



CubeR as interface of the OGC standards in rasdaman and the end user.

webcam time series in rasdaman. Focus here is on small-scale biodiversity monitoring, such as used for grasslands or for field plots, to classify plants, monitor growth, and derive cutting times, intervals, and wetting times.

"You can do completely new and much more precise analyses with the cam," Rossi enthuses. "We can use the same data cube concepts that we already know from satellite data. That opens up spectacular opportunities.

About rasdaman

With rasdaman, the paradigm of actionable spatio-temporal datacubes has been invented, documented by patents and scientific publications. The innovative datacube query language enables „any query, any time, on any volume“, making rasdaman blueprint for the datacube standards of ISO, OGC and INSPIRE. Rasdaman is standing out through its flexibility, scalability and performance, security, and the consequent support of open datacube standards. Rasdaman is official reference implementation, its technological lead has been acknowledged by a series of high-ranking national and international innovation awards.

The technology is continuously being advanced by rasdaman GmbH and Jacobs University and defines the state of the art in datacubes in science and engineering.

Learn more about rasdaman

www.rasdaman.com

or contact our rasdaman team: contact@rasdaman.com

