APPS4GMES - DEVELOPMENT OF OPERATIONAL PRODUCTS AND SERVICES FOR GMES – A BAVARIAN INITIATIVE

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ABSTRACT

The project APPS4GMES aims to develop prototype service chains based on standardized pre-processed EO data for operational product provision and dissemination. The specific pilot applications will be provided in the context of agriculture, water quality and quantity, environmental monitoring and climate protection by the different partners.

The challenge of APPS4GMES is the creation of the operational pilot services using the Sentinel satellites in terms of handling large data volumes and data streams, as well as automated information extraction and the use of cloud computing. To operate these services efficiently in the long term, the implementation of operational interfaces and data access mechanisms, as well as quality-controlled processing chains from data pre-processing up to the final product are mandatory. One of the main targets of the project is the optimized use of cloud computing as a dynamic service infrastructure, which provides the partners a scalable access to storage and computing capacities for the different needs of the services.

1. INTRODUCTION

Motivated by the coming Sentinel missions, ESA postulated during the DOSTAG Meeting in Sep 2013 a new model of moving the users' computers to the data. Dedicated "Exploitation Platforms" shall enable data access & exploitation in a Virtual Environment. The ideal case would be bringing together Data Centre + Computing Resources + Third Party Tools + Workflows + Integrated User Interface + Documentation + Collaborative Tools + Help desk & social network on one platform.

A similar, slightly "lighter" attempt is followed within the project APPS4GMES. The consortium is formed of four Bavarian small and medium enterprises (SMEs) in the EO value-adding industry and one international information and communication technology (ICT) and cloud computing provider. The project (2012-2015) is funded by the Bavarian Ministry of Economic Affairs, Infrastructure, Transport and Technology, and is targeting, beyond the technical solutions, to be later on providing EO services operationally by the involved partners.

A platform is under development within APPS4GMES that shall have direct access to the Sentinel data stream and provide hardware and software infrastructure for EO based workflows. The prototype service chains under development are based on standardized pre-processed, multi-mission EO data. These are used as input for operational product generation by making use of cloud computing technology. The platform will also serve for dissemination providing a set of collaborative tools e.g. for user handling, workflow execution or billing. Pilot applications are provided by the different value adding partners in the field of agriculture, water quality and quantity, environmental monitoring and climate protection.

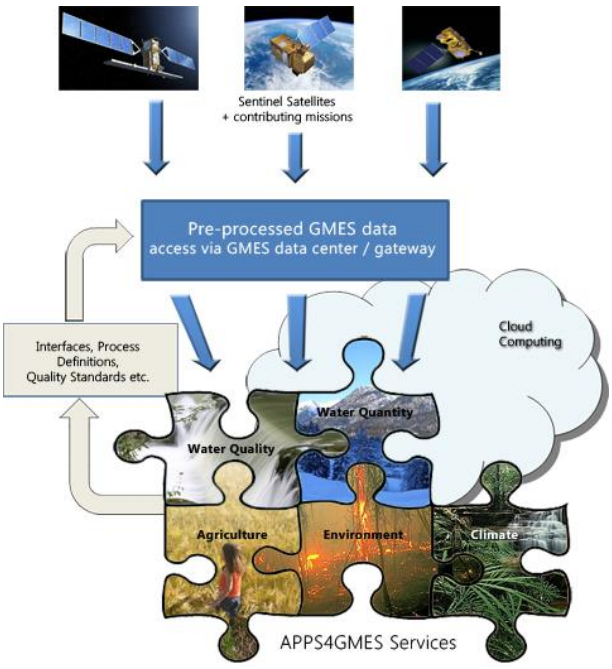

Figure 1: Overview of the APPS4GMES concept

Proc. 'ESA Living Planet Symposium 2013', Edinburgh, UK
9–13 September 2013 (ESA SP-722, December 2013)

The pilot services, named APPS (from applications, but not limited to applications on mobile devices) of the project are provided by the individual partners mainly located in and around Munich. All services are module based and able to use the same architecture regarding the data input and the cloud computing infrastructure. For some services also service interactions and service chains, connecting the modules of different partners, are foreseen.

The partners, their core business orientation and their contribution within the project are summarized in the table 1.

Table 1: Partners and Services

Partner & Logo	Core Business	Service Contribution
VISTA	Remote sensing and modelling in agriculture and hydrology	Project coordinator Agriculture, Water Quantity
EOMAP	Coastal and inland waters monitoring	Water Quality, water depth
RSS	Environmental monitoring, agriculture and forestry, cartography, natural hazards and damage analysis	Environment and REDD
ZEBRIS	GIS and Remote Sensing for natural resource management (forestry, water protection, fire management)	Fire Emission Monitoring and REDD
T-Systems	Global ICT and cloud computing services	Portals, Mobile, Billing and Cloud Computing

2. OBJECTIVES

Within the project the partners will prepare the operational use of Sentinel satellites and contributing missions of the Copernicus programme with an emphasis on managing the large data volumes and near real-time data streams, and on automated information extraction for their existing services.

Within this framework the APPS4GMES partners enhance their individual services in a collaborative environment to be interlinked in automated processing chains for dedicated services, making use of cloud computing technologies. The optimized use of and adaption of the processing on cloud computing as a dynamic service infrastructure will provide the partners with a scalable access to storage and computing capacities for the different needs of the services. Together with an optimized access to the Copernicus datasets, e.g. in connection with national collaborative ground segments, this is considered as a key for successful and economically viable service provision by the involved SMEs.

The objectives of the thematic services are manifold and cover a wide set of land applications. VISTA will offer service components for improved atmospheric correction that can be used by the other partners as inputs to their service chains. In the agricultural field, VISTA will provide crop variables starting from leaf area, crop water status, biomass and final yield [1,2]. VISTA will further transfer its hydrological services of snow monitoring, water balance simulations, runoff as well as hydropower modelling and forecast in the new infrastructure [3,4]. Both hydrological and agricultural applications use data assimilation techniques that are computationally very demanding and could strongly benefit from the cloud computing infrastructure.

EOMAP implements multi-resolution water quality [5] processors on the APPS4GMES infrastructure and disseminates products also via mobile devices. The EOMAP bathymetry processor [6] is currently improved to allow automated processing over large areas, serving then regular updates of the coastal environment.

The service chains of RSS cover a wide range of environmental monitoring applications in support of national and international conservation schemes such as NATURA 2000 [7]. In addition, RSS will develop EO service chains for monitoring, reporting and verification (MRV) in the framework of REDD, which aim on operational deforestation and forest degradation monitoring of tropical forests [8]. In cooperation with ZEBRIS, RSS also contributes to a fire monitoring service. ZEBRIS implements a cloud based service for monitoring carbon and trace gas emissions from fires to support REDD+ or other climate mitigation activities.

3. MOTIVATION

The need of a common and shared processing architecture for SMEs is based on the need of optimized access to EO data and products, scalable capacities of processing and dynamic storage. Serving the needs of a growing number of customers, the required hard- and software for service provision is out of the direct investment of the companies and can be sourced as cloud services. In addition, the cloud architecture enables the collaborative EO data handling and processing, to reduce workflow management, data traffic and overwhelming storage demands. The services existing so far, and currently being adapted for the APPS4GMES architecture, are able to run at the local facilities of the partners. But with the expected expansion of the services, which means more customers, more areas, more data, the advantage of cloud computing capabilities is obvious.

These new capabilities provide additional features, like scaling or bursting local processing into the cloud, billing services or mobile access, which moreover are benefiting successful service provision.

4. ARCHITECTURE

The architecture of APPS4GMES was designed to embed the already existing and now adapted services of the individual partner (red boxes) in a structure of shared modules (blue boxes), to handle the data streams from the different satellite service providers to the different clients and end users; altogether in a cloud environment. As input data, the project is mainly targeting at the use of Copernicus data (Sentinel data + third party missions) and additional commercial data sources.
The partners, as well as the end users of some services, will obtain the data (intermediate products) and the final product using a portal, also giving easy access to manage the services.

4.1. MODULAR SYSTEM

Within the architecture, five main modules are developed to provide the required capabilities to perform the targeted services.

These modules are:

- a common 'input data portal' allowing multi mission data access to EO products of Sentinel and Third Party Missions
- a common 'service chain manager' to handle the service chain workflows – and their interactions - of each of the services provided by the partners
- a common 'cloud toolkit' to use the cloud infrastructure provided by the project partner T-Systems to take advantage of a scalable service to handle the near real-time extensive data streams and large data volumes (Sentinels) and complex model approaches
- a common 'billing manager' to support the calculation of resource consumption and service usage between partners, and billing of customers
- a 'APPS4GMES portal' for allocation of internal and the provision of final products of the individual services

All modules are developed by the consortium, based on the requirements of the partners discussed within the design phase of the project.

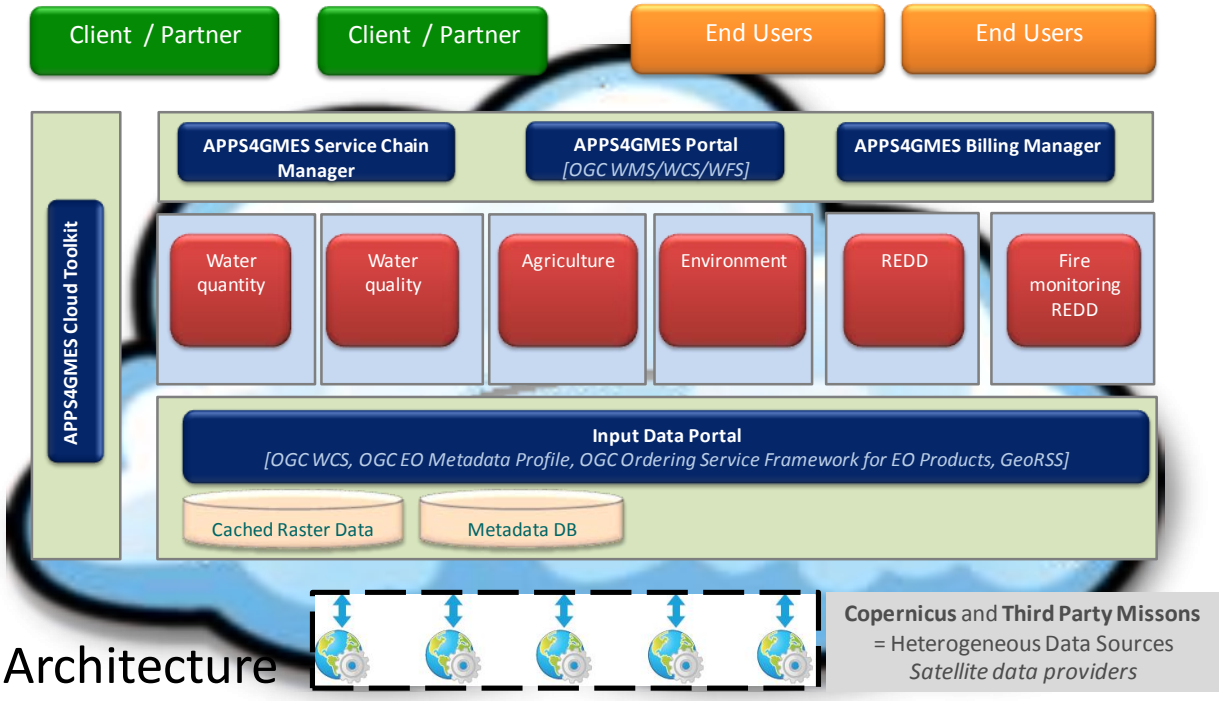

Figure 2: APPS4GMES architecture, showing the embedding of the services (red) with the shared project modules (blue) within cloud architecture

The modules are designed to serve all needs, are based on open-source software where possible and follow all applied standards and can communicate with each other and the outside world through standardized interfaces (APIs). By this architecture, the modules can be potentially extended to new partners, or serve as modules in future initiatives of data handling and service provision.

5. STATUS AND OUTLOOK

At the current stage of the project (total runtime is 36 month) the design of the architecture, leading to the presented modules, and the adaption of the individual services is completed. Regarding the implementation of the services and the testing and operation of the shared modules, the major questions have been solved. Within this progress some important and critical facts, regarding metadata-standards, and basic cloud and hardware requirements have been solved. The results and recommendations worked out within the project will be induced to different publications and will lead to software tools, potentially to be made available as open-source.

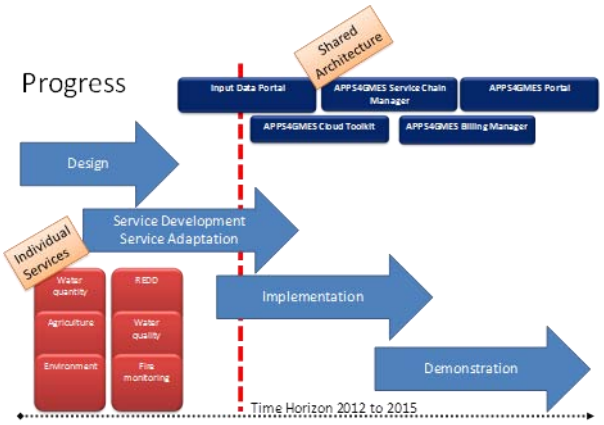

Figure 3: APPS4GMES progress, development and implementation of shared architecture for the pilot services, current status represented by the red line.

6. CONCLUSIONS

The APPS4GMES project will generate an architecture, modules and standards for operational services using operational EO data, with focus on Copernicus data. The data will be used to provide a series of pilot services, individually provided by the partners. This will also include collaborative service chains, connecting different modules. The challenges hereby are management of the enormous amount of data, the complex work and data flows, the information extraction and the quality assessment. The collaborative modular system will ensure cost efficient, reliable and fast services of the SMEs, a basis for commercial success. During the time of the project, the key questions on data handling (Sentinel) and optimized use of cloud computing are being solved. The results and recommendations will be contributed to a wider community. More information and contacts can be found via the project web page: www.apps4gmes.de

7. ACKNOWLEGMENT

The project is funded by the Bavarian Ministry of Economic Affairs, Infrastructure, Transport and Technology.

8. REFERENCES

[1] Bach, H.; Migdall, S.; Spannraft, K.; Hank, T; Mauser, W. (2012): Potential and challenges of using Sentinel-2 for Smart Farming; Sentinel-2 Preparatory Symposium, ESA-ESRIN, Frascati, Italy, 23 to 27 April 2012

[2] Bach H., Migdall, S., Mauser W., Angermair, W., Sephton, A. J., Martin-de-Mercado, G. (2010): An integrative approach of using satellite-based information for Precision farming: TalkingFields. Proceedings 61st International Astronautical Congress, Prague, CZ

[3] Appel, F, Bach, H., Hall, R., Metsamaki S., (2010): Snow Services from GSE Polar View – Five Winters of Operational Service and the Extension Towards a Pan-European Service, Proceedings of the ESA Living Planet Symposium. ESA Special Publication SP-686, CD-Rom.

[4] Bach, H., Appel, F., Rust, F., Mauser, W. (2010): Polar View Snow Service – Operational Snow Cover Mapping for Downstream Runoff Modeling and Hydropower Predictions, Proceedings of the ESA Living Planet Symposium. ESA Special Publication SP-686, CD-Rom

[5] Heege, T., Kiselev V., Gebhard S., Huth J., Trinh Thi Long, Vo Khac Tri (2009). Processing of Multiple Sensor Images of Aquatic Systems. Proc. of 33rd International Symposium on Remote Sensing of Environment (ISRSE), May 4-8, 2009, Stresa, CD-ROM publication.

[6] Sabine Ohlendorf, Andreas Müller, Thomas Heege, Sergio Cerdeira-Estrada and Halina T. Kobryn (2011): "Bathymetry mapping and sea floor classification using multispectral satellite data and standardized physics-based data processing", Proc. SPIE 8175, 817503; doi:10.1117/12.898652

[7] Franke J., Keuck V. & Siegert F. (2012): Assessment of grassland use intensity by remote sensing to support conservation schemes. Journal for Nature Conservation, Vol. 20(3), 125-134.

[8] Franke J., Navratil P., Keuck V., Peterson K. & Siegert, F. (2012): Monitoring fire and selective logging activities in tropical peat swamp forests. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, Vol. 5, Issue 6, 1811-1820.