DISSEMINATION OF THE UAE SOLAR RESOURCE ATLAS OVER THE WEB: PRELIMINARY RESULTS

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Abstract

The Research Center for Renewable Energy Mapping and Assessment at Masdar Institute was mandated by the UAE Government to develop the UAE solar and wind atlases as part of the UAE commitment to support the International Renewable Energy Agency (IRENA) in its advancement of a publicly-accessible atlas of solar and wind resources. The purpose of this project is to develop an online platform to make the produced solar and wind maps easily available to end users and stakeholders. The produced maps will be implemented in online interactive geospatial data portal (solar atlas) for easy navigation and analysis. The developed portal is based on Open Source technologies and standards (technology independent). This includes WMS (Web Map Service) and Open Geospatial Consortium (OGC) standards. A platform constituted by the data source, a server and a web application is under development to disseminate the UAE Solar and Wind Atlas through the web. The data source is composed by a collection of GeoTIFF images. The server is based on the GeoServer software and provides maps using OGC specifications, namely Web Map Service (WMS) specification. The web application aims to show the atlas maps over a base map and provide basic data management tools including the possibility to access pixel values and to derive historical histograms of solar and wind resources. This paper will focus on the dissemination of the UAE solar resource web portal, launched in October 2012.

Keywords: Atlas, OGC Standards, Solar Atlas, WebGIS.

1 INTRODUCTION

Atlases are a collection of knowledge about a specific topic in the form of maps and/or charts that provides valuable information for end users and decision makers.

The Research Center for Renewable Energy Mapping and Assessment at Masdar Institute was mandated by the UAE Government to develop the UAE solar and wind atlases as part of the UAE commitment to support the International Renewable Energy Agency (IRENA) in its advancement of a publicly-accessible atlas of solar and wind resources.

Taking the fact that the World Wide Web (WWW) has evolved significantly in the last years and is today one of the biggest repositories of information in the world, allowing data sharing between different users at different locations, this application uses the web as the communication channel to disseminate the solar and wind resource information.

This paper aims to show the ongoing project on the development of an application to make the produced solar and wind maps easily available to end users and stakeholders, technology independent and based on open standards.

2 OPEN GEOSPATIAL CONSORTIUM, OPEN STANDARDS AND WEB MAP SERVICE

One of the major issues that needs to be avoided regarding the dissemination of information over the web is data and information interoperability. "*Interoperability refers in general to the ability of various autonomous systems to bring together parts and to operate in collaboration. In most cases this means the exchange of meaningful information*" [1].

This can be done by developing applications that use clear standards in the process of exchange of information. The Open Geospatial Consortium (OGC), created in 1994, is an international consortium of companies, government agencies and universities participating in a consensus process to develop

publicly available interface standards, called specifications. These specifications (open standards) are technical documents that detail interfaces or encodings to exchange spatial information over the web and aim to support interoperable solutions that "geo-enable" the web, wireless and location-based services, and mainstream Information Technologies. These specifications empower technology developers to make complex spatial information and services accessible and useful with several kinds of applications [2].

Web Map Service (WMS) was, among many others, the most important specification developed by OGC. This specification defines the interface to remotely share and access Geographic Information (GI). The “requested map” is sent to the end user as a static image and not the data itself [3].

3 DEVELOPMENT OF THE APLICATION

A flowchart of the architecture of the UAE solar atlas application is presented in fig. 1. The used architecture is constituted by three components: data source, geospatial data server and user component.

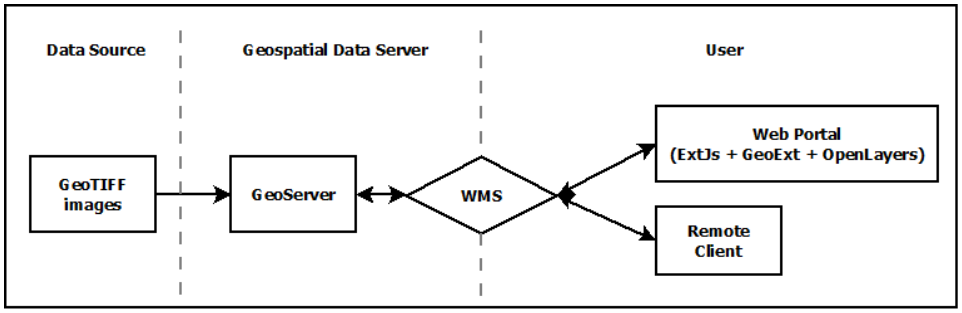

Fig. 1 - Architecture of the application

The data source component represents the data itself and is composed by GeoTIFF images, a format for interchanging georeferenced raster imagery of the solar irradiation components. The dispayed solar components are the Diffuse Horizontal Irradiation (DHI), Direct Normal Irradiation (DNI) and Global Horizontal Irradiation (GHI). These solar irradiation maps were calculated using an Artificial Neural Network (ANN) model developed at the Research Center for Renewable Energy Mapping and Assessment of Masdar Institute. The model is based on the thermal bands of the SEVIRI satellite, onboard Meteosat Second Generation, and ground measurements of solar radiation collected at seven different locations in the UAE [4]. Archived satellite data collected over the Arabian Peninsula between 2004 and 2010 were used as input to the model to derive both monthly and yearly solar maps for the United Arab Emirates (UAE). The same model was also used to derive solar resources over Qatar using the same set of archived satellite data.

The geospatial data server component aims to provide the data maps to the end users and is based on the GeoServer software. From the GeoServer website [5] a user can read that “*is an open source software server written in Java that allows users to share and edit geospatial data. Designed for interoperability, it publishes data from any major spatial data source using open standards*”. It is a high performance certified compliant WMS software and is also the reference implementation of WFS and WCS OGC standards, ensuring possible future extensions of the application in terms of functionalities. In the UAE solar atlas project, another important standard, the Styled Layer Descriptor (SLD), was also implemented in the Geoserver. This standard defines an encoding that extends the WMS standard to allow user-defined symbolization and colouring of geographic features, and provides the possibility to develop a graphic style to use with several maps.

The user component is constituted by a Web Portal and is the easiest way to visualize where users can access to the atlas data with a simple internet browser avoiding the installation of any additional software packages. The map layers were organized in tree configuration. Additional data processing tools were implemented to conduct simple visual analysis on the data. The other possibility to visualize the maps is to use any GIS desktop software that implements the WMS standard and connect directly to the GeoServer through the corresponding URL. The exchange of information between the user and the data components is always carried out through the GeoServer using the WMS standard.

The proposed architecture ensures the dissemination of the available maps over the web using open standards.

4 PRELIMINARY RESULTS

The screenshot presented in fig. 2 shows the layout of the Web Portal. The Web Portal is the visible part of the whole application allowing easy navigation and visualization of the atlas maps over a base map with some additional tools. It is structured with a top and bottom bars containing the logos of the Center for Renewable Energy Mapping and Assessment as well as the Center stakeholders and a left tree menu where all available maps are organized. The selective (active) map is shown in a large window in the middle of the screen. Both maps and the data tree components have toolbars to provide the user with additional functionalities.

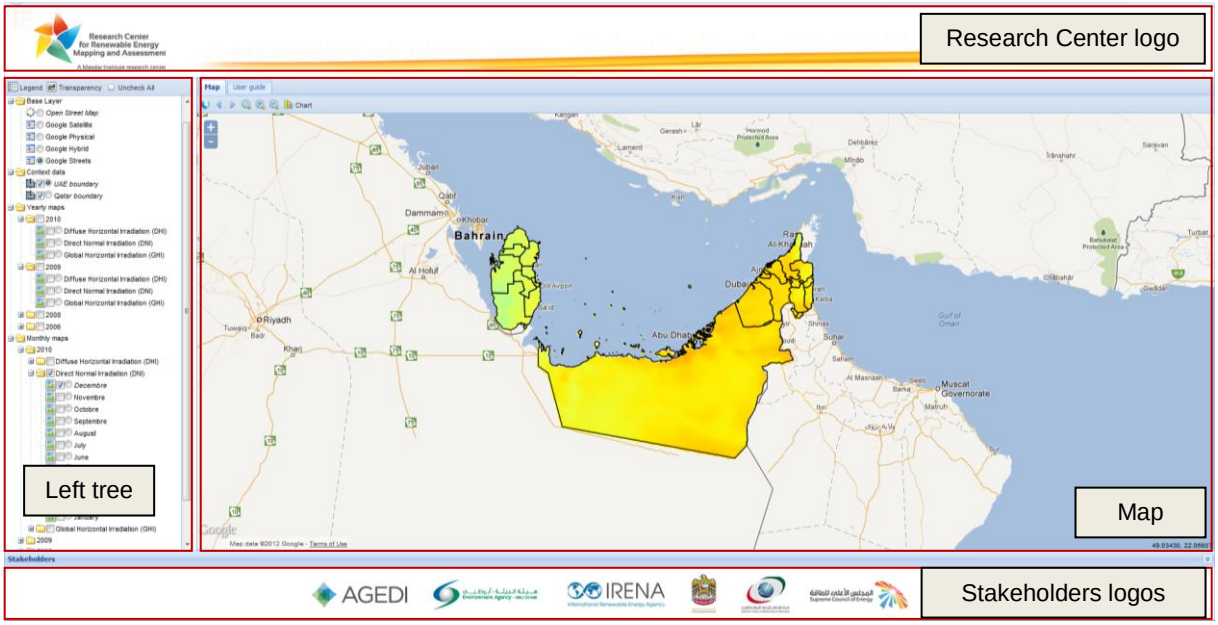

Fig. 2 – Web Portal layout

The left tree provides all the data available in an organized way, where the different types of information are properly separated and identified, for instance by Base Layer, Context data, Yearly maps and Monthly maps. The Base Layer represents the world map that is shown on the base of the viewer and can be selected among OpenStreetMap or Google Maps (satellite, physical, hybrid or streets). The context data is constituted by additional context information like boundaries, streets, population, etc. Regarding the yearly and monthly maps, representing the collection of solar irradiance maps, they are also organized according to the year for the yearly maps and according to the year and month information for the monthly maps. Each layer can be turned on/off (show/hide) by clicking on the respective checkbox and several layers can be checked at the same time. The radio buttons are used to define the active layer and only one can be defined at a time. The active layer is used to define the map that is shown on top of all selected maps and also to open its legend and change its transparency. These functionality options can be accessed by selecting the respective tool on the left tree toolbar.

The screenshot presented in fig. 3 shows two functionalities implemented in the webportal: map legend and chart window. The chart tool is available on the map toolbar and aims at show a chart with the pixel values of the layers that are turned on. For instance, if the user activates all the monthly DNI maps for 2010, the chart will show the monthly variation for that component in that year, but other analysis can be done, like to compare solar resources of different years.

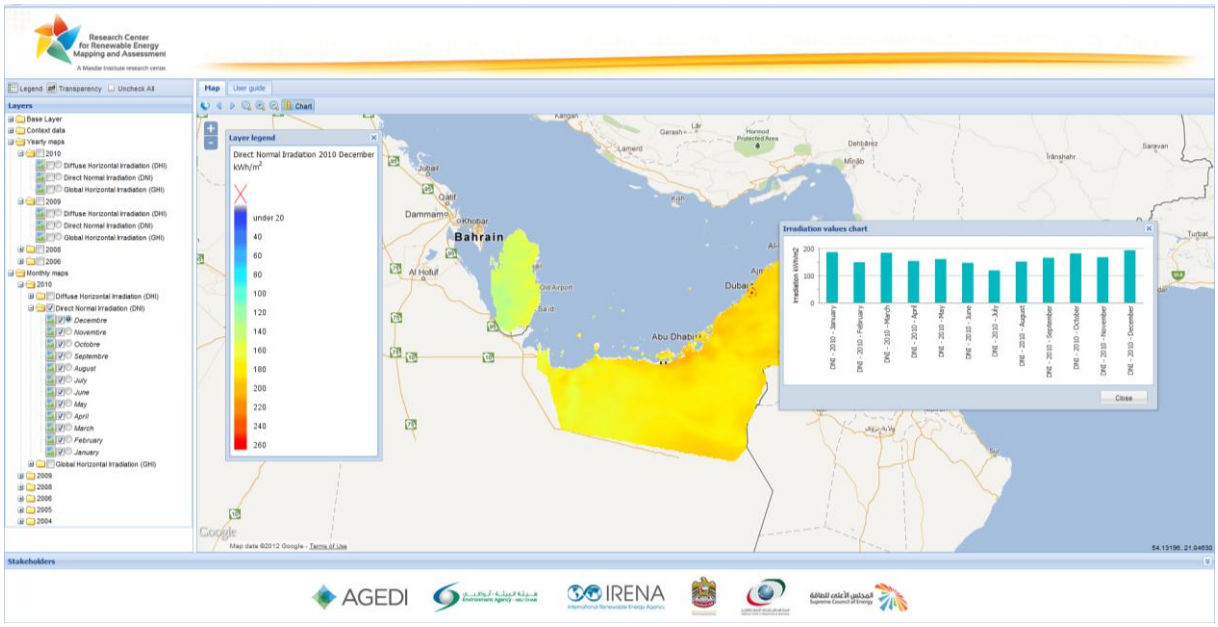

Fig. 3 - Legend and chart Windows

5 CONCLUSIONS AND FUTURE WORK

The UAE Solar Atlas is of extreme importance for the region regarding the dissemination of solar resource information of the UAE. This interactive tool provides a good way for users and stakeholders to have a better picture of the available solar resources in the country.

The dissemination of the data itself for certain types of users need to be considered. This can be achieved by using other available standards like WFS or Web Coverage Service (WCS). We are also planning to move the individual GeoTIFF images inside a geospatial database to improve data management and maintenance. Adding an authentication mechanism is also strategic to track the portal usage and get feedbacks from end-users. This mechanism will gives us the ability to have different profiles of users accessing different types of information, for instance the possibility to provide exclusive access to high-value data to stakeholders.

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Jacinto Estima has joined Masdar Institute in 2012 as GIS Developer & Programmer in its Research Centre for Renewable Energy Mapping and Assessment. He has a bachelor degree on Geomatics Engineering and a master degree on GIS and Science from University of Aveiro (Portugal) and Nova University of Lisbon (Portugal) respectively. He has also two specialization courses in 3D modeling and Municipal GIS, both from the University of Aveiro (Portugal). He has been working in the GIS field for more than 10 years and has also more than 4 years of teaching experience as Lecturer.

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