

# Poster: Supporting Climate Impact Research by a Smart View Management

Axel Radloff\*

University of Rostock, Germany

Thomas Nocke†

Potsdam Institute for Climate Impact Research, Germany

Heidrun Schumann‡

University of Rostock, Germany

## ABSTRACT

Climate impact research investigates the consequences of climate change to varying systems, like ecological systems. For this purpose a lot of different models and parameter settings simulating the future development of these systems are specified and explored. Typically, desktop systems are applied which limit the number of simultaneously displayable views. On the other hand, multi-display environments allow the presentation of multiple views at the same time. In particular, Smart Meeting Rooms support different users bringing in their own personal devices and systems working in such multi-display environment.

This paper discusses the use of the Vegetation Visualizer, a system supporting the visual presentation of varying attributes of climate impact models, within a Smart Meeting Room. On this example we show that the Smart View Management can be easily used as a software base to integrate different applications into a Smart Meeting Room.

**Index Terms:** H.5.0 [Information Systems]: Information Interfaces and Presentation—General; H.4.0 [Information Systems]: Information Systems and Applications—General

## 1 MOTIVATION

An integral component of climate impact research is to investigate the consequences of climate change to ecological systems. The results of this investigation and the investigation process itself is crucial for the research of different domain experts, as well as the risk assessment for policymakers and opinion forming for climate laypersons about the impact of climate change.

Therefore, attributes of climate models have been identified (e.g. temperature, precipitation, ...) which in principle influence the ecological systems development. In addition, the comparison of the same attributes of different ecological system models containing a large amount of different attributes is essential to evaluate the models. Thus, an effective simultaneous comparison of a multitude of representations is necessary.

For the visual presentation of these climate impact model attributes in combination with the climate driving forces a multi-view tool, the Vegetation Visualizer, has been developed [3]. It provides an easy-to-use access to simulation results for several driving climate models for researchers as well as laypersons and policymakers. However, the Vegetation Visualizer is a typical desktop system and therefore, only a subset of available views can be displayed at the same time.

Otherwise, Smart Meeting Rooms support the presentation of larger number of views for different users simultaneously. Thereby, we use a Smart View Management [4] as a generic middleware to arrange views in these environments by intertwining visual outputs of different applications.

\*e-mail: radloff@informatik.uni-rostock.de

†e-mail: nocke@pik-potsdam.de

‡e-mail: schumann@informatik.uni-rostock.de

In this poster we show the combination of the Vegetation Visualizer with the Smart View Management. Thus, visual representations of several attributes of the same climate impact model and the same attributes of various climate impact models can be compared simultaneously.

## 2 VEGETATION VISUALIZER

The Vegetation Visualizer is an interactive tool synchronizing multiple-views representing climate driving forces together with their possible impacts on the biosphere. It was designed to provide easy-to-use access to simulation results for several driving climate models, emission scenarios, vegetation variables / classifications and statistical derivations.

The Vegetation Visualizer bridges the gap between the complexity of climate related scenario analyzes and users. Providing a time chart and geo-referenced maps, it supports a variety of tasks, including various comparison tasks, the analysis of trends and extremes as well as the presentation of uncertainties. By interactive selection of spatial and temporal regions of interest it supports studying details. However, the number and type of simultaneously comparable views is strongly limited, and it can be steered by one expert only.

For speed, stability and portability reasons, the Vegetation Visualizer is based on pre-computed images. It provides different resolution versions for different output devices (HD screen, laptop screen, projector). This architecture is a good basis to utilize Smart Meeting Rooms for climate impact research.

## 3 SMART VIEW MANAGEMENT

The Smart View Management (SVM) was developed to integrate different applications into a heterogeneous ad-hoc ensemble with dynamically varying scenarios and configurations [4]. We do not realize this integration by intertwining different software systems, but the main idea is to combine their visual outputs.

The Smart View Management includes two strategies to combine the visual outputs – (i) application independent and (ii) with slight modification of the used software systems. The *application independent strategy* is realized by applying a view grabber. Thus, a fast and flexible strategy to gather the views is realized. The *modification strategy* is realized using a lightweight API. Thereby, the application will be able to provide the views itself.

The Smart View Management consists of three functional parts realizing the combination of visual outputs - the *View Package Generation*, the *Display Mapping* and the *View Layout*.

The **View Package Generation** combines different views from one or more applications into view packages. The views of one view package are intended to be shown on one or neighboring projection surfaces. The **Display Mapping** automatically assigns the views of the view packages to the different displays based on the positions and view directions of the users in Smart Meeting Rooms. Eventually, the **View Layout** realizes the arrangement of multiple views on one display. Furthermore, by taking the positions of the users into account, the areas occluded by presenters can be excluded for the positioning of views.

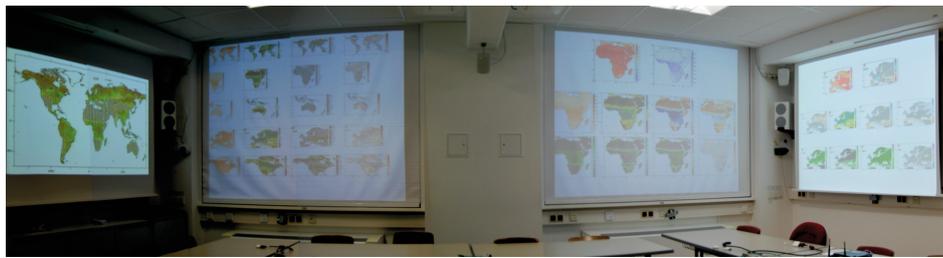


Figure 1: Illustration of Smart Vegetation Views: The left canvas shows a weaved image of the world to compare tree fraction and evaporation and on the right 40 views, grouped by attribute and region, are presented on three canvases.

#### 4 SMART VEGETATION VIEWS

In climate impact research the comparison of different views is the major task in understanding correlations of attributes and evaluating different models. The combination of the systems described above supports this aim by allowing to simultaneously display a large number of views presenting data to be compared.

Generally, this intertwining of these systems shows a use case for the Smart View Management and thus, a general procedure to adapt applications for the Smart View Management. This procedure consists of three steps, described below:

**View Package Generation** The major aim of this step is to define view packages that support the tasks of the application. In our case this means that we have to combine views to be compared into one view package. This is done by two wrappings:

- Views containing representations of one attribute of different climate impact models (e.g. ecological system models) are combined into one single view package.
- Views containing representations of different attributes of one model are combined into one single view package

Note, this configuration can be changed interactively by user interaction via a lightweight GUI, e.g. to combine all views which show extremes.

**Display Mapping** The Display Mapping, automatically assigns views to the displays, as described in [4]. This means that views belonging to the same climate impact model or views containing the same parameter settings are displayed close to each other to support the comparison.

**View Layout** Finally, the view layout constitutes the arrangement of the views on the display. An initial layout is generated by the use of a spring force or grid based layout algorithm. This initial layout can be changed by dragging views on demand.

We have introduced a further option to support the comparison of views enabling the user to directly compare two views in one image. A similar approach, the synthesis maps, has originally been proposed by Bertin [1]. However, instead of blending the colors we utilize the weaving approach for handling overlapping objects [2]. For example, Figure 2 shows two different models that were applied to present the evaporation (see Figure 2(a)) and the tree fraction (see Figure 2(b)) of Africa. Instead of two color coded images one image presenting both attributes in one image is generated using the weaving approach (see Figure 2(c)).

Here, colors of overlapping objects are not blended but aligned column (or row) wise next to each other. This is achieved by displaying the color of the first object in the first column, the color of the second view in the second column etc. (see Figure 2(c)). This presentation mode can be chosen by the users interactively via drag and drop interaction.

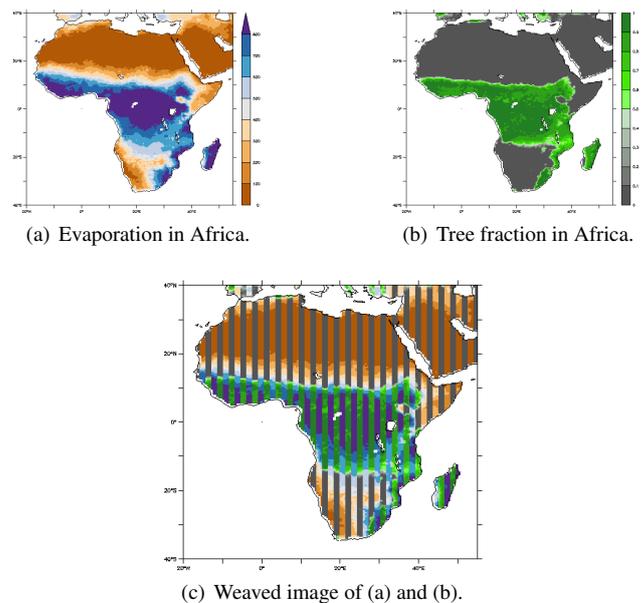


Figure 2: In (c) a weaved image of (a) and (b) is shown supports to explore the relationship of different models.

#### 5 RESULTS

Figure 1 shows the application of Vegetation Visualizer in the Smart Meeting Room presenting views on four of eight projection surfaces. Here, 40 views are shown simultaneously on three surfaces grouped by attribute and region. Additionally, a weaved image is shown to directly compare two attributes on the world map.

Through this combination of the View Management and the Vegetation Visualizer a multitude of visual representations showing attributes of different climate and climate impact models can be presented and compared simultaneously.

#### REFERENCES

- [1] J. Bertin. *Semiology of graphics: diagrams, networks, maps*. University of Wisconsin Press, 1983.
- [2] M. Luboschik, A. Radloff, and H. Schumann. A new weaving technique for handling overlapping regions. In *Proceedings of the International Conference on Advanced Visual Interfaces*. ACM, 2010.
- [3] T. Nocke, U. Heyder, S. Petri, K. Vohland, M. Wrobel, and W. Lucht. Visualization of biosphere changes in the context of climate change. *Information Technology and Climate Change, 2nd International Conference IT for empowerment*, pages 29–36, 2009.
- [4] A. Radloff, M. Luboschik, and H. Schumann. Smart views in smart environments. In *Smart Graphics 2011*, pages 1–12. Springer, 2011.