**A distributed in-situ sharing method of data resources for participatory modeling**

**Abstract**

1. **Introduction**

The earth system is a typical complicated giant system undoubtedly, which involves dynamic synthesis of chemical, biological, and physical processes as well as active human social behaviors. To explore the scientific laws behind it, multidisciplinary rather than isolated geographic knowledge ought to be applied on the real complicated geo-problems solving. Supported by the knowledge and experience of various disciplines, the geo-process and geographic phenomenon in the complicated geographic world could be more comprehensive understood and geo-analysis and geo-problems solving were more rational. Take the precipitation as an example, as the common geographic phenomenon, its formation and landing are the physical liquefaction process and variable acceleration movement, and it absorbs and dissolves sulfur dioxide, nitrogen oxides and other substances in the air forming acidic precipitation, which is chemical process and biological processes including transpiration of plants are influenced by the precipitation. In fact, geo-analysis models focus on expressing, describing or revealing the structure of different geo-processes and geographic phenomenon such as precipitation, soil erosion, air pollution, geographic distribution of organisms and so on, have been well-developed, which contributes to the geo-problems solving.

Furthermore, through integrating geo-analysis models breaking single model’s limitations in complicated geo-problems solving has been highly recognized based on the previous research and future outlook. With the efforts of integrating earth environment modeling (IEM) research, a range of integrated modeling frameworks have been developed for complicated geo-problems solving so far, such as the Earth System Modeling Framework (ESMF), the Open Modeling Interface (Open MI), the European Union’s Program for Integrated Earth System Modeling (PRISM), the Object Modeling System (OMS) and so on. However, research of integrating geo-analysis models require more about modelers with different academic background communicating and exchange ideas with each other participating in modeling as participants rather than simply merging a series of models, thus participatory modeling frameworks and methods have been raised in time such as teamwork-oriented integrated modeling method and so on.

Participatory modeling requires multidisciplinary stakeholders sharing their respective geo-analysis models, data and compute resources on the one hand as well as ideas and knowledge on the other hand to modeling the geo-process collaboratively. For the models, different models shared by the modelers of various domains are integrated from as software module to as model-services due to the growing maturity of service-oriented architecture (SOA), for the data resources, namely the models’ necessary input or output (I/O), multi-source heterogeneous data could be not only the model-driven input, but also both the former model’s output and the latter model’s input, which is the key of linking a series of models in integrating environment modeling. As a matter of fact, the trait that is multi-source heterogeneous of geo-analysis model’s input and output, in other words, data sources, used to be a challenge for the integrating modeling, while distribute models can be invoked as reusable web service with the help of the Community Surface Dynamic Modeling System (CSDMS) and the Open Geographic Modeling and Simulation Project (OpenGMS) at present. One of the effective solutions is that describe multi-source heterogeneous original data resources shared by different modelers by the Extensible Markup Language (XML) according to the Web Processing Service (WPS) standard developed by the Open Geospatial Consortium (OGC), which is clearer for the modelers with different knowledge background as participants to grasp the input or output (I/O) data of models in participatory modeling. Concretely, to accomplish an integrating modeling research, data resources shared by modeling participants should be well-prepared before invoking chains of model service, which is mainly rely on uploading and downloading in the way of centralization. Yet this form of data sharing is not sufficient to meet the needs of dynamically operation of data resources collaboratively and has high cost of migration and system running. Similarly, in the aspect of data utilization, datasets of models are always sharing in the way of centralized uploading or downloading in whole, while part of them is needed in most of participatory modeling cases. Moreover, in the aspect of security, the multi-source data resources are centralized managed free from data-owners’ respectively safety supervision increasing security risk. Although a great number of cases of integrating modeling benefit from this centralized collection, it’s widely craved that the collection of data resources for executing model services could be more effective and less inconvenient especially in participatory modeling.

In this article, a distributed in situ sharing method of data resources is proposed to support participatory modeling. Compared to the traditional centralized collection, the approach that distributed in situ share of multi-source heterogeneous data resources makes modeling participants to share their own local data resource with other modelers and obtain other participants' local data resources on demand, which supports to the complicated geo-problems solving in participatory modeling finally. From the teamwork-oriented integrated modeling perspective, the I/O data resources of models need to be dynamically shared, obtained and reused on demand collaboratively as well as directly, which enables different participatory modelers to share their own data resources under their control responding to other participants’ needs or to acquire other team members’ data to drive the model chains. Thus, the distributed in situ sharing method of data resources for participatory modeling is proposed in this study.

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1. **Basic Idea**
   1. **Data sharing in participatory modeling**
   2. **Distributed in situ sharing of data resources**
2. **Detailed process of in situ sharing of data**
   1. **Network solutions**
   2. **File level**
   3. **Information level**
   4. **Presentation level**
3. **Experiments**
4. **Conclusion and future work**
5. **Acknowledgments**
6. **References**

[Voinov, A](http://apps.webofknowledge.com/OutboundService.do?SID=5DTCcYZ9NbcLrROY8aq&mode=rrcAuthorRecordService&action=go&product=WOS&lang=zh_CN&daisIds=110896) (Voinov, Alexey)**[**[**1**](javascript:sup_focus('addressWOS:000279666700002-1'))**] Modelling with stakeholders**