# Chapter 11
# Geospatial Web Services for Distributed Processing:
## Applications and Scenarios

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## ABSTRACT

*Processing and modeling of geodata are essential parts of the daily work of GIS technology experts. Domain experts often need to perform sophisticated GIS analysis of complex data. Currently, capturing, storing and requesting data are embedded in Spatial Data Infrastructures using Service-Oriented Architectures. GIS analysis is performed locally by first downloading geodata such as from SDIs. With the advancements in network bandwidth, processing power and the standardization of Web technology and Geospatial Web Services, distributed geoprocessing is the next step of realizing GIS analysis on the Web. Geoprocessing Services are considered to be a key aspect of meeting the requirements for distributed geoprocessing on the web.*

*This chapter provides an overview of the current state-of-the-art approach of distributed geoprocessing by describing the related concepts, such as the OGC Web Processing Service, workflows, Quality of Service and legacy system integration. Furthermore, the chapter demonstrates different applications for distributed geoprocessing. Finally, this chapter examines the introduced concepts by two scenarios.*

# 1 INTRODUCTION

Geospatial data and maps have become increasingly accessible remotely in a distributed fashion through standardized Geospatial Web Services using Service-Oriented Architectures (SOA) (Lake & Farley, 2007). SOAs are a technical foundation for implementing Spatial Data Infrastructures (SDIs). SDIs focus especially on providing access to and sharing of geospatial data by defining the technical and organizational framework. The technical framework is often based on common data models and a set of standard Geospatial Web Service interfaces integrated using the SOA paradigm. A number of Geopatial Web Service interfaces are specified as open standards by the Open Geospatial Consortium (OGC) and the International Organization for Standardization (ISO). Currently SDIs address data delivery and web mapping, but the requirement for real-time geoinformation (extracted by GIS analysis based on most recent geodata in real-time) is not yet met by current SDI implementations. The need for near real-time geodata and geoprocessing increases for many geographic applications, such as emergency services, risk management and alerting, in which data from different sources have to be integrated to support decision making with real-time geoinformation. Geoinformation is generated from geodata using geoprocess models (i.e. models of real-world geoprocesses). Thus, embedding geoprocess models into the web, which facilitate distributed Geospatial Web Services for providing geospatial data in real-time, is a prerequisite to achieve web-based geoinformation. In this chapter, creating and performing geoprocess models that are encapsulated as Web Services and access remote resources (i.e. Geoprocessing Services or Data Services) to generate geoinformation is called *distributed geoprocessing*.

The aim of this chapter is to give an overview about the current approaches for distributed geoprocessing. The chapter will introduce the basic concepts (Section 2) for distributed geoprocessing by using the OGC Web Processing Service (WPS), establishing geoprocessing workflows, ensuring Quality of Service (Grid and Cloud Computing) and integrating functionality of legacy systems. Based on these concepts the chapter describes applications (Section 3), in which distributed geoprocessing on the web is utilized to provide real-time geoinformation. In particular, it will demonstrate how geoinformation extracted from web-based geospatial data can be integrated into mass-market applications. Two scenarios are described based on the introduced concepts to illustrate the full potential of distributed geoprocessing on the Web (Section 4). Section 5 will conclude the described approaches and will provide an outlook about future challenges. All the examples mentioned in this chapter are implemented as Open Source software at the 52°North Geoprocessing Community[1].

As this chapter focuses on distributed geoprocessing, the reader may refer to other chapters of the book for getting specific information on related topics such as Geospatial Web Services, data services (e.g. WFS, WCS).

# 2 RELEVANT CONCEPTS FOR DISTRIBUTED GEOPROCESSING

Geoprocesses are real-world processes that are modeled in computer systems to simulate and analyze real-world phenomena. For this chapter geoprocessing is defined as the application of a model representing a real-world geoprocess. As a result, geoprocessing is the transformation of geodata to geoinformation. The definitions of geodata and geoinformation are closely related to the definitions of data and information besides their specific geospatial focus. Geodata and geoinformation describe geospatial phenomena at different levels of abstraction. The terms data and information are not clearly defined in literature. This chapter follows the definitions of Ackoff (1989) and Chen et al. (2009). Ackoff (1989)

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