Chapter 6
Using Grid Computing and Satellite Remote Sensing in Evapotranspiration Estimation

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ABSTRACT

The most advanced and applicable approach today in the development of environmental monitoring programs is the integration of remote sensing and Grid computing services into a monitoring and forecasting system that helps the analyst to understand the problem without being a remote sensing or computer expert. In this chapter we present the main features of Grid computing and how we can use it in conjunction with remote sensing to develop several applications that will estimate ET (Evapotranspiration), LST (Land Surface Temperature) and some vegetation indices (VI’s) directly from a satellite image, these parameters playing an essential role in all activities related to water resources management.

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INTRODUCTION

Satellite remote sensing is a very important source of information, as it provides access to long-term data for large geographical areas. Measurements of key environmental parameters like surface temperatures, vegetation indices, soil types or precipitation make it possible for the scientific research to be done over weeks, months, years and decades, allowing us to better understand the processes that occur naturally in our environment. For example, remotely-sensed data reflecting the degree of vegetative surface in a particular region can be produced on a monthly basis over the course of several years, providing us with valuable information on how weather, climate change and human interaction may affect our agricultural production.

The remote data file size, consisting in high-resolution bands from satellites like Landsat, is very large; only one spectral band may be reaching up to several hundreds of megabytes. New high-resolution sensors, either multi-, super- or hyperspectral, lead to even higher data quantities to be processed. For example, the EO1 - Hyperion sensor provides a high resolution hyperspectral imager capable of resolving 220 spectral bands with a 30-meter resolution. To store these data or to process and analyze it, we will need a large memory storage space and high computational capabilities. Grid computing is the new technology that provides new ways to solve these requirements, binding geographically or departmentally separate machines to create a “virtual” supercomputer. This virtual machine appears as a single node of computing resources and possesses the computational power to do the jobs that individual computers cannot. Also, it encapsulates very powerful data processing capabilities coupled to the necessary computing and data resources in a manner that is transparent to the user (Aloisio et al., 2004). Such heterogeneous and distributed computing platforms currently represent an appropriate choice for efficient distribution and management of very high-dimensional data sets in remote sensing and other fields.

One of the benefits of using Grid computing is the ability to create frameworks called Problem Solving Environment (PSE) (Gallopolous et al., 1994). A PSE targets a specific class of problems within a given scientific domain and provides the tools in the natural language of the specific scientific discipline so that the user can manage the underlying resources with very little computing knowledge.

Many applications of remote sensing in Earth science require real or near real time processing capabilities, for instance, the programs of tracking and monitoring of hazards such as wild land and forest fires, oil spills and other types of chemical or biological contamination, hurricanes or earthquakes (Plaza & Chang, 2008; Plaza, 2009). The capability to assemble all the necessary resources based on the trigger event is very important, and, although this represents both a scientific and operational grand challenge problem, a Grid computing system can access these
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