Chapter I

Space Technologies for the Research of Effective Water Management: A Case Study

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ABSTRACT

This chapter summarizes the collective work of a team of students who participated in the 2004 International Space University summer session program in Adelaide, Australia. The project is called space technologies for the research of effective water management (STREAM). The work represented in this chapter was accomplished as part of the intensive space studies curriculum offered during the summer session. The team project focused on the importance of fresh water resource management and its impact on the surrounding communities. The team explored various space technologies and their current and future potential to enhance water resource management. A real world case study of Australia’s Murray-Darling basin (MDB) was performed to provide the central focus of the project. Based on the results of the case study, the team then extrapolated their results to other regions of the globe that are experiencing challenges to their fresh water supply. A significant space technology recommendation developed by the STREAM project team was to improve the soil moisture measurement capabilities in the MDB. The primary goal of the STREAM project team is that the recommendations outlined in the extensive final report (STREAM Team, 2004) will receive full attention from policy makers concerned with the water issues surrounding the MDB.
BACKGROUND

Fresh water is one of the most valuable resources on the planet. Although three quarters of the Earth’s surface is covered by water, less than 1% of the water is suitable for meeting human needs (Young, Dooge, & Rodda, 1994). Some parts of the globe suffer from droughts or the inaccessibility of fresh drinkable water, while torrential floods plague other parts of the world. The demand for fresh water does not end simply with human consumption. Every facet of our lives depends on the adequate supply of fresh water, from irrigating agricultural lands to raising livestock, manufacturing commercial goods, and preserving the health of our wetlands. To manage and maintain an equitable distribution of fresh water for all parties concerned, it is necessary to understand the flow of water through various tributaries and the impacts on the environment and various communities when the movements are altered or, in some cases, cut off. Space remote sensing technology offers scientists and environmentalists an avenue to see an area in its entirety. Aside from spatial information, other space technologies can offer temporal and spectral data of the land, sea, and atmosphere.

As the world population grows, both competition for available fresh water resources and degradation of those resources is increasing. The effective management of water collection and distribution is essential for the sustainable development of populated areas, particularly in Australia, one of the driest continents in the world. The available supply of fresh water must be balanced with demand in order to properly manage the equitable distribution of water for all those who need it.

Space offers an ideal vantage point for synoptic hydrological and climate studies, especially if coverage over large areas is required over an extended period of time. However, to date, the most widely used remote sensing tools are not space borne, but airborne sensors and ground networks, especially for studies on regional and local scales (Young et al., 1994). Consequently, proponents of space-based remote sensing must focus on providing an end-to-end strategy to provide products that meet the needs of the user community.

The MDB covers roughly one seventh of Australia’s land mass and is home to approximately 10% of its population (Oliver, 2003). The basin contributes between 30 and 40% of Australia’s total production from resource-based industries, and it generates about 50% of the nation’s gross value of agricultural production. This number reflects the importance of the MDB system in Australia. Growing water-related problems not only have severe affects on the MDB ecosystem but on the lives of all the Australians who depend on the MDB for their sustenance or their livelihood.

Of all the parameters that are measured within the MDB, soil moisture is currently the only one that is not readily available (Murray-Darling Basin Commission, 2004). To better understand the MDB water cycle, more soil moisture data with increased accuracy and reliability is required. Soil moisture is a required parameter both for the study of the global water cycle using general circulation models, and for water management issues like floods and drought predictions.

THE GLOBAL WATER CYCLE

The global water cycle (GWC) is a continuous renewal process that recycles and circulates the water on the planet. It is also the principal mechanism whereby fresh water is produced and distributed to different ecosystems around the world.

Fundamentally, the GWC involves the movement and transformation of water through the processes of evaporation (transpiration), condensation, and precipitation. The evaporation of water takes place primarily from the surface of the ocean, while transpiration is the transfer of mois-
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