Future Directions in Geographic Information Science

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I. INTRODUCTION

In recent years the phrase *geographic information science* (GIScience) has gained some currency, particularly among academic communities in the U.S. that are associated in one way or another with the technology known as geographic information systems. The University Consortium for Geographic Information Science (UCGIS) has grown since its initiation in 1995 into an organization of some 60 of the nation's top research institutions, and maintains as a condition of membership that institutions be able to demonstrate a multidisciplinary commitment to GIScience that extends across many departments and schools. In addition, several new programs in GIScience have emerged; a Geographic Information Science Center has been established at the University of California, Berkeley (this paper was originally presented at the opening of that center; and also draws heavily on a presentation made at the International Conference of Spatial Information Science and Technology in Wuhan, China, in December 1998 (Goodchild, 1998); the National Science Foundation sponsored a workshop in early 1999 on GIScience to explore its relevance to the Foundation's programs; this journal adopted the phrase in its title; and the *International Journal of Geographical Information Systems* recently changed its name. The field clearly has some momentum, so it seems appropriate to ask where it is headed, and in this paper I offer a few personal views on the nature of the discipline and its future.

The paper is structured as follows. The next section explores definitions of GIScience, and attempts a definition that is well-grounded in theory. This is followed by a discussion of alternative views of the GIScience research agenda, with reference to the agenda developed by the UCGIS in 1996 and revised in 1998; the agenda of the Varenius project; and others. The final section looks at how the agenda of GIScience might be moved forward, by identifying two related *moonshots*, or strategic goals that might capture the public imagination and the kinds of funding needed to have major impact.

II. DEFINING GISCIENCE

Recently there has been much discussion of what it means to be "doing GIS" in an academic setting. In a recent article (Wright *et al.*, 1997), Dawn Wright, Jim Proctor, and I explored this question, and identified several possible answers:

- doing GIS means using a combination of software, hardware, data, and communications to solve some spatially-explicit problem;
- doing GIS means developing algorithms, data models, or other elements of geographic information technology;
- doing GIS means working to advance our understanding of the principles, concepts, and theories on which GIS is based.

We concluded in the paper that only in the last sense was someone who claimed to be "doing GIS" also "doing science". Clearly there is much confusion and debate about the significance of GIS, and how it fits into the broader academic and intellectual enterprise.

That paper was aimed at an audience of academic geographers, many of whom worry about the place of GIS within the discipline of geography, and about narrower issues such as the importance of GIS in the undergraduate curriculum (Kemp *et al.*, 1992), and the demands placed by GIS on the departmental budget. More broadly, I think it is possible to identify four distinct views of GIS as a technology, all of them held to some extent within the academic community:

1). GIS is a mature and distinct application of electronic data processing comparable to word processing, or spreadsheets.
2). GIS is a branch of engineering, concerned largely with the practice of spatially explicit problem-solving.
3). GIS is an immature technology whose further development requires significant advances in research.
4). GIS is a technology that requires a strong con-

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