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20<sup>th</sup> September 2001

Dear Dr Dangermond,

I understand that a number of colleagues in the US, notably Dr Dawn Wright of Oregon State University, and Anne Hale Miglarese of NOAA's Coastal Information Services, wrote to you recently on behalf of the marine and coastal GIS community, to urge that ESRI develop a suite of tools and services specifically aimed at addressing the GI processing needs of these constituencies. In their letter to you of August 31<sup>st</sup> last, which I have seen, they set out the case in favour of such development far more eloquently than I could. However, as a geographer with over 20 years of interest and involvement in GIS, 15 years of which has been specifically focused on coastal applications of the technology, and also as a member of the International Geographical Union's Commission on Coastal Systems, and current Chair of the Executive Committee that organises the bi-annual CoastGIS conference series (see <http://www.coastgis.org>), I would like to add my own voice to their requests.

It may help if I put my own interest in this matter into context. I have been observing (and, in a modest way participating in) the evolution of GIS for some twenty years now, having first encountered GIS tools and concepts in the early 1980s, when I was a postgraduate student at Edinburgh University in Scotland (the late Tom Waugh, who I believe you knew from your days at the Harvard Lab, was one of my mentors and earliest instructors in the field). I had my first training in the use of Arc/Info when Edinburgh acquired the software some time in 1982 or 83, and first became interested in applying these tools to the coast a few years later, when I was engaged as research assistant on a survey of coastal erosion in Northern Ireland between 1986 and 87. *Inter alia*, my coastal GIS activities since then have included:

- My Masters' degree from Edinburgh University (1989), in which I interfaced a wave energy refraction model to Arc/Info, using a suite of AML programs;
- Instructing in a workshop on GIS for coastal zone management in 1993, held in Alexandria, Egypt and organized by the United Nations Institute for Training and Research (your ESRI colleague Jim Henderson was also at this workshop, and he subsequently visited us here in Cork, Ireland, to assist in an EU-funded training workshop that we organised);
- Working on an EU-funded study of vulnerability of the Irish coast to sea-level rise, in which we pioneered the use of dynamic segmentation – as implemented in Arc/Info Network – for representing coastal data (I presented a poster on this theme at the 1996 ESRI user conference in Palm Springs – and, incidentally, chaired one of the “oceans” sessions at this User Conference – and our work on dynamic segmentation was also documented in a special issue of *Marine Geodesy* in 1997). I believe we were one of the first laboratories anywhere to use dynamic segmentation for coastal GIS in this way.

- Helping in the initial stages of an innovative project to design and develop an Internet- and GIS-based information infrastructure for community-based coastal management in Bantry Bay, West Cork (see <http://bantrybaycharter.ucc.ie>);
- Most recently, I have started work on designing and developing a GIS-based decision support system to assist community-based management of a major marine nature reserve and national park (the Banc d'Arguin National Park) on the coast of Mauritania, West Africa.
- I also contribute to other GIS-based coastal projects, carried out by the Coastal Resources Centre here in University College Cork (for details of some of these, see <http://www.ucc.ie/research/crc>), mainly in an *ad hoc* consultancy and advisory capacity.

It is no exaggeration to say that access to and use of ESRI software has been central to, and has contributed enormously to the success of, almost all of these activities. However, it is equally true that in many cases the scope and analytical depth of these endeavours has frequently been constrained by the need to constantly adapt tools, originally designed for terrestrial applications, to the special and distinctive needs and characteristics of the coastal environment. Four areas of frustration stand out in particular, as far as the coastal GIS specialist is concerned:

1. The need to incorporate, analyse and visualise data referenced in three spatial dimensions. When working at the coast, the z dimension, working both positively (altitude) and negatively (depth below sea-level or other datum), is frequently as important as the x and y dimensions encountered in traditional GIS.
2. The inherent temporality of coastal data. The dynamics of natural coastal processes, as well as many aspects of human occupancy and interest at the shore, frequently requires that the time dimension be fully integrated into any decision-making and resource management. As is well known, incorporating the temporal dimension remains one of the weaker elements of current GIS technology.
3. The extremes of spatial (and temporal) scale that have to be considered in most coastal GIS applications. Michael Goodchild expressed this especially succinctly in his introduction to the book that Dawn Wright and I co-edited a couple of years ago (*Marine and Coastal Geographical Information Systems*. London: Taylor and Francis, 1999), when he pointed out that the spatial resolution required along the shore is likely to be different by several orders of magnitude from that needed across the shore, and that this latter is itself liable to be much less than the resolution required of any data in the vertical (z) dimension.
4. The inherent fuzziness of so many coastal entities and objects. This includes such phenomena as water and sand bodies, the distributions of fish and other organisms, and even delineation of "mean water mark".

I therefore entirely concur with and endorse the call by my US colleagues for ESRI to provide us with the ability to: (1) work with truly solid 3-D GIS objects, 3-D grids (i.e., voxels), and TIN envelopes that completely encompass a solid; (2) to go beyond visualisation, query, and database linkage to volumetric *analyses*; (3) and to map and track these object through time (i.e., 4-D GIS). To these, I would also ask for more attention to be given to the modelling, analysis and visualisation of objects with fuzzy or indeterminate boundaries within GIS.

In their August 31<sup>st</sup> letter to you, Dawn and her fellow-writers also addressed the market viability of GIS tools specifically geared to the coastal and/or marine communities. Clearly, these are relatively specialised "niche" markets. However, the importance of both sectors (for I think that, while they have much in common, the coastal and the deep-ocean GIS communities also each have their own needs, characteristics and constituencies) is growing rapidly and, with increasing concern over issues of sustainability, global change and so on, are likely to do so into the foreseeable future. Thus, I am convinced there would be sufficient interest to make such development worthwhile. I would also point out that a few specialist coastal and marine GIS tools are already on the market, although these remain very sector-specific and hence difficult to integrate into broader GI infrastructures: in Canada, the CARIS suite of products is probably the prime example, while you may also be aware of GeoKronos, an innovative spatio-temporal mapping and analytical system developed in Britain specifically for environmental applications (see <http://www.geokronos.com>). Dawn and colleagues suggested that ESRI might save some duplication of time and effort, and speed up product development, by entering some form of strategic partnership with another Canadian company, IVS. This prompts me to ask

whether a similar partnership with, say, either Caris or GeoKronos, might not bring similar mutual advantages in the development of tools for the coastal GIS community?

I thank you for taking the time to read this letter, and hope I might hear from you regarding these ideas and suggestions in due course.

Yours sincerely,

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cc: Clint Brown, ESRI Senior Software Developer