

University of New Mexico

UNM Digital Repository

Long Term Ecological Research Network

Long Term Ecological Research (LTER)

5-1988

Remote Sensing Facility Documents, 1988-1989

Long Term Ecological Research Network

Follow this and additional works at: https://digitalrepository.unm.edu/lter_reports

COVER SHEET FOR PROPOSALS TO THE NATIONAL SCIENCE FOUNDATION

FOR CONSIDERATION BY NSF ORGANIZATIONAL UNIT <small>(Indicate the most specific unit known, i.e. program, division, etc.)</small> Ecosystem Studies Biotic Systems & Resources		PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE	
SUBMITTING INSTITUTION CODE <small>(if known)</small>	FOR RENEWAL <input type="checkbox"/> CONTINUING AWARD <input type="checkbox"/> ACCOMPLISHMENT BASED RENEWAL <input type="checkbox"/> REQUEST, LIST PREVIOUS AWARD NO.:	IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? Yes ___ No <u>X</u> ; IF YES, LIST ACRONYM(S)	
NAME OF SUBMITTING ORGANIZATION TO WHICH AWARD SHOULD BE MADE (INCLUDE BRANCH/CAMPUS/OTHER COMPONENTS) Baruch Institute, University of South Carolina			
ADDRESS OF ORGANIZATION (INCLUDE ZIP CODE) Columbia, SC 29208			
IS SUBMITTING ORGANIZATION: <input type="checkbox"/> For-Profit Organization; <input type="checkbox"/> Small Business; <input type="checkbox"/> Minority Business; <input type="checkbox"/> Woman-Owned Business			
TITLE OF PROPOSED PROJECT Remote Sensing and GIS Applied to Inter-Comparison of Ecological Processes at Coastal LTER Marsh-Estuarine Ecosystems			
REQUESTED AMOUNT \$179,015	PROPOSED DURATION 12 months	DESIRED STARTING DATE August 1, 1988	
CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW: <input type="checkbox"/> Animal Welfare <input type="checkbox"/> National Environmental Policy Act <input type="checkbox"/> International Cooperative Activity <input type="checkbox"/> Endangered Species <input type="checkbox"/> Research Involving Recombinant DNA Molecules <input type="checkbox"/> Research Opportunity Award <input type="checkbox"/> Human Subjects <input type="checkbox"/> Historical Sites <input type="checkbox"/> Facilitation Award for Handicapped <input type="checkbox"/> Marine Mammal Protection <input type="checkbox"/> Interdisciplinary <input type="checkbox"/> Proprietary and Privileged Information <input type="checkbox"/> Pollution Control			
PI/PD DEPARTMENT Baruch Institute	PI/PD ORGANIZATION University of South Carolina	PI/PD PHONE NO. & ELECTRONIC MAIL (803) 777-5288 GTE OMNET: B.KJERFVE	
PI/PD NAME/TITLE Björn Kjerfve Professor	SOCIAL SECURITY NO.* [REDACTED]	HIGHEST DEGREE & YEAR Ph.D. 1973	SIGNATURE
ADDITIONAL PI/PD (TYPED) F. John Vernberg Director and Professor	[REDACTED]	Ph.D. 1951	
ADDITIONAL PI/PD (TYPED) William K. Michener Research Associate	[REDACTED]	M.S. 1980	
ADDITIONAL PI/PD (TYPED)			
ADDITIONAL PI/PD (TYPED)			
For NSF Use:			
AUTHORIZED ORGANIZATIONAL REP.	SIGNATURE	DATE	TELEPHONE NO.
NAME/TITLE (TYPED) Katherine O. McCoy Associate Director		5/11/88	(803) 777-7093
OTHER ENDORSEMENT (optional)			
NAME/TITLE (TYPED) James R. Durig, Dean College of Science and Mathematics		5/24/88	(803) 777-2505

*Submission of social security numbers is voluntary and will not affect the organization's eligibility for an award. However, they are an integral part of the NSF information system and assist in processing the proposal. SSN solicited under NSF Act of 1950, as amended.

1. OBJECTIVES and HYPOTHESES

To expand our ability to characterize and analyze spatial and temporal patterns and variability in ecosystems and test ecological hypotheses, we propose to develop a remote sensing/GIS facility at the Belle W. Baruch Institute for Marine Biology and Coastal Research, University of South Carolina. The remote sensing facility will serve to:

- (1) archive past, present, and future acquisitions of satellite and overflight data from the North Inlet, SC, LTER site;
- (2) enhance ongoing research and function as a decision support system during the experimental design phase for new studies at North Inlet;
- (3) facilitate LTER intra and inter-site comparison of patterns of vegetation, productivity, and other geographic attributes occurring in various ecosystems;
- (4) develop effective collaboration with the University of Virginia LTER program for comparison of distributions and processes in marsh-estuary systems;
- (5) facilitate development of boundary dynamics models initially focusing on forest-stream interactions at Coweeta, Andrews Experimental Forest and North Inlet.

Because of the extensive ecological data sets already in existence for North Inlet and other LTER sites, it is desirable to merge field data and satellite/overflight images into databases to be accessed and analysed via geographic information system (GIS) software. In addition to the powerful spatial search and overlay analytical capabilities available in a GIS, we propose to transfer GIS data layers to statistical and modelling software for development of complex georeferenced time-series models. One invaluable long-term application of such structured GIS databases is for the development of a knowledge-based expert system for hypothesis testing, investigating "what-if" system responses, and making decisions.

In addition to meeting the needs of the North Inlet LTER project for remote sensing and spatial analysis of coastal landscapes, the facility will provide us the opportunity to develop and play an active role in the inter-comparison of spatial ecosystem patterns at various LTER sites. In particular, our objectives are to:

- (1) investigate the differences in vegetation distribution, productivity, and marsh inundation that occur at the North Inlet and Virginia barrier island sites;
- (2) evaluate and develop optimal algorithms to highlight marsh and estuarine water characteristics;
- (3) compare the structure of the two coastal LTER ecosystems using identical algorithms;
- (4) compare the applicability of various remote sensors (e.g. TM, MSS, SPOT, and aerial photography) and their usefulness in distinguishing marsh features;
- (5) apply quality control and statistical analyses to the GIS-based image and field data.

In this regard, we are collaborating with LTER scientists at the Virginia barrier island LTER site, including Drs. R.D. Dueser, W.E. Odum, and J.C. Zieman. They have expressed an interest in collaborating on (1) optimizing remote sensing techniques for marsh sites; (2) inter-comparing characteristics and functions of the marsh ecosystem using image analysis; and (3) applying the results of the image analysis as input to develop hydrologic-hydrodynamic models for the two LTER systems. Through our interaction with Virginia LTER scientists, in particular, we intend to integrate remote sensing into the analysis of ecological processes and patterns. In this regard, this LTER add-on project will play an important role in the testing of many of the hypotheses formulated under auspices of the South Carolina LTER project. These include:

- H1. Annual marsh vascular plant productivity varies seasonally and yearly.
- H2. Annual production of Spartina alterniflora is a function of the elevation of the salt marsh surface and frequency of tidal inundation.
- H3. The elevation of the vegetated salt marsh surface is regulated by sediment transport processes and tends toward a steady state elevation equal to mean high tide.
- H4. Algae are controlling forces and major contributors to estuarine energetics.
- H5. The phytoplankton and benthic microalgae standing crop and productivity vary temporally and spatially.
- H6. Variations in algal biomass and productivity correlate with spatial variations of other biotic and abiotic constituents.
- H7. The magnitude of annual cyclic changes in concentration of suspended particulate matter are a direct result of changes in the physical environment and the biological activity.
- H8. Weather disturbances are important in the exchange of materials between the ocean and marsh system.
- H9. The mature marsh channels are relatively stable as evidenced by an absence of meander cutoffs and tributary channels joining their masters at right angles.
- H10. Washover sands overlay marsh muds on the landward side of North Inlet and can be used to determine the rate of landward migration of the modern beach.
- H11. The magnitude of tidal nutrient and sediment exchange is proportional to the magnitude of inundation at high tide.

In addition to collaborative research with the Virginia LTER site, Hank McKellar and other participants at the North Inlet site (including

Elizabeth Blood and Fred Sklar) are collaborating with LTER scientists at Coweeta Hydrologic Laboratory and Andrews Experimental Forest to develop a forest-stream interactions model. This model will aid in summarizing and synthesizing data from ongoing research and will provide a working basis for examining theoretical aspects of boundary dynamics where forest-stream interactions represent important interfaces of the landscape. The remote sensing/GIS facility will initially function in a data collection capacity. Aerial photography and, where appropriate, satellite images will be utilized to provide critical data on area and boundary dimensions for incorporation into the model. We will collaborate with Dr. Susan Stafford at the Andrews LTER site and Dr. Jack Waide at the Coweeta LTER site to develop the data layers.

Data management personnel will play an integral role in planning, development, and utilization of the remote sensing/GIS facility. Initially, documentation and archival protocols for images and GIS data layers will be developed, tested for their effectiveness, and refined as necessary. Successful implementation of these standards will be crucial to the long-term utility of the remote sensing/GIS database. Software necessary for maintenance of an audit trail, describing how each data layer or image was produced, will be developed. The audit trail will include rectification and geometric correction algorithms employed for remotely sensed images, methods used to eliminate polygon "sliver" problems associated with mismatch of data overlays, and description of smoothing and contouring algorithms used to edit manually digitized map layers. Exploratory graphical and statistical procedures will be linked to the GIS for quality assurance of the database (e.g. outlier detection) and to assist in model development by providing detailed analysis of the distribution of attribute data.

2. LTER PROGRAM AND ADD-ON WORK TASKS

The NSF LTER program was developed to allow the investigation of ecological phenomena that occur on time scales of decades or centuries, not normally the focus of NSF-supported investigations. The LTER program is designed to provide long-term scientific data from representative ecosystem types to understand salient processes and linkages and to develop predictive ecosystem models. Research efforts at the existing LTER sites are focused on (1) patterns and control of primary productivity; (2) spatial and temporal population distributions; (3) patterns and control of organic matter accumulation in surface layers and sediments; (4) dispersion of nutrients and inorganic matter through soils, groundwater, and surface waters; and (5) patterns and frequencies of disturbances. LTER sites are regional and national research facilities, designed to permit effective collaboration and inter-comparison between different research sites.

Remote sensing has been an established tool for mapping and assessment of environmental resources for two decades. The use of remote sensing and GIS techniques is of high priority for the LTER program as a whole, because (1) remote sensing provides a synoptic perspective, which facilitates the detection of large-scale patterns and trends; (2) remotely sensed data are suitable for storage, retrieval, and manipulation in a GIS and can be combined with other types of data sets; and (3) GIS-based data can be used for quality control and for making decisions in near real time.

Preliminary analysis of a 1982 North Inlet Thematic Mapper test image indicated the existence of spectacular patterns and patchiness on different scales in the marsh and sharp gradients within the estuarine water body. The image showed that the use of remote sensing combined with a GIS holds enormous potential as a tool in long-term ecological research.

North Inlet and the Virginia tide-dominated barrier-lagoon systems are the only two coastal landscapes selected as LTER sites. The LTER project has been in effect at North Inlet since the beginning of the program in 1979 and the Virginia site was selected as an LTER site in 1987. The data base for North Inlet includes meteorological data, 8 years of daily estuarine water samples analyzed for nutrients and sediments, 5 years of biological population data sampled biweekly at subtidal locations, and 5 years of primary productivity data.

The availability of the extensive long-term ecological database makes North Inlet an ideal site for developing and applying remote sensing and GIS algorithms, quality control procedures, and techniques for incorporating GIS-based data in statistical analysis and decision-making. Specifically, we will establish a remote sensing/GIS facility at the Belle W. Baruch Institute for Marine Biology and Coastal Research at the University of South Carolina, Columbia, SC. We will use this facility to develop, calibrate, and validate remote sensing algorithms for vegetation, water, and soil; formulate a productivity model; construct a vegetation distribution map; develop effective data management techniques for the GIS and remotely sensed data; and incorporate data layers into statistical and modelling procedures for further analysis, quality control, hypothesis testing and decision-making.

Initially, we will use TM data from the North Inlet system for development of algorithms and procedures. Afterwards, we will apply identical algorithms and procedures to TM images of the Virginia LTER site to test the extent to which spectral characteristics measured in images of the two systems represent similar environmental types and indicate comparative magnitudes of process rates, e.g. gross production. In addition, we will digitize high-resolution aerial photographs from each site and overlay these data onto a GIS-based TM image for inter-comparison. Previously archived field measurements will also be entered into the GIS and used for the inter-comparison.

Aerial photos and satellite images will be initially used to determine area and boundary dimensions of forest, streams, and wetlands at the Coweeta Hydrologic Laboratory, Andrews Experimental Forest, and North Inlet study areas. These data will be incorporated into the forest-stream interaction model for LTER intersite comparisons.

3. REMOTE SENSING/GIS FACILITY

We propose to build a remote sensing/GIS facility that will enable the development of a database of remote sensing products, and merge this database with the extensive LTER database of field measurements in a GIS. This goal will allow different temporal and spatial data in the GIS to be manipulated simultaneously, in such a way as to make the process transparent

to the user. Access to the GIS from the Coastal Field Laboratory or other LTER scientists will be supported.

Our long-term goal is to use a structured GIS as a component in a knowledge-based expert system. Coastal managers require timely access to current data to be effective in rational decision-making. The GIS component of our project facilitates rapid inclusion and analysis of new data. A knowledge-based system could then interact with the GIS to direct the user to the most pertinent dataset(s) for a particular problem.

GIS software packages include modules to collect and process spatial or georeferenced data from various sources, store and retrieve data, manipulate and analyze data, edit data for scale uniformity and overlaying, and produce output in either tabular or cartographic form. Additionally, the inclusion of a database management system (DBMS) with the GIS enables the user to search the database by geographic coordinates, data planes, or keywords describing attributes associated with particular data layers.

The remote sensing/GIS facility will be developed within the Physical Oceanography Laboratory of the Baruch Institute on the main campus in Columbia, SC. The laboratory consists of 8 technical staff and students and is equipped with direct computer 19,800 baud hook-up to a network of three DEC VAX-11/780 digital computers in the College of Science and Mathematics. These computers can be used for execution of specific models or other programs, but it is not feasible to attach an image analysis system nor a GIS software package and database to these computers on a permanent basis because of the multi-user demand for these machines.

The laboratory is also linked to two IBM 3081D computers and a large mass storage system which are supported by the University of South Carolina's Computer Services Division. The LTER database is archived on the mass storage system and can be accessed via a fiber optic communication network from the Baruch Field Laboratory or any affiliated campus within the state.

The University of South Carolina is in the process of installing a "mega-supercomputer" which will house 2,048 processors, each operating at 10 million instructions per second (MIPS) and each independently linked to 10 megabytes of memory. Currently, the mass storage facility is being replaced by a disk storage facility with a capacity of 20 gigaflops (billion megabytes). This facility will support near real-time spatial simulation modelling and is necessary for time series analysis of complex spatial databases.

Because the North Inlet LTER program and the University of South Carolina will greatly benefit from the proposed remote sensing/GIS capability, the Dean of the College of Science and Mathematics has agreed to cost-share this proposal by purchasing the required computer hardware at a total cost of \$58,400. This hardware-software purchase represents a long-term investment by both University of South Carolina and NSF. Although this add-on project is planned for one year, the system is expected to have a useful life of 10-12 years.

We are requesting a state-of-the-art, turn-key image analysis system with powerful analytical capabilities as well as GIS/DBMS software. We have evaluated several systems suitable for LTER needs and are proposing the following system configuration, which is optimal in terms of cost, system capabilities, and ease of data exchange with other LTER laboratories:

COMPAQ DESKPRO 386-130 SYSTEM, including 2.0 Mb RAM memory, 1.2 Mb floppy diskette drive, 130 Mb fixed disk drive, monochrome display and adapter, 80387-8 math co-processor, Compaq DOS 3.3, serial/parallel adapter;

ERDAS 1024 PC KIT, including 1,024x768x32 bit high resolution image processor, 19" high resolution RGB color monitor, bundled Microsoft mouse, CORE software module, and IMAGE PROCESSING software module;

ERDAS GEOGRAPHIC INFORMATION SYSTEM (GIS) software module;

TAPES software module, including applications software, 9-track 1600/6250 bpi M990 Cipher dual tape drive, and controller;

HARDCOPY (thermal) module, including thermal wax Tektronix 4693B hardcopy device (10"x10", 300 dpi output), starter kit, and applications software;

POLYGON DIGITIZING module, including applications software, 36x48" Calcomp 91480 digitizing tablet, 16 button cursor, power lift base, and power supply;

OPTICAL DISK STORAGE (WORM), including 5.25" Optotech 5984 optical disk drive, controller, and 12 double-sided 400 mb optical diskettes;

PC ARC-INFO, including starter kit, PC grid conversion, PC overlay, PC ARC edit, PC info, and software support;

The total hardware cost for the above system amounts to \$58,400, including SC state tax, shipping, and insurance. The total software expense amounts to \$29,700, including software subscription service, on-site installation and training by ERDAS professionals, SC sales tax, and shipping and insurance. The software prices are calculated minus the ERDAS 35% university discount and the ARC-INFO 25% university discount. In addition, we would like to purchase a maintenance contract on the system, which ERDAS offers at a cost of \$5,900.

The final choice and configuration of the system will be made at the time of purchase. We are also evaluating the Sun 386i, which operates under SUN/OS, a combined UNIX and PC DOS operating system. The ERDAS software are not yet implemented on this system in 32-bit mode but may be available at the time of purchase. The advantage of the SUN 386i would be its ability for multi-tasking. Via Ethernet hook-up, it will be possible to operate additional interactive terminals for maximum access to the remote sensing and GIS database.

4. PERSONNEL

The set-up of the proposed remote sensing/GIS facility and personnel training is time-consuming, independent of the current staff experience. However, we anticipate being fully productive within the first six months of this add-on project. Successful ecological applications are expected to be developed before the end of the project year.

Kjerfve is responsible for setting up, organizing, and operating the remote sensing/GIS facility. He will coordinate various project tasks and supervise the technical staff. Kjerfve has experience with image processing equipment from a recently completed NASA project involving remote sensing of coastal lagoons.

Vernberg is director of the LTER project at North Inlet as well as director of the Belle W. Baruch Institute for Marine Biology and Coastal Research. His participation in this add-on project will ensure that the goals of the remote sensing/GIS facility are closely integrated with other LTER objectives and activities.

Michener serves as director of the LTER database. His participation and interaction with the two technical staff members will insure that integration between remotely sensed data, GIS data layers, and the LTER database is achieved optimally. Michener has experience with remote sensing and GIS and recently completed a county-wide soil erosion model to assess potential impacts of various land use strategies.

Two full-time technical staff are required to operate the facility, develop add-on software, build and implement the GIS, and carry out the research tasks. Charlene T. Sailer is presently completing her Ph.D. at the University of California, Santa Barbara, in geography with remote sensing, GIS, and expert systems development as her specialties. She will be the primary person responsible for operating the computer system and building the GIS database. She will be employed as a post-doc on a full-time basis. Karen E. Magill holds an M.S. degree in geography from the University of South Carolina with remote sensing as her speciality. She will be responsible for carrying out image analysis work tasks, document procedures, and train others at the University of South Carolina to use the facility.

5. RELATIONSHIP TO EXISTING and PROPOSED REMOTE SENSING and GIS FACILITIES IN SOUTH CAROLINA

Recognizing that acquisition of images and GIS data layers is the most time-consuming and expensive component in the implementation of a GIS, we plan to collaborate extensively with existing ARC-INFO and ERDAS installations. Specifically, we will work closely with Dr. David Cowen, acting director of the USC Computer Services Division and expert in GIS, and Dr. John Jensen, professor of geography at USC and expert in remote sensing, as well as other Department of Geography faculty members and staff.

The Department of Geography has a M.S. and Ph.D. program in Geographic Information Processing which combines remote sensing, cartography and geographic information systems. Research undertaken by the department

includes analyzing the use of like and cross polarization microwave (RADAR) imagery in the coastal zone for monitoring changes in kelp and coastal land use, classification and mapping of wetland vegetation types in the Southeastern United States, development of algorithms for the extraction of biomass information for 8 year old loblolly pine trees, preparation of a GIS system for elevation and storm surge information for predicting the effects of storm surge on coastal Charleston, SC for the period 1980 to 2050, improved classification algorithms which incorporate texture information for mapping urban and rural land cover at the urban fringe and in coastal environments. The Department was one of four remote sensing centers invited by the Government of Colombia to provide one week training sessions in fundamentals of digital image processing at the National Center for Photointerpretation in Bogota, Colombia.

In addition, ARC/INFO is currently installed at South Carolina Land Resources Commission, South Carolina Water Resources Commission, and Clemson University's Forest Science Institute. We plan to cooperate extensively with GIS professionals at these institutions including Richard Lacey, Dr. Robert Somers, and Don Lipscomb. Such interaction will substantially reduce costs and time commitment necessary to establish data layers and produce final remote sensing/GIS products.

Funding for a single ARC-INFO personal computer installation was previously requested for the Baruch Field Laboratory. This proposal is pending and the proposed microcomputer and GIS software complement rather than duplicate hardware and software requested for the remote sensing/GIS facility. Activities at the Baruch Field Laboratory and the Physical Oceanography Laboratory will be coordinated. Appropriate ERDAS images will be translated into ARC-INFO data layers and transferred to the coastal facility. Manually digitized field data will be sent from the coastal laboratory to the Physical Oceanography Laboratory in ARC-INFO format for verification of remotely sensed data layers. Hydrologic-hydrodynamic models will be developed at the Physical Oceanography Laboratory and landscape simulation modelling will occur primarily at the coastal field laboratory. We plan to interact regularly with Dr. Fred Sklar (expert in spatial simulation modelling) and Terry Hiltz (data manager) at the Baruch Field Laboratory. Close cooperation will insure that personnel productivity is maximized and product development time is minimized.

6. RELATIONSHIP TO LTER REMOTE SENSING AND GIS FACILITIES

Scientists associated with the LTER project will be encouraged to utilize the facility for specific research tasks as well as choosing sampling sites for new studies. Initially, we will focus our efforts on intra-site hypothesis testing and intersite comparisons with the Virginia barrier island LTER site, Coweeta Hydrologic Laboratory, and Andrews Experimental Forest. We have contacted and planned for this collaboration with scientists at the Virginia island-lagoon LTER site, including Dr. Raymond D. Dueser, LTER Site Director and Professor of Environmental Sciences; and Dr. William E. Odum, Chairman and Professor of Environmental Sciences. In addition, we plan to collaborate with Dr. Susan Stafford, Director of the Andrews Experimental Forest LTER database; and Dr. Jack Waide, Forest Ecologist at the Coweeta LTER site.

Archival protocols and data management techniques developed specifically for remote sensing and GIS data will be shared with personnel from all LTER sites at the annual data management workshop held in conjunction with the Ecological Society of America meetings. Remote sensing/GIS algorithms and applications will be presented at the Remote Sensing Symposium and GIS Symposium to be organized by Michener and Dr. Susan Stafford at the 1989 and 1990 ESA/AIBS meetings.

7. BUDGET		NSF	USC
A.	SALARIES & WAGES		
	Kjerfve summer salary	4,200	0
	Post-doc (Sailer)	29,500	0
	Technician (Magill)	21,500	0
	Total salaries & wages	55,200	0
B.	FRINGE BENEFITS		
	22% of non-student salaries & wages	12,144	0
C.	SALARIES, WAGES, AND BENEFITS	67,344	0
D.	PERMANENT EQUIPMENT		
	Computer hardware components for the remote sensing/GIS system	0	58,400
E.	EXPENDABLE SUPPLIES & EQUIPMENT		
	Computer remote sensing analysis, GIS/DBMS, and software updates	29,700	0
	Ethernet hookup	2,500	0
	Project supplies	3,000	0
F.	TRAVEL		
	Domestic field travel to North Inlet and Virginia LTER sites	4,200	0
G.	OTHER		
	Telephone, mail, Omnet, photocopy	900	0
	Equipment service, maintenance, repair	5,900	0
	Two TM images	6,600	0
H.	TOTAL DIRECT COSTS	120,144	58,400
I.	INDIRECT COSTS		
	On-campus rate, 49% of MTDC	58,871	0
J.	TOTAL COSTS (H + I)	179,015	58,400

8. RESUMES

BJÖRN KJERFVE

Professor of Marine Science and Geology
Belle W. Baruch Institute for Marine Biology and Coastal Research
University of South Carolina, Columbia, SC 29208, U.S.A.
Phone: 803-777-2572; Telex: 258 602 BJKJ (UR)

Personal:

Born 4 November 1944, Skövde, Sweden; citizen of Sweden;
resident alien of the United States (1972-).

Education:

B.A. (mathematics), Georgia Southern College, 1968.
M.S. (oceanography), University of Washington, 1970.
Ph.D. (marine sciences), Louisiana State University, 1973.

Research Interests:

Oceanography of estuarine, coastal lagoons, and nearshore waters;
numerical modeling of circulation and transport processes; ecology of
salt marshes, mangroves, and coral reefs; coastal area management and
planning.

Professional Experiences:

- (a) Faculty member, University of South Carolina, 1973- .
- (b) Steering committee member, CARICOMP (Caribbean Coastal Marine Productivity) project, UNESCO/COMAR, 1985- .
- (c) Vice-President, Estuarine Research Federation, 1983-1985.
- (d) Member of S.C.O.R. Working Group 65, Coastal Ecosystems Relationship, 1982-1986.
- (e) Editorial board member: Estuaries 1977-1980; Coral Reefs 1980- ; Anales de Instituto del Mar y Limnologia (UNAM) 1982- ; Biological Bulletin (Thailand) 1984- .
- (f) International Consultancies: Penang Development Corporation, Malaysia 1986-1987; CNPq, São Paulo, Brazil 1984, 1985; IDRC, Malaysia 1985; UNESCO/UNDP, Bangkok, Thailand 1983.
- (g) International Research Projects: Mexico 1982-1987; Sweden 1981-1983; Australia 1980; Jamaica 1982-1985; Papua New Guinea 1980; Belize 1975-1979; Thailand 1985- Brazil 1987- .
- (h) Funded by NSF, UNESCO, Sea Grant, ONP, EPA, DOE, NASA.

Publications:

Two books; 61 journal papers; 13 technical reports; 76 abstracts and presentations, including:

Kjerfve, B. (editor). 1987. Hydrodynamics of estuaries. CRC Press.
Boca Raton, FL.

- Kjerfve, B., K.E. Magill, J.W. Porter, and J.D. Woodley. 1986. Hindcasting of hurricane characteristics and observed storm damage on a fringing reef, Jamaica, West Indies. *Journal of Marine Research* 44(1): 119-148.
- Kjerfve, B. 1986. Circulation and salt flux in a well-mixed estuary, pp. 22-29, In: *Physics of shallow estuaries and bays*. J. van de Kreeke (ed.). Springer Verlag. Berlin. 280 pp.
- Kjerfve, B., L.H. Stevenson, J.A. Proehl, T.H. Chrzanowski, and W.M. Kitchens. 1981. Estimation of material fluxes in an estuarine cross-section: a critical analysis of spatial measurement density and errors. *Limnology and Oceanography* 26(2): 325-335.
- Kjerfve, B. 1981. Tides of the Caribbean Sea. *Journal of Geophysical Research* 86(C5): 4243-4247.

CURRICULUM VITAE

Name: F. John Vernberg

Address: Belle W. Baruch Institute for Marine Biology and Coastal Research
University of South Carolina, Columbia, SC 29208

Date and Place of Birth: November 6, 1925 - Fenton, Michigan

Social Security Number: 376-20-2200

Education:

<u>College</u>	<u>Major</u>	<u>Dates</u>	<u>Degree</u>
DePauw University	Zoology	1946-49	A.B.
DePauw University	Zoology	1950	M.S.
Purdue University	Zoology	1951	Ph.D.

Employment:

Instructor to Professor, Duke University, 1951-1969
Baruch Professor of Marine Ecology, University of South Carolina
1969-present
Director of Baruch Institute, University of South Carolina 1969-present

Military Service: U.S. Navy 1944-1946

Honors and Awards:

Guggenheim Fellow, 1957-1958
Fulbright-Hayes Fellow, 1965
Russell Award for Research in Science and Engineering, 1977
William S. Proctor Prize for Scientific Achievement, Sigma Xi, 1983
South Carolina Wildlife Federation Conservationist of the Year, 1983
Drug Science Foundation Award for Contributions to Science in South
Carolina, 1987

Total Publications: 146 (Books and Papers)

Recent Publications:

Vernberg, F.J. 1984. Fiddler crabs: Ecosystems-Organisms-Molecules.
Amer. Zool., 24:293-304.
Vernberg, F.J. 1985. Environmental Physiology. IN: Physiological
Adaptations of Marine Animals, M.S. Laverack (ed.). Vol. 39. Society
for Experimental Biology, Great Britain pp. 1-31.
Vernberg, F.J., F. Thurberg, A. Calabrese, and W.B. Vernberg (eds.). 1985.
Marine Pollution and Physiology: Recent Advances. University of South
Carolina Press, Columbia, SC 545 pp.
Vernberg, F.J. et al (eds.). 1985. Shrimp Aquaculture in the Caribbean
Basin: Prospects and Constraints. University of South Carolina 443 pp.
Dame, R., T. Chrzanowski, K. Bildstein, B. Kjerfve, H. McKellar, D. Nelson,
J. Spurrier, S. Stancyk, H. Stevenson, J. Vernberg, R. Zingmark,
1986. The outwelling hypothesis and North Inlet South Carolina. Mar.
Ecol. Prog. Ser., Vol. 33: 217-229.

CURRICULUM VITAE

Name: William Kistler Michener

Address: Baruch Institute for Marine Biology and Coastal Research
University of South Carolina, Columbia, SC 29208
(803) 777-3939

Date and Place of Birth: January 25, 1955; Newark, Ohio

Social Security Number: 250-98-7520

Education

<u>College</u>	<u>Major</u>	<u>Dates</u>	<u>Degree</u>
Clemson University	Zoology	1977	B.S.
Clemson University	Marine Fisheries	1980	M.S.
University of South Carolina	Biological Oceanography	(candidate)	Ph.D.

Employment

Data Management Research Administrator, Belle W. Baruch Institute for Marine Biology and Coastal Research, University of South Carolina - 1984 to Present.

Statistician, Belle W. Baruch Institute for Marine Biology and Coastal Research, University of South Carolina - 1982 to 1984.

Research Associate (Project Coordinator for the Coastal Energy Impact Program) at the Baruch Institute for Marine Biology and Coastal Research, University of South Carolina, Georgetown, SC - 1980 to 1982.

Fisheries Research Technologist II, Department of Aquaculture, Fisheries and Wildlife, Clemson University, Clemson, SC - 1979 to 1980.

Research Assistant, South Carolina Wildlife and Marine Resources Department, Marine Resources Research Institute, Charleston, SC - 1978.

Military Service: None

Total Publications: 17

Recent Publications:

1987. Michener, W., and B. Kjerfve. North Inlet, South Carolina. pp. 56-60. In: The Climates of the Long-term Ecological Research Sites. D. Greenland (ed.). Occasional Paper No. 44. Institute of Arctic and Alpine Research, University of Colorado, Boulder, CO. 81 pp.
1987. Michener, W. K., R. J. Feller, and D. G. Edwards. Development, management, and analysis of a long-term ecological research information base: example for marine macrobenthos. pp. 173-188. In: New Approaches to Monitoring Aquatic Ecosystems, ASTM STP 940, T. P. Boyle, (ed.). American Society for Testing and Materials, Philadelphia.
1986. Michener, W. K. (ed.). Research Data Management in the Ecological Sciences. Belle W. Baruch Library in Marine Science, No. 16. W. K. Michener (ed.). University of South Carolina Press, Columbia, SC. 426 pp.

Current and Pending Support for Research and Education in Science and Engineering

APPENDIX VI

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of the proposal.

I. Name of Principal Investigator	Source of Support	Project Title	Award Amount (or Annual Rate)	Period Covered by Award	Person-Months or % of Effort Committed to the Project			Location of Research
					ACAD.	SUMM.	CAL. YR.	
F. John Vernberg								
A. <i>Current Support</i> List—if none, report none.	NSF Peace Corps NSF	Long-Term Ecol. Research Program in Warm Water Fish Research Equipment Grant	1,138,314 582,000 45,000	1/86-6/89 4/88-3/89 7/87-12/88			16% 5% 0	Georgetown & Columbia Georgetown & Columbia
B. <i>Proposals Pending</i> 1. List this proposal	NSF	LTER Supplemental	15,533	5/15/88 8/14/89			0	
2. Other pending proposals, including renewal applications. If none, report none.	NSF NSF	Instrument & Equipment Facilities Center	386,560 386,560	6/88-6/89 6/88-6/89			2 2	
3. Proposals planned to be submitted in near future. If none, report none.								
II. Name of co-principal investigator and/or faculty associate								
A. Bjorn Kjerfve	see following pages							
B. William Michener	see following pages							
III. <i>Transfer of Support</i> If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.								
IV. Other agencies to which this proposal has been/will be submitted								

USE ADDITIONAL SHEETS AS NECESSARY

CURRENT AND PENDING FUNDING

Current and pending funding for Kjerfve consists of the following grants:

1. Sea Grant, NOS, NOAA. Assessment and modeling of estuarine flow and transport processes in response to changing freshwater discharge. 48 months (1 September 1986 - 31 August 1990). An average of \$40,000 per year. Kjerfve is committed for 1.0 month per year towards this project.
2. National Science Foundation. Long-term ecological research at the North Inlet estuary. BSR-8514326. 1986-1990. \$1,825,000. F.J. Vernberg is principal investigator. Kjerfve is one of 19 scientists participating in this project, but has presently neither time nor fund commitments with respect to this project.
3. National Science Foundation (International Programs). Circulation and dispersion in a faulted Brazilian estuary: Itamaraca. INT-8612499. 24 months. (15 April 1987-15 April 1989) \$15,014 with Carmen Medeiros. Kjerfve has no remaining time commitment towards this project and receives no salary. This project is primarily to allow Ph.D. student Medeiros to conduct her dissertation research.
4. National Aeronautics and Space Administration. Shuttle Imaging Radar (SIR-C) for verification of propagation and refraction of hurricane/typhoon waves. 30 months. \$197,497 with Charlene T. Sailer. Kjerfve's time commitment is 2 months academic time per year for 3 years. This grant is currently pending but is not likely to go into effect until 1991.
5. National Science Foundation. Coastal boundary layer experiment (CoBLEX): Ecological patterns and processes in response to continental drainage. For Land-Margin Ecosystems Research (LMER) Program. 48 months. (1 September 1988-1 September 1992) \$1,550,364 with J.T. Morris, L.R. Gardner, F.H. Sklar, C.T. Sailer, and N. Christensen. Kjerfve's time commitment is 2 months academic time per year for 4 years. This grant is currently pending.

Current and Pending Support for William Michener

Current

Sea Grant/NOAA - "Spatial patterns in recruitment, growth, and survival of oysters", \$9,000, September 1987 - August 1989.

NSF - Research Equipment Grant, \$45,000, July 1987 - December 1988.

Pending

NSF - LTER data management activities", \$106,000, June 1988 - May 1991.

NSF - "A meta-laboratory for computational ecology: Research data synthesis at a national level", \$733,436, July 1988 - June 1991.

NSF - Instrument and Equipment, \$386,560, June 1988 - June 1989.