LIFE (Linked Institutions for Future Earth)

First Year Report to NSF: 2012-2013

ACCOMPLISHMENTS – What was done? What was learned?

What are the major goals of the project?

The overarching goal of LIFE (Linked Institutions for Future Earth) is to create an international network of researchers, institutions, and experimental sites/field observations dedicated to advancing the quantitative predictive understanding of the Earth surface system. LIFE centers on action- oriented interdisciplinary research as well as creating the next generation of Earth surface scientists, trained within an international setting.

The specific goals of LIFE are to: (1) Create a global network of leading institutions, including experimental, theoretical, and field strengths, to understand and predict the evolution of the Earth-surface environment under natural and human-induced change; (2) Cultivate a culture of action-oriented research which is much more ingrained in European and Latin American institutions compared to U.S. institutions of research and teaching; and (3) Create a forum for sharing data, ideas, and expertise while mentoring young researchers within a global interdisciplinary environment.

LIFE focuses its efforts on research related to Earth surface vulnerability in two key environments (watersheds and deltas) and implements its goals via the following closely linked programs: (1) Researcher exchange, (2) Shared and co-mentored postdoctoral researchers, (3) International shared graduate degree programs, (4) Theme-based focused research (mainly experimental and theoretical) campaigns, and (5) International summer institutes for graduate students and young researchers, (6) Data/model sharing for actionable research, and (7) science-to-public international exchange.

What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

Major activities:

Major activities, Specific Objectives, and Significant results (combined 3 sections):

In the first year of the project, the major activities included: (1) an international working group meeting called "Stochastic Transport and Emergent Scaling on the Earth Surface" (STRESS); (2) a short course entitled "Sediment Transport on Distributary Systems", hosted by our LIFE partner IPG in Paris; (3) the Summer Institute on Earth surface Dynamics (SIESD) focusing on Surface-to-Subsurface; (4) organization of special sessions at major meetings; and (5) several individual visits of PIs among LIFE participating institutions.

(1) STRESS working group – (April 25-27, 2013) Lake Tahoe, Nevada:

Connectivity, Non-Linearity, and Regime Transitions in Future Earthscapes: Earthscapes (a term used to represent both landscapes and waterscapes and their physical and biological constituents and interactions, including humans) are undergoing changes due to natural and anthropogenic causes and this change is expected to intensify in the future. An accelerated hydrologic cycle for example, sets in motion other changes in the watershed, from river reorganization, to sediment, nutrient, and bio-geochemical cycle changes, and can bring the whole system into states that are not desirable or sustainable. Under what conditions of forcing or internal dynamics can a system lead itself to a new regime? Do extreme events impact a system more when it is already undergoing transition or when it is in a stable steady-state? Can mild but prolonged changes in one variable cause a drastic abrupt change in another variable and in system dynamics and what windows of change are most critical? To study all these problems, complicated models may offer little hope, as parameters change and long-term predictions become very inaccurate or impossible. Instead, formalisms that look at the system dynamics in terms of connectivity, non-linear amplifications, and simplified rules offer more promise to identify vulnerable places, times, and interactions that may lead to regime transitions and undesired or unsustainable states.

25 participants attended, half of them students. LIFE PIs included: Efi Foufoula-Georgiou and V. Voller (and 4 of their students, Univ. of Minnesota), Praveen Kumar (and 2 of his students, Univ. of Illinois, Urbana-Champaign), Rina Schumer (Desert Research Institute, Reno), Liam Reinhardt (Univ. of Exeter, UK), Cristian Escauriaza (Pontifica Universidad Catolica de Chile), Christophe Bonnet (Institute de Physique du Globe de Paris), and Chris Keylock (Sheffield University, UK, as correspondent from the UK participating institutions). Invited participants included several assistant professors (Lauren Larsen and Sally Thompson, Berkeley; Ben Ruddell, Univ. of Arizona; and Bodo Bookhagen, U of California, Santa Barbara); Paola Passalacqua (University of Texas, Austin), and post-docs (Arvind Singh, Univ of Minnesota; Alejandro Tejedor, Univ of Nevada Reno). Other lectures included: Scott Peckham, Kelin Whipple, Ilya Zaliapin.

STRESS meeting lecturers included: Bonnet: Influence of climate on the geometry of landscapes ; Keylock: Reduced complexity models, non-linearities, and closures; Peckham: Network-based modeling in hydrology; Zaliapin: Network structure analysis for transport applications; Kumar/Ruddell (tutorial): Information-theoretic approaches for network processes I, II; Larsen: Connectivity and complexity in hydrology and ecology; Whipple: Landscape complexity and response to change; Passalacqua: Network-based modeling of deltas; Foufoula/Czuba: Synchronization, amplification, and partitioning from network process models; Singh: Preliminary results from a new landscape evolution experiment; Reihhardt: Landscape evolution under perturbations; Thompson: Climate-ecosystem nonlinear dynamics; Childers: Biogeochemical process modeling; Voller: Reduced complexity models; Schumer: Network-based approaches to modeling complex dynamics

(2) IPG Paris short course – (June 3-7, 2013), Paris:

Sediment Transport in Distributary Systems: The course was a short, intensive introduction to the mechanics of sediment transport and open-channel flow, focusing on distributary systems (fans and deltas). Each day included lectures plus a series of experiments, mainly conducted by the students, using IPG facilities in the same building as the lectures. Thus the students could

quickly go between theory and experiment, testing ideas developed in lecture. They also did homework most evenings of the course to build modeling skills. The course brought together students from four countries (US, UK, France, India) and represents a collaboration between LIFE faculty at two institutions (US and France). The course also spurred new research involving the US and French researchers who taught the course.

Lecturers: Chris Paola and V. Voller (Univ. of Minnesota), number of students: 6, of whom 4 from IPG, 1 from Berkeley, 1 from Aberdeen (all LIFE participating institutions)

(3) Summer Institute on Earth-surface Dynamics – August 14-25, 2013, Minneapolis, MN

The SIESD was initiated in 2009 in order to engage graduate students and young researchers in interdisciplinary investigation of Earth-surface processes based on integration of theory, physical experiments, field work and numerical modeling. The 2013 institute is entitled **"***Subsurface to surface: recovering surface dynamics from stratigraphic records***"** (from cores to stratigraphy, deciphering past environments to understand current and future variability and change). It will emphasize bridging the gap between the study of both near-past and 'deep' time scales of the Earth's past, using the rich archival record of its own surface evolution to create an understanding of how Earth's surface might change in the future, taking into consideration a wide spectrum of time scales. The goal of understanding these natural trends becomes increasingly valuable in the context of human influence on nature. Sustainable solutions require forecasting the effect of current practice over multi-generational time scales in order to be continued indefinitely without damaging or depleting future resources.

Lecturers include several LIFE PIs. 30 students from all over the world have been accepted to the SIESD 2013 after a selection process that includes application and three letters of recommendation.

(4) Special sessions at major meetings

This year we organized a special session at the EGU meeting and will organize the same at the 2013 Fall AGU meeting as described below.

From grains to landscapes: Understanding the links between surface topography, fluid mechanics and sediment transport.

Session organizers: Rina Schumer (Desert Research Institute), Taylor Perron (MIT), Efi Foufoula-Georgiou (U Minnesota), François Métivier (IPG Paris)

Most of the processes that shape landscapes involve complex interactions between topography and the dynamics of fluid (water, air, ice) and sediment transport. Models of landscape evolution rely on quantitative descriptions of these interactions, but many basic mechanisms and boundary conditions remain poorly defined. This session welcomes experimental, observational, theoretical and numerical contributions that address the transport of fluid and sediments over a landscape and the consequences for land surface evolution. This includes, for instance, surface flow mechanics, particle and bedform dynamics, soil transport, or channel development.

(5) PI exchanges and Web collaboration ideas

PI Voller visited Professor Vladimir Nikora, University of Aberdeen and LIFE partner on March 18-19, 2013. The purpose of the visit was to establish ongoing research collaborations realted to the LIFE priorities. In particular,

1. Made preliminary plans for a LIFE partners meeting at Aberdeen in 2014.
2. Identified a graduate student to participate in a LIFE workshop network node IPGP in Paris June 2013,
3. Initiated an idea to include lab technician exchanges as part of LIFE activities.
4. Voller gave a seminar: Non-local Sediment Transport Models Using Fractional Calculus.
5. Brainstormed on ways in which the relevant planed and on-going research at LIFE nodes could be made available to all in the network. Came up with the idea of a web collaboration proposal entitled "*Experiments to illustrate non-local transport behavior in sediment transport systems"* (see more details under Key Outcomes)

Specific objectives:

Please see the above section under "Major Activities"

Significant results:

Please see the above section under "Major Activities"

Key outcomes or other achievements:

Please see the section of "Major Activities". Due to space limitations in that section we list below details under subject (5) PI exchanges and Web collaboration ideas.

Specifically we plan to explore the following Web collaboration theme: "*Experiments to illustrate non-local transport behavior in sediment transport systems"* which will be led by Vaughan Voller, University of Minnesota and will materialize in the Fall of 2013

Scope: Develop experimental systems that provide clear and measurable demonstrations of non-local transport (as proposed by the LIFE PIs in several recent publications) in sediment transport systems. Use the data obtained to identify/develop/calibrate/validate theory for modeling non-local behaviors in sediment transport.

Possible collaborations: Experimental design and operation can take place at multiple sites. Experiments operating at a particular site will represent part of the thesis work of a graduate student. There will be regular and frequent connection between the students working in remote sites. As an experiment runs at a particular site researchers at remote sites will be able to view and interact in real time. Students from one site will have the opportunity to visit remote sites to share results, ideas and techniques.

What opportunities for training and professional development has the project provided?

Training has been provided via all LIFE activities, in the following categories:

1. One-to-one mentoring of students and post-docs by LIFE PIs
2. Engagement of students, post-docs, and young PIs into interdisciplinary research via the working group meetings (such as STRESS described above), short courses, and the Summer Institute on Earth surface Dynamics (SIESD) described above.
3. Mentoring of the next generation of students not only in research but also in broader impacts is accomplished via including into the SIESD program visits to the Science Museum of Minnesota, join poster programs with the REU students hosted at the same time at the University of Minnesota (most of them minority students), and lectures on broader impacts and science communication.
4. A formal international Post-Baccalaureate Certificate - International Certificate in Earth-surface Dynamics (ICED) is pursued at the University of Minnesota led by LIFE PI V. Voller. A preliminary outline has been prepared (see below) and the plan is to begin the University approval process Fall 2014.

>> International Certificate in Earth-surface Dynamics (ICED)—*Draft Outline*

<u>For registered U of M graduate students</u>

Students will take ~12cr of course work from a range of designated courses across the University of Minnesota system.

Students will be required to attend the Summer Institute for Earth surface Dynamics (SIESD) which is held each August at the University of Minnesota

Student will be required to undertake a graduate course of study in a relevant topic in an international institution equivalent to at least 3 U of M cr. . This could be a regular course, a special problems course (with prior approval), or a short course (e.g., the summer short course on Earth Processes offered by our partners at the Institut de Physique du globe de Paris (IPGP)). Students can take up to 9 equivalent credits in this fashion. Any cr above 3 will go toward reducing the 12cr at the U of M.

Students will be required to participate in a research activity in an international institution. One of the primary planks in our LIFE project is the development of shared experimental campaigns conducted through remote (virtual) and on-site involvement. So it is expected that a typical research activity would involve the student establishing/conducting/data analyzing/modeling one of the experimental campaigns at an international location. An activity that can coincide with the international coursework option noted above.

<u>For International graduate students</u>: Students will take a minimum of ~6 credits of course work from a range of designated courses across the University of Minnesota system. Remaining credits to make a total of 12 can, on approval, be counted from a foreign institution.

Students will be required to attend the Summer Institute for Earth surface Dynamics (SIESD) which is held each August at the University of Minnesota

Students will be required to participate in a research activity at the University of Minnesota. This could also be connected to a shared experiment campaign and can be conducted in the same time-frame as the two items identified above

For North American Students not at the U of M: Students will take a minimum of ~6cr of course work from a range of designated courses across the University of Minnesota system. Remaining credits to make a total of 12 can, on approval, be counted from the home institution.

Students will be required to attend the Summer Institute for Earth surface Dynamics (SIESD) which is held each August at the University of Minnesota

Student will be required to undertake a graduate course of study in a relevant topic in an international institution equivalent to at least 3 U of M credits. This could be a regular course, a special problems course (with prior approval), or a short course (e.g., the summer short course on Earth Processes offered by our partners at the Institute de Physique du globe de Paris (IPGP)). Students can take up to 6 equivalent credits in this fashion. Any credit above 3 can be used to reduce the home institution cr.

Students will be required to participate in a research activity in an international institution. One of the primary planks in our LIFE project is the development of shared experimental campaigns conducted through remote (virtual) and on-site involvement. So it is expected that a typical research activity would involve the student establishing/conducting/data analyzing/modeling one of the experimental campaigns at an international location. An activity that can coincide with the international coursework option noted above.

How have the results been disseminated to communities of interest?

The SIESD was announced in EOS, the major outlet for the Geosciences community, and also the Gilbert Club mailing list as it was targeting the whole international community. The STRESS meeting announcement was sent to a large list of people but more focused to people that do research on network and complexity in earth surface processes. The IPGP short course was announced via email to the LIFE participating institutions only.

What do you plan to do during the next reporting period to accomplish the goals?

In 2014 we will plan the major activities:

(1) Have a PIs meeting in conjunction with a society meeting (such as the 2013 PIs meeting which took place at the 2013 EGU meeting in Vienna).

(2) Offer the Summer Institute on Earth Surface Dynamics (SIESD) -- specific topic to be decided and we might consider offering it at a different LIFE institution

(3) Finalize the International Certificate in Earth-surface Dynamics (ICED) and start enrolling students

(5) Accelerate visits among LIFE PIs and graduate/post-graduate students

(6) Organize a special session at the EGU and AGU meetings

(7) Produce a special issue in a major journal (Water Resources Research or Journal of Geophysical Research) as a follow up of the STRESS meeting and the special session at AGU in 2013.

(8) Organize the STRESS 5 meeting in the Spring of 2014

(9) Implement the "Web research collaboration" idea on "Non-local transport experiments" as discussed in the previous section.

(10) In view of the NCED2 project which begins officially in the fall of 2013, coordination of major community campaigns that will include international participants (including LIFE participants) will be developed.

(11) Participate in joint training activities at the Summer School in Environmental Fluid Mechanics organized by the Marie Curie Initial Training Network "Hydrodynamic Transport in Ecologically Critical Heterogeneous Interfaces", Aberdeen, UK, 2014.

PRODUCTS – What has the project produced?

Publications

Zanardo, S., I. Zaliapin, E. Foufoula-Georgiou, Are American rivers Tokunaga self-similar? New results on fluvial network topology and its climatic dependence, *Journal of Geophysical Research: Earth Surface.* Vol. 118, 1-18. DOI:10.1002/jgrf.20029, 2013.

Singh, A., J.A. Czuba, E. Foufoula-Georgiou, J.D.G. Marr, C. Hill, S. Johnson, C. Ellis, J. Mullin, C.H. Orr, P.R. Wilcock, M. Hondzo, C. Paola, StreamLab Collaboratory: Experiments, data sets, and research synthesis, *Water Resour. Res.*, 49, 1746-1752, doi:10.1002/wrcr.20142, 2013.

Keylock, C., A. Singh, E. Foufoula-Georgiou, The influence of migrating bedforms on the velocity-intermittency structure of turbulent flow over a gravel bed, *Geophys. Res. Lett.*, 40, 1351-1355, doi:10.1002/grl.50337, 2013.

Ganti, V., C. Paola, and E. Foufoula-Georgiou, Kinematic controls on the geometry of preserved cross-sets, *J. Geophys. Res. - Earth Surf.*, doi: 10.1002/jgrf.20094, 2013.

Falcini, F., E. Foufoula-Georgiou, V. Ganti, C. Paola, V.R. Voller, A combined non-linear and non-local model for topographic evolution in channelized depositional systems, *J. Geophys. Res. - Earth Surf.*, accepted, doi: 10.1002/jgrf.20108, 2013.

Czuba, J.A. and E. Foufoula-Georgiou, Synchronization and amplification of sediment fluxes: a network-based predictive framework, *Water Resources Res.*, in review, 2013.

Hassan, M.A.; Voepel, H.; Schumer, R.; Parker, G.; Fraccarollo, L.V., 2013.

Displacement characteristics of coarse fluvial bed sediment. Journal of Geophysical Research - Earth Surface. 10.1029/2012JF002374.

Voepel, H., R. Schumer, and M.A. Hassan *Sediment residence time distributions: theory and application from bed elevation measurements*. In Review - Journal of Geophysical Research - Earth Surface

Voepel, H., R. Schumer, and M.A. Hassan *Influence of flow regime, particle characteristics and channel morphology on vertical mixing of coarse sediment in gravel-bed rivers*. In Review - Earth Surface Processes and Landforms special issue on Fluvial Morphodynamics

Patil, S.; Covino, T.; Packman, A.I.; Drummond, J.D.; Payn, R.; Schumer, R.; McGlynn, B., 2012, *Intra-stream variability in solute transport in rivers: Geomorphic controls on tailing behavior.* Journal of Geophysical Research - Earth Surface. doi:10.1029/2012JF0024

J.D. Drummond; T.P. Covino; A.F. Aubeneau; D. Leong; S. Patil; R. Schumer; A.I. Packman, 2012., *Effects of solute breakthrough curve tail truncation on residence time estimates: A synthesis of solute tracer injection studies.* Journal of Geophysical Research. v.117. n.G00N08. doi:10.1029/2012JG002019.

Nikora, N., Nikora, V., O'Donoghue, T. Velocity profiles in vegetated open-channel flows: combined effects of multiple mechanisms. *Journal of Hydraulic Engineering*, 2013, 139(10). (accepted).

Hart, D.D., Biggs, B.J.F., Nikora, V., Flinders, C.A. Flow effects on periphyton patches and their ecological consequences in a New Zealand river. *Freshwater Biology*, 2013, DOI: 10.1111/fwb.12147.

Nikora, V., Ballio, F., Coleman, S.E., Pokrajac, D. Spatially-averaged flows over mobile rough beds: definitions, averaging theorems, and conservation equations. *Journal of Hydraulic Engineering*, 2013, 139(8), 803-811.

Siniscalchi, F., Nikora, V. Dynamic reconfiguration of aquatic plants and its interrelations with upstream turbulence and drag forces. *Journal of Hydraulic Research*, 2013, 51(1), 46–55, http://dx.doi.org/10.1080/00221686.2012.743486.

Radice, A., Nikora, V., Campagnol, J. Ballio, F. Active interactions between turbulence and bed load: Conceptual picture and experimental evidence. *Water Resources Research*, 2013, 49, 1–10, doi:10.1029/2012WR012255.

Aberle, J., Coleman, S.E., Nikora, V. Bed load transport by bed form migration. *Acta Geophysica*, 2012, 60(6), 1720-1743, DOI: 10.2478/s11600-012-0076-y.

Siniscalchi, F., Nikora, V. Flow-plant interactions in open-channel flows: A comparative analysis of five freshwater plant species. *Water Resources Research*, 2012, 48, W05503, doi:10.1029/2011WR011557.

Siniscalchi, F., Nikora, V., Aberle, J. Plant patch hydrodynamics in streams: Mean flow, turbulence, and drag forces. *Water Resources Research*, 2012, 48, W01513, doi:10.1029/2011WR011050, 2012.

Bialik, R., Nikora, V., Rowinski, P. 3D Lagrangian modelling of saltating particles diffusion in turbulent water flow. *Acta Geophysica*, 2012, 60, DOI: 10.2478/s11600-012-0003-2.

Technologies or techniques

Not applicable

Inventions, patent applications, and/or licenses

Not applicable

Websites

We have developed a web site for the project which we will update further and populate with more context and our publications and products: http://www.life.umn.edu

Other products, such as data or databases, physical collections, audio or video products, software or NetWare, models, educational aids or curricula, instruments, or equipment

The data produced by LIFE will be handled in the same way as the NCED data, that is, stored in an easy to access format in the NCED web site and available to the research community at large and the public. Currently, discussions are taking place with SEAD (Sustainable Environment-Actionable Data) at the University of Michigan to mainstream and improve the storage and retrieval of the NCED2 and LIFE data and use them as demonstration case studies. A preliminary such case study with NCED data has already been developed.

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS – Who has been involved?

What individuals have worked on the project?

People that have contributed to the LIFE project by exchanging research ideas:

Efi Foufoula-Georgiou (University of Minnesota)

Chris Paola (University of Minnesota)

Vaughan Voller (University of Minnesota)

Barbara Burkholder (University of Minnesota)

Diana Dalbotten (University of Minnesota)

Debra Pierzina (University of Minnesota)

Praveen Kumar (Univ. of Illinois)

Rina Schumer (Desert Research Institute, Reno)

Patrick Hamilton (Science Museum of Minnesota)

Francois Metivier (IPG Paris)

Vladimir Nikora ((University of Aberdeen)

Antonio Parodi (CIMA Research Foundation, Italy)

Cristian Escauriaza (Pontifica Universidad Catolica de Chile)

David Mohrig (University of Texas, Austin)

Paola Passalacqua (University of Texas, Austin)

What other organizations have been involved as partners?

None entered. [Organizations include the participating institutions. The University of Nevada, Reno (with Rina Schumer as the PI) has also been included in these institutions.]

Have other collaborators or contacts been involved?

Yes

<u>IMPACT</u> – What is the impact of the project? How has it contributed?

What is the impact on the development of the principal discipline(s) of the project?

LIFE embraces understanding and predicting the Earth surface environment as the unifying theme of its activities, with a particular focus on vulnerability to change. The interconnected processes that shape Earth's surface exhibit a wide range of complex dynamics, including thresholds and other forms of non-linear behavior. These complexities lead to steep gradients in vulnerability, in the sense that small perturbations can lead to unexpectedly large changes – shifts in the system dynamics or transitions to alternate equilibrium states. Examples of these changes are many (e.g., abrupt river transitions, coupled landscape-ecosystem shifts, accelerated erosion, etc.). Because sensitivity to change varies so much in space and time, mapping and

quantifying vulnerability is critical to a sustainable future Earth. In our project (LIFE), the research embraces two major research themes:

(1) *Watershed vulnerability and resilience* – We will emphasize the effects of climate and human actions (e.g., accelerating extremes, and land-use change) on sediment dynamics, landscape organization, river morphodynamics, hazards, and water quantity and quality;

(2) *Delta vulnerability and resilience* – We will emphasize understanding the interplay of sea level rise and upstream human interventions on delta eco-geomorphology, the evolution, and organization of deltas, and the connectivity of biophysical processes in deltaic environments.

Research on these two themes advances the disciplines of geomorphology, hydrology, river biology, ecology, water resources engineering, and socio-economic sciences.

What is the impact on other disciplines?

The two research themes of LIFE (quantifying vulnerability and resilience of watersheds and deltas in a changing environment) are by nature multi-disciplinary (hydrology, geomorphology, ecology, engineering, social sciences). The PIs of LIFE are themselves from different disciplines and their collaboration and co-advising of students will have large impact on sister disciplines, in fact, the new discipline of earth-surface dynamics (which was created by NCED and is continued by LIFE).

What is the impact on the development of human resources?

Our approach to educating young researchers is to provide a rich 'educational nexus' of energetic exchange among the nodes in a global network of universities, experimental facilities, and field sites. From the first year activities of workshops, meetings, short courses, and summer institutes, this, young researchers are experiencing the immeasurable benefits of research that transcends the boundaries separating nations, disciplines, and scientific approaches. Our approach also includes disseminating science to broader audiences via engaging the public on issues related to the sustainability of Future Earth, the role of research in preventing and adopting to change, and the development of a forum for international exchange of science museum exhibits. The Science Museum of Minnesota, a LIFE partner, is already featuring an exhibit called "Future Earth" where the impacts of humans on the future of our resources is explained for the public.

What is the impact on physical resources that form infrastructure?

LIFE uses extensively the experimental laboratories in the U.S. and abroad (in the first year the St. Athony Falls Laboratory at the University of Minnesota and the laboratory facilities at IPG, Paris) for both education and research. In subsequent years more facilities will be engaged in the projects both in collaborative research and training.

What is the impact on institutional resources that form infrastructure?

Not applicable for the first year.

What is the impact on information resources that form infrastructure?

Not applicable for the first year.

What is the impact on technology transfer?

Not applicable in the first year.

What is the impact on society beyond science and technology?

The Earth's surface is undergoing profound change due to human activities (land use change, intensive agriculture to feed the world's increasing population, urbanization, etc.), natural hazards caused by increased extreme events in a warming climate (landslides, droughts, floods), and sea level rise causing coastal erosion and ecosystem degradation in deltas around the world. Our project brings together an international team of experts in geosciences and engineering, in a Virtual Institute called LIFE (Linked Institutions for Future Earth) aimed at coordinating research built on sharing unique experimental facilities, theoretical strengths, and field observations for advancing the quantitative, predictive understanding of the Earth surface system and its response to change.

The research findings are expected to play a major role in informing management and policy decisions in watersheds and deltas undergoing change.

CHANGES/PROBLEMS

In December 2012, permission from the NSF Program officer (Dr. Paul Cutler) was obtained to use part of the LIFE resources towards establishing collaboration between this Virtual Institute and a proposed new effort called DELTAS, submitted to the Belmont Forum call. The DELTAS effort is a truly international consortium aiming to advance delta research, predictive modeling, and data sharing towards a better management of deltas around the world. The DELTAS project has been recommended for funding and once this is finalized a synergy between the two projects will begin. It is emphasized that one of the two major foci of LIFE is deltas, so the two projects are really synergistic and both will benefit for this collaboration. The cost-share of LIFE to the DELTAS project was $100K for three years.

Actual or Anticipated problems or delays and actions or plans to resolve them

None

Changes that have significant impact on expenditures

None

Significant changes in use or care of human subjects

None

Significant changes in use or care of vertebrate animals

None

Significant changes in use or care of biohazards

None

SPECIAL REQUIREMENTS

None