LIFE (Linked Institutions for Future Earth)

Second Year Report to NSF: 2013-2014

Award Number: 1242458

Lead PI: Efi Foufoula-Georgiou (University of Minnesota)

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, (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:

In the second year of the project, the major activities included:

(1) Initiation of a new series of "Distinguished Lecture Series on Earth-Water-Life";

(2) Preparation of a special volume in *Water Resources Research* for research presented at the LIFE sponsored international working group meeting called "Stochastic Transport and Emergent Scaling on the Earth Surface" (STRESS);

(3) A short course entitled "Sediment Transport on Distributary Systems", hosted by our LIFE partner IPG in Paris in June 2014;

(4) The Summer Institute on Earth surface Dynamics (SIESD-2014) focusing on "Complexity and Predictability of surface-to-subsurface systems" hosted at the University of Minnesota in August 2014;

(5) Organization of special sessions at the AGU meeting (Fall 2013) and in the "Deltas in Times of Climate Change" meeting (August 2014);

(6) Several individual visits of PIs among LIFE participating institutions; and

(7) An International Certificate Program in Earth-surface Dynamics (ICED).

>> Significant results:

(1) Distinguished Lecture series on Earth-Water-Life:

This lecture series, started in the spring of 2014 and is designed to provide a forum for exchange of ideas, learning about the cutting-edge research of international groups affiliated with LIFE, and provide opportunities for students in our mutual programs to explore across-institutions research exchange visits for collaboration towards our LIFE objective of "advance discovery and actionable research in Watersheds and Deltas in a Changing Environment." The invited speakers were in residence for one week at the University of Minnesota. They gave a seminar and met with students and researchers over extended meetings during that week.

The invited speakers include: Francois Metiver (Institute the Physique, Paris, France), Sanjeev Gupta (Imperial College, UK), Stefano Lanzoni (University of Padova, Italy), Chris Keylock (University of Sheffield, UK), and Cristian Escauriaza (Pontifica Universidad Catolica de Chile), Vladimir Nikora (University of Aberdeen, UK). We also had as Distinguished lectures three young U.S researchers affiliate with LIFE: Lauren Larsen (University of California, Berkeley), Paola Passalacqua (University of Texas at Austin), and Rina Schumer (University of Nevada, Reno). This lecture series has been very productive and a source of ideas and will continue in the third year of the project.

(2) Special WRR Volume based on the STRESS working group meeting sponsored by LIFE:

25 participants attended the STRESS workshop (April, 2013, Lake Tahoe, Nevada), 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, and Ilya Zaliapin.

A special issue in Water Resources Research is planned and the papers are due by July 15, 2014. The topic of the workshop and the special volume is given below.

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.

(3) IPG Paris short course – (June 3-7, 2014), 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, and India) and represented 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.

Participants from LIFE included Chris Paola and V. Voller (Univ. of Minnesota) lecturers, and a number of students from LIFE institutions.

(4) Summer Institute on Earth-surface Dynamics – August 12-21, 2014, 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.

SIESD 2014: Complexity and Predictability in Depositional Systems:
The National Center for Earth-surface Dynamics is proud to provide ongoing support for the 6th annual Summer Institute for Earth-surface Dynamics. The SIESD engages graduate students and young researchers in interdisciplinary investigation of Earth-surface processes based on integration of theory, physical experiments, field work and numerical modeling. This year's theme builds on the SIESD 2013 theme of linking surface processes and depositional records, with a new focus on formal, quantitative analysis of complexity and its effect on prediction both of evolution and change in present-day systems and of 3D structure in the subsurface. **The key objective in this year's SIESD is to develop a working knowledge of analysis tools that can help us navigate the complexity of surface-process interactions to provide insights into the behavior of depositional systems.**

Lecturers include several LIFE PIs. 30 students from all over the world have been accepted to the SIESD 2014 after a selection process that includes application and three letters of recommendation.

(5) Special sessions at major meetings:

This year we organized a special session at the AGU meeting (*Delta sustainability: a multi-million dollar effort*) and a session at the EGU meeting (*From grains to landscapes: Understanding the links between surface topography, fluid mechanics and sediment transport).* Also, in collaboration with another project (Belmont Forum: DELTAS project) we organize a special session and a Deltas-in-Practice workshop at the "Deltas in Times of Climate Change" meeting in Rotterdam, Netherlands, Sept, 2014. Special sessions for AGU 2014 and EGU 2015 are planned right now.

(6) PI exchanges and Web collaboration ideas:

PI Voller visited Professor Vladimir Nikora, University of Aberdeen and LIFE partner on March 18-19, 2013. PI Efi Foufoula-Georgiou visited University of Southampton in Aug 2014 to collaborate with Profs. John Dearing and Robert Nicholls on depositional systems. Both Foufoula-Georgiou and Voller presented at the EGU meeting and met with LIFE partners attending EGU. Prof. Metivier and the Director of the IPG in Paris visited the University of Minnesota in March 2014 and discussed the development of a joint degree program that would foster and formalize the exchange of graduate students between US and France. Meetings with the VP for Research and the Provost at the University of Minnesota were arranged and progress is currently made on that degree program.

(7) Certificate Program

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

A long-term plan of LIFE is to establish an International Certificate Program in Earth Surface Dynamics (ICED). This will provide a formal means by which graduate students at all LIFE partner institutions can get credit for international research and learning experiences. In the last year, building toward this objective, we have initiated a prototype program between the University of Minnesota and IPGP at the University of Paris. At this point we are developing an MOU between these institutions working toward a student exchange. Our current plan is to put in place a mechanism where students at the University of Minnesota can participate in courses and research experiences at IPGP but obtain teaching/research credit under a U of M class number; a mechanism that will be mirrored for IPGP students. This approach will allow for a meaningful and certified student experience and is an excellent test bed for the more extensive and formalized ICED. Our plan is to have the first student exchanges in 2015.

>> Specific objectives:

Please see the above section under "Major Activities"

>> Key outcomes or other achievements:

(1) The LIFE project is in synergy with another international project that the lead PI is leading, namely a project funded by the Belmont Forum called DELTAS ("Catalyzing Action Towards Sustainability of Deltaic Systems with an Integrated Modeling Framework for Risk Assessment"). The BF-DELTAS project is a consortium of 11 countries (US, UK, France, Germany, Japan, Bangladesh, Netherlands, China, India, Brazil, Canada, Norway, and Vietnam). The project investigates the vulnerability of deltaic systems which is the second theme of the LIFE project. The five Working Packages of DELTAS are:

(1) **Delta-SRES**: *Develop a theoretical framework for assessing delta vulnerability and the possibility for transitions to undesired biophysical or socio-economic states under various scenarios of change.*

(2) **Delta-RADS**: Develop *an open-access, science-based, integrative modeling framework called the Delta Risk Assessment and Decision Support (RADS) Tool*.

(3) **Delta-DAT:** *Consolidate data on bio-physical, social, and economic parameters into* an *international repository of integrated data sets and make these readily available relevant data* for use by the community at large to assess critical parameters, compute vulnerability metrics, and provide input data to the Deltas-RADS modeling framework.

(4) **Delta-GDVI:** *Develop Global Delta Vulnerability Indices that capture the current and projected physical-social-economic status of deltas around the world ("delta vulnerability profiles") and*

(5) **Delta-ACT:** Work with regional teams and stakeholders to *put the products of Delta-SRES, Delta-RADS and Delta-DAT into action* by demonstrating the implementation of the developed framework to three major deltas: the Ganges-Brahmaputra-Meghna (GBM), Mekong, and Amazon deltas.

BELMONT FORUM PROJECT ON SUSTAINABLE DELTAS

Erosion of a large bar adjacent to the main Meghna River Channel in the Ganges-Brahmaputra Delta © Irina Overeem

DELTAS: Catalyzing action towards sustainability of deltaic systems with an integrated modeling framework for risk assessment is a three year project that started in September 2013, funded by the Belmont Forum. Led by Efi Foufoula-Georgiou (University of Minnesota), the project brings together experts from the physical and social sciences, economics, health/demographics, management and policy, as well as local stakeholders from government, business and non-profit organizations. It includes partners from Bangladesh, Brazil, Canada, China, France, Germany, India, Japan, Netherlands, Norway, UK, U.S.A. and Vietnam.

The project will investigate how climate change, combined with the pressures of engineering, development and human population growth, makes deltaic ecosystems vulnerable and how this affects the human communities which depend upon them. The project will look at the characters of deltas that make them resilient to change, so that we can reduce future risk to deltas while attaining sustainable development. It will consolidate data on bio-physical, social and economic parameters of deltas; create tools for assessing delta vulnerability and guide decision-making to promote sustainably managed deltas.

The project includes three demonstration sites: the Ganges-Brahmaputra-Meghna, Mekong and Amazon deltas. The project will be a critical component supporting the Sustainable Deltas 2015 Initiative that has been proposed by the project's team to ICSU (International Council for Science) (and accepted though not formally announced).

My role is to foster connections with other organizations, conventions and consortia. Please contact me (harrison.deltas@gmail.com) to discuss opportunities to link the DELTAS project with the priorities of the Ramsar STRP. Also see the project website: http://www.delta.umn.edu/.

Ian Harrison, Fellow,
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Commercial shrimp farm in polder just North of the Sundarbans, Ganges-Brahmaputra delta.
University of Colorado graduate student Stephanie Higgins sets sediment traps on both sides of the dike © Irina Overeem

DELTAS SUSTAINABLE DELTAS 2015 BELMONT FORUM

(2) **ICSU Sustainable Deltas 2015 (SD2015) Initiative**

The BF-DELTAS team spearheaded a global initiative called "Sustainable Deltas 2015" (SD2015) which was recently endorsed by ICSU (International Council of Scientific Unions). The SD2015 is a statement of urgency for global cooperation and a call to arms to the global community of citizens, scientists, policy makers, and funders to work together towards accelerating the understanding and sustainable solutions of these critical systems. The specific goals of the SD2015 initiative are to: (1) Increase awareness and attention to the value and

vulnerability of deltas worldwide; (2) Promote and enhance international and regional cooperation and data sharing at the scientific, policy, and stakeholder level; and (3) Launch a longer-term initiative committed to understanding these complex socio-ecological systems as the cornerstone of ensuring preparedness in protecting and restoring them in a rapidly changing environment. Activities to launch SD2015 are in progress and events will take place in many parts of the world during 2014 and 2015.

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, joint 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 PIs V. Voller, C. Paola, and E. Foufoula-Georgiou. A preliminary outline has been prepared (see below) and the plan is to begin the University approval process Fall 2015.

>> 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 credit above 3 will go toward reducing the 12 cr. 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.

For International graduate students: 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 experimental 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 ~6 cr. 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 credits.

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 special volume 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. Several news pieces have appeared around the world (for example in the LOICZ newsletter) about the DELTAS project.

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

In 2015 we will plan the major activities:

(1) Continue the "Distinguished Lecture series on Earth-Water-Life."

(2) Offer the Summer Institute on Earth Surface Dynamics (SIESD 2015) -- specific topic to be decided.

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

(4) Plan a STRESS 5 meeting at a LIFE institution. We are making plans for organizing it in collaboration with Cristian Escauriaza (Pontifica Universidad Catolica de Chile, a LIFE institution) and Professor Lauren Larsen of Berkeley is taking the lead in this organization.

(5) Organize a special session at the EGU 2015 and AGU 2014 meetings.

(6) Produce a special issue in a major journal (Water Resources Research or Journal of Geophysical Research) as a follow up of the STRESS 4 meeting and the special session at AGU in 2013.

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

(8) 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.

<u>PRODUCTS</u> – What has the project produced?

Publications

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>> 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)

Arvind Singh (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)

Lauren Larsen (University of California, Berkeley)

Chris Keylock (University of Sheffield, UK)

>> 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, 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 are 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. Anthony 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 early 2014 a revised budget request was submitted to the NSF program officer Dr. Paul Cutler to allow the possibility of using LIFE resources (allocated as participant expenses) to support limited travel of the US lead PI and 2 co-PIs and some young researchers who are involved in leadership roles in the LIFE project: Paola Passalacqua (lead contact PI at the University of Texas, Austin), Lauren Larsen (Berkeley, leading the organization of the STRESS 5 meeting in Chile in 2015), and Rina Schumer (Univ. of Nevada, Reno who led the organization of the STRESS 4 meeting and leads the special WRR volume that has resulted from that meeting).

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