A Strategy for Advancing Critical Zone Science - February 2016

Mission – Our Core Purpose

To discover how Earth's living skin is structured, evolves, and provides critical functions that sustain life

Core Values – Our Aspirations

Interdisciplinary Collaboration

- *Critical Zone science requires insights from a wide range of disciplines*
- *Our interdisciplinary, integrative approach drives innovation and transformative findings*
- *Working together in an open community, we are greater than the sum of the parts*

"Deep" Science

- *We encompass deep time from the instantaneous all the way to geologic time*
- *We embrace deep structure from the vegetative canopy down to fresh bedrock*
- *We explore deep linkages resulting in deep insights and impacts*

Predictive Knowledge

- *We believe exploration and quantitative modeling go hand in hand*
- *We test generalizable hypotheses to advance the field of Critical Zone science*
- *We generate and disseminate new knowledge that benefits humankind*

Our Vision for Critical Zone Science in 2026

Digging deep to project the future

- Critical Zone science is recognized as an important and groundbreaking new field of science
- We act as a vibrant and dynamic network of science sites strategically arrayed along environmental gradients and optimized to advance the state of Critical Zone science
- We have strong connections with other important networks and partners around the globe
- We have a growing set of conceptual models that guide our research
- We have adopted a set of common measurements
- We are collecting real-time data with a system of integrated sensors – the data is organized, available and easily accessible on shared platforms to everyone
- We have an ensemble of modular and integrated models and tools that are widely used to test important hypotheses at multiple scales and timeframes across the network
- We are viewed as an open, inclusive, collaborative community of researchers and educators

Our 4 Major Goals – the Focus for the Next 3 Years (explained on next pages)

Goal 1: Demonstrate the transformative nature of Critical Zone science

Goal 2: Integrate specific elements of infrastructure for the Critical Zone network by 2018

Goal 3: Increase awareness of and participation in Critical Zone science and network activities as an open and inclusive community

Goal 4: Articulate a compelling vision and structure for the future network of CZOs

Goal 1: Demonstrate the transformative nature of Critical Zone science

Desired Results:

- By Fall 2016, articulate and widely publicize three transformative ideas that form a compelling manifesto for Critical Zone science and are the direct result of the CZO network, as summarized below…

  The Critical Zone, Earth's living skin, has three dynamic and spatially structured co-evolving surfaces: the top of the vegetation canopy, the ground surface, and a third, deep surface below which earth's materials are unweathered.

  1) For the first time, we have obtained observations that reveal how the deep surface of the Critical Zone varies across landscapes.

  2) New mechanistic models now provide quantitative predictions of the spatial structure of the deep surface relative to the ground surface topography.

  3) For the first time we have obtained observations that reveal that differences in energy inputs at the Earth's surface translate into differences in water, minerals, and biotic activity at depth.

- Publicize the body of key Critical Zone findings from the network
- Create a synthesis across CZOs of the structure of physical, chemical, and biological properties
- By 2018, use the growing knowledge of Critical Zone structure to explain hydrologic partitioning

Key Strategies:

- Engage the broader Critical Zone community to adopt / modify / finalize these findings into a short, compelling manifesto.
- Publicize the list of key Critical Zone findings with links to published research papers.
- Launch an initiative to use the network's knowledge of Critical Zone structure to explain hydrological partitioning; co-fund a postdoc and two workshops to support the initiative.

Goal 2: Integrate specific elements of infrastructure for the Critical Zone network by 2018

Desired Results:

- Establish a defined set of common measurements in place across the Critical Zone network
- Establish a defined set of common data management protocols in place across the Critical Zone network
- Use selected models to test hypotheses at different scales and across the Critical Zone network

Key Strategies:

- Develop and begin using a defined set of common measurements across the network.
- Engage with other data platforms such as CUAHSI to develop data management protocols.
- Identify / prioritize a set of models that can be applied widely across the network.
- Implement an efficient, effective method to train people across the network on the defined set of models, data management protocols and measurements.

Goal 3: Increase awareness of and participation in Critical Zone science and network activities as an open and inclusive community

Desired Results by 2019:

- Establish at least one substantive, collaborative activity between the Critical Zone network and the LTER network by 2018
- Increase the number of institutions engaged in research and education at CZOs beyond the original funded partnerships
- Host an open Critical Zone science meeting that promotes collaboration with the broader scientific community
- Put a mechanism in place to facilitate sharing of education and outreach resources and expertise across the network
- Publicize the new Critical Zone network mission, values, and vision

Key Strategies:

- Leverage the National Office education and outreach personnel to support activities in this goal area.
- Strengthen and engage the Network Education and Outreach Working Group to facilitate cross-network sharing of resources and expertise.
- Enhance the National CZO web site to highlight opportunities for increasing participation by the broader community at CZOs.
- Publish an overview white paper that articulates the vision for collaborative interaction among CZO / LTER / NEON.
- Complete revisions on the InTeGrate course (undergraduate introduction to CZ science) and make the course publicly available at SERC website.
- Explore new avenues to use AGU events including the townhall or special lectures to engage the greater CZ science community with CZOs.

Goal 4: Articulate a compelling vision and structure for the future network of Critical Zone Observatories

Desired Results:

- In 2016, submit a position paper to NSF that articulates alternative models for the future network of Critical Zone Observatories
- By the end of 2017, engage the broader community to develop a set of big hypotheses about the Critical Zone that could be tested by a future network
- By the end of 2017, engage the broader community to explore alternative models and develop a recommended optimal structure for the future network of Critical Zone Observatories

Key Strategies:

- Publish the existing "common questions document" as a starting point for discussion on the key hypotheses about the Critical Zone that could be tested by the network in the future.
- Develop a proposed list of key hypotheses about the Critical Zone that could be tested by the network in the future.
- Develop a draft set of alternative models for how to structure the future network of CZ science sites.
- Engage the broader community at a specially designed workshop in 2017 to reach agreement on the big hypotheses and the alternative models for the Critical Zone Network.
- Develop and submit a report based on the 2017 community workshop to National Science Foundation.