REPORT OF THE COMMITTEE OF VISITORS, 2011-2013

Surface Earth Processes Section (SEP) of the Earth Sciences Division (EAR)

Executive Summary

This COV evaluated four programs grouped in the NSF GEO directorate: Hydrological Sciences (HS), Geomorphology and Land-use Dynamics (GLD), Sedimentary Geology and Paleobiology (SGP), and Geobiology and Low Temperature Geochemistry (GG). These programs support a portfolio of societally relevant research in the Surface Earth Processes (SEP) section. SEP support for broader impacts is crucial for workforce development since the U.S. Bureau of Labor Statistics projects vigorous growth in geoscience jobs over the coming decade.

This evaluation represents the first COV following the government-wide sequester of funds in FY13, and our committee saw the initial effects of this unprecedented cut in program funds in terms of increased program workloads and falling success rates. While NSF/SEP staff are doing a remarkable job of maintaining program function and continuity in the face of these cuts, the cumulative effects of lowered budgets coupled with increased proposal submissions represents an unsustainable situation that deserves concerted attention and creative solutions. We offer several suggestions to address these issues including:

1. carefully considering options to reduce proposal load, such as restructuring the frequency of proposal calls and implementing pre-proposals;
2. directly discussing these trends and impacts with universities and the broader science community;
3. expanding efforts to track research outcomes and improve NSF/SEP visibility;
4. appropriately balancing support between core program and new initiatives; and
5. improving data management to better understand emerging trends and consequences of the changing science funding environment.

Our major findings are:

1. Overall, the peer-review process implemented by the four SEP programs we reviewed is working well. The combination of ad hoc and panel reviews provided a good range of evaluations for each proposal, and we encourage SEP to continue to use this multifaceted approach for proposal assessment. The panel summaries and review analyses provided balanced and well-reasoned syntheses of these data and a compelling rationale for awarding and declining proposals.
2. Although Intellectual Merit and Broader Impacts were nearly universally evaluated in the review process, the relative weighting of these two components is not yet consistent across or within the four programs and reviewers had varying expectations of what constituted quality Broader Impacts. This inconsistency is reflected in ad hoc and panelist reviews, as well as in panel summaries and program officer analyses.
3. Over the three fiscal years we evaluated, the proposal load increased in all four SEP programs and total funding was level or decreased. Increasing community demand for decreasing research funding resources continues to ramp up program manager workload and leads to very low funding rates, and thus the inability to fund many highly ranked proposals. Such low funding rates indicate that significant numbers of strong proposals to examine scientific questions that are applicable to society are not being funded. Heavy workloads also limit program officer time to interface with the community, particularly early

career scientists with declined proposals. Despite high demand for societally relevant surface earth science and well trained practitioners in this field, the overall situation is lowering morale at NSF, in SEP, and in the community. SEP has been particularly affected by the disconnect between proposal demand and available funding. For example, while Deep Earth Processes (DEP) proposal pressure has remained steady at about 700 proposals per year over the past 3 years, the total number of proposals submitted to SEP rose from 833 to 1008 during the same period. In FY 11-13, funding rates for DEP have ranged between 30 and 36% according to data we reviewed; in contrast, funding rates for SEP were more than 50% lower, 19-21% — the lowest funding percent in GEO.

4. The statistical data provided to the COV was useful and illustrative; however archaic data management systems made it difficult to access some additional data that could have led to more in-depth analyses. Given the push for NSF to fund "big data" analysis, it would make sense to invest in a database system that could efficiently track all aspects of the proposal and review process.
5. The SEP POs are well qualified and dedicated individuals who are doing an excellent job of managing portfolios in challenging times. The SEP section has done a fine job of attracting well qualified and effective rotators and staff. For example, organizational support of the COV greatly facilitated the committee's ability to perform an in-depth review in a short time frame.

Recommendations include:

- Continue to use the existing assessment methods to evaluate proposals including ad hoc and panelist reviews. Ad hoc reviewing would be far easier to manage if reviewers could quickly accept or decline reviews and recommend other reviewers through an improved interface.
- Clarify expectations for the appropriate balance between Intellectual Merit (IM) and Broader Impacts (BI) in solicitations and communicate those expectations explicitly to ad hoc reviewers and panelists. A consistent panel summary template (with additions as necessary for specialized proposal calls) would likely be an important and useful step.
- Consider options to decrease proposal load and increase proposal success rates, which would lower NSF staff and PI workloads. Reducing workloads and increasing proposal success rates may require structural changes, potentially including: reducing the number of submission opportunities, going to calls with no specified deadlines, adoption of pre-proposals, and/or working to change current incentive structures at universities such as expectations for the number of proposal submissions per year. Reduced NSF staff workload would allow more constructive feedback to be given to early career faculty and those whose proposals are declined.
- Explore new data management platforms. Program analysis, both external and internal, would greatly benefit from the rapid availability of data in formats that can be readily mined to examine trends and areas of need.
- Strongly support the core programs of the SEP, while also supporting Critical Zone Observatories (CZOs) and other initiatives. At a minimum, it is essential to maintain staff at current levels and to allow staff to travel to interface with the community. Ideally the available grant funding in the SEP section should be significantly enhanced given the societal relevance of the research portfolio.

Introduction

The Committee of Visitors (COV) for the Surface Earth Processes Section (SEP) reviewed four programs in the NSF GEO directorate: Hydrological Sciences (HS), Geomorphology and Land-use Dynamics (GLD), Sedimentary Geology and Paleobiology (SGP), and Geobiology and Low Temperature Geochemistry (GG) along with the Critical Zone Observatories (CZOs). On June 2-4, 2014, the COV reviewed proposal e-jackets, analyzed program data, and spoke with Program Officers (POs) and administrators at the NSF headquarters in Washington DC. The 2013 COV members were:

- David Hyndman, Chair (Michigan State University),
- Paul Bierman (University of Vermont; member of the Advisory Committee for the Geosciences Directorate, AC-GEO),
- Russell Stands-Over-Bull (Anandarko Petroleum Corp.),
- Patricia Maurice (University of Notre Dame),
- Celina Suarez (University of Arkansas),
- Joanne Stubbs (University of Chicago),
- Elizabeth Screaton (University of Florida), and
- Gordon Grant (USDA Forest Service, Pacific Northwest Research Station).

The COV was charged to review actions taken across the programs in the SEP section, and review and comment on the effectiveness of the programs, areas needing improvement, and recommend future courses for the programs during the last three fiscal years (2011-2013). The review focused on (1) integrity and efficiency of proposal processes used to solicit, review, recommend, and document proposal action, considering intellectual merit, broader impact, transformative value; and (2) the relation between program portfolio and program goals.

Summary of Findings

NSF-supported research related to Surface Earth Processes (SEP) is critical for society. For example, understanding geochemical cycles (GG) is important to maintain soil fertility on intensively cultivated lands and to limit or remediate water pollution, geomorphology (GLD) funds science that can predict the location of devastating landslides, while hydrological science (HS) research provides critical information for the management of water, which is critical to life on Earth. Sedimentary geology and paleobiology (SGP) research provides key information for obtaining and securing the nation's energy resources and provides research crucial to better understanding the impacts of global change.

This COV covers FY11-13, which includes the impact of sequestration on NSF personnel, proposal loads, and funding rates. The impacts of this mandatory, agency-wide funding decrease include lower program budgets at the same time that more proposals are being submitted to NSF at least in part because other agencies reduced research funding and because of the critical importance of SEP research to societal needs. This "perfect storm" of rapid changes caused the

four SEP programs we evaluated to receive increased proposal loads by 16% to 42% in FY13 vs the two previous years.

The COV is concerned about the relationships among available program funding, proposal demand, success rates, and average award amounts. This is not a new issue, but the trend of flat to declining budgets and increased proposal loads, hence flat to declining success rates, represents a fundamental challenge to the broad geoscience community and NSF programs, POs, and panels. The situation is likely unsustainable in the long run, and while addressing it involves systemic issues that fall outside the purview of this COV, we feel compelled to comment on the implications of these trends for SEP and NSF in general.

The drivers of these trends are complex and, we suspect, well known to NSF administrators, but they bear repeating here. Like all Federal agencies, the EAR budget was cut by 10% due to sequestration, with no relief in sight. That represents a large and unprecedented reduction in program budgets, with significant aftershocks and continuing effects. Since much of this change happened in the middle of FY 13, proposal success reviewed in the latter half of FY 13 inevitably reflects this cut. The POs and section heads are to be commended for staying the course and maintaining continuity of funding across programs, including dealing with previously obligated funds, in the face of this unanticipated fiscal turbulence. Even without any other trends, these budget cuts represent a serious blow to geoscience research and education efforts.

At the same time that budgets are falling, proposal demand (defined as number of proposals submitted per year) is up across all SEP programs. While some of this increase is an artifact of how proposals are accounted for by timing of action, the trends are real and ominous, especially at a time of budget cuts. Furthermore, expectations for proposals to address a wider set of issues such as broader societal impacts including education and outreach activities is increasing with no commensurate increase in overall funding.

We speculate on the various trends that are driving proposal submissions upward. Other Federal agencies with research funding programs have experienced similar budgets cuts, likely pushing some researchers that might have applied elsewhere into the NSF pool. University scientists, particularly new hires, are being strongly encouraged to apply for multiple grants, and some promotion and tenure decisions are apparently being tied to numbers of grant applications submitted. Decades of successful NSF sponsored outreach and K-12 educational activities are bringing new and diverse scientists into environmental fields. While the latter trend is a positive accomplishment of these programs, it also means that there are more academic mouths to feed from a diminished funding pie. We see no signs that these trends will reverse.

There are also trends within NSF that contribute to these discouraging numbers. Although cross-directorate initiatives can focus on high-profile and emerging topics, they may reduce funding to core programs. While some of these new programs, such as Water Sustainability and Climate (WSC) and CZOs, were started with 'new' money, others have the potential to shift dollars out of core research programs. Our overall impression is that POs in SEP have successfully managed to minimize erosion of core programs and to leverage external funds, but the balance between core

programs and new initiatives needs to be carefully monitored. We recognize the scientific value and quality of these initiatives. However, they have the potential to contribute to the larger problem of diminished success rates and award amounts in core programs if these initiatives are not based on sustained and independent funding. Additionally, it seems likely that experienced senior faculty with well-established interdisciplinary collaborations and experience in managing large scale projects are more likely to apply for such initiatives, while early career faculty are more likely to apply to core programs in their field of expertise before branching out. Continuous cuts to core programs exacerbate an already difficult situation for early career scientists.

All of these changes are occurring against a backdrop of rapidly increasing societal focus and concern around environmental issues that are the mainstay of SEP-funded research. Increased frequency and severity of natural disasters, shifting weather patterns, global and regional climatic, ecological, and hydrological change, along with rising threats of pollution and habitat degradation would seem to set the stage for widespread public support for environmental research; yet, much of what NSF does remains hidden and unacknowledged in the popular media. Recent dissemination approaches, such as the coverage of the WSC projects by NBC-Learn, should be more broadly utilized as appropriate.

At the same time, there is a critical and well documented need to educate more young geoscientists. A 2014 American Geophysical Institute (AGI) report (*Status of the Geoscience Workforce*) estimated that there will be a shortfall of 135,000 geoscientists in the US workforce by 2020. The U.S. Bureau of Labor Statistics (Occupational Outlook Handbook) projected that jobs for geoscientists will increase faster than average, by 16%, from 2012-2022. Environmental Science jobs are also predicted to increase faster than average, by 15%.

These problems and their potential fixes fall outside the charge to this COV, yet they provide an important context for our comments on how the individual programs are being managed and their impacts on the field. Our overarching impression is that the SEP is doing an outstanding and commendable job of maintaining cogent, focused, and high-impact science programs in a difficult climate. Program Officers (POs) are handling the very high proposal loads as well as can be expected under the circumstances, and running quality panels that are serving the community well. However, we emphasize that the situation is likely not sustainable and needs attention before cracks appear in the system.

We would be remiss if we did not offer at least a few potential suggestions to deal with these complex issues. We are under no illusions that these problems can be remedied easily or quickly, but more could be done to address these issues to forestall a future crisis:

1) SEP programs should consider experimenting with strategies to reduce proposal loads. We emphasize the word "experiment" as these options should be initiated in a careful and controlled fashion for specified time periods with monitoring and data collection on outcomes. Possible strategies include: a) reduce core proposal calls from two to one per year; b) move to "no-deadline" calls; c) require panel-reviewed pre-proposals prior to full submission; d) increase the specificity of RFPs; e) stratify the calls by proposal size with one large proposal (possibly with required pre-proposals) every year or two years with one

small proposal call per year. We are aware that this goes against the counsel of the previous COV, which was concerned about the effect of a less frequent call on early career scientists. While we appreciate this concern, we are convinced that the current system already negatively impacts those early career researchers, as multiple calls stimulate large proposal volumes, taking large amounts of faculty time and in the end reduce success rates. We encourage SEP to explore how other Divisions at NSF are faring with their altered approaches to requests for proposals.

2) Perhaps in concert with such program changes, NSF POs could directly communicate with universities about the impact to programs of linking hiring and promotion decisions to proposal submissions, and how the current system and its very low success rates hurts new investigators. NSF could potentially leverage its reputation and stature to help reduce the flux of less competitive proposals. NSF should consider expanding its proposal training outreach efforts (perhaps using cyber seminars plus presentations at national meetings), and incorporating information on how to write high quality proposals into graduate curricula. We note that these efforts will require substantial PO time and ability to travel.
3) NSF/SEP should improve its ability to demonstrate outcomes and outputs from funded proposals. Developing a reporting system that allows reporting of papers and other products well after the end of a grant period would be a huge improvement. All programs should be able to show how funded research led to high impact papers and other high profile outlets, and broader societal impacts after the final report is submitted. This could be done without significantly increasing reporting workload. Along these lines, SEP should work with both the geoscience community and media and journalists to ensure that full credit is given to NSF for exciting and high impact research efforts. The public and policy makers need to better understand the immense value added of NSF-funded research; this is likely the only long-term antidote to declining budget trends.
4) The COV suggests that NSF significantly improve its data management system. For an organization that funds "Big Data" projects, the current system for tracking proposals and reporting outcomes is wholly inadequate. Within all reasonable limitations due to privacy and security concerns, NSF needs a data system that will allow useful and rapid data queries about the full range of proposal, reviewing, and funding statistics. We are convinced that there will be many important and useful lessons to be gleaned by moving to a more sophisticated data management system that allows management decisions to be made on the basis of accurate and complete information. At a minimum, the system should be able to track:
   A. success rates and award amounts for specific classes of PIs (i.e., first-time submitters, by career status, by PI discipline, diversity criteria, etc.);
   B. proposal and success rates over time for classes of proposal (I.e., competitive, CAREER, collaborative, initiative vs. core, etc...);
   C. proposals reviewed/awarded by individual panels over time;
   D. metrics of research success, such as publications (including those published outside the award period), numbers of students trained, significant BI achievements, etc.

5) We recognize the importance of POs being able to travel to speak directly their research communities and participate in community events (I.e., AGU, Chapman conferences, etc.). With tight budgets and increasing restrictions on Federal travel, we recognize that it is probably harder for POs to get authorization to travel, yet it is probably the best way for them to stay abreast of new ideas and developments in the field, to identify potential ad hoc reviewers and panelists, and to make themselves available for discussion with early career scientists.

I. Questions about the quality and effectiveness of the program's use of merit review process. *Note: individual programs are identified where we recognized differences among programs; where no program identifier is specified, our comments apply equally to all programs.*

1. Are the review methods appropriate?

The combination of ad hoc reviews and panels worked well and appeared to be very effective. Any discrepancies in the ad hoc versus panel review were well addressed and explained. We strongly recommend continuing in-person panels, although virtual panels may work for pre-proposals if implemented. Workshop, travel, and EAGER/RAPID proposals were commonly addressed without ad hoc and panel comments, which was seen as reasonable and appropriate.

GLD/SGP - We noted more variability in ad hoc review ratings than with reviews for SGP, but the panels did an excellent job of resolving this variability.

CZO - There was inconsistency in the jackets for the CZO's. After an initial panel, two CZO's were funded with no available panel summaries, likely as they were pulled from the original panel after additional funds became available.

HS/GG: In some cases, where ad hoc reviews consistently indicate the proposal is non-competitive and the panel concurs, no additional comments were provided to the PI. This was seen as necessary and efficient and a reasonable means to deal with the expanding workload. However, in cases with an early career PI, it would be beneficial for the PO to contact the PI directly when possible to suggest strategies for improving future submissions.

2. Are both merit review criteria addressed?

In general, reviewers and panels are addressing both merit review criteria. The COV noted greater variance in the evaluation of the Broader Impacts (BI) than in the evaluation of Intellectual Merit (IM). The use of a consistent template across SEP would help reduce this variance and perhaps enhance the utility of reviews. If more specific guidance were provided in the solicitations, proposers might better understand the importance of innovative BI strategies. We noted that substantial BIs will have costs, and this should be explicitly discussed in the budget justification. The COV understands that the level of possible BI will scale with budget.

a) In individual reviews?
In general both IM and BI were addressed; however there was much more detail about BIs in some reviews than in others. There was inconsistency in the ad hoc reviews as to the weighting and content evaluation of the BI. Some reviewers were fine with "run of the mill" BIs and some reviewers saw such limited BIs as problematic. Expectations for the level, and innovative nature of BI, as well as what constitutes BI, should be discussed across the Section and clearly communicated to PIs, panels, and ad hoc reviewers. The solicitations should more clearly articulate the expectations for nature and extent of BI work and the panel evaluations need to be consistent with these stated expectations.

b) In panel summaries?
In all programs, panels consistently addressed both IM and BI. Some panel summaries seemed inconsistent with the ad hoc reviews on BI. The weighting of BI and IM was not consistent between programs.

c) In Program Officer review analyses?
In general, IM and BI were consistently included in the review analyses across all the SEP programs; however, the relative importance of IM versus BI was not clearly and consistently defined, as shown in discussions with POs during the COV. This inconsistency ripples through the review process. For example, in GG a proposal was called out for weak BI by the ad hoc reviewers and by the two panels that co-reviewed the proposal. The weakness was echoed in the PO review analysis, but there was no documentation that this weakness was considered in the decision to fund the proposal. The COV felt that at minimum the weakness of the BI should have been brought to the attention of the PI in the PO comments. To the COV, this appeared as a teachable moment and the PO could have requested that the PI address the weak BI prior to funding. As a COV, we are not advocating a specific numerical weighting of BI and IM in proposal evaluation, but we feel strongly that expectations for the importance of BI should be clarified.

3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?
The community does a thorough job of reviewing proposals, with few exceptions. The POs do an excellent job of soliciting sufficient reviews from people with expertise in appropriate fields. One of the reasons why it is important for POs to travel to conferences and to network with their communities is to find expert reviewers in evolving fields.

Most reviewers provided substantive review comments across all the reviewed programs. When this was not the case, the panels and program officers took this into consideration when considering the ranking provided by such reviewers.

4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?
In nearly all cases, the panel summaries provide appropriate rationale for the decisions. We applaud the critical syntheses provided by the panels in their summaries. Most panel summaries

also do an excellent job of treating the outliers. There were only a few instances where outliers were not explicitly discussed. The COV noted variance in how the panel summaries were constructed and supports the current effort to move toward the use of a consistent template for panel summaries. This is particularly important for co-reviewed proposals.

5. Does the documentation in the jacket provide the rationale for the award/decline decision?

Yes, only a few jackets were missing some components such as the PO comments.

6. Does the documentation to the PI provide the rationale for the award/decline decision?

Yes, for the most part, but a few appeared to be missing PO comments. In co-reviewed proposals, an additional statement would be helpful to discuss how the different panel reviews were integrated into the final decision. Further, as high workloads permit, we encourage POs to make a particular effort to provide constructive criticism to young investigators in the case of non-competitive proposals.

7. Additional comments on the quality and effectiveness of the program's use of merit review process:

Overall, the merit review process is excellent and well implemented. The combined approach (ad hoc and panel) is necessary to continue funding the best science. However, the heavy workload is limiting constructive feedback to PIs. This is particularly crucial for young investigators.

The importance of providing constructive criticism that could improve future proposals or the PIs' research should be stressed to ad hoc reviewers and panelists. Perhaps additional language should be added to the panel review template to indicate whether the identified shortcomings can be readily addressed.

II. Questions concerning the selection of reviewers.

The process of reviewer selection is not entirely clear and appears to vary by program. Some programs appear to have long-serving panel members, while others have more rotation. The COV sees value in both approaches; it seems appropriate to have some overlap of panelists for continuity but also to bring in new viewpoints. Young scientists can benefit from serving on occasional panels, but time commitments need to be managed.

We again stress the importance of PO engagement with the community, especially in difficult budget times, to ensure excellent selection of quality reviewers and panel members.

1. Did the program make use of reviewers having appropriate expertise and/or qualifications?

The level of reviewer expertise and qualifications seems to be generally strong and appropriate. Across the board, the review panels show high diversity in expertise. They show broader geographic distribution, and diversity of institutional types than even the proposal submissions and awards, although a large number of review panel members are from "unknown" institutional types. Despite extensive data-mining efforts of SEP staff, data were not available to fully evaluate participation from under-represented groups. It is clear, however, that female and under-represented minority participation is significant. Each panel, across the programs, generally included at least a few members from a previous panel, which maintains institutional memory. There was one instance (GLD, 2011 Spring and Fall) in which the panels were nearly identical in makeup from one to the next. The two CZO panels apparently had no panel members in common.

2. Did the program recognize and resolve conflicts of interest when appropriate?

All reviewed programs seem to do an excellent job of screening for conflicts and resolving any that are identified during review/panel activities. For example, when a COI was pointed out after reviews were solicited, the PO removed that review from the e-jacket.

III. Questions concerning the management of the program under review.

1. Management of the program.

Overall, the SEP staff members are doing an excellent job of managing the program given their limited resources. The POs are innovative and secure additional funding for the programs when possible. SEP has undergone a great deal of management changes during the review period. For example, after departure of the former section head, several PO's rotated through the interim section head position, while still maintaining their regular PO duties. The section and the PO's should be commended on their excellent ability to keep the quality of the review process high through such difficult transitions. The COV is encouraged by the recent success in filling both the section head position and other rotator positions. The committee has been impressed with our interactions with the new section head. Establishing stability in leadership is critical for the success of the section and underlying programs.

The POs have done an excellent job of managing diverse programs with substantial workloads and through difficult budgets. The POs also seem to be doing a great job of managing interdisciplinary proposals, including those that are evaluated by more than one panel.

Funding percentages for the SEP proposals, and awarded budgets, have been consistently low relative to much of NSF. The societal relevance (Broader Impacts) of SEP research and education is clear and as population and the rate of global change increase, SEP-supported research will become even more relevant. The COV sees evidence that there is a clear need to increase funding levels for the SEP section. For example, while DEP proposal pressure has

remained steady at about 700 proposals per year over the past 3 years, during the same period, the total number of proposals submitted to SEP rose over the past three fiscal years from 833 to 1008. In FY 11-13, funding rates for DEP have ranged between 30 and 36%; in contrast, funding rates for SEP were more than 50% lower, 19-21% - the lowest funding percent in GEO.

Most of programs in SEP are doing an excellent job of processing their proposals near the 6-month target window (See Table 1). The GG program has an average dwell time per proposal ranging from 9 to over 11 months. A significant reduction occurred between 2012 and 2013, but additional progress should be made to get this program into closer agreement with the other programs in the section.

Table 1. Statistics on proposal dwell time by program from FY2011 through FY2013.

PGM	FY	# of Proposals	**Avg. (Months)**	Std. dev. (Months)	0-6 Months	>6-9 Months	>9-12 Months	**>12 Months**
GG	2013	238	**9.43**	6.86	53%	14%	6%	**27%**
	2012	168	**11.09**	8.29	36%	20%	16%	**29%**
	2011	171	**9.03**	5.65	43%	30%	4%	**23%**
GLD	2013	159	**7.06**	6.29	58%	29%	9%	**4%**
	2012	113	**6.39**	1.53	27%	67%	5%	**0%**
	2011	122	**7.89**	3.24	10%	66%	3%	**20%**
HS	2013	264	**6.16**	4.05	63%	34%	2%	**2%**
	2012	228	**5.83**	1.39	65%	32%	2%	**0%**
	2011	260	**6.37**	1.82	42%	54%	1%	**3%**
SGP	2013	347	**6.75**	7.28	81%	15%	0%	**4%**
	2012	274	**5.98**	2.52	84%	8%	4%	**3%**
	2011	277	**6.72**	4.79	61%	27%	8%	**4%**

2. Responsiveness of the program to emerging research and education opportunities.

In recent years, the SEP has been proactive in funding emerging research (for example, exploring linkages between the geosciences and health) and education (such as math and modeling, as well as NBClearn videos) both through cross-disciplinary programs and changes to the core programs. However, we are concerned about the ability of SEP to continue to be as proactive given contracting budgets.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

There is an appropriate mix of white papers, workshops, and reports, and advisory board involvement to development of the portfolio. We feel that it is important for POs to be able to travel to (inter)national conferences and to interface with the broader community for portfolio development. It appears that the various POs work well together on issues of portfolio development.

4. Responsiveness of program to previous COV comments and recommendations.
The previous COV indicated the workload of SEP POs was not sustainable. Additional program officers were added, but the workload increase has outpaced the growth of program officers. Although the previous COV recommended that the twice a year solicitation be retained, the current COV believes that may not be viable in the long term if current trends continue. We recommend that the section consider various potential solutions including once a year general program solicitations with staggered submission dates for the individual programs in the section, submissions with no deadline, and pre-proposals in some cases – especially with the larger multidisciplinary grants. We recommend a slow process that would allow for community support for experimental changes to the standard process. The best place to try such processes (especially pre-proposals) would likely be on new initiatives such as the potential successor to the WSC RFP. If pre-proposals are used, the COV believes that it would be important to have at least five reviewers including panelists.

IV. Questions about Portfolio.

1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?
Data on number of awards in sub-disciplines were provided and indicates that diverse subject matter is being investigated in each of the four SEP programs, and that the portfolios are consistent with the solicitations. We note that these data provided useful information, but better measures of portfolio diversity would be total funding amounts of number of projects, rather than proposal numbers since many proposals were part of collaborative projects. The range of subdisciplines shows good breadth across each of the programs and the balance within the programs seems reasonable.

2. Are awards appropriate in size and duration for the scope of the projects?
The average award duration (Table 2) and award size are both similar across all the four reviewed programs within SEP, except SGP seems to have many smaller awards. There is general concern over the level of funding both overall and per project, especially as the expectations, such as data repositories/dissemination and education and outreach/broader impacts continue to increase. Even apparently minor activities like providing research 'highlights' or 'nuggets' can add costs to a project. These additional activities are not without cost; yet, budgets have not been increasing accordingly. As funding decreases and the number of proposals increases (Table 3), the percent of successful proposals and the budget per proposal/per PI is becoming a greater concern is not sustainable in future. This is particularly problematic for early career scientists who may not realize the implications of budget reductions on their ability to complete the scientific work and to provide innovative broader impacts. We recommend that budget justifications specifically address program/NSF expectations such as BI activities so that the program and future COVs can better evaluate whether budgets are sufficient as expectations increase.

Table 2. Award Duration in years, by fiscal year and averaged.

Program	2011	2012	2013	Average FY11-13
GG	2.95	2.47	2.46	**2.62**
GLD	2.58	2.5	2.17	**2.43**
HS	2.57	2.74	2.79	**2.70**
SGP	2.31	2.57	2.68	**2.54**
Average SEP	**2.60**	**2.57**	**2.53**	

Table 3. Number of competitive grants submitted to the four programs in the SEP section.

# of Proposals	2011	2012	2013	total FY11-13
GG	173	168	238	**579**
GLD	122	114	159	**395**
HS	261	228	264	**753**
SGP	277	274	347	**898**
Total SEP	**833**	**784**	**1008**	

3. Does the program portfolio include awards for projects that are innovative or potentially transformative?

Yes, all of the programs have innovative and potentially transformative awards. The awards are also relevant to society and national security.

4. Does the program portfolio include inter- and multi-disciplinary projects?

Yes; each program in the SEP section funds a large percentage of inter- and multi-disciplinary projects. This is appropriate because the SEP section is inherently interdisciplinary; the biologic, hydrologic, geologic, mineralogic, and other components of the critical zone interact in a complex manner. The CZOs are especially noteworthy for their interdisciplinary scope. However, most core proposals are to some extent inter-disciplinary, even when single-investigator (e.g., a biogeochemist; hydrogeologist; a hydrologist with education in mathematics or mechanical engineering; or a geochemist with education in environmental chemistry), because the fundamentally complex, interdisciplinary nature of the SEP requires an inter- or multi-disciplinary approach.

5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?

The HS, GG, SPG, and GLD programs receive proposals and award grants broadly across the U.S., and this distribution is appropriate, with awards spread somewhat more broadly than the proposals. The geographic distribution of the CZO proposals and awards is understandably narrower than the other programs.

6. Does the program portfolio have an appropriate balance of awards to different types of institutions?

The majority of awards (> 80%) in GG, HS, SPG, and GLD went to Ph.D. granting institutions, with lesser numbers going to masters granting, 4-year, government, and other institutions.

Overall these programs are well balanced with respect to institution type. CZO awards went almost exclusively (98%) to Ph.D. granting institutions.

7. Does the program portfolio have an appropriate balance of awards to new investigators?

The section is strong at funding CAREER awards although there are uneven numbers of awards between the programs. The section tends to provide seed funding, as well as more substantive research grants, to new investigators, however there is a significant reduction (17 to 51%) in success percentages on competitive grants that involve new investigators (Table 5). The COV has significant concerns over these lower success rates, and there was not adequate data available to identify reasons for this anomaly. For example, it is possible that some new investigators are unsuccessful because their proposed research is not a good fit with a program's scope, but we were unable to fully evaluate this possibility.

Table 5. Success rate percentages for awards involving New Investigators compared with those without identified new investigators.

Program	With New Investigators?	2011	2012	2013	Average	% lower w/ New Investigators
GG	No	22%	35%	18%	25%	
	Yes	21%	17%	11%	17%	**33%**
GLD	No	27%	40%	26%	31%	
	Yes	26%	27%	22%	25%	**19%**
HS	No	18%	23%	17%	19%	
	Yes	12%	8%	8%	10%	**51%**
SGP	No	19%	18%	23%	20%	
	Yes	14%	9%	26%	16%	**17%**

8. Does the program portfolio include projects that integrate research and education?

Integration of research and education appears to be strong across the portfolio of the SEP section. The section does a good job of funding CAREER proposals, which tend to be extremely strong in integration of research and education. Funding is distributed to research institutions and teaching colleges, and some of the projects include integration with community colleges.

9. Does the program portfolio have appropriate participation of underrepresented groups?

As pointed out in response to the 2008-2010 COV report, "diversity is a consistent programmatic consideration in PO decision awards." The review of proposals indicates that there remains room for improvement. Members of underrepresented minority (URM) groups and persons from Minority-Serving Institutes (MSI) were PI's in a limited number of proposal submissions (Tables 6a,b), and were further sometimes listed as parts of projects' initiatives under the Broader Impact (BI) section. Proposals that included women as PI's or CoPI's accounted for roughly one third of competed proposals across GG, HS, and SGP, with somewhat lower rates for GLD (Table 6c).

Table 6a. Proposals competed with member(s) of URM Group(s) as PI or Co-PI

	2011	2012	2013
GG	10%	11%	7%
GLD	4%	4%	11%
HS	8%	8%	8%
SGP	4%	6%	7%

Table 6b. Proposals competed with PI or Co-PI from minority Serving Institutions (MSI)

	2011	2012	2013
GG	6%	6%	4%
GLD	2%	5%	4%
HS	4%	5%	4%
SGP	2%	2%	4%

Table 6c. Proposals competed with Women as PI or Co-PI

	2011	2012	2013
GG	40%	32%	39%
GLD	21%	16%	26%
HS	33%	32%	33%
SGP	28%	28%	32%

In GLD, HS, and SGP success rates for proposals involving women are comparable to, and in most years higher than, those for the overall pool (e.g., Tables 6e-g). Success rates in GG for proposals involving women are somewhat lower than the overall pool, although the gap shrank significantly over the three years under review (Table 6d). Success rates for proposals involving PI's from underrepresented minorities (URM) are more variable, with total success rates over FY11-13 approaching those of the overall pool for GG, GLD, and SGP (Tables 6d,e,g). Success rates for URM in HS were consistently lower than for the overall pool (Table 6e). Success rates for PIs from minority serving institutions (MSI) were comparable to, or higher than, the overall pool for GLD and SGP (Tables 6e,g), and significantly lower for GG and HS (Tables 6d,f). Experimental Program to Stimulate Competitive Research (EPSCOR) success rates were generally comparable to the overall pool for all SEP programs.

Table 6d. Success rates for underrepresented groups in GG

	2011	2012	2013	Total Period
All	21%	29%	16%	**21%**
Women	16%	25%	14%	**17%**
MSI	11%	13%	11%	**12%**
EPSCOR	14%	30%	10%	**18%**
URM	26%	19%	14%	**20%**

Table 6e. Success rates for underrepresented groups in GLD

	2011	2012	2013	Total Period
All	26%	35%	25%	**28%**
Women	35%	39%	29%	**33%**
MSI	33%	29%	50%	**38%**
EPSCOR	27%	33%	21%	**26%**
URM	33%	50%	13%	**25%**

Table 6f. Success rates for underrepresented groups in HS

	2011	2012	2013	Total Period
All	15%	16%	13%	**15%**
Women	15%	18%	18%	**17%**
MSI	0%	14%	0%	**6%**
EPSCOR	14%	28%	10%	**17%**
URM	10%	10%	5%	**8%**

Table 6g. Success rates for underrepresented groups in SGP

	2011	2012	2013	Total Period
All	17%	14%	24%	**19%**
Women	18%	12%	23%	**18%**
MSI	20%	50%	18%	**23%**
EPSCOR	12%	14%	23%	**17%**
URM	10%	0%	28%	**15%**

The three pronged approach defined in the response to the 2008-2010 COV report is well defined and we encourage continued pursuit of these goals, with more emphasis given to outreach efforts targeted at inclusion of academic institutions that serve large populations of underrepresented minority groups. Tribal colleges exist on most Native American reservations and should be included in this effort as well as outreach to historically black colleges and colleges in urban areas serving predominately populations under-represented in the STEM disciplines. PO participation in meetings focused on science in underrepresented groups such as NABGG and SACNAS should be encouraged. POs from HR, Geo diversity, and education outreach have participated in these events and should be commended but POs in the core programs should attend as well if SEP is serious about increasing diversity success in the portfolio. The education and outreach programs in NSF seem to be successful in bringing a number of new and diverse young scientists to the discipline, and that is to be commended. The inclusion of minority panelists and ad hoc reviewers is a positive step to encourage submissions, although it is important not to overload members of under-represented groups with review and panel duties. However, continued and added support at the core program level needs to occur to continue their success.

10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.

The program is directly relevant to pressing societal needs, including those surrounding issues of water, energy, and food production as well as prediction and mitigation of natural disasters, and understanding long-term climate dynamics. It supports every aspect of the agency's mission, from basic research through health, prosperity and welfare to national security.

David Hyndman

For the 2014 SEP COV
Dr. David Hyndman
Chair