Earth System Research Laboratory/Global Systems Division
Laboratory Science Review
3-5 November 2015

GSD's Final Implementation Plan Report on Responses to Review Recommendations

13 June 2016-18 July 2017

Submitted by:
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Introduction

Laboratory science reviews are conducted every five years to evaluate the quality, relevance, and performance of research conducted in the National Oceanic and Atmospheric Administration (NOAA) Office of Oceanic and Atmospheric Research (OAR) laboratories.
This review covered the ESRL/Global Systems Division research since 2010, which was conducted in November 2015. The research themes presented included Numerical Weather Prediction, Decision Support, and Advanced Technologies. The review agenda, presentations, posters, and guiding materials are available on the GSD website: http://www.esrl.noaa.gov/gsd/research/review/2015/.

GSD provided a response plan for implementing the review recommendations that was approved in June 2016 (https://www.esrl.noaa.gov/gsd/research/review/2015/GSD-Science-Review-Response-June-13-2016-FINAL.pdf). Since that time, GSD has implemented and tracked its progress on those responses. This report documents that implementation by updating the table in the original response plan with both completion dates and narrative. GSD successfully completed or closed out all but nine (9) of its proposed actions; these nine were designed to be ongoing efforts, and have been incorporated into GSD operational planning, implementation, and performance measurement where appropriate.

GSD Science Review Action Sheet

Section	Recommendation	Action	Person Responsible	Target Date	Date Done	Status/Notes
B6.1	Continue to build on opportunities presented by reorganization for synergistic work in: Software engineering, end-to-end forecast improvement, re-usable core software components	*Action B6.1.1: Identify software engineering lead that would facilitate discussions and develop a plan for the sharing of software approaches.*	John Schneider	2/2017	Completed2/ 2017	A team was established to review current software engineering platforms and approaches taking place across GSD, develop strategies for improving the sharing of code and software principles between projects, and provide recommendations for integrating new technologies into a common GSD software approach. The team met monthly throughout this process and identified several fundamental approaches that would improve collaboration within GSD's engineering environment: 1) build a more agile and flexible development environment, 2) develop a prototype toolbox that provides a sand-box for developing common technologies while improving the sharing, testing, and development of code, and 3) invest in exploring the use of cutting-edge technologies such use of the 'Cloud' and the development on-demand information systems. The team completed a document summarizing their findings, which is available on the GSD intranet. Recently, internal funding was provided to the team to explore several of their recommendations and to continue discussions The team will report their findings October 2018 to the Laboratory staff.

					B6.2.1. Completed. An initial scholarship has been established ($100K) at both CU and CSU Atmospheric Departments. Candidates have been selected and are on board. Candidate pools were provided by CU and CSU and were limited in terms of diversity, however in both cases, female students were selected.
					B6.2.2 Completed. Both students will be working with the GSD modeling team. The CU student will be working with the GSD Model Development Branch on "Improving Wind Forecast Skill through the Integration of the WRF Wind Farm Parameterization into the HRRR" and the CSU student will be working on topics related to blocking and subseasonal modeling.
B6.2	Seek, recruit, and train candidates for future hire (through graduate and/or postdoctoral fellowships) with particular attention of creating a pipeline of future employees with increased diversity.	*Action B6.2.1: Develop agreements with CU and CSU Atmospheric Science Department Chairs and the respective Cooperative Institute Directors to formalize the funding stipend for the first year.* *Action B6.2.2: Work with GSD staff to develop proposals for topics for CU and CSU students to consider.* *B6.2.3: Establish relationship with Minority-servicing Institution. Conduct workshop to introduce students with ESRL scientists.*	*Kevin Kelleher and Jennifer Mahoney (B6.2.1 and B6.2.2)* *Melinda Marquis (B6.2.3)*	B6.2.1 – 6/2016 B6.2.2 – 7/2016 B6.2.3 – 9/2016	B6.2.1 – completed 9/2016 B6.2.2- Completed 8/2016 B6.2.3 Completed 9/2016	B6.2.3 Completed. Established relationship with Howard University. Initially, NCAS Director Dr. Vernon Morris visited ESRL and described the NOAA program. Following up on this initial engagement, Kevin, Melinda, and Jennifer visited Howard University in July 2016. In September 2016, ESRL collaborated to invite 6 students to visit Boulder. This visit resulted in an interest in a few of the students by several ESRL Divisions. Currently GSD has brought on one of the Howard University post-docs under a NCAS grant. Two other ESRL Divisions are interested in a second student and will eventually decide in which ESRL Division the student will work. The next step is for a contingent from ESRL to visit another NCAS

						university, UTEP in El Paso, TX. Details are being worked out. At the same time ESRL completed development of an ESRL Diversity and Inclusion policy, which incorporates the NCAS collaboration.
B6.3	Continue to hire through CI while pursuing conversion of qualified candidates to Federal positions	*Action B6.3.1: Re-instate Local Level Review Panel to provide oversight, guidance, and justification for internal promotions and new federal positions.*	Kevin Kelleher and Jennifer Mahoney	7/2016	B6.3.1 Completed 7/2016	Updated guidelines for GSD's Local Level Review Panel to review and recommend GSD new Federal hires and internal promotions. The review process allows for a deliberate decision making process to focus new hires/promotions in top GSD priority areas. It ensures alignment of scarce GSD Federal personnel resources with GSD Grand Challenges and other strategic areas. In one specific example, the panel convened to assess the justification for a Band 4 to Band 5 promotion in 2016 and the person was successfully promoted just recently after the Government hiring freeze ended. In another example, a new Federal position is being opened for a key area in GSD. Approval to open this position was given only after the local PMAC committee reviewed a prioritized list of personnel gaps and priorities that were developed in 2015 following the GSD Strategic Plan and hiring plan.
B6.4	Senior GSD management and project managers should continue to improve good relationships with stakeholders (including the private sector) and regularly re-align	*Action B6.4.1: Discuss realignment of strategic priorities (i.e. Grand Challenges) at next GSD retreat. Document changes*	*Senior leadership Team*	10/2017	Completed	GSD held a 2-day retreat on 11-12 April 2017. All GSD staff were invited to attend. The agenda included: presentations from two invited experts to discuss topics of project management and staff accountability, discussions and breakout

	strategic research priorities	*and determine next steps forward.*				sessions focused on the GSD strategic direction and Grand Challenges, presentations from NWS and private sector representatives to gain a better perspective of the future, and discussions of potential innovated opportunities for GSD's future. Some key outcomes included: 1) modifications of GSD Grand Challenges with new focus on 1, 2 (HPC - new), 3, and 5. Grand Challenge 4 was removed since it is an AOML area of focus, and 2) focus on new areas of collaboration (e.,g. probabilities, and cloud services) with partners such as NSSL, the FACETs program, and John Cortinas' OWAQ efforts, and others. A summary of the retreat is available on the intranet (https://intranet.fsl.noaa.gov/2017-Retreat/index.html) We continue to build relationships with NWS and our private sector partners. For instance, we visit NWS Portfolio Managers and staff quarterly to work through issues, discuss and plan for new opportunities, and inform of any new directions. We work with private sector partners (which include IMSG and ENI) by establishing cooperative research and development agreements (CRADA). We also work to maintain current partnerships with FAA, DOE, and BLM through Interagency Agreements.
B6.5	Work closely with NWS to improve relationships and develop a clear integrative partnership	*On-going*	-	Continuous process	Completed. Interactions are on-going	GSD has worked to improve trust and collaboration with the NWS over the past 3 years through: face-to-face quarterly visits, improved project management and task planning, filling of 2 key positions (project

						manager and project support staff), improved tracking and communicating of technical decision points, issues, development strategies, and progress toward tasks and deliverables. These changes have resulted in an increase in trust between the two organizations, and a more primary development role for GSD development.
B6.6	Take a broader perspective on the users of its technologies towards achieving a more holistic realization of WRN objectives	*Action B.6.6.1 Identify technologies of interest not only to NOAA, but also to organizations outside of NOAA.*	John Schneider and Mike Kraus	12/2016	7/1/2017	Much of this work was incorporated into the Grand Challenge 3 and 5 roadmap. Specifically, a focus group (led by two GSD Branch Chiefs) was created to get momentum in this area. The group meets weekly. Funds (resources) were provided through the GSD DDRF to the team to flesh out ideas and plan next steps. Progress report was provided in April 2017 to GSD senior managers. Several proposals were developed out of the report recommendations (and funded from GSD Base) to explore ideas of direct interest to NWS that could also be used by organizations outside NOAA. The work outlined in the proposals are directed to meeting the goals of Grand Challenges 3 and 5 and include: R&D on the topic of probabilities, investigating the use of the NWS WAVE display system for improving GSD web-based displays, continuing the development of the GSD prototyping tool kit to provide a common infrastructure for GSD development, and investigating the 'Cloud' architecture for reducing IT costs and integrating cross-branch technologies.

						In addition, we continue to build relationships with organizations outside of NOAA. For instance, we have increased our collaboration with NCAR as is evidenced by 3 new IDIQ projects in FY17 and a continuation of a successful collaboration through the DTC. We have increased collaborations with the private sector. For instance, our CRADA with IMSG is an example of sharing our software outside of NOAA. GSD staff is also building closer relationships with NASA through proposal submissions and MOUs.
B6.7	Coordinate a community effort on model validation and verification involving GSD with NCEP, DTC, MDL and others	*Action B6.7.1. Deliver NGGPS verification roadmap to GSD Senior leadership.*	Bonny Strong	12/2016	Completed 7/2016	The Next Generation Global Prediction System (NGGPS) has been the driver for GSD to complete this action. GSD is working with the DTC to standardize the MET verification/validation software package that is intended to unify the operational (NWS/NCEP/EMC), research (OAR), and academic community. Document provided to SLT 11.7.16
B6.8	Develop mechanisms (matrix alignments, cross-cutting programs) to foster greater symbiotic collaboration across thematic areas in GSD and ESRL so that work in each area can take advantage of knowledge and expertise across the laboratory	*Action B6.8.1. Decide whether or not to institute a GSD Research and Development Council and determine membership.*	Senior leadership Team	8/2016	Completed 12/2016	One accomplishment with respect to cross-ESRL interaction has been the formation of an "ESRL Model Discussion Group." This group has members from each ESRL Division that are equipped to discuss various aspects of modeling from regional to global, data assimilation, air chemistry/composition, model physics, post processing, and model coupling. In addition, ESRL is providing support for the Joint Center for Satellite Data Assimilation to locate in the building and work together on, among other things, the JEDI project to refactor the NWS GSI

						data assimilation code. Specifically to GSD, senior leadership discussed the pros/cons of implementing a GSD Research Council. However, for cross-GSD interactions, it was decided to empower the mid-career team (known as the Evergreen Group) to step up and take on leadership roles within GSD. A joint mid-career/SLT meeting was held 27 Oct 2016. The Evergreen Group held their first meeting on 2 Nov 2016 with an aggressive agenda and plans for providing information to leadership. The group meets every two weeks. Some of the activities they have taken on include: planning the retreat, developing a series of training activities for staff, and developing better science & tech communication to staff through a series of TED like-talks, which occur through lunch meetings, videos, short coffee breaks etc.
B6.9	Further consolidate and coordinate GSD activities and ensure that all innovative initiatives with long-lead development horizons receive some base funding	*Action B6.9.1: This is already occurring through the Directed Director's Research Fund*	Kevin Kelleher and Jennifer Mahoney	6/2016	Completed 6/15/16	Using funds from the Director's Directed Research Fund (DDRF), 6 new projects that align with GSD's mission and Grand Challenges have been funded in FY17-18. In addition, GSD has invested another $850K in base funds on future-looking projects including making substantial progress on probabilistic forecasting (beyond ensemble modeling) that involves a social science component engaging with NCAR, testing and hosting for NWS a new web tool called WAVE, experimenting with Cloud storage/computing and the viability of running computer models in the Cloud, and supporting the NWS Hazard Services development by funding the integration of three

						segments of code into a single coherent structure.
B6.10	Identify, track and embrace broader metrics of GSD's success even if those metrics are outside of GSD's direct or sole influence, with particular focus on measures of key stakeholder outcomes	*Action B6.10.1. Explore the use of other metrics for measuring the quality of our science, tools, and technologies relative to the weather impacts on society.* *See Action C4.1.1*	Jennifer Mahoney delegated to Missy Petty	5/2017	Initial review of metrics completed with an interim report provided. Metrics Team meetings are On-going to complete document of recommendations	Initial kick off meeting of the Metrics Team occurred 2/2017. In addition to publications and product transitions, the Metrics Team surveyed a variety of metrics that are candidates for measuring the quality of our science, tools, and technologies. The Team is working to reduce the number to a representative set and blending that set with the broader Annual Operating Plan (AOP) effort. An interim report was provided July 2017 summarizing the list of metrics and the approach the team is going to use to move forward with the selection. Susan Cobb worked diligently with OAR staff to develop a message for describing GSD science in terms of impacts to society. She completed the powerpoint and provided it to OAR staff for use in Hill Briefings.
B6.11	Analyze problems/obstacles in previous R2O efforts (HRRR, MADIS, AWIPS, etc.) and define clear actions that can be taken to improve the process for all GSD R2O efforts in the future. (Example: hand over responsibilities as developments transition down the TR funnel)	*Action B6.11.1: Schedule meeting with GSD experts to analyze R2O obstacles across projects. Share lessons learned with staff.*	Jennifer Mahoney – delegated to Keith Searight	9/2016	Completed. Team continues to update as necessary	A team to discuss lessons learned from GSD's R2O process convened in October 2016. Through numerous meetings, the team documented the learned lessons, developed a robust list of knowledgeable focal points to answer questions for future transitions, developed a transition guide that serves as a starting place for all future transitions listing important steps in completing a transition, and developed a template for building transition plan. This template was based on documents used to transition technology to the NWS. The

					summary report presented to GSD staff is available [here]().
B6.12	Establish a process to continually set/realign priorities together at least every 2y involving key scientists, mid and upper level management	*See Actions B6.4.1 and B6.8.1*	-	On-going	Completed. Interactions are on-going	GSD senior management has set up a two-fold process for realigning/reviewing priorities. First, GSD is committed to having a Retreat every 12-18 months to review its priorities in the context of Grand Challenges. The broader weather enterprise will be considered, as well as GSD's specific "partners" (NWS, FAA, etc.). Second, at the mid-career scientist level, a group called the Evergreen Group meets every two weeks to discuss a number of issues, including priorities (as they see them). To kick this off, GSD held a 2-day retreat on April 11-12 2017. We invited everyone in GSD to participate. We discussed the GSD strategic direction, whether the Grand Challenges were still on track, and discussed innovation opportunities for the future. A summary of the retreat is available on the intranet (https://intranet.fsl.noaa.gov/2017-Retreat/index.html) and action to update the strategic plan is underway.
B6.13	Actively pursue visiting scientist and engineer programs to continue to infuse external knowhow into GSD in key areas of research	*See Action B6.2.2*	-	Ongoing	Initial progress made. On-going	GSD continues to explore a visiting scientist program, but is limited in what can be done at the moment given the NOAA travel ceiling restrictions. We know there is interest in exchanging personnel with NWS/EMC, which would benefit both organizations. We will

						continue to look for new opportunities as they arise. In the meantime, see response B6.2.2 for progress made in infusing energy and knowledge through a post-doc program.
B6.14	Make continuous workforce education and training a priority of mid-level management to ensure employees remain fully up up-to-date in terms of scientific, project management and software engineering methods	*Action B6.14.1: Determine opportunities for project management training and continued training for senior and mid-level leaders.*	Senior leadership Team	Assess Quarterly	On-going	Executive and mid-career coaching and developmental opportunities were provided to GSD employees over the previous 2-years. This year, we engaged two different professional coaches to help improve workplace 'team' dynamics with an emphasis on an individual's personal responsibilities as a member of a team. In addition, the Evergreen Group has set up a series of mini-learning activities for GSD staff, examples include learning about leadership and how to deal with difficult people. Please see B6.15 for more information regarding engineering and software gaps and opportunities for training.
B6.15	Introduce GSD-wide standards for software engineering (e.g. agile development, code reviewing, unit testing, regression testing, automated continuous integration systems, transparent issue and feature tracking)	*Action B6.15.1: Review GSD software engineering practices and tools with the goal to increasing efficiency and reduce duplication.*	-	-	Plan was completed 6/2017. Steps toward implementation are on-going	GSD DDRF has provided Base resources (funds) to develop a set of common tools (GSD Prototyping Toolkit) that allow GSD research groups to share common technologies. A team working on GSD's Grand Challenges 3 and 5 completed a plan outlining a way forward where software can be developed in an agile, adaptive, and flexible environment using service-oriented architectures, cloud technologies, software repository, interface standards, continuous delivery, common data and software standards, improved sharing, access to, and training of technical people, and better sharing of plans. The

						team identified important skills for continued innovation including probabilistic forecast information, probabilistic forecasting, machine learning and artificial intelligence. The team also developed a process for evaluating projects from inception, throughout the life cycle to completion providing guidance to project managers and GSD Leadership.

Numerical Weather Prediction (NWP)

C4.1	Identify core competencies within NOAA and the broader community and develop a strategy for how it can best utilize this expertise to improve the research and operational NWP suite.	***Action C4.1.1: Determine lead and members to address Grand Challenges 1 and 2.*** ***The team would develop and deliver a plan summarizing a strategy to improve the research and operational NWS numerical weather suite. This plan incorporates recommendation C4.5.***	Melinda Marquis	5/2017	Completed 6/2017 Refinement is On-going	Dr. Melinda Marquis was selected to lead the development of an initial strategy for NWP. The team completed a draft implementation plan for GSD's Grand Challenges 1 & 2. The plan articulates the broad list of collaborators that will be needed to be successful, including the other 3 Divisions in ESRL, NCEP/EMC, NCAR, NASA, GFDL and JCSDA. After an initial assessment, the team identified a gap in their planning so the group informally commissioned another team (Grand Challenge 1.5) to focus on high performance computing.
C4.2	Build on the current success of HRRR as a basis to help develop a convection-permitting ensemble capability for the nation.	**On-going**	David Dowell, Stan Benjamin	6/2017	5/2017	HRRR-E (HRRR Ensemble) was successfully configured and run during the Hazardous Weather Testbed (HWT). The model data are being evaluated. Research will continue to improve the ensemble.
C4.3	In global modeling, finalize and implement a plan to contribute to NGGPS with selected NGGPS core and develop a longer-term plan for GSD's global modeling efforts, including a reduction in FIM, NIM	***Action C4.3.1: Complete negotiations on Year 2 of the NGGPS MOU by March 2017 to be implemented in April 2017 (consistent with the***	Kevin Kelleher	3/2017, implement 4/2017	Completed	When Phase 2 of the NGGPS program selected FV3 as the Nation's next generation global model, GSD redirected resources formally focused on NIM to FV3. The FIM model still has some value in terms of FIM-chemistry science and atmospheric-ocean coupling

	work, and especially the hydrostatic FIM	*NGGPS Program's funding cycle).*				that still shows impressive skill in subseasonal forecasting. These attributes will be transferred to FV3 over the next year or two. Specifically related to the NGGPS MOU, Year 2 has been completed by GSD and collaborators. MOU was provided to NWS for approval on 10/31/16. NGGPS projects have been funded for FY17 and include verification, DTC, GMTB, NESII, physics work, and chemistry. GSD has written a draft plan with milestones for addressing these issues in the context of GSD's Grand Challenges 1 & 2 (NWP).
C4.4	To improve quality metrics, develop and implement concrete mechanisms within GSD to encourage and reward publications and other types of scientific engagement in the research community beyond GSD and ESRL. Develop and implement mechanisms to mentor scientists on how to publish R2O and applied work, given constraints of funded efforts.	*See B10.1.1* *Action C4.4.1: Schedule meeting with SLT to develop process and incentives for increasing quality metrics including number of publications. Document process and share with staff at quarterly All-hands meeting.*	Senior leadership Team	12/2016	Initial review of metrics completed.	Publications are OAR's, and by extension GSD's, primary metric. Consequently, publications have been a canonical metric that has increased by 30% since the new Director arrived in 2013. GSD's second most important metric is number/quality of applications, technologies, or techniques either made ready to transfer or actually transferred into operations. In an effort to improve GSD's metrics, a team was commissioned in 2/2017. Please see B6.10.1 for details for progress of the Metrics Team.
C4.5	Design strategies for prioritizing future GSD NWP efforts in a way that balances advancing the science and technology of NWP with stronger operational partnerships and including more robust understanding of users' needs from early on in system planning and development.	*Action C4.5.1: Complete or update projects in VLAB to include transition plans for projects at stage TRL 4 or greater. Assign focal point for tracking projects through the transition process and for updating the information as needed.*	Susan Cobb and Phyllis Gunn	9/2016	Completed 10/2016	GSD has written roadmaps for its Grand Challenges. The plans articulate key partners that will be needed to achieve the milestones within the plans. Regarding tracking progress in a transparent manner, GSD has assigned a point person (Phyllis Gunn) to keep the projects in VLAB updated on a quarterly basis. She reports progress to OAR as requested. A spreadsheet was been

						developed to track GSD projects, deadlines, and transition progress. All project leads have been trained to update the spreadsheet quarterly. In addition, NOAA has begun using Transition Plans that address the issue of early engagement of operational partners with GSD researchers. Through GSD's internal R2O evaluation process, it became evident that NCEP uses a different format for their required transition plan vs AWIPS vs the formal NOAA template. GSD staff developed an integrated template for Transition Plans by combining elements of each of the existing NWS and NOAA templates, which is being used by those GSD projects entering RL5. GSD senior management has worked intentionally to improve communication with upper level NWS Portfolio Managers so that projects and research is planned jointly and leads to a direct NWS benefit. In addition, GSD developed a report template that is provided to NWS monthly to improve accountability and transparency for tracking deliverables, issues, and project progress.
C4.6	It is essential that a plan for national OSSE and OSE research be developed in collaboration with AOML, JCSDA, NASA/GMAO, NESDIS, perhaps via QOSAP. Test systems should include existing and possible ground-based remote	*No Action*	-	-	Closed	GSD defers to the NOAA OSSE Program lead on this, Dr. Robert Atlas at AOML, who manages the NOAA QOSAP program.

	sensing and in situ systems					
C4.7	Work to clarify and tighten GSD's roadmap, make necessary efforts to ensure buy-in across NOAA. Incorporate a clearer understanding of who might be using the predictions, how, and why into NWP system development from the beginning	*Action C4.7.1: Develop initial roadmap outlining steps toward Grand Challenges 3 and 5.* *Action C4.7.2: Develop steps for seeking buy-in across OAR, NWS, and NOAA.*	John Schneider and Mike Kraus	5/2017	Completed C4.7.1 C4.7.2 In progress	GSD has tightened its roadmap, which is driven by the GSD Grand Challenges. During this refinement process, GSD GCs were reduced to 4. GC #4 (OSSE focus) was removed, given that our sister lab (AOML) has the lead on OSSE R&D. GSD will continue to contribute, but will not lead this effort. GSD now has a roadmap for all its Grand Challenges, with milestones, that includes close collaboration with NCEP/EMC, GFDL, NCAR, NASA, and the other 3 ESRL Divisions. To begin the coordination with the other ESRL Divisions, an "ESRL Modeling Discussion Group" was formed, led by GSD's Dr. Stan Benjamin, which includes the top modelers from each of the ESRL Divisions. This group will discuss both science and programmatic issues associated with NWP in NOAA. As GSD's roadmaps for the Grand Challenges evolve, we discuss and communicate the ideas through the specific committees and sub-committees that GSD staff participates or leads, in addition to direct communication with NWS managers. For instance, GSD staff contribute to the NWS NGGPS program, FAA program, and DTC. GSD staff serve as members and/or Co-Leads of the various subcommittees that are bringing together the modeling community for the development of FV3.

C4.8	Collaborate with the National Water Center. This seems like a natural fit and could lead to some productive and interesting innovation in the area of water forecasting.	*In process and on-going*	-	-	Closed	Given the loss of GSD's key coordinator of its water-related research (Tim Schneider left GSD to work at NWS), GSD has taken on a secondary role with respect to collaborations with National Water Center. GSD staff work closely with ESRL/PSD (Rob Cefelli) to support water research by providing weather forecasts using the HRRR model, which serve as the "forcing" for the water models (specifically QPF), and decision support technologies as needed.
Decision Support						
D4.1	Improve partnerships with national level programs to complement current efforts to support forecasters in the field. Perhaps opportunities like FACETs and WRN pilot programs could serve as shared initiatives to better integrate the efforts.	*Action D4.1.1: Continue to explore new partnerships and opportunities with national level programs, such as those with the GOES-R program. To begin, invite GOES-R focal point for presentation and discussion of new opportunities.*	Mike Kraus	12/2016	Completed	GSD has become fully engaged in the FACETS. GSD is leveraging its expertise in AWIPS-2 to help implement some of the technologies and techniques coming out of the Program. GSD is also key to the Warn-on-Forecast Program using the HRRR model as a driver for the finer-scale WOF model. Regarding GOES-R, Daniel Nietfeld has been appointed GSD's focal point for the initial exploration of GOES-R and ways GSD can help the National Centers. Promising opportunities are underway with National Centers for Hazard Services development. New opportunities with NWS continue to be explored. One new project included the National Scale application of Hazard Service. $50K was provided as seed money in FY17 to explore the needs and requirements. Another new project is GSD has agreed to install the WAVE software being used by the WFOs and to see if improvements can be made on

						its performance as its usage grows within NWS.
D4.2	Begin incorporating social science perspectives and knowledge into decision support activities to help realize Grand Challenge goals.	*Action D4.2.1: Schedule follow-on meetings with NCAR to develop opportunities for collaboration. Identify leader to continue this interaction.*	Jennifer Mahoney	7/2016	Completed. On-going collaboration is expected.	GSD is building on progress with FACETS/WoF and other initiatives to engage social scientist into the work that we do. Therefore, GSD is funding NCAR/MMM's Weather Risks and Decisions in Society (WRaDS) Group for an 18 month collaboration. WRaDS is well connected in the weather decision support arena and their expertise with social science will help ensure that the initiative will be successfully executed. WRaDS will provide corporate knowledge of other programs addressing similar questions about the preparation, use, and interpretation of probabilistic weather forecast products. They will support GSD interactions with other NOAA programs interested in the presentation and use of weather-related forecast uncertainty. This support will include organizing a workshop.
D4.3	Develop a broader strategic direction for GSD Decision Support, or update existing strategic directions	*Action D4.3.1: Provide a plan for addressing Grand Challenges 3 and 5 to Senior leadership Team for review and approval - December 2016.*	John Schneider and Mike Kraus	12/2016	Ongoing	Consolidated under C4.7
D4.4	Clarify what "decision support" means for GSD	*No Action*	-	-	Completed	Consolidated under C4.7
D4.5	Consider the appropriateness of developing technologies that support broader sets of users and uses	*See Action B.6.6.1*	-	-	Completed	Consolidated under B.6.6.1

	while maintaining current competencies					
D4.6	Balancing meeting the needs of current users with taking a more active role in offering capabilities and pursuing new opportunities that leverage existing work to serve broader sets of users	*See Action B.6.6.1*	-	-	Completed	Consolidated under B.6.6.1
D4.7	Enhance awareness of other public and private sector decision support activities to remain competitive and collaborate where beneficial	***Action D4.7.1. Investigate whether there are other new innovative opportunities, including workshops and conferences that would provide opportunities for expanding our knowledge of decision support and report to SLT.***	Mike Kraus	5/2017	On-going	GSD approved an initiative for "Understanding and improving the production, presentation, and use of probabilistic forecasts and associated decision support products – End to End." This initiative provides an opportunity for GSD to become more connected with the meteorological decision support community, and other decision makers. See also connection to NCAR/MMM's Weather Risks and Decisions in Society (WRaDS) Group collaboration summarized in D4.2.
D4.8	Seek opportunities to build a set of common core tools that can be leveraged across GSD	*See Action B.6.15.1*	-	-	On-going	Consolidated into B.6.15.1
D4.9	Utilize knowledge from Best Practices in aviation program: Assessment reports, methodology reviews by stakeholders and developers to guide other programs	***Action D4.9.1. Apply best practices used in FIQAS to other parts of GSD.*** ~~Explore the feasibility for developing a joint roadmap with NWS for GSD projects.~~	Daniel Nietfeld	5/2017	Completed	Best practices used in FIQAS that have been applied to other parts of GSD include: improved monthly reporting of status to our sponsors, better tracking of deliverables/timelines/expenses and better quantification of the work to be completed that is described in statements of work that are provided to our NWS sponsors.
Advanced Technologies						
E4.1	Continue to support and mature the highly successful SOS, MADIS and HPC initiatives.	*No Action*	--	-	On-going	Additional GSD Base funding has been used to support the ATO Branch.

	Including the use of base funding to ensure long-term sustainability of these programs.					
E4.2	Work with NOAA ops to tighten the R2O process for GSD's role in the continued evolution of operational MADIS, including acquiring new data sets and improve data latency	No Action	-	-	On-going	Progress has been made working with NWS on tightening the R2O process through continuous dialog and negotiations. Several new data sets (including those related to road weather) have been added.
E4.3	Along with all of GSD's NWP initiatives, become a contributor to, integral to, and tightly aligned with NOAA-wide strategic and tactical plans to develop next generation global and regional modeling capabilities: including establishing benchmarks for model optimization success and a program to reach those benchmarks.	Action 4.3.1 In collaboration with the NGGPS Program, develop a plan for establishing a baseline and associated metrics for speedup of NOAA's next generation global model.	Mark Govett	5/2017	Completed	As part of the Sandy Supplemental and desire for the US to be more competitive globally in global weather forecasting, NOAA has obtained and installed a new fine-grain computer. GSD has successfully ported a high resolution (3.5km) global model to this new architecture, meeting the final milestone of the HIWIP program. This accomplishment has paved the way for GSD to now build upon what has been learned to port the nation's next generation global model (FV3) to this new fine-grain computer. Initial efforts have successfully ported the recently released FV3GFS model to the new GPU system. Portions of the FV3GFS ported to the GPU system are running 2-3 times faster than on the CPU. These efforts are paving the way for the US global model to run more quickly allowing for the model to run at higher resolutions or with more complex physics increasing our forecasting abilities.

E4.4	Work with NCEP/EMC to inject GSD's HPC talent and capabilities into the development of NCEP operational models, and in particular the NGGPS program and expand the GSD HPC activities as necessary to support this national imperative.	*Action 4.4.1 Continue to work with the NGGPS Program to identify areas in which GSD's HPC talent can directly contribute to optimizing the dycore selected, as well as assisting/leading in the optimization of associated model components such as the data assimilation and model physics.*	Mark Govett	5/2017	6/2017	GSD is working on the optimization of the NGGPS dynamical core, model physics, and data assimilation systems used by NCEP. It appears that the NGGPS Program and NWS do not view optimization of FV3 on Fine-grain computing a high priority, which limits the progress GSD can make in this area.
E4.5	Rather than developing new visualization tools, consider how to integrate new GDS-developed visualization technologies into existing visualization tools to avoid creating niche applications with limited utility - but rather create capabilities that will have broad use and distribution.	*Action 4.5.1 Review GSD's visualization tool development and identify areas in which these tools could be generalized for broader use.*	John Schneider	12/2016	4/2017	Visualization technology was incorporated into Grand Challenge 5. In addition, GSD DDRF has provided funds to develop a set of common tools (GSD Prototyping Toolkit) that allow GSD research groups to share common technologies.