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NOAA Technical Memorandum OAR LCI-001

Analysis of OAR Transition of Research and Development (2014-2017)

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NOAA/Laboratories and Cooperative Institutes
Silver Spring, Maryland
April 2018

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Executive Summary

Following the inaugural Technical Report on OAR transitions (Sen 2015), OAR's office of Laboratories and Cooperative Institutes (LCI) compiled an inventory of all research and development (R&D) that had been transitioned to application, operation, or commercialization (R2X) between August 2014 and July 2017. Utilizing the methods set forth in the inaugural report, submissions were categorized based on function, output, application, recipient type, number of recipients, and strategic goal. This report tracks changes in the understanding and reporting of transition within the OAR research portfolio between the two sampling periods as well as utilizes additional data to explore new metrics to track OAR transition over time (e.g., rate of transition, Readiness Levels).

During this sampling period, 71% of projects (101 submissions of 143) were consistent with the definition of transitioned R&D, with 56% of submitted projects fitting the "Technology Transfer" functional classification and 15% of submissions fitting the "Education and Outreach" function classification. This is a large increase in reported transitions, as the 2015 report noted very few submissions that actually met the definition of transition (39%; 96 submissions of 245). The increase in proportion of projects deemed transition and the decrease in overall reported projects (perceived transition projects) indicates that the understanding of transition within the OAR community has greatly increased in recent years.

While the percentage of submissions correctly identified as transitions greatly improved, some gaps in understanding did persist. Activities that were misidentified as transitions primarily fell into two categories: routine observations that produce data and transfers with no identified recipient. The production of data that is considered an operational service or the performance of product maintenance is not, by definition, a successful transition. Additionally, several submissions did not include a specific recipient. While this could be a reporting error, it is also indicative of a lack of understanding that true transitions must contain a specified recipient, even in cases where the public is the ultimate recipient.

Since the inaugural report, OAR (and on an agency-level, NOAA) has bolstered its commitment to transition and developed several resources and tools to aid in the understanding of transition: 1) the report itself, as it provides several key definitions and examples of what does and does not constitute a transition activity; 2) the NOAA Administrative Order on Research and Development Transitions (NAO 216-105B) and its associated handbook which provide an updated definition of transition and recommend the use of transition plans at Readiness Level (RL) 4 and above; 3) the NOAA Research and Development Database (NRDD) which can aid in the tracking of projects through RLs and transitions; and 4) the forthcoming OAR circular that addresses proper transition planning and approval protocol. As the majority of OAR projects fall between RL 2 and RL 6 (Fig. 1), it is important to encourage consistent understanding of transitions and transition planning within early stages of R&D.

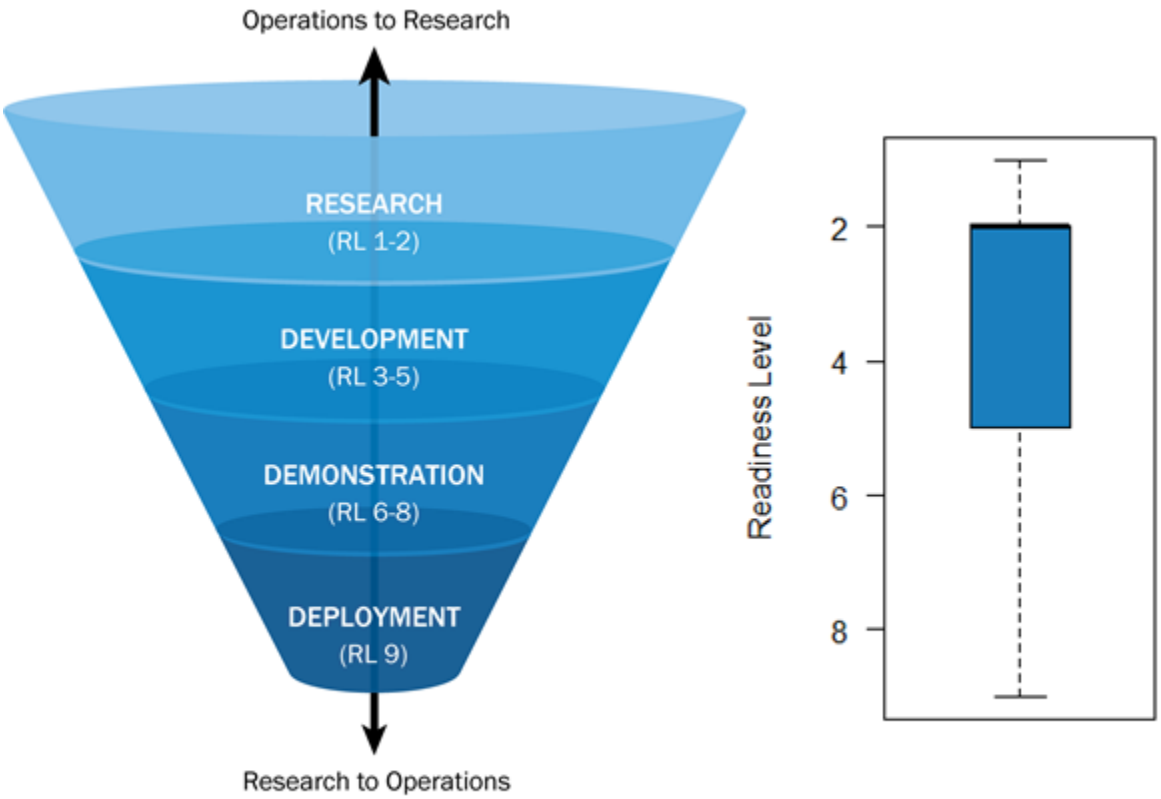

Figure ES-1. The distribution of OAR Projects by Readiness Levels (RLs) in 2017 based on NRDD data. The majority of projects indeed are in the lower RLs of R&D, however, this may be a manifestation of reporting bias driven by errors in RL assignments that skew towards RL 2. In the box-whisker plot on the right, the upper (lower) bound of the box represents the 25th (75th) percentile, such that 50% of the samples occur in the range of the box. Note: RL does not necessarily define whether a project is "transition ready" since projects can transition to application without moving through every RL along the way.

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List of Acronyms

Abbreviation	Description
AOML	Atlantic Oceanographic and Meteorological Laboratory
ARL	Air Resources Lab
CPO	Climate Program Office
DAA/S	Deputy Assistant Administrator for Science
DoC	Department of Congress
ESRL CSD	Earth Systems Research Laboratory Chemical Science Division
ESRL DO	Earth Systems Research Laboratory Director's Office
ESRL GMD	Earth Systems Research Laboratory Global Modeling Division
ESRL GSD	Earth Systems Research Laboratory Global Systems Division
ESRL PSD	Earth Systems Research Laboratory Physical Science Division
FMC	Financial Management Center
GFDL	Geophysical Fluid Dynamics Laboratory
GLERL	Great Lakes Environmental Research Laboratory
JTTI	Joint Technology Transfer Initiative
LCI	Laboratories and Cooperative Institutes
MAPP	Modeling, Analysis, Predictions, and Projections
NAO	NOAA Administrative Order
NRDD	NOAA Research and Development Database
NSSL	National Severe Storms Laboratory
NWS	National Weather Service
OAR	Oceanic and Atmospheric Research
OER	Office of Exploration and Research
OWAQ	Office of Water and Air Quality
PEML	Pacific Marine Environmental Laboratory
R&D	Research and Development
RL(s)	Readiness Level(s)
RTAP	Research Transition Assistance Program
R2X	Research to Operations, Applications, Commercialization (etc.)
SG	Sea Grant
UAS	Unmanned Aircraft Systems

1 Introduction

Efficient transition of R&D to application, operation, commercialization, and other uses (R2X) showcases the accountability, utility, and stewardship of NOAA to the public (Rood 2018). As such, transition has become increasingly important to NOAA leadership, appearing in several publications (e.g., Green 2006), NOAA policies, and R&D Plans. Additionally, increased R2X has been identified by Department of Commerce (DoC) and the Administration as a priority for government-funded R&D. As the only research-specific Line Office of NOAA, OAR aims to become a leader in transition planning, reporting, execution, and other transition-related activities.

OAR has already begun implementing several of the recommendations made from the inaugural transition report. The 2015 report recommends four criteria to identify which outputs can be labeled as transition: 1) the output is the product of research or development, 2) the application is particular and verifiable, 3) the activity is focused on translation and adaptation, and 4) the output is a productive system or component thereof (Sen 2015). These criteria form the basis for the understanding of transition used in this report and within the OAR community. The inaugural report also highlights the utility of transition plans for enabling a more consistent and replicable transition process which could also improve monitoring and assessment. Furthermore, the report recommends the use of RLs for defining the readiness of all R&D activities. NOAA Administrative Order (NAO) 216-105B forms the agency policy that guides the use of RLs and the development of transition plans. The use of RLs within OAR has increased as a result of the NAO and with the inception of the NOAA Research and Development Database, however, there continue to be some challenges with the determination and reporting of RLs.

Between the data collection for the 2015 report and this present report, NOAA internally socialized the concepts surrounding R2X through policy development and implementation, workshops, and funding opportunities with distinct elements of R2X. This report provides an update on the state of R&D transition within OAR,that also evaluates (in part) the impact of the past 3 years of effort within NOAA to advance transition of R&D. Furthermore, it explores new methodologies to track transitions within the line office and establishes guidelines for continued assessment and improvement of the OAR transition process.

2 Methodology

In August 2017, OAR leadership requested all OAR senior managers provide a detailed inventory of OAR research and development (R&D) that had been successfully transitioned during the period of August 1, 2014-July 31, 2017. Information was compiled by OAR’s Office

of Laboratories and Cooperative Institutes (LCI) to create an inventory and provide analysis of OAR's transition capabilities.

Following the methodology of the inaugural report on OAR Transitions (Sen 2015), a request to complete a spreadsheet was sent to each Laboratory and Program Office director. The spreadsheet contained columns for project name, thing transitions, purpose of transition, from where (organization, point of contact, and email), to where (organization, point of contact, email), and date completed (month and year) for each R&D projects that had successfully transitioned to applications, operations, commercialization, and other uses (R2X) within the timeframe. Transition projects were required to be discrete, discernable, and explainable.

LCI received 142 submissions from 13 of the 16 OAR Labs and Programs queried. Projects were categorized following the qualitative coding/labeling system set forth by Sen (2015; categories described in Appendix 2). Categories were assigned independently by two LCI staff (Ian Kroll and Laura Newcomb). Any disagreements were discussed and brought to a third LCI staff member (Christopher Moses) for resolution. Categorization was validated by the OAR Deputy Assistant Administrator for Science (DAA/S; Gary Matlock).

After classification was complete, a tally of reported transitions was taken for all labels within their respective categories. Data were analyzed independently and compared with the data presented in the inaugural Transition Report (Sen 2015).

The number of transitions per FMC (Financial Management Center) were counted from 2013 - 2017 based on the data collected in Sen (2015) and the submissions in this report. Seventeen projects did not list a date of transition, and were therefore excluded from this analysis.

To assess whether Readiness Levels (RLs) of FMCs' ongoing projects could be used as a predictor of how many transitions they might generate over a sample period, RLs from each FMC were averaged across projects submitted to the NOAA Research and Development Database (NRDD; a web-based repository for R&D projects developed and funded by NOAA) during the 2017 collection window (January-November 2017). The number of transitions in 2017 were then plotted against mean RL for each FMC to assess any potential relationships between the mean RL and number of transitions that could be expected.

3 Results

This section provides a summary of how submissions were categorized; potential relationships between project functions, outputs, applications, strategic goals, and recipients; and how results from this sampling period compare with those from the inaugural report. Following Sen (2015), shades of orange indicate categories that are consistent with the definition of transition, whereas shades of blue indicate categories that are consistent with the definition of research and/or

development. More information on categories (including definitions) can be found in Appendix 2.

Unlike the 2015 report, preliminary analysis showed little difference in category distribution when removing projects that did not qualify as transition. Therefore, figures display data for *all* submissions (i.e., actual transitions *plus* projects still in the R&D phase), not just those deemed transitions. Function, Output, and Application Types (Fig. 2, Fig.3, Fig. 6, respectively) all displayed large increases in transition-associated categories when compared with the inaugural report (See Sen 2015 for original data).

3.1 Type of Function

Based on the assessment of the information submitted by OAR program and lab officials, projects were categorized into activities from the inaugural report and the OAR strategic plan. Only two categories indicated transition: Extension and Outreach and Technology Transfer. All other functions were considered either Research or Development.

Most (71%) of the projects initially reported for this time period were determined to be transitions (Fig. 2). The change between 2015 and 2018 is primarily due to an increase in projects with a Transition: Technology Transfer function (27% to 56%) and decrease in projects with a Research: Observations and Data function (35% to 6%). Fewer projects were associated with Research and Development categories in 2014-2017, except for Research: Models and Assessment and Development: Emerging Technologies.

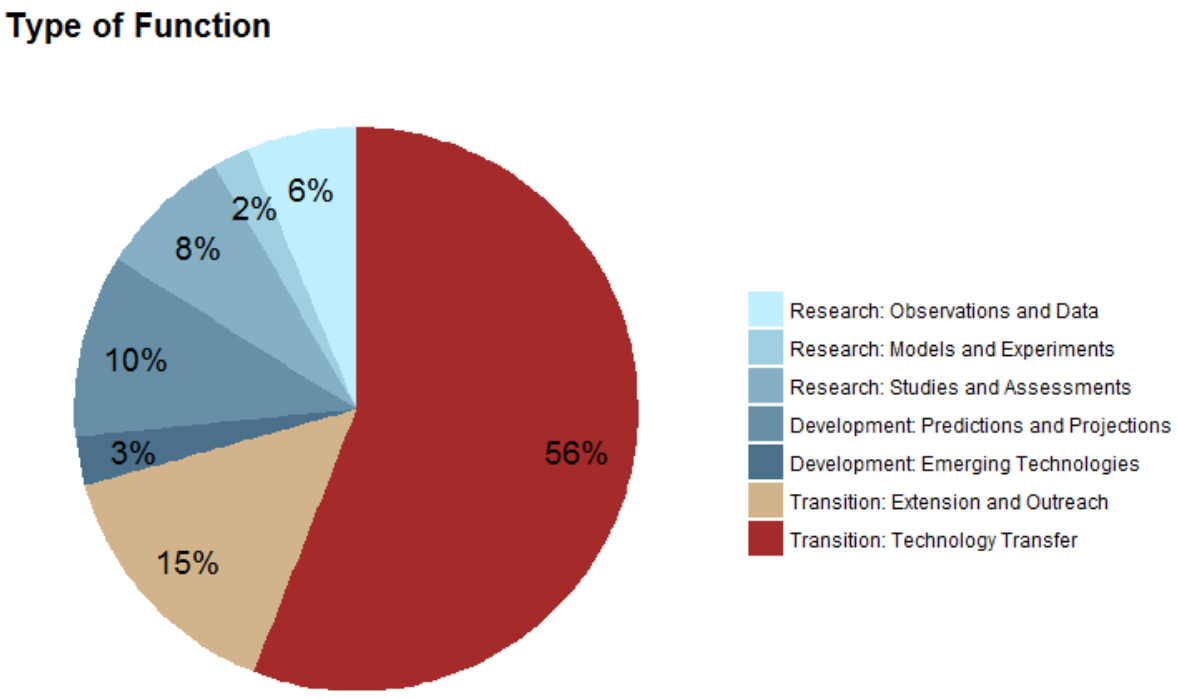

Figure 3.1. Percentage of submissions categorized within each Function type.

3.2 Type of Output

Consistent with the definition of transition (see Appendix 1), output that is indicative of data collection, operation and maintenance, or products that are made available to anyone to use through publication were not assigned transition-related outputs (e.g., original data, synthesized products, etc.). However, some science products were counted as a transition (i.e., Science: Interpreted Product T) as they functioned to translate discipline-specific knowledge into application-specific knowledge.

The majority of outputs (69%) were associated with a Technology-related product and, overall, 79% of submissions identified outputs that were indicative of transition (Fig. 3). The largest category of output transitioned was within the Model Algorithm category (33%). Of the R&D-associated outputs (not transitions), Science: Original Data was the most frequently reported.

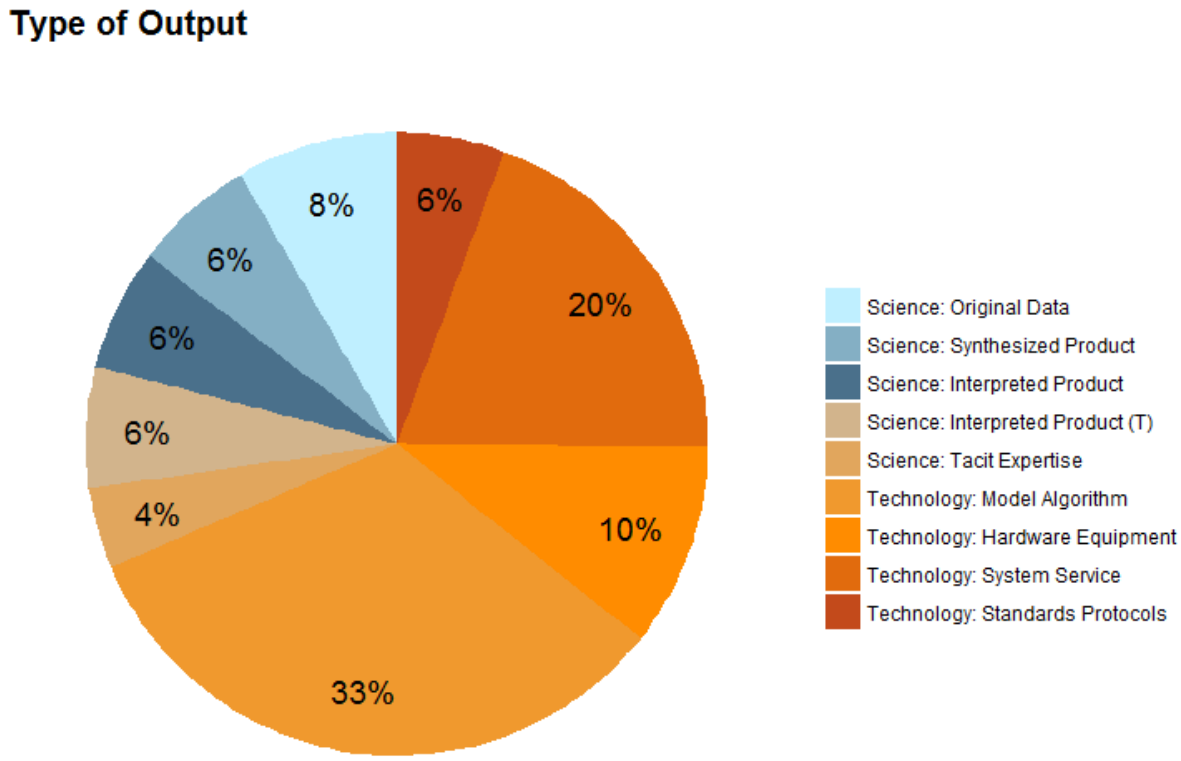

Figure 3.2. Percentage of submissions categorized within each Output type.

3.3 Number and Type of Recipient

While the type of recipient of a transition does not often determine whether a project is categorized as a transition, transitions do require a clearly identifiable and specific recipient who

have specific requirements for specific applications. Submissions that did not identify the recipient or denoted an infinite number of recipients (e.g., “the public”) were not categorized as transitions.

Most proposed transitions were associated with a single (59%) or several (24%) recipients (Fig. 4), which is consistent with transition. Projects associated with infinite recipients, which are generally not associated with the definition of transition (See Appendix 1), represented a substantial (14%) number of submissions. A new “Cannot Determine” category was included for cases where the “transitioned to” category was unclear.

Several transitions were associated with having a Public, NOAA- Federal (Not OAR), recipient (Fig. 5). An additional category, “Multiple Users,” was added in this analysis to incorporate those submissions that identified several recipients and multiple levels (e.g., Public-Federal-NOAA, Public-State/Local/Tribal, and Academic). The Multiple Users category boasted the second-highest frequency within recipient types, consisting of 22% of submissions.

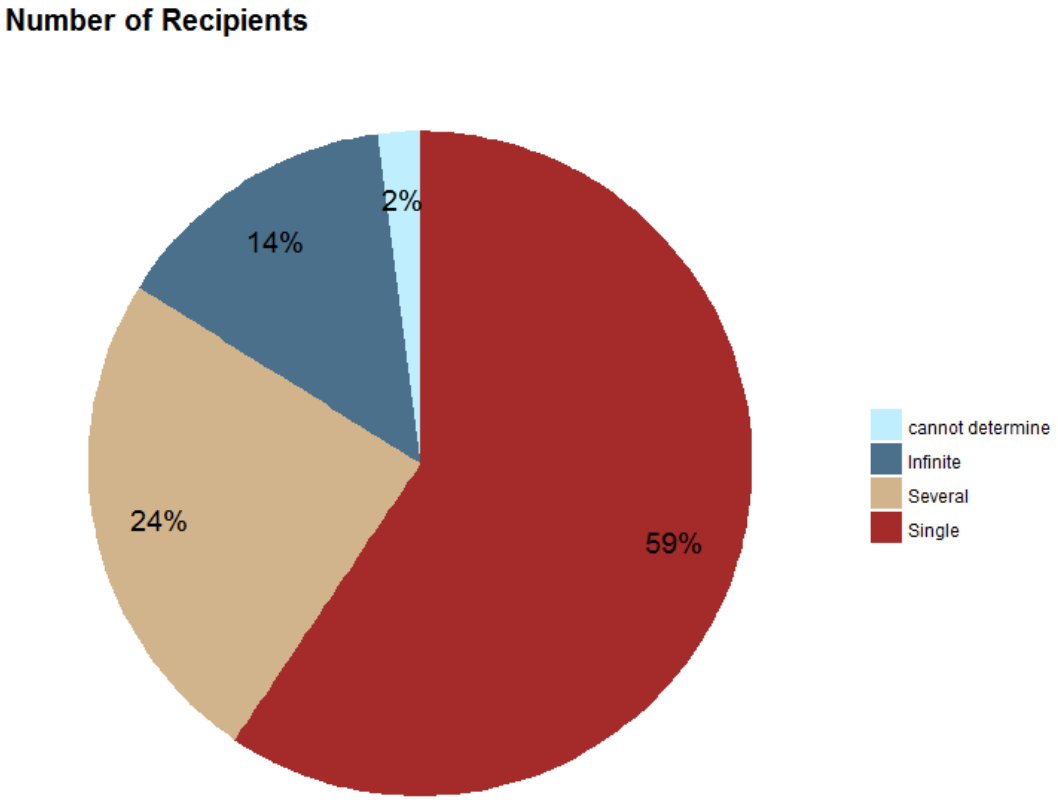

Figure 3.3. Percentage of submissions categorized within each Number of Recipients based on identified transition recipient.

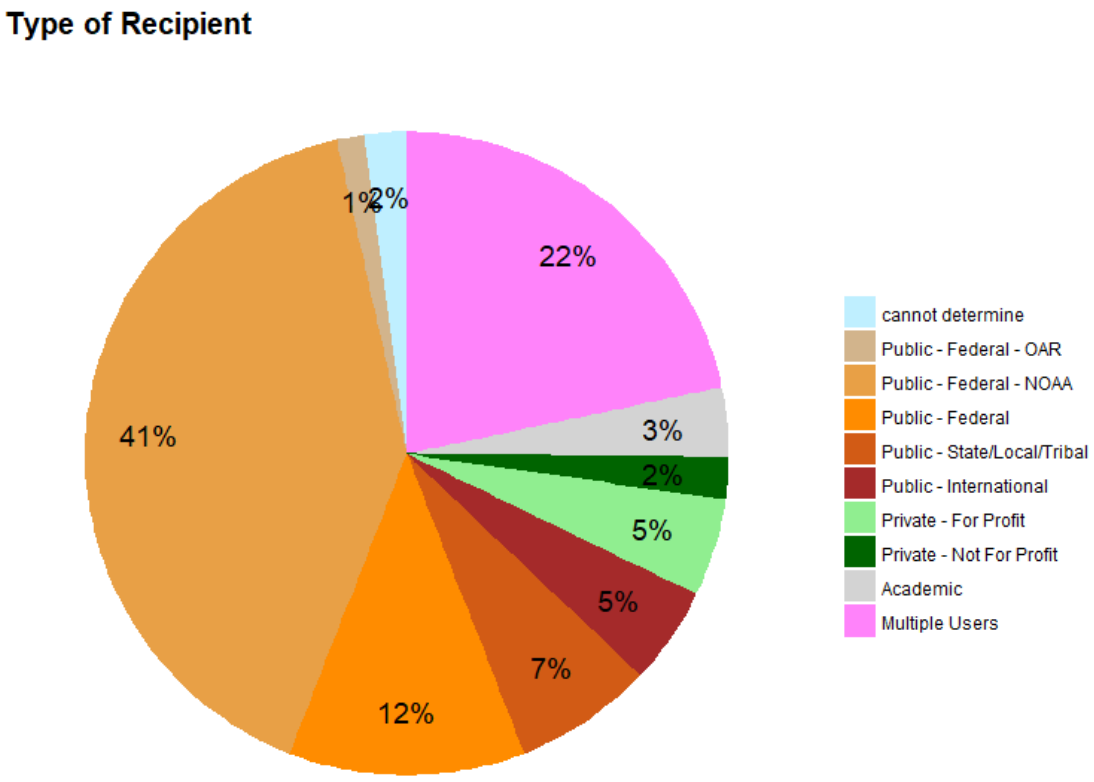

Figure 3.4. Percentage of submissions categorized within each Recipient Type based on identified transition recipient.

3.4 Type of Application

The application of a project does not inherently determine whether it is a transition. However, a specific application must be identified. Additionally, research is not an application, as it does not create direct value beyond improved scientific understanding.

Most proposed transitions could be associated with an application; however, 26% were associated with additional research, not a true application (either operational or quasi-operational; as defined in Appendix 1; Fig. 6). Environmental Intelligence was the most commonly-associated application type for submissions (49%). Research, which is generally not considered a transition application, comprised 26% of submissions. No submissions were associated with Policy, Legislation, and Law. We did not include a “Cannot Determine” category, as submission application types were easily discernible from project descriptions.

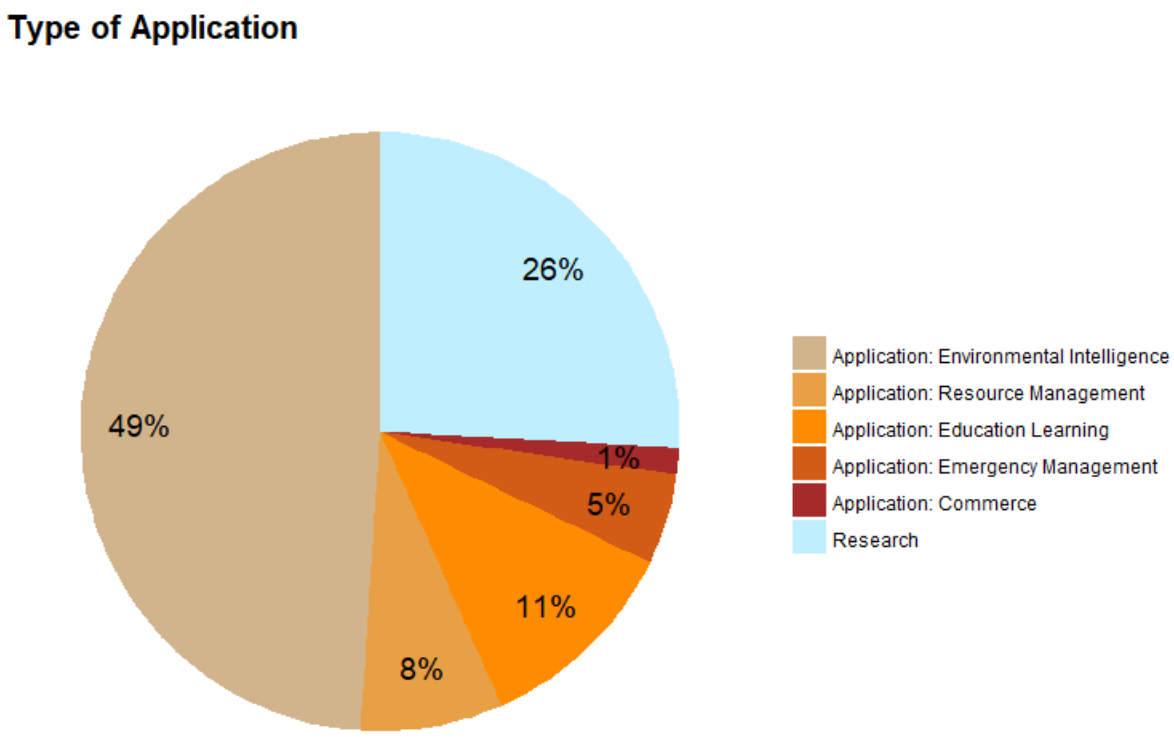

Figure 3.5. Percentage of submissions categorized within each application type.

3.5 Strategic Goal

How a project aligns with a specific OAR Strategic Goals does not accurately predict whether it is a transition. In fact, a diversity in strategic goals helps contribute to a balanced research portfolio. Strategic Goals for this study differ than those for the inaugural study: they were re-written and expanded for the NOAA Five-Year Research and Development Plan for 2013-2017 (Appendix 2) since it was reasonable that projects started under that plan were beginning to transition.

Submissions were most frequently associated with the Integrated Environmental Modeling System goal (26%) and were least frequently associated with the Resilient Coastal Communities and Stakeholder Engagement goals (both at 8%; Fig. 7). Submissions displayed a relatively even distribution among Strategic Goals.

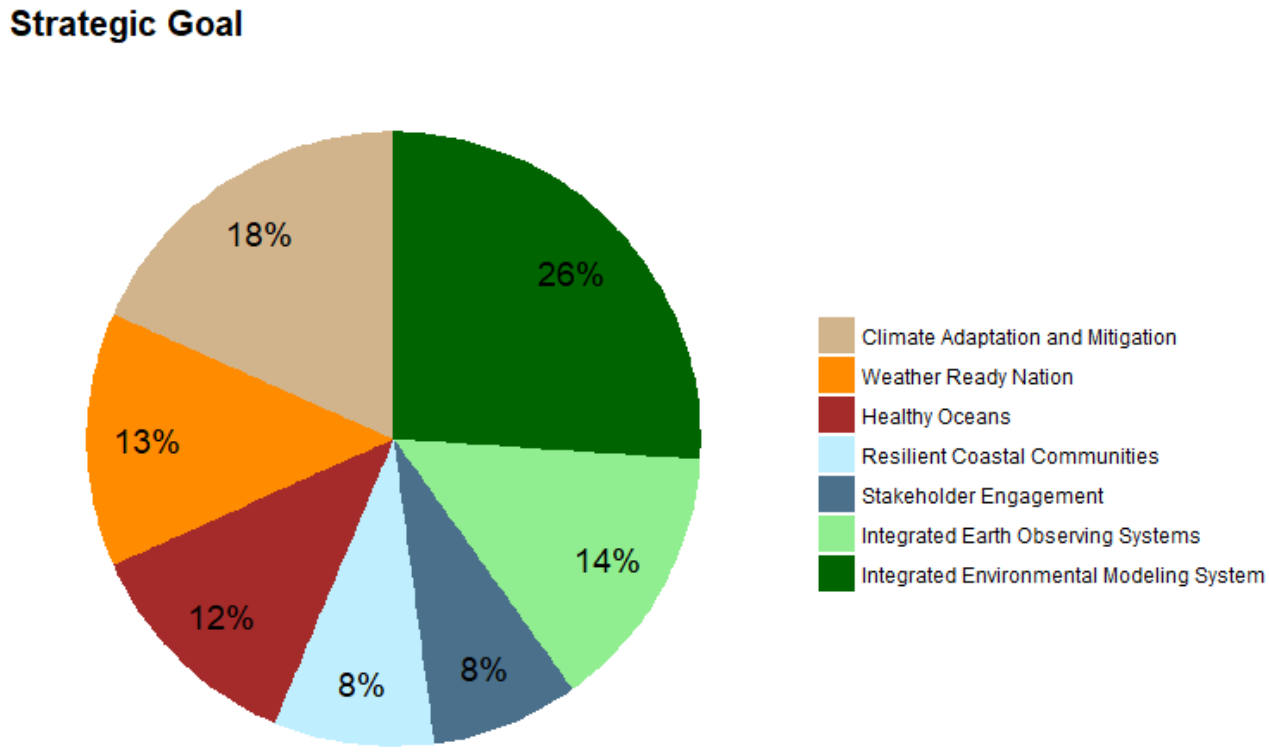

Figure 3.6. Percentage of submissions categorized within each Strategic Goal, as identified in the NOAA Five-Year Research and Development Plan for 2013-2017.

3.6 Function and Output

While the inaugural report only began to examine potential connectivity between categories, this report highlights the frequency with which specific functions result in specific outputs. Potential linkages between function and output may help reinforce the definition of transition to the OAR community.

Function type and output displayed high instances of connectivity, with the majority of transition-based functions feeding into technology-related outputs (Fig. 8). Submissions that were categorized within a development phase function led to every type of output except for Science: Tacit Expertise and Technology: Standards Protocols. The majority of submissions with a Research function resulted in a Science output.

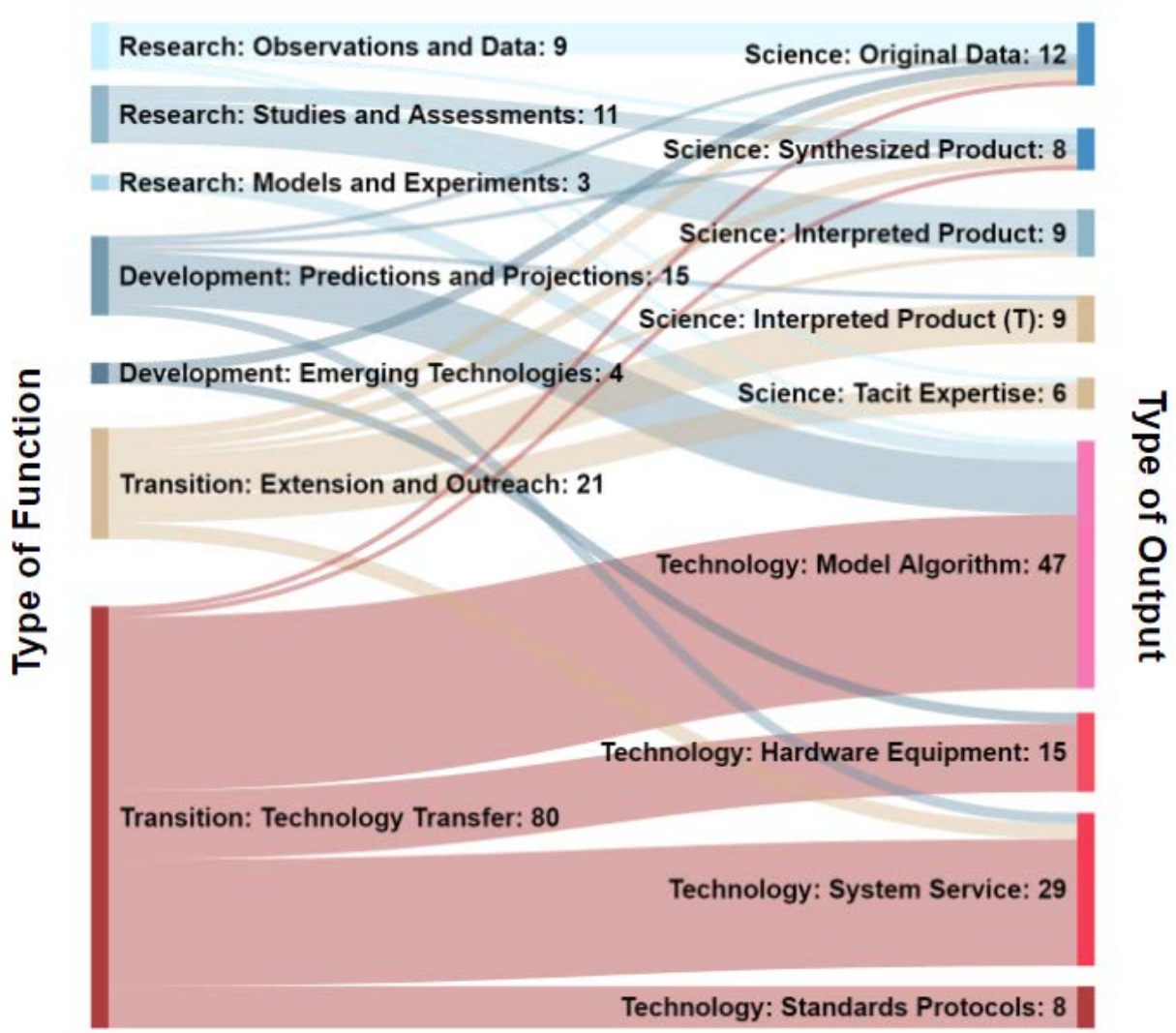

Figure 3.7. Sankey diagram displays connections between submission Function and Output type.

3.7 Function and Strategic Goal

Strategic goal does not inherently determine whether a project is deemed transition or not. However, it is beneficial, when assessing the robustness of the OAR research enterprise.

Linkages between function type and strategic goal show a balanced research portfolio among OAR offices and programs; submissions categorized as Transition: Technology Transfer contributed to every strategic goal (Fig. 9). However, roughly 30% of Transition: Technology Transfer submissions were linked to the Integrated Environmental Modeling System Goals. Stakeholder Engagement was the least frequently assigned strategic goal, with the majority of its submissions also labeled as Transition: Technology Transfer.

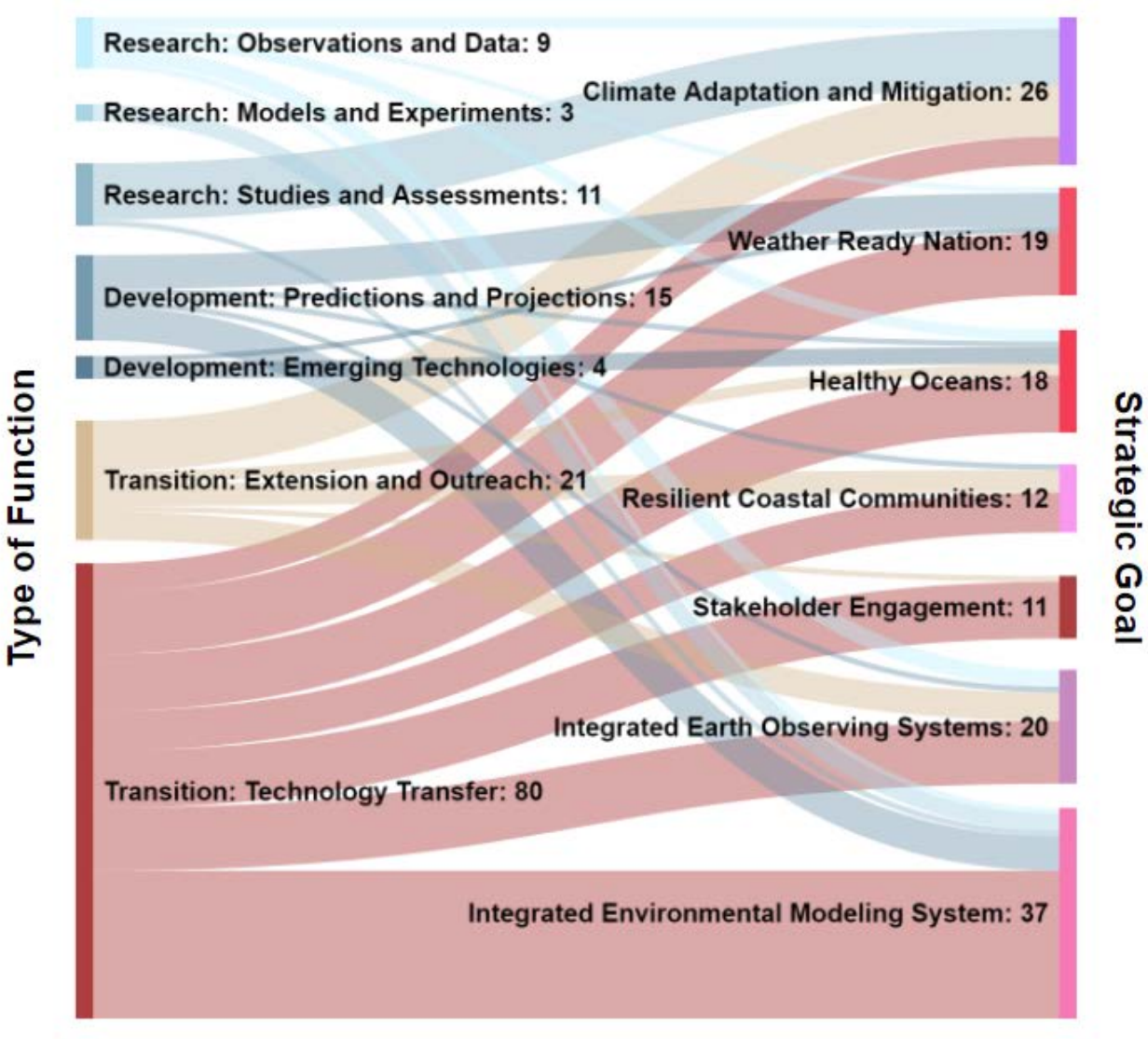

Figure 3.8. Sankey diagram displays connections between submission Function and associated Strategic Goal.

3.8 Function and Recipient Type/Number

Exploring the connection between function and recipient of submissions can helps identify strengths within each FMC and may serve as a valuable resource management support tool.

All 13 FMCs that submitted transitions included projects that could be categorized as "Transition: Technology Transfer," with ESRL GSD submitting the highest proportion of Transition projects (Fig. 9). Transitions were also distributed to all of the recipient types. Functions that were associated with Research were most commonly received by the Public-

Federal-NOAA category of recipient.

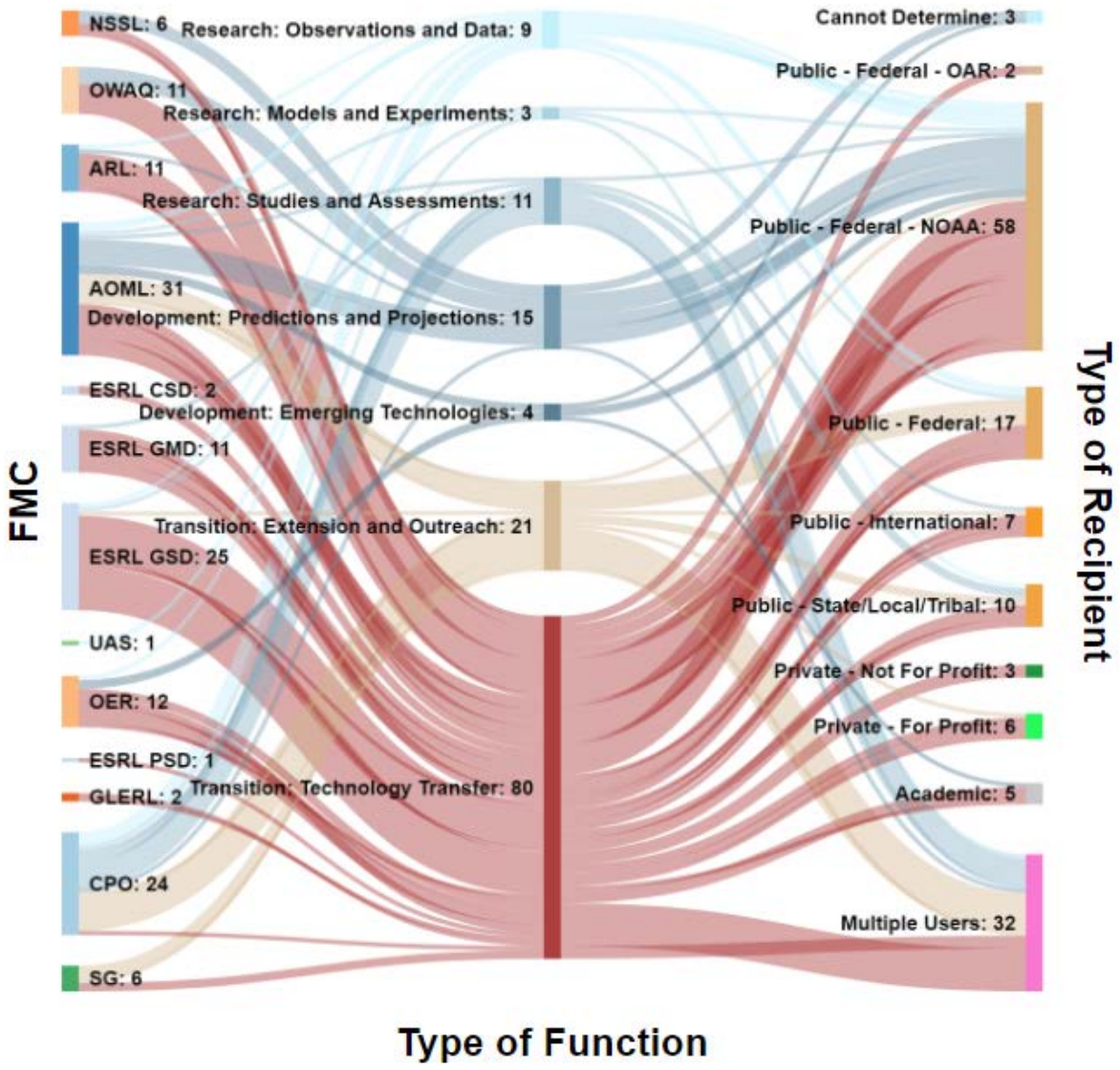

Figure 3.9. Sankey diagram displays connections between FMC submissions, Function, and Recipient Type.

3.9 A Broader Picture of the OAR R&D Portfolio

Additional analysis in this report was used to create a new metric for tracking transition over time: transition rate (number of transitions per year). By contextualizing OAR Financial Management Center (FMC)-specific transition rates within the overall transition rate, FMC progress in the understanding of transition can be monitored and assessed. Additionally, potential reporting errors can be identified. Readiness Level (RL) data for ongoing projects within each FMC was extracted from the NRDD to assess potential relationships between RL and number of transitions.

Overall transition rates, number of reported transitions per year, declined from 2013-2016 but began to increase in 2017 (Fig. 11a). To explore this trend, transition rates for individual FMCs were examined (Fig. 11b). While the rates of transition for some FMCs were consistent over time (e.g., ESRL GSD, GLERL, OER, ARL), others followed a more uneven model of transition with many transitions in one year followed by very few in other years (e.g., SG, AOML). Sea Grant (SG) appeared to have the largest difference between years and was likely the driving force behind the peak (and subsequent decline) of transitions in 2013.

To explore the possible link between project RLs and transition, a model was constructed to compare RLs of ongoing FMC projects and their reported number of transitions (Fig. 12). As RL increased from 3 to 6, the number of reported transitions also increased. Beyond RL 6, RL was not a predictor for the number of transitions an FMC will produce ($r^2 = 0.3$, $p < 0.001$). The shaded area highlights where transition is most influenced by RL, and therefore where resources applied to advancing RLs may be most effective.

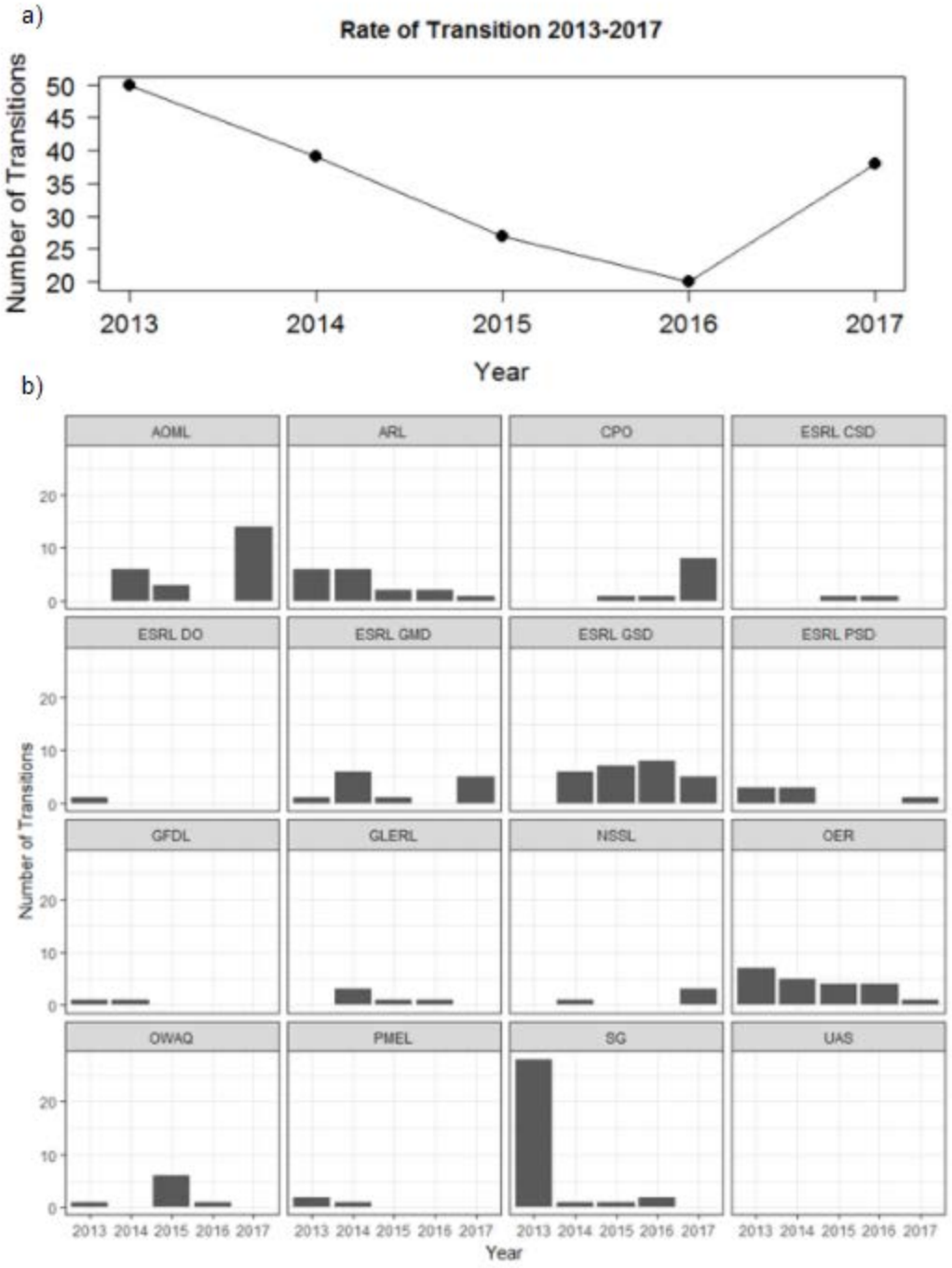

Figure 3.10. Number of reported transition per year a) overall and b) by FMC. Figure does not include 17 transition projects that were submitted with no year.

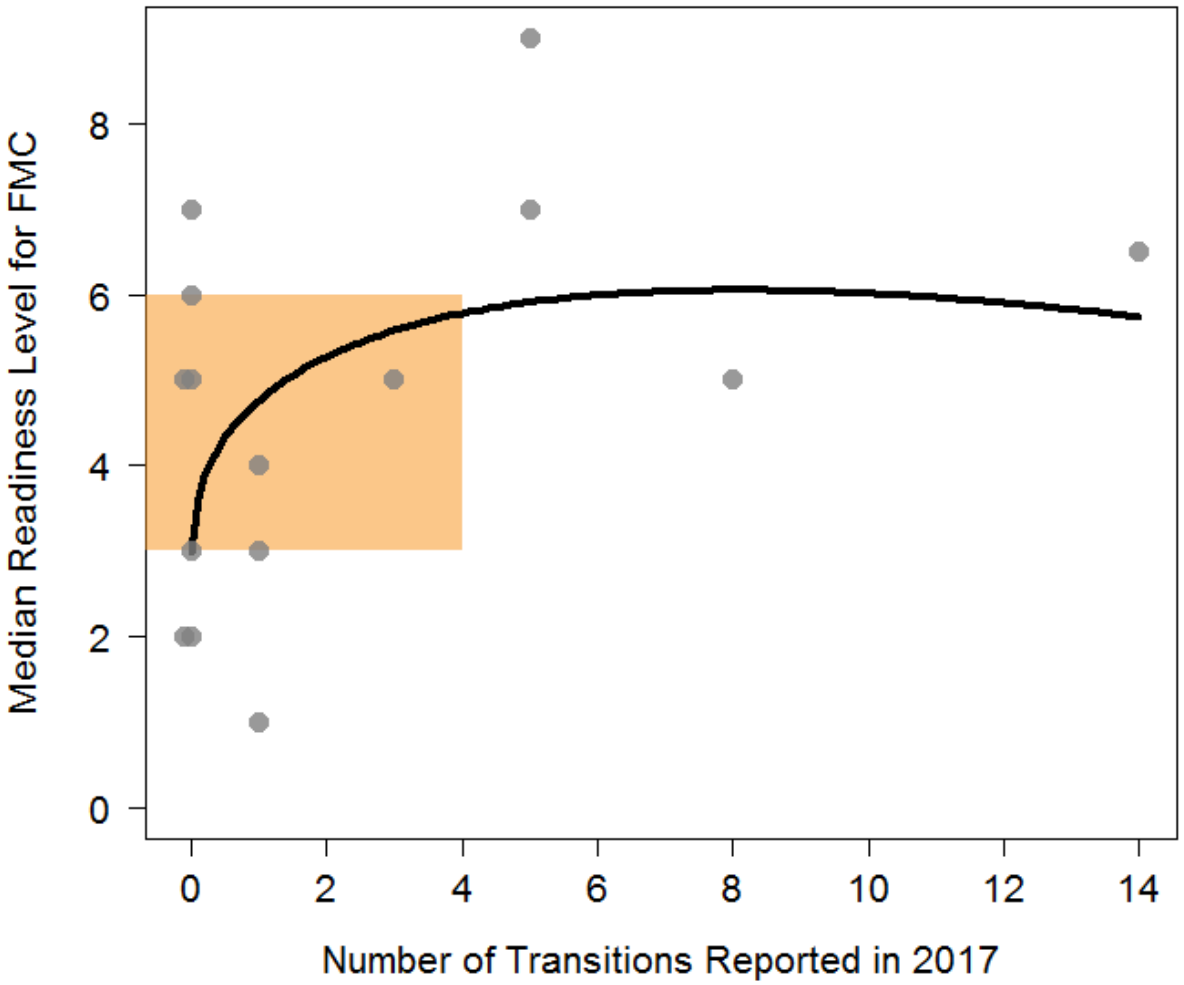

Figure 3.11. The median Readiness Level (RL) of each FMC for projects reported in 2017 as a function of the number of reported transitions.

4 Conclusions

4.1 Improved Understanding of Transitions Over Time

Since the inaugural report, accuracy in transition reporting has nearly doubled (39% to 71% of submissions correctly identified as transition) with higher proportions of both submission function and output types that are indicative of transition. This analysis suggests that the understanding of transition within OAR has greatly improved over time. However, it does not answer another important question: do more transitions occur as our understanding of transition improves?

This report created a transition rate metric (number of transitions per year) and assessed transition rates for FMCs and OAR as a whole from 2013-2017 (Fig. 11). While specific FMC transition rates can drive overall trends (e.g., Sea Grant in 2013), transition among most FMCs remained relatively consistent over time. Overall transition rates may provide insight into the impacts of policy and legislation on OAR's mission. Transition rates have the potential to not only become a pivotal management decision support tool, but also better our understanding of how internal and external factors can affect the transition process.

This report additionally utilized RL data from the NRDD to characterize the relationship between RL and number of transitions (Fig. 12). As projects move from RL 3 to RL 6, the number of reported transitions increases rapidly; however, after RL 6, RL is less indicative of the number of transitions produced. This trend could indicate that resources aimed at bringing RL 7-8 projects to RL (9) may not actually affect the number of transitions produced. However, resources directed at projects between RL 3-6 can increase the number of transitions (up to a point). Two novel programs within OAR have attempted to capitalize on this concept: the Joint Technology Transfer Initiative (JTTI) which serves to increase transitions to the National Weather Service (NWS), and the Research Transition Assistance Program (RTAP) which serves to increase transitions more broadly. These programs have both demonstrated the promise of success, however, they are in their infancy and future funding is uncertain. Applying the metrics introduced in this report to evaluate future OAR transitions will provide key insights into the need for and benefits of these programs.

4.2 Transition Is Balanced Across NOAA's Research Priorities

The strategic goals used in this report were updated to align with the seven R&D priorities identified by the NOAA 2013-2017 Five Year R&D Plan. As a result, the distribution of strategic goals in this study should not be compared to that of the past study. However, submissions displayed a breadth of diversity among the R&D priorities (Fig. 7), with transition-related submissions forming a relatively even distribution among strategic goals (Fig. 9). It is interesting to note that Stakeholder Engagement is the least represented goal, especially when considering how few projects categorized in "Transition: Extension and Outreach" were linked to engagement. This is likely an artifact of selecting only one strategic goal for each project

when most projects impact multiple strategic goals. A vibrant and balanced research portfolio highlights the functionality of the transition program within OAR and its commitment to the NOAA mission.

The majority of projects categorized within the "Transition: Technology Transfer" function were linked to the Integrated Environmental Modeling System strategic goal. While this pattern may be indicative of the focus of many of OAR's programs and labs, it may also help us understand some reporting nuances. As RLs were originally written to meet technological standards (Mankins 2009) and most definitions of transition involve technology as examples, models, software, and other technological projects often have the most well-defined transitions. Projects that involve education or social science are often less clear and transition can be an ongoing process. This report, along with its predecessor and the other OAR and NOAA transition resources, can be utilized to increase the understanding of non-technological transitions.

4.3 Misconceptions of Transition Persist

Sen (2015) outlined several misconceptions surrounding what type of activities qualify as transition. Primarily, the report noted issues with submitted transitions that *did not* qualify as a discrete output of R&D, contain an application beyond R&D, mature or evolve from an original product, or run an operational or quasi-operational service. While this report did find that OAR's understanding of transition has greatly improved between sampling times, some misconceptions still prevail.

As with the original report, many observation-related submissions were incorrectly identified as transitions. Most routine data collection and observation are generally components of the operation and maintenance of the original transition and not in themselves transitions. Transitions also require specific applications and identified recipients-- posting reports on a general-use website or publishing within an academic (or other) journal inherently does not target a specific recipient and therefore, is likely not a transition. Furthermore, transitions require the product to have actually been transitioned. Projects in development were routinely misidentified as transitions even though there was no record of the product being delivered to the transition partner. Technologies that are still being evaluated and tested within the office it originated are not yet transitions.

The use of transition definitions, transition plans, and RLs can alleviate a majority of the misconceptions identified in this report. Transition definitions (see Appendix 1) provide the basis for understanding transitions and have been reviewed and approved by OAR leadership for distribution. Transition plans not only identify a specific recipient and application of the project, but also identify any associated operational service or maintenance activities associated with the transition to avoid miscategorization. The use of designated RLs (see Appendix 1) ensures that

projects can be consistently and appropriately identified along the path from R&D to transition, reducing the number of projects within development stages that are reported as transitions.

The self-reporting and classification processes developed by Sen (2015) in the inaugural report introduces occasional categorization difficulties. Some FMCs did not submit any transitions to the inventory. While this is unlikely due to a lack of transitioned projects, it does minimize the ability to fully capture how transition understanding, execution, and reporting has evolved within OAR. Additionally, some submitted projects contained descriptions that were unclear or descriptions that were broad enough to fit into multiple categories. In these instances, general consensus was reached after review by three LCI employees (I. Kroll, L. Newcomb, C. Moses). There was some difficulty categorizing transitions that were neither inherently technological nor extension and outreach (e.g, an interpreted product that was transitioned to congress to aid in policy formation). Therefore, it may be helpful to update the "Technology Transfer: Extension and Outreach" category to "Technology Transfer: Extension, Outreach, and Assessment."

5 Recommendations

5.1 Utilize NOAA and OAR Resources to Increase Understanding and Success of Transition

Despite vast improvement in the understanding of transition within OAR and the increased availability of resources, several misclassifications persisted among submissions. NAO 216-105b, its handbook, the inaugural report, and this report provide supporting documentation and monitoring strategies for transition, transition planning, and RLs. These definitions are paramount to OAR's transition success and will only become more useful in the future. For example, the use of correct RLs help OAR leadership track transitions, identify resource needs, and improve overall transition success. Additionally, a forthcoming OAR Circular on transition will require the use of transition plans for all OAR projects RL4 and above. The Circular is intended to streamline the transition process and increase accountability to the public. However, compliance is predicated on the understanding of the transition planning progress.

This analysis also demonstrates how advancing a project from RL 3 through RL 6 can directly impact its likelihood to transition. OAR currently offers some (albeit limited) funding opportunities that target these RLs through the Modeling, Analysis, Predictions and Projections (MAPP) program, Joint Technology Transfer Initiative (JTTI) and Research Transition Acceleration Program (RTAP) programs. Optimizing these resources may increase the number of transitions occurring and strengthen the OAR research enterprise. Continued analysis of these programs and highlighted success may also help increase the resources available to them.

5.2 Use of NRDD to Track Transitions at a Project Level

The NOAA Research and Development Database (NRDD) is a web-based repository for R&D projects developed and funded by NOAA. The NRDD has the potential to streamline and

improve transition tracking, execution, and overall accountability. Project outcomes, RLs, and transition plans can all be included in NRDD submissions, making this information readily accessible to the NOAA community.

Accurate and timely reporting of project updates within NRDD would also increase the ability to assess the progress of the OAR (and NOAA) research enterprise. This report relied on self-reporting from OAR program managers and lab directors. While most FMCs provided transition information, some did not, limiting the conclusions and recommendations that could be made. As transition tracking is a valuable resource management and support tool, having access to the complete data set (as should be reported in the NRDD), would only increase the utility of reports such as these. Furthermore, if all data were reported in the NRDD, additional data calls would be less frequent and likely only request verification of or updates to existing information.

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Appendix A: Transition Definitions

Application: The use of NOAA R&D output as a system, process, product, service, or tool. Applications in NOAA include information products, assessments, and tools used in decision-making and resource management (NAO 216-105B § 2.01).

Development: In this tech memo, Development is used inclusively to span the stages of Development and Demonstration defined as:

a. Development: The systematic work, drawing on knowledge gained from research and practical experience and producing additional knowledge, that is directed to producing new products or processes, or to improving existing products or processes (OECD, 2015). (NAO 216-105B § 2.06)
b. Demonstration: Activities that are part of R&D and are intended to prove or to test whether a technology or method does, in fact, work as expected. (NAO 216-105B § 2.04)

Research: Research can be classified as basic research or applied research. (NAO 216-105B § 2.12)

a. Basic Research: Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view. Basic research can be oriented or directed towards some broad fields of general interest, with the explicit goal of a range of future applications (OECD, 2015).
b. Applied Research: Applied research is the original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective. Applied research is undertaken either to determine possible uses for the findings of basic research or to determine new methods or ways of achieving specific and predetermined objectives (OECD, 2015).

Transition: The transfer of an R&D output to a capability ready for an operation, application, commercial product or service, or other use. (NAO 216-105B § 2.14)

Readiness Levels (RLs): A systematic project metric or measurement system that supports assessments of the maturity of R&D projects for transition from research to operation, application, commercial product or service, or other use and allows the consistent comparison of maturity between different types of R&D projects. (Note: NOAA's RL's are similar to Technology Readiness Levels developed by NASA (Mankins, 1995) and embody the same concept for quantifying the maturity of research). A program may include projects at different RLs depending on the goals of each project. Inventions may be generated at any RL. NOAA’s Policy on Research and Development Transitions can be found in NAO 216-105B.

There are nine RLs as follows:

RL 1: Basic research, experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view. Basic research can be oriented or directed towards some broad fields of general interest, with the explicit goal of a range of future applications (OECD, 2015);

RL 2: Applied research, original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective. Applied research is undertaken either to determine possible uses for the findings of basic research or to determine new methods or ways of achieving specific and predetermined objectives (OECD, 2015);

RL 3: Proof-of-concept for system, process, product, service or tool; this can be considered an early phase of experimental development; feasibility studies may be included;

RL 4: Successful evaluation of system, subsystem, process, product, service or tool in laboratory or other experimental environment; this can be considered an intermediate phase of development;

RL 5: Successful evaluation of system, subsystem process, product, service or tool in relevant environment through testing and prototyping; this can be considered the final stage of development before demonstration begins;

RL 6: Demonstration of prototype system, subsystem, process, product, service or tool in relevant or test environment (potential demonstrated);

RL 7: Prototype system, process, product, service or tool demonstrated in an operational or other relevant environment (functionality demonstrated in near-real world environment; subsystem components fully integrated into system).

RL 8: Finalized system, process, product, service or tool tested, and shown to operate or function as expected within user's environment; user training and documentation completed; operator or user approval given;

RL 9: System, process, product, service or tool deployed and used routinely.

Appendix B: Definition of Classifications

Type of Activity

Research. "Systematic study directed toward fuller scientific knowledge or understanding of the subject studied" (NSF/OMB definition). Per the OAR Strategic Plan, the following are products of research activities:

> Research: Observations and Data. Collecting data on the Earth system for use in models and studies. This includes analyzing observations and developing insights based on those observations, as well as procuring and maintaining observing systems, quality control of data, and archive and access.
>
> Research: Models and Experiments. Models codify our understanding of a system in terms of the relationships among its elements, both qualitatively and quantitatively. Scientific experiments test hypotheses about these relationships as the basis for creating, refining, and rethinking models. This combines lab and field work with coding experimental algorithms and running simulations.
>
> Research: Studies and Assessments. Synthesizing scientific knowledge of Earth systems into tools for decision making and future research, often using observational data, model output, experimental results, and other research as source material.

Development. "Systematic use of the knowledge or understanding gained from research, directed toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes. It excludes quality control, routine product testing, and production" (NSF/OMB definition). Per the OAR Strategic Plan, the following are products of development activities:

> Development: Predictions and Projections. Applying advanced models of Earth systems to make predictions about the future (using present-day conditions) or projections (using plausible economic development scenarios). They are pre-operational products intended for use in regular services. They require models, data, advanced computing architectures and techniques, and the publication and interpretation of information.
>
> Development: Emerging Technologies. Creating new or significantly improved technology for observation and modeling systems, as well as tools for information delivery and stakeholder engagement. Typically, this involves the development or application of new hardware or software, or the integration of technologies into systems.

Transition. "Transition is the transfer of knowledge or technology from a research or development setting to an operational setting. Transition occurs in two phases: 1) Demonstration (e.g., the use of test-beds to confirm operational usability or demonstration using rapid prototyping), which is part of R&D; and 2) Deployment (e.g., the integration of new people, equipment, or techniques into an operational environment), which is part of operations" (NAO 216-105B). Per the OAR Strategic Plan, the following are products of transition activities:

> Transition: Extension and Outreach. Working directly with stakeholders on the ground to understand their needs, conduct research that meets those needs, and translate results so that they are meaningful and actionable. Ensuring that the results of R&D are accessible to and understood by stakeholders that might use them.
>
> Transition: Technology Transfer. Working with end-users to integrate mature technologies (and associated expertise) into larger systems, either in NOAA operations or partner applications, via testbeds, patents, etc.

Type of Output

The "things transitioned" were understood as outputs and fell into the broad categories of either science or technology. Within these categories, definitions of specific output types are below. The first three (original data, synthesized product, and interpreted product) are taken from NOAA Information Quality Act Guidelines, maintained by the NOAA CIO. The other definitions were constructed per web searches of relevant terms, which was deemed to be accurate enough for these general concepts.

Science Outputs. These are defined as data, information, or knowledge (either codified or tacit) -- they allow us to understand things we would not have otherwise understood.

> Science: Original Data. Original Data are data in their most basic useful form. These are data from individual times and locations that have not been summarized or processed to higher levels of analysis. While these data are often derived from other direct measurements (e.g., spectral signatures from a chemical analyzer, electronic signals from current meters), they represent properties of the environment. These data can be disseminated in both real time and retrospectively. Examples of original data include buoy data, survey data (e.g., living marine resource and hydrographic surveys), biological and chemical properties, weather observations, and satellite data.
>
> Science: Synthesized Product. Synthesized Products are those that have been developed through analysis of original data. This includes analysis through statistical methods;

model interpolations, extrapolations, and simulations; and combinations of multiple sets of original data. While some scientific evaluation and judgment is needed, the methods of analysis are well documented and relatively routine. Examples of synthesized products include summaries of fisheries landings statistics, weather statistics, model outputs, data display through Geographical Information System techniques, and satellite-derived maps.
Science: Interpreted Product. Interpreted Products are those that have been developed through interpretation of original data and synthesized products. In many cases, this information incorporates additional contextual and/or normative data, standards, or information that puts original data and synthesized products into larger spatial, temporal, or issue contexts. This information is subject to scientific interpretation, evaluation, and judgment. Examples of interpreted products include journal articles, scientific papers, technical reports, and production of and contributions to integrated assessments.

Science: Tacit Expertise. Tacit knowledge (as opposed to formal, codified or explicit knowledge) is the kind of knowledge that is difficult to transfer to another person by means of writing it down or verbalizing it. For example, stating to someone that London is in the United Kingdom is a piece of explicit knowledge that can be written down, transmitted, and understood by a recipient. However, the ability to speak a language, use algebra, or design and use complex equipment requires all sorts of knowledge that is not always known explicitly, even by expert practitioners, and which is difficult or impossible to explicitly transfer to other users.

Technology Outputs. These are defined as automated processes or artifacts (hardware or software) -- they allow us to do things we would not have otherwise done.

Technology: Model, Algorithm. A mathematical model is a description of a system using mathematical concepts and language. A model may help to explain a system and to study the effects of different components, and to make predictions about behavior. Mathematical models include dynamical systems, statistical models, differential equations, or game theoretic models. An algorithm is a step-by-step procedure for calculations. Algorithms are used for calculation, data processing, and automated reasoning.

Technology: Hardware, Equipment. The artifacts of technology. Material objects designed, engineered, and built to serve a purpose. Any physical item -- i.e., a tool or device -- that can be used to achieve a goal, especially if the item is not consumed in the process. In NOAA's case, this includes computers, sensors, observation platforms. It does not include software, data, or information. A piece of hardware or equipment is a discrete item, and may be incorporated as a component within a larger system or service.

Technology: System, Service. A system is a set of interacting or interdependent components forming an integrated whole or a set of elements (often called 'components') and relationships which are different from relationships of the set or its elements to other elements or sets. A Service is a set of actions or solutions that are put in place or are performed to provide a repeatable and consistent set of outcomes, deliverables, and performance for people, organizations, and systems that represent consumers or beneficiaries of such results.

Technology: Standards, Protocols. A technical standard is an established norm or requirement in regard to technical systems. It is usually a formal document that establishes uniform engineering or technical criteria, methods, processes and practices. A technical standard can also be a controlled artifact or similar formal means used for calibration. In the natural sciences a protocol is a predefined written procedural method in the design and implementation of experiments. Protocols are written whenever it is desirable to standardize a laboratory method to ensure successful replication of results by others in the same laboratory or by other laboratories.

Number of Recipients

Recipient number for the thing transitioned were captured in rough orders of magnitude: a single recipient, several recipients, or a very large (essentially infinite) number of recipients. This categorization was necessary to understand how widely or narrowly applicable the output is relative to applications.

Single. One party named in submission.

Several. A discrete number of parties named in submission.

Infinite. Recipient is understood as "the public" or "the scientific community".

Unknown/Cannot Determine. Data provided in submission did not provide a clear number of recipients.

Type of Recipient

Recipient type was bundled within three sectors: public, private and academic. The former two sectors were subdivided into more particular categories (e.g. within the public sector, OAR vs NOAA beyond OAR vs other federal agencies). While recipient type and the application type (see below) are related, in the course of the analysis, it became necessary to distinguish between them.

Public - Federal - OAR. Any organization within Oceanic and Atmospheric Research (i.e. Laboratories or Program Offices).

Public - Federal - NOAA (not OAR). Any Line (or Staff) Office at the National Oceanic and Atmospheric Administration besides Oceanic and Atmospheric Research.

Public - Federal (not NOAA). Any Federal agency or body besides the National Oceanic and Atmospheric Administration.
Public - State/Local/Tribal. An organization of a state, regional, municipal, or tribal government (e.g., a local port authority).

Public - International. An organization of a foreign government or multinational organization (e.g. the United Nations).

Private - For Profit. Organizations that operate for profit, including corporations that are either privately held or publicly traded. This also includes start-ups as defined as small, recently founded organizations that operate for profit. Start-ups did comprise their own category in the previous analysis but that distinction was not warranted in this analysis.

Private - Not For Profit. Non-governmental organizations that aim for public welfare outcomes, not profits.

Academic. Colleges, universities, and other institutions focused on research and education.

Multiple Users. A new category was included to incorporate submissions that were targeted for use by multiple users of different recipient types (e.g., a model that is transitioned to Academic, Federal, and state agencies).

Type of Application

Applications were the immediate application of the output, rather than downstream or ultimate application. “Research” was used to label those instances where the immediate use of the output was follow-on research, but is not understood to be an application, per se, as it does not create social or economic value beyond improved scientific understanding.

Application: Environmental Intelligence. Information measured, gathered,

compiled, exploited, analyzed and disseminated to characterize the current state and/or predict the future state of the environment at a given location and time.

Application: Resource Management. Environmental resource management is the management of the interaction and impact of human societies on the environment. It aims to ensure that ecosystem services are protected and maintained for future human generations, and also maintain ecosystem integrity through considering ethical, economic, and scientific (ecological) variables.

Application: Policy, Legislation, Law. This includes the crafting and influencing of policy at the local, state, tribal, federal, or international levels. Policy can be the proceedings and directives of legislatures or executives or judiciaries. Applications may be the creation, implementation or the debate over public law.

Application: Education, Learning. This is the imparting of knowledge and understanding. Education and learning applications include, but are not limited to K-12 education. They can also include higher education or "lifelong learning" of adults. This may be lecturing, activity based learning, or the production of educational materials.

Application: Emergency Management. Disaster management (or emergency management) is the managerial function charged with creating the framework within which communities reduce vulnerability to hazards and cope with disasters. Disaster management does not avert or eliminate the threats, instead it focuses on creating plans to decrease the impact of disasters.

Application: Commerce. Commerce is the whole system of an economy that constitutes an environment for business. It can also be defined as a component of business which includes all activities, functions and institutions involved in transferring goods from producers to consumers.

Research. "Systematic study directed toward fuller scientific knowledge or understanding of the subject studied" (NSF/OMB definition). Note that, research is included as an "application" for ease of binning only; follow-on research may be the use of a NOAA research output, but it is not an application in the sense of a mature capability that provides social/economic value beyond that of improved understanding.

Strategic Goal

OAR focuses on NOAA's outcome-oriented goals (per the Next Generation Strategic Plan) for climate, weather, oceans and coasts, which are themselves derived from the NOAA vision.

Those goals, which have been updated in this version to reflect the most recent NOAA 5-Year Research and Development Plan and the OAR Strategic Plan, are as listed below.

Climate Adaptation and Mitigation: An informed society anticipating and responding to climate and its impacts.

- What is the state of the climate system and how is it evolving?
- What causes climate variability and change on a global to regional scales?
- What improvements in global and regional climate predictions and projections are possible?
- How can NOAA best inform and support the Nation's efforts to adapt to the impacts of climate variability and change?

Weather-Ready Nation: Society is prepared for and responds to weather-related Events.

- How can we improve forecasts, warnings, and decision support for high-impact weather events?
- How does climate affect seasonal weather and extreme weather events?
- How can we improve space weather warnings?
- How can we improve forecasts for freshwater resource management?

Healthy Oceans: Marine fisheries, habitats, and biodiversity are sustained within healthy and productive ecosystems.

- How do environmental changes affect marine ecosystems?
- How is the chemistry of our ocean changing and what are the effects?
- What exists in the unexplored areas of our oceans?
- How can emerging technologies improve ecosystem-based management?
- How can we ensure aquaculture is sustainable?

Resilient Coastal Communities and Economies: Coastal and Great Lakes communities are environmentally and economically sustainable.

- What is the value of coastal ecosystems?
- How do coastal species and ecosystems respond to habitat loss, degradation and change?
- How do we ensure that growing maritime commerce stays safe and sustainable?
- How do we reduce the economic and ecological impacts of degraded water quality?
- How is the Arctic affected by expanding industry and commerce?

Stakeholder Engagement

- How can we support informed public response to changing environmental conditions?
- How can we improve the way scientific information and its uncertainty are communicated?

Accurate and Reliable Data from Sustained and Integrated Earth Observing Systems

- What is the best observing system to meet NOAA's mission?
- How can we best use current and emerging environmental data?
- How can we improve the way we manage data?

An Integrated Environmental Modeling System

- How can modeling be best integrated and improved with respect to skill, efficiency, and adaptability?
- What information technology developments can help NOAA improve quantitative predictions?

Appendix C: Project Descriptions

Reported Transition Projects from August 2014-July 2017

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
OER	Exploration of deep ocean via untethered free vehicles	An untethered oceanographic instrument platform for use in ocean depths 1000m+	OER Grantee: University of Puerto Rico	Oceanographic community	2017
OER	Installation of new high speed VSAT to demonstrate innovations in telepresence/data transmission	Funding for a new state of the art high speed Very Small Aperture Terminal (VSAT) to the Global Foundation for Ocean Exploration to install aboard NOAA Ship Okeanos Explorer	OAR OER	Global Foundation of Ocean Exploration	2016
OER	Ambient Sound at Full Ocean Depth	The instrument is a unique deep-ocean mooring that is comprised of specially designed Virtovex glass spheres, dual acoustic releases, double-yoke stainless-steel frame sensor package housing, and topped with a satellite beacon mast. The buoyancy of the package is designed to achieve optimum descent/ascent rates of 0.5-1.0 m s-1. The pressure sensor and ocean hydrophone are uniquely designed to withstand the extreme hydrostatic pressures at these ocean depths. OER is developing this technology with industry, federal and academic partners.	OER Grantee: PMEL	Applications to NMFS, NOS and OAR/OER observing requirements	2015
OER	Real Time Video Annotation system	Novel method of collecting real time annotations during ROV dives	NOAA OER	Ocean Network Canada	2017

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
AOML	HFIP (Hurricane Forecast Improvement Project) Observations	HWRF V11.0: HWRF upgrade includes implementation of cycling hybrid EnKF-3DVAR Data Assimilation System with real-time NOAA-P3 TDR, dropsonde, and flight-level inner core data assimilation	AOML	NWS/NCEP/ EMC and DTC	2017
AOML	HFIP (Hurricane Forecast Improvement Project) Observations	2017 Basin-HWRF with high resolution (18-6-2 km) 2-way interactive moving nests and 61 vertical levels for Cat 4 storms, ocean coupling to MPIPOM in ATL and EPAC, plus operational initialization	AOML	NWS/NCEP/ EMC and DTC	2017
AOML	Gulf of Mexico ocean indices in support of bluefin tuna assessment and management	An ocean indicator developed to monitor and track areas in the Gulf of Mexico with favorable conditions during the spring for the occurrence of bluefin tuna larvae (Thunnus thynnus), the BFT_Index	AOML		
CPO	NMME (North America Multi-Model Ensemble)	First year of data from the NMME operational and research platform		NWS/NCEP	2017
OWAQ	Upgrades to the Operational Monte Carlo Wind Speed Probability Program	Replacing the linear forecast interpolation scheme with a more precise spline fit scheme, and applying a bias correction to the radii-CLIPER (Climatology and Persistence) model used by the MC model to improve the accuracy of the wind speed probabilities for exceptionally small or large tropical cyclones	CIRA/CSU, NESDIS	NHC	2017
OWAQ	Improving the GFDL/GFDN Operational Tropical Cyclone Models at	Upgrade the GFDL and GFDN ocean model resolution, physics, domain configuration, and	U. of Rhode Island, OAR/GFDL	EMC	2017

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
	NOAA/NCEP and Navy/FNMOC	initialization using URI's newly developed MPIPOM-TC ocean model			
OWAQ	Kalman-filter/Analog Predictions of Surface PM2.5: Research to Operations	A post-processing technique to further address the issue of bias correcting intermittent forest fires called the Continuous Iterative Persistence (CIP) which can be applied to either the new Analog (AN) or Kalman-Filter Analog (KFAN) bias correction schemes	U. Colorado/ CIRES,OAR/ESRL/ PSD	EMC	2017
OWAQ	Post-Processing of CMAQ Air Quality Predictions: Research to Operations	The CIP technique tests indicate that it improves the overall variability of the post-processed forecasts, improves forecast skill for high-amplitude events such as forecast fires and dust storms while also reducing RMSE and increasing Correlation	U. Colorado /CIRES,OAR/ESRL/ PSD	EMC	2017
ARL	New READY web site: HRRR and SREF	The High Resolution Rapid Refresh (HRRR) model was added to all HYSPLIT and meteorological display programs. The HRRR contains sigma level forecast data every hour from forecast hours 0 to 15 on a 3 km 1799 x 1059 grid covering the United States and Southern Canada	ARL	HYSPLIT user community	2016
AOML	Global Vibrio Risk fields	Series of algorithms describing the risk of vibrio-related waterborne infections that comprise daily, short-term forecast and cumulative fields and are distributed using Web Services within a Service-oriented Architecture (SOA) framework			
AOML	Gulf of Mexico Near-Real-Time	System performs analysis of the ocean state based on daily assimilation of remotely sensed			

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
	Analysis/Forecast System	observations (altimetry and SST), with 7 day forecast			
AOML	Development and validation of the HYCOM-HWRF coupled TC prediction system (RTAP)	Project will implement three-way atmosphere-wave-ocean coupling and upgrade physics parameterizations that govern the coupled TC system	AOML		
AOML	Juvenile Spotted Seatrout Performance Measure for Everglades Restoration	An ecological model to be used in the assessment and evaluation of Everglades Restoration and the individual projects being undertaken to complete Everglades Restoration	AOML	US Army Corps of Engineers, South Florida Water Management District	2017
AOML	Development of new advanced nature run for hurricane OSSEs	Improved hurricane OSSE system. RL9. Transitioned to QOSAP to be used by multiple line offices and agencies	AOML	transitioned to QOSAP to be used by multiple line offices and agencies	2017
ARL	Update CMAQ 5.0.2	Aerosol science upgraded from the Community Multiscale Air Quality Model (CMAQ) to CMAQ5.0.2 for CONUS ; Compiled to NAM's last upgrade	ARL	NWS/NCEP/ EMC and NCO	2017
CPO	CPO RPD Climate Process Teams	Results from 3 Climate Process Teams enhancing NOAA model transitioned to climate model improvements	GFDL	NOAA laboratories and operational centers; broad	2016

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
				climate research community;	
CPO	Week 3-4 Outlook	Transition of Week-3-4 prediction tool to NWS operations based on MAPP-CTB project outcomes		NWS/CPC; Weather and Climate Operational Supercomputing System	2017
AOML	Development of NOAA Seasonal Severe Weather (SSW) outlook for the US	A Seasonal Severe Weather (SSW) outlook was developed to expand and complement the current SSW outlooks at NOAA beyond seven days	AOML		
NSSL	Radar Product Improvement - Coherency Based Thresholding	Technique was developed to mitigate radar sensitivity loss after the dual-polarization upgrade	CIMMS/NSSL	NWS/ROC	2014
NSSL	Radar Product Improvement - Radial-by-Radial Noise Estimator	Technique was developed to improve the measurement of noise power, which contaminates the desired weather signals	CIMMS/NSSL	NWS/ROC	2014
NSSL	Radar Product Improvement - Hail Size Discrimination Algorithm (HSDA)	Technique was developed to provide forecasters guidance in identifying regions within a storm that may be more likely to harbor large (between 1"-2" in diameter) and/or giant (>2" in diameter) sized hail based upon polarimetric radar data	CIMMS/NSSL	NWS/ROC	2016
OWAQ	Improvements in Statistical Tropical	Extended range climatology and persistence (CLIPER) model for track and intensity	CIRA/CSU, NESDIS	NHC	2015

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
	Cyclone Forecast Models				
OWAQ	Improving the operational TC models at NOAA/NCEP and Navy/FNMOC	Implemented a unified GFDL/GFDN version control framework and implemented wave coupling into GFDL/GFDN for future operations, and coupled GFDL-WAVEWATCHIII-MPIPOMTC framework	U. of Rhode Island, OAR/GFDL	EMC	2015
ESRL GSD	WRF-Chem v3.9 model	Weather Research and Forecast (WRF)-Chemistry model integrates atmospheric chemistry and dynamics together	OAR/ESRL/GSD	Public release for other met agencies to use	2017
SG	Assisting Coastal Communities Plan and Manage Their Working Waterfronts and Waterways: The Boating and Waterway Planning Program	Provision of science-based methods for comprehensive waterway use planning, management, and policymaking by facilitating interagency collaboration; sponsoring community forums; implementing regional and statewide conferences and workshops; and assisting government agencies in evaluating environmental and social impacts.	Florida Sea Grant	Florida Department of Environmental Protection and Wildlife Conservation Commission	2015
ESRL GMD	Standards - WMO Global Scales	NOAA ESRL GMD is the World Meteorological Organization (WMO), Global Atmosphere Watch (GAW) Central Calibration Laboratory (CCL) for: CO2, CH4, N2O, SF6, and CO	OAR/ESRL/Global Monitoring Division	e.g., Max Planck Institute for Biogeochemistry	2017
ESRL GMD	Standards - NOAA Scales	NOAA ESRL GMD maintains calibration scales for 21 minor gases (outside of the CCL)	OAR/ESRL/Global Monitoring Division	Atmospheric scientists and chemical oceanographers around the world	

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
ESRL GMD	Standards - Dobson Regional Standards	Calibration of JMA and BoM Dobson Regional Standards in Boulder	OAR/ESRL/Global Monitoring Division	WMO partners and other partners and scientists investigating total ozone.	
ESRL GMD	Standards - Central UV Calibration Facility	Highly accurate and long-term repeatable calibrations and characterizations of UV monitoring instruments.	OAR/ESRL/Global Monitoring Division	USDA/Colorado State University/UV-B Monitoring and Research Program (UVMRP)	
AOML	Adaptable Bottom Instrument Information Shuttle System (ABIISS)	A system that will significantly reduce ship time needs, and hence NOAA costs, by transmitting data from ocean bottom moored instruments back to land via satellite	AOML		
ESRL GMD	GMD Contributions to State of the Climate Report	Global atmospheric composition products supported by GMD are analyzed, assessed, and contributed to the annual State of the Climate Report	GMD	General public, policy-makers, as well as research, modeling, and assessment communities	2017
ARL	Update READY website: NARR	The North American Regional Reanalysis (NARR) 32 km horizontal resolution grid was added to READY. This data set has data available on 22 pressure levels every 3 hours over North America from 1979 to 2014	ARL	HYSPLIT user community	2015

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
OER	Okeanos Explorer Biological and Geological Sample Repositories	Biological and geological samples collected on Okeanos Explorer expeditions are now transferred to public repositories for public access	OAR OER	Smithsonian Institution's National Museum of Natural History, Oregon State University's Marine and Geology Repository, Ocean Genome Legacy Center	2016
ESRL GMD	Annual Greenhouse Gas Index	The NOAA Annual Greenhouse Gas Index (AGGI) measures the commitment society has already made to living in a changing climate	ESRL GMD	EPA, USGCRP, WMO Global Atmosphere Watch	2017
ESRL GMD	Global Carbon Dioxide Record	Long-term trend of CO2 from all remote marine boundary layer sites in NOAA's global monitoring network	ESRL GMD	EPA, USGCRP, WMO Global Atmosphere Watch	2017
AOML	An interoperable viewer in support of AOML HRD field activities	A tool to provide a single point of access to a great variety of products from remote sensing, models and insitu observations	AOML		
AOML	Transmission of underwater glider temperature and salinity profile data in real-time for tropical cyclone	Data from observations, approximately 7,000 profiles of temperature and salinity per year, have been inserted in real-time into the GTS with the objective of providing upper ocean temperature and salinity data in regions highly undersampled	AOML	NOS, GTS	2017

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
	intensification studies and forecasts				
CPO	CFS Reanalysis and Reforecast Project	The completion of the public archive of the reforecasts and reanalysis from the Climate Forecast System (CFSv2), the current NOAA NCEP operational system for weekly, monthly and seasonal forecasts		NESDIS/NCEI	2016
ESRL GSD	GPS-Meteorology (GPS-Met)	Global Positioning System (GPS) Met is a ground-based water vapor observing system which uses GPS radio signal delay measurements to derive Integrated Precipitable Water (IPW)	OAR/ESRL/GSD	NWS/Office of observations/Program Management Branch	2016
UAS	Hurricane glider operations in Atlantic Ocean	Real-time profile data	NOAA/AOML	NWS, EMC, GTS	2014
CPO	CPO MAPP NMME	Release of the NMME dataset, peer-reviewed publications, and a report to inform the related NWS/NCEP FY15 AOP milestone	GFDL	NOAA laboratories and operational centers; broad climate prediction research community	2016
OER	Nautical chart improvements in poorly mapped areas from Okeanos Explorer expeditions	New system to transfer high resolution multibeam sonar bathymetric survey data collected by OER during NOAA Okeanos Explorer expeditions to the Office of Coast Survey	NOAA OER	Office of Coast Survey, Hydrographic Survey Division	2015

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
ESRL GMD	AirCore	Atmospheric sampling system that samples the atmosphere and preserves a profile of the trace gas of interest	OAR/ESRL/Global Monitoring Division	Southwest Research Institute, and several research organizations worldwide	
AOML	US Argo Data Assembly Center implemented processing system for deep Argo floats	Real-time Ocean Observation Data necessary to accommodate the deep APEX floats	AOML	Global Argo Data Assembly Center at NAVOCEANO and IFREMER; and GTS	2015
AOML	Ecological Forecasts for Coral Reefs	Initial development of R2A Transition Plan for NOS and/or NMFS: Ecological Forecasting for Coral Reefs	AOML	NCCOS	
ESRL GMD	CarbonTracker - Near Real time	CarbonTracker is a CO2 measurement and modeling system developed by NOAA to keep track of sources (emissions to the atmosphere) and sinks (removal from the atmosphere) of carbon dioxide around the world	OAR/ESRL/Global Monitoring Division	Act-America	2017
ESRL GSD	F2C-ACC Compiler (GSD's GPU compiler)	Evaluations of Cray and PGI commercial Fortran OpenACC compilers for Massively Parallel Fine Grain (MPFG) processors	OAR/ESRL/GSD	NVIDIA, PGI, Cray	2014
AOML	Geo-HSS OSSE required by Congress under HR353	Report summarizing the impact of a proposed constellation of Geo-HSS satellites in weather forecasting	AOML	Will be transitioned to Congress	2017

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
AOML	Observation System Simulation Experiments (OSSE) on TROPICS	Report describing the expected impact of different numbers of mirco-satellites in the TROPICS mission to improve weather forecast	AOML	NASA's TROPICS Project	2017
AOML	OSSE on Cyclone Global Navigation Satellite System (CYGNSS)	Report describing the expected impact of the CYGNSS mission in tropical cyclone analysis and forecasts	AOML	NASA's CYGNSS Science Team	2017
CPO	CPO MAPP Coupled Model Intercomparison Project (CMIP) Comparisons	Finalize an OAR technical report on CMIP3 vs CMIP5 comparisons for North America	GFDL	National Climate Assessment	2016
AOML	Global Navigation Satellite System (GNSS) RO OSSE required by Congress under HR353	Report summarizing the results of the impact of a GNSS RO constellation in NOAA's weather forecast models	AOML	US Congress	2017
AOML	Additional GNSS RO OSSE for NWS	Report with the impact in global weather forecast skill expected from the COSMIC-2 mission	AOML	NWS	2017
CPO	CPO MAPP Earth System Modeling Coordination	Complete a study to assess status of state-of-the-art climate/ Earth system modeling at NOAA	GFDL, ESRL	NOAA	2016
CPO	Standardized Precipitation Index	Develop Standardized Precipitation Index (SPI) based on global monitoring tool		NWS/NCEP/CPC	2017

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
CPO	State of the Climate Report	Characterize the changing state of the ocean in the annual State of the Climate report		Public	2017
CPO	Annual Arctic Report Card	The Arctic Report Card considers a range of environmental observations throughout the Arctic, and is updated annually		Public	2017
AOML	SOCAT, Surface Ocean Carbon Atlas	Automated Surface water CO2 analyses obtained on ships and buoys from NOAA and international investigators are uniformly quality controlled and collated to provide annual authoritative surface water CO2maps	AOML, PMEL	SOCAT	
CPO	CPO MAPP National Integrated Drought Information System (NIDIS)	Produce an assessment report on the understanding and predictability of the 2011-2014 California Drought in support of NIDIS	ESRL	General public, water managers, researchers and operational personnel	2015
CPO	U.S. Climate Resilience Toolkit (CRT)	U.S. Climate Resilience Toolkit Launch	OCM, NWS, NESDIS	Decision-makers in communities, businesses, and federal, state, local and tribal governments	2015
CPO	CPO COD State of the Climate Report	Global ocean data and products supported by CPO and OAR are analyzed, assessed, and contributed to the annual State of the Climate Report	PMEL, AOML, ESRL, GFDL	General public, policy-makers, as well as research, modeling, and assessment communities	2016

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
CPO	CPO Earth System Science (ESS) Atlantic Meridonal Overturning Circulation (AOMC)	AMOC Science Report to increase understanding of the current state of AMOC science, identify scientific gaps, and develop plans to fill those gaps	AOML	Policymakers (international, federal, state, local and tribal), general public, research community	2016
CPO	Regional Integrated Sciences and Assessments (RISA)	Publish RISA book that showcases lessons learned from the history of the RISA program		Public/users	2017
CPO	CPO COD Arctic Report Card	Arctic ocean, atmospheric, and ecosystem data and products supported by CPO and OAR are analyzed, assessed, and contributed to the annual State of the Climate Report	PMEL, GLERL and others	General public, policy-makers, as well as research, modeling, and assessment communities	2015
CPO	CPO CASD Vulnerability	Drawing from existing data and peer-reviewed research, the Colorado Climate Change Vulnerability Study summarizes the key challenges facing seven sectors: ecosystems, water, agriculture, energy, transportation, outdoor recreation and tourism, and public health		State of Colorado resource managers and policy makers	2016
SG	Monitoring Bluff Stability	This project developed new bluff monitoring instruments, and in addition, recorded a sudden bluff failure	Wisconsin Sea Grant, and collaboration with engineers in UW-Madison's Geoscience department	Wisconsin Coastal Atlas, Property owners	

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
SG	Effects of Aquaculture Practices on Vibrio spp. in the Eastern Oyster, *Crassostrea virginica*: Test of Fouling Control Practices.	A Wisconsin Sea Grant-funded project developed and tested new instrumentation that has the potential to predict within minutes the timing of bluff failure along the Great Lakes shoreline, informing future monitoring and protecting people and property	MS-AL Sea Grant	Co-PIs and NOAA; Public	2014
AOML	Mandatory Ship Reporting System - MSR	The information collected by the MSR database yields data on ship traffic volume, routes, ports of call, and whale sighting locations, and will assist in tailoring any necessary future ship strike mitigation measures	AOML	U.S. Coast Guard and NMFS	2017
ESRL GSD	Science On a Sphere Installations	Considered R2U for public education and outreach, Science On a Sphere (SOS) is a room-sized global display system that uses computers and video projectors to display planetary data on a six-foot diameter sphere to help illustrate earth system science to people of all ages	OAR/ESRL/GSD	SOS customers; SOS Users Collaborative Network	2016
AOML	Capacity Building for Molecular Source Tracking (MST) Analysis in CNMI Bureau of Environmental Coa stal Quality	Molecular diagnostic capability provided to US North Marina Islands (CNMI) government to protect coral and human health from microbial contamination.	AOML	Commonwealth of Northern Mariana Islands, Saipan	2017
CPO	Climate.gov	Publish narratives and data visualizations that show how NOAA advances climate science		Public/users	2017

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
		understanding, and how those advances benefit society			
CPO	Climate.gov	Build and launch a mobile-friendly version of Climate.gov		Public/users	2017
CPO	Climate.gov	Develop and deploy Climate Explorer v2.0 and Climate Widget v1.0 for browsing climate data in both geospatial and historical contexts		Public/users	2017
CPO	Climate.gov	Launch a new public engagement effort to teach citizens, educators, and decision makers how to use Climate.gov's geospatial tools in their work		Public/users	2017
CPO	Climate Literacy	Develop an Educator Learning Progression for Climate and Energy Literacy for K-12 teachers based on the NRC Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas		K-12 teachers	2017
CPO	Climate Literacy	Deploy the Educator Learning Progression for Climate and Energy Literacy on Climate.gov to integrate the National Climate Assessment, related federal climate resources and the CLEAN collection		Educators and public	2017
CPO	Climate Resilience Toolkit (CRT)	Expand the CRT's catalog of training courses to cover all of the section's topics, and stitched together into purposeful learning progressions for building skill and capacity among non-scientists		Public/users	2017
SG	Preparing for Climate Change in Oregon Estuaries: Flooding, Ecological	An innovative modeling approach supported by Oregon Sea Grant (OSG) to better predicts coastal estuary flooding to inform state and local	Oregon Sea Grant	Oregon State University	2016

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
	Impacts, and an Integrated Approach Toward Adaptive Management	development planning in response to a changing climate			
OER	Chemical and Isotopic Exploration of Deep-sea Environments	A new deep-sea laser-based stable isotope analyzer brings a science laboratory to the ocean floor, transforming ocean exploration. Few in-situ oceanographic chemical sensors exist for deep-sea science and exploration.	OER Grantee: Woods Hole Oceanographic Institute	Oceanographic and ocean exploration communities	2014
AOML	R2C: CRADA 3RR3HWSP14, Research to Aid Management of Coastal Water and Watershed Quality	Molecular Source Tracking (MST) assays are genomic-based tools to identify sources of fecal contamination in coastal environments and drinking water	AOML	Weston Solutions Inc.	2017
AOML	Transition of Global Drifter Array to Iridium	Transition of data to Iridium format	AOML	Iridium	
ESRL CSD	Commercial licensing of Printed Optical Particle Spectrometer (POPS)	Small, lightweight aerosol instrument was developed at CSD and a patent issued	NOAA/OAR/ESRL/ Chemical Sciences Division	Handix Scientific, LLC	2015
ESRL CSD	Commercial licensing of Open Path Cavity Ring-Down Spectrometer	Instrument to measure aerosol extinction by open path technology was developed at CSD and a patent issued	NOAA/OAR/ESRL/ Chemical Sciences Division	Handix Scientific, LLC	2016

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
	for measurement of aerosol extinction				
NSSL	Clutter Environment Analysis using Adaptive Processing (CLEAN-AP)	Weather radar signal processing technique (algorithm description)	CIMMS/NSSL	Baron Services, Inc.	2017
OER	In Situ ORP and LSS sensors for deep ocean characterization	A Light scattering sensor and Oxygen-Reduction Potential sensors provided to Global Foundation for Ocean Exploration	OAR Pacific Marine Environmental Laboratory	Global Foundation of Ocean Exploration	2016
OER	Okeanos Explorer Biological and Geological Sampling	Developed capability to take physical biological and geological samples with Deep Discoverer ROV	OAR OER	Global Foundation of Ocean Exploration	2015
AOML	Development of Iridium satellite transmission for XBT observations	Transition of eXyendable BathyThermomgraph (XBT) transmission data from Inmarsat-C to Iridium satellites	AOML	NWS, GTS	2017
ESRL GMD	Balloon Prediction Software	Software developed in GMD to users at ozonesonde stations around the world.	OAR GMD	Ozonesonde station: North Slope of AK, Oliktok Point	2015
GLERL	Hypoxia Warning System Buoy	Buoy system that monitors oxygen conditions for hypoxia	GLERL/OSAT	Great Lakes Observing System	2015
AOML	Variational Analysis Method to Preprocess	Complete Variational Analysis System for ocean surface winds that converts scalar CYGNSS winds	AOML	U.S. Navy/ NRL	2017

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
	CYGNSS wind observations for data assimilation into numerical models	to vector winds and produces ocean surface wind analyses.			
ARL	Nuclear Regulatory Commission Support	Provided NRC with the HYSPLIT model code and consulting support for their effort to replace their simple dispersion model with HYSPLIT for severe nuclear accidents	ARL	Nuclear Regulatory Commission	2014
ESRL GSD	FxCAVE	FxCAVE is an experimental AWIPS II thin client workstation and data service using the Internet.	OAR/ESRL/GSD	National Interagency Fire Center	2016
OER	Coral In Situ Metabolism and Energetics (CISME) Instrument	A new instrument to non- destructively measure coral metabolism and bioenergetics in situ, as a tool for rapid assessment and monitoring of metabolic health of massive reef corals and other benthic substrate types	OER supported Cooperative Institute CIOERT	NOS and National Sanctuaries; coral research community	2016
AOML	HFIP (Hurricane Forecast Improvement Project) Observations	Hurricane NMM-B (HMON) uses double nested configuration very similar to HWRF with 2-way interactive moving nest domains at resolutions of 18, 6 and 2 km with 41 vertical levels	AOML	NWS/NCEP/ EMC	2017
ARL	North American Mesosclae Forecast System (NAM) AQ update	Assisted EMC to adapt NAQFC to new operational NAM; Emissions: CONUS, AK and HI with EPA NEI 2005 as basis for area and mobile sources	ARL	NWS/NCEP/ EMC and NCO	2014
ARL	Update hysplit v7.2	Update to ARL r560 (pre-computed random numbers, lagrangian time scale) and unified all applications to use same HYSPLIT executables	ARL	NWS/NCEP/ EMC and NCO	2014

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
ARL	WOC HYSPLIT	Updated HYSPLIT and a newer version of the ALOHA chemical source term model into the Web Operations Center (WOC) HYSPLIT system	ARL	NWS	2014
ARL	CONUS CMAQ 4.6	Unified CTM code. Applied to CONUS, AK and HI based on EPA cmaq4.6; Emissions: CONUS, AK and HI. Mobile from NEI2005, area from NEI2011. For CB05	ARL	NWS/NCEP/ EMC and NCO	2015
ARL	Update hysplit v7.3	Changed GFS/GDAS codes that convert to ARL to input grib2 instead of grib1. Wet deposition upgrade/fix	ARL	NWS/NCEP/ EMC and NCO	2015
ARL	CMAQ vertical layers	Linked global operational aerosol model for LBC. # layers from 22 to 35;Emissions: CONUS, AK and HI. Mobile from NEI2005, area from NEI2011	ARL	NWS/NCEP/ EMC and NCO	2016
ARL	Update hysplit 7.4	Update to ARL r723 (wet deposition): add volcano trajectories and extend NAM conusnest output to 48-h from 24-h	ARL	NWS/NCEP/ EMC and NCO	2016
ESRL PSD	National Blend of Models precipitation guidance	Improved precipitation forecast algorithm for the statistical postprocessing of multi-model ensemble forecast data using short training data sets	NOAA/OAR/ESRL/ PSD	NOAA/NWS/STI /MDL	2017
ESRL GMD	SkySonde Client/Server Software	Software developed in GMD to users and transitioned to ozonesonde stations around the world	OAR GMD	Ozonesonde station: Hilo, HI	2017
AOML	HFIP (Hurricane Forecast Improvement Project) Observations	Transition observing technologies for use by the operational hurricane forecast model (HWRF) in order to improve forecast guidance	AOML	NWS	2017

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
ESRL GSD	RAPv3 Operational Implementation	RAPv3 expands the North America computational domain to include Hawaii	OAR/ESRL/GSD	NWS/NCEP/ EMC	2016
ESRL GSD	HRRRv1 Operational Implementation	NWP model that is a real-time 3-km resolution, hourly updated, cloud-resolving, convection-allowing atmospheric model, initialized by 3-km grids with 3-km radar assimilation	OAR/ESRL/GSD	NWS/NCEP/ EMC	2014
ESRL GSD	HRRRv2 Operational Implementation	HRRRv2 was intended to improve high-resolution, hourly-updated, storm-scale weather predictions used by transportation industries, utilities, emergency managers and responders, and any other entities requiring very localized weather predictions	OAR/ESRL/GSD	NWS/NCEP/ EMC	2016
ESRL GSD	MADIS v2.1.4	Software package to incorporate the NWS Automated Flood and Warning System observations into Meteorological Assimilation Data Ingest System (MADIS) at NWS.	OAR/ESRL/GSD	NWS/Office of Dissemination; NWS/Office of Observations; NWS/NCEP Central Operations	2016
ESRL GSD	MADIS v2.1.5	Software package to incorporate Clarus system capability from the U.S. Federal Highways Administration, NWS Hydrometerological Automated Data System (HADS), and USDA's Snow Telemetry and Snow Course Data and Products	OAR/ESRL/GSD	NWS/Office of Dissemination; NWS/Office of Observations; NWS/NCEP Central Operations	2016
ESRL GSD	MADIS 2.1.5.10	This software package contains a new real-time display of aircraft water vapor sensor system (WVSS-II) for the public	OAR/ESRL/GSD	NWS/Office of Dissemination; NWS/Office of Observations;	2017

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
				NWS/NCEP Central Operations	
ESRL GSD	LAPS in NWS AWIPS II	Local Analysis and Prediction System (LAPS) model transition to NWS AWIPS II forecast system	OAR/ESRL/GSD	NWS Office of Science and Technology - NWS/OST	2015
GLERL	Lake Erie Operational Forecast System	Operational hydrodynamic model that predicts water levels, temperatures, 3D currents in Lake Erie	GLERL/IPEMF	NOS/CO-OPS	2016
NSSL	FLASH	FLASH is a software application that uses the MRMS forcing and produces flash flood forecasts at 1-km/5-min resolution through direct, forward simulation	NSSL/CIMMS	NWS/Central Processing	2017
OWAQ	Development of a Probabilistic Tropical Cyclone Genesis Prediction Scheme	Disturbance-following tropical cyclone (TC) genesis index (TCGI)	U. Miami/CIMAS, OAR/AOML	NHC	2015
OWAQ	Improvement to the Statistical Hurricane Intensity Prediction Scheme (SHIPS) Rapid Intensification Index	Statistically based rapid intensification index (RII) that employs predictors from the SHIPS model	OAR/AOML, DoD/NRL	NHC	2015
OWAQ	Updating the secondary eyewall formation	A new model that provides probabilities of secondary eyewall formation (SEF) in hurricanes using a Bayesian statistical approach	NCDC	NHC	2016

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
	probabilistic model, completing new climatologies of intensity and structure changes associated with eyewall replacement cycles, and construction of new forecast guidance tools based on the new climatologies				
OWAQ	Improved SFMR surface wind measurements in intense rain conditions	Bias correction algorithm for wind speed errors in real-time operations	OAR/AOML	NHC	2015
NSSL	Multi-Radar/Multi-Sensor (MRMS) System	MRMS is a system with automated algorithms that quickly and intelligently integrate data streams from multiple radars, surface and upper air observations, lightning detection systems, and satellite and forecast models	NSSL/CIMMS	NWS/Central Processing	2017
ESRL GSD	MADIS Realtime System	The Meteorological Assimilation Data Ingest System (MADIS) is a global database and delivery system that serves the greater meteorological community by collecting, integrating, quality controlling and distributing many thousands of NOAA and non-NOAA observations for use by NWS and public and non-public subscribers alike	OAR/ESRL/GSD	NWS/Office of Dissemination; NWS/Office of Observations; NWS/NCEP Central Operations	2015

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
ESRL GSD	MADIS Data Recovery System	MADIS Data Recovery System captures data that is two (2) hours to 35 days old, as well as data that may have been lost due to communications or system error	OAR/ESRL/GSD	NWS/Office of Dissemination; NWS/Office of Observations; NWS/NCEP Central Operations	2015
ESRL GSD	MADIS Data Archive System	A daily archive data push to NESDIS/NCEI (formerly NESDIS/NCDC) of data that has gone through the last of the ingest/processing on MADIS (data that is greater than 2-1/3 hours old up to 35 days old from the data recovery system component)	OAR/ESRL/GSD	NESDIS/NCEI/ DSD/Data Operations Branch	2015
OWAQ	The assimilation of non-NOAA and non-AF GPS dropwindsonde data into NOAA numerical models	Assimilation of dropwindsonde data collected using the NASA DC-8 and NSF G-V aircraft into hurricane forecast models	OAR/AOML	EMC	2015
OER	OER Video Portal	Video Data Management Modernization Initiative Pilot Project transitioned to the operational OER Video Portal	NESDIS/NCEI	OAR/OER	2016
OER	Sampling Operations Database Application (SODA)	A customized database application to capture the details of specimen collection operations onboard the NOAA Ship Okeanos Explorer	NESDIS/NCEI	OAR/OER	2015
ESRL GSD	SOS Explorer Lite (SOSx Lite) software release 1.0	Users can explore a select group of SOS datasets and walk through three pre-programmed educational tours on a personal computer display or projector screen	OAR/ESRL/GSD	Public release available from website	2015

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
ESRL GSD	SOS Explorer Lite (SOSx Lite) software release 2.0	Users can explore a select group of SOS datasets and walk through three pre-programmed educational tours on a personal computer display or projector screen	OAR/ESRL/GSD	Public release available from website	2017
ESRL GSD	Science On a Sphere software release v4.2	This release provided a collection of usage statistics, live video PIPs, ability to use one graphics card instead of two, and improvements to spherecasting	OAR/ESRL/GSD	SOS customers; SOS Users Collaborative Network	2014
ESRL GSD	Science On a Sphere software release v4.3	Major reorganization of the data catalog, experimental auto alignment, volume control, bluetooth connectivity	OAR/ESRL/GSD	SOS customers; SOS Users Collaborative Network	2015
ESRL GSD	Science On a Sphere software release v5.0	Public kiosk software released, interactive sphere splitter, support for 4k projectors, support for translations, preview edition of the visual playlist editor, improved auto alignment	OAR/ESRL/GSD	SOS customers; SOS Users Collaborative Network	2015
ESRL GSD	Science On a Sphere software release v5.1	New version of operating system, fully feature version of the visual playlist editor, custom datasets searchable on iPad	OAR/ESRL/GSD	SOS customers; SOS Users Collaborative Network	2016
ESRL GSD	Science On a Sphere software release v5.2	Text PIPs, improvements to Visual Playlist Editor, new layer control on iPad, projector control utility, rewritten documentation	OAR/ESRL/GSD	SOS customers; SOS Users Collaborative Network	2017
ESRL GSD	SOS Explorer (SOSx) software release v1.1	Flat screen version of Science On a Sphere (SOS)	OAR/ESRL/GSD	SOS Explorer customers	2016

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
ESRL GSD	SOS Explorer (SOSx) software release v1.2	Version 1.2 of the software included improvements to the Tour Builder, better support for 3D models such as satellites, and the ability to run the software in dual screen or single screen mode	OAR/ESRL/GSD	SOS Explorer customers	2017
ESRL GSD	SOS Explorer (SOSx) software release v1.3	Version 1.3 of the software included better camera control for 3D models, major improvements to the Tour Builder, an expanded content collection, better translation support, and compatibility with the Oculus Rift virtual reality goggles	OAR/ESRL/GSD	SOS Explorer customers	2017
ESRL GSD	Graphical Forecast Editor (GFE) for Spain	GFE software tool performs mathematical operations on sensible weather grids that are used as the basic forecast information generated at NWS	OAR/ESRL/GSD	AEMET: Agencia Estatal de Meteorologia	2014
AOML	NOAA-developed assays for tracking sources of microbial contamination	Two qPCR assays were included in an international interlaboratory validation exercise and accepted for inclusion in an instructional manual for the state of California which provided the protocols and explanations on how to implement these molecular technologies for microbial source tracking (MST).	AOML	State of California	2014
AOML	Transition of molecular diagnostic operational capabilities to state stakeholders	Florida Department of Environmental Protection received technology transfer of molecular techniques to determine the source of fecal contamination that poses risk to human, animal, and ecosystem health	AOML	Florida Department of Environmental Protection	2015
AOML	Methods Development, Validation, and Transition to Operations for Molecular Microbial	Broward County Environmental Lab has now established their own MST lab capacity resulting from AOML training and mentorship	AOML	Broward County Environmental Lab	

FMC	Project Name	Description	Transitioned From	Transitioned To	Year
	Source Tracking (MST) of Fecal Bacteria and Pathogens in the Marine Environment				
SG	A semi-automated zooplankton analysis system for Delaware Bay and coastal waters: method development and implementation	Autonomous pattern recognition routine correctly identified blue crabs from a mixed assemblage of megalopae with ~85% accuracy	Delaware Sea Grant	NOAA-NMFS Coastal & Oceanic Plankton Ecology, Production, & Observation Database (COPEPOD)	2016