# NOAA SWPC Readiness Level (RL) - Expanded Definitions

*Modified 04/05/2023*

**RL 1: Basic research:** *Systematic study directed toward understanding of the fundamental aspects of phenomena <u>without any targeted applications specified</u>. Basic research, however, may include activities with broad applications in mind*.

**RL 2: Applied research:** *Systematic study to gain knowledge or understanding necessary to <u>determine the means by which a recognized and specific need may be met</u>; invention and concept formulation. Investigation 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.*

**RL 3: Proof-of-concept for capability (system, process, product, service or tool):** *This can be considered an <u>early phase of development</u>. Beginning at RL 3, an increasing involvement of the deploying unit, receiving unit, or end user is anticipated in order to assist in guiding the research toward a mission application. The earliest version of a concept of operations (CONOPS) should be developed no later than RL 3.*

**RL 4: Validation of capability in development (laboratory/experimental) environment:** *This can be considered an <u>intermediate phase of development</u>. Projects should not be resourced beyond RL 4 without a transition plan in place and having been developed in close coordination with the intended deploying unit. Such transition plans are expected to describe a viable path extending beyond a project's established RL through a successful operational implementation (RL 9).*

**RL 5: Validation of capability in an operations-relevant environment through testing and prototyping:** *This can be considered the <u>final stage of development</u> before demonstration begins. At RL 5, validation should be done on a prototype of at least medium fidelity in a Proving Grounds test environment, to rigorously*

*confirm the attainment of pre-defined, quantitative performance expectations resulting from previous RL 4 validation efforts. This should include the integration with realistic supporting elements such that the system can be tested in a simulated end-use environment.*

**RL 6: Demonstration of prototype capability in a testbed environment (potential demonstrated).** *RL 6 is a level where it becomes necessary to engage with a testbed. At this stage, a high-fidelity implementation of the capability is demonstrated in a testbed environment which includes all critical components of the end-use environment. At this stage, the capability functions as intended under real world operational constraints, provides acceptable lead times relevant to forecasting efforts, and meets established performance requirements.*

**RL 7: Demonstration of prototype capability in an operational environment (functionality demonstrated in near-real world environment; subsystem components fully integrated into system).** *Capability shown to execute robustly (effective error handling and monitoring in place) within an operational environment using available real-time data streams. CONOPS fully implemented and successfully demonstrated.*

**RL 8: Finalized capability tested and shown to operate, or function, as expected within the user's environment; user training and documentation completed; operator or user approval given.** *Execution in production parallel "staging" environment. This is the final stage of testing aiming to confirm the expected execution performance, robustness to the operational environment, and failure response.*

**RL 9: Capability deployed and used routinely.** *Once the system, product, process, service, or tool is fully deployed, it has completed the process transition of R&D. However, the originating research unit may continue to be involved in support of continued refinements or incremental improvements throughout the total life cycle of the capability (O2R). An RL 9 designation means that the project has transitioned to operations and the research entity is not responsible for operating the system.*