



## Military Installations and Sea-Level Rise

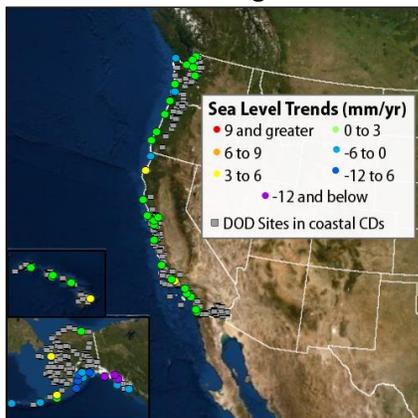
The Department of Defense (DOD) manages more than 1,700 military installations in worldwide coastal areas that may be affected by sea-level rise. These installations support DOD readiness and operations including naval vessel embarkation and disembarkation, amphibious training, and special operations forces training. Military installations on and near the coast are at risk for high-tide and storm surge flooding amplified by sea-level rise. Congress may choose to assume a role in preparing military installations for sea-level rise based on its authority in fiscal and national security matters.

### Sea-Level Rise and Climate Change

Global climate observations from the National Oceanic and Atmospheric Administration (NOAA) show trends of increased surface, air, and ocean temperatures that correlate with sea-level rise. The U.S. Global Change Research Program (USGCRP) reports that global mean sea level (GMSL) has risen by approximately 7-8 inches since 1900; further, GMSL has risen 3 inches since 1993 (see CRS Report R43229, *Climate Change Science: Key Points*, by Jane A. Leggett).

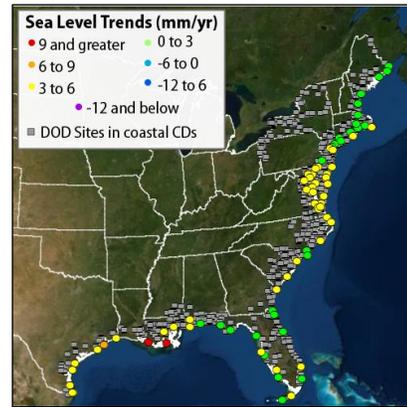
NOAA identifies the two major causes of GMSL rise as thermal expansion (water expanding from rising ocean temperature) and melting land ice (ice sheets and glaciers) adding water to ocean basins. Factors such as land rebounding, sediment compaction, oil and gas extraction, and land management influence relative sea level (RSL), the sea level relative to the land surface from which it is measured (for more information, see CRS Report R44632, *Sea-Level Rise and U.S. Coasts: Science and Policy Considerations*, by Peter Folger and Nicole T. Carter).

**Figure 1. Relative Sea-Level Change Trends & Military Installations in West Coast Congressional Districts, 2017**



**Source:** NOAA, Tides & Currents, “U.S. Sea Level Trend Map”; U.S. Census Bureau; Homeland Infrastructure Foundation-Level Data.  
**Notes:** Colored dots are monitoring stations; CD = Congressional District with coastline; mm/yr = millimeters per year.

**Figure 2. Relative Sea-Level Change Trends & Military Installations in East Coast Congressional Districts, 2017**



**Source:** NOAA, Tides & Currents, “U.S. Sea Level Trend Map”; U.S. Census Bureau; Homeland Infrastructure Foundation-Level Data.

**Notes:** Colored dots are monitoring stations; CD = Congressional District with coastline; mm/yr = millimeters per year.

RSL trends vary across the U.S. coastline (see **Figure 1** and **Figure 2**). For example, in 2017, RSL was rising at a rate of 9-12 millimeters per year along Louisiana’s Mississippi River Delta where parts of the land surface was sinking (**Figure 2**), while RSL was dropping along portions of the Pacific Northwest coastline and near southern Alaska (**Figure 1**). With few exceptions, RSL is rising along the coastlines of the contiguous United States; according to USGCRP, both GMSL and RSL levels are expected to continue to rise for the foreseeable future.

### Impacts to Military Installations

Military installations differ in terms of their existing infrastructure and potential vulnerabilities. A number of coastal military installations already routinely experience high-tide flooding, and storm surge from recent hurricanes has exacerbated flooding, disrupted operations and caused extensive damage to infrastructure. Likewise, infrastructure outside of military installations, (e.g., mission critical access roads) can be impacted by sea-level rise, further impeding military operations.

A study led by DOD’s Strategic Environmental Research and Development Program (SERDP) observed that sea-level rise threatens the sustainability of coastal installations through intensified storm surge, increased flood frequency, and saltwater intrusion into the groundwater aquifer (see SERDP study RC-1701). SERDP study RC-2334 found that U.S. military installations on low-lying atolls in the Pacific Ocean will be negatively impacted when “mean sea level is 0.4 meters higher...the amount of sea water flooded onto the island will be of sufficient volume to make the groundwater non-potable year-round.” In the 2014 *Climate Change Adaptation Roadmap*, DOD identified the Hampton Roads, VA region, which houses the largest concentration

of military sites in the world, as vulnerable to projected RSL rise of 1.5 feet (0.45 meters) over the next 20 to 50 years.

The Government Accountability Office (GAO) describes climate change and sea-level rise as issues of “fiscal exposure” (see GAO-19-453). According to the report, the 2018 hurricane season was especially damaging to DOD installations, highlighting that DOD’s worldwide real-estate portfolio is vulnerable to extreme weather. Hurricane Michael damaged every building on Florida’s Tyndall Air Force Base (repair estimate \$4.7 billion). Hurricane Florence dropped 36 inches of rain, flooding three North Carolina Marine Corps installations (repair estimate \$3.6 billion). While more intense hurricanes have not been confidently linked to climate change, higher sea levels magnify the adverse impact of storm surges (see chapter 1 of the Fourth National Climate Assessment).

### DOD Response to Rising Sea Levels

DOD has identified climate change as a cause of risk in military operations and to its installations since 2010 (See 2010 Quadrennial Defense Review). In 2014, DOD’s *Climate Change Adaptation Roadmap* named “rising sea levels and associated storm surge,” as one of four primary climate change related phenomena likely to impact DOD activities.

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Vulnerabilities to installations include coastal and riverine flooding. Coastal flooding may result from storm surge during severe weather events. Over time, gradual sea level changes magnify the impacts of storm surge, and may eventually result in permanent inundation of property. Increasing coverage of land from nuisance flooding during high tides, also called “sunny day” flooding, is already affecting many coastal communities.

DOD Report on Effects of a Changing Climate, 2019

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In 2016, the Department issued DOD Directive (DODD) 4715.21, *Climate Change Adaptation and Resilience* (updated in 2018), which assigns responsibility to all organizational entities within DOD to assess the effects of climate change and integrate them into planning. Section 2.2 (a) of DODD 4715.21 identifies the Office of the Assistant Secretary of Defense for Energy, Installations, and Environment (OASD (EI&E)) as the primary climate adaptation official responsible for considering climate change adaptation and resilience in the installation planning process. DODD 4715.21 also assigns OASD (EI&E) responsibility to provide direction on technologies, engineering standards, and tools for climate change adaptation and resilience, including the Unified Facilities Criteria (UFC) Program. UFC documents specify “planning, design, construction, sustainment, restoration, and modernization criteria,” for military installations in accordance with DODD 4270.5 (Military Construction).

### Congressional Actions

Through the National Defense Authorization Act (NDAA), Congress has exercised oversight of how DOD assesses and prepares for sea-level rise by legislating changes to DOD’s

military construction policies, forms, and procedures. For example, the FY2019 NDAA (P.L. 115-232):

- Requires an update of DOD Form 1391; and by extension, UFC 3-201-01, *Civil Engineering*, to direct planners for new military construction projects to identify whether they are in the Federal Emergency Management (FEMA) 100-year floodplain, and if so, requires them to specify mitigation plans and build 2-3 feet above base flood elevation (Section 2805(a)(B), FY2019 NDAA)
- Directs the Secretary of Defense to incorporate authorized, site-specific, and long-term climate projections, via amendment of UFC 1-200-01, General Building Requirements, and 1-200-02, High Performance and Sustainable Building Requirements. (Section 2805(c), FY2019 NDAA)
- Expands Defense Access Roads authority to improve critical roads outside installations impacted by sea-level rise and recurrent flooding. (Section 2865, FY2019 NDAA)

Congress has required DOD to assess and report installation vulnerability to extreme weather and sea-level rise. Section 335 of the FY2018 NDAA instructed DOD to assess climate-related impacts to installations, resulting in DOD’s 2019 *Report on Effects of a Changing Climate*. Some Members of Congress requested that DOD revise the report based on concerns it had not met statutory requirements. DOD complied and issued an addendum in March 2019.

### Possible Issues for Congress

- **Standard definitions of extreme weather.** DOD installation vulnerability assessments suggest that the understanding of extreme weather terms (including sea-level-related terms like storm surge) varies across DOD. A standard list of extreme weather definitions could assist DOD with assessing and preparing for sea level-related and other impacts of extreme weather events on coastal and noncoastal installations.
- **Instructions for incorporating climate projections into planning.** DOD does not have a process for evaluating and incorporating the use of climate projections into guidance. UFCs 1-200-01 and 1-200-02 lack guidance on the use of different projections, integration into facilities planning, and the development of site-specific climate projections. DOD is in the process of developing guidance for incorporating sea-level rise projections into UFCs, but does not have a timeframe for incorporating other climate projections.
- **Medium and small sites are not required to consider extreme weather in planning.** Presently, only officials at major military installations – defined by the *Base Structure Report* as a large site with a Plant Replacement Value (PRV) greater than or equal to \$2.067 billion – are required to incorporate extreme weather, such as storm surge enhanced by sea-level rise, into master plans (10 U.S.C. § 2864).

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