The Florida Senate

BILL ANALYSIS AND FISCAL IMPACT STATEMENT

(This document is based on the provisions contained in the legislation as of the latest date listed below.)

Prepared By: The Professional Staff of the Committee on Environment and Natural Resources

BILL:	SB 1284
INTRODUCER:	Senator Diaz
SUBJECT:	Florida Land Subsidence Research Initiative
DATE:	February 14, 2020 REVISED:

	ANALYST	STAFF DIRECTOR	REFERENCE	ACTION
1.	Schreiber	Rogers	EN	**Favorable**
2.			AED	
3.			AP	

I. Summary:

SB 1284 creates the Florida Land Subsidence Research Initiative between the Department of Environmental Protection (DEP) and Florida International University (FIU). The goal of the initiative is to collect and analyze information to understand natural hazards, such as land subsidence and sinkholes, and their effects on sea-level rise.

The bill requires DEP to contract with FIU to implement the initiative. FIU must collaborate with Florida State University, the University of Florida, the University of North Florida, and the University of South Florida to implement the initiative. Funds specifically appropriated by the legislature for the initiative must be allocated by DEP to FIU to achieve the initiative's goals. FIU must use a portion of these funds to engage other state universities to implement the initiative statewide.

The bill requires FIU to submit a report every two years, beginning on July 1, 2022, to the Governor and Legislature. The report must provide an update on the progress of the research and include a summary and analysis of the data collected by each state university. FIU must submit a final report to the Governor and Legislature by July 1, 2030, in coordination with contributing state universities. The final report must include the following:

- The assessment methodologies for data collection used by each university.
- A summary of the data collected by each university.
- An analysis, using all relevant data, of the trends in land subsidence in the state.
- An estimation of current and future sea level risks, including land subsidence and other natural hazards, such as coastal flooding and sinkholes.

II. Present Situation:

Sea-Level Rise and Coastal Flooding

With 1,350 miles of coastline and relatively low elevations, Florida is particularly vulnerable to coastal flooding.[1] There are three primary ways that climate change influences coastal flooding: sea-level rise, storm surge intensity, and rainfall intensity and frequency.[2]

Sea-level rise is an observed increase in the average local sea level or global sea level trend.[3] The two major causes of global sea-level rise are thermal expansion caused by the warming of the oceans (water expands as it warms) and the loss of land-based ice (ice sheets and glaciers) due to melting.[4] Since 1880, the average global sea level has risen about 8 to 9 inches, and the rate of global sea-level rise has been accelerating.[5] The National Oceanic and Atmospheric Administration (NOAA) utilizes tide gauges to measure changes in sea level, and provides data on local sea-level rise trends.[6] Analysis of this data shows some low-lying areas in the southeastern U.S. experience higher local rates of sea-level rise than the global average.[7]

Florida's coastal communities are experiencing high-tide flooding events, sometimes referred to as "sunny day" or "nuisance" flooding, with increasing frequency because sea-level rise increases the height of high tides.[8] The areas of the state most at risk from sea-level rise include the 35 coastal counties that contain approximately 76% of Florida's population.[9] In the U.S., sea-level rise and flooding threaten an estimated $1 trillion in coastal real estate value, and analyses estimate that there is a chance Florida could lose more than $300 billion in property value by

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[1] Florida Division of Emergency Management, *Enhanced State Hazard Mitigation Plan, State of Florida*, 107-108, 162 (2018) [hereinafter *SHMP*], *available at* https://www.floridadisaster.org/globalassets/dem/mitigation/mitigate-fl--shmp/shmp-2018-full_final_approved.6.11.2018.pdf. This measurement of Florida's coastline increases to over 8,000 miles when considering the intricacies of Florida's coastline, including bays, inlets, and waterways.

[2] *Id.* at 107.

[3] DEP, *Florida Adaptation Planning Guidebook*, Glossary (2018) [hereinafter *DEP Guidebook*], *available at* https://floridadep.gov/sites/default/files/AdaptationPlanningGuidebook.pdf; *see* NASA, Facts, *Vital Signs: Sea Level*, https://climate.nasa.gov/vital-signs/sea-level/ (last visited Dec. 20, 2019).

[4] *DEP Guidebook*, at Glossary; NOAA, *Climate Change: Ocean Heat Content*, https://www.climate.gov/news-features/understanding-climate/climate-change-ocean-heat-content (last visited Dec. 19, 2019). More than 90 percent of the warming that has happened on Earth over the past 50 years has occurred in the ocean; IPCC, *The Ocean and Cryosphere in a Changing Climate*, SPM-8, SPM-10, SPM-19, SPM -21, SPM-23, 1-15, 4-3, 4-4, 4-14 (Sept. 2019) [hereinafter *IPCC Ocean and Cryosphere*], *available at* https://report.ipcc.ch/srocc/pdf/SROCC_FinalDraft_FullReport.pdf. Uncertainty regarding projected sea-level rise by 2100 is mainly determined by ice sheets, especially those in Antarctica and Greenland, which are losing ice at increasing rates. The sum of glacier and ice sheet contributions is now the dominant source of global mean sea-level rise.

[5] U.S. Global Change Research Program, *Fourth National Climate Assessment*, 757 (2018)[hereinafter *NCA4*], *available at* https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf; *IPCC Ocean and Cryosphere*, at SPM-10, 4-3.

[6] NOAA, *What is a Tide Gauge?*, https://oceanservice.noaa.gov/facts/tide-gauge.html (last visited Dec. 19, 2019); NOAA, Tides and Currents, *Sea Level Trends*, https://tidesandcurrents.noaa.gov/sltrends/ (last visited Dec. 19, 2019); *see DEP Guidebook*, at 8, 16.

[7] *NCA4*, at 757.

[8] *SHMP*, at 108, 101, *available at* https://www.floridadisaster.org/globalassets/dem/mitigation/mitigate-fl--shmp/shmp-2018-full_final_approved.6.11.2018.pdf; NOAA, *High-Tide Flooding*, https://toolkit.climate.gov/topics/coastal-flood-risk/shallow-coastal-flooding-nuisance-flooding (last visited Dec. 19, 2019).

[9] *DEP Guidebook*, at III, *available at* https://floridadep.gov/sites/default/files/AdaptationPlanningGuidebook.pdf.

2100.[10] Sea-level rise affects the salinity of both surface water and groundwater through saltwater intrusion, posing a risk particularly for shallow coastal aquifers.[11] Sea-level rise also pushes saltwater further upstream in tidal rivers and streams, raises coastal groundwater tables, and pushes saltwater further inland at the margins of coastal wetlands.[12]

Storm surge intensity and the intensity and precipitation rates of hurricanes are generally projected to increase,[13] and studies suggest the overall extent of destruction from hurricanes is also rising.[14] Higher sea levels will cause storm surges to travel farther inland and impact more properties than in the past.[15] Stronger storms and sea-level rise are likely to lead to increased coastal erosion.[16]

Increases in evaporation rates and water vapor in the atmosphere increase rainfall intensity and extreme precipitation events, and the sudden onset of water can overwhelm stormwater infrastructure.[17] As sea levels and groundwater levels rise, low areas drain more slowly, and the combined effects of rising sea levels and extreme rainfall events are increasing the frequency and magnitude of coastal and lowland flood events.[18]

Land Subsidence

Land subsidence is a gradual settling or sudden sinking of the Earth's surface due to the movement of underground materials.[19] Land subsidence is most often caused by the removal of water, oil, natural gas, or mineral resources from the ground, but it can also be caused by natural events such as earthquakes, soil compaction, erosion, sinkhole formation, or land adjusting from a previous ice age.[20] According to the United States Geological Survey (USGS), more than 80

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[10] *NCA4*, at 324, 758; Zillow, *Climate Change and Housing: Will a Rising Tide Sink All Homes?* (2017), https://www.zillow.com/research/climate-change-underwater-homes-12890/ (last visited Dec. 20, 2019) (stating that by 2100 $883 billion in U.S. homes are at risk of being underwater with the total value of potentially underwater properties in Florida at $413 billion); Union of Concerned Scientists, *New Study Finds 1 Million Florida Homes Worth $351 Billion Will Be At Risk From Tidal Flooding* (2018), https://www.ucsusa.org/about/news/1-million-florida-homes-risk-tidal-flooding (last visited Dec. 20, 2019).

[11] *SHMP*, at 106, *available at* https://www.floridadisaster.org/globalassets/dem/mitigation/mitigate-fl--shmp/shmp-2018-full_final_approved.6.11.2018.pdf.

[12] *Id.* at 108.

[13] *Id.* at 106, 141; *IPCC Ocean and Cryosphere*, at 6-21, *available at* https://report.ipcc.ch/srocc/pdf/SROCC_FinalDraft_FullReport.pdf; *NCA4*, at 95, 97, 116-117, 1482, *available at* https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf.

[14] *See* Aslak Grinsted et. al., *Normalized US Hurricane Damage Estimates Using Area of Total Destruction, 1900-2018*, Proceedings of the National Academy of Sciences Nov. 2019, 116 (48) 23942-23946, *available at* https://www.pnas.org/content/116/48/23942.

[15] *NCA4*, at 758; *SHMP*, at 107; *see also* NOAA, *Florida Marine Debris Emergency Response Guide: Comprehensive Guidance Document* (Jan. 2019), *available at* https://marinedebris.noaa.gov/sites/default/files/publications-files/FL_Marine_Debris_Emergency_Response_Guide_2019.pdf.

[16] *NCA4*, 331, 340-341, 833, 1054, 1495; *SHMP*, at 108, 221; IPCC, *Climate Change and Land*, 4-44–4-45 (Aug. 2019), *available at* https://www.ipcc.ch/site/assets/uploads/2019/08/Fullreport-1.pdf.

[17] *SHMP*, at 99, 106, 116, 141, 181; *NCA4*, at 88, 762-763; *see* Florida Senate, Committee on Infrastructure and Security, *Meeting Packet for October 14, 2019*, *available at* http://www.flsenate.gov/Committees/Show/IS/MeetingPacket/4649/8266_MeetingPacket_4649_2.pdf.

[18] *SHMP*, at 106; *NCA4*, at 763.

[19] NOAA, *What is Subsidence?*, https://oceanservice.noaa.gov/facts/subsidence.html (last visited Feb. 10, 2020).

[20] *Id.*

percent of known land subsidence in the United States is a consequence of groundwater use.[21] Land subsidence is a global problem, and in the United States more than 17,000 square miles, in 45 states, have been directly affected.[22]

In Florida, the Department of Environmental Protection's (DEP) Florida Geological Survey (FGS) provides a database of voluntarily reported subsidence incidents statewide.[23] Currently, a majority of the records come from the State Watch Office, which is the clearinghouse for emergency response calls involving man-made and natural disasters.[24] Data is also received from citizens who use FGS's subsidence incident report form or who call FGS.[25] According to DEP's website, for a majority of the reported incidents, the incidents have not been field-checked and the cause of subsidence is not verified.[26]

Studying land subsidence involves the field of geodesy, which includes measuring and understanding the earth's geometric shape and how it changes over time using geodetic techniques.[27] The detection of regional-scale subsidence has historically occurred with the identified movement of key benchmarks over long periods of time.[28] Today, the USGS's methods for measuring subsidence include Interferometric Synthetic Aperture Radar (InSAR).[29] InSAR uses radar signals from satellites to measure changes in land-surface altitude at high degrees of measurement resolution and spatial detail.[30] InSAR produces a map of ground deformation that covers a very large spatial area with centimeter-scale accuracy.[31] In addition to InSAR, land subsidence can be measured with techniques such as Global Positioning System (GPS) receivers, repeated surveys of geodetic leveling, or installations of ground and water sensors.[32]

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[21] USGS, *Land Subsidence*, https://www.usgs.gov/mission-areas/water-resources/science/land-subsidence?qt-science_center_objects=0#qt-science_center_objects (last visited Feb. 10, 2020).
[22] *Id*.
[23] DEP, *Subsidence Incident Reports*, https://floridadep.gov/fgs/sinkholes/content/subsidence-incident-reports (last visited Feb. 6, 2020); DEP, *Map Direct: Subsidence Incident Reports Map*, https://ca.dep.state.fl.us/mapdirect/?focus=fgssinkholes (last visited Feb. 11, 2020).
[24] DEP, *Subsidence Incident Reports*, https://floridadep.gov/fgs/sinkholes/content/subsidence-incident-reports (last visited Feb. 6, 2020); *see* DEM, *State Watch Office*, https://floridadisaster.org/dem/response/operations/ (last visited Feb. 11, 2020).
[25] DEP, *Subsidence Incident Reports*, https://floridadep.gov/fgs/sinkholes/content/subsidence-incident-reports (last visited Feb. 11, 2020).
[26] *Id*.
[27] NOAA, *What is Geodesy?*, https://oceanservice.noaa.gov/facts/geodesy.html (last visited Feb. 11, 2020); NOAA, *National Geodetic Survey*, https://www.ngs.noaa.gov/index.shtml (last visited Feb. 12, 2020); Florida International University, *Geodesy Lab*, http://geodesy.fiu.edu/index.html (last visited Feb. 11, 2020).
[28] USGS, *Land Subsidence*, https://www.usgs.gov/mission-areas/water-resources/science/land-subsidence?qt-science_center_objects=0#qt-science_center_objects (last visited Feb. 10, 2020).
[29] USGS, *Land Subsidence*, https://www.usgs.gov/mission-areas/water-resources/science/land-subsidence?qt-science_center_objects=0#qt-science_center_objects (last visited Feb. 10, 2020).
[30] USGS, *Interferometric Synthetic Aperture Radar (InSAR)*, https://www.usgs.gov/centers/ca-water-ls/science/interferometric-synthetic-aperture-radar-insar?qt-science_center_objects=0#qt-science_center_objects (last visited Feb. 11, 2020).
[31] USGS, *InSAR—Satellite-Based Technique Captures Overall Deformation "Picture,"* https://volcanoes.usgs.gov/vhp/insar.html (last visited Feb. 11, 2020).
[32] NOAA, *What is Subsidence?*, https://oceanservice.noaa.gov/facts/subsidence.html (last visited Feb. 11, 2020).

Sinkholes

Sinkholes are closed depressions in areas underlain by soluble rock, and they form when surface sediments subside or collapse into underground voids and cavities created by the dissolving action of ground water in the underlying rock.[33] Sinkholes are just one of many forms of subsidence, but they are not technically considered "subsidence incidents" by DEP.[34] The Division of Emergency Management identifies two common types of sinkholes in Florida: "cover collapse sinkholes," where the ceiling of an underground cavity can no longer support the overlying weight and collapses, forming a hole in the land surface; and "cover subsidence sinkholes," where the ground slowly migrates down into fissures and cavities in the underlying rock, resulting in a depression in the land surface.[35]

Land Subsidence and Sea-Level Rise

The experience of sea-level rise on each coast and community is different, depending on local factors such as land subsidence or accretion,[36] land use, and erosion.[37] Land subsidence can increase sea-level rise rates and affect the measurement of local sea-level rise.[38]

"Relative sea level" is measured at the local level by a tide gauge, which measures the height of the surrounding water relative to a specific point on land.[39] "Eustatic sea level" is the elevation of the sea's surface based on the total volume of water in the ocean.[40] Unlike eustatic sea level, relative sea level can change based on vertical movement of the land on which the tide gauge sits.[41] Land subsidence can cause relative sea level to rise faster than the global average due to the downward vertical movement of the land.[42]

Closely monitoring subsidence can help ensure the accuracy of sea level rise measurements.[43] Incorporating information on local land subsidence improves projections of future sea-level

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[33] DEP, *Sinkhole FAQ*, https://floridadep.gov/fgs/sinkholes/content/sinkhole-faq (last visited Feb. 11, 2020); DEP, *Subsidence Incident Reports*, https://floridadep.gov/fgs/sinkholes/content/subsidence-incident-reports (last visited Feb. 6, 2020); *see* s. 627.706(2)(h), F.S. Providing a definition of sinkhole.
[34] DEP, *Subsidence Incident Reports*, https://floridadep.gov/fgs/sinkholes/content/subsidence-incident-reports (last visited Feb. 6, 2020); USGS, *What is the Difference Between a Sinkhole and Land Subsidence?*, https://www.usgs.gov/faqs/what-difference-between-a-sinkhole-and-land-subsidence?qt-news_science_products=0#qt-news_science_products (last visited Feb. 11, 2020). Land subsidence can affect areas that are thousands of square miles in size.
[35] *SHMP*, at 252-253, *available at* https://www.floridadisaster.org/globalassets/dem/mitigation/mitigate-fl--shmp/shmp-2018-full_final_approved.6.11.2018.pdf.
[36] Florida Living Shorelines, *Glossary of Terms*, http://floridalivingshorelines.com/resources/ (last visited Feb. 10, 2020). "Accretion" is the gradual accumulation of sediment; *see* NCA4, at 690. Generally, accretion increases elevation; *see IPCC Ocean and Cryosphere*, at SPM-14, 5-113. Accretion in some coastal ecosystems can match the sea level rise rate.
[37] *NCA4*, at 855, *available at* https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf.
[38] *NCA4*, at 689, 1495.
[39] *SHMP*, at 107, *available at* https://www.floridadisaster.org/globalassets/dem/mitigation/mitigate-fl--shmp/shmp-2018-full_final_approved.6.11.2018.pdf; NOAA, *What is the Difference Between Local Sea Level and Global Sea Level?*, https://oceanservice.noaa.gov/facts/sealevel-global-local.html (last visited Feb. 10, 2020). While tide gauges measure local sea level, satellite measurements provide the average height of the entire ocean.
[40] *SHMP*, at 107.
[41] *Id.*
[42] *Id.*; *NCA4*, at 1495.
[43] Southeast Florida Regional Climate Change Compact Sea Level Rise Work Group, *Unified Sea Level Rise Projection, Southeast Florida*, 29 (2015), *available at* https://southeastfloridaclimatecompact.org/wp-content/uploads/2015/10/2015-Compact-Unified-Sea-Level-Rise-Projection.pdf.

rise.[44] However, global projections of sea level rise do not always take subsidence into account.[45] Reasons for this include that no global data sets for subsidence are available for the scenarios used in climate models, and that subsidence often takes place on a smaller scale than the spatial scale used in climate models.[46]

III. Effect of Proposed Changes:

Section 1 creates s. 380.29, F.S., titled "Florida Land Subsidence Research Initiative."

The bill states that it is the intent of the Legislature to establish an independent and coordinated effort among state universities to determine the rate of land subsidence in the state by measuring changes in land elevation.

The bill establishes the Florida Land Subsidence Research Initiative. The initiative is a partnership between the Department of Environmental Protection (DEP) and Florida International University (FIU). The goal of the initiative is to collect and analyze data using geodetic techniques, including global positioning system and other satellite approaches, to understand natural hazards, such as land subsidence and sinkholes, and their effects on sea-level rise.

The bill requires DEP to contract with FIU to implement the initiative. DEP must allocate funds specifically appropriated by the Legislature for the initiative to FIU to achieve the goals of the initiative. The bill requires FIU to use a portion of the funds to facilitate additional engagement with other state universities to assist in implementing the initiative statewide. FIU must collaborate with Florida State University, the University of Florida, the University of North Florida, and the University of South Florida to implement the initiative. FIU must develop specifications for the collection and reporting of data for the initiative that all participating state universities must use.

The bill requires FIU to submit a report every two years, beginning on July 1, 2022, to the Governor, the President of the Senate, and the Speaker of the House of Representatives. The biennial report must provide an update on the progress of the research and include a summary and analysis of the data collected by each state university. FIU must submit a final report to the Governor and Legislature by July 1, 2030, in coordination with contributing state universities pursuant to the responsibilities of the initiative. The final report must include the following:

- The assessment methodologies for data collection used by each university.
- A summary of the data collected by each university.
- An analysis, using all relevant data, of the trends in land subsidence in the state.
- An estimation of current and future sea level risks, including land subsidence and other natural hazards, such as coastal flooding and sinkholes.

Section 2 states that the bill takes effect on July 1, 2020.

[44] *NCA4*, at 65.
[45] *IPCC Ocean and Cryosphere*, at 4-13.
[46] *Id.* at 4-30.

IV. Constitutional Issues:

A. Municipality/County Mandates Restrictions:

None.

B. Public Records/Open Meetings Issues:

None.

C. Trust Funds Restrictions:

None.

D. State Tax or Fee Increases:

None.

E. Other Constitutional Issues:

None.

V. Fiscal Impact Statement:

A. Tax/Fee Issues:

None.

B. Private Sector Impact:

None.

C. Government Sector Impact:

The bill requires DEP to create a partnership with FIU. DEP must contract with FIU to implement the initiative, and allocate funds appropriated for the initiative to FIU. These duties may cause DEP to incur additional costs.

VI. Technical Deficiencies:

None.

VII. Related Issues:

None.

VIII. Statutes Affected:

This bill creates section 380.29 of the Florida Statutes.

IX. Additional Information:

A. Committee Substitute – Statement of Changes:
(Summarizing differences between the Committee Substitute and the prior version of the bill.)

None.

B. Amendments:

None.