

U.Va. was No. 1.
Then it was out.
What happened
in the NCAA
tournament?

UP TO
\$313
IN COUPONS TODAY



STEPHEN M. KATZ | THE VIRGINIAN-PILOT

The Virginian-Pilot

Sunday

Our 152nd year | 03.18.18 | PILOTONLINE.COM | \$2.50 in Hampton Roads; \$3 in outlying areas

cars and clovers

Thousands lined Norfolk streets to watch the 51st annual Ocean View St. Patrick's Day Parade on Saturday morning.

The Gulf Stream:
A “wild card”
for sea level rise

SCIENTISTS MONITOR the current for signs of long-term weakening. They’ve noticed that when it slows, even temporarily, coastal flood risk rises.

By Dave Mayfield
The Virginian-Pilot

Early in the fall of 2015, over a period of a few weeks, the tides in Hampton Roads rose well beyond what was predicted – as much as 3 feet higher, enough in some cases to flood low-lying roads throughout the region.

Tal Ezer had an idea about what might be contributing to the problem, and the Old Dominion University oceanography professor knew where to look – an obscure website that compiles a daily average of water pouring through a strait between Florida and the Bahamas.

What it showed was a dramatic slowing in something known as the Florida Current, a section of the Gulf Stream, the mighty offshore river that rages up the coast before veering northeast toward the open Atlantic off Cape Hatteras.

See GULF, PAGE 15

Hampton Roads
North Carolina
South Carolina
Georgia
Florida
Bahamas
Cuba
Jamaica
Haiti

The Gulf Stream

Image from NASA video of a visualization showing ocean surface currents around the world from June 2005 through December 2007.

NASA/GODDARD SPACE FLIGHT CENTER SCIENTIFIC VISUALIZATION STUDIO

How the 2018
General Assembly
will change your
everyday life

By Jordan Pascale
The Virginian-Pilot

RICHMOND

The Virginia General Assembly wrapped up last weekend with legislators passing 919 bills.

Many are narrow carve-outs affecting a small group of people, like staggering the election of City Council members in the small southwestern town of Buchanan. Others deal with rather trivial things that don't seem like they need a law – such as the one allowing your kids to bring sunscreen to school without a doctor's note.

One thing that will prove different about the 2018 session: vetoes. So far Gov. Ralph Northam has said he would veto only one bill,

which outlaws sanctuary cities in Virginia. Last year, then-Gov. Terry McAuliffe vetoed 49, giving him the all-time title for most vetoes of any Virginia governor with 120.

But lawmakers failed to pass one big bill: the budget. Legislators will return to Richmond on April 11 in hopes of passing a \$115 billion, two-year budget after the House and Senate couldn't agree on whether to include Medicaid expansion. A group of 13 lawmakers will negotiate behind the scenes in the interim.

Meanwhile, here are a dozen bills that could affect many of us in our daily lives when they become law on July 1.

See ASSEMBLY, PAGE 14

Criminal case against
Whitaker has been
shrouded in mystery. It
goes to trial this week.

By Scott Daugherty
The Virginian-Pilot

PORTSMOUTH

More than a year ago, the Sheriff's Office started a criminal inquiry into an outspoken councilman critical of the sheriff.

In time, officials with the U.S. Treasury Department and the federal agency that regulates credit unions joined the investigation, and the city's commonwealth's attorney stepped aside amid concerns of a conflict of interest.

An indictment would be handed down and political recriminations would fly.

But through it all, one question remained unanswered – at least publicly.

What exactly does the prosecution believe Coun-



Portsmouth City Councilman Mark Whitaker is charged with two counts of identity fraud, seven counts of “uttering a forged check” and 11 counts of forgery.

cilman Mark Whitaker did to warrant 20 felony fraud and forgery charges?

The city should learn the answer this week as the councilman's trial kicks off Wednesday in Portsmouth Circuit Court.

See WHITAKER, PAGE 16



THE GOVERNOR'S
SCHOOL FOR THE
ARTS TURNS 30

THE SUNDAY BREAK



TRUMP LAWYER:
RUSSIA PROBE
MUST END NOW

Attorney calls Mueller's investigation fatally flawed and “corrupted” by political bias. He wants the Justice Department to shut it down.

PAGE 5

cool with
some sun

High: near 50.
Low: 30s.

Details on back page of Sports



GULF

SLOWING CURRENT COULD ADD TO FLOODING

Continued from Page 1

Hurricane Joaquin had been banging around the Bahamas around that time, and its fierce winds and the waves they created blasted hard against the headwaters of the Gulf Stream. As the current decelerated, water levels climbed higher along much of the East Coast.

The episode drove home the importance of the Gulf Stream to coastal sea levels at a time when flooding is becoming more persistent. And it suggested something more ominous: If the current slackens permanently, as some climate change models predict, scientists say that's bound to cause even more flooding in places like Hampton Roads.

Only a small slowdown in the Gulf Stream could add more inches to the 2 to 6 feet of sea level rise already predicted before the end of this century. How many more inches is anybody's guess.

"For a place like Norfolk, this is a potential wild card that really needs to be considered," said William Sweet, who researches tides, currents and sea level rise for the National Oceanic and Atmospheric Administration.

"You live along a volcano, you're aware of its eruptions. You live along the Gulf Stream, you need to be aware of its fluctuations" and its long-term patterns, he said. "Its consequences are just bigger ... in this day and age, when every inch matters."

The Gulf Stream matters a lot. But only in recent decades have scientists really dug into quantifying its impact.

It "has a lot bigger variability than oceanographers realized, say, 20 years ago. And I think that variability, not only is it large in magnitude, but it can impact us, in the Chesapeake Bay, in the southern Chesapeake Bay especially," said Hali Kilbourne, who studies climate change through the ages for the University of Maryland's Center for Environmental Science.

Much of Kilbourne's work focuses on ocean currents. She's among scientists who've been watching the Gulf Stream and the circulation loops of which it's a part with increasing concern.

Oceans already are expanding as a warming atmosphere raises sea temperatures, and on top of that comes water from an increase in ice melt. All of this is raising sea levels and threatening to disrupt ocean currents.

Massive climate-caused disruptions have happened before in the span of what would be today's average human lifetime, Kilbourne said – even more reason for the increased scrutiny the Gulf Stream is getting.

It's hard to find a scientist who's brought more attention to the Gulf Stream in recent years than Ezer. He's written extensively about variability in the current and its effect on coastal sea levels.

His research documenting connections between temporary, abrupt Gulf Stream slowdowns and coastal flooding is among the most-cited in his field.

And, Ezer sheepishly admits, he's never been out on the Gulf Stream. In the rarefied world of physical oceanography, physics and mathematics rule. When your products are data tables and computer models, a fast internet connection beats a choppy ride on the ocean any day.

Among the tools in his Gulf Stream study kit is satellite altimetry. It charts the surface elevation of the Gulf Stream and the waters around it. What it shows is that across the current's 60 miles or so in width, there's a significant slope.

The ocean on the landward side of the Gulf Stream can be 3, 4 or even 5 feet lower than on the warmer east side, Ezer said. The stronger the current, the steeper the slope, with force from Earth's rotation continually helping to push the current toward the right.

What Ezer derives from all this is that, if not for the strength of the current, there would be much more saltwater settling in coastal neighborhoods throughout the mid-Atlantic.

It might end up as something less than a one-for-one

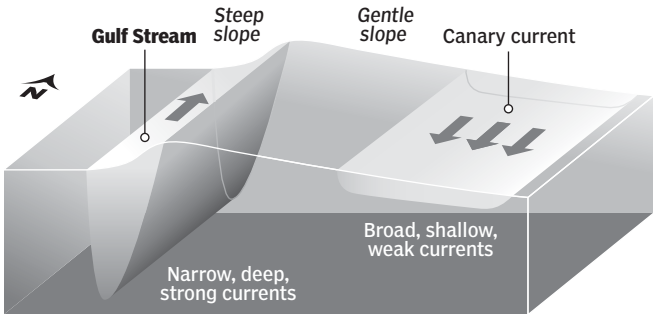


KRISTEN ZEIS | THE VIRGINIAN-PILOT

Tal Ezer, an ODU oceanography professor, has been modeling the Gulf Stream since the early 1990s and researches the current's role in Atlantic Coast sea levels and sea level rise. He says it can take only a day for a slowdown in the Gulf Stream's southern reaches to reverberate in coastal Virginia.

THE GULF STREAM'S COASTAL EFFECTS

The Gulf Stream is a current of warm water that originates from the Gulf of Mexico and flows north along the East Coast. The Atlantic Ocean is generally 3 to 5 feet lower on our side, the colder side, of the current. The stronger the current, the steeper the slope. When the current slows down abruptly, tide gauges can edge up.



shift in the sea level from one side of the Gulf Stream to the other, Ezer said, as other factors would be in play. But certainly it'd be no small amount of extra water to deal with.

When the Israeli-born Ezer first started modeling the Gulf Stream back in the early 1990s, he didn't give much thought to its impact on sea levels. He was doing postdoctoral research at Princeton, and the university was helping the Navy.

"I think it started in the Cold War with the threat of Soviet submarines, you know, hiding behind the Gulf Stream and spying on the U.S. coast," Ezer said. America's naval leaders were still eager to find any undersea advantage they could by better understanding the erratic current and the eddies that rapidly come and go alongside it.

Ezer's Gulf Stream knowledge at that time came from textbooks. They told him that it clocked speeds as high as nearly 6 mph and could carry upward of 4 billion cubic feet of water per second at places where it's the widest and deepest. That makes it more powerful, many times over, than all the freshwater rivers of the world combined.

The texts also told of how winds help drive the Gulf Stream. And they noted that it's part of an ocean conveyor belt, in which cold water in the far northern latitudes sinks deep and works its way

south. Warm surface waters from the Gulf Stream constantly help replenish the loop up north.

Benjamin Franklin was the first to chart the current, in the 1760s, when he was in London as a deputy postmaster general for mail sent to and from the Colonies.

Franklin borrowed on the knowledge of his cousin, a merchant ship captain. Dubbing it the Gulph Stream, he reasoned that ships carrying mail to Colonial America would get there faster if their captains avoided (and stopped fighting) the current. Of course, they'd also return to England sooner if they rode the current back.

Nearly a century later, Matthew Fontaine Maury, a pioneering naval officer and scientist for whom Norfolk's Maury High School is named, helped popularize the Gulf Stream with poetic flourishes.

In one of his groundbreaking books, the current was "a river in the ocean." Maury wrote: "The Gulf of Mexico is its fountain, and its mouth is in the Arctic Seas."

Ezer regularly cites Franklin's and Maury's work. But when he gives talks to the general public about the Gulf Stream, he's more likely to be asked about a 2004 disaster movie, "The Day after Tomorrow." In it, an epic meltdown in the global climate brings ocean currents to a halt.

Could it happen?



LIBRARY OF CONGRESS

A chart of the Gulf Stream by Benjamin Franklin.

Not like in the movie, Ezer said.

"It doesn't happen in a week."

Decades, perhaps, he said. Or centuries.

Still, Ezer said, the underlying premise that a massive ice melt caused by global warming could not only swell the oceans, but bring ocean currents to a standstill, isn't completely without merit.

Some scientists think that it's happened before around warming periods. Some even think it might have occurred, at some places in time, within decades.

Now that we're in the midst of another big melt, as greenhouse gases continue adding blankets around Earth, it's not surprising that scientists are scouring harder for evidence of such precedents.

So much more water is being dumped into the northern seas from shriveling glaciers that it's easy to imagine the ocean conveyor belt getting gummed up there.

Some measurements, from satellites and other trackers, indicate a Gulf Stream slow-

down already may have begun. But with only a few decades of precise, continuous data to work with, it's too early for Ezer to call it a long-term trend.

It could still be within the norms of natural fluctuations, he explained: It might take decades more to confirm that something extraordinary is occurring.

He's not the only oceanographer who sounds conflicted at times. What's happening with ocean circulation is one of climate science's most robust debates. It won't be settled anytime soon.

In the meantime, Ezer continues focusing on what can be measured here and now. The Gulf Stream's role in coastal sea levels must be better understood, he said.

It's never the only factor, especially in Hampton Roads, where the sinking of land – also known as subsidence – is blamed for roughly half of the region's relative sea level rise. But, clearly, the Gulf Stream is a factor.

Sweet, the NOAA oceanographer, said Ezer deserves a lot of credit for connecting the Gulf Stream dots. He said Ezer is taking something "abstract and esoteric" and "really advancing, using modern observational techniques ... our understanding of its role in flooding."

"When you can connect those two, all of a sudden people are talking about it like they're talking about the weather."

Skip Stiles talks about the tides a lot as executive director of a Hampton Roads-based nonprofit group called Wetlands Watch. He said when he first learned of Ezer's use of the Florida Current data, "I thought this is about the coolest thing I've ever seen, putting a speedometer on the Gulf Stream. Dang, who'd have thought of that?"

Ezer is quick to point out that it wasn't he who invented the measurement, which started back in 1982. Ezer's innovation, often with the help of Larry Atkinson, an

oceanography colleague at ODU, has been finding new ways to crunch the collected bits of information.

The data come from an abandoned telephone cable that stretches for about 55 miles between West Palm Beach and Grand Bahama Island.

A copper wire runs inside it, and the salt particles in the warm water shooting through the strait from the Gulf of Mexico are calculated as they pass through the wire's electromagnetic field. NOAA filters and analyzes the data and reports the averages on its website.

Ezer has incorporated the data into various studies in recent years, and said that it can take only a day for a slowdown in the Gulf Stream's southern reaches to reverberate in coastal Virginia.

He's pointed to the flooding tides in Norfolk in September and October of 2015 as one such correlation.

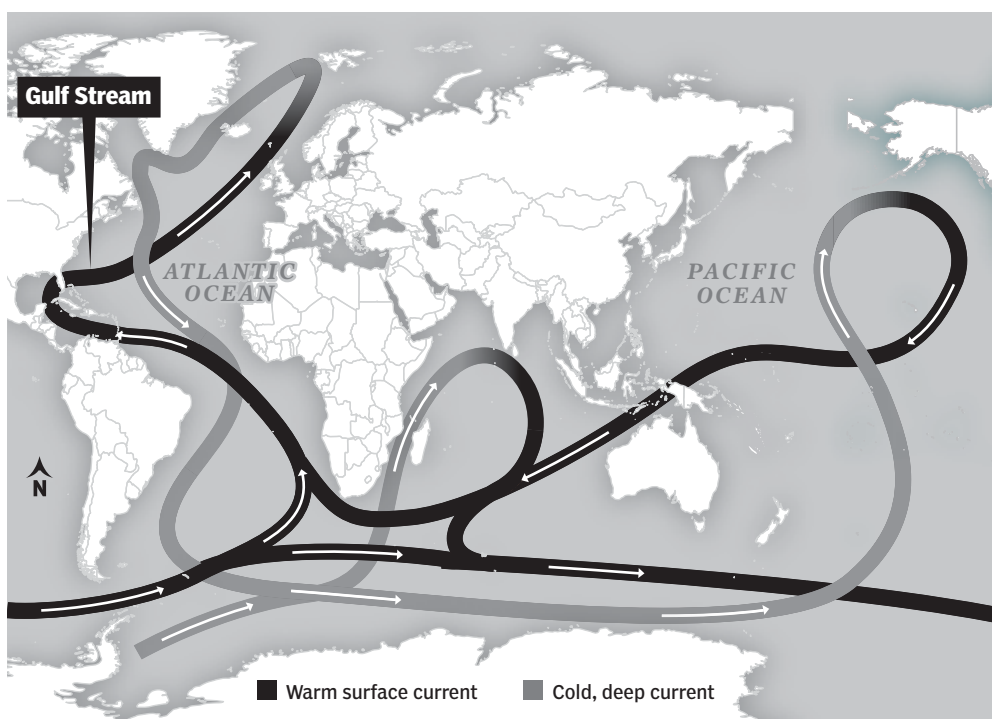
Hurricane Joaquin never neared the Virginia coast at that time. It spent its windiest days around the Bahamas before trailing off toward Bermuda.

The hurricane did help spawn another system that dumped heavy rain and stirred strong winds across the mid-Atlantic, and its long swells as it moved northward piled onto the storm surges. But forecasters tried accounting for all of that, and yet the tides still went well beyond what they expected.

The biggest missing piece, Ezer's research suggests, may have been the effect of the Gulf Stream slowdown. At its Florida Current leg, volume fell by more than a third from the pre-hurricane high.

Such episodes add to the evidence, Ezer said, that "something happening hundreds or thousands of miles away" to disrupt the Atlantic's mighty offshore river could mean trouble all along the coast.

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SOURCE: National Oceanic and Atmospheric Administration

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