The extraordinary Atlantic Niño of 2019/2020

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Background
Composite Atlantic Niño from ERA5
criterion: 0.75 std dev of JJA ATL3

composite AZM+ JUL

shd: SST, vect: sfc winds
cnt: precip

upper: omega (shd), zonal u (cnt);
lower: ocean T (shd)

from Richter and Tokinaga (2021)
The Atlantic Niño II

SST (shd), 10m wind (vect), precip (cnt) during ND

from Okumura and Xie 2006
Decreasing variability in recent decades

Weakening of the equatorial Atlantic cold tongue over the past six decades

Hiroki Tokinaga\textsuperscript{1}\textsuperscript{*} and Shang-Ping Xie\textsuperscript{1,2}

Seasonal and interannual variations of the equatorial cold tongue are defining features of the tropical Atlantic Ocean, with significant climatic\textsuperscript{3,4} and biogeochemical\textsuperscript{5} effects. However, its long-term changes are poorly understood owing to biases in observations and climate models\textsuperscript{5}. Here we use a suite of bias-corrected observations, and find that cold-tongue variability has weakened during the past six decades. We find that sea surface temperature has increased across the basin, with a local enhancement over the eastern equatorial Atlantic. This warming pattern of the sea surface is most pronounced during boreal summer, reducing the annual cycle through a positive ocean-atmosphere feedback. Specifically, the eastward-intensified warming leads to enhanced atmo-

from Tokinaga and Xie 2011
Decreasing variability in recent decades


from Prigent et al. 2020
ATL3 time series 1948-2018
NCEP/NCAR Reanalysis

from Richter and Tokinaga (2021)
The 2019/2020 event in context
OISST ATL3 for all years since 1982
time series linearly detrended

ranking according to
NDJ mean
More context

ATL3 index for 2019/2020, NDJ composite, and JJA composite
Evolution of the 2019/2020 event
SST (shd) and 10m winds (vect) in ERA-5
ePIRATA temp anomalies (K)

ave: 0N23W, 0N10W, 0N0E
Evolution in the ePIRATA data

- ATL3 u_sfc
- ATL3 T_1m
- ATL3 z20 *0.1
GODAS: lon/depth sections of budget terms

godas: advection terms [K/mth] 3S - 3N
AVISO SSH anomalies in 2019

Ion/time sections shading: 0.5S-0.5N
Contours: 3-4N
Evidence for off-equatorial Rossby wave
Summary

• pronounced Atlantic Niño occurred in 2019/2020
• strongest event in 20 years, and possibly last 40
• vertical advection dominated the warming
• preceded by moderately strong eq. westerlies
• likely contribution from off-equatorial wind stress
curl -> off-equatorial Rossby waves
• possibly other factors played a role too
• is AZM activity picking up again?
Extra slides
Detrended ATL3 index in 9 data sets

epIRATA, ICOADS, GODAS, ERA-5, ERSST, COBE, HadISST, OISST v2, OISST (v2+v2.1)
Detrended ATL3 index in 9 data sets

ePIRATA, ICOADS, GODAS, ERA-5, ERSST, COBE, HadISST, OISST v2, OISST (v2+v2.1)
ePIRATA mixed layer heat budget
ATL4 u10 in reanalyses and obs
u10 (40-10W,3-8N) in reanalyses and obs