

Making NASA Climate Information Locally Relevant: Demonstration with Prince George's County

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NASA Goddard

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Maryland Adaptation & Resiliency Working Group Meeting



EARTH FLEET

INVEST/CUBESATS

- NACHOS 2022
- CTIM 2022
- NACHOS-2 2022
- MURI-FD 2023
- SNOOPI* 2024
- HYTI* 2024
- ARGOS* 2024

JPSS INSTRUMENTS

- OMPS-LIMB 2022
- LIBERA 2027
- OMPS-LIMB 2027
- OMPS-LIMB 2032

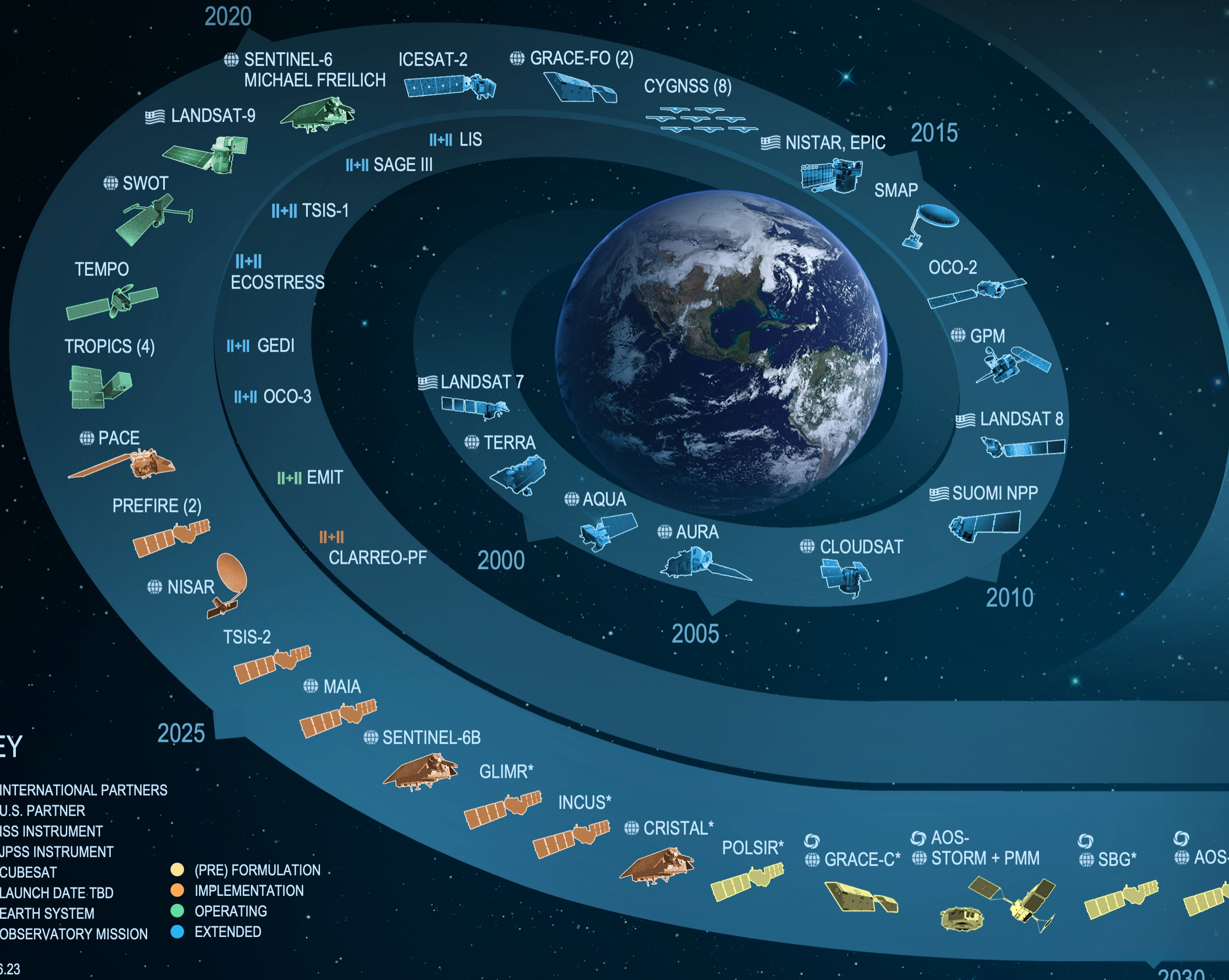
ISS INSTRUMENTS

MISSIONS

KEY

- INTERNATIONAL PARTNERS
- U.S. PARTNER
- ISS INSTRUMENT
- JPSS INSTRUMENT
- CUBESAT
- LAUNCH DATE TBD
- EARTH SYSTEM
- OBSERVATORY MISSION

- (PRE) FORMULATION
- IMPLEMENTATION
- OPERATING
- EXTENDED



**Launched Feb 8, 2024:
PACE!**



Built at NASA Goddard in Greenbelt

- Team effort ~300 managers, engineers, scientists
- 10 years to build and launch
- Cost: \$948M
- Polar orbit
- ~420 miles above Earth

Antonio Mannino, PACE
Deputy Project Scientist with
life-sized PACE replica outside
the Goddard clean room

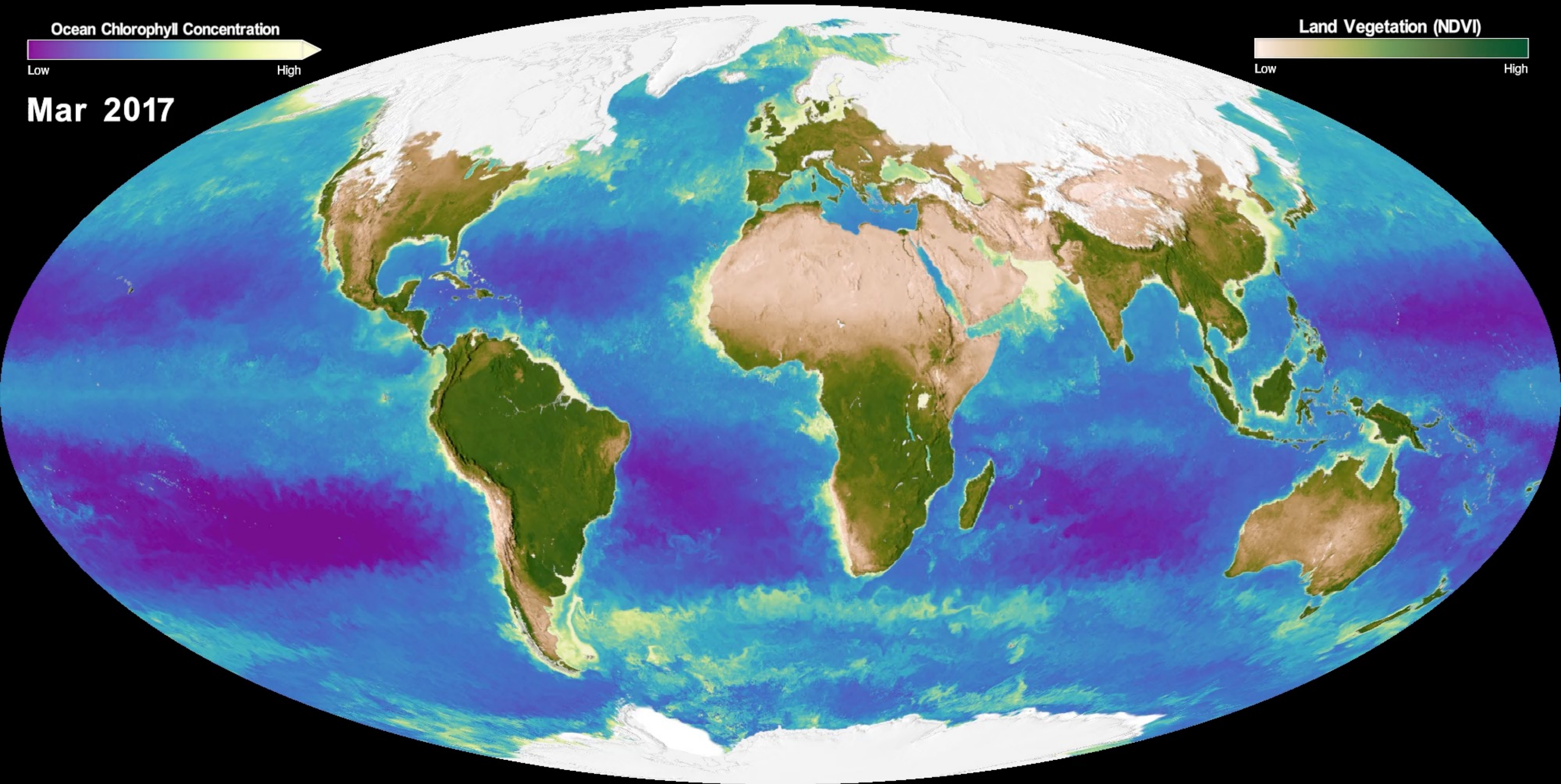


Ocean Chlorophyll Concentration



Mar 2017

Land Vegetation (NDVI)



Applied Uses of Ocean Color

Toxic algae's return to Utah Lake could force it to close for holiday



Credit: Santa Barbara Mariculture

'The commercial fishing business is not easy. As the ocean is warming, stocks are shifting northward. People who survive in this business are using this technology to find fish more efficiently, comply with all the rules and regulations and limit bycatch and waste.'

~ Capt. Bill Bright, Northwest Atlantic fishing fleet

Chesapeake Bay water quality project

Working with Maryland Dept of Environment shellfish division, UMD, NOAA to combine sampling of biology, chemistry, physics with optical measurements (in water, above water, satellite)



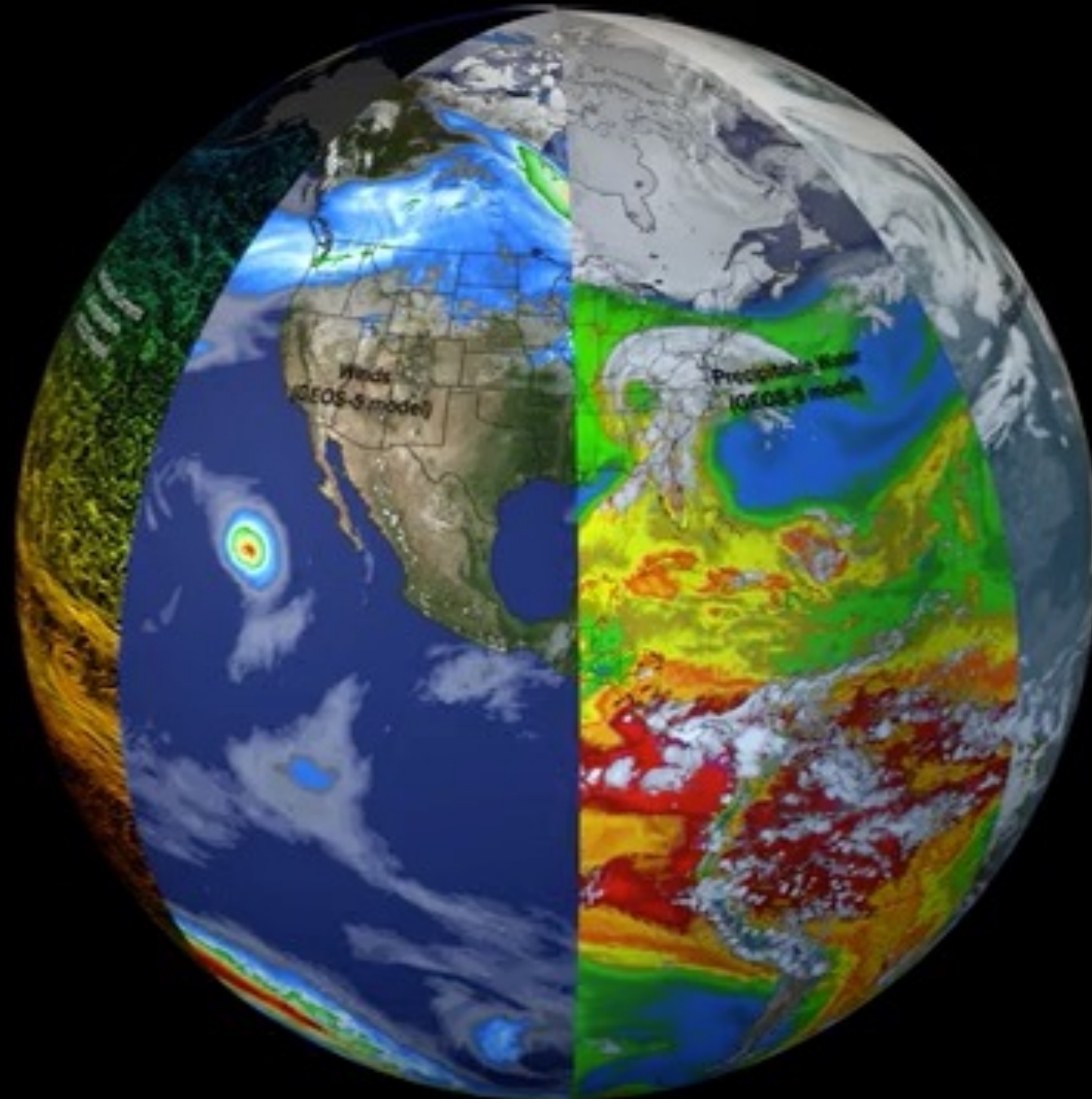
- Aquaculture is a growing industry world-wide
- Remote sensing may provide early warning of harmful algal blooms and polluted run-off that cause shellfish bed closures
- Remotely sensed optical techniques are being explored
- Developing AI for water quality

Photo credit: John 'Rusty' McKay/MDE

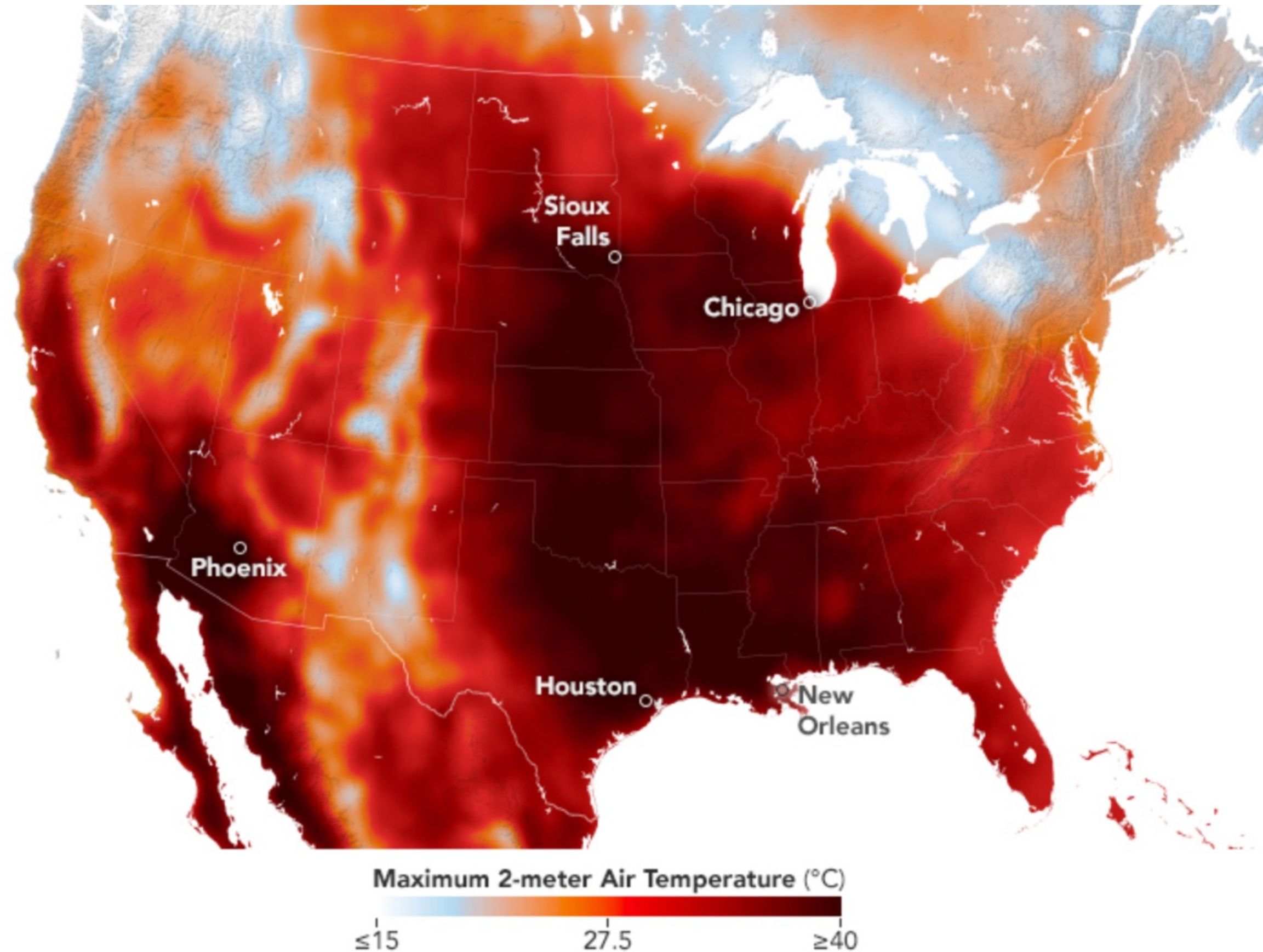
Partners:



Earth System

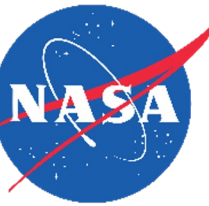


Summer 2023 extreme temperatures and humidity across U.S.

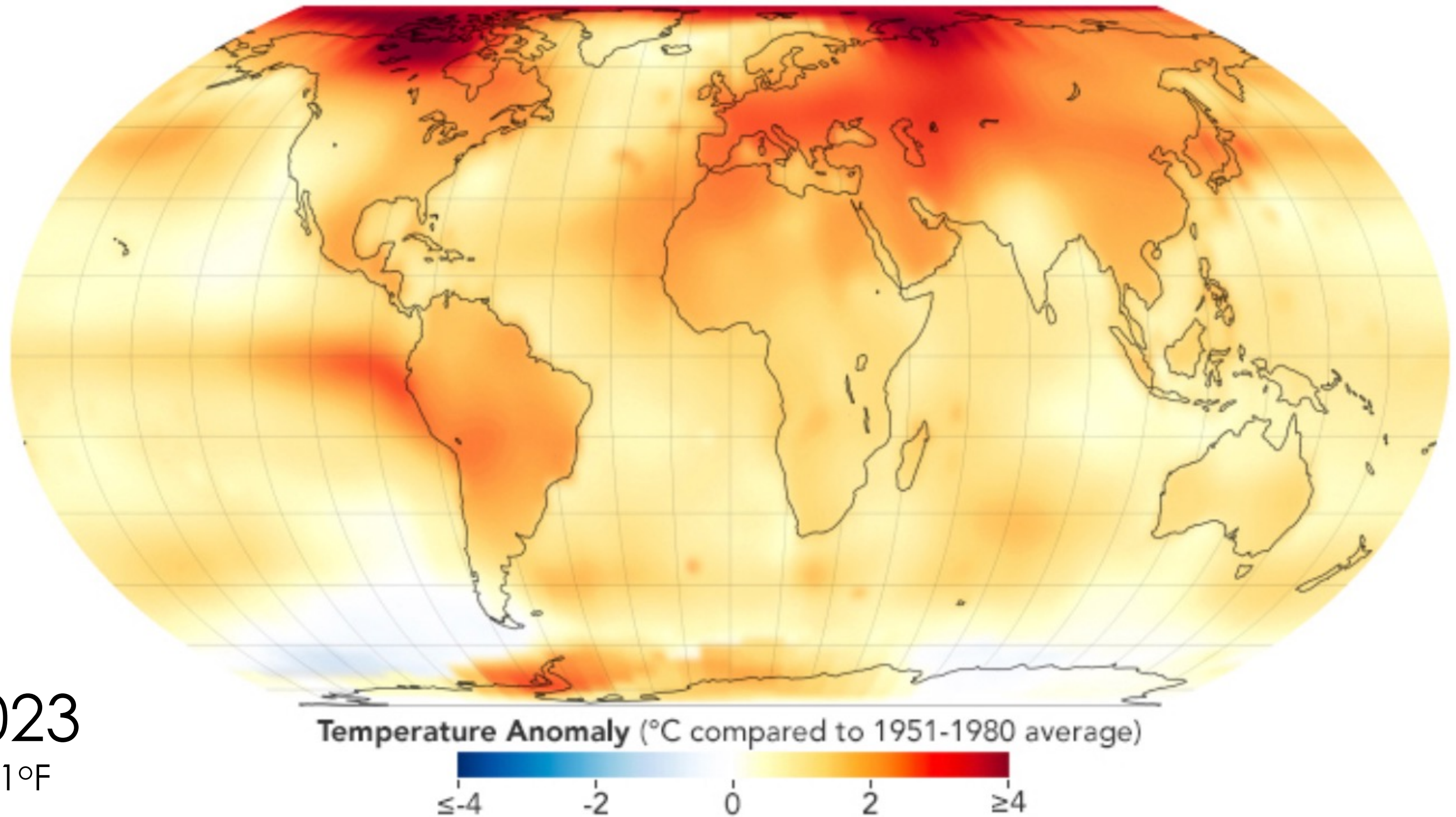


Source: NASA Earth Observatory Image of the Day for August 26, 2023

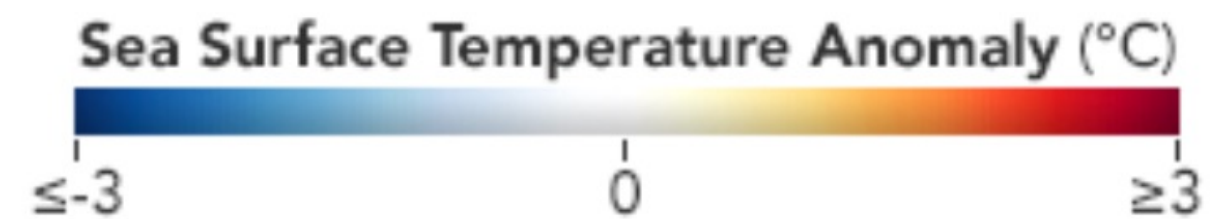
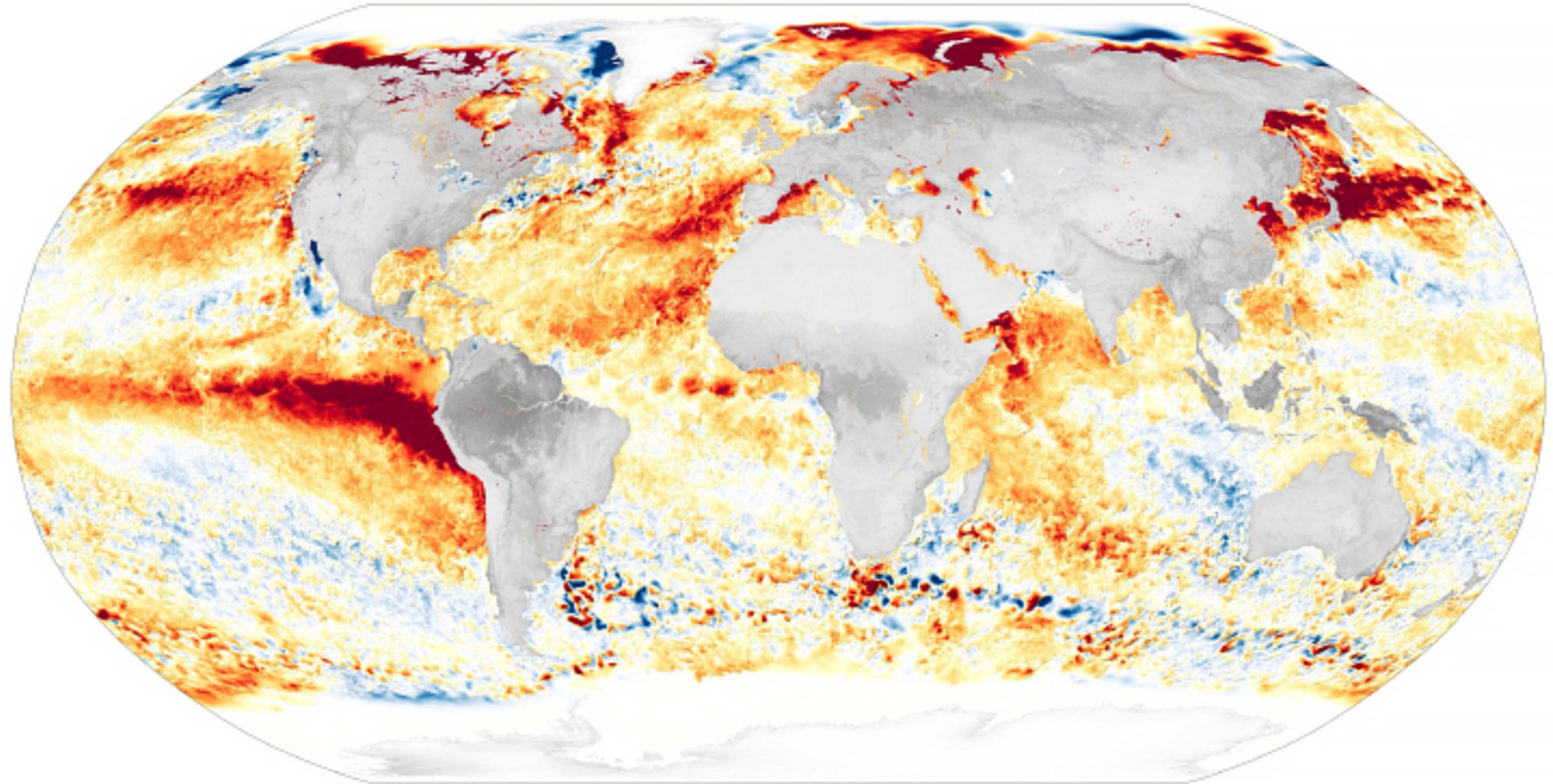
Last 10 years warmest on record



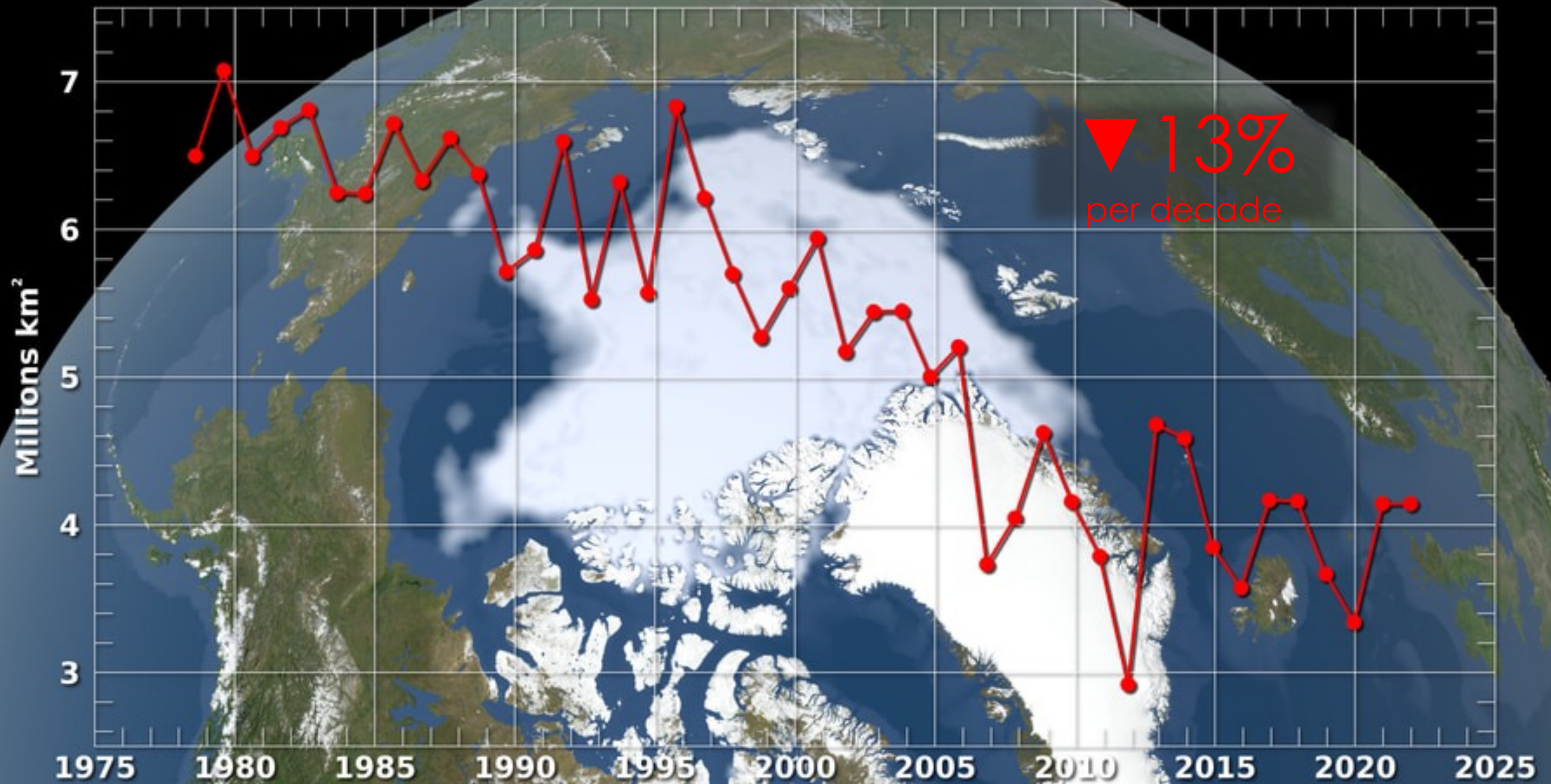
2023
2.1°F

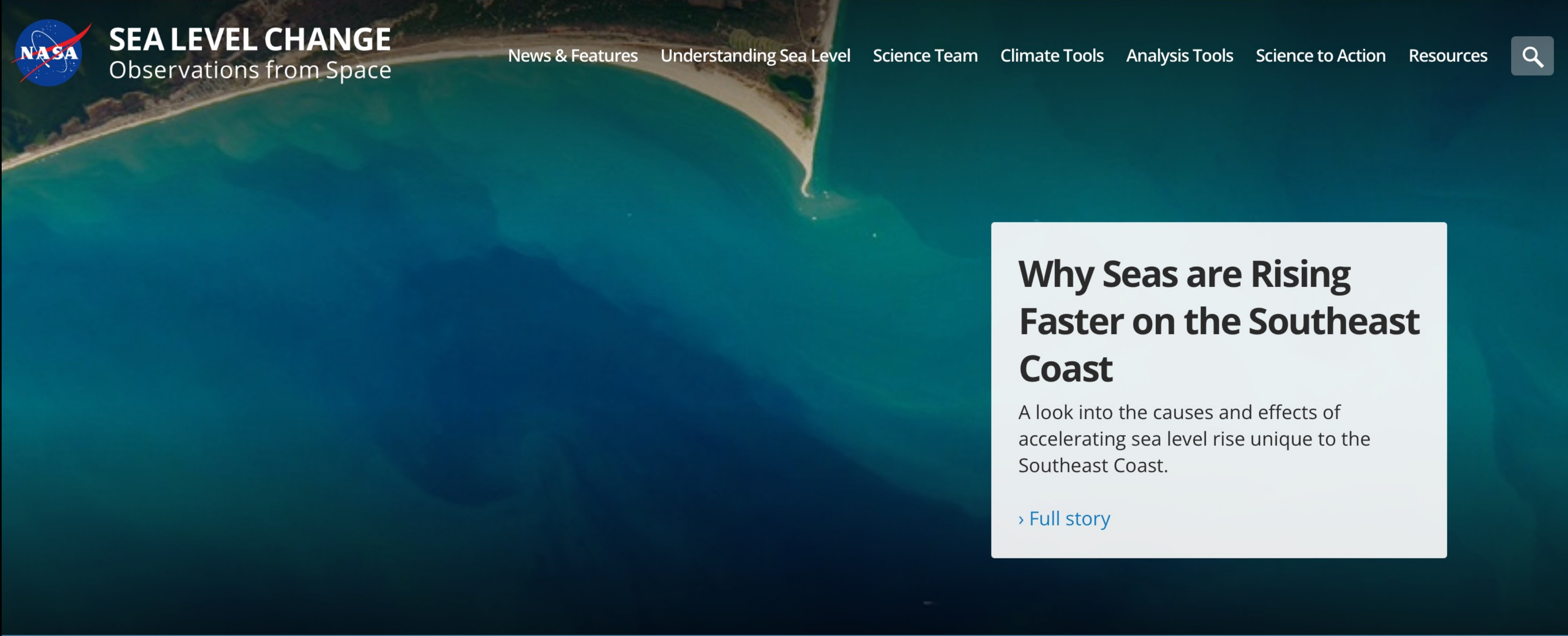


Global sea-surface temperatures are also at record high



Arctic sea ice extent shrinking





SEA LEVEL CHANGE

Observations from Space

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Why Seas are Rising Faster on the Southeast Coast

A look into the causes and effects of accelerating sea level rise unique to the Southeast Coast.

[Full story](#)

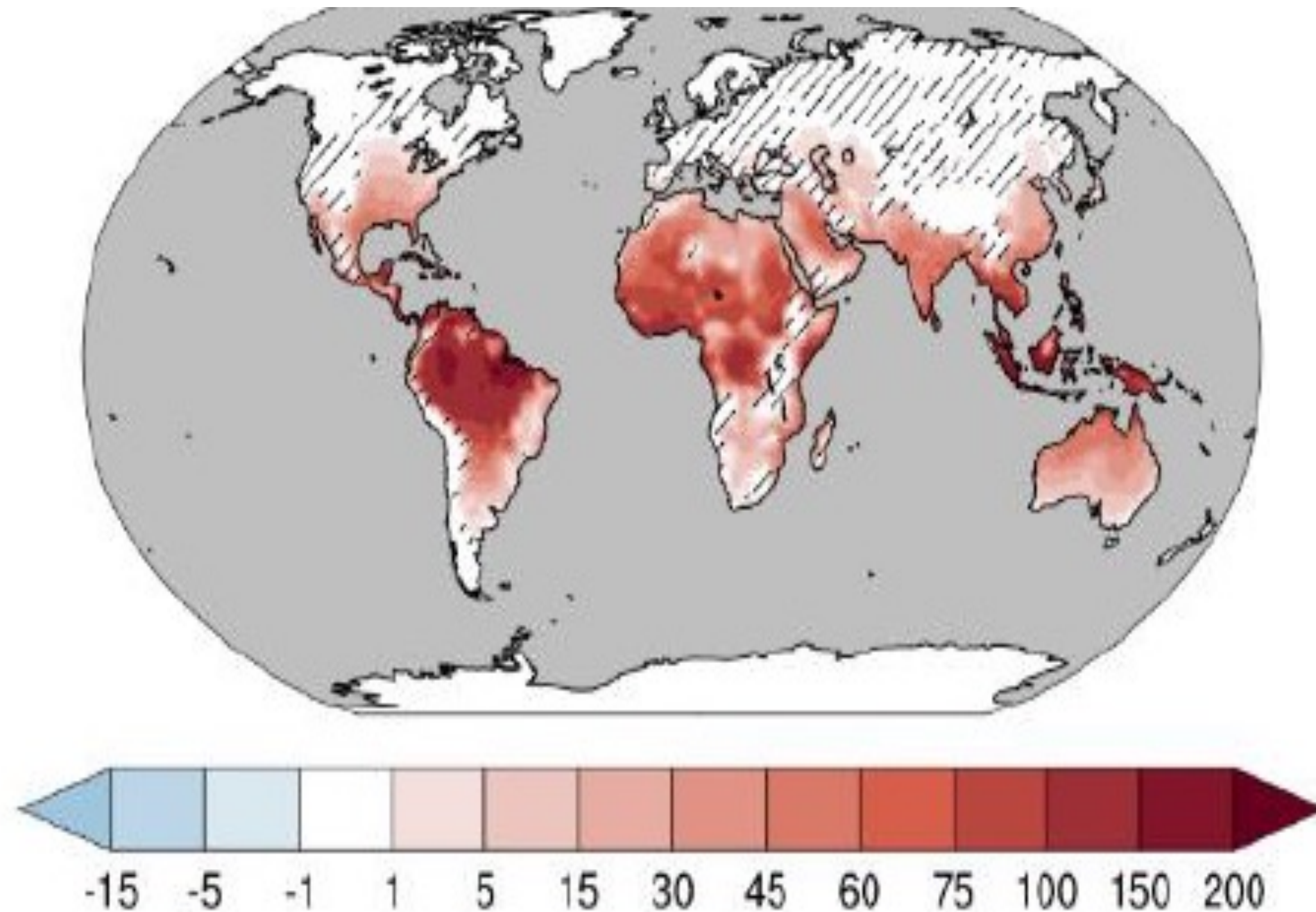
GLOBAL MEAN SEA LEVEL ↑ 100.5 mm since 1993	OCEAN MASS ↑ 2 ± 0.3 mm/yr	STERIC HEIGHT ↑ 1.3 ± 0.2 mm/yr	GREENLAND ICE MASS CHANGE ↓ 269 ± 21 Gt/yr	ANTARCTICA ICE MASS CHANGE ↓ 142 ± 39 Gt/yr	
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// NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP-CMIP6)

The NEX-GDDP-CMIP6 dataset is comprised of global downscaled climate scenarios derived from the General Circulation Model (GCM) runs conducted under the Coupled Model Intercomparison Project Phase 6 (CMIP6) and across all four "Tier 1" greenhouse gas emissions scenarios known as Shared Socioeconomic Pathways (SSPs). The CMIP6 GCM runs were developed in support of the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR6). This dataset includes downscaled projections from ScenarioMIP model runs for which daily scenarios were produced and distributed through the Earth System Grid Federation. The purpose of this dataset is to provide a set of global, high resolution, bias-corrected climate change projections that can be used to evaluate climate change impacts on processes that are sensitive to finer-scale climate gradients and the effects of local topography on climate conditions.

Outdoor heat tolerance threshold will be more frequently exceeded



Change in the Number of days per year with dangerous Heat Index
Mid-century under a high emissions pathway

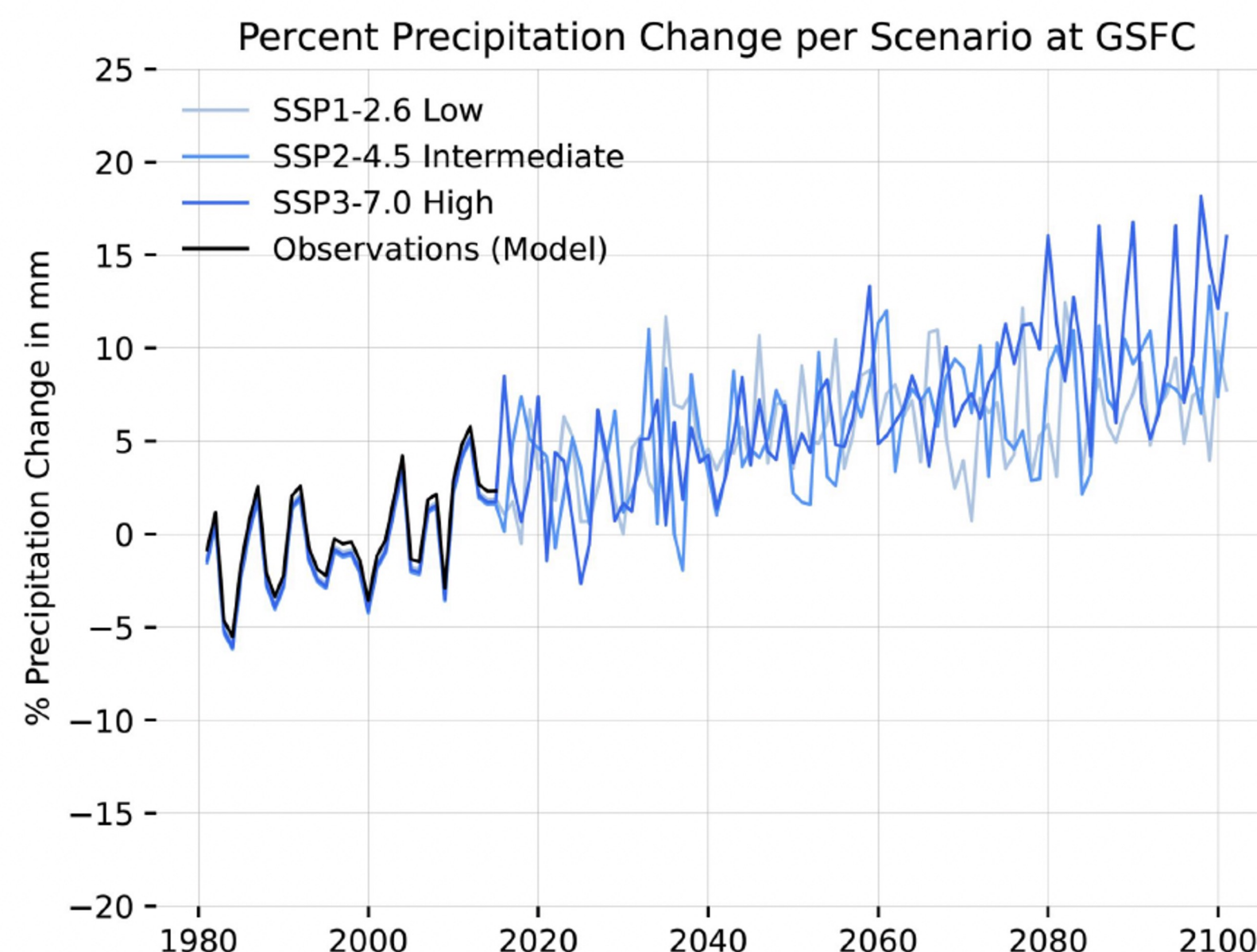
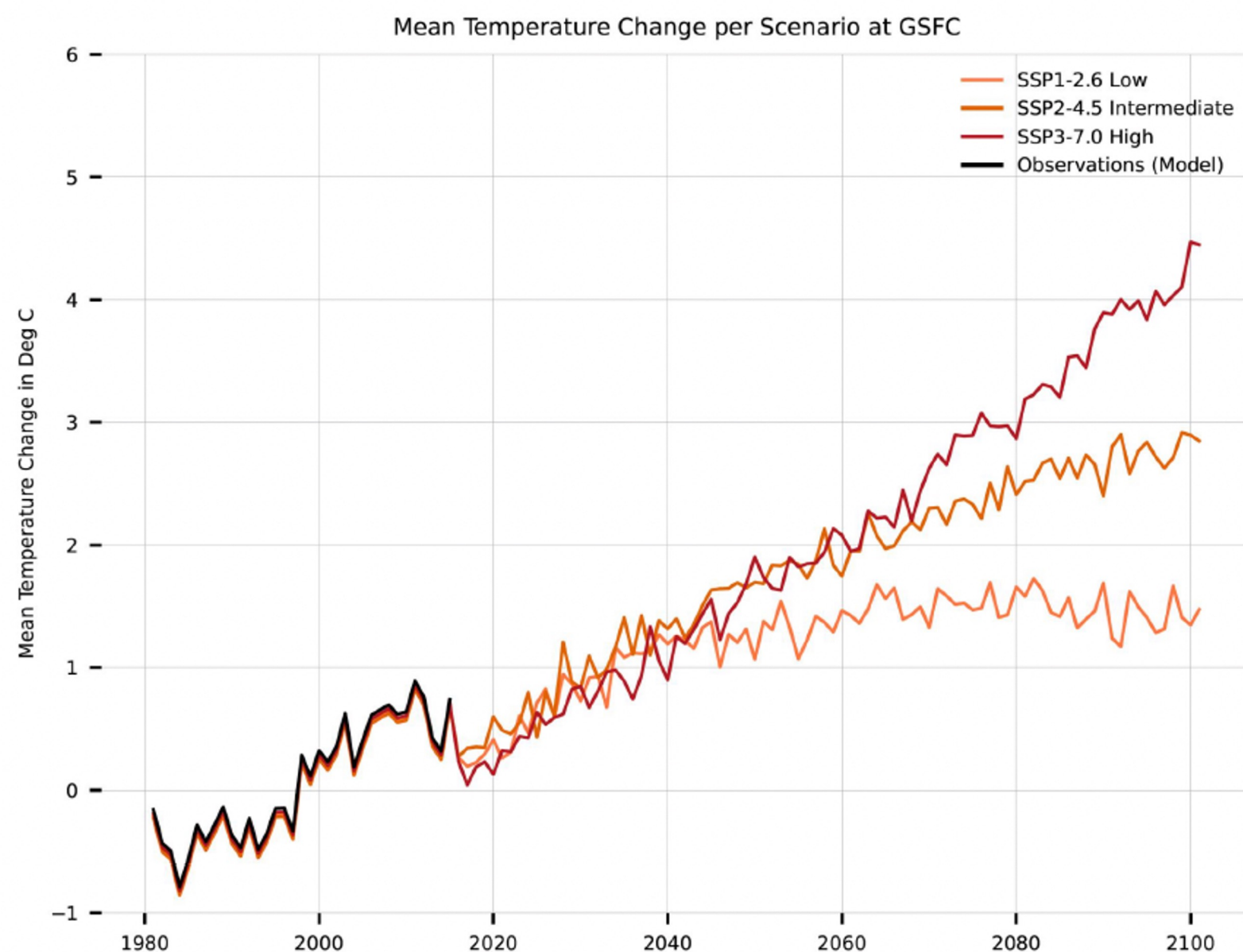
- Each category of climate information can be further elaborated with useful indices and metrics
- *Important to consider connected extremes: compound, sequential, simultaneous*

Bottom line:

- To produce climate information relevant for impacts and risk assessment, identify the types of conditions that drive responses.
- These are contextual and cannot be universally declared 'hazards'
- Work closely with expert partners to determine metrics and thresholds
- Close information gap, recognize strengths and limitations in climate risk understanding

GSFC Temperature and Precipitation Projections

*Baseline
1981-2020*



- Work with communities around NASA Goddard to apply relevant global climate information
- Understand priorities of Prince George's County Department of Environment and where NASA data might fill gaps, i.e. Climate Action Plan
- Learn about local climate information needs, particularly around:
 - Assess temperature trends, including heat islands
 - Tree canopy prevalence
 - Extreme precipitation events and associated flooding
 - Sea level rise and tidal flooding
- Heat risk pilot project in formulation
- Separate project working on flood risk projections and validation

PRIORITY RECOMMENDATIONS

A-1 INTEGRATE CLIMATE RESILIENCE CRITERIA INTO LONG-RANGE COUNTY PLANS, POLICIES, AND CIP PROGRAMS BY 2026

A-2 IMPLEMENT CLIMATE RESILIENT STORMWATER MANAGEMENT AND EXPAND FLOOD MITIGATION PROGRAMS

A-3 PRIORITIZE PRESERVING AND RESTORING NATURAL RESOURCE AREAS AND AGRICULTURAL OPEN SPACE TO REDUCE FLOOD RISK

A-4 EVALUATE AND ADDRESS CLIMATE RISK TO DAMS AND LEVEES

A-5 REQUIRE COMMUNITY-WIDE CLIMATE RESILIENT GREEN INFRASTRUCTURE

A-6 EXPAND INFORMATION AND ASSISTANCE TO THE PUBLIC REGARDING IMPACTS OF CLIMATE RISKS AND OPPORTUNITIES TO IMPLEMENT CLIMATE ACTIONS

A-7 REDUCE EXPOSURE OF VULNERABLE POPULATIONS TO EXTREME HEAT

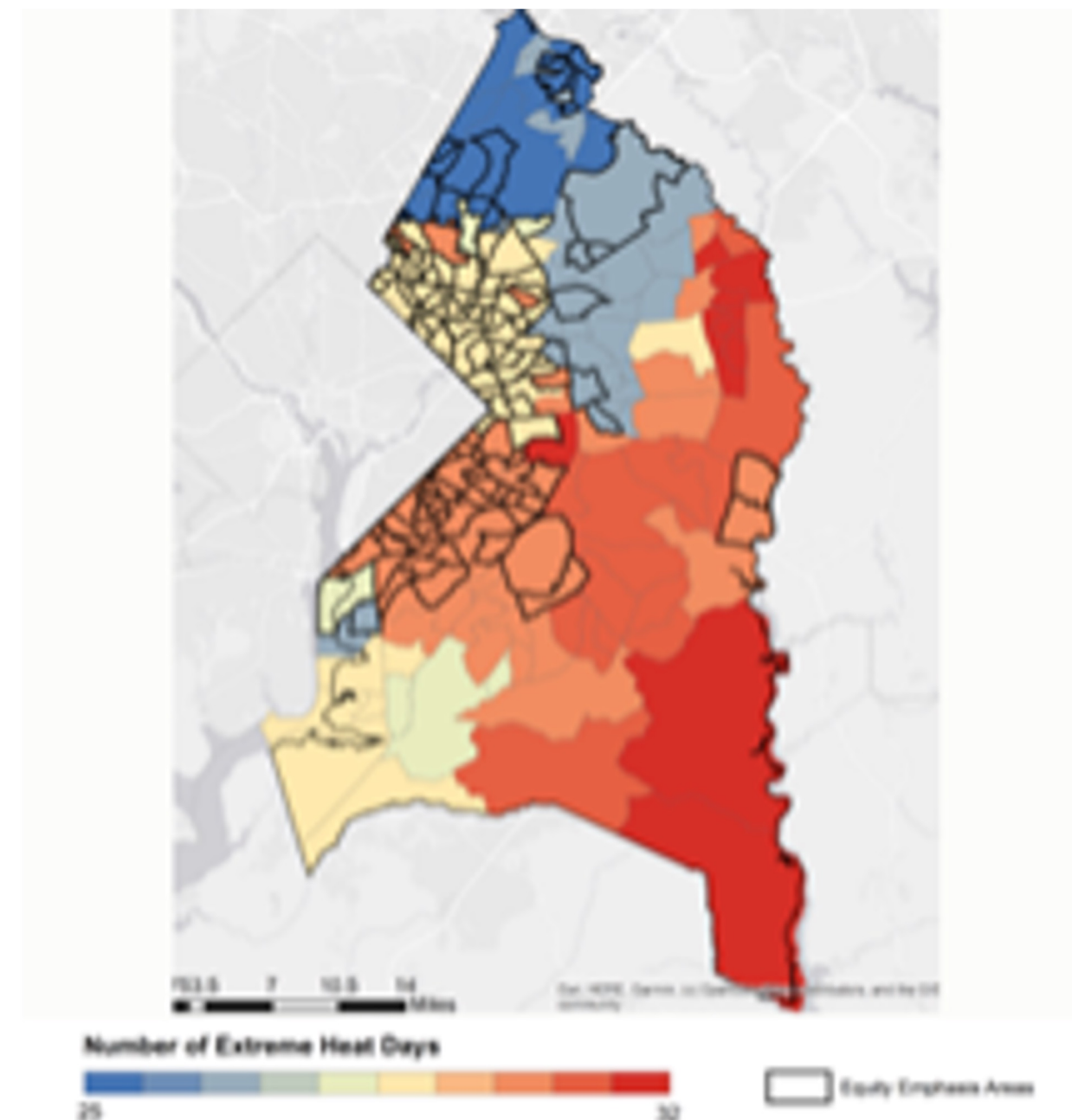
A-8 ESTABLISH RESILIENCE HUBS TO SERVE THE NEEDS OF VULNERABLE COMMUNITIES.

A-9: ADOPT CODES, STANDARDS, AND PRACTICES TO SUPPORT CLIMATE-READY, GREEN BUILDINGS, AND DEVELOPMENT

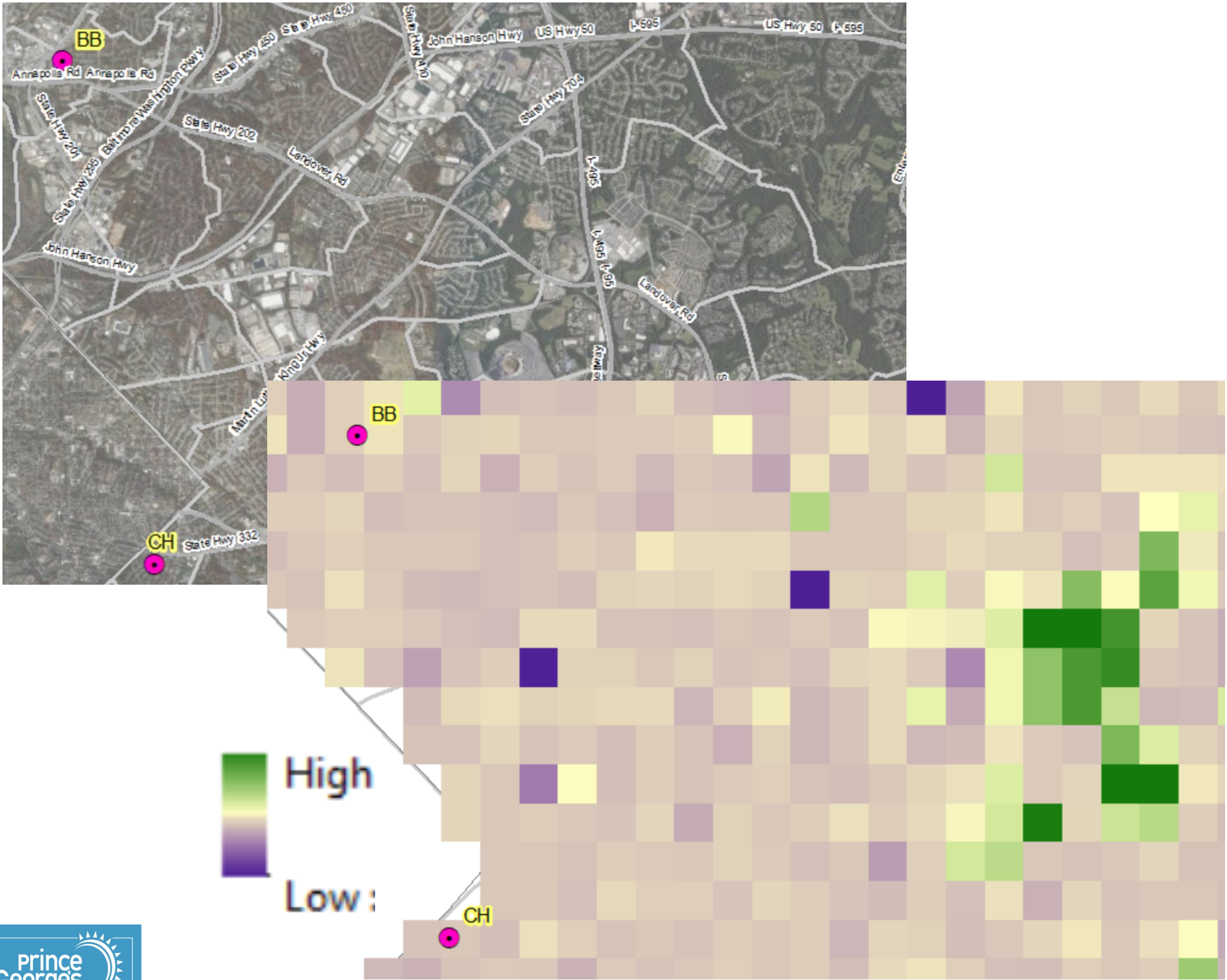
A-10: PROMOTE A HEALTHY FOOD SYSTEM SUPPORTED BY LOW-CARBON, REGENERATIVE AGRICULTURAL PRACTICES

Established regular meetings with Prince George's County Department of Environment:

1. Survey NASA data relevant to temperature, land use, tree canopy
2. What environmental data does County currently use? Can NASA data can augment information gaps?
3. Are any satellite data adequate given spatial resolution, revisit, and duration of record?
4. Design a pilot study around heat distribution and trends across County over 20 years.



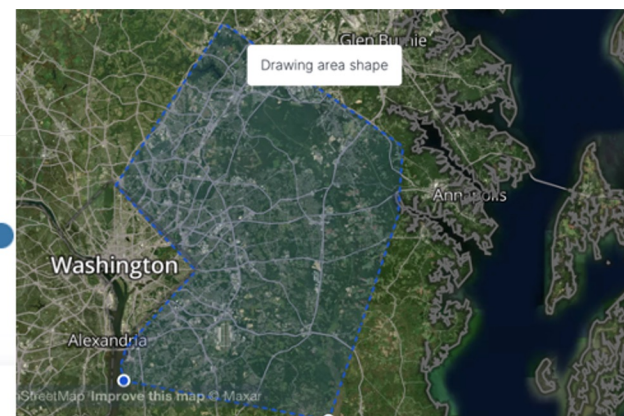
Rec #	Recommendation	Within County Control	Existing Initiative Alignment	Technical Feasibility	Cost Effectiveness	Timeline (Years)	Co-Benefits
A-7	Reduce exposure of vulnerable populations to extreme heat	●	●	●	●	0-4	



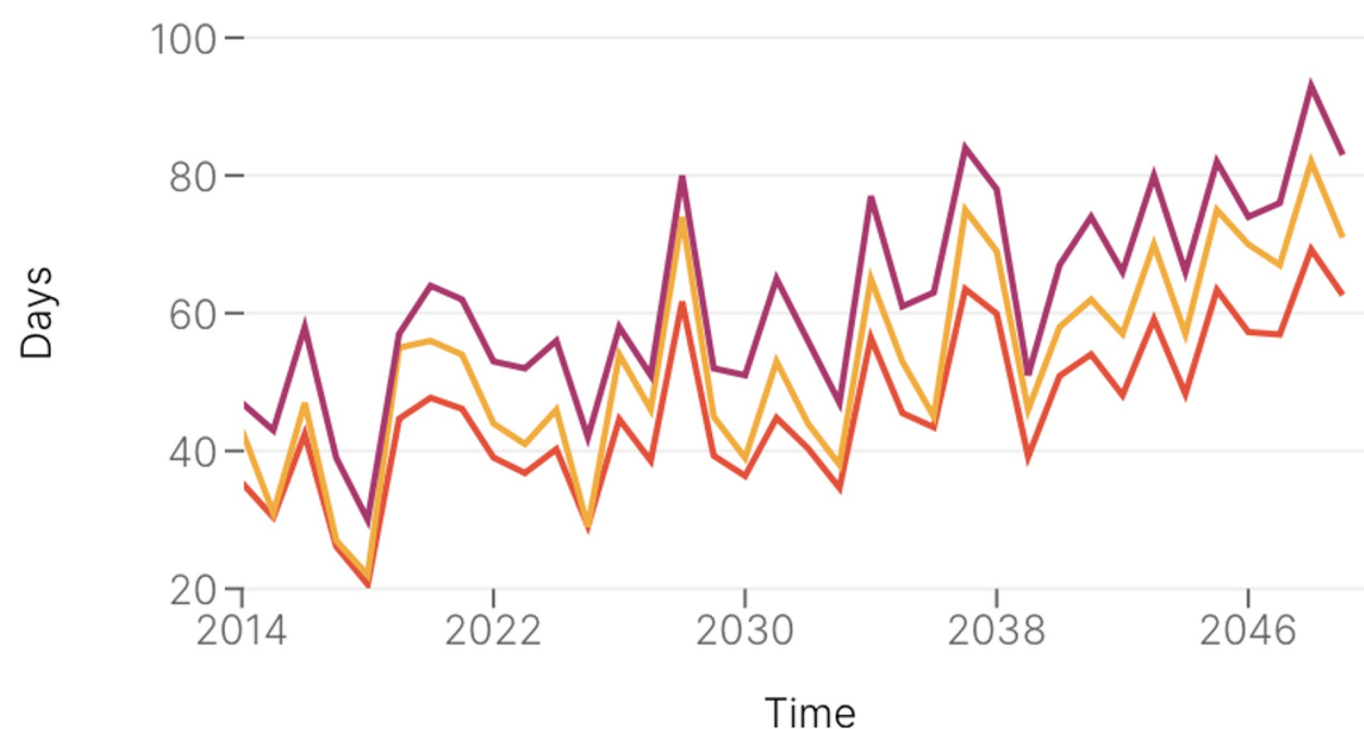
Purple areas have decreased vegetation

Green areas increased vegetation

LEGEND ● Min ● Average ● Max ● St Deviation ●



Days Above 90°F (SSP245)



1. Retrospective assessment serves Climate Action Plan implementation, helps us learn County needs
2. Longer-term objective to provide climate model projections, ranges and uncertainties
3. Goal to co-produce downscaled product that informs climate resilience decisions as a proof-of-concept

Number of extreme heat days in Prince George's County, MD near NASA Goddard. Source: NEX-GDDP-CMIP6 from earth.gov

Validating climate models against historical precipitation data

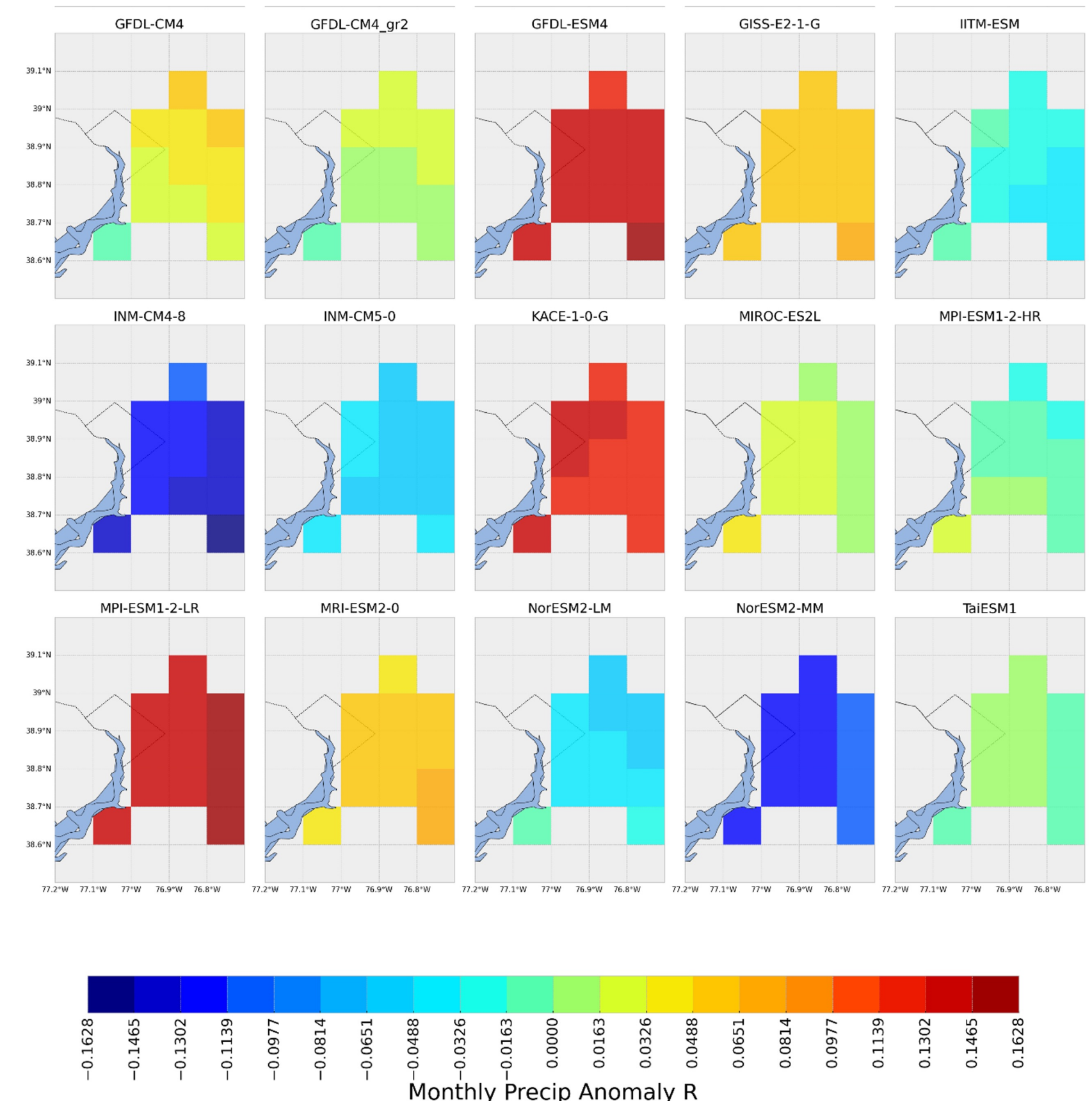
For Prince George's County, Maryland:
climate models (intermediate emissions SSP2-4.5)
vs satellite-derived precipitation observations:
period: 2001-2014 (168 months)
spatial resolution: 10km x 10km bins

Method:

Calculated monthly 14-year averages
Subtracted monthly climatology for anomalies
Computed correlation between anomalies
(CMIP6 model vs IMERG satellite derived data)

Results:

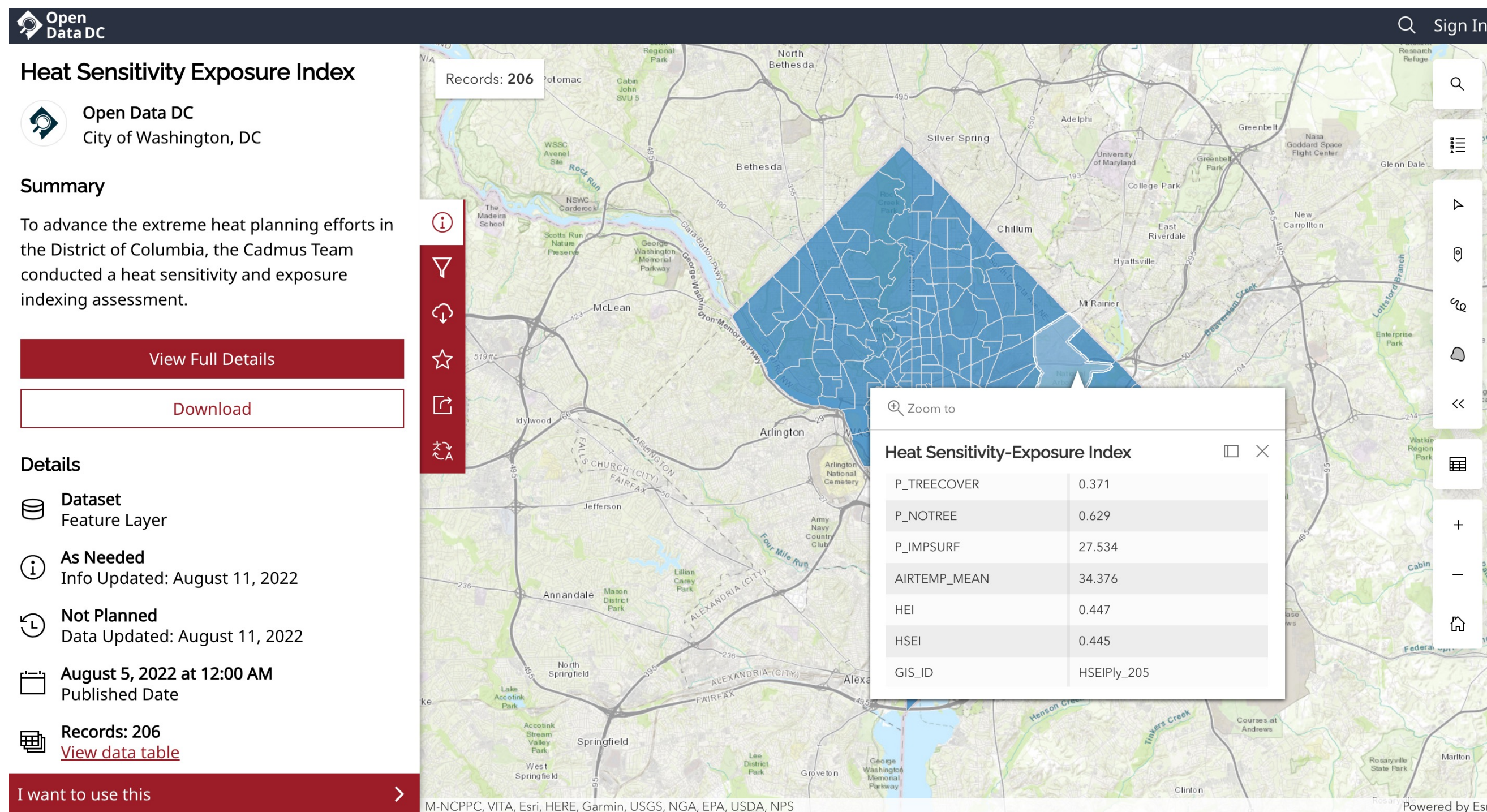
Red indicate CMIP6 models most consistent with
satellite observations



“All models are wrong; some are useful.”

Washington, DC – Heat Sensitivity Exposure Index

- Cadmus Team conducted a heat sensitivity and exposure indexing assessment for extreme heat planning
- Index combines a Heat Sensitivity Index and a Heat Exposure Index allowing users to visualize census tracts most heat exposed
- Heat Sensitivity Index made up of variables that influence an individual's ability to adapt, cope, or recover from extreme heat.
- Heat Exposure Index includes ambient air temperature as the heat exposure variable and two physical variables that contribute to heat retention (i.e. impervious surfaces and lack of tree canopy cover).



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