



Air Quality

HOUSTON REGIONAL SUMMIT

**Welcome to the 2026 Houston
Regional Air Quality Summit!**



Houston-Galveston
Area Council

Opening Logistics



Dr. Meredith Jennings
Director, Local Govt. &
Community Initiatives,
Houston Advanced Research
Center

Agenda at a Glance

Time	Activity
9:00 a.m.	Coffee Networking + Registration + Opening
10:00 a.m.	The Region's State of Air Quality
11:00 a.m.	From Planning to Action: Implementation in Practice
11:40 a.m.	Networking Activity & Exhibits Session
12:00 p.m.	Lunch & Networking
1:00 p.m.	8 Dynamic Breakout Sessions
3:40 p.m.	AI & Air Quality
3:55 p.m.	Closing Reflections



**Scan to view our
digital full
agenda and plan
your day!**

Venue Logistics

Restrooms

Located in Hallway to the Left of the Main Stage (O'Quinn Great Hall)

WiFi

Network name: UHGuest

Student Poster Showcase



Life Member Room (Enter to Left of Main Hall)

Supporting Partner Exhibits



HARC



 Life Member Room (Enter to Left of Main Hall)

Welcome Remarks



Andrew DeCandis

**Air Quality Program
Senior Manager,
Houston-Galveston Area
Council**

Clean Air Action Plan

Set Regional Goals - Clear Vision for cleaner air & healthier communities

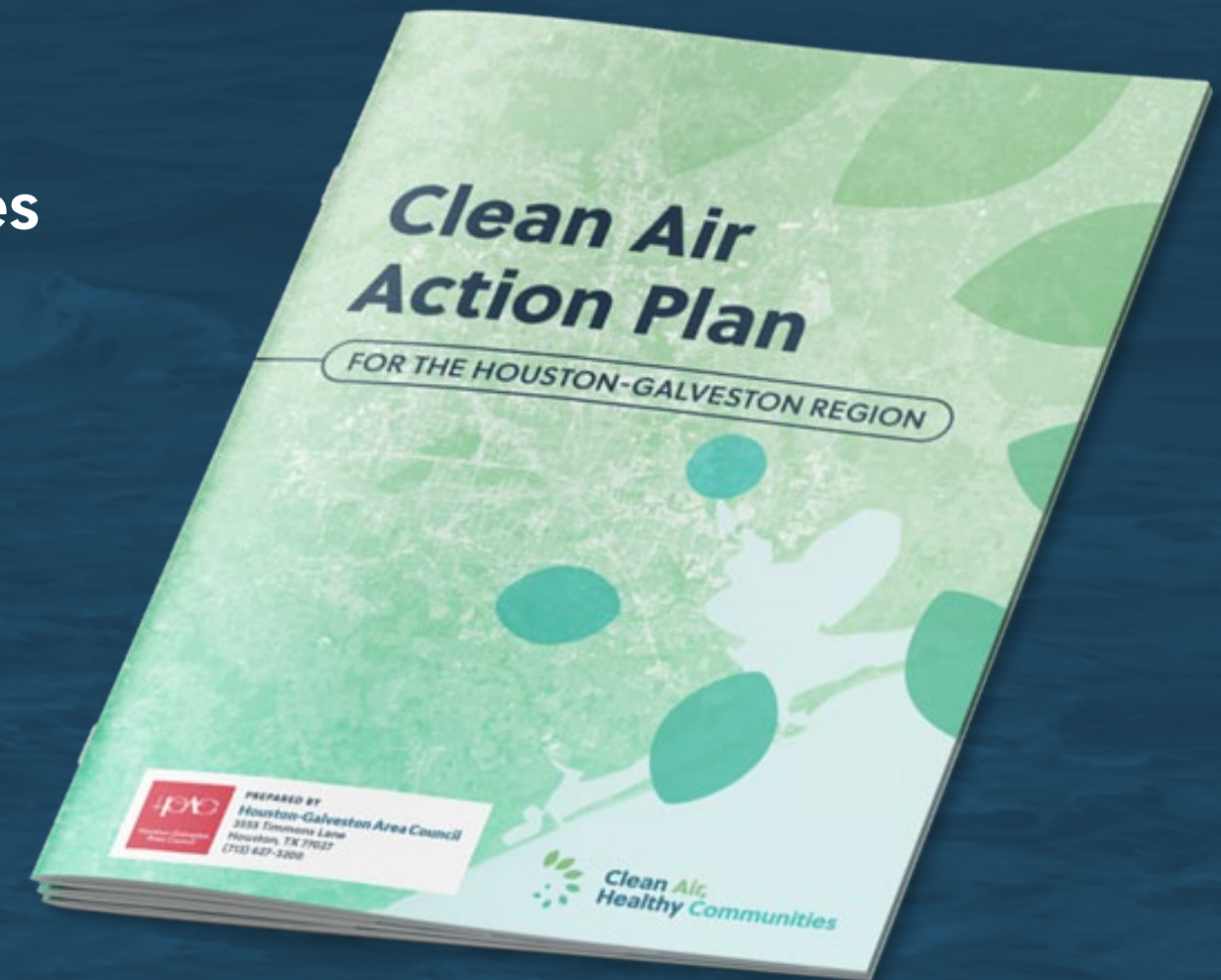
Cut Emissions - Strategies for transportation, industry, and energy

Engage Communities - Public input and equity-focused solutions

Improve Health - Reduce pollution impacts on vulnerable groups

Track Progress - Use data, monitoring, and regular updates

Collaborate & Fund - Partner regionally to secure financial resources for projects



Explore the Clean Air Action Plan today!



Clean Air Action Plan

Set Regional Goals - Clear Vision for cleaner air & healthier communities

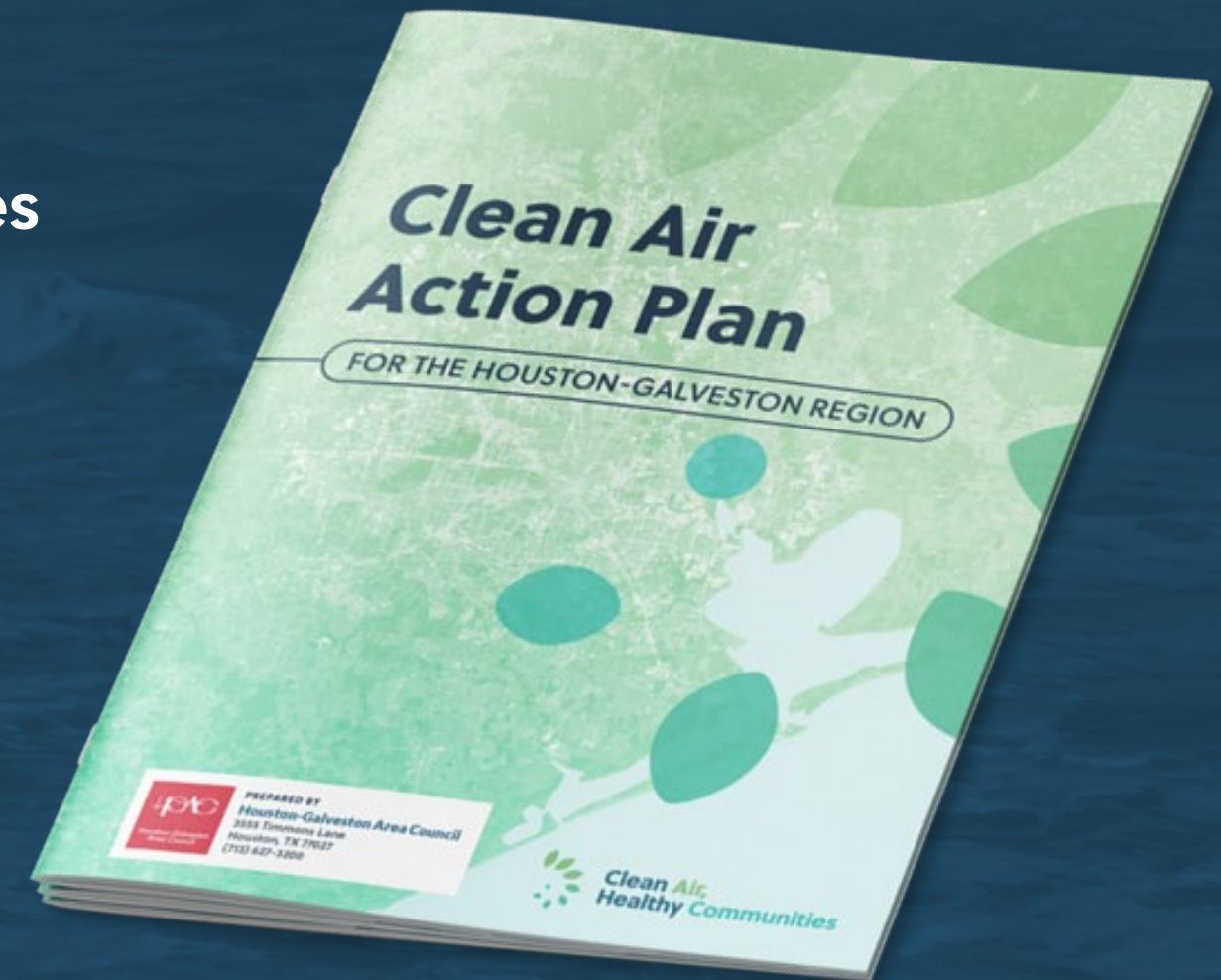
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Explore the Clean Air Action Plan today!



Facility Sponsor Remarks

Dr. Thomas Lapen

**Chair,
Dept. of Earth and
Atmospheric Sciences,
University of Houston**





Welcome to the 2026 Houston Regional Air Quality Summit

Highlights of UH/EAS

(Dept of Earth and Atmospheric Sciences)

Tom Lapen

October 08, 2026



❖ Who we are...



- **164 Undergraduate Students**
- **165 Graduate Students**
- **5 Undergraduate Degree Options**
- **8 M.S./Ph.D. Degree Options**
- **49 Faculty, instructors, and researchers**

❖ What we do...



- **Broad research areas in:**
 - **Atmospheric & Earth Surface Systems**
 - **Energy & Earth Resources**
 - **Earth & Planetary Dynamics**
- **Student education is enhanced by our broad research areas and experiential learning opportunities.**

❖ How to stay connected with EAS

← → ↻ 🔍 https://www.uh.edu/nsm/earth-atmospheric/ ☆ 📁 | T ⋮

UH UNIVERSITY OF HOUSTON 🔍 Visit Apply NSM Home

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EAS students are engaged in field research on seven continents and across the world oceans.

[About Our Department >](#)

❖ How to stay connected with EAS



[Undergraduate Programs ›](#)



[Graduate Programs ›](#)



[Petroleum Short Courses ›](#)

FEATURED NEWS



EAS Celebrates Five Years of Graduate Research Competition

Graduate students in EAS competed in the fifth annual Three-Minute Thesis and Dissertation Competition, with two earning top honors.



UH Researchers Combine Field Measurements and Remote Sensing to Track Methane Emissions

An ETI-funded project aims to separate natural wetland methane from industrial emissions.



Student Field Journal: Environmental & Geophysical Field Camps to Sierra Madera & Meteor Crater 2026

By Pragya Lama, Ph.D. Geophysics Student.



Basin Analysis in the Field: A Trip to the Permian

A field trip to West Texas and Southeastern New Mexico provided an overview of the geology of the Guadalupe, Hueco, and Franklin Mountains.

**Visit our website and sign up for the
department newsletter for more EAS news!**

Visit: <https://uh.edu/nsm/earth-atmospheric/>



❖ Please help support EAS



Thank You to Our Co-Host!



Department of Earth
and Atmospheric Sciences

College of Natural Sciences
and Mathematics

The Region's State of Air Quality

Keynote Address



Lance Wood

**Meteorologist,
Harris County
Flood Control District**

HOUSTON AIR QUALITY

Progress, climate trends, and the challenges ahead

Lance Wood
Harris County Flood Control District



What controls helped clean Houston's air?

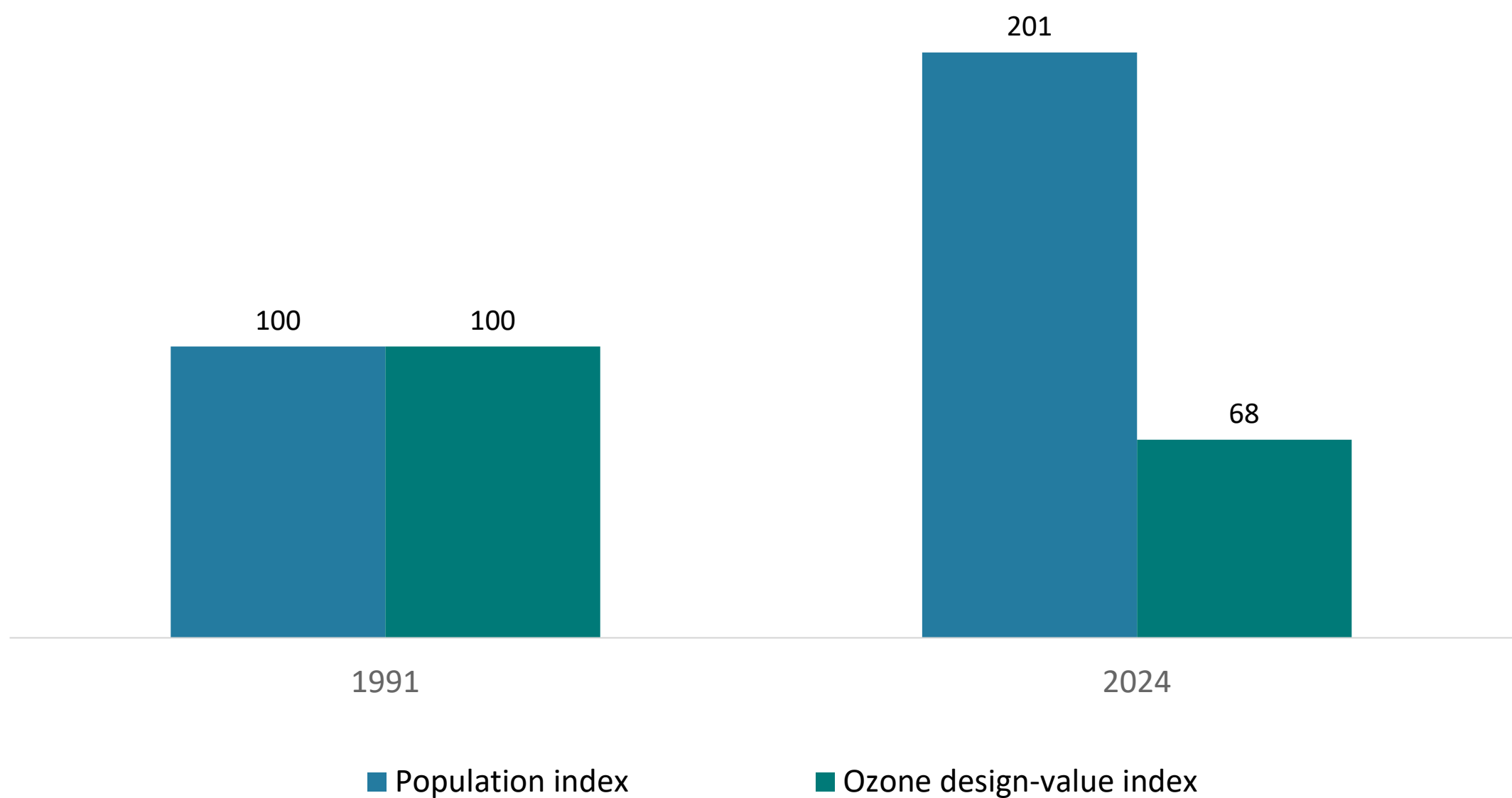
Decades of local, state and federal measures lowered the ozone-forming precursor baseline.



Controls tightened in waves as standards became more protective and Houston remained in ozone nonattainment.

Result: a much lower emissions baseline — so today's highest-ozone episodes depend more on weather and transport.

Cleaner air, greater weather sensitivity



Controls worked

The ozone design value fell about 32% while regional population grew about 100%.

The remaining peaks

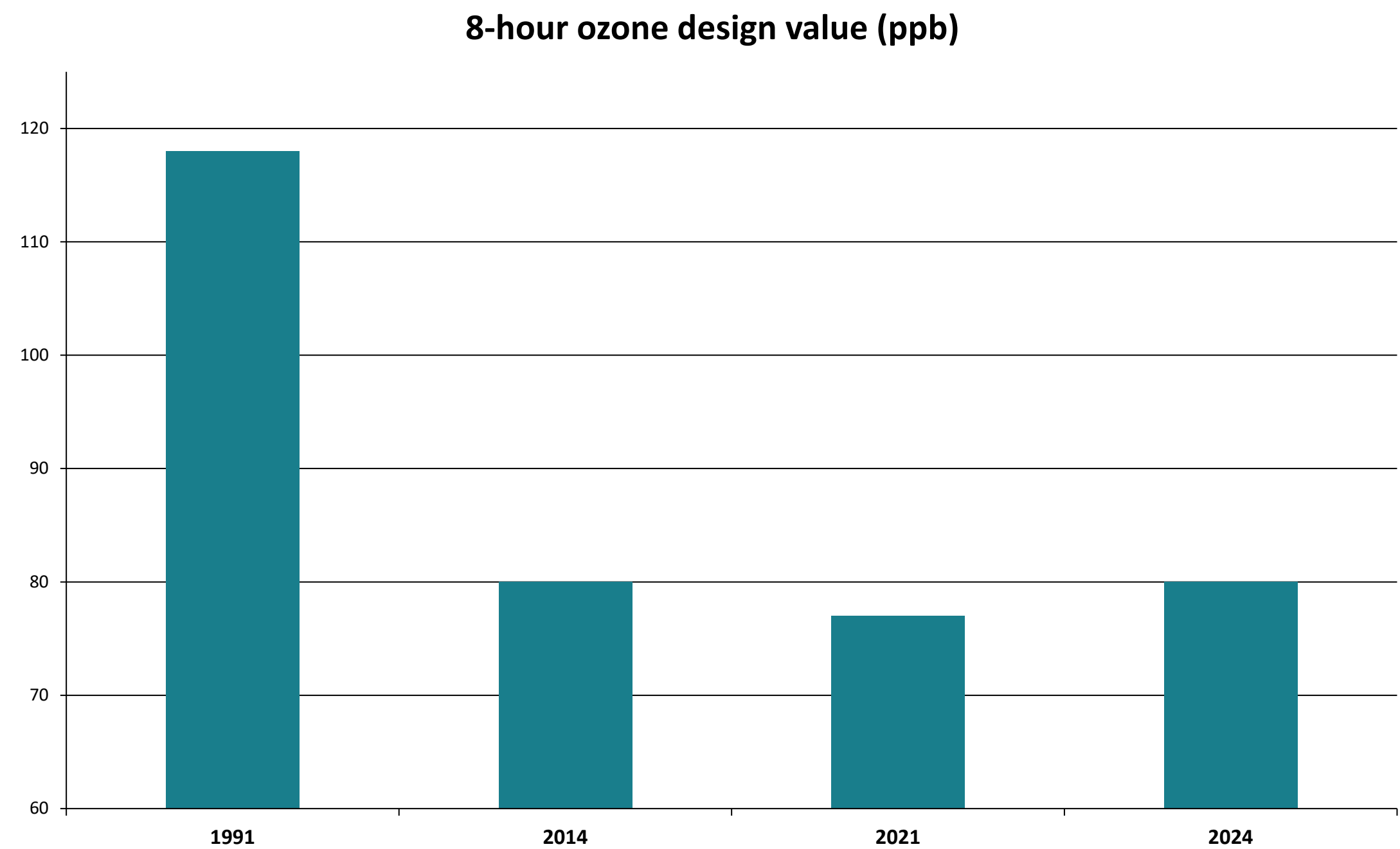
High days depend more on specific combinations of heat, sunlight, stagnation and coastal transport.

WHAT “INDEX = 100” MEANS

1991 is set equal to 100 for both series.
Population 100 → 201 = roughly doubled.
Ozone 100 → 68 = about 32% lower.

Ozone design value = EPA’s regulatory metric: **the 3-year average of each year’s 4th-highest daily maximum 8-hour ozone concentration.**

Houston ozone: major progress, but still above today's standard



THE STANDARDS TIGHTENED

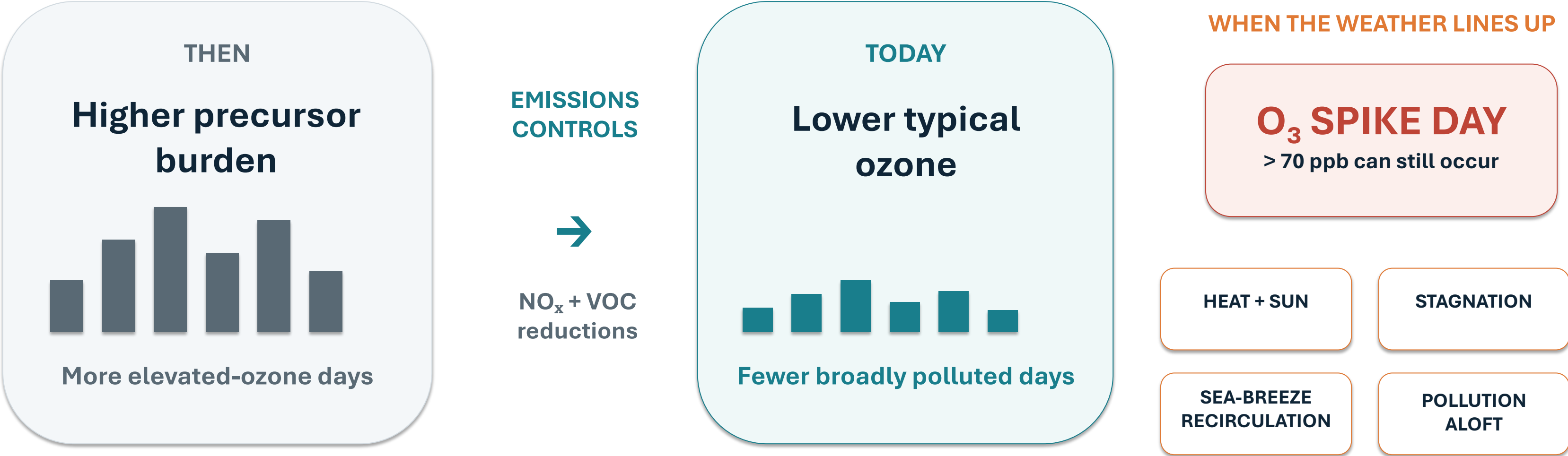
1997: 84 ppb
2008: 75 ppb
2015: 70 ppb

The long-term improvement is real: TCEQ reports the HGB design value fell about 32% from 1991–2024 even as population roughly doubled.

Design value = 3-year average of each year's 4th-highest daily maximum 8-hour ozone.

TCEQ HGB ozone design-value trend; EPA AQS. 1991/2024 bars align with TCEQ's reported 32% decline; 2014=80 ppb and 2021=77 ppb are published TCEQ values.

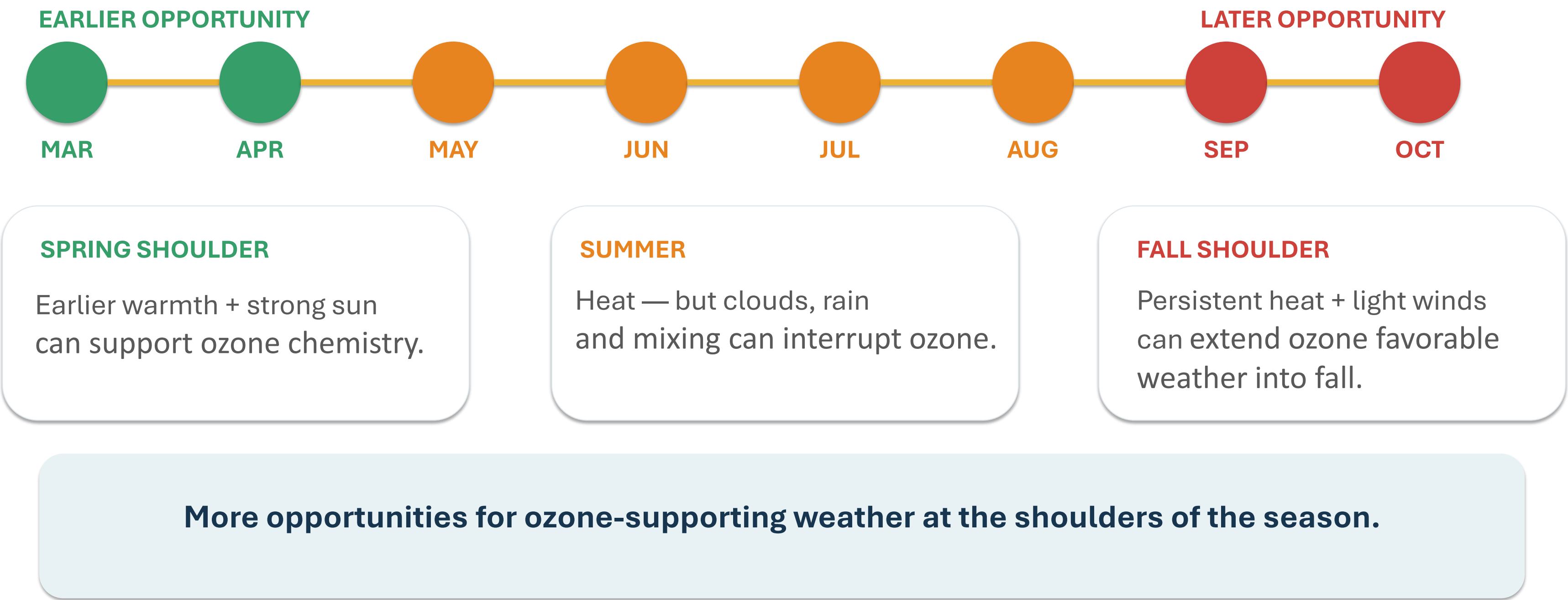
Cleaner overall - but weather increasingly determines the bad days



Cleaner air has reduced the frequency of high-ozone days. The remaining exceedances increasingly depend on whether heat, sunlight, stagnation and Houston’s coastal circulation line up.

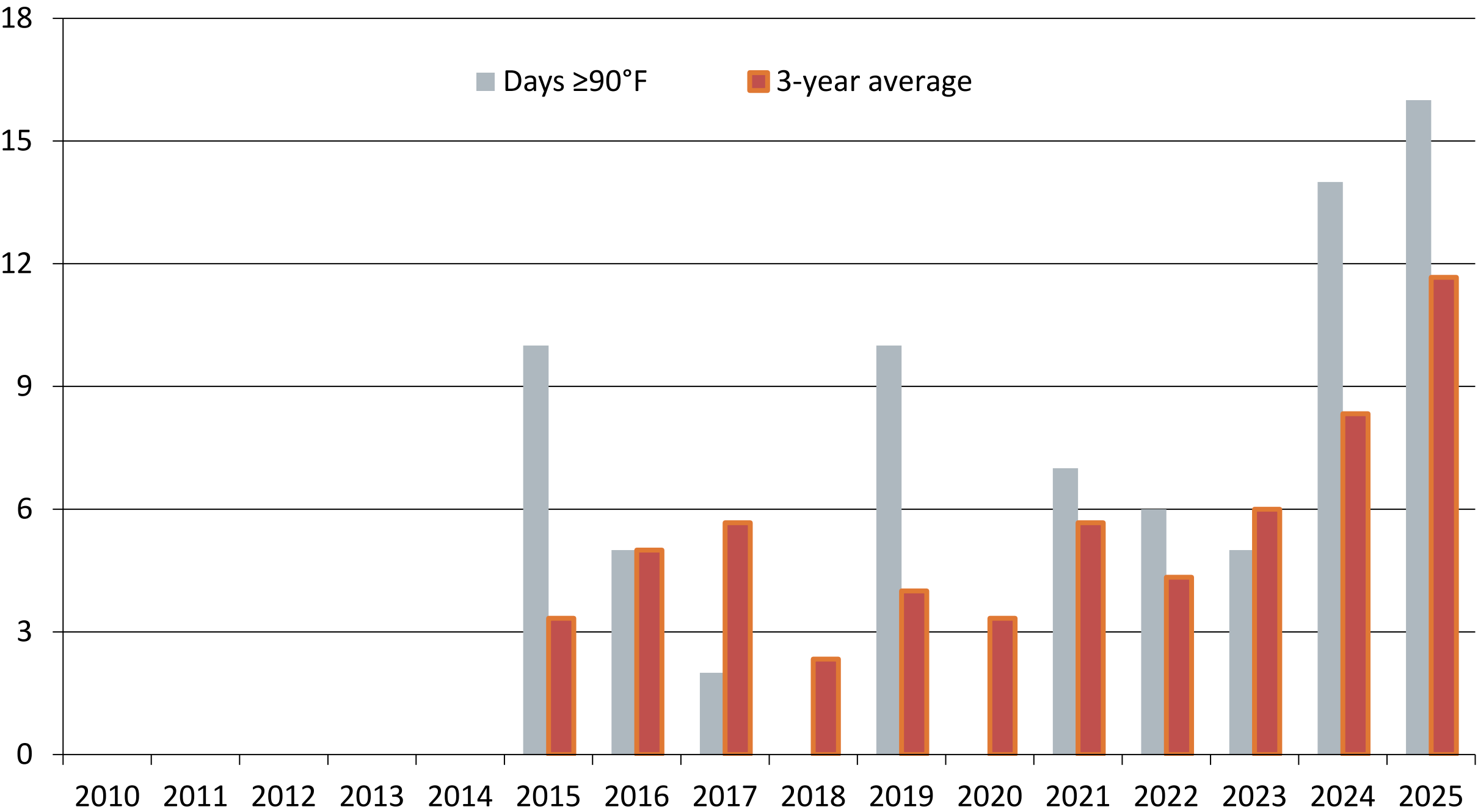
A warming climate is stretching Houston’s ozone-weather window

More warm, sunny days at the edges of the season create more opportunities for ozone-favorable weather.



TCEQ: Houston ozone-favorable conditions occur primarily March–October; Houston ozone forecasting extends through November.

October 90°F days: late-season heat is increasing



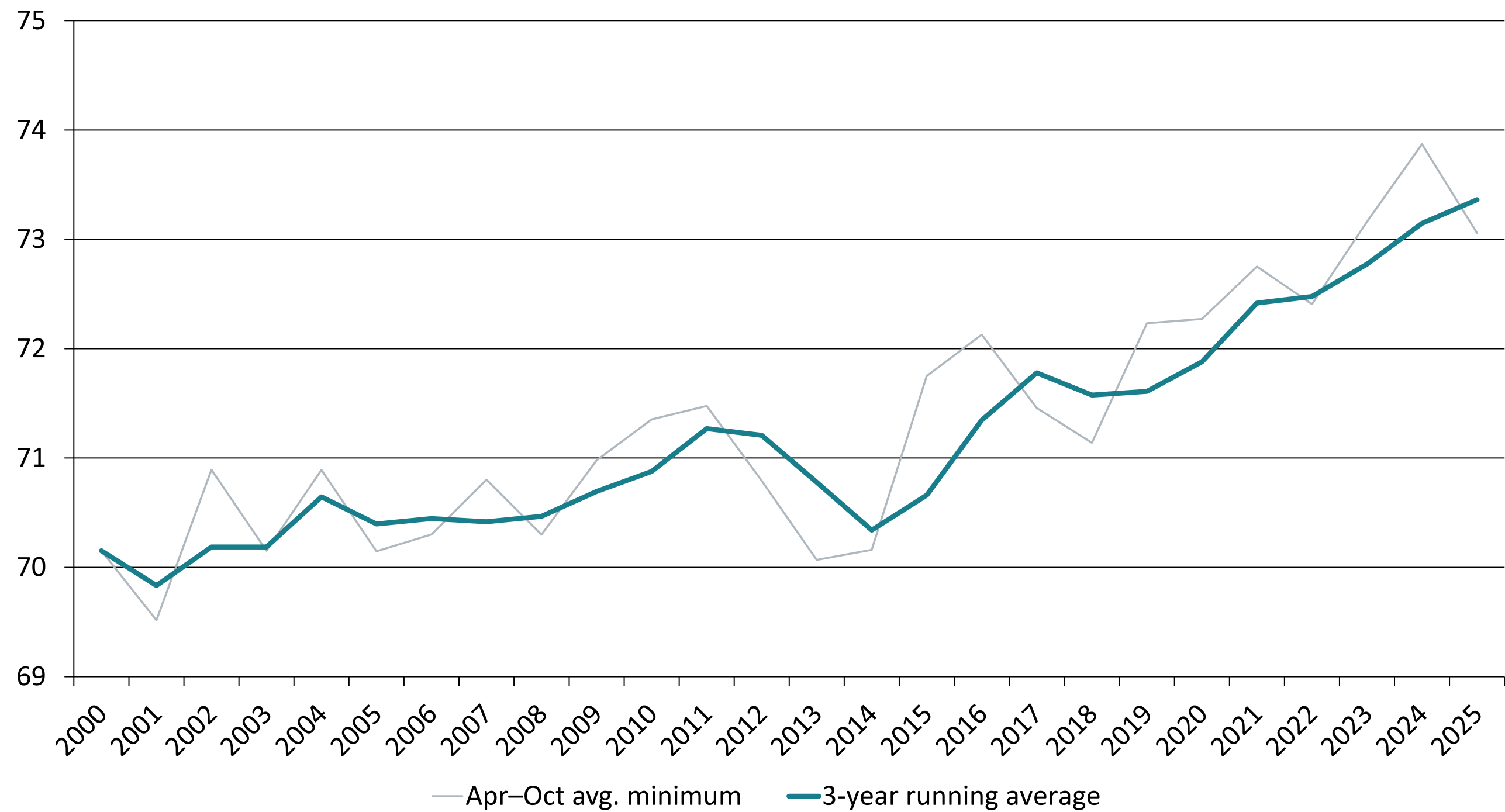
THE SIGNAL

2024: 14 days
2025: 16 days

The individual years jump around. The 3-year average makes the recent increase in October heat much easier to see.

Houston/Hobby Airport. Recent counts verified from NWS Houston/Galveston CF6 climate reports; 3-year running average shown for context.

Warm-season nighttime lows are rising at Hobby Airport



APRIL–OCTOBER

2000: 70.2°F
2025: 73.1°F

The 3-year average filters year-to-year weather and highlights the warmer overnight baseline during Houston’s warm season.

Houston/Hobby Airport monthly observations; Apr–Oct average weighted by days/month. NWS record at Hobby extends from 1931 to present.

Nighttime doesn't always reset Houston's ozone or heat risk

ATMOSPHERE — POLLUTION CAN CARRY OVER

AFTERNOON O₃ builds in the daytime mixed layer

OVERNIGHT Some O₃ remains aloft in the residual layer

NEXT MORNING Growing boundary layer mixes some O₃ downward

PEOPLE — HEAT CAN CARRY OVER TOO

HOT AFTERNOON Heat stress accumulates

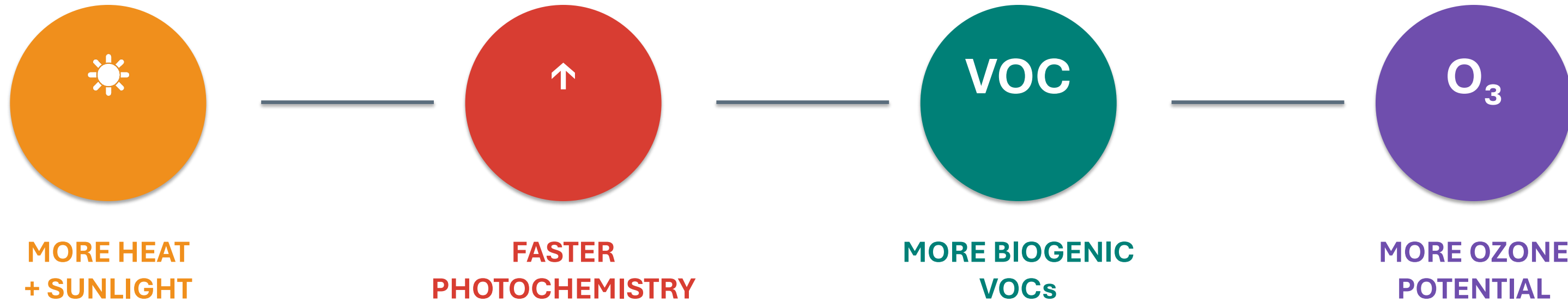
WARM NIGHT Less overnight thermal relief

NEXT DAY Another hot afternoon adds to the burden

A bad air-quality day doesn't necessarily start from zero the next morning — and during prolonged heat, neither do people.

Why warming can favor more ozone

Temperature does not guarantee high ozone — but it can make the atmosphere more favorable when the ingredients line up.

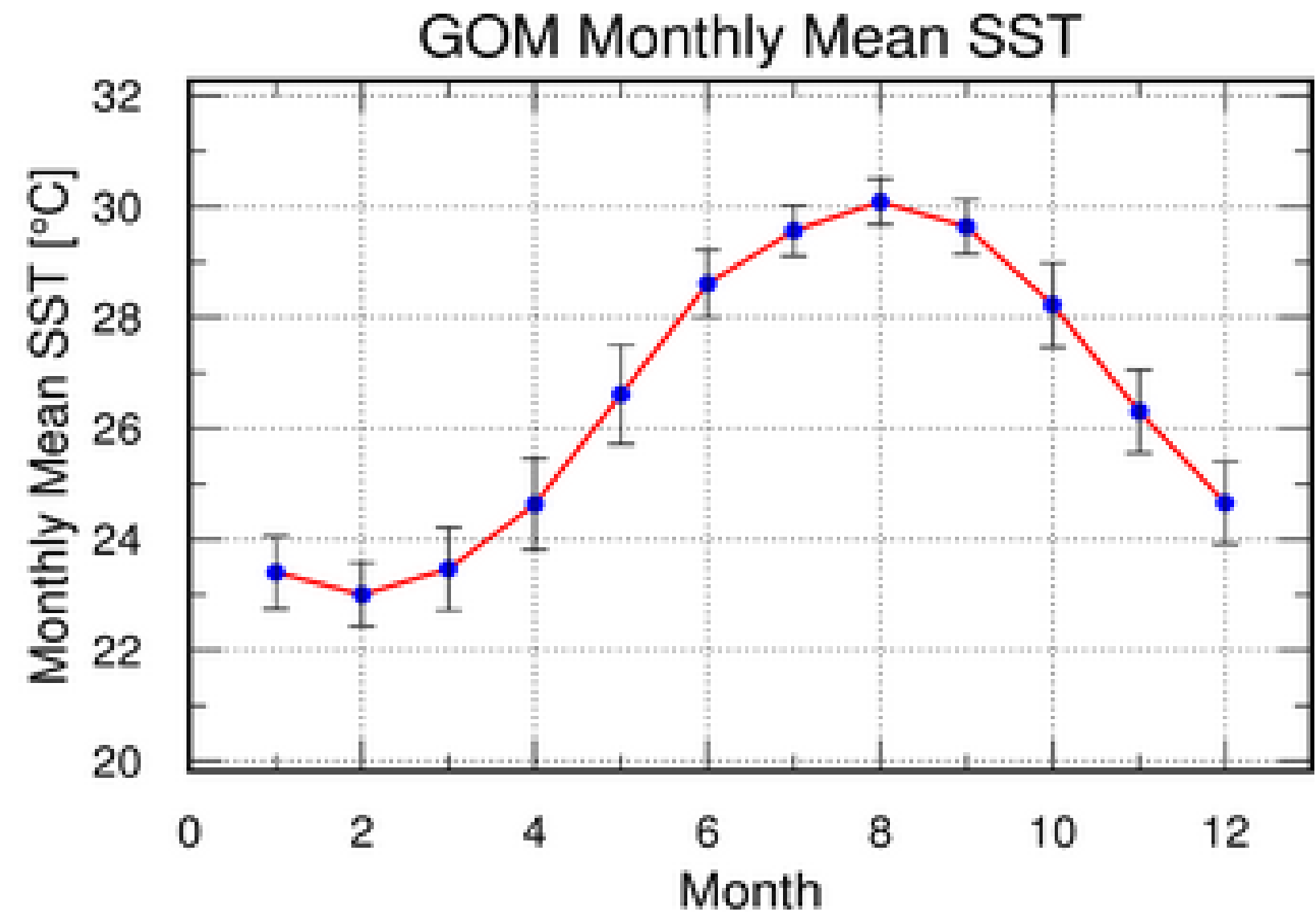
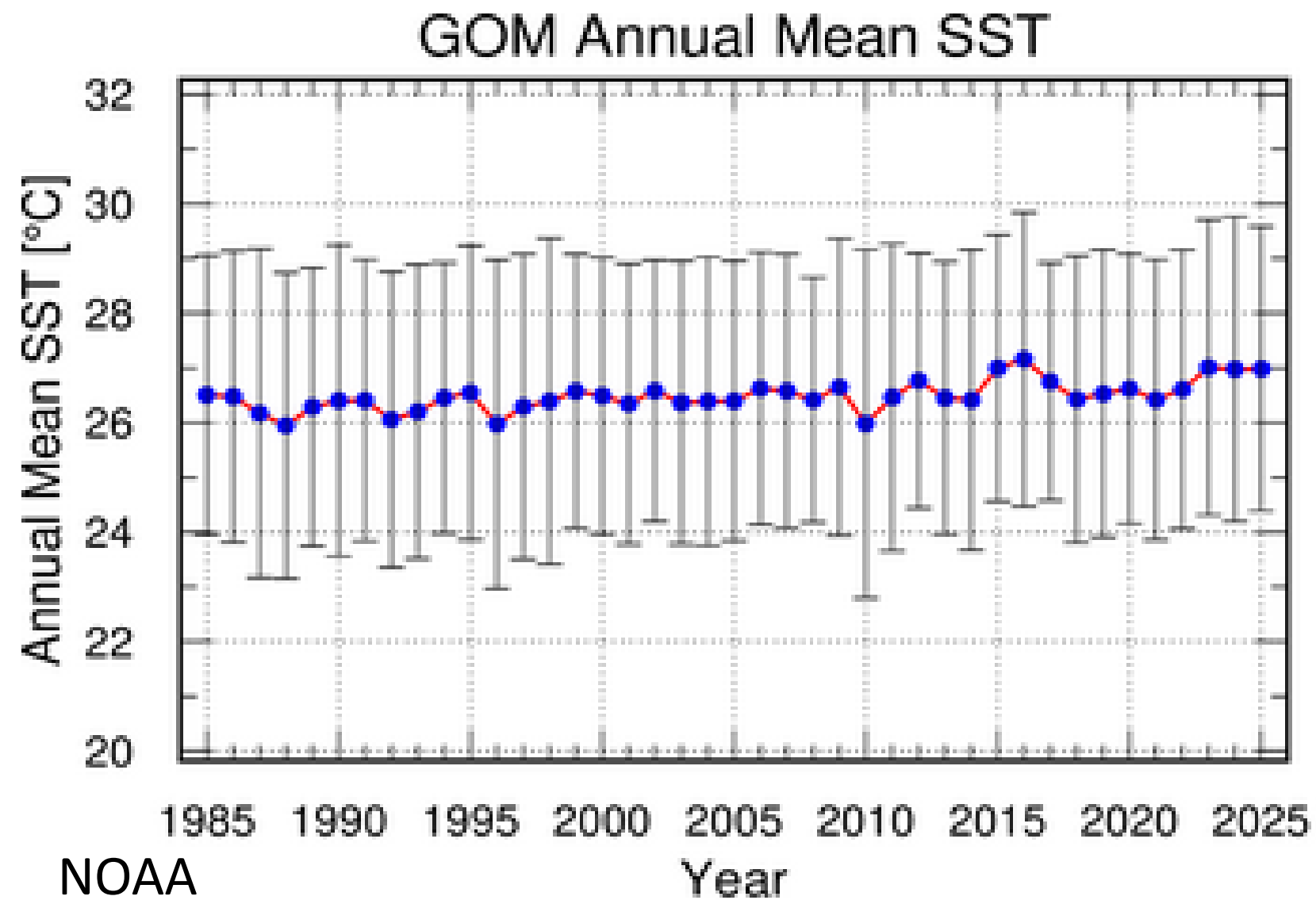


SAME PRECURSOR EMISSIONS → MORE OZONE POTENTIAL

when sunlight, NO_x/VOC supply, stagnation and transport are favorable

Emissions controls can still drive ozone downward — warming adds a meteorological headwind on favorable days.

Gulf sea surface temperatures are getting warmer



~1.0°C (1.8°F) warmer, 1970–2020 ~0.19°C per decade.

Warmer Gulf increases humidity - heat risk increases, but pollution effects vary

Heat

Higher humidity limits evaporative cooling and raises heat stress.

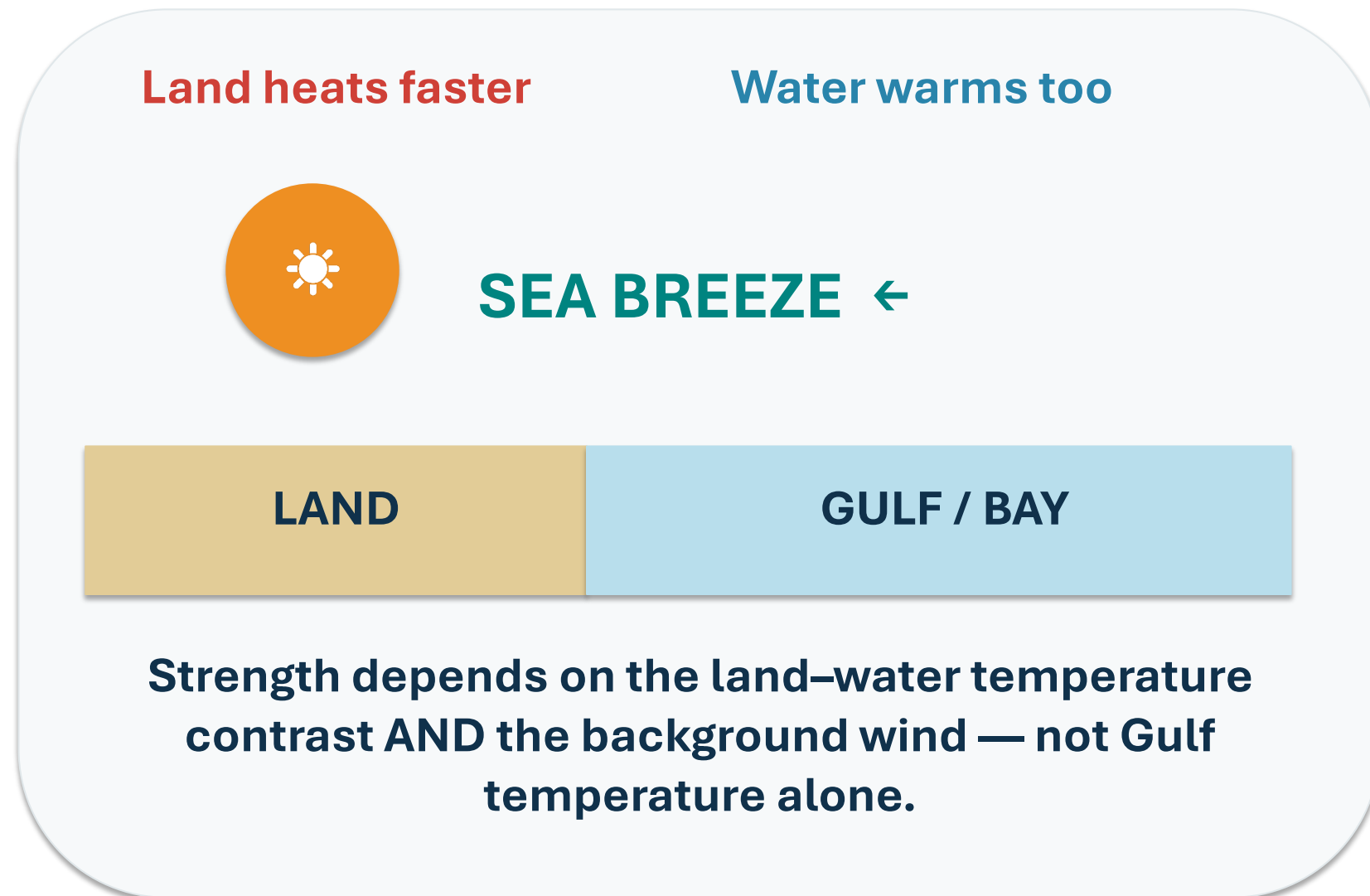
Ozone

Clouds, rain and mixing can offset the effect of moisture. Higher humidity does not automatically mean higher ozone.

PM_{2.5}

Particle water and additional chemical aging can increase mass during humid recirculation events.

A warmer Gulf does not guarantee a stronger sea breeze



The key contrast

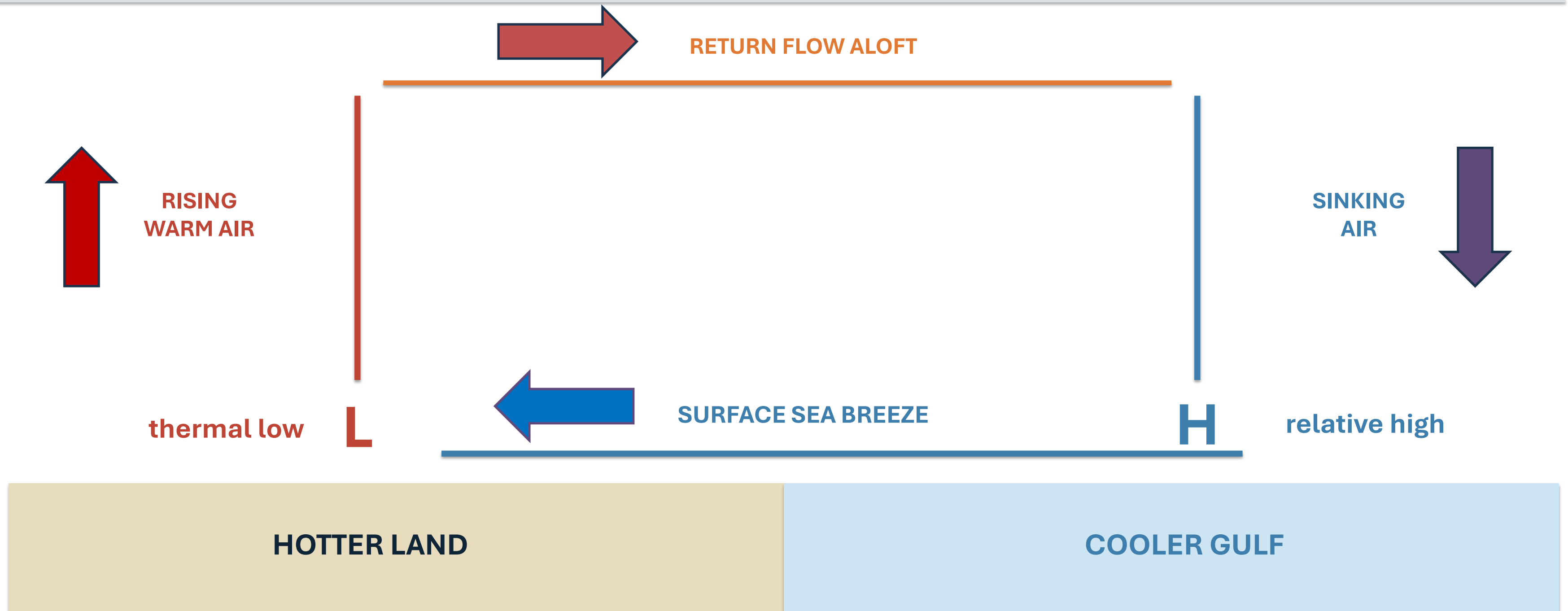
Sea-breeze strength depends on the daytime land-water temperature difference, not Gulf temperature by itself.

The background flow

Synoptic wind, stability and clouds can delay, weaken or overwhelm the local circulation.

More confident signal: warmer Gulf water supports higher coastal moisture, dew points and warm nights.

Sea breeze: a thermally direct circulation

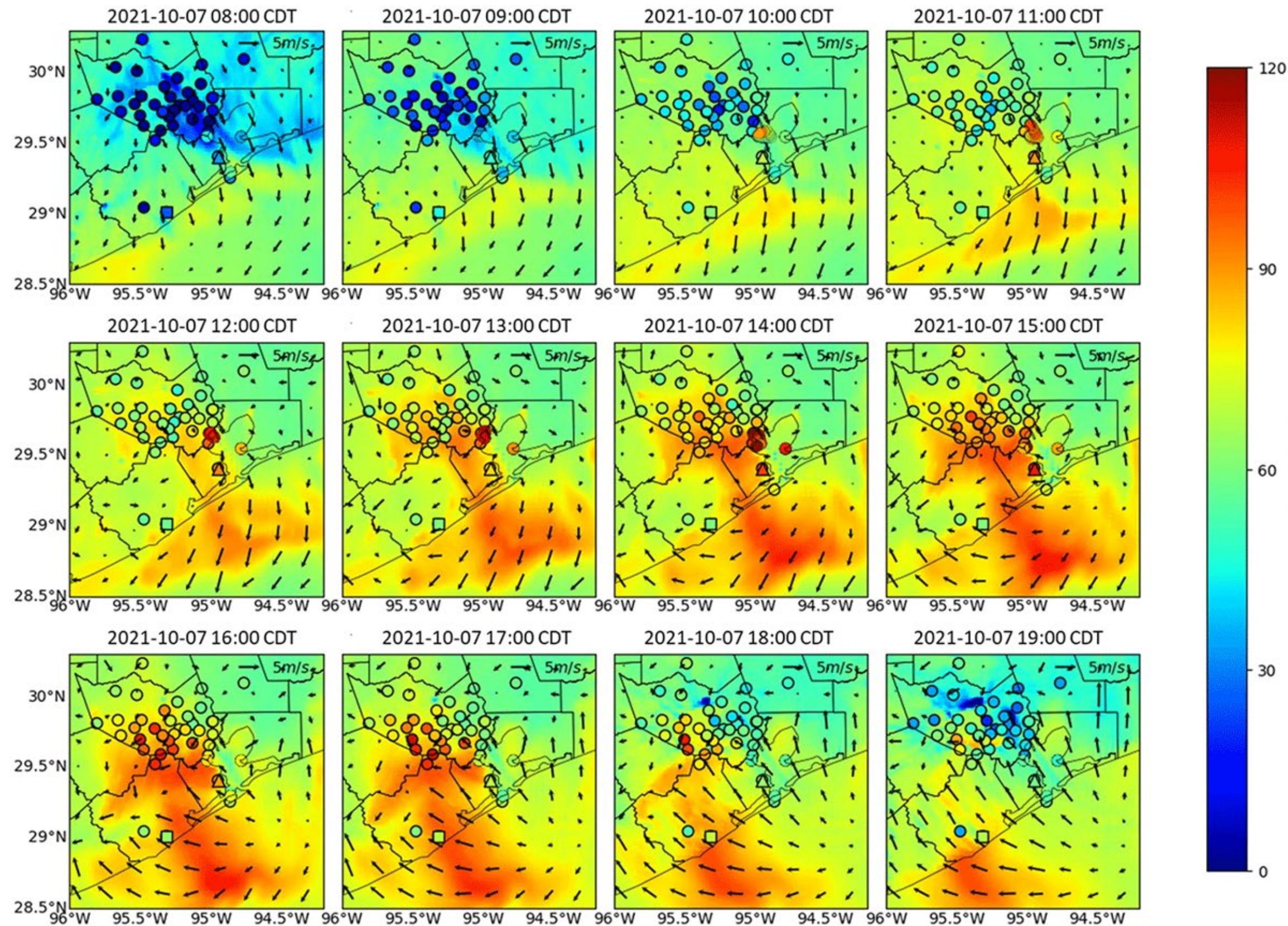


DAYTIME: land heats faster → pressure falls over land → marine air flows inland → air rises over land and returns seaward aloft.

Coastal recirculation remains central

Morning export

Land breeze moves fresh precursors offshore.



Afternoon return

Bay and sea breezes bring aged air inland.

Transported particulate matter remains a wildcard

WILDFIRE SMOKE

A warmer climate increases western fire potential, creating more opportunities for long-range smoke transport. Houston can see elevated PM_{2.5} far from the source.

WESTERN DUST

Some projections show increasing dust activity across the southern Great Plains, but the magnitude and Houston impacts remain uncertain.

SAHARAN DUST

Periodic Saharan Air Layer outbreaks can substantially raise Houston particle concentrations, but future trends are uncertain and may not increase.

These events can produce important short-term PM_{2.5} episodes, but their future frequency depends strongly on source conditions and atmospheric transport.

Houston can receive particles from very different source regions — wildfire smoke from most directions, western dust, and Saharan dust transported across the Atlantic and Gulf.

The main future problem is likely the spike days — not every day

EMISSIONS CONTROLS PUSH THE BASELINE DOWN

↓ NO_x + VOC precursor burden

↓ typical regional ozone

Fewer broadly polluted days
than decades ago

WEATHER STILL CONTROLS THE HIGHEST DAYS

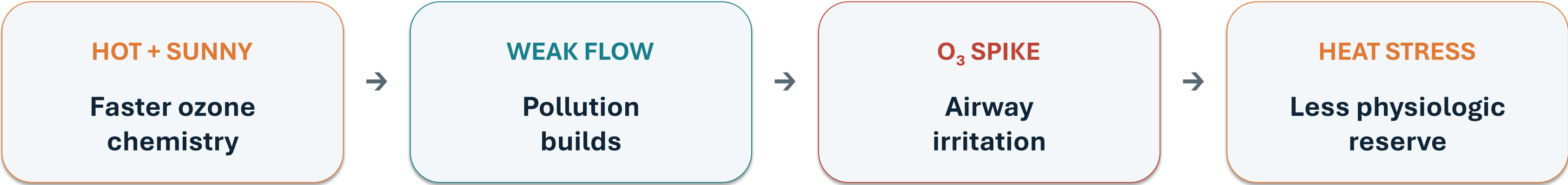
Heat + strong sunlight

Stagnation + weak synoptic flow

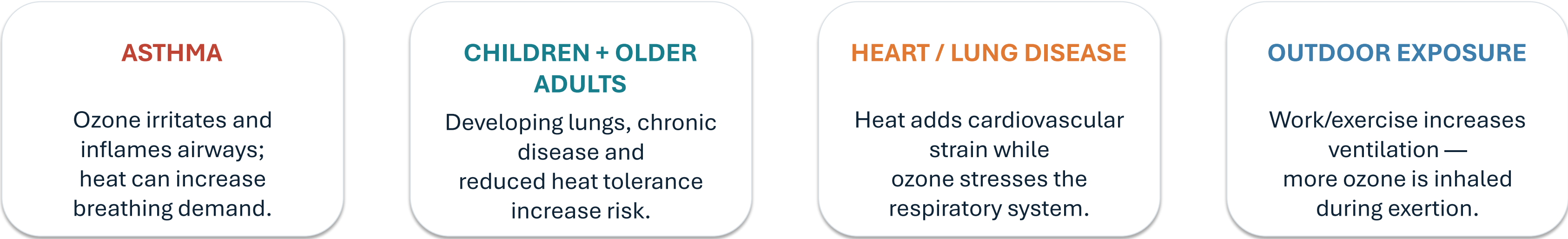
Land/sea-breeze recirculation

Pollution stored aloft / transported

Houston spike days can be a double exposure: ozone + heat



The same weather pattern that favors Houston ozone episodes often produces dangerous heat so vulnerable people can face both hazards on the same afternoon.



On hot ozone-alert days, public messaging should address BOTH air quality and heat — especially for asthma and outdoor activity.

The State of Air Quality

Keynote Address

Q&A

From Planning to Action

Keynote Address



Elizabeth Carlson

Chair, Sustainability
Committee,
FIFA Houston 2026



SUSTAINABILITY & HUMAN RIGHTS REPORT

HOUSTON'S FIFA WORLD CUP 2026™
IMPACT & LEGACY



WASTE OUTCOMES

WASTE MANAGEMENT INFRASTRUCTURE

66 Coca-Cola recycling station sets deployed throughout FIFA Fan Festival™ Houston

40 recycling/trash barrel pairs for vendors and back-of-house areas

60 compost bins available on-site for back-of-house sorting

MATERIAL & WASTE MANAGEMENT RESULTS

72% audit compliance with vendor requirement for packaging to be reusable, recyclable, or compostable.

An audit was conducted midway through the event and revealed an increase in non-recoverable items that were procured as food trucks ran low on packaging. Results from the mid-way audit found that 56% of evaluated serveware items were compostable, 16% were recyclable, and 28% were non-recoverable.

276 metric tonnes of waste generated at FIFA Fan Festival™ Houston



66% WASTE DIVERSION RATE

An operational dumpster hauling error likely reduced the overall diversion rate and reinforced the importance of dedicated container identification and communication with waste haulers during large-scale events.

22% PREPARED FOR DONATION OR REUSE

47,825 kg (154,000+ sq. ft) of turf prepared for donation to [Aspire Futbol Club](#), [Beaumont Pets Alive](#), [Big Paws K9 Foster House](#), [Rescued Pets Movement](#), and local parks for reuse

4,354 kg of food donated to local nonprofit [Second Servings Houston](#)

3,919 kg of event materials—including signage, cabanas, tables, and other usable assets—donated to [Houston YMCA](#)

3,266 kg of wood pallets donated for reuse to [Goodwill of Houston](#) and [Reuse Warehouse](#)

1,205 kg of textiles and mesh to be upcycled through local nonprofit [Magpies & Peacocks](#)

410 kg of bike rack covers (~220 covers) donated to [Houston Habitat for Humanity](#), the Houston Rodeo, and [Magpies & Peacocks](#)

34% LANDFILLED

93,649 kg of trash sent to landfill¹²

39% RECYCLED

55,757 kg of construction and demolition materials recycled
52,027 kg of single stream recycling—including bottles, cans, paper, and clean recyclables—and cardboard recycled

1,134 kg of flexible plastic packaging sent for specialized recycling with iSustain¹³

5% COMPOSTED

12,800 kg of organic waste composted with Moonshot Compost

ENERGY



**872
MWh**

of electricity was consumed over the 90 days of site activity, including the 39 days of FIFA Fan Festival™ Houston operation.



100%

of electricity was sourced as renewable electricity through Reliant's 100% Wind Energy plan, which procured Renewable Energy Certificates (RECs) from qualifying wind energy resources equal to the FIFA Fan Festival™ Houston's electricity consumption.⁵

**45
MWh**

(4,830 liters) of fuel was consumed through the very limited use of fuel-powered generators and mobile equipment during event set-up and take-down when grid electricity was not accessible to a site.



The 5.4 kw Solar Tower by Janta Power with battery backup was installed outside Fan Festival at the entrance to the Columbia Tap Trail, providing renewable energy accessible to the community in the long-term.

CARBON FOOTPRINT

TOTAL EMISSIONS SCOPES 1, 2, AND 3

01 SCOPE 1 EMISSIONS: 15 tCO₂e

02 SCOPE 2 EMISSIONS (MARKET-BASED): 0 tCO₂e

03 SCOPE 3 EMISSIONS: 309,853 tCO₂e

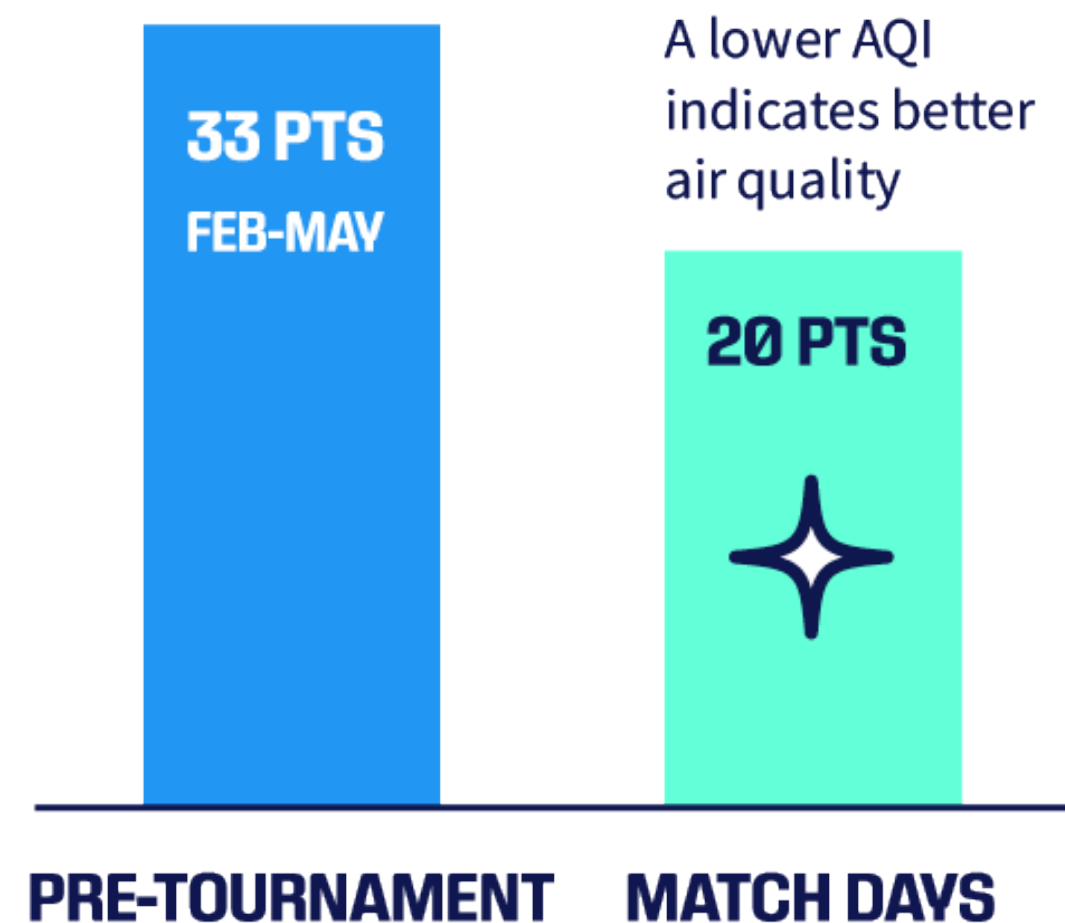
SCOPE 3 EMISSIONS: 309,853 tCO₂e

All GHG Protocol Scope 3 emission categories were evaluated against FIFA Fan Festival™ Houston activities, resulting in the following categories determined to be relevant:⁹

SCOPE 3 CATEGORY	EMISSIONS SOURCE	tCO ₂ e
PURCHASED GOODS AND SERVICES¹⁰	Production and transportation of temporary event infrastructure, goods, and services procured for the FIFA Fan Festival™ Houston.	2,588
CAPITAL GOODS	Permanent event infrastructure including fences, signage, and lighting structures at FIFA Fan Festival™ Houston.	241
FUEL- AND ENERGY-RELATED ACTIVITIES	Production, transportation, and transmission of fuels and electricity consumed at FIFA Fan Festival™ Houston.	70
WASTE GENERATED IN OPERATIONS	Waste collection, transport, and disposal during FIFA Fan Festival™ Houston. Includes the preparation for donation/reuse, composting, recycling, landfill, and other recovery mechanisms.	74
UPSTREAM LEASED ASSETS	Host Committee leased facilities inclusive of the Volunteer Center, Polk Street and Main Street Offices that supported the greater FIFA Fan Festival™ Houston operations.	129
FAN TRAVEL & ACCOMMODATION	Attendee travel to Houston, within Houston, and overnight accommodations.	306,752

AIR QUALITY

Air Alliance Houston calculated the following Air Quality Index (AQI) scores by averaging the measurements taken at multiple sites from February to May pre-tournament and across all match days.



TSU Student Project Findings:

- PM_{2.5} levels ranged 21-55 $\mu\text{g}/\text{m}^3$ at Houston Stadium and Third Ward, with peaks on Game Day and July 4th
- All readings within a safe range below the $\sim 74 \mu\text{g}/\text{m}^3$ threshold

AIR QUALITY

Informational materials were shared via the City of Houston's Air Quality Monitoring Van and Harris County Pollution Control Services Department, promoting awareness of air quality for visitors and residents.



ADDRESSING AIR IMPACT

SUPPORTING EMISSIONS MITIGATION WITH LOW-CARBON TRANSPORTATION

73%

of surveyed FIFA Fan Festival™ Houston attendees utilized low-carbon transportation modes

96K+

boardings at EaDo Station at FIFA Fan Festival™ Houston

26K+

rideshare trips to and from FIFA Fan Festival™ Houston

A free bicycle parking station was provided at FIFA Fan Festival™ Houston, courtesy of Houston Methodist

NATURE-BASED

~8,500

new trees planted city-wide, restoring shade and habitat

131

tCO₂e estimated annual carbon sequestration benefit



Volunteers plant trees along the Green Corridor, in collaboration with Aramco and Trees for Houston

GREEN CORRIDOR

1,500+

trees planted across collaborating organizations

48

prairie and pollinator gardens installed

NEW AIR QUALITY

monitoring network established in East Downtown and Third Ward

3

new water stations and 2 bike repair stations

3

innovation projects focused on heat resilience, renewable energy, and circularity

12

student art installations



With Midtown Houston, we enabled a demonstration of new heat mitigation technology by Solar Mantle, tree planting, bike repair stations, water stations, student art, and educational signage at Midtown Park and Plaza areas.



In collaboration with East Downtown Management District, we installed an innovative solar tower from Janta Power, self-watering planters with student art, and educational signage at the entrance to the Columbia Tap Trail.



With Friends of Columbia Tap, Pilgrim's Community Center, and the Greater Southeast Management District, we added a pollinator garden, edible trees, and student art along the Columbia Tap Trail at Blodgett Street.



To highlight the Green Corridor's potential as both a transportation route and educational experience, we developed an innovative Green Corridor Story Map featuring key sites, stories, amenities, and existing sustainable infrastructure along the corridor.



Together with METRO, we installed a native prairie demonstration, trees, and student art at Wheeler Transit Center.



Houston City College (HCC) and University of Houston students & alumni, with Impact Leadership Academy, contributed to a mural at Third Ward bike shop by Carlos Mendoza.



Together with Greater Southeast Management District and Houston Public Works, a resilience hub demonstration in Third Ward was composed of a repurposed wind turbine solar canopy, water fountain, and bike repair station.

BAYOU CLEAN-UP EVENTS



Locations

- Buffalo Bayou
- Hermann Park
- Willow Waterhole & Bayou
- Allen's Landing
- Kuhlman Gully
- Monument Inn
- Texas City Dike
- Seawolf Park
- Lake Livingston
- Columbia Tap Trail

Collaborating Organizations

- [SPLASH](#)
- [Buffalo Bayou Partnership](#)
- [Keep Houston Beautiful](#)
- [Willow Waterhole Greenspace Conservancy](#)
- [Friends of Woodland Park](#)
- [Hermann Park Conservancy](#)
- [Friends of Columbia Tap](#)
- [Trinity River Authority of Texas](#)



2

CLEAN-UP
TRAININGS HELD

22

CLEAN-UPS HELD
IN COLLABORATION
WITH LOCAL
PARTNERING
ORGANIZATIONS



685

VOLUNTEERS
PARTICIPATED



636

KG OF WASTE
COLLECTED

YOUTH ENGAGEMENT

University Collaborations:

- Rice: Playbook tools and Sustainable Ecologies Exhibit.
- UH Energy Transition Institute:
- Wind turbine shade structure.
- UH Downtown: Student designs for educational signage.
- Texas Southern: Air quality student internships.
- Texas A&M AgriLife: Tree planting and sustainable soccer field guidelines.

K-12 PROGRAM

\$20,700+

in microgrant funding awarded
to teachers



7,468

students earned a Sustainable
School Badge



39

schools participated

SUSTAINABLE SOCCER FIELDS

- 130 new trees planted
- Invasive plant species removed
- Habitat restoration area created, supported by field drainage
- Children's nature exploration area crafted by Houston Community ToolBank
- New picnic tables and bleachers installed with a cool coating
- Educational signage and student art incorporated

“Chevron is proud to invest in the communities where we live and work, and Mason Park is a perfect example of what's possible when we come together around a shared goal. Soccer brings people of all backgrounds together, and every family deserves a space that is beautiful, safe, and built to last.”

Leah Casey, Chevron's Senior Manager of Corporate Affairs, Houston



SUSTAINABLE SOCCER FIELDS

This field is designed with resilience in mind to help protect players, fans, and the environment. Smart drainage helps capture and filter rainwater, reducing flooding and supporting the bayou habitat. Trees add shade and reduce air pollution, improving community health. An innovative coating keeps bleachers cool.

Help keep this field game-ready:

- **STAY COOL:** Take breaks in the shade and drink plenty of water.
- **STAY DRY:** Protect the turf after rain—avoid muddy areas and give the field time to recover.
- **WASTE LESS:** Trash left on the ground flows to the bayou—and from there, to the ocean. Bring reusable water bottles and dispose of all trash in proper bins.



HOSPITALITY SUSTAINABILITY PROGRAM



Numerous local hospitality businesses attended the Road to FIFA World Cup: Hospitality Readiness & Citywide Preparation Luncheon, hosted by the Houston Hotel & Lodging Association and featuring a Sustainability Vendor Fair highlighting companies that offer sustainable products for hotels.

OF VERIFIED BUSINESSES PER INDUSTRY

43
DINING

25
LODGING

14
EVENT VENUE/
CATERING

NEXT STEPS

Learning:

- Difficulties in “comparable” data
- Low response to surveys and tabling
- Good response to volunteer-led games
- Sustainability plans aren’t the norm and thus more prone to human error

Magic wand wish list:

- Communication campaigns
- Maintenance / long-term funds

Keep the collaboration going!

- This summit for continued collaboration on air quality!
- Clean City Commission and Keep Houston Beautiful for urban greening and waste reduction?





HOUSTON DONORS



THANK YOU.

VISIT US ONLINE: SPORTSAUTHORITYFOUNDATION.ORG



Clean Air Connections Challenge



Haris Khan

**Project Management and
Accessibility Consultant,
Outreach Strategists**

Clean Air Connections Challenge

**Pick up a Network Challenge Card
at the Registration Table**

**How to
Connect**

1. Talk to your neighbor
2. Explore the Exhibitor Space
3. Check out the Student Poster Showcase
4. Complete at least 4 prompts
5. Submit your sheet to win a prize

Ready, Set, Connect!

Turn in your card at the registration table before closing remarks.



Houston-Galveston
Area Council

Morning Wrap Up: Lunch Menu



Lunch Entrees

- Crunchy Chicken Sandwich (contains nuts)
- Garden Sammie (Vegan)
- Truffled Egg Salad Sandwich
- Pork Banh Mi Sandwich
- Roasted Steak Sandwich

Sides & Treats

- Potato Salad
- Housemade Potato Chips
- Chocolate Chunk Cookies



Air Quality

HOUSTON REGIONAL SUMMIT

**Welcome to the 2026 Houston
Regional Air Quality Summit!**



Houston-Galveston
Area Council

Afternoon Breakout Sessions

Choose 1 Dynamic Breakout Per Time Session

Location

Breakout A:
O'Quinn Great Hall

Breakout B:
Melcher Boardroom

Breakout C:
Douglass Library

Breakout D:
Blomstrom Conference

Session 1 1:00 p.m.

Community Air
Monitoring to Action

Community
Solutions in
Action: SEED

Economic Benefit
through Clean Air
Action

Industry in
Action

Session 2 2:15 p.m.

Transportation in
Action

Public Health
Impacts from Air
Quality Action

Nature-Based
Solutions in Action:
Urban Trees

Action in Buildings &
Energy Sector

Clean Air Connections Challenge

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Houston-Galveston
Area Council

AI and Air Quality

Dr. Yuan will showcase how artificial intelligence and online regional resources can put new tools and information in the hands of communities and decision-makers.



Dr. Tammy Yuan

**Assistant Professor,
University of Houston**

AI for the Future of Clean Air: Lessons from Methane

2026 Air Quality Houston Regional Summit

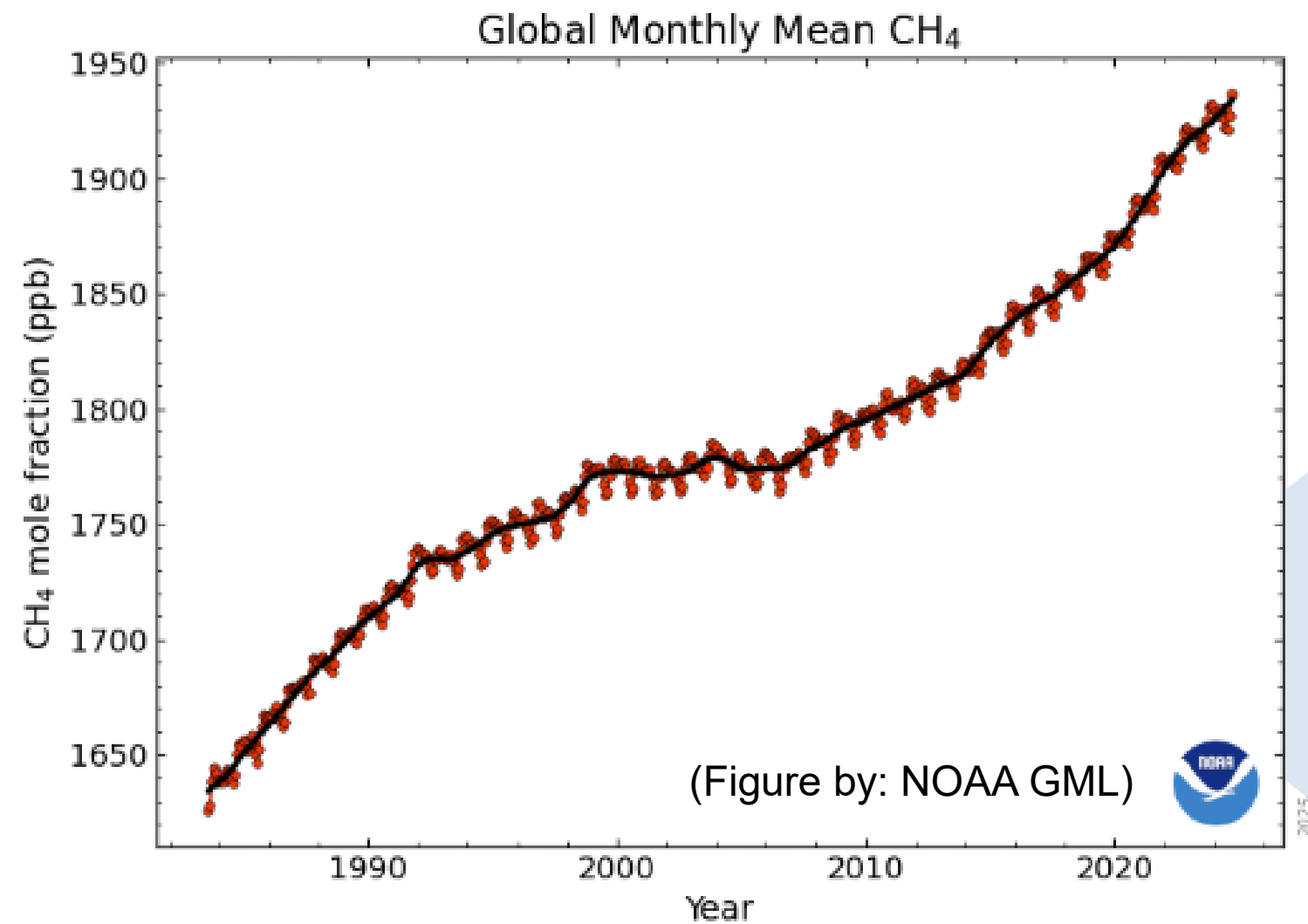
Tammy (Kunxiaoja) Yuan

Assistant Professor

Department of Earth & Atmospheric Sciences, University of Houston



Methane links climate and air quality



CH₄ sources



Fossil fuel



Wetlands



Livestock



Rice paddy



Waste



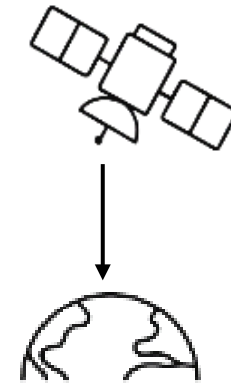
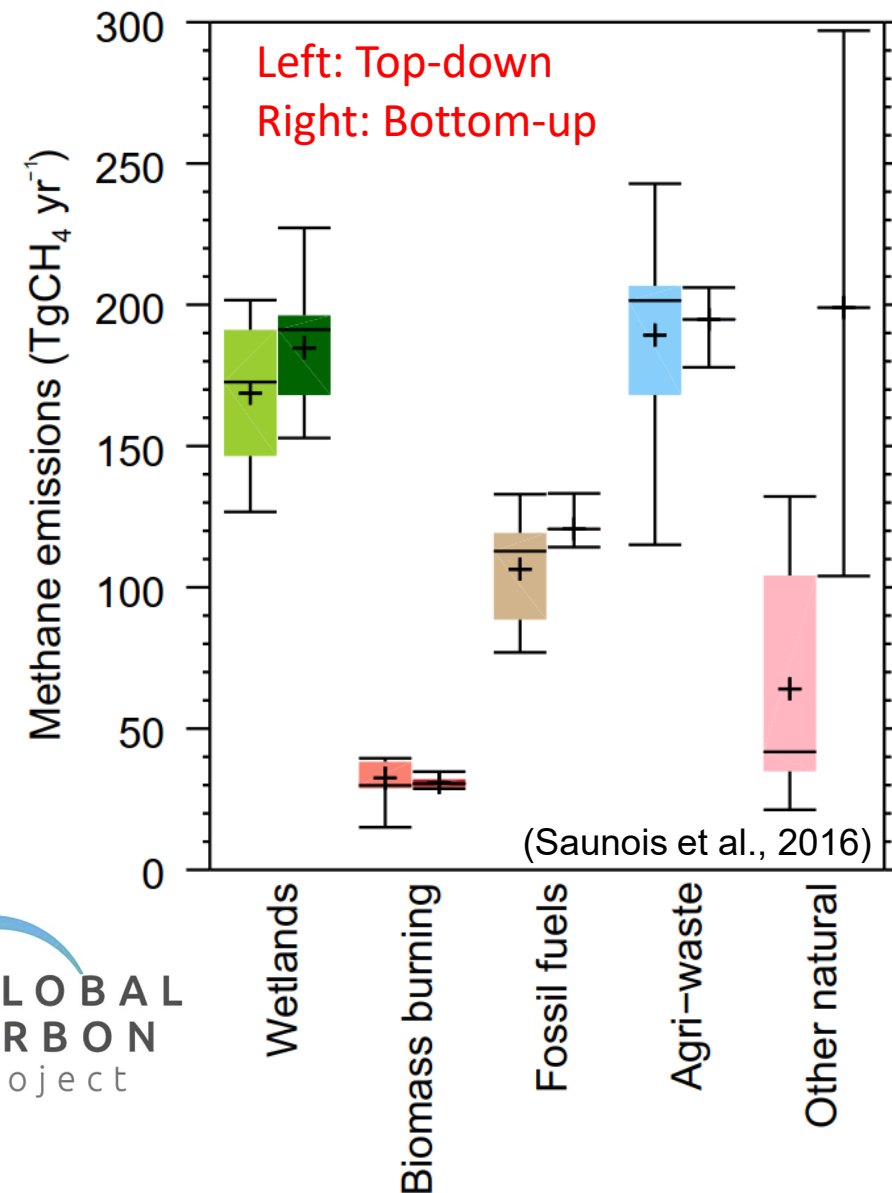
Biomass burning

Methane:

- Climate forcing + ozone formation.
- Often co-emitted with other pollutants.
- Rapid increase in recent decades, with diverse and complex sources.

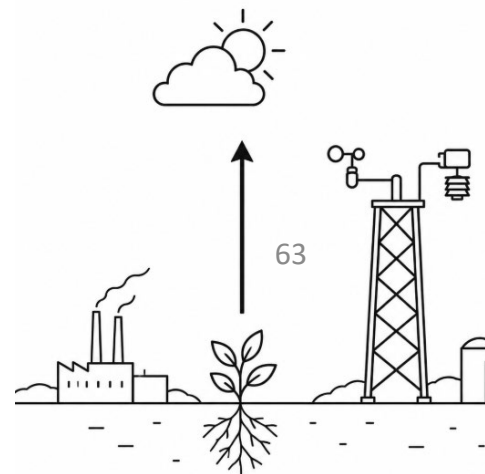
Methane budget – different approaches

2000-2012



Top-down approaches:

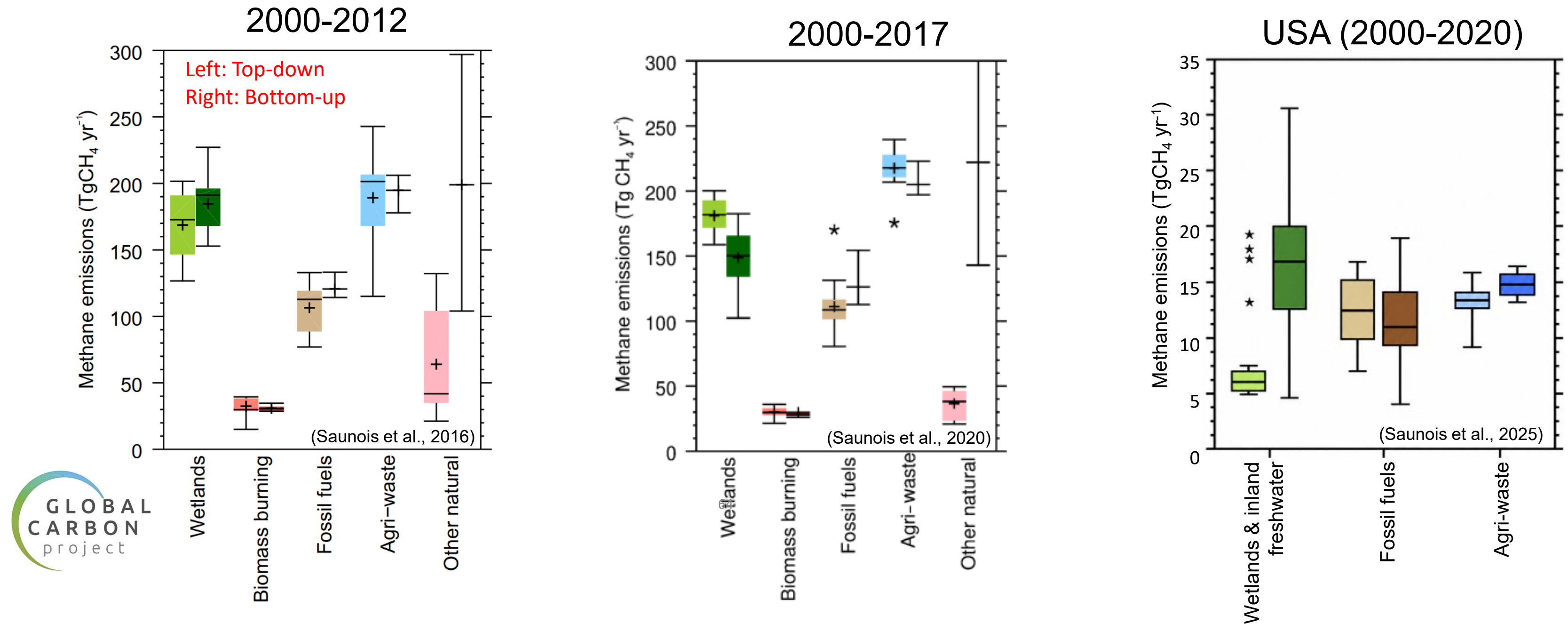
- Atmospheric inversions
- Satellite observational constraints



Bottom-up approaches:

- In-situ measurement constraints
- Emission inventory constraints
- Land-surface processes

Methane budget – large uncertainties



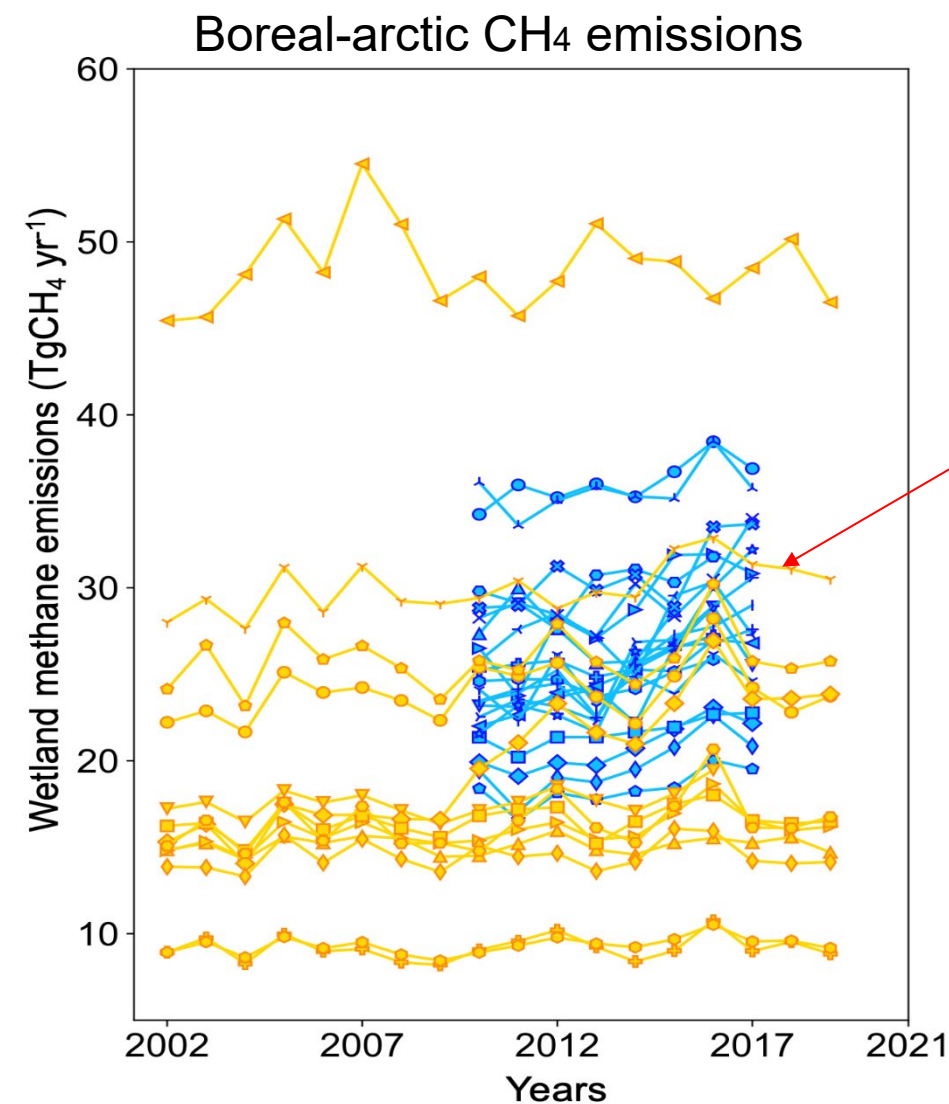
Methane:

- Large discrepancies across traditional methane-budget estimates.
- Large uncertainties in magnitude, source attribution, and temporal trends.

Model limitations

Process-based models:

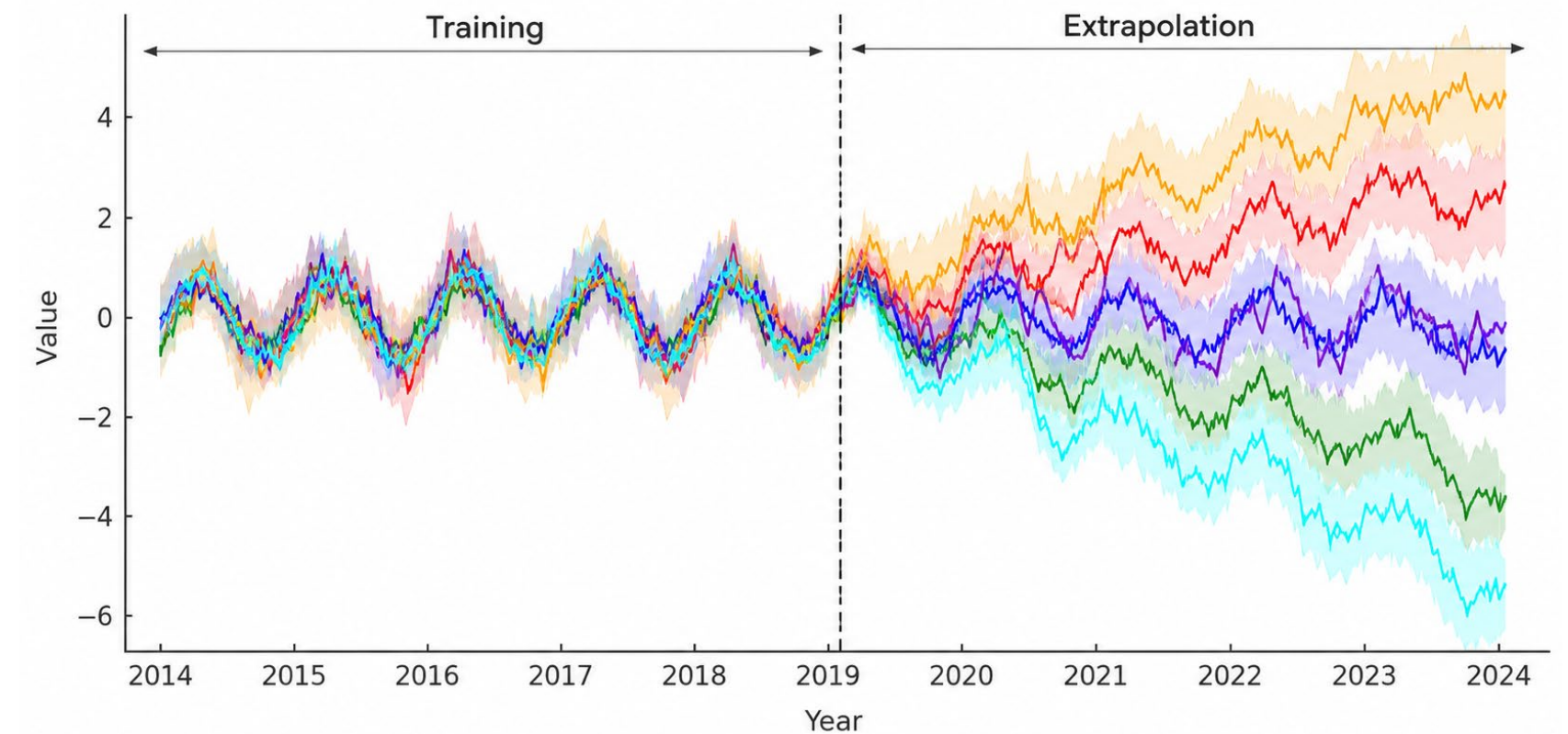
- **Strong** physical prior
 - Simplified/incorrect processes
- **Weak** data constraints



Physics-driven modeling alone is not enough

Data-driven AI models:

- **Data-driven**, with high accuracy in training
- Correlation-based & **no** physical prior
 - Sometimes capture wrong relationships
 - Large uncertainties in extrapolation



High accuracy ≠ trustworthiness

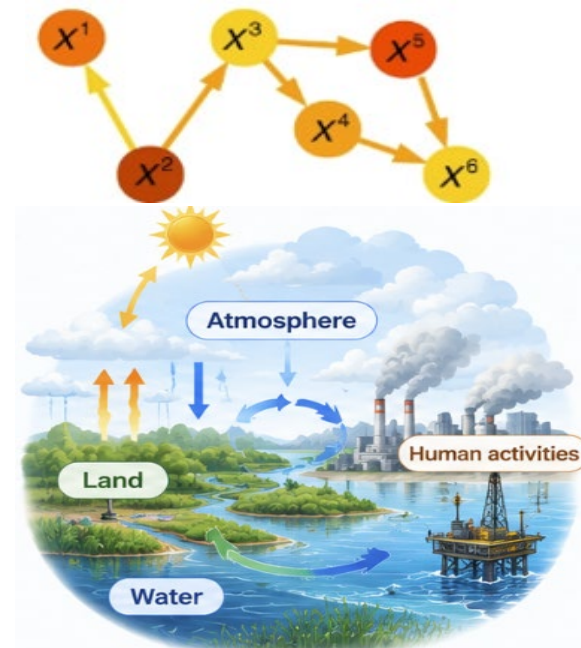
Knowledge-guided AI

Robust physical prior + observational constraints

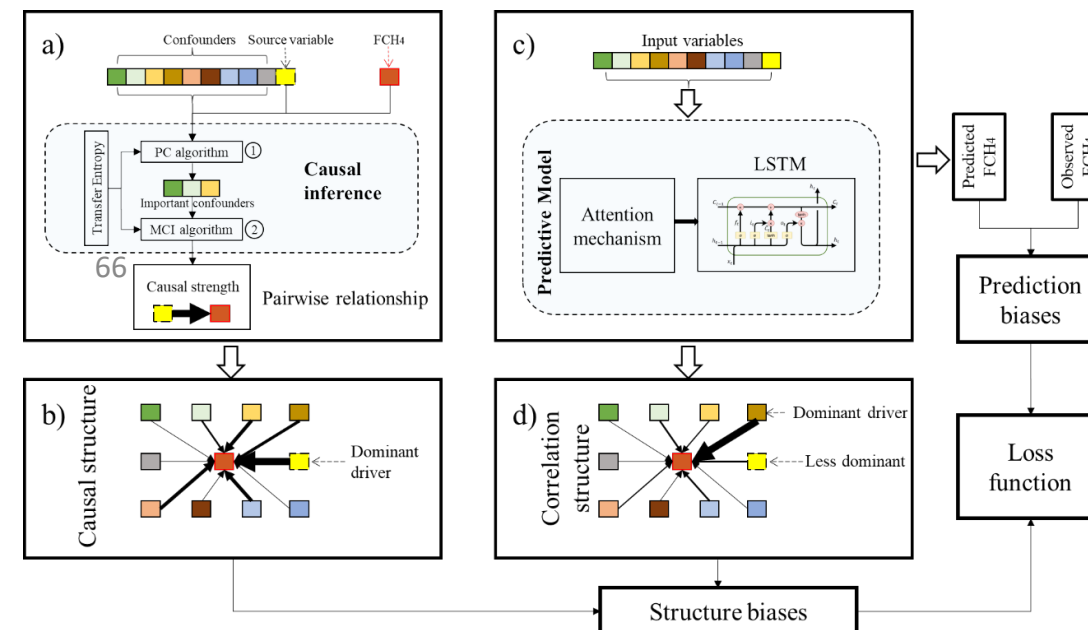
- High prediction accuracy
- Follow physical principles and domain knowledge
- Narrow uncertainty during extrapolation



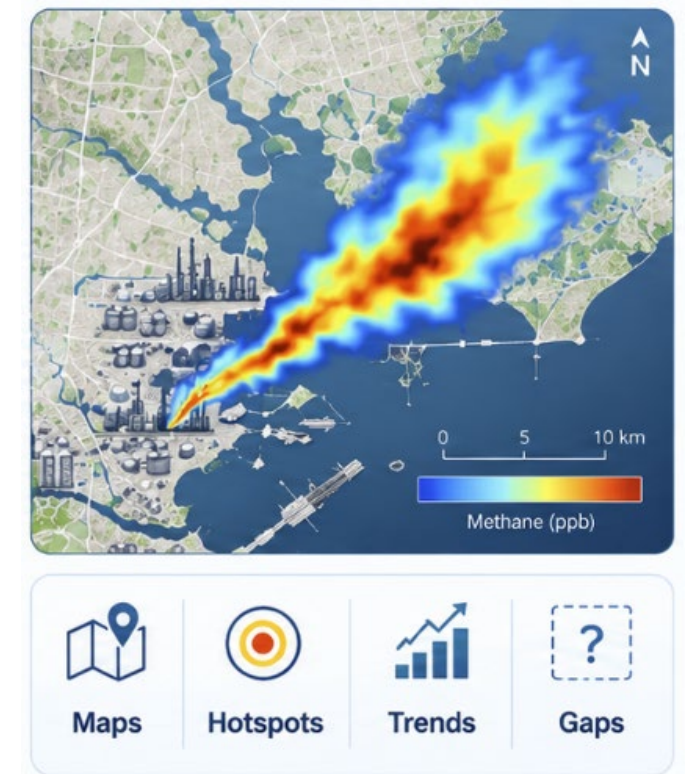
Multi-sourced
Observation



Domain knowledge
& Physical principles



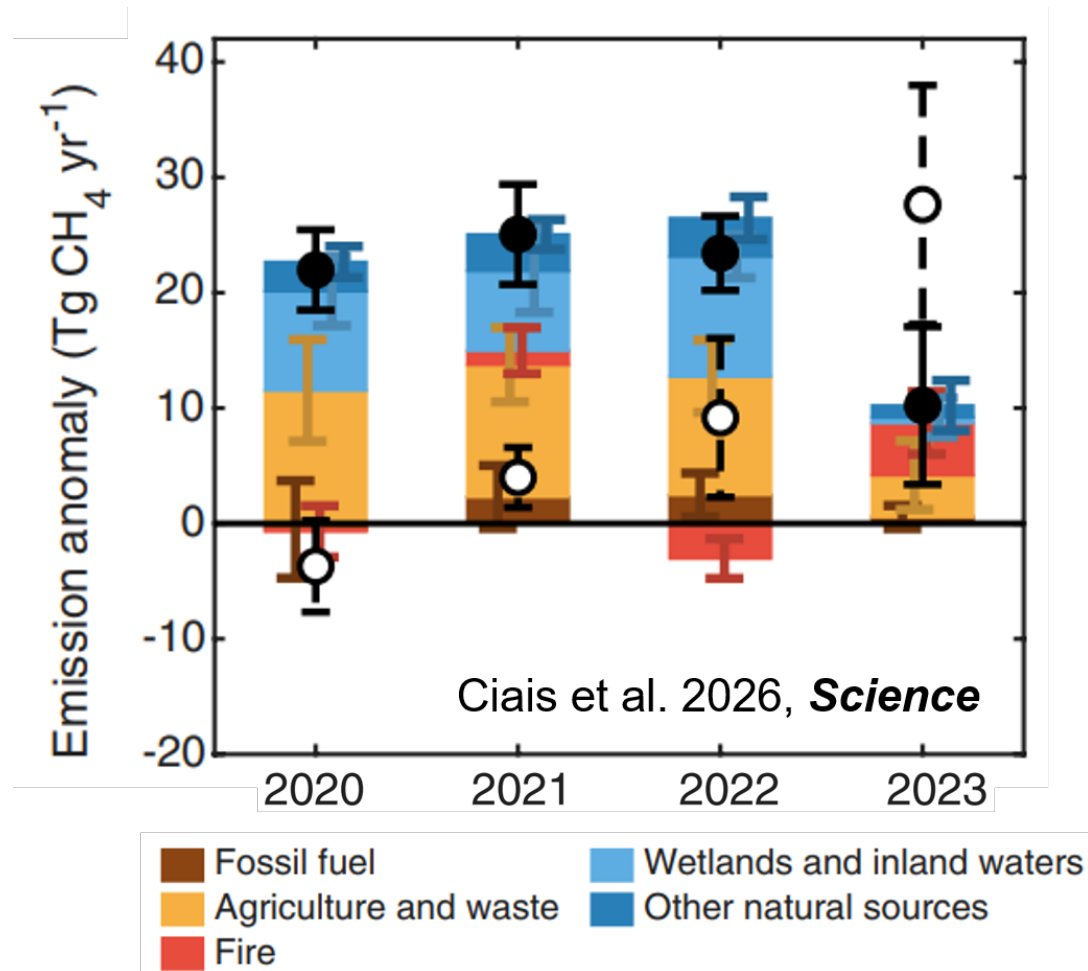
AI framework



What can AI enable?

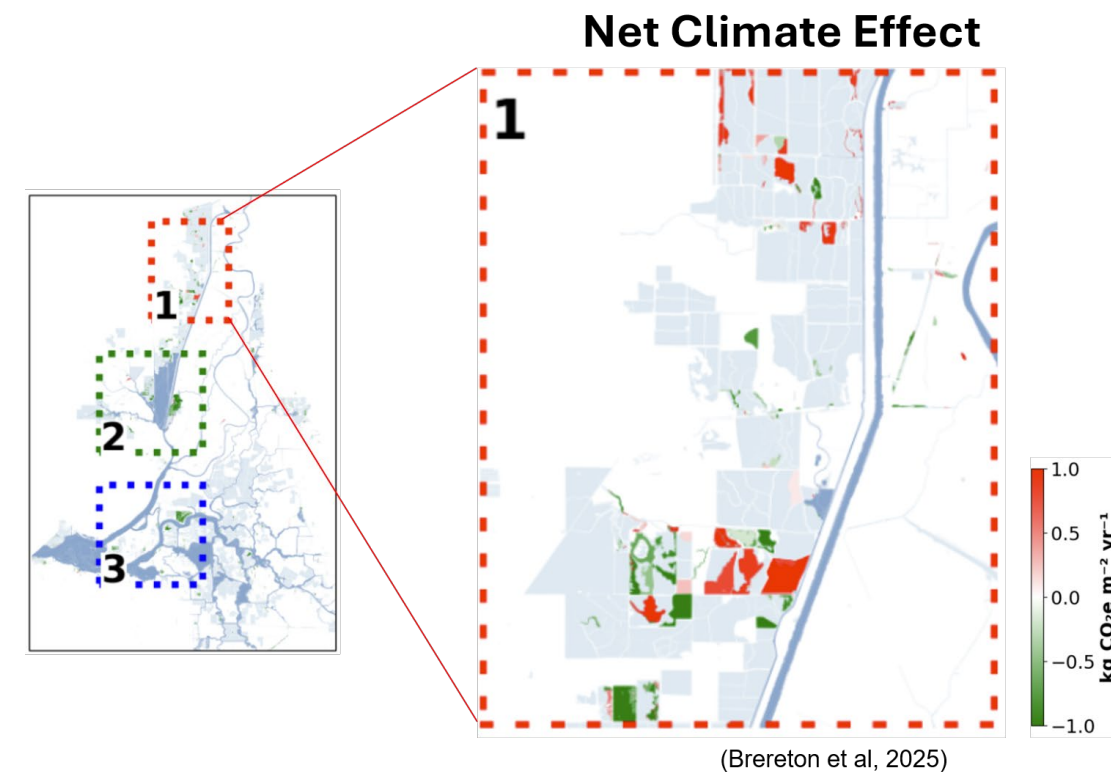
Our case studies:

- **Mapping & Analysis:** From global patterns to regional and local hotspots (Li and Yuan et al., 2026, Yuan et al., 2024, Yuan et al., 2022)
- **Attribution:** What drove the rapid methane rise in the early 2020s? (Ciais et al. including Yuan, 2026)
- **Monitoring design:** Where should we measure next? (Zhu et al. including Yuan, 2025)
- **Nature-based solutions:** Could CH₄ offset climate benefits of wetland restoration? (Brereton et al. including Yuan, 2025)



Attribution: Explaining the early-2020s CH₄ surge
(Ciais et al. including Yuan, 2026)

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Nature-based Solutions: Quantifying climate benefits of coastal wetland restoration in California
(Brereton et al. including Yuan, 2025)

Our work in Greater Houston

- Methane in coastal Texas has both anthropogenic and natural sources, making detection and source attribution challenging.
- At our field site at Baytown Nature Center, wetlands and natural methane sources coexist with major petrochemical infrastructure.



Field site at Baytown Nature Center

Multi-sensor and multi-scale field measurements

Chamber-based CH_4 flux measurements



NIRview™ methane sensing – Blue Sky Measurements



Canister sampling & isotopic analysis



Drone: LiDAR, multispectral & Aeris STRATO

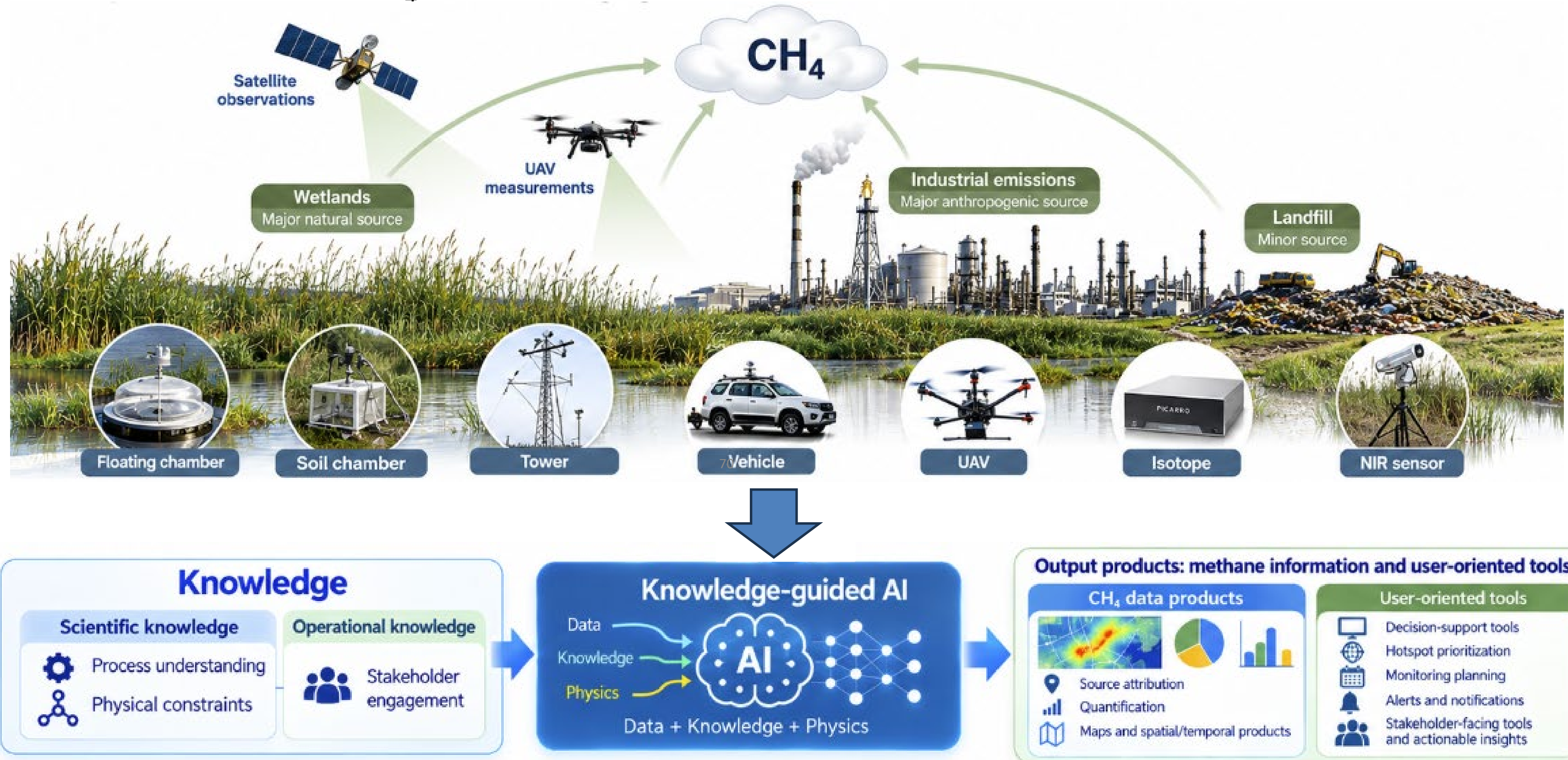


Drone-based CH_4 measurements



An integrated CH₄ observing and modeling framework for Greater Houston

We integrate surface-based and remote-sensing observations with knowledge-guided AI to better monitor and understand CH₄ emissions from diverse sources.



Key Message

1. AI can be a useful tool for clean-air science and management.

2. But AI alone is not enough.

High accuracy does not mean trustworthiness. Black-box AI can have large uncertainties.

3. Knowledge-guided AI may offer a better path forward, but it still requires:

- Better observations
- Domain knowledge + operational information
- Models designed around specific user needs



**For a future with cleaner air,
AI should be interpretable and trustworthy.**

Much work still lies ahead!

Thanks for listening!

Kunxiaoja (Tammy) Yuan kyuan@central.uh.edu

Closing Remarks



Pharr Andrews

**Air Quality Principal Planner,
Houston-Galveston Area
Council**

Student Poster Showcase

**People's Choice
Research Excellence Award**

Krinaben Patel

Beyond the Inhaler: Is AQI The
Missing Vital Sign in Asthma and
COPD Care

Clean Air Connections Challenge

Prize Winners

Thank you for your participation in our Networking Activity!
Here are our winners:

First Name	Last Name
Grace	Lewis
Olanrewaju	Soneye-Arogundade
Lander	Gonzalez
Kazi	Quddus

Thank you for Attending!



**Please take our post-event
survey!**