

# A NASA Earth Venture Mission - EVM3 - Proposed Mission

EVMs are science driven, competitively selected, low cost satellite missions

## BUTTERFLY

a satellite mission to reveal the oceans' impact on our weather and climate.



**Principal Investigator:** Dr. Chelle Gentemann  
**Deputy Principal Investigator:** Dr. Carol Anne Clayson  
**Project Scientist:** Dr. Tony Lee  
**Deputy Project Scientist:** Dr. Shannon Brown

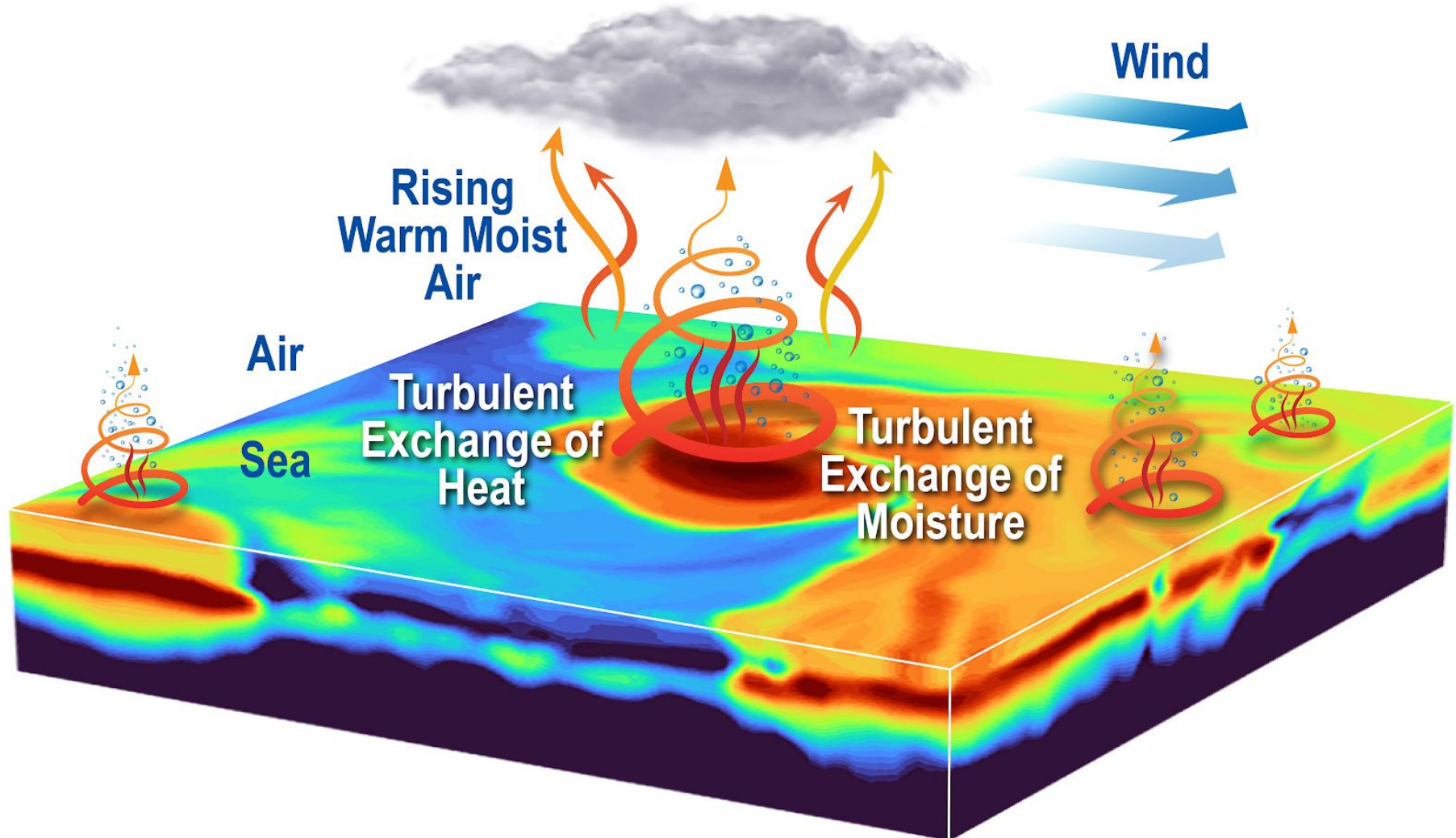


**Science Team:** Aneesh Subramanian, Mark Bourassa, Hyodae Seo, Kelly Lombardo, Sarah Gille, Tom Farrar, Rhys Parfitt, Brian Argrow





At the ocean surface, the exchange of heat and moisture **fuel** atmospheric weather and climate *and ocean variability*.





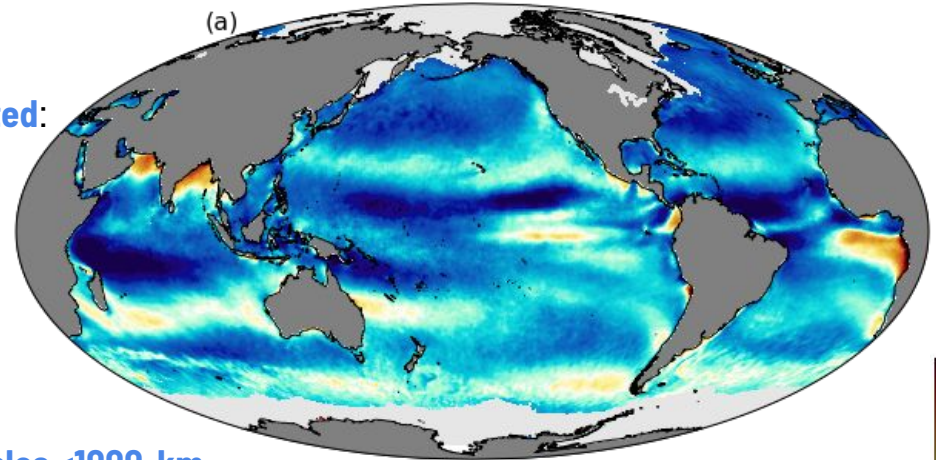
**Increased resolution reveals new and different coupling between the ocean and atmosphere. At scales <1000 km, the SST-wind speed correlation reverses sign, indicating that the ocean is forcing the atmosphere.**

Wind & SST data show:

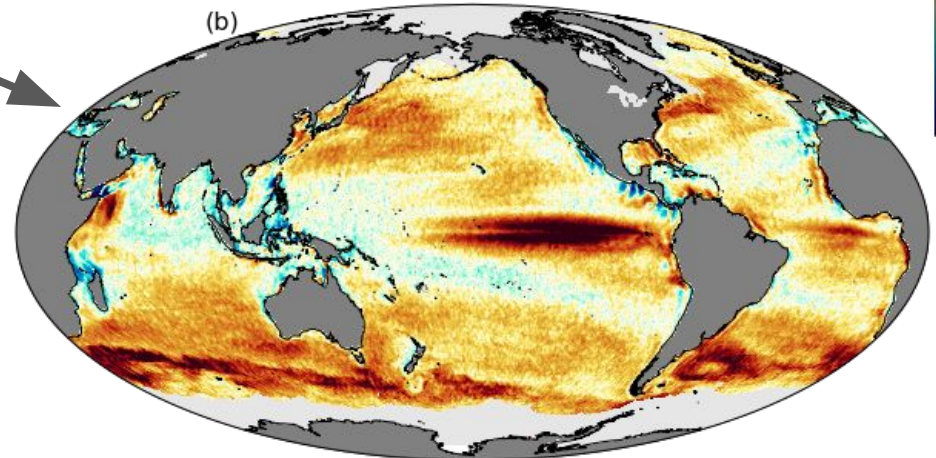
At large scales the **atmosphere** drives the ocean.

At small scales the **ocean** drives the atmosphere.

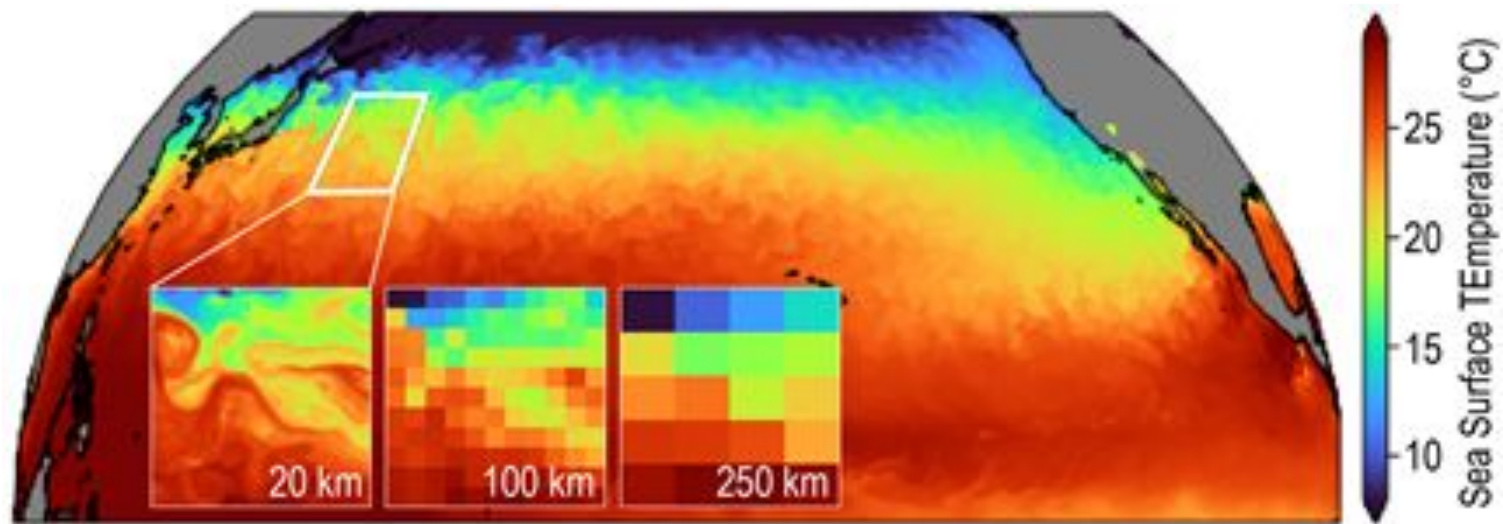
How it started:



How's it going? At scales <1000-km



**Fronts and eddies fill the global ocean and affect air-sea fluxes but the existing air-sea flux data are calculated by cobbling together different datasets with low accuracy/resolution**



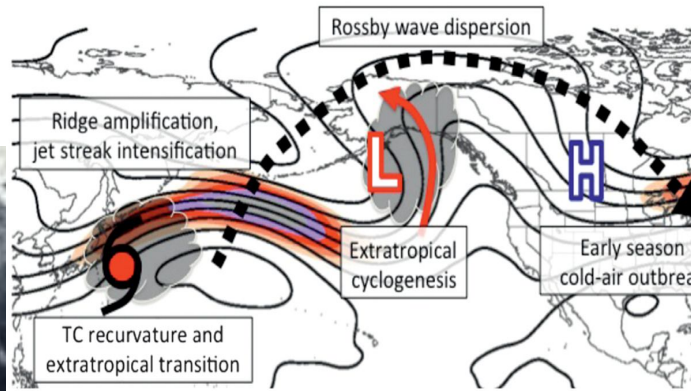
Model studies show that ~25-km fluxes and their subsequent effect on the lower atmosphere influence the upper atmosphere (tropospheric) circulations through different mechanisms than the linear response suggested by lower-resolution models. This discrepancy is due to the low-resolution model's inability to represent the non-linear interactions between the atmosphere and ocean.

## Affecting weather across the U.S.

Models show us that....

storms in the Eastern Pacific respond to 25 km air sea fluxes

This can shift regional weather patterns



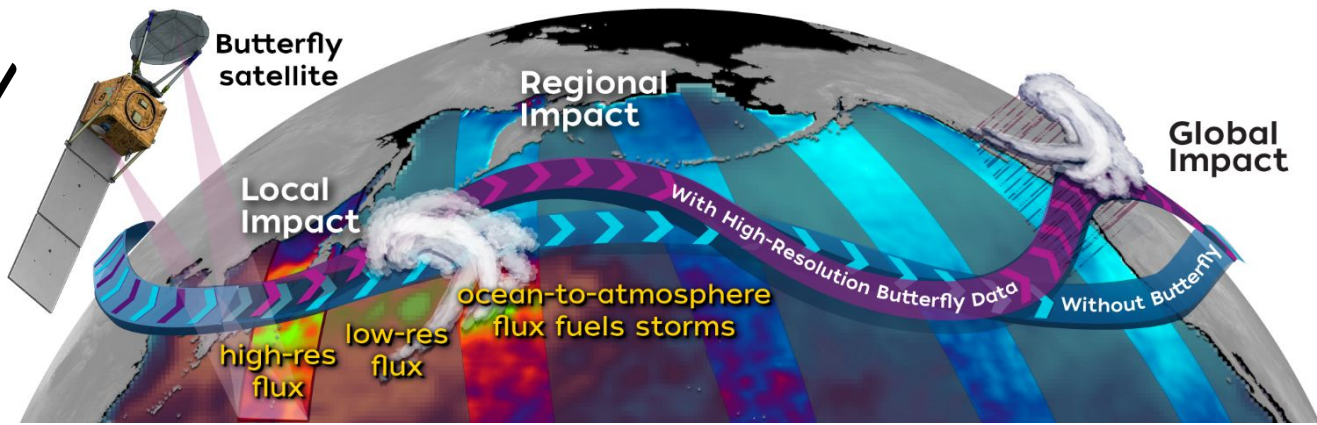
Archambault et al., 2013







revealing the  
oceans' impact on  
weather & climate



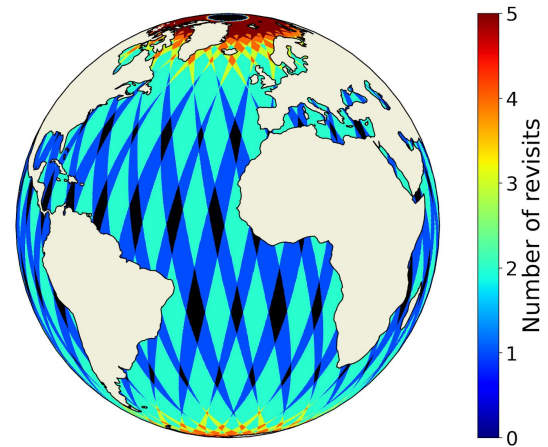
## WHAT

Butterfly is the first satellite mission to **simultaneously** measure sea surface temperature, wind, & near-surface air temperature & humidity in order to estimate air-sea turbulent heat and moisture fluxes at a spatial resolution and accuracy sufficient to resolve the impact of small-scale ocean features on large-scale weather and climate.

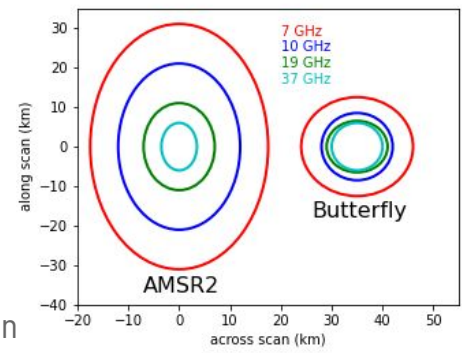
## WHY

The ocean supplies the atmosphere with heat and moisture, dominating the global water and energy cycles while fueling weather and **climate variability**. Butterfly measures this air-sea exchange at spatial scales never before observed to unlock how the **small-scale** ocean “drives” the **large-scale** atmosphere, transforming predictability from mere days to weeks.

## 2-DAY COVERAGE



Mission	Details
Launch Date	4/2026
Length (minimum)	18-months
Orbit	>80° inclination
Swath Width	640 km
Resampled Footprint	20 km



## HOW

Butterfly’s passive microwave instrument is specially designed to measure air-sea turbulent heat and moisture flux at <25-km resolution.

# Why now?

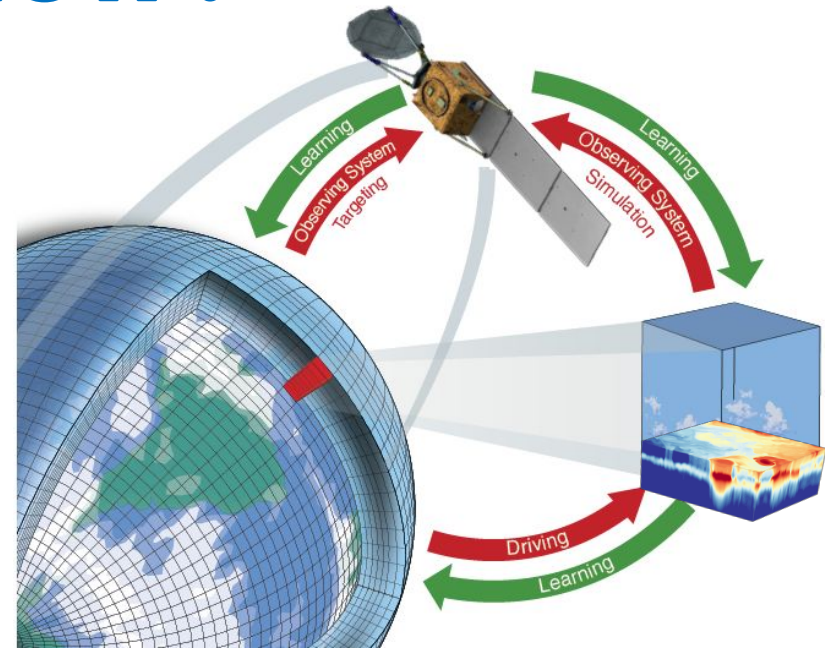
***Our observations have fallen behind modeling and science needs***

**Weather and seasonal forecasting.** Butterfly's 2026 launch will align with expected resolution advances in coupled models (e.g. NOAA's UFS)

**Climate Change.** Butterfly will provide air-sea flux estimates to test and improve climate models and their projections (e.g. CMIP7)

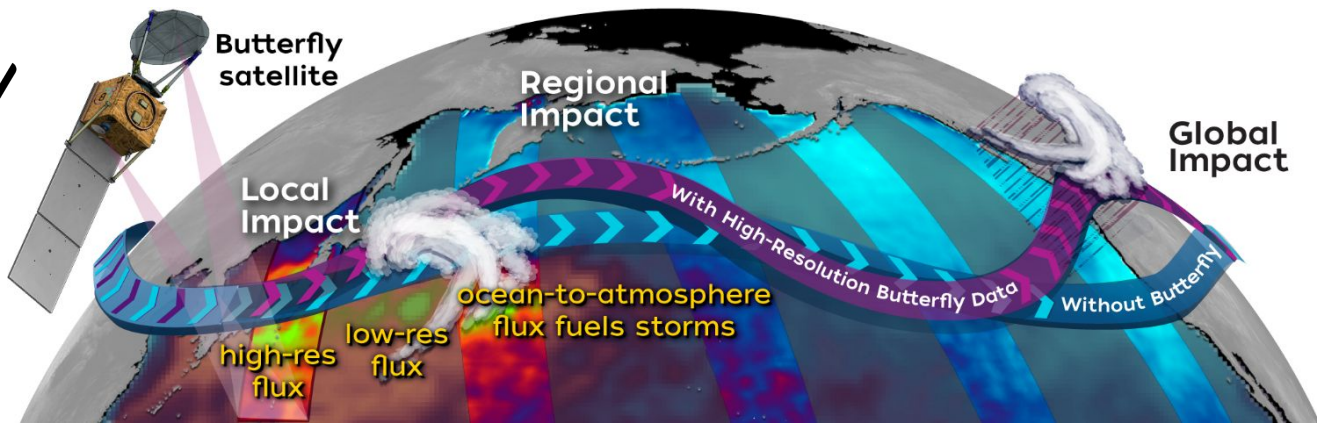
**Ocean Sustainability Science.** 2021-2030 is the UN Decade of Ocean Science for Sustainable Development

**Decadal Survey science priorities.** Butterfly data will advance 7 out of 13 'Most Important' or 'Very Important' Weather and Climate Panel Science and Application Questions.





revealing the  
oceans' impact on  
weather & climate



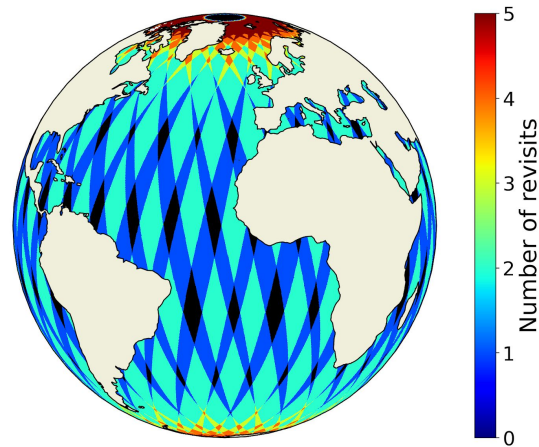
## WHAT

Butterfly is the first satellite mission to **simultaneously** measure sea surface temperature, wind, & near-surface air temperature & humidity in order to estimate air-sea turbulent heat and moisture fluxes at a spatial resolution and accuracy sufficient to resolve the impact of small-scale ocean features on large-scale weather and climate.

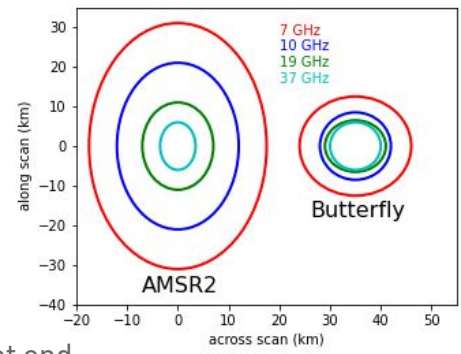
## WHY

The ocean supplies the atmosphere with heat and moisture, dominating the global water and energy cycles while fueling weather and **climate variability**. Butterfly measures this air-sea exchange at spatial scales never before observed to unlock how the **small-scale** ocean “drives” the **large-scale** atmosphere, transforming predictability from mere days to weeks.

## 2-DAY COVERAGE



Mission	Details
Launch Date	4/2026
Length (minimum)	18-months
Orbit	>80° inclination
Swath Width	640 km
Resampled Footprint	20 km



## HOW

Butterfly’s passive microwave instrument is specially designed to measure air-sea turbulent heat and moisture flux at <25-km resolution.