

# The Orbiting Carbon Observatory (OCO-2 and OCO-3) missions

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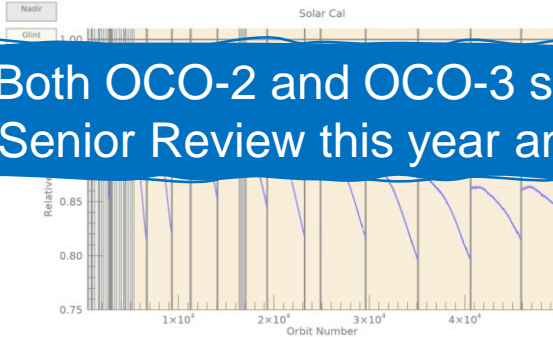
Tuesday, 24<sup>th</sup> October 2023



# Status of the two missions

## OCO-2 “aging like a fine wine”

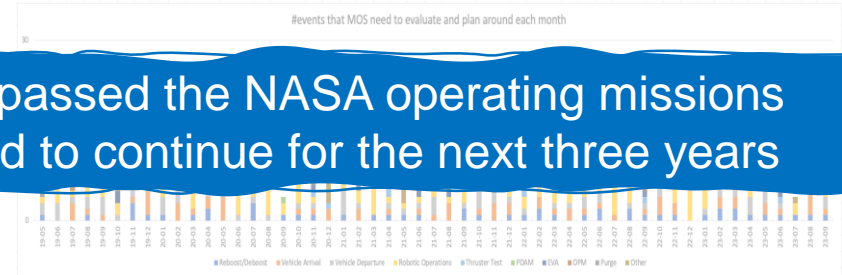
- 9+ years of global XCO<sub>2</sub> and SIF measurements
- Instrument and spacecraft are in excellent health!
- Outgassing/icing impacts diminishing as the mission extends in time



- Due to budgetary constraints, temporary loss of science data over **weekends-only** between Oct. – Nov. 2023 (~ 8 Saturdays data is lost)

## OCO-3 “the youngest child syndrome”

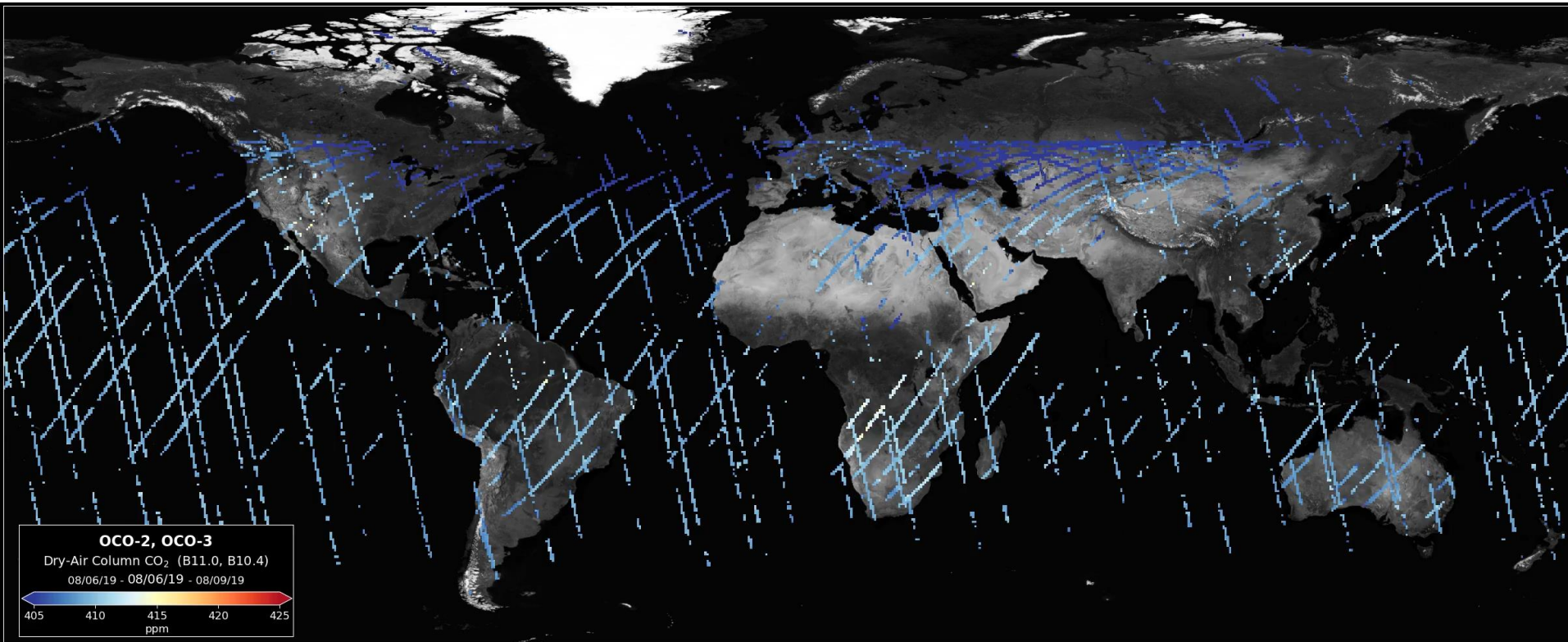
- 4+ years of XCO<sub>2</sub> and SIF measurements between 52°N - 52 °N
- Payload is healthy and operating nominally!
- ISS is a busy and dynamic environment with LOTS of activities that our ops need to account for



- Will be in storage from Nov. 2023 – May 2024 to let another NASA mission complete its prime mission
- Following reinstallation on ISS, OCO-3 will continue science operations till the “lifetime of ISS”

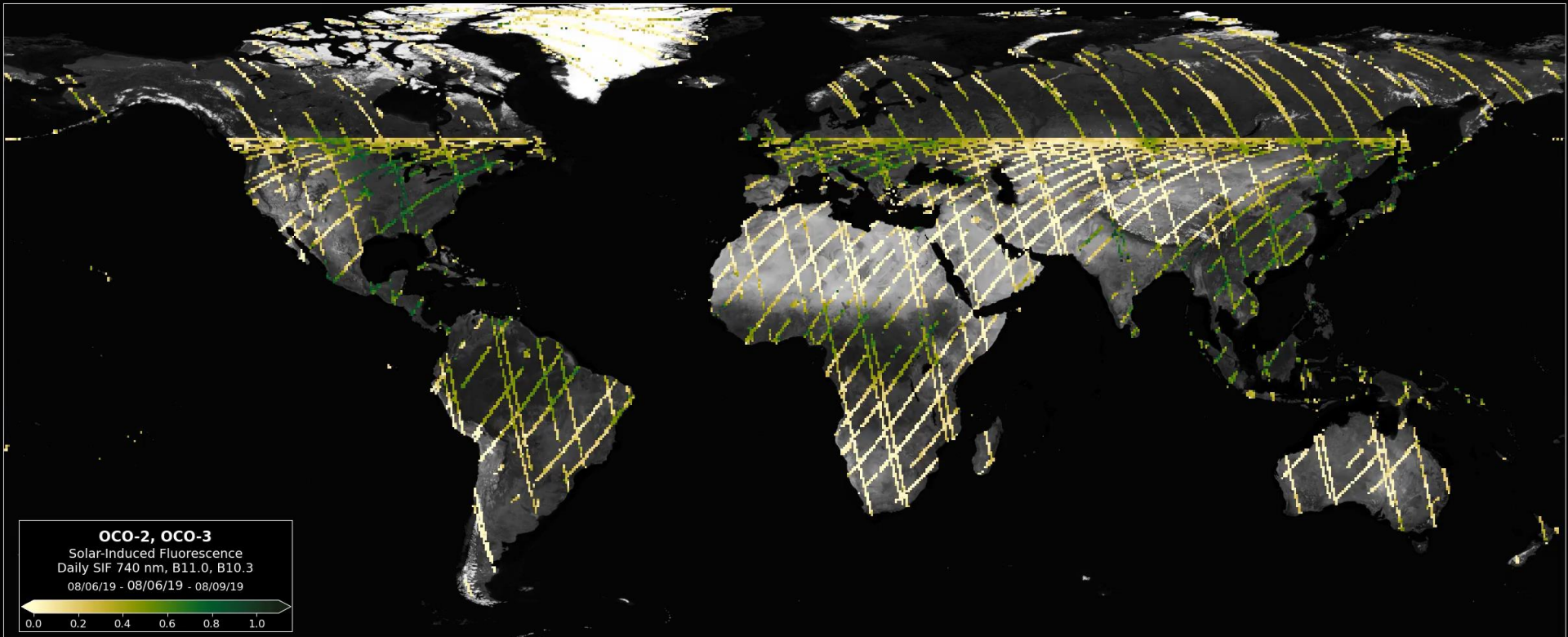
Both OCO-2 and OCO-3 successfully passed the NASA operating missions Senior Review this year and authorized to continue for the next three years

# Thousands of soundings per day measuring XCO<sub>2</sub> ...





# SIF shows where and when carbon uptake by plants is occurring



**OCO-2, OCO-3**

Solar-Induced Fluorescence  
Daily SIF 740 nm, B11.0, B10.3  
08/06/19 - 08/06/19 - 08/09/19

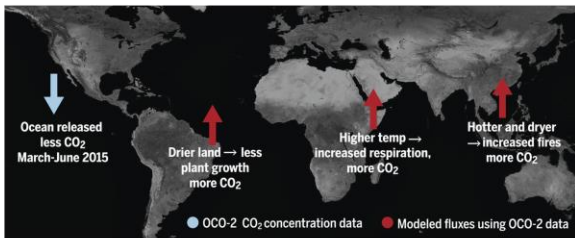
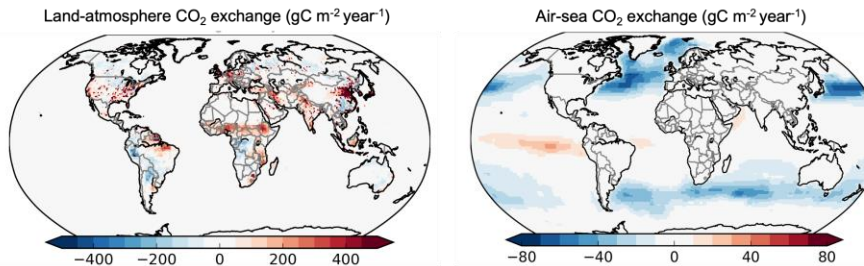
0.0 0.2 0.4 0.6 0.8 1.0

# Delivering insights into fundamental carbon cycle science questions & providing CO<sub>2</sub>/SIF data for actionable information



What are the magnitude and distribution of global and regional carbon sources and sinks? What are their year-to-year variations?

See Crowell et al. 2019, Piero et al. 2022, Phillips et al. 2022, Byrne et al. 2023, among others

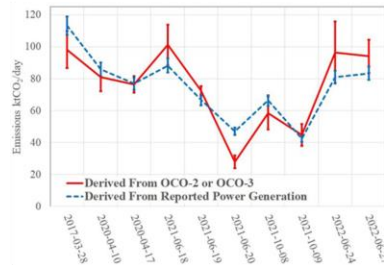


How does the global carbon cycle, terrestrial and aquatic ecosystems respond to extreme events and climate variability?

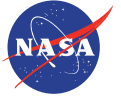
See Liu et al., 2017, Chatterjee et al., 2017, Yin et al., 2020, Feldman et al. 2023, among others

What are the effects of human activities on atmospheric CO<sub>2</sub> concentrations? How are CO<sub>2</sub> emissions evolving? Can we track those changes?

See Ye et al. 2020, Weir et al. 2021, Wu et al. 2022, Chevallier et al. 2022, Nassar et al. 2023, Hakkarainen et al. 2023, among others



## Stakeholders



# Contribution to the Global Stocktake & various GHG initiatives

## Timeline for the Paris Agreement Ambition Mechanism

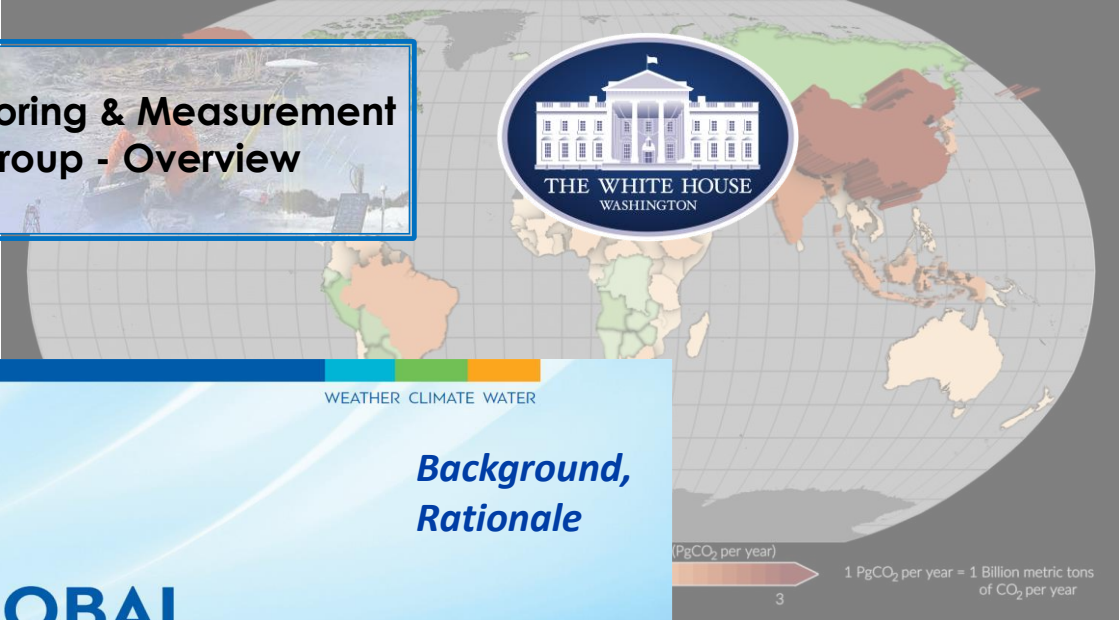
### Starting Now

How high the ambition of the future globally depends on the strength of the agreement we build today. To build a strong agreement for action by 2020 and meet our emissions reduction, we need to:

- Tighten the rules** to ensure all emissions are counted with no cheating
- Take early action** to address specific gases like HFCs
- Set our sights on longer term transformational action** to develop 2050 plans that build robust and business support
- Revise and strengthen the first round of climate plans** as part of a collective conclusion in 2018
- Provide money** to support the transition to zero emissions and resilient activities



## Greenhouse Gas Monitoring & Measurement Interagency Working Group - Overview



# WMO GLOBAL GREENHOUSE GAS WATCH



10/27/2023

of CO<sub>2</sub> from 2015 to 2020  
satellite measurements.  
removed than emitted appear as  
green depressions, while countries with higher emissions are tan or red and  
appear to pop off the page



# Deeper, stronger roots brings high-quality fruits ...

Science & Applications



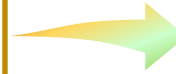
Operations

Algorithm

Calibration

Validation

Instrument



*Need to nurture all parts of the mission tree “equally”*



# Key Takeaways

- NASA's OCO missions are **key elements of a global greenhouse gas observational network** to meet the needs of scientific understanding and mitigation policies.
- Between the two OCO missions, we have:
  - 9+ years of data from OCO-2 and 4+ years of data from OCO-3
  - atmospheric CO<sub>2</sub> measurements with high precision, accuracy, resolution, and coverage
  - solar-induced chlorophyll fluorescence (SIF) measurements
- These measurements have now been used to:
  - capture spatial (facility scale → global) and temporal (diurnal → decadal) trends in CO<sub>2</sub>
  - quantify how CO<sub>2</sub> emissions are being offset by natural carbon sinks
  - show two-way interactions between carbon and climate
  - demonstrate that spaceborne measurements can be used to accurately quantify CO<sub>2</sub> emissions from anthropogenic hotspots
  - finding a growing number of stakeholders and applied users



# OCO Science Team Meeting, October 2023, Boulder, USA



## QUESTIONS

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