

Update on the deployments of the Marine- Atmospheric Emitted Radiance Interferometers (M-AERIs), and radiometers on Saildrones

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Outline

- M-AERI
- Covid & post-pandemic deployments and status
- SST_{skin} from Sairdrones in the Arctic Ocean.
- Future activities

M-AERI

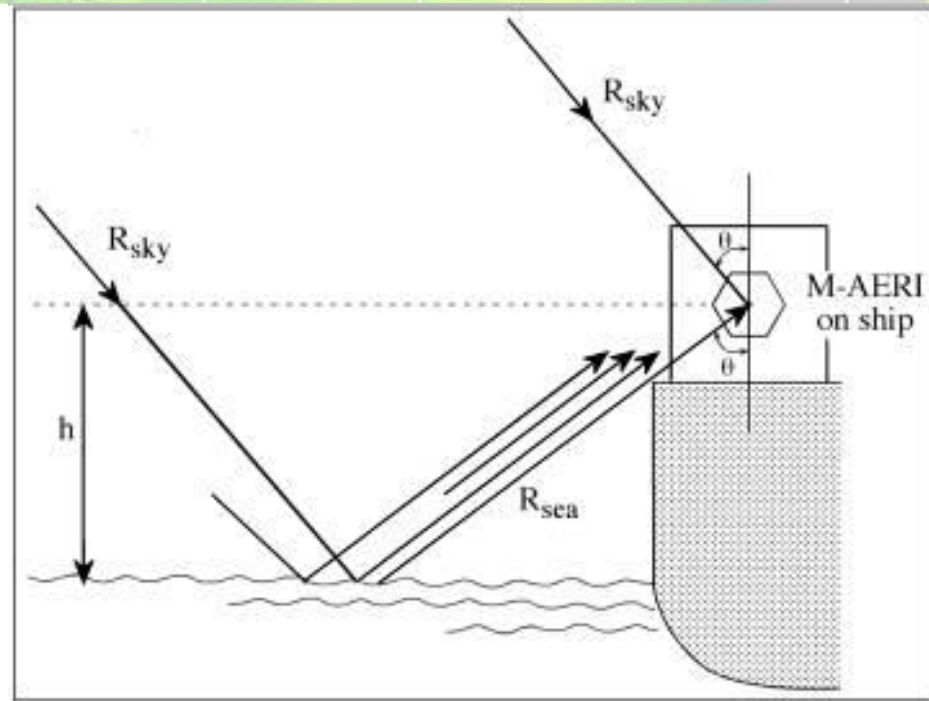
- The Marine-Atmospheric Emitted Radiance Interferometer (M-AERI) is an accurate, self-calibrating, Fourier transform IR spectroradiometer that measures emission spectra from the sea and atmosphere.
- At sea calibration by two internal blackbody cavities with thermometers with SI-traceable calibration.
- Calibration sequence before and after each cycle of measurements.
- Calibration before and after deployments using NIST-designed water-bath blackbody calibration target at RSMAS. Uses SI-traceable thermometers at mK accuracy.
- Periodic radiometric characterization of RSMAS water-bath blackbody calibration target by NIST TXR and NPL AMBER.
- M-AERIs run autonomously.
- SST_{skin} derived from spectral radiance measurements at $\sim 7.7 \mu\text{m}$.

Minnett, P.J., Knuteson, R.O., Best, F.A., Osborne, B.J., Hanafin, J.A., & Brown, O.B. (2001). The Marine-Atmospheric Emitted Radiance Interferometer (M-AERI), a high-accuracy, sea-going infrared spectroradiometer. *Journal of Atmospheric and Oceanic Technology*, 18, 994-1013

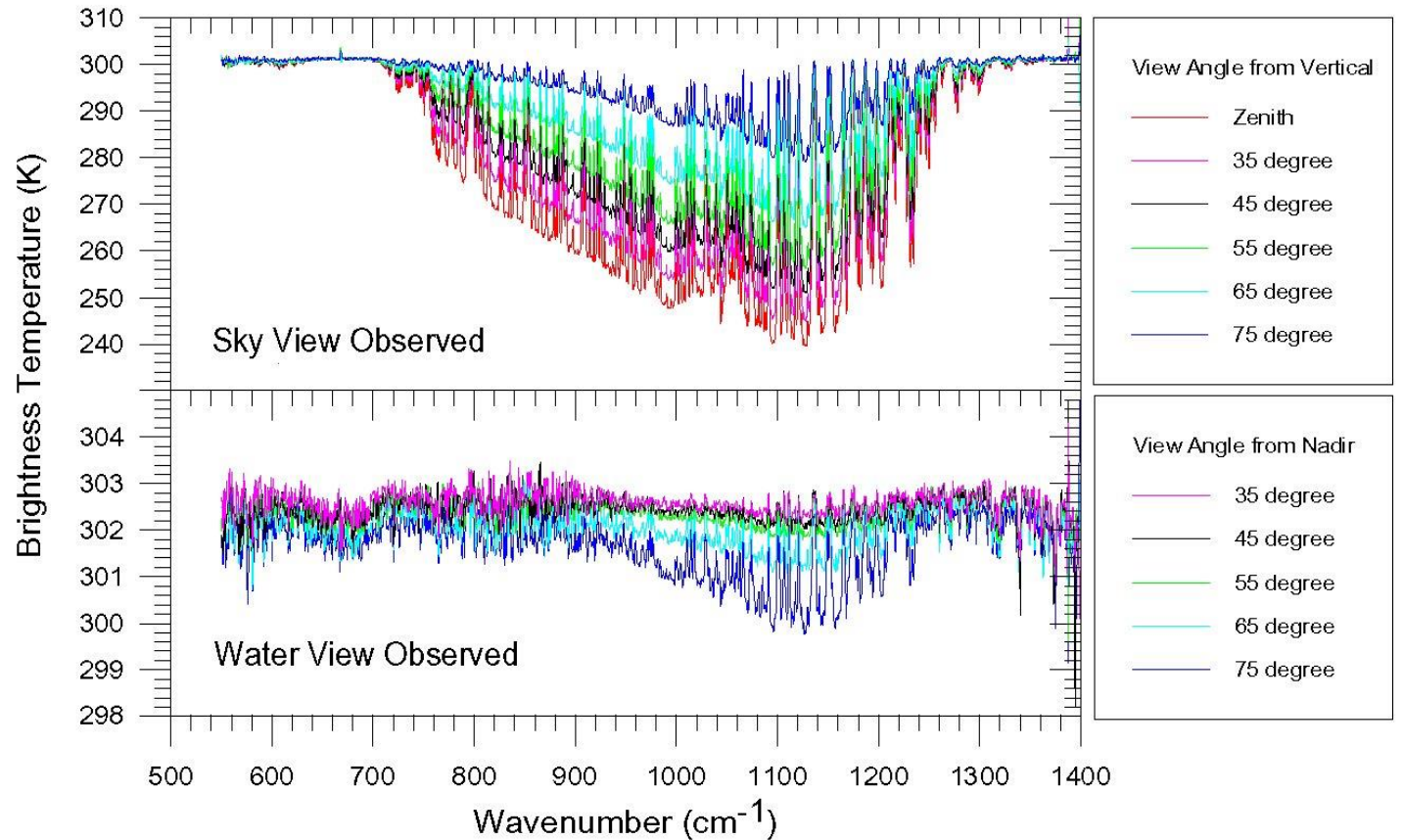
FRM4SST: ISFRN Workshop

22-23 April 2024

M-AERI at-sea measurements



$$R_{\text{water}}(\lambda, \theta) = \varepsilon(\lambda, \theta)B(\lambda, T_{\text{skin}}) + (1 - \varepsilon(\lambda, \theta))R_{\text{sky}}(\lambda, \theta) + R_h(\lambda, \theta)$$



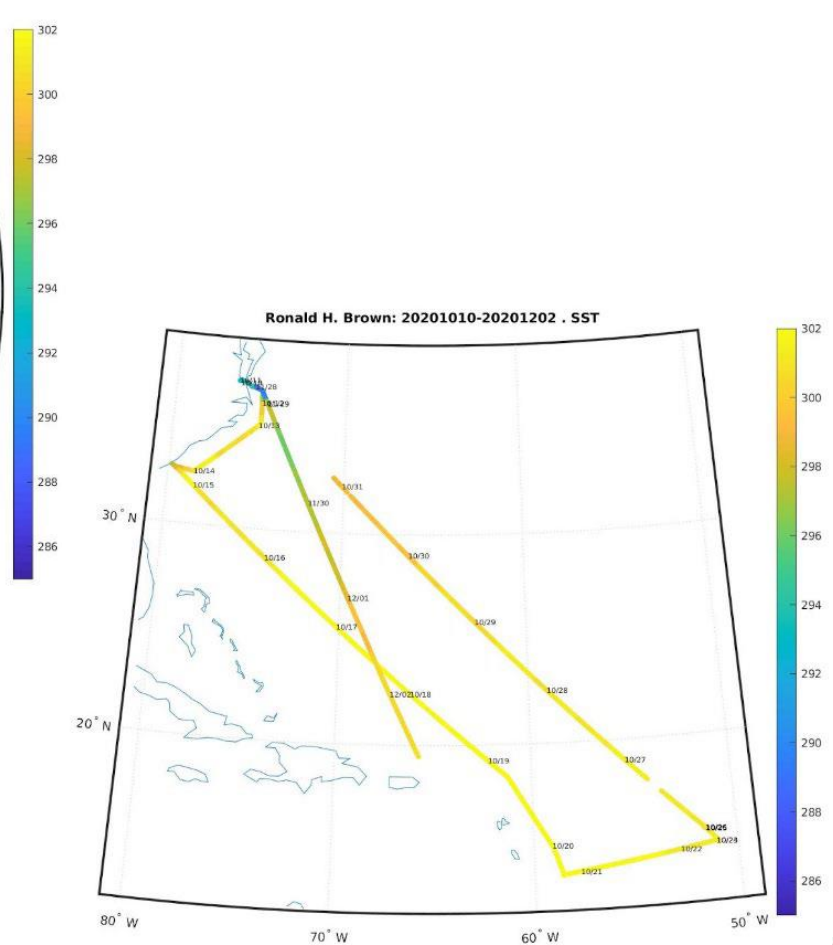
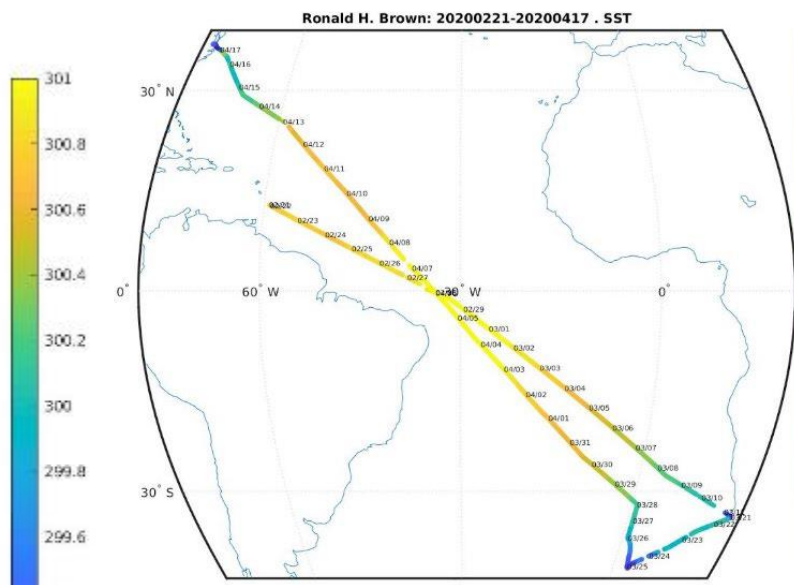
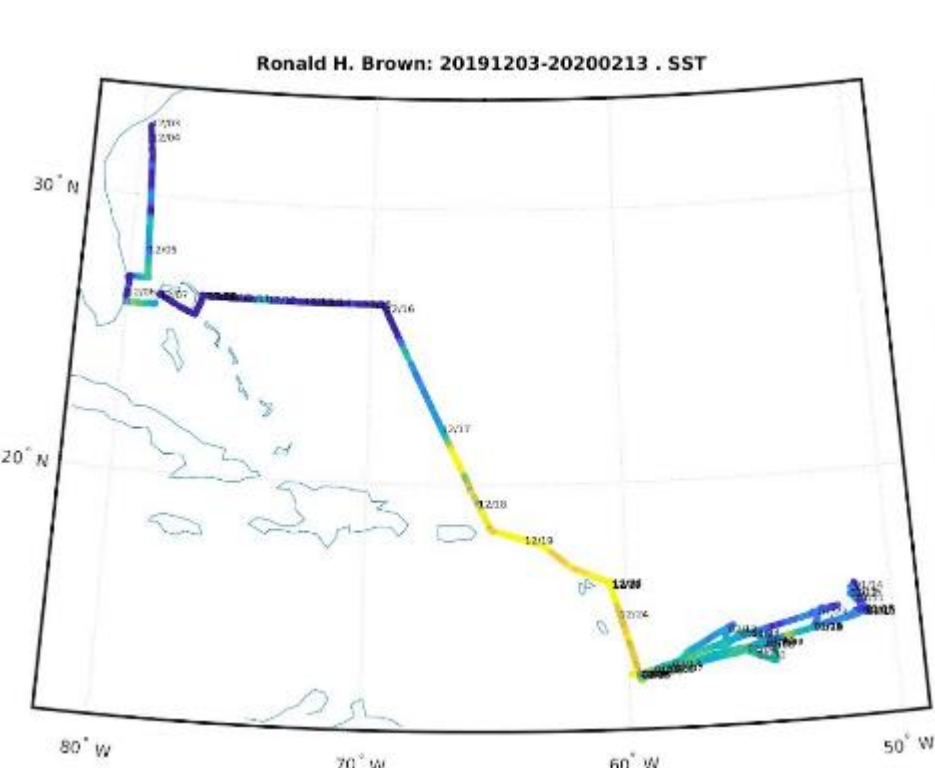
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Consequences of COVID-19 – NOAA *S Ronald H Brown*.

- The NOAA *S Ronald H. Brown* was on a transect to Cape Town, S.A., when COVID became widespread.
- Cruise plans from Cape Town were abandoned and ship returned to USA.
- Ship was tied up in Norfolk, VA, from May 10 to October 11, 2020, when research cruises resumed.
- Ship entered port in Pascagoula, MS, in May 2023 for a major refit. Return to service not expected before August 2024.
- Our equipment was removed and brought back to RSMAS for refurbishment and recalibration.

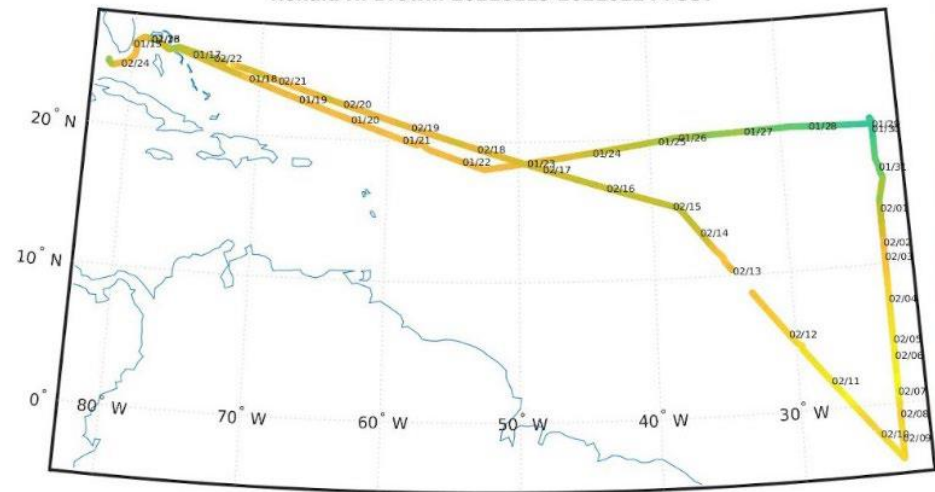
Cruise tracks of the *Ronald H. Brown* 2020



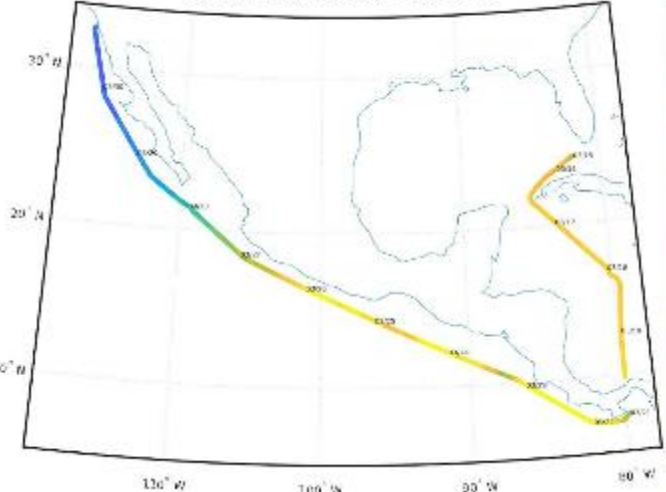
Cruise tracks of the *Ronald H. Brown* 2021



Ronald H. Brown: 20210115-20210224 . SST



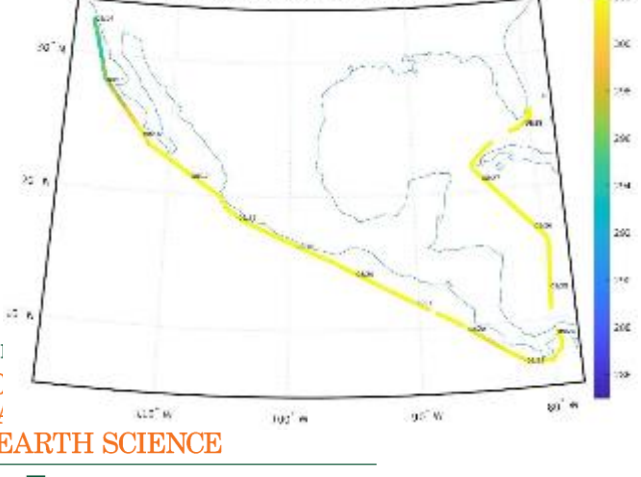
Ronald H. Brown: 20210315-20210330 . SST



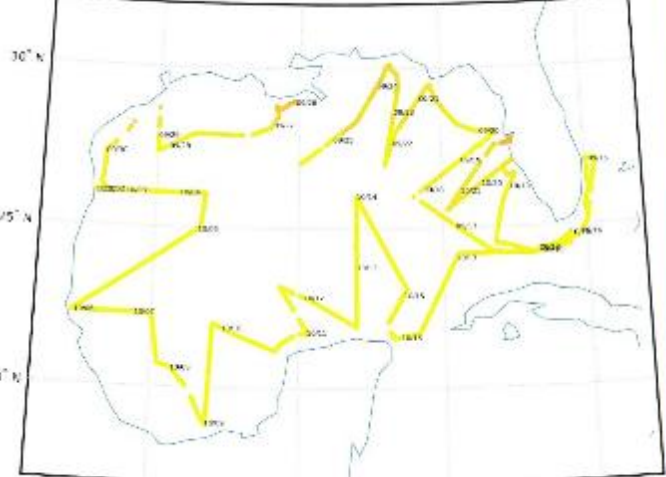
Ronald H. Brown: 20211113-20211219 . SST



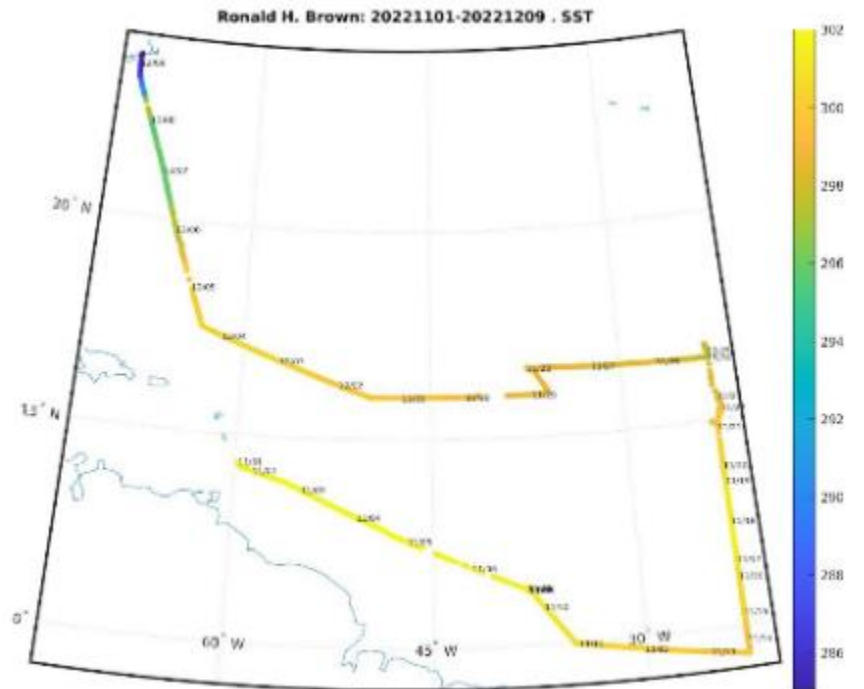
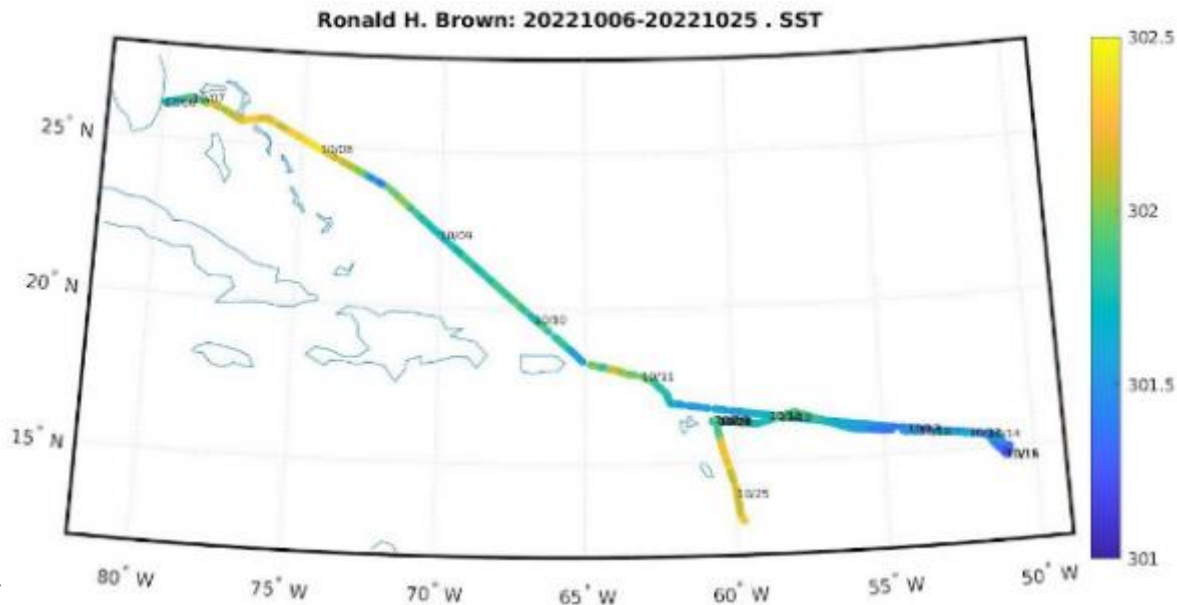
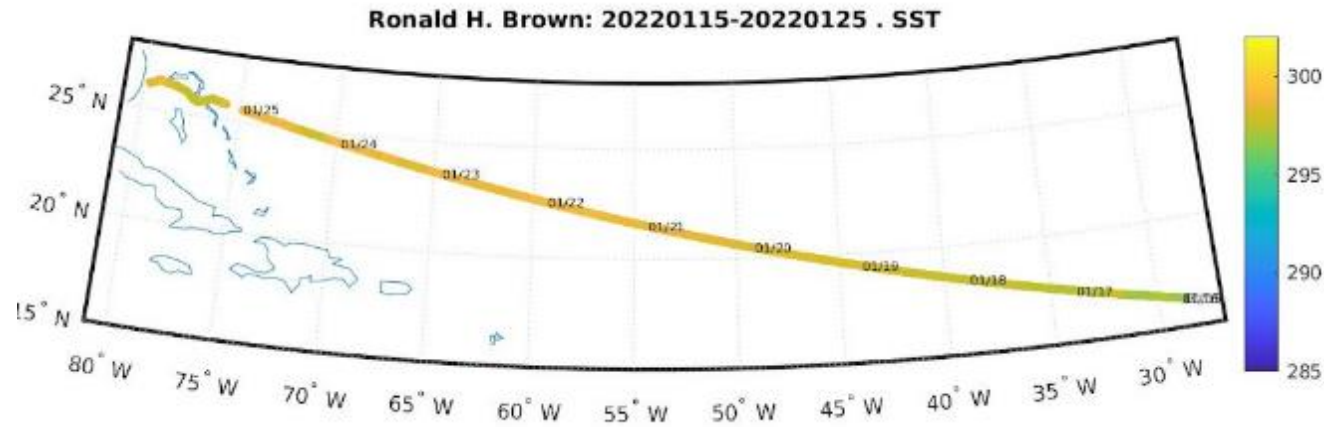
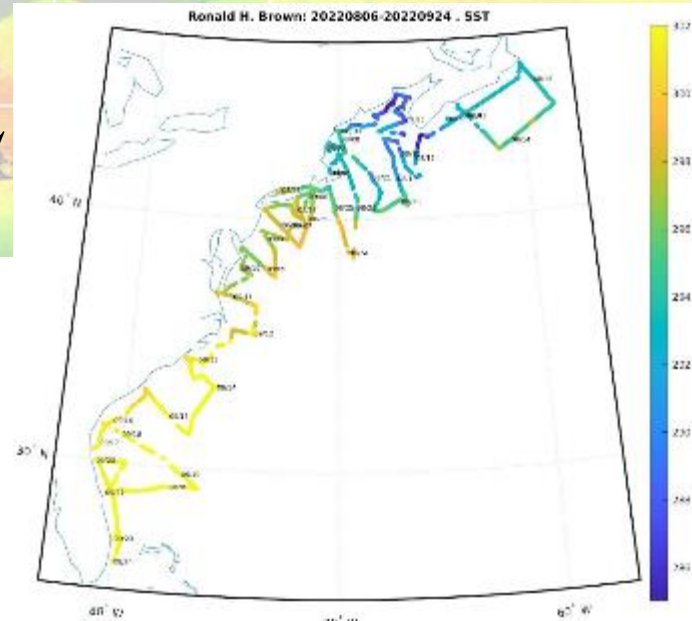
Ronald H. Brown: 20210814-20210829 . SST



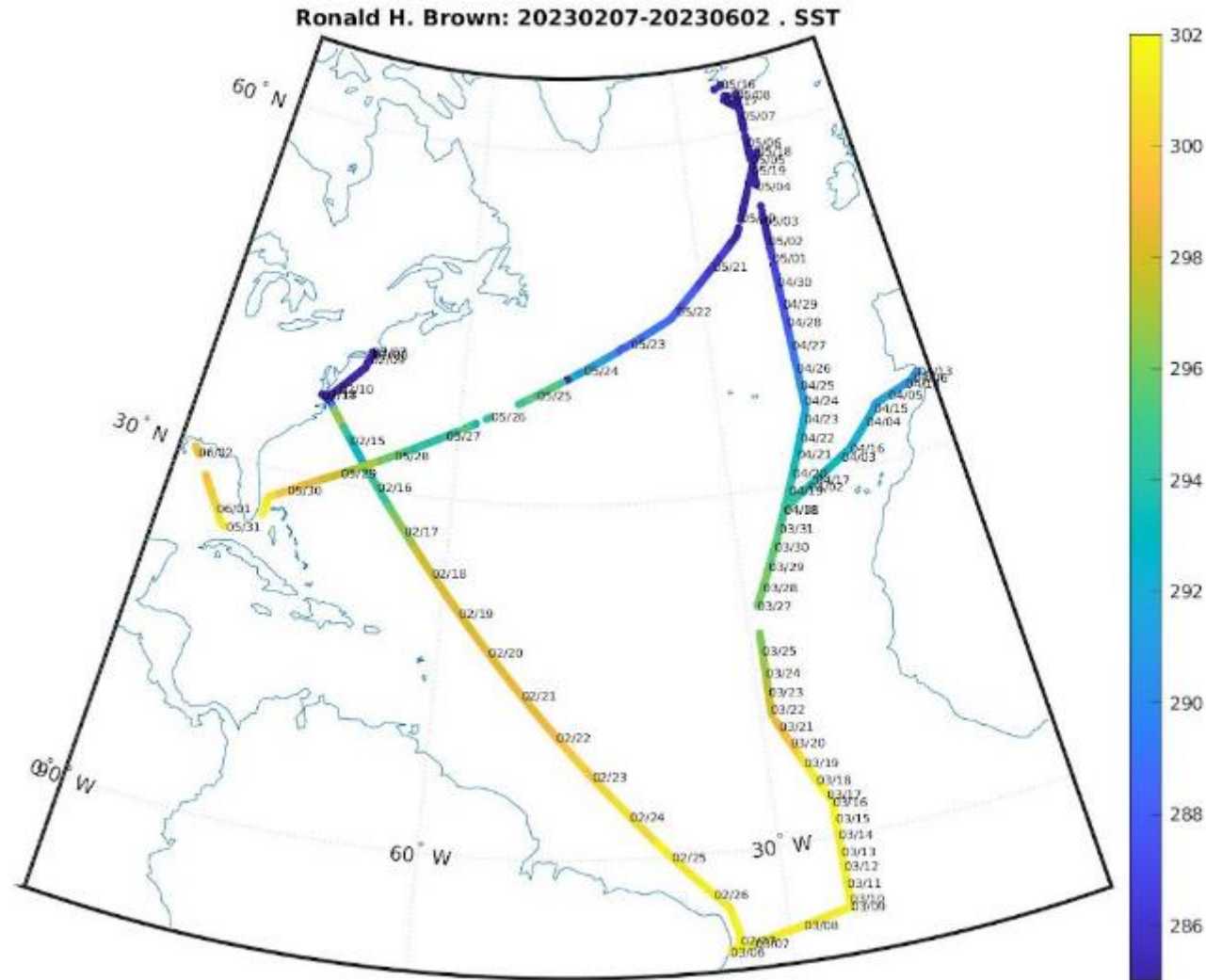
Ronald H. Brown: 20210913-20211021 . SST



Cruise tracks of the *Ronald H. Brown* 2022



Cruise tracks of the *Ronald H. Brown* 2023



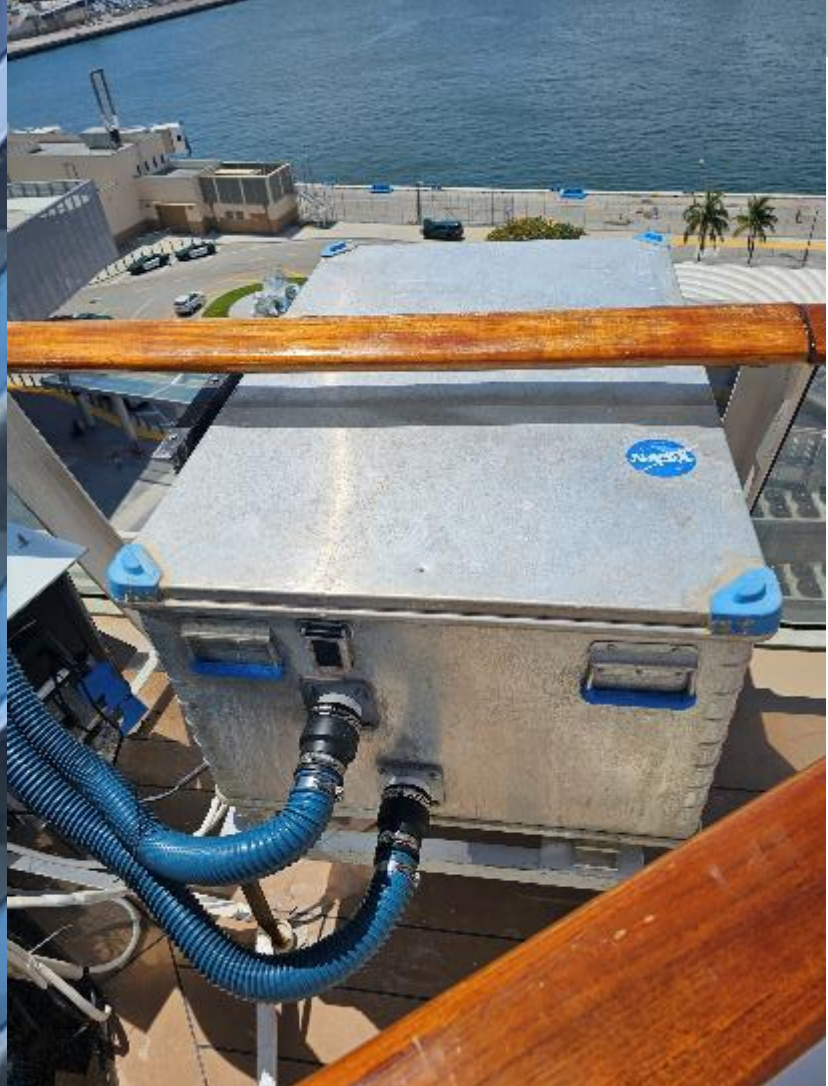
22-23 April 2024



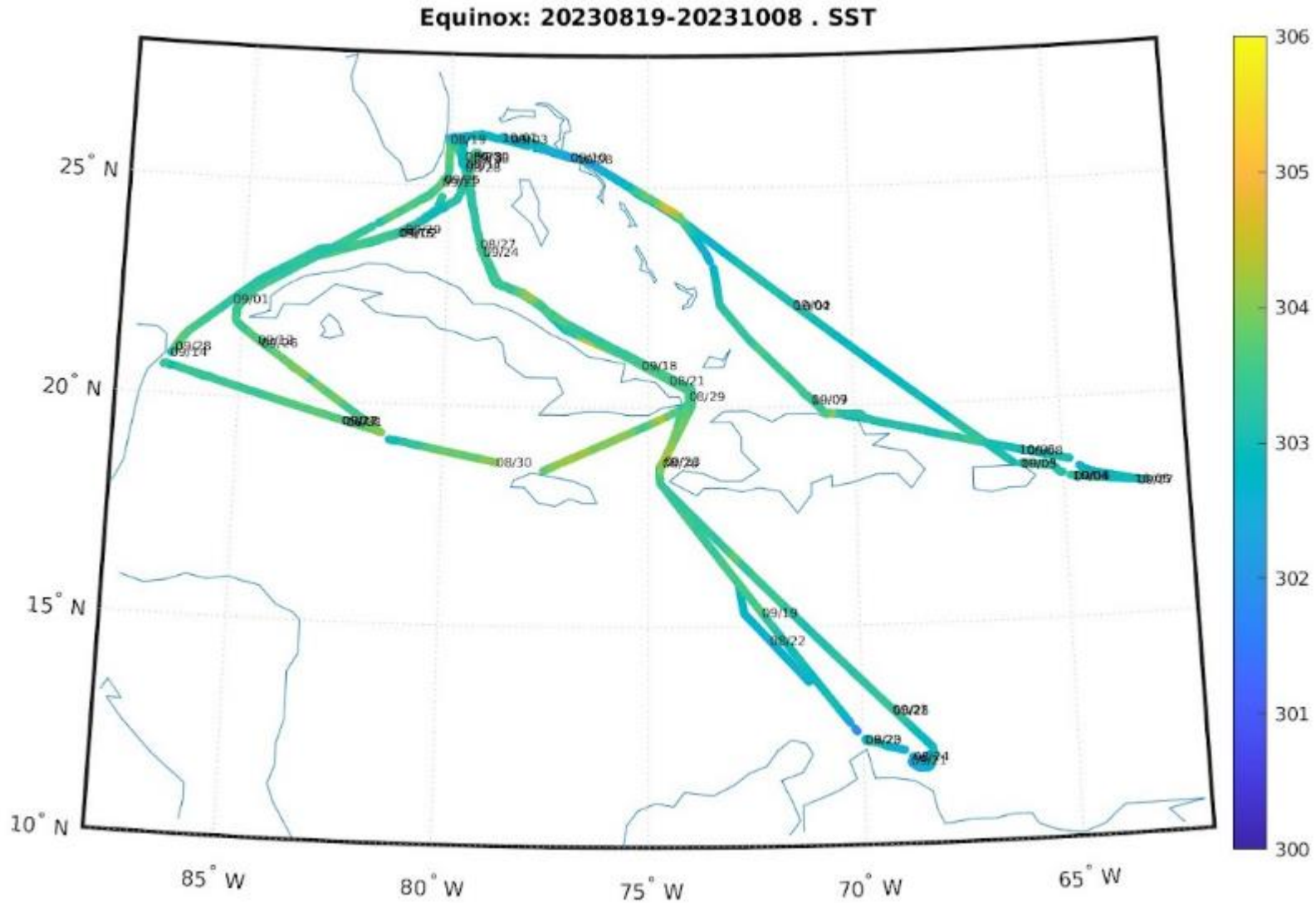
Consequences of COVID-19 – Royal Caribbean

- Royal Caribbean ships were voluntarily idled in March 2020. We had no access to the instruments on the ships.
- Cruises were resumed once vaccines were widely used, and in late 2022 we started refurbishing the mountings on the *Celebrity Equinox*.
- Data from the *Celebrity Equinox* restarted on August 19, 2023.

M-AERI on *Celebrity Equinox*



M-AERI data from *Celebrity Equinox* 2023



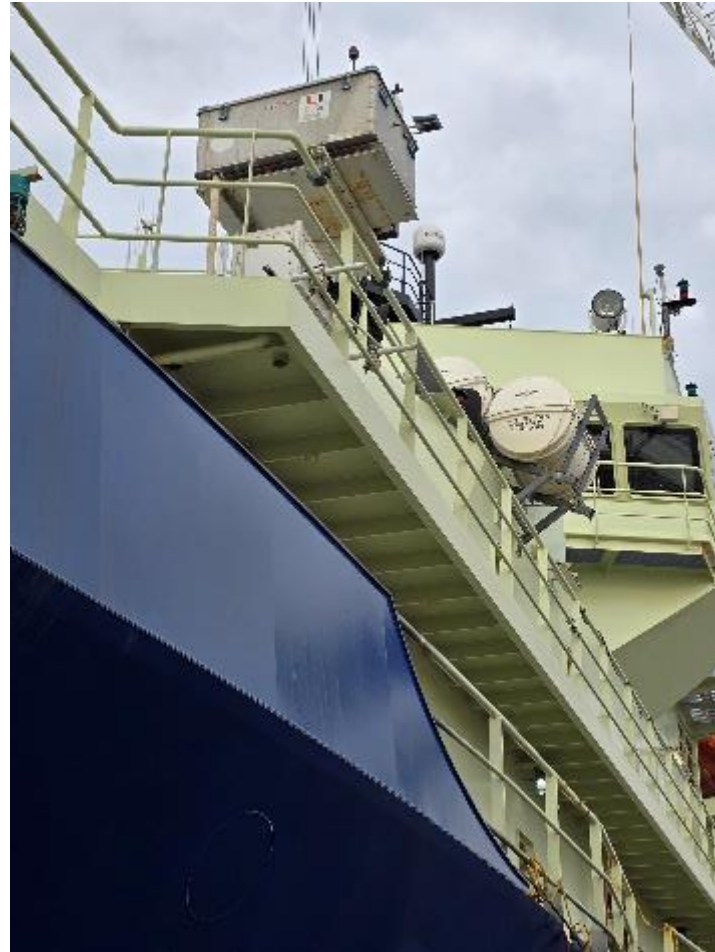
M-AERI on the R/V *Neil Armstrong*

- Installed M-AERI on the R/V *Neil Armstrong*, completed on March 31, 2024.
- Sails predominantly in northern Atlantic.



<https://www.whoi.edu/what-we-do/explore/ships/ships-neil-armstrong/>

M-AERI on the R/V *Neil Armstrong*

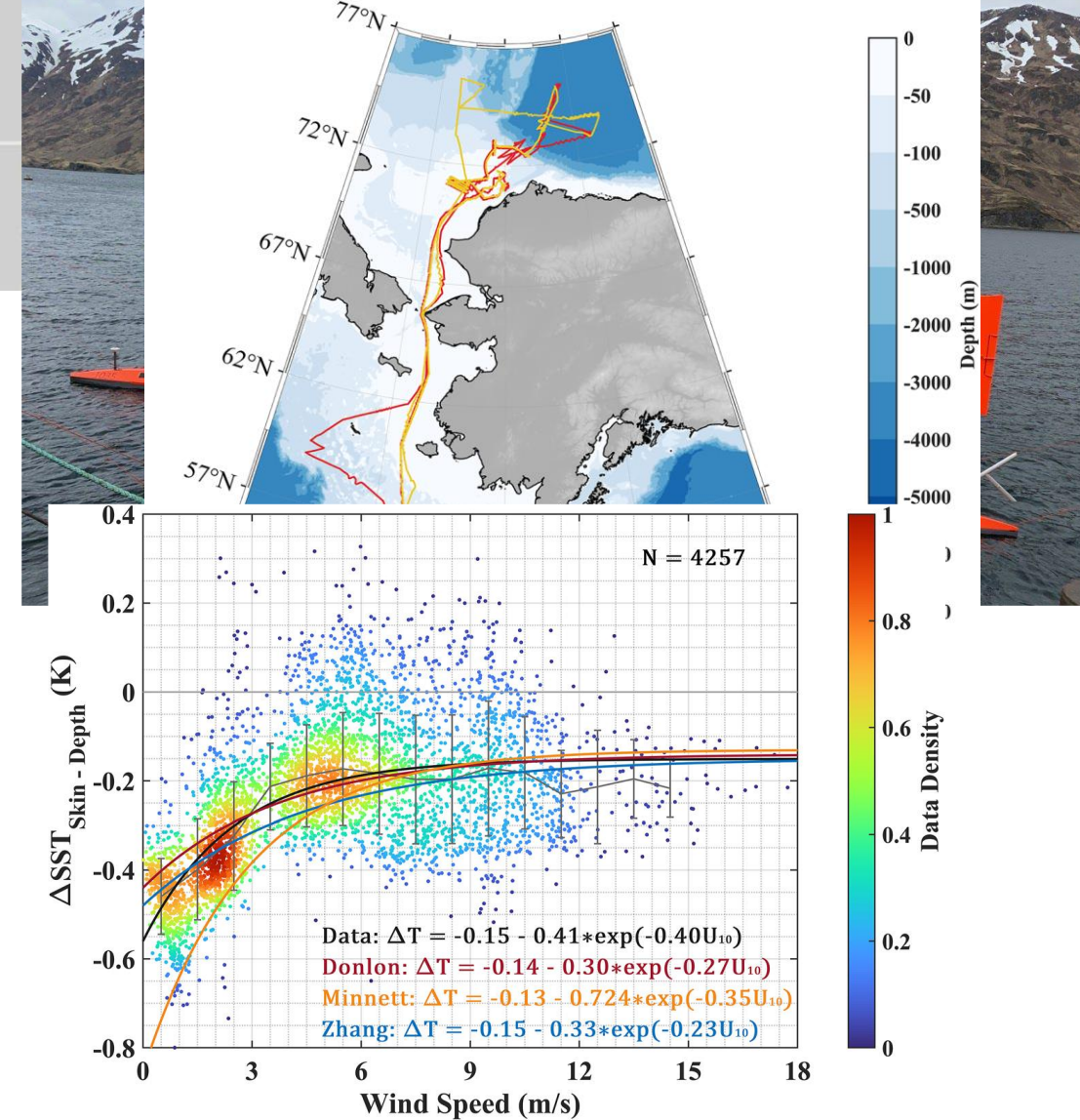


SST_{skin} from Saildrones.

- Saildrones are autonomous surface vehicles that carry a range of oceanographic and meteorological instruments.
- Two Saildrones were deployed for 150-day cruises in the Pacific Sector of the Arctic in 2019. Each carried a pair of Heitronics radiometers for the derivation of SST_{skin}.
- After stringent qc, SST_{skin} can be derived to 0.12 K.
- Wind speed dependence of skin effect is “in family.”

Jia, C., Minnett, P.J., Szczodrak, M., & Izaguirre, M. (2023). High Latitude Sea Surface Skin Temperatures Derived From Saildrone Infrared Measurements. *IEEE Transactions on Geoscience and Remote Sensing*, 61, 1-14

Jia, C., Minnett, P.J., & Luo, B. (2023). Significant Diurnal Warming Events Observed by Saildrone at High Latitudes. *Journal of Geophysical Research: Oceans*, 128, e2022JC019368



Future Plans

- *Celebrity Equinox* will be in the Mediterranean Sea until December 2024.
- Installations on *Allure of the Seas* and *Adventure of the Seas* beginning.
- Continue to collect data from R/V *Neil Armstrong*.
- SST_{skin} datasets will continue to be available for Ships4SST archive.

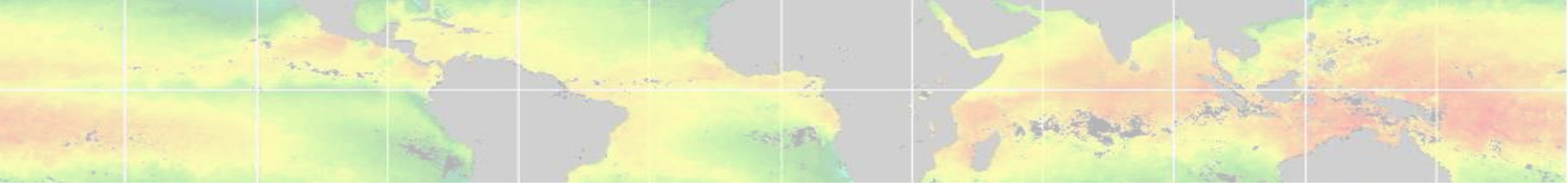


Summary

- M-AERI cruise operations are resuming following the limitations imposed by the COVID-19 pandemic.
- High-latitude SST_{skin} from 2019 from Saildrone deployments provide data from a very under-sampled region.
- All M-AERI and Saildrone SST_{skin} datasets are available for inclusion in Felyx and other data bases.

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Thank you.

