# RBR

Welcome, the RBR Webinar will begin shortly…

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# Instruments for Wirewalker™

Daniel Nelson
Technical Sales Manager
North America, West

# Future Webinars

DEL MAR OCEANOGRAPHIC

Using waves and power efficient loggers for autonomous profiling

**Chris Kontoes (DMO) & Andrew Lucas (SIO)**

**September 17, 2020 at 11AM AEST (GMT+10)**

RBR

Loggers


OEM

Sensors


Systems


RBRconcerto³
RBRcoda³
RBRconcerto³
RBRmaestro³
RBRconcerto³
RBRbrevio³
RBRsolo³

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| Sensor | Accuracy |
|---|---|
| Conductivity | ±0.003 mS/cm |
| Temperature | ±0.002°C |
| Depth | ±0.05% FS |


# RBR*concerto*$^3$ C.T.D for Wirewalker™

RBR*concerto*$^3$ C.T.D|fast8, RBR*concerto*$^3$ C.T.D|fast16, RBR*concerto*$^3$ C.T.D|fast32

Directional dependent sampling

Depth rating up to 750m

Autonomous logging or real-time telemetry; connection to extra battery power

Integration with other sensors

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# CTD System for Wirewalker™


# Additional Sensors


- Dissolved oxygen
- Optical backscatter
- Fluorometry
- Irradiance
- Turbidity

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# RBR2020 Cohort

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# Thank You

## Contact Us

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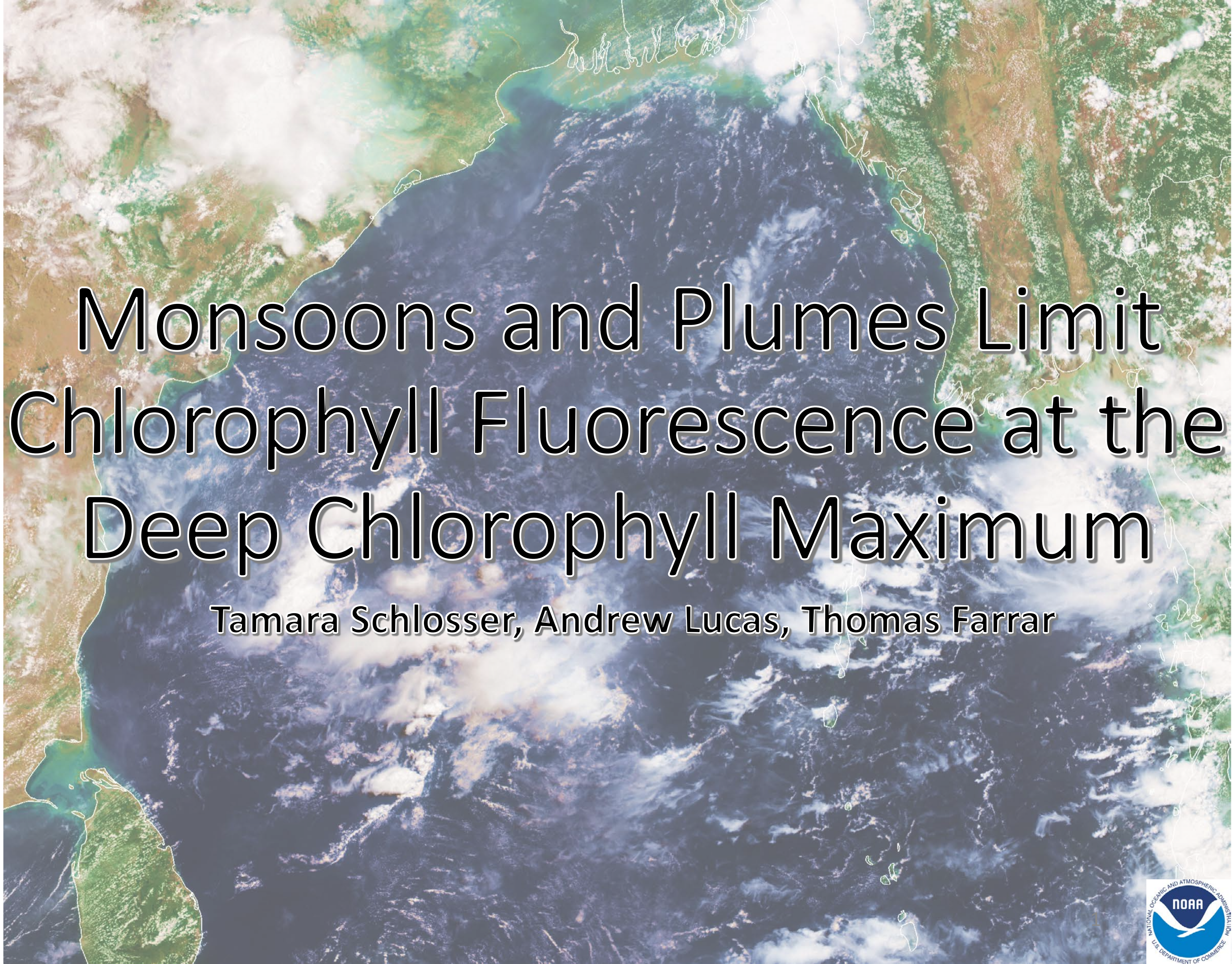
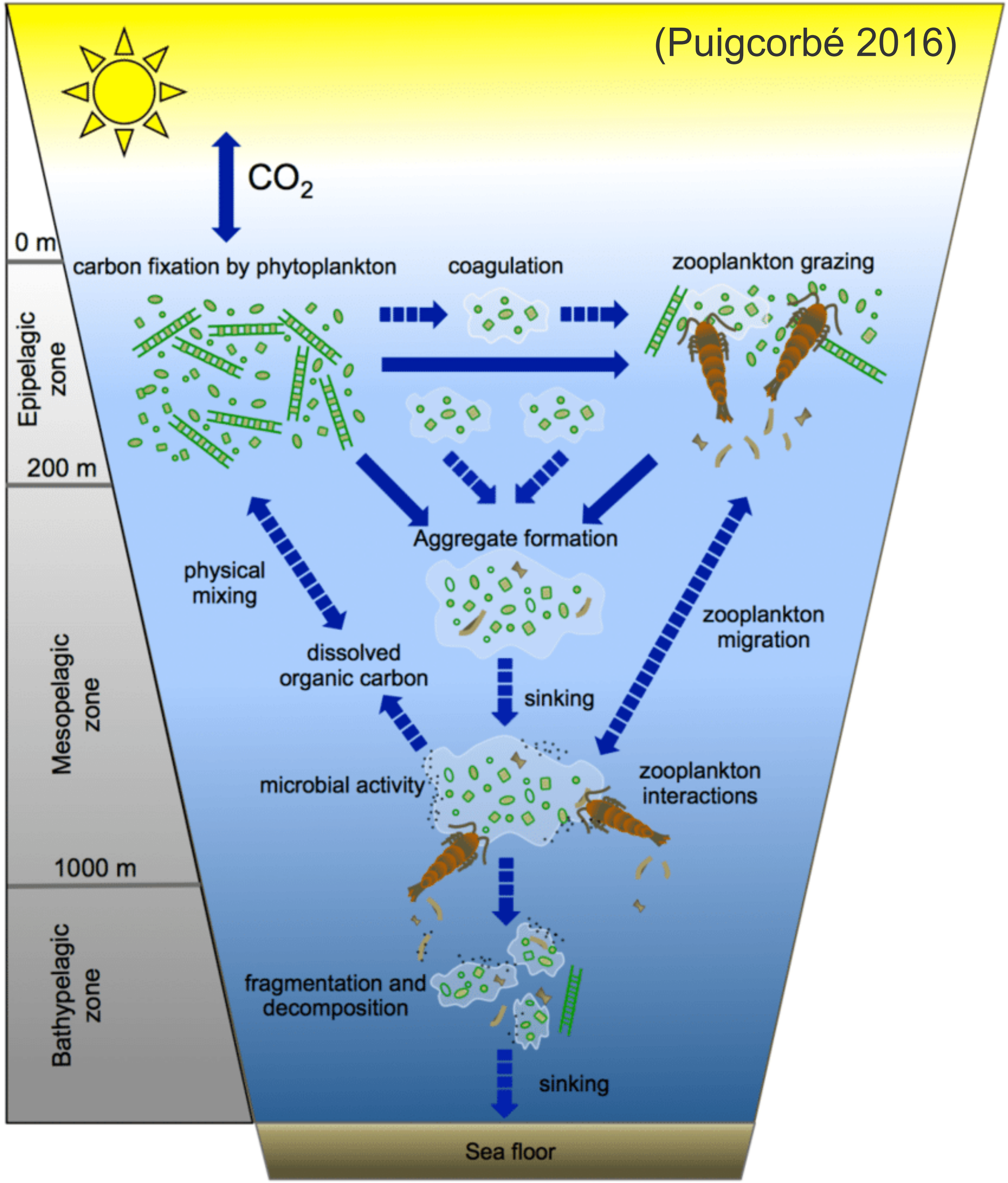


# Monsoons and Plumes Limit Chlorophyll Fluorescence at the Deep Chlorophyll Maximum

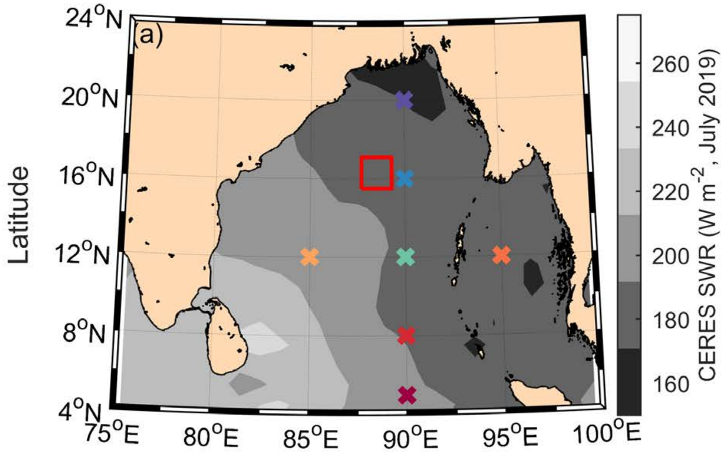
Tamara Schlosser, Andrew Lucas, Thomas Farrar

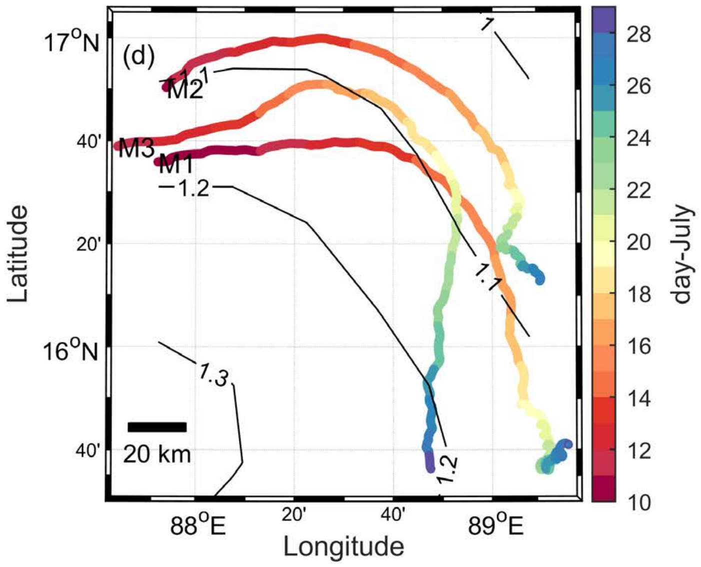
# Introduction

- Primary productivity has implications, for example, for the biological pump of carbon and upper ocean heat content.
- Primary productivity can be limited by nutrients or light
- The southwest monsoon affects the Indian subcontinent and is economically important, but also leads to devasting flooding. Predicting the monsoon is difficult and the focus of ongoing research like MISO-BOB and ASIRI.
- Under light-limited conditions, primary productivity can depend on both cloudiness, a characteristic of the monsoon, and the optical qualities of water



# Study Site- July 2019 campaign




- We deployed three profilers for ~18 days in July, 2019, in the Bay of Bengal

- a) Spatial variability in shortwave radiation (SWR) throughout Bay of Bengal (BoB) with smaller SWR toward the northern and eastern sections in July, 2019.

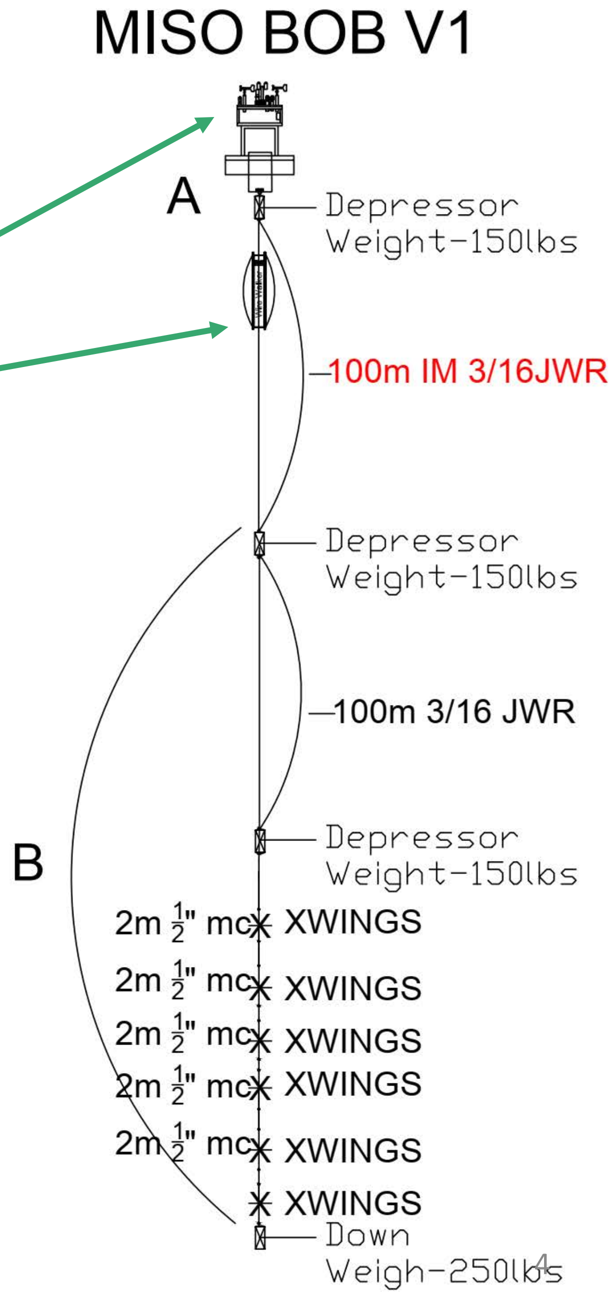
# Drifter Design

Instrumentation presented here (subsample of all data):

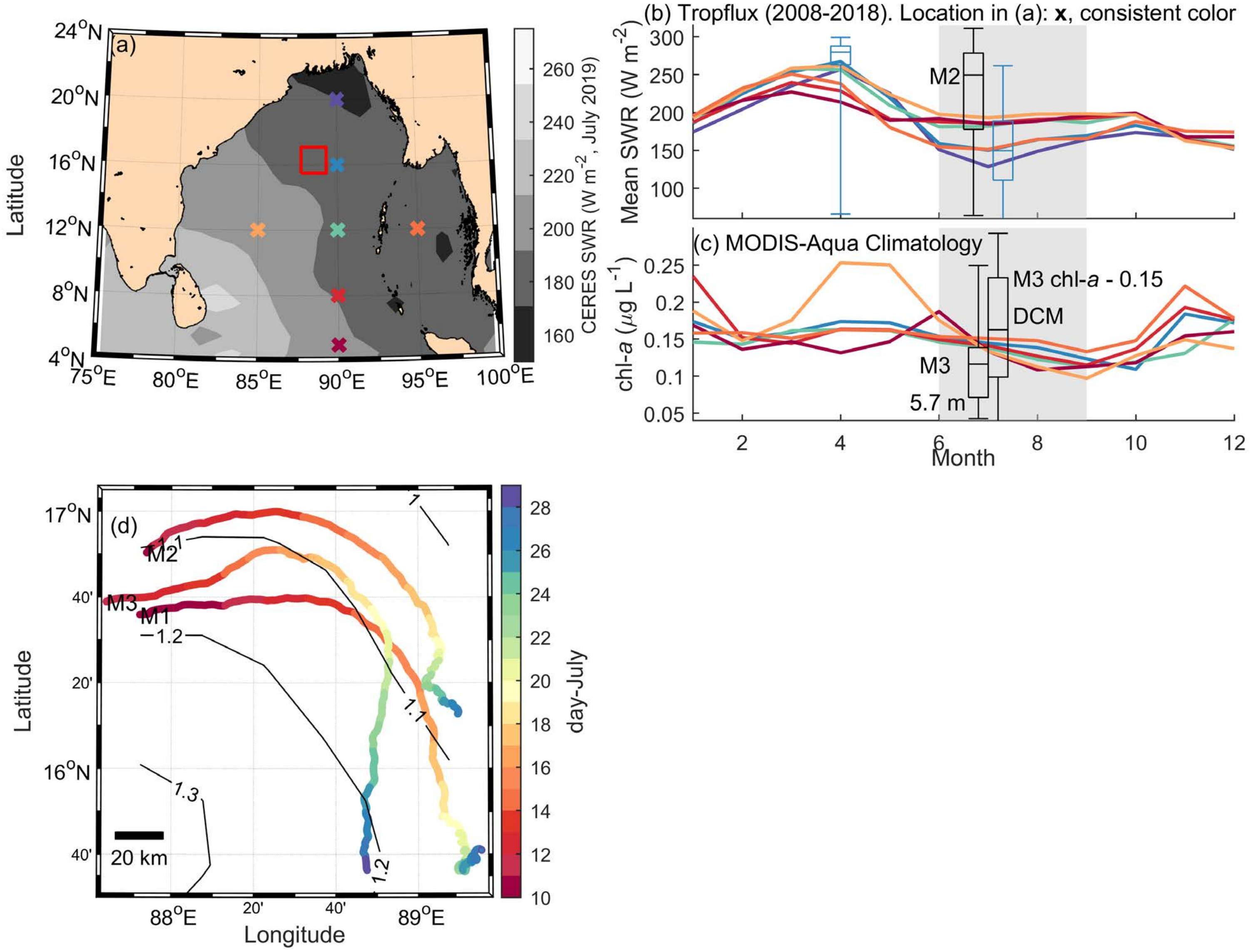
- WHOI metocean buoy including shortwave radiation (SWR)
- Wirewalker profiling upper 100 m including:
  - CTD
  - Chlorophyll-*a* (chl-*a*) fluorescence, a proxy for the concentration. We did not calibrate in the field so concentrations presented here are not precise.
  - Downward irradiance at wavelengths 380, 412, 490, and 532 nm
  - To estimate photosynthetically available radiation (PAR):

$$PAR(z,t) = \int_{380}^{532} I(z,t)d\lambda \times \frac{700-400}{532-380}$$

  - Optical backscatter
  - Acoustic backscatter from Nortek Signature (processed by Bofu Zheng) and from shipboard adcps
  - Most variables were telemetered to the ship in real time



# Study Site- July 2019 campaign




- a) Spatial and b) seasonal variability in shortwave radiation (SWR) throughout BoB with larger seasonal variability towards northern and eastern sections.

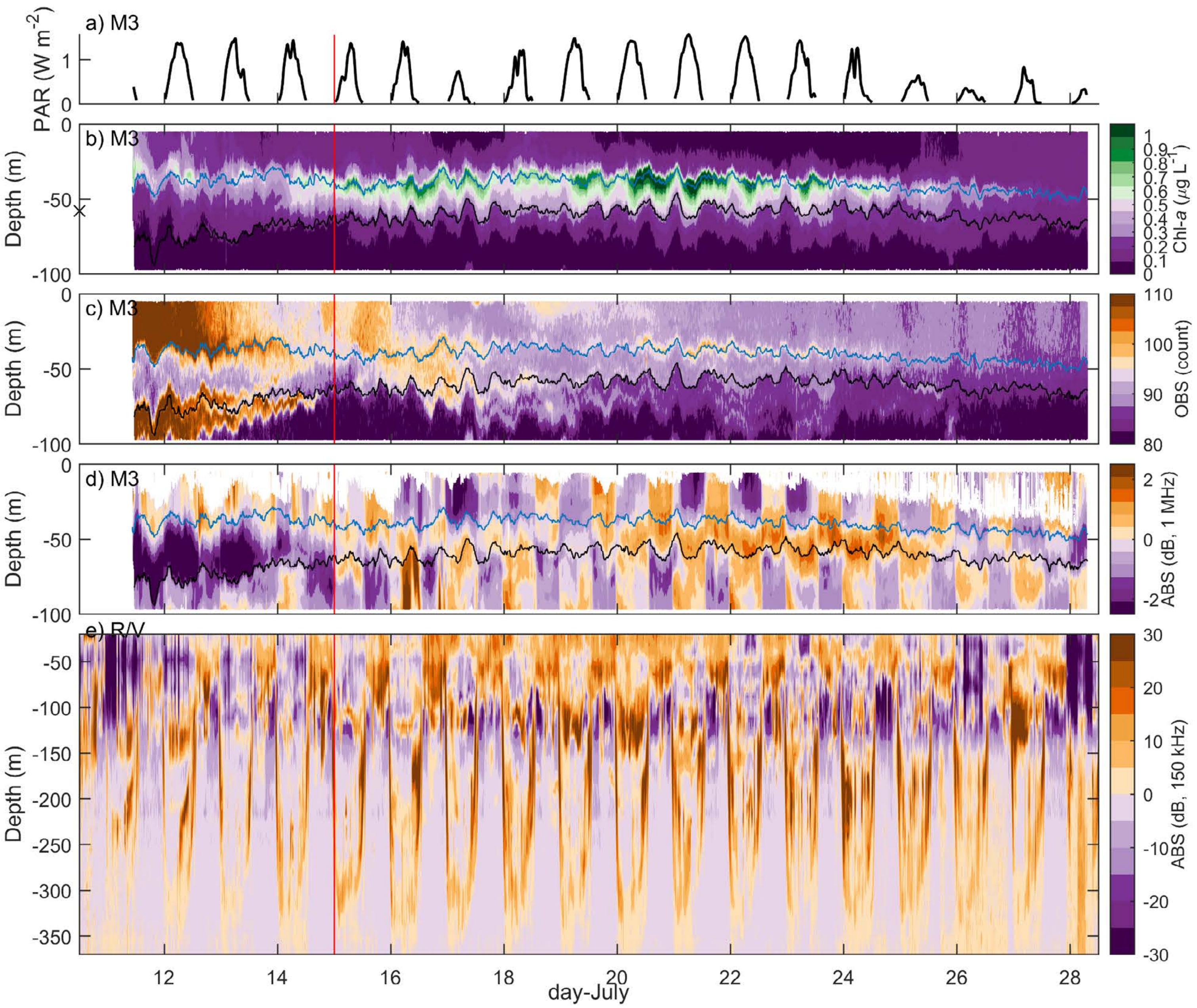
- b) even sunny months have cloudy days with SWR<100 W $m^{-2}$ and July 2019 was atypically sunny (M2, black)

- c) Surface chlorophyll-*a* (chl-*a*) does not appear consistent with SWR. July 2019 observations were consistent at 5.7 m depth, but underestimates average chl-*a* over the deep chlorophyll maximum (DCM, densities<1023 kg $m^{-3}$).

- Is subsurface chl-*a* light limited during the southwest monsoon?

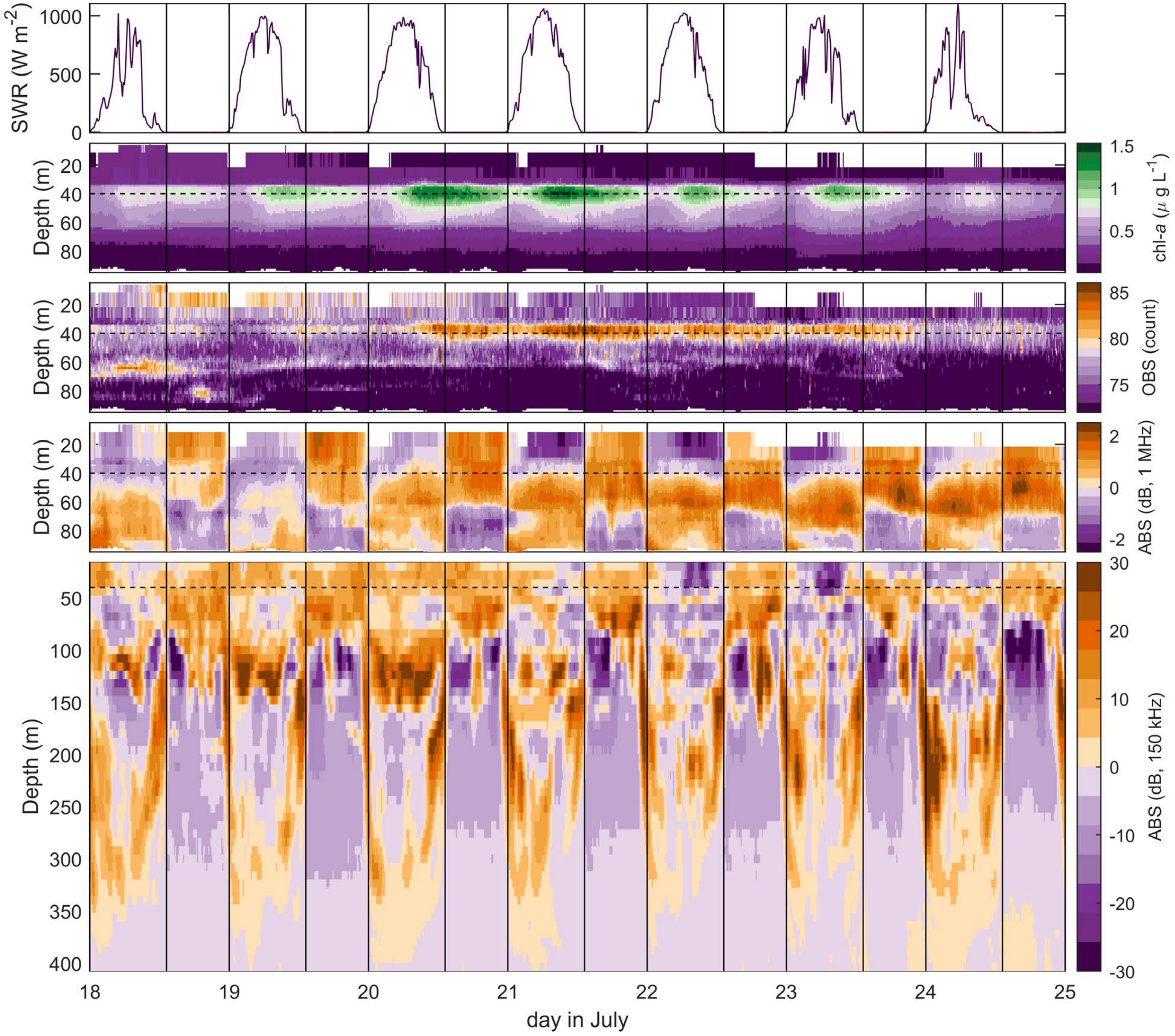
# Observations

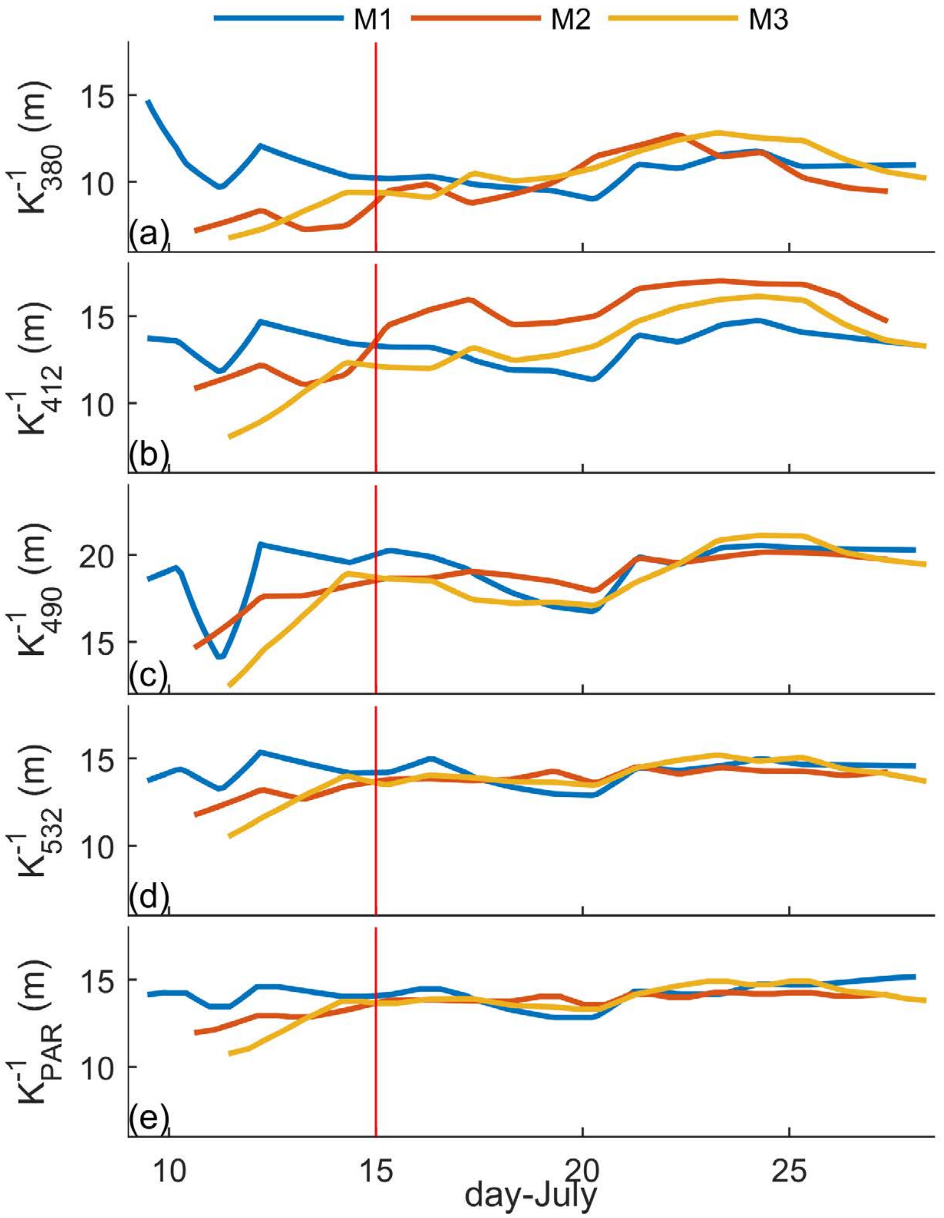
- Chl-a peaks near the 1021.5 kg $m^{-3}$ (blue contour)
- Average euphotic zone depth of 60 m (black cross)
- High optical backscatter (OBS) before July 15 – coastal plume
- Acoustic backscatter (ABS) peaks above 1021.5 kg $m^{-3}$ – likely zooplankton and fish



# Along-isopycnal

- Due to the high vertical resolution of samples, we can remove the influence of the internal tide and other changes in density to show the ‘pseudo-depth’.
- Chl-*a* and optical backscatter were high along constant isopycnals- density-keeping
- Acoustic backscatter at 150 kHz shows vertical migration during daylight to deeper depths with same phasing as observed at 1000 MHz and keeping to around the deep chlorophyll maximum at night





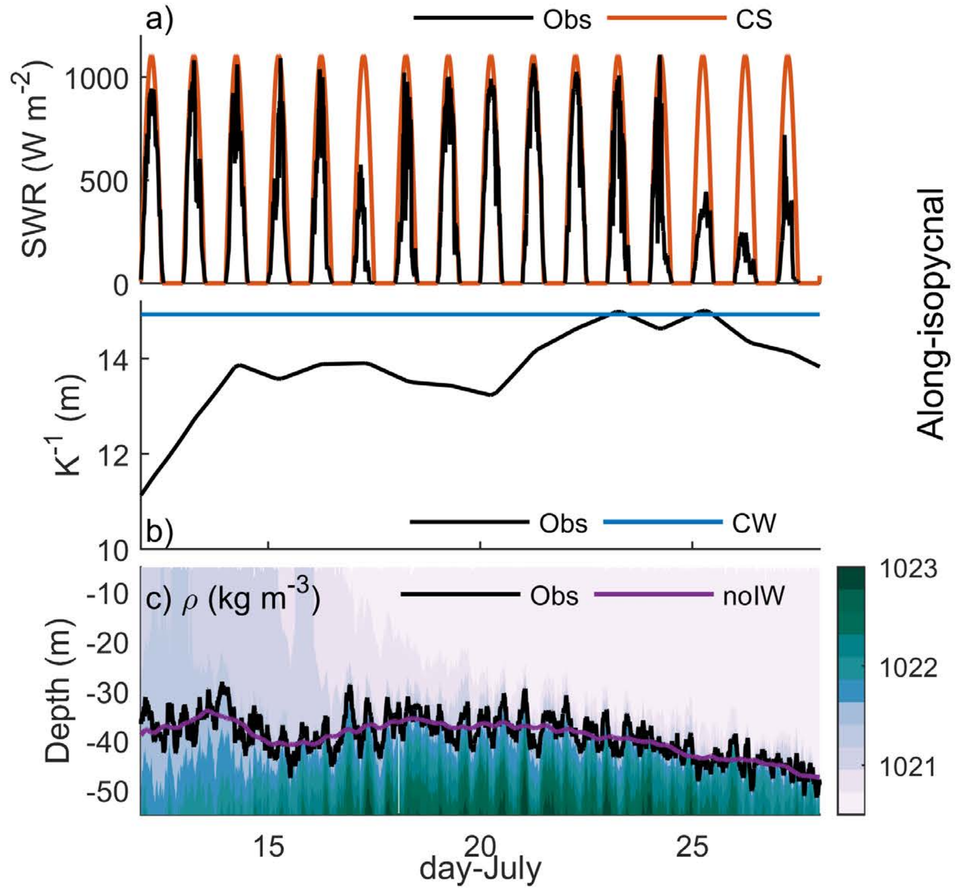

# Light Attenuation ($K$)

$$PAR(z,t) = I_0 \sum a(\lambda) e^{-K(\lambda,t)z}$$

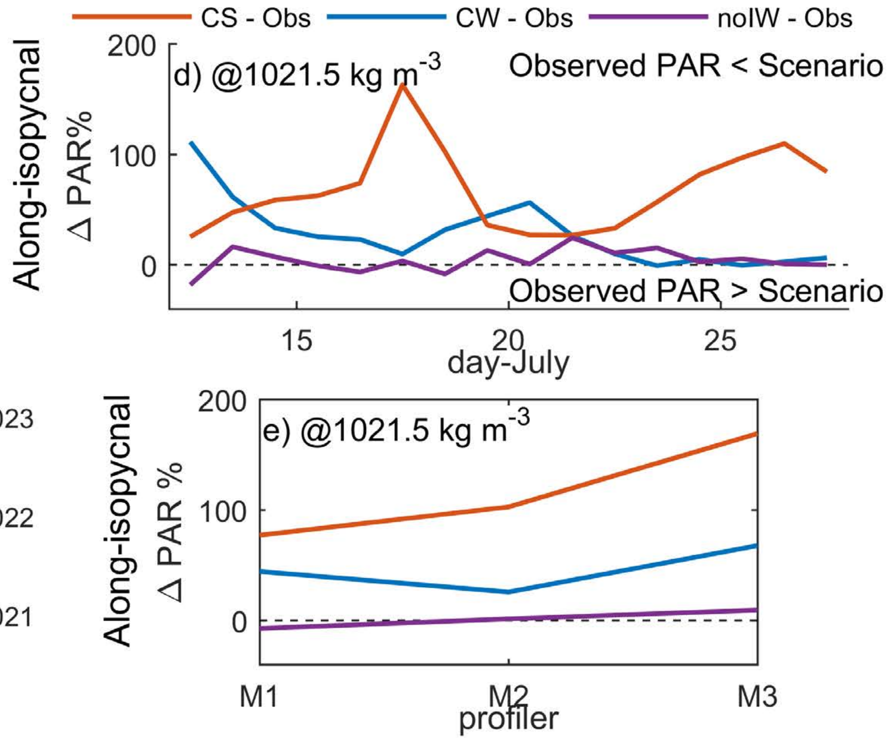
$I_0$ : Visible light proportional to SWR
$\lambda$: wavelength (nm)
$a$: magnitude scale

- $K^{-1}$ was smaller inside coastal plume and was significantly correlated to optical backscatter

# Observations vs. Clear Skies (CS), Clear Water (CW), and no Internal Waves (noIW)



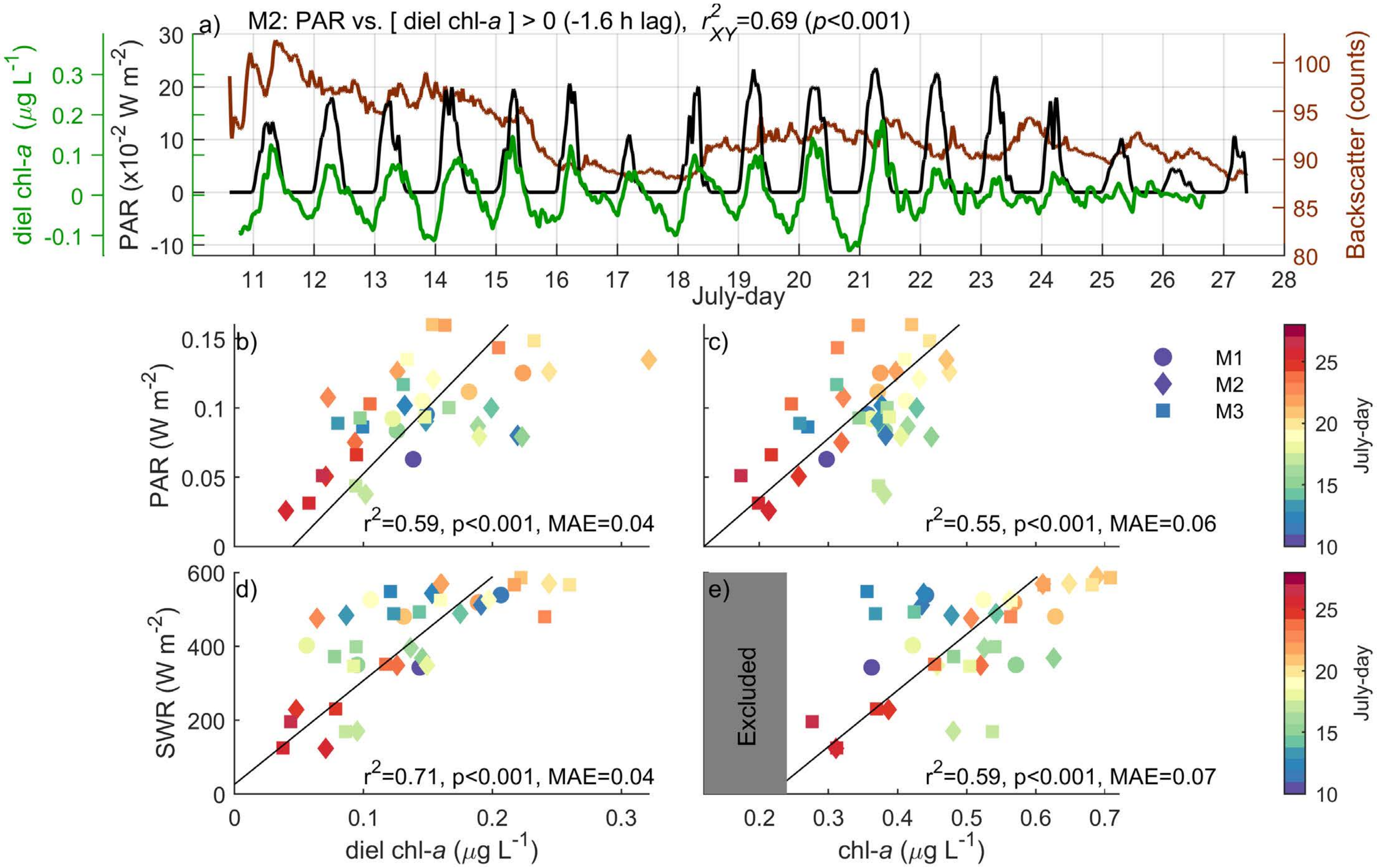

$$I(z,t) = I_0(t)\exp[-K(t)z]$$




- Test change in PAR along an isopycnal intersecting peak chl-a due to:
    - cloud cover (orange),
    - time-varying water clarity (blue), and
    - internal waves changing isopycnal depth (purple)

- Clouds had the biggest impact on light availability, followed by water clarity

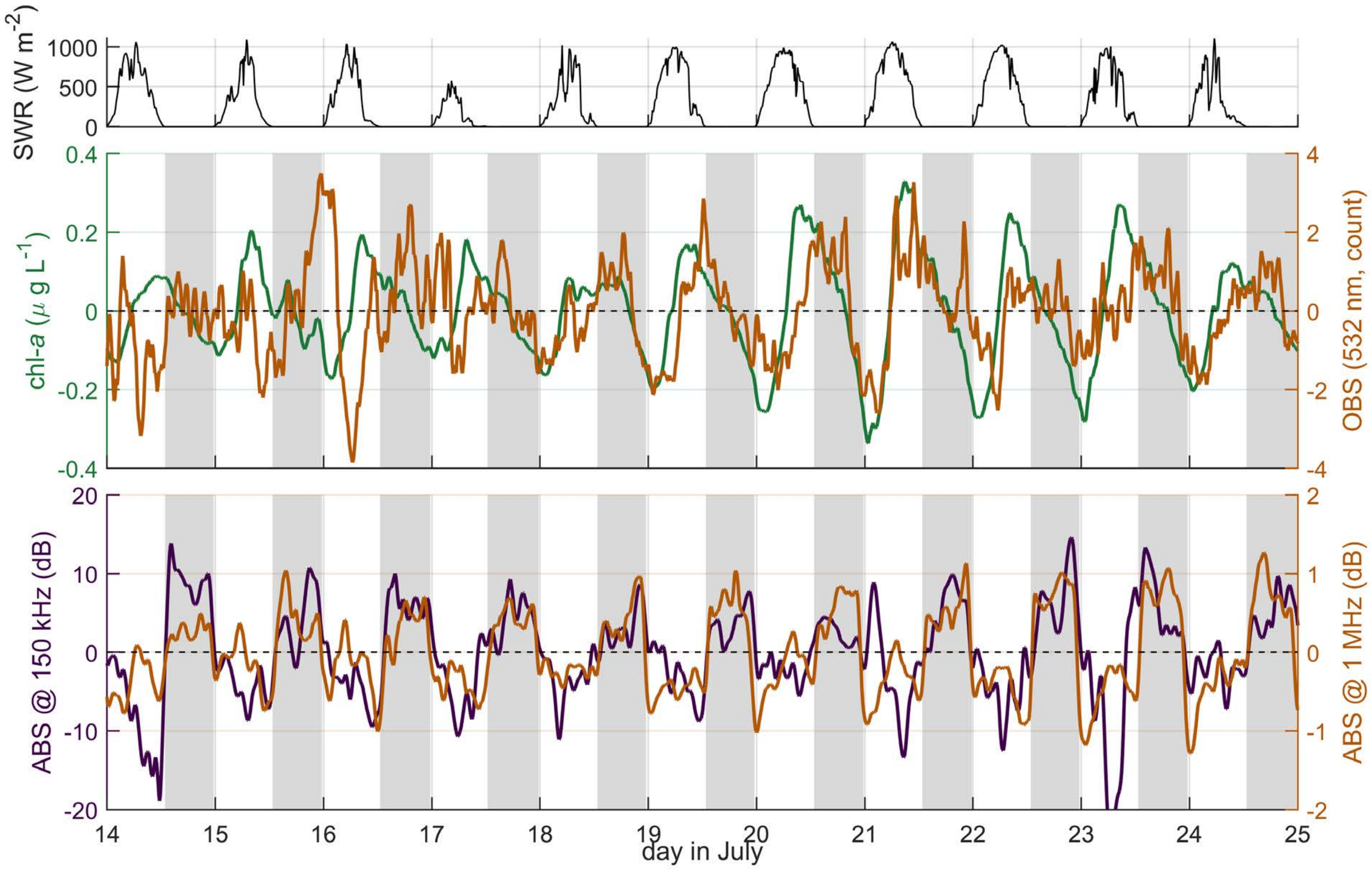
# Light limited growth




- PAR and diel variations in chl-*a* were significantly correlated
  - i.e. diel variations in chl-*a* were larger on sunny days with clear water
- We can predict both the average chl-*a*, and the diel variations in chl-*a*, from PAR, and to a poorer degree SWR (due to time-varying water clarity)
- The performance of these fits are surprising given nutrient limitations and grazing is ignored

# Diel variability at the DCM

- At the deep chlorophyll maximum (DCM) chl-*a* and optical backscatter (from day 17) increase from dawn to dusk and then decrease from dusk to dawn
- The optical backscatter suggests changes in chl-*a* corresponded to changes in biomass and not, for example, changes in photosynthetic capacity (i.e. circadian rhythms)
- Acoustic backscatter had a 12 hour lag with the shortwave radiation.
- Results consistent with night-time grazing responsible for diel variability in chl-*a*



# Conclusions

- Chl-*a* concentrations over the course of the day are tightly connected to, and well predicted by, optical observations of subsurface irradiance
- Subsurface irradiance was dependent on cloudiness, a characteristic of the monsoon, and water clarity, which reduced within a coastal filament
- Our observations indicate monsoonal weather patterns likely impact subsurface primary productivity in the Bay of Bengal, especially in the northern and eastern sections of the Bay where shortwave radiation is typically smaller during the southwest monsoon
- Chl-*a*, optical backscatter and acoustic backscatter were tightly coupled at the DCM. Vertically migrating organisms can transport carbon across the pycnocline, indicating monsoons and plumes may modify the transfer of carbon from the atmosphere to the deep ocean by limiting chl-*a* and phytoplankton biomass.

# Acknowledgements

Big thank you to crew and science personnel from the R/V Sally Ride!