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Takaya Uchida, Dec. 1, 2020

JGR Oceans

RESEARCH ARTICLE

10.1029/2019JC015355

Key Points:

- In situ estimates of phytoplankton biomass and its seasonal cycle are derived based on optical backscatter from biogeochemical Argo floats
- Depth-integrated biomass peaks after mixed layers start shoaling, but accumulation rates turn positive, while mixed layers are deepening
- Biomass is low in Ekman downwelling regions and high in the Antarctic Circumpolar Current and seasonal sea ice zone

Southern Ocean Phytoplankton Blooms Observed by Biogeochemical Floats

Takaya Uchida[1], Dhruv Balwada[2], Ryan Abernathey[1,3], Channing J. Prend[4], Emmanuel Boss[5], and Sarah T. Gille[4]

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We only used the quality-controlled data here; this included data points that had been flagged as good or had been corrected by inspection (as indicated by quality flags–1, 2, 5, and 8; Carval et al., 2014, https://archimer.ifremer.fr/doc/00187/29825/40575.pdf). In situ temperature and salinity measurements were used to calculate the potential density and stratification (N^2) using the Python implementation of the Thermodynamic Equation of Seawater 2010 (McDougall & Barker, 2011, https://teos-10.github.io/GSW-Python/). The mixed-layer depth was defined using the density threshold criterion: the depth at which the density is greater by 0.03 kg m^{-3} relative to 10 dbar (Ardyna et al., 2019; Carranza et al., 2018; de Boyer Montégut et al., 2004). Figures S4–S6 show that this criterion picks up the sharp vertical gradient in stratification.

For the BGC properties of chlorophyll and backscatter, additional processing was required. We used the chlorophyll concentrations that had been corrected for nonphotochemical quenching and the optical backscatter measured at 700 nm. We subtracted out the median of all measurements per float below 600 dbar to account for the potential bias between different measurement technologies and then applied a five-point median filter in the vertical to remove spikes in the profile. Similar methods have been used previously (e.g., Carranza et al., 2018; Erickson & Thompson, 2018; Mignot et al., 2018). The removal of the deep median assumes that nonzero values at depth are generally a result of an instrument bias and background values of backscatter rather than true phytoplankton-related signal. The despiking removes measurement noise or potential signal due to aggregates. In order to correct for the known bias between measurements by Argo floats and shiptrack high-performance liquid chromatography (HPLC), we first doubled the corrected chlorophyll concentrations to account for the global factor of 2 (Roesler et al., 2017) and then adjusted them based on an empirical fit for each data set: $\mathrm{Chl}_{\mathrm{HPLC}} \approx 0.21 \times \mathrm{Chl}_{\mathrm{SOCCOM}}^{0.714}$ (Johnson et al., 2017; Haëntjens et al., 2017) and $\mathrm{Chl}_{\mathrm{HPLC}} \approx \mathrm{Chl}_{\mathrm{SOCLIM}}/3.46$ (Roesler et al., 2017, Table 1 in their paper). Henceforth, we drop the subscript $(\cdot)_{\mathrm{HPLC}}$, i.e., $\mathrm{Chl} = \mathrm{Chl}_{\mathrm{HPLC}}$.

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Acknowledgments
This research was supported by NASA Award NNX16AJ35G as part of the SWOT Science Team. Abernathey acknowledges additional support from NSF Award OCE-1553593. Prend is supported by an NSF Graduate Research Fellowship under Grant DGE-1650112. Gille acknowledges NSF awards PLR-1425989 and OCE-1658001. We thank Joan Llort and another anonymous reviewer for very useful comments on the manuscript. The code used for the analysis in this study is available on Github (doi:10.5281/zenodo.3336575).

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roxyboy / **SouthernOcean-ARGO**

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Takaya Uchida period — 726a99a on Jul 15, 2019 — **23** commits

SOCCOM	corrected cell for ACC fronts	17 months ago
SOCLIM	merged LIM dataset	17 months ago
binder	should work	17 months ago
eg-data	example data	17 months ago
COMCLIMphasing.ipynb	updated notebooks	17 months ago
Cphyto.ipynb	Cp notebook	17 months ago
README.rst	period	17 months ago

README.rst

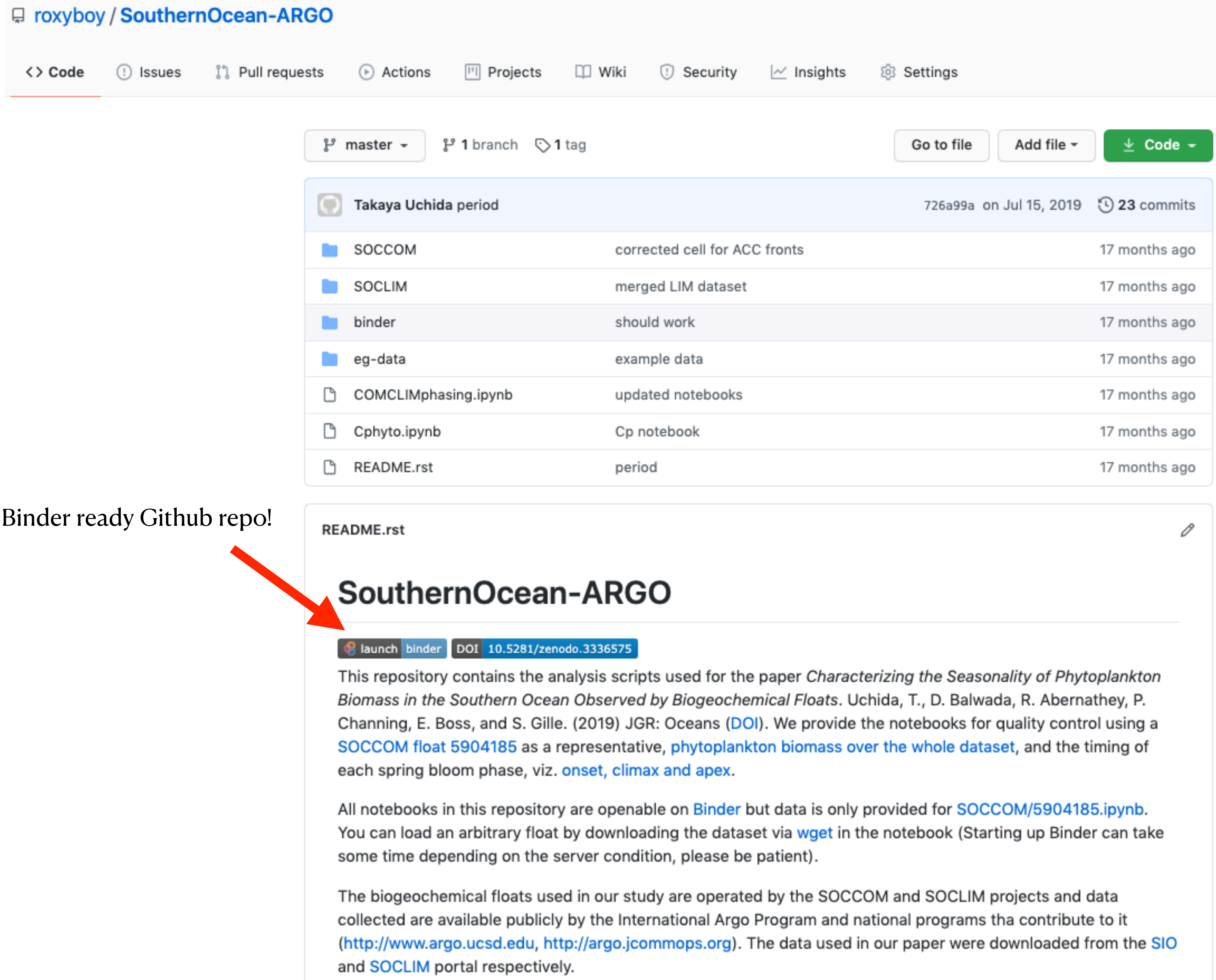
SouthernOcean-ARGO

launch binder | DOI 10.5281/zenodo.3336575

This repository contains the analysis scripts used for the paper *Characterizing the Seasonality of Phytoplankton Biomass in the Southern Ocean Observed by Biogeochemical Floats*. Uchida, T., D. Balwada, R. Abernathey, P. Channing, E. Boss, and S. Gille. (2019) JGR: Oceans (DOI). We provide the notebooks for quality control using a SOCCOM float 5904185 as a representative, phytoplankton biomass over the whole dataset, and the timing of each spring bloom phase, viz. onset, climax and apex.

All notebooks in this repository are openable on Binder but data is only provided for SOCCOM/5904185.ipynb. You can load an arbitrary float by downloading the dataset via wget in the notebook (Starting up Binder can take some time depending on the server condition, please be patient).

The biogeochemical floats used in our study are operated by the SOCCOM and SOCLIM projects and data collected are available publicly by the International Argo Program and national programs tha contribute to it (http://www.argo.ucsd.edu, http://argo.jcommops.org). The data used in our paper were downloaded from the SIO and SOCLIM portal respectively.



Binder ready Github repo!