



# Effect of light and upwelling intensity on the phytoplankton community composition in the Peruvian upwelling system

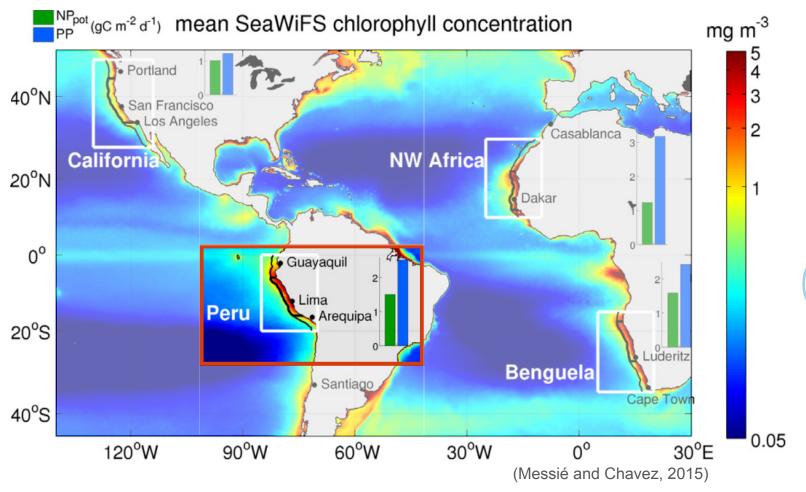
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### Climate Change in Peruvian Upwelling System





Increase in light intensity due to stronger stratification



Changes in nutrient availability due to changes in wind (& upwelling) intensity

Motivation: To better understand and predict the effect of climate change on the phytoplankton community composition

#### **Hypotheses:**



large cell-sized groups (e.g. diatoms)

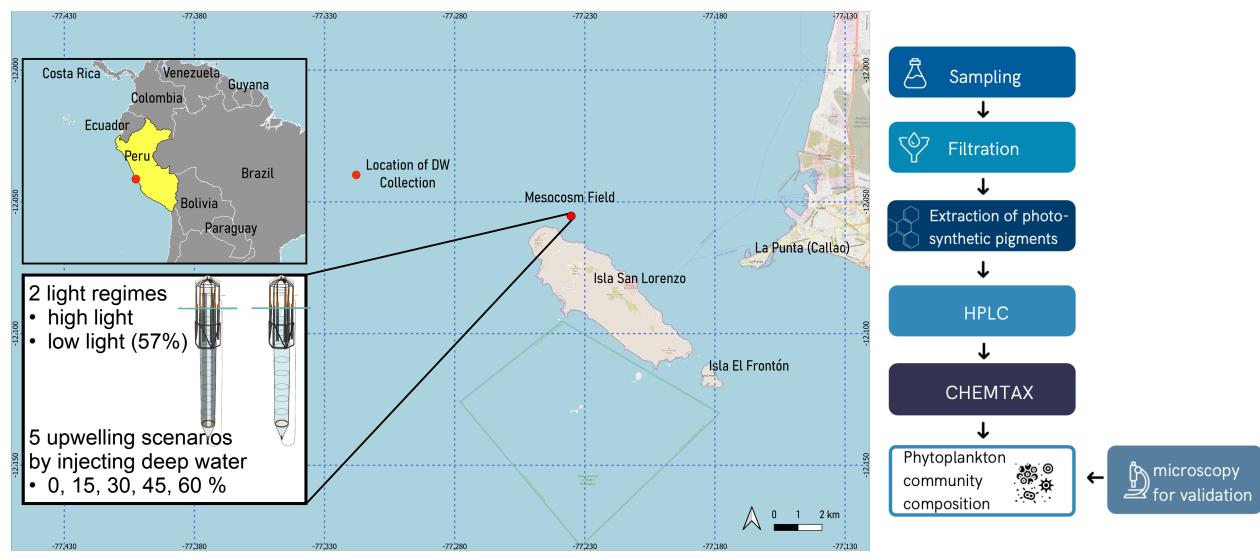


especially diatoms



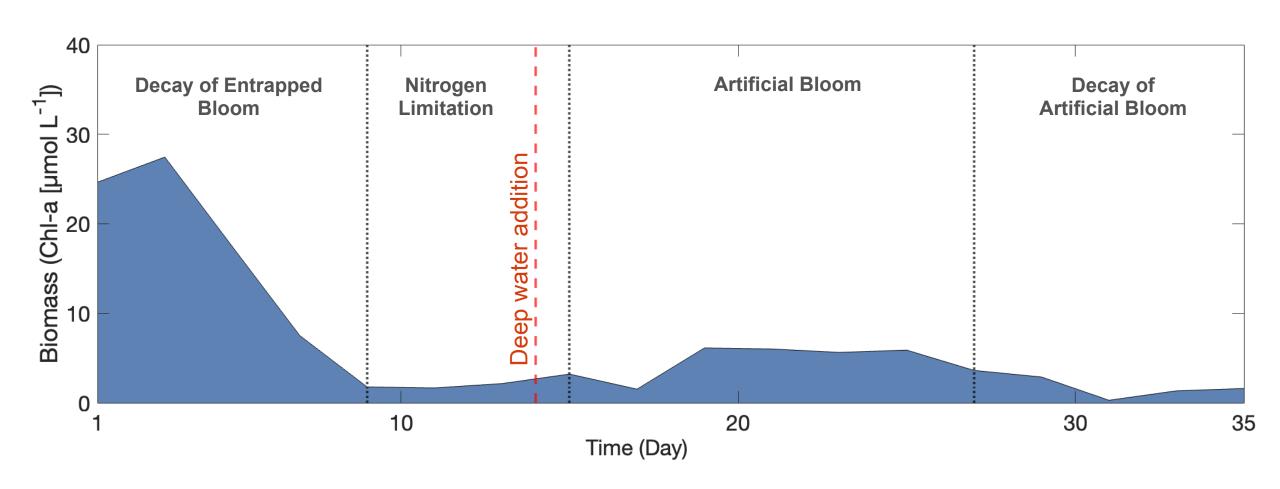
small cell-sized groups (e.g. prasinophytes)

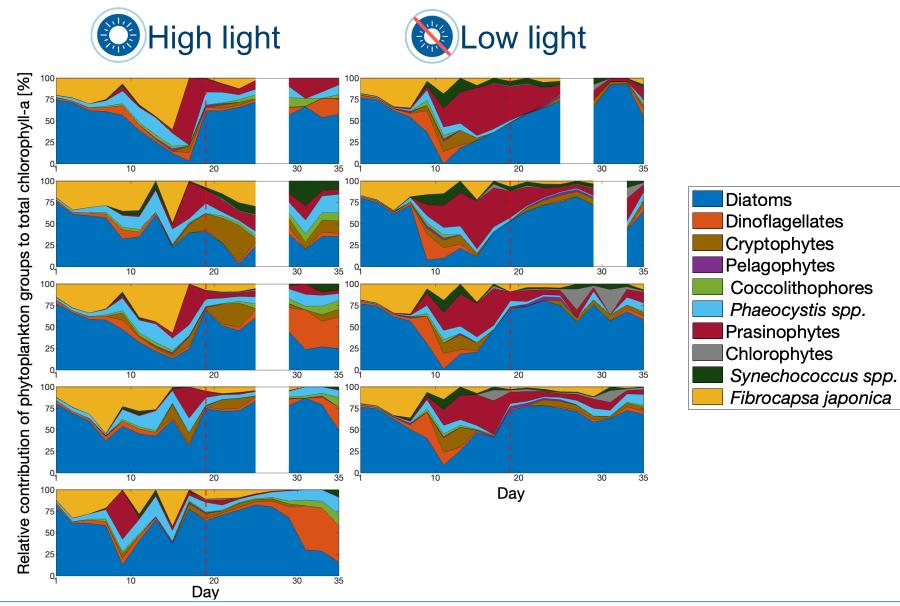
#### Materials and Methods

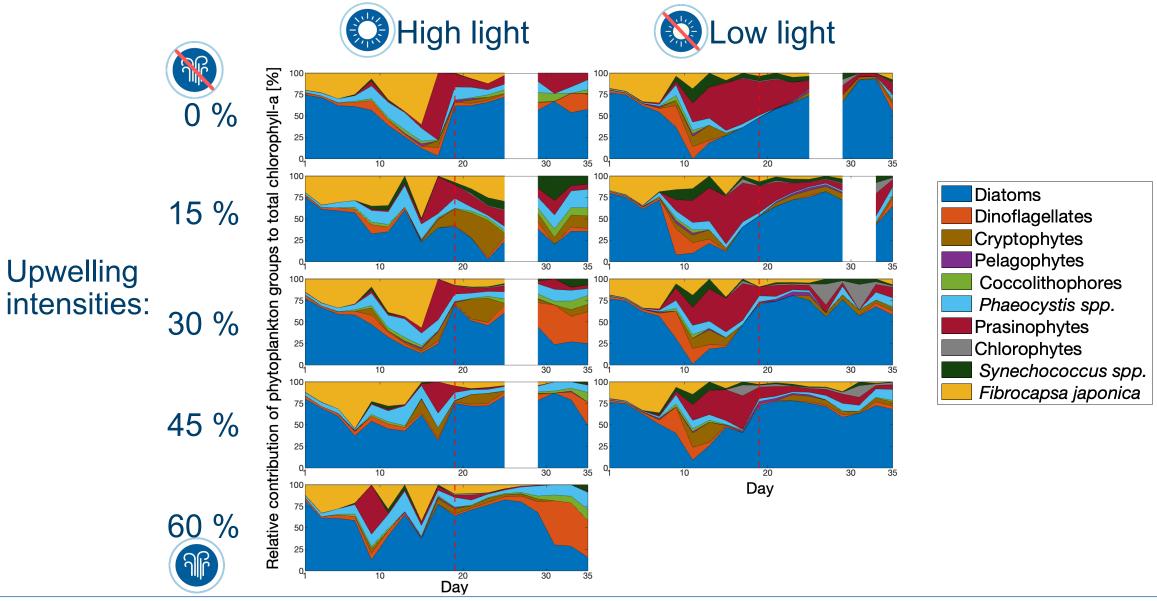


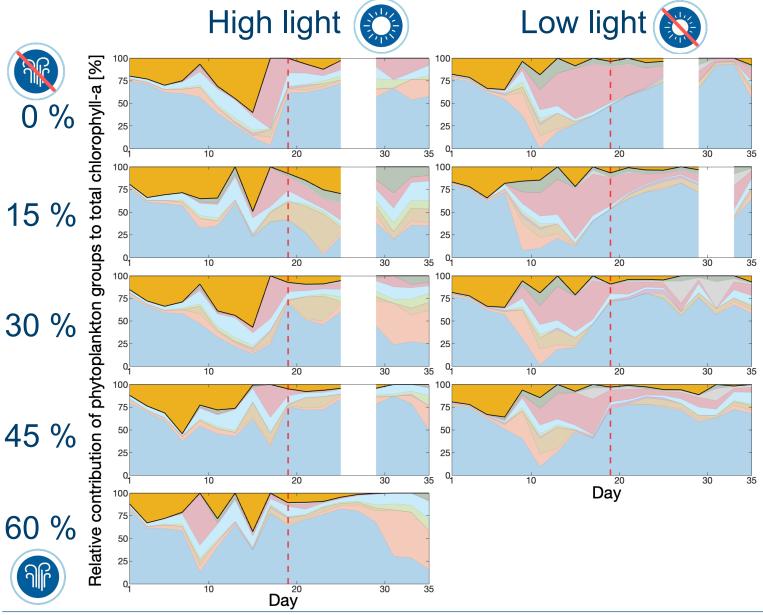
Statistics: GLMs & ANOVAs

### Temporal development of chlorophyll-a

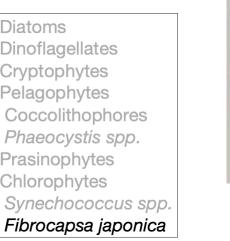








Fibrocapsa japonica: detected for 1st time off Peru



**Diatoms** 

Dinoflagellates

Cryptophytes

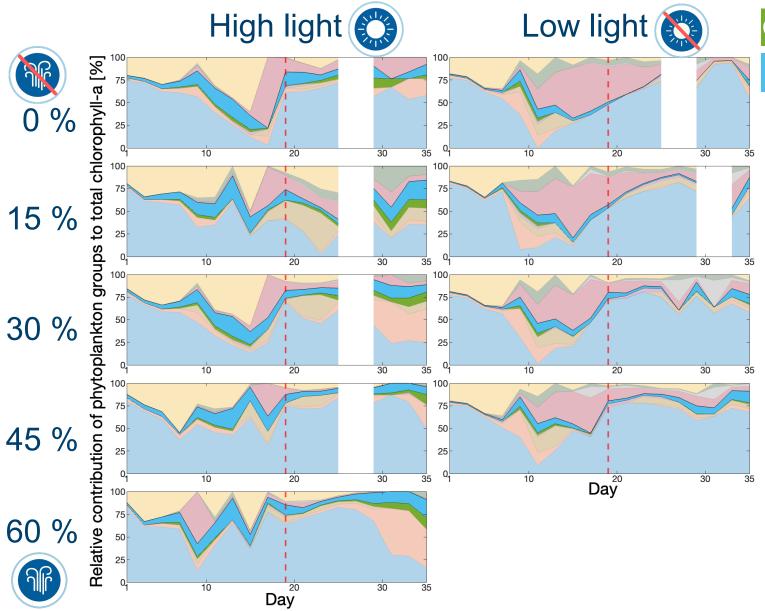
Pelagophytes

Chlorophytes

Coccolithophores Phaeocystis spp. Prasinophytes

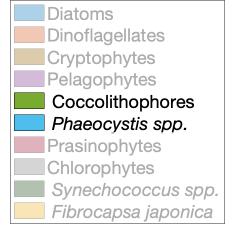
10 μm

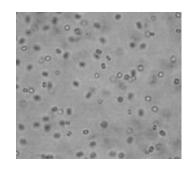
Fibrocapsa japonica (Sanchez et al., 2021)



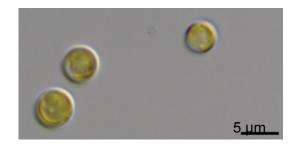
Coccolithophores high light adapted

Phaeocystis high light adapted

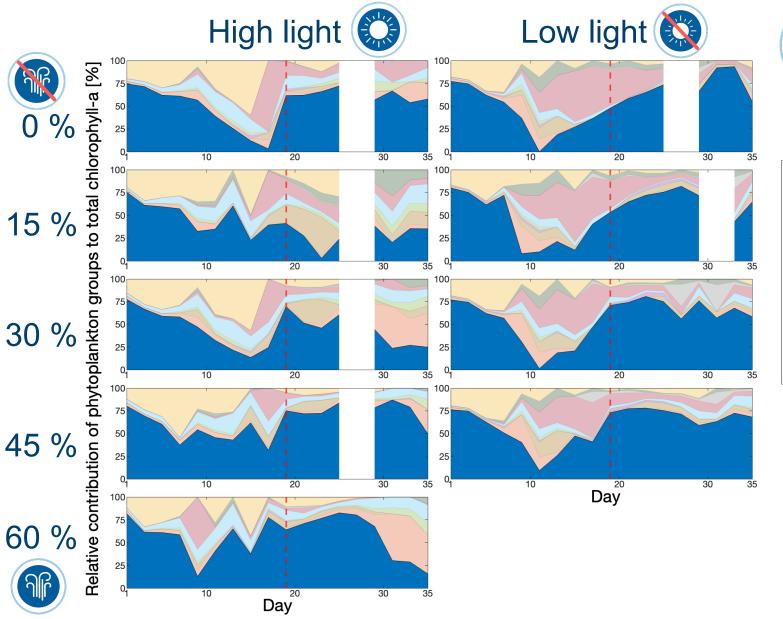




Phaeocystis globosa (Baumann et al. 1994)



Emiliani huxleyi (Labeeuw et al. 2016)





**Diatoms** 

Dinoflagellates

Coccolithophores Phaeocystis spp.

Synechococcus spp. Fibrocapsa japonica

Cryptophytes Pelagophytes

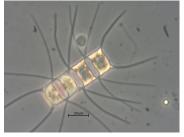
Prasinophytes Chlorophytes

#### Diatoms: favored by high light and upwelling

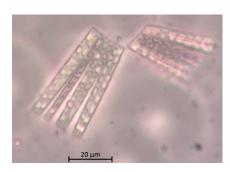




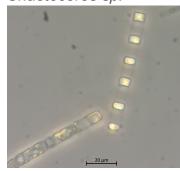
Leptocylindrus sp.



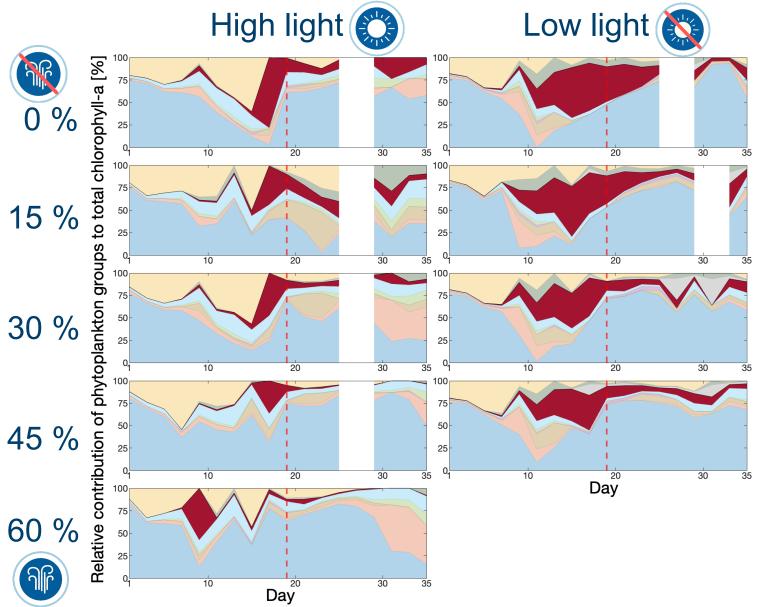
Chaetoceros sp.



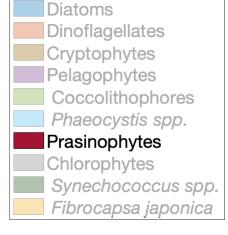
Thalassionema sp.



Skeletonema costatum and Guinardia sp.

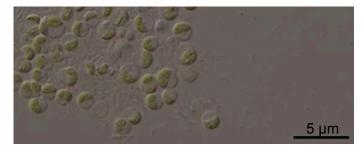








Pyramimonas sp. (Photo credit: M. Arellano)



Picocystis salinarum (prasinophyte) (Tarazona Delgado et al. 2017)

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#### Conclusions

F. japonica → detected for the first time off Peru



HL exposure due to stronger stratification → Diatoms, *Phaeocystis*, coccolithophores



Enhanced upwelling in poleward regions → **Diatoms** 



Weakened upwelling in equatorward regions → Prasinophytes



Overview of some main species in KOSMOS2020-Peru (Photo credit: M. Arellano)

### Thank you!

The KOSMOS Peru 2020 experiment is part of the CUSCO project (Coastal Upwelling System in a Changing Ocean).

Phytoplankton team: Alexandra Smith, Avy Bernales, Eleni Charmpila, Leila Kittu, Mar Fernández-Méndez, Silvia Georgieva













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#### References

Baumann, M., Lancelot, C., Brandini, F., Sakshaug, E., and John, D. (1994). The taxonomic identity of the cosmopolitan prymnesiophyte phaeocystis: A morphological and ecophysiological approach. Journal of Marine Systems, 5:5–22.

Labeeuw, L., Khey, J., Bramucci, A., Atwal, H., de la Mata, A. P., Harynuk, J., and Case, R. (2016). Indole-3-acetic acid is produced by emiliania huxleyi coccolith-bearing cells and triggers a physiological response in bald cells. Frontiers in Microbiology, 7.

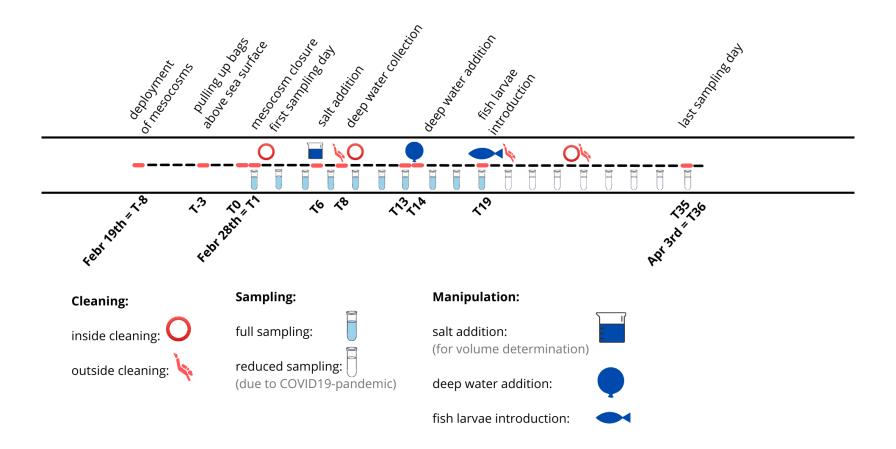
Messié, M. and Chavez, F. (2015). Seasonal regulation of primary production in eastern boundary upwelling systems. *Progress in Oceanography*, 134:1–18.

Sanchez, S., Jacobo, N., Delgado, E., Franco, A., Romero, L., Bernales, A., and Lorenzo, A. (2021). Fibrocapsa japonica en Perú. First report of a Fibrocapsa japon- ica Toriumi & Tanako bloom in the northern Humboldt current ecosystem.

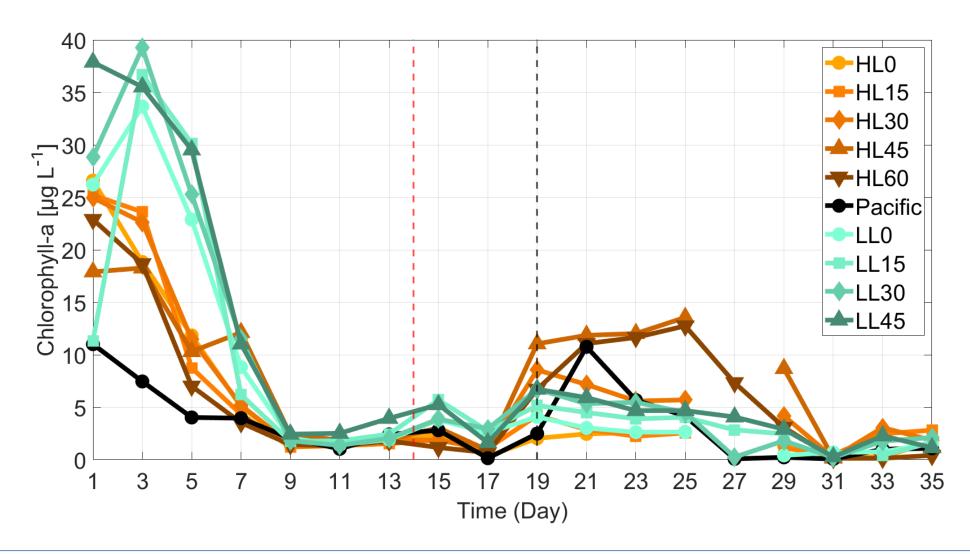
Tarazona Delgado, R., Montoya Terreros, H., Mariano Astocondor, M., and Mayta Huatuco, E. (2017). Picocystis salinarum (Prasinophyceae, Chlorophyta) en las Salinas de Chilca, Lima, primer registro para el Perú. Arnaldoa, 24:557 – 566

- Supplementary Material -

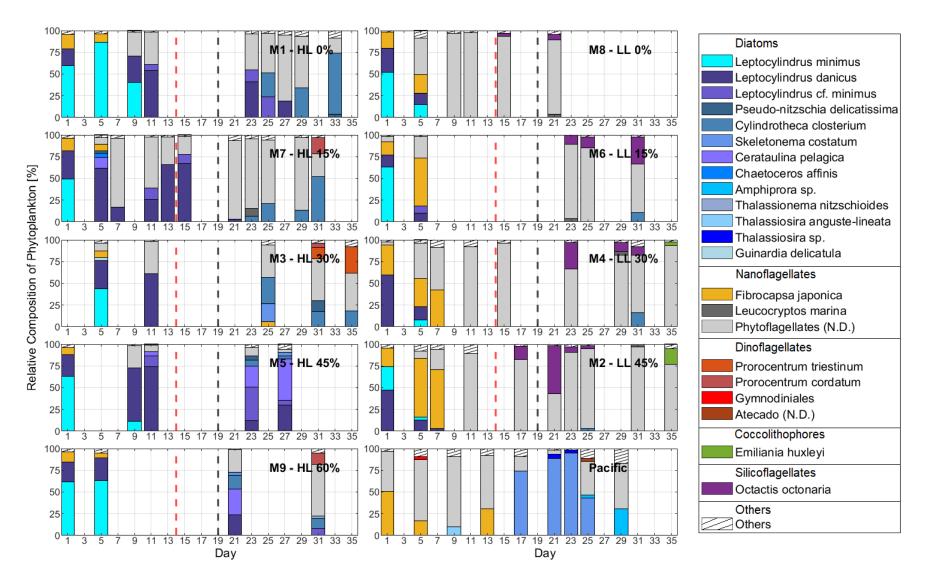
#### **Timeline**

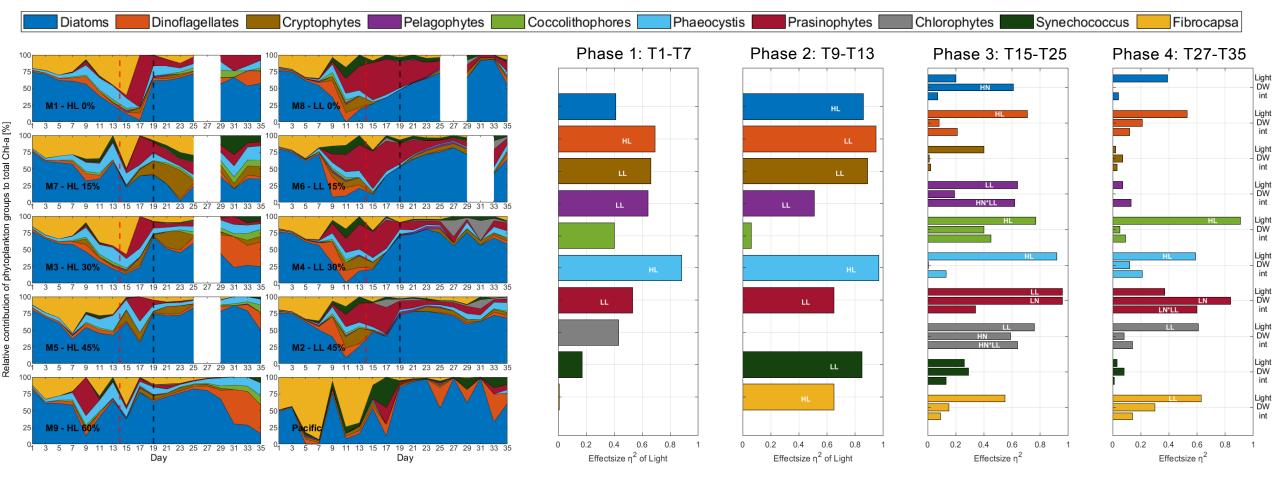


#### Effect of light and upwelling on bulk biomass

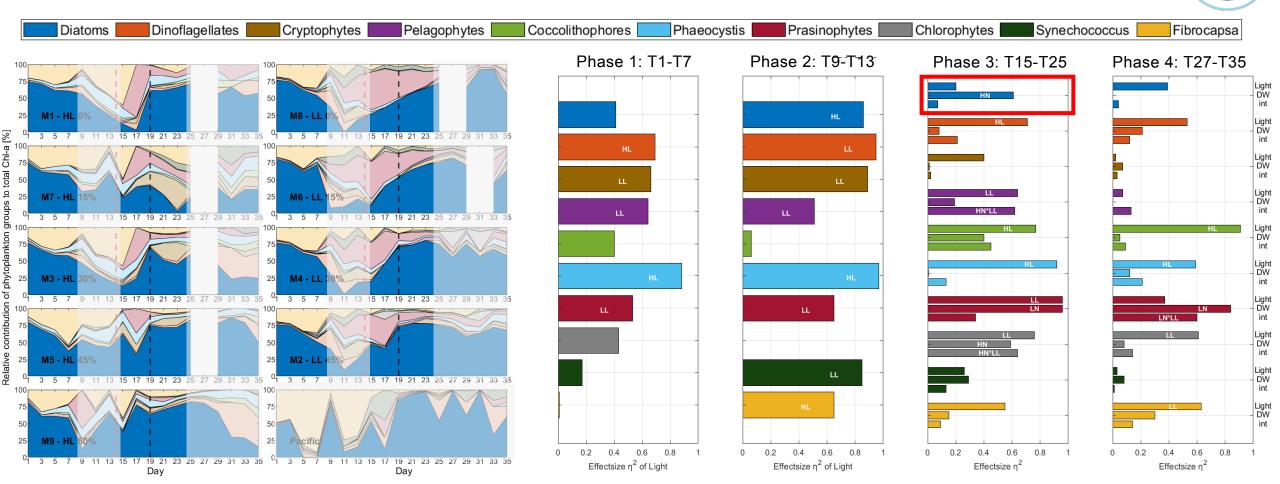


#### Microscopy taxa - abundance



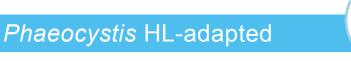


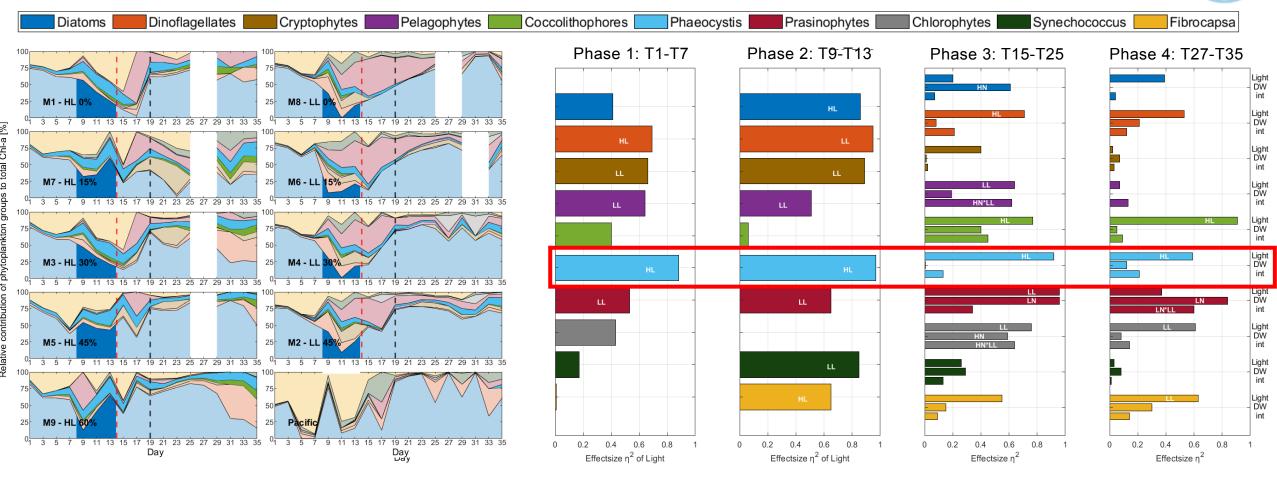
# Effect of light and upwelling intensity on phytoplankton community composition Diatoms: favored by upwelling (HN)



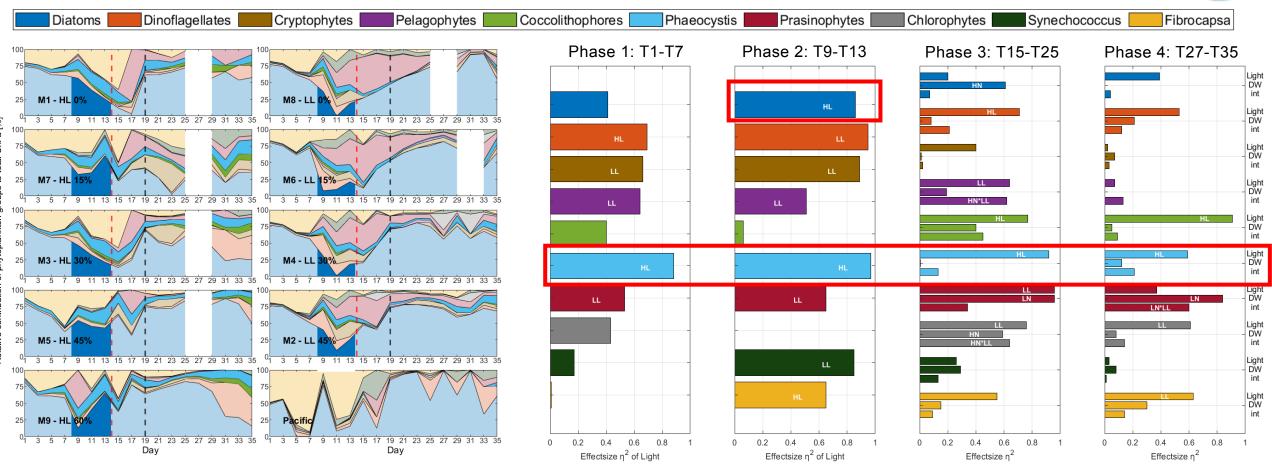
# Effect of light and upwelling intensity on phytoplankton community composition Prasinophytes: LN-adapted (weaker upwelling)

Dinoflagellates Cryptophytes Pelagophytes Coccolithophores Phaeocystis Prasinophytes Chlorophytes Synechococcus Fibrocapsa Diatoms Phase 1: T1-T7 Phase 2: T9-T13 Phase 4: T27-T35 Phase 3: T15-T25 Light DW Light DW Light DW Effectsize n<sup>2</sup> of Light Effectsize n<sup>2</sup> of Light Effectsize n Effectsize n2





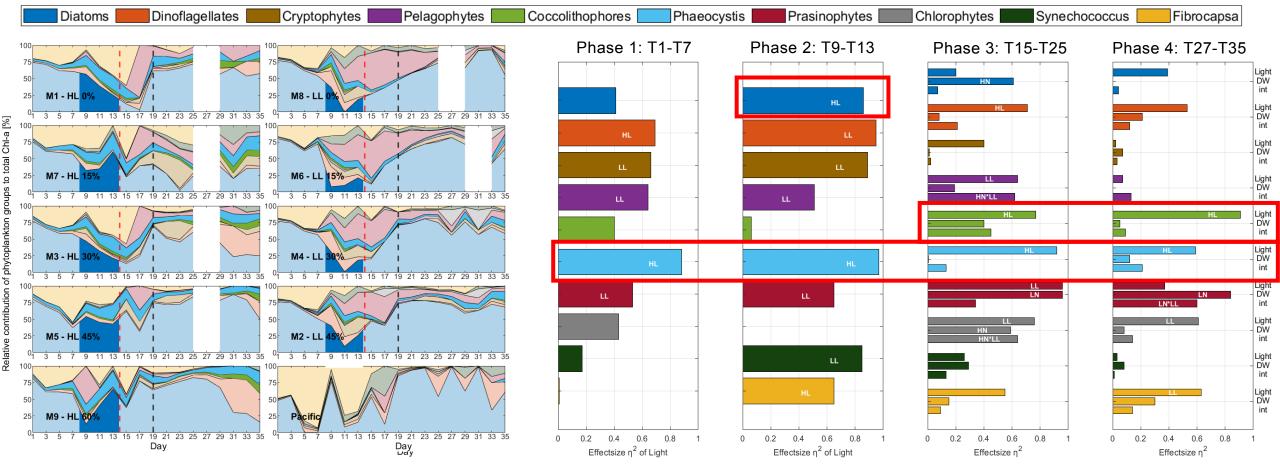




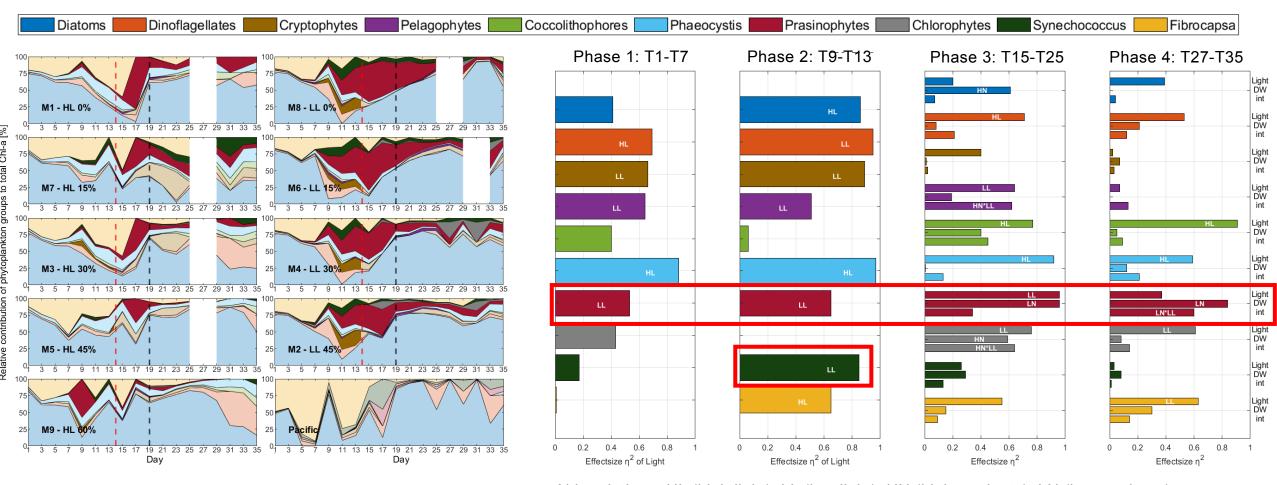
Abbreviations: HL (high light), LL (low light), HN (high nutrients), LN (low nutrients)

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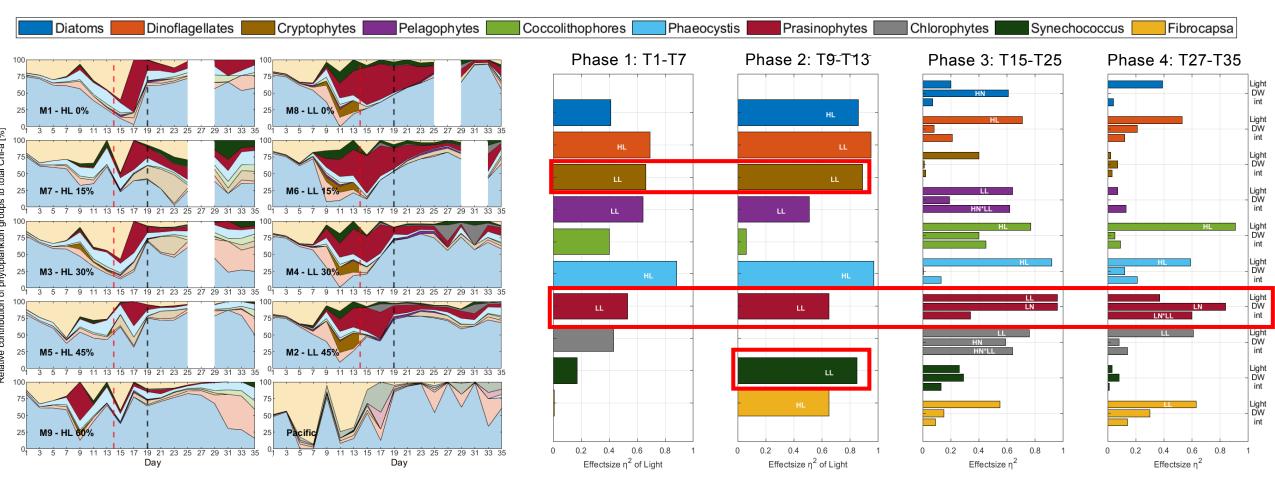




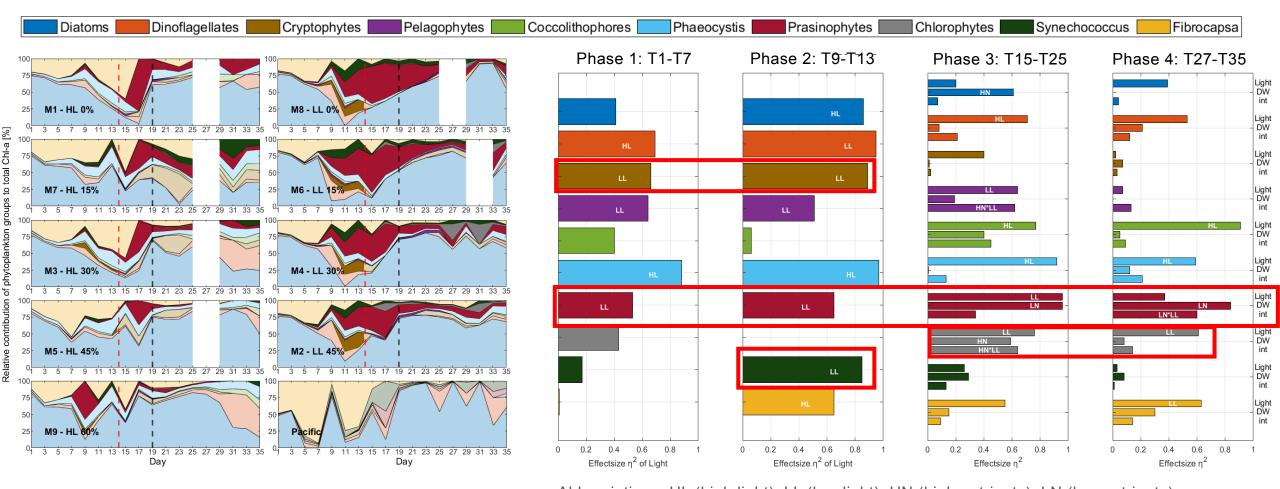
# Effect of light and upwelling intensity on phytoplankton community composition Synechococcus LL-adapted



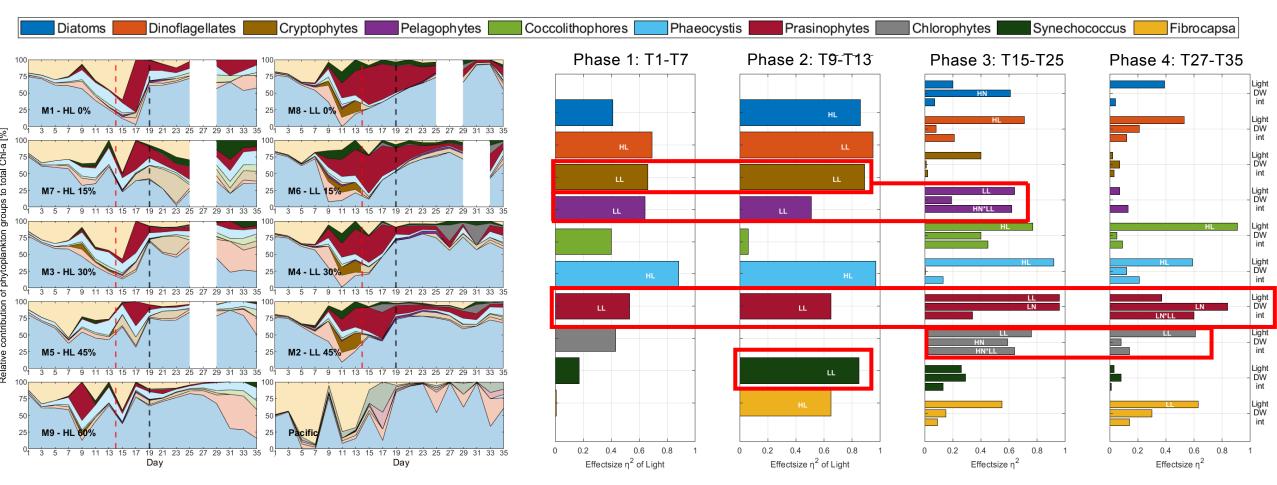
# Effect of light and upwelling intensity on phytoplankton community composition Cryptophytes LL-adapted



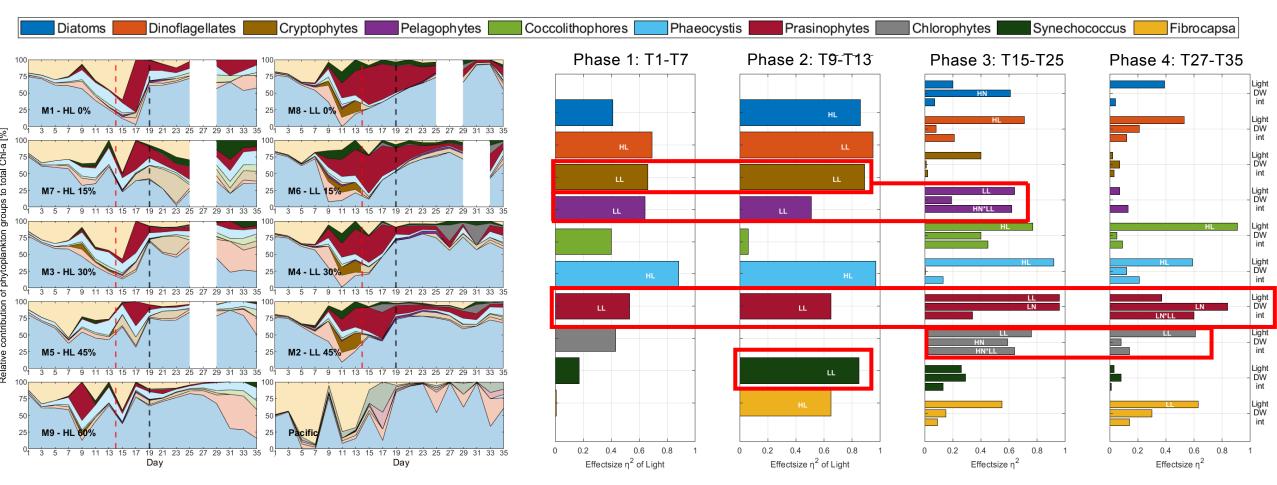
# Effect of light and upwelling intensity on phytoplankton community composition Chlorophytes LL-adapted



# Effect of light and upwelling intensity on phytoplankton community composition Pelagophytes LL-adapted (Octactis octonaria)



# Effect of light and upwelling intensity on phytoplankton community composition Pelagophytes LL-adapted (Octactis octonaria)



# Effect of light and upwelling intensity on phytoplankton community composition Pelagophytes LL-adapted (Octactis octonaria)

