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## **Introduction**

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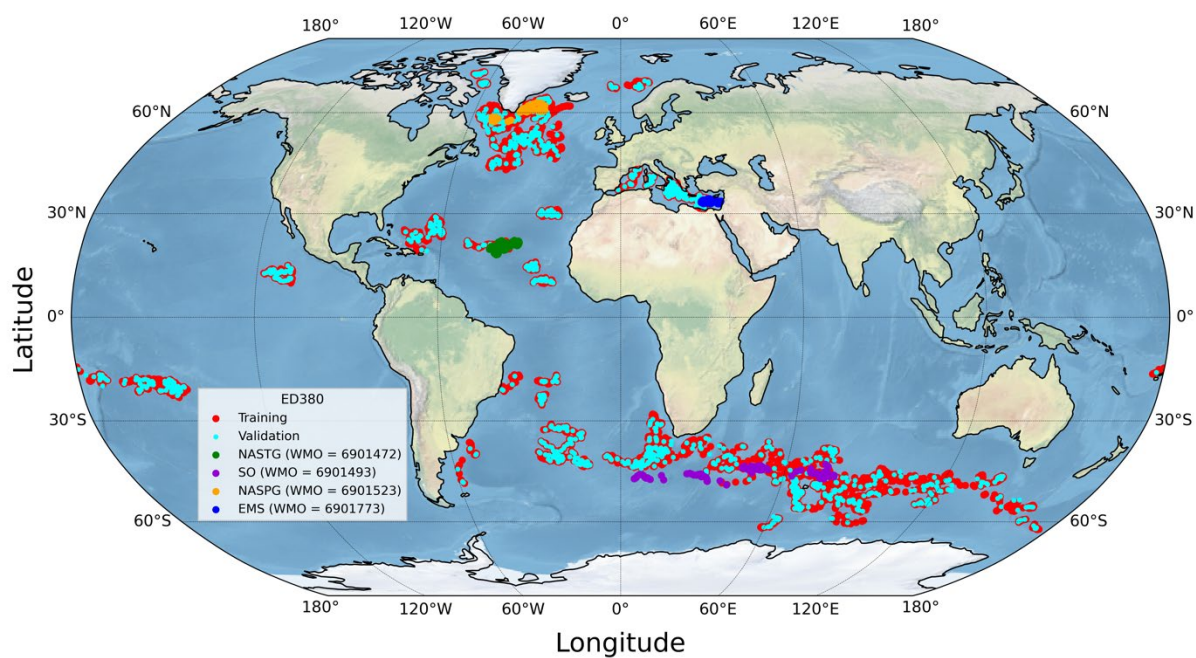


Figure S1. Geographical distribution of BGC-Argo profiles used for the development and validation of the SOCA-light model for ED380.

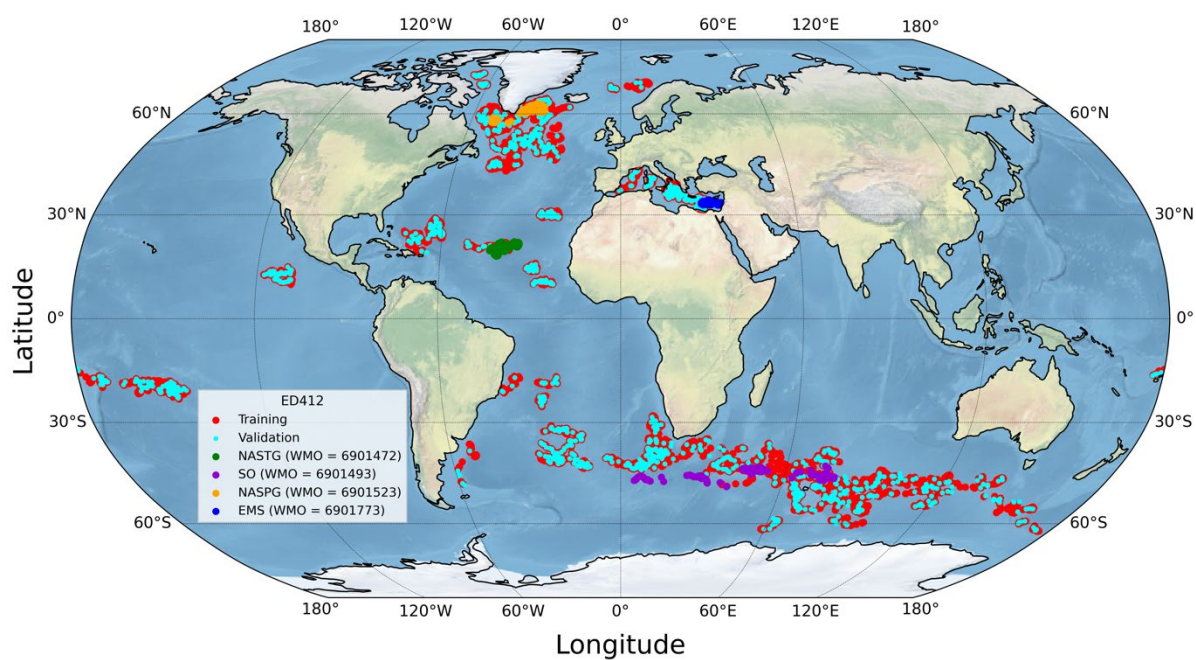


Figure S2. Geographical distribution of BGC-Argo profiles used for the development and validation of the SOCA-light model for ED412.

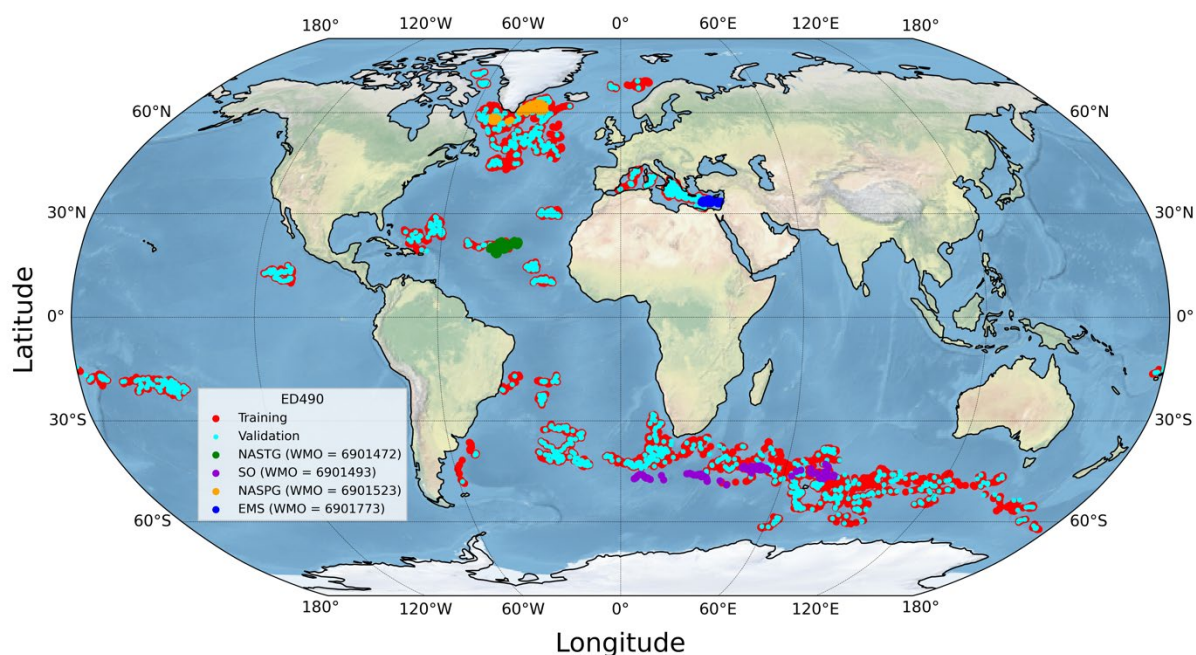


Figure S3. Geographical distribution of BGC-Argo profiles used for the development and validation of the SOCA-light model for ED490.

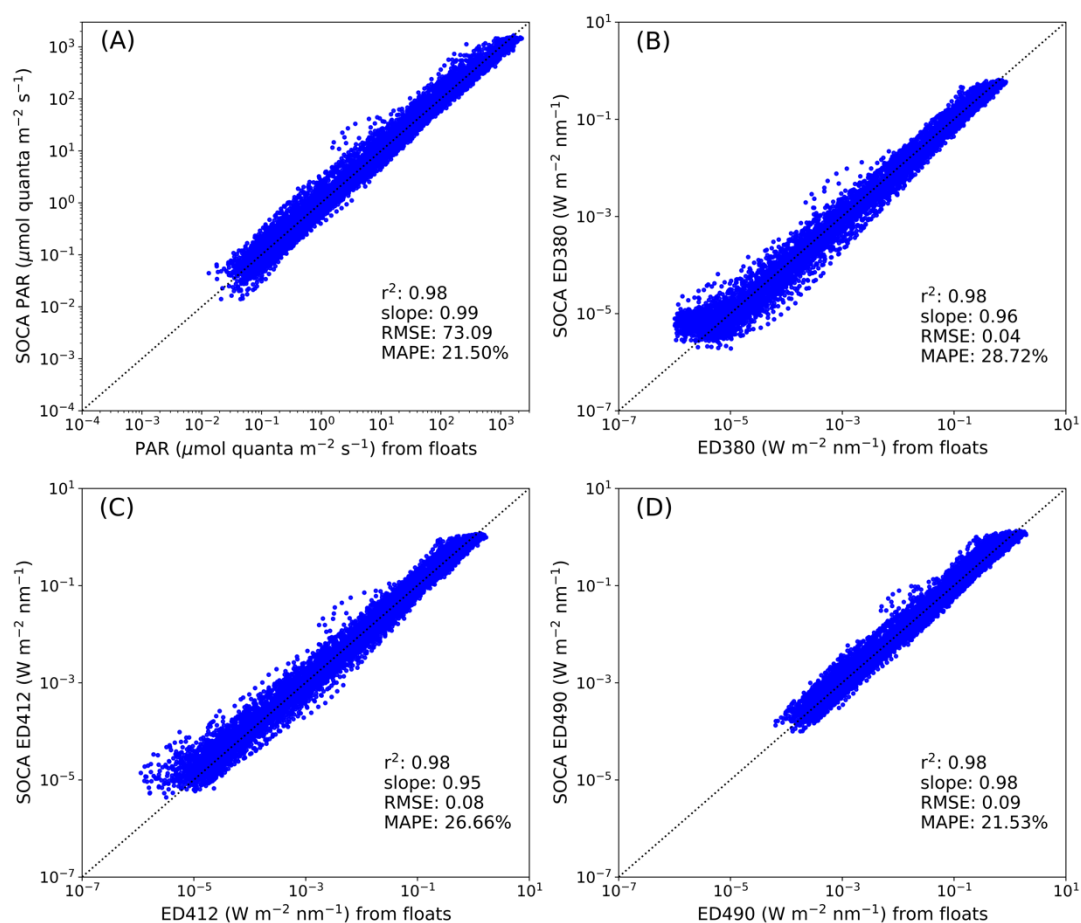


Figure S4. Scatter-plots between light variables (PAR, ED380, ED412, and ED490) modeled by SOCA light models versus their corresponding BGC-Argo measurements from NASTG. PAR (A); ED380 (B); ED412 (C); ED490 (D).



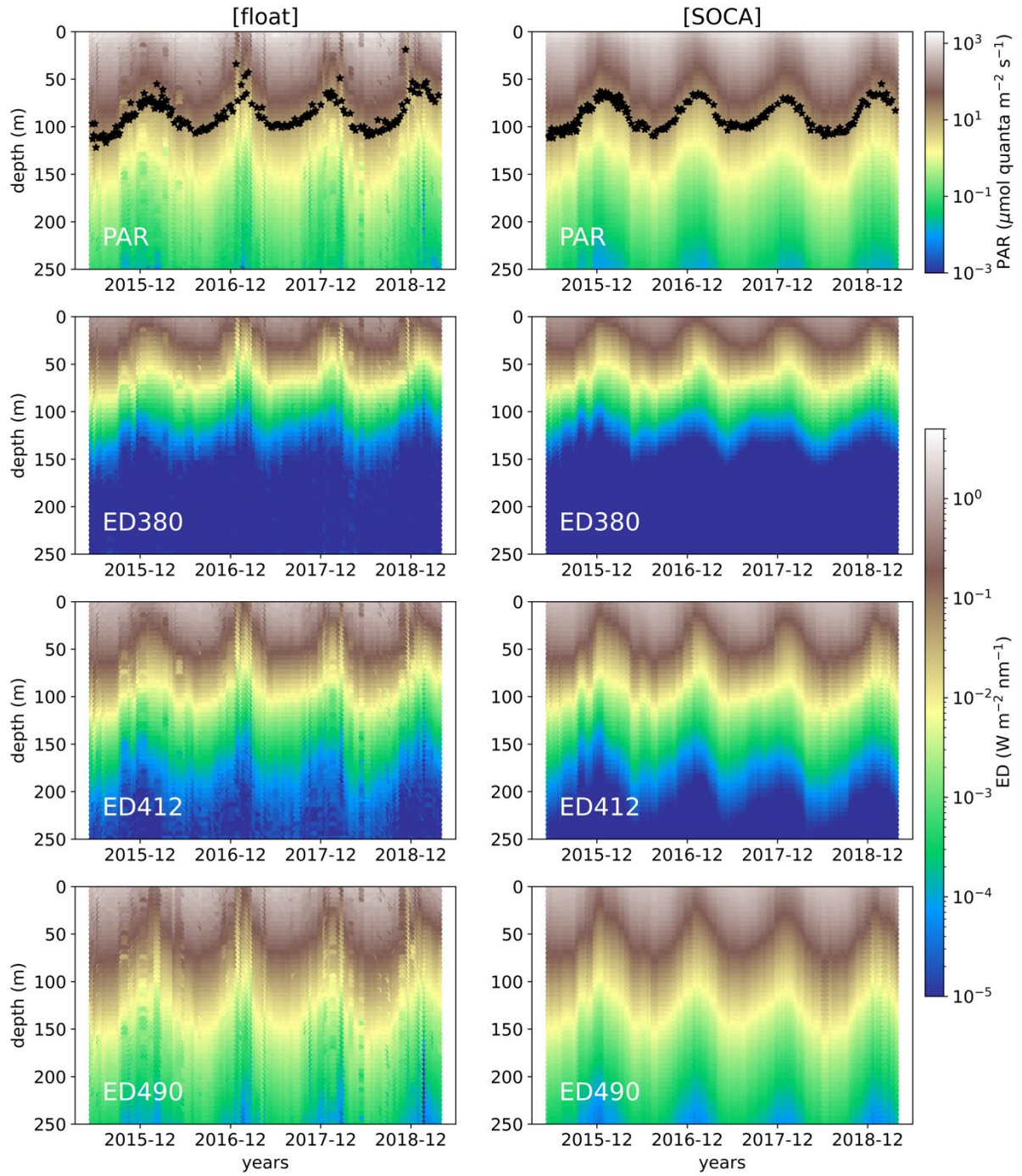


Figure S5. Time series of the vertical distribution of the four light variables in the Eastern Mediterranean Sea (EMS) measured by BGC-Argo float WMO 6901773 (left column) and modeled by SOCA-light (right column). The variables in each subplot are indicated by text in the corresponding subplots. The black stars indicate the depth at which instantaneous PAR value =  $15 \mu\text{mol quanta m}^{-2} \text{s}^{-1}$ .

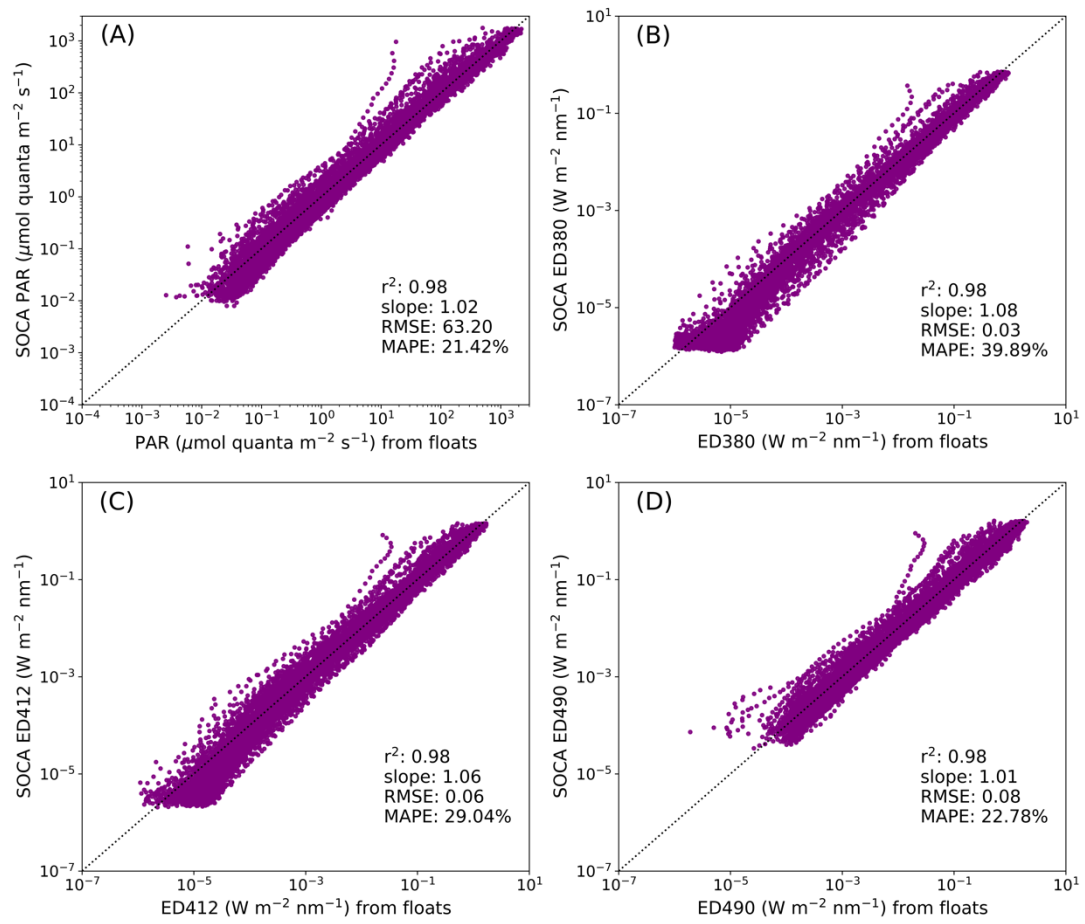


Figure S6. Scatter-plots between light variables (PAR, ED380, ED412, and ED490) modeled by SOCA light models versus their corresponding BGC-Argo measurements from EMS. PAR (A); ED380 (B); ED412 (C); ED490 (D).

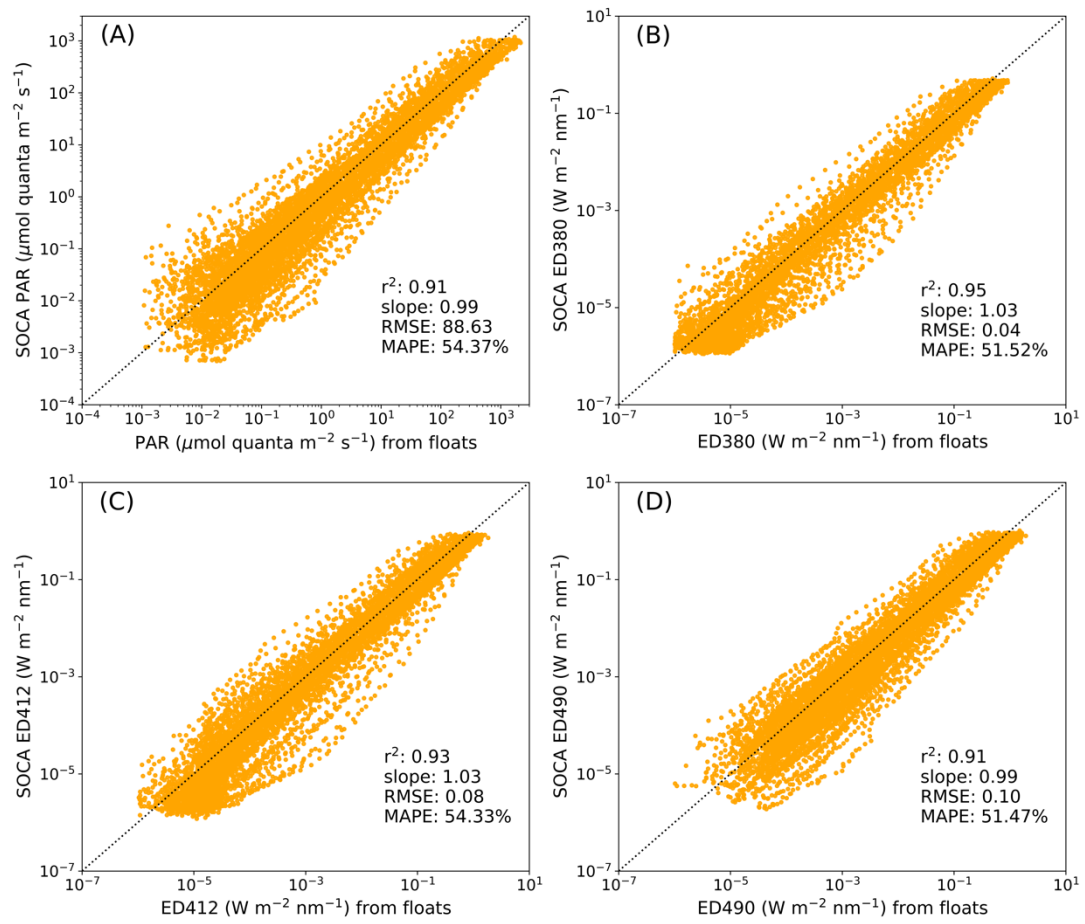


Figure S7. Scatter-plots between light variables (PAR, ED380, ED412, and ED490) modeled by SOCA light models versus their corresponding BGC-Argo measurements from SO. PAR (A); ED380 (B); ED412 (C); ED490 (D).

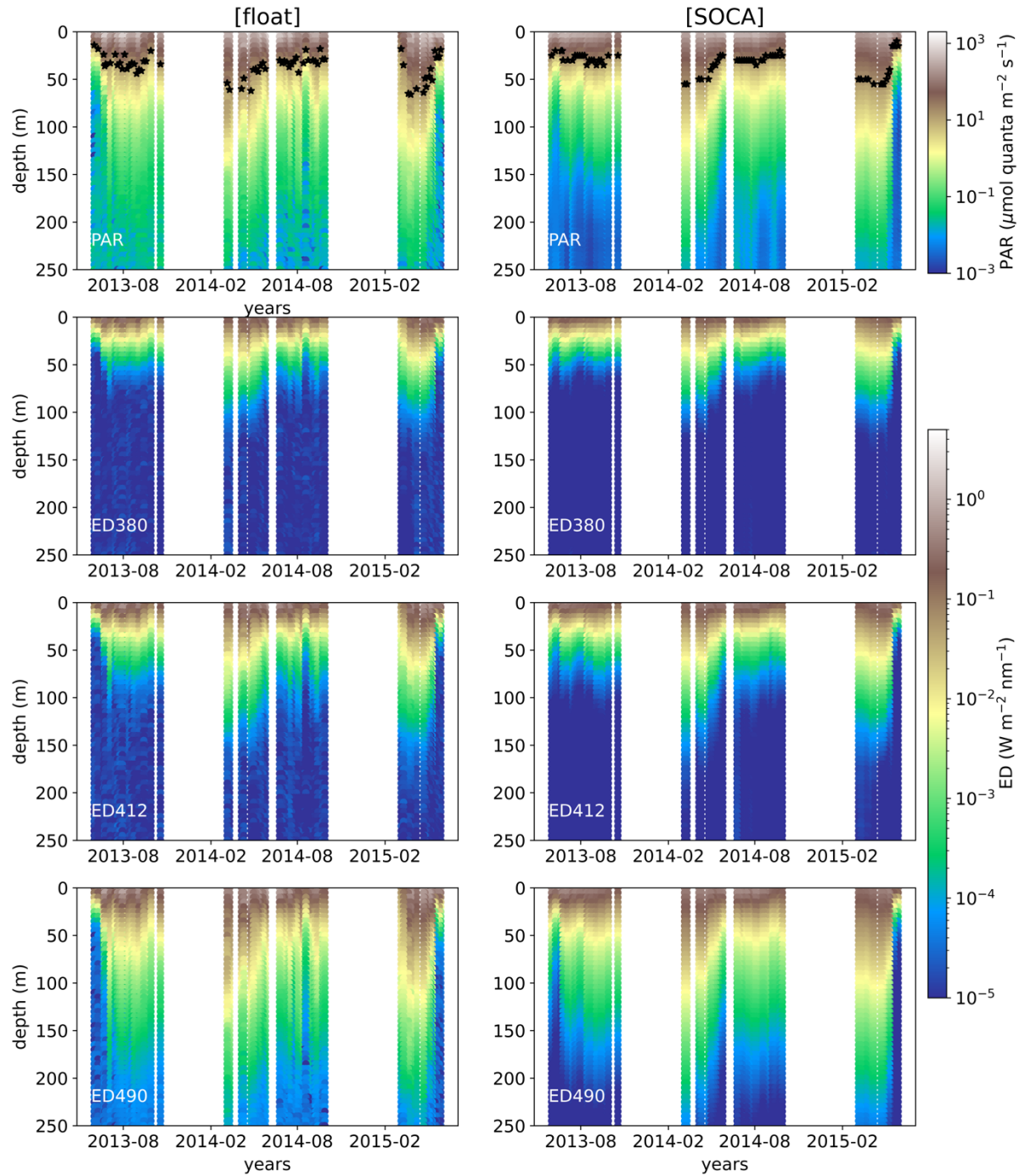


Figure S8. Time series of the vertical distribution of the four light variables in the North Atlantic Subpolar Gyre (NASPG) measured by BGC-Argo float WMO 6901523 (left column) and modeled by SOCA-light (right column). The variables in each subplot are specified by text in the corresponding subplots. The black stars indicate the depth at which instantaneous PAR value =  $15 \mu\text{mol quanta m}^{-2} \text{s}^{-1}$ .

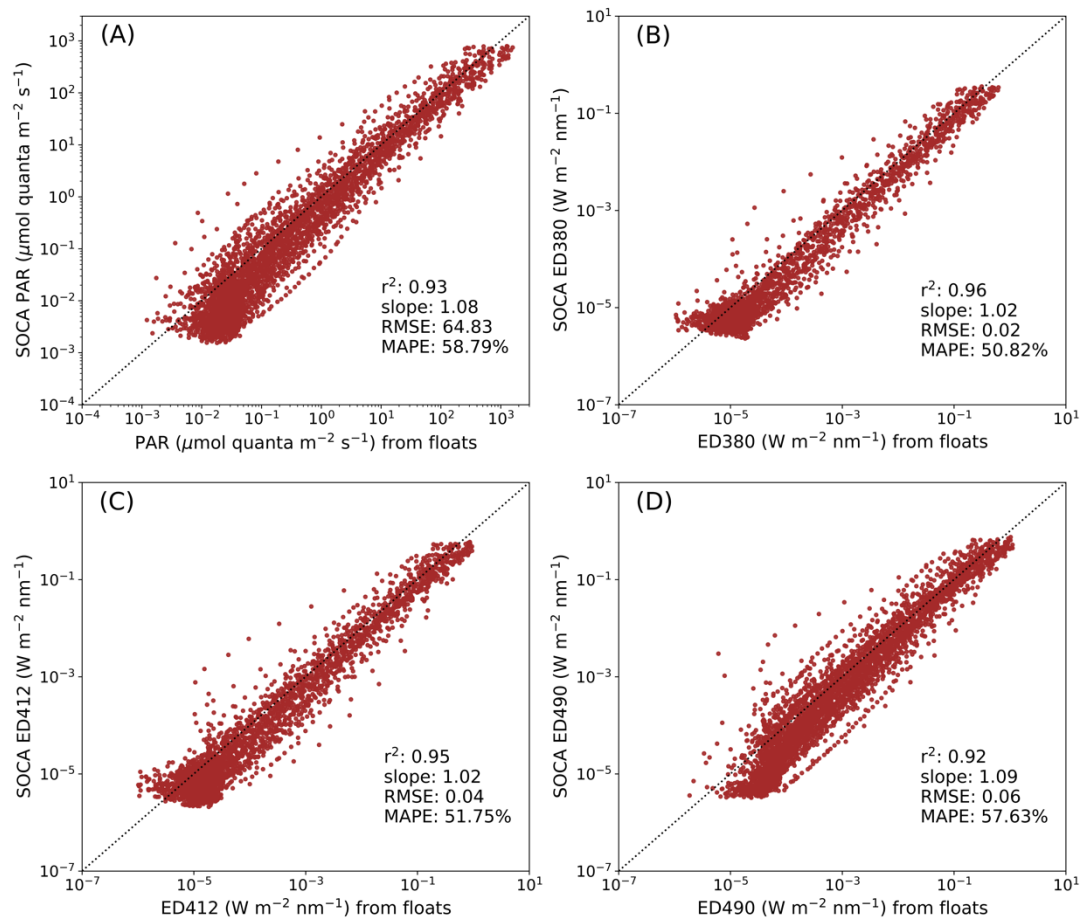


Figure S9. Scatter-plots between light variables (PAR, ED380, ED412, and ED490) modeled by SOCA light models versus their corresponding BGC-Argo measurements from NASPG. PAR (A); ED380 (B); ED412 (C); ED490 (D).