

Seasonal variations of the dinoflagellate algae *Noctiluca scintillans* abundance in the western Arabian Sea and the northern Black Sea

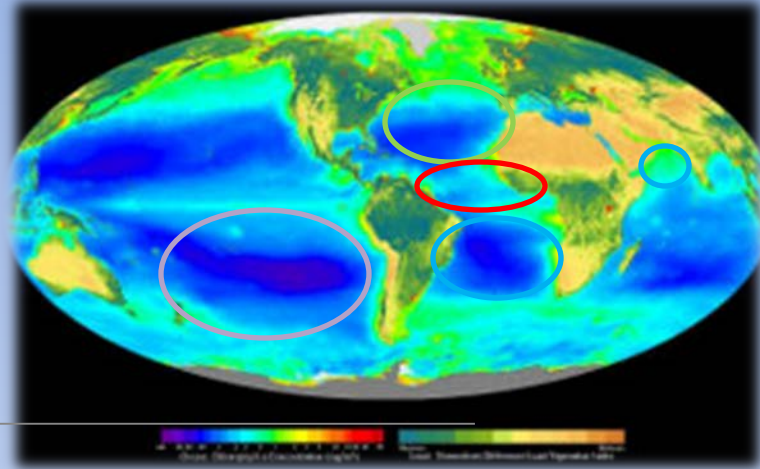
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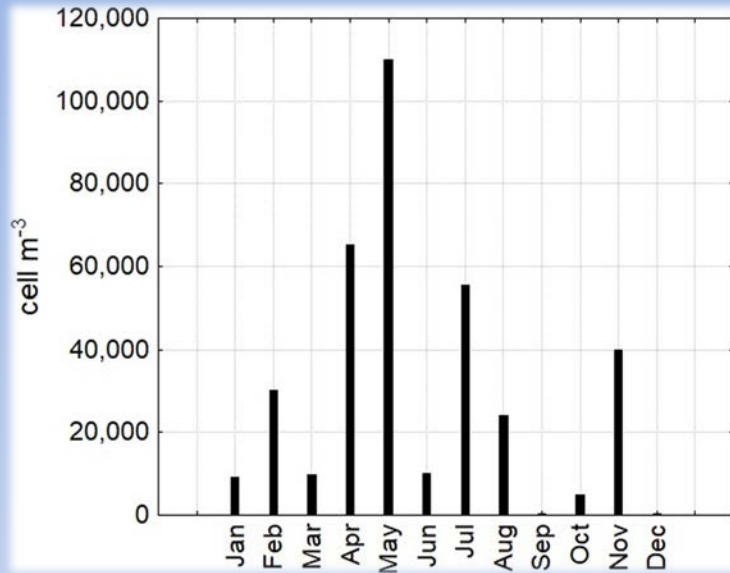
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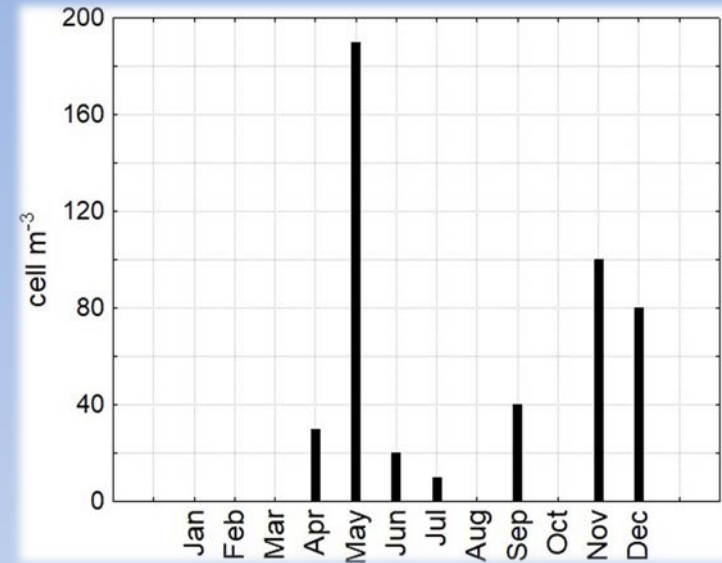
Regions, sampling periods and sampling methods used to monitor the *Noctiluca* blooms.

***Asterisk denotes the regions in which we analyzed just a fragment of interannual *Noctiluca* time series, in order to keep the range of seasonal patterns comparable over regions.**

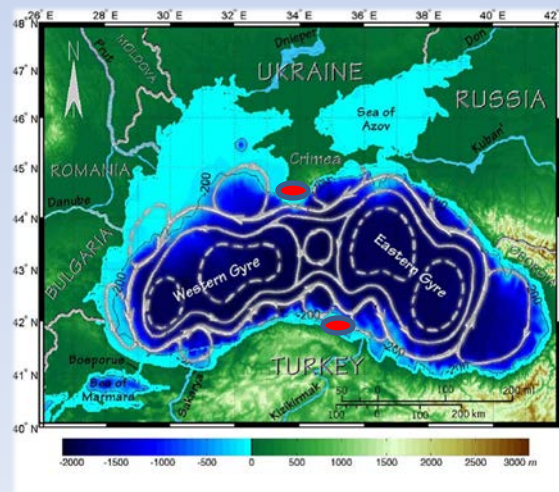
Region	Sampling period	Method	Reference
Northern central Black Sea (Crimean shelf)	2002	Juday net, 140 µm	Zagorodnaya et al., 2007
Northeastern Black Sea	2004-2012	Juday net, 178 µm	Mikaelyan et al., 2014
Southern Black Sea	2005-2006*	Zooplankton net, 210 µm	Üstün et al., 2018
Sea of Marmara	2003	Hydrobios Niskin bottles	Turkoglu, 2013
Northwestern Arabian Sea (Gulf of Oman)	2005-2010	Bongo net, 120 µm	Al-Hashmi et al., 2019
Northern Arabian Sea (Pakistani shelf and open sea waters)	2000	Niskin bottles	Chaghtai & Saifullah, 2006 Gomes et al., 2008
Eastern Arabian Sea (Indian shelf)	2003, 2004, 2009*	Multiple type of nets	D'Silva et al., 2012; Dwivedi et al., 2006 Madhu et al., 2012;



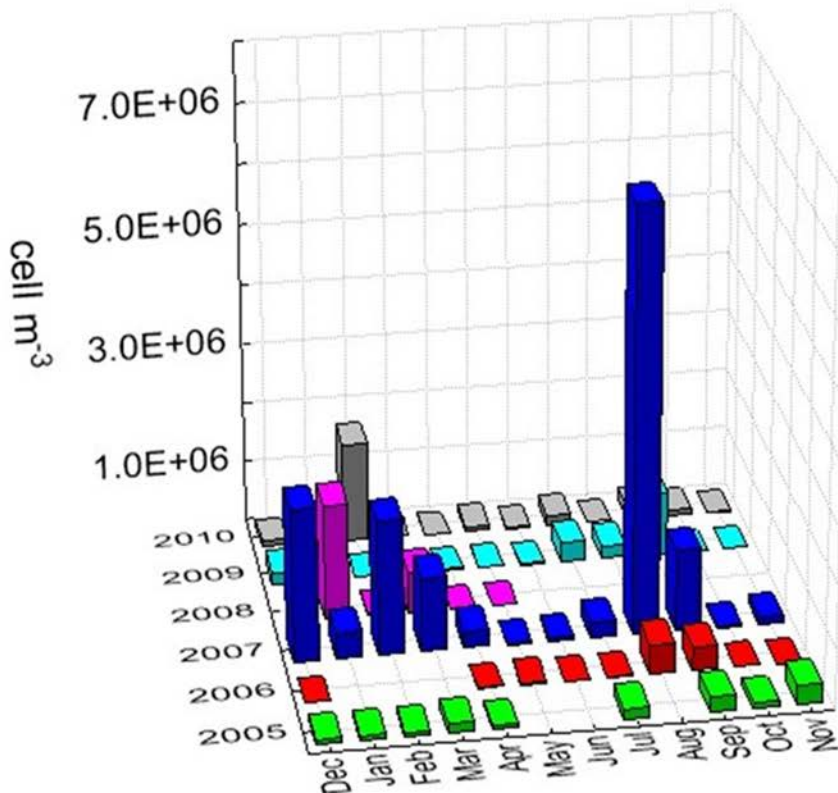
***Noctiluca* abundance in the southern Black Sea -off Sinop (Üstün et al., 2018).**



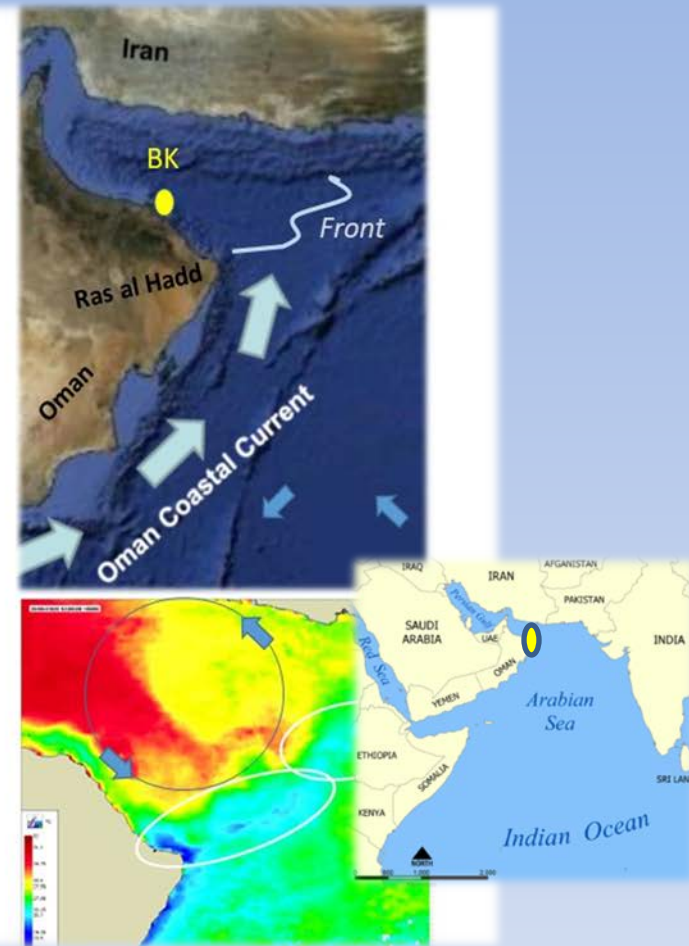
***Noctiluca* abundance in the northern central part of the Black Sea, along the Crimean coast (Zagorodnaya et al., 2007).**



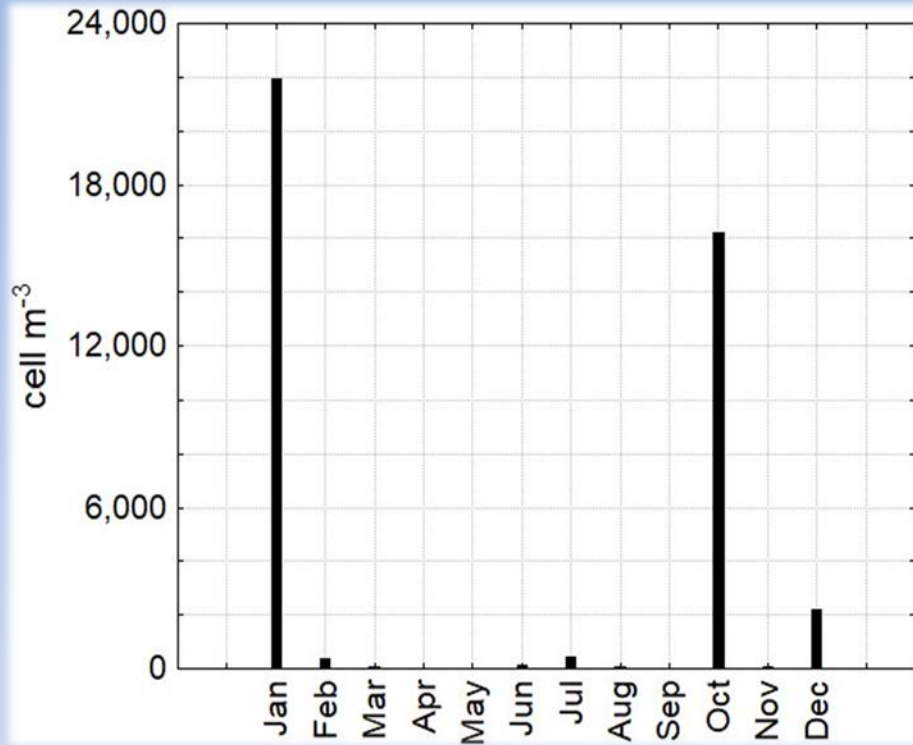
The basin scale circulation, with a color bar of depths (Oquz et al., 1993).



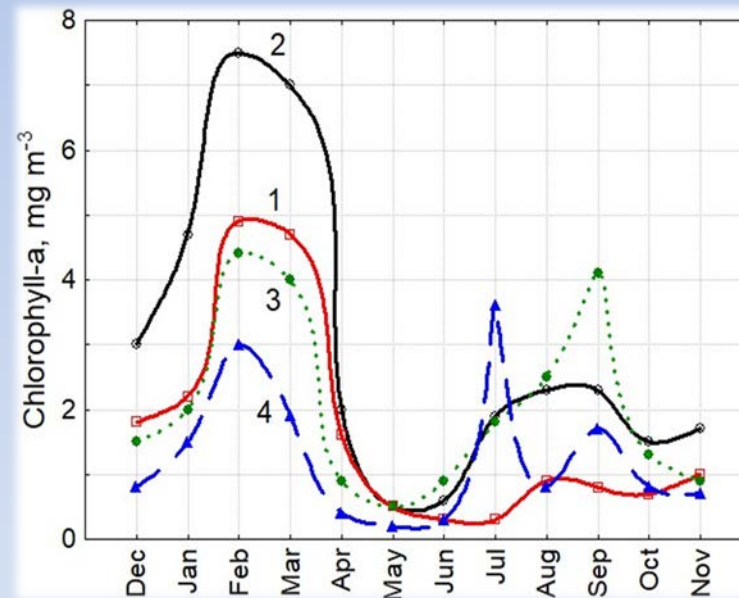
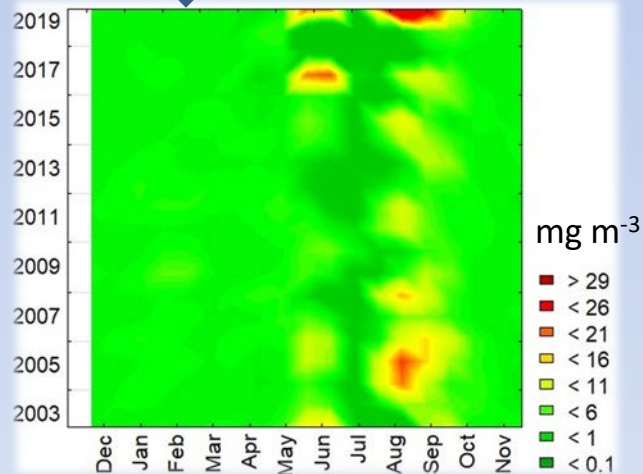
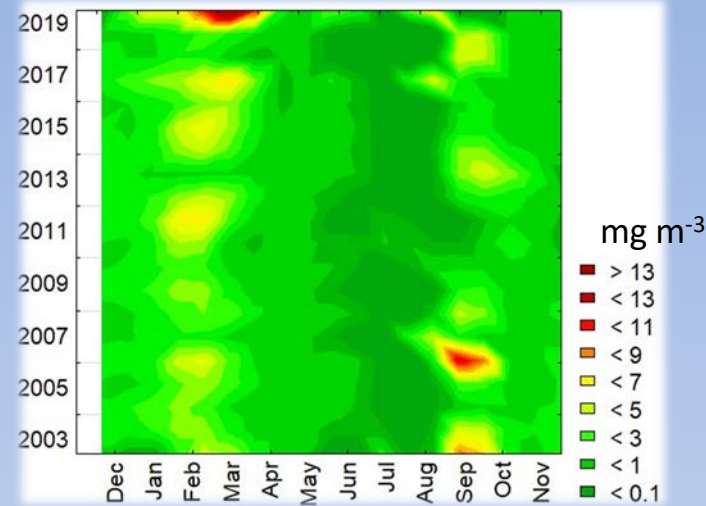
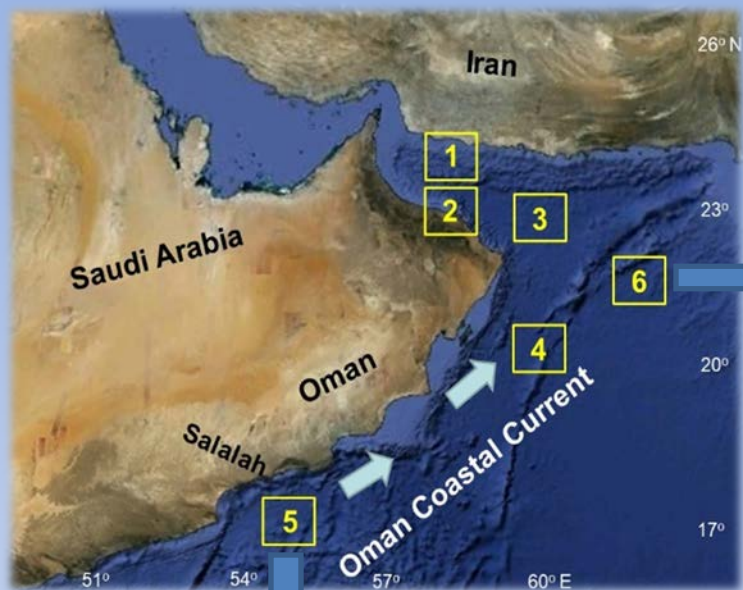
Seasonal variation of the *Noctiluca* abundance on a coastal station BK in the Gulf of Oman (left panel) and regional circulation patterns (right panel).



An episode of the Ras Al Hadd frontal zone pronounced in the sea surface temperature, and the location of a cyclonic eddy (August 2009, modified, <http://www.cls.fr>).



Seasonal variation of the *Noctiluca* abundance in the northwestern Arabian Sea (averaged for 2009-2011) and remotely sensed spatial pattern of the winter bloom (14 February 2015, NASA MODIS-Aqua, <https://phys.org/news/2017-03-algae-bloom-arabian-sea-tied.html>).



The location of four regions used to retrieve the seasonal cycles of chlorophyll-*a*, (right panel).

Abbreviations: 1-Gulf of Oman, northern part. 2-Gulf of Oman. 3-Arabian Sea, western part. 4-Arabian Sea, southern part. 5-the Salalah region, southern part. 6-the Northwestern Arabian Sea.

Green plots: Seasonal and interannual variation of the chlorophyll-*a* concentration in the Salalah region (box 5) and the northwest Arabian Sea (box 6). Color bar stands for the chlorophyll-*a* (mg m^{-3}).

Regions/months	1	2	3	4	5	6	7	8	9	10	11	12
Black Sea (northern central shelf)												
Black Sea (southern shelf)												
Black Sea (northeastern shelf)												
Sea of Marmara												
Northern Arabian Sea (Pakistan shelf)												
Northwestern Arabian Sea (open sea regions)												
Western Arabian Sea (Gulf of Oman)												

Occurrence of *Noctiluca* major abundance peaks over regions and months (1-12)

Conclusions

A comparison of seasonal patterns of *Noctiluca* abundance pointed to the persistence of a bimodal seasonal cycle in both Black Sea and Arabian Sea regions.

The major peak was observed during spring in the Black Sea and during the winter (Northeast) monsoon in the Arabian Sea. The timing of the second (minor) peak was different over regions as well. This peak was modulated by the advection of seasonally fluctuating velocity of coastal currents which transport waters enriched by nutrients by coastal upwelling.

The major peak of *Noctiluca* abundance ($\sim 1.5 \times 10^6$ cells m^{-3}) was two orders of magnitude higher in the western Arabian Sea compared to the northern Black Sea.

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