

## ***Interactive comment on “Hydrodynamics and light climate structure alongshore phytoplankton blooms in spring” by G. Brandt and K. W. Wirtz***

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We thank the referee for clearly pointing to the weaknesses of the manuscript. We are thoroughly revising the entire manuscript with special emphasis on clarity and conciseness.

Please find brief responses to the specific comments below.

1. **Referee 1:** page 2: line 1-2: *I would recommend to start the abstract more study specific, not by a 'textbook' sentence.*  
Done.

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2. **Referee 1:** line 4: *that is right, but blooms in other areas can also be highly variable (e.g. E.huxleyi blooms!) - try to be more precise in what you intend to say.*  
Rephrased sentence.

3. **Referee 1:** line 13-15: *this sentence is confusing, it says that you compared phytoplankton growth in 2004 with spatial structure in 2005. I guess, you mean chl-a distribution for both years?*  
Right, the CHL-a distribution is meant in both years.

4. **Referee 1:** line 20-22: *this sentence is not precise, too. The term 'ecosystem function in coastal environments' covers much more and is too broad when the impact of hydrodynamics of phytoplankton bloom dynamics should be pointed out.*

Ecosystem function in coastal environments clearly covers more than the impact of hydrodynamics on phytoplankton blooms. However, since there are only a few members of the coastal ecosystem that are not significantly affected by the timing and amplitude of the spring bloom, the reference to 'ecosystem functioning' appears justified.

5. **Referee 1:** *Introduction:*  
*Improve the overall structure. Make more clear that you have to deal with different features:*  
(a) *Lacking of high resolution measurements of chl-a but also other parameters like e.g. nutrients, water turbidity, zooplankton grazing, benthic filter feeders*  
(b) *Different modeling approaches (please make clear to non-modelers what the difference is between Langerian and Eulerian models)* (c) *The scientific question of what leads to interannual differences in spring blooms spatial distribution*  
To our understanding, (c) is by far the most relevant question of this manuscript. The two other features you mention are not of equal importance. We nevertheless

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less take this point and will clearly distinguish between the different modelling approaches and the problems associated with inadequate data coverage.

6. **Referee 1:** *page 3: line 9: maybe better 'diversities' instead of 'irregularities'. (what would be a regular bloom and what a irregular one?)*  
Done.

7. **Referee 1:** *line 10: why is turbidity considered as biological condition?*  
Done. Turbidity is rather a physical than a biological condition. Biological processes (such as EPS production and subsequent TEP formation) may, however, significantly influence turbidity levels.

8. **Referee 1:** *Methods:*

*page 6: I very much miss detailed information on the spatial/temporal resolution of Ferry Box measurements since they are the very basis of this study. Also, it should be mentioned explicitly, that Chla was determined by the Ferry Box fluorometrically (you only mention SCUFA II from Turner Design in the Appendix) and also, if/how the seawater was pumped in. If the Ferry Box pumped the water before Chla was measured, Chl-a concentrations are likely to be underestimated. (It is known, that different pumps could damage different phytoplankton species differently.) Chl-a is the models most important state variable, so more attention needs to be paid on this parameter!*

Added more information on FerryBox data with emphasis on the measurement procedure and associated problems.

Water is pumped prior to analysis. The FerryBox *in situ* data are unmatched regarding coverage and frequency, but it is known that especially the fluorometrically determined CHL-a data is associated with large uncertainties (Petersen et al. 2008). This is why we do not simply try to minimise deviations between measured and simulated data, but to reproduce spatio-temporal patterns with the model. We hence assume that the relative distribution of CHL-a in the study

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area is captured by the FerryBox even if absolute CHL-a values may have considerable errors.

9. **Referee 1:** *Results:*

*In Fig 5, squares indicate different areas to calculate the Chla gradient – why are these squares different in both years?*

Position and size of the squares that are used to determine the lateral CHL-a gradient are manually chosen to best capture the spatio-temporal patterns of CHL-a during the spring bloom in both years. The different sizes of the squares do, thus, reflect the different CHL-a dynamics in 2004 and 2005.

10. **Referee 1:** *Please be more consistent with the names you use to indicate different water masses*

Done. Harmonised geographic names.

11. **Referee 1:** *page10 line 1-5: you write the same content twice!*

Done. Deleted redundancy.

12. **Referee 1:** *Discussion:*

*Since it is still an ongoing discussion, whether P or N are limiting nutrients in the Wadden Sea/German Bight*

Our results do not critically depend on the choice of the model currency. Especially the timing of the spring bloom and spatial gradient of CHL-a are insensitive to changes of the macronutrient. It may, however, influence the amplitude and the duration of the bloom, two features that are not in the major focus of this study. Moreover, Loebl et al (2009) suggest that P or Si rather than N is the limiting nutrient in the Western Wadden Sea.

13. **Referee 1:** *page16: The study of Loebl et al 2007 is on primary production not on microzooplankton grazing!?*

Correct, we wanted to refer to: Loebl, M. and van Beusekom, J. E. E. (2008),

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Seasonality of microzooplankton grazing in the northern Wadden Sea, J Sea Res.

14. **Referee 1:** page 20: You write: "*Many assumptions, e.g. the ignorance of remineralisation processes or adaptation in algal stoichiometry and/or community structure, have to be re-considered prior to a potential application to the entire season.*" So, why do these factors do not play a role for modeling spring bloom dynamics?

For the relatively short period of the spring bloom, the influence of these ratios and processes can be assumed constant (algal stoichiometry, community structure). The relative importance of remineralisation for primary production is lesser during the spring bloom than later in the year and, moreover, the process can be implicitly accounted for by the model parametrisation (cf. response to review 2).

We furthermore assume that on an interannual timescale all parameters do not change either, which is probably too simplistic. It allows us, however, to identify which part of the spring bloom dynamics can be explained by variable physical forcing only.

15. **Referee 1:** line 24: please explain CPR – probably not everybody might know what it means continuous plankton recordings, I guess?

Done. The Continuous Plankton Recorder Survey is meant here.

On behalf of all authors

Gunnar Brandt

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