

How to understand the dynamics that shape microbial communities

Monitoring Bacteria in the German Bight

AWI Phd-Days 2014

Judith Lucas

Dr. Gunnar Gerdts, Dr. Antje Wichels



Microbes interact with environment on different scales

1. Temporal scales

- Short-term variation
- Seasonal

ORIGINAL ARTICLE

Defining seasonal marine microbial community dynamics

Jack A. Gilbert^{1,2,3}, Joshua A. Steele⁴, I. Gregorv Canoraso⁵, Lars Steinbrück⁶, Jens Reeder⁵.

RESEARCH ARTICLE

Temporal dynamics in the free-living bacterial community composition in the coastal North Sea

Gerhard J. Herndl^{1,2}, ... Netherlands; and ²Department of Marine

Lack of spatiotemporal studies !

2. Spatial scales

- Microscale patterns
- Global distributions
- Vertical and horizontal expansion

Community properties

in the southern North Sea

Beate Rink, Nico Grüner, Thorsten Brinkhoff, Katja Ziegelmüller, Meinhard Simon*

Institute for Chemistry and Biology of the Marine Environment (ICBM), University of Oldenburg, 26111 Oldenburg, Germany

Spatial patterns of bacterial abundance, activity and community composition in relation to water masses in the eastern Mediterranean Sea

Taichi Yokokawa^{1,*}, Daniele De Corte^{1,2}, Eva Sintes³, Gerhard J. Herndl^{1,3}

¹Department of Biological Oceanography, Royal Netherlands Institute for Sea Research (NIOZ), PO Box 59, 1790 AB, Den Burg, The Netherlands

²Center for Ecological and Evolutionary Studies, University of Groningen, PO Box 14, 9750 AA Haren, The Netherlands

³University of Vienna, Department of Marine Biology, Faculty Center of Ecology, Althanstrasse 14, 1090 Vienna, Austria

The bacterial community composition in the German Bight

1. Describe temporal and spatial diversity and variability of bacterial community composition
2. Determine influencing factors and deconvolute temporal and spatial signals

March 2012 – Feb 2013

- Monthly sampling on three transects

- Fractionated filtration:

 - 10 μm (plankton attached)

 - 3 μm (particle attached)

 - 0.2 μm (free living)

- Contextual data

 - Temperature

 - Salinity

 - pH

 - Chl a

 - cDOM, DOC

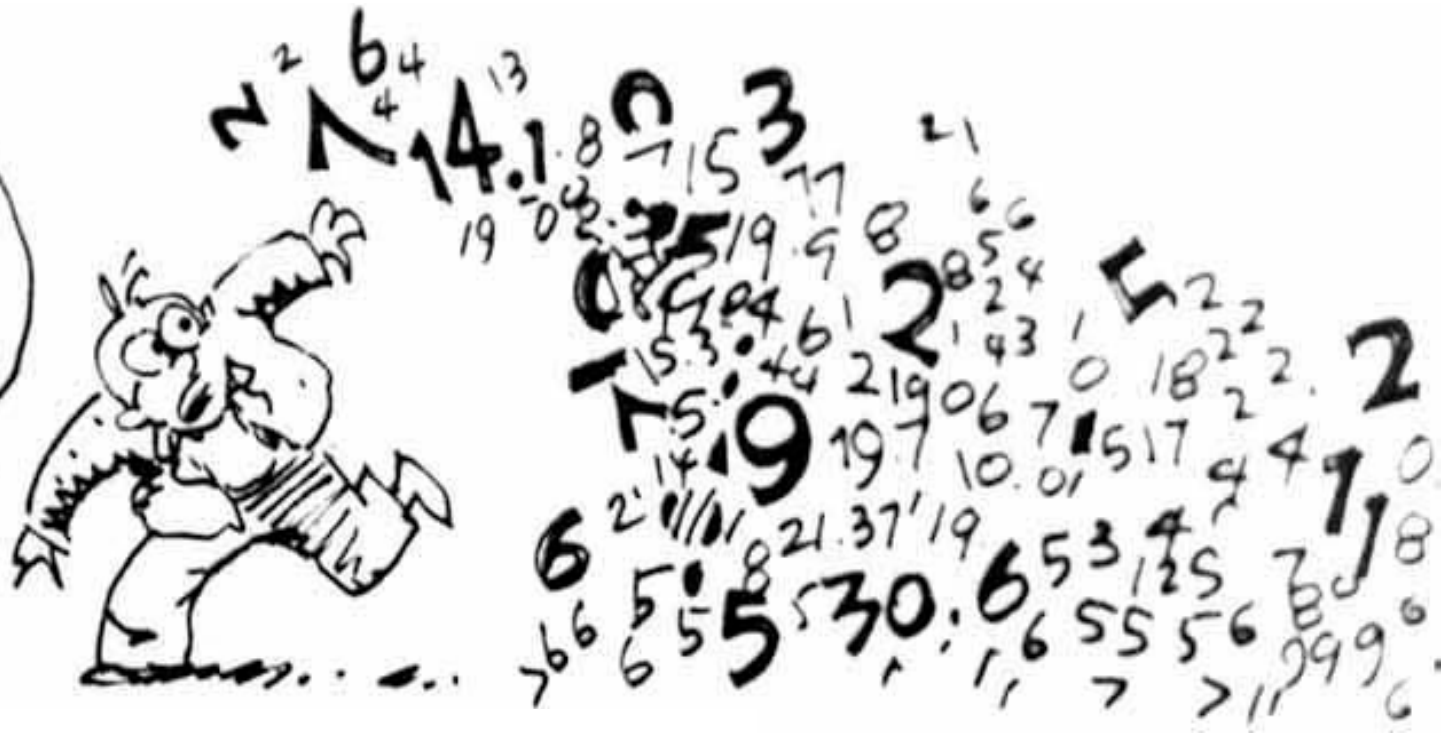
 - Dissolved Oxygen

 - Turbidity, PAR

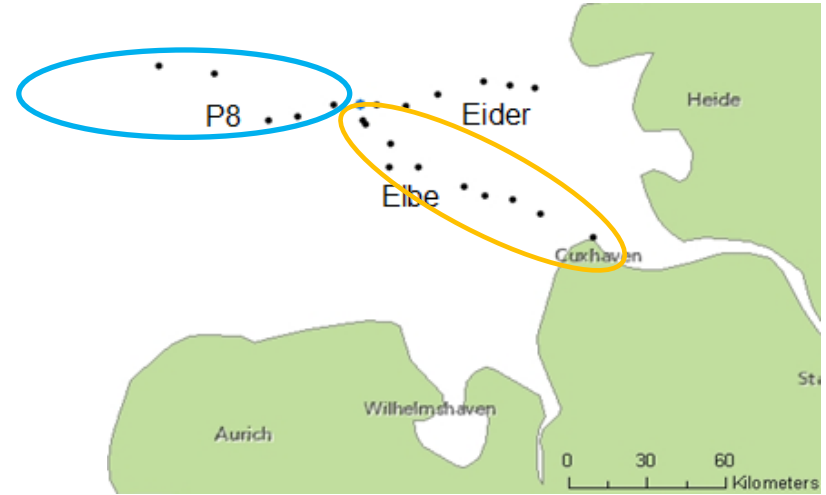




Multivariate statistics

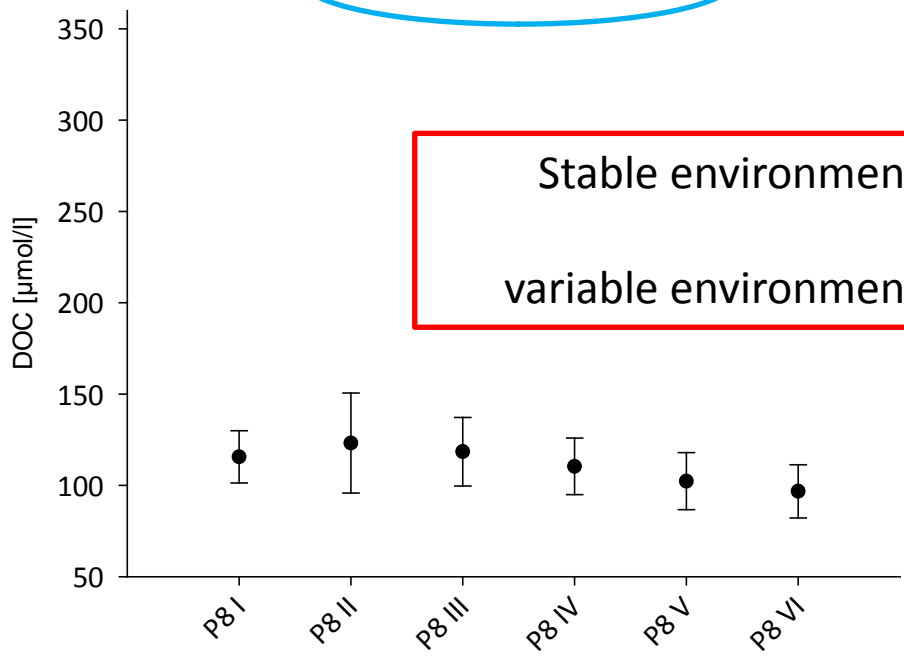


Environmental gradients

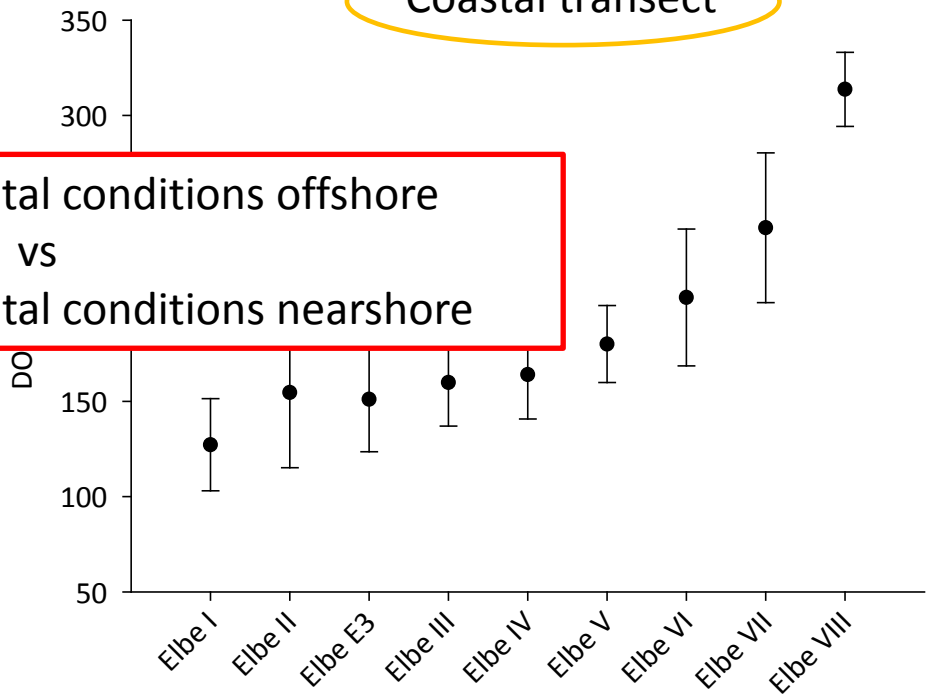


Offshore transect

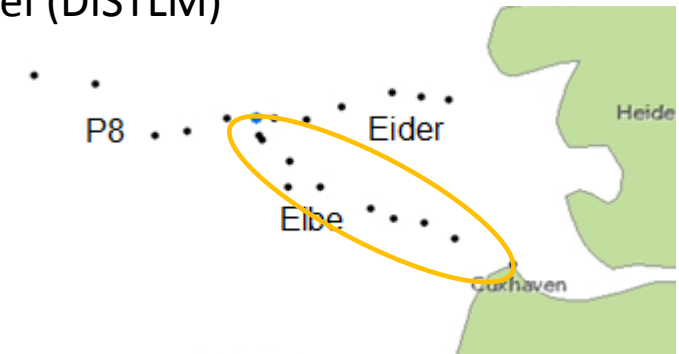
Coastal transect



Stable environmental conditions offshore
vs
variable environmental conditions nearshore

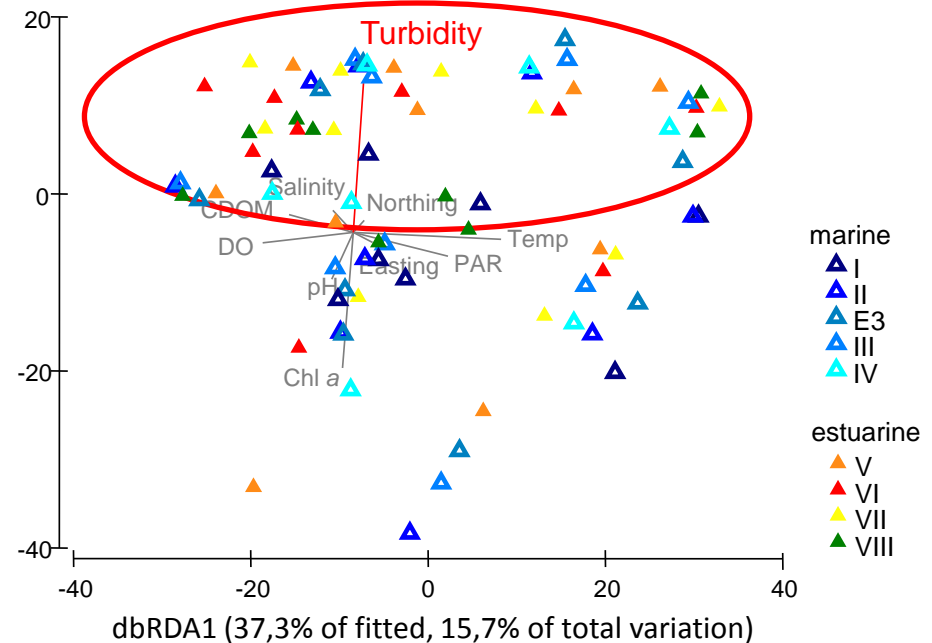
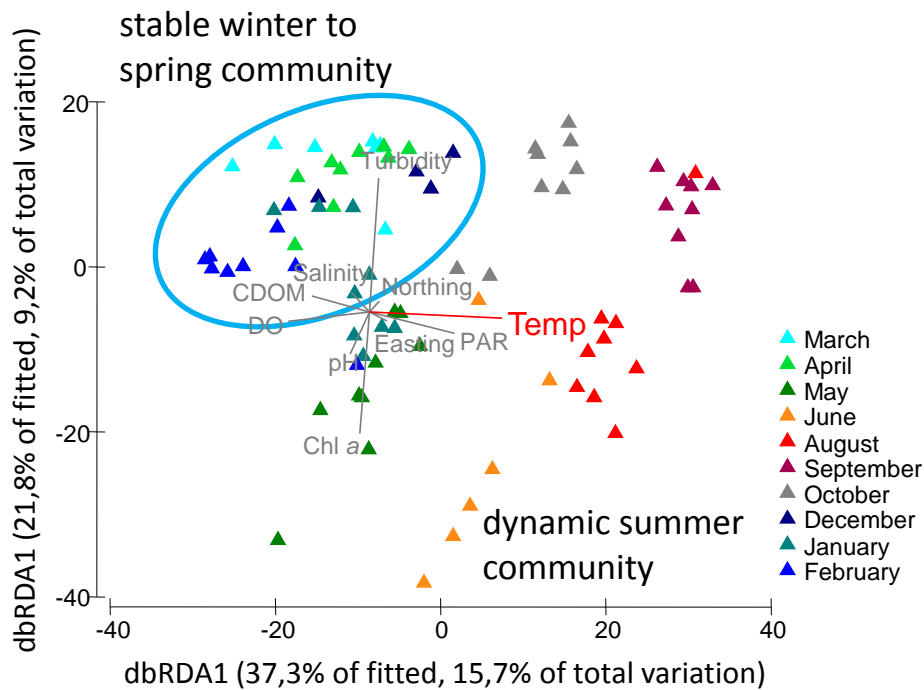


Distance based multivariate multiple regression model (DISTLM)



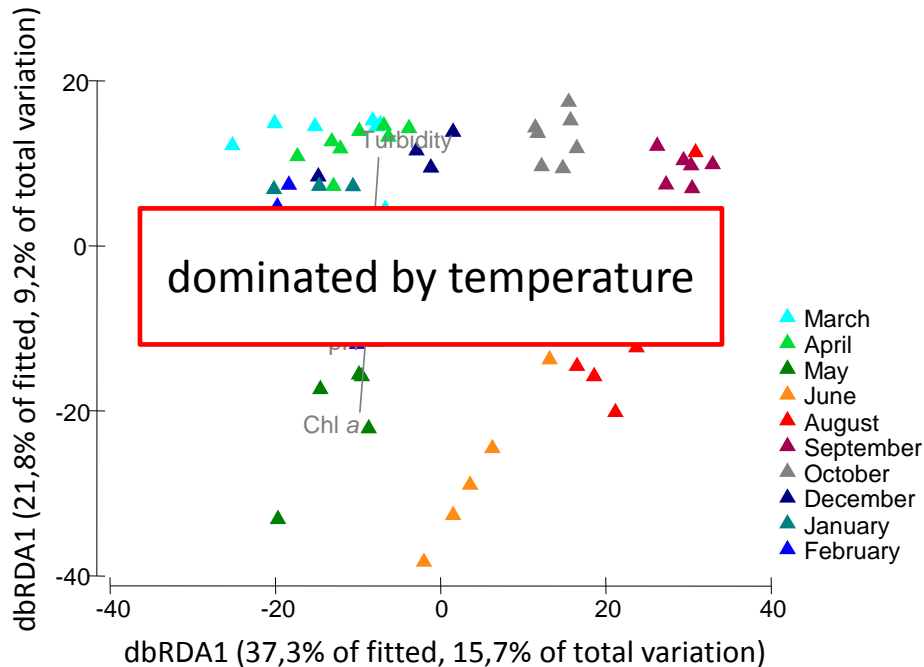
temporal

spatial

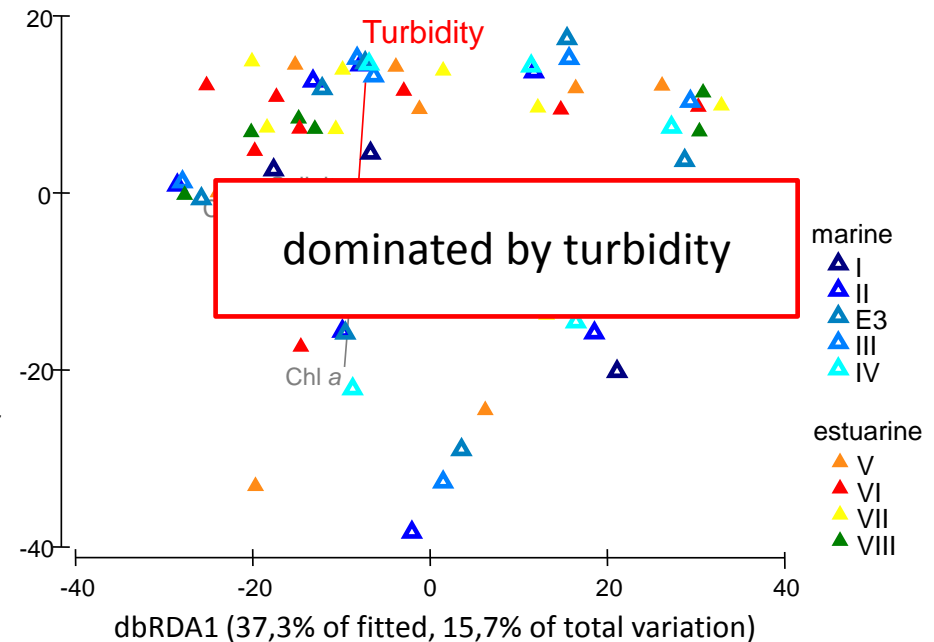


- Bacterial community is highly dynamic over time and space
- Temporal and spatial variation triggered by different factors
- Temporal variation superimposes spatial variation

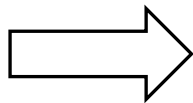
temporal



spatial



- Analyses of particle and plankton attached fractions
- Analyses of bottom water
- 16S rRNA tag sequence analyses
- Linkage with hydrodynamic simulations



**Prediction of bacterial community composition
depending on environmental factors**

Many thanks to:

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Silvia Peters

Kristine Carstens

Diverse Master students 😊

Friends and colleagues



Thanks for your attention !

Distance based multivariate multiple regression model (DISTLM)

Marginal test

Variable	Pseudo-F	P	Proportion of Variance
Northing	0,88	0,5364	0,056
Easting	5,09	0,0001	0,253
SiO₄	5,55	0,0001	0,270
PO₄	5,71	0,0001	0,276
NO₂	5,00	0,0001	0,250
NO₃	5,68	0,0001	0,275
NH₄	5,51	0,0001	0,269
pH	4,87	0,0001	0,245
Temperature	2,30	0,0256	0,133
Salinity	4,75	0,0001	0,241
DO	5,00	0,0001	0,250
Chla	6,10	0,0001	0,289
Turbidity	6,72	0,0001	0,309
CDOM	6,73	0,0001	0,310
DOC	6,28	0,0001	0,295
PAR	1,29	0,2174	0,079

Sequential test

Variable	Pseudo-F	P	Proportion of Variance
CDOM	6,73	0,0001	0,310
Chla	2,99	0,0018	0,121
DO	2,08	0,0328	0,078
PO₄	2,14	0,02	0,074
PAR	2,15	0,0105	0,068
Salinity	1,86	0,0413	0,055
Easting	1,78	0,0675	0,048
SiO ₄	1,42	0,2155	0,037
Temperature	1,17	0,351	0,030
Northing	1,16	0,3607	0,029
NH ₄	1,32	0,2881	0,031
Turbidity	1,18	0,3472	0,027
NO ₂	1,12	0,3767	0,025

$p < 0.05$