Study and modelling of DMSP production and its conversion into DMS by North Sea specific phytoplankton

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CONTEXT AND OBJECTIVES

Dimethylsulphide (DMS) is a climatic gas affecting the global climate through the production of atmospheric aerosols. The ocean is the main natural source as dimethylsulfoniopropionate (DMSP), the DMS precursor, is mainly synthesized by phytoplankton and macroalgae. The lack of correlation between observed DMS and phytoplankton distributions is explained by the complexity of DMSP production and conversion to DMS pathways. Indeed the ability to synthetize DMSP is species-specific and varies with environmental conditions. Moreover, the enzymatic cleavage of DMSP in DMS can either be performed by phytoplankton or bacterial lyases (Fig.1).

In the coastal Southern North Sea, the spring/summer bloom is characterized by the succession of 2 diatom communities (small colonials and *Chaetoceros*), the Haptophyceae *Phaeocystis globosa,* known as a high DMS(P) producer, and big diatoms (*Guinardia* and *Rhizosolenia*).

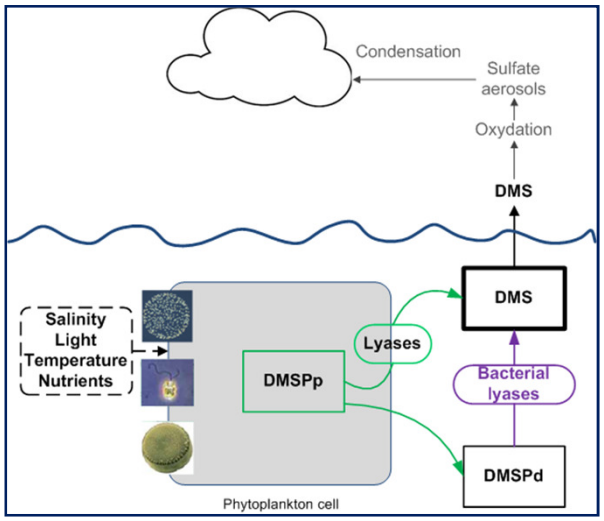

Figure 1: Part of the DMS cycle related to the phytoplankton

In this context, this thesis aims to :

(i) improve the mechanistic understanding of DMSP/DMS production by microbial communities

(ii) assess biotic and abiotic controls on the DMS production and its emission in the coastal Southern North Sea.

RESEARCH STRATEGY – 3 COMBINING APPROACHES

EXPERIMENTATION

Laboratory-controlled experiments on pure phytoplankton cultures of *Phaeocystis globosa* colonies/free living cells ; spring (*Chaetoceros spp., Thalassiosira spp., Skeletonema costatum*) and summer (*Rhizosolenia spp.*) diatoms:

- DMSP cell quota and regulation by salinity, temperature, light and nutrients
- DMSP-lyase activity

OBSERVATION

Source: The Marine Executive

Field measurements along a seasonal cycle:

- DMSP:C and DMSP:Chla
- DMSP (algal and bacterial) lyase activity
- Environmental variables (salinity, temperature, light, nutrients)
- Phytoplankton community structure and biomass
- Bacterial biomass

MODELISATION

The MIRO-DMS (Fig.2) model results from the coupling between a DMS module and the ecological model MIRO that describes phytoplankton successions and the associated C, N, P and Si cycling in the North Sea.

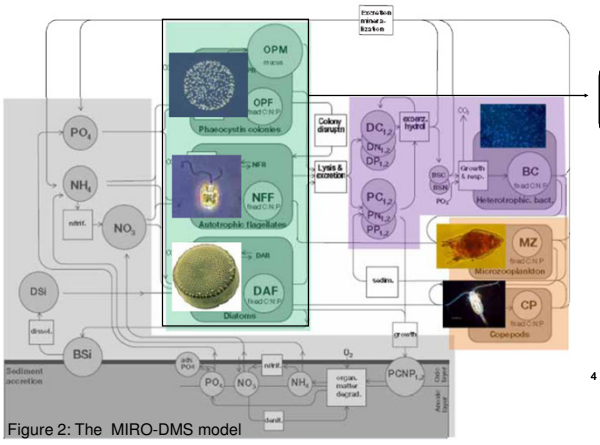

Figure 2: The MIRO-DMS model

Source: Gypens et al., 2014

Model development and validation:

- Parameterisation through the integration of experimental data
- Model simulations
- Validation through the comparison with field data

The model will be analysed for assessing biotic and abiotic controls of DMS production and its emission into the atmosphere.

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