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

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Dimethylsulphide (DMS) is a climatic gas affecting the global climate through the production of atmospheric aerosols (Charlson *et al.*, 1987). The ocean is the main natural source (Bates *et al.*, 1992) as dimethylsulphoniopropionate (DMSP), the DMS precursor, is synthesized by mainly phytoplankton (e.g. Stefels *et al.*, 2007). 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 (Keller *et al.*, 1989; Matrai and Keller, 1994) and varies with environmental conditions (Keller and Korjeff-Bellows, 1996; Stefels, 2000). Moreover, the enzymatic cleavage of DMSP in DMS can either be performed by phytoplankton (Stefels and Dijkhuizen, 1996) or bacterial lyases (Kiene and Bates, 1990). In this context, this thesis aims to improve the knowledge and modelling of DMS production and its emission to the atmosphere in the coastal North Sea. The research strategy combines 3 approaches: laboratory-controlled experimentation with monospecies phytoplankton cultures, field measurements, mechanistic modelling. The DMSP cellular concentrations and regulation by environmental conditions (salinity, temperature, light and nutrients) and the DMSP-lyase activity of key-phytoplankton species isolated from the North Sea will be measured by gas chromatography. These data will be synthesised and integrated in the mechanistic model MIRO-DMS. This 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. Thereafter, this model will be applied to the Southern Bight of the North Sea, and DMS(P) and phytoplankton simulations will be compared with field measurements obtained along a seasonal cycle. Once validated, the model will be analysed for assessing biotic (phytoplankton diversity) and abiotic (temperature, light, salinity, nutrients, wind speed) controls of DMS production and its emission to the atmosphere.

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