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KLIWAS Schriftenreihe
KLIWAS-23C/2013

The KLIWAS Climatology for Sea Surface Temperature and Ocean Colour Fronts in the North Sea

Part C: Ocean Colour Products

Koblenz, im Oktober 2013

BSH
BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

BROCKMANN CONSULT GMBH

Fronts
Recognition and analysis of time series derived from satellite data


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Part C: Ocean Colour Products

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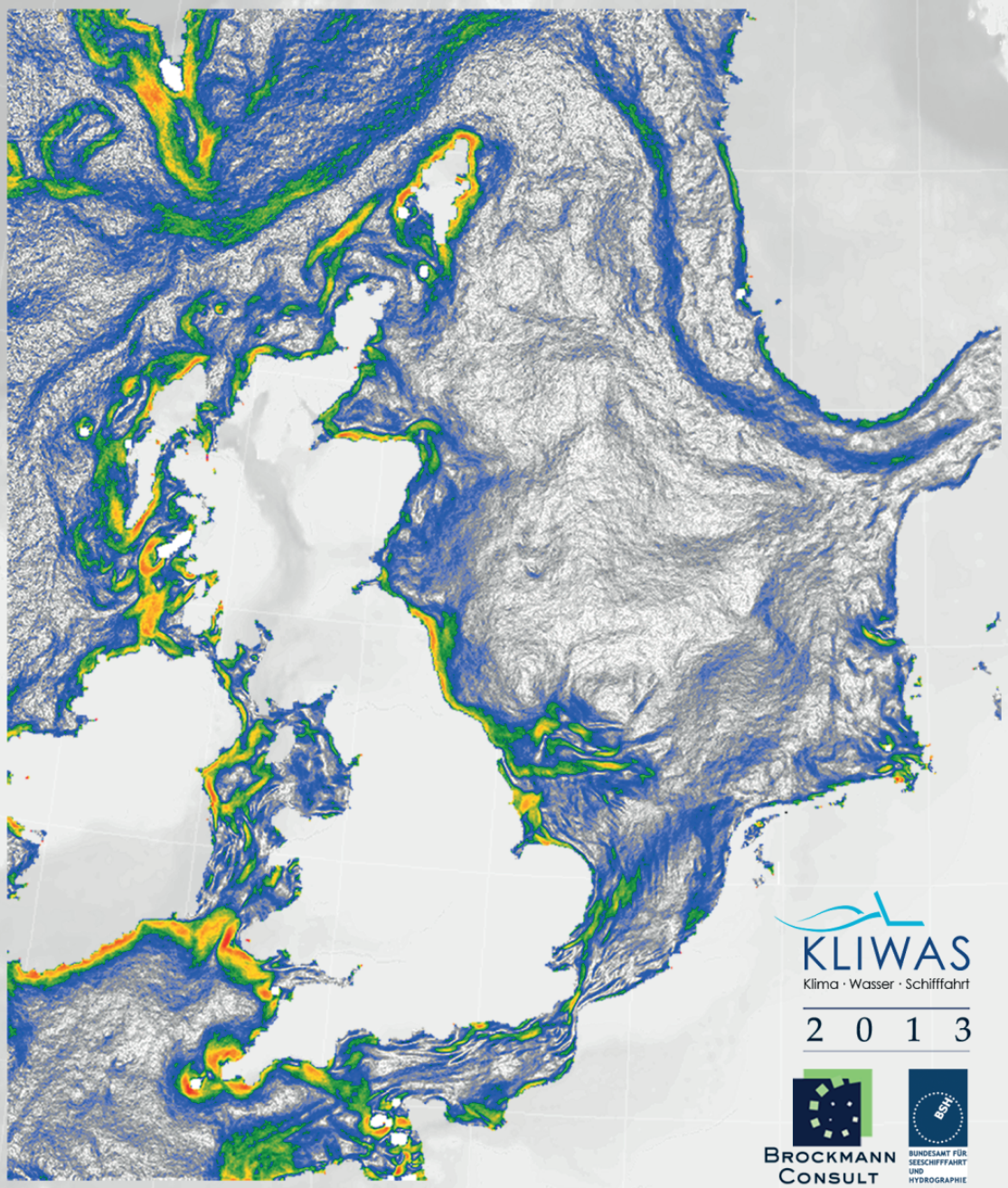
CLIMATOLOGY

of SST and Water Colours Fronts in the North Sea



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Page Chapter

Contents

Page Figure

List of figures

Page Figure

List of figures

1 Abstract

The KLIWAS climatology of sea surface temperature (SST) and ocean colour (OC) fronts in the North Sea was established by a co-operation of the Federal Maritime and Hydrographic Agency (BSH) and Brockmann Consult (BC) in order to generate a reliable reference data set for the assessment of changes in frontal position, gradients, and seasonal variability due to climate change on the basis satellite data.

Frontal zones are relative sharp boundaries between different water masses and can be identified by feature extraction and classification of satellite data from different sensors providing information about the SST and OC i.e. chlorophyll or suspended matter concentration. While frontal zones can be identified directly from SST, water quality parameters such as chlorophyll concentration can be a proxy for a frontal zone, but not every strong OC gradient is mandatory an oceanic front. More than two decades of satellite data have been analysed for this climatology referring to type and location of frontal zones, horizontal scales (e.g. gradients perpendicular to the front), and sensor characteristics like spatial resolution and noise.

This report consists of three parts:

Part A describes background, methods, data, the new algorithms, and the data access via ftp. The data are freely available for everyone.

Part B presents a selection of SST products, and

Part C (this document) presents a selection of OC products.

2 OC time series

2.1 Total suspended matter (TSM) time series based on the data of the MERIS-sensor on ENVISAT

2.1.1 Time period 2002-2010, annual means

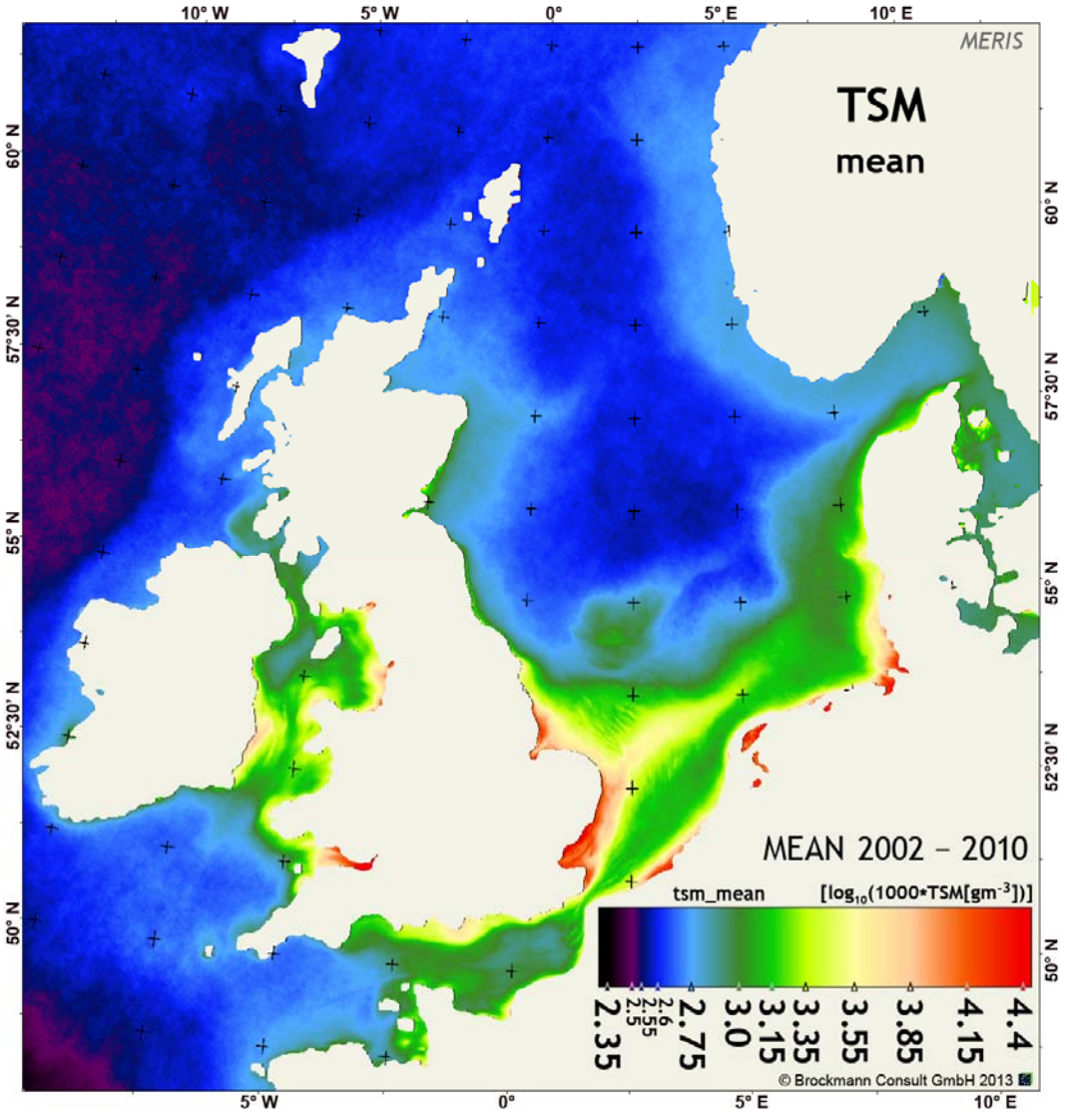

Fig. 1: TSM mean field based on the data of the MERIS sensor on ENVISAT 2002 - 2010

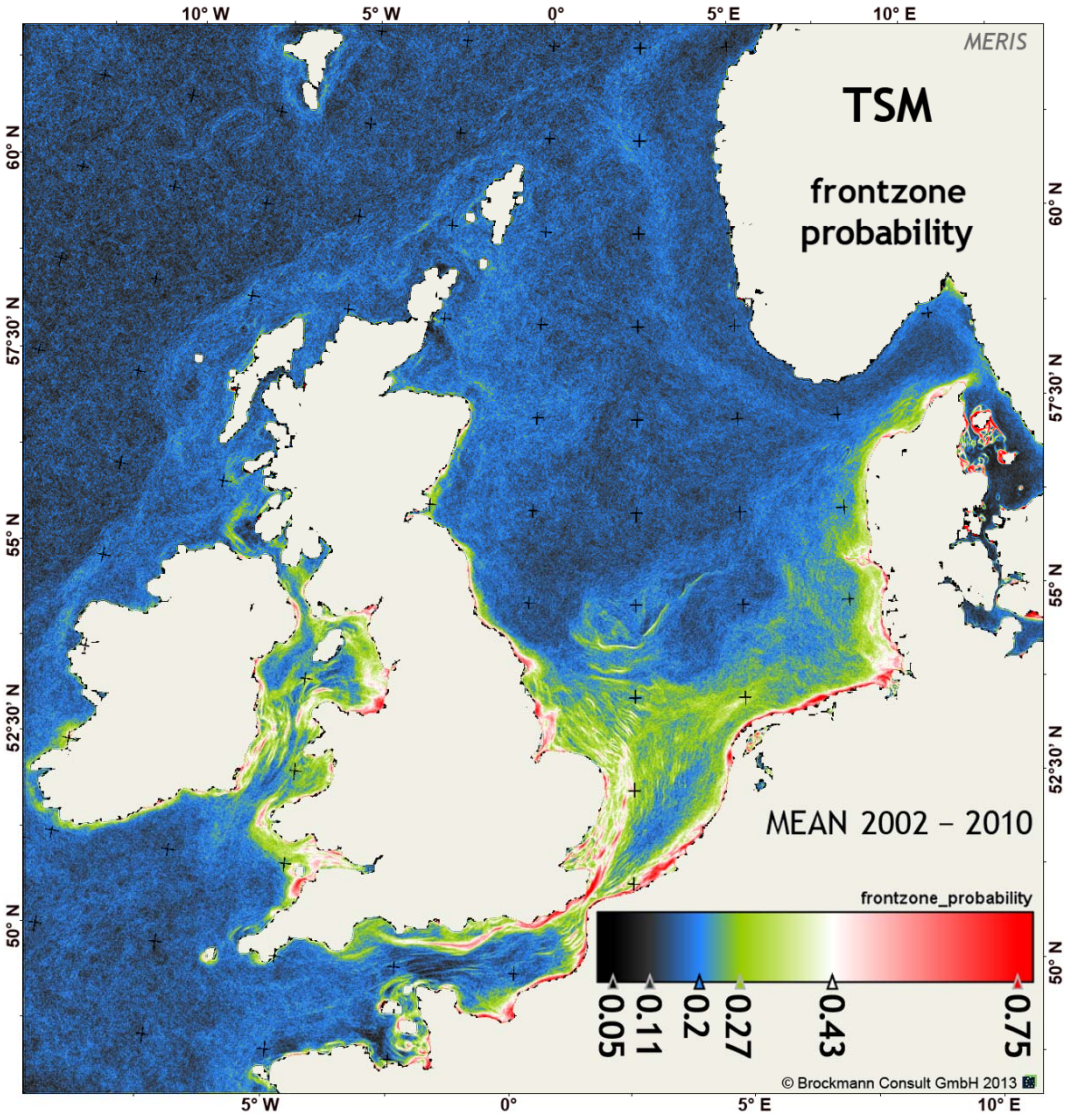

Fig. 2: TSM front probability based on the data of the MERIS sensor on ENVISAT 2002 - 2010

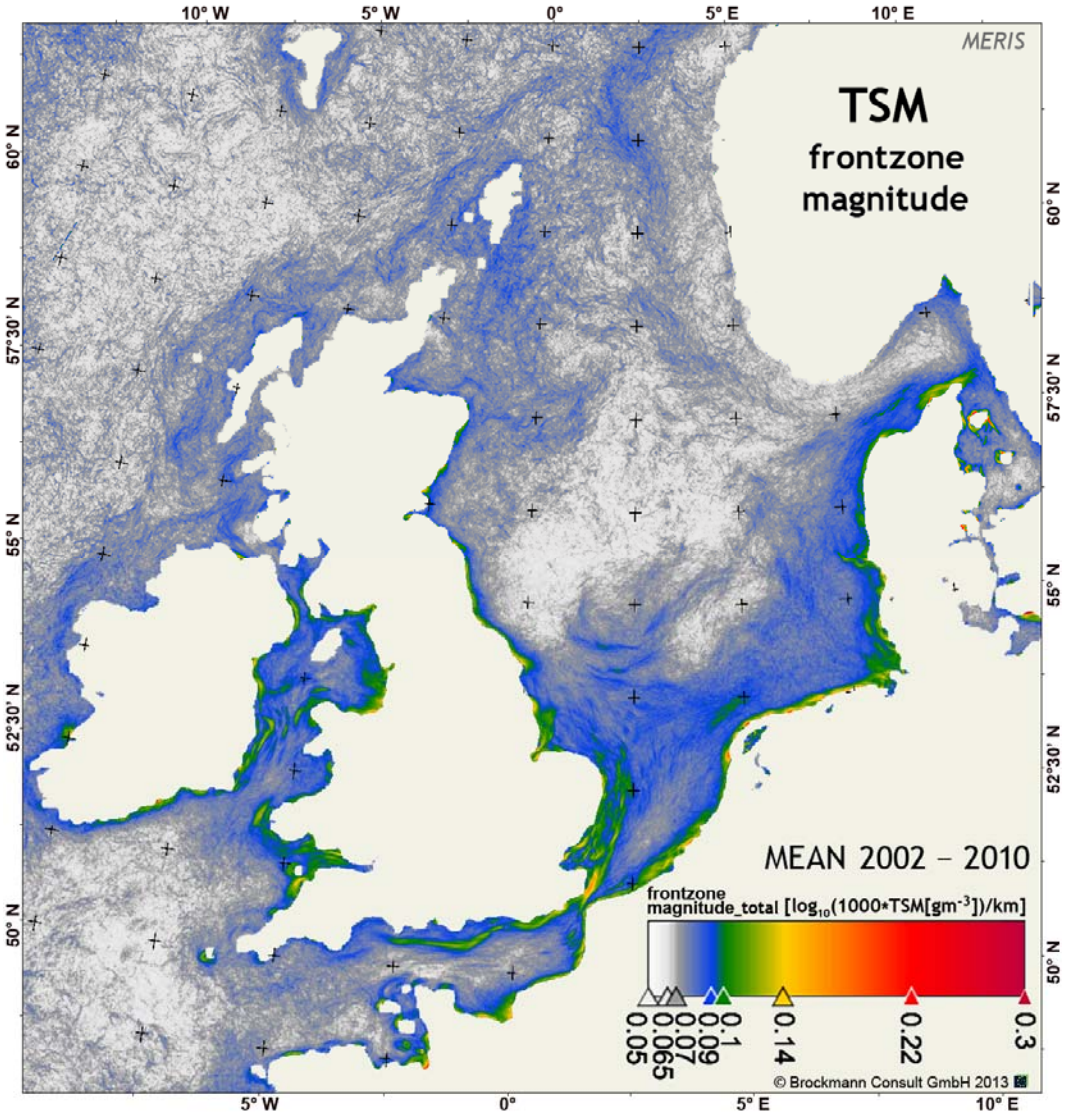

Fig. 3: TSM: mean of gradient magnitude for frontal zone based on the data of the MERIS sensor on ENVISAT 2002 - 2010

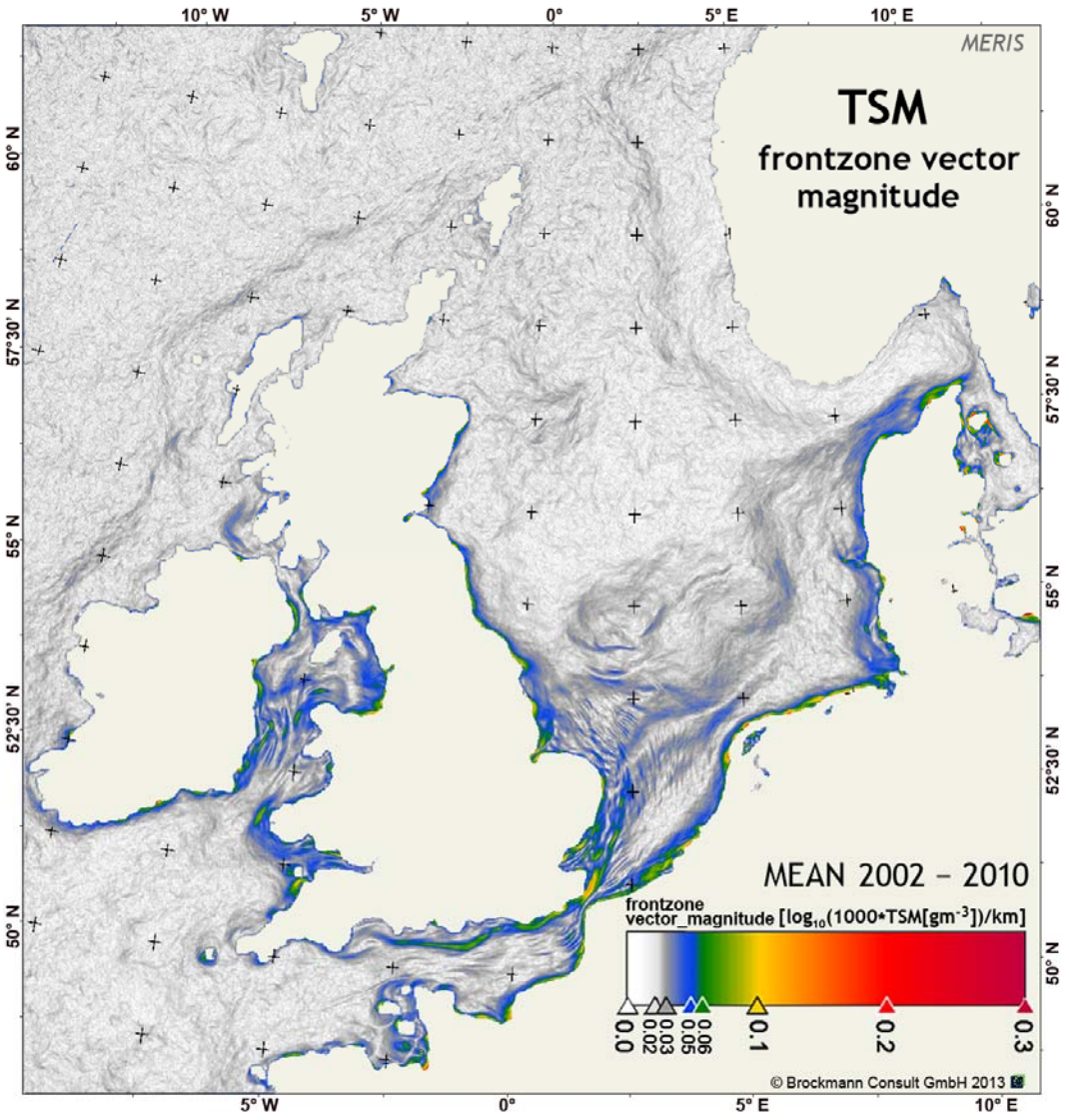

Fig. 4: TSM: magnitude of mean gradient vector for frontal zone based on the data of the MERIS sensor on ENVISAT 2002 - 2010

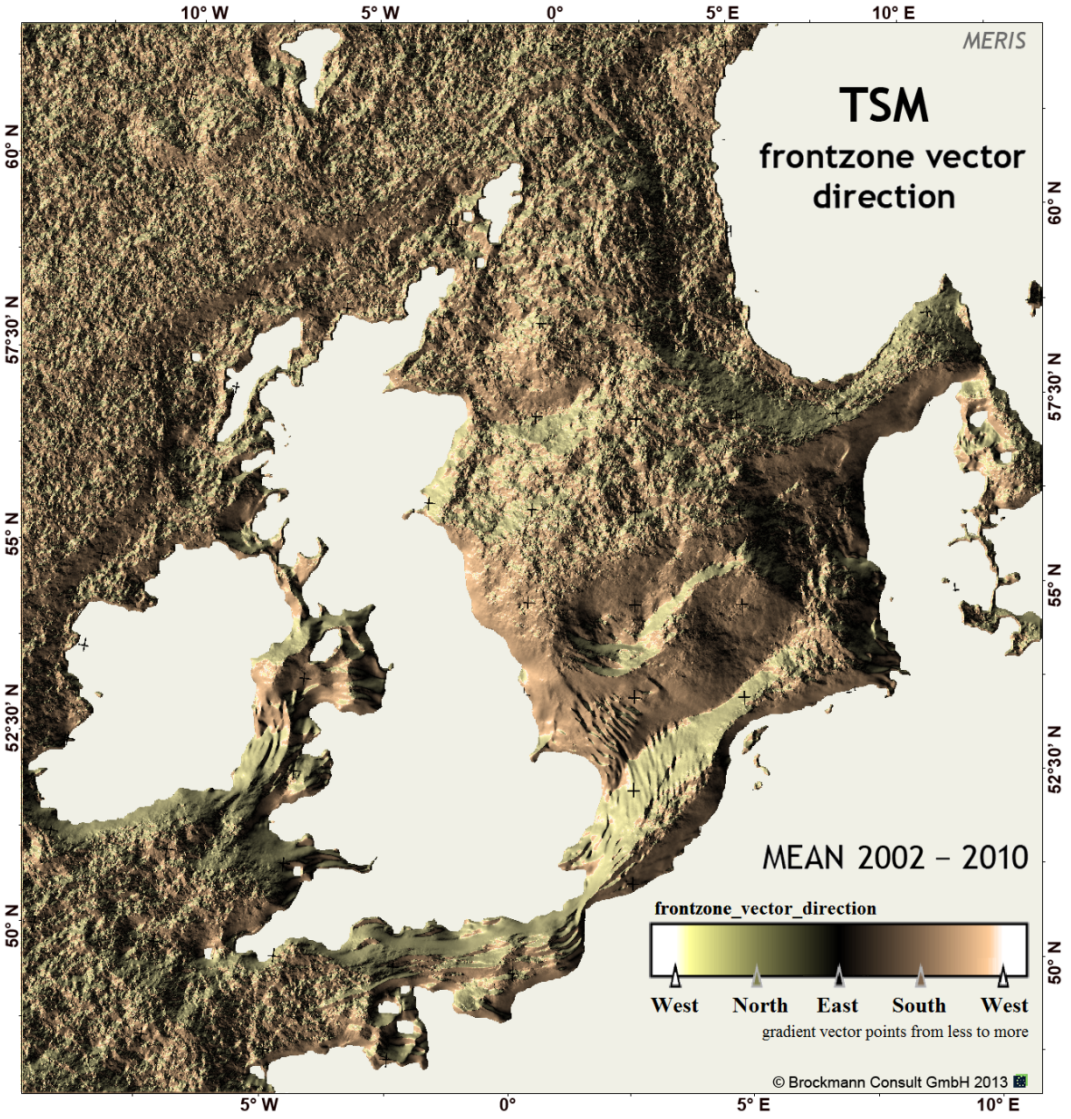

Fig. 5: TSM: direction of mean gradient vector for frontal zone based on the data of the MERIS sensor on ENVISAT 2002 - 2010

2.1.2 Time period 2002-2010, seasonal means

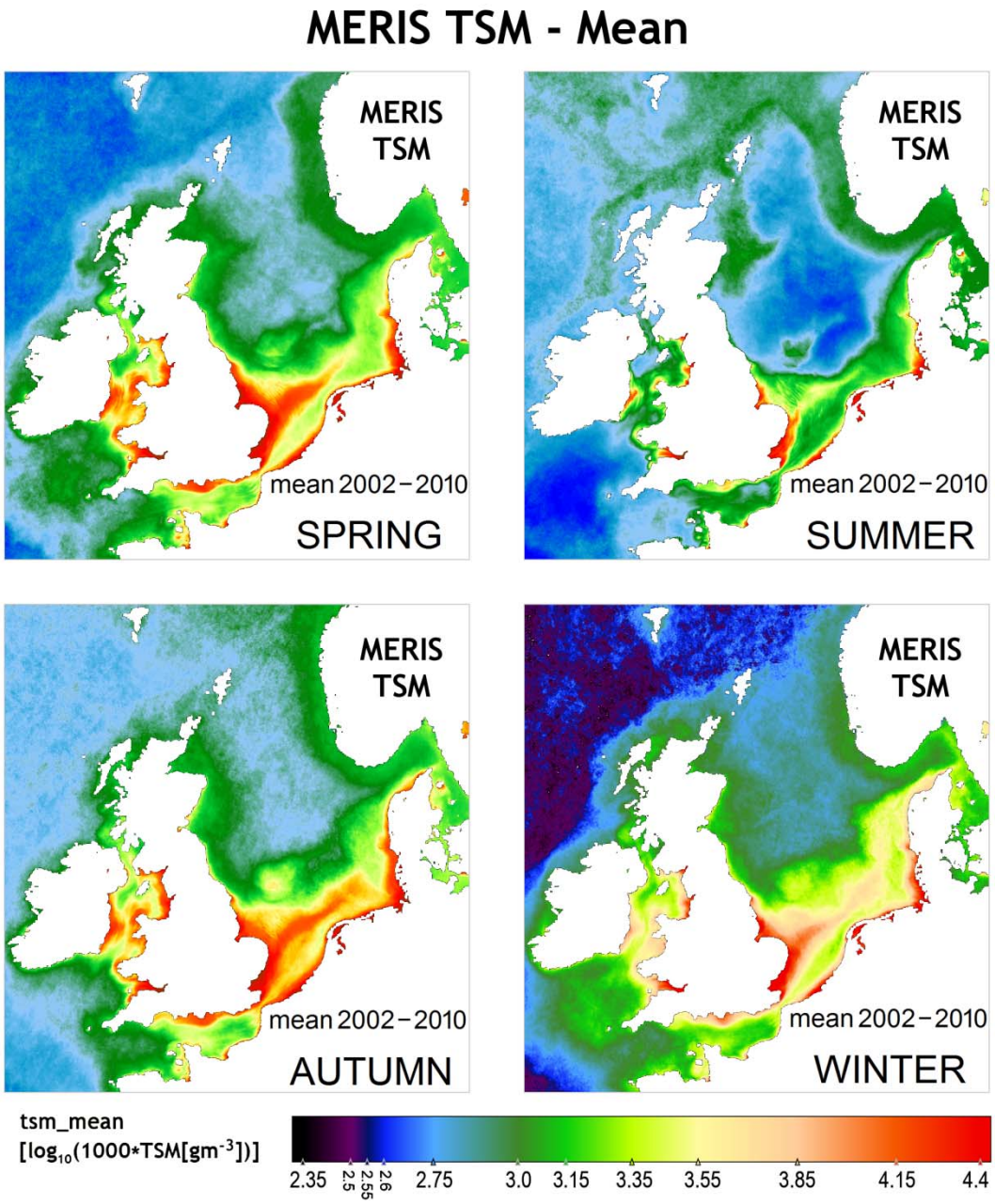

Fig. 6: TSM mean field based on the data of the MERIS sensor on ENVISAT 2002 - 2010

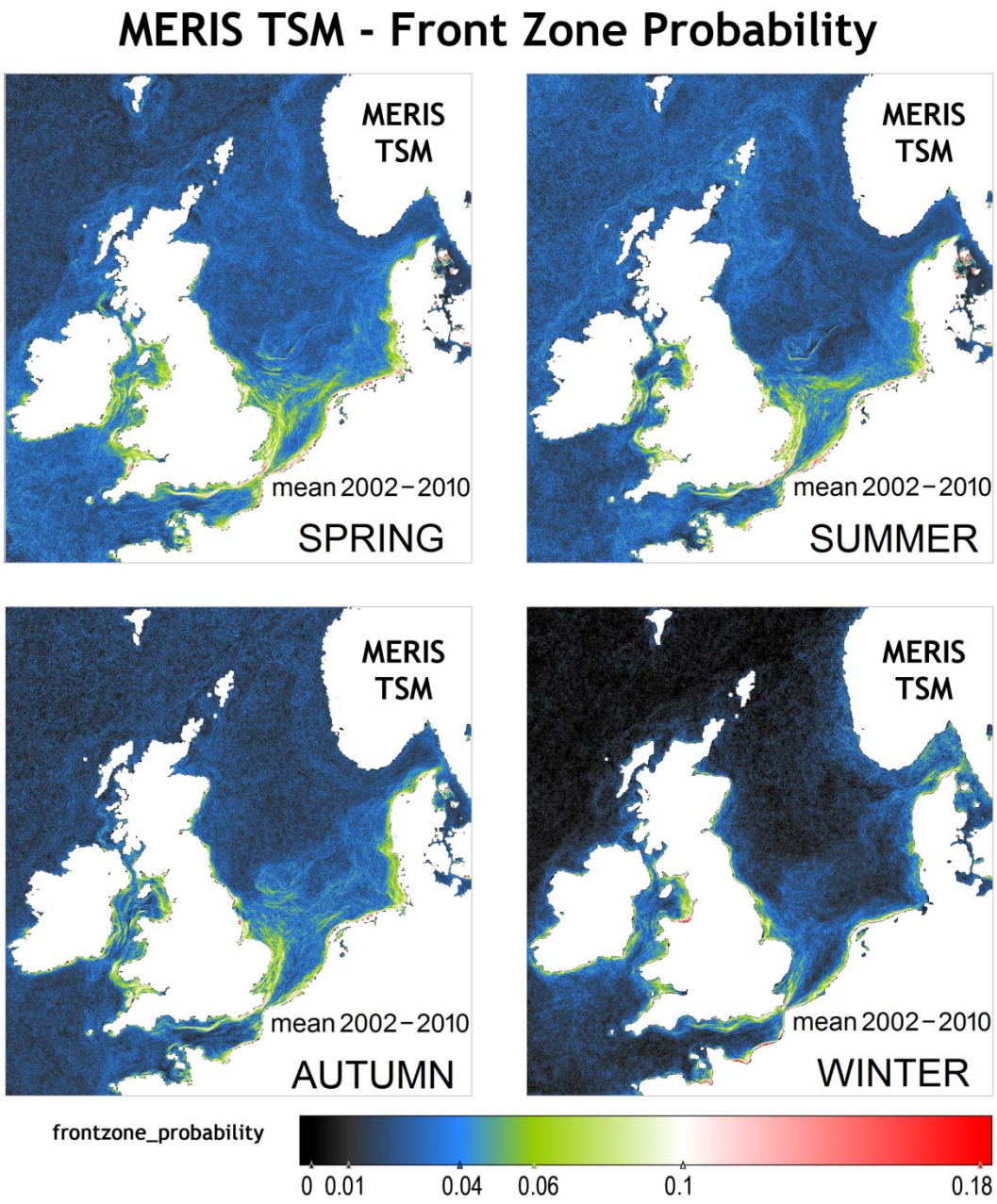

Fig. 7: TSM: front probability based on the data of the MERIS sensor on ENVISAT 2002 - 2010

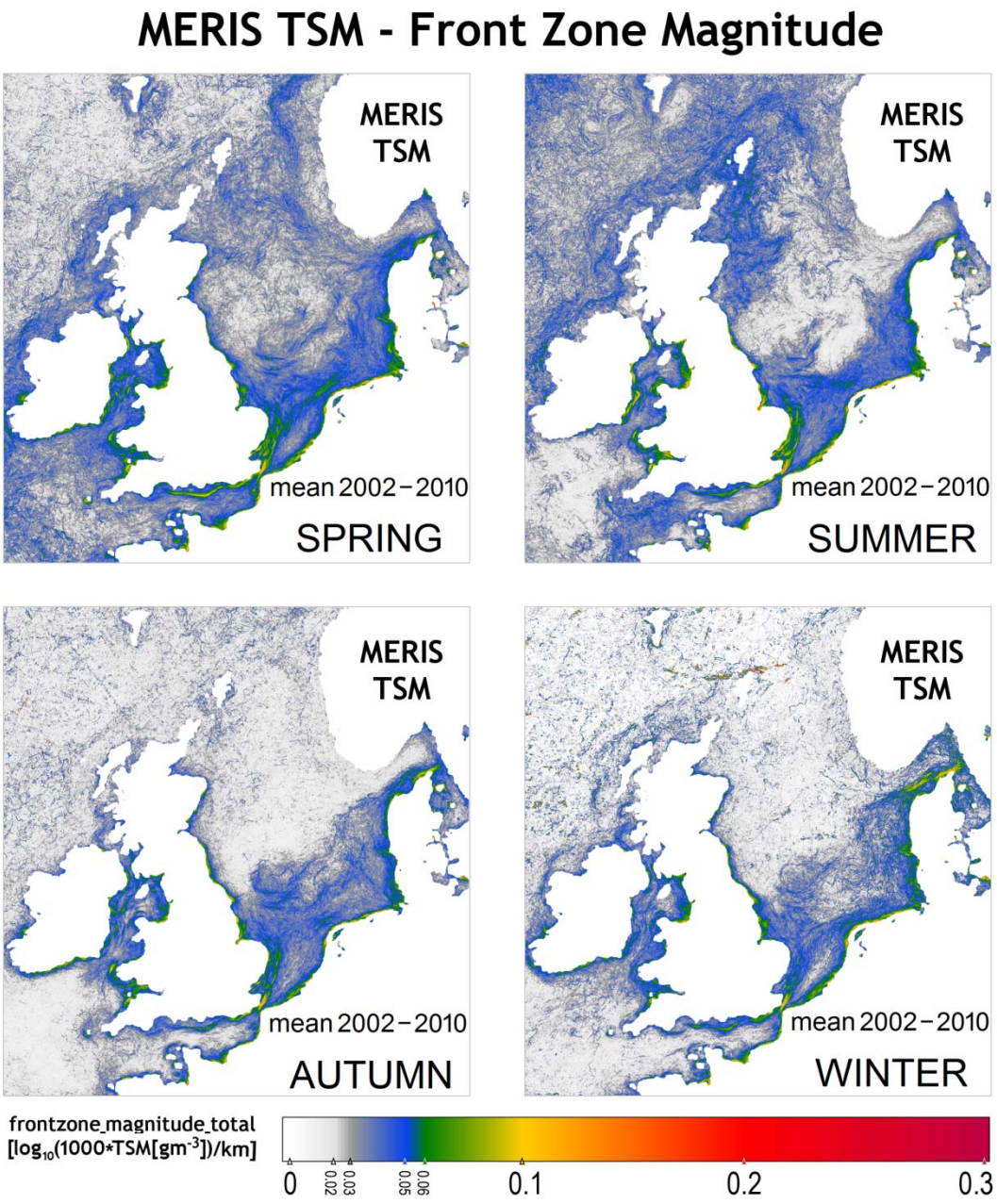

Fig. 8: TSM: mean of gradient magnitude for frontal zone based on the data of the MERIS sensor on ENVISAT 2002 - 2010

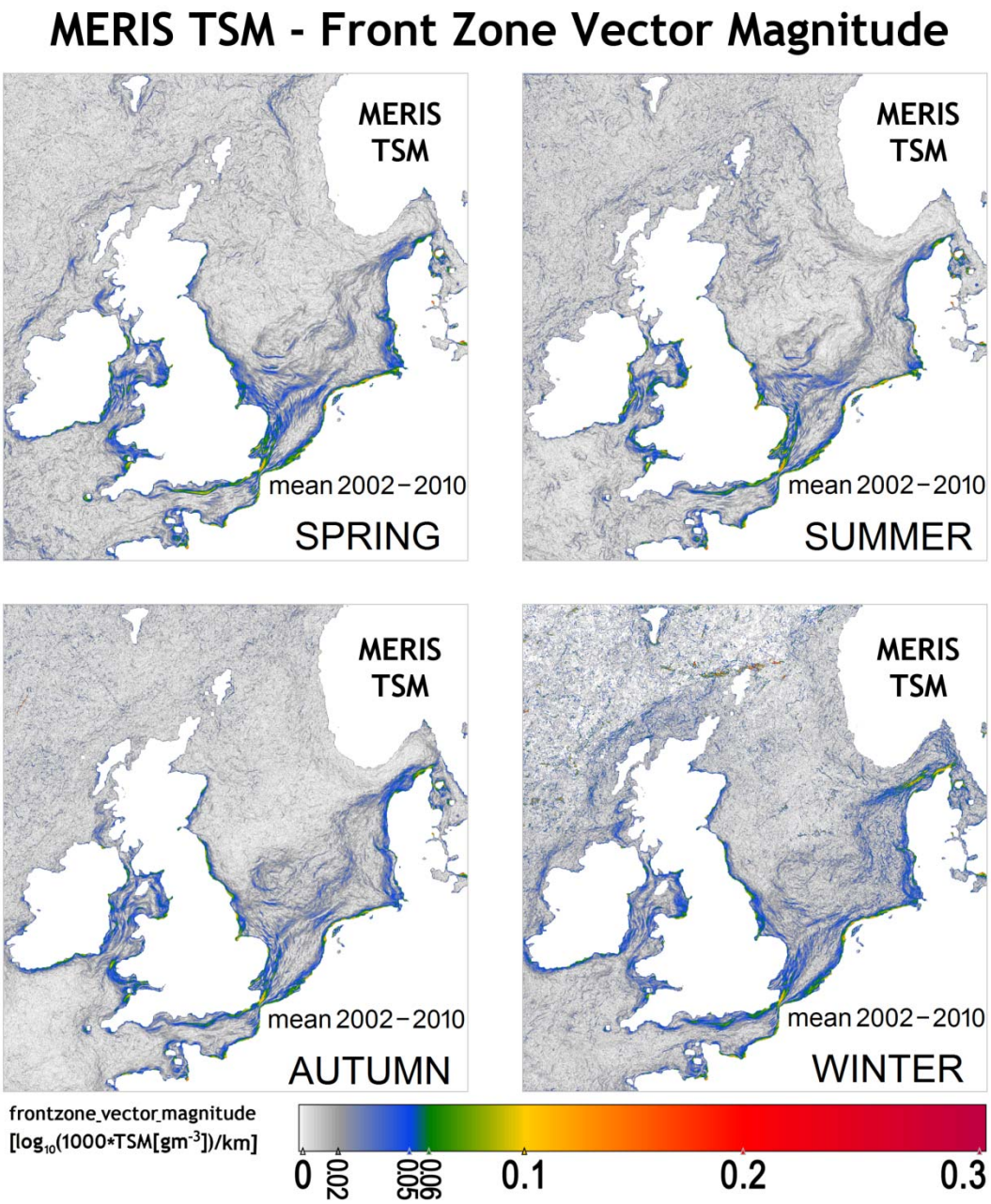

Fig. 9: TSM: magnitude of mean gradient vector for frontal zone based on the data of the MERIS sensor on ENVISAT 2002 - 2010

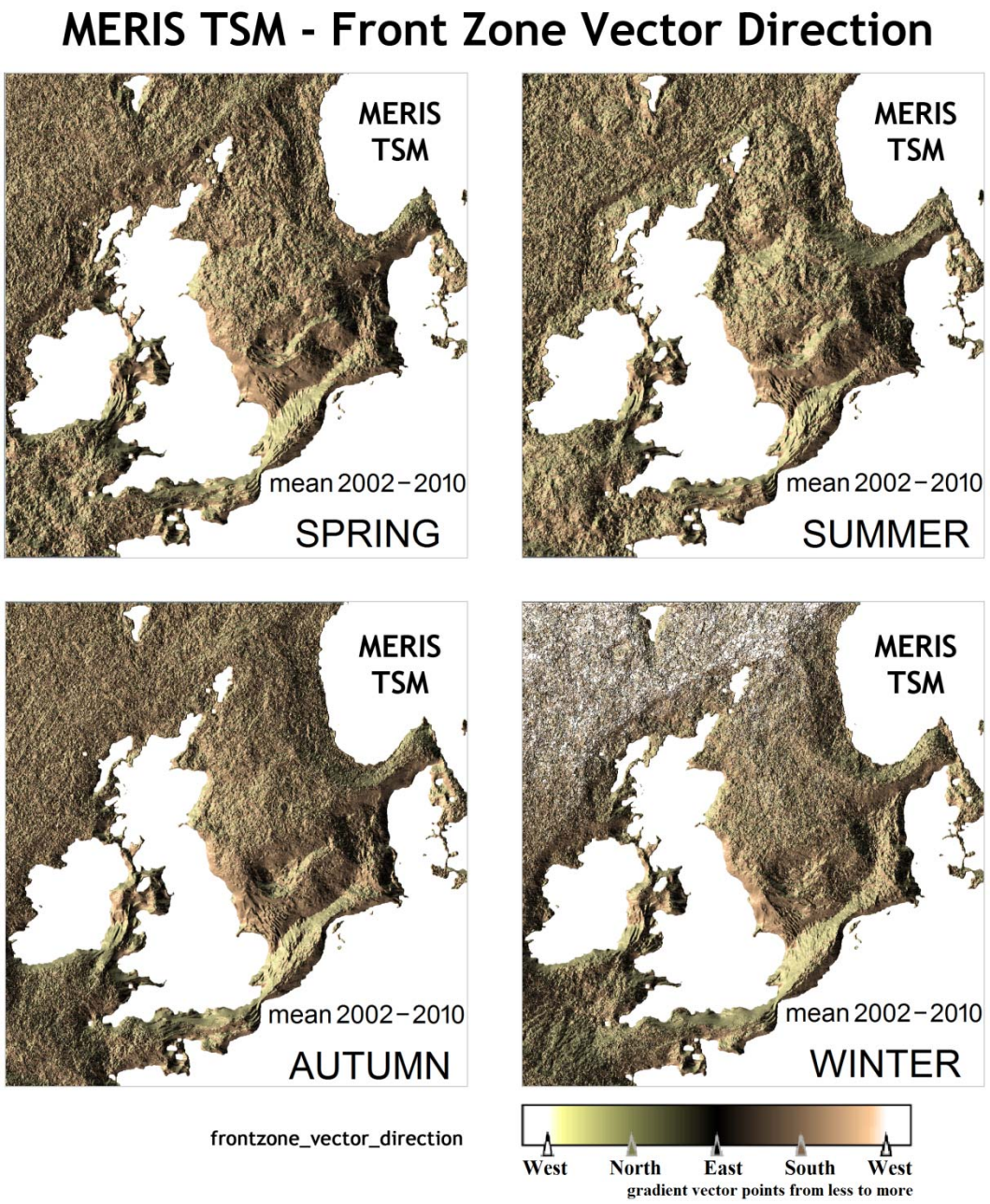

Fig. 10: TSM: direction of mean gradient vector for frontal zone based on the data of the MERIS sensor on ENVISAT 2002 - 2010

2.2 Chlorophyll time series based on the data of the MERIS-sensor on ENVISAT

In case of chlorophyll concentration, the statistical measurements could have only calculated both for spring and summer time and for growing season which is here defined as the period from March 16th to October 15th. The cause of this is to be found in the restrictions of the algorithms for deviation of the chlorophyll concentration for MERIS data.

2.2.1 Time period 2002-2010, growing season

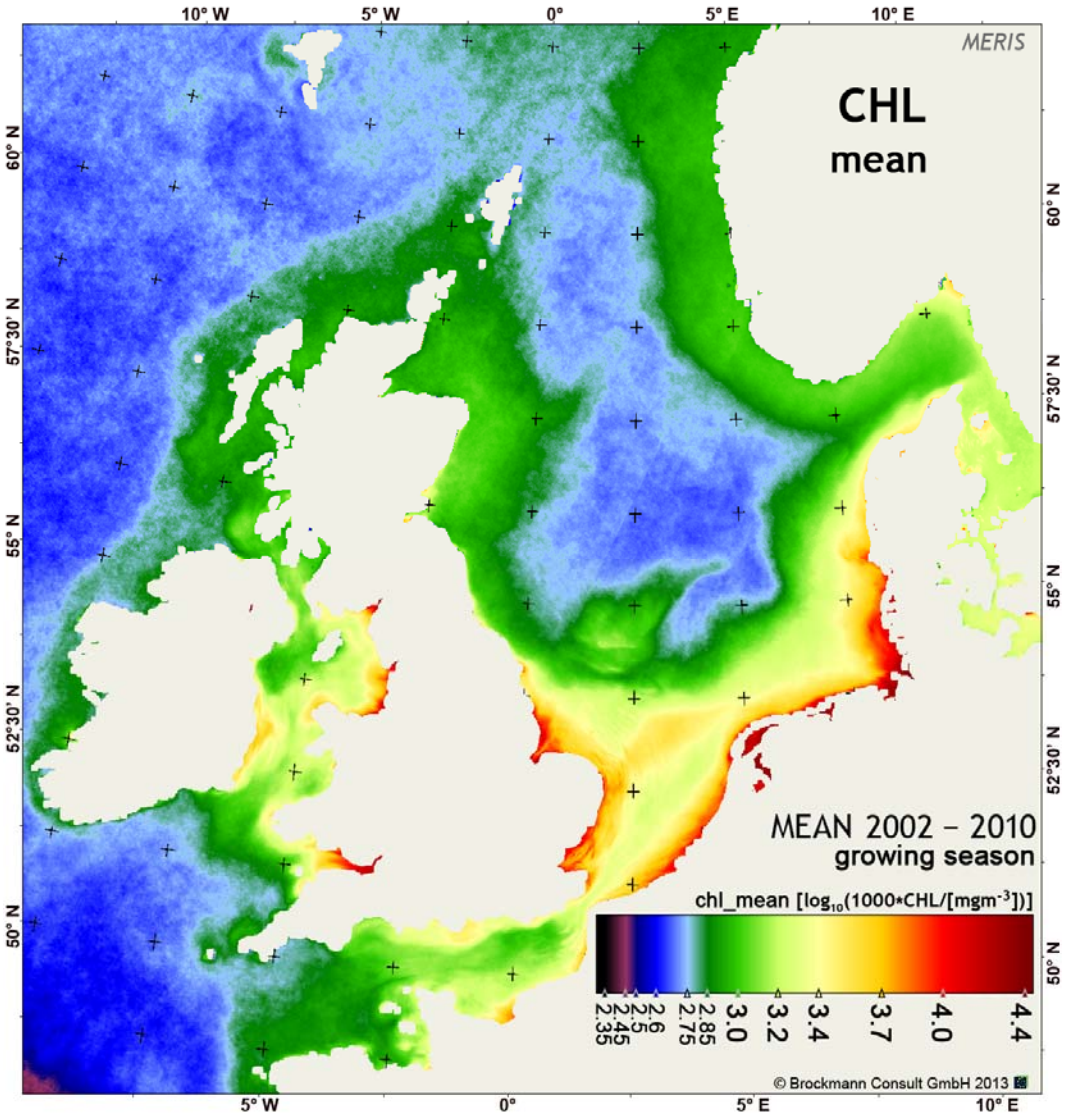

Fig. 11: Mean chlorophyll field based on the data of the MERIS sensor on ENVISAT 2002 - 2010

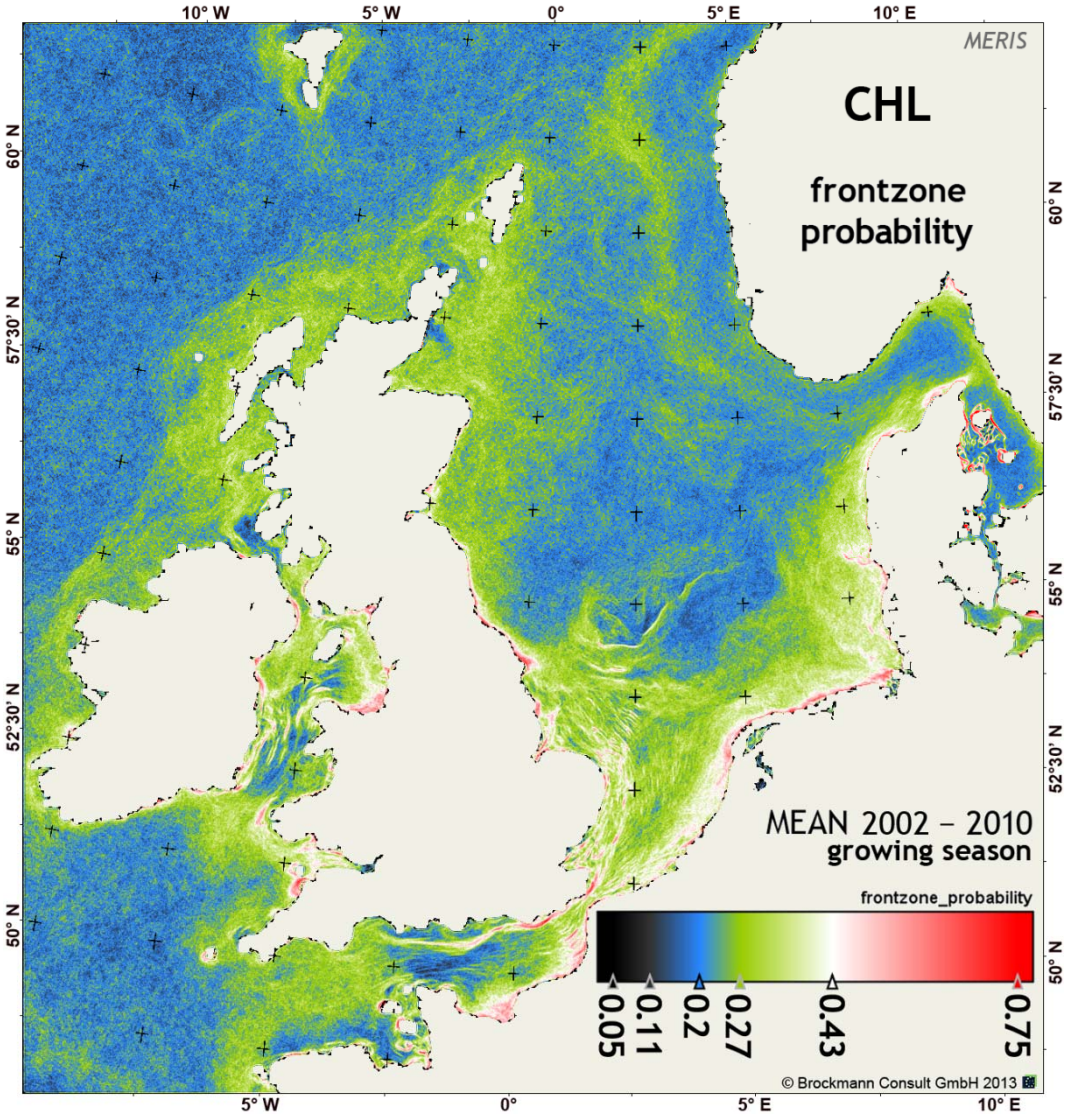

Fig. 12: Chlorophyll: front probability based on the data of the MERIS sensor on ENVISAT 2002 - 2010

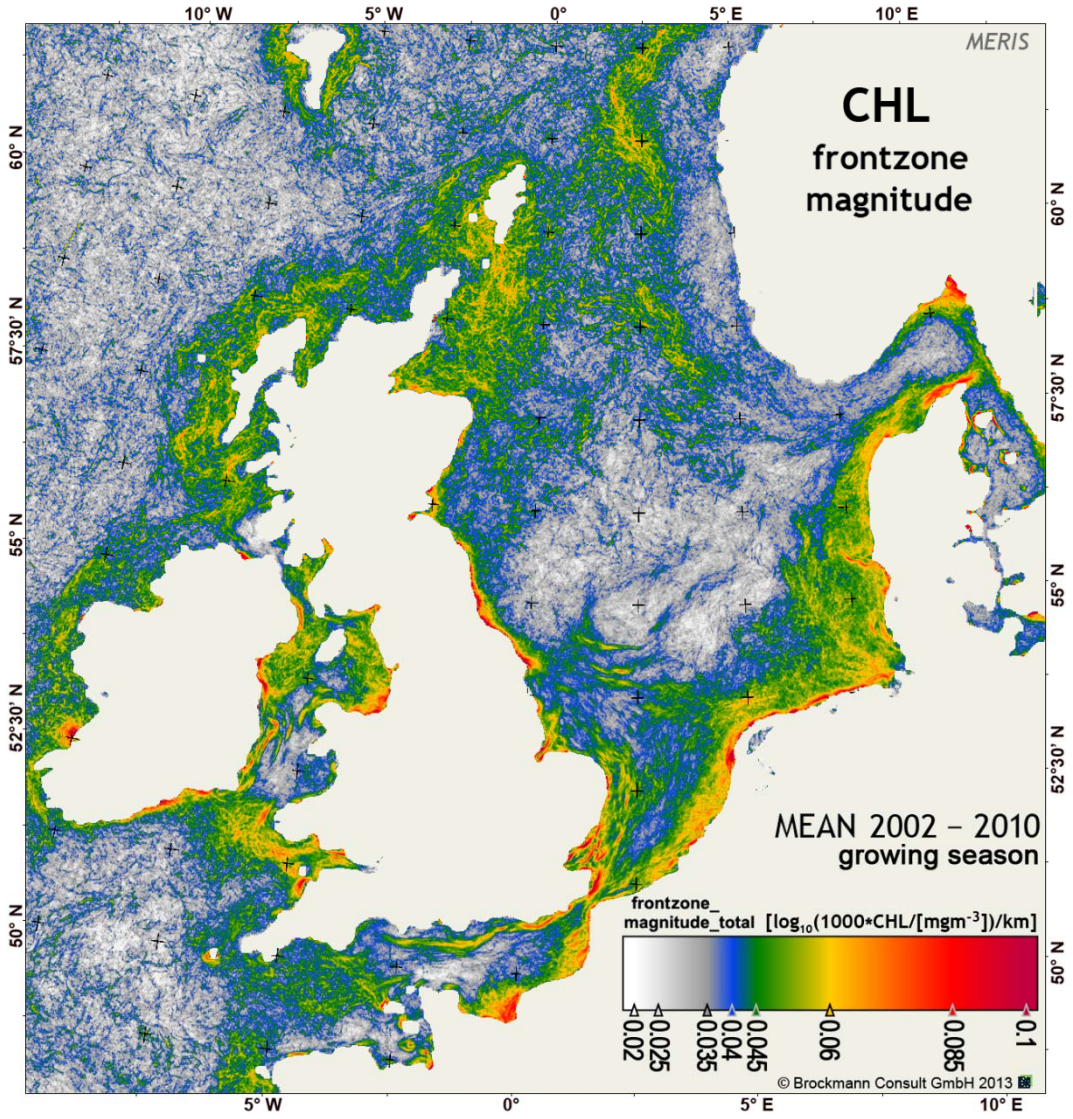

Fig. 13: Chlorophyll: mean of gradient magnitude for frontal zone based on the data of the MERIS sensor on ENVISAT 2002 - 2010

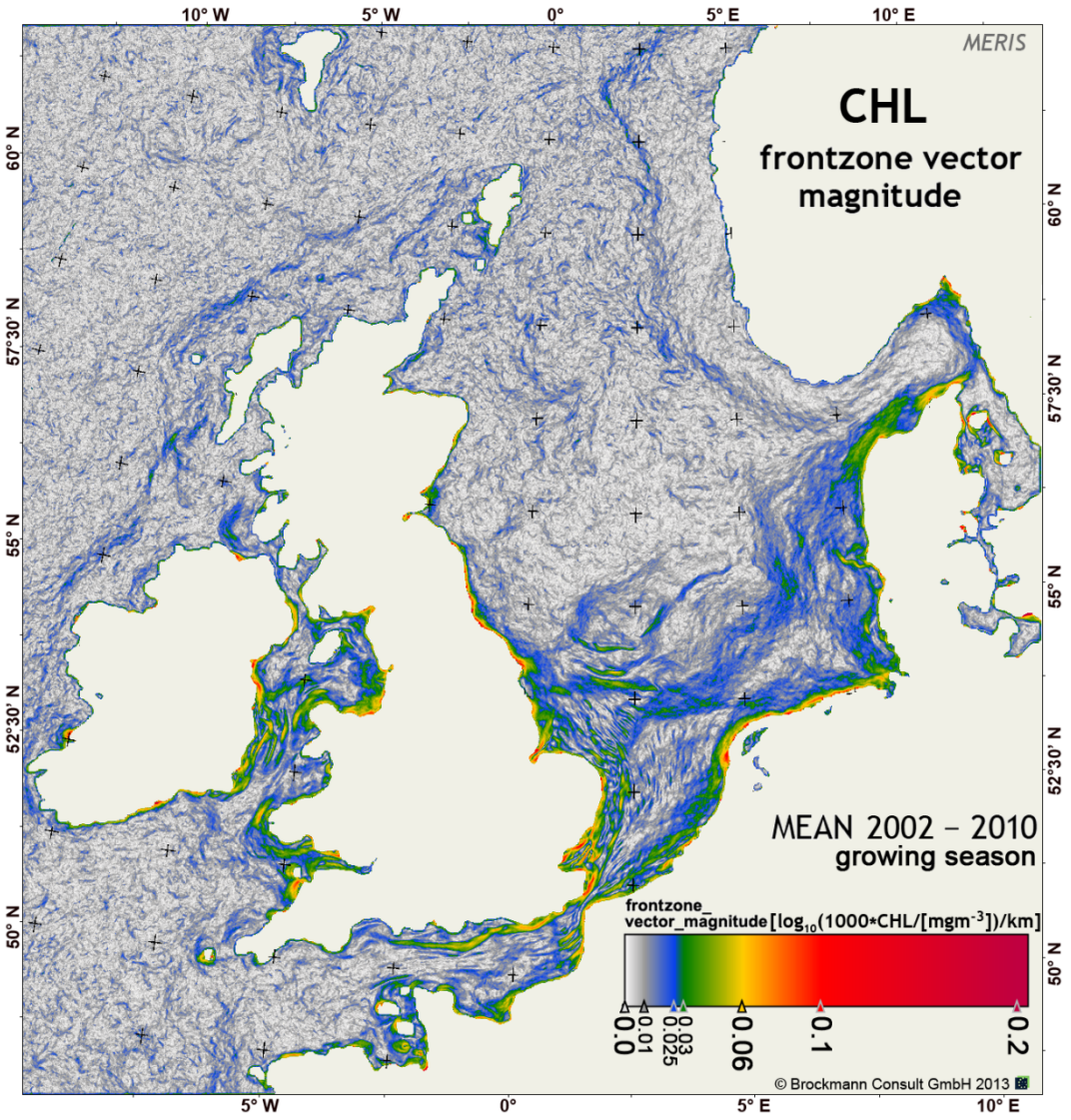

Fig. 14: Chlorophyll: magnitude of mean front gradient vector based on the data of the MERIS sensor on ENVISAT 2002 - 2010

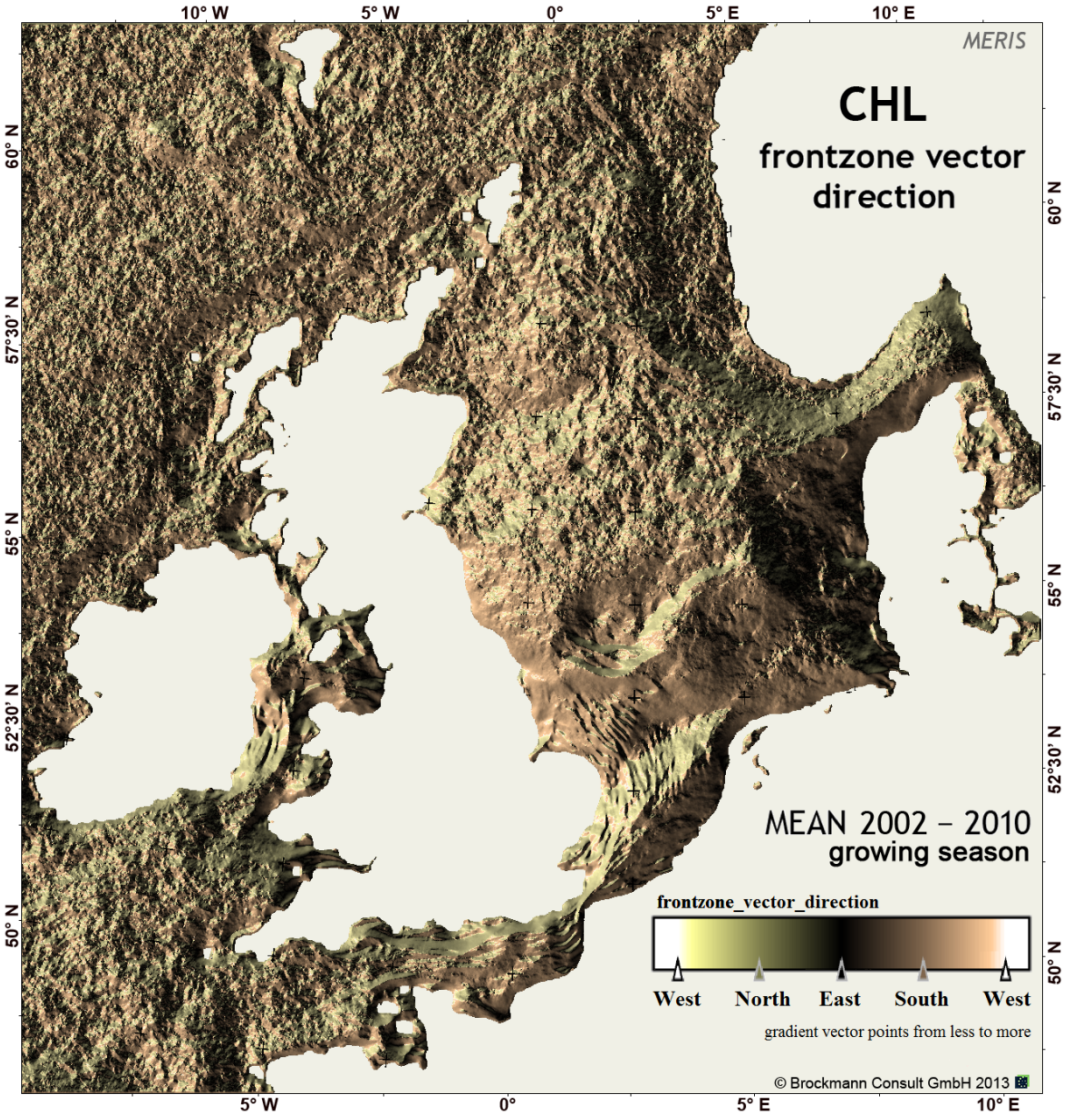

Fig. 15: Chlorophyll: direction of mean front gradient vector based on the data of the MERIS sensor on ENVISAT 2002 - 2010

2.3 Yellow substance (YS) time series based on the data of the MERIS-sensor on ENVISAT, 2002 - 2010

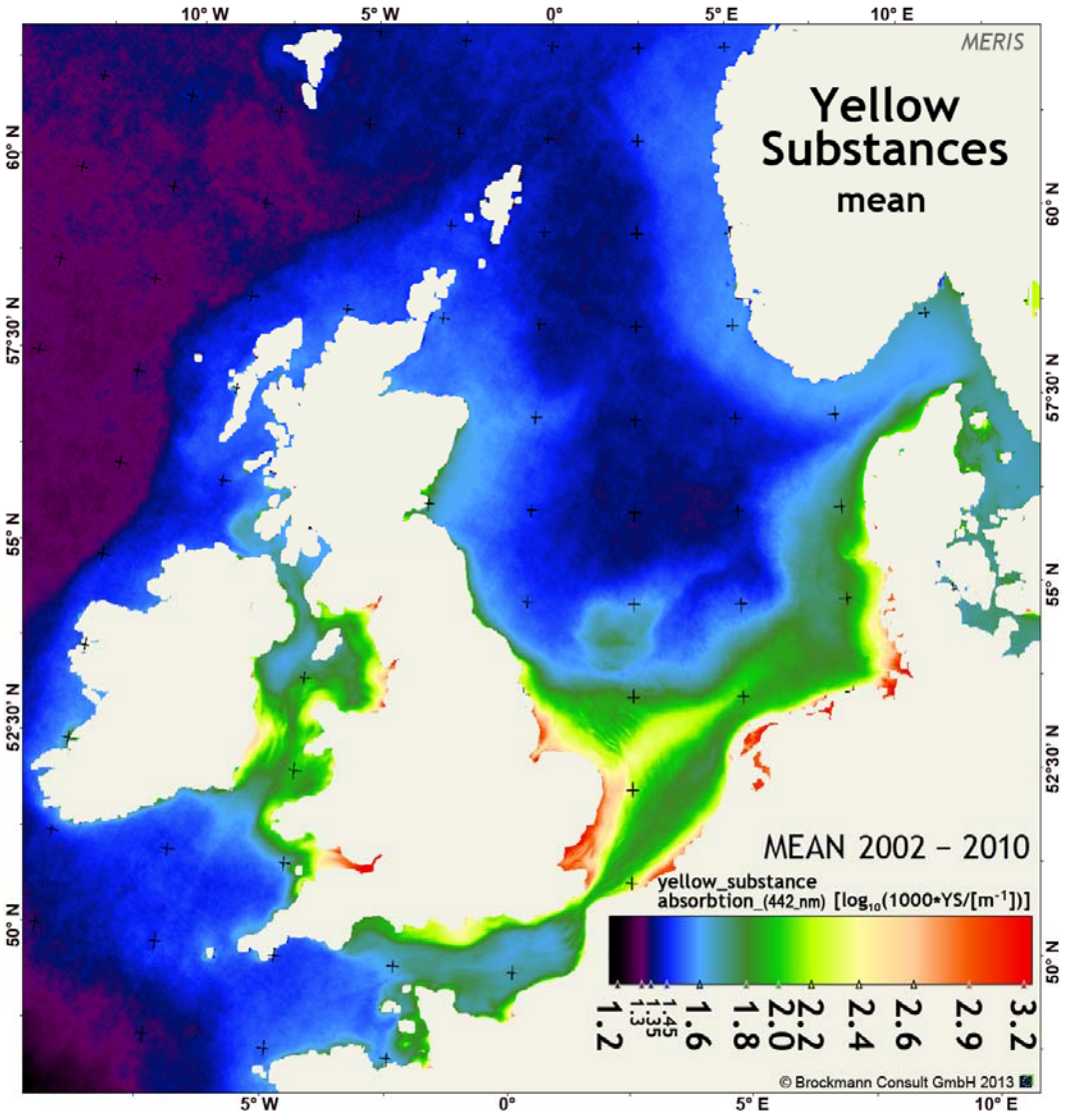

Fig. 16: Mean YS field based on the data of the MERIS sensor on ENVISAT 2002 - 2010

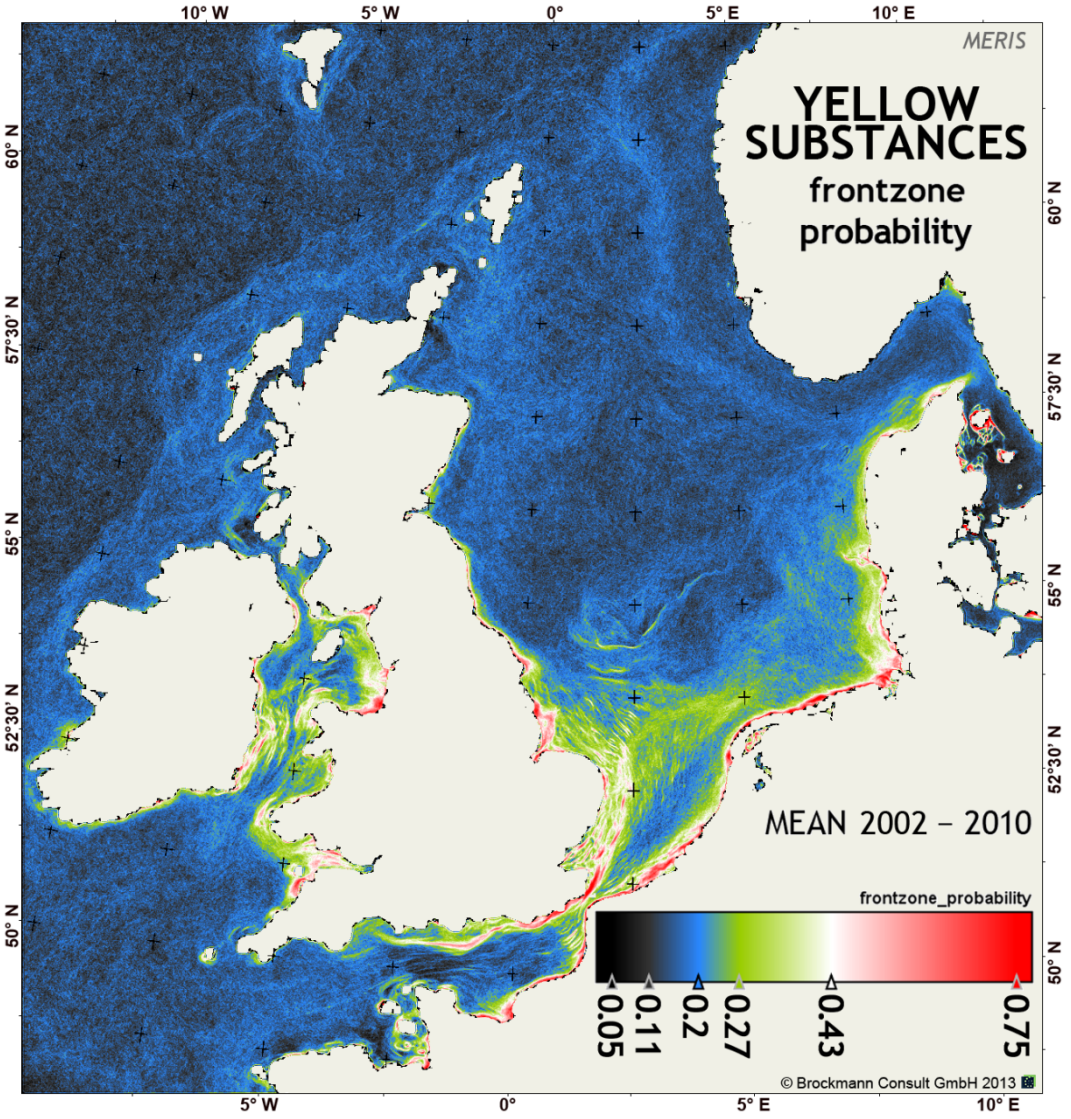

Fig. 17: YS: front probability based on the data of the MERIS sensor on ENVISAT 2002 - 2010

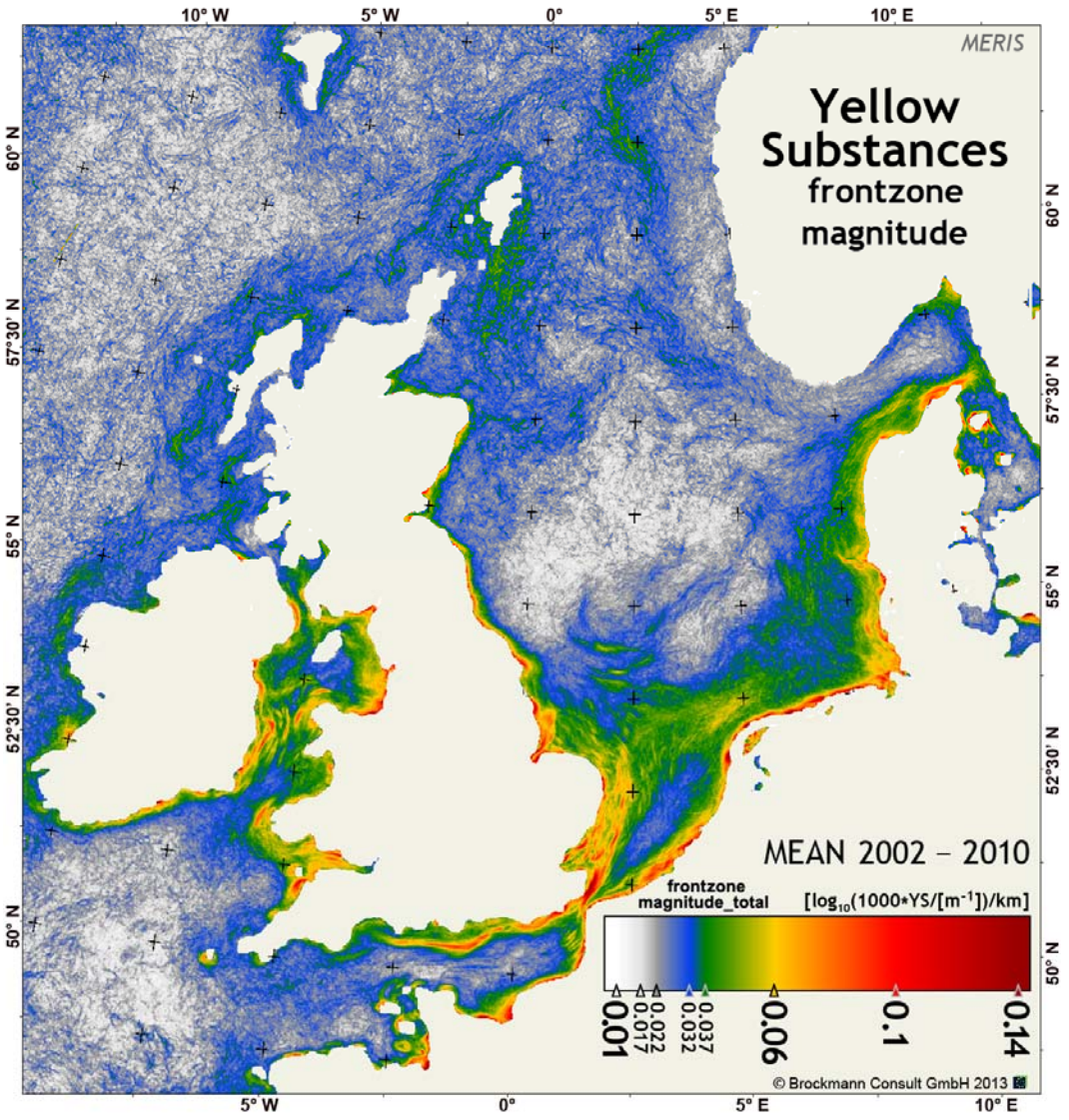

Fig. 18: YS: mean of gradient magnitude for frontal zone based on the data of the MERIS sensor on ENVISAT 2002 - 2010

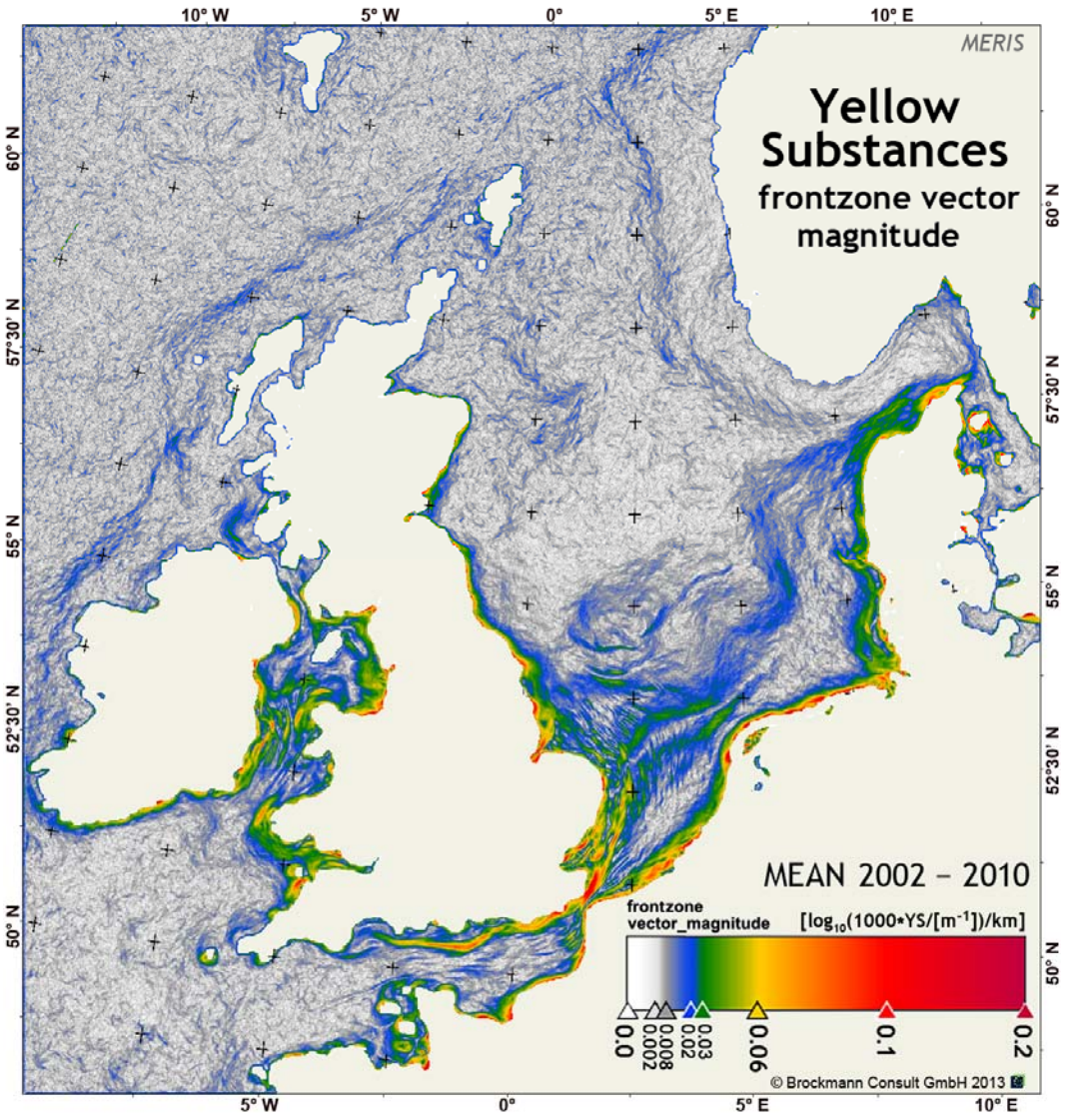

Fig. 19: YS: magnitude of mean gradient vector for frontal zone based on the data of the MERIS sensor on ENVISAT 2002 - 2010

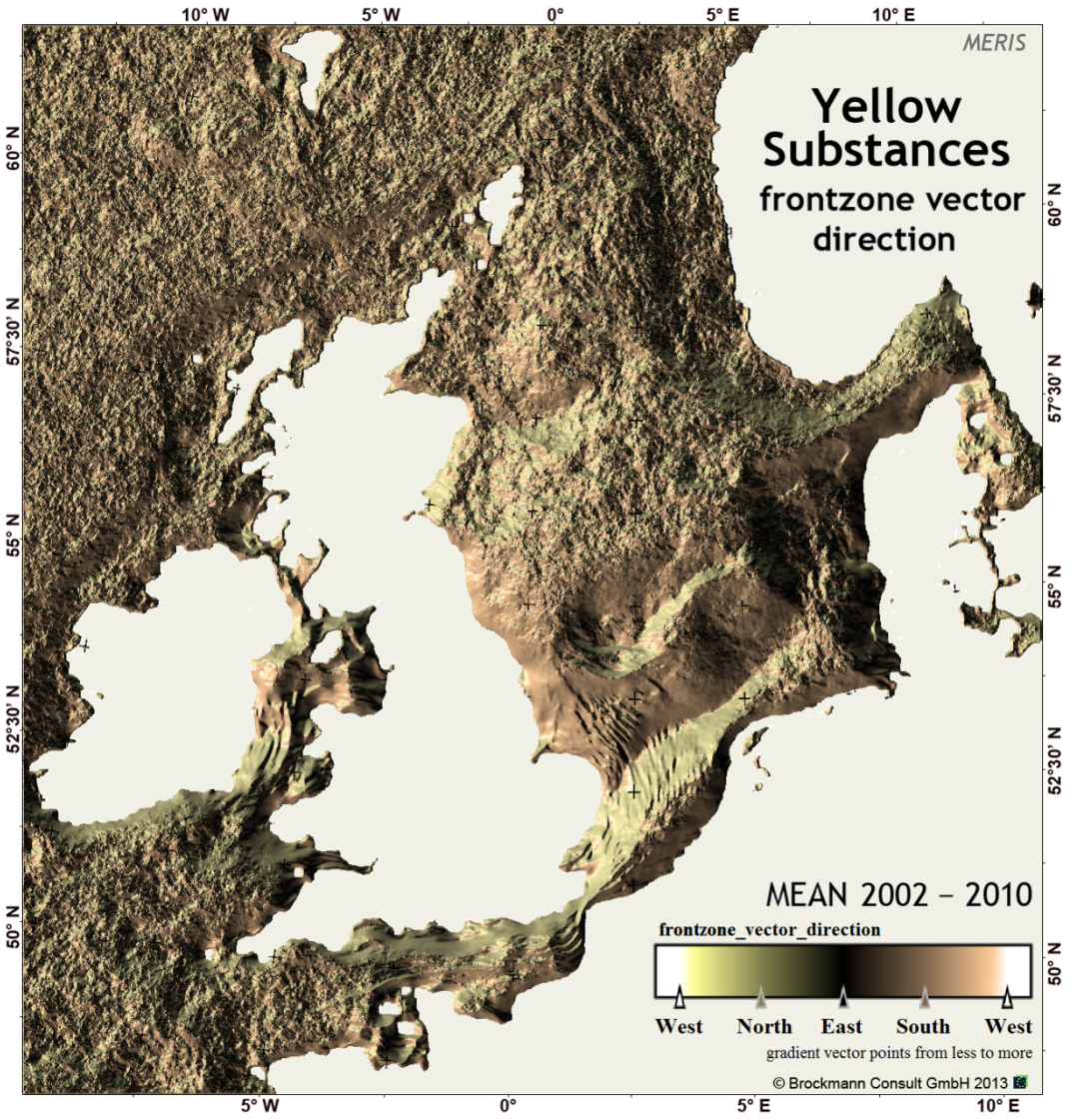

Fig. 20: YS: direction of mean gradient vector for frontal zone based on the data of the MERIS sensor on ENVISAT 2002 - 2010

2.4 Turbidity time series based on the data of the MERIS-sensor on ENVISAT, 2002 – 2010

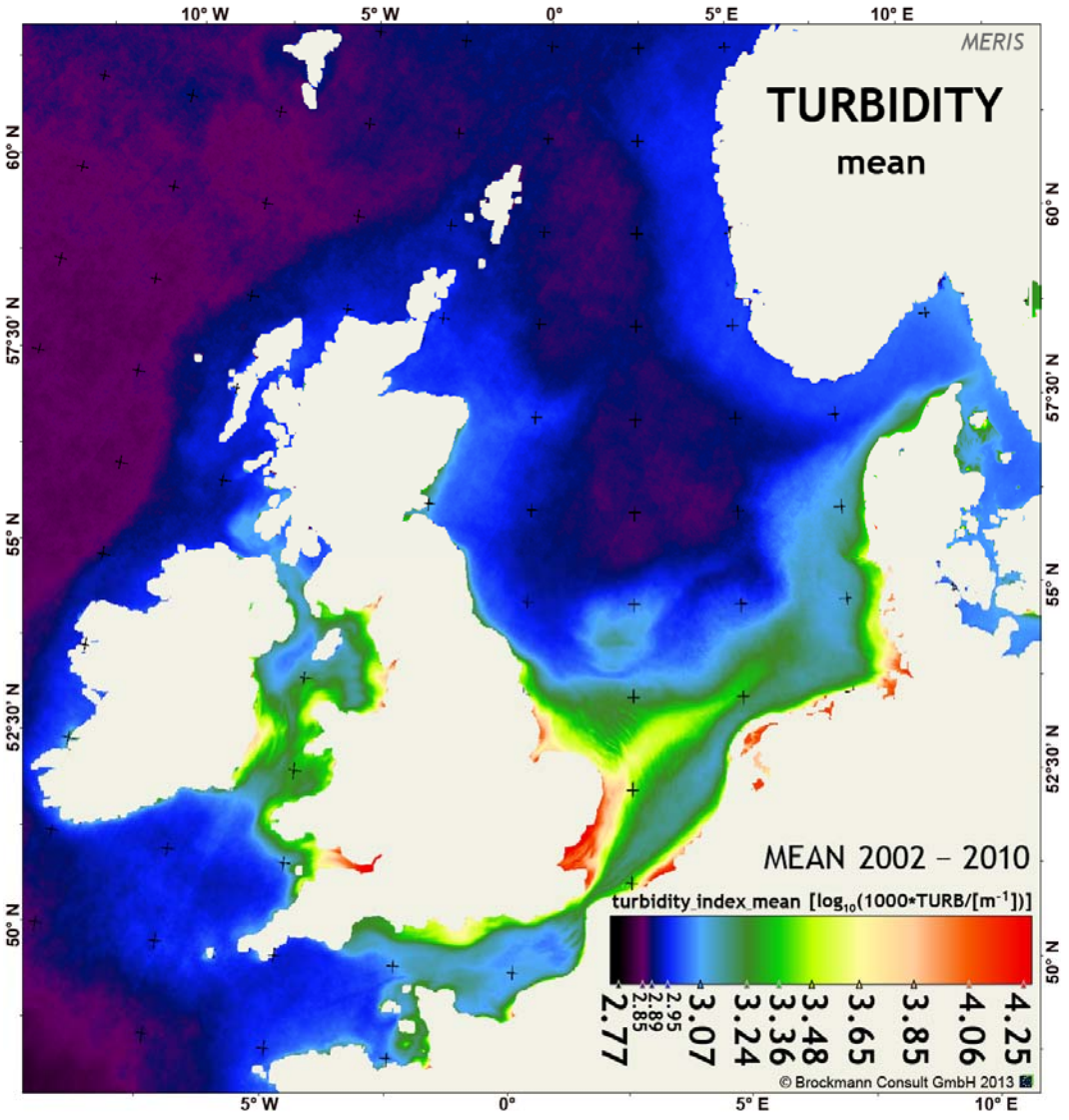

Fig. 21: Mean turbidity field based on the data of the MERIS sensor on ENVISAT 2002 - 2010

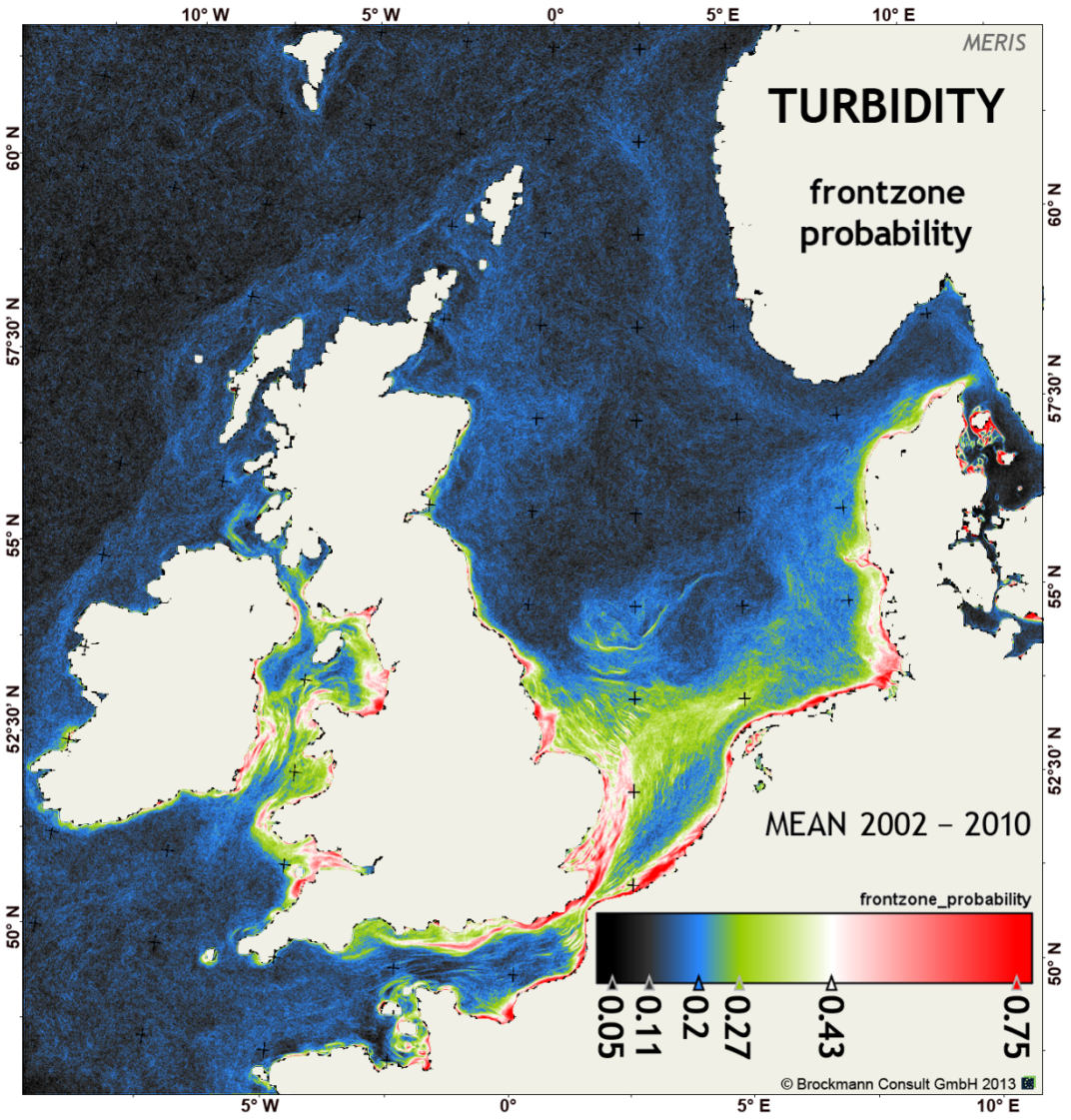

Fig. 22: Turbidity: front probability based on the data of the MERIS sensor on ENVISAT 2002 - 2010

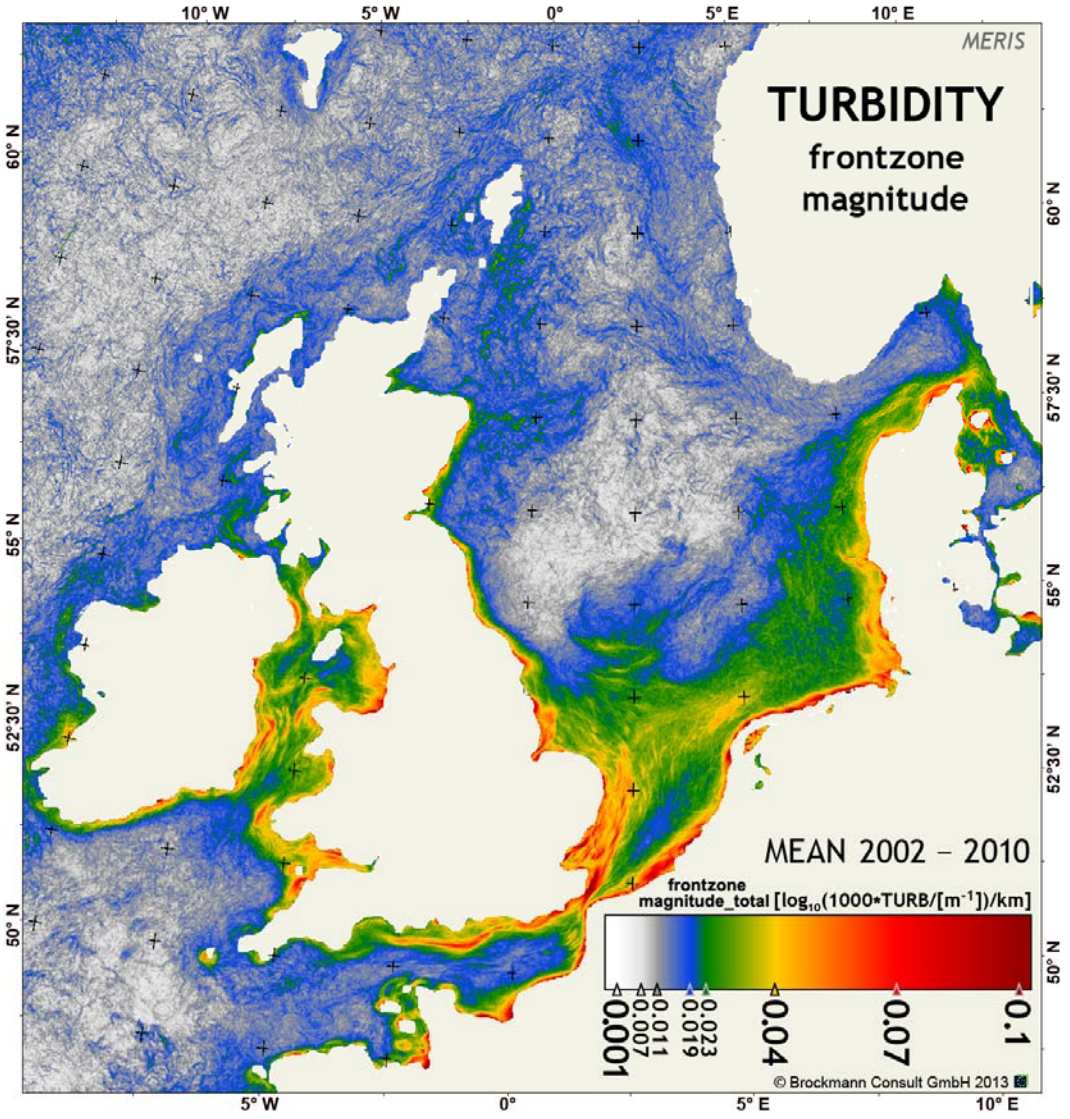

Fig. 23: Turbidity: mean of gradient magnitude for frontal zone based on the data of the MERIS sensor on ENVISAT 2002 - 2010

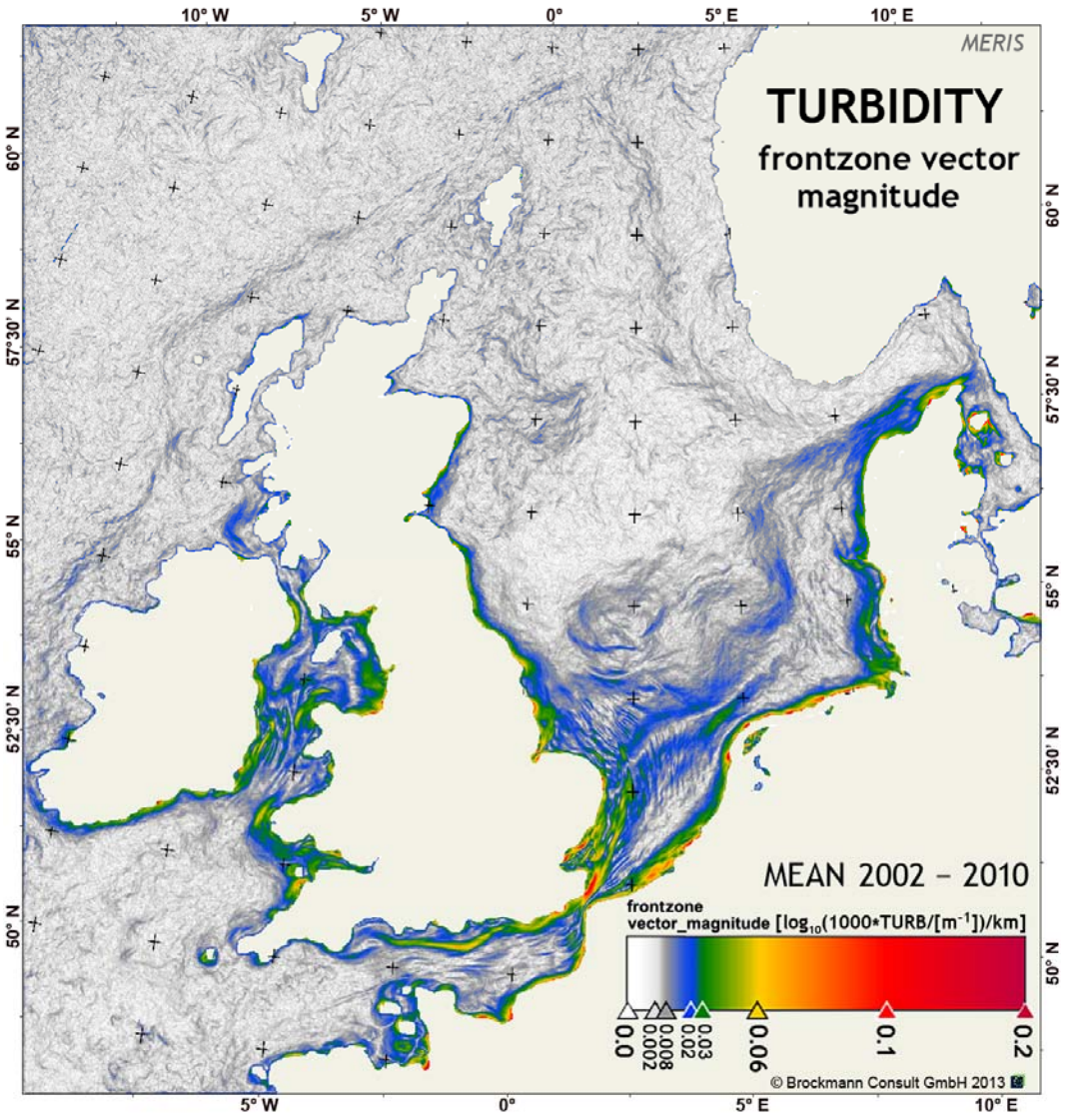

Fig. 24: Turbidity: magnitude of mean gradient vector for frontal zone based on the data of the MERIS sensor on ENVISAT 2002 - 2010

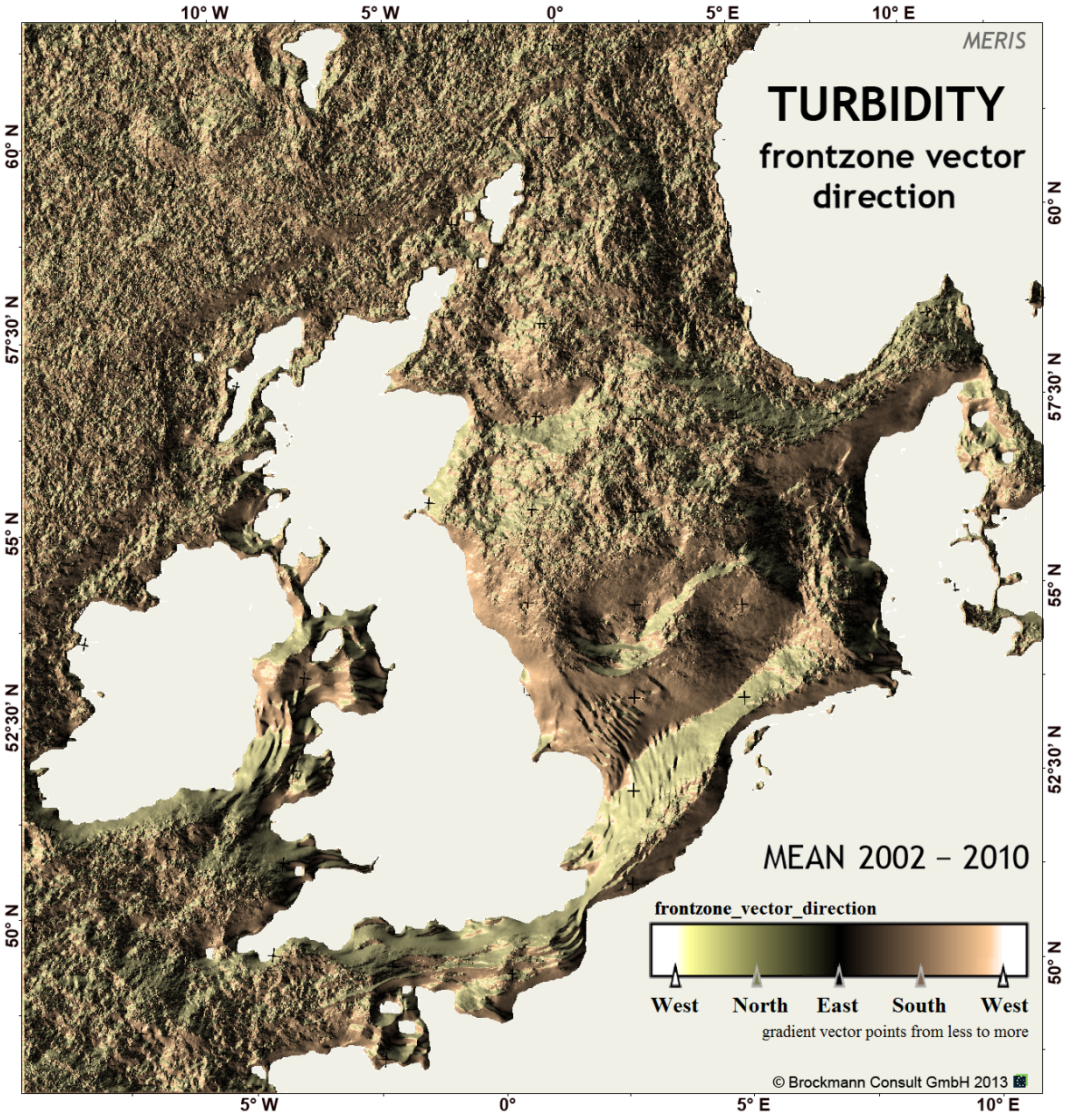

Fig. 25: Turbidity: direction of mean gradient vector for frontal zone based on the data of the MERIS sensor on ENVISAT 2002 - 2010

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