National Oceanography Centre

INTERNAL REPORT

Atlas of Tides, North West European Shelf

Volume II: Tide and surge

Joanne Williams and Clare O'Neill

4th October 2024

NOC Internal Report No. 28

Atlas of Tides, North West European Shelf

Volume II: Tide and surge

The Atlas has 2 volumes:

Volume I: Tide-only

Volume II: Tide and surge

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and

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4th October 2024

Content

This Atlas contains co-phasal maps of tidal constituents' amplitudes and phases, and summary statistics for the NEMO surge model. They are derived from the AMM7 regional (North West European Shelf) ERA5-forced hindcast run of the NEMO surge and tide model. The hindcast was run by Clare O'Neill at the Met Office on behalf of NOC as part of the EA-funded project on radiational tides. All postprocessing to derive tides has been done by Joanne Williams, NOC.

This document contains figures of the maps. The data is available as netcdf files from zenodo via https://doi.org/10.5281/zenodo.13882297 .

Volume I is derived from the tide-only run.

Volume II is from the model forced by the ERA5 hindcast. In this case although the maps are labelled eg "HAT" to be consistent with the other set, it's actually highest/lowest tide+surge. All the statistics are calculated on the full 42-year 15-minute timeseries at each grid point, rather than estimates from the tidal constituents.

All means are relative to the surge and tide model datum only and will require correcting to local chart datum or ODN.

A 7km model cannot reproduce the tide accurately on complex coastlines, for example shallow water and estuaries can significantly change the range of the tide. These data are provided for research purposes into the spatial structure of the tides are the UK. They are not locally validated, and are not sufficient for navigation, flood forecasting or legal purposes.

Model

The NEMO surge model is used as the main operational surge model for the UK, for which it is run every 6 hours forced by the atmospheric pressure and surface winds from the Met Office deterministic and ensemble weather forecasts. Model surge residuals are the difference between the tide-and-surge model run and a tide-only run. This analysis is on the ERA5-hindcast forced run.

Tidal analysis

Tidal analysis is done on the full 42-year timeseries at each grid point independently. This is done using the NOCtide software, a least-squares fit method. These are harmonic tides predictions including up to 115 constituents, including the annual SA. (See Table 1). The nodal correction is within the code so constituents are unchanged between years.

The harmonic tidal prediction $\tilde{G}$ is constructed:

$$\tilde{G}(t) = Z_0 + \sum_N A_n f_n \cos[\sigma_n t - g_n + (V_n + u_n)],$$

where Z_0 is the mean of G, and the tidal constituents with frequencies σ_n have amplitude A_n and phase g_n. $f_n(t)$ and $u_n(t)$ are nodal modulations to amplitude and phase applied in order to allow for the 18.61-year nodal cycle and 8.85-year longitude of the lunar perigee cycle. V_n represents the phases of the equilibrium tide, which we take as for Greenwich, using UTC for all times.

Statistics Maps

The statistics maps are:

HAT, Highest Astronomical Tide
LAT, Lowest Astronomical Tide
MHW, Mean High Water
MLW, Mean Low Water
MHWS, Mean High Water Springs
MLWS, Mean Low Water Springs
MHWN, Mean High Water Neaps
MLWN, Mean Low Water Neaps
MHHW, Mean Higher High Water
MLLW, Mean Lower Low Water
RangeAT, HAT - LAT, Maximum Tidal Range
MSRange, MHWS- MLWS, Mean Spring Tidal Range
MRange, MHW - MLW, Mean Tidal Range
MNRange, MHW - MLWN, Mean Neap Tidal Range

Acknowledgements

Many people contribute directly or indirectly to the routine analysis of the tide gauge data and surge forecasting. In particular, thanks are due to:

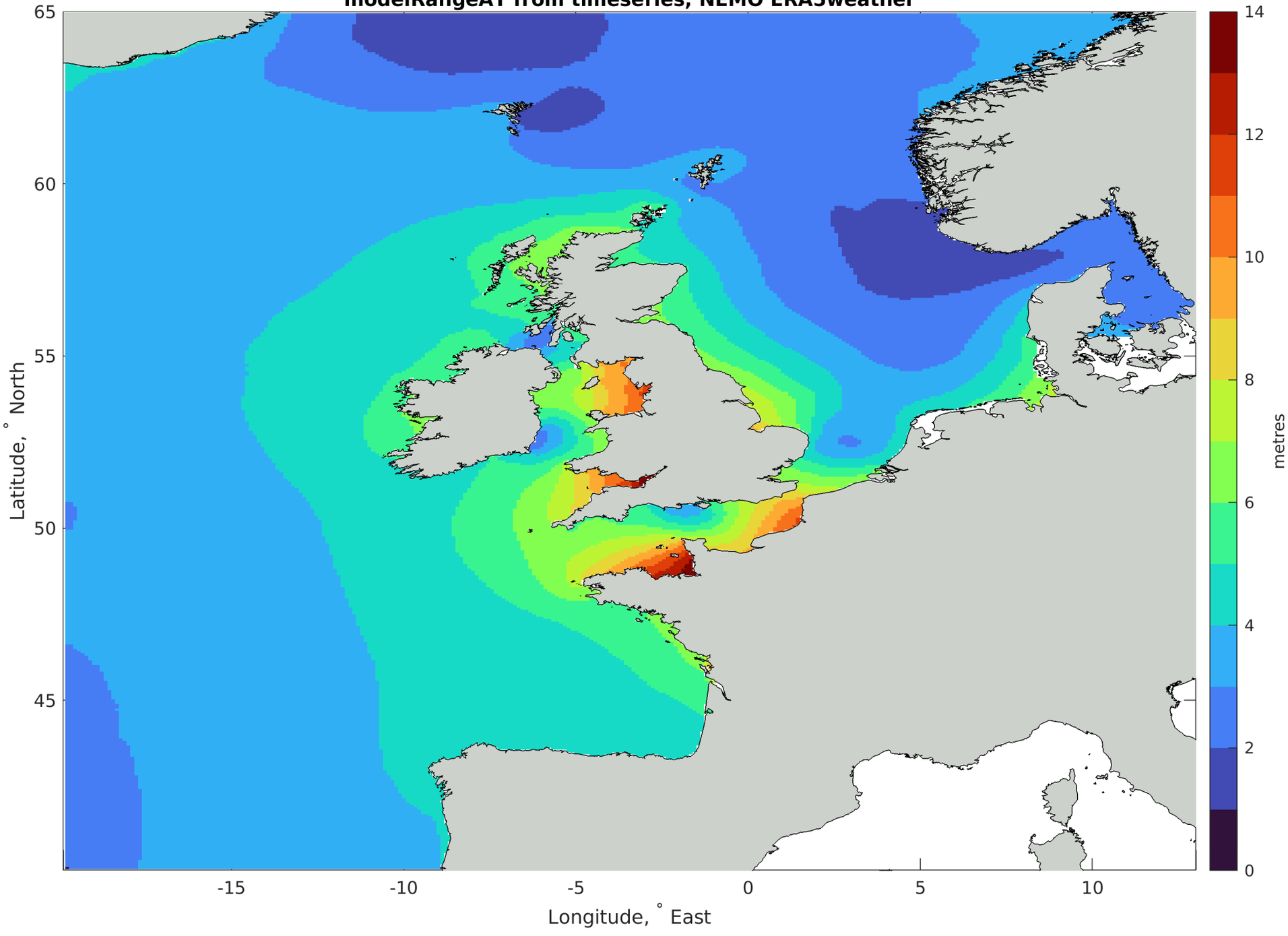
Clare O'Neill and Andy Saulter at the Met Office, for operational surge modelling and development;

Angela Hibbert , Jeff Polton, Andy Matthews and Sveta Jevrejeva, at NOC Liverpool, for project management of this and related projects and many useful discussions;

Jenny Sansom, Roger Quinn and Philip Staley at the Environment Agency, for project management of this and related projects and many useful discussions.

Table 1: Names and periods of 115 constituents, in the order used in the NOCtide code.

Name	Period, hours	Name	Period, hours	Name	Period, hours
SA	8765.8211	KJ2	11.7545	4MK6	4.1932
SSA	4382.9052	2SM2	11.6070	4MS6	4.1891
MM	661.3092	MO3	8.3863	2MSNK6	4.1702
MSF	354.3671	M3	8.2804	2MV6	4.1628
MF	327.8590	SO3	8.1924	3MSK6	4.1441
2Q1	28.0062	MK3	8.1771	4MN6	4.1144
SIG1	27.8484	SK3	7.9927	3MSN6	4.0672
Q1	26.8684	MN4	6.2692	MKL6	4.0634
RO1	26.7231	M4	6.2103	2MN8	3.1346
O1	25.8193	SN4	6.1602	3MN8	3.1198
MP1	25.6681	MS4	6.1033	M8	3.1052
M1	24.8412	MK4	6.0949	2MSN8	3.0926
CHI1	24.7091	S4	6.0000	3MS8	3.0782
PI1	24.1321	SK4	5.9918	3MK8	3.0760
P1	24.0659	2MN6	4.1663	MSNK8	3.0637
S1	24.0000	M6	4.1402	2MS8	3.0517
K1	23.9345	MSN6	4.1179	2MSK8	3.0495
PSI1	23.8693	2MS6	4.0924	4MS10	2.4668
PHI1	23.8045	2MK6	4.0886	3M2S10	2.4498
TH1	23.2070	2SM6	4.0457	4MSN12	2.0645
J1	23.0985	MSK6	4.0419	5MS12	2.0581
SO1	22.4202	2MN2S2	13.6323	4M2S12	2.0462
OO1	22.3061	3MSK2	13.3978	MVS2	13.0925
OQ2	13.1667	3M2S2	13.3569	2MK2	12.9097
MNS2	13.1273	MNK2S2	13.0881	MA2	12.4382
2N2	12.9054	SNK2	12.6950	MB2	12.4030
MU2	12.8718	2SK2	12.0329	MSV2	11.8143
N2	12.6583	2MS2N2	11.5798	SKM2	11.5763
NU2	12.6260	MQ3	8.4940	2MNS4	6.3821
OP2	12.4559	2MP3	8.3703	MV4	6.2612
M2	12.4206	2MQ3	8.0773	3MN4	6.1525
MKS2	12.3855	3MK4	6.3302	2MSN4	6.0475
LAM2	12.2218	3MS4	6.3211	NA2	12.6767
L2	12.1916	2MSK4	6.2191	NB2	12.6401
T2	12.0164	3MK5	5.0062	MSO5	4.9364
S2	12.0000	M5	4.9682	MSK5	4.8632
R2	11.9836	3MO5	4.9309	2MN2	12.1916
K2	11.9672	2MNS6	4.2429		
MSN2	11.7861	3MNS6	4.2158		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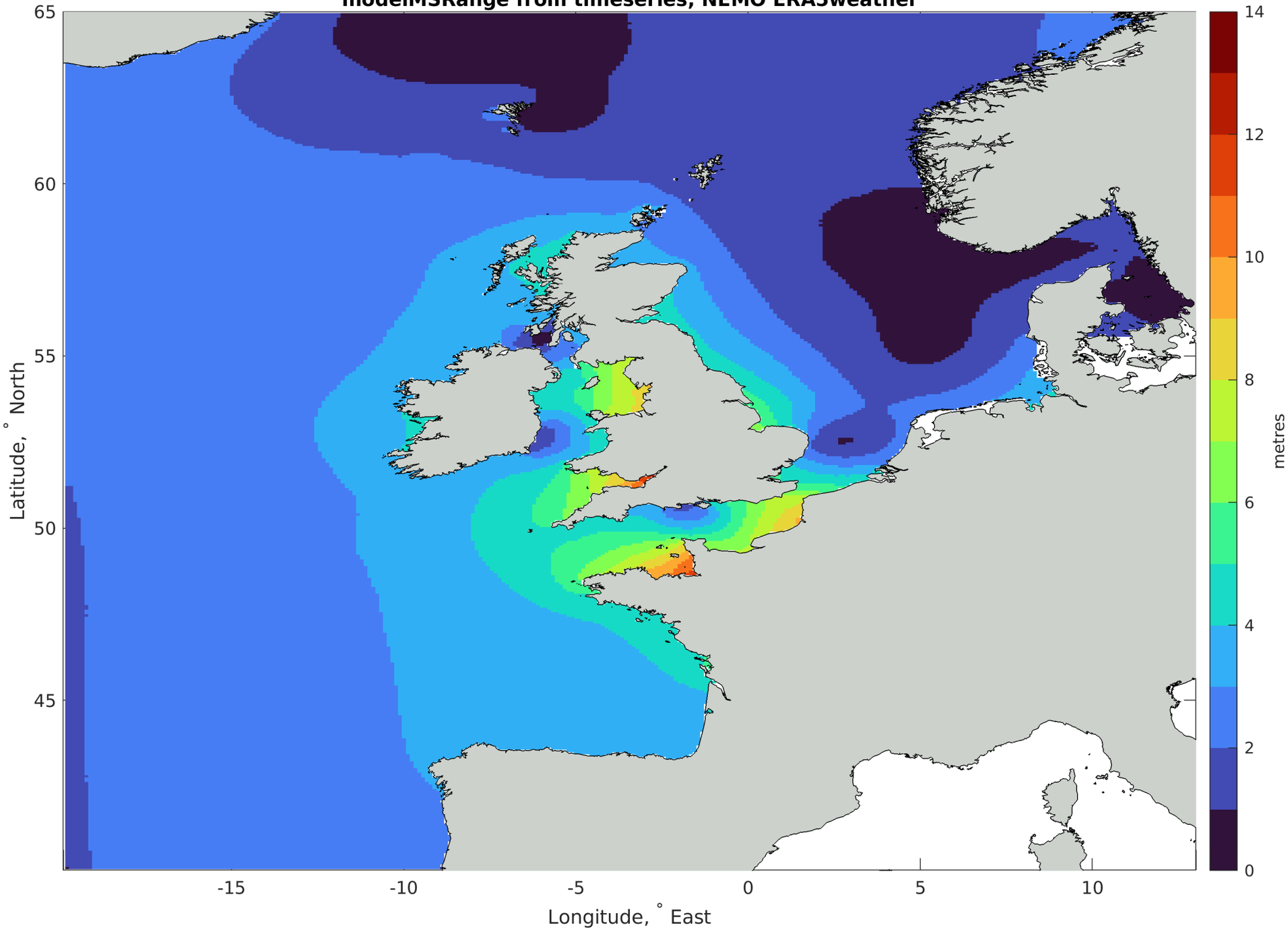
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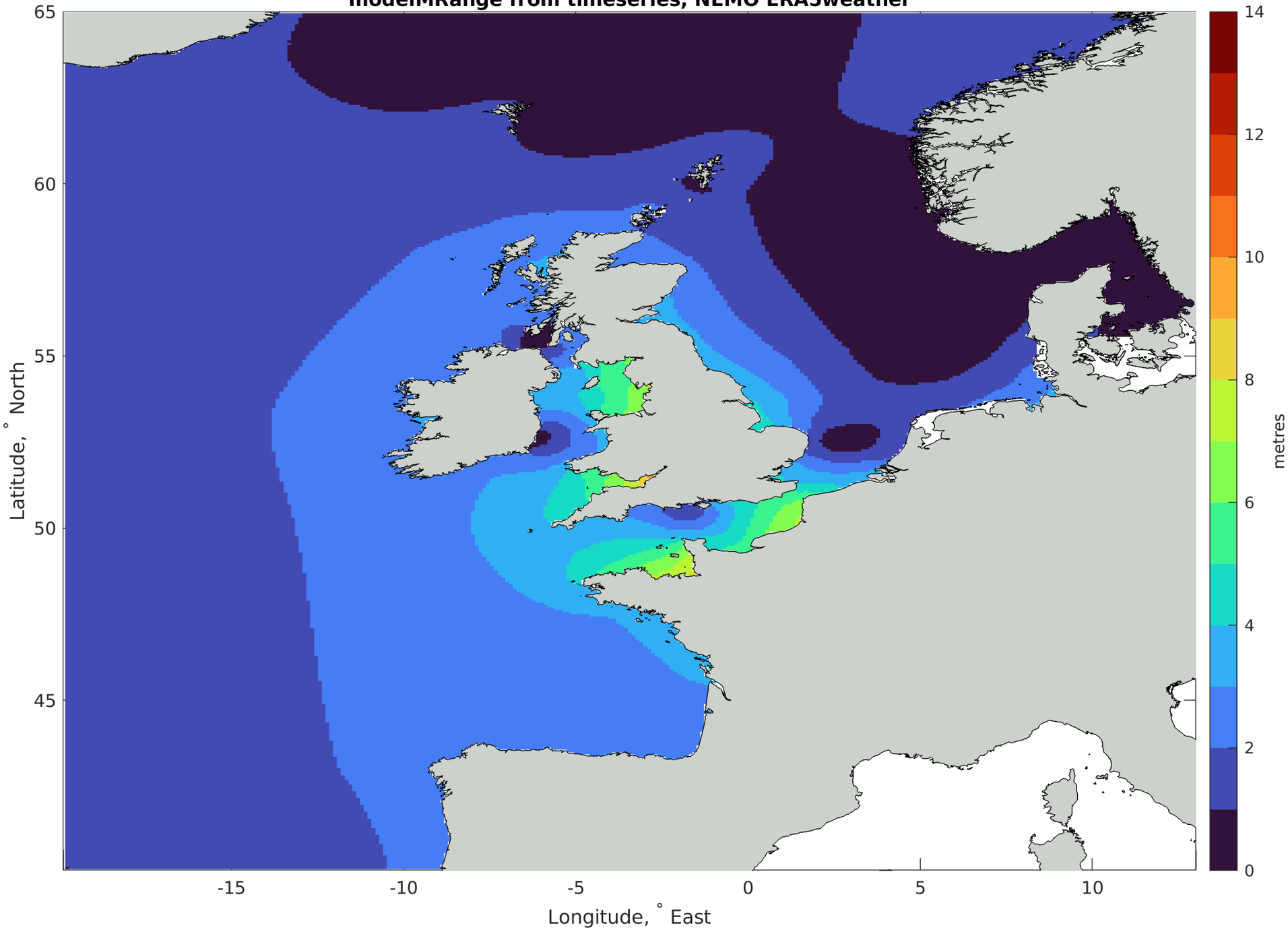
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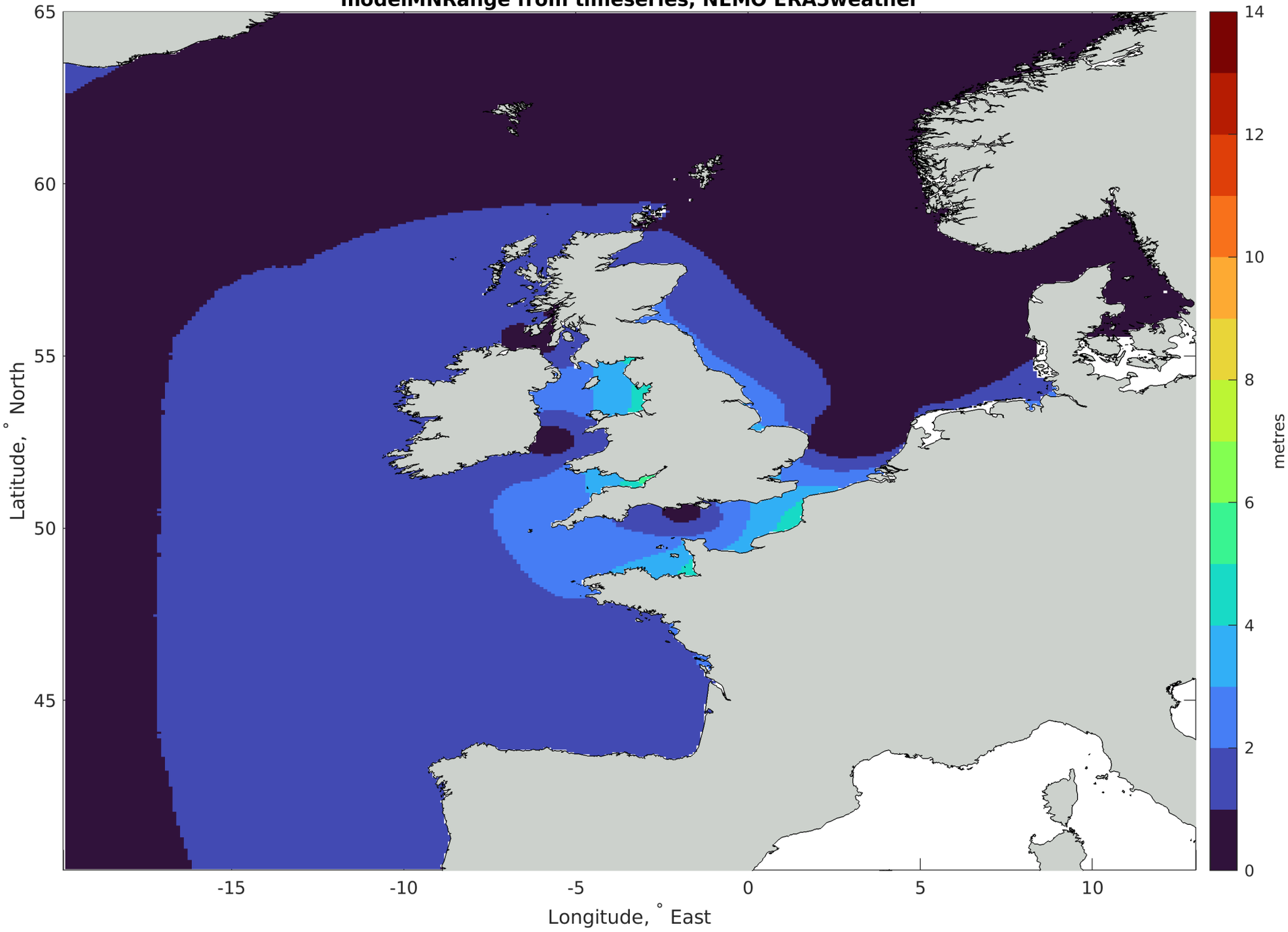
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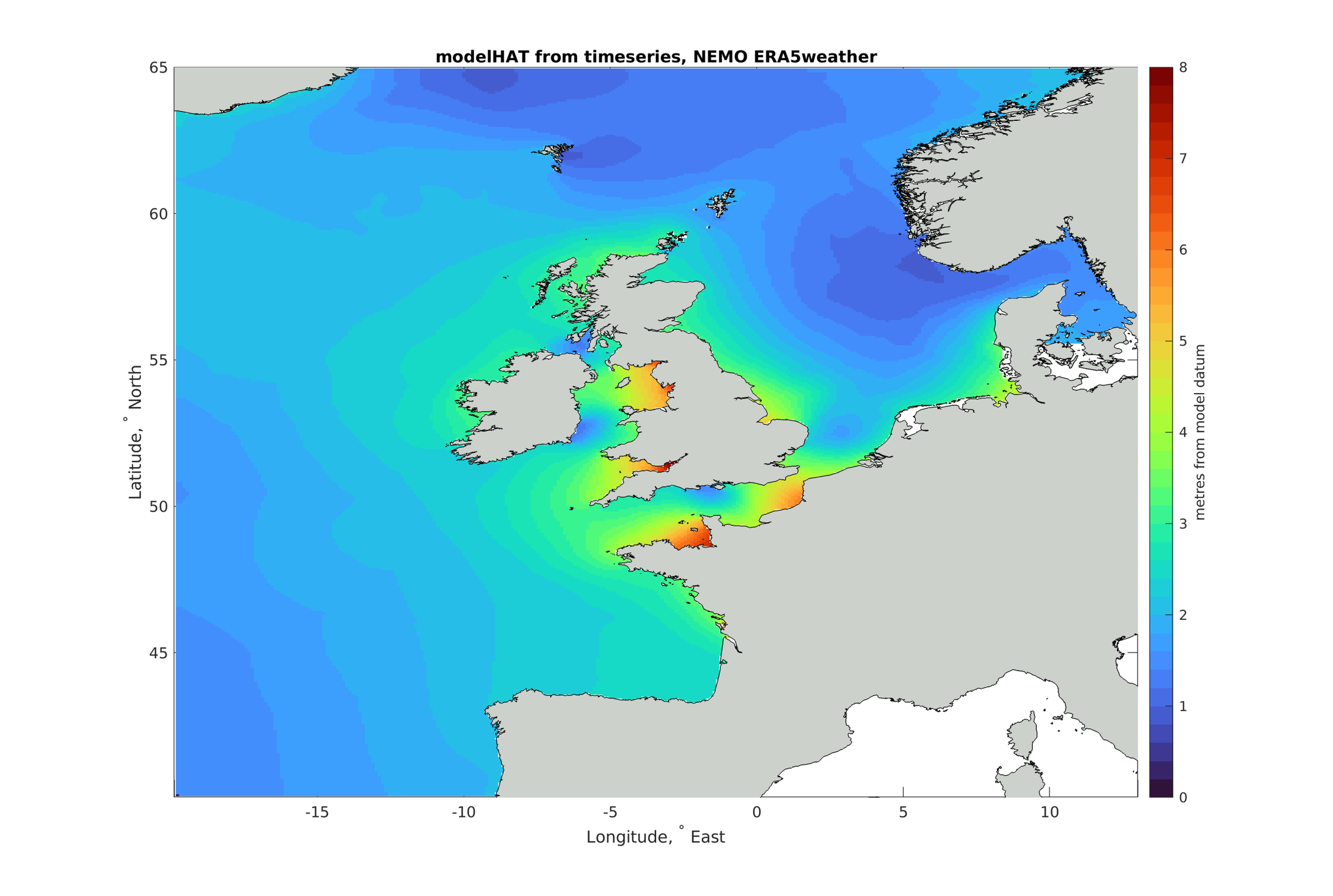
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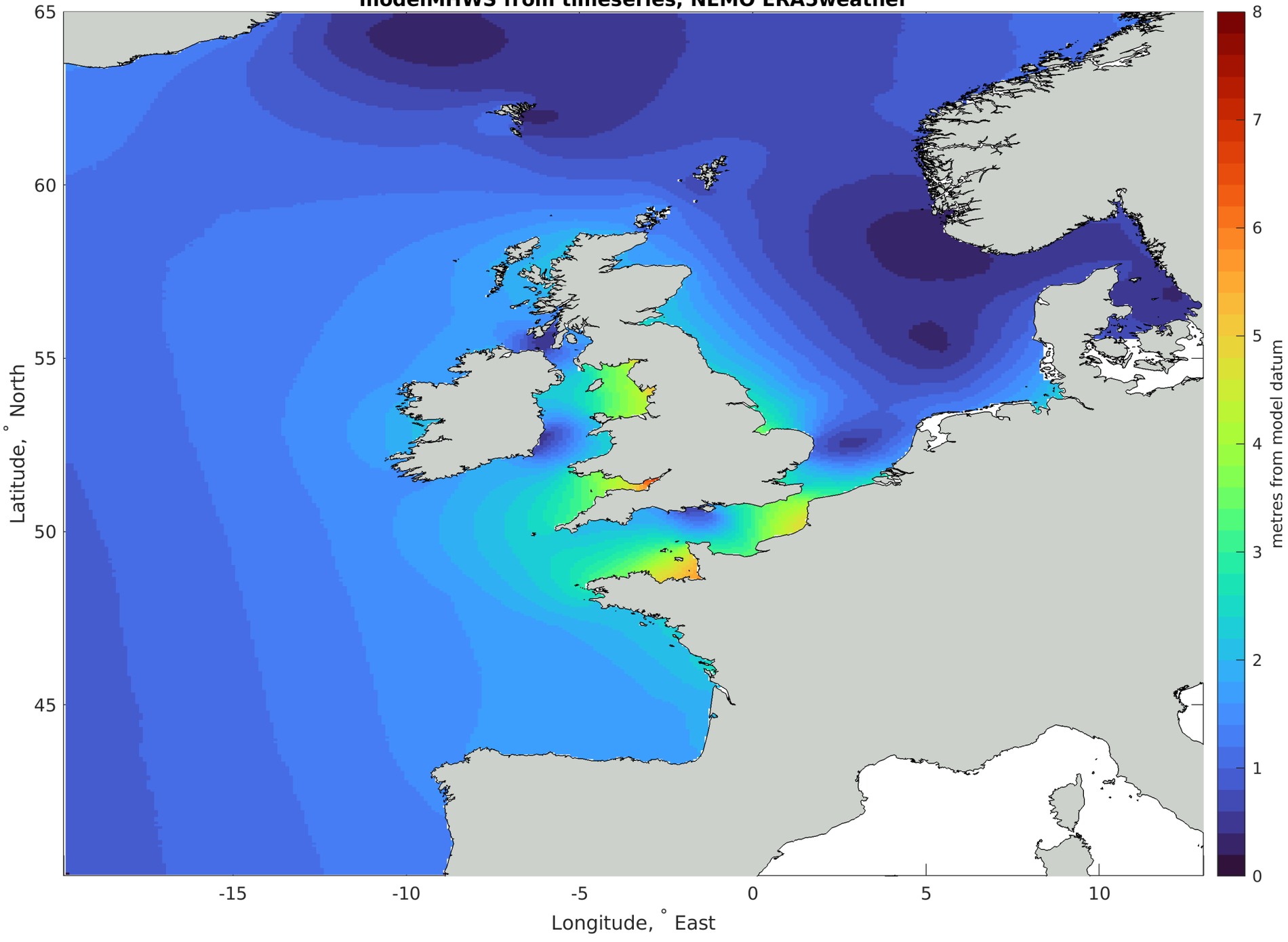
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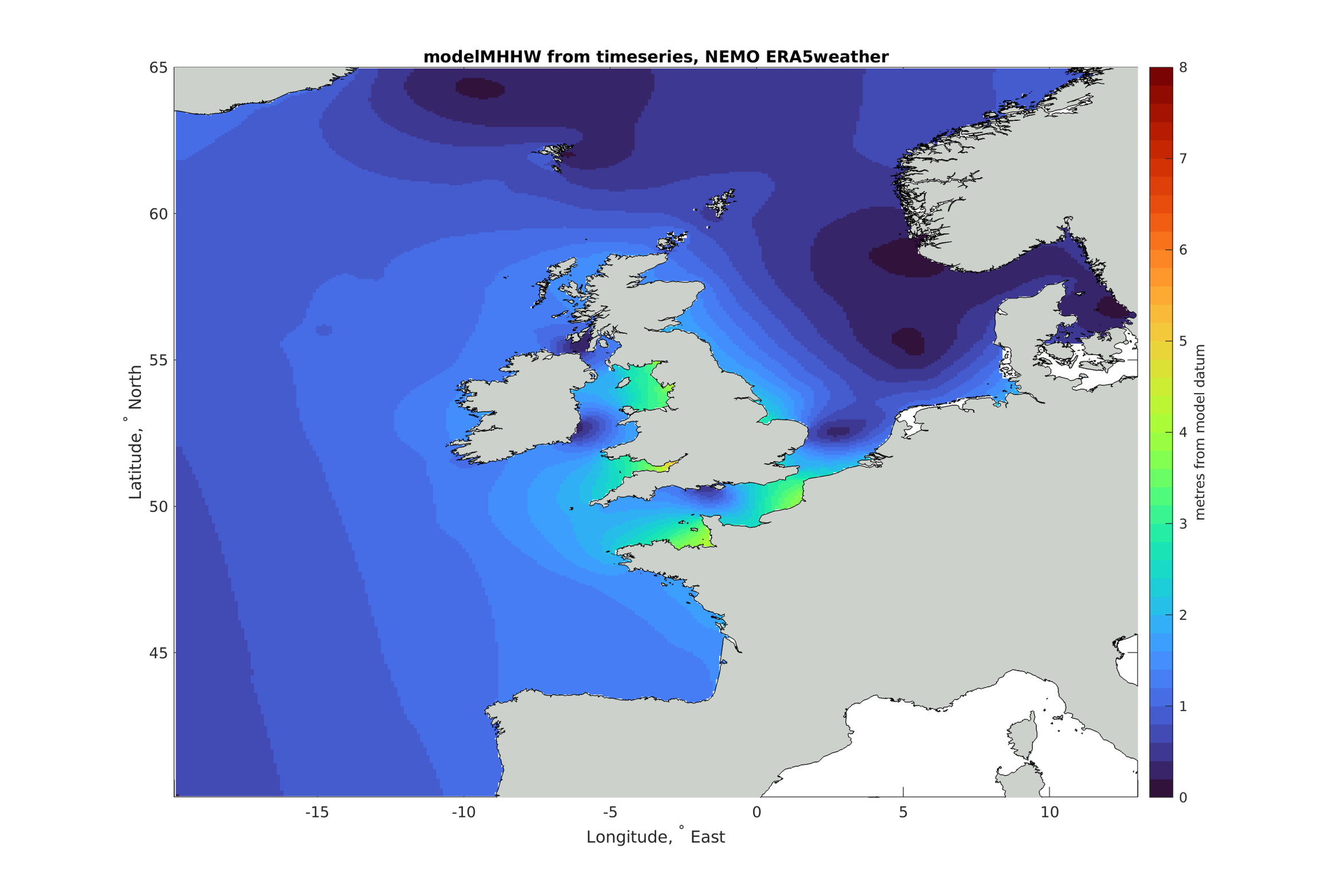
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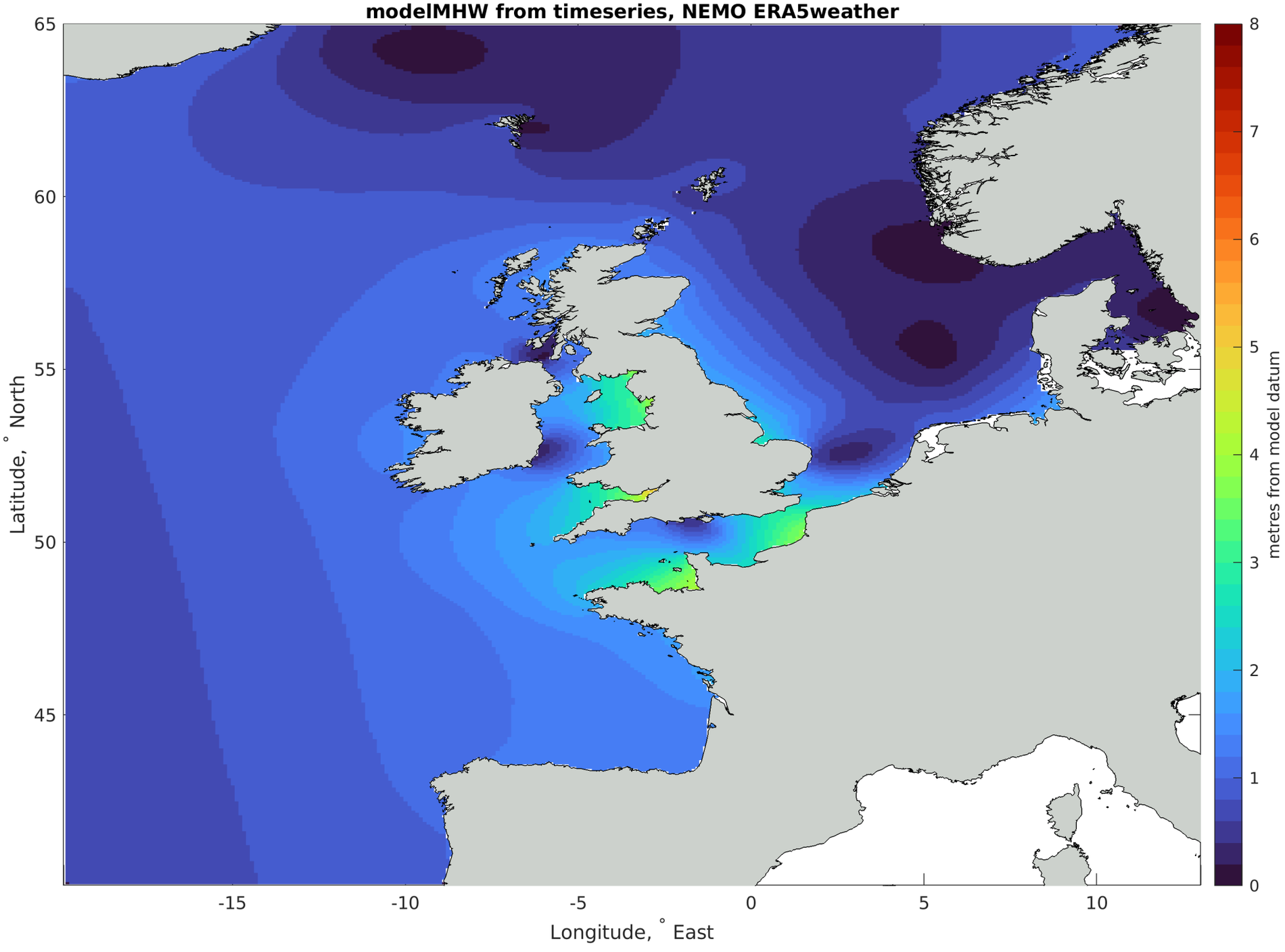
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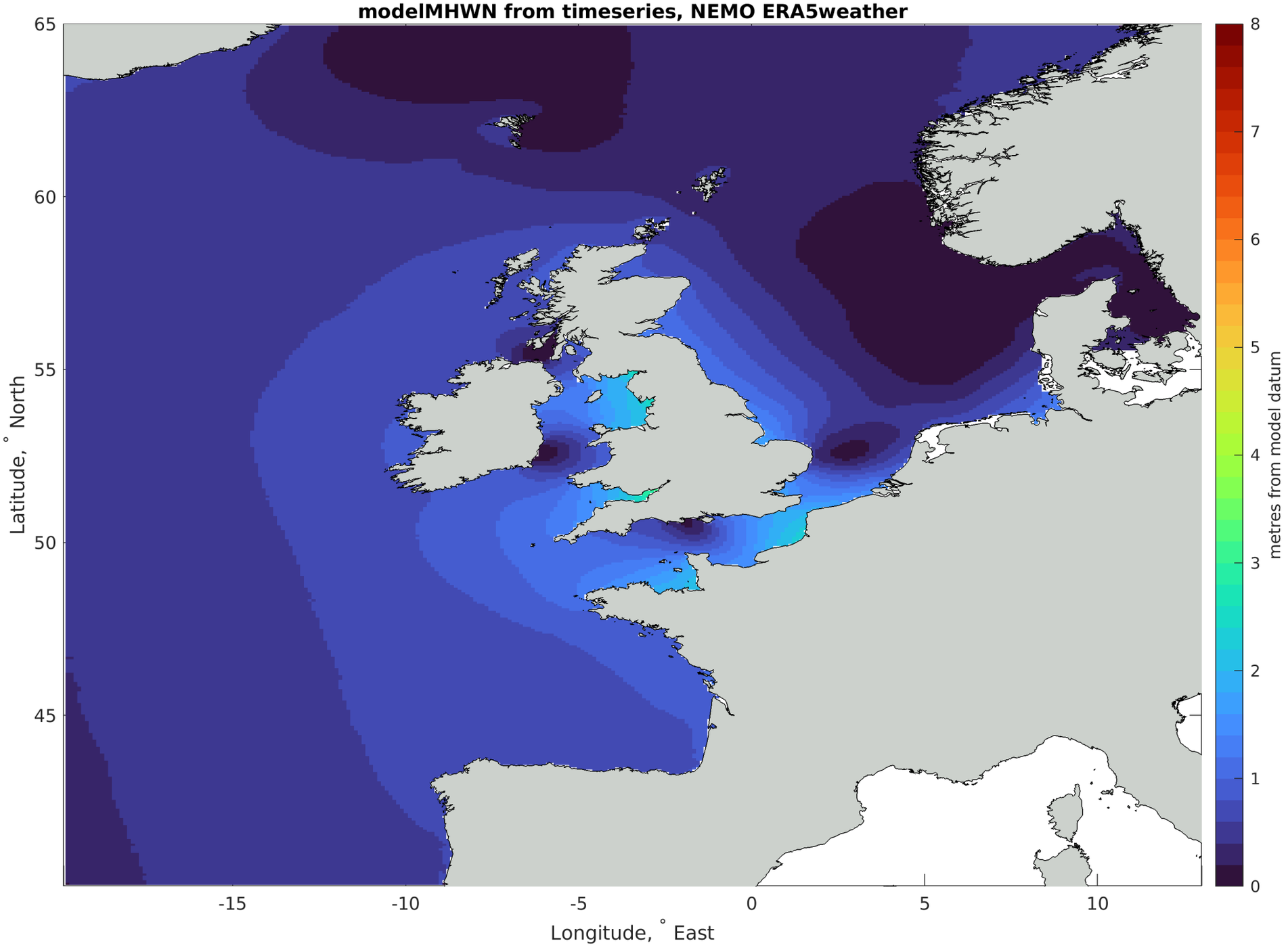
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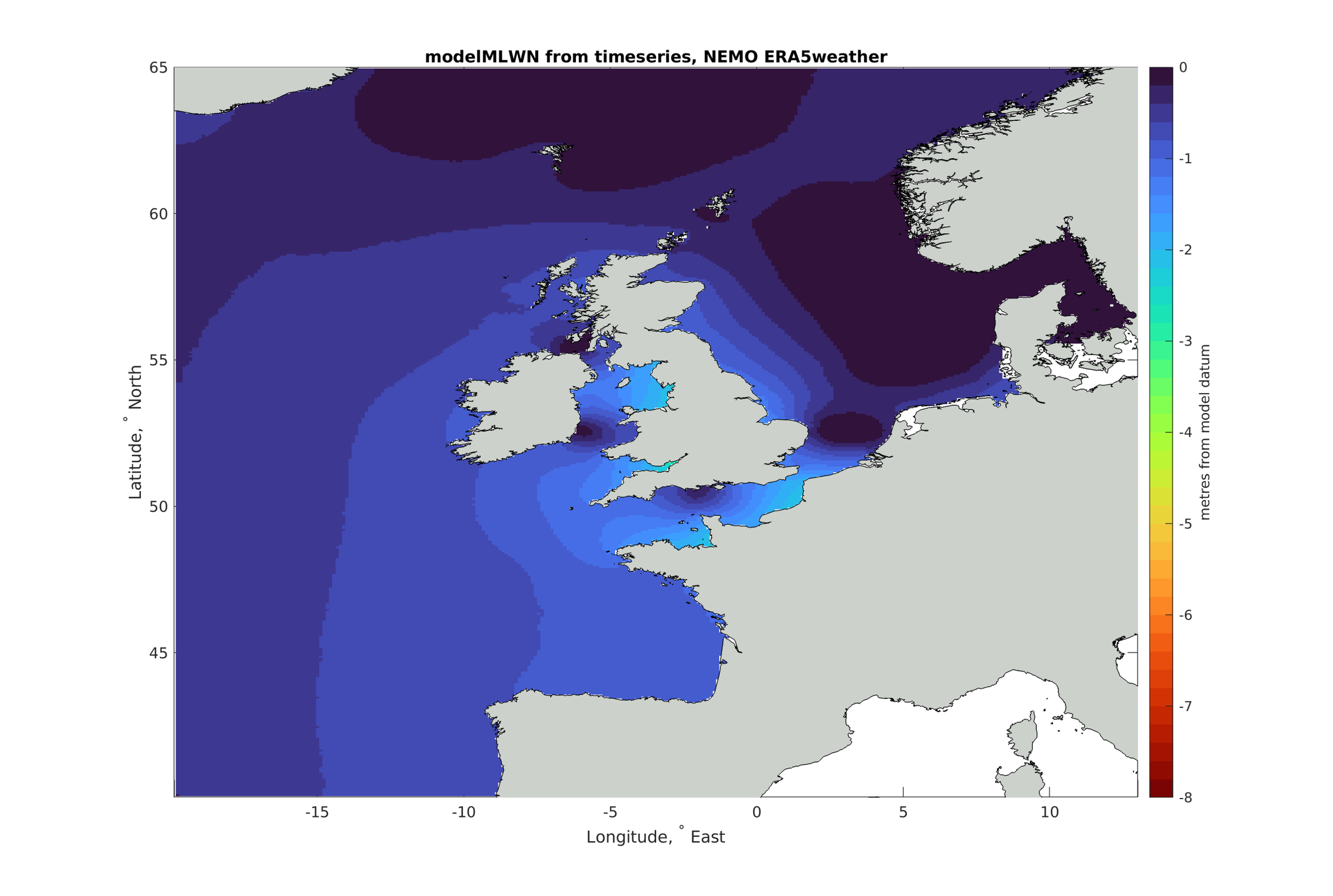
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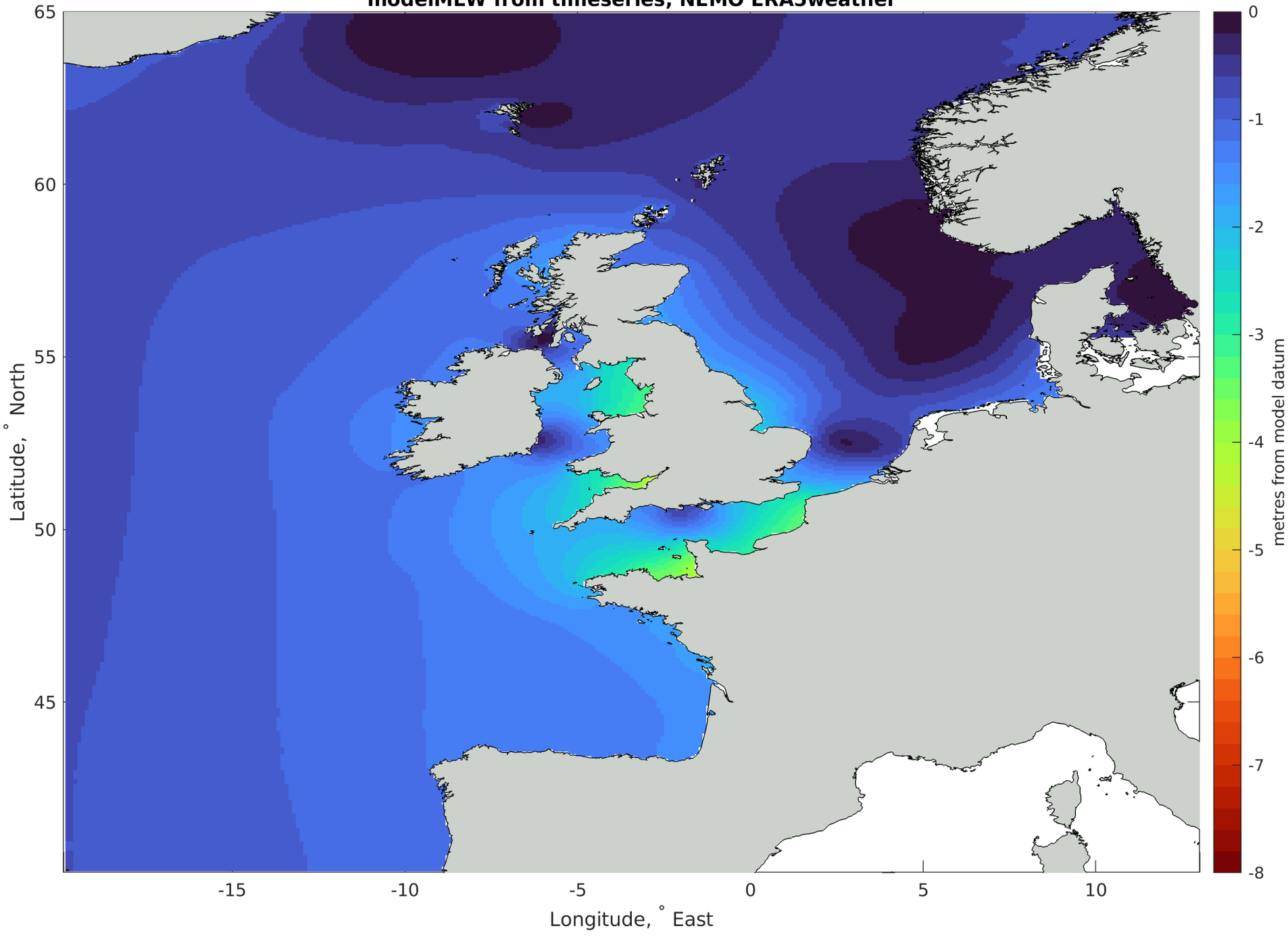
metres from model datum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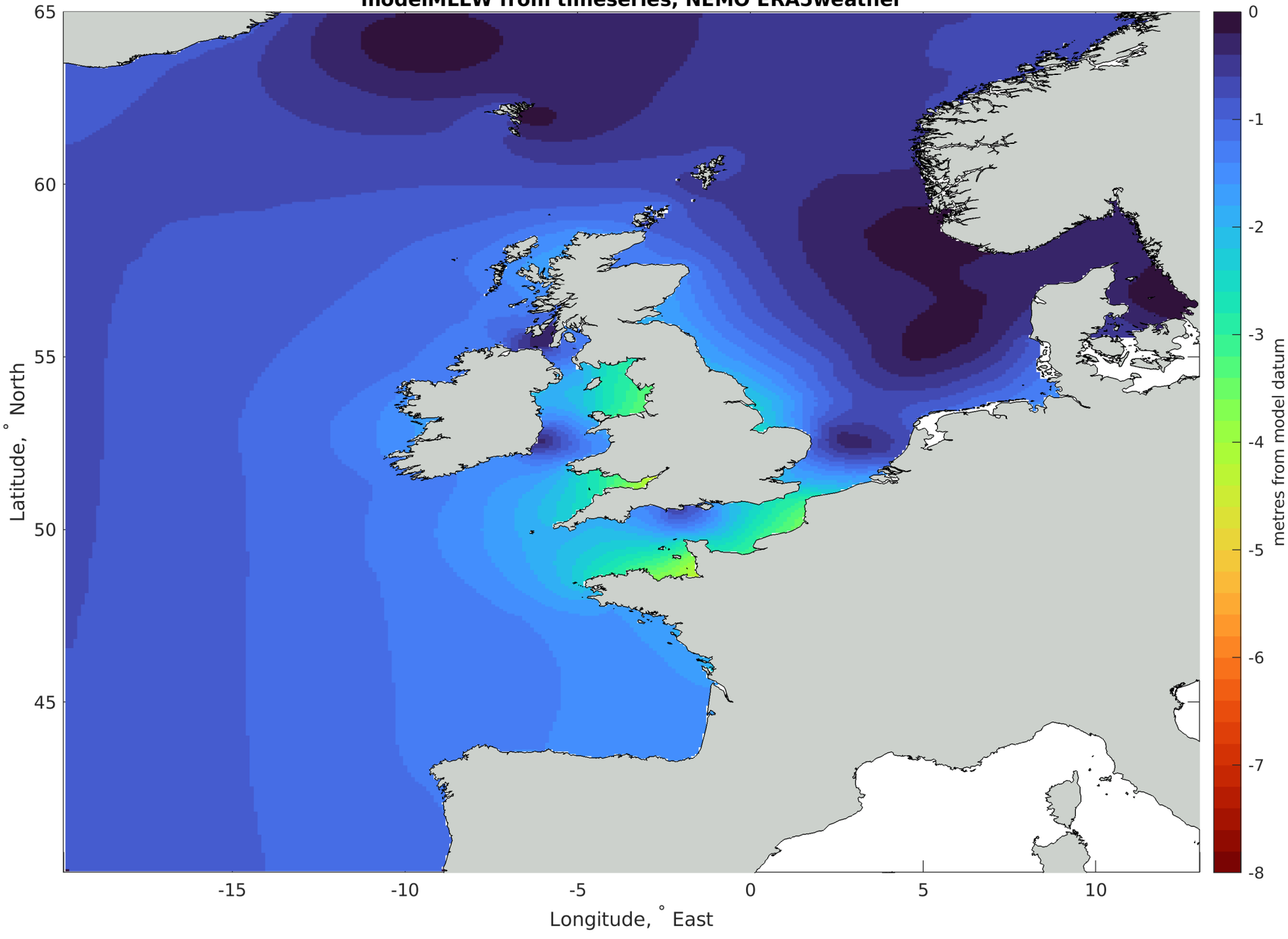
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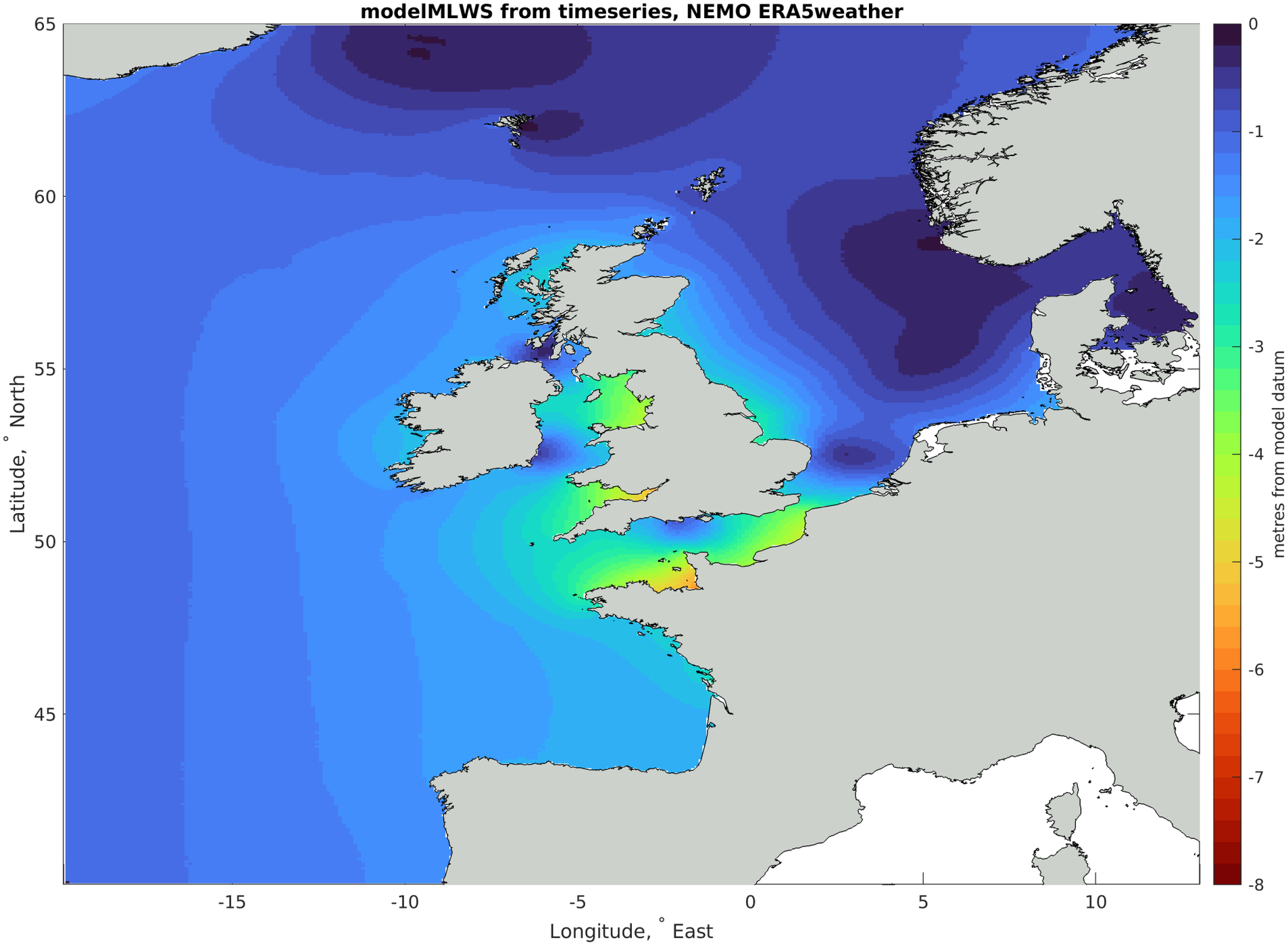
metres from model datum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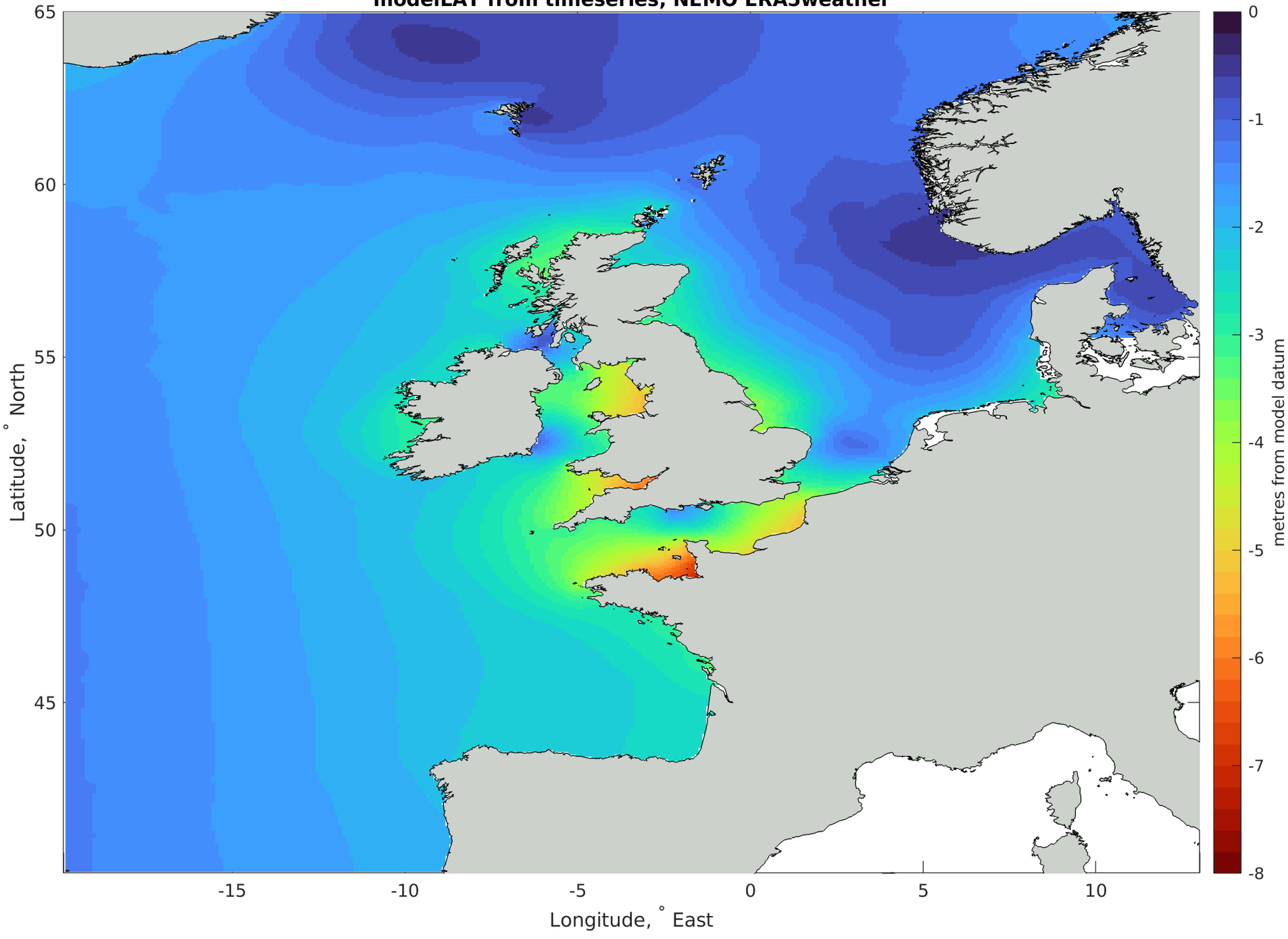
metres from model datum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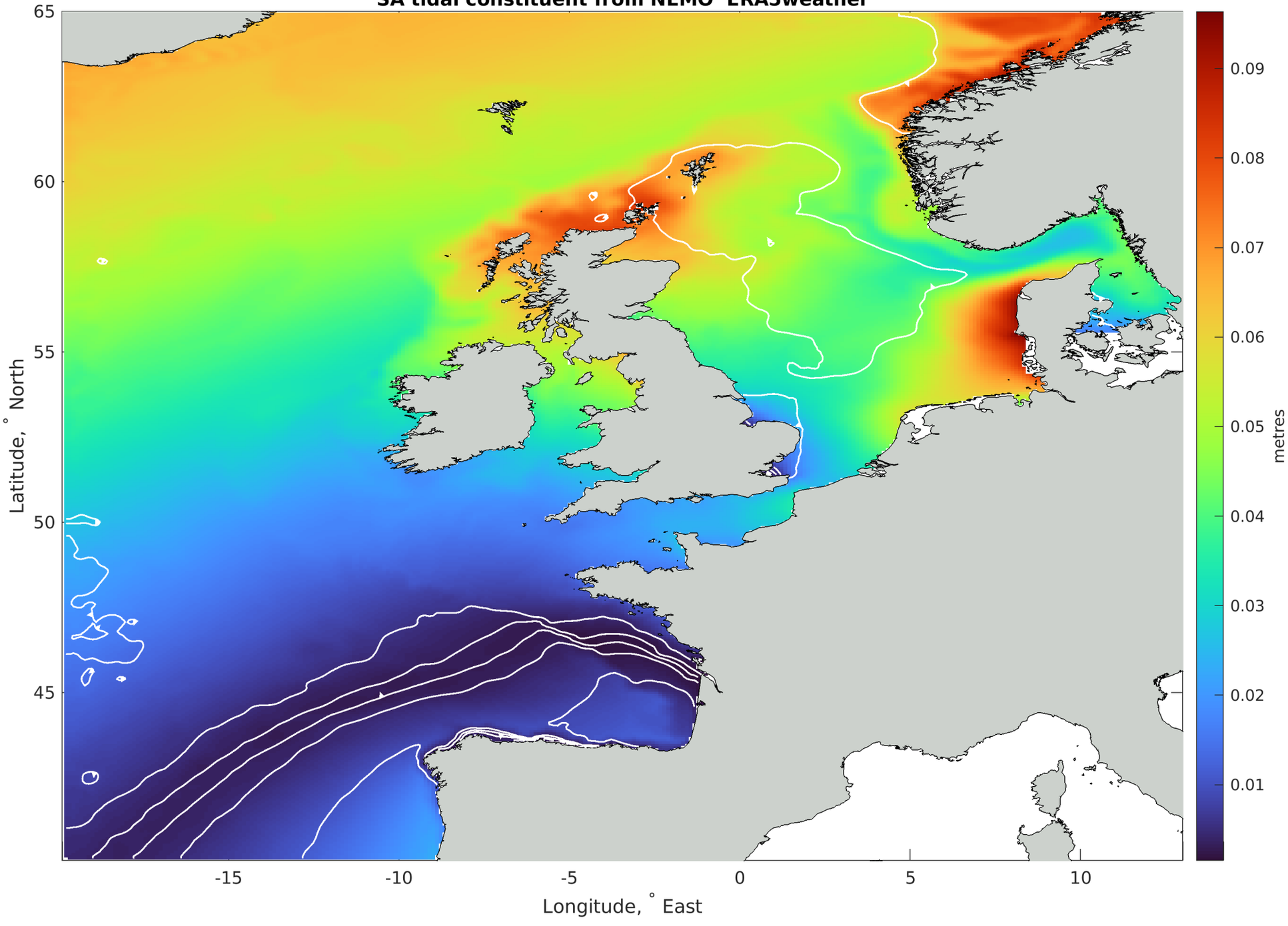
metres from model datum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Latitude, ° North
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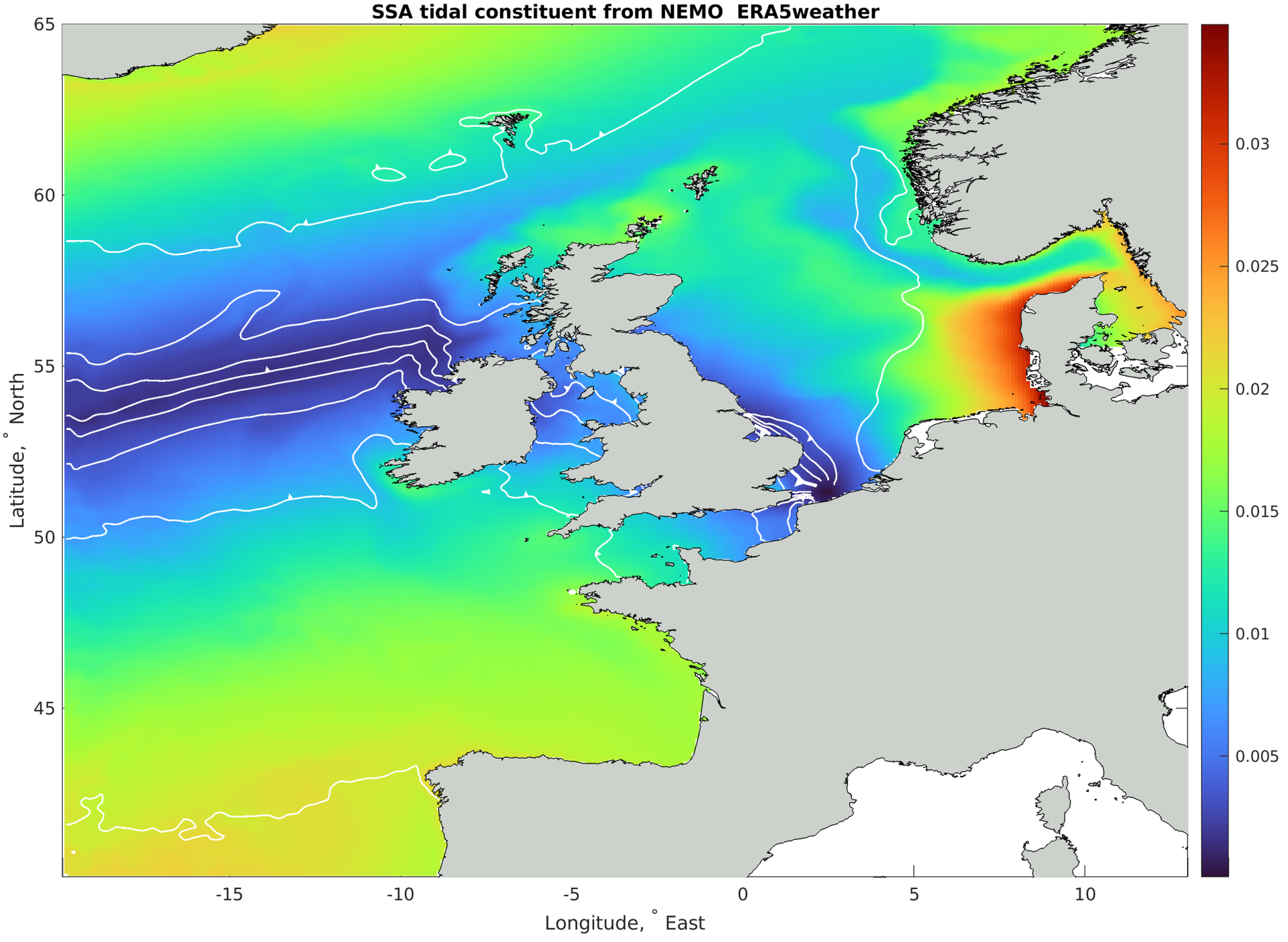
0.02
0.01
metres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Latitude, ° North
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0.01
0.005
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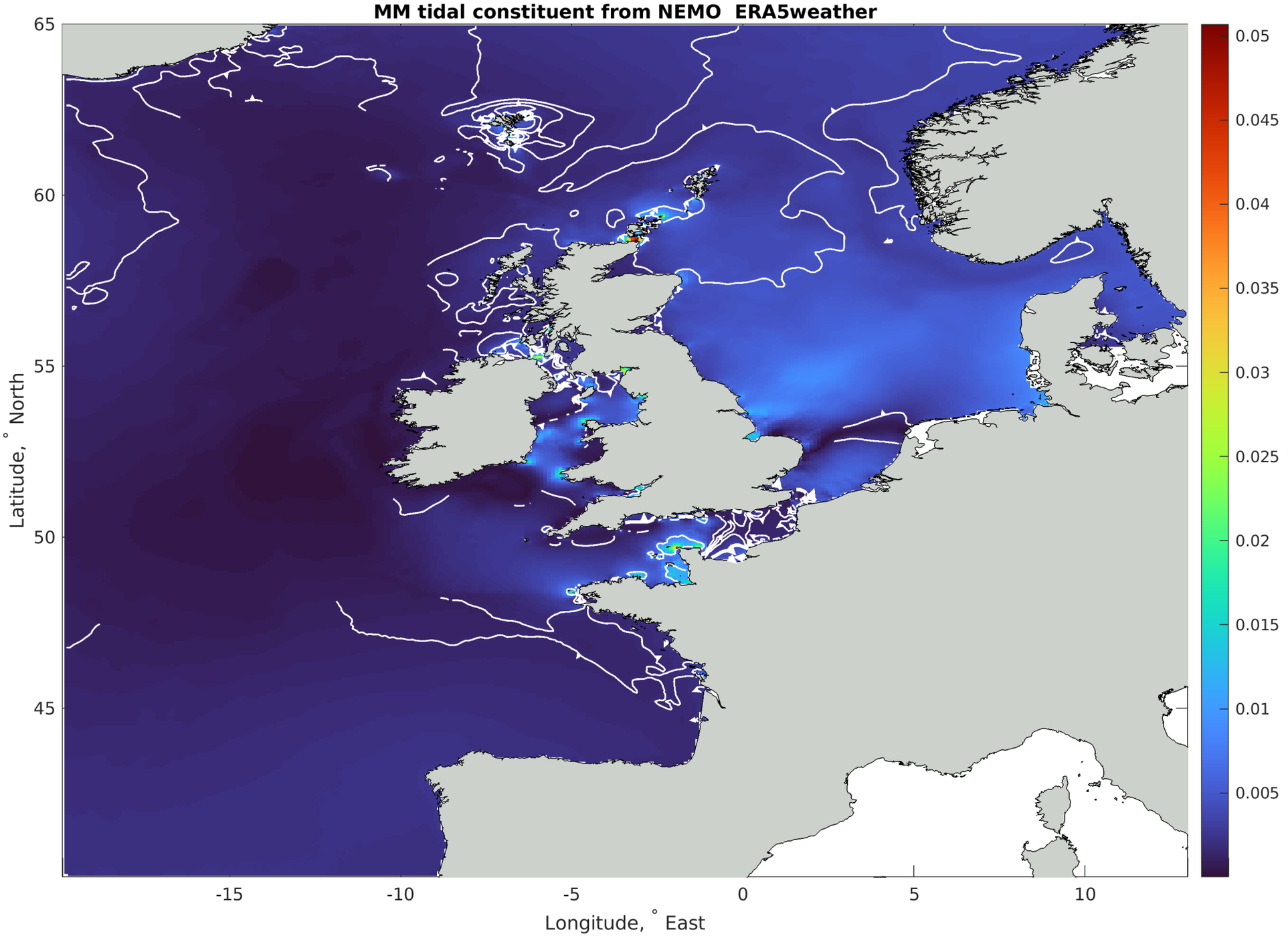
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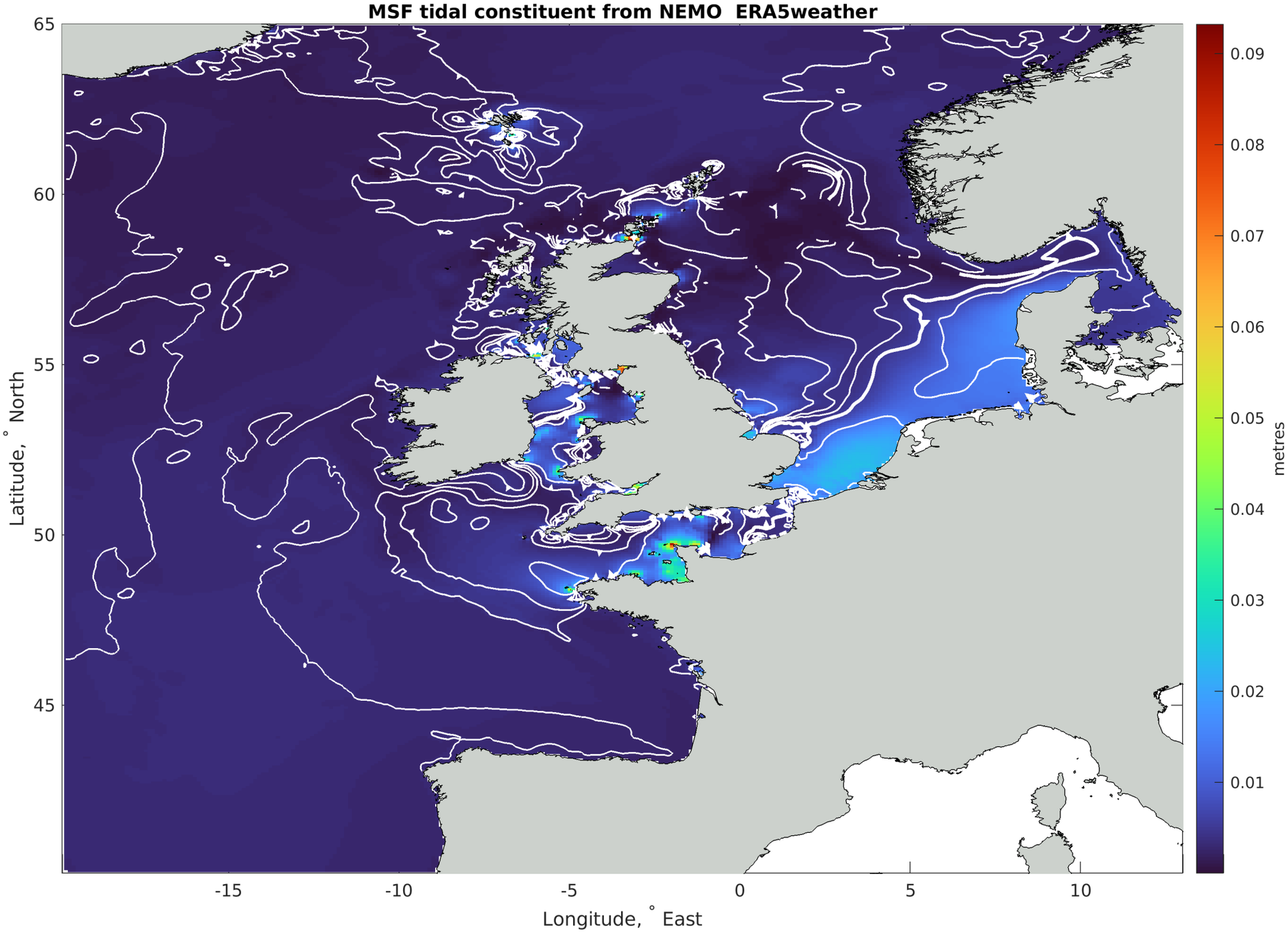
metres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Latitude, ° North
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0.03
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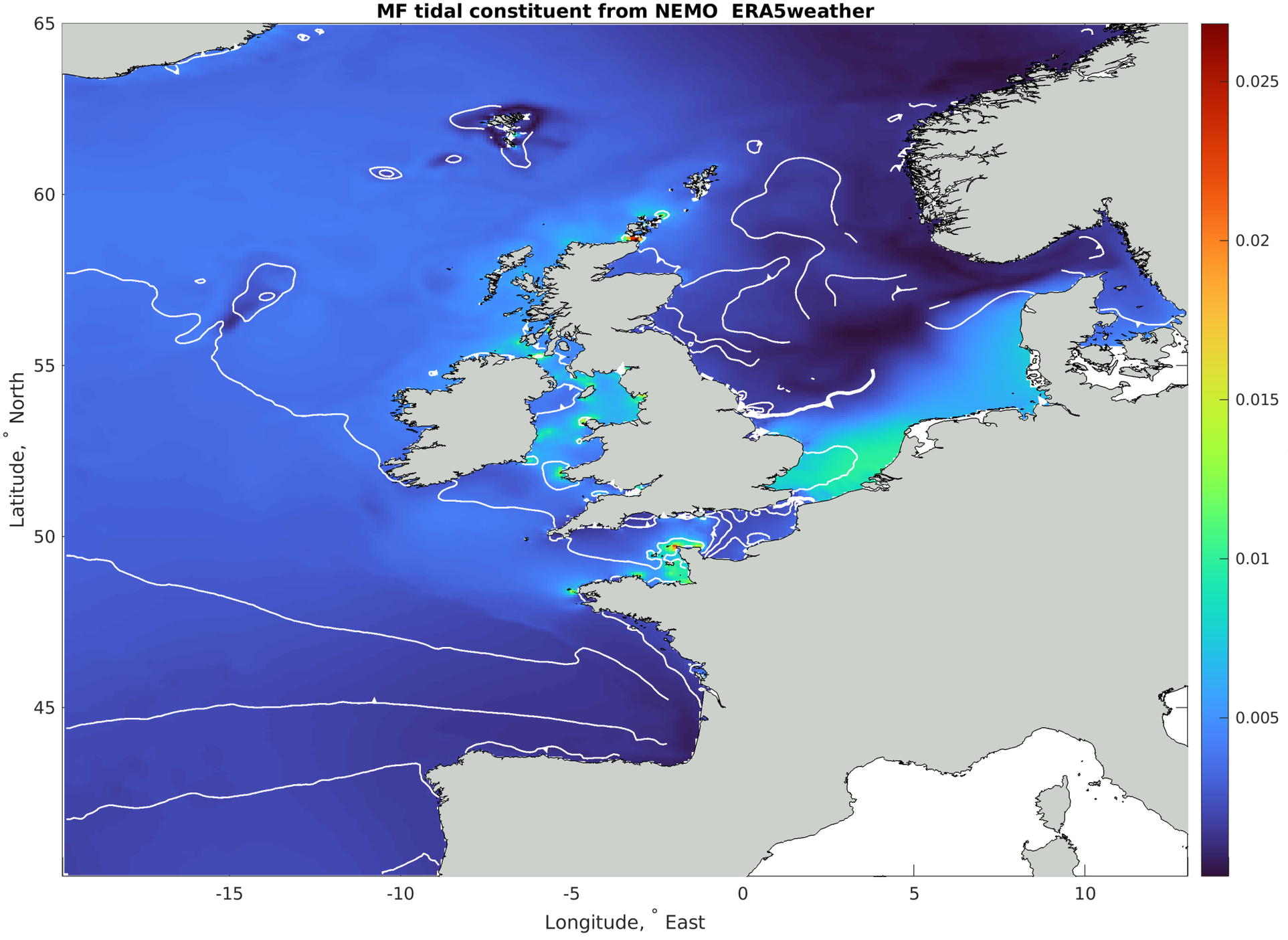
0.01
metres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Latitude, ° North
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Longitude, ° East
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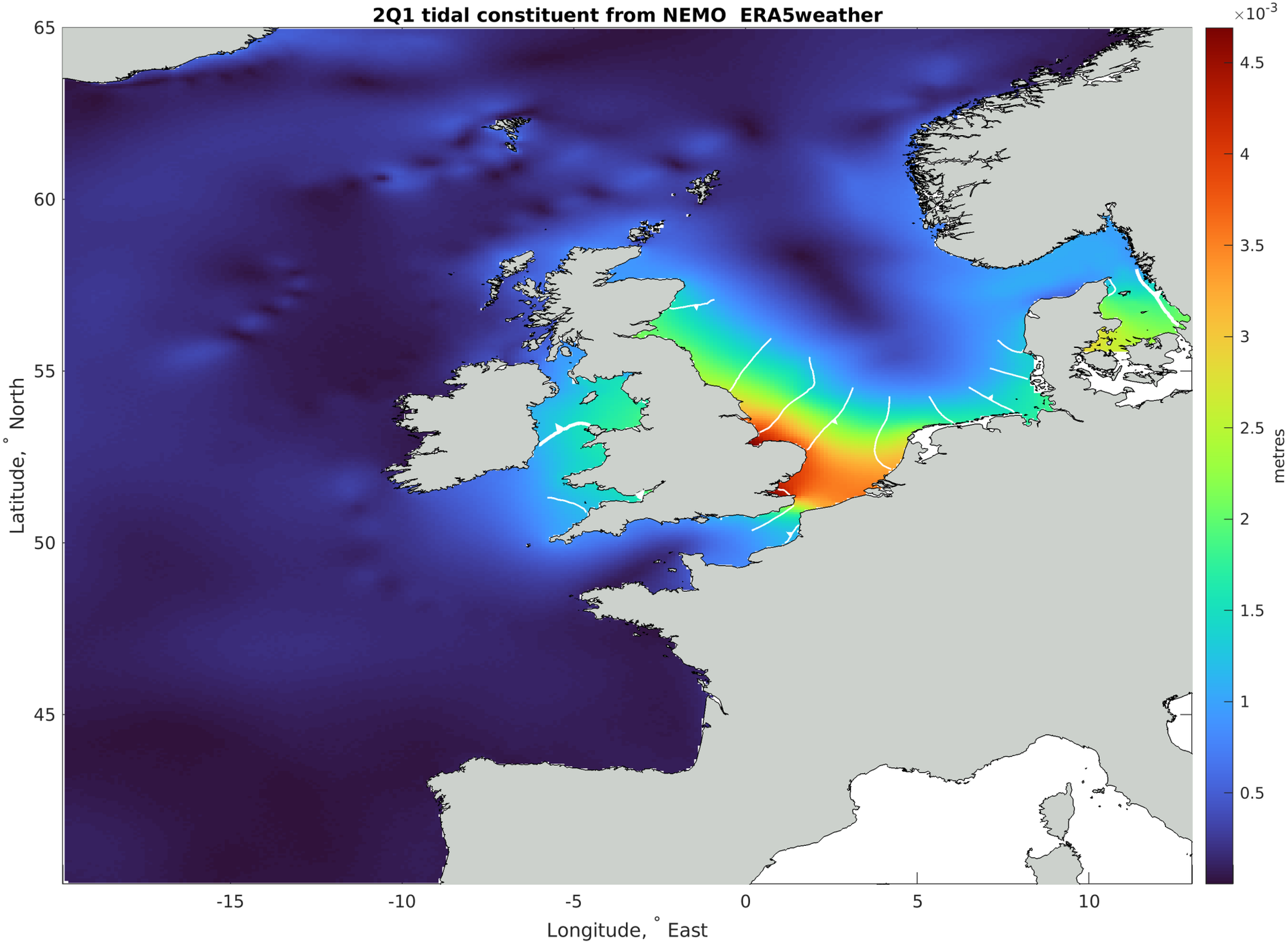
0.01
0.005
metres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45
Latitude, ° North
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Longitude, ° East
×10-3
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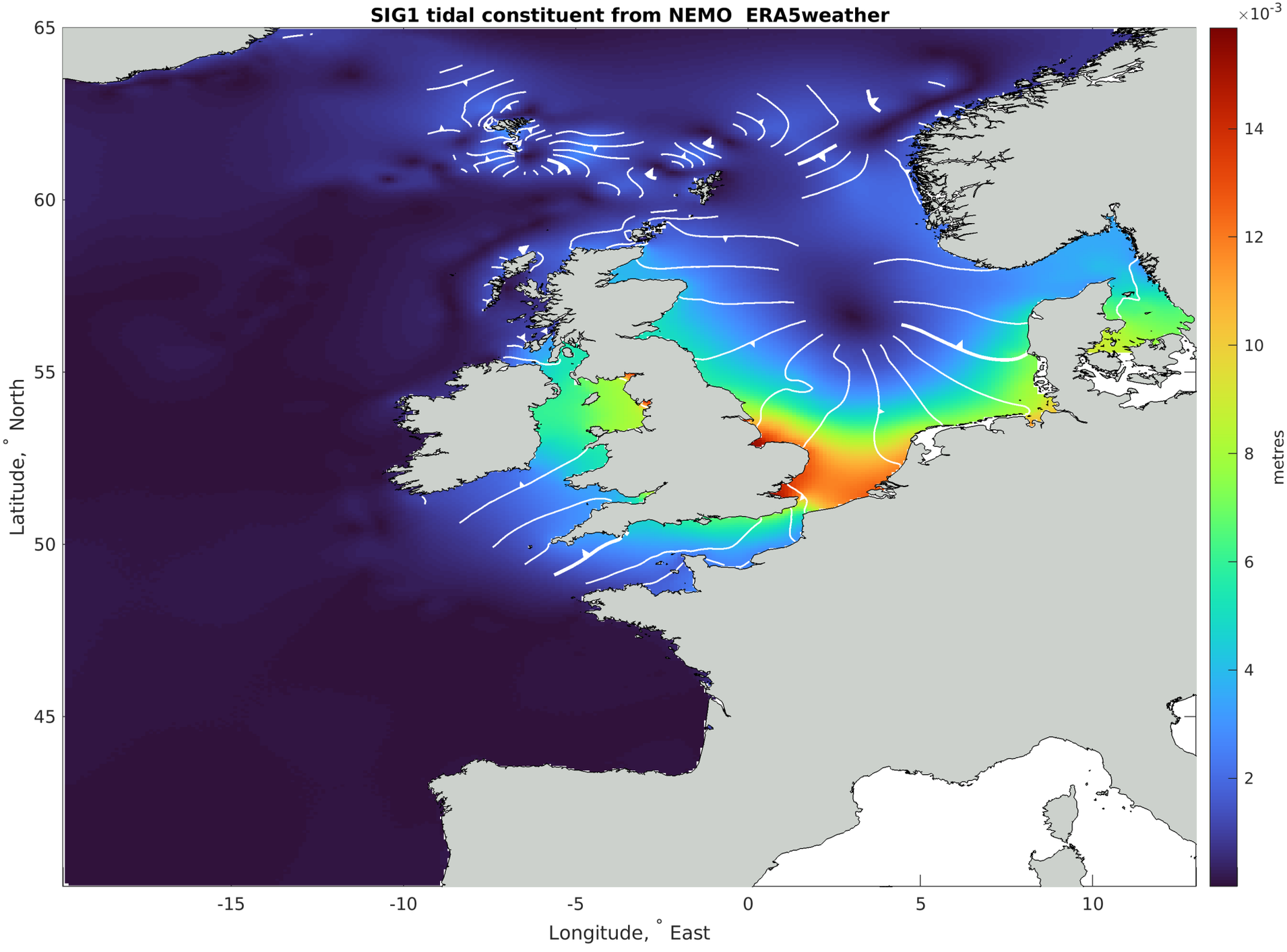
4
3.5
3
2.5
2
1.5
1
0.5
metres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Latitude, ° North
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Longitude, ° East
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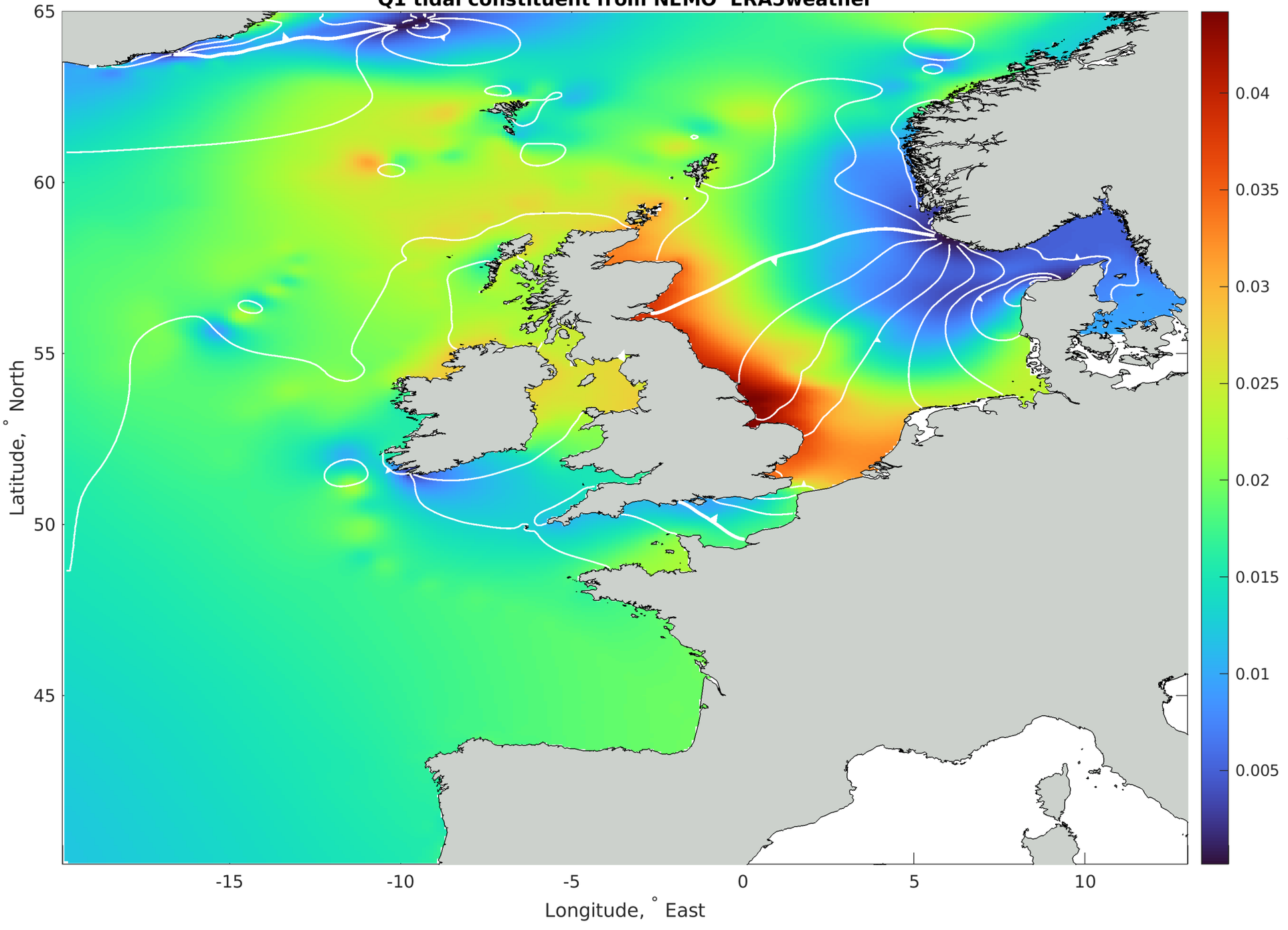
14
12
10
8
6
4
2
metres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Latitude, ° North
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-10
-5
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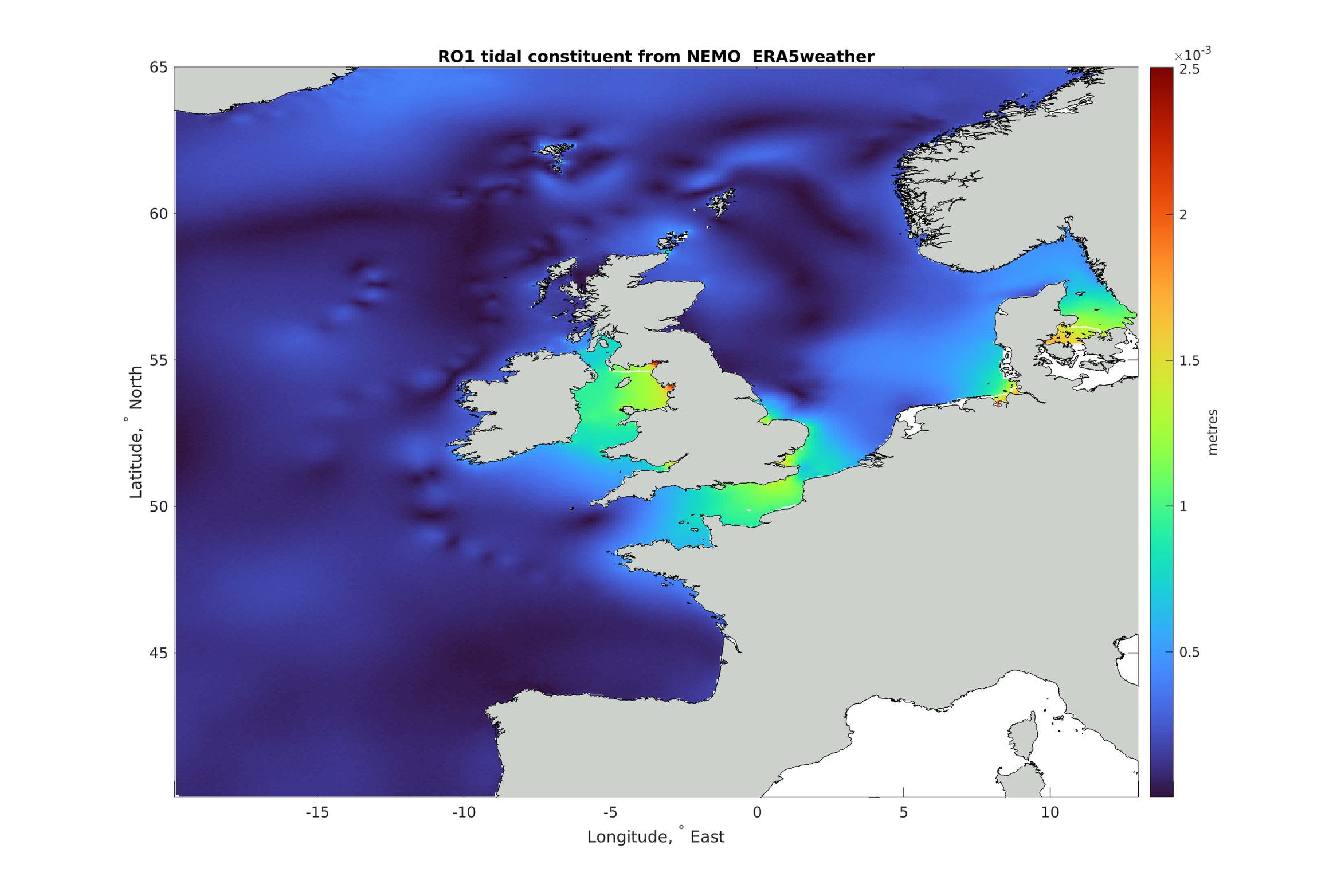
0.03
0.025
0.02
0.015
0.01
0.005
metres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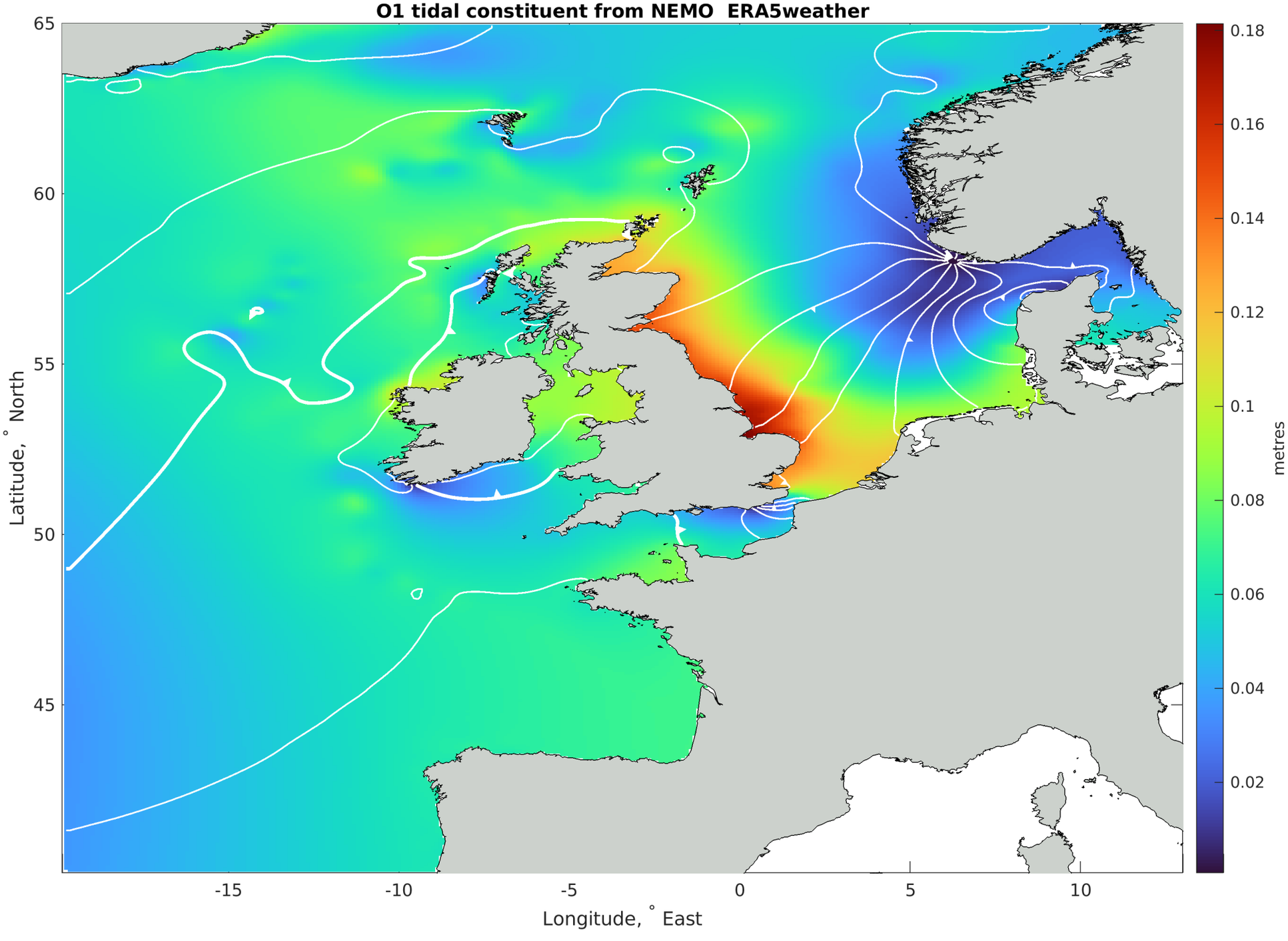
2
1.5
1
0.5
metres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0
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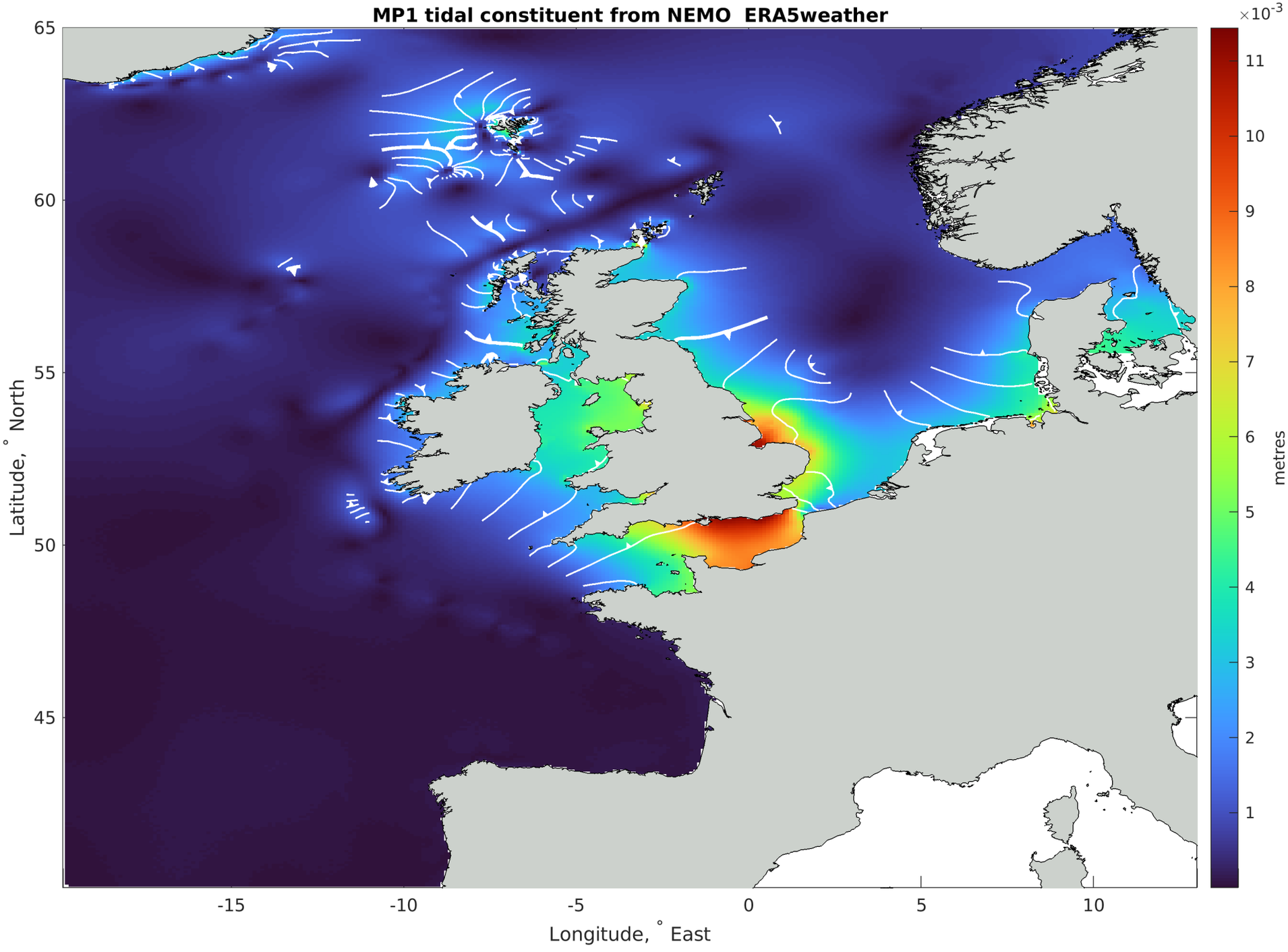
0.04
0.02
metres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45
Latitude, ° North
-15
-10
-5
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Longitude, ° East
×10-3
11
10
9
8
7
6
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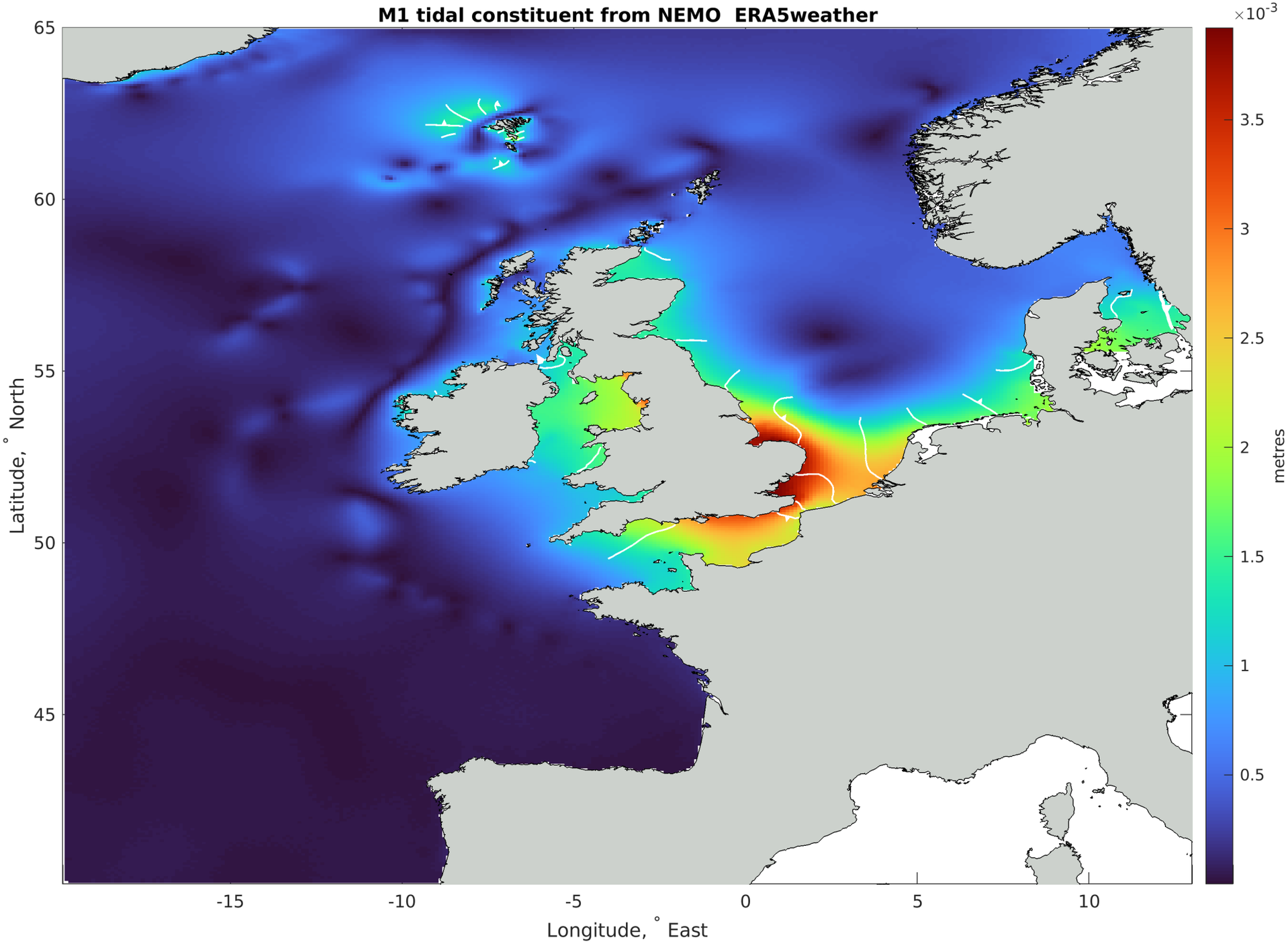
4
3
2
1
metres


M1 tidal constituent from NEMO ERA5weather
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Latitude, ° North
-15
-10
-5
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5
10
Longitude, ° East
×10-3
3.5
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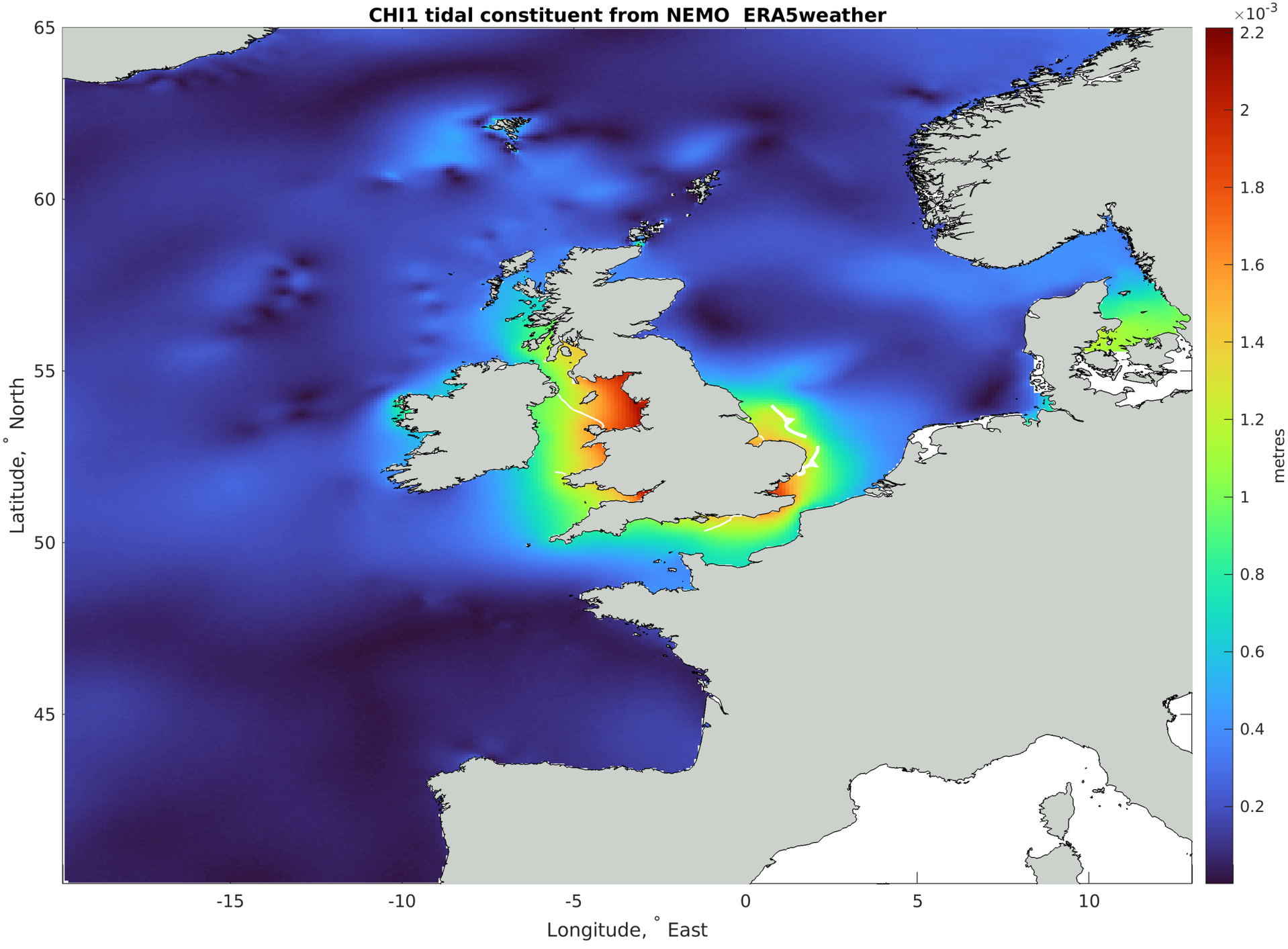
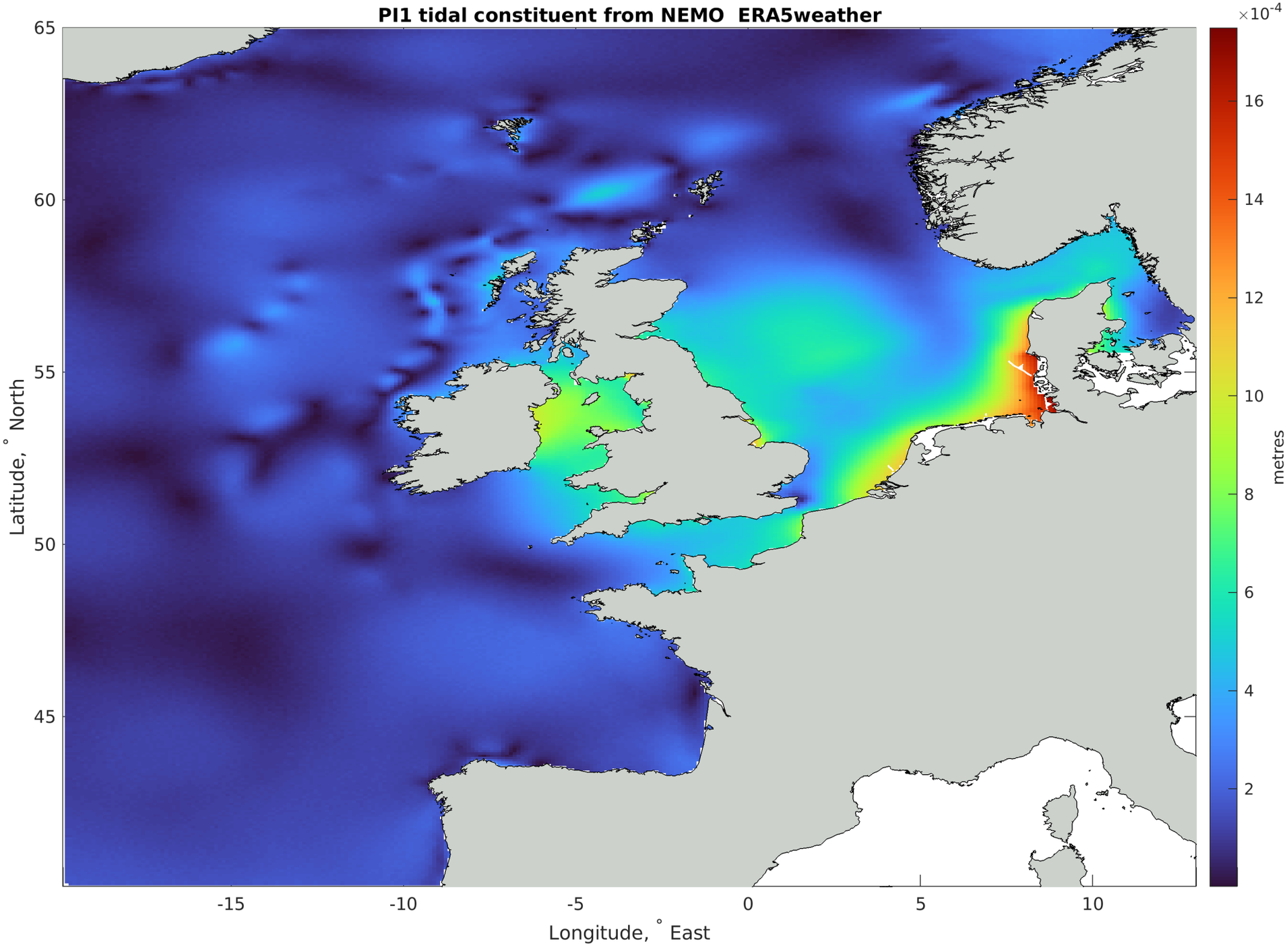
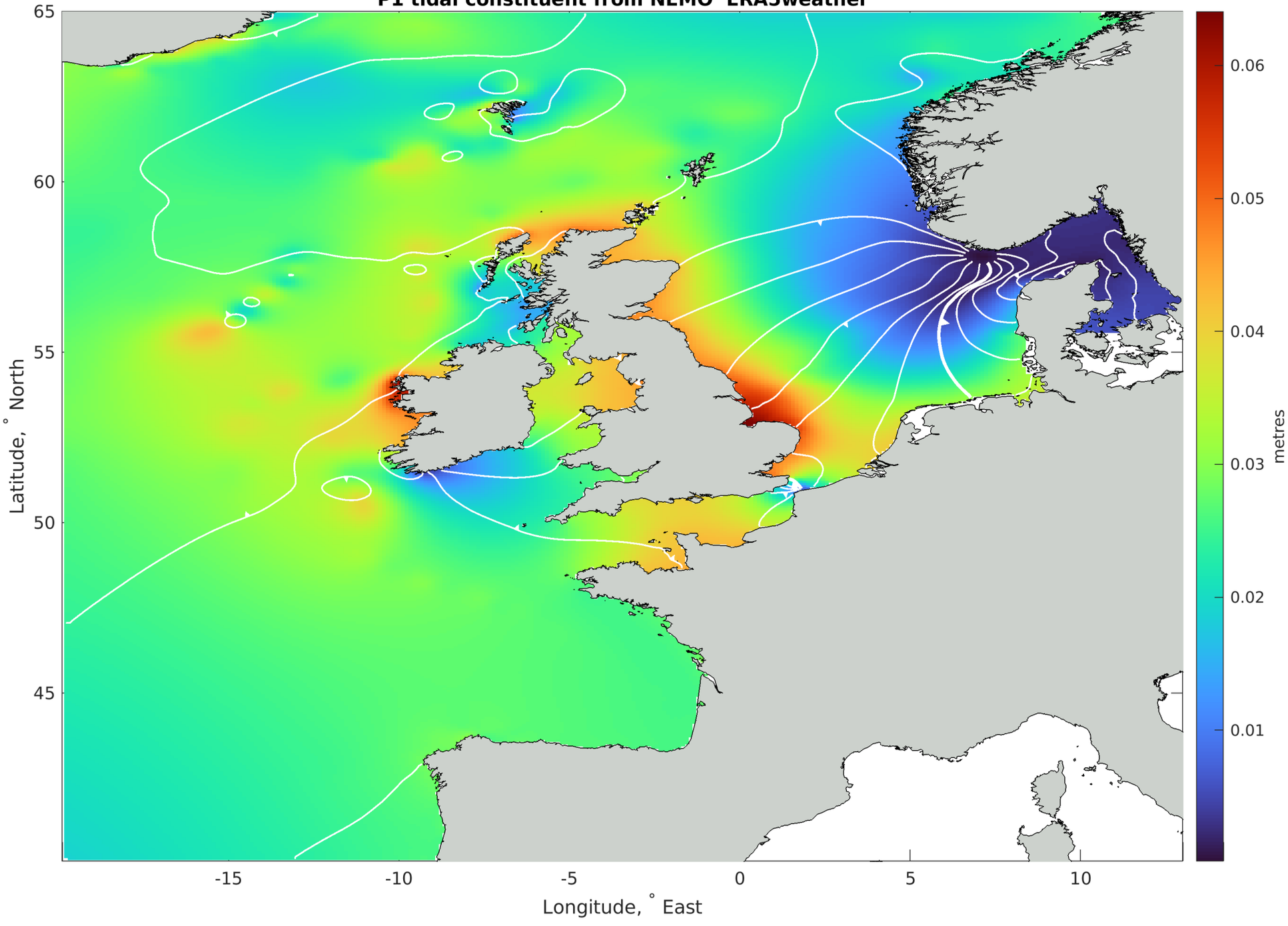
2.5
2
1.5
1
0.5
metres


CHI1 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
metres


PI1 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-4
16
14
12
10
8
6
4
2
metres


P1 tidal constituent from NEMO ERA5weather
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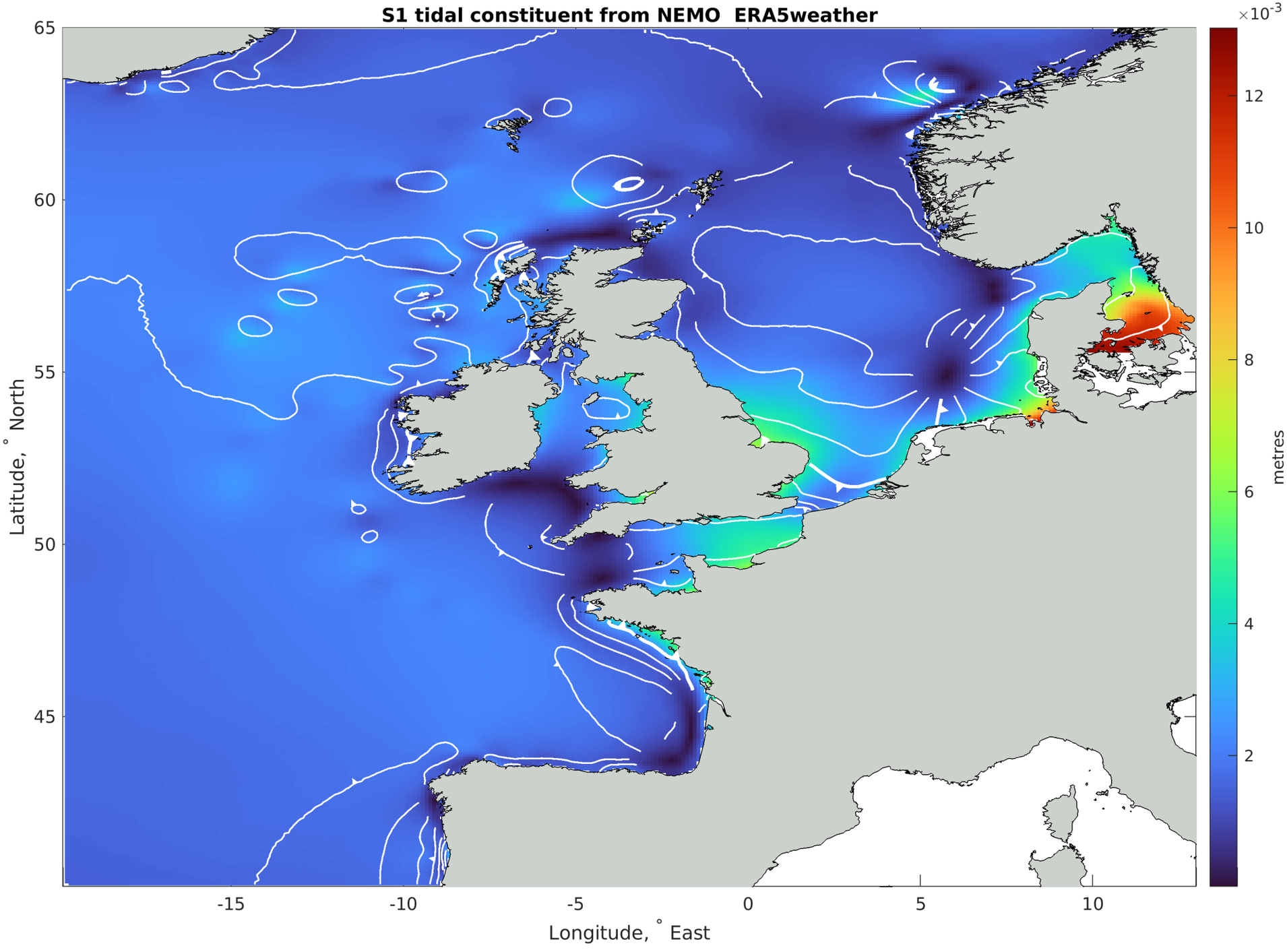
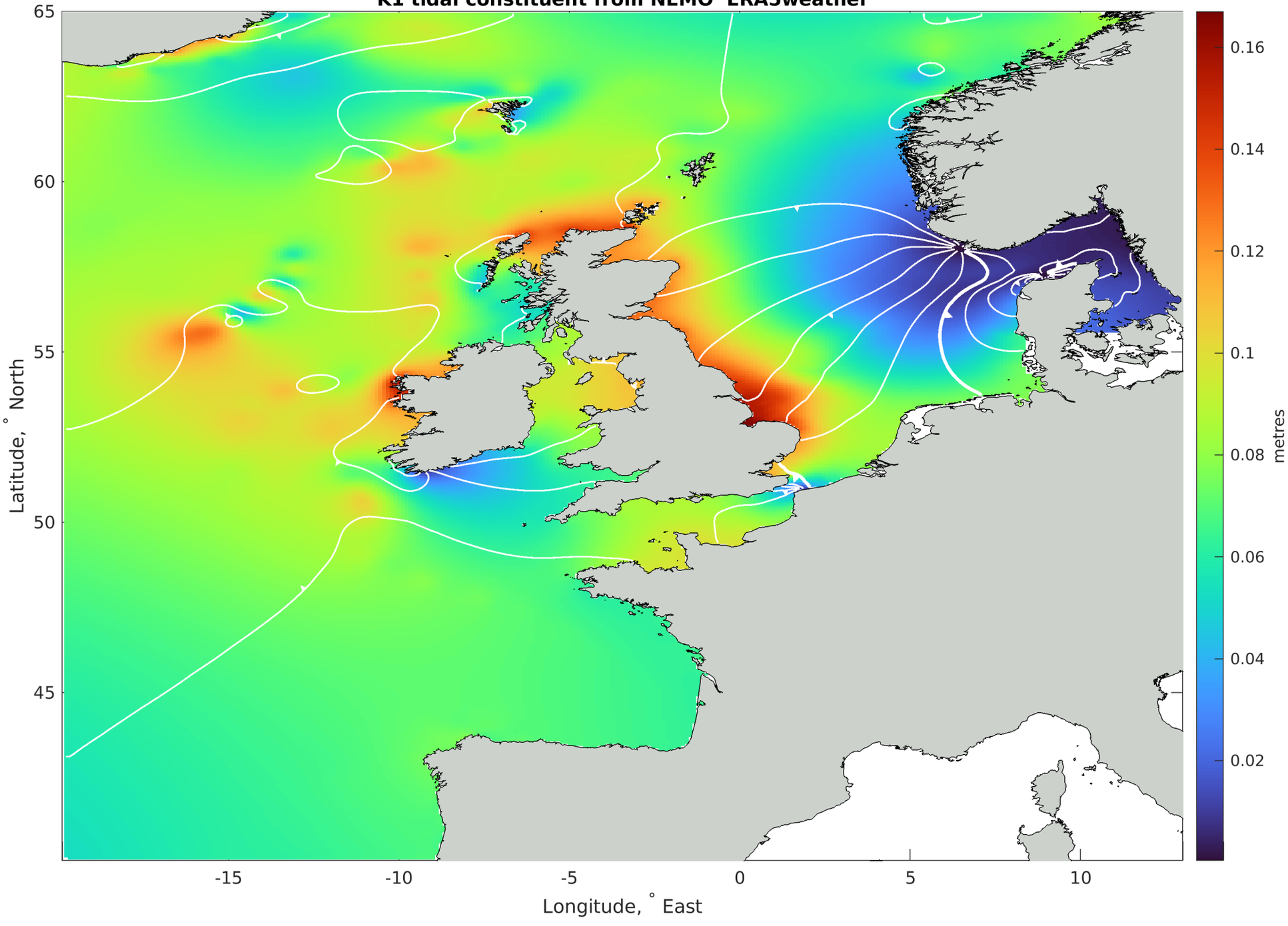
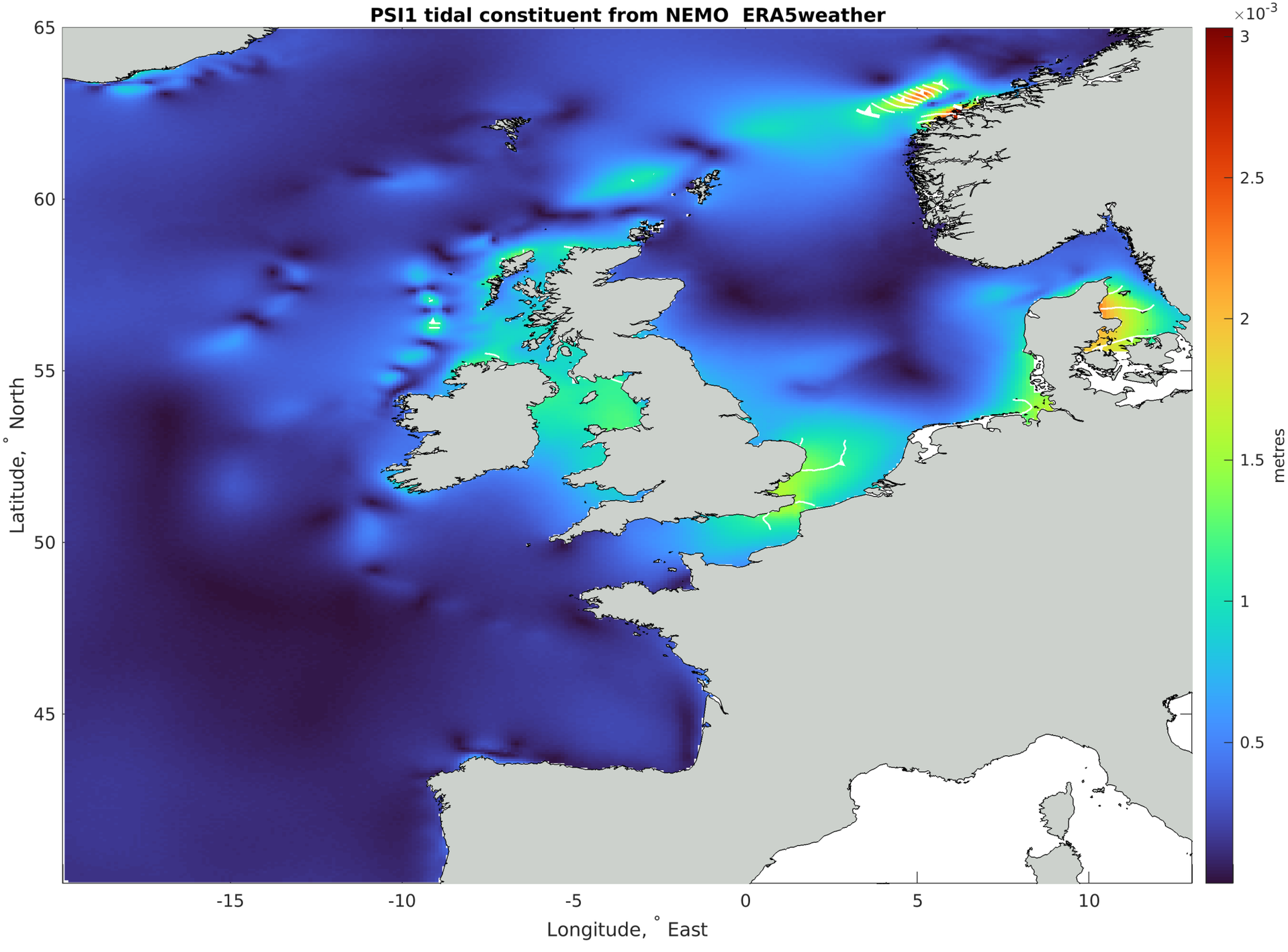
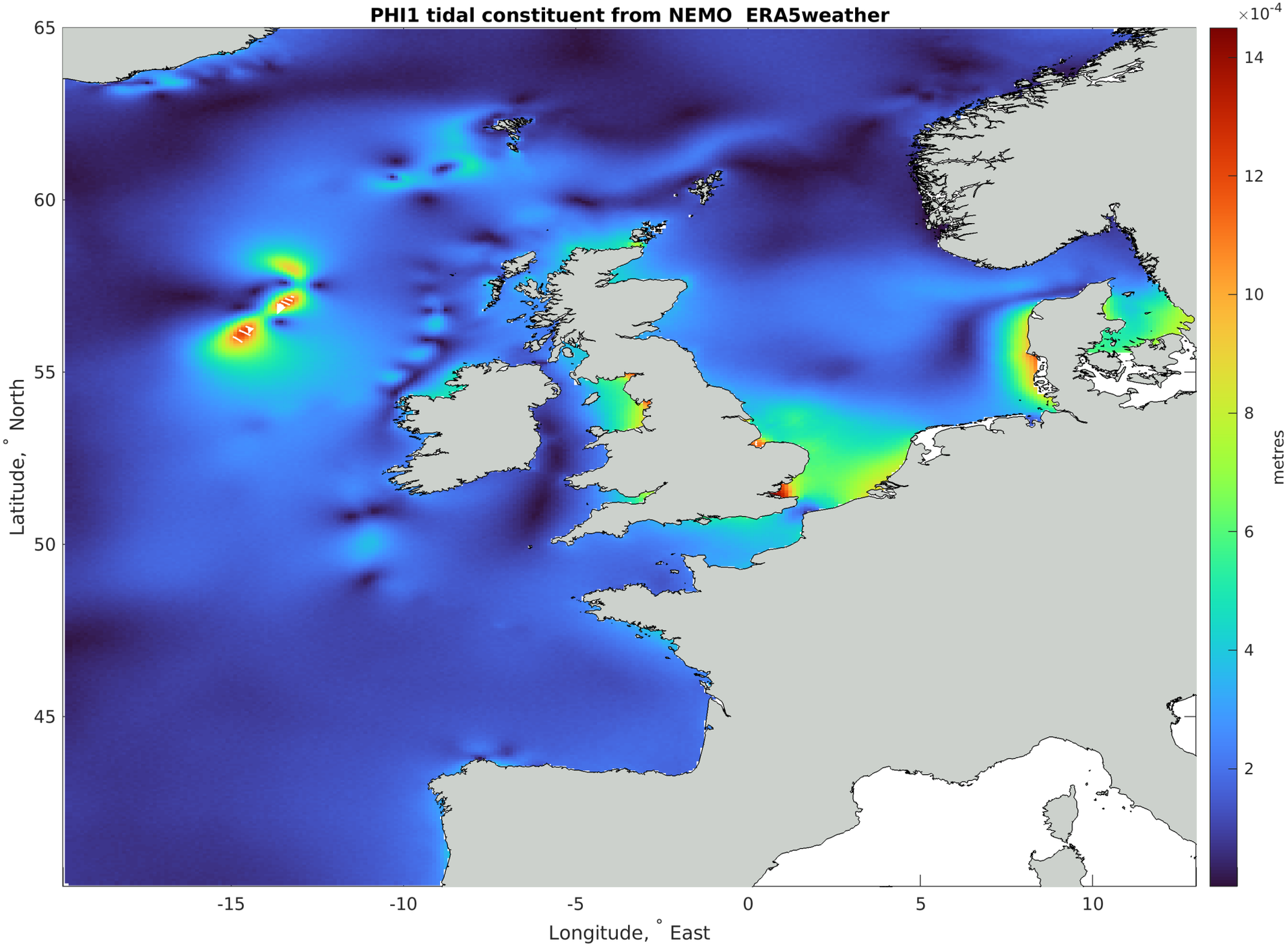
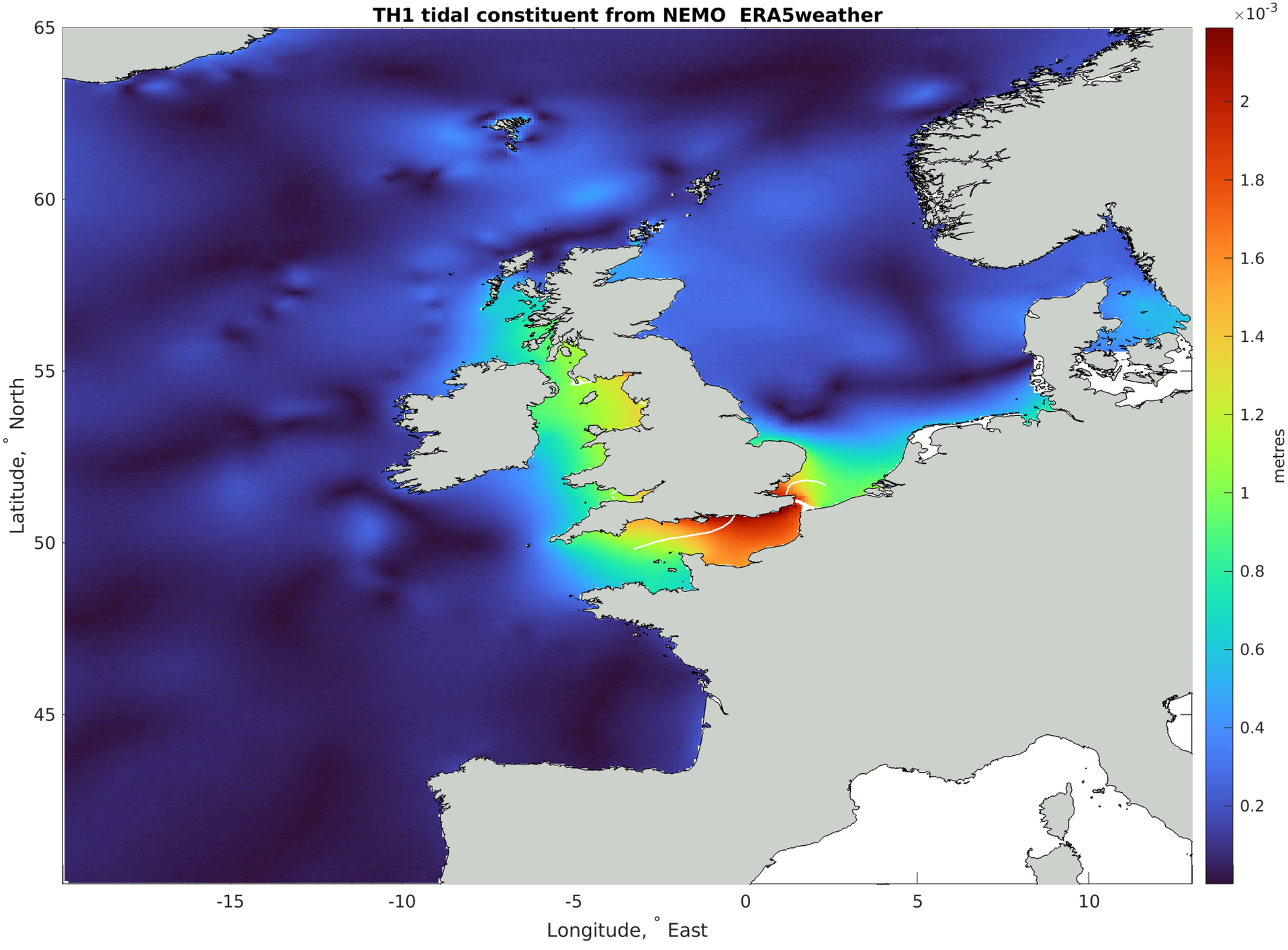
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.06
0.05
0.04
0.03
0.02
0.01
metres

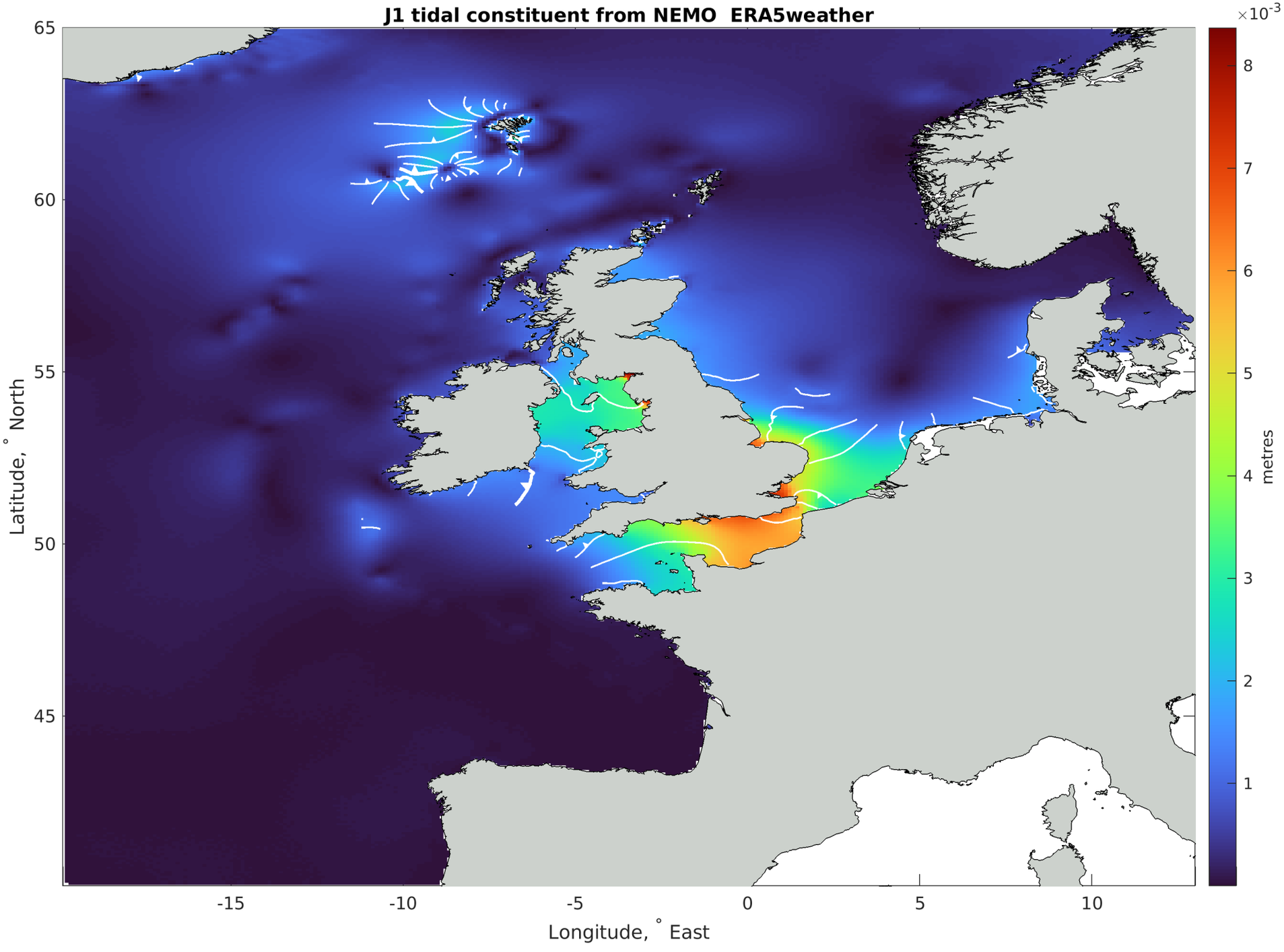

S1 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
12
10
8
6
4
2
metres

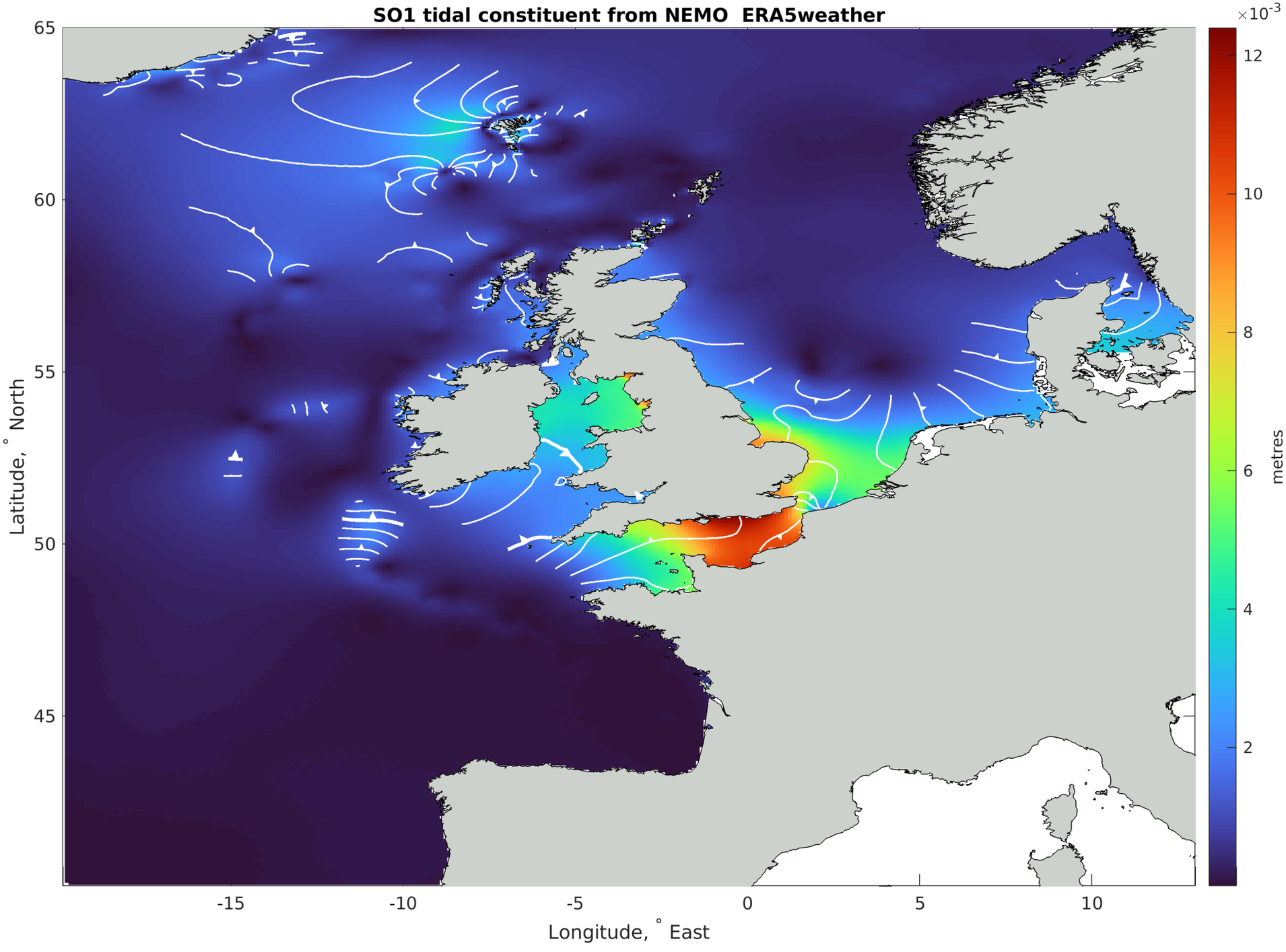

K1 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
metres

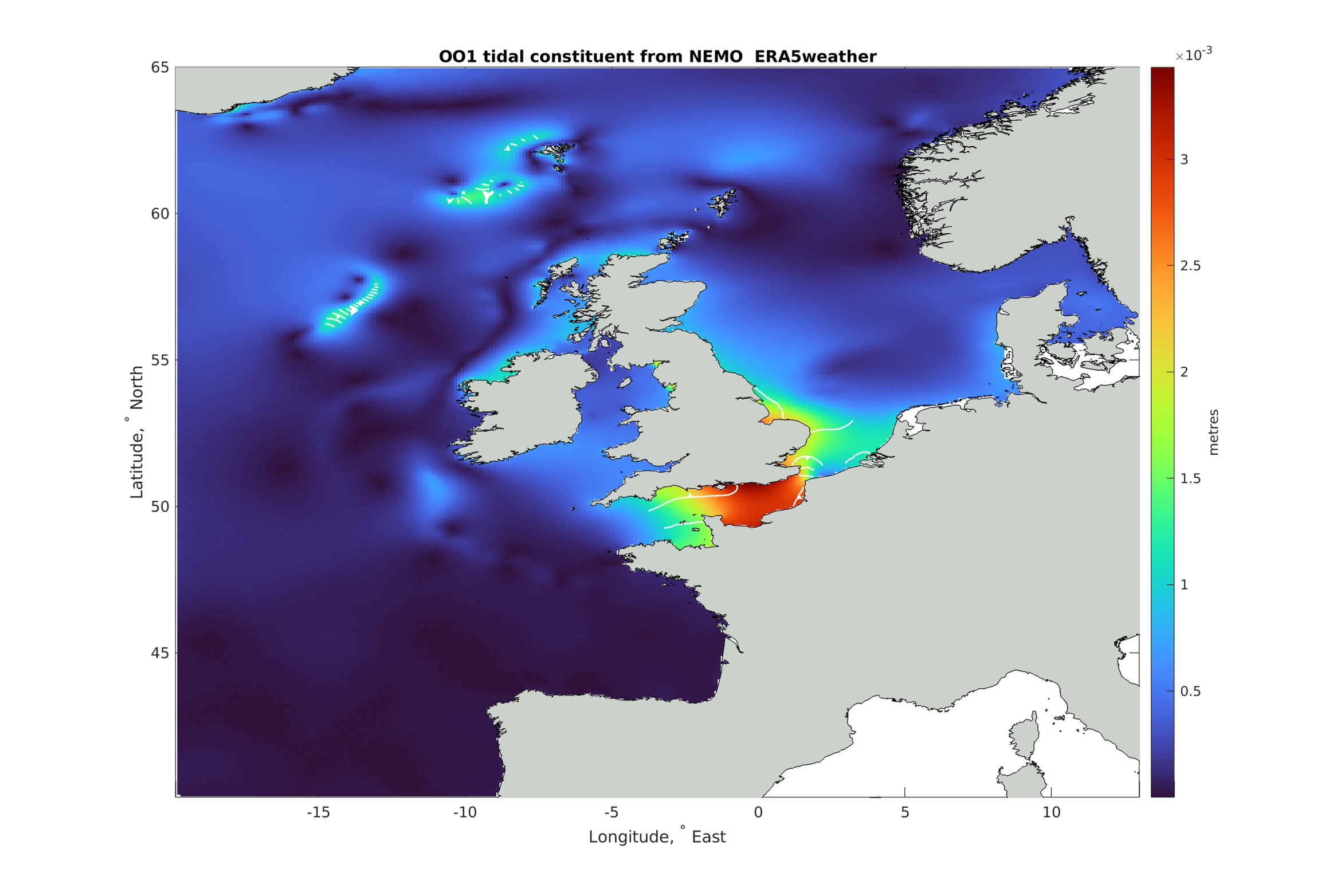

PSI1 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
3
2.5
2
1.5
1
0.5
metres

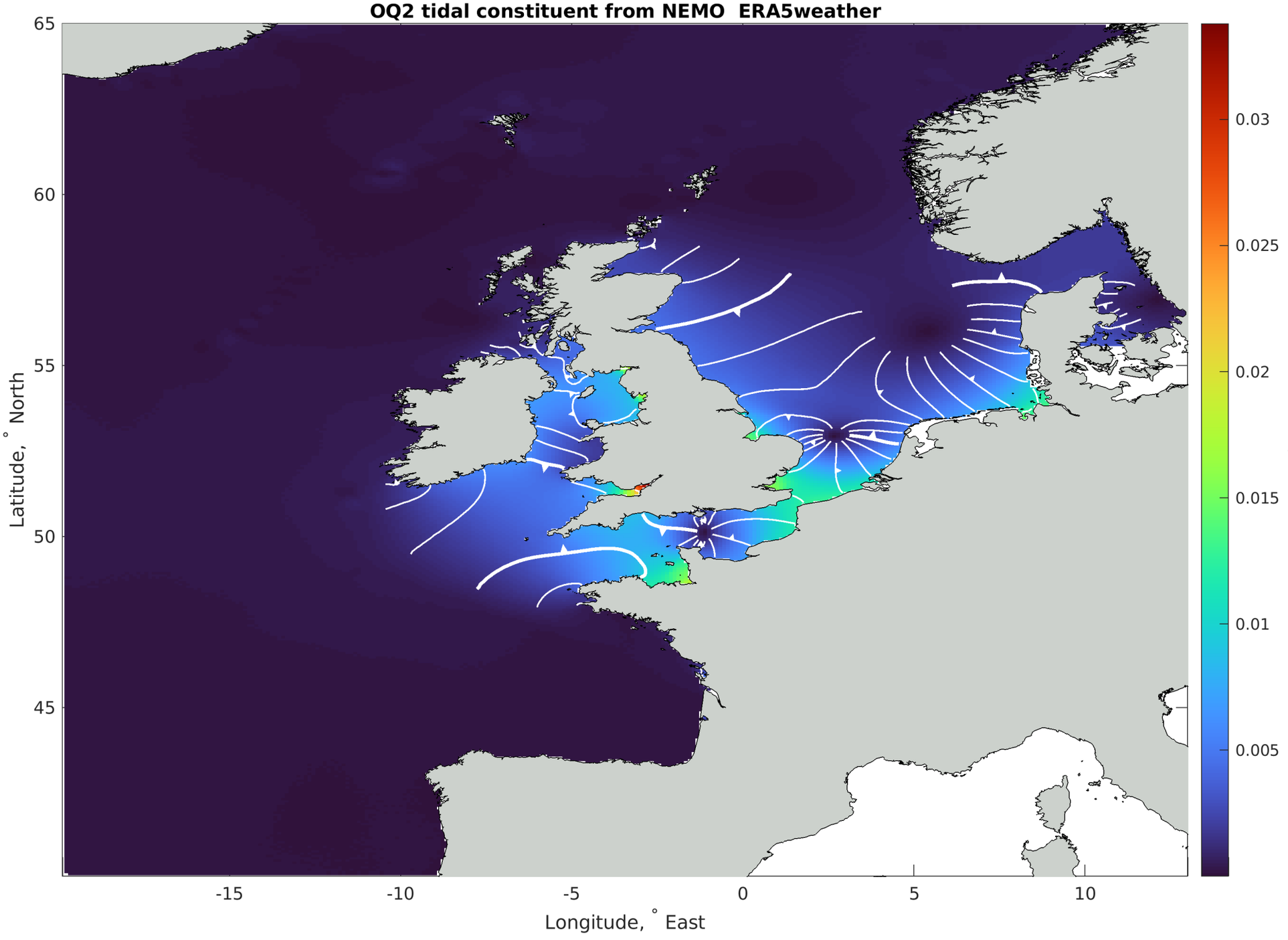

PHI1 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-4
14
12
10
8
6
4
2
metres

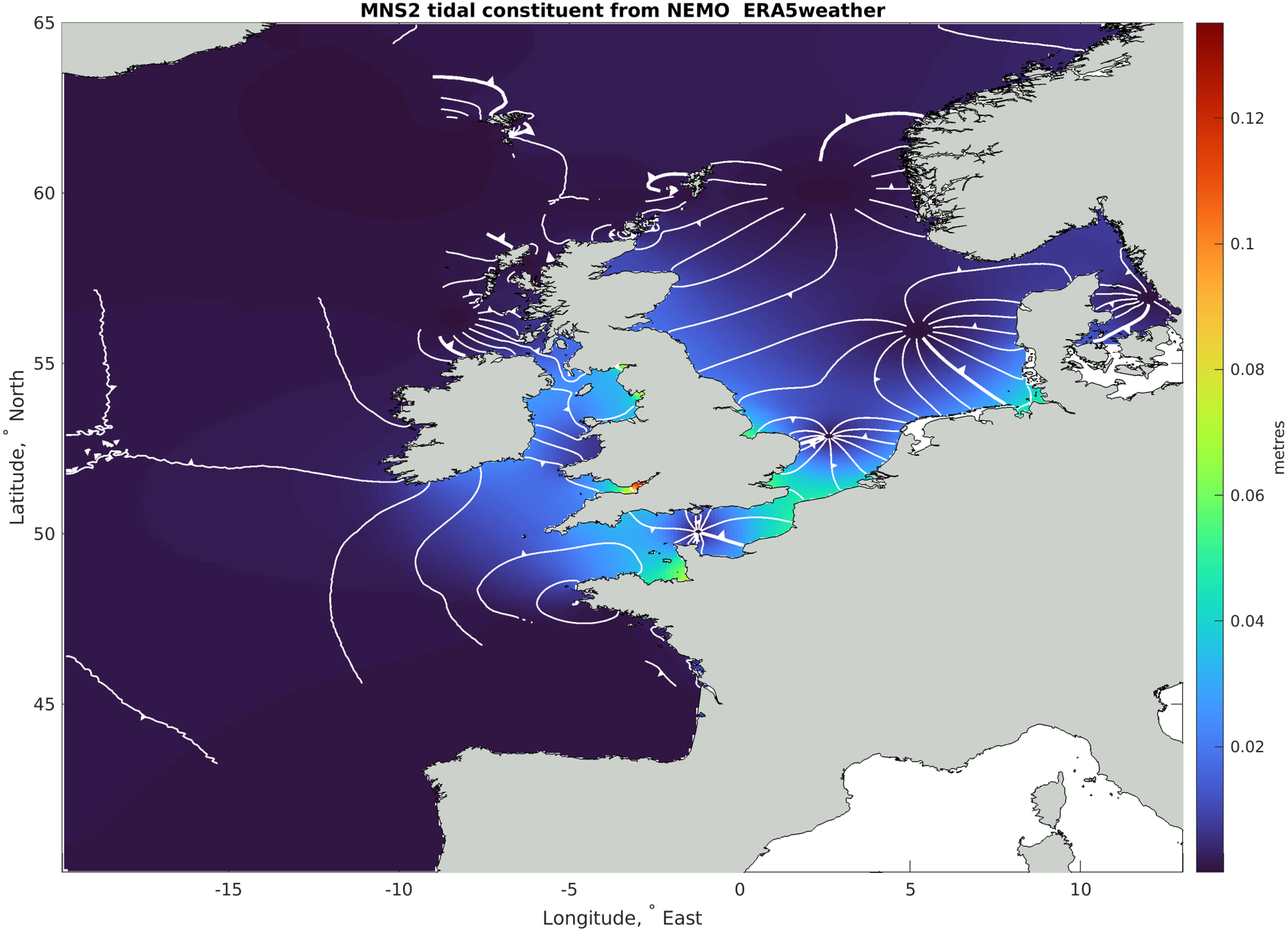

TH1 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
metres

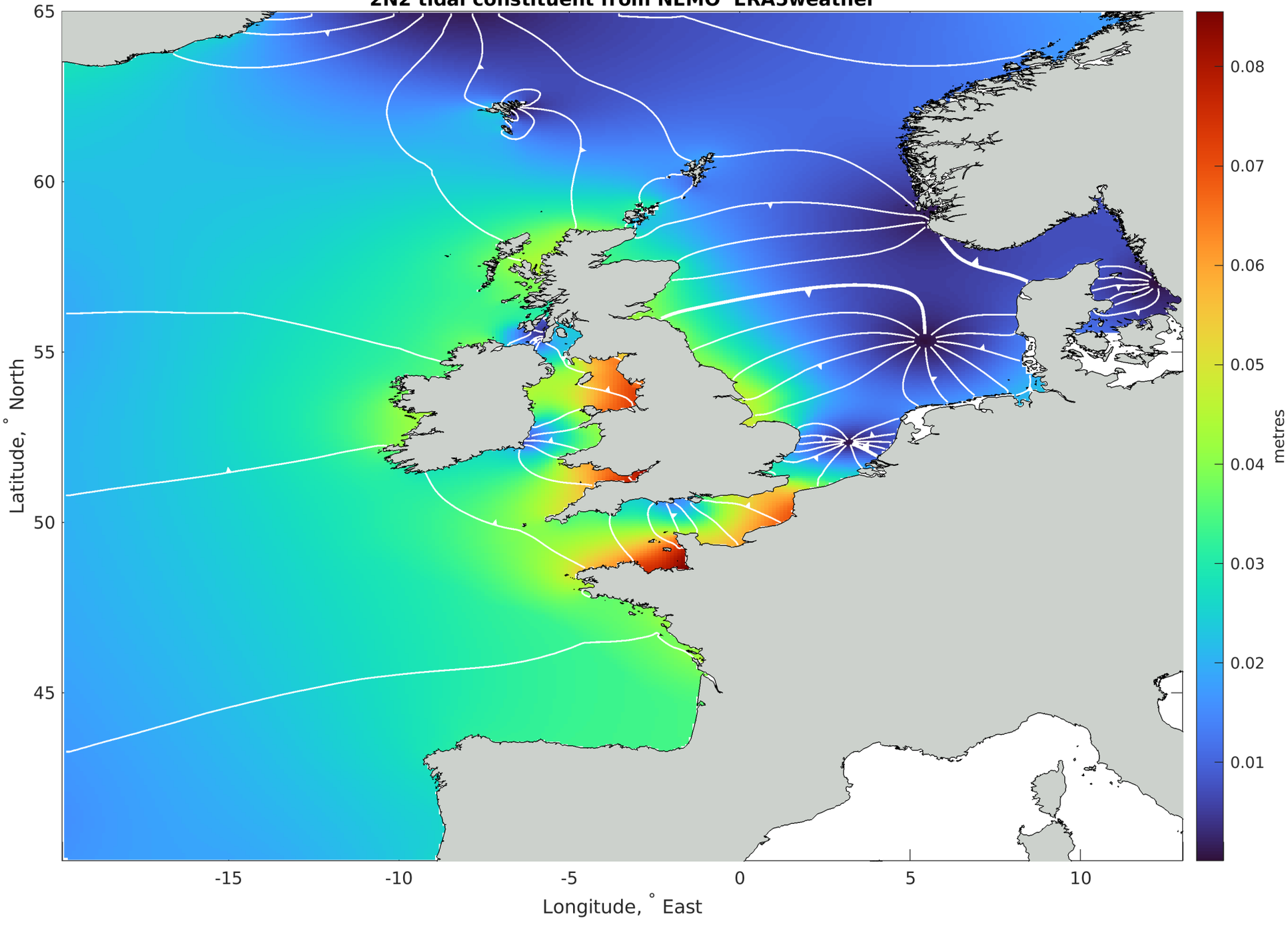

J1 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
8
7
6
5
4
3
2
1
metres

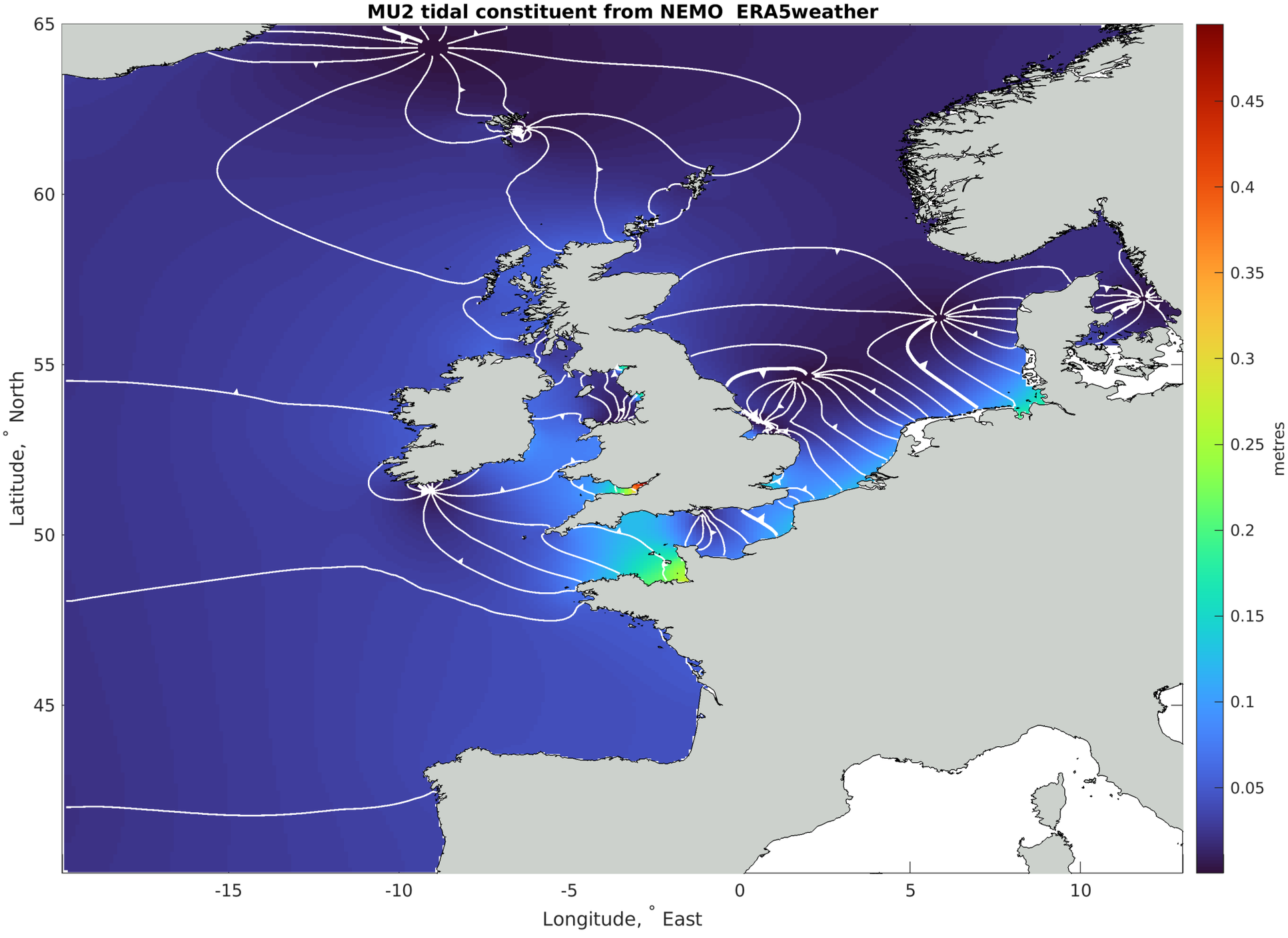

SO1 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
12
10
8
6
4
2
metres

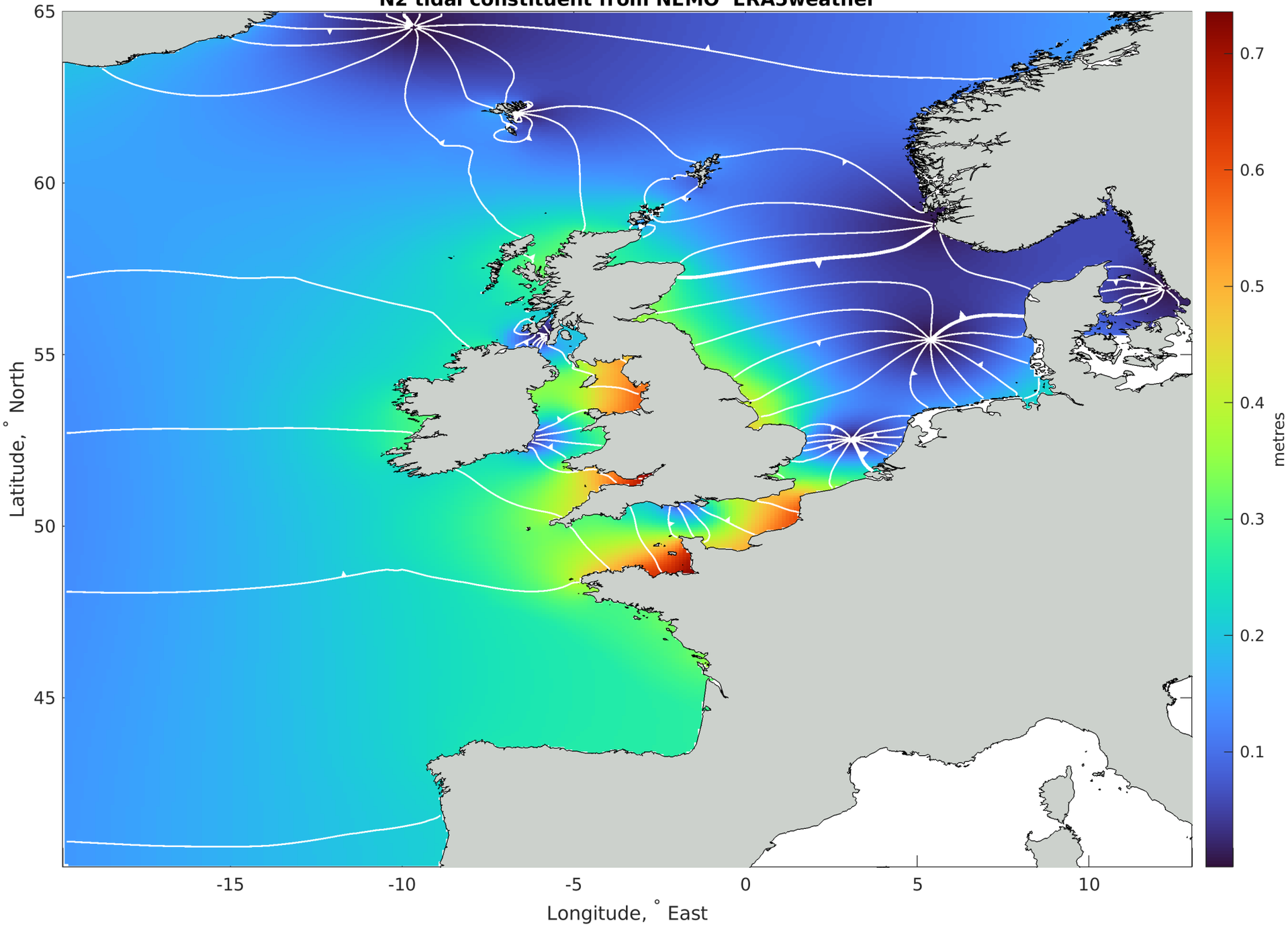

OO1 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
3
2.5
2
1.5
1
0.5
metres

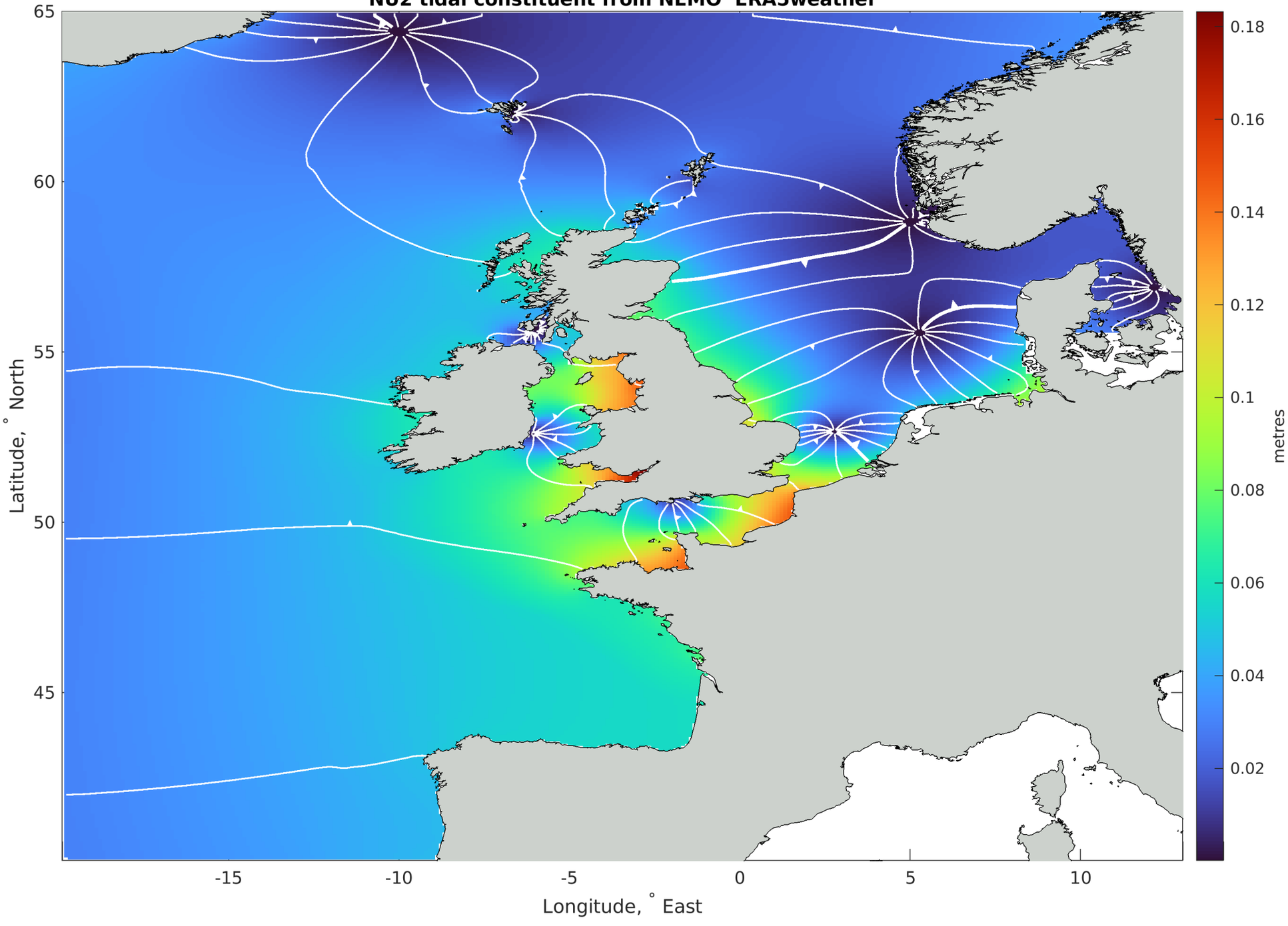

OQ2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.03
0.025
0.02
0.015
0.01
0.005
metres

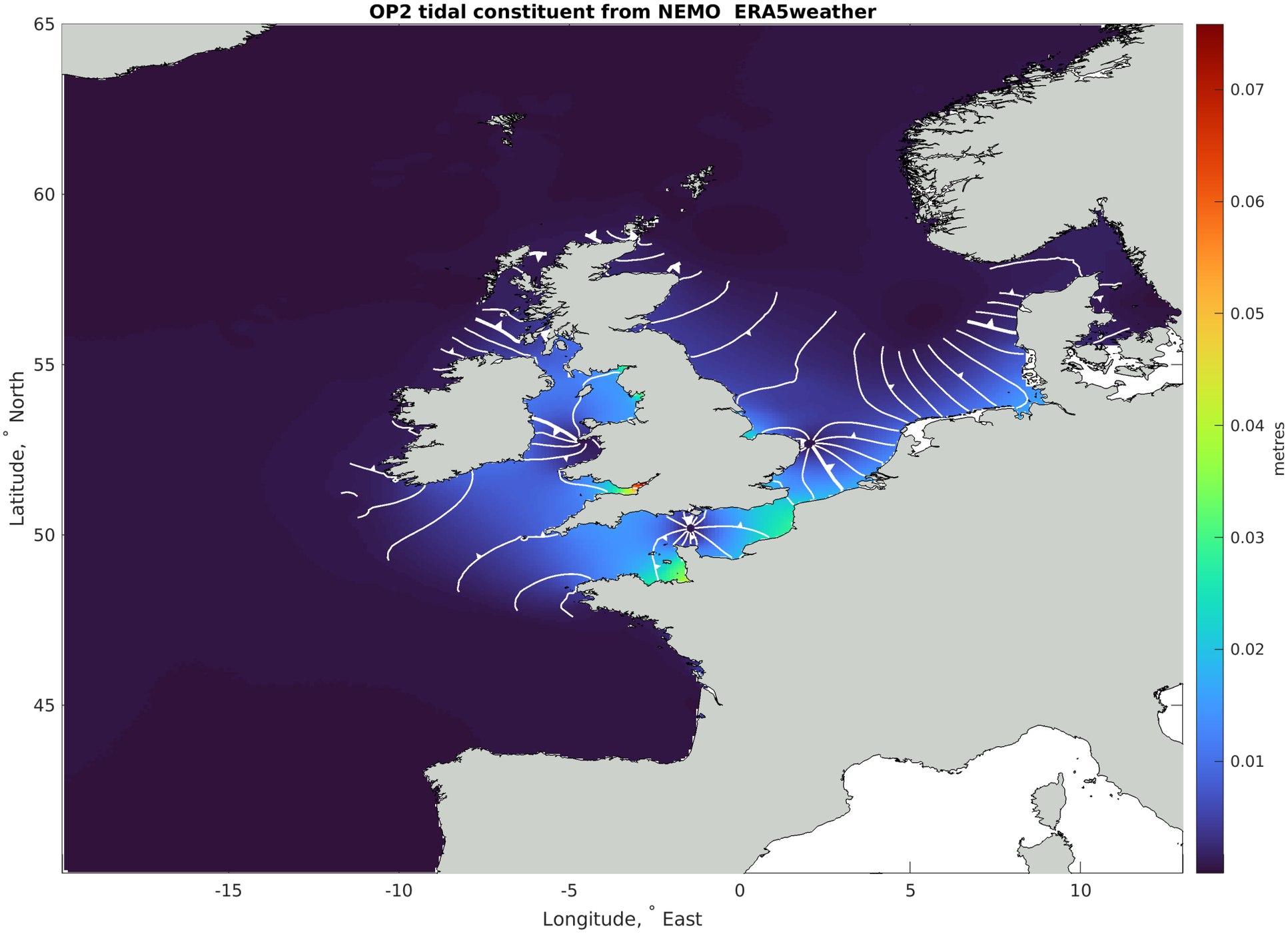

MNS2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.12
0.1
0.08
0.06
0.04
0.02
metres

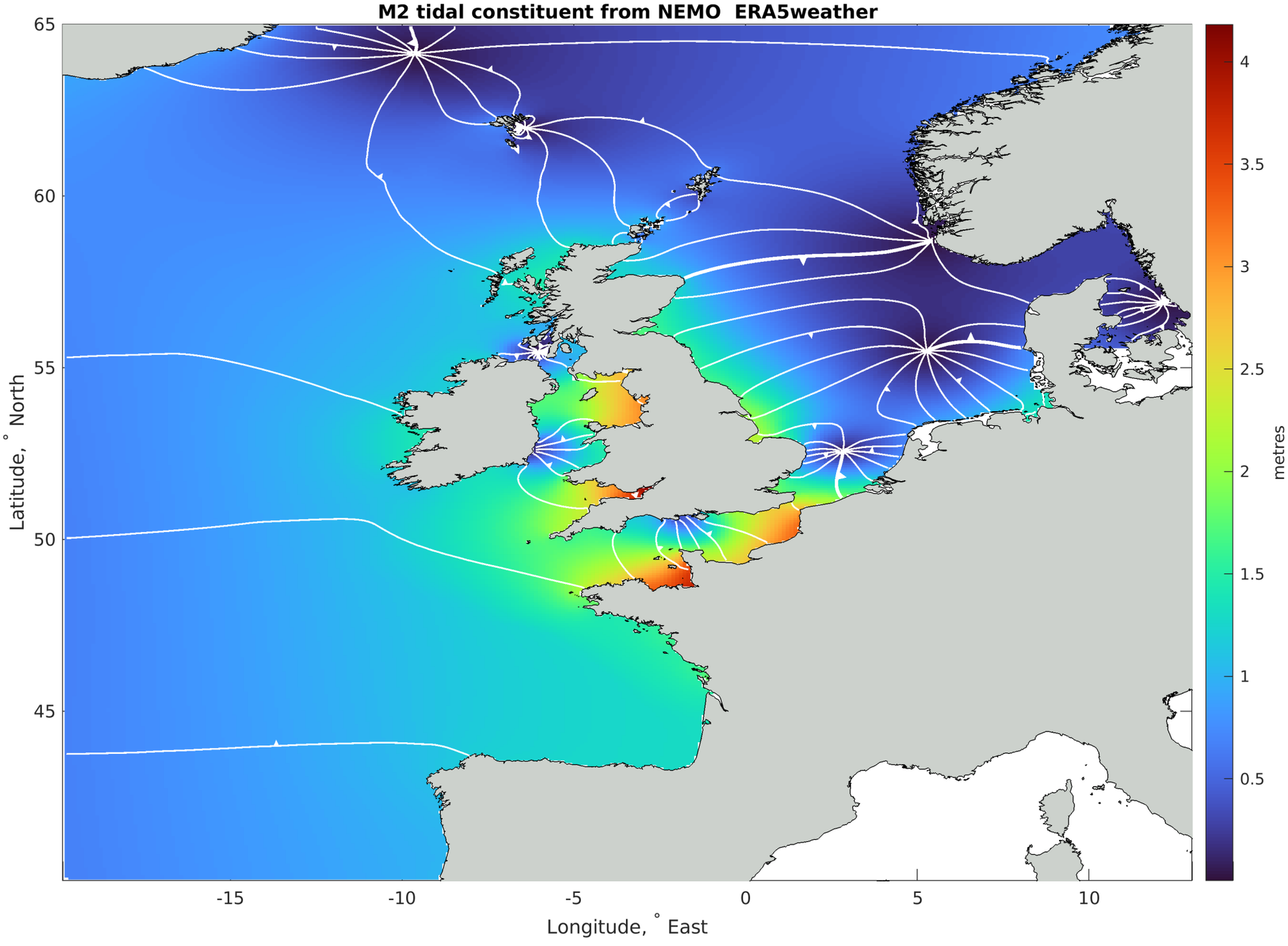

2N2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
metres

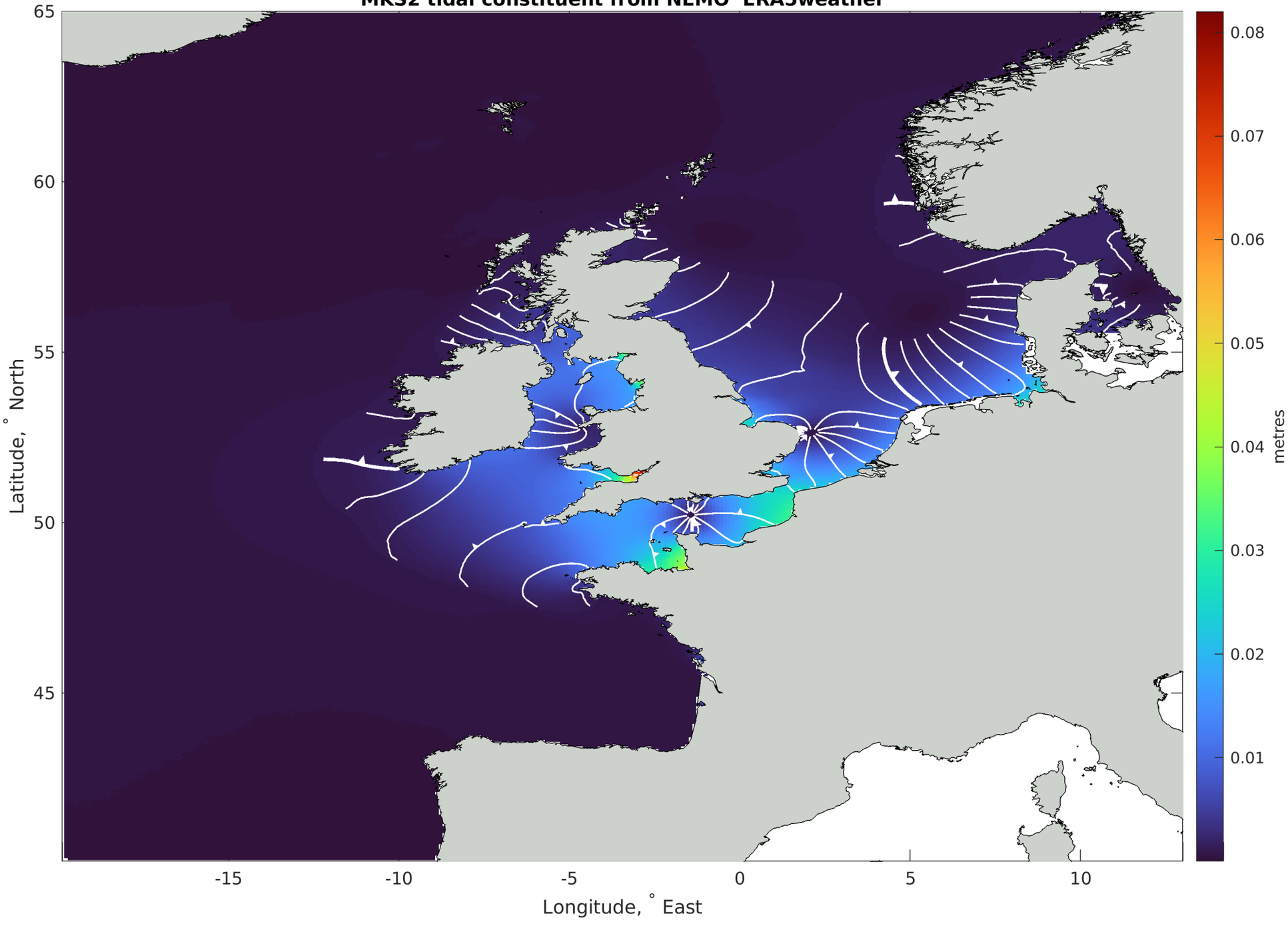

MU2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
metres

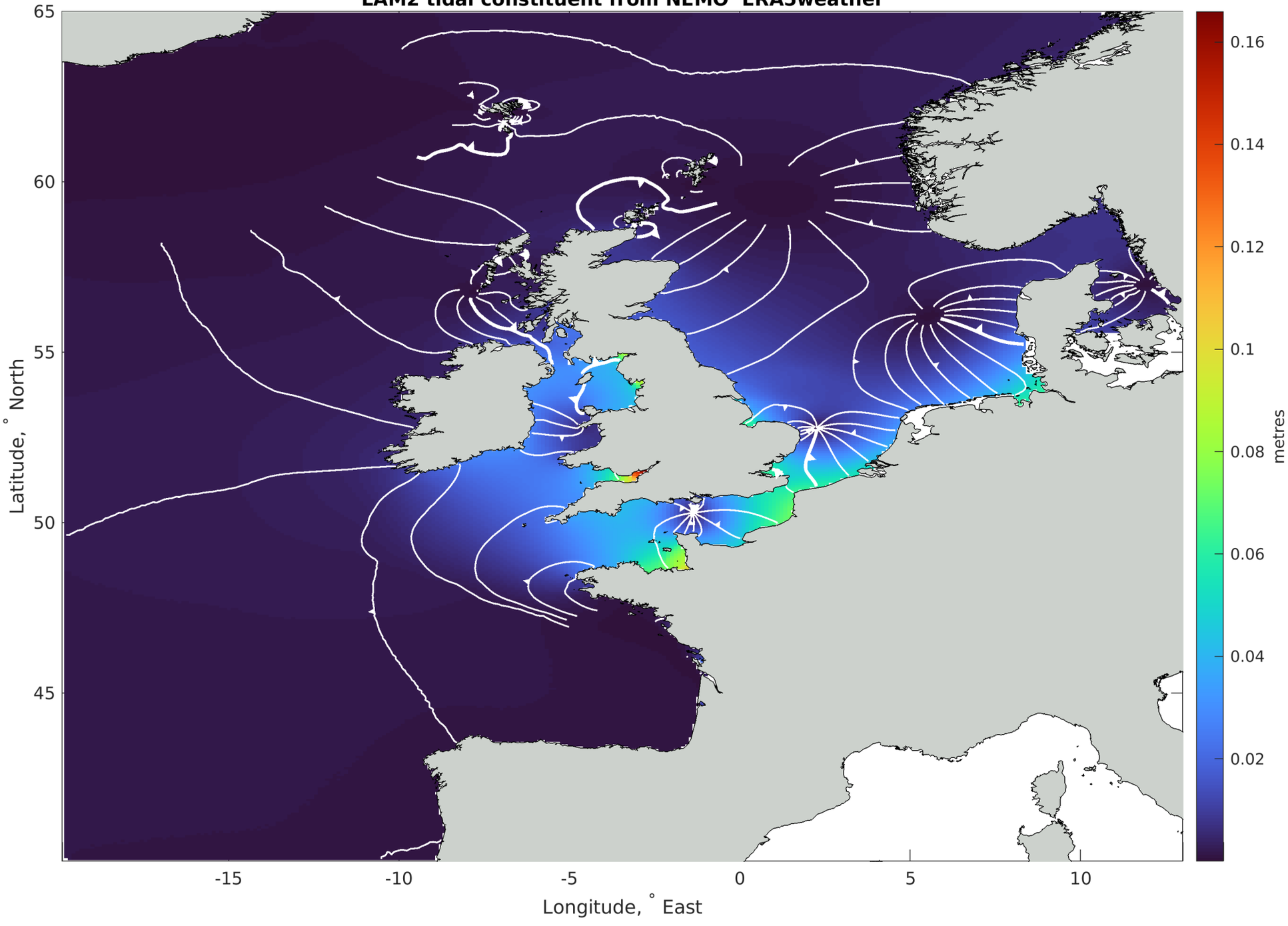

N2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.7
0.6
0.5
0.4
0.3
0.2
0.1
metres

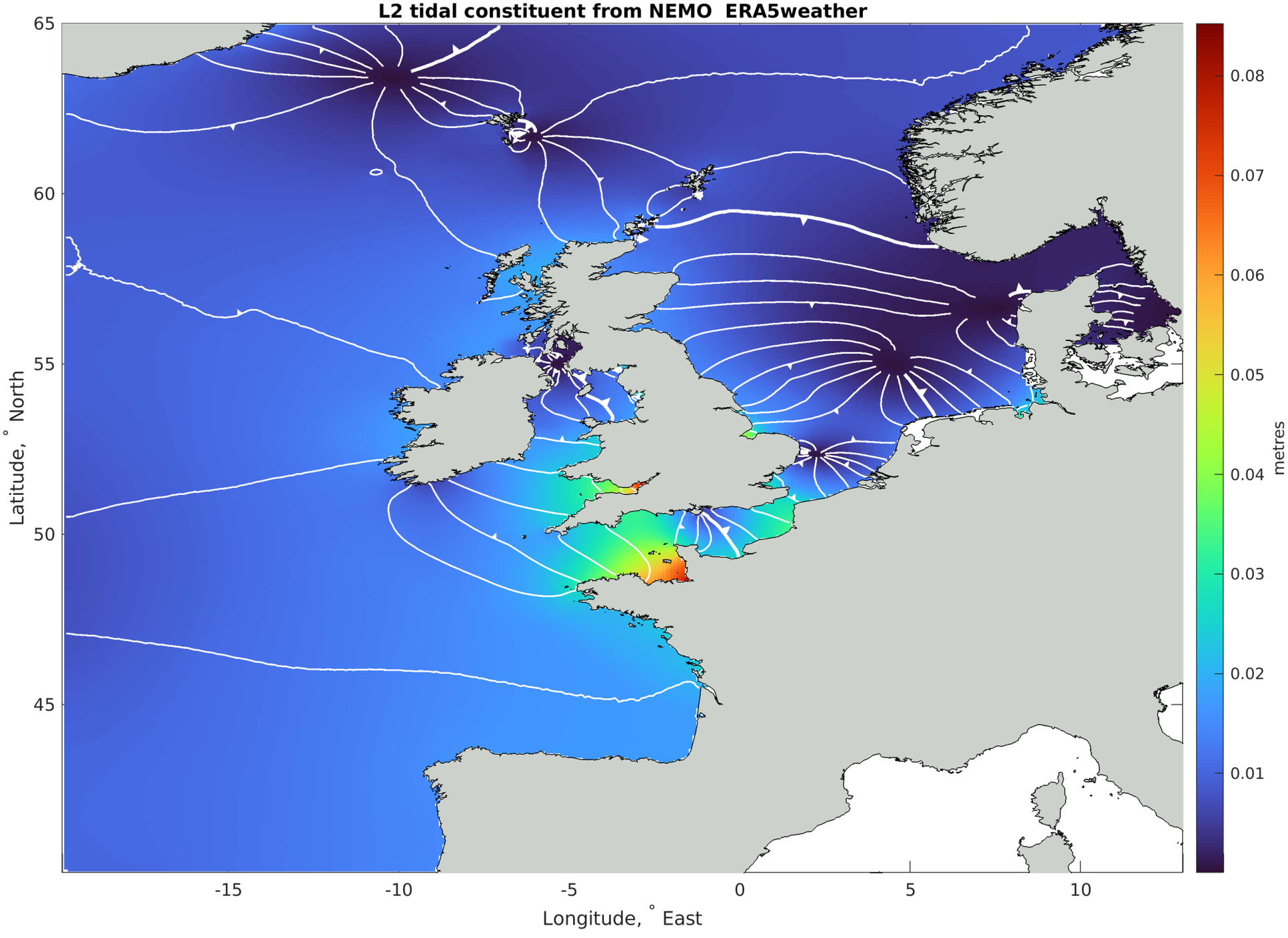

NU2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
metres

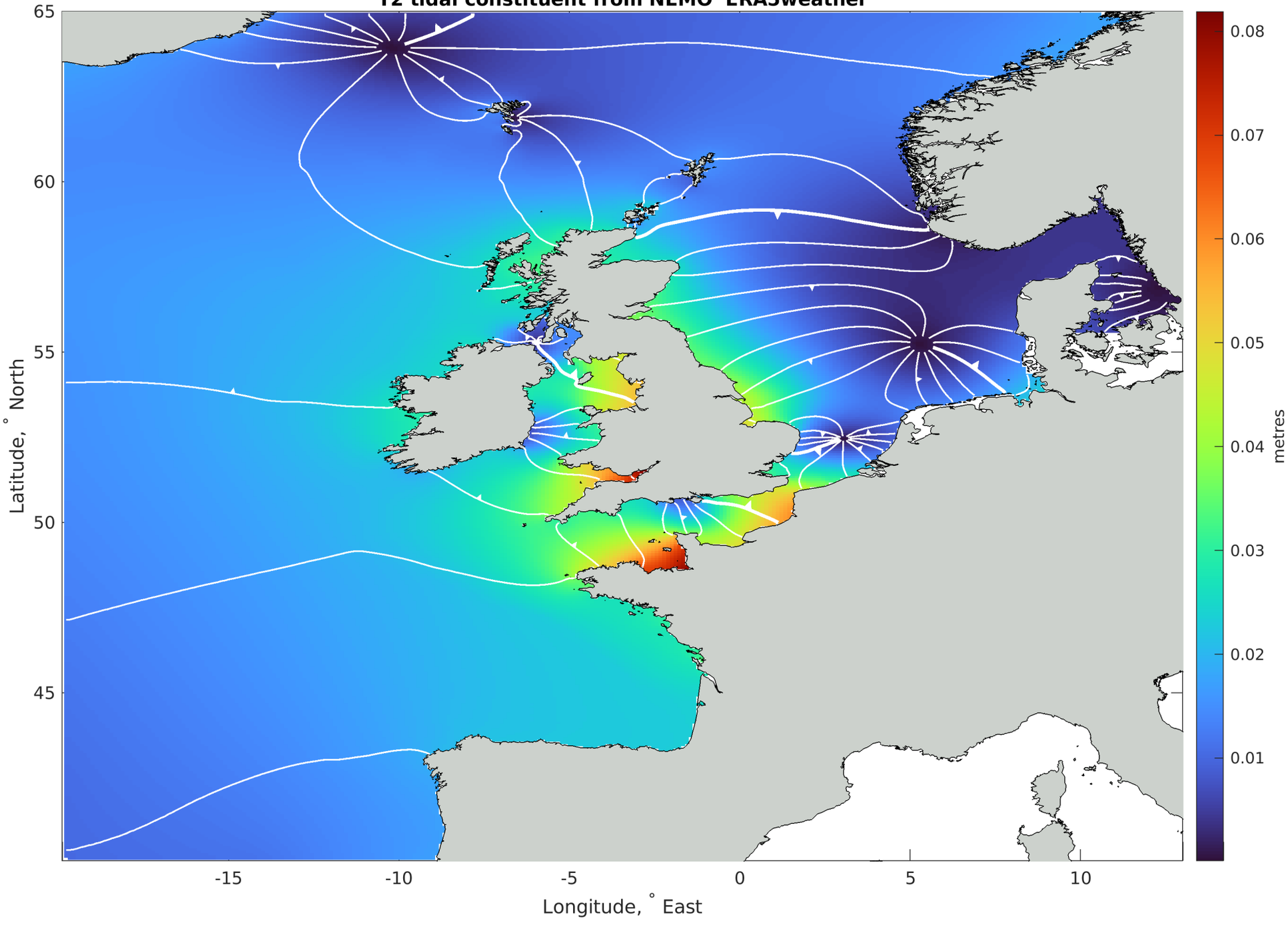

OP2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.07
0.06
0.05
0.04
0.03
0.02
0.01
metres

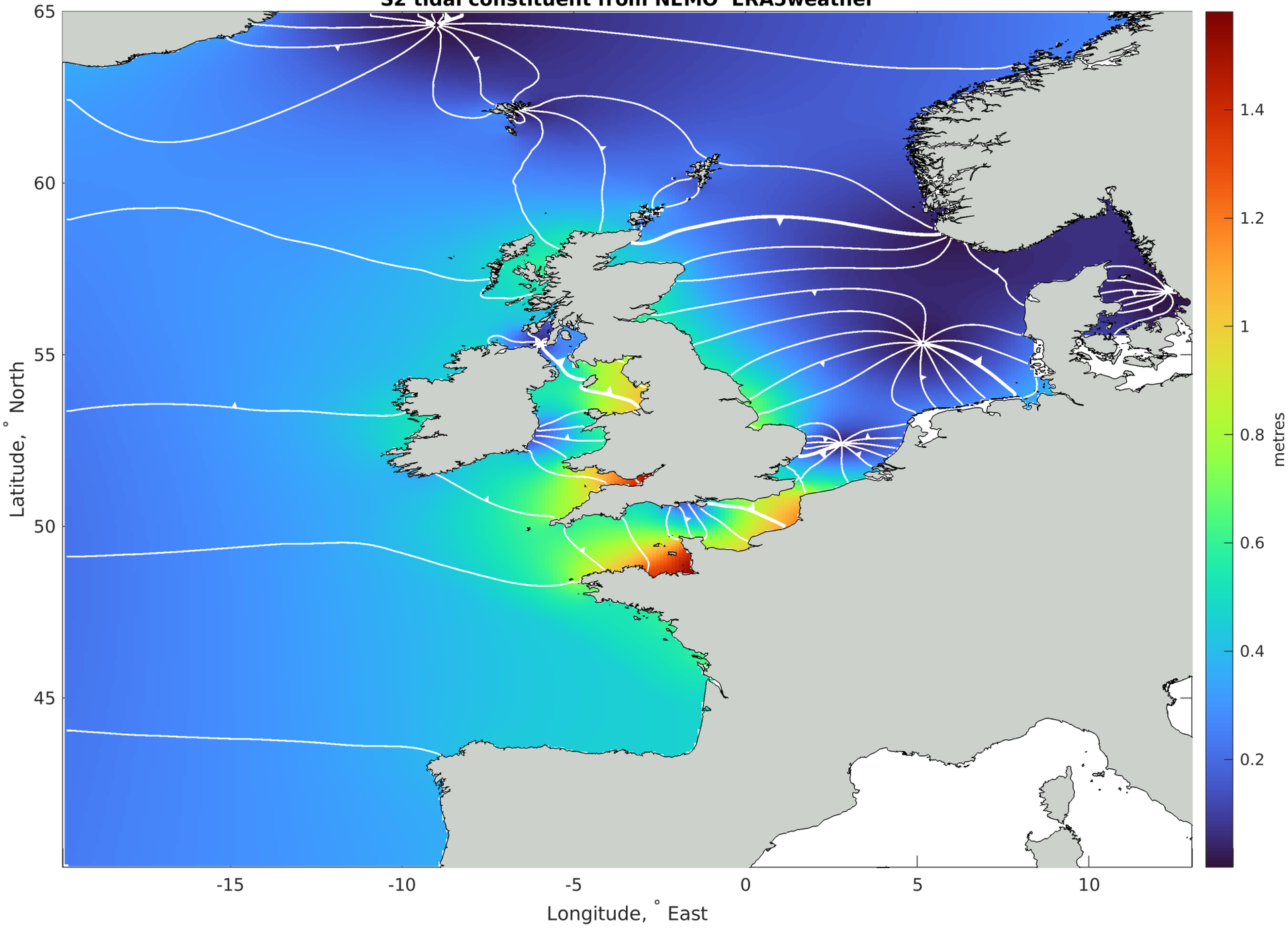

M2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
4
3.5
3
2.5
2
1.5
1
0.5
metres

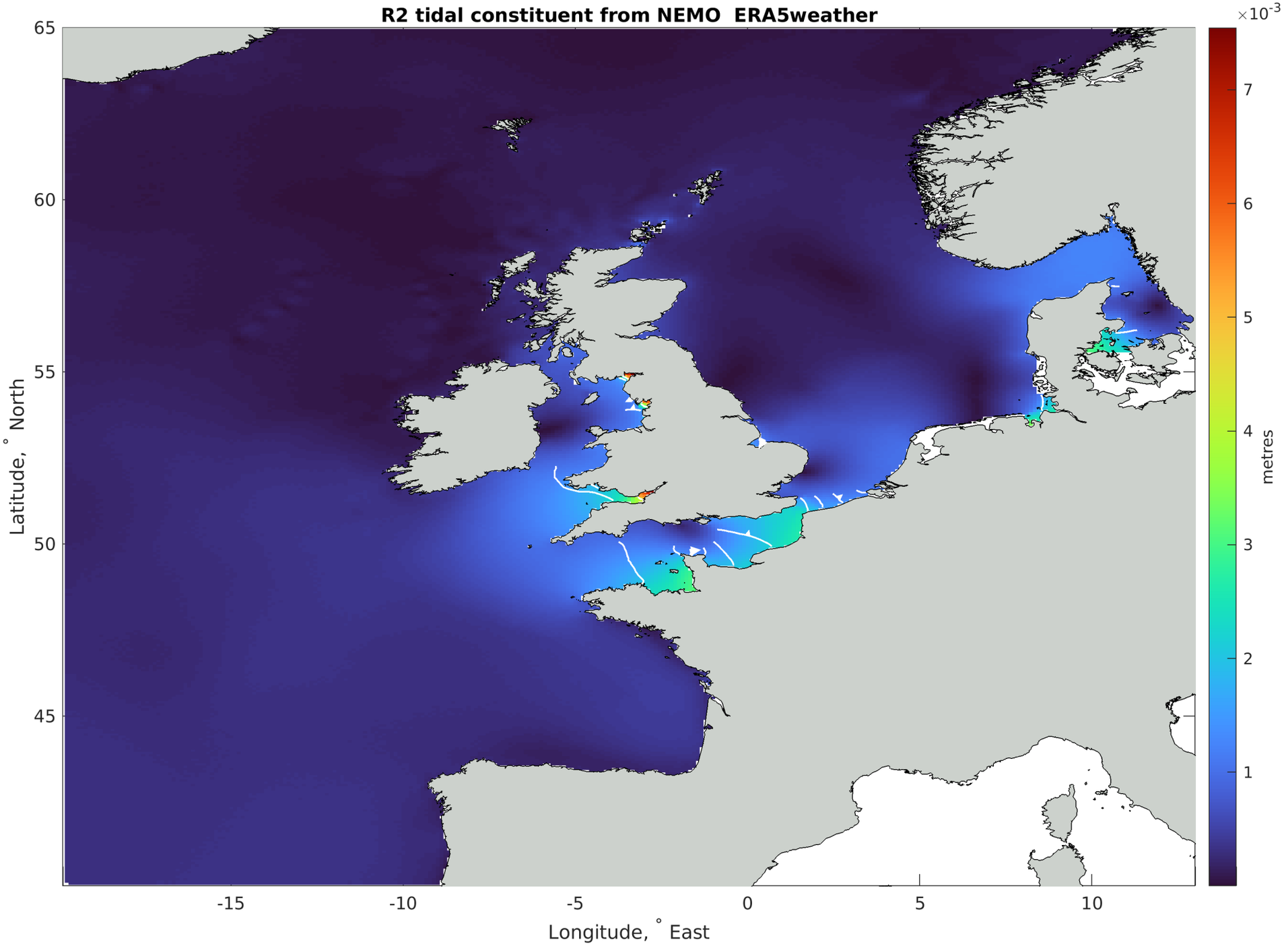

MKS2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
metres

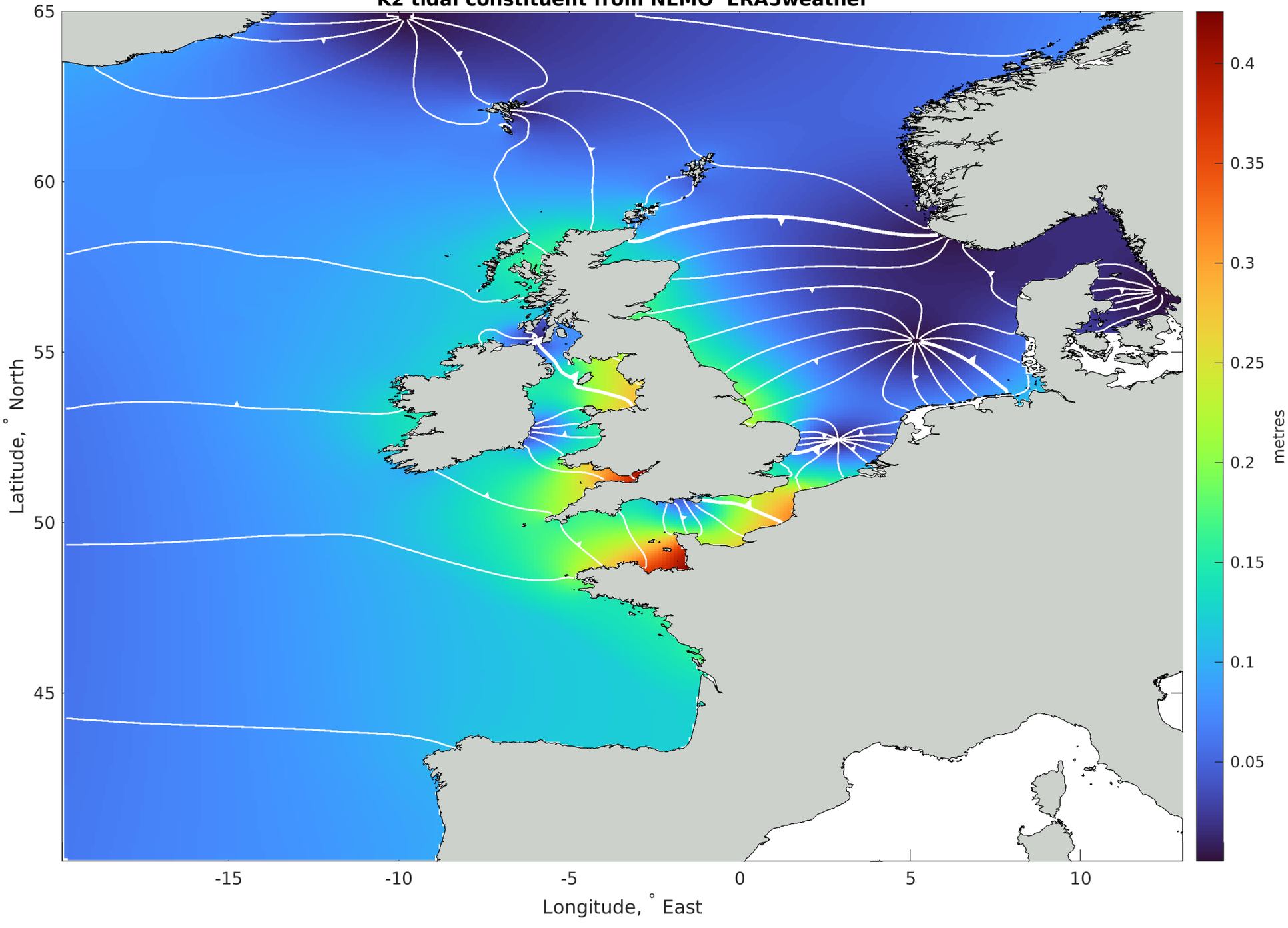

LAM2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
metres

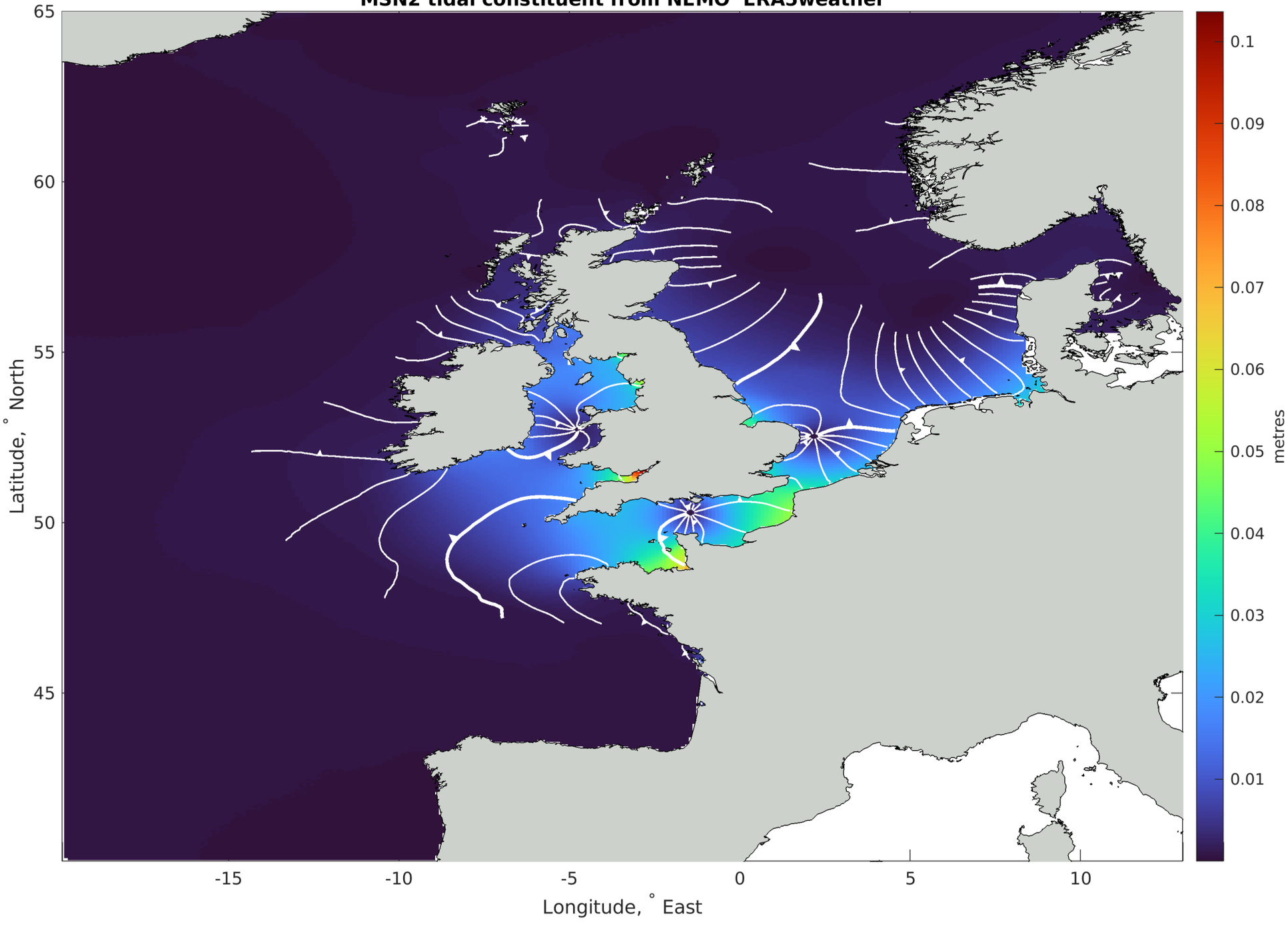

L2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
metres

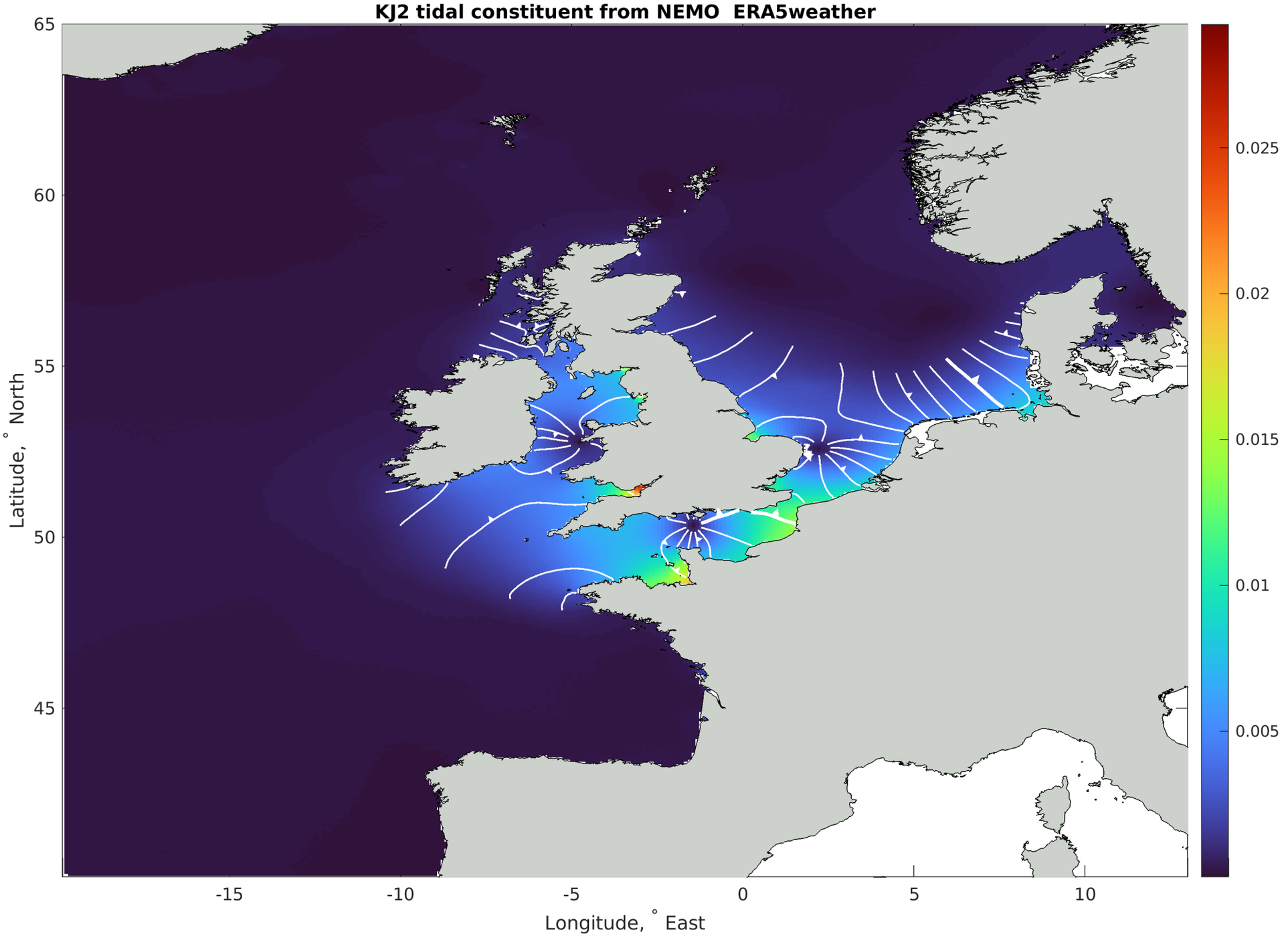

T2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
metres

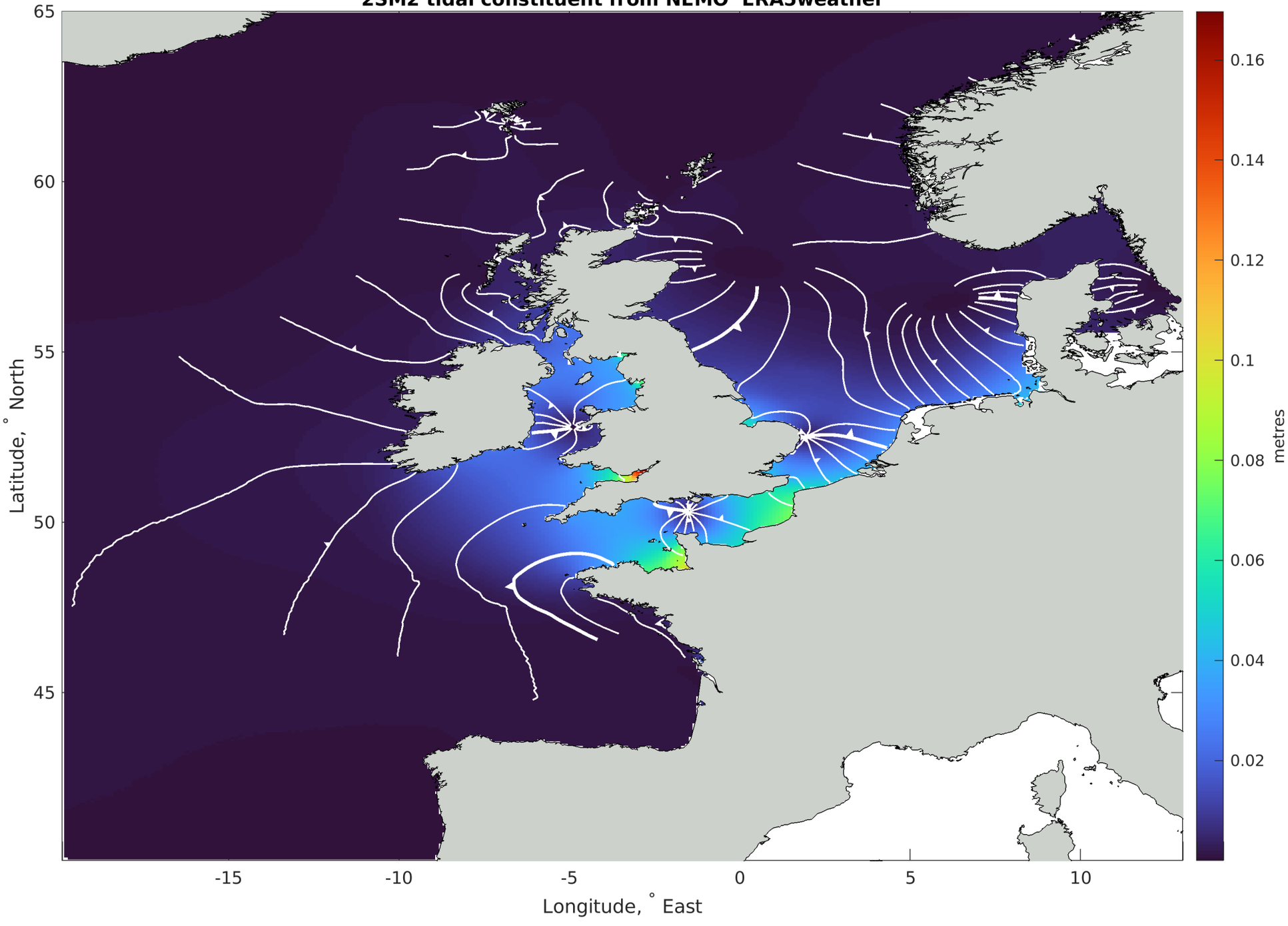

S2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
1.4
1.2
1
0.8
0.6
0.4
0.2
metres

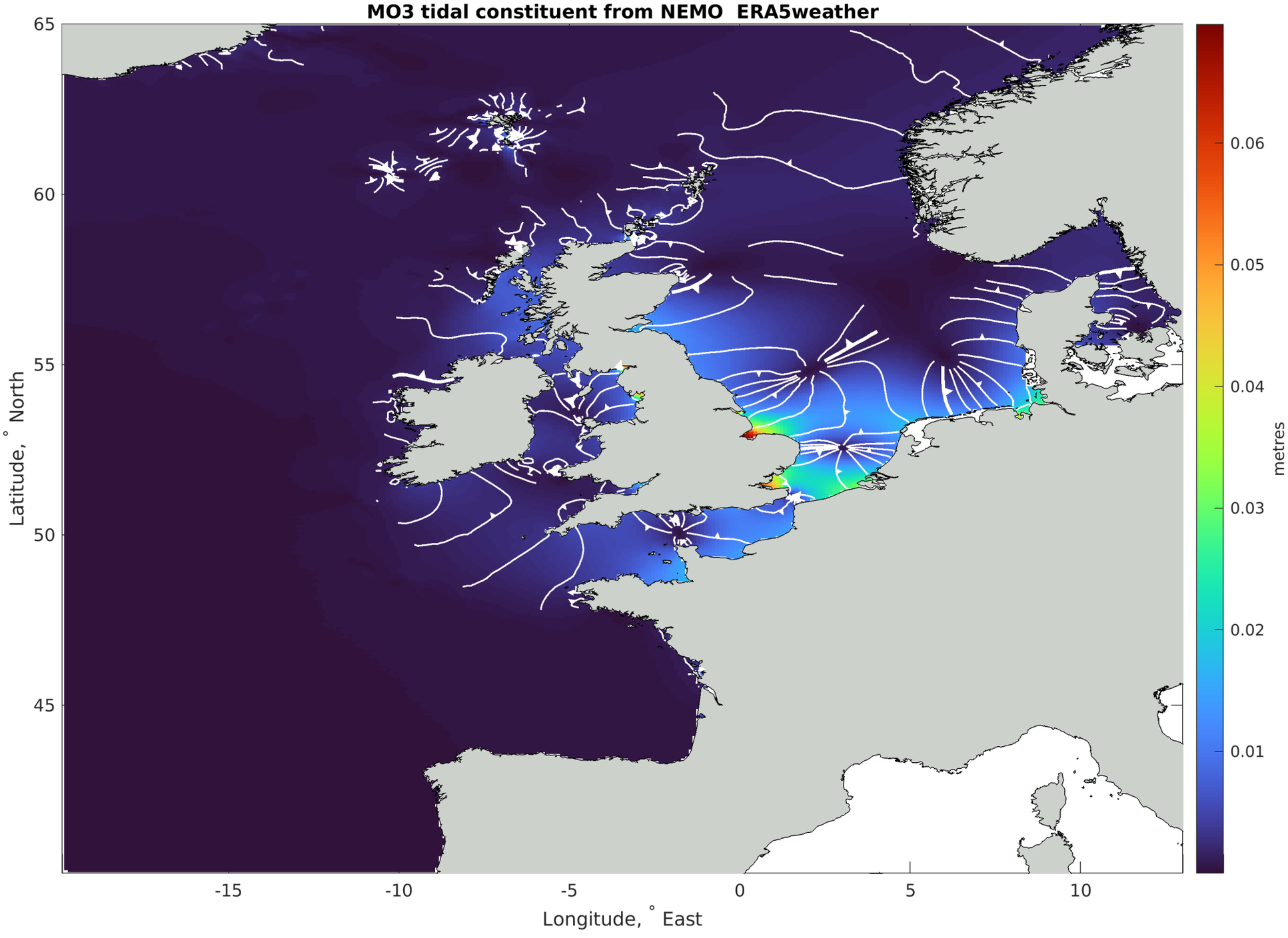

R2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
7
6
5
4
3
2
1
metres

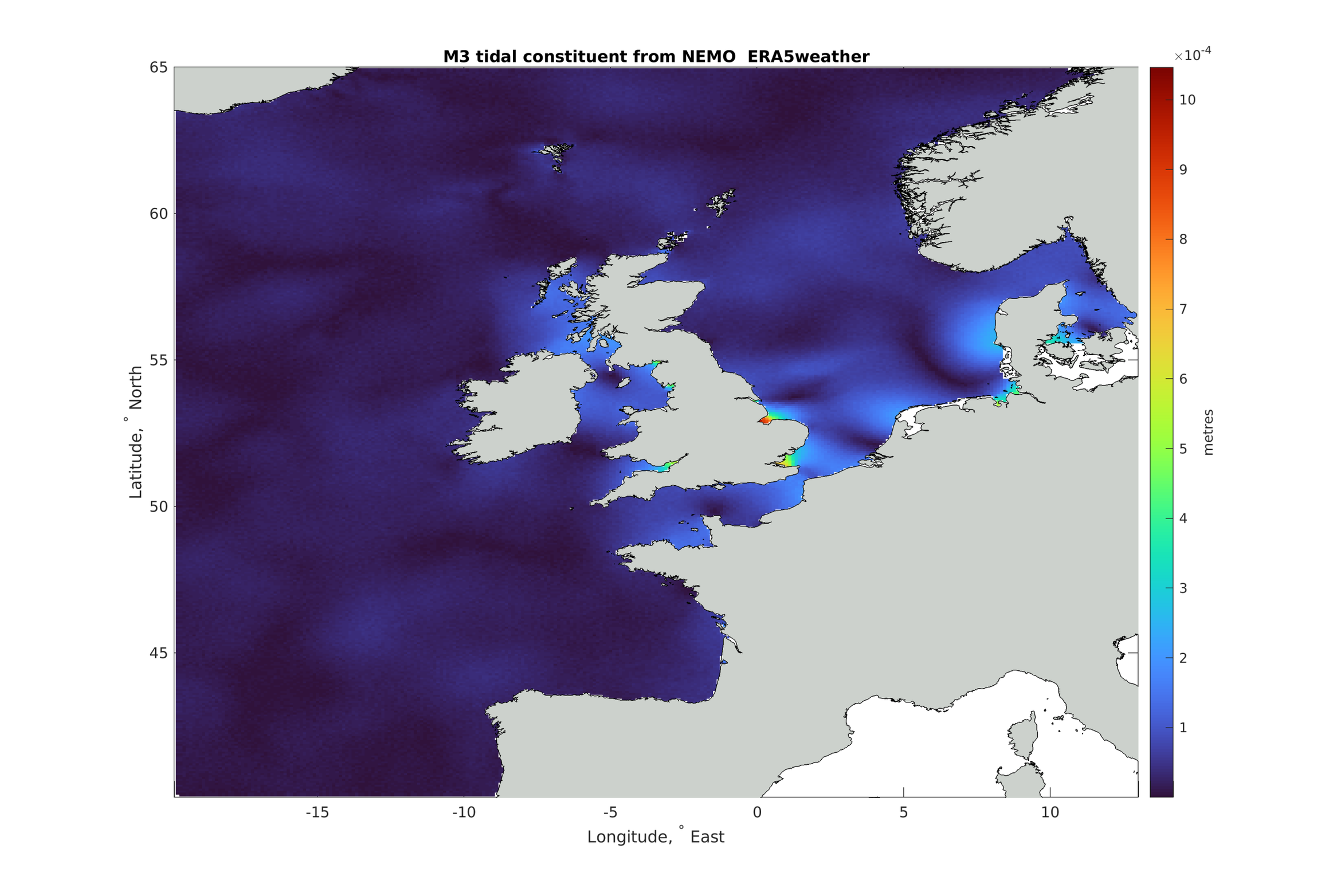

K2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
metres

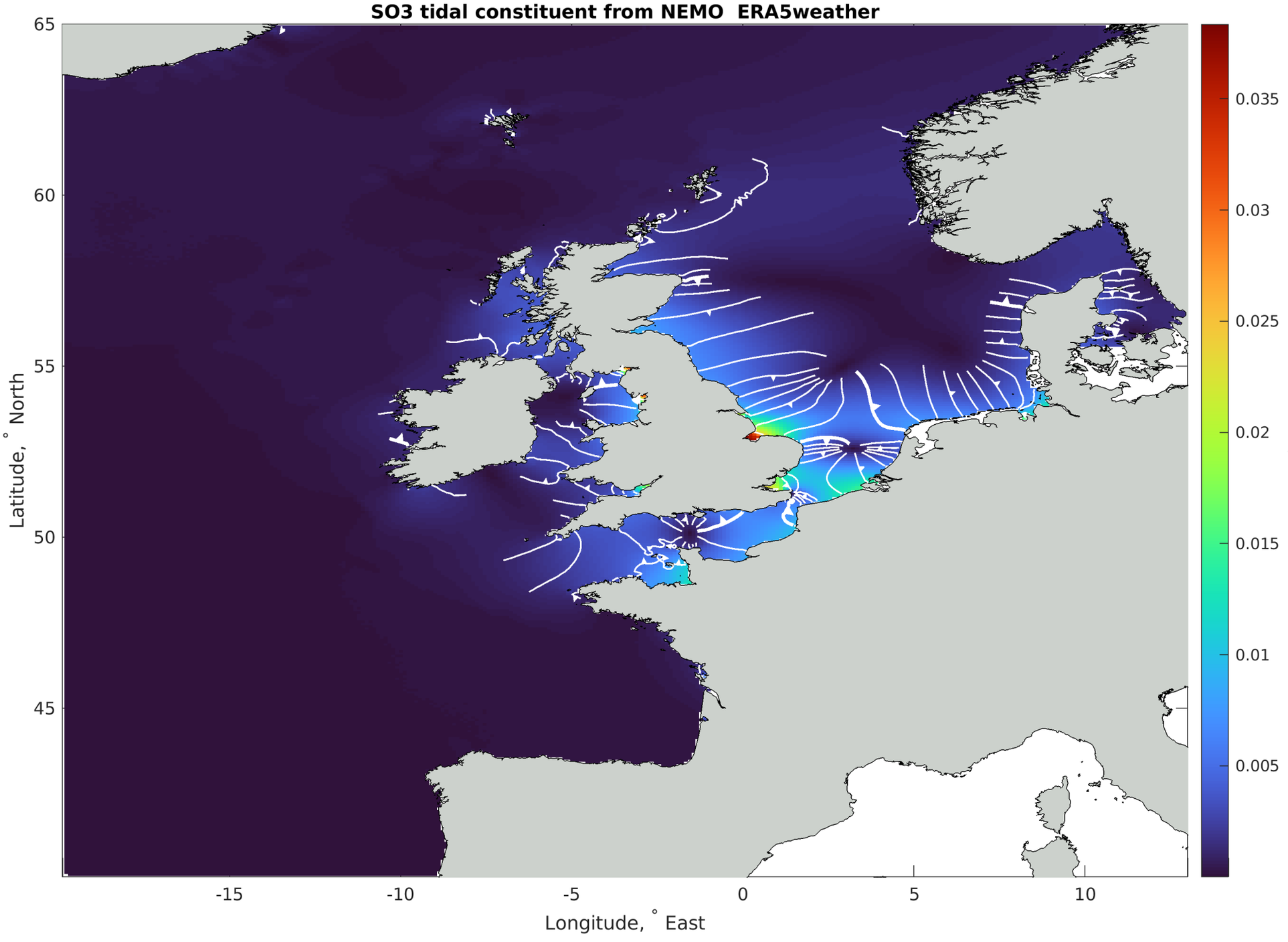

MSN2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
metres

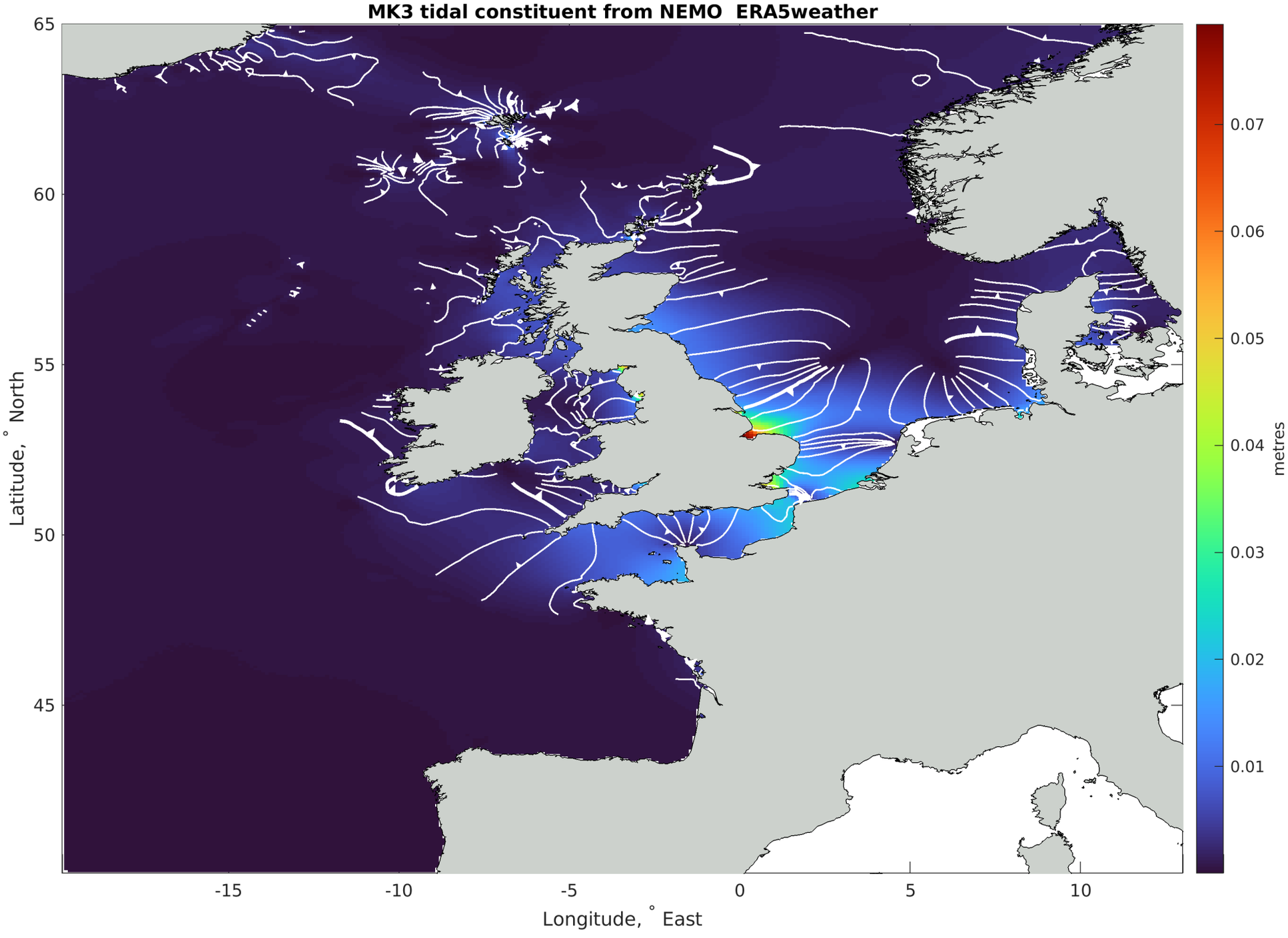

KJ2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.025
0.02
0.015
0.01
0.005
metres

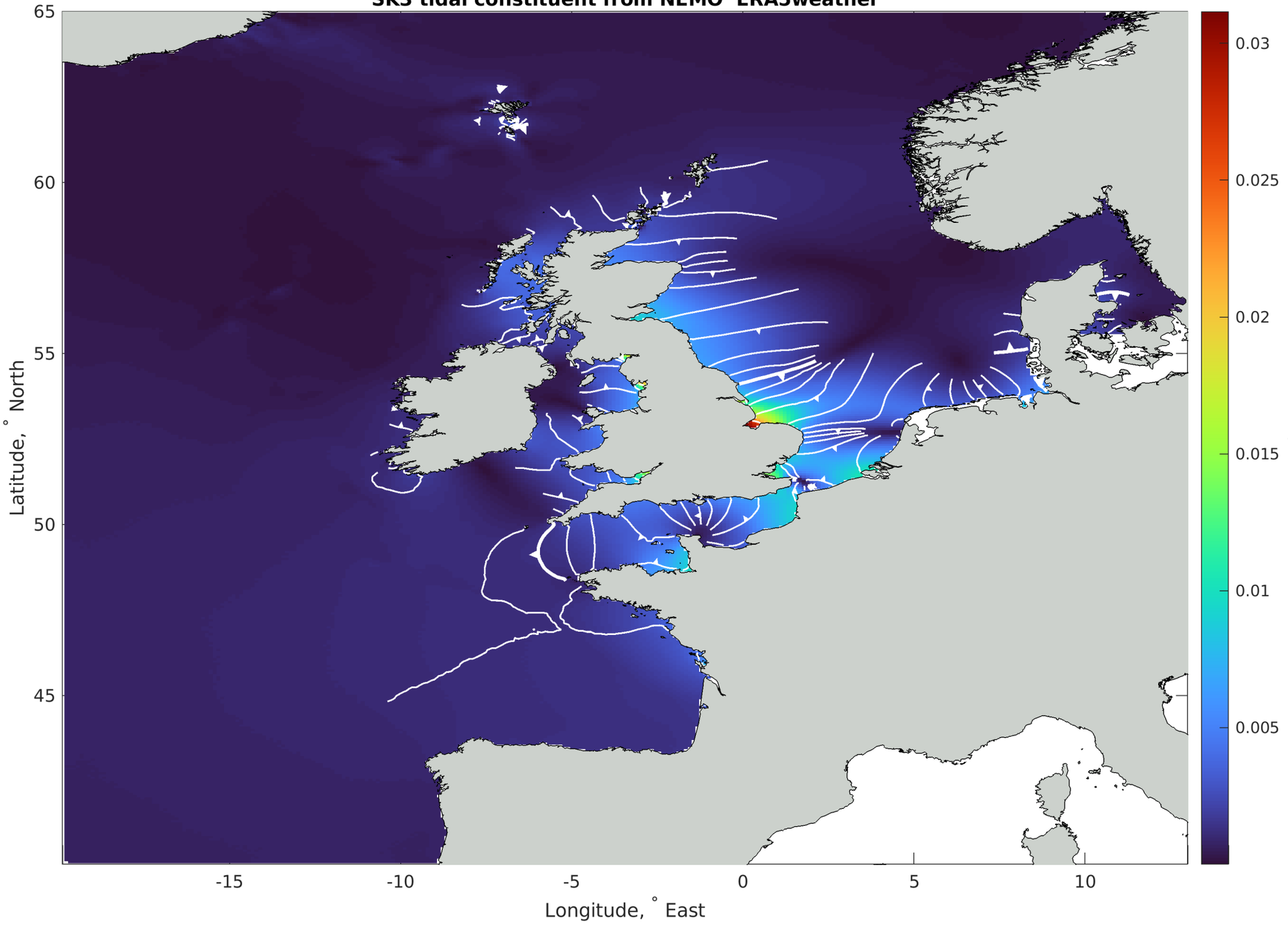

2SM2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
metres

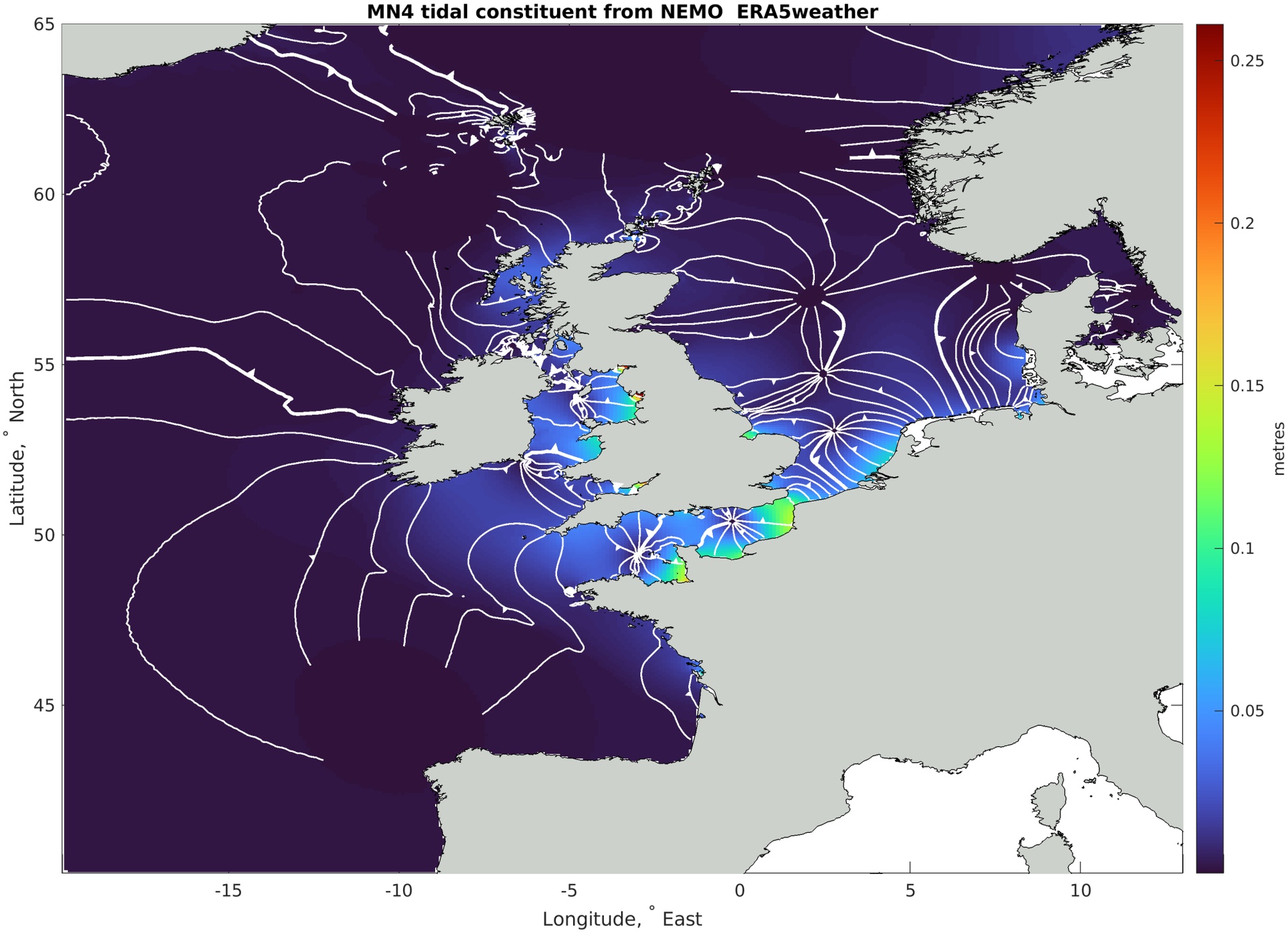

MO3 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.06
0.05
0.04
0.03
0.02
0.01
metres

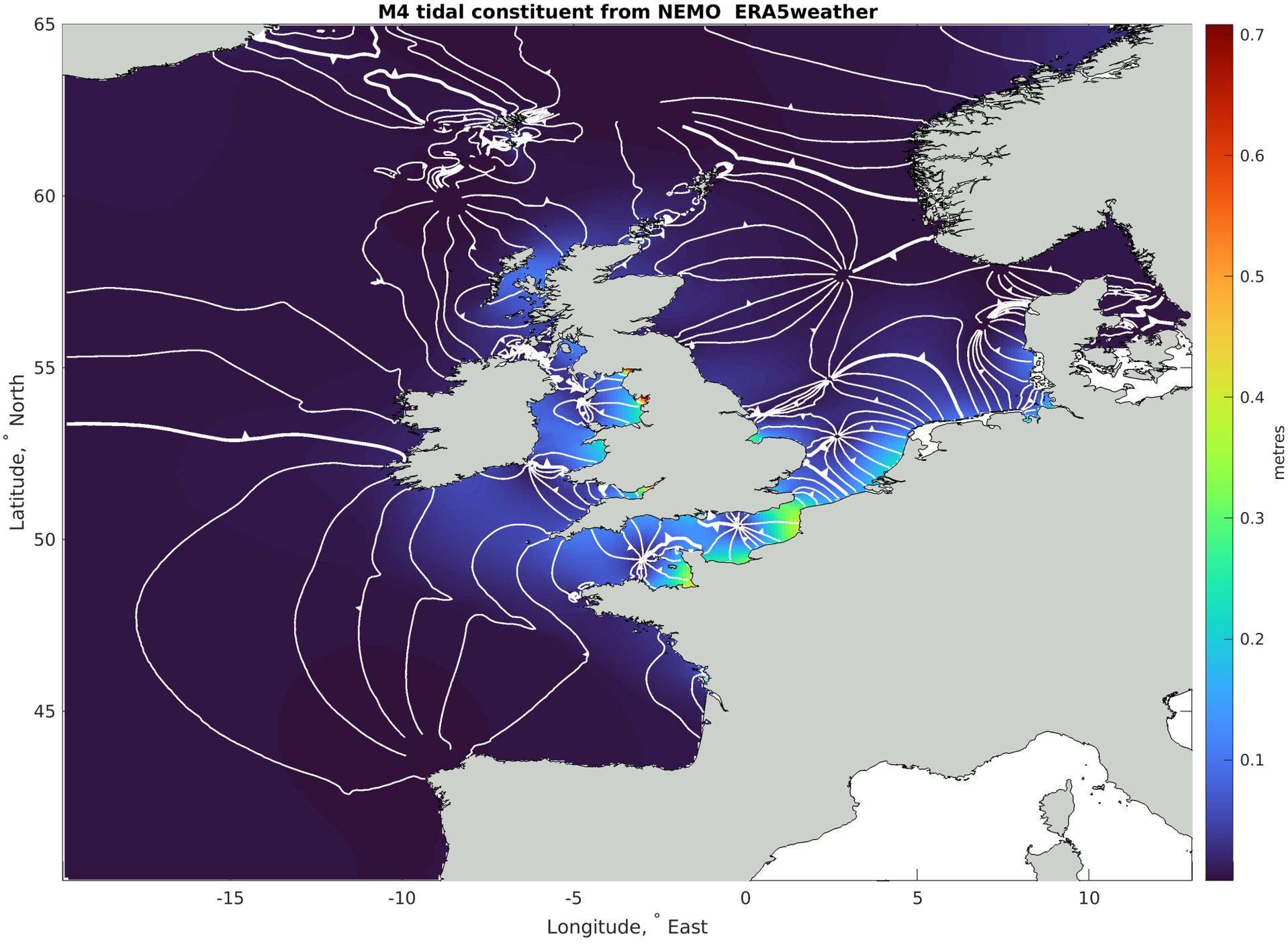

M3 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-4
10
9
8
7
6
5
4
3
2
1
metres

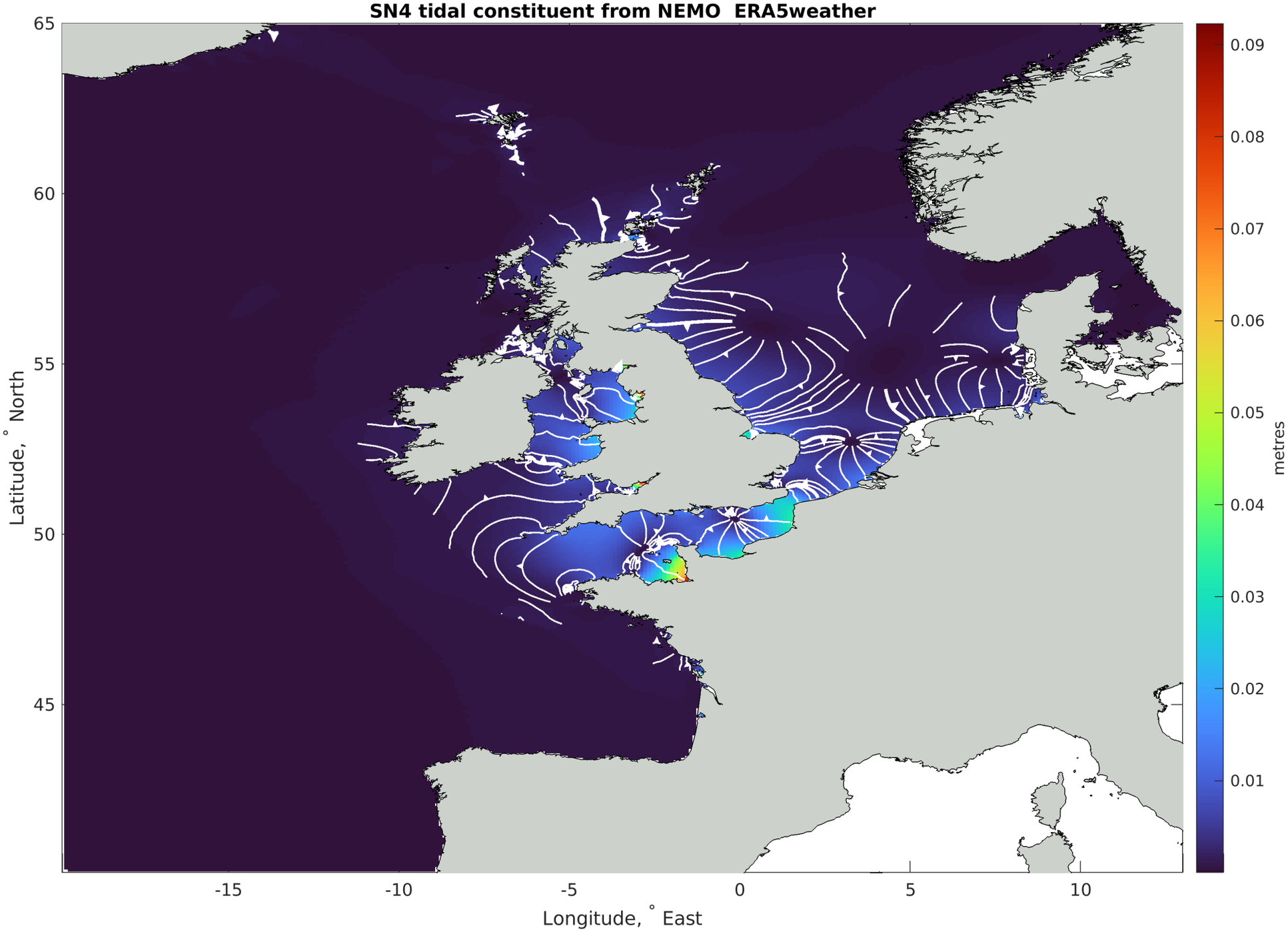

SO3 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.035
0.03
0.025
0.02
0.015
0.01
0.005
metres


MK3 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.07
0.06
0.05
0.04
0.03
0.02
0.01
metres


SK3 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.03
0.025
0.02
0.015
0.01
0.005
metres


MN4 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.25
0.2
0.15
0.1
0.05
metres


M4 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.7
0.6
0.5
0.4
0.3
0.2
0.1
metres


SN4 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
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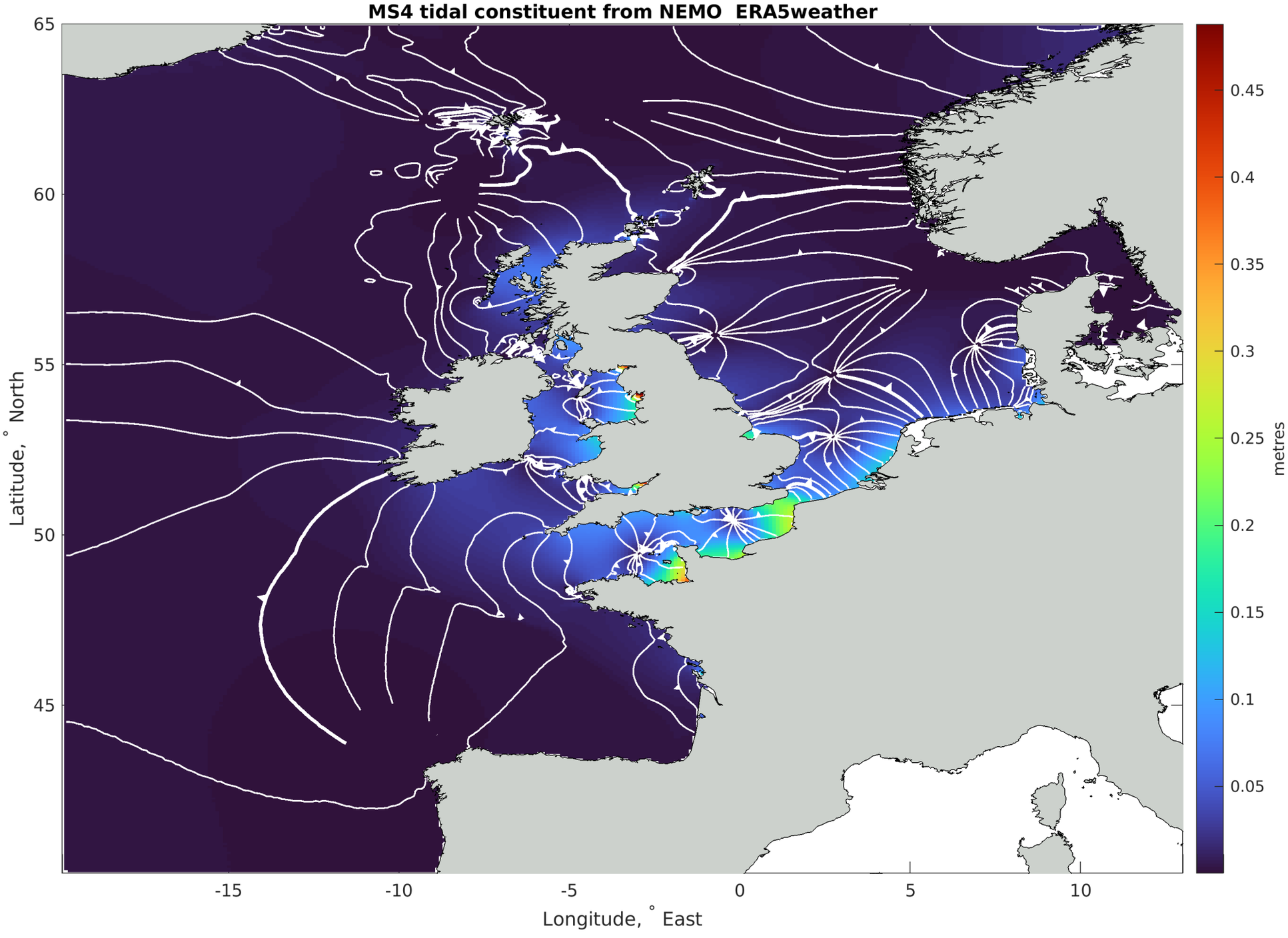
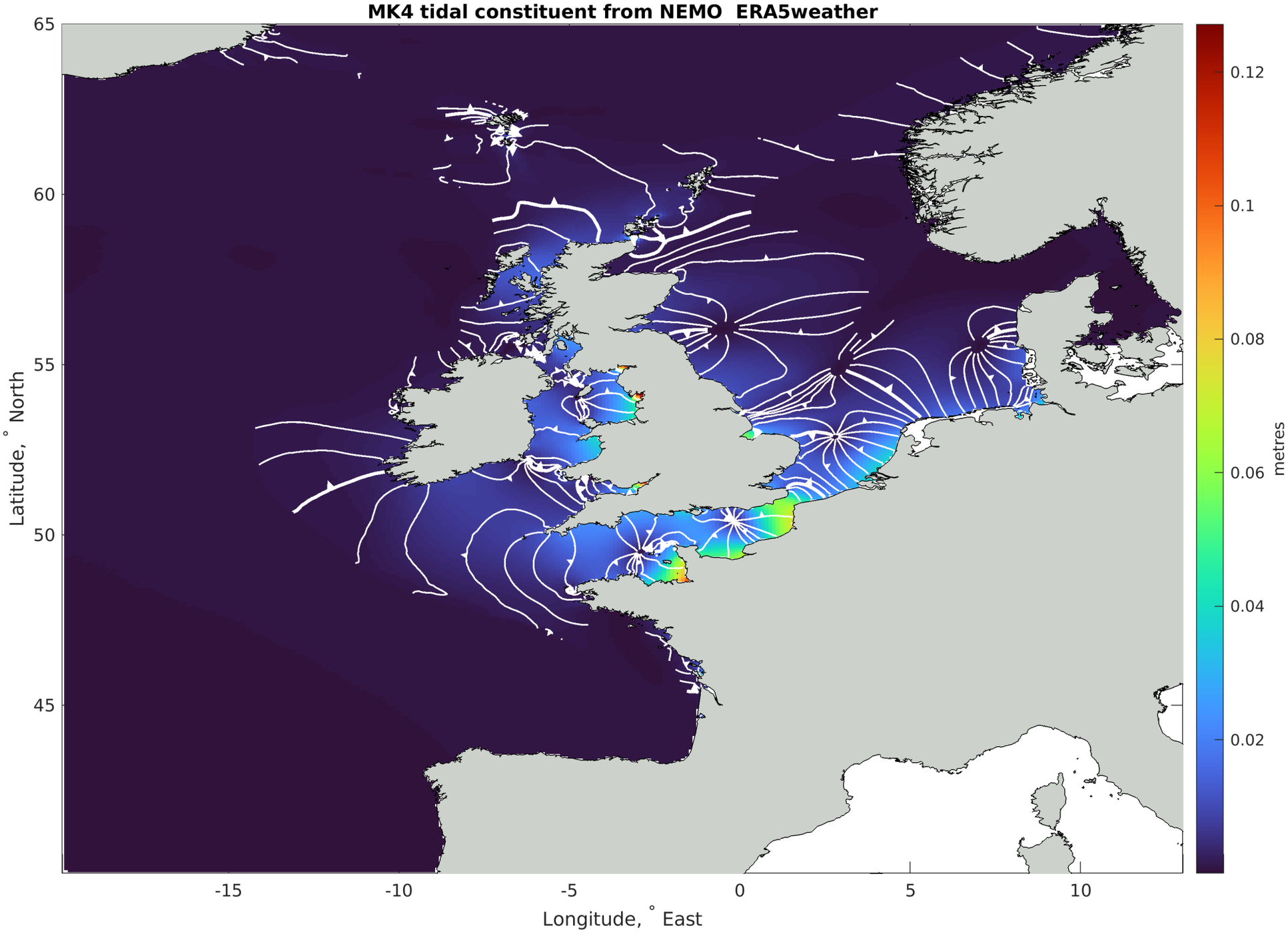
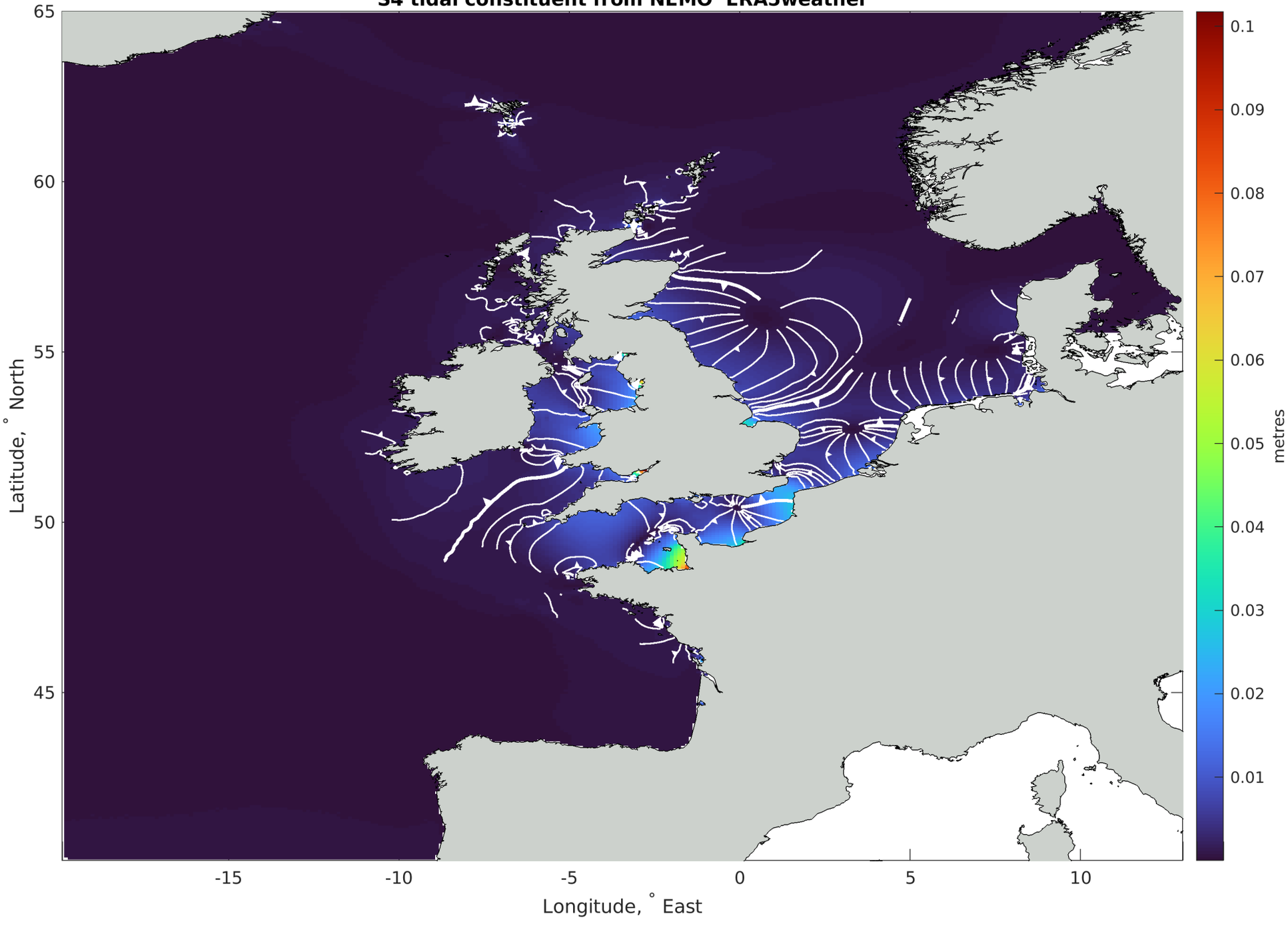
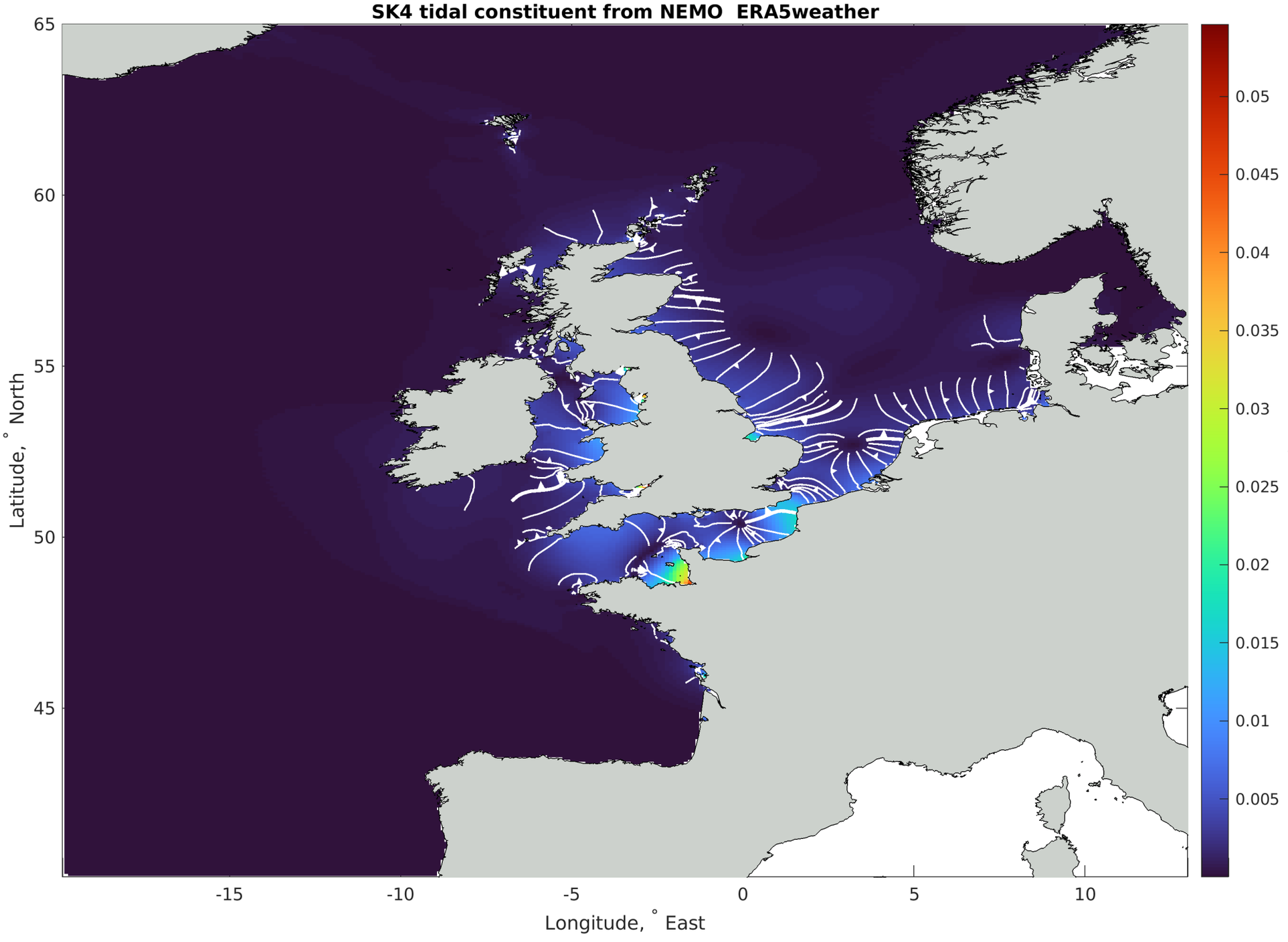
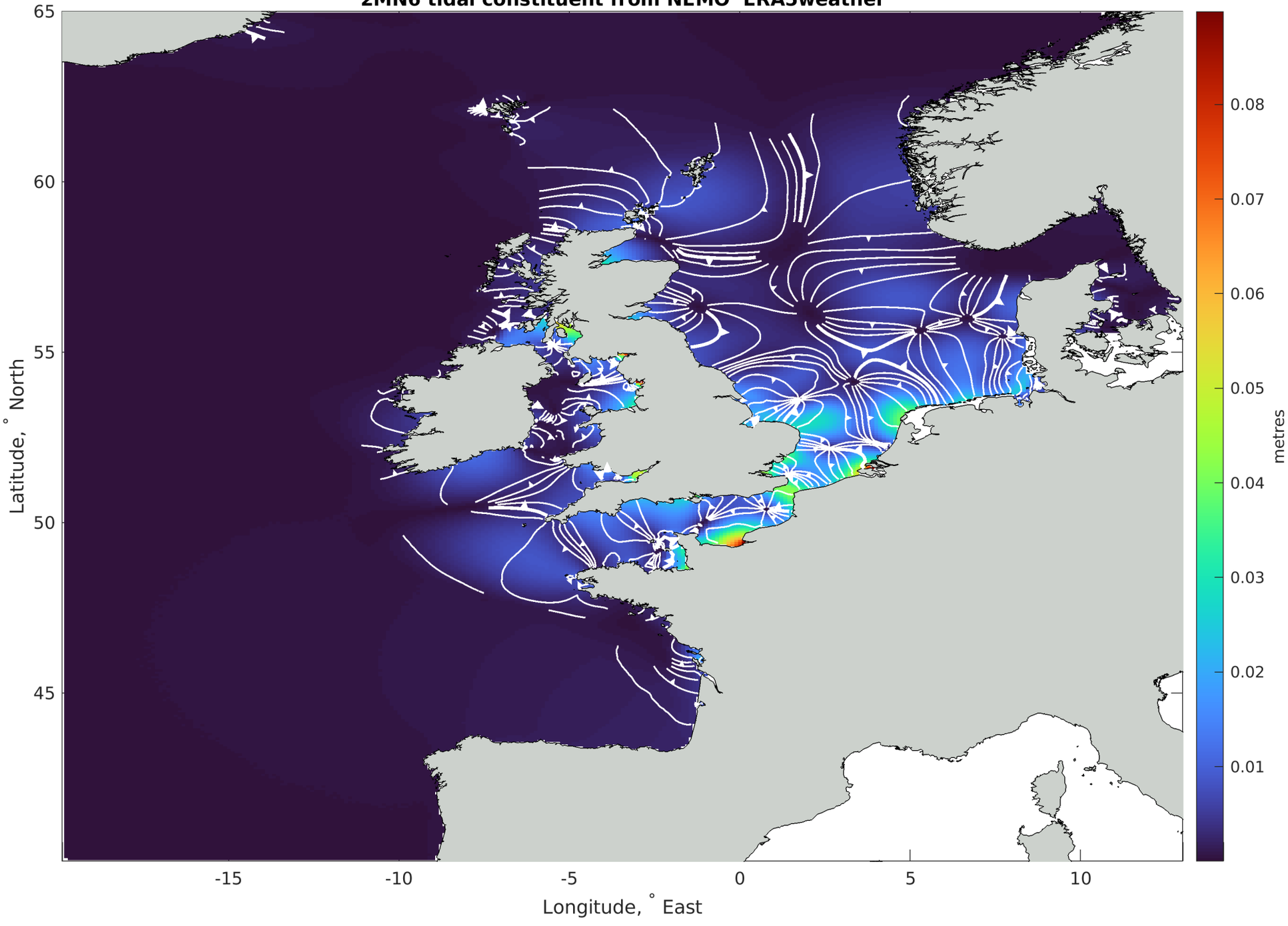
Longitude, ° East
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
metres


MS4 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
metres


MK4 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.12
0.1
0.08
0.06
0.04
0.02
metres


S4 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
metres


SK4 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
metres


2MN6 tidal constituent from NEMO ERA5weather
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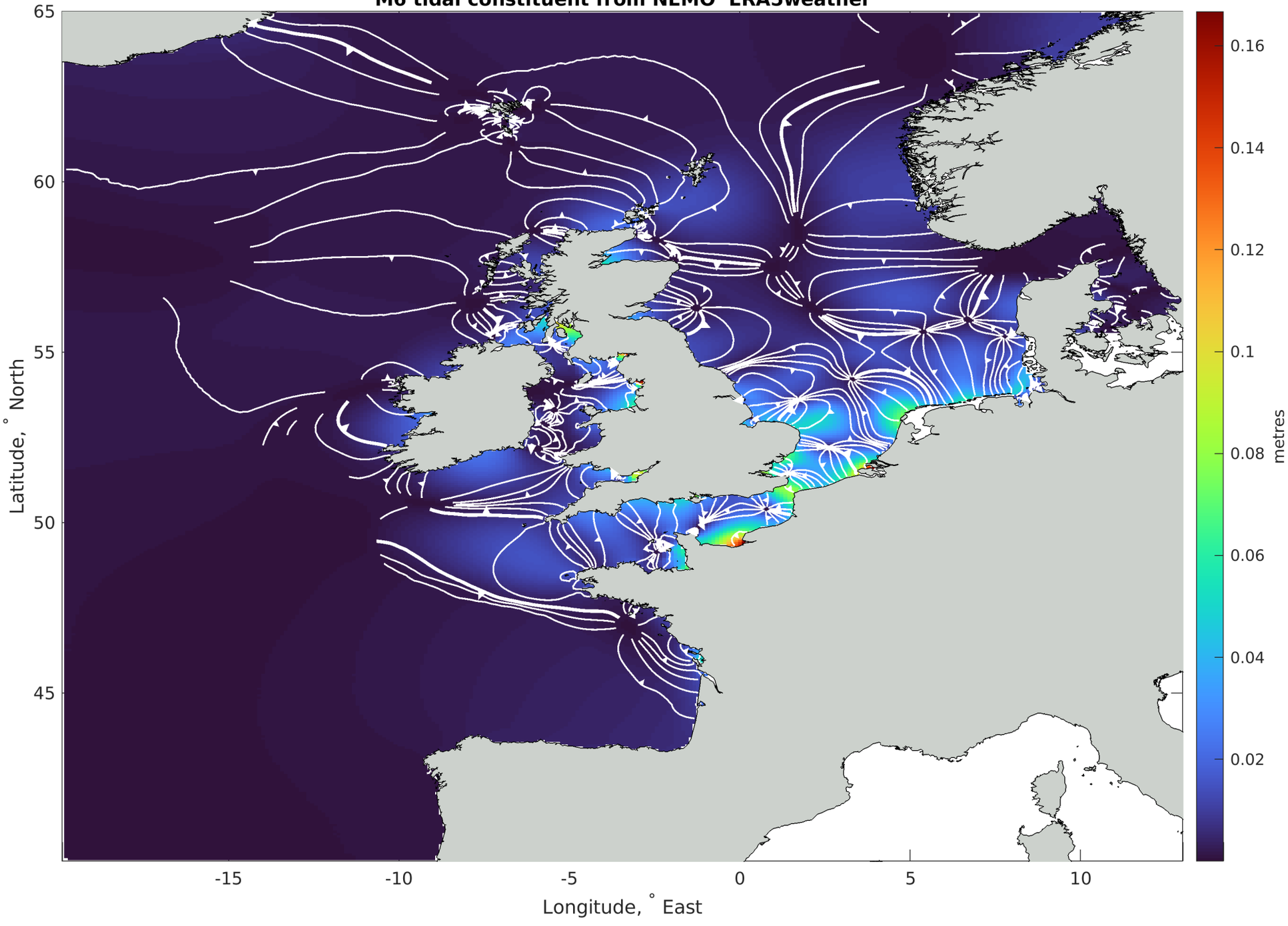
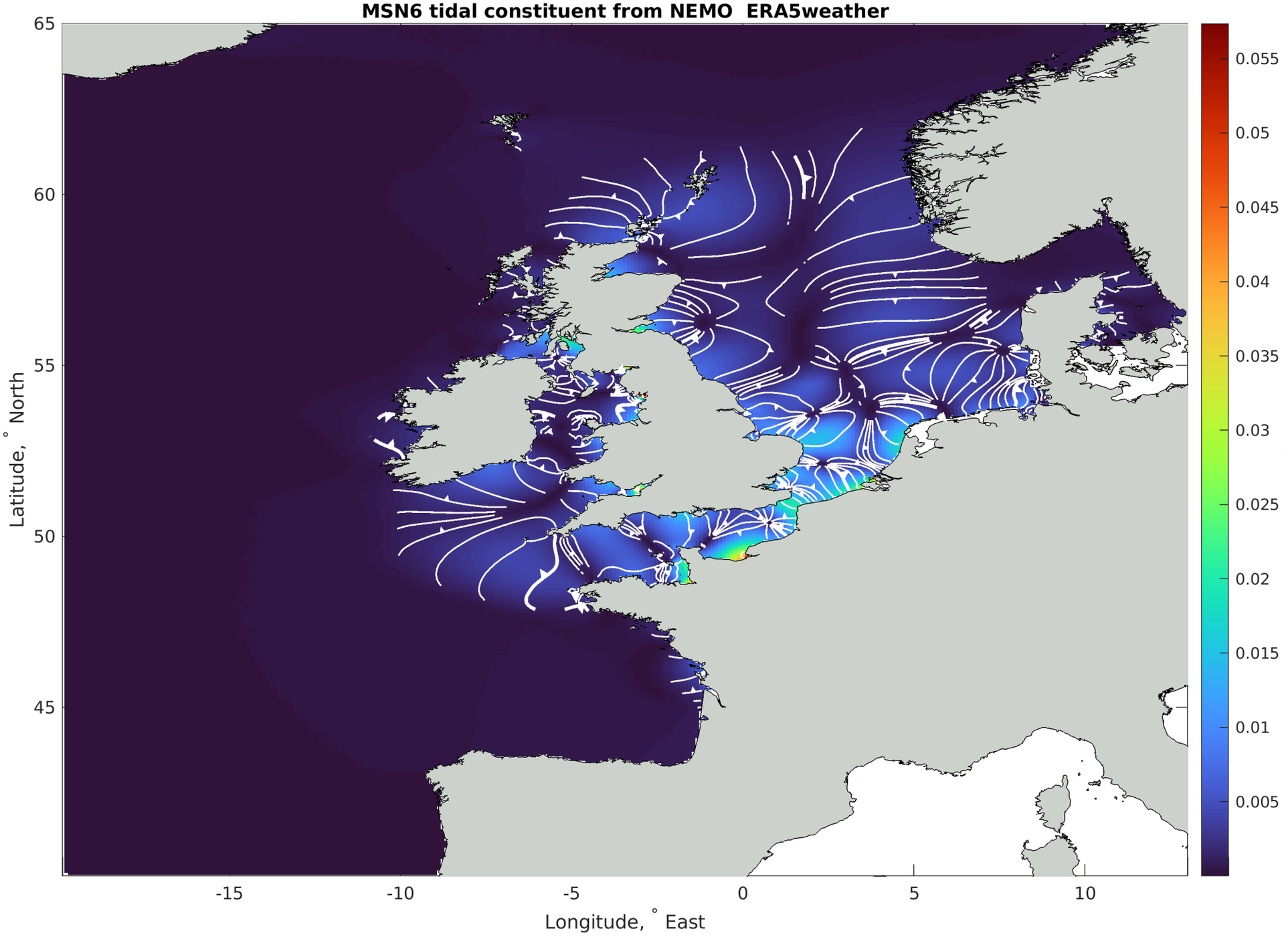
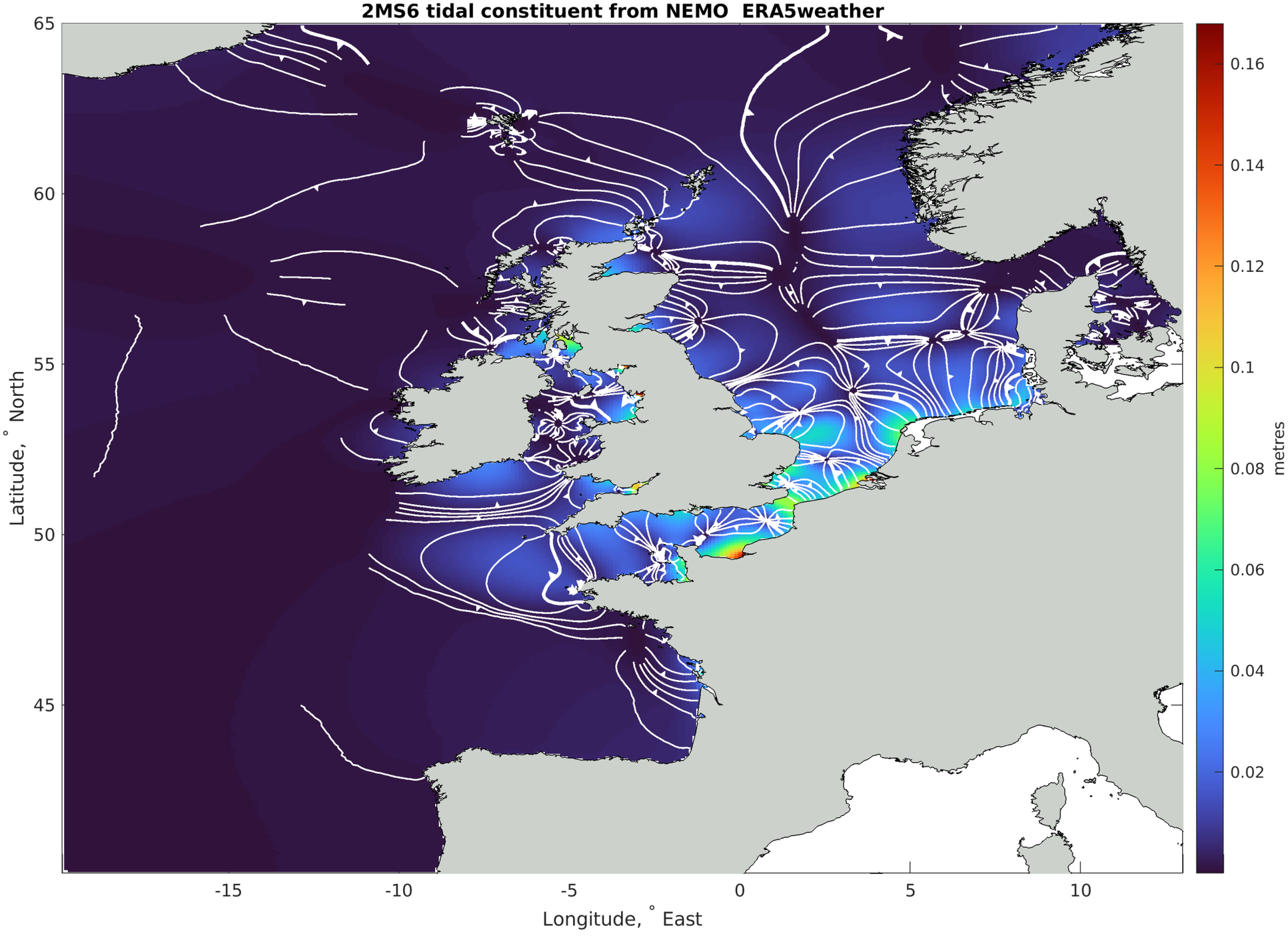
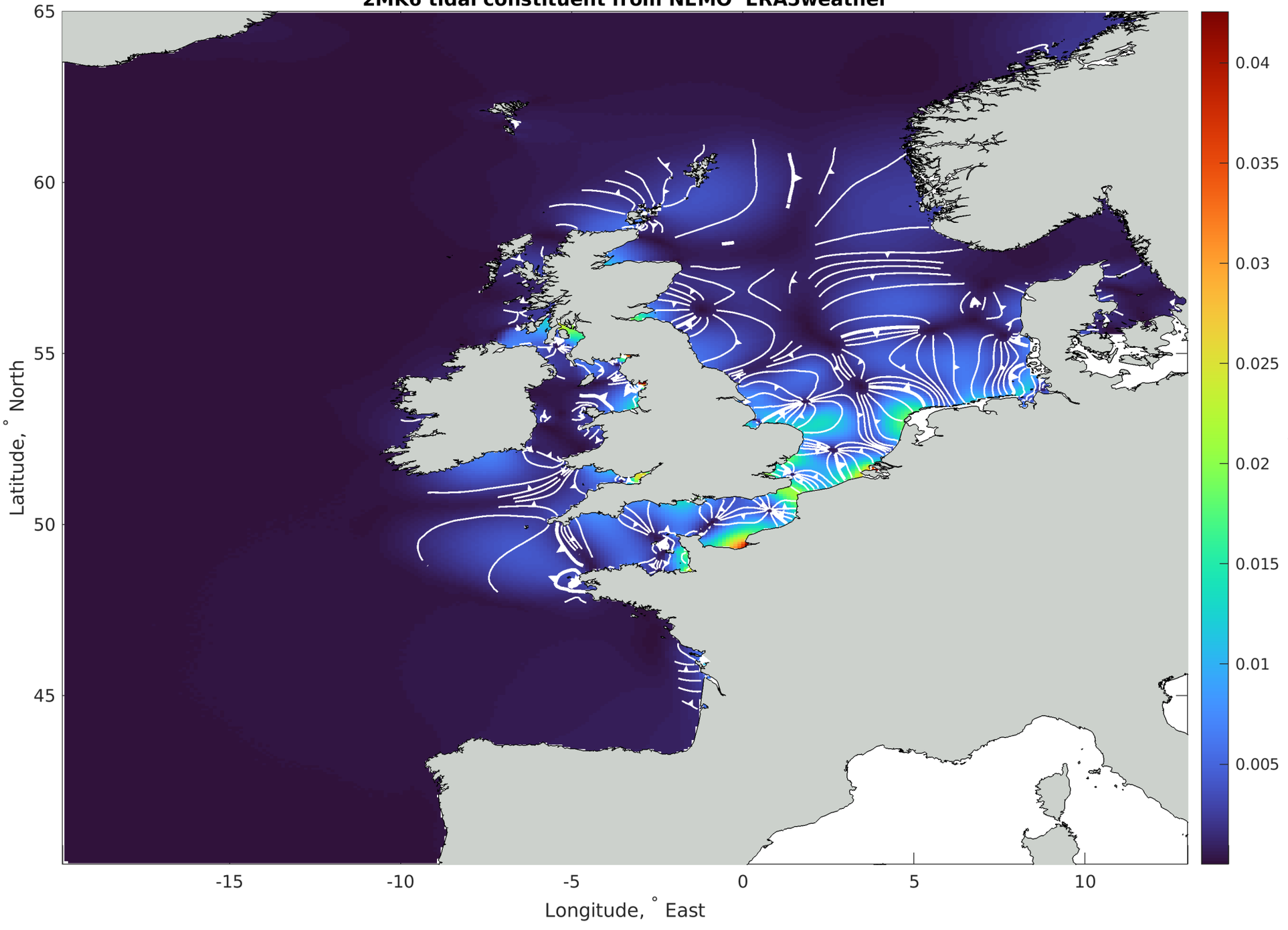
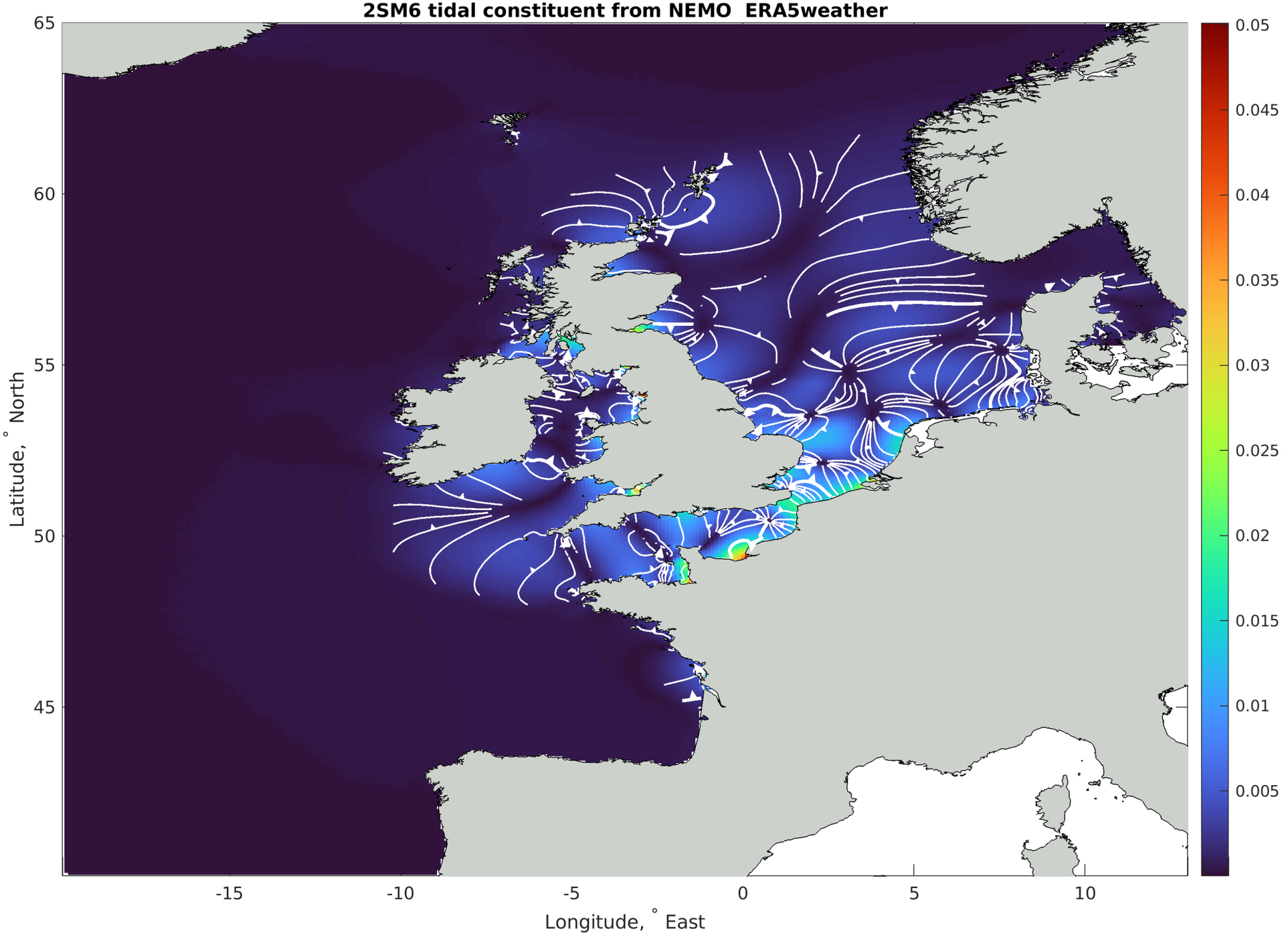
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
metres


M6 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
metres


MSN6 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.055
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
metres


2MS6 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
metres


2MK6 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
metres


2SM6 tidal constituent from NEMO ERA5weather
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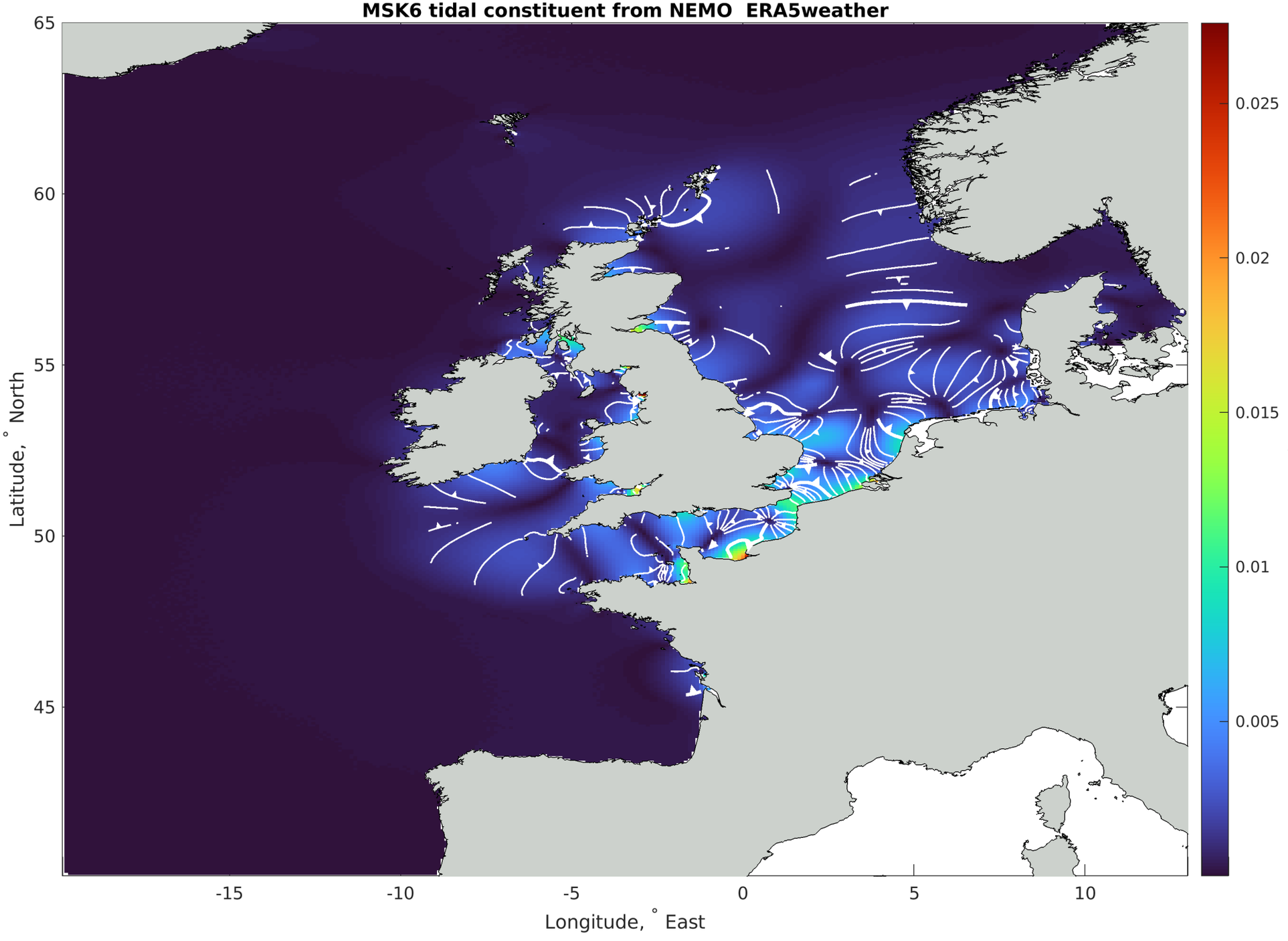
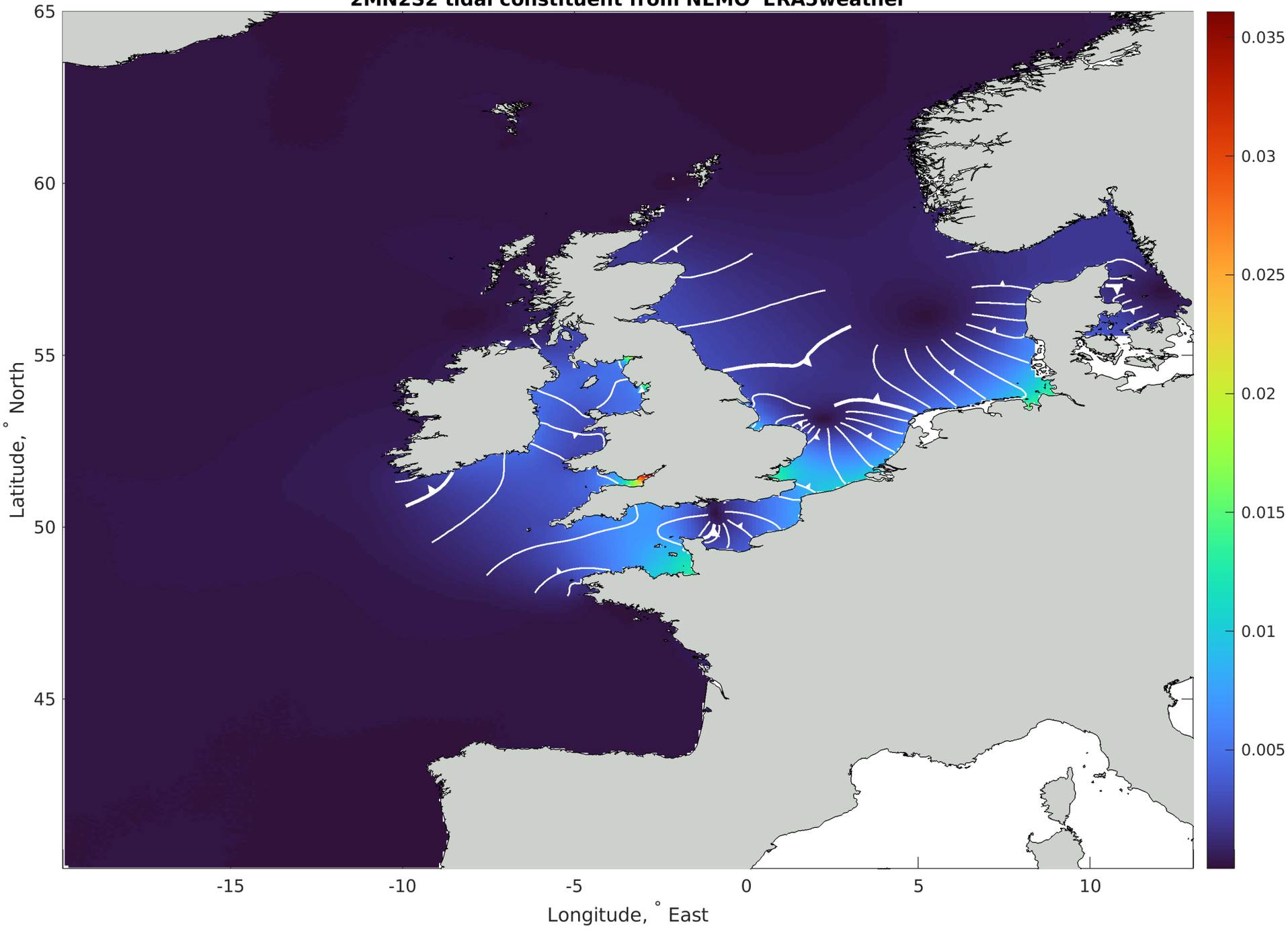
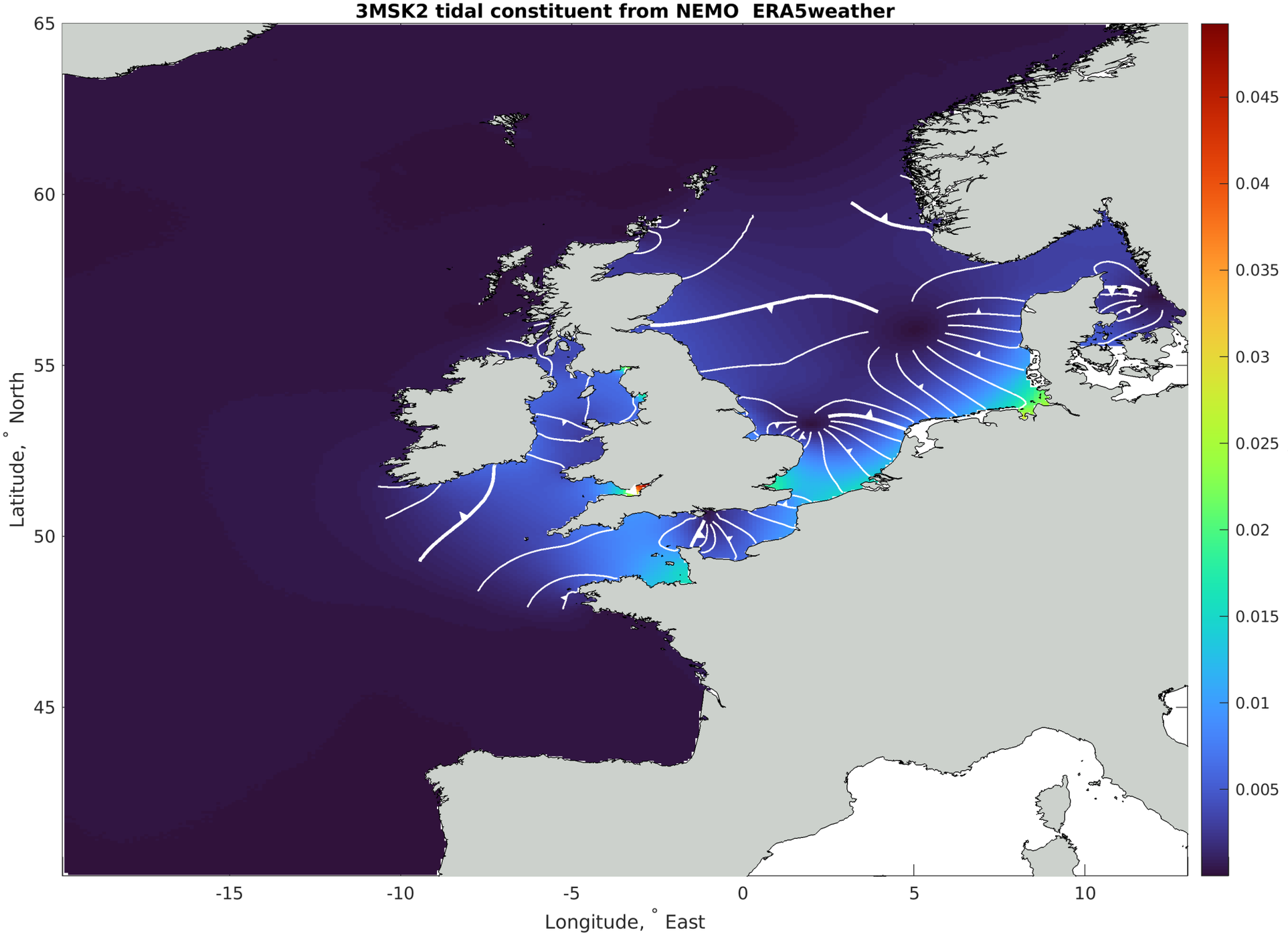
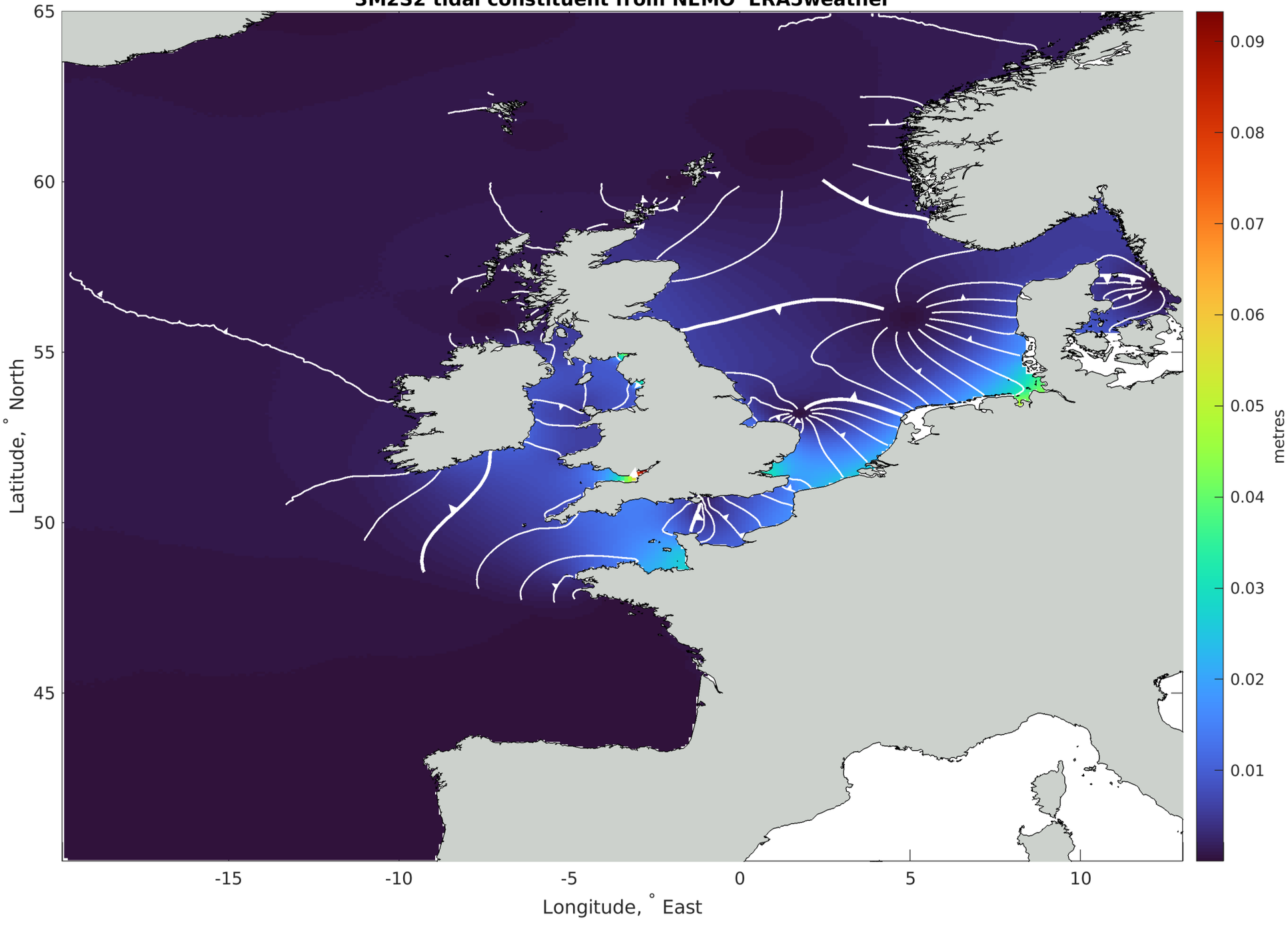
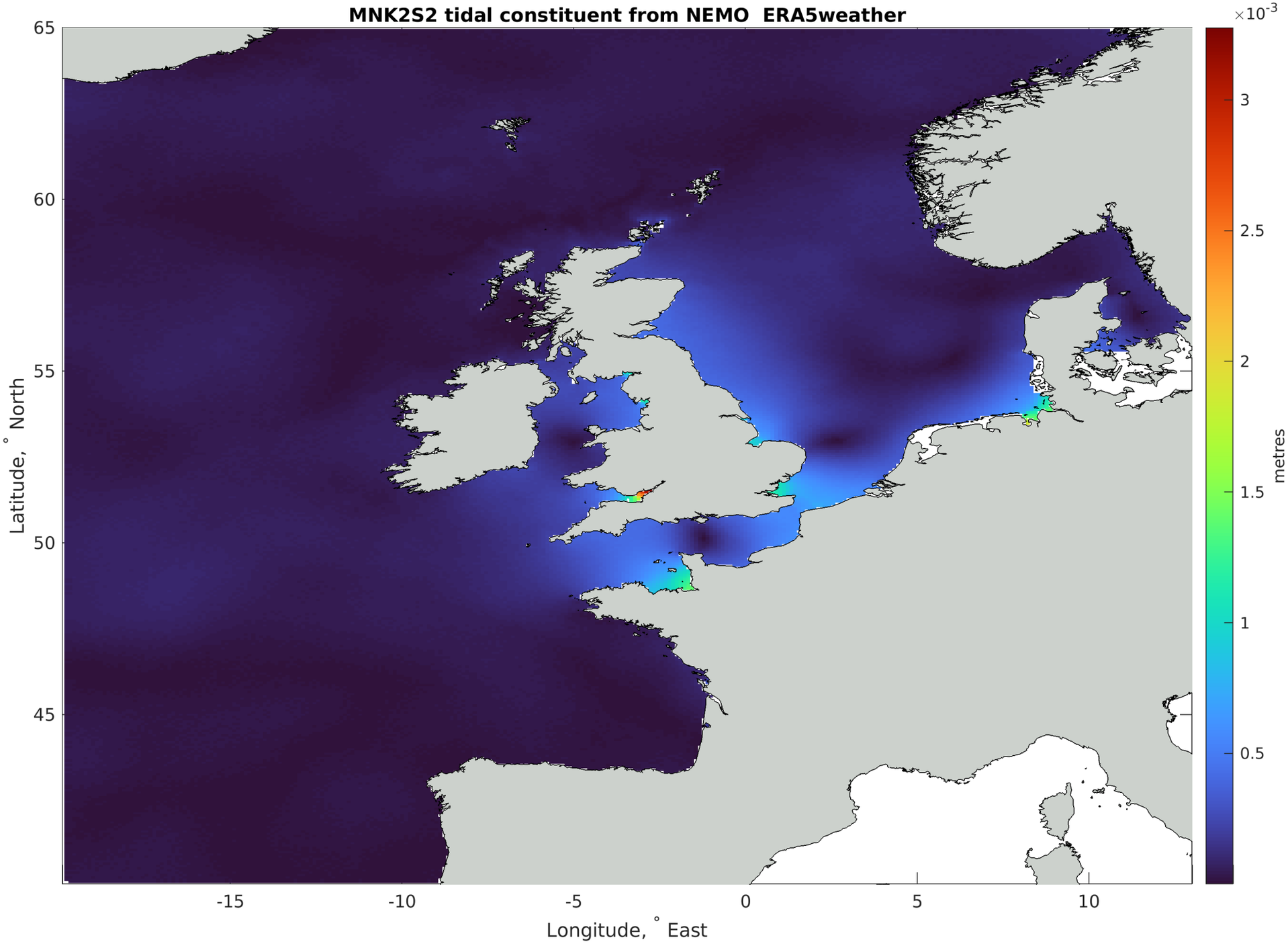
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
metres

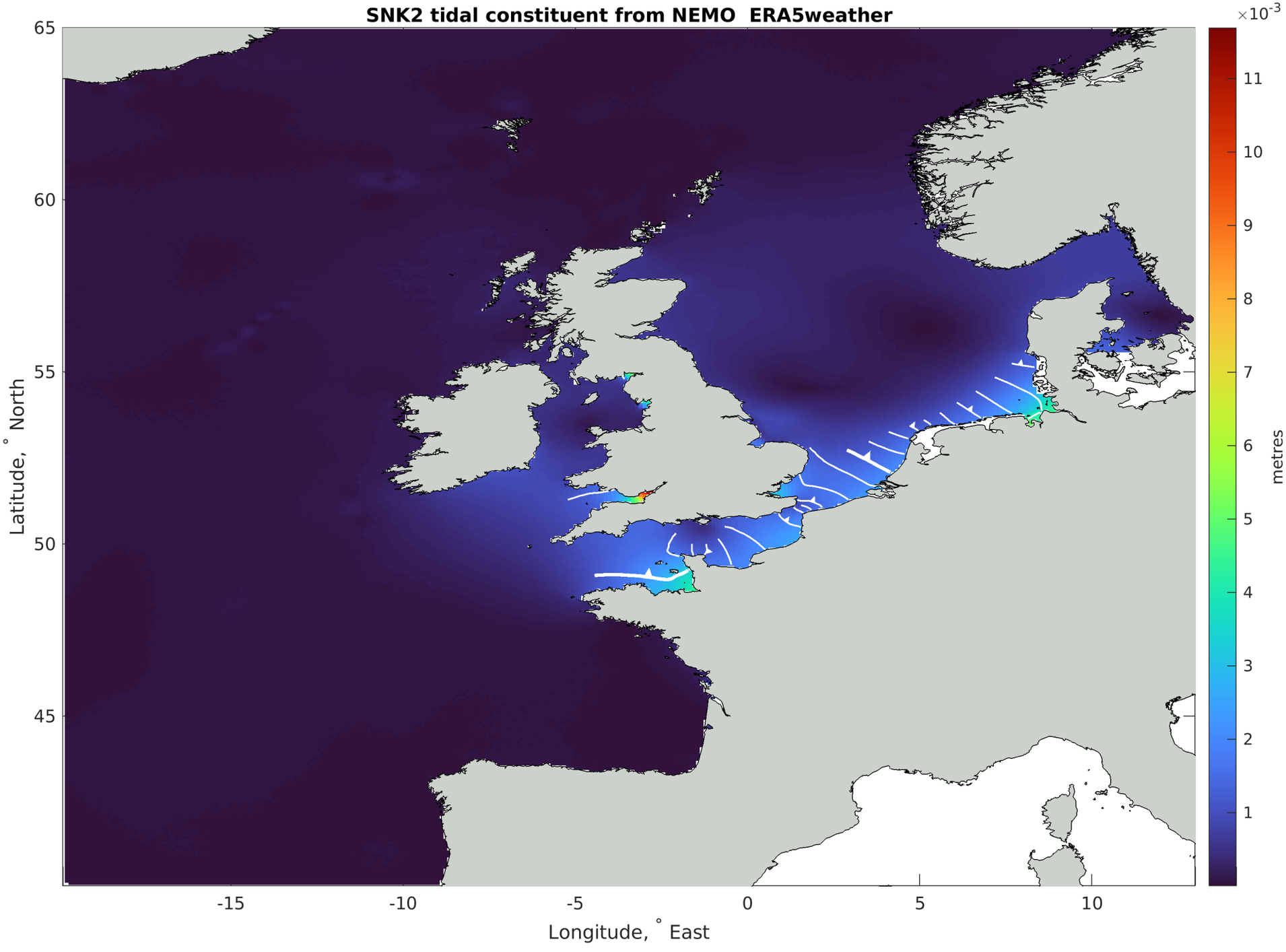

MSK6 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.025
0.02
0.015
0.01
0.005
metres

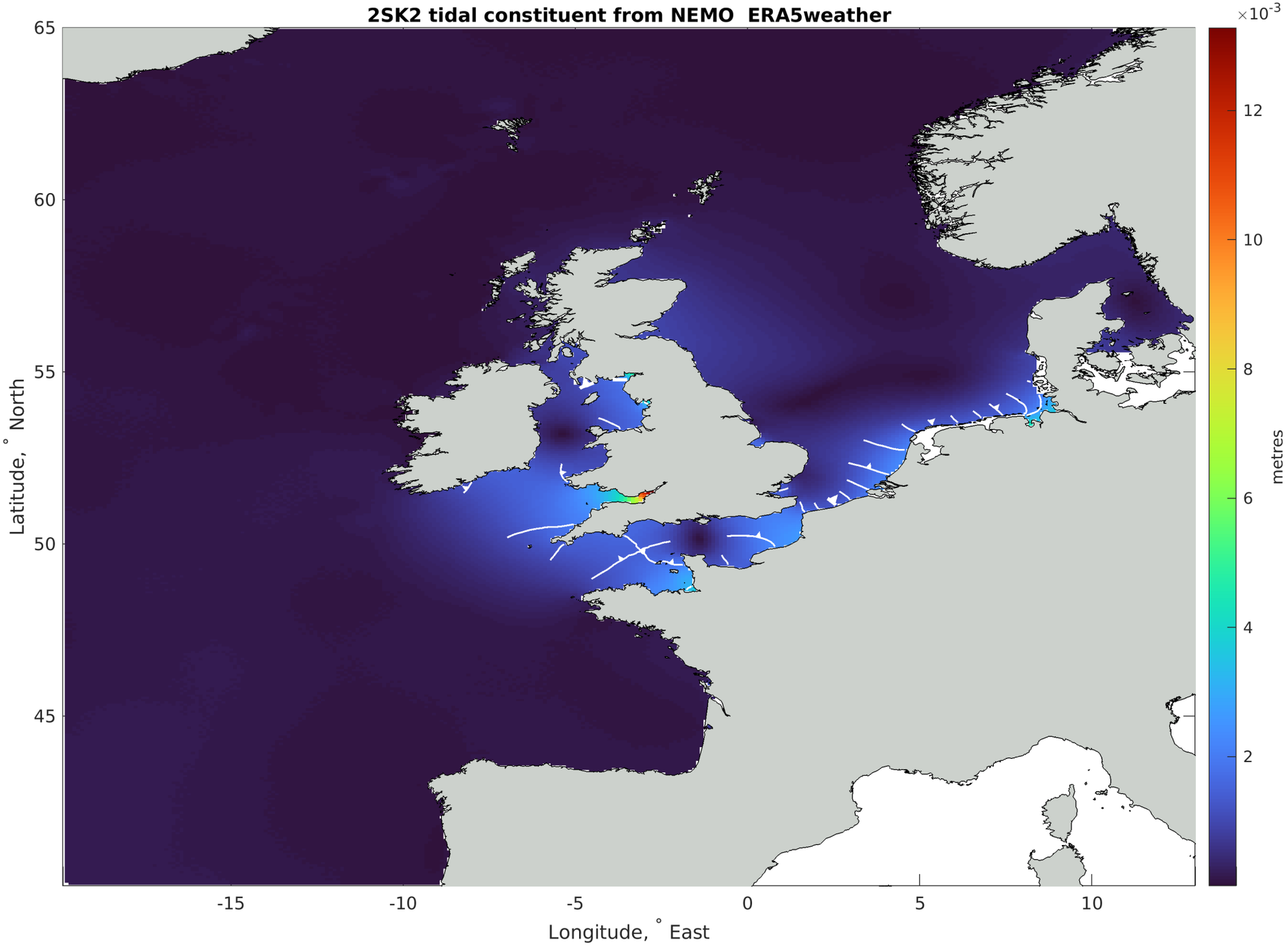

2MN2S2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.035
0.03
0.025
0.02
0.015
0.01
0.005
metres


3MSK2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
metres


3M2S2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
metres


MNK2S2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
3
2.5
2
1.5
1
0.5
metres


SNK2 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
11
10
9
8
7
6
5
4
3
2
1
metres


2SK2 tidal constituent from NEMO ERA5weather
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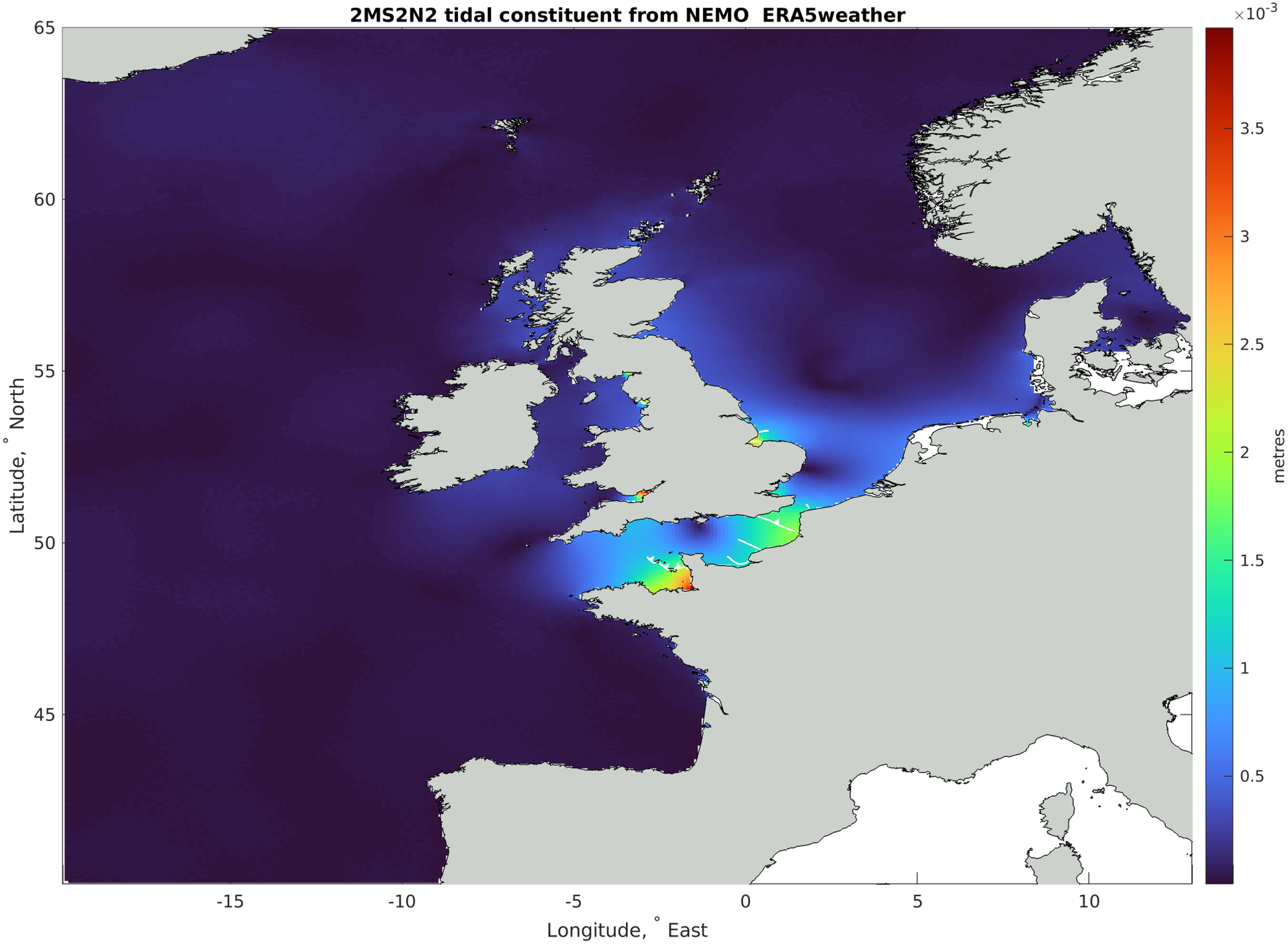
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
12
10
8
6
4
2
metres


2MS2N2 tidal constituent from NEMO ERA5weather
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60
55
50
45
Latitude, ° North
-15
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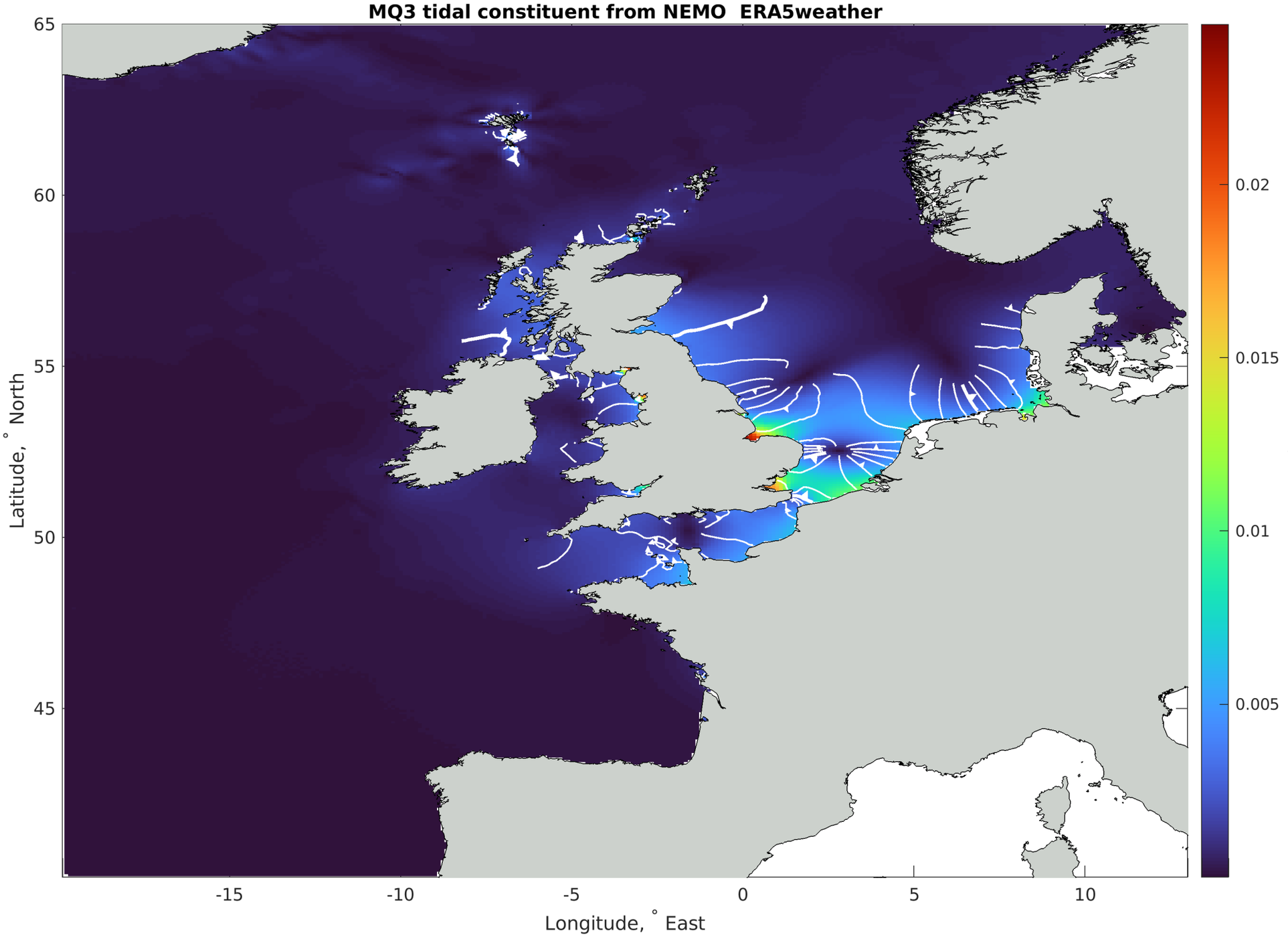
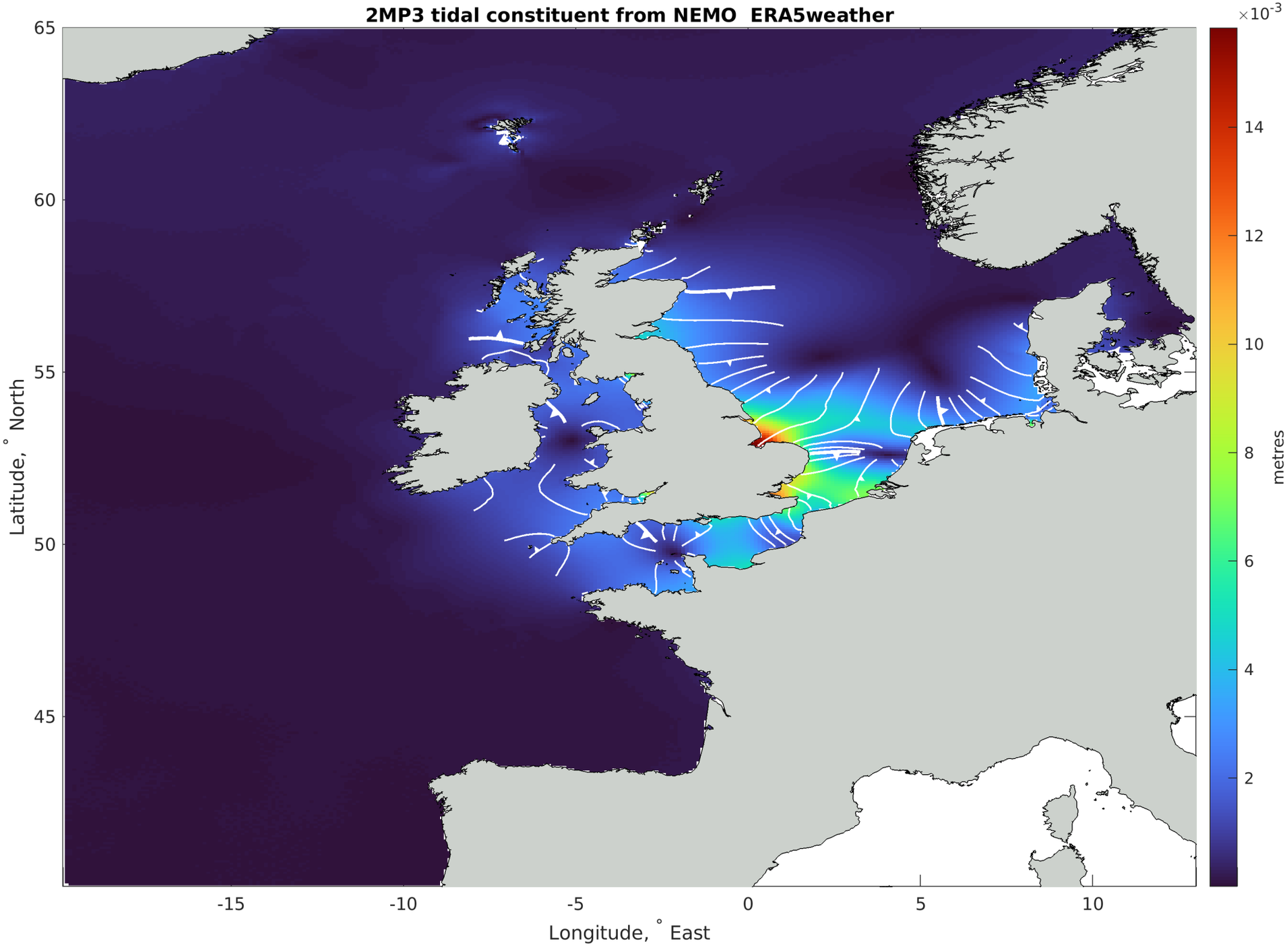
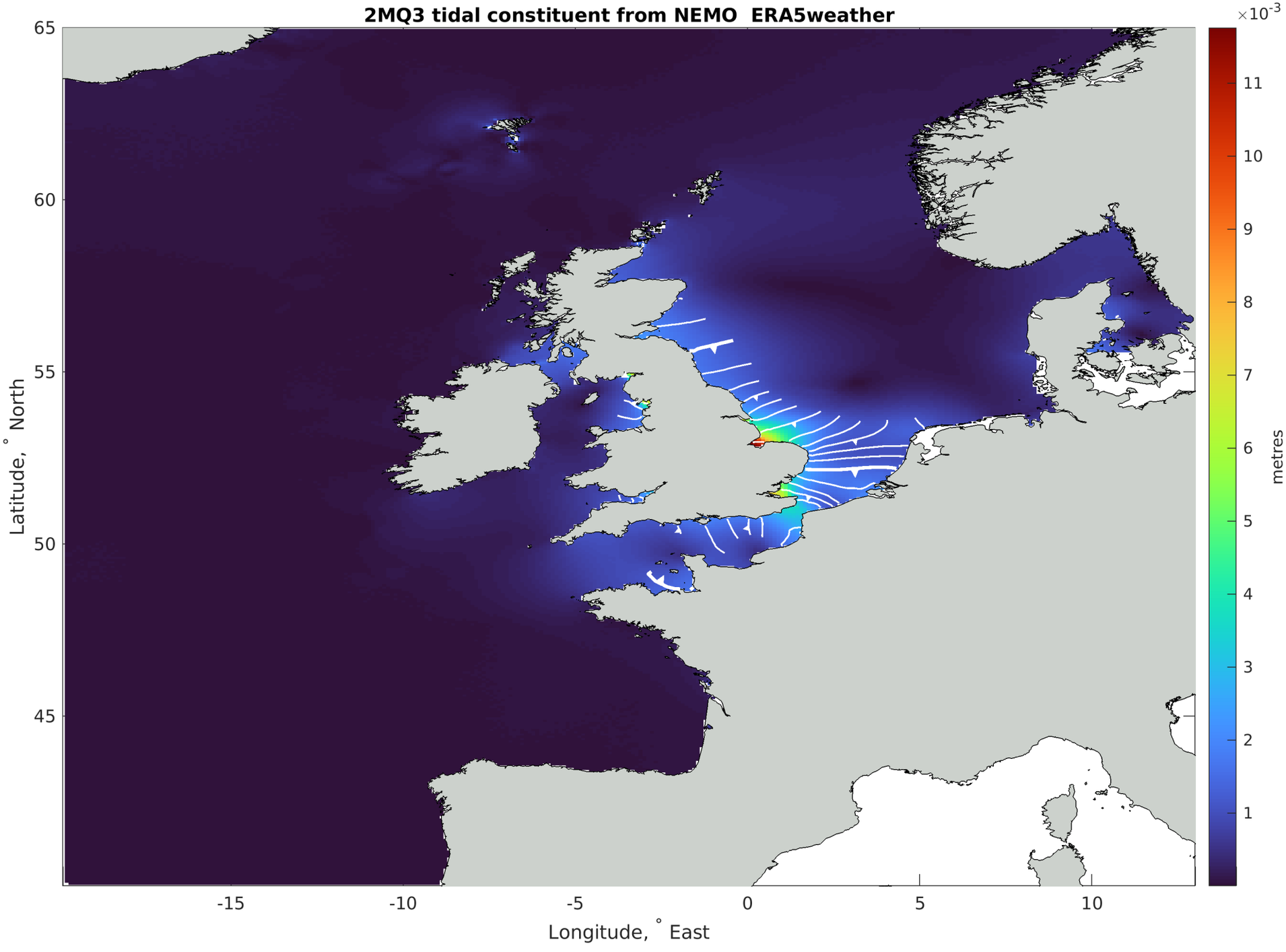
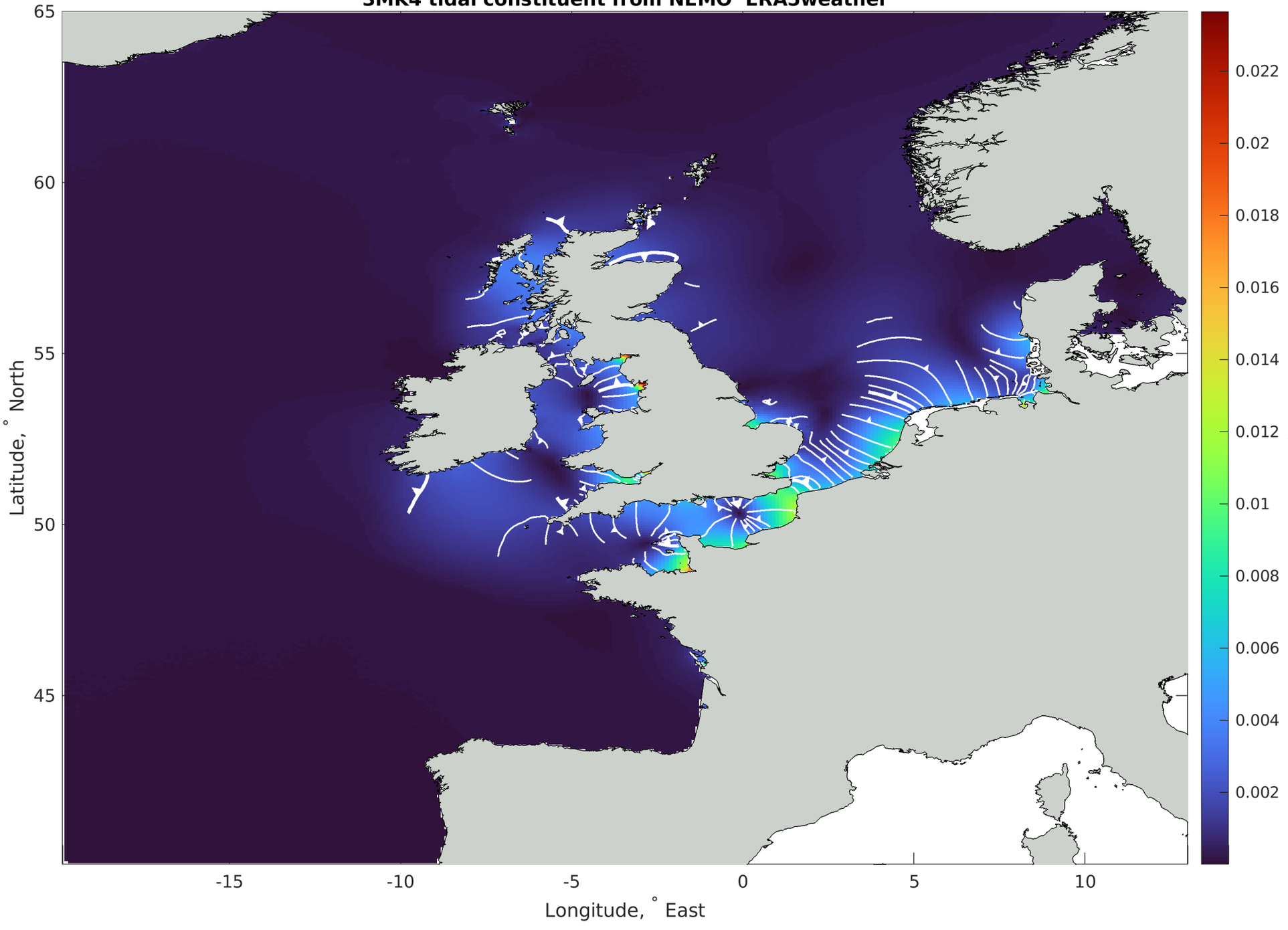
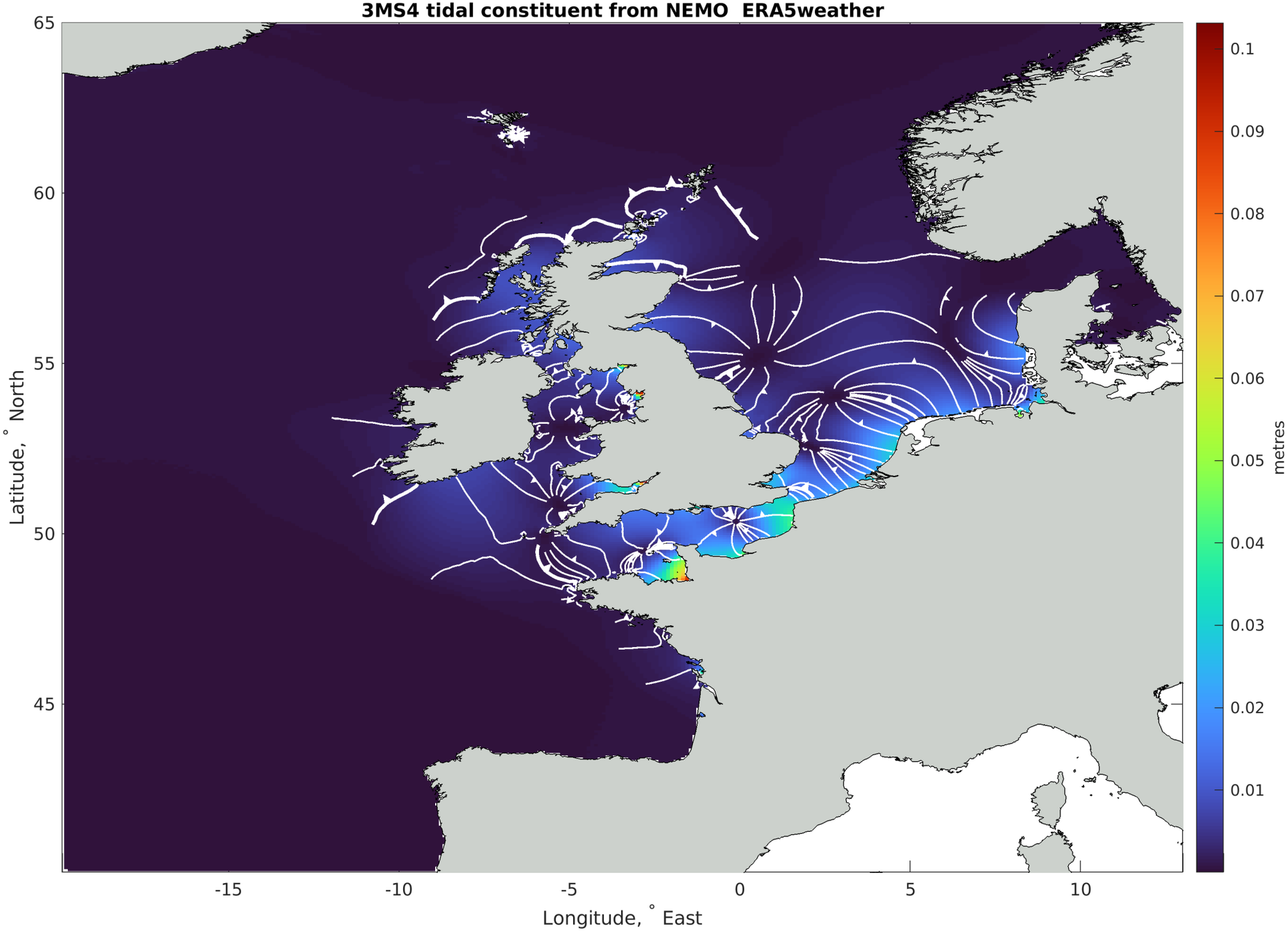
0
5
10
Longitude, ° East
×10-3
3.5
3
2.5
2
1.5
1
0.5
metres

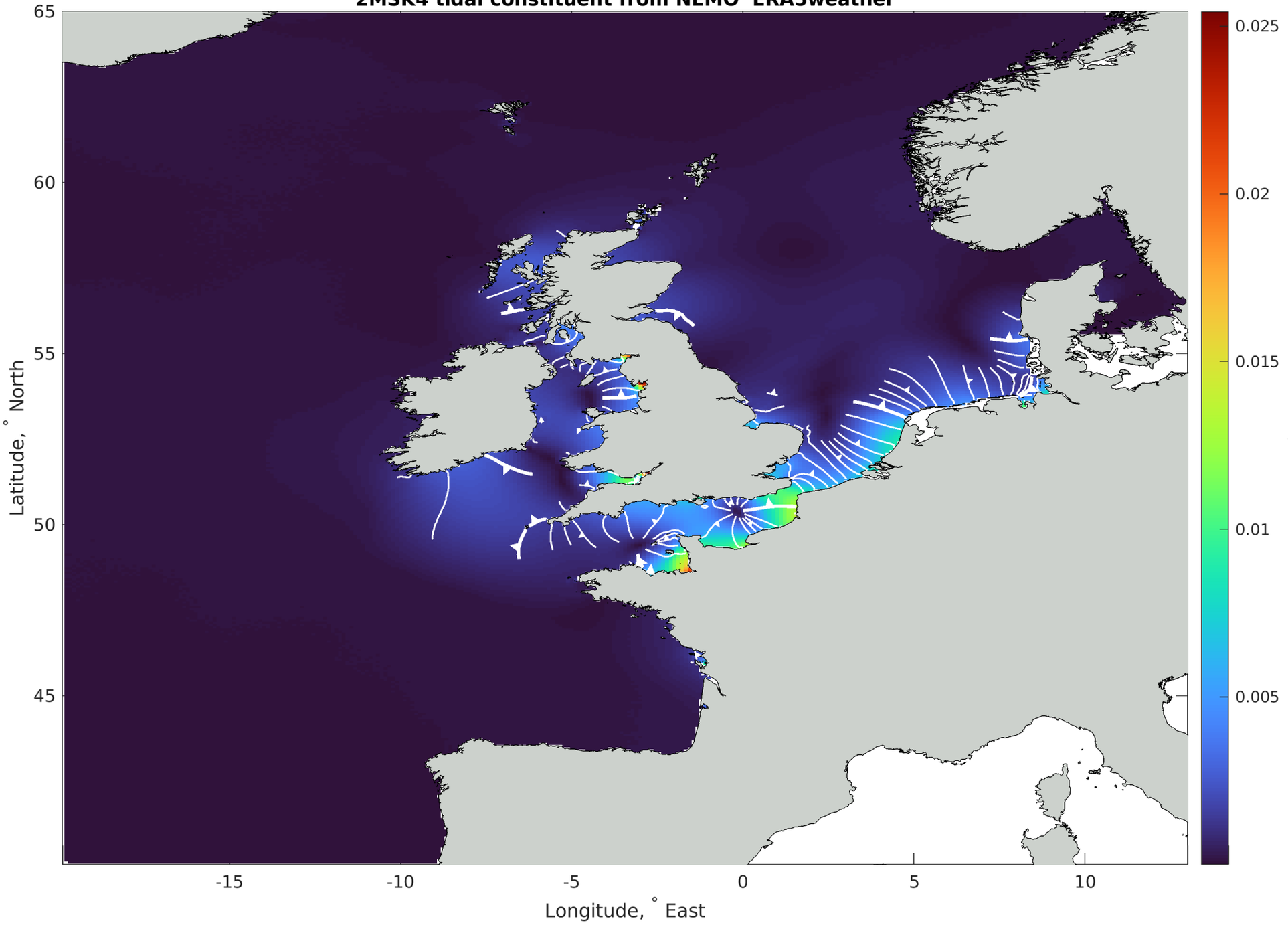

MQ3 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.02
0.015
0.01
0.005
metres

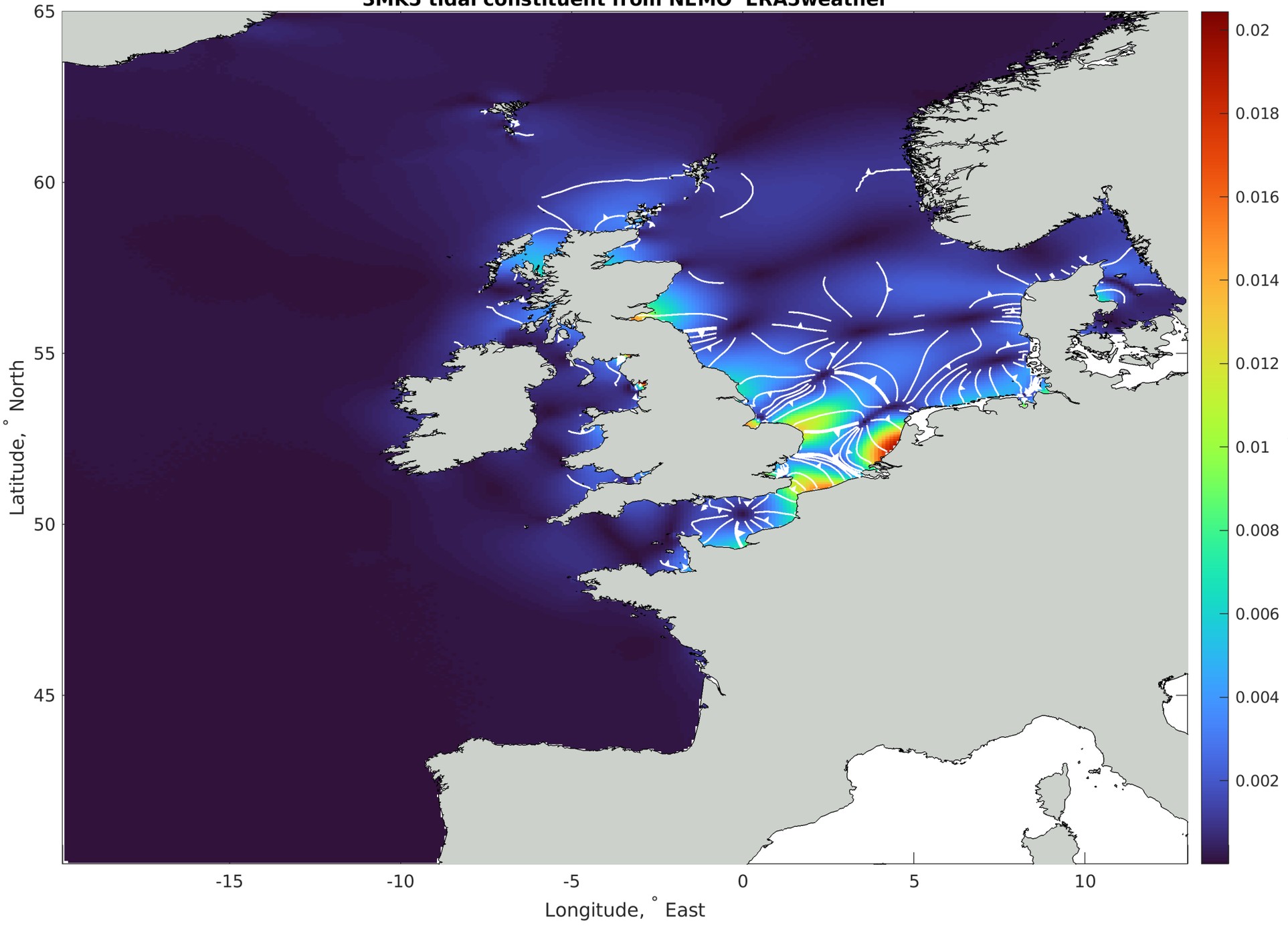

2MP3 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
14
12
10
8
6
4
2
metres

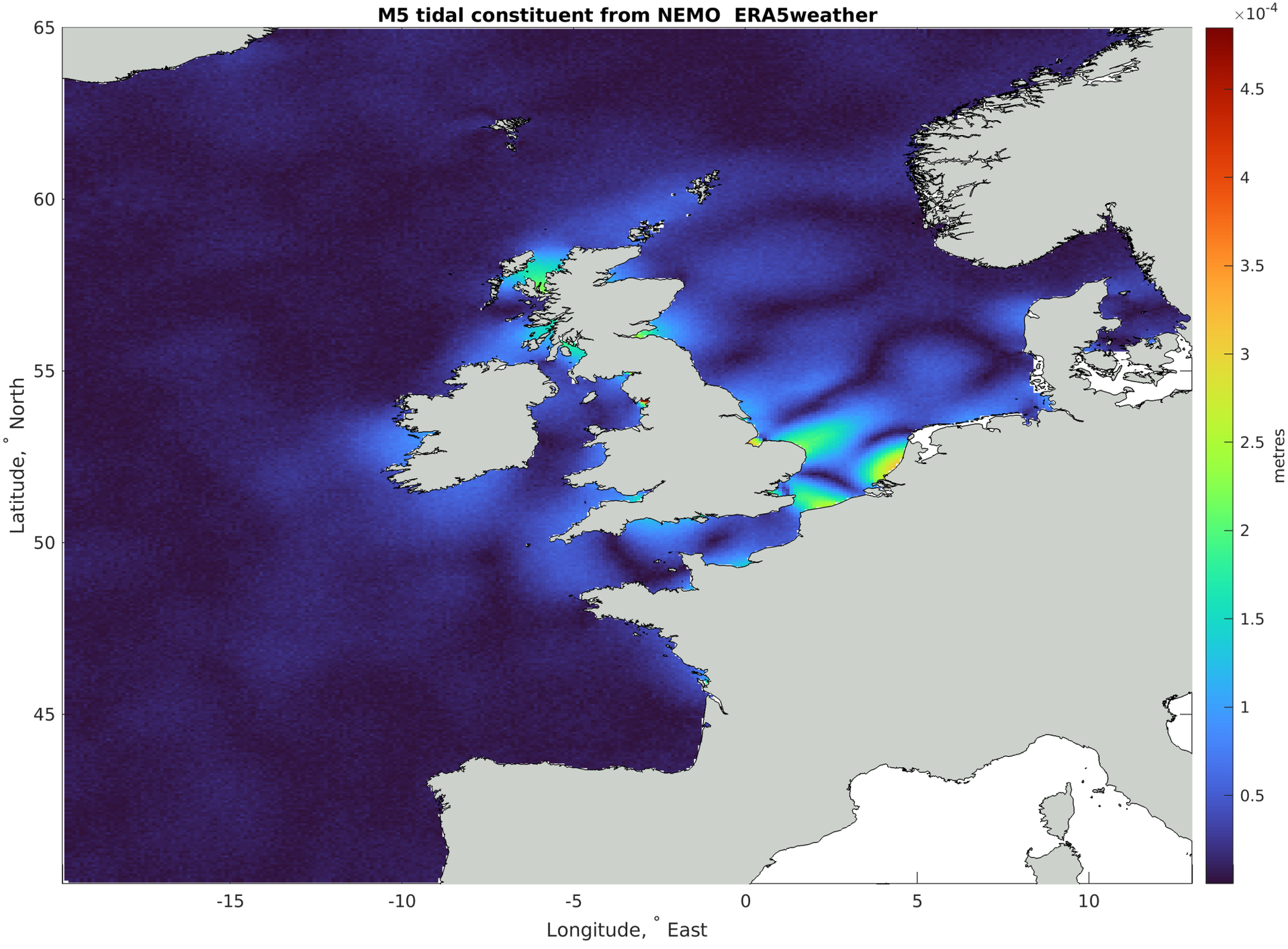

2MQ3 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
11
10
9
8
7
6
5
4
3
2
1
metres

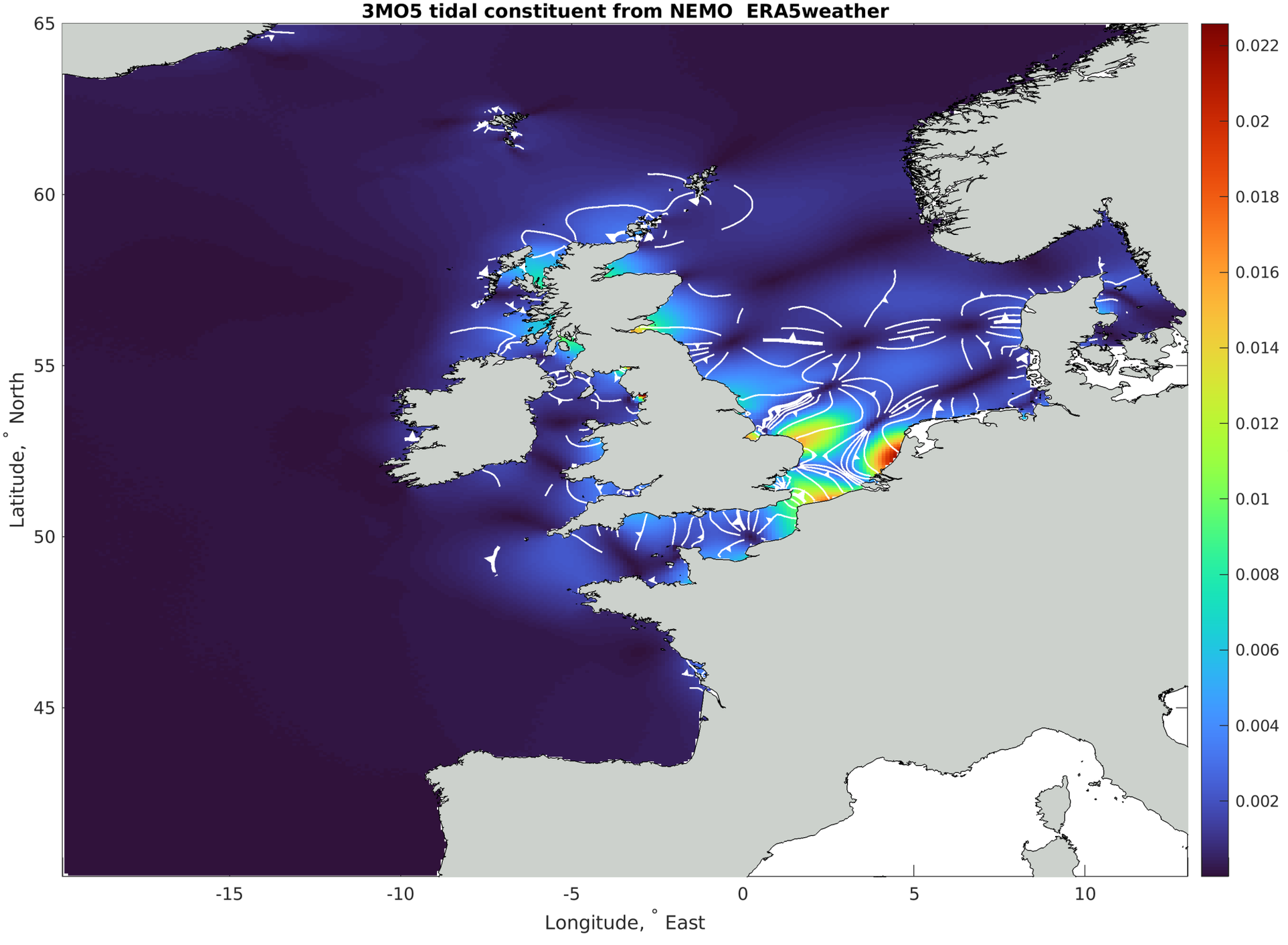

3MK4 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.022
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
metres

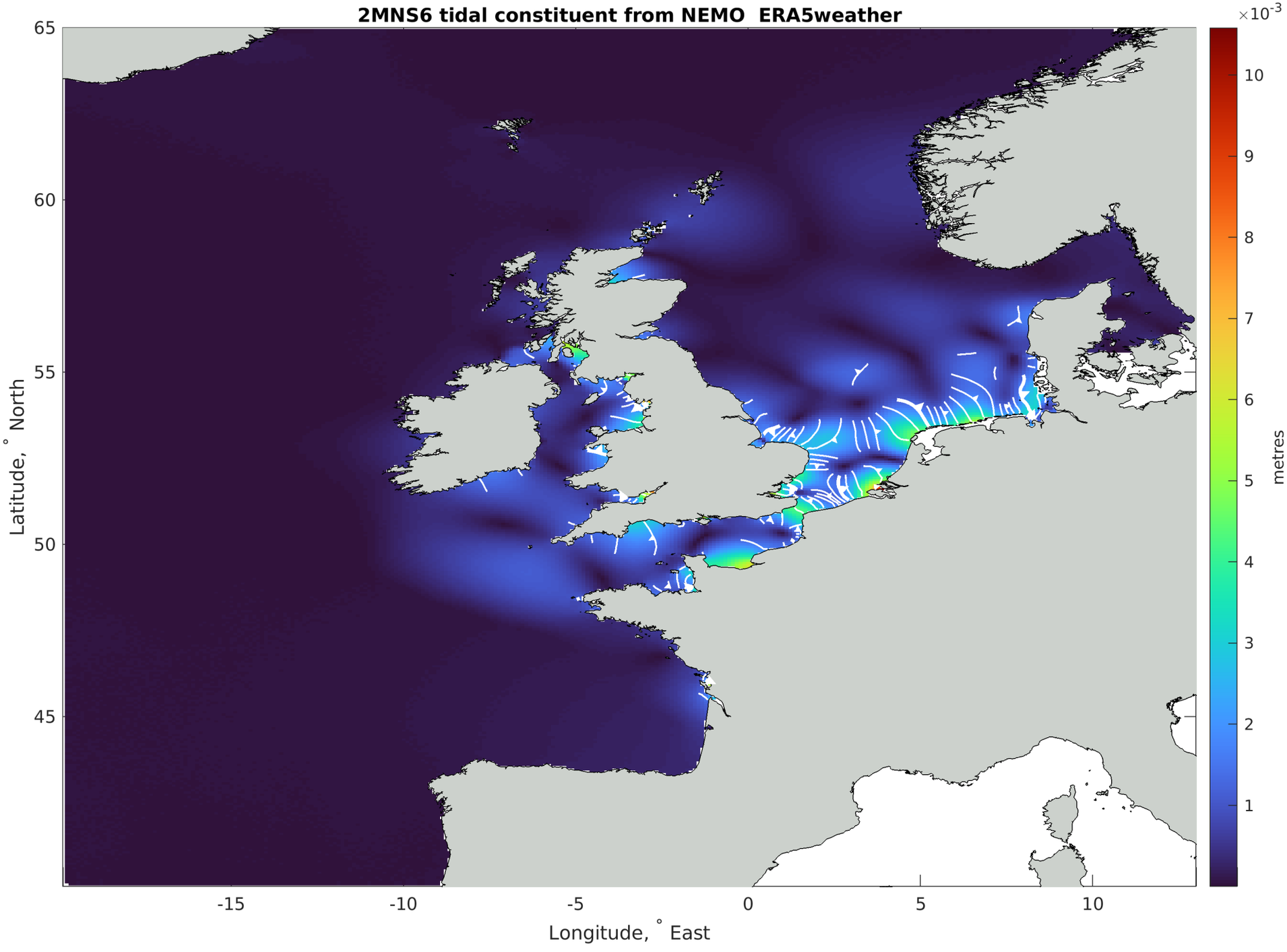

3MS4 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
metres

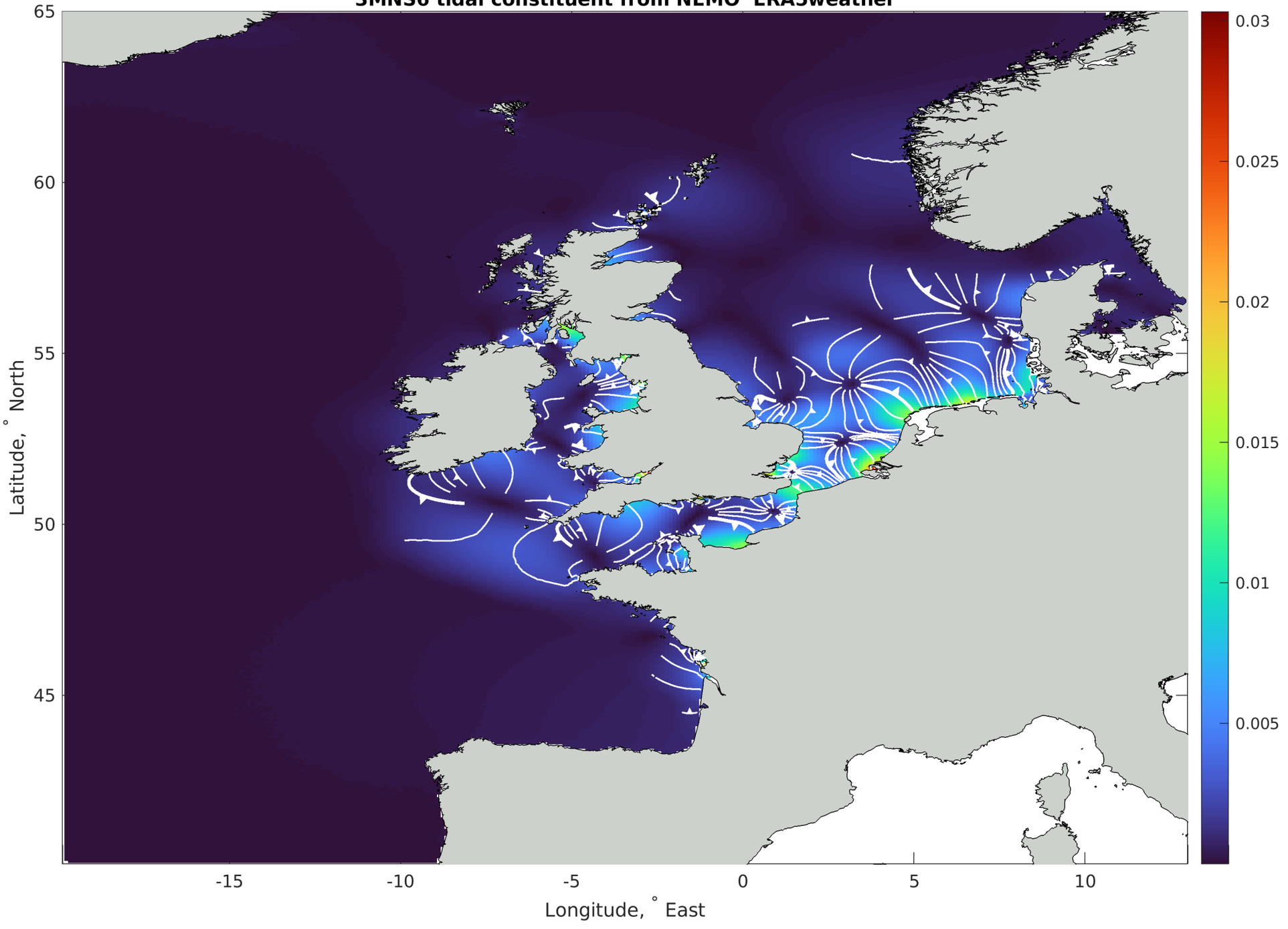

2MSK4 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.025
0.02
0.015
0.01
0.005
metres

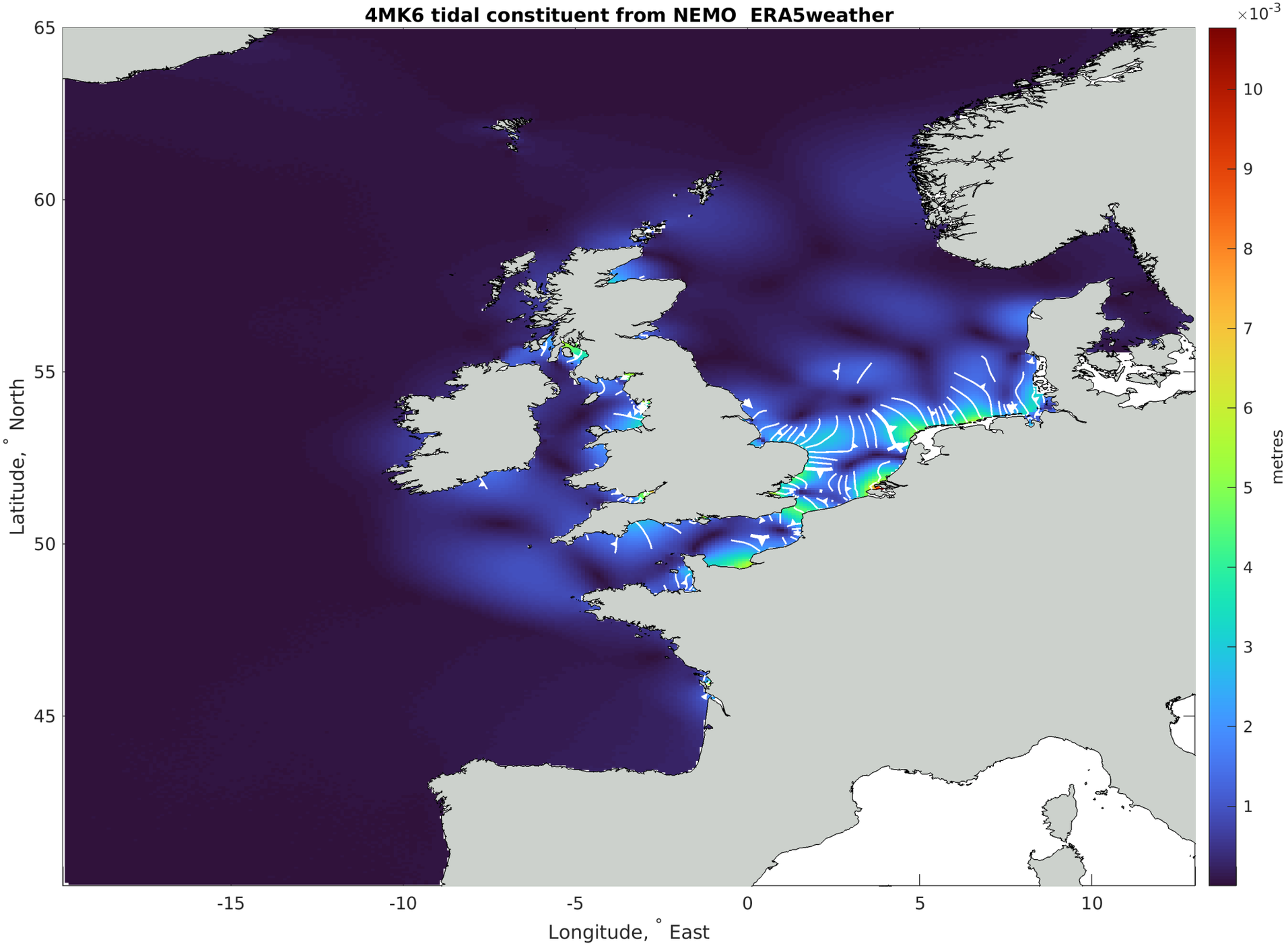

3MK5 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
metres

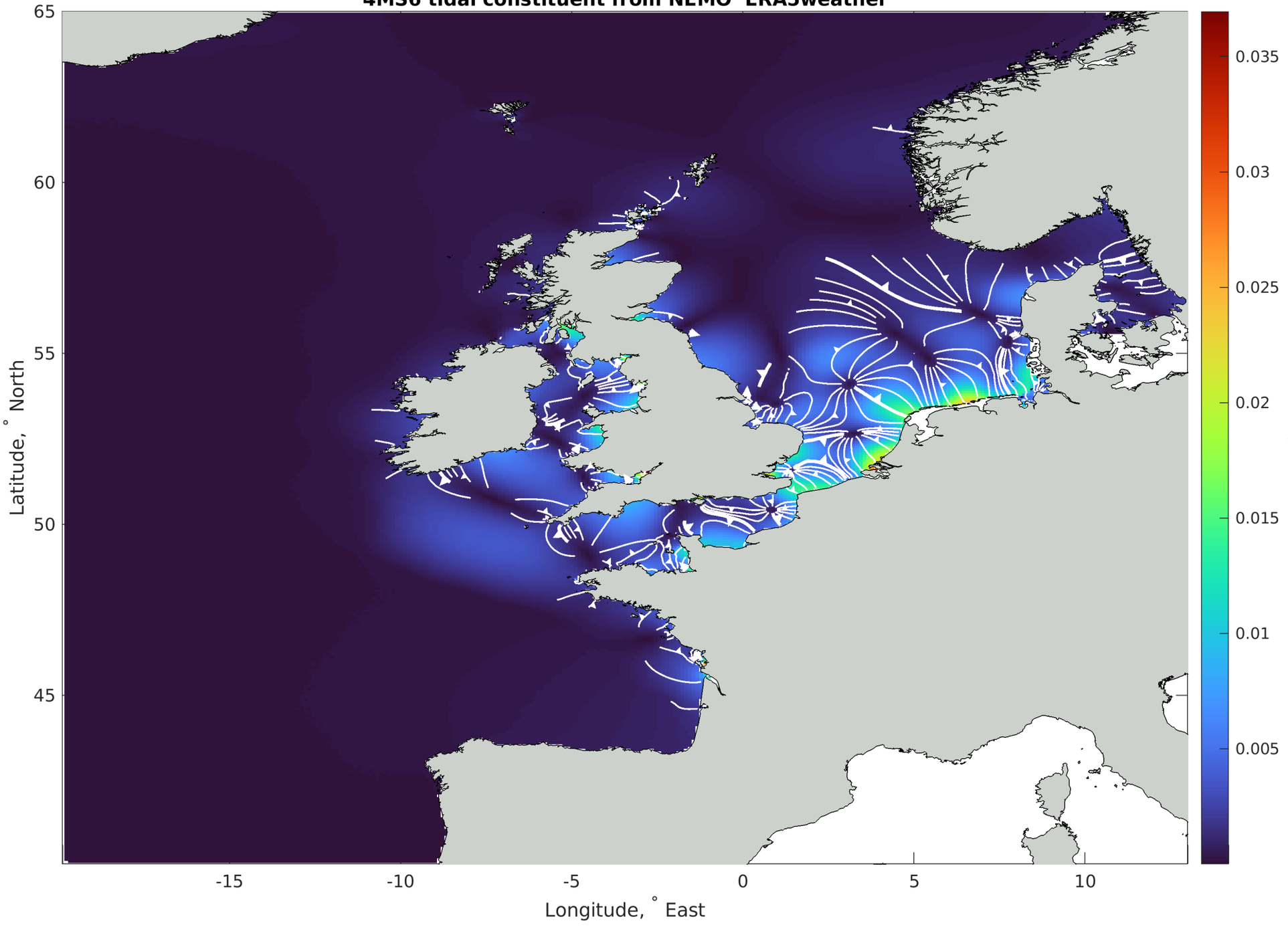

M5 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-4
4.5
4
3.5
3
2.5
2
1.5
1
0.5
metres

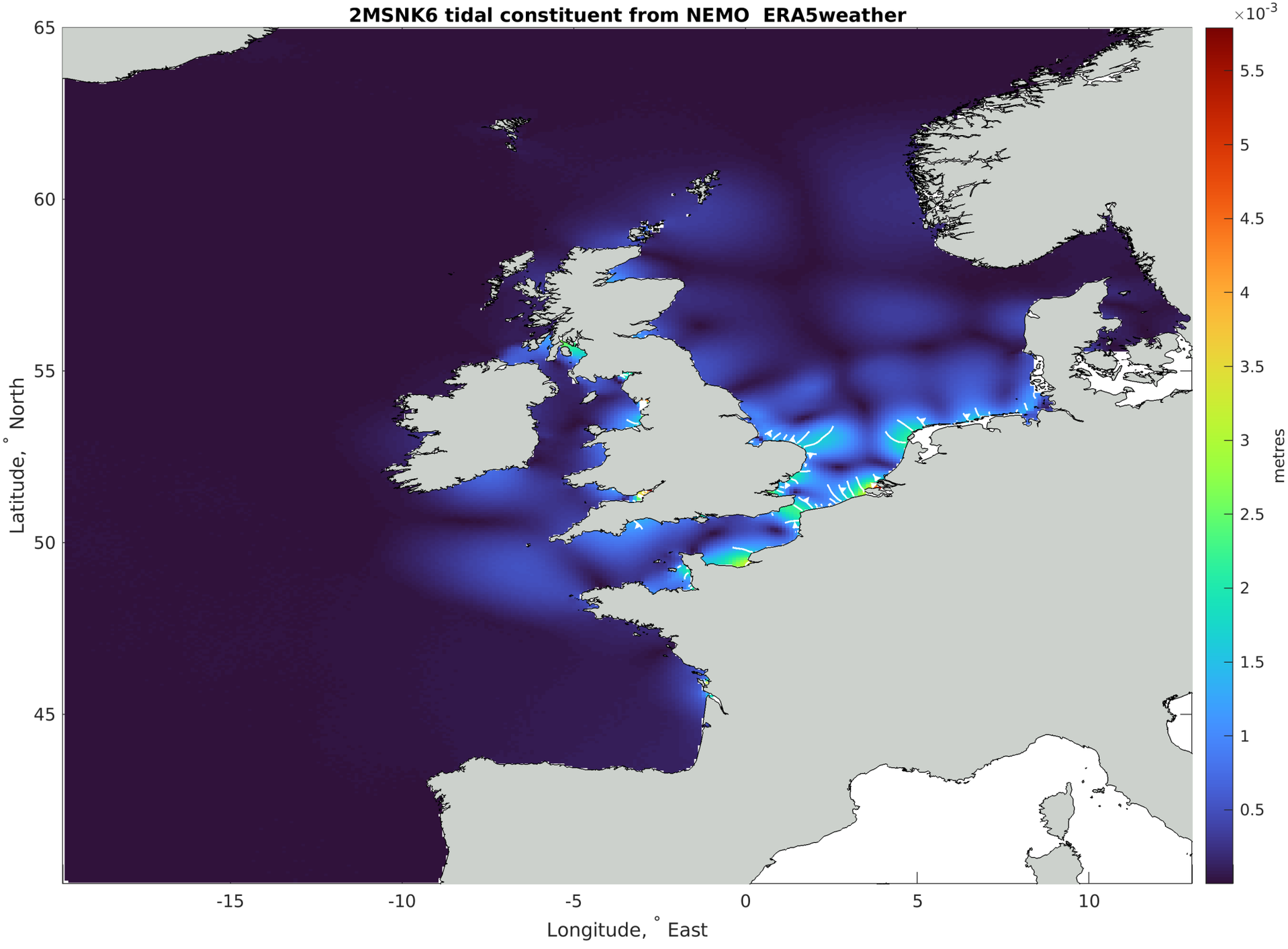

3MO5 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.022
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
metres

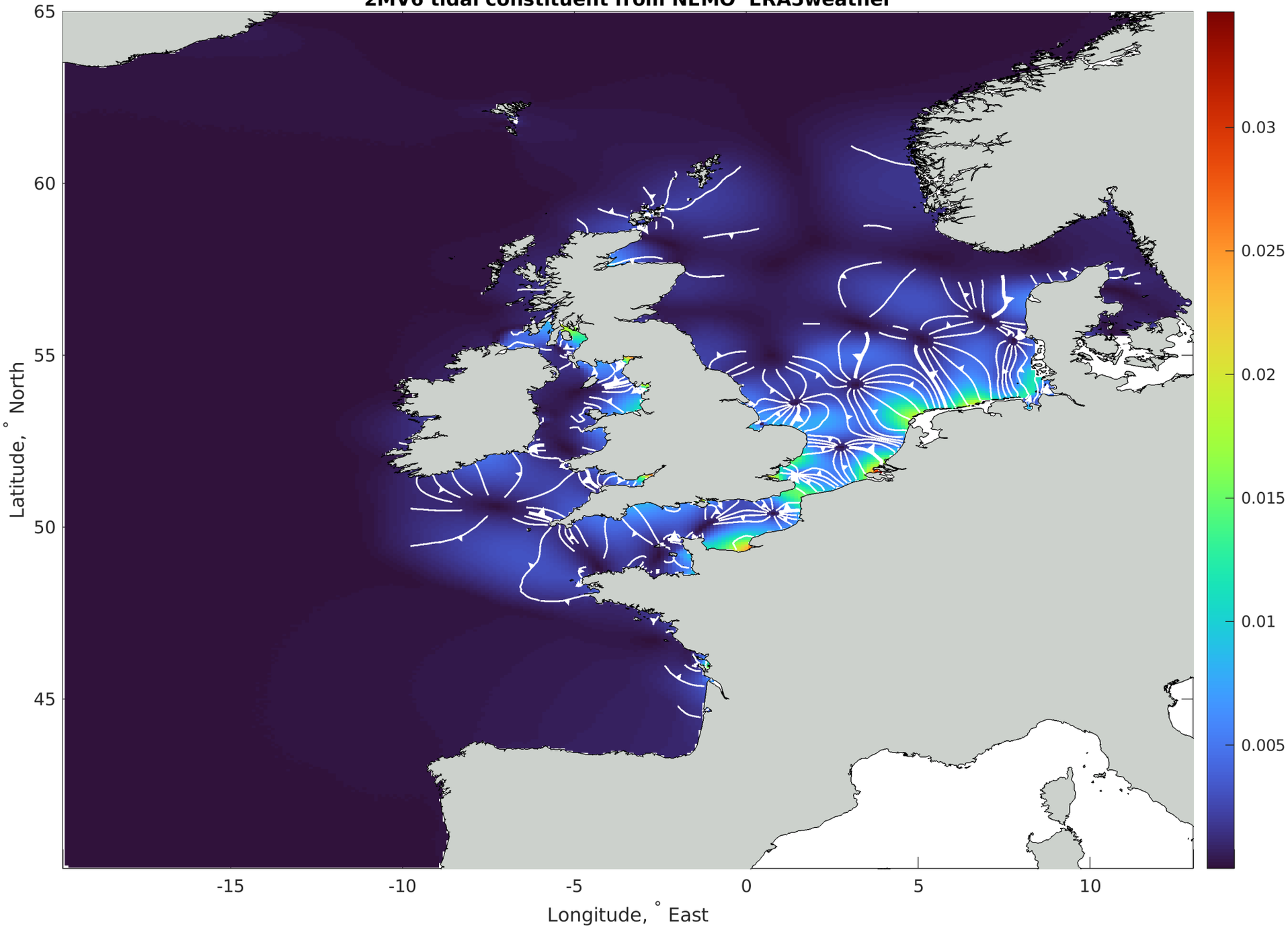

2MNS6 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
10
9
8
7
6
5
4
3
2
1
metres

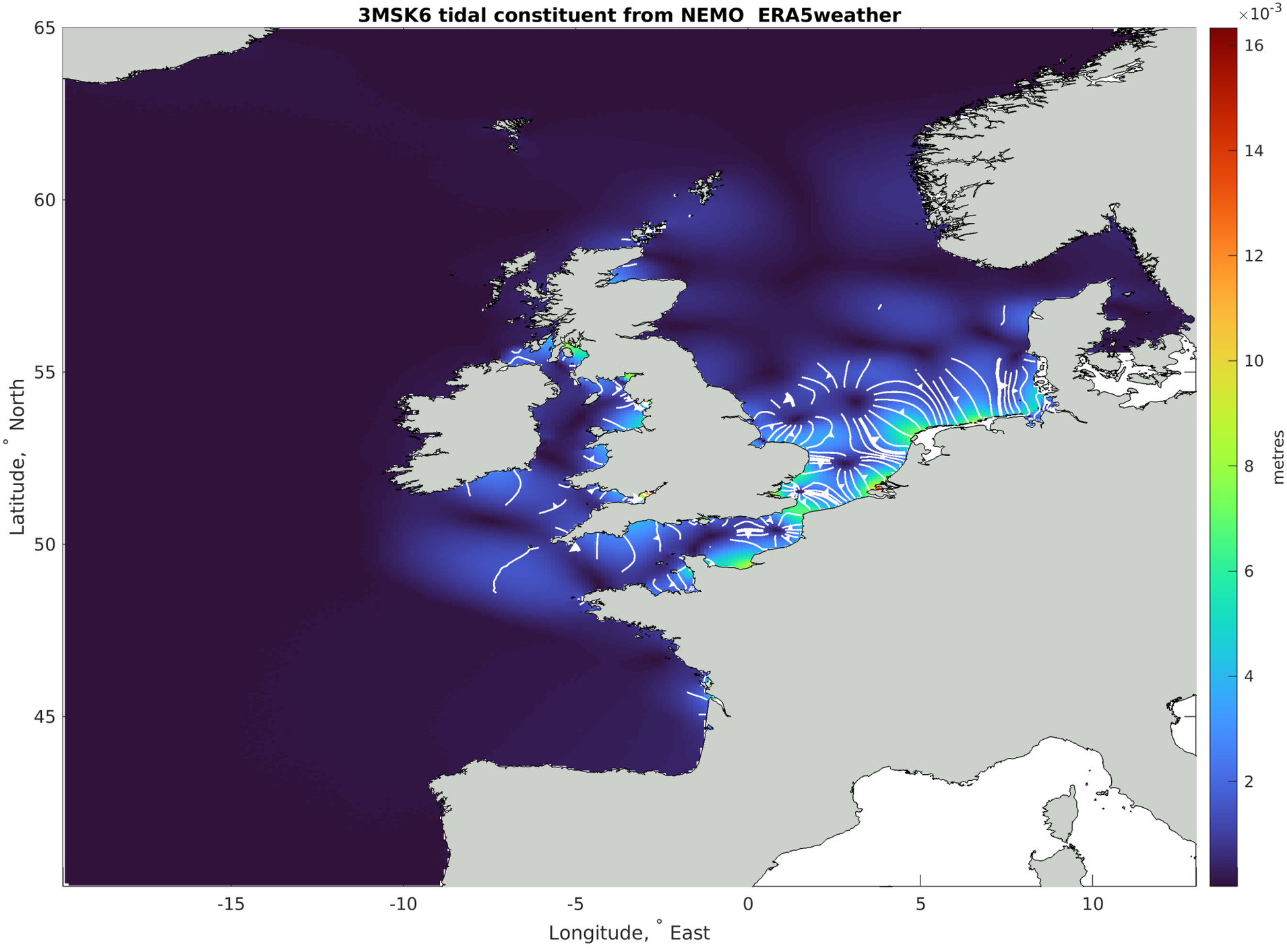

3MNS6 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.03
0.025
0.02
0.015
0.01
0.005
metres


4MK6 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
10
9
8
7
6
5
4
3
2
1
metres


4MS6 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.035
0.03
0.025
0.02
0.015
0.01
0.005
metres


2MSNK6 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
×10-3
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
metres


2MV6 tidal constituent from NEMO ERA5weather
65
60
55
50
45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.03
0.025
0.02
0.015
0.01
0.005
metres


3MSK6 tidal constituent from NEMO ERA5weather
65
60
55
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45
Latitude, ° North
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Longitude, ° East
×10-3
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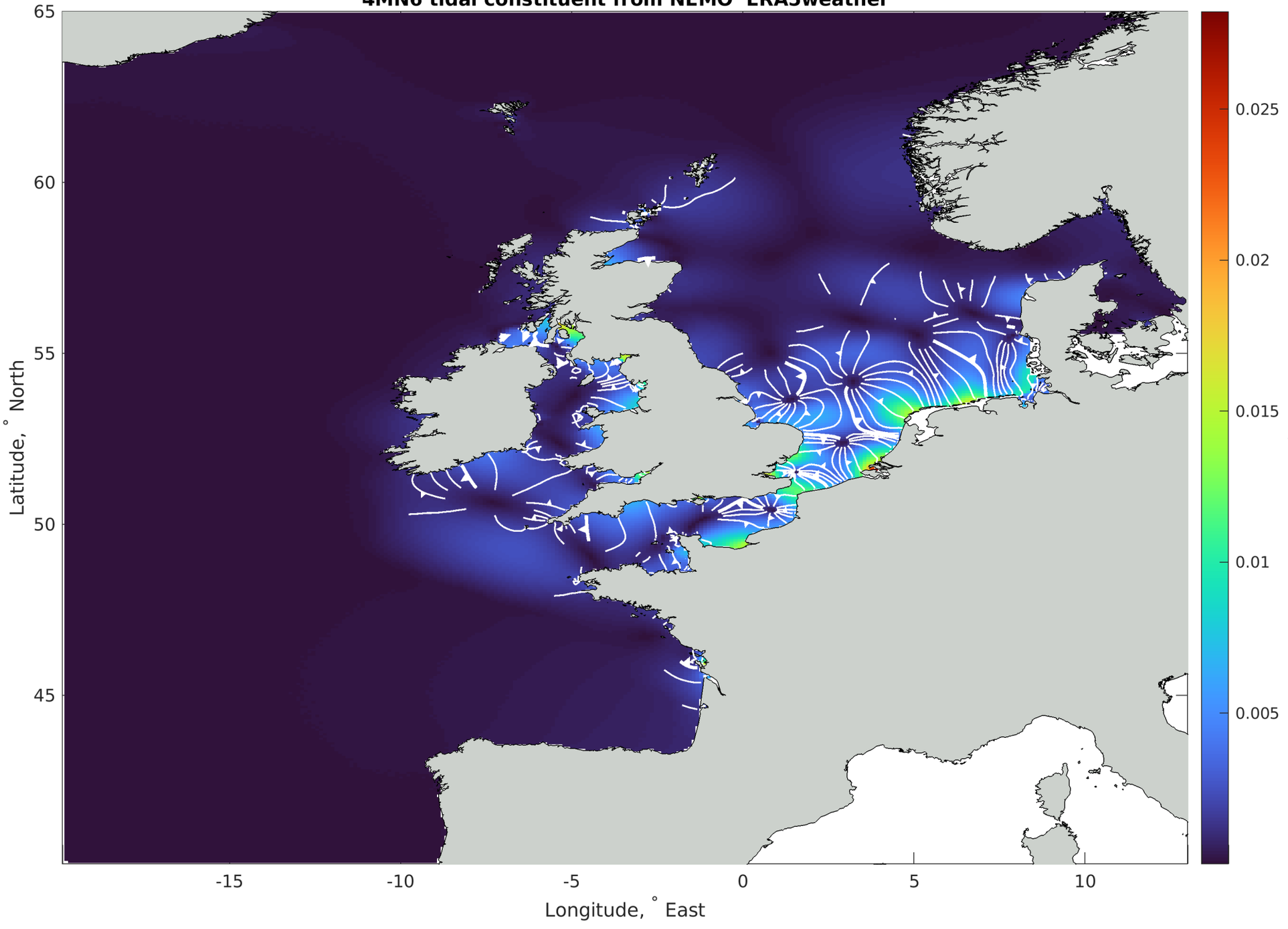
metres


4MN6 tidal constituent from NEMO ERA5weather
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45
Latitude, ° North
-15
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Longitude, ° East
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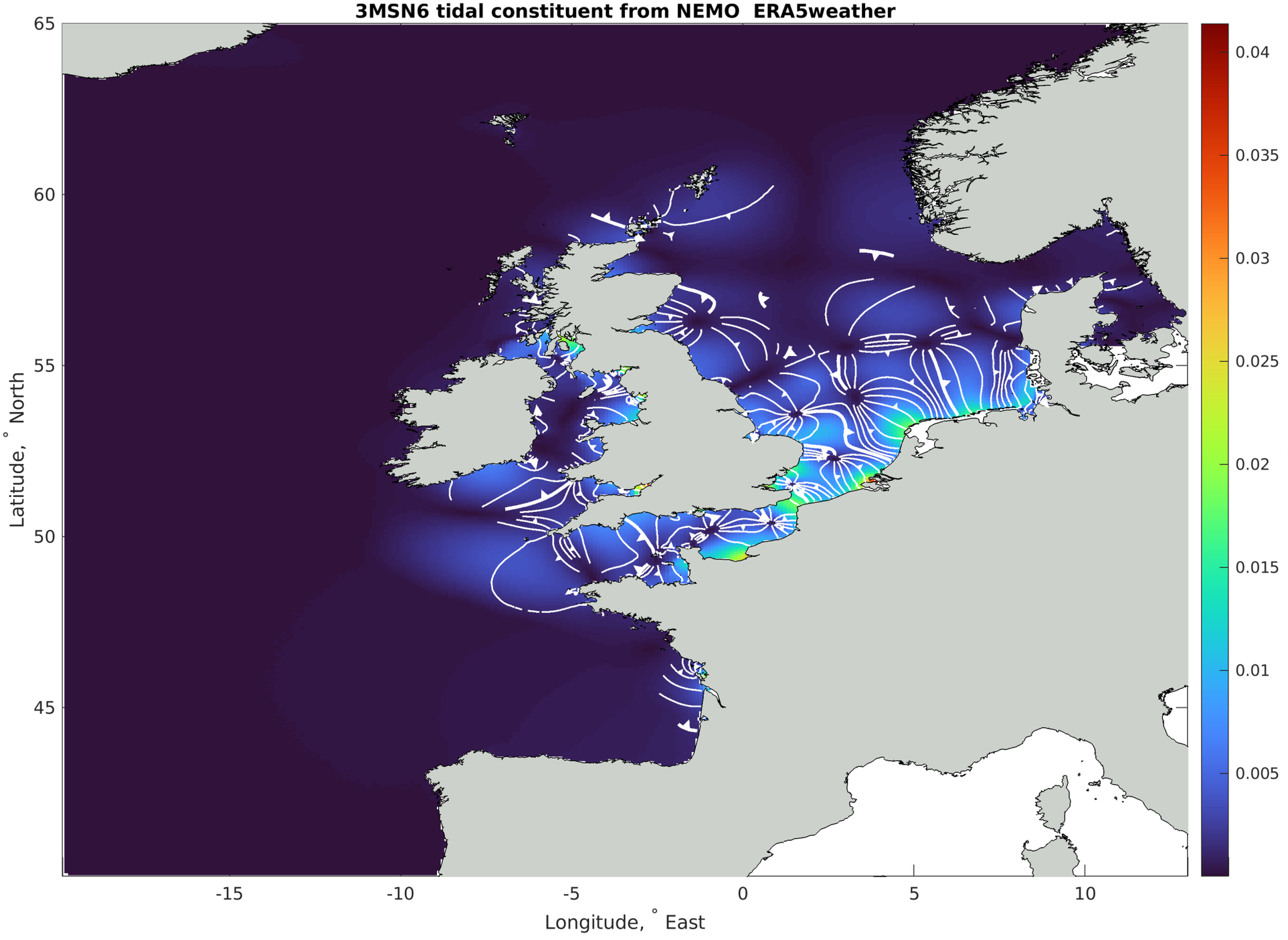
metres


3MSN6 tidal constituent from NEMO ERA5weather
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Latitude, ° North
-15
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-5
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Longitude, ° East
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0.03
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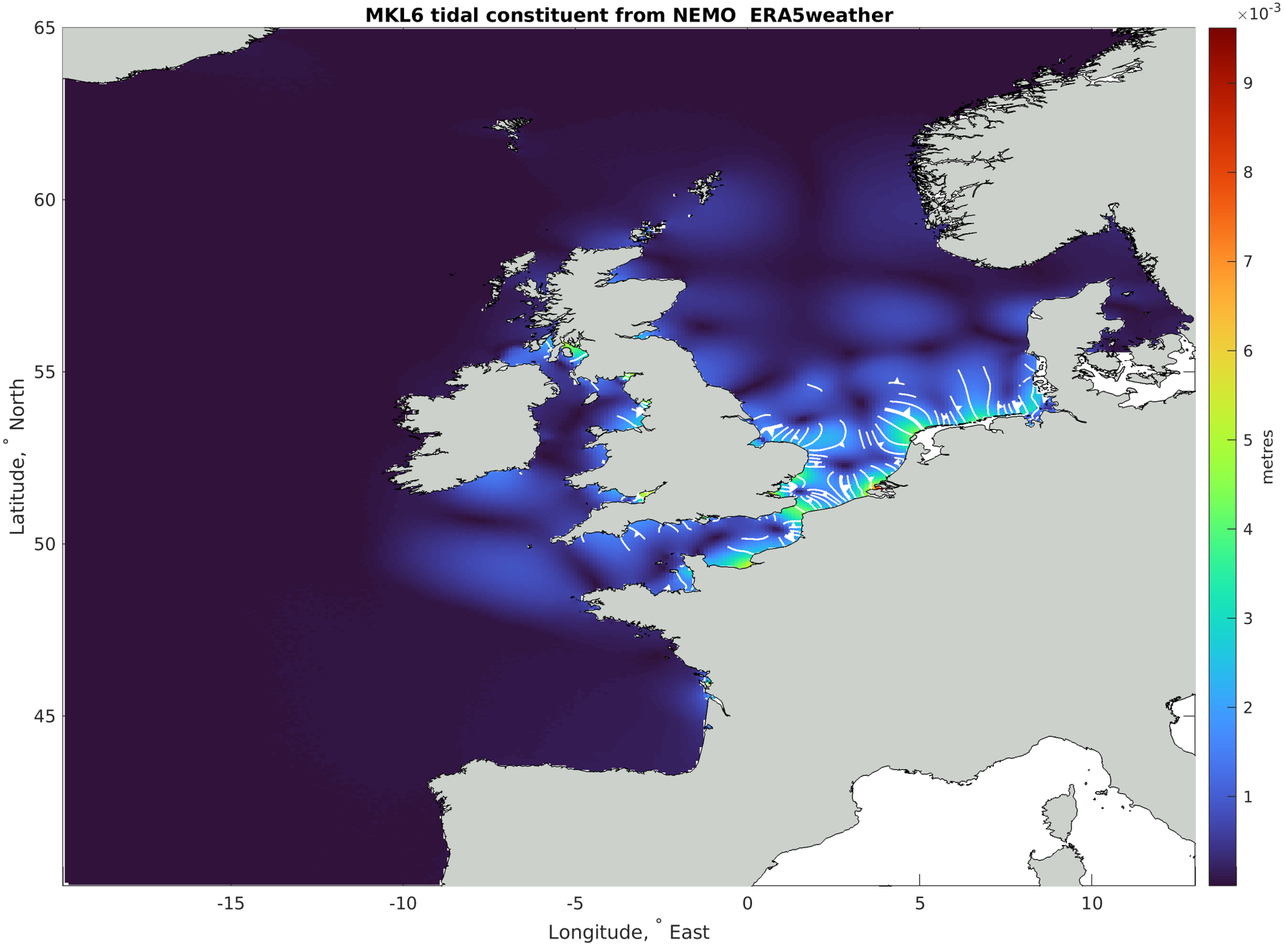
0.01
0.005
metres


MKL6 tidal constituent from NEMO ERA5weather
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60
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Latitude, ° North
-15
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Longitude, ° East
×10-3
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4
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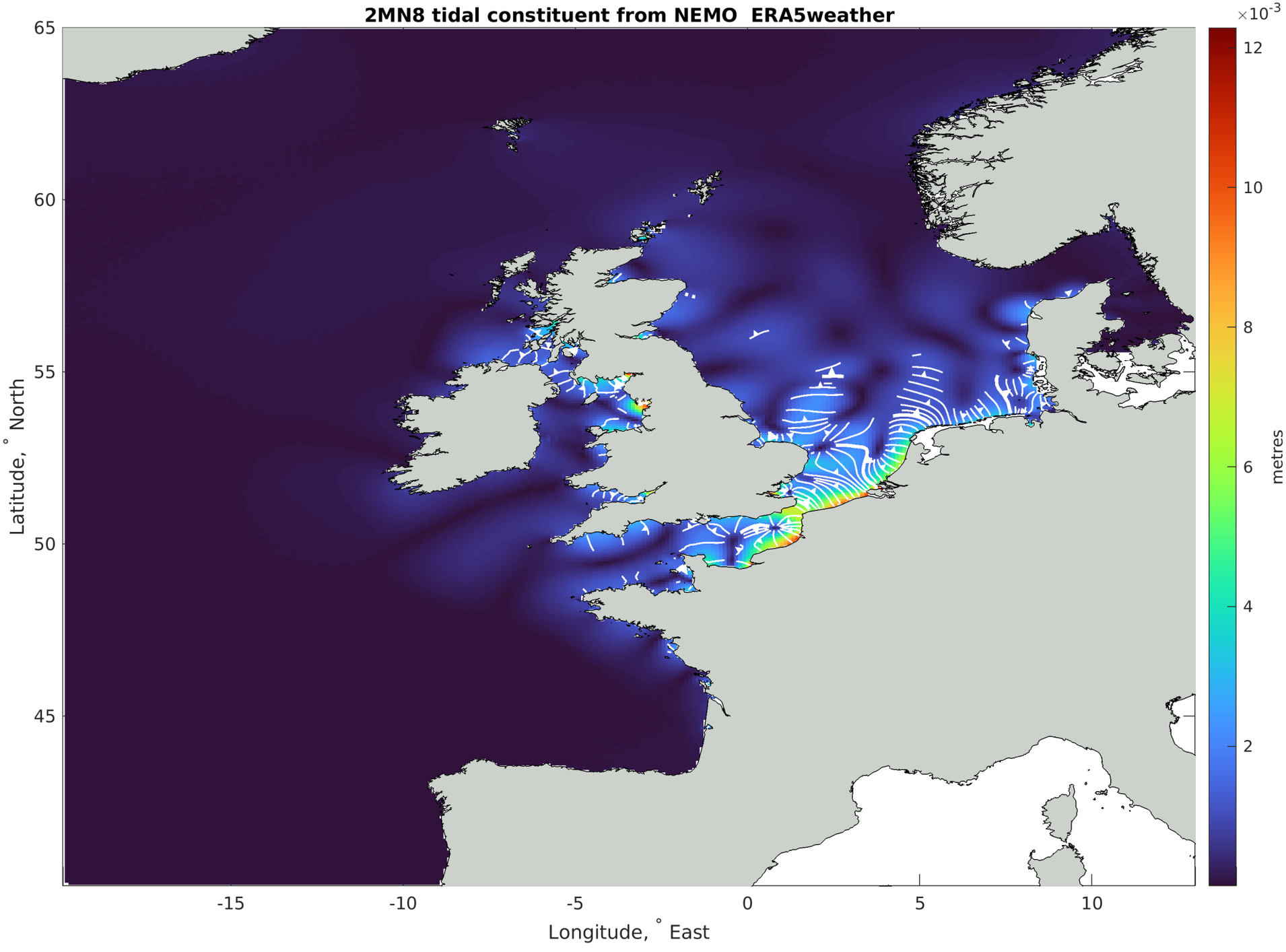
2
1
metres


2MN8 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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-5
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Longitude, ° East
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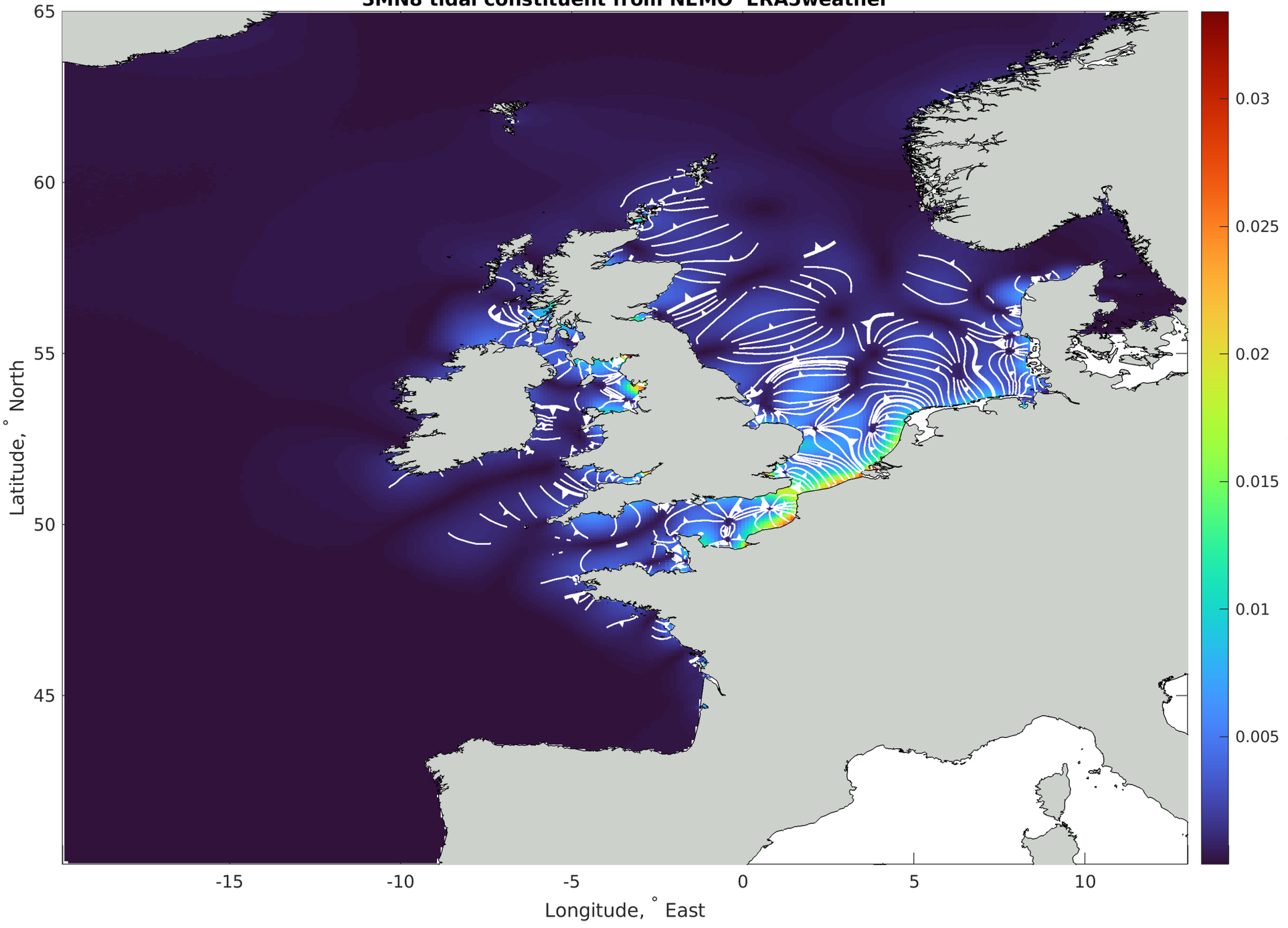
4
2
metres


3MN8 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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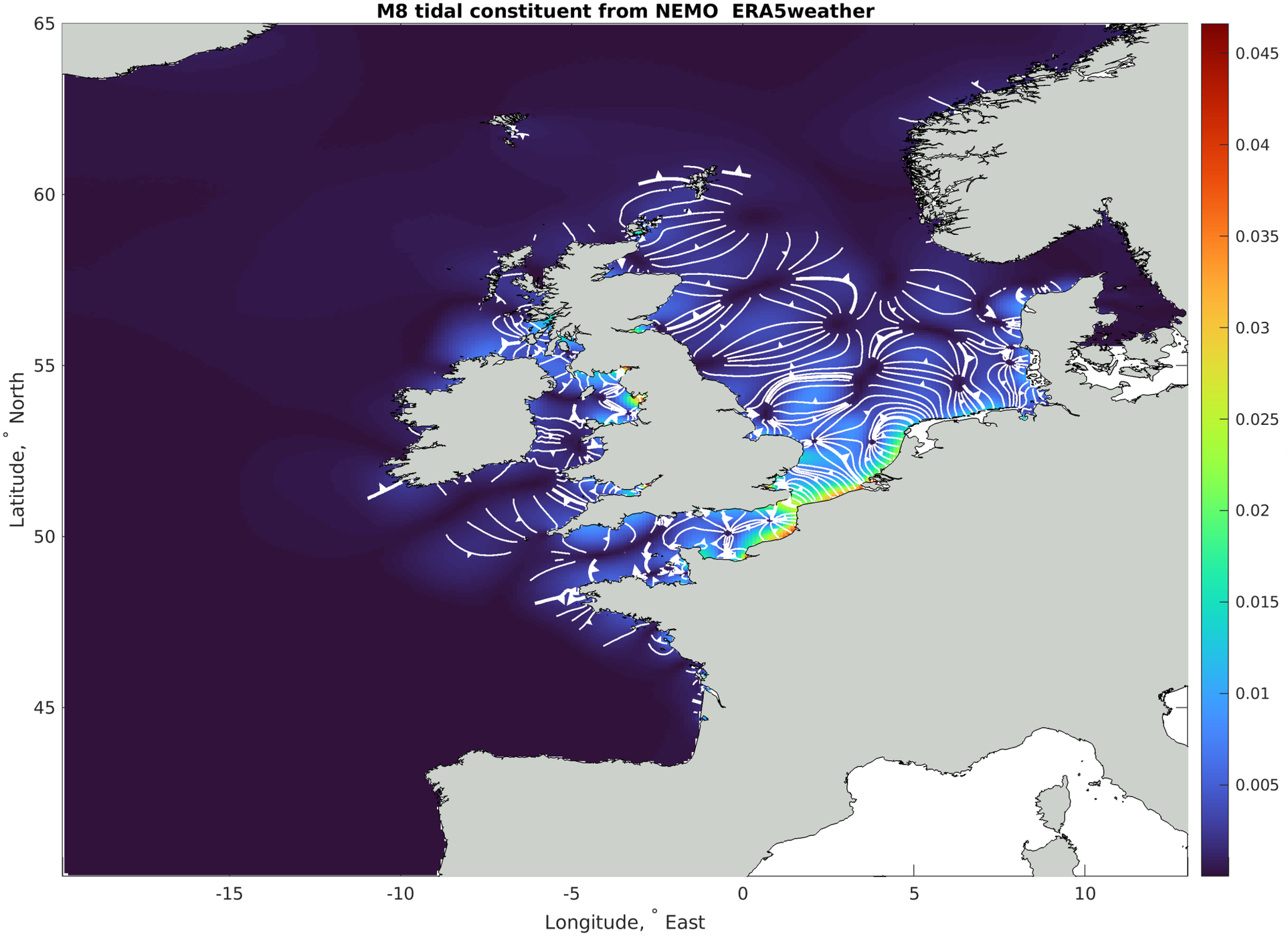
10
Longitude, ° East
0.03
0.025
0.02
0.015
0.01
0.005
metres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Latitude, ° North
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Longitude, ° East
0.045
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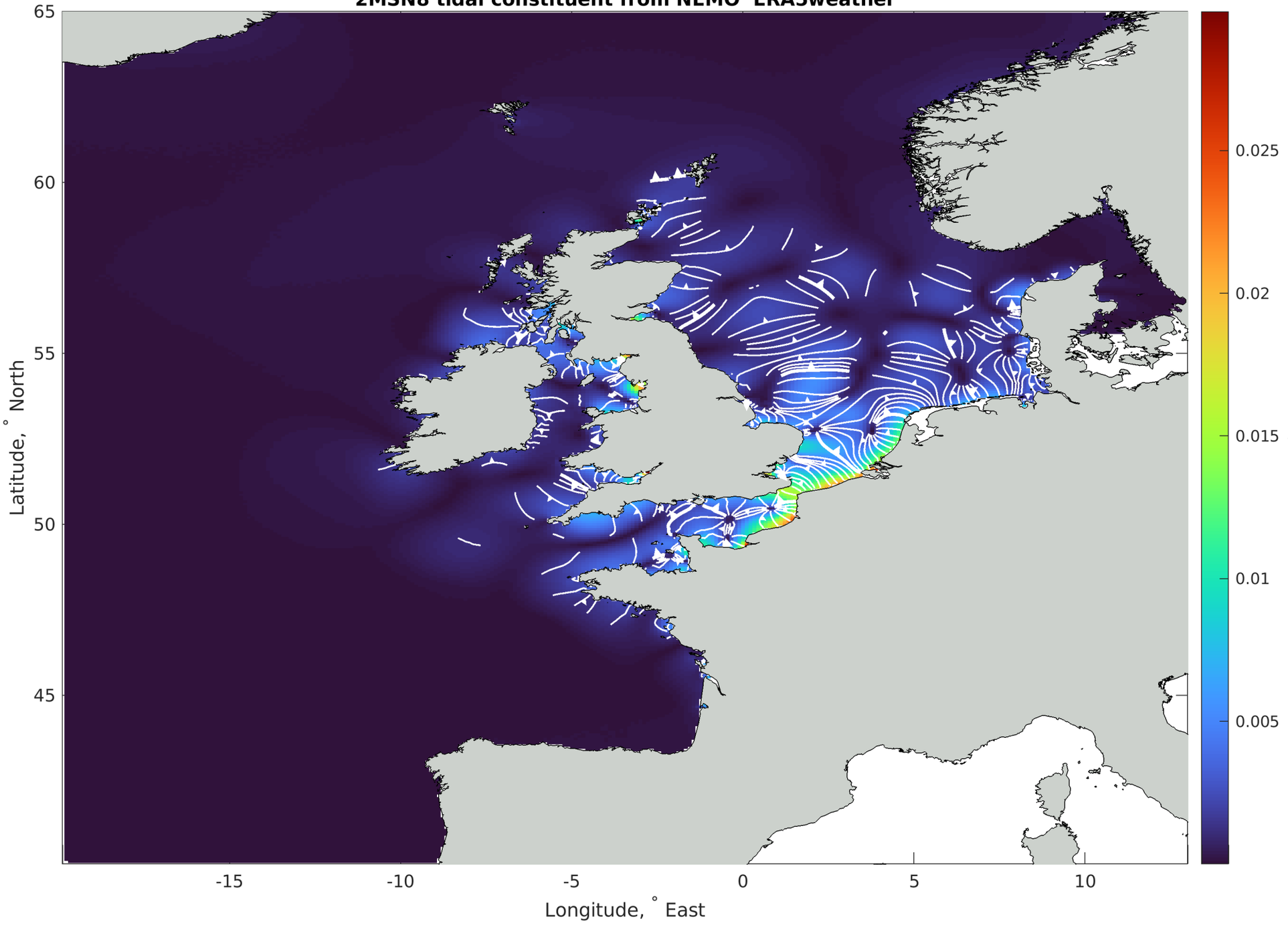
0.01
0.005
metres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45
Latitude, ° North
-15
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-5
0
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Longitude, ° East
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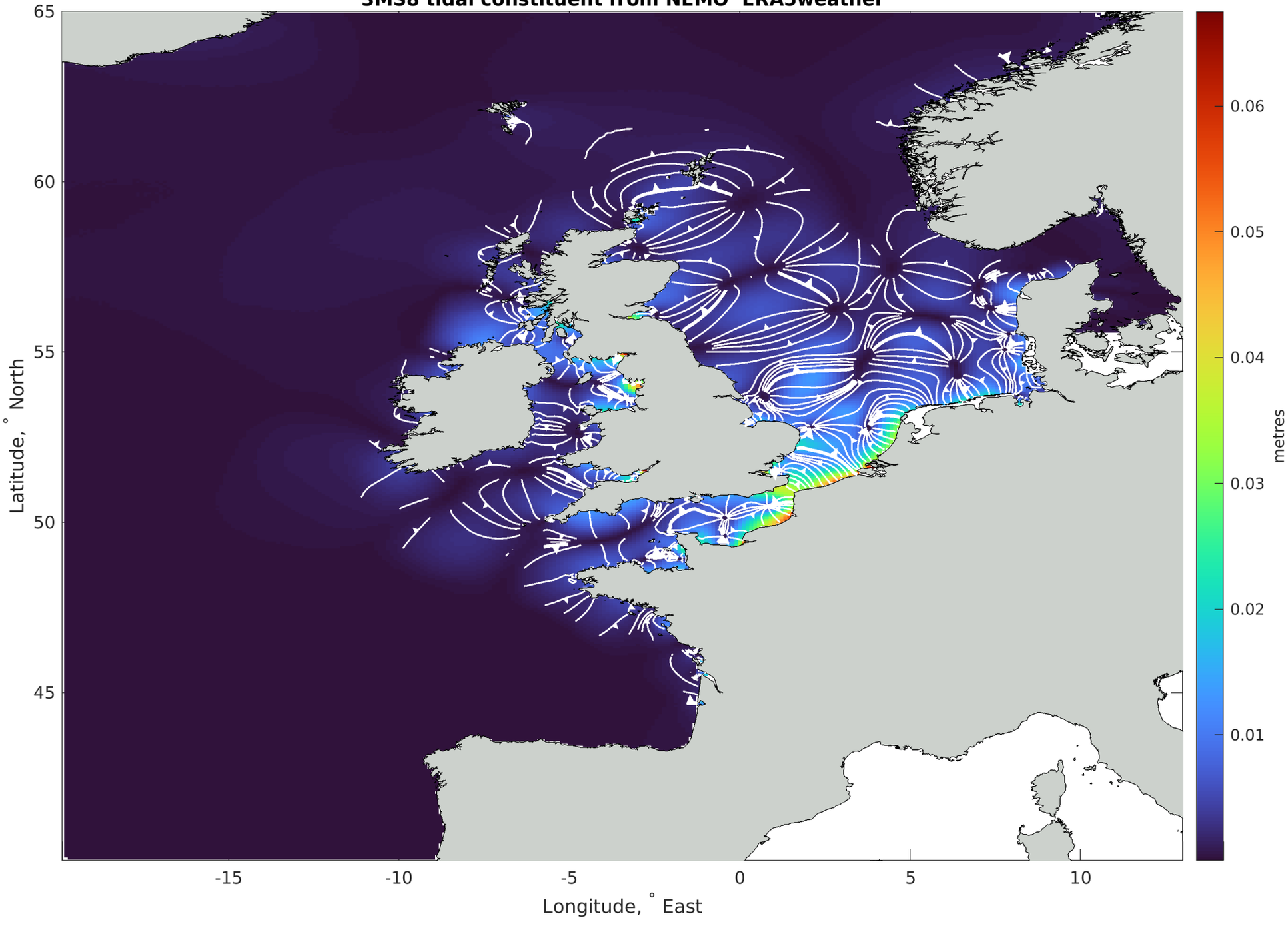
0.02
0.015
0.01
0.005
metres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Latitude, ° North
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Longitude, ° East
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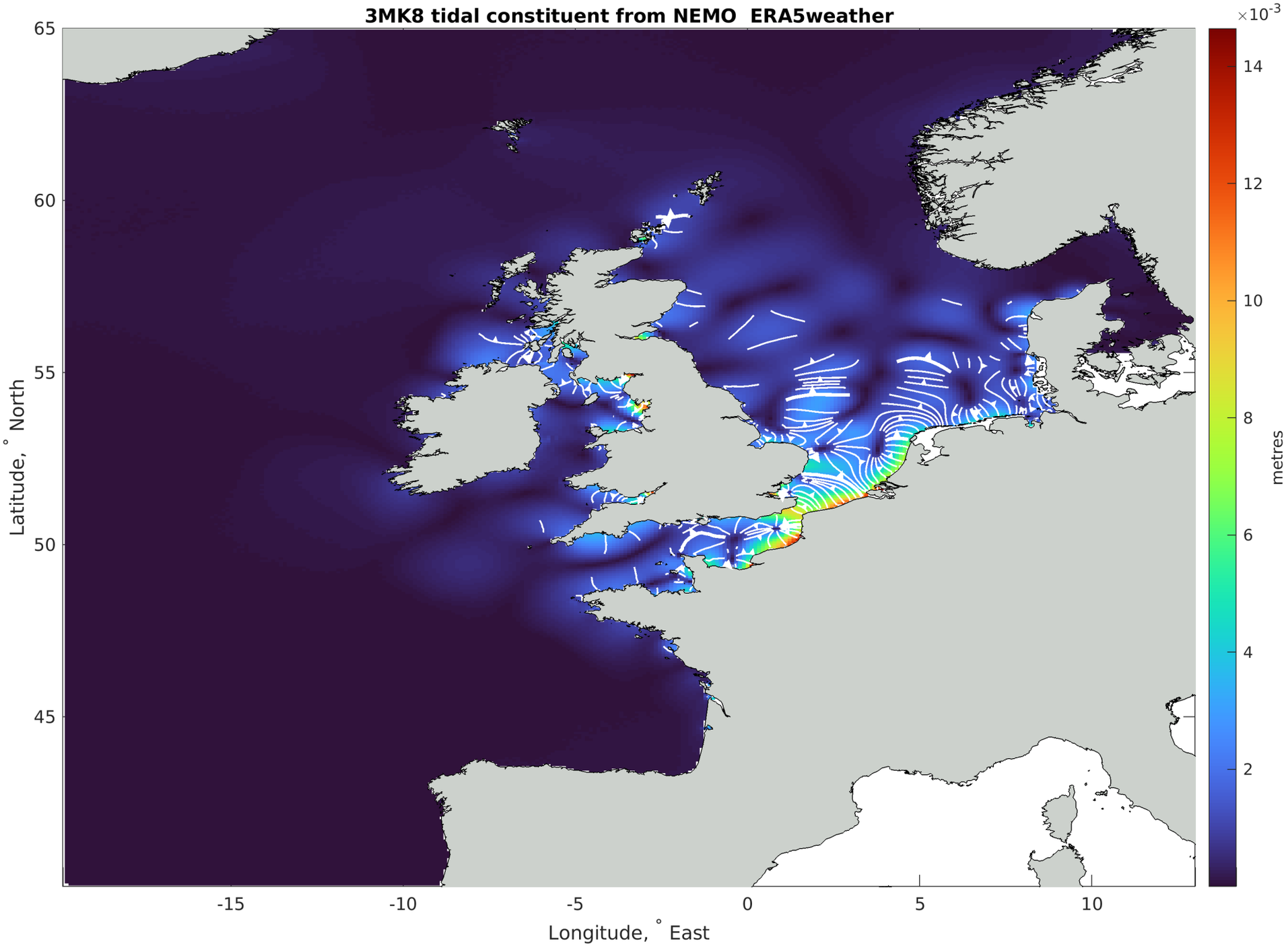
0.03
0.02
0.01
metres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Latitude, ° North
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Longitude, ° East
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12
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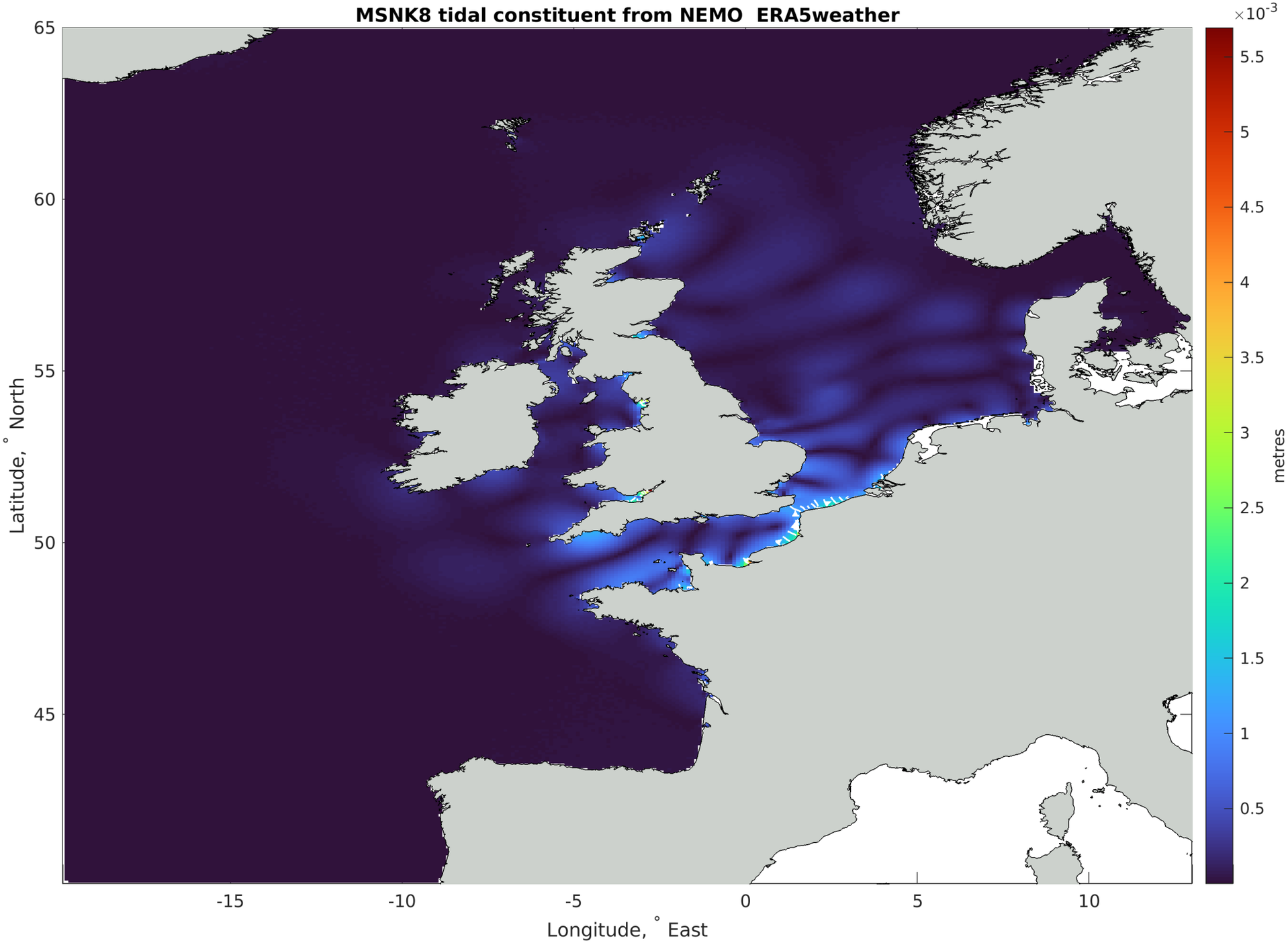
4
2
metres


MSNK8 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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0
5
10
Longitude, ° East
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5
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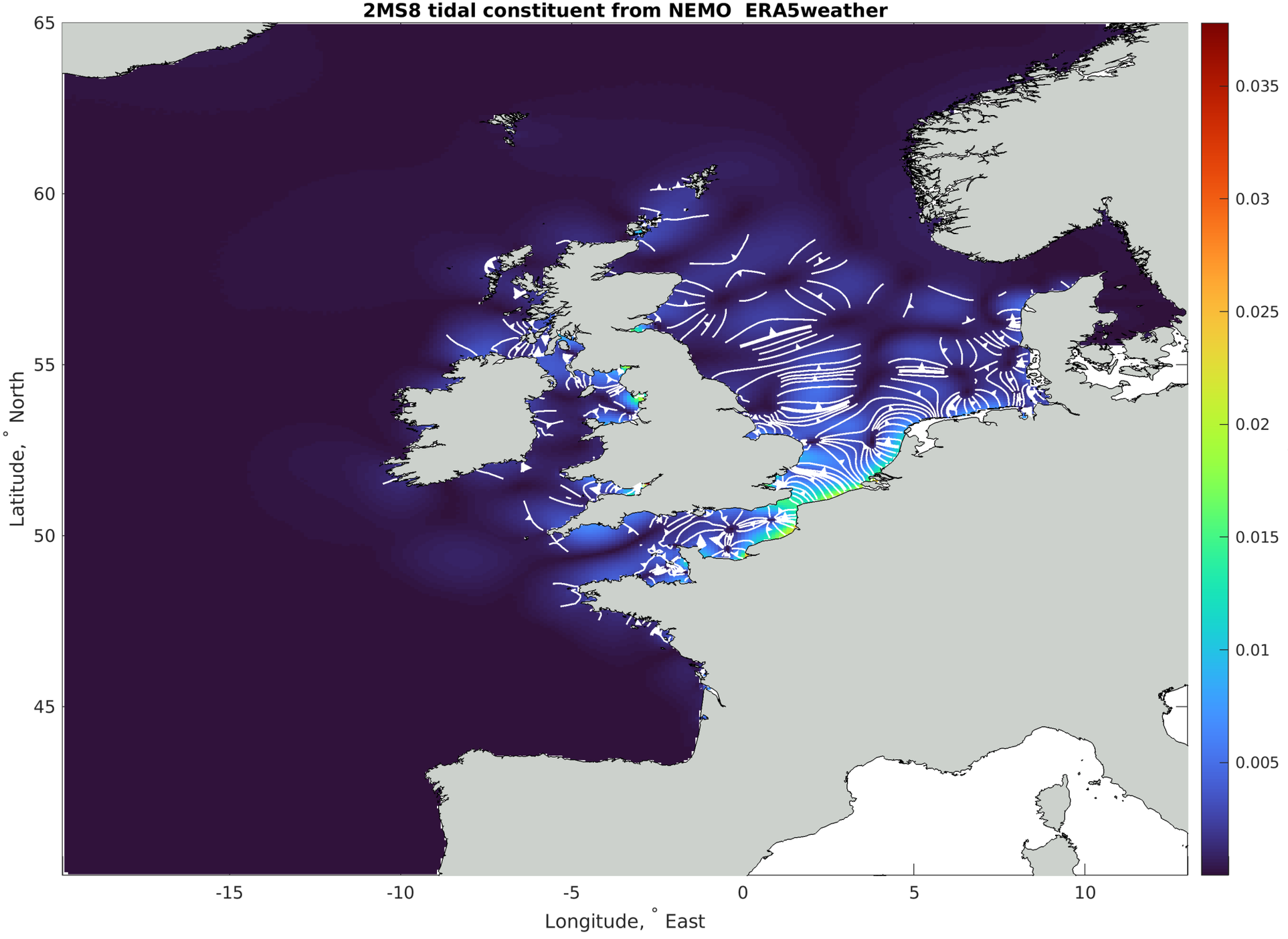
4
3.5
3
2.5
2
1.5
1
0.5
metres


2MS8 tidal constituent from NEMO ERA5weather
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50
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Latitude, ° North
-15
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10
Longitude, ° East
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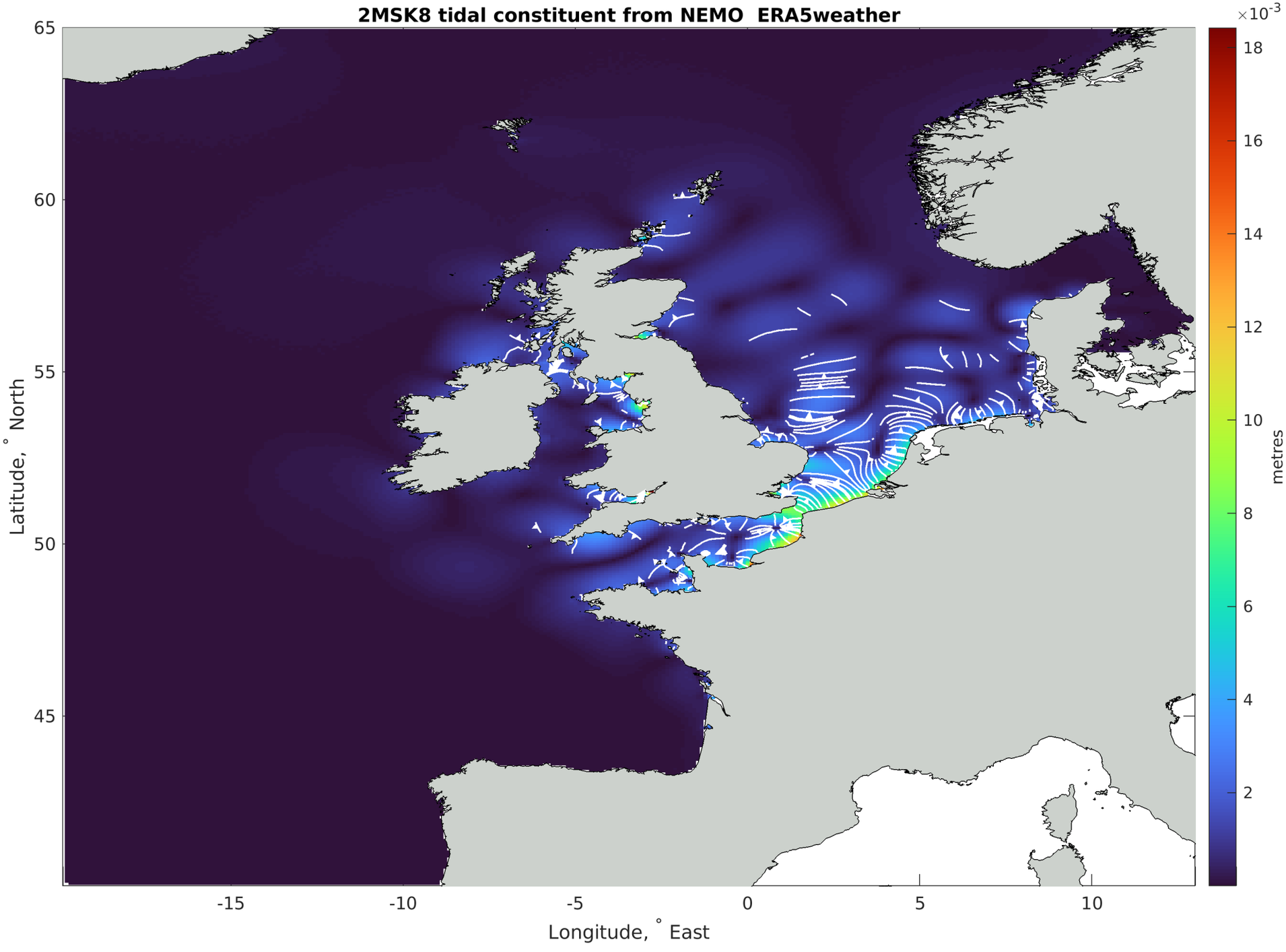
0.025
0.02
0.015
0.01
0.005
metres


2MSK8 tidal constituent from NEMO ERA5weather
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Latitude, ° North
-15
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Longitude, ° East
×10-3
18
16
14
12
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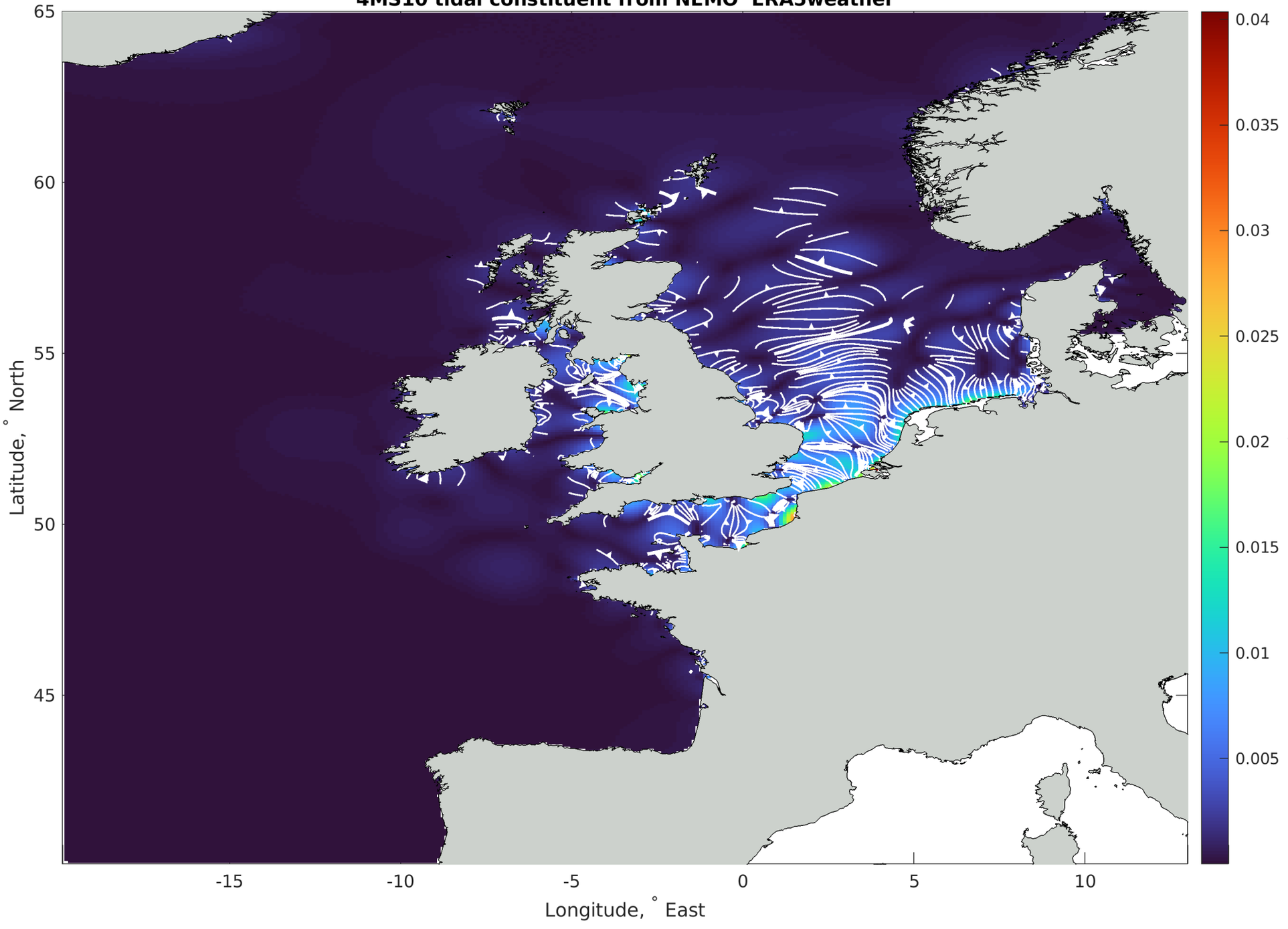
8
6
4
2
metres


4MS10 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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-5
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Longitude, ° East
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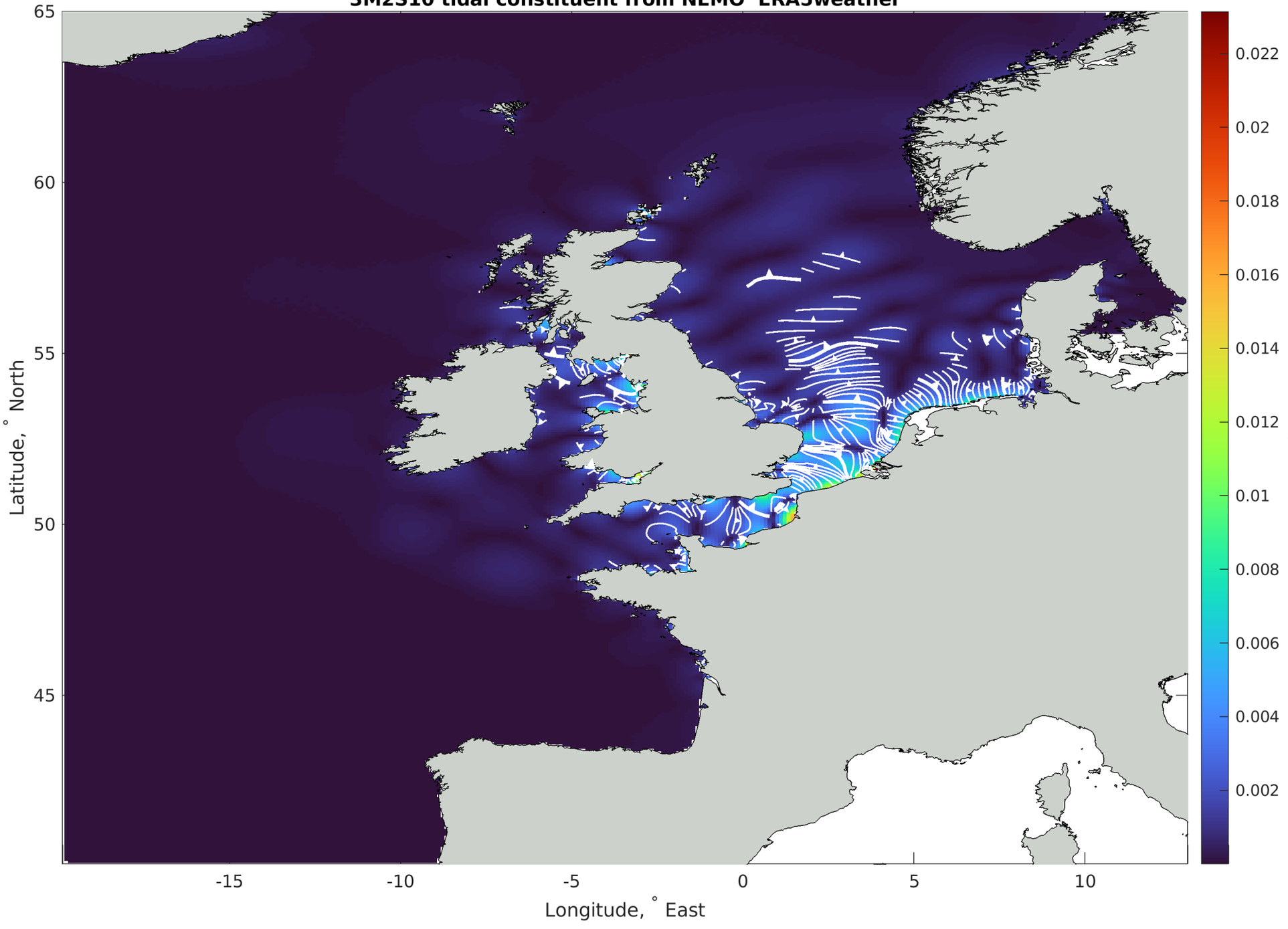
0.03
0.025
0.02
0.015
0.01
0.005
metres


3M2S10 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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-5
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10
Longitude, ° East
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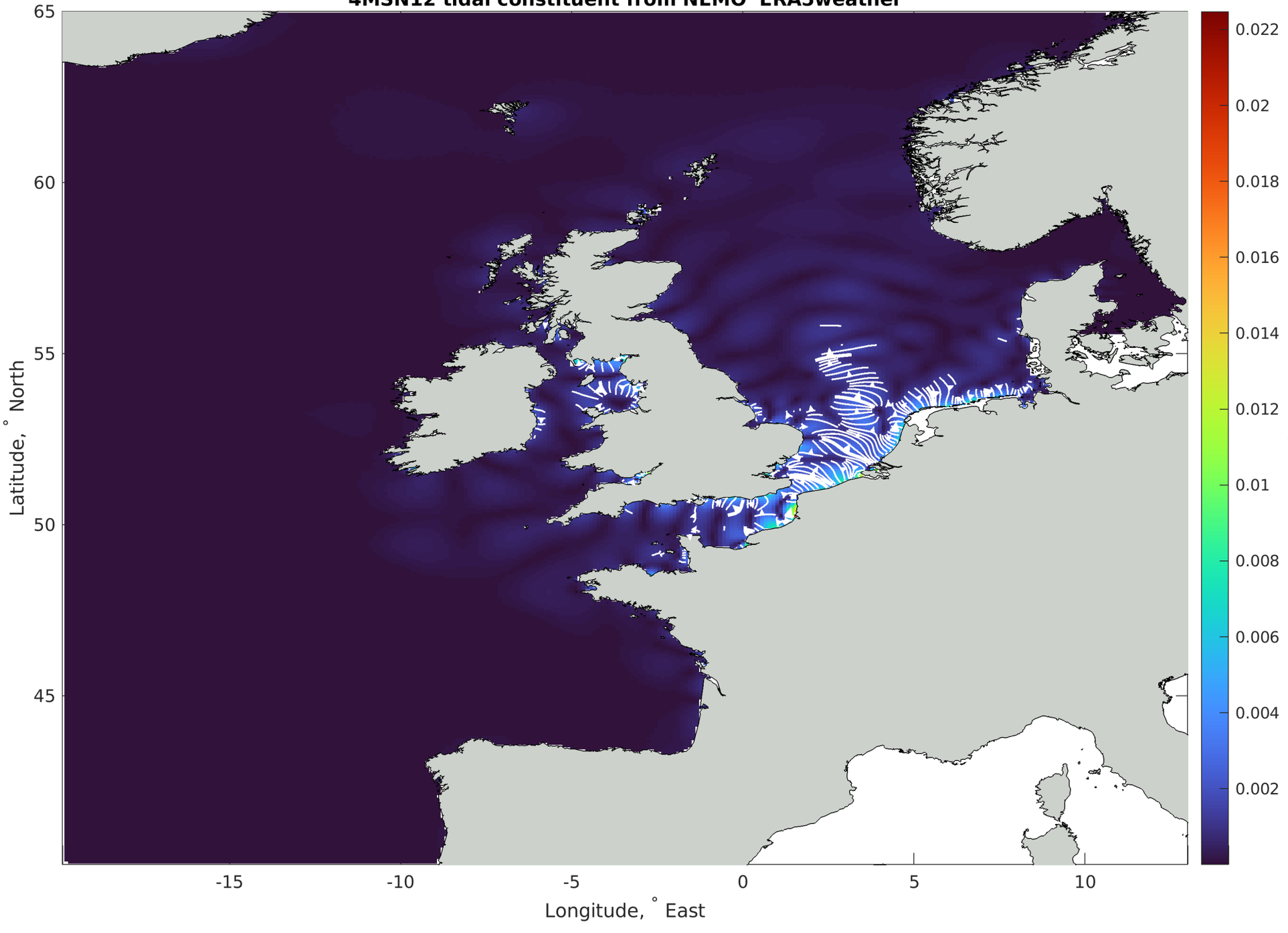
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
metres


4MSN12 tidal constituent from NEMO ERA5weather
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55
50
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Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
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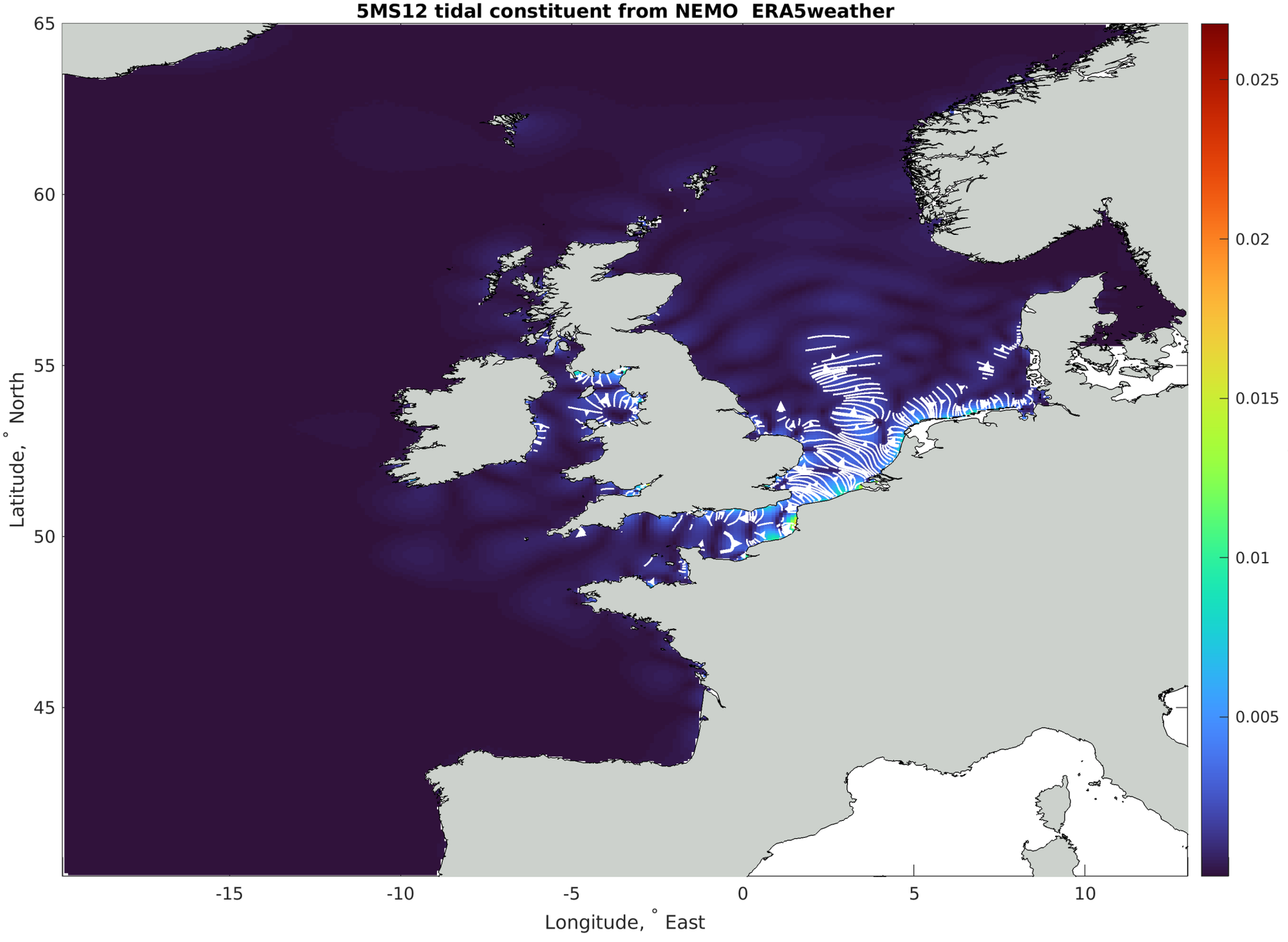
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
metres


5MS12 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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Longitude, ° East
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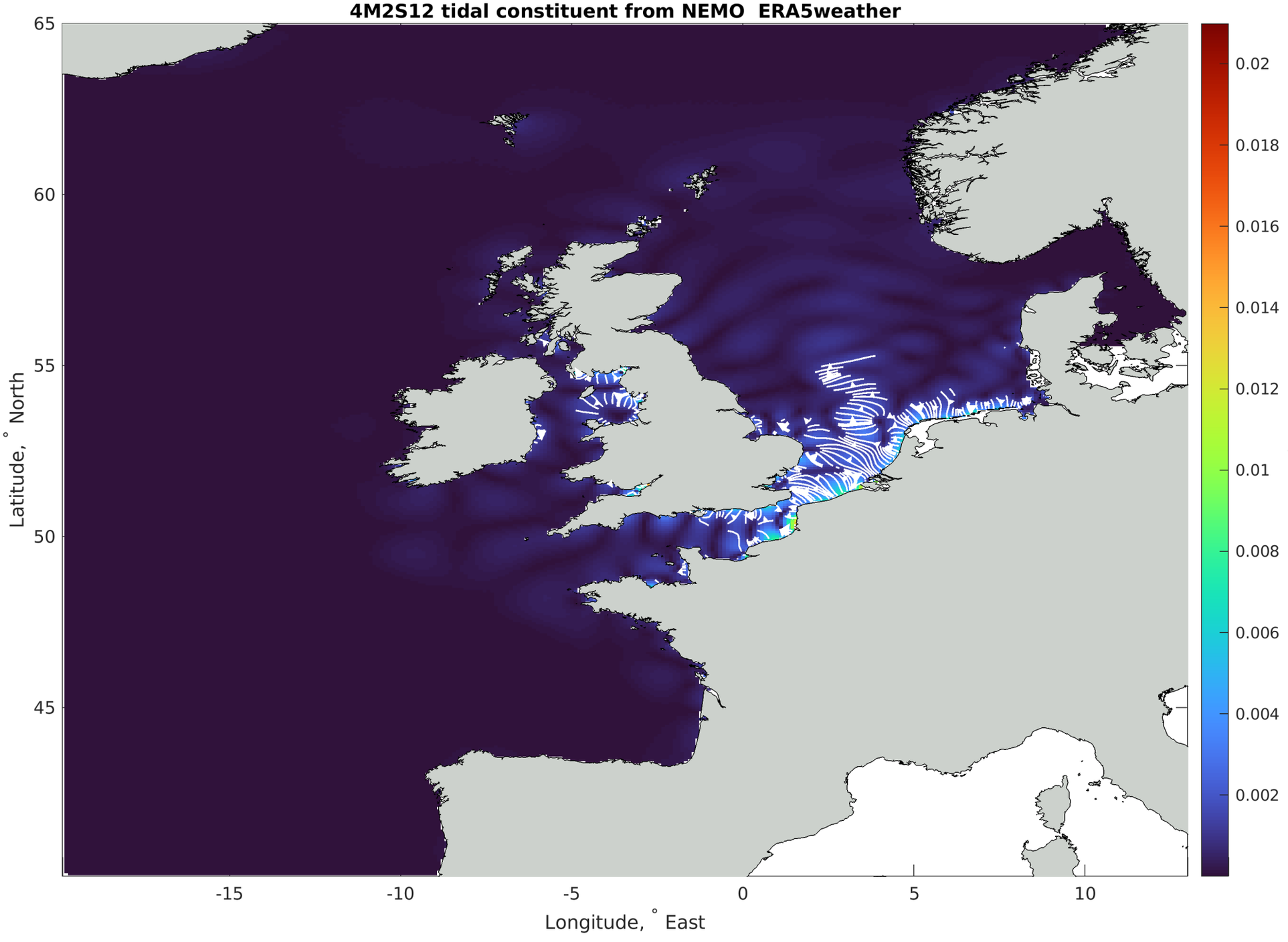
0.02
0.015
0.01
0.005
metres


4M2S12 tidal constituent from NEMO ERA5weather
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50
45
Latitude, ° North
-15
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-5
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10
Longitude, ° East
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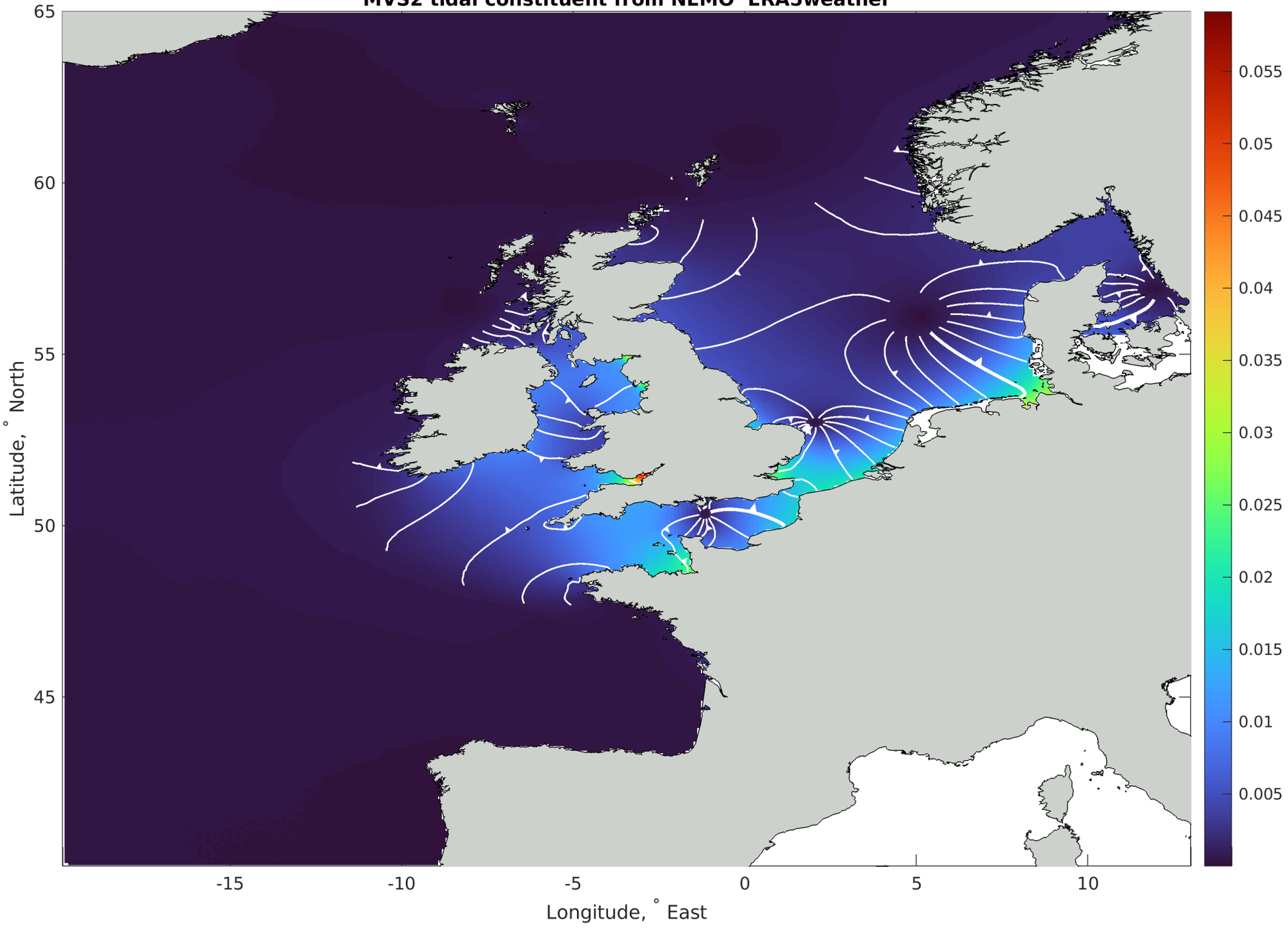
0.002
metres


MVS2 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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0
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Longitude, ° East
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0.045
0.04
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0.03
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0.02
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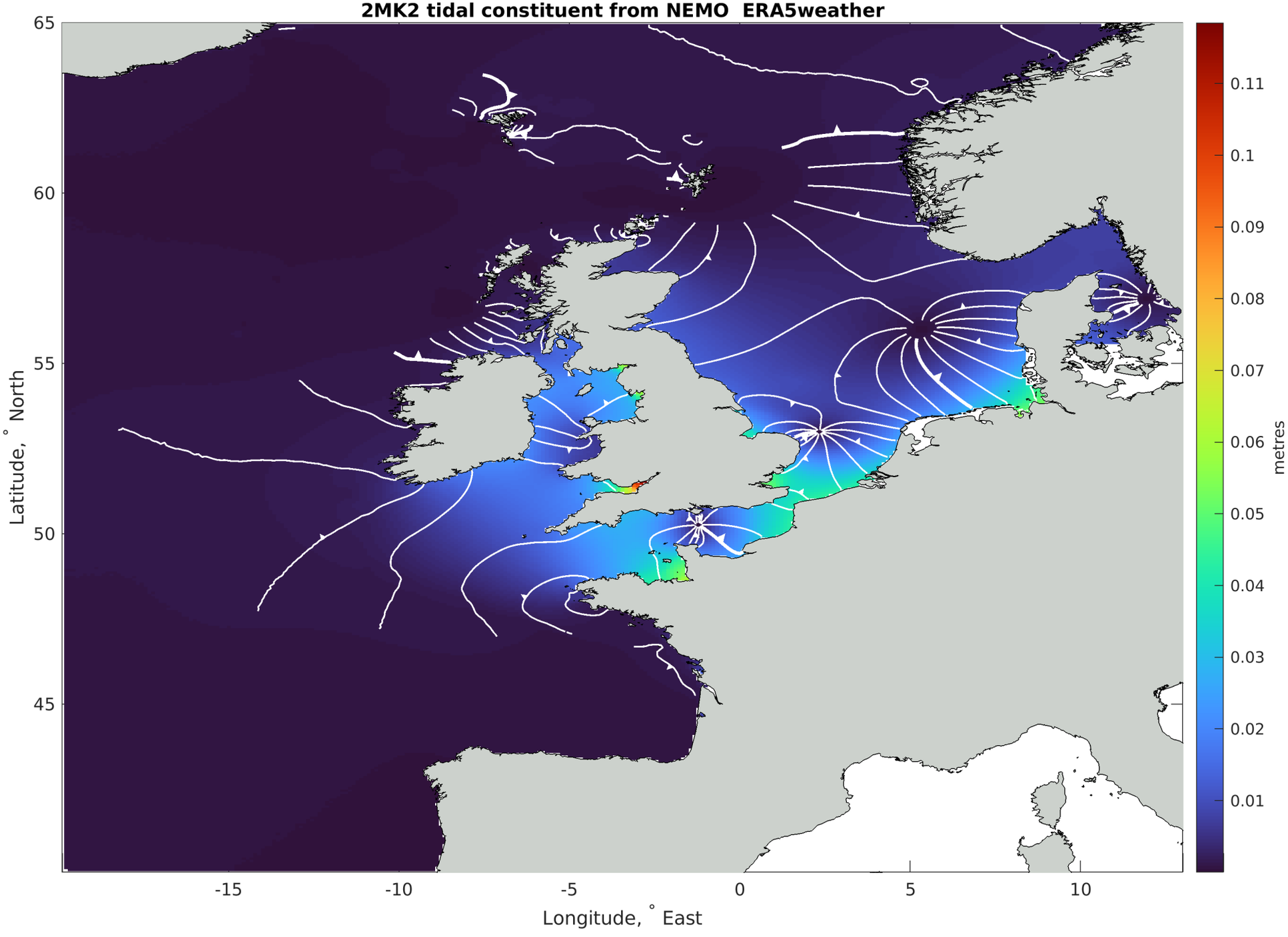
0.01
0.005
metres


2MK2 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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-10
-5
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10
Longitude, ° East
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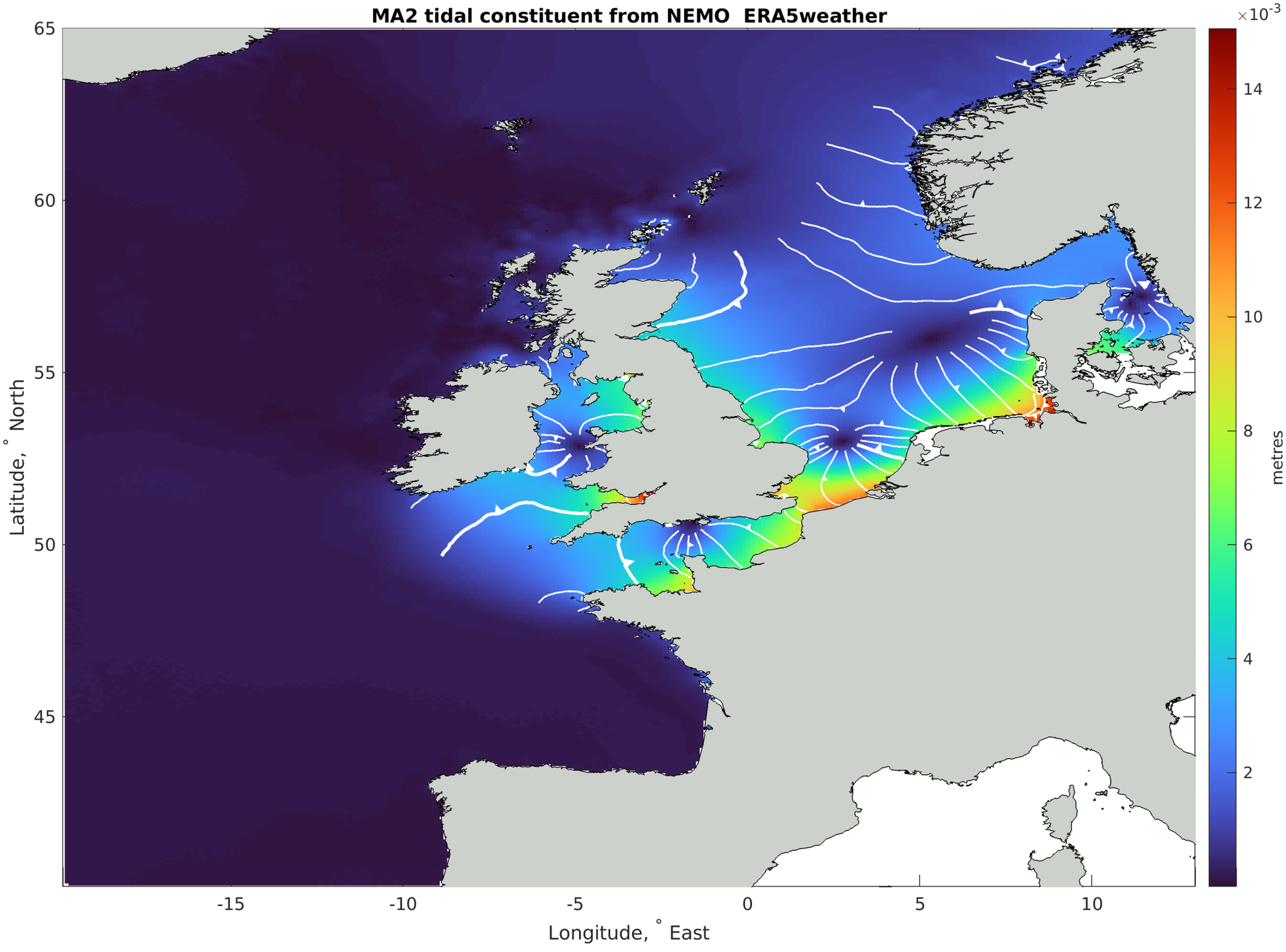
0.03
0.02
0.01
metres


MA2 tidal constituent from NEMO ERA5weather
65
60
55
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Latitude, ° North
-15
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0
5
10
Longitude, ° East
×10-3
14
12
10
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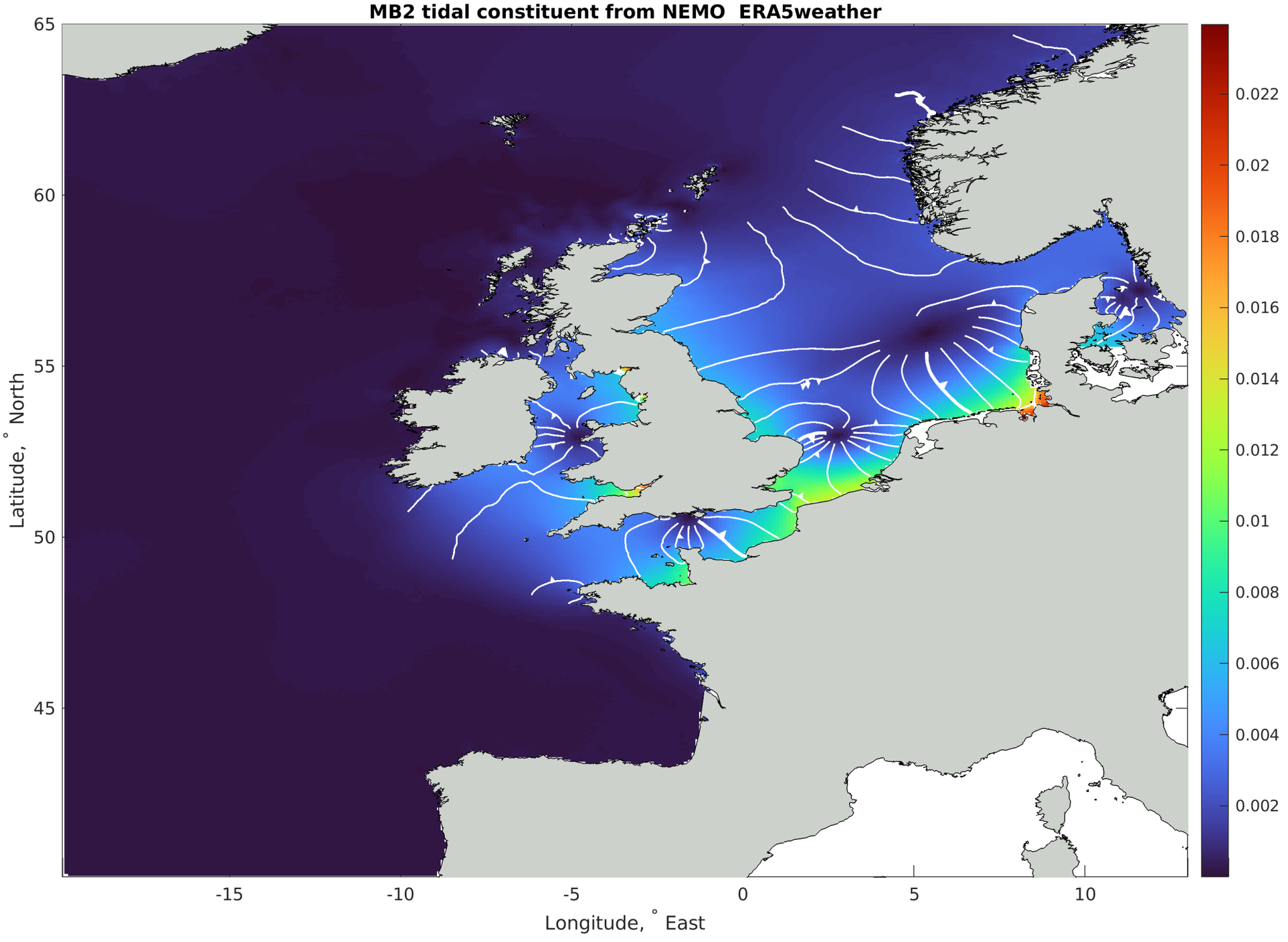
4
2
metres


MB2 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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-10
-5
0
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10
Longitude, ° East
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0.016
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0.012
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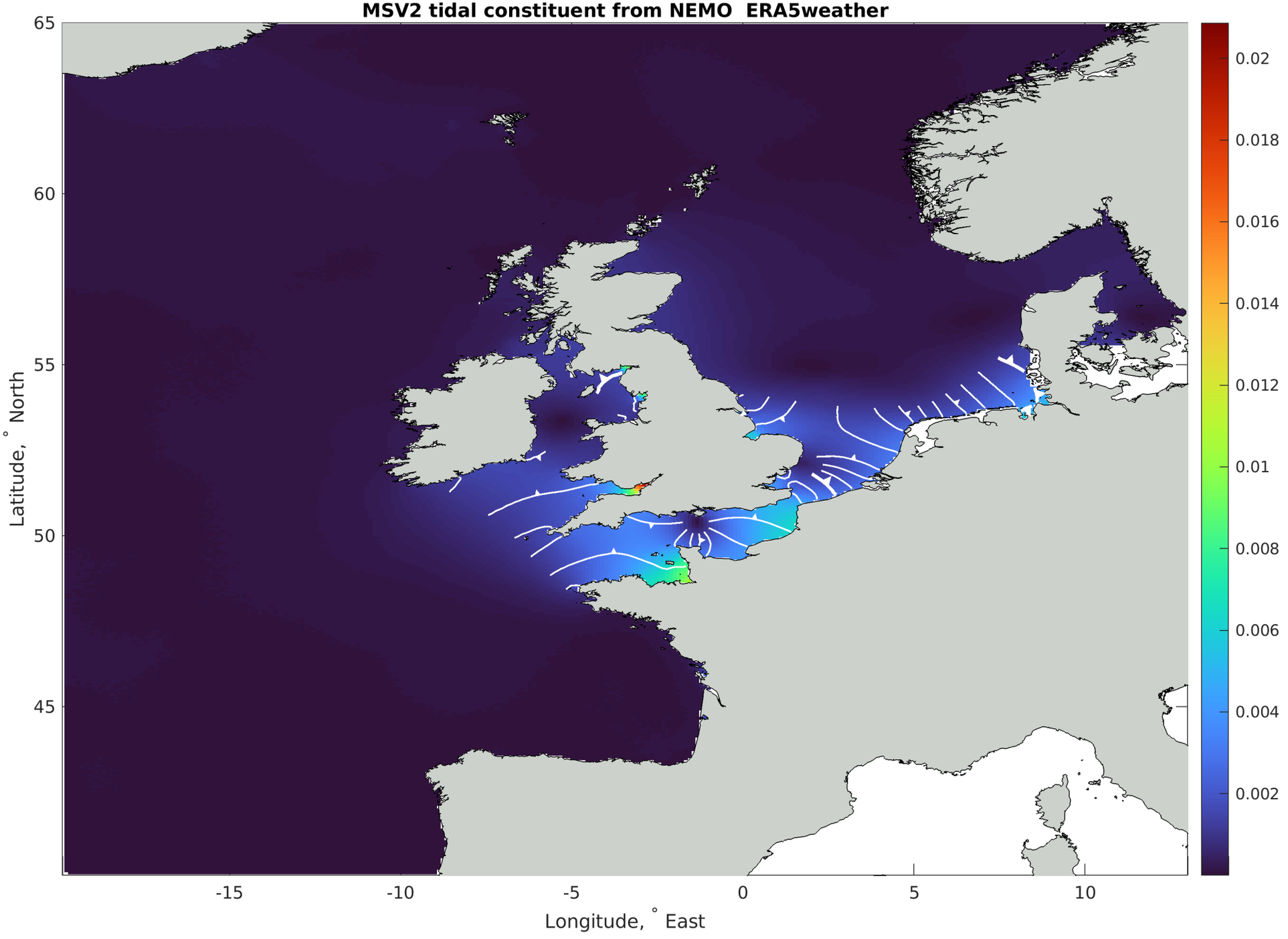
metres


MSV2 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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-5
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5
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Longitude, ° East
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0.012
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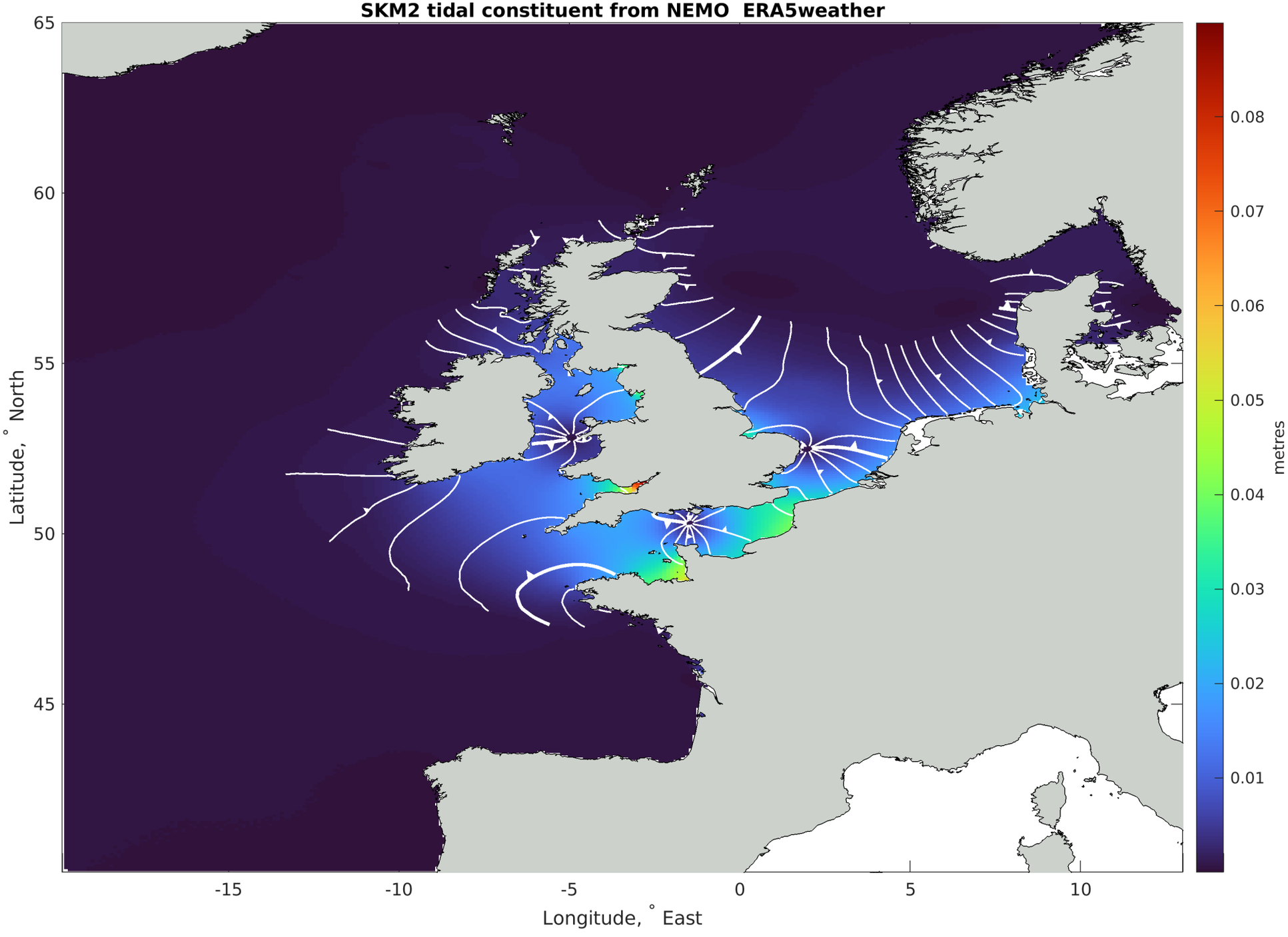
metres


SKM2 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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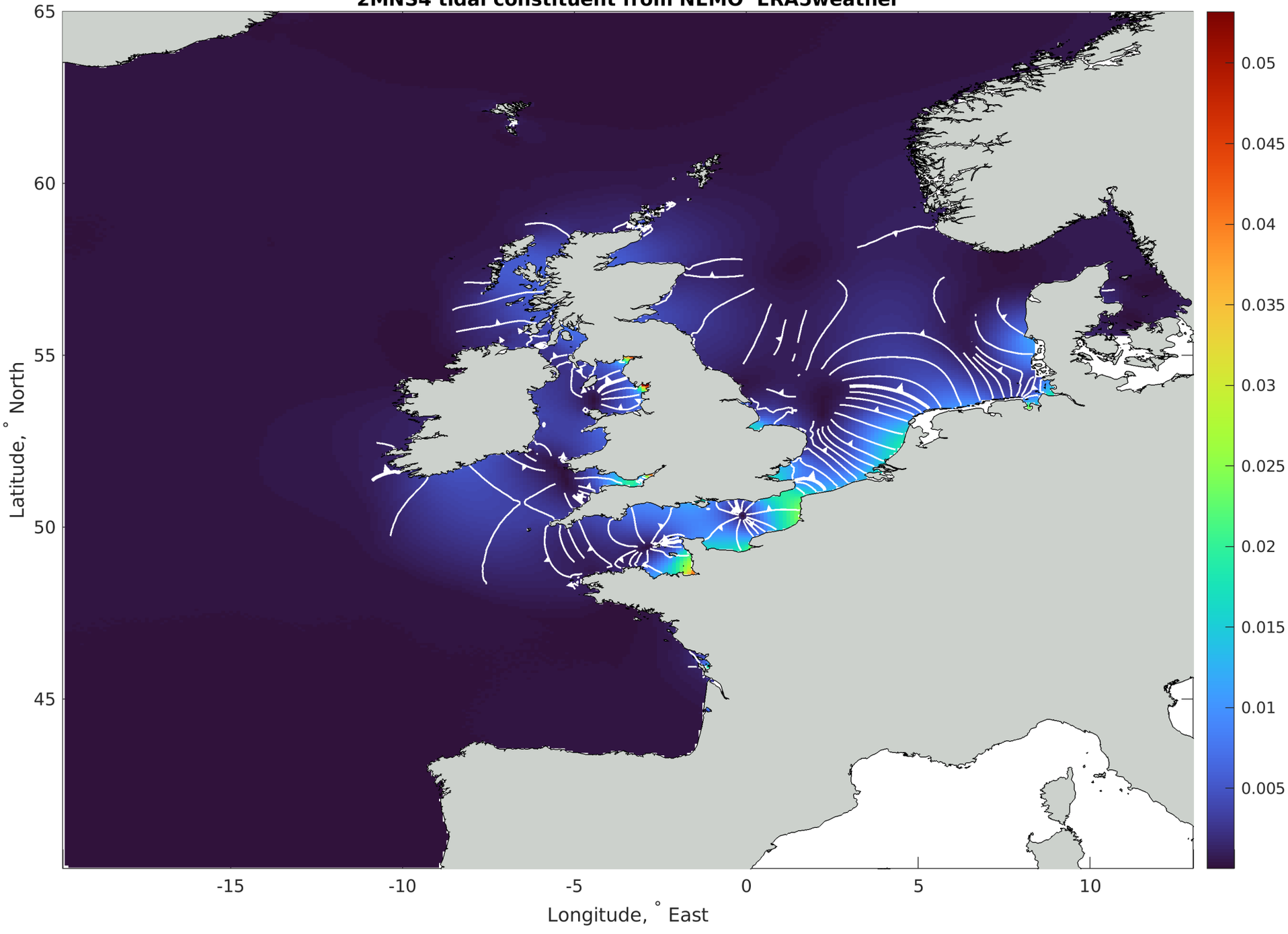
metres


2MNS4 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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-5
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10
Longitude, ° East
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0.03
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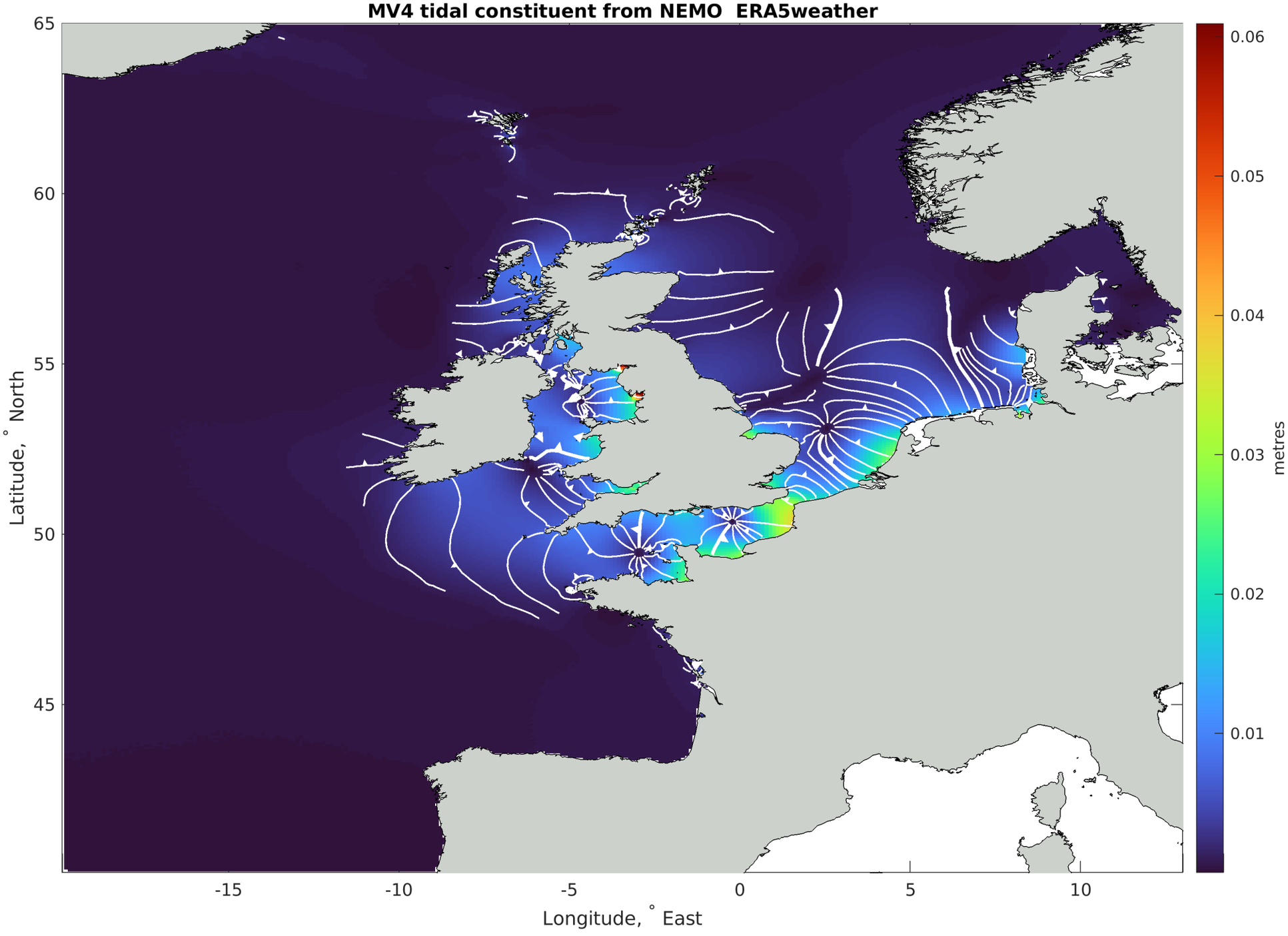
0.01
0.005
metres


MV4 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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Longitude, ° East
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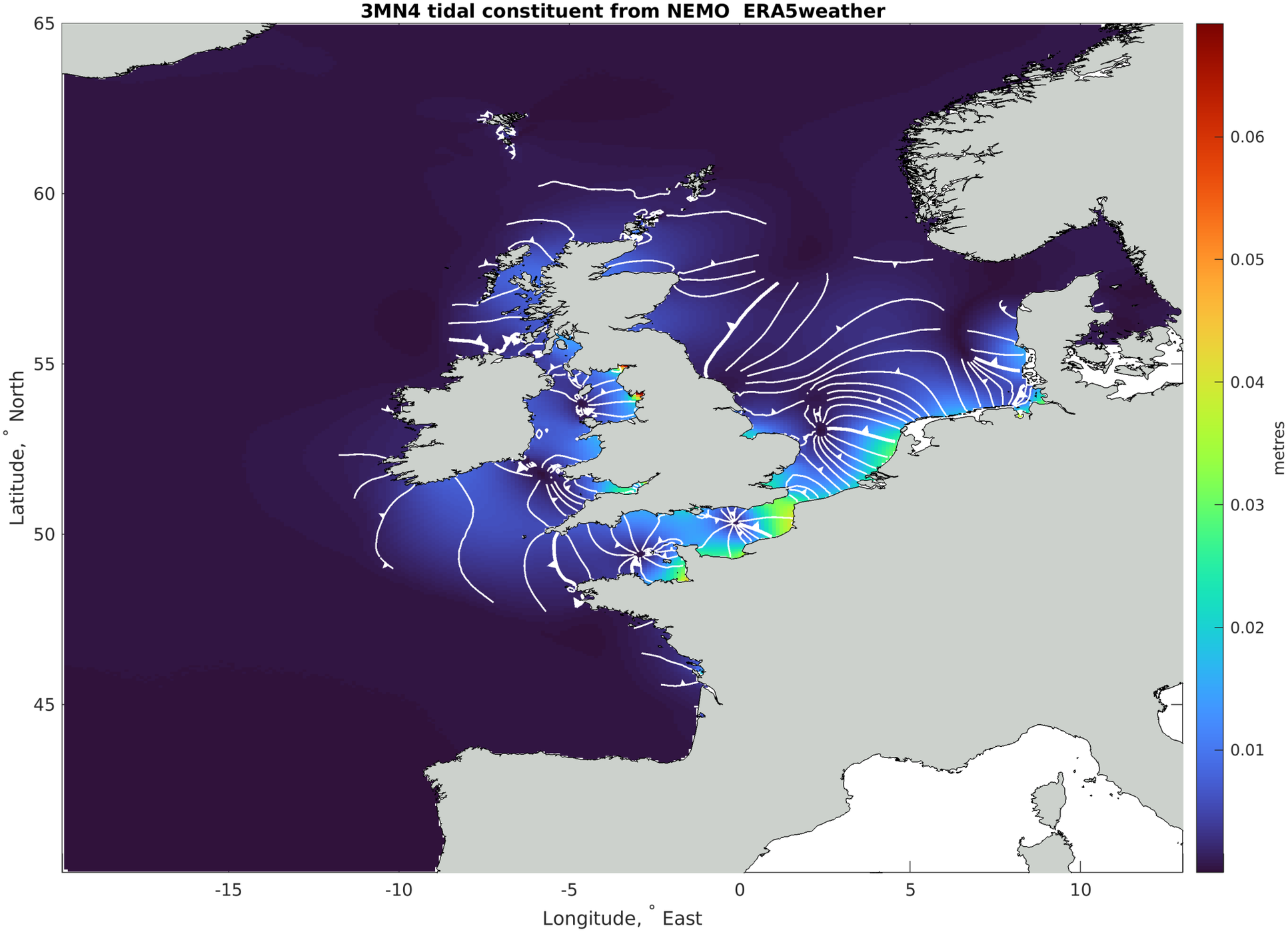
metres


3MN4 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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Longitude, ° East
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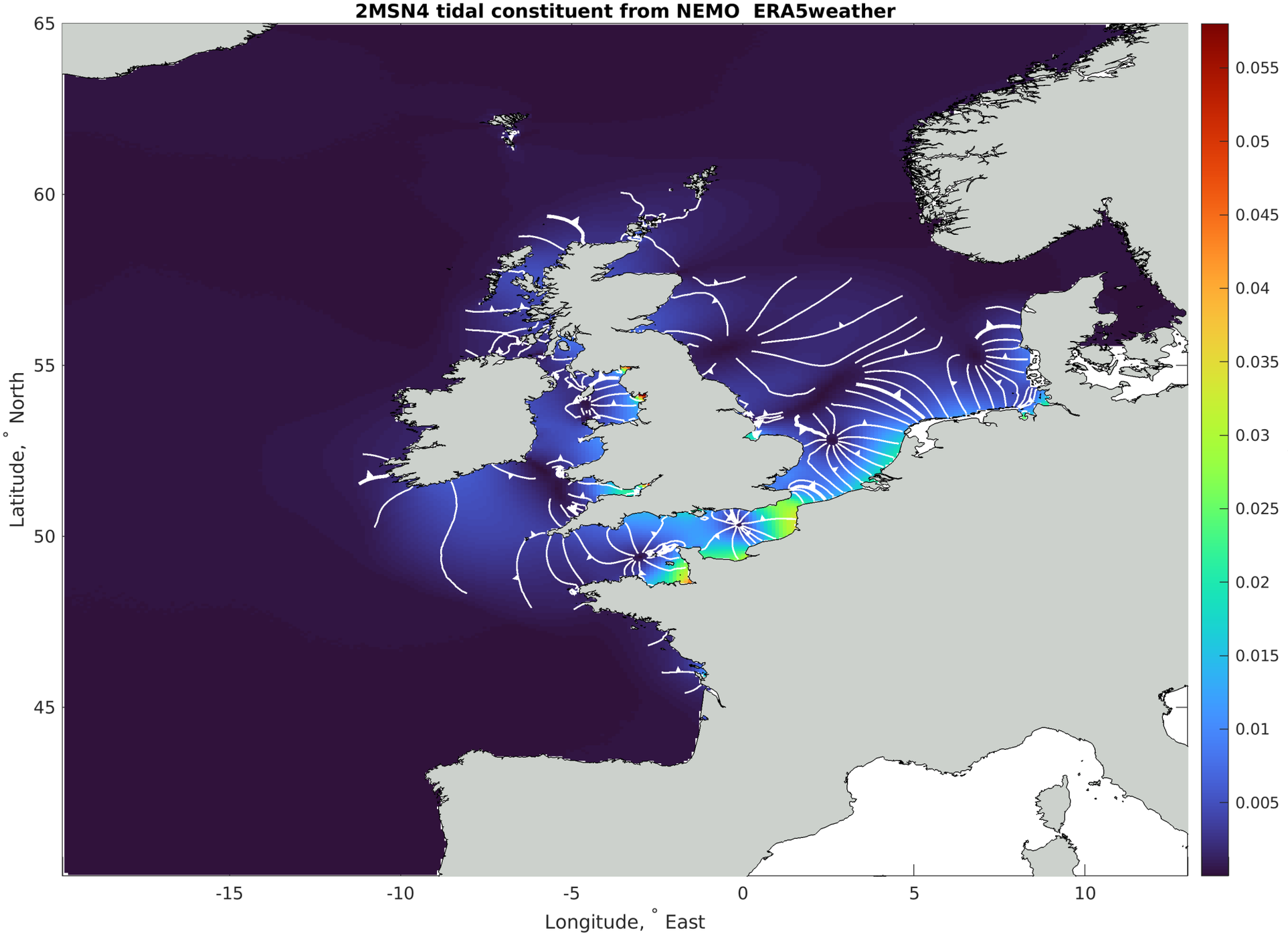
metres


2MSN4 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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Longitude, ° East
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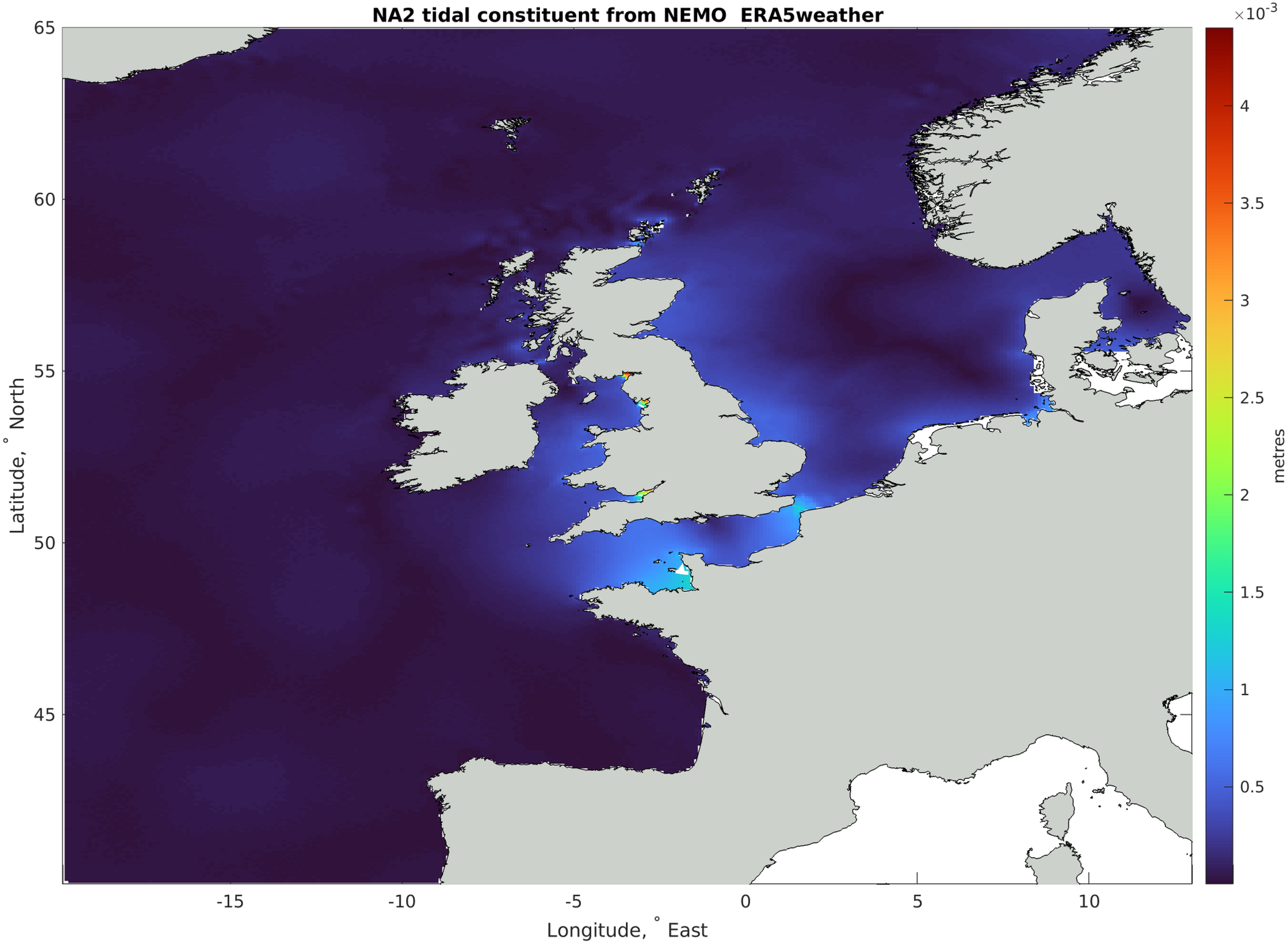
metres


NA2 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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Longitude, ° East
×10-3
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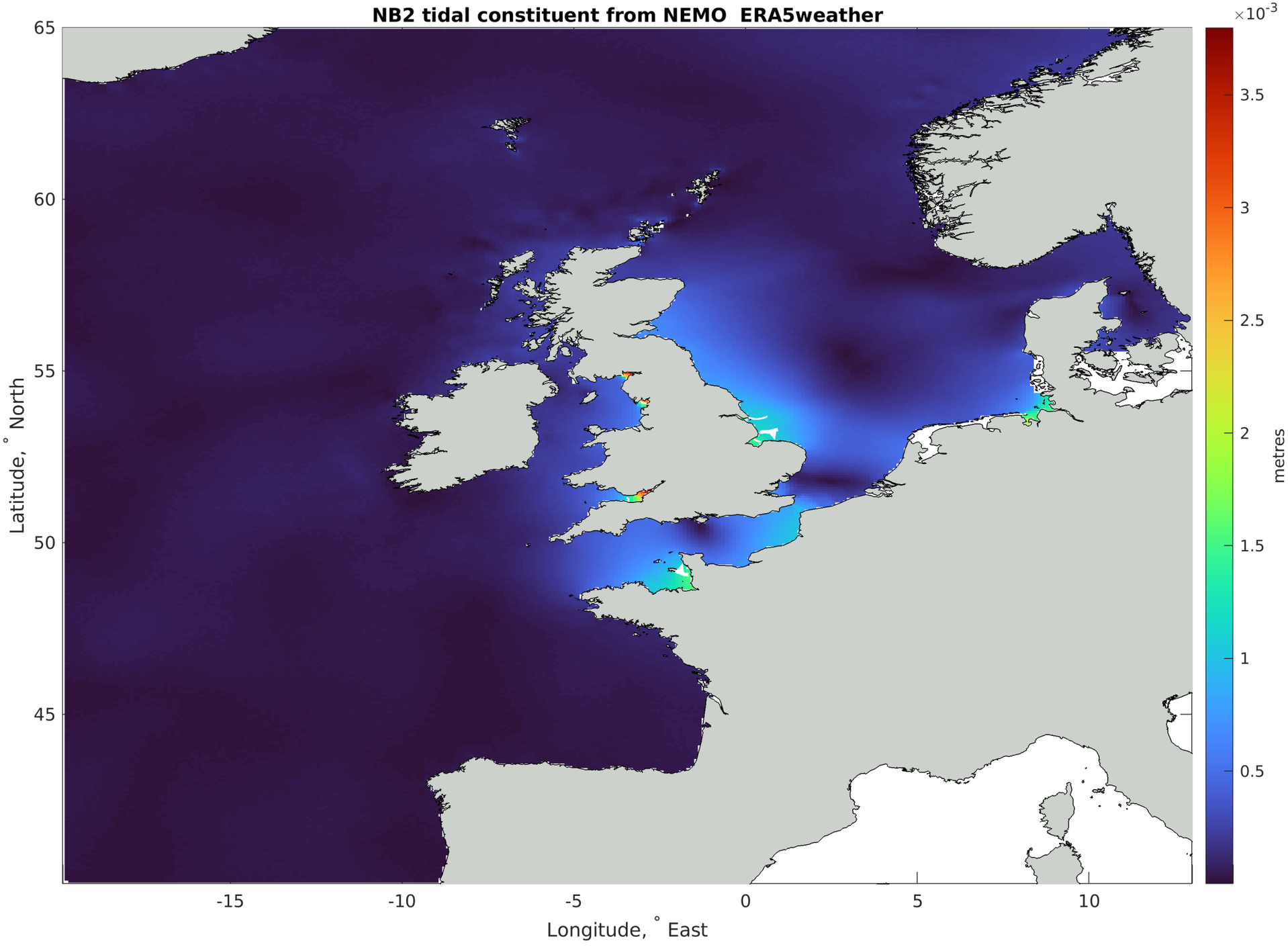
metres


NB2 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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Longitude, ° East
×10-3
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2.5
2
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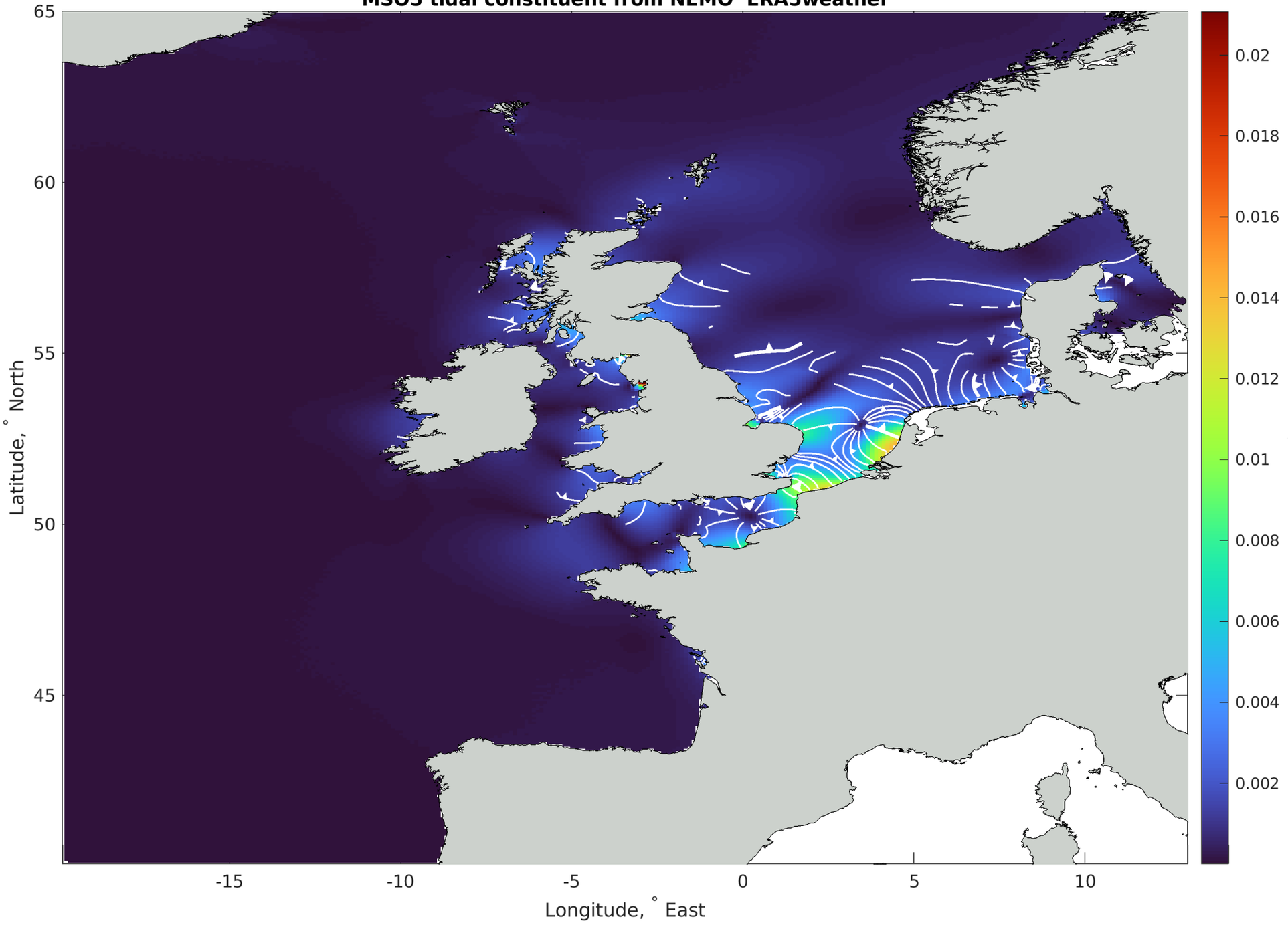
1
0.5
metres


MSO5 tidal constituent from NEMO ERA5weather
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Latitude, ° North
-15
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0
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10
Longitude, ° East
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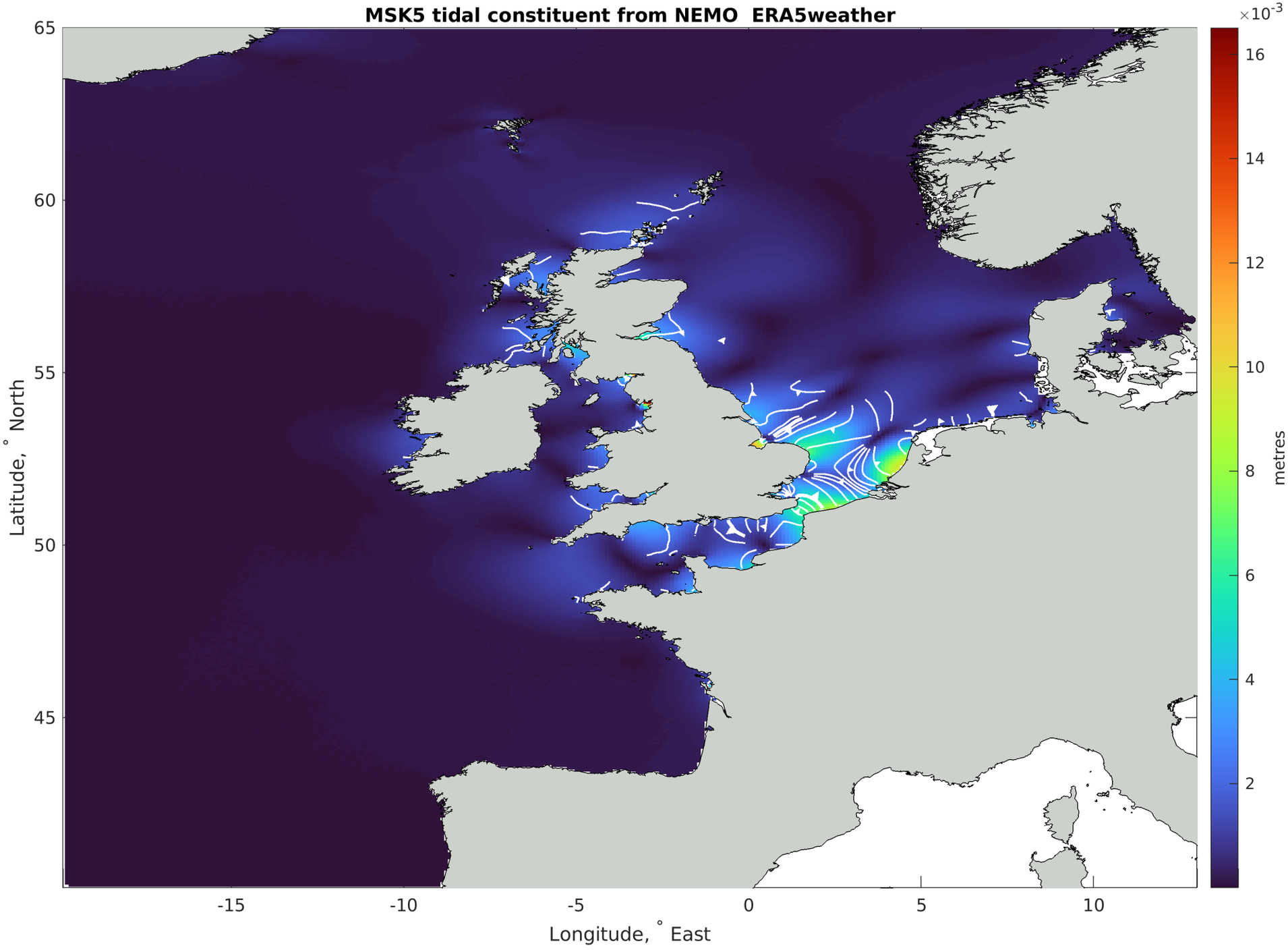
metres


MSK5 tidal constituent from NEMO ERA5weather
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Latitude, ° North
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10
Longitude, ° East
×10-3
16
14
12
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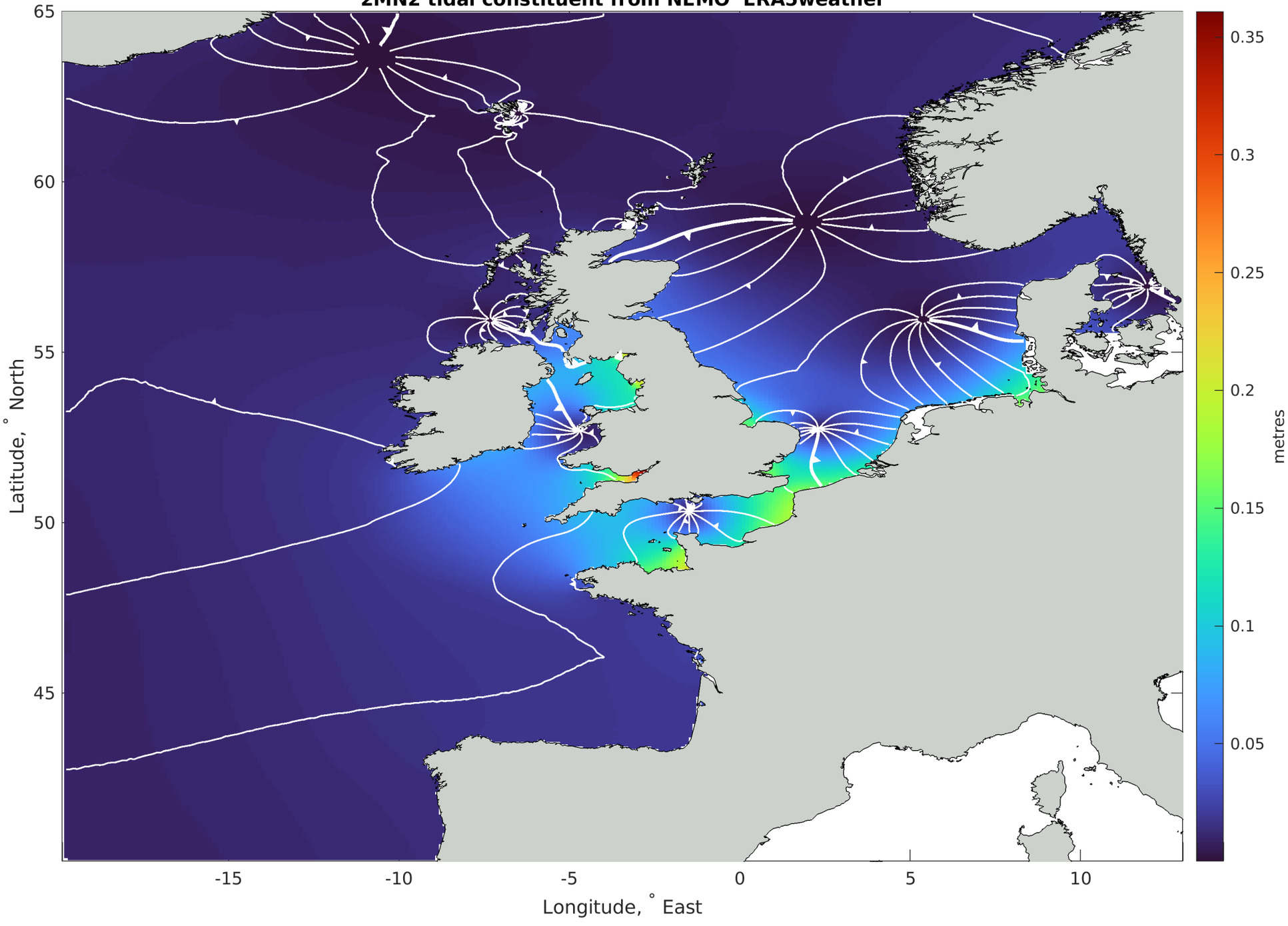
8
6
4
2
metres


2MN2 tidal constituent from NEMO ERA5weather
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45
Latitude, ° North
-15
-10
-5
0
5
10
Longitude, ° East
0.35
0.3
0.25
0.2
0.15
0.1
0.05
metres

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