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igg

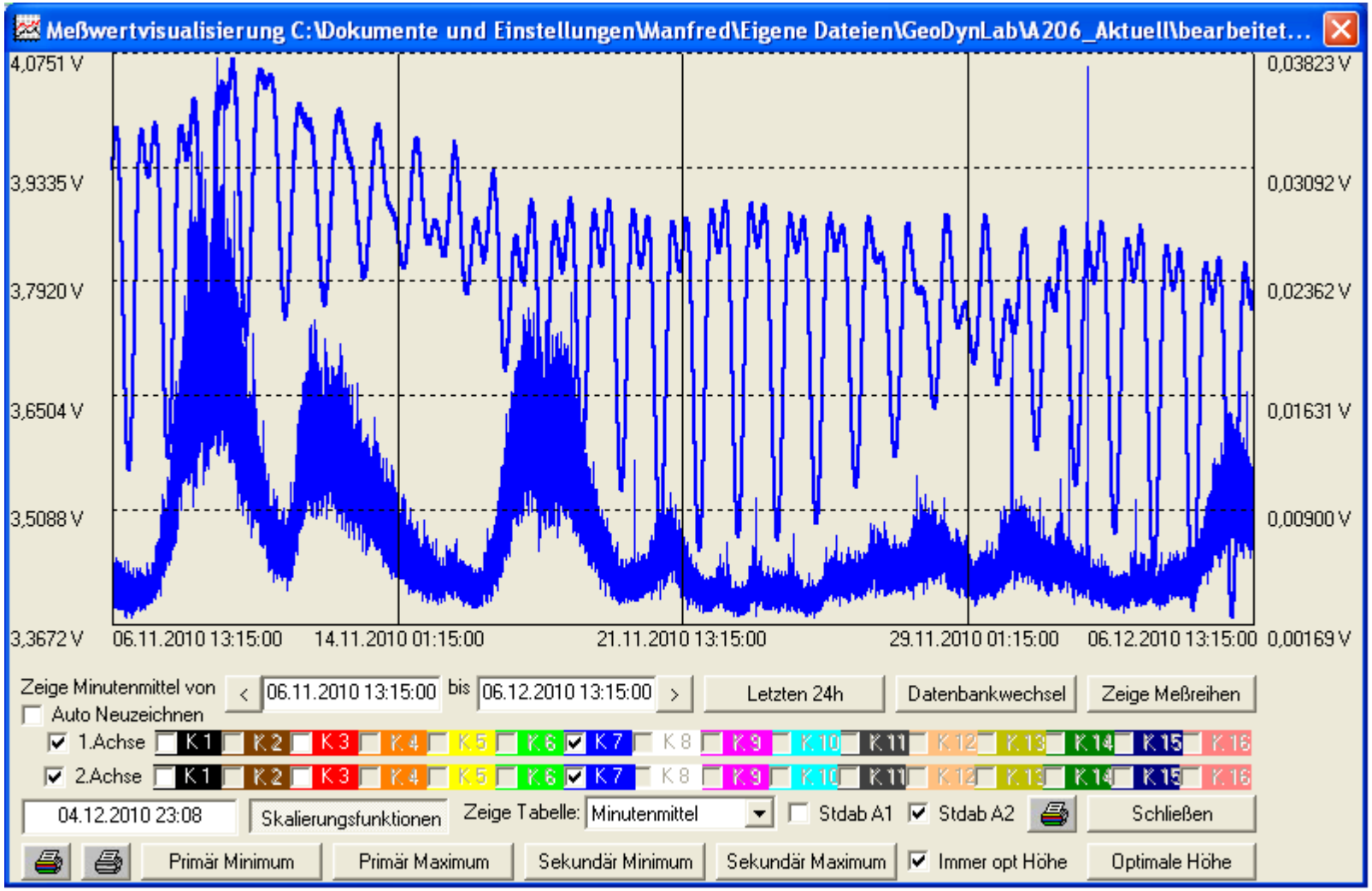
Institut für Geodäsie und Geoinformation

Manfred Bonatz

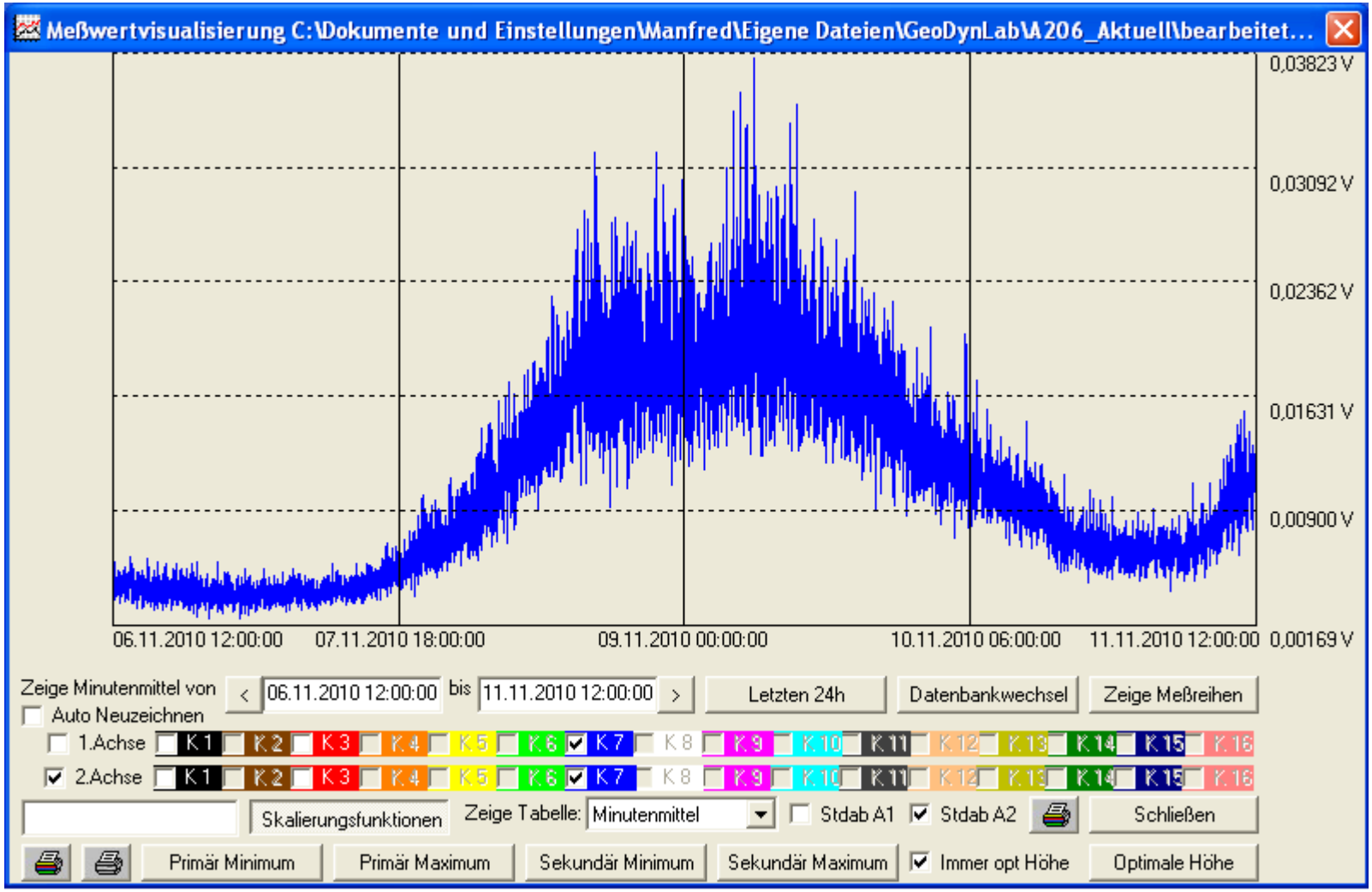
Prediction of Gravimetric Noise for Western Europe

Extended Abstract

In Western Europe the chronological sequence of gravimetric noise exhibits pronounced variations. Noise sourcing reveals a strong influence of the sea state close to and along the European coasts.



GeoDynLab of the Walferdange Underground Laboratory: Example of gravimetric noise level variations during one month, Gravimeter Askania A206 unfiltered data, sampling rate 1 sec, minute means of observations with associated standard errors.

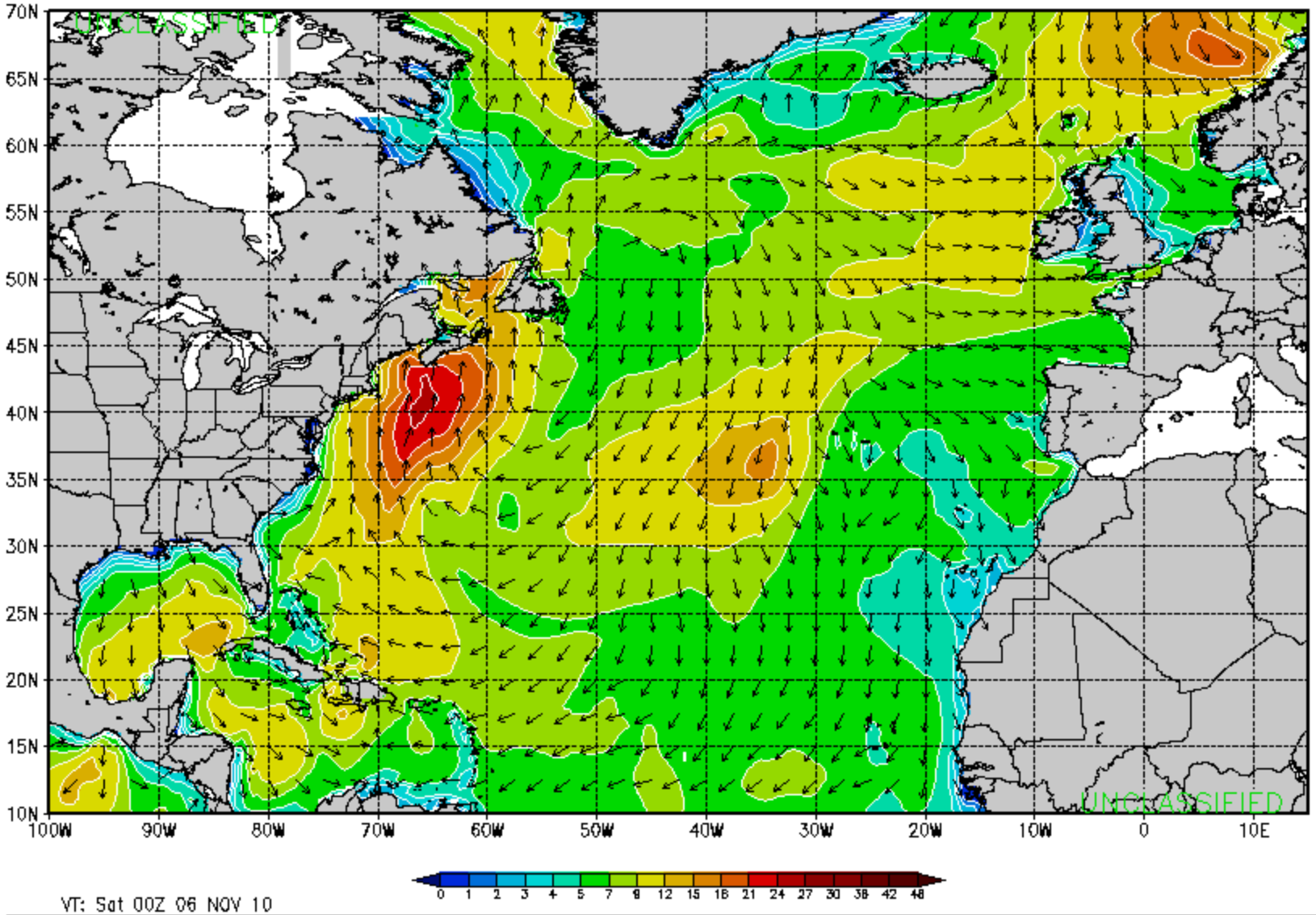


Walferdange Underground Laboratory for Geodynamics: Time dependency of the gravimetric noise in the period 2010 October 06 12:00 until October 11 12:00, standard errors of minute means.

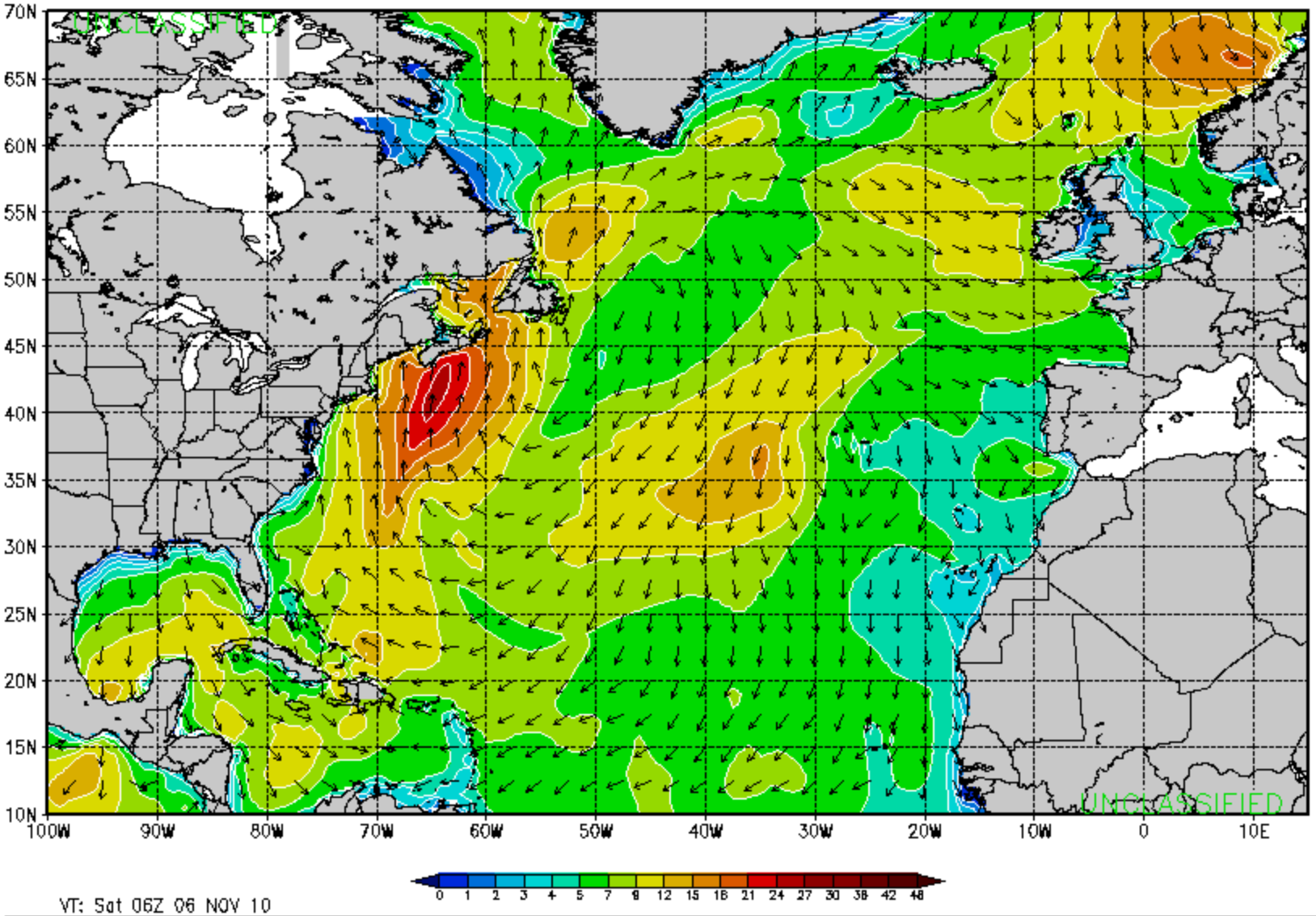
Sequence of the sea state development in the Northern Atlantic

period 2010 October 06 10:00 until October 11 18:00

Significant wave height an direction



VT: Sat 00Z 06 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110600Z Tau: 0



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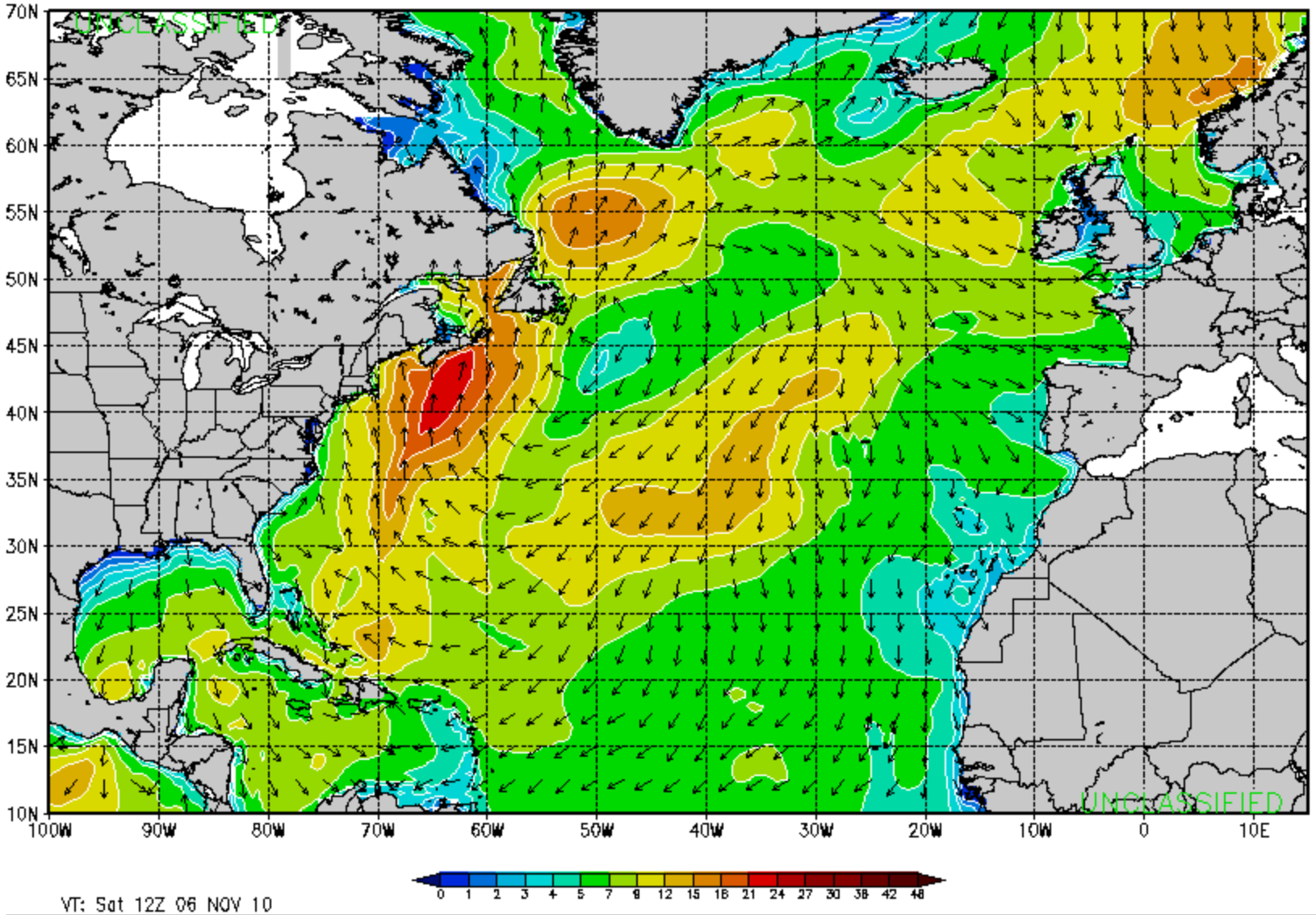
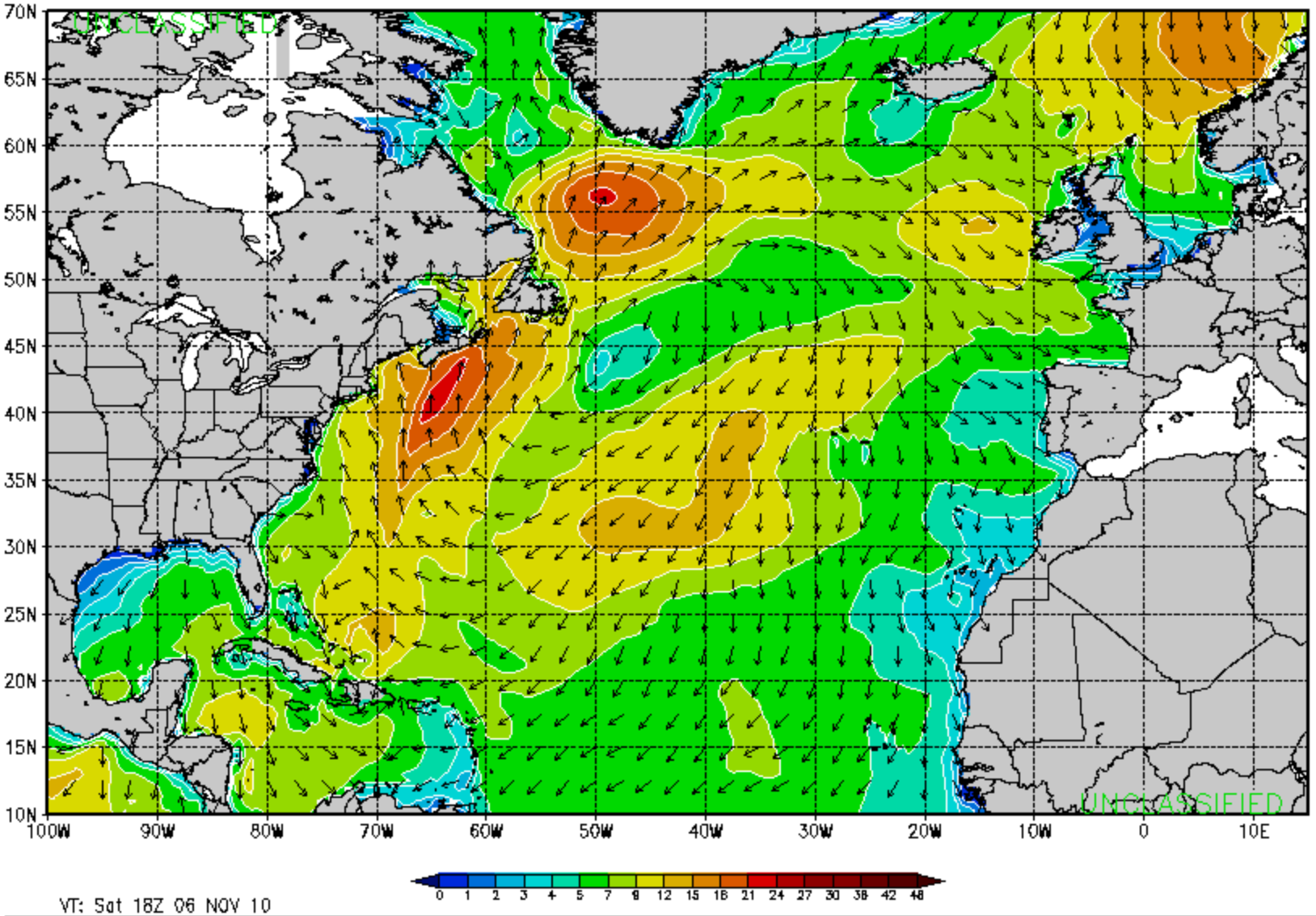
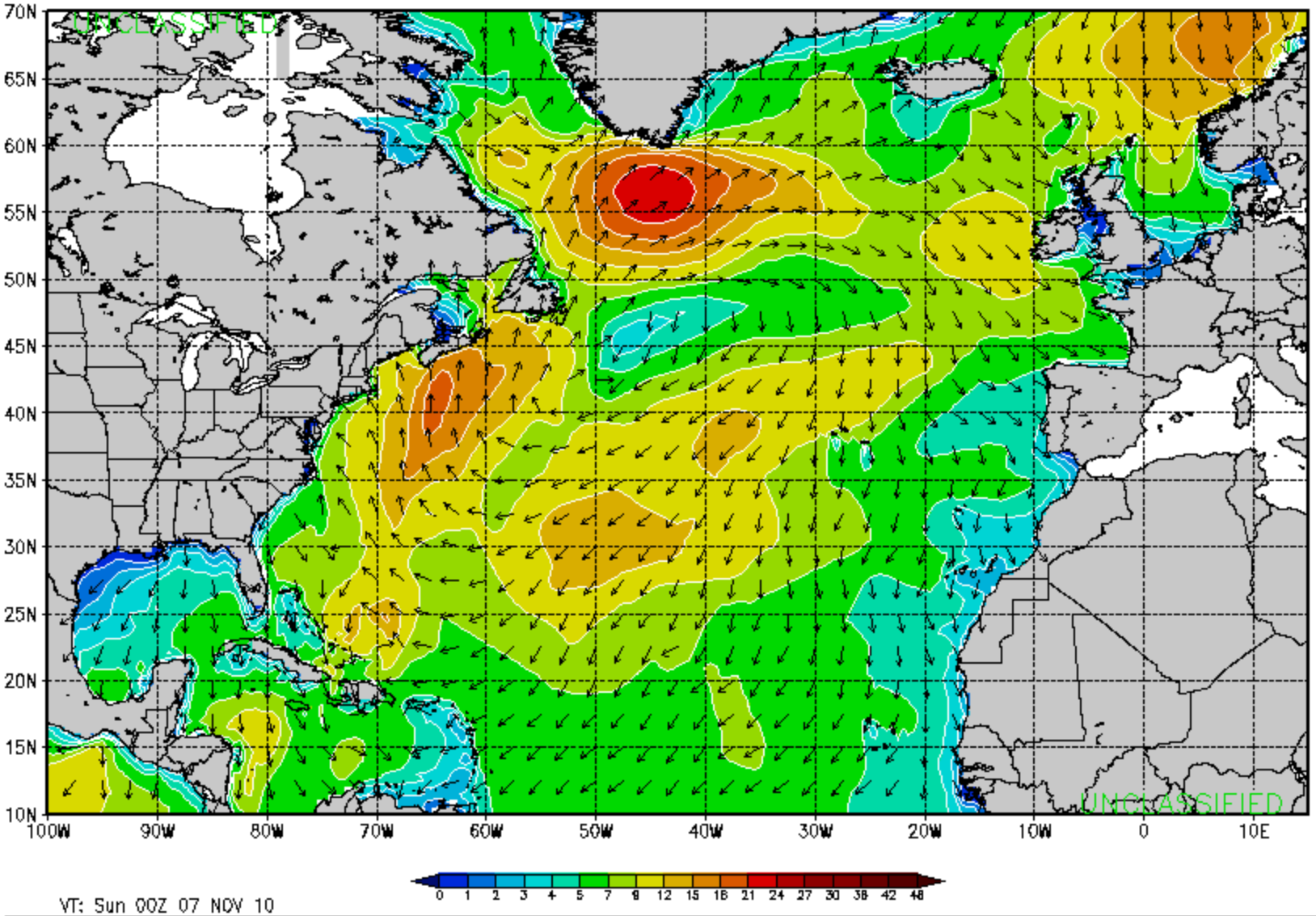
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110606Z Tau: 0



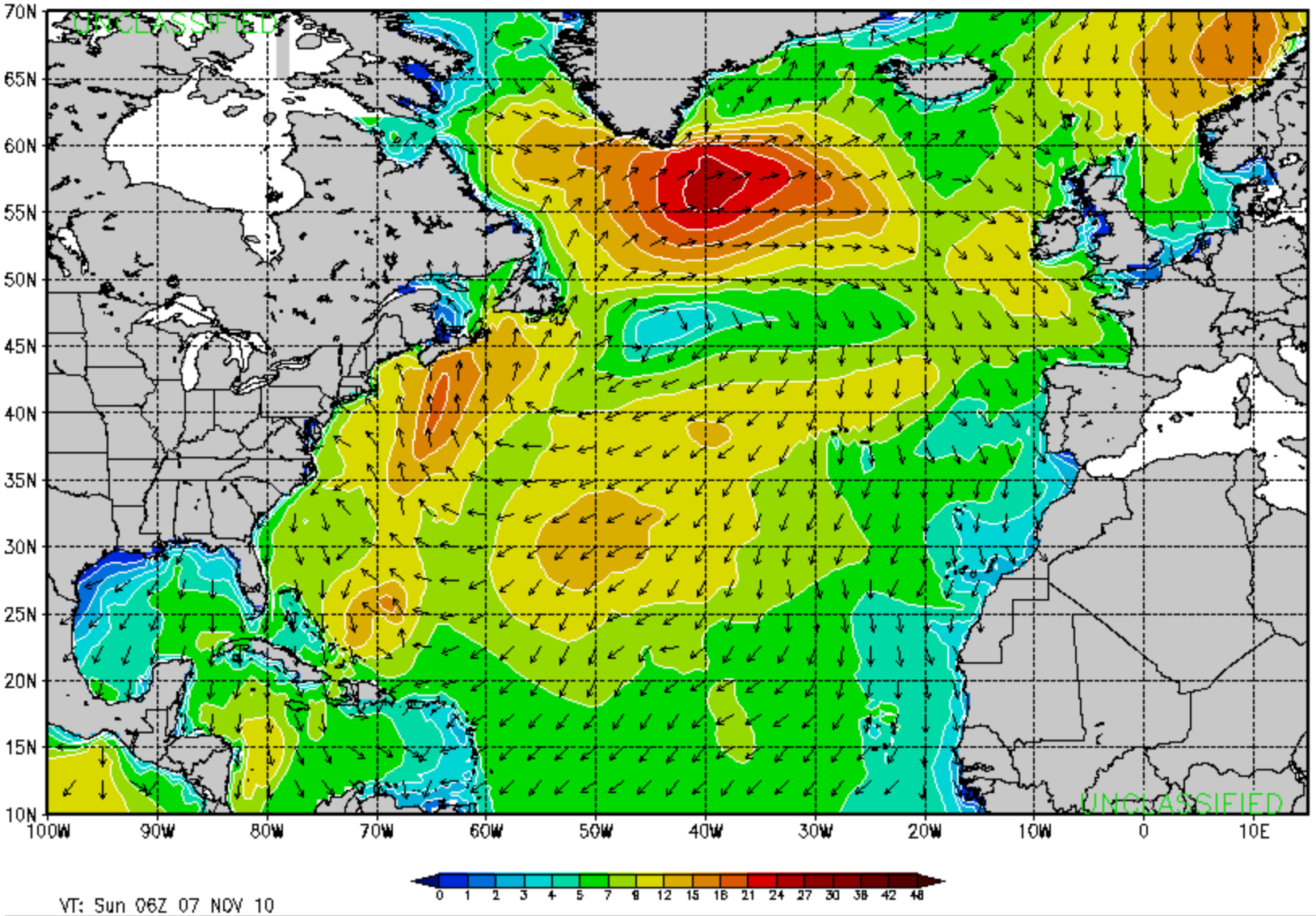
VT: Sat 12Z 06 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110612Z Tau: 0



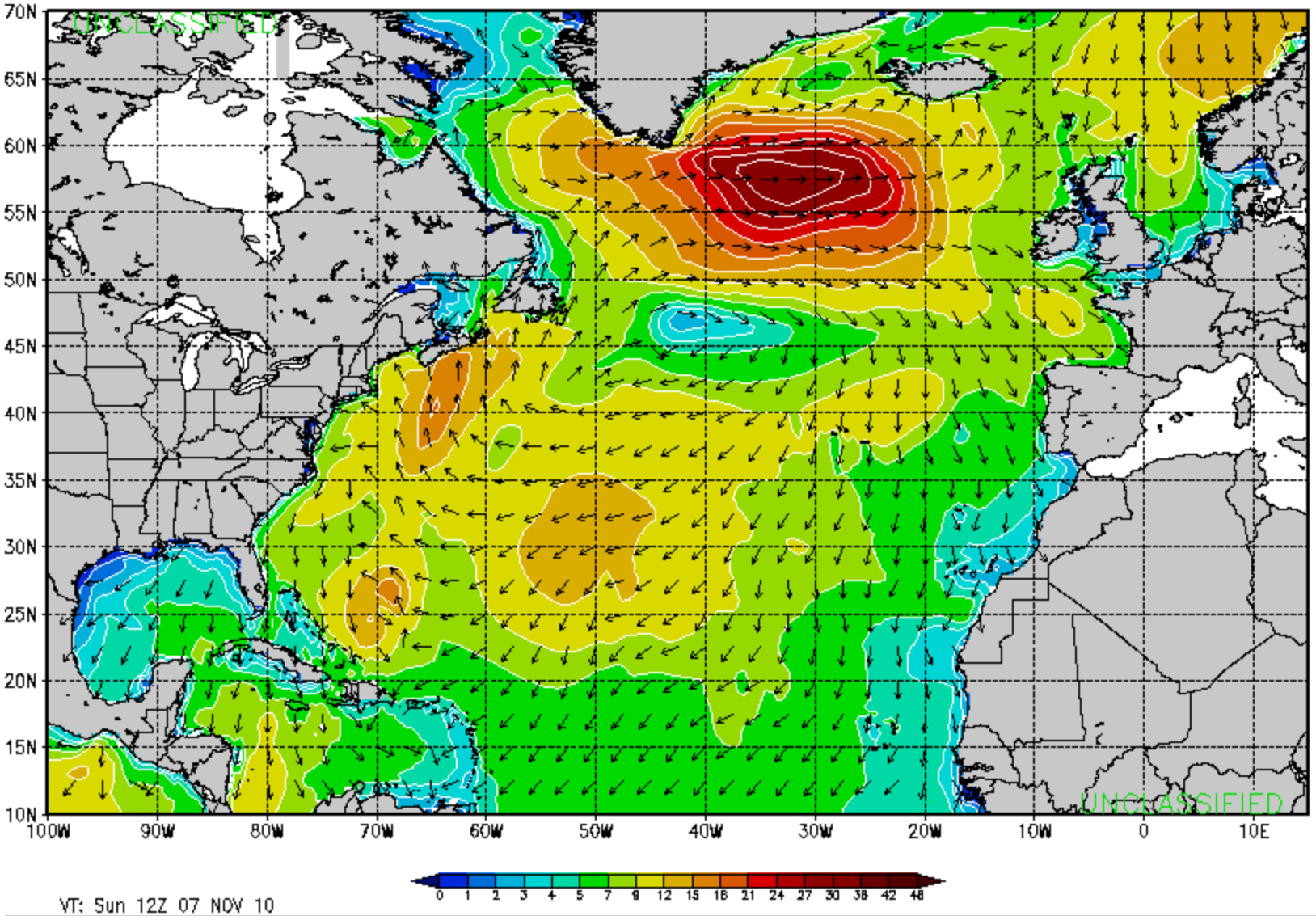
VT: Sat 18Z 06 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110618Z Tau: 0



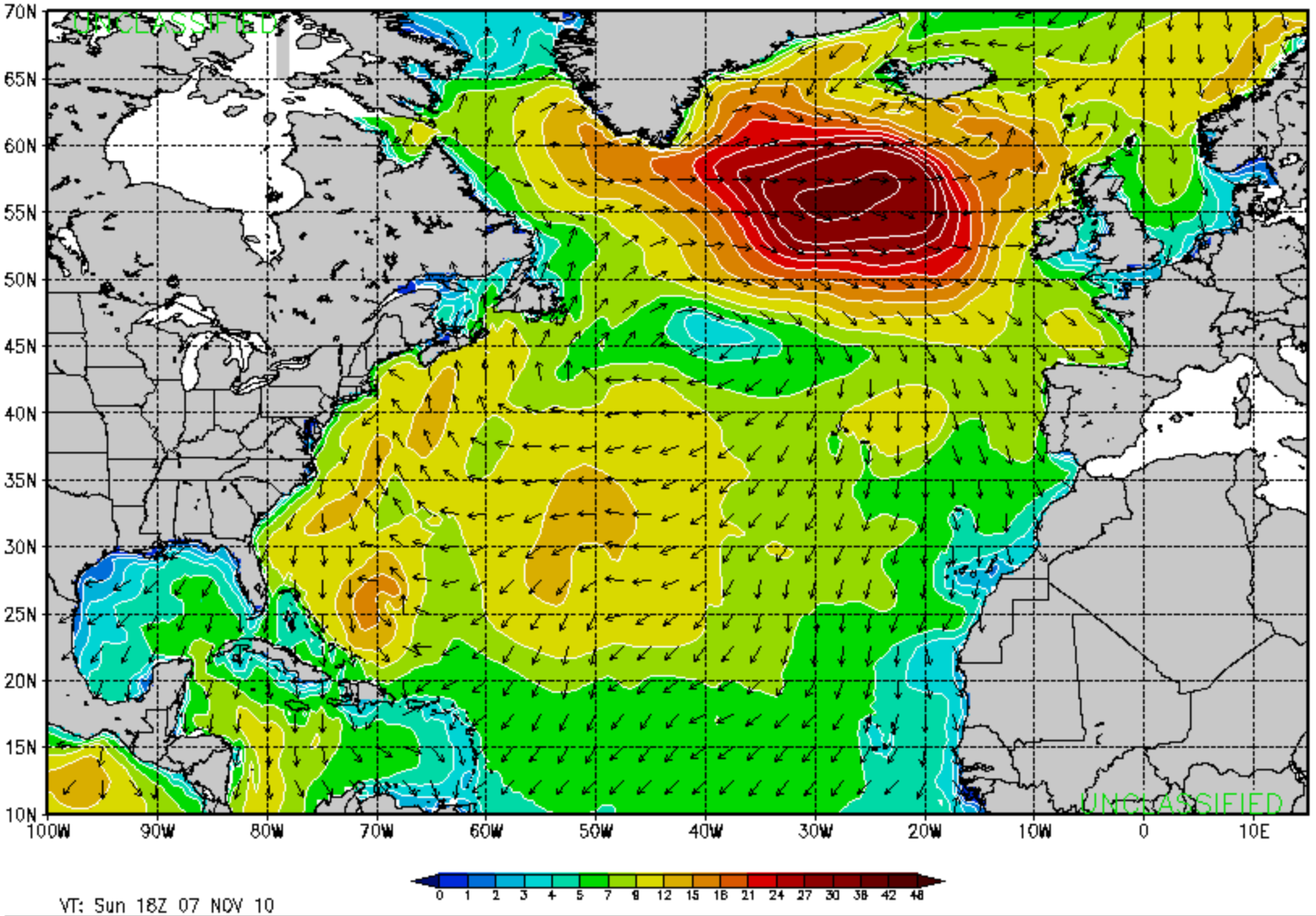
VT: Sun 00Z 07 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110700Z Tau: 0



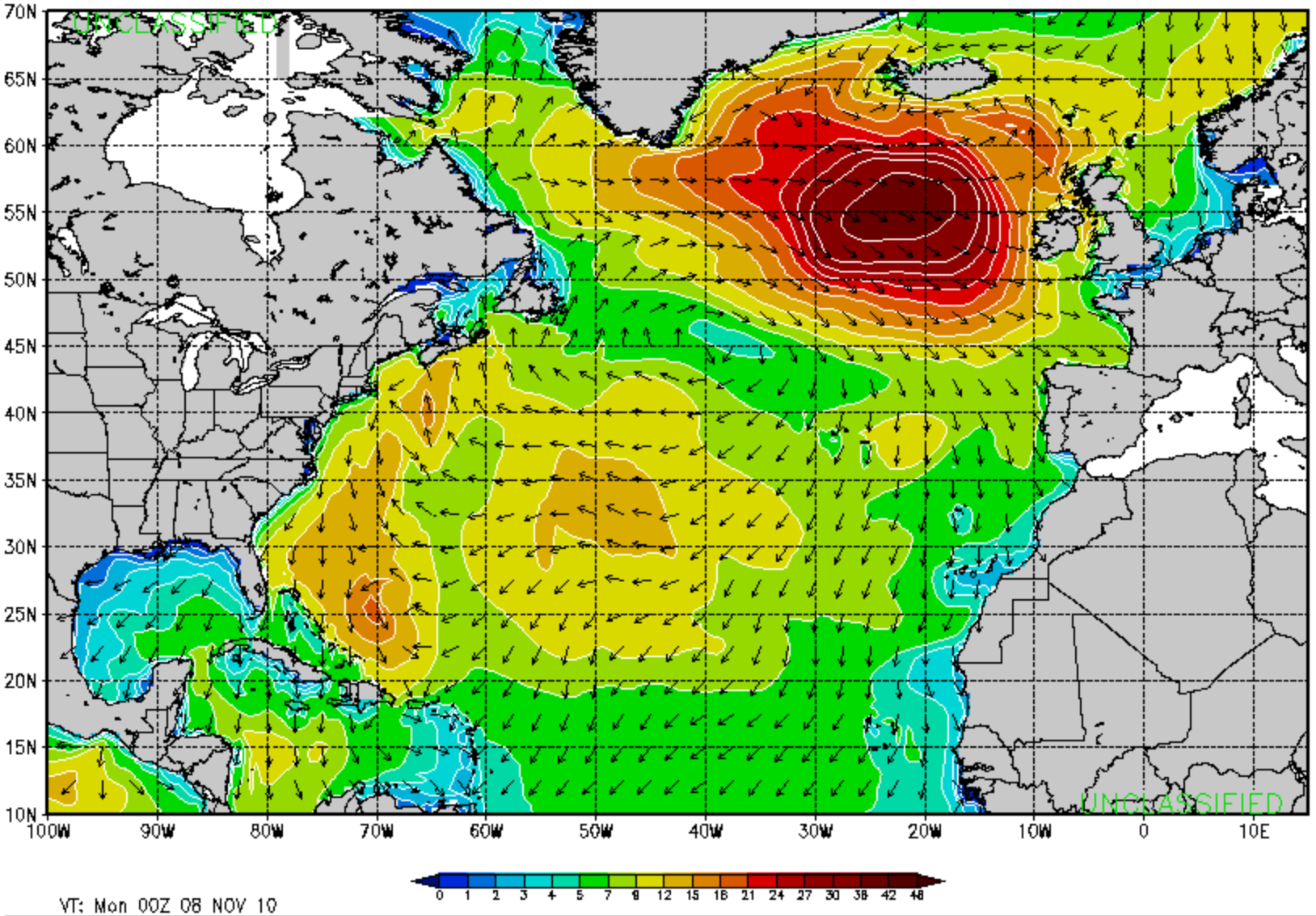
VT: Sun 06Z 07 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110706Z Tau: 0



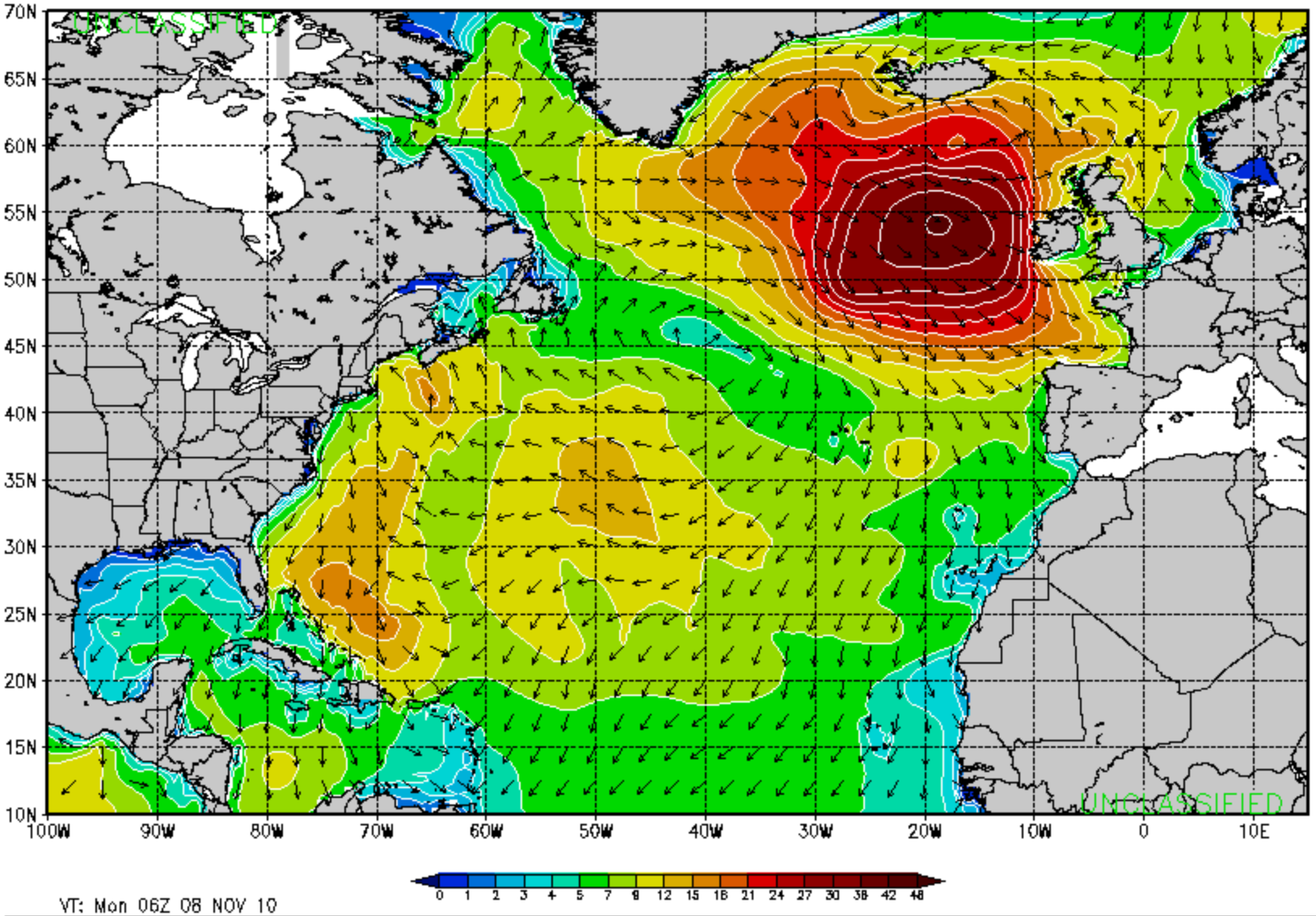
VT: Sun 12Z 07 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110712Z Tau: 0



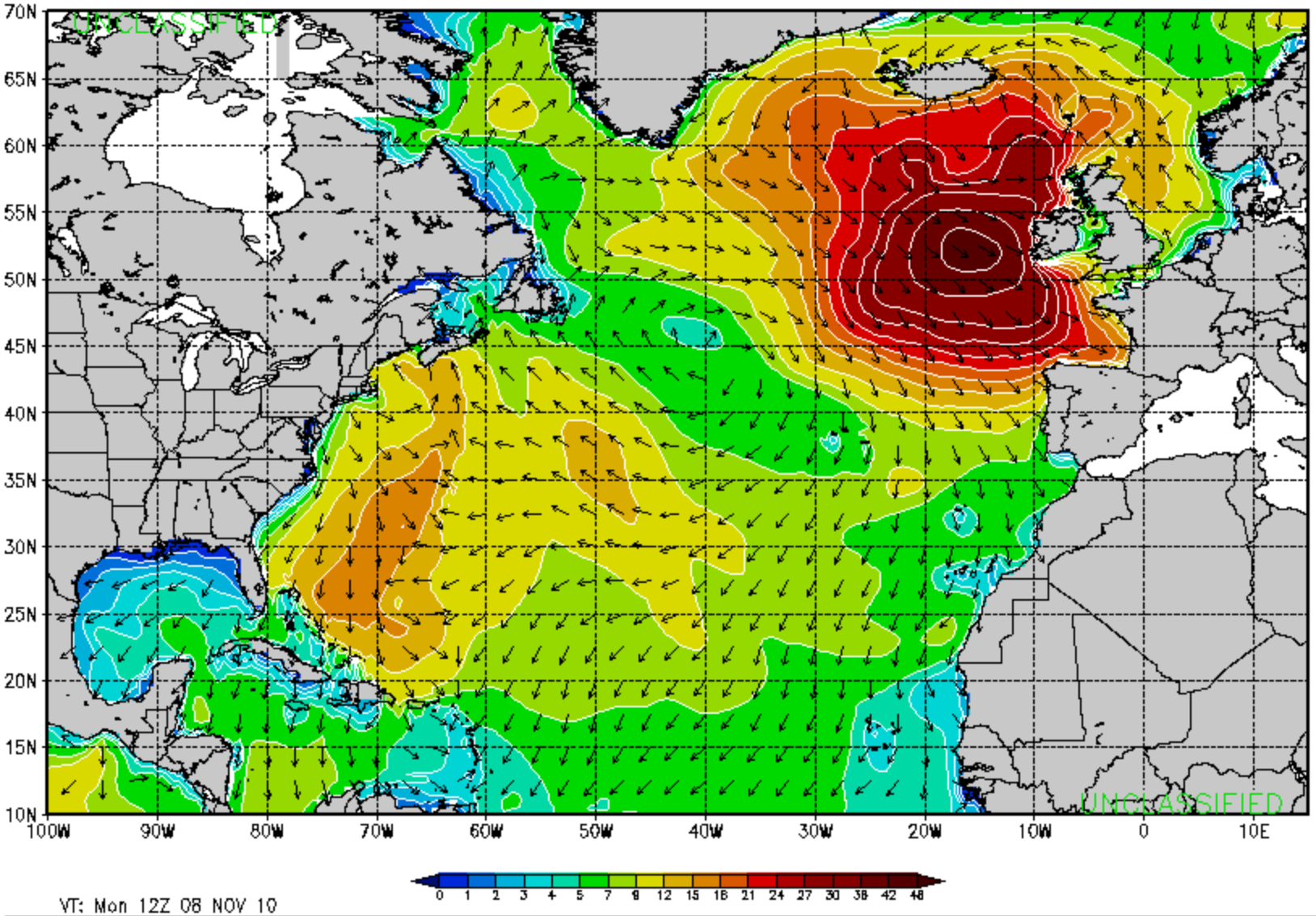
VT: Sun 18Z 07 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110718Z Tau: 0



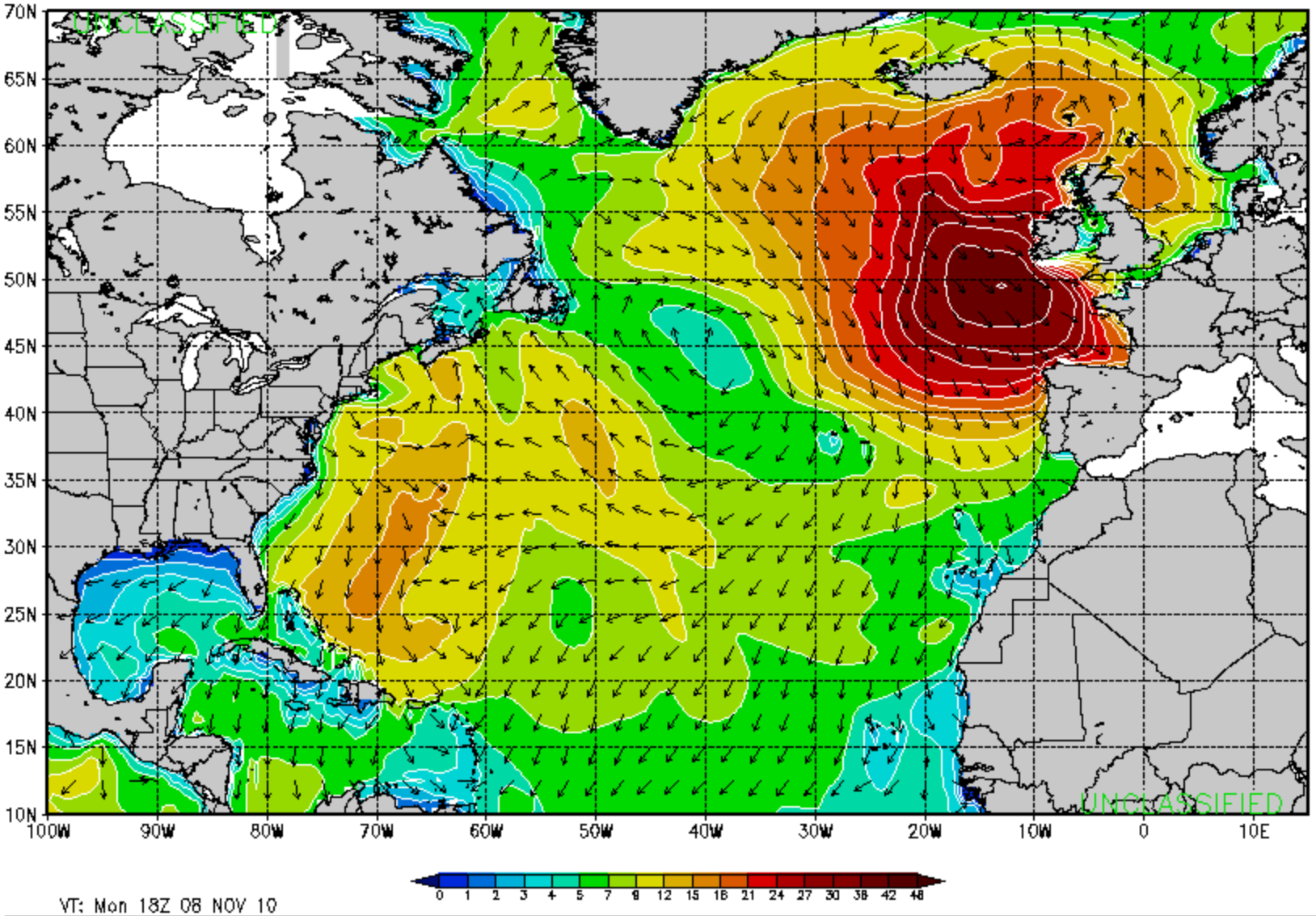
VT: Mon 00Z 08 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110800Z Tau: 0



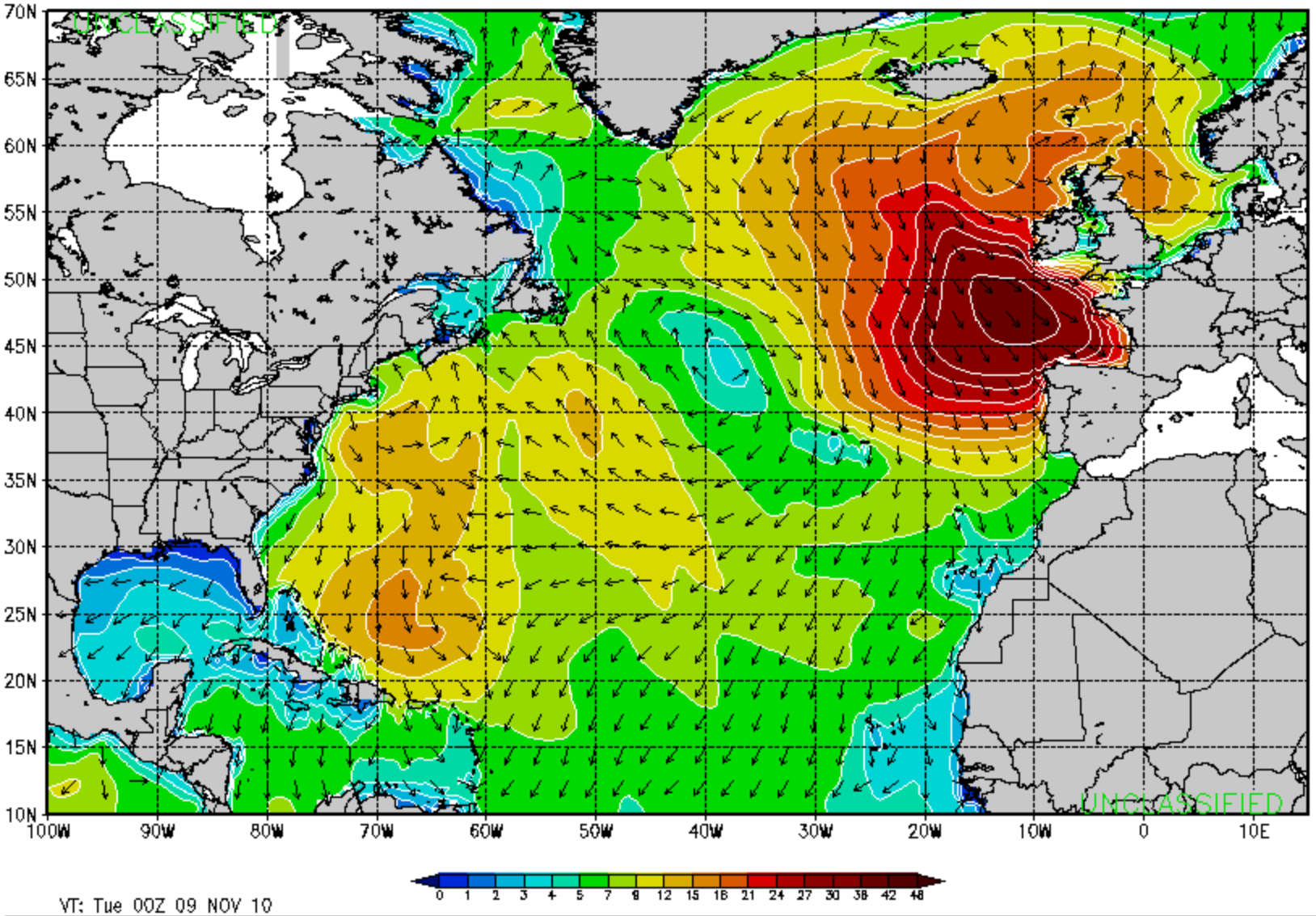
VT: Mon 06Z 08 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110806Z Tau: 0



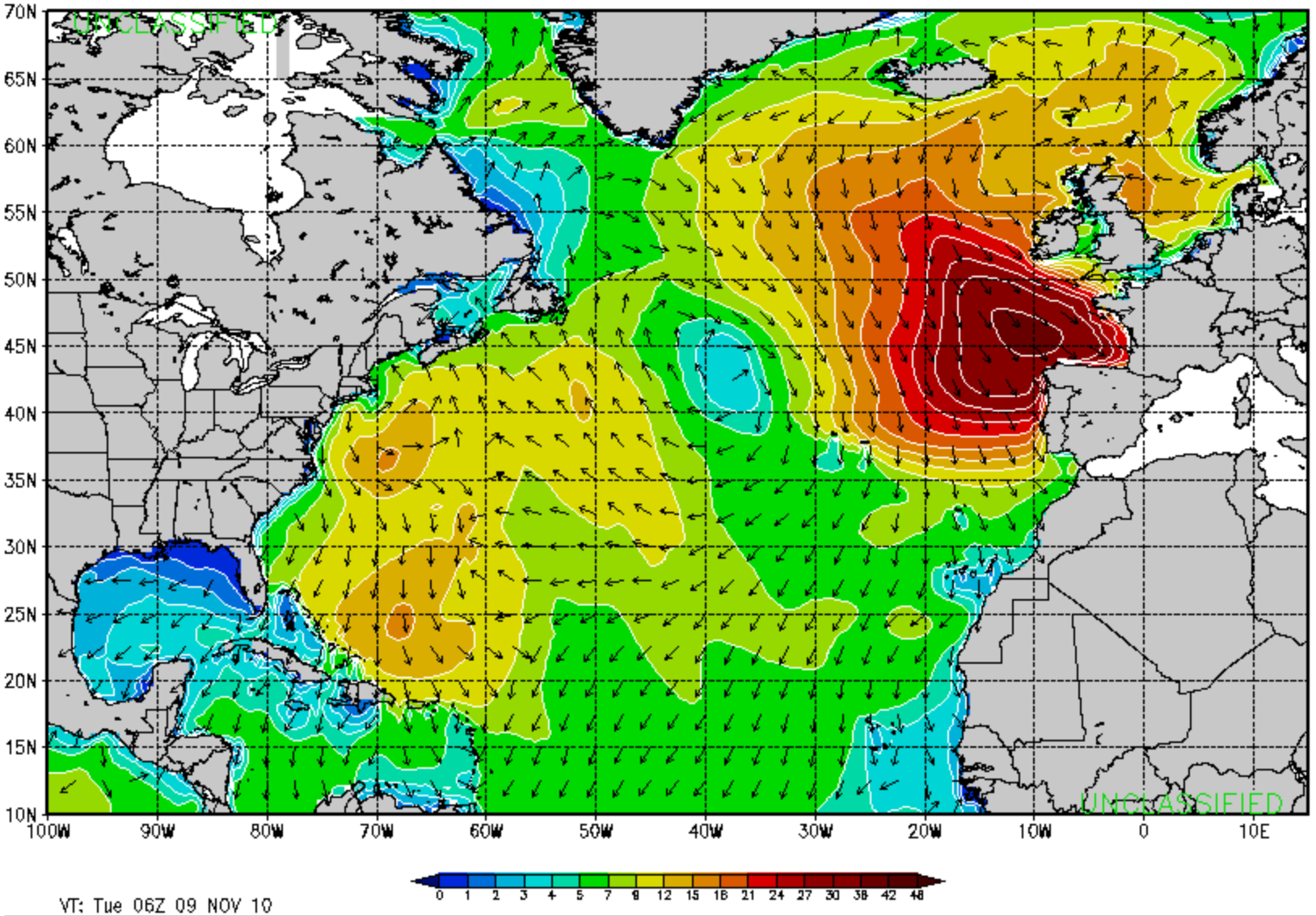
VT: Mon 12Z 08 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110812Z Tau: 0



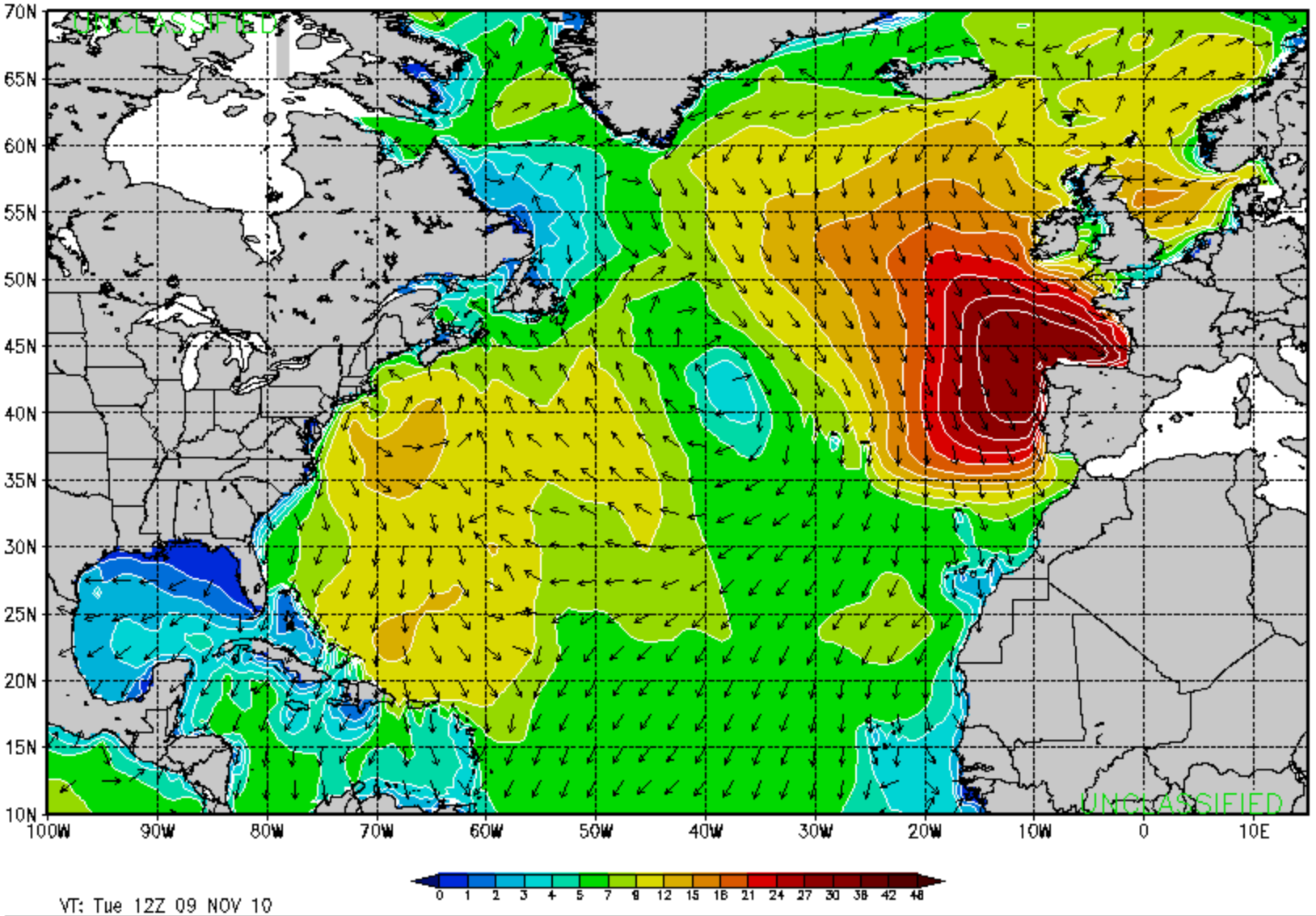
VT: Mon 18Z 08 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110818Z Tau: 0



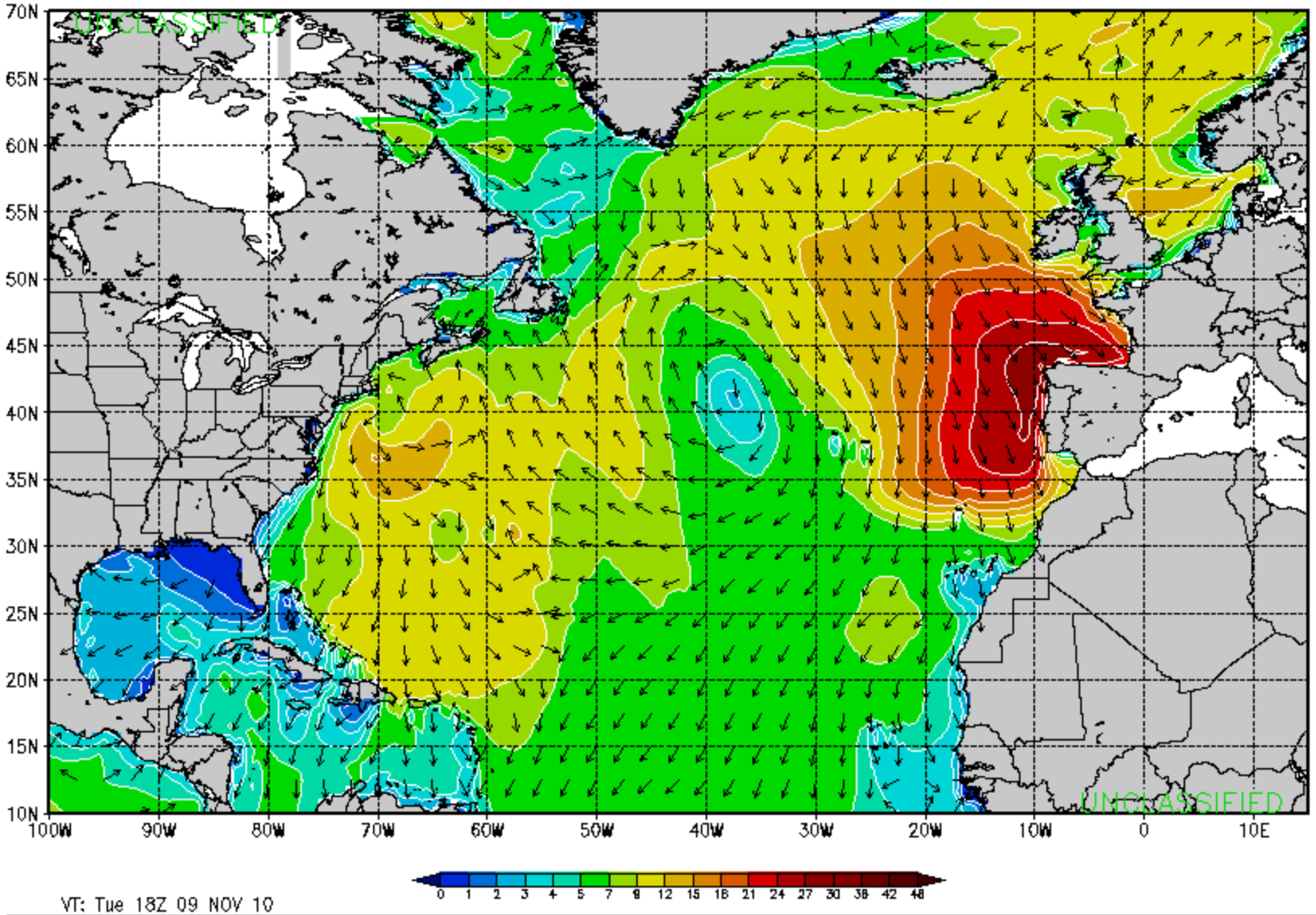
VT: Tue 00Z 09 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110900Z Tau: 0



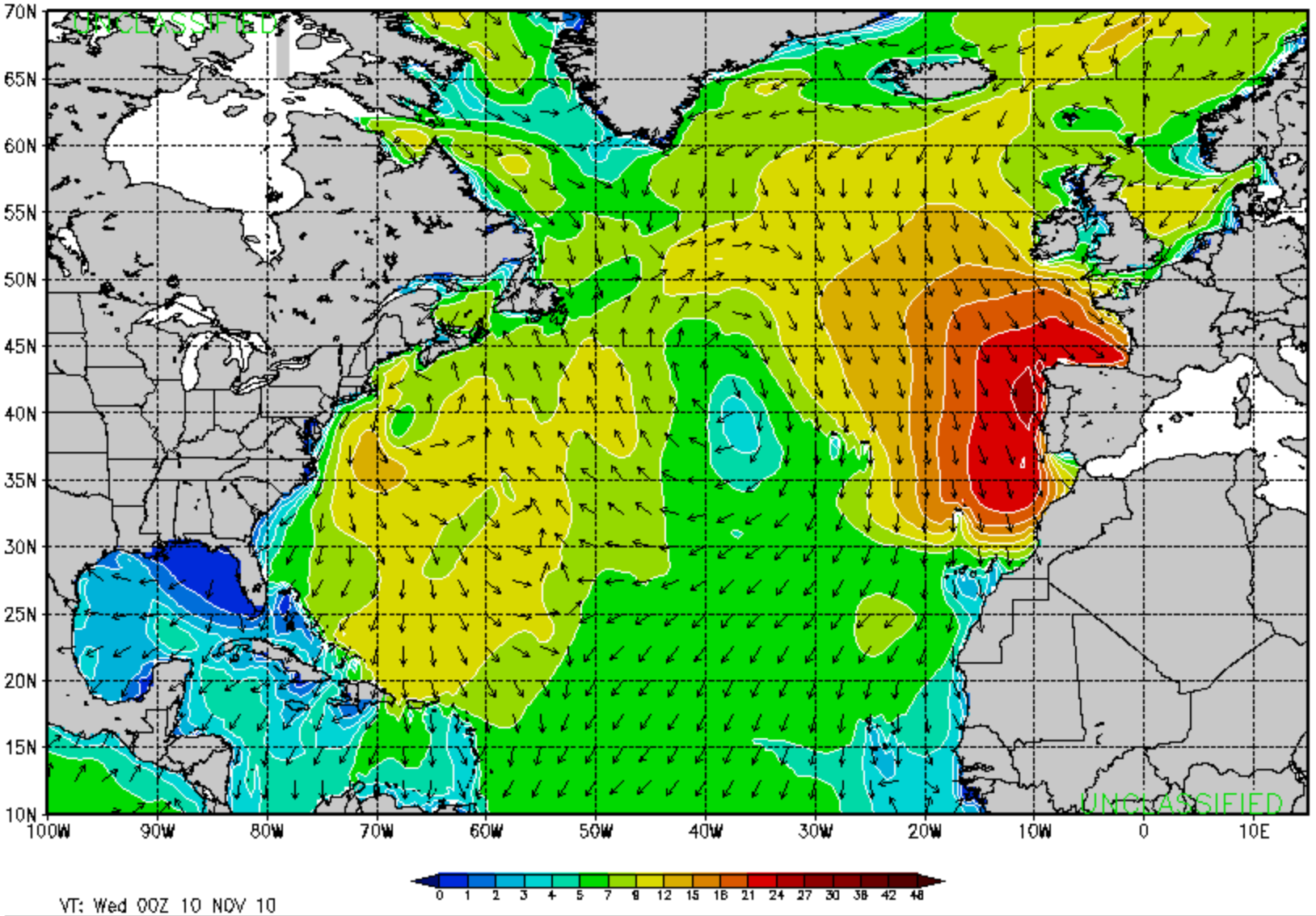
VT: Tue 06Z 09 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110906Z Tau: 0



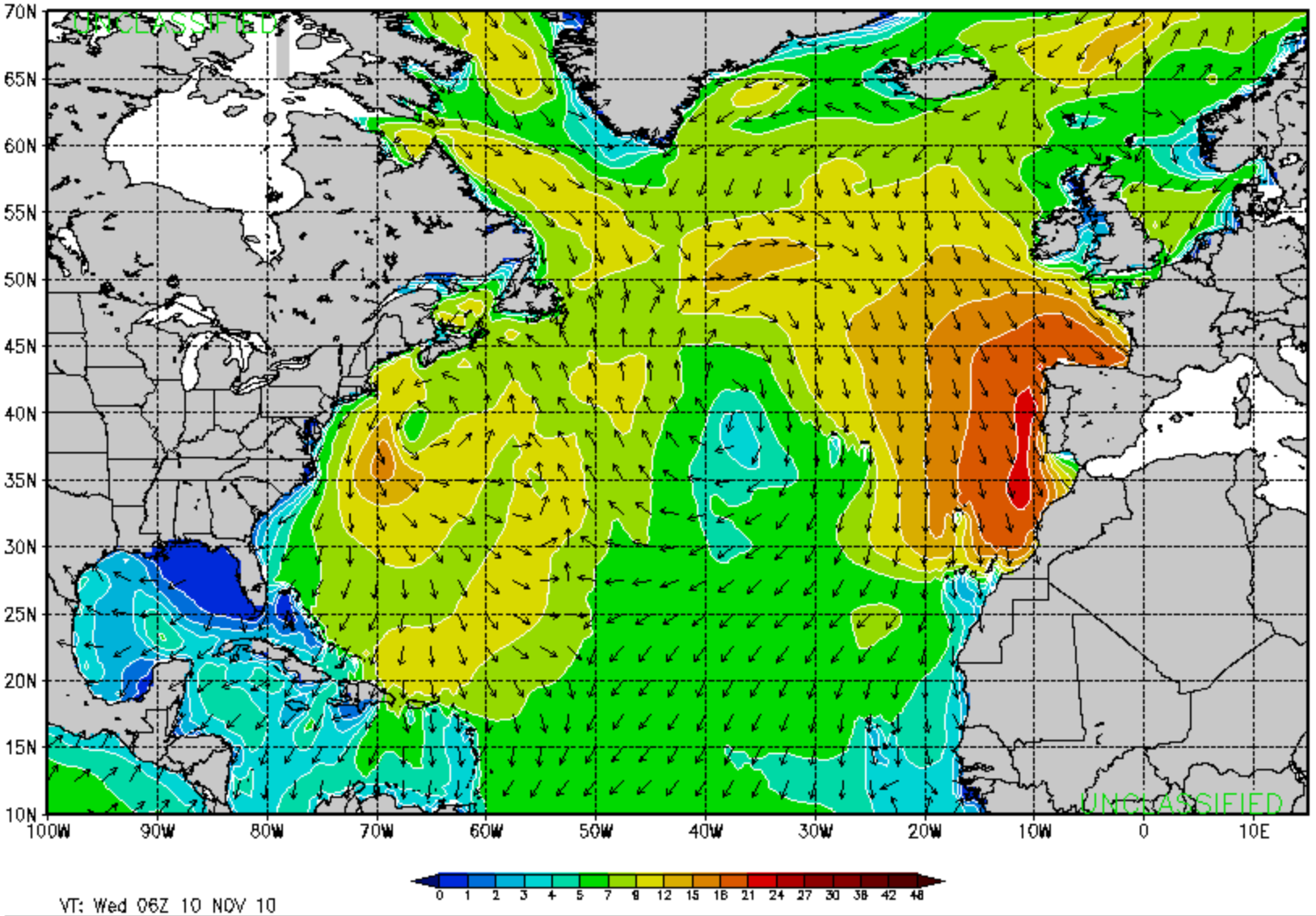
VT: Tue 12Z 09 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110912Z Tau: 0



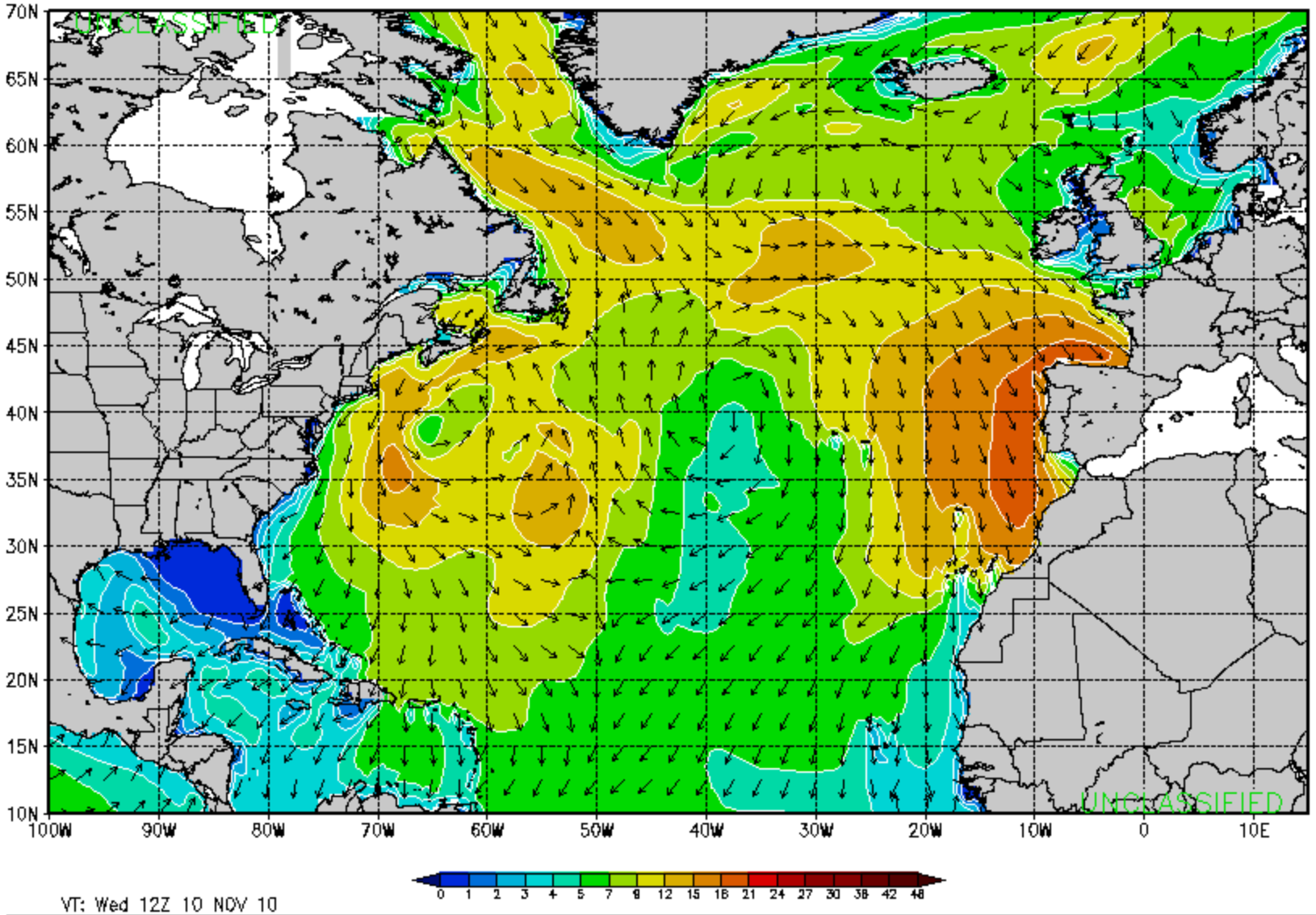
VT: Tue 18Z 09 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010110918Z Tau: 0



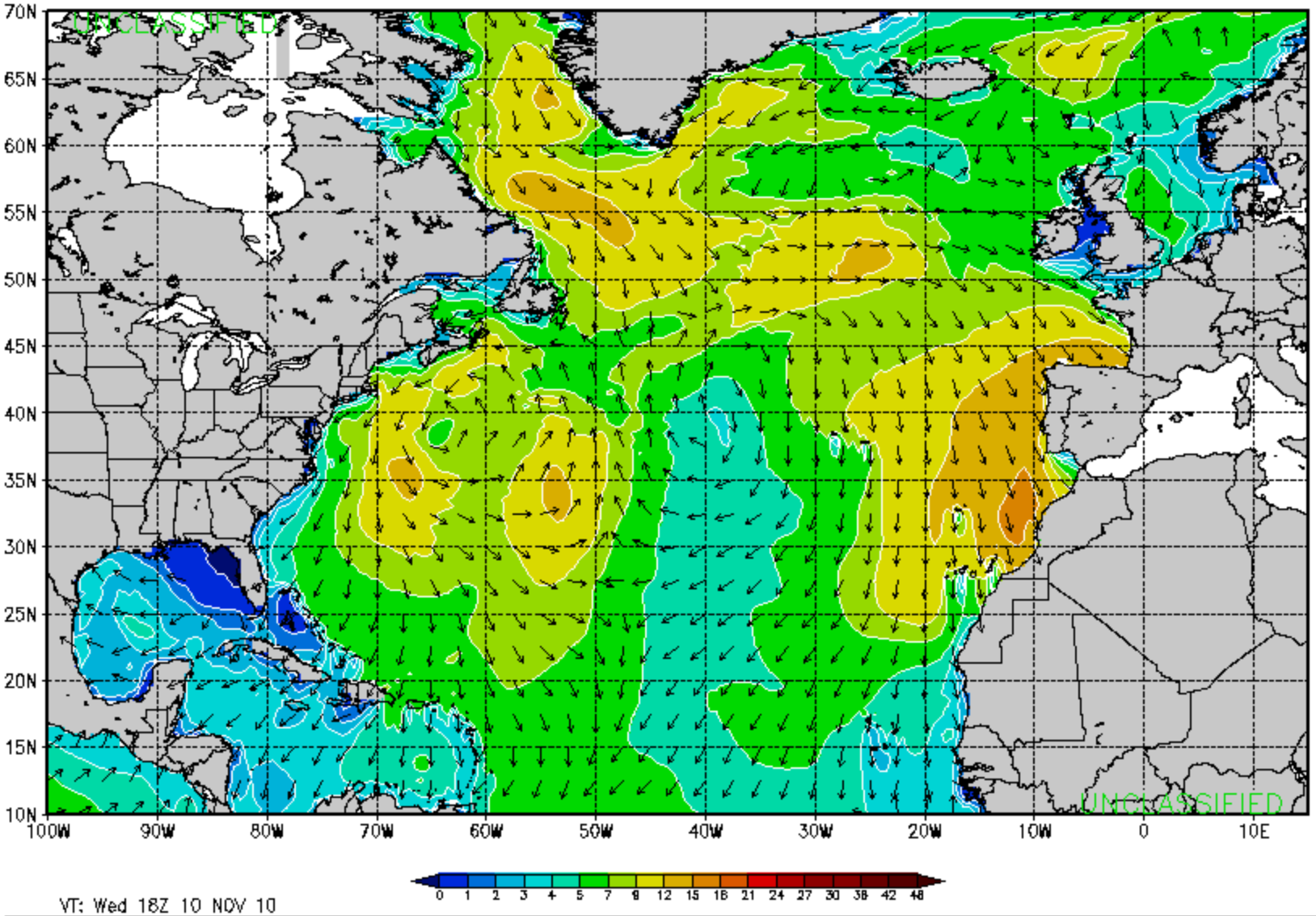
VT: Wed 00Z 10 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010111000Z Tau: 0



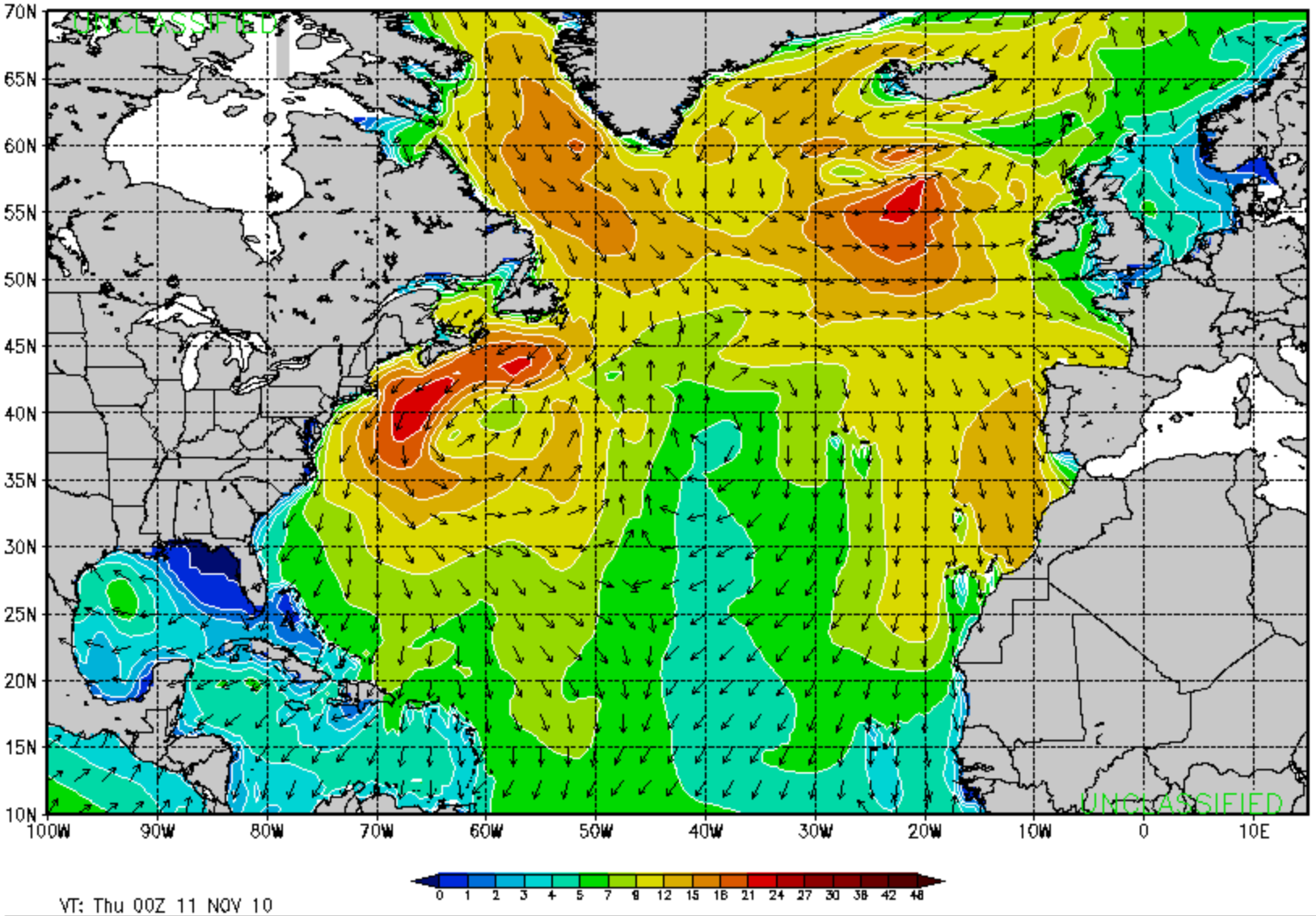
VT: Wed 06Z 10 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010111006Z Tau: 0



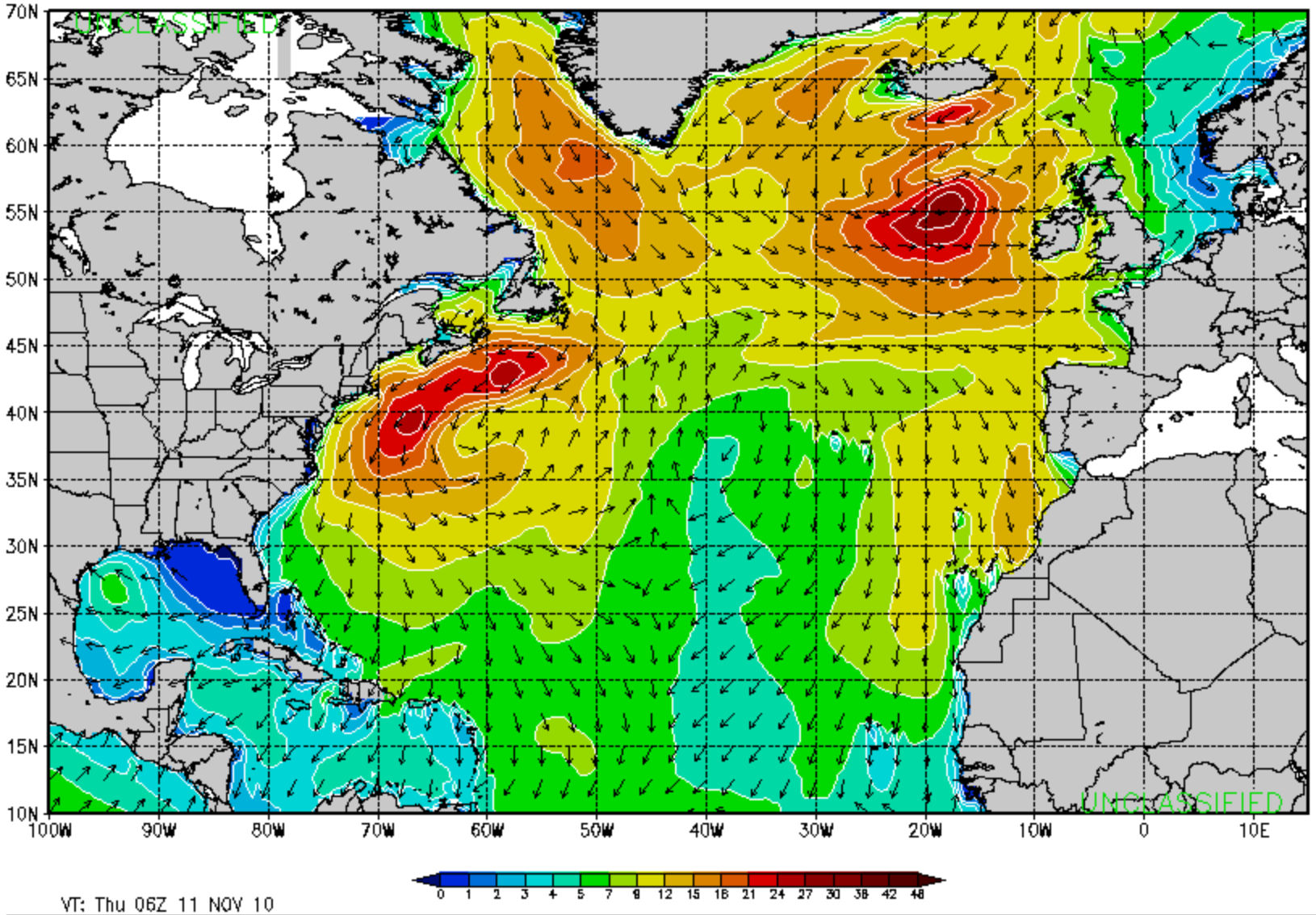
VT: Wed 12Z 10 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010111012Z Tau: 0



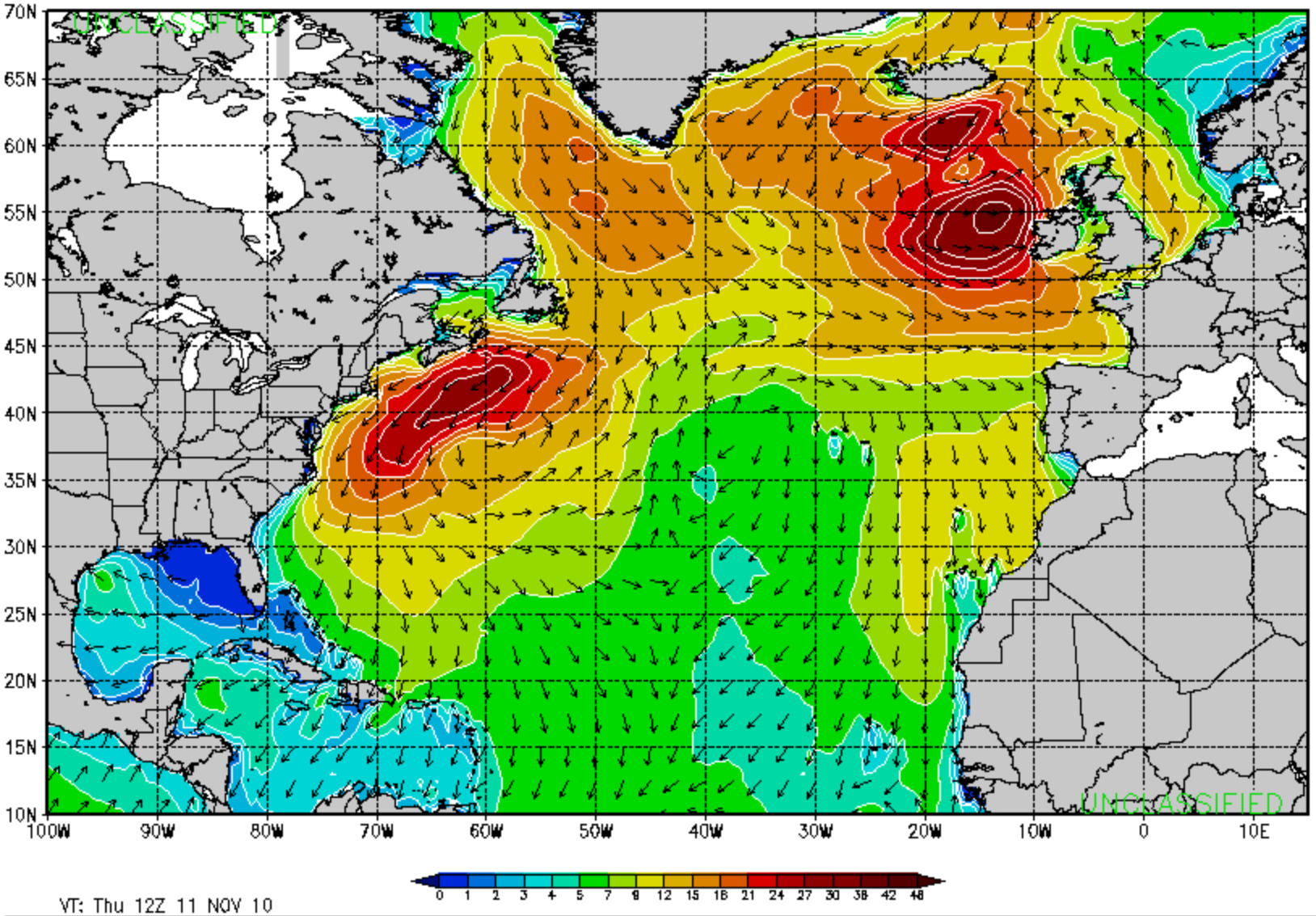
VT: Wed 18Z 10 NOV 10
FNMOC NOGAPS (U): Swell Wave Height [ft] and Direction
Run: 2010111018Z Tau: 0



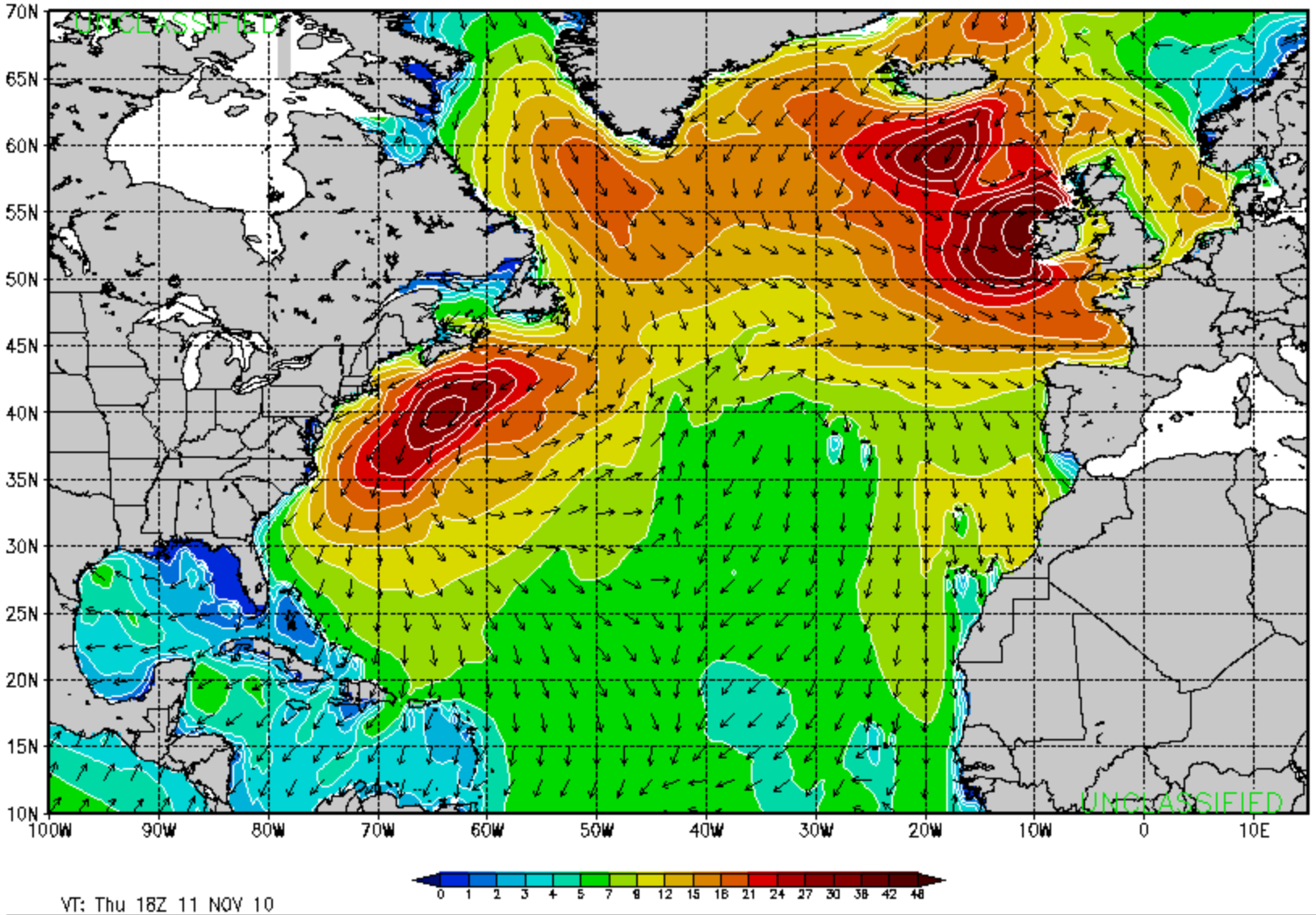
VT: Thu 00Z 11 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010111100Z Tau: 0



VT: Thu 06Z 11 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010111106Z Tau: 0



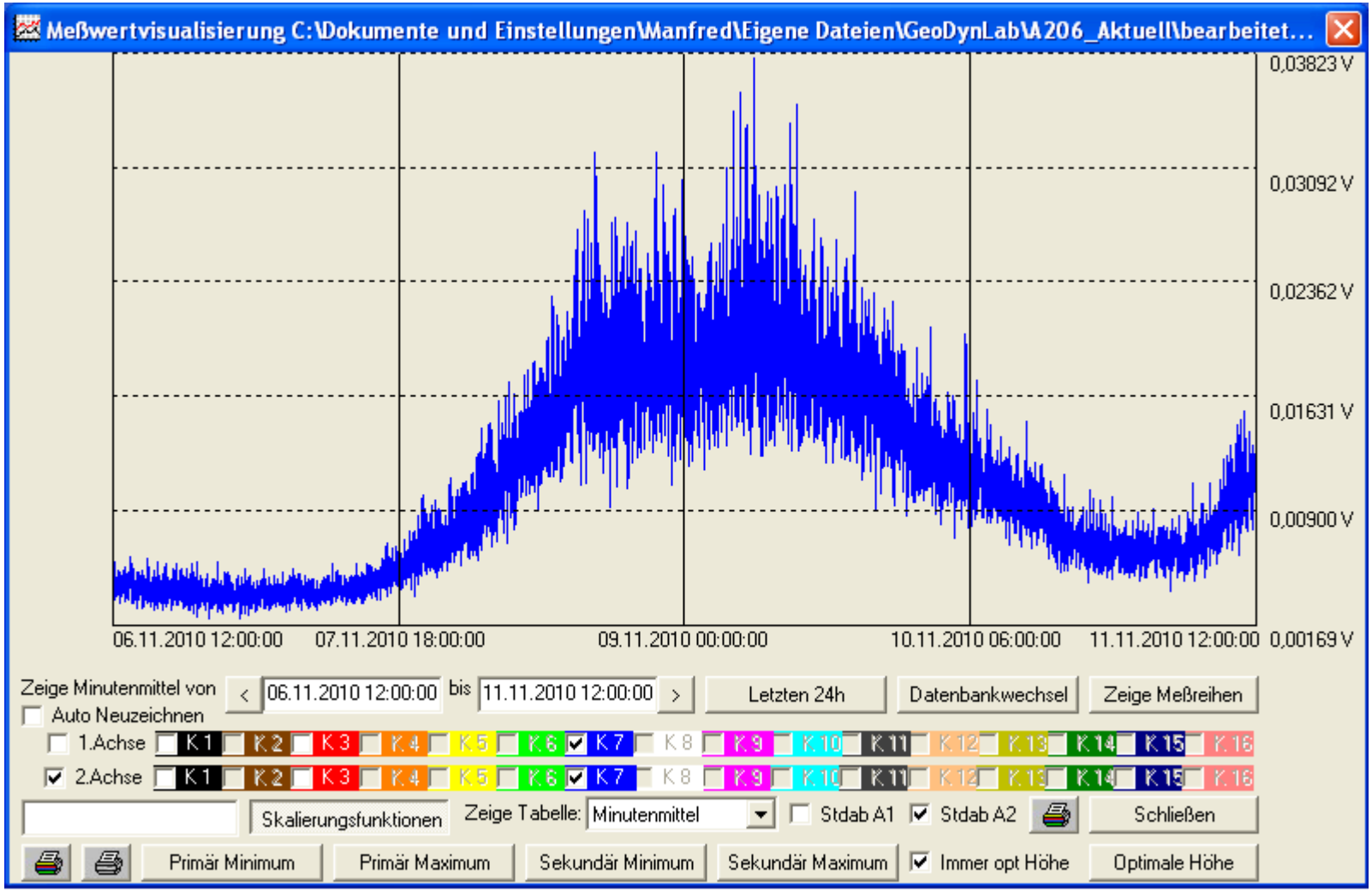
VT: Thu 12Z 11 NOV 10
FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction
Run: 2010111112Z Tau: 0



VT: Thu 18Z 11 NOV 10

FNMOC NOGAPS (U): Significant Wave Height [ft] and Direction

Run: 2010111118Z Tau: 0



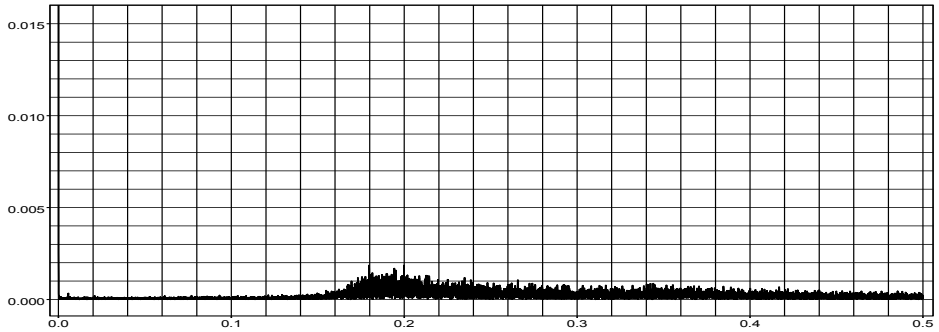
Walferdange Underground Laboratory for Geodynamics :
Time dependency of the gravimetric noise
in the period 2010 October 06 12:00 until October 11 12:00,
standard errors of minute means.

WULG

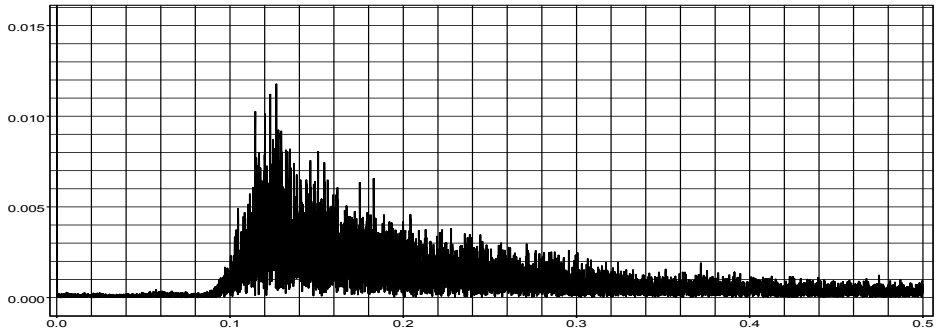
Amplitude spectra of gravity observations with Gravimeter A206

sampling rate 1 second, scale **0,01Volt > 5,37µGal**

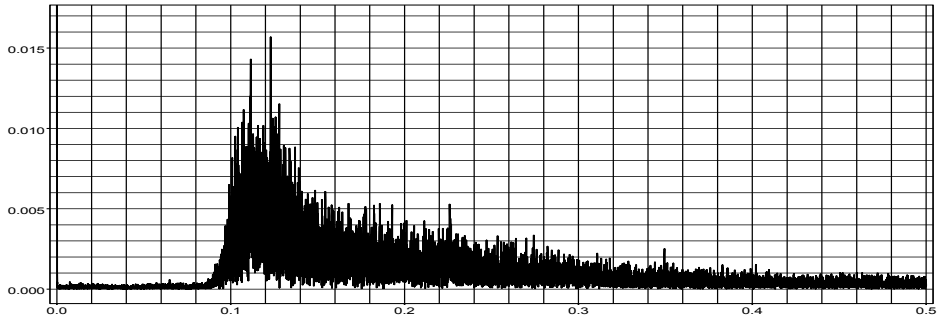
Date 2010_11_07 Interval 6 hours **03:00:00 UT until 09:00:00 UT**



Date 2010_11_08/09 Interval 6 hours **21:00:00 UT until 03:00:00 UT**

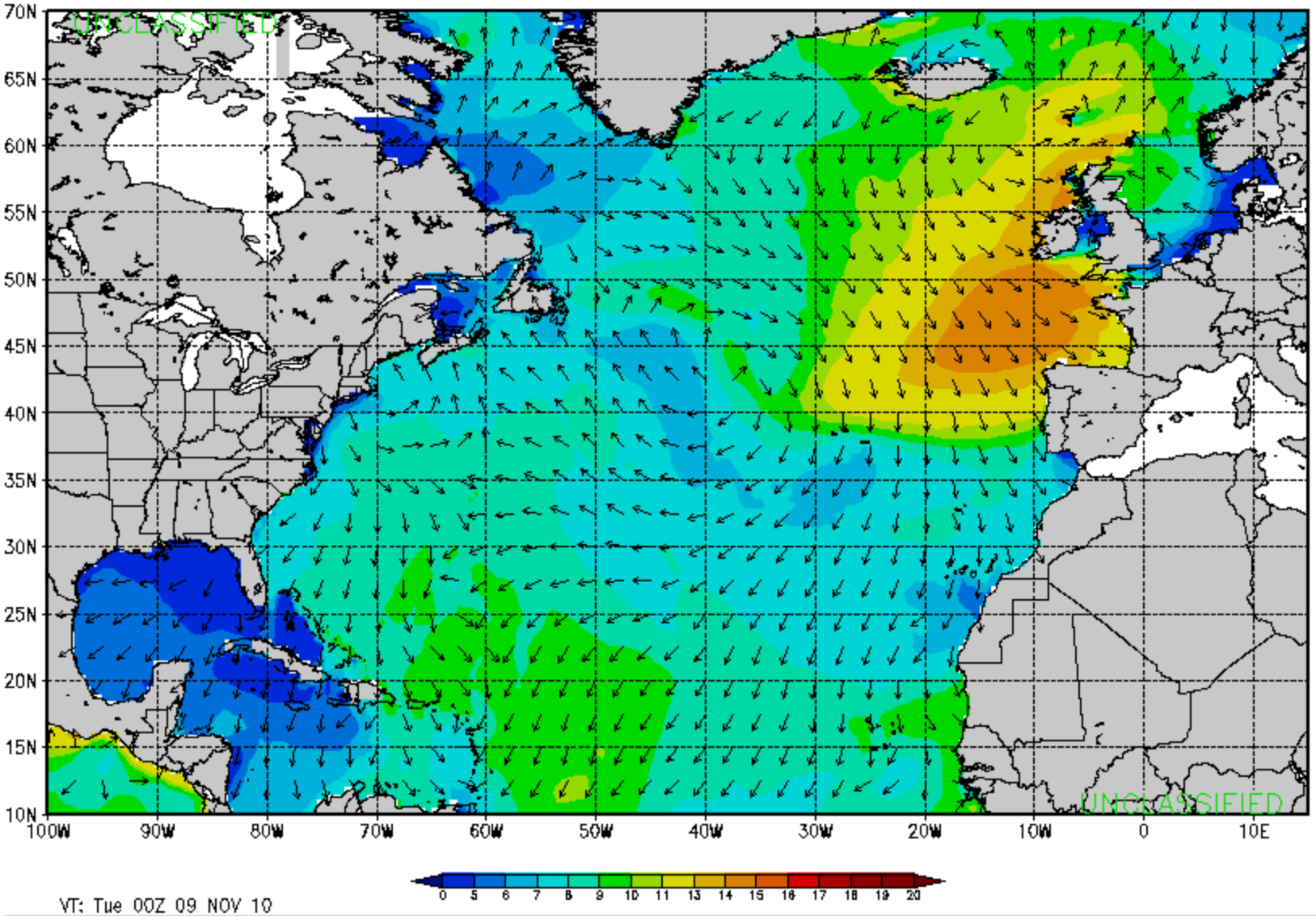


Date 2010_11_09 Interval 6 hours **03:00:00 UT until 09:00:00 UT**

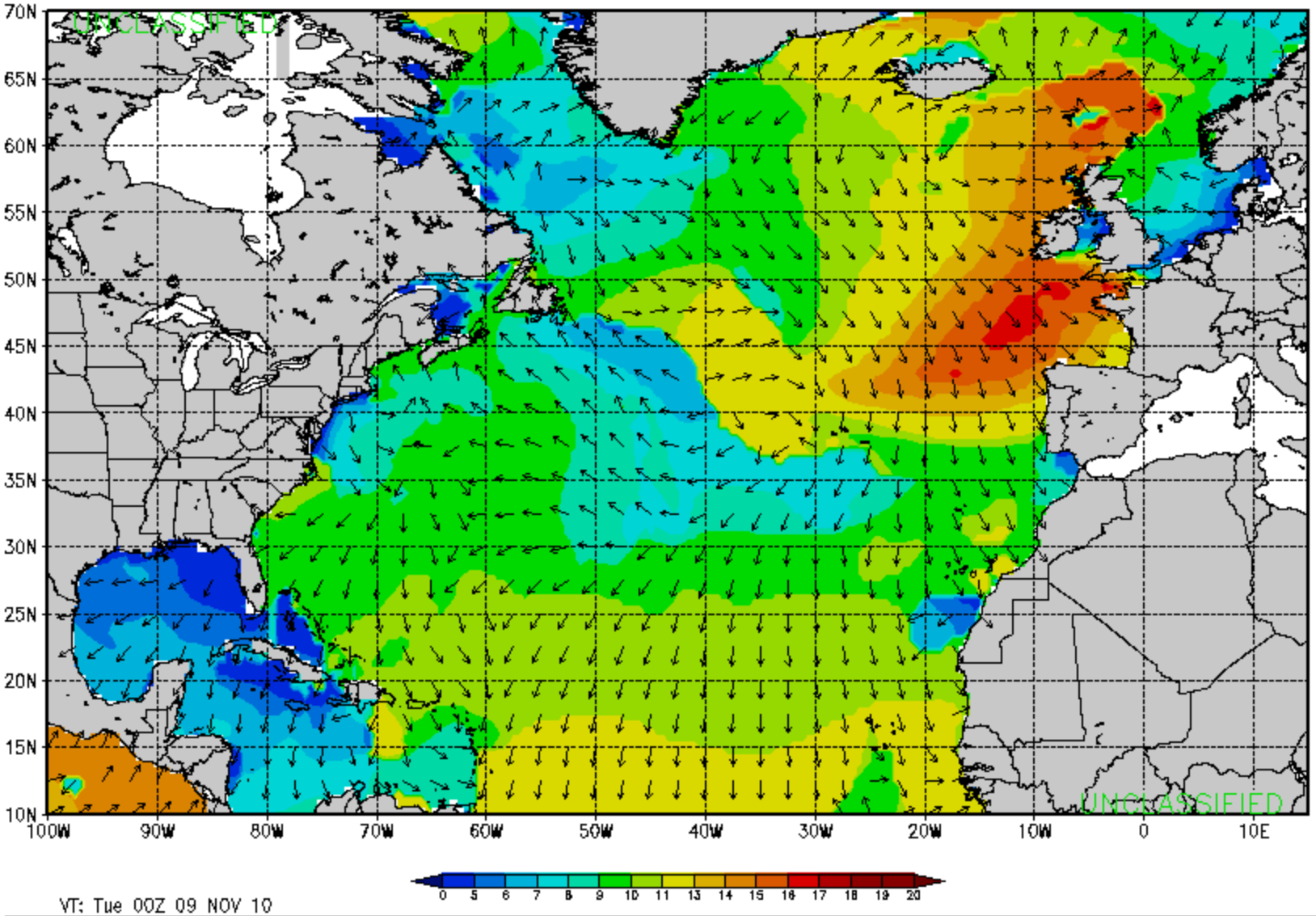


Examples of wave periods and directions

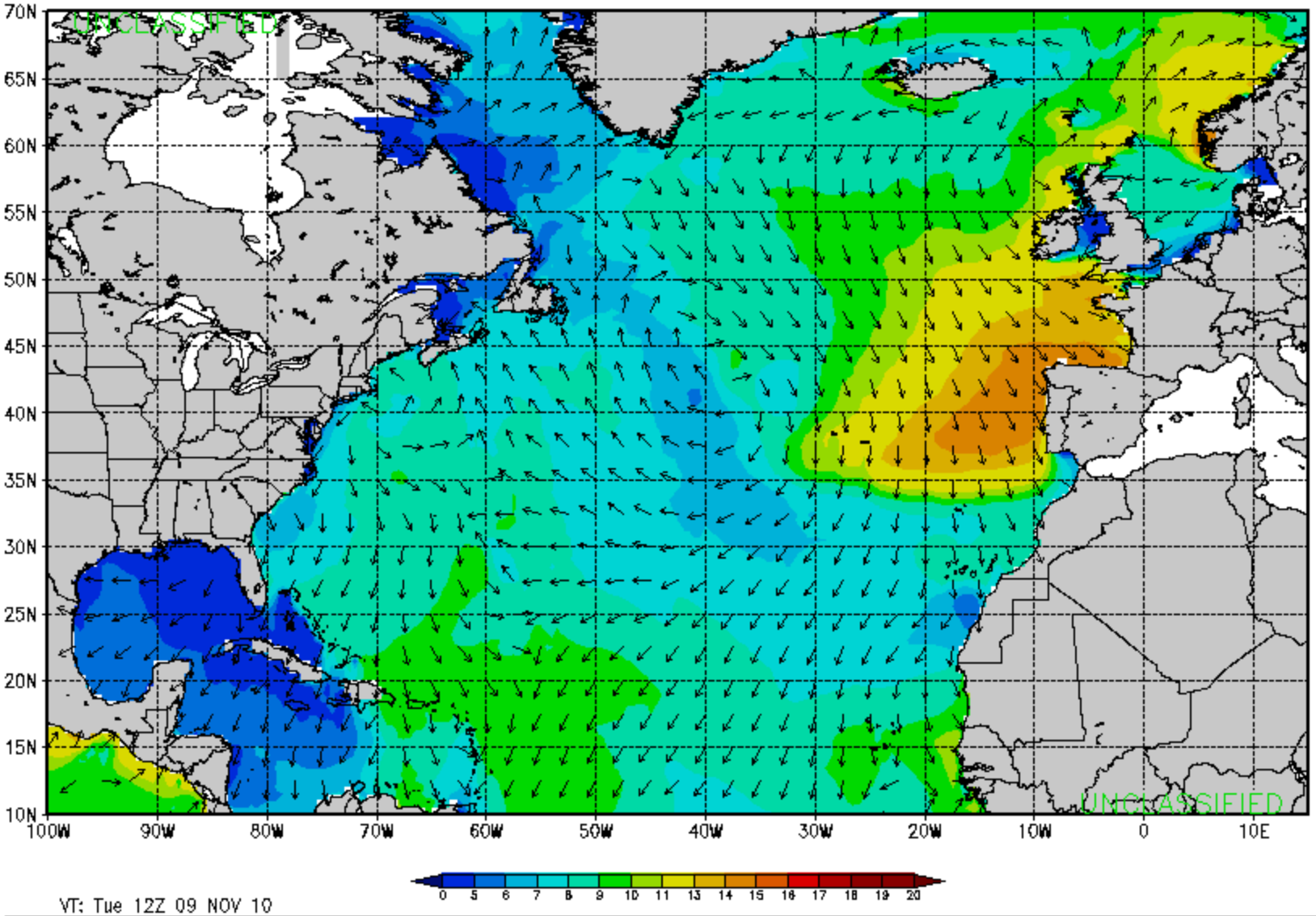
Swell Wave Period and Direction
Peak Wave Period and Direction



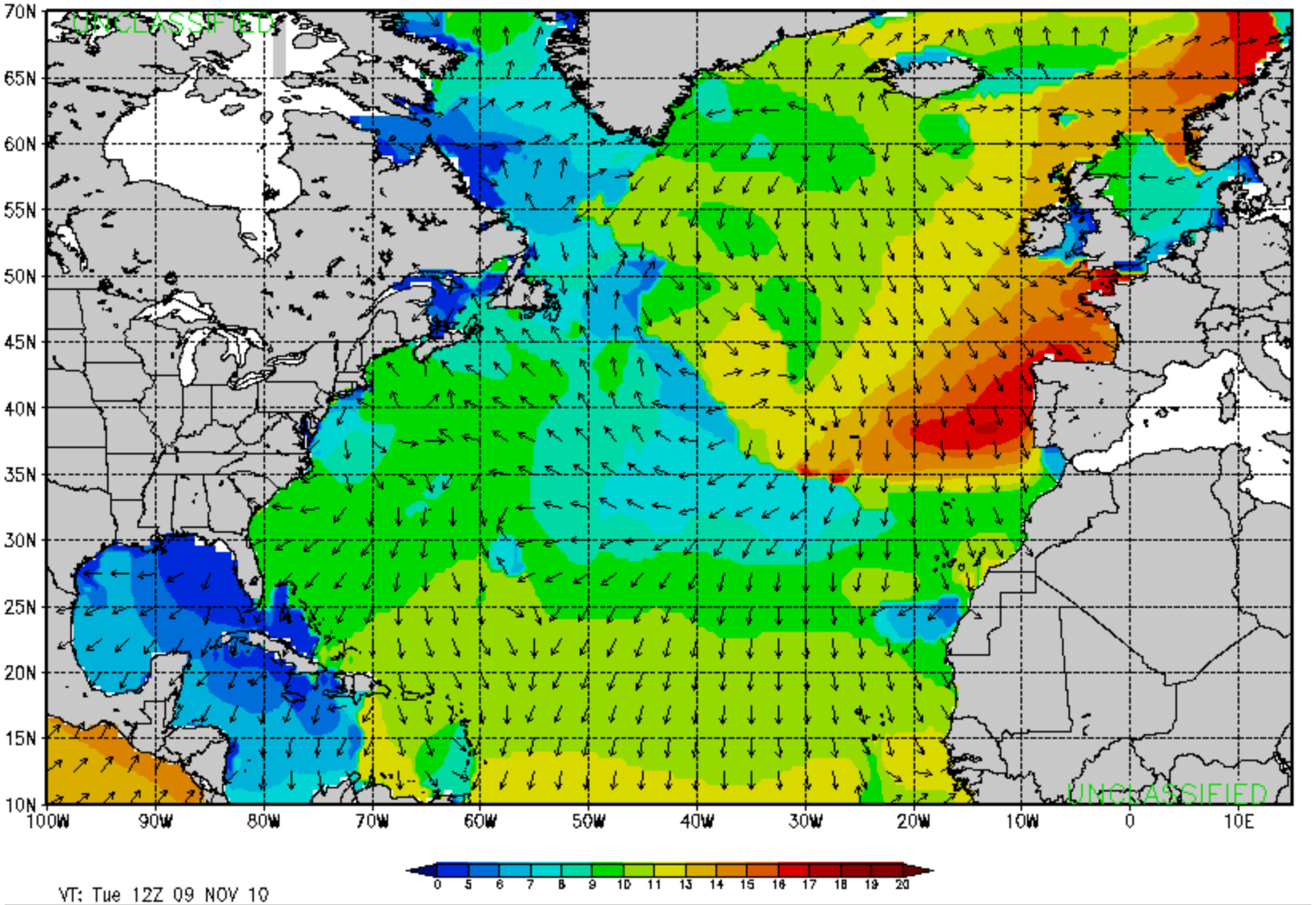
VT: Tue 00Z 09 NOV 10
FNMOC NOGAPS (U): Swell Wave Period [second] and Direction
Run: 2010110900Z Tau: 0



VT: Tue 00Z 09 NOV 10
FNMOC NOGAPS (U): Peak Wave Period [second] and Direction
Run: 2010110900Z Tau: 0



VT: Tue 12Z 09 NOV 10
FNMOC NOGAPS (U): Swell Wave Period [second] and Direction
Run: 2010110912Z Tau: 0

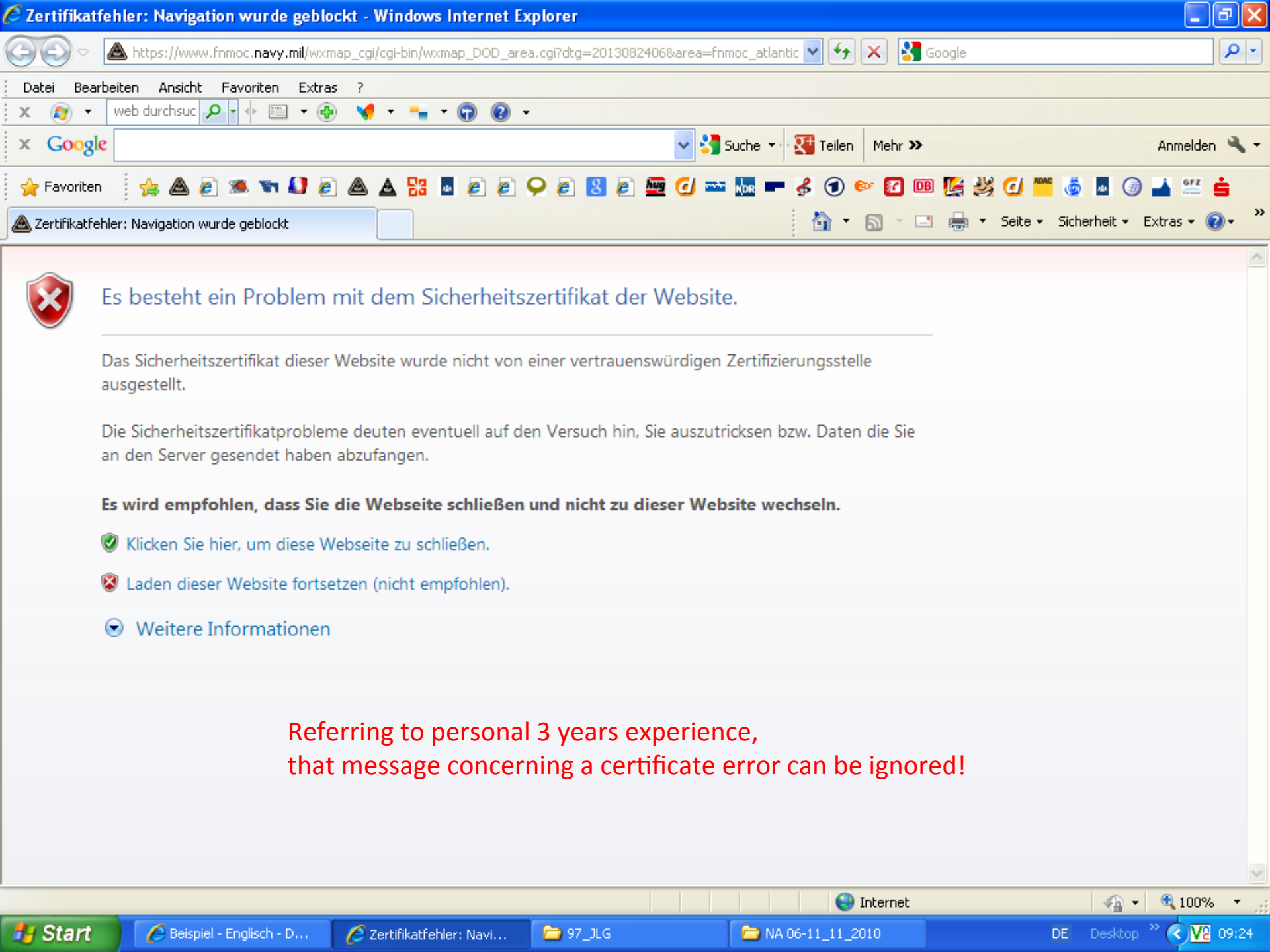


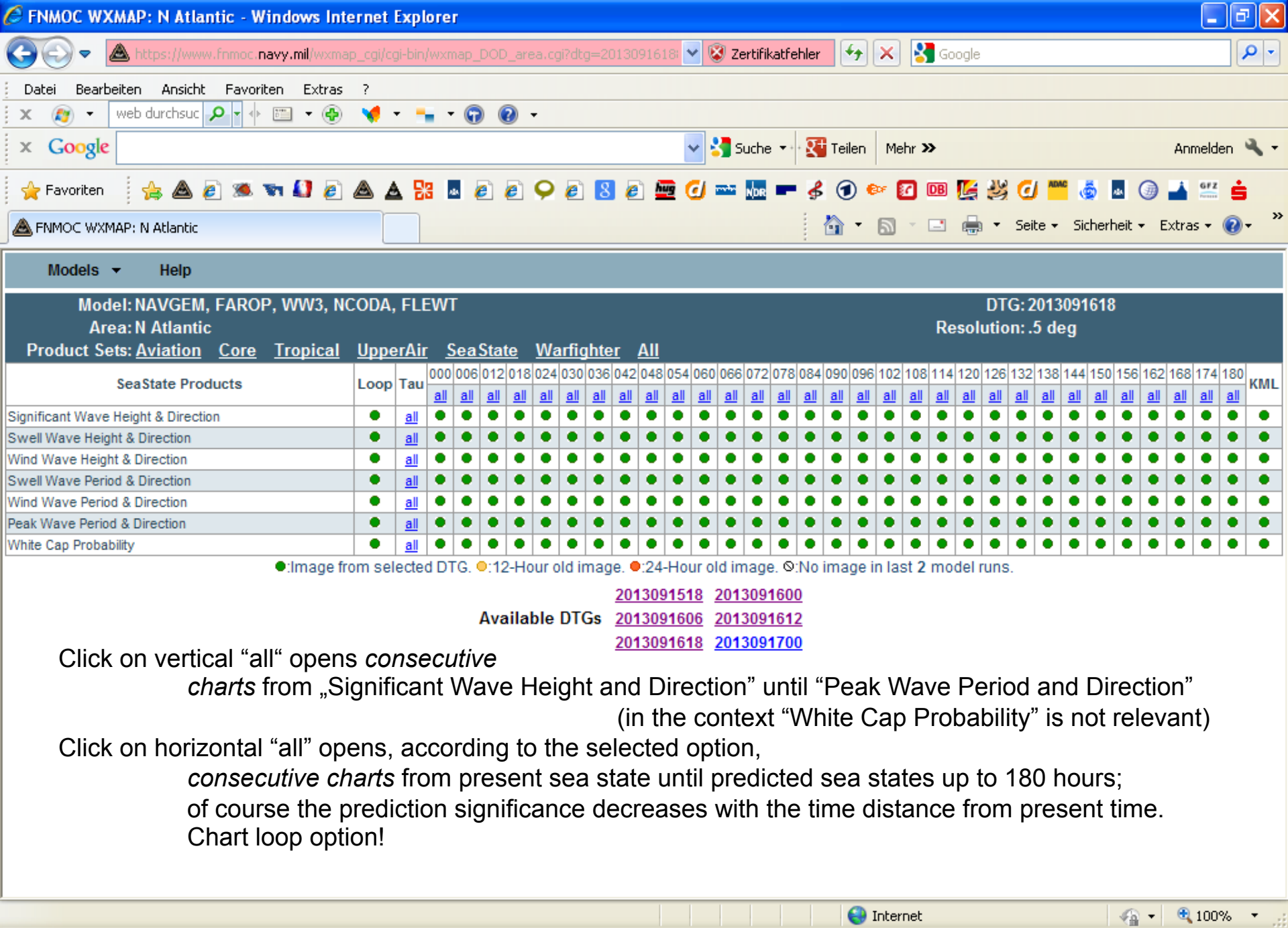
VT: Tue 12Z 09 NOV 10
FNMOC NOGAPS (U): Peak Wave Period [second] and Direction
Run: 2010110912Z Tau: 0

How to get sea state information

Consecutively, sea state models are provided by the Fleet Numerical Meteorology and Oceanography Center (*FNMOC*) of the US Navy (http://www.usno.navy.mil/FNMOC/) with the special note *"Approved for public access. Distribution is unlimited"*.

For Western Europe particularly relevant are the charts of the *North Atlantic* with a actualisation rate of 6 hours
https://www.fnmoc.navy.mil/wxmap_cgi/cgi-bin/wxmap_DOD_area.cgi?dtg=2013082406&area=fnmoc_atlantic&set=SeaState
and of the sea areas of Europe including the Mediterranean and Baltic seas with an actualisation rate of 12 hours
https://www.fnmoc.navy.mil/wxmap_cgi/cgi-bin/wxmap_DOD_area.cgi?dtg=2013041100&area=15km_europe&set=SeaState


Zertifikatfehler: Navigation wurde geblockt - Windows Internet Explorer
https://www.fnmoc.navy.mil/wxmap_cgi/cgi-bin/wxmap_DOD_area.cgi?dtg=2013082406&area=fnmoc_atlantic
Google
Datei Bearbeiten Ansicht Favoriten Extras ?
web durchsuc
Google
Suche
Teilen
Mehr »
Anmelden
Favoriten
Zertifikatfehler: Navigation wurde geblockt
Seite
Sicherheit
Extras
Es besteht ein Problem mit dem Sicherheitszertifikat der Website.
Das Sicherheitszertifikat dieser Website wurde nicht von einer vertrauenswürdigen Zertifizierungsstelle ausgestellt.
Die Sicherheitszertifikatprobleme deuten eventuell auf den Versuch hin, Sie auszutricksen bzw. Daten die Sie an den Server gesendet haben abzufangen.
Es wird empfohlen, dass Sie die Webseite schließen und nicht zu dieser Website wechseln.
Klicken Sie hier, um diese Webseite zu schließen.
Laden dieser Website fortsetzen (nicht empfohlen).
Weitere Informationen
Referring to personal 3 years experience,
that message concerning a certificate error can be ignored!
Internet
100%
Start
Beispiel - Englisch - D...
Zertifikatfehler: Navi...
97_JLG
NA 06-11_11_2010
DE
Desktop
09:24

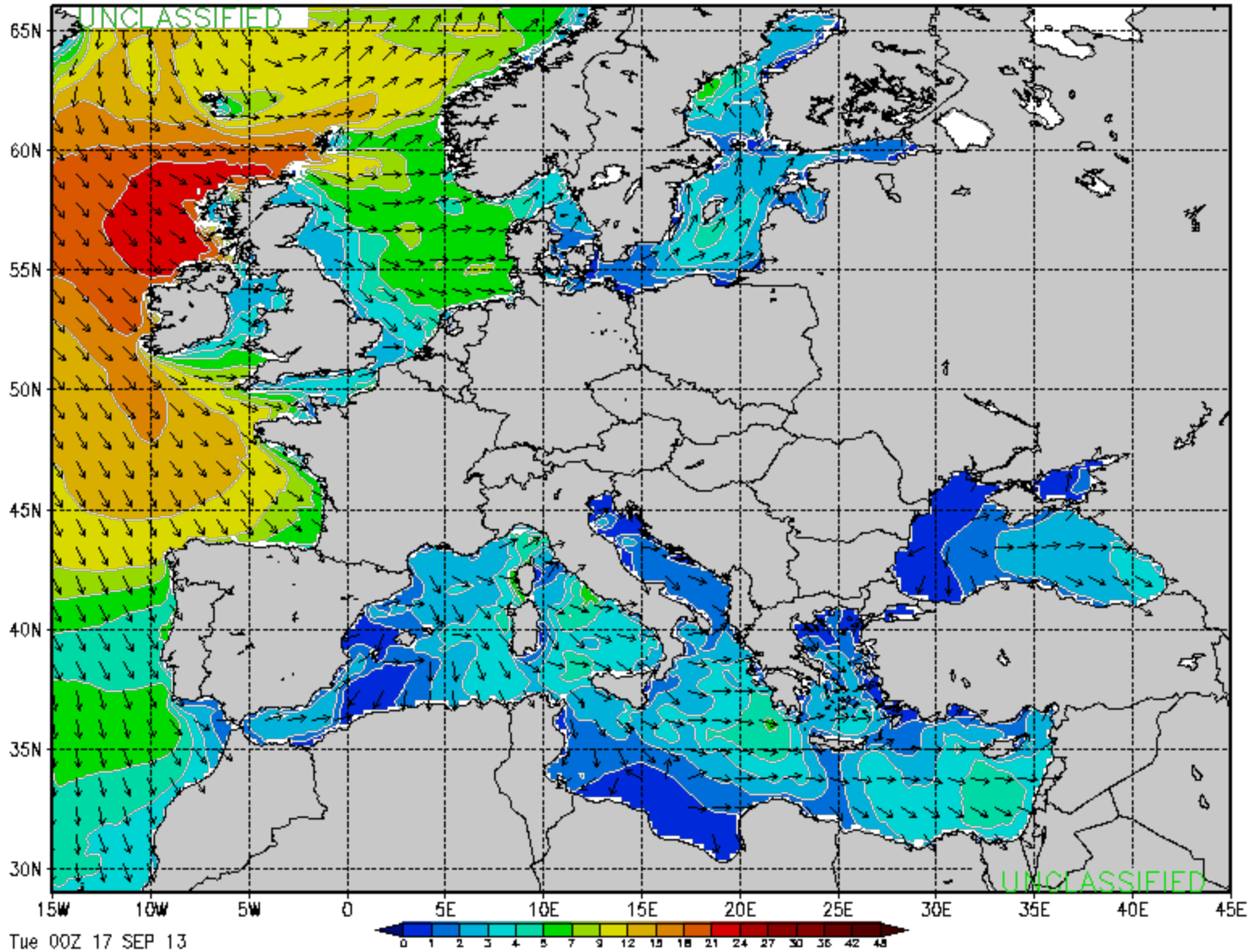


Click on vertical “all“ opens *consecutive charts* from „Significant Wave Height and Direction” until “Peak Wave Period and Direction”
(in the context “White Cap Probability” is not relevant)

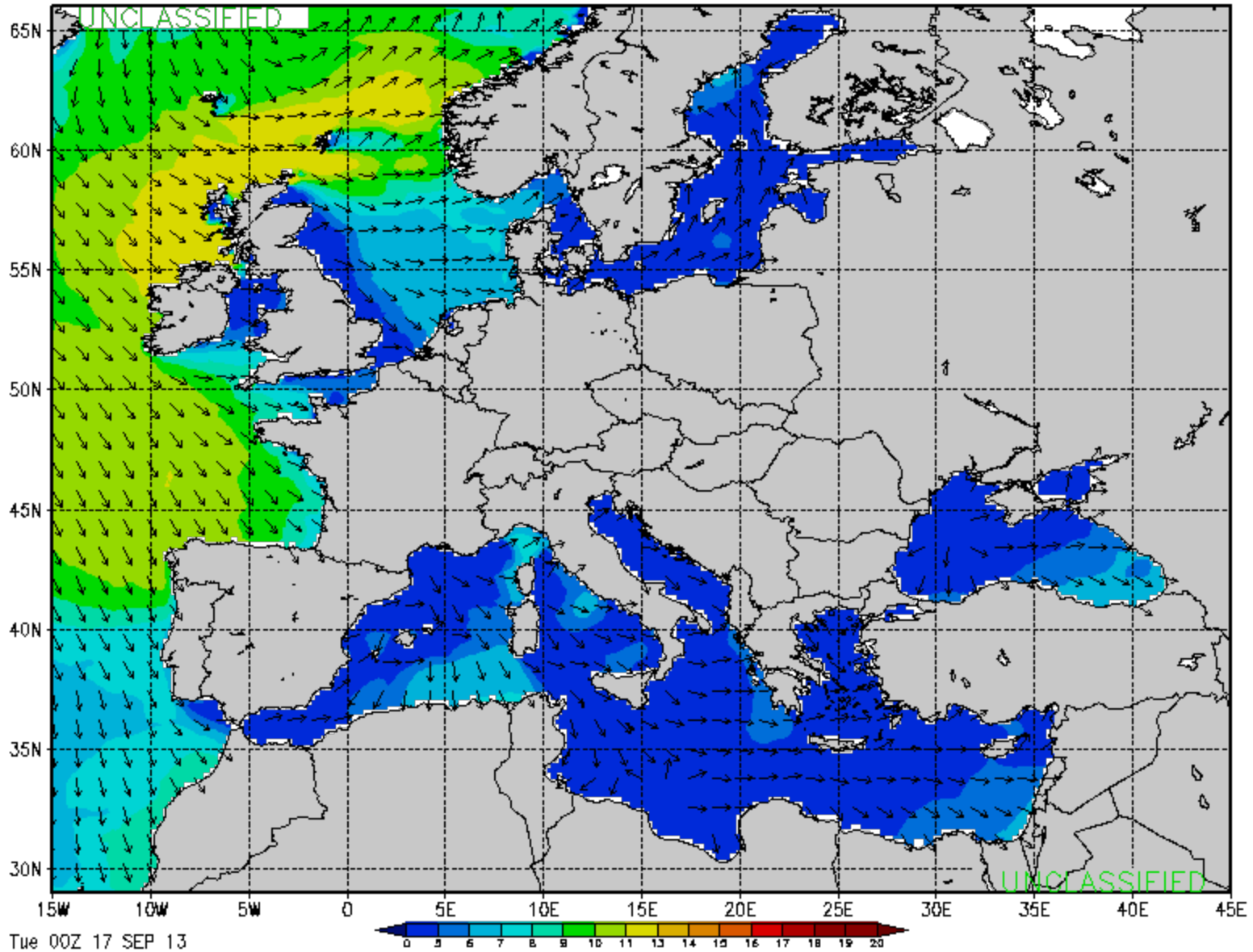
Click on horizontal “all” opens, according to the selected option,
consecutive charts from present sea state until predicted sea states up to 180 hours;
of course the prediction significance decreases with the time distance from present time.
Chart loop option!

Charts of the sea areas of Europe including the Mediterranean and Baltic seas with an actualisation rate of 12 hours.

Swell Wave Height and Direction
Swell Wave Period and Direction



VT: Tue 00Z 17 SEP 13
FNMOC COAMPS (U): Swell Wave Height [ft] and Direction
Run: 2013091700Z Tau: 0



VT: Tue 00Z 17 SEP 13
FNMOC COAMPS (U): Swell Wave Period [second] and Direction
Run: 2013091700Z Tau: 0

Prediction of Gravimetric Noise

Once knowing that a significant interrelation exists between the sea state pattern and the associated gravimetric noise pattern, for any station in Western Europe the *sea state induced gravimetric noise* can be predicted, within certain limits. In many cases that noise component is dominating; the ratio between maximum and minimum sea state induced noise level can easily exceed the factor 20!

The physical cause of sea state induced noise are breaking waves along the West European coast lines and the associated energy transmission. Concerning the North Atlantic, the sea state forecasting horizon amounts up to one week when applying the *FNMOC* approach.

Since the noise can significantly affect the quality of an aiming gravimetric signal, certain measurements, including metrological investigations and measures, have necessarily to be performed under optimal noise conditions. Prediction facilitates planning and execution essentially. Different from instrumental noise, sea state induced noise is a physical phenomenon and can therefore only be minimised by selection of appropriate observation periods.

At present the size of the sea state induced gravimetric noise can a-priori be *assessed* on the basis of increasing experience regarding predicted wave heights and directions along the European sea coasts.

The evaluation of observed gravimetric data may be extended into the direction of a *modelling* (quantification) of the correlation between the sea state pattern along the West European coast lines and the noise observed in the respective station. Certainly, this is a complicated endeavour since one is concerned with a spatially extended noise source , instead of a point source. Additionally , the horizontal and vertical geometry of the respective coastal region has to be considered as well as local and regional geological structures.

Perhaps, the conversion processes of breaking waves energy into seismic energy and the transmission pattern contain geo-scientifically relevant information.

Anyway, even a rather qualitatively determined correlation between sea state and gravimetric noise can improve the chances of detailed *noise sourcing* when already knowing one major part of the noise origins.

In September 2010 the author started to establish a North Atlantic Sea State data base (sampling rate 6 hours) containing FNMOC charts for

- Significant Wave Heights and Direction
- Swell Wave Heights and Direction
- Wind Wave Height and Direction
- Swell Wave Period and Direction
- Wind Wave Period and Direction
- Peak Wave Period an Direction

In September 2012 the record was temporarily stopped and restarted in April 2013.

The data base is open for any user (refer to geo.bonatz@t-online.de)