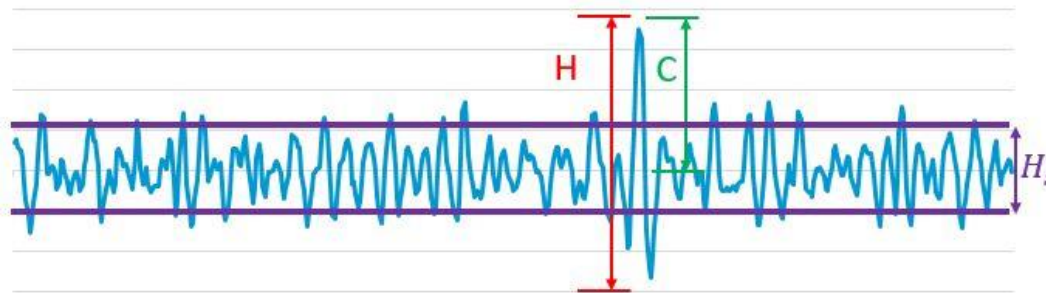


ROGUE WAVES IN THE SOUTHERN NORTH SEA



Ina Teutsch

with thanks to Dr. Ralf Weisse

2nd Baltic Earth Conference

Helsingør, Denmark

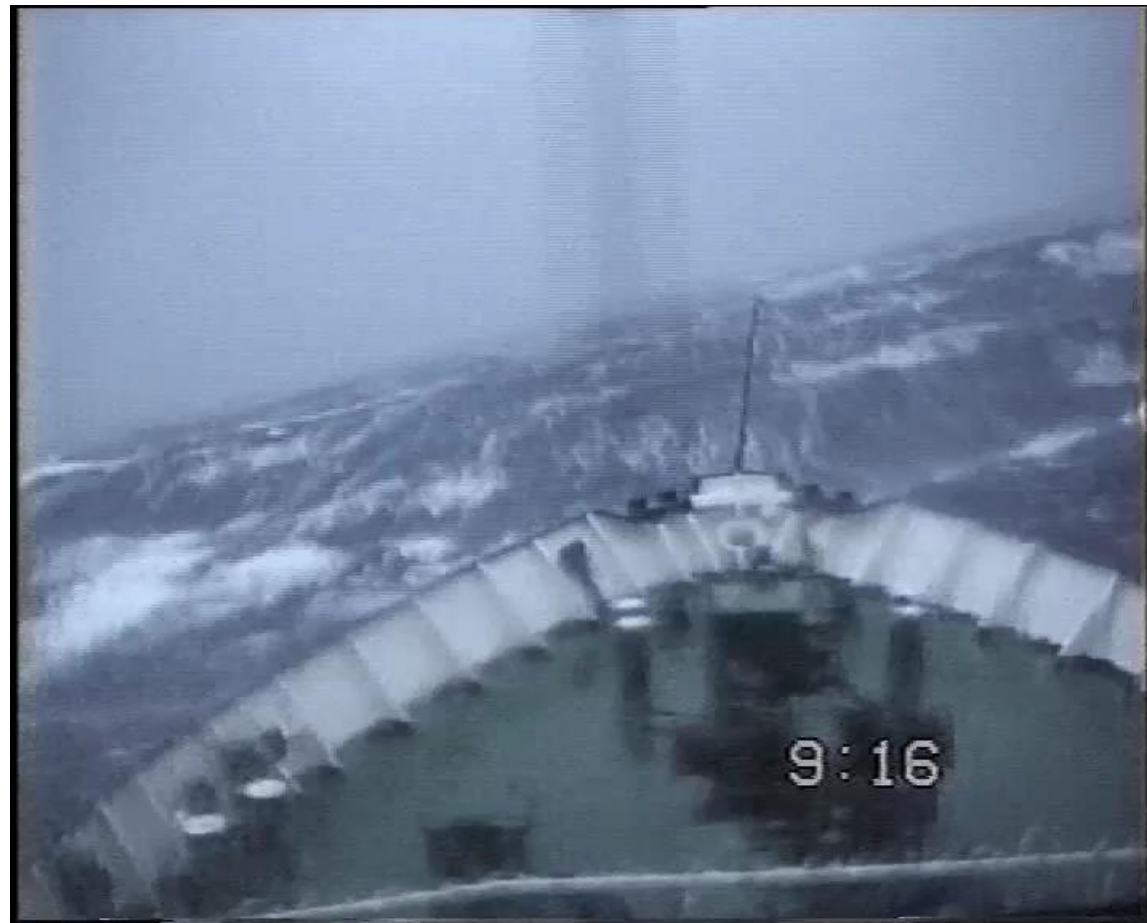
13 June 2018

 **Helmholtz-Zentrum
Geesthacht**

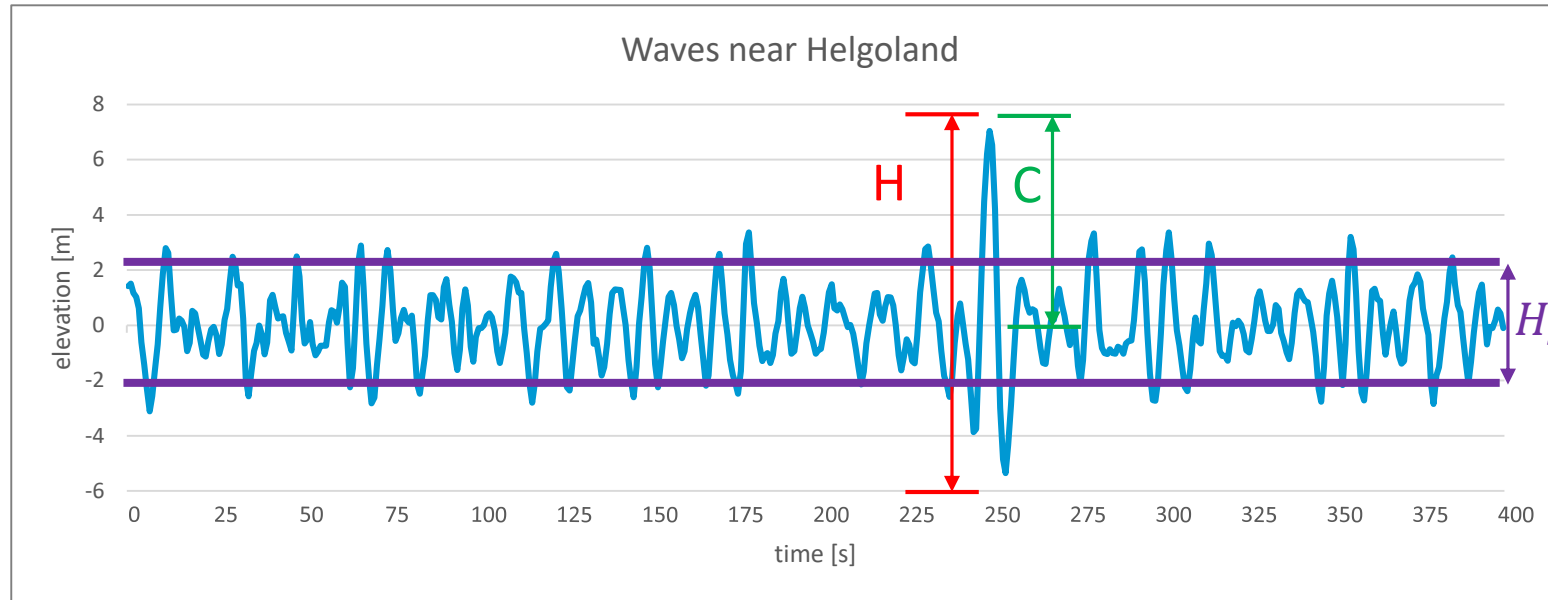
Centre for Materials and Coastal Research

1. Motivation
2. Definition
3. Data
4. Measurement Results
 - a) Statistics
 - b) Comparison with theory
 - c) Weather Patterns
 - d) Changes in the Spectrum?

Motivation



DEFINITION



H- wave height
 C- crest height
 H_s - significant wave height (33% highest waves)

$$\frac{H}{H_s} > 2 \quad \text{OR} \quad \frac{C}{H_s} > 1.25$$

Haver criterion [2000]

DATA

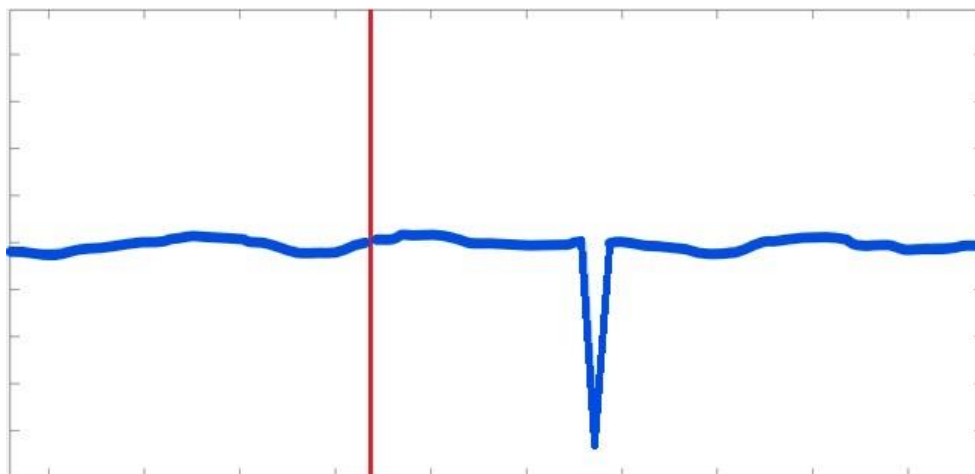
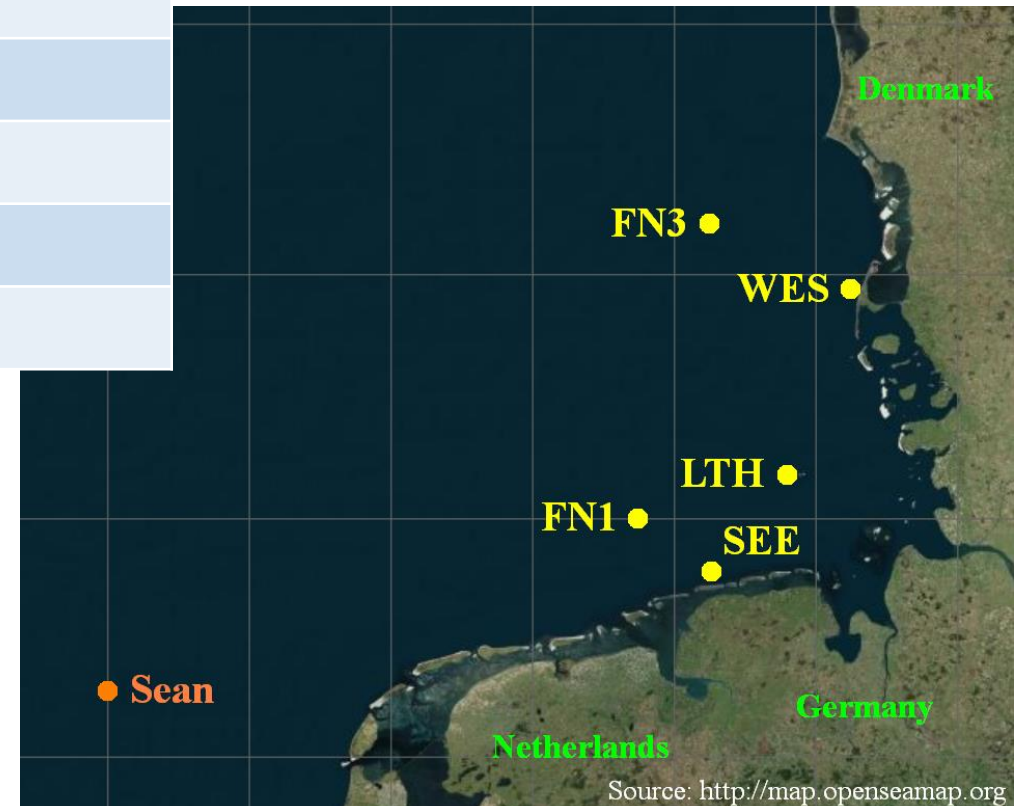
Study area

From 2011 to 2016, sample length 1800s.
After quality control:

Station	Water Depth	Instrument	No. Samples
LTH	30 m	Buoy	85582
FN1	30 m	Buoy	83704
WES	13 m	Buoy	69601
FN3	25 m	Buoy	65474
SEE	10 m	Buoy	73861
Sean	31 m	Radar	70112

Orange: Radar measurement station at gas platform

Yellow: Wave buoys

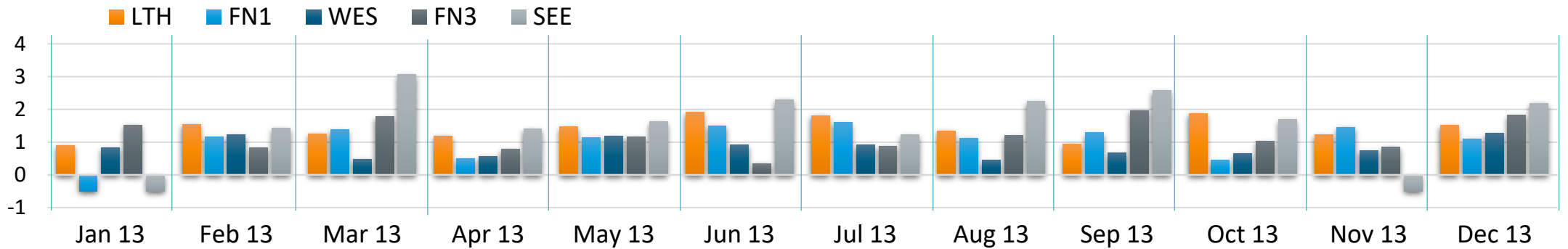


Ina Teutsch. Rogue Waves.

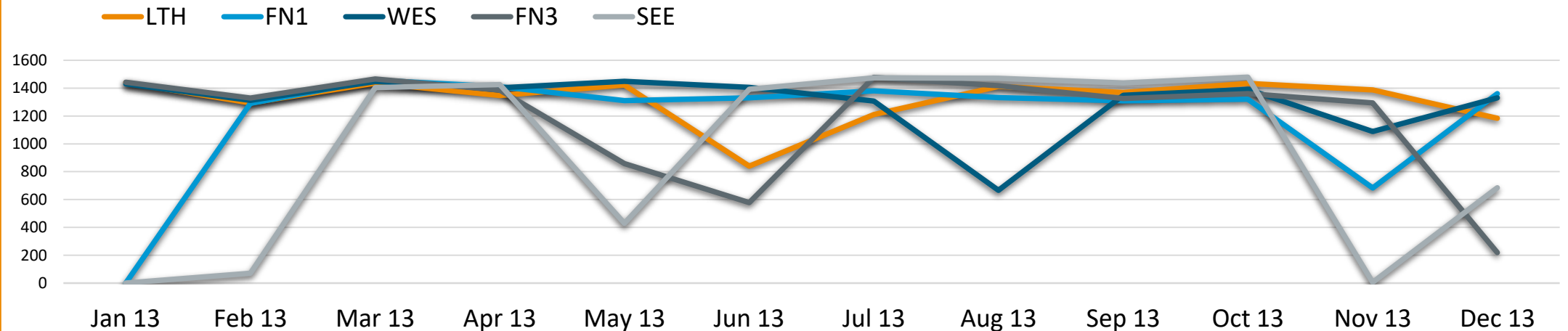
MEASUREMENT RESULTS

Statistics 2013

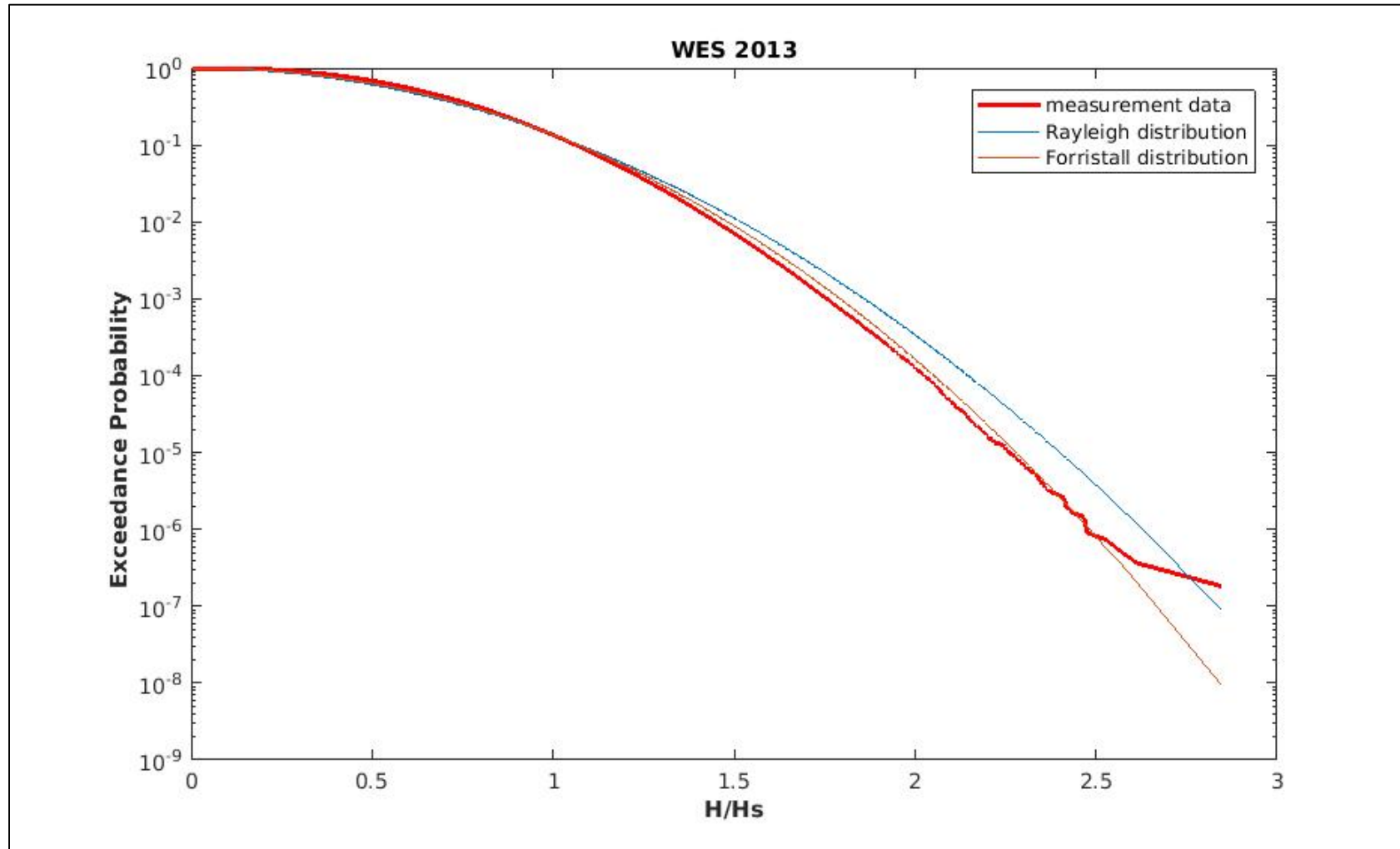
Relative number of rogue waves 2013



No. of records available



Weibull distribution $P(H > H_0) = \exp(-(x/a)^c)$

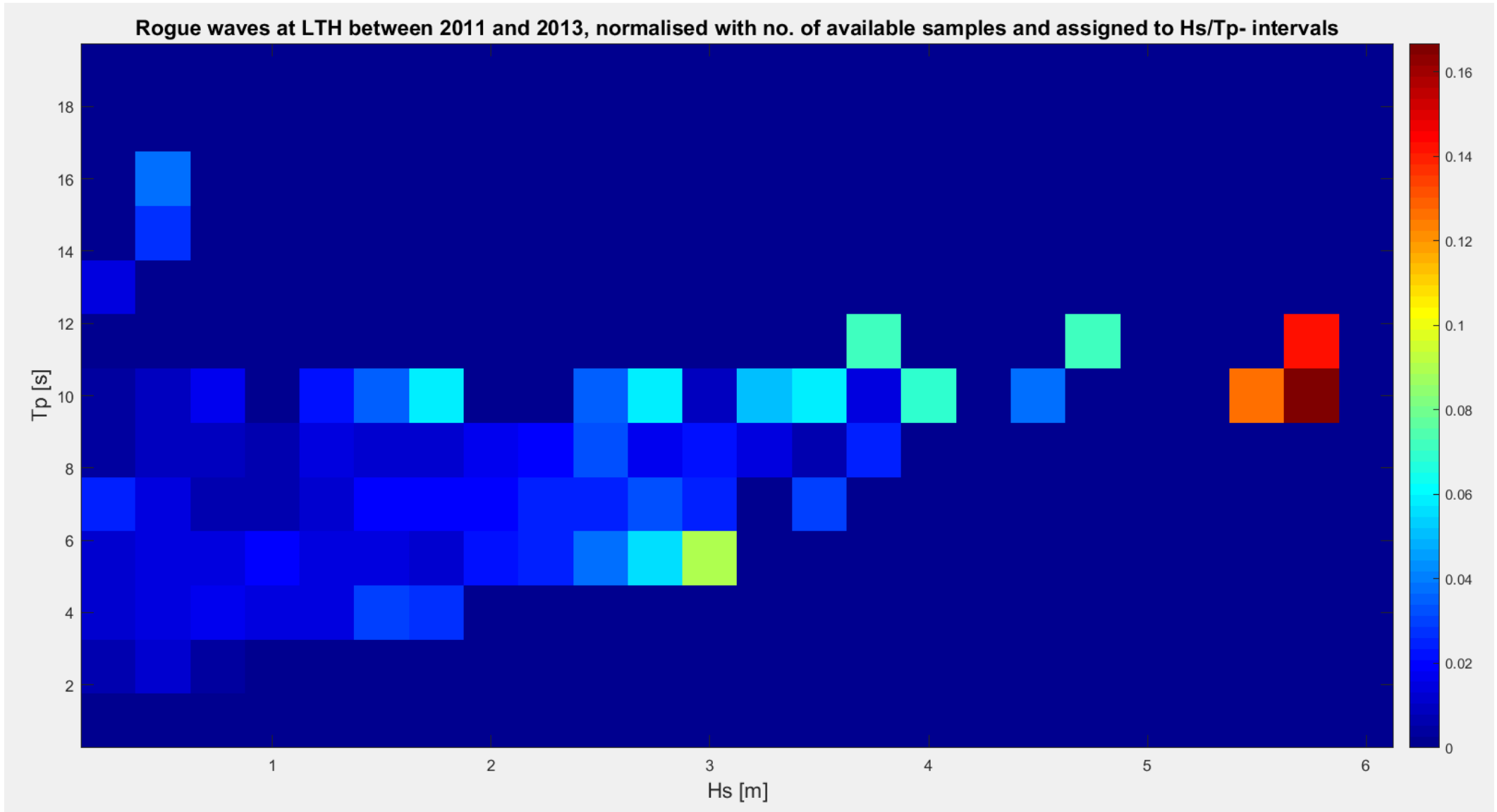


Rayleigh distribution: Applied by Longuet-Higgins [1952]; $a=1/\sqrt{2}$; $c=2$

Forristall [1978] distribution: Weibull distribution with empirical parameters; $a=0.7218$; $c=2.126$

MEASUREMENT RESULTS

Wave Heights and Periods

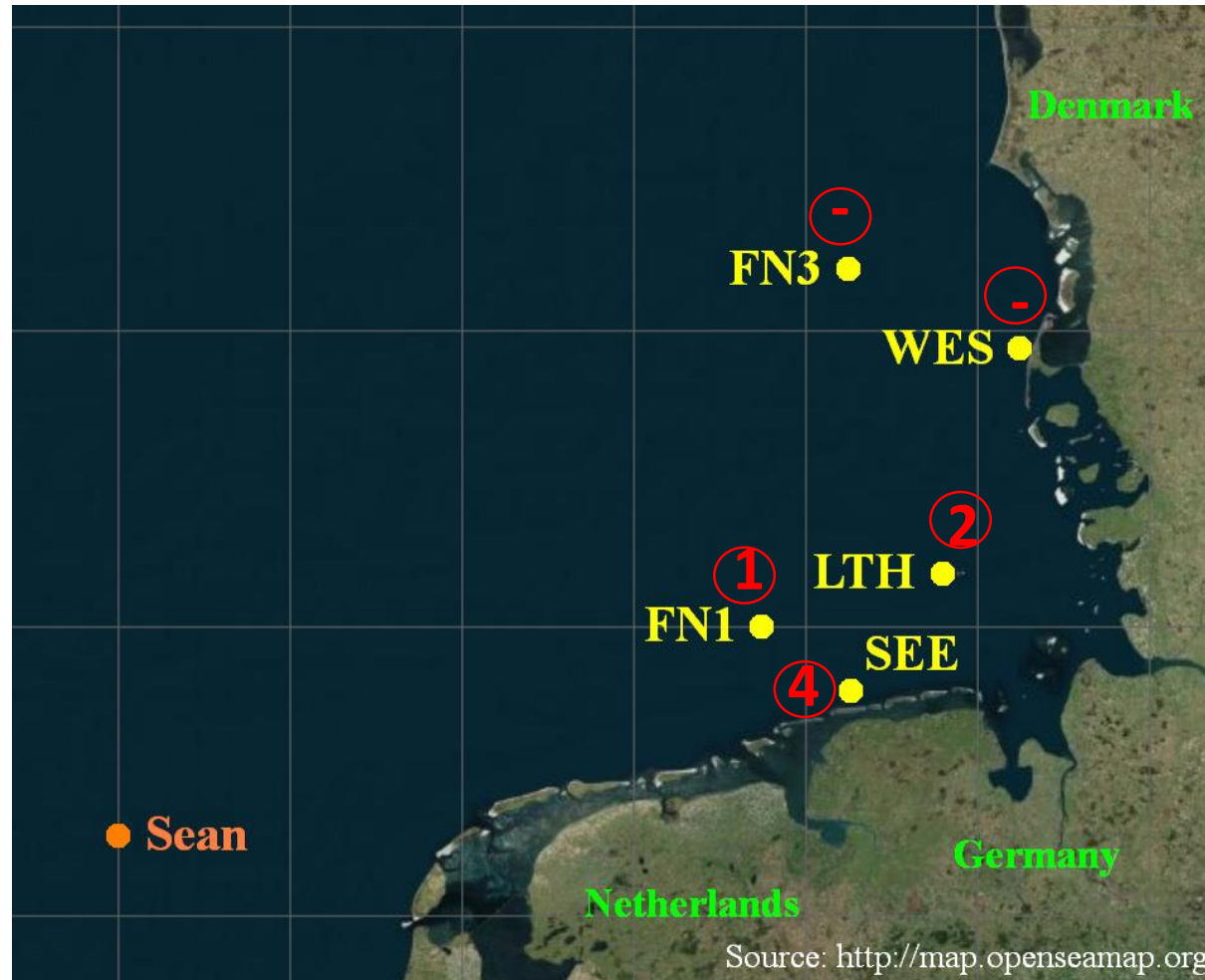


MEASUREMENT RESULTS

Rogue Days

Example: 2011-11-27.

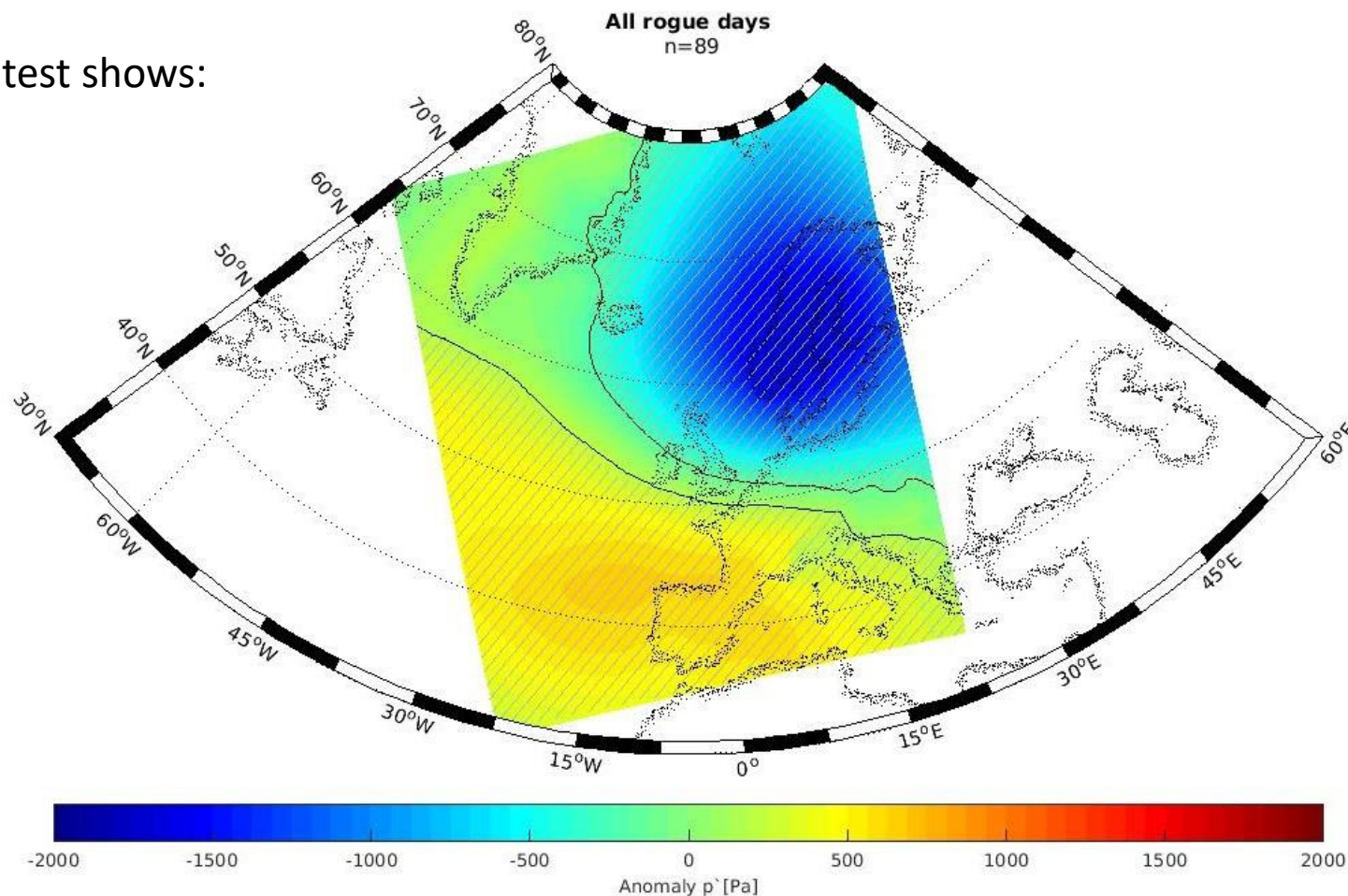
Waves in the 95th percentile of H_S :



Are rogue days related to a specific weather pattern?

Null hypothesis: The mean pressure field on a ROGUE DAY does **not** differ from the long-term mean.

A t test shows:

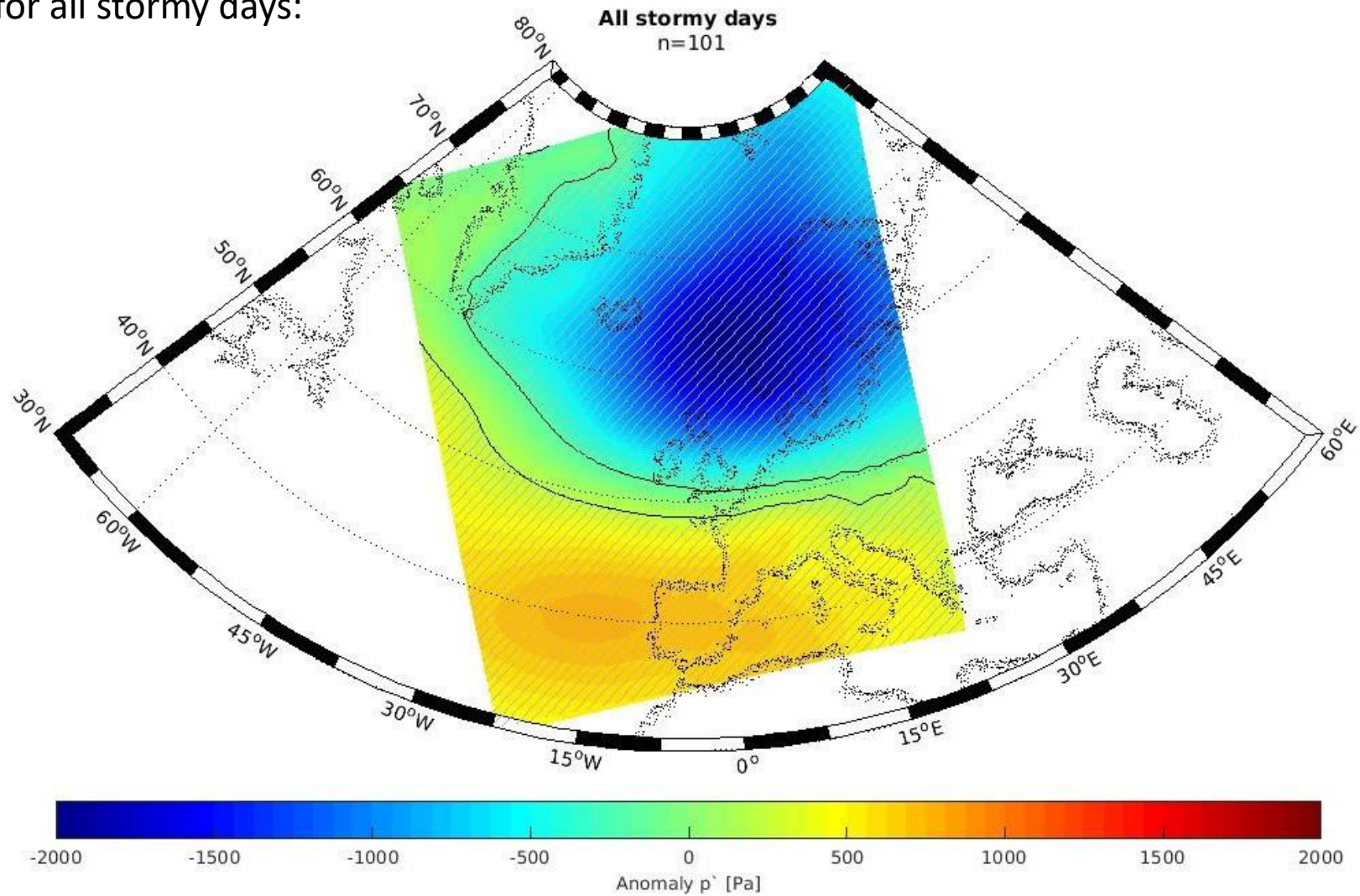


Null hypothesis rejected.

MEASUREMENT RESULTS

Weather Patterns

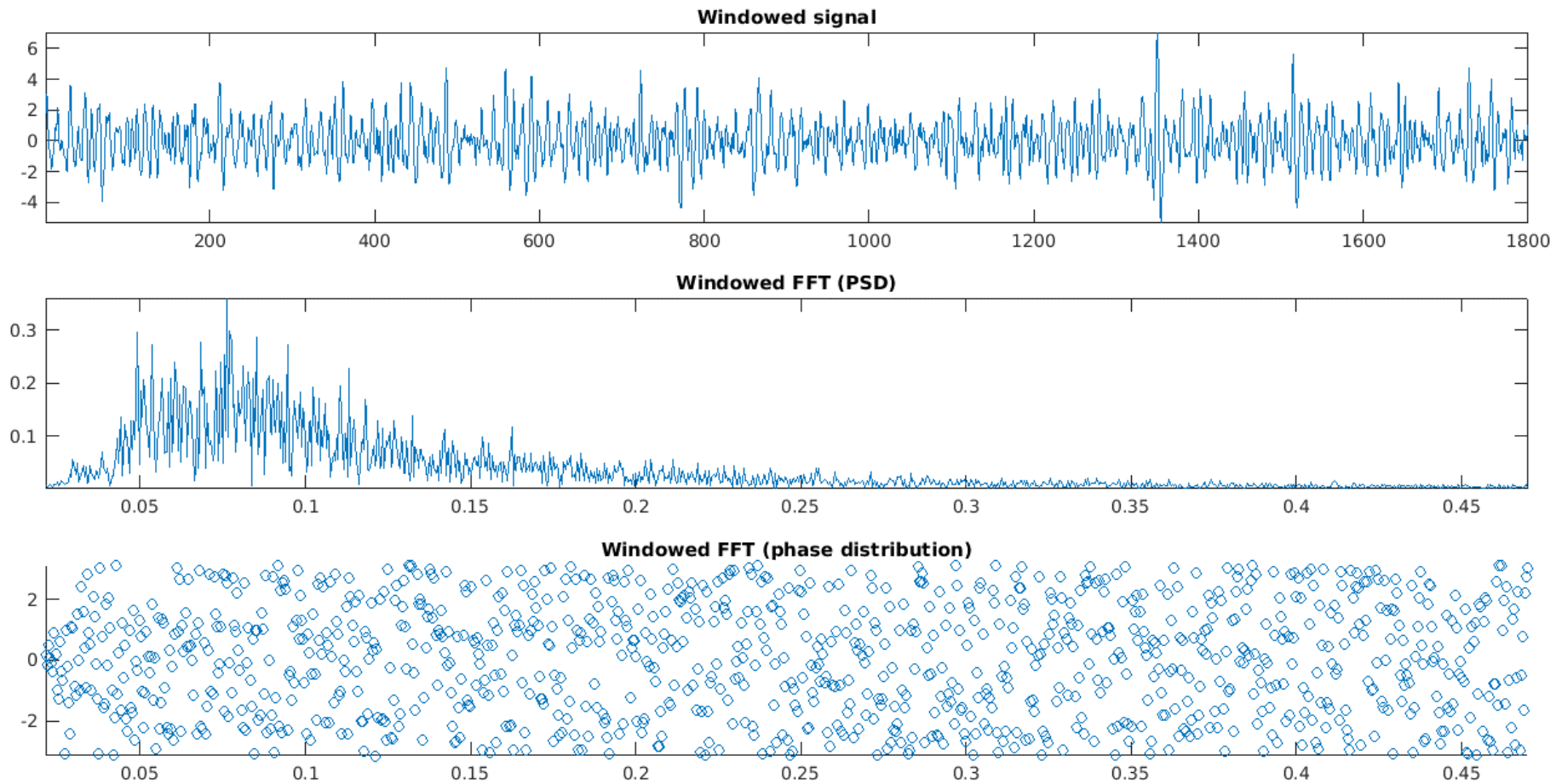
t test for all stormy days:



CHANGES IN THE SPECTRUM?

Phase distribution

Is the phase near a rogue wave randomly distributed?



CHANGES IN THE SPECTRUM?

Phase distribution

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