APPENDIX F: Maps Of Indicative Offshore Extremes in Significant Wave Height

F1. Introduction

On the next 4 pages maps of *indicative* extremes in offshore significant wave height are presented. They have been generated from ERS-1, ERS-2 and TOPEX-Poseidon significant wave height data, and cover the period October 1992 to September 1998. Significant wave height data from each altimeter have been extracted, quality controlled and separately calibrated according to linear corrections given in Cotton., 1998 (see Appendix E). These data have then been combined together to generate monthly means and variances on a 1¡ latitude by 2¡ longitude global grid. The monthly values (means and variance) have then been combined into seasonal, annual and multi-annual values.

F2. Analysis Procedure

The statistical analysis assumes that the gridded altimeter significant wave height data fit a Fisher-Tippett type 1 distribution. The mean and variance (*VAR*) of the gridded data were then used to generate the FT-1 α and β parameters, for each grid square, as follows:

$$\beta = (6^{0.5} / \pi) \,.\, VAR^{0.5} \quad (1)$$

$$\gamma = 0.5772 \text{ (euler's const)} \quad (2)$$

$$\alpha = \text{mean} - (\gamma . \beta) \quad (3)$$

These α and β parameters were then used to calculate exceedance probabilities (i.e. the probability that significant wave height measurement would exceed a certain significant wave height threshold, *Xlim* (eqn. 4).

Exceedance probability, P

$$P(x > Xlim) = 1 - \exp(-\exp(-(Xlim - \alpha)/\beta)) \quad (4)$$

The α and β parameters were also used to generate estimates of return values (x) for significant wave heights for a given probability, P, eqn (5).

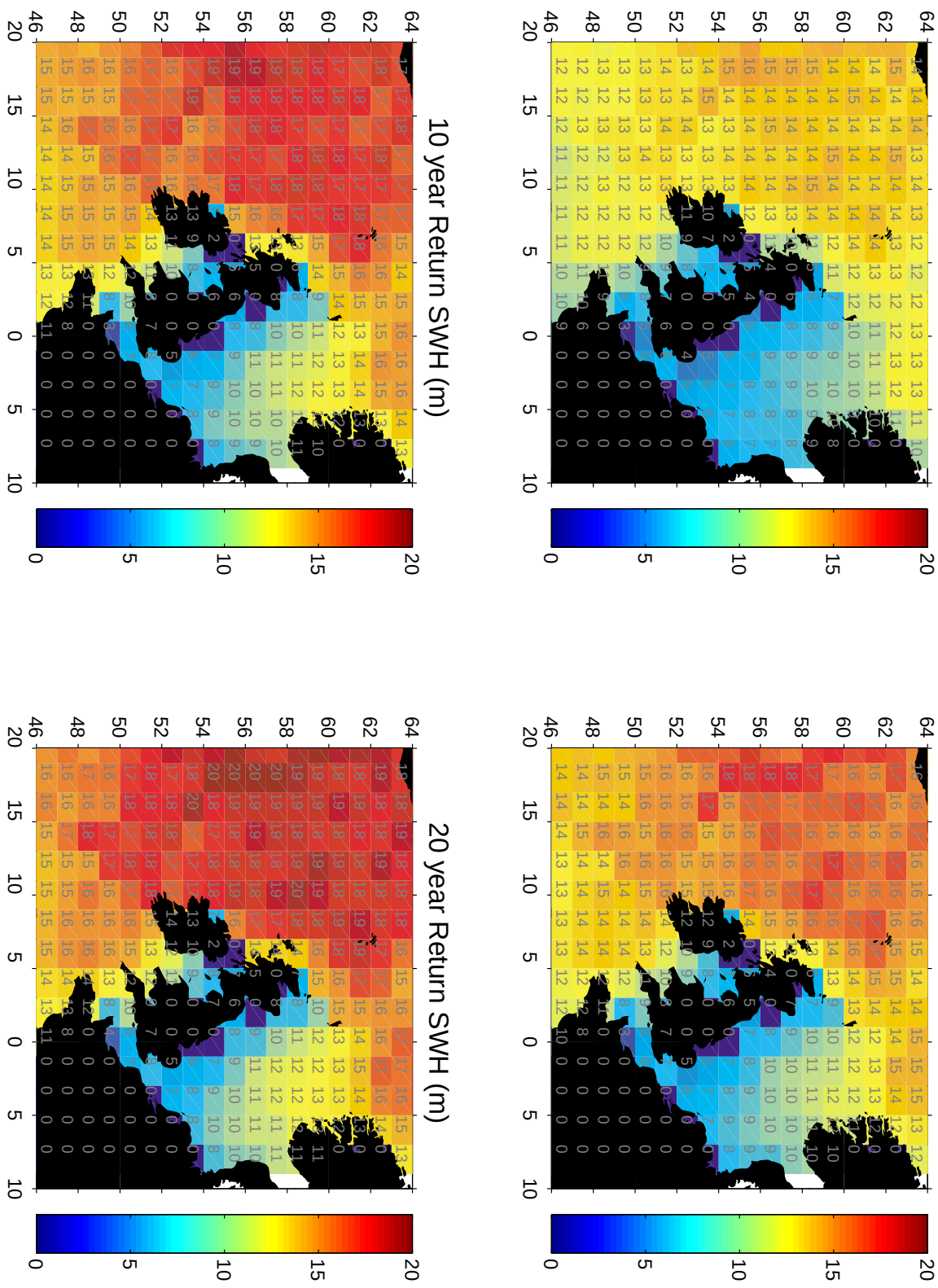
$$x = [(-\ln (-\ln (1-P))). \beta] + \alpha \quad (5)$$

e.g the probability of a one in a hundred year wave in a three hourly sampled data set (three hours is taken as the time between independent values of significant wave height at any given location), P_{100} is given by

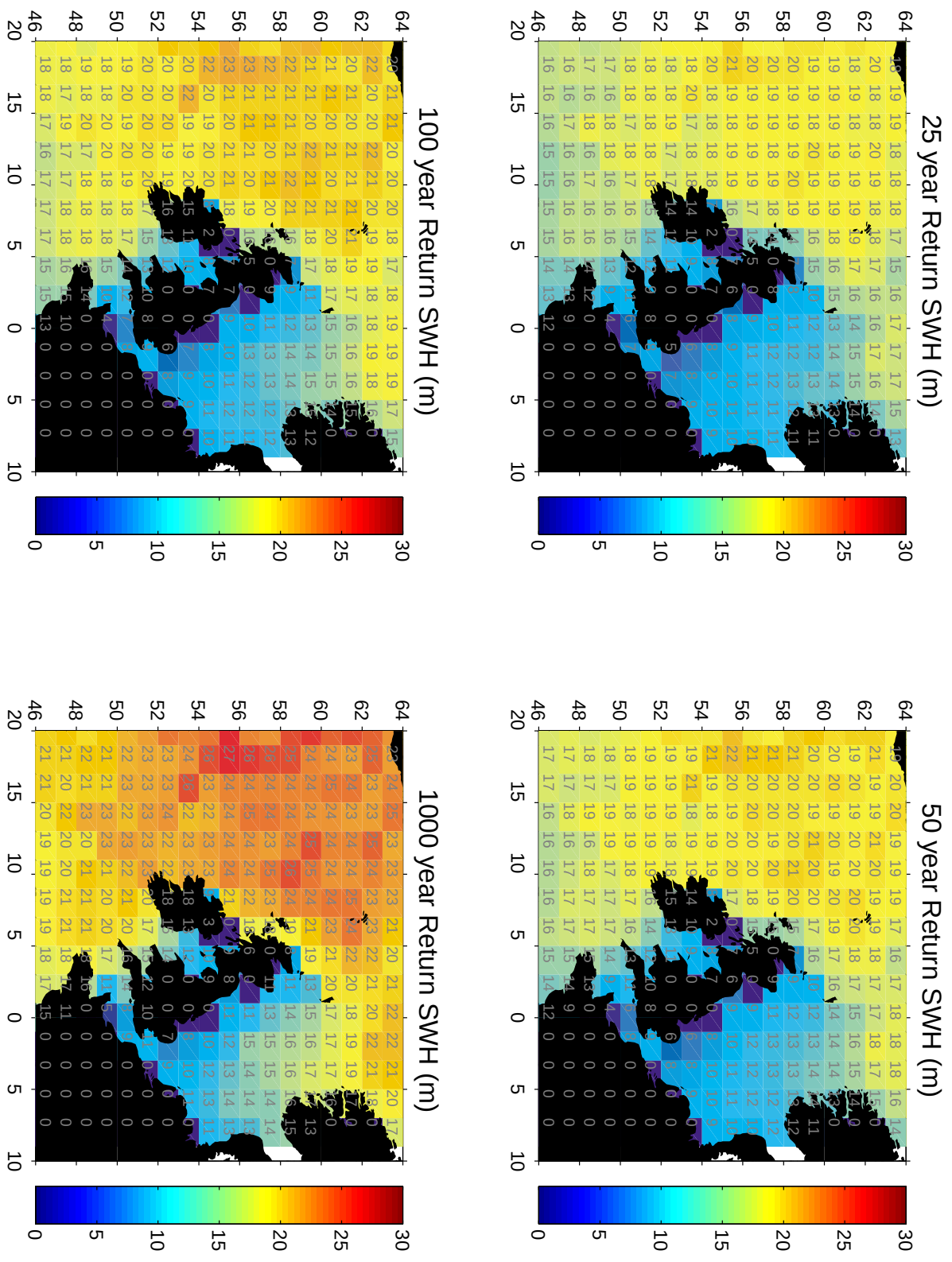
$$P_{100} = 1/ (8 \times 365 \times 100) \quad (6)$$

Thus it is now possible to generate maps on the 1¡ x 2¡ UK grid of exceedance probabilities for any selected value of significant wave height, by season or year. Similarly one can map return values for any selected probability. The figures on following pages represent a subset of such maps . When viewing such maps one should always bear in mind the assumptions that have been made in the calculations. Also, although we have generated the maps at the highest spatial resolution that is possible, given the satellite sampling, it is clear that some grid squares cover regions that will contain a widely varying wave climate. One should also remember that these estimates have been derived for the *offshore* wave climate (more than 30 km from the coast). Thus these are *indicative* maps, because they are based on certain assumptions as to the nature of the distribution of significant wave heights in this region, and then generated by applying a generic function to all the data. A true map of extremes would require more careful and thorough analysis of the distribution of the data in a series of representative locations on the map grid.

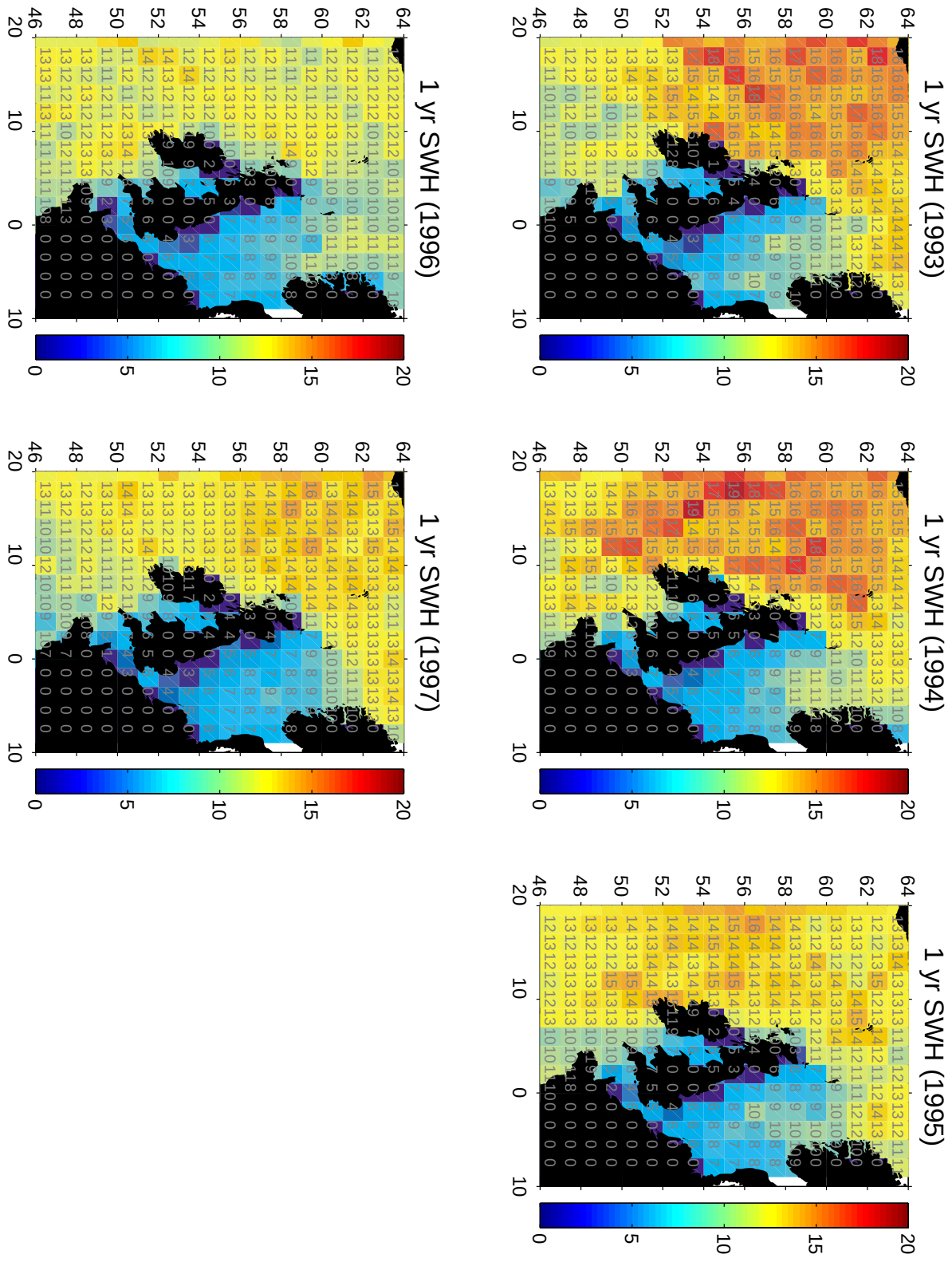
Nonetheless, spot checks against reliable references (e.g. the HSE Guidance Notes), suggests that the values presented in this appendix provide a good indication of expected return values and probability exceedances.



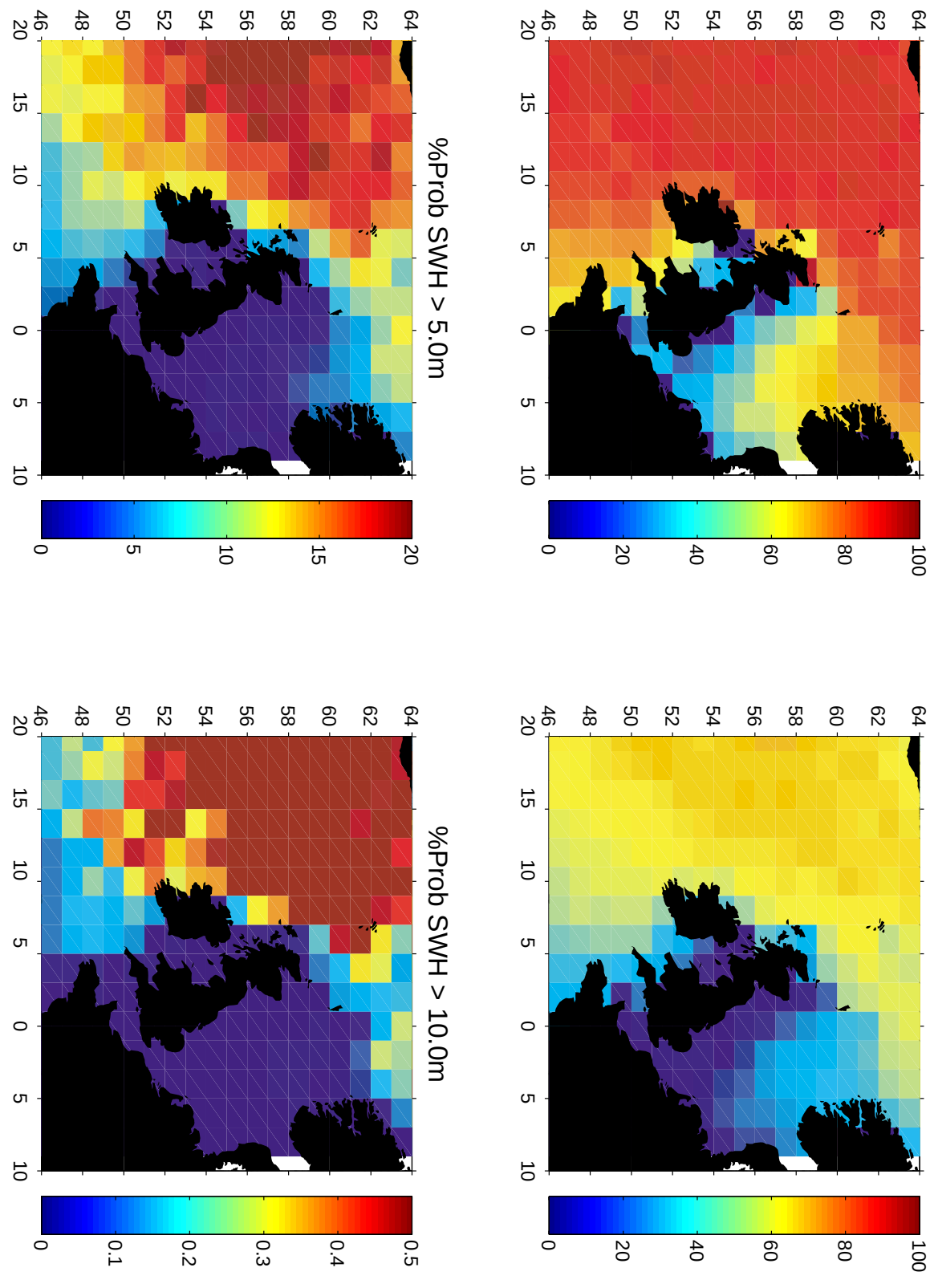
.Figure F1. Return values of significant wave height (m), derived from the mean and variance values (see text) over the years 1993-97. Top left - 1 year return value, top right 5 year, bottom left 10 year, bottom right 20 year.



.Figure F2. Return values of significant wave height (m), derived from the mean and variance values (see text) over the years 1993-97. Top left - 25 year return value, top right 50 year, bottom left 100 year, bottom right 1000 year.



.Figure F3. 1 year return values of significant wave height (m) derived separately for each of the years 1993-97



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.Figure F4. Percentage probabilities that a sample measure of significant wave height will exceed a given threshold, derived from the mean and variance values (see text) over the years 1993-97. Top left — threshold is 1.5 m, top right 2.5 m, bottom left 5 m, bottom right 10 m.