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Scottish Universities Research & Reactor Centre

AN AIRBORNE GAMMA RAY SURVEY OF THE DUDDON ESTUARY IN FEBRUARY 1993.

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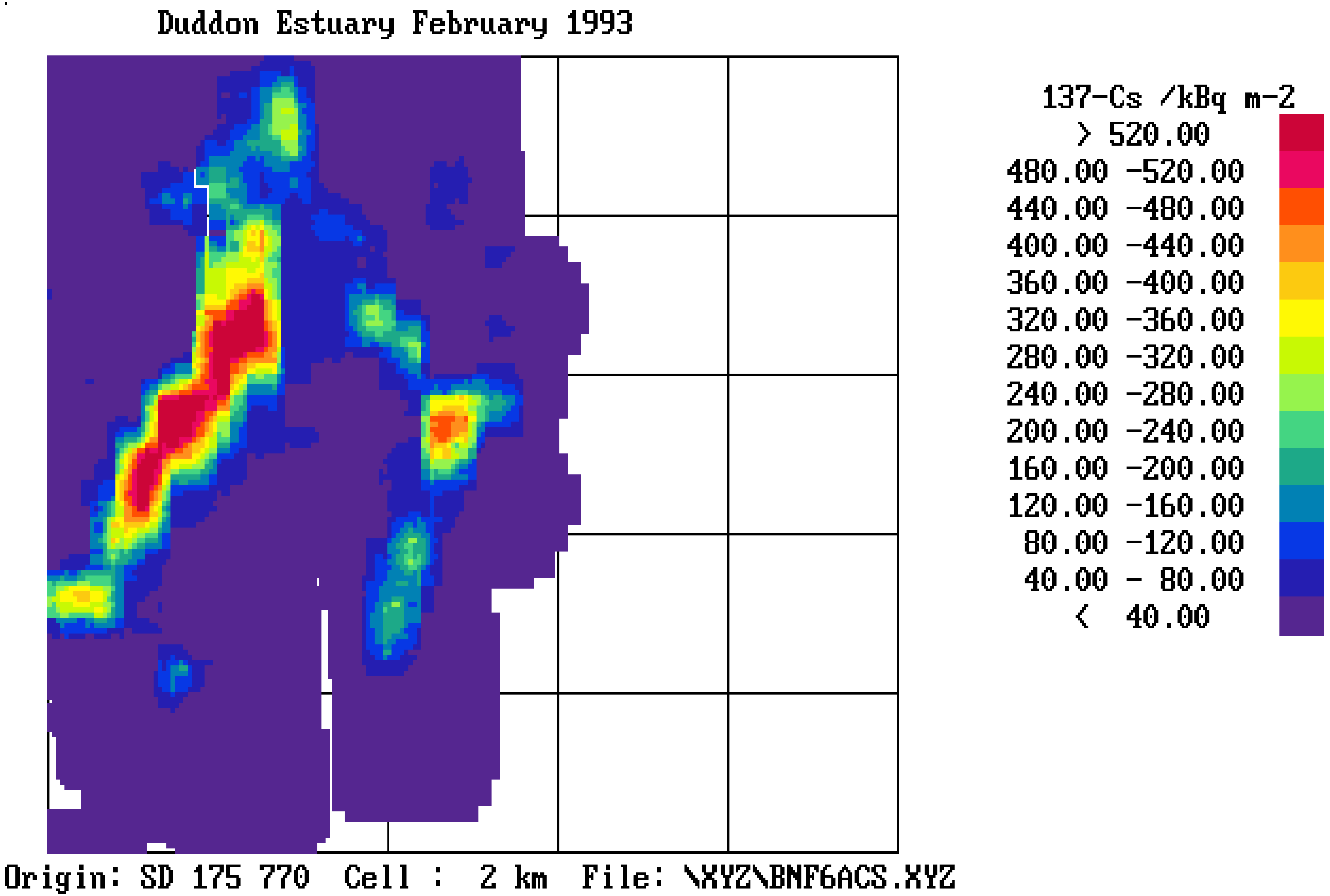
SUMMARY

A short aerial survey was conducted of the Duddon Estuary, as a supplementary task to an emergency response exercise, conducted by SURRC on behalf of BNFL, around Chapelcross and Sellafield on 25th February 1993. An 8 litre NaI detector was operated from an AS355B Twin Squirrel helicopter. Gamma ray spectra were recorded every 5 seconds, together with radioaltimetry results and GPS positional information. Flight lines were arranged in a North-South direction with nominal spacing of 300m, from OS westings OS SD 180 to 229. Navigation was conducted using per-programmed GPS waypoints.

The survey flight lasted for 1.3 hours during which time 766 spectra were recorded. The results were backed up, summarised, and calibrated following standard SURRC procedures. This entails subtraction of detector background, stripping of channel interferences, correction for altitude variations, and scaling to calibrated results from a reference site. The effect of utilising previous, or more recent stripping matrices was investigated, and shown to have a minor influence on stripped count rates. The calibration constants for ^{137}Cs were defined to produce a correct inventory estimation at survey heights for the Caerlaverock calibration site (80 kBq m^{-2}), which had been visited the previous day with the same aircraft. Previous working calibration factors had underestimated the inventory at Caerlaverock (Sanderson et al, 1992), due essentially to the differing extent of source burial between inland sites affected by fallout of varying ages, and the merse environment. In the absence of more detailed investigation of the vertical activity profile at Duddon, the working maps have been produced to match the Caerlaverock profile. We have subsequently established that the calibration response in the Ribble at Warton Bank, is also compatible with this condition. The extent to which vertical profiles vary from marsh to marsh around the eastern Irish Sea remains to be seen. Working calibration values for natural nuclides were retained from previous work, and provide estimates of the activity per unit area from 0-30cm depth for these nuclides.

Maps of the distribution of ^{137}Cs, ^{40}K, ^{214}Bi, ^{208}Tl and estimated gamma dose rate were produced on the 25th March, and stored as image bit maps. These are appended to this brief report. The distribution of ^{137}Cs on estuarine and marsh areas is clearly defined, the greatest concentrations largely following the salt marsh boundaries. It is possible that spatially small scale features in the upper reaches of the river may also show similar concentrations, but would be under-represented within the field of view of the detector. The gamma dose rate map indicates that Cs contamination is a controlling dose contributor to these contexts. The natural sources also show considerable variations, reflecting the local geological and geomorphological structures. It is notable that the ^{214}Bi map shows an anomaly in the vicinity of Millom. Since ^{214}Bi is a radon daughter this signal may have a dynamic component. Alternatively the signals may originate from industrial or mining wastes in the area. It would nonetheless be of interest to identify the origins of this source at ground level, and to examine the levels of radon in the vicinity. It is hoped that these results may be of use in assisting ground sampling. Retrospective calibration would be possible if better knowledge of the vertical activity distribution became available. The data could also be re-mapped in finer detail if required.



Duddon Estuary February 1993
137-Cs /kBq m-2
> 520.00
480.00 -520.00
440.00 -480.00
400.00 -440.00
360.00 -400.00
320.00 -360.00
280.00 -320.00
240.00 -280.00
200.00 -240.00
160.00 -200.00
120.00 -160.00
80.00 -120.00
40.00 - 80.00
< 40.00
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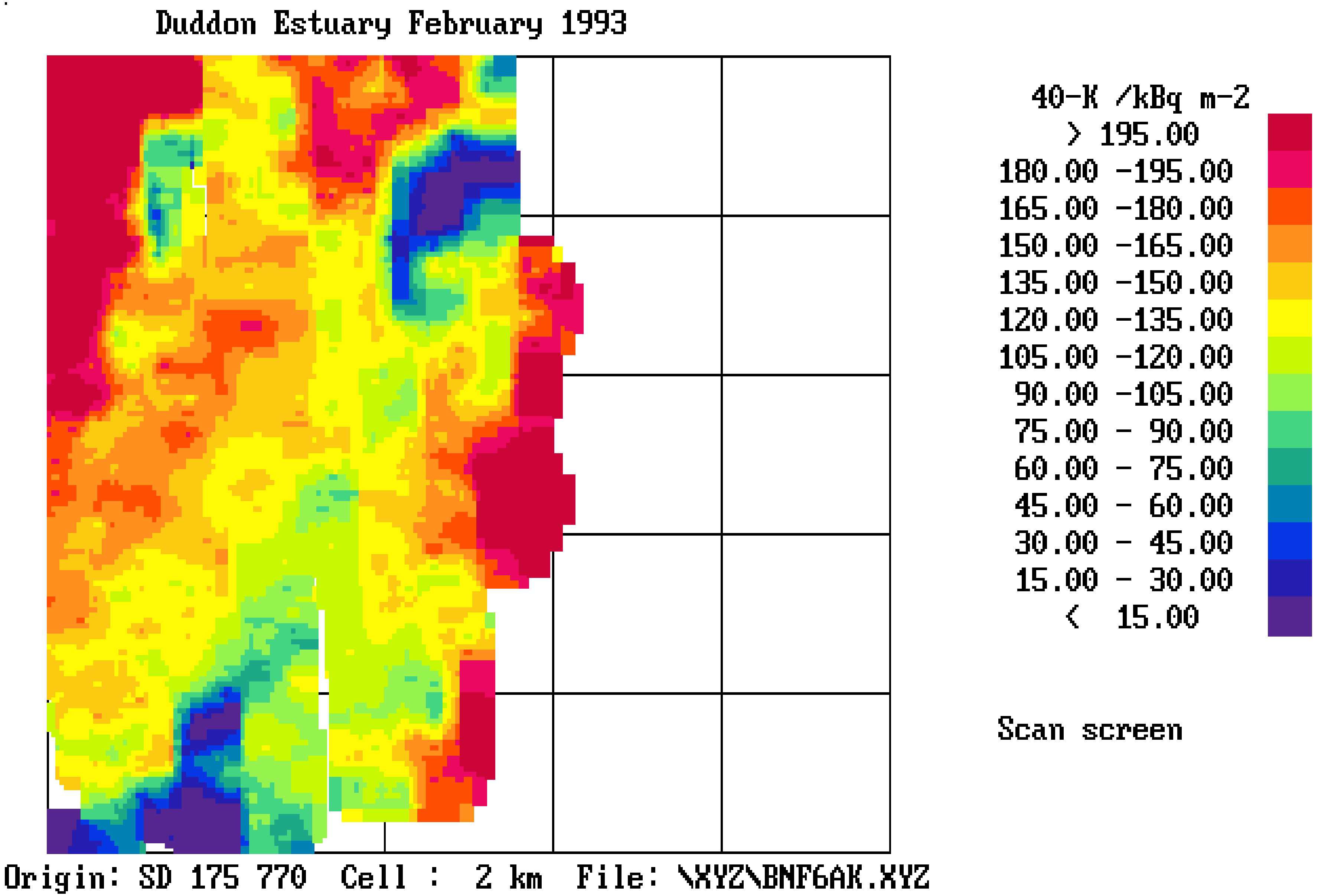
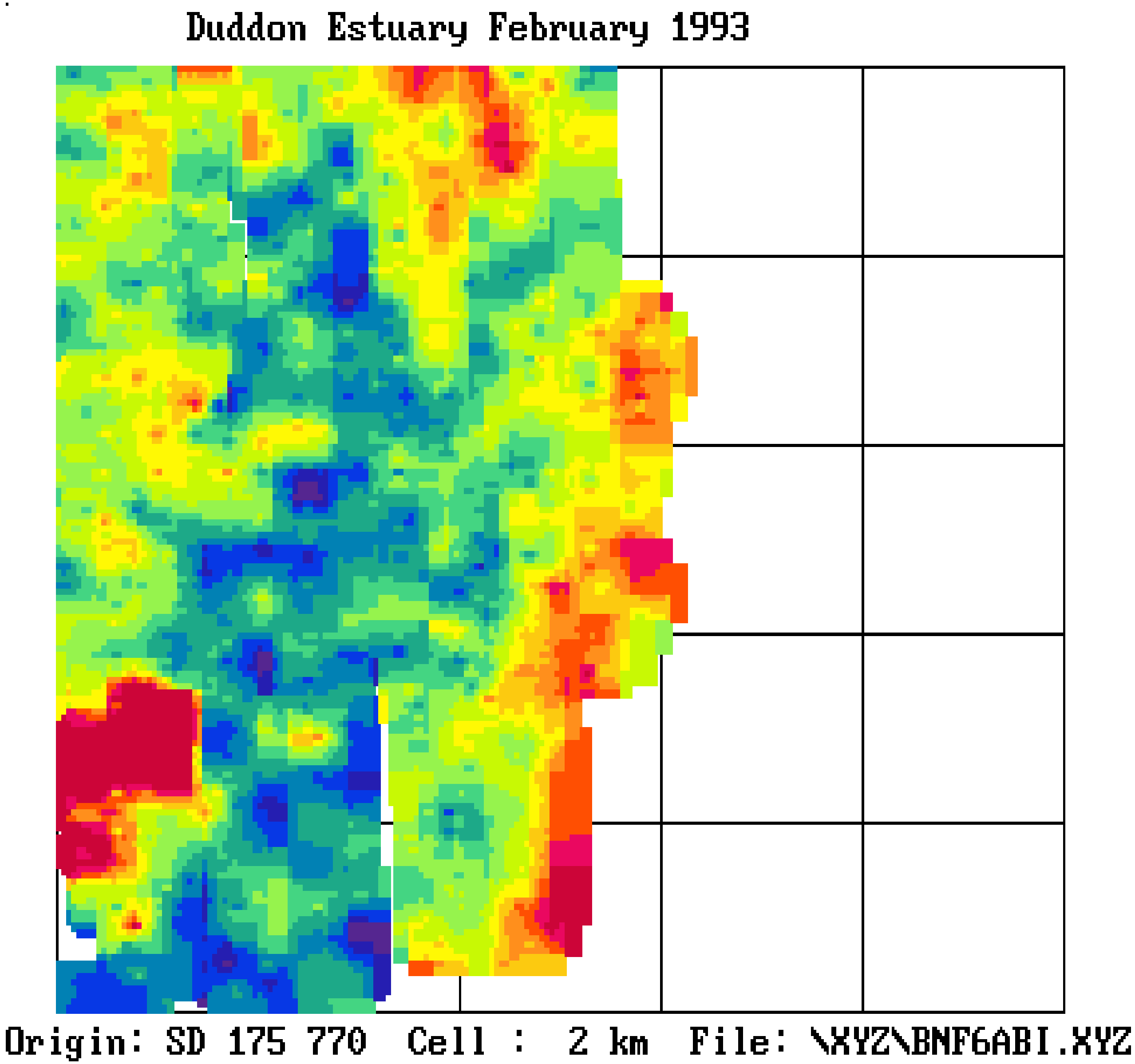
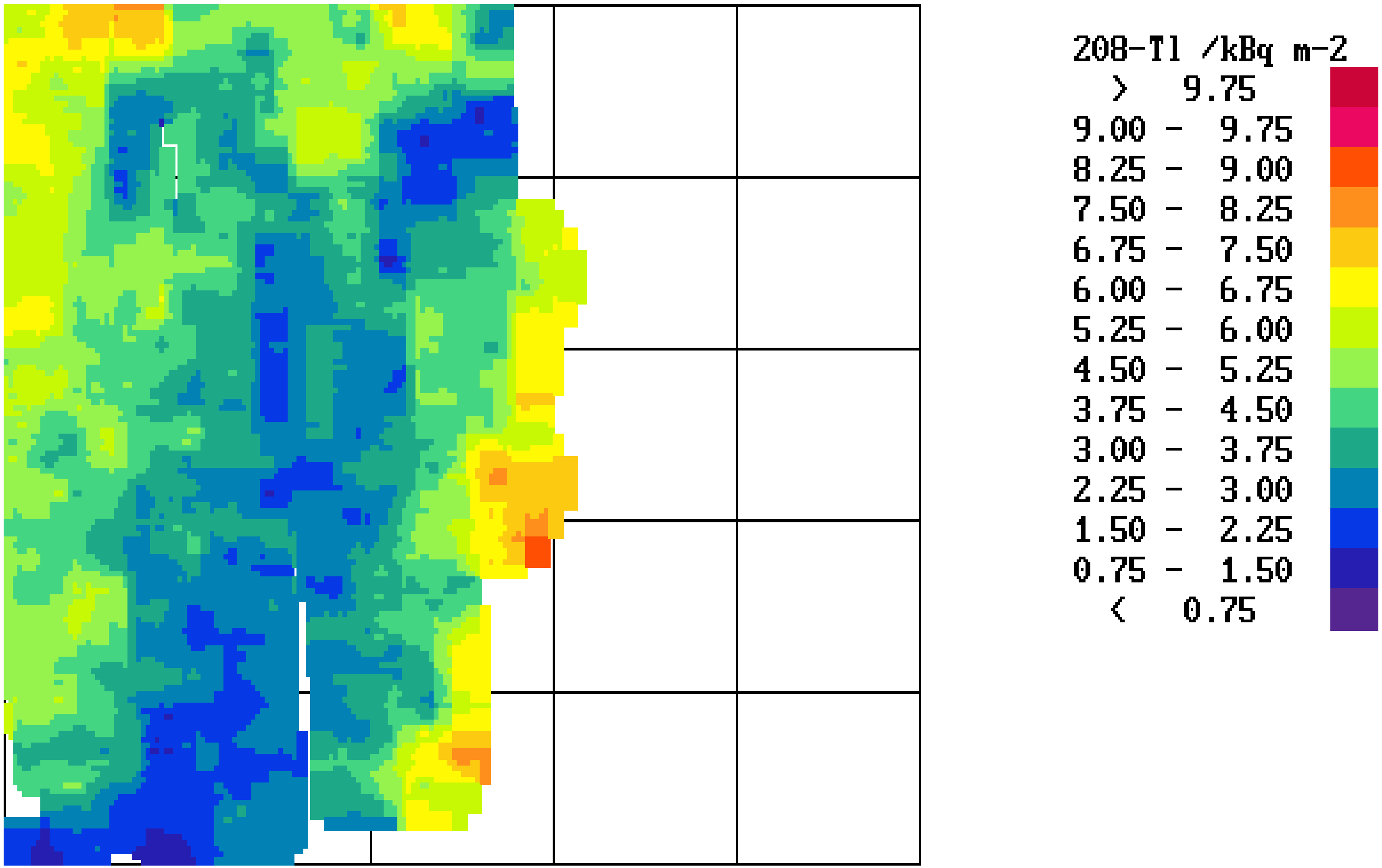


Duddon Estuary February 1993
40-K /kBq m-2
> 195.00
180.00 -195.00
165.00 -180.00
150.00 -165.00
135.00 -150.00
120.00 -135.00
105.00 -120.00
90.00 -105.00
75.00 - 90.00
60.00 - 75.00
45.00 - 60.00
30.00 - 45.00
15.00 - 30.00
< 15.00
Scan screen
Origin: SD 175 770 Cell : 2 km File: \XYZ\BNF6AK.XYZ


Duddon Estuary February 1993
214-Bi /kBq m-2
> 9.75
9.00 - 9.75
8.25 - 9.00
7.50 - 8.25
6.75 - 7.50
6.00 - 6.75
5.25 - 6.00
4.50 - 5.25
3.75 - 4.50
3.00 - 3.75
2.25 - 3.00
1.50 - 2.25
0.75 - 1.50
< 0.75
Origin: SD 175 770 Cell : 2 km File: \XYZ\BNF6ABI.XYZ

Duddon Estuary Februarey 1993



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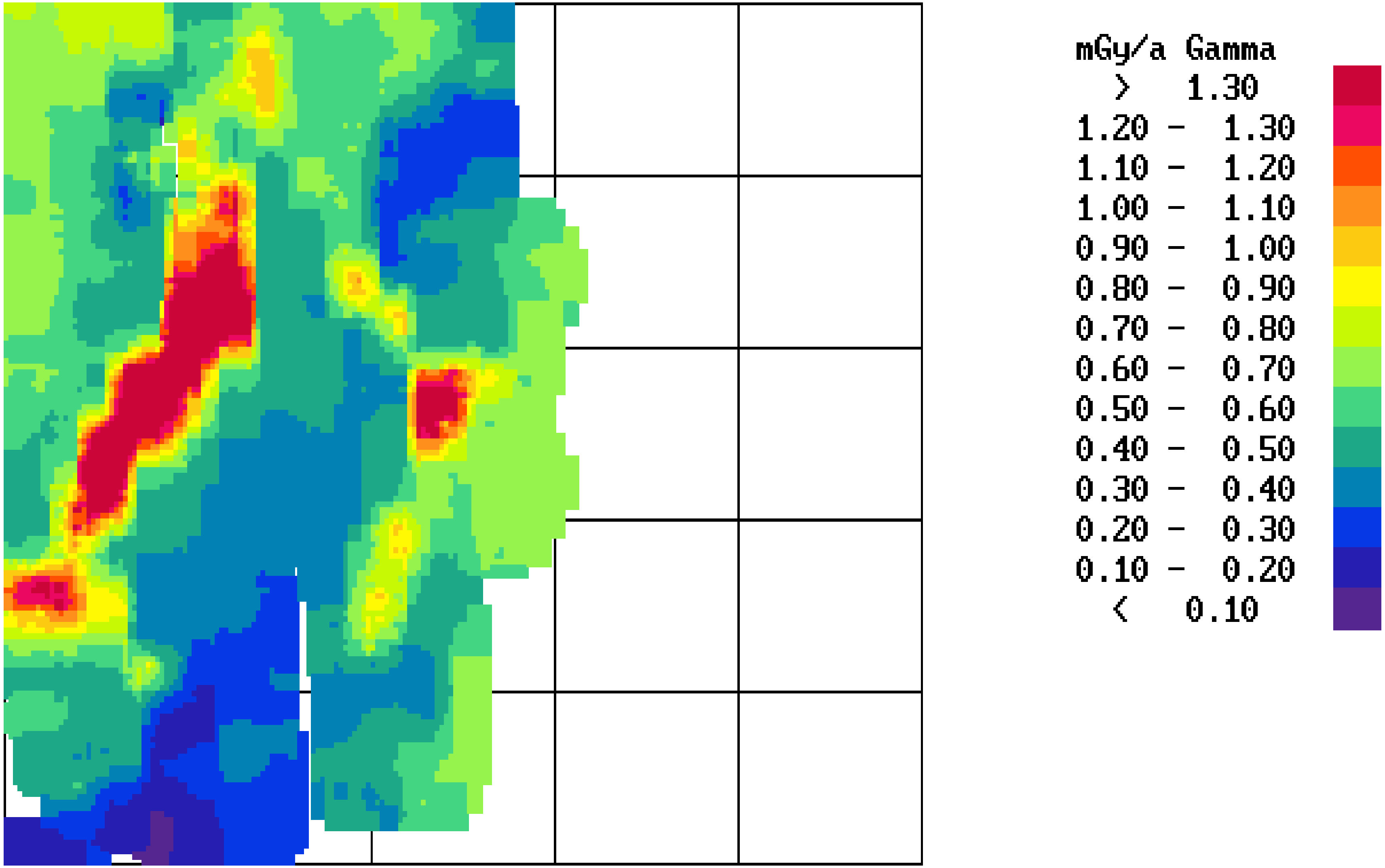
Duddon Estuary February 1993



Origin: SD 175 770 Cell : 2 km File: \XYZ\BNF6AGA.XYZ