forum for RENEWABLE ENERGY development in Scotland

Tidal Current Energy Conversion: Resource Issues

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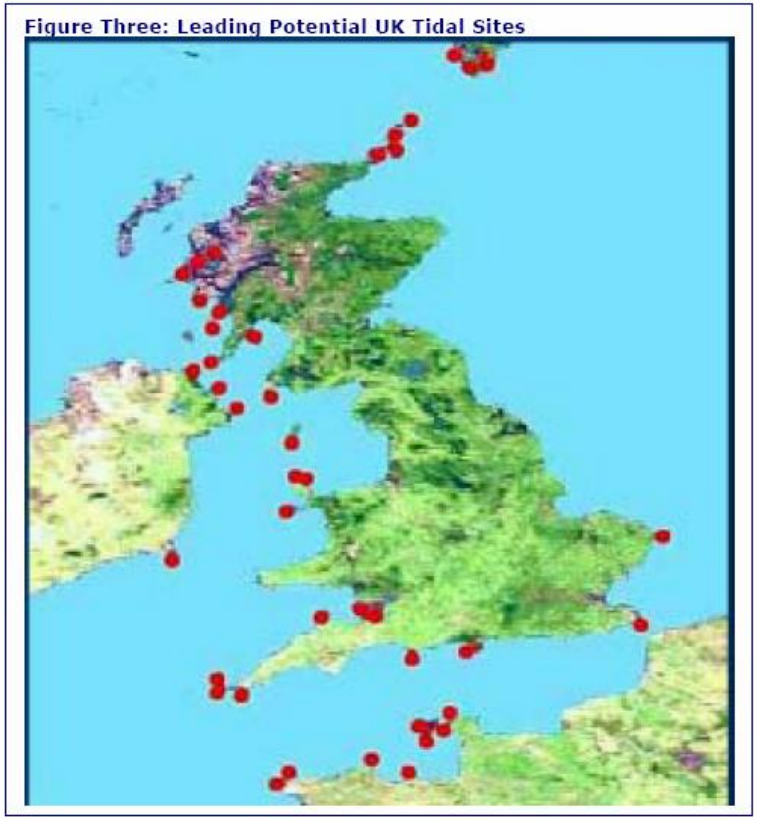
Resource Estimation in the FREDS(MEG) Report

- 10% of Scotland's electricity production can come from marine resources;
- we could see 1300 Megawatts of marine energy capacity installed in Scottish waters, increasing at a rate of 100MW per year;

Tidal Current

	2020 %	Rated MW	Annual Energy (GWh)
Pentland Firth	79%	1837	4827
Orkney	5%	115	303
Shetland	7%	153	403
West Highlands	3%	77	202
South West Scotland	7%	153	403
	100%	2336	6138

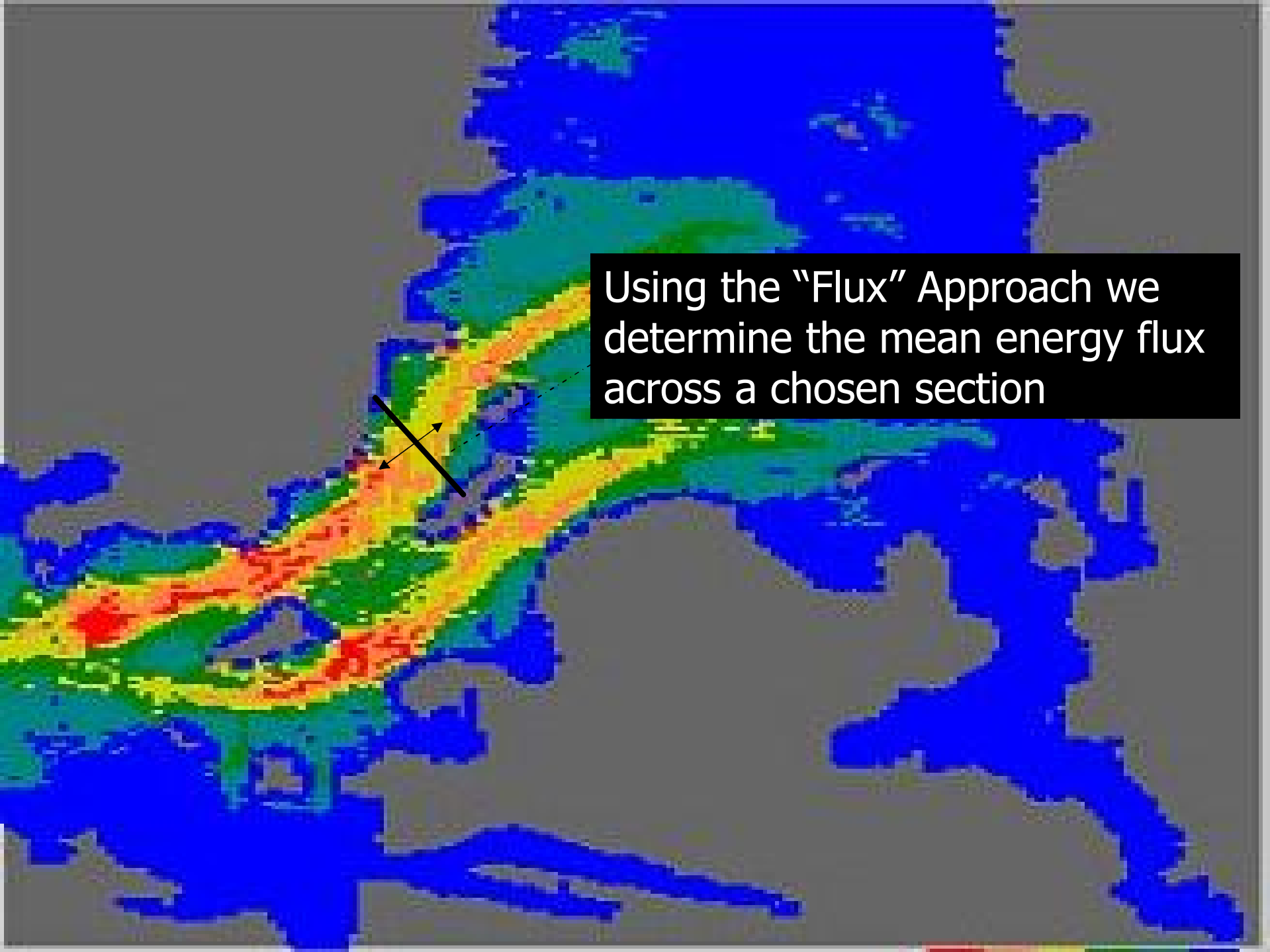


The “Old Approach”

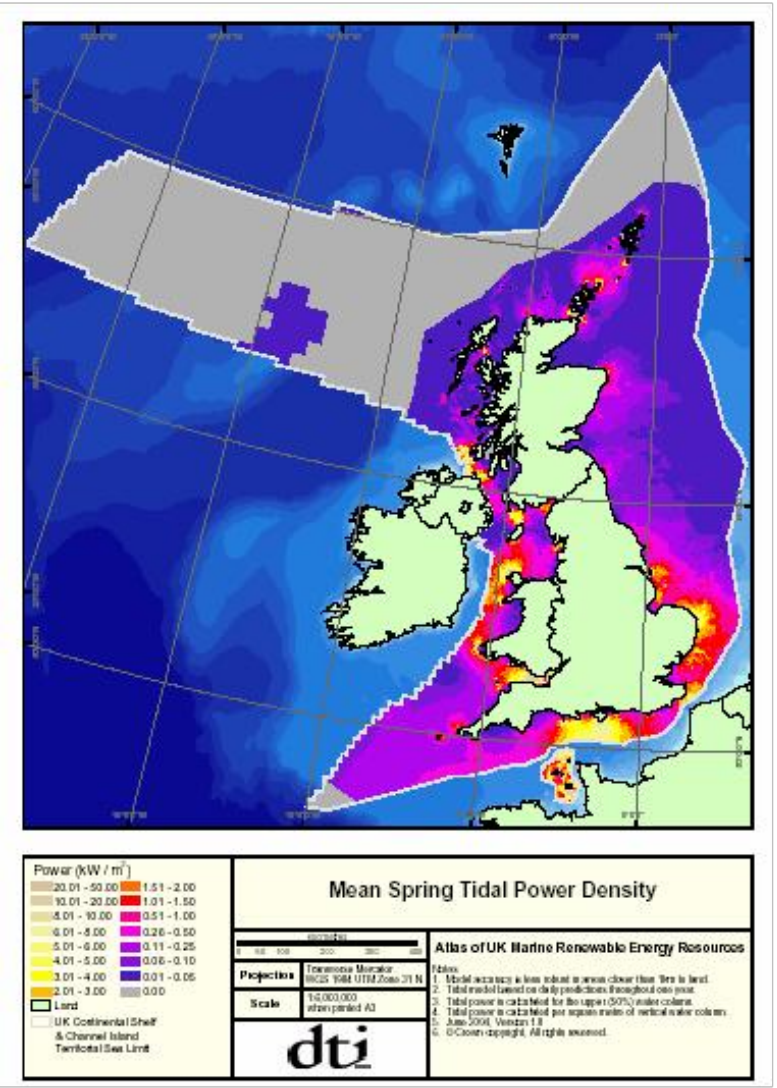
- Draw parallels with wind energy
- Express resource capacity in terms of MW/unit area
- This approach neglects the hydraulic nature of tidal currents and can easily suggest a resource capacity which exceeds 100% of the actual

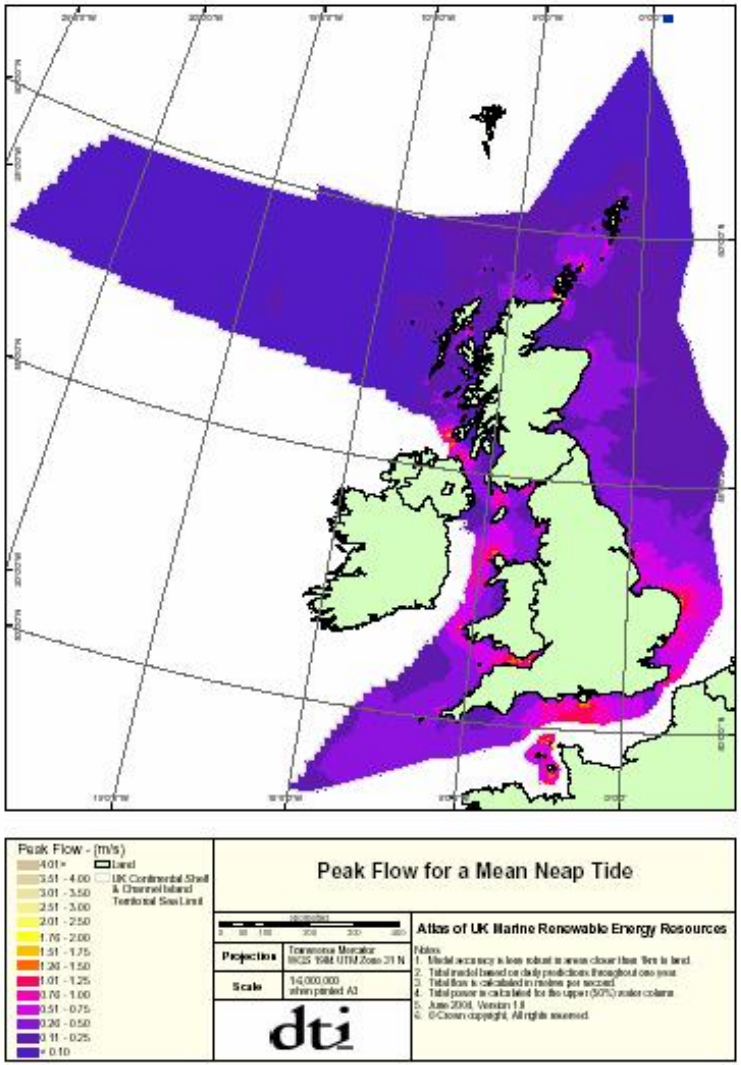
The “New Approach”

- Recognises that energy in tidal currents exists in the form of a flux of kinetic and potential energy
- Recognises that the “Raw” flux is, at best, a secondary indicator of resource capacity
- Potential of a site to deliver energy requires an understanding of the effective impedance of a channel or other location


Using the “Flux” Approach we determine the mean energy flux across a chosen section

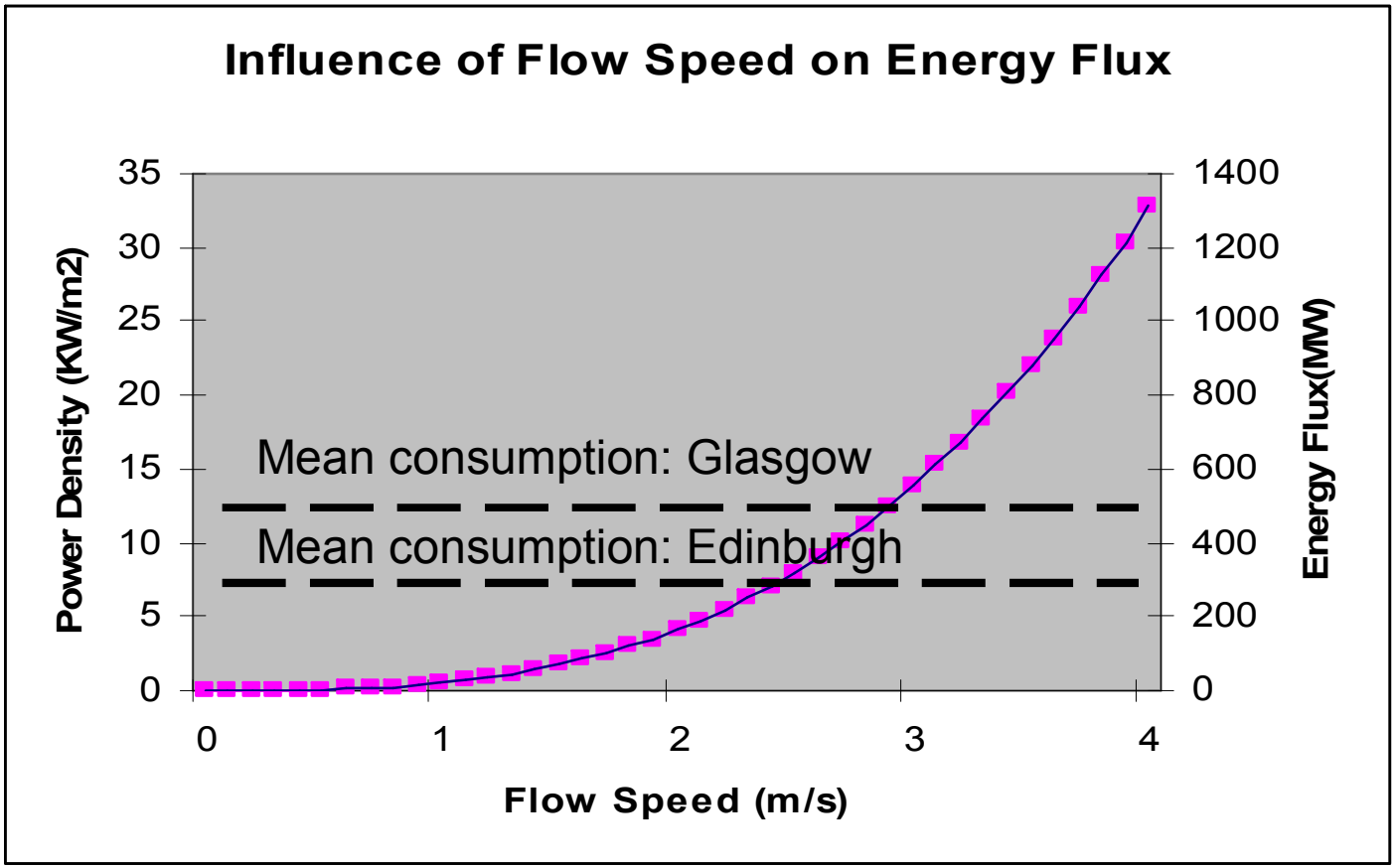
Tidal Current Energy Flux Density





Influence of Flow Speed on Energy Flux in a Simple Channel

Channel Width	1000m
Channel Depth	40m



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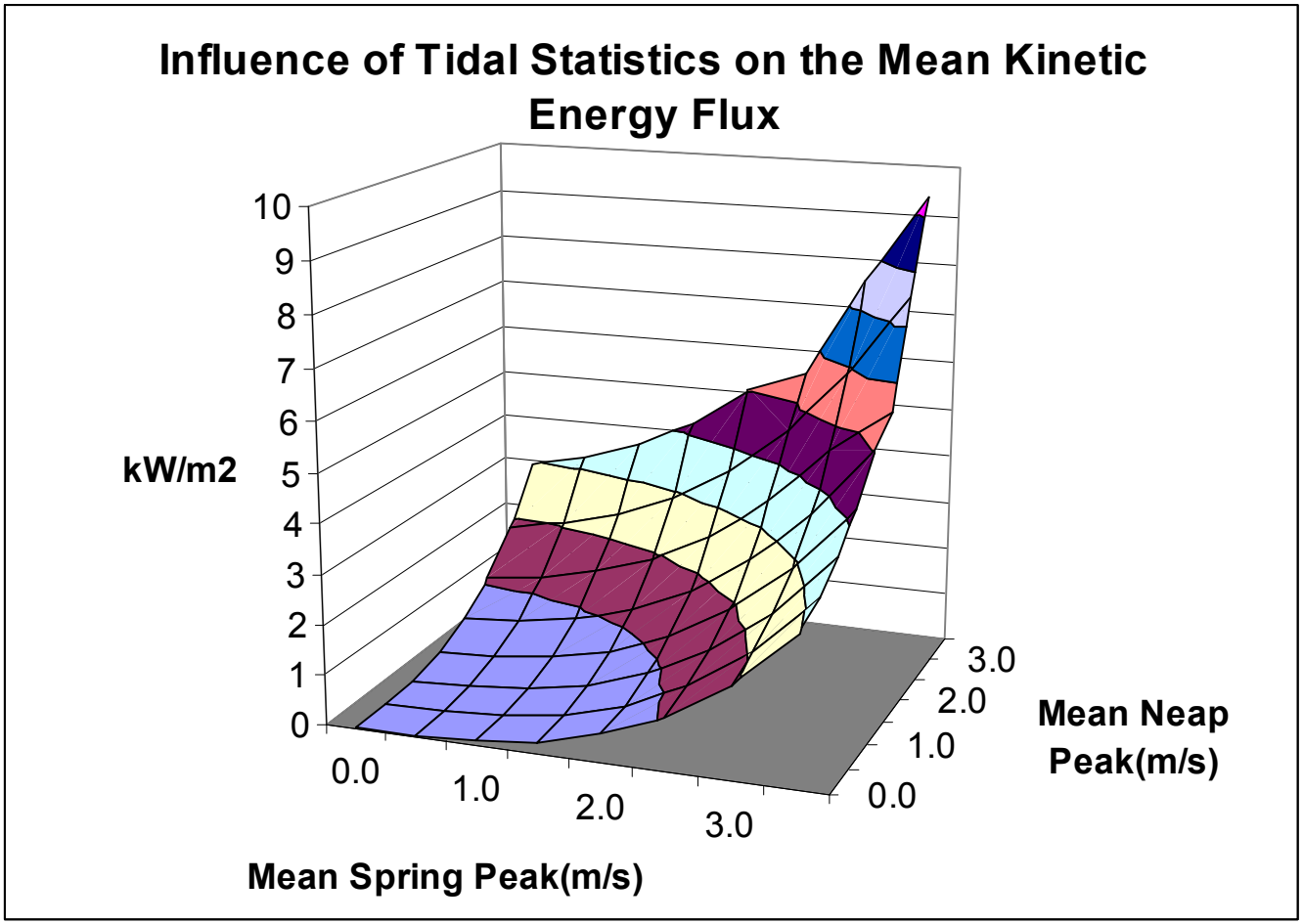
But:Influence of Flow Statistics



Obviously vital that the full tidal statistics are considered and not just the spring peak!

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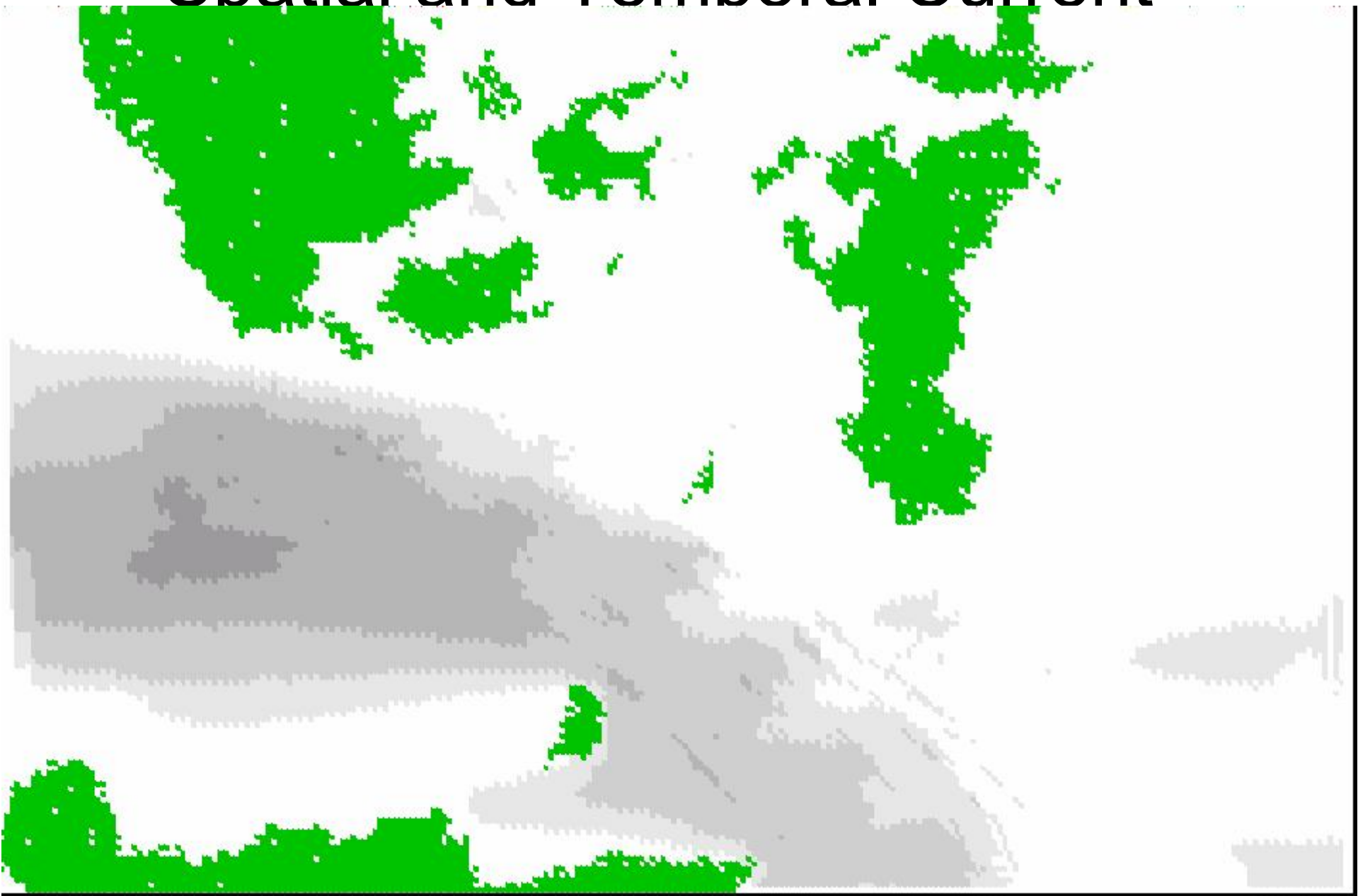
Assessment of Energy Flux at a Site Level

- Necessary to consider temporal variation over the semi-diurnal and spring/neap cycles
- Also necessary to consider the variation in current flow spatially
- In some sites, “Energy Hot Spots” may move between flood and ebb tides
- Need to identify regions of spatial stability for device installation

Spatial and Temporal Current

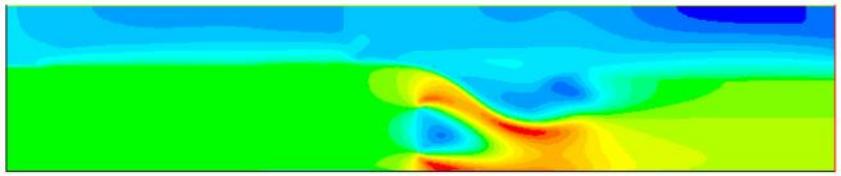


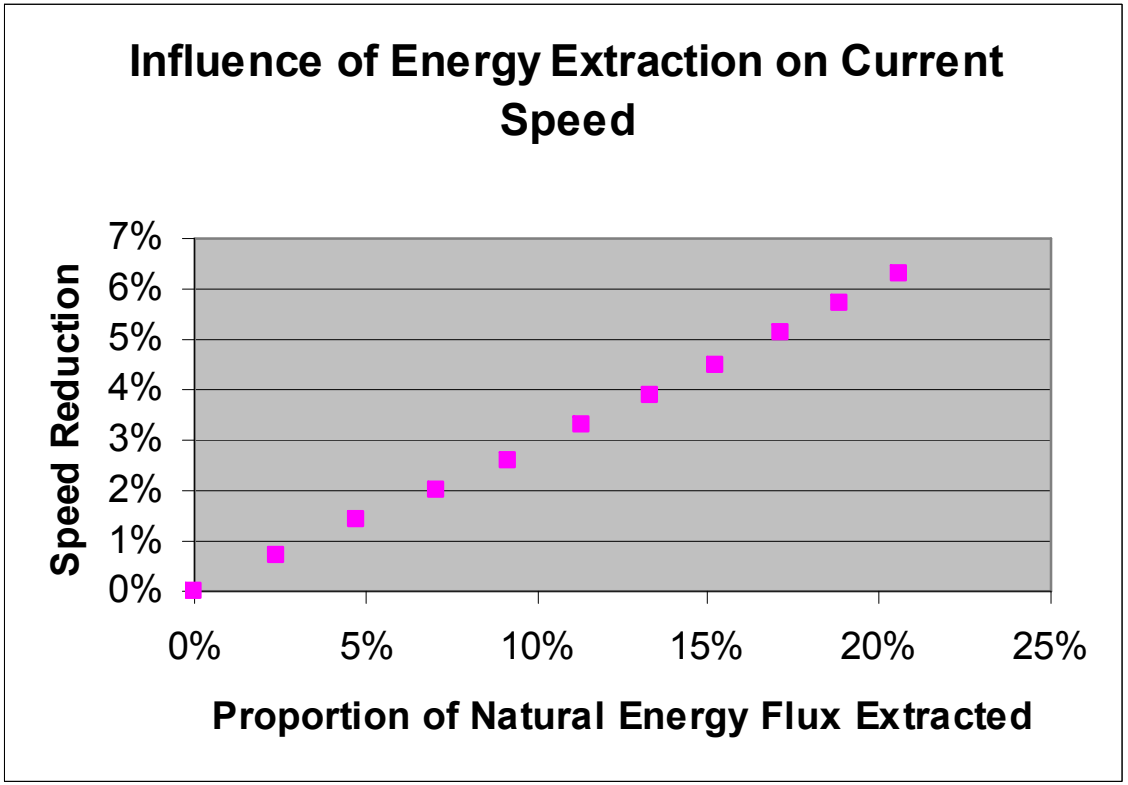
Identifying Limits to Extraction

The extraction of energy from a tidal flow will alter the underlying hydraulic nature of a tidal environment.

This will set limits to how much energy can be extracted without causing unacceptable changes

What those limits are will depend upon the site





Based on a simple 1 dimensional channel model

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Other Factors

- Need to know depth limitations of technology type, so that comparative assessments can be made.
- Likely exclusions issues
- Still no comprehensive national resource assessment, including all constraint identification