Waves + Hydro-Sed

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(Matthew Peck, Celia Martinez Ramos, Sabrina Sayers

Linear Wave Theory: An approximation of the time-mean wave energy flux (wave power) (kW/m^2 time unit converted to seconds) :

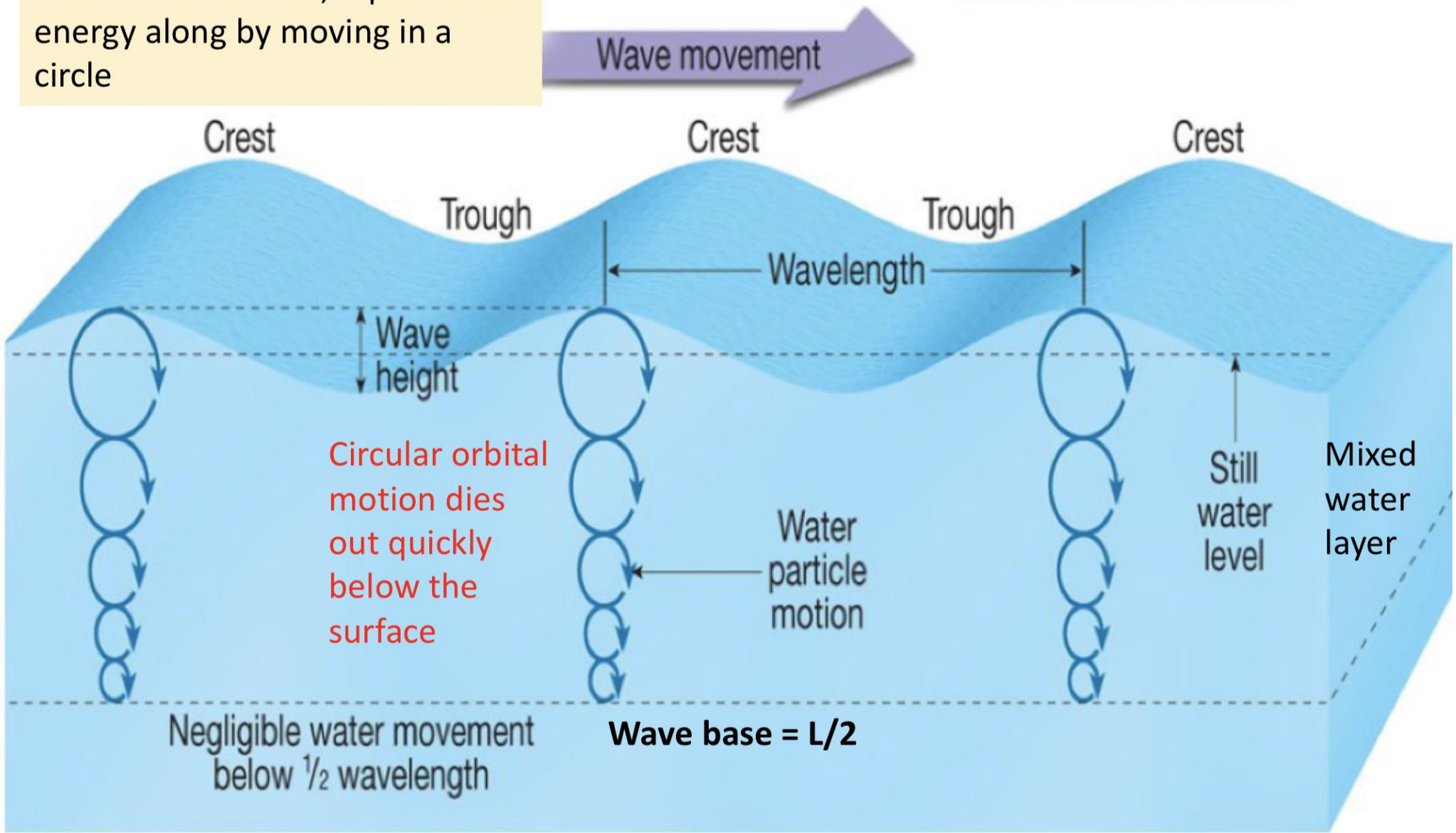
$$Pwl = \frac{\rho g^2}{64\pi} H_{m0}^2 T_e$$

$$E = \frac{1}{16} \rho g H_{m0}^2$$

Characteristics and Movement of a Wave

As the wave travels, it passes its energy along by moving in a circle

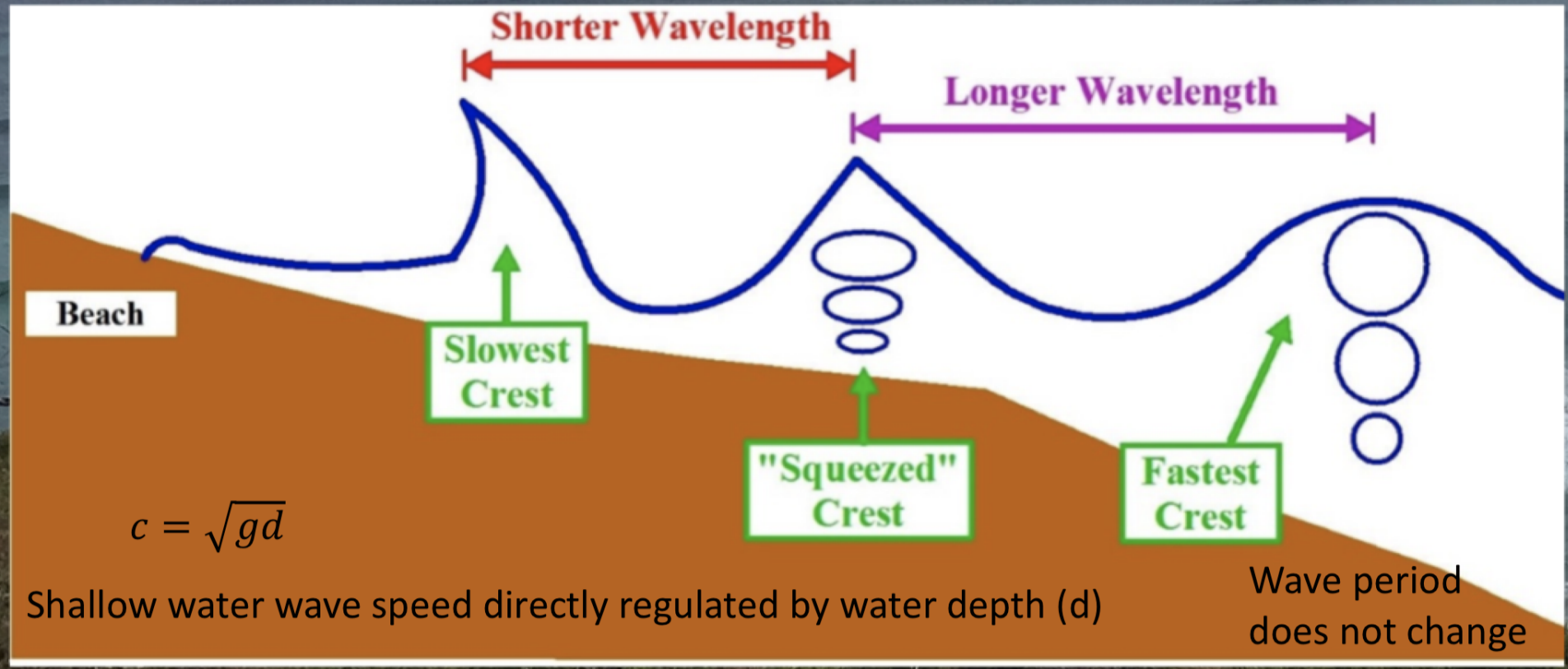
Circular orbital motion



Shallow water transformation (shallow water wave, depth<1/20 of wave length):

As a wave moves into shallow waters: **Altering wave form and speed (not period)**

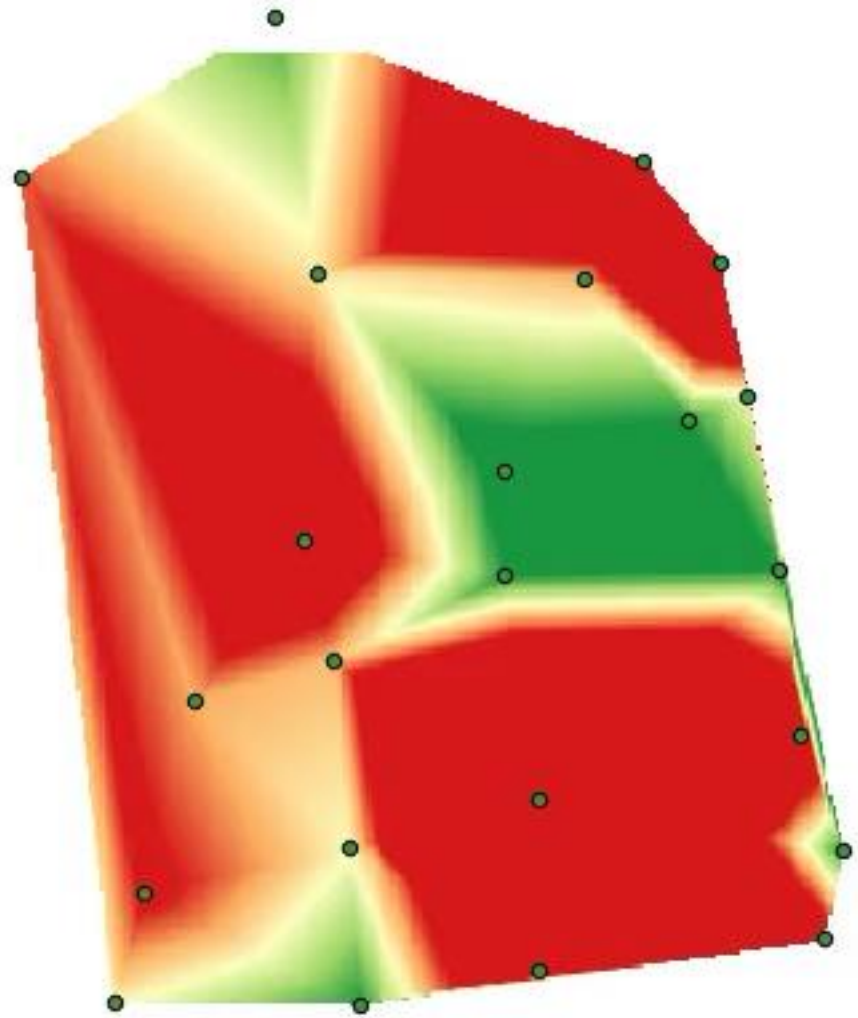
- orbitals interact with the ocean floor (feel the bottom) and DRAG
- waves closer to shore slow down while those travelling behind them are faster **reducing the wavelength**
- **Shoaling** of the waves in the shallows
- The water in between crests is “squeezed” and has no where to go but up
- **Increases wave height (not changing energy)**
- Not two crests merging, but rather a change in steepness of the wave



Shallow water wave speed directly regulated by water depth (d)

Wave period does not change

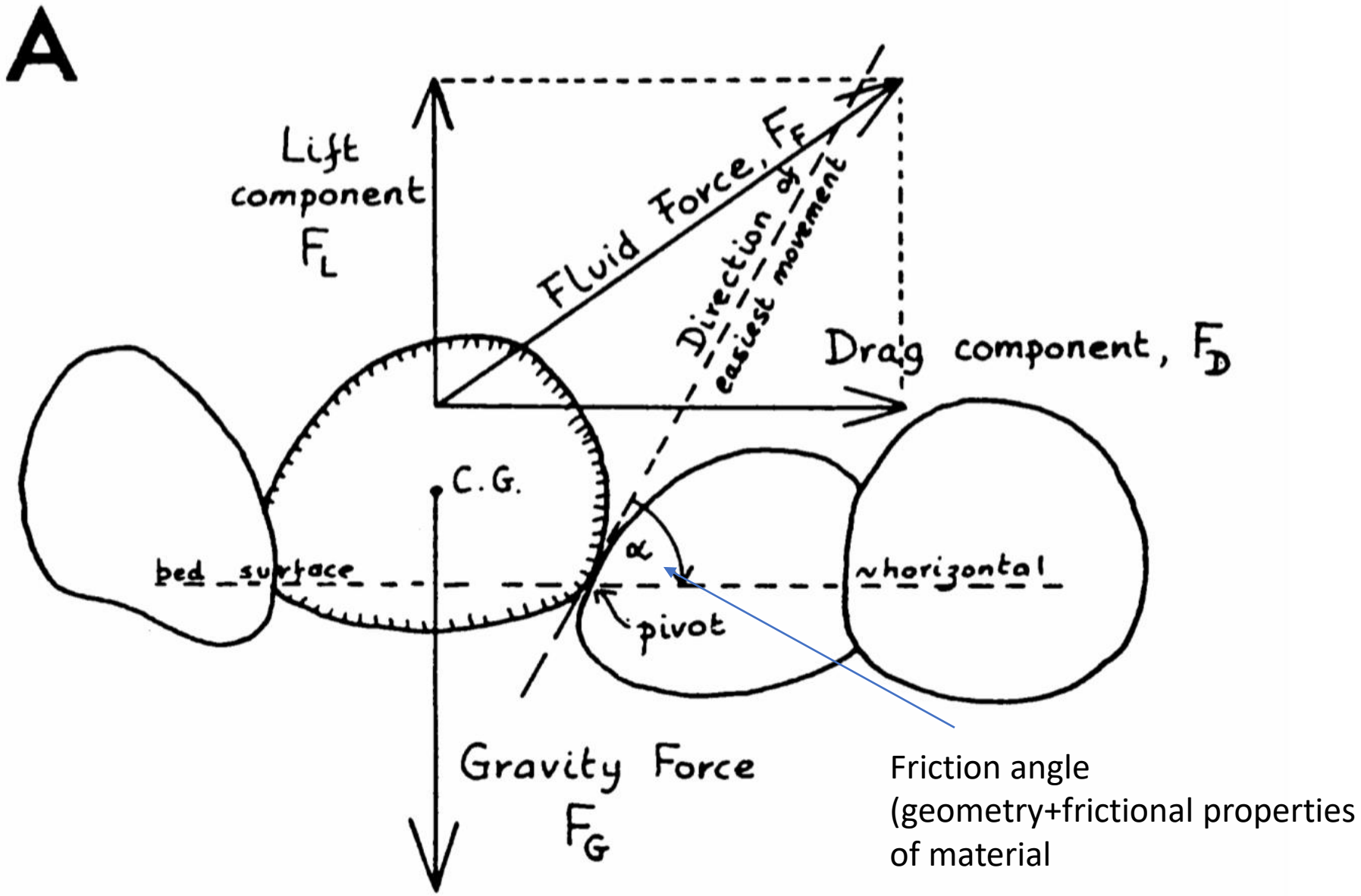

T20
T8
T23
T3
T21
T4
ANENOMETER
T10
T16
T17
T13
BOARDWALK
T1
T6
T25
T5
AAAA
T18
T15
T19
T26
T2
T7
T14
T11
OBS
bing



Seconds elapsed: 10.0

Calcium

Zinc



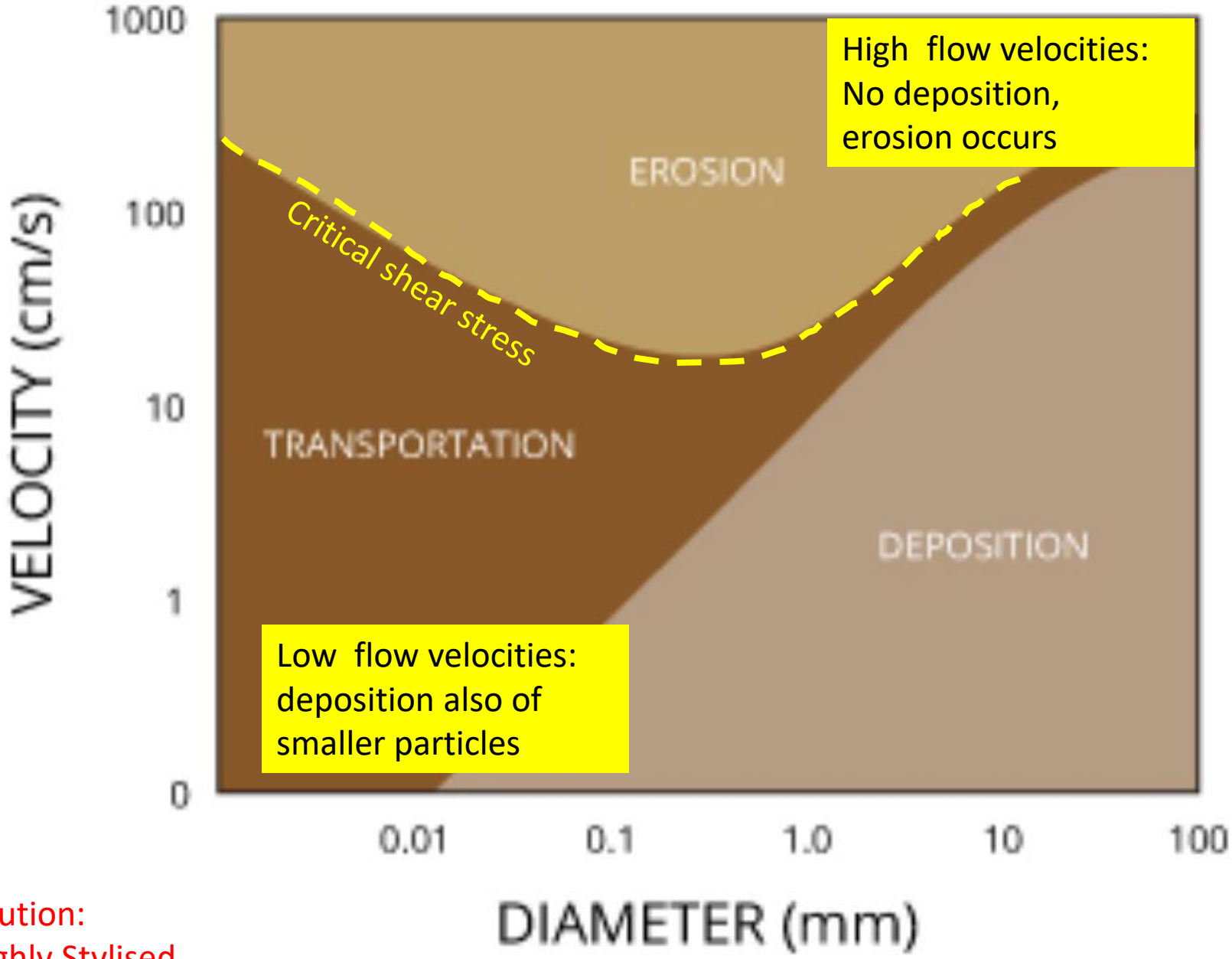
A range of moments operate on a sand particle: fluid force, gravitational force, drag

Reference graphs and tables are used in conjunction with formulas to estimate sediment transport rates (Qs):

Particle classification name	Ranges of particle diameters		Shields parameter (dimensionless)	Critical bed shear stress (τ_c) (N/m^2)
	φ	mm		
Coarse cobble	-7 – -8	128 – 256	0.054 – 0.054	112 – 223
Fine cobble	-6 – -7	64 – 128	0.052 – 0.054	53.8 – 112
Very coarse gravel	-5 – -6	32 – 64	0.05 – 0.052	25.9 – 53.8
Coarse gravel	-4 – -5	16 – 32	0.047 – 0.05	12.2 – 25.9
Medium gravel	-3 – -4	8 – 16	0.044 – 0.047	5.7 – 12.2
Fine gravel	-2 – -3	4 – 8	0.042 – 0.044	2.7 – 5.7
Very fine gravel	-1 – -2	2 – 4	0.039 – 0.042	1.3 – 2.7
Very coarse sand	0 – -1	1 – 2	0.029 – 0.039	0.47 – 1.3
Coarse sand	1 – 0	0.5 – 1	0.033 – 0.029	0.27 – 0.47
Medium sand	2 – 1	0.25 – 0.5	0.048 – 0.033	0.194 – 0.27
Fine sand	3 – 2	0.125 – 0.25	0.072 – 0.048	0.145 – 0.194
Very fine sand	4 – 3	0.0625 – 0.125	0.109 – 0.072	0.110 – 0.145
Coarse silt	5 – 4	0.0310 – 0.0625	0.165 – 0.109	0.0826 – 0.110
Medium silt	6 – 5	0.0156 – 0.0310	0.25 – 0.165	0.0630 – 0.0826
Fine silt	7 – 6	0.0078 – 0.0156	0.3 – 0.25	0.0378 – 0.0630

It's hard to resuspend a bed of small grains!

Critical shear stress by particle-size classification for determining approximate condition for sediment mobility at 20 degrees Celsius.

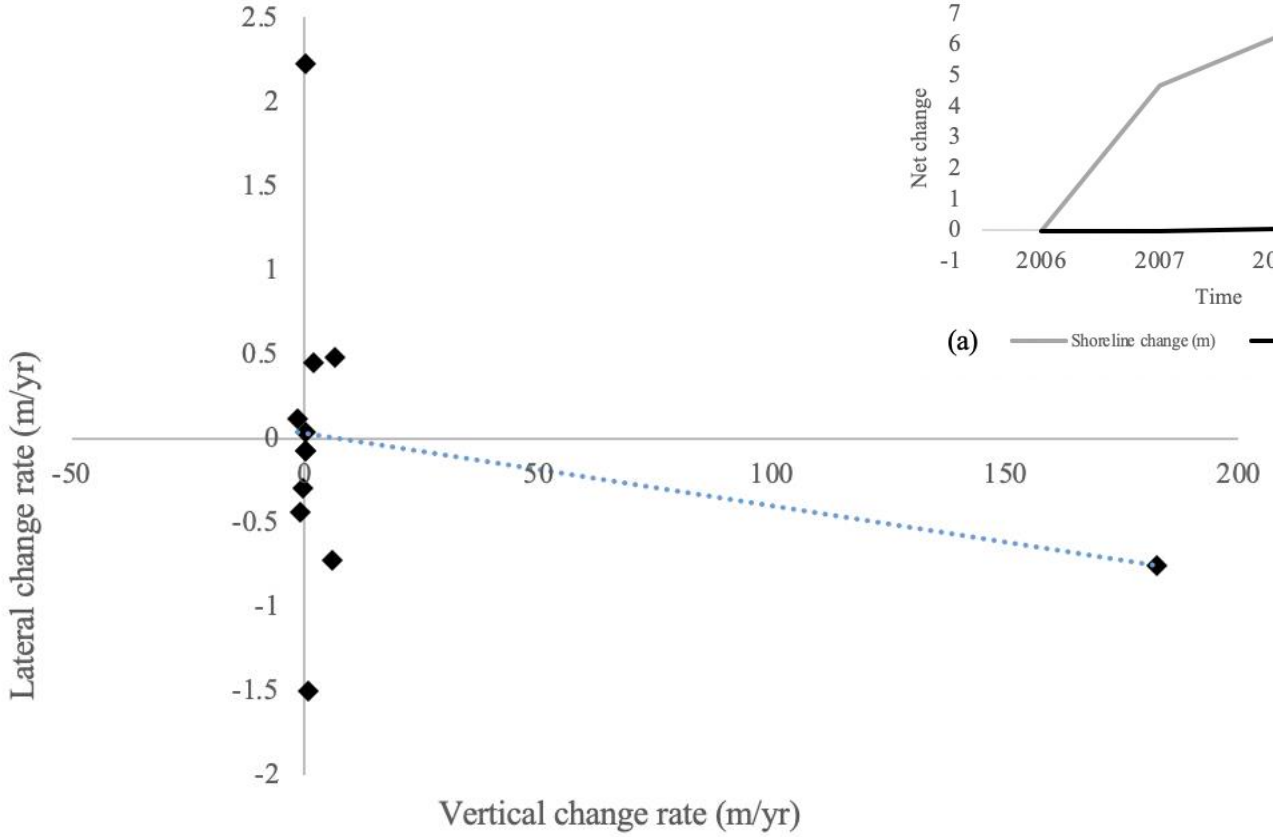


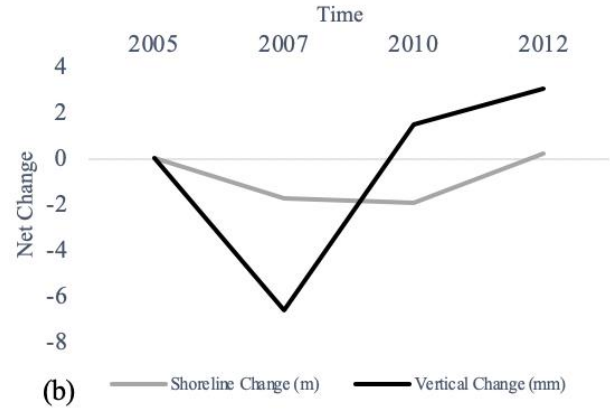
High flow velocities:
No deposition,
erosion occurs

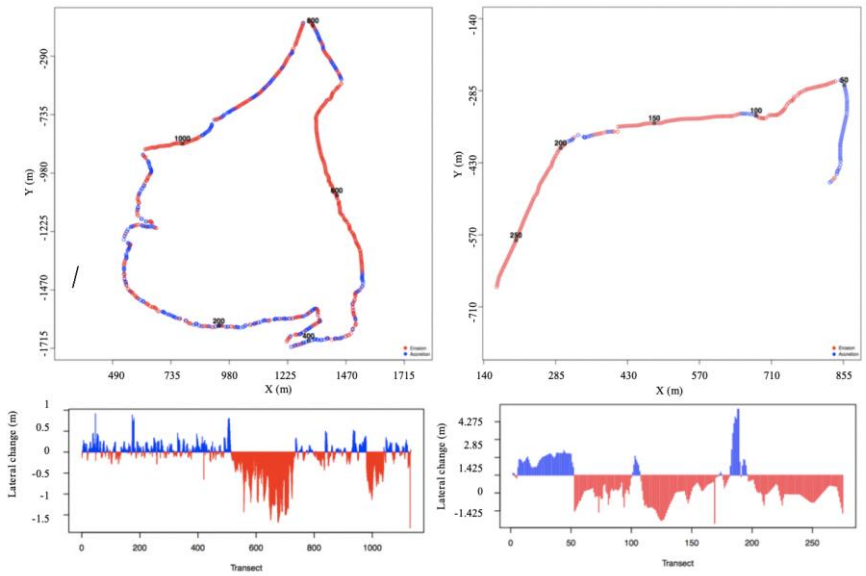
Low flow velocities:
deposition also of
smaller particles

Caution:
Highly Stylised

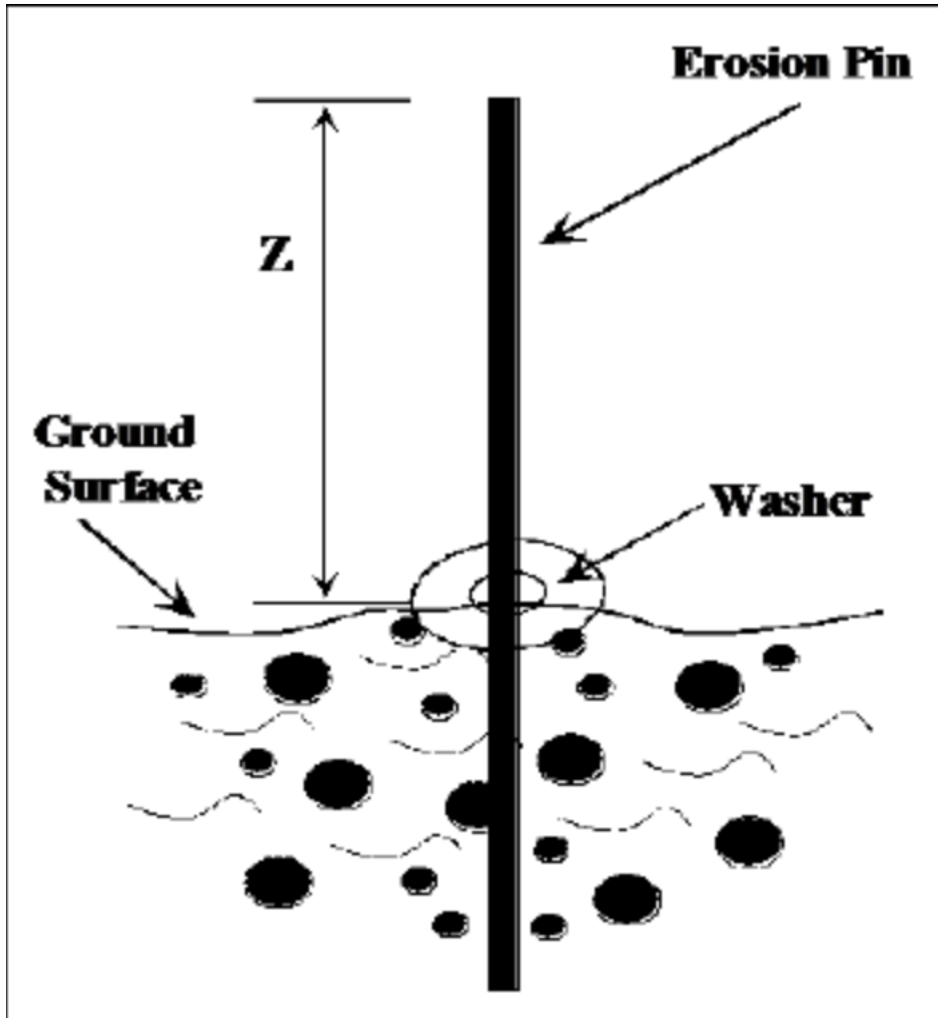
What is erosion? There is no significant relationship between lateral and vertical changes at sites we've studied (Gordon and Reef 2019)








Western Port
Erosion Pins Experiment Sites
Legend
Locations
Tooradin
Hastings
Crib-point
Pioner-bay
Rhyll

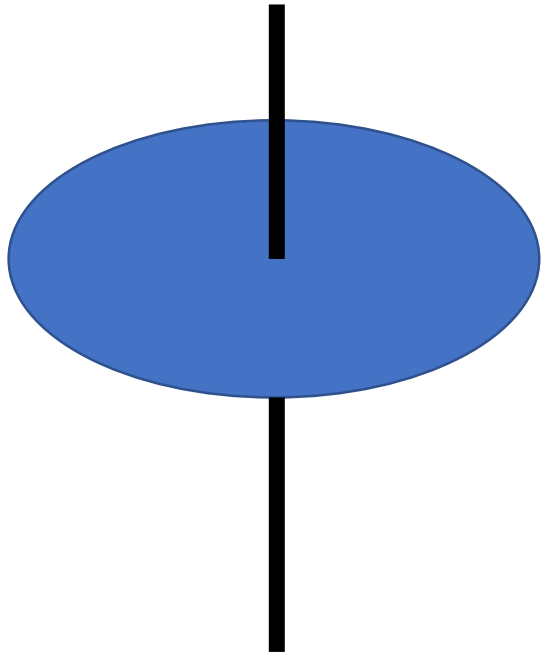


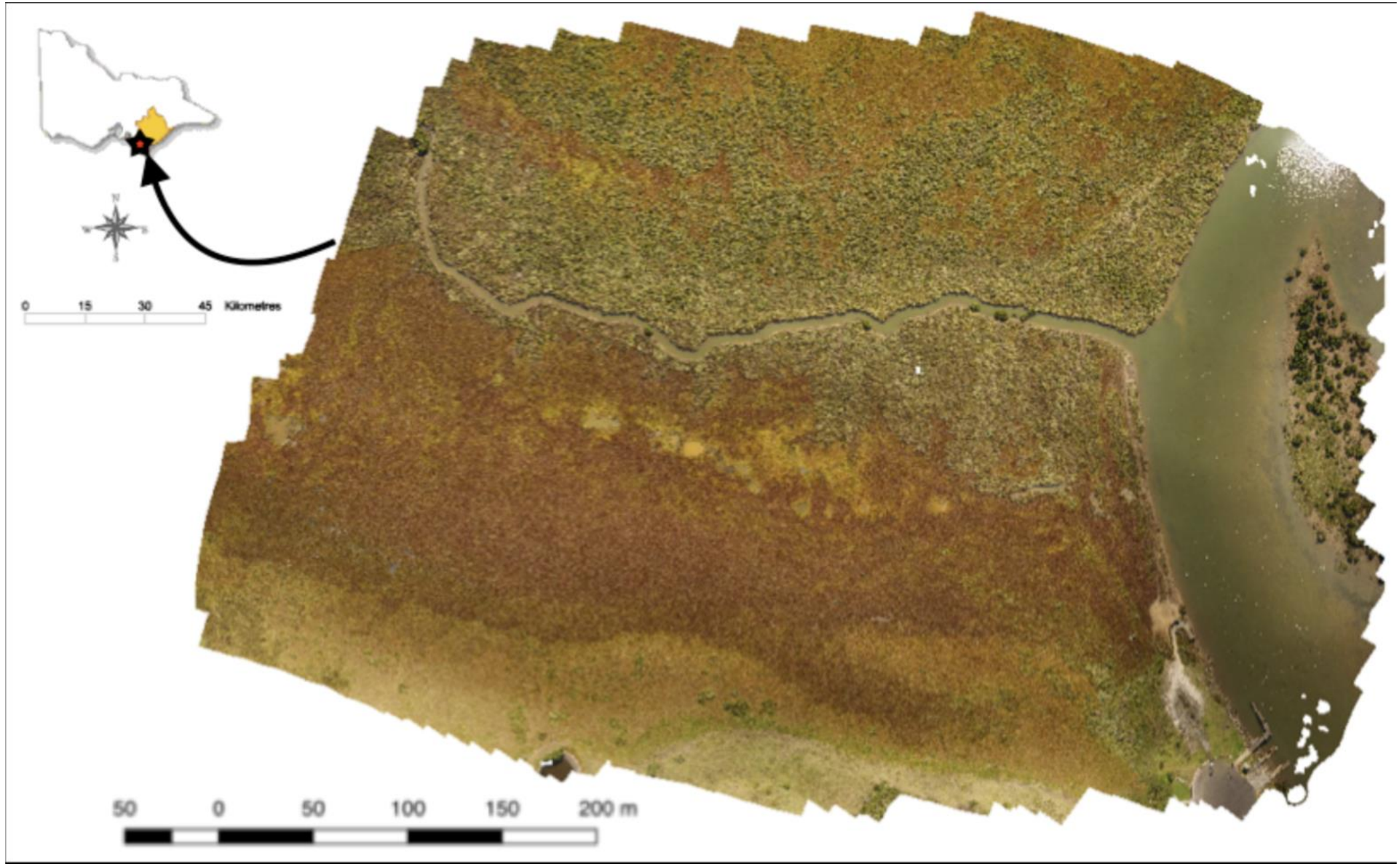
- 5 sites in WP Bay
- 100 pins per site
- Rectangular Grid
- Varying distance from the shoreline
- Varying vegetation types
- Seasonal patterns

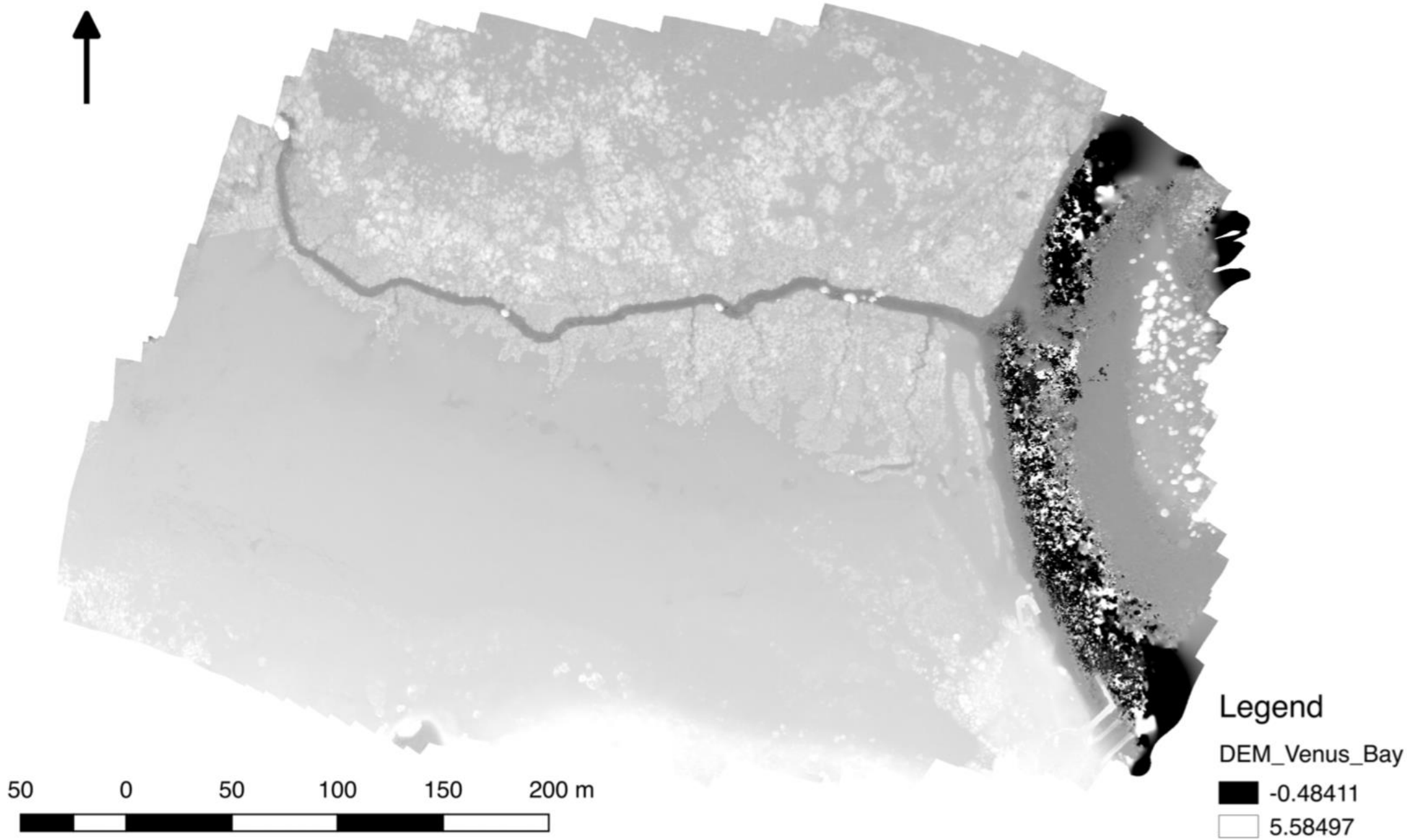
RTK and Drone Surveys
+ inSAR retmote sensing

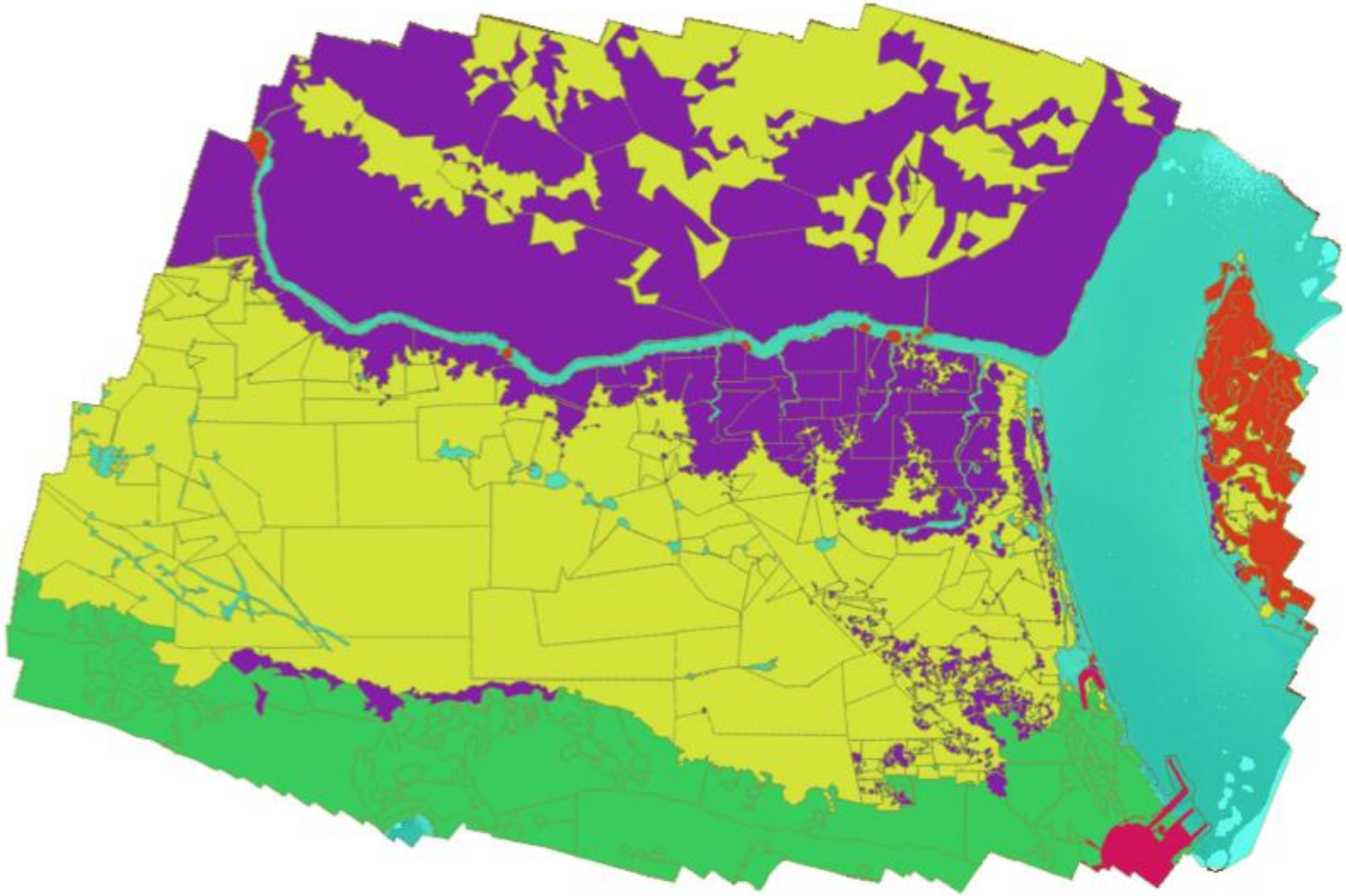
- Permanent aluminum base plates, repeat surveys, long term subsidence

  (+ French Island, because eddy covariance tower is there)

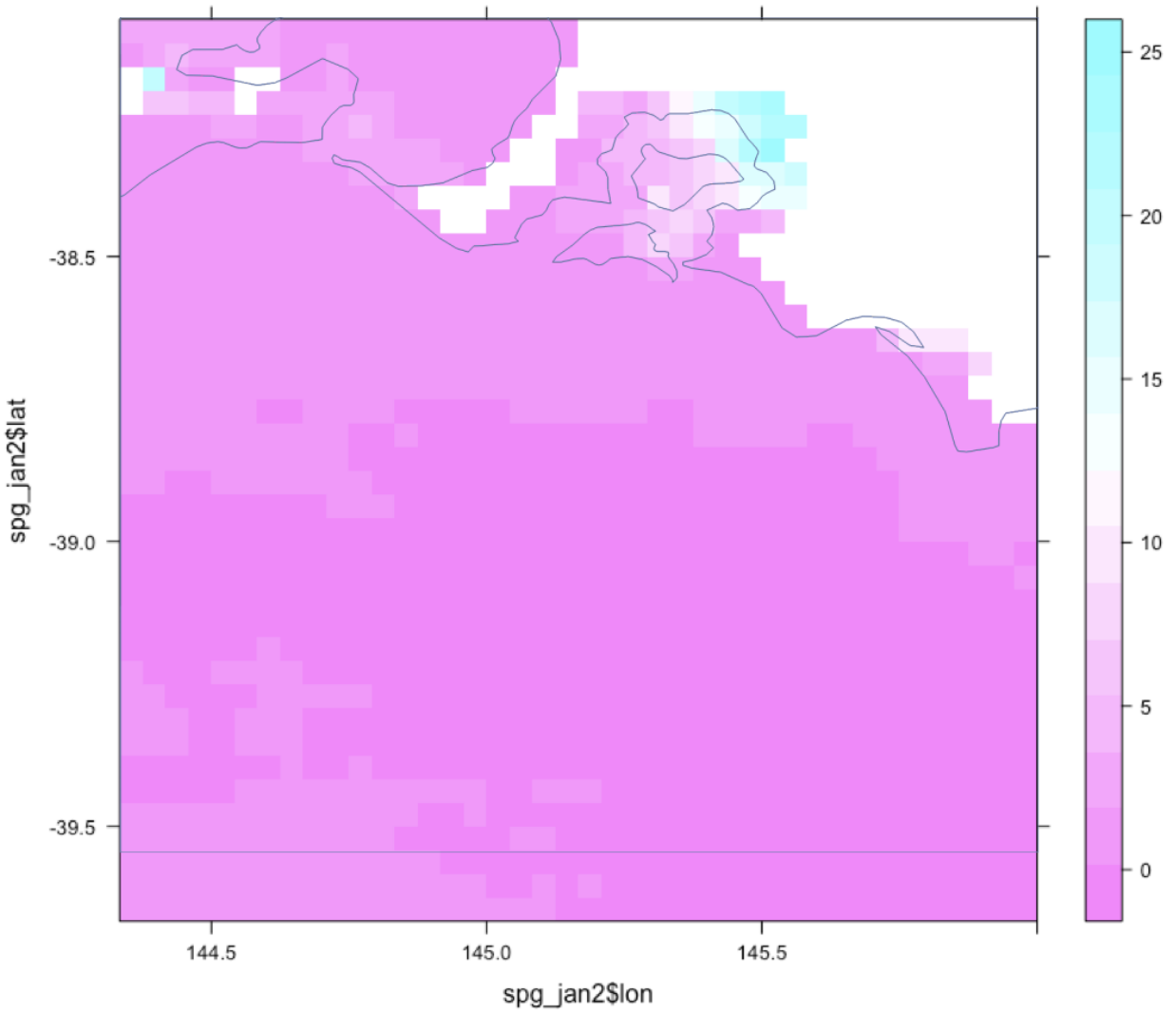



0 15 30 45 Kilometres
50 0 50 100 150 200 m


50 0 50 100 150 200 m
Legend
DEM_Venus_Bay
-0.48411
5.58497



Elevation and tide height	% Of saltmarsh area	% Saltmarsh flooded by tidal range	No. Inundations in elevation range p/a	% High tides inundating elevation range	Predominate Veg/ land use in elevation range
<4	12.46	12.46	711	100	Mud/ open water/ mangroves
4.0-4.2	16.12	28.04	687	96.62	*Sarcocornia*
4.2-4.4	19.34	47.38	517	72.71	*Sarcocornia*
4.4-4.6	25.62	73.01	270	37.97	*Sarcocornia*
4.6-4.8	12.09	85.09	76	10.69	*Sarcocornia/ Gahnia*
4.8-5	6.45	91.53	20	2.81	*Gahnia* /Sea couch
5-5.2	3.71	95.25	Storm surges	Storm surges	Boardwalk/ terrestrial veg.
5.2-5.4	2.42	97.66	Storm surges	Storm surges	Infrastructure/ terrestrial veg.
5.4-5.6	1.45	99.11	Storm surges	Storm surges	Infrastructure/ terrestrial veg.
5.6-5.8	0.56	N.A.	No inundation	No inundation	Infrastructure/ terrestrial veg.
>5.8	0.32	N.A.	No inundation	No inundation	Infrastructure/ terrestrial veg.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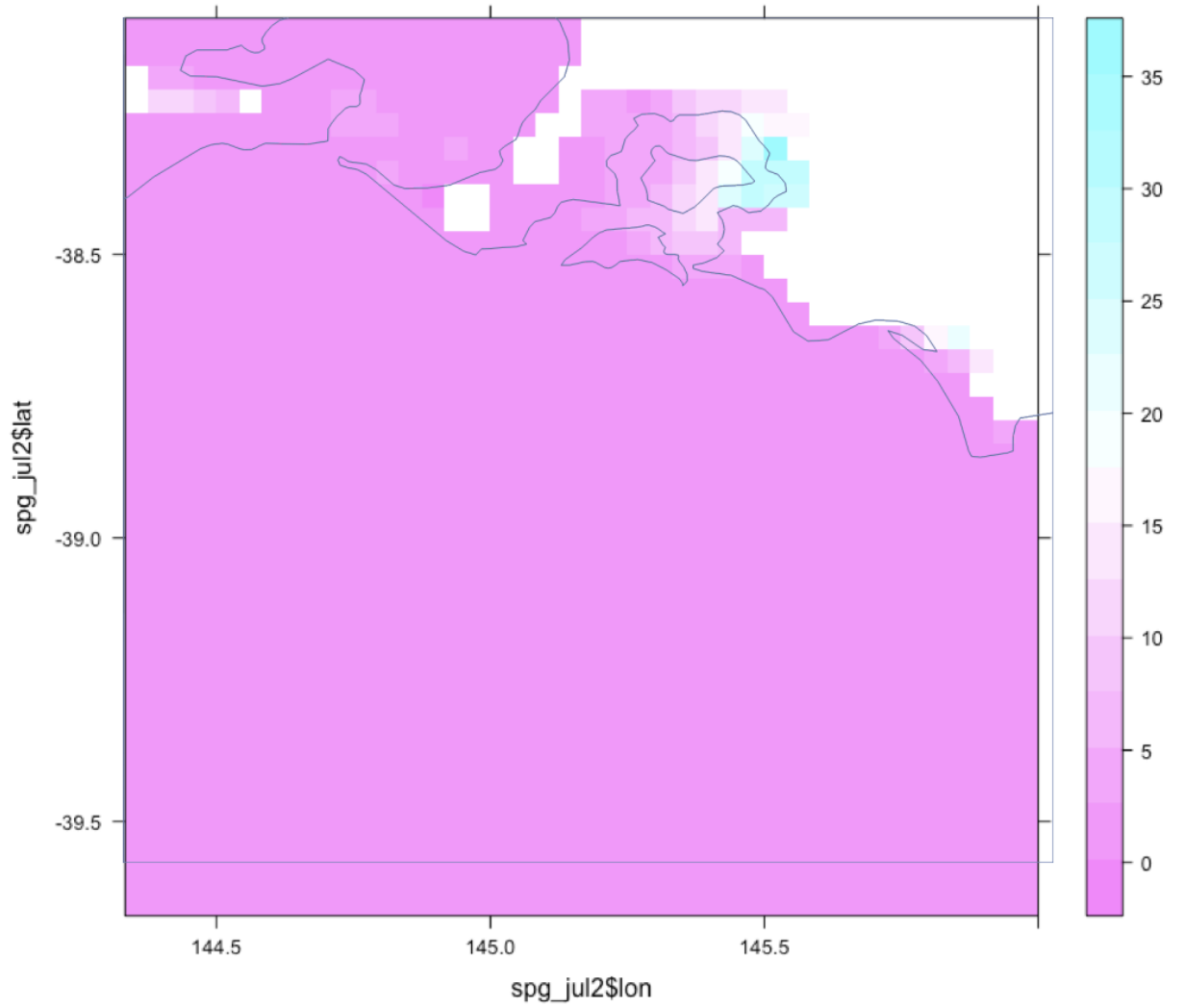
-39.5
144.5
145.0
145.5
spg_jan2$lon
25
20
15
10
5
0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-39.5
144.5
145.0
145.5
spg_jul2$lon
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15
10
5
0