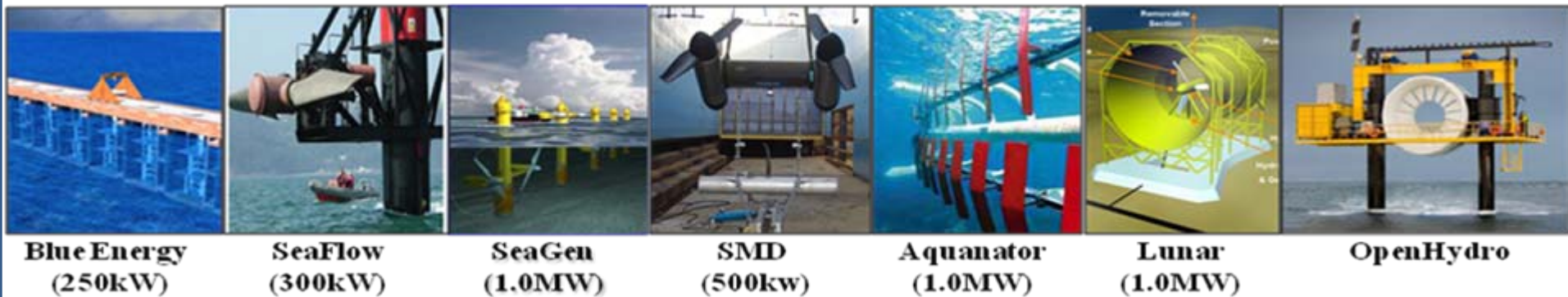


The development of a tidal current power unit for the sea near Keelung

Cheng-Han Tsai,
Professor

PECC
2012/03/28





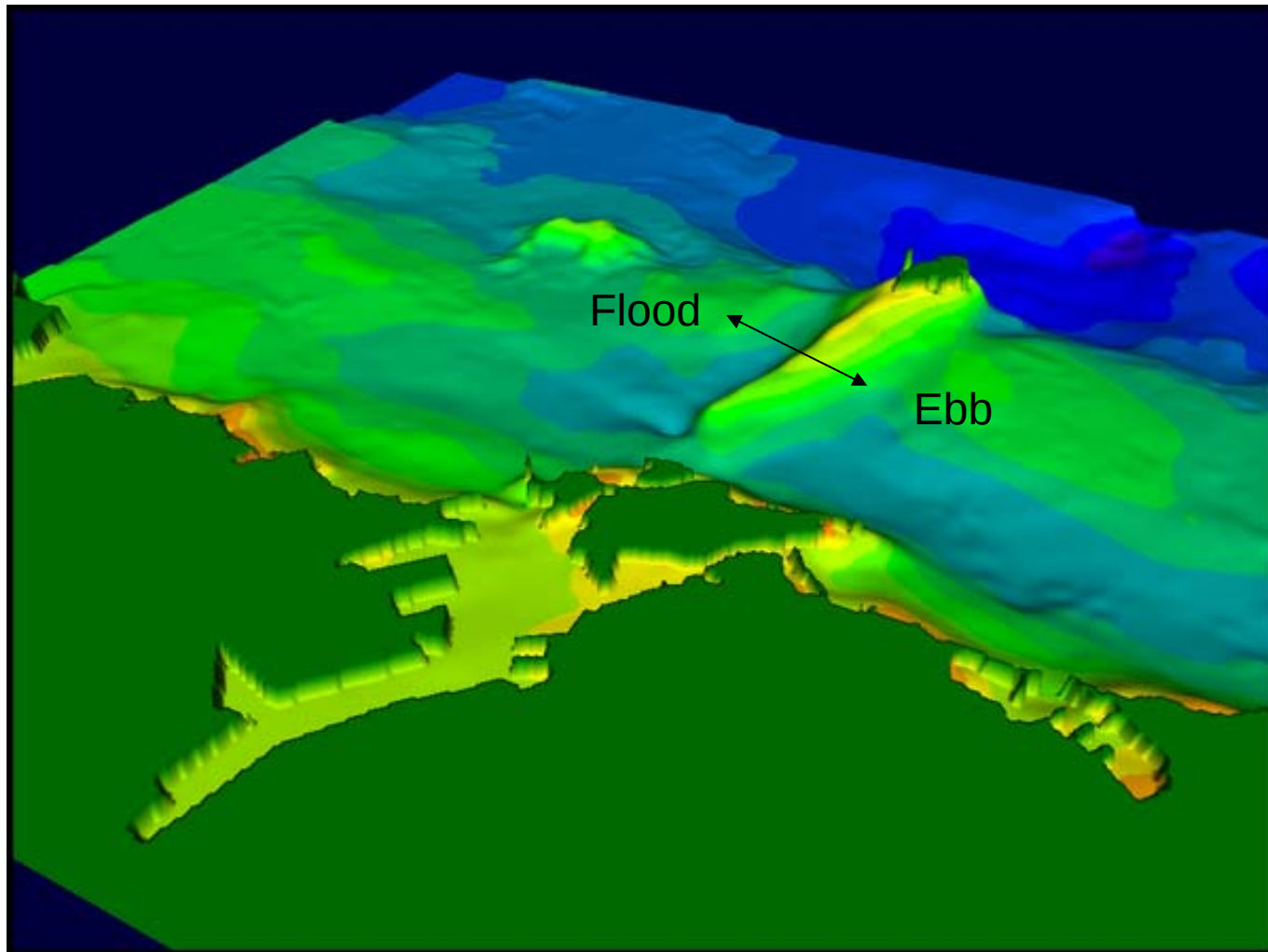
NTOU tidal power project structure

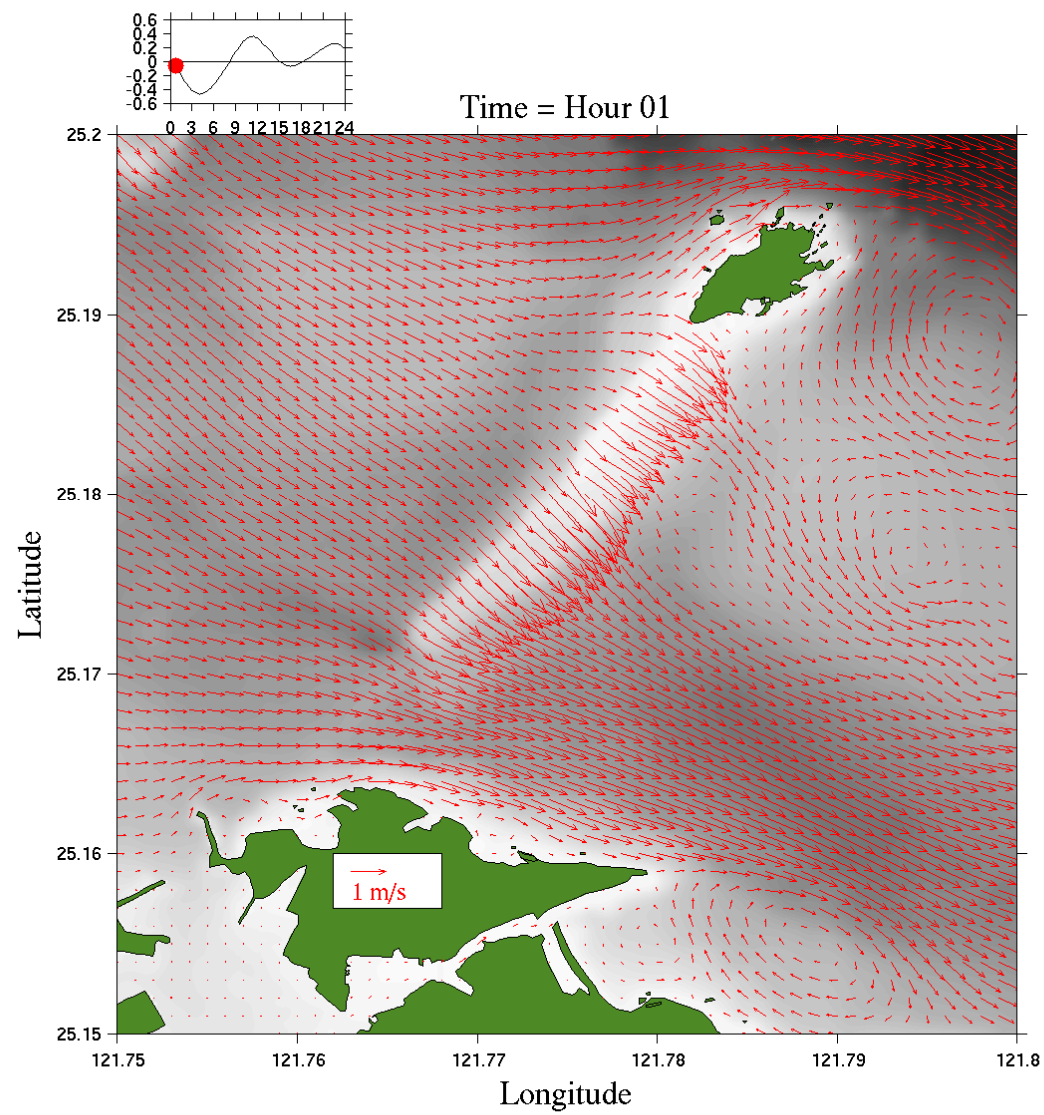
(A 2010-2012 National Science Council project)

1. Tidal current simulation by numerical modeling
2. Assessment of tidal current power by in-situ measurements
3. Assessment of tidal current power by satellite remote sensing
4. Research and development of tidal current power unit
5. Typhoon wave forces on the tidal power unit



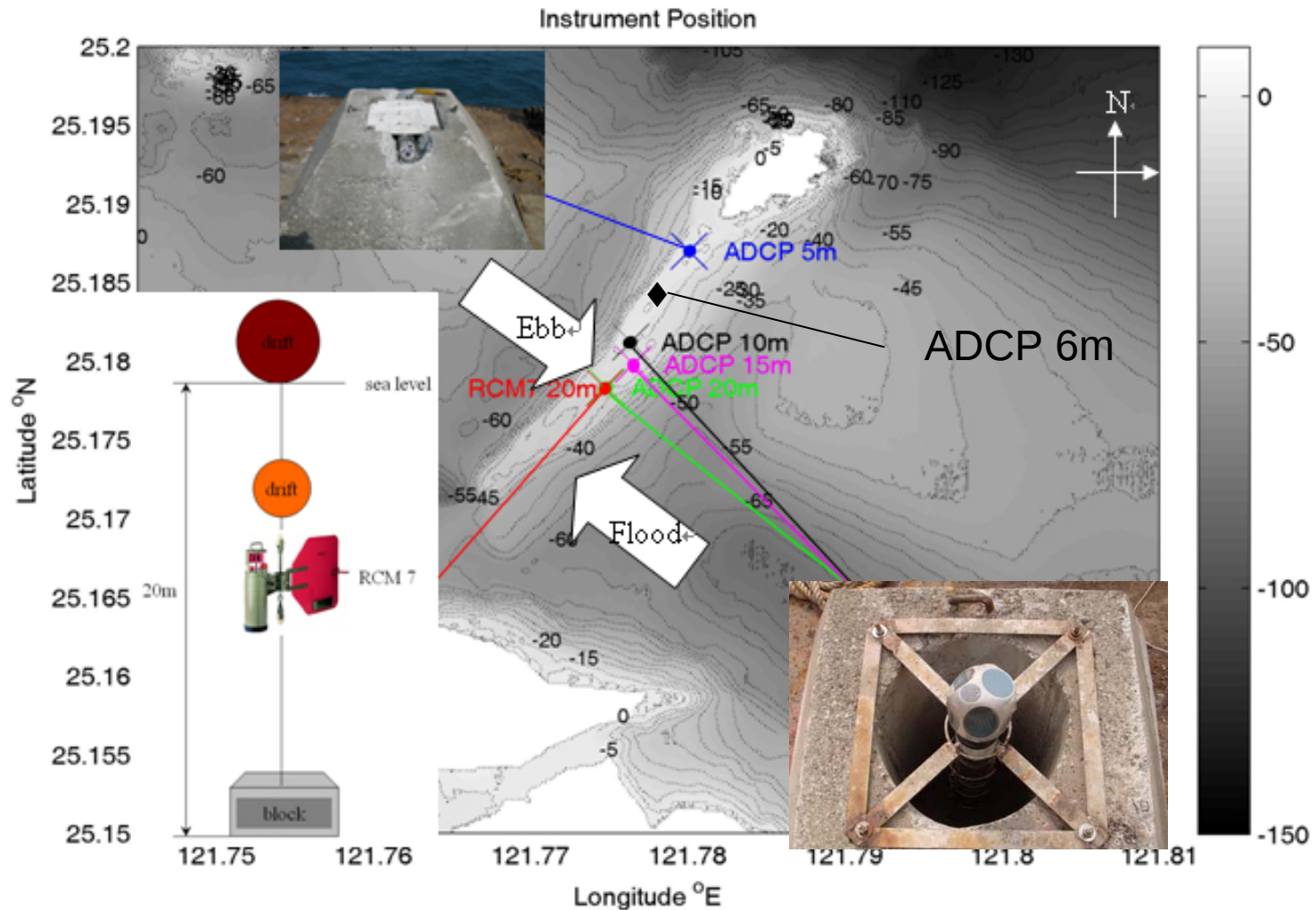
The Keelung Sill (2km by 300m)







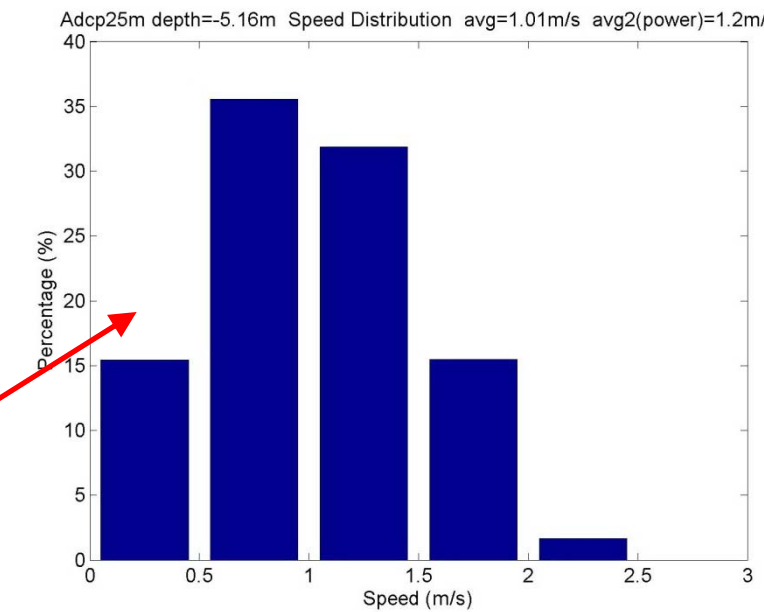
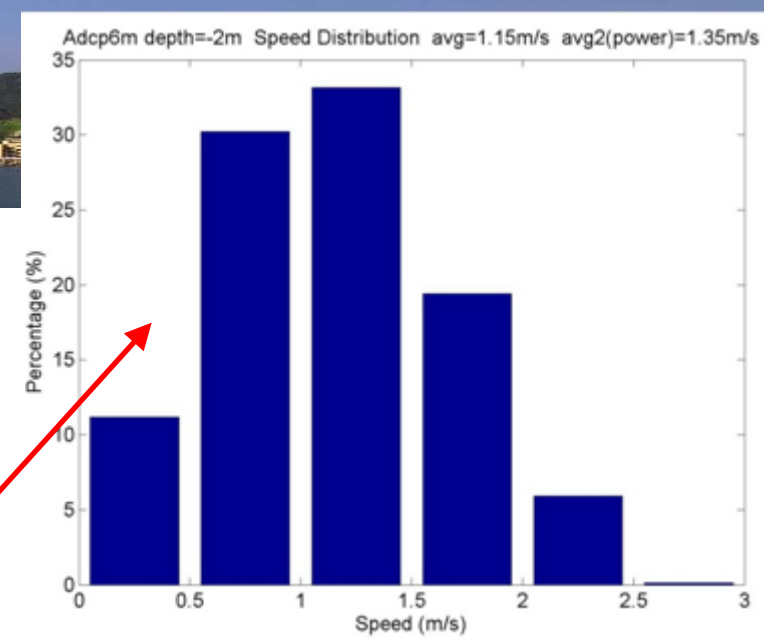
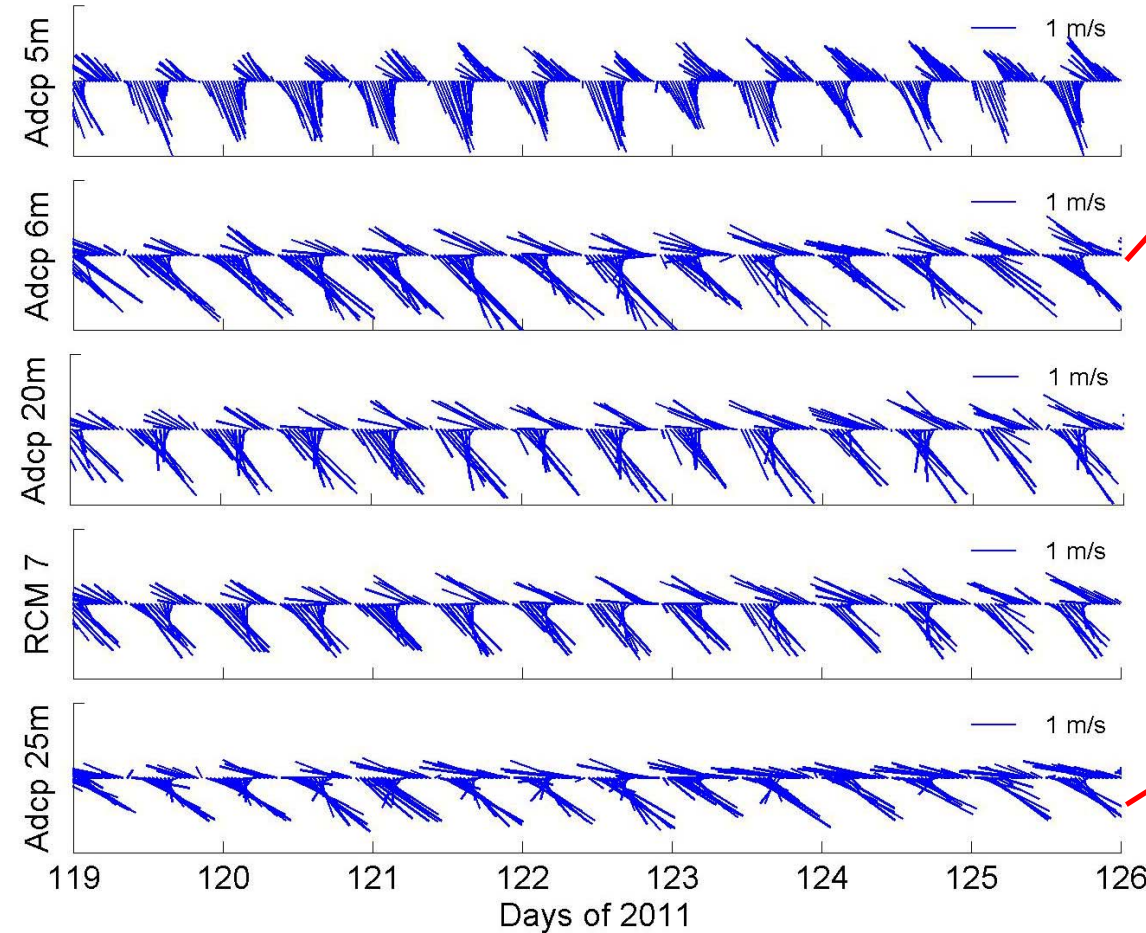
Rough surface on the Keelung Sill on 2011/08/06



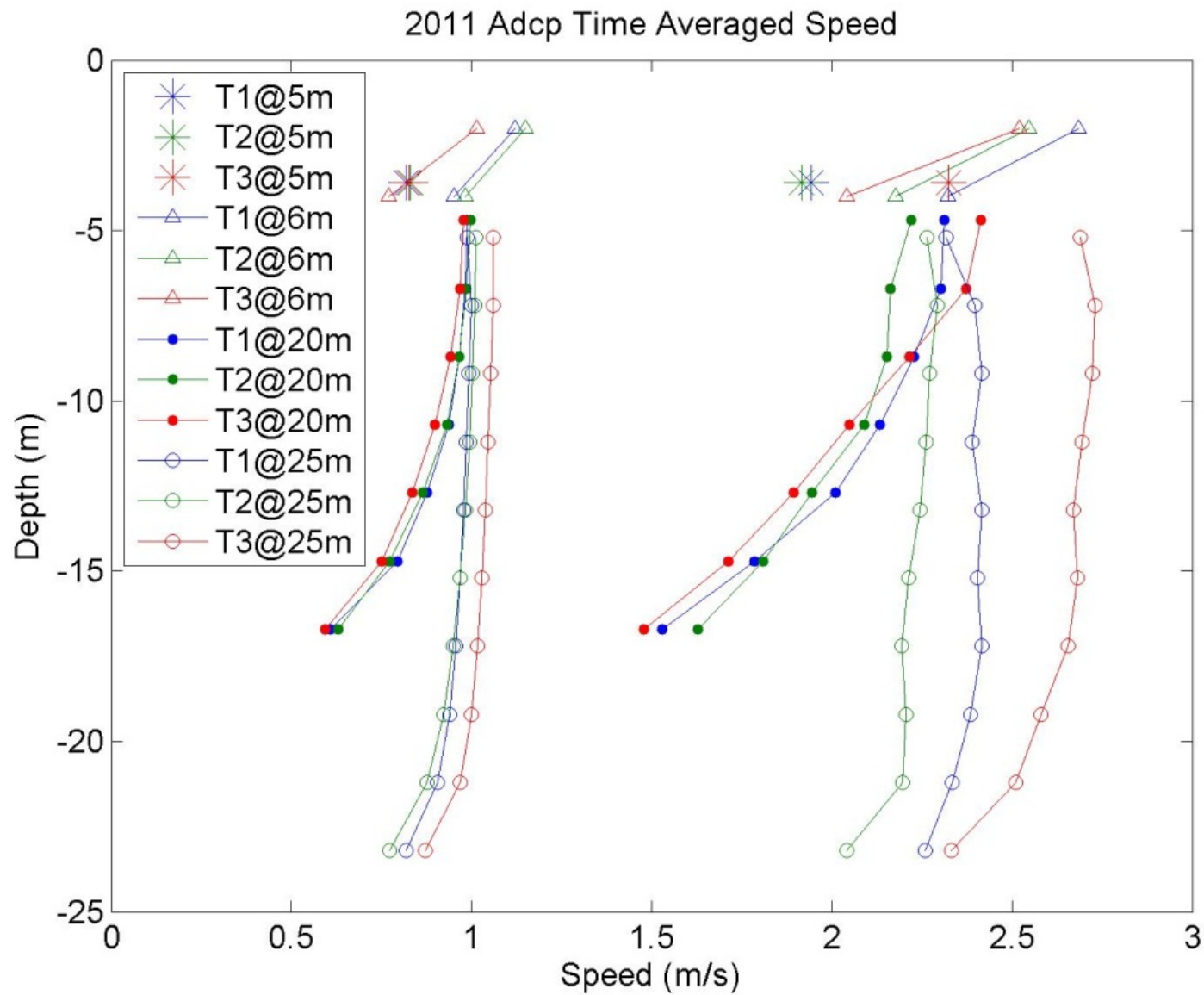
Five deployments: 2010/02-03, 04-05, 07, 10 and 2011/04-05



UV stickplot



實測潮流及流速分佈百分比(以6m及25m分佈為例)₇



2011年各測站發電功率密度及流速表

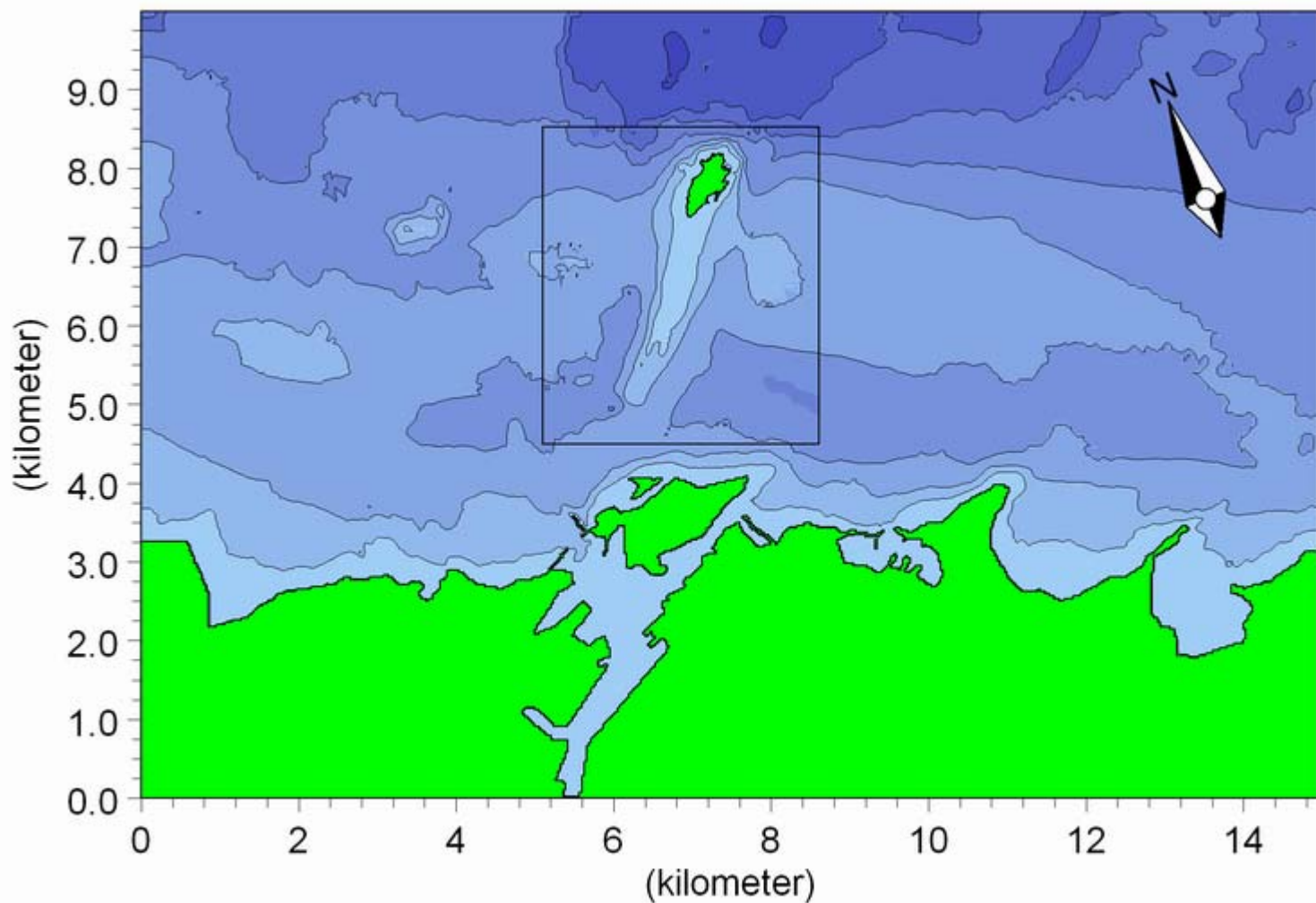
Power density (W/m²) and speed (m/s)

Site depth (m)

Location	5m	6m	20m	25m
Bottom (Avg)	-	650	200	550
	-	(1.1)	(0.7)	(1.0)
Bottom (Max)	-	6410	2210	6500
	-	(2.3)	(1.6)	(2.3)
Top (Avg)	460	1140	830	930
	(1.0)	(1.3)	(1.2)	(1.2)
Top (Max)	6430	9900	7210	9960
	(2.3)	(2.7)	(2.4)	(2.7)



Numerical Modeling area



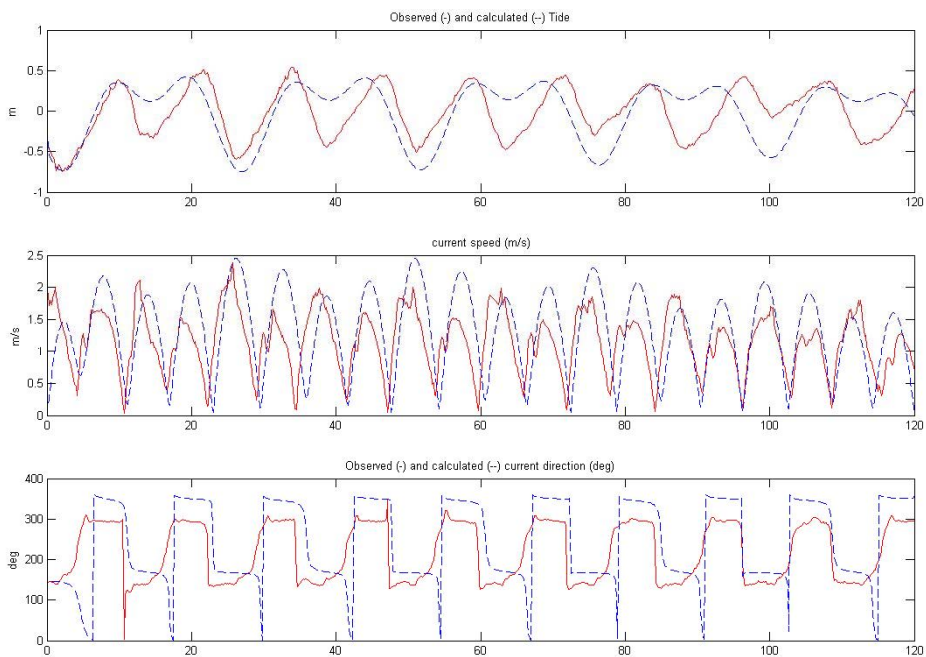
D:\DHI\KL Island\30m\Bathy\Bat3_97_30m_KL Harbor_interp_21_flt3_frame_adj.dfs2
D:\DHI\KL Island\30m\Bathy\Bat3_97_30m_KL Harbor_interp_21_1_adj.dfs2

Scale 1:95870

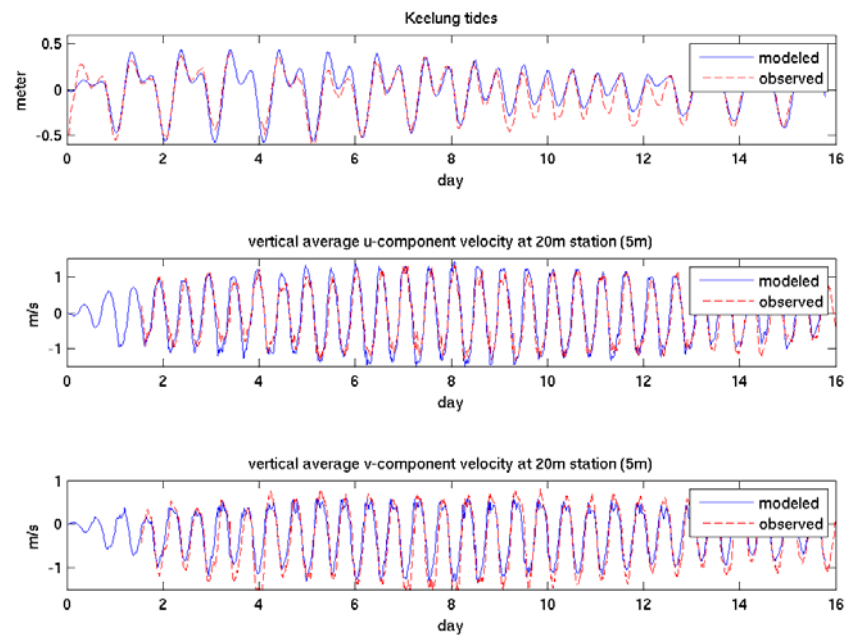
3D model

POM model

3D model



POM model (2D)

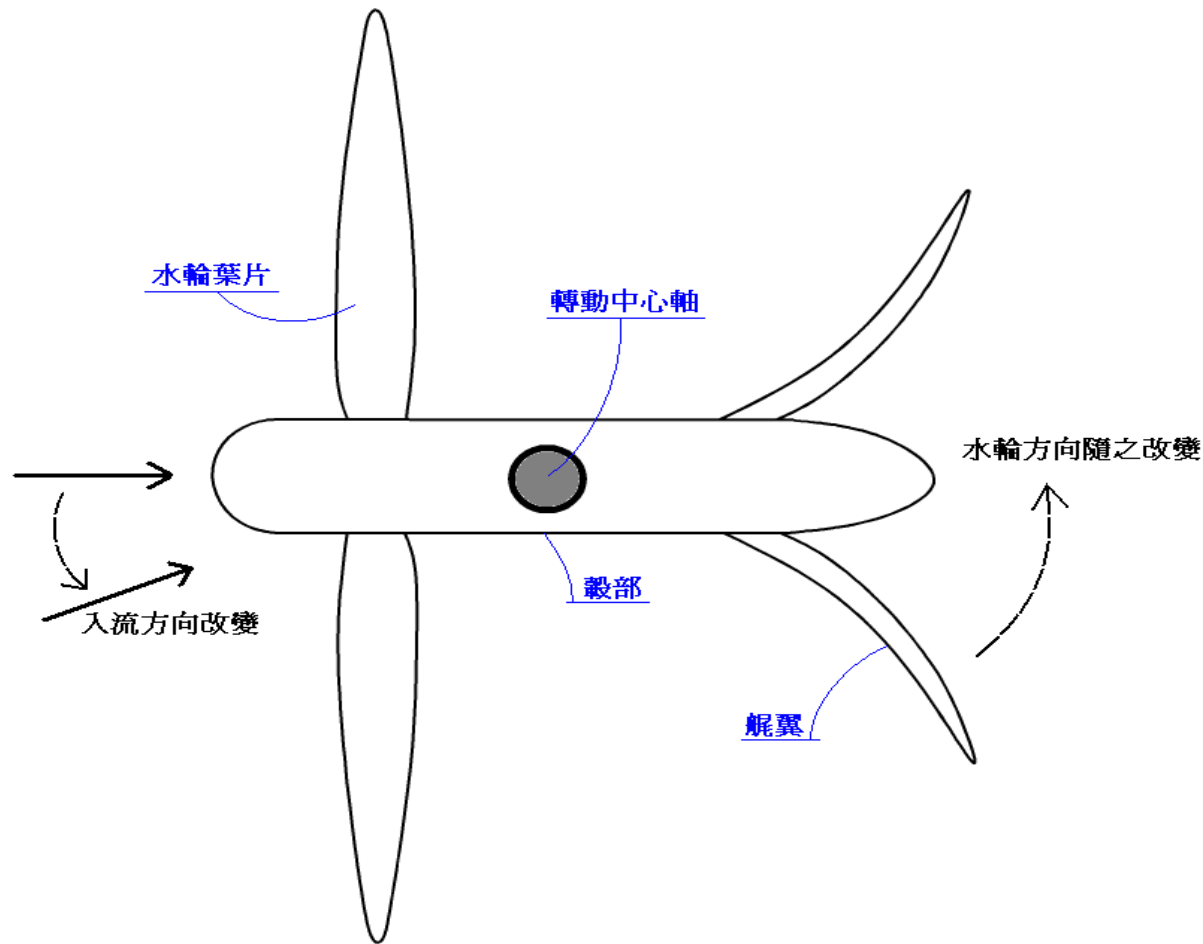


Comparisons of results of modeling with observed data (20m site)

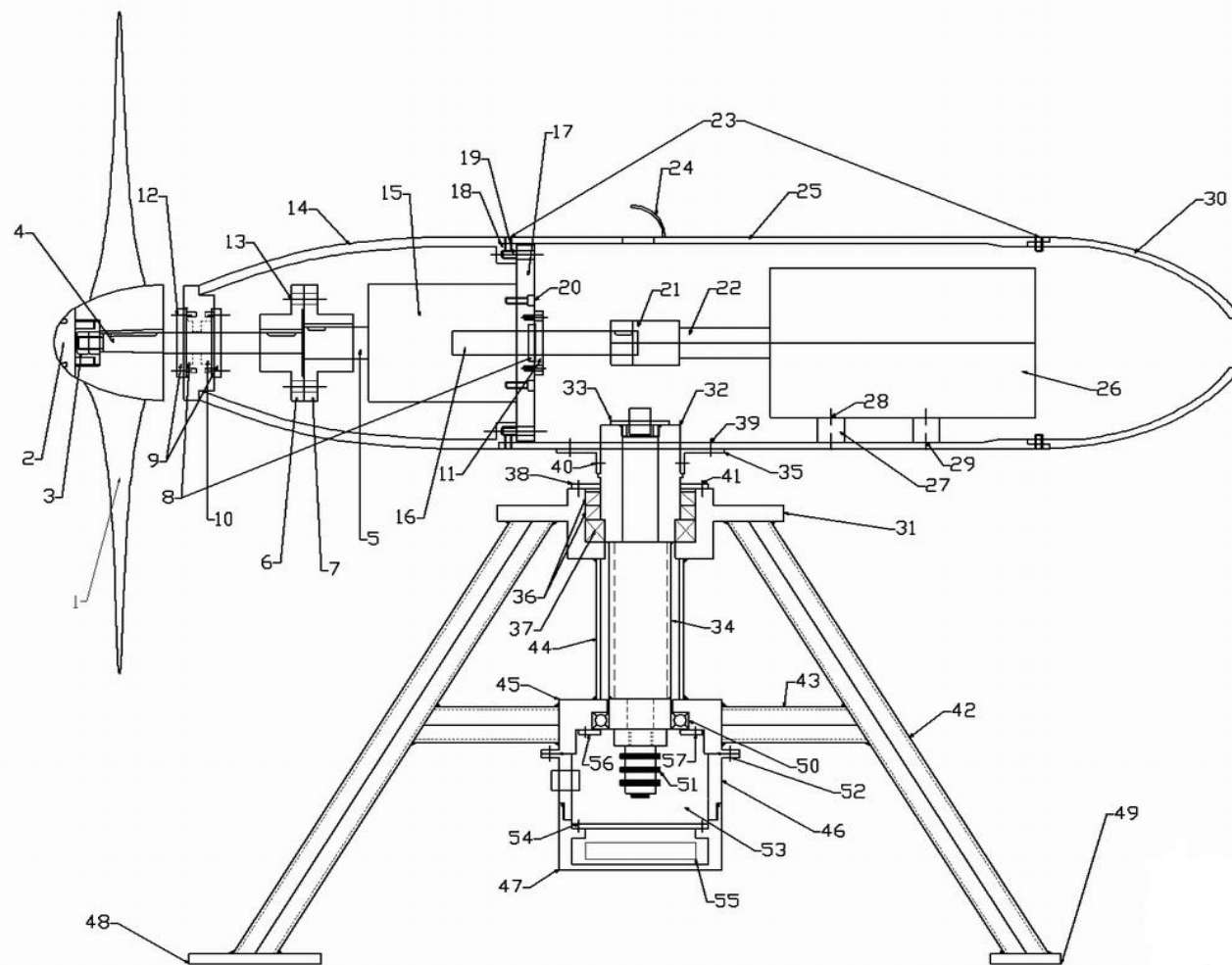


On the design of turbine blade

- Propeller lifting line theory is used for the design of the turbine blade.
- A 3-bladed turbine is adopted.
- The blade made of Ni-Al-Bronze.
- The design current speed is 3 m/s
- Blade diameter is 0.8m.
- 6.2 RPS



The power unit with aft-fins so that it can turn with the tide



15: gear box



26: underwater generator

Tidal power unit

Cavitation tunnel in the NTOU



The third largest cavitation tunnel in the world
Test section 10m (l) x 2.6m (W) x 1.5m (H)
Variable and reversible current
Maximum speed of 12 m/s



Tidal current unit turns towards the incoming flow



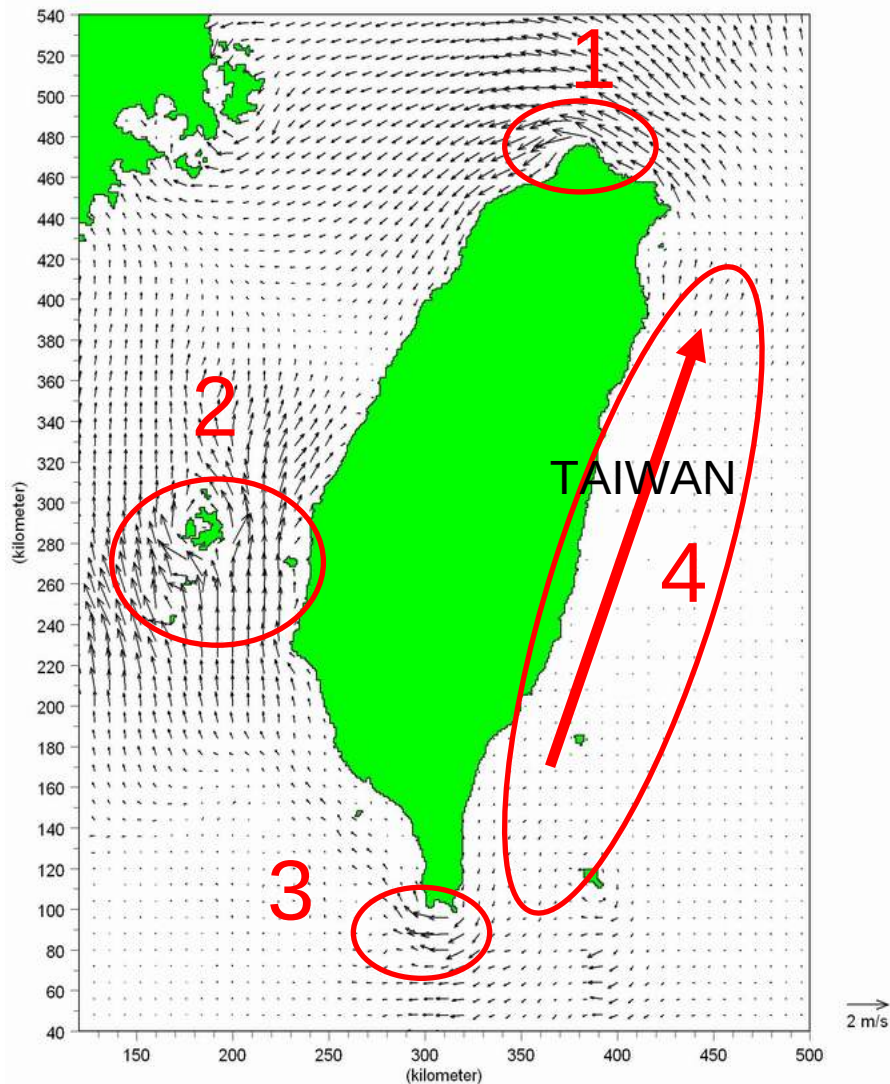
Our laboratory tests show that:

1. There is no water leakage.
2. The unit turns with the current.
3. At a speed of 3 m/s, the power generated is 1800 W.





4. The turbine itself is designed to generate 3 kW with the current speed of 3 m/s.
5. The total loss is 40%, including 20% in gear, transmission, and seals; with additional 20% in generator and power regulator system.
6. Our turbine design is on target.
7. Tests with 80 cm turbine showed that the start-up speed is 1.65 m/s
8. Tests with 1.22 m turbine showed that the start-up speed reduces to 1.35 m/s



03/01/2010 21:00:00

Tidal stream
potential sites

1. Northern coast
2. Penhu
3. Southern tip

Ocean current
potential area

4. Kuroshio



Goal of the project:

This year, we will test this tidal current generator at the Keelung Sill site.

Ultimate goal:

1. Develop other tidal stream sites
2. Power generation using Kuroshio current



Thank you