

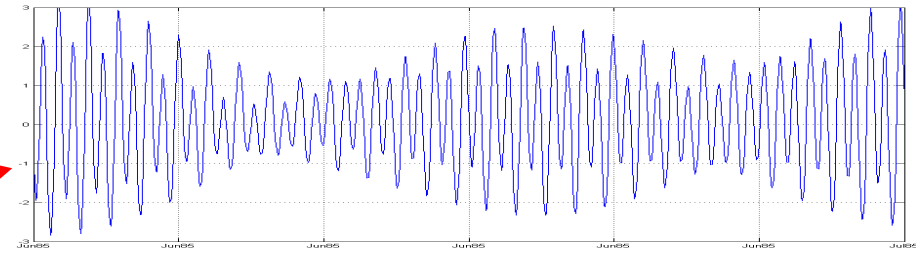


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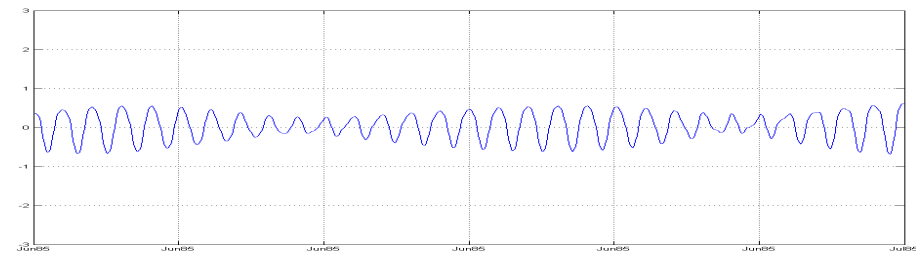
Progress on Marine Energy in MEXICO

Gerardo Hiriart
26 April 2007

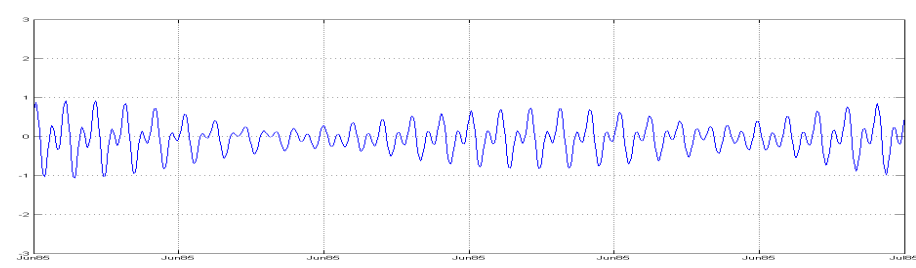
Gulf of California



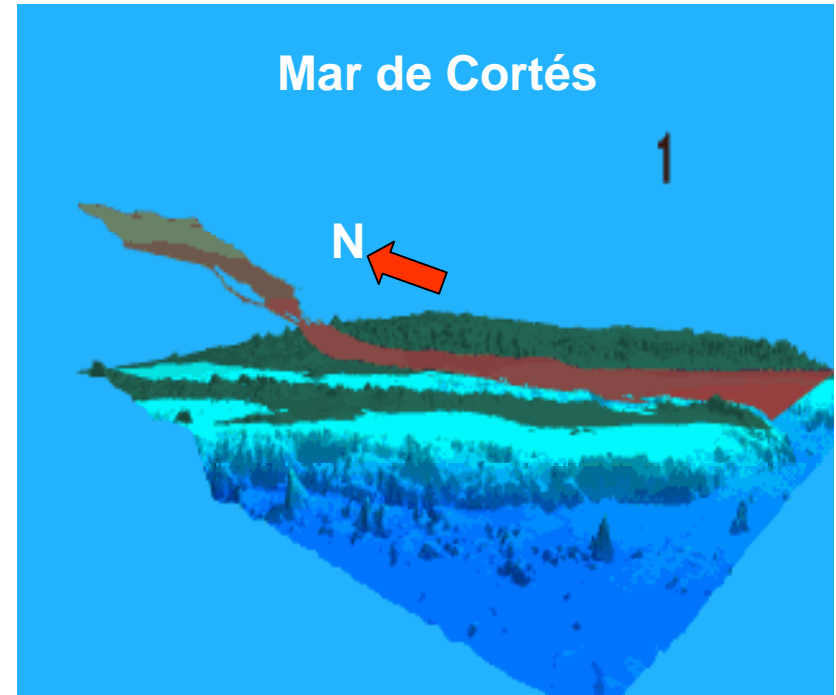
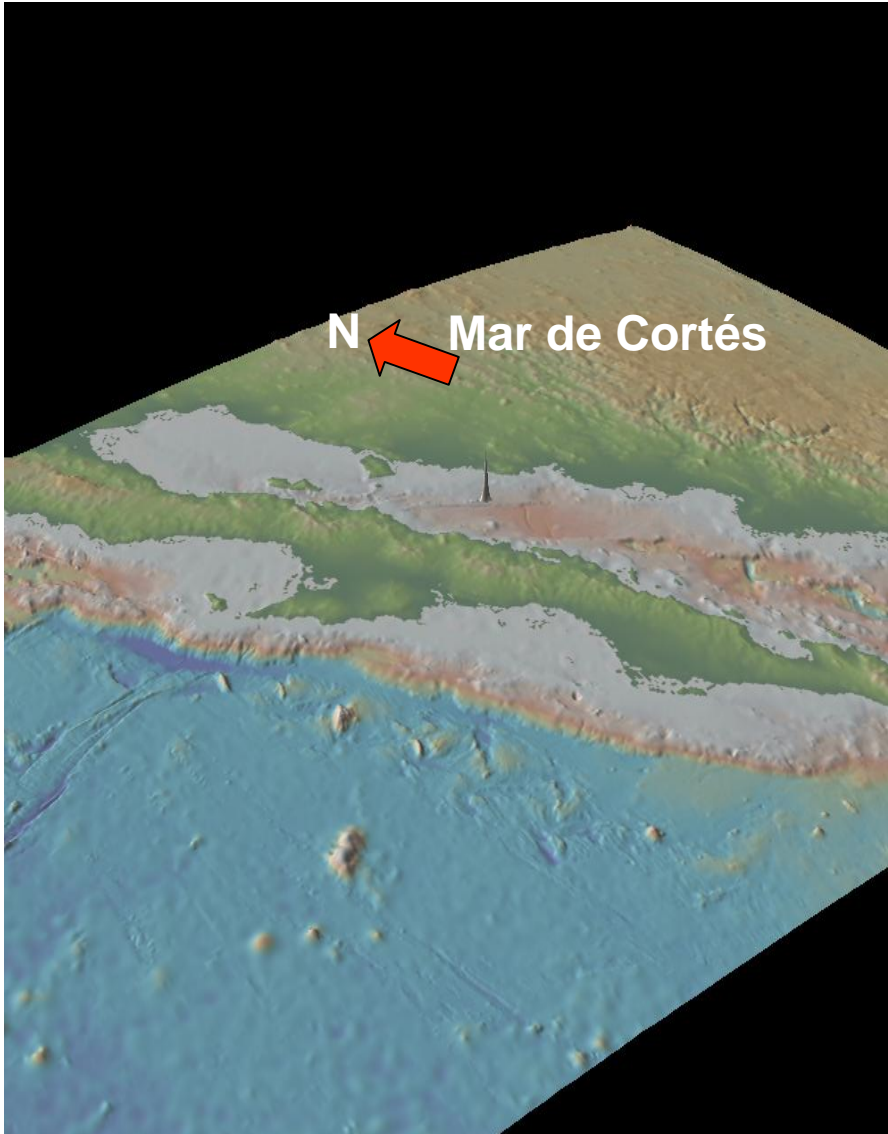
Tide max=6 m



Tide max=1.2 m



Tide max=1.8 m



Cortesía del CICESE

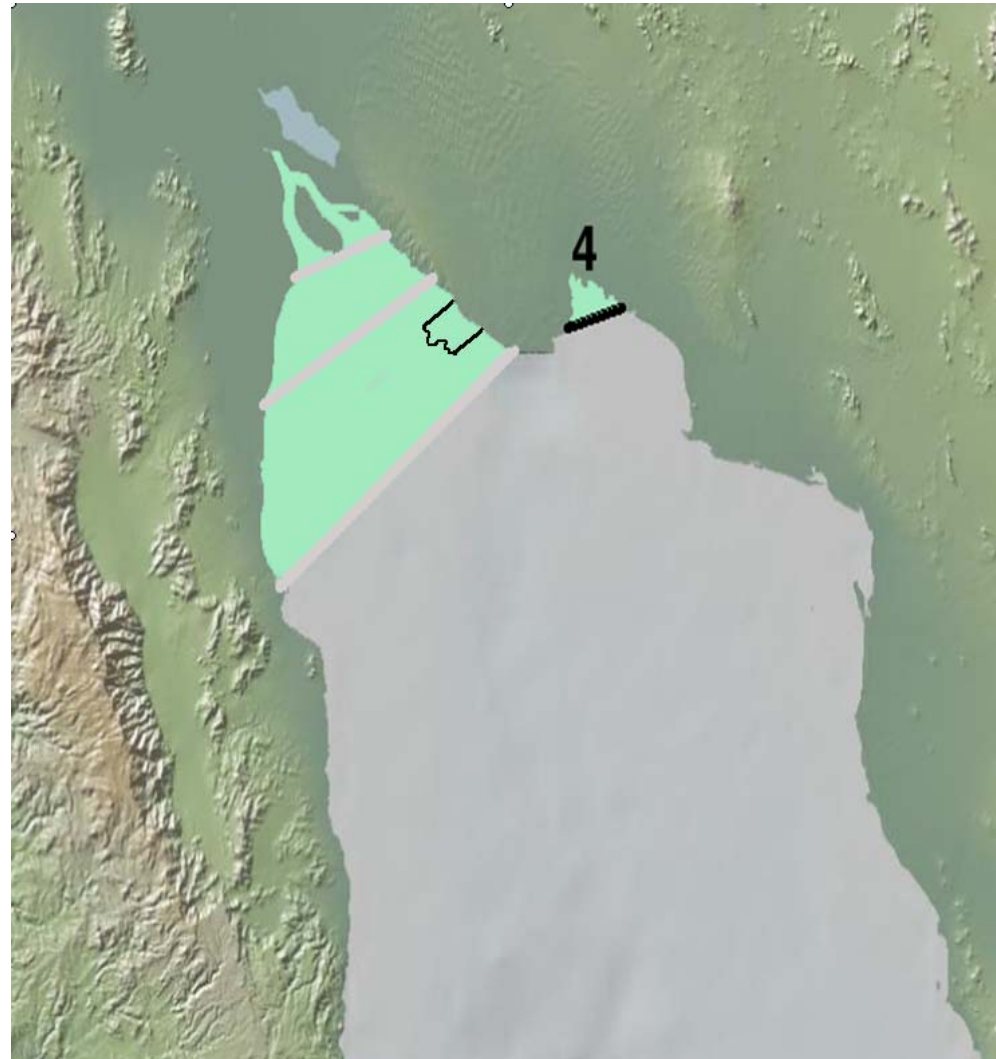
Generation with a single basin

1 Basin area **2,590** km²
 Length of dam **74** km
 Power installed **38,828** MW (FP 6%)
 Annual Generation **21,657** GWh/año

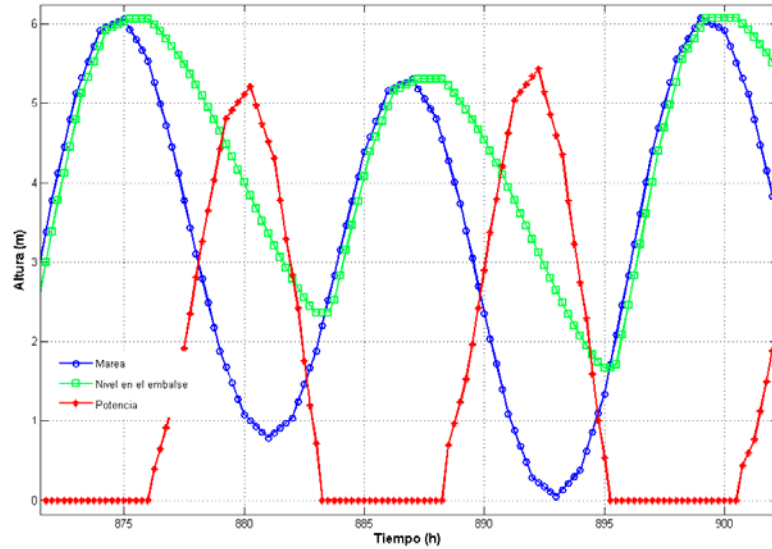
2 Basin area **630** km²
 Length of dam **47** km
 Power installed **9,451** MW (FP 6%)
 Annual Generation **5,260** GWh/año

3 Basin area **130** km²
 Length of dam **16** km
 Power installed **1,979** MW (FP 6%)
 Annual Generation **1,090** GWh/año

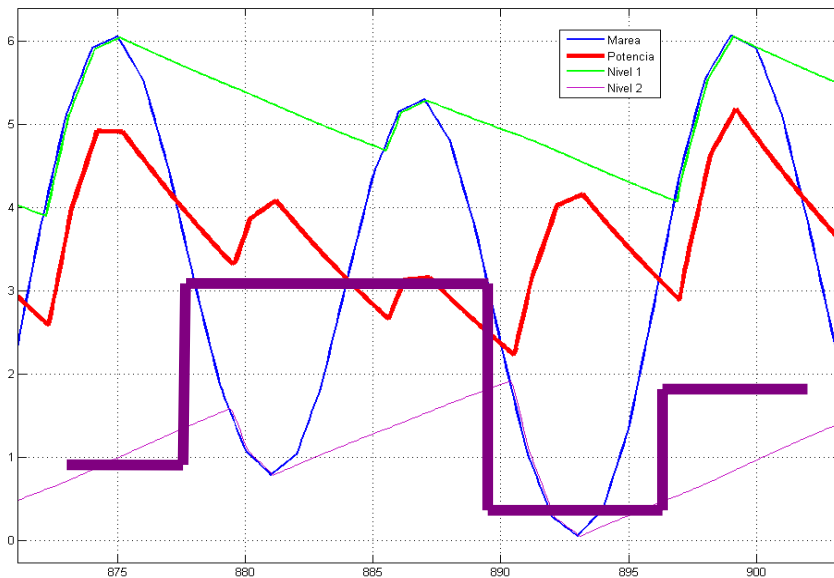
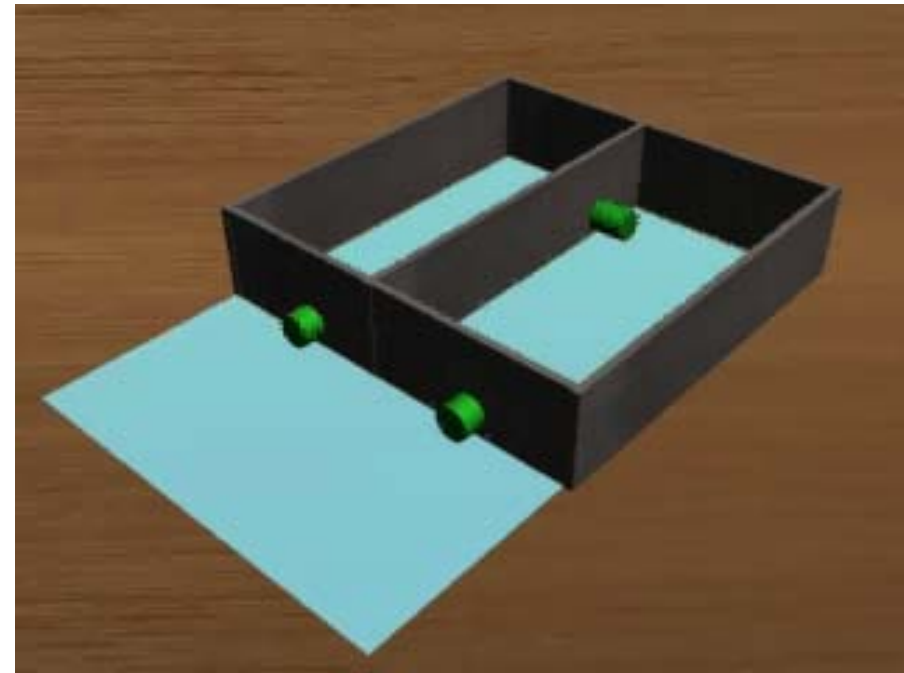
4 Basin area **53** km²
 Length of dam **11** km
 Power installed **766** MW (FP 7%)
 Annual Generation **438** GWh/año



Generation with double basin

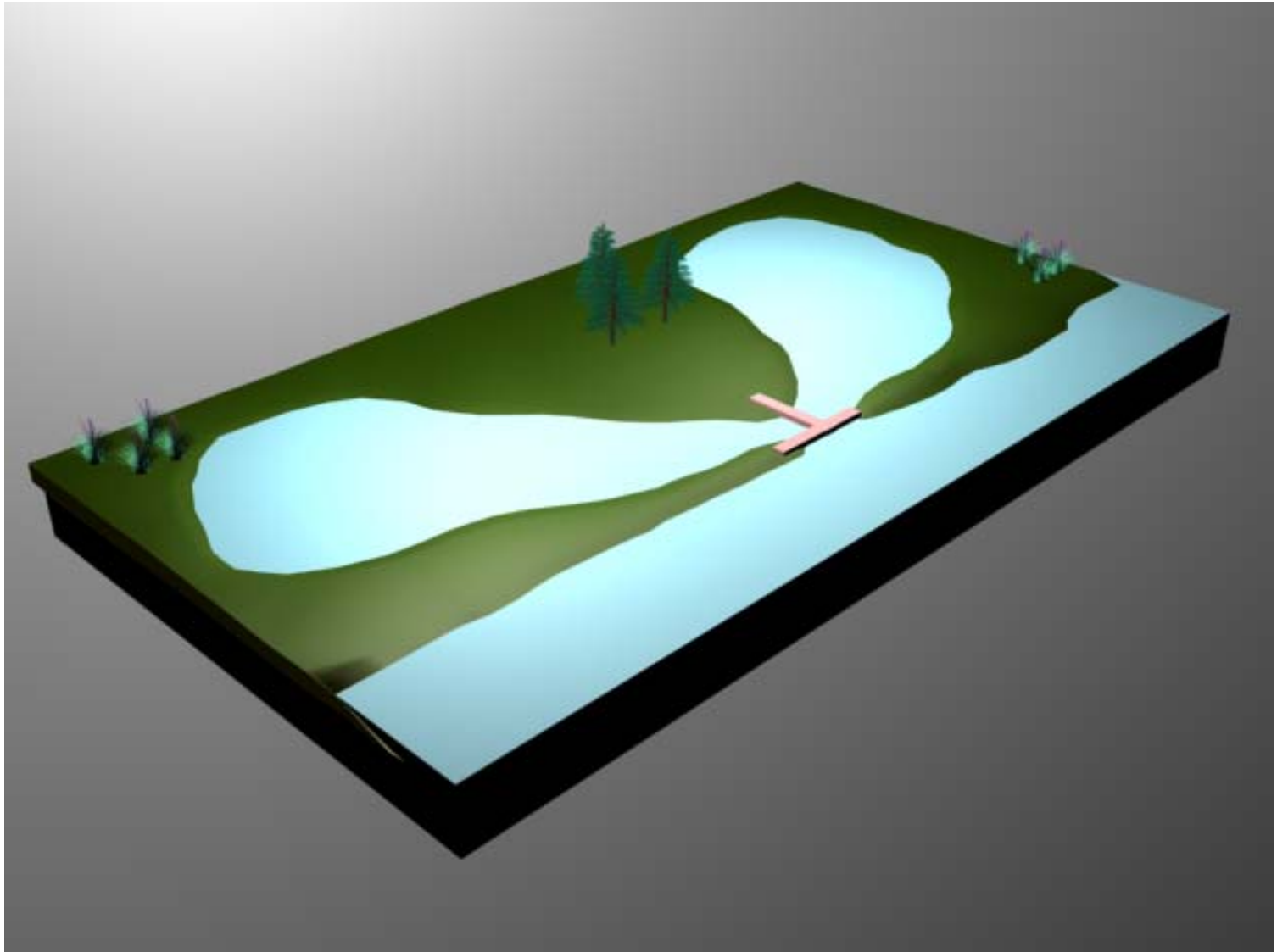


A single basin



Double basin

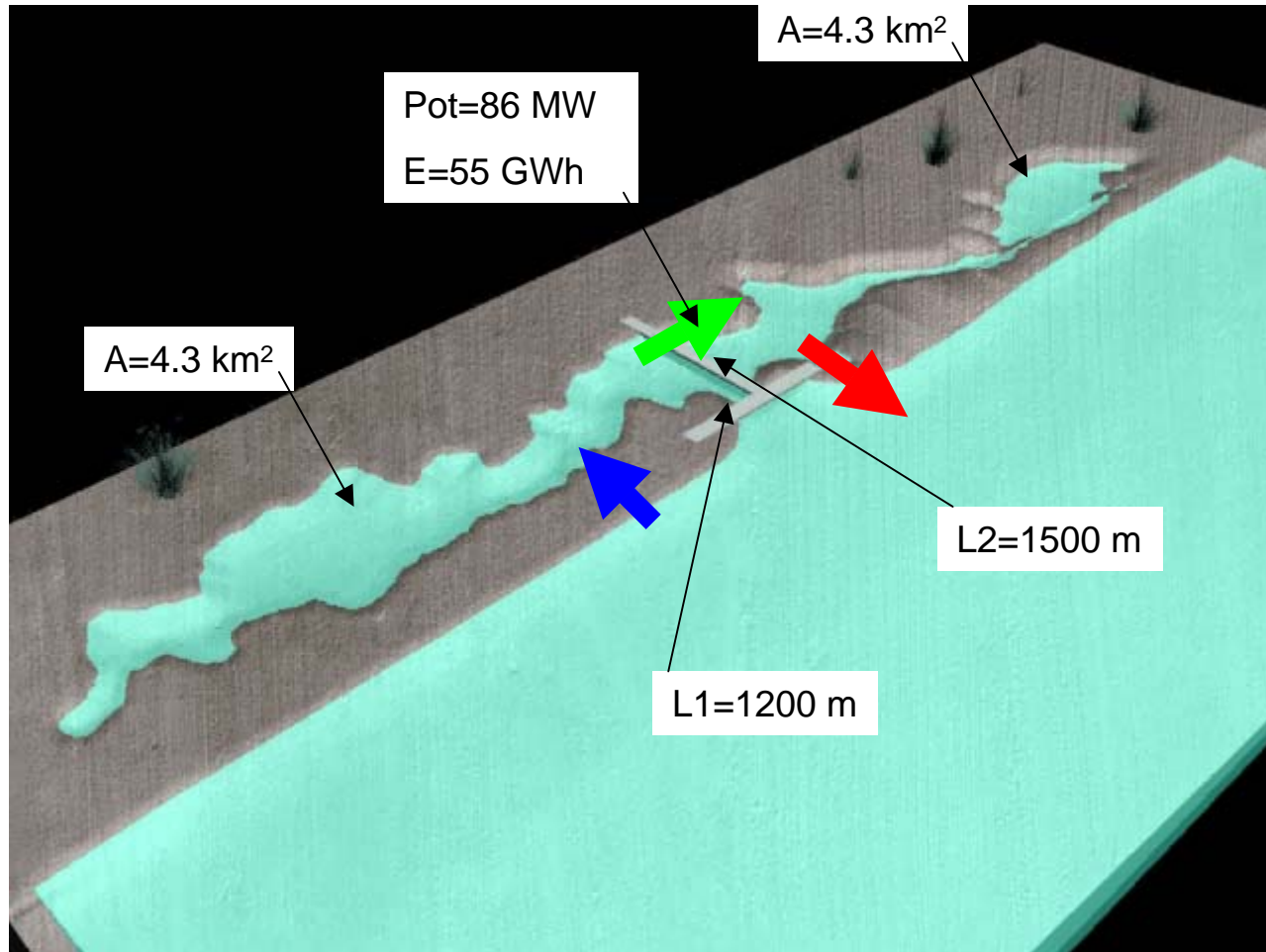
Ideal topography configuration



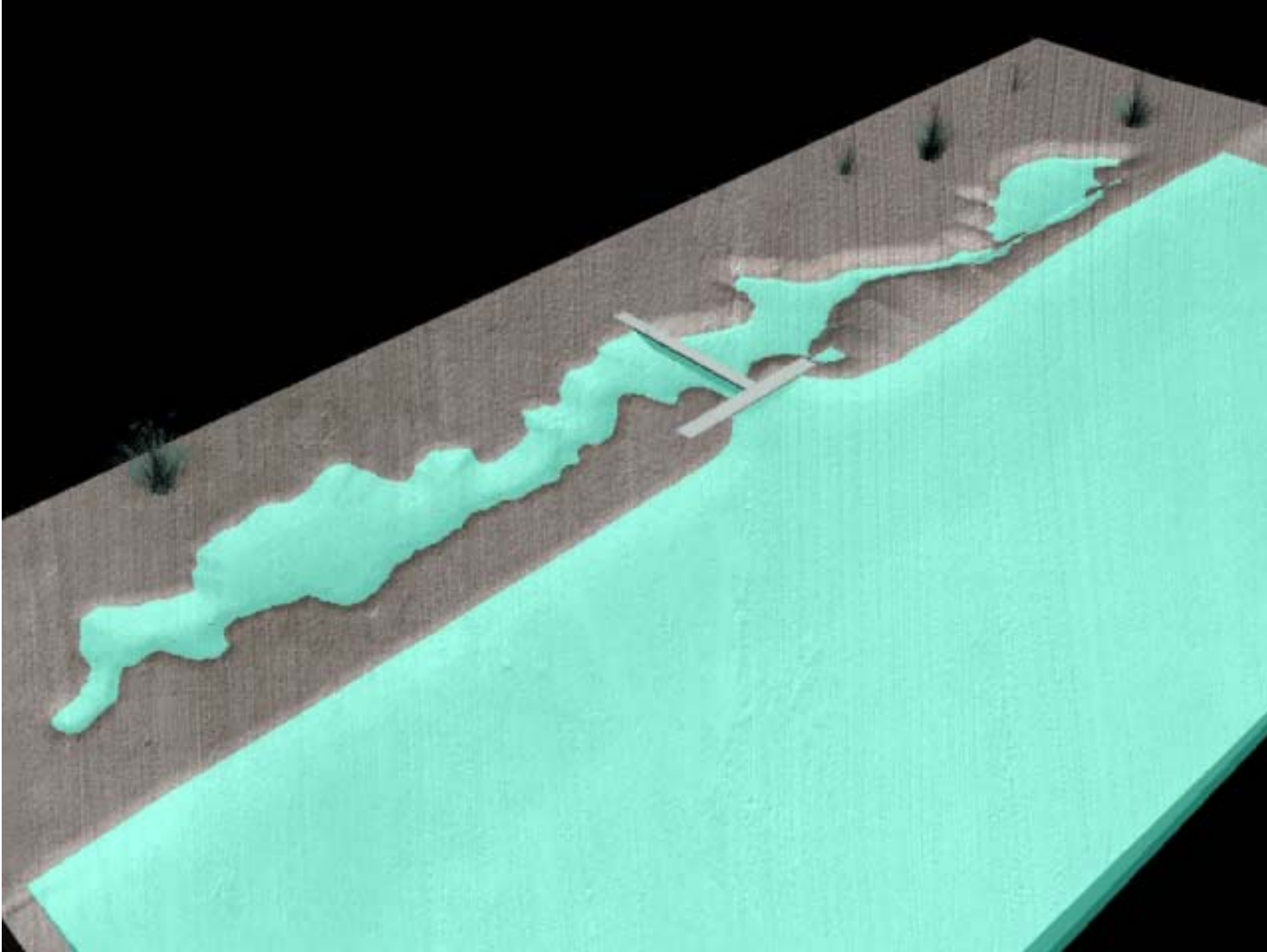
Topography found in Puerto Peñasco



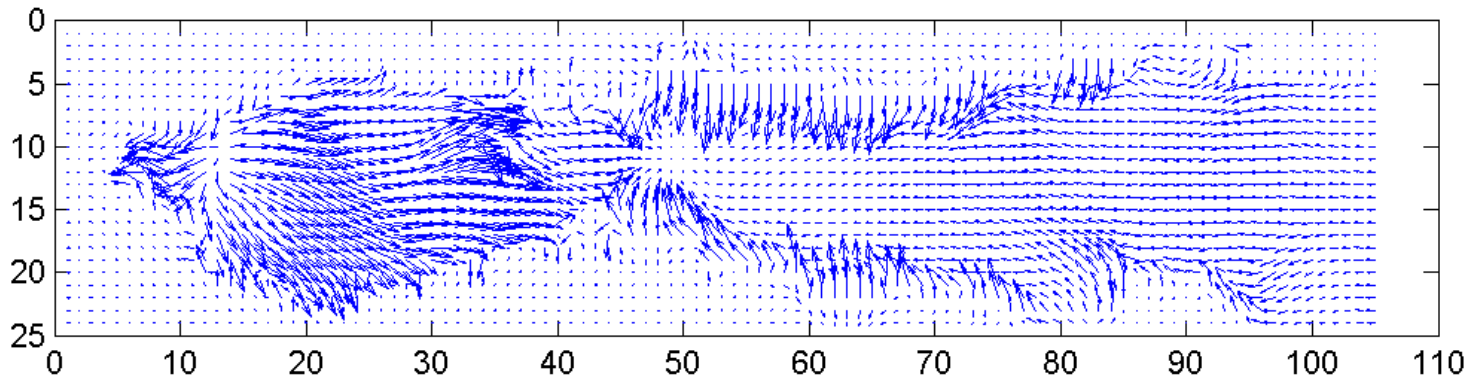
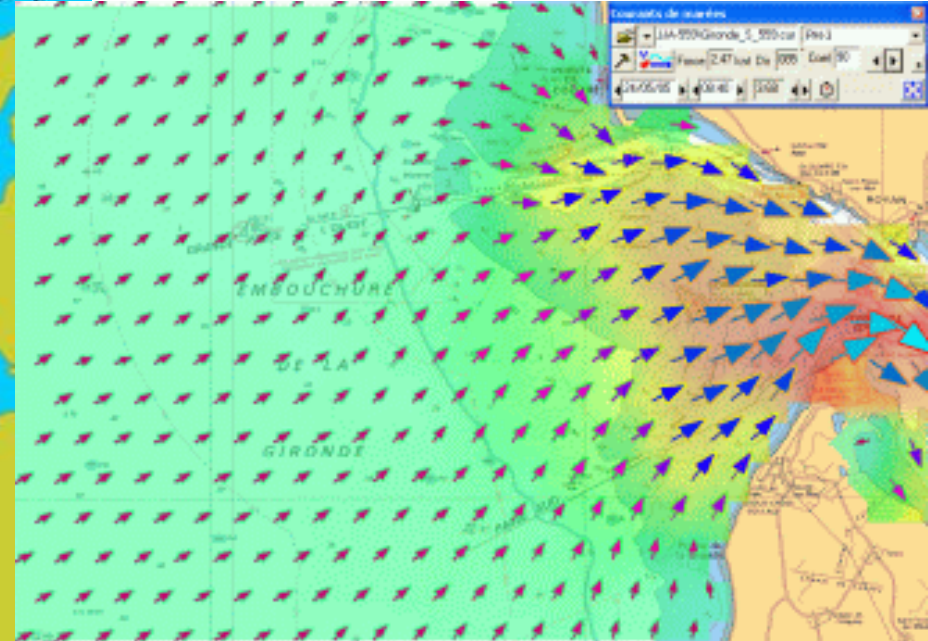
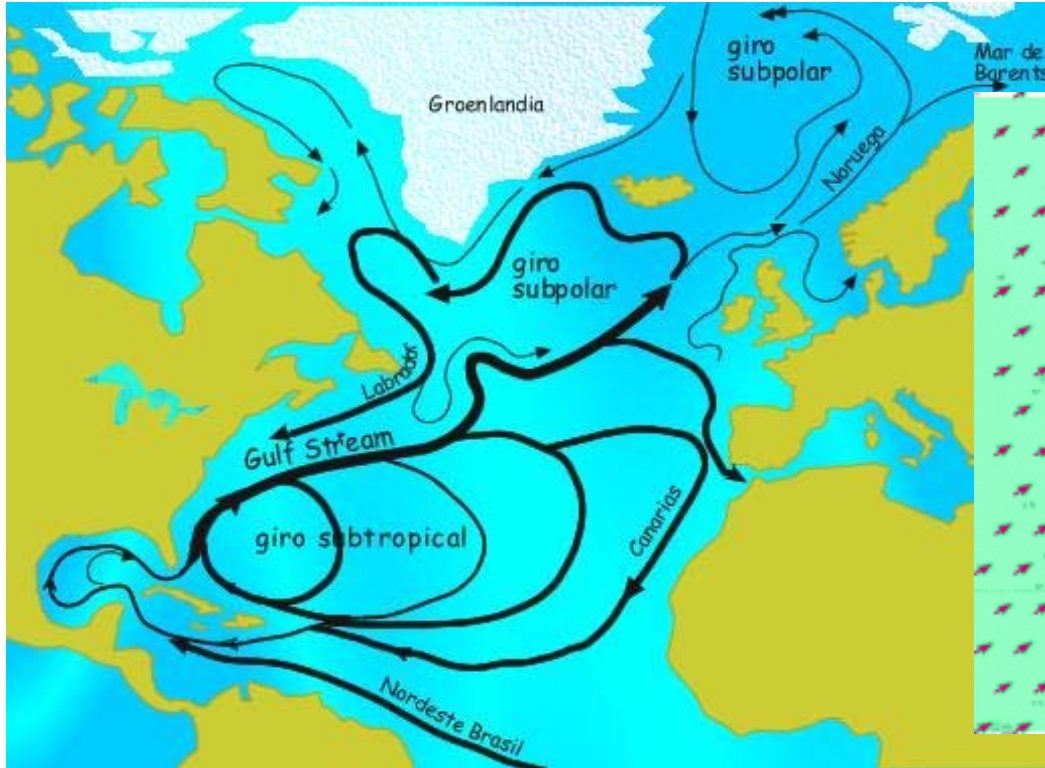
Topography found in Peñasco port



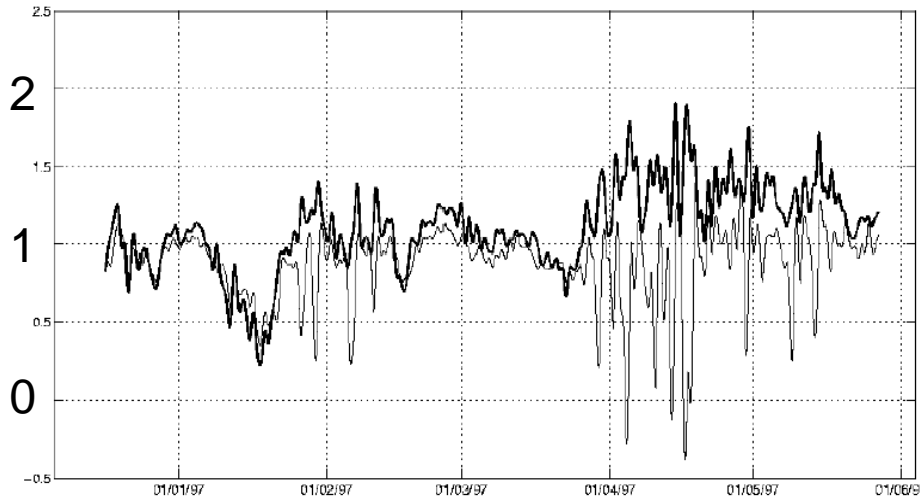
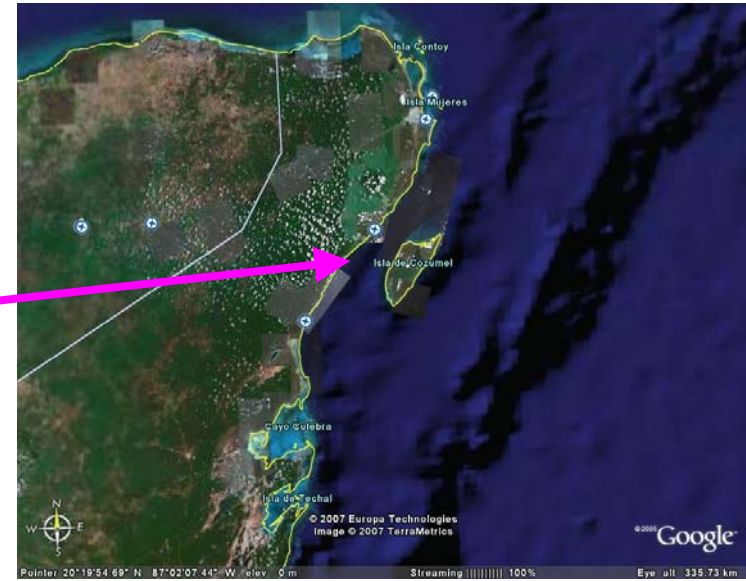
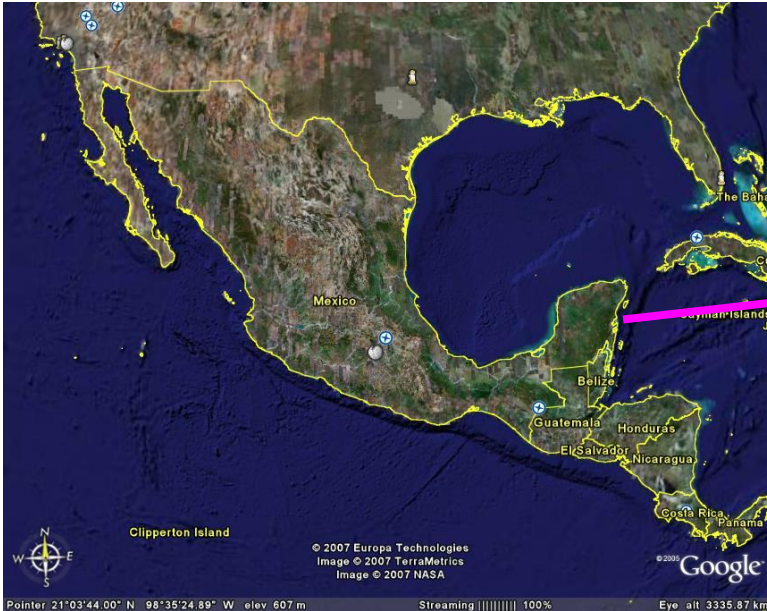
Topography found in Peñasco port



Currents



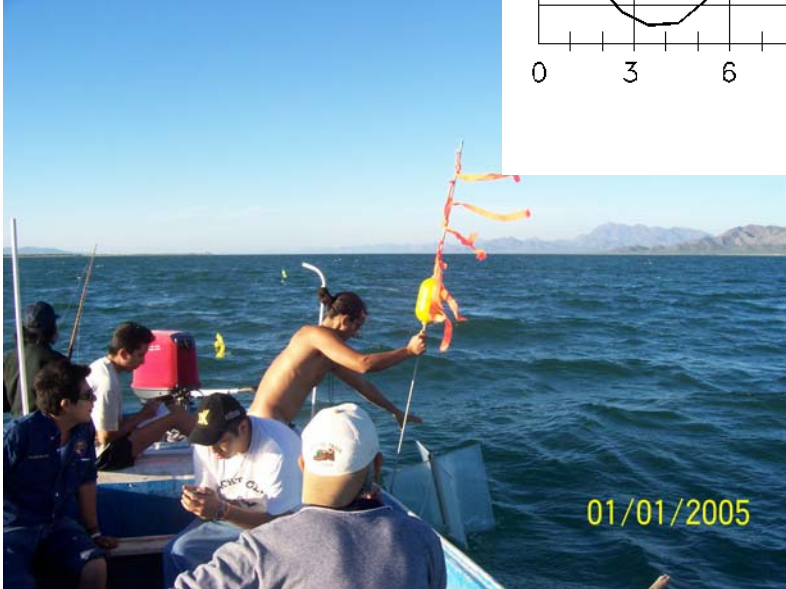
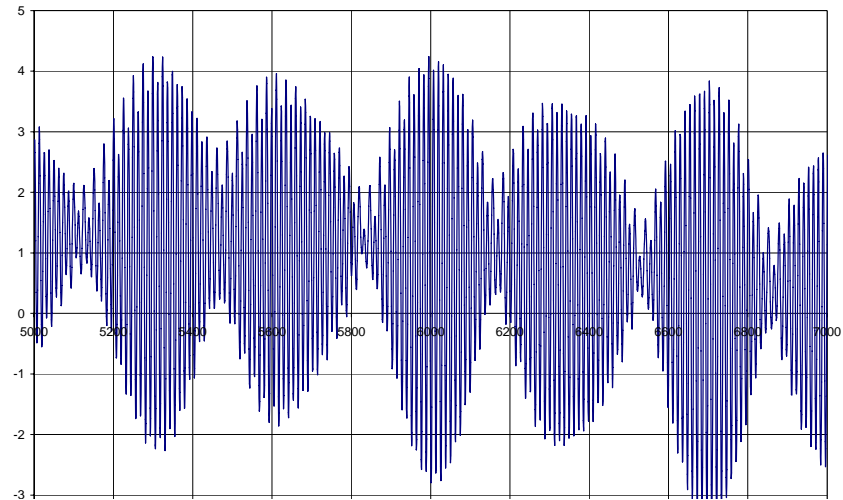
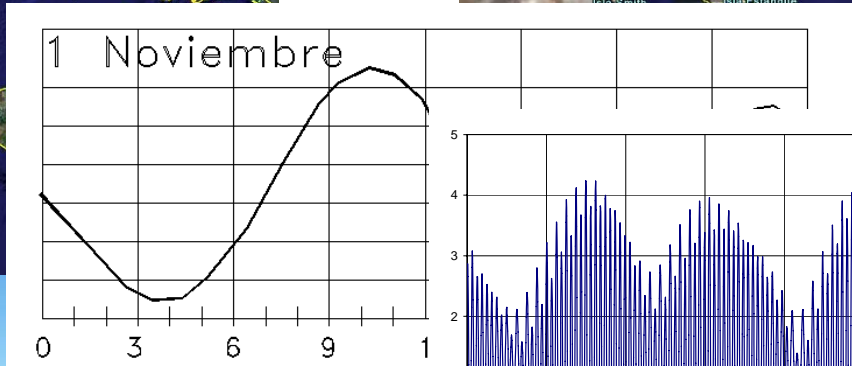
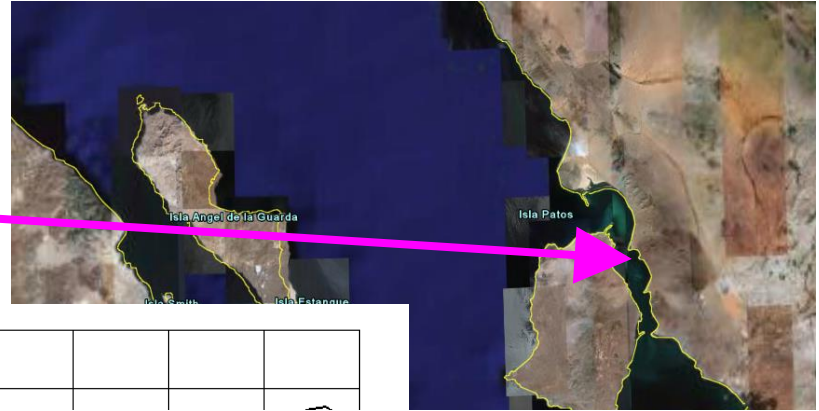
Currents in Cozumel's channel



Data record of 4 days in Cozumel's channel

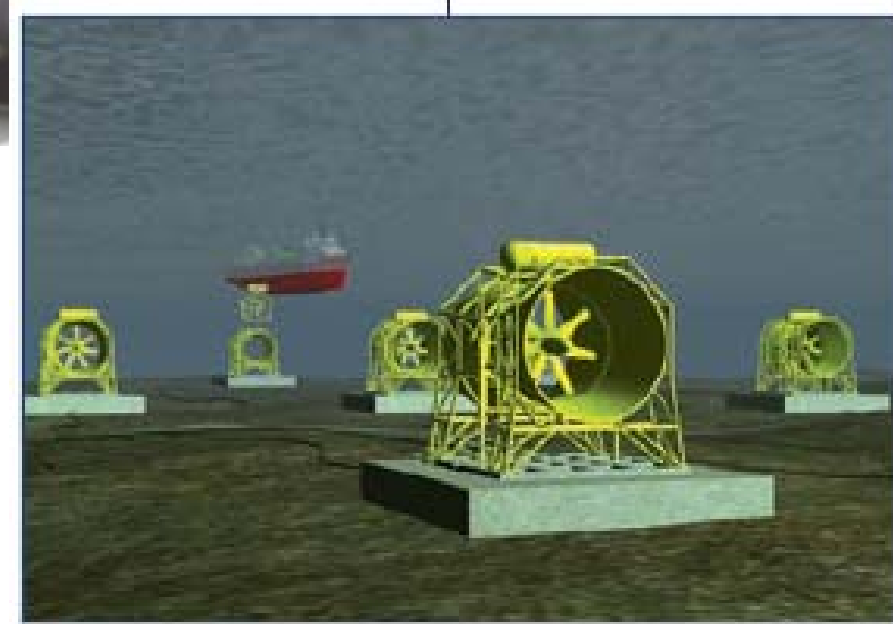
Mean velocity 1.5
Max velocity 3 (m/s)
(Sheinbaum, 2003).

Currents in Infiernillo's channel

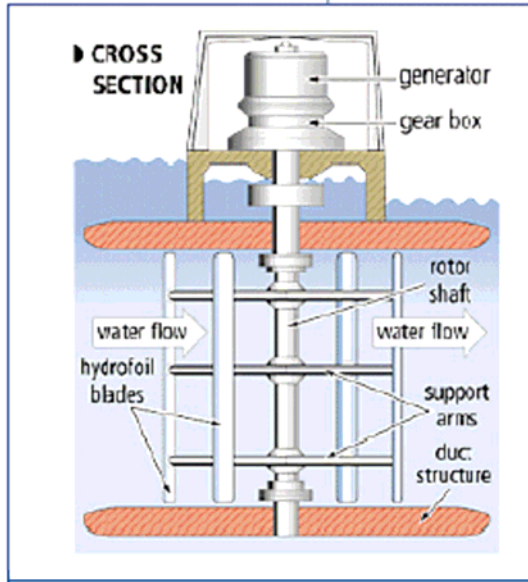
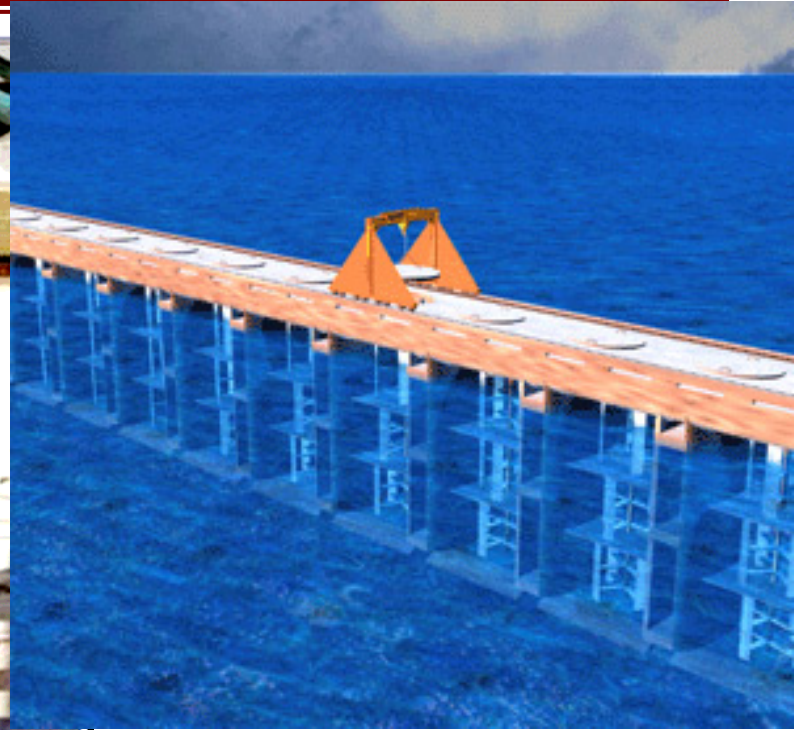
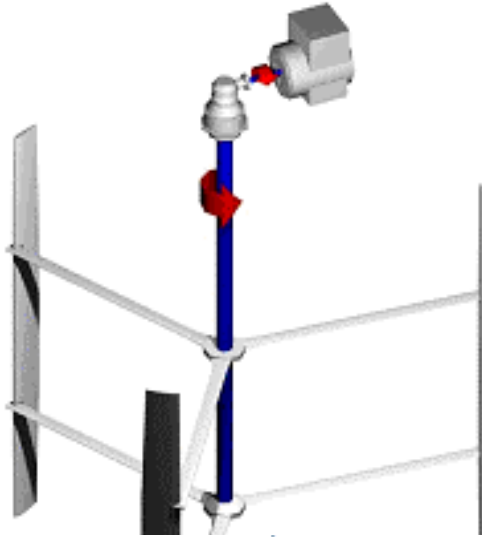


According to CICESE's papers and model result there can be currents about 3 and 4 m/s

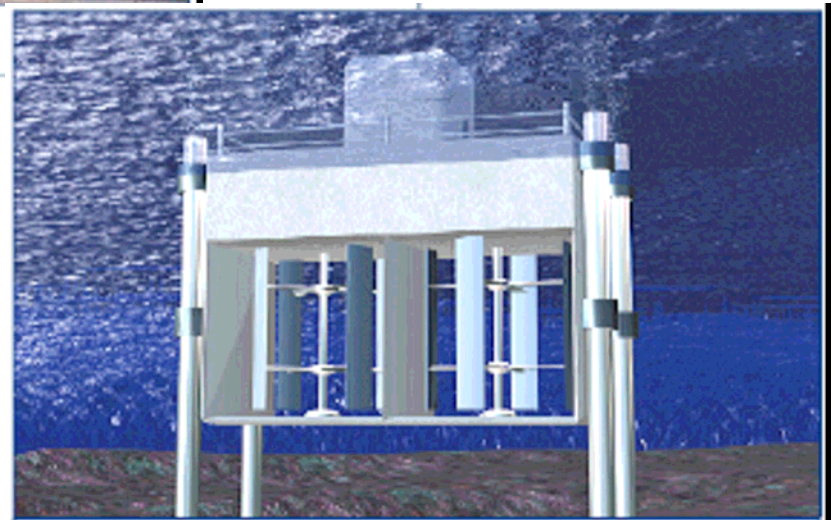
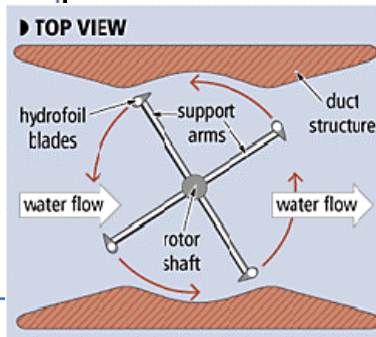
Turbine with horizontal axes



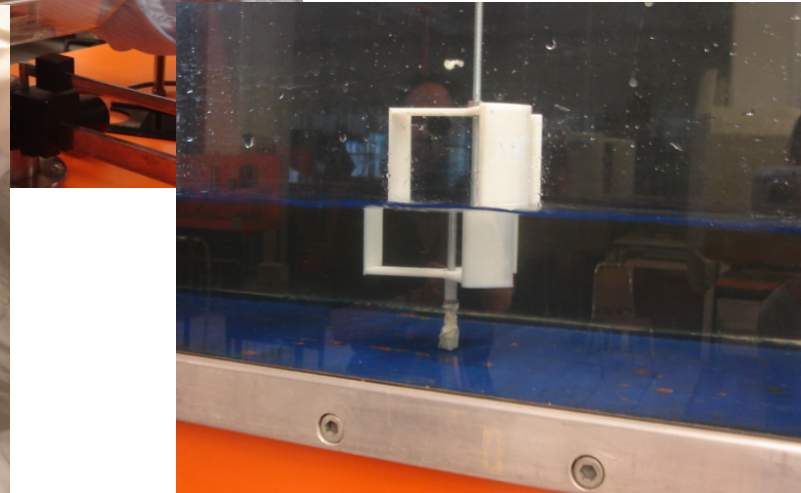
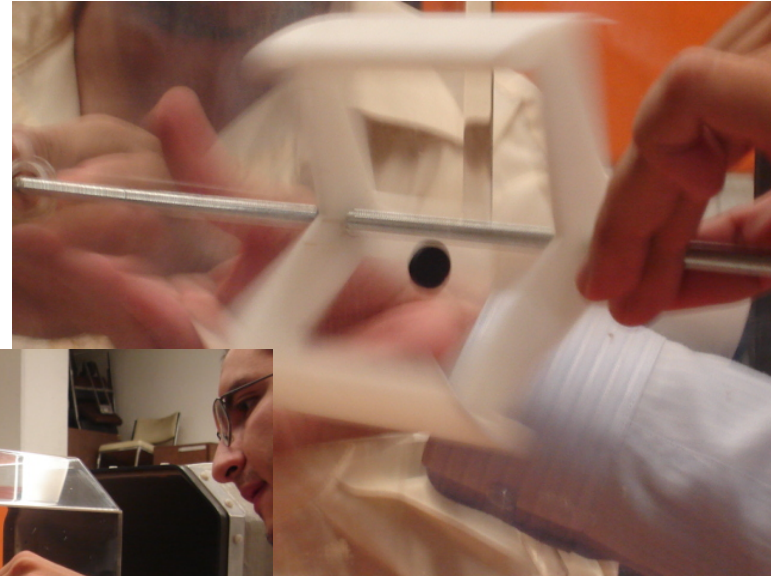
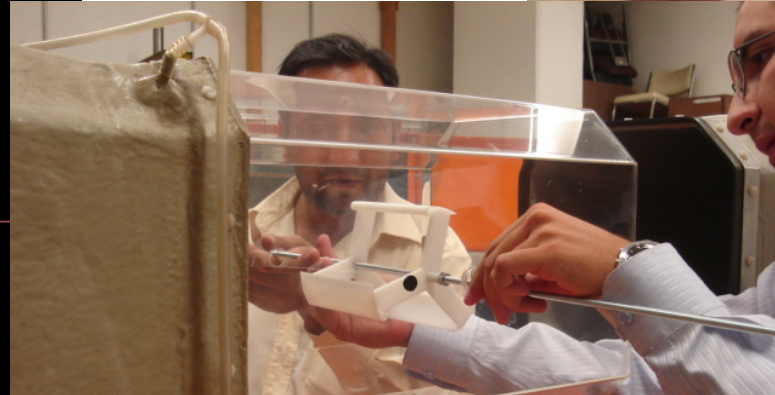
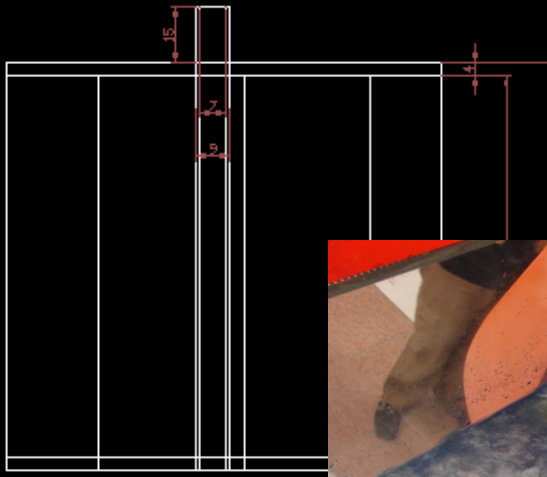
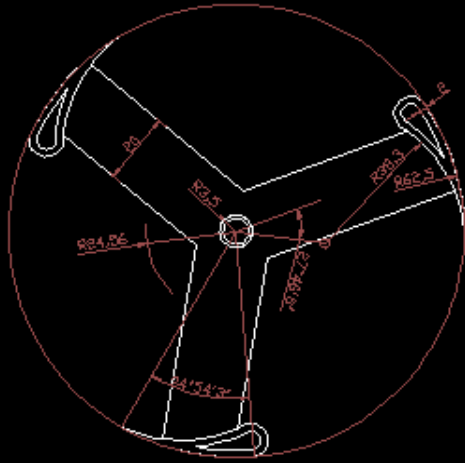
Turbines with vertical axes

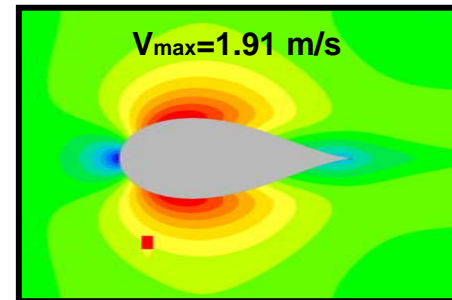
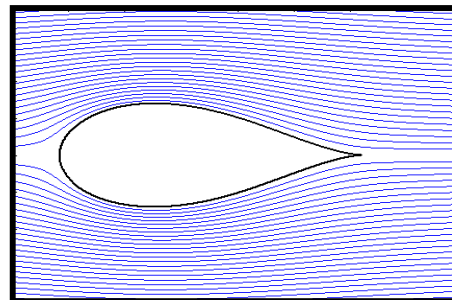
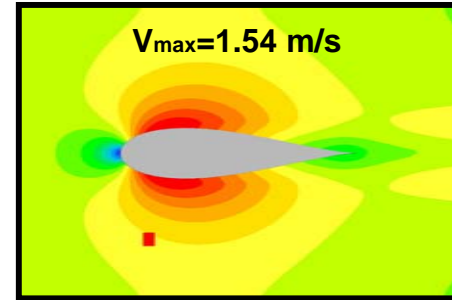
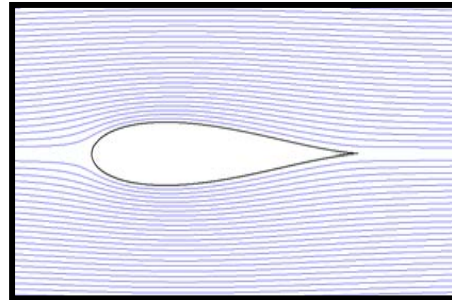
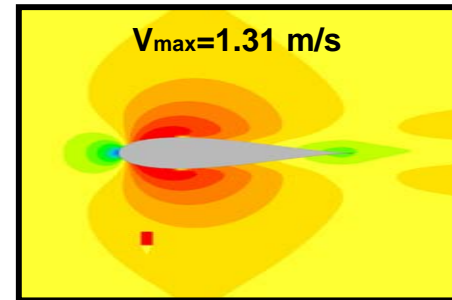
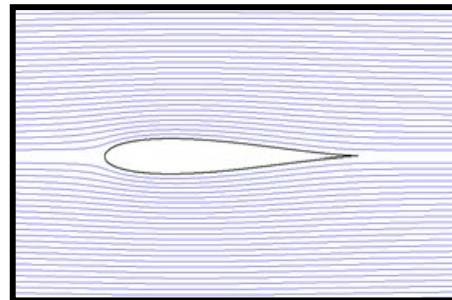


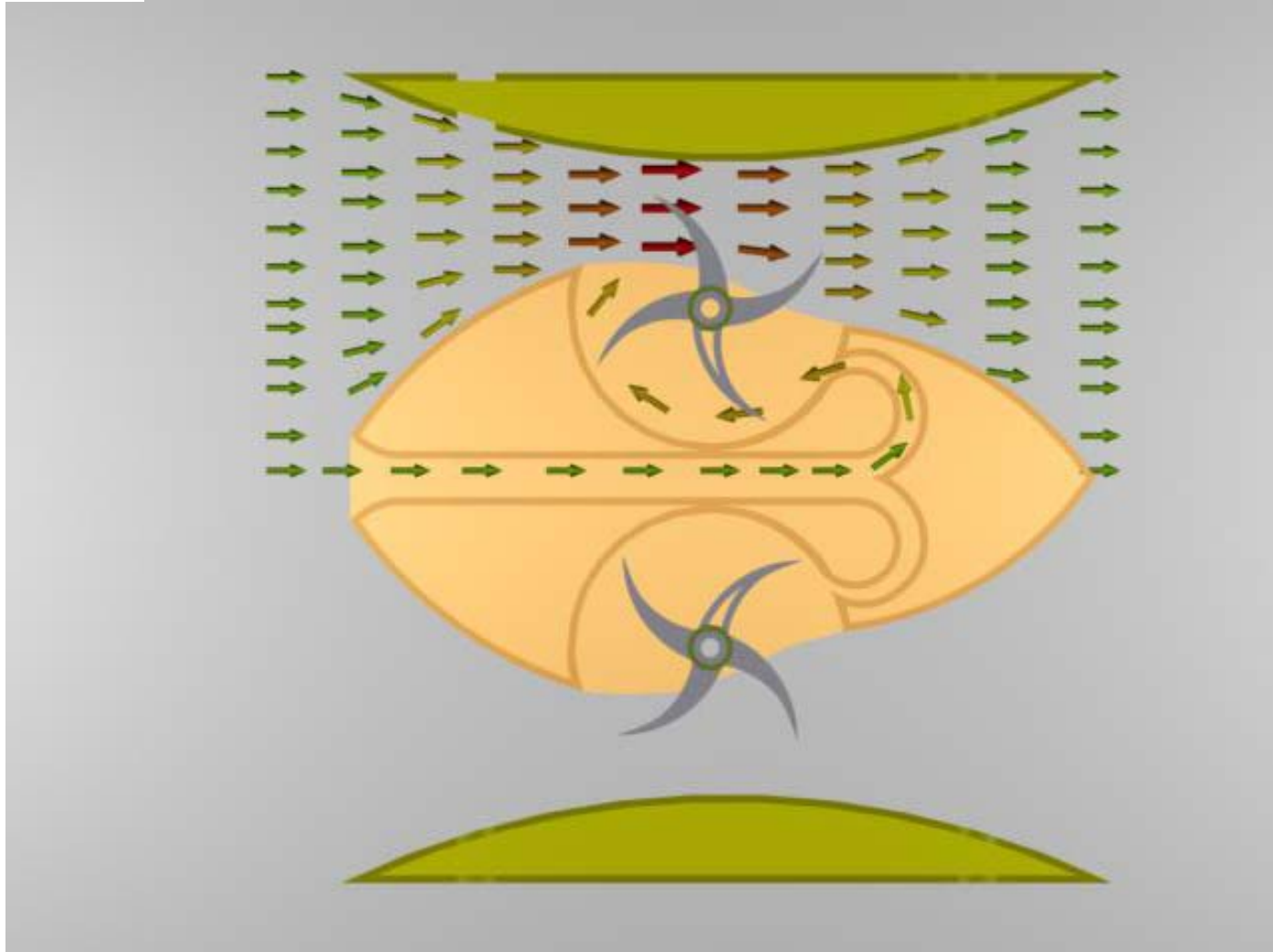
The Gorlov helical tidal turbine.



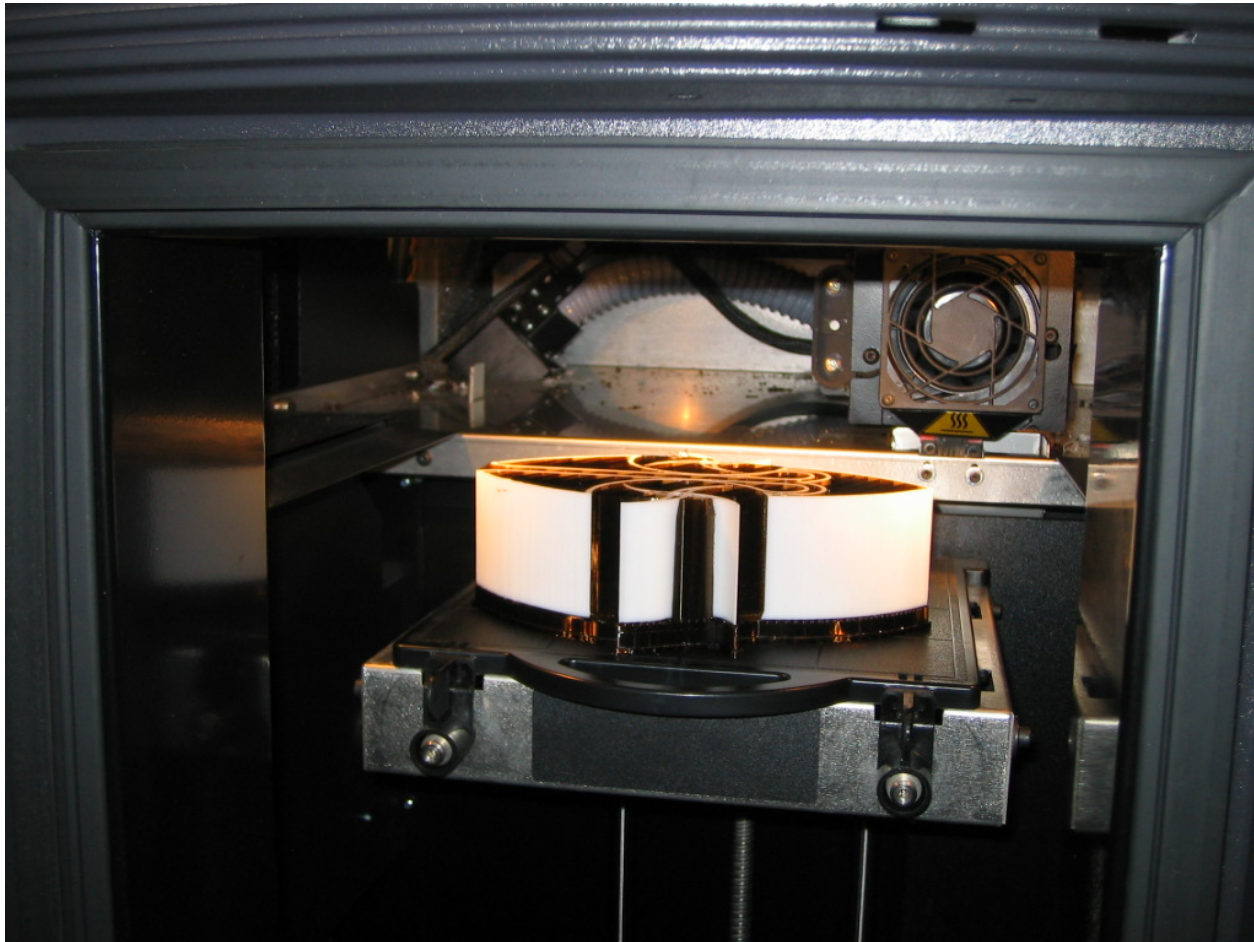
Understanding and training with physic model

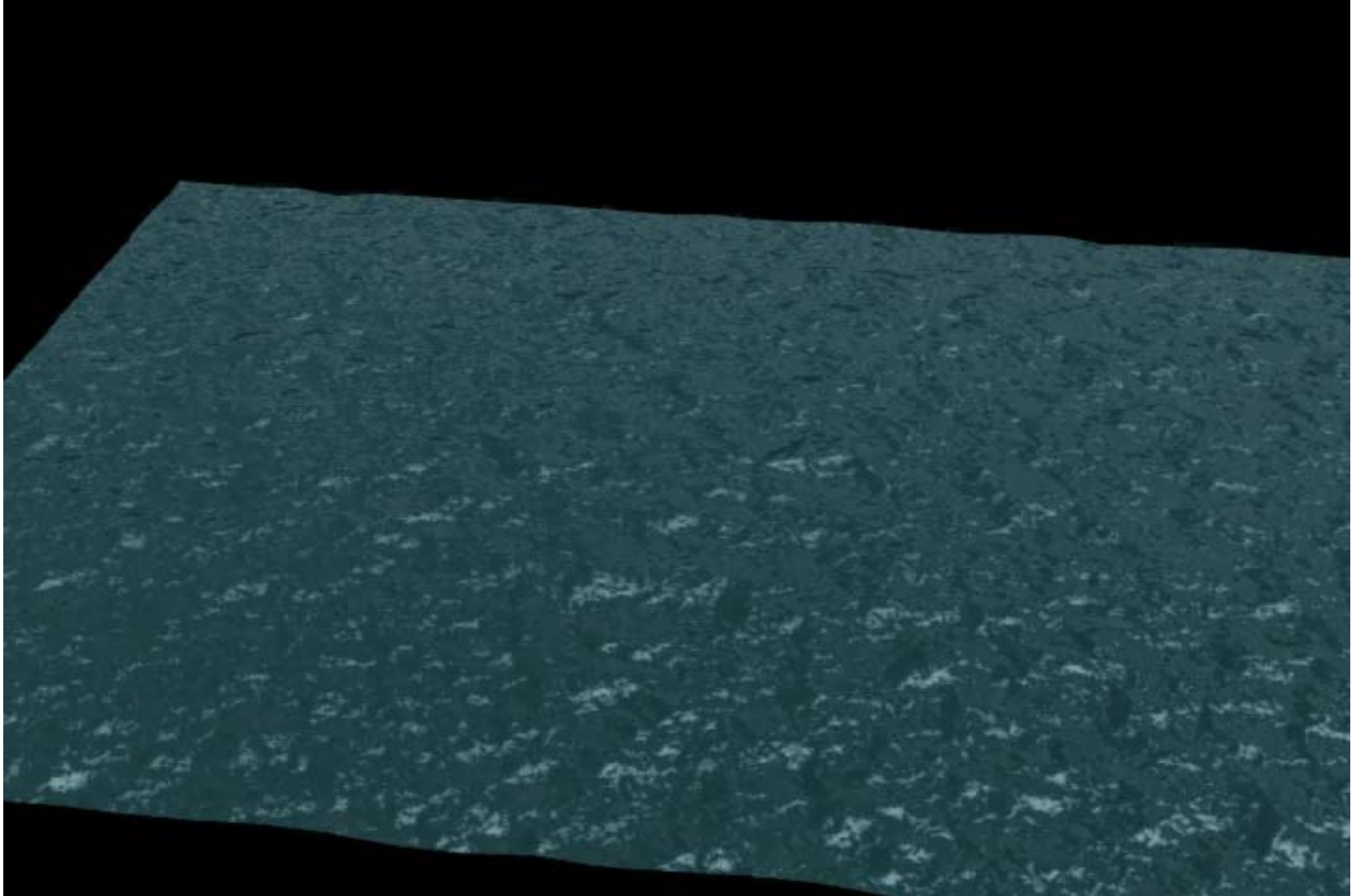






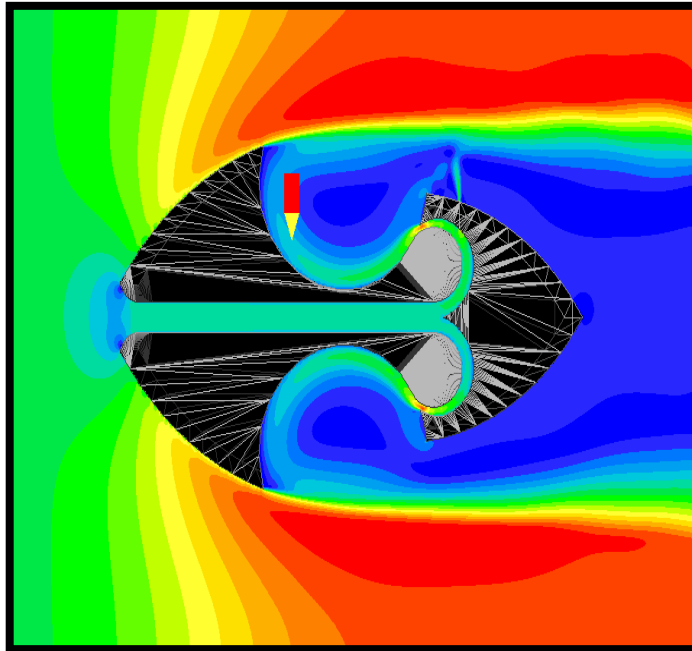
Making our own physic model



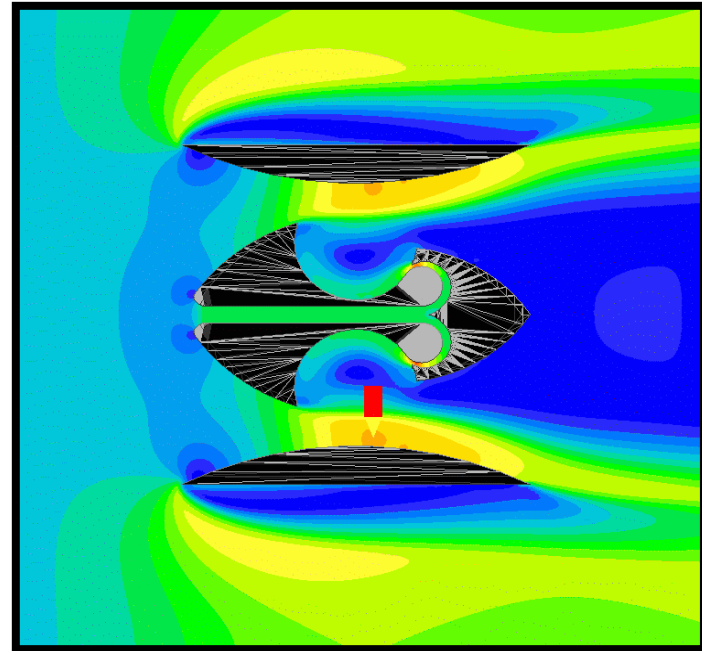




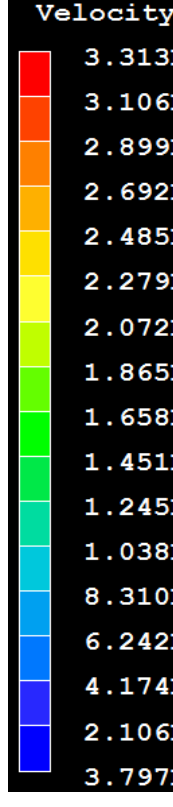
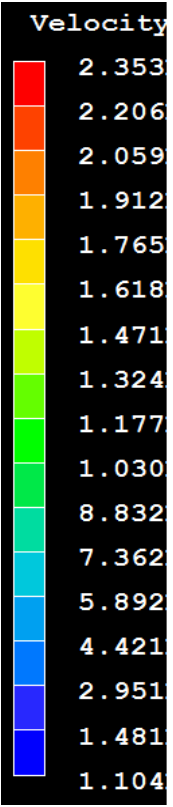
Velocidad inicial= 1 m/s



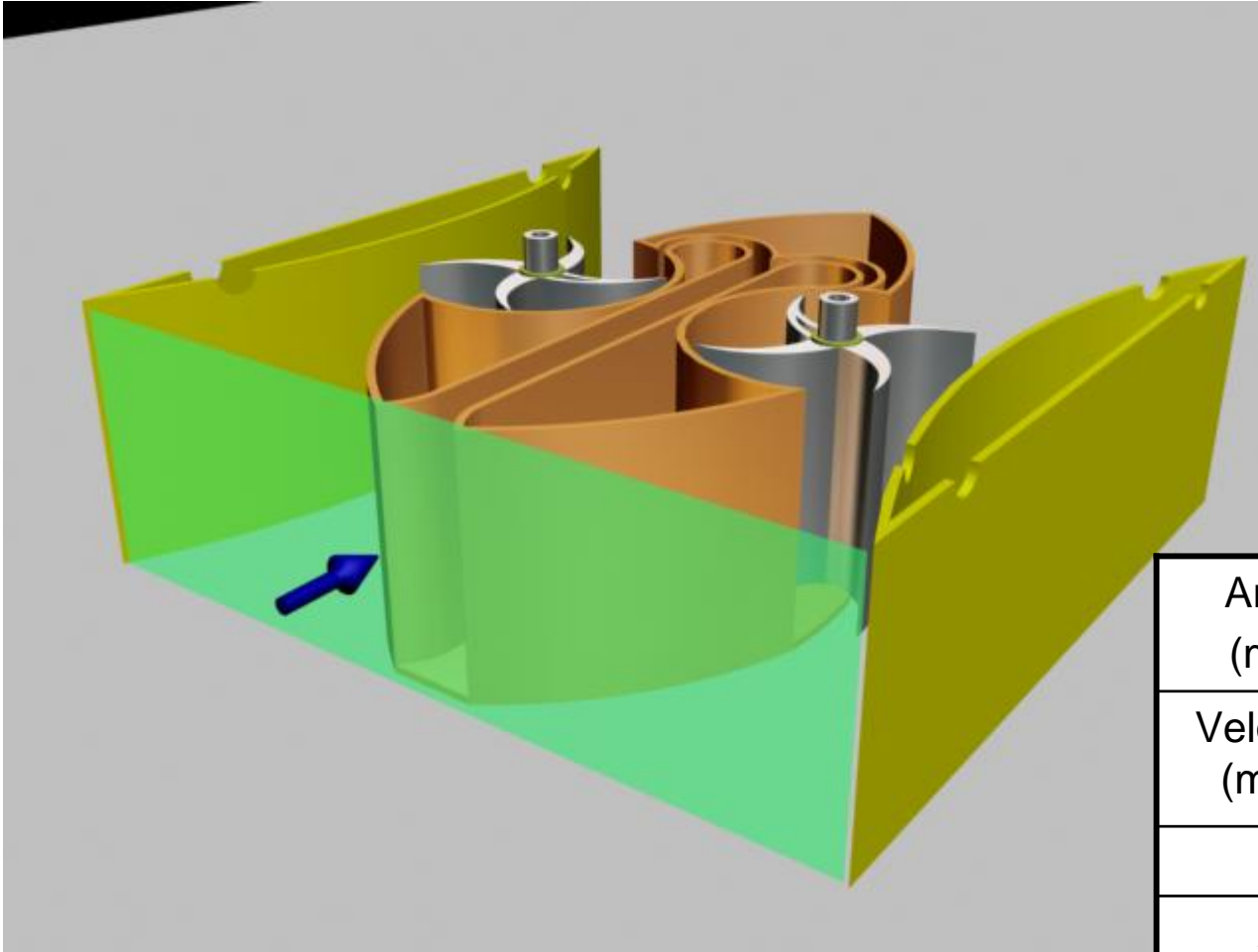
$V_{\max}=2.35$ m/s



$V_{\max}=3.31$ m/s



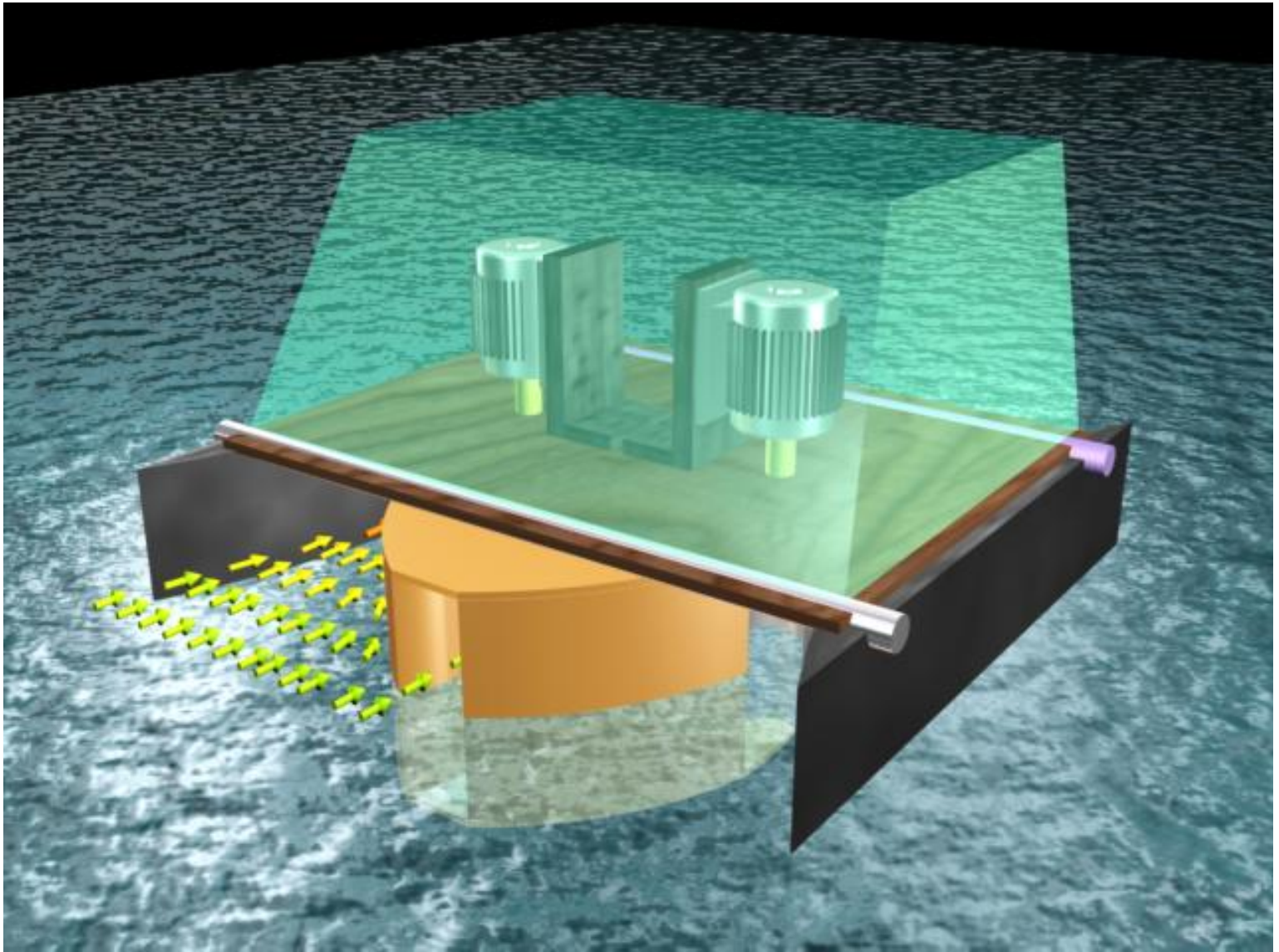
Turbine power



$$Pot = \eta \frac{1}{2} AV^3$$

$$\eta = 0.60$$

Area (m ²)	12	24
Velocity (m/s)	Power (kW)	Power (kW)
1	4	7
2	29	58
3	97	194

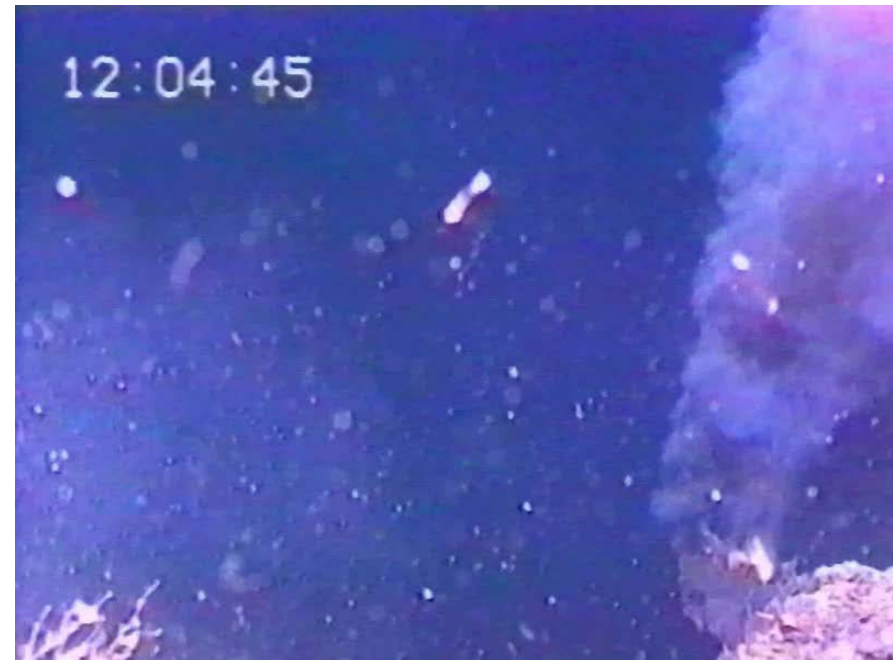




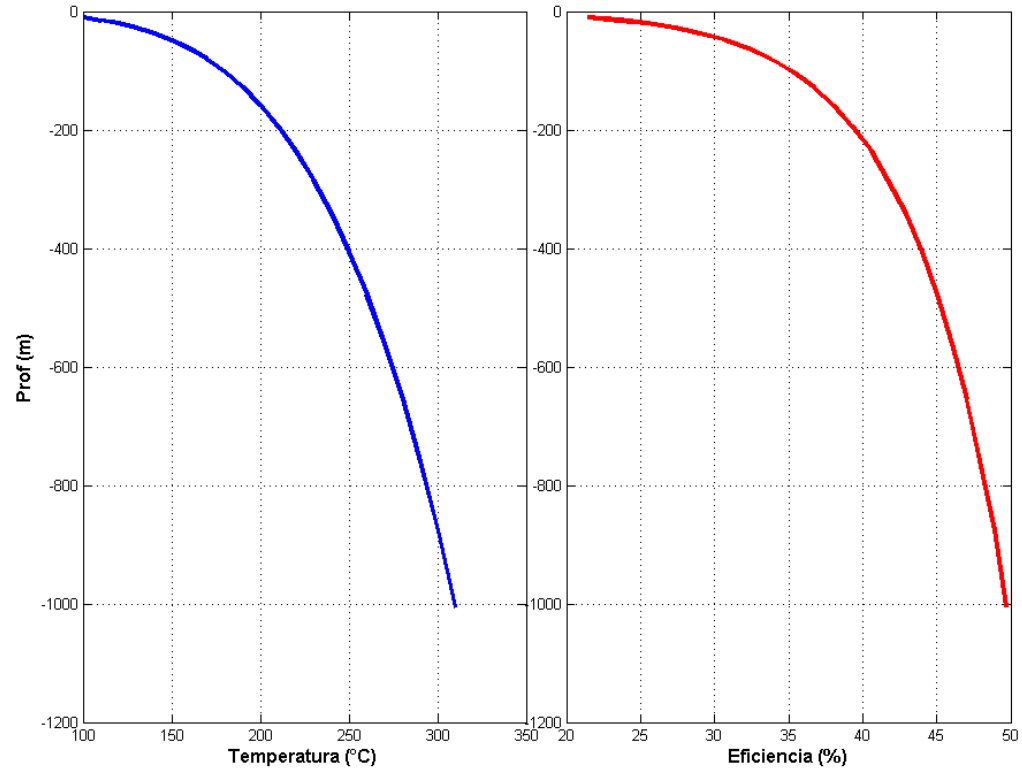
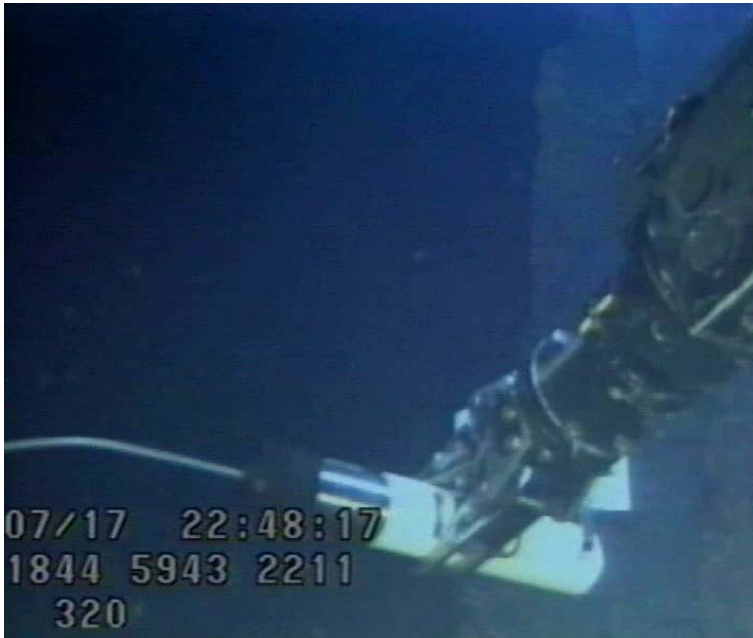
Taking advantage of hot
hydrothermal vents to generate
electrical energy



- Fosa de Wagner (Puerto Peñasco)
- Guaymas
- Canal de ballenas



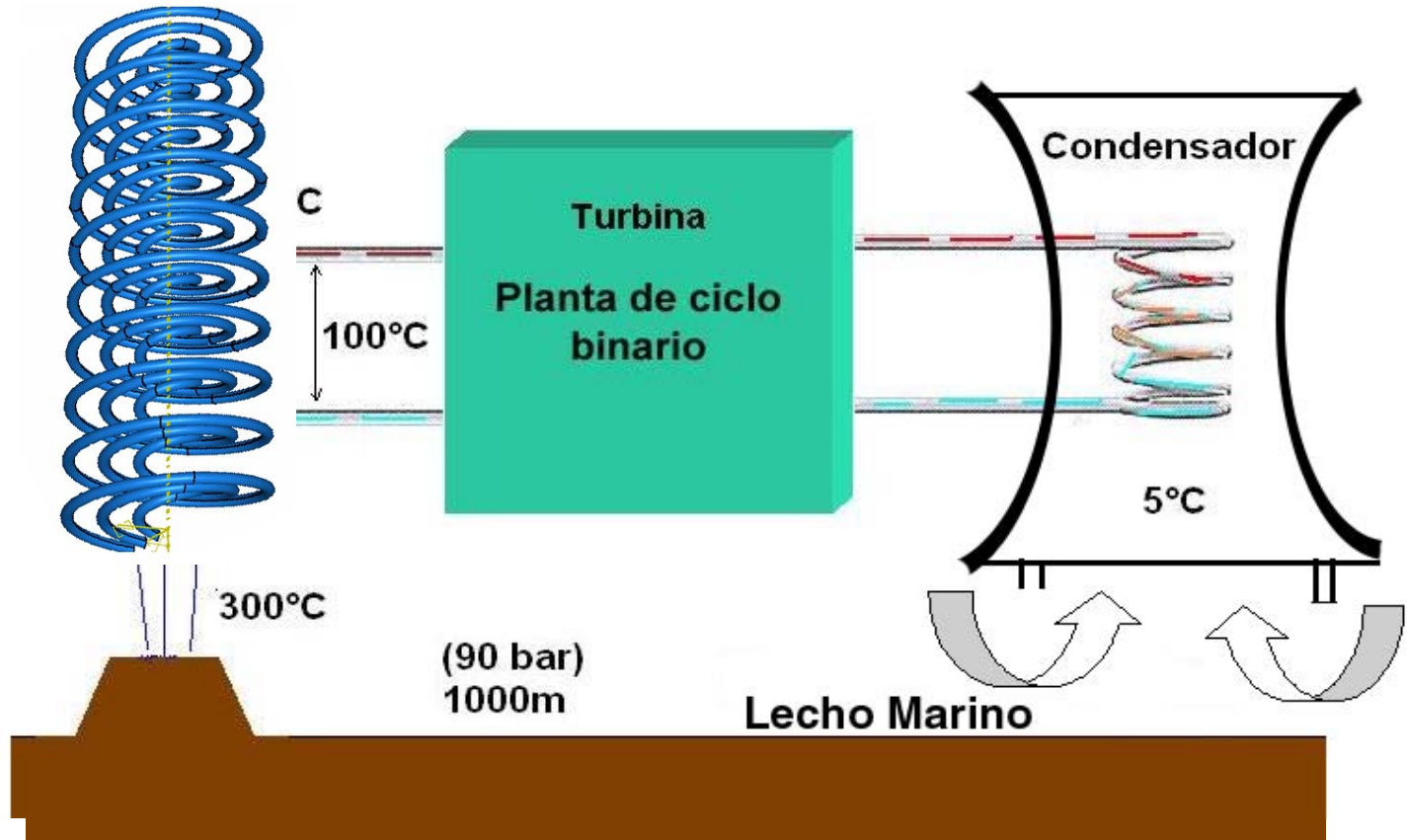
Hydrothermal vents with high temperature



Hydrothermal vents with high temperature



Scheme of operation



Power installed

MW electricos netos	Temperatura de entrada [°C]	180			
	La eficiencia de transformación	17.14			
	Diametro de la salida [in]	10	20	30	40
	Área de la salida [m ²]	0.05	0.20	0.46	0.81
Velocidad del chorro [m/s]	0.2	0.58	2.32	5.23	9.30
	0.5	1.45	5.81	13.08	23.25
	1.0	2.91	11.62	26.16	46.50
	2.0	5.81	23.25	52.31	93.00

Potencia Instalada: **23** [MW]
 Velocidad del chorro: **0.5** [m/s]
 Diámetro de salida: **40** [in]

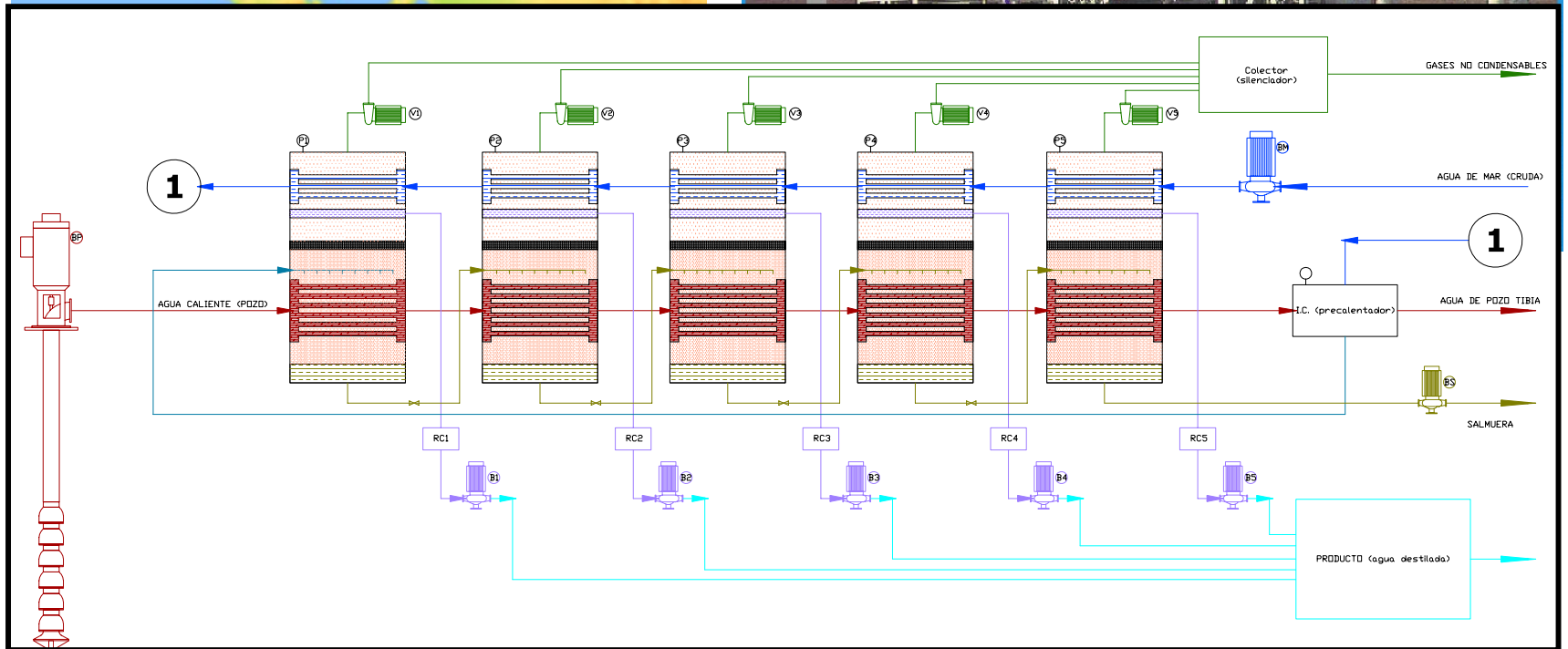
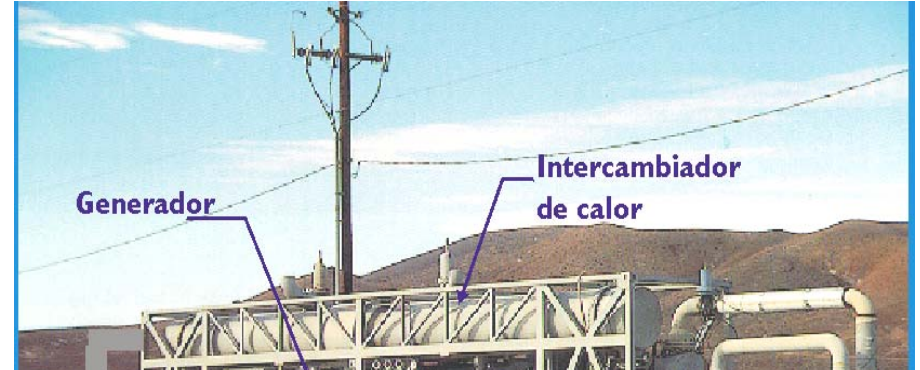
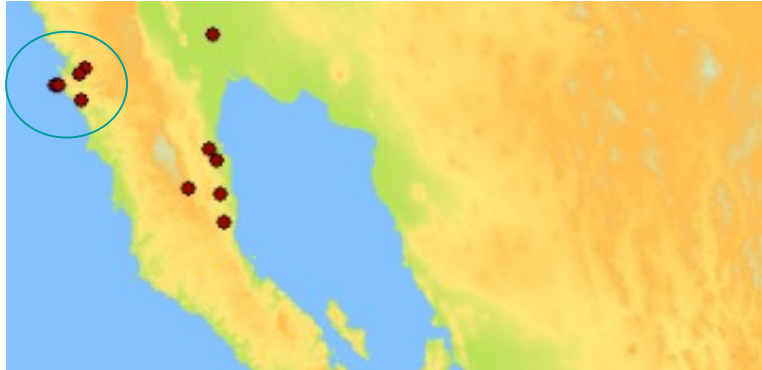
Potencia Instalada: **1.4** [MW]
 Velocidad del chorro: **0.5** [m/s]
 Diámetro de salida: **10** [in]

Hot Water

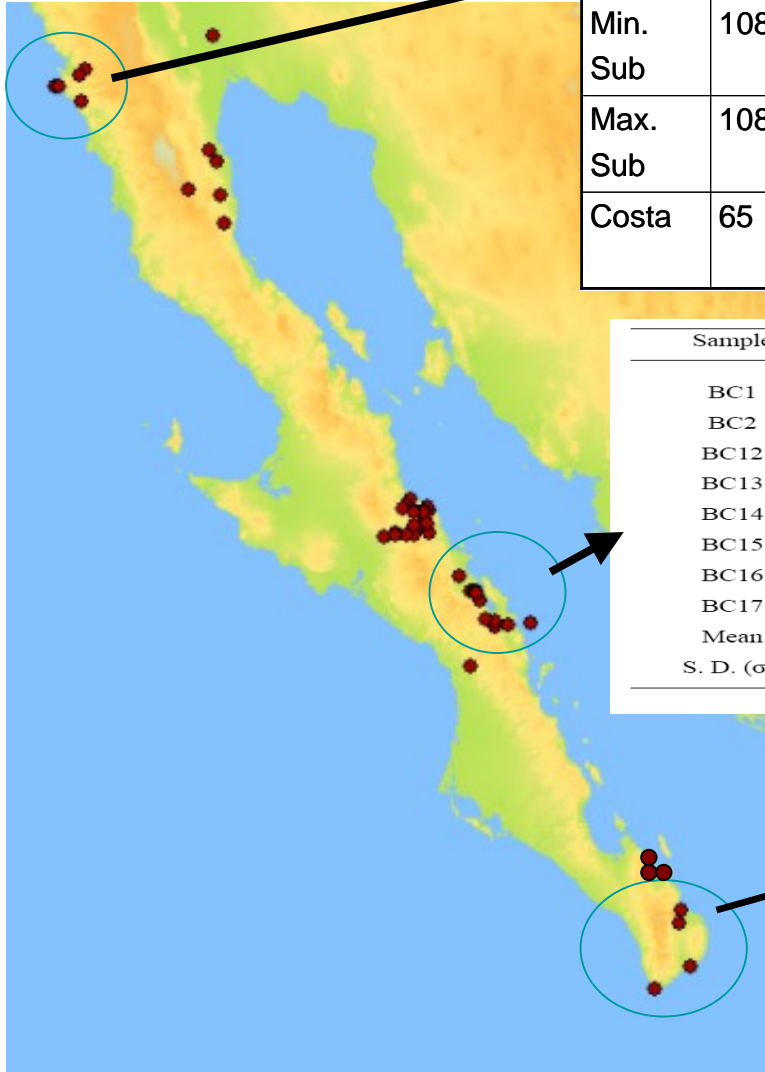
**Taking advantage of thermal
source in the Peninsula of Baja
California**

- Generation low enthalpy**
- Desalination hot water**

Hot water



Hot water



muestra	T _{desc} (°C)	T-Si (°C)	T _{-Na-K-Ca-Mg-corr} (°C)	T _{-SO₄-H₂O} (°C)	T _{-SO₄-H₂S} (°C)
Min. Sub	108	200	202	198	213
Max. Sub	108	205	204	216	213
Costa	65	213	213	--	--

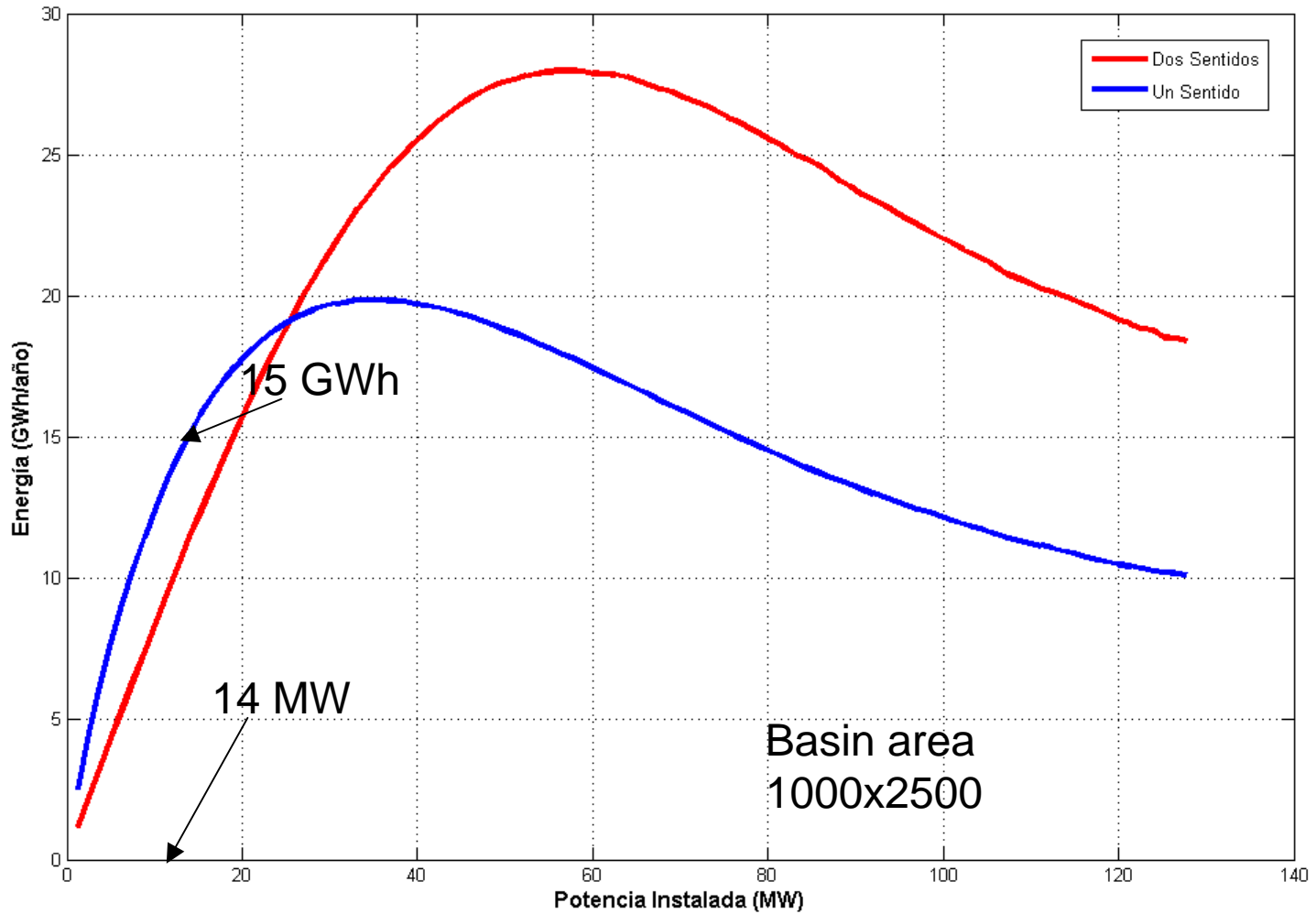
Geotermómetros

Sample				T _{C1/C2} (°C)
BC1	0.0045	120.33	165	217
BC2	0.0091	127.37	180	218
BC12		82.96		208
BC13		79.84		207
BC14		64.97		202
BC15		73.84		205
BC16		87.85		209
BC17		74.68		205
Mean	0.0068	88.98	173	209
S. D. (σ)	0.0033	22.64	10.61	5.74

Sample	T(°C) Na/K1	T(°C) Na/K2	T(°C) S	T(°C) Na/K/Ca
LC-4	171.6	189.7	170.6	36.1
LC-5	181.8	199.3	192.8	28.3
LC-6	132.3	152.1	73.4	52.4

Thanks for your attention

Generation with single basin



flood and ebb (red)

Ebb (blue)

[Back](#)