



Blue energy - Design process of a wave energy converter:

ISWEC case study

Giuliana Mattiazzo

Offshore Renewables Group

Politecnico di Torino

Department of Mechanical and Aerospace Engineering

C.so Duca degli Abruzzi, 24

TORINO

ITALY

Email: giuliana.mattiazzo@polito.it



Ocean Energy – 2050 Europe Policy

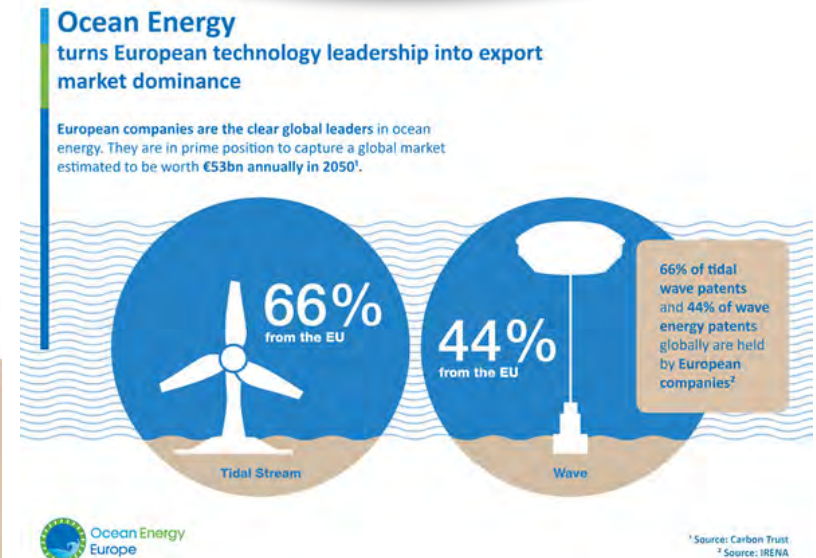
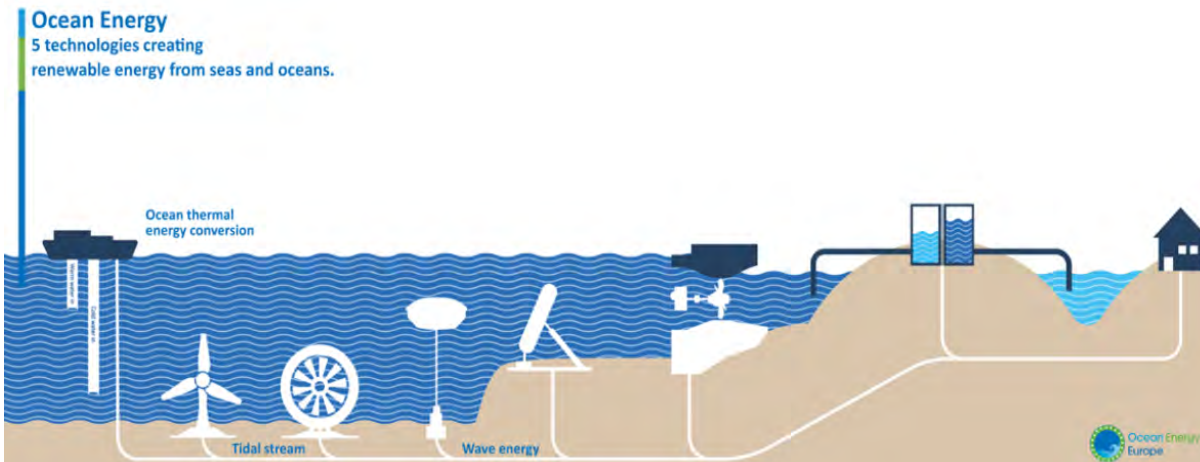
European Goals:

- **Low Carbon Economy**
- By 2050, the EU should cut greenhouse gas emissions to **80%** below 1990 levels
- By 2030, 30% of the energy should be provided by **renewable energies**

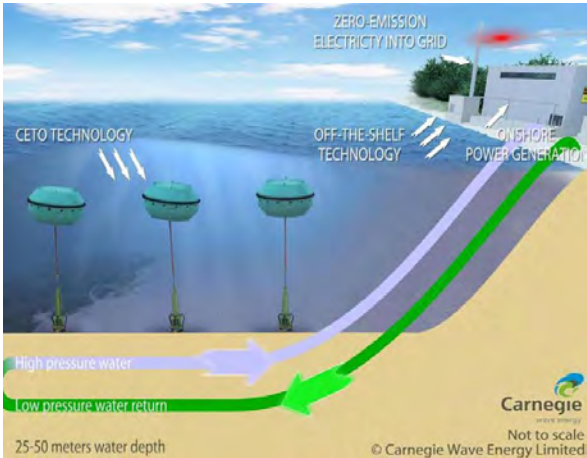
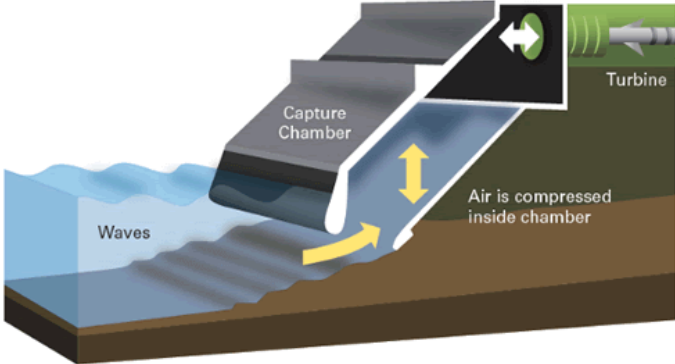
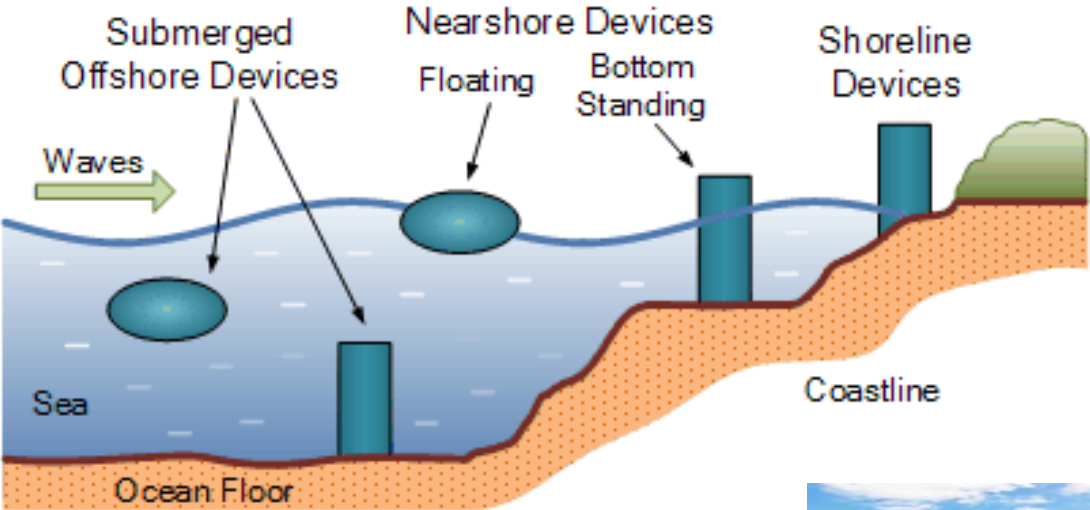


Ocean Energy Policies:

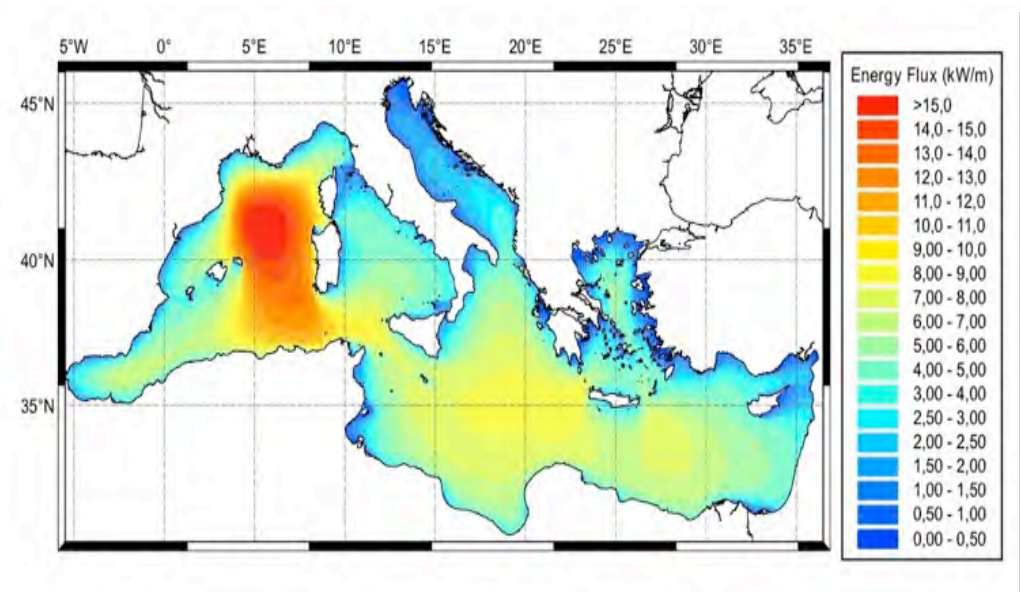
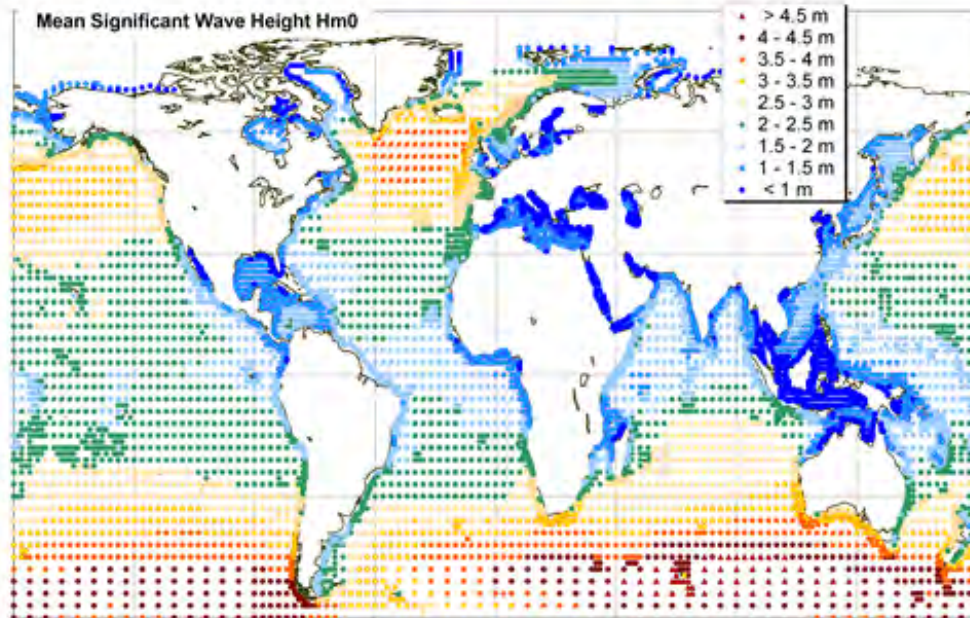
By 2050, 100 GW of Ocean Energy can be installed in Europe



Wave Energy: Onshore & Offshore

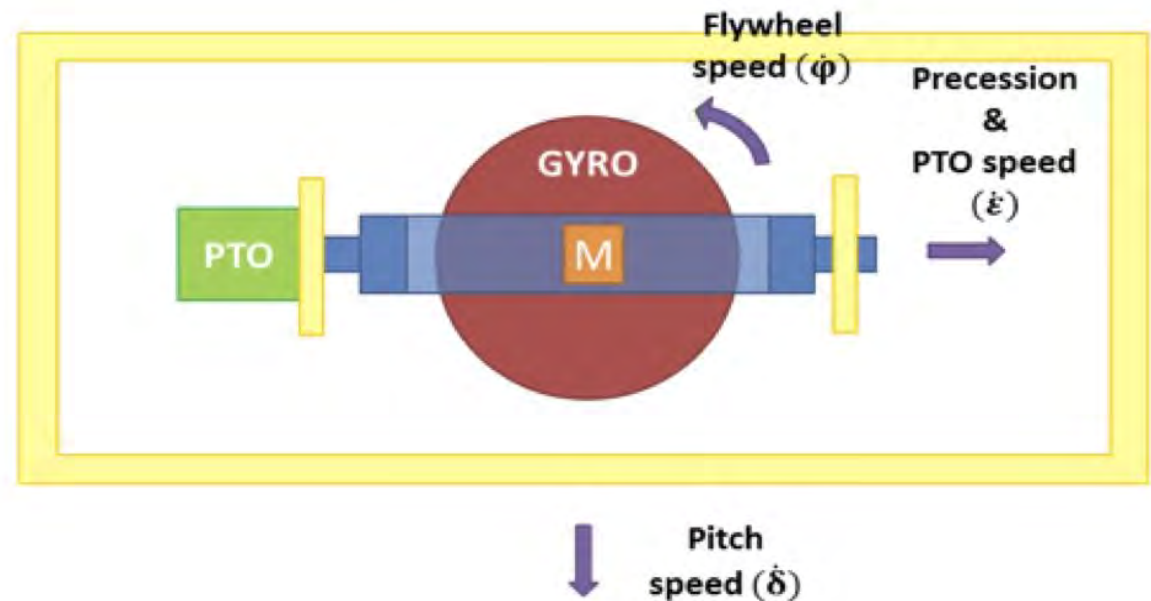
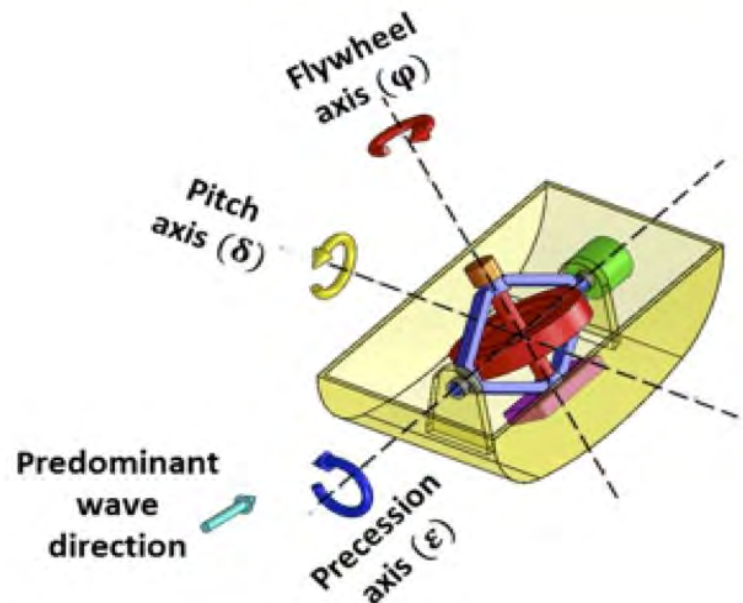


Resource Analysis



Sviluppo del concept e modellazione

- Sistema completamente stagno, con nessuna parte mobile esposta all'ambiente marino
- Device modulare e altamente scalabile, con minimi requisiti di manutenzione
- Impatto ambientale estremamente limitato
- Architettura galleggiante basata su sistema di conversione giroscopico



Prototipi sviluppati dal 2009

2009

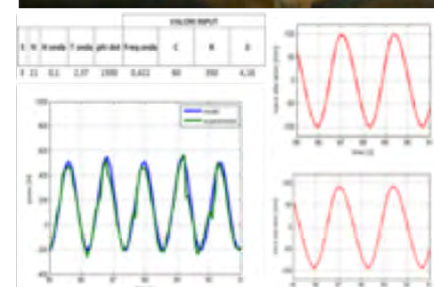
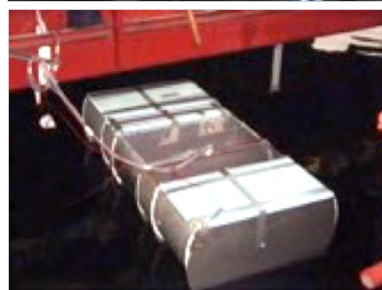
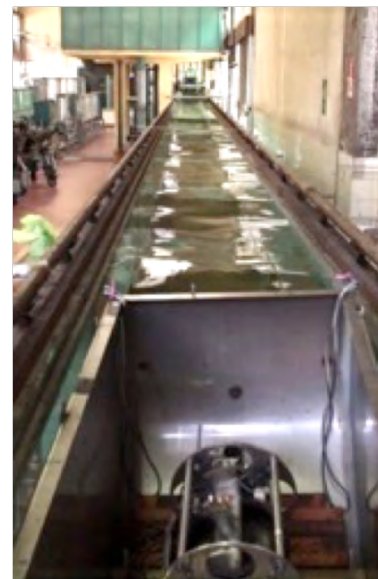
2012

Edinburgh, 1:45

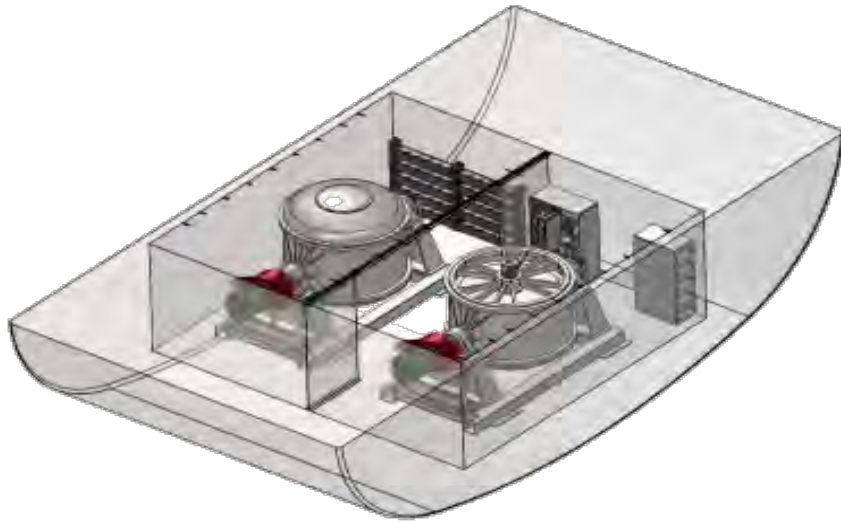
Naples, 1:45

Turin, 1:45

Rome, 1:8



Sistema full scale a Pantelleria



Struttura

Massa

- Meccanica: 115 ton
- Zavorra: 170 ton
- Totale: 285 ton

Sviluppo

Dimensioni fuori tutta

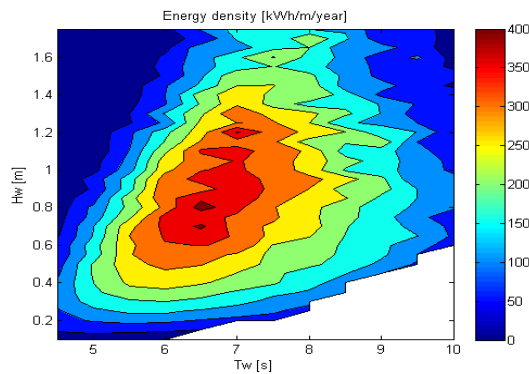
- Larghezza: 8 m
- Lunghezza: 15.3 m
- Altezza: 5 m
- Pescaggio: 4 m

Sito d'installazione

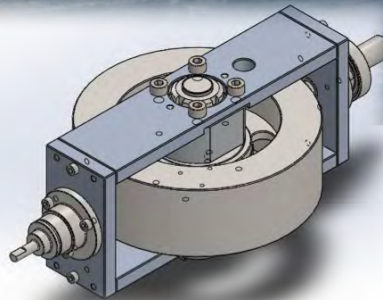
- Lat 36° 49' 39" N
- Long 11° 55' 20" E

Test

- Risorsa media a Pantelleria: 62.5 MWh/m/anno
- Producibilità: 150 - 250 MWh/anno



Sviluppo del PTO full scale

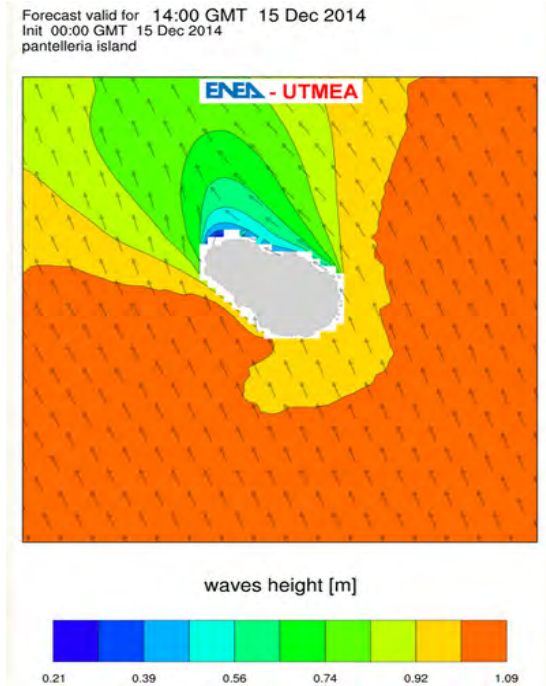


Total Target Power	250	(kW)
Max Power single PTO	125	(kW)
Max Torque single PTO	68	(kNm)
Max PTO speed	300	(rpm)
Gear Ratio	10	-

Angular moment	$8,2 \cdot 10^5$	Nms
Max flywheel speed	500	(rpm)
External Diameter	2,5	(m)
Mass	10	(t)
Number of Gyros	2	-



Chiusura del controllo sulle previsioni



Esempio di analisi dello stato
del mare per Pantelleria

20150523,05,	1.64388,	325.83801,	6.74000,
20150523,06,	1.55881,	326.41501,	6.61770,
20150523,07,	1.48633,	327.51901,	6.44470,
20150523,08,	1.42714,	328.94501,	6.24040,
20150523,09,	1.37444,	330.24301,	6.05050,
20150523,10,	1.31802,	330.56900,	5.93530,
20150523,11,	1.26188,	329.63101,	5.89080,
20150523,12,	1.22045,	327.81299,	5.87010,
20150523,13,	1.18846,	325.53699,	5.85690,
20150523,14,	1.14892,	323.15201,	5.93660,
20150523,15,	1.11405,	321.70099,	5.99980,
20150523,16,	1.08353,	320.69699,	6.02780,
20150523,17,	1.05690,	319.82001,	6.03840,
20150523,18,	1.03661,	319.02301,	6.03870,
20150523,19,	1.02469,	318.33200,	6.04510,
20150523,20,	1.01990,	317.78201,	6.06690,
20150523,21,	1.01847,	317.39600,	6.09610,
20150523,22,	1.01592,	317.20300,	6.12140,
20150523,23,	1.00930,	317.17001,	6.13590,
20150524,00,	0.99668,	317.09799,	6.14290,
20150524,01,	0.97940,	316.94699,	6.13590,
20150524,02,	0.96015,	316.81000,	6.11070,
20150524,03,	0.94058,	316.70801,	6.07520,
20150524,04,	0.92274,	316.73199,	6.02090,
20150524,05,	0.90857,	317.08301,	5.92170,
20150524,06,	0.89287,	317.43100,	5.81700,

Esempio del database di dati utilizzato
per il controllo della macchina



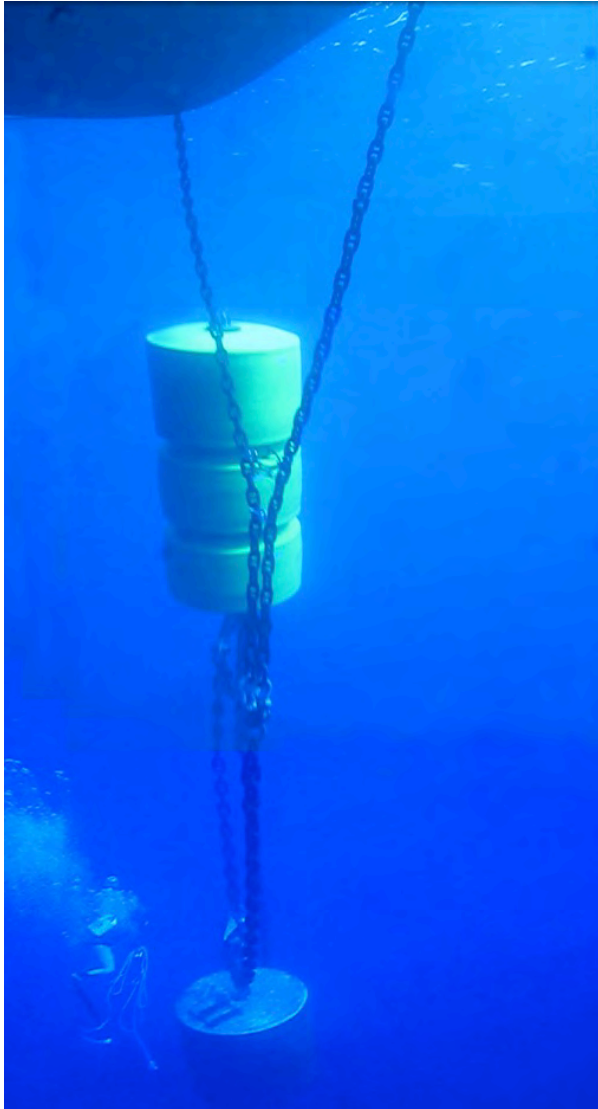




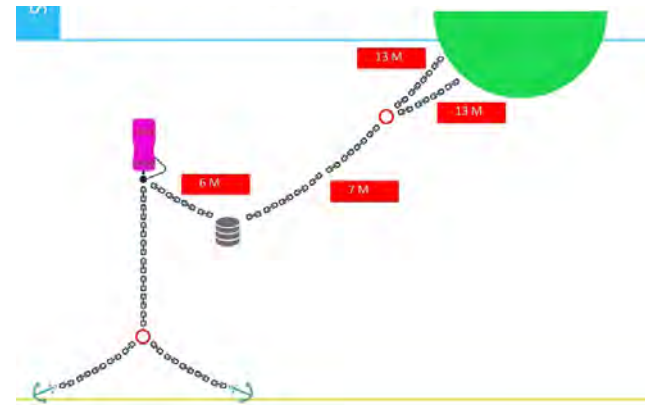
WAVE FOR ENERGY



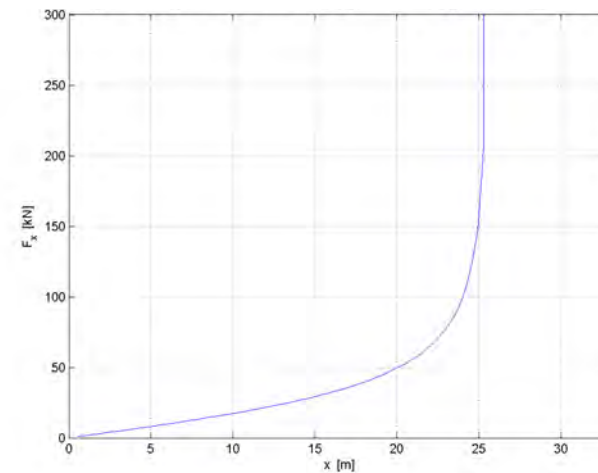
Sviluppo del sistema d'ormeggio per ISWEC full scale



Layout sistema d'ormeggio



Caratteristica di richiamo non lineare



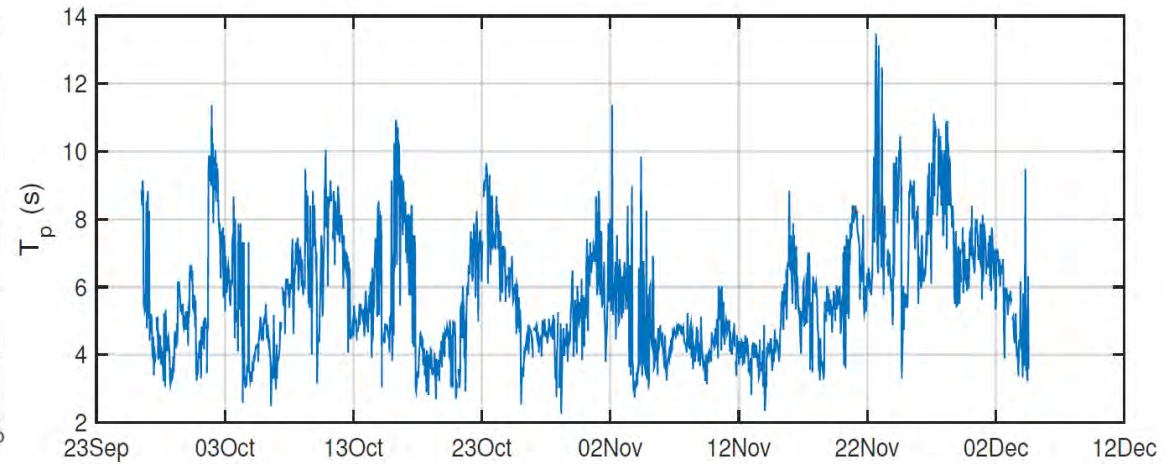
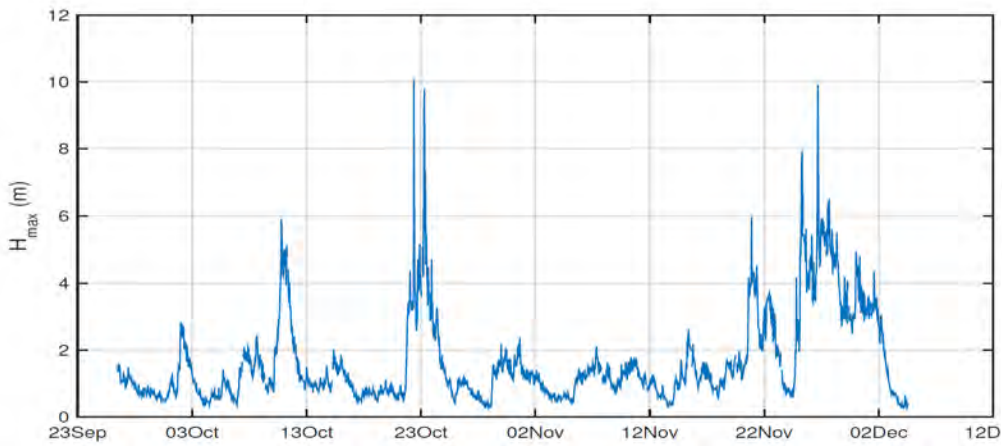
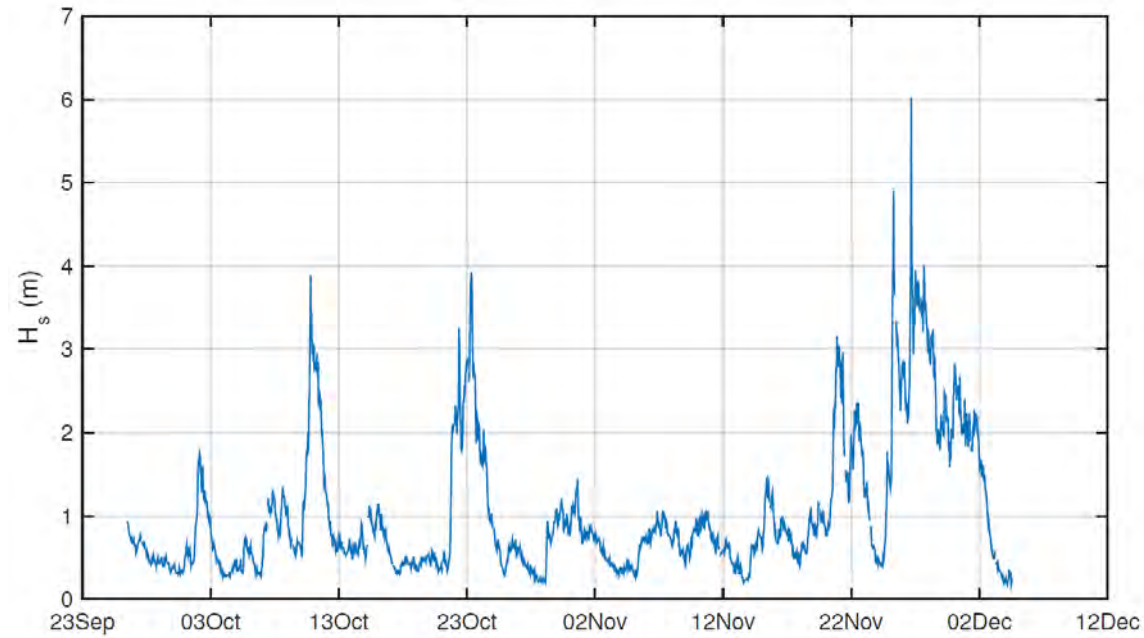
Video ISWEC full scale



Gyroscopic Group: PTO Unit

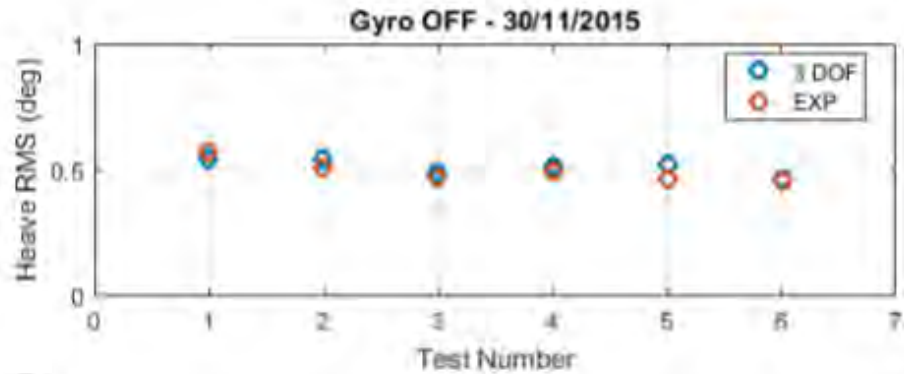


Test in ambiente operativo – TRL 7

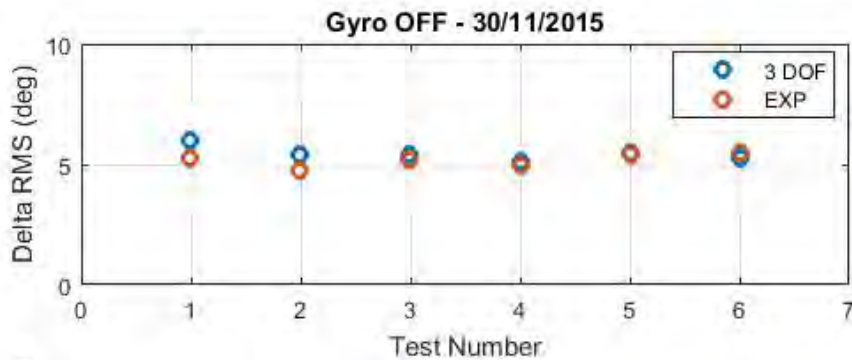


Dati sperimentali Vs. modello a 3 gdl

Hull heave



Hull heave



Test Number	ROLL RMS (deg)	ANGLE PITCH RMS (deg)			HEAVE RMS (m)		
		EXP	SIM	Relative Errors	EXP	SIM	Rel. Err
---	---	---	3DOF	3DOF	---	---	---
1	2.64	5.24	5.50	5%	0.57	0.54	-5%
2	2.51	4.73	4.97	5%	0.5	0.54	8%
3	2.29	5.15	5.43	5%	0.47	0.49	4%
4	1.87	5	5.14	3%	0.49	0.51	4%
5	2.16	5.42	5.5	1%	0.46	0.50	8%
6	2.18	5.49	5.28	-4%	0.45	0.46	2%



Dal laboratorio alla realtà





Grazie

