WP3: Sea state forecasting and resource evaluation

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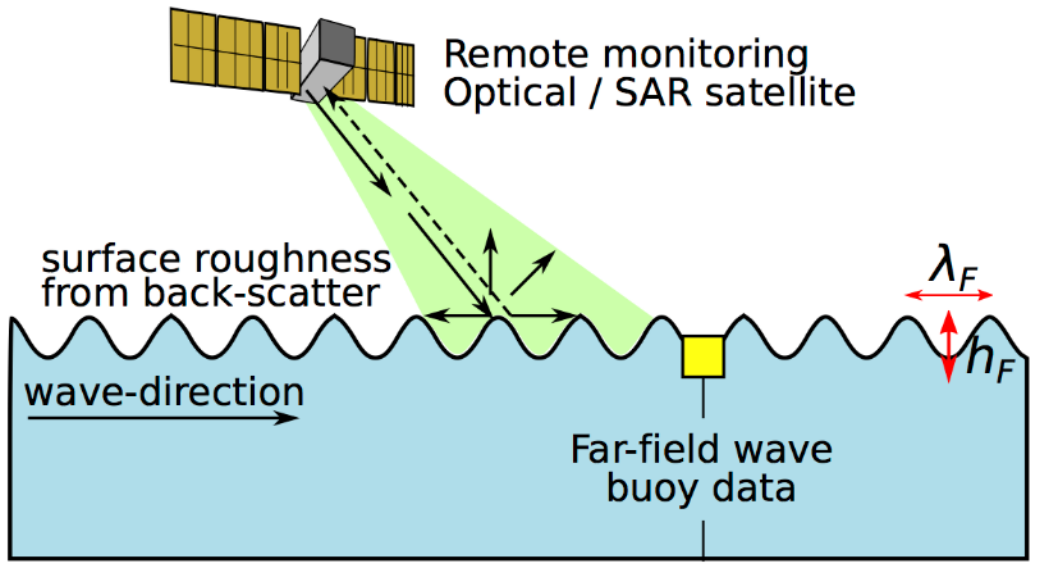
SmartWave

Capable of simulating and enabling forecasting of significant wave height

Motivation: Develop SmartWave to simulate parameters useful for marine renewables

Satellite images

- Satellite images are capable of providing hindcast information in very high resolution
- How it works:
  - Radar transmits a pulse
  - Some of the energy in the radar pulse is reflected back
  - Every pixel of a complex SAR image contains amplitude and phase information.
- Can provide information about the sea roughness
- Using SAR images that means:
  - Unaffected by weather
  - Unaffected by cloud cover
  - Larger datasets



How it works

Data Acquisition

- Sentinel 1 - SAR Images
- Buoy data

Data processing

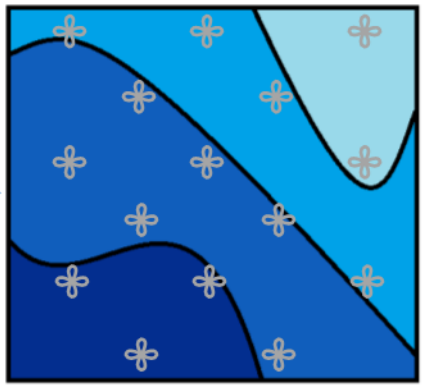
Initial processing, Extract parameters related to sea roughness from different SAR image bands

Artificial neural networks (ANNs)

Correlate sea roughness parameters to buoy data

Spatial distribution

Apply ANNs to derive sea state in any location



Example results – Burbo Bank

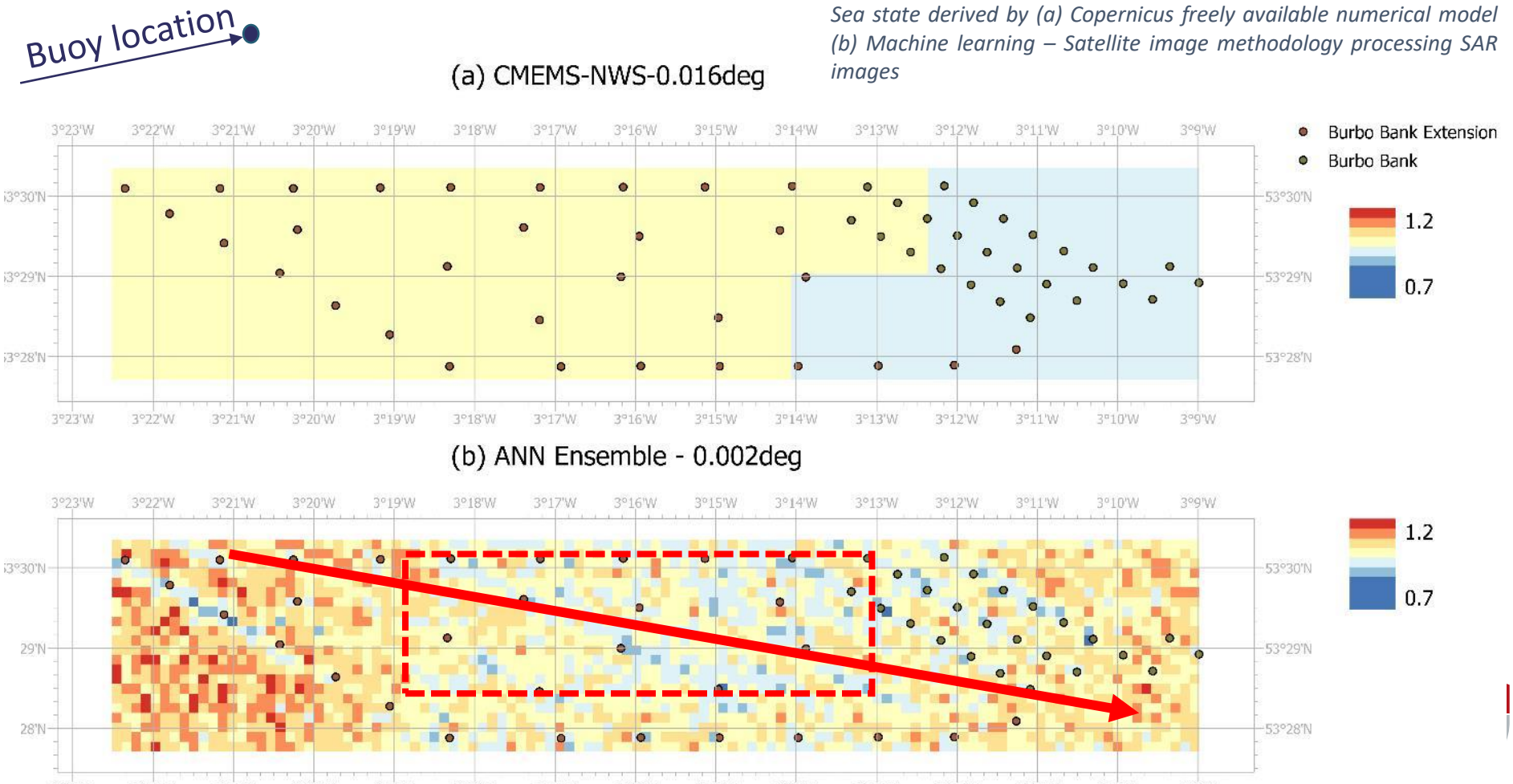
Comparison of Sea state conditions at 2/4/2019 06:32:16am

Buoy data: 0.89m (6:30am) – 1.07m (7:00am)

Numerical model at the buoy: 0.92m

ANN Ensemble: 0.95m

- Same trend of significant wave height for both hindcasts
- Higher resolution for machine learning-satellite image methodology
- Possible to identify pattens like sheltering in the inner wind turbines compared to the ones that are at the edge of the wind farm.

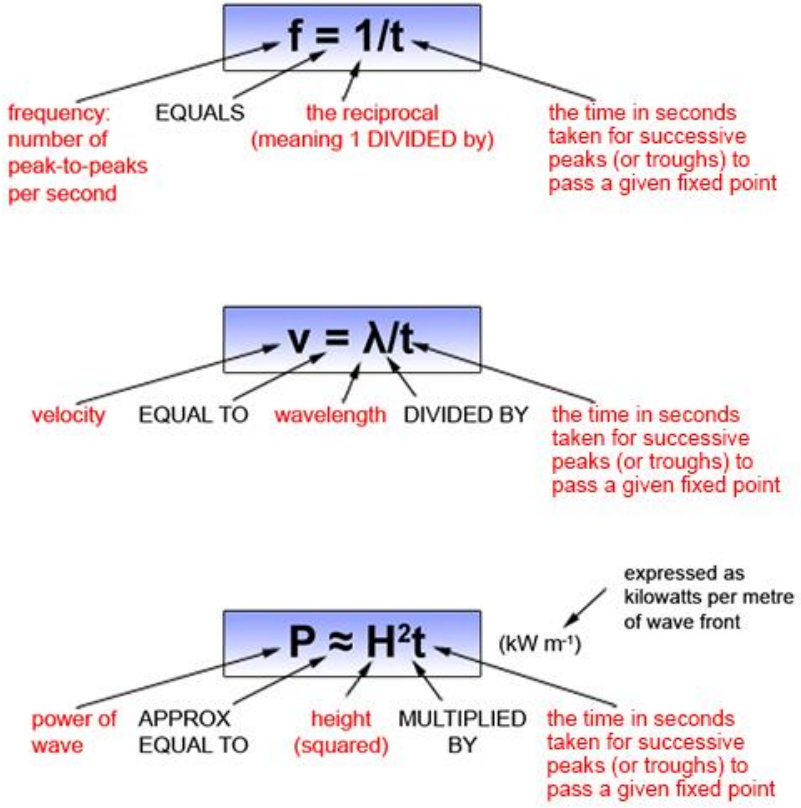


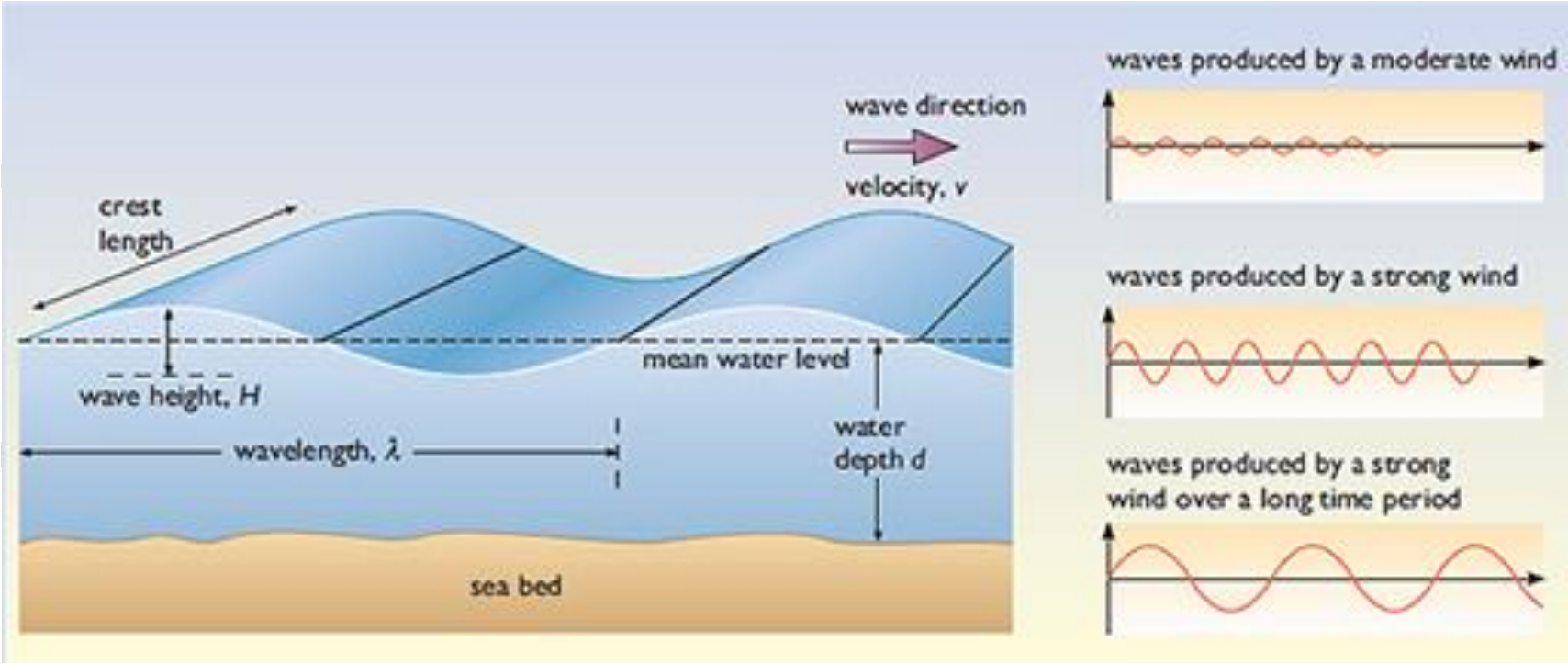
Sea state derived by (a) Copernicus freely available numerical model (b) Machine learning – Satellite image methodology processing SAR images

Uses of SmartWave

NHP-WEC plans

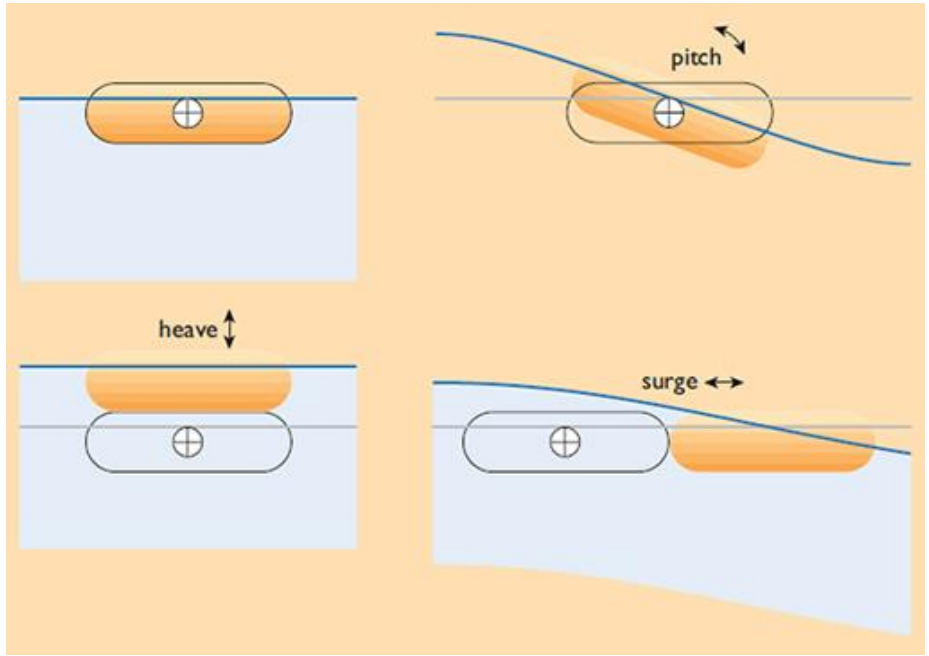
- Development of SmartWave to simulate:
  - Wave length (λ) – the distance between successive peaks of the wave
  - Wave height (H) – the difference in height between peaks and troughs
  - Period (t) – the time in seconds taken for successive peaks pass a given fixed point.

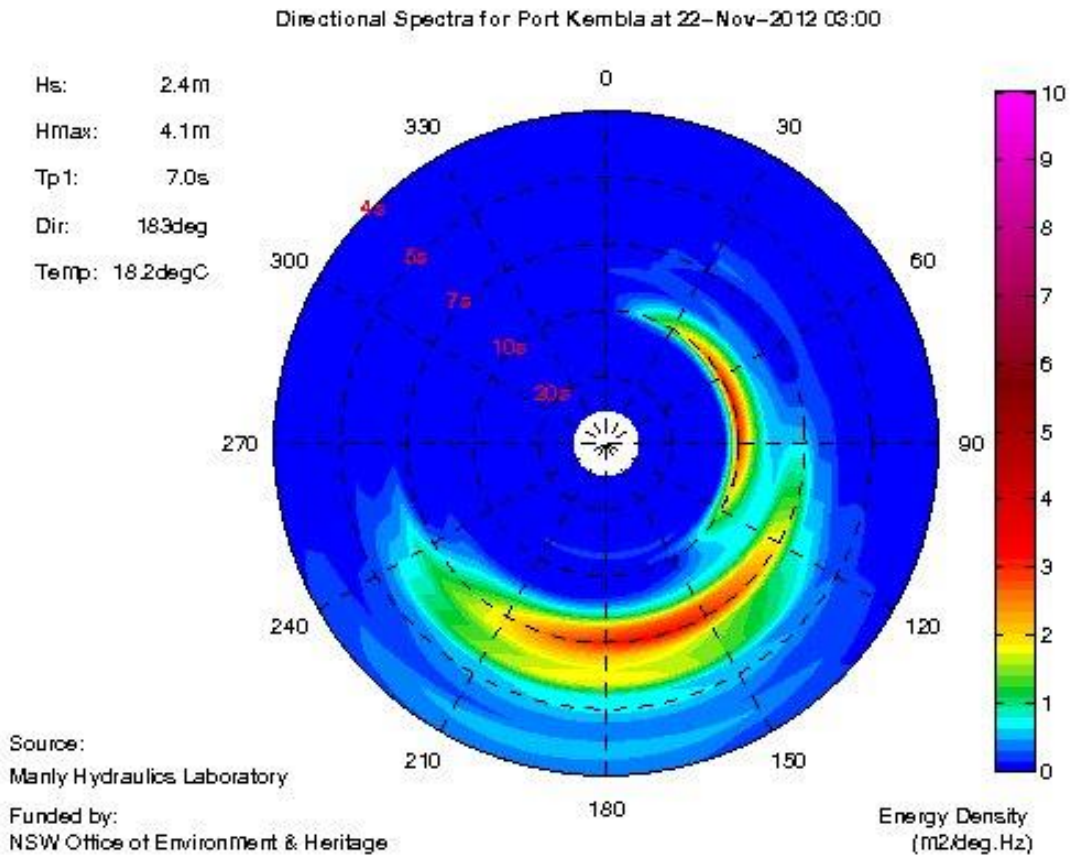




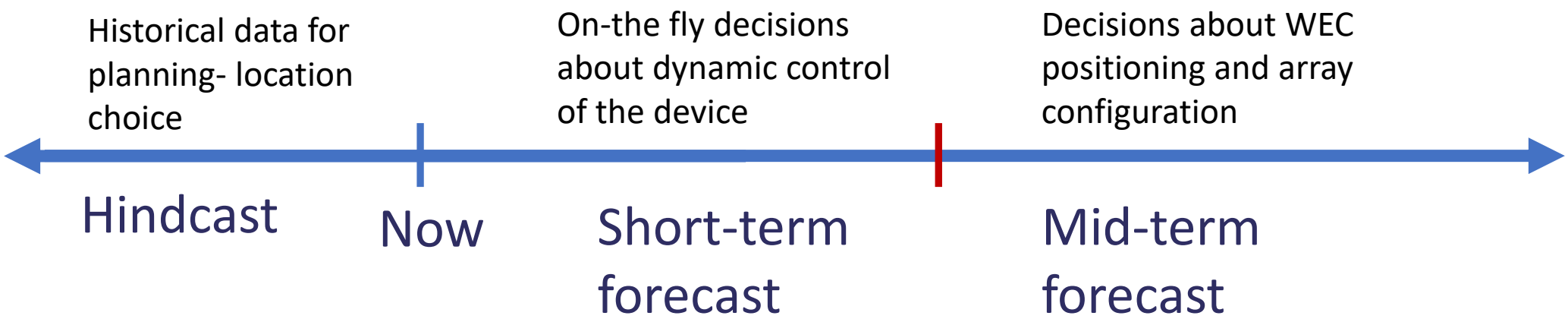
Wave parameters

- Ideally to fully characterise a wave field we need the spectra
- Help calculate the energy produced from each motion

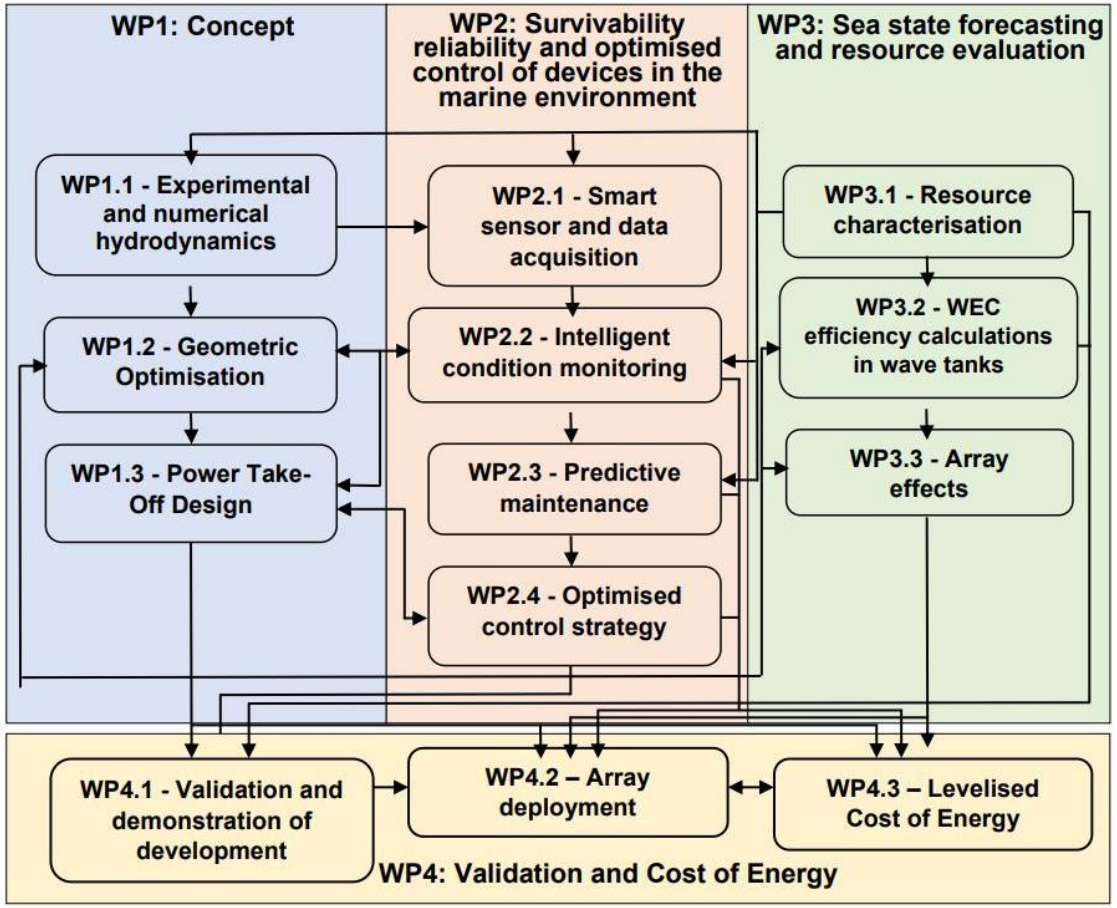




Uses of SmartWave



Interaction with other WPs



Timeline

Tasks	Quarter	1	2	3	4	5	6	7	8	9	10	11	12
WP3: Sea state forecasting and resource evaluation													
Resource characterisation													
WEC efficiency calculations in wave tanks													
Array effects													
WP4: Validation and Cost of Energy													
Levelised Cost of Energy													