

Efficient methodologies for large scale wave fully spectral generation and propagation

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**Programa de doctorado en
Ingeniería Civil
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PhD goal

Creation of a methodology that allows to create fully spectral wave hindcast databases in a relatively cheap manner

1. COST of modeling waves:

- 1 GCM (global climate model) -> AFFORDABLE, but expensive.
- Several GCM -> VERY EXPENSIVE (i.e. USGS, 6 GCMs, historical and projections, 1M core*h -> \$\$\$)

2. Products of wave models

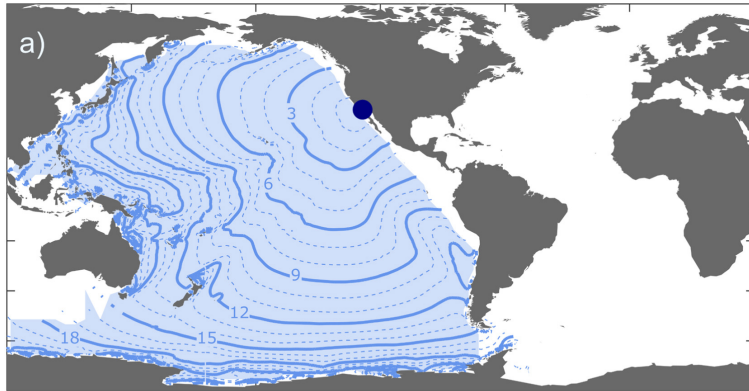
- Most existing wave databases: Integrated spectral parameters + shape -> Several TB per GCM
- Some databases, fully spectral output -> 10's of TB to PB per GCM

3. Two objectives:

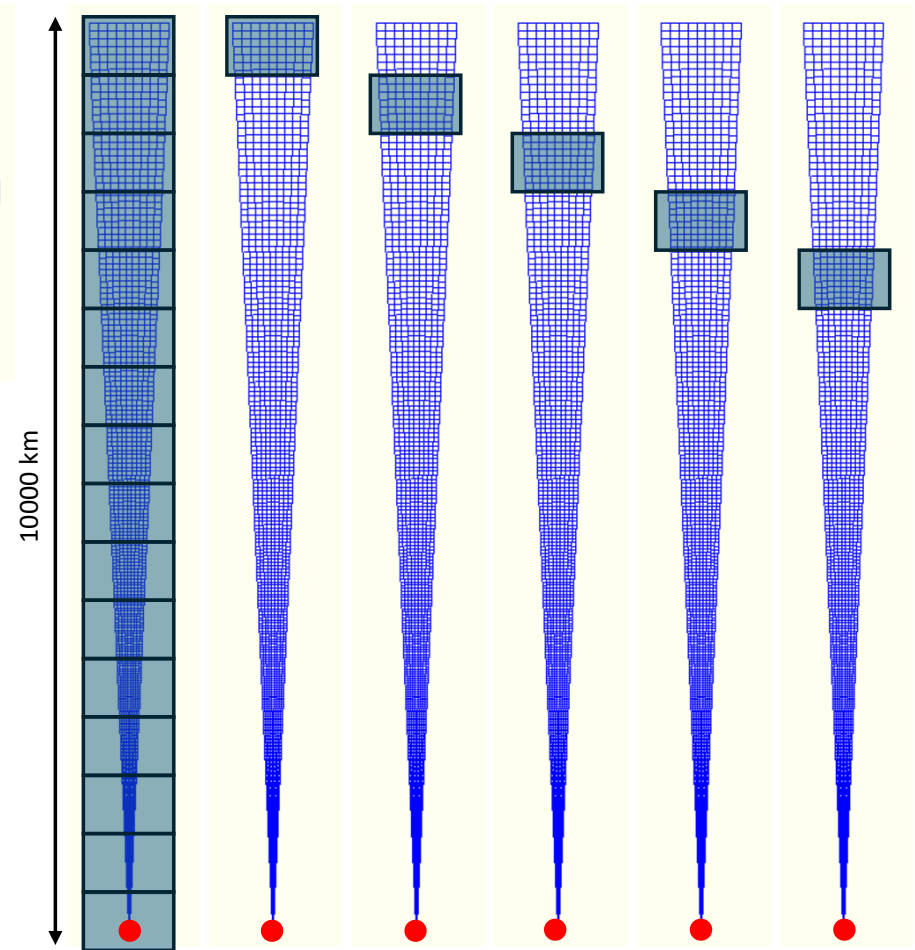
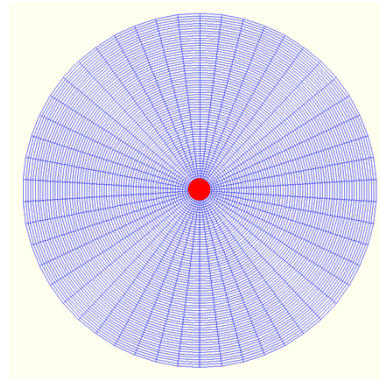
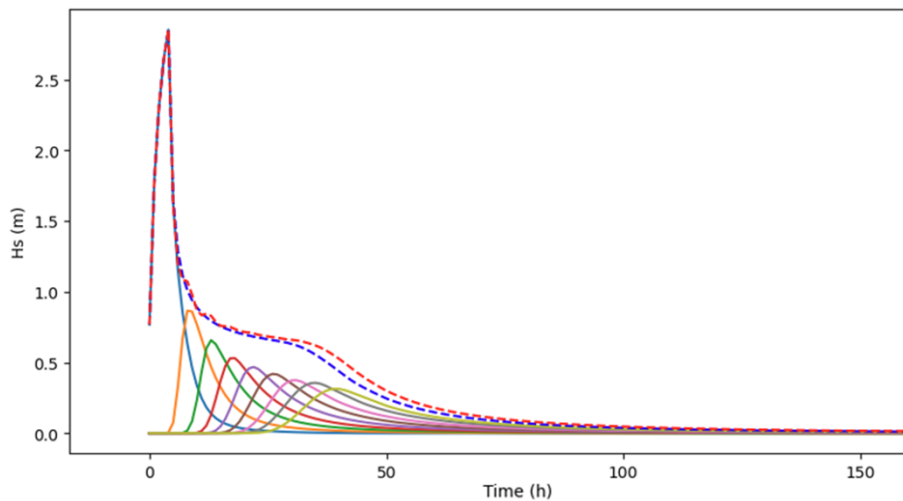
- Reduction of computational times
- Reduction of required storage (no need to save everything for further downscaling) by ad-hoc computation.

PhD subjects

Development of a hybrid method for wave generation at ocean scales ($O(10^3-10^4 \text{ km})$)

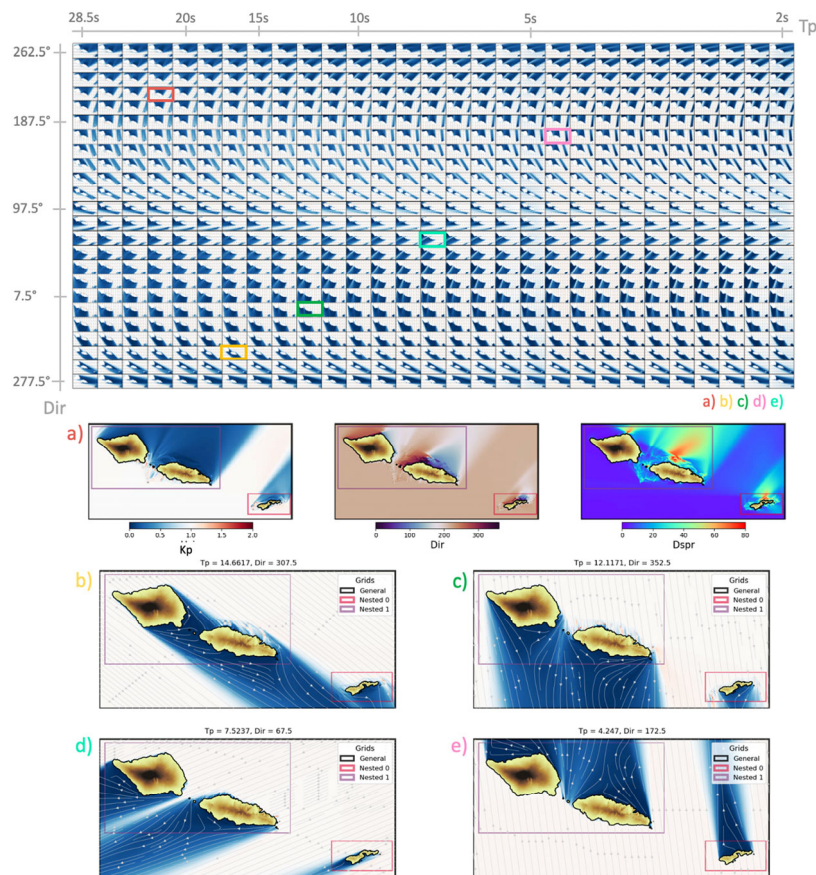


[Modified from Cagigal et al., 2020](#)

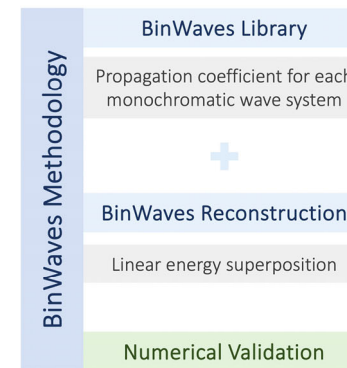


PhD subjects

Development of a hybrid additive method for wave climate downscaling with variable boundary conditions



[Cagigal et al., 2024](#)



Offshore
 $U(f_i, \theta_j)$

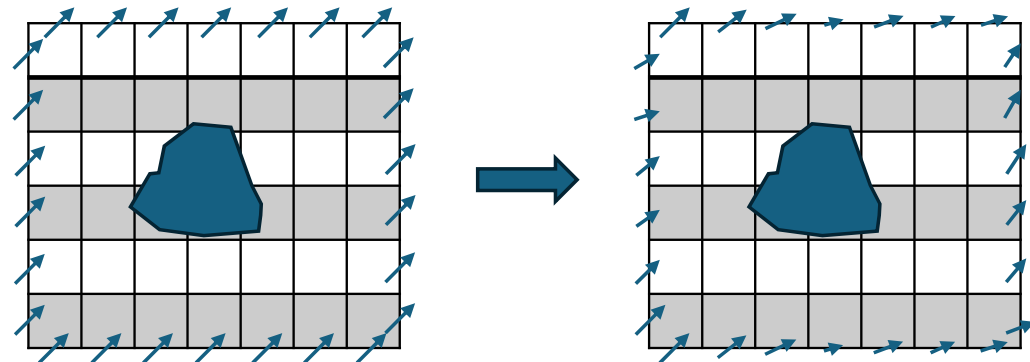
Each point
 $U_p(f_i, \theta_j)$

$$K_p(f_i, \theta_j) = \frac{U_p(f_i, \theta_j)}{\iint U(f_i, \theta_j) df d\theta}$$

Offshore
 $S(f, \theta)$

Each point
 $S_p(f_i, \theta_j) = \sum_i \sum_j S(f_i, \theta_j) * K_p^2(f_i, \theta_j)$

[Cagigal et al., 2024](#)



Technical expectations

- Creation of a methodology that allows to create fully spectral wave hindcast databases in a relatively cheap manner
- Ad-hoc generation of long duration spectral wave hindcast databases
- With the foreseen abundance of fully spectral information, establish the basis for its inclusion of in coastal engineering applications

Personal motivation

- Consolidation of almost 20 years of work related to ocean wave generation and propagation applied to coastal engineering
- Improvement of communication skills both in technical and non-technical forums
- Strengthen existing relationship with a world-class research group