

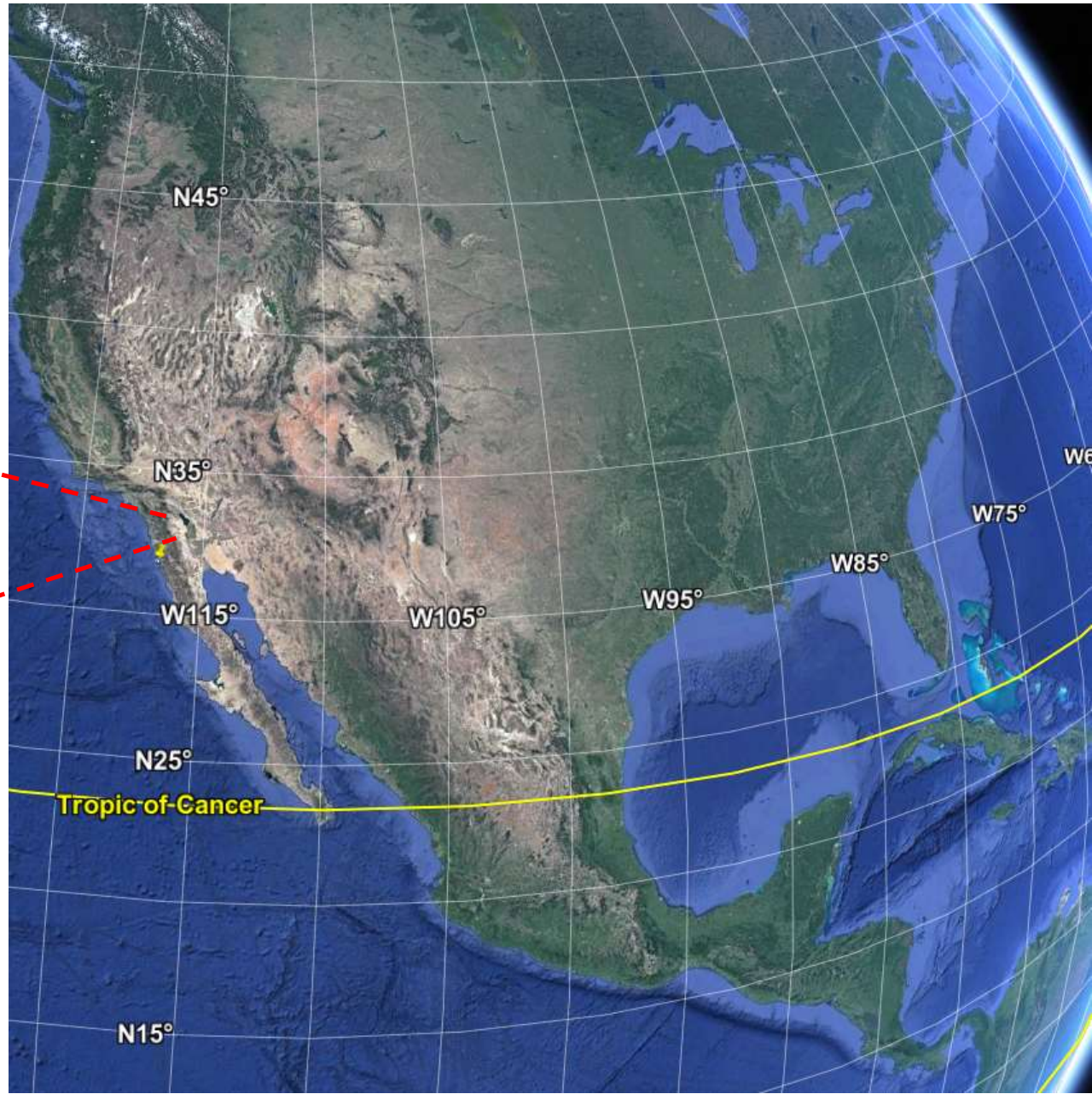
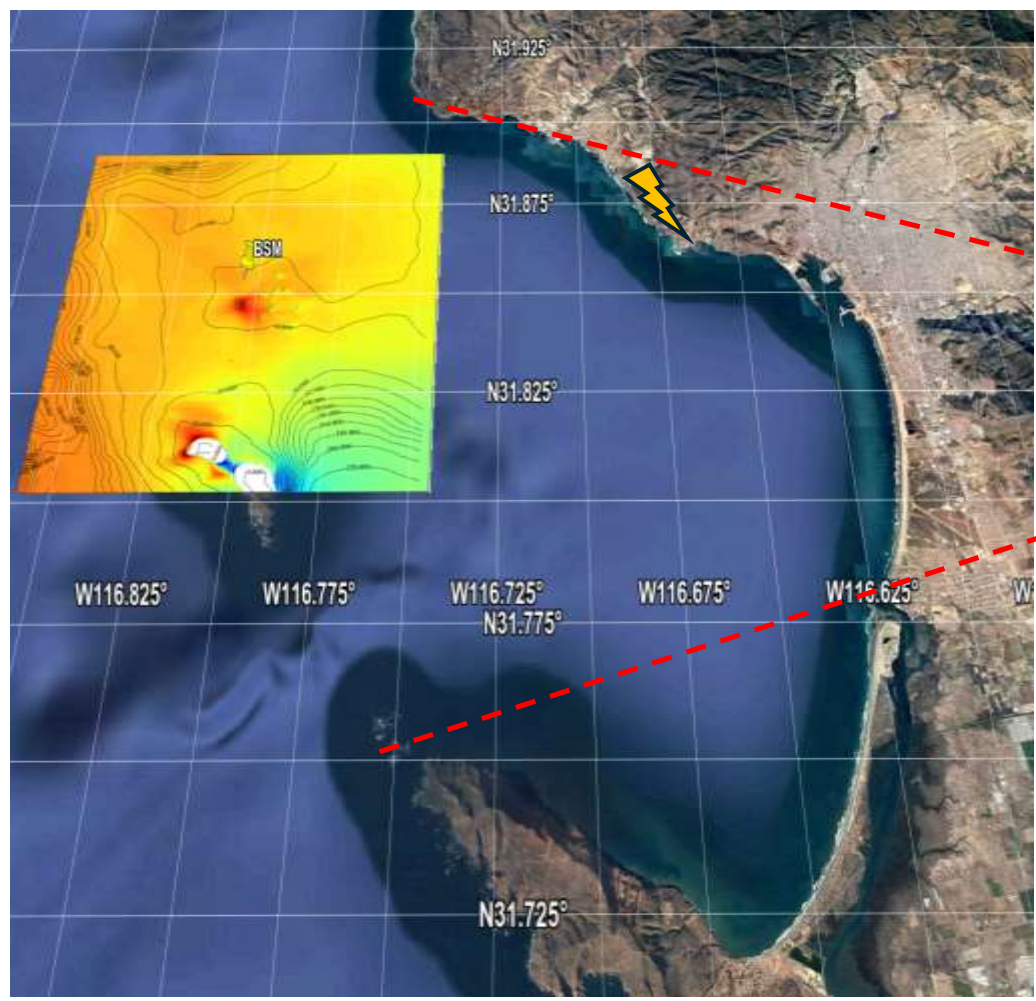
# Optimization of a wave park using a spectral wave model and a binary genetic algorithm.

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# Region



 Position of electricity network

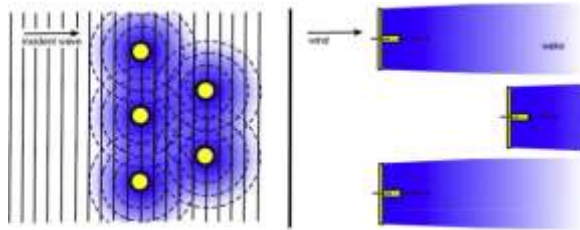
# Objective

- Evaluate the extractable power, through the analysis of different configurations and dimensions of wave energy converter device parks. Optimize the configurations and dimensions of a park

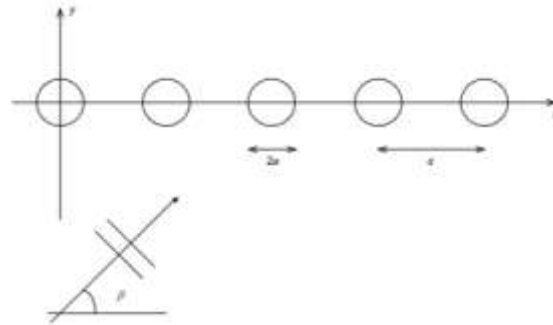
$$LCoE = \frac{\sum_{y=0}^Y PV(CapEx_y) + \sum_{y=0}^Y PV(OpEx_y) + \sum_{y=0}^Y PV(Dec_y)}{\sum_{y=0}^Y PV(AEP_y)}$$

# Antecedents

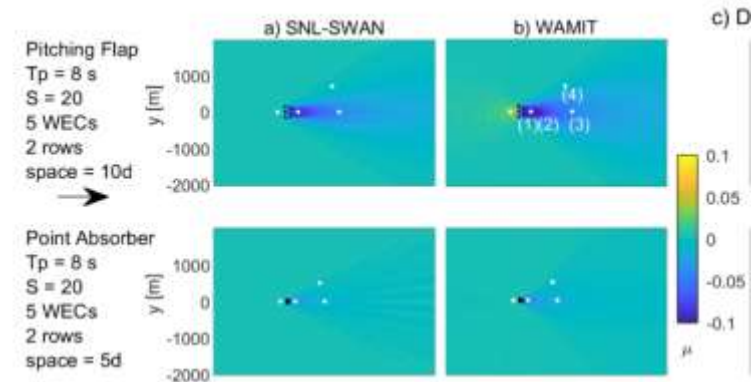
- Constructive and destructive interactions can impact the power generated by array.



(Babarit, 2013)



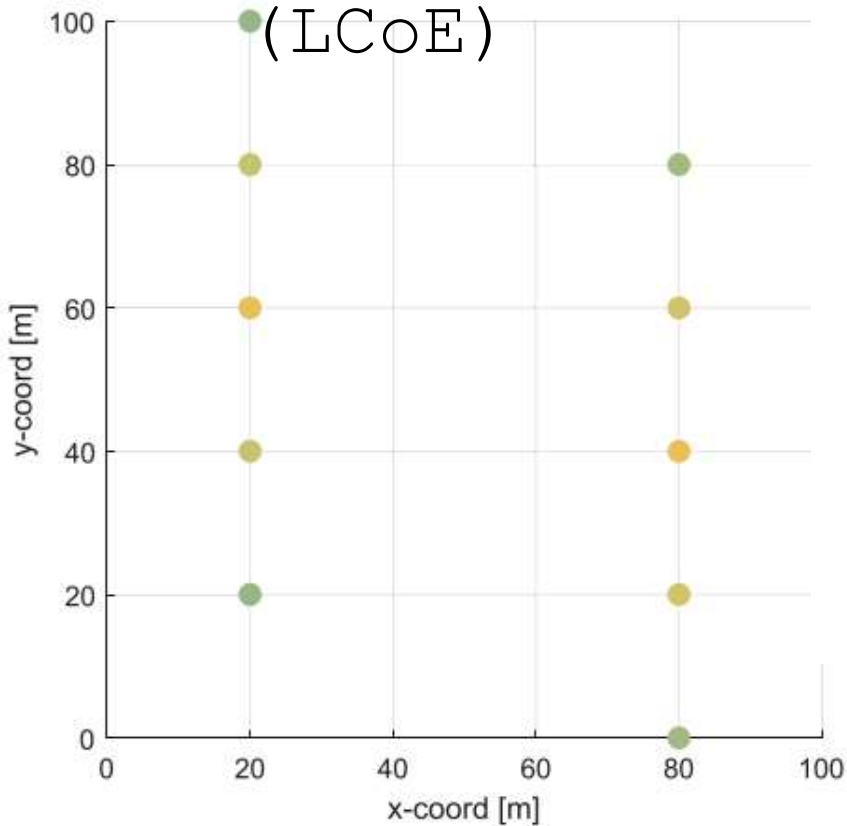
Fitzgerald and Thomas, 2016;



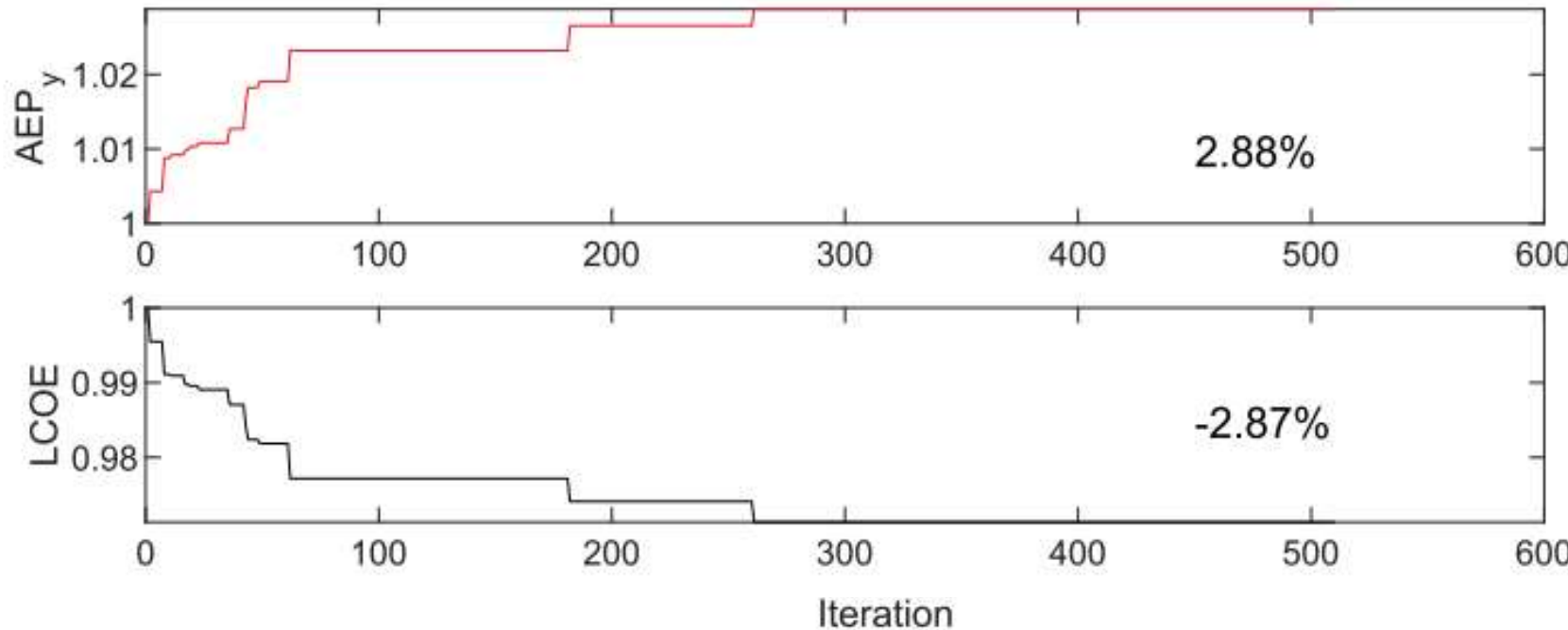
McNatt et al. (2020)

# Optimization using LCoE

- For energy projects, cost is generally quantified using the levelized cost of energy



(a) 10 WECs (40 m)



(a) 10 WECs (40 m)

Giassi et al.  
(2020)

# Methodology



Definition of objective function and restriction.



1. First we choose the region, where we run the spectral model. Mesh size  $0.1 \times 0.1$  degrees. with  $256 \times 256$  cells.



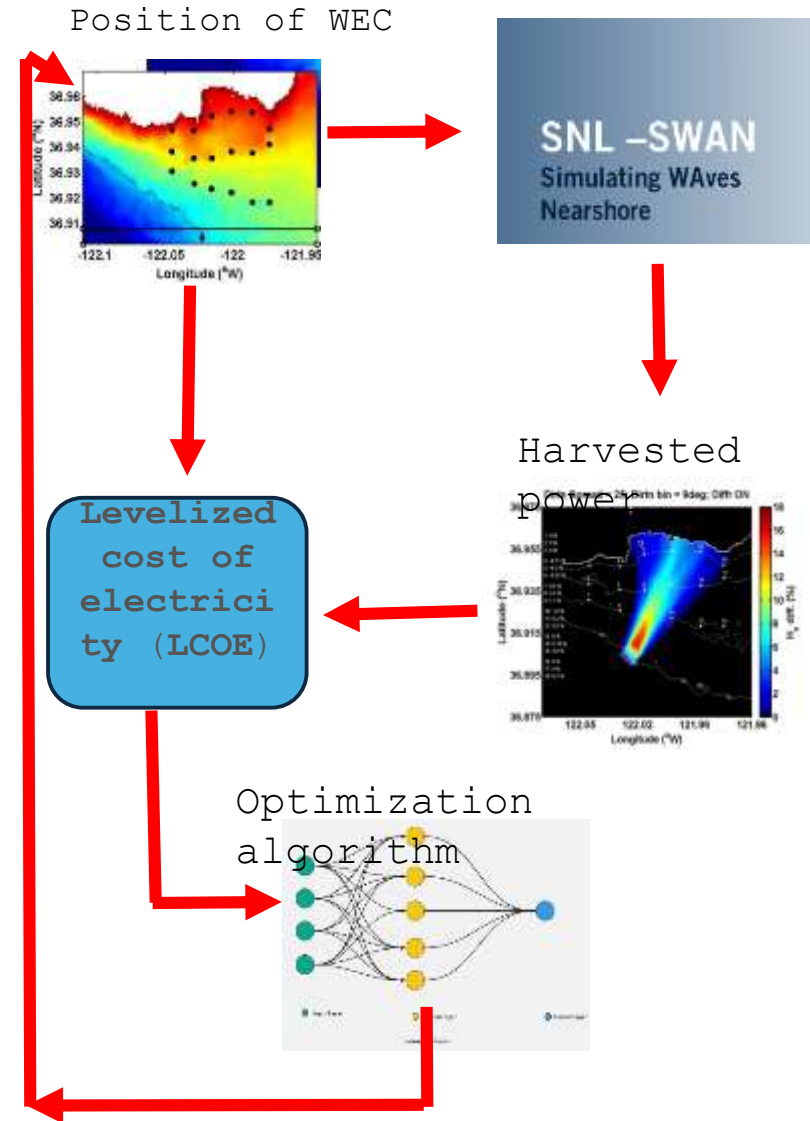
2. Using position WEC in SNL-SWAN we obtain the power of the park.



3. With installation cost and maintain cost, we calculate the cost, The levelized cost of energy



4. Waves boundary conditions from Görr-Pozzi et al. (2021) They simulated waves of the period from 2008 to 2018, with model SWAN.



# What is a genetic algorithm?

It is a high-level search procedure that applies some rule or rules that are based on some source of knowledge in order to explore the search space efficiently.

Disadvantages are that it does not guarantee the global optimum, and its computational cost.

Its main advantages are that it is flexible and easy to use, and it is one of the latest frontiers of optimization.

# Basic operation of a genetic algorithm

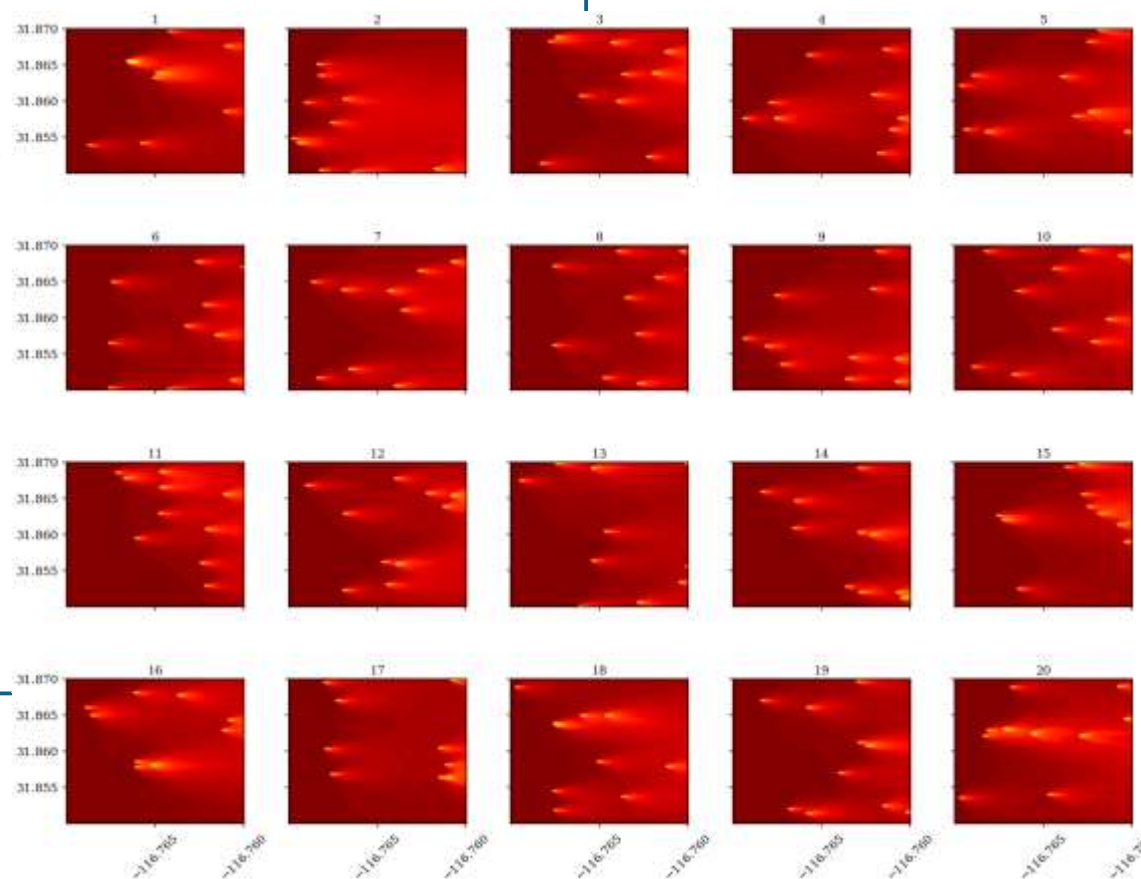
1. Randomly generate an initial population.
2. Calculate the fitness of each individual.
3. Select probabilistically based on fitness.
4. Apply genetic crossover and mutation operators to generate the following population.
5. Repeat steps 2 to 4 until a certain stop condition. Maximum number of iterations.



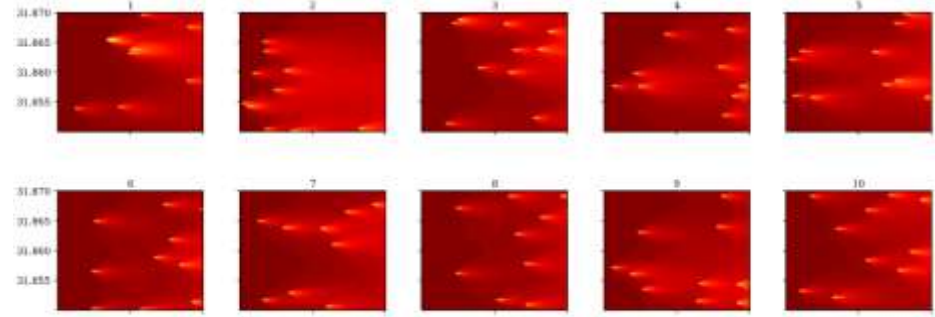
# Genetic algorithm

with SNL-SWAN

Initialization

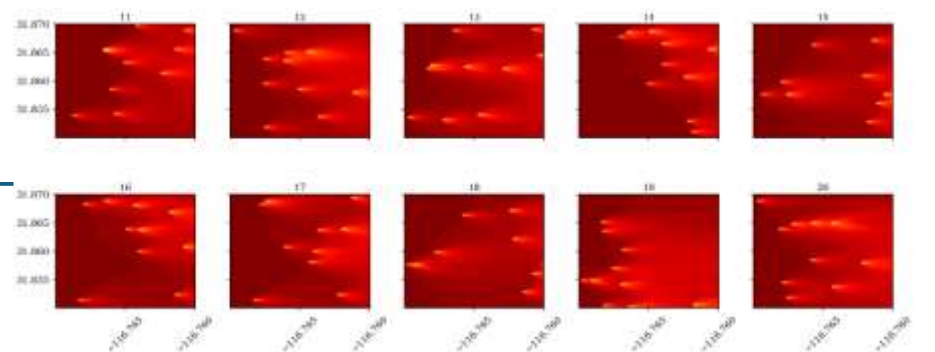


Parent selection



Recombination

Mutation



Termination

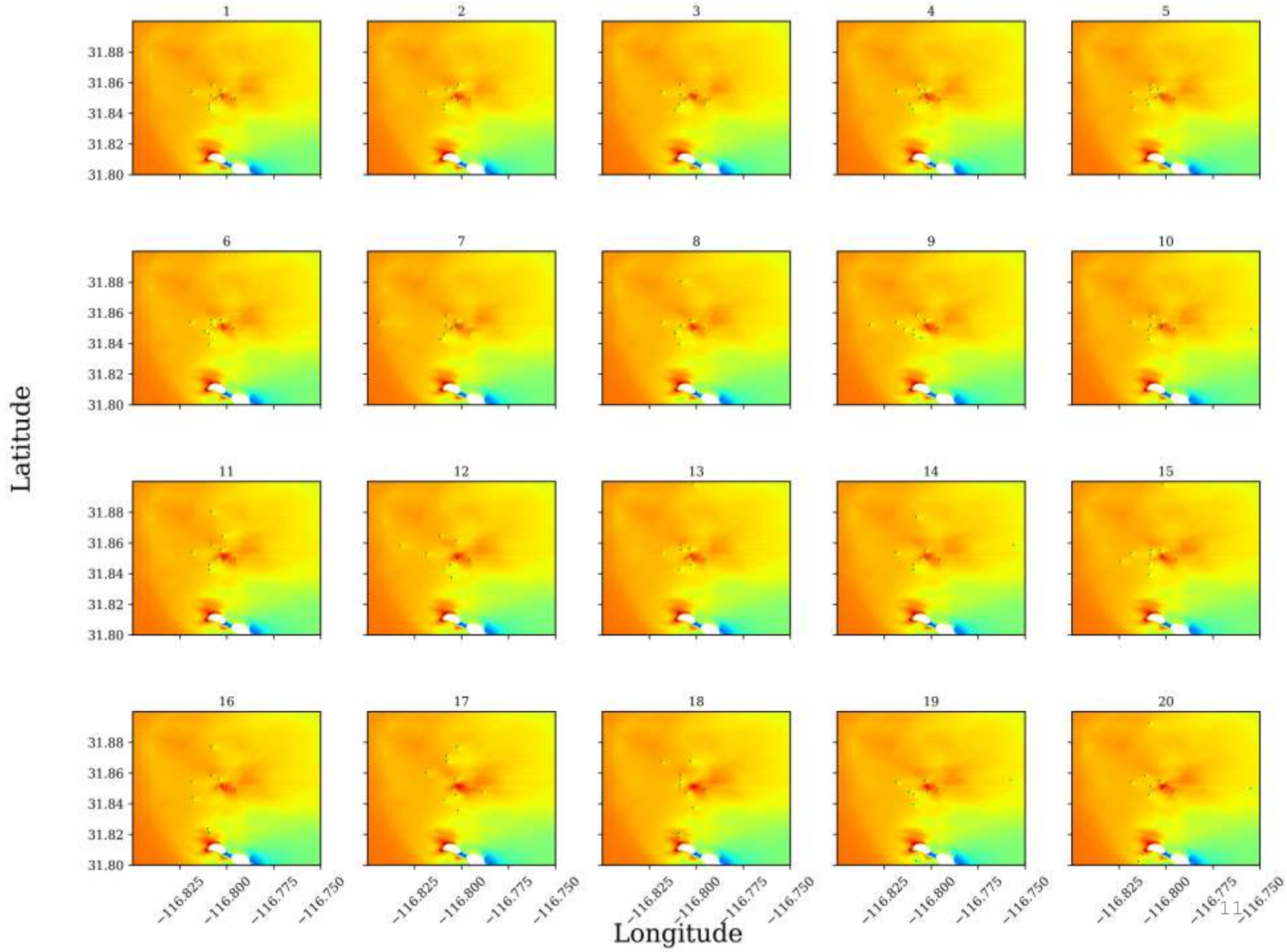
Survivor selection



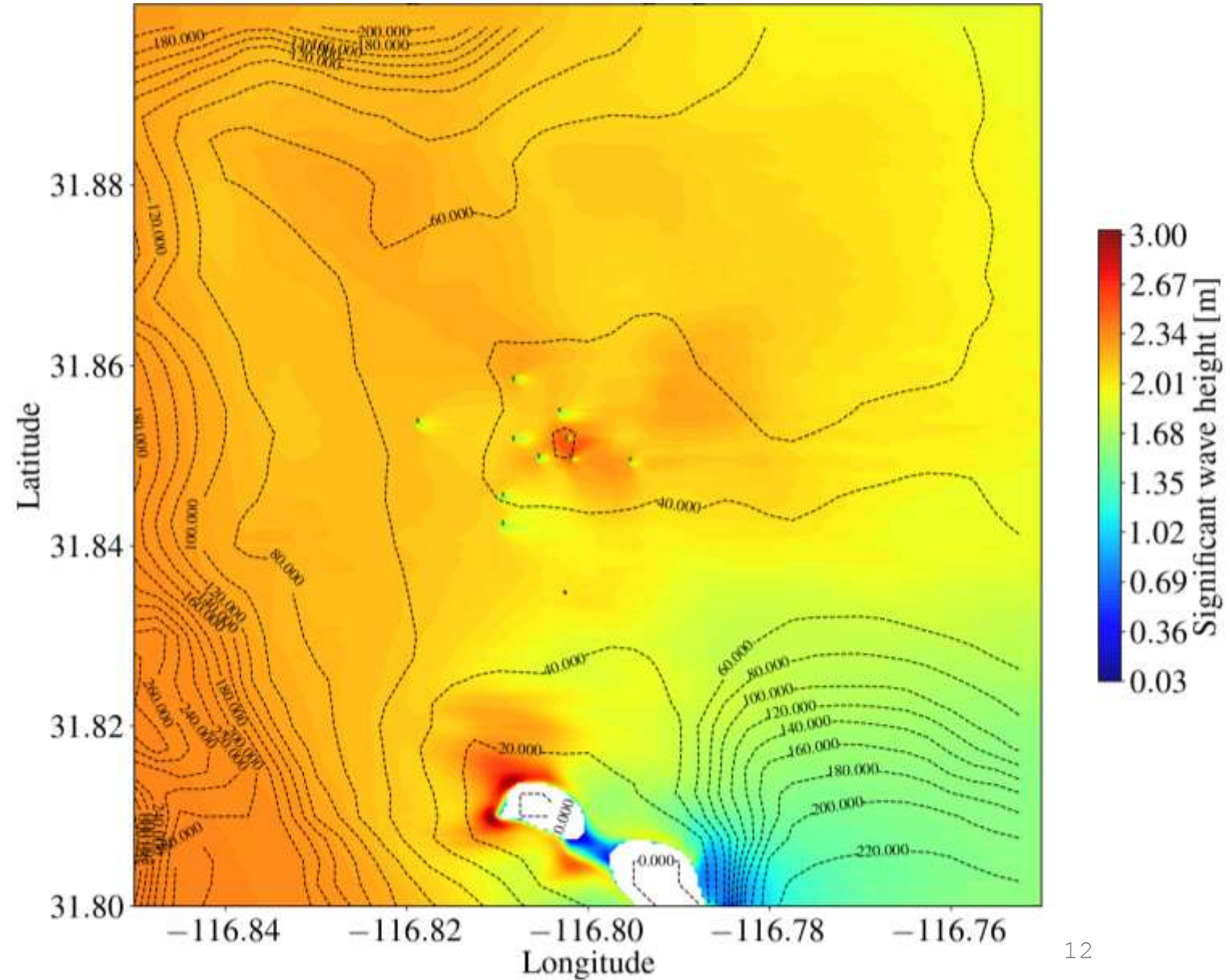
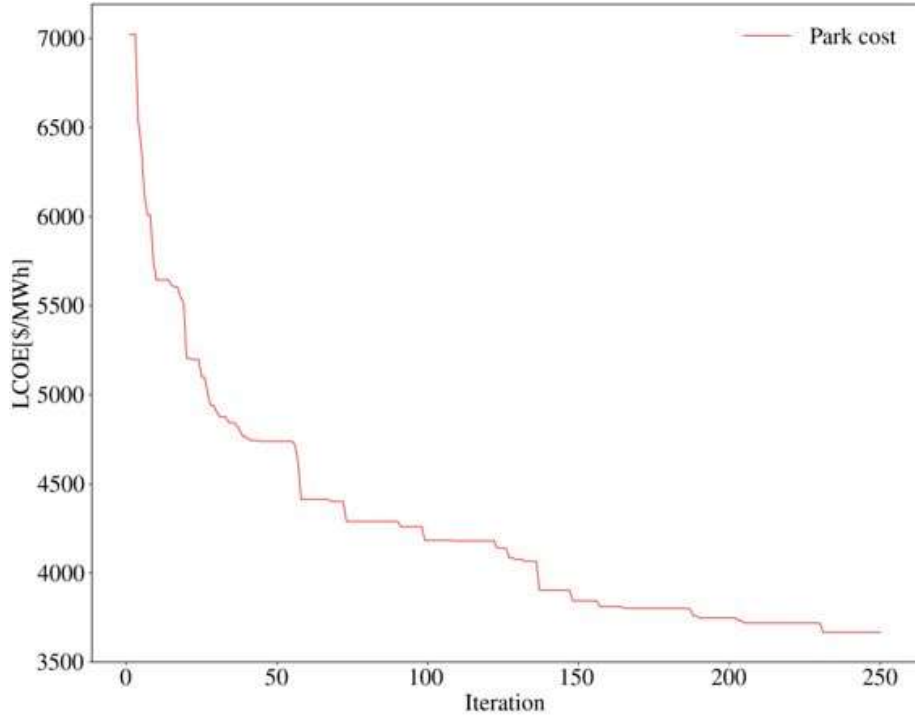
# Preliminary results

# The best sceneries found

GA



# The highest rated scenario



Some issues  
until now

Get prices for another  
devices

Power matrix

Lack of experiments in  
wave channels to  
validate

We are optimized only  
LCoE but not maximized  
power production.

Thank you



**CONAHCYT**

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CIENCIAS Y TECNOLOGÍAS

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