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Resolving Transformed Wave Directions Near Coastal Structures

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Deployments in Coastal Waters

Bottom mounted instruments are subjected to transformed waves since

(1) commonly used for monitoring conditions near harbor entrances and protective structures.

(2) They are limited to depths where structures are located and tranformations exist.

Transformations may be attributed to structures, currents, bottom variations.

Standard directional estimates can be misleading and special treatment must be considered

Malaga, Spain
Breakwater Study

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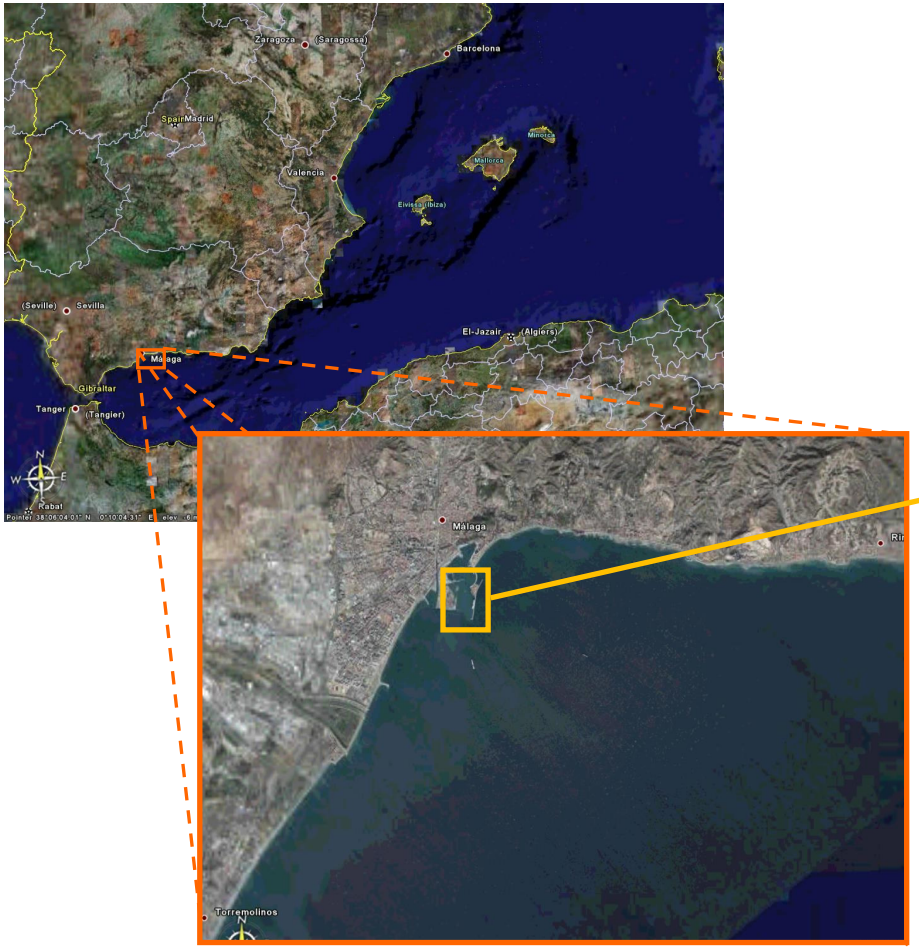
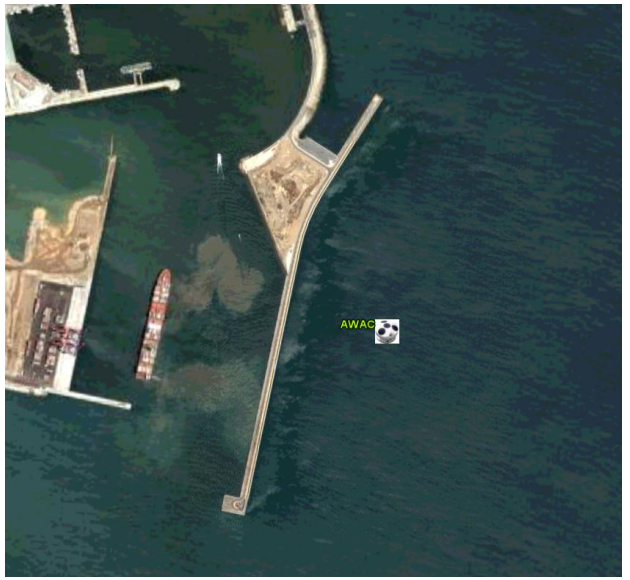
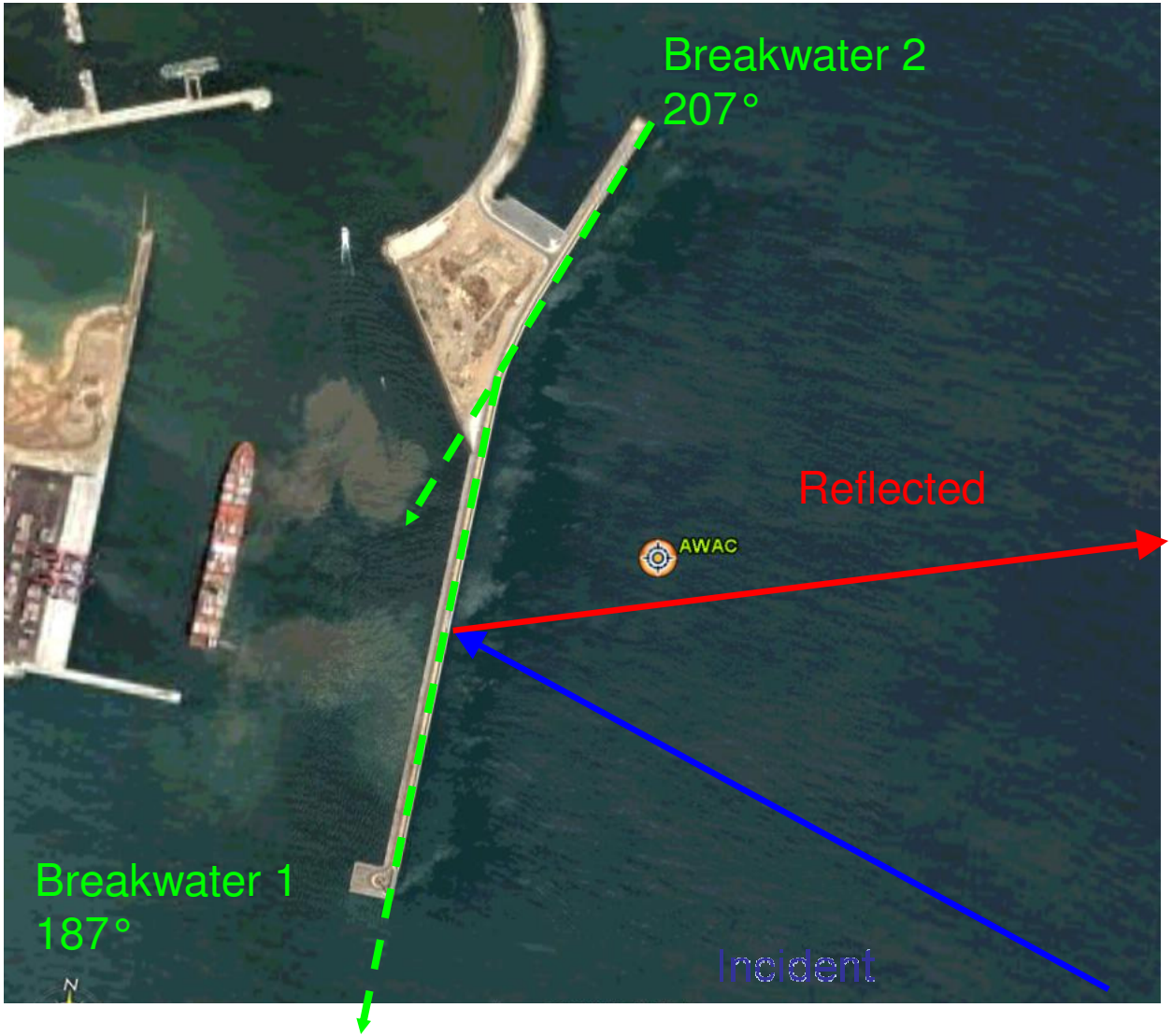
- 22 meter depth
- 2 months of data
  - 1 burst/hour
  - 1500+ burst
- Substantial Reflection

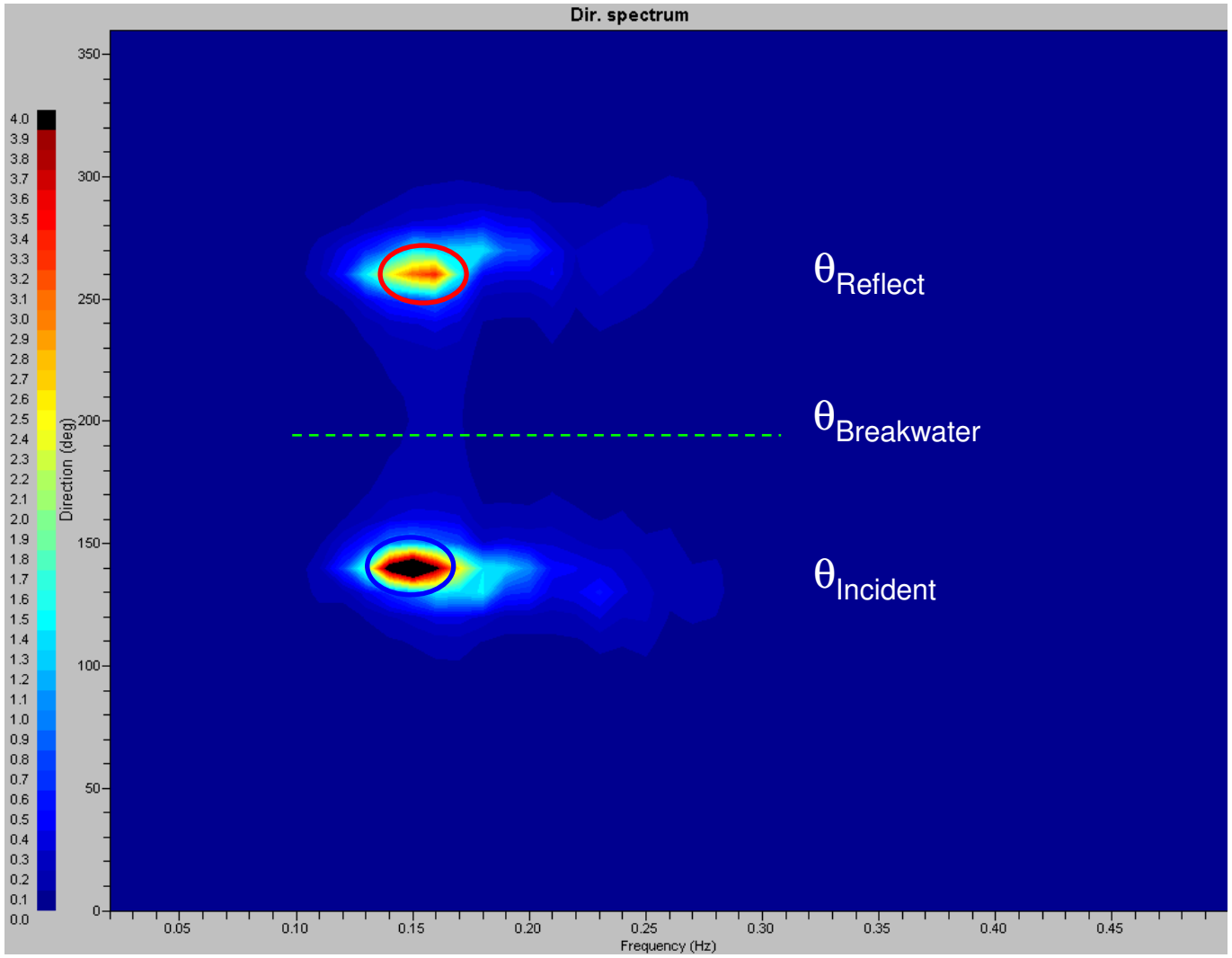




Breakwater Reflections

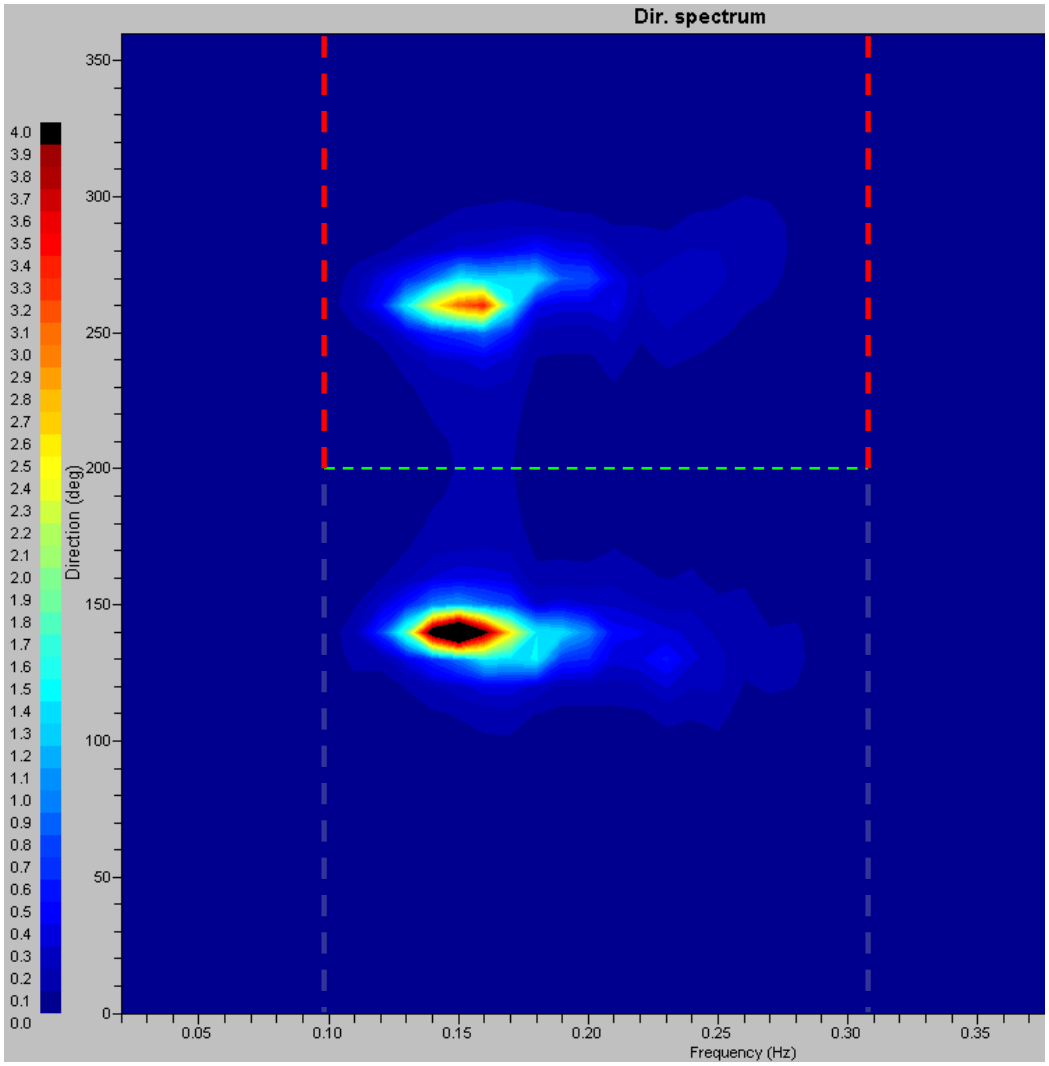


Peak Direction Test



$$\theta_B = (\theta_I + \theta_R)/2$$

Reflection Coefficient



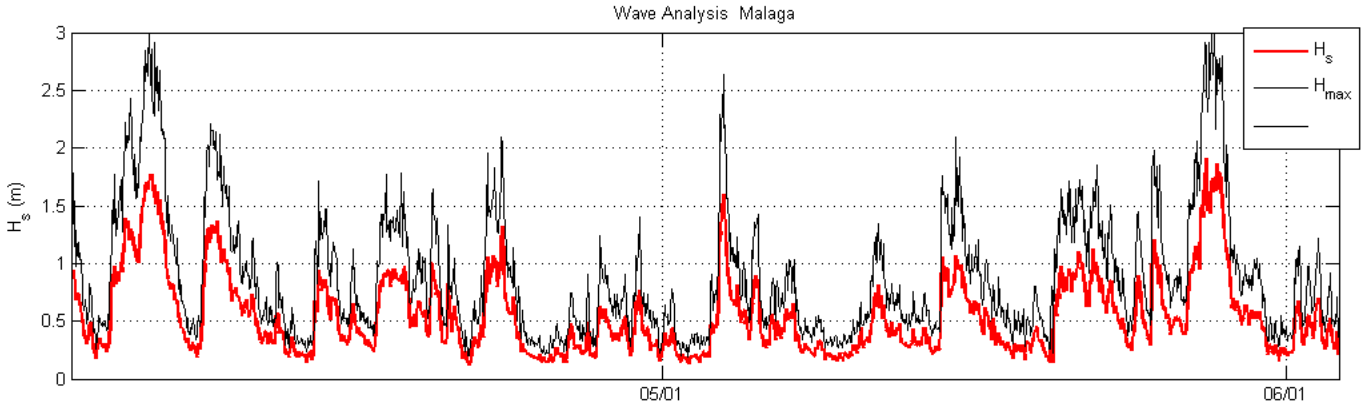
$$E_{ref} = \sum_{freq} \sum_{\Theta} Energy$$

$$E_{Inc} = \sum_{freq} \sum_{\Theta} Energy$$

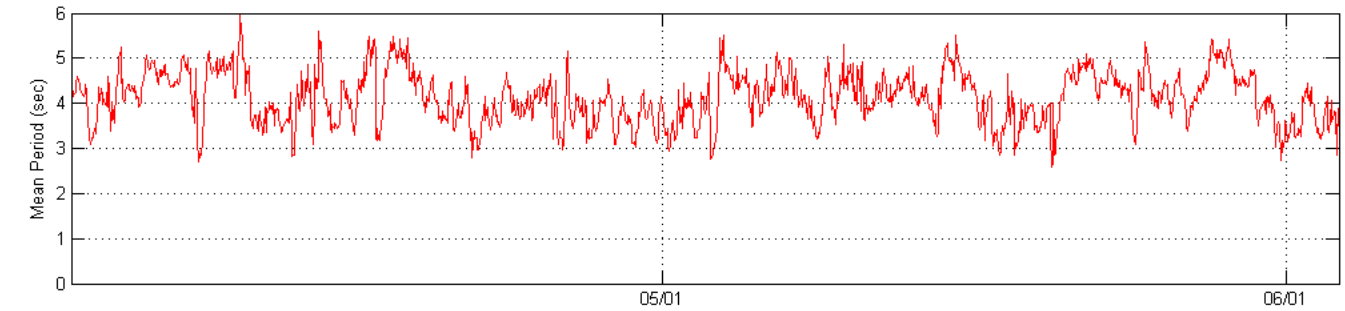
$$K_R = \sqrt{\frac{E_R}{E_I}}$$

$$0 < K_R < 1$$

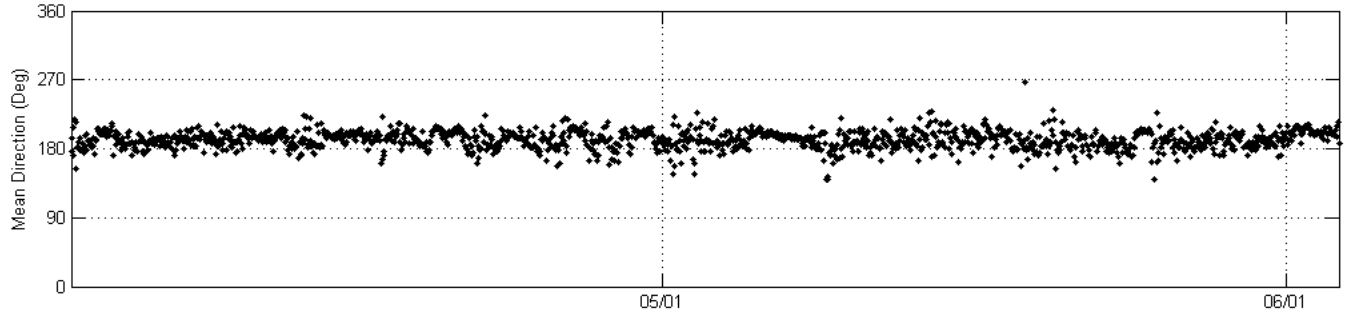
Malaga: Wave Estimates



low H_S
(H_S=H_I +H_R)



Short waves



Mean & Peak Direction Based on Fourier Coefficients A_1 & B_1
Not Adequate!!

Reflection Analysis

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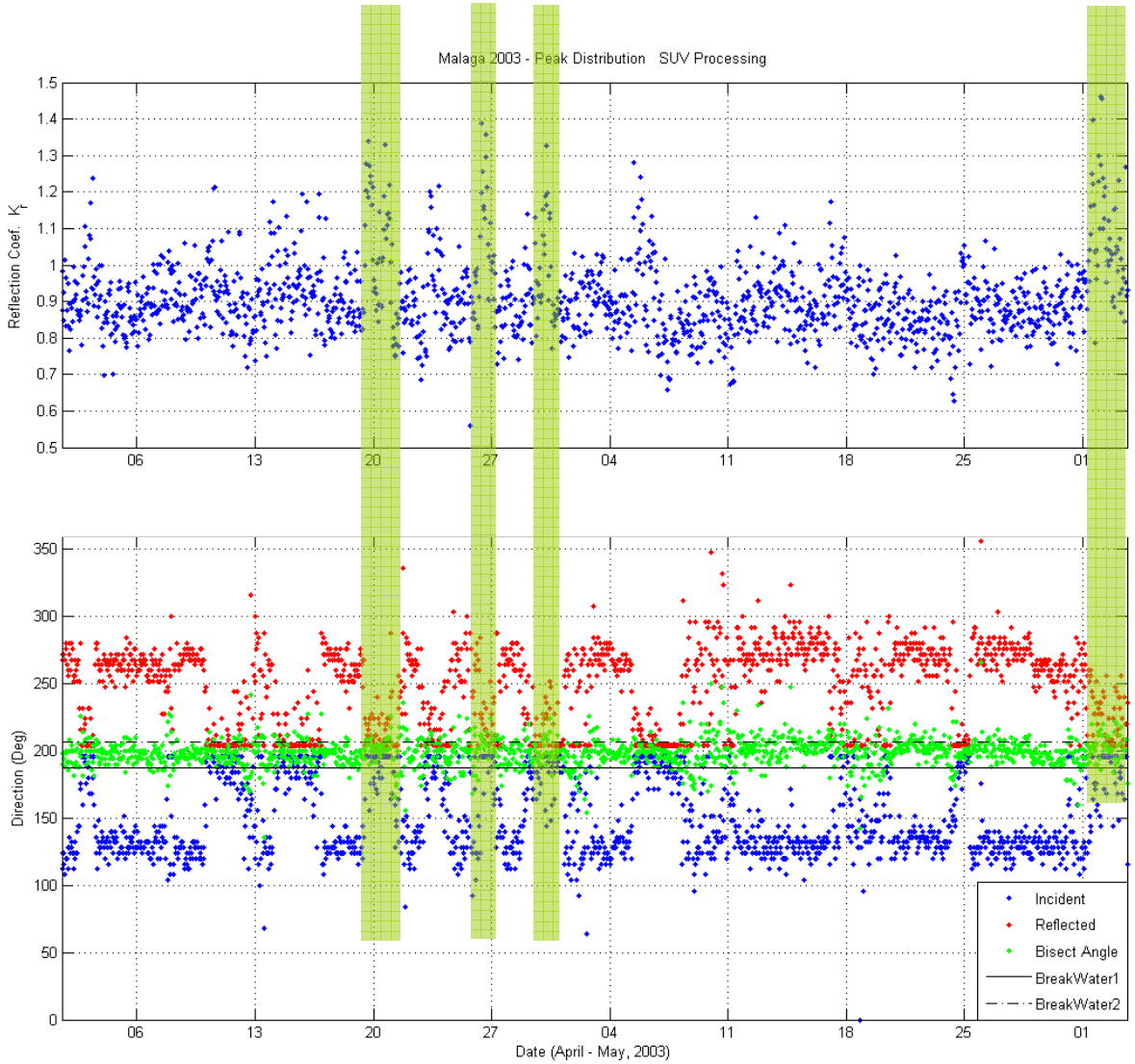
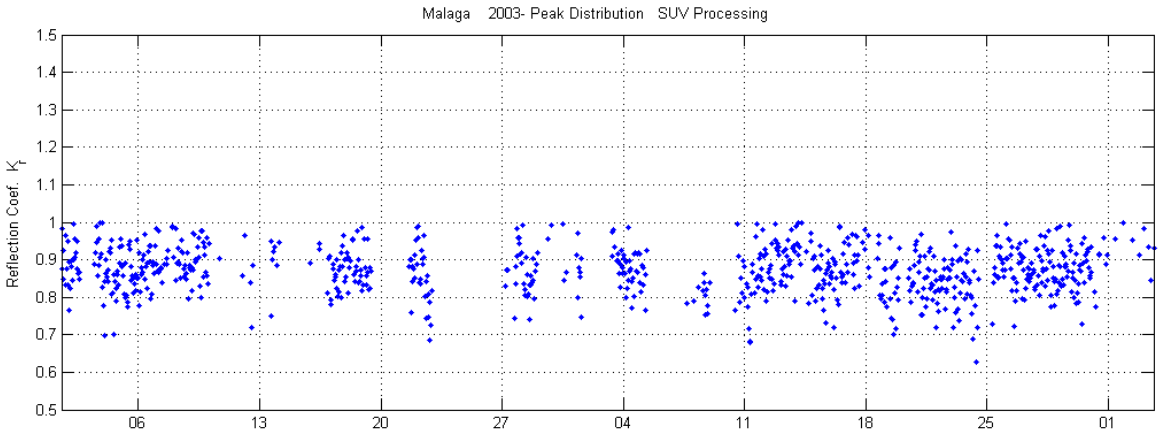


Mean of reflected and Incident peak Dir Approximates Breakwater Dir

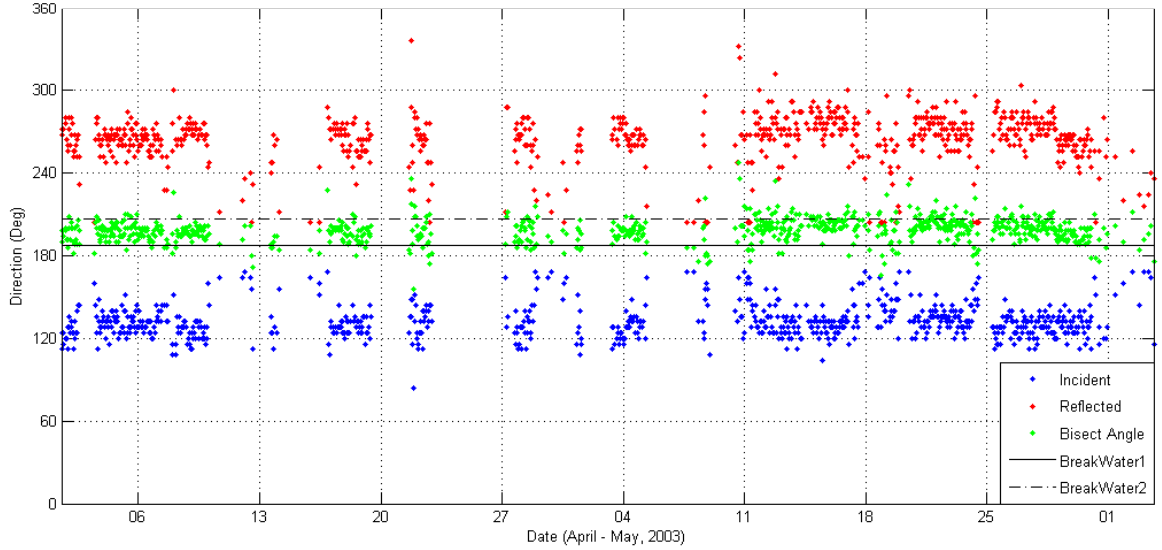
Occasionally K_R>1

Meaningful Analysis requires filtering:
- **Southerly Waves**
- **H_S < 0.25 meters**

Reflection Analysis: Cleaned



Mean(K_R) = 0.86 reasonable



Mean $\theta_{Breakwater}$ = 197°

Expected angle to be closer to B1(187°) than B2 (207°) but still promising

Final Remarks

Malaga data indicated quite promising possibilities for evaluating response for structure-wave interaction.

Directional peak distribution of Incident and Reflected waves was confirmed by calculated ”Breakwater angle”.

Standard directional estimates based on first pair of Fourier coefficients misleading.

Subsequent analysis of Reflection coefficient showed reasonable estimates.

K_R > 1 can be possibly acounted for by local amplification from double reflection of dual breakwater system.

Represents an initial step and a natural follow along would be a less complicated structure (single breakwater).