

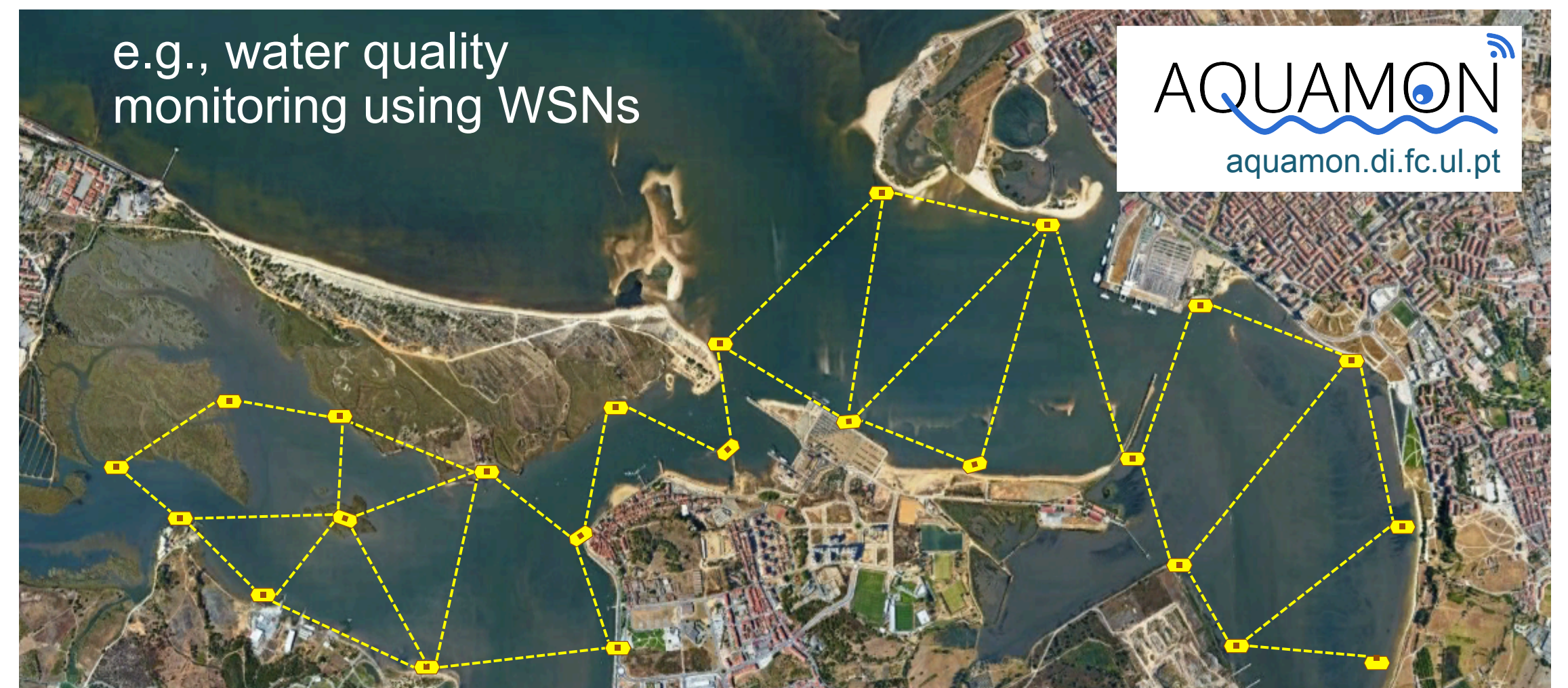
On the Two-Ray Model Analysis for Overwater Links with Tidal Variations

Motivation

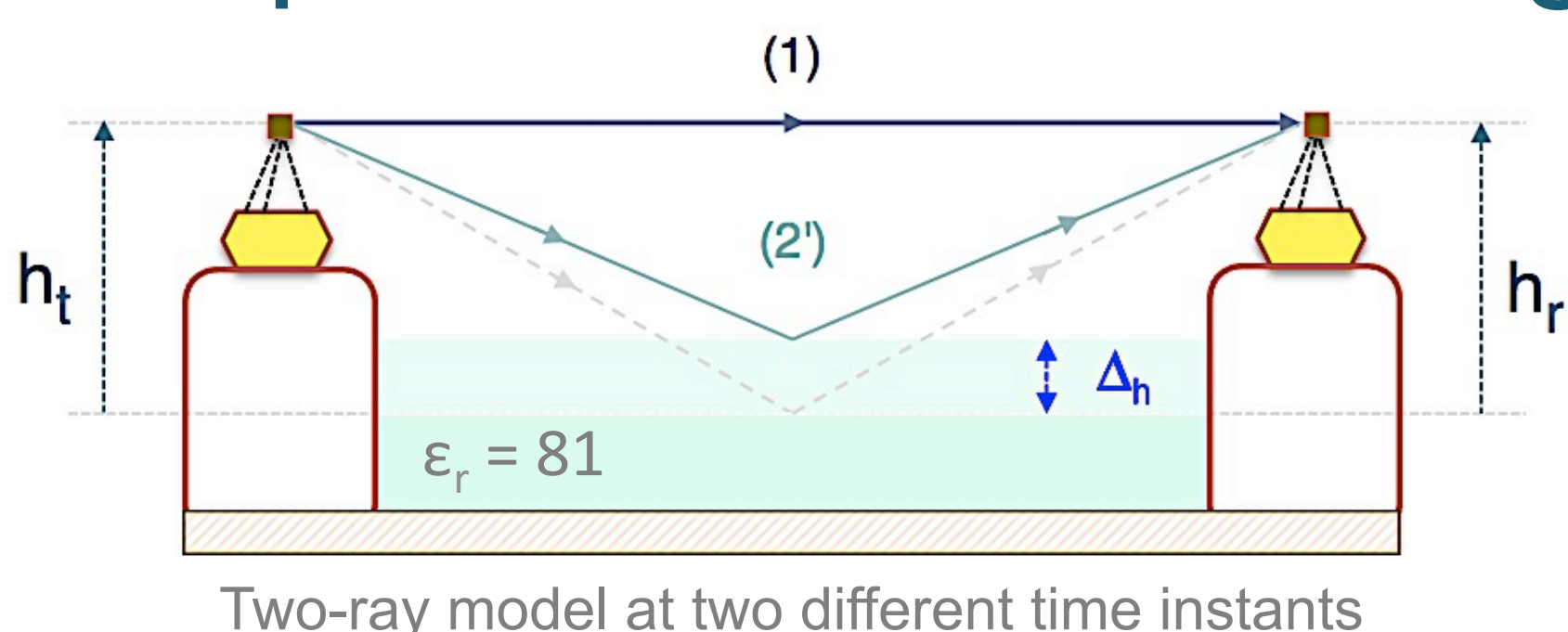
- **Large-scale WSNs** in a coastal environment that involves:
 - Several links of short-to-medium range distance
 - Antennas installed at a few meters above the surface
 - Tidal variations in the range of the antennae height

Objective:

assess the impact of **antenna height and polarization** on overwater links during the cycle of tidal variations.



The impact of antennae height

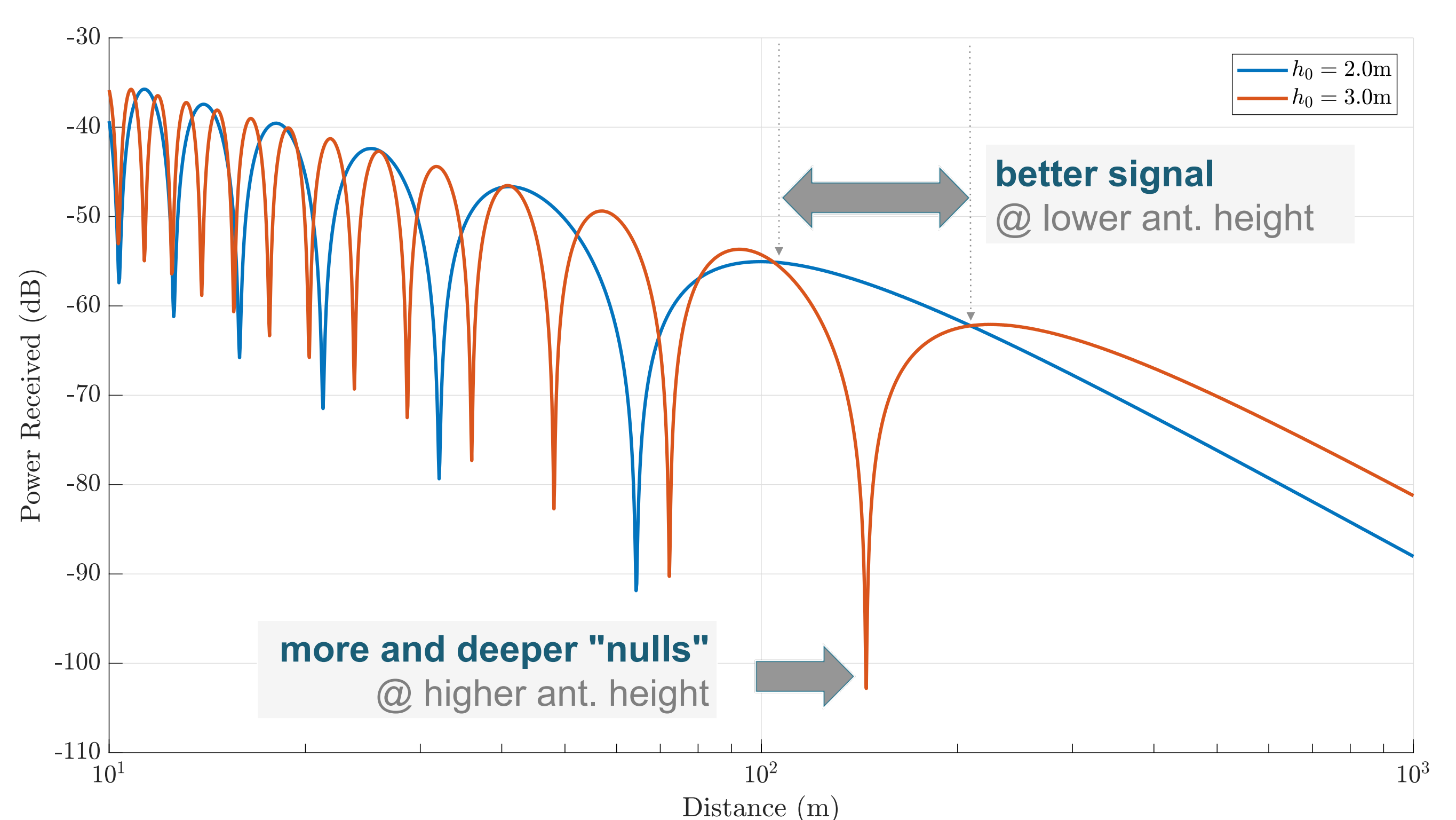


Power received (Pr) is a function of the distance link (d), the wavelength (λ) and $A(\theta)$

$$P_r(d, \theta) = A^2 \frac{\lambda^2}{(4\pi d)^2} P_t$$

$$A(\theta) = \sqrt{(1 + \Gamma \cos \theta)^2 + (\Gamma \sin \theta)^2}$$

A(θ) is a geometrical factor depending on the two-ray model and the Fresnel reflection coefficient (Γ)



The impact of tidal cycle & polarization

- The **tidal cycle** adds a temporal dimension to the analysis of the two-ray model
- The **vertical & horizontal polarizations** have an impact significantly different on Pr

Vertical Polarization

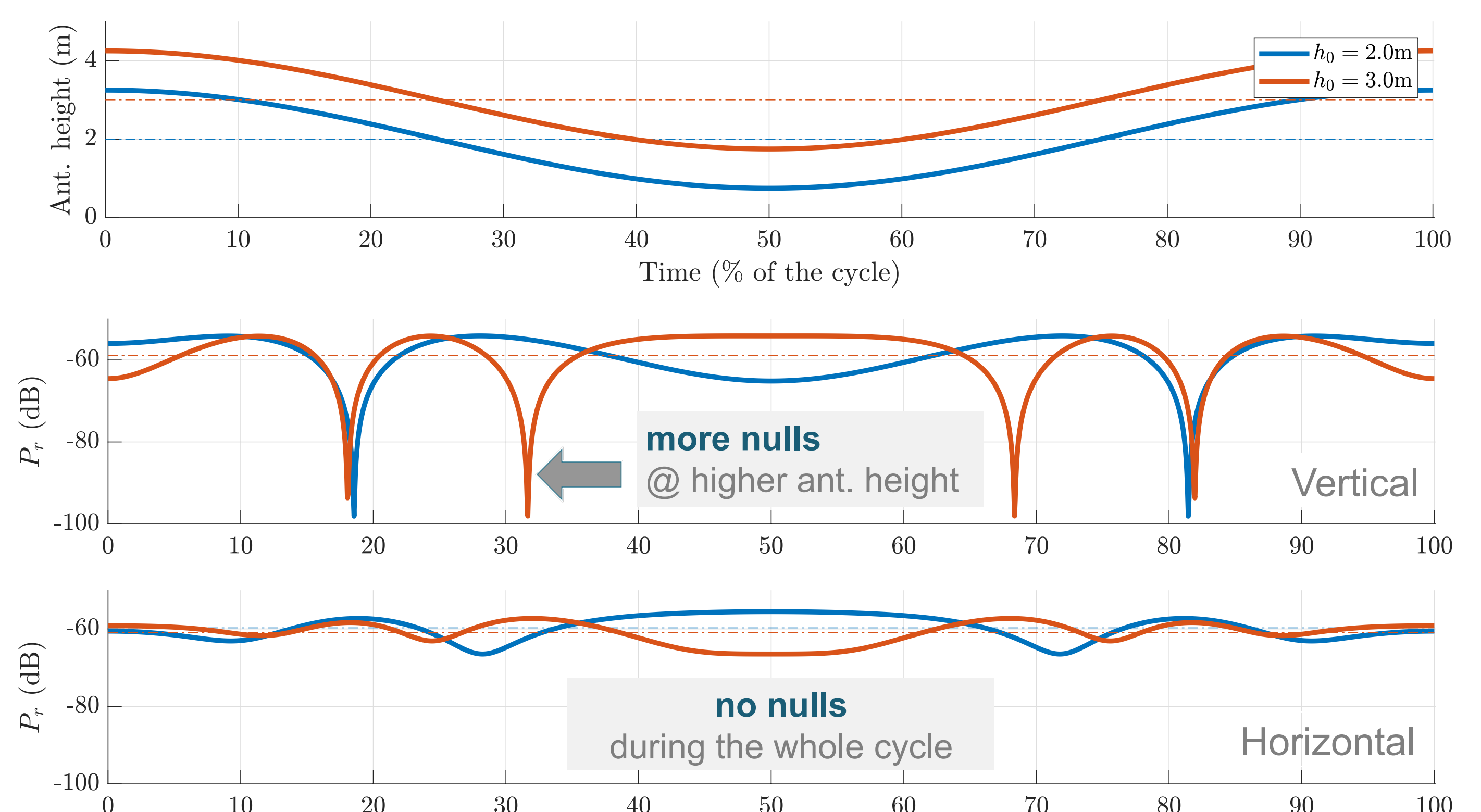


$$\Gamma_V(\theta) = \frac{-\epsilon_r \sin \theta + \sqrt{\epsilon_r - \cos^2 \theta}}{\epsilon_r \sin \theta + \sqrt{\epsilon_r - \cos^2 \theta}}$$

Horizontal Polarization



$$\Gamma_H(\theta) = \frac{\sin \theta - \sqrt{\epsilon_r - \cos^2 \theta}}{\sin \theta + \sqrt{\epsilon_r - \cos^2 \theta}}$$



Major observations

- We observed the **horizontal polarization** shows less susceptibility on signal degradation
- We also observed that **lower antenna heights** perform better for part of the tidal cycle

Conclusion & Future Work

- As a result, **traditional approaches** using **higher antenna heights** and **vertical polarization** may present **lower performance** when evaluated over a full tidal cycle
- In future works, we aim to understand which antenna configuration provides better link quality for a longer interval of the tidal cycle