

UNIVERSITAT POLITÈCNICA DE CATALUNYA



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BARCELONATECH

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Escola Superior d'Enginyeries Industrial,  
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ANALYSIS AND STUDY OF A  
**SHALLOW WATER MODEL CODE FOR APPLICATIONS TO  
PLANETARY ATMOSPHERES**

A thesis submitted by Arnau Prat Gasull for the BSc Degree in Aerospace Vehicle  
Engineering

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## **Part III**

# **Budget and environmental impact**

# CHAPTER 1

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## Budget

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In this chapter, a compilation of all the costs and expenses related to the realization of this FYP is presented. The figures in Table 1.1 are approximations.

The costs of this project can be mainly attributed to personnel costs and the powering of computers (see Table 1.1). The price of a Matlab license is also included in the budget, even though that if the software had not been available, an open source alternative such as Julia or Python might have been used.

Table 1.1: Costs of the study

Concept	Amount	Unit cost	Attributed
Engineering work	630 h	16 $\frac{\text{€}}{\text{h}}$	10 080 €
Matlab license	1 u.	800 $\frac{\text{€}}{\text{u.}}$	800 €
Electricity consumption	65 W for 600 h	0.17 $\frac{\text{€}}{\text{kW} \cdot \text{h}}$	7 €
Computer depreciation	650 € per 60 mo.	11 $\frac{\text{€}}{\text{mo.}}$	65 €
Total cost	NaN	NaN	10 951 €

The author has assumed the hourly salary of a junior engineer to obtain a first approximation of *Engineering work* and that the depreciation of the value of the computer with time is linear.

At the time of writing, Shallow Worlds has not been thought of a viable source of income. If the development of the solver continues and it becomes a flagship of a department, the research could be sustained with funds and initiatives coming from academic organizations, enterprises, and governmental and intergovernmental institutions.

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### Environmental impact

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Different amounts of CO<sub>2</sub> have been emitted to the atmosphere during this FYP according to different estimates:

- According to the average of the 2015 Factor Mix published by the Industry Ministry of Spain<sup>?</sup>, 4.68 kg of CO<sub>2</sub> have been emitted to the atmosphere. The emissions factor used in this case is  $0.12 \frac{\text{kg}}{\text{kW} \cdot \text{h}}$  of CO<sub>2</sub>.
- This factor should not be used as it does not take into account the weight of each of the enterprises. A better approximation is  $0.245 \frac{\text{kg}}{\text{kW} \cdot \text{h}}$  of CO<sub>2</sub>, which leads to an emitted amount of 9.56 kg of CO<sub>2</sub>.
- A conservative estimate of the emissions is 15.60 kg of CO<sub>2</sub> for a factor of  $0.4 \frac{\text{kg}}{\text{kW} \cdot \text{h}}$  of CO<sub>2</sub>.
- In the past, a factor of  $0.649 \frac{\text{kg}}{\text{kW} \cdot \text{h}}$  of CO<sub>2</sub> was used. In this case, the attributable to this FYP is 25.31 kg of CO<sub>2</sub>.

No other environmental factors have been taken into account in this FYP.

As a side note, large clusters of computers such as supercomputers are very energy demanding and their environmental impact may be very significant.