Coastal Dynamics open codebook

Notebook Chapter 9 – Escoffier Curve

# Introduction

Chapter 9 of CDot focusses coastal inlets and tidal basins. The chapter covers general basin and inlet types (§9.2), main morphology units (§9.3): ebb-tidal delta (§9.4), entrance channel (§9.5) and inner basin(§9.6), discusses how these units can be described by empirical relations and deals with the mechanisms for basin net sediment import and export (§9.7).

This notebook acts as an interactive learning tool for the topic of §9.5 “Stability of the inlet cross-sectional area”, the Escoffier curve. Below the concept of the notebook is discussed.

## Creating an Escoffier curve

*Read pages 438, 439 and first 3 lines of 440*

Escoffier’s curve is a so-called closure curve and describes the relationship between maximum channel velocity and the parameter , which is primarily, but not solely, a function of the channel cross-section. If we consider a sinusoidal tidal velocity signal:

|  |  |  |
| --- | --- | --- |
|  |  | (9.5) |

Where is the tidal signal amplitude, the tidal prism, the channel cross-section and the tidal period (see Intermezzo 9.4 of the book).

The process that leads to the Escoffier curve explained in the book. In this notebook we provide a short visualisation, see the interactive plot below. We start with an imaginary channel cross-section that is very small, close to point A, such that the tidal difference in the estuary is smaller than the tidal range. Increasing the cross-section () results in an increase of the tidal prism () so large that increases too (recall eq. 9.5). At some point the tidal difference in the estuary is equal to the tidal range and we reach the peak of the closure curve. A larger cross-section now reduces as remains constant (again, recall eq. 9.5).



Figure – Placeholder for interactive slider plot, see Appendix A

The next step is to determine an equilibrium channel velocity below which no erosion of the channel occurs. This velocity is only slightly dependent on the cross-section and can be approximated as just a function of sediment size. Larger sediment size leads to a larger and vice versa.

The closure curve and a value for leads to the well-known Escoffier curve as depicted in Figure 9.22 in the book.



Figure 2 – Typical Escoffier curve

## Channel stability

----Here we ask questions on what happens at the 5 red locations and see if some students can answer this based on the above explanation. Otherwise we can refer back to the lecture/book pg. 440 (although they probably already did either one)-----



## Three “types” of Escoffier curves

-----Here we ask questions on what happens to the channel at location 1 and 2 (in red) for the two alternative types of Escoffier curves. We can also think of something similar with , perhaps ask if we can change by dredging/filling/changing channel sediment.-----



## Questions

-----Here we ask other questions related to the Escoffier curve. Some examples are given.-----

* What would happen if becomes really large?
* Can in the closure curve go to infinity?
* What happens to is becomes really large?
* Is there a limit to ?
* How can you modify the Escoffier curve through engineering?
* Can the closure curve vary in time? Explain your answer.

Appendix A

The interactive plot in 4 steps as a proof of concept. Preferably this in programmed in Python with a slider widget, but might turn out difficult. Also, actual data for this would be useful.

The black dashed line indicates the tidal range at sea, the red dashed line the tidal difference in the estuary, the tidal prism.



Inspiration:

