INDIRECT DAMAGE - EROSION

Contents derive partly from

<https://en.wikipedia.org/wiki/Longshore_drift> <https://en.wikipedia.org/wiki/Sedimentary_budget>

https://en.wikipedia.org/wiki/Swash#Cross-shore\_sediment\_transport

The sea was wet as wet could be,

The sands were dry as dry.

The Walrus and the Carpenter

Were walking close at hand:

They wept like anything to see

Such quantities of sand:

“If this were only cleared away,"

They said, “it *would* be grand!”

“If seven maids with seven mops

Swept it for half a year,

Do you suppose," the Walrus said,

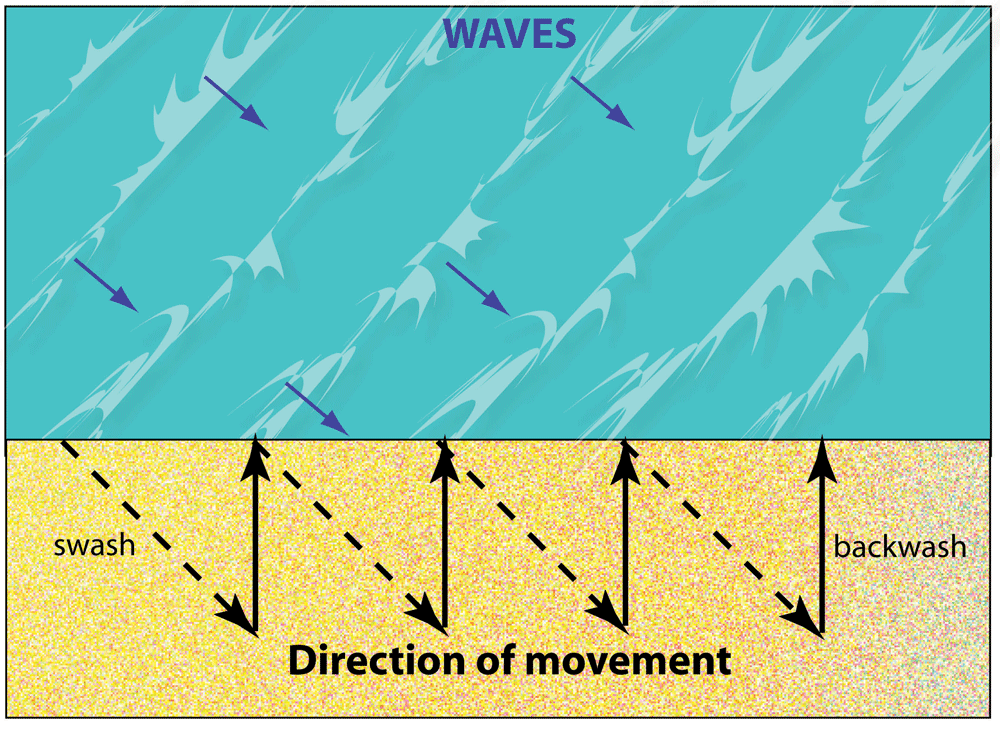
“That they could get it clear?”

“I doubt it," said the Carpenter,

And shed a bitter tear.

**Lewis Carrol**

**MOVIMENTO DEI SEDIMENTI**

****

Nello studio dei processi costieri è pratica comune quella di distinguere tra:

Trasporto cross-shore, (trasversale) che avviene in direzione perpendicolare alla linea di costa, determinato innanzitutto dalla ripidità dell’onda, dalla dimensione dei sedimenti e dalla pendenza del profilo di spiaggia.

Trasporto long-shore, (longitudinale, lungo costa) diretto parallelamente alla linea di costa.

E’ conveniente dare prima uno sguardo al trasporto trasversale, poi a quello longitudinale.

**CROSS SHORE SEDIMENT TRANSPORT**

**Cross shore erosion and accretion (long term)**

BACKGROUND: The term "erosion" usually describes subaerial (i.e.: beach above the sea level) erosion, i.e.,removal of material from the visible beach

Although erosion and accretion commonly refer to the response of the subaerial beach, material may not be lost or gained in the total system, but only displaced and rearranged.

Complex modelling techniques are nowadays available to compute erosion and accretion; however, while erosion mechanism are well understood, the available techniques still fail to simulate beach accretion in a reliable way.

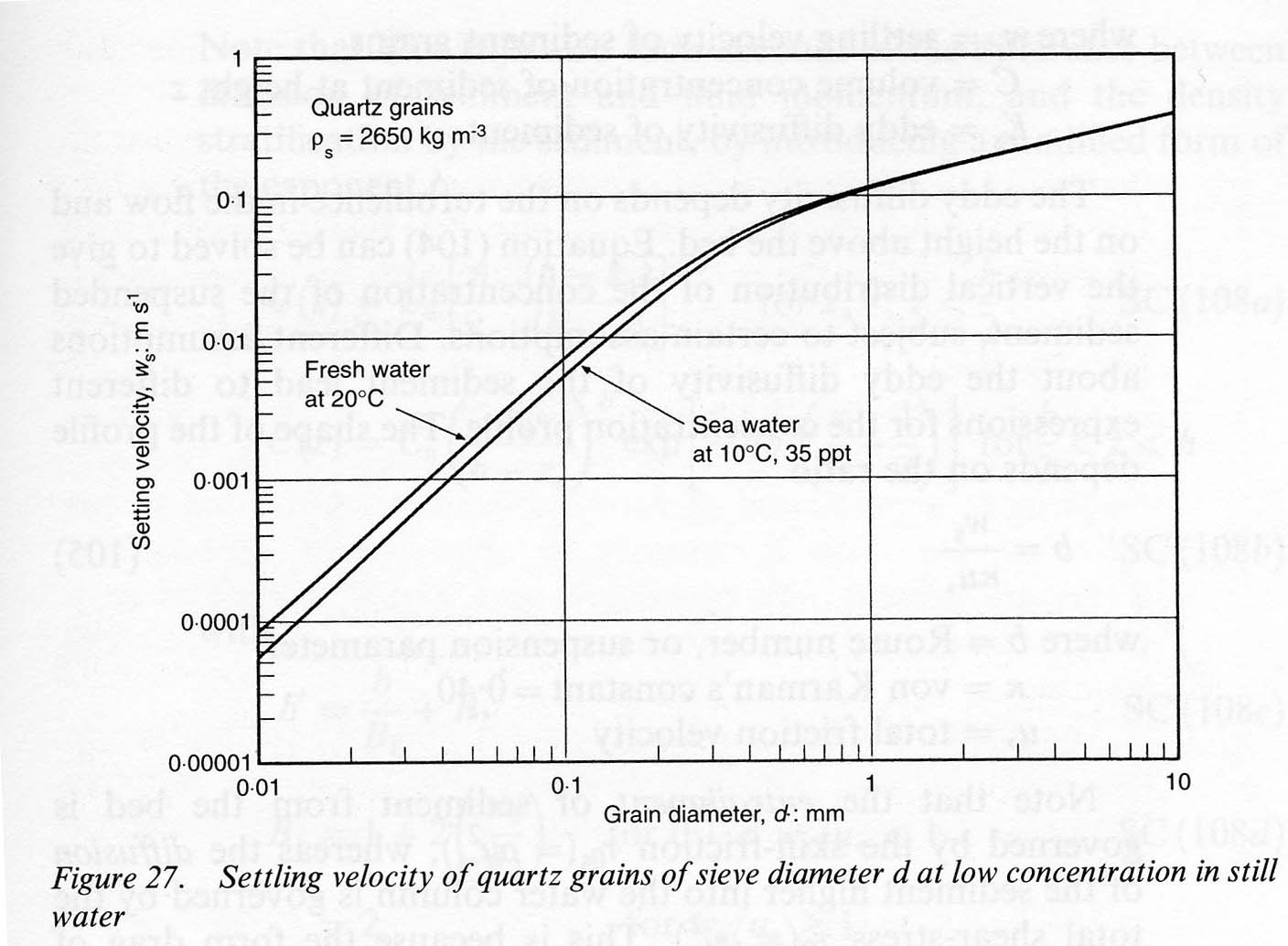
Some indication is available for long term terms of these processes; the following variables determine in great part whether a beach will erode or extend:

**wave steepness: Ho/Lo**

**offshore wave height: Ho (=SWH)**

**Median grain size: d50** (or, equivalently, sand **fall velocity w**)

Significant wave height Ho and wavelength Lo are evaluated in deep water, as denoted by the subscrit "0” The deepwater wavelength is given by linear wave theory as Lo = g/(2Π) To2, Thus, wave period is also a factor controlling beach erosion and accretion.



PREDICTION METHODS: criteria are presented for estimating whether a beach

of known median grain size will erode or accrete due to cross-shore transport

produced by incident waves of specified characteristics.

(Larson and Kraus 1988). In the following formulas, significant wave height and period (T should be used

-\_

Criterion 1: This criterion uses the wave period T, deepwater wave steepness Ho/Lo and **fall velocity w**  and is expressed as



Criterion 2: This criterion is expressed in terms of the deepwater wave

steepness and the ratio of deepwater wave height and median grain size, as

shown by the diagonal line in Fig. 2, and is given by

Eq. 3 ~~is easy to apply since it is expressed in terms of readily available~~

~~variables; however, it is strictly limited to quartz sand and water~~

~~temperatures well above freezing.~~

~~Criterion 3: This criterion is expressed in terms of deepwater wave steepness~~

~~and Dean's (1973) parameter πw/gT, which is formed with the grain fall~~

~~velocity and wave period. The criterion is expressed by~~



The three criteria defined by Equations 2, 3, and 4 are equivalent.

*Only the first criterion (eq 2) above is to be used in the exercises.*

Please note that while energy can be divided into “accretion” and erosion, the actual amount is not simply related with such expression. There is no simple way of predicting how much a profile will increase or retreat form cross shore action.

**LONGSHORE PROCESSES**

**Longshore-drift (sediment transport))**

In principle, longshore sediment transport could be studied by considering the solution of the longshore current reported above, and by introducing the relevant formula for suspension and/or sea bed transport.

However , the best way to analyse this phenomenon is to consider it as the result of two distinct processes: the breaking of the waves, which brings the sediment into suspension e and the transport which is due to the longshore current.

As a consequence, it can be expected that the driving process should be the energy entering the shallow water zone along the shoreline; we already considered the momentum flux when we examined the radiation stresses, so it can be expected that the energy flux should be quite similar, except that – also for dimensional reasons- it should be multiplied by the wave group velocity Cg. Since the latter is in shallow water proportional to the square root of the depth, we end up with formulas for Ql – longshore flux of sediment- which look like the following:

**Ql = Kcal Hsb^(5/2) \* sen(2 αb)**

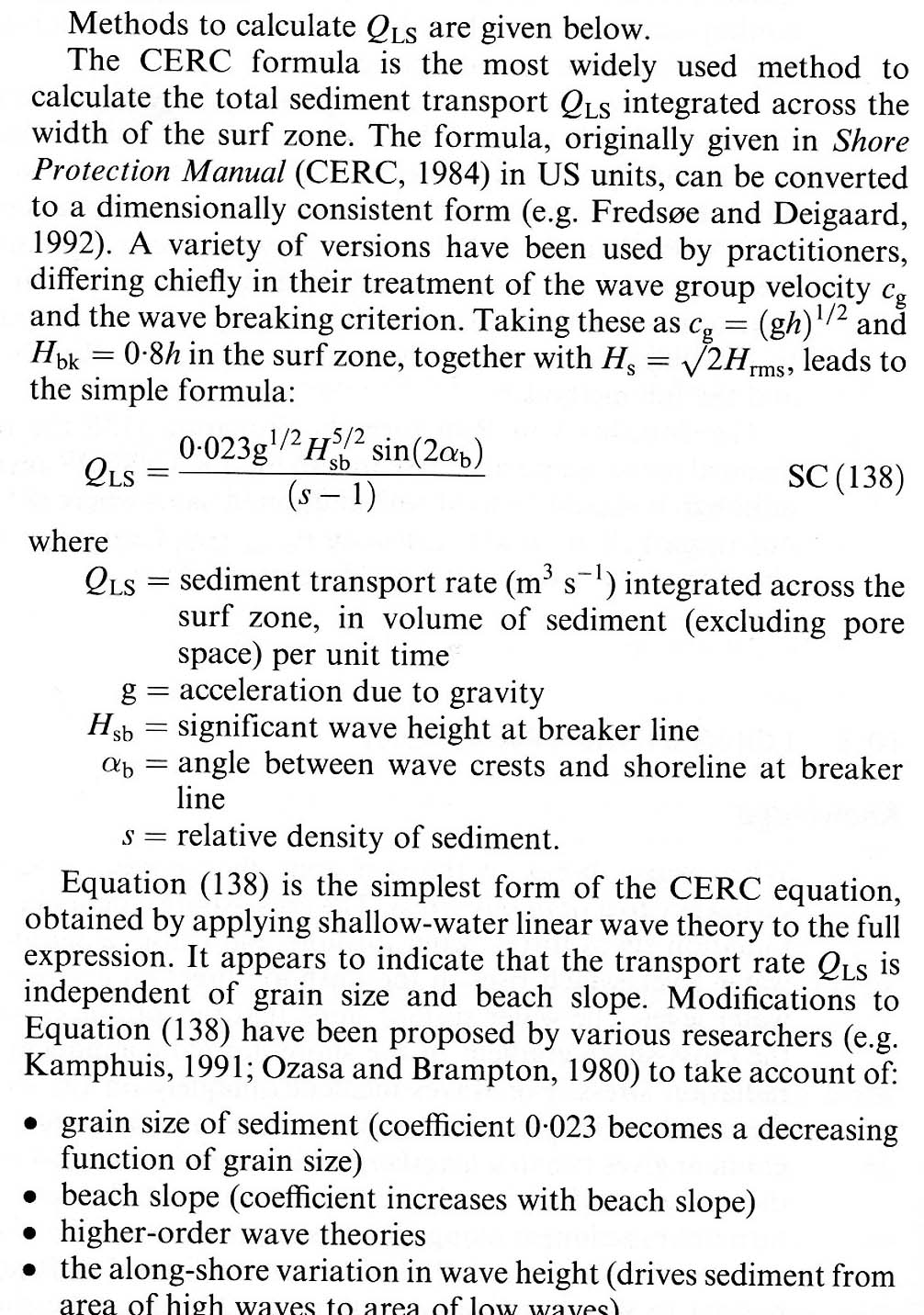
And indeed, most formulas look like that one, which is known as "CERC" formulas.

Please note that Kcal is a calibration coefficient, which has to be determined on the basis of the available *data (an example will be given as an exercise )*

CERC-like formulas, take into account physical parametres such as the sand grain size D50, the porosity p, the ratio between the gravity of the sediment and the gravity of water s= ρs / ρw etc

The formulas need not be learned by heart, but their structure must be fully understood and remembered: dependence on H2.5 and dependence on twice the breaking angle ,

**DA QUI IN POI NON E’ PIU’ PARTE DEL PROGRAMMA**

..



End of erosion processes

Further reading

“Dynamics of marine sands” – R. Soulsby, Hr Wallingford-Thomas Telford Publications”, which also reports a very useful formula, page 195