WAVE ANGLE CONTROL ON DELTAIC CHANNEL ORIENTATION

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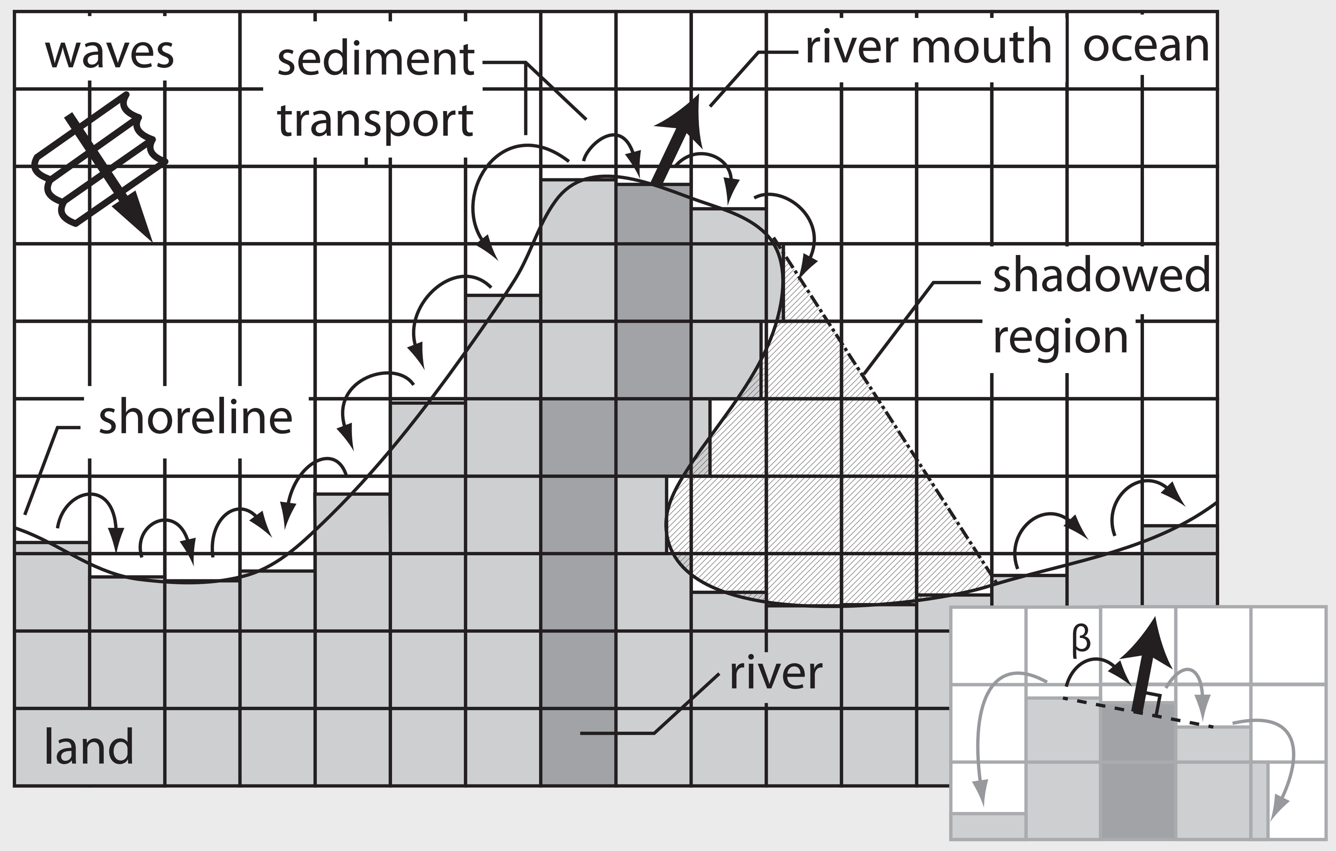
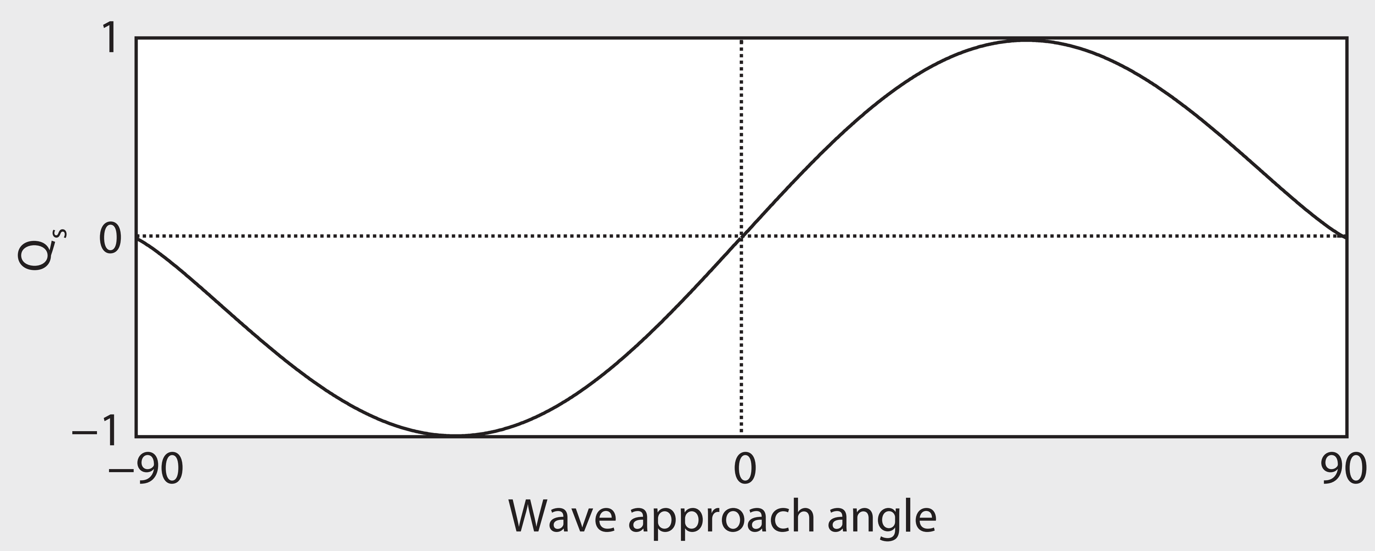
Channels respond to waves

Alongshore transport effect on channel trajectory



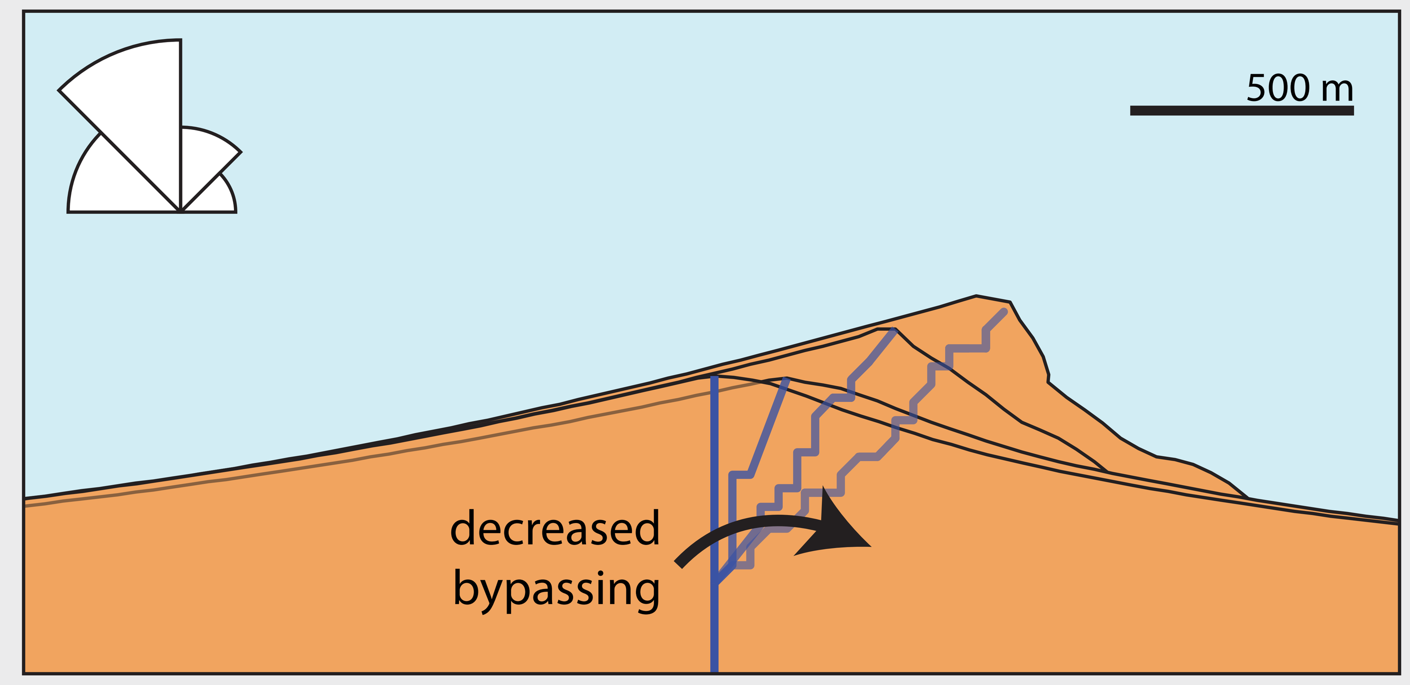
Two simple adjustments to the CEM model (7 lines of code):
1. Channel progrades perpendicular to the shoreline
2. A littoral transport fraction β can bypass the river mouth

[csdms.colorado.edu/wiki/Model:CEM]

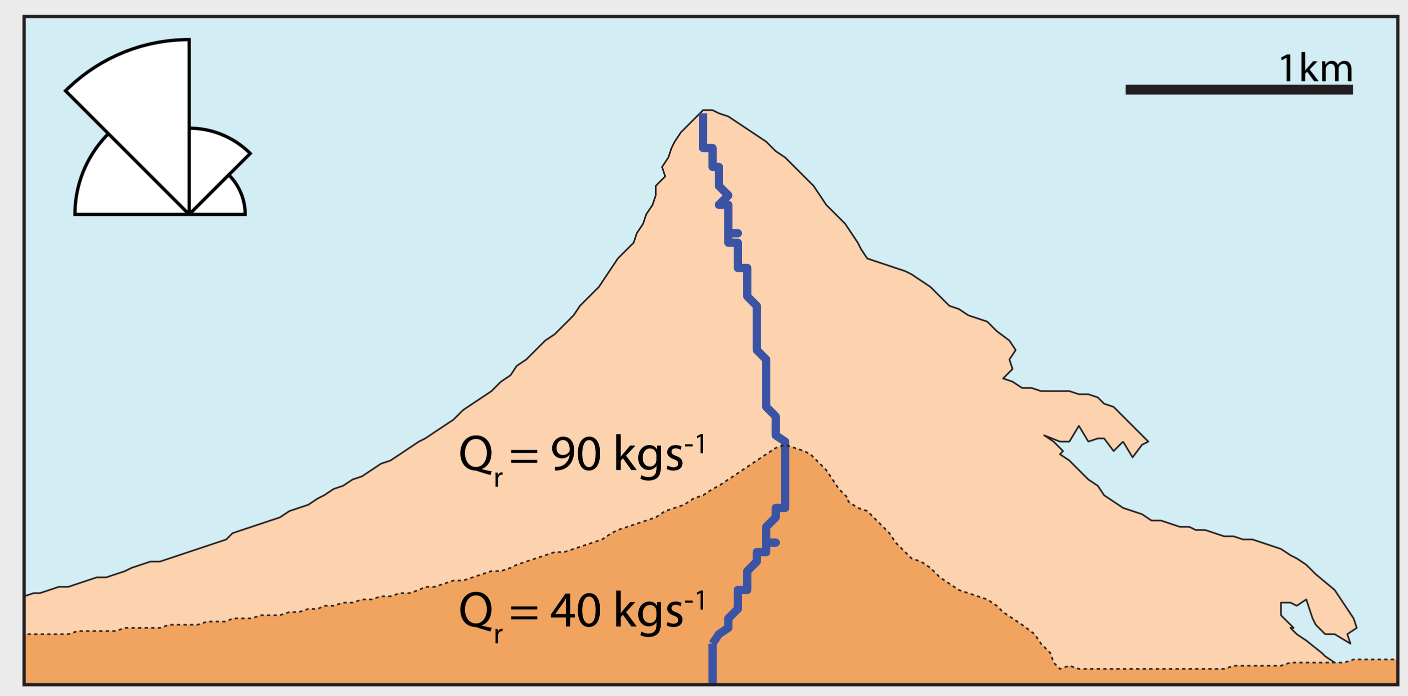


Littoral transport is a function of wave approach angle, setting up a feedback with the changing shoreline orienation of a delta [Ashton & Murray, JGR, 2006]

Effect of sediment bypassing the river mouth

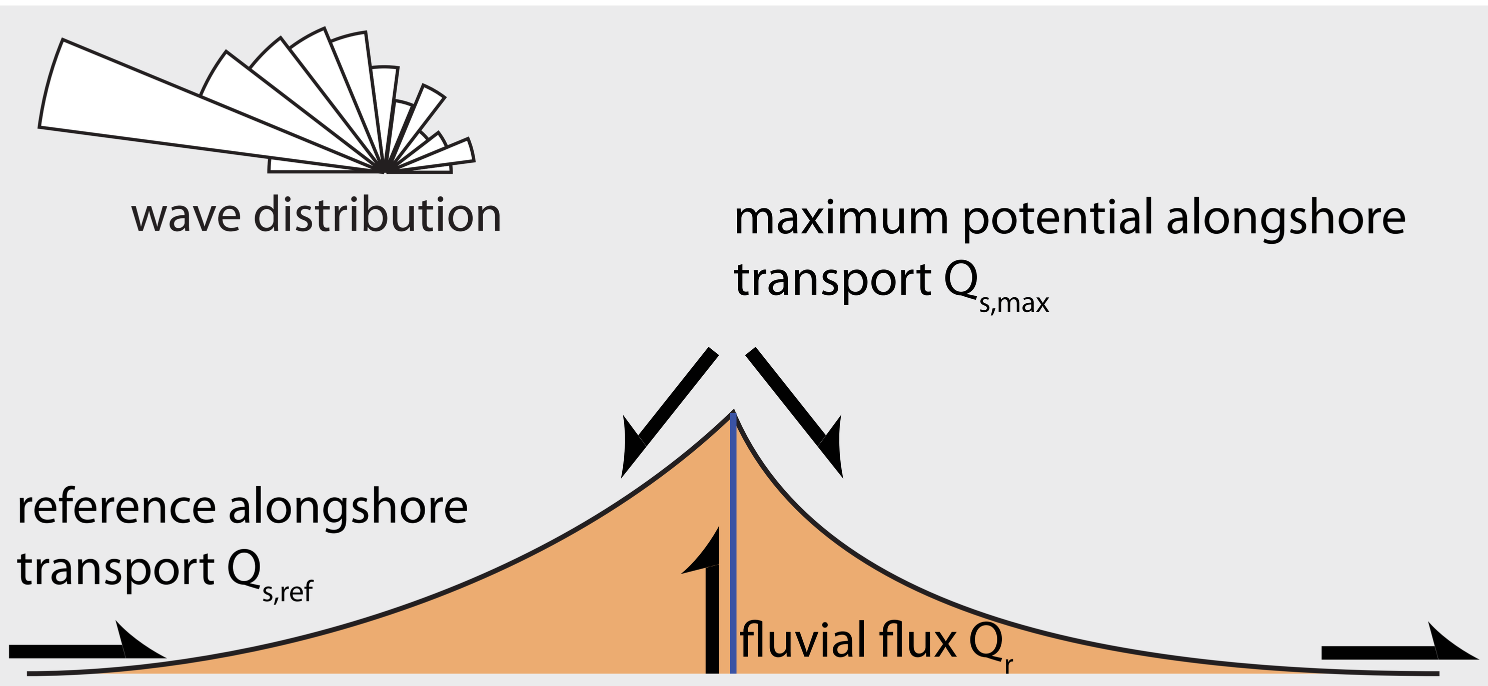


Channels only deflect away from waves if the river mouth obstructs alongshore transport. The fraction of sediment that is allowed to bypass influences channel orientation.

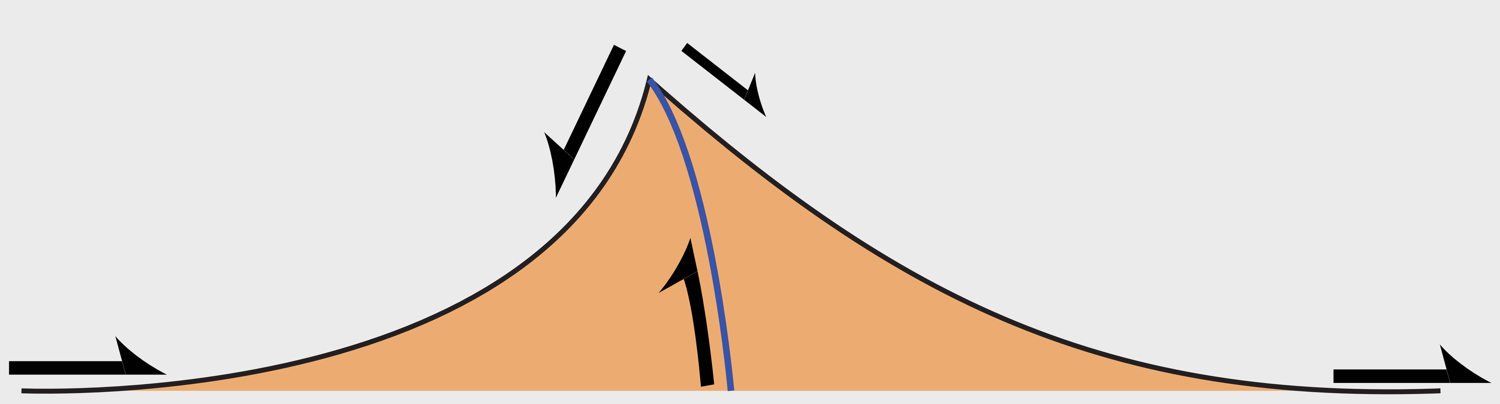


Channels can change orientation as a response to a change in fluvial sediment supply [see Pranzini, Geomorphology 2001].

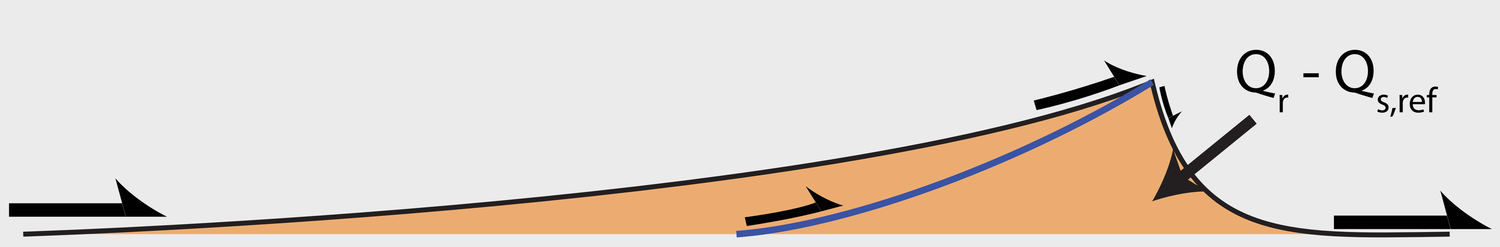
Physical mechanisms of channel steering



The previous model [Ashton & Giosan, GRL, 2011] fixed the channel trajectory. Asymmetry is reflected in sediment accumulation on the updrift flank.

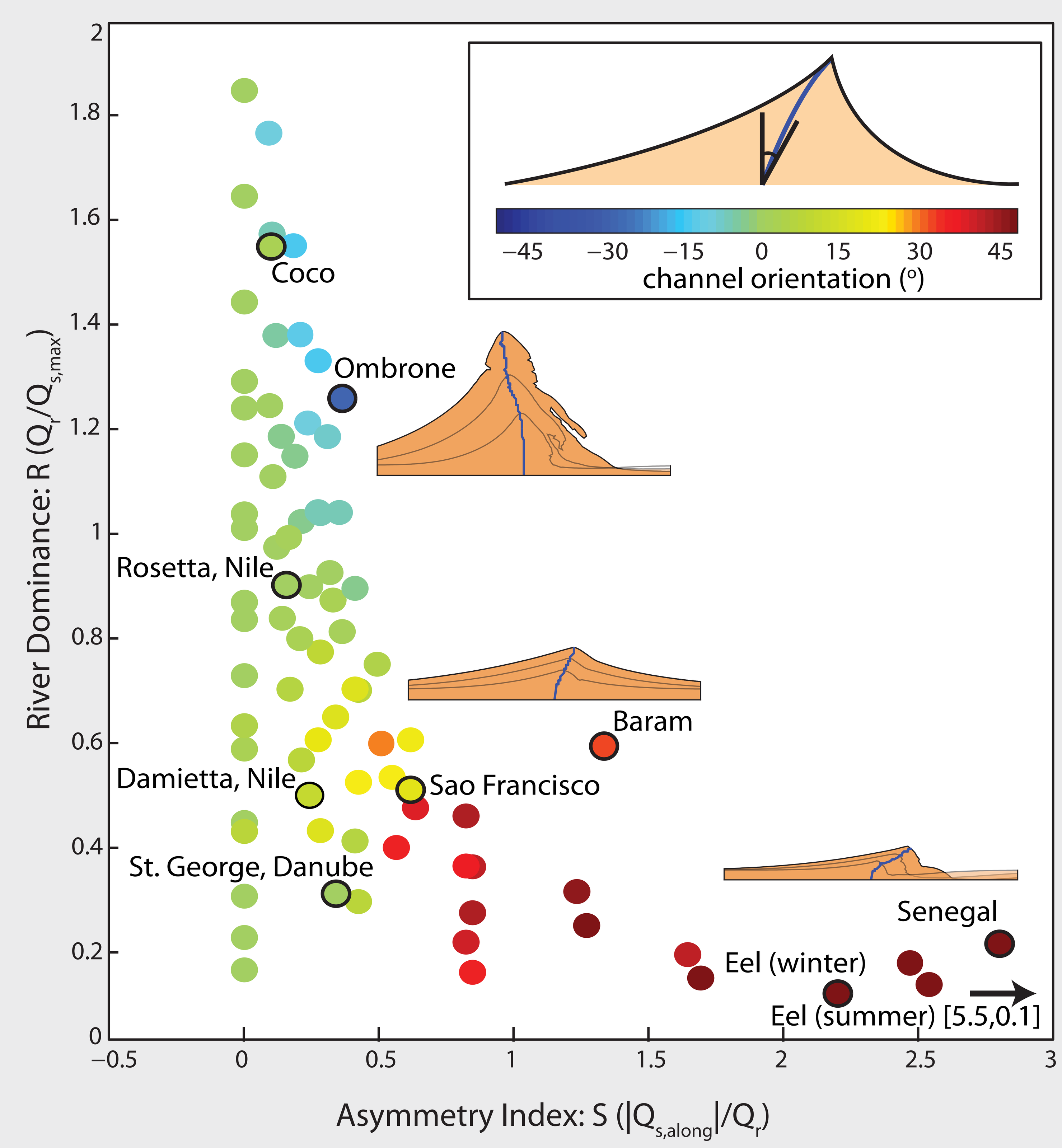


High fluvial flux. Updrift migration when downdrift shoreline passes angle of maximum transport (R>1) [Pranzini, Geomorphology, 2001].



Low fluvial flux. Downdrift deflection (S>1) when the sediment budget (Q_r -$Q_{s,ref}$) for the downdrift flank is negative.

Physical framework of channel steering



Two new indices explain the spread of channel angles seen in modeled and natural examples.