

What determines the seaward limit of mangrove and salt marsh vegetation?



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Why do we need to know where the seaward limits are?

- Inform restoration guidelines
- Predict effects of sea level rise
- Understand tipping points



Where actually is
the seaward
marsh or
mangrove limit?



Look at the pioneers

- First to establish on tidal flats
- Hydrochorous
- Buoyant for at least a certain period of time
- Rapid germination/rooting
- Exposed to hydrodynamic forces by currents and waves
- Burial and erosion can lead to establishment failure



Establishment requires inundation free periods

Wiehe 1935 *Journal of Ecology*

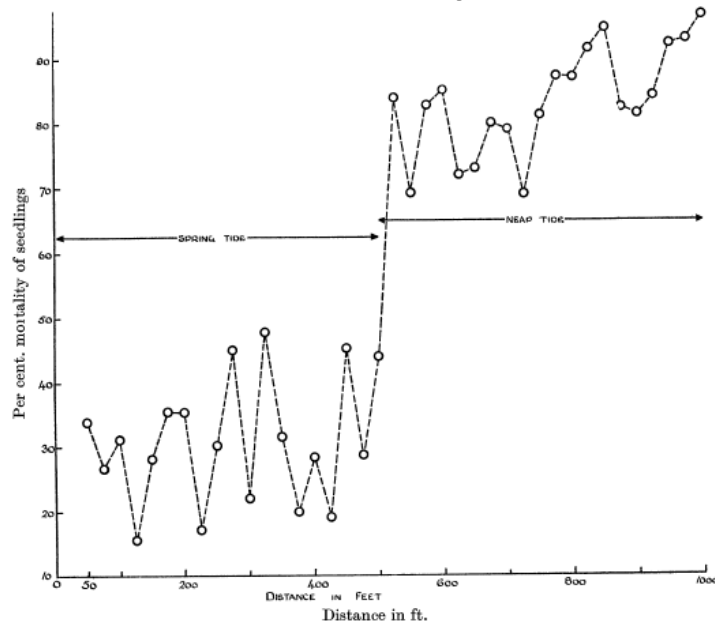
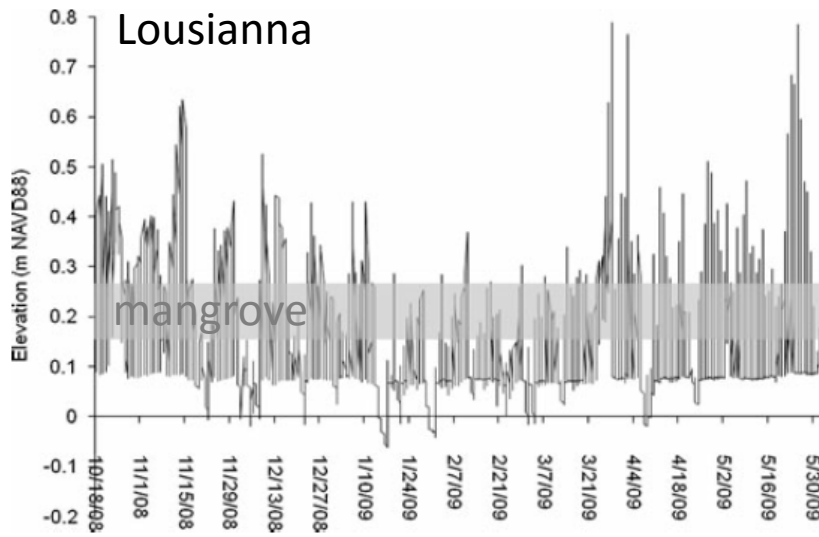


FIG. 3. Percentage mortality of *Salicornia* seedlings along transect II.



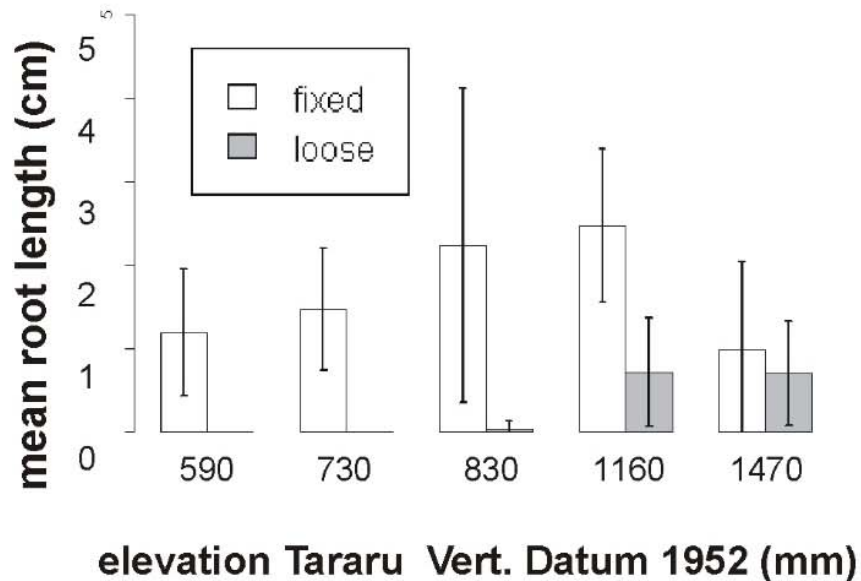
Alleman and Hester 2011
Estuaries and Coasts



This is also evident in riparian vegetation 'recruitment box' (Mahoney and Rood 1998 *Wetlands*)

Disturbance free *Windows of Opportunity*

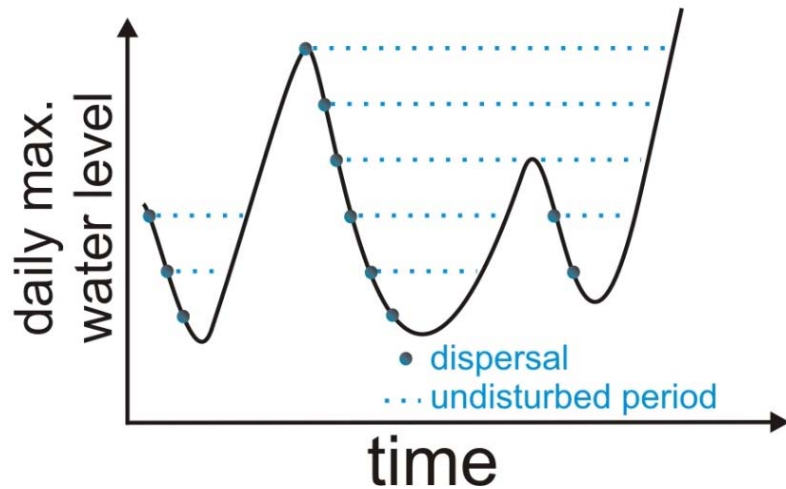
- Dispersal to suitable tidal flat
- Minimum required disturbance free period for rooting
- Easily quantifiable in flume/mesocosm and field experiments (see refs below)
- ~3-5 days WoO for *Avicennia alba*



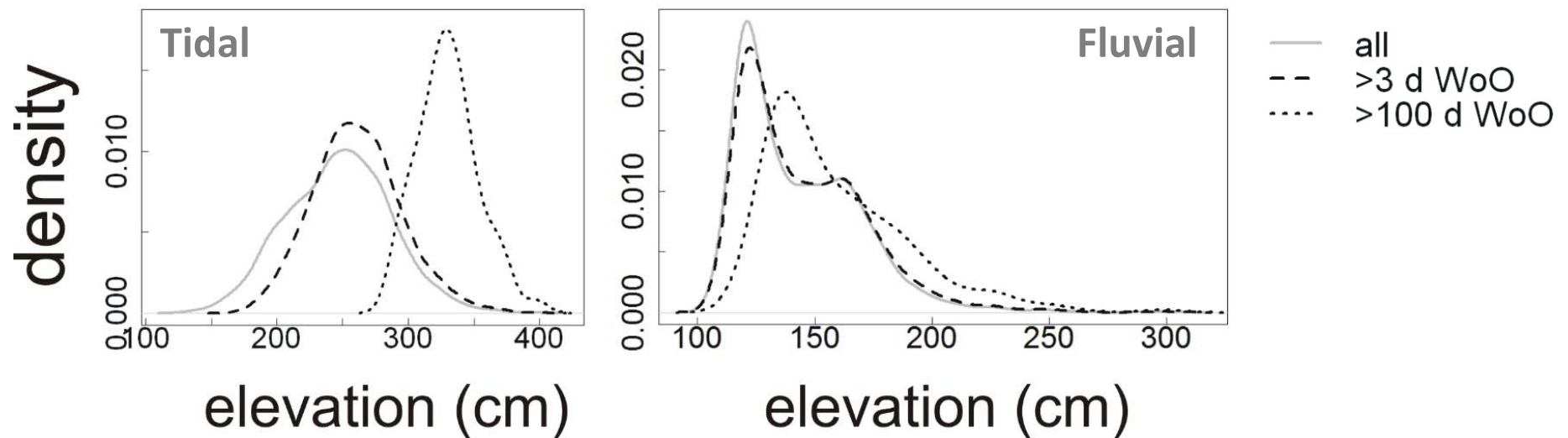
Balke, Swales, Lovelock, Herman, Bouma 2015 *Journal of Exp. Mar. Biology and Ecology*

Balke et al. 2011 *Mar. Ecol. Progr. Ser.*, Balke et al. 2013 *J Appl. Ecology*, Balke et al. 2013 *Biogeoscience*

The Window of Opportunity (WoO) concept

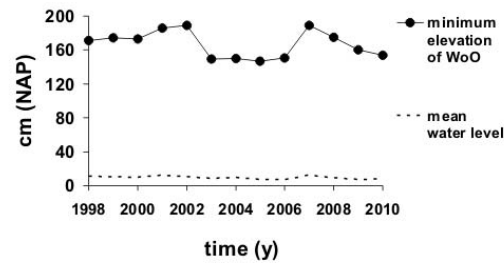


Calculate elevation for
inundation free periods of
defined duration

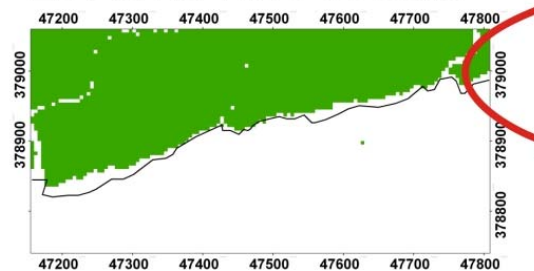


Scaling up: predicting vegetation establishment with WoO

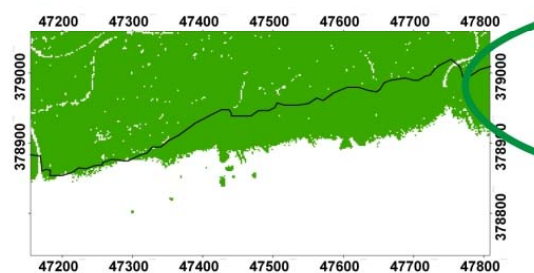
- time series analysis for a Dutch saltmarsh
- 3day Windows of Opportunity



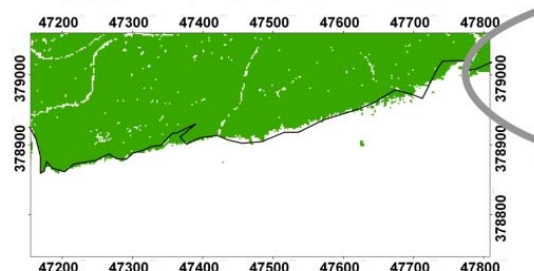
2001: no WoO in front



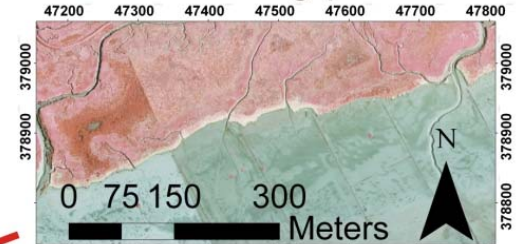
2004: WoO in front of cliff



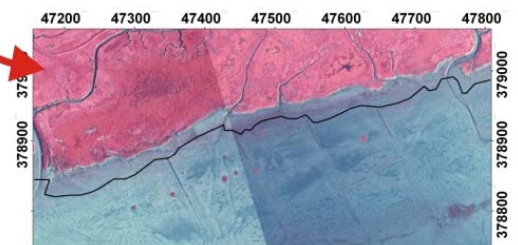
2008: no further WoO



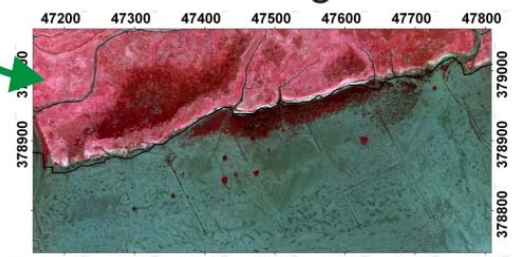
1998: starting plateau



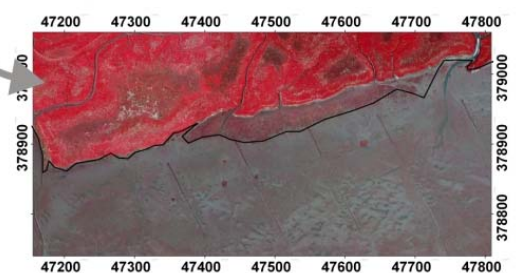
2004: cliff retreated



2008: new vegetation



2010: stable situation

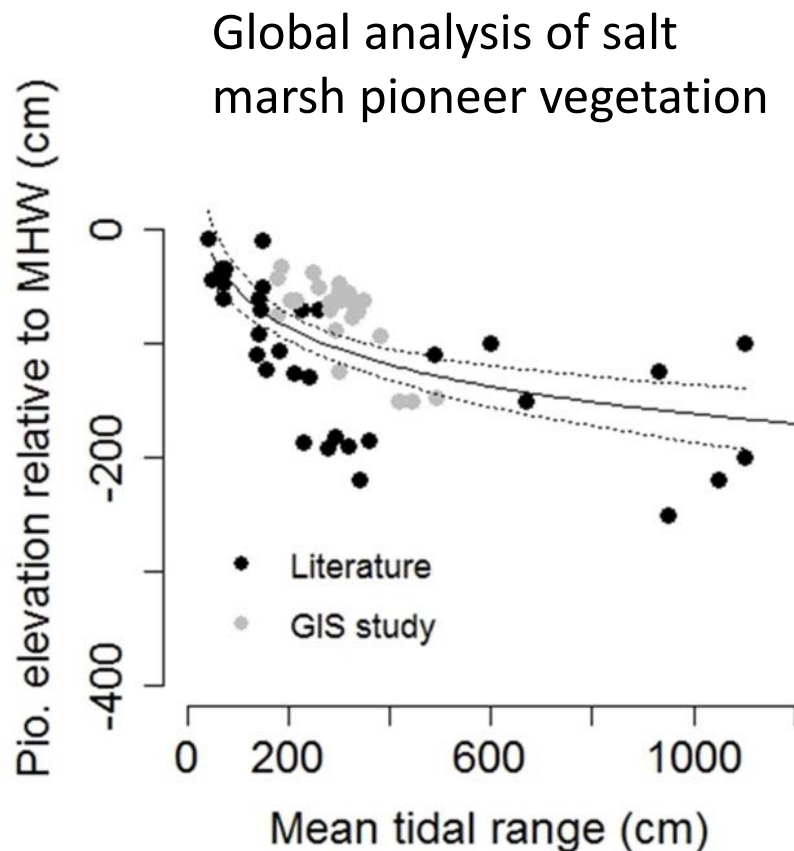


WoO PREDICTION

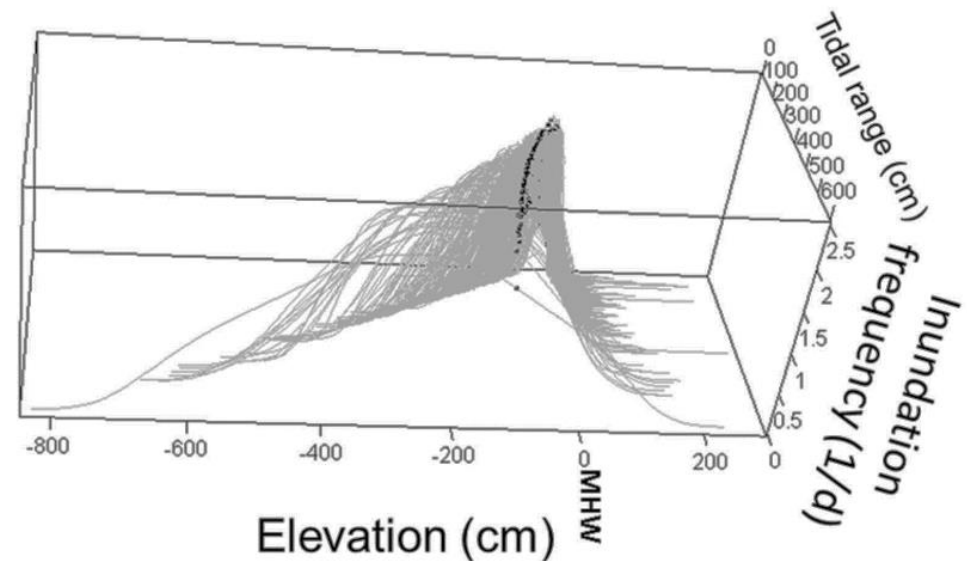
VEGETATION

So where is the seaward limit of pioneer vegetation?

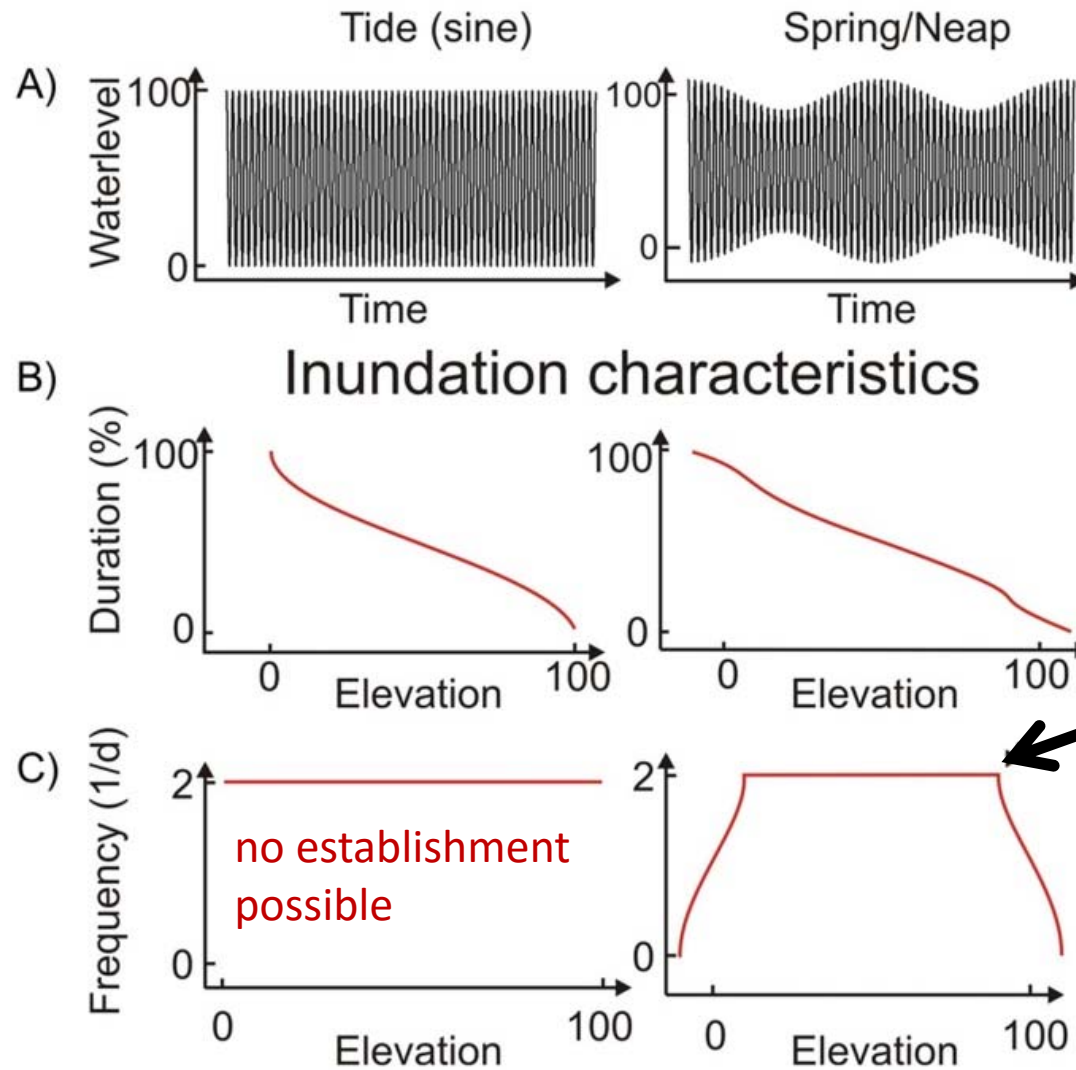
- Salt marsh and mangrove pioneer vegetation establishes above elevations where inundation free periods occur



Results plotted on inundation frequency plot



A simple model: semidiurnal tides



theoretical lowest elevation
for pioneer vegetation
establishment +/- exposure to
hydrodynamic forcing

Conclusions

- Seaward limits/elevation is different for retreating vs. prograding mangroves
- Establishment above elevations with infrequent inundation free periods of >3 days (Mean High Water of Neap Tides for meso- to macrotidal range)
- Stochastic variability of high water levels



thank
you

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