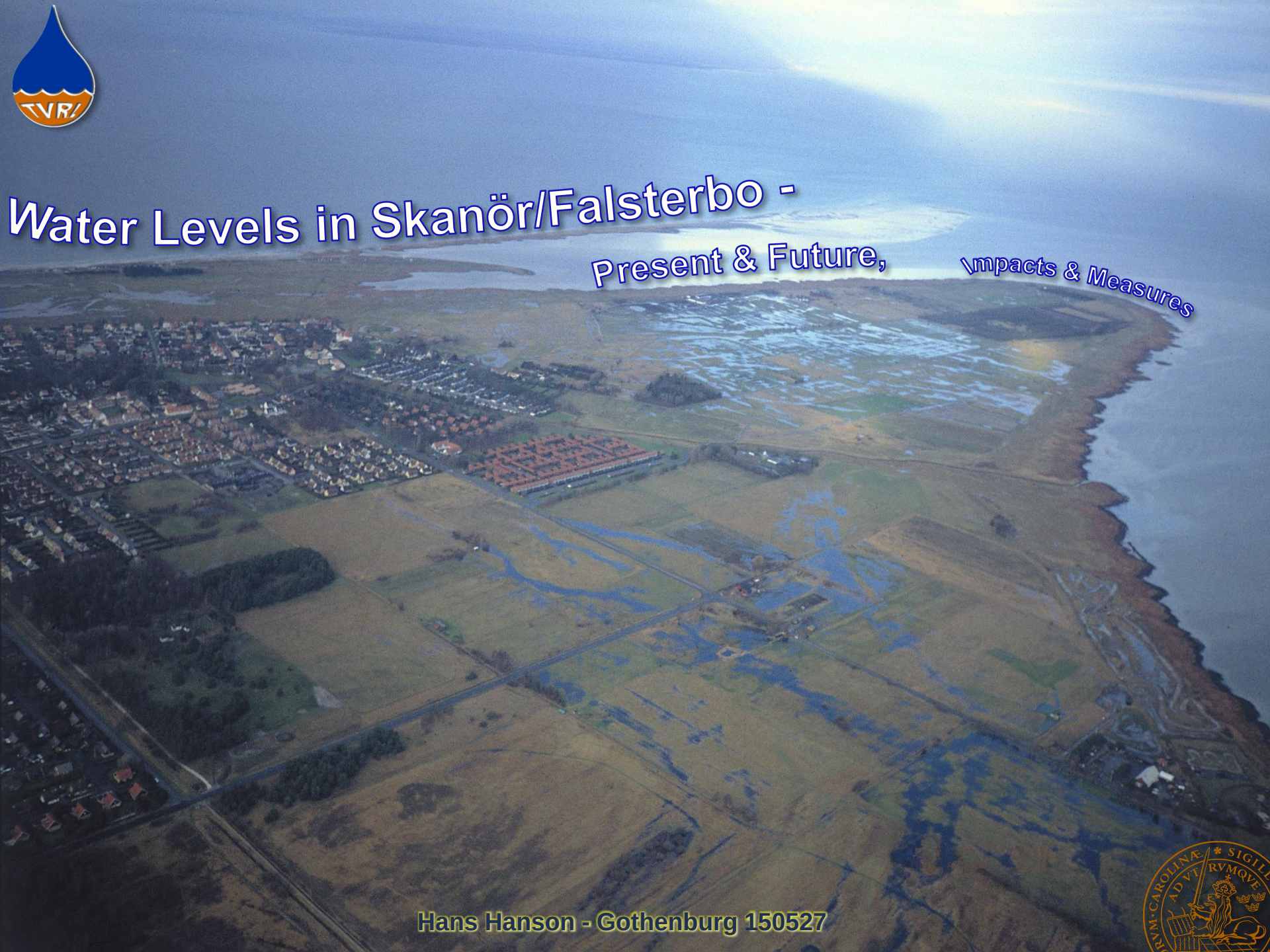
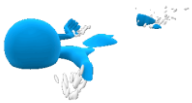

Water Levels in Skanör/Falsterbo -
Present & Future,
Impacts & Measures
Hans Hanson - Gothenburg 150527

LECTURE OVERVIEW

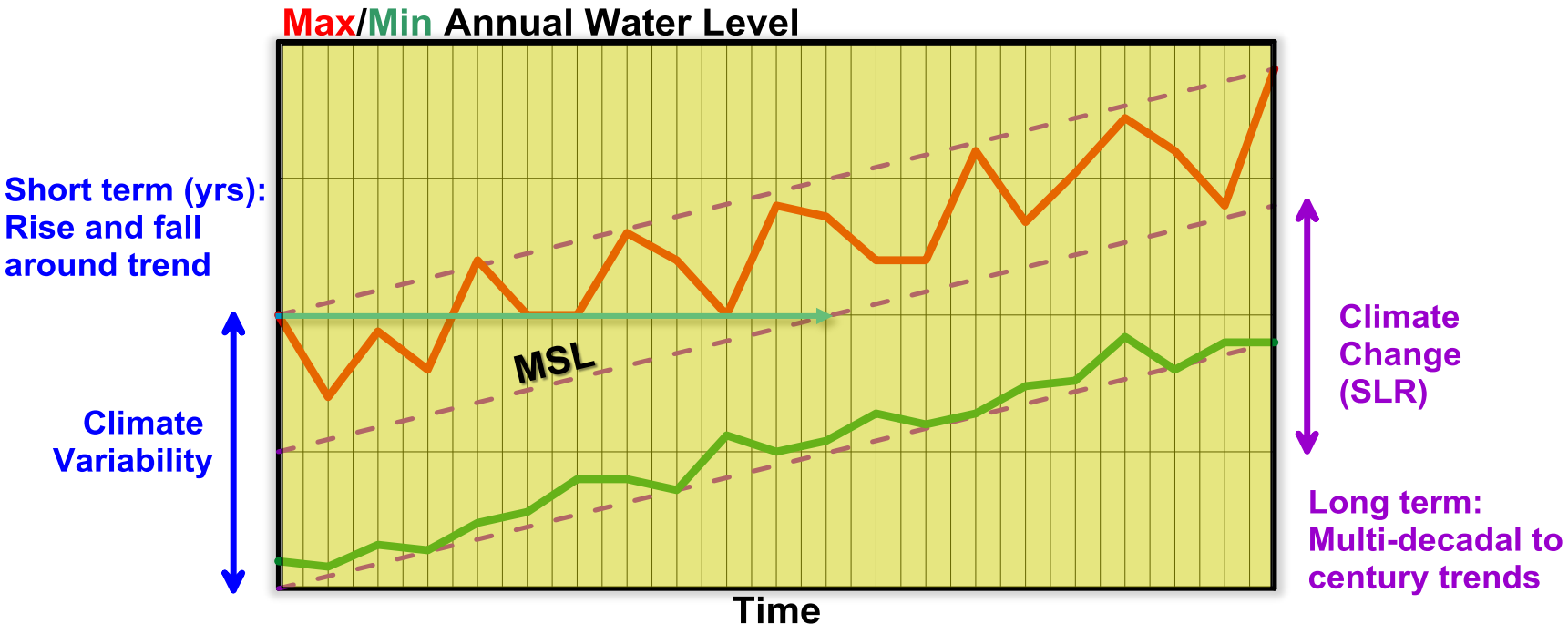
- Sea Level Rise 
-  Protective Measures
- Beach Nourishment 
-  Sand as Storm Protection
- Value of Beaches 
-  Water Levels and Consequences in Skanör/Falsterbo

EXPECTED CLIMATE CHANGE ISSUES 'OF INTEREST'

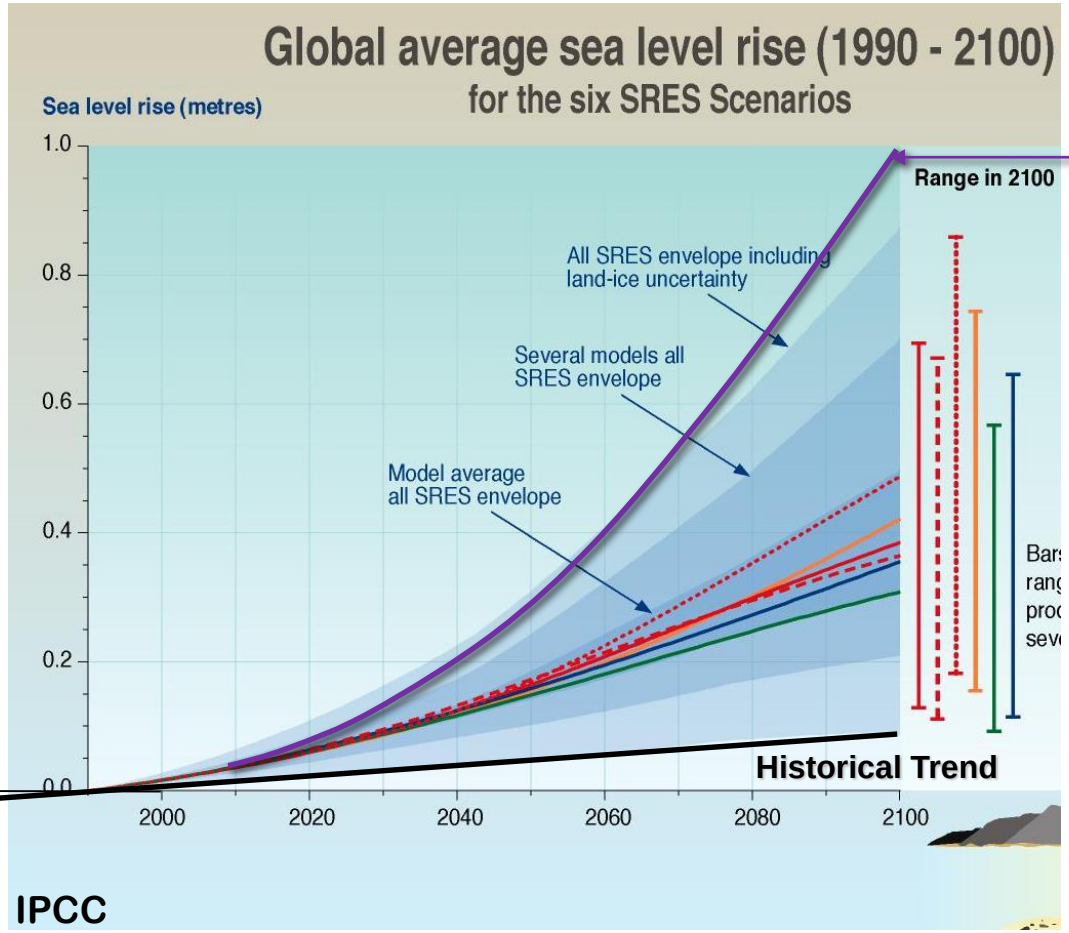
Rising sea levels!

Increased storminess?

CLIMATE CHANGE vs. VARIABILITY

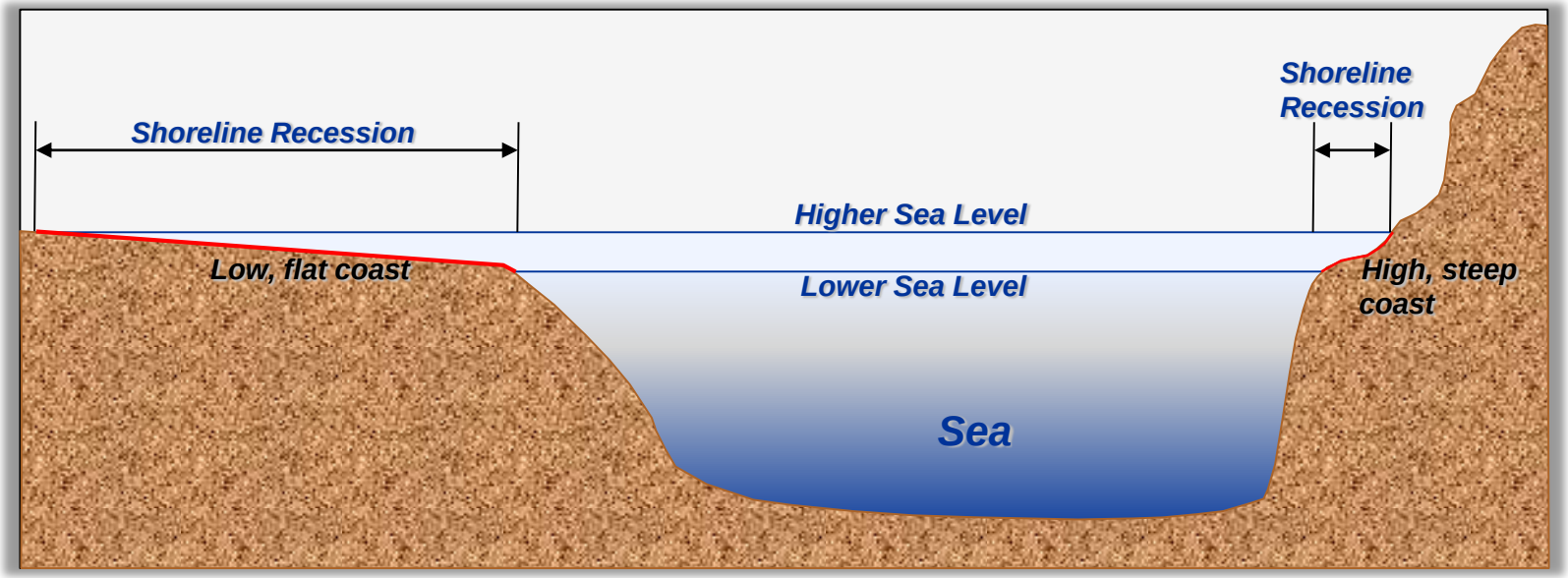


FUTURE SEA LEVELS! – WE THINK!

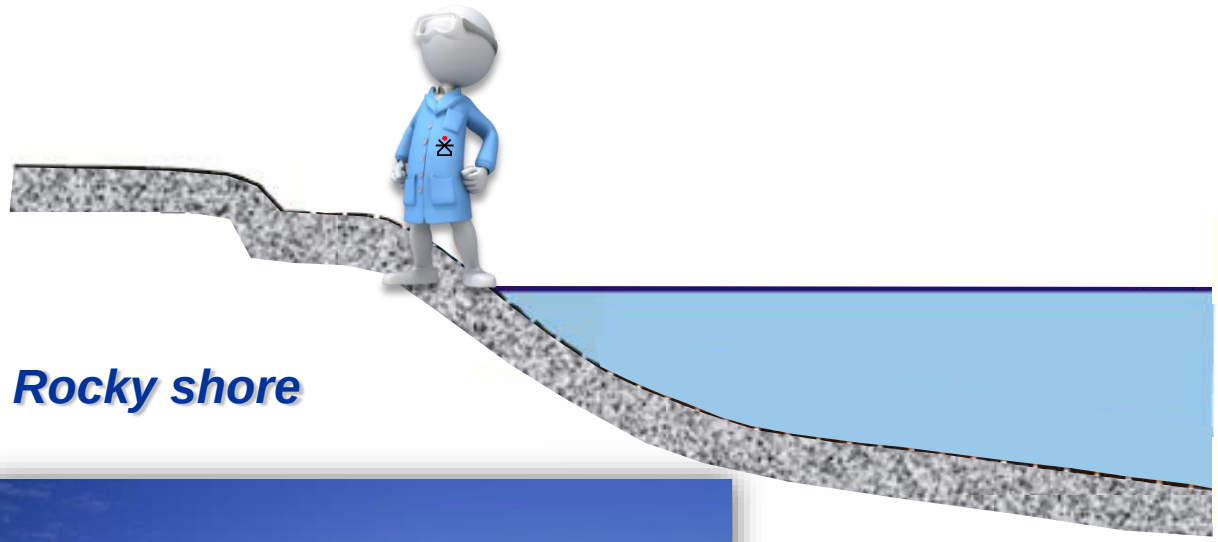


SMHI 2009 estimation 100 cm for The Baltic Sea

CONSEQUENCES OF SEA LEVEL RISE

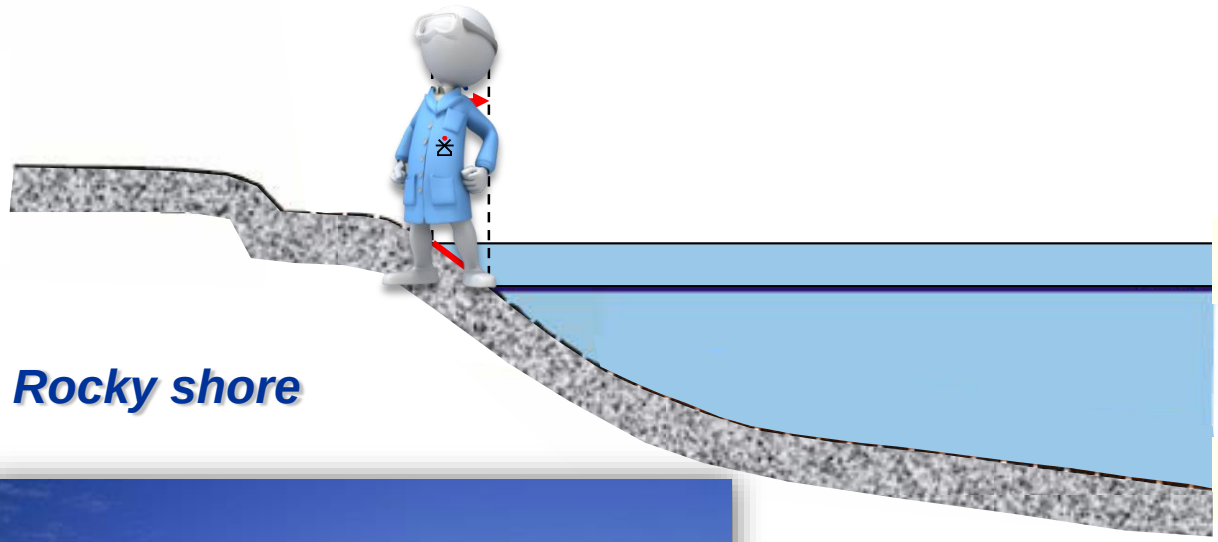


SEA LEVEL RISE! WHAT HAPPENS TO THE BEACH?



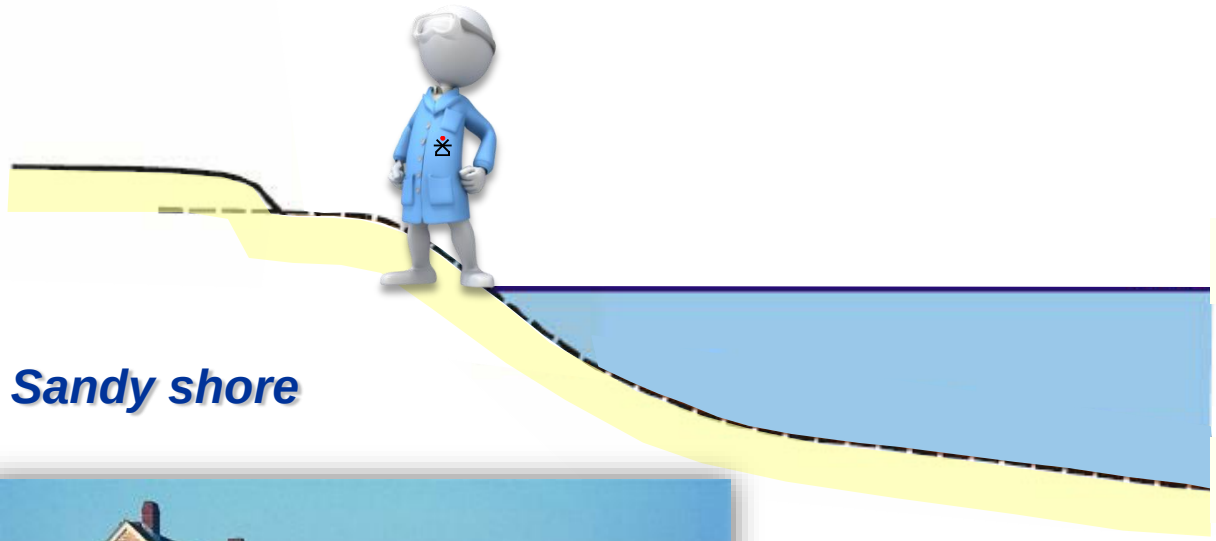
Rocky shore

SEA LEVEL RISE! WHAT HAPPENS TO THE BEACH?



Rocky shore

SEA LEVEL RISE! WHAT HAPPENS TO THE BEACH?

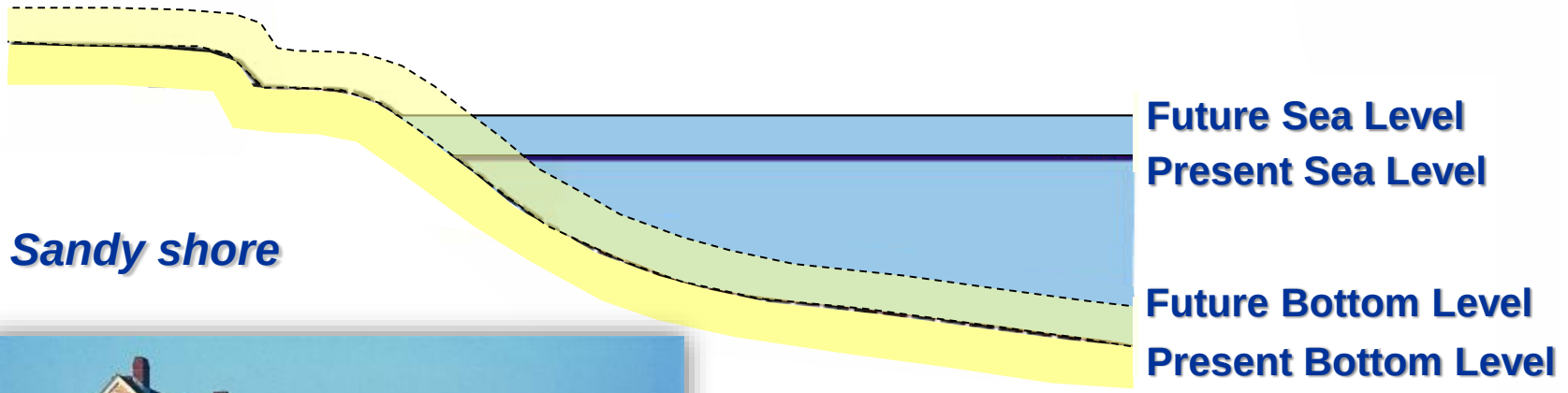


Present Sea Level

Present Bottom Level

Sandy shore

SEA LEVEL RISE! WHAT HAPPENS TO THE BEACH?



Sandy shore

SEA LEVEL RISE! WHAT HAPPENS TO THE BEACH?

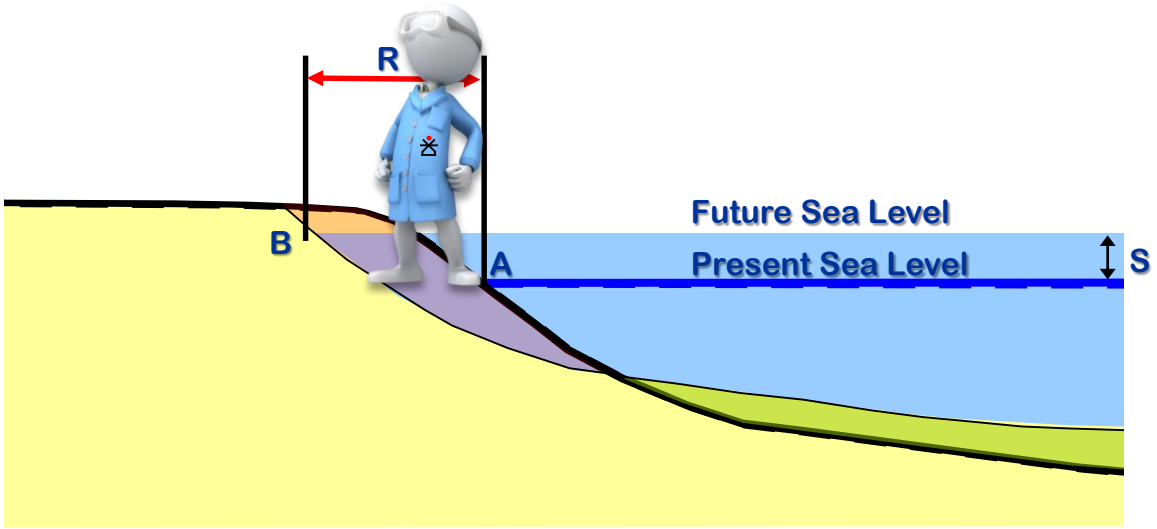
Eroded material

Ackumulated material

Present beach profile

Future beach profile

R = S/bottom slope



Sandy shore

Bruun rule: An increase S of MSL => coastal erosion R = S/bottom slope.

If bottom slope = about 1/100 =>
A sea level rise of 1 m => erosion R = 100 m.

PERMANENT COASTAL RETREAT IN YSTAD 2100?

W treatment plant

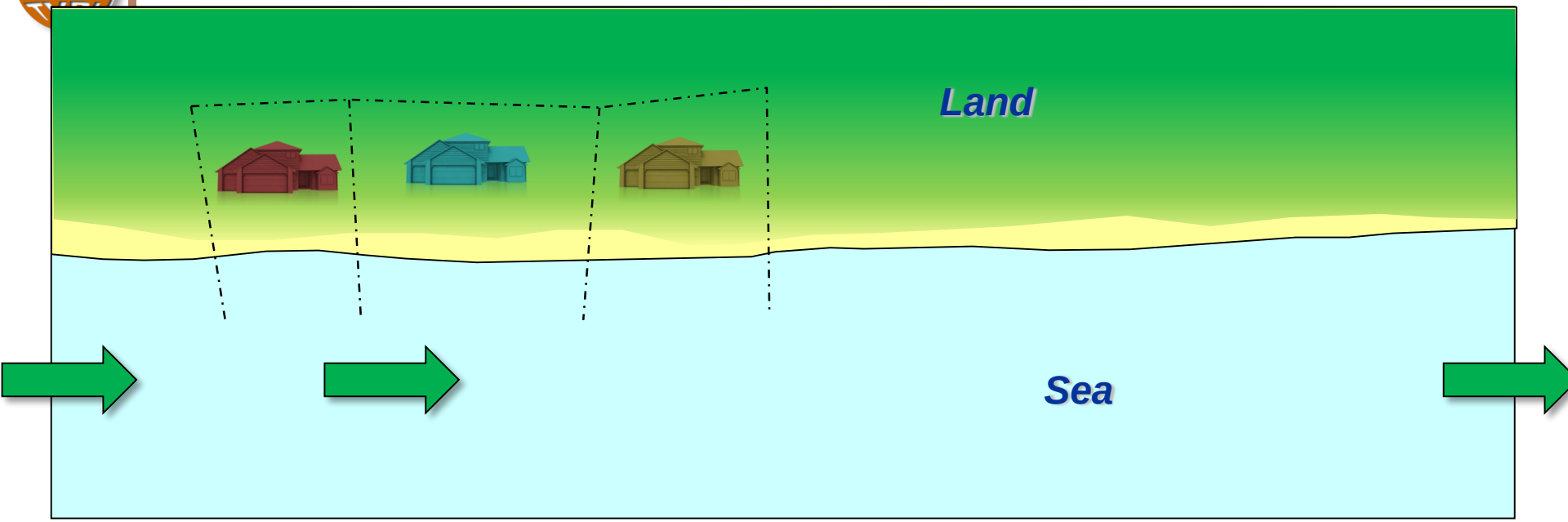
W marina

Sandskogen beach

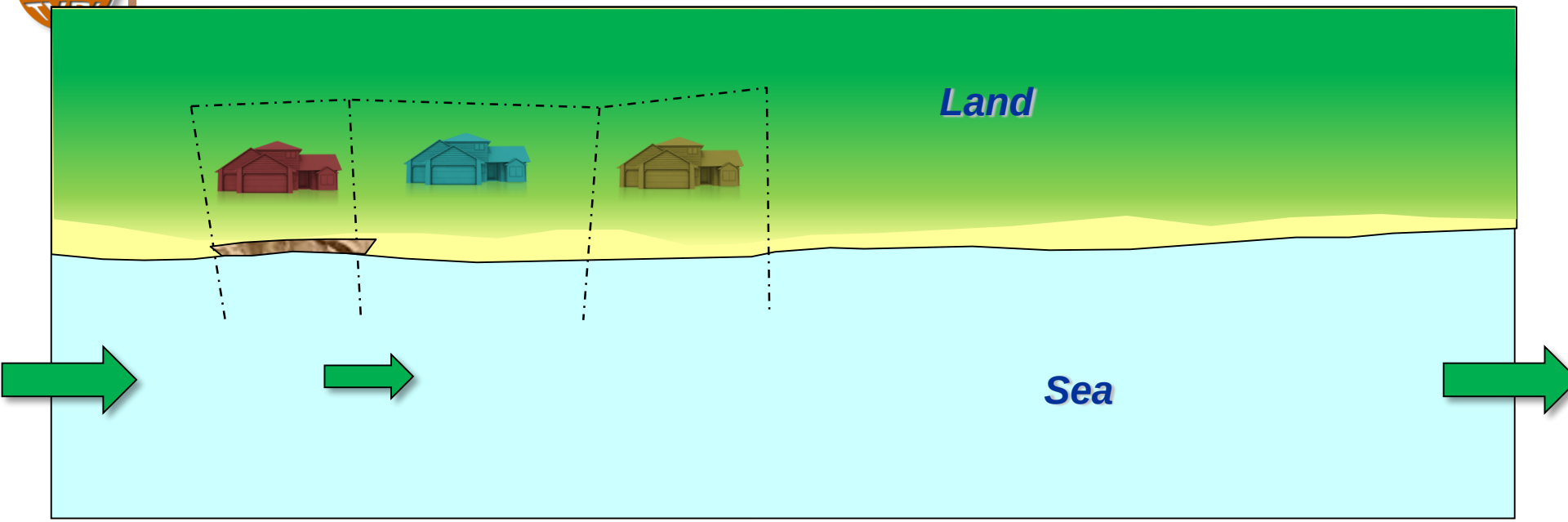

What can we do?
What should we do?

EXPECTED SLR! SOLUTION? SEAWALL?

SEAWALL – AN APPROPRIATE ALTERNATIVE?



SEAWALL – AN APPROPRIATE ALTERNATIVE?



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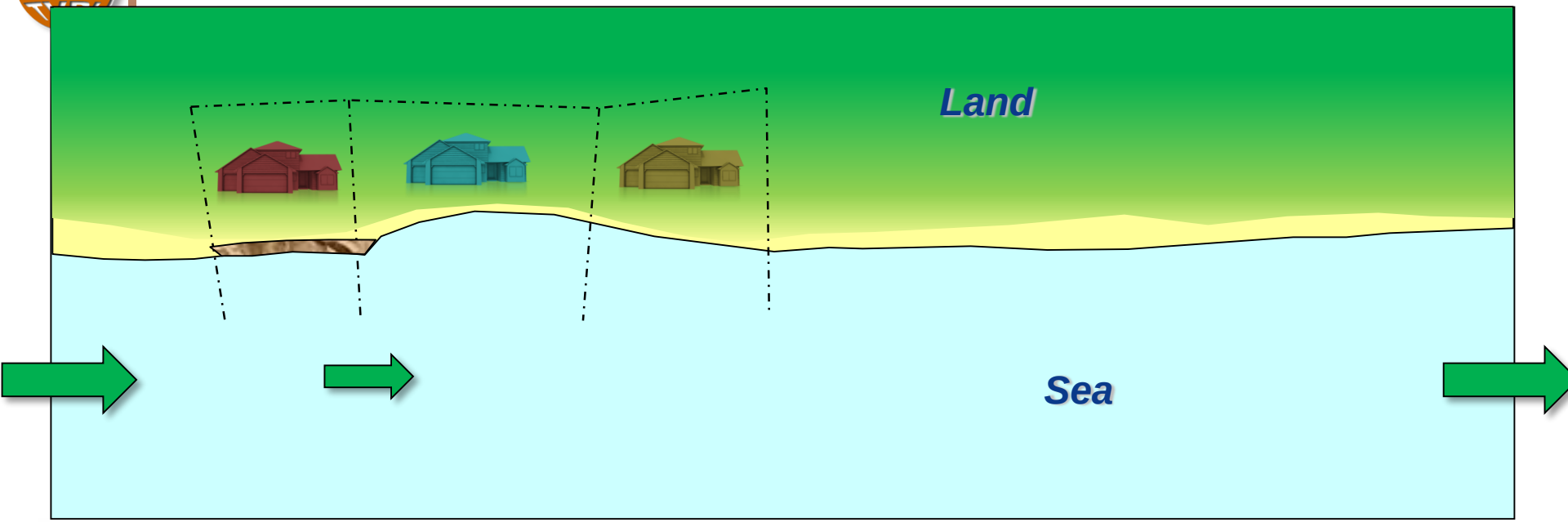

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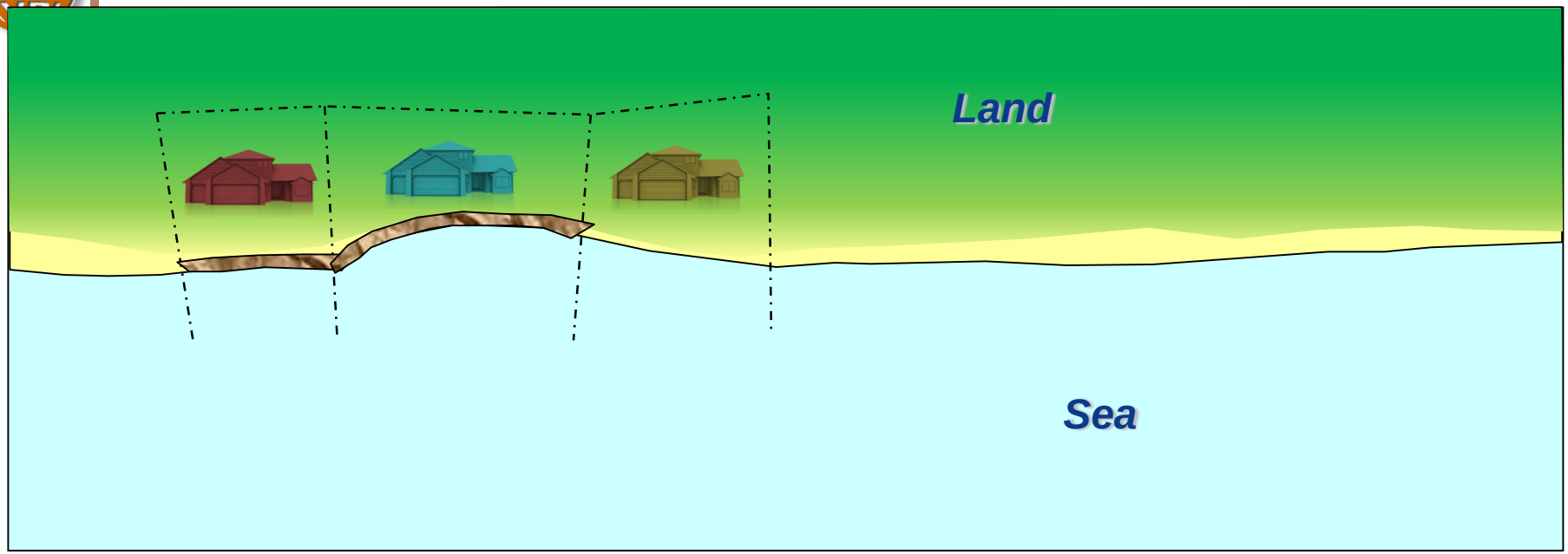

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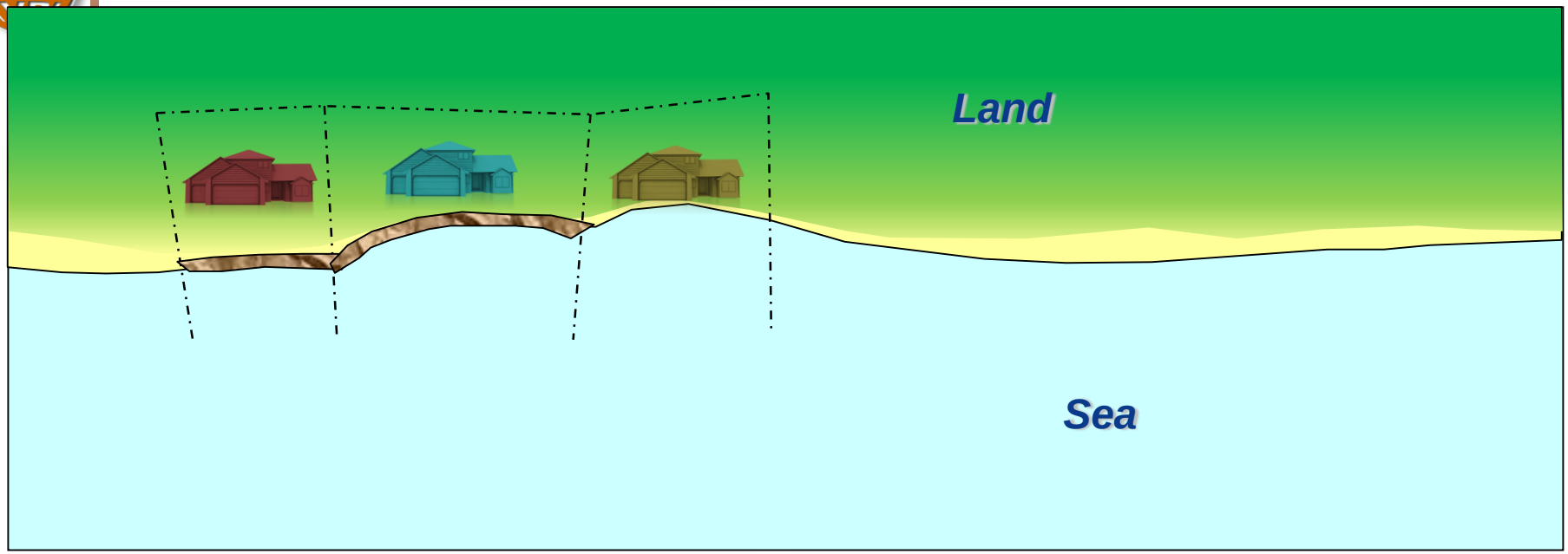
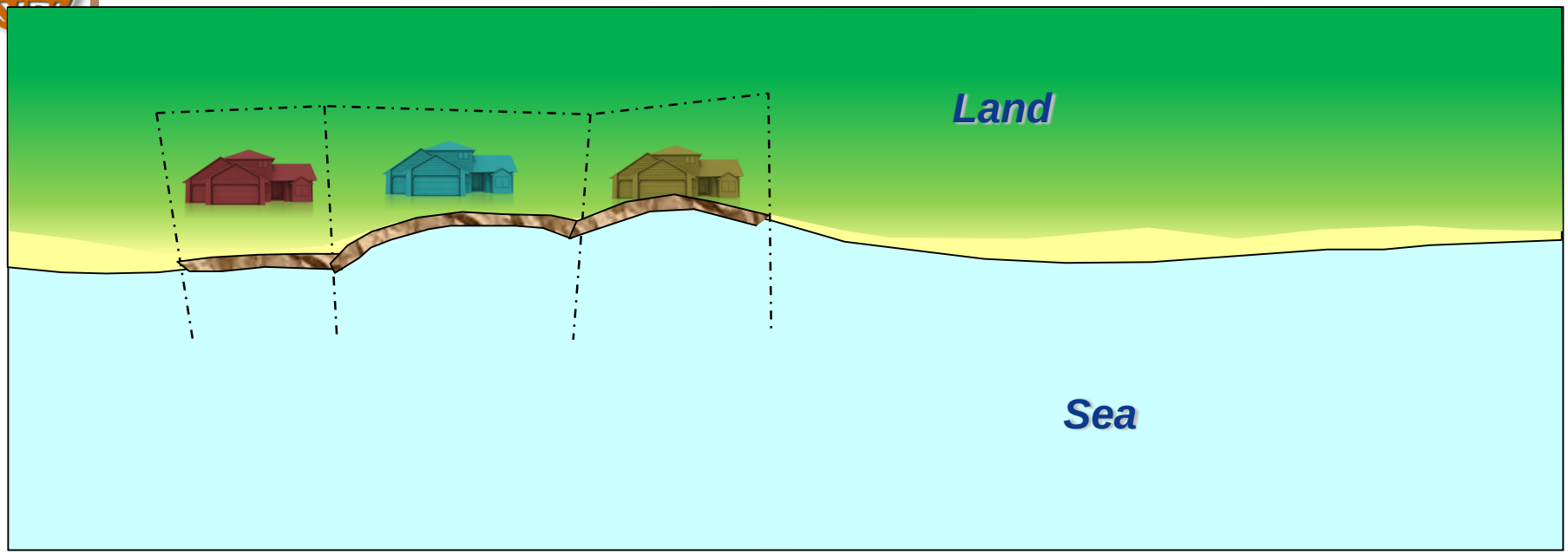
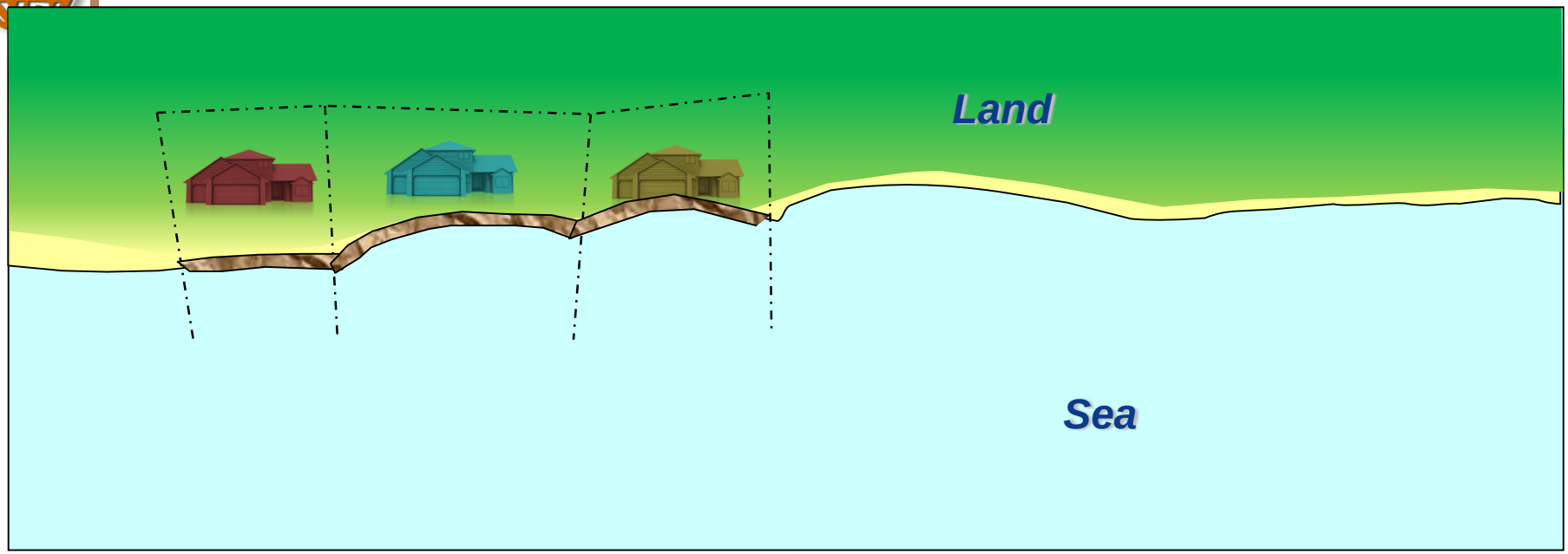


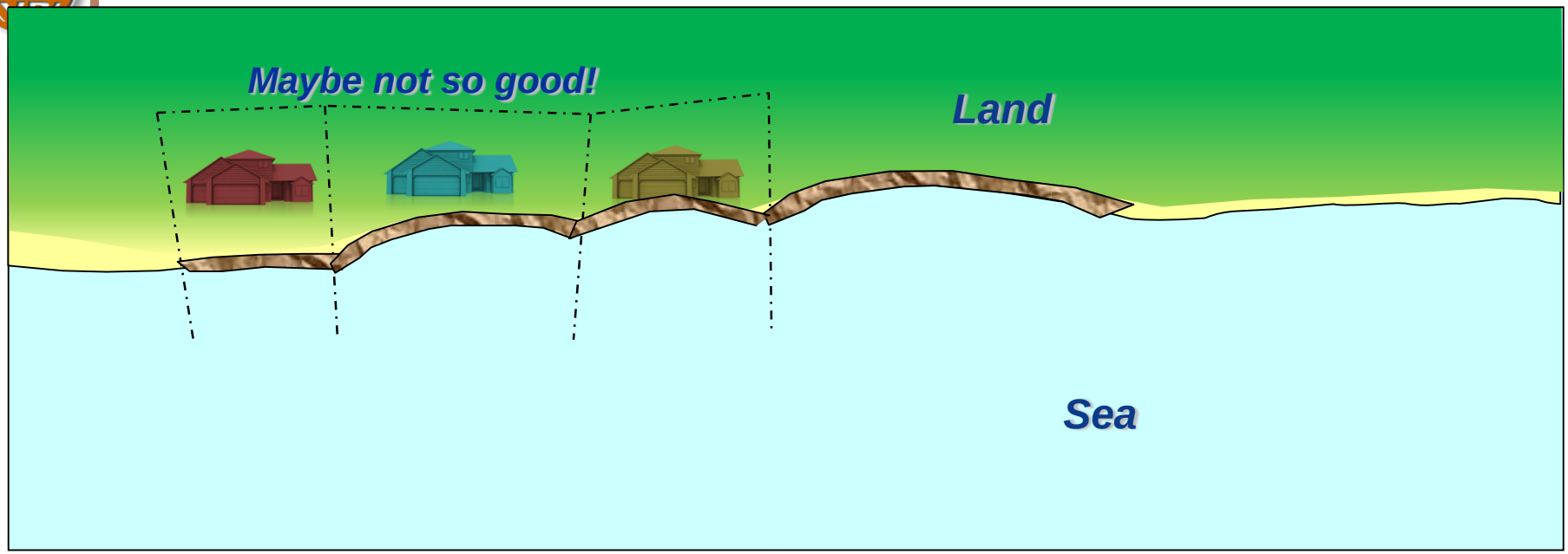
SEAWALL – AN APPROPRIATE ALTERNATIVE?



SEAWALL – AN APPROPRIATE ALTERNATIVE?

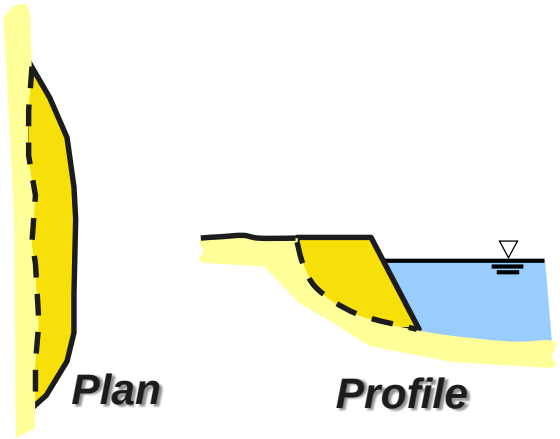


SEAWALL – AN APPROPRIATE ALTERNATIVE?



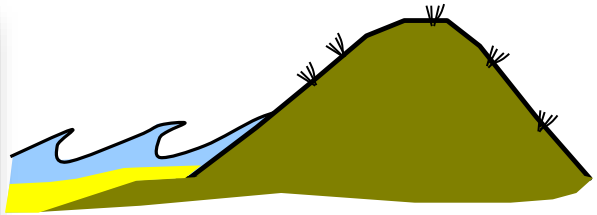
STABILIZING – SOFT MEASURES

Beach fills

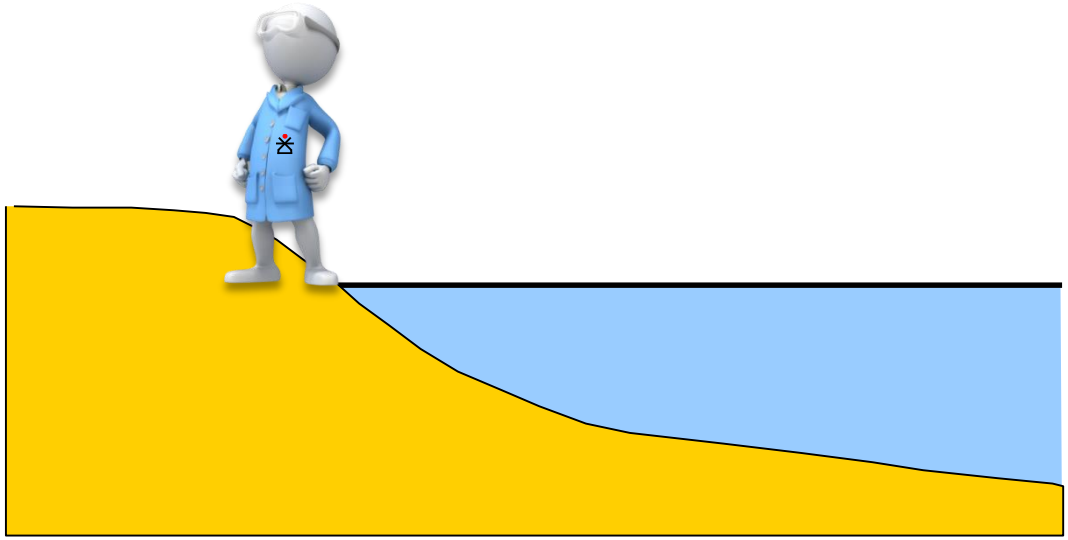


Construction, reinforcement & vegetation of dunes

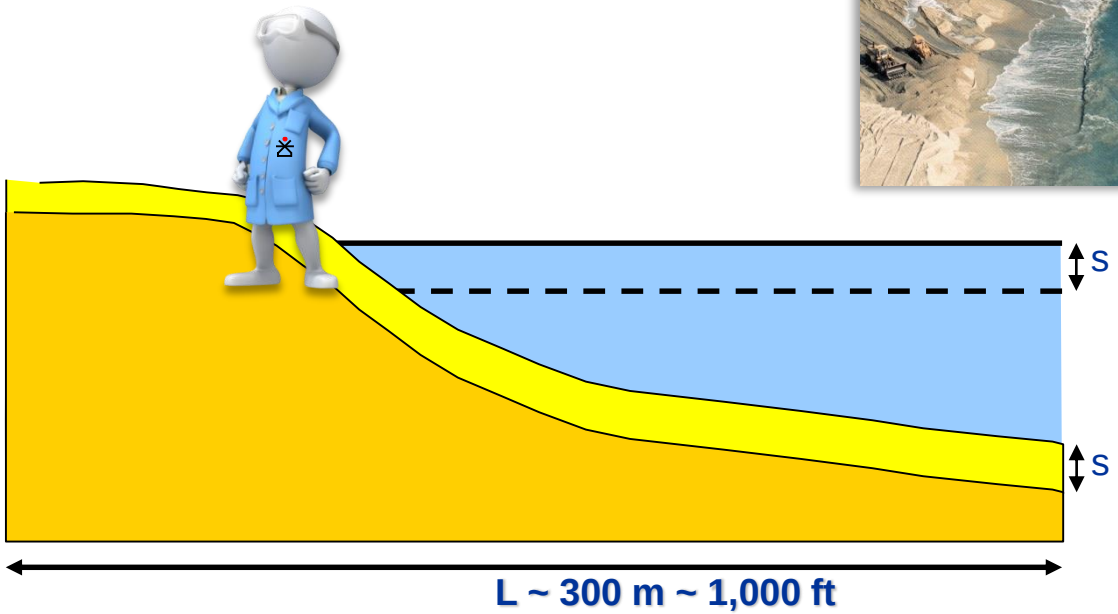
Vegetated earth dams



SOFT MEASURES AGAINST RISING SEA LEVELS?



SOFT MEASURES AGAINST RISING SEA LEVELS?

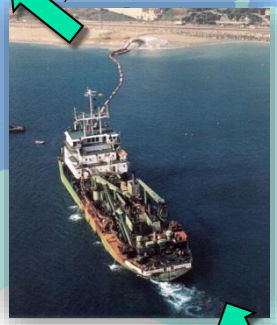


S ~ 1 m year 2100

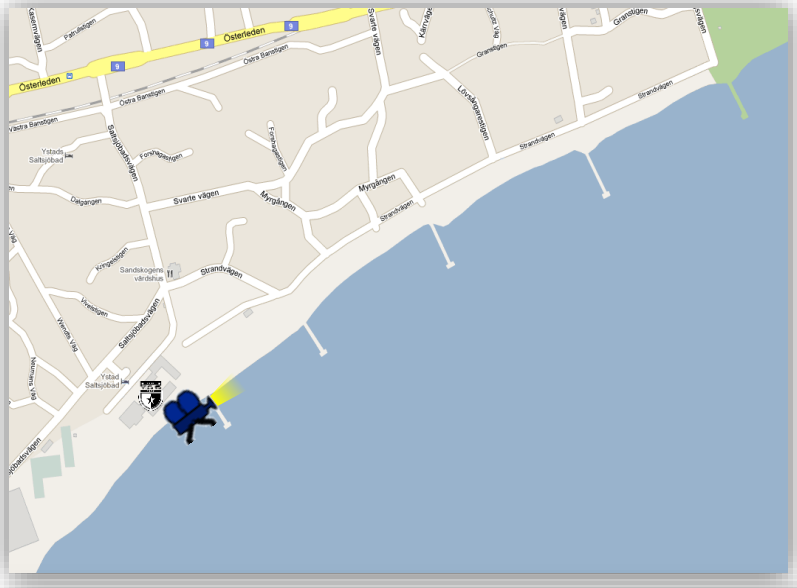
Added volume V = S*L m^3/m beach

V ~ 300 000 m^3/km ~ 3 300 m^3/km per yr ~
$33,000 /km/yr over 90 yrs!

BORROW SAND – FROM SEA BOTTOM TO NOURISHED BEACH



NEW BEACH IN YSTAD – PIER 0 EAST



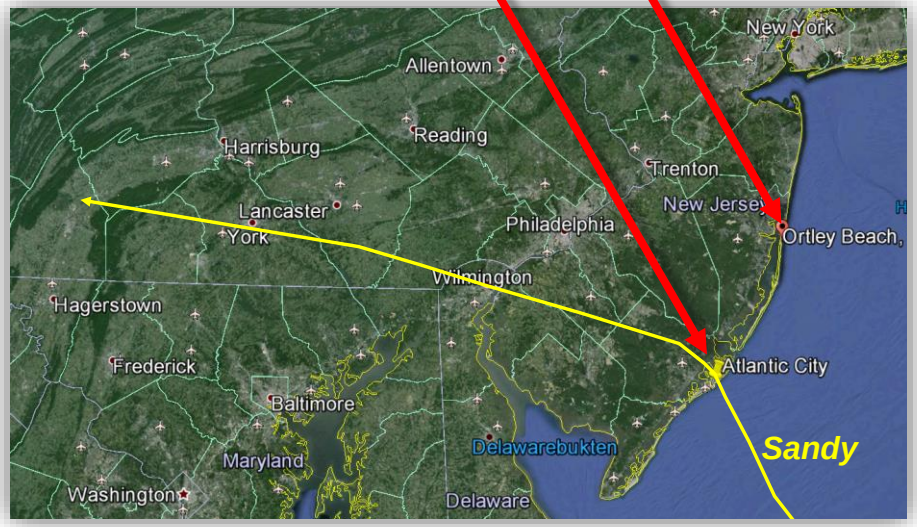
Before

After

SAND FOR STORM PROTECTION?

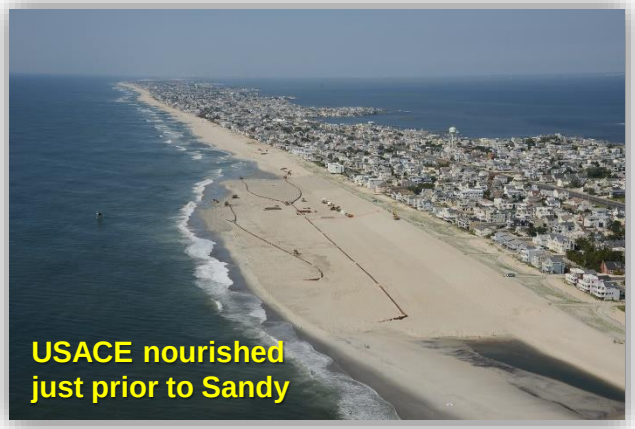
In Atlantic City, NJ, with wide nourished beach, tourist industry working again 4 days after hurricane Sandy 2012.

In Ortley Beach, NJ, without wide nourished beach, the coast was still in shreds 6 months after Sandy.

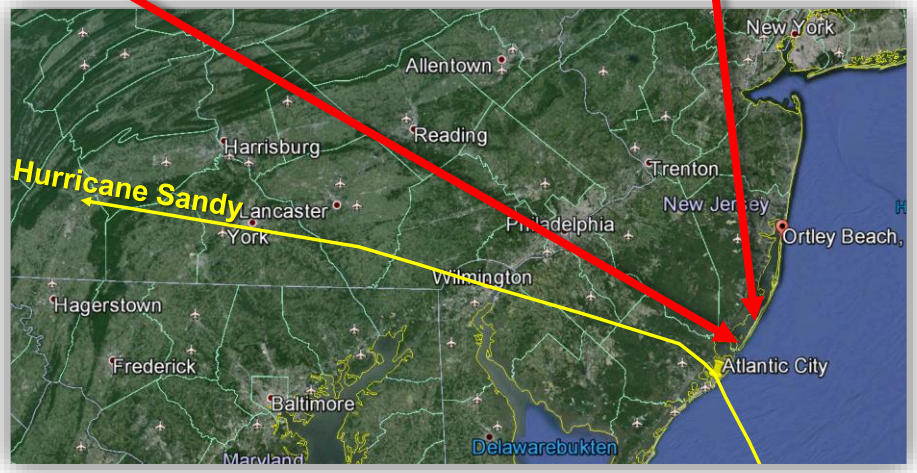


SAND FOR STORM PROTECTION?

Holgate, NJ, "Complete destruction – it's like a war zone"

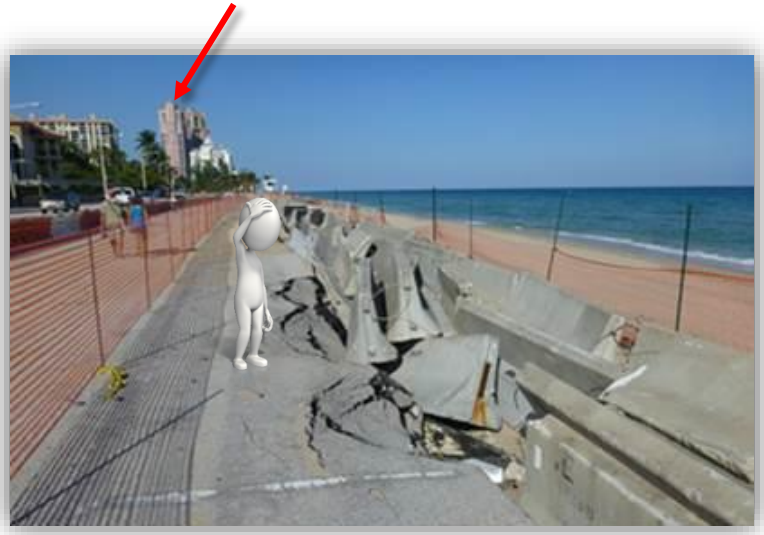


6 miles N, Brant Beach, NJ,
"No overwash or wave damage"



Mayor Mancini estimated that if the entire Long Beach coast (18 miles) had had the same beach as Brant Beach they would have saved ~$500M.

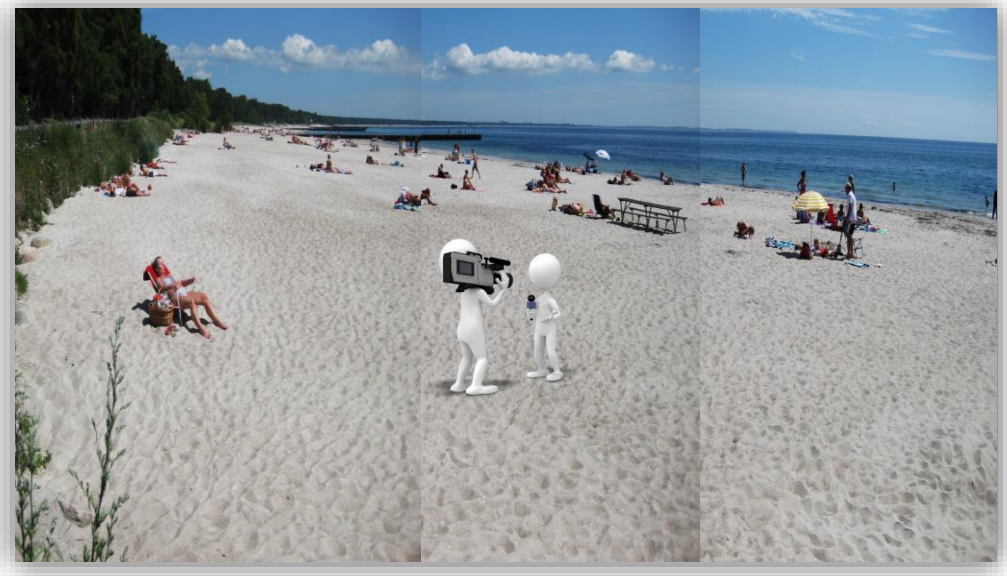
SAND FOR STORM PROTECTION?



Concrete seawall in Ft. Lauderdale, FL, destroyed by hurricane Sandy 2012.

Concrete seawall replaced by beach nourishment to hold for the 100-yr storm.

WHAT IS A BEACH WORTH?



VALUATION OF TURISM IN YSTAD

Calculations according to the 'Halmstad model' showed

Ystad beaches sales 2010 ~ $44M!

BEACH INCOME YSTAD 2010

Turist income Ystad:

Income ~ 12% of sales = **$5.5M/yr**
Assume 80% over 10 summer weeks => **$450 000/week**.

Nourishment cost:
$1M every 3 yrs

Tax income from inhabitants in Ystad:

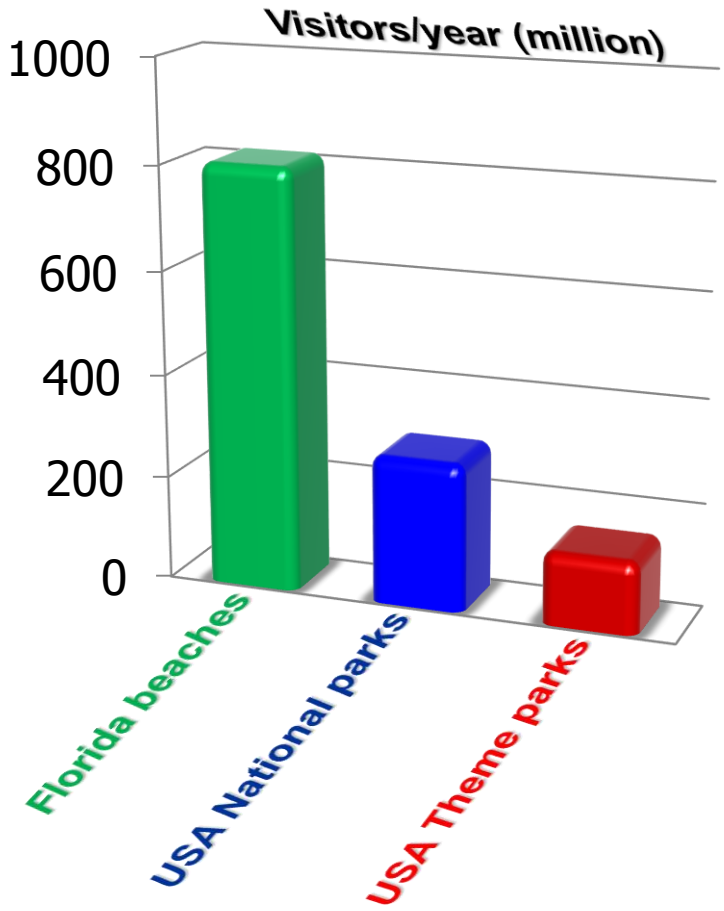
Total taxation ~ $115M/yr
Assume 20% because of its beaches → ~ **$23M/yr!!**
Of these, assume 2/3 refer to 10 summer weeks => **1.5 $M/week**.

Thus, total beach income = $28.5M/yr!!
During summer **$2M/week!**

WHAT IS A BEACH WORTH?

Ft. Meyers Beach, FL

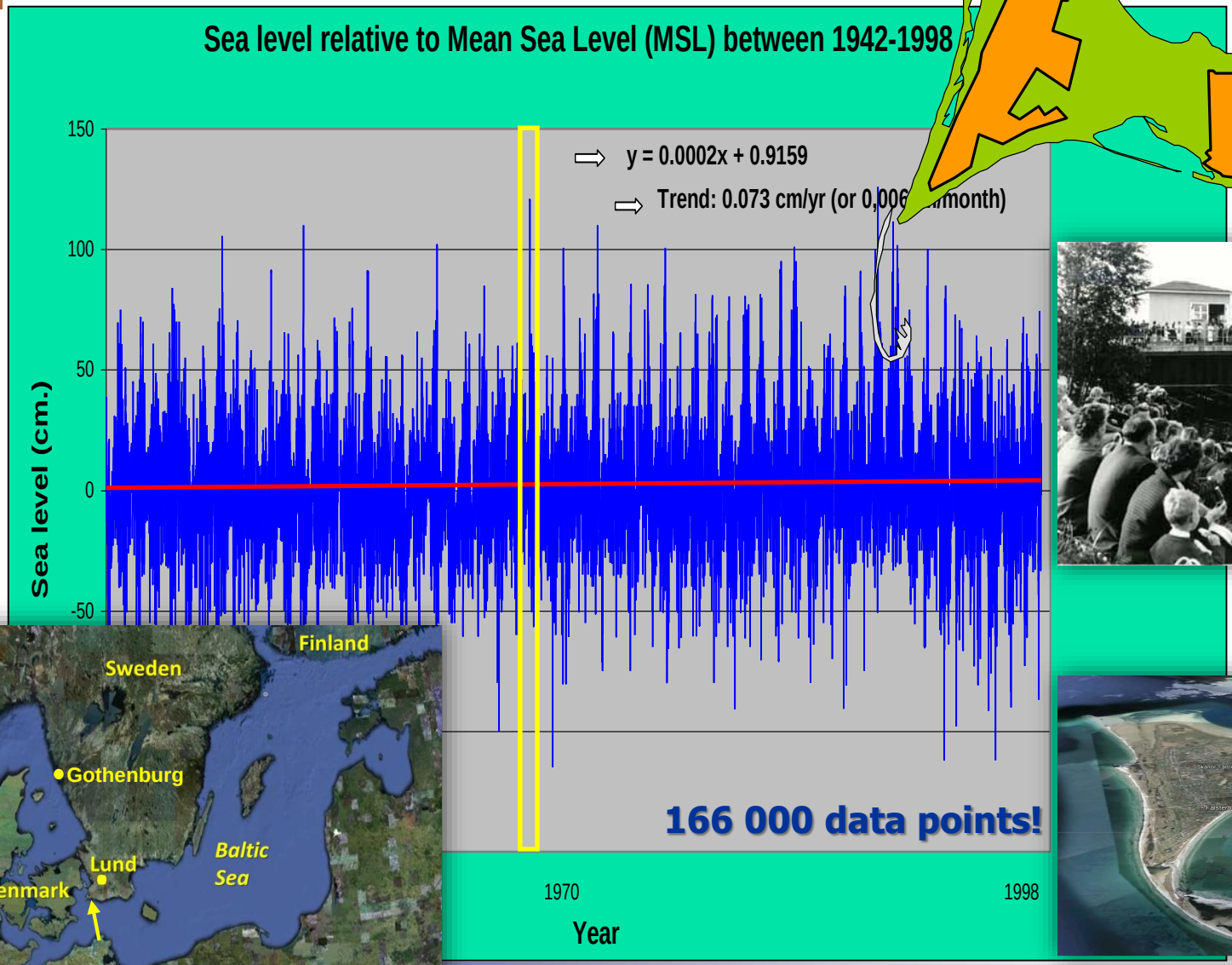
Miami Beach, FL



*Florida's beaches have an estimated annual value of **$50 billion** (Houston, 2013).*

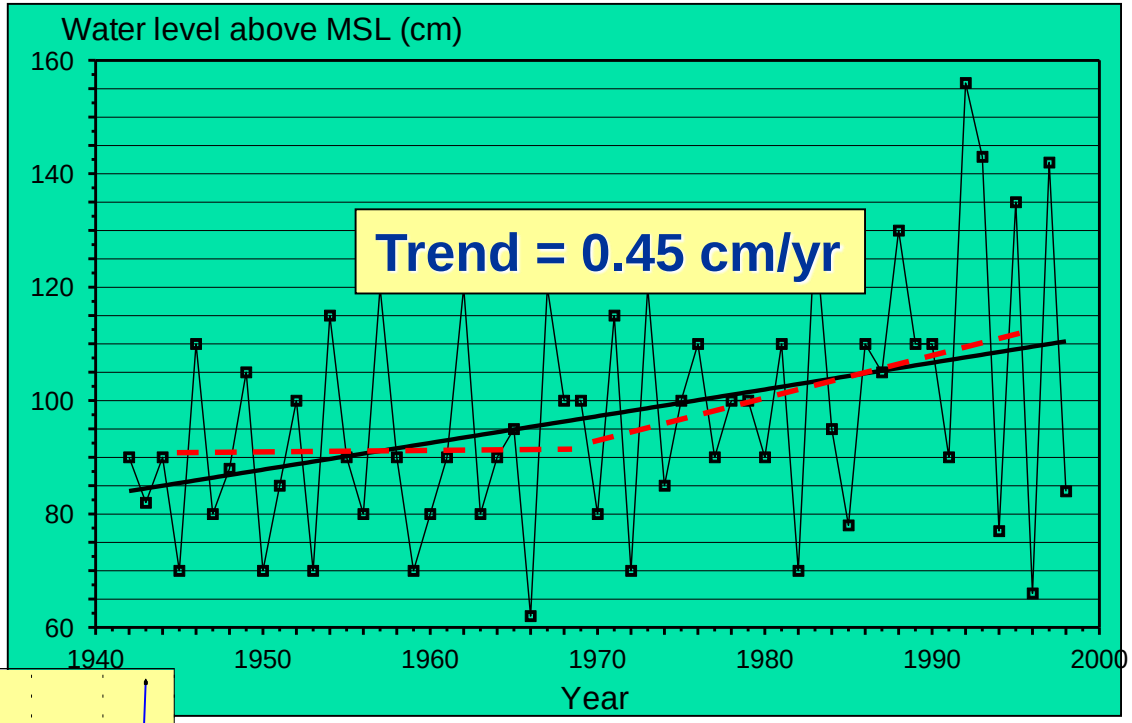
*For every $ in annual cost for beach nourishment, the return is **$1800** per yr from international tourists alone in Miami Beach (Houston, 2013).*

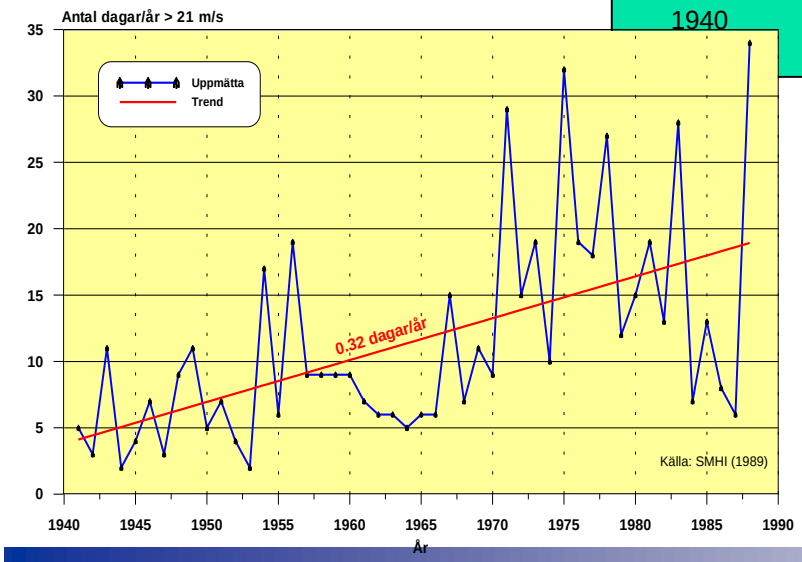
WATER LEVELS IN FALSTERBO CANAL



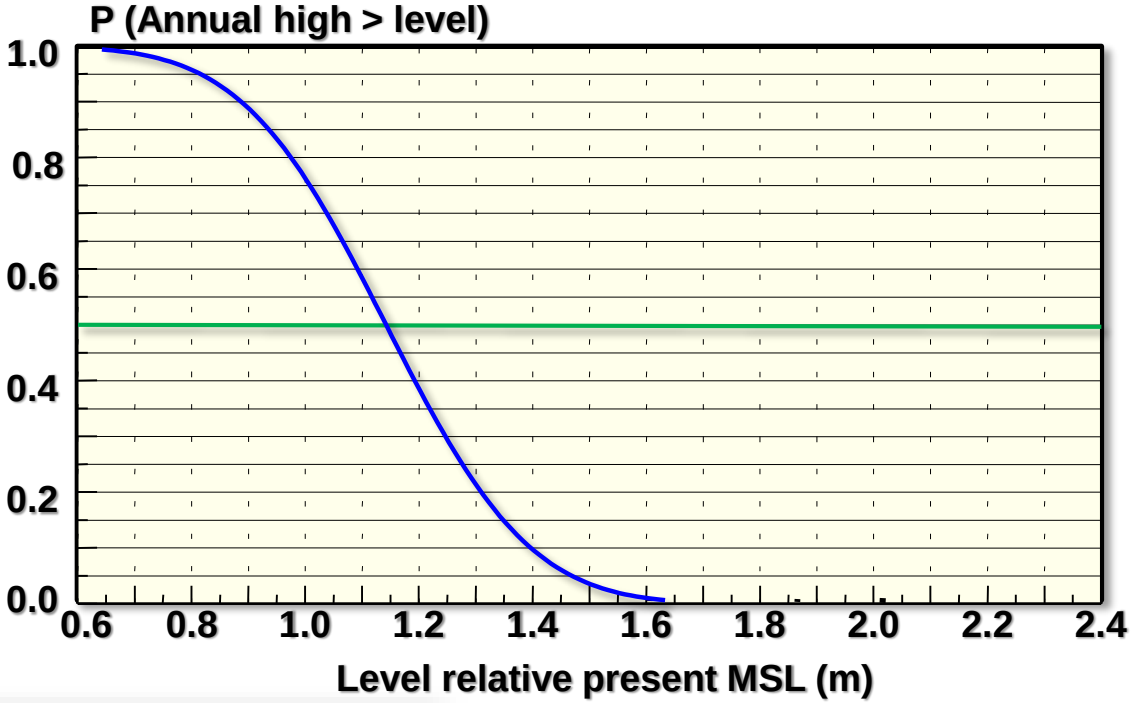
Hans Hanson – Gothenburg 150527

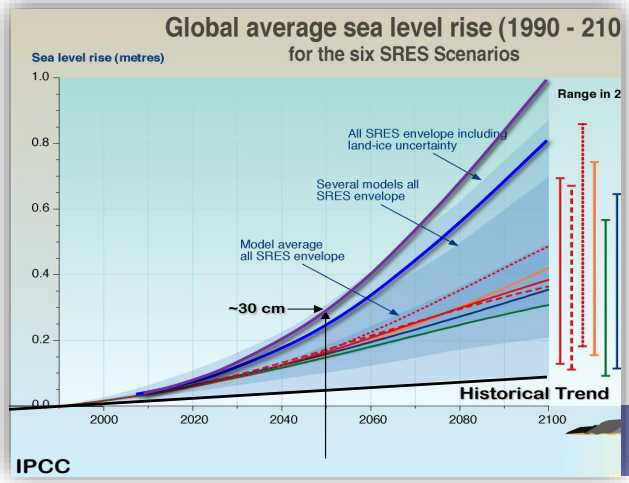
ANNUAL HIGH WATER LEVELS (CORRECTED FOR MSL CHANGE)





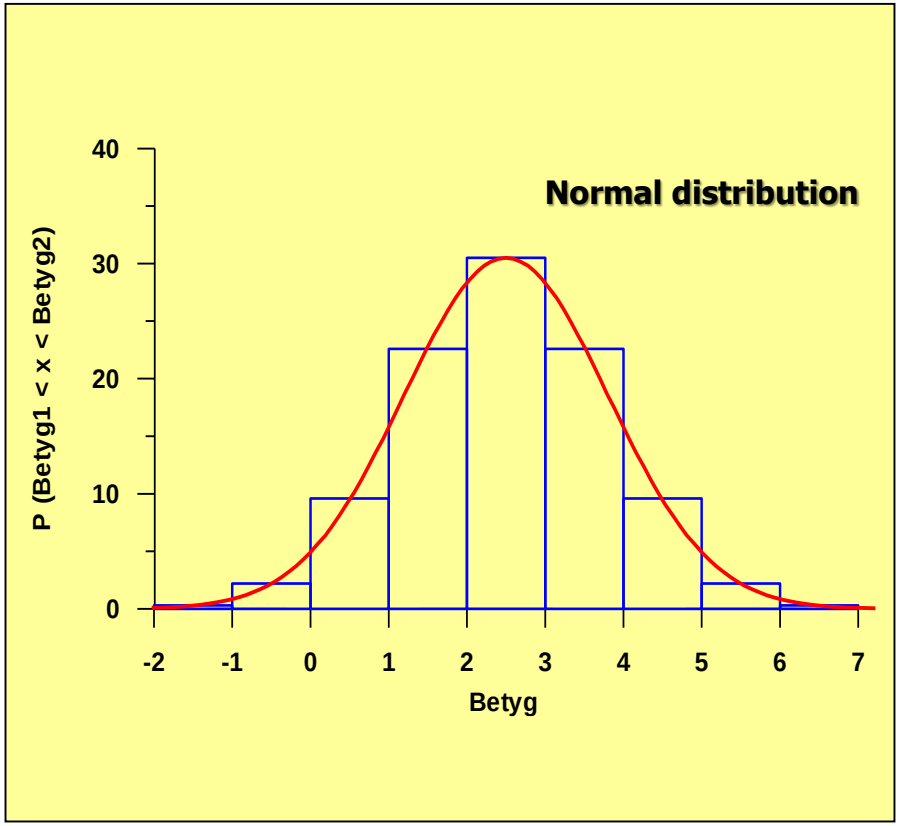
FUTURE SEA LEVELS?

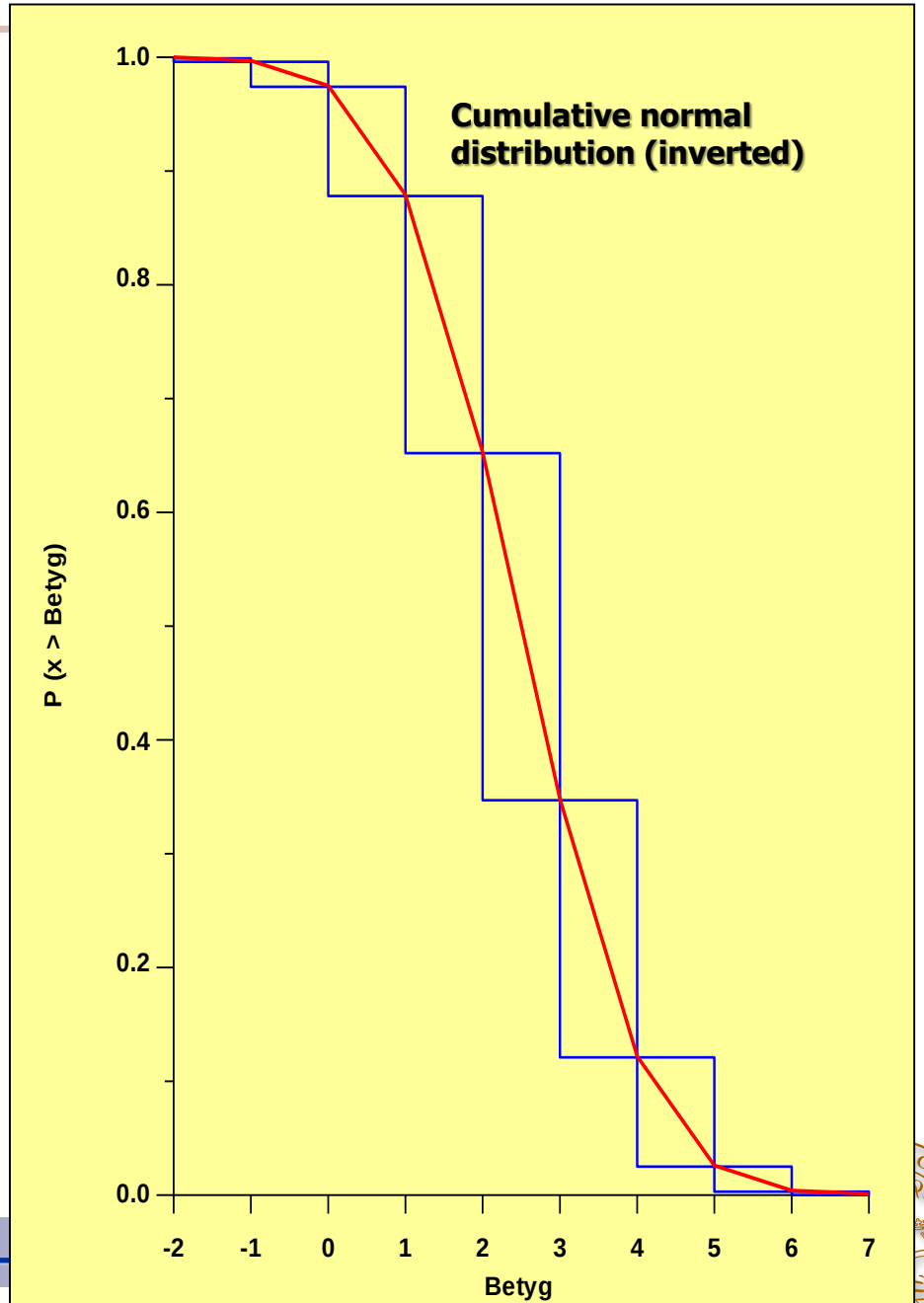




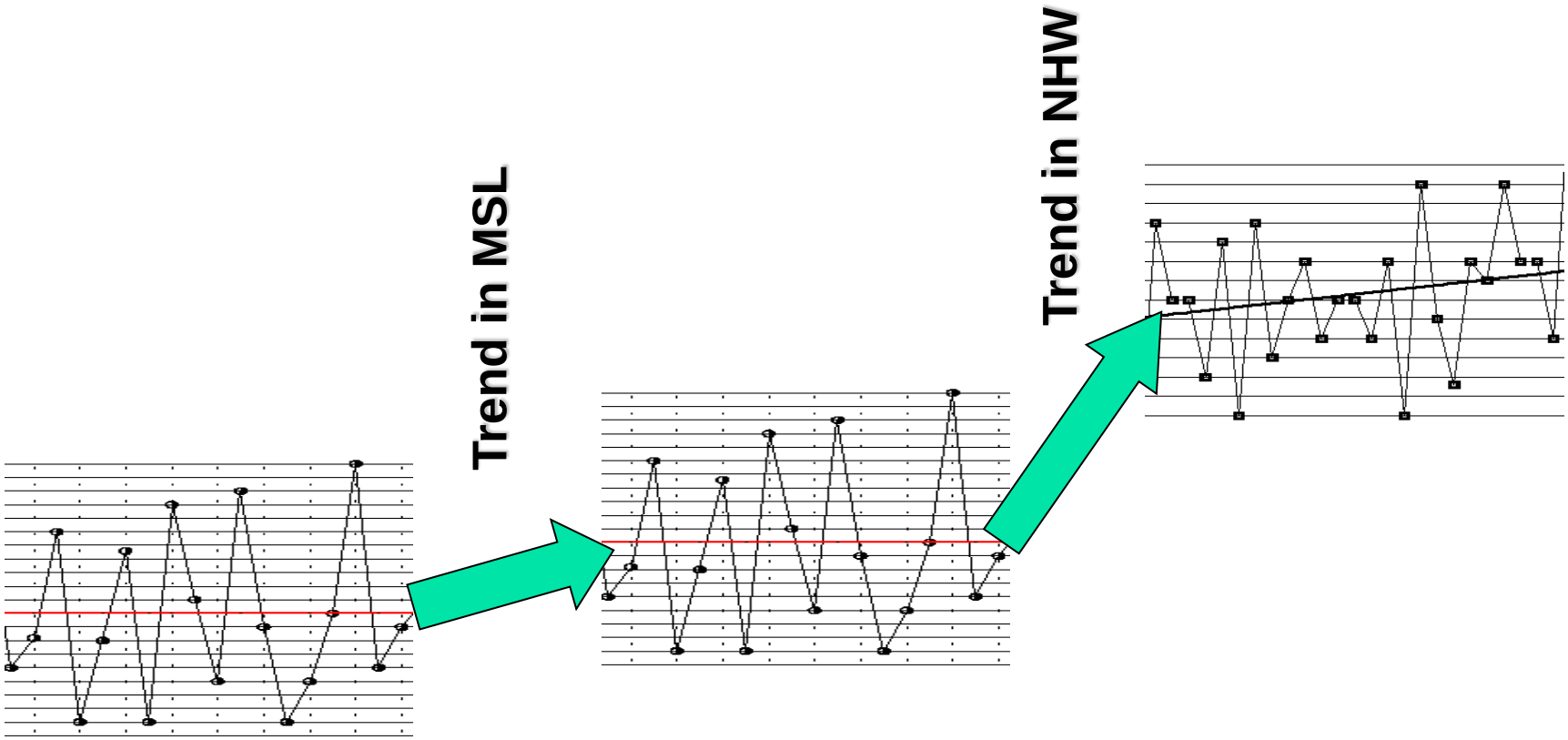
Present situation

NORMAL DISTRIBUTION

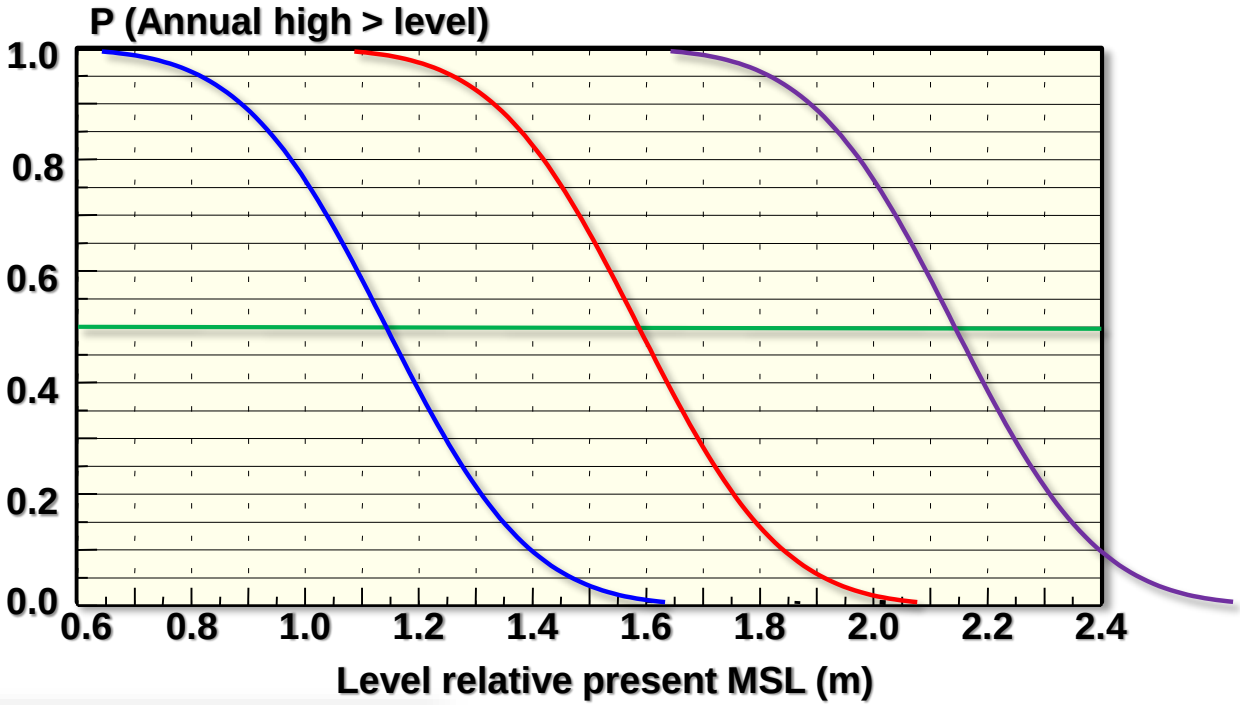


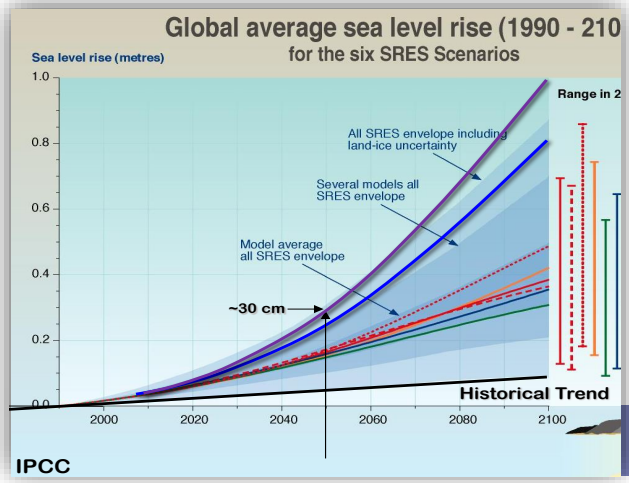


INCREASE IN WL 2000 – 2050 – 2100



FUTURE SEA LEVELS?

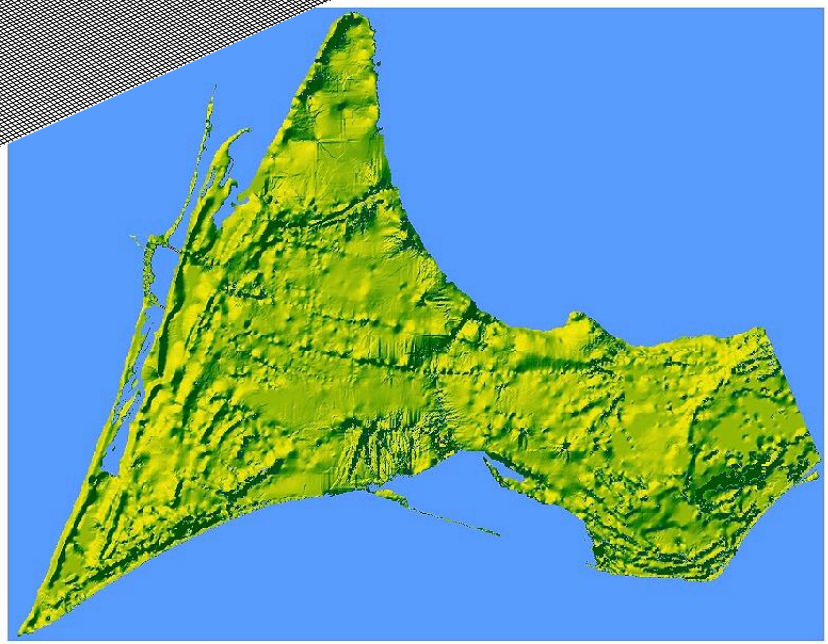




- Present situation
- 2050, 57-yr trend+ increased GHE
- 2100, SMHI

RISING SL – WHAT IS FLOODED?

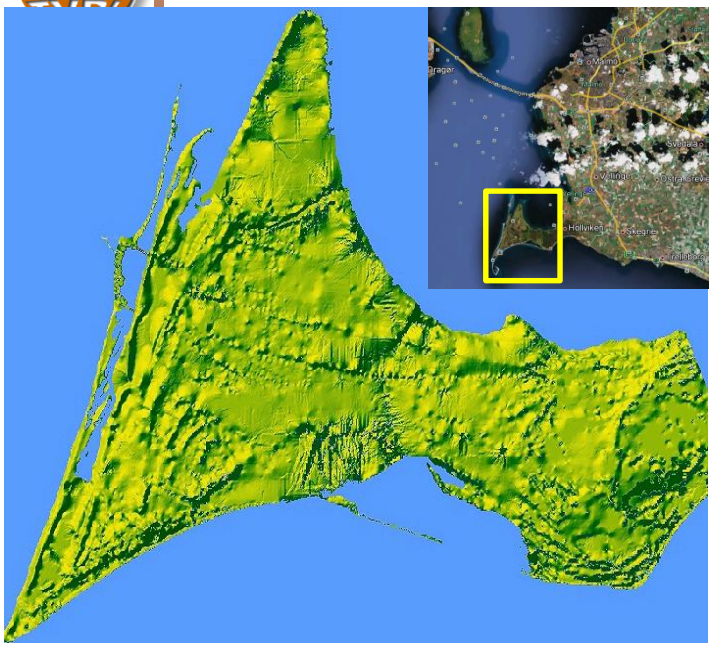
DIGITAL ELEVATION MODEL

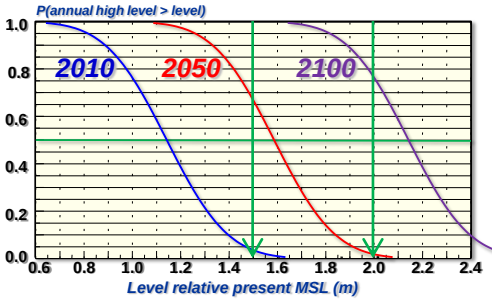


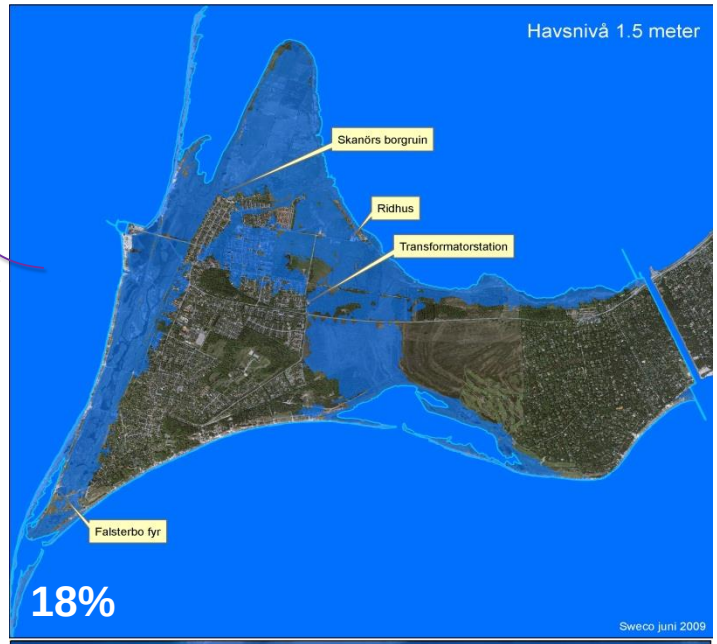
Based on 18,000 known points (x, y, z).

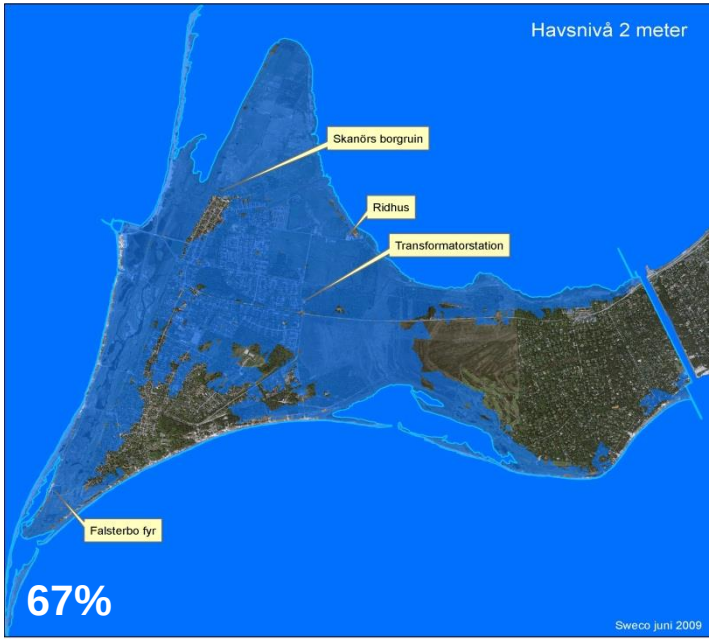
Vertical scale exaggerated to enhance 3D-effekt.

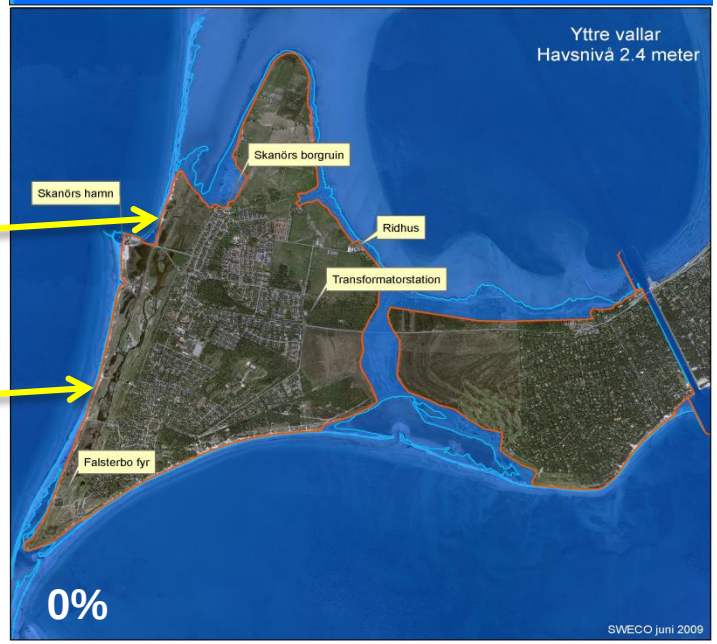
SKANÖR/FALSTERBO – FLOODED REAL ESTATE FOR DIFFERENT SEA LEVELS...











IS IT ECONOMICALLY DEFENDABLE?

Total number of houses ~ 3,100

Cost dams/dunes (50 yr):
about 0.6 MEuro/km =
$10M ~ $0.2M/yr

$0.5M/yr

Cost sand (~10 km):
$15M over 50 yrs = $0.3M/yr

Protected values (c:a) (2012):
$6,000M
Cost ~ 0.4% ~ 0.008%/yr

Home insurance premiums 2012 ~ $450/yr/house (avg SE) ~ $1.5M/yr
Living expences 2011 (avg SE) ~ $12,000/month/house ~ $37M/yr

Commute cost (10 000 out, 3 000 in, 1.5 pers/car, 15 km*2) ~ $0.1M/day!

NL: Protective measures $1,600M/yr ~ 0.1%/yr


Thank you for your attention!
Questions?
Hans.Hanson@tvrl.lth.se