



## **Adapting to future climate change in the Thames estuary**

**Tim Reeder  
Environment Agency UK**



## Anglo Saxon Chronicle 1009

"...on the Festival of St Martin the sea flood sprang up to such a height and did so much harm as no man remembered that it did before and this was the first day of the new moon..."

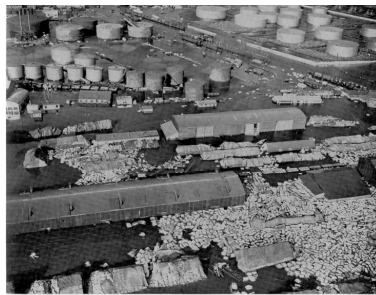
## Another flood recorded on the same day in 1236

"...which caused the marshes about Woolwich to be all at sea wherein boats and other vessels were carried in the stream. In the great Palace of Westminster men did row in wherries in the midst of the hall..."



## Daily Mirror 200 DEATH-ROLL IS FEARED AS SEA-FLOOD HORROR STRIKES BRITAIN

Two to whom death came in a night of terror...



Oil drums and paper afloat at Purfleet on Monday, 2 Feb., and warehouses and tarpaulins stacks of merchandise, including raw sugar and reals of newsprint, half-submerged.



Rail tankers half-submerged on the Shell-Mex and B.P. site at Purfleet.

Flood damage to industry: The Shell-BP site at Purfleet. The white objects are partly submerged rolls of paper from a nearby mill



## The 100th Thames Barrier Closure



## What is TE2100?

A Project to provide a plan demonstrating how **flood risk** can be managed in the **Thames Estuary** over this **century** in response to:

- a changing climate



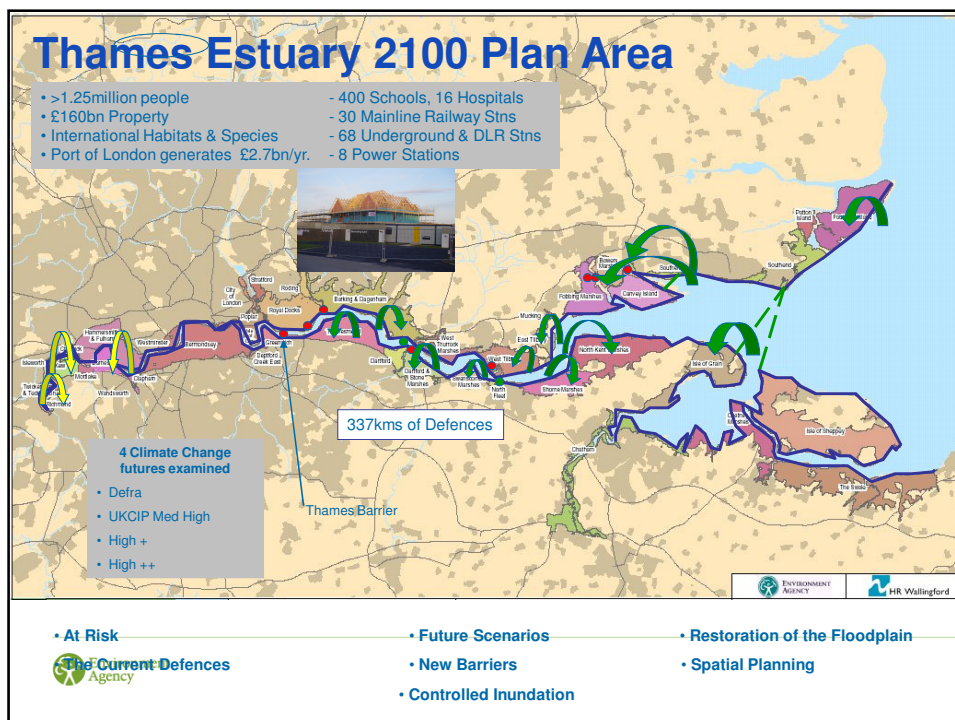
- a changing estuary



- ageing flood defences







## Climate Change & TE2100

- ⇒ Climate Change critical issue for flood risk
- ⇒ Main driver of physical flood risk sources in order of uncertainty at project start :-

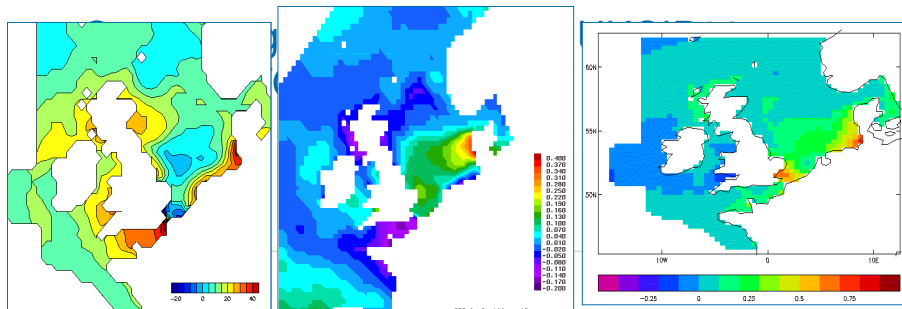


- ⇒ Waves
- ⇒ Fluvial Flow
- ⇒ Sea Level Rise
- ⇒ Surge
- ⇒ Joint Probability



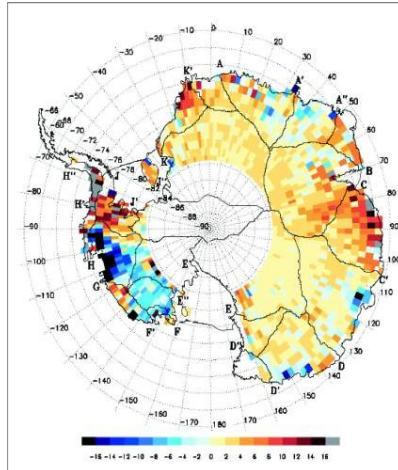
## Science before TE2100

- ⇒ River flow - DEFRA guidance – 20 % increase
- ⇒ Mean SLR – IPCC 3<sup>rd</sup> Assessment Report, UKCIP02



## Latest Satellite Altimeter Results

- East Ant : - 0.12mm/y msl
- West Ant : + 0.16mm/y msl
- Marine ice sheet zones
  - major discharges :
    - Pine Island - Thwaites in West Antarctica
    - Totten and Cook in East Antarctica



## TE2100 Programme & Approach

- ➔ MOHC POL CEH studies provide probabilistic scenarios for Thames Estuary for Storm Surge, Sea Level Rise, Fluvial Flow,
- ➔ Storm Surge and Sea Level Rise benefit to UKCP 09
- ➔ Climate Change Critical Factor – TE2100 input to IPCC 4th Assessment Report, Stern
- ➔ Structured project around uncertainty and decision testing



## TE2100 – Planning for an uncertain future



### Thames Estuary 2100 Project

- ➔ To achieve the project objectives we have based our programme of studies around a Decision-Making Framework that has largely been piloted by ESPACE...







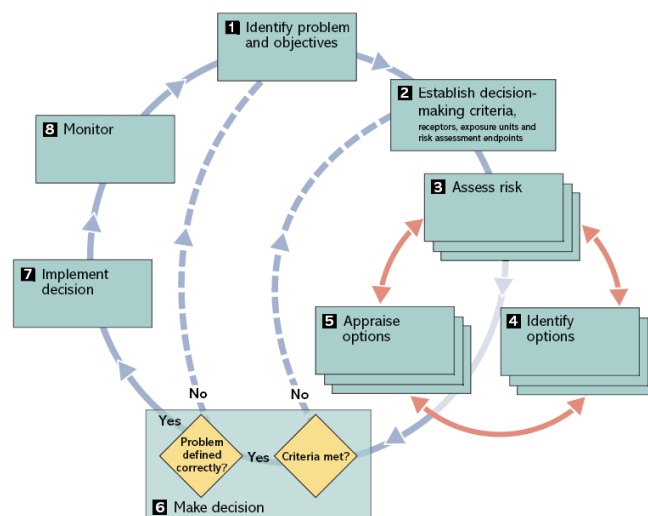
**Climate adaptation:  
Risk, uncertainty  
and decision-making**

Helps deliver policies and projects that are robust in the face of an uncertain future climate



[www.ukcip.org.uk](http://www.ukcip.org.uk)

## Eight-stage decision-making framework





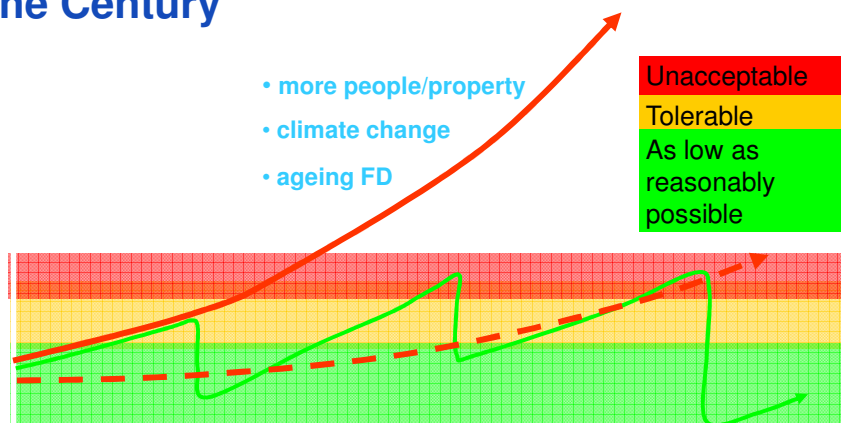
## TE2100 Techniques

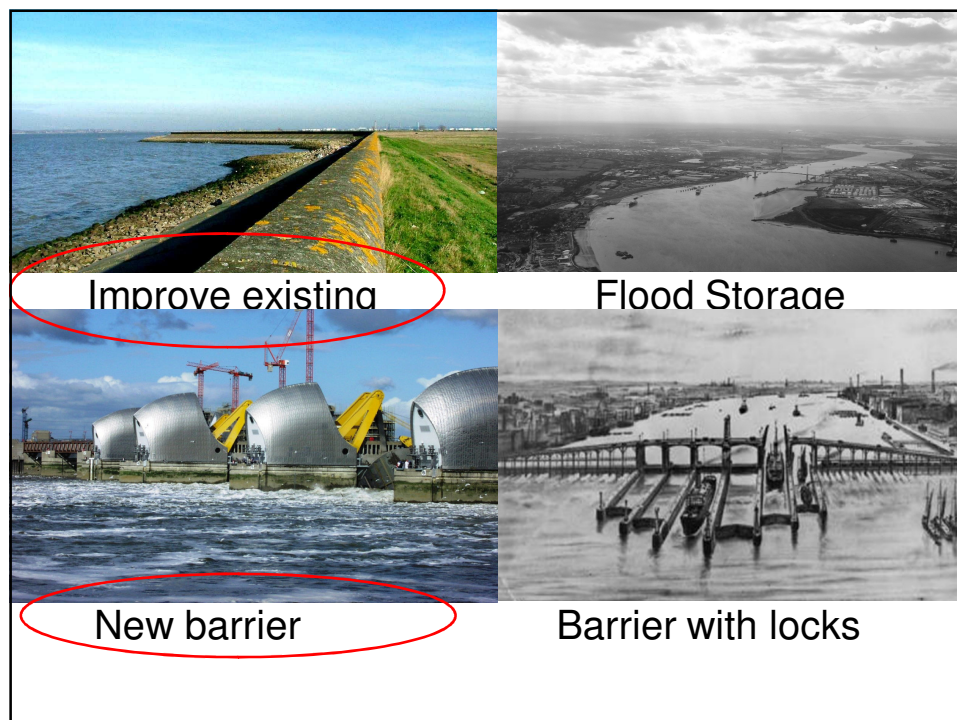
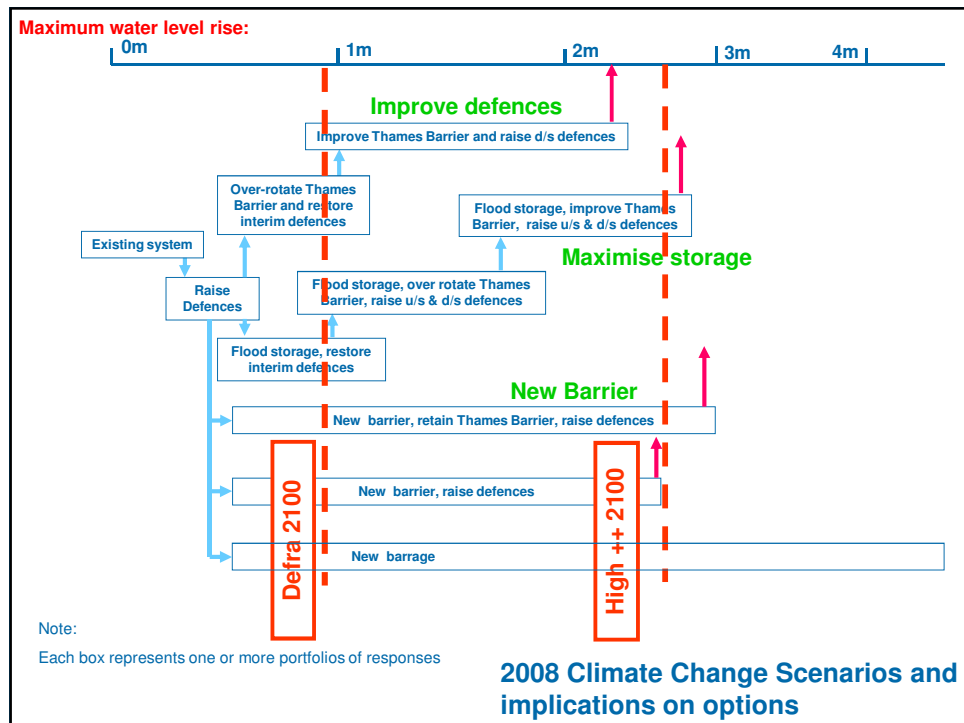
- ⇒ Scenario neutral analysis – thresholds for responses
- ⇒ Led to decision pathways and adaptable options
- ⇒ Monitoring - links with BAS, at cutting edge of ice melt science – essential for adaptable plan - with critical lead times

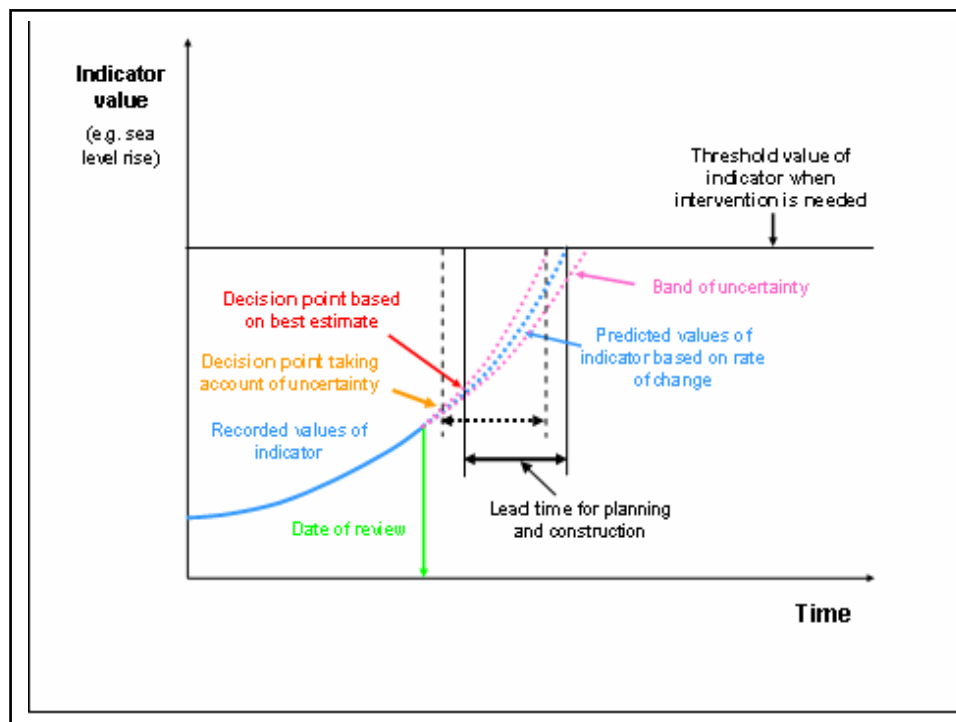


## Managing Flood Risk through the Century

- more people/property
- climate change
- ageing FD

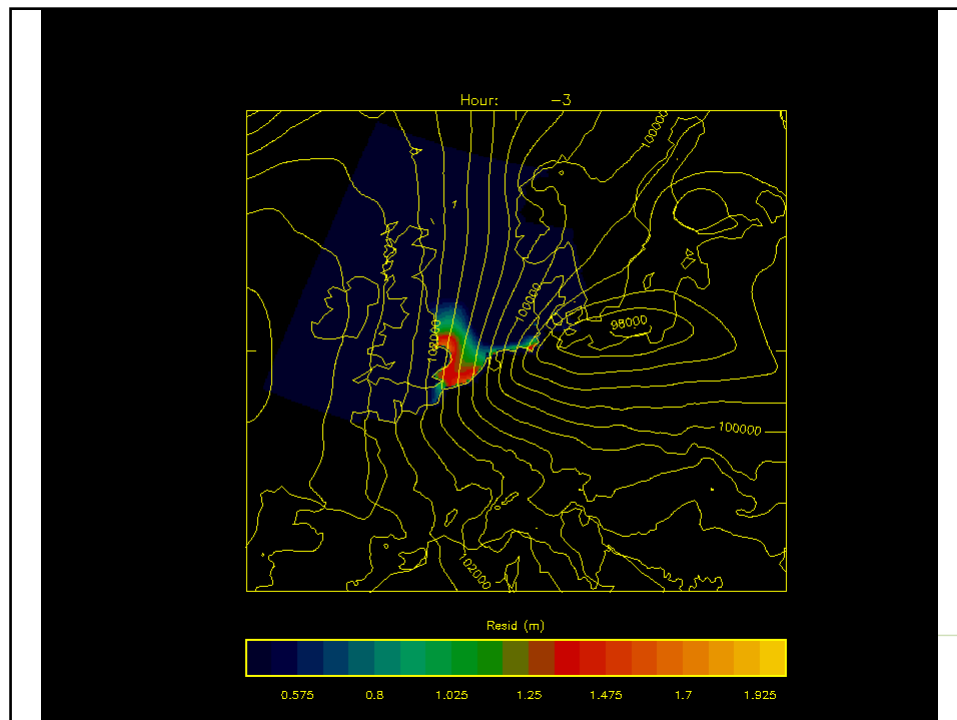
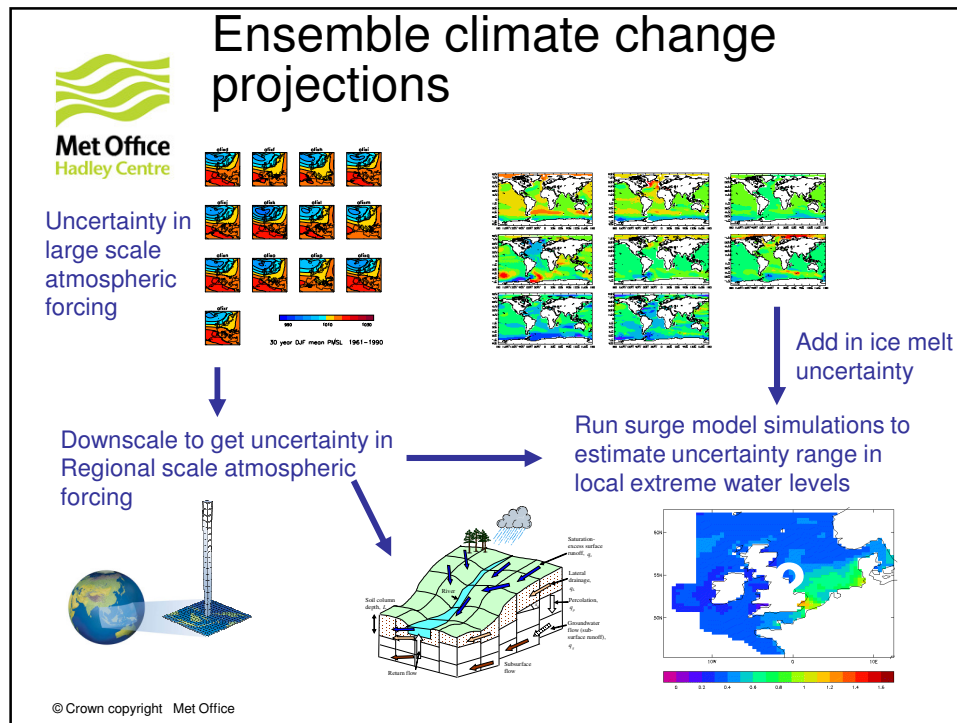


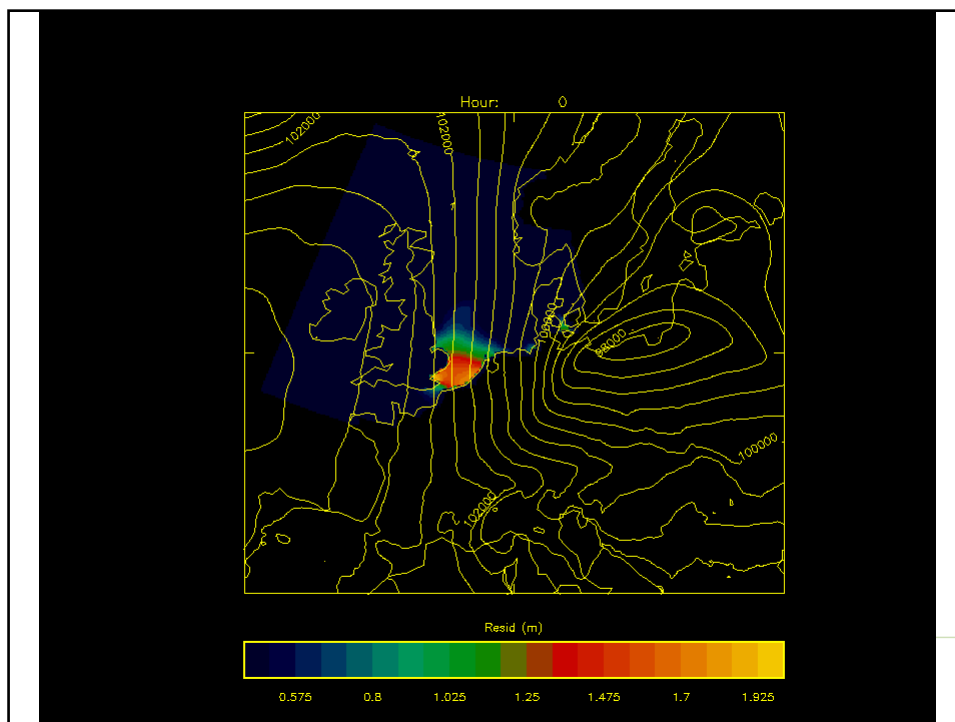
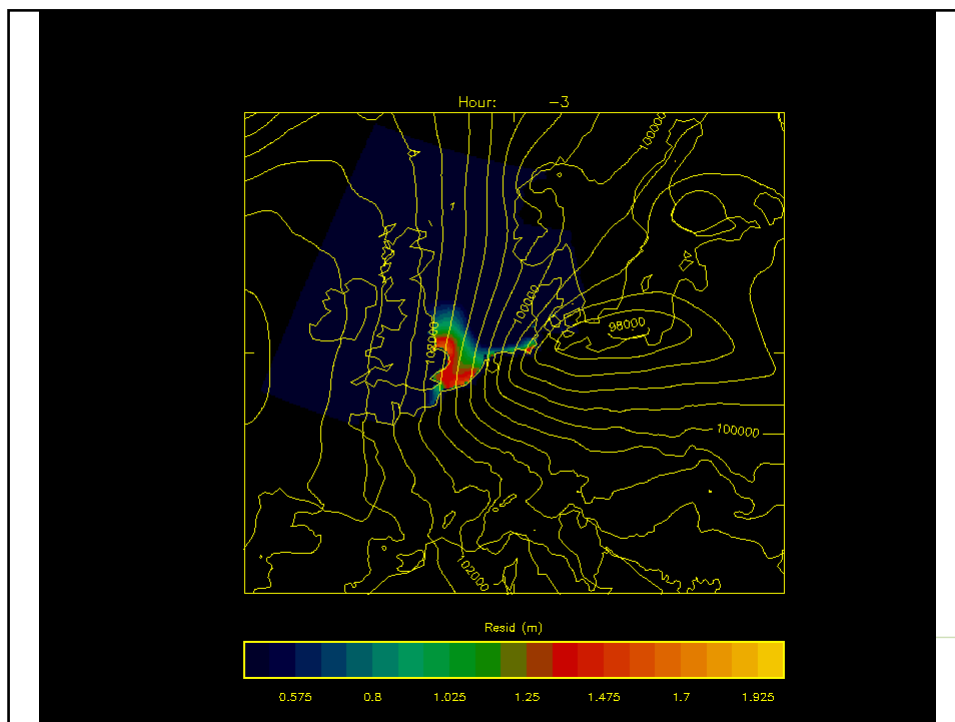




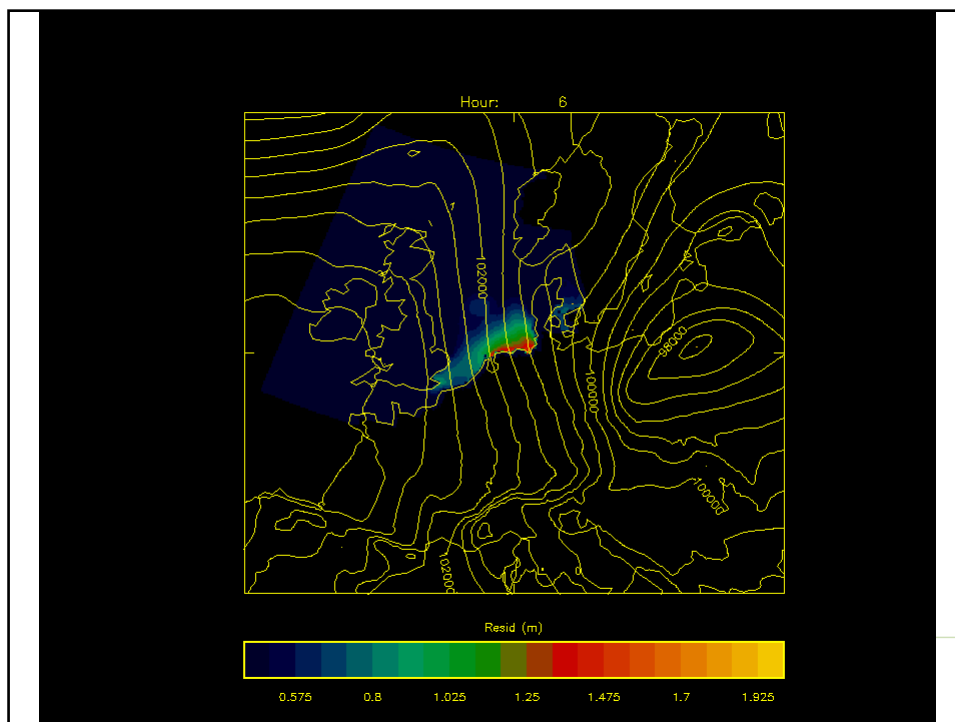
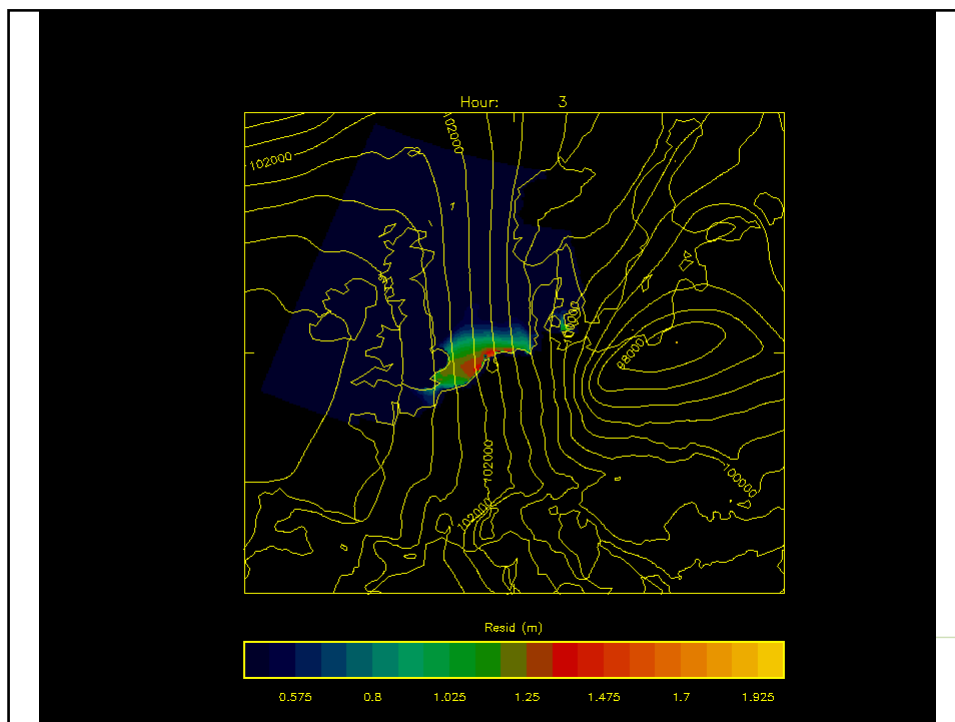
## TE2100 – Driving the science

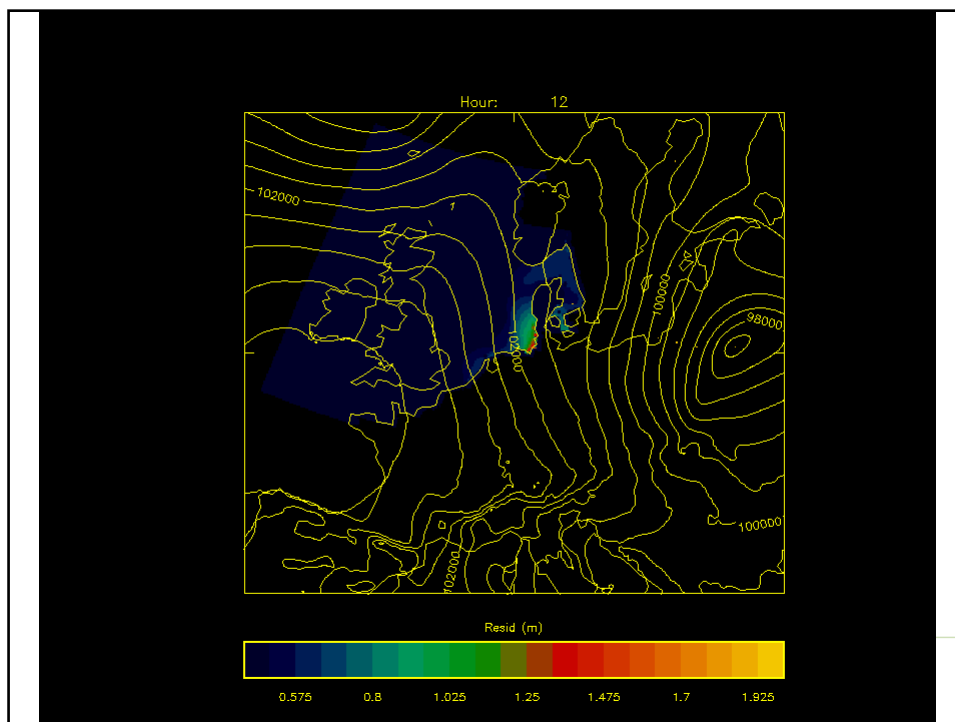
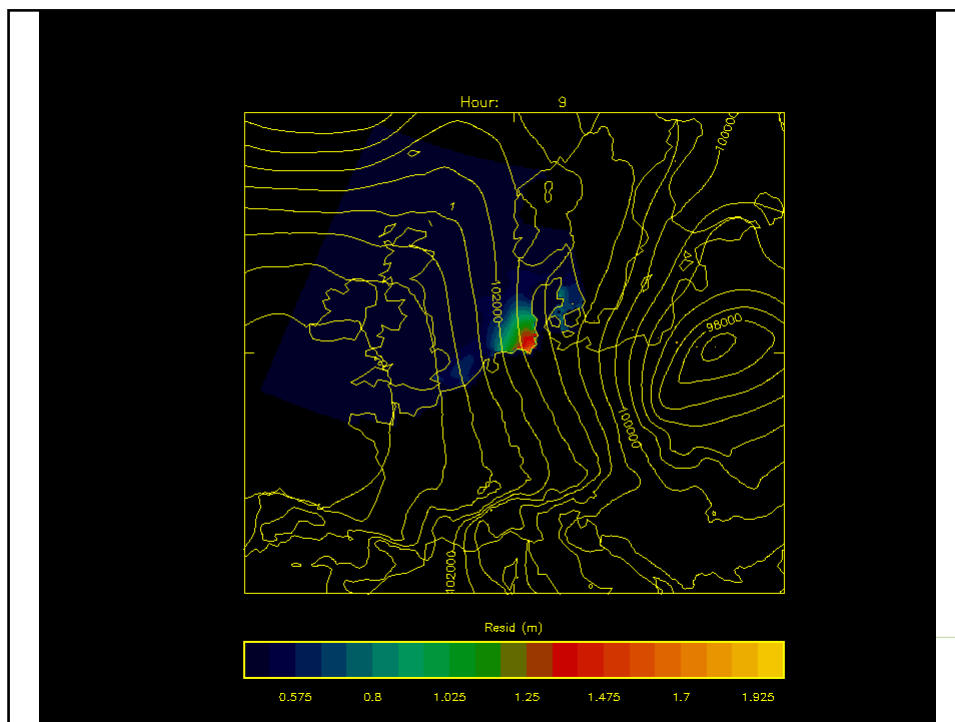
### Feeding into UKCP09



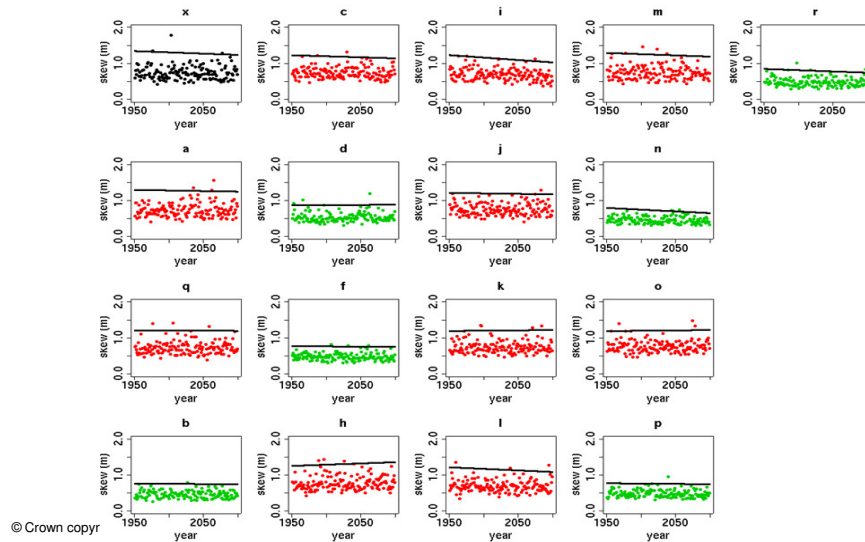




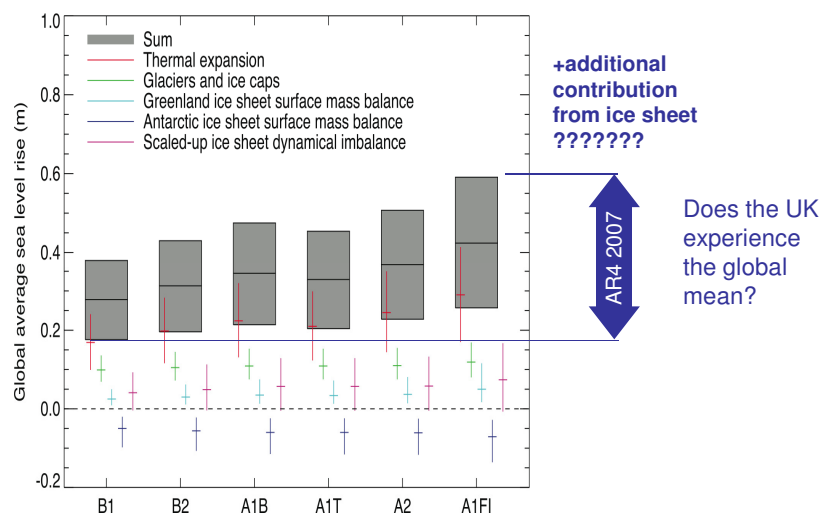




## What about the trends?



## IPCC AR4 mean sea level Projections





## Adding it all together



- Global mean
- UK ocean deviation
- Vertical land movement
- No significant trend in surges

Including emissions uncertainty  
We project 20cm to 90cm  
increase in extreme SL by  
2100.

This value is VERY close to the  
current Defra guidance, which  
is based on the IPCC TAR

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## Is 90cm the upper limit?

### For mean sea level rise

- Probably not less than zero
- Probably not more than 12m
- 4m – based on Lenton et al., 2008 (based on Hansen, 2005)
- $1.6 \pm 0.8$ m – Rohling et al., 2008 (based on Red Sea observations)
- 2m - various personal comms with ice sheet “experts”
- 2m – Pfeffer et al., 2008

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**Met Office**  
Hadley Centre

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- **We present two scenarios to 2100**
  - The 0.20m to 0.90m as the **LIKELY** range, with no trend in surges.
  
  - **H++ range of 1m to 2m for mean sea level rise for sensitivity testing. With our H++ surge scenario the full H++ range extends to 2.7m for a 5-year period event.**
  - **We think the upper end of this range is VERY UNLIKELY to occur by 2100**

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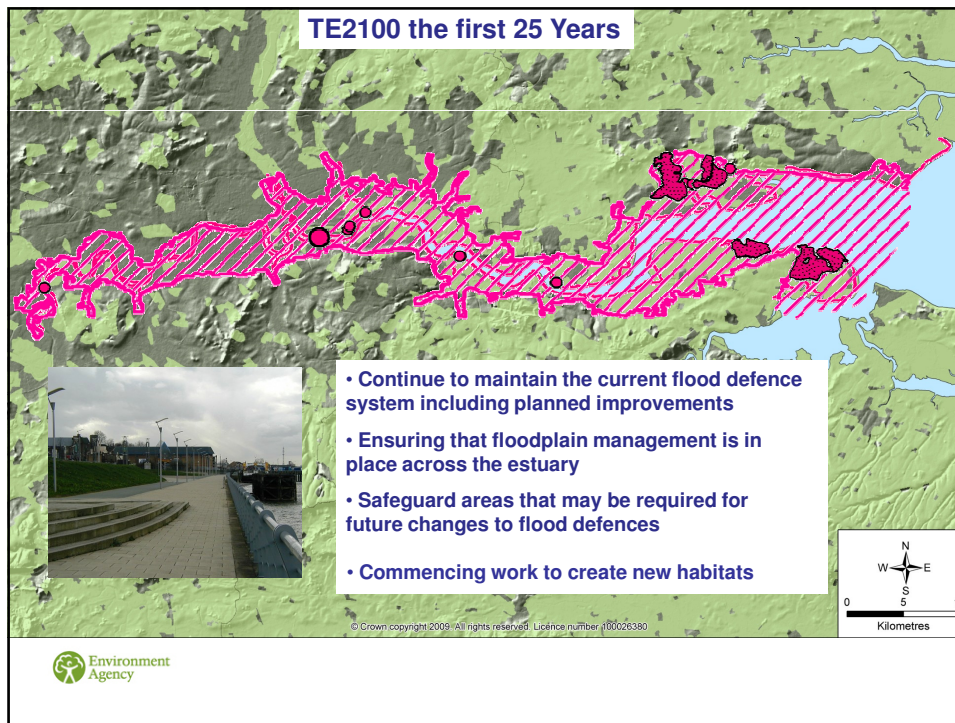
## TE2100 Science Key Findings

- Sea level rise in the Thames over the next century due to thermal expansion of the oceans, melting glaciers and polar ice is likely to be between 20cm and 90cm.
- There is still much uncertainty over the contribution of polar ice melt to sea level rise. At the extreme it may further raise sea levels up to 2m (including thermal expansion) - although this is thought highly unlikely.
- Although still uncertain, climate change is less likely to increase storm surge height and frequency in the North Sea than previously thought.
- Future peak freshwater flows for the Thames are also uncertain. At Kingston they could increase by around 40% by 2080.
- To reduce the uncertainty over the potential effect of polar ice melt on sea level rise, further research and monitoring is needed.



Environment  
Agency





## Summary

- ➔ **TE2100 is the first major project in the UK to have put climate change adaptation at its core. We have developed a method to test flood risk measures against climate change scenarios. Working with the Met Office Hadley Centre and other key organisations, we have improved our understanding of future climate change impacts in the Thames Estuary. This gives us confidence that our Plan is adaptable to future climate change.**

