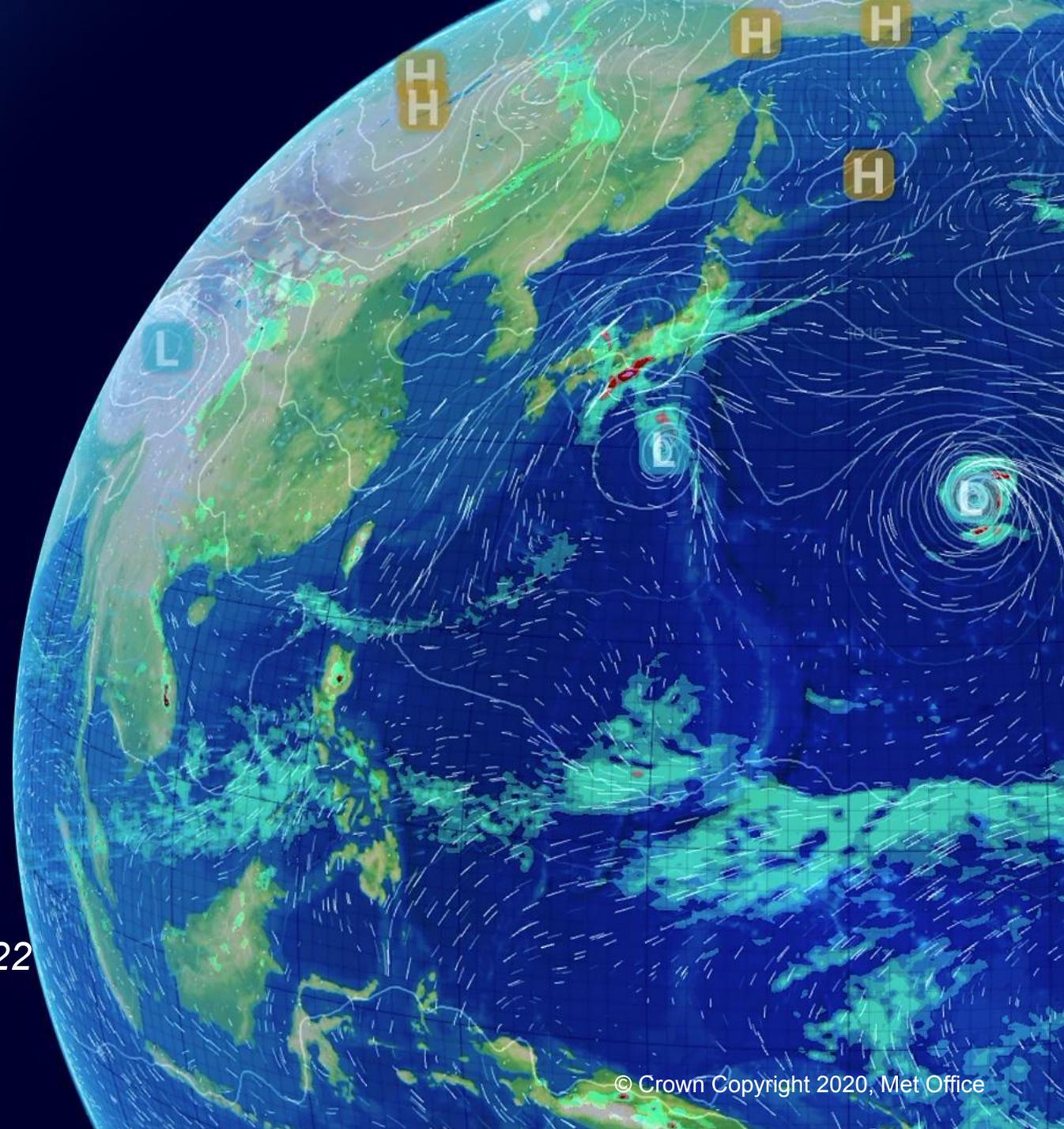


Insight into applications of ocean digital twins from IPCC AR6

Helene Hewitt and Jason Lowe

Met Office Hadley Centre

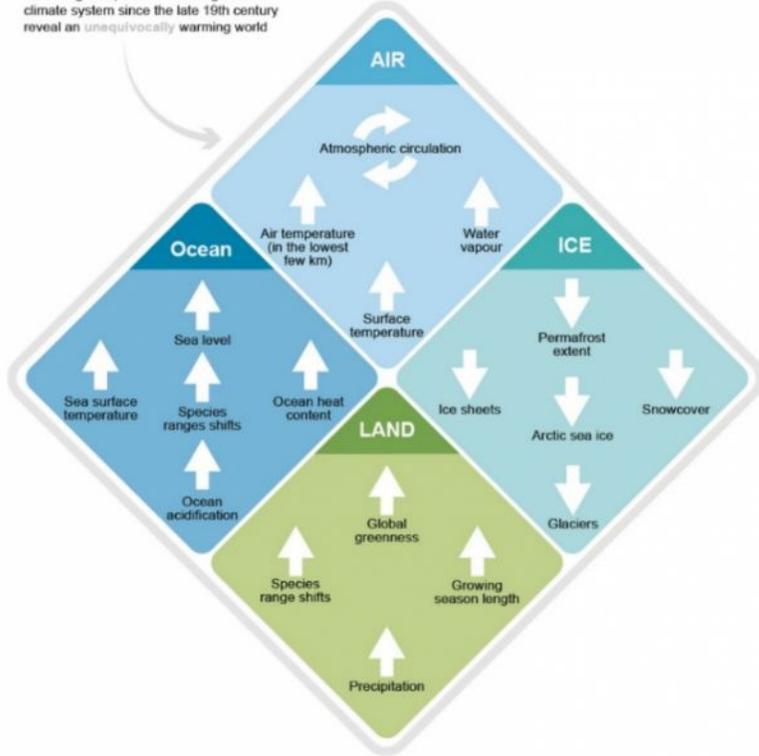
International Digital Twins of the Ocean Summit 2022



IPCC Sixth Assessment Report

FAQ2.2: What is the evidence for climate change?

Taken together, observed changes in the climate system since the late 19th century reveal an unequivocally warming world



IPCC AR6 Working Group I:
Climate change affecting all parts of the climate system, widespread, rapid, intensifying, unprecedented in thousands of years.



Monitoring ongoing changes and responses to mitigation.



Adapt to unavoidable climate change.



Assess impact of potential mitigation measures.

Digital Twins of the ocean for decision making

Ocean is part of the wider climate system – need to link to other environmental digital twins

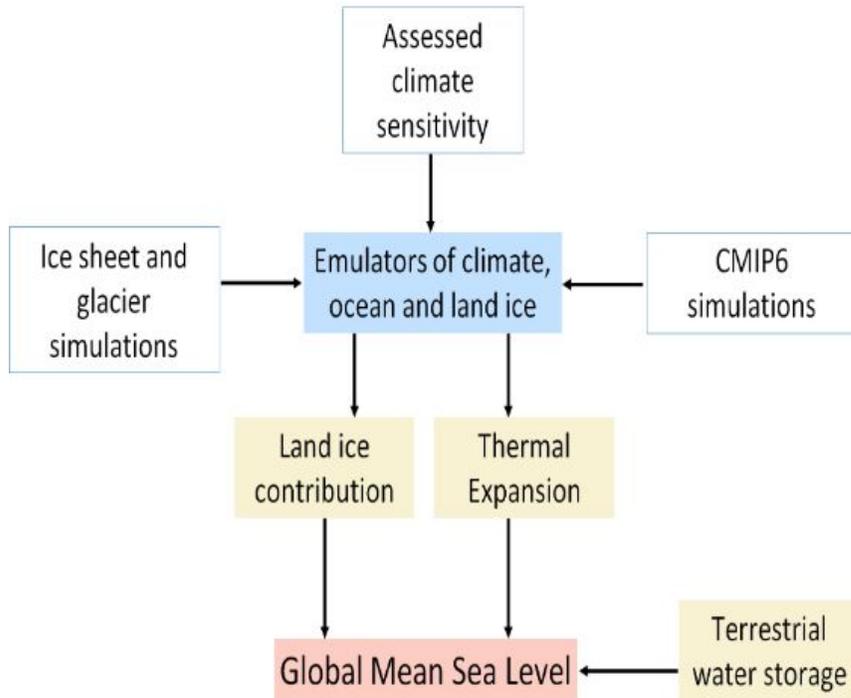


Federated digital twins to enable effective decision making linking to health, transport, etc as well as atmosphere, land, etc

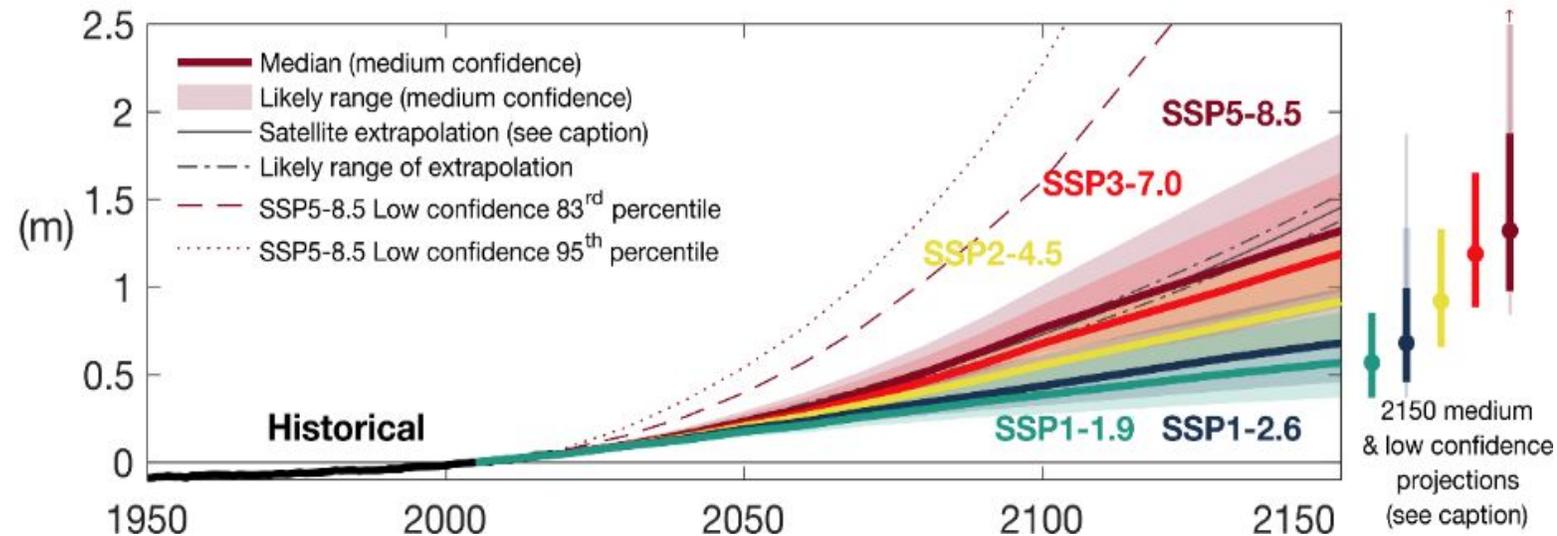
IPCC AR6 Working Group II Chapter 17 discusses ‘good and bad adaptation’. As tools for decision making, digital twins have potential to transform adaptation by allowing users (planners, policymakers) to interrogate data to make decisions



Sea level projections in IPCC AR6

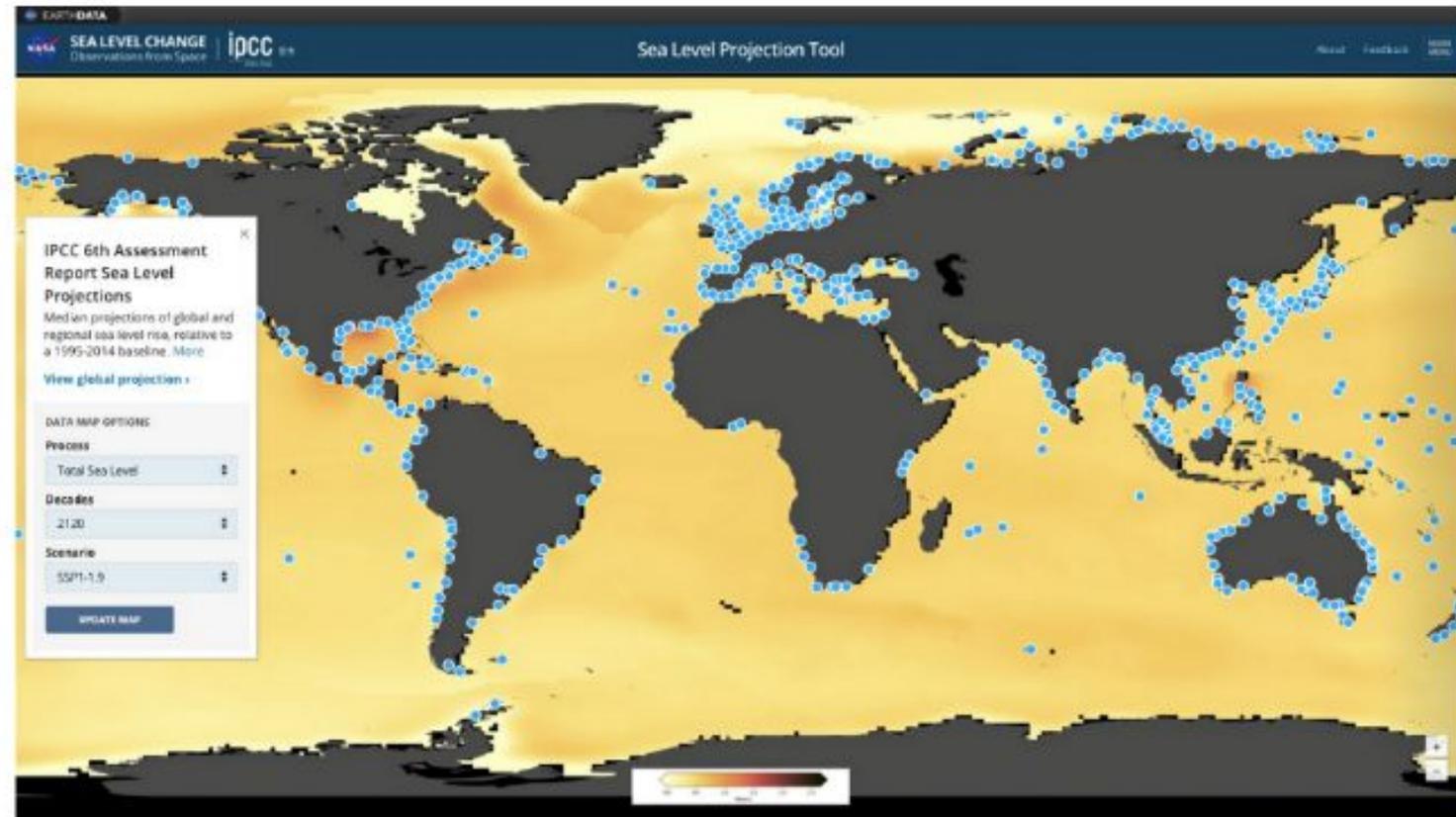
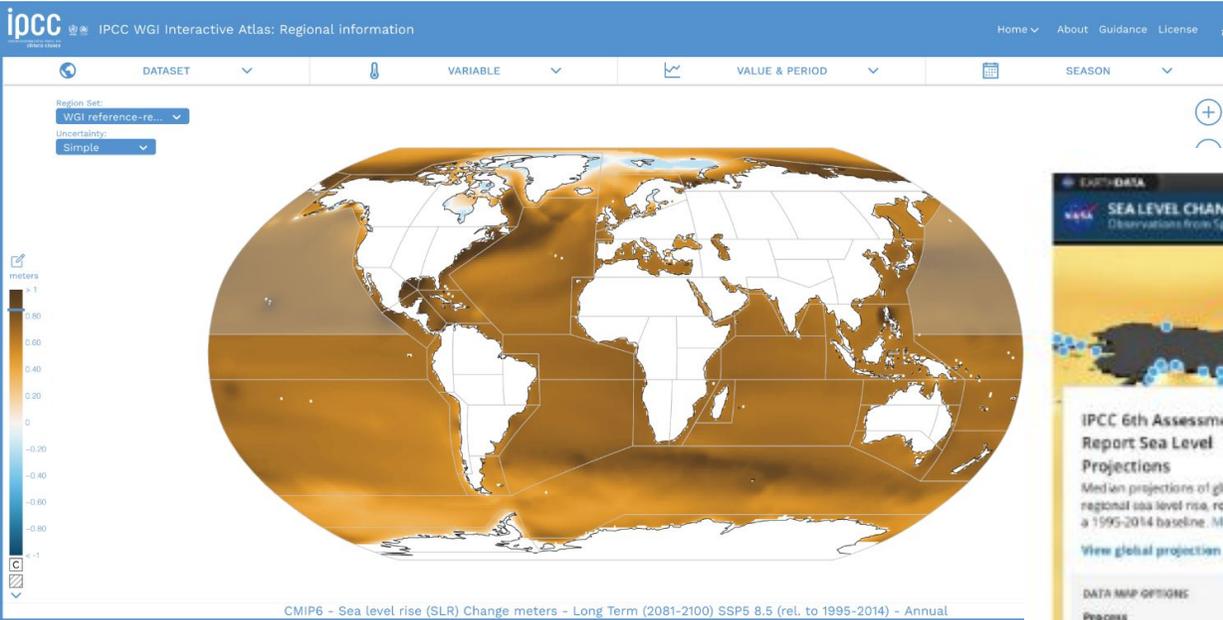


Projected global mean sea level rise under different SSP scenarios



- Methodology for producing sea level projections is updated relative to AR5 and SROCC
- Rely on emulators to encompass some of the uncertainty range
- Deep uncertainty associated with ice sheet processes is treated separately

Going beyond projections to make decisions?

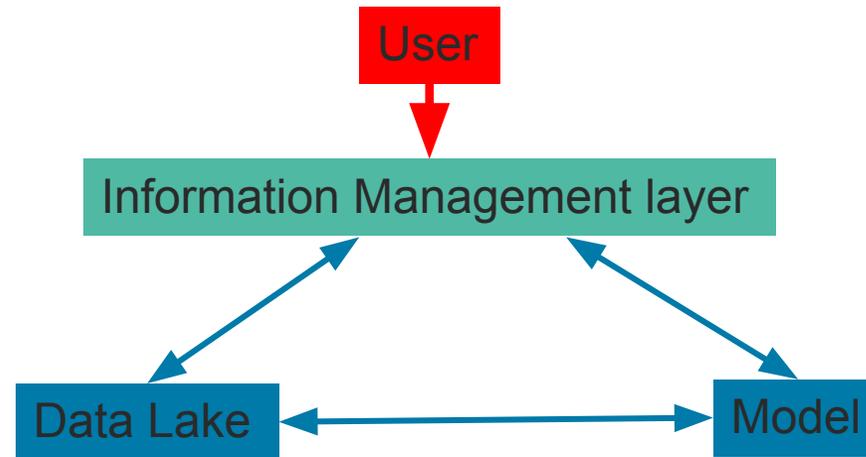


interactive-atlas.ipcc.ch

<https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool>

Digital twin for adapting to sea level rise

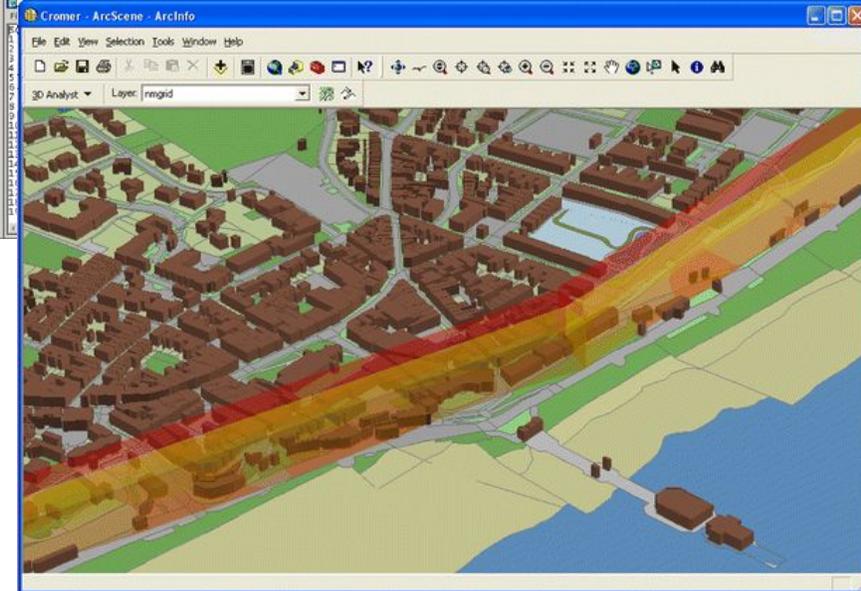
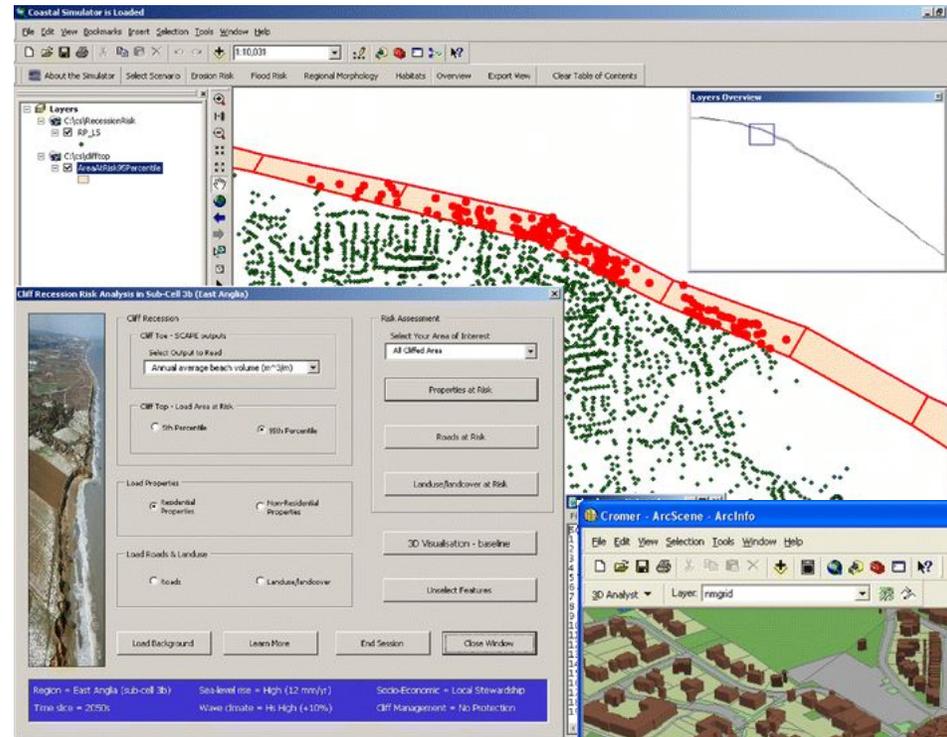
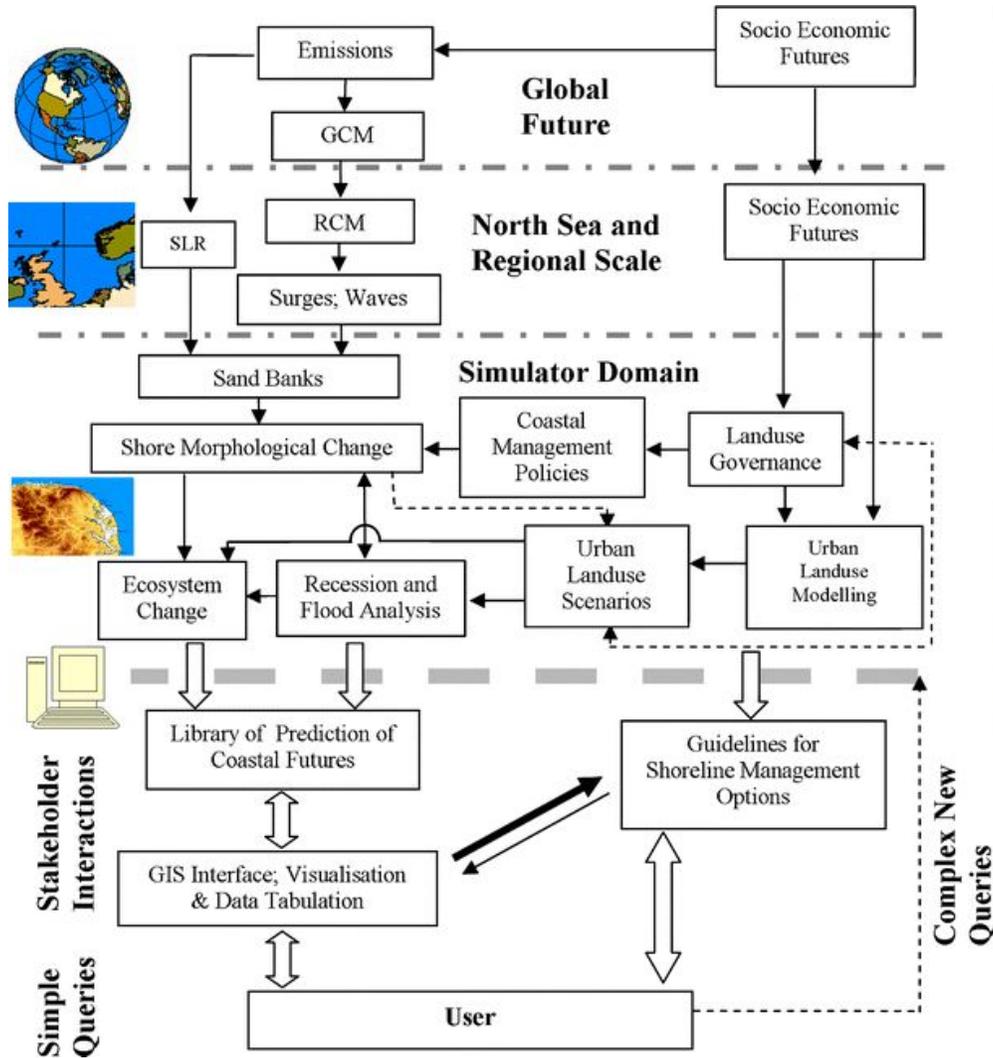
- Adaptation decisions requires one way coupling
- Sea level information can be provided to allow decisions on water supply, transport, housing and communications resilience to be made



Severe flooding events
Events with severe impacts
High impact, low likelihood events
Global and regional sea level projections

Federated environmental digital twin
Sea level inputs affecting water supply, communications, transport, housing, etc

Tyndall coastal emulator



Other potential applications

- There are a number of other policy relevant topics that could relate to ocean digital twins including:
 - Observing systems for net zero (ie, autonomous vehicles), for targeting regions for improved coverage, for key systems such as AMOC (WG1)
 - Early warning system design for ENSO, tropical cyclones, marine heatwaves, harmful algae blooms, ice shelf collapse (SROCC, WG1)
 - Testing fishing strategies under changing ecosystems, governance for marine spatial areas (SROCC)
 - Testing responses to sea level rise (coastal management, man-made barriers, etc) (SROCC, WG1, 2)
 - Assessing prospects and impacts of ocean based CDR schemes (blue carbon management, ocean alkalisation, ocean fertilisation) (WG3)
 - Assessing prospects and impacts on ocean environment of low carbon energy sources (SROCC, WG3)

Summary

- Working Group I affirms that the scientific evidence for climate change is clear (and stated in Glasgow Climate Pact)
- This moves the agenda even more towards decision making for adaptation and mitigation
- In particular, digital twins have potential to enable good adaptation decisions to be made
- Example focussed on responding effectively to rising sea levels. Expand beyond this?