

International Atomic Energy Agency Scientific Forum

# THE BLUE PLANET

Boardroom D  
C Building  
4th Floor

Nuclear Applications for a Sustainable  
Marine Environment

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## Session I: Oceans of Change

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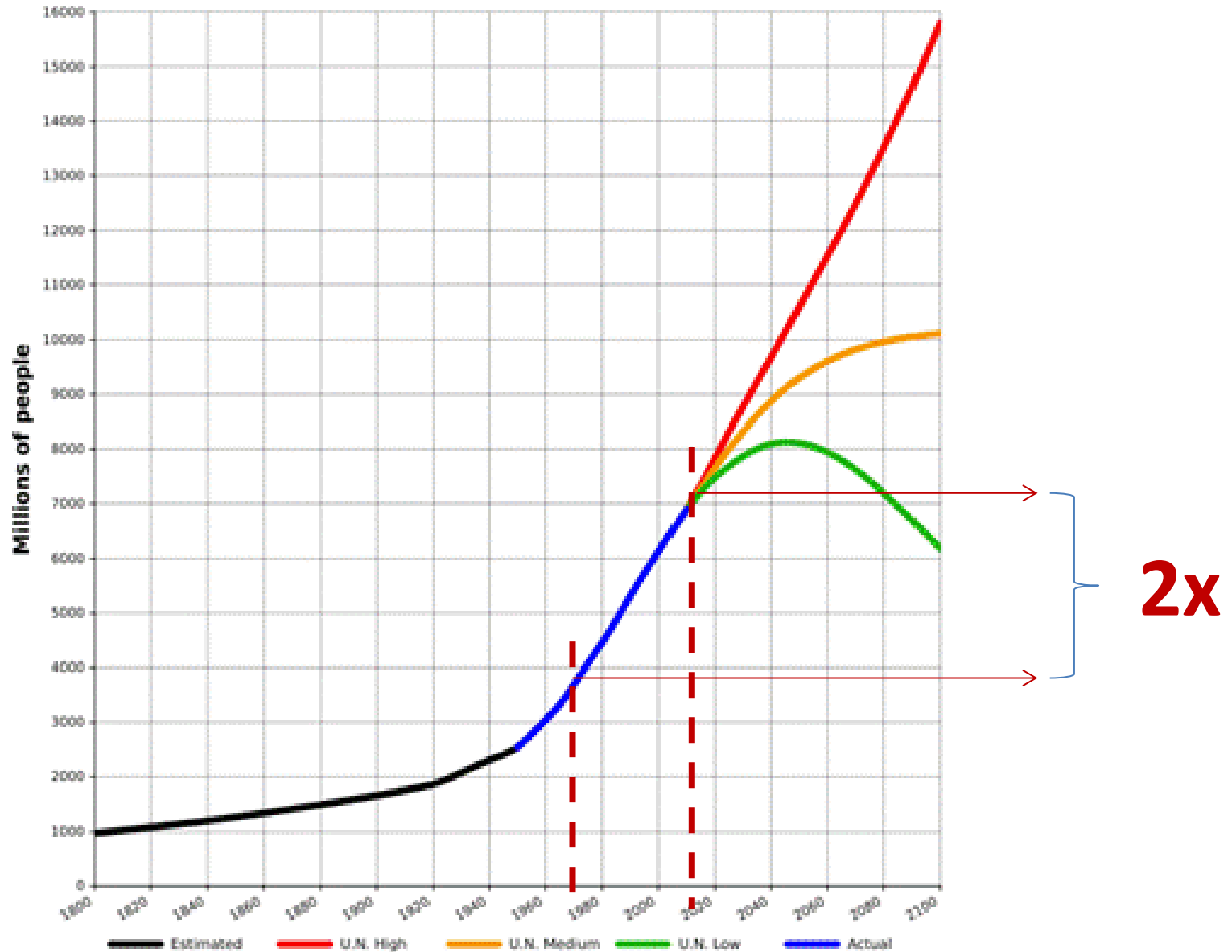


A satellite view of Earth showing the Americas and the Atlantic Ocean, with text overlaid. The image shows the Earth from space, with the Americas on the right and the Atlantic Ocean on the left. The text "Ocean acidification" is overlaid in white, bold, sans-serif font.

Ocean acidification

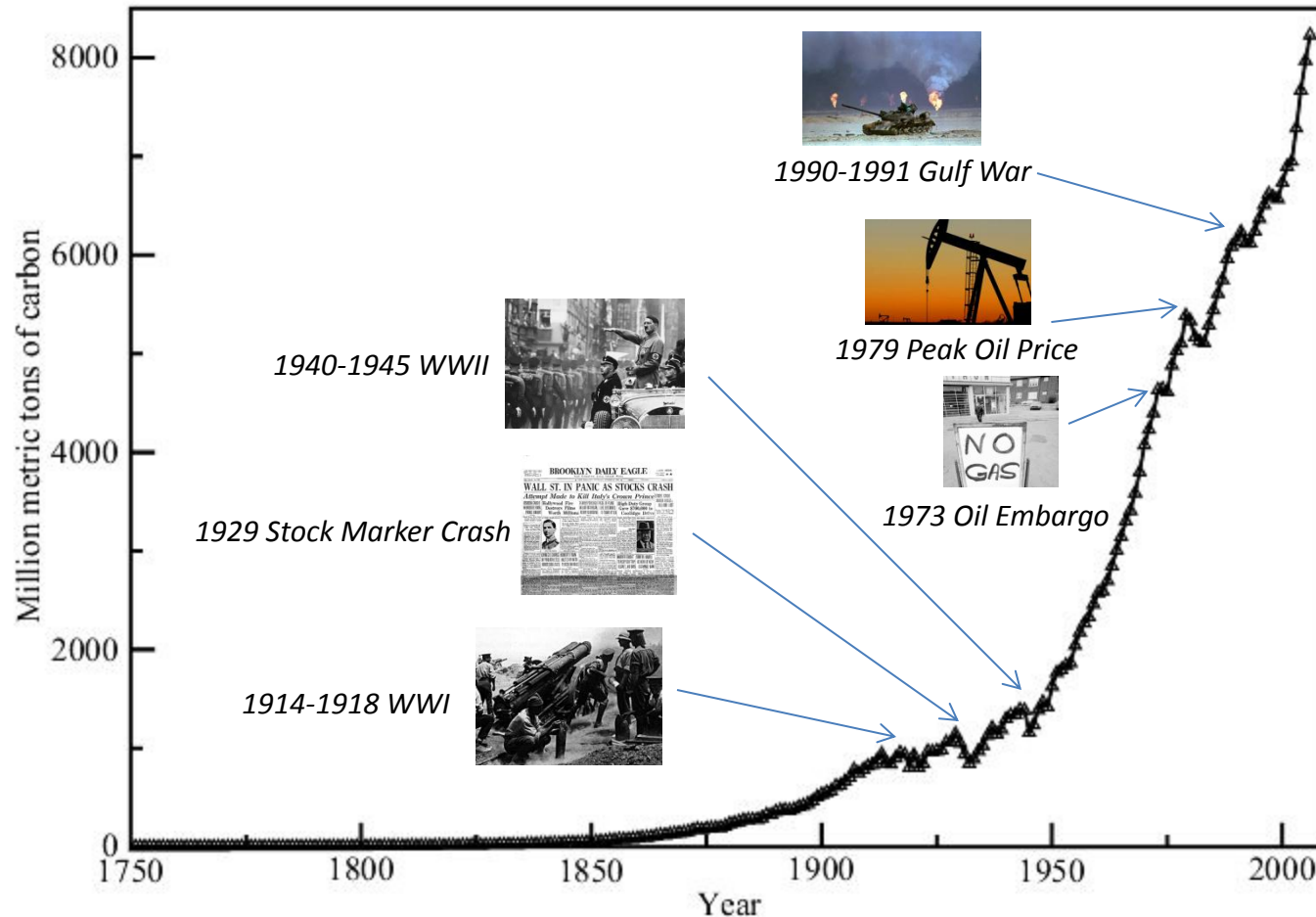
The other CO<sub>2</sub> problem

# The problem: human demography



# The disease: CO<sub>2</sub> emissions

Global Fossil-Fuel CO<sub>2</sub> Emissions



# *The symptoms:*

Global warming

Catastrophic events

Sea level rise

Hypoxia

Salinity changes

**Ocean acidification**



# Ocean acidification



30% more acidic since 1800

Two times more acidic by 2100

Faster/higher changes than in 20 millions years

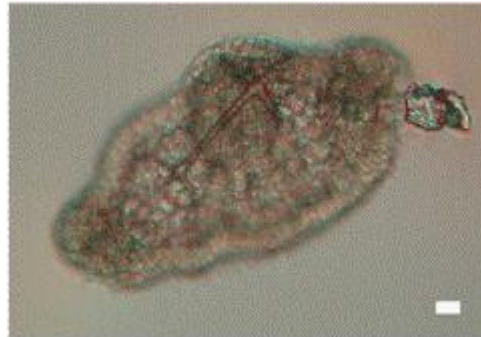
# The consequences:

## Winners & Losers

Today



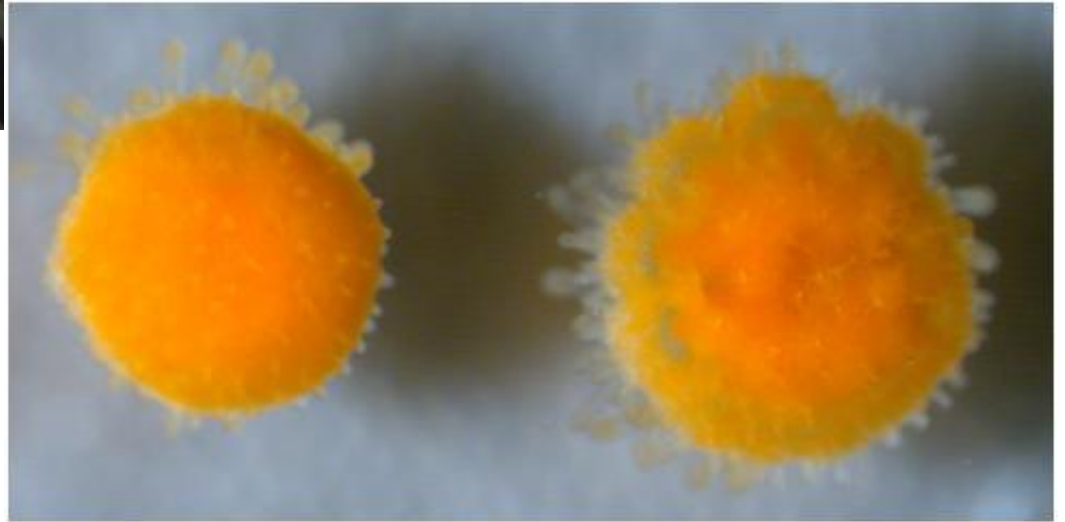
2050



*OA can lead to species extinction*

# The consequences:

*But not all species are negatively impacted*





**ECHINODERMS**

- Abyssocucumis sp.*
- Amphiura filiformis*
- Arbarcia drufresnei*
- Arbarcia punctulata*
- Asterias rubens*
- Crossaster papposus*
- Cystechinus sp.*

- Denstraster excentricus*
- Echinocardium cordatum*
- Echinometra mathaei*
- Eucidaris tribuloides*
- Evechinus chloroticus*
- Heliocidaris erythrogramma*
- Hemicentrotus pulcherrimus*
- Lytechinus pictus*
- Ophiothrix fragilis*
- Ophiura ophiura*
- Paracentrotus lividus*
- Pisaster ochraceus*

- Psammechinus miliansi*
- Pseudechinus huttoni*
- Sterechinus neumayeri*
- Strongylocentrotus franciscanus*
- Strongylocentrotus purpuratus*
- Tripneuste gratilla*

**BRYOZOANS**

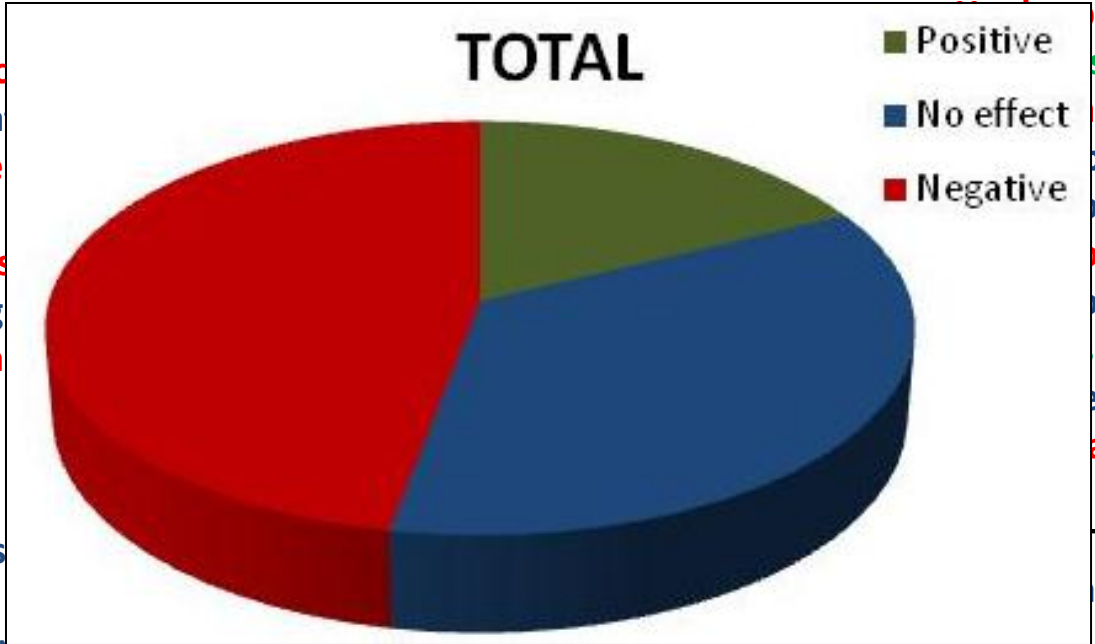
- Myriapora truncata*

**MOLLUSKS**

- Argopecten irradians*
- Bathymodiolus brevior*
- Benthoctopus sp.*
- Cavolinia inflexa*
- Crepidula fornicata*
- crossostrea ariakensis*

**CRUSTACEANS**

- Callinectes sapidus*
- Echinogammarus marinus*
- Elminius modestus*
- Elminius modestus*
- Euphasia superba*
- Gammarus locusta*



- Stomatopoda*
- Stomatopoda americana*
- Stomatopoda*
- Stomatopoda*
- Stomatopoda elegans*
- Stomatopoda pacificus*
- Stomatopoda serratus*
- Stomatopoda plebejus*
- Stomatopoda knabeni*
- Stomatopoda balanoides*

- GIARDIA**
- Giardia corrugatus*

- Strombus aratus*
- Strombus luhuanus*
- Urosalpinx cinerea*

**ANNELIDS**

- Nereis virens*
- Hydroides crucigera*

**TUNICATES**

- Asciidiella aspersa*
- Ciona intestinalis*
- Oikopleura dioicea*

**ACOELOMORPHA**

- Symsigatifera roscoffiensis*

# What do we know?

1. OA is real, fast and directly related to **CO<sub>2</sub> emissions**
2. Impact of OA on marine species, ecosystems and services is **certain** (Marine ecosystems will change)
3. This impact can be **dramatic**, including species extinction within decades



# *Ocean acidification is happening now*



*OA already have socio-economic consequences*

# *What we do not know*

*Every experiment is an abstraction of reality*

Acclimation

Carry-over  
effects

Adaptation  
potential

Synergy  
between  
stressors

Ecological  
interactions

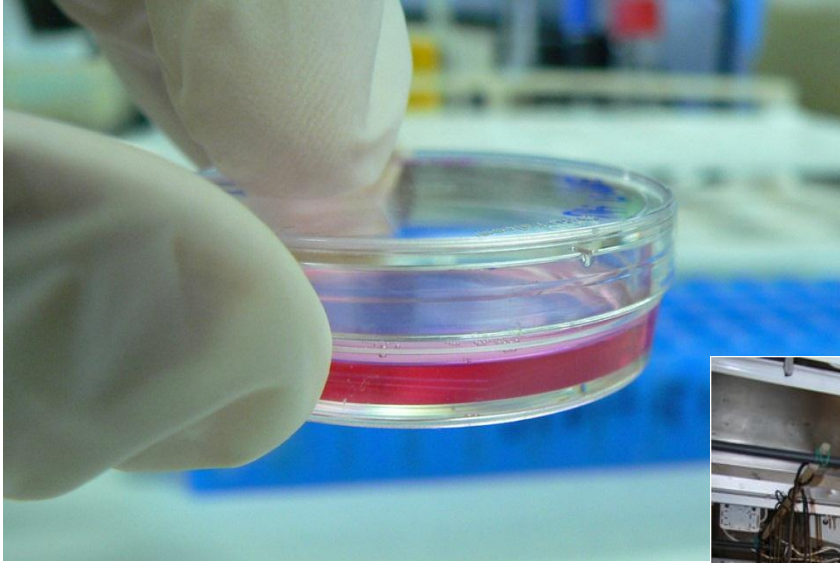
Environmental  
variability

Measured  
parameters

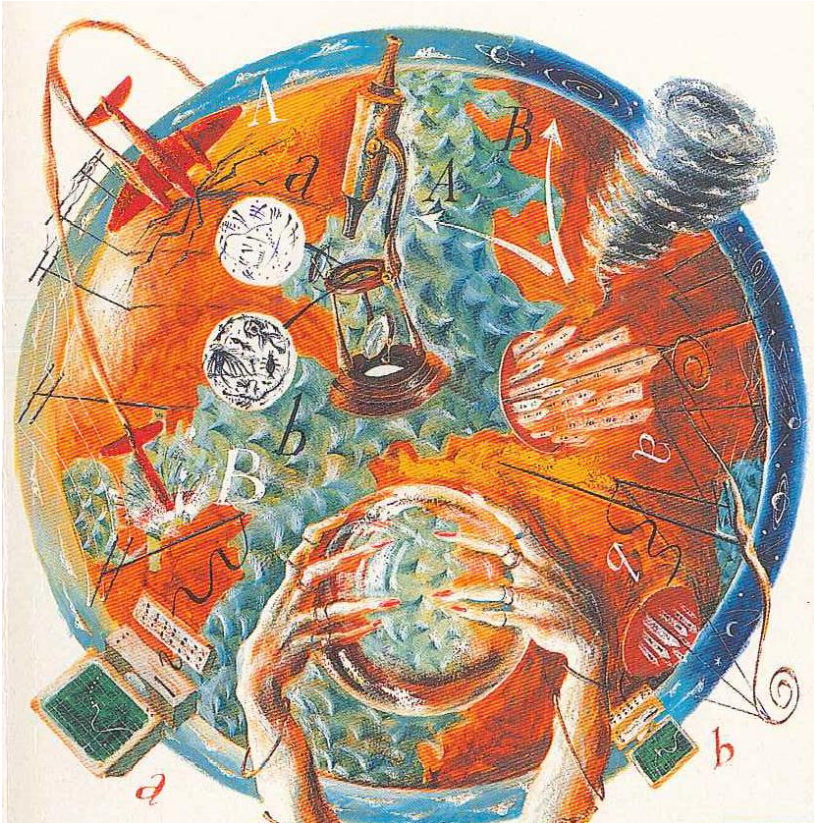
*Not 1 species with the requested level of information  
BUT we mostly **under-estimate** the impact*

***The real experiment is happening now***

# *Work in progress*



# *What will be the impact?*



Things will change...

Cost??? How bad???

We do not know enough  
(We'll never know enough)

# Solutions: what can we do?

*Decrease CO<sub>2</sub> emissions*

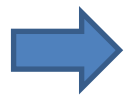
Science can help to buy some time

*e.g. increase ecosystem resilience*

*e.g. act on other pressures*

*e.g. select resilient strains*

*e.g. identify hotspots (socio-eco, chemistry, biology)*



*More research is needed*

# **BUT...**

# *We know enough to act*



We **KNOW** that a major catastrophic event is coming

We **KNOW** how to prevent it

We **CANNOT PREDICT** exact costs, casualties and damages

But... uncertainties is NOT an excuse for inaction







*time for a global mind change*