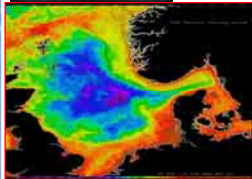


Ocean Acidification: Communication, Dissemination and Outreach

Carol Turley
Plymouth Marine Laboratory, UK



ESF Strategic Workshop on Ocean Acidification, Meloneras, Gran Canarias, 28-31 January 2008

Simple, Clear Messages

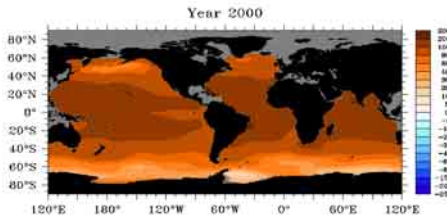
- What is ocean acidification?
- Why should we worry about it?
- What can we do about it?
- How do we do that?
- Link to messages they might be more aware of such as those issued from the climate change community

Simple Messagesthe Oceans are Acidifying

Ocean uptake of CO₂ from fossil fuel burning is changing the chemistry of our oceans, it is **simple chemistry so the certainty is high**

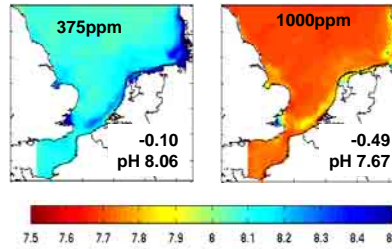
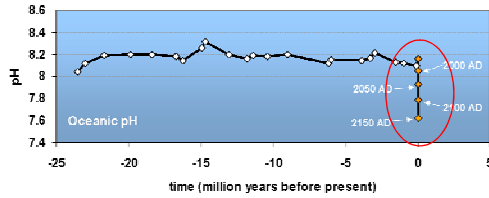
It is happening now, at a **rate and to a level not experienced by marine organisms for ~ 20MY**

Consistency in Global and Shelf Seas Biogeochemical Models



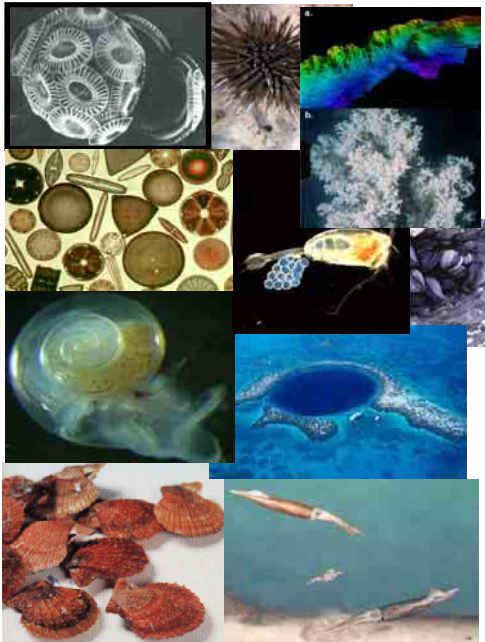
Aragonite Saturation State of Surface Waters (Orr et al 2005)

Changes in pH over the last 25 million years (Blackford & Gilbert 2007)

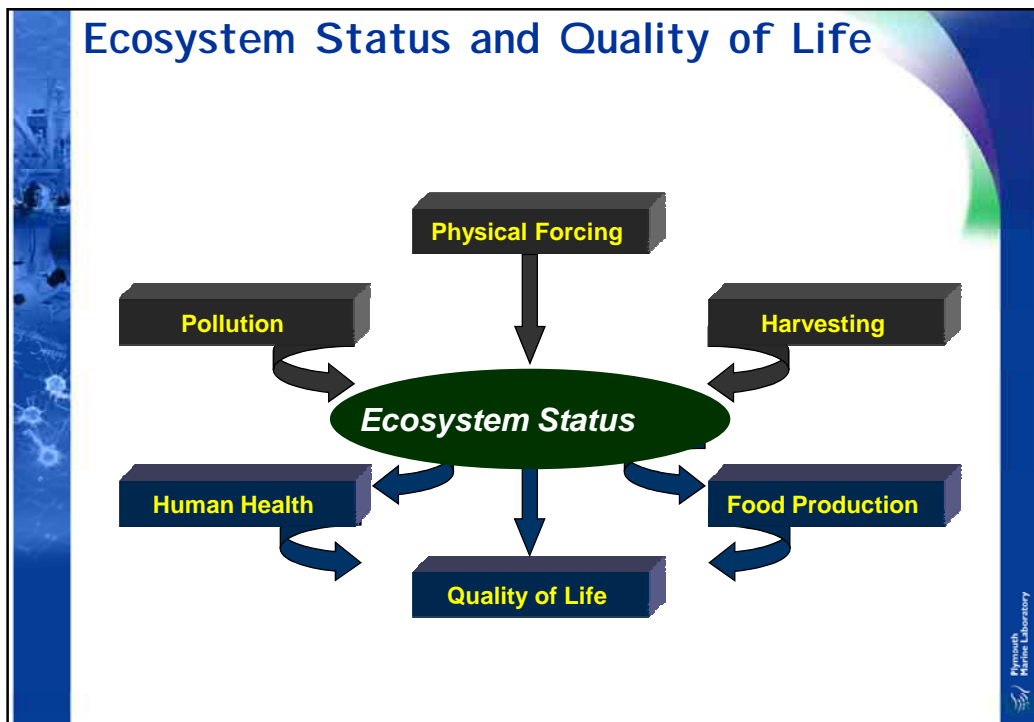


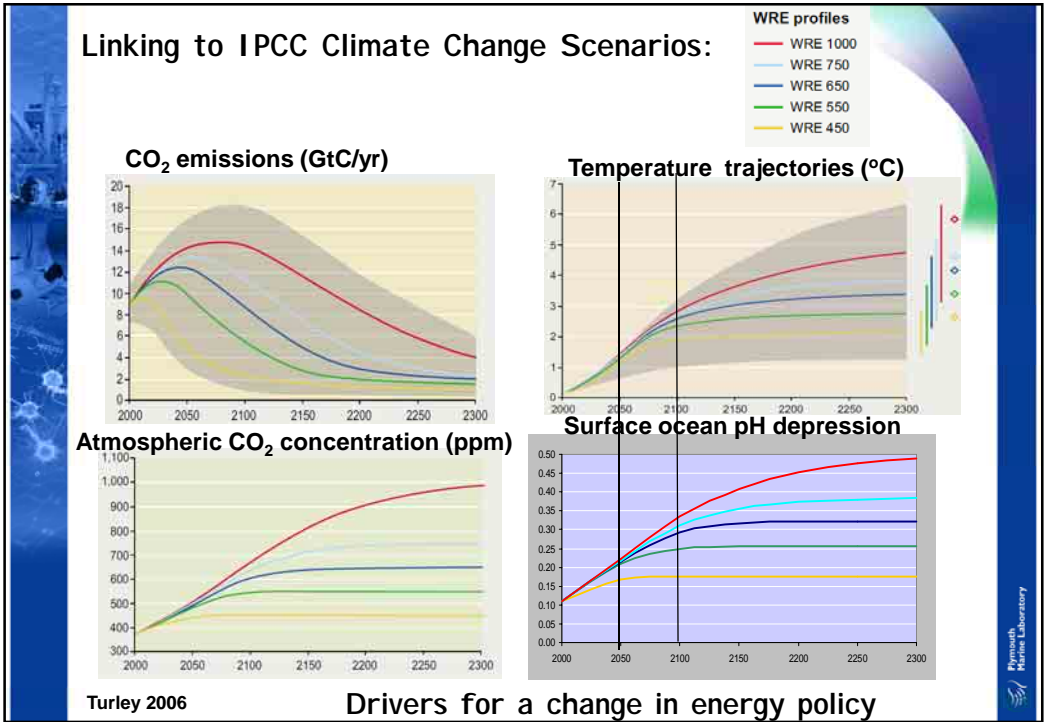
Shelf Sea Model Predictions: Annual mean surface pH (Blackford & Gilbert 2007)

Concern for Many Marine Organisms and Ecosystems



➤ We have the advantage of very photogenic material to get the message over





For example - Multiple Impacts of Climate Change and Ocean Acidification on Arctic Waters

2040 = Aragonite undersaturation
2070 = Calcite undersaturation

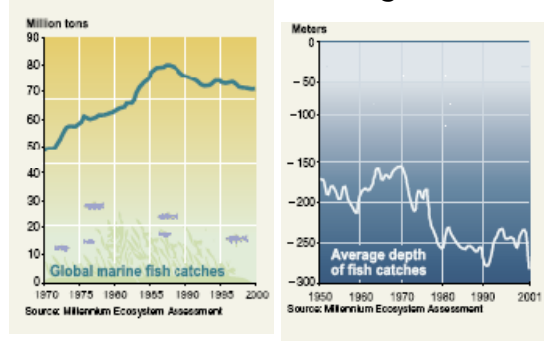
Projected Arctic Ice Melt due to Warming

2030 2060 2090

+ Ocean warming

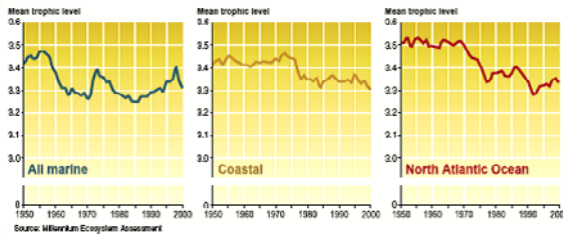
- Same time, same place
- Does this mean triple trouble for the Arctic Ecosystem?

Relevance to Services to Humans: Food Provision Declining Due to Over Fishing



Since the 1980's fish catch is decreasing despite:

- fishing deeper
- lower in the food web



What will be the added effect of :

- Climate Change
 - Ocean acidification
- on this ecosystem service?

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Human Dependence on Fish

Worldwide, fish provides 15-20% of the animal protein consumed by people

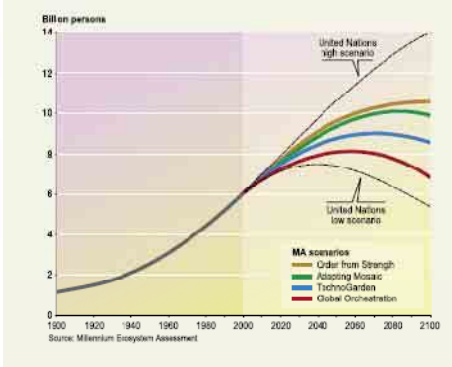
The twelve countries with the highest level of nutritional dependency on fish:

	Nutritional dependency Index
Maldives	100
Solomon Islands	95
Ghana	79
Comoros	73
Sierra Leone	72
Kiribati	72
Gambia	69
Indonesia	68
Sri Lanka	62
Sao Tome and Principe	60
Bangladesh	58
Seychelles	56

26 of the 30 countries most dependent on fish as a protein source are in the developing world

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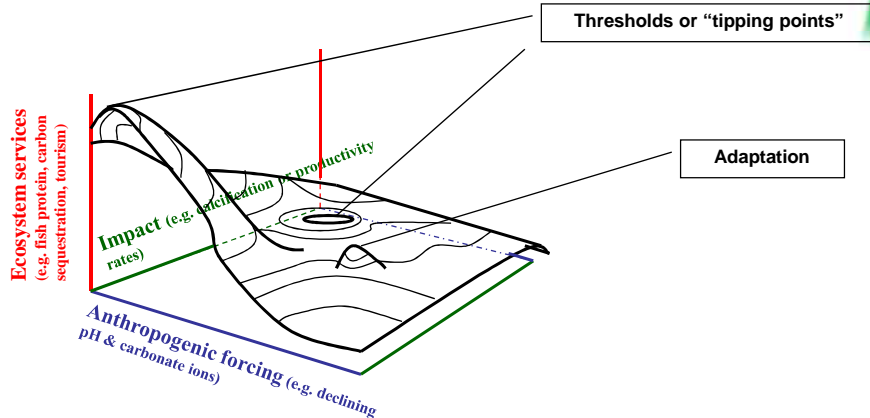
Human Population is Increasing - the Challenge is to Live Sustainably on a Planet Under Environmental Pressure from Many Sources



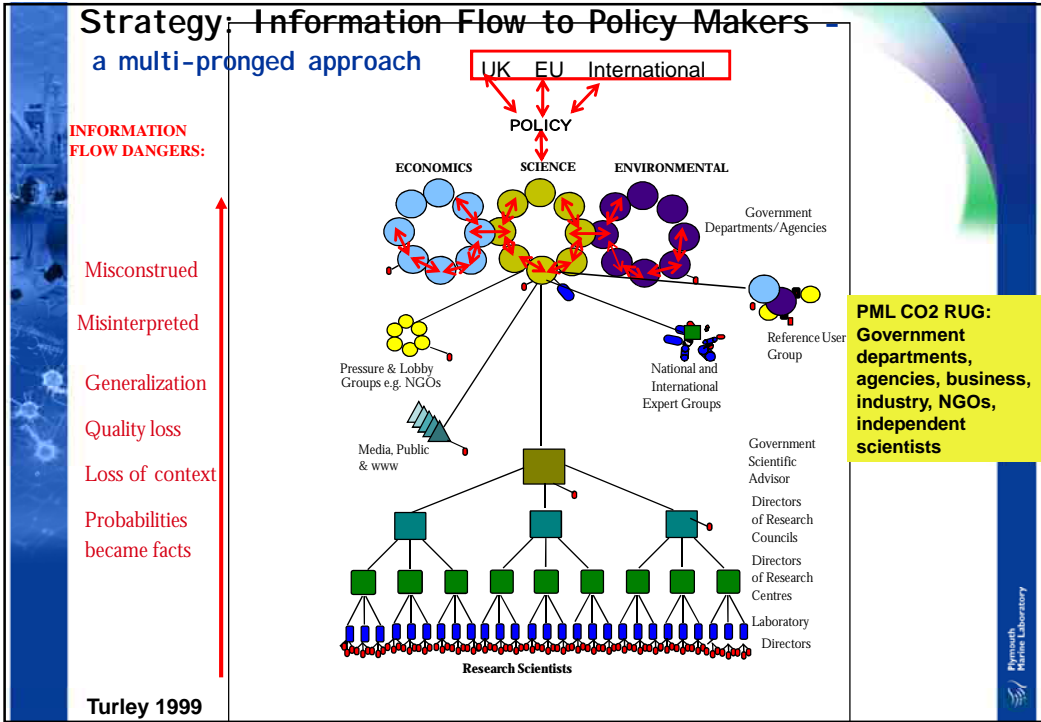
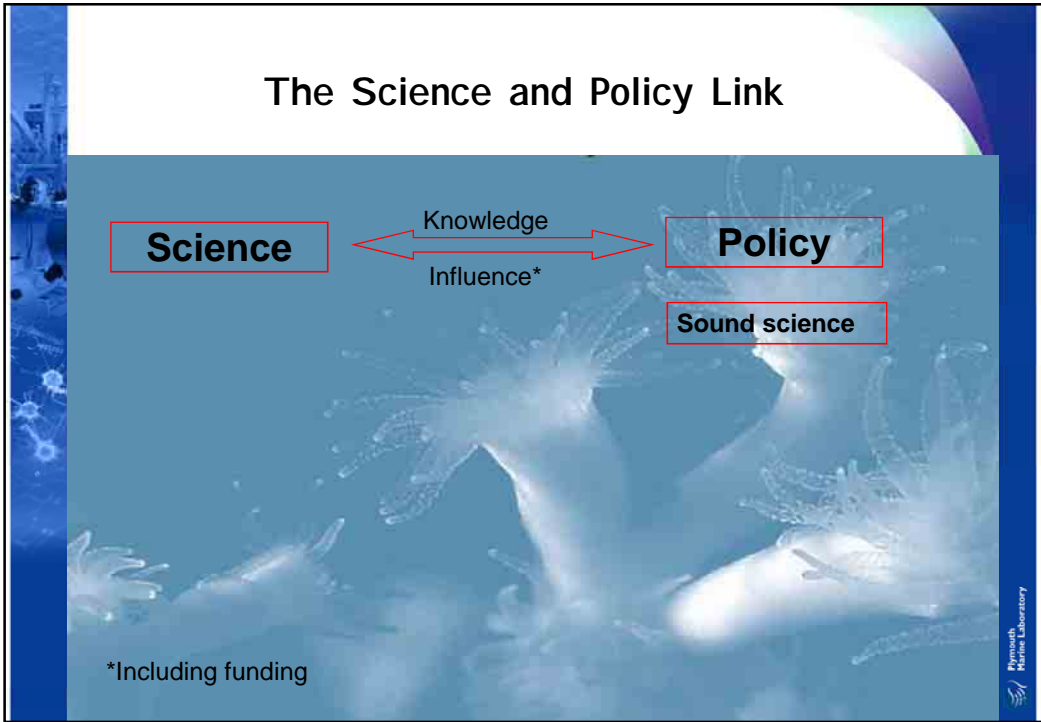
2000 = c. 6 billion

2040 = c. 9 billion

Anthropogenic Forcing, Impact on Processes and the Provision of Ecosystem Services



All of these are interconnected so we need to know these relationships and the "tipping point" and possible adaptations

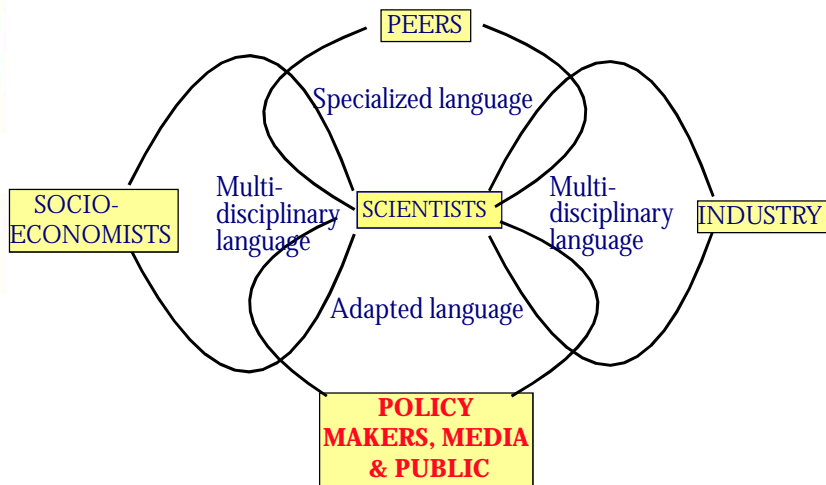


Involving the User Community in the Science

The PML Reference User Group (RUG) for High CO₂:

- **Government Depts:** DEFRA, DTI, SE
- **Government Agencies:** EN/NE, EA, UKCIP, SNH
- **Industry:** BP
- **NGOs:** WWF, Greenpeace, E3G
- **Europe:** EEA
- **Independents:** BGS, The Royal Society
- **Chair:** Dan Laffoley - Natural England & IUCN WCPA

Taking the Science to Stakeholders: Getting the Language Right



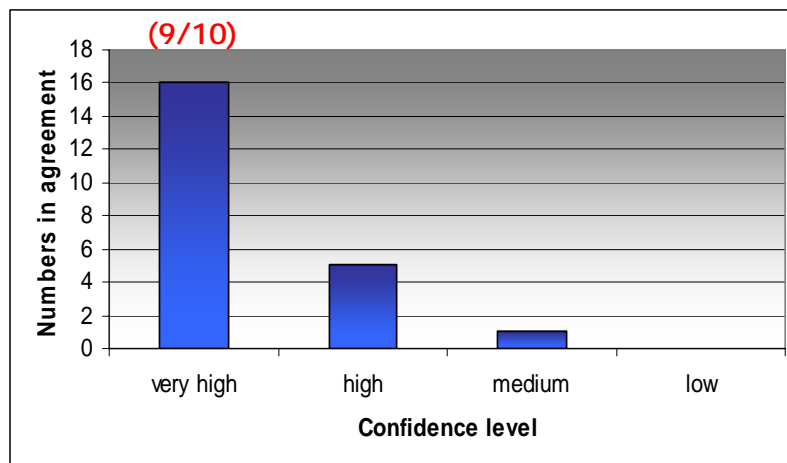
Learning the Climate Change Policy Language: How certain are we in the statements we make using the following confidence levels?

Terminology	Degrees of Confidence in Being Correct
Very High Confidence	9 out of 10 chance of being correct
High Confidence	~8 out of 10 chance
Medium Confidence	~5 out of 10 chance
Low Confidence	~2 out of 10 chance

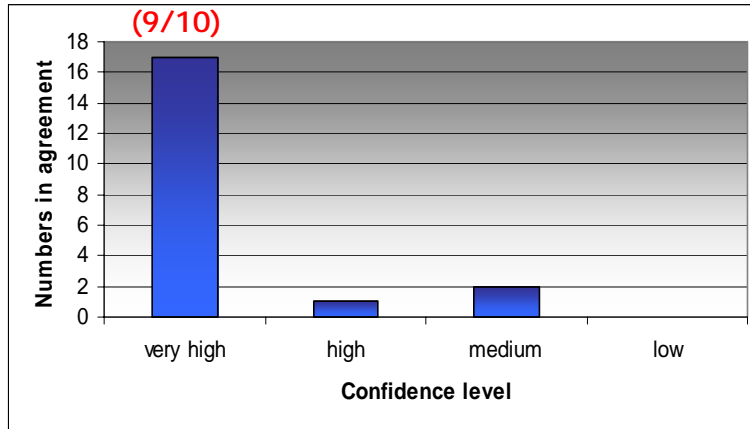
During an ocean acidification expert workshop participants were able to mark the confidence level they placed on key statements. The following are the results:

Expert Agreement on Level of Certainty - No Ambiguity

"Ocean acidification will impact a wide range of planktonic and shallow benthic marine organisms especially those using aragonite to make their shells or skeletons (e.g. pteropods, corals)."



Statement 4: "Substantial reduction of CO₂ emissions is the only method of reducing impacts from ocean acidification."



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Scientists Getting the Message to Stakeholders - a concerted international effort



The Power of Reports!

Interest and uptake by:

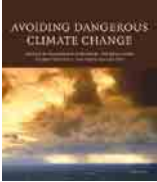
- National and International Research Funders
- International Agencies (IWC, WWF, EEA)
- National Governments
- United Nations Framework on Climate Change
- Intergovernmental Organisations (IGBP, SCOR, IOC, G8, Montreal Protocol, OSPAR & London Conventions)
- Intergovernmental Panel on Climate Change FAR
- Non-governmental organisations
- EU-FP7
- Media

Government policy makers and funders listening now we need to get them investing

IGBP-SCOR Fast Track Initiative "Ocean Acidification"

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Engaging the Climate Change Policy Community



Avoiding Dangerous Climate Change

Presentation at the **ADCC** Symposium at the Met Office, Exeter 1-2 February 2005 + Publication



United Nations Framework Convention on Climate Change

Presentation at **UNFCCC** Twenty-Second Sessions of the Subsidiary Bodies and seminar of governmental experts, Bonn May 2005

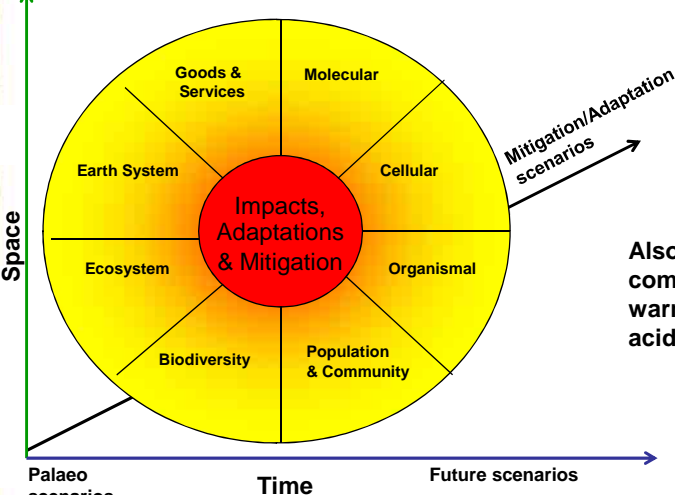
New IPCC report in 2007 – will help drive new framework on climate change i.e. post Kyoto.
Ocean acidification included for the first time and made it through to the IPCC Synthesis Report



INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
WMO UNEP

Scales of Impact, their Adaptation and Mitigation

There will be an increasing demand for deeper understanding of the impact of different mitigation options and adaptation possibilities over a wide range of temporal and spatial scales



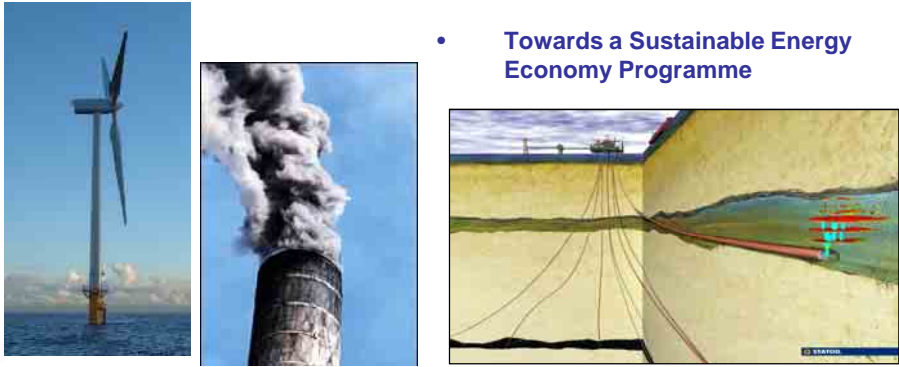


Also need to consider combined impacts of warmer and more acidic oceans

Engaging the Energy Community

Climate change and ocean acidification key drivers for change in energy policy

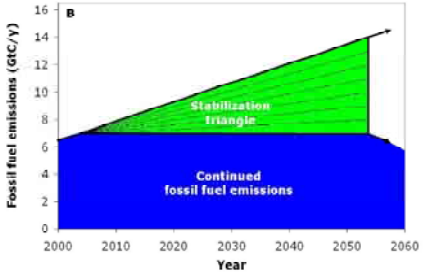
- UK Energy Research Council
- EPSRC Energy Programme
- UKRC 2007 SR bid on Energy
- Towards a Sustainable Energy Economy Programme



OSPAR Commission
for the Protection of the Marine Environment
of the North-East Atlantic

UN International Maritime Organization
LONDON CONVENTION 1972

Evidence presented to the **London Convention** and to **OSPAR** from 2004-2006 on acidification due to high atmospheric CO₂ **helped influence laws restricting CCS** – CCS now legal from 2007



Year	Continued fossil fuel emissions (GtC/y)	Stabilization path (GtC/y)
2000	6.5	6.5
2010	7.5	7.5
2020	8.5	6.5
2030	9.5	6.5
2040	10.5	6.5
2050	11.5	6.5
2060	14.0	6.5

no single approach to mitigating man-made contributions to climate change.

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Input into the Stern Report on Economic of Climate Change

- **Compelling evidence of climate change**

It will impact water, food, health and environment. **Ocean acidification recognised as an important issue**

- **Consequence of “Business as Usual” disastrous**

By 2050 200 million people will be impacted and could cost 1/5th of the World’s wealth to manage

- **The sooner we act the less costly it will be**

We have a 10 year window of opportunity for action

- **Action must be an international framework for urgent and substantial CO₂ reduction (to 550 ppm CO₂)**

- **New era of politics for the environment**

Will require a cultural and economic change otherwise we leave a dreadful legacy for the next generations.



www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm

Working with Government Departments...



Dti: request for information on CCS (via OSPAR & London Convention), presentations



Defra: requests for information on CCS and OA (Marine and Global Atmosphere Divisions), presentations, report on research needs



Marine Climate Change Impacts Partnership

Annual Report Card December 2006:
section on ocean acidification supplied by PML - www.mccip.org.uk/arc

GECC (Global Environmental Change Committee): presentation, report, questionnaire on research needs 2006

"CO₂ Emissions Could Violate EPA Ocean-Quality Standards Within Decades"

- In a commentary in the September 25, 2007, issue of the *Geophysical Research Letters*
- By a large team of international scientists lead by Ken Caldeira
- State that human-induced carbon dioxide (CO₂) emissions will alter ocean chemistry to the point where it will violate U.S. Environmental Protection Agency Quality Criteria [1976] by mid-century if emissions are not dramatically curtailed now
- This is the **first recognition** that atmospheric CO₂ emissions will cause ocean waters to **violate EPA water quality criteria**

Working and Informing UK Government.....

Government initiatives as part of the UK Presidency of the EU and G8

Evidence to Government reviews, enquiries and committees, Government Ministers, MPs and Civil Servants

Publication in *Science in Parliament*

Work with a range of Government departments and agencies

House of Commons Exhibition and Receptions:

"Climate Change and the Oceans - An exhibition on Marine Science and Ocean Acidification"



PH. SP. 02. 04. Picture by Ruthanna Hamel / April 01 02 2007. A visitor walks past Plymouth Marine Laboratory's CO₂ exhibition at the House of Commons in London.

Lessons: Working with Policy Makers

- They use **evidence based** approach to sound policy making: don't over egg it!
- Openly recognise the **unknowns** and **uncertainties**
- Be **honest** and admit when asked about topics outside your experience and refer them
- Be aware that each organization can have its own **vested interest** and has certain legislative duties to meet
- **Independence** and **integrity** are essential and appreciated



Lessons: Working with Policy Makers

- Keep them **informed** of new developments (e.g. new scientific findings, media focus) so that they can be prepared
- Build a relationship of **mutual trust**
- Using a **multi-organisational approach**- remember different stakeholders talk to each other
- Sit on committees and give **advice**
- Ensure **support** of your institute, lab and colleagues



Informing & Influencing Research Funders..... through lobbying and contributing to their strategies



UK: **New NERC Strategy: 2007-2012 - Next Generation Science for Planet Earth - Ocean Acidification a key priority**



EU FP7: Call on December 2006 - Ocean acidification mentioned throughout the first call with a request for a **specific consortium on ocean acidification**.
EPOCA = 105 PIs from 30 laboratories located in 10 countries, coordinated by Jean-Pierre Gattuso



US: An Ocean Acidification Research Bill Introduced in the US Senate by Senator Frank Lautenberg that would establish an interagency committee to **establish an ocean acidification program within the National Oceanic and Atmospheric Administration**

Other countries doing similar - Germany, Norway, Ireland

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The IGBP Network



IMBER, SOLAS & PAGES both promote research into ocean acidification

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Public Understanding – Media, Articles & Art

- Summer 2004: **Press Releases** from IGBP, NOAA, PML and The Royal Society - Some take up by Radio and Broadsheets
- **Reports** in 2005/6 stimulated large media uptake
- **BBC1 Climate Chaos Series** “Are We Changing Our Planet” starring David Attenborough 2006
- **Major articles** in New Scientist, New Yorker, New Statesman, The Marine Scientist in 2005/6
- Numerous articles in the broadsheets and **TV, radio, newspaper** interviews – UK and internationally
- 34 Google **News** hits between 27 Dec 2007 and 23 Jan 2008
- **Children's and university books** on climate change
- Take up by **Artists**



Lessons: Dealing with the Media!

- Policy makers are **responsive** to media pressure
- The media get to more people than you can – **high impact** (but short memory!)
- Realise it can take **time and effort** to do it well e.g. BBC Newsnight team filmed for a day
- Ask them for a **list of questions**
- Create **visual and verbal imagery** that will be remembered
- Offer to **read drafts**
- **Overcome the fear** of saying the wrong thing (but try not to!) or being misquoted
- Don't let them put words in your mouth. **Don't be bullied!**

On-line Events and the WWW.

Many useful web sites - distributed at this meeting



- Live World Ocean **Web Caste** on SOA 13 November 2006
 - 14-18 yr olds from around the world
 - Presentations by experts
 - Q & A
 - Text dialogue
- <http://www.thew2o-events.net/oa.php>

Google search hits on "ocean acidification":

October 2003 =	17
June 2006 =	267,000
February 2007 =	326,000
August 2007 =	356,000

Key Policy Questions for the Future:

- Are there detectable impacts already?
- Can organisms/ecosystems adapt or acclimatise to such rapid future changes?
- What are the feedbacks to Planet Earth?
- What will ocean ecosystems look like in the future?
- How is this going to affect humans?
- What can be done about it?
- What are the certainties and uncertainties?
- What level of pH change is dangerous?
- Are there important "tipping points" in ocean acidification that could be important in the CO₂ emission mitigation discussions?
- What level of emissions mitigation have acceptable impacts?

These questions go beyond our current knowledge – we need a substantial international investment in research to address them

Sunset Over an Ocean with Man's Footprint Now Detectable - Warmer, More Acidic, Less Diverse and Over Exploited

Oceans will become more acidic - high certainty.

The only way of reducing the impact of ocean acidification is a substantial and urgent reduction in CO₂ emissions - high certainty.

It is a key driver for a change in energy policy.

The level of certainty and potential impacts should be a strong driver in climate change mitigation policy negotiations.

We need to ensure that these messages get delivered to the right people & organisations at the right time.