Climate change: “empirical data”.. and more!
Adjunct Professor Colin Butler

Environmental Health: More than a checklist
Envtl Health Australia NSW Conference
Port MacQuarrie, Sept 7, 2016
Health Research Inst, Univ. of Canberra, Visiting Fellow NCEPH, ANU
The future of global health - consequences of global environmental changes
Empirical evidence: experiential acquired by means of senses, particularly observation and experimentation.

From Greek for experience, ἐμπειρία (empeiría)

In contrast to theories – which in science, are evidence-based..

Senator Malcom Roberts
Prof Brian Cox, holding a graph showing empirical (observed) data
John Tyndall, 1859

water vapour, carbon dioxide, methane reduce heat loss, oxygen, nitrogen virtually transparent to heat.

without these, Earth .. "held fast in the iron grip of frost."
Empirical observation: marsh gas traps heat –

Theory:

“greenhouse” gases warm Earth.
if greenhouse gases increases, so will global temperature
if Earth heats, sea level will rise
if atmosphere warms rainfall events will intensify

Ample empirical evidence for these

if climate change >2 degrees then highly dangerous for society

Limited empirical evidence as yet; case mounting
Most radiation absorbed by Earth, warming it

Some energy is radiated back into space as infrared waves

Feedback - additional GHGs

Some outgoing infrared radiation trapped by atmosphere, warming it

Aerosols: net cooling effect
Greenhouse gases

\( \text{CH}_4 \quad \text{N}_2\text{O} \quad \text{CO}_2 \)

\( \text{CO}_2 \) also wetlands, tundra, biomass burning, deforestation

\( \text{CH}_4 \) wetlands, rice, tundra

Slide adapted from one courtesy Prof Steffen Loft, University of Copenhagen, Denmark
Empirical evidence
Flooding of Coast, Caused by Global Warming, Has Already Begun

Scientists’ warnings that the rise of the sea would eventually imperil the United States’ coastline are no longer theoretical.

By JUSTIN GILLES | SEPT. 3, 2016
Big coastal cities sink faster than seas rise


ruins of Fort Proctor partly submerged in “Lake” Borgne, east of New Orleans, La.
CO$_2$ has not been this high in >half a million years.
Climate change, more than “empirical data”

Physical effects
Heat    Floods and fires
The carbon budget    Sea level rise
Other extreme events

Health effects:
“Primary”, “Secondary”, “Tertiary”

What can you do?

Conclusion
Rahmstorf, from NASA data
Year-to-Date Global Temperature
for 2016 and the other seven warmest years on record
July 30, 2015 “heat dome”

stepping outside like “walking into a fire,” said Zainab Guman, a 26-year-old university student who lives in Basra. “It’s like everything on your body — your skin, your eyes, your nose — starts to burn,” she said.

Global Warming Cited as Wildfires Increase in Fragile Boreal Forest

Scientists say the near-destruction of Fort McMurray last week by a wildfire is the latest indication that the vital boreal forest is at risk from climate change.

By JUSTIN GILLIS and HENRY FOUNTAIN  MAY 30, 2016
fire tornado images
Fort McMurray flooding a 'bad dream' after wildfire

'It's just not our year,' city councillor says after flooding damages homes that escaped wildfire

By Zoe Todd, CBC News  Posted: Aug 01, 2016 6:00 AM MT  |  Last Updated: Aug 01, 2016 8:15 AM MT

Torrential downpours flooded areas of Fort McMurray, Alta., on the weekend, prompting the Regional Municipality of Wood Buffalo to reopen its emergency operations centre. (Derek Walker/Facebook)
Forget Tornadoes. Rain Bombs Are Coming for Your Town

Climate change is weaponizing the atmosphere.

July 29, 2016
a microburst in Phoenix, AZ, USA July 2016
Observed U.S. Trend in Heavy Precipitation

Baseline: 1901-1960

Louisiana warns that flooding may not be over: 'There's nothing comparable to this'

> 20k Louisiana residents rescued from their homes; 12k currently in shelters in the wake of historic, devastating flash flooding

Flooding in Louisiana, USA, August 2016

Climate change, "empirical data" .. And more!

The carbon budget

July 2016  L-OTI(°C) Anomaly vs 1951-1980  0.83
Carbon budget: 1 trillion tones:
to have at least 66% chance of limiting global temperature increases to < 2°C

already emitted 2/3rds of this

Vulnerable carbon sinks

\[ NDC = \text{Nationally determined contribution} \]
Queensland's mangrove ecosystem dying in secret

The proverbial canary in the coal mine of the Queensland ecosystems went off months ago and we missed the calls.

There have been large scale diebacks of mangrove trees in the Gulf of Carpentaria for months and scientist have only just noticed as they are in the most remote areas of Queensland.
Climate change, “empirical data” .. And more!

Physical effects

Sea level rise

July 2016  L-OTI(°C) Anomaly vs 1951-1980  0.83
Greenland Melt Extent 2016

http://nsidc.org/greenland-today/

26 Aug 2016
Fort Lauderdale, Miami, Florida

Credits: Dave/Flickr Creative Commons/CC BY 2.0
Flooding is becoming a “normal” nuisance in Miami, as the sea inexorably rises

Photo by Joe Raedle/Getty Images
A house in Norfolk, Va., that has been repeatedly hit by tidal floods sat on temporary supports as workers prepared to elevate it permanently in June. Credit Eliot Dudik for The New York Times Sept 2016

Water from a tidal stretch of the Potomac River flooded Old Town Alexandria in Virginia during high tides in early June, 2016 Credit Gabriella Demczuk for The New York Times
At the City Market in Charleston, S.C., one of the most popular spots in town, shoppers dodged seawater that bubbled up from storm drains during high tide in June, 2016. Credit Hunter McRae for The New York Times

“We’re putting enough heat in the ocean to send water over us, no question,” Dr. Stoddard said. “Ultimately, we give up and we leave. That’s how the story ends.”
Mar-a-Lago, Palm Beach, Florida
Projected flood days per year on Trump-branded properties

Mar-a-lago Club
Palm Beach

2016 - 210

Trump Hollywood
Hollywood

2016 - 200

Trump International
Beach Resort
Sunny Isles Beach

2016 - 140

Trump National Golf
Club
Jupiter

2016 - 97

2016 - 65

Climate Change and Global Health

Edited by Colin D. Butler
Health effects of eco-climate-social stress

primary

Heat waves, fewer cold waves, injuries, floods, fires
Australia: Getting Hotter
from: CSIRO/BoM State of the Climate, March 2010

No. of record hot days [max temperature] at Australian climate reference stations, 1960-2009

Average number of record hot days per year, by decade

No. of record hot days

Data source: Bureau of Meteorology
Mean Daily Land Surface Temperature (LST) in the Melbourne Metropolitan Area by 2006 Postcode Area

Day-time

Night-time

‘Heat Island” Effect:
Melbourne, Australia
Heatwave, Jan 2009

From: M Loughnan, Monash University
Heatwaves, Illness Events and Mortality

Melbourne, Australia, 2009

28-30 Jan: > 43°C

60% increase, Jan 29-30, in ambulance call-outs
126 out-of-hospital deaths (vs. 44 expected deaths)

Elderly at most risk: vulnerable to exacerbation of chronic illness?

Ambulance attendances for heat-related illnesses in Metropolitan Melbourne: 19 Jan – 1 Feb, 2009
Super Typhoon Haiyan approaching the Philippines on Nov 7, 2013. Credit: EUMETSAT (Wide-angle satellite image)
Typhoon Haiyan, Tacloban, The Philippines
Strongest recorded storm to make landfall
Direct death toll: >5,000
Displaced: >4 million
Total Burden of Disease?
Fraction attributable to climate change?
A woman, who survived the typhoon by climbing up a steep hill, stands beside her temporary home. “I’m scared living here. When the tide comes up here, I’m very nervous that my house will be destroyed,” she said.

Photograph: Eleanor Farmer/Oxfam
Super typhoons becoming more powerful and more frequent, new study finds

Peter Hannam  Sept 6, 2016

Typhoon Chan-hom (2015)
Infectious diseases, especially vector borne, allergies, air pollutants, infrastructure
Climate and Infectious Disease

• Climatic conditions set the geographic and seasonal boundaries of potential transmission.

• Other environmental, social and behavioural factors – and public health strategies – determine where/when actual transmission occurs.
Mosquitoes established in Lhasa city, Tibet, China

3650m
(13,000 feet)
Dengue’s principal vector: *Aedes aegypti*

**Effects of Temperature Rise on Dengue Transmission**
- Faster *viral* incubation in mosquito
- Shorter *mosquito* breeding cycle
- Increased *mosquito* feeding frequency
Areas suitable for **dengue transmission** in 2100 under 4 climate change scenarios (grey = ≥50% likelihood of transmission)

Bambrick et al., 2009, *Global Hlth Action*

- 1. Hot & Dry
- 2. Hot, Median humidity
- 3. Hot & Wet
- 4. Warm (strong mitigation)

Map-projection of changes to rainfall across Australia to 2100 under ‘dry’ and ‘wet’ scenarios.

Using evidence from published literature, modelled how these changes would affect dengue distribution over space and time.
Flesh-eating Buruli ulcer cases soar as disease spreads to Melbourne

Chloe Booker
Bats (pteropid species) colonising urban environments
Habitat loss, new-habitat attraction, climate change
Potential source of many new viruses

Nipah, Ebola, Hendra, ...

D’Souza et al., 2003
Health effects of eco-climate-social stress

tertiary

famine, conflict, pop’n displacement, refugees, development failure
Climate change in the Fertile Crescent and implications of the recent Syrian drought

Colin P. Kelley\textsuperscript{a,1}, Shahrzad Mohtadi\textsuperscript{b}, Mark A. Cane\textsuperscript{c}, Richard Seager\textsuperscript{c}, and Yochanan Kushnir\textsuperscript{c}

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Edited by Brian John Hoskins, Imperial College London, London, United Kingdom, and approved January 30, 2015 (received for review November 16, 2014)
Damascus, 2014. Line for food aid from UN Relief and Works Agency in a great city - large parts of which have been destroyed by civil war, along with basic food supply infrastructure.
Climate change, conflict and health

“a risk multiplier”

Devin C Bowles¹, Colin D Butler² and Neil Morisetti

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Riots erupted on the Greek border with Macedonia on Monday after the Macedonian authorities sealed the frontier to prevent refugees from entering.

Louisa Gouliamaki/Agence France-Presse — Getty Images

Related:
Violence Erupts in Greece as Migrants Try to Cross Into Macedonia
Riots Erupt on Greek Border

After stranded migrants stormed a portion of Macedonia’s border with Greece, the police fired tear gas at them.

Louisa Gouliamaki/Agence France-Presse — Getty Images

Related:
Violence Erupts in Greece as Migrants Try to Cross Into Macedonia
Burden of Disease (proportion)

- PRIMARY (e.g. heat, injury, productivity)
- SECONDARY (e.g. vector-borne diseases, air pollution, allergies)
- TERTIARY: (a “systemic multiplier”) famine, conflict, large-scale migration, economic collapse

Year widely accepted

now

2050?
Climate change, more than “empirical data”

What can you do?
Individual

- Eat less meat
- Use more active transport
- Consider solar panels

Collective???

Increased coverage on Environmental health curriculum
Heat warnings, food safety
Position paper and join climate and health lobby groups

Most harm still in the future
Choice of Meat?
- Greenhouse gas (esp. methane) emissions
- Dietary fat content

**Tonnes of GHG emissions per head per year (CO₂ equivalents)**

- **KANGAROO**: 0.003
- **SHEEP**: 0.14
- **CATTLE**: 1.67

**Fat content per 100 gms of raw meat**

- **BEEF**: Lean fillet - 6.3g
- **LAMB**: Trimmed steak - 5.8g
- **CHICKEN**: Lean breast - 1.6g
- **KANGAROO**: Fillet or steak - 1.3g

Kangaroo is low in fat, including saturated fat, compared with other red meat and even chicken.

*New Scientist, Oct 9, 2010*
Climate change, more than "empirical data"
The far-sighted amongst you are anticipating broader global impacts on property, migration and political stability, as well as food and water security. … Past is not prologue … the catastrophic norms of the future can be seen in the tail risks of today.

Mark Carney, 2015
(Governor of the Bank of England)

Crisis = opportunity
Ingenuity in the Year without a summer (1816)
COST OF SILICON PHOTOVOLTAIC SOLAR CELLS
US$ PER WATT

$76.67

1977 TO 2014 PRICE DECLINE
$76.67 TO $0.36 = 99.5%

Solar is now cheaper than coal, says India energy minister (April, 2016)

Denman Prospect: The first Australian suburb with every home powered by solar

October 9, 2015

Emma Kelly
Canberra Times reporter

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The new suburb of Denman in Canberra Photo: Supplied

- Canberra Airport owners to deliver 2000 dwellings in new suburb of Denman
- Canberra’s newest suburb Denman takes shape
ADDICTED
TO DIRTY, CHEAP ENERGY

COAL MINING AND POWER GENERATION
There is a price to pay to maintain our habit
Burning coal releases dozens of toxic substances
Costly for our health and the environment
HEART DISEASE
LUNG CANCER
ASTHMA
STROKE
CLIMATE CHANGE

Coal addiction trades future health for short term gain

IT'S TIME TO QUIT NOW

Coal is a health hazard

make the switch TO CLEAN ENERGY

for more information, visit www.dea.org.au