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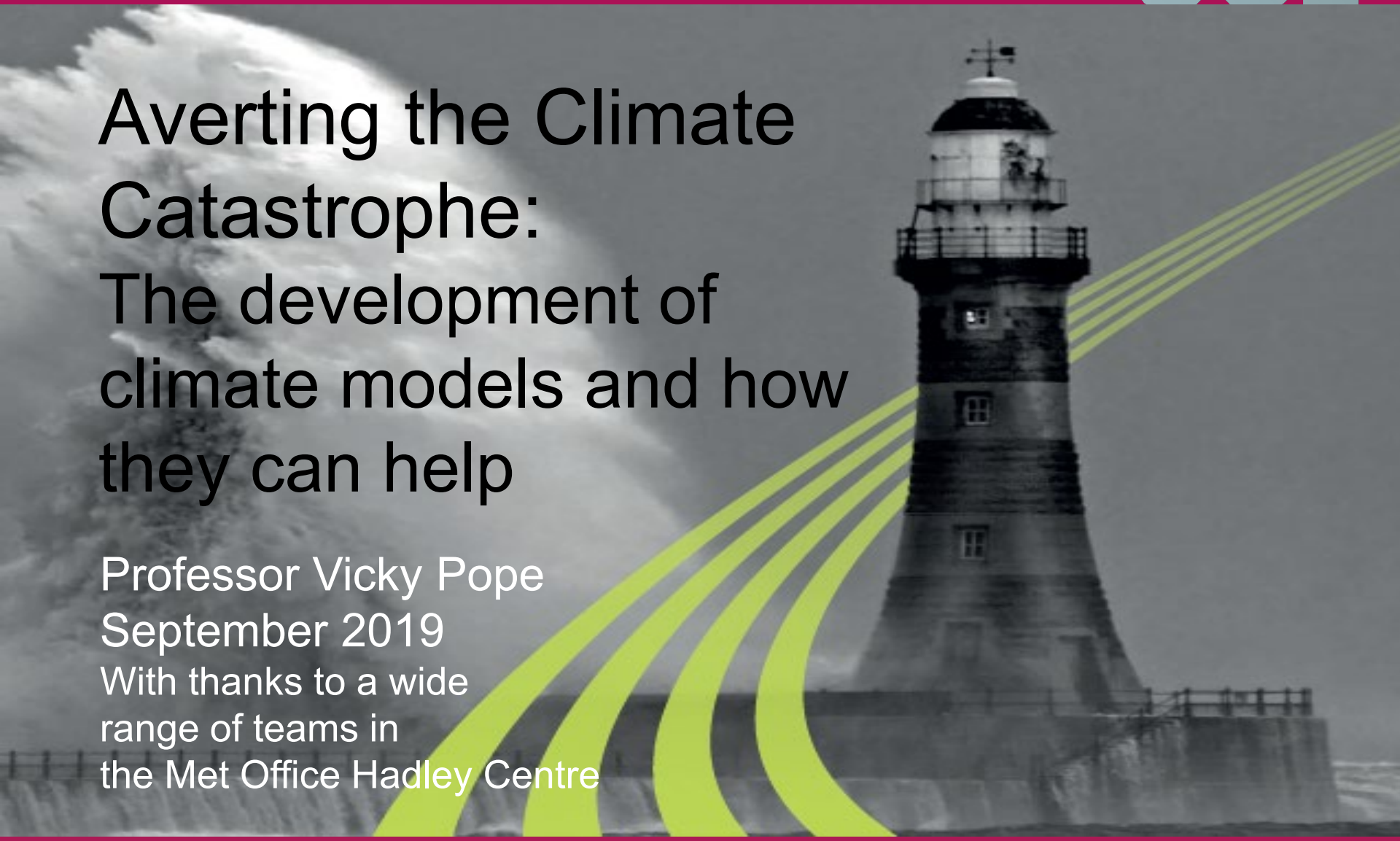


Averting the Climate Catastrophe:
The development of climate models and how they can help

Professor Vicky Pope

September 2019

With thanks to a wide range of teams in the Met Office Hadley Centre

Some types of extreme weather have become more frequent or more severe

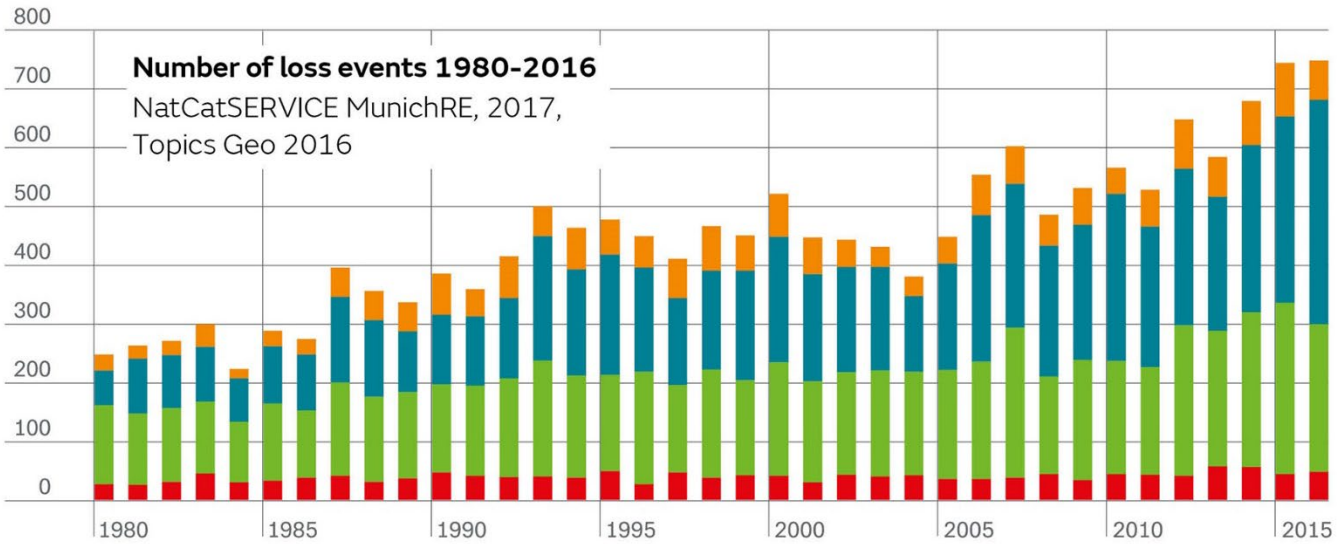


Image source: https://www.metoffice.gov.uk/binaries/content/assets/mohippo/pdf/climate/cop23/observed_changes_in_extremes_final_v1.0.pdf

Some types of extreme weather have become more frequent or mor

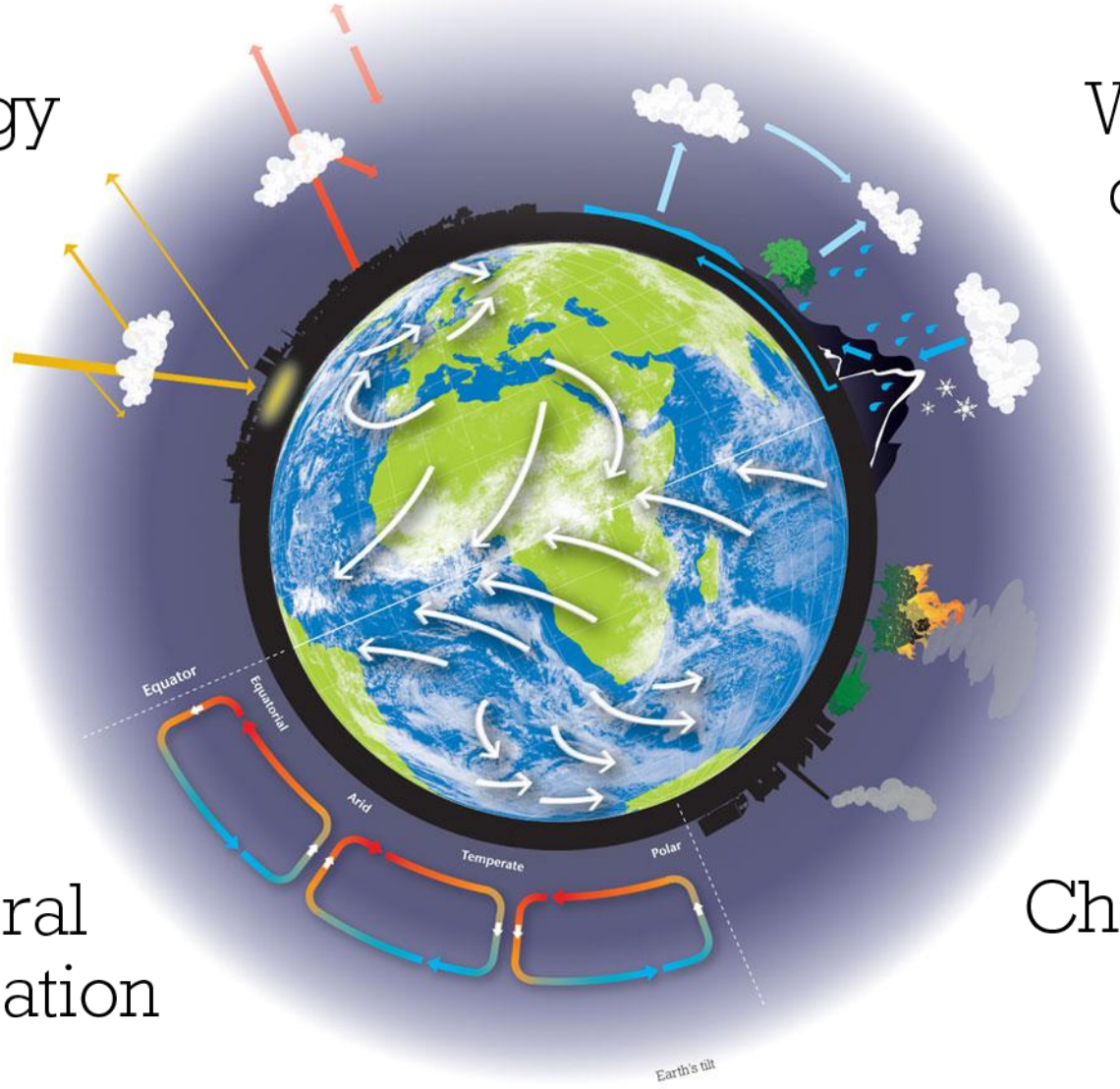
More than 60% of extreme events studied to date were made more likely or more severe by manmade climate change

Image source: https://www.metoffice.gov.uk/binaries/content/assets/mohippo/pdf/climate/cop23/observed_changes_in_extremes_final_v1.0.pdf

What drives the weather and climate?

Energy cycle

Water cycle



General circulation

Change

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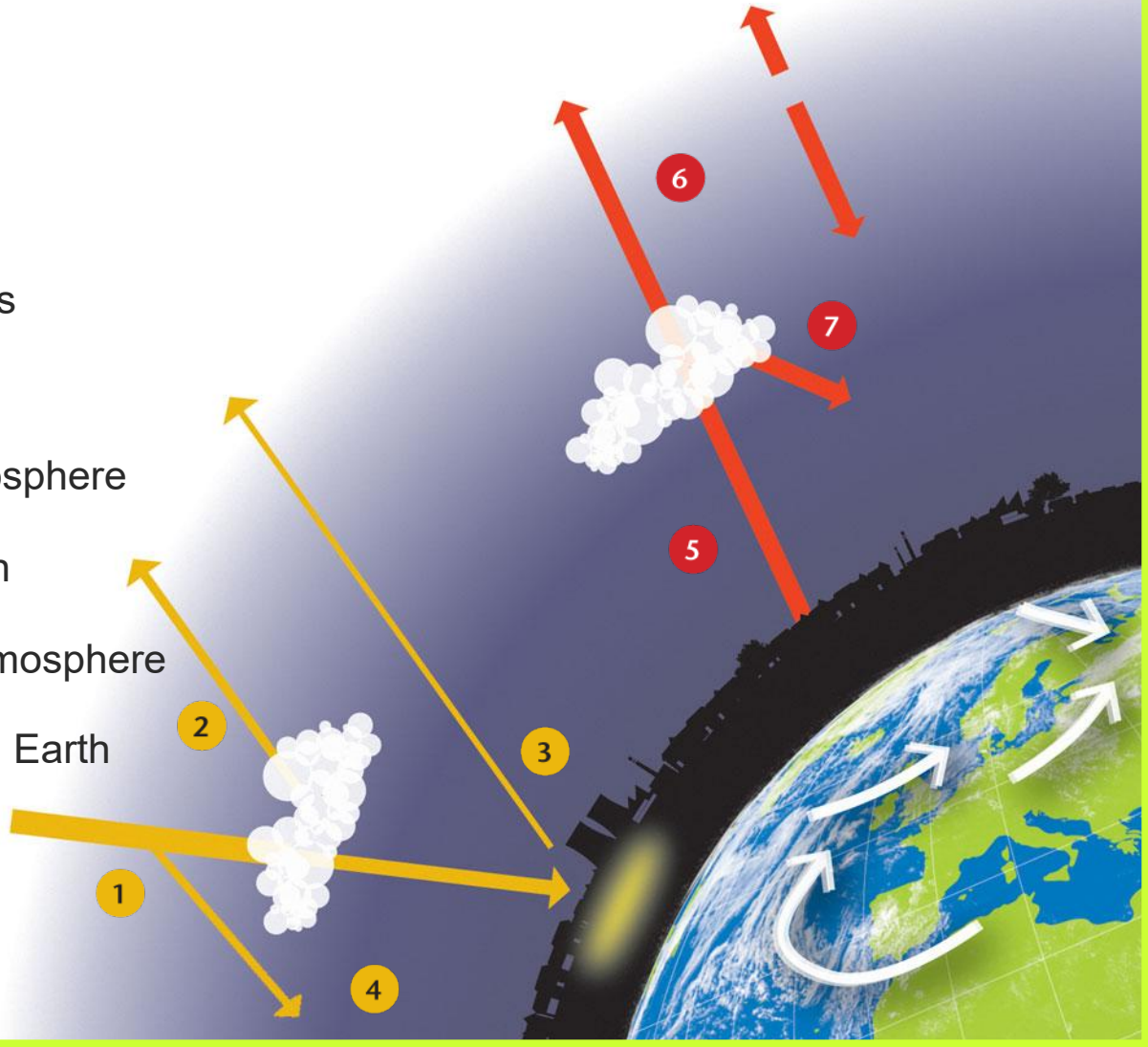
Energy from the sun drives Earth's climate

Energy cycle

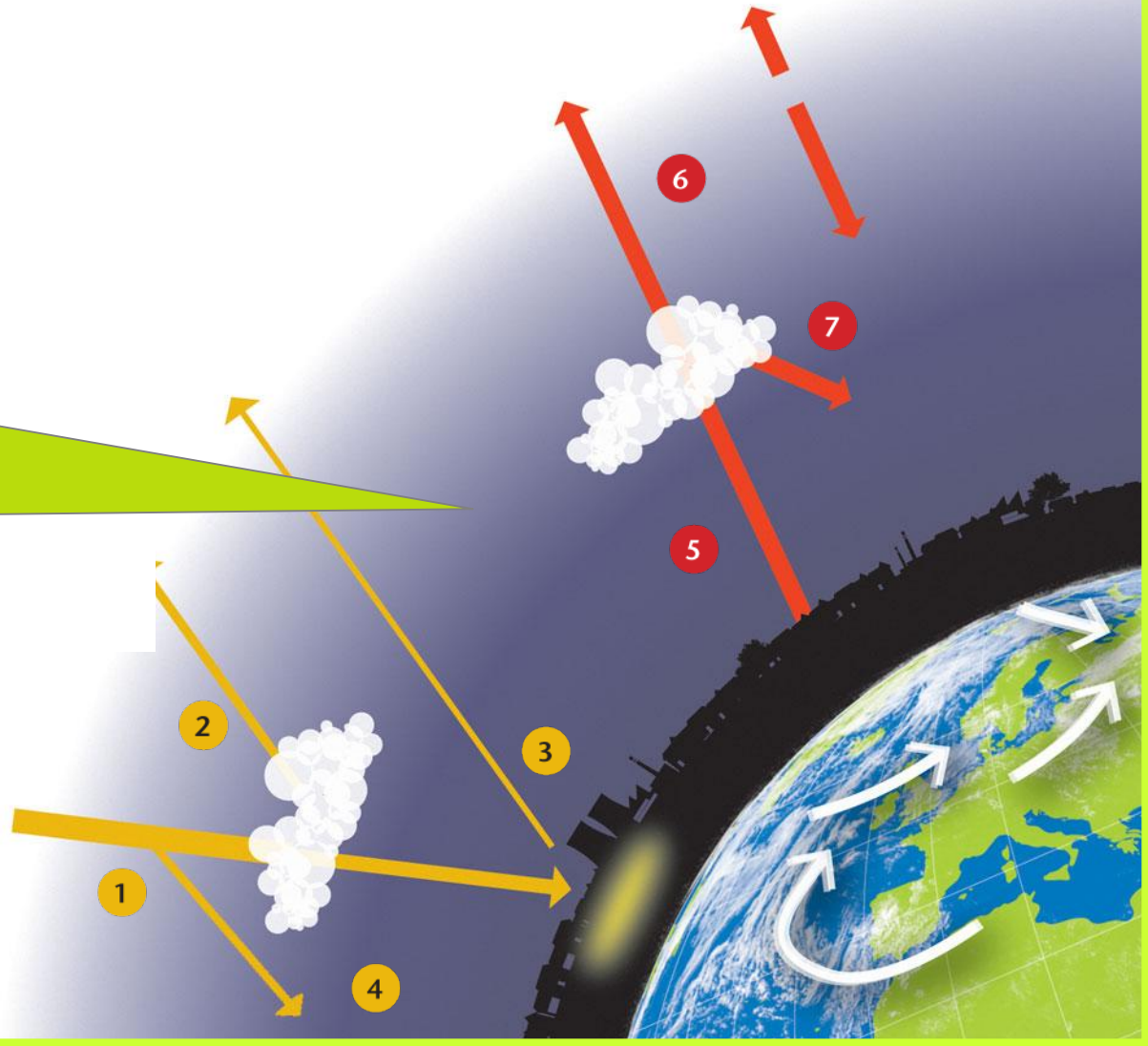
1. Incoming energy from the sun
2. Sun's energy reflected by clouds
3. Sun's energy reflected by Earth
4. Sun's energy absorbed by atmosphere
5. Heat energy radiated from Earth
6. Heat energy passes through atmosphere
7. Heat energy re-emitted to warm Earth



Energy from the sun drives Earth's climate

Energy cycle

Greenhouse gases
trap heat
Like a "duvet"
+15°C instead of -18°C



What drives the weather and climate?

Water cycle

1. Water evaporates from rivers lakes and the ocean
2. Water condenses to form clouds
3. Loss of water from plants, soil, animals and people
4. Water returns to land as precipitation
5. Water carried downhill by rivers
6. Water seeps into ground and flows to sea

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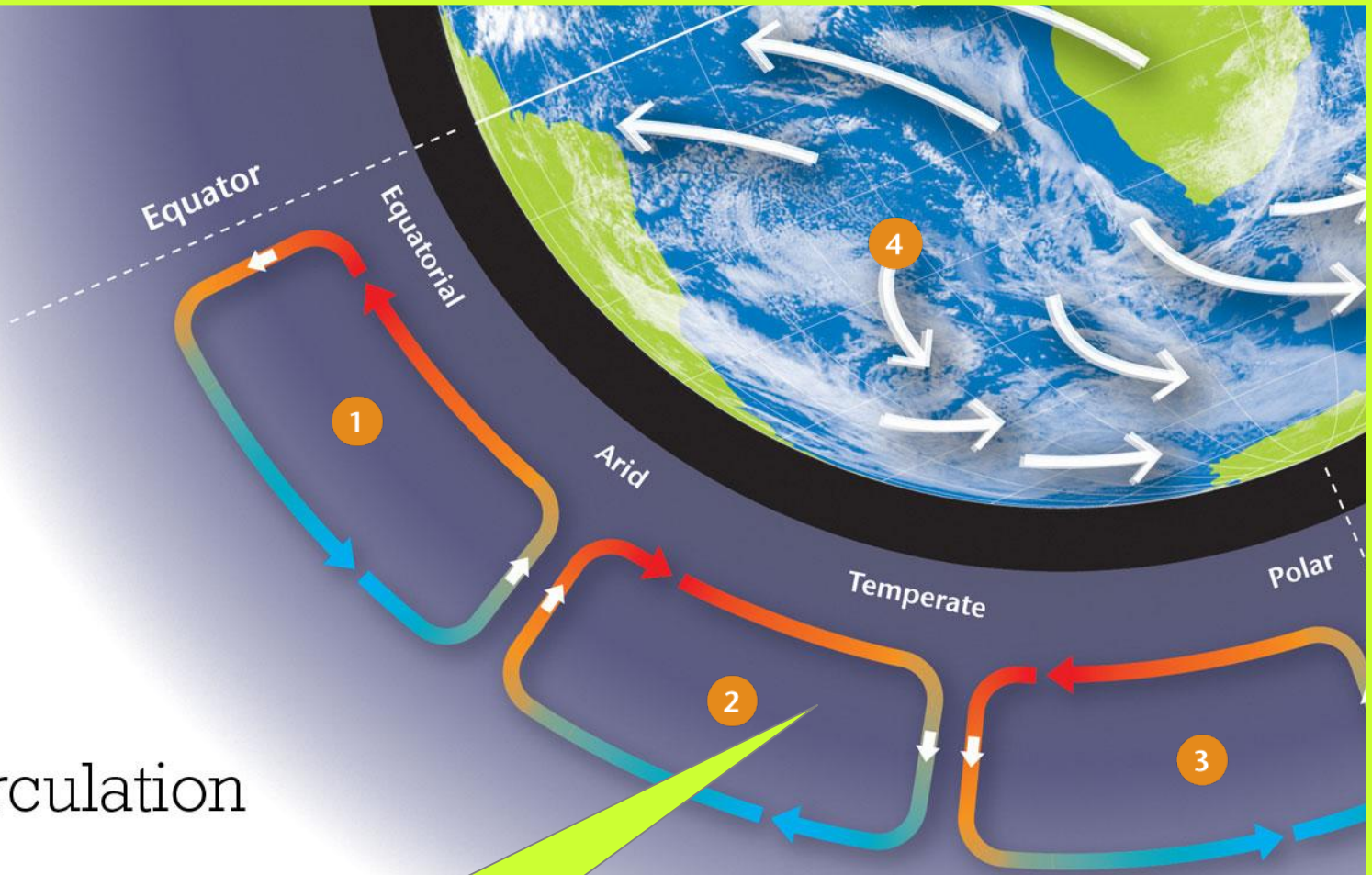


General circulation

1. Hadley cell
2. Ferrel cell
3. Polar cell
4. Trade winds

The movement of the air and the ocean rebalances heat across the globe

What drives the weather and climate?

One thing changes everything

Met Office MODEL IMPROVEMENTS – GC3.1 vs HadGEM2

More than doubled layers in the atmosphere to help capture more detail.

85

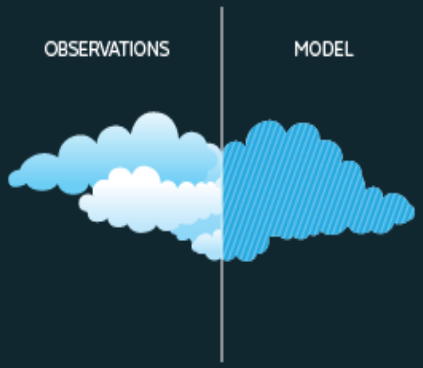
35

75

40

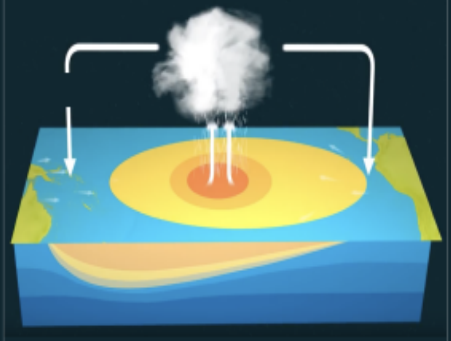
Layers in the ocean have almost doubled – helping to capture mixing between different levels.

New code simulates clouds, a major driver of global climate, more accurately than ever before.



Oceans are represented in 25x more detail – helping to capture ocean currents and eddies with greater accuracy.

Better representation of key natural cycles of variability – such as El Nino and La Nina.



Captures northern hemisphere jet stream more accurately – helping simulate storm tracks and regional climate.

New model simulates changes in ocean circulation under Antarctic ice shelves, preparing the way for more confident estimates of sea level rise

Better representation of variability in Arctic sea ice cover which is important for projecting change in regional climate.

For more information, see Williams, K.D. et al (2017): The Met Office Global Coupled Model 3.0 and 3.1 (GC3.0 and GC3.1) Configurations

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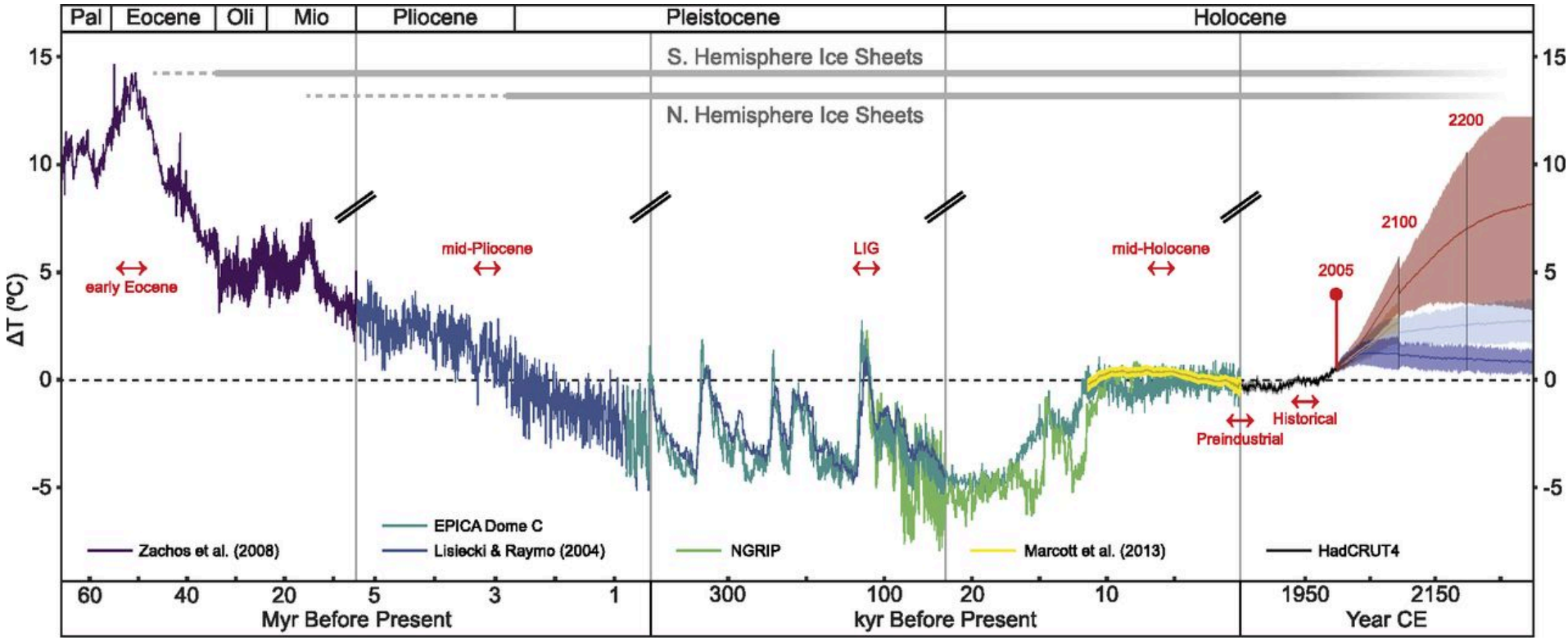
The future for climate

The future for climate: Is it like the past?



Pliocene and Eocene provide best analogs for nearfuture climates K. D. Burkea,1, J. W. Williamsb, M. A. Chandlerc,d, A. M. Haywoode, D. J. Luntf, and B. L. Otto-Bliesnerg
13288–13293 | PNAS | December 26, 2018 | vol. 115 | no. 52

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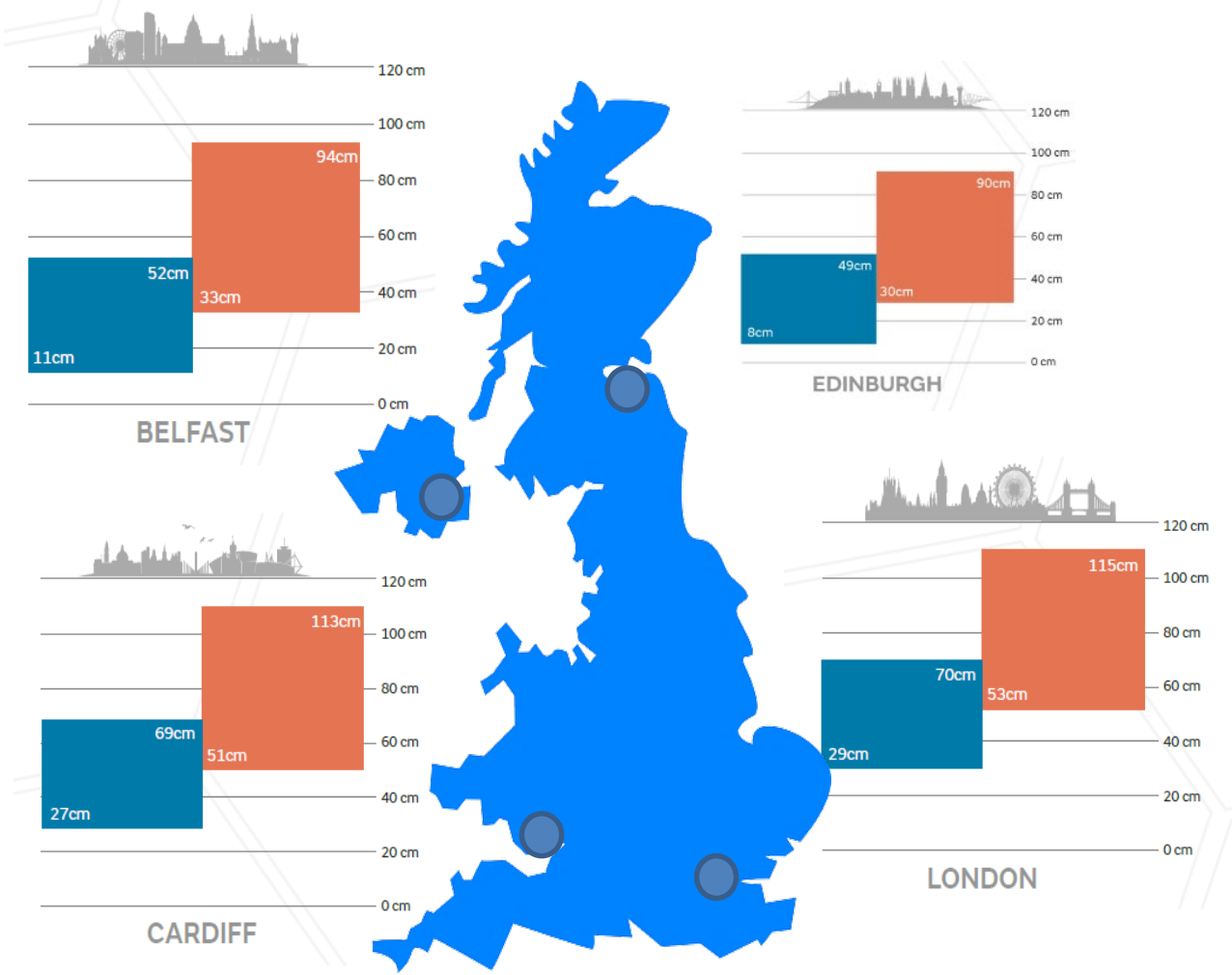
Sea-level rise

Increase will generally be greater in the south than in the north



(by 2100 relative to 1981-2000)

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Urgent action is needed to minimise risks from climate change

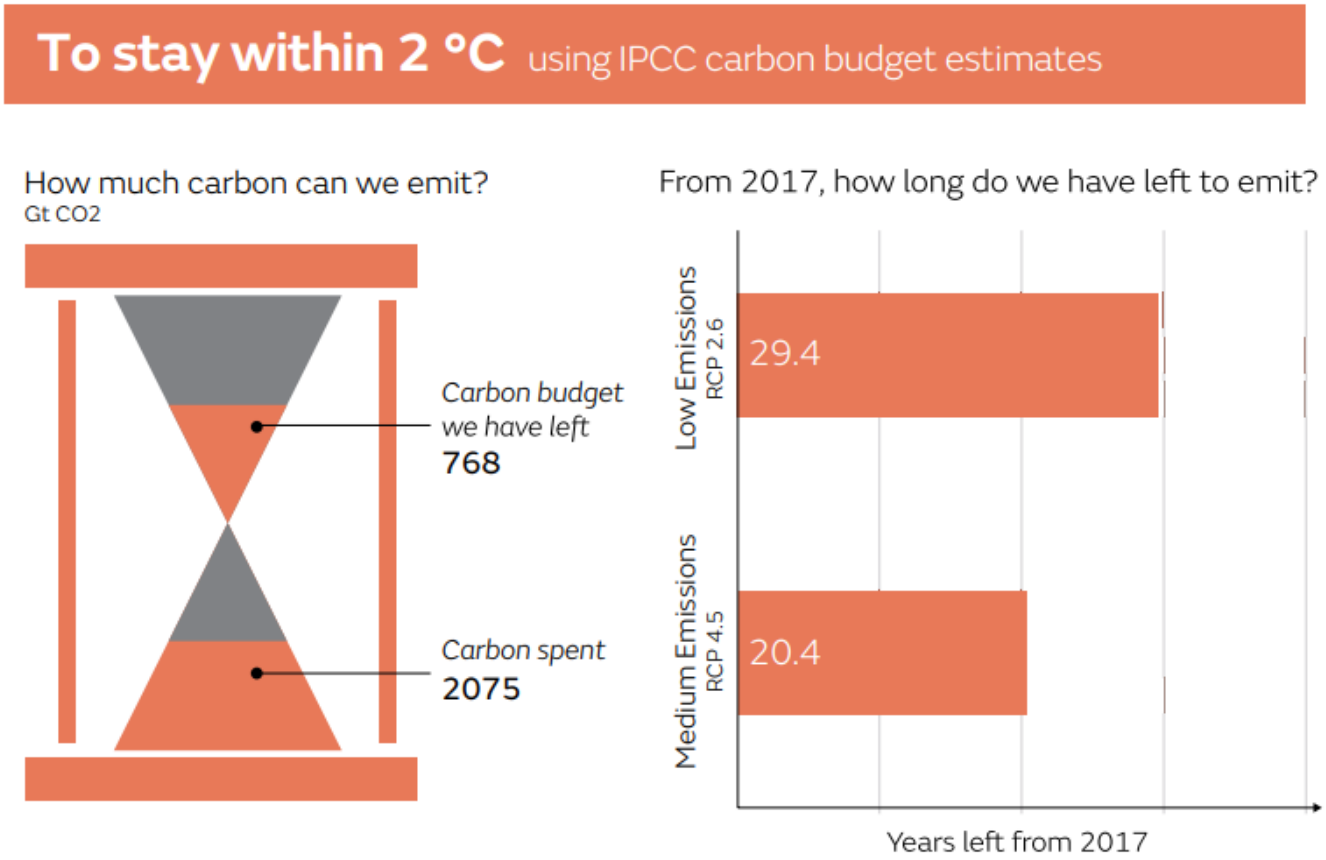
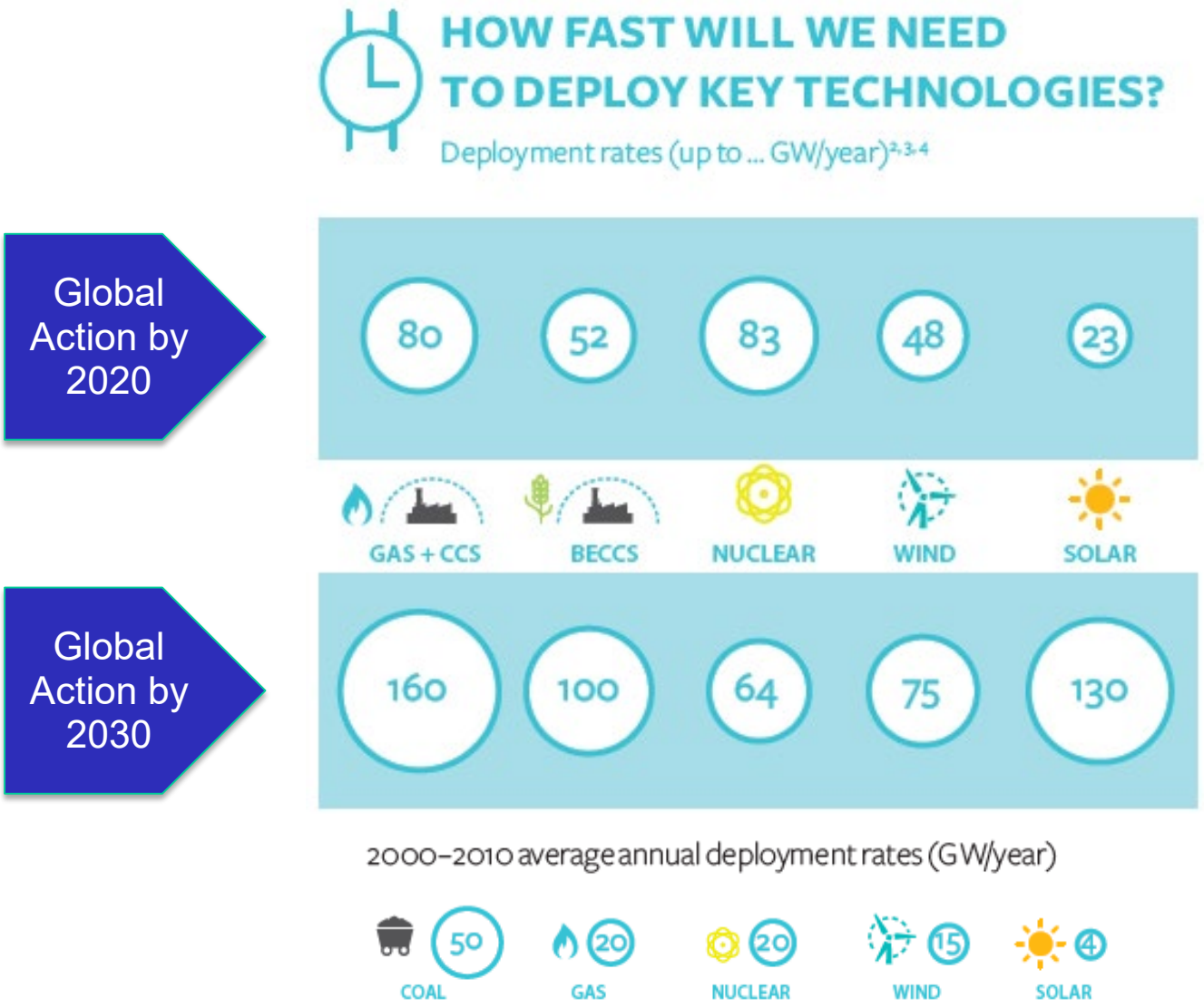


Image source: https://www.metoffice.gov.uk/binaries/content/assets/mohippo/pdf/climate/cop23/how-can-we-limit-warming-v4.pdf

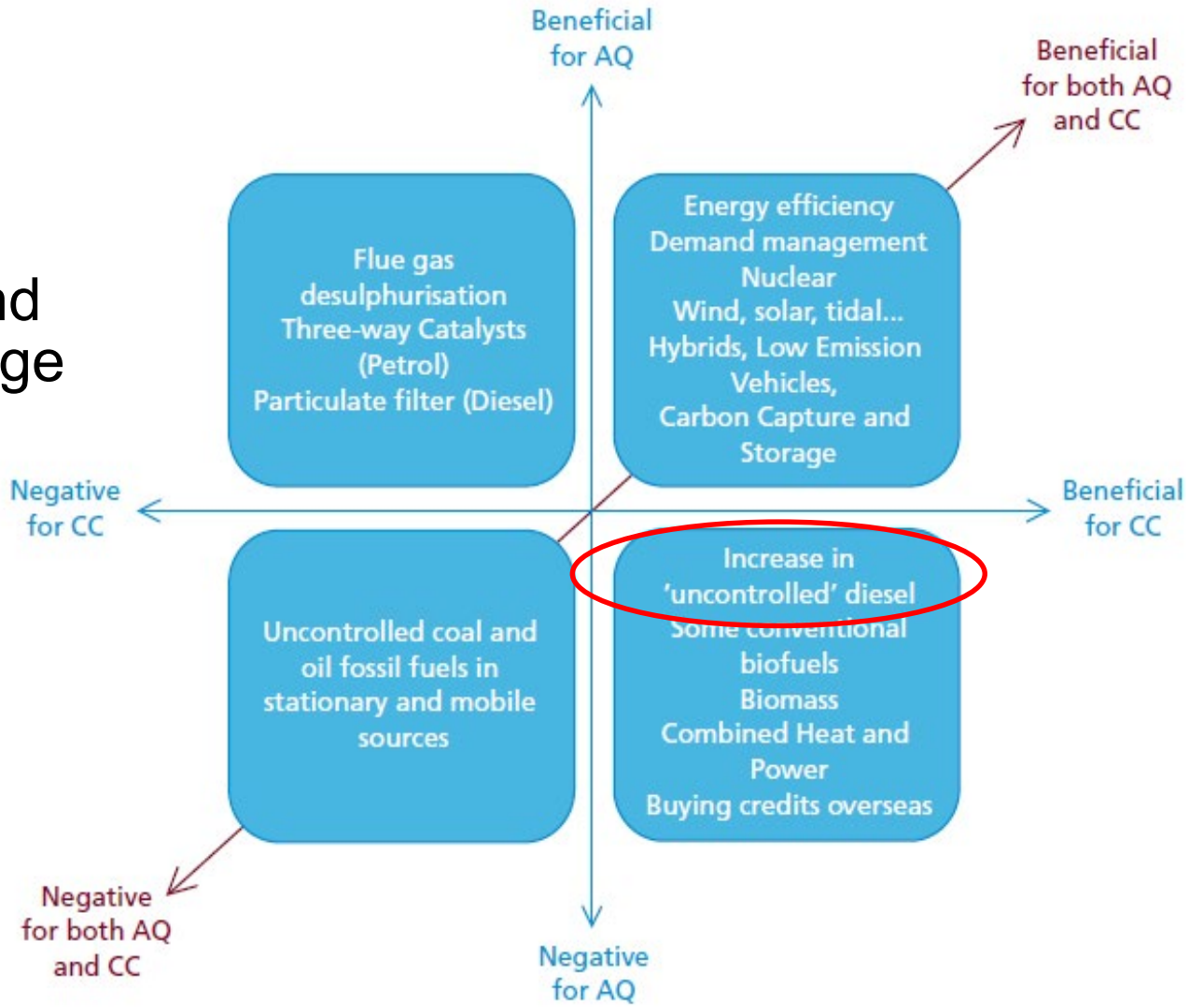
For 2°C, earlier action means less aggressive technology deployment



AVOID 2

Climate change is not the only problem

Air quality and climate change



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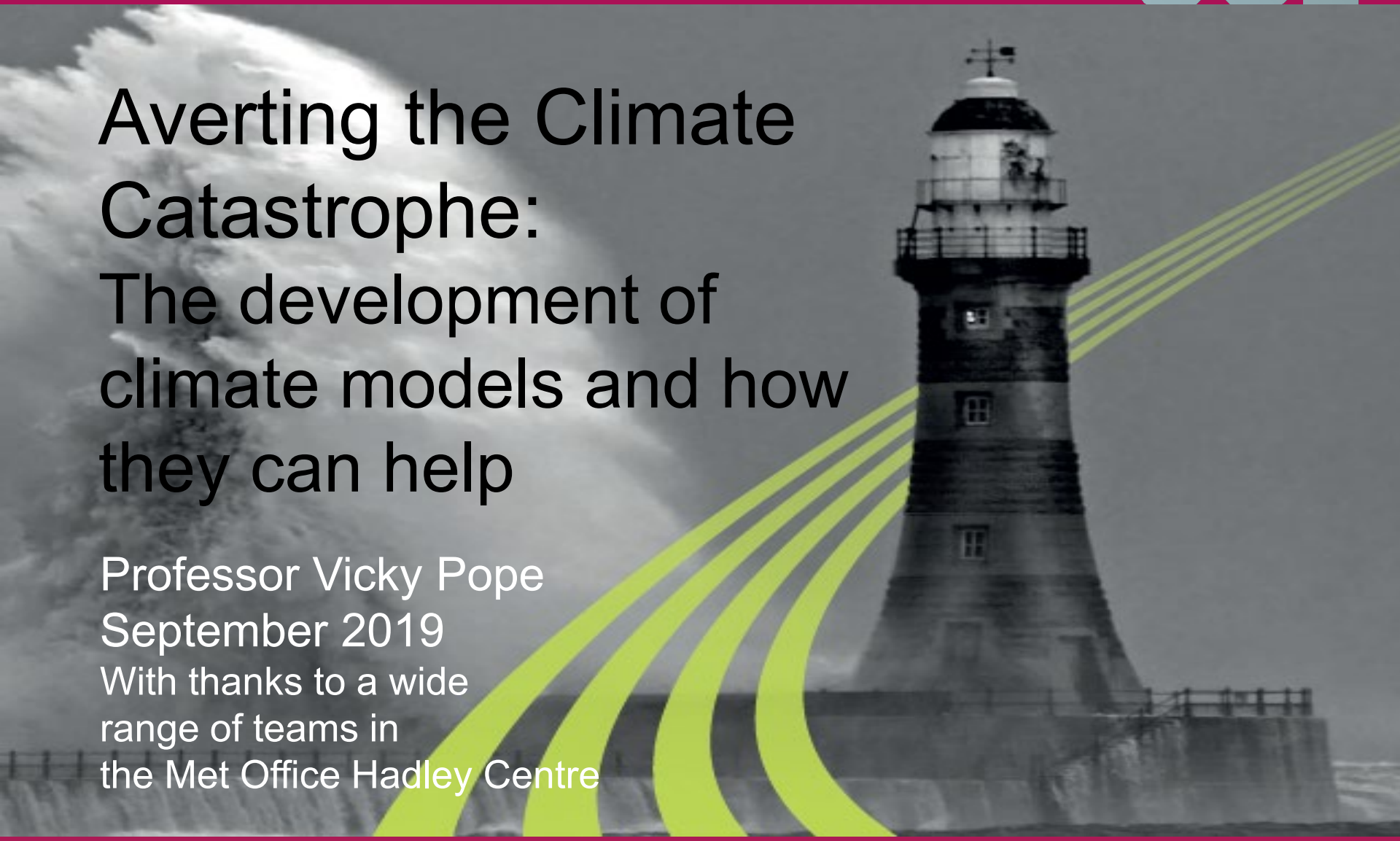

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