HOW TO ALIGN PORTFOLIOS WITH THE PARIS AGREEMENT?
WEBINAR – 6TH JULY 2022, 4PM CEST

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- **Presentation** (45mn)
  - Introduction (5mn)
  - How can we meet the Paris Climate Agreement targets? (20mn)
  - Aligning investment portfolios with the 1.5°C commitment (20mn)
- **Q&A** via Zoom Webinar tool (10-15mn)

FIRST POLLING QUESTION

Do you think that, if all investors were to invest in a Paris aligned way, we can stop global warming?

The answers to this questionnaire will allow TOBAM to have an overview of the market, no personal data will be reused for any other purpose

How can we meet the Paris Climate Agreement targets?

Dr. Philip Goodwin

Associate Professor of Earth System Dynamics

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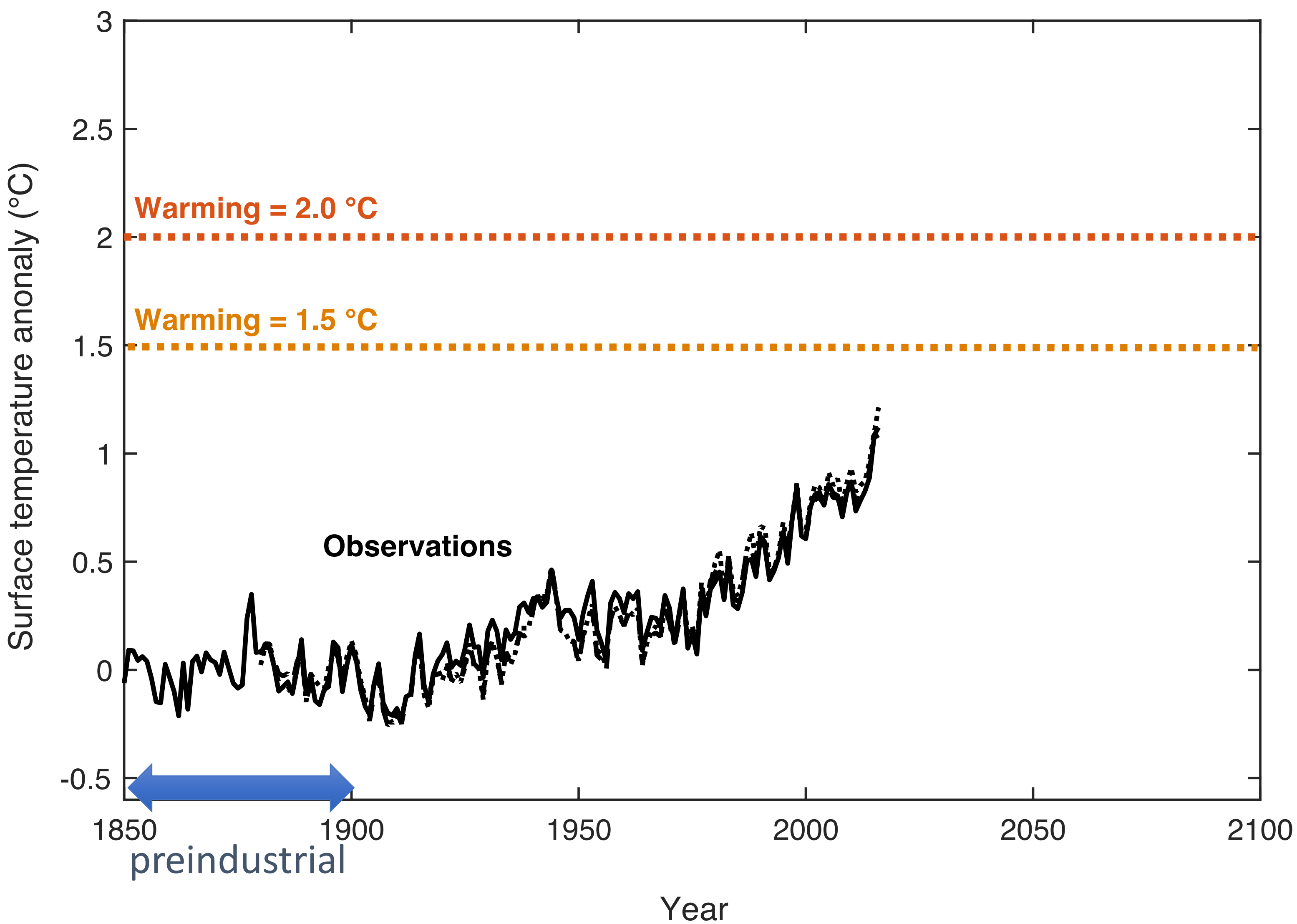
Paris Climate Agreement: *Climate targets*

The Paris Climate Agreement commits signatories to:

"Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change"

- ***So far ~ 1 °C of warming, and continuing***
- ***How might might the warming be kept < 2 °C, or < 1.5 °C?***
- ***Have to tackle carbon emissions, the leading cause of warming ...***

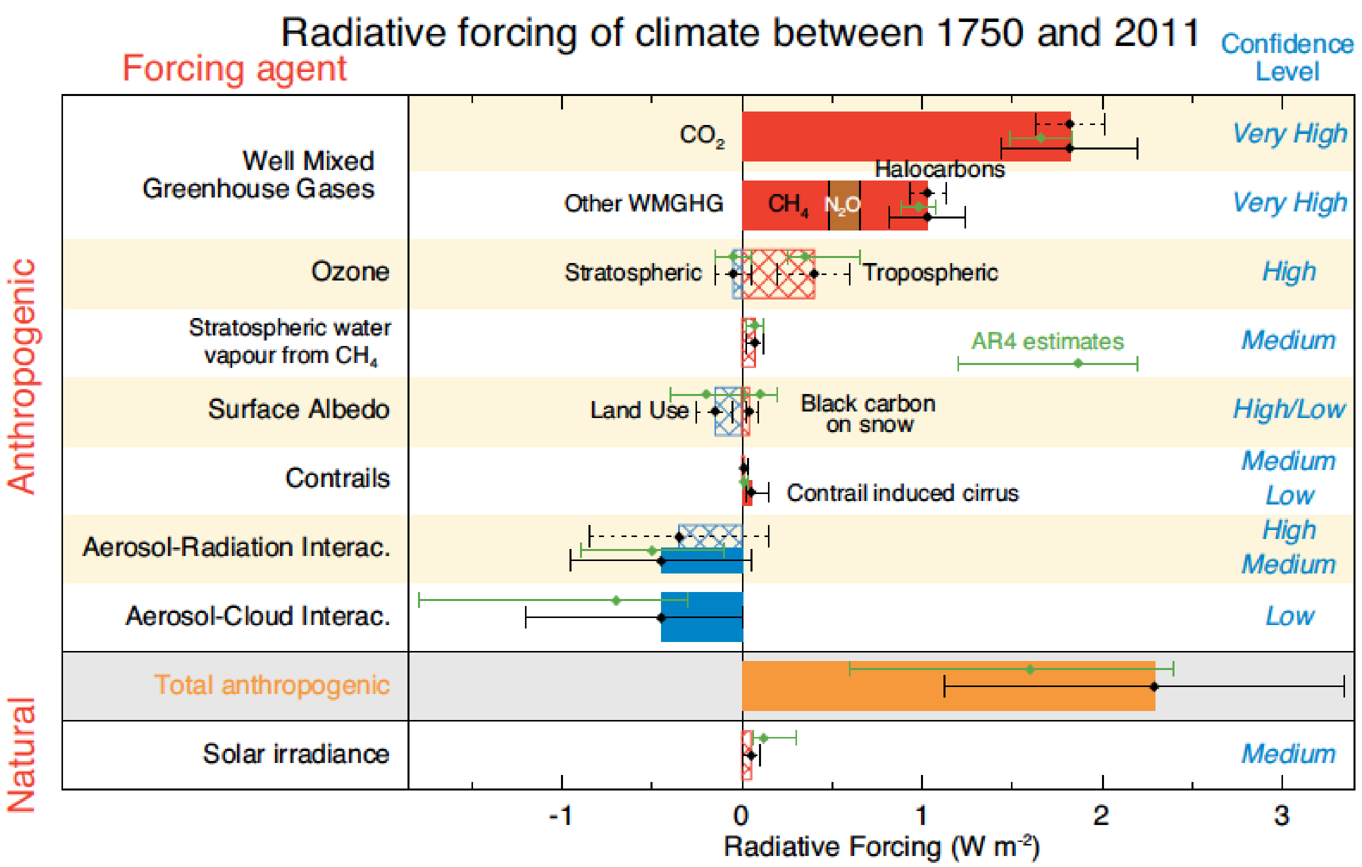
Climate change so far: *How much warming?*



- Shown are records for '***Global average surface temperature change***'
- Consider 1850 to 1900 average as 'preindustrial'

Heating Agents: *anthropogenic greenhouse forcing*

- Preindustrial CO_2 =280ppm, now ~ 415 ppm
- Carbon dioxide is the dominant anthropogenic warming agent
- Other greenhouse gases contribute
- Aerosols have a negative contribution (*highly uncertain*)

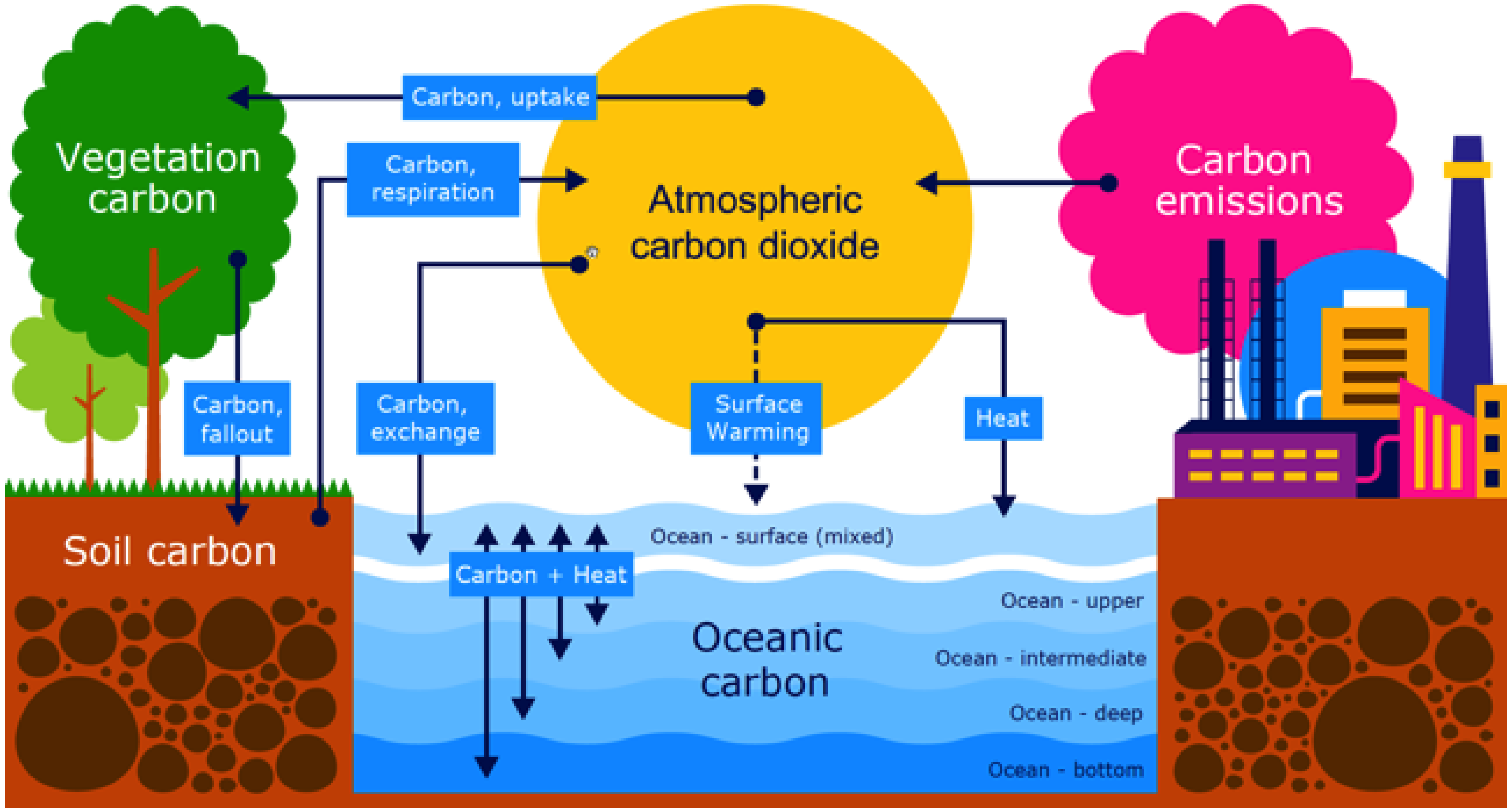


Radiative forcing, ***R*** (in Wm^{-2})

IPCC AR5

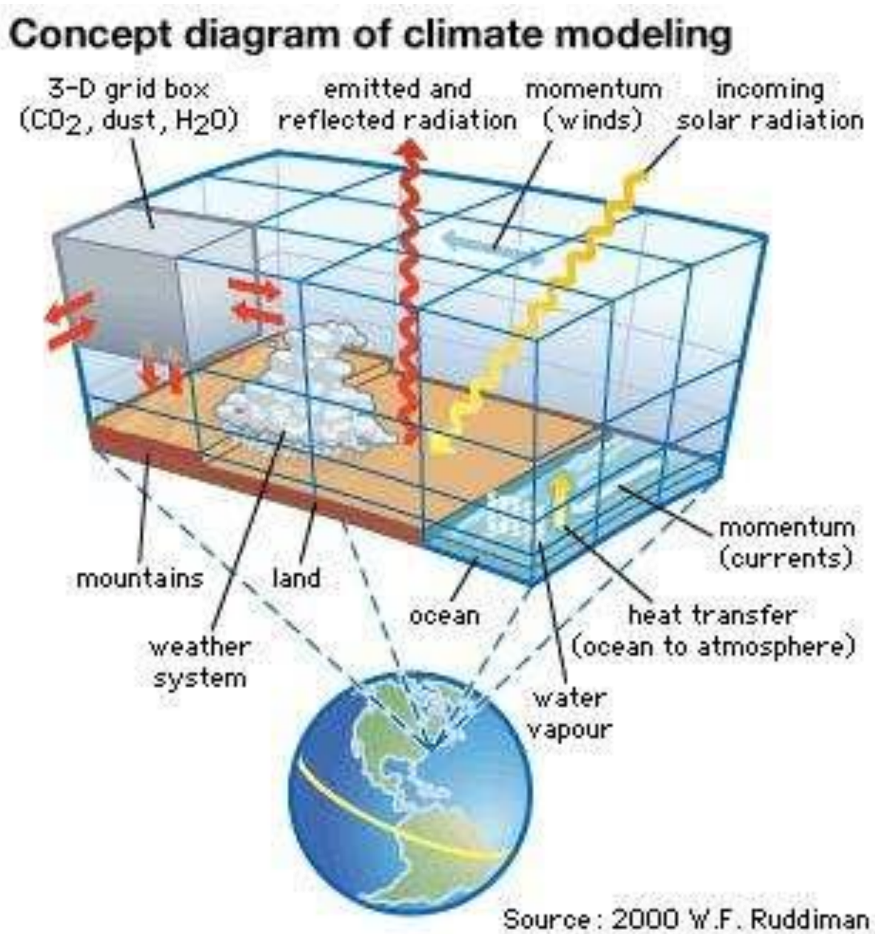
Carbon cycle: *what happens to carbon emissions?*

- Emit CO_2 into atmosphere
- Ocean and terrestrial systems both absorb some of the CO_2
- Only the CO_2 that remains in atmosphere leads to climate change
- Some of the emitted carbon stays in the atmosphere for tens of thousands of years



How can we predict future warming from human greenhouse emissions?

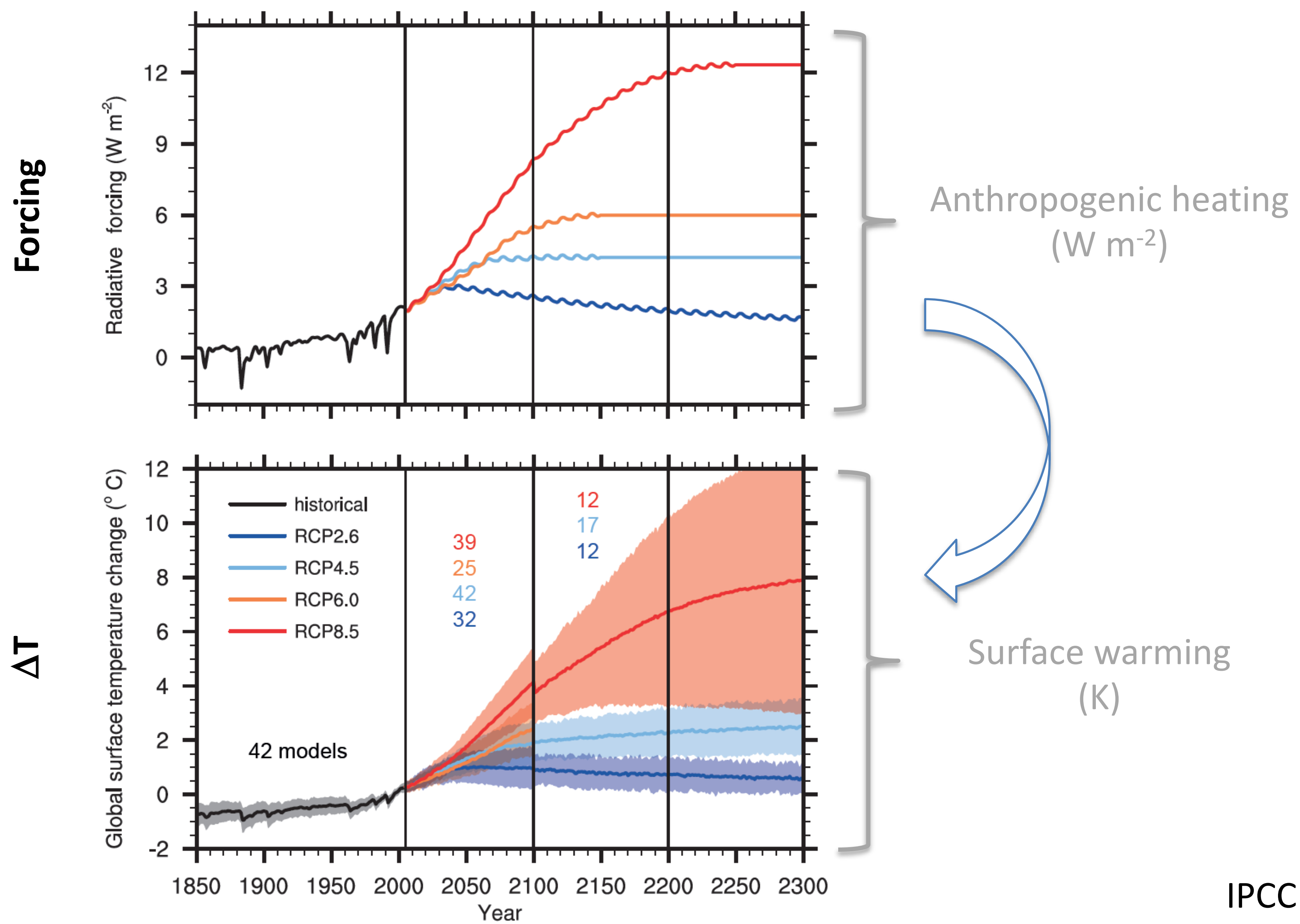
Complex climate models: ‘*CMIP’ ensembles*



Climate Model Intercomparison project Phase 6

- Over 20 models from research groups spread globally.
- 3D representations of the atmosphere and ocean
- Representations of hydrological cycling and terrestrial carbon cycling
- Representations of atmospheric chemistry
- Forced with historic and future CO2 concentrations, other greenhouse gasses and aerosols.

Complex climate models: *CMIP ensemble*

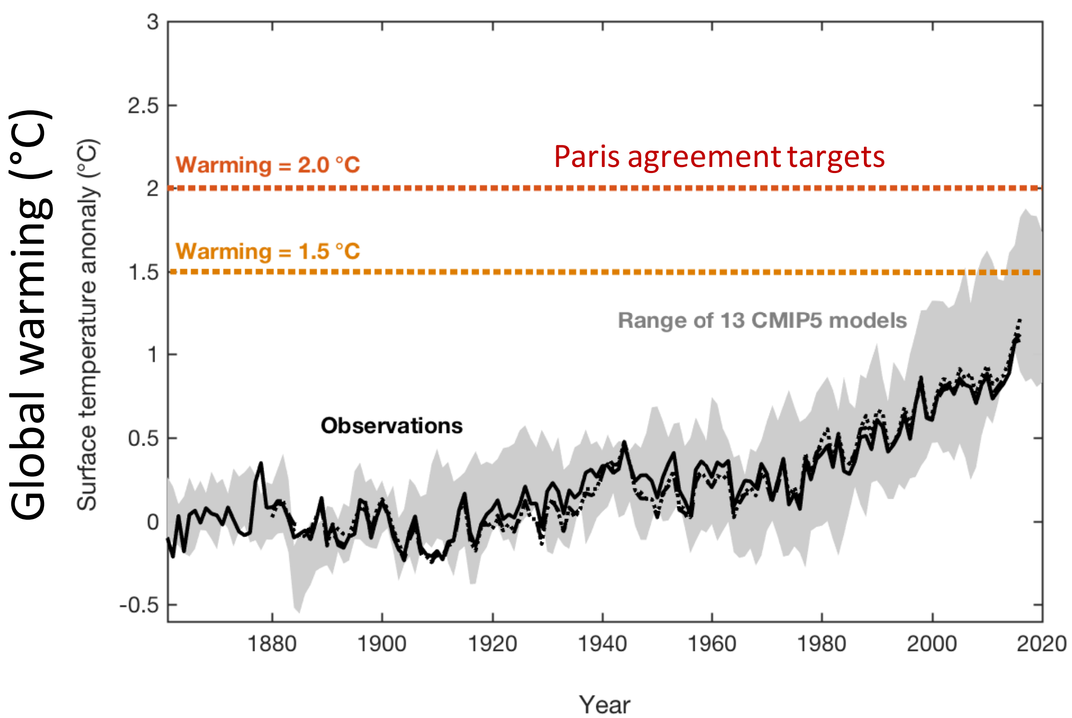


IPCC AR5

Warming over time for different scenarios

- Large uncertainty in warming from the different CMIP models
- *But how much carbon can we emit for Paris Agreement?*

Linking warming to carbon emissions



Observations

13 Complex 'CMIP5' models:

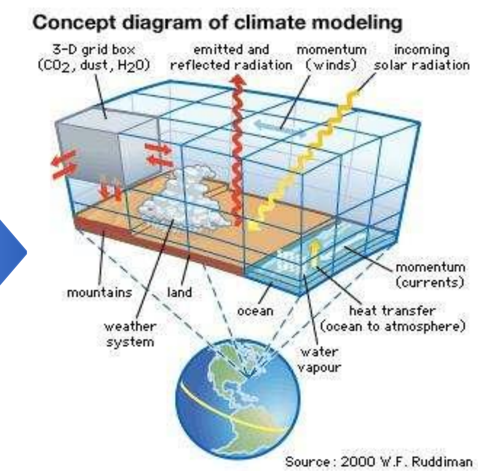
Mean error ~ 0.2 °C

Goodwin et al (2015) in Nature Geoscience

'Complex' Earth system model method:

Emissions

$\boxed{I_{em}(t)}$ ➡



➡ $\boxed{DT(t)}$

Warming

- 'Complex' models are very computationally expensive – a supercomputer gives ~ 1 simulation every ~ 6 months

- **Simulated warming ≠ observed warming**
  - in CMIP5, mean error 0.2 °C, or 20% of observed warming

- Want to ***constrain*** the simulations using observations

2. Efficient climate models constrained with observations

Want climate simulations that **agree with observations** up to now.

'Observation-constrained' approach to solve for warming:

- Use a computationally efficient box model of **heat** and **carbon** fluxes:

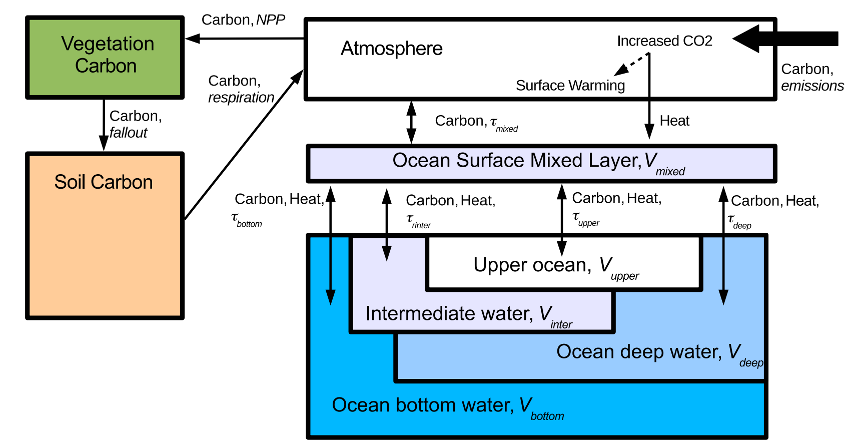
  => Warming, **A**cidification and **S**ea level **P**rojector (**WASP**)

- Computationally fast:
  - >1000 simulations per second
  - One hundred-million simulations in 24 hrs

- Have to specify parameter values (e.g. climate feedback) …

$$\Delta T(t) = \left(\frac{a}{\lambda_B}\right)\left(1 - \frac{N(t)}{R(t)}\right)\left(1 + \frac{I_{Usat}(t) - \Delta I_{ter}(t)}{I_{em}(t)}\right)\left(\frac{R(t)}{R_{CO2}(t)}\right) I_{em}(t)$$

+



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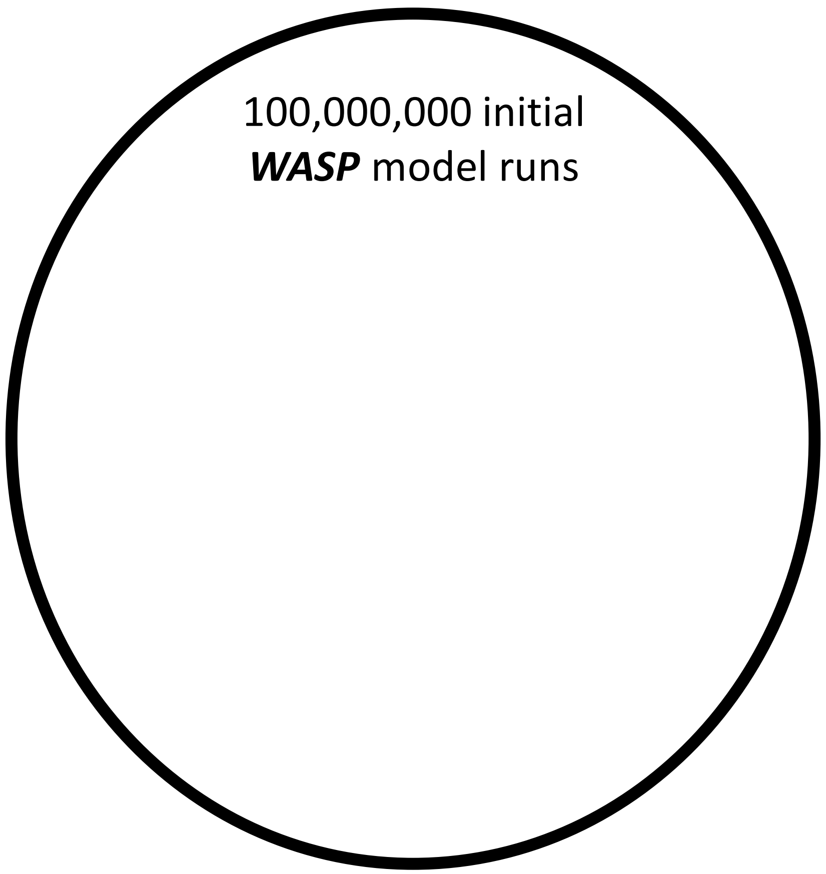
WASP

Goodwin 2016; *Goodwin et al.* 2017; 2018a; 2018b

Observation-constrained climate projections



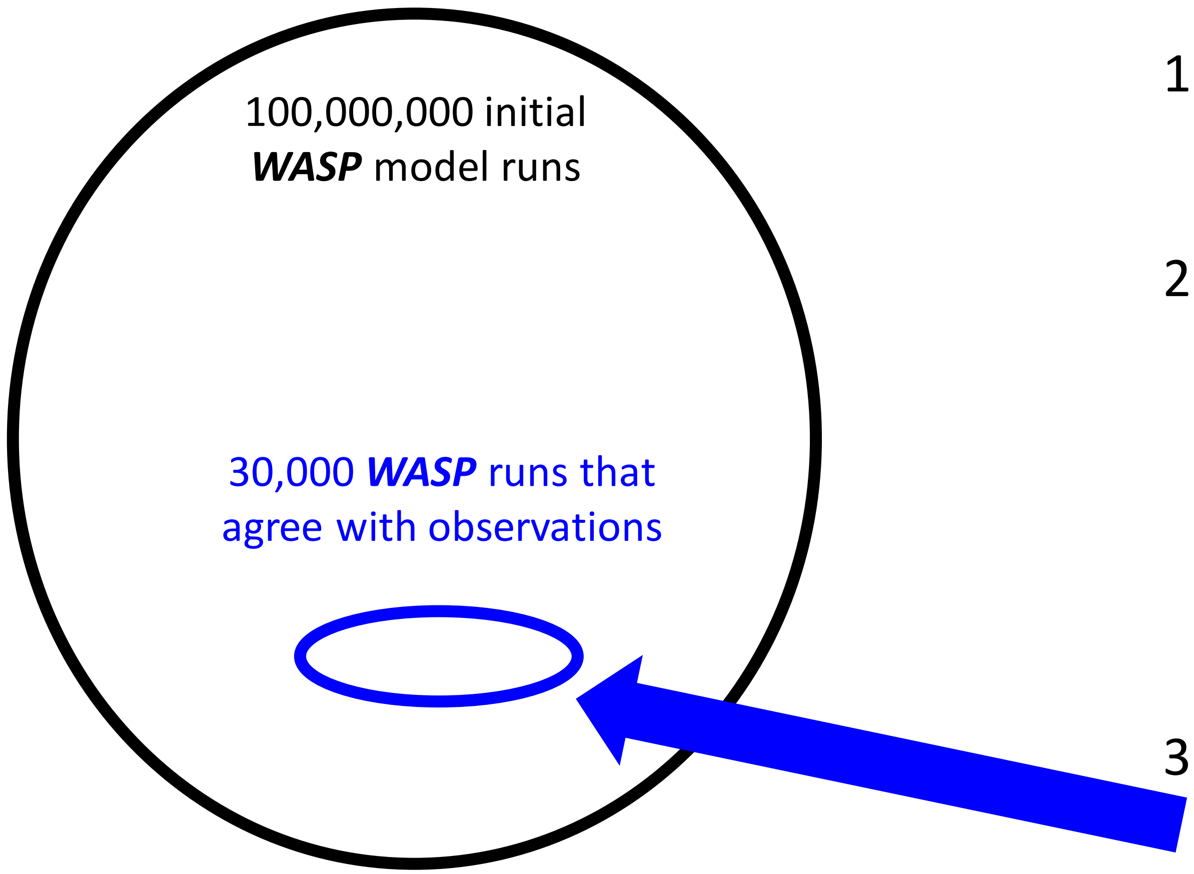
Monte Carlo + history matching:

1. Generate **initial** set of model runs, and run from 1750 to 2020

2. Test each simulation against **observations** of:
    - surface warming
    - ocean heat uptake
    - ocean carbon uptake
    - land carbon uptake
    - sea level rise

Goodwin et al (2018) in Nature Geoscience

Observation-constrained climate projections



Monte Carlo + history matching:

1. Generate **initial** set of model runs, and run from 1750 to 2020

2. Test each simulation against **observations** of:
   - surface warming
   - ocean heat uptake
   - ocean carbon uptake
   - land carbon uptake
   - sea level rise

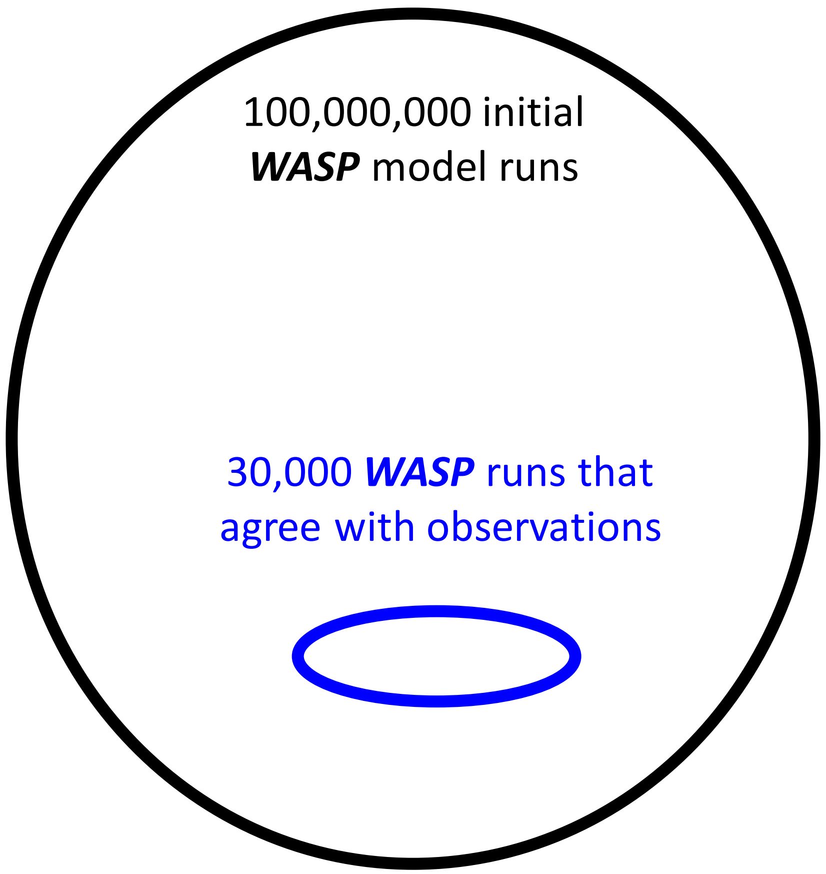
3. Extract only the simulations that ***agree with observations to 95% confidence***, and make future projections with those *(~ 0.03 % of initial runs)*

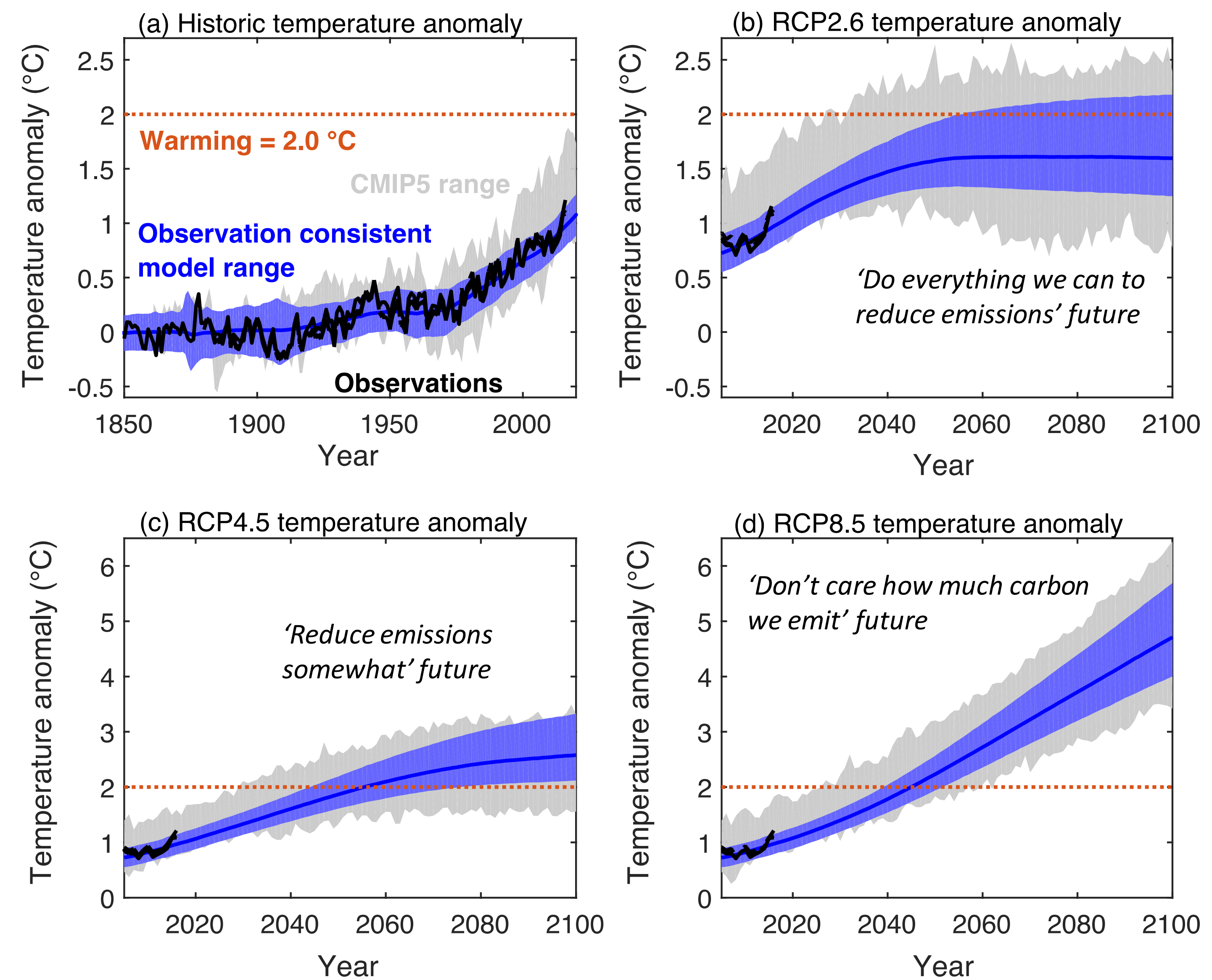
Goodwin et al (2018) in Nature Geoscience

How do the future projections of human-caused warming relate to the Paris Agreement?

Future projections depend on how much carbon dioxide we emit

- **Constrained** models closer to **observations** than **complex models**



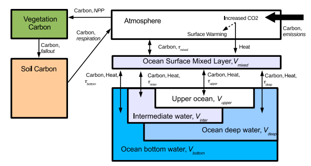


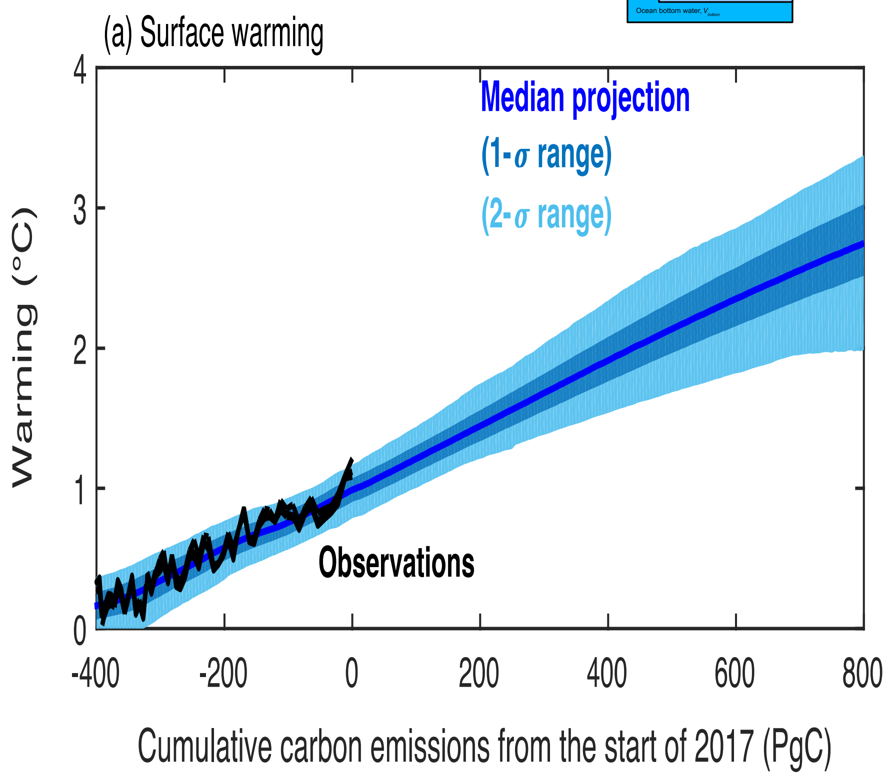
Complex models, 'CMIP5'
observations
WASP ensemble (observation consistent)

Goodwin et al (2018) in Nature Geoscience

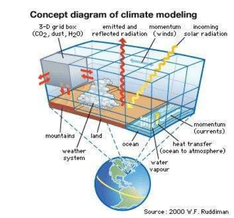
Projected warming from carbon dioxide emissions

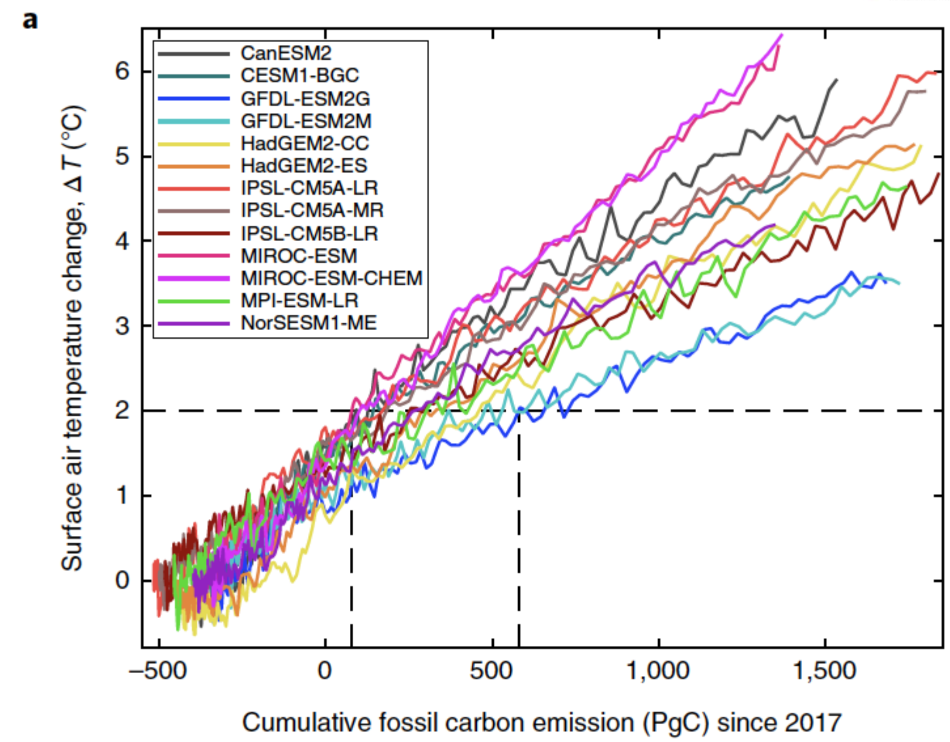
Observation-constrained projections





Complex model projections:



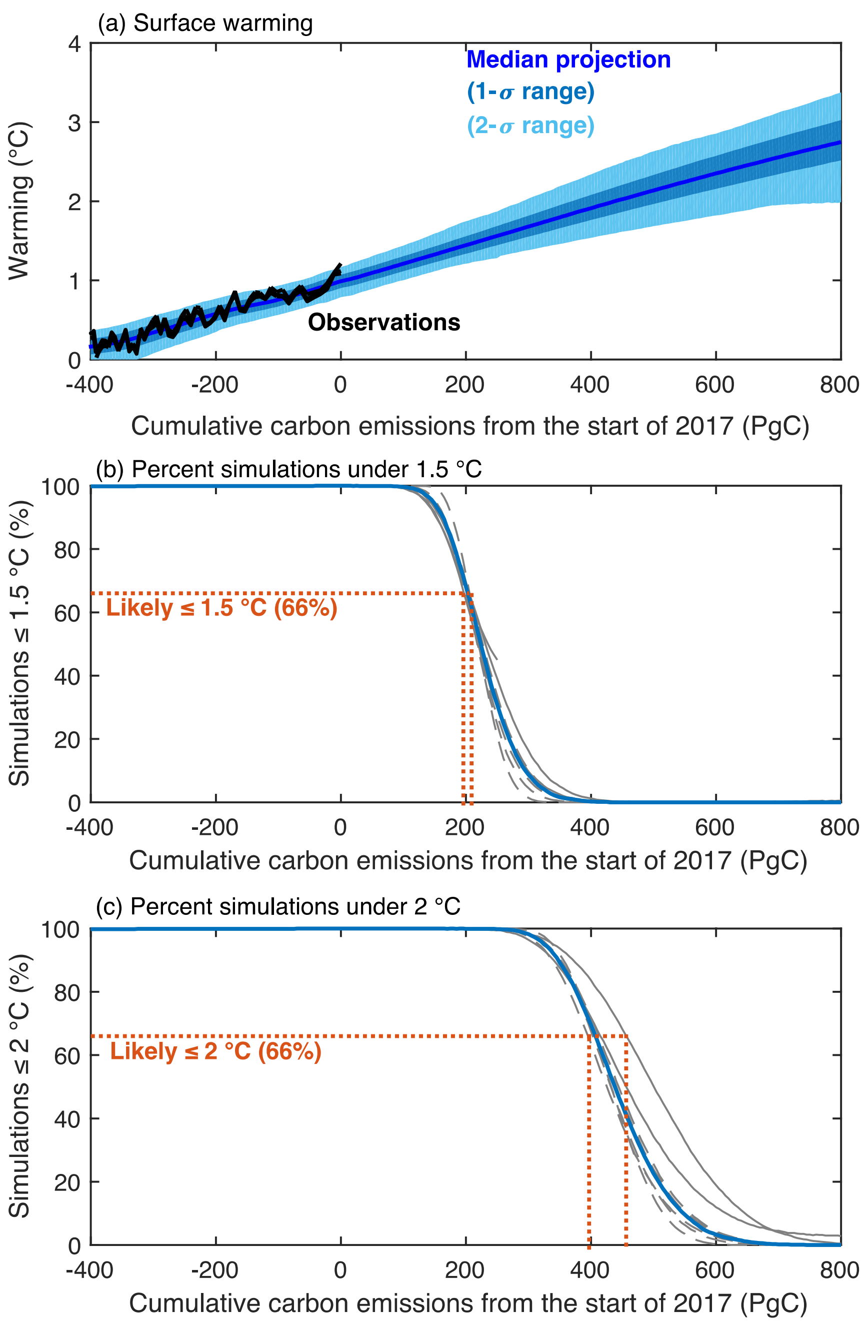


Warming projections from both methods agree:

=> Warming is related to the **total amount of carbon dioxide emitted**

=> Each warming target has a '**Future Carbon Budget**' that we cannot exceed

Meeting the Paris Agreement: *data constrained projections*



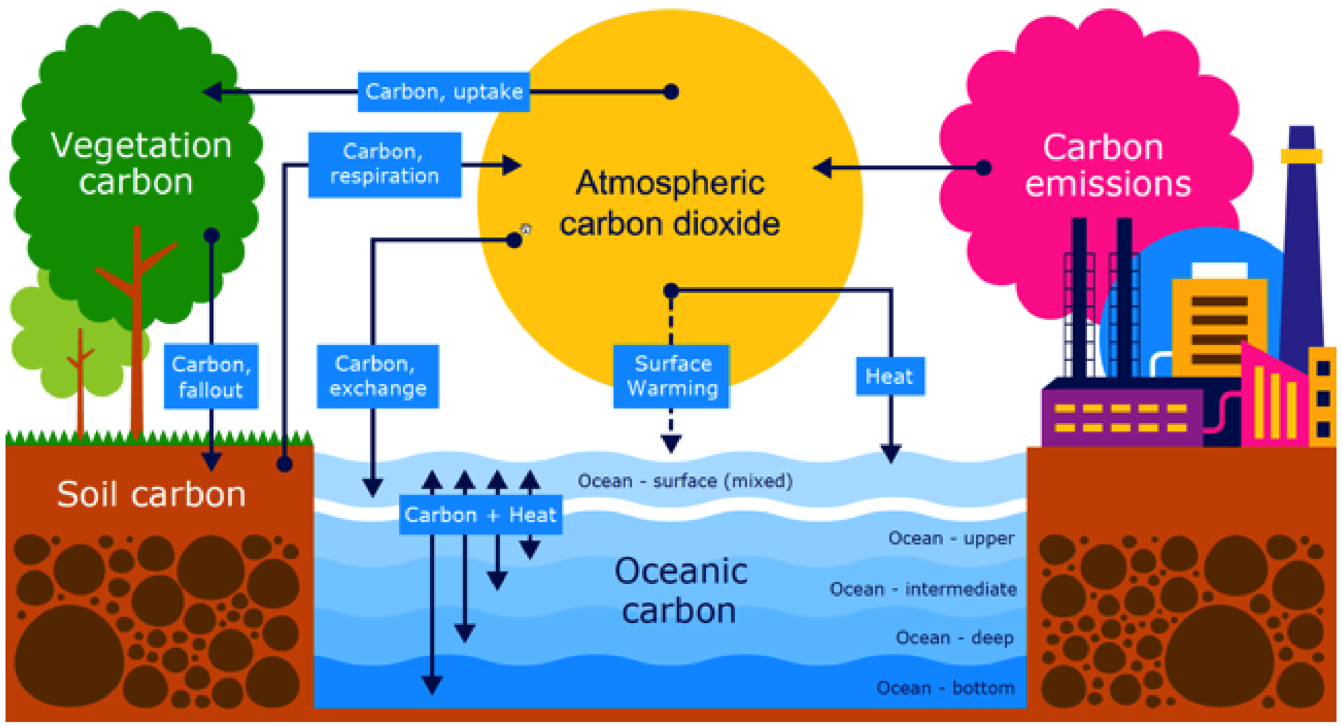
How much carbon gives a 'likely' (66%) chance meet Paris

- We currently emit 11 Pg of Carbon per year
- When another 200 PgC are added, we are no longer 'likely' to be < 1.5 °C
  - Will occur in 2034 or 2035 @ current rates
- When 400 PgC are added, we are not 'likely' to be < 2°C
  - Will occur from 2052 to 2062 @ current rates

We have to get to **net-zero** emissions before these Future Carbon Budgets are exceeded!

Some additional points

How long will human-caused warming last?



1. It will take ~ 1000 years for the whole ocean to heat up

=> Warming of the atmosphere will increase as the ocean heats up

2. It will take ~ 1000 years for the whole ocean to absorb carbon dioxide

=> Warming will decrease as the ocean absorbs carbon dioxide from the air

3. The increase in warming from the ocean heating over the next 1000 years offsets the decrease in warming from ocean absorbing carbon dioxide.

4. Any human-caused warming from carbon dioxide emissions will last for thousands of years!
   - *If we cause 3 °C warming now, it will still be ~ 3 °C warmer in thousands of years time*

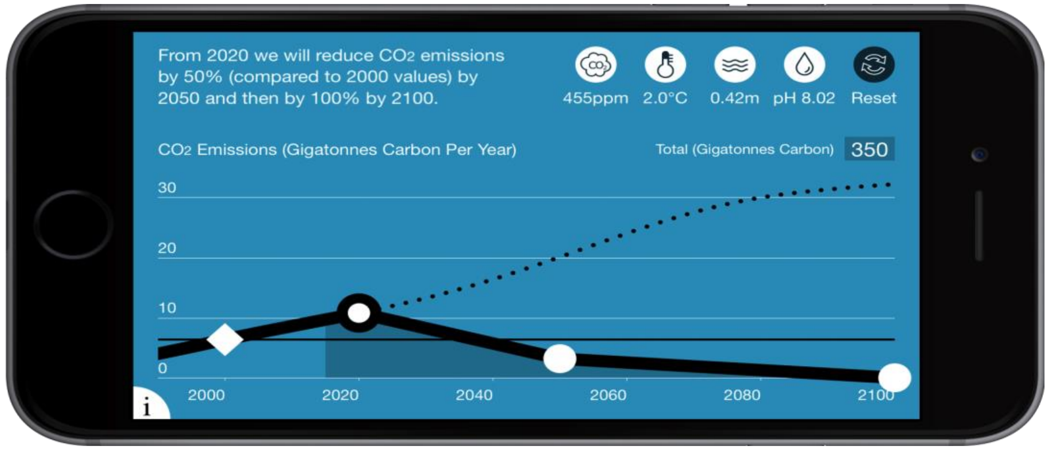
Open challenges for calculating Future Carbon Budgets to meet the Paris Agreement targets

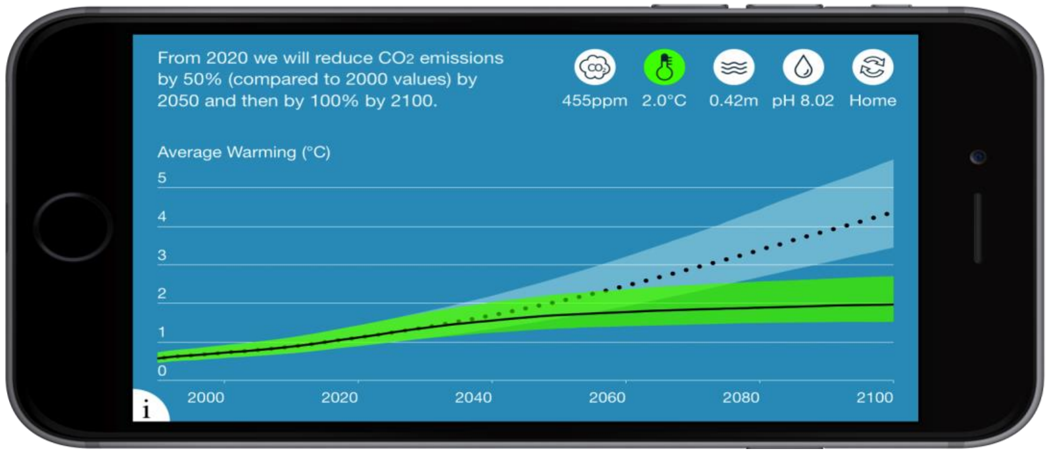
1. Aerosol cooling
   - Man-made aerosols {e.g. visible pollution that reduces air-quality} cool climate. As we clean up the air pollution levels, this cooling will stop - making it more difficult to meet the Paris Agreement.
   - We don't know how much cooling currently happens from man-made aerosols …

2. Permafrost carbon
   - As climate warms permafrost regions will thaw and large reservoirs of frozen carbon could be released, making it more difficult to meet the Paris Agreement
   - We don't know how much permafrost carbon will be released and at what temperatures …

CO2 Modeller App

- Runs an ***efficient climate*** model (WASP)
- Turns a tablet/smartphone into a climate model
- Apple devices (iOS, or Mac with M1 chip)
- User picks emissions reductions
- App performs 1000 '***WASP'*** model simulations
- App projects (up to year 2100):
  - Atmospheric $\boldsymbol{CO_2}$
  - Global mean ***Warming***
  - Global mean ***Sea level rise***
  - Surface Ocean ***pH***
- See how fast emissions must fall to meet the Paris Agreement!





More info:
web: www.CO2Modeller.info ;
twitter: @CO2Modeller
Search 'CO2 modeller' on the App store

SECOND POLLING QUESTION

What are the pitfalls you're seeing in Paris aligned investing?

The answers to this questionnaire will allow TOBAM to have an overview of the market, no personal data will be reused for any other purpose

ALIGNING INVESTMENT PORTFOLIOS WITH THE 1.5° COMMITMENT

July 2022

1. What is the Challenge?
2. How to Implement Temperature Constraints
3. Some Research Results

THE CHALLENGE: KEEPING GLOBAL WARMING BELOW 1.5°

- IPCC*: Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate.

Source: Nasa, https://climate.nasa.gov/ask-nasa-climate/2544/glaciers-on-the-edge/

- How can we translate the climate research results into guiding principles for portfolio construction to help (with our limited means) mitigate emissions and global warming?

*IPCC: Intergovernmental Panel on Climate Change (IPCC) is an intergovernmental body of the United Nations responsible for advancing knowledge on human-induced climate change

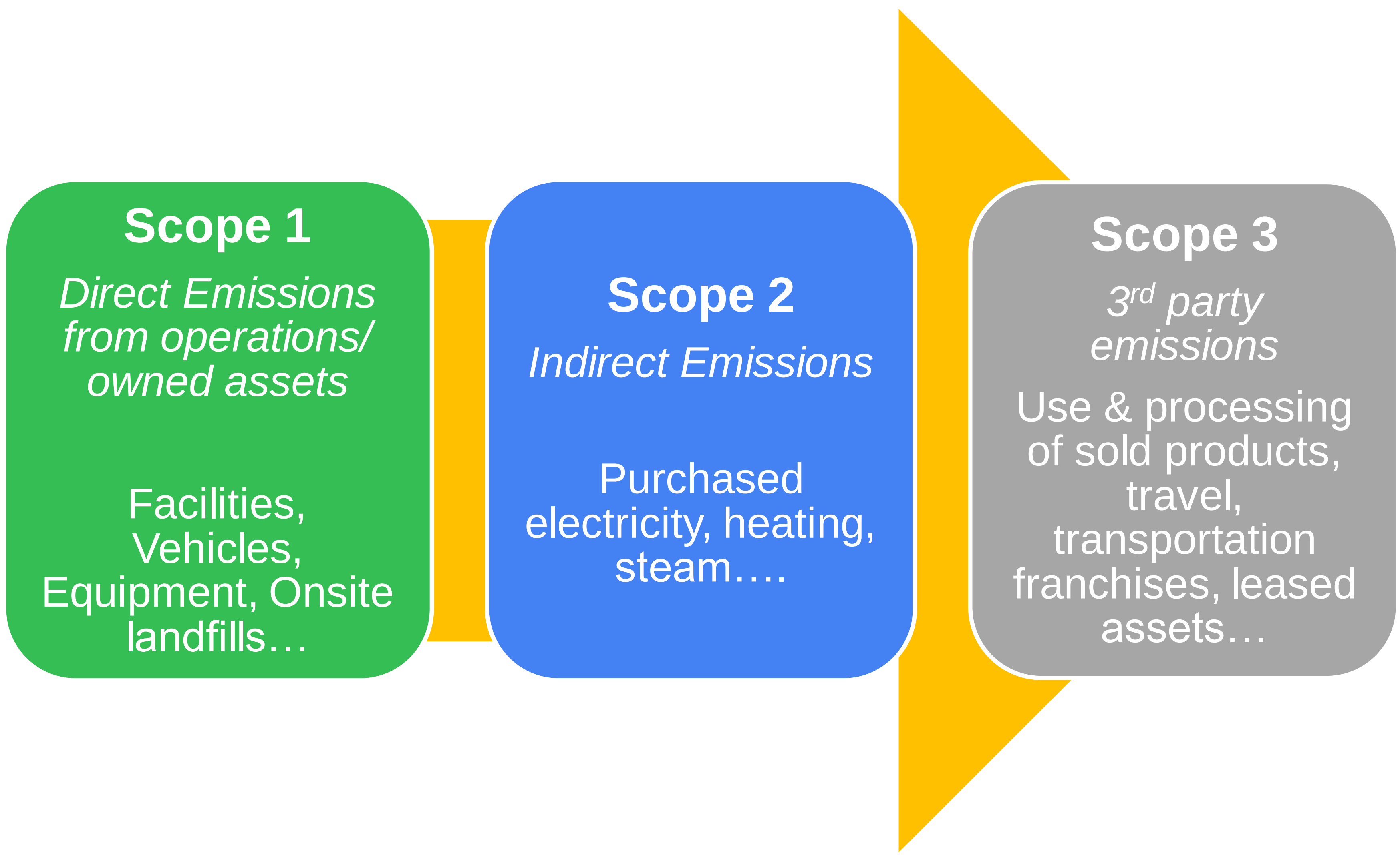
1. What is the Challenge?

2. How to Implement Temperature Constraints

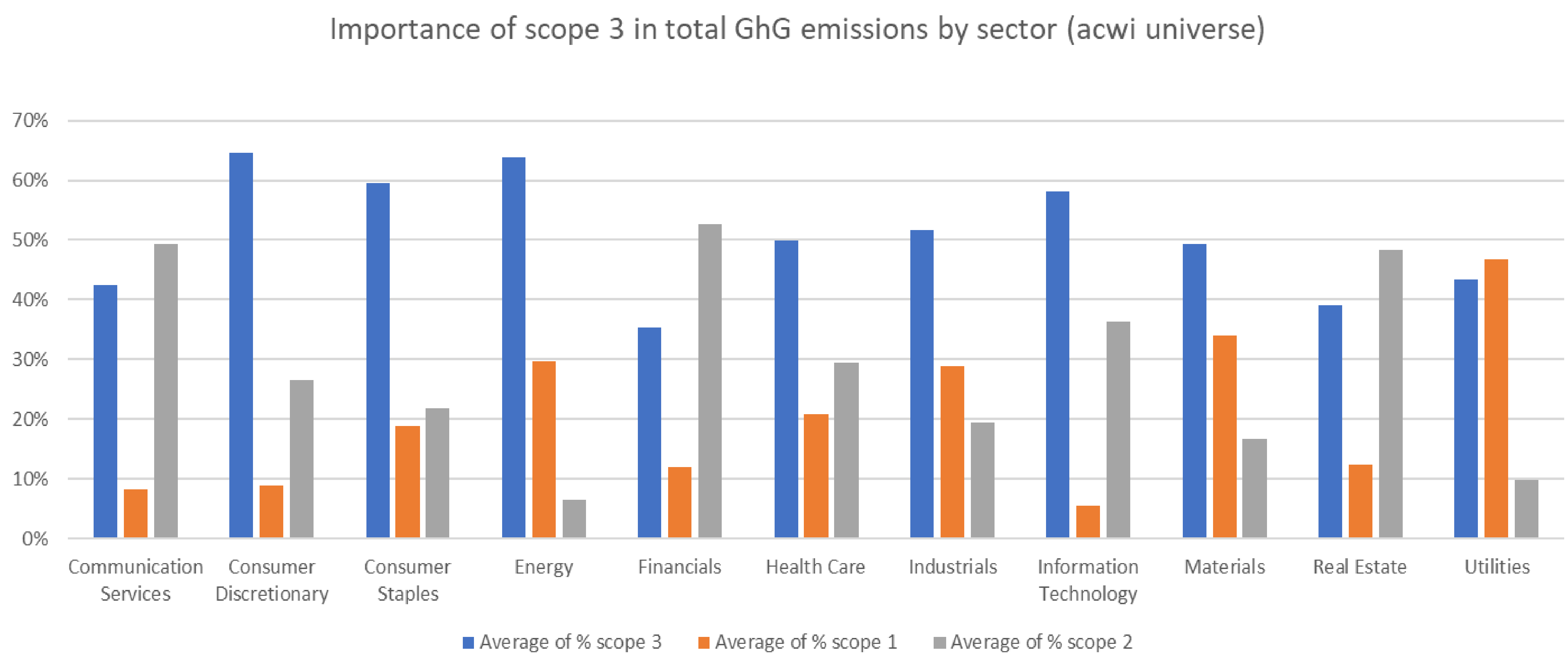
3. Some Research Results

EMISSION & TEMPERATURE CONSTRAINTS

- Minimum GHG Emissions Scope 1, 2 (+3) Reduction: 50% (Scope 3 phase in up to 4 years).
- Fossil Fuel Related Exclusions: Coal (1%+ revenues), Oil (10%+ revenues), NatGas (50%+ revenues), high GHG emission electricity producers (higher 100g$CO2_e$ /kwh (50%+ revenues).
- YoY self-decarbonization: 7% on average p.a. in line with or beyond the trajectory of the IPCC 1.5°C scenario.



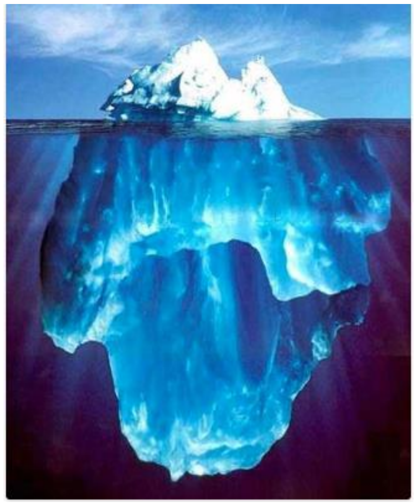
SCOPE 3 EMISSIONS: HIDDEN PART OF THE ICEBERG OR DOUBLE COUNTING?



Source: Bloomberg,TOBAM. Based on median estimate of GHG emissions for the fiscal year 2019

- Not incorporating Scope 3 emissions means to consider only the tip of the iceberg.

- There is a risk of double/triple etc counting if, within a single portfolio, there are multiple companies that are active within the same supply chain.
- Nevertheless, it is not necessarily very impactful and also not undesirable. Carbon exposure is present through the supply chain and affects each company equally, even when the responsibility for these emissions may be shared (e.g., taxes on fossil fuels).

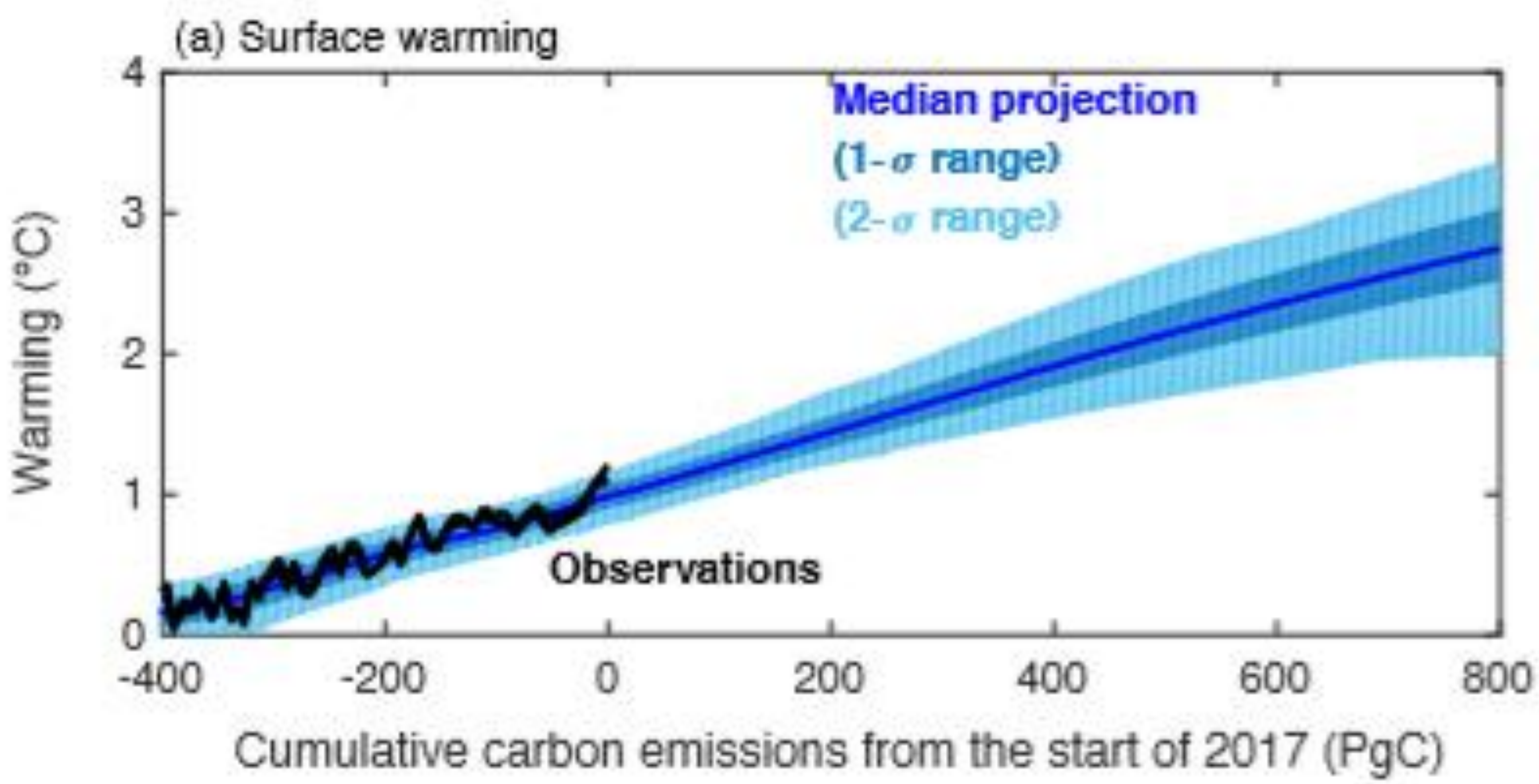


SCIENCE BASED TARGETS: REWARDING THE "GOOD STUDENTS"

Source: sciencebasedtargets.org

- At the end of 2021, 2,253 companies across 70 countries and 15 industries, representing more than one third of global market capitalization, had approved emissions reductions targets or commitments with the SBTi.
- Almost 80% of targets approved in 2021 were aligned with 1.5°C. SBTi companies are delivering excess reductions at an accelerated rate compared to their peers.
- We want to reward the "good students" and take into account in our approach the emission path of companies who have committed to the SBTi. Whether they have kept their promise or not is monitored on a yearly basis.

TRANSLATING CLIMATE RESEARCH INTO AN INVESTMENT PORTFOLIO (1)

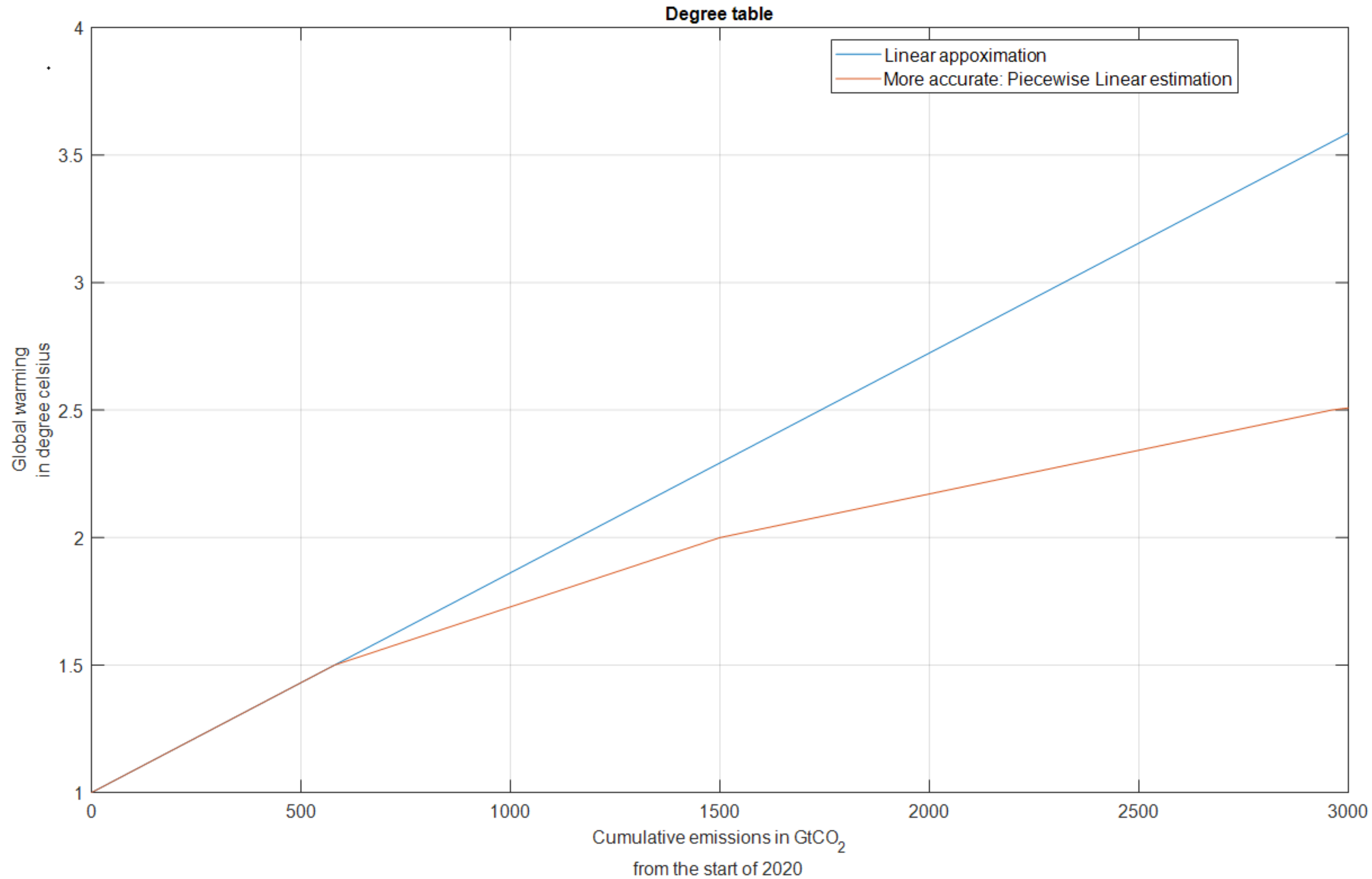


Source: Goodwin et al. (2018): Pathways to 1.5 and 2 ° C warming based on observational and geological constraints, Nature Geoscience, 11, pp. 102-107.

- There is a near/linear link between global warming and cumulative carbon emissions.
- According to the latest IPCC report there is a remaining carbon budget of 580 GtCO2* if we want to stay in line with the 1.5°C scenario.

*GtCO2: gigatonnes of carbon dioxide

TRANSLATING CLIMATE RESEARCH INTO AN INVESTMENT PORTFOLIO (2)

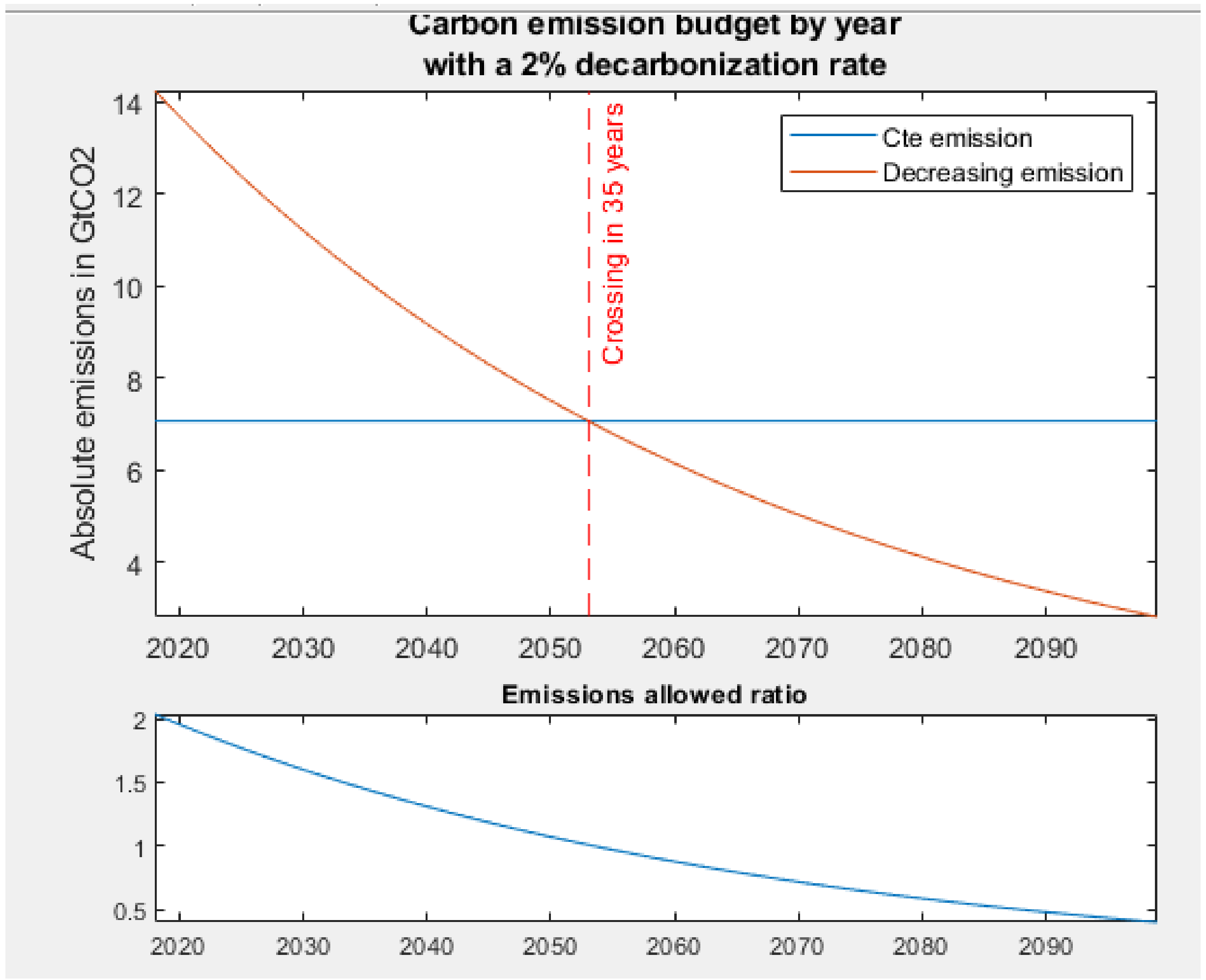


Source: TOBAM.

- To compute the temperature impact that our portfolios should not exceed to align with the 1.5°C scenario, we assume that everyone would invest as we do.
- We then compute using the weighted average carbon intensity of our portfolio applied to worldwide invested assets the temperature impact implied by this carbon intensity.
- To do so it is important to know the slope of the curve that relates Carbon emissions to temperature impact and which determines the emission budget.
- This is where climate research provides the key input.

tobam* unbiased.

TRANSLATING CLIMATE RESEARCH INTO AN INVESTMENT PORTFOLIO (3)



Source: TOBAM.

- To be considered as PAB it is also important that the way how our portfolio consume the emission budget accounts for the fact that we need to be able to show a decarbonization path YoY.

- It is arguable how much sense this really makes compared to an approach that consumes the budget at the same rate over time and that would reduce by a lot more right now emissions. But this is the regulation…

tobam* unbiased.

1. What is the Challenge?

2. How to Implement Temperature Constraints

3. Some Research Results

tobam unbiased.

RESULTS: EXAMPLE OF OUR MAXDIV EQUITY INDICES

USA	Ann. Ret.	Volatility	Sharpe ratio	Beta	TE vs BMK	TE vs Current Model	TE vs Current Model with EV	IR	Average TO	Average DR^2
MD_USA_stnd	11.19%	16.86%	0.66	0.88	5.03%	0.00%	0.69%	-0.57	31.75%	5.25
MD_USA_mrPA	11.83%	17.04%	0.69	0.89	4.80%	1.01%	1.07%	-0.46	32.74%	5.09

WORLD	Ann. Ret.	Volatility	Sharpe ratio	Beta	TE vs BMK	TE vs Current Model	TE vs Current Model with EV	IR	Average TO	Average DR^2
MD_WORLD_stnd	9.58%	13.16%	0.73	0.80	5.11%	0.00%	0.17%	-0.35	32.51%	6.87
MD_WORLD_mrPA	10.00%	13.23%	0.76	0.81	4.91%	0.75%	0.79%	-0.28	33.06%	6.65

EM	Ann. Ret.	Volatility	Sharpe ratio	Beta	TE vs BMK	TE vs Current Model	TE vs Current Model with EV	IR	Average TO	Average DR^2
MD_EM_stnd	4.08%	15.15%	0.27	0.87	5.18%	0.00%	0.28%	-0.55	28.84%	7.28
MD_EM_mrPA	4.27%	15.13%	0.28	0.87	5.14%	0.52%	0.49%	-0.52	29.05%	7.19

ACWI	Ann. Ret.	Volatility	Sharpe ratio	Beta	TE vs BMK	TE vs Current Model	TE vs Current Model with EV	IR	Average TO	Average DR^2
MD_ACWI_stnd	8.33%	12.49%	0.67	0.79	5.13%	0.00%	0.22%	-0.49	32.52%	7.75
MD_ACWI_mrPA	8.79%	12.51%	0.70	0.79	5.04%	0.60%	0.66%	-0.41	33.15%	7.57

Source: Bloomberg, TOBAM. Backtest are run from 31/12/0014 until 30/09/2021. Past performance is not indicative of future results, nor are they reliable indicators of future performance.

From a risk/return and diversification point of view the indices behave very similarly no matter whether we apply the additional constraint or not.

CONCLUSION

- Climate change is real and we have already lost a lot of time to fight it.

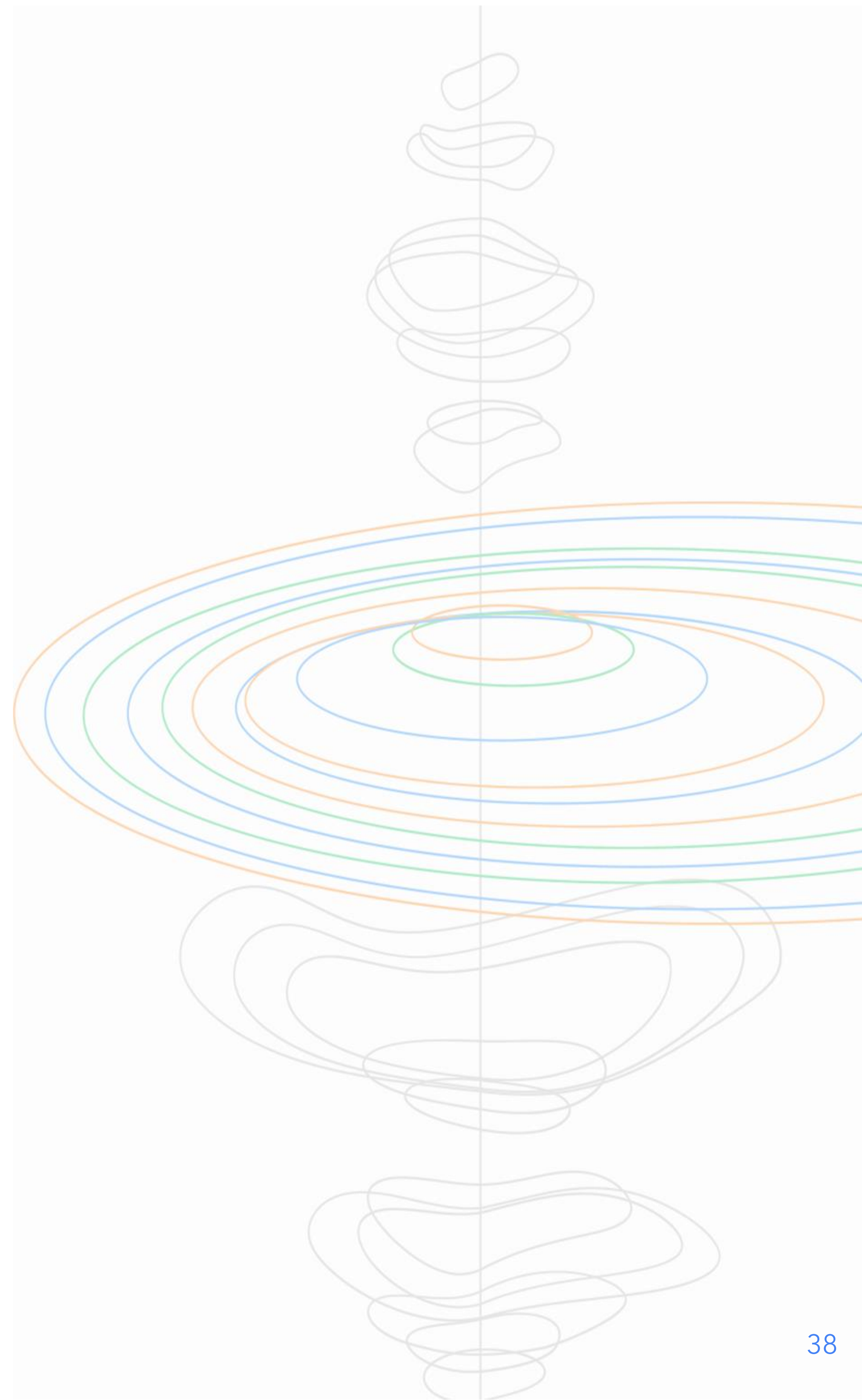
- The financial industry is not able alone to fix the problem but it plays in important role in:
    1. Setting the right incentives to companies to reduce their emissions even if this comes at a cost today (but the cost in the future will be higher if we miss the 1.5°C target!)
    2. Contributing to the financing of climate transition.
    3. Creating awareness for what still needs to be done so that we can implement climate aware policies into our investment portfolios based on more precise data and cutting-edge climate research.

- Thanks to our portfolio construction based on correlations, we are confident to implement Paris aligned climate policies into our portfolios without being afraid of cutting our clients off diversification potential.

- Let us all make our contribution to preserve this beautiful planet for future generations!

Q&A

ABOUT TOBAM



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The Maximum Diversification® approach, TOBAM's flagship investment process founded in 2006, is supported by original, patented research and a mathematical definition of diversification and provides clients with diversified core exposure, in both the equity and fixed income markets.

In line with its mission statement and commitment to diversification,
TOBAM also launched a separate activity on cryptocurrencies in 2017.

TOBAM manages USD $10 billion (in December 2021).
TOBAM's team is composed of 51 professionals.

For more information, visit www.tobam.fr

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