Accounting metrics for climate impacts… black carbon, methane…

~~*A deeper look*~~

Stop looking so deep

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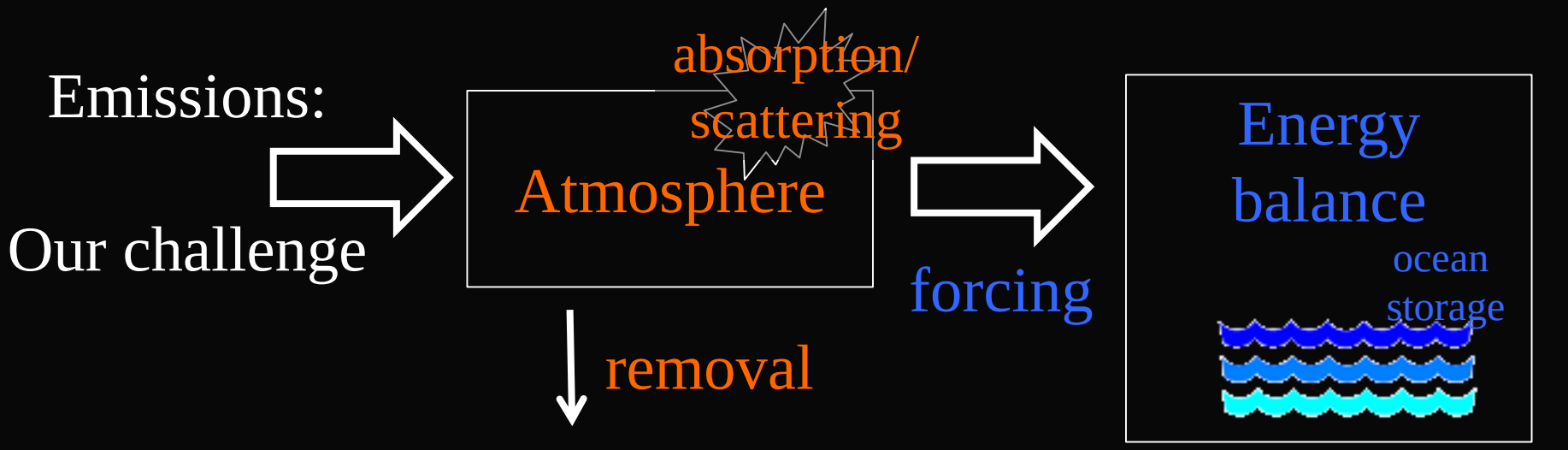
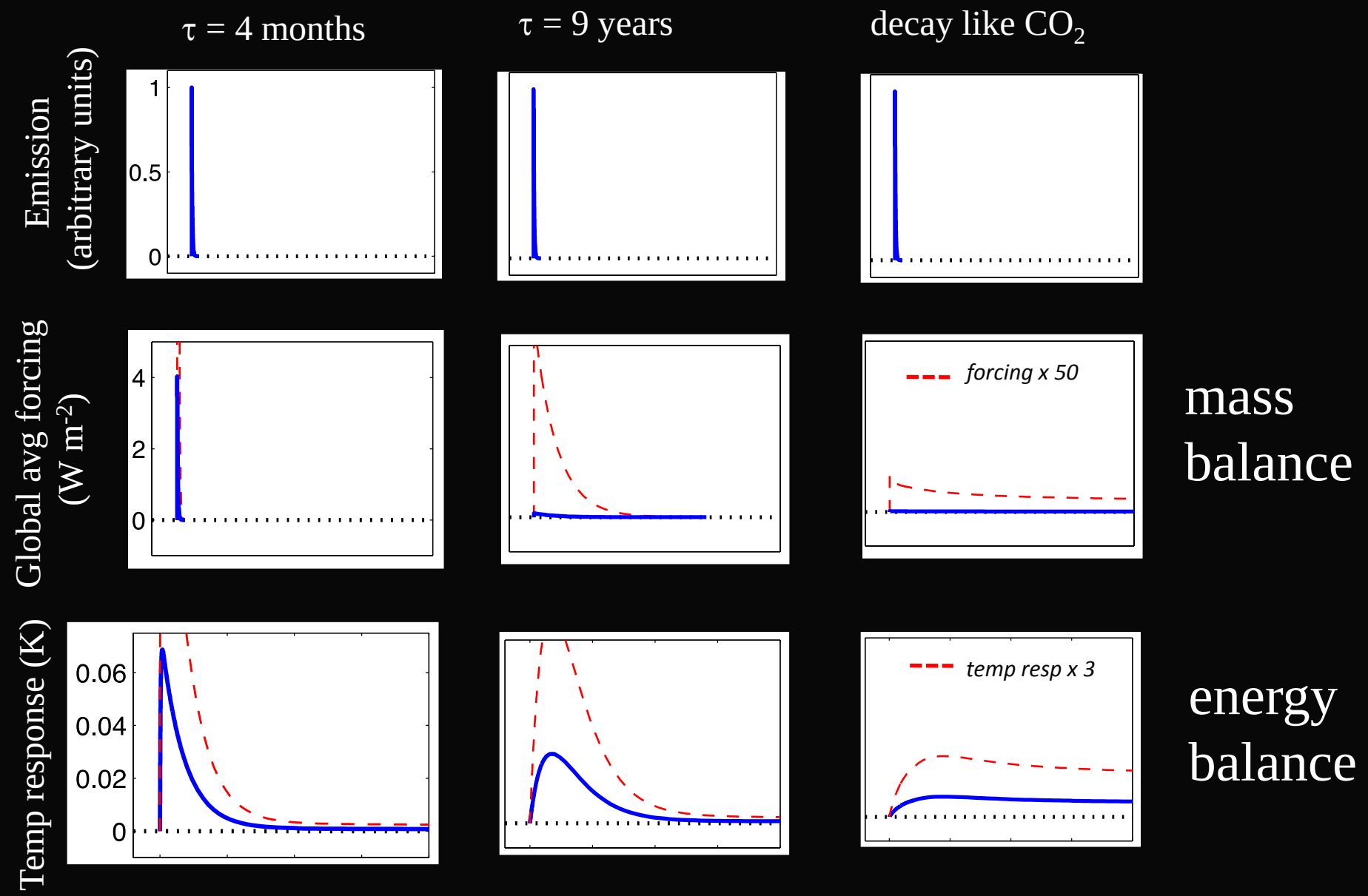
Two (nearly separate) systems: atmospheric reactor and energy balance

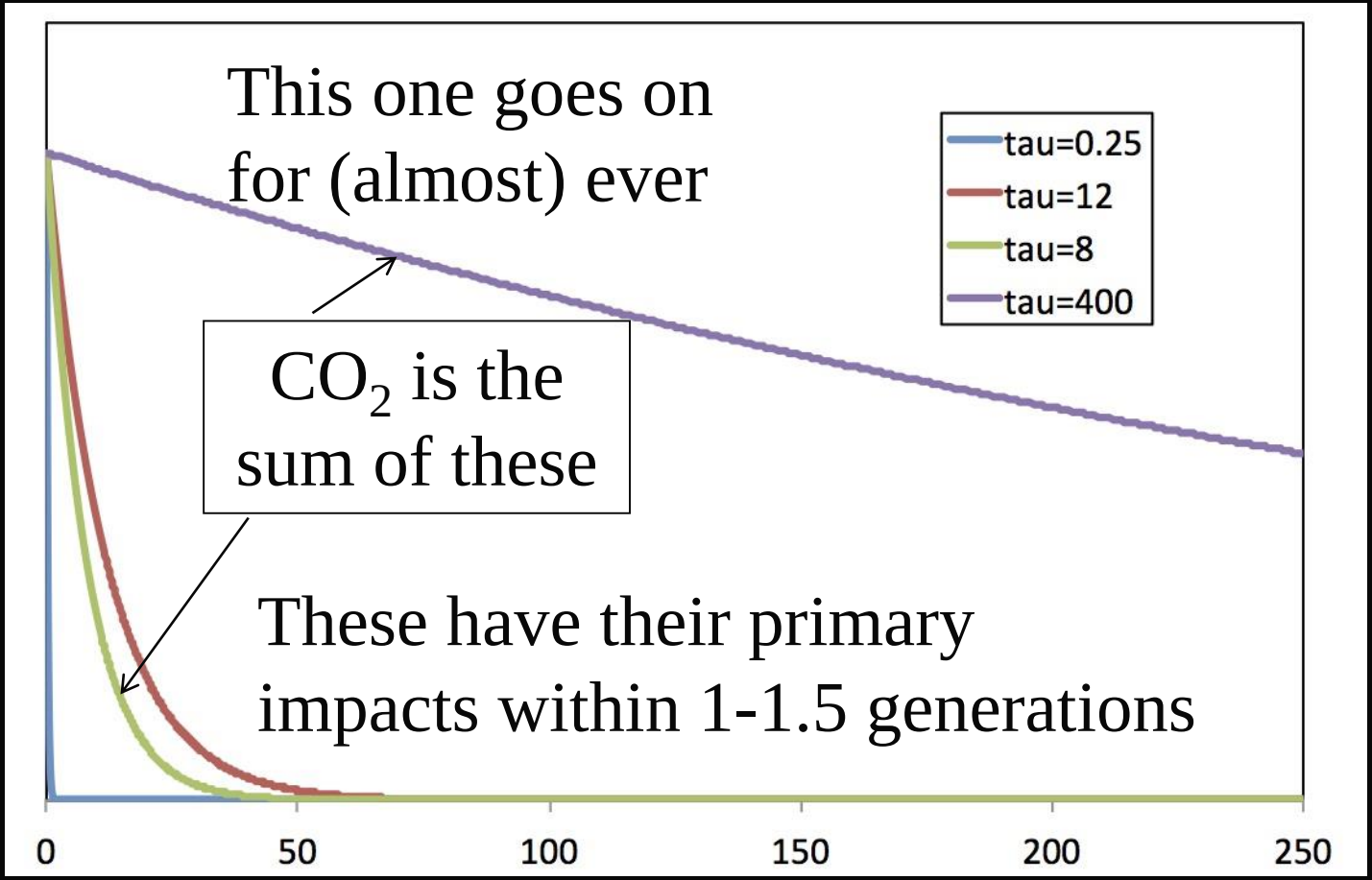


Characteristic times (τ) in years: 0.02; 0.3; 4; 12; 400 | 8; 400

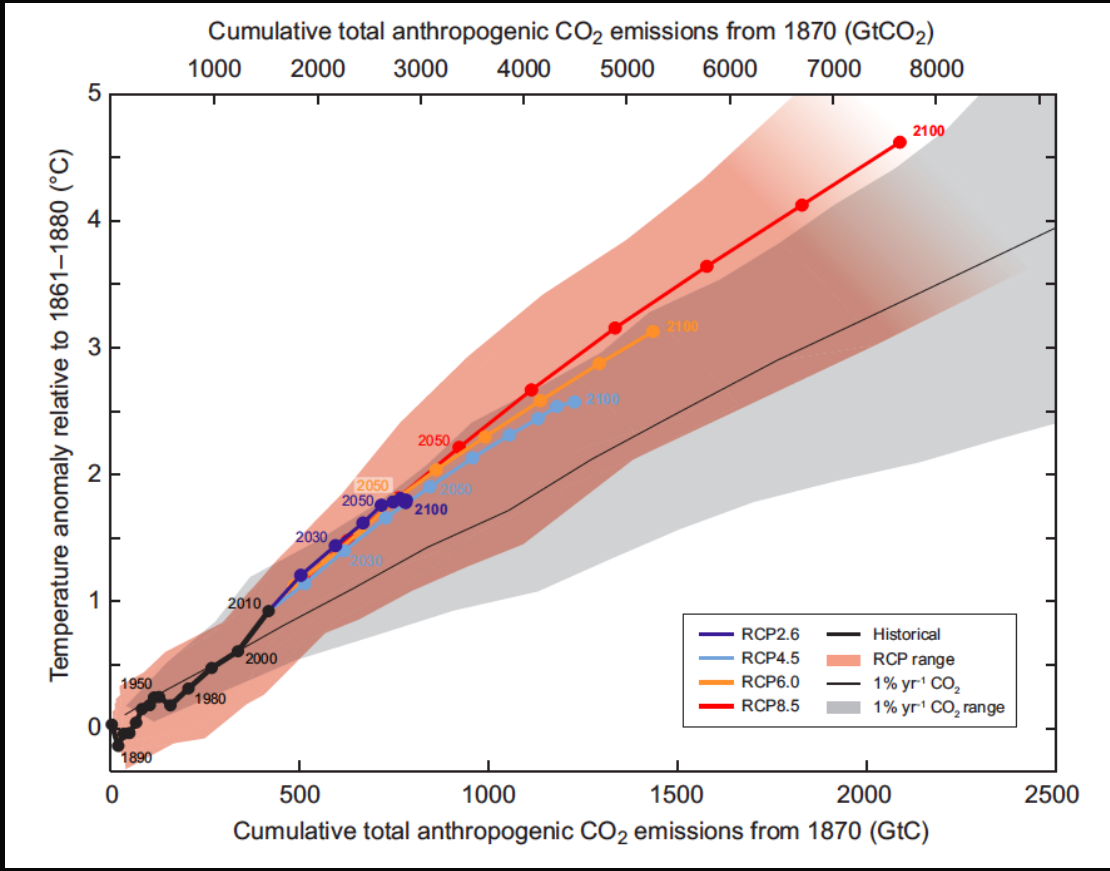


Bond et al. ACP 2011

There are two kinds of forcers in the world…

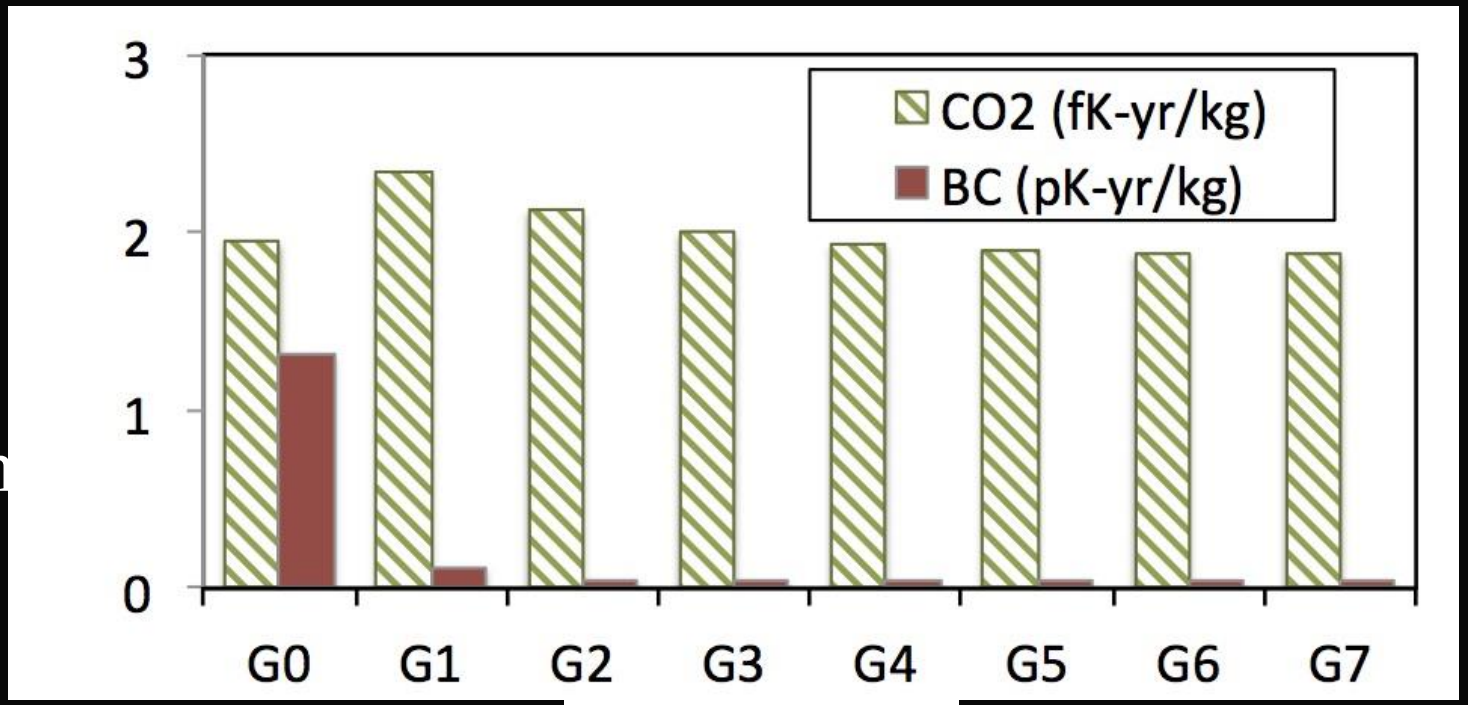


Peak temp. is proportional to cumulative carbon because of the *long-lived portion*



IPCC AR5 Fig SPM.10
Based on work since 2009 & since
See Allen et al, Nature 458, 1163;
Matthews et al, Nature 459, 829;
Zickfeld et al, PNAS 106, 16129

Average T change after emission of pulse CO_2 and BC

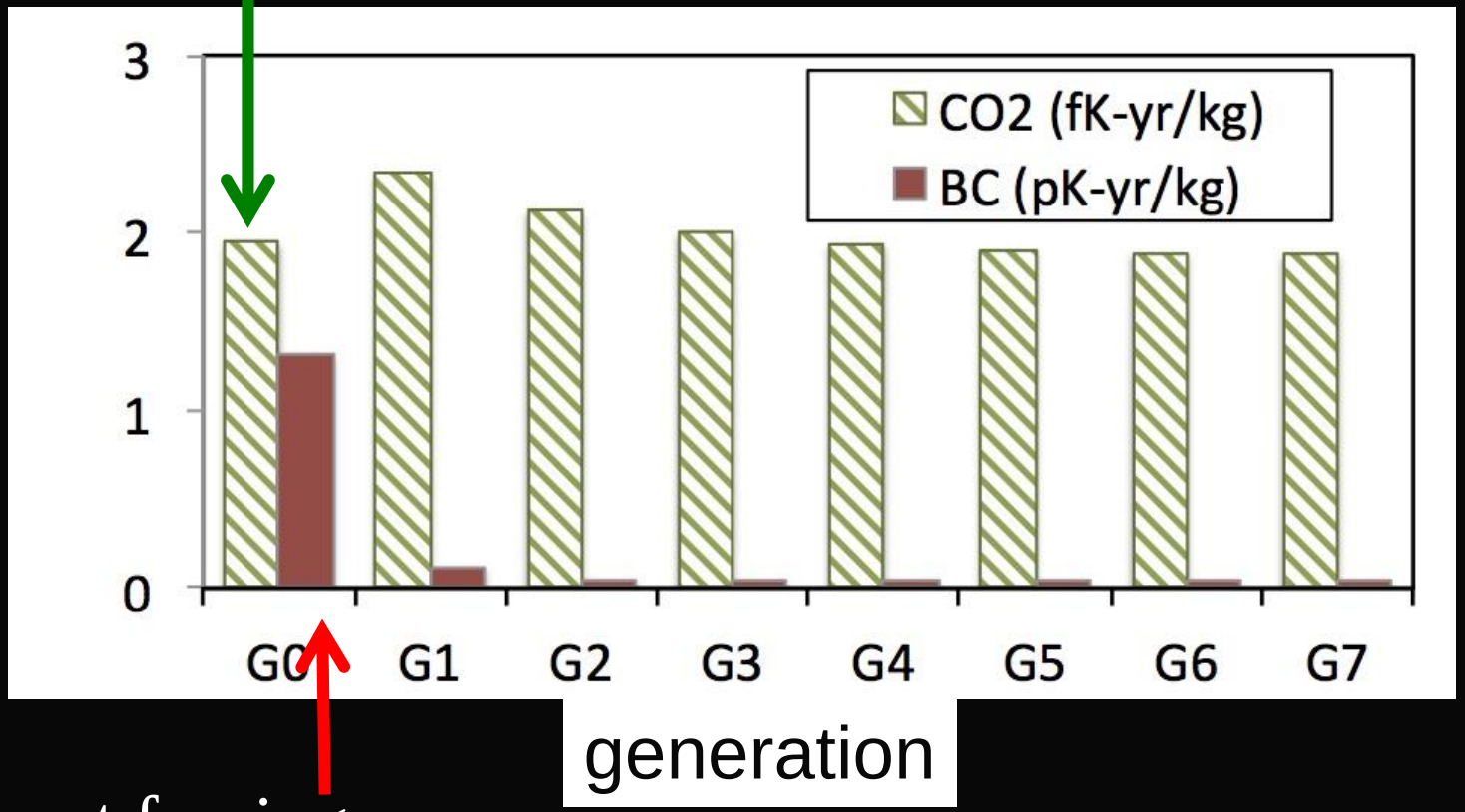


Picture changes a bit (but not much) for 10yr τ

Hade & Bond, really close to submission...

Dual roles for LLCF & SLCF (not news)

constant T commitment;
stabilization



current forcing;
management

Hade & Bond, really close to submission...

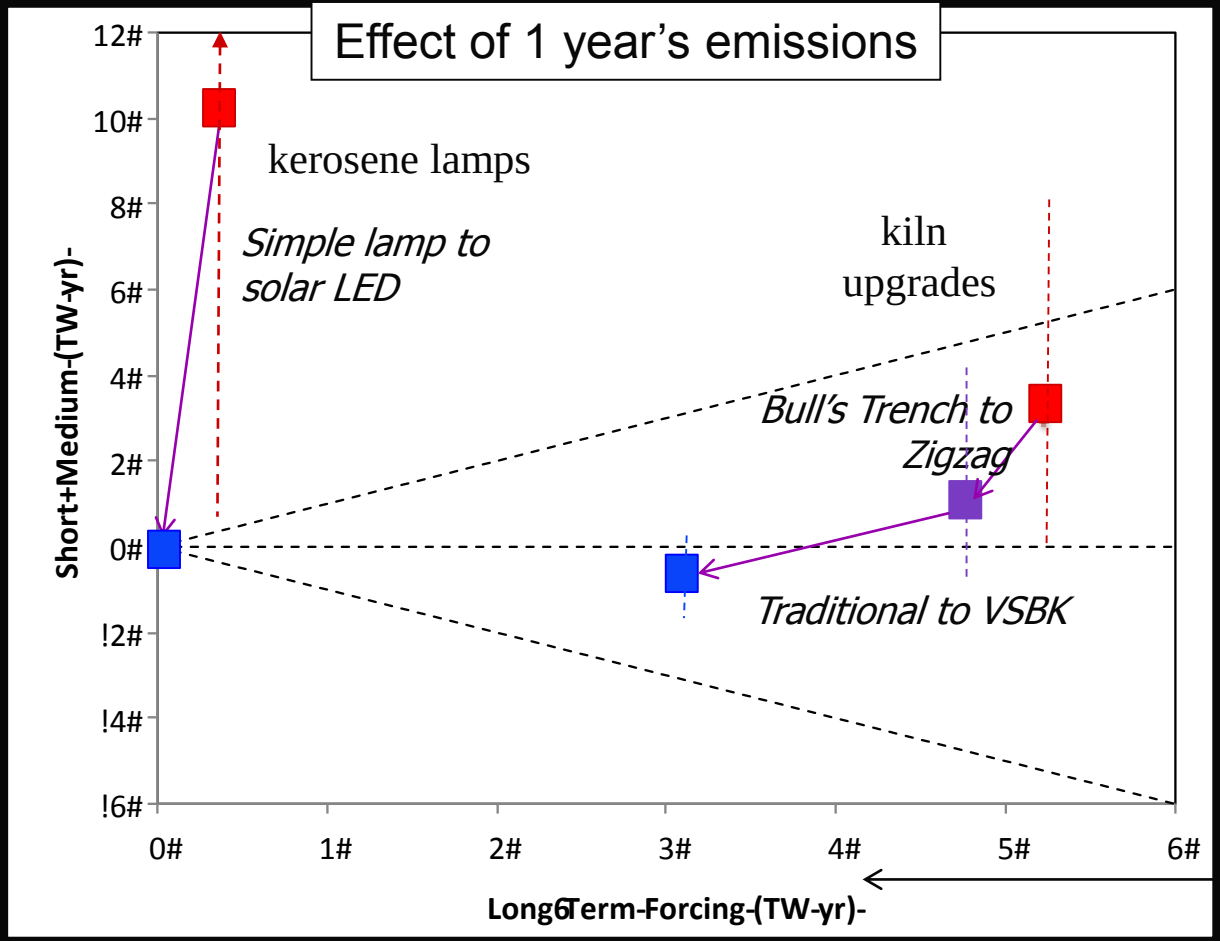
What current emission metrics provide

- Global Warming Potential: How much forcing is done?
  - Good: Integrated measure; well-accepted
  - Bad: Doesn’t communicate what we care about
- Global Temperature Potential: Will we have an effect on temperature in year N?
  - Good: (More) relevant to what people care about
  - Bad: What about all the other years?

Important use of emission metrics: Answer the questions "Should we care? Should we worry"?

Do SLCF considerations alter mitigation choices?
Are they worth thinking about?

Use same units (equivalence) for comparison only



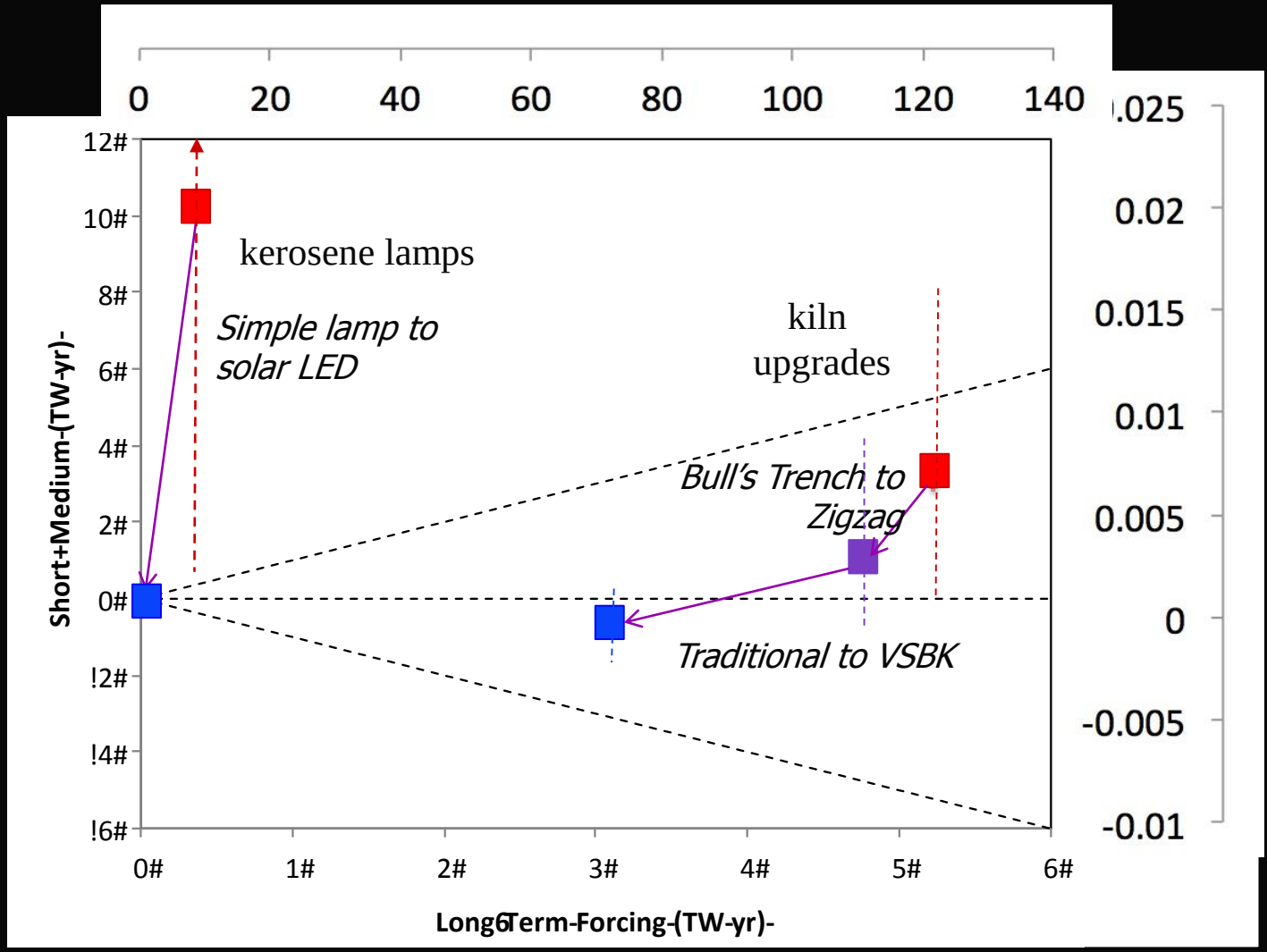
1:1 line
"Should we worry?"

Basically AGWP

Lamps: Lam et al., ES&T 46, 2012; Kilns: Weyant et al., Env. Sci. Tech 48, 2014

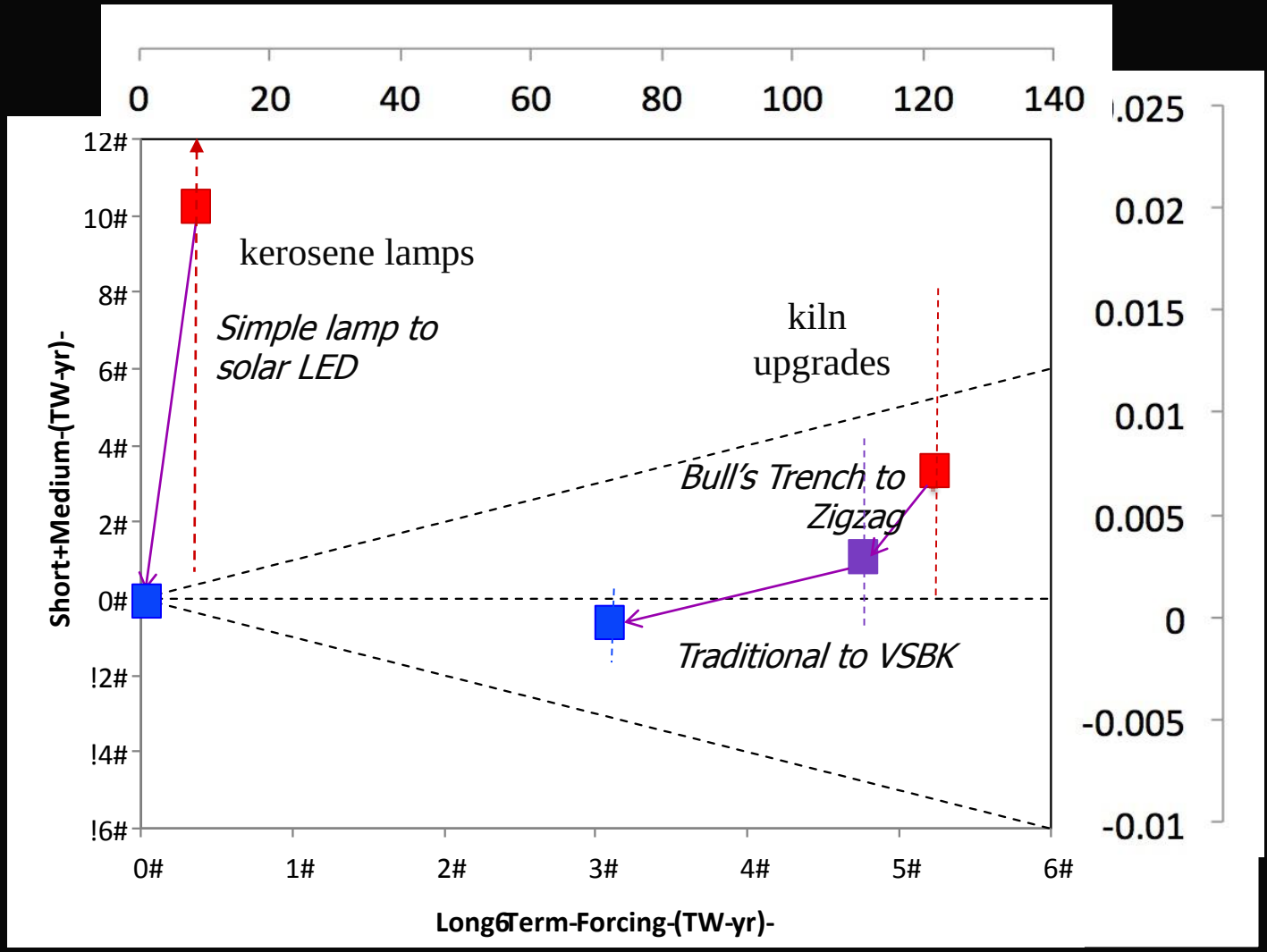
Next, add the units that communicate.

Mtonne CO_2



LLCF, tonne CO_2: mass – no timeframe – persistent

Mtonne CO_2



SLCF, W/m^2: forcing – instant = current-generation

We have much bigger problems than determining "equivalence"

SLCF reductions won't help climate unless they are constant into the future.

We may be able to quantify the benefit
but we have no way to enforce persistence.

→ Do something simple for guidance, move on,
start worrying about the hard stuff

Persistent uncertainty
in the responses that people care about most
will remain until it's "too late"

Regional temp, precip, circulation change,
extreme events…
20 years later, we have general ideas of the direction,
little idea of the magnitude

"Too late": Achieving persistent change requires
investment in infrastructure & governance
-- must start NOW for results in 2-3 decades

We have much bigger problems than determining "equivalence"

Only brief discussion of disbenefits. Examples:

- sulfate reductions
- organic carbon/cloud effects
- NOx on O_3 (good), methane (bad)

We are changing the atmosphere and its systems in ways that will take many years to characterize

→ Do something simple for guidance, move on, set a "good-enough" course

Use equivalence metrics for guidance and direction-setting ONLY.

We'll need something completely new to make sure mitigation efforts stay on course.