Tipping Points for Abrupt Climate Changes and Need for Fast-Track Mitigation

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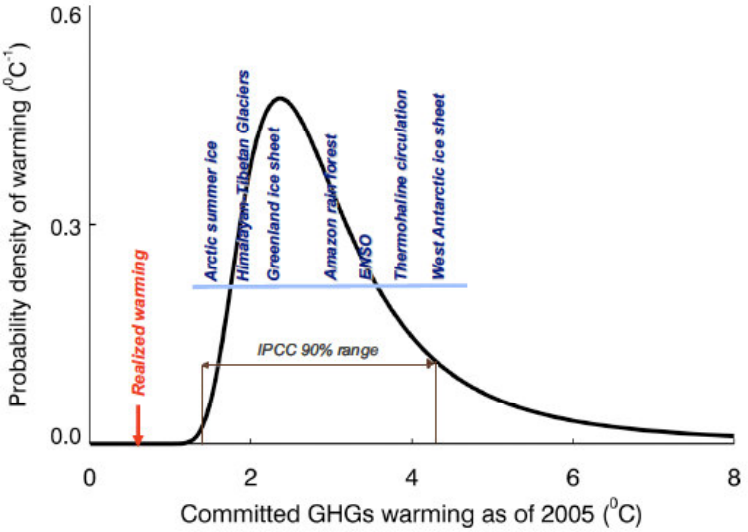

"Probability distribution for the committed warming by GHG between 1750 and 2005. … Shown are the tipping elements [large-scale components of the Earth's system] and the temperature threshold range that initiates the tipping. …" [1]

1. Race between:
   a. Accelerating climate feedbacks leading to abrupt climate change (ACC)
   b. Accelerating climate solutions, including fast-track strategies, and mid- and long-term strategies, esp C02/coal

2. Leadership, as well as law, will determine who wins.
   a. Must delay ACC
   b. Must speed up solutions

3. ACC:
   a. Climate is both linear and non-linear
   b. Non-linear changes are sudden, abrupt
   c. Occur when we cross critical threshold, or point-of-no-return
   d. No more energy needed for system change
   e. Like walking off cliff; last step is a killer.

4. ACC occurred in past, and will occurred in future
   a. Will occur "***faster than the cause … "***
   b. ***Won't have time to adapt.***

[1] V. Ramanathan & Y. Feng, *On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead*, 105 Proc. of the Nat'l Acad. of Sci. 14245, 14245 (23 September 2008).

5. Examples:
    a. Shift in Indian and other monsoons (per Air Marshal Singh)
    b. Disappearance of Arctic summer sea ice
    c. Reduction of Tibetan snow/ice (per Air Marshal Singh)
        i. Headwaters for most major rivers of Asia, including Yellow, Yangtze, Red, Mekong, Irrawady, Ganges, Indus, etc.
    d. Collapse of the Greenland and West Antarctic Ice Sheets,
    e. Shutdown of the Atlantic THC
    f. Die-off of Amazon and boreal forests.

6. Impacts could include many meters of sea level rise, water shortages, megadroughts, and famine
    a. Could release methane and other GHG from permafrost and ocean hydrates, and set off ***runaway feedbacks***.
    b. Could lead to political instability and resource wars.

7. Anthropogenic emissions now pushing climate system toward such tipping points ***sooner than previously expected***

8. As of 2005, committed to warming of "2.4ºC above the preindustrial surface temperatures." (As Dr. Velders noted Monday.)

9. This is within the range of predicted tipping points. See Figure.

10. The committed warming is comprised of:

    - Observed increase = **0.76ºC**
    - Warming currently trapped by ocean thermal **inertia = 0.6ºC.**
    - Warming masked by ABC = **1ºC**

11. Total committed warming is 2**.4ºC,** with more than 50% expected to occur within decades.

12. As we reduce atmospheric brown clouds, which containing cooling particulates as well as GHG and other pollutants, we are unmasking the 1ºC+ increase committed from current emissions.

    a. Need to approach like we're ***dis-arming a thermonuclear*** device.

13. High latitude, high altitude temperatures rising faster than global average:
    a. Arctic = 2X faster
    b. Greenland Ice Sheet = 2.2X faster
    c. Tibetan Plateau = 3X faster (up to 0.3ºC per decade)

14. Melting Arctic sea ice reduces albedo, or reflectivity, leading to more absorption of heat by darker Arctic waters exposed by loss of ice.

15. BC darkens polar surfaces and other show ice.

16. 2.4 C is within range for TP/ACC, and could be passed this century, ***or even this decade***.

17. Under a "BAU" scenario, where atmospheric CO_2 concentrations are increasing 2-3 ppm/year, ***question is not whether abrupt climate change will occur, but rather how soon***.

18. CO_2 concentrations will approach 441 ppm with a corresponding temperature of 3.1ºC by 2030 ***in the absence of strong countervailing mitigation***.

19. Despite the certainty that abrupt changes have occurred in the past and could be triggered again in the near future, current climate change policy does not account for abrupt climate change.

    a. IPCC doesn't address (as Dr. Velders noted Monday).

20. Focus must continue on mid- and long-term mitigation strategies to reduce CO_2.

21. But also must begin fast-track mitigation strategies for immediate climate mitigation to delay passing tipping points.

22. Can still hold 2ºC line, yet the race between climate feedbacks and climate solutions is a close one.

23. Improve odds with fast-track mitigation, including BC, MP, Biochar, etc.

24. Still must bend down the GHG emissions by 2015-2020, phasing out carbon dioxide emissions completely by 2100.

25. This requires an industrial revolution for sustainability starting now.
    a. Moore's Law for climate solutions.

26. ***Black carbon, or soot, may be the second largest contributor to climate warming, and because its atmospheric lifetime is days to weeks, reducing it may offer the fastest mitigation***.
        i. BC forcing may be "as much as ***55% of the CO_2*** forcing" (0.9 W $m^{-2,}$ with range 0.4 to 1.2 W m^{-2}).

27. BC reductions act fast: atmospheric concentrations will decrease within months of reducing emissions. ***Actions taken today will have almost immediate benefits***.

28. Other near-term climate mitigation strategies:

a. Reducing other short-lived forcers such as methane and tropospheric ozone precursors
b. Accelerating efforts under the Montreal Protocol to reduce ozone-depleting substances, which are powerful climate gases.
c. bio-sequestration in forests and soils, including biochar
d. Improving energy efficiency and expanding renewables, especially wind, which could provide 30% of world's electricity by 2030.

29. Need to focus on strategies with strong co-benefits for the development agenda, such as public health benefits from black carbon reductions, soil enhancement from biochar, and lower cost and increased energy security from efficiency and increasingly from renewables.

30. The co-benefits provide further incentives to act now to forestall ACC.

31. California AB 32: 44 early-action strategies, inc "Cool Roofs" and cars, ODS/foams

    a. Ubran Albedo

32. Many jurisdictions already will have some legal authority to address some of these strategies. Improving compliance can help promote near-term climate mitigation.

33. INECE recently issued *Climate Compliance Alerts* on black carbon and illegally harvested timber.

Take-away:

1. *Fast-track = down payment*
2. Start, Strengthen, Scale up
3. Military has power to act now, and to lead, by example, as this gathering shows
4. Leadership is Force Multiplier
    a. Knowledge
    b. Initiative
    c. Enthusiasm
5. Military has all of this and more
6. World needs your talent.