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Informing trade-offs between mitigation pathways: The link between climateilmpacts, eeedbacks, and Emission scenarios

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Ideally, on-the-ground decisions about mitigation are informed by climate science. In this presentation, I explore the guidance that climate models can provide to industry players facing the trade-off between mutually exclusive technology pathways (e.g., one pathway that offers immediate modest emission reductions (say 20%) and one that takes more time but offers potential for greater emission reductions (say 80%)). This is indeed the situation in some industry sectors and regions today; mitigation pathways may be mutually exclusive due to a host of factors, including economies of scale, limitations of money and time, inertia, and infrastructure lock-in. The questions underlying the trade-off are: To what extent are modest near-term emission reductions preferable to larger long-term reductions? What relative magnitude of benefits do near-term reductions provide in terms of smaller feedback effects and reduced impacts? Said another way, if a certain level of anthropogenic radiative forcing (RF) is delayed by 10-15 years, what has been gained? I'll explore these questions from two related perspectives: feedback effects and climate impacts. For feedbacks, I will compare the CO2 airborne fraction and planetary albedo between mitigation scenarios (SRES, RCP) - across time and across model runs in CMIP3 and/or CMIP5, as available. I'll use two metrics: global RF and Feedback Ratio (herein defined as feedback RF / total RF). I'll then compare the model runs with what might be expected from the two trade-off scenarios. For climate impacts, I will use the examples of ocean pH, extreme heat days, and September sea ice to illustrate how impacts compare across mitigation scenarios, across time, and across model runs in CMIP3 and/or CMIP5, as available. (some variables are available in CMIP3 or CMIP5, not both) The analyses presented will provide only partial answers to the questions posed at the beginning about trade-offs between mitigation pathways. To fully answer these questions and communicate the results, much more work is needed. I'll close with (at least) two implications for the research agenda. First, some climate model runs should reflect the generic types of investment decisions faced by industry leaders, so that trade-offs between technology pathways can be informed by climate science. Second, much more research and communication is needed comparing decadal feedbacks and impacts between emission scenarios and across models. Impacts are much easier to envision for the lay audience than incremental temperature changes, and on-the-ground industry trade-off decisions require a tangible sense of consequences. Production of cross-scenario, cross-model, time-bound projections for a wide range of feedbacks and impacts will require fundamental research advances, storage of additional impacts-relevant variables and emissions variables in a CMIP format, and close collaboration between the scientists in IPCC Working Groups I & II.