

Global-mean and Arctic temperature trajectories for various scenarios, with and without CO2 removal (CDR) and Solar Radiation Management (SRM)

In summary, the conclusions that are derived from the diagram are:

- global decarbonisation alone would lead to catastrophic global warming;
- the effect of decarbonisation is made worse by the removal of SO₂ cooling, e.g. from coal-fired power stations;
- global SRM is needed to keep the global-mean temperature below 1.5°C and bring it down below 0.5°C;
- CDR and methane suppression should be ramped up quickly to offset emissions and then help keep the global temperature safely near 0°C for the long-term, thereby allowing SRM to be phased out;
- Emergency SRM to refreeze the Arctic – this is needed to stave off catastrophes which could arise:
 - from partial disintegration of the Greenland Ice Sheet, leading to a sudden sea level rise of a metre or more;
 - from the Arctic Ocean becoming free of sea ice at the end of summer leading to a permanent change to global weather patterns;
 - from a massive discharge of methane from subsea permafrost, threatening the transition to a hot-house Earth.

Bringing both global and Arctic temperatures down to old norms means that sea level can be stabilised, i.e. the sea level rise from ocean thermal expansion and Greenland ice mass loss is halted. The greater cooling of the Arctic restores the temperature difference between Arctic and the equator, meaning that weather systems are stabilised again – jet stream behaviour is returned to the old norm and this reduces the weather extremes which cause so much damage. Arctic permafrost is refrozen, which means that methane emissions are suppressed.

Notes:

[1] Arctic Amplification (AA) is shown in the diagram by having two superimposed scales: one for global temperature trajectories and one (in blue) for the Arctic.

[2] Arctic Amplification is shown to be a factor of about 4 in NASA's resource "A Degree of Concern: Why Global Temperatures Matter" where at 2°C global warming the Arctic is around 8°C. See: <https://climate.nasa.gov/news/2865/a-degree-of-concern-why-global-temperatures-matter/>

[3] The rapid Arctic warming appears to have started around 1970, See: <http://berkeleyearth.org/global-temperatures-2017/>