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Rising methane: consequences, causes, and prognosis.

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Methane's atmospheric mole fraction has risen by about 70 ppb since 2007. After a period of stability in the early years of this century, the rise began unexpectedly in 2007, followed by several years when methane rose by 5-7 ppb/yr. Then in 2014, the growth rate trend accelerated, with an increase 12.5 ppb in that year, followed by ongoing very strong rises in 2015 (10 ppb), 2016 (7 ppb). The strongly rising trend has continued though 2017 (NOAA data and Royal Holloway measurements at ASC, ALT, ZEP, CPT). The rise has been accompanied by a significant isotopic shift to more C-13 depleted 'lighter' values. The causes of methane's rise since 2007, and acceleration from 2014, as well as the isotopic shift, are controversial: the proportion of biogenic sources may have increased; the OH sink may have declined; or both may have happened, especially as the latitudinal zone under the inter-tropical convergence has warmed and expanded.
Methane's unexpected strong rise has significant consequences for the Paris Agreement. Representative concentration pathway RCP2.6 demands a rapid drop in methane; instead, there has been a very significant rise. Methane is now about 100 ppb higher than envisaged in the Paris-compliant scenario, in contrast to CO_2 which is currently close to the expected growth path. This methane rise has major warming consequences, especially as methane's global warming impact has recently been revised upward. The current rise may be driven by climate feedbacks that may not be easy to manage. There is urgent need to improve our knowledge of the global methane budget, to constrain latitudinal fluxes and isotopic balances, and to predict methane's likely response to near-future climate change. To bring methane back to a pathway compatible with the Paris Agreement, the best responses will likely be vigorous measures to reduce those anthropogenic emissions that can most easily be controlled: from the fossil fuel industry, from landfills and waste, and by reducing agricultural emissions. There is little sign that methane growth will slow: but unless this is done, urgently, the prognosis for the Paris Agreement is not good.