BIOGEOCHEMISTRY

Methane on the rise

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TERRY DONNELLY / ALAMY STOCK PHOTO

After approximately a decade of stability, the globally averaged concentration of methane in the atmosphere began to increase again from 2007 at a rate of 5.7 ± 1.2 ppb per year. The causes of this trend are important for our understanding of the impacts of climate change and the potential for positive feedbacks to enhance climatic changes.

Euan Nisbet from Royal Holloway University, UK, and co-authors utilize data from the NOAA cooperative global air sampling network and Royal Holloway measurements at Alert, Canada, Ascension Island, equatorial Atlantic, and Cape Point, South Africa, to investigate the reasons for the rise. They develop a budget analysis of monthly average values of methane mole fraction and $\delta^{13}C_{CH4}$ — a measure of the $^{13}C/^{12}C$ isotope ratio in methane — over four latitudinal zones.

The sustained shift to more ^{13}C-depleted values and the degree of interannual variability — indicative of biogenic methane sources — together with the tropical and Southern Hemisphere loci of methane growth indicate that fossil fuel emissions are unlikely to be the dominant driver of this trend. Although the data do not provide conclusive source diagnoses, the authors suggest that increased methane emissions from tropical wetlands and agriculture, linked to unusual climatic conditions, are the most likely culprits driving observed methane increases. *AB*

CRYOSPHERIC SCIENCE

Anthropogenic signals

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Climate models project increases in Antarctic surface mass balance — the difference between snowfall and evaporative ice loss — due to anthropogenic warming. Observations, however, do not reveal any significant change in mass balance in recent decades. Rates of Antarctic ice loss, or gain, have potentially important implications for both changes in sea level and its predictability.

Michael Previdi and Lorenzo Polvani from Columbia University, USA, investigate the cause of this discrepancy using an ensemble of 35 coupled atmosphere–ocean models. These effectively capture the climatological features of Antarctica's surface mass balance. Comparisons of pre-industrial and future simulations are used to distinguish forced anthropogenic signatures from natural variability.

Results indicate that the large range of natural variability in surface mass balance masks anthropogenic impacts, making them undetectable at present. This explains the apparent inconsistency between observational records and model simulations. Nevertheless, the authors expect that anthropogenic signals will emerge by the 2040s, wherein warmer temperatures and resultant increases in atmospheric moisture content enhance snowfall and thus increase Antarctic surface mass balance, partially mitigating future global sea level rise. *GS*

INTEGRATED MODELLING

New social pathways

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Models that project how policies may impact future emissions rely on projections of how society may change in the coming decades. Over the last three years, researchers have refreshed the assumptions used to inform these models, known as the shared socio-economic pathways (SSPs), with a new set now presented in a special issue of *Global Environmental Change*.

Keywan Riahi and colleagues from institutions across the globe present an overview of the new SSPs. The pathways are based on five narratives that seek to capture the breadth of possible development paths, factoring in differing levels of inequality, insecurity, technological progress and population growth. The narratives are then turned into quantitative projections that can be used in integrated assessment models.

Unsurprisingly, there is a wide range of results depending on which SSP is used; for instance, emissions associated with the various baseline scenarios range from 25 $GtCO_2$ per year to more than 120 $GtCO_2$ per year by 2100. The new SSPs are now ready for use by the wider community, the authors say, with next steps including developing regional extensions and employing them with a new generation of Earth system models. *MH*

CORAL REEFS

Community responses

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Climate change threatens reef growth most notably by increasing temperatures and ocean acidity. Because scleractinian corals vary in their sensitivity to these factors, species composition might be expected to influence reef community response under climate change. However, projections of reef growth under climate change typically neglect this nuance.

To begin to fill this knowledge gap, Remy Okazaki from University of Miami, USA, and co-workers investigate the calcification of twelve Caribbean coral species under a variety of combined temperature and CO_2 partial pressures (p_{CO2}), an indicator of acidification. They then estimate community-level scleractinian calcification responses for Florida Keys' reef composition under projected climate conditions.

Under a business as usual emissions scenario they find that three of the four most abundant species have negative calcification responses to both elevated temperature and p_{CO2}. Reefs abundant in these species have projected end-of-century declines in scleractinian calcification of >50%. A fourth common species, *Siderastrea siderea*, is insensitive to both drivers tested: consequently, reefs dominated by this species have more stable growth rates. These findings support the importance of species composition in determining community responses to climate change. *AB*

Written by Alastair Brown, Mat Hope and Graham Simpkins.