These results are intriguing, but as always there are a number of caveats. First, the study neglected any effects of solar variability on ozone chemistry, which would probably amplify the signal. Second, the simulations consider only the limited UV wavelength range, which is in phase with the solar cycle, but not the visible or the near-infrared wavelengths. In the visible and near-infrared range, SIM measurements are out of phase with the solar cycle, contrary to previous understanding of 11-year solar variability. The SIM data have been used in a radiative-photochemical model[9] and in climate models[10,11], to assess the atmospheric implications of the radiation changes across the entire spectrum of wavelengths, but without explicit simulation of full ocean dynamics. However, these simulations did not attempt to quantify the impact of changes in solar activity on surface climate in the region under the influence of the NAO. Finally, the trends seen in the SIM observations are still under discussion and remain to be confirmed.

The results reported by Ineson *et al.* are unique, in that the impacts of changes in solar UV radiation on surface climate have never before been simulated with a climate model that encompasses a dynamic ocean as well as the atmosphere up to altitudes of 85 km. Moreover, the decadal-scale surface signal resembles observations strikingly well. If the SIM measurements are correct and the spectral distribution can be confirmed over a full solar cycle, then a reproduction of the decadal signal in a similar model, but including variations in solar radiation in the visible and near-infrared wavelengths, could provide exciting perspectives for decadal-scale climate predictions.

The study by Ineson and colleagues[3] hints at a strong effect of the 11-year solar cycle on decadal surface climate during Northern Hemisphere winter. But the findings await confirmation of the large amplitude of variability in solar UV radiation with SIM measurements taken over a longer period, and an incorporation of the full spectral variability in climate model simulations that consider the stratosphere, ozone chemistry and full ocean dynamics. ❐

Katja Matthes is at the Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Telegrafenberg, 14473 Potsdam, Germany.
e-mail: matthes@gfz-potsdam.de

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CLIMATE SCIENCE

Roofs and roads

Around half of the world population now lives in cities, a staggering amount given that urban areas cover just a small portion of the land surface. These dense centres of human activity are characterized by their own, unique environment. They are home to carbon dioxide domes, soaring levels of ground-level ozone and particulate matter and, in some developing countries, a shortage of clean water.

Cities are also built with materials that retain heat and disrupt the flow of moisture and energy between the ground and the air above. As a result, urban areas tend to be warmer than their rural surroundings, particularly at night, when the heat stored up in the day is radiated back out to the atmosphere. This phenomenon, known as the urban heat island effect, is thought to be mainly of local importance.

Now, Mark Jacobson and John Hoeve suggest that urban surfaces could account for 2–4% of gross global warming — that is, warming in the absence of aerosol cooling — in the first quarter of the twenty-first century (*J. Clim.* http://dx.doi.org/10.1175/JCLI-D-11-00032.1; 2011). They model the impact of roofs and roads in all urban areas on global climate over a 20-year period, starting in 2005. According to their simulations, urban surfaces raise global temperatures by an average of 0.06–0.11 K over this time frame.

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Climate feedbacks seem to enhance the warming induced by urban islands. Roof and road surfaces increase sensible heat flux from the ground to the atmosphere in populated areas, but reduce the flux of moisture. The net result is a reduction in relative humidity and cloud formation, and a concomitant increase in the amount of solar radiation reaching the surface. In this way, a positive feedback ensues.

A number of geoengineering schemes have been proposed to dampen urban heating, including the use of reflective roofing materials. In an additional simulation, Jacobson and Hoeve tested one such scheme: painting roofs white in urban areas. The scheme lowered temperatures locally, owing to an increase in the proportion of incoming solar radiation reflected back to space. However, the scheme raised globally averaged temperatures, owing to a reduction in cloudiness brought on by an increase in atmospheric stability, and a range of other feedbacks. Although the researchers note that the effect on global temperatures is highly uncertain at this stage.

As urban areas continue to be developed at breakneck speed, careful thought regarding their construction could help to alleviate some of the climatic toll, at least on a local level.

ANNA ARMSTRONG