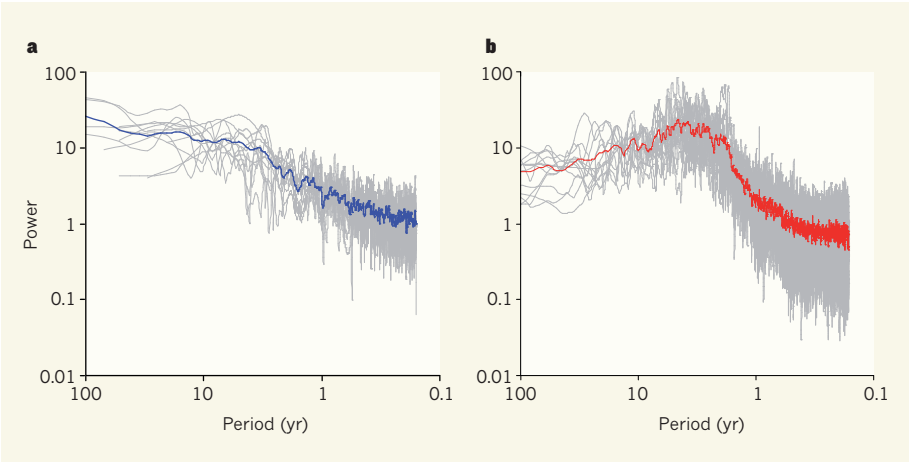

Figure 1 | Spectra of the Southern Oscillation. The Southern Oscillation is the large-scale oscillation in sea-level atmospheric pressure that occurs between the eastern and western Pacific, and is usually viewed as an atmospheric response to anomalous sea surface warming (El Niño) or cooling (La Niña) in the central and eastern Pacific. **a**, Clement *et al.*[2] have used 13 models in which the atmosphere is thermodynamically coupled to a motionless, 50-metre-deep slab of ocean to plot spectra of the Southern Oscillation (shown). The spectra plot power — a dimensionless measurement of the magnitude of the difference in atmospheric pressure between the western and eastern Pacific — against the period of the oscillation. The blue line denotes the multi-model average, whereas the grey lines indicate results from individual models. In these models, the magnitude of the Southern Oscillation increases with the period of the oscillation. **b**, The authors also plotted spectra using another 13 climate models in which full ocean dynamics are dynamically and thermodynamically coupled to the same atmospheric models as those used in **a**. These spectra show that the strongest variations in the Southern Oscillation occur roughly every 2–8 years. The difference between the two spectra indicates the role of coupled ocean dynamics in generating the variability of the Southern Oscillation at different timescales. (Data courtesy of A. Clement.)

Because the tropical atmosphere is influenced by SST, the 'redness' of SST variation is reflected in the spectra of the Southern Oscillation, which show how the magnitude of the difference in sea-level atmospheric pressure between the western and eastern tropical Pacific varies with the period of the oscillation (Fig. 1). Thus, interactions between the tropical atmosphere and ocean help to generate coupled climate modes. In the absence of the Bjerknes feedback, the authors' models describe a robust, thermally coupled mode whose structure resembles the El Niño–Southern Oscillation (ENSO) on both interannual timescales (periods in the range of two to ten years) and decadal or multidecadal timescales.

Do Clement and colleagues' findings suggest that the Bjerknes feedback and ocean dynamics are not important for tropical climate? Not necessarily. In their second experiment, they simulated tropical climate using 13 models in which the atmosphere is coupled to a fully dynamic ocean[2]. The interannual ENSO signal predicted by these models was, on average, two to three times stronger than that predicted by the slab-ocean models. What's more, a previous study[5] found that 19 out of 24 computer models lacking coupled ocean dynamics severely underestimate the intensity of ENSO. These results, taken together with Clement and colleagues' findings[2], explicitly affirm the classic ENSO theory involving coupled ocean dynamics that underpins extensive current research into ENSO and global-climate forecasts on seasonal-to-interannual timescales. However, on decadal and longer timescales, ocean dynamics seem to be less important than was thought: the magnitude of the variance in SST in the climate mode observed by Clement *et al.*[2] in their ocean-slab models is comparable to that observed in reality. When the authors coupled full ocean dynamics to the atmosphere in their models, this actually weakened the decadal and multidecadal variability by constraining the variance of tropical climate to interannual timescales.

The underlying mechanisms of decadal and multidecadal climate variation in the tropical Pacific are unknown. A lack of ocean observations means that the precise roles of the ocean — particularly the role of subsurface signals originating from the extratropics, the regions poleward of the tropics — remain controversial. There is even debate over whether the decadal ENSO-like mode is a physical entity or an artefact arising from the nonlinearity of ocean–atmosphere coupling[6]. Similar debates have been sparked by attempts to detect and project tropical Pacific climate change under global warming[7,8]: will increased anthropogenic greenhouse-gas emissions lead to an El Niño-like state, or the opposite (a La Niña-like state)? Clement and colleagues' work supports neither of the two scenarios, but questions the importance of the Bjerknes feedback, the core element of prevailing hypotheses.

One limitation of the authors' findings[2] is that many of their climate models are severely flawed when simulating the period and

50 Years Ago

The circumstances of our age seem to present us with a very real problem which may fittingly be discussed under the title of "Science and the Classics". In response to an international challenge we are engaged in expanding our educational services. The urgent need is for more scientists, more technologists, more engineers. This means a relative, if not an absolute, decline in the study of the humanities. Is this shift in the character of our education good or bad? Is there anything in the claim that the study of the humanities produced a more balanced type of man? Is there in the scientific mode of training any tendency against which it is desirable to be on our guard? I think that there is a tendency among scientists to suppose that the physical world alone is real, and that the very successful methods they have devised for dealing with it are applicable to every aspect of life. This, to my way of thinking, is a dangerous illusion.

From *Nature* 30 September 1961

100 Years Ago

Exhaustive tests have been made during the last two weeks by Mr. A. W. Sharman with instruments invented by him for telephoning through water without wires. A small telephone station has been erected in a room in an hotel on the cliffs at Pegwell Bay, and the other station has been fitted up on a motor-boat cruising in various parts of the bay … The speech transmitted through the water has been very distinct, and the system has shown good possibilities of its being used as a means of verbal communication between two ships, such as a battleship and a submarine.

From *Nature* 28 September 1911

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