CLIMATE CHANGE IN A NUTSHELL

Can the complexity of the Earth's climate be distilled down to a single number like an economic index? The IGBP climate-change index does just that and it seems effective at exposing underlying trends.

Wherever you are in the world this scene will be familiar. You are watching the news on TV. Towards the end of the bulletin, before the weather, the newsreader says "and now it's time to go to the markets". Then some numbers flash up on the screen. It could be the Dow Jones index, the FTSE, the Nikkei, the DAX or the Hang Seng. Whichever one it is, the message is instant and clear: the economy is growing, it is shrinking, or it is stable. And you get a visual clue as to the rate of change too.

Economic indices like the Dow Jones are extremely powerful communications tools. The single number, distilled from perhaps hundreds of sources, combines a wealth of underlying information. The underlying data are essential to professionals in the field, but they are an unnecessary distraction to most others. The media stops at the index, only delving deeper when the markets crash or soar: most people are not interested in the detail.

Economic theorists argue how inaccurate these economic indices are for predicting economic trends, but nevertheless the press, the public, policymakers and economists follow them daily. They are easy to digest, and give a simple thumbs up/thumbs down assessment of economic trends.

Given the incredible complexity and interannual variability of the Earth's climate, you might reasonably argue there is no way this overall trend could be distilled down to a single number. But such a number could be useful. Many of the key parameters – temperature, sea level, Arctic sea-ice extent – vary naturally each year. The underlying trend is not always so clear to the casual observer. An index could expose the underlying trend and visually indicate if climate change is accelerating or slowing. This is the idea behind the IGBP climate-change index. It works like the famous economic indicators and gives the press, the public and policymakers a visual summary of the trajectory of climate change.

The index removes natural variability extremely effectively.

The index brings together the key parameters from the atmosphere, ocean and cryosphere: atmospheric carbon dioxide levels – the main driver of change – global surface temperature, sea-level rise and summer Arctic sea- ice extent. In doing so the index provides a compelling snapshot of which direction we are heading, and how fast.

The idea came about when several IGBP scientists, including Steven Running, former IGBP director Kevin Noone, Kathy Hibbard, Mark Stafford Smith, IGBP executive director Sybil Seitzinger, Peter Cox, Suzi Kerr and Pierre Friedlingsten, realised that the way various global datasets are reported throughout the year is confusing. It is uncoordinated, there is a variety of unfamiliar units, and natural variability sometimes masks a trend. The press and public are not clear about the scale of the changes scientists are witnessing. The index is a response to these concerns.

Why those four metrics? Steven Running from the University of Montana says, "The iconic Mauna Loa atmospheric CO_2 concentration was obvious. Global air temperature is already widely reported at the end of each calendar year, so that was a logical choice too.

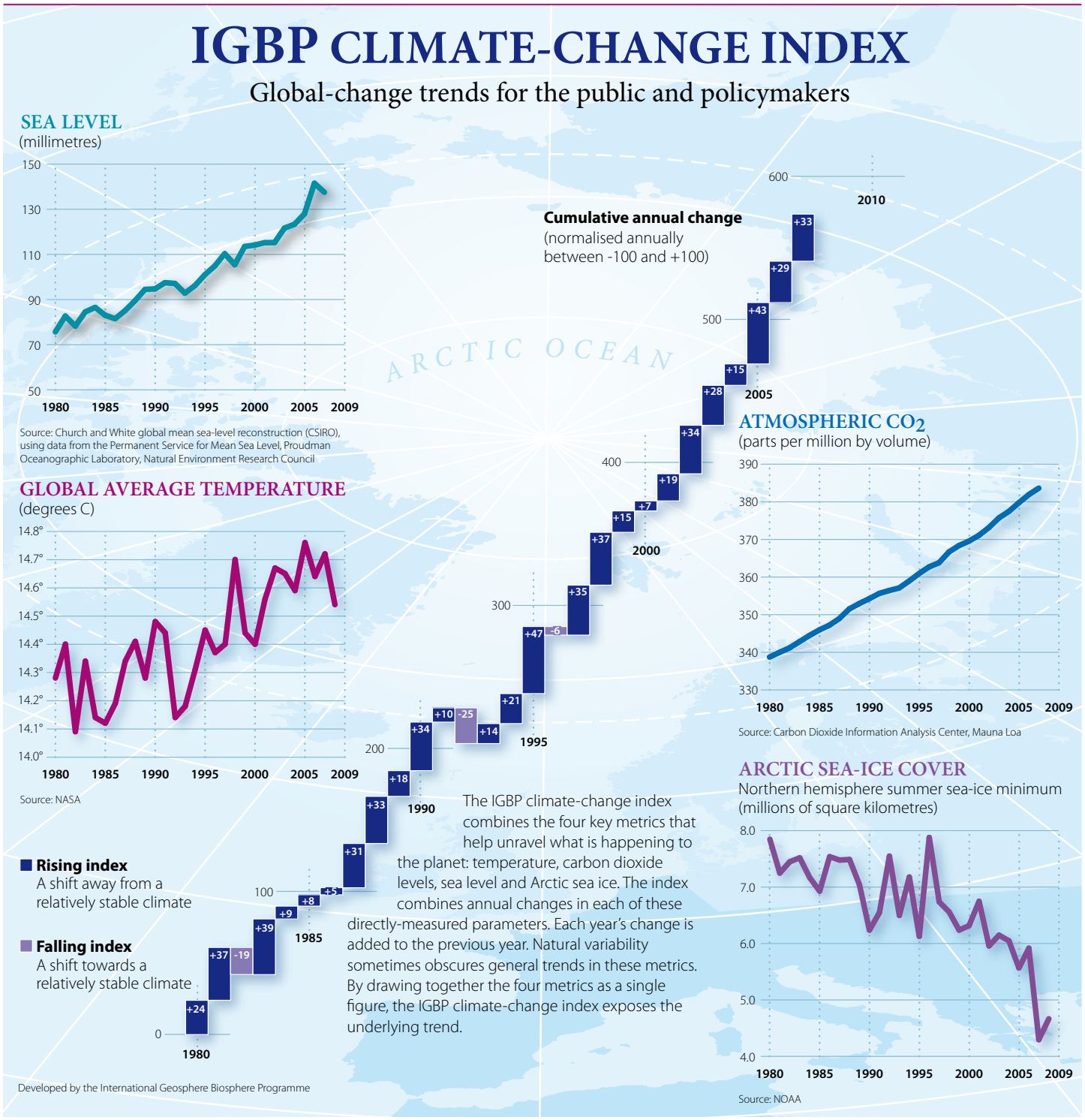
"We needed an oceanic measure and chose sea-level rise because the impact is global and of high public interest. Growing concern about the rate of loss of summer sea ice in the Arctic led us to choose this metric. This parameter broadly represents the Earth system and it is interesting that the summer sea ice extent is shrinking much faster than models predicted five, ten years ago."

In the future, other variables could be added. "We did not identify any good land surface variable, because no good standard exists," says Running. "But some day we may have annual albedo or land-cover change."

Number crunching

The index displays yearly *change*. So even though sea ice is reducing and the other parameters are increasing the index shows that every year, we are moving rapidly away from a nominal 1990 level – chosen because 1990 is the baseline for emissions reductions under the Kyoto Protocol.

Each parameter is normalised between -100 and +100. Zero is no annual change. One hundred is the maximum-recorded annual change since 1980. The param-



eters are added together and averaged. This gives the index for the year. The value for each year is added to that of the previous year because we are talking about cumulative change.

Running says, "Some of us thought we'd need a five-year rolling average to help dampen fluctuations and to elucidate core trends. But when we first produced the index it was obvious this was unnecessary: the index removes natural variability extremely effectively." The index shows that, since 1980, the rate of annual change is steadily increasing. The index decreased in value for just three years in the 30-year period: 1982, 1992 and 1996.

There is growing international interest in the index. IGBP will publish it annually and promote it to policymakers, government departments, the public, the media, organisations such as WWF and schools. It will be available on the IGBP home page and as a PowerPoint slide, and we will ensure easy access to the underlying data.

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Requests have also come in to backdate the index 100 years, maybe even 1000 years or more. Probably the first development, though, will be an index on extreme events.

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