Pacific decadal climate variability

VicDRIP
Victorian Drought Risk Inference Project

A factsheet for Australian water resource planners

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Q1. What is Pacific decadal variability (PDV)?

Climate variability in the Pacific is driven primarily by the El Niño Southern Oscillation (ENSO). But, slower moving phenomena, called the Interdecadal Pacific Oscillation (IPO) and its north-Pacific cousin the Pacific Decadal Oscillation (PDO), describe the decade-to-decade changes that occur in the Pacific Ocean. These phenomena have been collectively referred to as Pacific Decadal Variability (PDV). A variety of indices have been developed to describe PDV. The indices reveal shifts around 1945 to the negative phase, 1977 to the positive phase and 1999 to the negative phase. The most recent data suggests that PDV might be on the move into its positive phase.

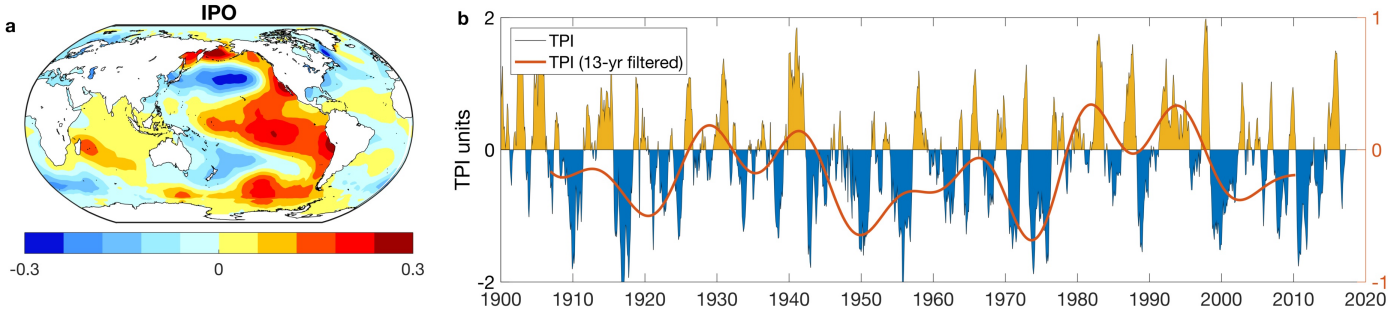

Figure 1 Spatial pattern and timeseries of the IPO

Q2. Why are we, as scientists and water managers, interested in PDV?

PDV has influences on the global climate system and Australia's climate. This includes impacts on temperature and rainfall, and interactions with the interannual-scale climate phenomena such as ENSO, the Indian Ocean Dipole (IOD) and the Southern Annular Mode (SAM). It is critical that we learn more about decadal-scale variability in order to improve seasonal forecasting and long-term planning.

Q3. What about PDV before modern times? Has it always existed?

There are 12 palaeoclimate reconstructions of the IPO or PDO, stretching for between 300 and 1000 years into the past. The reconstructions use tree ring, coral and ice core data from the Pacific, Asia and the Americas. All of the reconstructions demonstrate significant decadal variability back in time, but in general, the reconstructions show limited agreement with each other. This indicates that regional expressions of PDV in palaeoclimate proxies might not be uniquely representative of a common PDV forcing. Although the critical ground work has been laid, more research is needed on data collection and collation, palaeoclimate reconstruction and mechanistic diagnosis. With more research we will be able to clearly identify whether or not a coherent, large-scale PDV phenomenon has existed in past centuries, and the precise nature of its origins and characteristics.

This fact sheet is a brief, plain English, summary of key aspects of a review paper published in the journal *Global and Planetary Change*. Please email Ben for a copy of the full paper (bhenley@unimelb.edu.au): **Henley, B. J.** (2017). Pacific decadal climate variability: Indices, patterns and tropical-extratropical interactions, *Global and Planetary Change* (link to paper).

Q4. What is the current state of the PDV? When will it next change phase?

The IPO has been in its negative state since about the year 2000. Recent data suggests that the IPO might be entering a positive phase, but we require several more years of data to confirm the switch. The following figure illustrates our current uncertainty of the IPO phase.

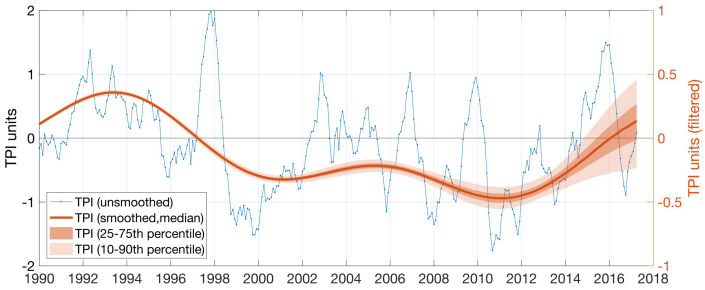

Figure 2 Uncertainty in PDV in the recent past

Q5. Is the IPO a "*real*" climate mechanism, or just the by-product of El Niño?

The patterns of decadal variability are real - data doesn't lie! But PDV appears to arise from a complex set of interactions between the atmosphere and the ocean in the tropics and beyond. ENSO is certainly a big part of the story. Work is underway to better understand decadal mechanisms, but we need much more research focus on it. One possible mechanism which could explain what we see is shown in the figure below, and described in the review paper. There are lots of hints that PDV is much more than just the tropical variability of ENSO. This is an opportunity for climate scientists to explore, and a probable avenue for better understanding low frequency climate variability.

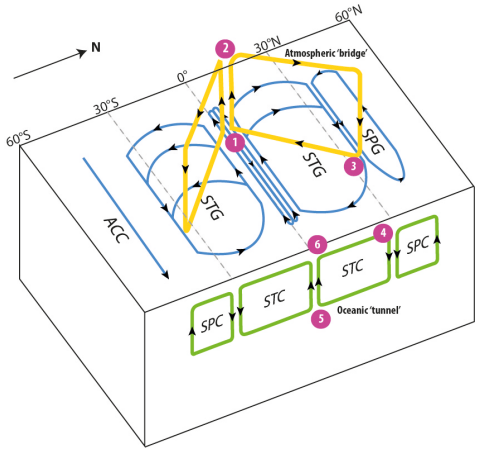

Figure 3. A possible PDV mechanism

Q6. Where can I read more?

The vicdrip.org website provides updates on PDV and information about our linkage project investigating severe drought. The National Oceanic and Atmospheric Administration (NOAA) website publishes Ben's updates of the TPI timeseries. You can also read more in the articles and on *The Conversation* at the links below.

Links and References

Henley B. J. (2017) Pacific decadal climate variability: indices, patterns and tropical-extratropical interactions, invited review in *Global and Planetary Change, 155, pp. 42-55. doi:10.1016/j.gloplacha.2017.06.004*

Henley B. J. & King, A. D. (2017) Trajectories towards the 1.5°C Paris target: modulation by the Interdecadal Pacific Oscillation. *Geophys. Res. Lett.*, pp. 1–7. doi:10.1002/2017GL073480

Henley, B. J., Meehl, G., Power, S., Folland, C., King, A., Brown, J. & Neukom, R. (2017) Spatial and temporal agreement in climate model simulations of the Interdecadal Pacific Oscillation. *Environmental Research Letters, doi: 10.1088/1748-9326/aa5cc8*

Henley, B. J., Gergis, J., Karoly, D. J., Power, S. B., Kennedy, J. & Folland, C.K., (2015) A Tripole Index for the Interdecadal Pacific Oscillation. *Climate Dynamics*, 1–14. doi:10.1007/s00382-015-2525-1

Henley, B. J. & King, A. D. (2017) Global warming could accelerate towards 1.5℃ if the Pacific gets cranky *The Conversation* (9 May 2017)

Henley, B. J. et al (2017) Meet El Niño's cranky uncle that could send global warming into hyperdrive. *The Conversation (6 February 2017)*

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