Canberra observed

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Trump proposes big cuts to science in 2018 US budget: how will they affect Australia?

I often complain about low levels of investment in science by Australian governments, whether they be Labor or the Coalition. At least most of them recognise the importance of Research and Development, even if the rhetoric isn't always backed up by the numbers in the budgets.

Not so Donald Trump. His 2018 budget request as presented to Congress appears to be a bad deal for science, health, and all research unless it involves nuclear technology and defence.

The outlays proposed by Trump for 2018 will be approximately the same as in 2016 but $47 billion more will be allocated to the military, $20 billion more to infrastructure and there will be miscellaneous increases of $5 billion. Consequently, to achieve the same outlay, savings of $72 billion will have to be found in other areas.

It should be noted that in 2016 US military investment was estimated as more than the total military spending from the next eight biggest-spending countries. To put this in perspective, the increase requested in one year is larger than Japan's total annual military spending in 2016.

Before some of the detailed programmes are considered, it is worthwhile comparing the size of the US budget with Australia's.

Table 1 compares the overall outlays in US$ for the US and Australia. The annual per-capita investment is US$12 500 in the US and US$14 000 in Australia. The debt/GDP value is much worse in the US, but the R & D investment in the US (according to the latest OECD report https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm) at 2.8% GDP is much better than Australia's 2.1% GDP, which is below the OECD average of 2.4%.

Cuts to US science agencies

Figure 1 from http://www.sciencemag.org/news/2017/03/trumps-first-budget-analysis-and-reaction shows how the main science agencies fared in the President's budget request. Since the President tabled his requests in June 2017, a House of Representatives appropriations subcommittee has already advanced a $37.5 billion energy and water bill that would slash funding for renewable and efficiency programmes and eliminate the Advanced Research Projects Agency-Energy agency, which had a budget of over $300 million in 2017.

Fortunately all the President's proposals will have to be approved by Congress, so the lobbying will already have started to amend his proposals. The estimated R & D investment by the US Science Agencies in 2017 was about $140 billion, of which half was spent by the Department of Defence. Therefore, there must be savings from the other agencies of approximately $70 billion to meet the overall budget outlays. In this context the USGS, which had a budget of just over $1 billion in 2017 is small, but significant. Its role and functions are similar to Geoscience Australia's.

How did the USGS fare?

The President Trump has proposed a $922.2 million allocation for the US Geological Survey in 2018. This amounts to a saving of $137.8 million from the FY 2017 allocation or a cut of 13 percent.

The Minerals and Energy programmes remain intact, which is good, but there is a 19% cut in the Natural Hazards Programme from the $145 million provided in 2017 to the $118 million, requested. A good summary of what the impact would be is at: https://www.usgs.gov/news/president-proposes-922-million-fy18-budget-usgs

This two-page document has been prepared by the USGS and is accessible in the public domain, presumably for consideration by lobbyists, stakeholders, and clients. It contains summaries of the goals of the different programmes and what the impact would be if the President's budget is accepted.

There is no equivalent process in Australia. It's like the Director of the National Library of Australia producing a public document to outline the impact of the efficiency divided cuts on the NLA's programme. I don't think the Government would allow such openness.

Table 2 summarises the situation for each of the Hazard Programmes in the USGS.

The most significant of these proposals is probably the elimination of the Geomagnetic Programme, a component of the multi-agency US National Space Weather Programme. This would not only affect the United States, but has global implications. It would mean there would be almost no reliable, real-time,

Table 1. Comparisons between Federal USA and Australian budgets

2017/18 estimates	Population millions	Outlays (billions, US$)	Current debt % GDP	Target year for balanced budget	Military spending billions 2016 + (US and Aus. for 2018)
US	327	4100	77	2027	611+ (47)
Australia	25	350	25	2020	25 + (2)

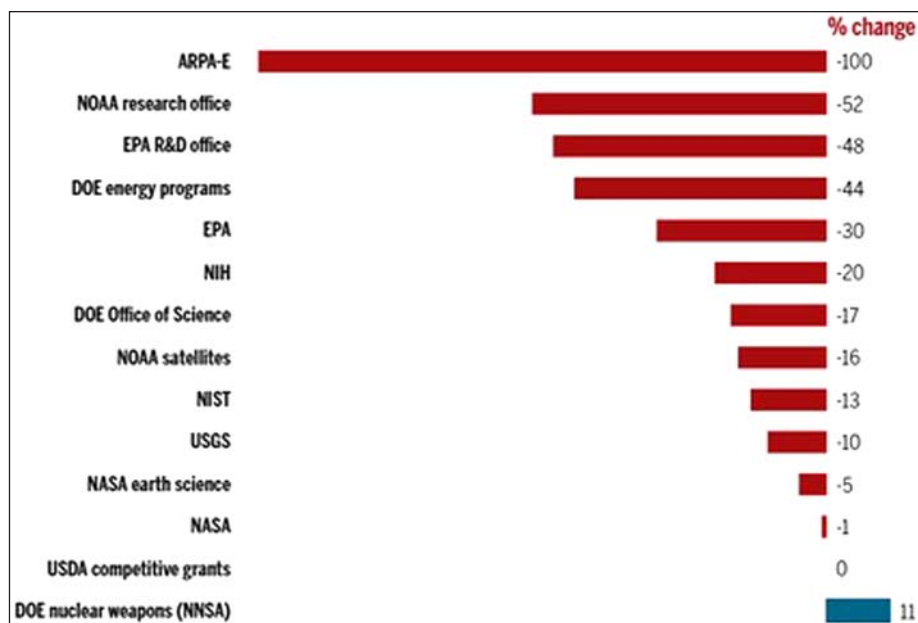Comparisons between Federal USA and Australian budgets (assume A$ = US$0.78)[A]

[A]*From the following websites:*
https://www.google.com.au/search?q=A+Quick+Summary+of+President+Trump%27s+FY+2018+Budget&oq=A+Quick+Summary+of+President+Trump%27s+FY+2018+Budget&aqs=chrome..69i57j69i64j69i60.2687j0j8&sourceid=chrome&ie=UTF-8
http://budget.gov.au/2017-18/content/glossies/overview/download/Budget2017-18-Overview.pdf
https://www.sipri.org/sites/default/files/Trends-world-military-expenditure-2016.pdf
https://www.nytimes.com/2017/05/22/us/politics/trump-budget-winners-losers.html

Figure 1. *Cuts to USA Science Agencies in in Donald Trump's 2018 budget request. Source: http://www. sciencemag.org/news/2017/03/trumps-first-budget-analysis-and-reaction). ARPA-E, Advanced Research Projects Agency (Department of Energy); NOAA, National Oceanic and Atmospheric Administration (US Department of Commerce); EPA, Environmental Protection Agency; DOE, Department of Energy; USGS, US Geological Survey; NIH, National Institutes of Health; NIST, National Institute of Standards and Technology; NASA, National Aeronautics and Space Administration; USDA, US Department of Agriculture.*

open access of geomagnetic data from the US and its Territories (including Antarctica).

The long time-series of geomagnetic activity, some covering periods of more than 100 years, would be interrupted and the standard geomagnetic indices would not be measured over a significant part of the globe. These data are used to provide geomagnetic storm alerts for aeromagnetic surveys, operators of electricity grids and satellite systems.

The accuracy of the International Geomagnetic Reference Field (IGRF) would be degraded without US input of both data and modelling capability. This will affect the results from aeromagnetic surveys where the data are blended with earlier and overlapping surveys and where the IGRF is used to determine the anomalies.

The US commitments to the World Data Centres in Japan and Germany will no

longer be met. The Paris Climate Accord revisited?

How will these changes affect Australia?

At least four issues could/would affect Australia:

1. The geomagnetic global data-set will be degraded and the quality of

the applications of these datasets for global studies will be reduced because of the gaps.
2. The global expertise in recording, analysing, and using the geomagnetic data will be significantly reduced. Although only 15 people are employed in this programme, they have very special skills that will be lost to the global geophysical community.
3. The anti-science factor in the Australian Parliament may use the Trump budget as an opportunity to reduce the Australian capability, not just in geomagnetism but throughout the science sector. Notice that the global seismological programme has also been cut by Trump.
4. If the US withdraws from this discipline, it could withdraw from other global studies carried out by NOAA and NASA and this would result in a bad outcome for everyone on planet Earth.

The Agencies like NOAA, NASA, the USGS and the NSF are the ones that have made America great. There is no point in spending big on defence if there is not enough to sustain these wonderful institutions.

I hope that the value of these agencies will be recognised and the resources needed to carry on their good work will be provided, but lobbying from Australia is unlikely to work – we would just be asked to contribute to the short fall!

Table 2. Impact of Donald Trump's 2018 budget request on the USGS Hazard Programmes

Programme	Budget request	FTE	Reduction from 2017	FTE losses
Earthquake Hazards	$51 388 000	220	$9 000 000	12
Volcano Hazards	$22 432 000	135	$3 639 000	7
Landslide Hazards	$3 531 000	22	0	0
Geomagnetism	$0	0	$1 884 000	15
Global Seismographic Network	$4 986 000	10	$1 455 000	2
Coastal-Marine Hazards and Resources	$35 774 000	188	$4 659 000	16

FTE, full-time equivalent staff.
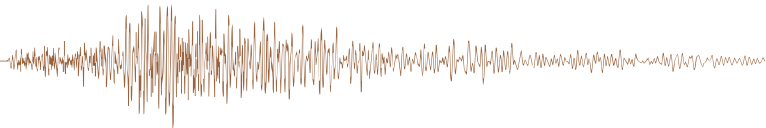
New World Stress Map released

For the 30th anniversary of the World Stress Map project a new data base, WSM 2016, has been released. It now contains 42 870 data records from a number of regions including Australia, Canada, Great Britain, Iceland, Texas, Oklahoma, Switzerland, China, Italy, and New Zealand. The number of data records has almost doubled since the last major release in 2008. They have all been added in a standardised format and quality-ranked for reliability and comparability on a global scale. The new data include the observations from approximately 4000 boreholes.

The WSM project started in 1986 as a project of the International Lithosphere Programme (ILP), under the leadership of Mary-Lou Zoback. From 1995 to 2008 it was a project of the Heidelberg Academy of Sciences and Humanities headed by Karl Fuchs and Friedemann

Wenzel. Since 2012 the WSM is a member of the ICSU World Data System. The data are maintained at the Helmholtz Centre Potsdam GFZ German Research Centre.

All stress information is analysed and compiled The WSM is an open-access public database and is used by various academic and industrial institutions working in a wide range of Earth science disciplines such as geodynamics, hazard assessment, hydrocarbon exploitations and engineering. The main operational areas are:

• Reservoir characterisation and management
• Stability of mines, tunnel, boreholes and waste disposal sites
• Calibration of geomechanical-numerical models
• 4D Thermo-Hydro-Mechanical (THM) simulations

• Hazard assessment, e.g. by means of fault-slip tendency and fracture potential analysis.

The website is: http://www.world-stress-map.org/ and Figure 1 shows the detail of data in the World Stress Map in the Australian region.

References

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Heidbach, O., Tingay, M., Barth, A., Reinecker, J., Kurfeß, D., and Müller, B., 2010, Global crustal stress pattern based on the World Stress Map database release 2008: *Tectonophysics*, **482**, 3–15. doi:10.1016/j.tecto.2009.07.023
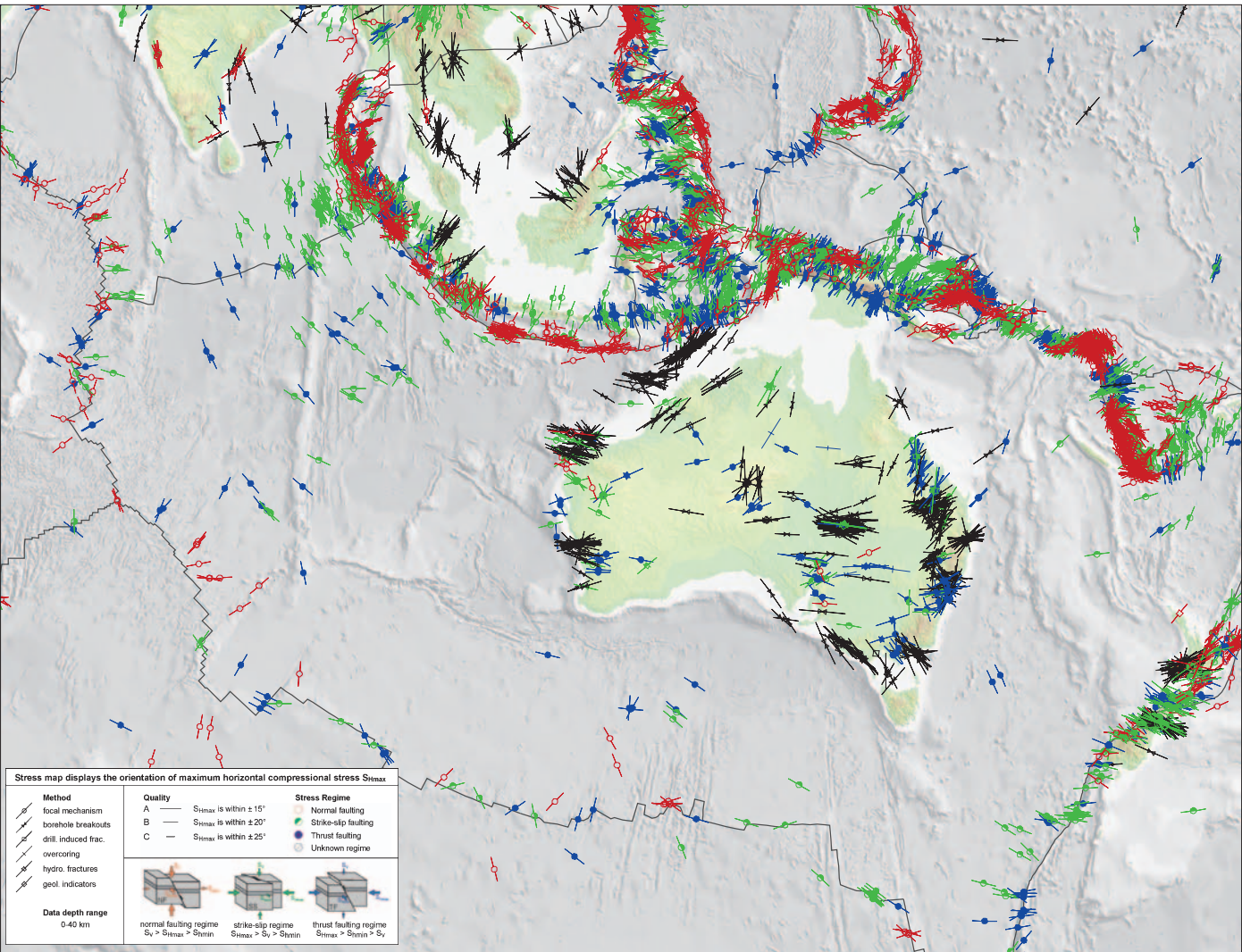
Figure 1. *Detail of data in the World Stress Map in the Australian region. Source: http://www.world-stress-map.org/*