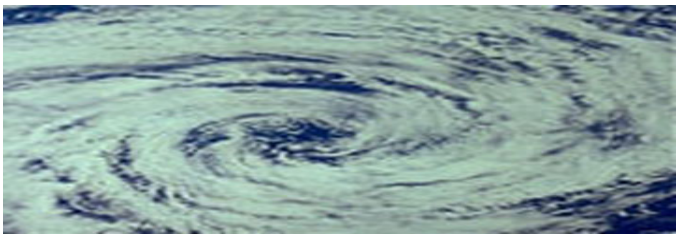


Climate Change Research Centre

Annual Report 2012



UNSW AUSTRALIA

Our Vision

The CCRC strives to make fundamental contributions to our understanding of the Earth's climate system and be recognised as one of the world's top research programs in physical and biophysical climate sciences.

Climate Change Research Centre
University of New South Wales

ANNUAL REPORT 2012

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1. *The Climate Change Research Centre at a Glance*

2012 Key Acheivements:

- *$3.8 million external research revenue*
- 84 peer reviewed publications, predominantly in the most highly esteemed journals. One book and two book chapters
- Three staff directly involved in writing and editing IPCC AR5, due for release in 2013
- Prestigious awards for Matthew England (NSW Scientist of the year category winner) and Lisa Alexander (AMOS Priestley Medal)

UNSW CCRC is a multi-disciplinary research group comprising one of the largest university research facilities of its kind in Australia.

CCRC houses research expertise in the key areas of Earth's climate: atmospheric, oceanic and terrestrial processes. We apply basic scientific principles to pressing questions on climate dynamics, global climate change, and extremes of weather and climate.

The Climate Change Research Centre (CCRC) was formed within the Faculty of Science in 2008 with initial financial support from the DVC Research and the Faculty. CCRC research focuses on basic climate system science across several core disciplines. The CCRC interacts with numerous schools and Centres on campus. Within the Faculty of Science particularly strong research and teaching synergies exist between the Centre and the Schools of Mathematics and Statistics, Physics and Biological Earth and Environmental Sciences (BEES). Its research focus is innovative and arguably unique among university units worldwide, and it has quickly grown into the largest hub of such research in the Australian region.

2012 saw the CCRC continue its successful track record in attracting grant funding and producing and publishing excellent, world-class research.

2 Director's Report

2012 was a year of growth and consolidation for the CCRC. The enthusiasm of our success in starting up the Centre of Excellence for Climate System Science yielded to the rolling-up of shirt sleeves and getting to work, with our new postdocs settling in during the year. The growth associated with this, and our hosting of NARCLiM and Superscience projects, caused us to overflow our space capacity in Mathews and spill into a temporary site off campus on Eurimbla Avenue near Randwick hospital; which, albeit remote from the buzz of the CCRC, yielded a quiet space for those who preferred it. Plans were also laid for expansion into space formerly held by Psychology on the sunlit side of the CCRC space, for occupancy in mid-2013, which will allow us to reconsolidate all staff in Matthews.

A key CCRC goal has been to minimize our financial footprint and remain research-focused by supporting staff on external Fellowships. While no more of our continuing staff applied for 2012 fellowships, two of our outstanding postdocs – Erik van Sebille and Shayne McGregor – won DECRA fellowships, as did Stephanie Waterman whom we welcomed in the latter part of the year, and research scientist Chris Fogwill won a Future Fellowship, the third for the CCRC. We also recruited a new staff member Angela Maharaj, who researches El Nino and coastal oceanography, and has been a teaching star. Two of our staff, Katrin Meissner and Jason Evans, were promoted to Associate Professor. Accolades for our staff in 2012 included the awarding of the Australian Meteorological and Oceanographic Society's Priestly Medal to Dr Lisa Alexander, and A/Prof Meissner's receiving the well-deserved UNSW Postgraduate Council Supervision award.

Our administrative staff have worked wonders, deftly synergizing between CoECSS and CCRC activities as evidenced for example by the report you now hold in your hand (or more likely hover over with your mouse). Centre of Excellence Manager Stephen Gray initiated and organised a successful workshop for the professional staff of the three ARC Centres at UNSW. Vilia Co continues to capably manage the Centres' budgets and finances. Early in the year we recruited Bronwen Smith as the able new CCRC administrative assistant, usually the first person you will see when entering the Centre, and Swa Rath joined the CoECSS in an E.A. role – rounding out an energetic, collegial, and highly effective admin team working across the CCRC and the Centre of Excellence.

I also have taken over sole directorship of the CCRC, but work closely with Andy Pitman to coordinate the activities of the two Centres. Matt England remains on hand as Deputy Director of the CCRC.

Research continues to grow at the CCRC, with publications exceeding those of 2011 by over 30%, including several in high-profile journals. Our staff continue to be very active in international activities including contribution to the Intergovernmental Panel on Climate Change (IPCC) report to be delivered in 2013, service to scientific organisations, and public outreach and media. Enrolments in our largest course, CLIM1001, also rose by nearly 50% from the previous year. Perhaps most impressively, we welcomed four overseas visiting research students and six summer undergraduate research students to the CCRC at the end of the year, far more than in the previous four years combined. At least one of the summer students is going on to enrol in a PhD at the CCRC in 2013. All seemed to find their experience at the CCRC a

rewarding one, and we hope to repeat this success in the upcoming 2013/14 summer.

Last but not least, in 2012 it was finally determined that the CCRC would move into School of Biological, Environmental and Earth Sciences (BEES) effective January 2013. While we will remain physically separate from the School, there may be a gradual integration of some of our financial and administrative functions. In 2013 we will strive to ensure that any disruption from this move will be minimal, and expect that our staff and students will benefit from having a new and more secure home within the Faculty of Science.

Professor Steven Sherwood

3 Personnel

2012 Highlights:

- Steven Sherwood took over as sole Director of the Centre with Matthew England assuming the role of Deputy Director from 2012 onwards
- Jason Evans took up his Future Fellowship in July 2012
- Dr Angela Maharaj joined the centre as a teaching fellow
- Dr Joe Kidston took up his DECRA Fellowship in January 2012
- Stephanie Waterman took up her DECRA Fellowship in November 2012

Continuing staff appointed to the CCRC include one Laureate Fellow (England), two Future Fellows (Meissner and Evans), one ARC QEII Fellow (McNeil), and two ARC Future Fellows (Meissner and Evans) Fixed term staff include an ARC Australian Research Fellow, an ARC Postdoctoral Fellow and three Super Science Fellows.

The CCRC also houses Chris Turney, a Laureate Fellow appointed to BEES. Chris' research group includes Future Fellow Dr Chris Fogwill.

The CCRC continues to attract distinguished visitors on sabbatical stays including Professor Tim Bralower, Dr Katsumi Matsumoto and Professor Rüdiger Gerdes in 2012. The Centre is also a sought out destination for international researchers making shorter visits (Dr Annegret Larsen, Dr Paul O'Gorman and Dr Simon Wild) as well as for students on research internships (full list of visiting students appears at Appendix C).

A full list of personnel associated with the Centre in 2012 appears in Appendix C.

4 Research outputs and grant summary

2012 Impact

- One paper published in *Nature* and two papers published in *Science*:

Allen, RJ, **Sherwood, S**, Norris, JR, & Zender, CS, 2012, 'Recent Northern Hemisphere tropical expansion primarily driven by black carbon and tropospheric ozone', *Nature,* 485, pp. 350 - 354.

Pagani, M, Huber, M, Liu, Z, Bohaty, SM, **Sijp, WP**, et al, 2012, 'The role of carbon dioxide during the onset of Antarctic glaciation', *Science,* 334, pp. 1261 - 1264.

Rule, S, Brook, BW, Haberle, S, **Turney, C,** et al, 2012, 'The aftermath of megafaunal extinction: Ecosystem transformation in Pleistocene Australia', *Science* , 335, pp. 1483 - 1486.

- Significant media coverage including:
  - 14 TV appearances/interviews
  - 23 Radio appearances/interviews
  - Over 30 print and online articles, interviews and op eds

- Lisa Alexander, Matthew England and Andy Pitman are members of the Scientific advisory panel of the Climate Commission

The CCRC published 87 individual peer reviewed outputs in 2012 which continues the Centre's upward trend from 33 in 2010 and 67 in 2011. The CCRC continues to publish papers primarily in the highest impact, high quality journals - those ranked A and A* under the former ERA scheme and those with a high Thomson ISI impact factor. See Appendix A for a full list of publications.

Category	2011 Outputs (non weighted)	2012 Outputs (non weighted)
A1	1	1
B1	3	2
C1	54	84
E1	9	0

The Centre has gone from strength to strength since its formation, culminating in the successful bid for the ARC Centre of Excellence for Climate System Science (COECSS) which commenced operations on 1 July 2011. In addition to CoECSS Director Andy Pitman, three CCRC academic staff are Chief Investigators in the Centre of Excellence - Alexander, England and Sherwood - each dedicating 0.3 FTE of their time to the CoECSS. A further eight CCRC staff were Associate Investigators in 2012.

(Abramowitz, Evans, Sen Gupta, Kidston, Taschetto, van Sebille, Meissner and Waterman). The two centres successfully share space and administrative support and there are significant opportunities for collaboration across the research strengths and foci of both centres.

CCRC's success in attracting grant funding continued through 2012. In addition to research projects carrying on from previous years, eight newly awarded research projects commenced in 2012. Among the newly established projects are Jason Evans' Linkage project on East Coast low pressure systems and Stephanie Waterman and Joe Kidston's ARC DECRAs.

A full listing of research projects in progress in 2012 appears in Appendix B.

Below are some highlights of other ***awards, contributions and service*** throughout 2012

- A number of CCRC staff are involved in the preparation of the IPCC's Fifth Assessment Report (AR5): Lisa Alexander and Steven Sherwood are chapter lead authors; and Andy Pitman is a Review Editor
- CCRC staff are very active on significant national and international committees, panels and associations: Steven Sherwood sat on the Bureau of Meteorology Training Program assessment panel; Steven Phipps is on the National Council for the Australian Meteorological and Oceanographic Society (AMOS) and was on the organizing committee for the 2012 AMOS conference which was led by Jason Evans; Gab Abramowitz is the only university-based representative on the CABLE Management Committee; Stephen Gray is the UNSW Institutional Coordinator for the Association for Tertiary Education Management (ATEM)
- Katrin Meissner and Matthew England are members of ARC Selection Advisory Committees
- Matthew England jointly awarded NSW Scientist of the Year in the category of Mathematics, Earth Sciences, Chemistry and Physics
- Lisa Alexander was awarded the AMOS Priestley Medal
- Katrin Meissner was awarded a UNSW Postgraduate Supervision award

Research Snapshot 1: Plastics will pollute our oceans for hundreds of years

Understanding how the ocean works and how ocean currents move mass, heat and salt around the Earth is a core Centre activity. Real world applications for this research are already emerging.

In a fascinating piece of research, **Dr Erik Van Sebille** (doi:10.1088/1748-9326/7/4/044040) examined the movements of plastic pollution around our oceans. In the process of doing this, he discovered that an entirely new plastics garbage patch could potentially form in the Barents Sea within the next few decades. At the same time, his research also showed for the first time that ocean pollution like plastics moves freely between garbage patches. Previously, it was suspected that there was no exchange of pollution plastics between these patches.

To achieve his results, the researchers used data from drifter buoys, which are part of the Global Drifter Program, to determine the movement of surface ocean currents. The program releases hundreds of drifter buoys into the ocean every year.
Each buoy floats around the ocean sending out regular 140 character messages on its location and the ocean conditions it's experiencing. Dr Van Sebille describes it as being like Twitter from the ocean.

The data gathered by these buoys was then used to determine how garbage, and plastics in particular, moved around the ocean. The garbage eventually found its way to areas where ocean currents and winds converged, known as the subtropical gyres. It was here that the massive garbage patches formed.

See http://www.adrift.org.au/ for an innovative, interactive demonstration of this significant research.

Research Snapshot 2: A regionalised climate model for NSW

In collaboration with the NSW Office of Environment and Heritage (OEH) and led at the CCRC by Associate Professor Jason Evans we are developing new, fine-scale climate projections for south-east Australia as part of the NSW and ACT Regional Climate Modelling project or NARCliM.

NARCliM will improve our ability to predict changes in temperature, wind and rainfall in the state which, in turn, will provide critical information to manage the impacts of climate change on health, settlements, agriculture, weather extremes and services, such as water and energy supplies.

NARCliM uses the Weather Research and Forecasting (WRF) model, a dynamical regional climate model that gives high resolution projections of temperature, rainfall and many other meteorological variables. WRF has been demonstrated to be effective in simulating temperature and rainfall in NSW (Evans & McCabe 2010 *J. Geophys Res*. 115) and provides a good representation of local topography and coastal processes. It was jointly developed by several major weather and research centres in the United States and is widely used internationally.

No model can perfectly represent the Earth's climate – some regions of the modelled climate may be slightly hotter or drier, for example, than the climate we experience in reality. These differences are known as error or bias. To minimise potential bias from a single model, four global climate models (GCMs) are used as input to the regional model.

WRF has different settings which reflect uncertainties in our understanding of some physical processes. Varying these settings between model runs and using several different settings with each GCM provides a more realistic set of projections. Performing multiple model runs also captures more reliable information on rare, extreme weather events, such as heatwaves, heavy rain and drought.

There are four components to the NARCliM project:

Modelling

The modelling component is mainly being run and supervised at the Climate Change Research Centre at the University of NSW. WRF will be run with four separate GCMs (MIROC-medres 3.2, ECHAM5, CGCM 3.1 and CSIRO mk3.0). Each will be repeated three times for a total of 12 runs, using a single, representative emissions scenario: the IPCC high emissions scenario A2. Projections will be produced for several variables, including temperature, rainfall, wind, relative humidity, sea surface temperature and soil temperature.

Data storage

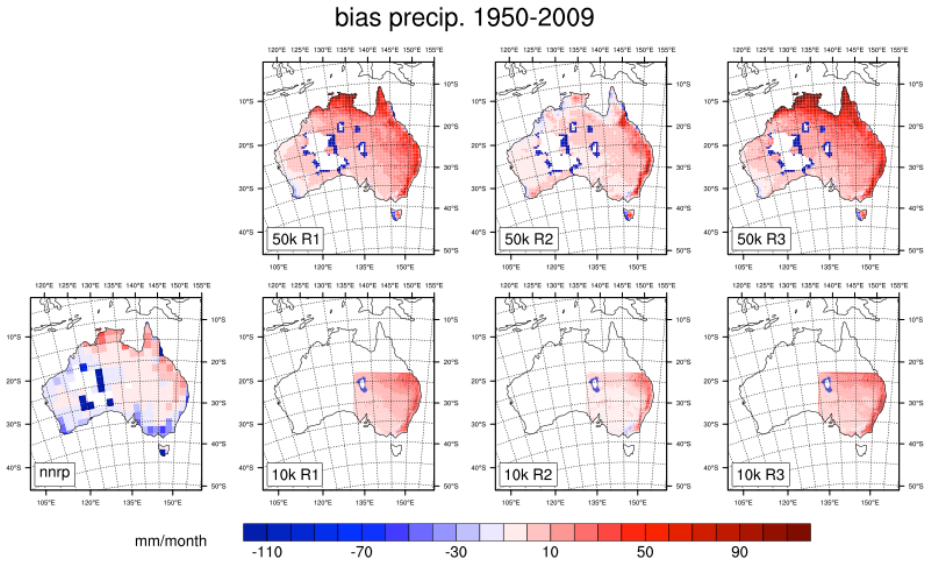
NARCliM will generate a very large dataset, estimated to be around 1 petabyte in size (1 million gigabytes), which will be systematically managed by OEH.

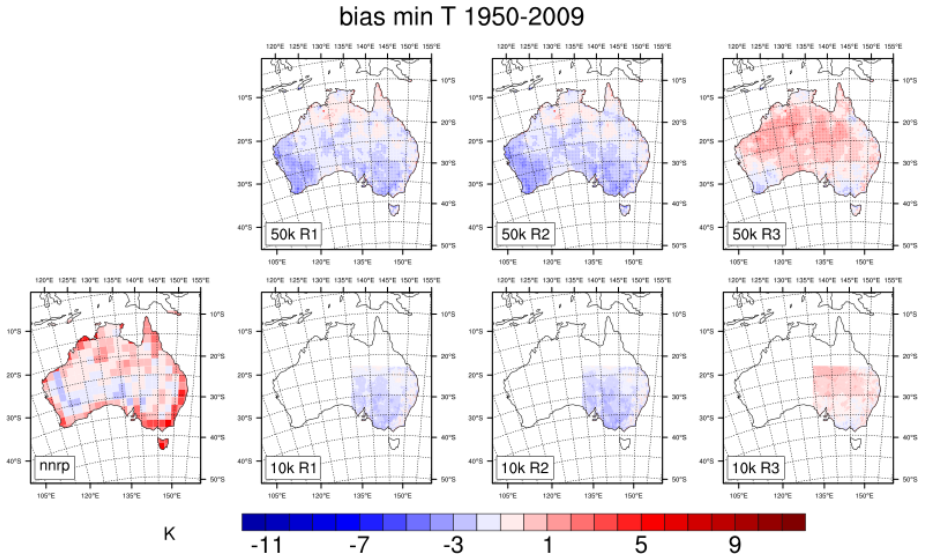
Data retrieval and access

NARCliM is designed to give the community easy access to both raw climate modelled data and, more importantly, information that combines the model projections into climate statistics that can be readily used by the public and agencies like local government. Inquiry, summary and visualisation tools are being developed using feedback from a user reference group. This will include tools to calculate fire weather hazard or extreme events, such as flood risk.

Synthesis reports

A report synthesising and interpreting the projected changes in climate across NSW will be jointly completed by staff from OEH and the Climate Change Research Centre at the University of NSW.





Top: Shows Regional model R2 tends to do the best in terms of precipitation.
Below: R3 tends to do the best for min temperature

5 Teaching and research supervision

The Climate Change Research Centre has a growing cohort of Postgraduate research students. There were 25 students enrolled in the centre's PhD program, 1 Master's student and 4 Honours students supervised in 2012.

The CCRC continued its robust annual progress review scheme, led by Post Graduate coordinator Katrin Meissner. In addition to the stipulated annual reviews and presentations for all students, the Centre runs half-yearly "informal" committee meetings for all enrolled students where progress can be discussed and students can raise any concerns they may have. Feedback from students regarding the Centre's review process is overwhelmingly positive.

Three research students graduated in 2012

Michael Bates. PhD thesis title: A dynamic, embedded Lagrangian model for ocean climate models. (Supervised by Matt England)

Francia Avila. PhD thesis title: The impacts of land use-induced land cover change on climate extremes. (Supervised by Andy Pitman)

Alejandro Silva Brito. MS thesis title: El niño and el niño modoki impacts on South American rainfall (Supervised by Matt England)

Centre staff continued to be engaged in undergraduate teaching. Courses run by CCRC staff are CLIM1001 – Introduction to Climate Change, MSCI0501 – The Marine Environment (with the School of BEES), CLIM2001 – Fundamentals of Atmospheric Science (with the School of Physics) GEOS2241 – Peak Carbon: Climate Change and Energy Policy and CLIM3001 – Climate Systems Science.

6 Statement of financial performance for 2012

Summary of statement of financial performance

The Climate Change Research Centre's total revenue for 2012 was $5,825,800. 65.7% of this was from external income sources. The remainder was from a combination of Faculty and Central/Strategic funds, including generous support associated with Matthew England's Laureate Fellowship.

The Centre increased its external funding in 2012 from the previous year's figures by 15%. This was partly attributable to the timing of the release of funds, but also clearly representative of continual strong success in grant applications. Of the $3.8m research revenue earned in 2012, $2.5m was Category 1 income.

At 81% of total expenditure, people costs account for by far the largest portion of the centre's expenditure across all fund types. 58% of all people costs were externally funded in 2012.

7 Statement of in-kind contributions including academic and other salaries, infrastructure and other resources provided to the Centre

The value of the University's infrastructure and space in-kind contribution to the CCRC in 2012 was $213,803. (Figure based on calculation metrics provided by UNSW Space Audit Manager).

The Centre gratefully acknowledges support provided by UG student administrative staff in the Schools of BEES and Physics as well as assistance from the Science Student Centre, Faculty of Science Finance team, the Research Strategy Office and significant support from the Grants Management Office.

Full countersigned financial statement follows.

Centres please note; the financial statements are prepared on a cash basis and any accrual information including unpaid invoices can be shown in the 'Notes to the Statement of Financial Performance' section beneath the financial statements. The account types below are meant as a guide, Centres are encouraged to include additional accounts or delete superfluous accounts. Seperate account lines should be shown to indicate the different sources of UNSW internal Revenue/Funding ie. School, Faculty or DVC/VC

Climate Change Research Centre - CCRC

Statement of Financial Performance
for the Year Ended 31 December 2012

	Notes	2012 $	2011 $
Revenue:			
Research Revenue	1	3,832,602.26	3,288,930.46
Faculty Contributions	2	1,000,627.91	1,095,676.23
UNSW Contributions	3	992,569.54	910,001.40
Other External Revenue		0.00	46,654.00
Total Revenue:		5,825,799.71	5,341,262.09
Costs:			
People Costs	4	4,132,850.34	3,834,723.52
Scholarship Stipends		171,887.62	135,255.09
Travel	5	279,926.58	416,572.92
Equipment		115,054.24	106,850.72
Other Non People Costs	6	371,508.62	191,968.01
Total Costs:		5,071,227.40	4,685,370.26
Operating result		754,572.31	655,891.83
Opening Balance: Surplus(Deficit) from Prior Year		1,420,456.81	749,382.00
Correction of Prior Year Opening Balance		0.00	15,182.98
Adjusted Opening Balance		0.00	764,564.98
Closing Balance: Surplus(Deficit)	7	2,175,029.11	1,420,456.81

Notes to the Statement of Financial Performance

1. 2012 Category 1 income was $2.5m, which was down on 2011 figures.
2. Faculty's 2012 CCRC contribution consist of a 9% decrease from 20111
3. Sources of UNSW funding for 2012 included $672k from the SPF01 fund, 95% consist of the five year commitment and $320k in other strategic funds (SIR30 and SIR50).
4. 81% of the Centre's total 2012 expenditure was on people costs compared to 82% in 2011, 74% in 2010 and 75% in 2009. In 2012, 42% of people costs came from base operating and strategic (SPF01, SPF02, SIR30, SIR50) funds meaning that more than half of the centre's salaries and on-costs are supported by fellowships or research grants.
5. In 2012, 74% was funded by external grants compared to 60% in 2011.
6. In 2012, 'Other non People Costs' accounted for the second largest proportion of expenditure with 83% funded by external grants.
7. The large surplus was due to a number of factors, but mostly as a result of time taken to spin up projects announced by the ARC in the second half of 2012.

L. McINTYRE
8/2/13.

8 CCRC Management and oversight

Until the end of 2012 CCRC stood as an autonomous staffing unit within the faculty. From 2013 onwards the CCRC will be progressively amalgamated with BEES. In 2012 the centre had 11 continuing academic staff, one teaching fellow and 30 fixed term research staff employed at the centre, most funded from Category 1 grants.

The CCRC is overseen by a Management Committee chaired by Professor Mark Hoffman (Formerly AD-R, Faculty of Science). The other members of the Management Committee are: Michael Ashley (Physics), Rob Brooks, (EERC/BEES), Mark Holzer (Mathematics and Statistics) and Richard Stuetz (WRC/Civil and Environmental Engineering). Dean of Science, Merlin Crossley also attended management committee meetings in 2012. The make up of the committee is a reflection of the collaborative ties the Centre has with different Schools and Centres across UNSW. The Management Committee primarily has a strategic advisory role. The Committee formally met in May and in August. Input and feedback was also sought from board members during the preparation of material for the Centre's review in November.

Responsibility for day to day management and operation of the centre is shared between the Director, Centre Manager and staff with delegated portfolios (such as the PG Coordinator, IT coordinator, UG Coordinator, Honours Coordination, Marketing/outreach coordinator, etc). The centre leadership team works closely and cooperatively with the Faculty of Science executive group and faculty committees.

The CCRC's PhD and undergraduate programs are officially administered by BEES, but the centre manages its own finances, teaching development, administration and IT (including an investment of 0.5 EFT in the Faculty IT unit), as well as administration relating to postgraduate student applications, enrolment and scholarships and the formal postgraduate review process.

Appendix A
2012 Publications

HERDC Category A1 – Books

Saul, B, **Sherwood, S**, McAdam, JA, Stephens, T, & et al, 2012, *Climate Change and Australia: Warming to the Global Challenge*, Federation Press, Australia.

HERDC Category B1 – Book Chapters

Alexander, LV, & Tebaldi, C, 2012, *Weather and Climate Extremes: observations, modelling, projections*, *The Future of the World's Climate* (2nd, pp. 253 - 288)., Elsevier Science.

Turney, C 2012, *Surface 3C in Australia: A quantified measure of annual precipitation?*, *Peopled Landscapes (Terra Australis 34)* (pp. 435 - 443), ANU, Australia.

HERDC Category C1 – Journal Articles

Abramowitz, G, Pouyanne, L, & Ajami, H, 2012, 'On the information content of surface meteorology for downward atmospheric long-wave radiation synthesis', *Geophysical Research Letters,* 39, Article No. L04808.

Abramowitz, G, 2012, 'Towards a public, standardized, diagnostic benchmarking system for land surface models', *Geoscientific Model Development,* 5, pp. 819 - 827.

Allen, RJ, **Sherwood, S**, Norris, JR, & Zender, CS, 2012, 'Recent Northern Hemisphere tropical expansion primarily driven by black carbon and tropospheric ozone', *Nature,* 485, pp. 350 - 354.

Allen, RJ, **Sherwood, S**, Norris, JR, & Zender, CS, 2012, 'The equilibrium response to idealized thermal forcings in a comprehensive GCM: implications for recent tropical expansion', *Atmospheric Chemistry and Physics,* 12, pp. 4795 - 4816.

Arblaster, JM, & **Alexander, LV,** 2012, 'The impact of the El Nio-Southern Oscillation on maximum temperature extremes', *Geophysical Research Letters,* 39, Article No. L20702.

Argueso, D, Hidalgo-Munoz, JM, Gamiz-Fortis, SR, Esteban-Parra, MJ, et al, 2012, 'Evaluation of WRF Mean and Extreme Precipitation over Spain: Present Climate (1970-99)', *Journal of Climate,* 25, pp. 4883 - 4895.

Arzel, O, **England, MH**, Colin de verdiere, A, & Huck, T, 2012, 'Abrupt millennial variability and interdecadal-interstadial oscillations in a global coupled model: sensitivity to the background climate state', *Climate Dynamics,* 39, pp. 259 - 275.

Avila, FB, Pitman, AJ, **Donat, MG**, **Alexander, LV**, **Abramowitz, G**, 2012, 'Climate model simulated changes in temperature extremes due to land cover change', *Journal of Geophysical Research-Atmospheres*, 117, pp. 4621 - 4640.

Baker, A, Bradley, C, **Phipps, S**, Fischer, M, et al, 2012, 'Millennial-length forward models and pseudoproxies of stalagmite 8O: an example from NW Scotland', *Climate of the Past Discussions,* 8, pp. 869 - 907.

Bates, ML, Griffies, SM, & **England, MH,** 2012, 'A dynamic, embedded Lagrangian model for ocean climate models, Part II: Idealised overflow tests', *Ocean Modelling*, 59-60, pp. 60 - 76.

Bates, ML, Griffies, SM & **England, MH,** 2012, 'A dynamic, embedded Lagrangian model for

ocean climate models. Part I: Theory and implementation', *Ocean Modelling*, 59-60, pp. 41 - 59.

Blockley, SPE, Lane, CS, Hardiman, M, Rasmussen, SO, **Turney, C,** et al, 2012, 'Synchronisation of palaeoenvironmental records over the last 60,000 years, and an extended INTIMATE1 event stratigraphy to 48,000 b2k', *Quaternary Science Reviews,* 36, pp. 2 - 10.

Blockley, SPE, Lane, CS, **Turney, C**, & Bronk Ramsey, C, 2012, 'The INTegration of Ice core, MArine and TErrestrial records of the last termination (INTIMATE) 60,000 to 8000 BP', *Quaternary Science Reviews,* 36, pp. 1.

Boisier, J-P, De Noblet-Ducoudré, **Pitman, AJ, Cruz, FT**, et al, 2012, 'Attributing the impacts of land-cover changes in temperate regions on surface temperature and heat fluxes to specific causes: Results from the first LUCID set of simulations', *Journal of Geophysical Research,* 117, Article No. D12116.

Bormann, KJ, Westra, SP, **Evans, JP**, & McCabe, MF, 2012, 'Spatial and temporal variability in seasonal snow density', *Journal of Hydrology,* 484, pp. 63 - 73.

Bormann, KJ, Mccabe, M, & **Evans, JP,** 2012, 'Satellite based observations for seasonal snow cover detection and characterisation in Australia', *Remote Sensing of Environment,* 123, pp. 57 - 71.

Bradshaw, C, Cooper, A, **Turney, C**, & Brook, B, 2012, 'Robust estimates of extinction time in the geological record', *Quaternary Science Reviews,* 33, pp. 14 - 19.

Brennan, CE, Weaver, A, Eby, M, & **Meissner, K,** 2012, 'Modelling oxygen isotopes in the University of Victoria Earth System Climate Model for Pre-industrial and Last Glacial Maximum Conditions', *Atmosphere - Ocean,* 50, pp. 447 - 465.

Bryan, SE, Cook, AG, **Evans, JP**, Hebden, K, et al, 2012, 'Rapid, long-distance dispersal by pumice rafting', *PLoS One* , 7, Article No. e40583.

Chamberlain, MA, Sun, C, Matear, R, & **Phipps, SJ,** 2012, 'Downscaling the climate change for oceans around Australia', *Geoscientific Model Development,* 5, pp. 425 - 458.

Clarke, H, Lucas, & Smith, P, 2012, 'Changes in Australian fire weather between 1973 and 2010', *International Journal of Climatology,* 33, pp. 931 - 944.

Cook, C, & Jones, RT, 2012, 'Catchment instability and Asian summer monsoon variability during the early Holocene in southwestern China', *Boreas,* 42, pp. 224 - 235.

Cook, C, Leng, MJ, Jones, RT, Langdon, PG, et al, 2012, 'Lake ecosystem dynamics and links to climate change inferred from a stable isotope and organic palaeorecord from a mountain lake in southwestern China (ca. 22.6-10.5 cal ka BP)', *Quaternary Research,* 77, pp. 132 - 137.

Cook, C, & Jones, RT, 2012, 'Palaeoclimate dynamics in continental Southeast Asia over the last approximately 30,000 Cal yrs BP', *Palaeogeography Palaeoclimatology Palaeoecology*, 339-341, pp. 1 - 11.

Decker, M, Brunke, MA, Wang, Z, Sakaguchi, K, et al, 2012, 'Evaluation of the reanalysis products from GSFC, NCEP, and ECMWF using flux tower observations', *Journal of Climate,* 6, pp. 1916 - 1944.

Donat, MG, & Alexander, LV, 2012, 'The shifting probability distribution of global daytime and night-time temperatures', *Geophysical Research Letters,* 39, pp. Article No. L14707.

Evans, JP, & Westra, SP, 2012, 'Investigating the mechanisms of diurnal rainfall variability using a regional climate model', *Journal of Climate,* 25, pp. 7232 - 7247.

Evans, JP, & Boyer-Souchet, I, 2012, 'Local sea surface temperatures add to extreme precipitation in northeast Australia during La Ni', *Geophysical Research Letters*, 39, Article No. L10803.

Fernández-donado, L, González-rouco, JF, Raible, C, Ammann, C, **Phipps, SJ**, et al, 2012, 'Temperature response to external forcing in simulations and reconstructions of the last millennium', *Climate of the Past,* 8, pp. 4003 - 4073.

Fogwill, CJ, Hein, A, Bentley, MJ, & Sugden, DE, 2012, 'Do blue-ice moraines in the Heritage Range show the West Antarctic Ice Sheet survived the last interglacial?', *Palaeogeography Palaeoclimatology Palaeoecology*, 335-336, pp. 61 - 70.

Froyland, G, Horenkamp, C, Rossi, V, Santitissadeekorn, N & **Sen Gupta, A**, 2012, 'Three-dimensional characterization and tracking of an Agulhas Ring', *Ocean Modelling*, 52-53, pp. 69 - 75.

García díez, Fernandez, J, **Fita Borrell, L**, & Yague, C, 2012, 'Seasonal dependence of WRF model biases and sensitivity to PBL schemes over Europe', *Quarterly Journal of the Royal Meteorological Society,* 139, pp. 501 - 514.

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Appendix B

CCRC Research Grants Active in 2012

Investigators	Abramowitz, G.
GrantScheme	EIF SUBCONTRACT
GrantTitle	Development of research infrastructure to support the protocol for the analysis of land surface models (pals) online web application.
Duration	2012 -- 2014

Investigators	Alexander, L Karoly, D. Vose, R. Pitman, A.
GrantScheme	ARC Linkage Grants
GrantTitle	Transforming our research capacity in the analysis of climate extremes
Duration	2011 -- 2014

Investigators	Alexander, L Karoly, D. Vose, R.
GrantScheme	ARC Linkage Grants (Industry portion)
GrantTitle	transforming our research capacity in the analysis of climate extremes
Duration	2011 -- 2014

Investigators	England, M.
GrantScheme	ARC Laureate Fellowships
GrantTitle	Future risks associated with ocean surface warming: impacts on climate, rainfall, carbon, and circulation
Duration	2011 -- 2016

Investigators	England, M. Pitman, A. Sherwood, S. Evans, J.
GrantScheme	ARC Super Science Fellowships
GrantTitle	Precipitation-groundwater interactions over eastern Australia: climate change impacts at multiple scales
Duration	2010 -- 2013

Investigators	Evans, J.
GrantScheme	Government Grants (Non-Cat 1)
GrantTitle	Engineers Australia Contract Research: Modelling and analysis of rainfall extremes in the greater Sydney region.
Duration	2011 -- 2014

Appendix B

CCRC Research Grants Active in 2012

Investigators	Evans, J.
GrantScheme	ARC Future Fellowships
GrantTitle	How will climate change affect sub-daily precipitation? (project costs)
Duration	2011 -- 2015

Investigators	Evans, J.
GrantScheme	ARC Future Fellowships
GrantTitle	How will climate change affect sub-daily precipitation? (Salary support)
Duration	2011 -- 2015

Investigators	Evans, J.
GrantScheme	ARC Linkage Grants
GrantTitle	Will east coast lows change in frequency or intensity in the future?
Duration	2012 -- 2015

Investigators	Evans, J.
GrantScheme	ARC Linkage Grants (Industry portion)
GrantTitle	Will east coast lows change in frequency or intensity in the future?
Duration	2012 -- 2015

Investigators	Green, D. Bambrock, H. Alexander, L.
GrantScheme	NHMRC Project Grant
GrantTitle	Health impacts of climate change on indigenous Australians: identifying climate thresholds to enable the development of informed adaptation strategies
Duration	2011 -- 2014

Investigators	Kidston, J.
GrantScheme	ARC DECRA Fellowships
GrantTitle	The cause of the poleward shift of earth's storm tracks and jet streams
Duration	2012 -- 2014

Appendix B

CCRC Research Grants Active in 2012

Investigators	McNeil, B. Meissner, K. Matear, R.
GrantScheme	ARC Discovery Grants
GrantTitle	Examining the vulnerability of ocean carbon biogeochemistry in a high CO2 world
Duration	2011 -- 2014

Investigators	Meissner, K.
GrantScheme	ARC Future Fellowships
GrantTitle	What caused abrupt climate change events in the past and what can they tell us about the future?
Duration	2010 -- 2014

Investigators	Pitman, A. Abramowitz, G. Leunig, R.
GrantScheme	ARC Discovery Grants
GrantTitle	Are proposed land-based sinks for greenhouse gases resilient to climate change and natural variability?
Duration	2011 -- 2014

Investigators	Pitman, A.
GrantScheme	NSW Environmental Trust Research Program
GrantTitle	Dynamically downscaled climate projections for the Eastern Seaboard.
Duration	2011 -- 2014

Investigators	Pitman, A. Hirsch, A.
GrantScheme	SCHOLARSHIP
GrantTitle	OCE PhD scholarship for Annette Hirsch. Earth system science. Role of land surface dynamics in climate processes.
Duration	2012 -- 2015

Investigators	Sen Gupta, A. England, M. Karumuri, A
GrantScheme	ARC Discovery Grants
GrantTitle	The Changing relationship between the South Asian and Australian monsoon in a warming world.
Duration	2011 -- 2013

Appendix B

CCRC Research Grants Active in 2012

Investigators	Sijp, W.
GrantScheme	ARC ARF
GrantTitle	ARF The equable climate conundrum: the role of the global ocean in multiple climate regimes.
Duration	2010 -- 2014

Investigators	Sijp, W.
GrantScheme	ARC Discovery Grants
GrantTitle	The equable climate conundrum: the role of the global ocean in multiple climate regimes.(Project budget)
Duration	2010 -- 2015

Investigators	Taschetto, A.
GrantScheme	ARC ARF
GrantTitle	modes of pacific ocean variability and their relationship to regional southern hemisphere climate
Duration	2010 -- 2014

Investigators	Taschetto, A.
GrantScheme	ARC Discovery Grants
GrantTitle	Modes of pacific ocean variability and their relationship to regional Southern Hemisphere climate (Project Budget)
Duration	2010 -- 2013

Investigators	van Sebille, E.
GrantScheme	ARC DECRA Fellowships
GrantTitle	Inter-ocean exchange around Australia and its relation to regional and global climate
Duration	2013 -- 2015

Investigators	Waterman, S.
GrantScheme	ARC DECRA Fellowships
GrantTitle	Ingredients of the eddy soup in Southern Ocean dynamics: processes, climate impacts and parameterisation
Duration	2012 -- 2015

Appendix C
Centre Personnel 2012

There were no resignations or retirements among full time, permanent academic staff in 2012.

Professors

Prof Matthew England (Australian Laureate Fellow, CCRC Co-Director)
Prof Andy Pitman (CoECSS Director)
Prof Steven Sherwood (CCRC Co-Director)
Prof Chris Turney (ARC Laureate Fellow, Adjunct)

Academic Staff and Research Fellows

Dr Gab Abramowitz
Dr Lisa Alexander
Dr Jason Evans (ARC Australian Research Fellow)
Dr Donna Green
Dr Joseph Kidston
Dr Angela Maharaj
Dr Ben McNeil (ARC QEII Research Fellow)
Dr Katrin Meissner (ARC Future Fellow)
Dr Alex Sen Gupta

Post Doctoral Research Fellows, Research Associates and Research Assistants

Laura Ciasto	Charlotte Cook (Adjunct)
Mark Decker	Markus Donat
Eden Duthie	Dr Jean-Francois Exbrayat
Dr Chris Fogwill (Adjunct)	James Gilmore
Nicholas Jourdain	Yi Liu
Shayne McGregor	Xianhong Meng
Benedicte Pasquer	Steven Phipps
Agus Santoso	Willem Sijp
Paul Spence	Yoichi Takayama
Andrea Taschetto	Caroline Ummenhofer
Erik van Sebille	Leanne Webb
Kirien Whan	Hongang Yang
Qinglong You	Jan Zika

Professional Staff

Vilia Co	(Finance Officer)
Stephen Gray	(Centre Manager CCRC and CoECSS)
Simone Purdon	(Executive Assistant CoECSS. January to October)
Swa Rath	(Executive Assistant CoECSS. From October)
Bronwen Smith	(Executive Assistant CCRC)

PhD, MS and Honours Research Students (and their primary supervisor)

Francia Avila (Pitman)
Kathryn Bormann (Evans)
Hamish Clarke (Pitman)
Annika Dean (Green)
Ned Haughton (Abramowitz)
Willem Huiskamp (Turney)
Agata Imielska (Alexander)
Karin Kvale (Meissner)
Tanya Lipman (Alexander)
Nicola Maher (England)
Daniel Miller (Turney)
Shirley Qin (Sen Gupta)
Jessica Roe (Turney)
Emily Shaw (McNeil)
Matthew Ward (Meissner)
Witold Bagniewski (Meissner)
Cameron Cairns (Kidston)
Timothy Cowan (England)
David Fuchs (Sherwood)
Annette Hirsch (Pitman)
David Hutchinson (England)
Andrew King (Alexander)
Yue Li (Sen Gupta)
Ian Macadam (Pitman. On leave)
Penny Maher (Sherwood)
Claire O'Neill
Nina Ridder (England)
Tristan Sasse (McNeil)
Graham Simpkins (England)
Bevan Warren (Green)

Adjuncts, Visiting Fellows and Visiting Researchers

Prof Tim Bralower
Dr Willow Hallgren
Prof Lance Leslie
Dr Paul O'Gorman
Milton Speer
Dr Simon Wild
Marc d'Orgeville
Dr Annegret Larsen
Dr Michael Molitor
Dr Oleg Saenko
A/Prof David Thompson

Affiliated UNSW Staff

Prof Mike Archer
A/Prof Dale Dominey-Howes
Dr Mark Holzer
Dr Matthew McCabe
Dr Robin Robertson
Dr Krishna Shestha
Prof Andy Baker
A/Prof Gary Froyland
Prof Jane McAdam
Dr Scott Mooney
Prof Ashish Sharma
Dr Scott Sisson

Visiting Students

Marvin Alfaro	(Fullbright Scholar)
Ryan Batehup	(CoECSS Summer Scholar)
Julia Brandenberg	(ETH Zurich)
Christopher Bull	(CoECSS Summer Scholar)
Scott Liles	(Summer Scholar)
Mat Lipson	(CoECSS Summer Scholar)
Edward McDonald	(CoECSS Summer Scholar)
Suso Peña-Izquierdo	(ICM CSIC, Spain)
Quentin Raffaillac	(MINES, ParisTech)
Alice Walker	(UNSW Summer Scholar)

Appendix D
Media and publicity

Name	Media Type	Media Outlet	Media Activity	Article/Program Name
Donat, M.	Radio	ABC Radio	Pre-record package segment	PM segment
Donat, M.	Online	Science News	Reference from MR	Extreme hot spells rising
Donat, M.	Press/Media Release	UNSW website	Media release	Global warming fingerprint revealed as worldwide heat events increase
England, M.	Radio	2GB	Grab taken from previous interview	Afternoons
England, M.	Radio	2SER-FM	Live interview	The Wire
England, M.	Radio	2UE	Recorded interview	Night time talk back 8-12am
England, M.	Radio	2UE News	Radio interview	2UE News
England, M.	Online	702 AM	Interview	702 AM with Tony Eastley
England, M.	Online	9 news	Interview	Second wettest year on record for Aust: UN
England, M.	Film/Documentary	ABC	Documentary Video	I can change your mind about... Climate
England, M.	Press/Media Release	ABC	Televised Interview	News 24
England, M.	TV	ABC	Televised Interview	News 24
England, M.	TV	ABC	Televised Episode	Q & A Adventures in Democracy
England, M.	TV	ABC 1	Interviewed	Q&A
England, M.	Radio	ABC 666 Canberra	Live to air interview (13 mins)	Afternoons
England, M.	Radio	ABC 666FM	Radio interview	AM ABC Radio National
England, M.	Radio	ABC 666FM Canberra	On air interview with Louise Maher	Drive
England, M.	Radio	ABC Bundaberg	Interview	
England, M.	TV	ABC News 24	On-air live interview	Morning news and current affairs
England, M.	TV	ABC News 24	On-air interview	Weekend Breakfast
England, M.	Radio	ABC North Queensland	Interview	Regional Afternoons
England, M.	Radio	ABC Radio	Radio Interview	World Today
England, M.	TV	ABC1	Pre-record for news piece	News
England, M.	Newspaper	Australian Financial Review	Interview	Warnings on warming intensify
England, M.	Newspaper	Bellingen Courier Sun	Phone interview	Climate change role in floods won't be clear for a decade, say scientists
England, M.	TV	Channel 10	Interview	Ten News at 5pm
England, M.	TV	Channel 10	Interview	The project
England, M.	TV	Channel 7	Recorded Interview	Weekend Sunrise
England, M.	TV	Channel 7	On-air interview	Morning Sunrise
England, M.	Newspaper	Narooma News	Letter writer talking about Matt's earlier interview	IPCC projections stand test of time
England, M.	Online	Ninemsn	Journalist backgrounding	Second wettest year on record for Aust: UN
England, M.	Press/Media Release	Ninemsn	Media release	9 News
England, M.	Radio	Perth Radio RTR	Radio Interview	Radio RTR - 9:08am (Perth)
England, M.	Radio	Radio 6PR (Perth)	Radio interview	Radio 6PR - 7:15am
England, M.	Online	SBS World News	Journalist backgrounding	Second wettest year on record for Australia: UN
England, M.	Online	Sky News	interview	Second wettest year on record for Aust
England, M.	Newspaper	Sydney Morning Herald	Phone interview for news article	Climate change role in floods won't be clear for a decade, say scientists
England, M.	Online	The Australian	Journalist backgrouding	Warming world defies La Nina
England, M.	Online	The Daily Telegraph	Journalist backgrouding	Last decade 'hottest ever'
England, M.	Radio	Triple J	Recorded Interview	Hack with Tom Tilley
Evans, J.	Online	Ninemsn	Interview	Warms eas helped cause 2010 Qld Floods

Evans, J.	Newspaper	Sydney Morning Herlad	Interview	Ocean Temperature Made Queensland Floods Worse
Phipps, S.	Radio	ABC Radio National	Recorded interview	Breakfast ABC Radio National Breakfast
Phipps, S.	Online	Australian Science Media Centre	Online briefing	Online briefing
Phipps, S.	Newspaper	The Age	Newspaper article	Climate research has a ring of truth
Phipps, S.	Newspaper	The Guardian, UK	Newspaper article	Australasia has hottest 60 years in a millennium, scientists find
Pitman, A.	Radio	2GB	Online interview followed by caller commentary	Night Time
Pitman, A.	Radio	ABC 666 Canberra	Panel	Science discussion segment
Pitman, A.	Radio	ABC 666 Canberra	Interview	News
Pitman, A.	TV	ABC News 24	Interview for package	ABC News
Pitman, A.	TV	ABC News 24	Pre-packaged news item	News
Pitman, A.	TV	ABC News 24	Interview as part of a panel	Afternoon Live
Pitman, A.	Radio	ABC Radio National	Interview	Off Track
Pitman, A.	Newspaper	Canberra Times	Phone interview	The rain makes us sceptical
Pitman, A.	Radio	Radio National ABC	Pre-recorded sound bite for feature story	The World Today
Pitman, A.	Newspaper	SMH	Interview	World at point of no return on emissions
Sen Gupta, A.	Radio	Korean Morning Radio	Live Interview	Effect of ENSO on Korea
Sherwood, S.	Radio	ABC Radio National	Recorded interview	Mark Colvin
Sherwood, S.	Newspaper	Canberra Times	Interview with Esther Han on wind farm story	Warm air down and cold air up: wind farms may affect weather.
Sherwood, S.	Online	Graham Readfearn	Extensive quote	Greenhouse gas theory disproved with two fish boxes and a roll of clingfilm
Sherwood, S.	Newspaper	LA Times (internaitonal)	Interview as part of larger story on sporting deaths	Heatstroke deaths prompt new high school football rules
Sherwood, S.	Newspaper	Newcastle Herald (pg 8)	Interview with Esther Han	Wind farms warm: study
Sherwood, S.	Online	The Conversation	Contributed article	What is 'carbon pollution' and why are we trying to stop it?
Sherwood, S.	Online	The Conversation	News story	20 years on, climate change projections have come true
Stone, A.	Newspaper	Sydney Morning Herald	Report passed on	Bushfire conditions worsen near Melbourne
van Sebille, E.	Radio	RadioLIVE (New Zealand	Live on-air interview	Talkback
van Sebille, E.	Online	The Conversation	Opinion piece	Leave the ocean garbage alone. We need to stop polluting first