



Tasmanian Climate Change



A Hydro Tasmania, CSIRO, UTAS and TPAC Project

Hydro Tasmania
the renewable energy business



UNIVERSITY
OF TASMANIA

Fact Sheet – April 2006



Background

In 2001 Hydro Tasmania undertook a review of its future production strategy. As well as presenting operational strategy options the review also included an in-house analysis of historic catchments inflow data. This analysis showed a statistically significant change in annual and spatial distribution in the last 50 year inflow record.

A business risk analysis identified climate change and its implications for a hydro generator as a high risk. Consequently Hydro Tasmania commissioned CSIRO Marine and Atmospheric Research to undertake a high resolution modelling study of Tasmania's climate with a view to estimating likely trends in the major climate elements due to global warming.

This fact sheet is a synopsis of the project and its results with comment on possible future work. The full CSIRO / UTAS / TPAC reports are available on request from Hydro Tasmania and CSIRO.

The Project

The research project was set up as a five stage project with the individual stages providing learning opportunities and assessment hold-points. The project had a Hydro Tasmania budget of \$389,000 with \$459,000 in-kind contribution from the research partners. CSIRO commenced modelling work in late 2003 and Hydro Tasmania called a halt to the project at the completion of Stage 3 in June 2005. There had been a number of problems with the down-scaling of the global models, necessitating several repeat runs of stages two and three. Results from Stage 3 can be used to assess the order of business risk due to climate change and the need for further work.

Stage 1 was a general assessment of observed and projected climate change in Tasmania, using observations and existing climate models (General Circulation Models - GCMs). This was delivered in 2004 ("Climate change in Tasmania", McInnes et al. 2004). The findings and their implications for Tasmania's future climate were sufficient to continue the project into Stage 2.

Stage 2 compared the output from a high resolution regional model (nested within a GCM) with observed data. The objective was to prove and calibrate the high resolution model. The results were disappointing. The usefulness of the comparison

was compromised by the unexpected doubtful quality of the observed data. The validity of the high resolution model therefore had to rest entirely on the intrinsic status of its parent GCM.

Stage 3 used the nested high resolution regional model to project Tasmanian climate to 2040.

Stage 4 was to have provided the variability by repeating the future projections with the same emission scenario but with a range of different GCMs.

Stage 5 was the provision of a final report. This has been completed to the end of Stage 3.

Over the next six months the results will be assessed in terms of potential business impact of climate change. This outcome with the consolidation of knowledge about climate models derived from this project will indicate future work directions.

Interpretation of Results

The IPCC (2001) report indicates that climate change in the southern hemisphere is moderated by the large proportion of ocean in the hemisphere. Global warming is expected to be on the lower end of the scale due to the ocean's thermal inertia, and this is likely to translate to reduced warming over land masses with a maritime climate such as Tasmania.

The general assessment part of this project showed that Tasmania sits in a region where different global models tend to disagree about the sign of the change in rainfall, wind speed and pressure. The models do agree that temperatures will increase, although at a rate lower than the global average.

The results of the detailed regional model runs add weight to the expectation that climate change might be relatively moderate in Tasmania out to 2040. There will be some warming and some change in rainfall patterns and winds, but there is so far no reason to expect a major change of climate in Tasmania in the next 35 years.

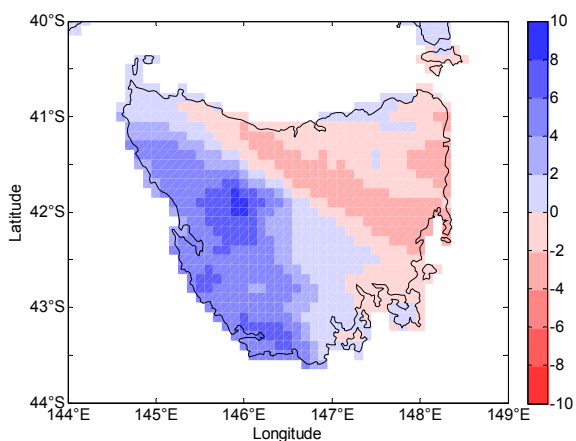
There is some result uncertainty due to the use of a single emission scenario, rather than an ensemble of scenarios. However, the scenarios do not diverge very much by 2040, so it is expected that the use of a single scenario contributes only a small amount to the uncertainty. Similarly there is some uncertainty from using a single rather than an ensemble of different global models.

The model scenario results should be taken as one possible future, rather than a detailed forecast of climate change. In particular, it would be misleading to use the results to infer specific details about limited regions or time periods. Rather, the results should be used as a guide as to how the climate of Tasmania might change by 2040.

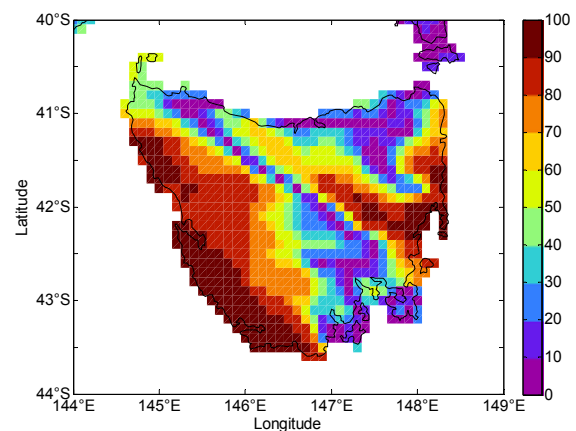
The language of uncertainty used here is necessarily qualitative. Without conducting an ensemble of model scenarios, it is simply not possible to put realistic quantitative error estimates on the outcomes.

The Results

Annual rainfall is projected to increase by 7-11% in the west and centre and a decrease in the NE of around 8%. On a seasonal basis there is increased winter and early spring rainfall in all areas (~1-2 mm per year in each of those months). There is also a drying trend in the NE in the first half of the year, only partly compensated by increase rainfall later in the year.

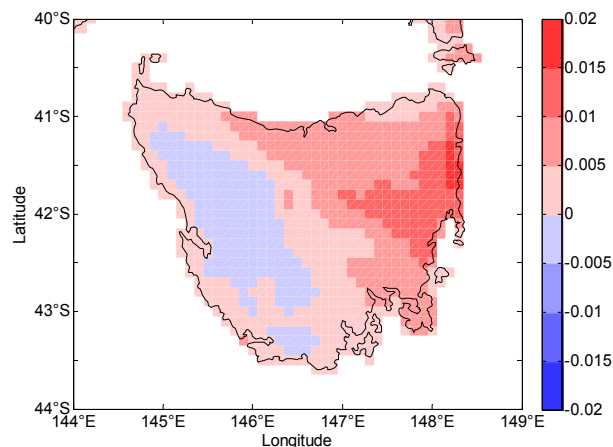


Annual rainfall trend (mm/year) for 2006-2040



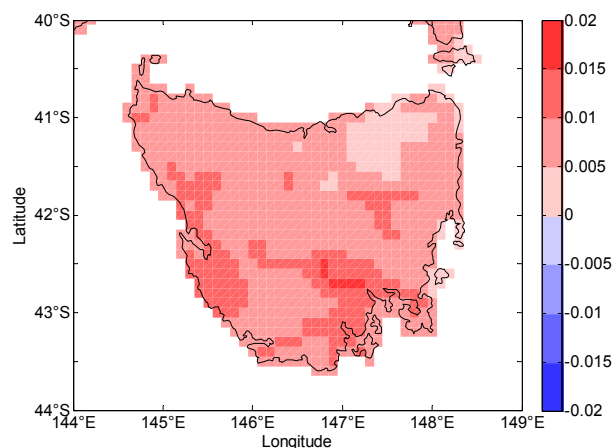
Significance of the annual rainfall trend. High values denote high significance.

The trends in the maximum temperature are insignificant in all areas except the NE, where the projected warming by 2040 is 0.33°C.



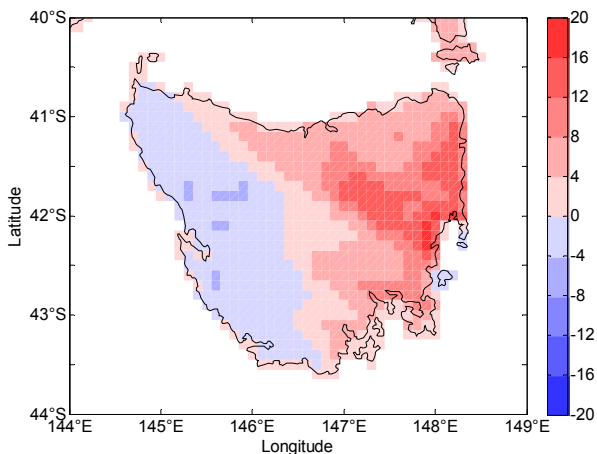
Trend in annual maximum screen temperature (°C/year) from 2006 to 2040.

The trend in annual minimum temperatures is more definite, with generally warmer minimum temperatures in winter and late spring / early summer, with a magnitude of about 1°C by 2040. Averaged over all months, all areas exhibit an increase of minimum temperatures of about 0.3°C by 2040.



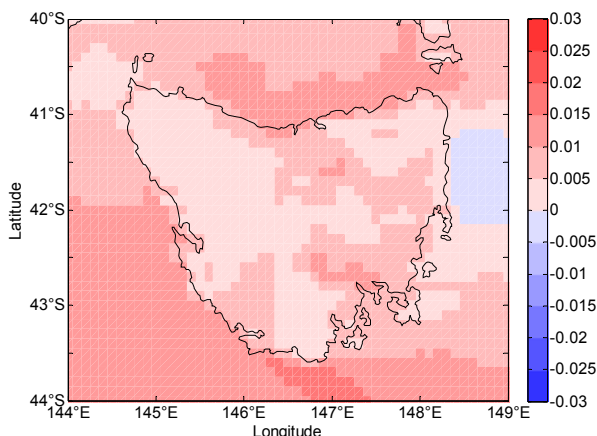
Trend in the annual mean minimum screen temperature (°C/year) from 2006 to 2040.

Annual potential evaporation in the scenario is projected to increase in all areas except the west coast and adjacent highlands where small decreases are indicated. On a seasonal basis in the catchments, the main change is projected to be an increase in potential evaporation in the NE during the 6 month period centred on summer, leading to an annual increase in this catchment of about 12% by 2040.



The trend in annual potential evaporation (mm/year) for the period 2006 to 2040.

Wind speeds are projected to increase by a small amount. The strongest positive trends occur in winter/early spring and early summer. There is also some evidence of a decrease in the north in late autumn. The greatest increases are indicated in the NW for July/August, where the trends imply increases in the monthly mean wind speed by 2040 of between 1.5 and 2 ms⁻¹.



The annual trend in the mean wind speed at 10m over the period from 2006 to 2040. Units are ms⁻¹/year.

Wind direction projection shows an increase everywhere in the westerly component, with a maximum along the north coast. The trend there is a little over 0.02 ms⁻¹/year, or 0.7 ms⁻¹ by 2040. The southerly component is not expected to change much. This implies an anti-clockwise turning of the annual average wind, with values mostly less than 3.5 degrees by 2040.

Result Assessment

The climate projection from 2005 to 2040 output about 100 model variables; the model runs with a 15 minute time step, outputting daily summary data for every grid point of 14km spacing for the area of Tasmania and its surrounding oceans; an enormous amount of data.

Over the next six months Hydro Tasmania will be turning this raw data into catchment inflows which, along with the wind data, will be used in simulation models to assess potential business impact.

Should the business impact be significant, then consideration will be given to complete Stage 4 of the project to assess the variability. Otherwise it is likely that the next review would occur in 2-5 years time when improvements in modelling techniques as well as physical understanding may be able to produce more certain results.

Future Work

A lot has been learnt from this project by both the project team and the researchers. A better understanding has been gained of what is a reasonable duration of analysis, the sort of parameterisation problems that occur when down-scaling a model, what the model is intrinsically capable of, the availability and accuracy of observed data and how to run a project like this. CSIRO are understandably keen to take advantage of the lessons learnt and push on with further research. As described in the preceding section, for Hydro Tasmania the question of further research rests on two issues – the potential business impact and the potential of more certain results.

Antarctic Climate & Ecosystems CRC is considering putting forward a proposal for a Commonwealth grant to fund further work in this area. There is a greater chance of success if industry support can be demonstrated.

Key points

- *Expectations are that climate change may be relatively moderate in Tasmania out to 2040.*
- *The North Eastern area of the state shows trends towards lower rainfall, higher maximum and minimum temperatures and higher evaporation.*
- *The remainder of the state shows trends to higher rainfall, higher minimum temperatures and, on the west coast and highlands, a decrease in evaporation.*
- *There is uncertainty due to the use of a single emission scenario and a single global model.*
- *Further work to assess the potential variability of future climate change may be advisable.*

Contacts

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