• Where I am coming from
• Australian regional modelling applications
  • CCAM
  • Other
• GCM selection issue
Climate change in Australia (2007)

- Probabilistic projections for seven variables
- CMIP3 database
- Full uncertainty sampling
- No downscaling

Reactions

- Multiple variable combinations
- Demand for finer resolution
- Massive demand for future application ready data sets

www.climatechangeinaustralia.gov.au
Where I am coming from

Planning new national projections for 2013/14

Considering the role dynamical and statistical downscaling will play in these

- CORDEX

Concerns regarding representation of uncertainty

- GCM selection issue

- Dependence on one or two downscaling techniques
CCAM (McGregor and Katzfey, CSIRO)

- Lateral boundaries
  - Stretched-grid
- Domain size and placement
  - Stretched-grid
  - Scale-selective filter
- Ensembles
  - Downscale multiple GCMs
- Host model forcing
  - Bias-adjusted SSTs (with or without nudging)
- Variability – internal and external (from host model)
  - External same as GCMs (ENSO)
CCAM regional applications

- ‘Climate Futures Tasmania’
- Pacific
- Indonesia
- Other
Climate Futures Tasmania

- Major research program
- CCAM-based climate scenarios
- Multi-sectoral impact assessment

Acknowledgements: Grose, MR, Corney SP, Bennett JB, Bindoff NL, Katzfey, J, and McGregor, J.
CCAM modelling for *Climate Futures Tasmania*

1) 60 km C64 runs over Australia for Climate Futures Tasmania (1961-2100) – 140 years

   - Mk3.5      A2  B1
   - GFDL 2.1   A2  B1
   - GFDL 2.0   A2  B1
   - ECHAM5     A2  B1
   - HADCM3     A2  B1
   - MIROC-Med  A2  B1

2) 14 km C48 runs over Tasmania Australia (1961-2100) – 140 years downscaled from above 60 km CCAM runs
Current climate rainfall simulation

Simulated annual rainfall for Tasmania at different resolutions

- **Global Model**
- **CCAM 60 km**
- **CCAM 14 km**

Observations

SST correc.

Spectral forcing
Climate projections mean rainfall (6 model mean)

1980-1999 to 2090-2099 SRES A2
Summer rainfall response – impact of downscaling

Source: Corney et al. 2010
Assessing runoff changes

1) Statewide Gridded Runoff
2) Modelled 78 Catchments
3) Modelled > 2000 subcatchments
Percent runoff change 2070-2099 v 1961-1990

CSIRO-MK3.
MIROC3.2(medres)
GFDL-CM2.0
GFDL-CM2.1
ECHAM5/MPI-O
UKMO-HadCM3
Biologically Effective Growing degree days
1975-2030-2085

Pinot Noir

25th - 75th percentiles
90th percentile
10th percentile
Outlier
DJF rainfall chg (2085-1985) – GCMs v CCAM

csiromk3.5

echam5

gfdlcm20

csiromk3.5 - CCAM

echam5 - CCAM

gfdlcm20 - CCAM
DJF rainfall chg (2085-1985) – GCMs v CCAM

- gfdlcm21
- mirocmr
- ukhadcm3

- gfdlcm21 - CCAM
- mirocmr - CCAM
- ukhadcm3 - CCAM
Pacific Climate Change Project (PCCSP)

- Same six GCMs and A2
- Uses monthly bias-corrected SSTs
- Grid resolution is about 60 km (C160)
- Simulations from 1961-2100
- Downscaled to 8 km over seven islands
  - employing digital filter
- New set of runs with mixed-layer ocean
Multi-model dynamical downscaling methodology for Pacific

To dynamically simulate the regional climate, we need to address:

- Uncertainty in regional climate model dynamics/physics
- PCCSP additional downscaling
- Two time periods: 1981-2000, 2046-2065

CCAM global 60 km in GFDLcm2.1

Zetac, WRF, PRECIS, MM5, RegCM

Ensemble of Regional Climate Models, in addition to CCAM
Observed DJF rainfall and NCEP-based simulations
Indonesia ensemble CCAM 60 km simulations

- Same six GCMs and A2
- Uses monthly bias-corrected SSTs
- Proceeds via 200 km quasi-uniform CCAM simulations
- Final grid resolution is about 60 km
- 60 km simulations from 1971-2000, 2041-2060, 2081-2100

Stretched C48 grid with resolution about 60 km over Indonesia
WRF in use at University of NSW (Jason Evans)
Selecting Model Subsets

• Much interest in this issue in the region
  • Both for downscaling and other purposes
  • Attempts to pick best models
• An issue in the CCAM work
Do we know how to select a set of best models?

Smith and Chandler (2010) (updated)

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No!
‘Reliability’ and ‘Applicability’ and a representative subset of models

• In attempting to select we are not good at controlling for **reliability**: the extent to which we can trust the simulated future climate **change**

• Even if we could chose more reliable models, the ‘robust decision-making*’ approach to adaptation requires the range of plausible climates to be considered, not just more likely ones.

• However some models are clearly more **applicable**: have greater realism of simulated surface climate in variables relevant to impact applications

    ➢ *Choose a subset of applicable models which are representative of the range of plausible future climates*

* Lempert & Schlesinger, 2000, Dessai 2009
Knowledge of future climate change

Projected climate change

T

P
Projected climate change

Classify future climates into a small set of relevant future climates.

Climate science can add probability based on model evaluation, etc.
Project climate change

Application ready future climate data sets

Classify climate model results
Option to downscale and use a representative subsample

Small set of climate futures, not models, form the framework for all players

Just warmer
Warmer, drier
Hotter, much drier
How to classify?

Probability?

Collaboration between climate scientists and users
Classifying and using plausible future climates

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<th>Warmer 0.5 to 1.5°C warmer</th>
<th>Hotter 1.5 – 3.0°C warmer</th>
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SE Australia region, A1FI, 2070

- Usually T and P, but not always
- With users, subset of climates selected and then populated with applicable data sets
- **Probability?**
- **Classifying downscaled data without seeing them?**
- **Different models selected by user and sector**
Simulated Australian climate change and regional SST (Watterson, submitted)

PID = Warming in Eq. Eastern Pacific minus warming in the Eq Western Indian

Correlation of CMIP3 simulated precipitation changes with a regional index of SST changes: ‘PID’
CMIP3 model spread, PID and global SST
(I. Watterson, submitted)

Larger global warming
Warmer Indian

Warmer Pacific

Lesser global warming
Warmer India

Warmer Pacific

In most locations 60% of range of change captured
Concluding comments

• Various recent CCAM based simulations available for the region based on six GCMs
  • Well analysed only in some sub-domains
  • Analysis under way for the Southwest Pacific region
  • Set of 60km simulations available globally (i.e. for CORDEX regions)
• Encourage simulations for the Australian region!
• Some methods for model selection presented
  • Temperature and precipitation
  • Regional climate drivers (SST warming patterns), possibly preferable