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Australian Rainfall Patterns in General Circulation Models and Observational Data: A Multi-Model Comparison Study

Honours Research Proposal for Annette Hirsch

Supervisors: Dr Janette Lindesay & Dr Frank Mills

Research Questions

1. How well do climate models reproduce the observed Australian rainfall patterns for the period 1979 to 1999?

   i. What is the range of observational uncertainty?

   ii. Does model performance depend on temporal scale?

   iii. Is model performance uniform across Australia?

2. What are the characteristics within the models that contribute to differences between the model simulations?

   i. Can these differences be attributed to particular cloud and convection schemes?

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Scope of Project

- Limited to the Australian region for the period 1979 to 1999

- Region defined as 0-50°S, 110-160°E
  - Smaller regions impractical
  - Larger regions increase complexity
  - Include surrounding oceans and tropics to consider land/ocean boundaries are treated within the models

- Only evaluate how precipitation patterns are reproduced by the models
  - Largest impact of climate change on society will likely come from changes in precipitation patterns and variability
  - Intention of extending the analysis to encompass other variables in future projects

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Observational Data Sources

- Climate Prediction Centre Merged Analysis of Precipitation (CMAP)
    - 2.5° latitude x 2.5° longitude monthly gridded dataset

- Bureau of Meteorology Rainfall reanalyses dataset Version 3
    - Prepared as part of the Australian Water Availability Project

- If time permits....
    - Global Precipitation Climatology Project (GPCP) dataset

Model Data Sources

- Coupled Model Intercomparison Project phase 3 (CMIP3)

- The ACCESS model – AMIP experiments

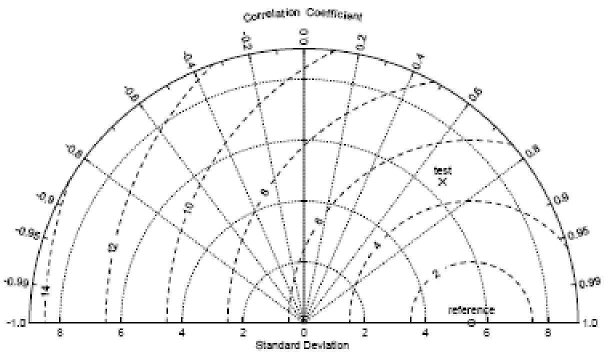
- CMIP3 Model Selection:
  - Preference for models that do not require flux adjustment
  - Ability to capture ENSO variability
  - Ability to reproduce reasonable simulations of Global and Australian precipitation patterns

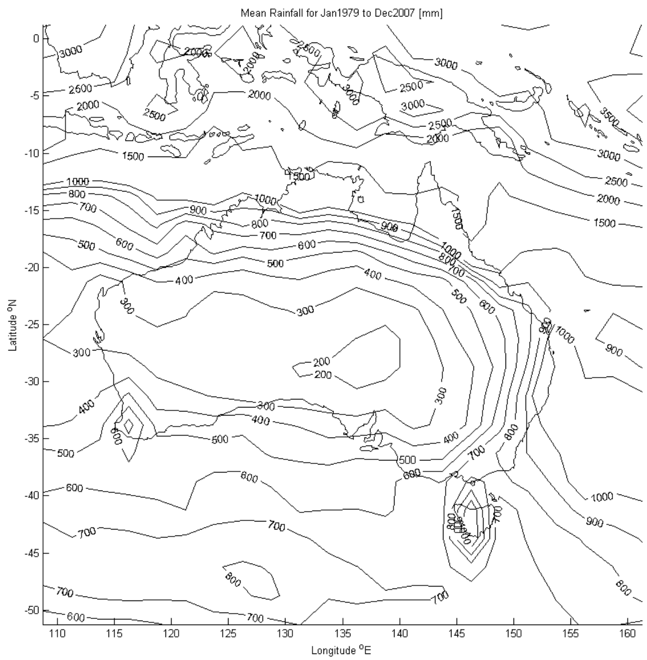
- Models selected:
  - ECHAM5, GFDL-CM2.1 & HadGEM1

Approach & Methods

1. Formatting and interpolation of datasets onto a common grid
2. Comparison of Observational Datasets
3. CMIP3 model comparison
4. ACCESS model comparison of AMIP experiments

- Data Analysis Techniques:
  - Graphical: Contour maps, Taylor diagrams
  - Statistical: pattern correlation, RMSE, skill measures



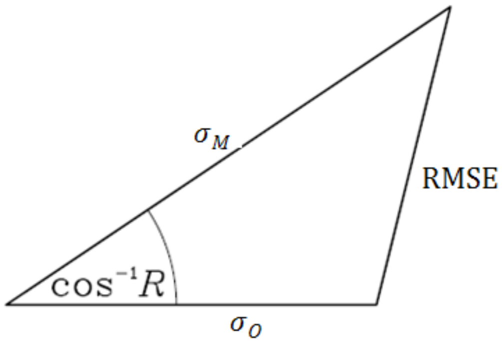


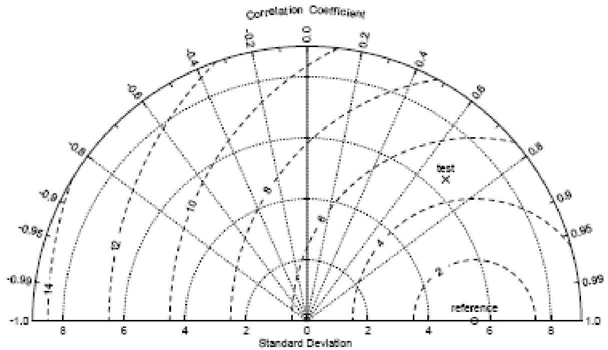
Work Schedule

February	Honours Commences	
	Topic Formulation	Complete
	Introduction & Proposal	Complete
March	Literature Review	Complete
April	Model Selection	Complete
	Datasets & Methodology Chapters	Complete
May	Development of Scripts	Partially complete
	Comparison of Observational Datasets	Commenced
June	CMIP3 Model Comparison	
July	ACCESS Model Evaluation	
August	Conclusions	
September	Submit Thesis Draft to Supervisors	
October	Submission of Thesis	
November	Honours Seminar	
December	Graduation	

Taylor Diagrams

- Summarises relative model performance in a single diagram
- Plots Correlation, RMSE & Standard Deviation
- Based on the Law of Cosines: $c^2 = a^2 + b^2 - 2ab\cos(\varphi)$





$$RMSE^2 = \sigma_O{}^2 + \sigma_M{}^2 - 2\sigma_O\sigma_M R$$

Where:

$\sigma_O \equiv Standard\ Deviation\ of\ the\ Observations\ (read\ along\ the\ x\ axis)$

$\sigma_M \equiv Standard\ Deviation\ of\ the\ Model = value\ on\ y\ axis \div \cos(\varphi)$

$R \equiv \text{Correlation Coefficient} = \cos(\varphi)$

Taylor (2001) *J. Geophys. Res. Atm.*