Importance Of Extreme Climate Events On Annual Pasture Production In South Eastern Australia

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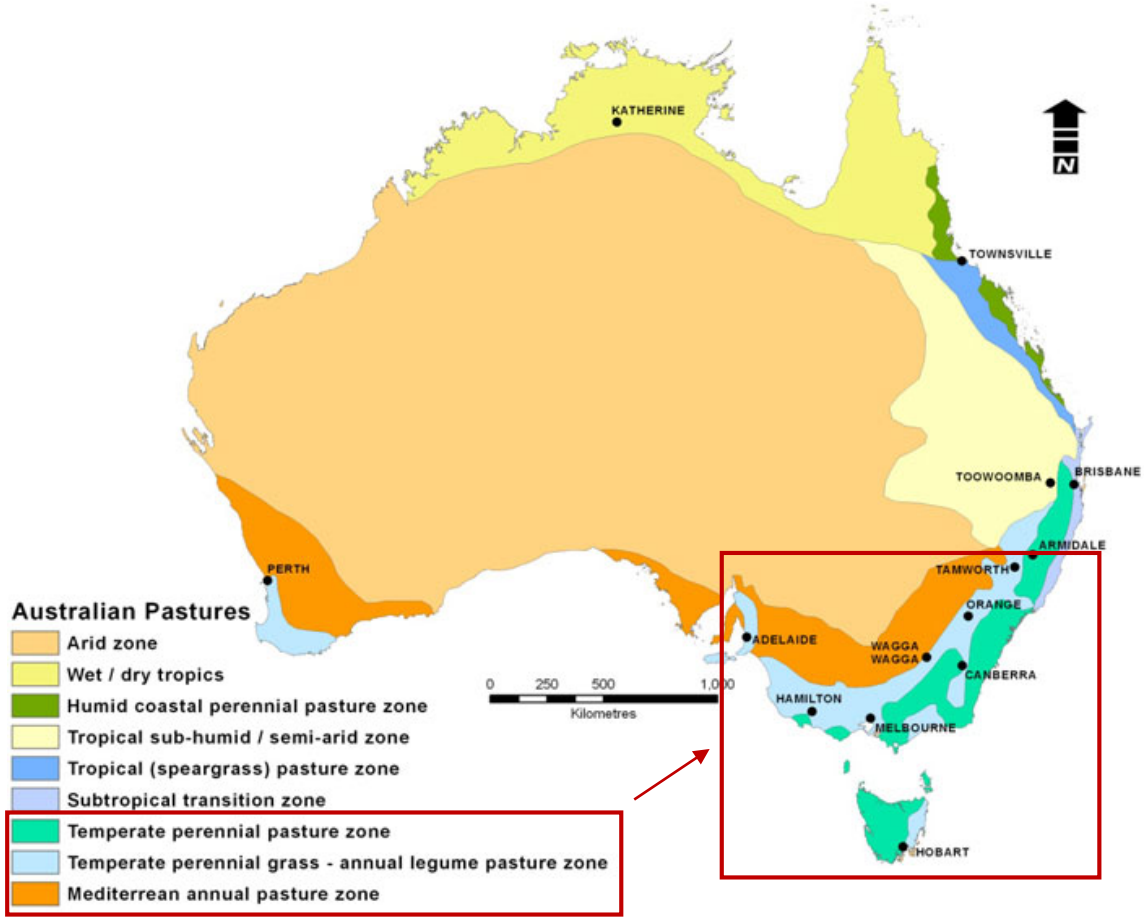
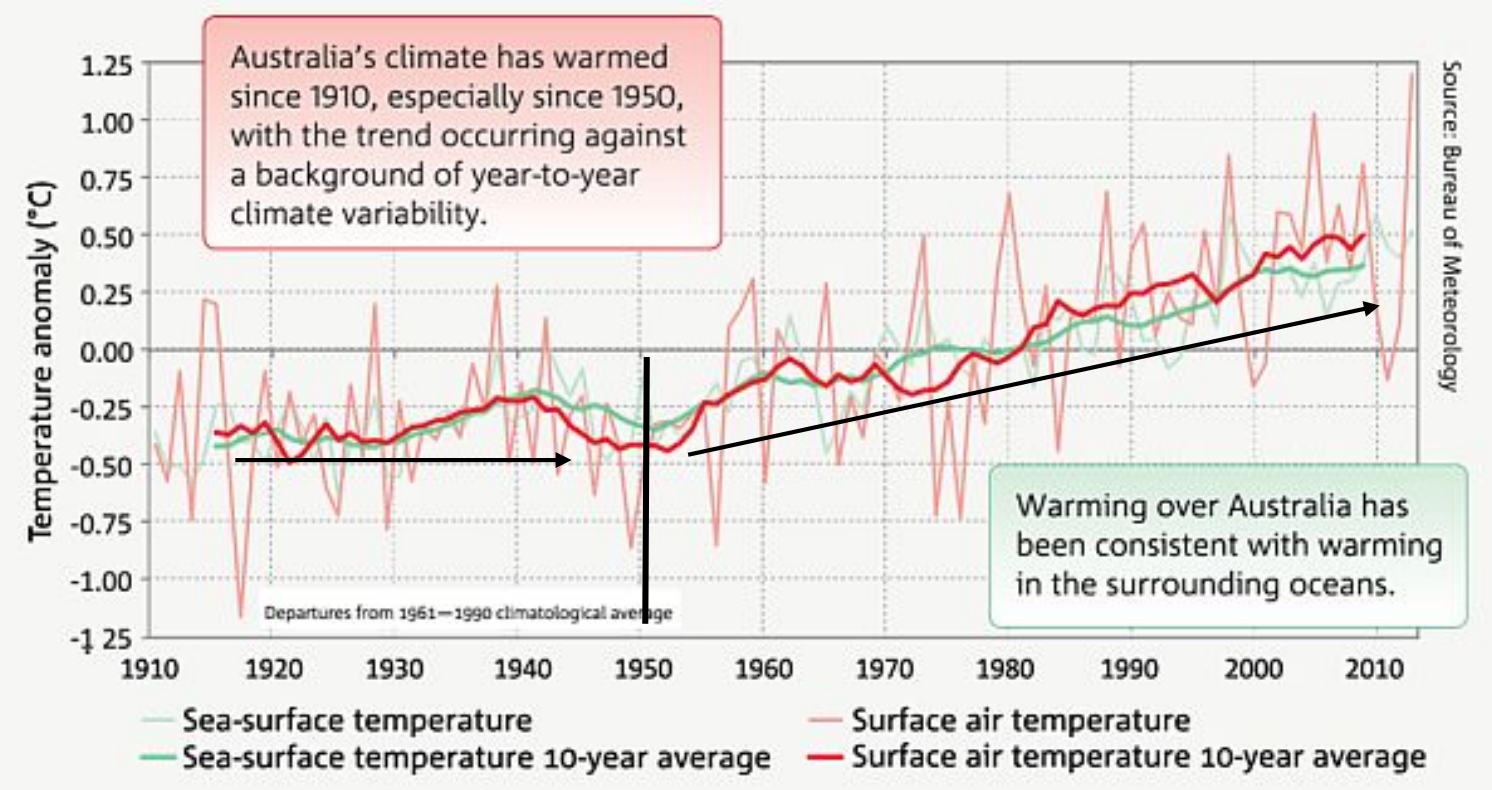
Relevance to pasture industry

- Australia has the most variable rainfall pattern (Love, 2005)
- SE Australia has cool temperate climate
- This climate is suitable for growing cool season pastures
- Pasture industry underpins sheep and dairy industry in this area
  - Cheap feed supply
- However, changing climate variability and extremes challenge pasture **production** and **persistence**

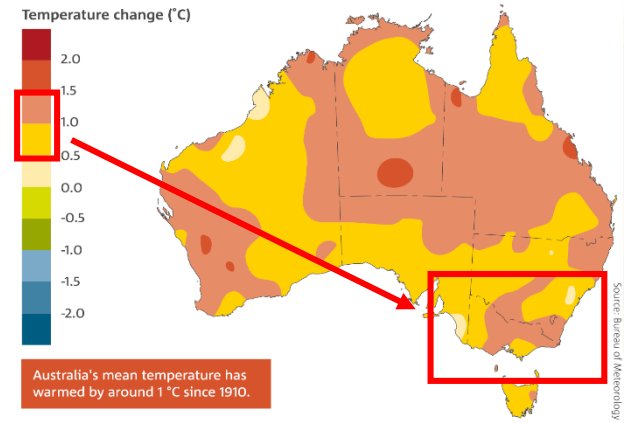


Pastures of Australia based on the limits to the adaptation of tropical and temperate pasture species (after Moore, 1970; Hill, 1996; B. Cook, personal communication)

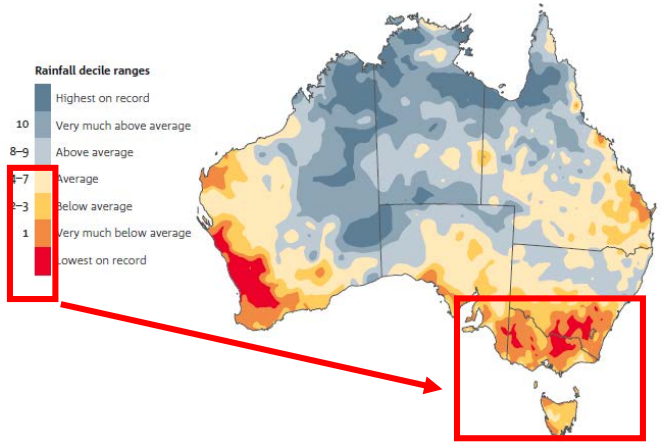
Trends in historical climate



SOURCE: State of the Climate, 2014. SOURCE: Bureau of Meteorology and CSIRO



Annual mean temperature changes across Australia since 1910



Rainfall deciles for **April to September** 1997-2013, relative to the reference period 1900–2013, based on awap data (source: bom, 2014a)

Significance

- Increased frequency of extreme climate events. eg: number of hot days
- Extreme climate events are likely to be detrimental to agricultural systems

- Objectives:
  - To develop a matrix of extreme climate indices using meteorological definitions and biological thresholds of pasture species
  - To develop an approach to explain annual pasture yield variability using extreme climate indices and general climate statistics
  - To identify which climate extremes are important in determining annual yields in SE Australia, and analyse their trends

Methodology – site selection and species composition

Site	Climate	Soil type	Species composition
Ellinbank	High rainfall, Cool temperate	Red Ferrosol	Perennial ryegrass, white clover
Dookie	Medium rainfall, Warm temperate	Red Chromosol	Phalaris, Subterranean clover


Perennial ryegrass


White clover


Subterranean clover


Phalaris

Methodology

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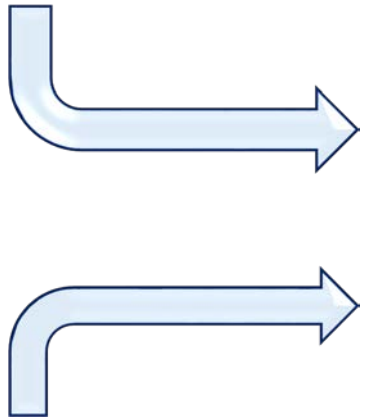
General climate statistics (15)

- Annual and seasonal rainfalls
- Annual and seasonal maximum temperatures
- Annual and seasonal minimum temperatures

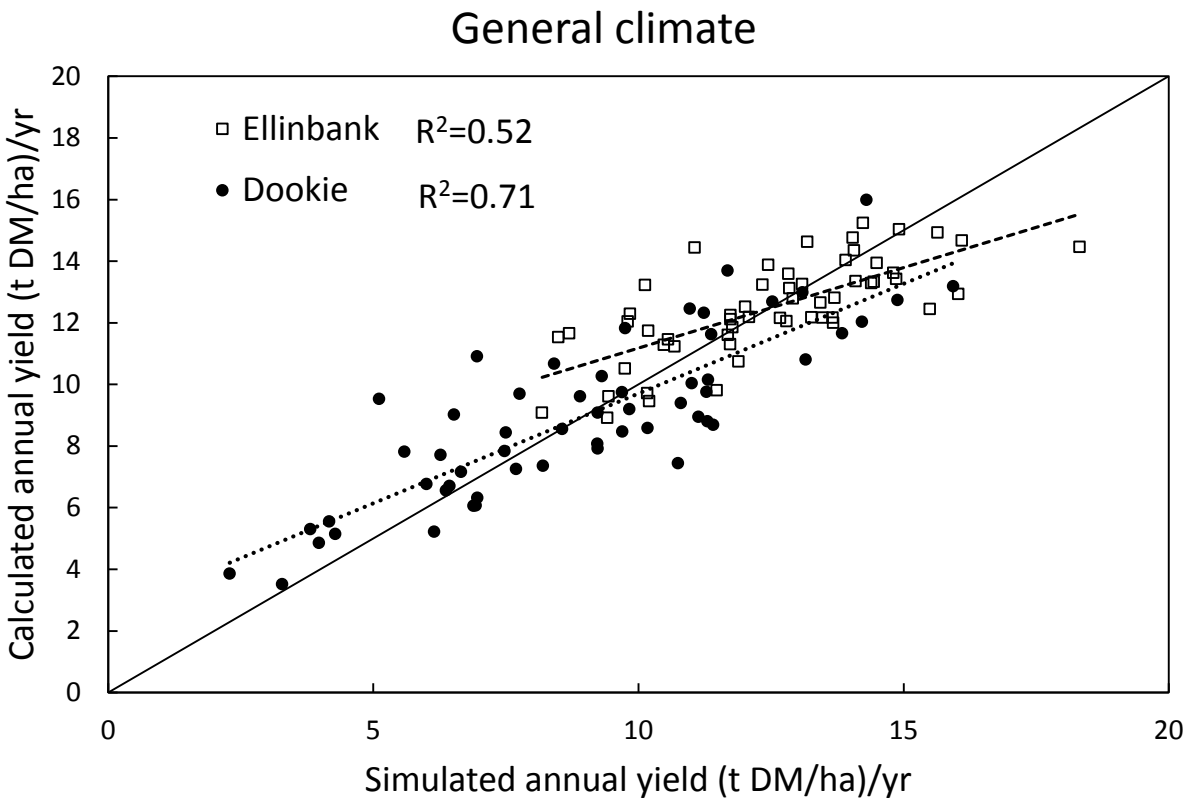


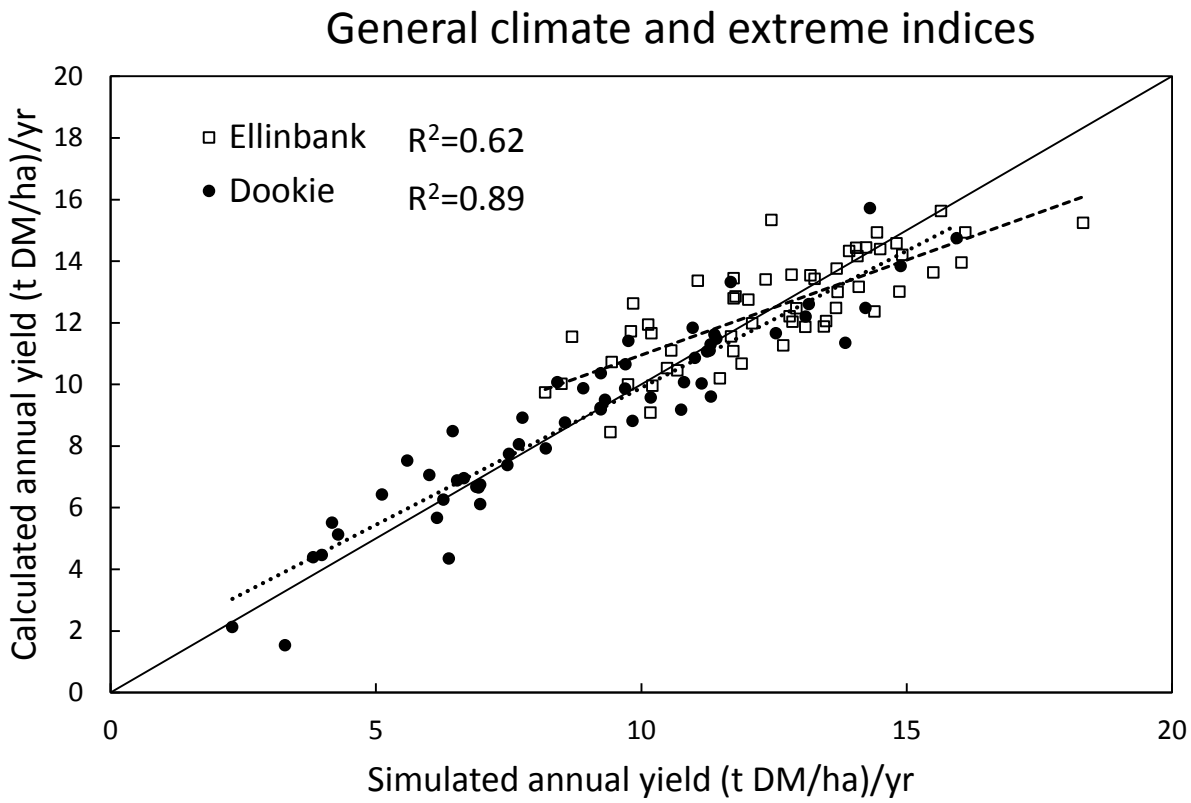
Multiple regression analysis model fitting procedure

Simulated annual pasture yield (t DM/ha)

Extreme climate indices (9)

Results and Discussion





- Predictive power of the models (R^2) have increased when the extreme climate indices are incorporated

Results and Discussion

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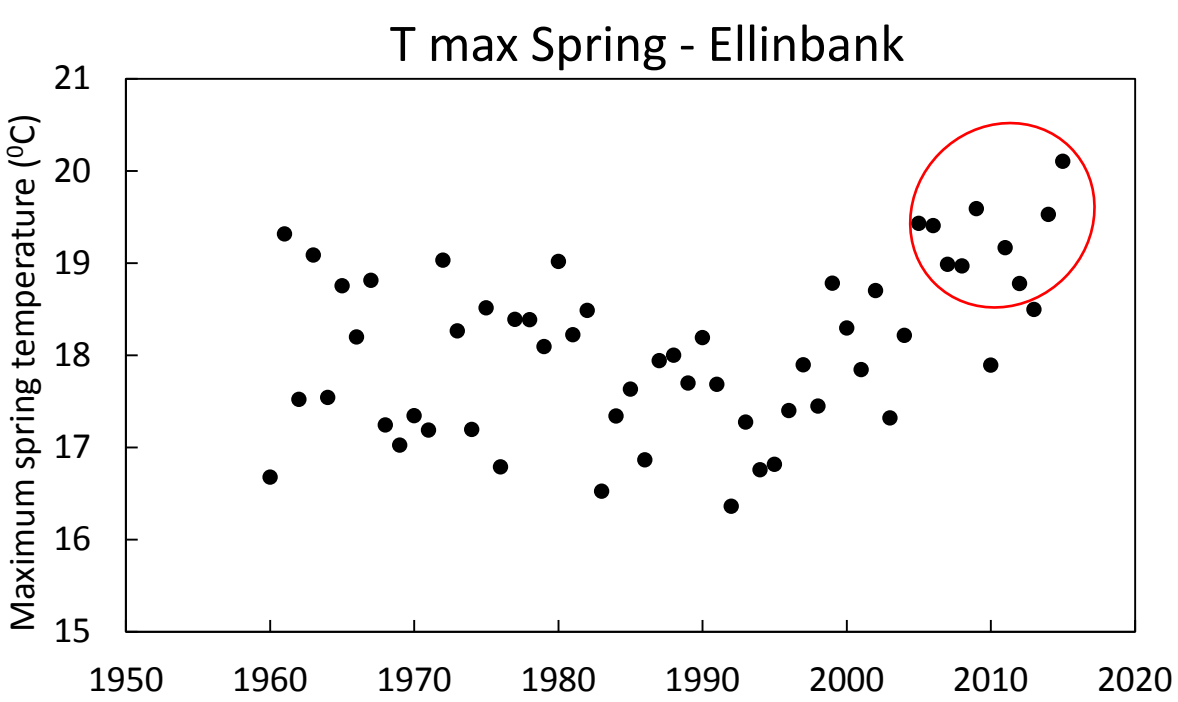
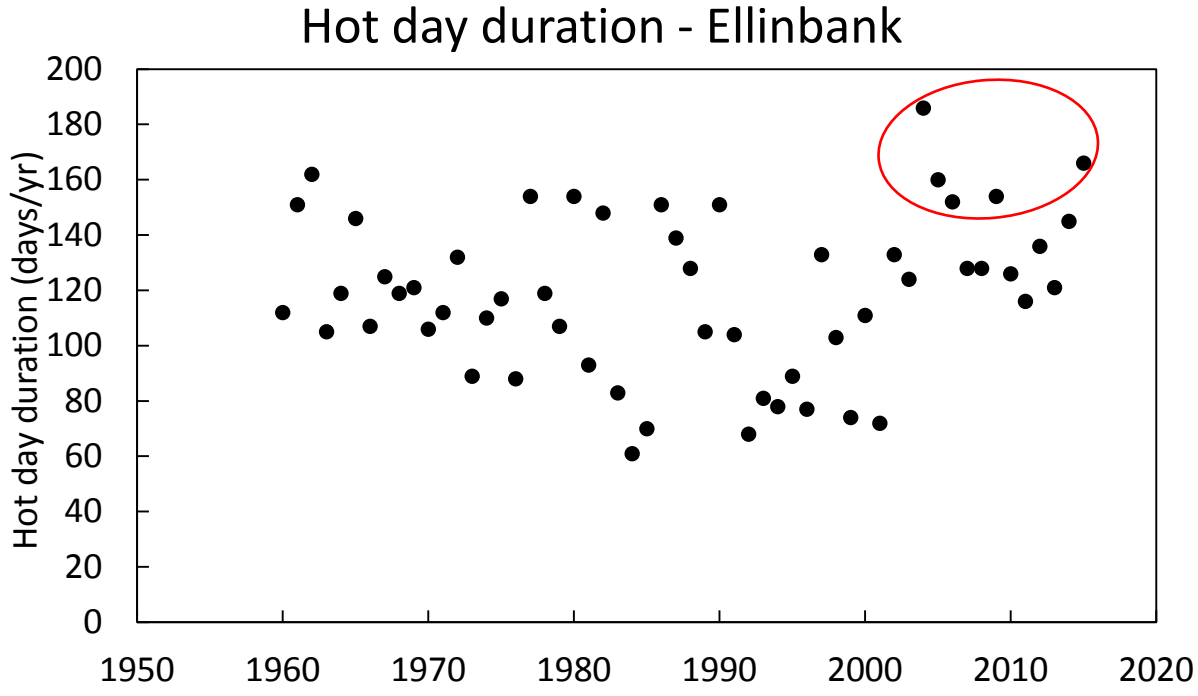
Table: Regression coefficients of the fitted models NS- Not significant , NA – Not applicable

Category	Climate variable	Dookie		Ellinbank	
		General climate	**General and extreme climate**	**General climate**	**General and extreme climate**
General climate	Annual average rainfall	0.02	0.01	0.01	0.01
	Average Tmax -winter	Ns	1.24	Ns	Ns
	Average Tmax –spring	Ns	Ns	-0.64	Ns
	CO_2	Ns	0.02	0.04	0.04
Extreme indices	Severely dry months/yr	NA	-1.35	NA	Ns
	Extremely dry months/yr	NA	-0.61	NA	Ns
	Moderately wet months/yr	NA	Ns	NA	-0.44
	Extremely wet months/yr	NA	-1.16	NA	-0.72
	Hot day duration	NA	Ns	NA	-0.02
	(R^2)	71%	89%	52%	62%

Results and Discussion





Conclusions

- Extreme climate events are important in explaining annual pasture yield variability across SE Australia

- Extreme events affect negatively on annual pasture yields

- Future climate projections indicate greater frequency of extreme climate events. It is vital that we gain a better understanding of the impact of extreme climate events on agricultural systems.


Thank you

Pasture growth simulation

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Inputs

Pasture species
Perennial ryegrass, white clover, sub clover, phalaris

Soil properties
location soil characteristics

Climate

Daily climate data from BOM SILO database

CO_2 (ppm) – measured at Cape Grim Tasmania

Pasture growth simulation

DairyMod

(Version 5.6.5)

Daily pasture growth rates

Management

Non-irrigated

Nutrient non-limiting

cut trial

Annual pasture Yield (1960-2015)

Development of extreme climate indices