Will climate change negate better farm management for improving water quality in north eastern Australia?

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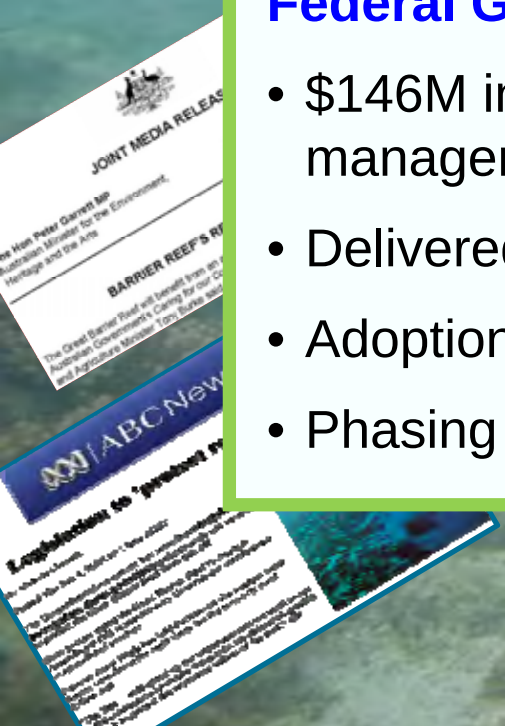
Runoff from agriculture a threat to health of the Great Barrier Reef

Brodie et al. (2008) Scientific Consensus Statement on Water Quality in the Great Barrier Reef.

Federal Govt Reef Rescue $200M package 2008-2013

- $146M in incentives to farmers to adopt improved management practices
- Delivered through NRM Bodies
- Adoption of A-Class and B-Class practices
- Phasing out of C-Class and D-Class practices



The study – What, why and how

- Sugarcane
  - Major source of dissolved N
- Mackay-Whitsunday region
  - Biggest ‘single’ area of sugarcane
    - ~150,000 ha, 30% of total area
  - Dominates cropping (> 99%)
- Approach...

APSIM Farming systems model + Management practices (A-D) + Predicted climate change

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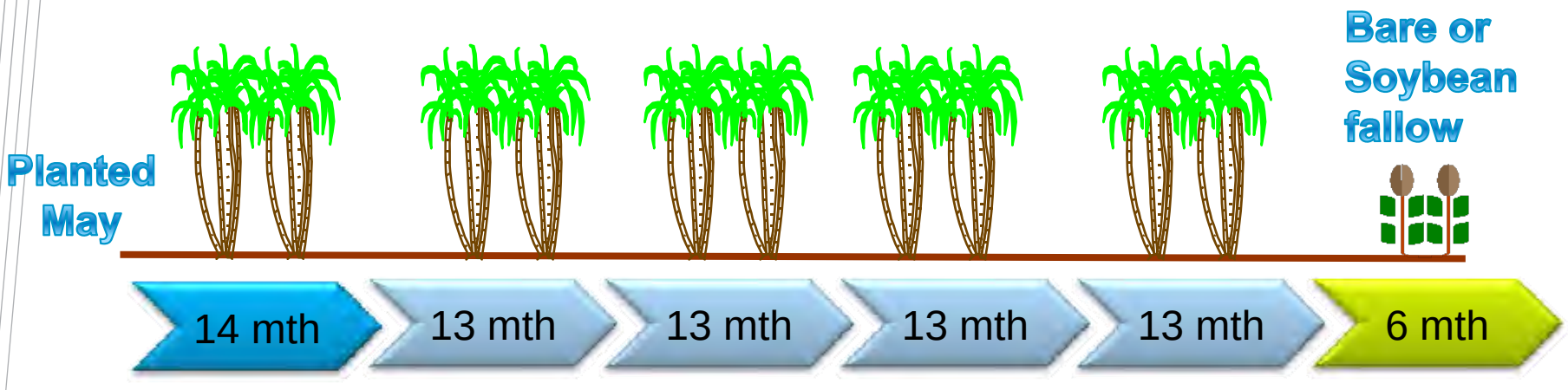
A ‘typical’ sugarcane farming system

- A basic planting/harvest schedule
  - Planted May
  - Plant Crop: 14 months long
  - 4 Ratoon Crops: 13 months long
  - Fallow: 6 months long
    - Bare OR Soybean (Leichhardt variety)
  - Limited irrigation (<= 100mm / crop)



Representing management practice classes

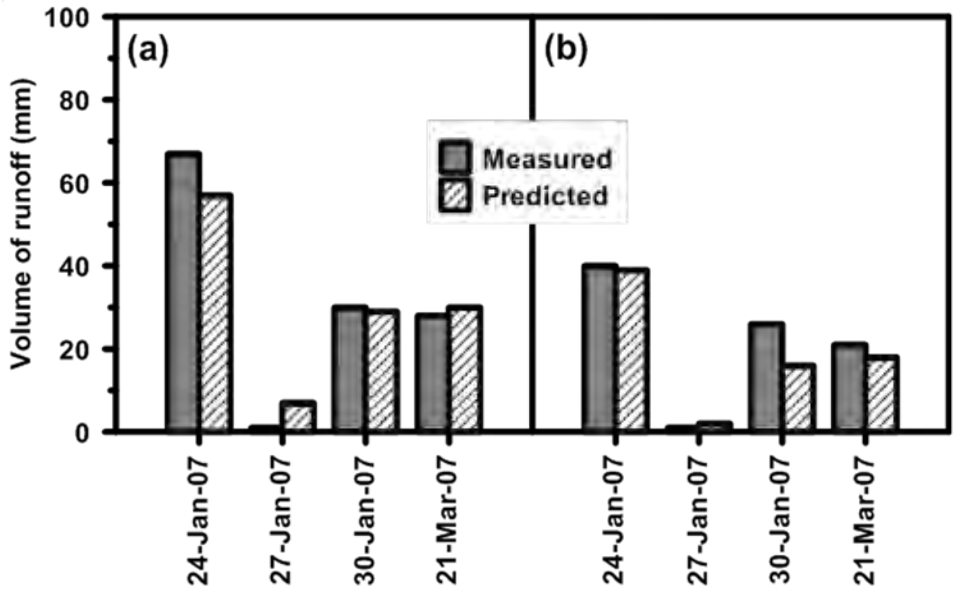
- ABCD Management classes from Mackay-Whitsunday *Water Quality Improvement Plan*
  - Management of soil, fallow, N rate and tillage.

Class	Traffic	Fallow	N Fertiliser (kg/ha) plant / ratoons*	Tillages per crop cycle
A	controlled	Soy (harvest)	**0 / ~85** *('N-Replacement')*	1
B	controlled	Soy (cover)	**0 / 130-140** *('Soil specific')*	2
C	conventional	Bare	**144 / 180** *('Calcino')*	11
D	conventional	Bare	**192 / 240**	20

*Based on different recommendation systems

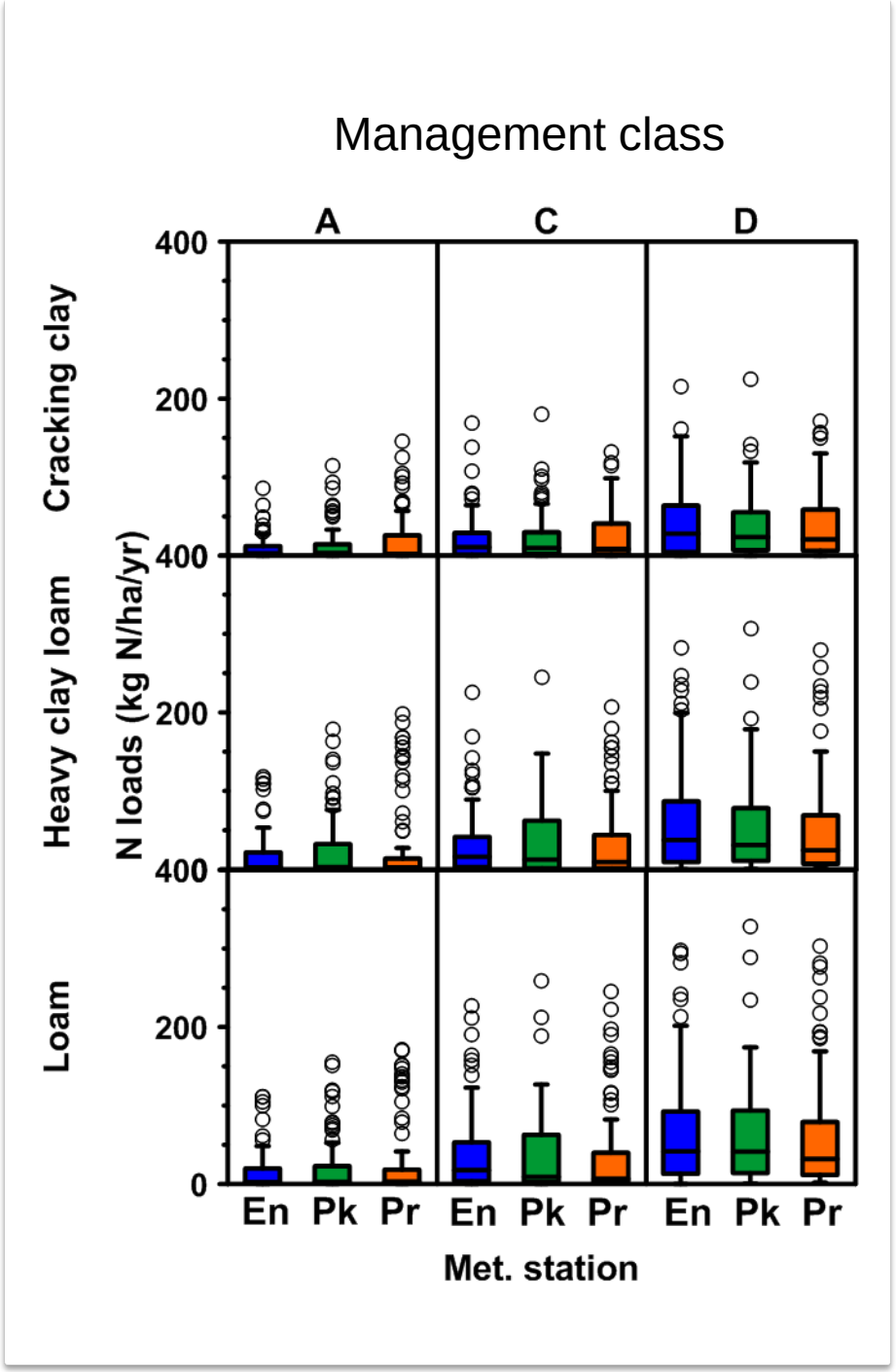
Representing controlled traffic

- Controlled traffic reduces runoff *c.f.* conventional tillage
  (Masters et al. 2008)
- APSIM determines runoff through curve numbers (CN)
  - A low CN results in higher infiltration and hence less runoff
  - CN affected by residue cover, tillage and soil water
- APSIM CN values parameterised from Masters et al. (2008)



Representing regional variability

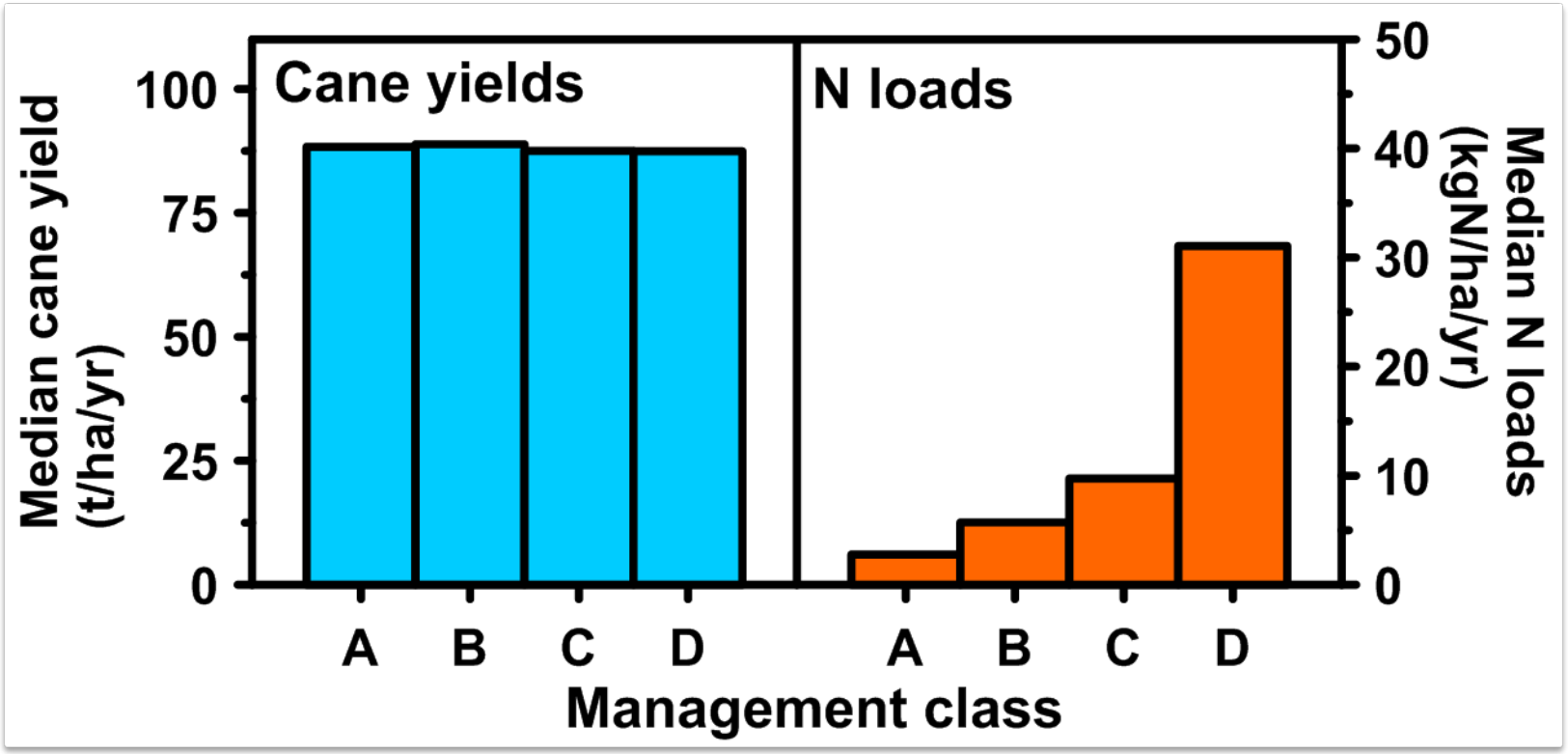
- 3 soils (previously modelled)
  - Cracking clay / Heavy clay loam / Loam
- 3 contrasting sub-regional climates ('Met station')
  - Eton(En) / Plane Ck (Pk)/ Proserpine(Pr)
- Long term simulation
  - ~70 years
- Large and consistent effect of management class
  - Soils and Met combined



Effect of management class:

Yields not affected but N loads are...

- Median N loads reduced
  - Reduced from 31 to 3 kg N/ha/yr



Historical climate, across all soils and met stations

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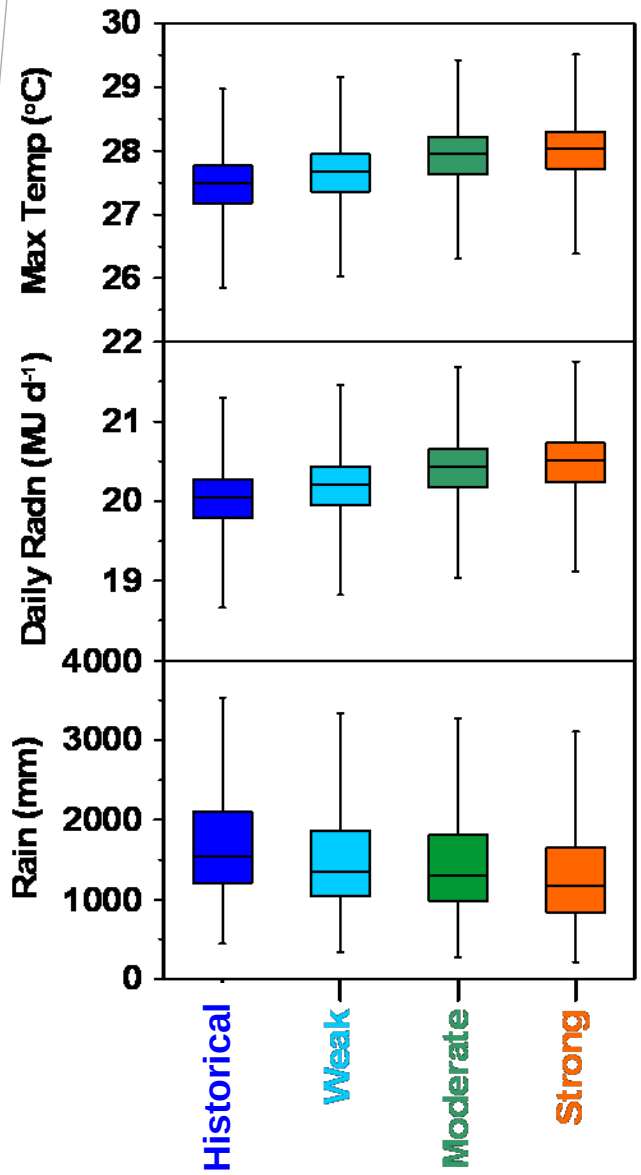
Climate change predictions: Historical + 3 projections



- *All projections based on 2030*
  - *CO_2 increase to 437 ppm*
  - *A combination of GCM and historical trends in the distribution of climate extremes (Crimp et al. 2002).*
  - *CO_2 fertilisation*
- **Weak**
  - MUIB/KMA ECHO-G / SRES B1
- **Moderate**
  - ECHAM5/MPI-OM / SRES A1B
- **Strong**
  - GFDL CM2.1 / SRES A1FI
- **Historical (local past climate data)**

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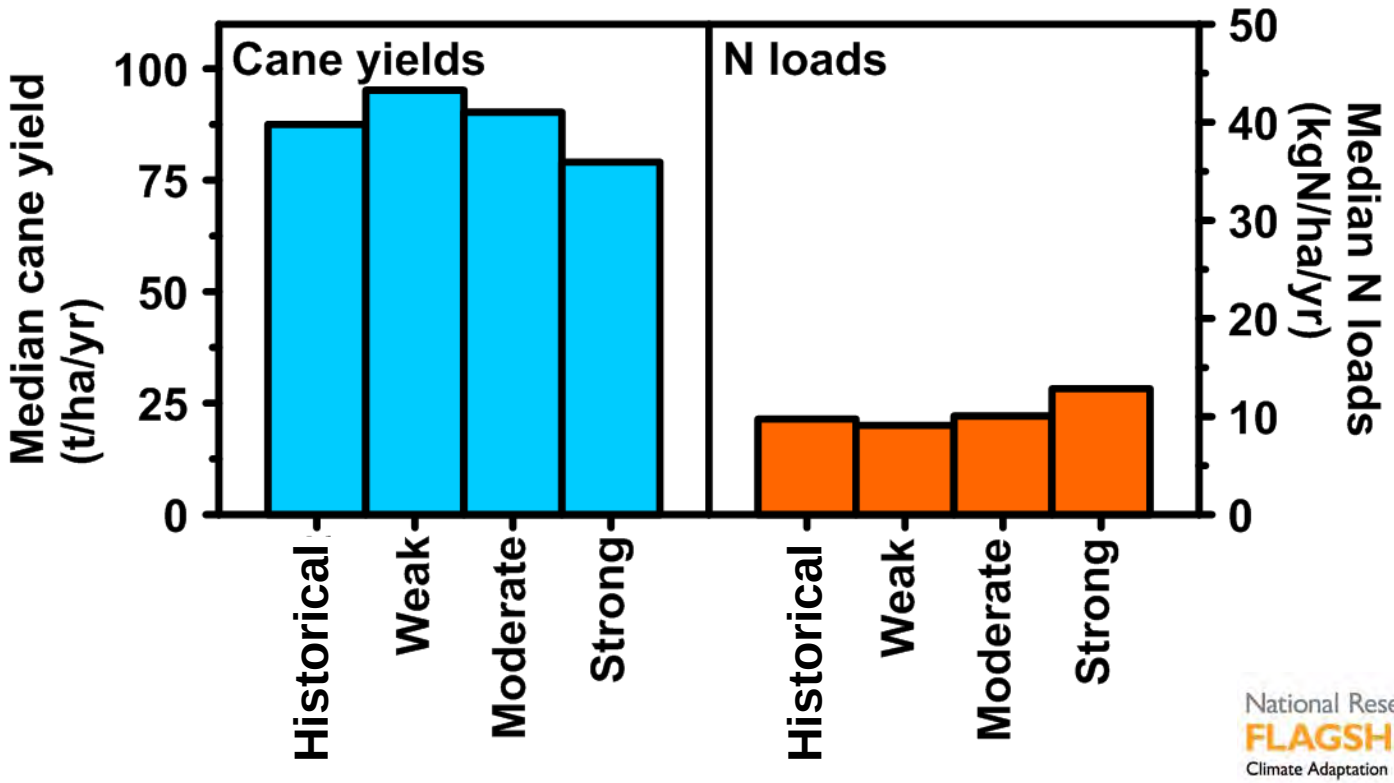
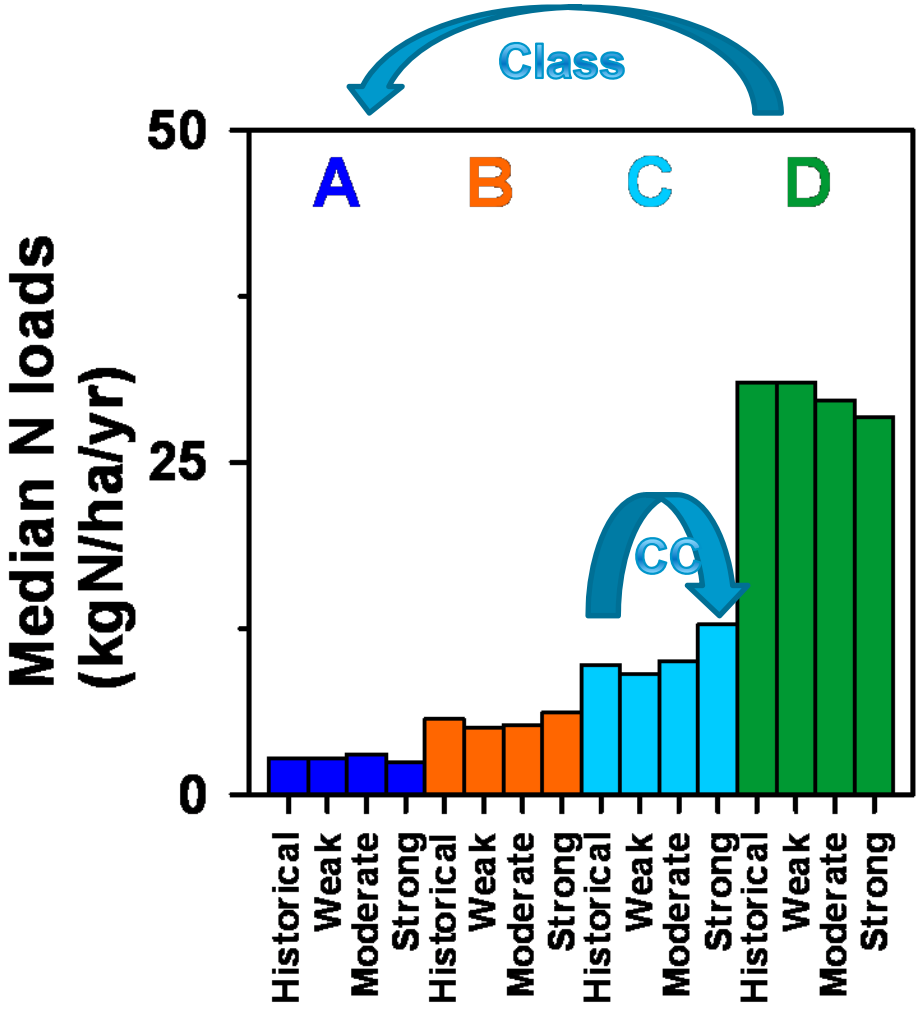
Effect of climate change:
Example for C Class management

- Yields different by up to 15 t/ha/yr
  - Strong = Smallest yield
  - Weak = Largest yield
  - Moderate ***similar to*** Historical
- N loads < 5 kg N/ha/yr different



Climate change compared to management change

- Effect of management change >> ***greater than*** 2030 CC.
  - Class D = 31 kgN/ha/yr
  - Class A = 3 kgN/ha/yr
  - Maximum CC ***less than*** 5 kgN/ha/yr
- In fact:
  - 1 Class change ***similar to maximum*** CC by 2030



Conclusions

- Is best practice always going to be better? Yes.
  - Moving towards an ‘A’ class practice will provide significant improvements in N loads for all climate change scenarios investigated here.
- Effect of weak climate change possibly good & strong bad
  - Production
  - N Loads
- Predicted ‘benefits’ strongly affected by CO_2 fertilisation
  - Substantial uncertainty

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