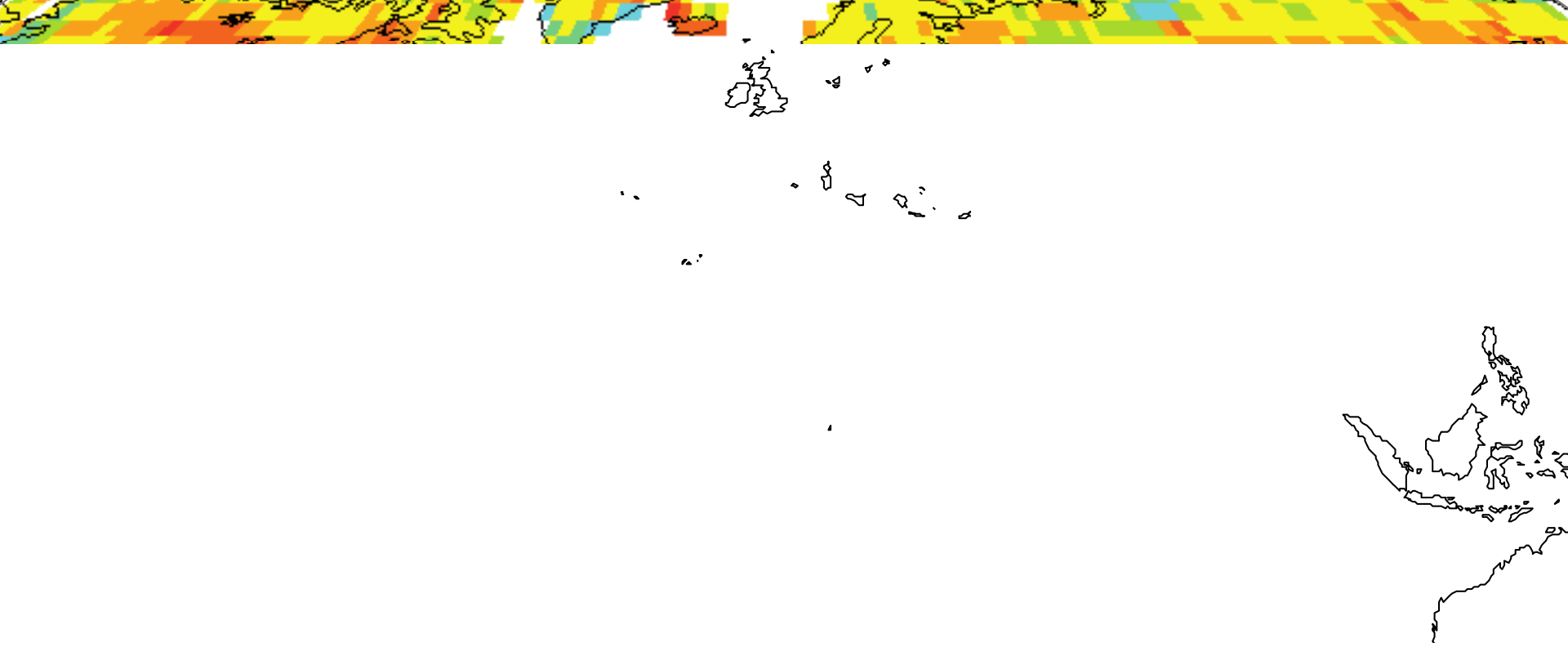


How much global temperature increase can we afford?

Irina Mahlstein

Reto Knutti, Susan Solomon, Robert Portmann and John Daniel

March 15, 2012

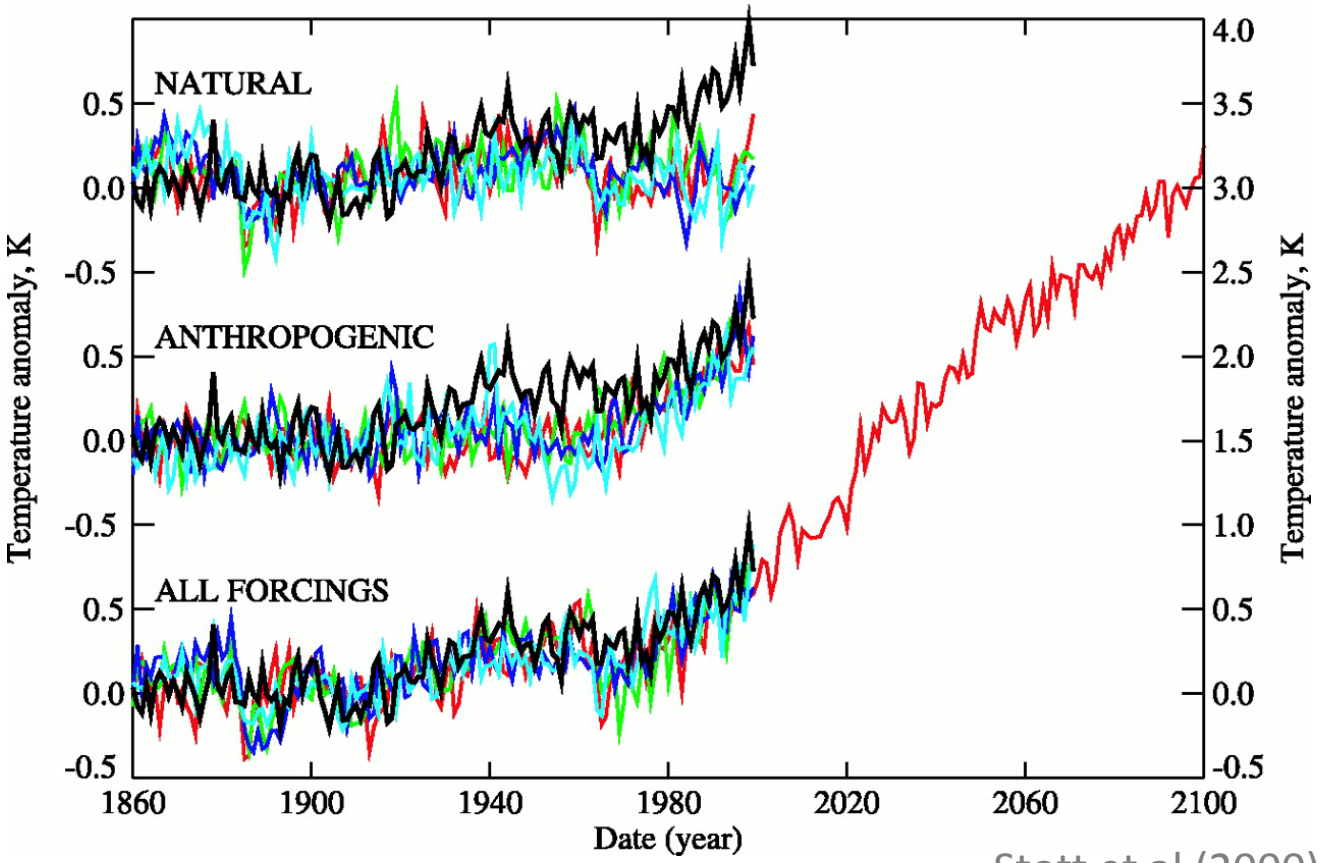
At what global temperature increase…

1. … do local temperature changes become perceptible?

2. … do regional precipitation changes become perceptible?

Motivation & Outline

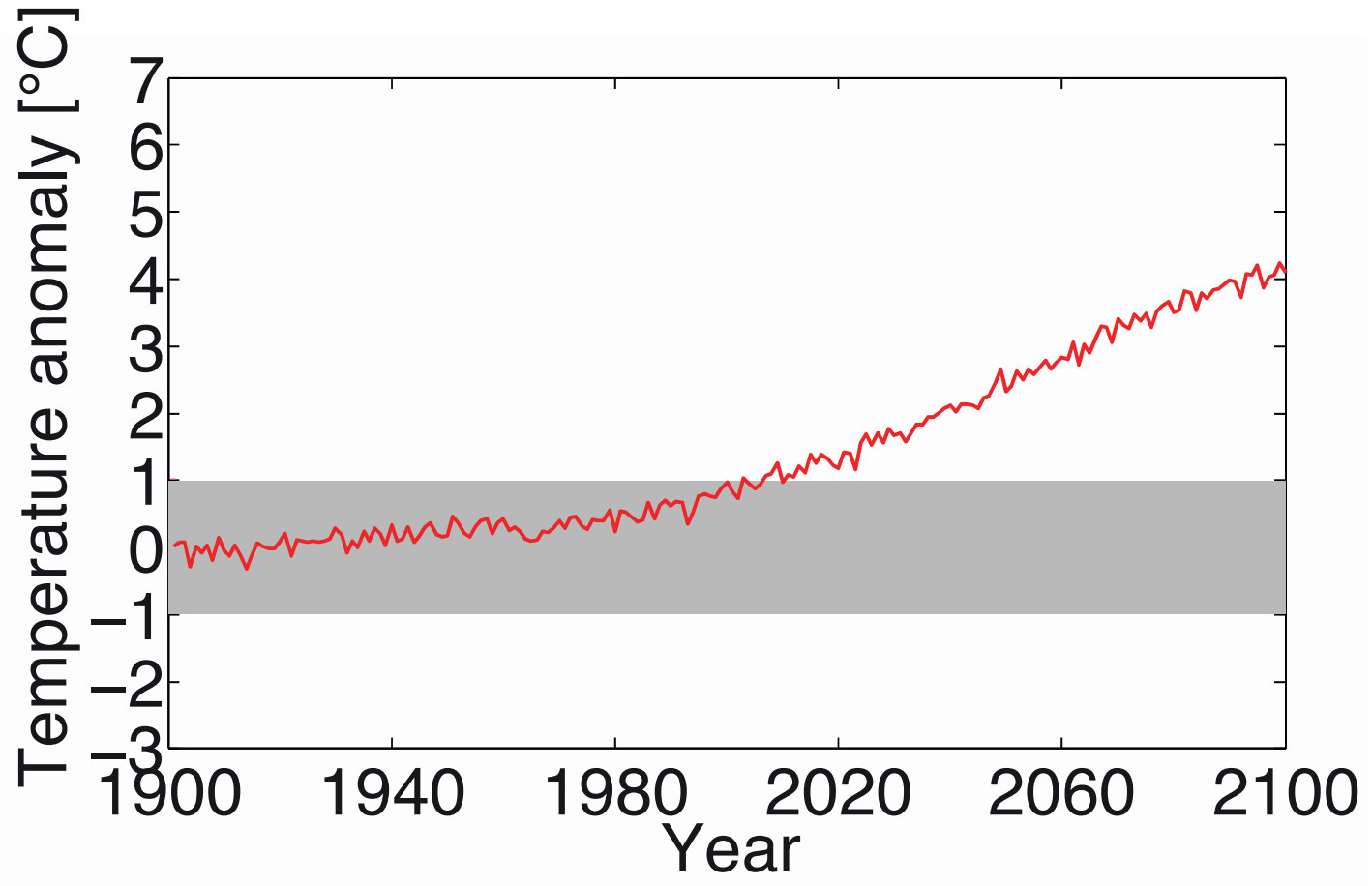
Detection of temperature changes



Stott et al (2000)

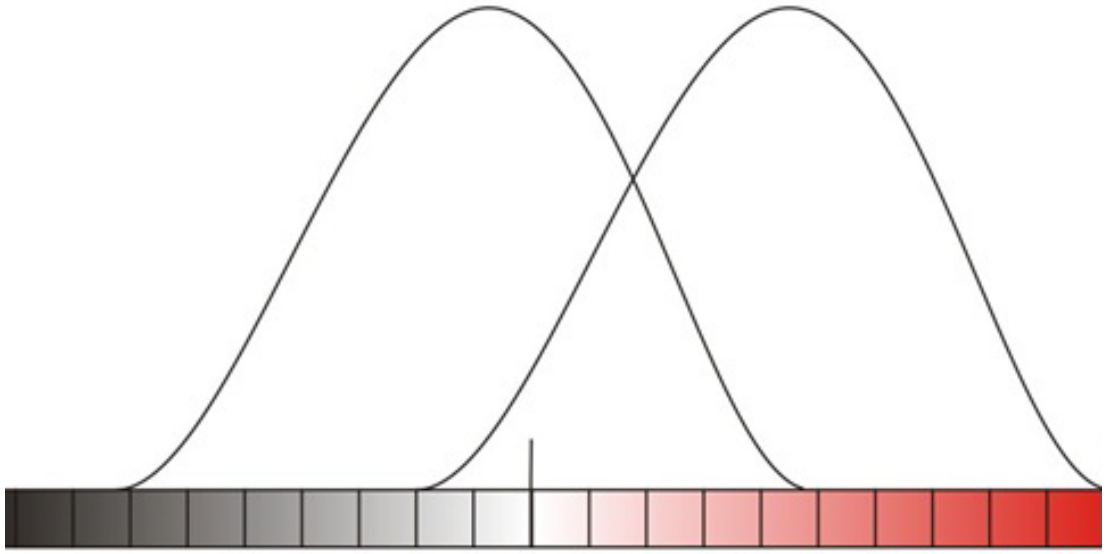
Does not imply that perceptible to people

When is the signal emerging from natural variability?



Modified from Mahlstein et al. (2011)

Method



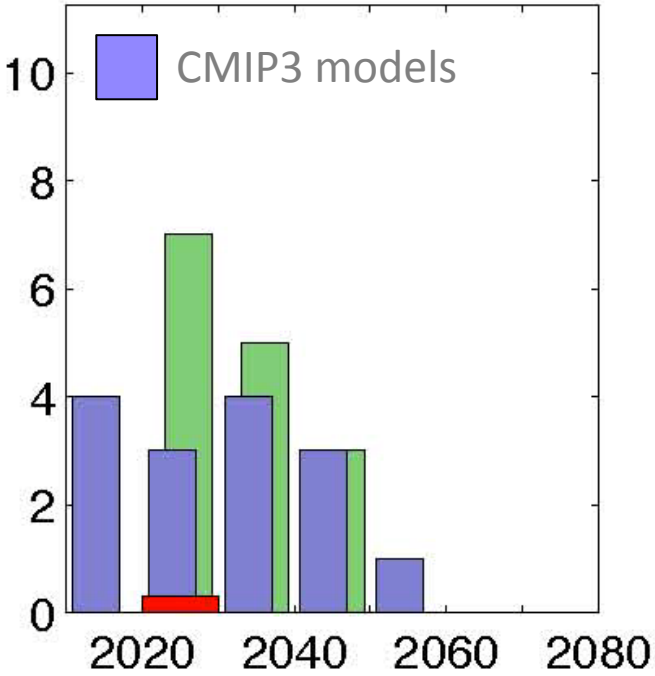
30yr base period (1900-1929)

30yr future period (??-??)

Year when signal emerges

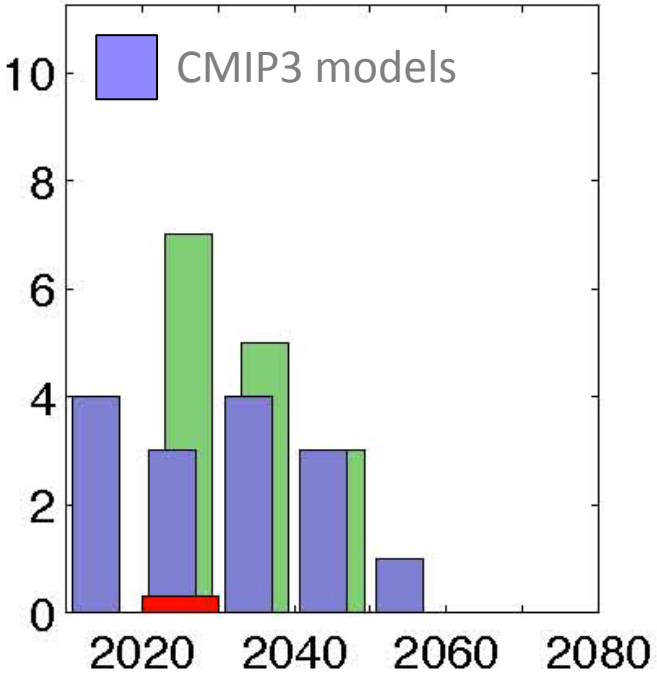
Temperature above 1900-1929 levels

Method



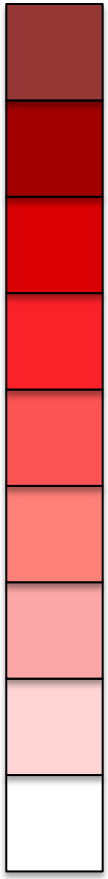
Modified from Hawkins and Sutton (2012)

Method



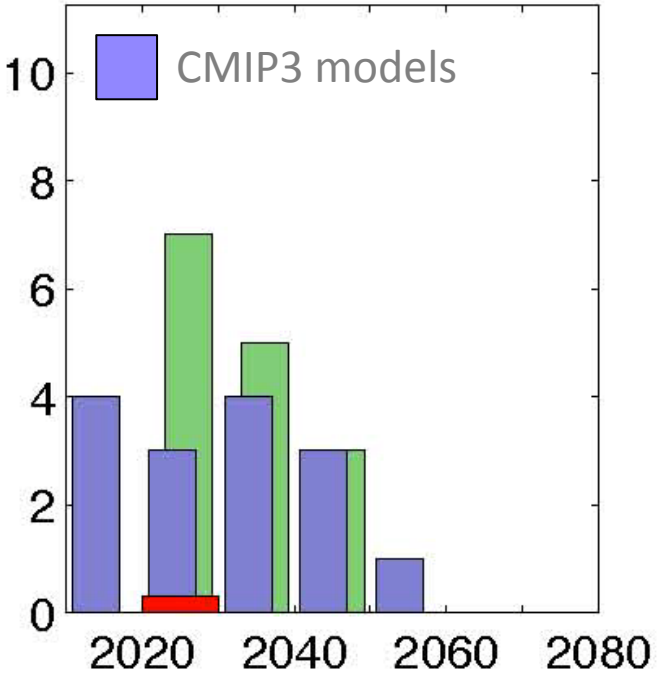
Modified from Hawkins and Sutton (2012)

Region 1



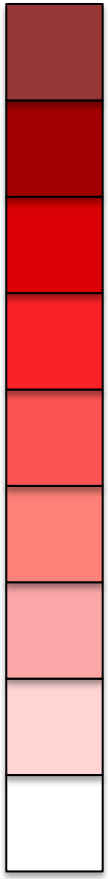
Model 1

Method



Modified from Hawkins and Sutton (2012)

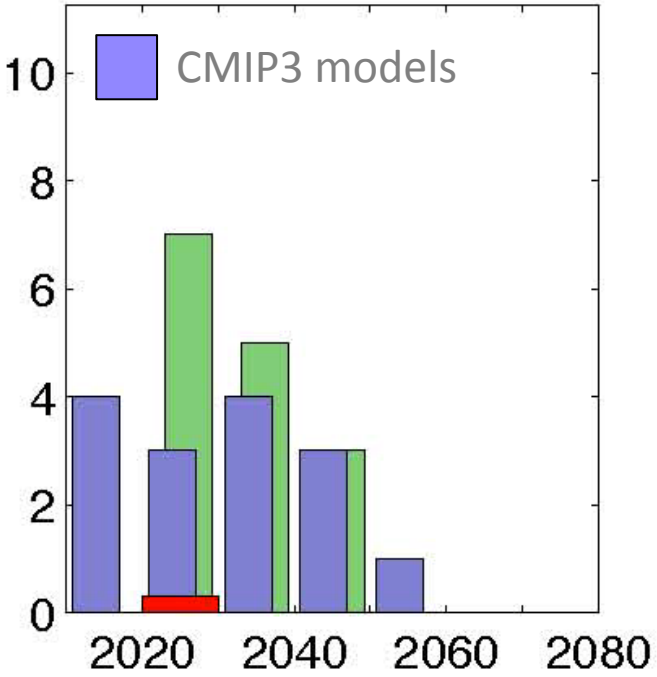
Region 1



Model 1

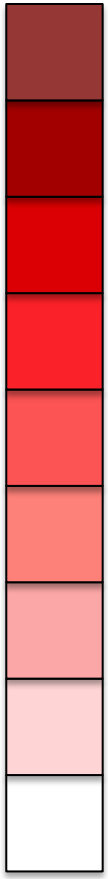
Model 2

Method



Modified from Hawkins and Sutton (2012)

Region 1

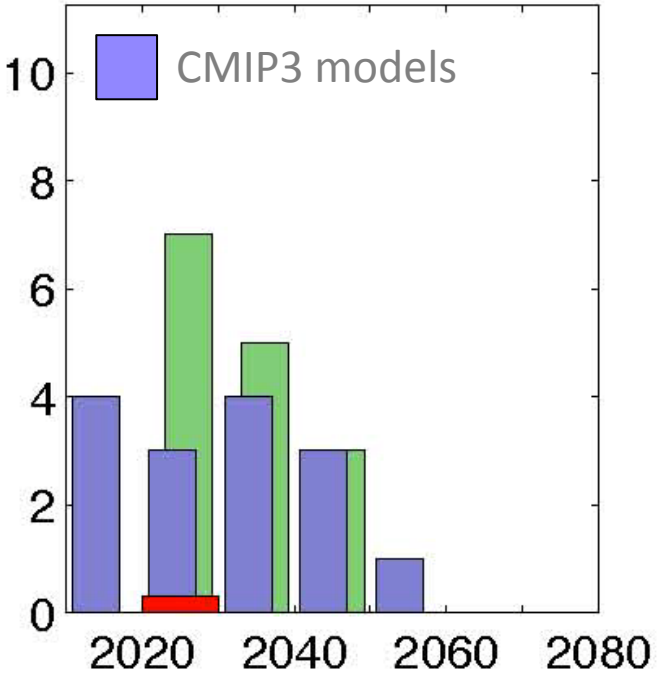


Model 3

Model 1

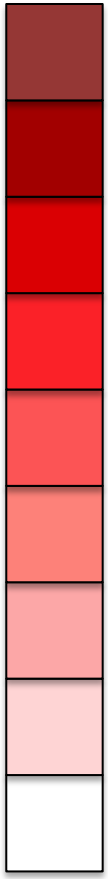
Model 2

Method



Modified from Hawkins and Sutton (2012)

Region 1



Model 6

Model 3

Model 5

Model 1

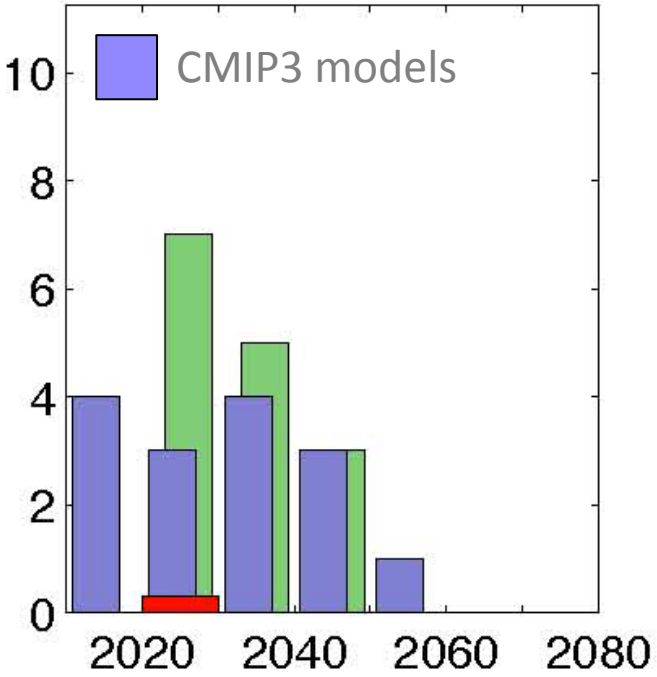
Model 7

Model 8

Model 2

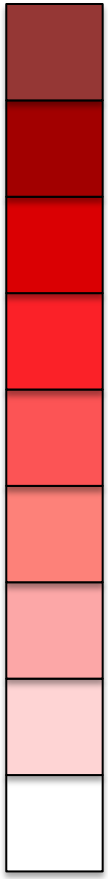
Model 4

Method



Modified from Hawkins and Sutton (2012)

Region 1



Model 6

Model 3

80% Quantile

Model 5

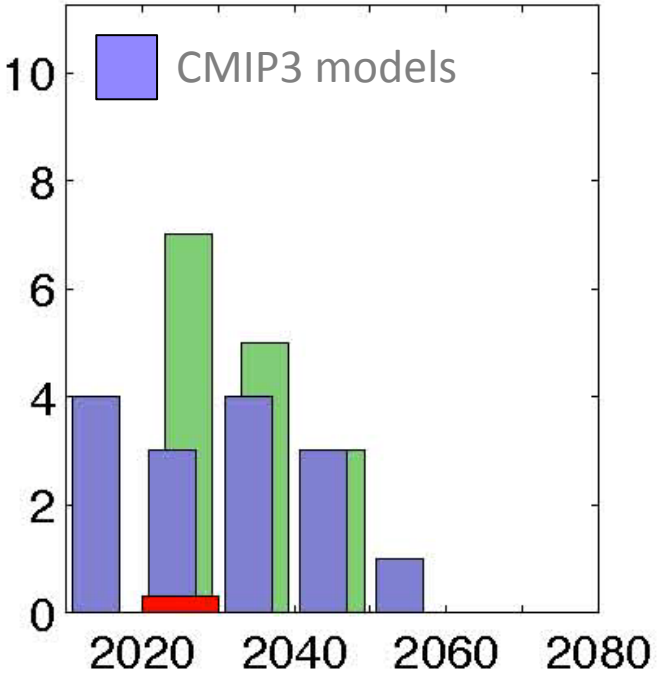
Model 1 Model 7

Model 8

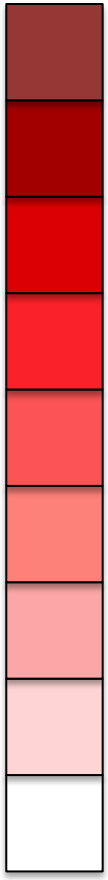
Model 2

Model 4

Method



Modified from Hawkins and Sutton (2012)



Region 1

Model 6

Model 3

Model 5

Model 1 Model 7

Model 8

Model 2

Model 4

Region 2

Model 2

Model 1

80% Quantile

Model 4 Model 7

Model 5 Model 6

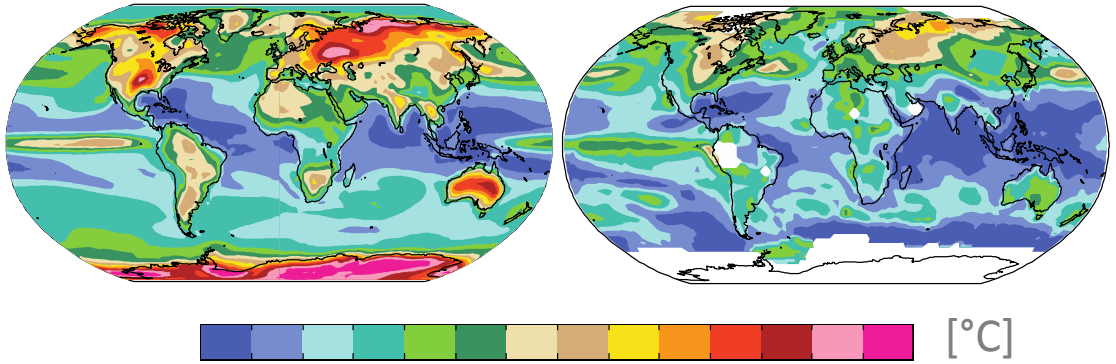
Model 8

Model 3

Models (1900-1999)

GISTEMP (1900-1999)

Interannual variability
('noise')



[°C]

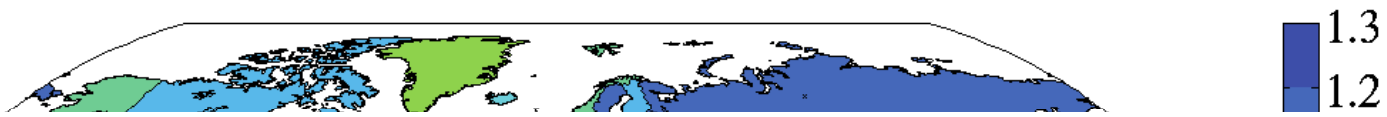
Signal

[°C]

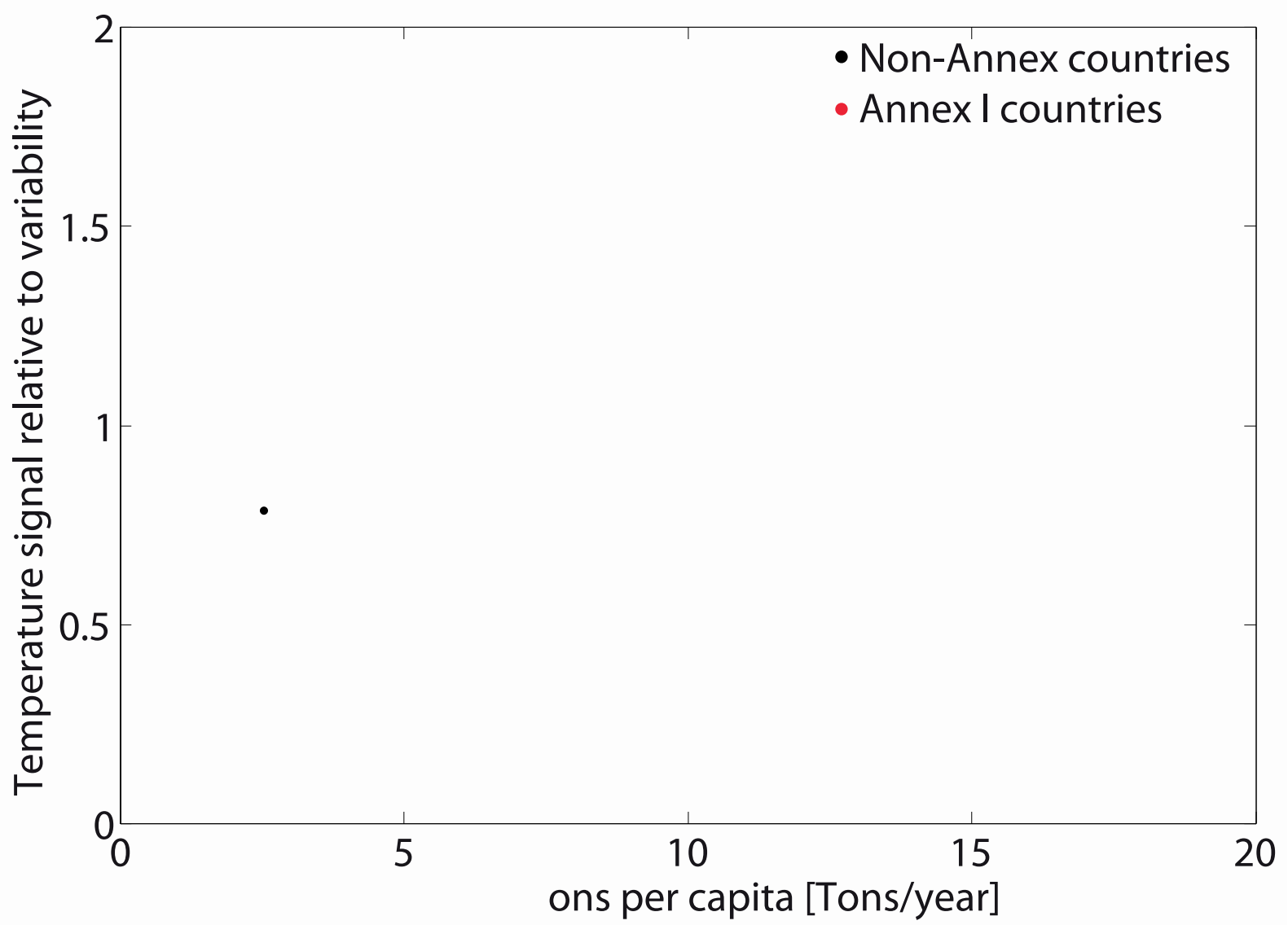
Signal to noise

-0.4 -0.2 0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8

Comparison models and observations



Significant changes in low latitude countries



The most affected caused it the least

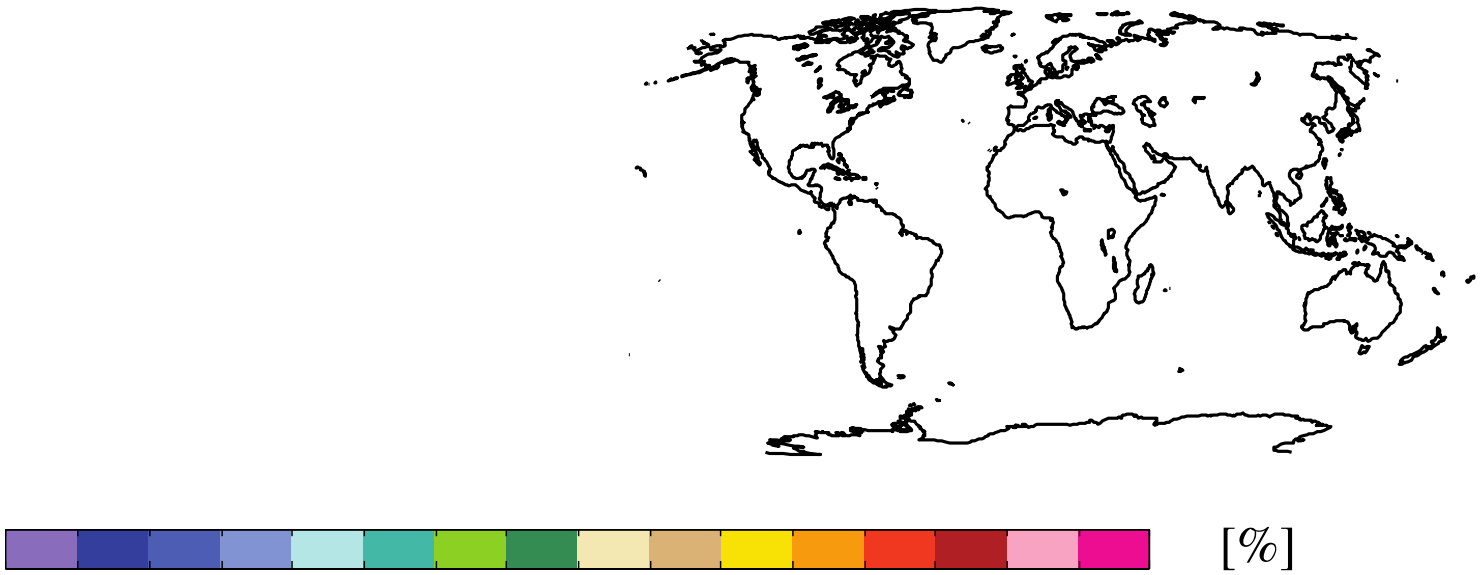
Issues with precipitation:

1. Large interannual variability
2. Weaker trends
3. Less agreement between models and observations

Dealing with Precipitation

Hulme Dataset
(1900-1998)

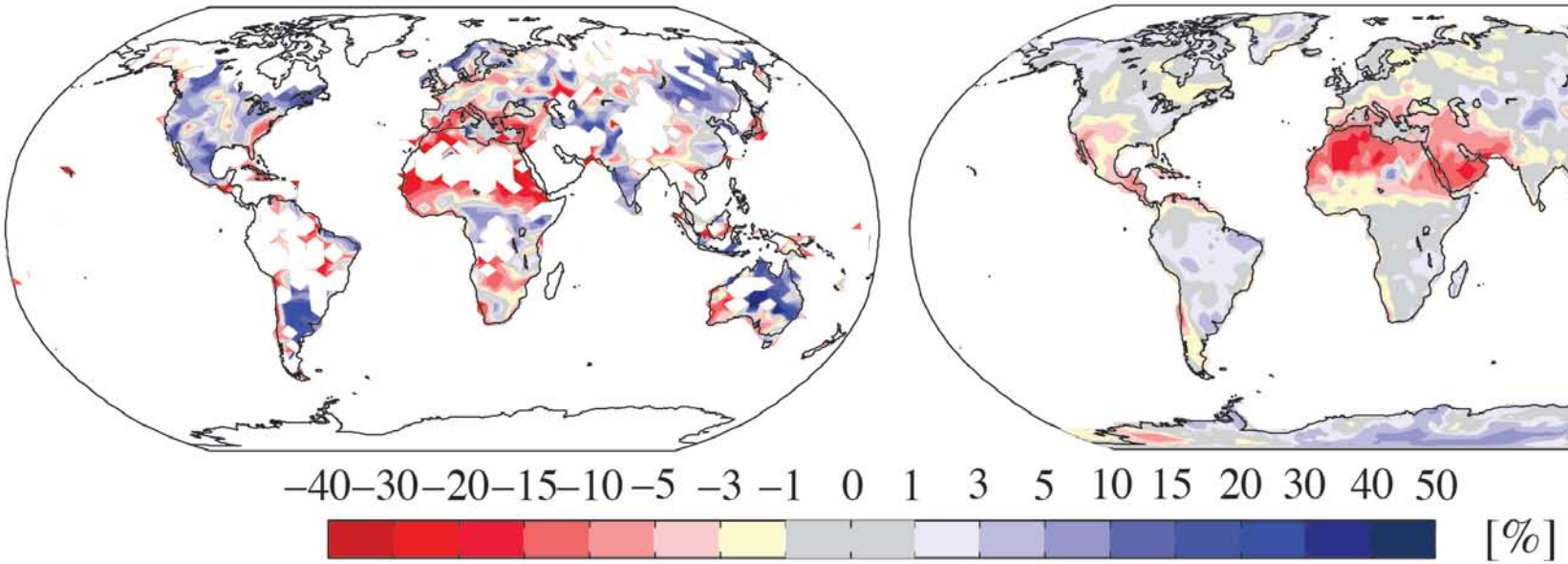
CMIP3 multi model mean
(1900-1998)



Natural variability (noise) in wet season

Hulme Dataset
(1970-1998)-(1900-1929)

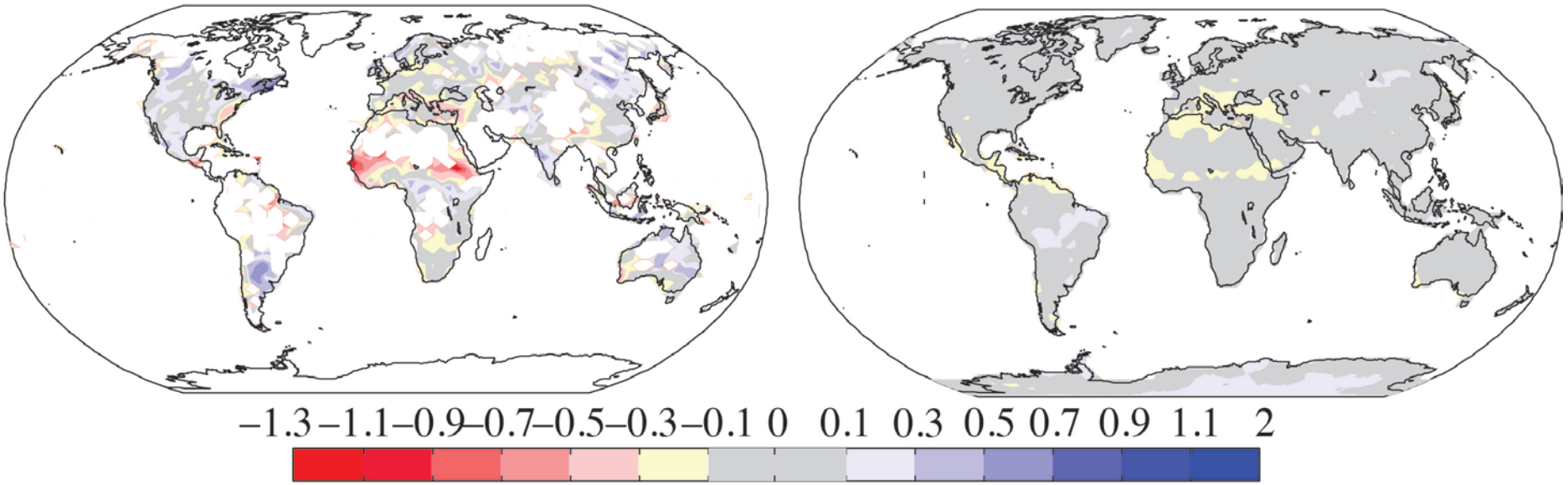
CMIP3 multi model mean
(1970-1998)-(1900-1929)



Signal in wet season

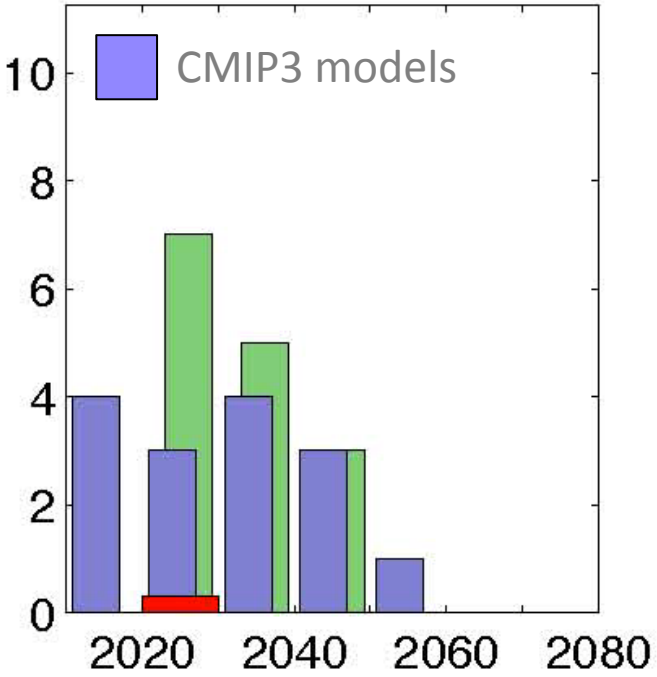
Hulme Dataset

CMIP3 multi model mean



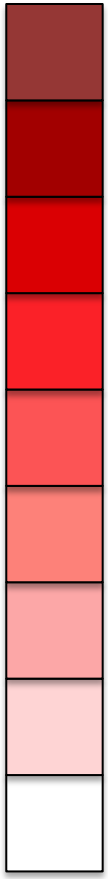
Signal to noise in wet season

Method



Modified from Hawkins and Sutton (2012)

Region 1



Model 6

Model 3

66% Quantile

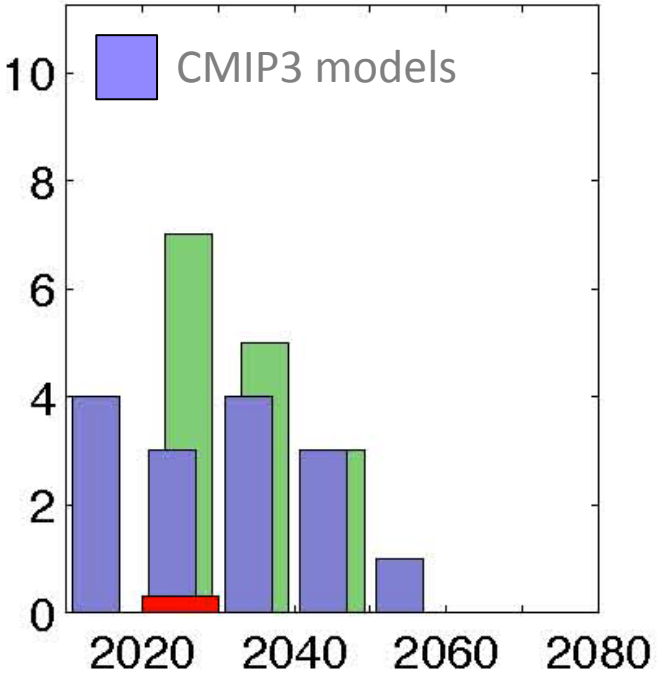
Model 5

Model 1

Model 2

Model 4

Method



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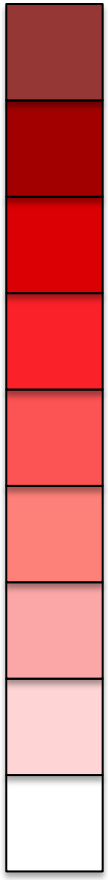
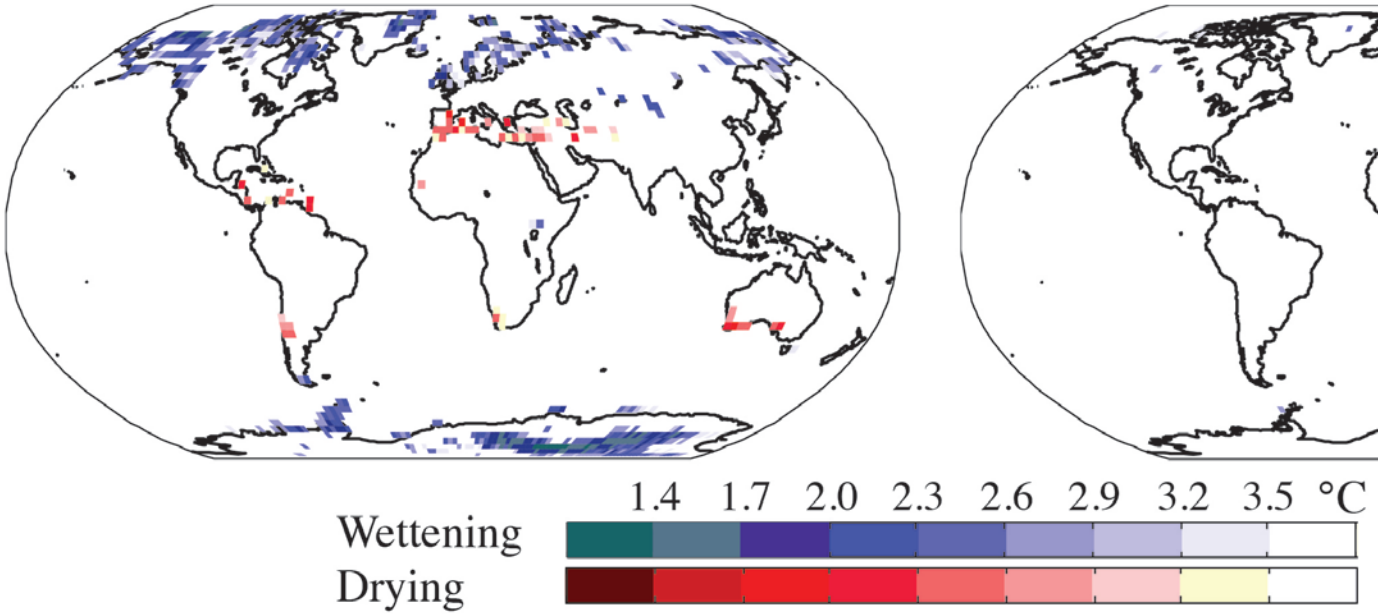


Region 1	Region 2
Model 6	
Model 3	
Model 5	Model 1
Model 1	
	Model 4
Model 2	Model 5
Model 4	

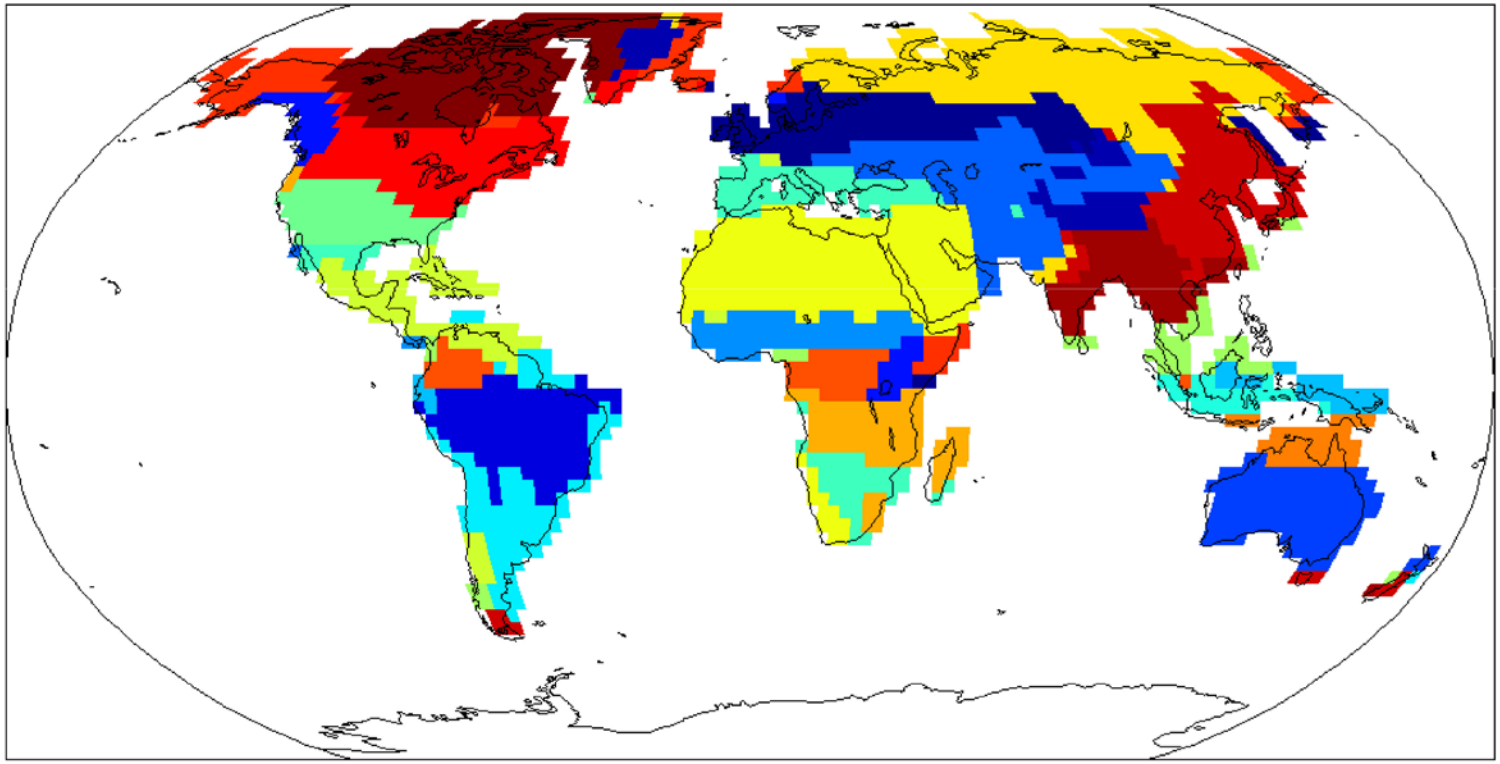
No emergence!

66%
(likely)

90%
(very likely)



Grid cell

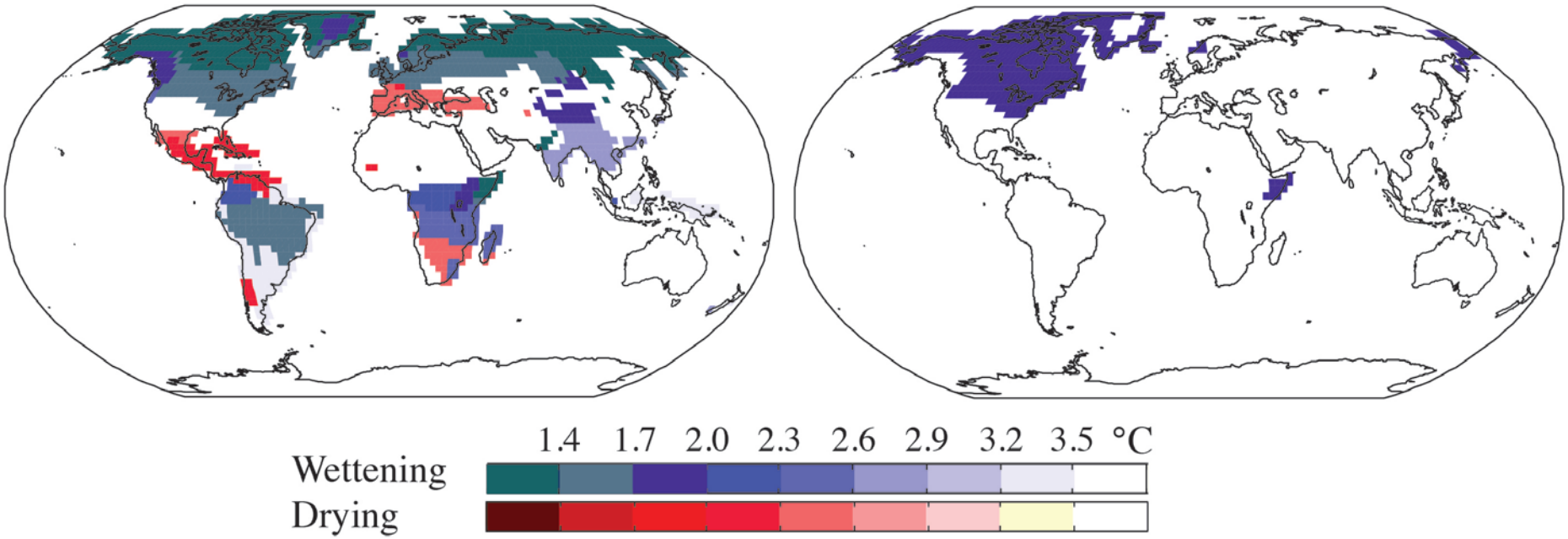


Regions based on cluster analysis

Mahlstein and Knutti (2010)

66%
(likely)

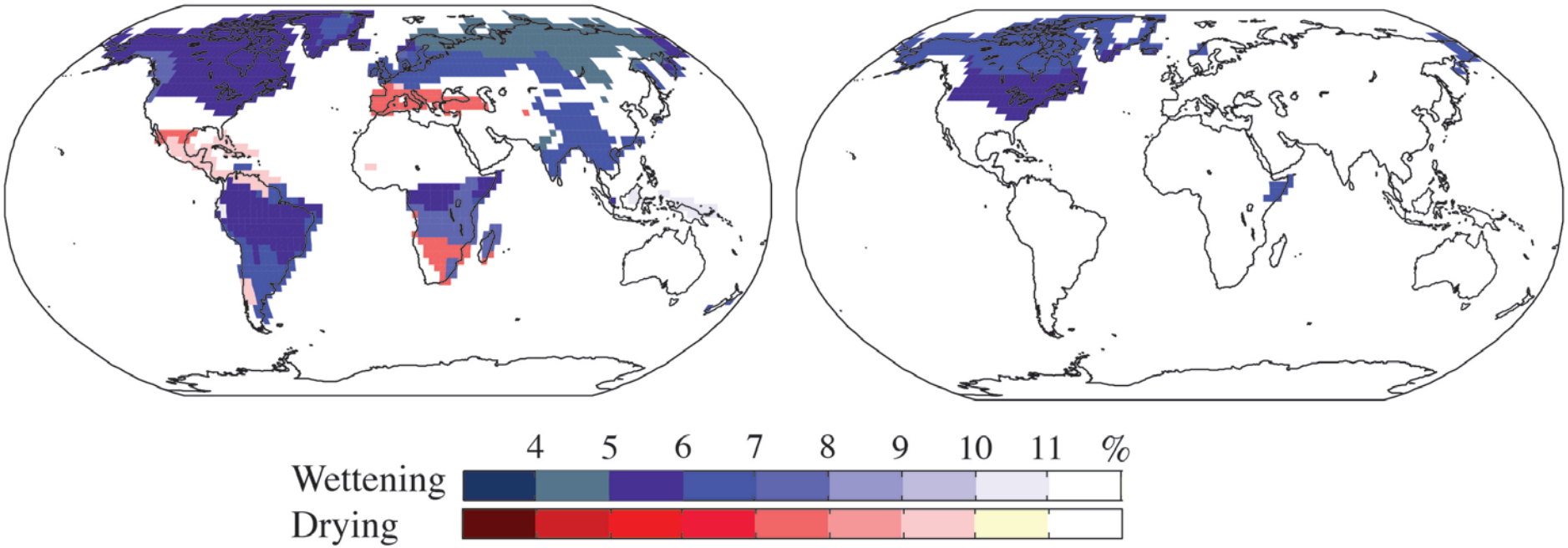
90%
(very likely)



Regions

66%
(likely)

90%
(very likely)

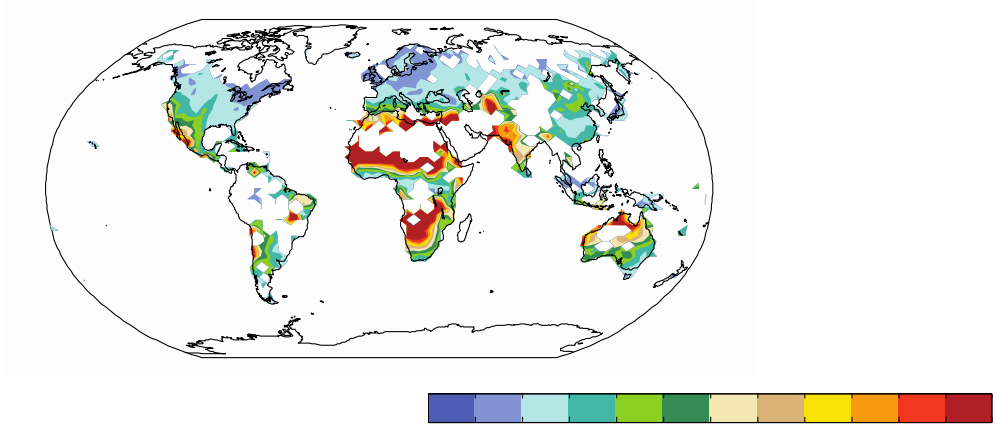


Changes compared to 1900-1929 precipitation levels

- Perceptible temperature changes have already occurred in low latitude countries and all land areas are committed to them.

- Perceptible precipitation changes in wet season cannot be expected very soon (1.4°C increase).

Take home messages



b)

e)

c)

f)