

# Climate Time Scales:

*What's all that noise?*  
*And, why is it getting louder?*

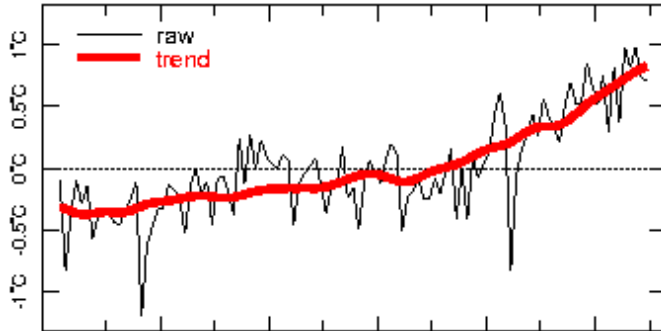
**Lisa Goddard**

International Research Institute  
for Climate and Society  
EARTH INSTITUTE | COLUMBIA UNIVERSITY

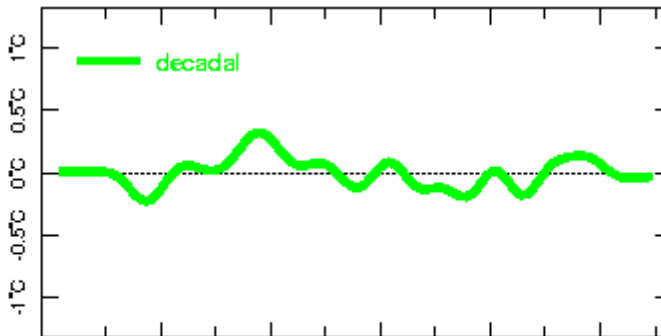
# Climate Variability & Change Globally

## Annual Mean Temperature

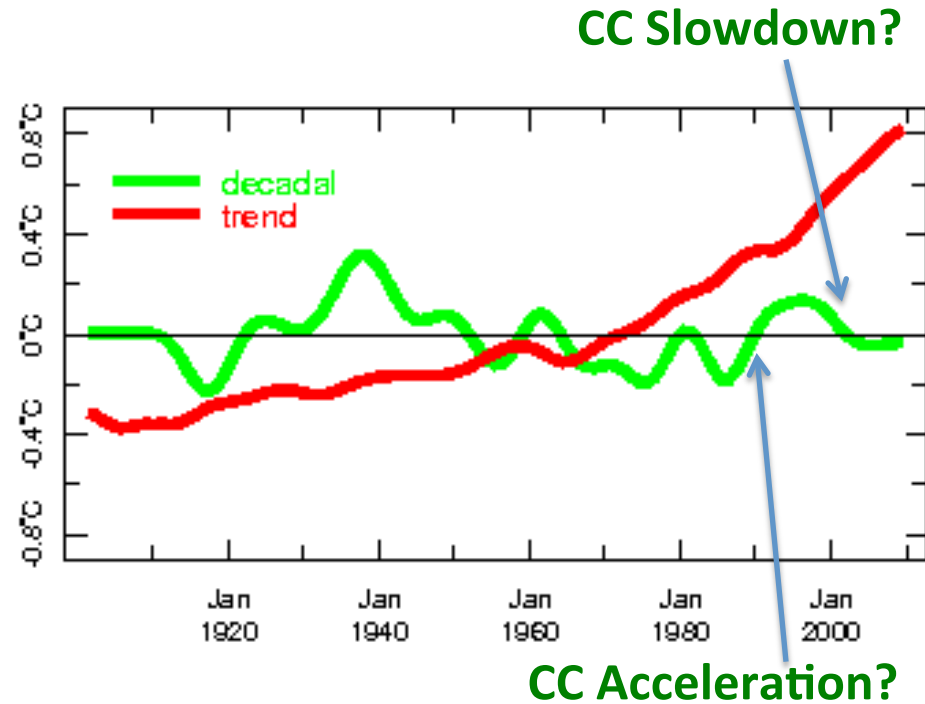
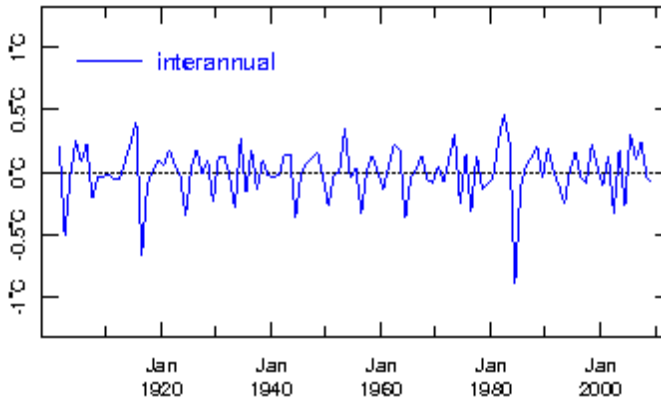
63%



9%

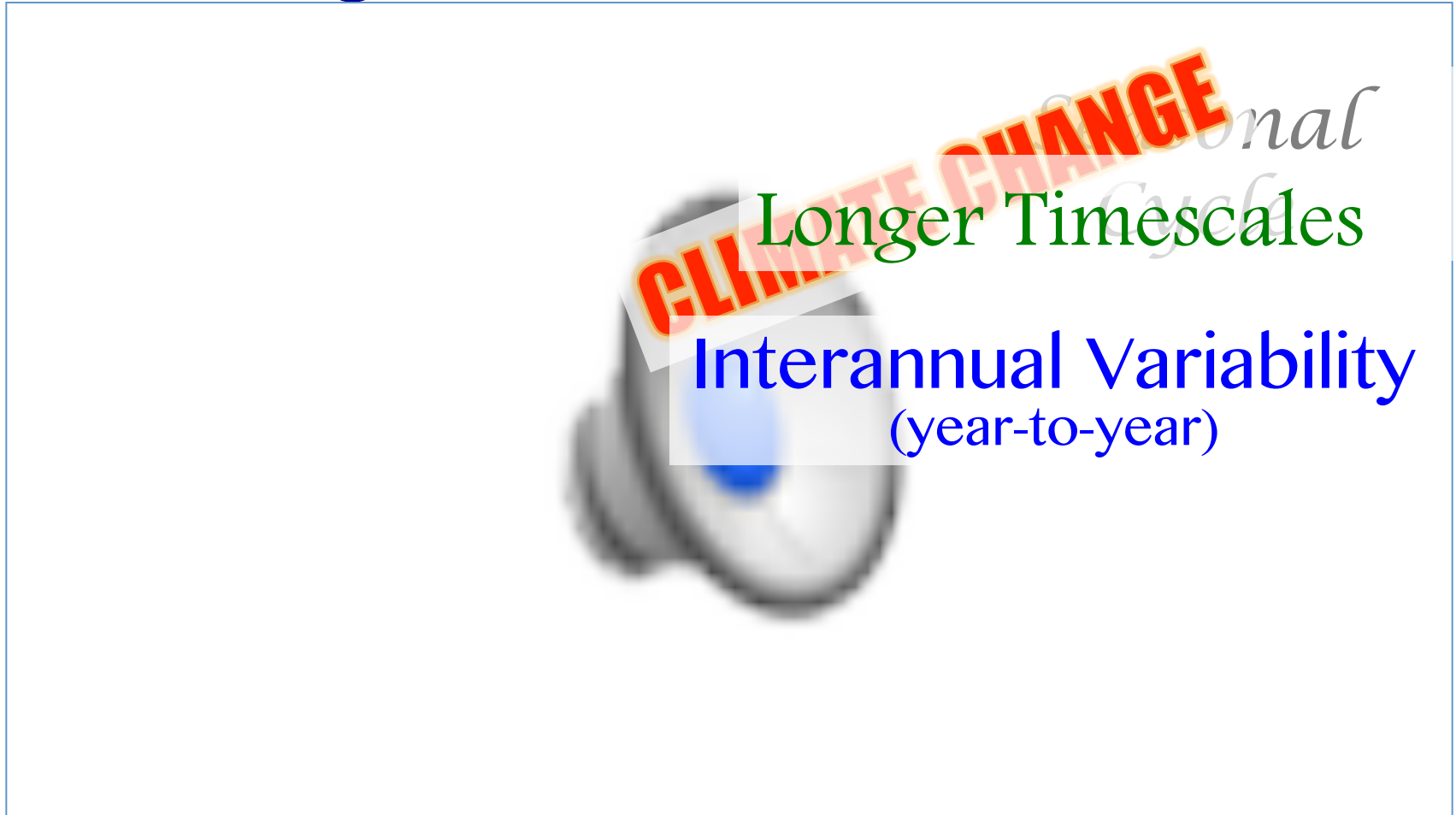


27%



(Greene, Goddard & Cousin, *EOS*, 2010)

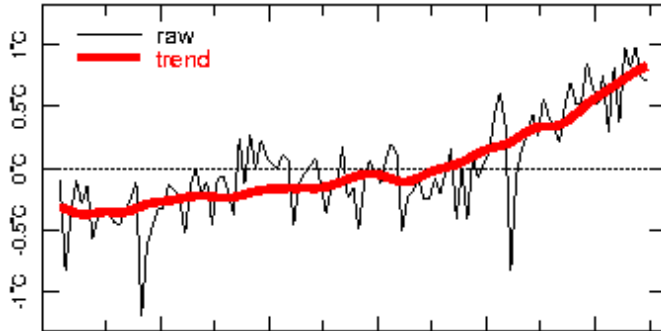
# Climate is made up of many processes acting on different timescales



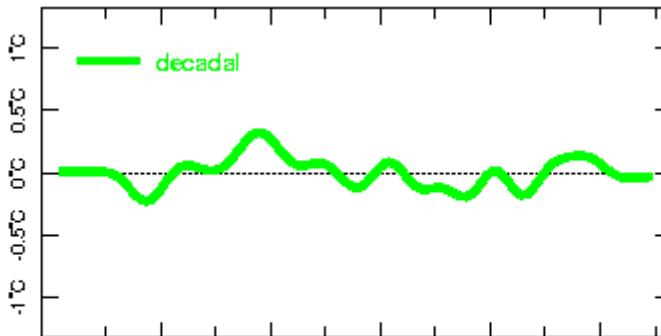
# Climate Variability & Change Globally

## Annual Mean Temperature

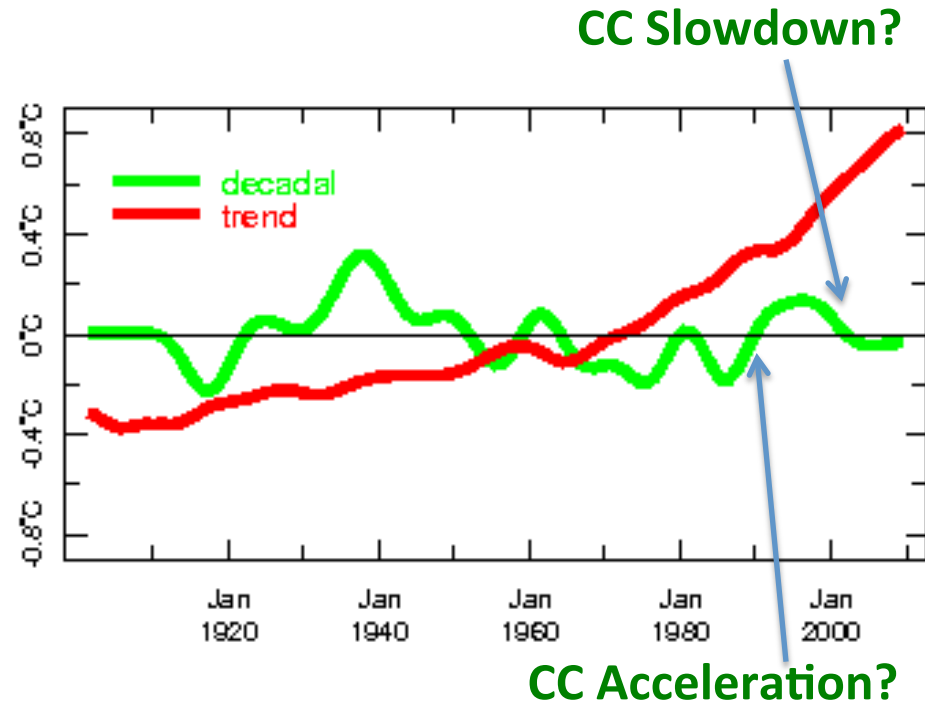
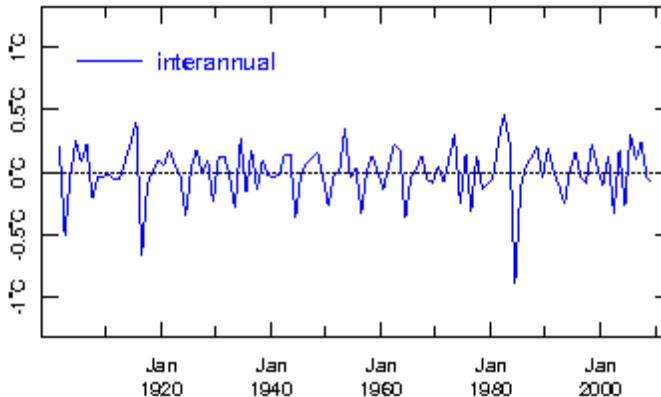
63%



9%



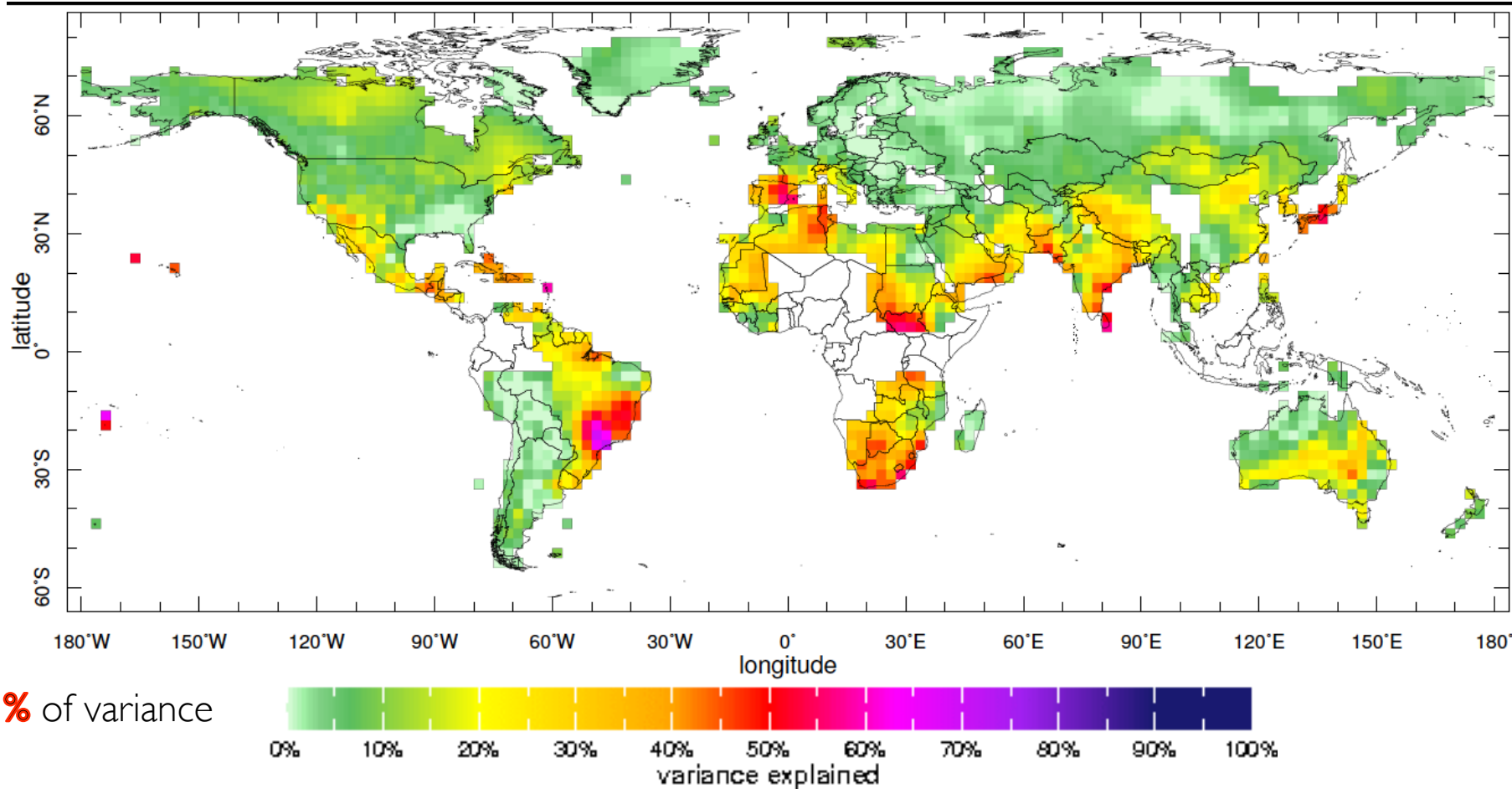
27%



(Greene, Goddard & Cousin, *EOS*, 2010)

# Temperature Trends

## 20<sup>th</sup> Century Observations -- Annual Means

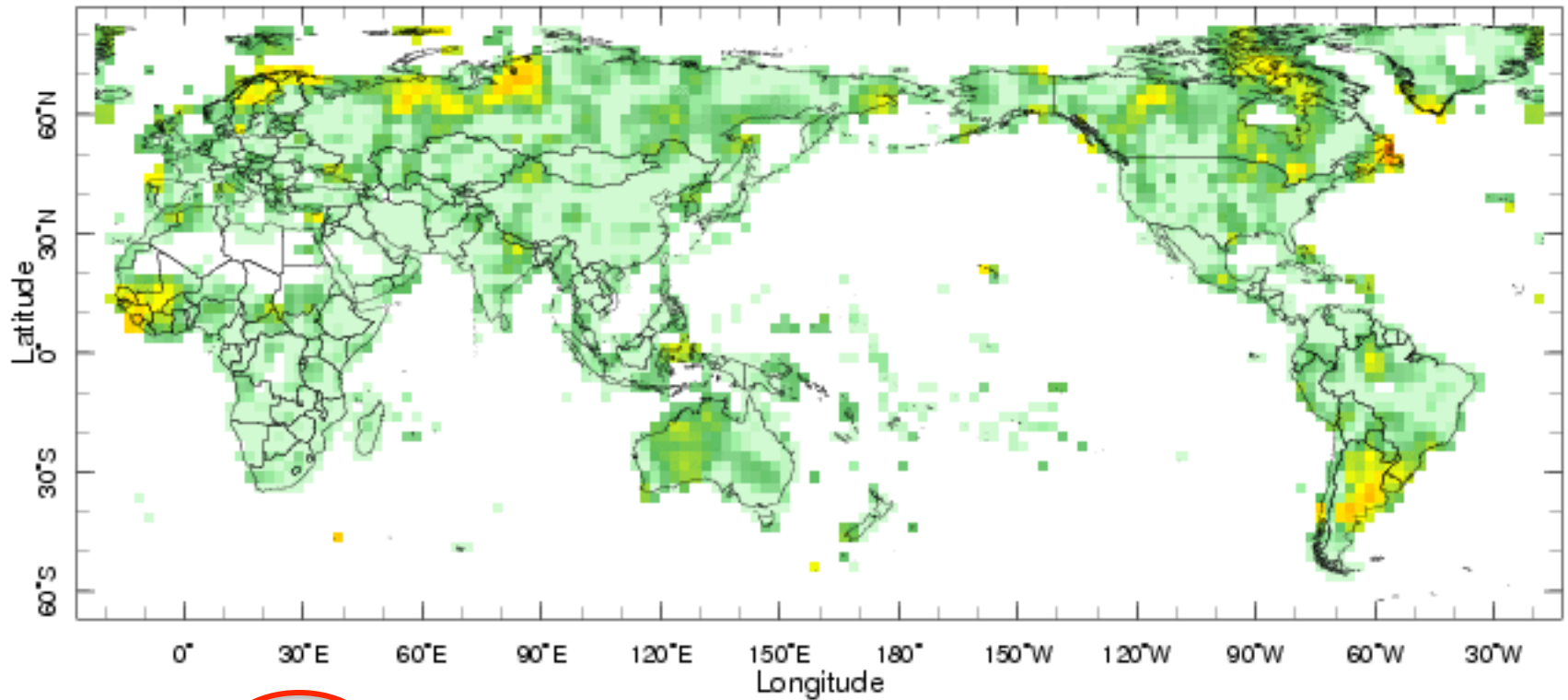


[http://iridl.ldeo.columbia.edu/maproom/Global/Time\\_Scales/](http://iridl.ldeo.columbia.edu/maproom/Global/Time_Scales/)

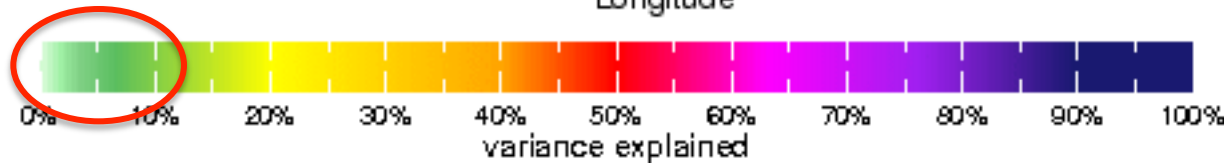


# Precipitation Trends

20<sup>th</sup> Century Observations -- Annual Means



% of variance

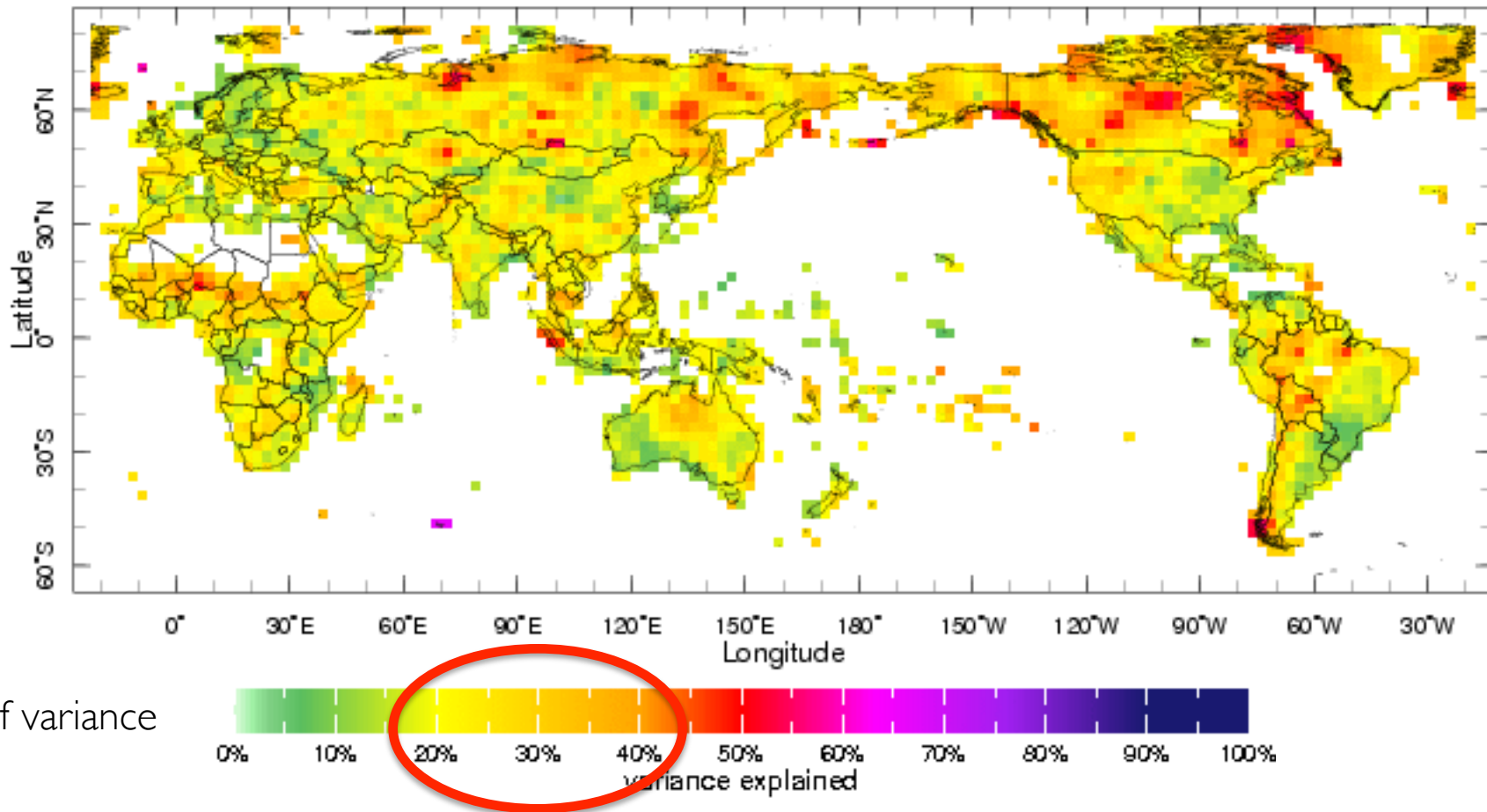


[http://iridl.ldeo.columbia.edu/maproom/Global/Time\\_Scales/](http://iridl.ldeo.columbia.edu/maproom/Global/Time_Scales/)



# Precipitation Decadal Variability

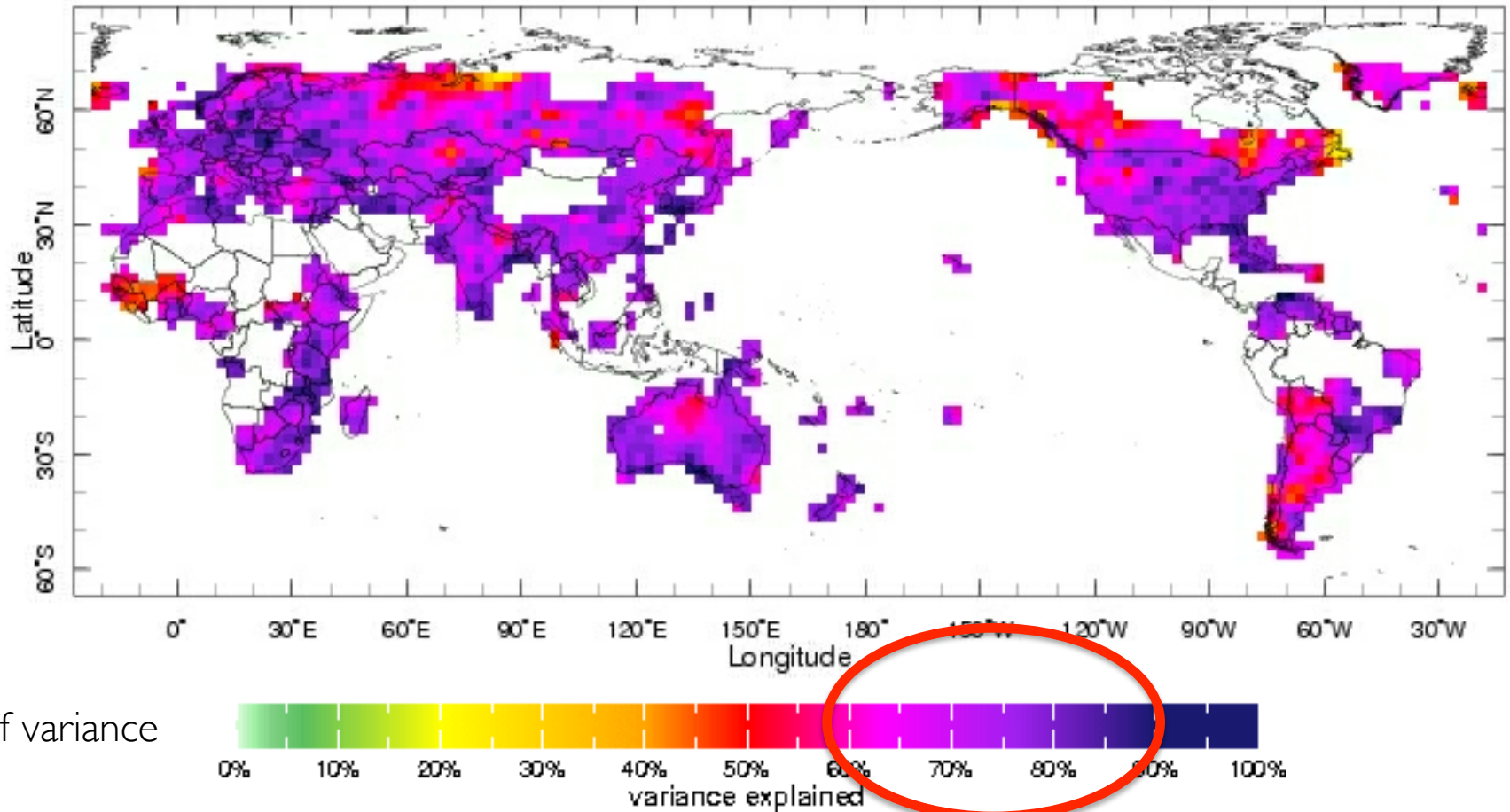
## 20<sup>th</sup> Century Observations -- Annual Means



[http://iridl.ldeo.columbia.edu/maproom/Global/Time\\_Scales/](http://iridl.ldeo.columbia.edu/maproom/Global/Time_Scales/)

# Precipitation Interannual Variability

## 20<sup>th</sup> Century Observations -- Annual Means



[http://iridl.ldeo.columbia.edu/maproom/Global/Time\\_Scales/](http://iridl.ldeo.columbia.edu/maproom/Global/Time_Scales/)

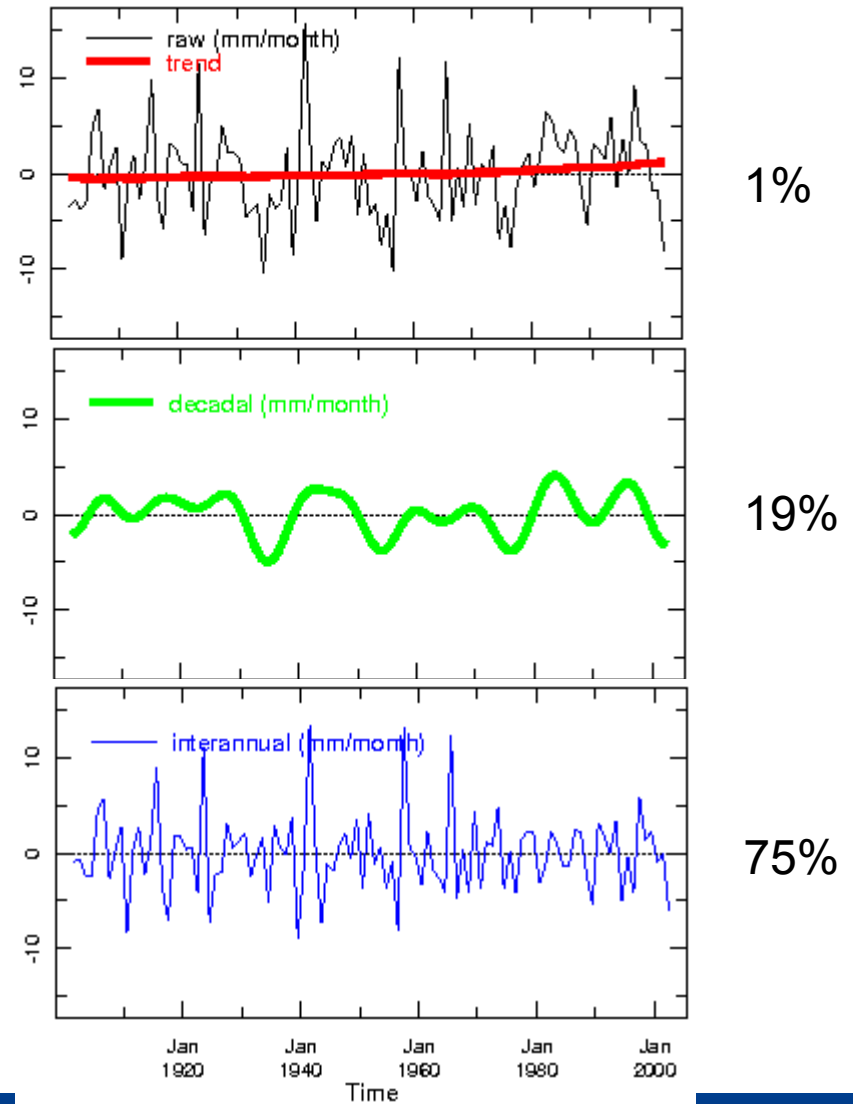
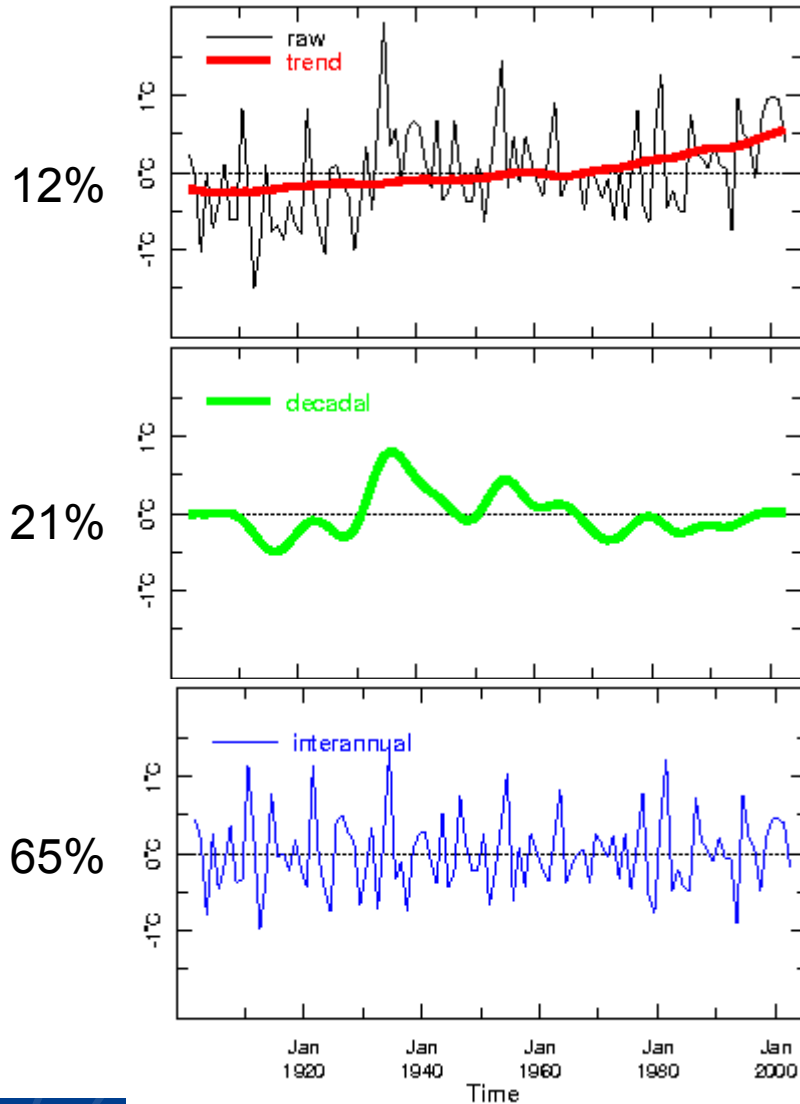


# Climate Variability & Change Locally

Temperature

Observations for Colorado, USA - DJF

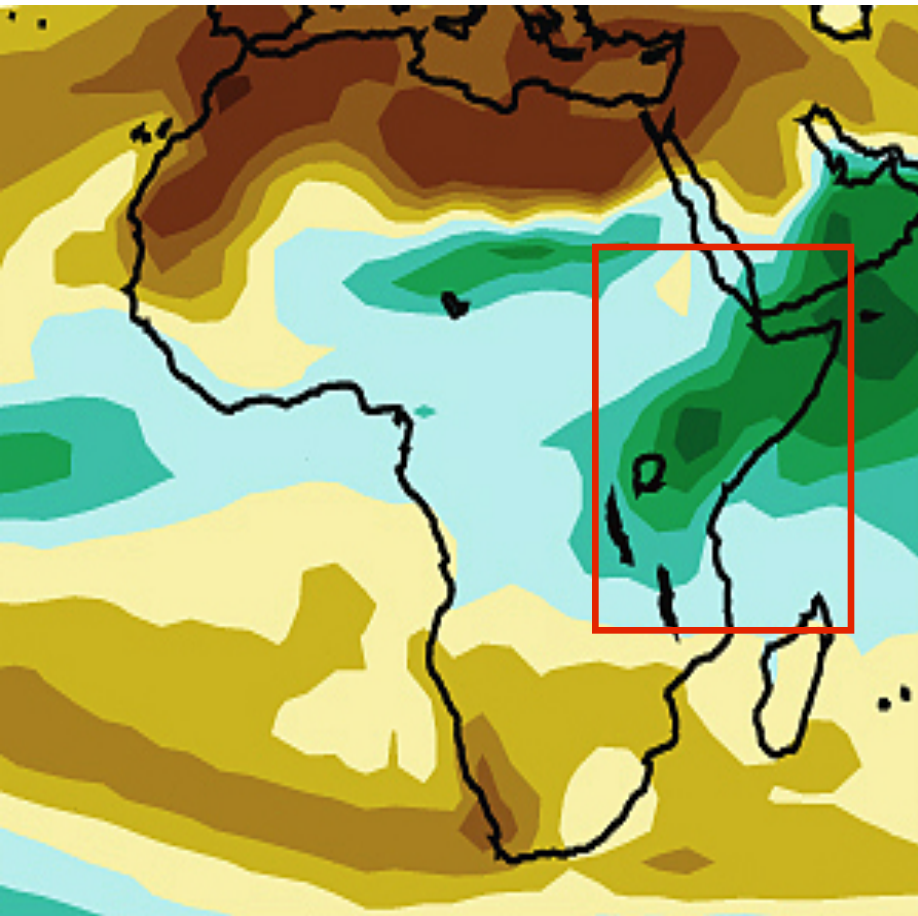
Precipitation



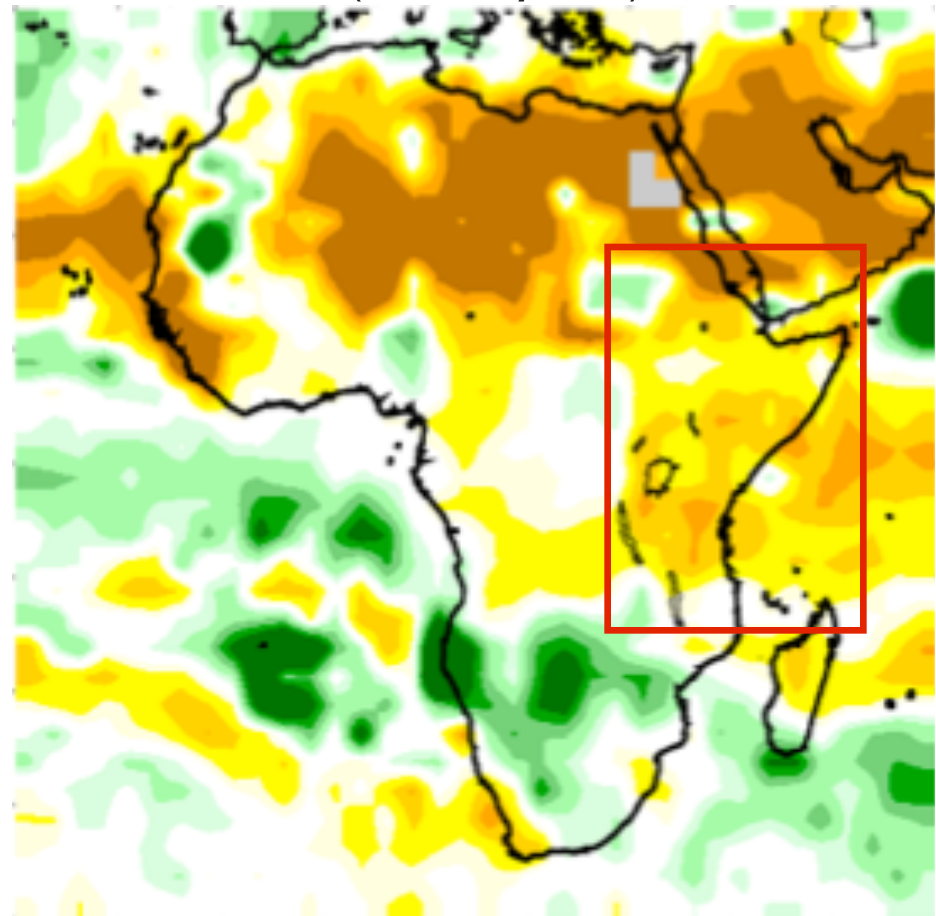
All timescales matter

# Decadal-scale variability is important

Climate Change Projections  
(end of 21st century)

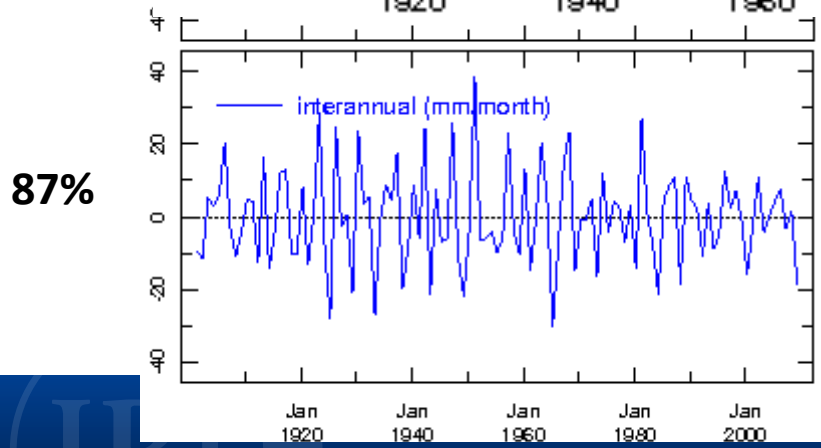
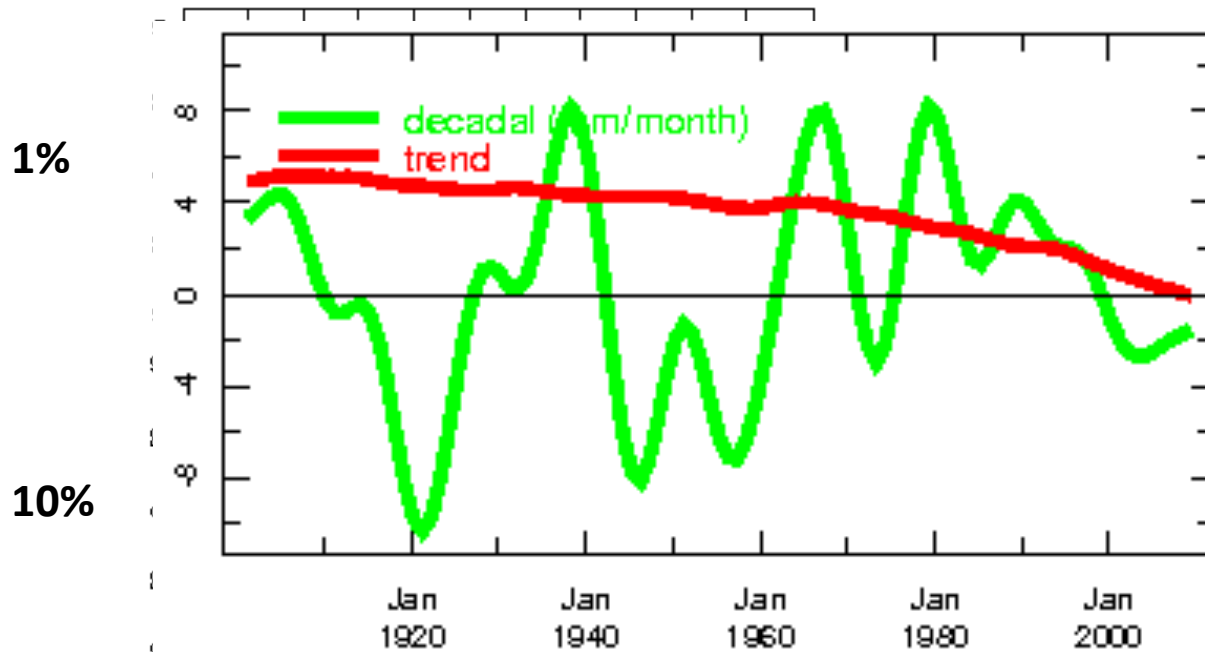


Observations  
(last 15 years)

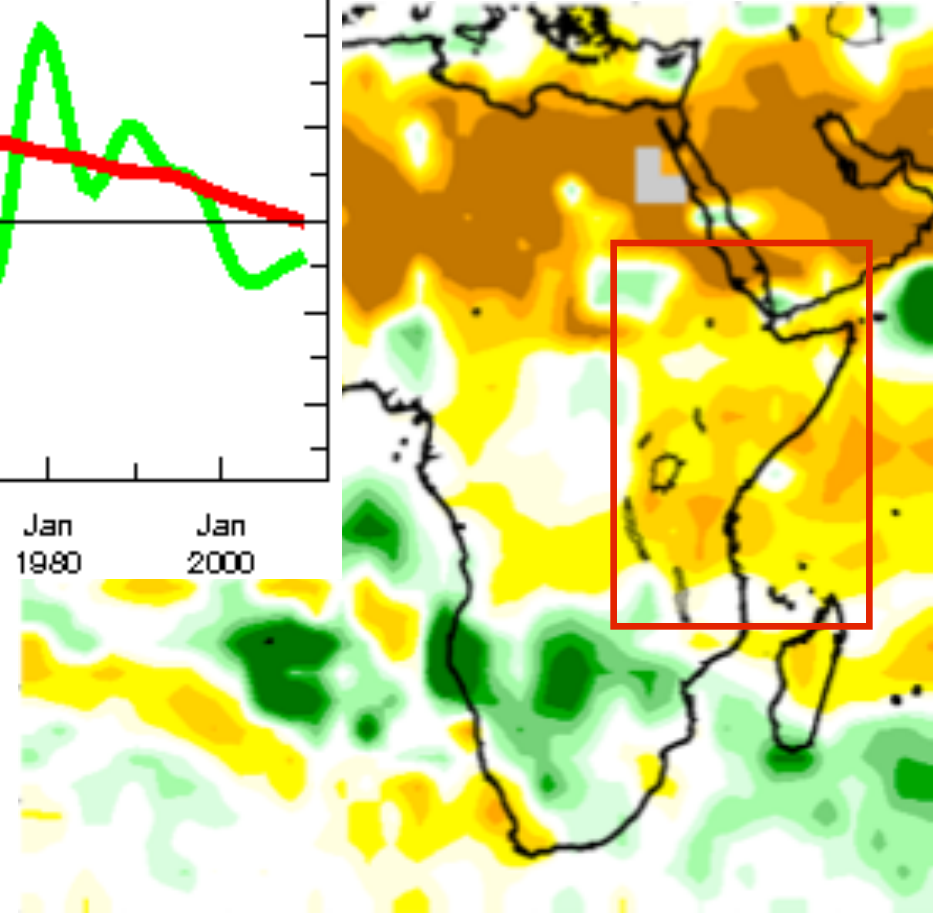


# Decadal-scale variability is important

Mar-Apr-May Rainfall Totals



Observations (last 15 years)





FUTURE AHEAD?





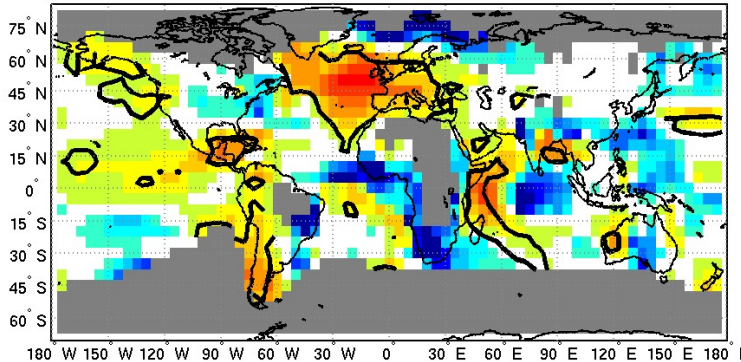
## Skill: Decadal Predictions

# Decadal Predictions: *Skill still to be demonstrated*

Multi-model Ensemble (12 models: Equal Weighting)

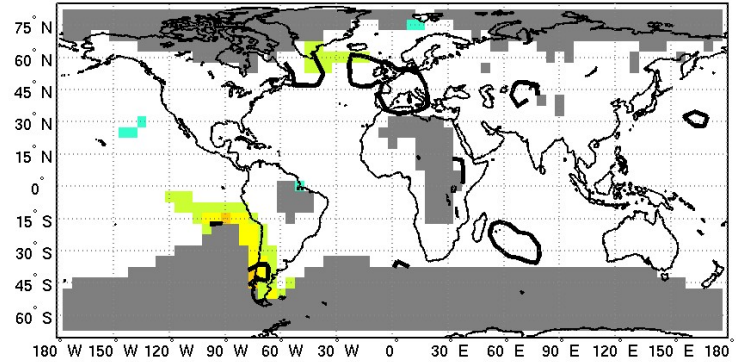
### Mean Squared Skill Score

MME temp MSSS: year 2-9 ann  
Initialized - Uninitialized

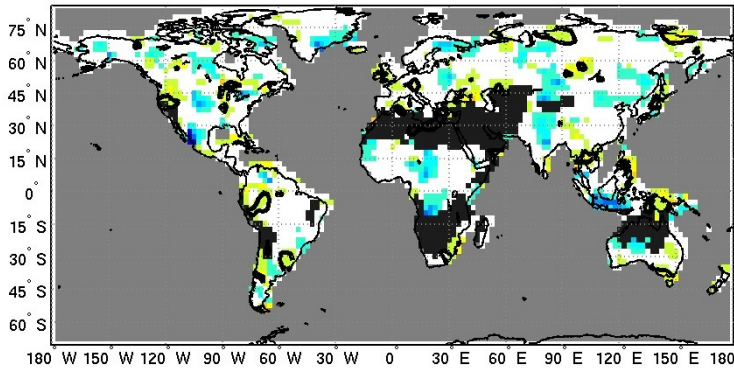


### Correlation

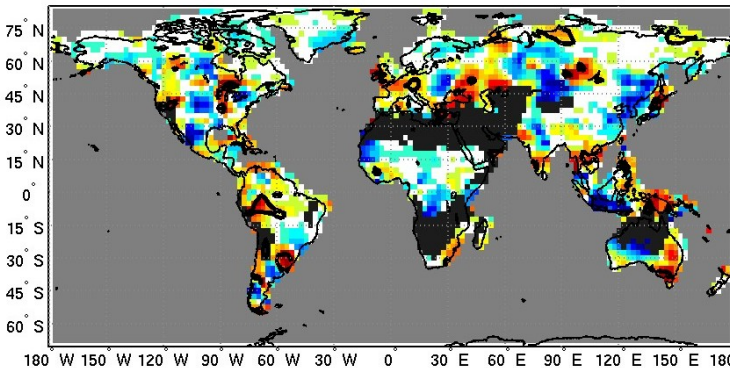
MME temp Correlation: year 2-9 ann  
Initialized - Uninitialized



MME prcp MSSS: year 2-9 JAS  
Initialized - Uninitialized

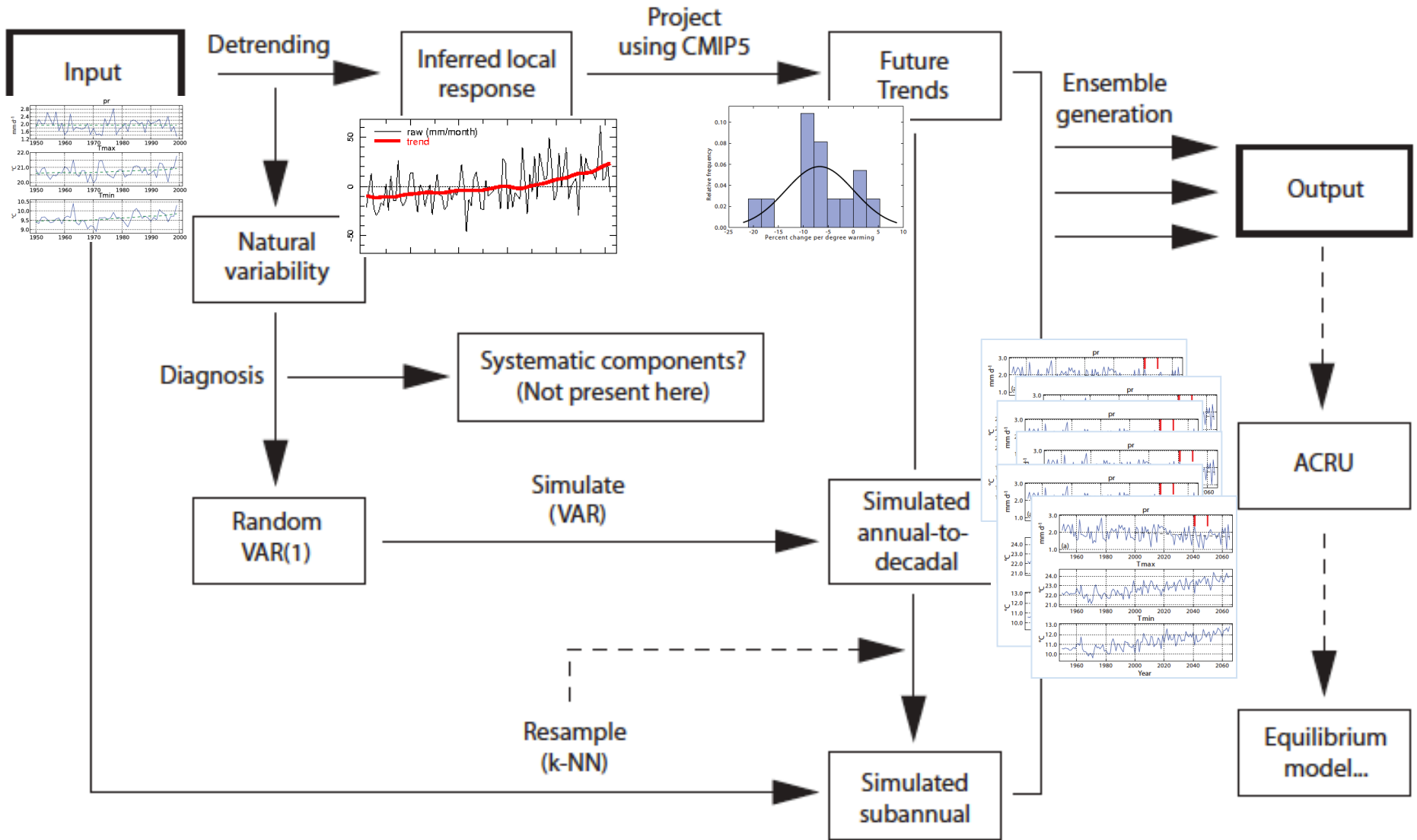


MME prcp Correlation: year 2-9 JAS  
Initialized - Uninitialized



(based on Goddard et al. 2012, *Climate Dynamics*; See also <http://clivar-dpwg.iri.columbia.edu>)

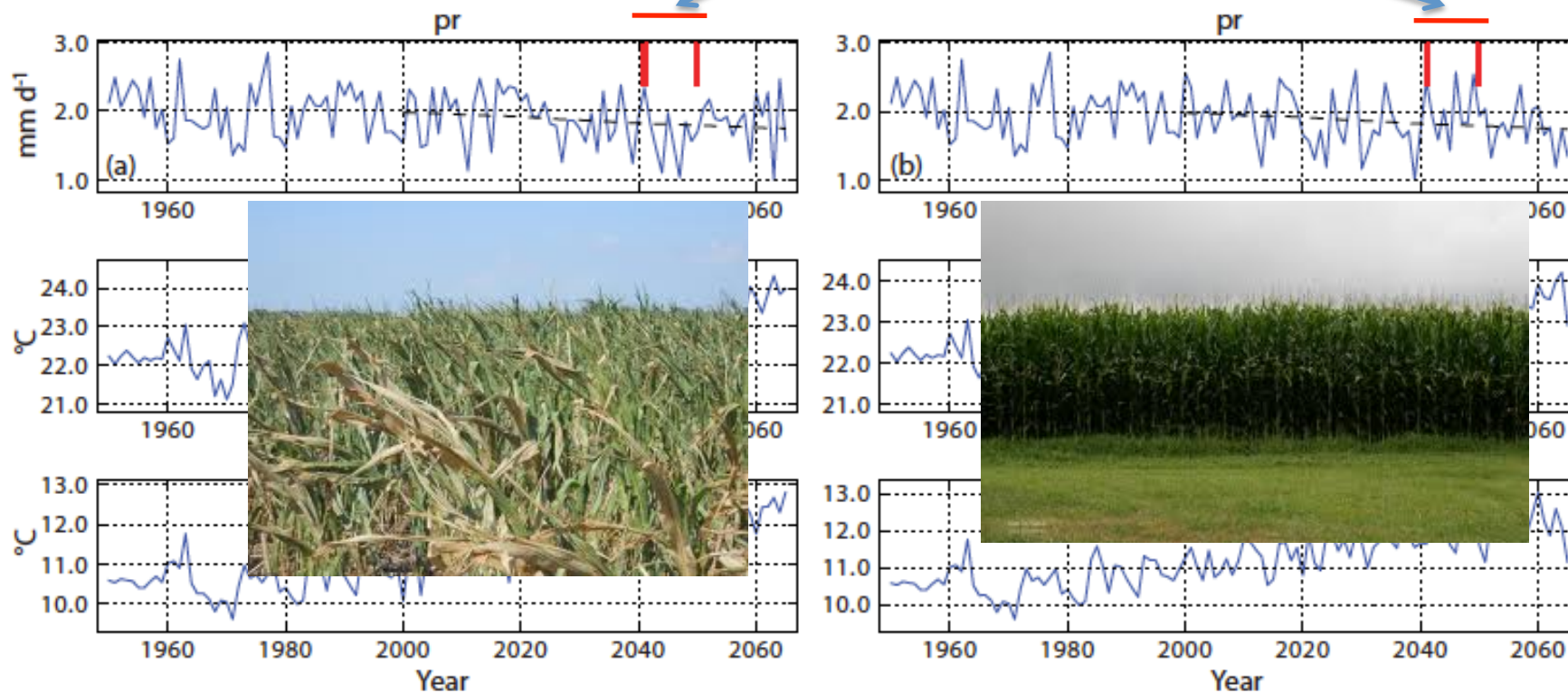
# STOCHASTIC SIMULATIONS: *Characterize variability on top of projected trends*



(Greene, et al. 2012)

STOCHASTIC SIMULATIONS: e.g. 2 Ensemble Members

Decadal Variability





# OPPORTUNITY

- Consider the timescales of your decisions, and the relative importance of climate
- Examine recent 'trends' and expectations
- Identify climate information that addresses your needs and expectations



# Thank You

