



# Famine: the Geography of Scarcity

Environmental Systems

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# Malthusian crises unlikely today...



Years	Location (epicentre)	Excess mortality	Causal triggers
1903-06	Nigeria (Hausaland)	5,000	Drought
1906-07	Tanzania (south)	37,500	Conflict
1913-14	West Africa (Sahel)	125,000	Drought
1917-19	Tanzania (central)	30,000	Conflict & Drought
1920-21	China (Gansu, Shaanxi)	500,000	Drought
1921-22	<b>Soviet Union</b>	<b>9,000,000</b>	<b>Drought &amp; Conflict</b>
1927	China (northwest)	3,000,000-6,000,000	Natural disasters
1929	China (Hunan)	2,000,000	Drought & Conflict
1932-34	Soviet Union (Ukraine)	7,000,000-8,000,000	Government policy
1943	China (Henan)	5,000,000	Conflict
1943	India (Bengal)	2,100,000-3,000,000	Conflict
1943-44	Rwanda	300,000	Conflict & Drought
1944	Netherlands	10,000	Conflict
1946-47	<b>Soviet Union</b>	<b>2,000,000</b>	<b>Drought &amp; Government policy</b>
1957-58	Ethiopia (Tigray)	100,000-397,000	Drought & Locusts
1958-62	<b>China</b>	<b>30,000,000-33,000,000</b>	<b>Government policy</b>
1966	Ethiopia (Wollo)	45,000-60,000	Drought
1968-70	Nigeria (Biafra)	1,000,000	Conflict
1969-74	West Africa (Sahel)	101,000	Drought
1972-73	India (Maharashtra)	130,000	Drought
1972-75	Ethiopia (Wollo & Tigray)	200,000-500,000	Drought
1974-75	Somalia	20,000	Drought & Government policy
1974	<b>Bangladesh</b>	<b>1,500,000</b>	<b>Flood &amp; Market failure</b>
1979	<b>Cambodia</b>	<b>1,500,000-2,000,000</b>	<b>Conflict</b>
1980-81	Uganda (Karamoja)	30,000	Conflict & Drought
1982-85	Mozambique	100,000	Conflict & Drought
1983-85	Ethiopia	590,000-1,000,000	Conflict & Drought
1984-85	Sudan (Darfur, Kordofan)	250,000	Drought
1988	Sudan (south)	250,000	Conflict
1991-93	Somalia	300,000-500,000	Conflict & Drought
1995-99	<b>North Korea</b>	<b>2,800,000-3,500,000</b>	<b>Flood &amp; Government policy</b>
1998	Sudan (Bahr el Ghazal)	70,000	Conflict & Drought

*“The conceptual shift is required is from asking:  
 ‘What caused the famine?’  
 to asking  
 ‘Who caused the famine?’”*

Devereux (2007) *The New Famines*, p. 10

### Causal triggers of 20<sup>th</sup> C famines

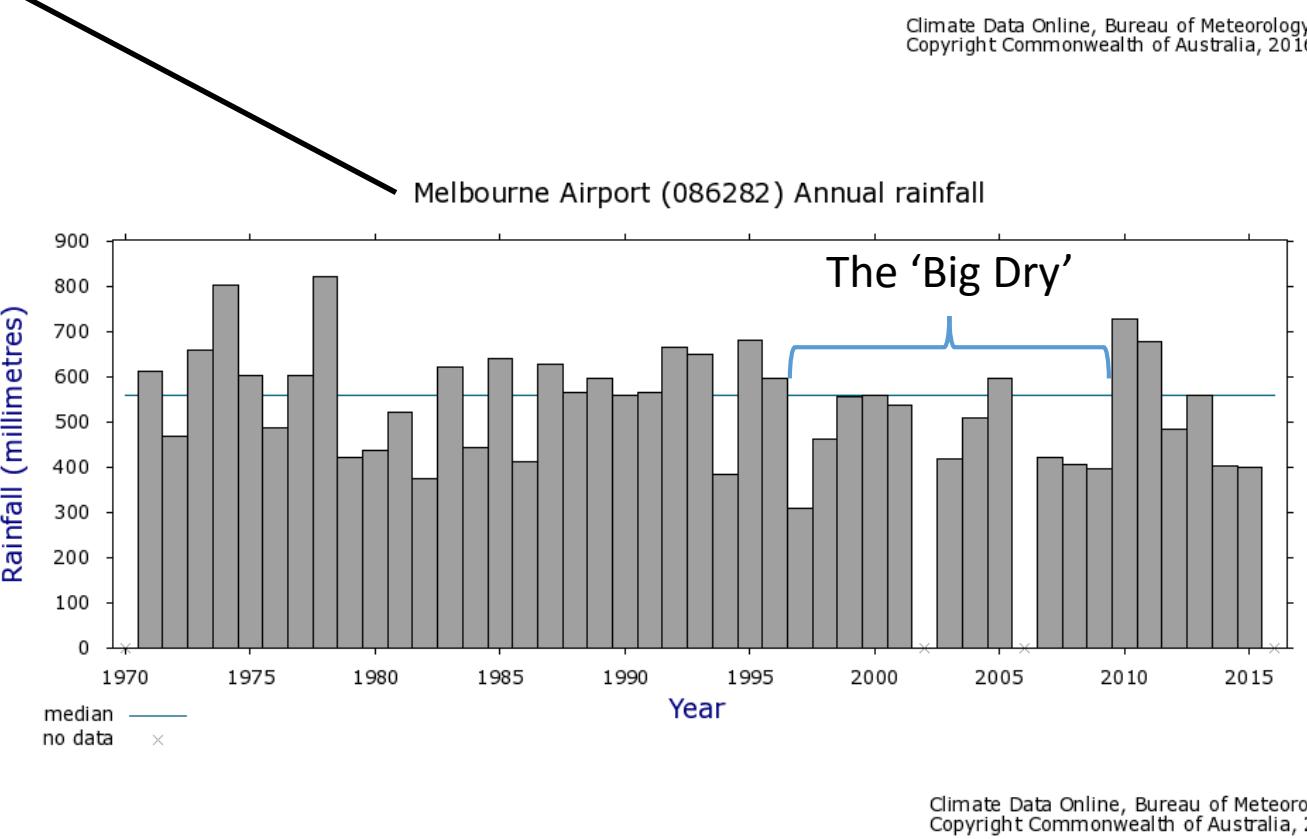
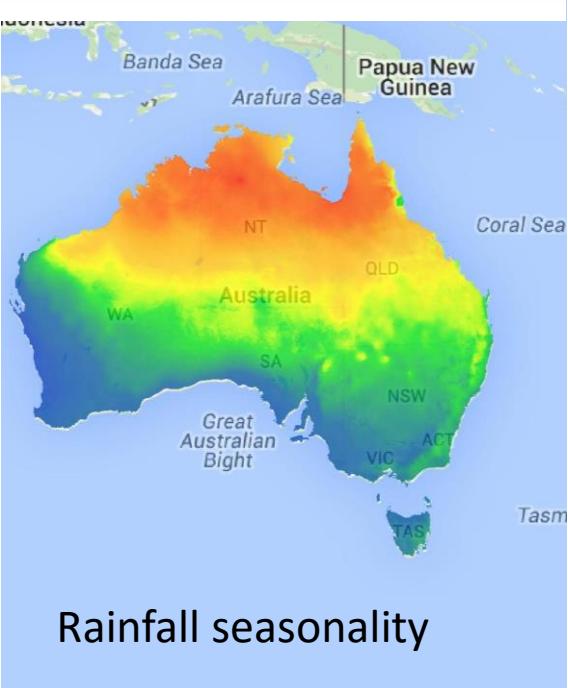
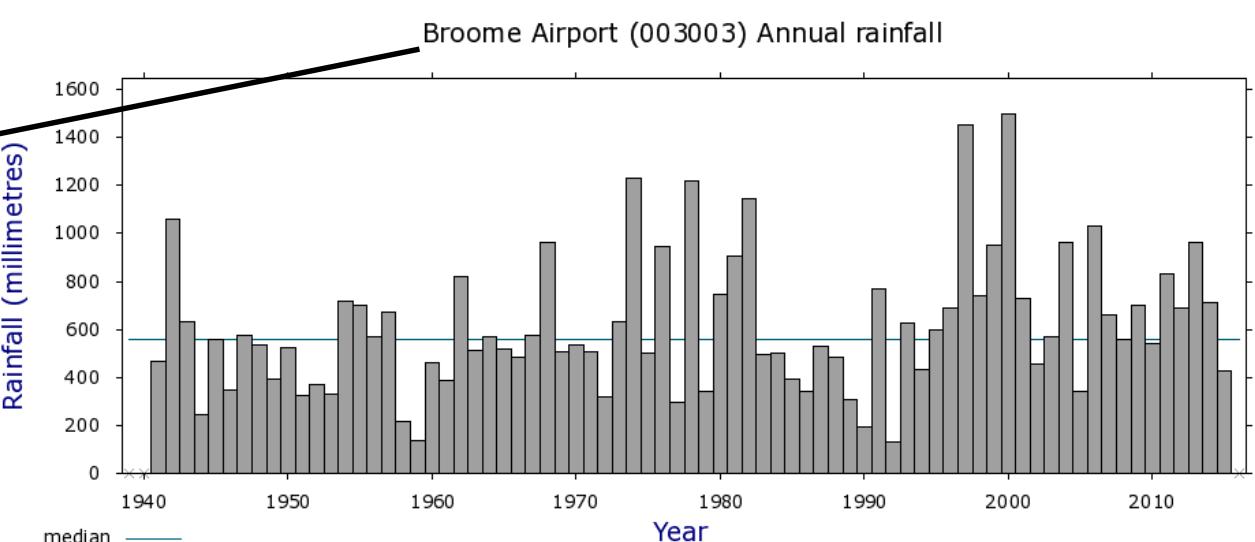
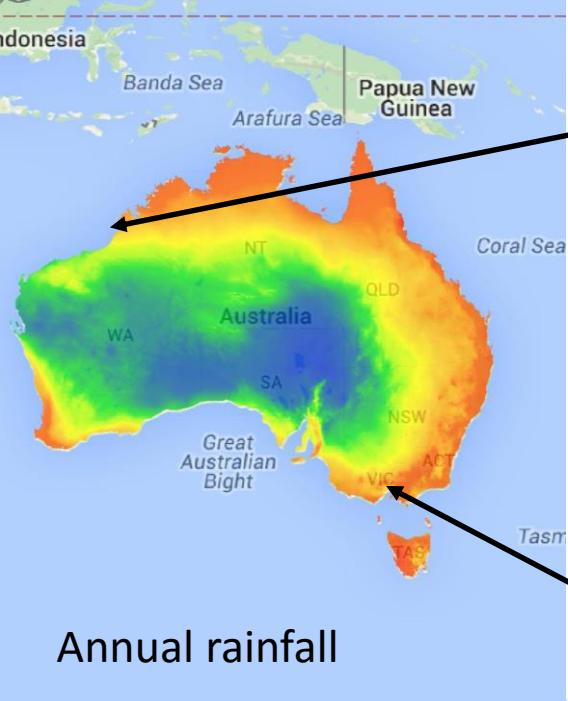
Drought:	20
Conflict:	16
Government policy:	5
Flood:	2
Natural disasters:	1
Locusts:	1
Market failure:	1

Devereux 2000

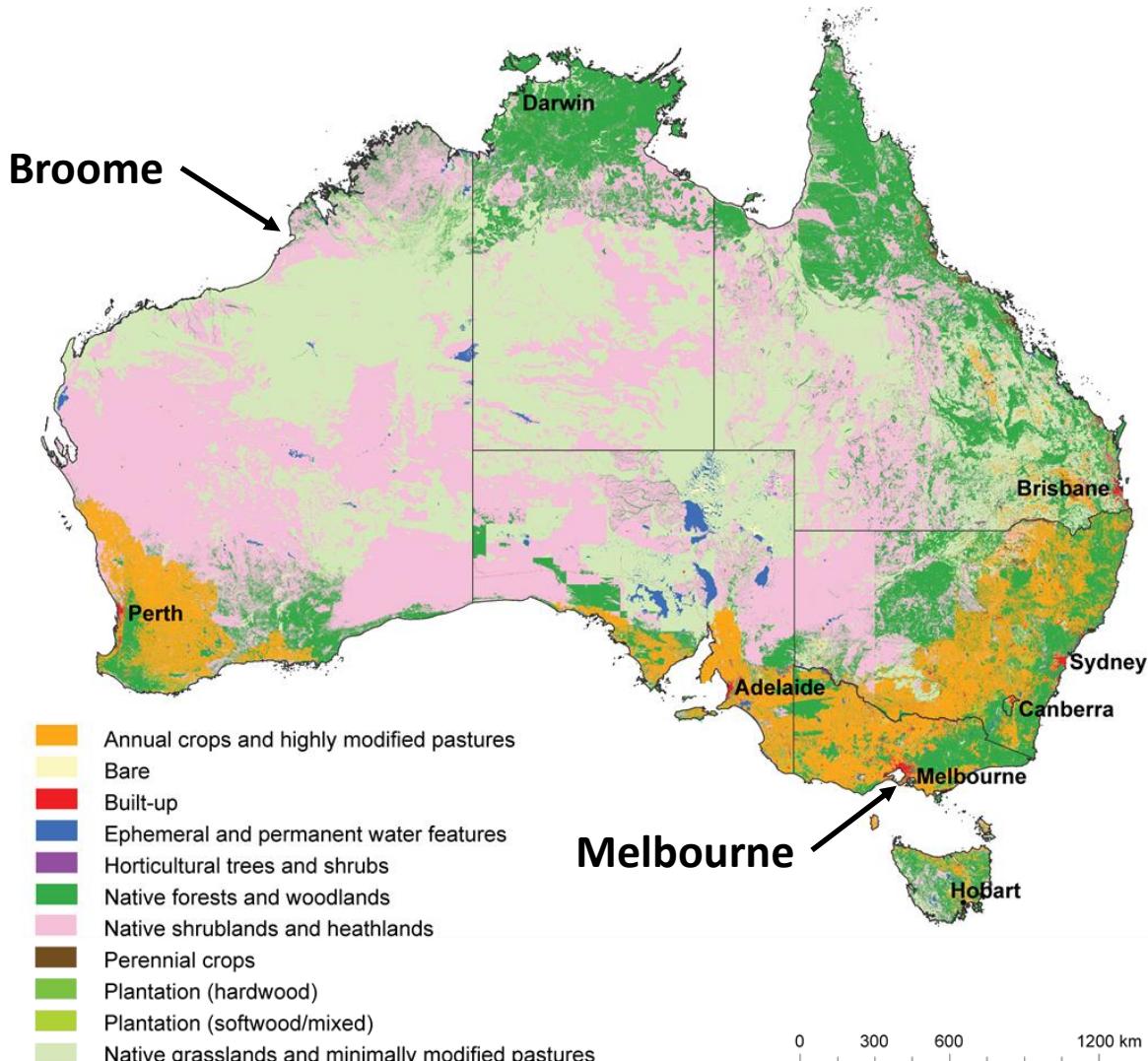


Drought is still a  
major *trigger* for  
famine...

but is it the *cause*?

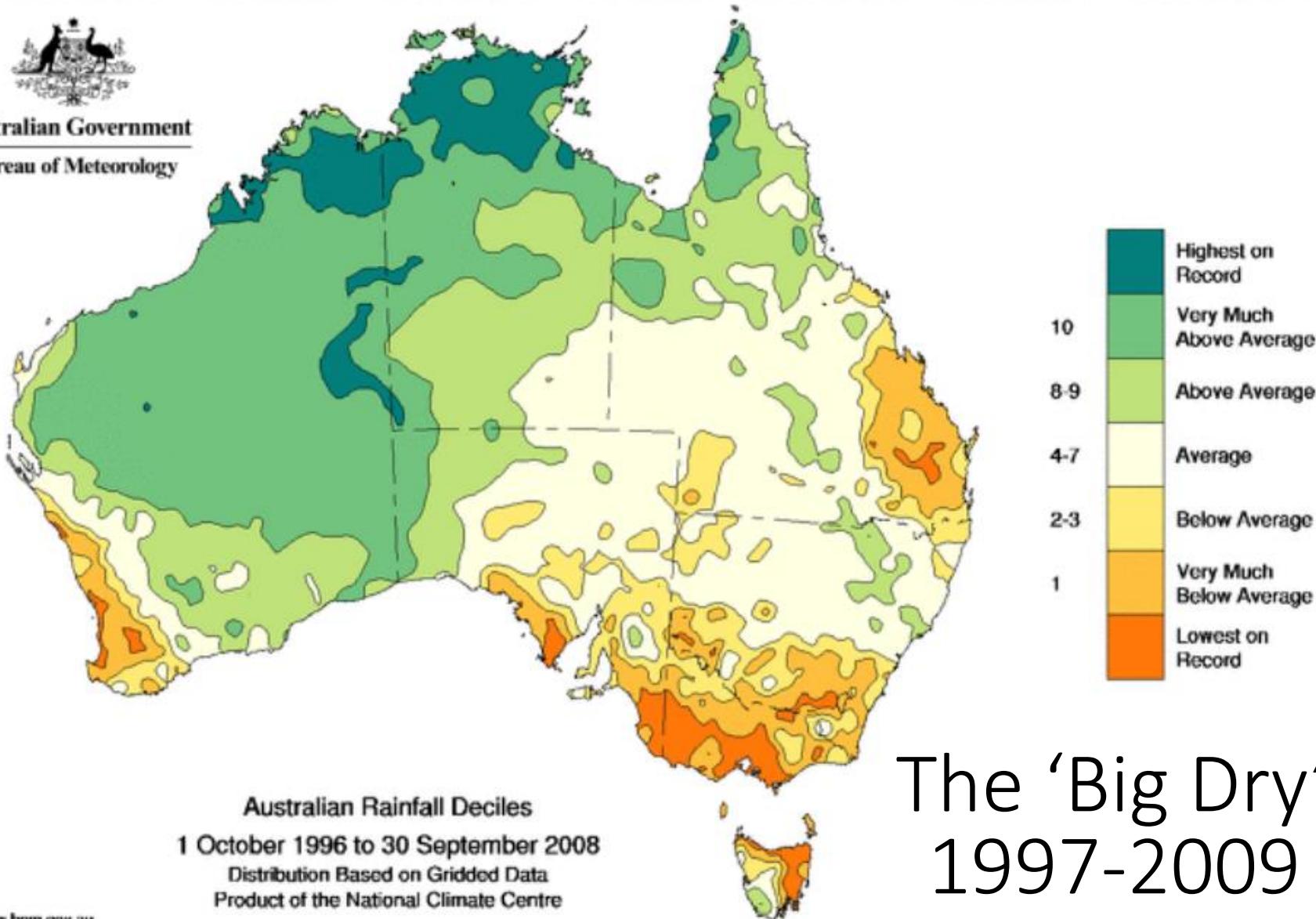


# Impacts depend on land use





Australian Government  
Bureau of Meteorology



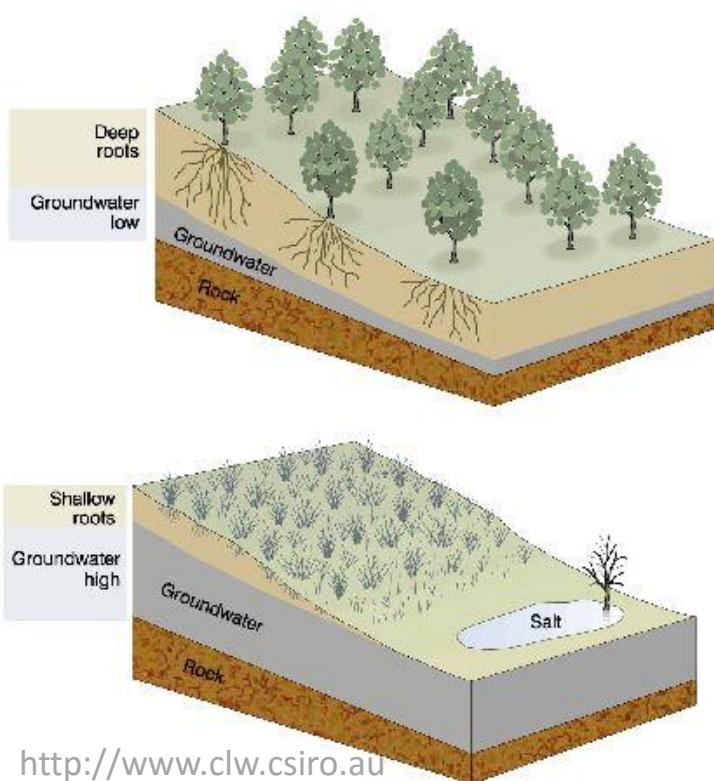
# The Murray-Darling Basin

- The “food bowl” of Australia
- 40% of national agricultural production
- Cotton, rice, wheat, corn, grapes, citrus and fruit
- Cattle and sheep
- 60% of Australia’s agric. water use



# Land already stressed by salinity

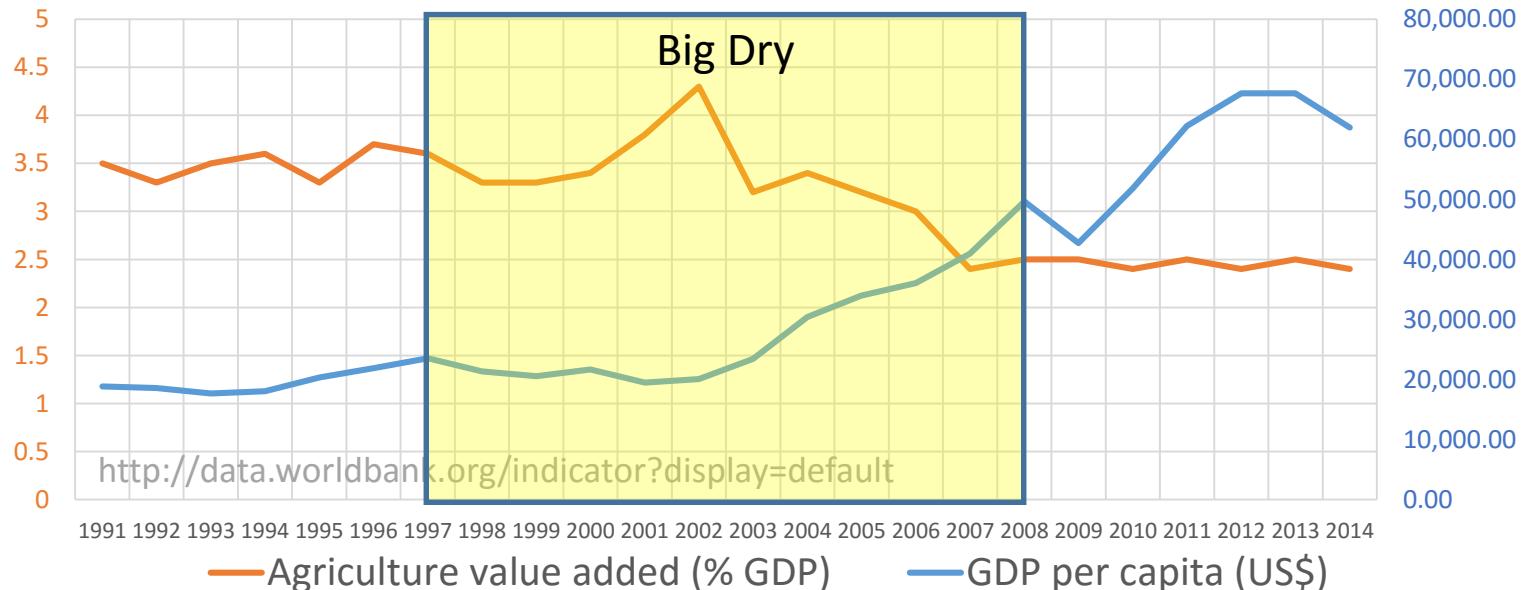
- Cost of dryland salinity in the Murray-Darling Basin estimated \$130-305 million per annum, not including social and environmental costs



# Economic impacts

- US\$10 billion in losses in 2002, 65% of this due to reduced agricultural exports; similar losses 2006-2007
- Between 2000 and 2007, the value of irrigated agriculture dropped by US\$140 million **per year**
- Irrigated land declined 42% between 2005-2008

United Nations World Water Development Report 4

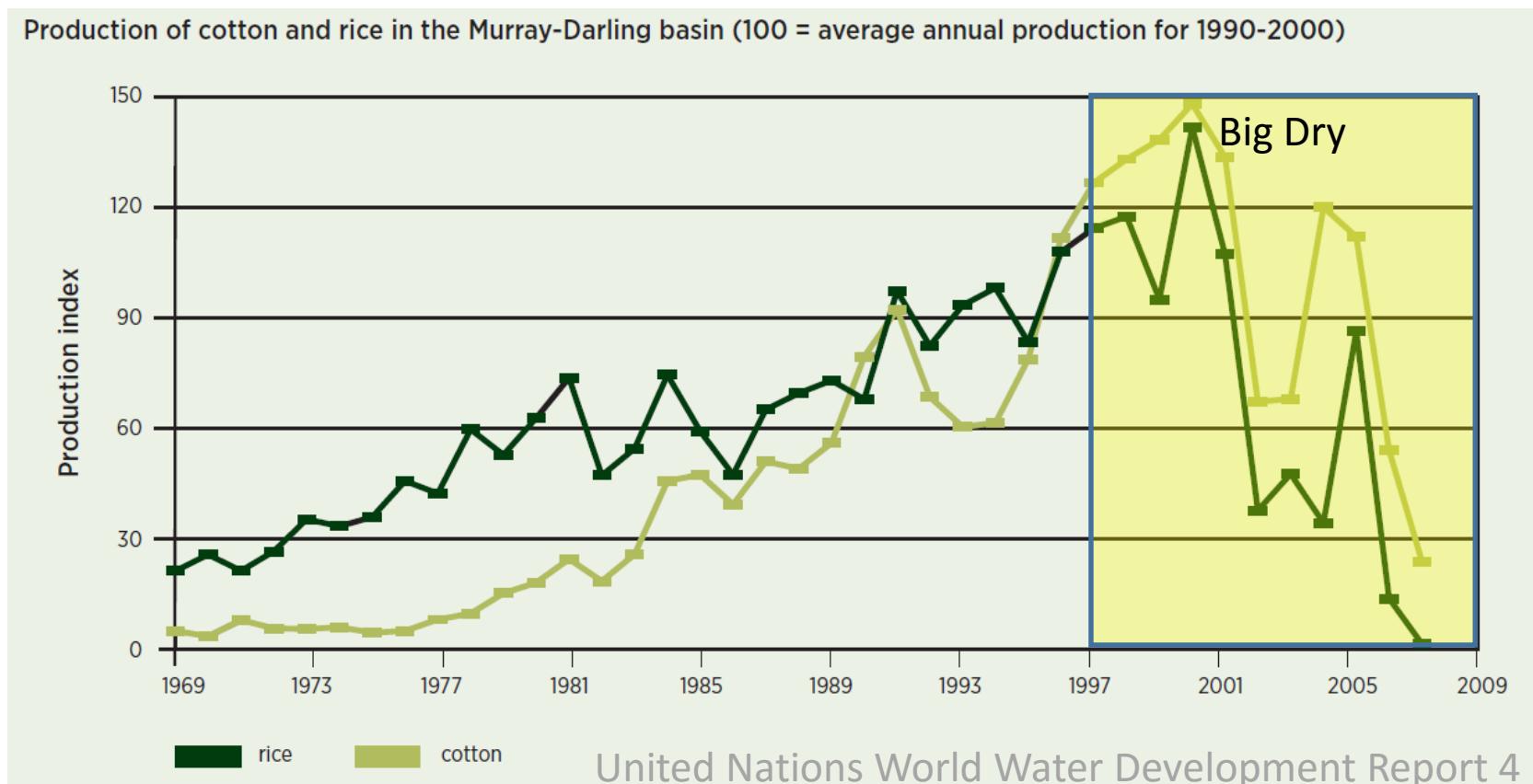




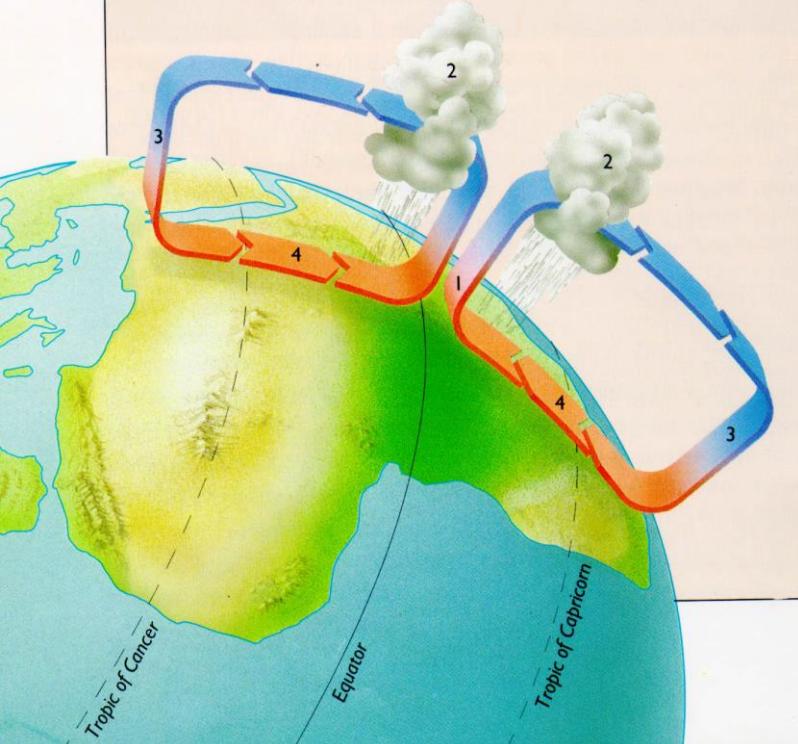
# 'Big Dry' in Victoria



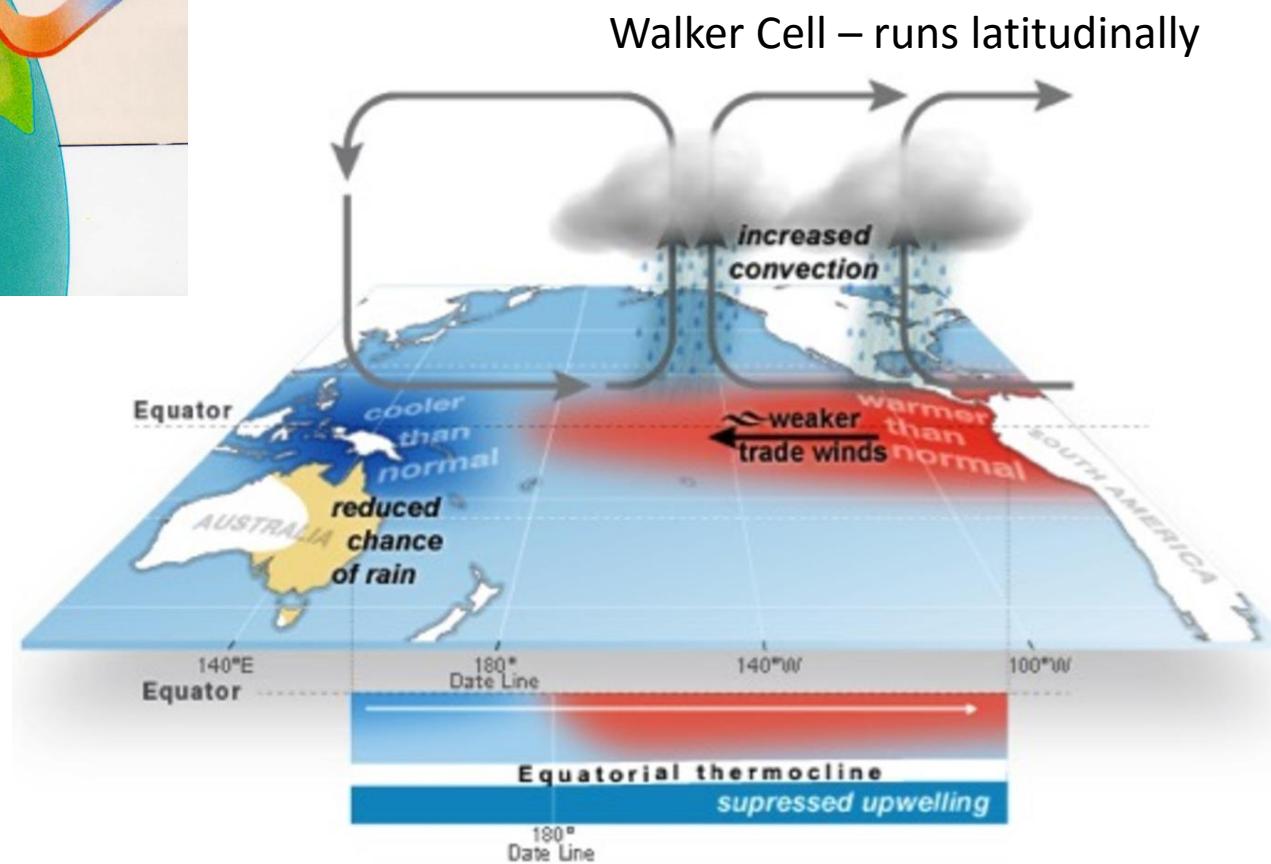
# Cotton and rice crops plummet...



Imagine what would have happened if Australia couldn't afford to import rice!

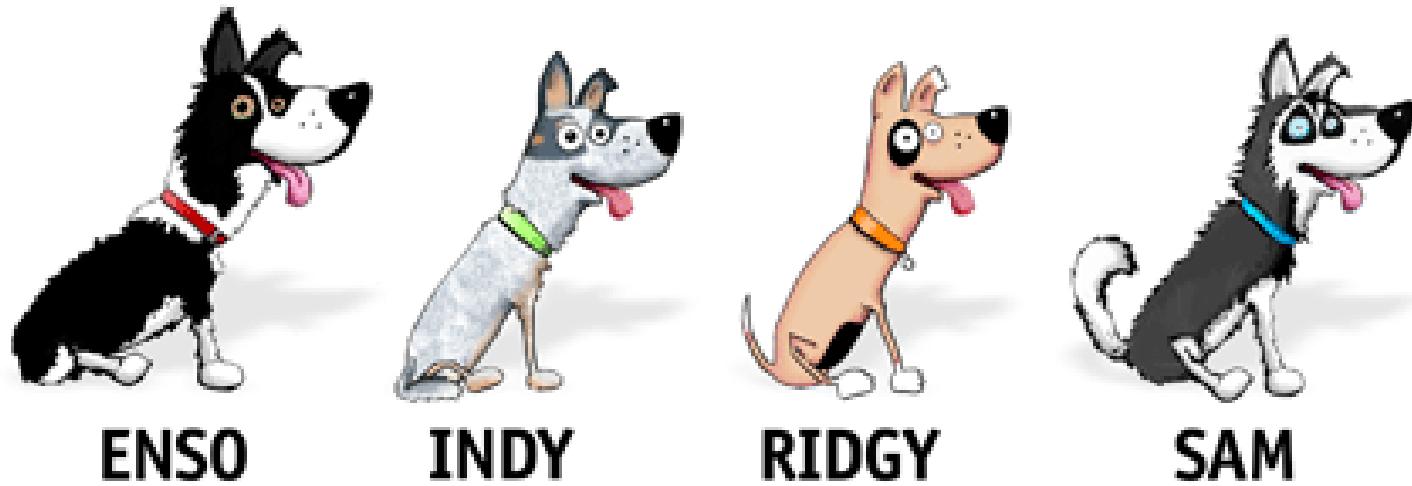


Hadley Cell – runs longitudinally

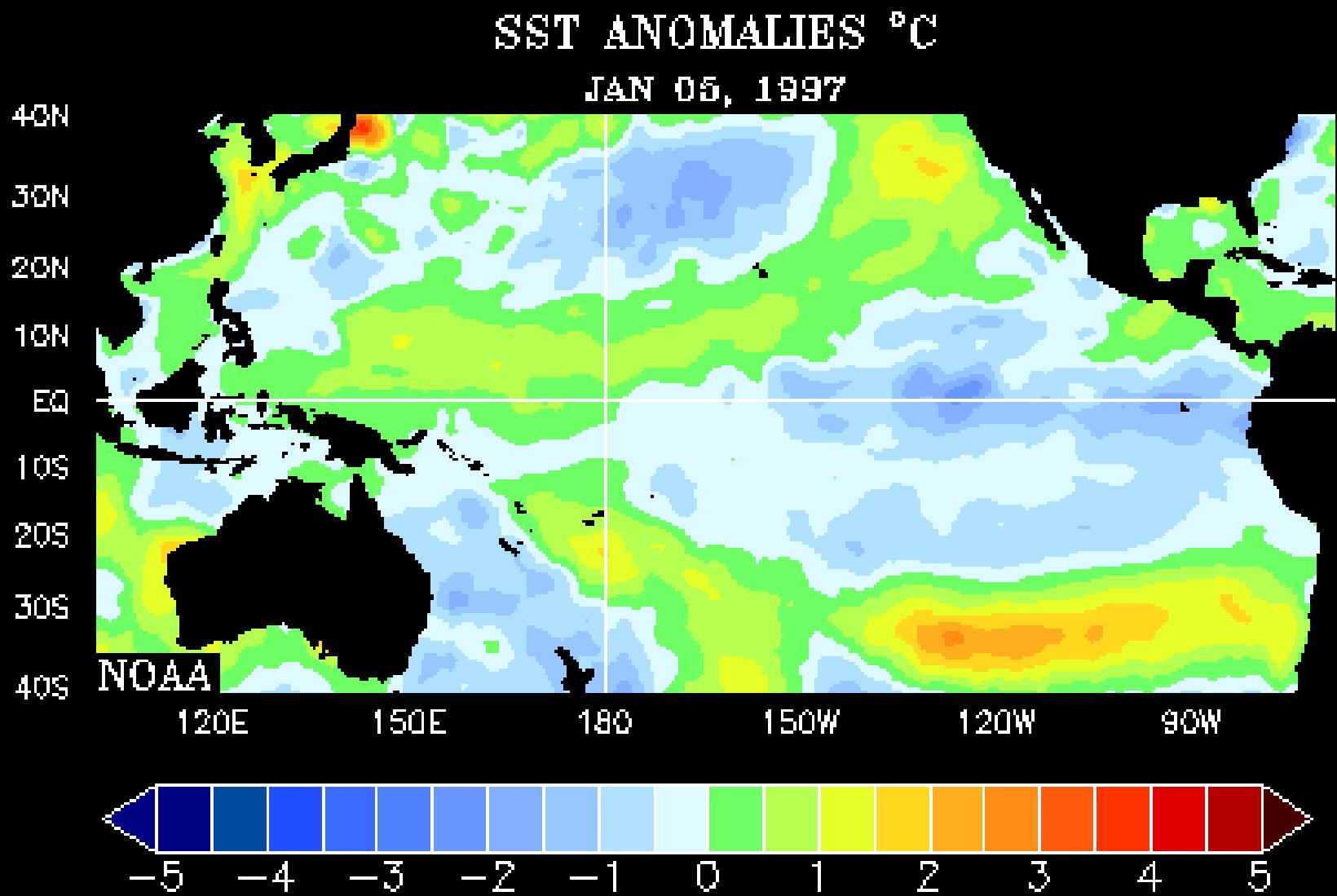


El Niño–Southern Oscillation (ENSO): El Niño

# Bring on the Climate Dogs!



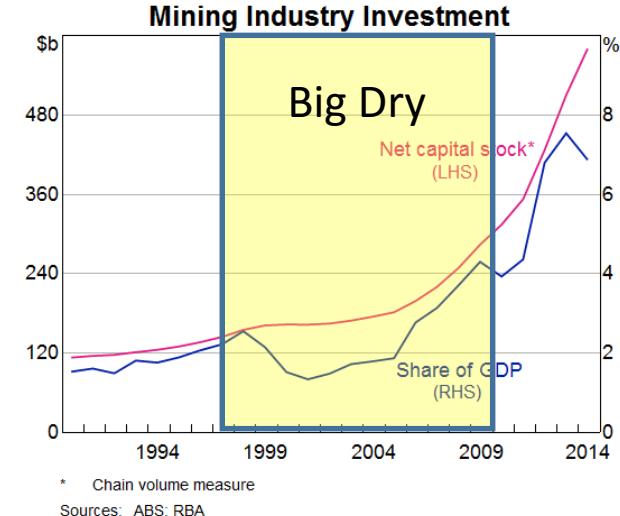
# Beginning of the Big Dry



# Drought resilience

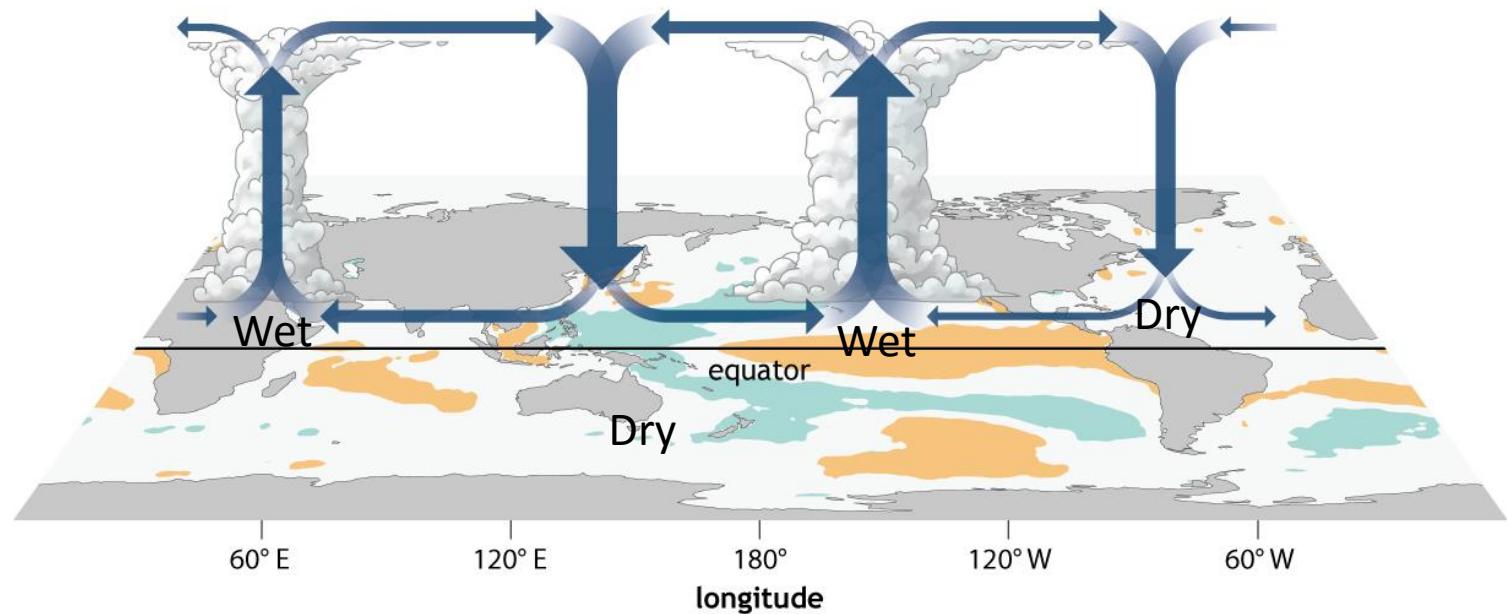
What would have happened:

- If the mining boom hadn't taken the edge off the economic impacts of drought?
- If Australia didn't have coordinated drought response?
- If drought continued past 2009?
- If the country was stressed by civil war, disease and a refugee crisis?
- If Australia had a per capita GDP of US\$ 350 instead of 50,000?



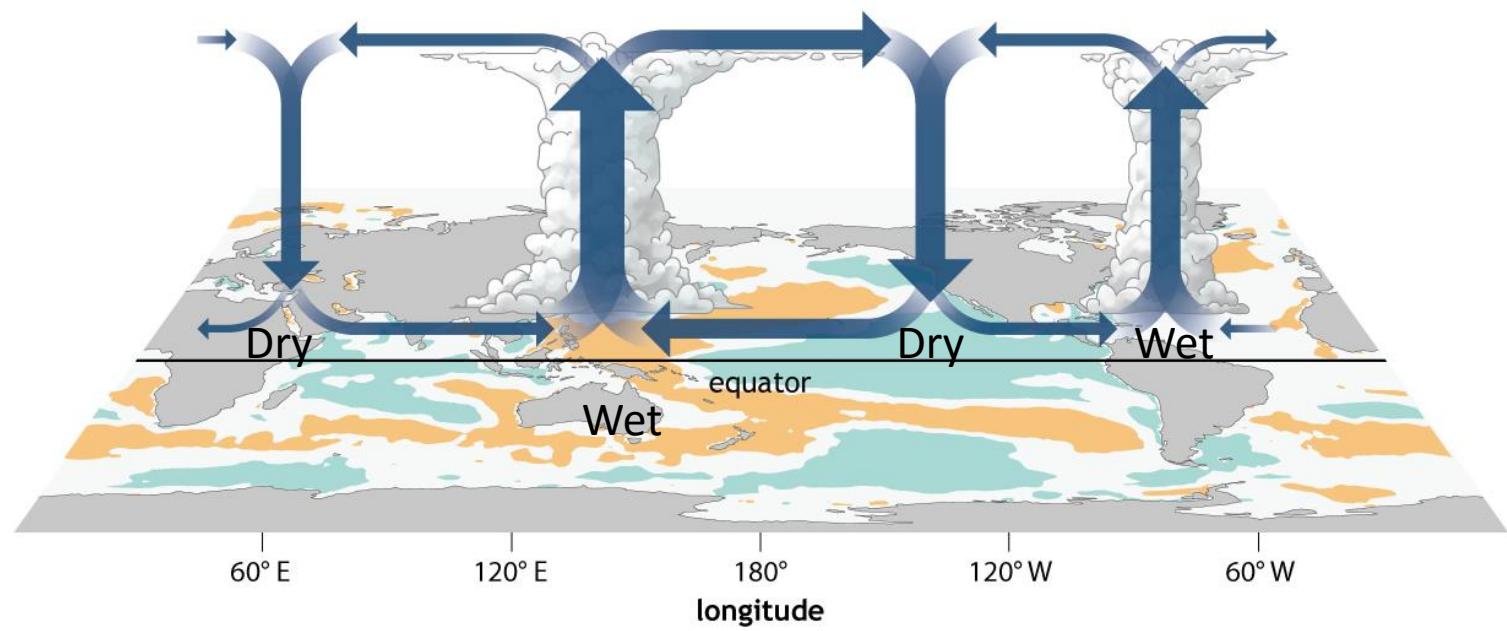
- Drought
- Drought Response Package
- Victoria's Drought Preparedness and Response Framework
- Farmer Workshops
- Preparing your farm for drought
- Managing resources in-drought
- Climate monitoring
- Financial support
- Health and social welfare
- Business support

### El Niño conditions

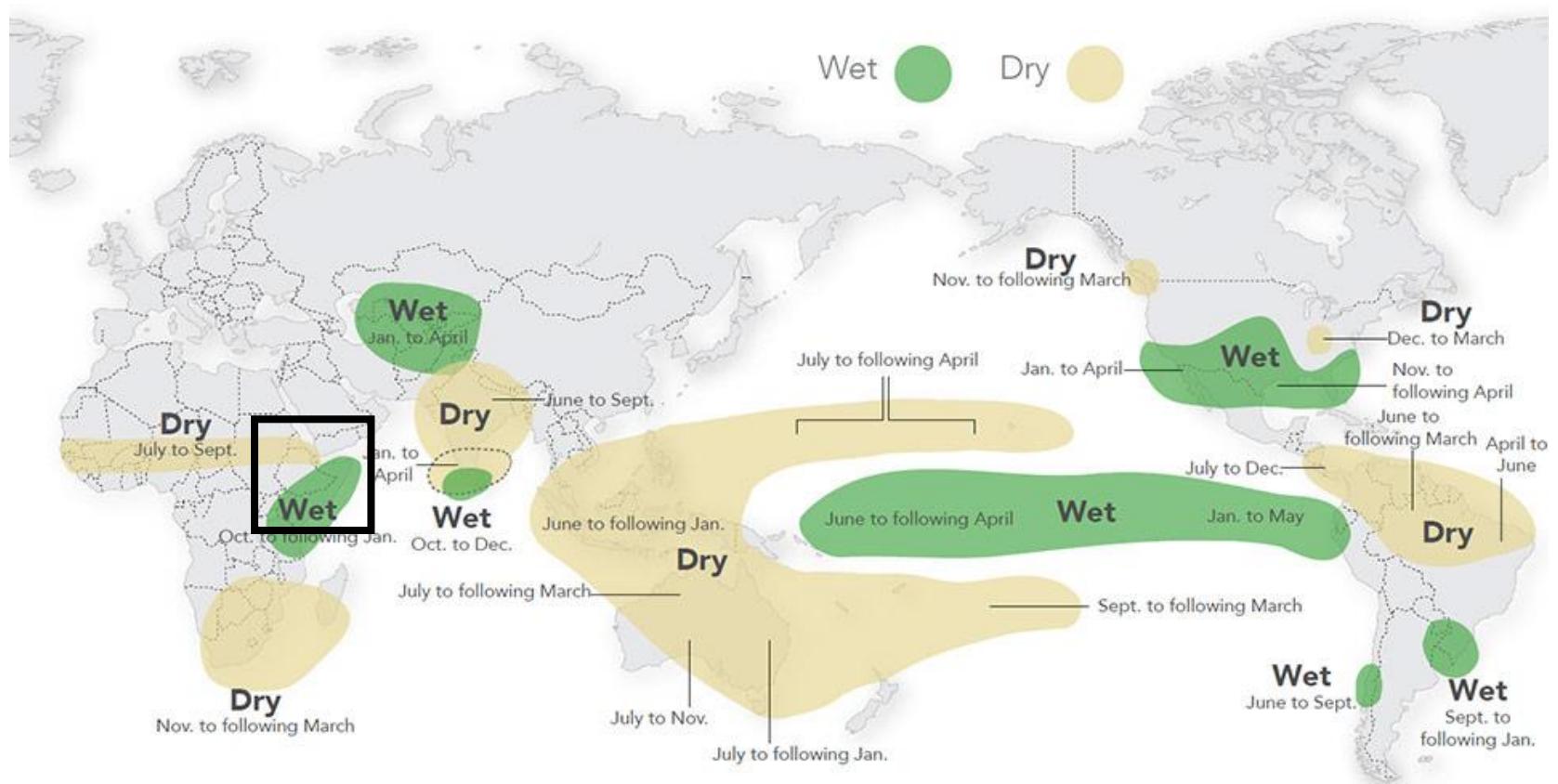


NOAA Climate.gov

### La Niña conditions



# El Niño's global effects

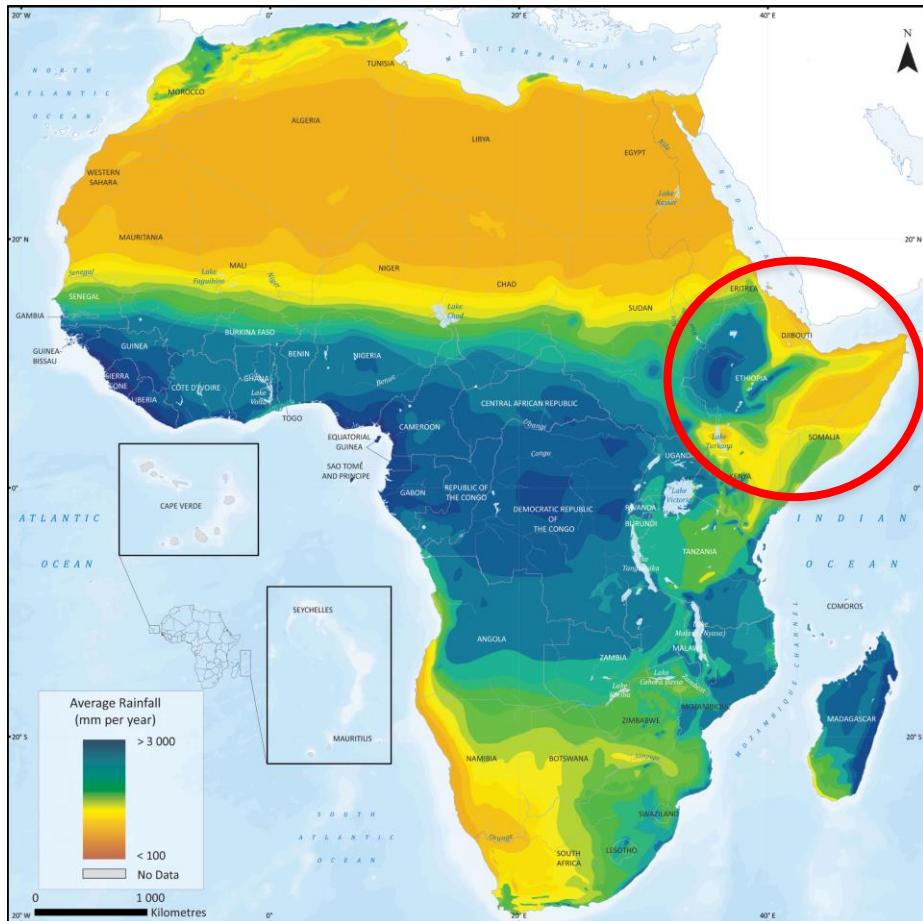


# East Africa Famine 2011

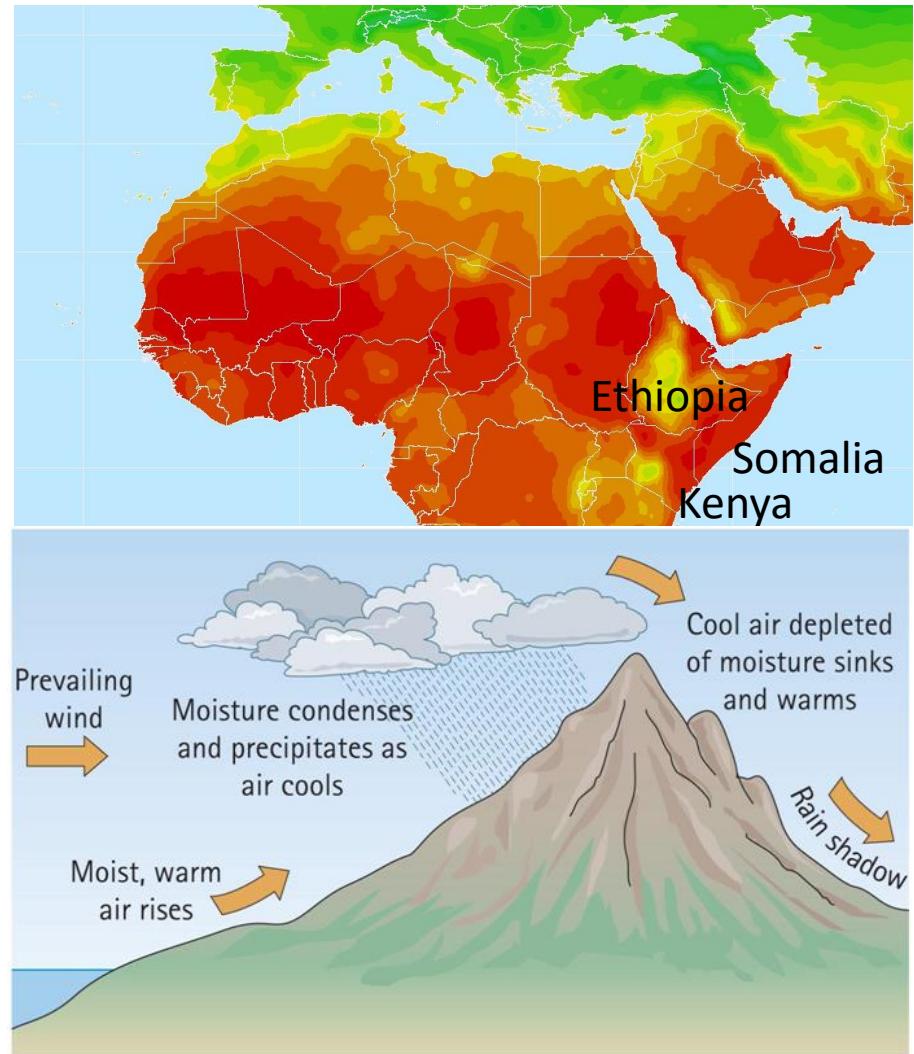


Abandoned pastoral holdings overrun by migrating sand dunes, eastern Somalia.

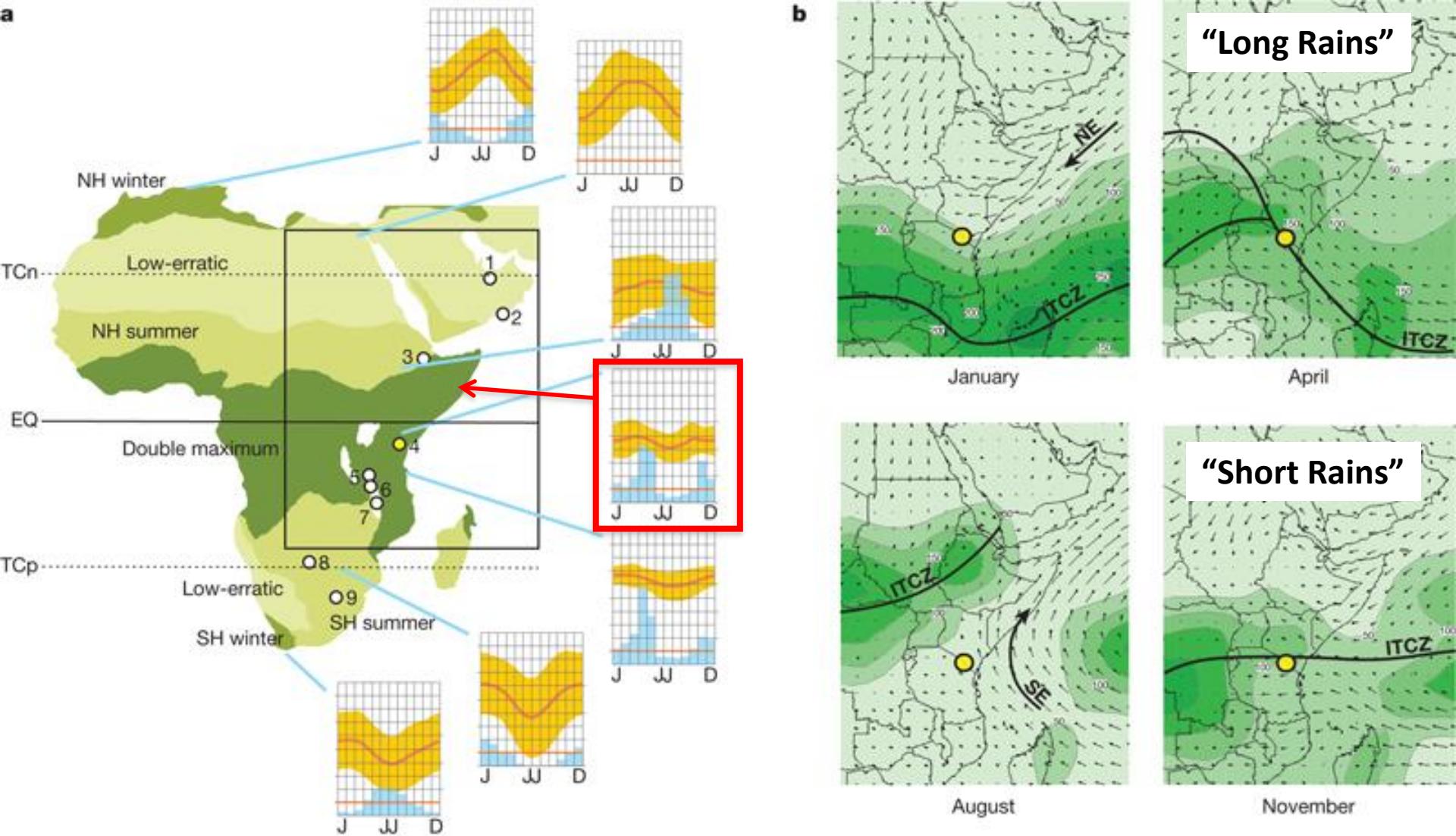
# Horn of Africa climate



[http://na.unep.net/atlas/africaWater/images/maps/pngs/annual\\_avgare\\_rainfall.png](http://na.unep.net/atlas/africaWater/images/maps/pngs/annual_avgare_rainfall.png)



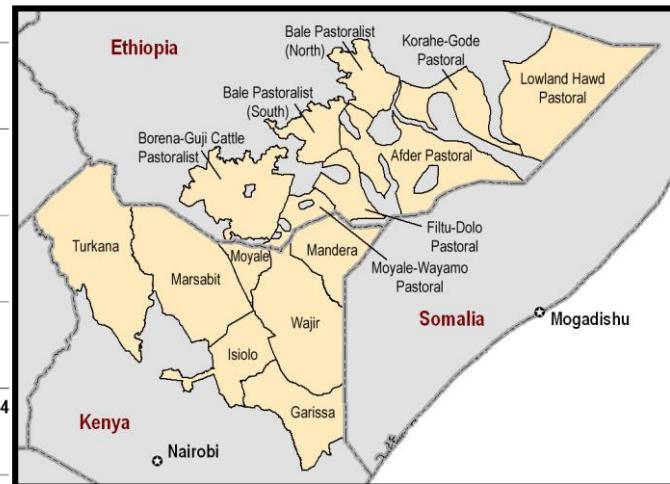
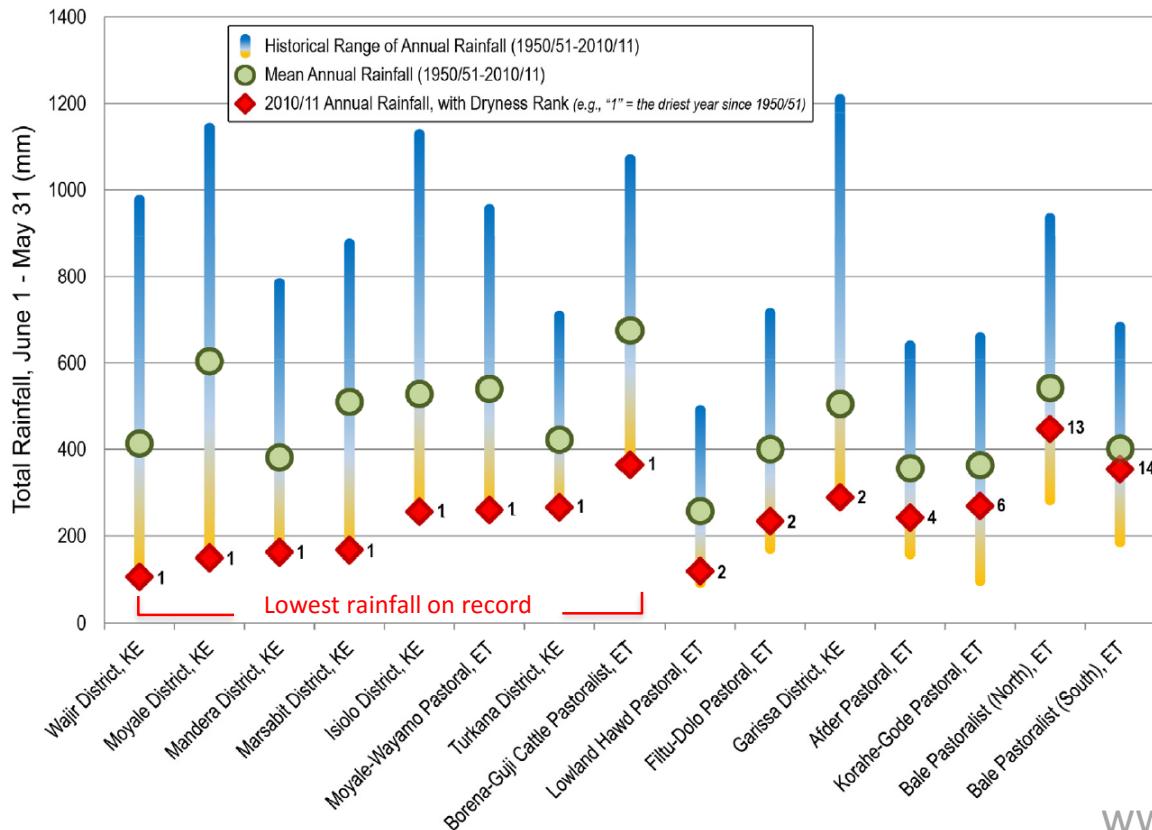
# Rainfall seasonality



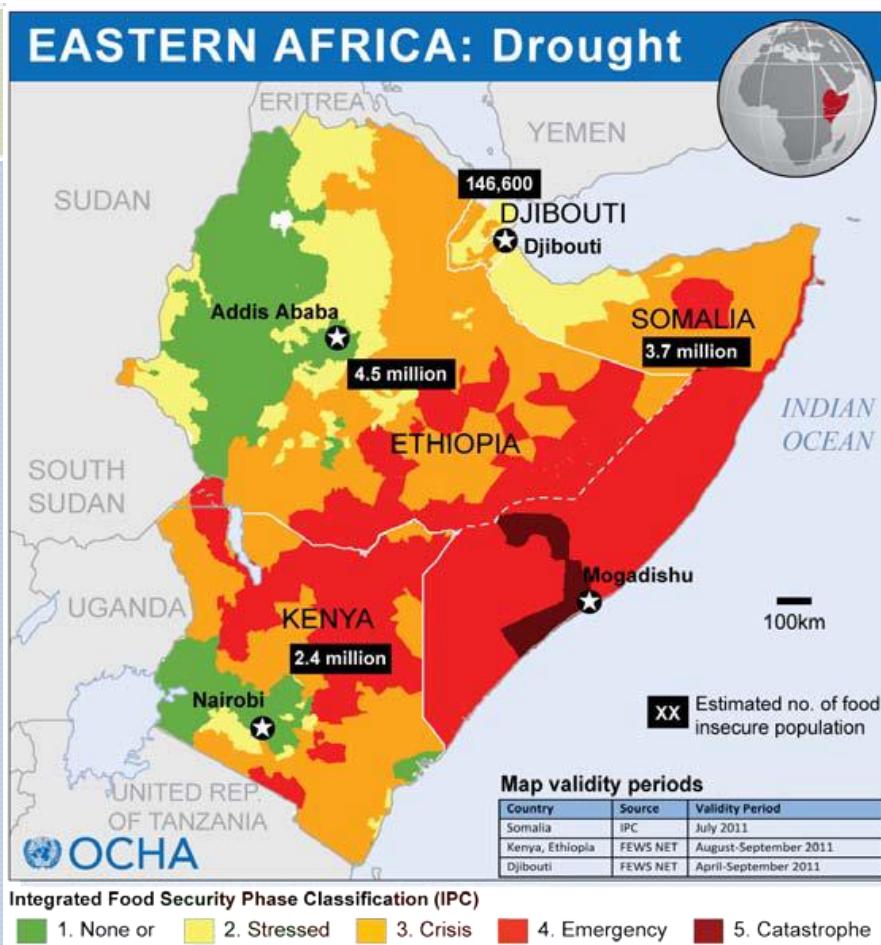
# Drought of 2010-2011

- Near-complete failure of the ‘short rains’ of 2010, and well-below-average 2011 ‘long rains’

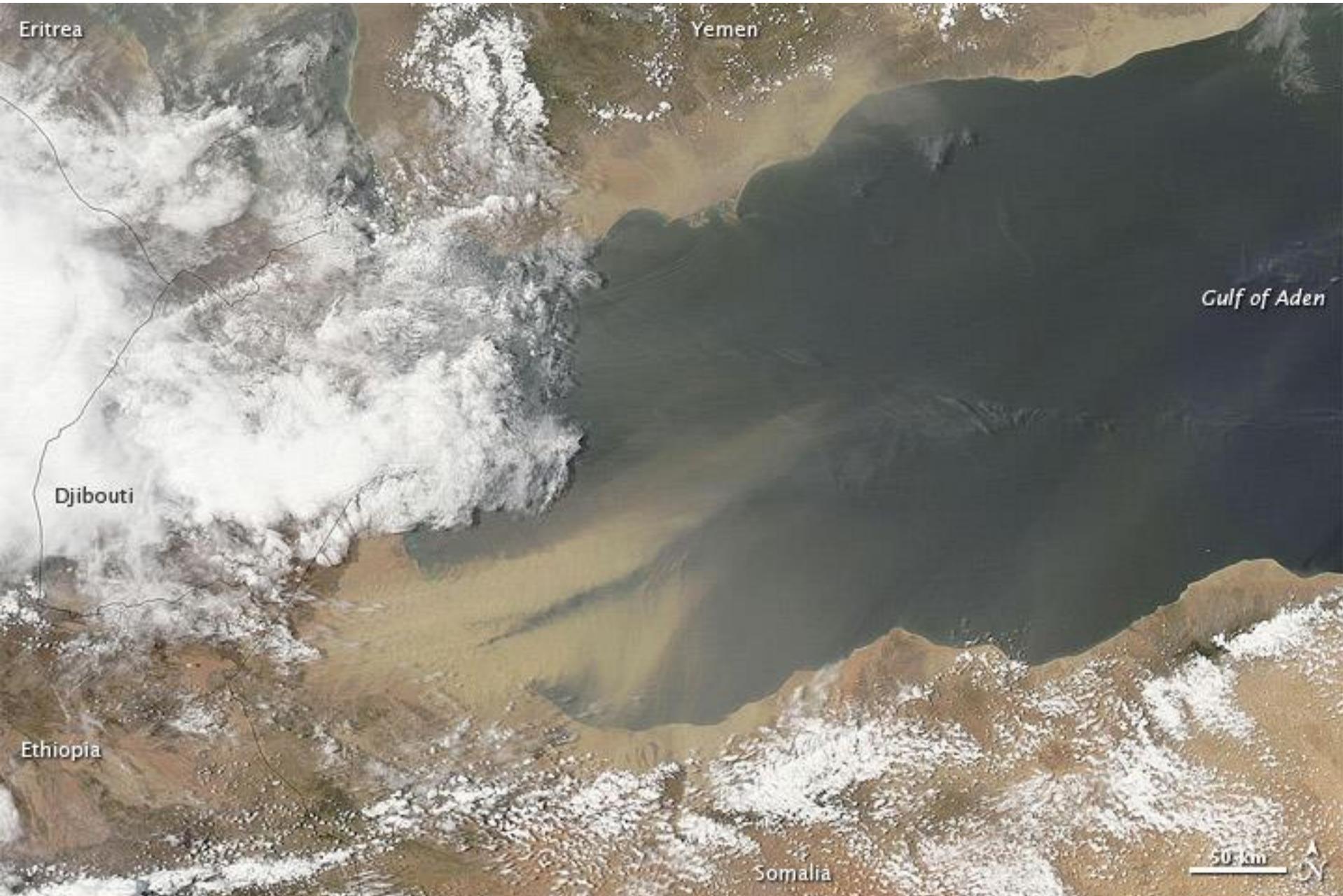
**Figure 2.** 2010/11 rainfall compared to historical totals since 1950/51 in select pastoral areas of Kenya and Ethiopia



# Geographic extent



Satellite image from August 2011 showing dust plume from drought affected area

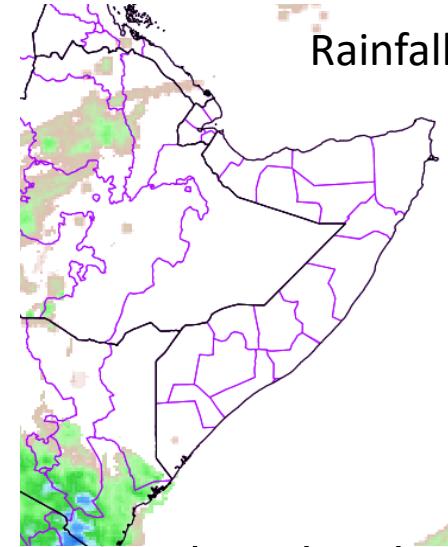


# Impact on food production

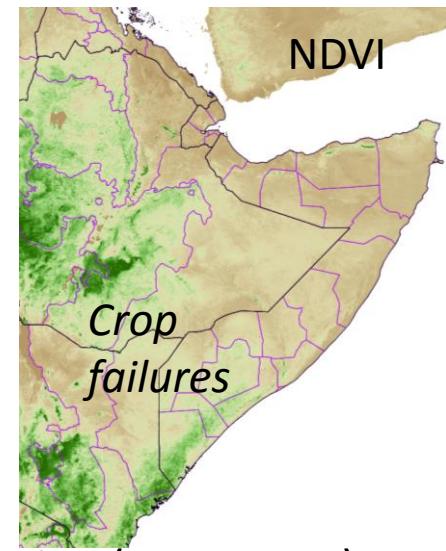
2011 harvest estimated <30% of average, but data uncertainty due to:

- Civil unrest
- Poor access
- Informal economy
- No baseline

Solution: remote sensing data - NDVI

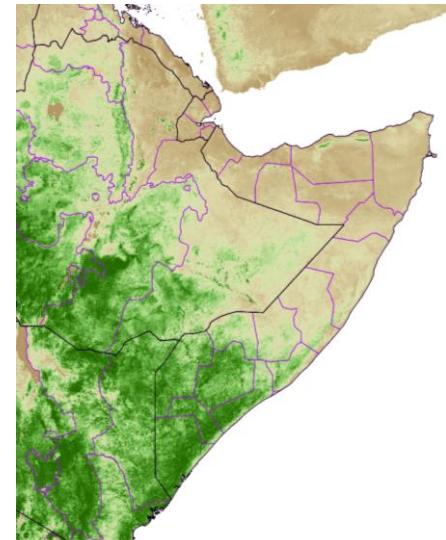
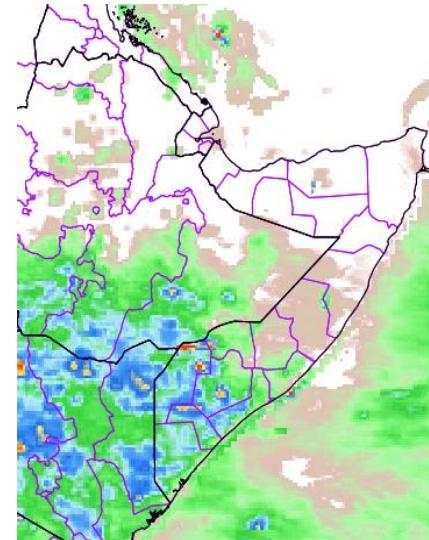


Rainfall

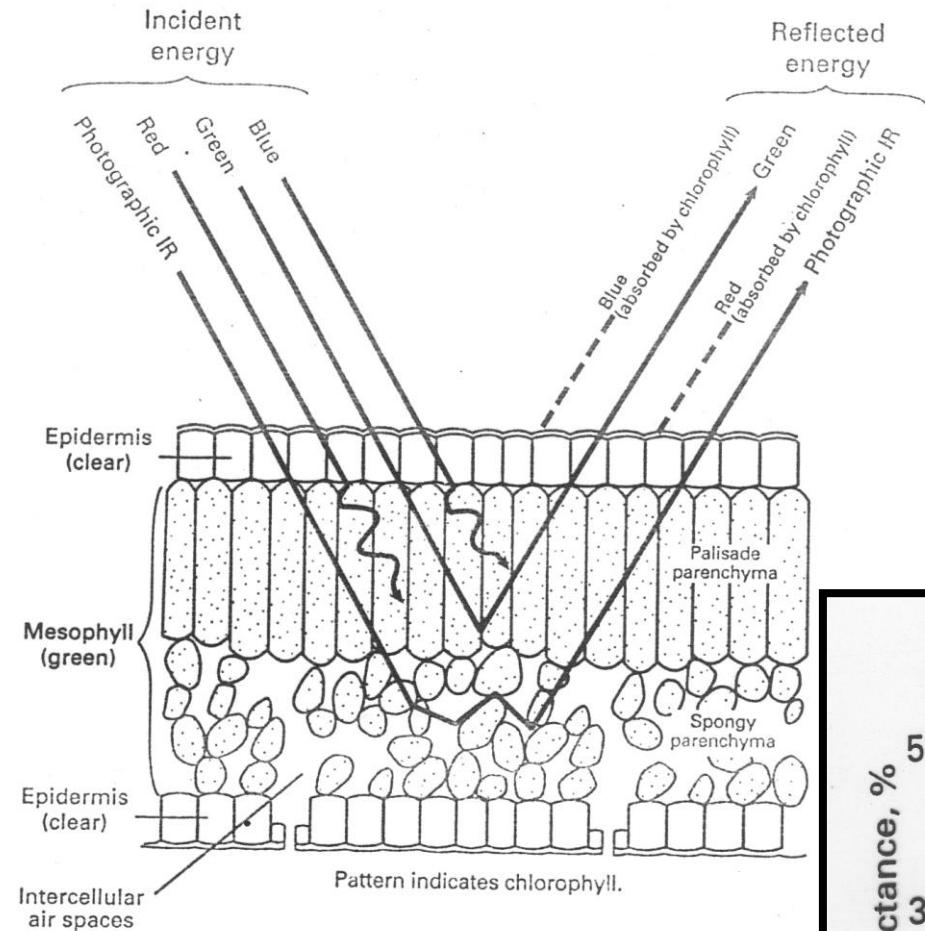


NDVI  
Crop  
failures

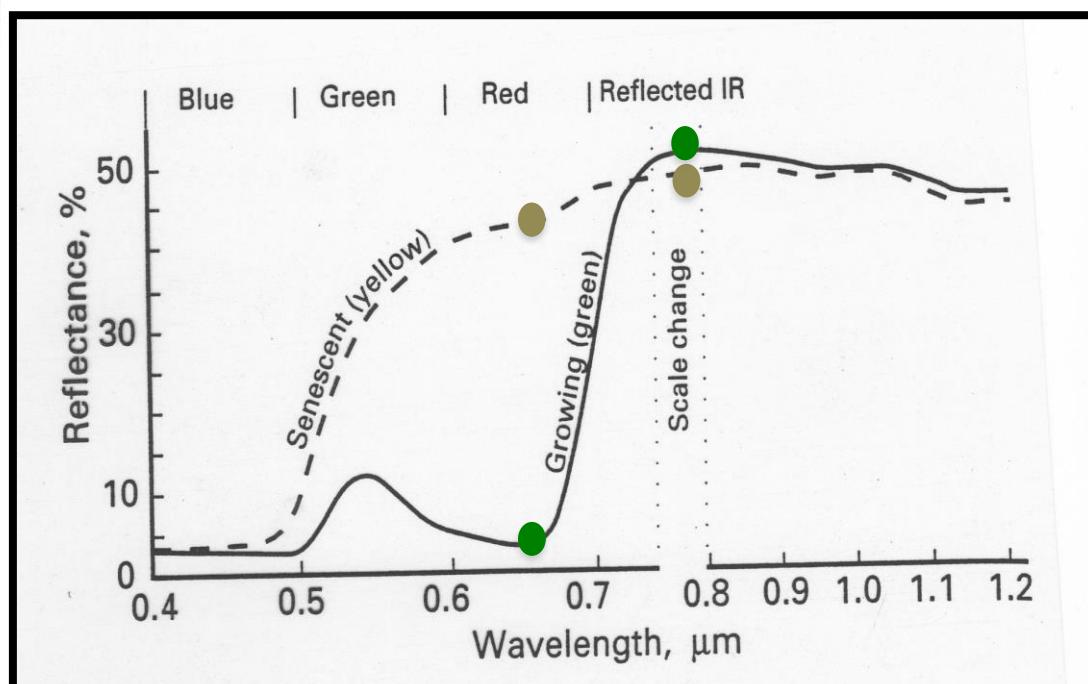
During drought: short rains (Dec. 2010)



Same period, the following (wetter) year



- Crop/plant cover can be monitored from space: chlorophyll is used as a proxy for crop or pasture status
- Vegetation indices based on reflectance properties in red and near-IR



# NDVI - normalised difference vegetation index:

$$\bullet R_{\text{NDVI}} = (R_{\text{Near-IR}} - R_{\text{red}}) \div (R_{\text{Near-IR}} + R_{\text{red}})$$

## 1. Healthy veg example:

near-IR = 180, red = 30

$$\text{NDVI} = 150 \div 210 = 0.714$$

## 2. Sick veg example:

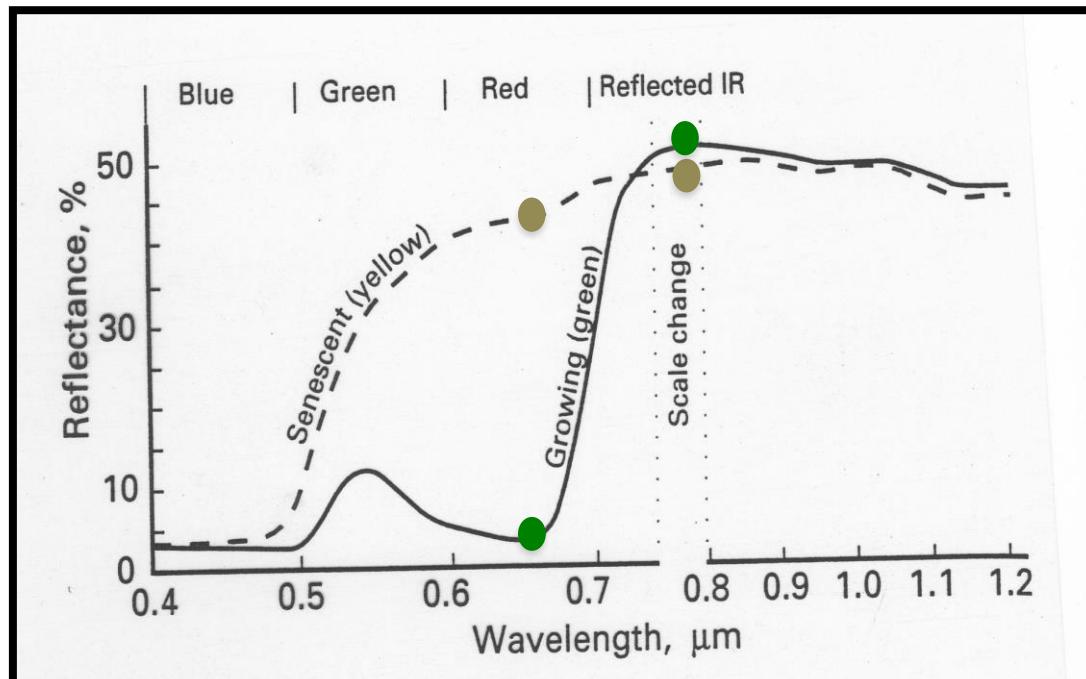
near-IR = 170, red = 155

$$\text{NDVI} = 15 \div 325 = 0.046$$

## 3. Non-veg example:

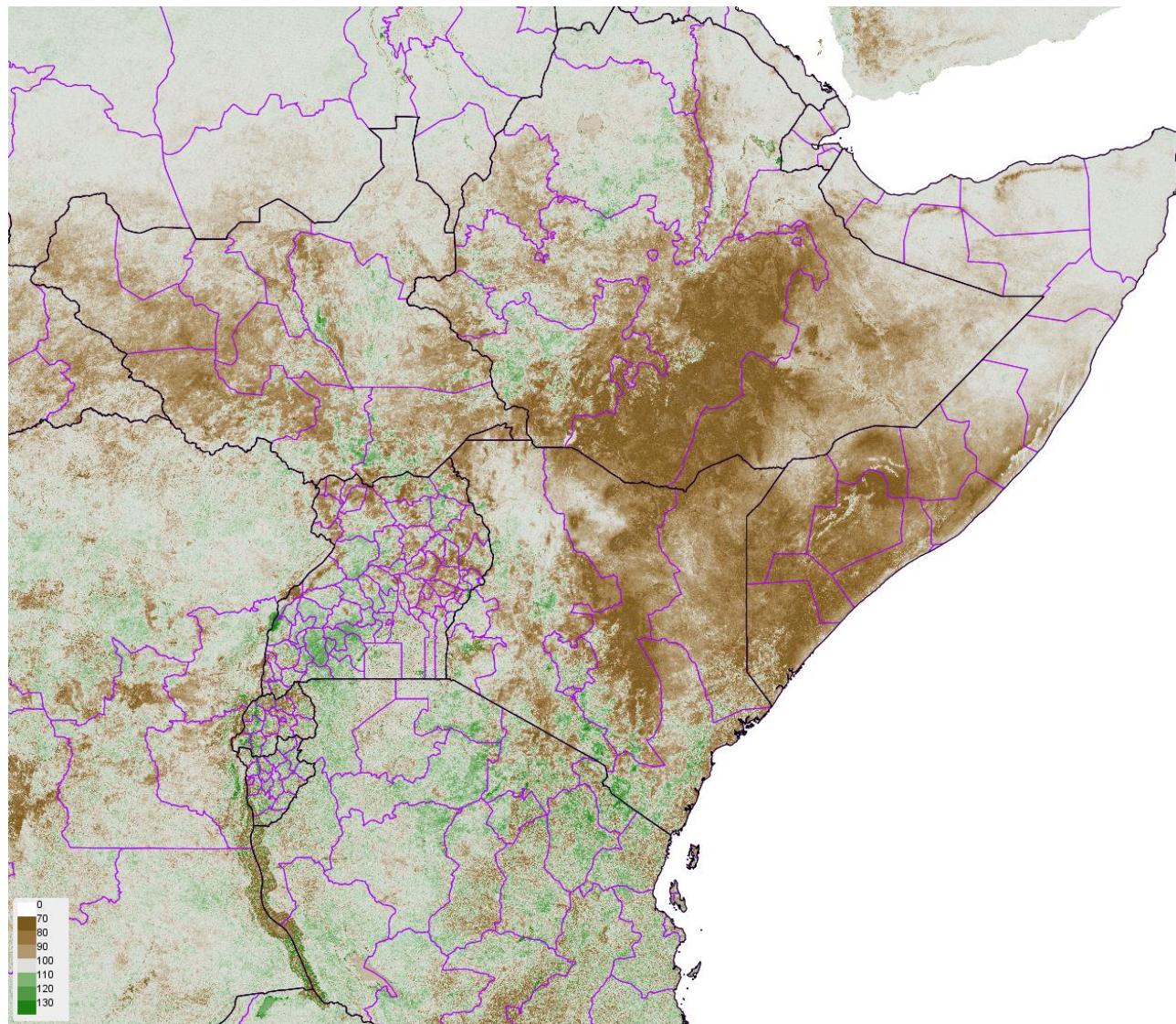
near-IR = 10, red = 65

$$\text{NDVI} = -55 \div 75 = -0.733$$



# Vegetation cover anomaly for April 2011

(brownest areas have the greatest negative anomalies, i.e. the greatest deviations from average April plant cover)





Key Message Update

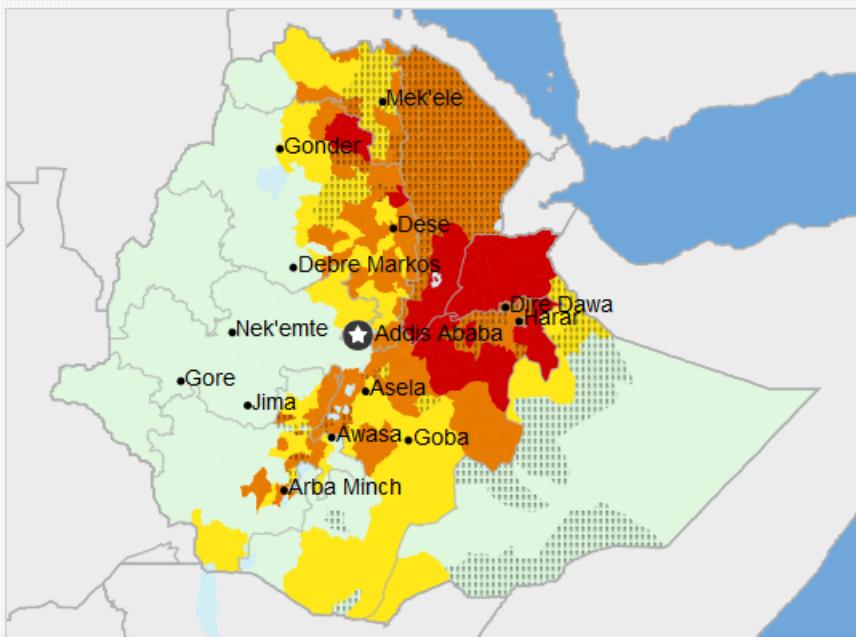
Archive

Emergency continues in central and northeastern Ethiopia

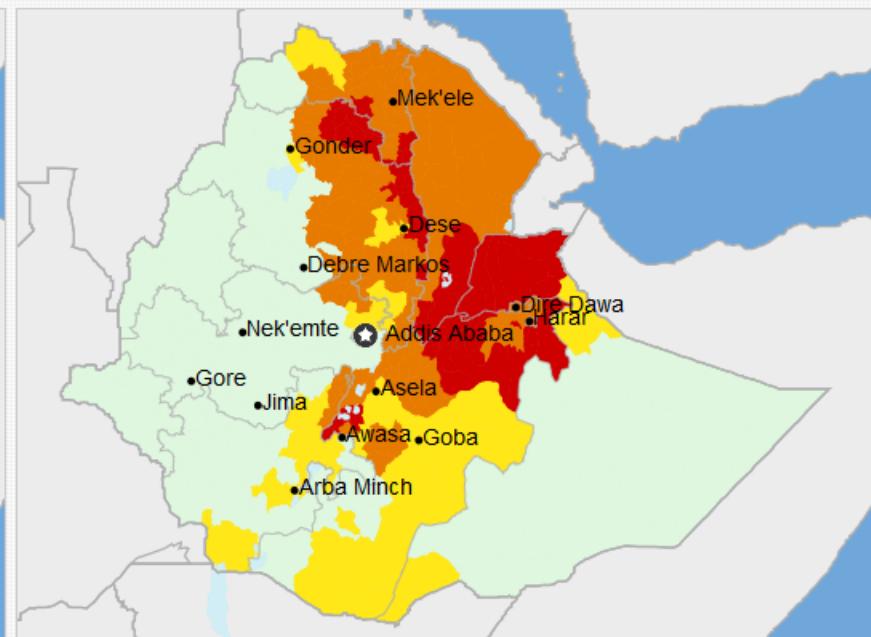
March 2016

## Hang on... wasn't it Southern Ethiopia in 2011???

Near Term: February - May 2016



Medium Term: June - September 2016

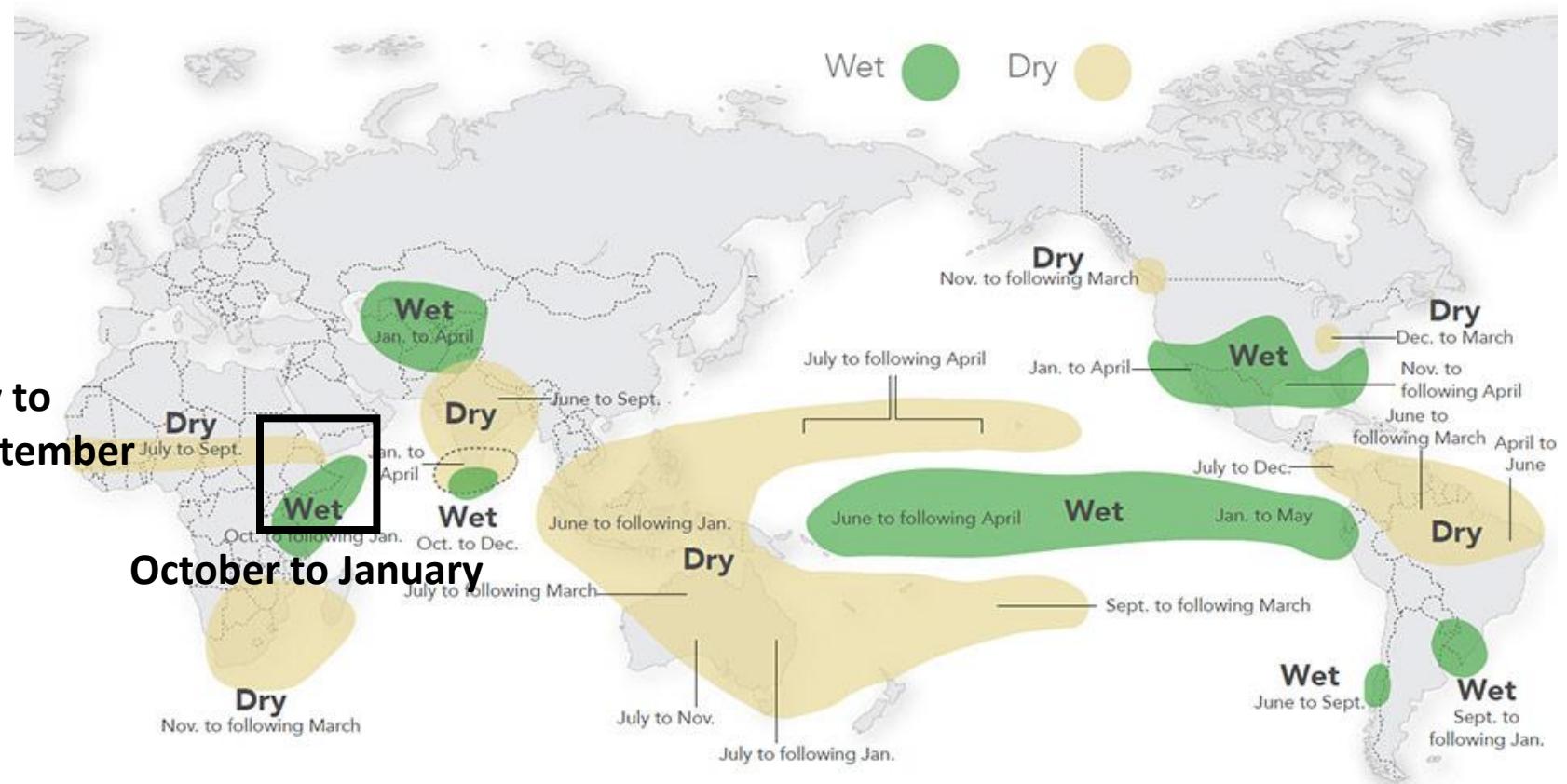


### IPC 2.0 Acute Food Insecurity Phase

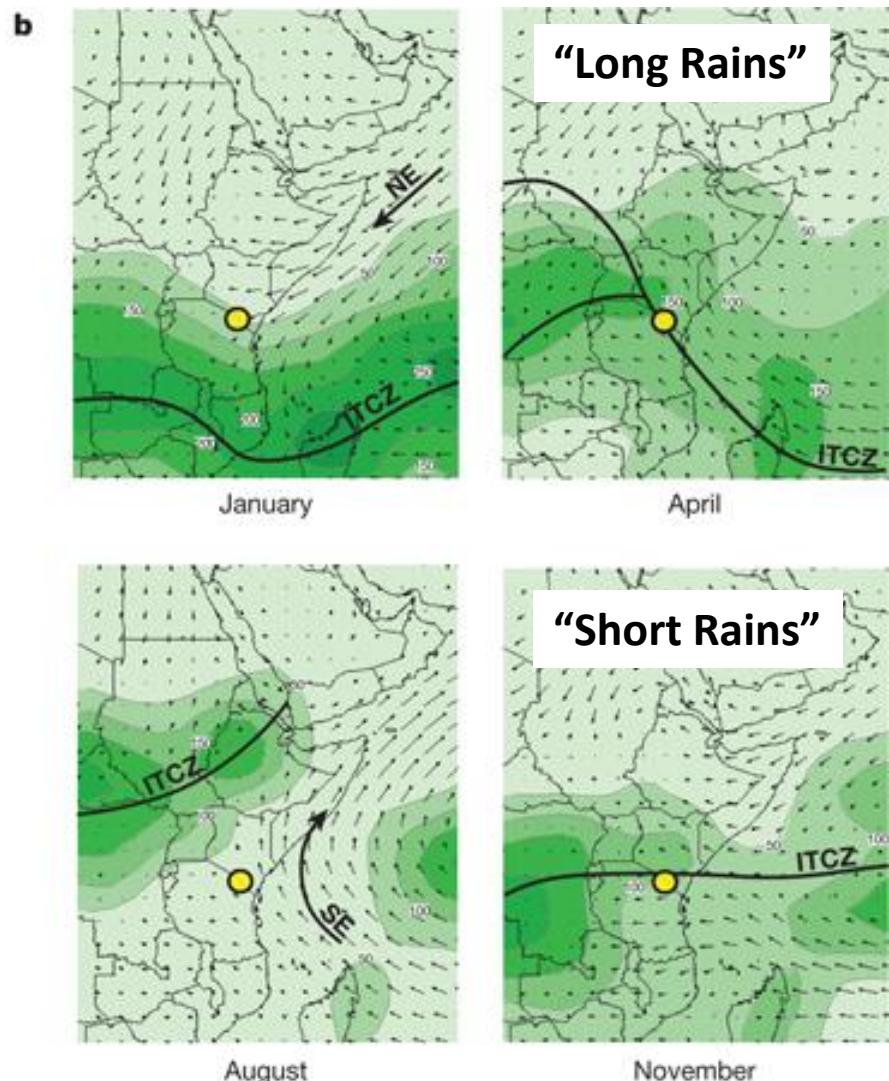
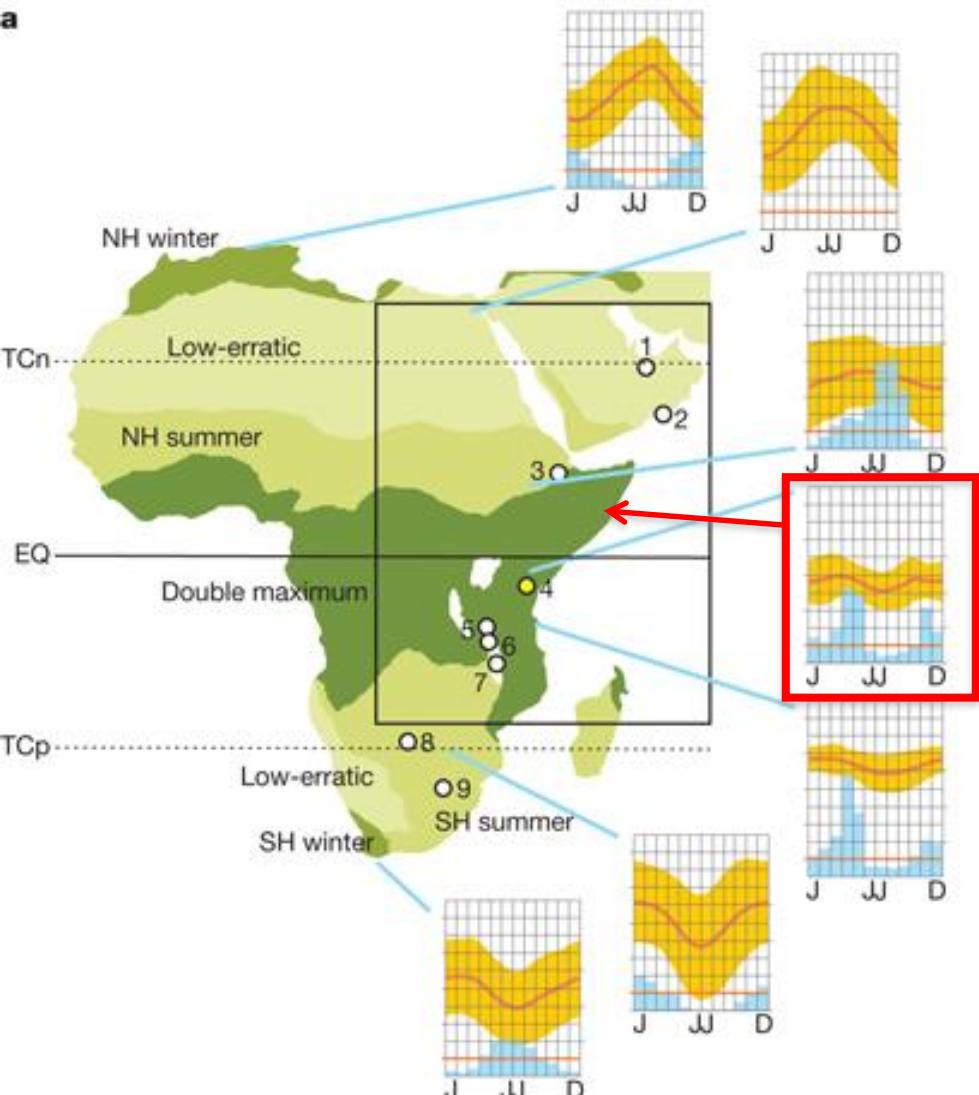
! 1: Minimal    2: Stressed    3: Crisis    4: Emergency    5: Famine

! Would likely be at least one phase worse without current or programmed humanitarian assistance

# El Niño's global effects

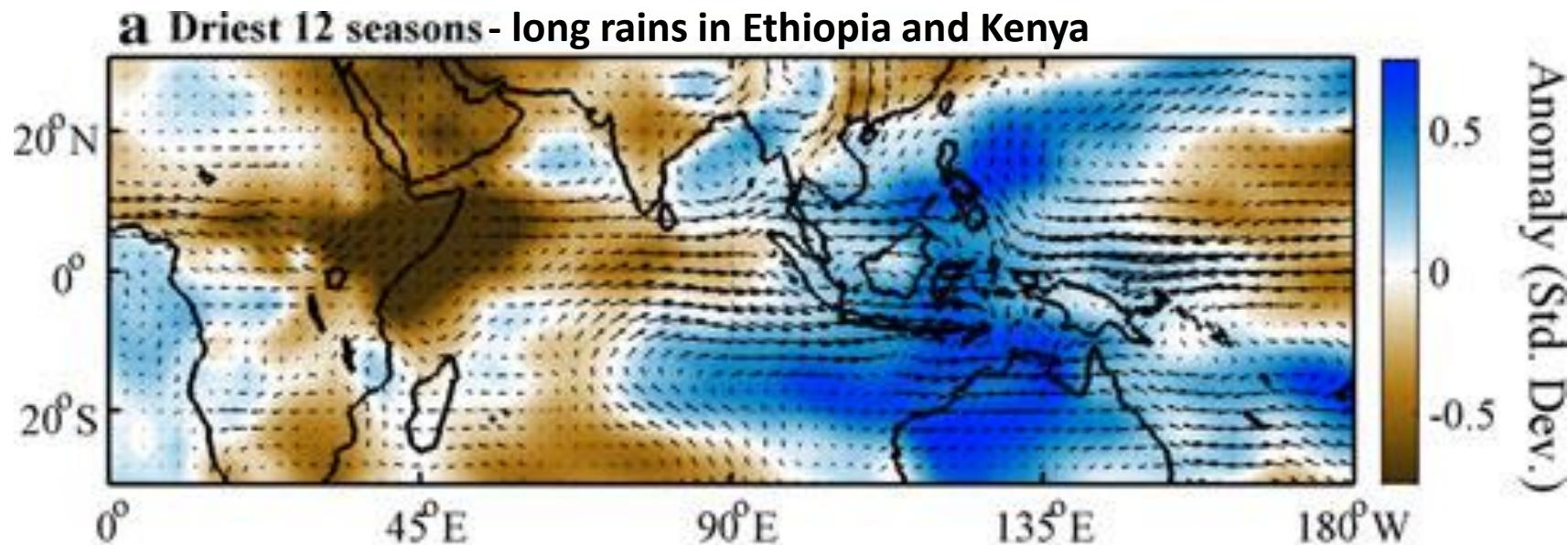


# Rainfall seasonality



Failure of “Short Rains” is likely to be related to ENSO

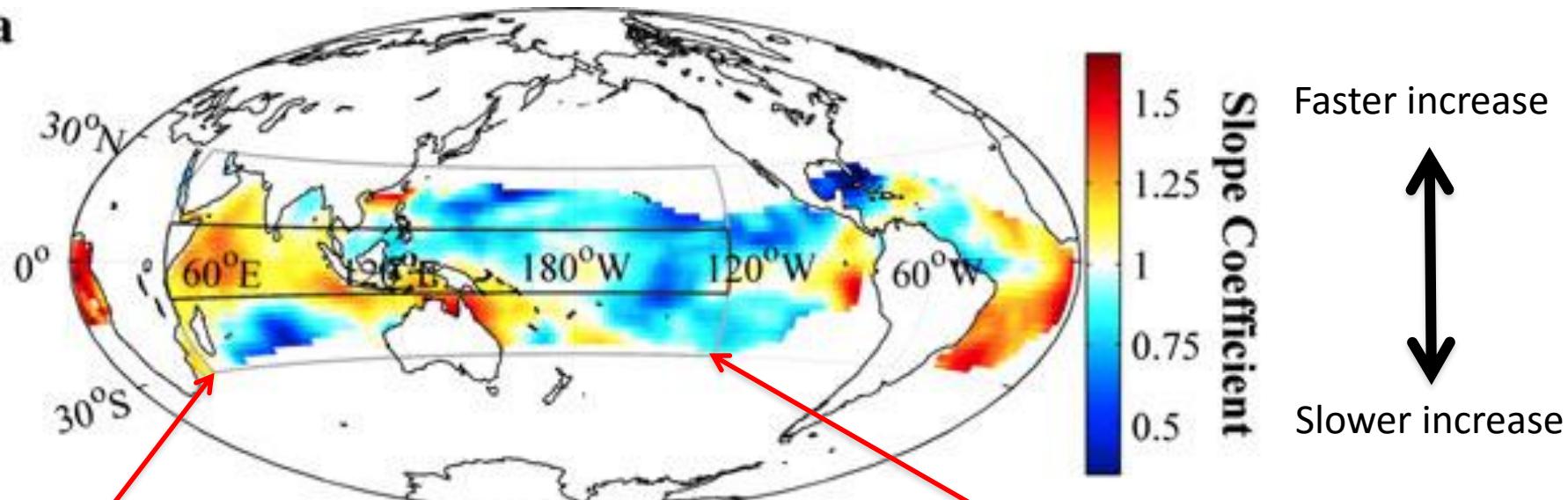
# Why did the Long Rains fail?



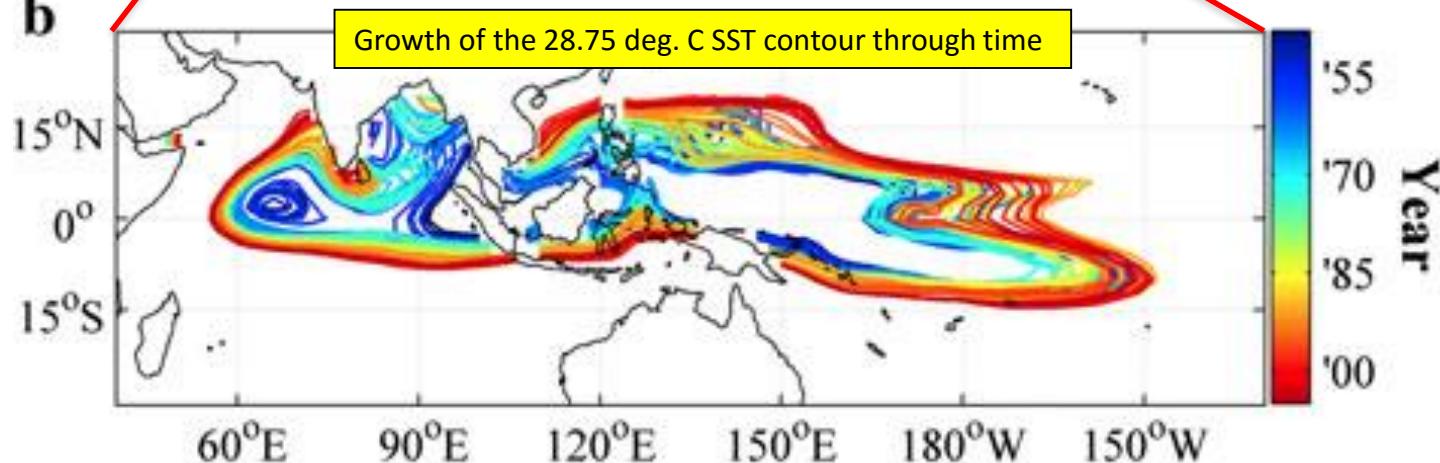
- Brown = drier; Blue = wetter
- Warming in the Eastern Indian Ocean has altered the Walker Cell, forcing dry air on the Horn of Africa

Sea Surface Temperatures (for MAMJ) in the Indian Ocean are increasing at a faster rate than the Pacific Ocean

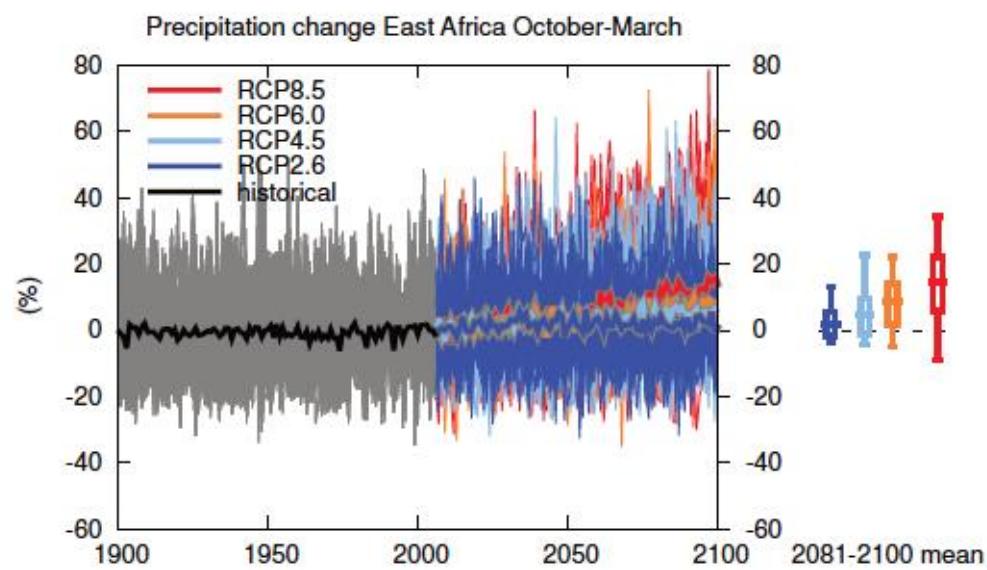
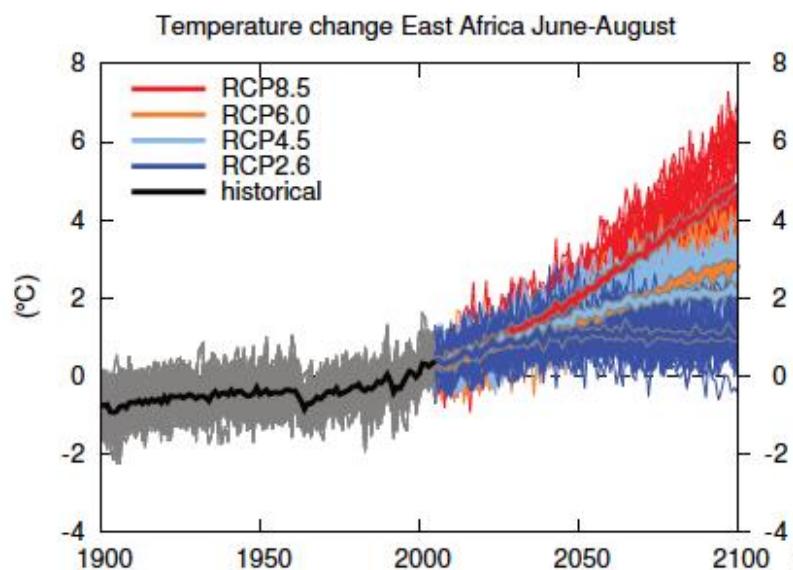
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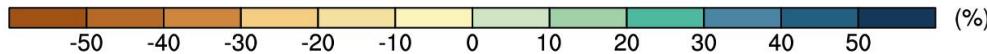
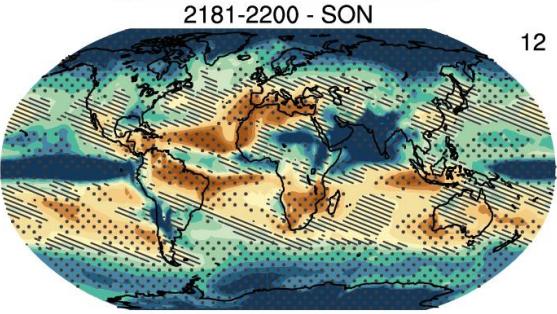
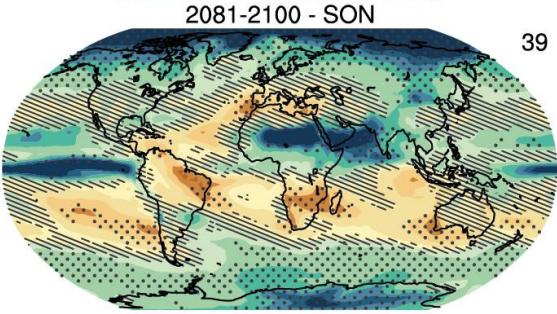
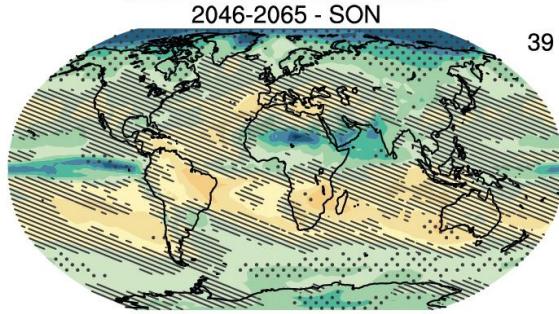
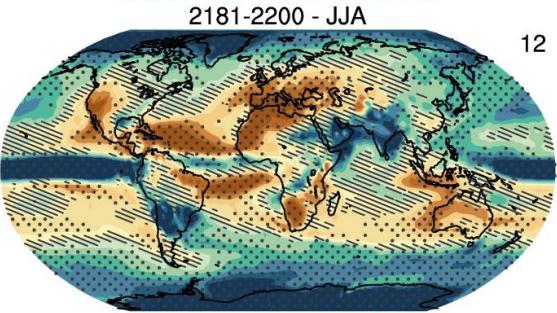
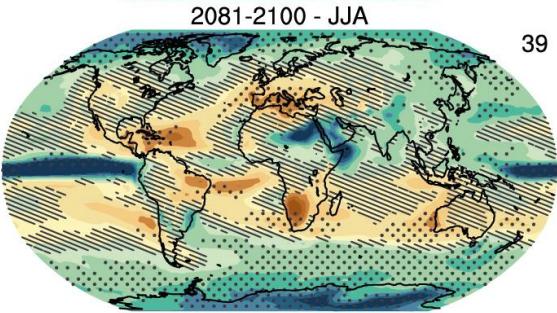
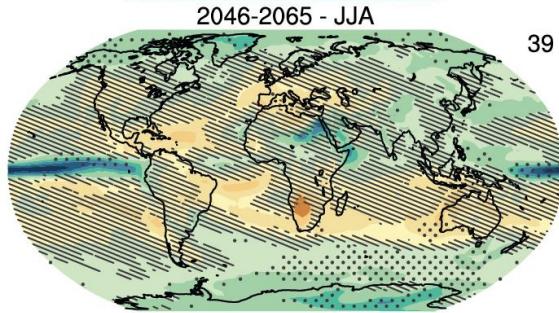
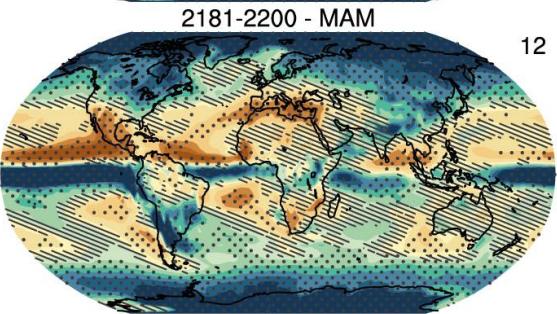
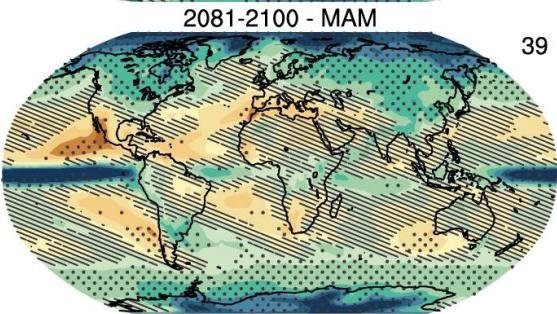
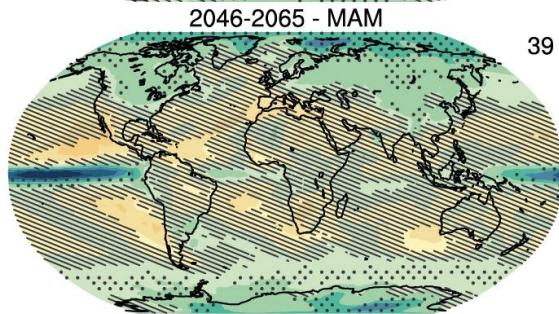
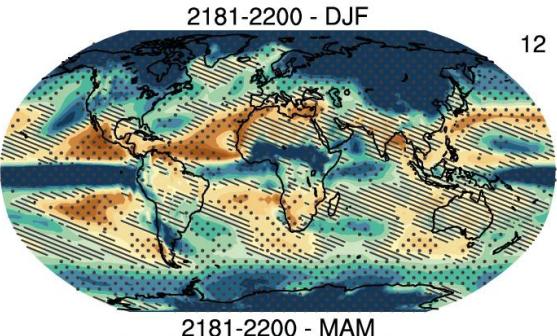
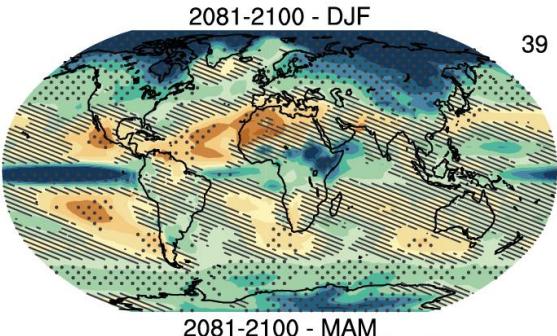
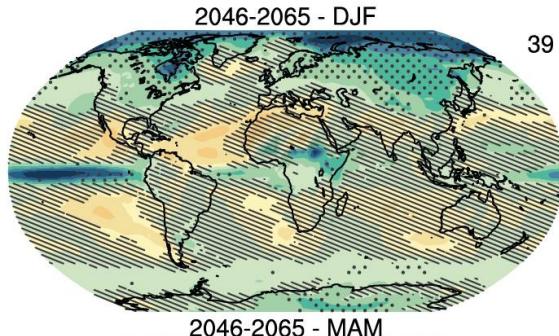
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# What's predicted to happen?

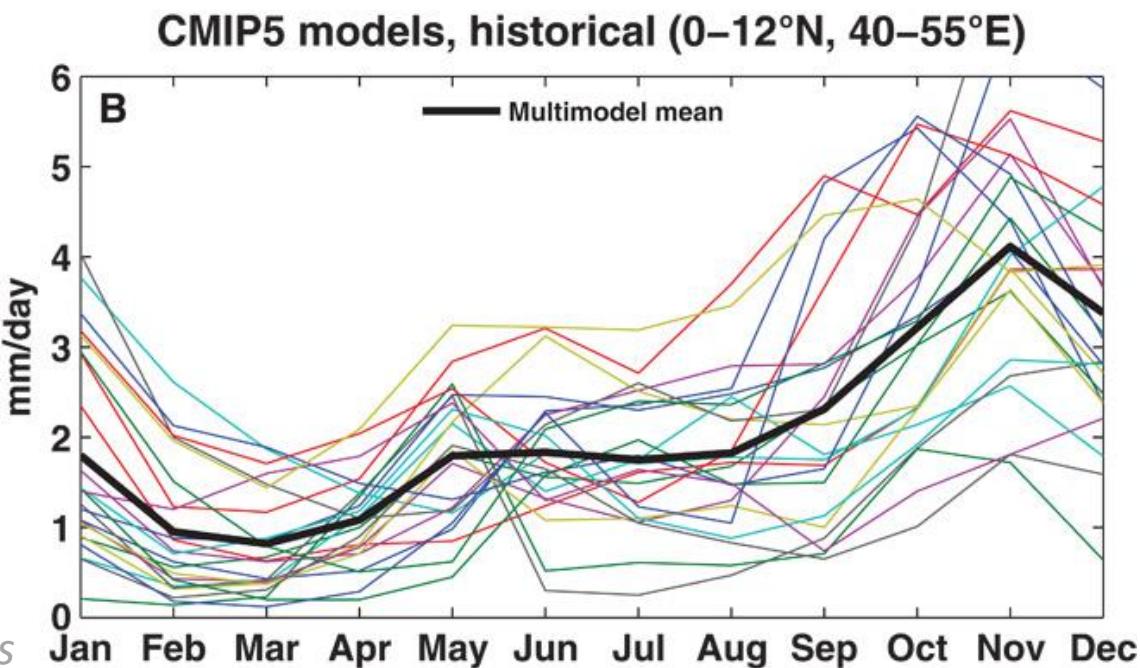
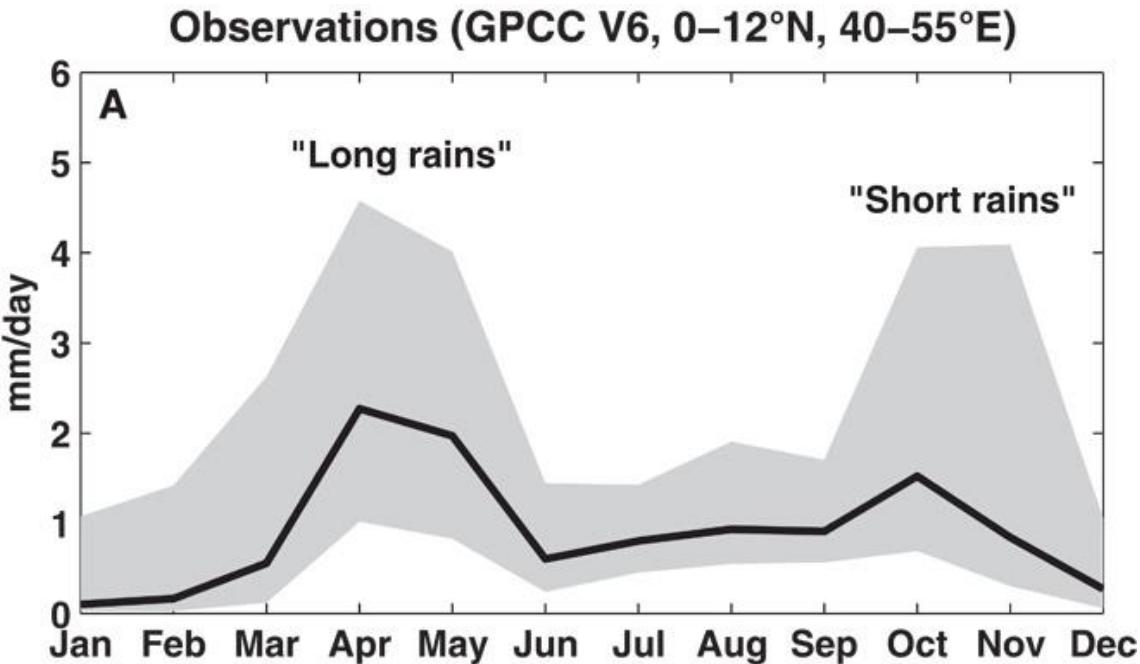


# Seasonal mean percentage precipitation change (RCP8.5)

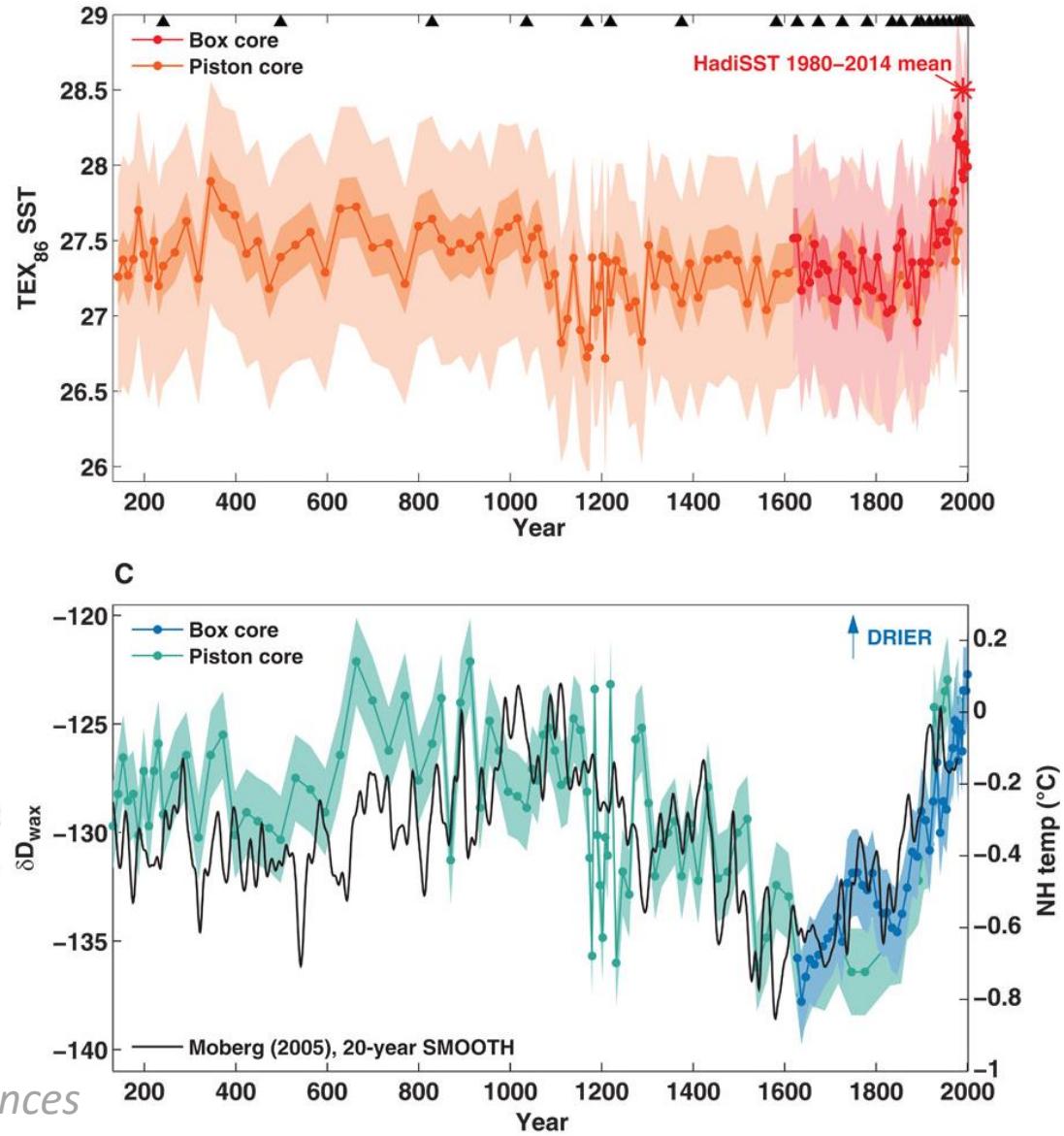
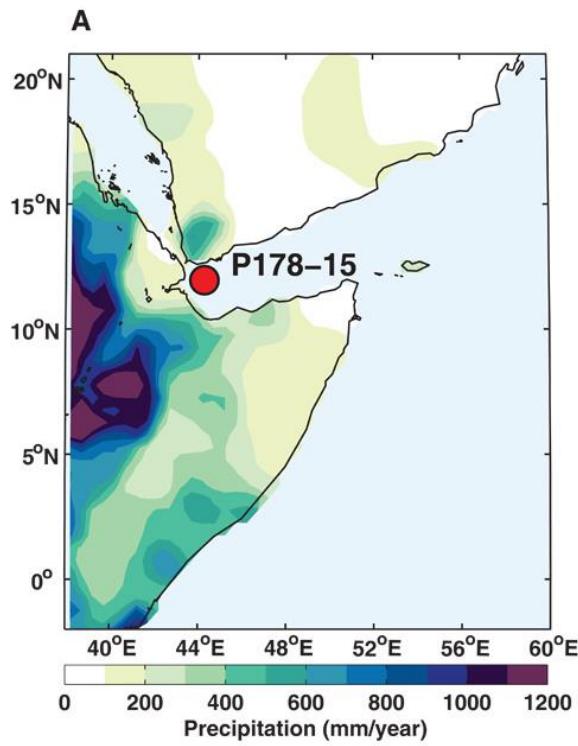


But...

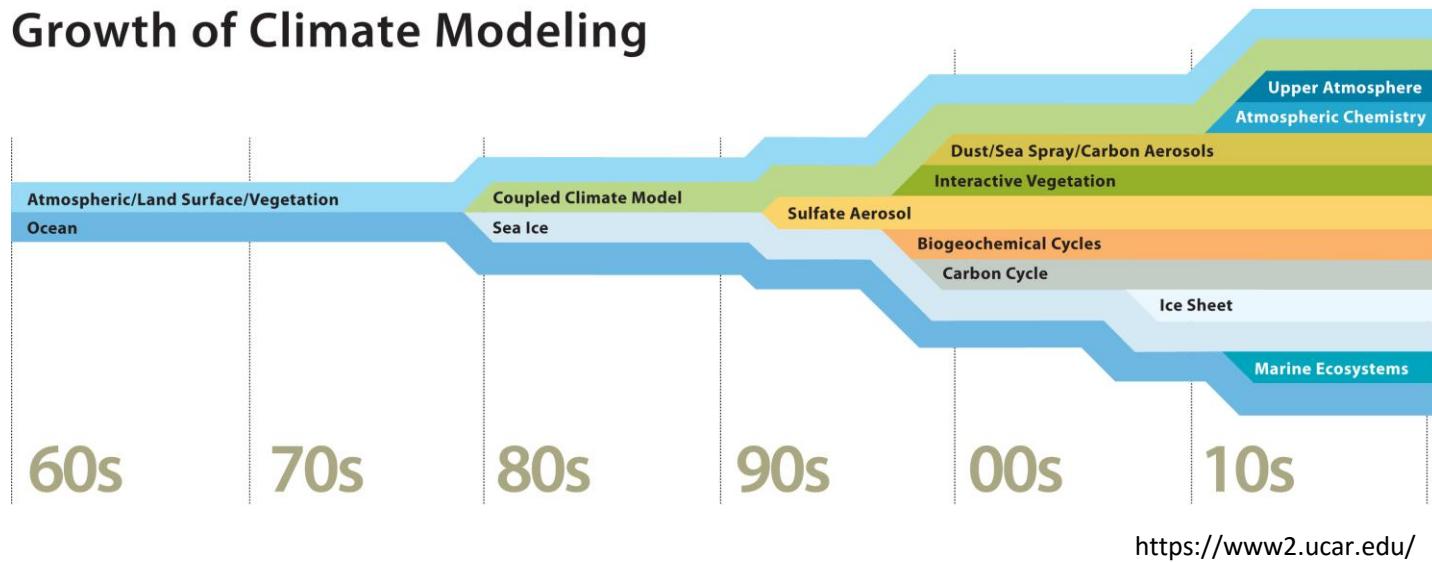
- Modelling of historical data doesn't accurately portray the “Long Rains”
- Can we be sure about the modelled increase?



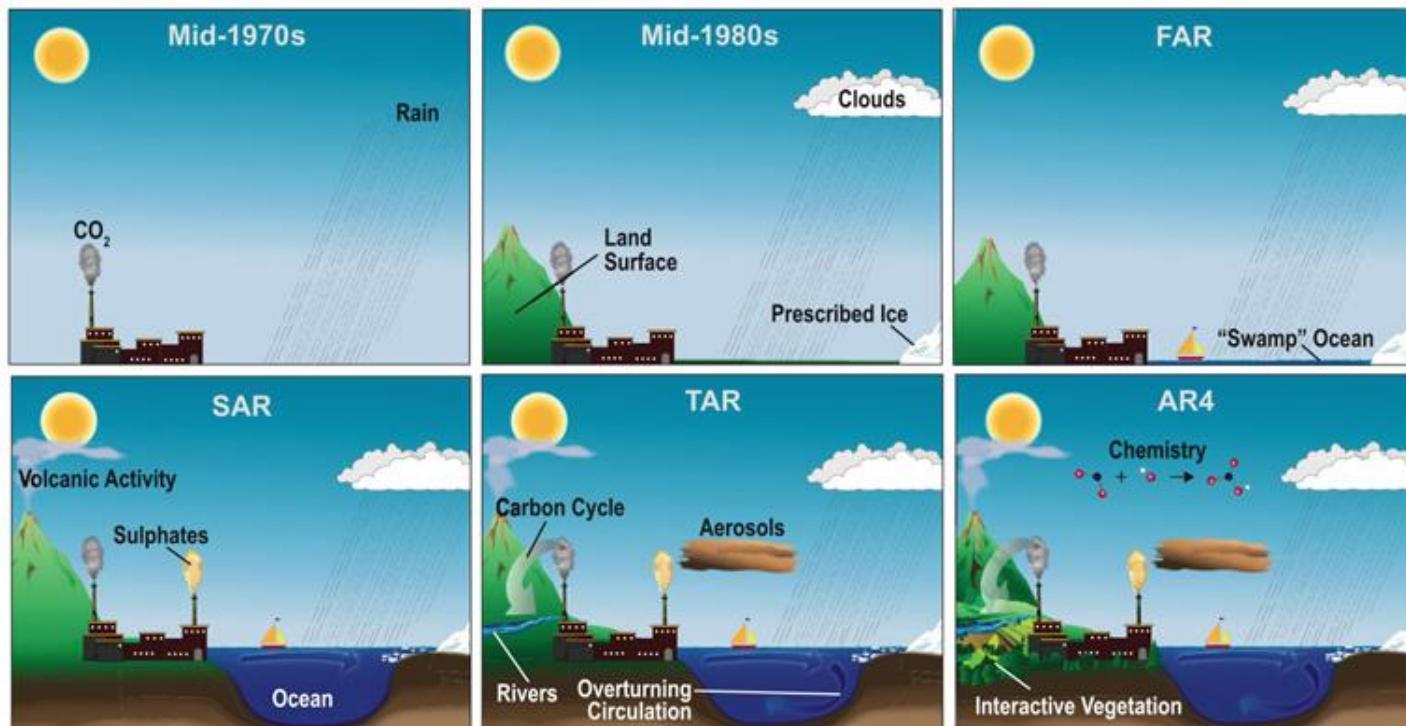
# Warmer SSTs = drier Horn?



# Growth of Climate Modeling



<https://www2.ucar.edu/>



<http://www.windows2universe.org>

# Tutorial reading



## Vulnerability variables

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Population-resource conditions  
Availability of food

Diversity of available, accessible food  
Health of food resources

Social conditions  
Connections

Storage  
Mobility

Equal access

Barriers to resource areas

# Conclusions



- El Niño Southern Oscillation (ENSO) is a major cause of inter-annual variability
- Can be the cause of drought
- Can be a contributing factor to food insecurity
- But many other factors define whether a particular area will be vulnerable or resilient to famine
- Uncertainties about future climate highlight the need for social and political responses now
- Next week: less about climate more about plants!