Famine: the Geography of Scarcity

Environmental Systems

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Where you are so far…

	Entitlement category	Famine theories	Famine paradigm
Malthus **Neo-Malthusians**	Production-based	'Food Availability Decline' (FAD) theories: • Climate (drought, flood, *El Niño*, global warming) • Environment (desertification, soil fertility decline) • Demography (Malthusianism)	*'Old famines': Failures of food supply ('pre-modern')*
Sen's entitlements approach	'Market-based' (trade, labour)	• Fragmented or missing markets • Market failure (speculation, hoarding) • Poverty • 'Exchange entitlement decline'	*1st shift: Failures of access to food ('modern')*
'New famines'	Transfer-based	• Accountability failures • Failure of informal safety nets • Food aid failure • 'Priority regimes'	*2nd shift: Failures of response ('post-modern')*

Devereux (2007) *The New Famines* p. 12

The ‘new famines’

“In the 21st century, it is not shocks to a food system, but failures to respond to such shocks, that need to be explained.

The question is no longer: ‘What caused the food shortage?’ (drought, poverty, market failure, war?), but why did the food shortage become a famine?’ or – more politically – ‘Who allowed the famine to happen?’ or even ‘Who made it happen?’ (government, militia, aid agencies?).

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

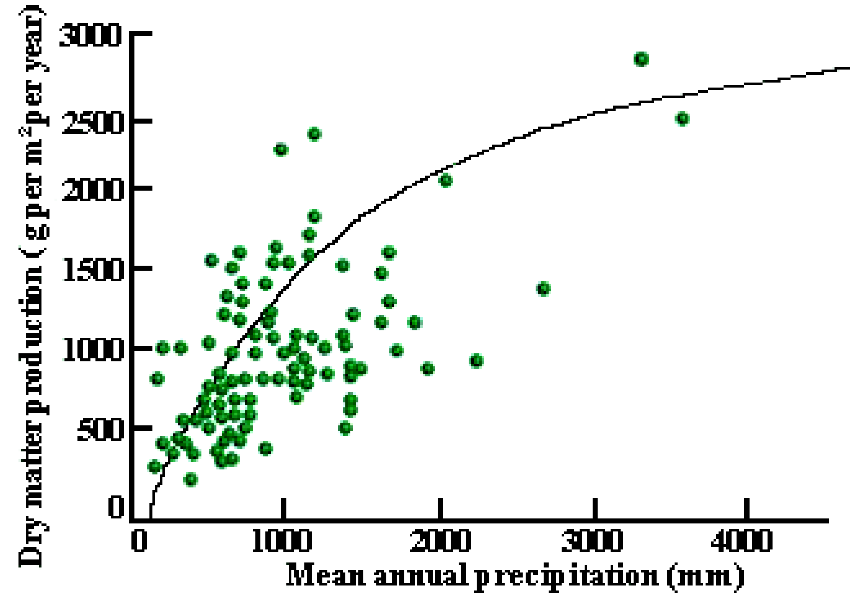
Years	Location (epicentre)	Excess mortality	Causal triggers
1903-06	Nigeria (Hausaland)	5,000	Drought
1906-07	Tanzania (south)	37,500	Conflict
1913-14	West Africa (Sahel)	125,000	Drought
1917-19	Tanzania (central)	30,000	Conflict & Drought
1920-21	China (Gansu, Shaanxi)	500,000	Drought
1921-22	**Soviet Union**	**9,000,000**	**Drought & Conflict**
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	**Soviet Union**	**2,000,000**	**Drought & Government policy**
1957-58	Ethiopia (Tigray)	100,000-397,000	Drought & Locusts
1958-62	**China**	**30,000,000-33,000,000**	**Government policy**
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	**Bangladesh**	**1,500,000**	**Flood & Market failure**
1979	**Cambodia**	**1,500,000-2,000,000**	**Conflict**
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	**North Korea**	**2,800,000-3,500,000**	**Flood & Government policy**
1998	Sudan (Bahr el Ghazal)	70,000	Conflict & Drought

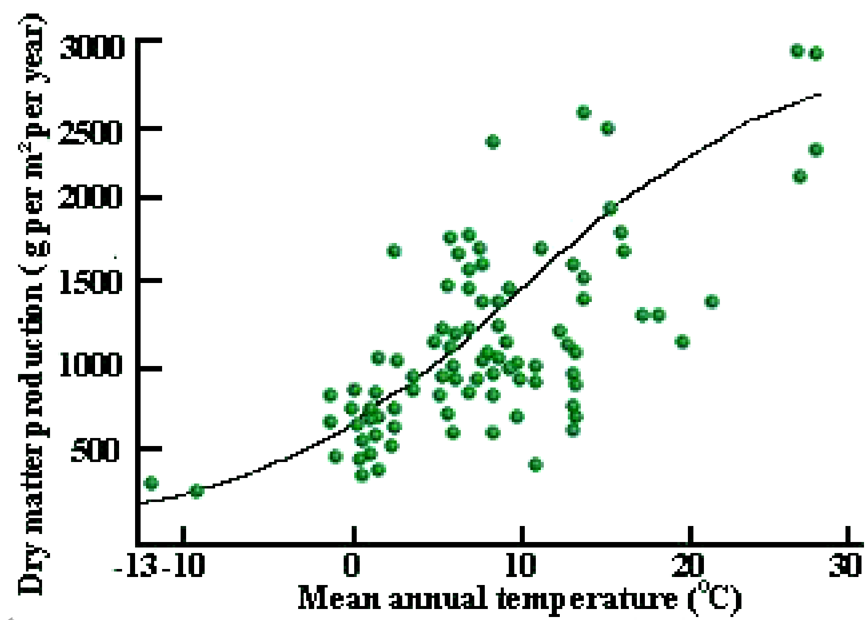
[Devereux 2000]


Does climate play a
role in famine?

Climate and food

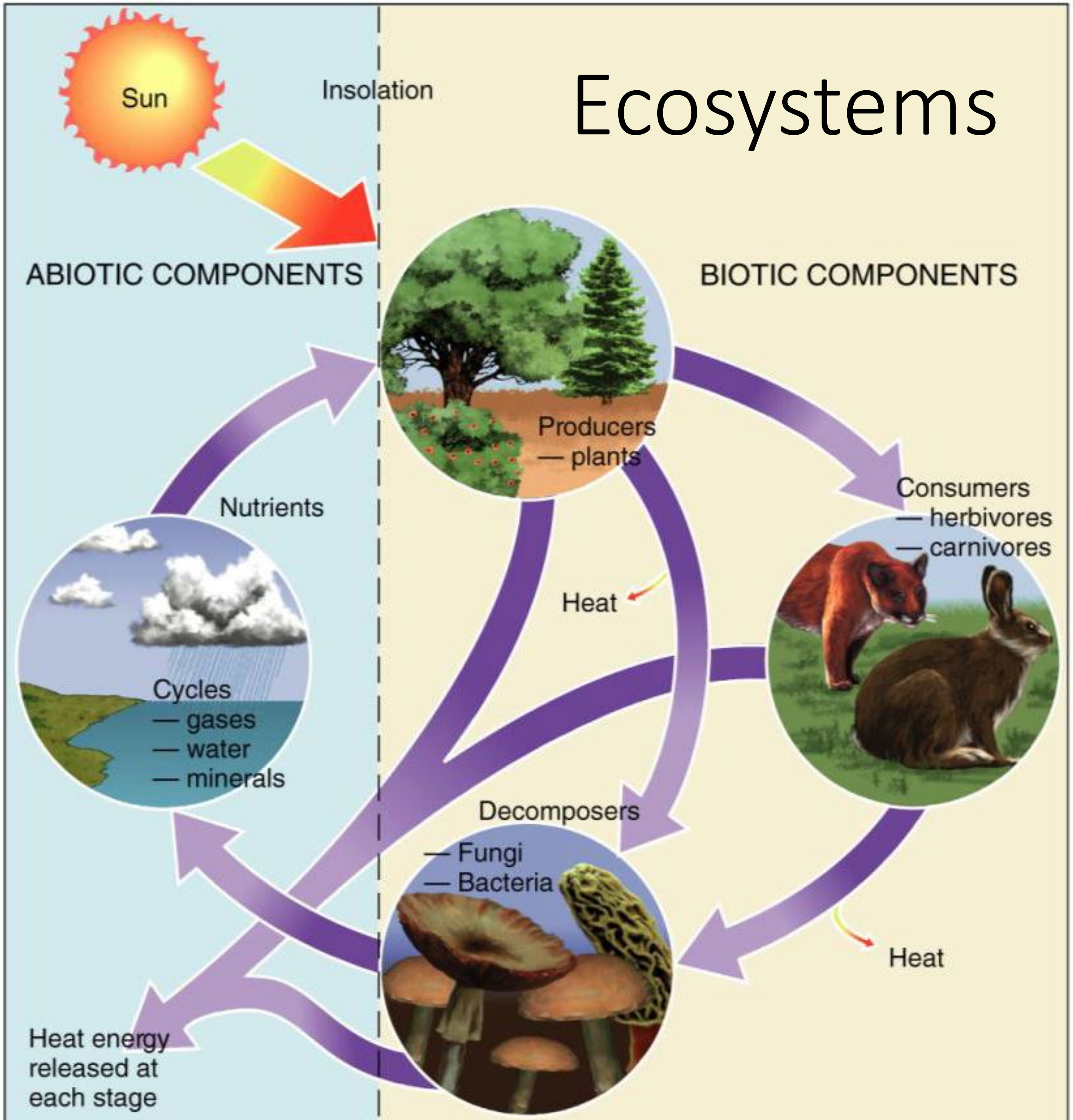
- Primary Production (PP) is intimately linked to climate:
  - PP generally increases with temperature and precipitation
- In terms of food security, it is **variability** in PP from year to year that can be critical





Lieth (1972) Human Ecology, vol. 1

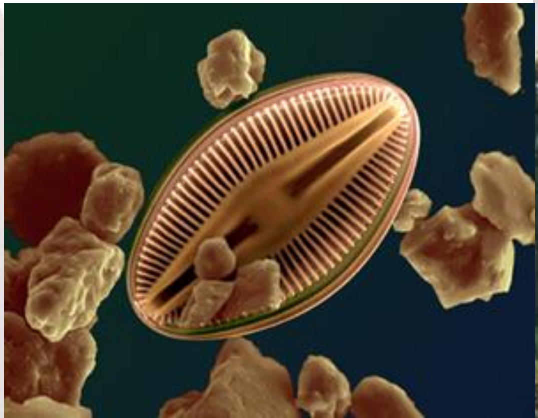
Ecosystems



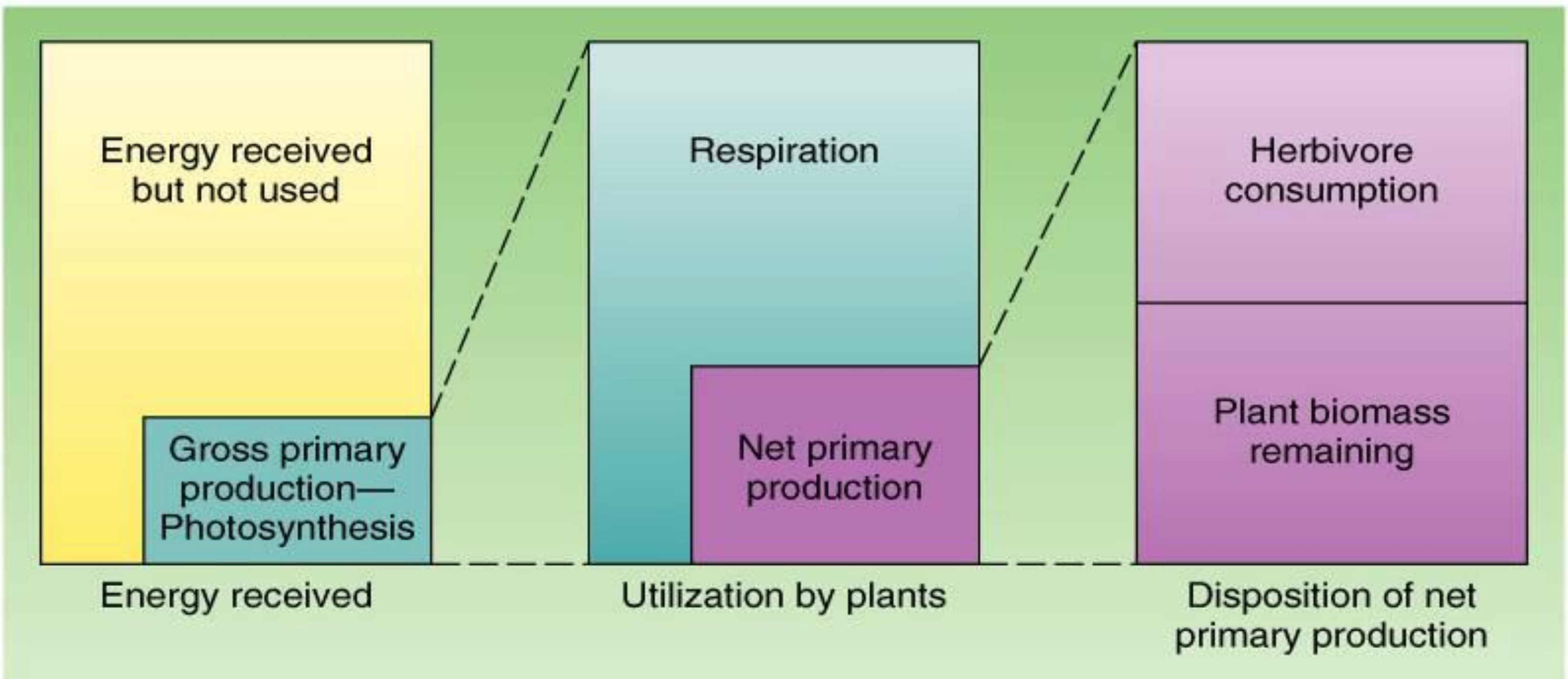
Include omnivores like us humans

Why are plants important?

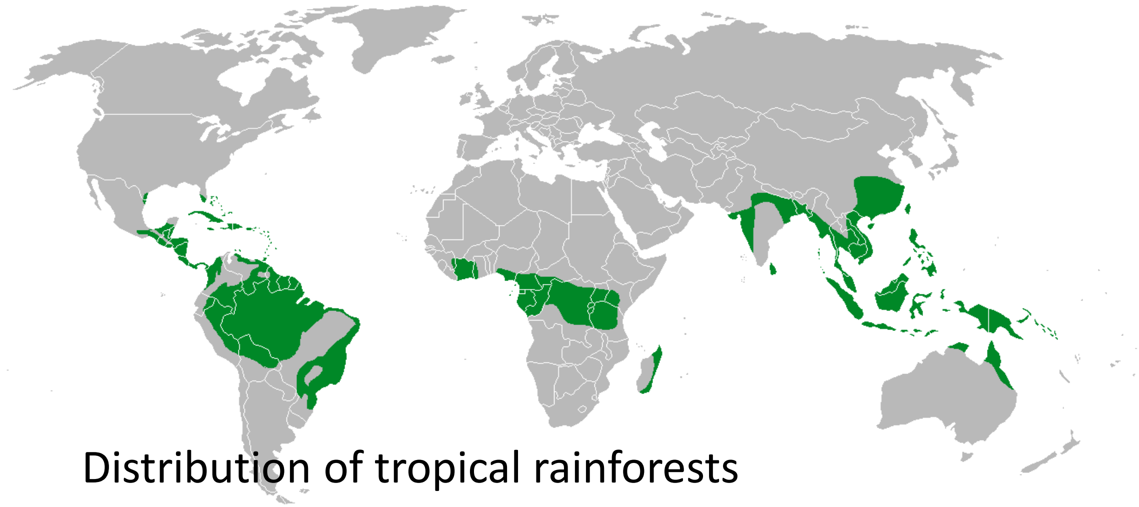
- Plants are the basis of almost every ecosystem on Earth
- Plants have the **unique** capacity to convert the sun's energy into food for other organisms = photosynthesis



Primary production

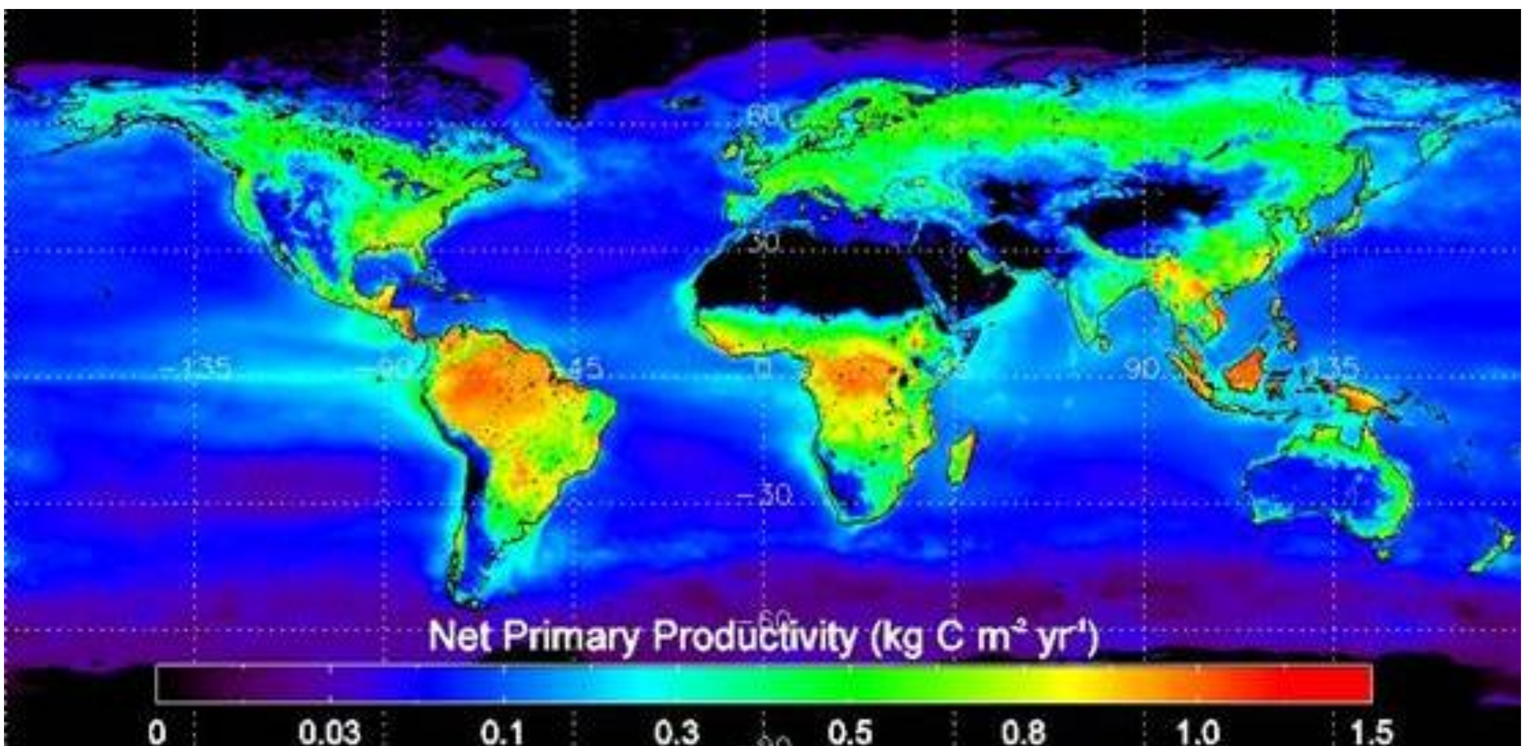


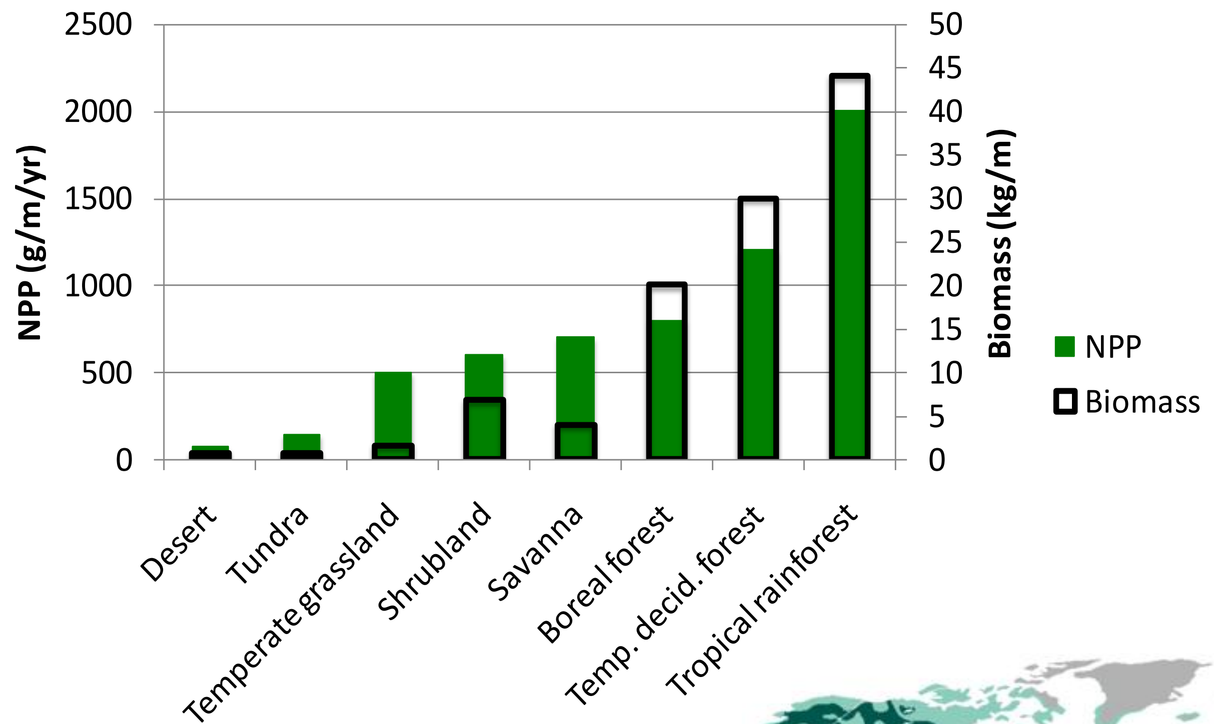
Net Primary



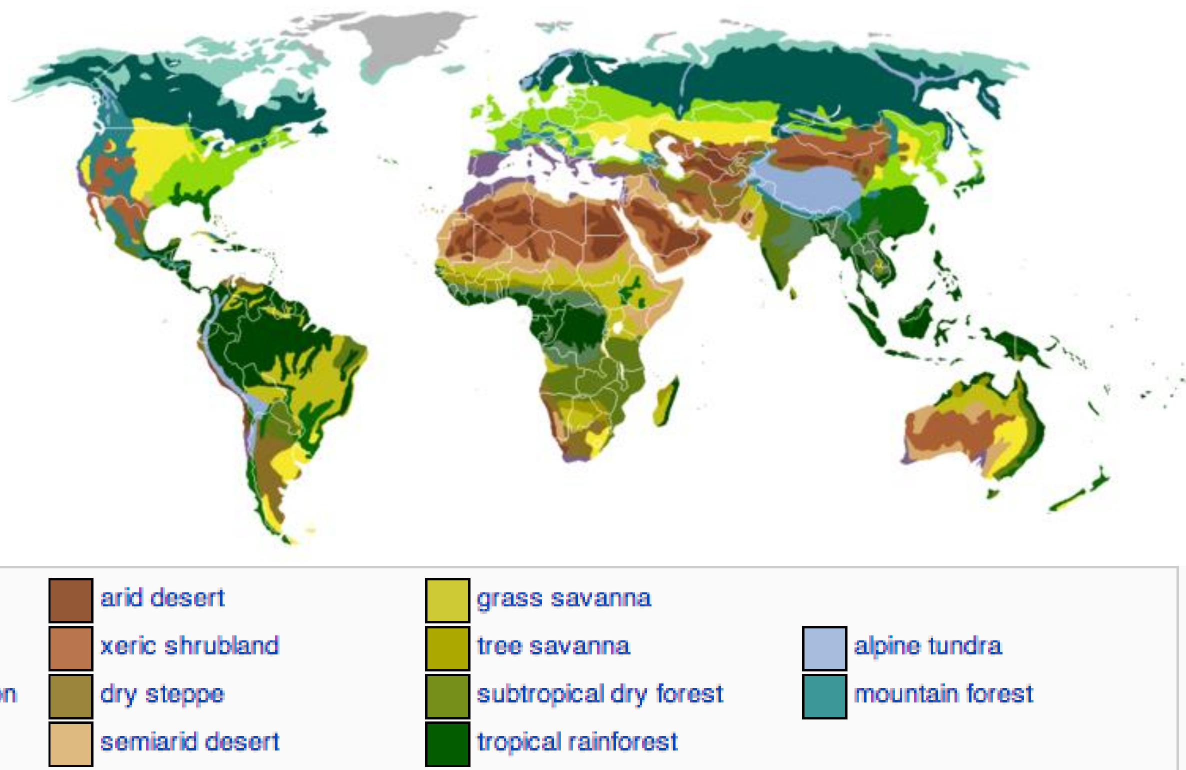
Distribution of tropical rainforests

- NPP = P_G – R
- Products of photosynthesis minus losses to respiration – available to other organisms





Zones with high climatic variability are more susceptible to climate-induced food insecurity



NPP and solar radiation

- http://earthobservatory.nasa.gov/GlobalMaps/view.php?d1=MOD17A2_M_PSN&d2=CERES_NETFLUX_M

- Other factors apart from solar radiation are also important controls on NPP:
  - Soils and landscape processes
  - Human land use
  - Species and ecosystems
  - Disturbances such as fire
  - Climate – from microclimate to macroclimate

Climate and landscape processes

- Climate shapes the landscape, particularly through the action of water and wind, and its influence on soil formation processes and erosion

- Climate therefore indirectly affects plant growth through its control on, for example, soil fertility, moisture-holding capacity and degradation

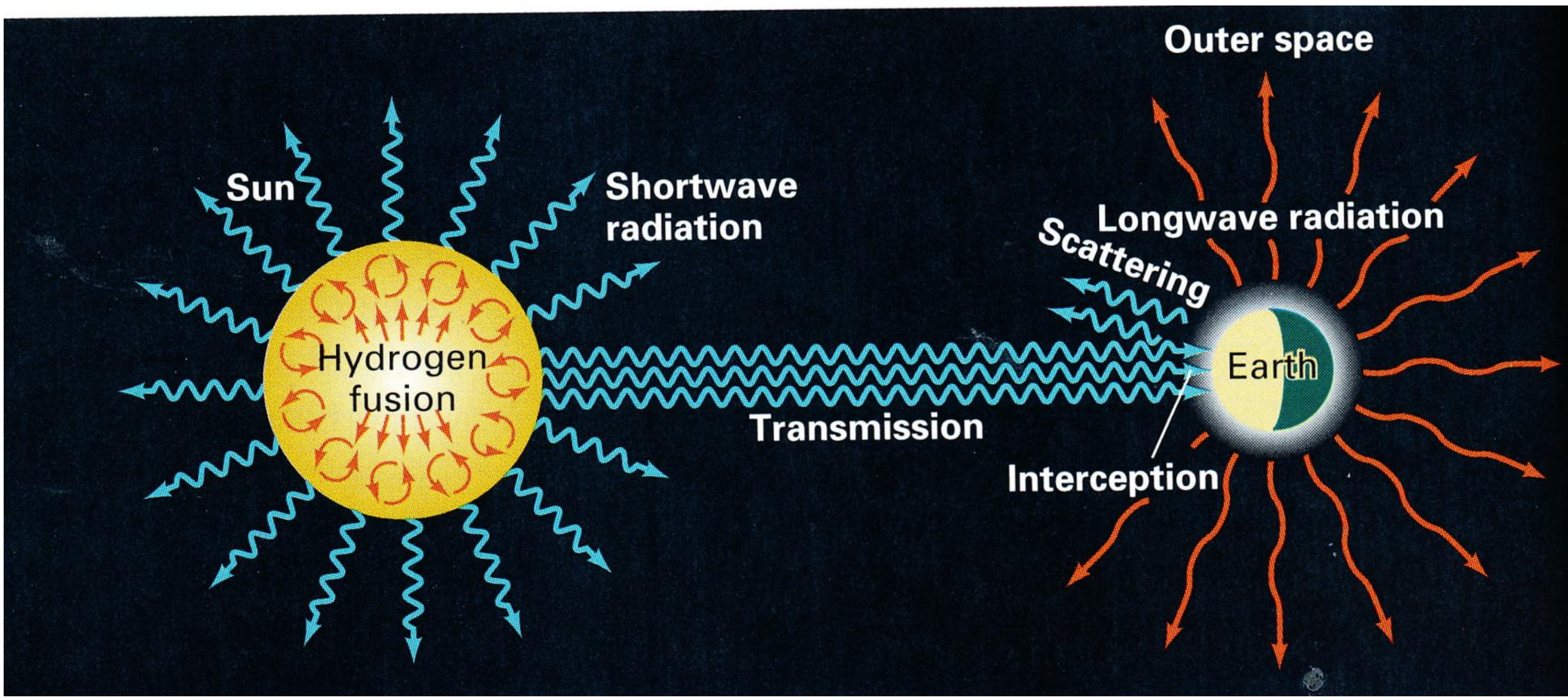
Climate and food security

- Why are some areas of the globe susceptible to drought (that might lead to famine)?

- To address this we need to consider:
  - the global energy balance
  - general circulation
  - global patterns of temperature and precipitation
  - climate variability

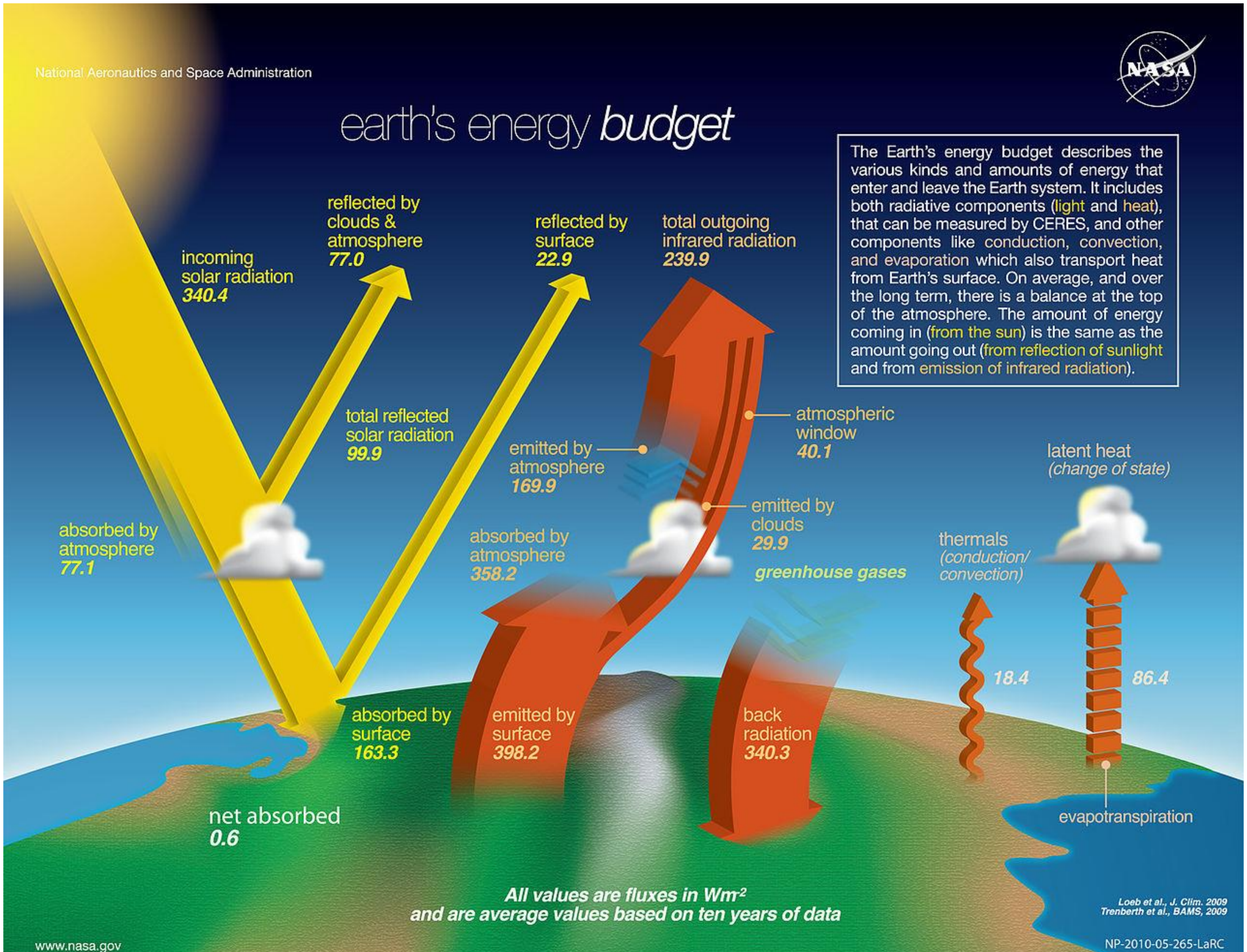
(I am assuming that none of you have any background in this area… my apologies if you do!)

The Sun: engine of the climate system



From Strahler & Strahler (2002) Physical Geography

The Earth’s energy balance

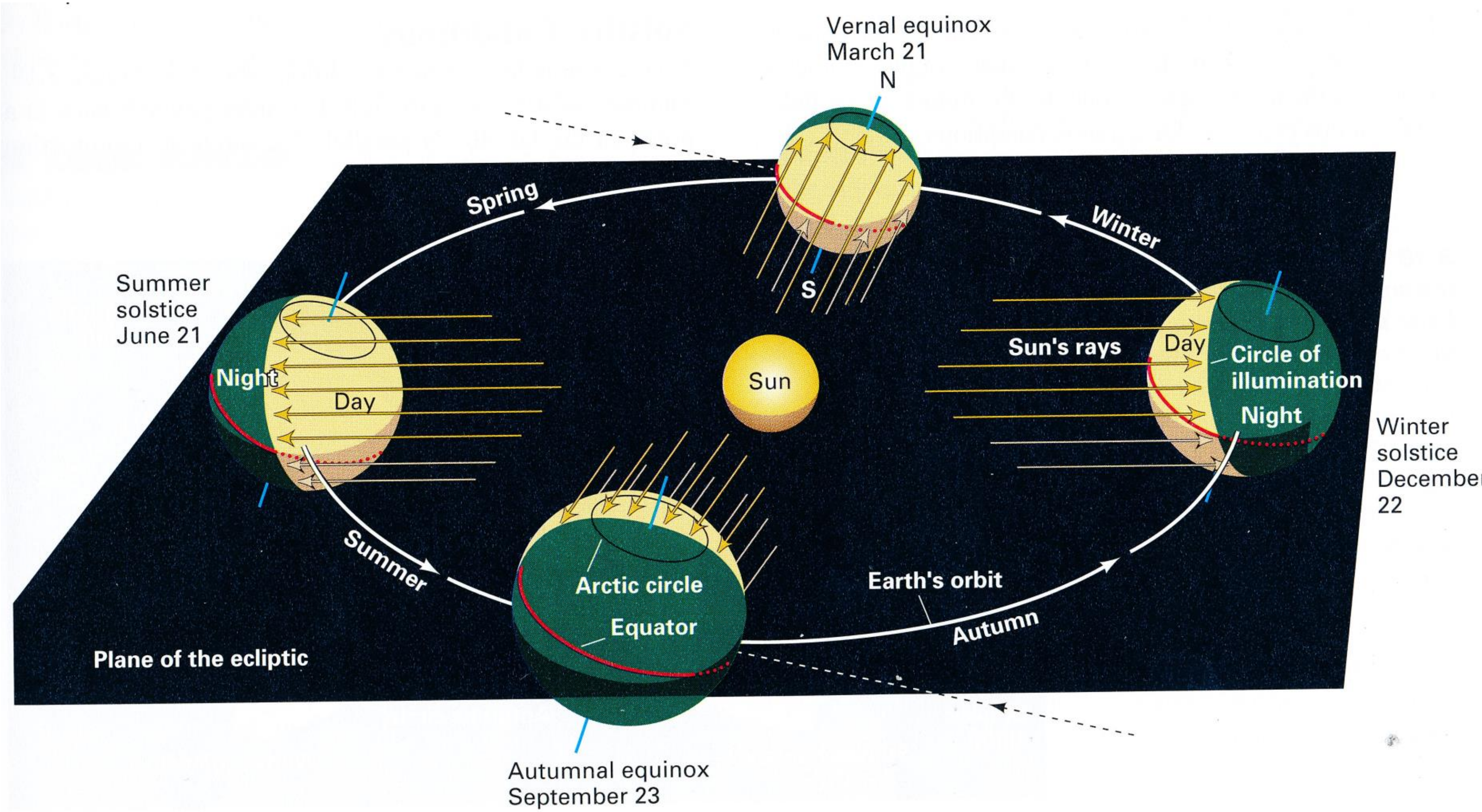


The global scale

- At the global scale, there are temporal and spatial variations in incoming radiation:
  - these ‘imbalances’ drive atmospheric and ocean circulation which redistributes heat and moisture globally
  - as a result, rainfall in some regions makes it marginal to grow food

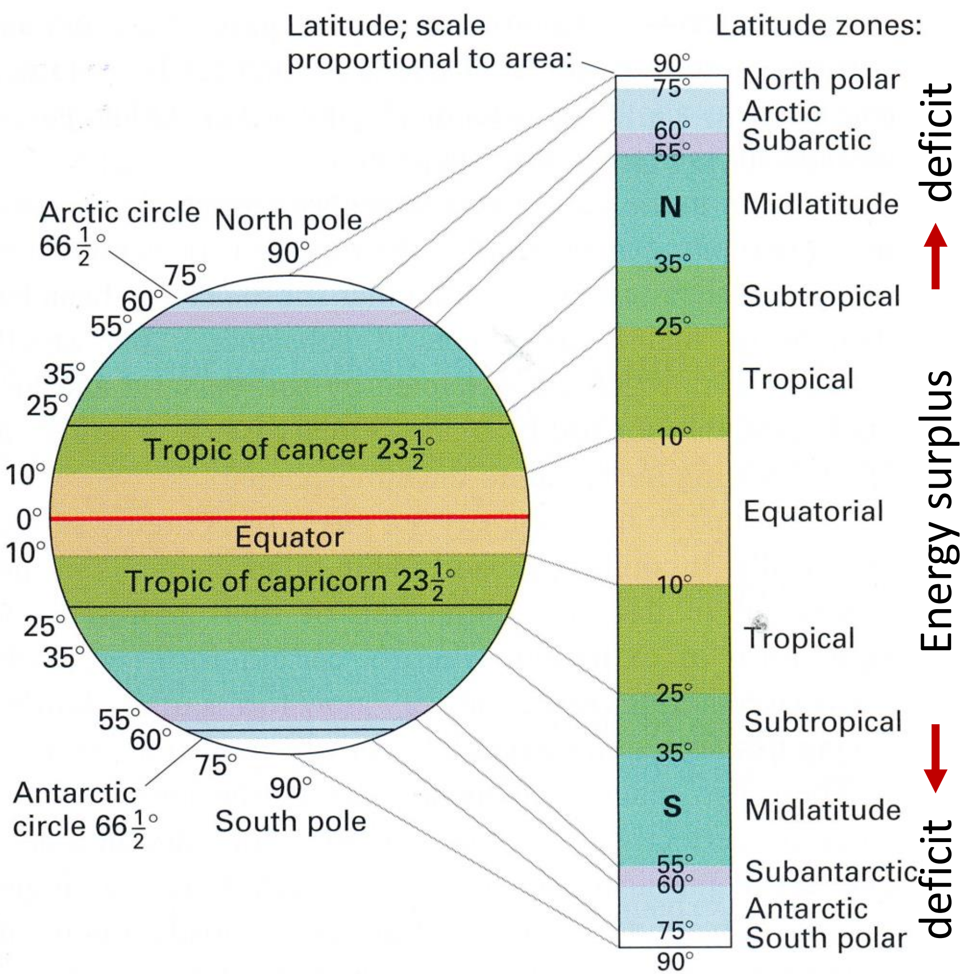
These ‘marginal’ regions are often where famines occur

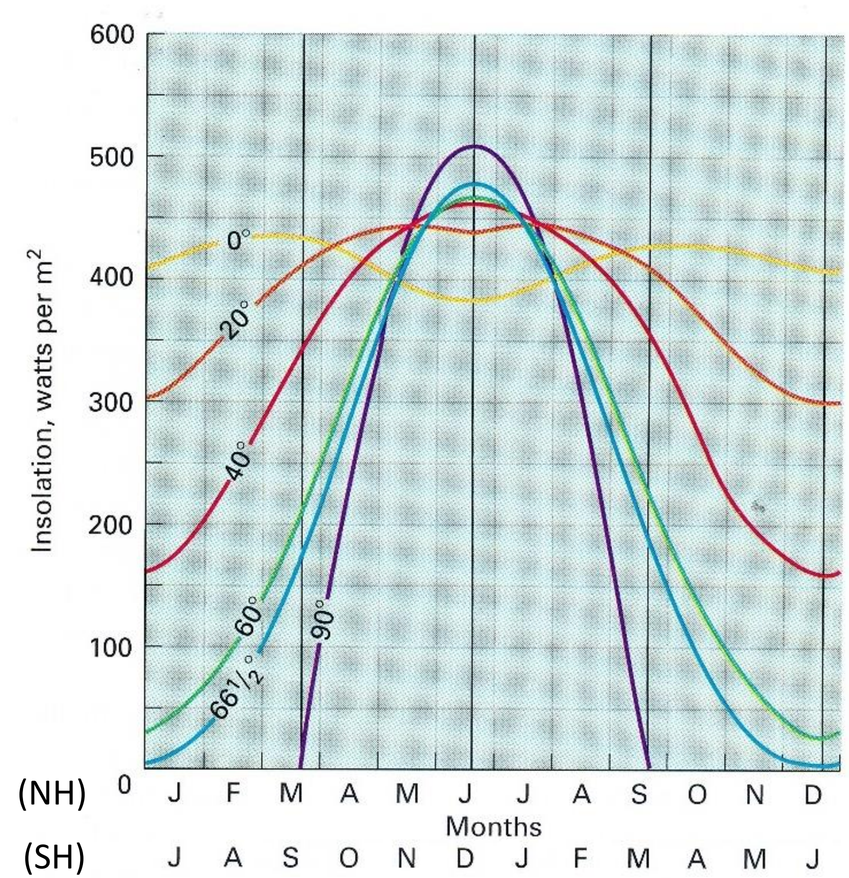
Temporal gradients: diurnal and seasonal variations



From Strahler & Strahler (2002) Physical Geography

Spatial gradients: latitudinal effects on incoming radiation

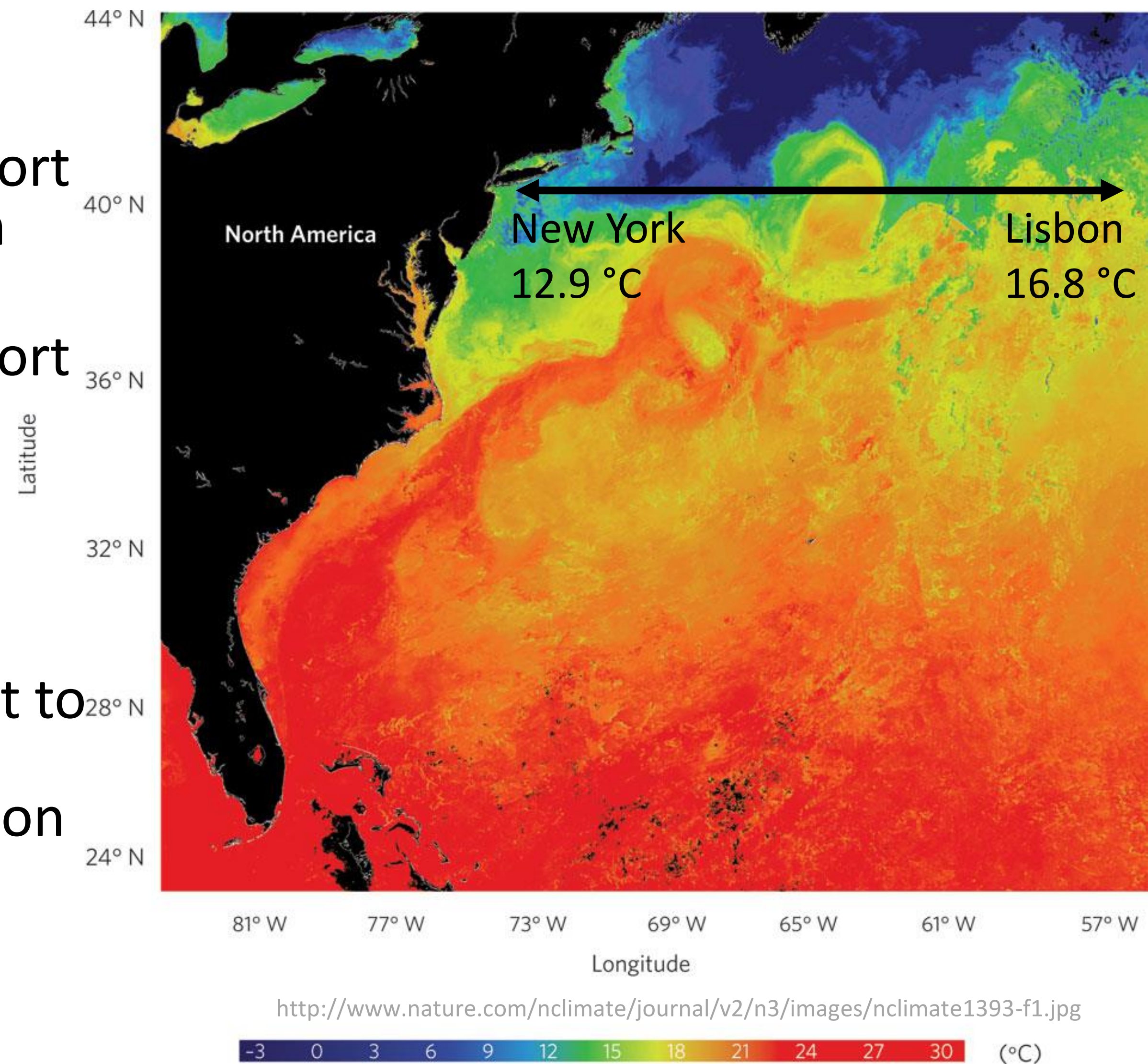




From Strahler & Strahler (2002) Physical Geography

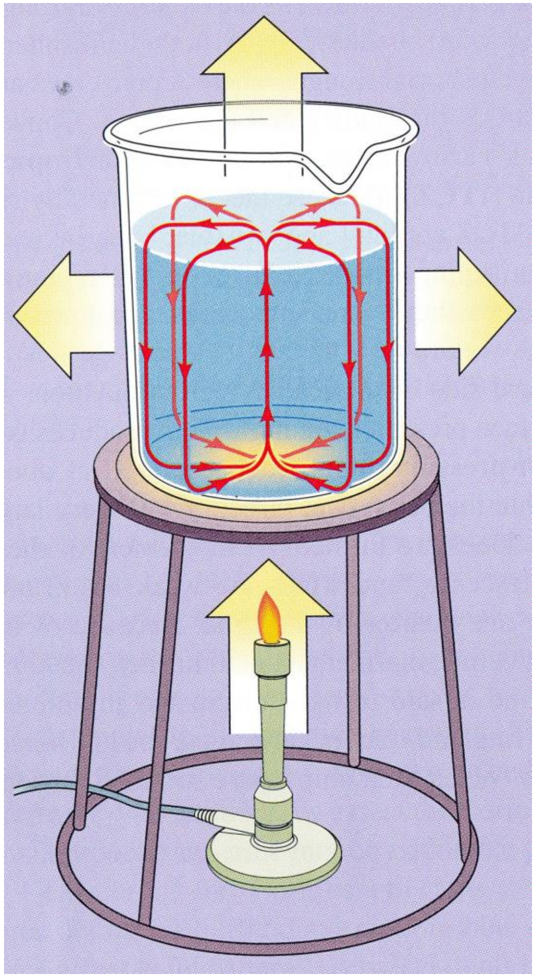
How is heat redistributed?

- Sensible heat
  - Poleward transport of heat by ocean currents
  - Poleward transport of heat via atmospheric circulation
- Latent heat
  - Transport of heat to the atmosphere due to evaporation from the oceans

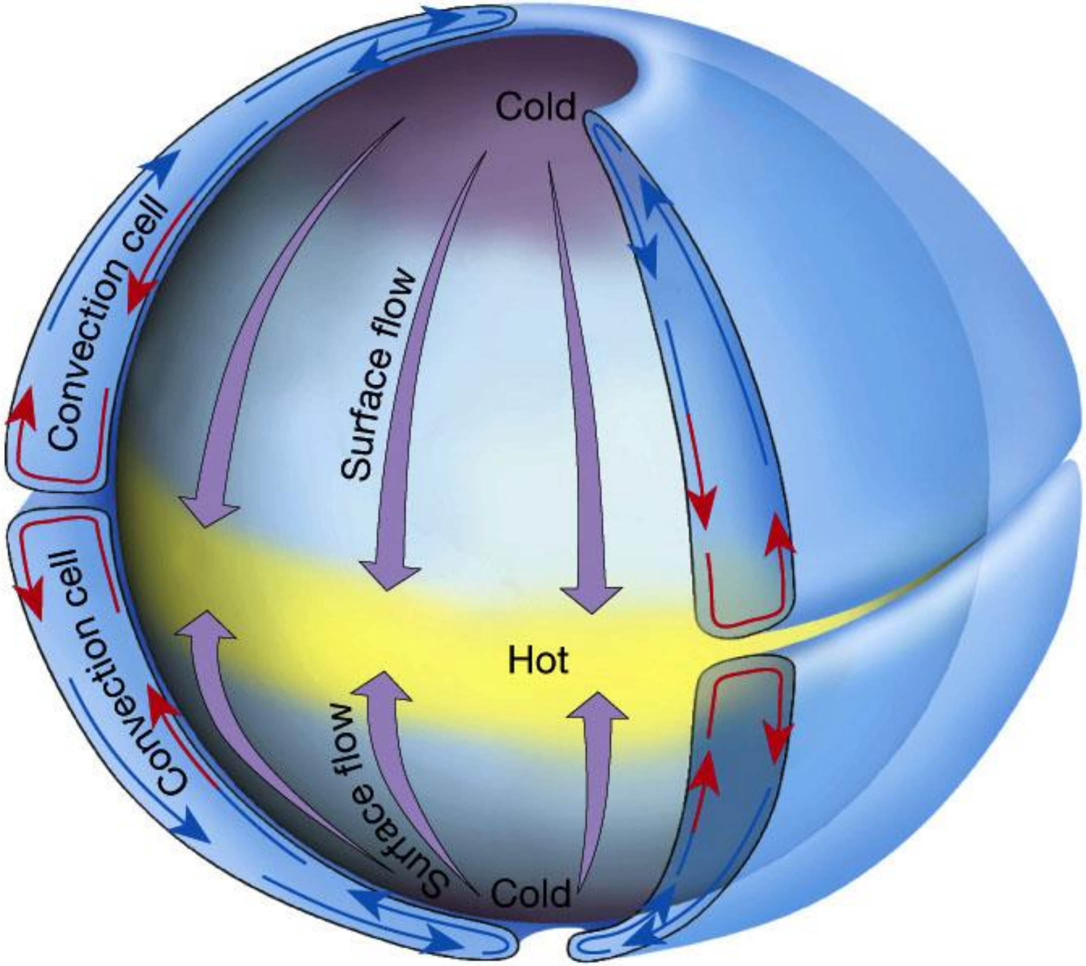


http://www.nature.com/nclimate/journal/v2/n3/images/nclimate1393-f1.jpg

Large-scale atmospheric circulation



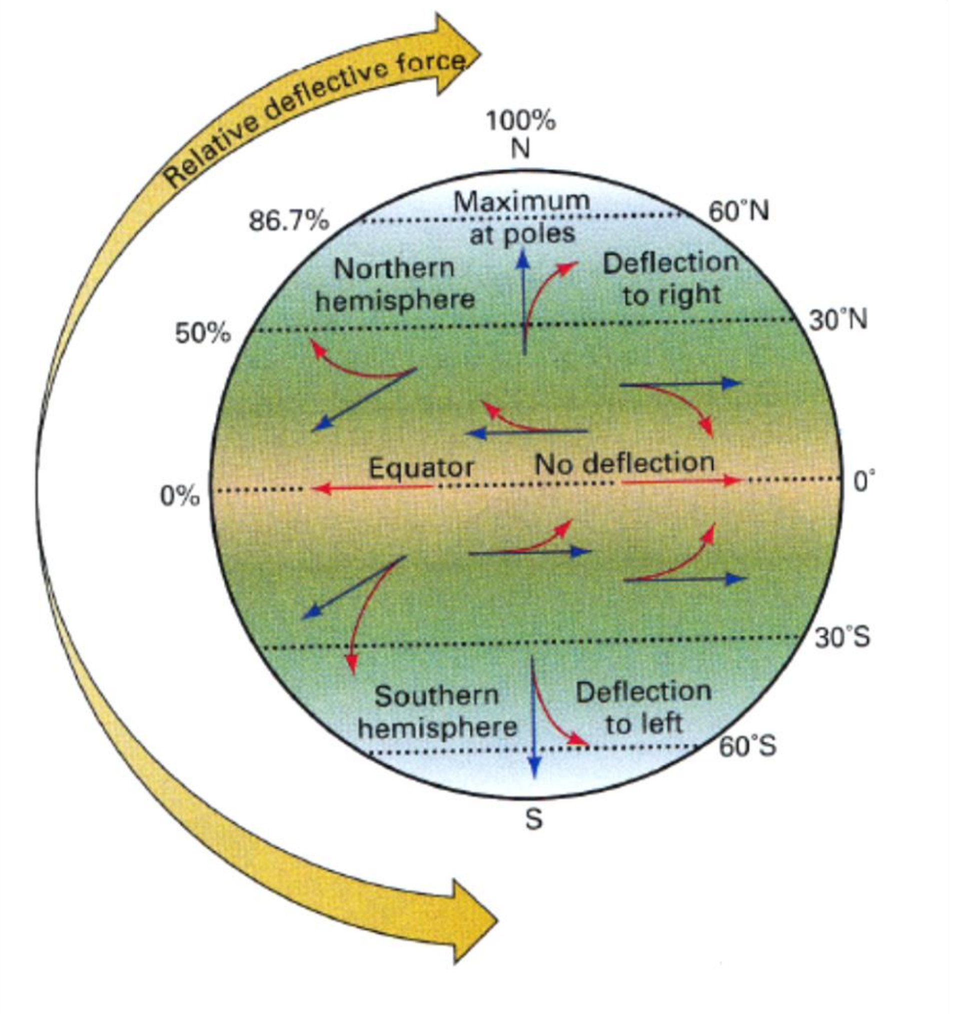
Strahler & Strahler (2002)
Physical Geography

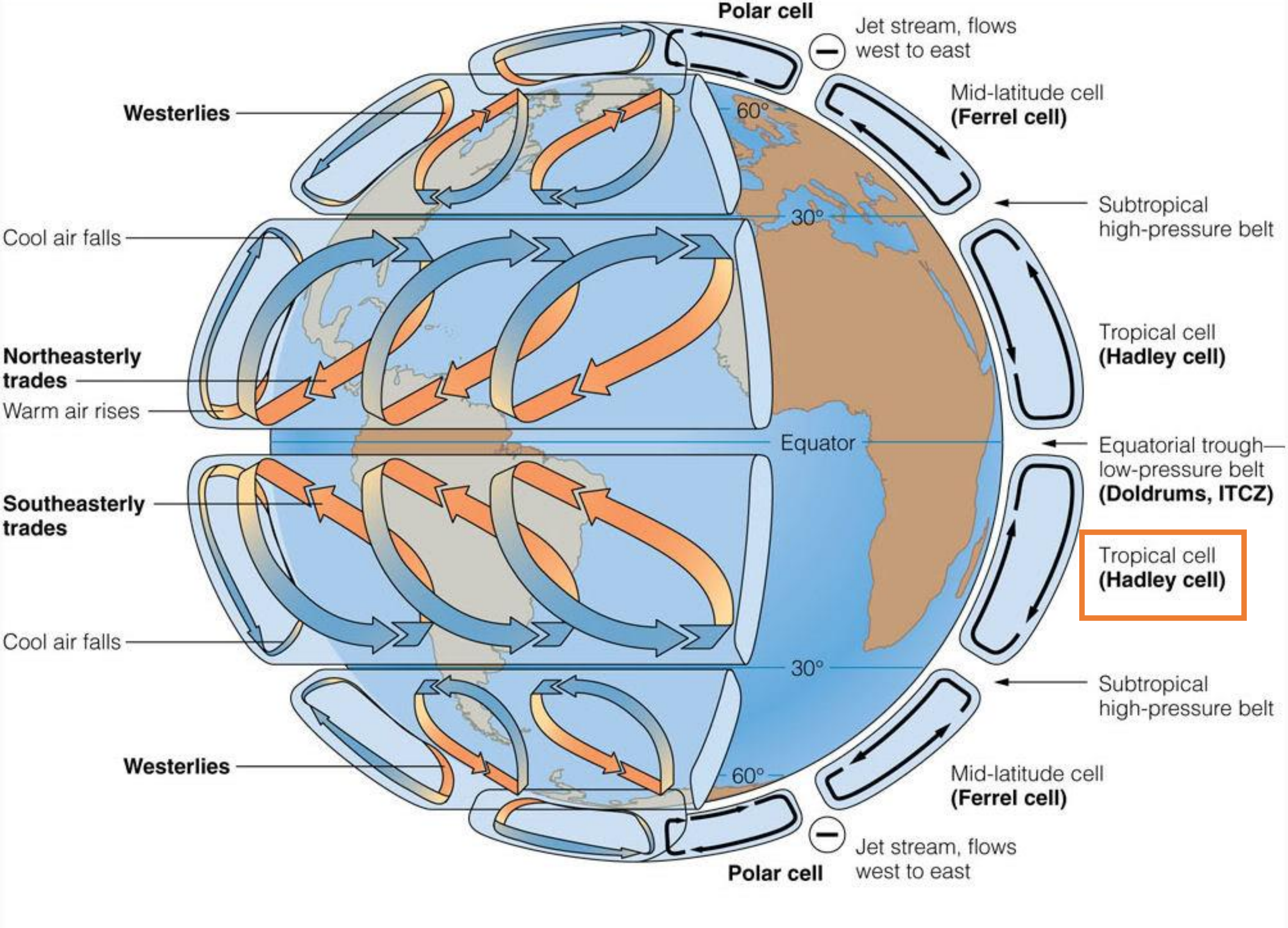


www. http://www.ux1.eiu.edu/~cfjps/1400/circulation.html

But the Earth is spinning…

- [The Coriolis Effect]()
- Deflects air streams to the right of the pressure gradient in the Northern Hemisphere
- …and to the left in Southern Hemisphere
- Air circulation really circulates

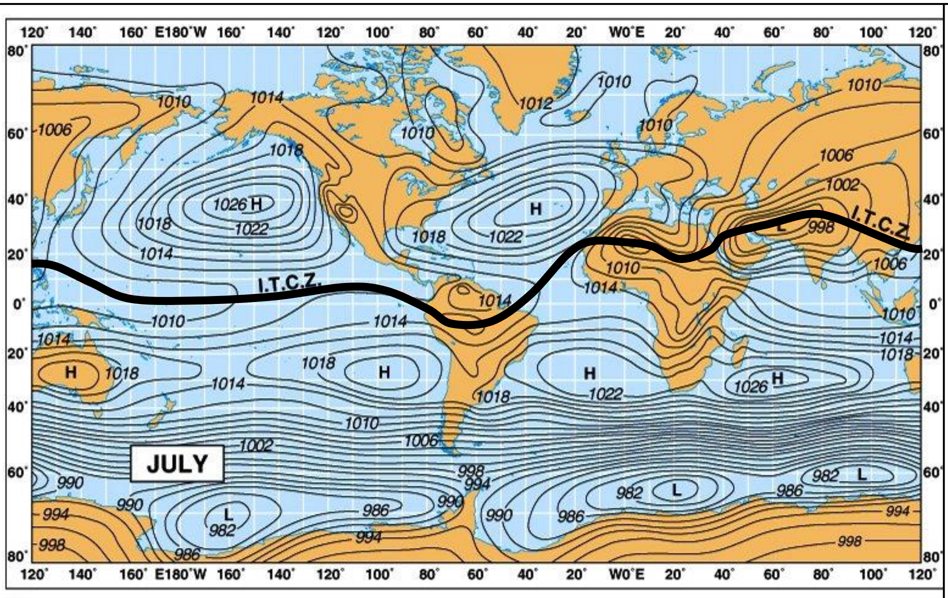


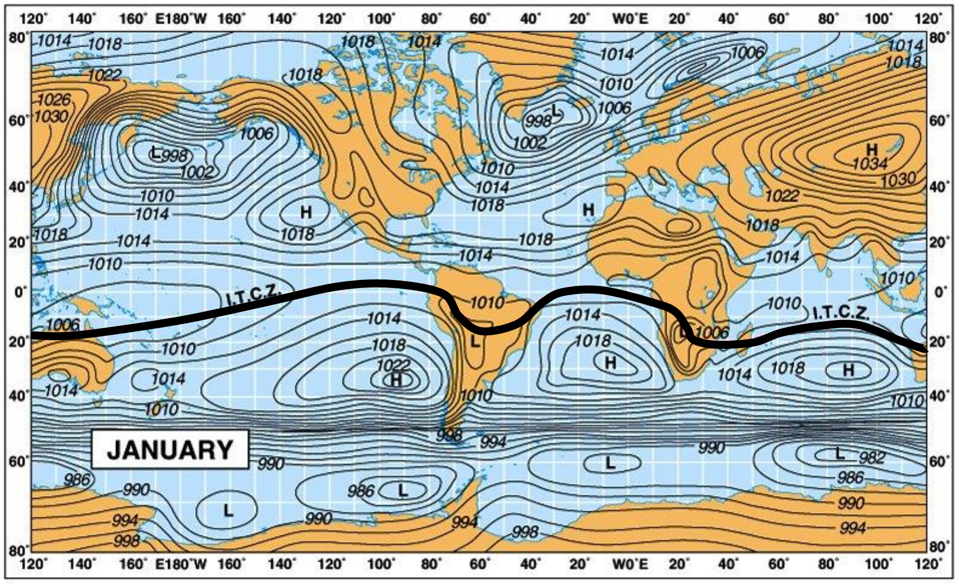

Polar cell
Jet stream, flows west to east
60°
Mid-latitude cell
(Ferrel cell)
Westerlies
Subtropical high-pressure belt
30°
Cool air falls
Tropical cell
(Hadley cell)
Northeasterly trades
Warm air rises
Equator
Equatorial trough—low-pressure belt
(Doldrums, ITCZ)
Southeasterly trades
Tropical cell
(Hadley cell)
Cool air falls
30°
Subtropical high-pressure belt
Westerlies
60°
Mid-latitude cell
(Ferrel cell)
Jet stream, flows west to east
Polar cell

Hadley Cells

- https://www.youtube.com/watch?v=T6Us1sPXBfA
- The descending arm of the Hadley Cell is moisture-depleted – as it warms, it literally sucks the moisture out of desert regions
- Seasonal movements in the position of the Intertropical Convergence Zone (**ITCZ** or 'doldrums') affect rainfall in desert margin regions

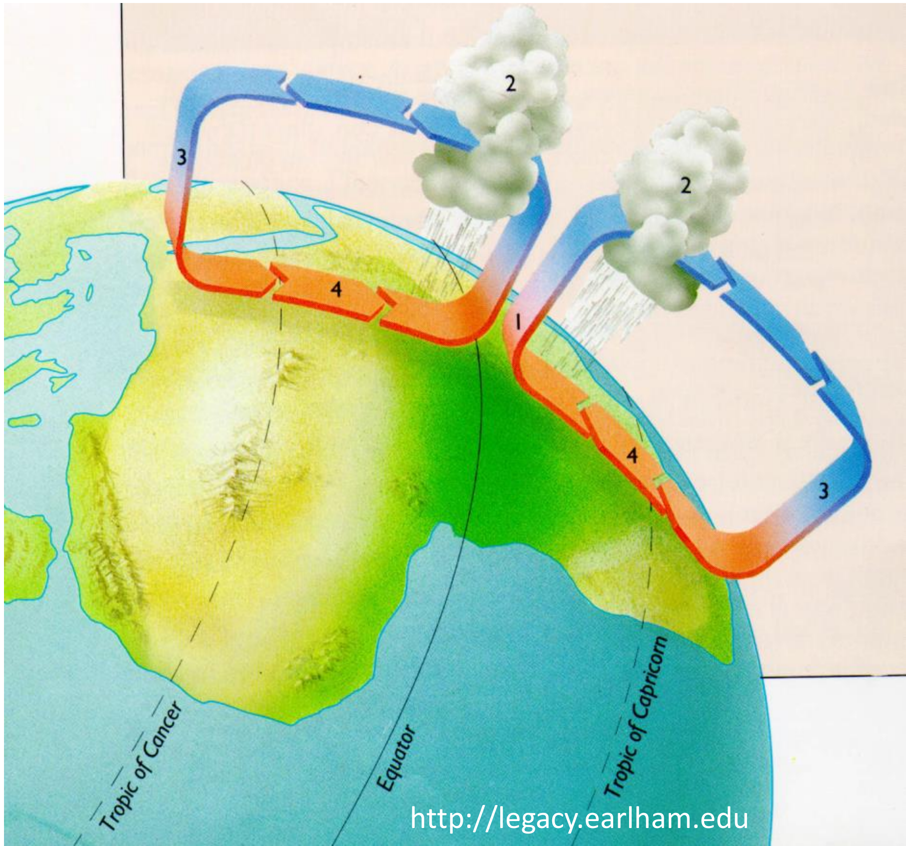
From: http://www.sci.uidaho.edu/scripter/geog100/



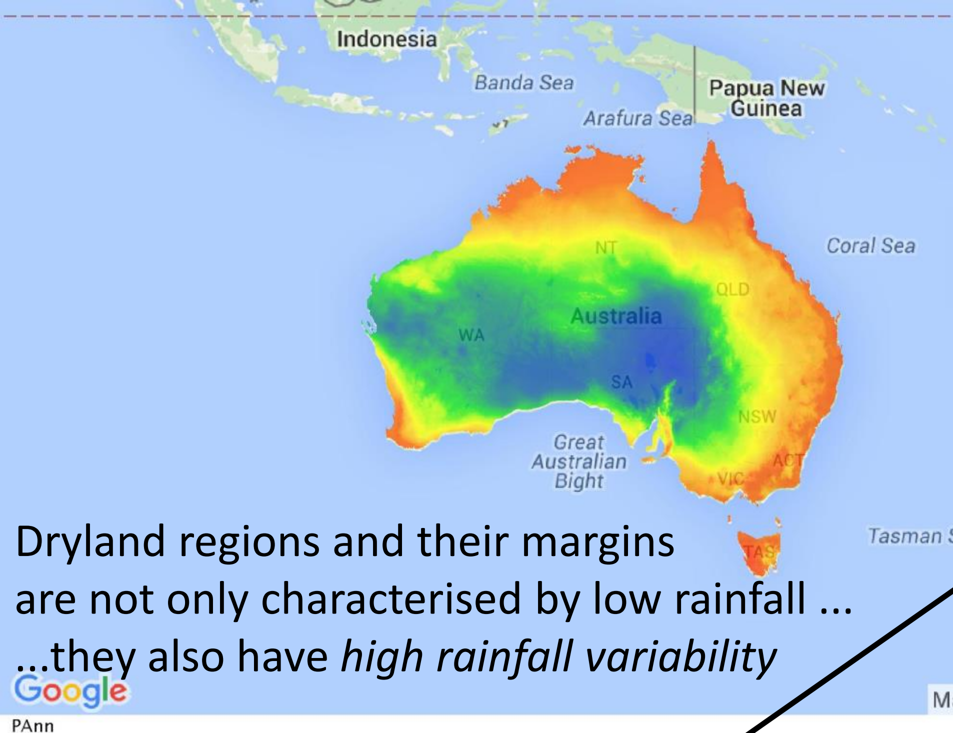


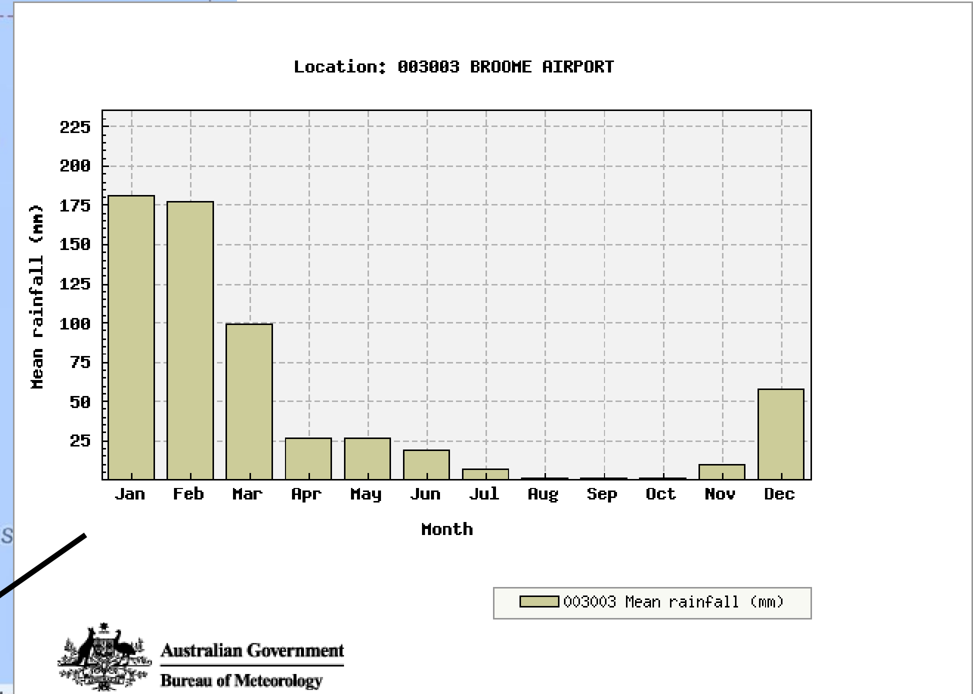
Seasonal precipitation change

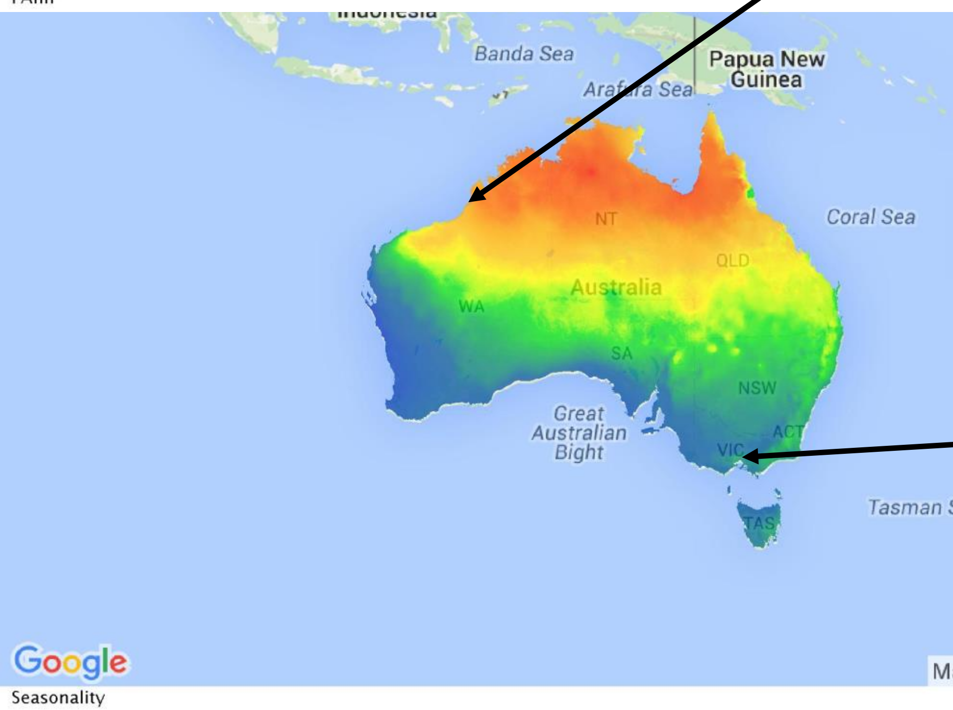
- http://earthobservatory.nasa.gov/GlobalMaps/view.php?d1=MOD17A2_M_PSN&d2=TRMM_3B43M

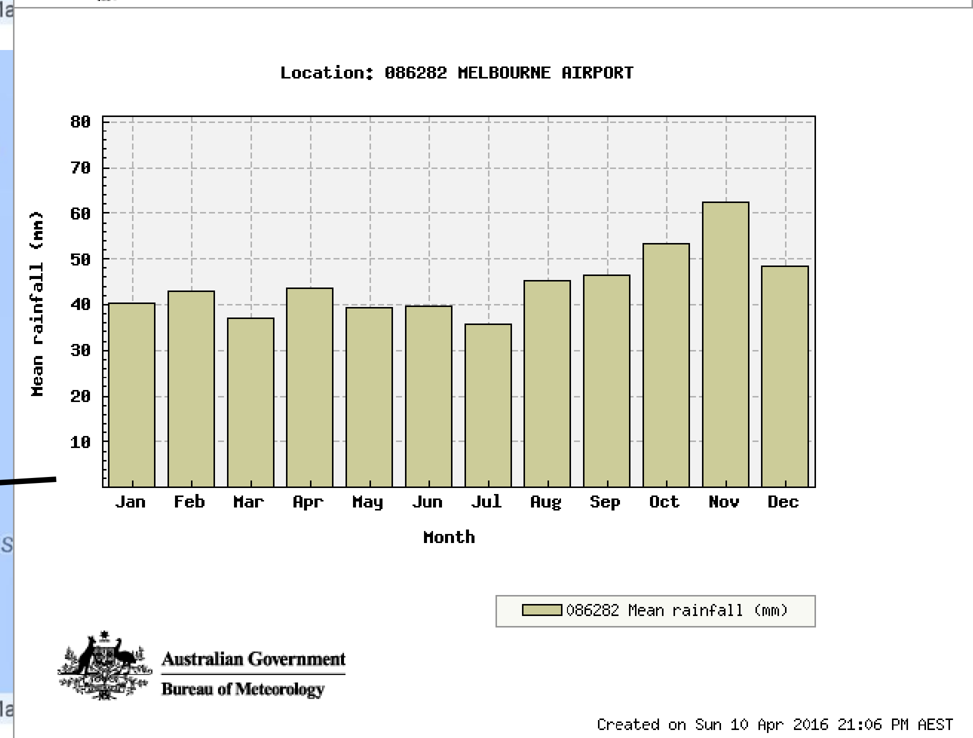


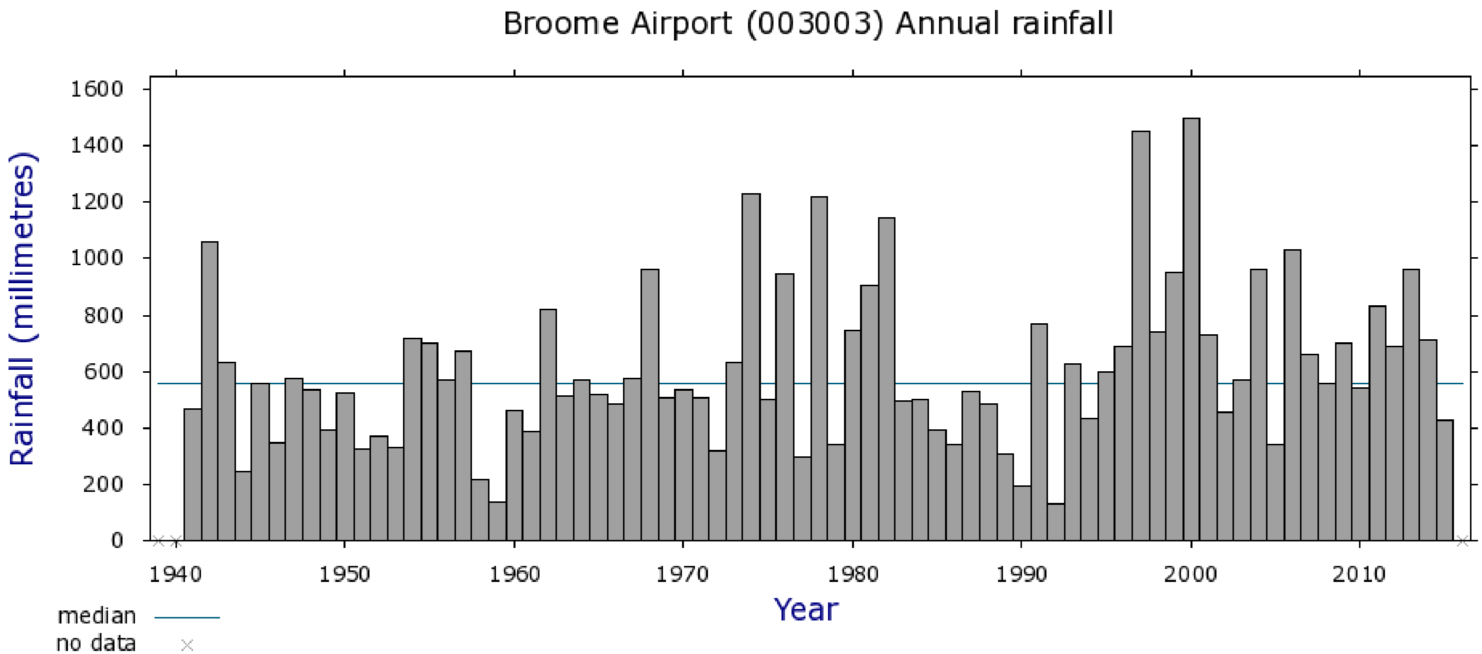
Dryland regions and their margins are not only characterised by low rainfall ...
...they also have *high rainfall variability*

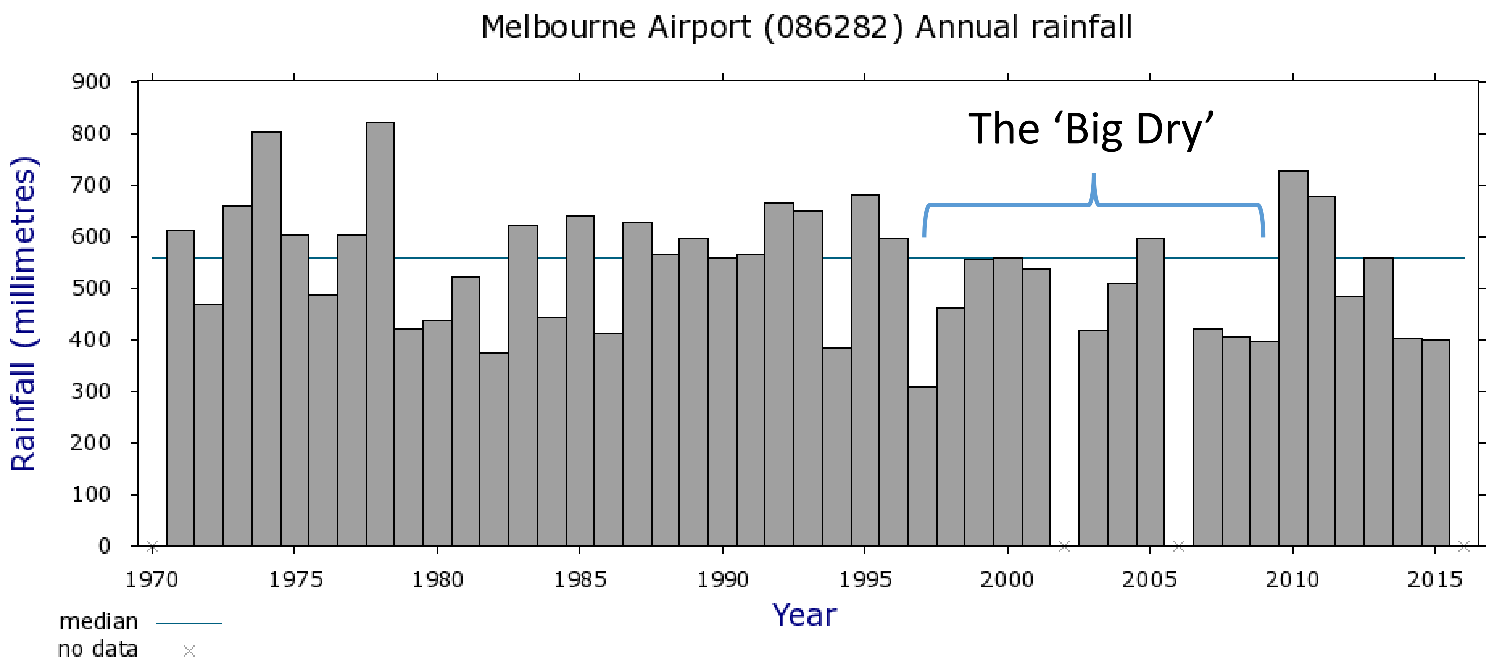


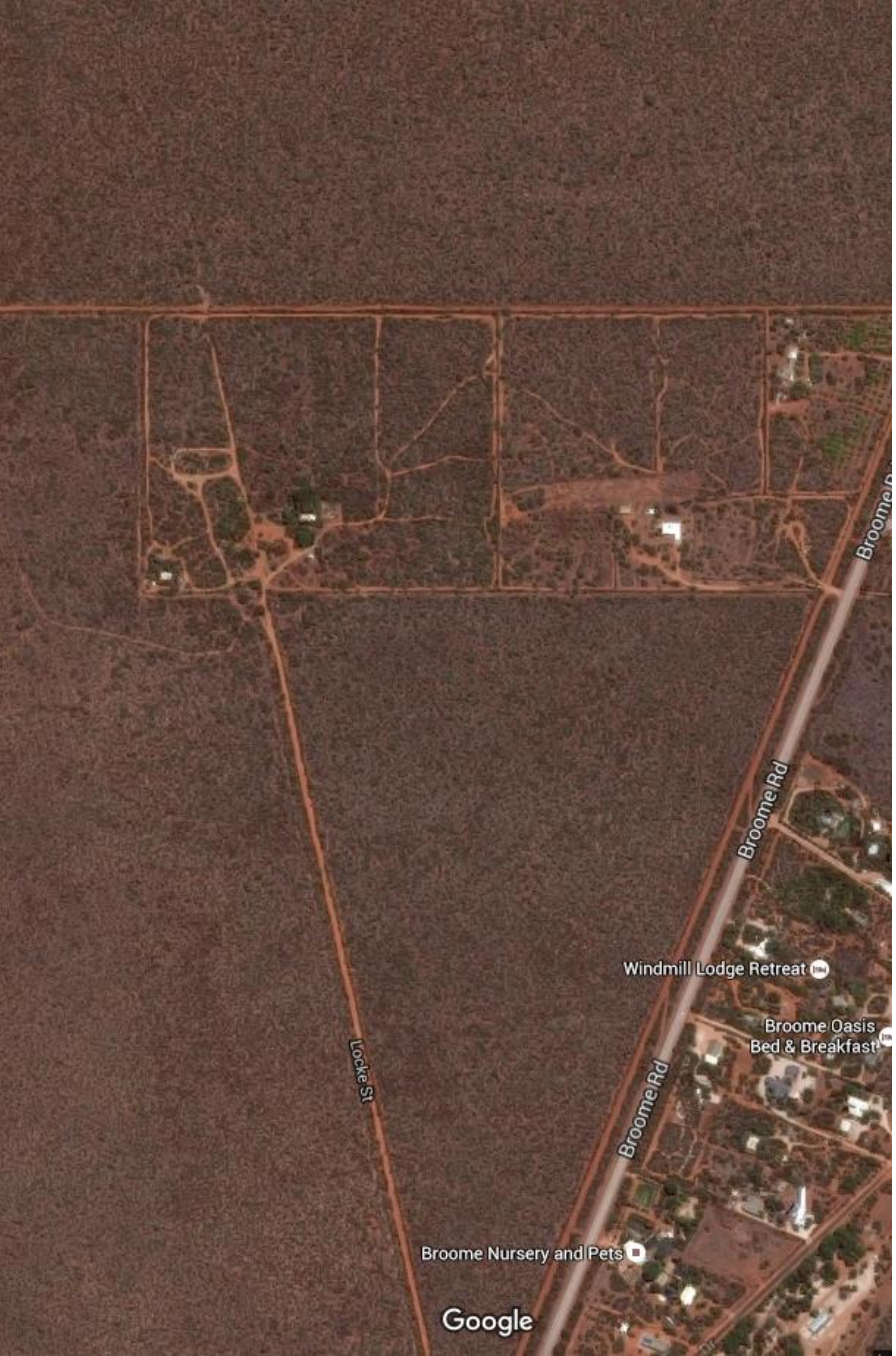






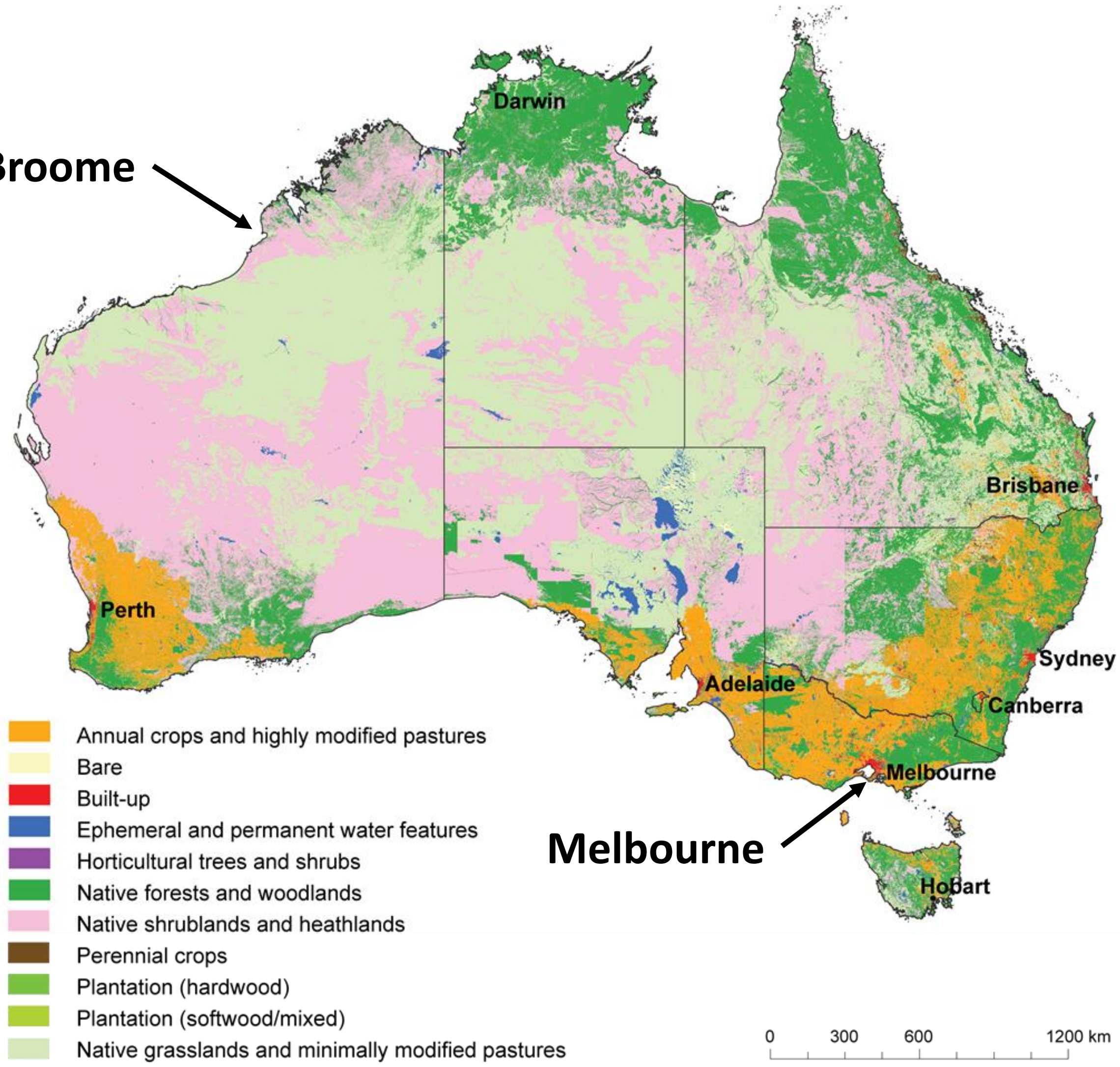

Broome Airport (003003) Annual rainfall
Rainfall (millimetres)
1600
1400
1200
1000
800
600
400
200
0
1940
1950
1960
1970
1980
1990
2000
2010
Year
median
no data


Melbourne Airport (086282) Annual rainfall
The 'Big Dry'
Rainfall (millimetres)
900
800
700
600
500
400
300
200
100
0
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
Year
median
no data


Broome Rd
Broome Rd
Broome Rd
Locke St
Windmill Lodge Retreat
Broome Oasis
Bed & Breakfast
Broome Nursery and Pets
Google

Werribee Park National
Equestrian Centre
K Rd
11
11
Vic State
Rose Garden
Wyndham Cache
Google

Impacts depend on land use

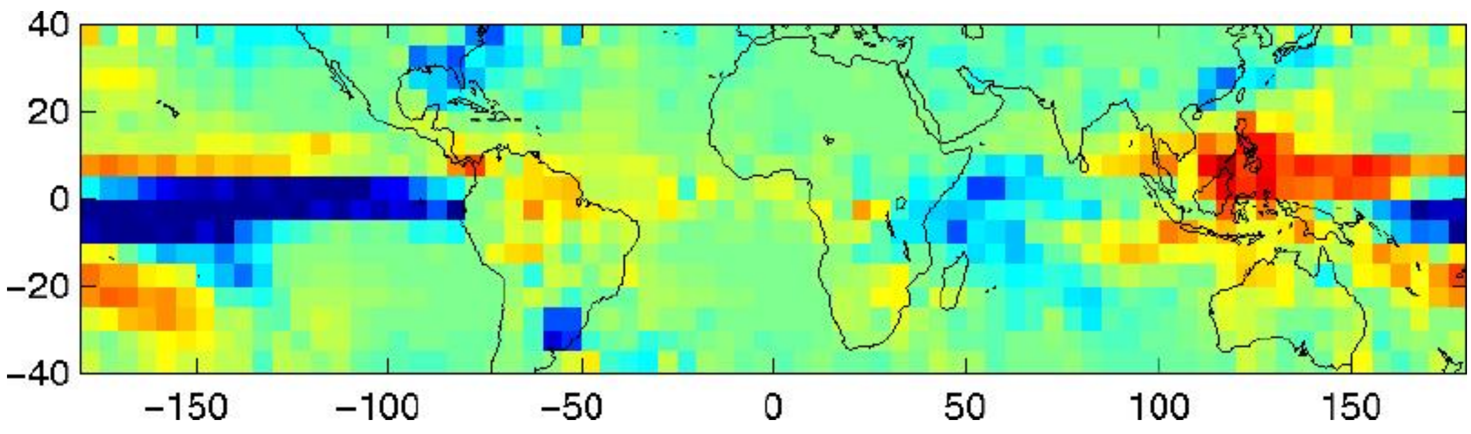


Source: Australian Bureau of Agricultural and Resource Economics and Sciences[36]

Conclusions

- Primary production controlled by solar energy
- Atmospheric circulation patterns influence where plants can grow to sustain life, esp. Hadley Cell
- Rainfall variability between years = flood/drought

- Next lecture: climatic systems that cause drought



trmm.jpl.nasa.gov

Mini essay #2

"When writing your essays, I encourage you to think for yourselves while you express what I'd most agree with."

- Due date: 29 April
- 600 words
- Learning objectives from Handbook:
  - Distinguish between competing interpretations of scarcity, with reference to historical and modern famines
  - Analyse and contrast competing interpretations and arguments relating to famine/scarcity demonstrating an understanding of particular strengths and weaknesses

Context

- Food security crises may be compounded by droughts and other environmental changes.
- Some authors, like deMenocal (2001), argue that environmental change contributed directly to food insecurity and the collapse of complex societies in the past (this theoretical standpoint is known as ‘environmental determinism’).
- Others, such as Butzer (2014), suggest that the historical causes of food insecurity are more complex. Butzer (2014) suggests that environmental factors were secondary to socio-political factors in explaining the collapse of ancient societies.

DeMenocal, P. 2001. Cultural responses to climate change during the Late Holocene. *Science* 292: 667-673.

REVIEW

Cultural Responses to Climate Change During the Late Holocene

Peter B. deMenocal

Modern complex societies exhibit marked resilience to interannual-to-decadal droughts, but cultural responses to multidecadal-to-multicentury droughts can only be addressed by integrating detailed archaeological and paleoclimatic records. Four case studies drawn from New and Old World civilizations document societal responses to prolonged drought, including population dislocations, urban abandonment, and state collapse. Further study of past cultural adaptations to persistent climate change may provide valuable perspective on possible responses of modern societies to future climate change.

In the spring of 1785, the geologist James Hutton presented a lecture to the Royal Society of Edinburgh that changed scientific inquiry into natural processes. The essence of his view was simple enough: The present is records are sufficiently long to document climate phenomena that vary at interannual time scales, such as El Niño, but they are too short to resolve multidecadal- to century-scale climate variability that we know to exist from ed States. The drought was triggered by a large and widespread reduction in rainfall across the American West, particularly across the northern Great Plains (*5*). It displaced millions of people, cost over $1 billion (in 1930s U.S. dollars) in federal support, and contributed to a nascent economic collapse. Subsequent analysis of the Dust Bowl drought has revealed that its tremendous socioeconomic impact was, in part, due to wanton agricultural practices and overcapitalization just before the drought, when rainfall had been more abundant (*5*). A subsequent decadal-scale drought in the 1950s (Fig. 1, A and B) was also severe but less widespread, main-

PNAS

Collapse, environment, and society

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This contribution is part of the special series of Inaugural Articles by members of the National Academy of Sciences elected in 1996.

Edited by B. L. Turner, Arizona State University, Tempe, AZ, and approved December 2, 2011 (received for review September 10, 2011)

Historical collapse of ancient states poses intriguing social-ecological questions, as well as potential applications to global change and contemporary strategies for sustainability. Five Old World case studies are developed to identify interactive inputs, triggers, and feedbacks in devolution. Collapse is multicausal and rarely abrupt. Political simplification undermines traditional structures of authority to favor militarization, whereas disintegration is preconditioned or triggered by acute stress (insecurity, environmental or economic crises, famine), with breakdown accompanied or followed by demographic decline. Undue attention to stressors risks underestimating the intricate interplay of environmental, political, and sociocultural resilience in limiting the damages of collapse or in facilitating reconstruction. The conceptual model emphasizes resilience, as well as the historical roles of leaders, elites, and ideology. However, a historical model cannot simply be applied to contemporary problems of sustainability without adjustment for cumulative information and increasing possibilities for popular participation. Between the 14th and 18th centuries, Western Europe responded to environmental crises by innovation and intensification; such modernization was decentralized, protracted, flexible, and broadly based. Much of the current alarmist literature that claims to draw from historical experience is poorly focused, simplistic, and unhelpful. It fails to appreciate that resilience and readaptation depend on identified options, improved understanding, cultural solidarity, enlightened leadership, and opportunities for participation and fresh ideas.

Butzer, K.W. 2014. Collapse, environment, and society. *PNAS* 109: 3632-3639.

Essay question

Does Karl Butzer's model for historical collapse (Butzer 2014, Fig. 1) adequately account for the factors involved in [more recent food security crises](), or are other explanations, such as environmental determinism, more relevant to the newer famines?

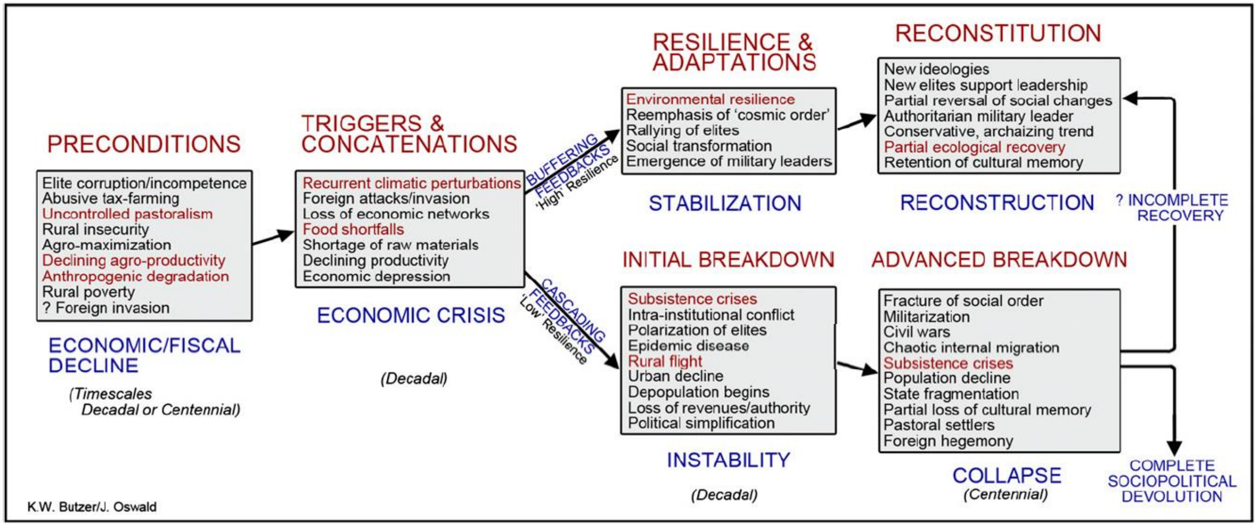

Fig. 1. A conceptual model for historical collapse, situating the variables and processes of stress and interaction discussed in the text. Timescales range from multidecadal to centennial. Alternate pathways point to important qualities of resilience. Red superscripts identify stages that are elaborated by blue subscripts. Environmental components (red within boxes) are secondary to sociopolitical factors.

Essay hints

- In 600 words you cannot possibly cover every recent food security crisis, so **pick <u>one</u> from the 20th century or later** and use that as a case study (e.g. Bengal, Ethiopia, Malawi or any recent food security crisis of your choosing)
- Focus your research on finding out about the **causes** of that particular crisis (your chosen references should reflect this focus)
- Your answer to the question should not be a simple 'yes' or 'no' – you are expected to use the published literature to **critically test** Butzer's model **and** the theory of environmental determinism; you may come up with alternative explanations based on your reading and what you've learned through the semester

Essay hints

- A great way to test Butzer's model (Fig. 1) is to **annotate it** based on your research – you can include this annotated version as a figure in your essay submission (it won't contribute to your word count); maps, graphs or tables can help you stay within the word limit while supporting your arguments, so don't be afraid to include one or two
- **Structure your essay** into paragraphs that each deal with an aspect of the essay question. For example, the first paragraph might compare environmental determinism with Butzer's model and could explain why it's important to think about this question (*i.e. the Aim*); the second paragraph could discuss your case study of a food-security crisis and its causes (*i.e. Methods & Results*); the third paragraph might analyse how this crisis fits (or not) with the two theories (*i.e. Discussion*); and a final paragraph could draw some brief conclusions (making sure you address the original question!)

Good luck!