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Sahara Greening

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Key Messages

①

The Sahara has switched between two stable states in the past.

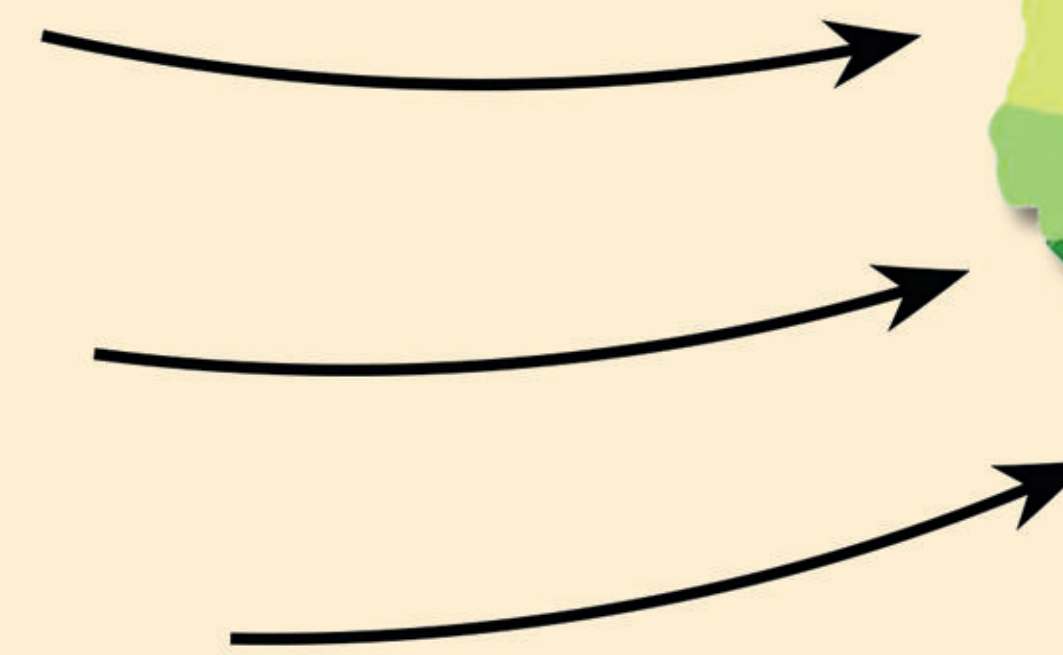
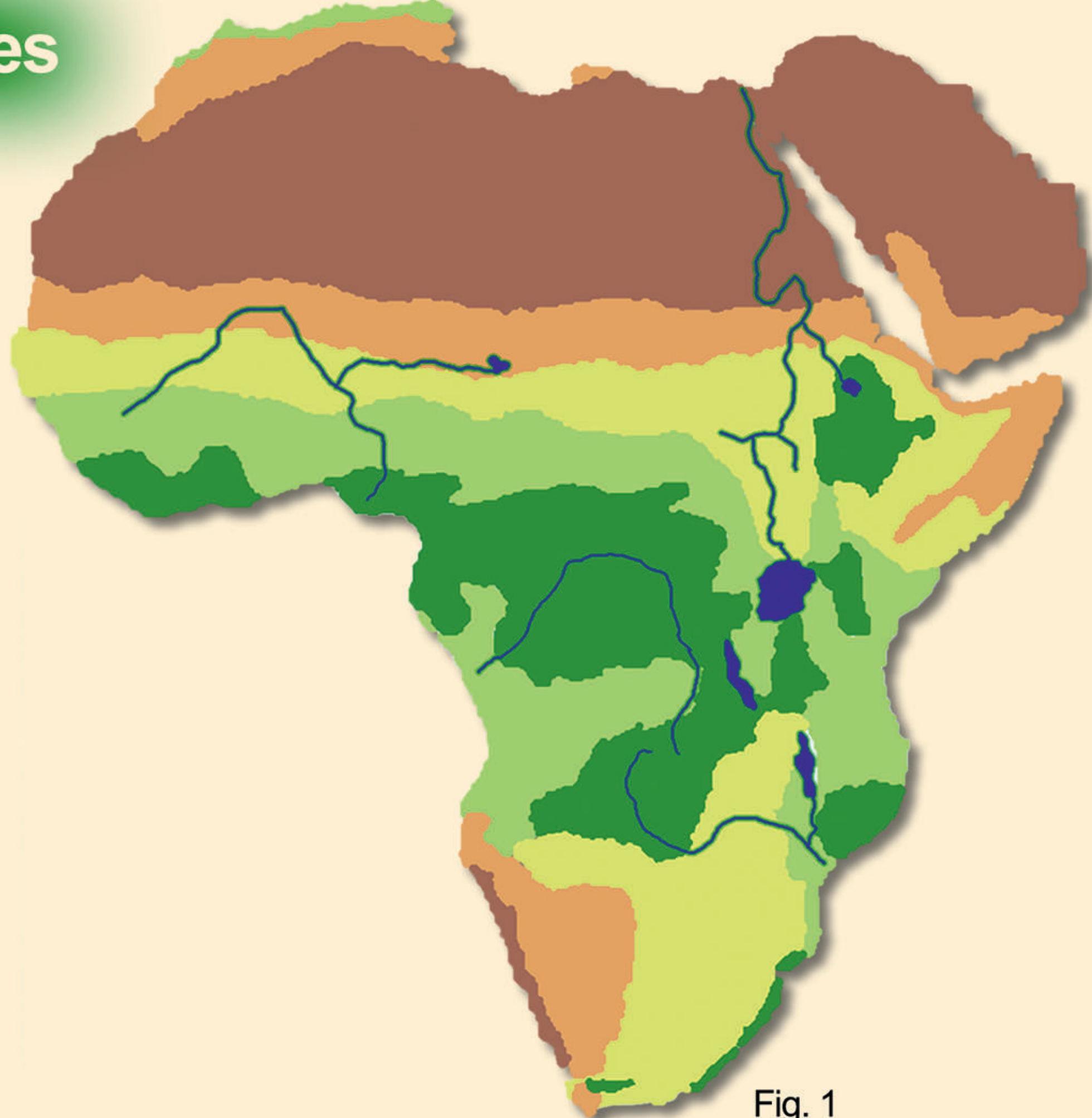
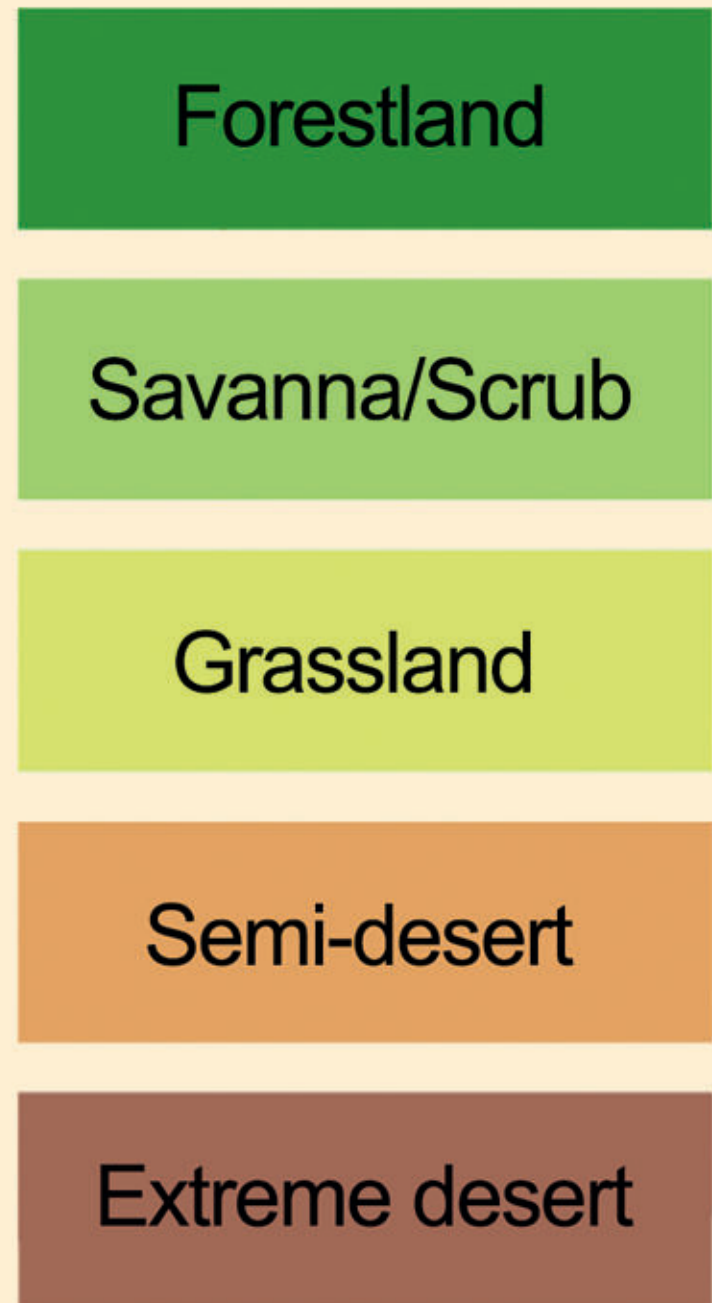
②

The transitions are driven by complex feedback mechanisms.

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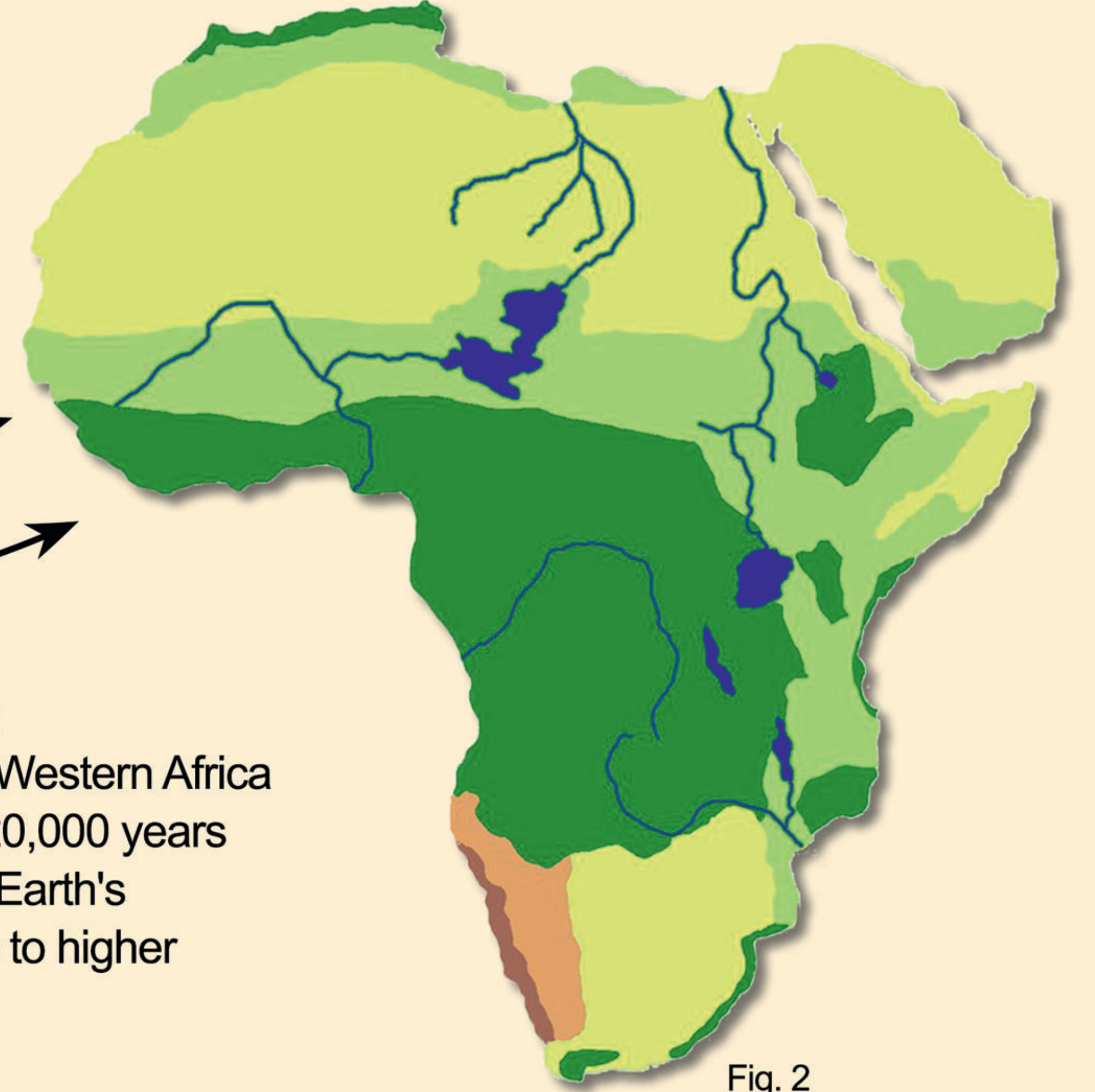
The current climate change effects are unclear.

The Two States



The West African Monsoon

shapes the weather patterns of Western Africa and it intensifies roughly every 20,000 years due to periodic variations in the Earth's orbit around the Sun. This leads to higher precipitation over North Africa.



Dry Period (Today)

- Biggest hot desert in the world
- Largest source of airborne mineral dust
- Rock paintings of water dependant animals (e.g. elephants, giraffes and hippos) in areas that are now desert
- Still annual monsoons, but not to the same extent

African Humid Period (AHP)

- Between ca. 14.500 and 5.000 years ago
- Sahara covered with vegetation and lakes (Savannah-like landscape)
- Probably the largest climate-induced environmental changes in the Holocene
- Warmer and longer summers than today
- Not the first green period --> about 230 occurred in the last 8 Million years
- Abrupt termination of the AHP

Feedback Mechanisms

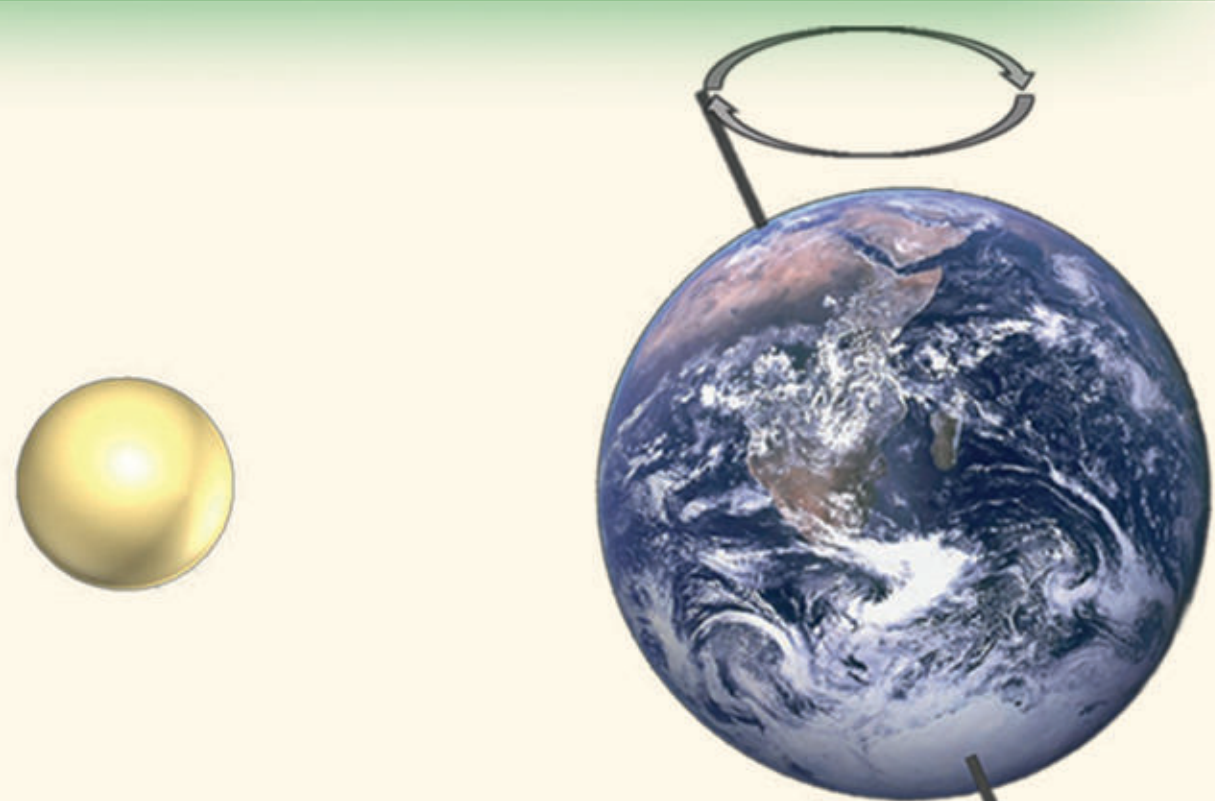
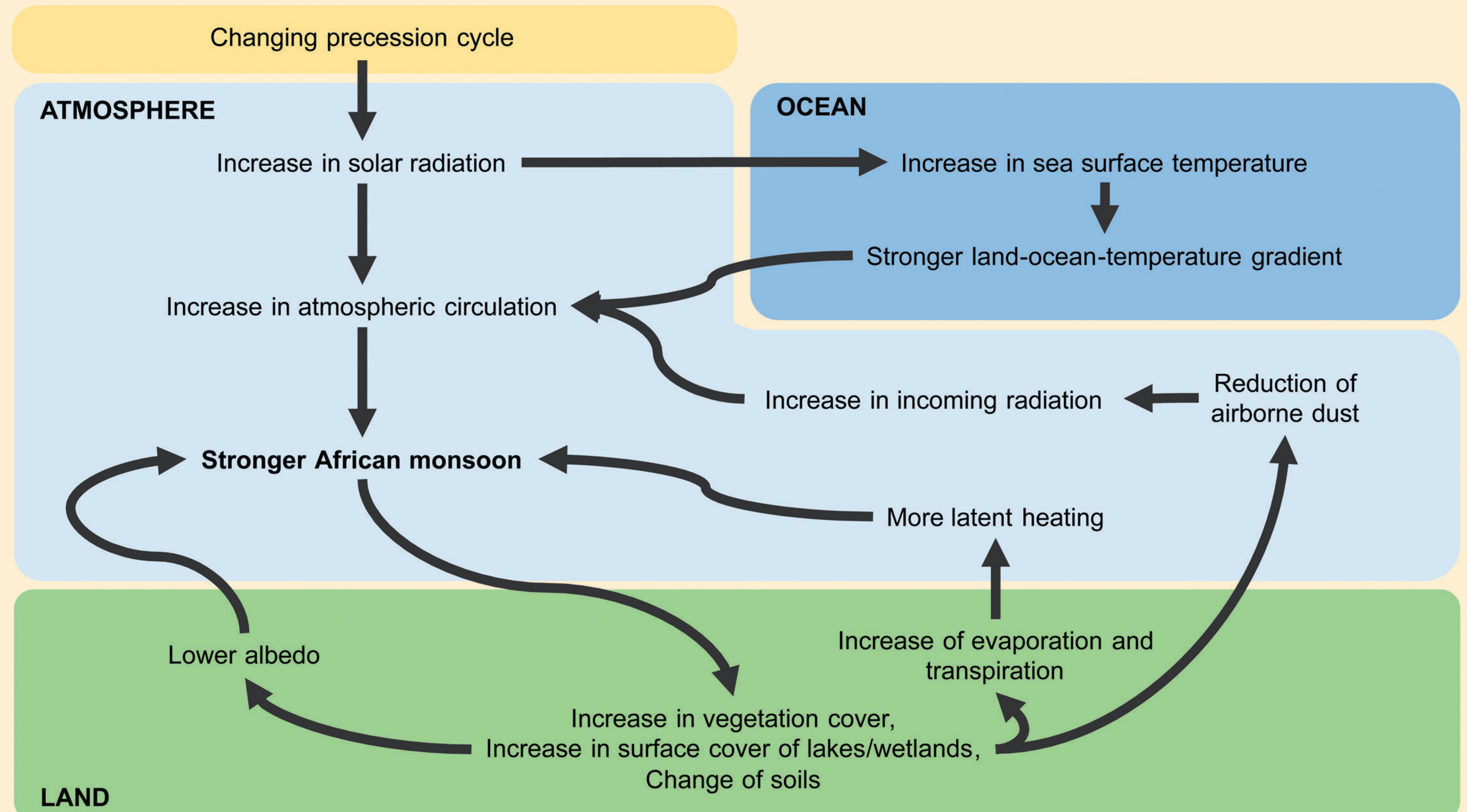


Fig. 3

The main driver: precession

Precession is the wobbling of the Earth's axis over a ~25,000 year cycle. The strength of insolation and length of season are affected by this cycle, including the intensity of the African Monsoon. Both the onset and the termination of the AHP occurred when summer insolation crossed a certain threshold. Precession is the main forcing that drives the AHP cycles, but its effect is not strong enough to be the sole reason for the intensity of precipitation change during the mid-Holocene.



Anthropogenic Impact

According to projections, current anthropogenic climate change might lead to increased precipitation in large parts of the Sahel, but to decreased precipitation in its Western stretches. Together with increased CO2 levels, this might lead to an expanded greening of the Sahel and the dominance of woody flora over grassland. However, these trends are not comparable to the magnitude of the AHPs.

On the contrary, rising temperatures will lead to more heat stress for plants, especially in Northern Africa. A further factor in the vegetation development is human land use. While expansion of pastoralism into newly vegetated areas could counteract these greening trends, irrigation and geoengineering projects could in turn support a more vegetated Sahel.

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 - deMenocal, P. B. & Tierney, J. E. (2012) Green Sahara: African Humid Periods Paced by Earth's Orbital Changes. Nature Education Knowledge 3(10):12.
 - Fig. 1 & 2: Climate areas based on data and maps from the Oak Ridge National Laboratory Paleovegetation project <http://www.esd.ornl.gov/projects/qen/>
 - Fig. 3: Photo by NASA on Unsplash. <<https://unsplash.com/photos/vhSz50AaFAs>>