Mitigating Climate Change Impacts on Critical Assets and World Heritage Sites

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SUSTAINABILITY
FUTURE GROWTH

Global Platform for Disaster Risk Reduction
Geneva, Switzerland
May 8 to 13, 2011

Hyogo Framework for Action 2005-2015

International Strategy for Disaster Reduction: Building the Resilience of Nations and Communities to Disasters

Propose Funding Mechanism through Integration of Risk Assessment in the Environmental and Social Impact Assessment (ESIA) Processes

ESIA Process

Climate studies: historic conditions for length of record, GHG contribution
Cultural studies: if comprehensive, reconstruct past environmental conditions
Hydrology studies: surface and groundwater water availability, flooding
Geology studies: substrate permeability, seismic concerns
fault lines and earthquake history
Mitigation Measures, Management Plans, Post-closure Development Plans

What's Missing?

Integration of these Baseline Studies, Mitigation Measures
and Management Plans into Local, Regional
or National Pre-disaster Hazard Mitigation Plans



ESIA for a Gold Mining Project in the Sudano-Sahel Region of Africa

- Evaluated Impacts of Climate Change on Water Availability for Mine Operations and Agricultural Sustainability for Local Farmers
- Identified Probable Climate Change for 20 – 40 Years into the Future and Planned for its Impacts

Project Team:

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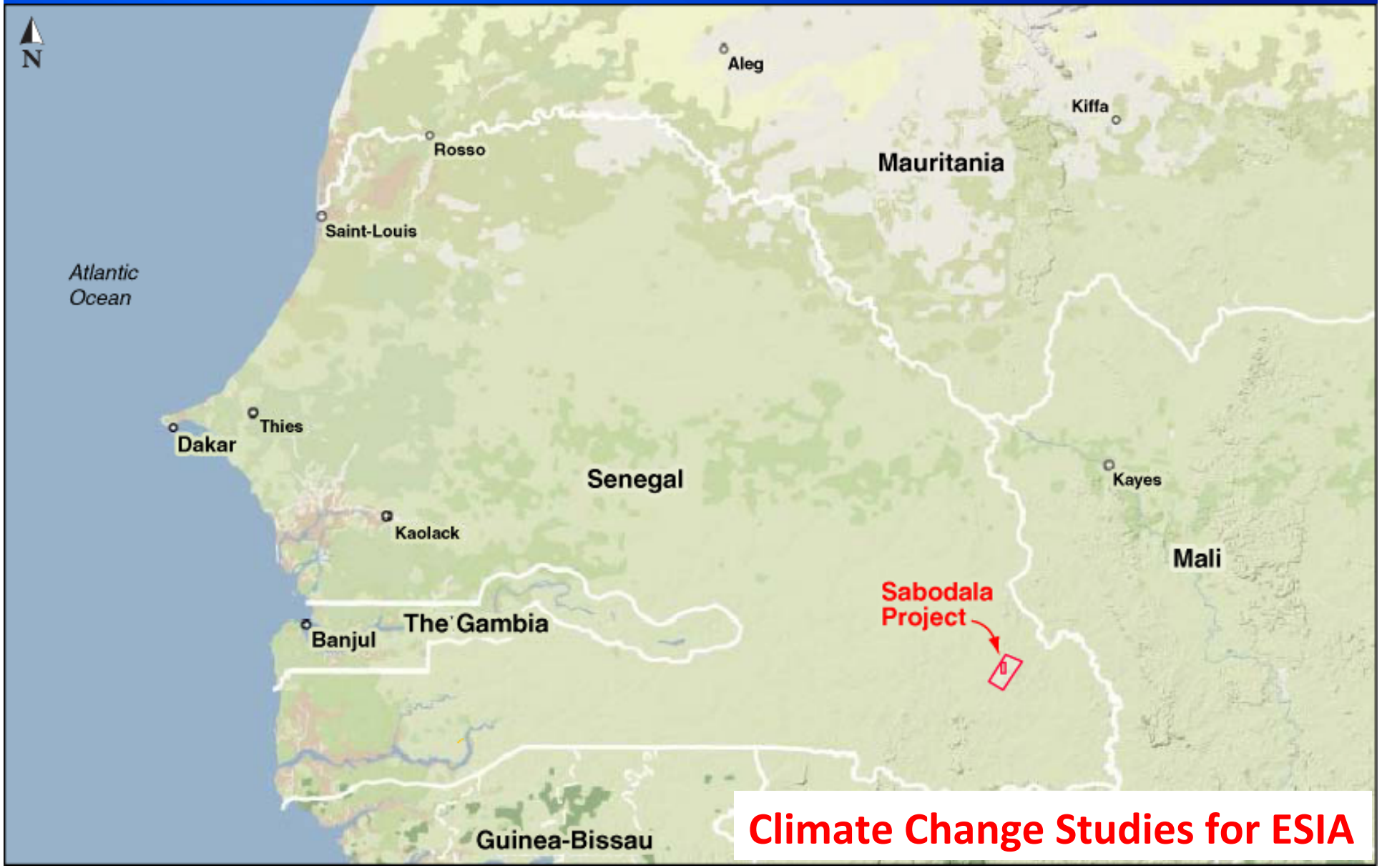
Sponsored By:

OROMIN
JOINT VENTURE GROUP

The Oromin Joint Venture Group
Gold Mining Project, Sabodala, Senegal



Climate Change Studies for ESIA

Purpose of the Study

Determine Cumulative Impacts of Climate Change and Project Development on Sustainable Agriculture

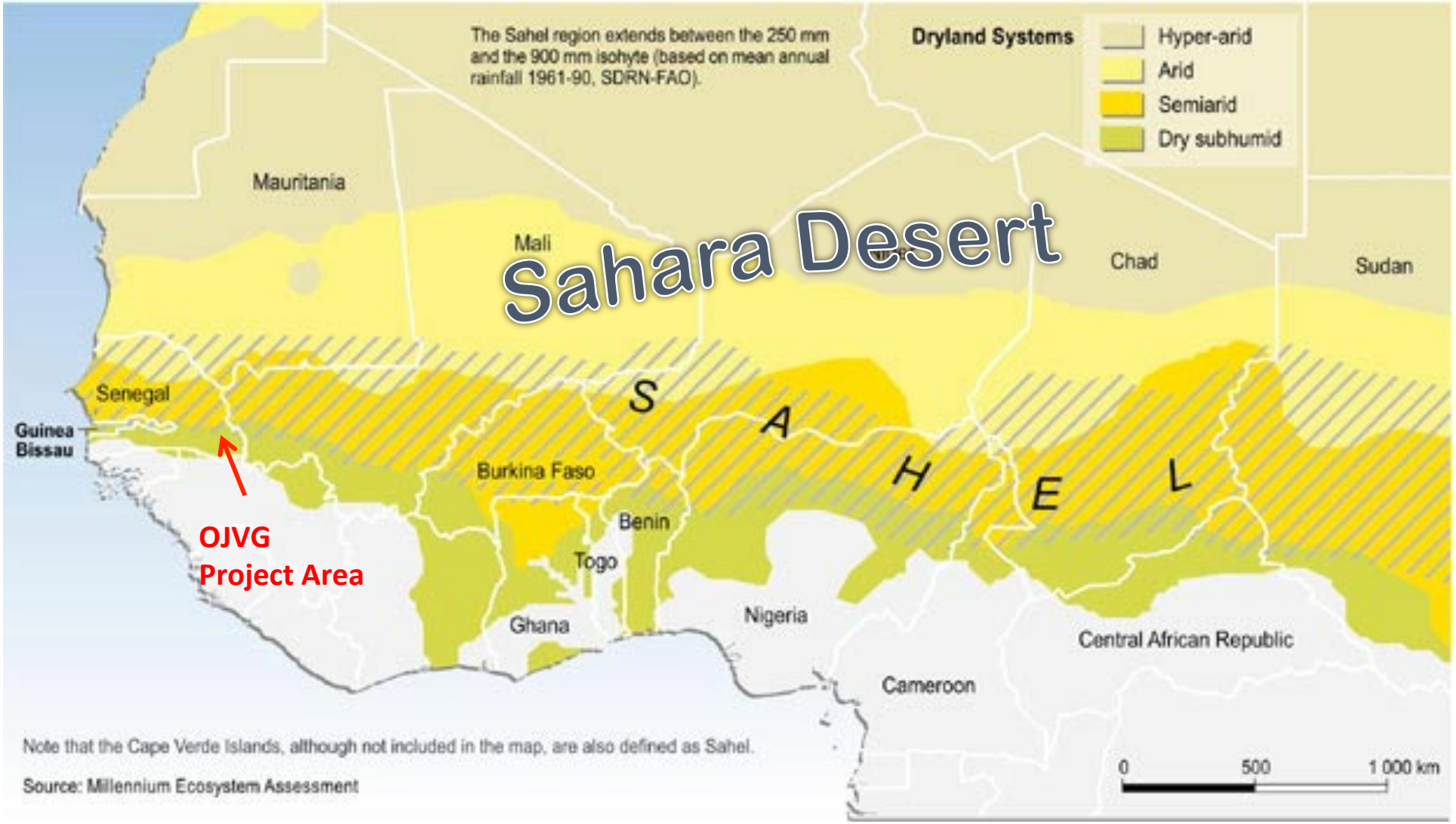
- Development will reduce the amount of arable land available for agriculture, contributing stress to the agricultural carrying capacity
- Historically, southern Senegal has attracted immigrants during droughts in the Sahara
- Future climate change, as well as social stresses, may lead to more immigrants fleeing to the region and further stress the carrying capacity of agricultural lands.



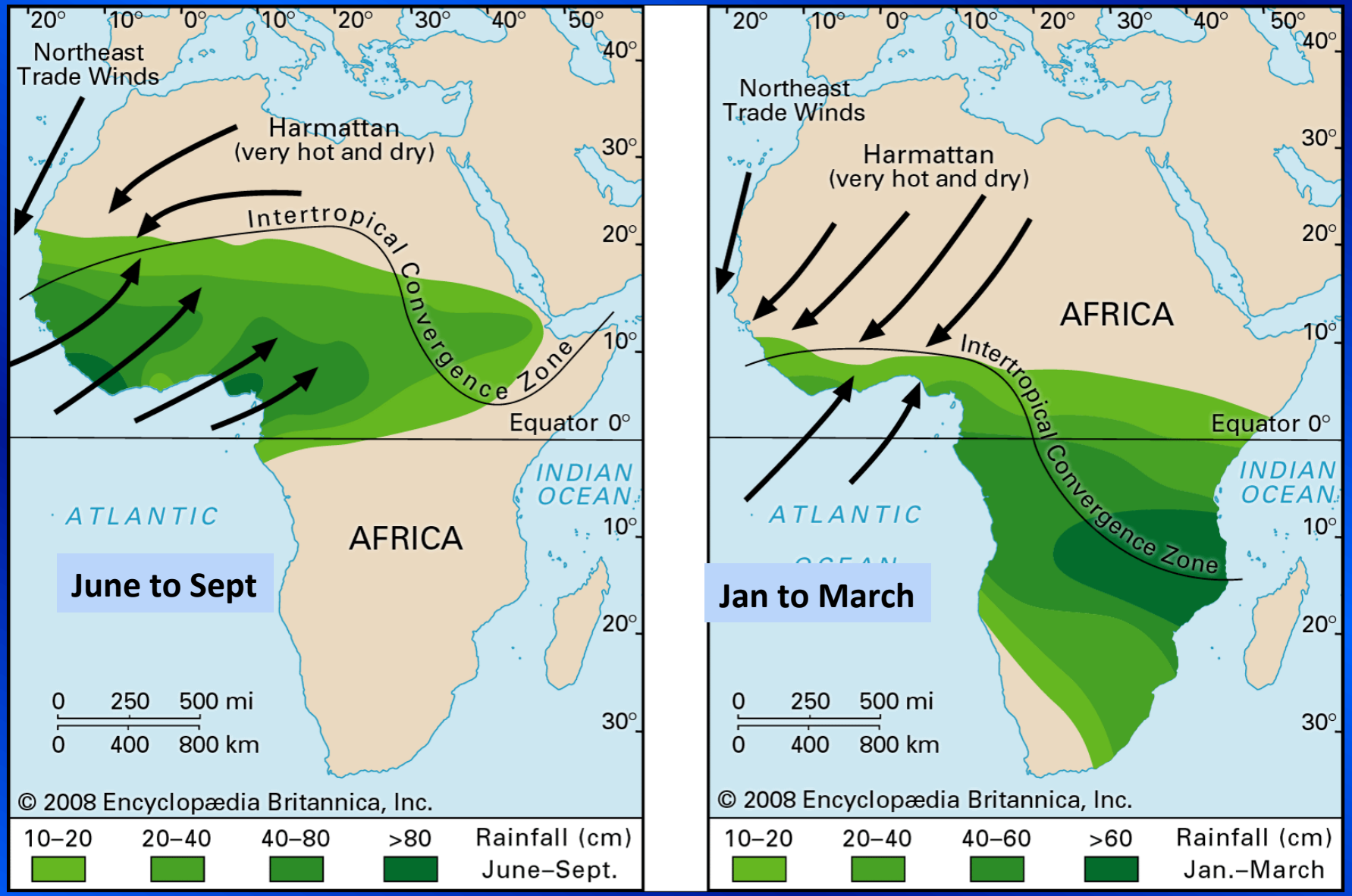

Approach

- Identify Current **Climate** and Environment of the Region.
- Identify Correlation between Past Climate of the Region, Solar Cycles and Atmospheric Teleconnections.
- Determine how Future Solar Cycles and Atmospheric Teleconnections will Influence the Climate of the Region:
  - During Project Operations, and
  - Post closure to 250 years into the future.

Current Climate of the Sudano-Sahel



ITCZ and Seasons of the Sahel



Climate Forcing Mechanisms

- **Earth's Orbit around the Sun**: long term cycles that accentuate shorter term cycles
- **Sun Spot Cycles**: primary driver of shorter term climate cycles and teleconnections
  - Pacific Decadal Oscillation (PDO)
  - Atlantic Multidecadal Oscillation (AMO)
  - Arctic Oscillation (AO)
  - North Atlantic Oscillation (NAO)
  - El Nino Southern Oscillation (ENSO)

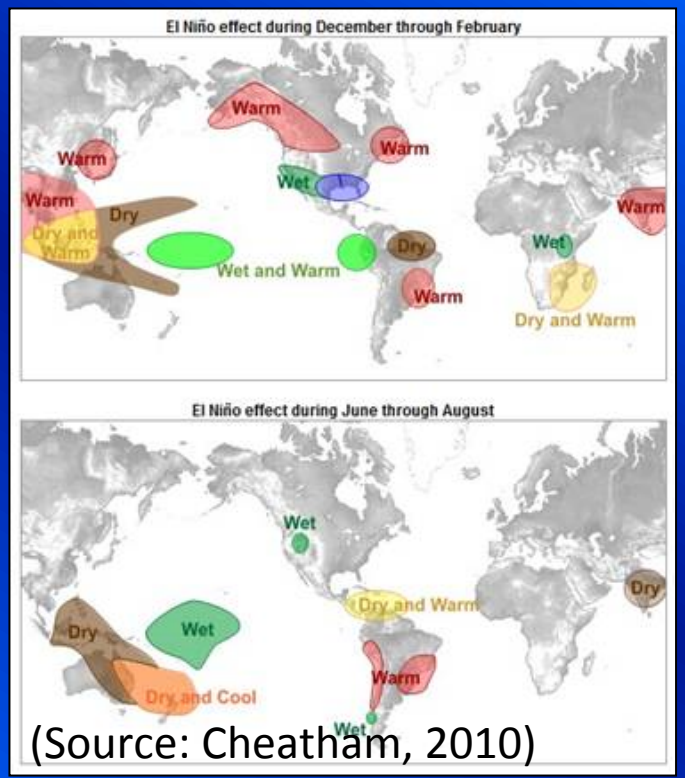
Study Did Not Consider Effect of Anthropogenic GHGs: Natural Forces Only

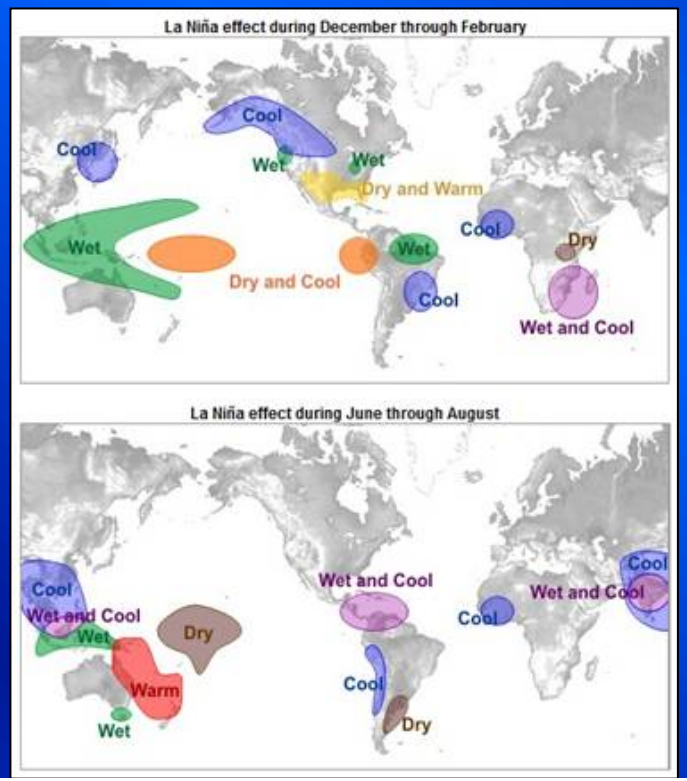
Earth's Orbital Parameters will Affect Little Climate Change for the Life of the Mine

Teleconnections

- Large-scale patterns of pressure and circulation anomalies that cover large geographic areas.
- Can span oceanic basins, continents and hemispheres.
- They reoccur, are persistent and may last for several weeks to several months.
- Can be prominent for several consecutive years and have a significant impact on the climate of a region.

Phases of El Niño





Phases of La Niña

(Source: Cheatham, 2010)

Solar Cycles and Climate Trends in the Sudano-Sahel Region: 1880 - present

Climate Trends in the Sudano-sahel Region: Relative to 2010.			
Time Period	**Temperature**	**Precipitation**	**Conditions**
1880-1910	-	+	cooler, moister
1910-1940	+	+	warmer, moister
1940-1960	-	-/+	cooler, increasing aridity
1960-1994	+	-	warmer, drier (intense drought 1972-1985)
1994 - 2003	-/+	-/+	cooling, decreasing aridity
2004-2010	present	present	near present conditions
Source: Thiam and Singh, 2002; UNEP, 2010; and Vendrig, 2010			

Estimated Future Climate of the Sahel: Based on Phases of Climate Drivers

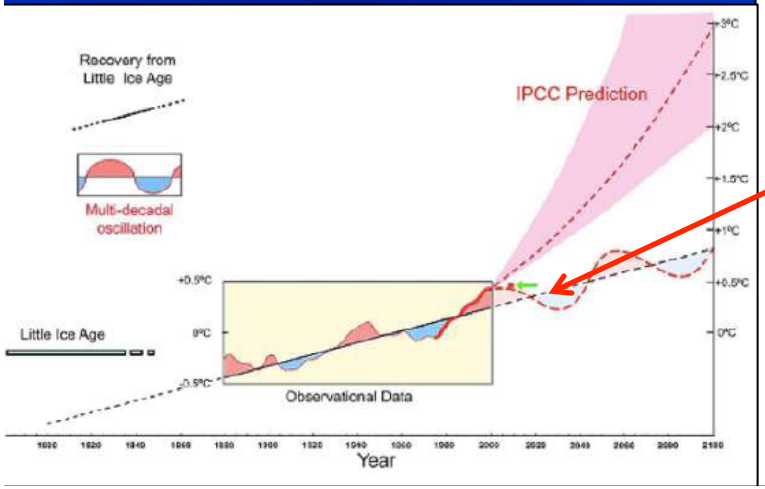
System	System Phase	Sahel Climate: 2010 – 2030/2040
Sunspots and; ENSO	Low sun spot activity associated with more La Niña type events.	Cooler, and wetter through 2023, then may move to higher sunspot activity.
PDO and; PDO/ENSO	Shift to cold phase, corresponds with more La Niña type events.	Colder, increased rainfall to 2030 or 2040: causes intensified western monsoon.
NAO	Currently in a weakening negative phase. Becoming positive (more rain) and will peak in 2026.	Increased rainfall to 2026, but with some uncertainty, then transition to negative phase.
AMO	Moving to positive phase, will peak in 2020. Positive phase causes increased Sahel rainfall.	Increased rainfall to 2020, then transition to negative phase.
AO	Moving to positive phase: stronger Sahel trade winds and warm Mediterranean will supply moisture to Sahel.	When positive phase reached, rainfall will increase and peak, likely around 2020.

After Vendrig, 2010

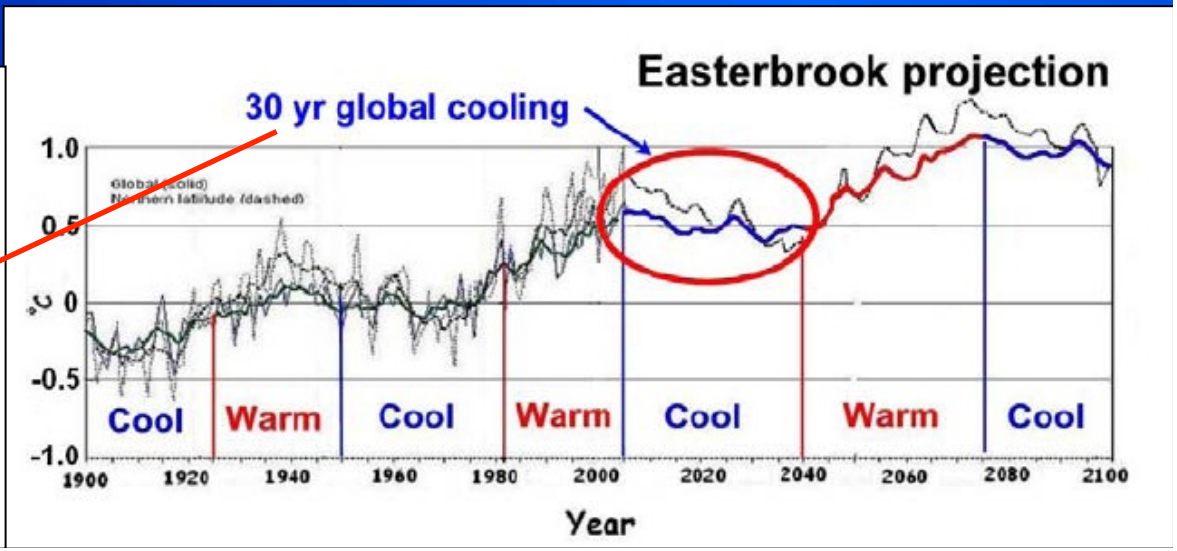
Estimated Future Climate of the Sahel (summary)

- Reasonably assured that precipitation will increase slightly and stabilize at slightly higher levels than present through 2030, possibly 2040.
- This period will be followed by a 30 to 40 year period of warming and increased aridity.

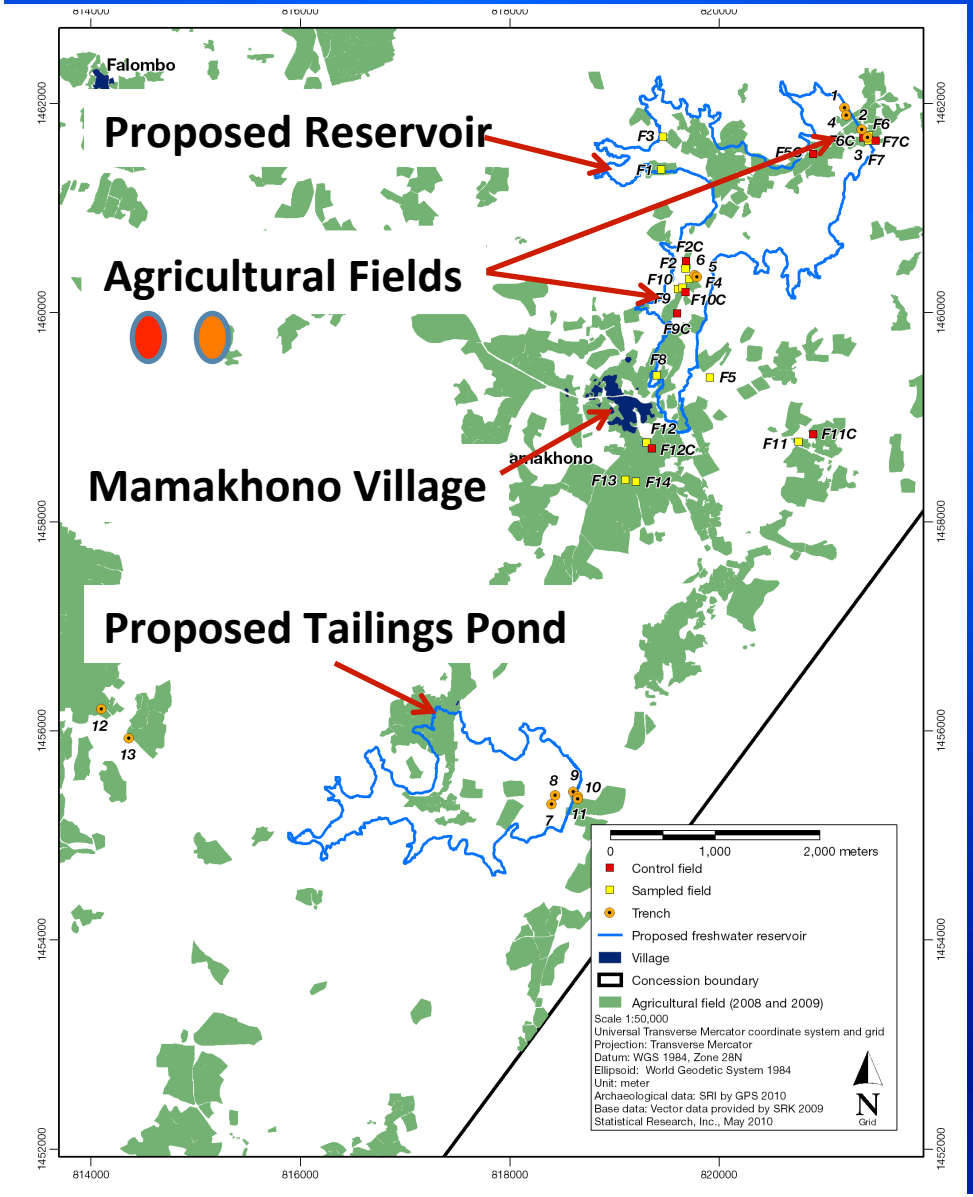
Akasofu, 2009



Easterbrook, 2008



OJVG Gold Mine and Agriculture: Mamakhono Village, Sabodala Area



- Construction of a reservoir to support mining operations will eliminate fields that are cultivated by local farmers
- Population of Sabodala is significantly higher and growing faster than other communities in the concession because of the increased job opportunities.
- Increased population may increase the competition for agricultural land.
- Consequently, there may be greater pressure on these agricultural soils, pressures that could cause soil quality to decline in the coming years.

Project Team's Post Mine Closure Project Recommendations

- On-going consultation with the local farmers to help ensure early identification of stresses to agricultural productivity, as well as social stresses.
- Government will manage reservoir post closure, and provide fish
- Reservoir will be used for localized irrigation agriculture.
- Sediment will be dredged and mixing with compost to fertilize new fields, also keeps reservoir from In-filling.
- OJVG is developing a nursery and training locals to provide supplemental market and locally consumed crops.





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