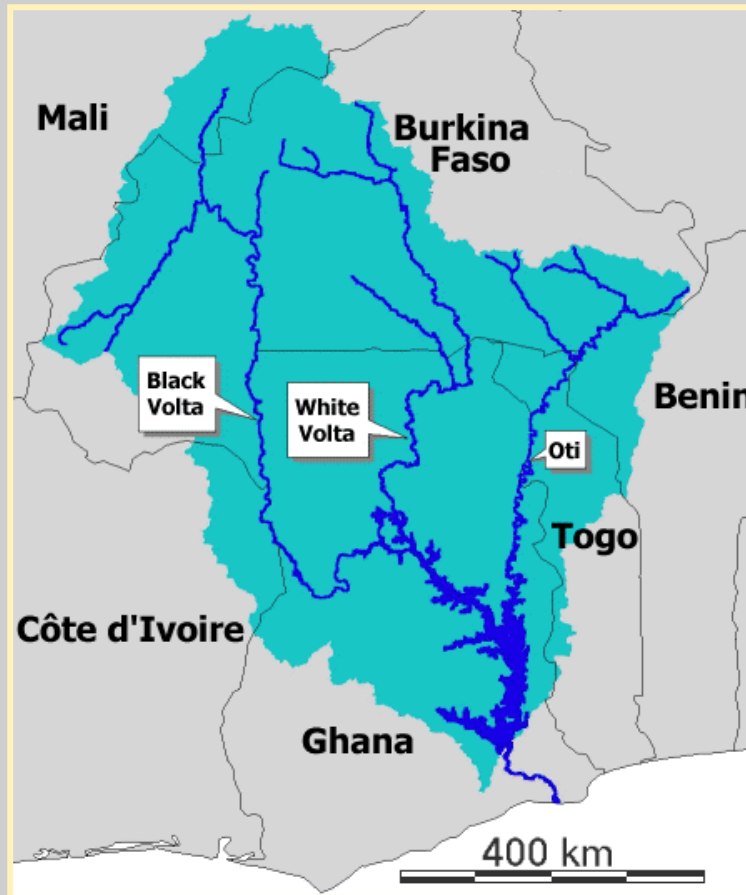


Week 1: Volta

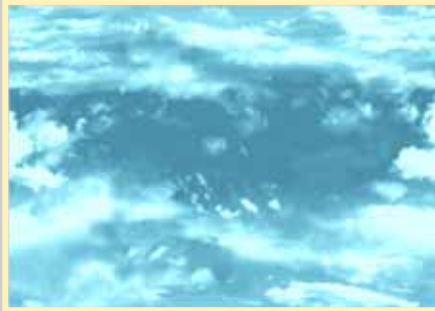


Characteristics

- 400,000 km²
- 15 million people, \$650/yr
- Average rain 1000 mm/year
- 9% in rivers
- Lake Volta

Week 1: Volta

Atmosphere



Land use



Water use



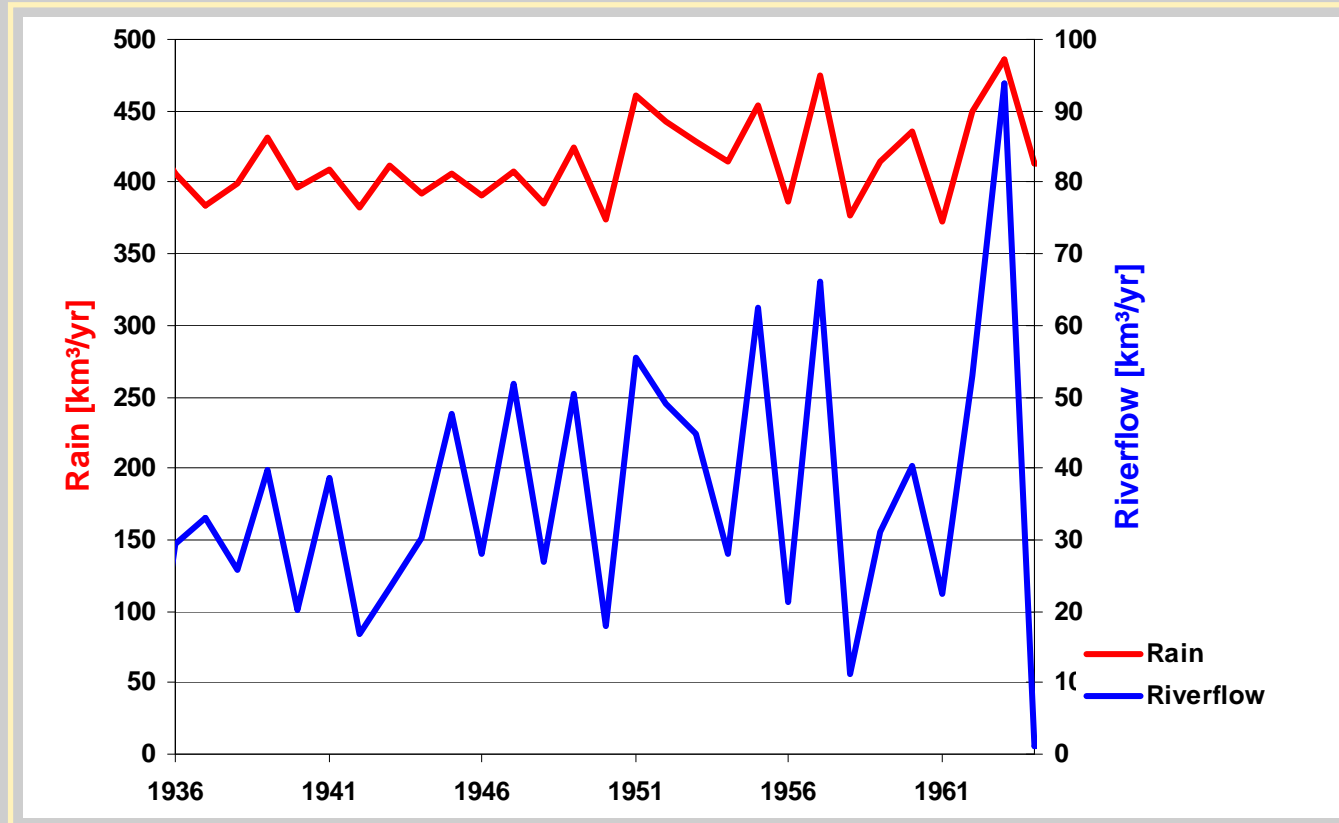
Water related issues

- Climate change, regional & global
- Rapid landuse change
- **Competition for water:**
 - Hydropower
 - Mining/Industry
 - Irrigation
 - Households



Week 1: Volta

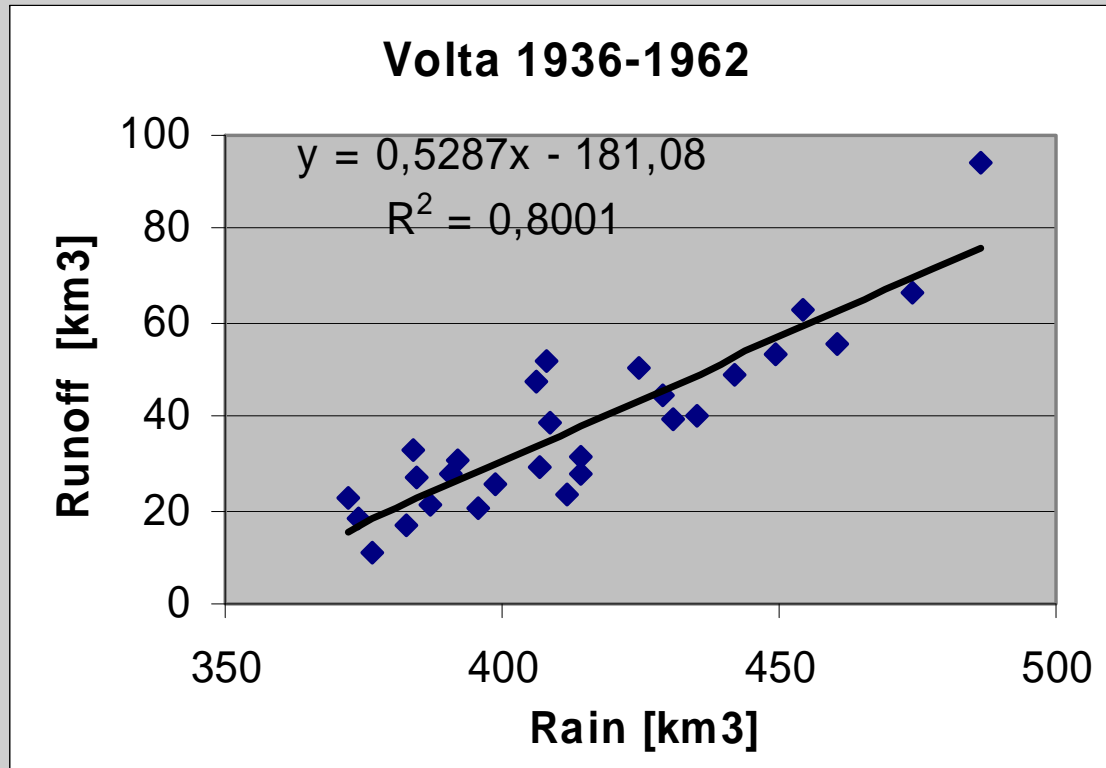
IWM Fall 2013



Rainfall (CV 7%) and Runoff (CV 36%)

Week 1: Volta

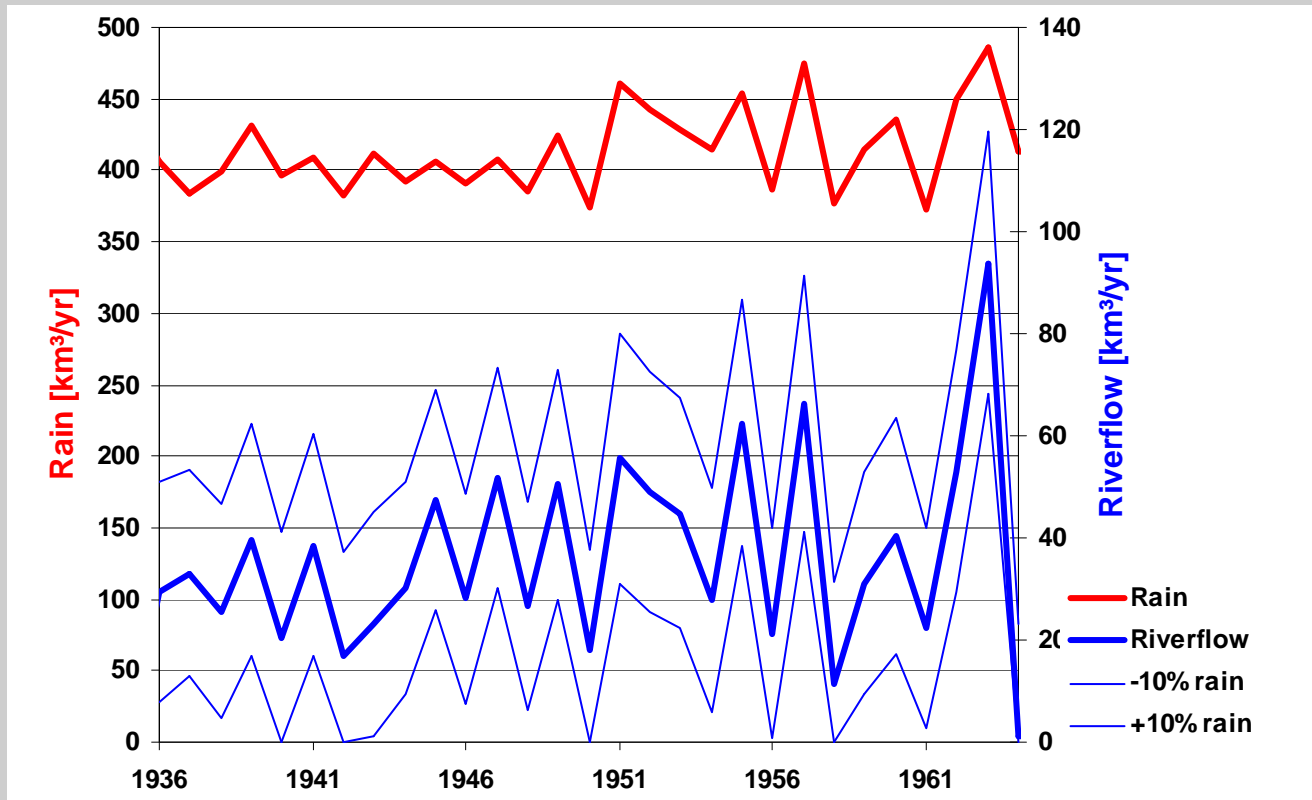
IWM Fall 2013



High sensitivity:
 $Q = 0.53 * (\text{Rain} - 341) \text{ [km}^3\text{]}$
(r = 0.89)

Water supply

Week 1: Volta



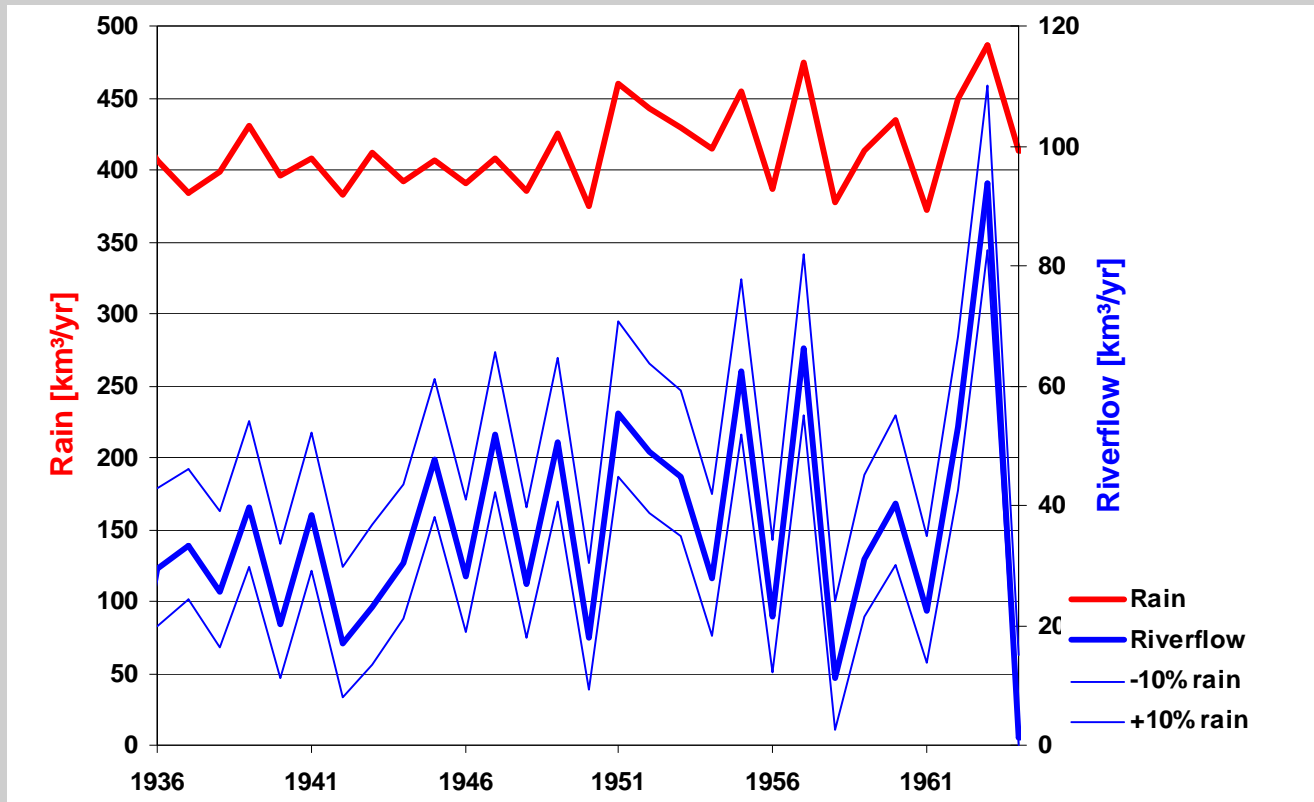
High sensitivity:

$$Q = 0.53 * (\text{Rain} - 341) \text{ [km}^3\text{]}$$

$$(r = 0.89)$$

Water supply

Week 1: Volta



Future climate 2070-2099:

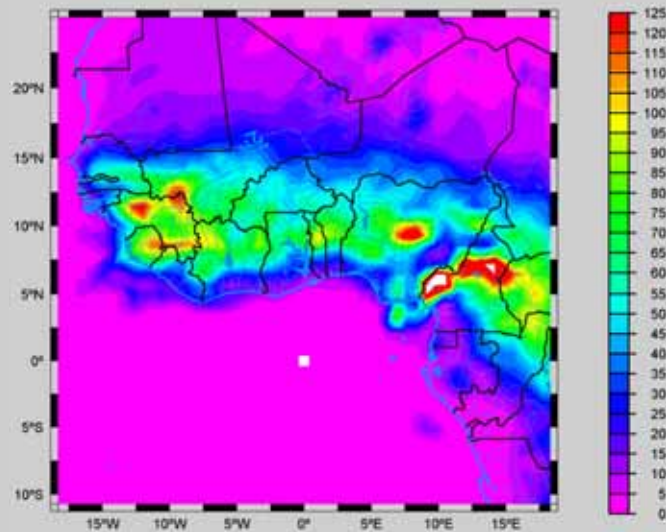
Max: **+6.3%** (ECHAM4, GG)

Min: **-4.4%** (Hadley, GG)

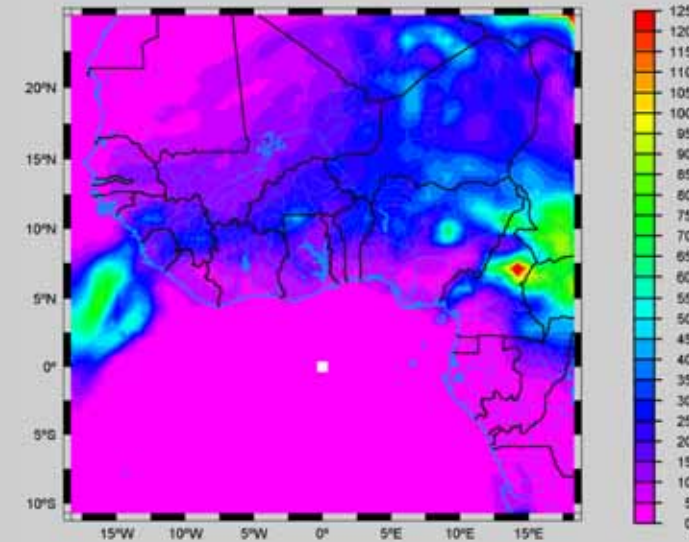
Week 1: Volta



1991



2032



Source: www.lehrer.uni-karlsruhe.de

Comparison ECHAM 4, 1991 vs. 2032: Precipitation (in cm) domain1

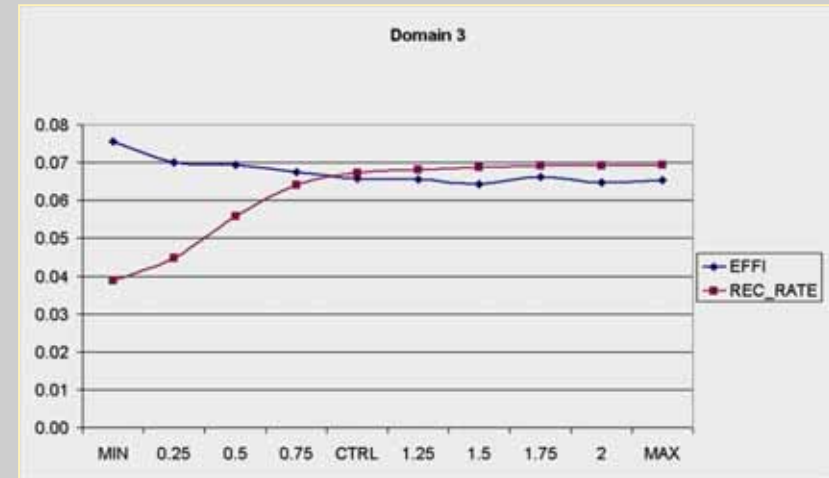
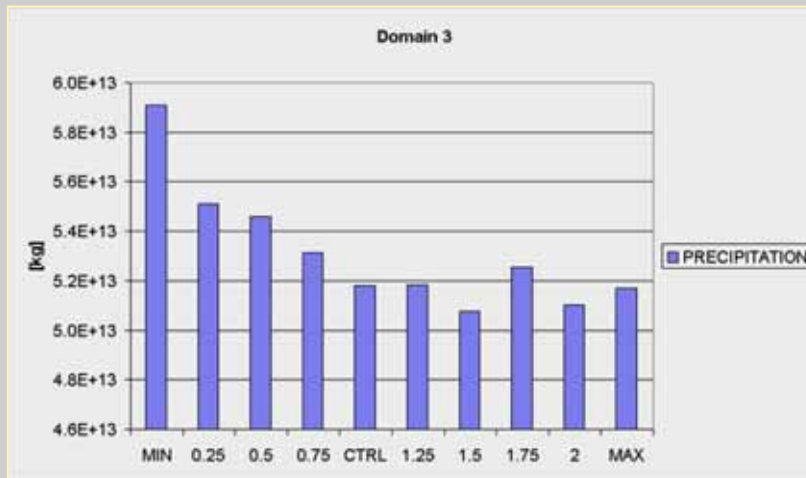
- Dramatic decrease of total precipitation for ECHAM 4, 2032
- **Caution:** 2032 is only **ONE** realisation of future climate

Water supply



Week 1: Volta

Feedback land surface - atmosphere



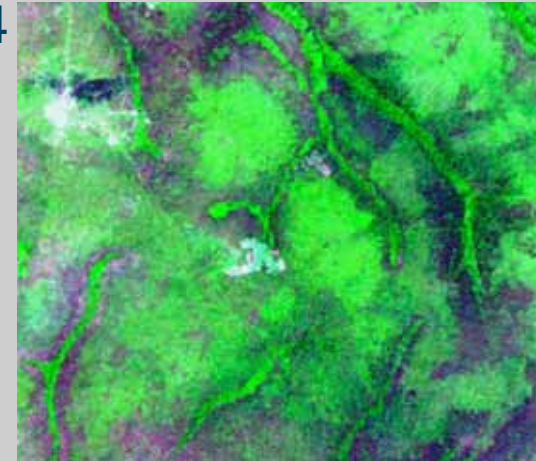


Week 1: Volta

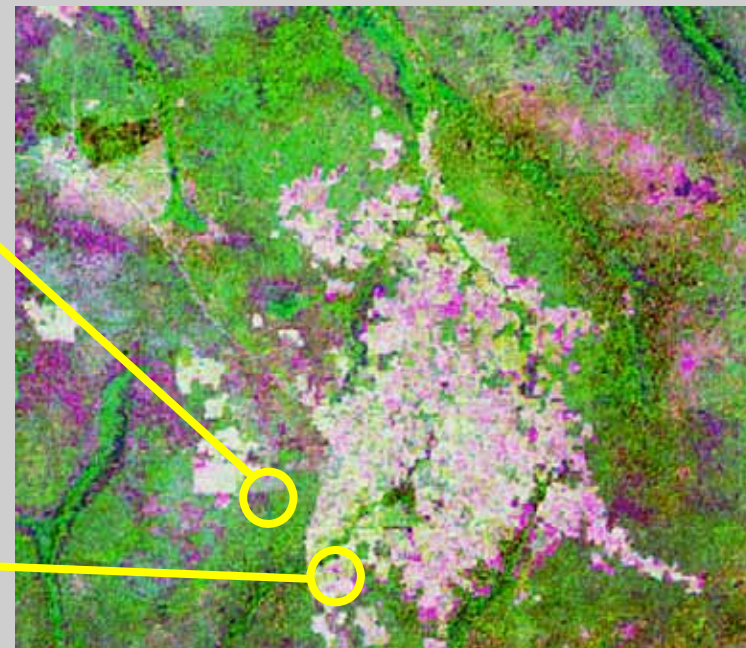
Landuse Change



1984



1999

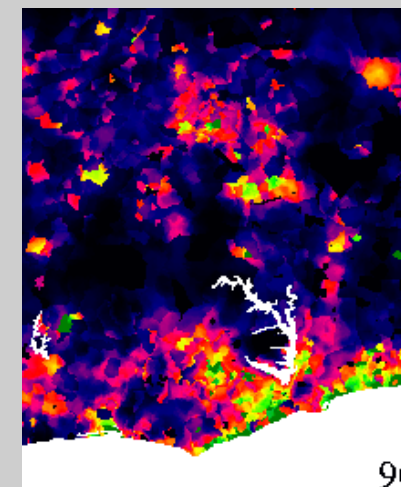
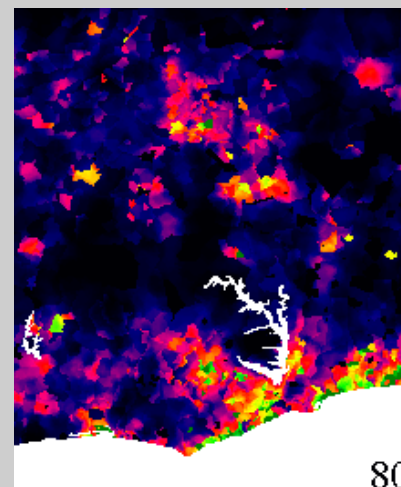
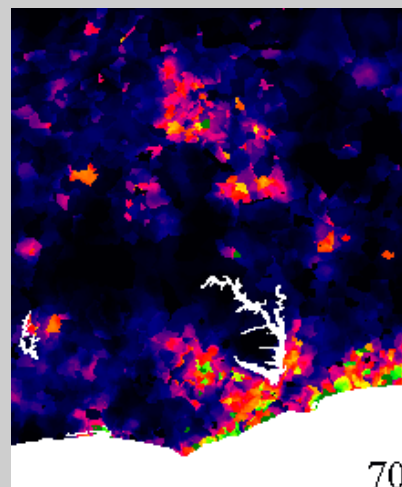
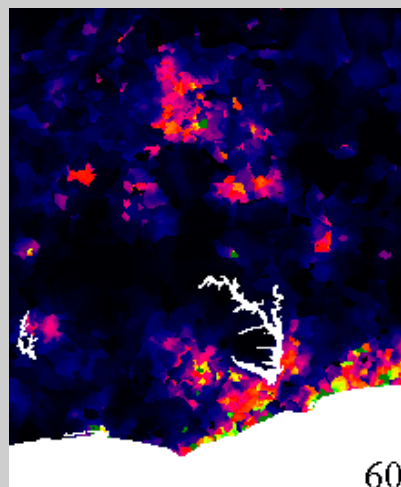


Water supply

IWM Fall 2013



Week 1: Volta



IWM Fall 2013

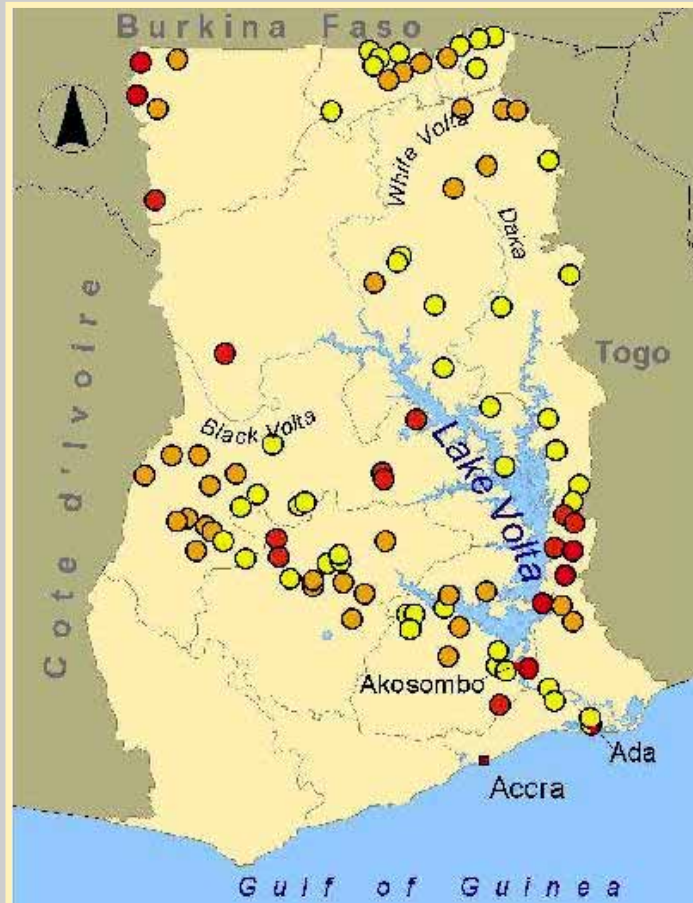
Population Increase

Water supply & demand



Week 1: Volta

Access to improved water sources



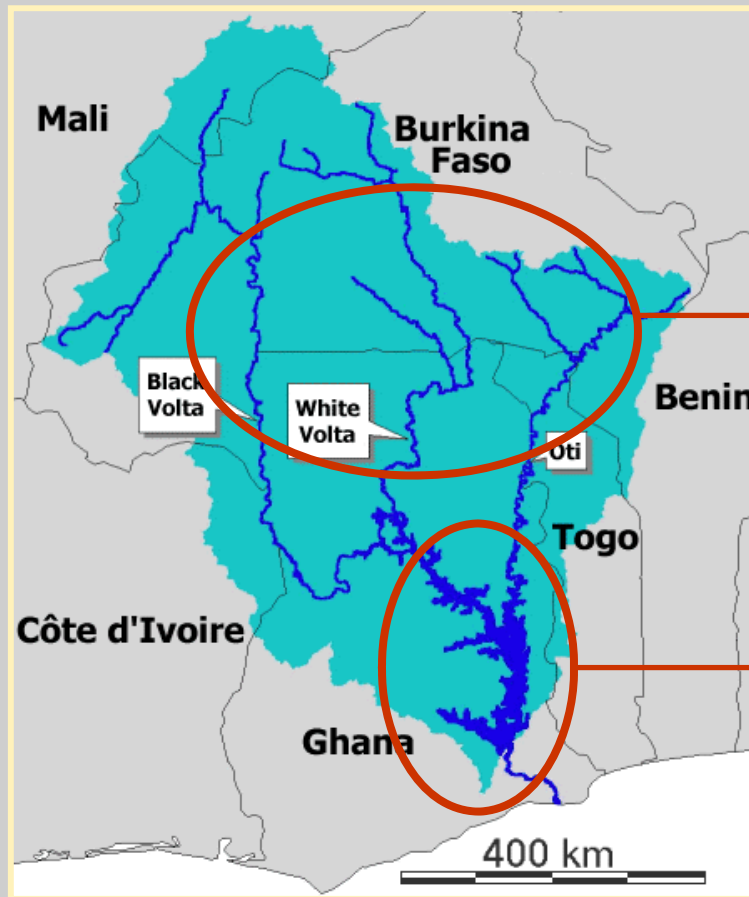
- < 25%
- 25-50%
- 50-75%
- > 75%

Water demand



Week 1: Volta

Main issue



Irrigation

Hydropower

Water demand



Week 1: Volta

Irrigation



IWM Fall 2013

Development 70's (Tono)

Water demand



Week 1: Volta

Irrigation



Village level Development 90's

Water demand



Week 1: Volta

Irrigation



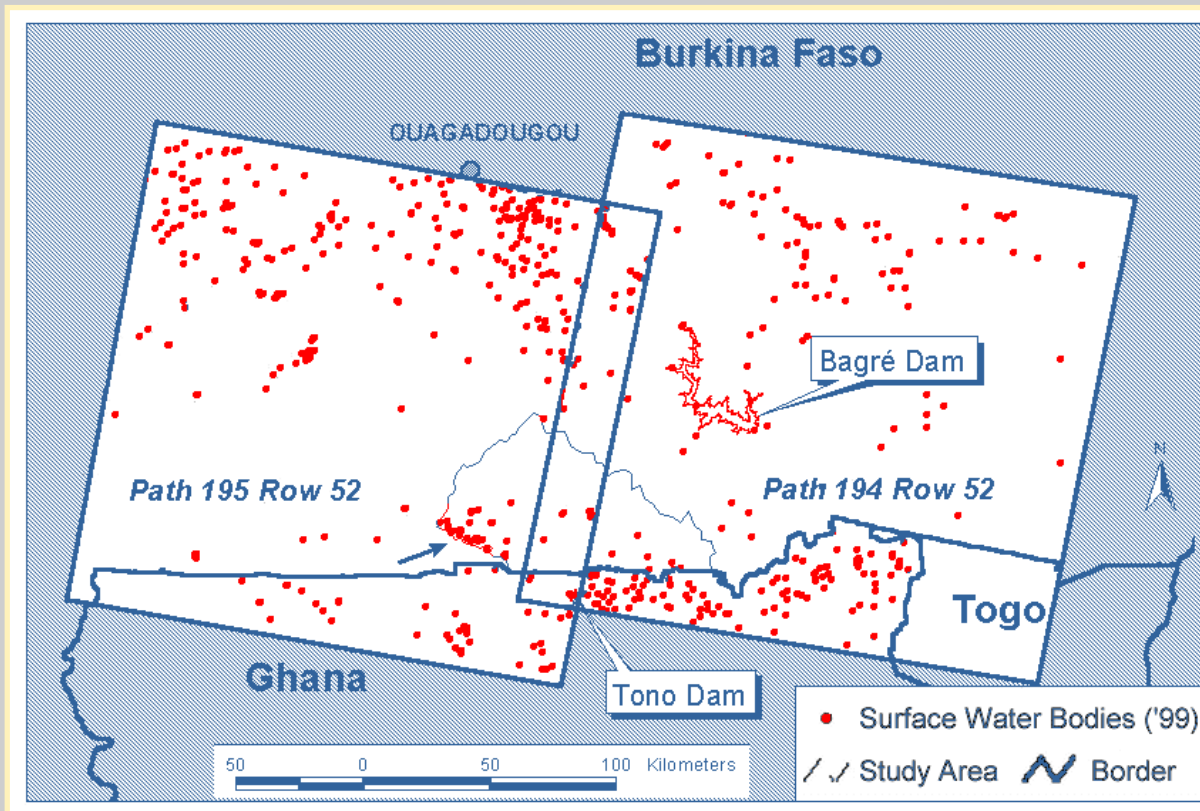
Village level Development 90's

Water demand



Week 1: Volta

Irrigation



IWM Fall 2013

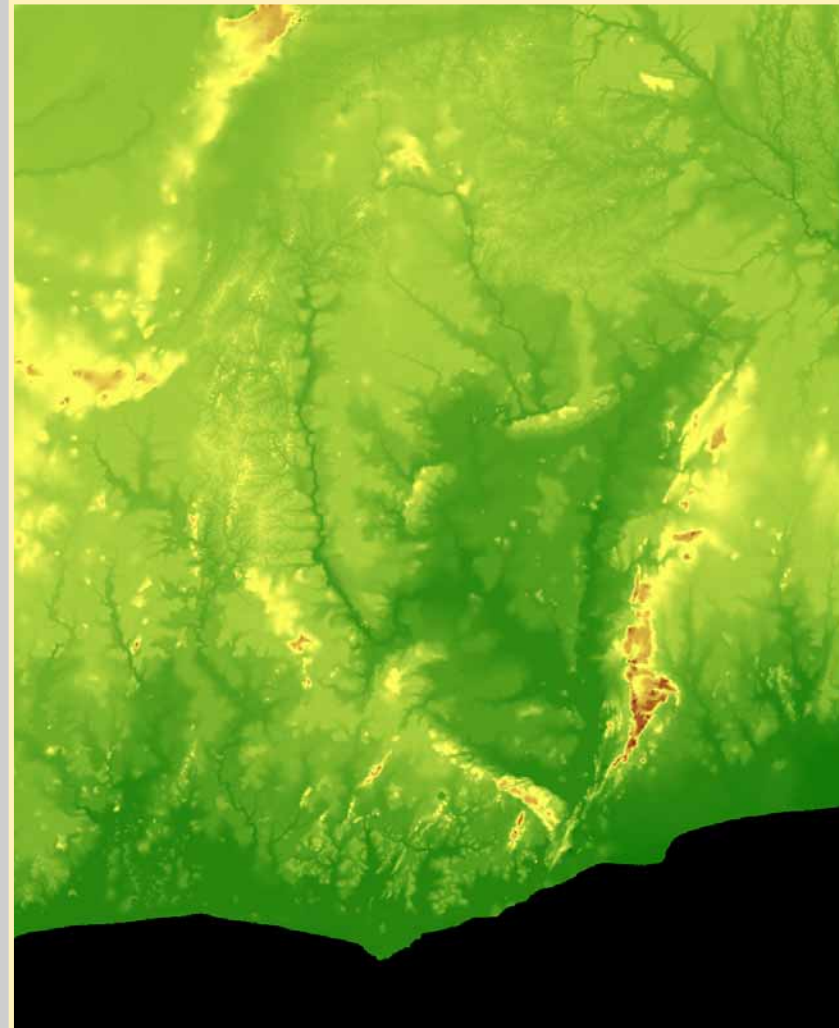
	1984	1999
# Dams	302	710
ha Reservoirs	4134	31200

Water demand



Week 1: Volta

Hydropower



Lake Volta

Water demand



Week 1: Volta

Hydropower



Akosombo

Water demand



Week 1: Volta

Hydropower



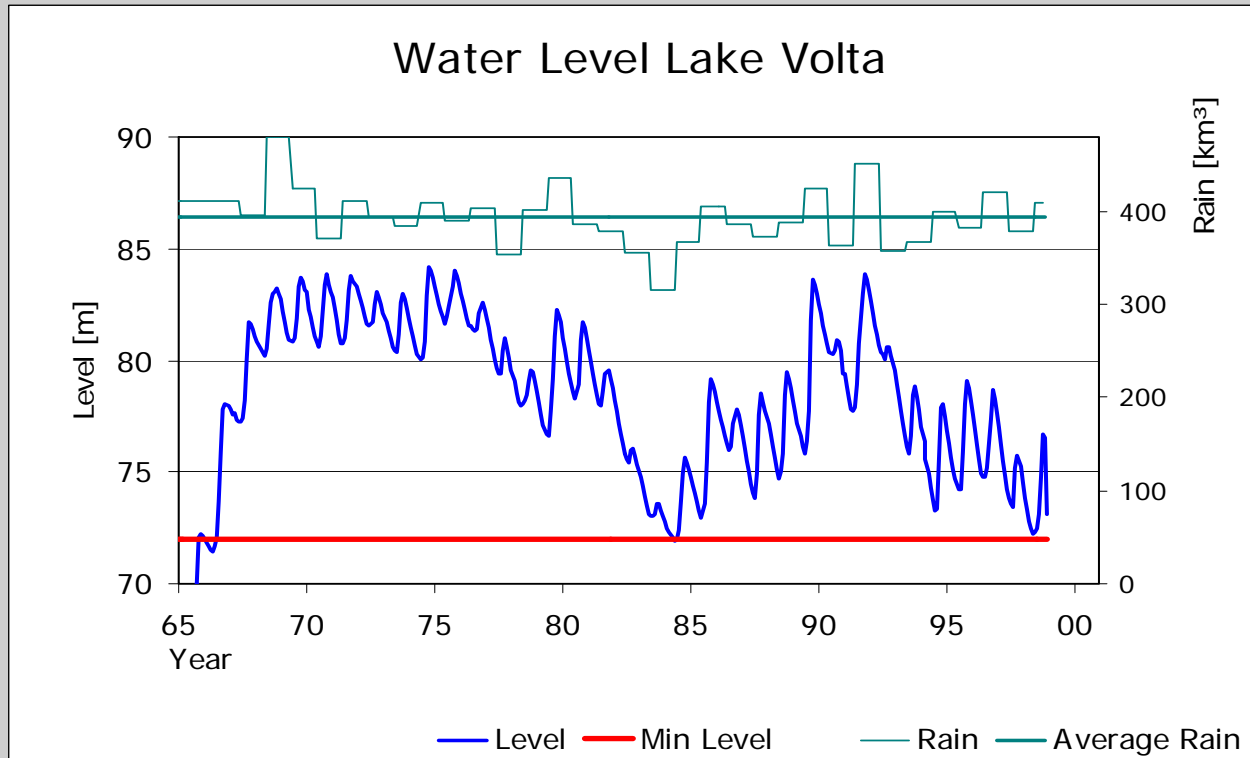
Lake Volta

Water demand



Week 1: Volta

Hydropower



IWM Fall 2013

1970's: Normal use

1984: Real drought

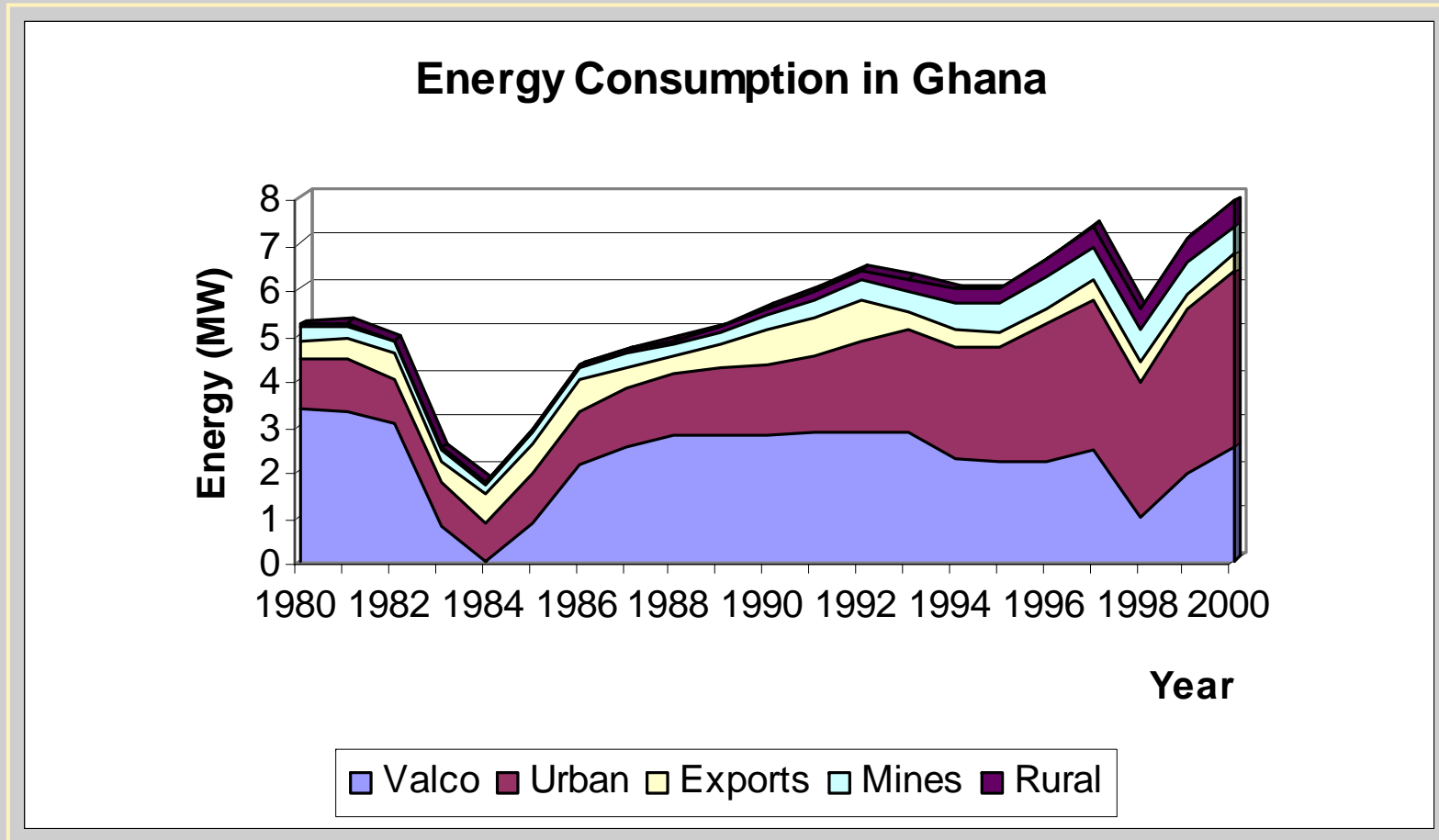
1990's: Increased withdrawals

1998: Minor drought

Water demand



Hydropower



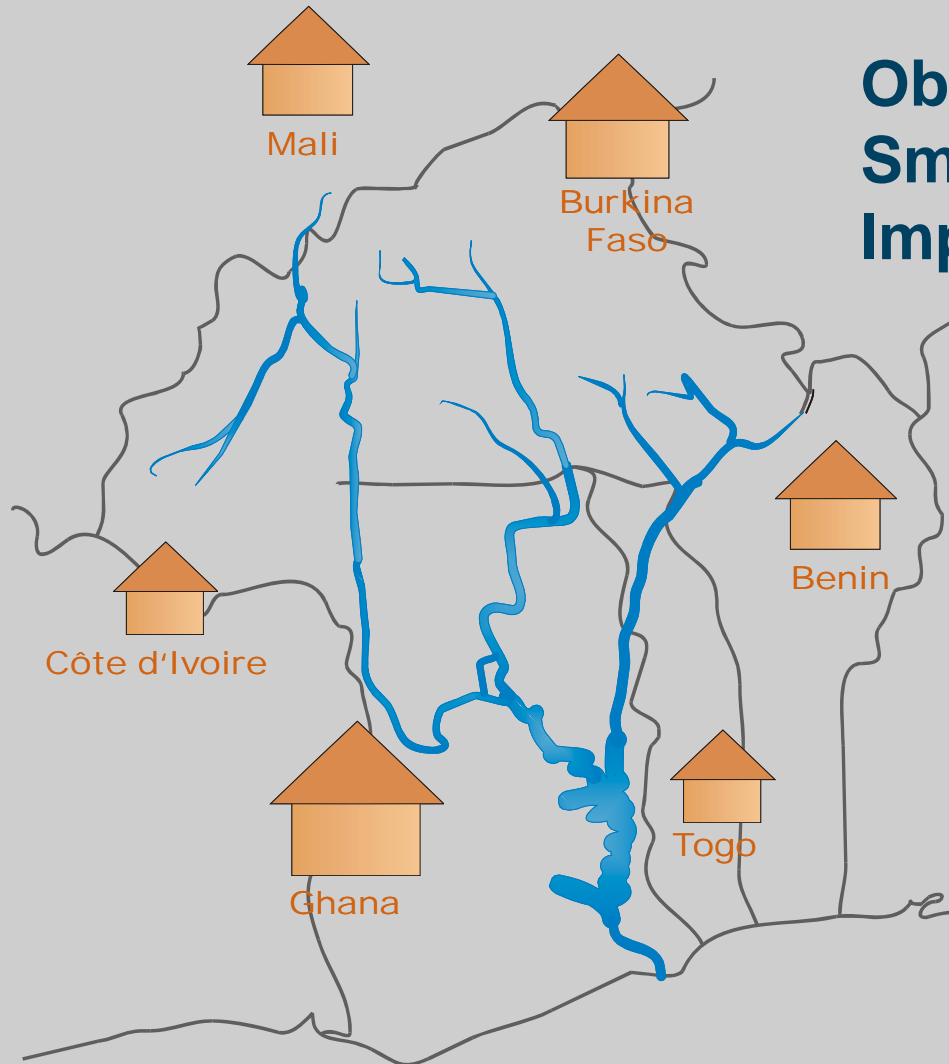
Continuous **increase urban sector**

Water demand



Institutional Development

Objective:
Small scale development
Impact plus & minus





Week 1: Volta

Clients

Objective:

Small scale development
Impact plus & minus

- Volta River Authority (Power Company Ghana)
- DGIRH (Water Ministry Burkina Faso)
- Irrigation Development Authority (Ghana)
- World Bank (NGO)

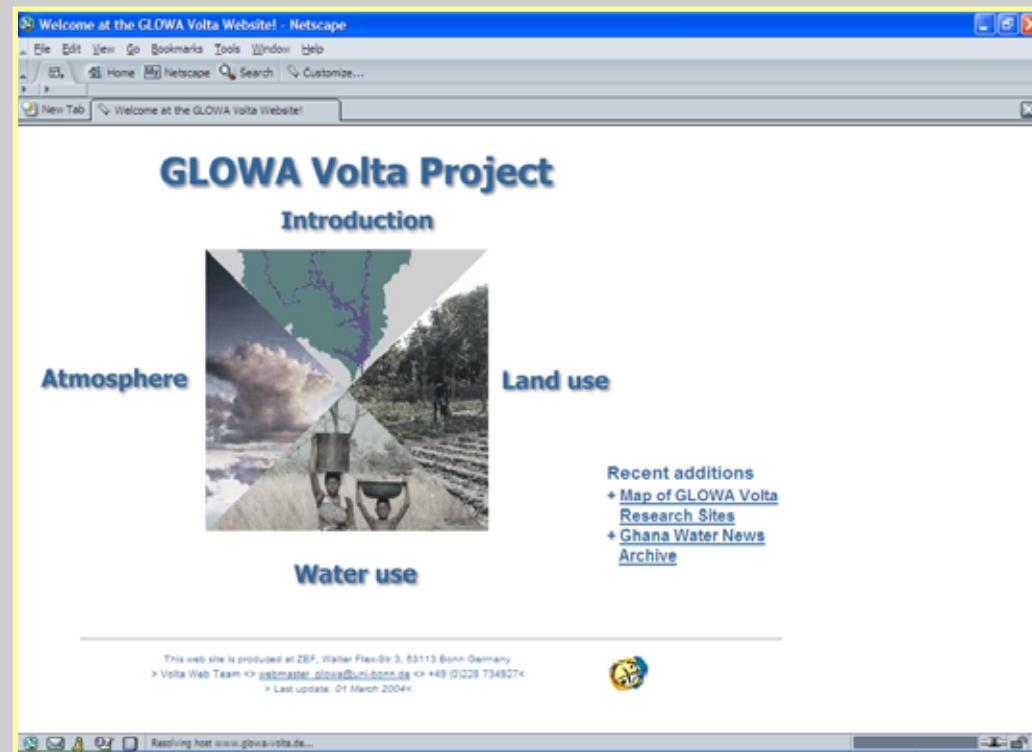


Week 1: Volta

Data

www.glowa-volta.de
www.smallreservoirs.org

Link to data CD
on BlackBoard





Week 1: Volta

Data





Week 1: Volta

Data

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n.c.vandegiesen@tudelft.nl