ACC DAR Adapting to Climate Change in Coastal Dar es Salaam

Technical Workshop on Monitoring Seawater Intrusion in Coastal Groundwater

CLIMATE CHANGE EFFECTS ON GROUNDWATER IN COASTAL AREAS

Dar es Salaam, 14 November 2011

Centro Interuniversitario di Ricerca Per lo Sviluppo sostenibile - CIRPS

Sapienza Università di Roma

Giuseppe FALDI

SAPIENZA University of Rome (DIAEE)

giuseppe.faldi@yahoo.com

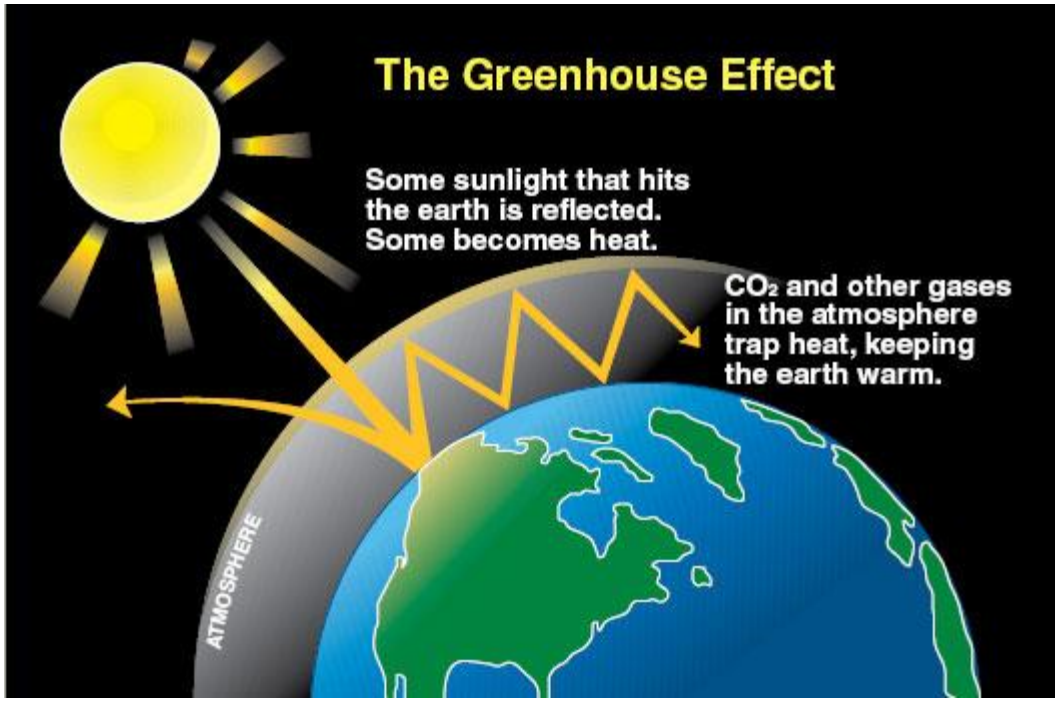
CLIMATE CHANGE: definition

DEFINITION

Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods

(UNFCCC, 21 March 1994)

→ In this sense the term climate change is used as synonymous with anthropogenic global warming, because of increased concentration of greenhouse gases (GHGs)



CLIMATE CHANGE: a fast history

DEVELOPMENT OF THE CONCEPT OF CLIMATE CHANGE

1978 First World Climate Conference - World Meteorological Organization (WMO)

First concerns on climate change; election of an international Commission for assessing the status, causes and conseguences of climate change on global scale

1988 Institution of the IPCC (Intergovernamental Panel on Climate Change)

Working Group 1 (WG1): assessing the scientific aspects of the climate system and its changes over time

Working Group 2 (WG2): assessing the vulnerability of socioeconomic and natural systems to climate change and adaptation strategies

Working Group 3(WG3): evaluate possible strategies for limiting emissions of GHGs and for the mitigation of climate change

1992 Institution of the UNFCCC (United Nations Framework Convention on Climate Change),during the United Nations Conference on Environment and Development, Rio de Janeiro

First legal instrument on climate change, with the goal of signing international agreements on reducing emissions of GHGs in the atmosphere

1997 Kyoto Protocoll

Internation agreement for regulamentation of GHGs emissions (reduction of 6%-8% before 2012 from the emission level in 1990) [USA and Australia do not stipulated the Protocoll]

2009 United Nations Climate Change Conference, Copenaghen

Failure in the proposal of limitating GHGs emission for 2020. No international agreements were stipulated

VULNERABILITY TO CLIMATE CHANGE

Climate change

→ is internationally recognized as one of the most important and complex challenges for the society of the XXI century

→ acts as a "threat multiplier" that accelerates and magnifies trends, tensions and instability

→ raises issues of enormous importance on social justice, equality and human rights for all nations and for all generations

Inequality between those who are the cause and who will suffer the most serious consequences

VULNERABILITY TO CC

degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC, 2007).

Vulnerability = f (Exposure, Sensitivity, Adaptive Capacity)

Under this approach, people vulnerability result from the interaction between:

Physical Factors → potential that an environmental system can be damaged by the consequences of a harmful event and therefore identify the degree of exposure of humans to the perturbation

Social Factors → ability of individuals and communities to cope with disturbance, absorb impact, recover, or adapt to change (sensitivity of the social system)

COPING WITH CLIMATE CHANGE

MITIGATION = Reduction in GHGs emission .

Long Term strategies, Global Level by international agreements, Industrialized Country

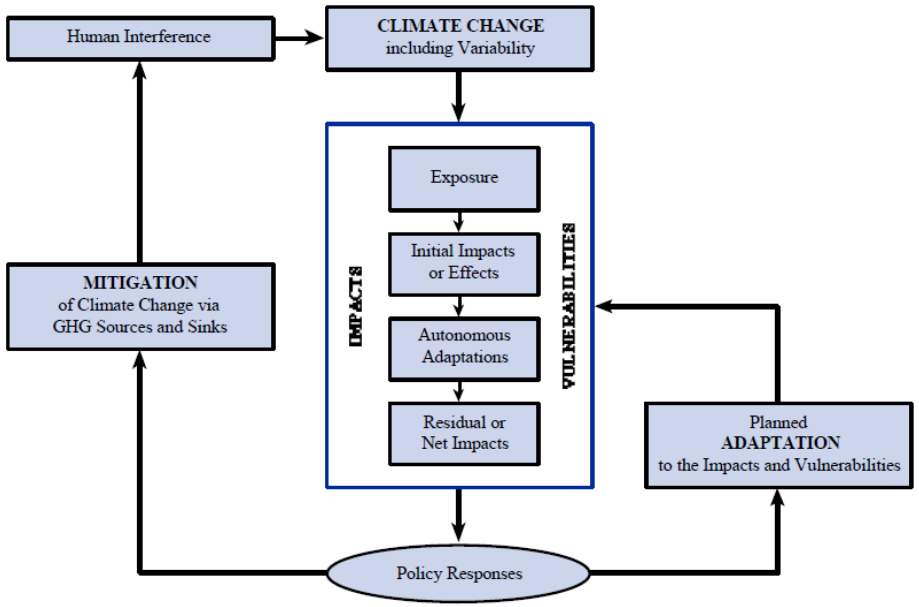
ADAPTATION = Enhance people adaptive capacity and limit the environmental, social and economic risk to climate change

Mid-Short Term strategies, Local Level, Developing Country

Adaptive capacity of a social or natural system, against the consequences of climate change: "The ability of a system to adapt to climate change (including climate variability and extremes) to reduce the potential damages, exploit opportunities, and to cope with the adverse consequences" (IPCC, 2007)

→ indirectly proportional to the vulnerability and varies considerably between different Countries, Regions and Socioeconomic Groups

At present, the policy measures to cope with CC continue to remain below the minimum level needed to solve the problem, although in recent years at international level (UNFCCC) have moved the first steps to take responsibility (financial compensation for adaptation actions) by the Industrialized Countries to the Developing ones



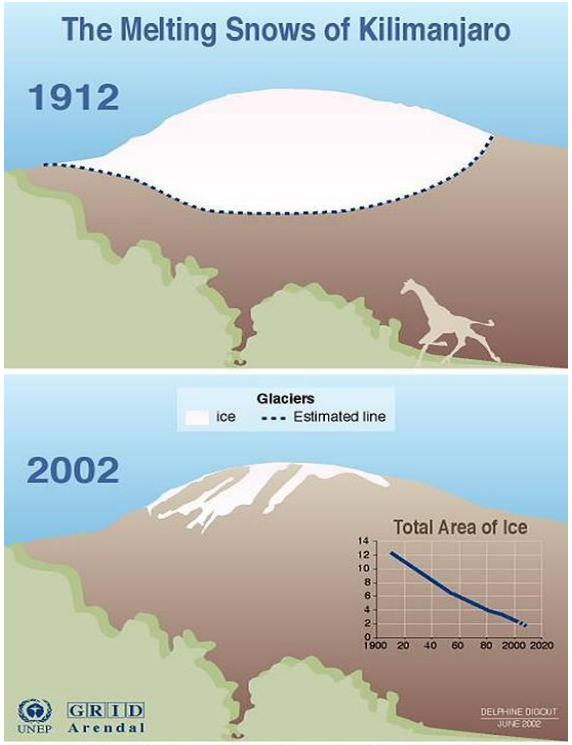
IPCC International framework for assessing the effects of climate change and the types of possible responses

CONSEQUENCES OF GLOBAL WARMING

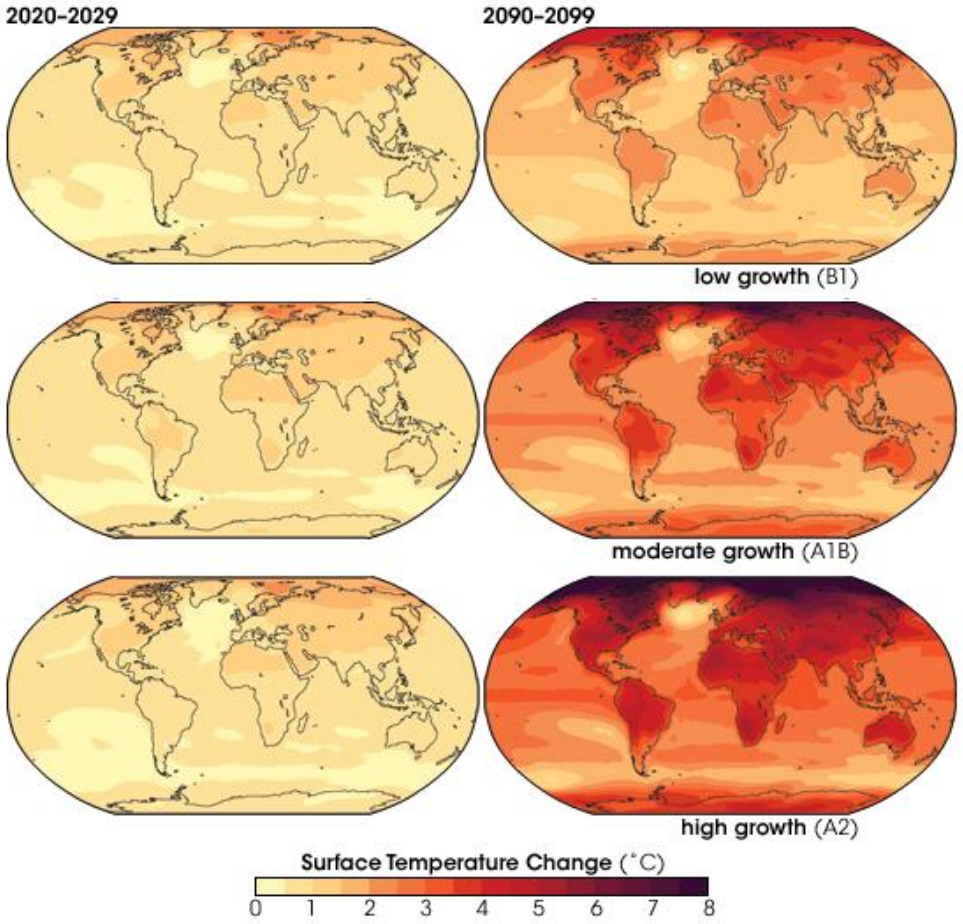
SURFACE TEMPERATURE INCREASE

From 1,4 ° C to 5,8 ° C between 1990 and 2100

Decreases in snow cover and sea ice



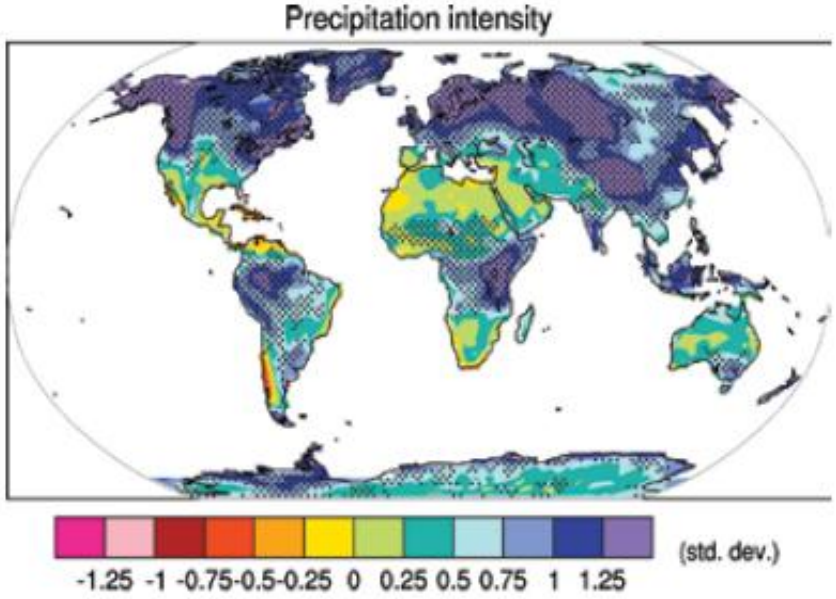
Sources: Meeting of the American Association for the Advancement of Science (AAAS), February 2001 ; Earthobservatory.nasa.gov.



Source: IPCC, *Climate Change 2007: Impacts, Adaptation and Vulnerability*, 2007

CONSEQUENCES OF GLOBAL WARMING

Change in rainfall pattern and increases in the frequency of intense rainfall



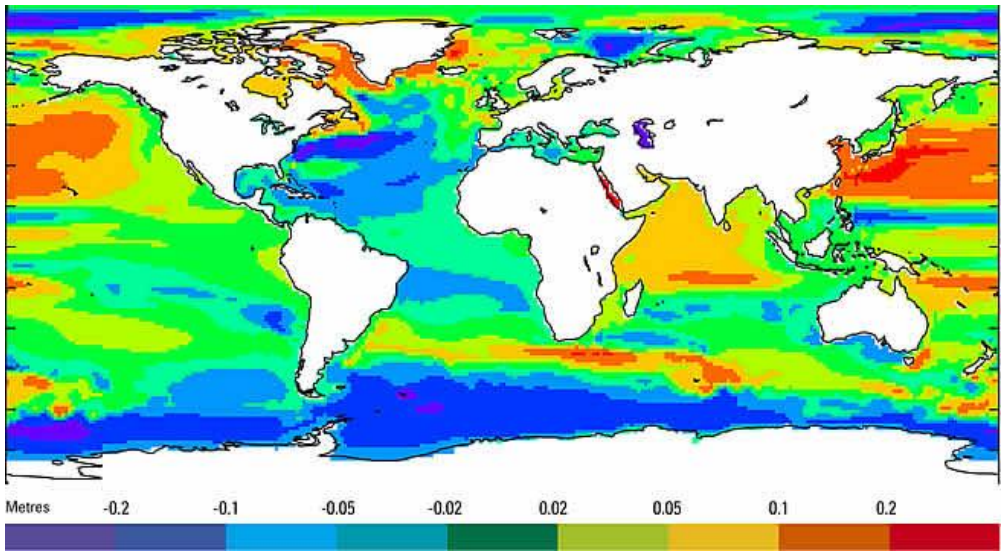
Scenario 2090 – 2099 (IPCC, 2007)

Increase in extreme climate events, such as drought, hurricane, typhon, etc.

More frequent and intense Heat Waves

Sea Level Rise

From 10 cm up to 50 cm in the next 100 years IPCC



Scenario 2090 – 2099 (IPCC, 2007)

Ocean Temperature Rise

Widespread Ocean Acidification

IMPACTS OF CLIMATE CHANGE

Change	*Impact on agriculture & water*	*Impact on urban areas*	*Impact on health*
Warm spells and heat waves frequency up on most land areas	Reduced crop yields in warmer regions, wildfire risk up	Heat islands with higher temperatures (up to 10°); often large concentrations of vulnerable populations; air pollution worsened.	Increased risk of heat-related mortality and morbidity; increased respiratory disease if air pollution worsens, new disease ecologies (eg malaria spreading its range)
Heavy precipitation events, frequency up over most areas	Damage to crops, soil erosion, water-logging, water quality problems	Disruption to assets, livelihoods and city economies, damage to physical capital such as homes, possessions, financial capital from businesses and to transport and infrastructure; often large displacements of population, with risks to networks and social capital	Flooding & landslide risks up; deaths, injuries, water-borne diseases; dis-locations; risks to mental health, especially associated with displacement
Intense tropical cyclone activity increases	Damage to crops, trees and coral reefs, disruption to water supplies		Risk of deaths, injuries and food and water-borne diseases up
Increased area affected by **drought**	Land degradation, lower crop yields, livestock deaths, wildfire risks and water stress up	Water shortages, distress migration into urban centres, hydro-electric constraints, lower rural demand for goods/services	Increased food & water shortages, malnutrition and food and water borne diseases up
Increased incidence of **extreme high sea level**	Salinization of water sources	Permanent erosion and submersion of land, Loss of property and livelihoods, damage to tourism, damage to buildings from rising water table	Coastal flooding, increasing risk of death and injuries

Source: IPCC, 2007

ACC DAR PROJECT

WP2: Develop Methodologies for Designing Adaptation Initiatives

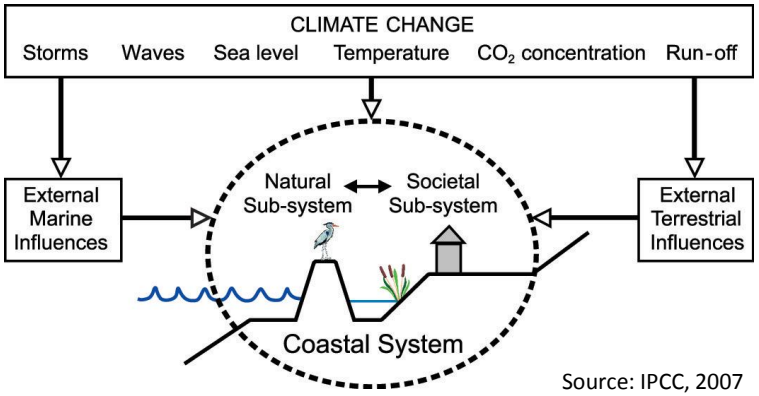
Activity 2.2 Develop methodologies for exploring CC vulnerability scenarios

TOPIC TO BE INVESTIGATED: seawater intrusion in coastal aquifer

CC EFFECTS ON GROUNDWATER IN COASTAL AREAS

as regards seawater intrusion phenomenon

Difficult to foresee climate change effects in a such complex environment as coastal areas, especially in urban areas



Source: IPCC, 2007

NATURAL FACTORS
- *NATURAL VARIATION IN AQUIFER RECHARGE*
- *TIDAL EFFECT*

ANTHROPOGENIC FACTORS
- *OVEREXPLOTATION OF COASTAL AQUIFER*
- *CHANGE IN LAND USE*

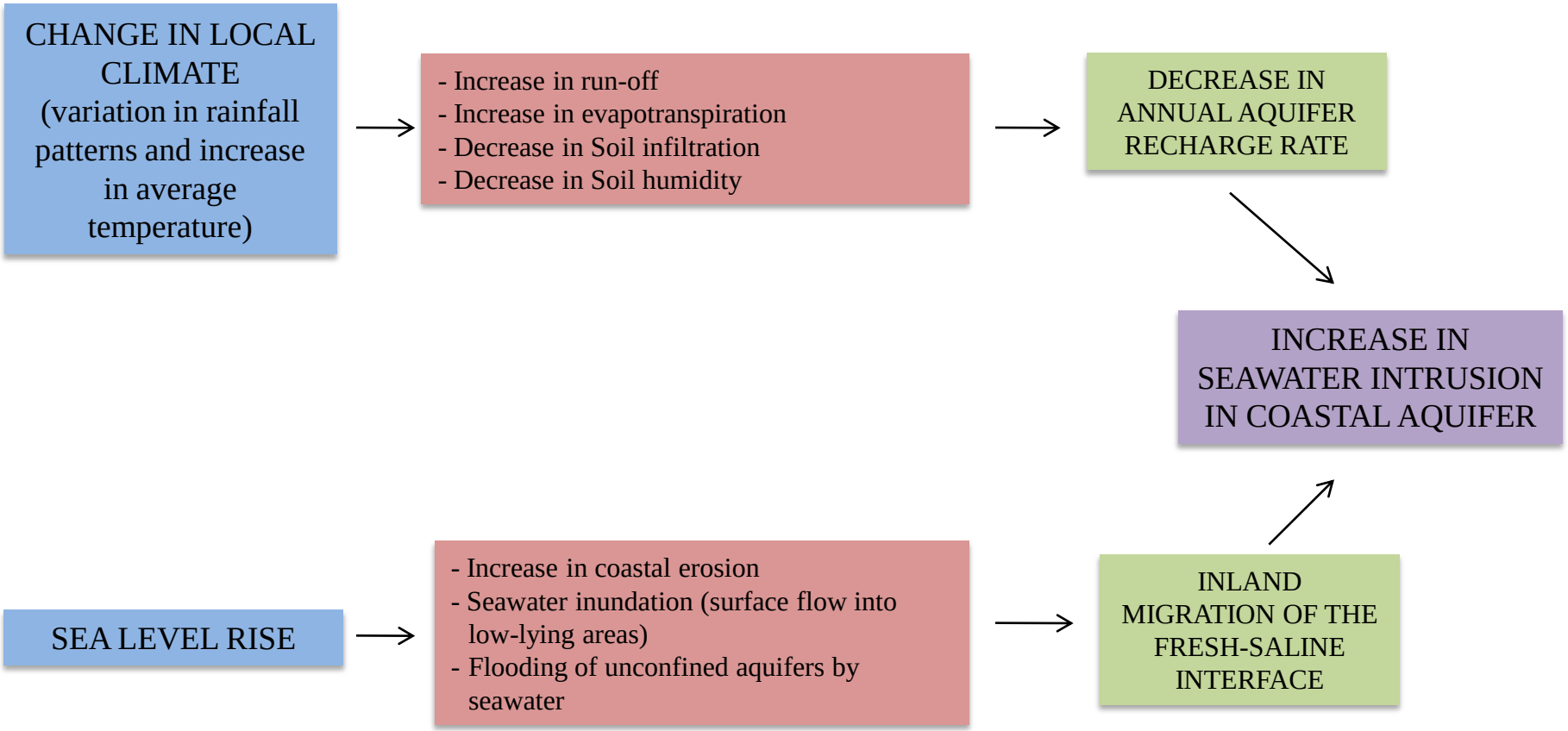
SEAWATER INTRUSION

CLIMATE CHANGE
- *CHANGE IN LOCAL CLIMATE (temperature, rainfall pattern)*
- *SEA LEVEL RISE*

CC EFFECTS ON GROUNDWATER IN COASTAL AREAS

as regards seawater intrusion phenomenon

CLIMATIC FACTORS



CC EFFECTS ON GROUNDWATER IN COASTAL AREAS

as regards seawater intrusion phenomenon

ANTROPHOGENIC FACTORS