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Groundwater Dependent Ecosystems (GDEs) and climate change: A vulnerability assessment

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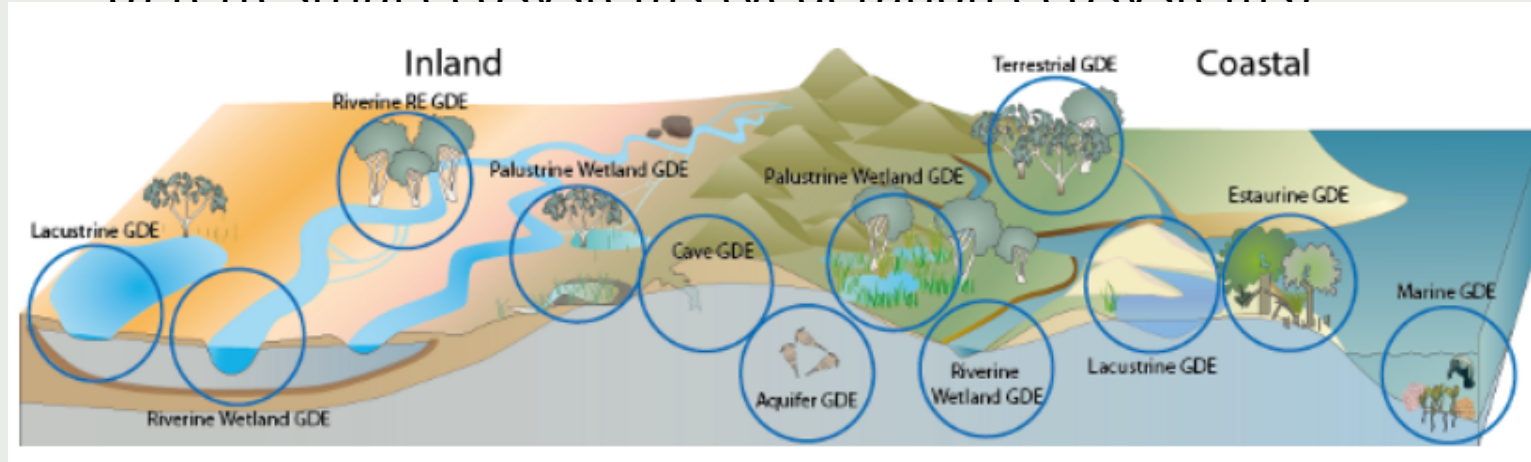


Introduction

Groundwater Dependent Ecosystems (GDEs)

Ecosystems rely on groundwater to **fulfil all or part of their water requirements**

Types of GDE: a) freshwater ecosystems, near-shore marine, estuarine ecosystems such as springs, wetlands, rivers, cave and aquifer ecosystems
b) terrestrial ecosystems (vegetation ecosystems)



Source: <https://wetlandinfo.des.qld.gov.au>

Introduction

GDEs value

Ecosystems services: benefits that people obtain from ecosystems and the direct and indirect contribution of ecosystems to human well-being such as:

- water source (e.g. spring water)
- food supply
- cultural/recreational services

Factors of GDEs vulnerability:

- groundwater depletion (over-exploitation)
- groundwater quality degradation (saltwater intrusion, nitrate pollution, etc)
- climate change (foreseen additional pressure on groundwater availability and quality)

GDEs related legislation and policy

European legislation and policy

- **European Directive 2006/118/EC:** protection of groundwater against pollution and deterioration
- **European Directive 2000/60/EC:** framework for Community action in the field of water policy
 - **Emphasize the need** for ensuring GDEs protection
 - State that **quantitative and qualitative status of groundwater systems** have effects on GDEs sustainability
 - **Threshold values** for pollutants should be established by the Member States based on interactions between groundwater and associated aquatic and dependent terrestrial ecosystems.

GDEs related legislation and policy

Australian legislation and policy

- **National Water Initiative** (2004), Council of Australian Governments (COAG):
 - ✓ specify that surface water, groundwater systems and their dependent ecosystems should be incorporated in states water frameworks
 - **Groundwater Dependent Ecosystems Atlas (GDE Atlas):** National Dataset of Australian GDEs:
 - ✓ expresses the **potential for groundwater interaction/use** for river/spring/wetland and vegetation ecosystems across Australia
 - ✓ **categorize GDEs** depending on their interaction status with groundwater:
high, moderate or low potential for groundwater interaction
- Scope:**
- ✓ to regularly update groundwater planning and management practices
 - ✓ to ensure that all the GDEs are included in the water management decisions

GDEs related legislation and policy

United States legislation and policy

- ✓ Water resources management strategies in the United States are generally designed and implemented by each state
- ✓ GDEs protection policies **vary greatly among the states**
- ✓ Some states provide indirectly and/or direct protection to GDEs by:
 - Recognizing **water rights** for citizens (drinking, agriculture use, etc)
 - Providing protection for surface flows affected by groundwater flows
 - Adopting integrated surface and groundwater management practices
 - Supporting the maintenance of fish population
 - Assessing **changes** in vegetation and wetlands
 - Setting **minimum groundwater levels** to support dependent flora and fauna

GDEs and climate change

Climate change impacts on GDEs and related services:

- Direct and indirect consequences
- Imposed by changes in precipitation and temperature
- Vary among the different types of the GDEs and services

Indicative expected impacts:

- Springs, streams, riparian areas, wetlands: altered hydrology, decrease in size over time
- Groundwater-dependent terrestrial vegetation: negatively affected by foreseen piezometric decrease
- Drinking and irrigation water (GDEs services): vulnerable to salinization imposed by foreseen sea level rise
- Groundwater and GDEs quality: affected by altered groundwater temperatures due to rising air and river temperatures

GDEs monitoring and evaluation

Monitoring groundwater and GDEs response to climatic variables changes -
Examples

Water availability monitoring



- ☐ Abstraction/recharge
- ☐ Groundwater levels
- ☐ Water balance

Physico-chemical characteristics



- ☐ Temperature
- ☐ Dissolved oxygen
- ☐ NO₃

Biological characteristics



- ☐ abundance of species
- ☐ communities composition
- ☐ % tolerant plant species to salinity

GDEs and climate change adaptation

- **Optimize** use of water resources & also ensuring resilience of GDEs and related services
- Examples of **adaptation measures** already proposed and assessed:
 - changes in cropping patterns
 - water transferring
 - recycling and reuse
 - water pricing
- **Main mechanisms of adaptation:** research, education, monitoring, legislation
- Combined use of **monitoring and modeling** to understand **how and to what extent** GDEs are affected by climate change

Discussion and conclusions

- Groundwater and GDEs have a **significant role** in humans prosperity and ecosystems sustainability
- GDEs are vulnerable to changes in climate, particularly in **temperature and precipitation** variations
- Climate change impacts on GDEs vary according the **type of the ecosystem** and **over time and space**
- As changes in groundwater due to climatic variables alteration is generally slow, **long-term monitoring** is recommended for GDEs vulnerability assessment.
- Due to the **uniqueness** of each GDE ecosystem, **case-based measures** should be assessed and adopted



**Thank you for your
attention !!**