GLOBAL STATUS OF GROUNDWATER

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Abstract. This paper provides an overview of the current hydrological, biogeochemical and recharge levels of 37 existing groundwater basins. In addition, the map of drought levels of underground water and the table of climatic indicators of basins are mentioned. Also , the levels of recharge of underground water and indicators by region, solutions for the minimization of anthropogenic impact, and negative and positive situations that may arise through future scientific achievements were discussed.

Key words: Groundwater dynamics, remote sensing, deep aquifers, reservoirs, co-management, anthropogenic impact, groundwater pumping, salinity, GRACE analysis.

Introduction.

Groundwater accounts for 99% of terrestrial freshwater reserves and is the world's most used source and storage of freshwater. In many regions, groundwater is the only constant perennial water source. It is also important in relation to seasonal and long-term changes in surface water availability due to climate change. Groundwater currently provides nearly half of all drinking water, approximately 40% of irrigation water, and 1/3 of all industrial water (1).

Observing and understanding the human and natural dynamics (e.g., biology, physics, chemistry, economics, and sociology) of groundwater systems in response to climate change and regional human activities is important for developing appropriate management strategies and predicting societal outcomes. Significant advances have been made in hydrogeology, geophysics, geostatistics, remote sensing, and applied research in areas of greater groundwater availability. Similar advances in the social science literature have documented the role of various instruments (eg, distribution, regulation, enforcement, pricing, and market relations). Nevertheless, in many cases, groundwater remains invisible at the spatial and temporal scales of management. Aquifers, groundwater users, and pollution sources are diverse. Linking water use and pollution data to human and natural impacts at the appropriate spatial and temporal resolution is challenging. This common pool, resource problem is difficult to predict and manage.

In the following sections we will:

(a) groundwater quantity and quality conditions and main problems,

(b) data limitations and the application of global groundwater models;

(c) examples of groundwater management features and promising strategies;

(d) we synthesise the important future issues.

RESEARCH MATERIALS AND METHODOLOGY

Status of Groundwater Resources: In recent decades, increased interest in groundwater monitoring and management has resulted in research, technology, policy, and practice focusing on groundwater dynamics and its relationship to climate dynamics and human activities. led to a better understanding of Remote sensing at the planetary scale has made it possible to map large-scale changes in groundwater storage. The GRACE (Gravity Recovery and Climate Experiment) satellites have shown that 21 of Earth's 37 major aquifers are drying up (2). Geophysical instruments and techniques provide new measurements that lead to better understanding of subsurface features. (Figure 1).

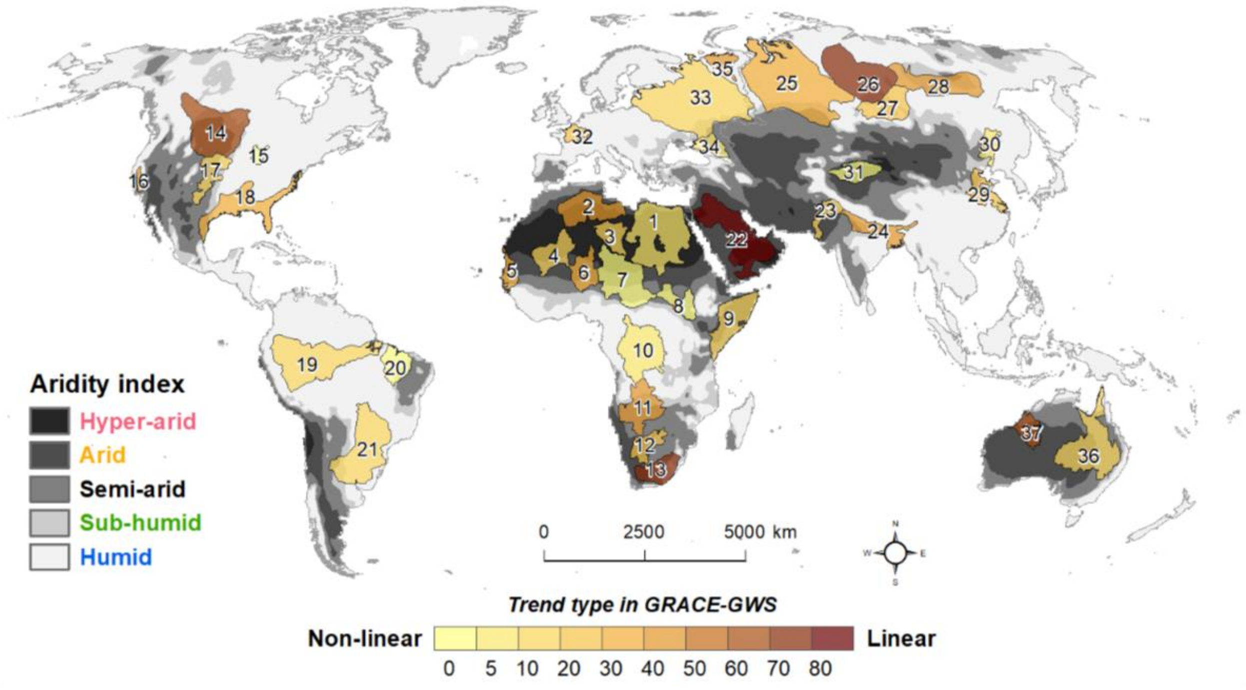


Figure 1. Drought index of underground water bodies in the world.

No	Name of the aquifer	Continent	Climate zone (based on aridity index)	No	Name of the aquifer	Continent	Climate zone (based on aridity index)
1	Nubian sandstone aquifer	Africa	Hyper-dry	20	Maranhao Basin	South America	Wet
2	Northwest Sahara aquifer	Africa	Dry	21	Guaraní Aquifer System (Paraná Basin)	South America	Wet
3	Murzuk-Djado basin	Africa	Hyper-dry	22	Arabian aquifer system	Asia	Dry

4	Taudeni-Tanezrouft basin	Africa	Hyper-dry	23	Indus River Basin	Asia	Semi dry
5	Senegal-Mauritania basin	Africa	Semi dry	24	Ganges-Brahmaputra basin	Asia	Wet
6	Jullenmeden-Irhazer aquifer	Africa	Dry	25	West Siberian artesian basin	Asia	Wet
7	Lake Chad basin	Africa	Dry	26	Tungus Basin	Asia	Wet
8	Umm Ruwaba Aquifer (Sudd Basin)	Africa	Semi dry	27	Angara-Lena basin	Asia	Wet
9	Ogaden-Juba basin	Africa	Dry	28	Ruby Basin	Asia	Wet
10	Congo Basin	Africa	Wet	29	Aquifer system of formations in North China	Asia	Wet
11	Upper Kalahari-Kuvelai-Zambezi Basin	Africa	Semi dry	30	Formation of Songliao	Asia	Wet

12	Lower Kalahari-Stampriet Basin	Africa	Dry	31	Tarim basin	Asia	Dry
13	Karoo Basin	Africa	Semi dry	32	Paris basin	Europe	Wet
14	Northern Great Formation aquifer	North America	Low humidity	33	Northern European aquifer system	Europe	Wet
15	Cambro-Ordovician aquifer system	North America	Wet	34	North Caucasus basin	Europe	Semi dry
16	Aquifer system in the Central Valley of California	North America	Semi dry	35	Pechora basin	Europe	Wet
17	Ogailala Aquifer (High Plains)	North America	Semi dry	36	Kata Artesian Basin	Australia	
18	Atlantic coast formations aquifer	North America	Wet	37	Canning basin	Australia	Dry
19	Amazon basin	South America	Wet				

Table 1: Table of regional and climatic indicators of artesian basins in the world. [7]

Climate variability plays an important role in changes in groundwater storage. For shallow aquifers, changes in saturation due to persistent drought or wet periods have a direct impact.

Due to the lack of global (or even regional) data on deep aquifers, much of the global modeling of groundwater assessment has focused on shallow aquifers, agriculture, and climate dynamics. However, most urban and large-scale agricultural or industrial sites are subject to groundwater extraction. In deep aquifers, recharge is observed to be less sensitive to climate change. They are also observed to be less sensitive to pollution. But deeper aquifers are declining around the world, a trend that has accelerated in the 21st century as the rate of extraction often exceeds the rate of recharge, and groundwater recharge times exceed at least a hundred years.

Determining and measuring (and reporting) the amount of water reabsorbed into deep aquifers remains a practical challenge in groundwater extraction. Unfortunately, this uncertainty is widespread in many groundwater systems , as discussed in previous sections . However, GRACE scientific studies have developed alternative indicators of absorption [3].

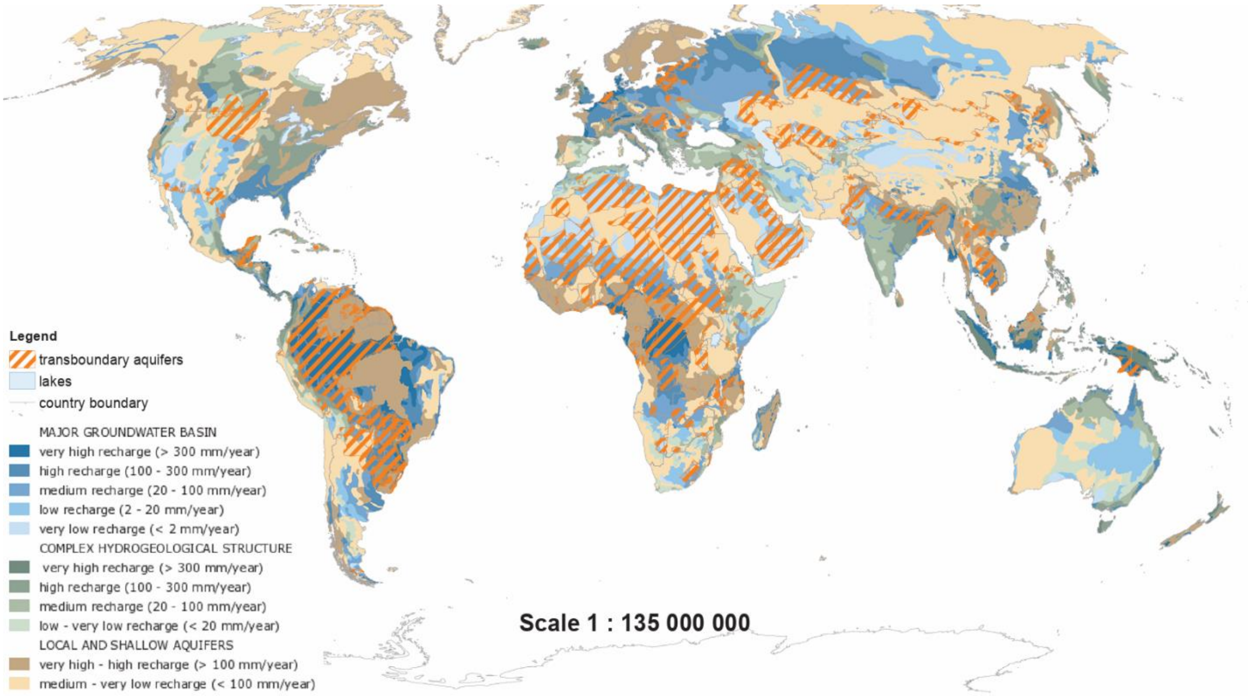
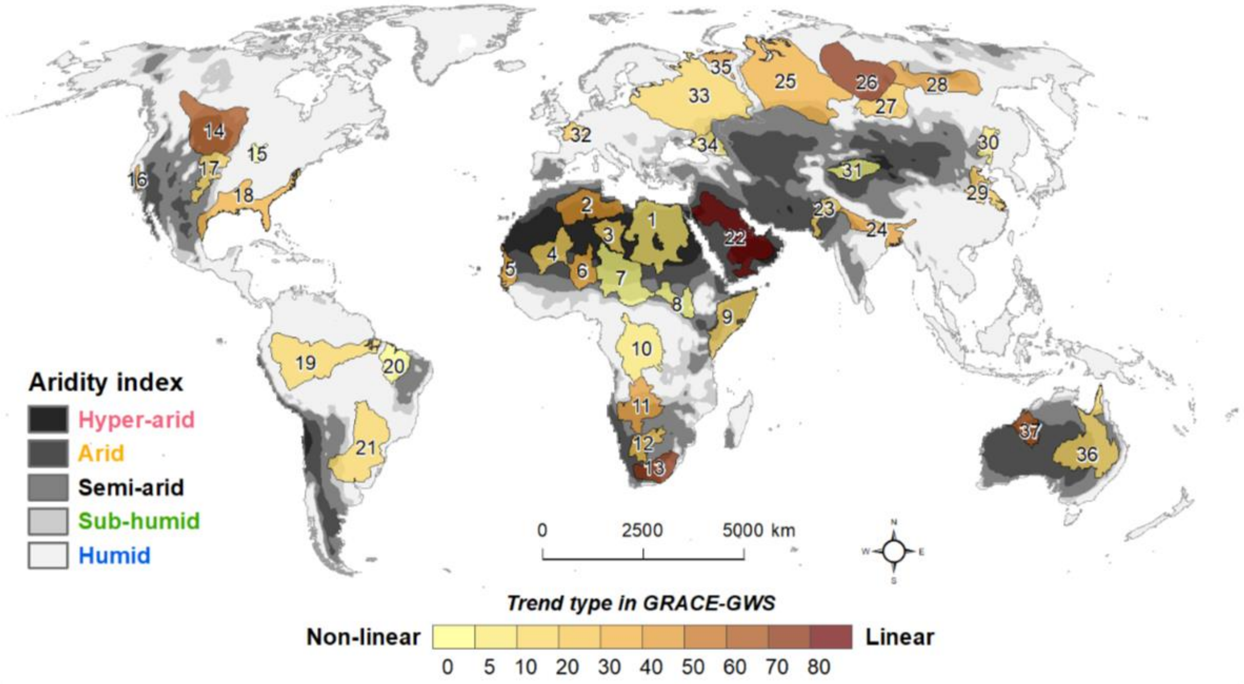


Figure 2. Indicators of groundwater recharge levels and regions [8].



(TBAmap_2015.pdf (un-igrac.org))

RESEARCH RESULTS

Management of quantity and quality through shared use: Monitoring and management of groundwater together with surface water is known as shared use management. Model programs and plans have been developed for water users and managers in order to optimize the speed and timing of extraction of many water resources. Optimization goals for sharing plans; based on reliability, economics, environmental conditions, or a combination thereof. The data gaps discussed above are an important problem in joint use planning. Because it is necessary to accurately simulate the interactions between surface and groundwater systems. Due to the presence of uncertainties in the systems in society, data-driven statistical and mechanism-based computational methods are widely used [4].

reservoirs and minimize anthropogenic impact include:

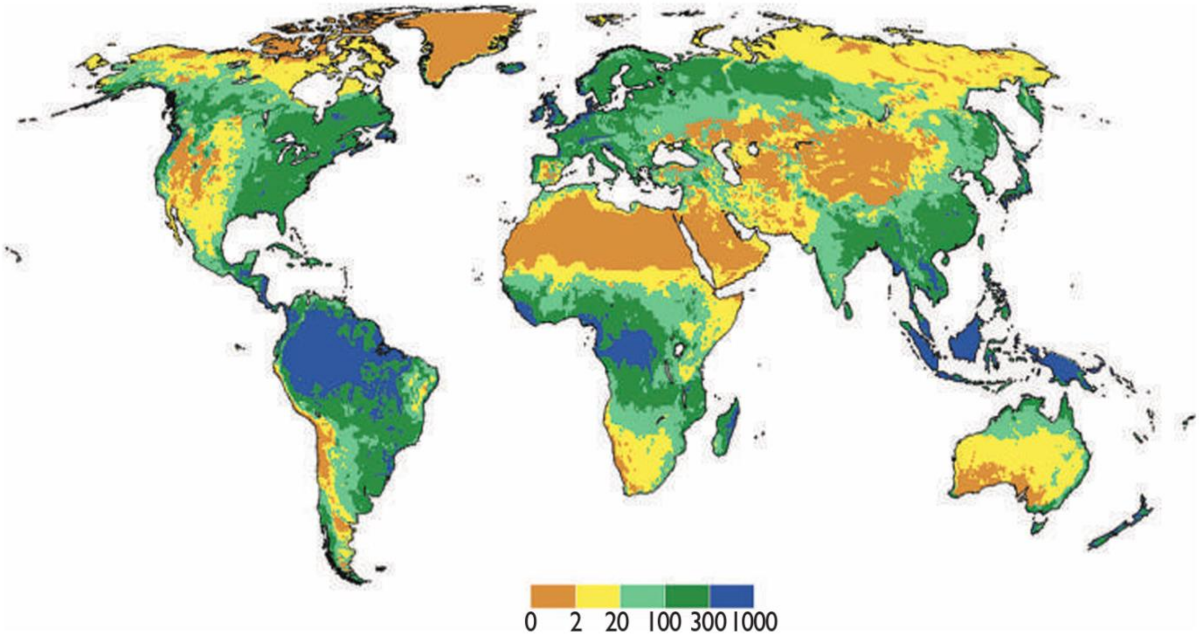
(a) Judicious selection of water sources for use.

(b) Monitoring to identify water sources.

(c) occurrence, impact and transformation of pollutants, treatment of water before use [5].

Although significant progress has been made in optimization models for groundwater management at local and regional scales, many of these models are difficult to apply in practice. They are generally considered to have a specific objective of managing water quality or quantity.

Managed Aquifer Recharge: Transferring and storing water to aquifers is the best option for judicious use combined with aquifer protection. Because underground aquifers are not subject to evaporation like surface aquifers and allow land to be used for other purposes without occupying land. Where surface water or treated wastewater is available, aquifer recharge is being promoted as a component of water sharing.

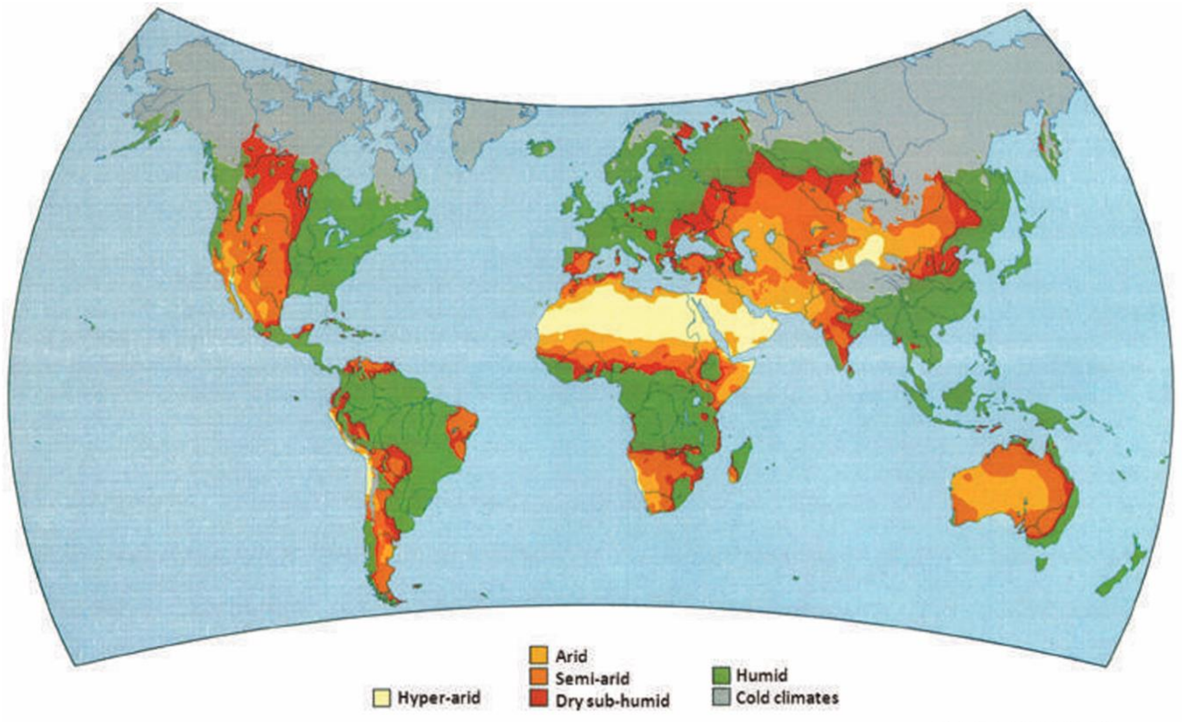


Annual infiltration, global distribution of average annual groundwater recharge in mm/year (1961-2010). (Based on a scale of 1 mm/year = 1,000 m3/year per km ^{2}).[9]

(Groundwater_around_world.pdf (un-igrac.org))

DISCUSSION

Future Issues: 1. Sea-level rise may increase saltwater intrusion, particularly into groundwater systems. As growing coastal cities pump more groundwater, this poses a significant threat to groundwater, especially for residents of coastal cities who rely on "karst aquifers" for consumption. Due to climate change, as well as a growing world population, additional pumping of groundwater is increasing year by year in order to support highly intensive agriculture. If these things continue unregulated, we can predict the disappearance or contamination of groundwater in many regions of the world in the next 50 years based on the above data and GRASE data [6]. In both cases, groundwater crisis can lead to mass displacement of people and drastic changes in the economy.



Distribution of arid and semi-arid regions of the world. [Source: UNESCO 19 94].[9] (Groundwater_around_world.pdf (un-igrac.org)).

2. Renewable energy is expected to become very cheap soon, and this is expected to drive very different future directions for groundwater and surface water, i.e. accelerating the use of groundwater or making desalination and wastewater reuse cheaper.

3. Trends in groundwater quantity and quality and the desire for better information on how to develop better groundwater management practices are growing worldwide. This should lead to improvements, and such systems are increasingly evident, particularly in the way data are collected on groundwater use and quality.

CONCLUSION

In short, published scientific studies and mass media are paying more and more attention to groundwater depletion. Significant changes and many challenges to the sustainability of groundwater resources are being highlighted around the world due to changes in our lifestyles. GRACE analyzes provide a vivid picture of the extent of groundwater depletion. Nevertheless, the consequences of decline and management challenges are largely local and regional. Perhaps global attention to these regional problems will help to better understand the state of resources. In this case and under these circumstances, the challenges associated with anthropogenic groundwater pollution and increased water use, given the costs associated with chronic pollution remediation, which appear as cumulative effects over space and time with the fact that the mobilization of geogenic pollutants can actually occur poses a greater challenge. Climate variability and change will exacerbate these negative groundwater dynamics, resulting in worsening groundwater conditions over time due to limited runoff saturation and the addition of pollutants. Few of the resource problems can be solved, requiring spatial data and conclusions that link the results of the analysis. Synthesis of models in this field includes the process from academic research to their regular application in practice. In the last few decades, the importance and relevance of model synthesis has been shown in science. Therefore, much work remains to be done, to make policy decisions based on important information on resource management and regulation, and to reduce uncertainty for the future of groundwater resources with greater confidence. Using model synthesis as a researcher to better understand climate change adaptation and action on groundwater issues would be appropriate in this regard.

References.

[1]. United Nations WATER. 2018. Groundwater Overview: Making the Invisible Visible. Delft, Neth: Int. Groundw. Resource. Assess. Cent.

[2]. Richey A.S, Thomas B.F , LoM-H, Reager J.T, Famiglietti J.S, et al. 2015. Quantifying renewable ground water stress with GRACE. Water Resour. Res. 51:5217–38.

[3]. Chen J, Famigliett JS, Scanlon BR, Rodell M. 2016. Groundwater storage changes: current status from GRACE observations. In Remote Sensing and Water Resources, ed. A Cazenave, N Champollion, J Benveniste, J Chen, pp. 207–27. Cham, Switz.: Springer.

[4] Milan S.G, Roozbahani A, Banihabib M.E. 2018. Fuzzy optimization model and fuzzy inference system for conjunctive use of surface and groundwater resources. J. Hydrol. 566:421–34.

[5]. Upmanu Lall, Laureline Josette, Tess Russo. A Snapshot of the World's Groundwater Challenges, Columbia University, New York-2020. Pages 172-173.

[6]. Thomas B.F, Famiglietti J.S, Landerer F.W, Wiese D.N, Molotch N.P, Argus D.F. 2017. GRACE groundwater drought index: evaluation of California Central Valley groundwater drought. Remote Sens. Environ. 198:384–92.

[7]. (https://www.annualreviews.org/doi/10.1146/annurev-environ-102017-025800).

[8]. (TBAmap_2015.pdf (un-igrac.org)).

[9]. (Groundwater_around_world.pdf (un-igrac.org)).