Making the unseen groundwater levels a drought indicator

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INTRODUCTION

South Africa is known for droughts and its effect on groundwater. Water levels drop, and some boreholes run dry during low recharge periods. However, how different groundwater levels indicate a drought? Can you put a drought in groundwater on a map?

The Department of Water and Sanitation monitors the water levels of just over a 2000 geosites of which some monitored on a monthly, bi-monthly, quarterly and some bi-yearly base. The data is analysed from a national perspective to assess the groundwater level trends. The analysis is used to inform the management of the Department of Water and Sanitation to make timely decisions to prevent damage or loss to life or livelihoods especially during drought conditions.

METHODS

The whole groundwater level monitoring record is assessed per geosite. From the entire monitoring record, the shallowest and deepest groundwater levels (value) are obtained. The shallowest (Spw) and deepest (Cgw) groundwater levels are subtracted from each other to get a groundwater level range value. The current (Cgw) groundwater level is subtracted from the deepest groundwater level to get a current groundwater level value. The current groundwater level value is presented as a percentage (% of the Groundwater Level Status (GwLS) value (Figure U).

Example:

- Shallowest groundwater level (Spw) = 2.00m
- Deepest groundwater level (Cgw) = -12.00m

Current groundwater level (Cgw) = -5.00m

\[
\text{Status} = \left\{ \begin{array}{ll}
D_gw = \frac{C_{gw} - Spw}{C_{gw} - C_{gw}} \\
(12) & (10) \\
7 & \\
70 & \\
\end{array} \right.
\]

RESULTS

The method allows the comparison of any geosite/borehole level with each other on the same scale. The GwLS values of geosite within an aquifer/region (specific define area) can be average to present an Average GwLS that is presentable on a map and graphs. Alternatively, present the GwLS in specific Class Ranges. (Figure V)

Mapping Mapping the individual GwLS of each geosite/ boreholes resulted in a cluster map in areas of high-density monitoring (Figure W-1).

The country is divide with 40x40 cell grid and averages the GwLS values within each cell (Figure W-2).

DISCUSSION

The term “Risk” is used to describe the GwLS if presented against the percentiles of the historical groundwater levels (Figure X.). The Risk graph provides a visual presentation to indicate drought conditions. Restriction on groundwater abstraction can be implemented timeously before any negative impacts occur.

Reporting The national monitoring network provides a national perspective with a regional analysis (Figure Y). The methodology can be applied to a local level if detail monitoring information is available. Reporting on a monthly or quarterly bases per province with a focus on regional areas allows the distribution of results in an informative and understandable manner. The audience consist of Senior Managers, Regional Office Heads, groundwater sections, and the public.

CONCLUSIONS

The Groundwater Level Status methodology allows the comparison of groundwater level data of any geosite / borehole with each other on the same scale. The Averages of the Groundwater Level Status can be plotted on a map, classed into ranges and Risk profiles developed for decision makers.

The methodology can be applied on an Aquifer Region or wellfield / local aquifer scale as a Sustainable Development Goal indicator or as a drought indicator.

References:


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