KNW-Water: Thema Drought

Statement of purpose:

The overall aim of the Knowledge Network Water is to identify knowledge needs in the Dutch water sector that can be addressed by future space missions or by advanced use of planned/existing space infrastructure and Earth Observation (EO) that are presently at low Technology Readiness Levels (TRL 1/2/31). Pragmatic solutions based on existing or near-future EO platforms for present day problems need to be identified and prioritized. As numerical simulation models play an important role in modern water management, special attention will be paid to improving the present models and their parameterization through EO.

The 2018-2022 droughts created social distress, induced huge economic losses in agricultural production and degradation in agriculture and nature ecosystems. The assessment of the responses and resilience of plants and ecosystems to droughts requires combining multi-spectral, thermal infrared, and microwave satellite (future) missions, in-situ observations, advanced models, and machine learning algorithms.

This online document will serve as a living document to collect shared needs, ideas/issues, potential solution pathways (EO-based)/feedbacks on the topic of drought monitoring. The aim is to develop a roadmap on drought monitoring/prediction that will link TRL1/2/3 concepts to pragmatic solutions for real-world problems in the Dutch water sector.

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Jun-18, 2024 | KNW-Water Kickoff Meeting, Drought group

Attendees: Joost Heijkers, Marloes Mul, Joost Brombacher, Theo Brandsma, Jolien Diekema, Rogier van der Velde, Mattijn van Hoek, Arthur Lutz, Paul Vermunt, Joost Beckers, Jesse Schoenmakers, Qianqian Han, Yijian Zeng

Recap:

Following our insightful discussion on the shared need for EO-based drought monitoring, I am pleased to share the draft meeting minutes. You can review the minutes by clicking this link. Your suggestions, comments, and adjustments are most welcome. Below is a brief summary of our discussions:

1. **Using Satellite Data/Products for drought observations/ monitoring:** different drought types (eg meteorological, hydrological, agricultural) can be monitored using remote sensing data/products. Different indicators identified include, precipitation deficit, SPEI, etc, which require different spatial and temporal resolution depending on their application. Identified RS products: precipitation, reference ET, actual ET, groundwater/surface water, rootzone soil moisture, biomass production, with varying spatial/temporal resolution and uncertainty estimates.
2. **Validation of Satellite Data/Products**: The validation of satellite data/products (e.g., ET, Surface/Root-Zone SM) is critically important. Our discussion highlighted the need to invest in in-situ ground-truthing observation networks to support future EO missions. These networks are essential for validating satellite data, quantifying uncertainty, and bridging the gap between satellite products and their application in policy-making, decision-making, and daily operations. Notably, stakeholders (companies) have expressed willingness to support and invest in such in-situ research infrastructure.
3. **Translation of Research to Application**: It was noted that the process of translating research-grade EO-based drought information and knowledge into practical applications for multi-level stakeholders and users can take many years (and steps). This underscores the need for sustained investment and collaboration to ensure that EO-based solutions can be effectively utilized.

Notes

A. Essential water variables like precipitation, evapotranspiration (ET), surface and root zone soil moisture, river discharge, groundwater table are crucial for drought monitoring.

The discussion was heated-up on validation of the ET estimation for different land cover types. Currently, the number of Eddy Covariance Stations in the Netherlands is still limited, which is not helpful to have a full picture on understanding ET across the Dutch ecosystems. If there will be a space mission dedicated to monitor ET at high spatiotemporal resolutions, it would be very well appreciated by the community.

B. For the water board in the Netherlands, the precipitation deficit ('neerslagtekort') is used to quantify meteorological drought, for which reference evapotranspiration is needed (wherein the Makkink formula is used). Water boards used this indicator for defining policy and strategy against drought.

C. For the drinking water company (for example, Vitens), the key concerns include:
    I. how will drought impact groundwater resources in future? Or more in general, how quick the groundwater resource will be depleted and what measures shall be sought to prepare for such 'dire' future under the dropback of environmental and climatic changes?
    II. During drought year, farmers are using NHI/LHM model simulation results to report drought damage and claim compensation from Vitens, which is about 30 million euros per year (?). It becomes then very important how to quantify such drought damage. If in-situ or space-based monitoring of ET could be in place for high spatial resolution (e.g. at parcel scale), these data will help greatly to quantify the drought damage.
    III. There are ca. 9000 GW monitoring wells at Vitens. If the new EO mission can help, in certain way, reduce such intensive GW monitoring need to a certain optimal degree, that would be very helpful.

D. KNMI is going to produce 1km products (based on DTE projects?), including ET_act product.

E. There are currently so many ET products (including Precipitation, Surface/Root-zone soil moisture) . Perhaps an idea is to produce ET ensemble mean with relevant uncertainty range. Such product with uncertainty bounds will be welcomed by policy/decision-makers.

F. The drought risk assessment mapping (HKV) is discussed, in terms of probability of drought occurrence (return period etc.), which can support the development of relevant insurance products. It is noted that for such assessment, one also needs to define the vulnerability and exposure.

G. GRACE Downscaling data was mentioned to support the need of GW data at regional scale.

H. We shall also pay attention to land subsidence, particularly in the western part of the country, drought is very much linked to land subsidence.

With the above discussions, two important points can be summarized as below:

1. The validation of satellite data/products (i.e., ET, Surface/Root-Zone SM) is paramountingly important. From the discussion, it becomes clear that although we are collecting ideas (shared need) for future EO missions on monitoring drought, we also need to invest on in-situ ground-truthing observation networks. Such in-situ research infrastructure is very much needed to validate satellite data, quantify uncertainty, and bridge the gap from the satellite product to its use in policy/decision-making, and daily operations. And stakeholders (companies) are willing to support/invest in such in-situ research infrastructure.
2. It should be noted that it takes many years for translating research-grade EO-based data and knowledge to be applied by multi-level stakeholders/users.