Towards a sustainable future scenario and pathways for subsidence in the Netherlands

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Introduction:

Natural-induced and human-induced soil subsidence has been going on for centuries in peat meadows area in the Netherlands. Water indexation has been the dominant procedure for dealing with soil subsidence for many years, which caused irreversible subsidence of several meters in a wide extent of this area. As a result of the acceleration of climate change and sea level rise, there is a need to study different soil subsidence scenarios of different possible adaptation and mitigation measures in order to highlight all potential near and far future outcomes in terms of socio-economic and sustainability, and to help different stakeholders and decision makers in choose the appropriate pathways for the near and far future.

Why are new soil subsidence scenarios important?

Previous nation-wide subsidence scenarios were based on lowering ground water level (indexation) or stabilizing water level at the current situation (fixation) under different climate change scenarios. Therefore, there is a gap here represented in not taking into account different levels of raising water level (mainly the low ground water level: GLG) by raising the surface water level in ditches and channels or by using other measures including the shifting towards land use / land cover changes and agricultural policies in order to reduce dehydration of the top soft soil, Because this dehydration process represents the main subsidence driver in shallow soil in the Netherlands. Therefore, the choice of any measure should be informed by the optimal GLG level, as well as socio-economic and sustainability while taking into consideration the significant acceleration in climate change that was highlighted in the new climate change scenarios KNMI'23.

Observed trends and scenarios of climate change's variables:

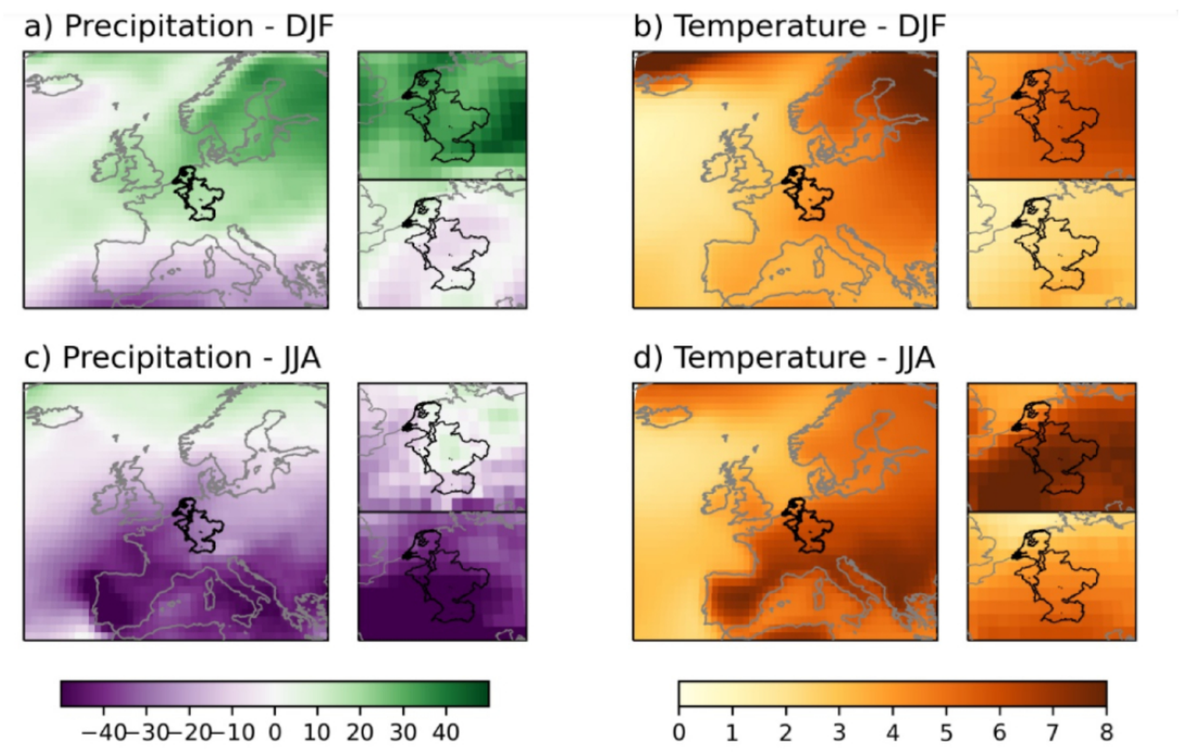

Fig.1: Large panels: CMIP6 multi-model mean projected regional climate change in Europe for SSP5-8.5 in 2100 (ΔGSAT = 4.0 C), for (a,c) precipitation [%], (b,d) 2 m temperature (C), and (a,b) in the winter season (DJF), (c,d) in the summer season (JJA). Small panels show the models with the largest and smallest trend in NL+RM region (in black) [KNMI'23].

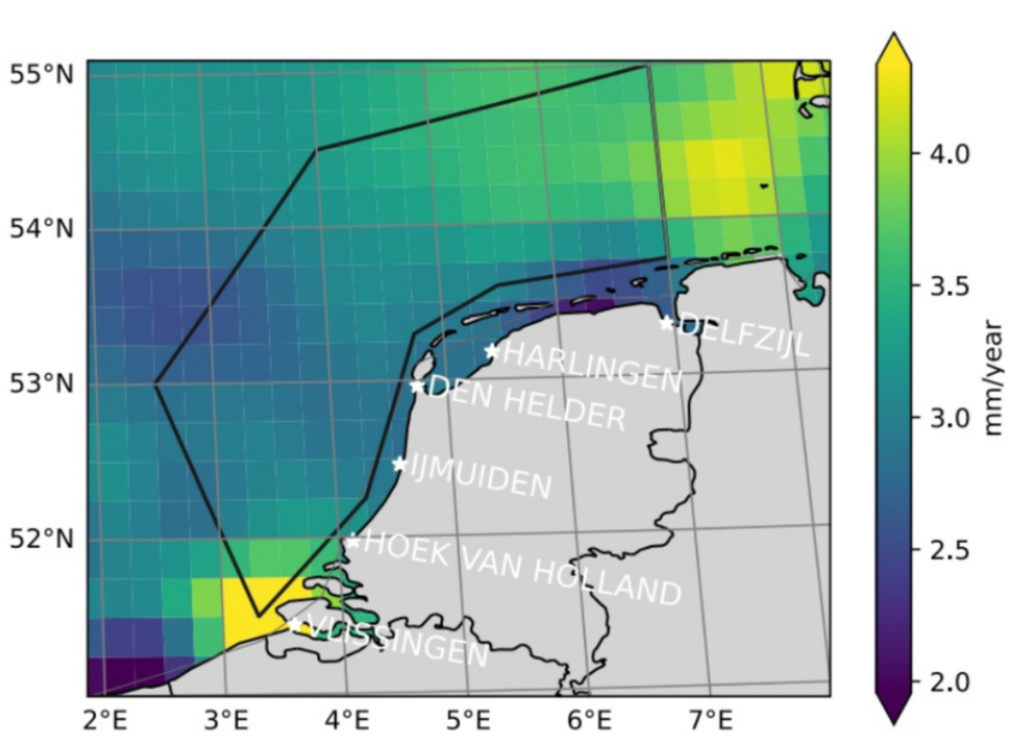

Fig.2: Linear fit to the sea level from satellite altimetry over the period 1993-2021 (The locations and names of the 6 main tide gauges are in white) [KNMI'23].

Methodology:

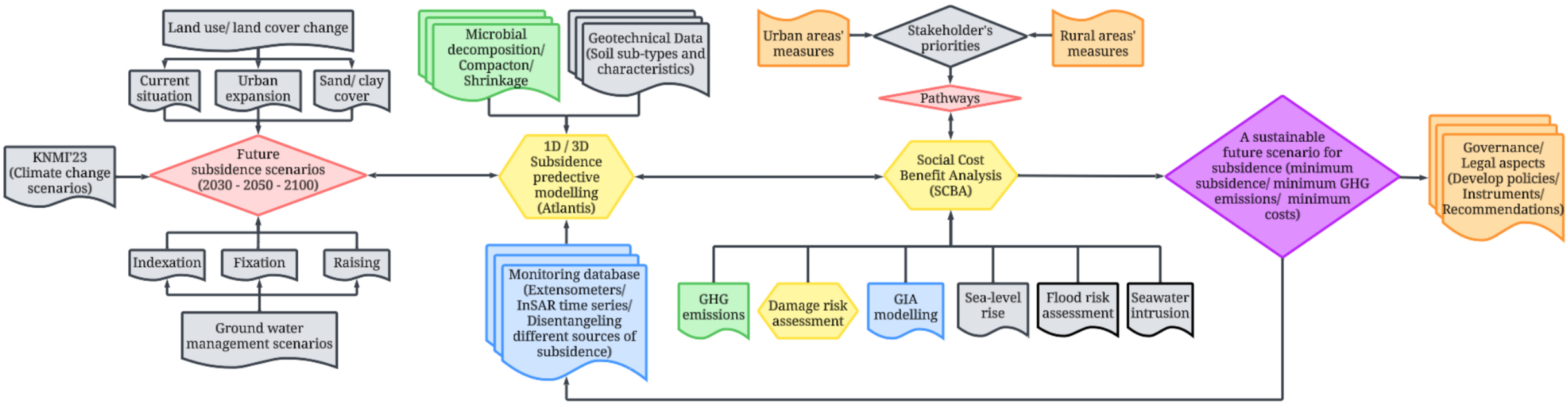

Fig.3: The workflow of the LOSS project (blue: WP1, green: WP2, yellow: WP3, orange: WP4, red: WP5 and grey: external resources) to reach a sustainable future scenario for subsidence (purple).

What are the main expected outcomes?

- **Future subsidence rates** under different scenarios can be estimated for the whole Netherlands (water boards / municipalities).
- **The optimal low ground water level** will be revealed for shallow soil subsidence areas taking into account minimum subsidence rates, minimum GHG emissions and socio-economic costs.
- **Carbon emission dynamic:** Understanding the relationship between subsidence and greenhouse gas emissions is important for the Netherlands' commitments to Paris Agreement.
- **Urban expansion / land use guide:** Knowing about where each land use type exacerbates subsidence is essential for informed decision-making in rural areas and also for better urban planning.

Conclusion:

working on a sustainable scenario and pathways for soil subsidence in the Netherlands helps in the process of preparing for future challenges, ensuring resilience against changing climatic conditions, sea-level rise, and other unforeseen events.