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Monitoring the effect of daily water use efficiency and deficits saline agriculture

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Water scarcity is one of the leading challenges of the twenty-first century. Already in 2010, it was shown that 80% of the world's population is exposed to high threat-levels to water security. These threats will only increase due to increased demand and decreased availability. By increasing salinity of soils (in coastal productive areas). Furthermore, because of groundwater irrigation and poor drainage these soils are becoming more saline, inducing loss of yield in this areas.

In this view, research has been performed for more than 60 years on using seawater for growing crops. However, the research was focused on traditional measurements where leaves have to be sampled locally to calculate the effect on intrinsic plant traits. With RS sensor technology, key plant traits – including leaf chemical traits and canopy structure – can now be retrieved at adequate spectral and spatial resolutions. These 'spectral' plant traits can be mapped over large areas in continuous manner. However, the impact of salt-stress on vegetation functioning has never been investigated. Before large scale RS technologies can be implemented to monitor factors that impact plant-growth, research linking plant-traits to salt-stress needs to be performed.

In our research we linked spectral plant-traits to salt stress. We collected our spectral data at Salt Farm Texel by measuring 15 different species divided over 6 beds, specifically: pak choi (2 treatments), kohlrabi (3 species), cauliflower, potato, carrot (2 species), beetroot (2 species) and cabbage (4 species). Every species received 6 different salt treatments, namely with concentrations of 1, 4, 8, 12, 16 and 20 dS/m. This therefore provided a total of 540 cases. During the growth season we performed multiple samples per individual on every plot (4x6 = 24).
Our analysis first focused on a preliminary analysis of both spectral and bidirectional variation of canopy reflectance given by leaf and canopy traits, using PROSAIL. This allowed us a specific spectral area (at 670nm) to focus on the further analysis on. Here, statistics were estimated to see the effect of salinity on the chlorophyll content. The results showed a varying effect of the salinity, but all with negative effect of salinity of the spectral reflectivity (with an average sensitivity of 11 %) . In particular, we find that the carrot species of Daucus carota var. natuna was effected the most by the salinity (having a sensitivity of 23.5 %) , while the cabbage species of Brassica oleracea var. X was effected the least (having a sensitivity of 2.5 %). We therefore conclude that the effect of saline irrigation can clearly be identified from remote sensing techniques. However as this research focused on only a single spectral band, more research should be performed to better investigate the potential of spectroscopy in saline agriculture.