Laboratory experiments on rheological effects of exopolymers on particle sinking in seawater

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Exopolymers secreted by algae and bacteria are intrinsic element of aquatic environment. Field studies have reported locally elevated concentration of exopolymers during algal blooms in seas all over the world. Excessive amount of these substances is known to increase the viscosity of seawater and to affect other rheological properties locally turning seawater into a non-Newtonian liquid. However, we lack understanding on how exopolymers dispersed in seawater affect basic transport processes such as sinking of particles. To address this issue, we performed laboratory study combining rheological measurements and settling experiments. We used artificial seawater with dispersed polysaccharides and model passive marine particles. We characterised rheological properties of modified seawater in terms of flow properties and viscoelasticity. Next, we measured sinking dynamics of particles in a settling column using Particle Tracking Velocimetry. The results showed that settling velocity of individual particle decreases with increasing polymer content as an effect of drag increase due to non-Newtonian properties of modified seawater. We analysed these results along with the flow models and viscoelastic properties of test liquids and assessed drag correction factor to demonstrate the scale of non-Newtonian effects on sinking velocity in modified seawater. In this contribution, we discuss the possible implications of exopolymers excess for transport processes including sedimentation and carbon pump.