**Context**

Sedimentation of organic matter through the water column is a key process in the marine biological carbon pump (Collins et al. 2015). In general, we may consider particulate organic matter as a heterogeneous group of particles with different characteristics such as mass, volume, origin, etc. During sedimentation they further respond in various ways to biological and physical processes such as coagulation, fragmentation, growth, and remineralization in addition to turbulence and advection. This will influence the quantity and quality of organic matter reaching the seabed (Boyd and Trull 2007).

**How does the transformation of an organic particle will affect its sedimentation to the bottom?**

This study takes place in the scientific context of understanding the ecosystem of the North Water Polynya (NOW) in northern Baffin Bay (Canadian Arctic). There, it was found that benthic organisms feeding mainly on fresh microalgae grew significantly faster (Gailloud 2015) during a period where the surface primary production was decreasing (Bélanger et al. 2013). We hypothesize that the apparent contradiction may be resolved by putting the pelagic-to-benthic interactions in a 4D context.

**Methods**

As a first step of this project, we will use the coupled physical-biogeochemical 1-D General Ocean Turbulence Model (GOTM; Burchard et al. 2006) to study the effect of coagulation and size modification of the particles on the quality and quantity of organic matter reaching the seabed.

- **Physical model**
  - The numerical grid resolves a 100-m deep water column with Δx=2m and Δt=2s. Salinity, temperature and nutrients were initialized by initial value with a two-layer stratification. No wind where prescribed, and a constant incident photosynthetically available irradiance of 200 Wm⁻² is prescribed at the surface.

- **Biological Model**
  - We set the biological model with 3 variables:
    - Two will be our initial particles and the third one will be the produced marine snow.
    - The only link between our two initial variables will be the possibility for them to coagulate (stick together) following the coagulation rate equation.
  - The marine snow variable will only increase following the coagulation rate.

\[
\text{Coagulation rate} = \beta_c \times \frac{1}{r_1} \times \frac{1}{r_2} \times \alpha_c \times \alpha_i
\]

\[
\text{Brownian motion} = \beta_B = \frac{2 k_B T (r_1 + r_2)^2}{r_1 r_2}
\]

\[
\text{Shear} = \beta_s = \frac{8}{3} \omega_{ms}^2 \text{min}(r_1, r_2)^2
\]

\[
\text{Differential settling} = \beta_D = \beta_B + \beta_s + \beta_p
\]

- **Settling velocities**
  - Up 0.001 m
  - Down 0.001 m

\[
\omega_{ms} = -50r_{ms} (\text{m}^2/\text{s})
\]

\[
\omega_{ms} = -160r_{ms} (\text{m}^2/\text{s})
\]

- We set settling velocities different in depth and time for our 3 variables.

- Settling velocities will vary only with the size of our particles.

- **Size for particles**
  - Will vary randomly between 2 limiting values.

- **Size for marine snow**
  - Its size will be modified depending on the ratio of particles (with different size) that will compose it.
  - This size will be kept in memory to be the « new size » from which we will have to add the new ratio and increase size at the next time step. Some parameters of the environment are set in our model, to be sure that the increase of size happens when we have marine snow in the water column as well as a certain concentration of particles which may compose it.

\[
r_{ms2}(t) = r_{ms}(t_0) + \sum_{i=1}^{n} F_i(t) \times r_i(t)
\]

**Fig 1:** Particle concentrations (mmol N.m⁻³)

**Fig 2:** Marine Snow concentration (mmol N.m⁻³)

**Fig 3:** Size augmentation (m)

**Fig 4:** Final size of marine snow (m)

**Fig 5:** Settling velocity (m·d⁻¹)

**Results**

**Figure 1** represents the dynamic of the concentration of our initial particles in the simulated water column following the initial conditions.

- The decrease of concentration is related to the coagulation rate loss only.

**Note:** Concentrations are expressed in mmol N as it is our model currency.

**To conclude:**

- **Coagulation** plays an important role in the transport of organic matter through the water column.

- **Size** plays an important role in the coagulation rate as well as in the settling velocities of particles.

**References**

Gwenaëlle Gremion

(wgwenaelle.gremion@gmail.com)

PhD candidate:

I. R. Schloss ²,², P. Archambault ⁴ and D. Dumont ³

(²) Université de Montréal, Département de Biologie, Montréal, QC, Canada
(³) Université Laval, Département de Biologie, Québec, QC, Canada
(⁴) Université de Sherbrooke, Département de Biologie, Sherbrooke, QC, Canada