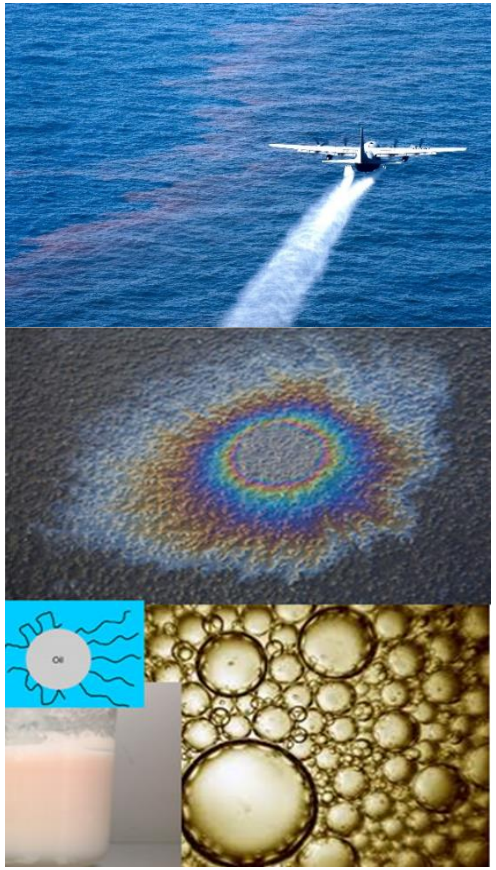
Arctic Oil-Spill Response based on Biomaterials

Henrikki Liimatainen
Fiber and Particle Engineering
University of Oulu

ARCRESPO – Towards Efficient and Sustainable Arctic Oil-Spill Response



Aim: To develop green dispersing and herding agents from Northern bioresources (cellulose and chitosan) for sustainable Arctic oil spill response

In many cases, chemical surfactants, which can rapidly be applied from aircrafts, may be the most feasible response option for the oil-spills in the Arctic waters

Partners:

University of Oulu, Fiber and Particle Engineering (coordinator)

- Assoc. Prof. Henrikki Liimatainen
- M.Sc. Jonna Ojala

Lappeenranta University of Technology, Laboratory of Green Chemistry

- Prof. Mika Sillanpää
- Dr. Eveliina Repo
- M.Sc. Simo Kalliola, M.Sc. Bhairavi Doshi

SUSTAINABLE OIL SPILL RESPONSE USING GREEN CHEMICALS

The chemical surfactants can be used in two different ways:

- **Dispersing agents** can enhance the natural biodegradability of oil by breaking oil down the small droplets
- **Herding agents** can thicken the thin oil slick sufficiently to enable in situ burning of the oil

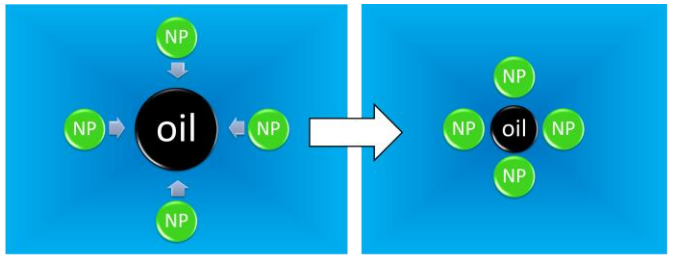
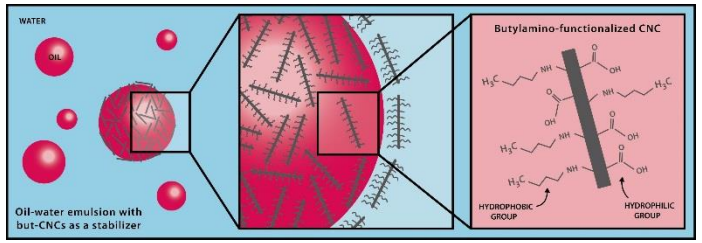
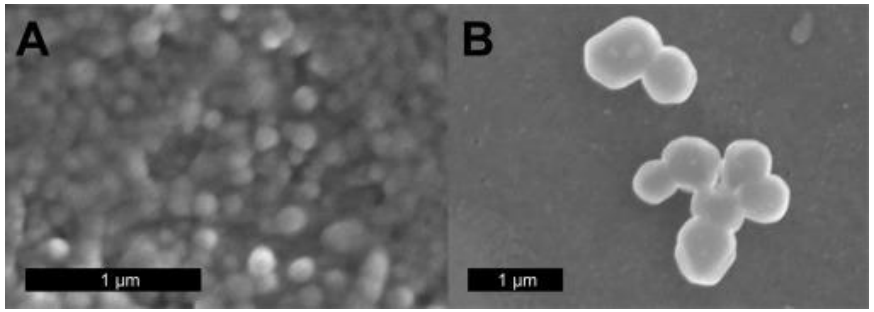


Fig. 1 Schematic illustration of how chitosan nanoparticles (NP) work on oil.

Despite their effectiveness, the use of ***synthetic dispersing agent formulations has been questioned, because of their potential negative health effects for the humans and marine ecosystem***

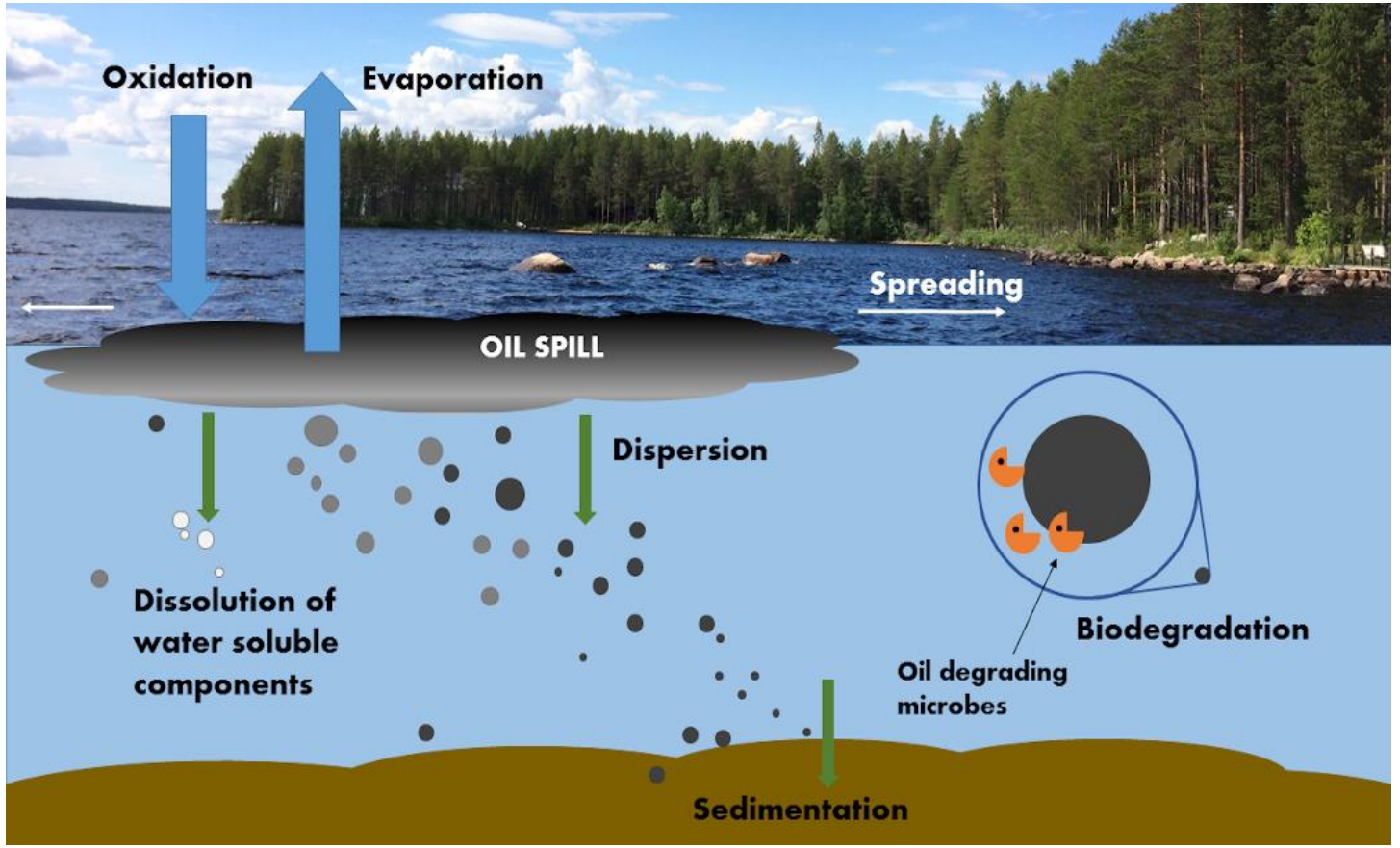


*Ojala et al. Chem. Eng. J. 2016



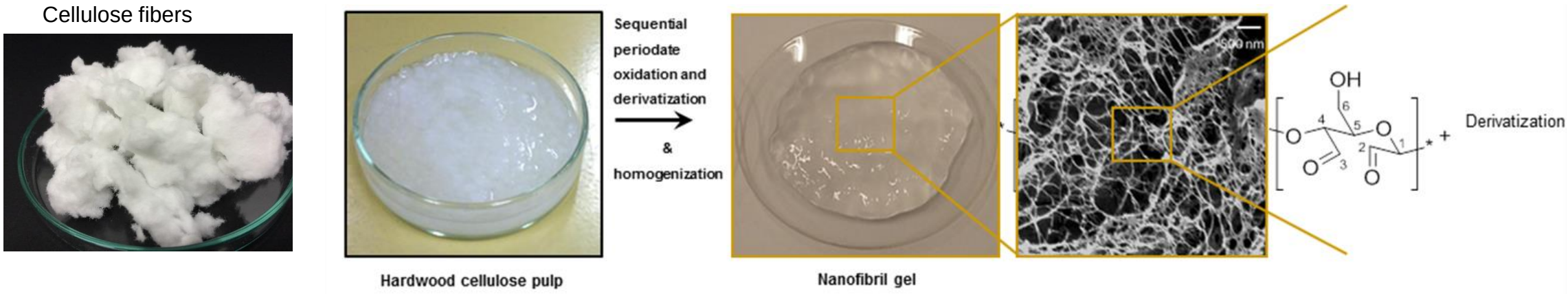
*Kalliola et al. Colloids and Surfaces A. 2016

BIODEGRADATION OF DISPERSED OIL

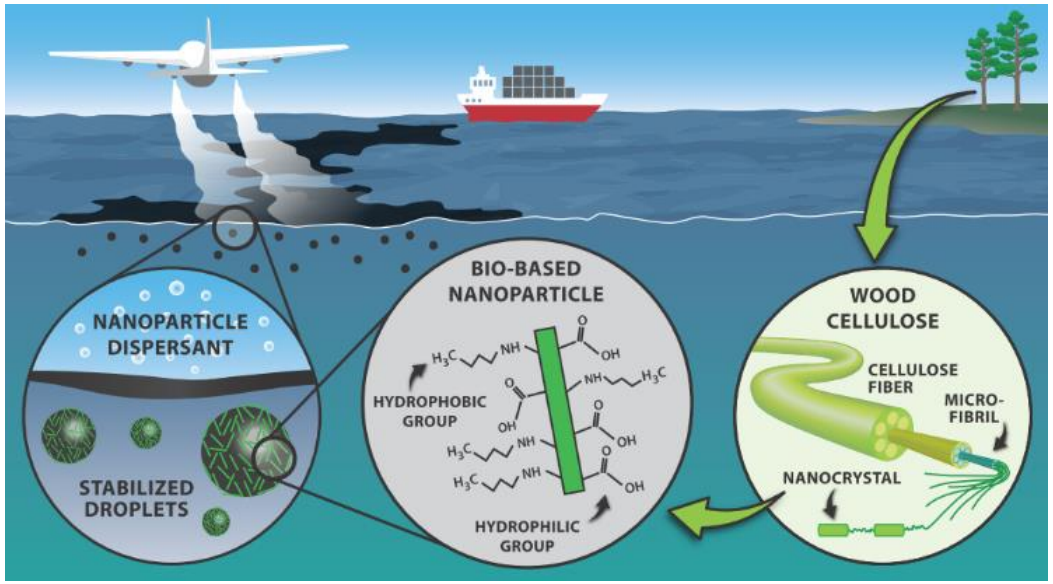


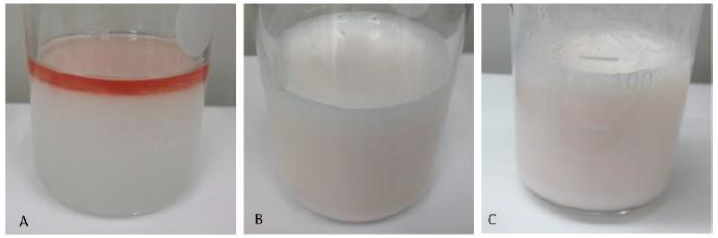
APPROACH

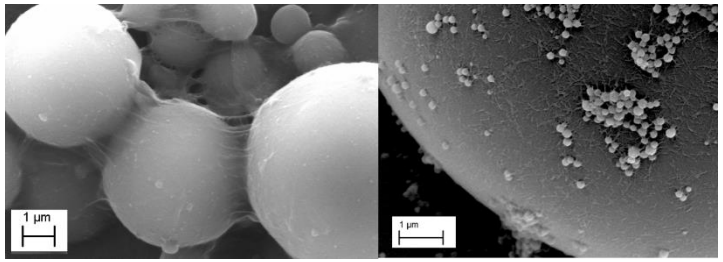
- Fabrication of green surfactants from chitosan and nanocellulose
  - Surface chemistry modification
- Demonstration of green dispersing and herding agents in cold conditions
- Toxicity and biodegradability of green surfactants
  - Assessment of non-harmful feature



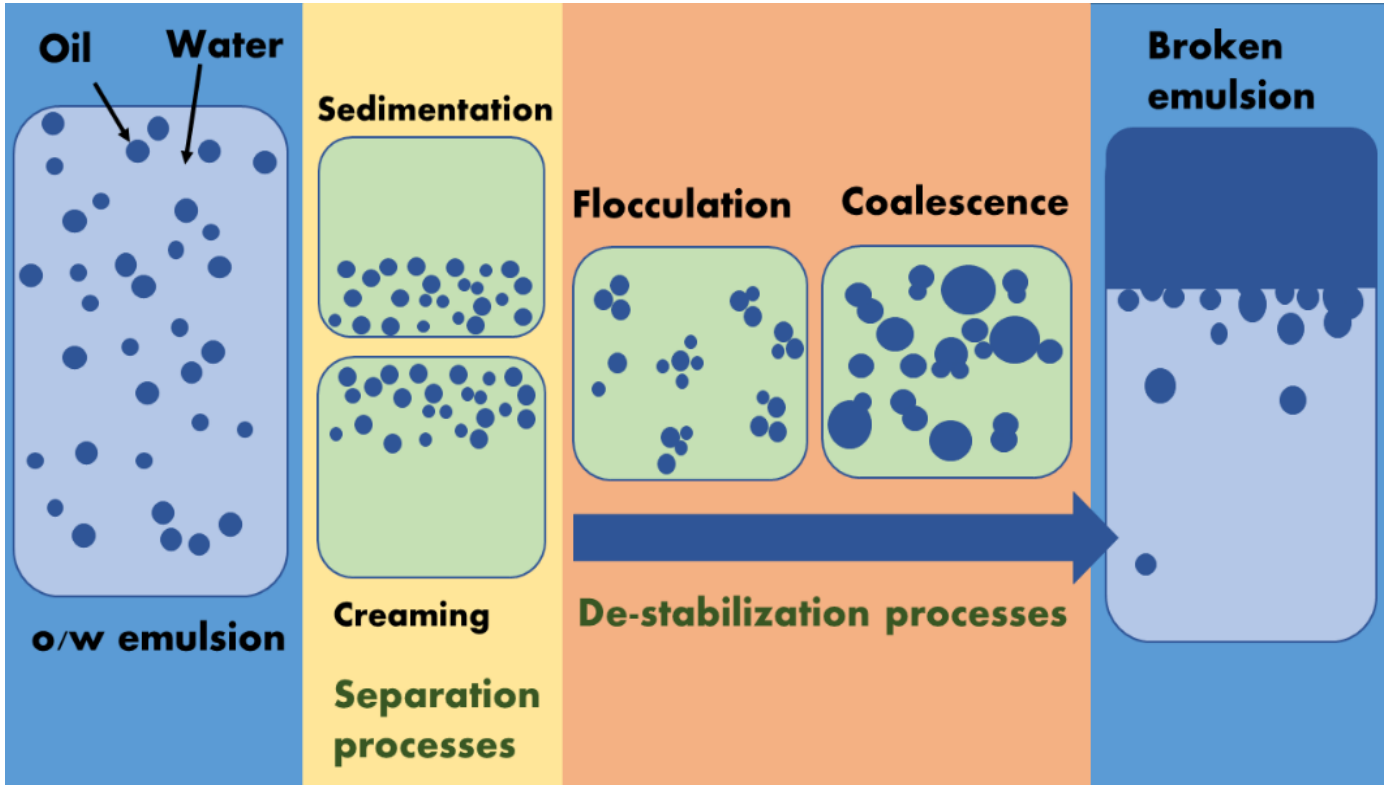
HIGHLIGHT I: Modified nanocelluloses as dispersing agents



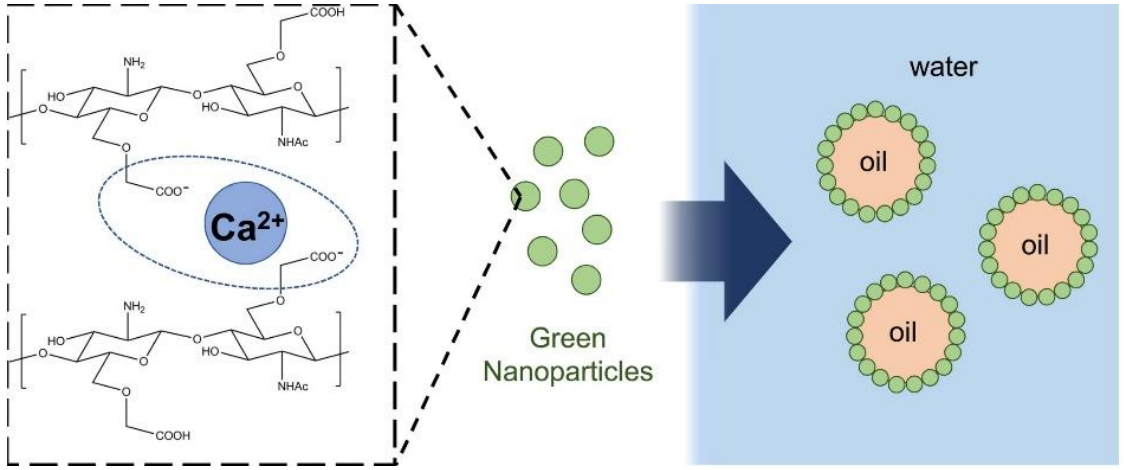


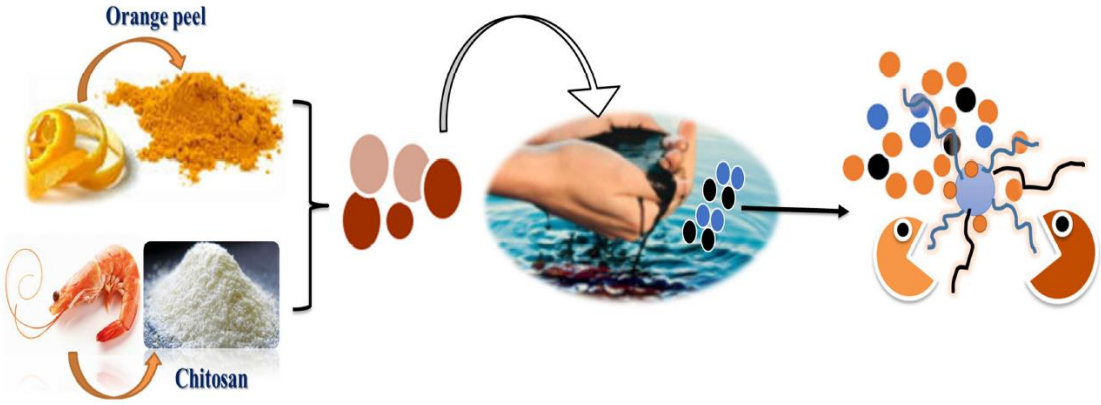


HIGHLIGHT II: Understanding the mechanisms of oil-dispersing in Arctic marine water



HIGHLIGHT III: Chitosan derivatives as stable emulsifying agents in marine water conditions





CONCLUSIONS

Within the ARCRESPO project we demonstrated

- Potential of Northern biomasses as a resource for preparation of bio-based surfactants
- Green synthesis routes to fabricate amphiphilic bio-based nanoparticles from cellulose and chitosan
- Performance of bio-particles as efficient dispersing agents for oil spills in the simulated Arctic marine conditions
- Preliminary indication of biodegradability of bioparticles in marine conditions

Thank you!

Contact:

henrikki.liimatainen@oulu.fi

mika.sillanpaa@lut.fi