Alexander Vanhulle, Sébastien Le Clec’h, and Philippe Huybrechts

Modelling the basal hydrology under the Greenland Ice Sheet

Corresponding author: alexander.vanhulle@vub.be
• Basal water routing is of significant importance
  • Basal processes (such as basal sliding)
  • Submarine melt at calving fronts
• Implemented an efficient model to route basal water
  • Based on the hydraulic potential $\phi = P_w + \rho_w gh$
• Sensitivity analysis
  • 1, 4 and 8 directional routing algorithms
  • Uncertainties in dataset
  • 500 m, 1 km and 5 km resolution
  • Different floatation factors affect routing
• Application
  • Construction of 1980-2018 timeseries of subglacial outflow for 8 important outlets (division per sector according to Slater et al., 2019)
Many uncertainties

- Water pressures are not uniform
- Water pressure ≠ ice overburden pressure
- Can affect routing

Specific catchment areas for the 1D and 8D routing algorithms near Jakobshavn Isbrae on a resolution of 5 km

Specific catchment areas on resolutions of 1 km and 5 km near the termini of the NEGIS (8D routing algorithm)
Application: timeseries

- Subglacial outflow of 8 important outlets
  - Runoff: ERA Interim forced by MAR v3.9
  - Basal melt rate: GISM-VUB
- Includes uncertainties due to
  - Bedrock / ice thickness data
  - Water pressure
  - 800 members in ensemble
- Uncertainties in the 95% confidence interval can be large during high-melt years
  - Nioghalv fjordsbrae 7.0 km$^3$ ± 0.8 km$^3$ in 2008
  - Jakobshavn Isbrae 22 km$^3$ ± 1.4 km$^3$ in 2012