# Role of variable form drag coefficients over sea ice for the ocean surface layer in polar regions

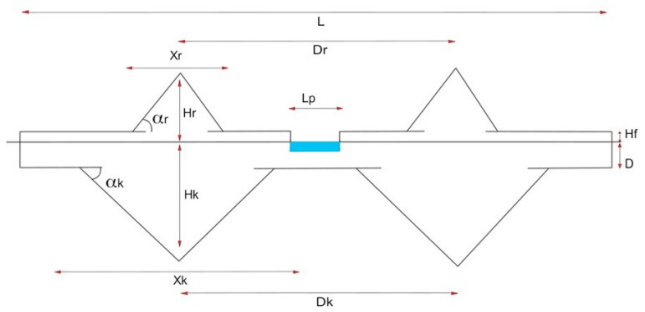
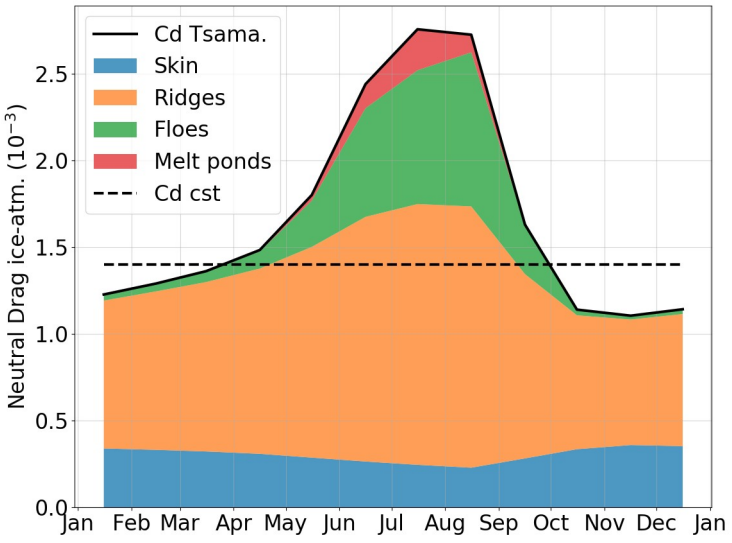
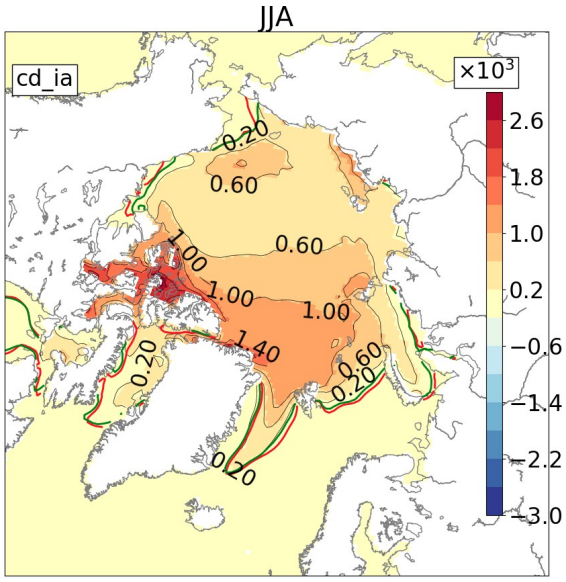



FIG. 1. Schematic representation of an idealized sea ice floe comprising a system of two triangular sails and keels and a single melt pond. The quantities that are needed to derive the ANDC and ONDC are shown: the floes size $L$, the freeboard $H_f$ [Eq. (26)], the draft $D$, the pond size $L_p$, the distance between sails $D_s$, the distance between keels $D_k$, the sail and keel heights $H_s$ and $H_k$, the slopes of the sail and keel $\alpha_r$ and $\alpha_k$, and the bases of the sail and keel $X_s$ and $X_k$.




Difference between variable and constant drag coefficients in summer at the ice-atm. interface

The scheme of Tsamados et al. (2013) decompose the drag coefficients into the sum of form drag components, associated to sea ice features

The scheme includes the effect of floe edges, ice ridges, melt pond edges, and skin surface

Seasonal maximum in mean drag coefficients occurs in July-August

The form drag leads to larger drag coefficients in summer in the Arctic, compared to the default constant coefficients used in LIM3

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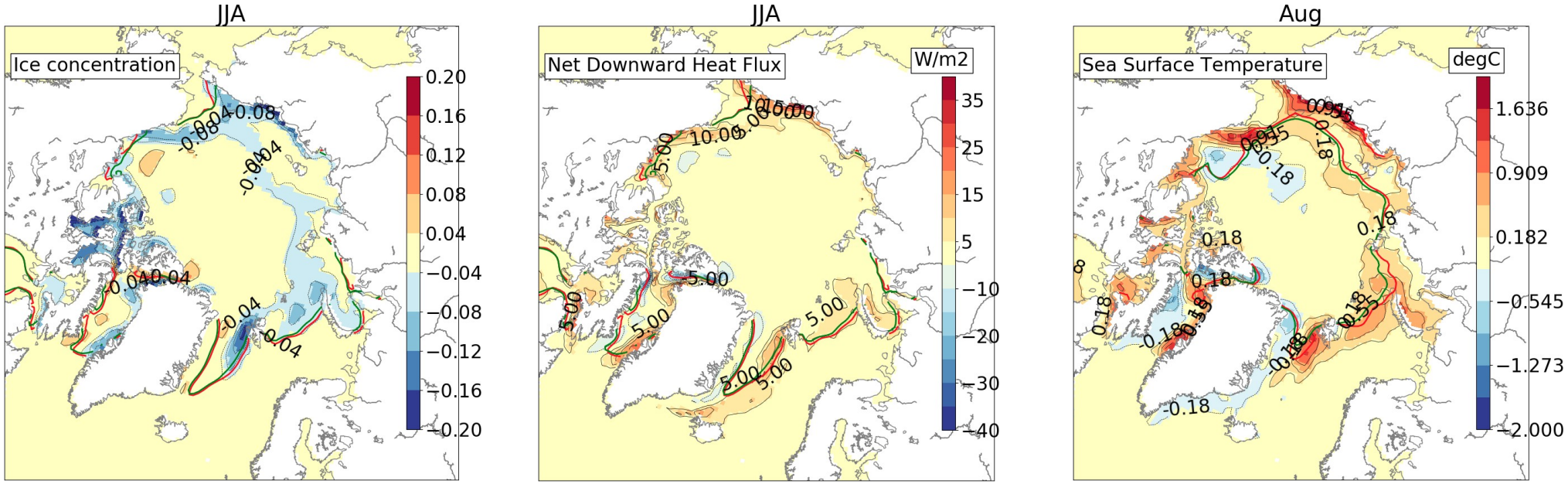


Difference between simulations with variable and constant drag coefficients in summer mean ice concentration (left), net downward heat flux (center), and SST in August (right)

In summer, variable drag coefficients leads to:

- A decrease in ice concentration along the 15% concentration line
- Further absorption of heat through leads by the ocean in the same regions
- Warming of the ocean surface temperature in the marginal ice zone

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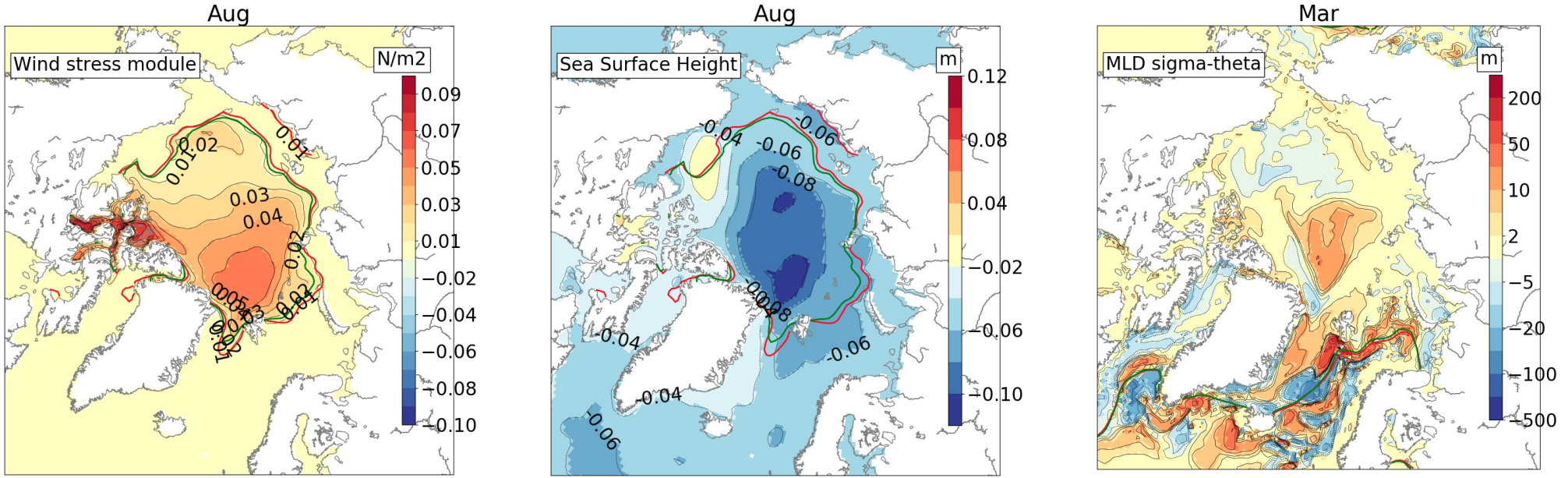


Difference between simulations with variable and constant drag coefficients in mean surface stress (left) and SSH (center) in August , and MLD in March (right)

Variable drag coefficients leads to:

- an increase in the surface stress experienced by the ocean surface
- a deepening of the SSH under sea ice
- moderate variations in the MLD; however the deepening in MLD occurs at a different time of the year than the maximum in drag coefficients