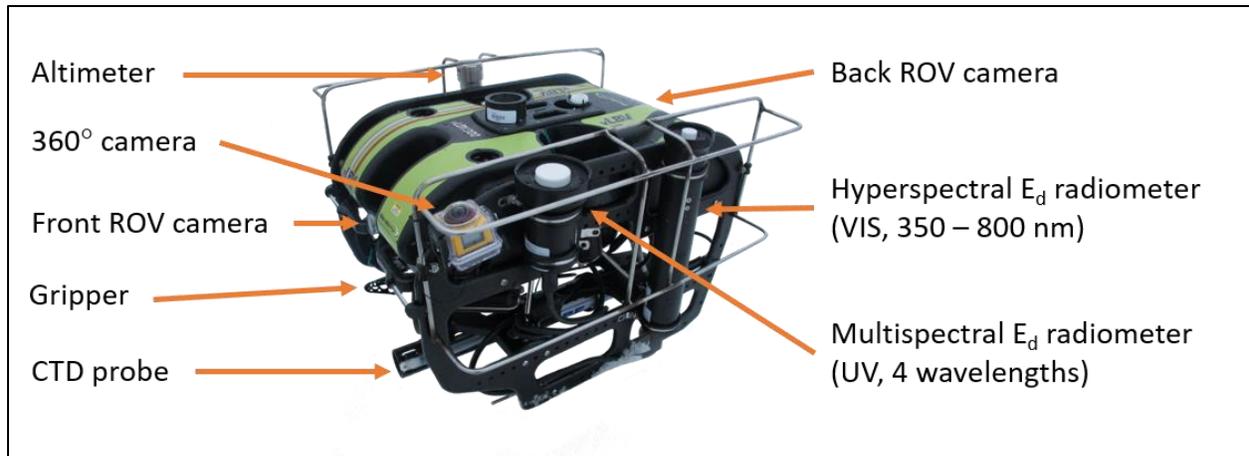
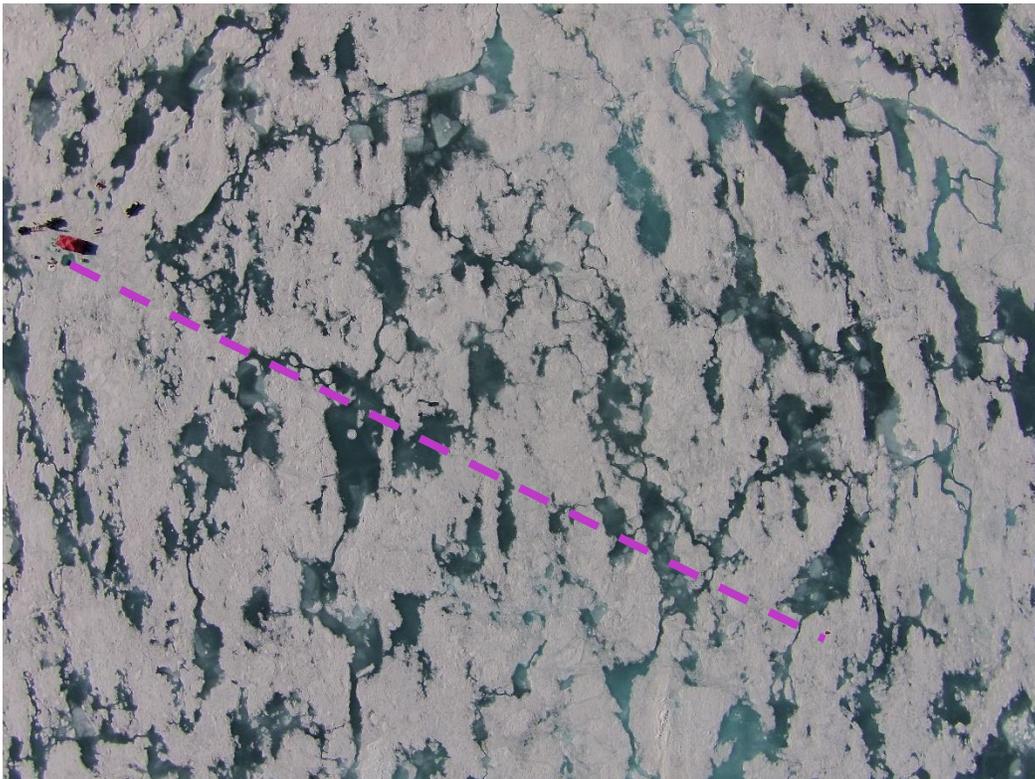


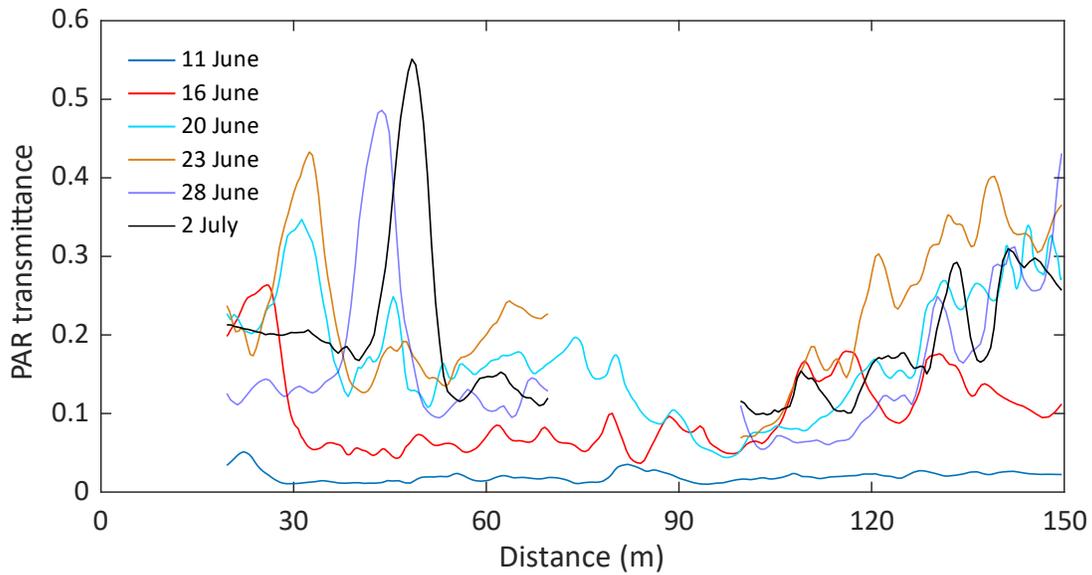
Supplemental Material



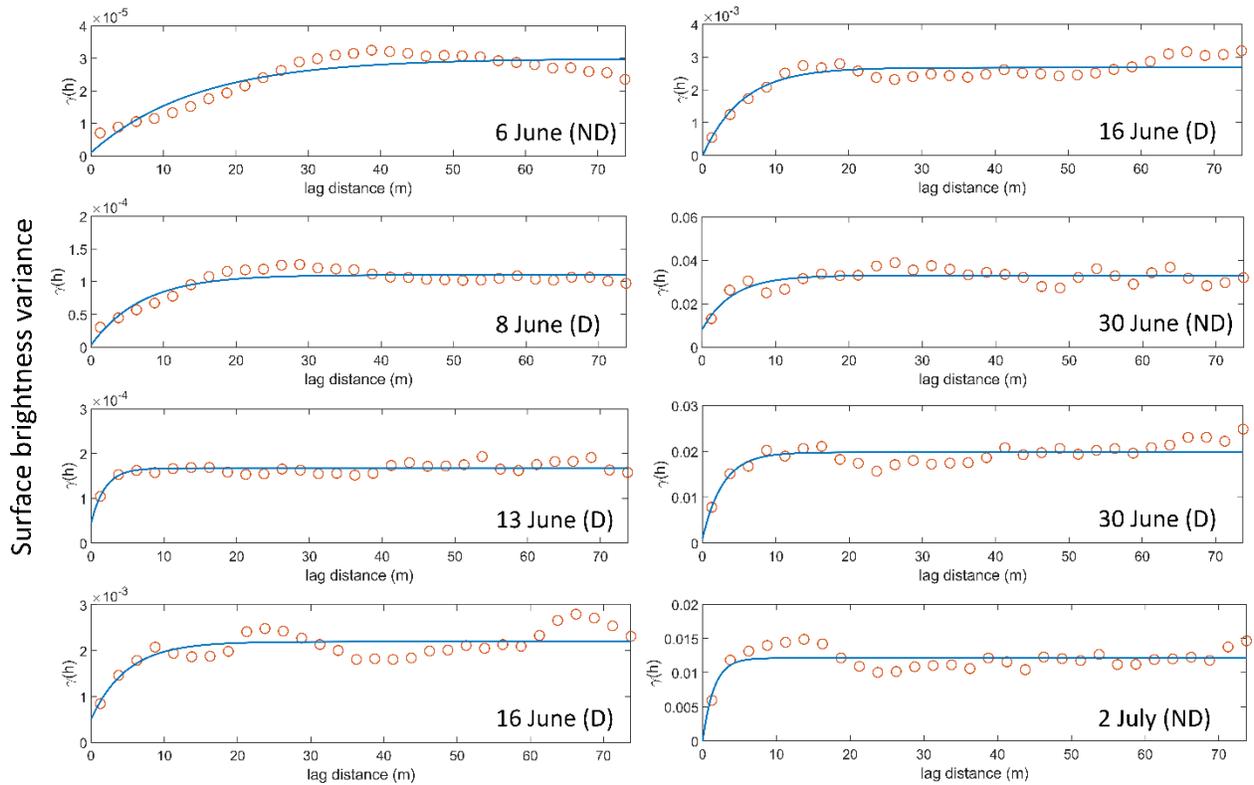
Supplementary Figure S1. Photograph of ROV equipped with sensors, cameras and a gripper for under-ice measurements.



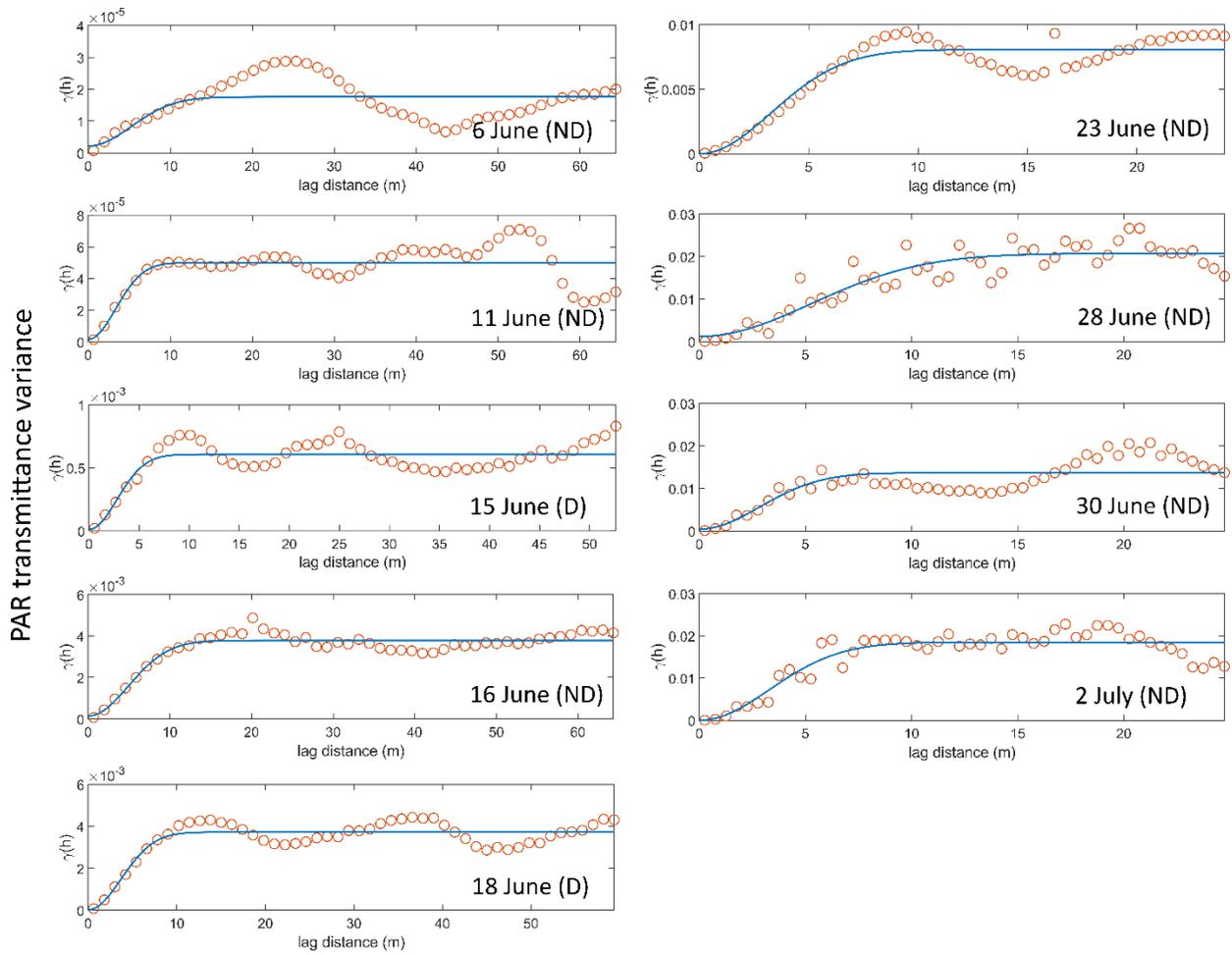
Supplementary Figure S2. Aerial drone image of sampling area taken at 90 m height on 30 June 2016. The surveyed D transect is shown as orange line.



Supplementary Figure S3. PAR transmittance calculated along the ND transect for five days over the sampling period.



Supplementary Figure S4. Variograms of surface brightness obtained from horizontal transects. Empirical variograms are shown as orange dots and fitted theoretical exponential variograms are shown as black lines.



Supplementary Figure S5. Variograms of PAR transmittance obtained from horizontal transects. Empirical variograms are shown as orange dots and fitted theoretical gaussian variograms are shown as black lines.

Supplementary Table T1. Computed mean variogram range (m) of surface reflectance and PAR transmittance of the observed melt stages (I - III).

	Variogram range (m)	
	Surface brightness	PAR transmittance
Stage I	4.4	6.0
	n = 2	n = 2
Stage II	5.1	5.3
	n = 2	n = 3
Stage III	2.8	5.2
	n = 3	n = 4

Supplementary Video V1. Video of ice bottom recorded at 2 m with a 360 degree action camera along horizontal D transect on 13 June.