Figure S1: An example of typical sea ice found in Stage 1, as acquired by S-2 on A) June 8, 2021, and B) May 17, 2021. The surface of sea ice during this stage is typically free of melt ponds, as seen by S-2.
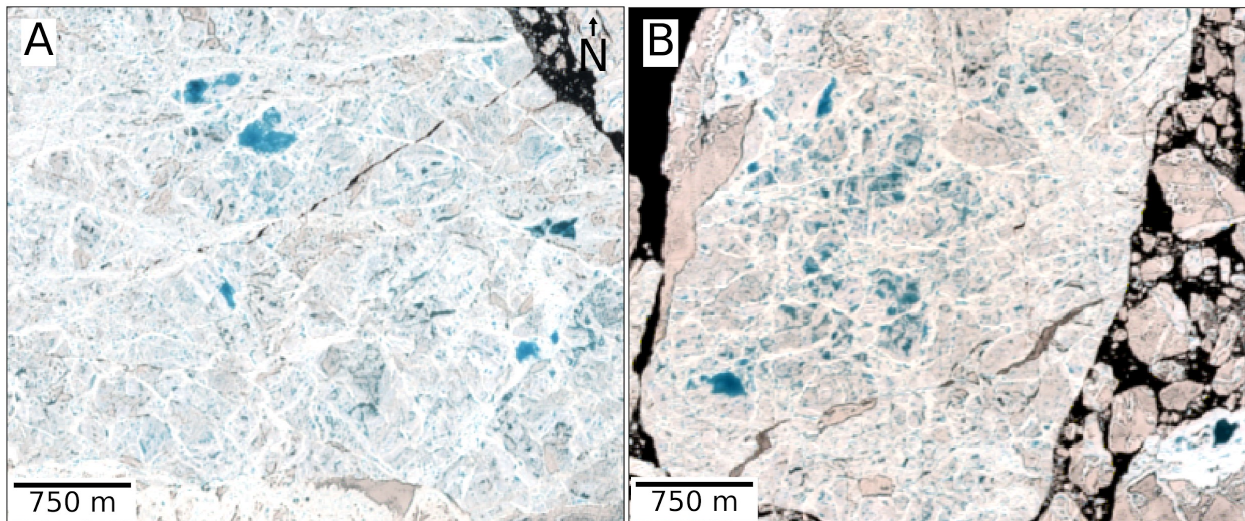
Figure S2: A) An example of typical sea ice found in Stage 2, as acquired by S-2 on A) June 27, 2020, and B) July 3, 2020. During this stage, distinct, individual melt ponds can be seen on the sea ice surface.
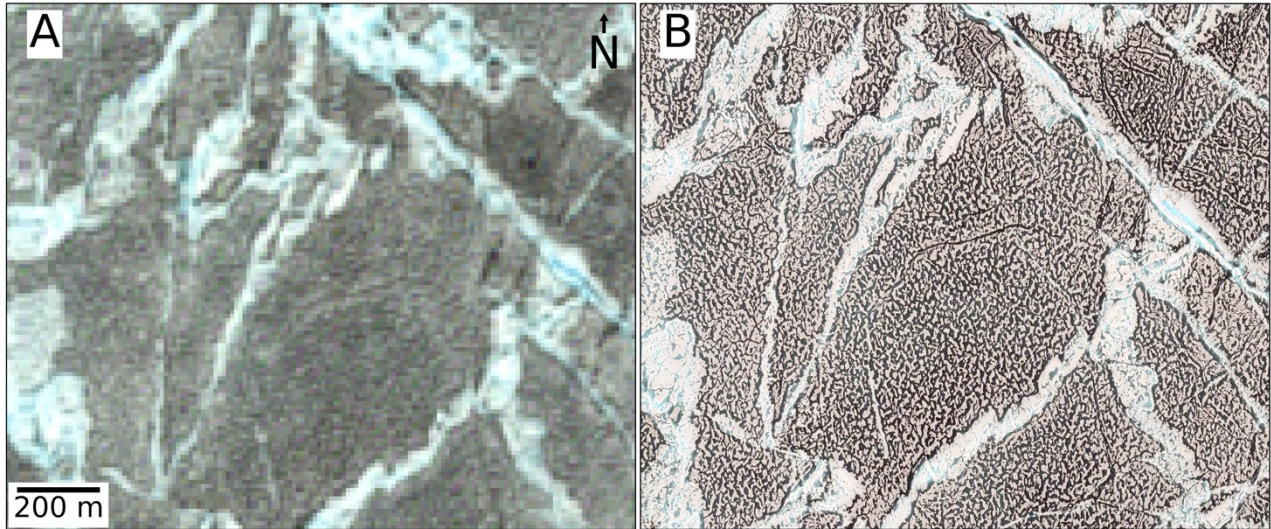
Figure S3: A) An example of typical sea ice found in Stage 3, as acquired by A) S-2 and B) WV-3, on July 16, 2022. During this stage, individual ponds coalesce into drainage channels and form complex, interconnected structures.
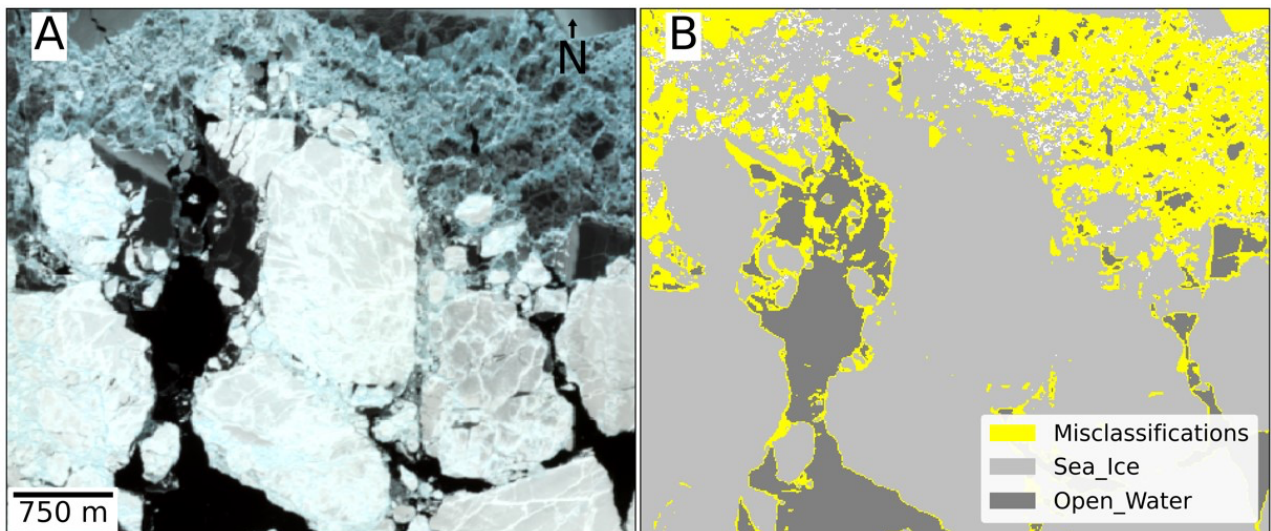
Figure S4: A) An example of sea ice with widespread presence on nilas, and B) the result of RF classification showing nilas misclassified as melt ponds in yellow.
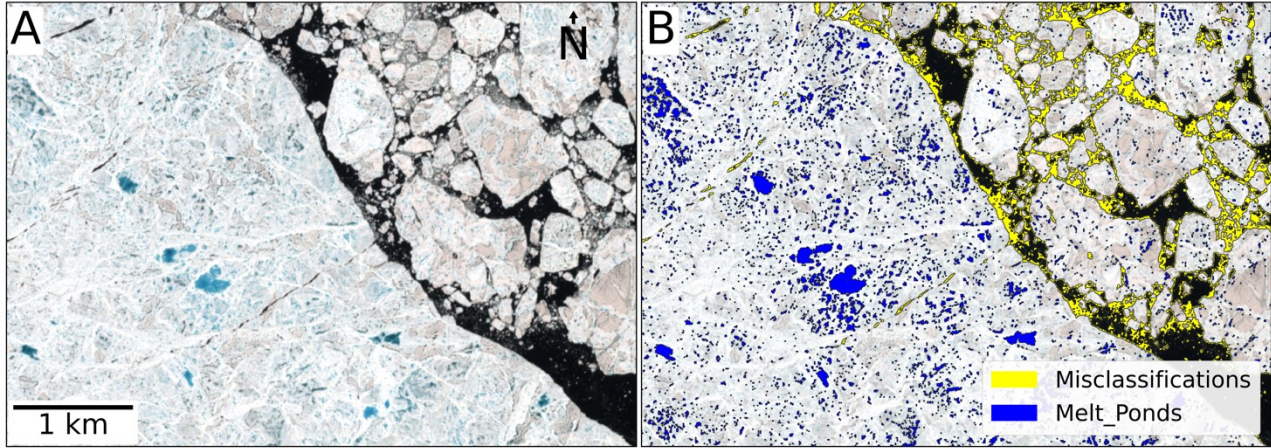
Figure S5: A) An example of sea ice with brash ice floes, and B) the result of RF classification showing brash ice misclassified as melt ponds in yellow.
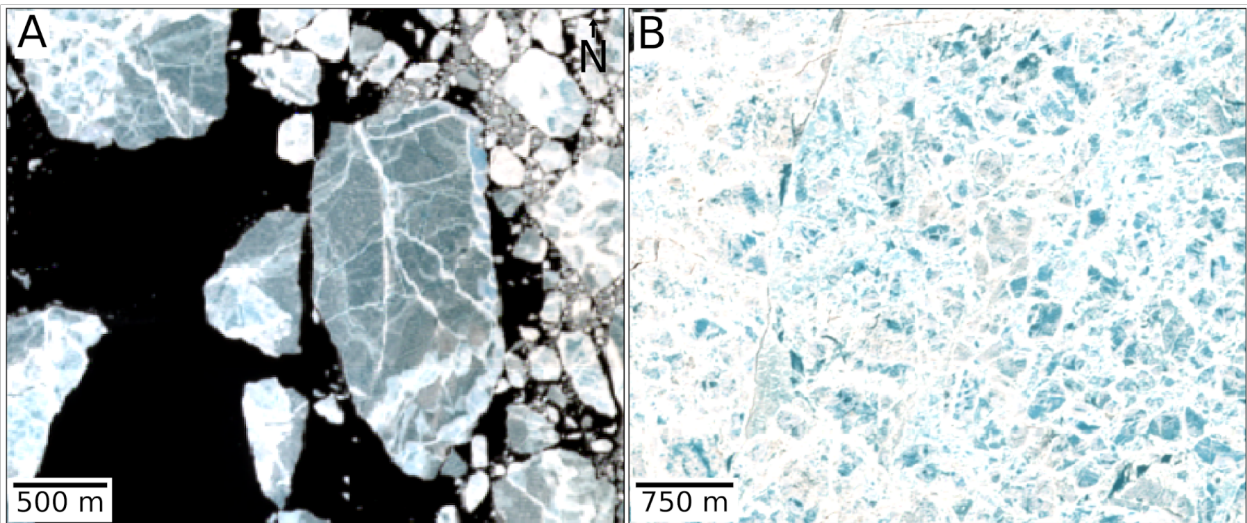
Figure S6: A) S-2 image acquired on June 12, 2020, showing flooded ice floes, and B) S-2 image acquired on June 18, 2021, with distinct, individual melt ponds.
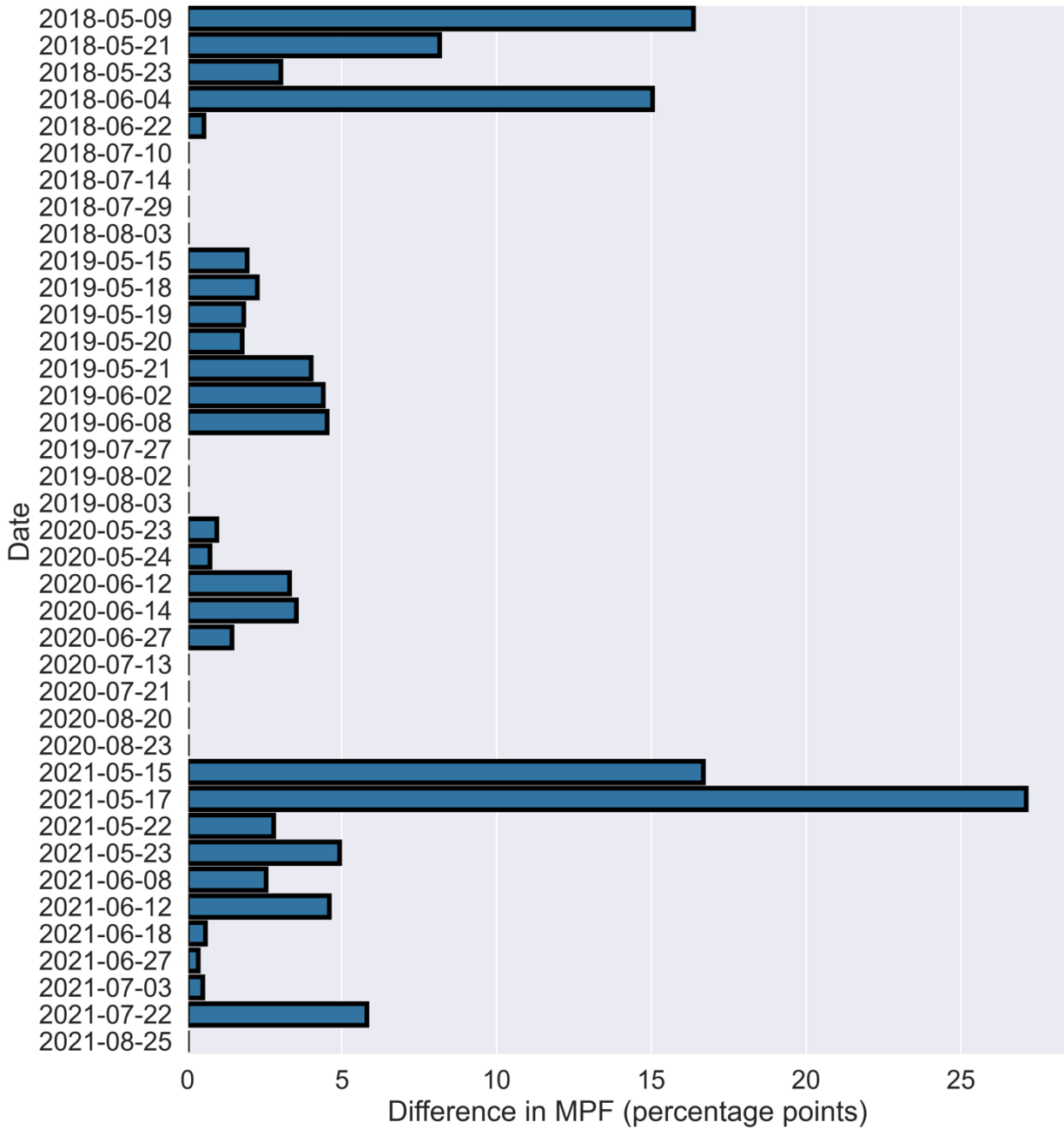
Figure S7: Difference between adjusted MPF from Fig. 3 and MPF obtained after applying Morphological Dilation.
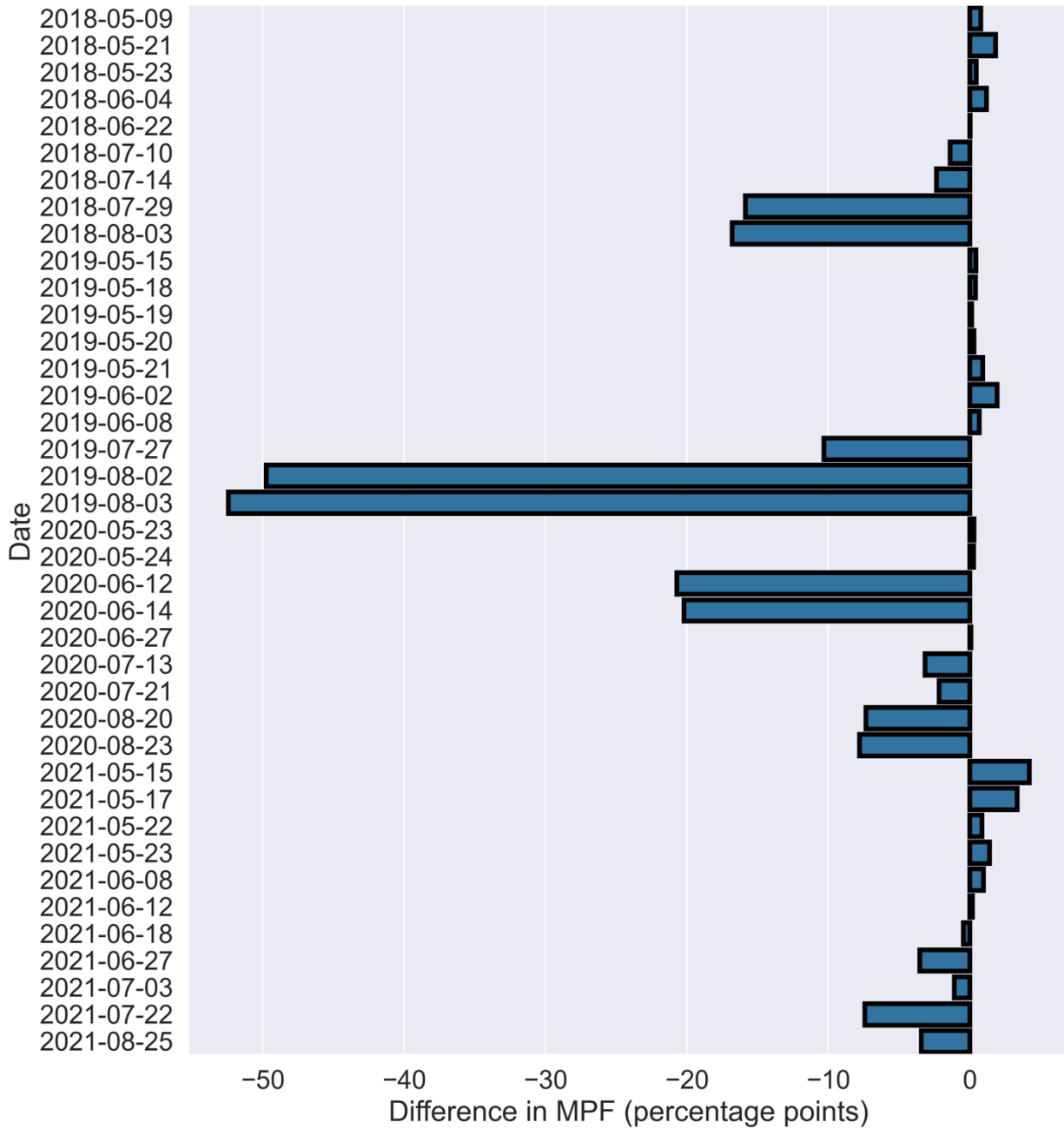
Figure S8: Difference between adjusted MPF from Fig. 3 and MPF obtained after applying Morphological Reconstruction. Negative values indicate images where the reconstruction algorithm removed true melt ponds along with misclassifications.
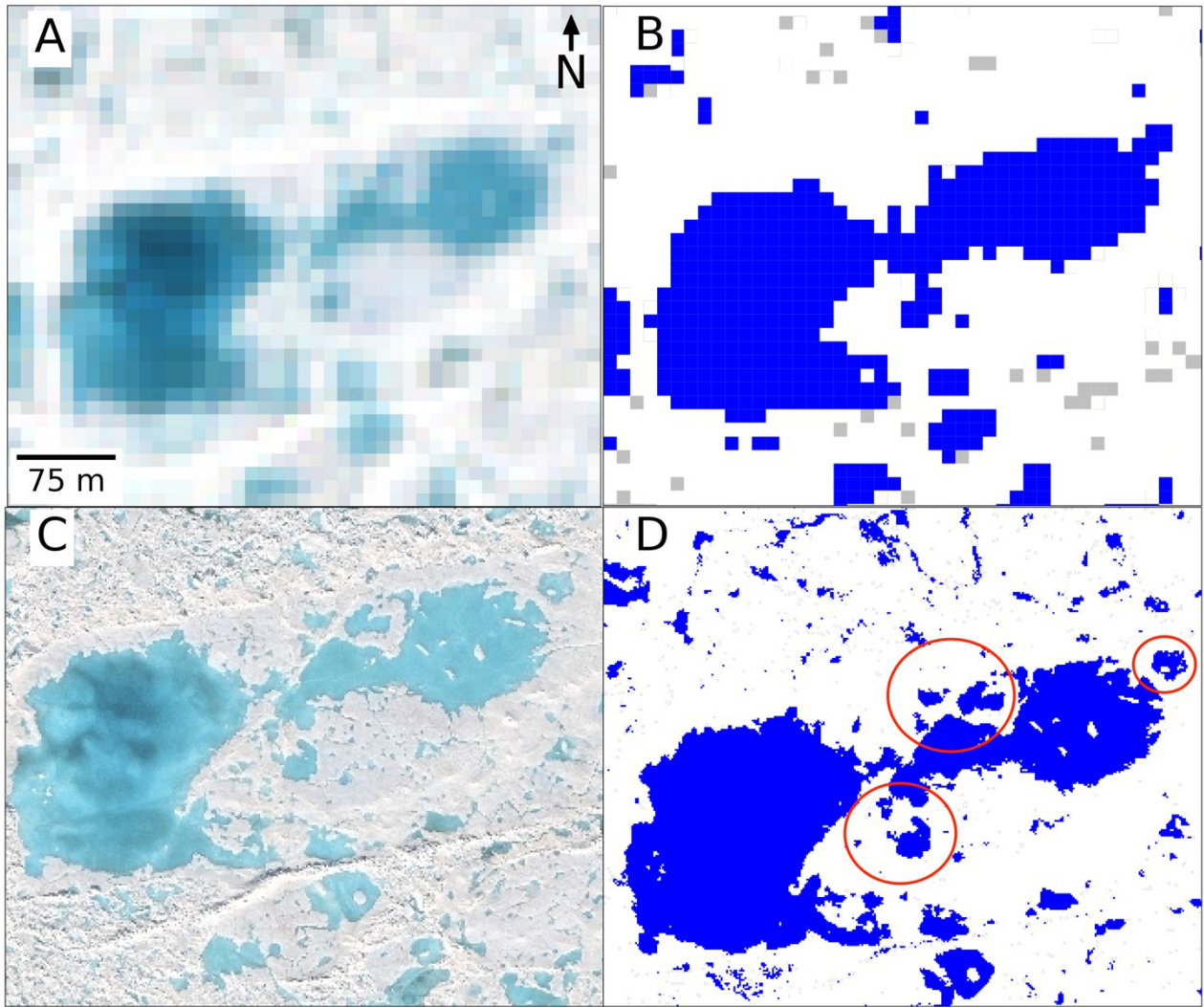
Figure S9: A) An S-2 image acquired on June 27, 2020, B) RF classification of the S-2 image showing melt ponds in blue, C) coincident WV-3, and D) RF classification of the WV-3 image. The red circles in D show the smaller, individual melt ponds that were classified as one big melt pond in S-2 image (A and B) due to lower resolution.