Validating VIIRS Day & Night Band Water Mask Over North Pole

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Abstract

The goal of this project is to determine whether water is correctly or incorrectly identified in VIIRS (Visible Infrared Imaging Radiometer Suite) satellite images in the North Pole region. A binary mask, which is the experimental mask, will be calculated where a 1 indicates water, while conversely a 0 indicates anything not water. This mask will then be superimposed on a base image, where the water locations are assumed to be correct, and visually verified. This is achieved through Python and GRASS GIS scripting in a Linux environment.
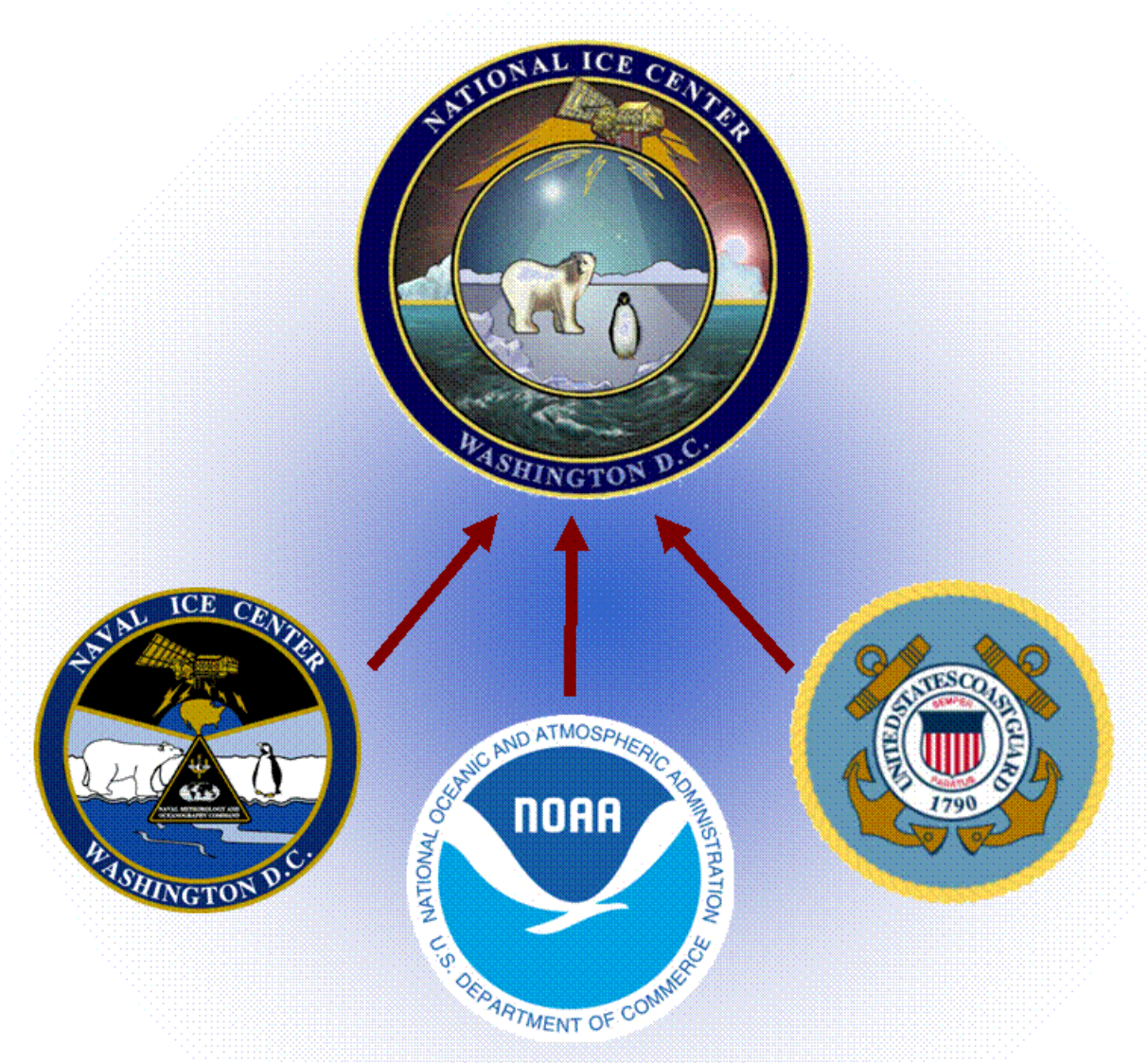
Data Sources

VIIRS

The VIIRS (Visible Infrared Imaging Radiometer Suite) is a scanning radiometer mounted on the Suomi National Polar-orbiting Partnership weather satellite. It collects imagery of land, atmospheric, polar, and oceanic environments in the visible and infrared spectrum. VIIRS largely aids climatologists in understanding Earth's global change. The data it collects is used to measure many variables: cloud and aerosol properties, surface temperatures, ice motion, etc.

Instrument Specifications	
Imaging Optics:	19.1 cm, 114 cm focal length
Orbit Average Power:	200 Watts
Weight:	275 kilograms
Development Institutions:	Raytheon Company

VIIRS

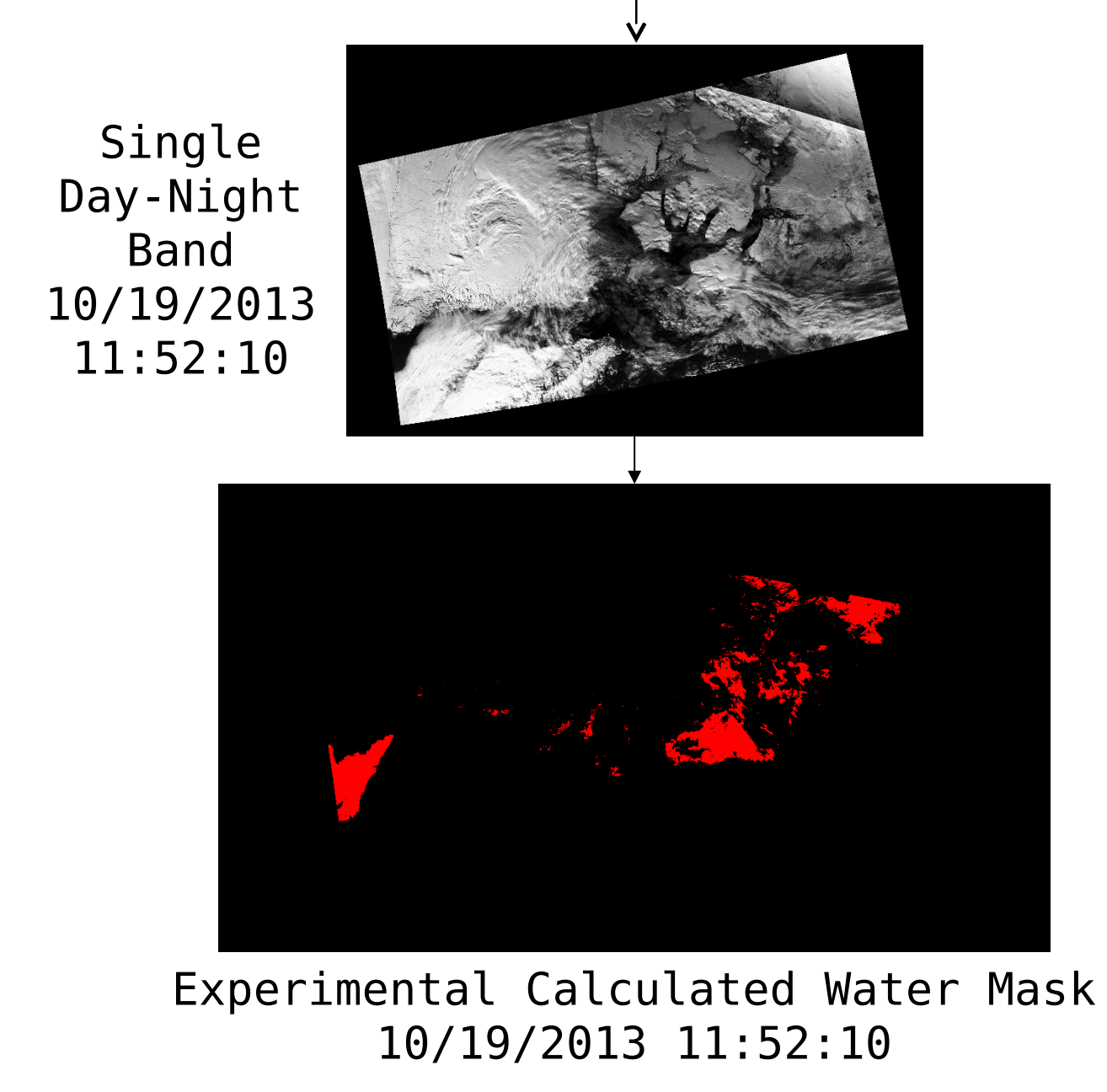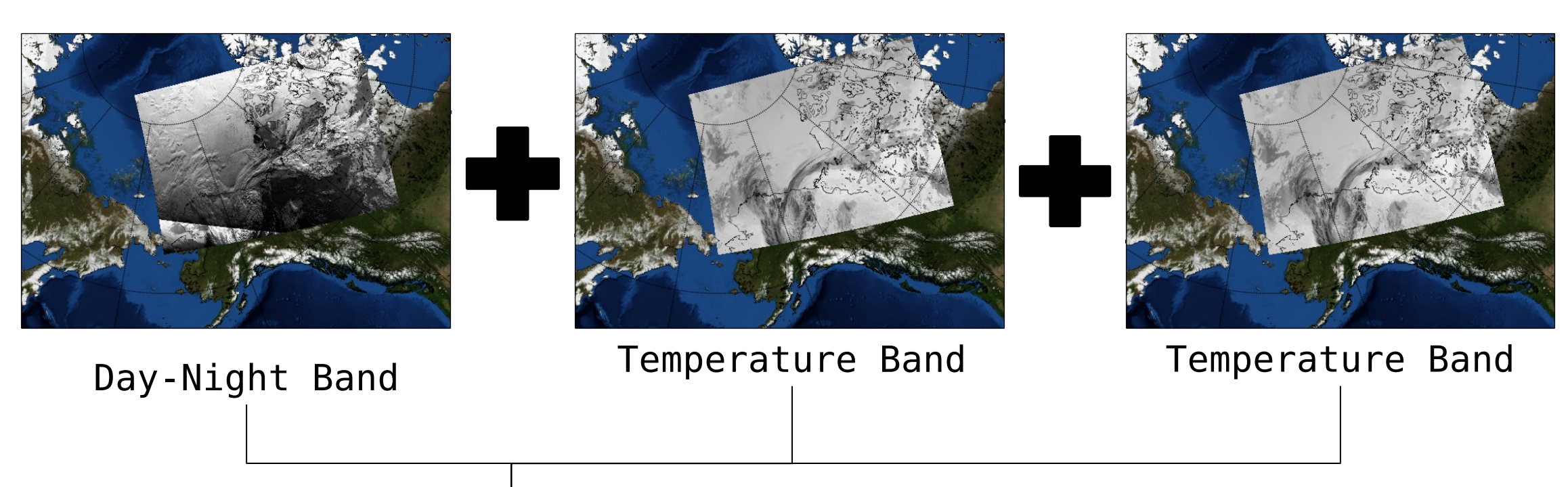Sample VIIRS Image (Earth at night)
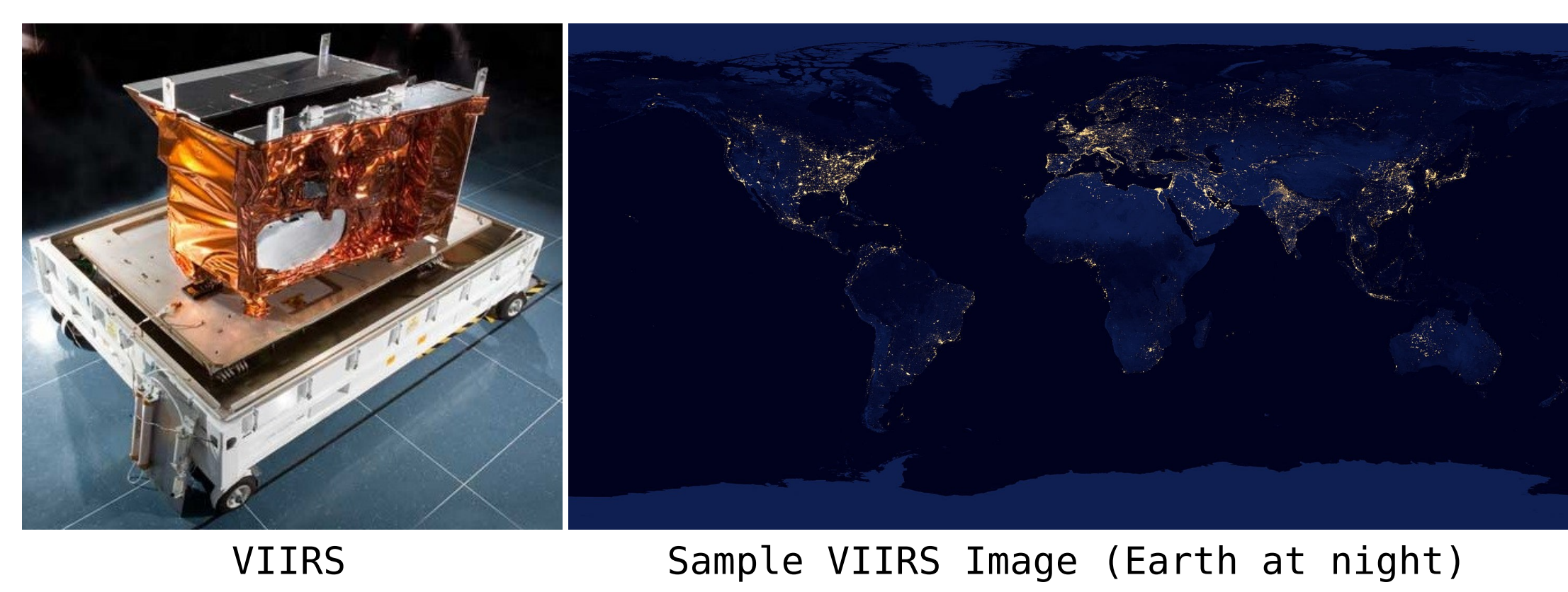
NATICE

The National Ice Center is an operational center with close association between NOAA and the U.S. Navy which began in 1956. Its goal is to provide global ice analyses for the United States Armed Forces, allied nations, and U.S. government agencies. Moreover, it produces world-wide sea ice charts, cryospheric GIS products, and tracking of Antarctic icebergs.
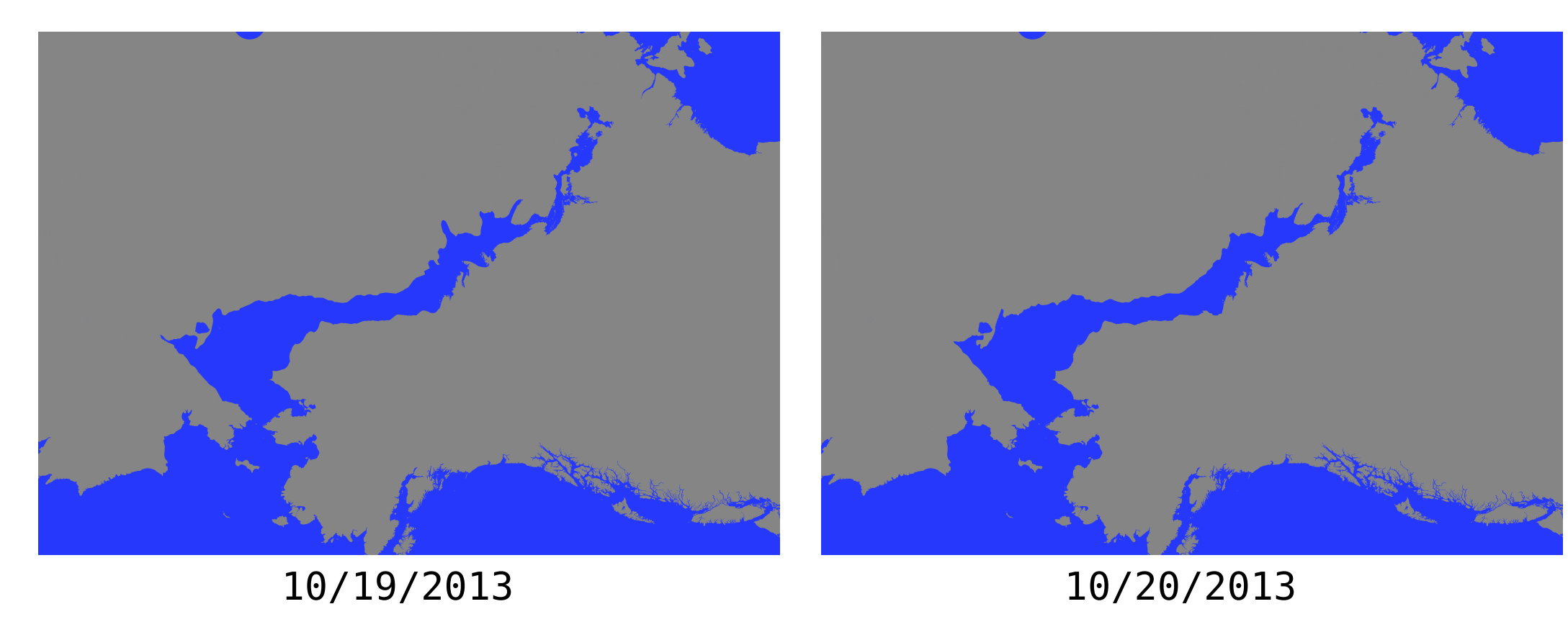
Validation Input

Day-Night Band   +   Temperature Band   +   Temperature Band

Single Day-Night Band
10/19/2013
11:52:10

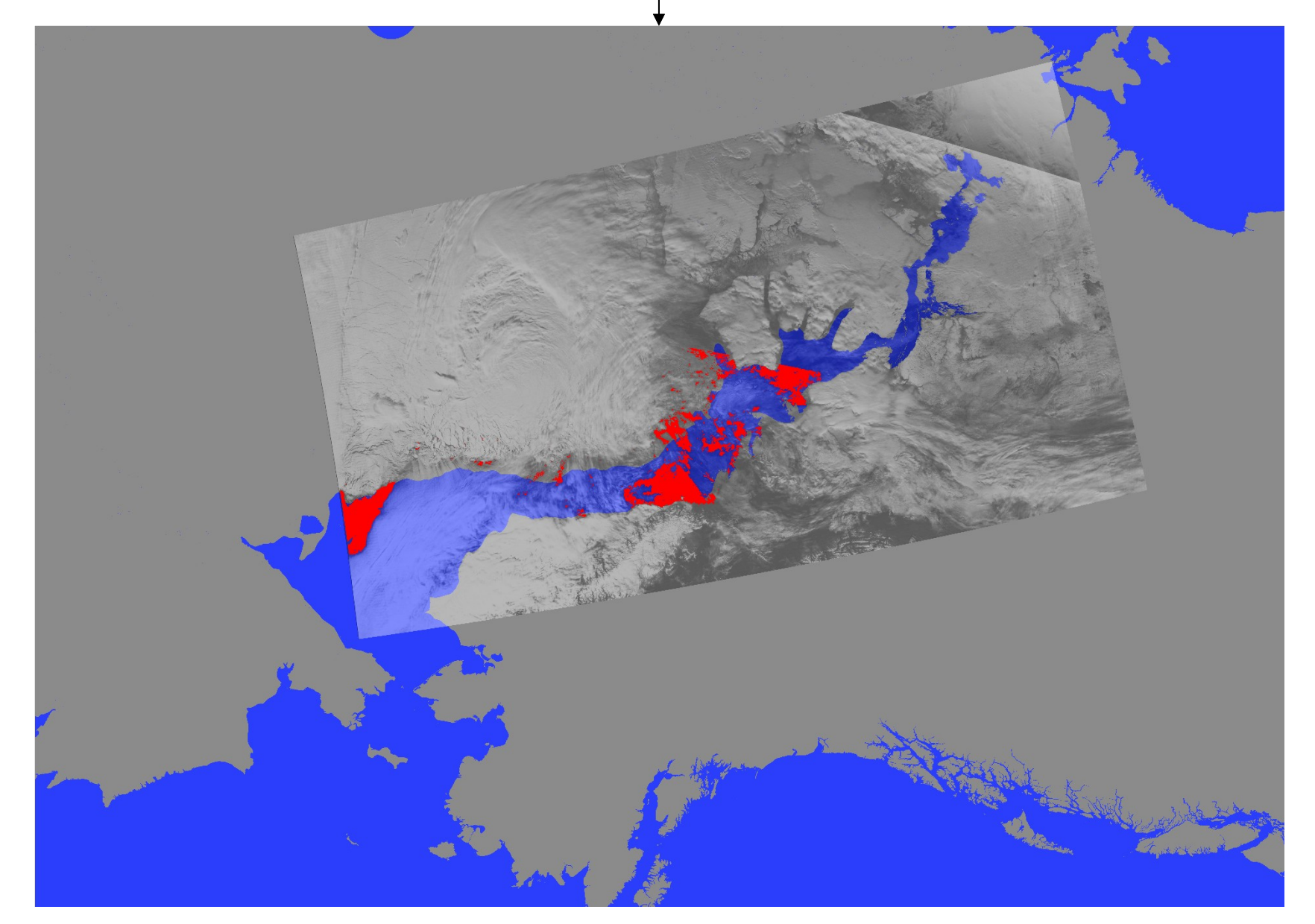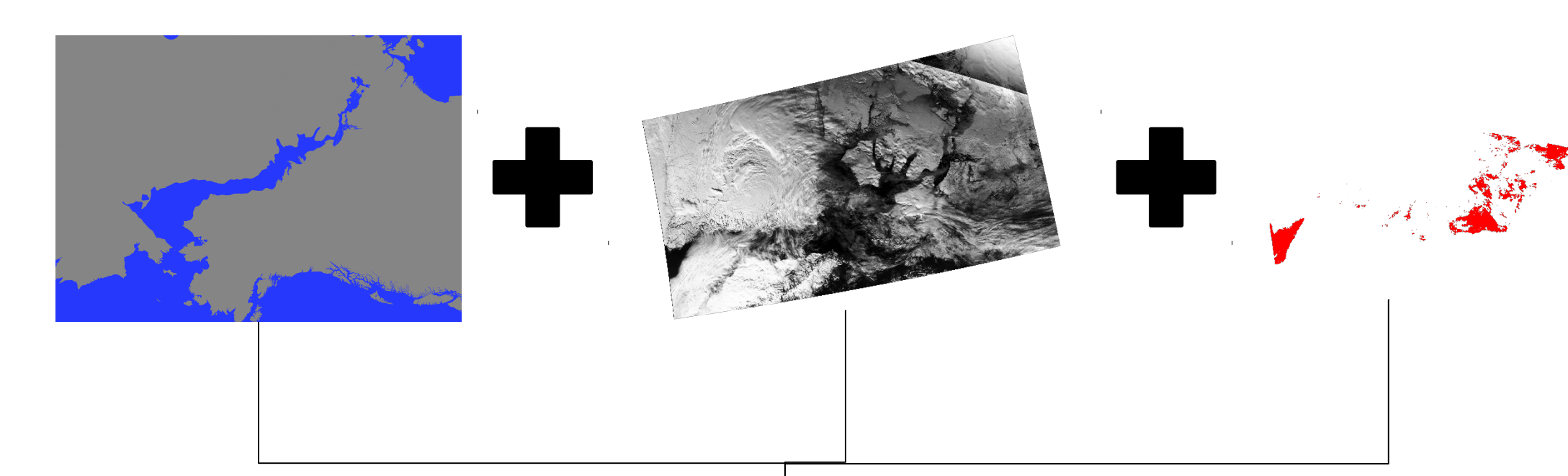Experimental Calculated Water Mask
10/19/2013 11:52:10

The above white bands were directly taken from VIIRS and projected onto the NASA "Blue Marble" Basemap of Earth. They were then combined and formatted into the single band on the left. From the single band, small patches of water were calculated using a specific threshold that differentiated between clouds and water. The resulting patches are shown on the left as well, and will be superimposed on a mask already assumed to be correct.

NATICE Shapefile Examples

These particular shapefiles are produced weekly, and illustrate ice conditions in the Arctic region. They can be precisely interpreted through the shapefile library in the Python programming language, or with Quantum GIS for seamless viewing. Shapefiles contain a set of coordinates in a particular Earth projection, which can then be drawn over a Basemap image that shows a small region of Earth. These coordinates are automatically connected by lines, yielding a shape that can represent either ice or water. Some examples are depicted below from Python.

Beaufort Sea, 07/01/2014

Beaufort Sea, 07/03/2014

Beaufort Sea, 07/08/2014

Beaufort Sea, 07/10/2014

Validation Results
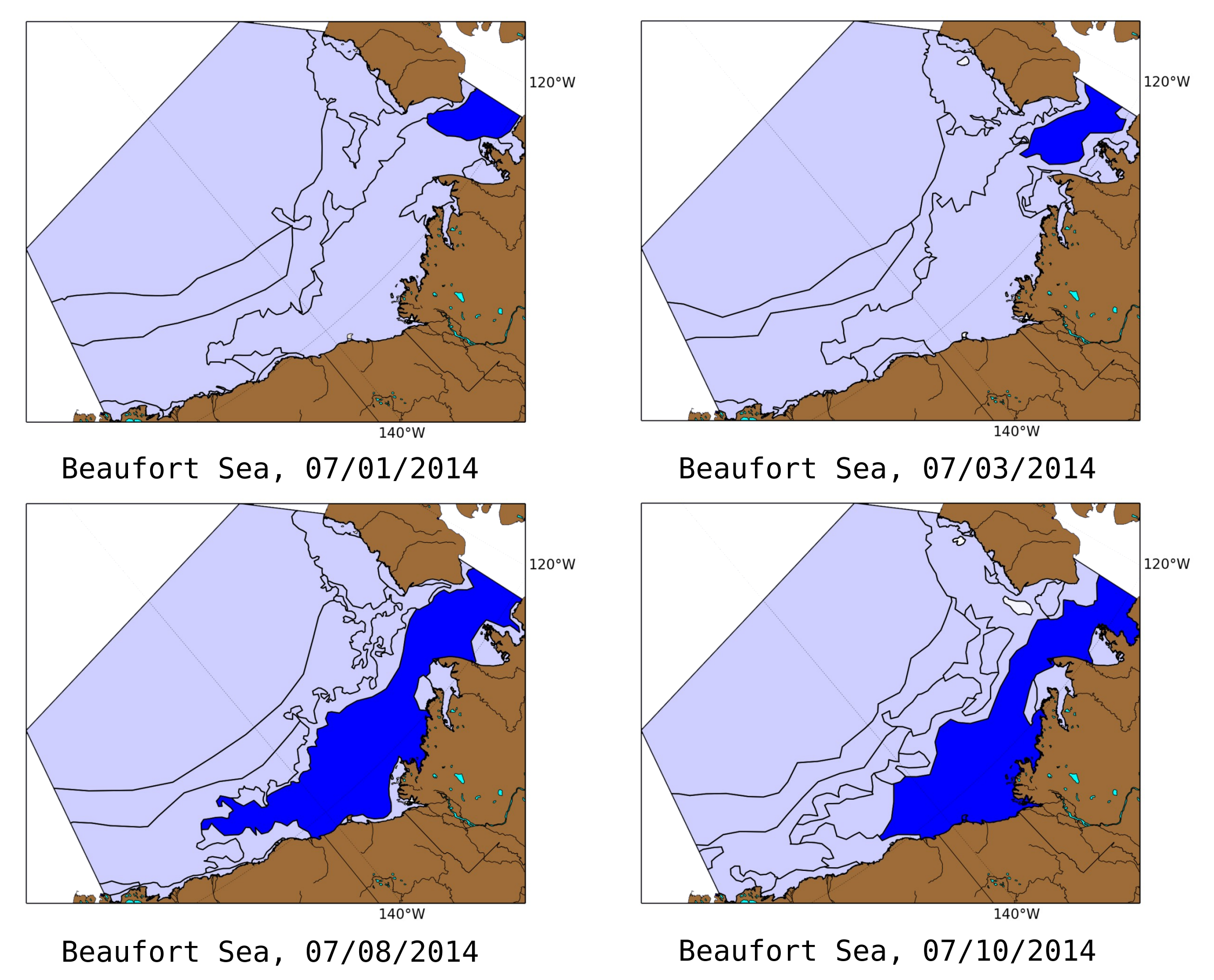
10/19/2013   10/20/2013

The above 2 images are examples of the final versions of the water mask for their respective dates, calculated in GRASS GIS. The blue in the images represent water, while the gray is a combination of both land and ice. Because only the water is significant to the goal of this project, the ice and land shapefiles for the respective date can be combined together and rasterized – or flattened and treated as one material. The negative space left in the image must be the water.

Below, the experimental water mask (red) and default VIIRS image of clouds (white) are layered over the water-land mask. From this image, it can be seen that the experimental water mask is not very extensive and cannot deduce what is underneath the clouds, but still manages to fairly accurately find water where it exists despite drifting slightly onto the ice.

Superimposed Water Mask on Land-Ice Mask
10/19/2013 11:52:10

Acknowledgements