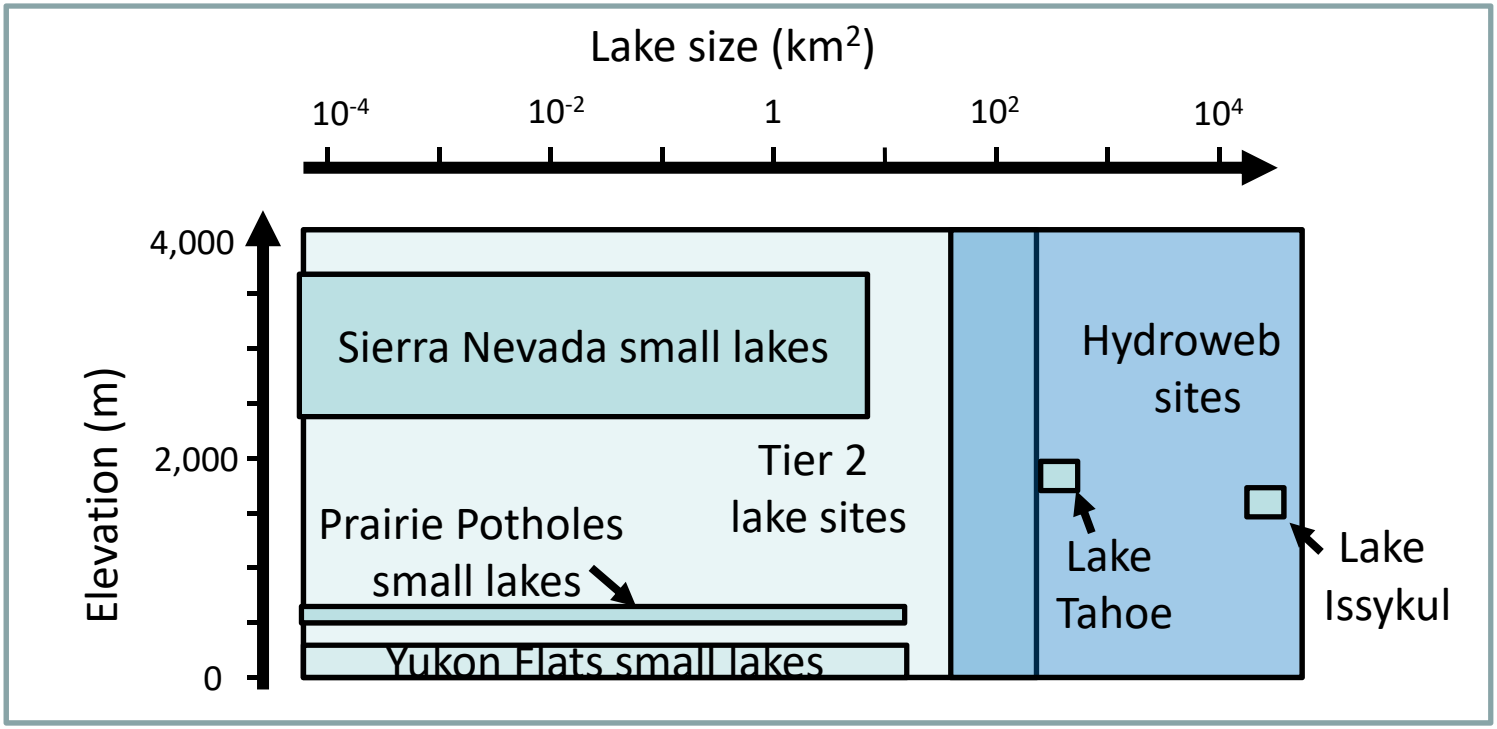
US Lakes Cal/Val

J. Toby Minear
University of Colorado, Boulder
ESOC / CIRES

Tier 1 Lake Sites

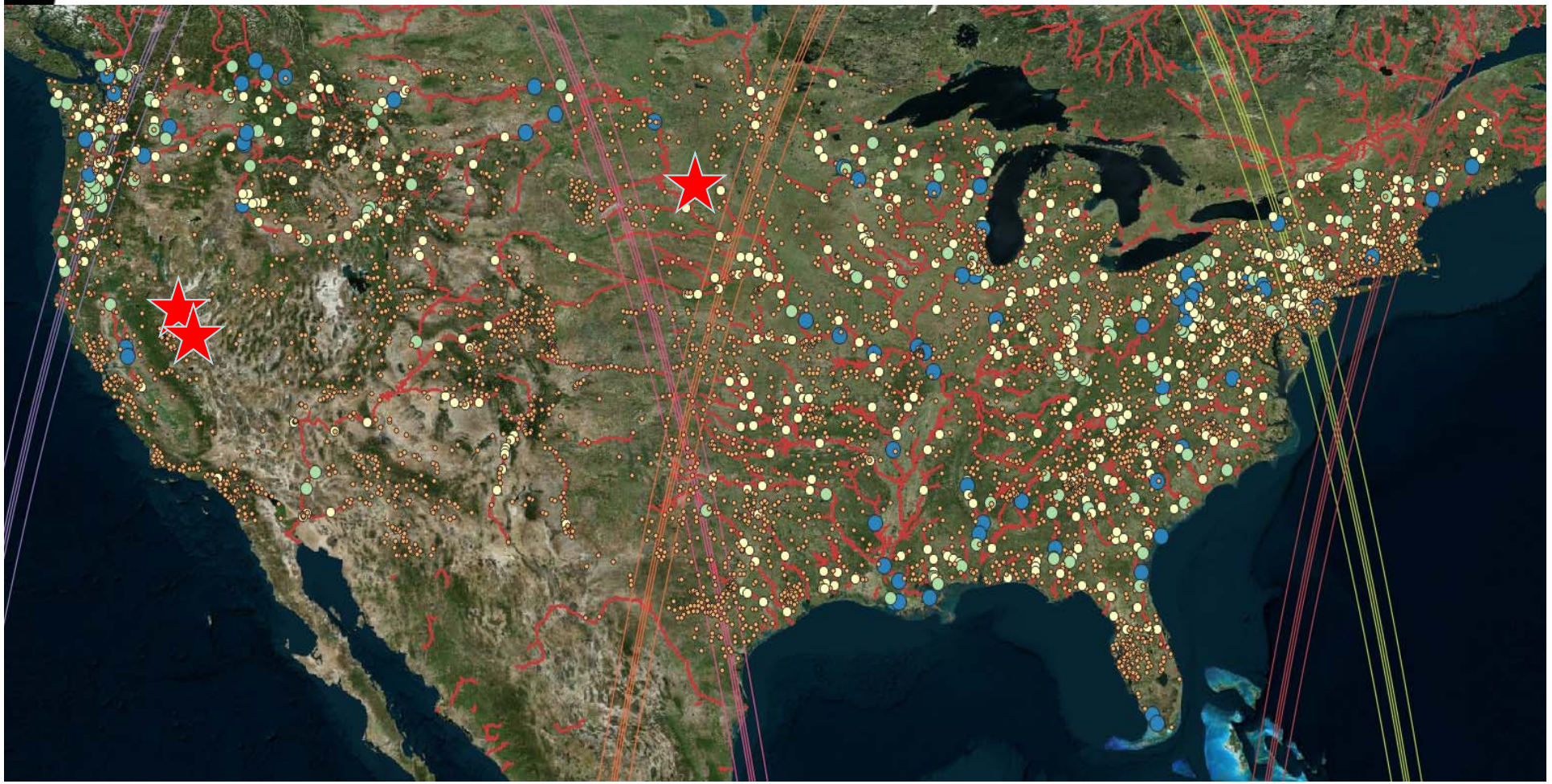
- Lake Issykkul (FR)
- Lake Tahoe (US)
- Prairie Potholes (US)
- Yukon Flats Lakes (US)
- Sierra Nevada (US)
- South American Lakes (FR)
- HydroWeb



SWOT Cal/Val Lakes

None are under 1-day fast repeat

- Shift Prairie Potholes east to under the 1-day fast repeat orbit?



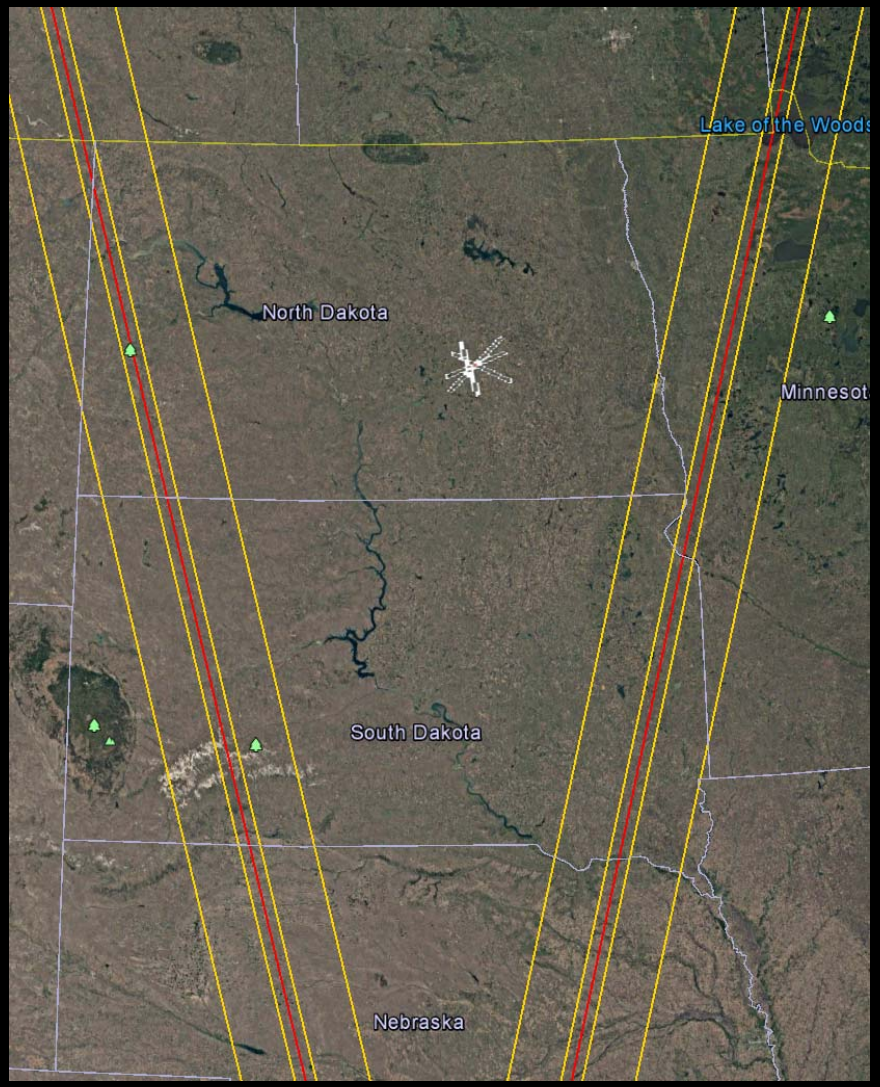
Prairie Potholes Tier 1 site

Cal/Val Site Goals (Cal/Val Study Plan, 2018):

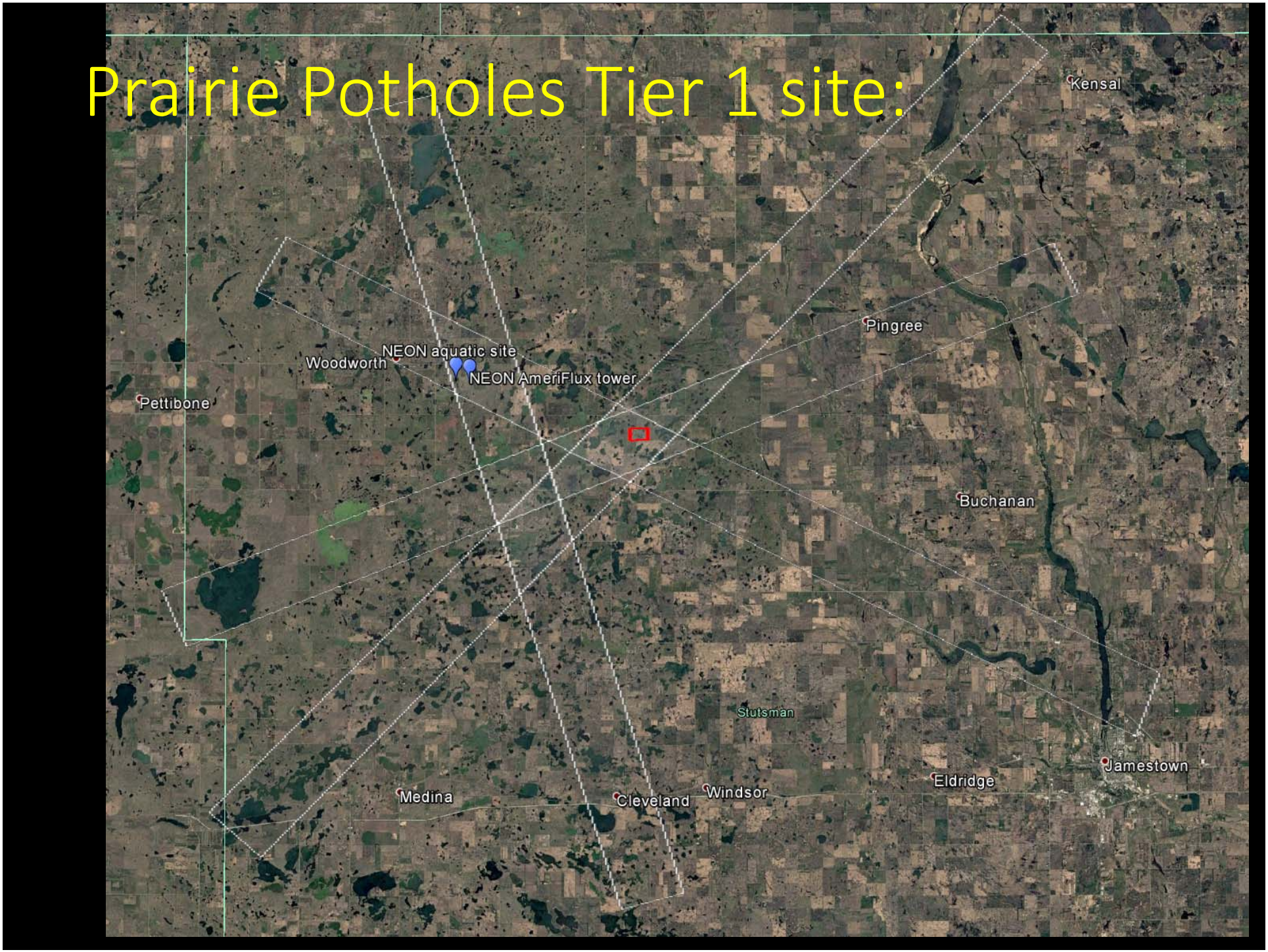
- Validate SWOT measurements of surface-water height
- Validate SWOT measurements of inundated area for small waterbodies

<u>Objectives for 2017:</u>

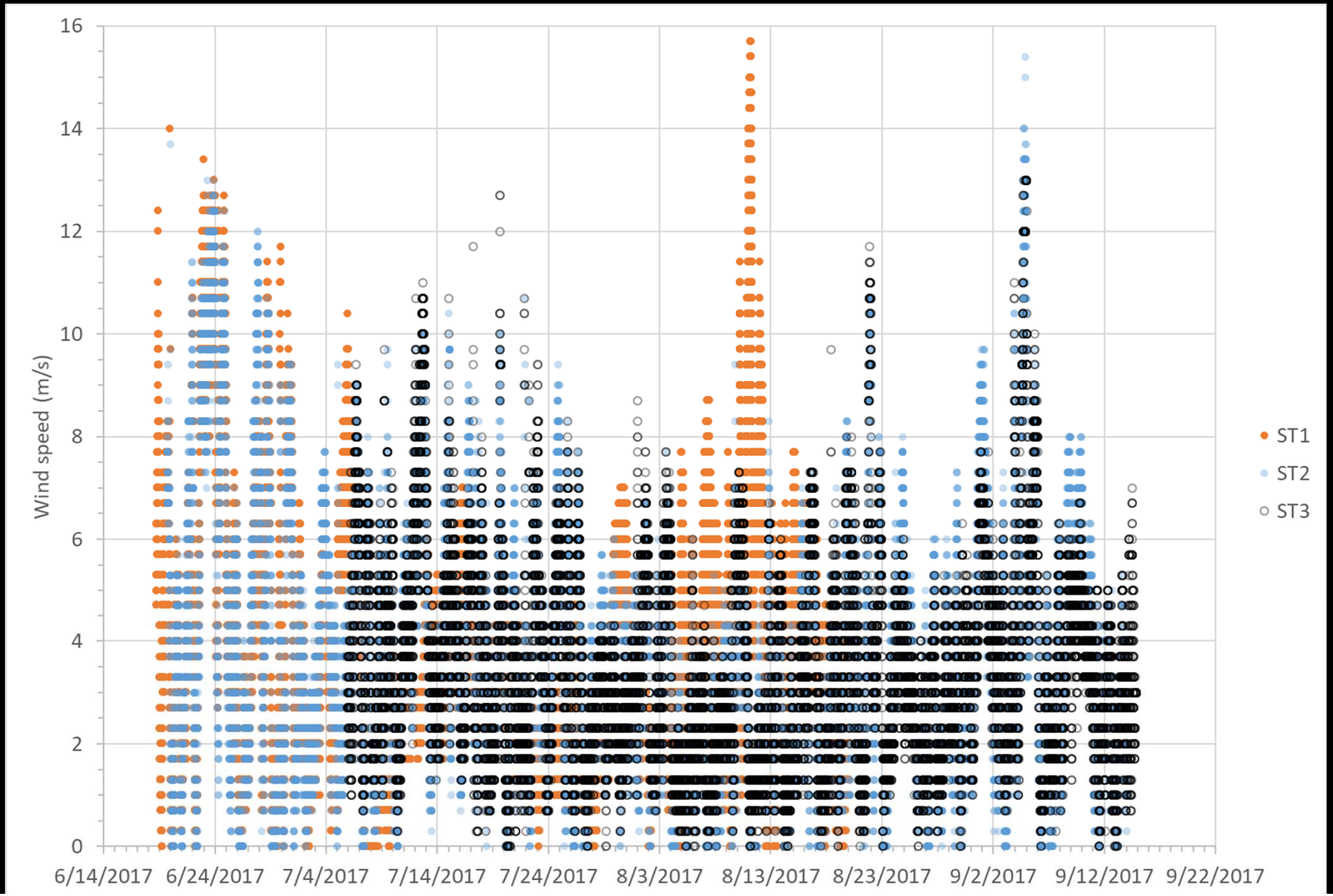
- Test of wind setup on lakes
- AirSWOT WSE over small lakes



Prairie Potholes Tier 1 site:



Windy


16
14
12
10
8
6
4
2
0
Wind speed (m/s)
6/14/2017
6/24/2017
7/4/2017
7/14/2017
7/24/2017
8/3/2017
8/13/2017
8/23/2017
9/2/2017
9/12/2017
9/22/2017
ST1
ST2
ST3

Instrumentation

Pressure transducers:

- 24 in-water transducers, 3 barometric
- 9 lakes

Weather stations:

- 3 stations deployed next to lakes of interest

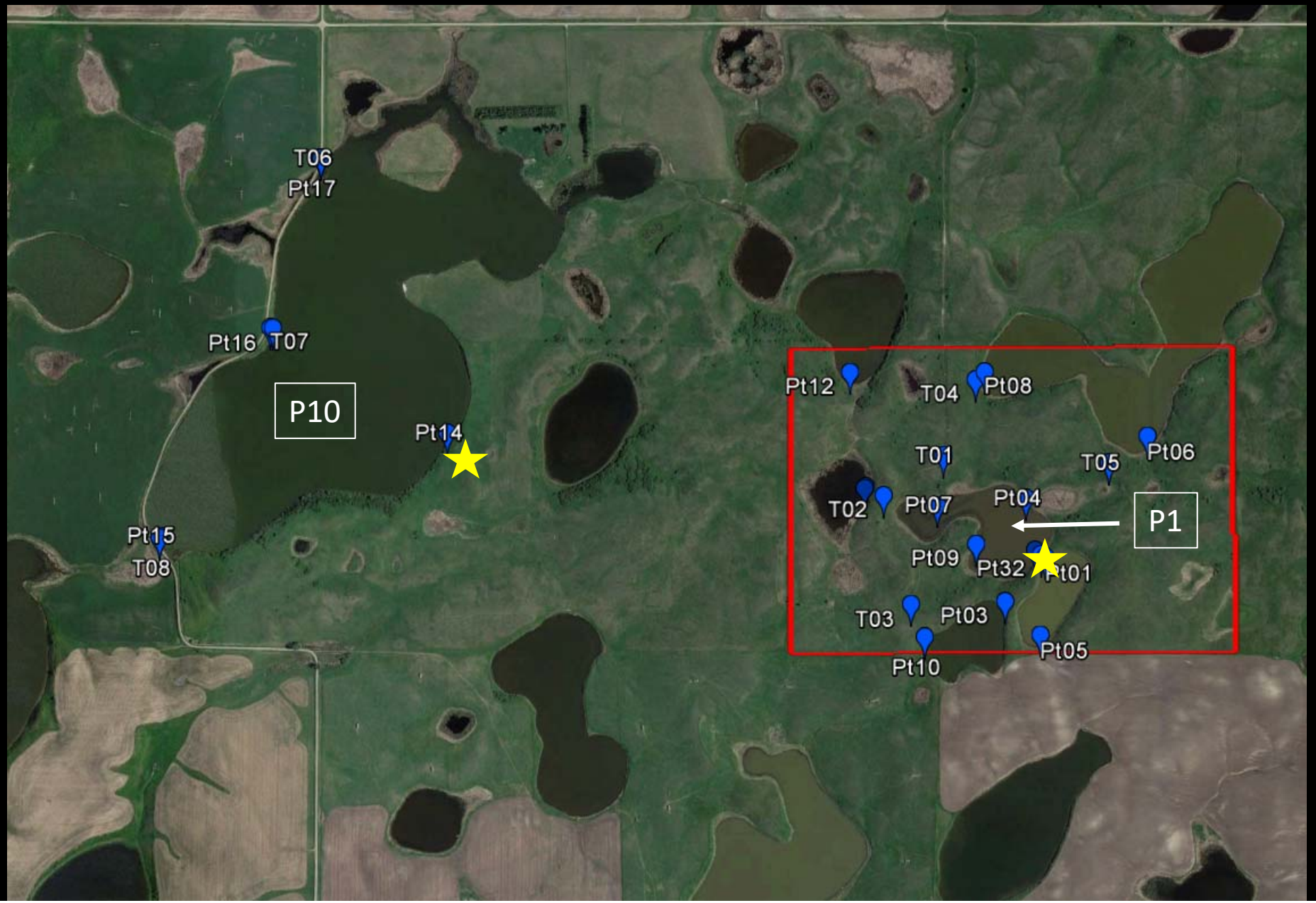
GNSS surveys:

- positioning for transducers (PPP, PPK)
- water extent survey (PPP, PPK)
- GNSS reflectometry (3x base)

Drone:

- water extent survey of (9/11/2017)

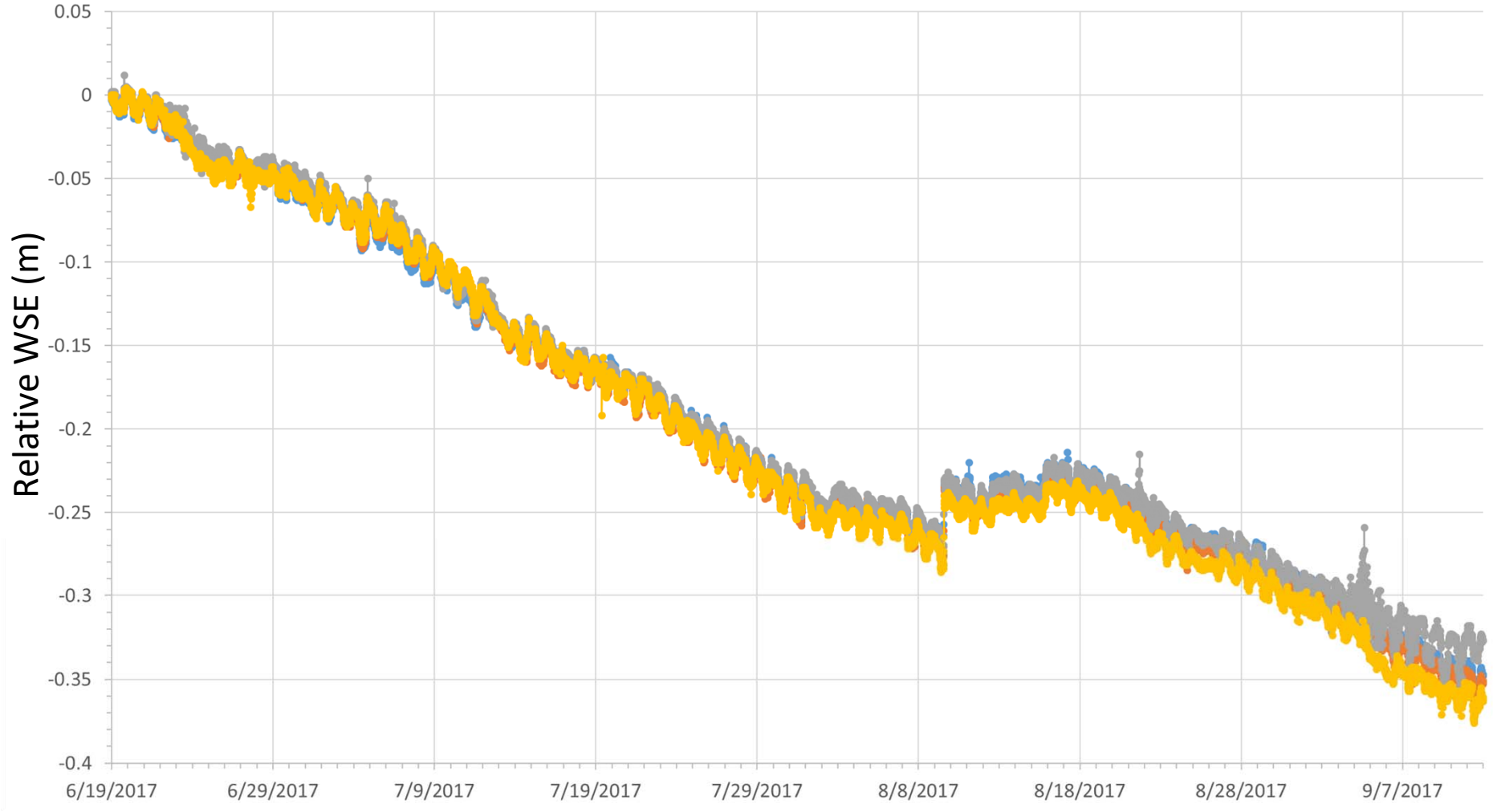
Cottonwood Lakes site

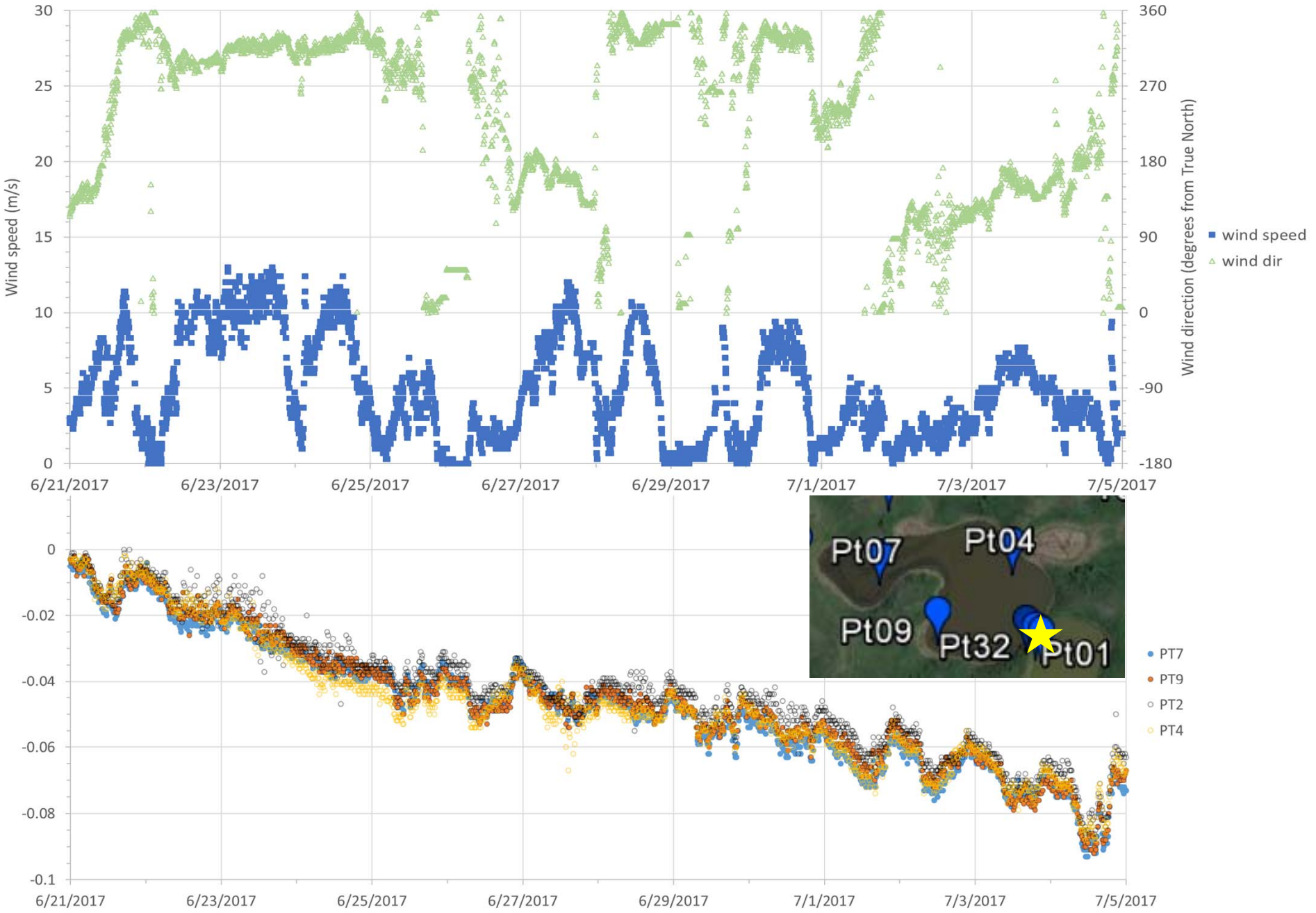


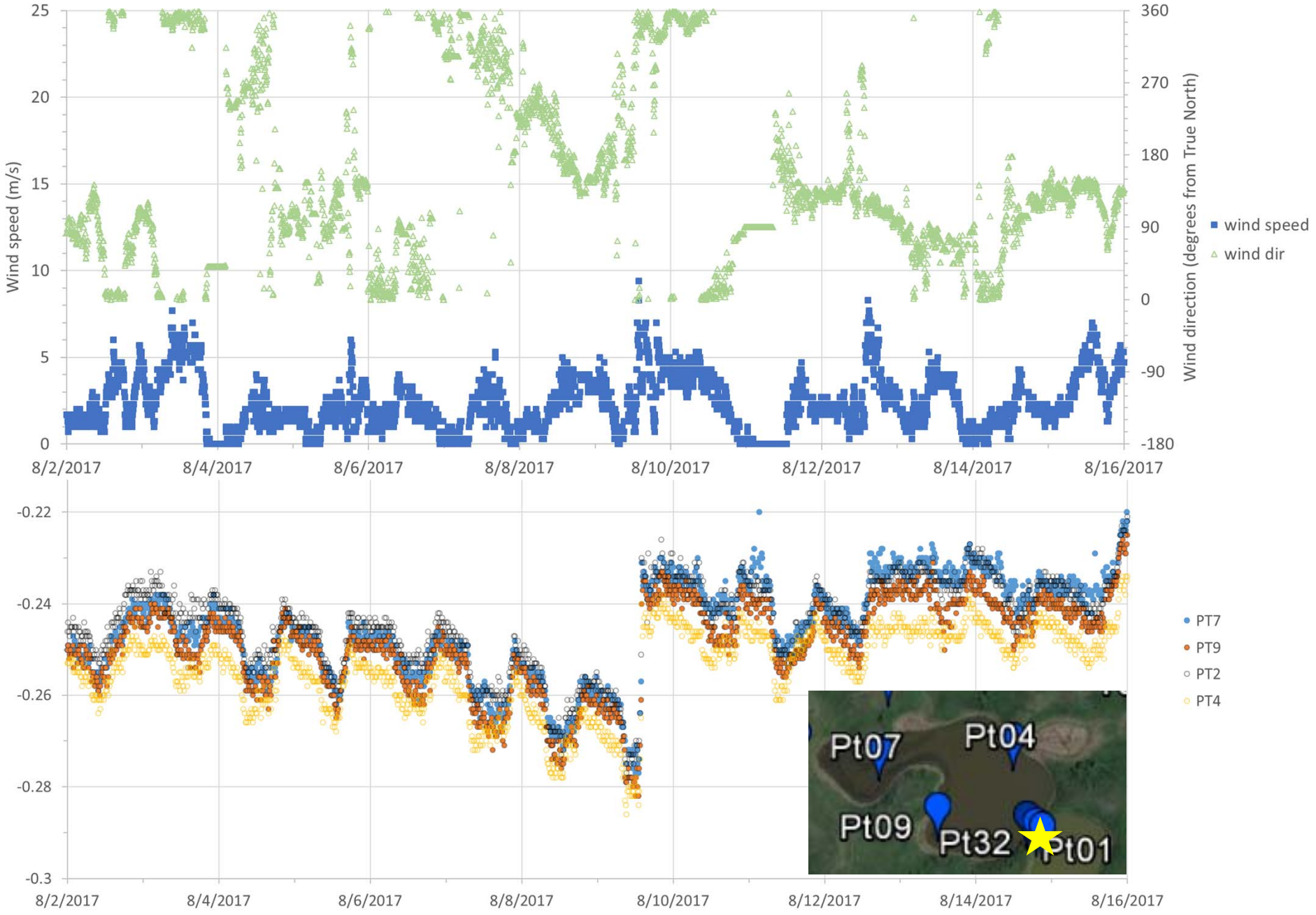
Cottonwood Lakes

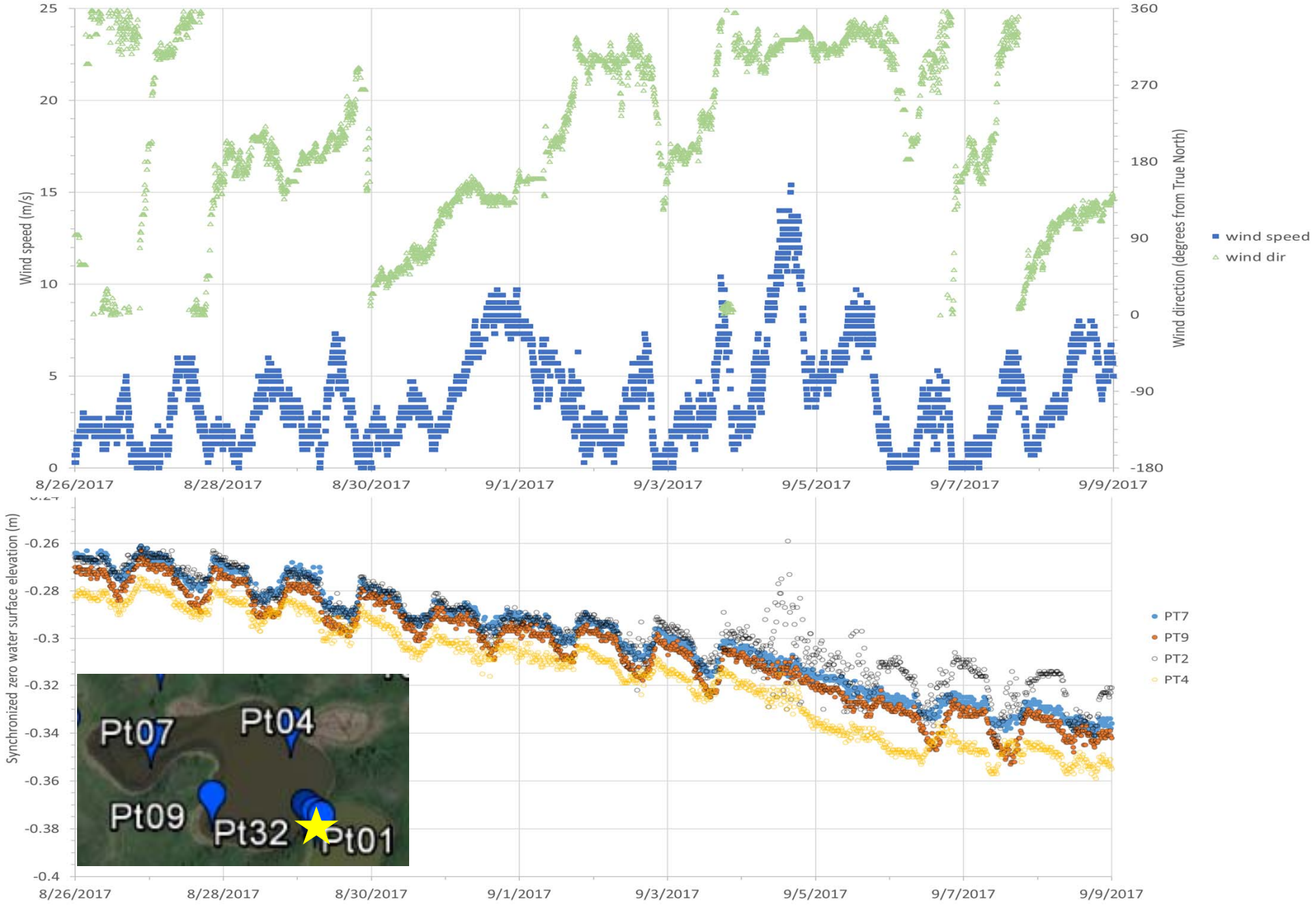
Lake P1, looking west. Note the relatively high topography.

Cottonwood Lake P1



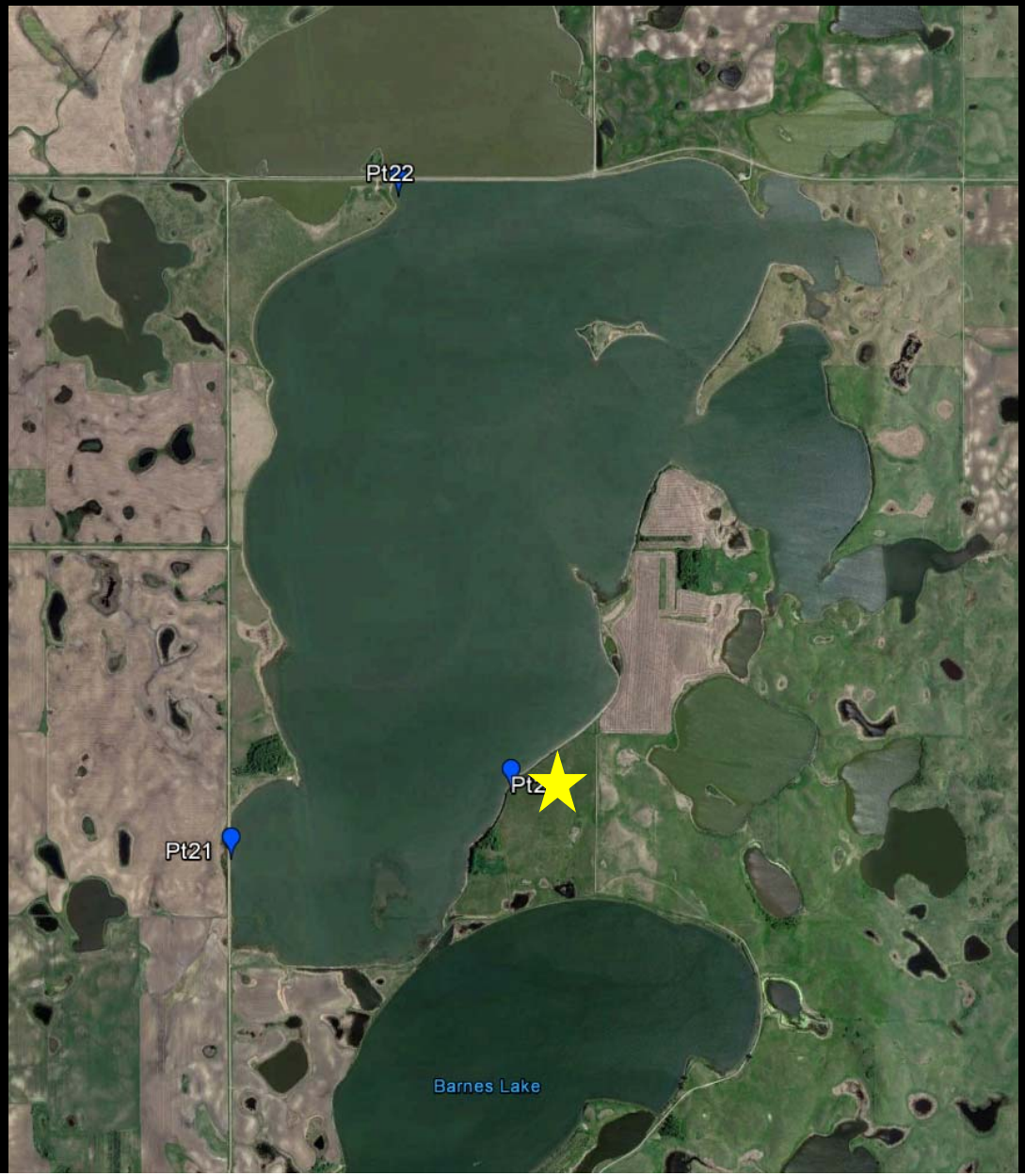

Wind speed (m/s)
Wind direction (degrees from True North)
wind speed
wind dir
30
25
20
15
10
5
0
360
270
180
90
0
-90
-180
6/21/2017
6/23/2017
6/25/2017
6/27/2017
6/29/2017
7/1/2017
7/3/2017
7/5/2017
0
-0.02
-0.04
-0.06
-0.08
-0.1
Pt07
Pt04
Pt09
Pt32
Pt01
PT7
PT9
PT2
PT4

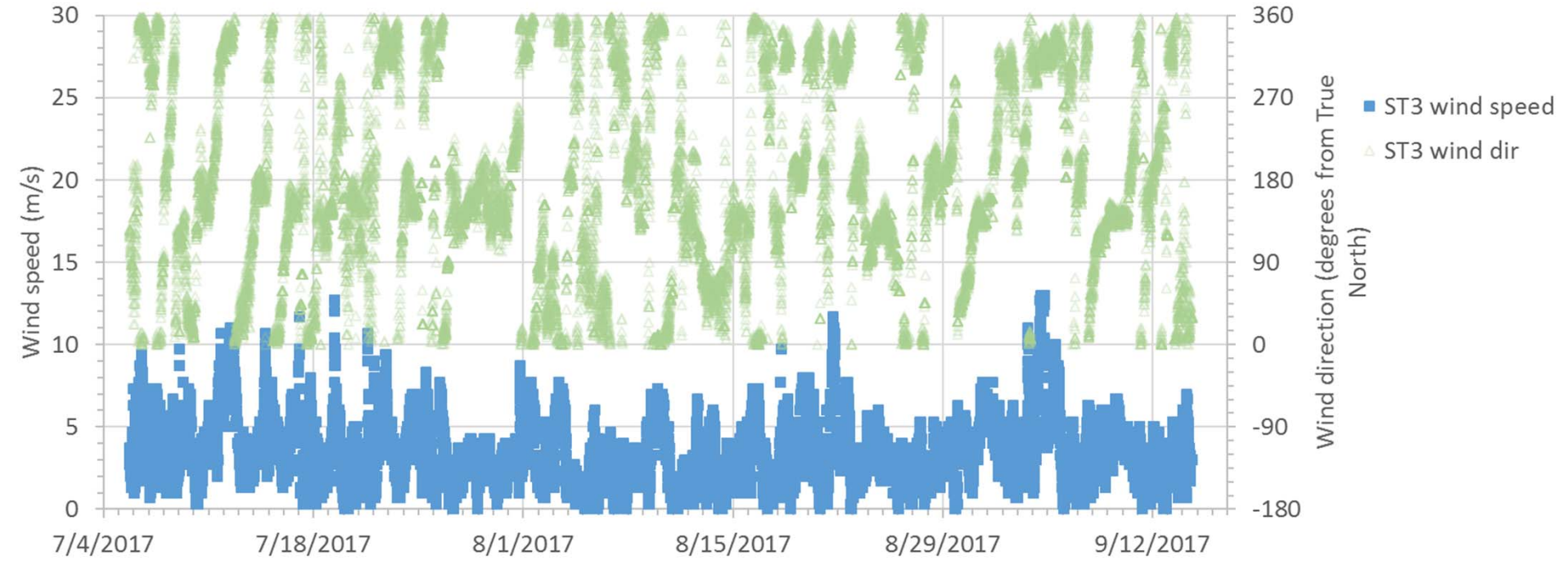

Wind speed (m/s)
Wind direction (degrees from True North)
wind speed
wind dir
25
20
15
10
5
0
360
270
180
90
0
-90
-180
8/2/2017
8/4/2017
8/6/2017
8/8/2017
8/10/2017
8/12/2017
8/14/2017
8/16/2017
-0.22
-0.24
-0.26
-0.28
-0.3
PT7
PT9
PT2
PT4
Pt07
Pt04
Pt09
Pt32
Pt01

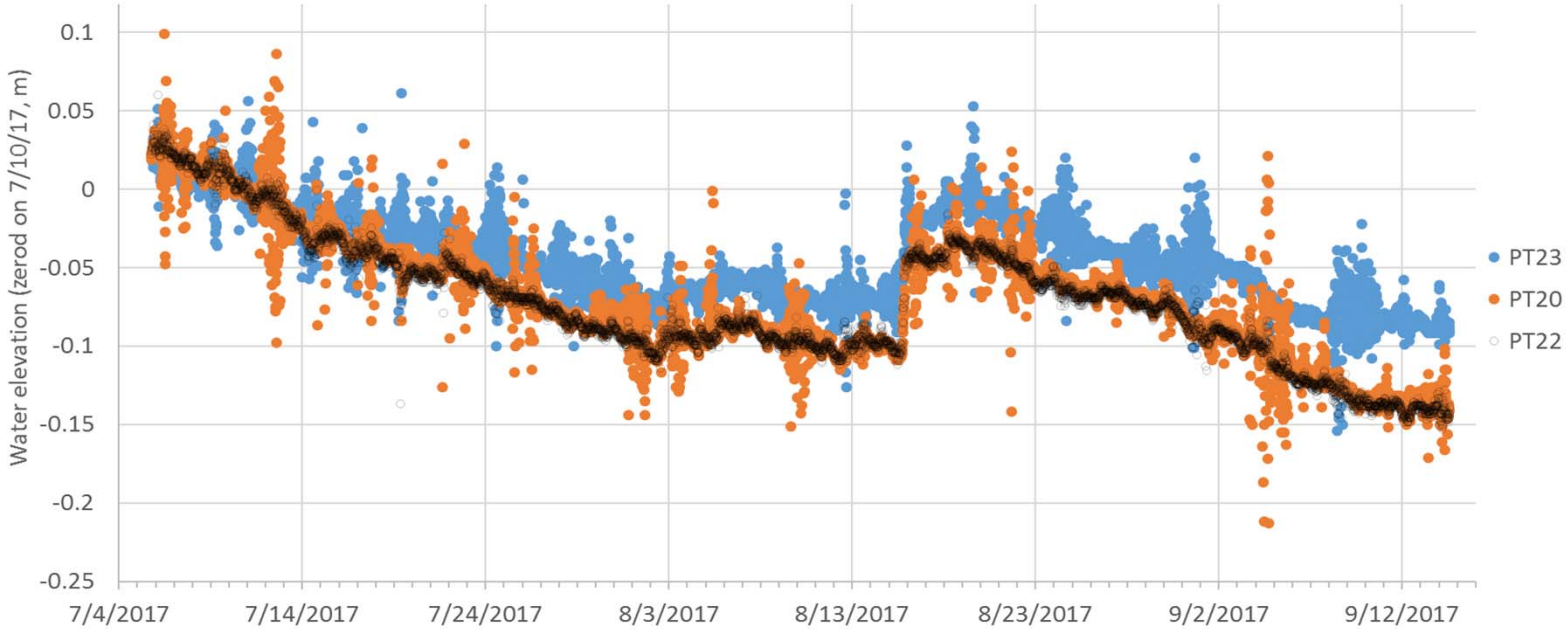

Wind speed (m/s)
Wind direction (degrees from True North)
wind speed
wind dir
8/26/2017
8/28/2017
8/30/2017
9/1/2017
9/3/2017
9/5/2017
9/7/2017
9/9/2017
Synchronized zero water surface elevation (m)
PT7
PT9
PT2
PT4
Pt07
Pt04
Pt09
Pt32
Pt01

Mallard Lake

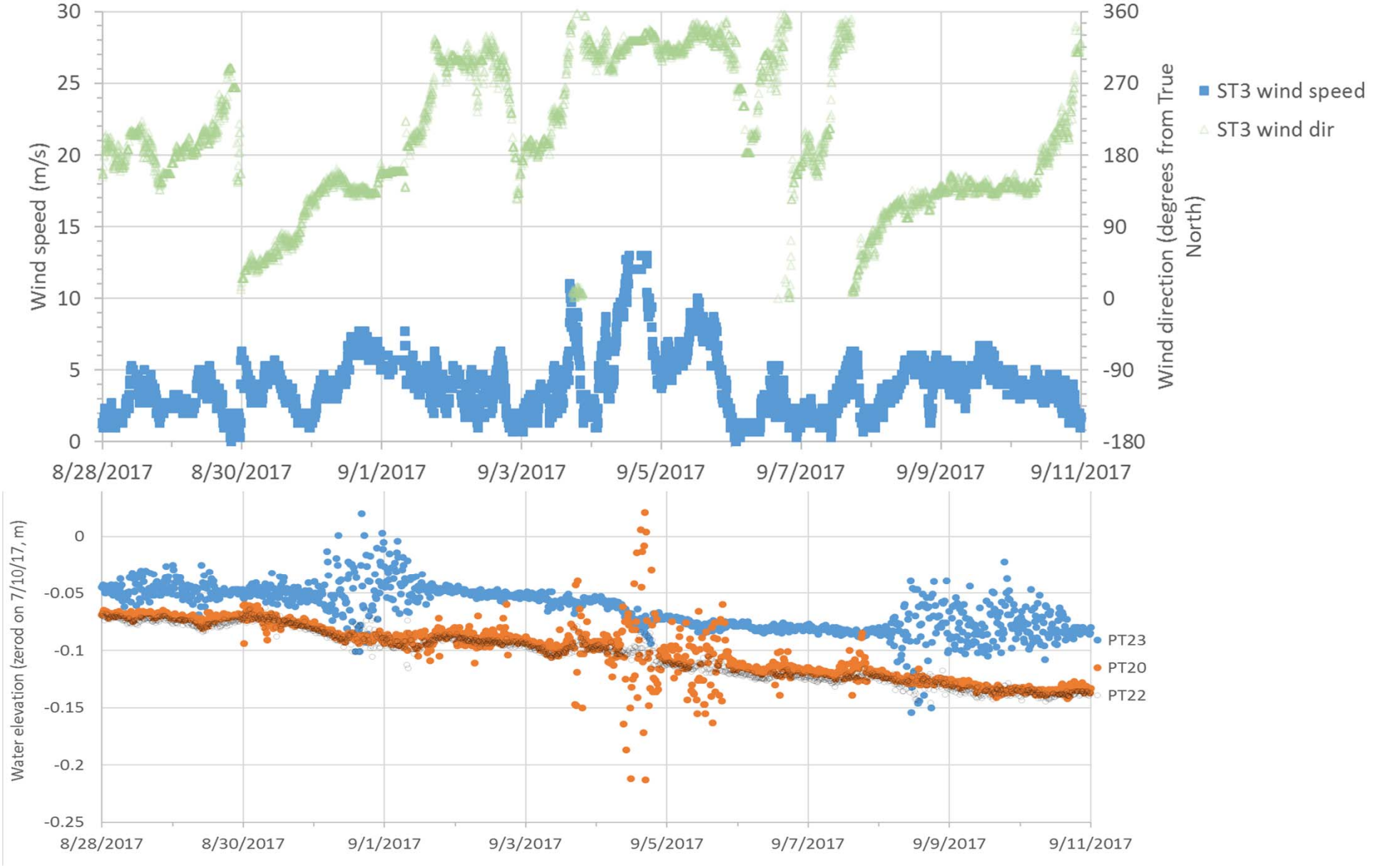
- Largest lake
- ~2.5 km wide




Wind speed (m/s)
30
25
20
15
10
5
0
360
270
180
90
0
-90
-180
Wind direction (degrees from True North)
ST3 wind speed
ST3 wind dir
7/4/2017
7/18/2017
8/1/2017
8/15/2017
8/29/2017
9/12/2017


Water elevation (zerod on 7/10/17, m)
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
7/4/2017
7/14/2017
7/24/2017
8/3/2017
8/13/2017
8/23/2017
9/2/2017
9/12/2017
PT23
PT20
PT22

Mallard Lake



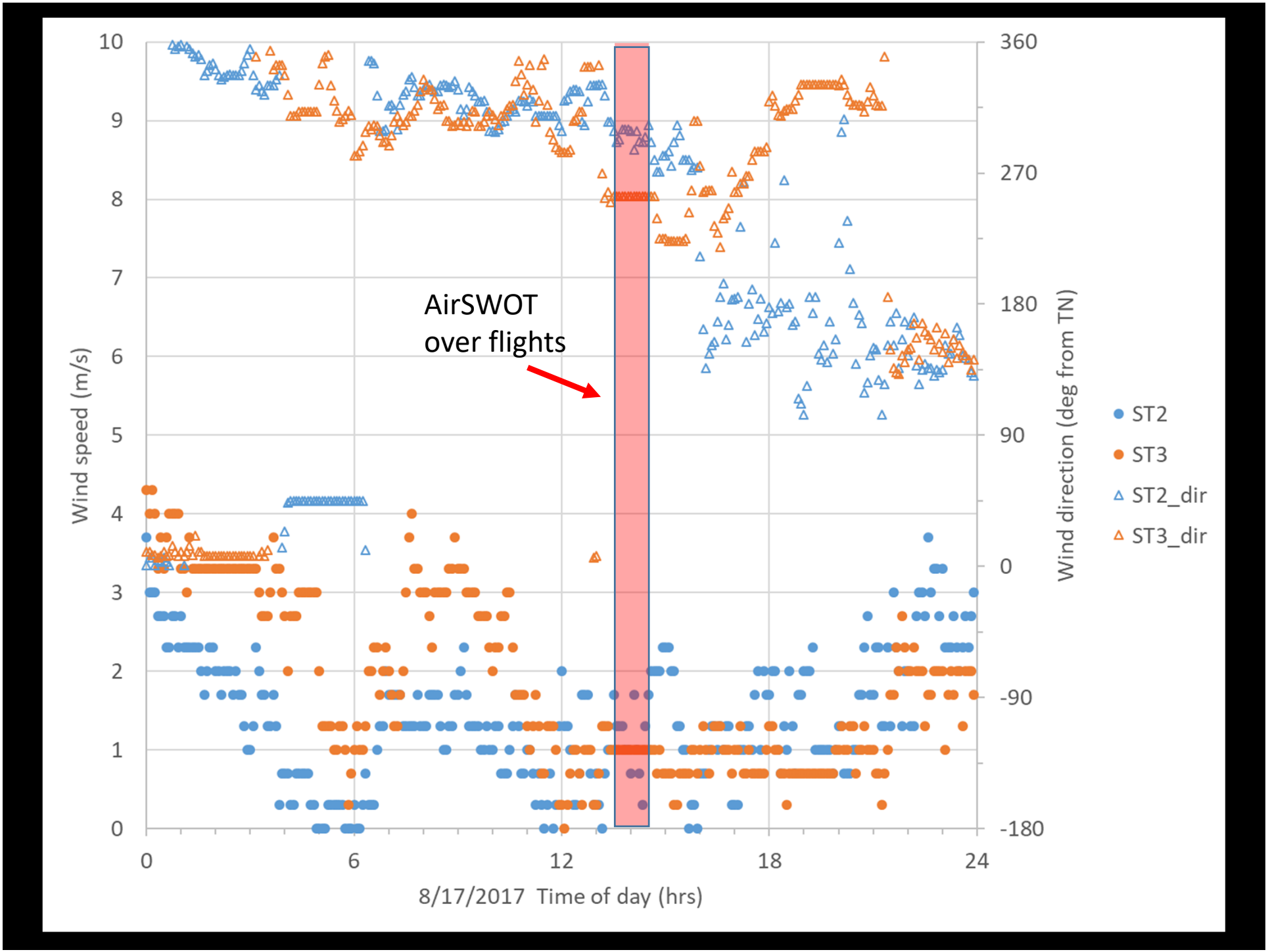
AirSWOT Timeline

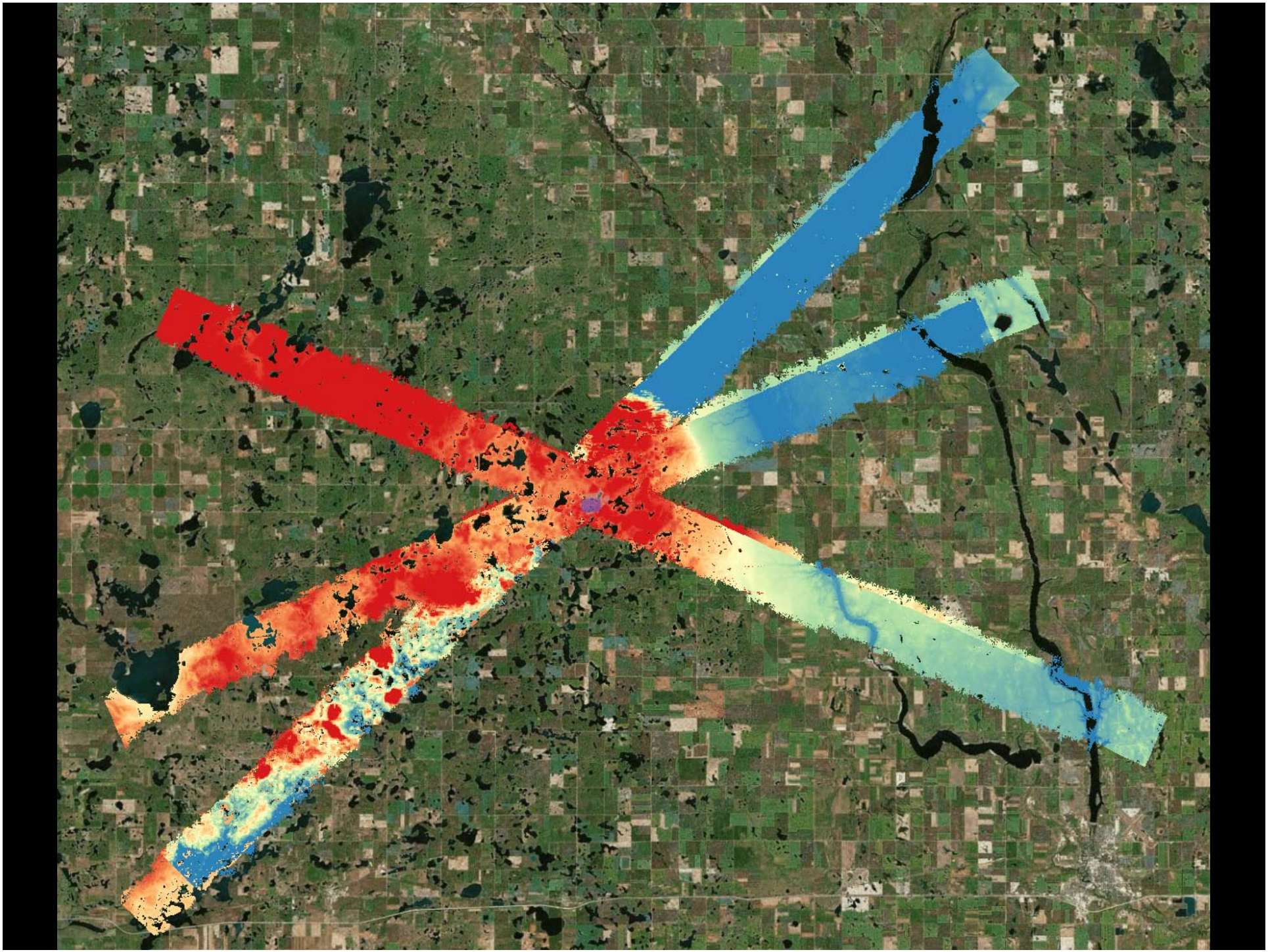
Prairie Potholes during ABoVE 2017:

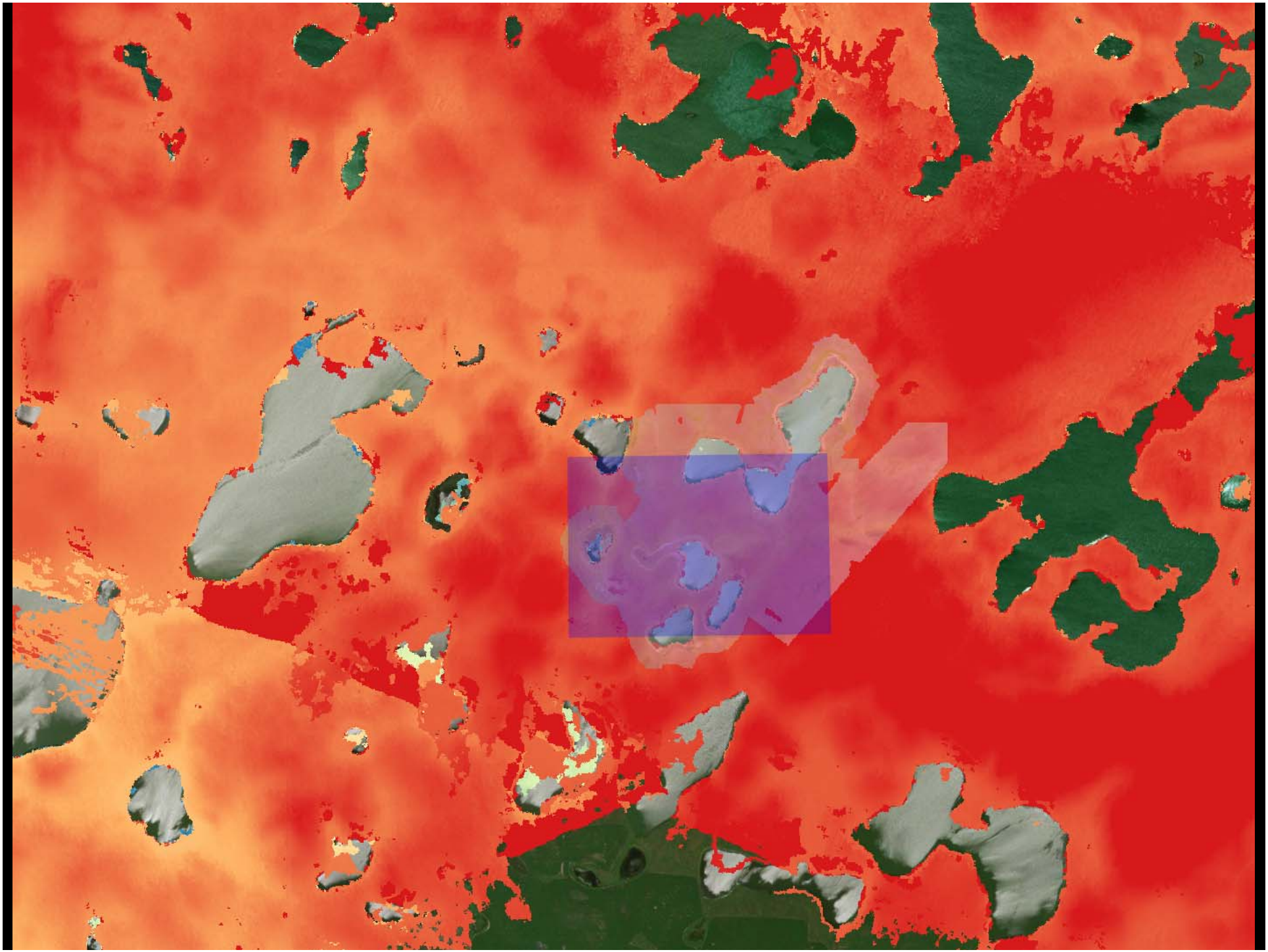
On North leg, AirSWOT was originally scheduled to fly 7/6/2017 but had instrument issues, focused instead on N. Sask

On return trip, during ~1 hr on 8/17/2017, AirSWOT collected 3x up-and-back strips for 6 total flight lines (total length ~350 km) over the Prairie Potholes site

Did not collect the 4th strip (Mallard Lake)


AirSWOT
over flights
Wind speed (m/s)
Wind direction (deg from TN)
8/17/2017 Time of day (hrs)
ST2
ST3
ST2_dir
ST3_dir
0
1
2
3
4
5
6
7
8
9
10
-180
-90
0
90
180
270
360
0
6
12
18
24





Take aways

- Under most wind conditions (<10 m/s), these lakes have less than 2 cm variation in WSE from edge to edge
- With wind over 10m/s, it appears that superelevation of the lake surface can occur, even in small well-sheltered lakes, though it could be from waves
- Pressure transducers may be susceptible to drift, particularly if left out for longer than 1 month. Drift rate can be as much as ~1cm/month. It is unclear if the mechanism is biologic fouling or settling of mounts into underlying substrate

Implications

- May need to place multiple transducers in lakes, though if waves are determined to be the culprit, averaging over them might work.
- Placing pressure transducers much deeper might reduce the effect of waves
- Place barometric transducer in a very sheltered location
- Need to revisit, clean and reset pressure transducers every month (?)