New technical developments in tropical cyclones observing systems: ocean-air observations during typhoon Fanapi

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OUTLINE

- Overall science questions and goals;
- Technology and methods;
- Observations within typhoon Fanapi;
- Conclusions & outlook.

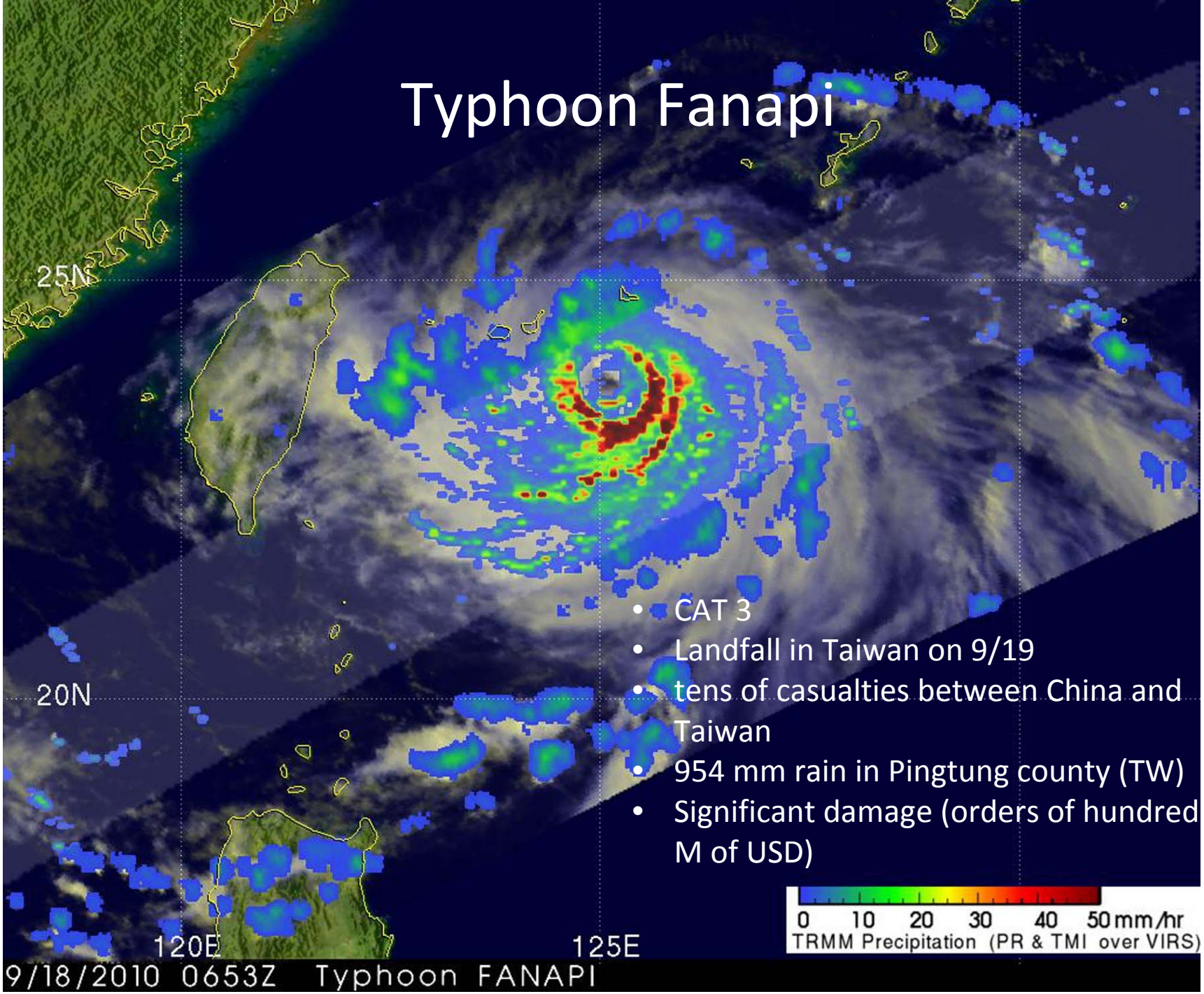
Overall science questions

- How does the ocean upper temperature affects the intensification of tropical cyclones?
- What are the processes that influence the evolution of the wake?

Specific goals

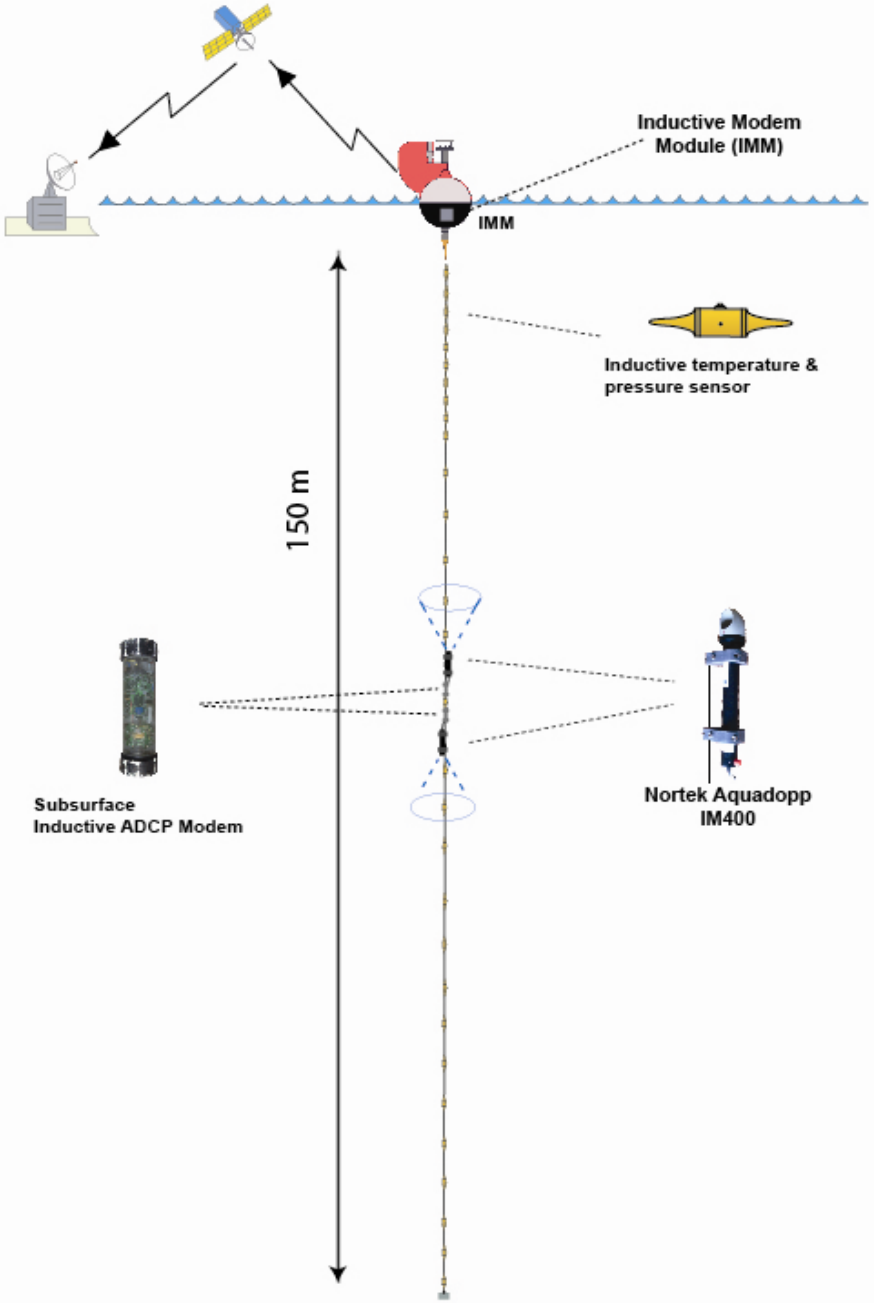
- Demonstrate the use of the sonic anemometer for tropical cyclone research;
- Characterize the tropical cyclone and associated upwelling.

Typhoon Fanapi

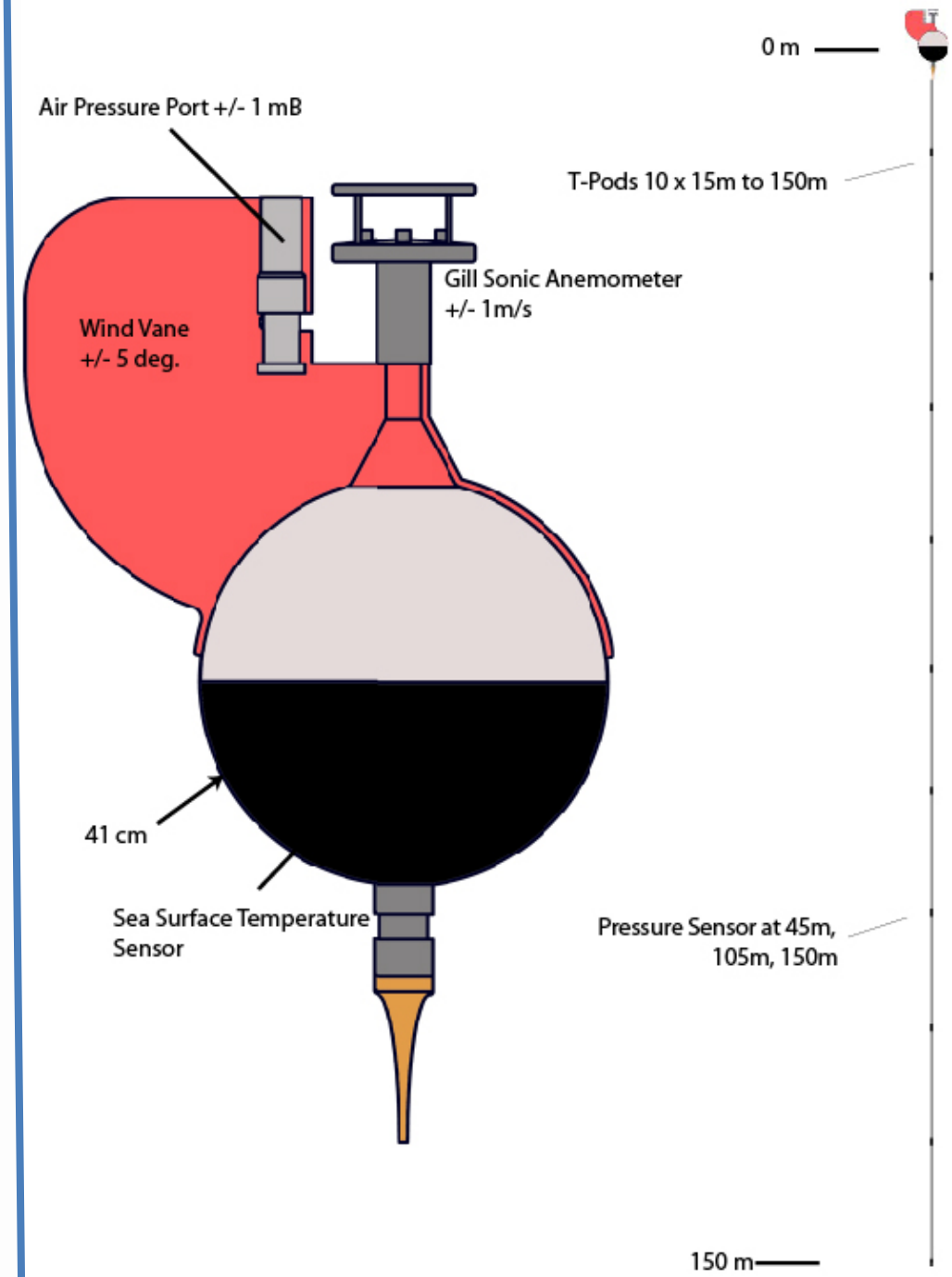


- CAT 3
- Landfall in Taiwan on 9/19
- tens of casualties between China and Taiwan
- 954 mm rain in Pingtung county (TW)
- Significant damage (orders of hundred M of USD)

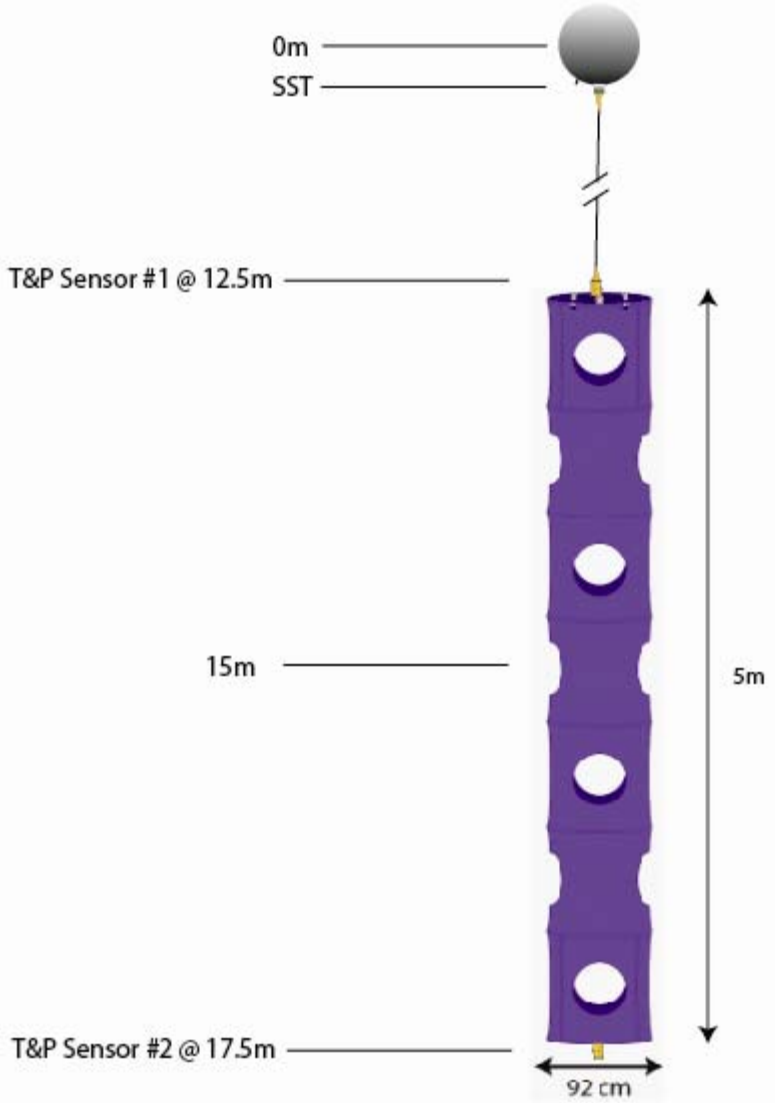
Super ADOS



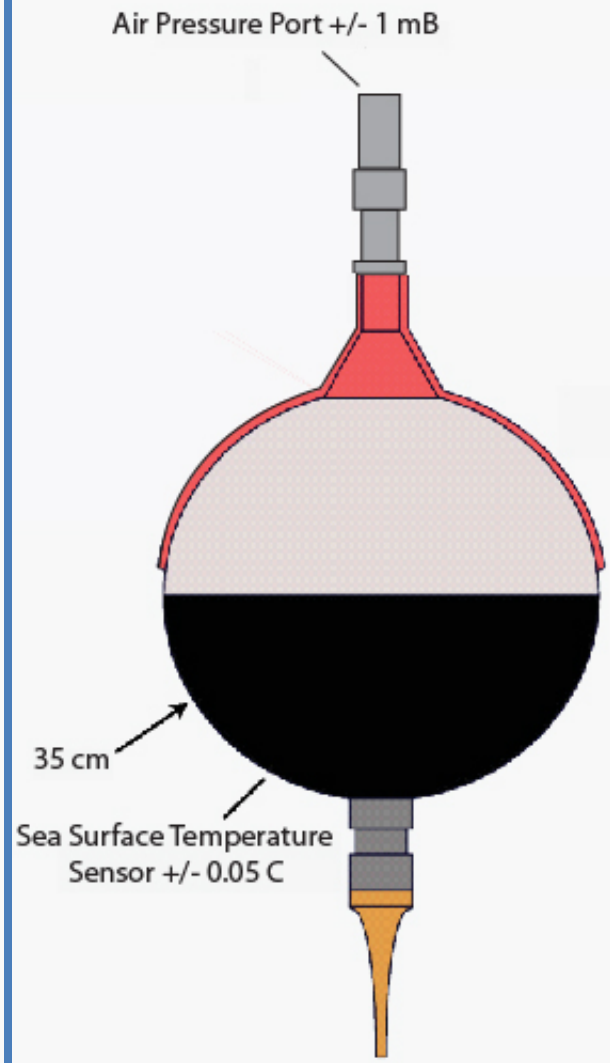
ADOS

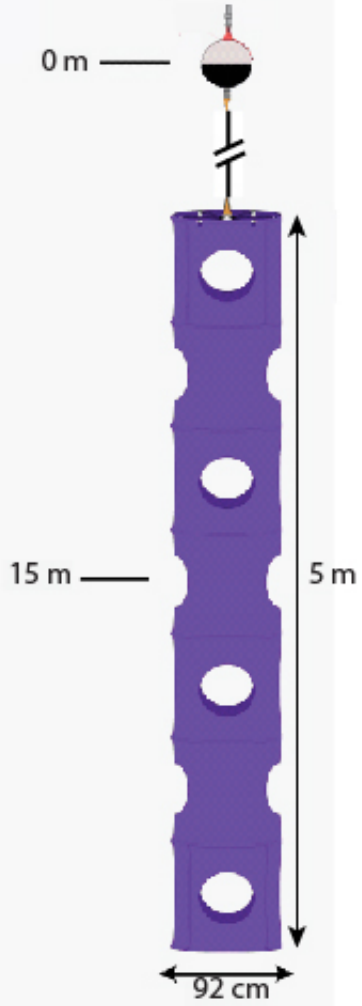


SVP-2T


0m
SST
T&P Sensor #1 @ 12.5m
15m
5m
T&P Sensor #2 @ 17.5m
92 cm

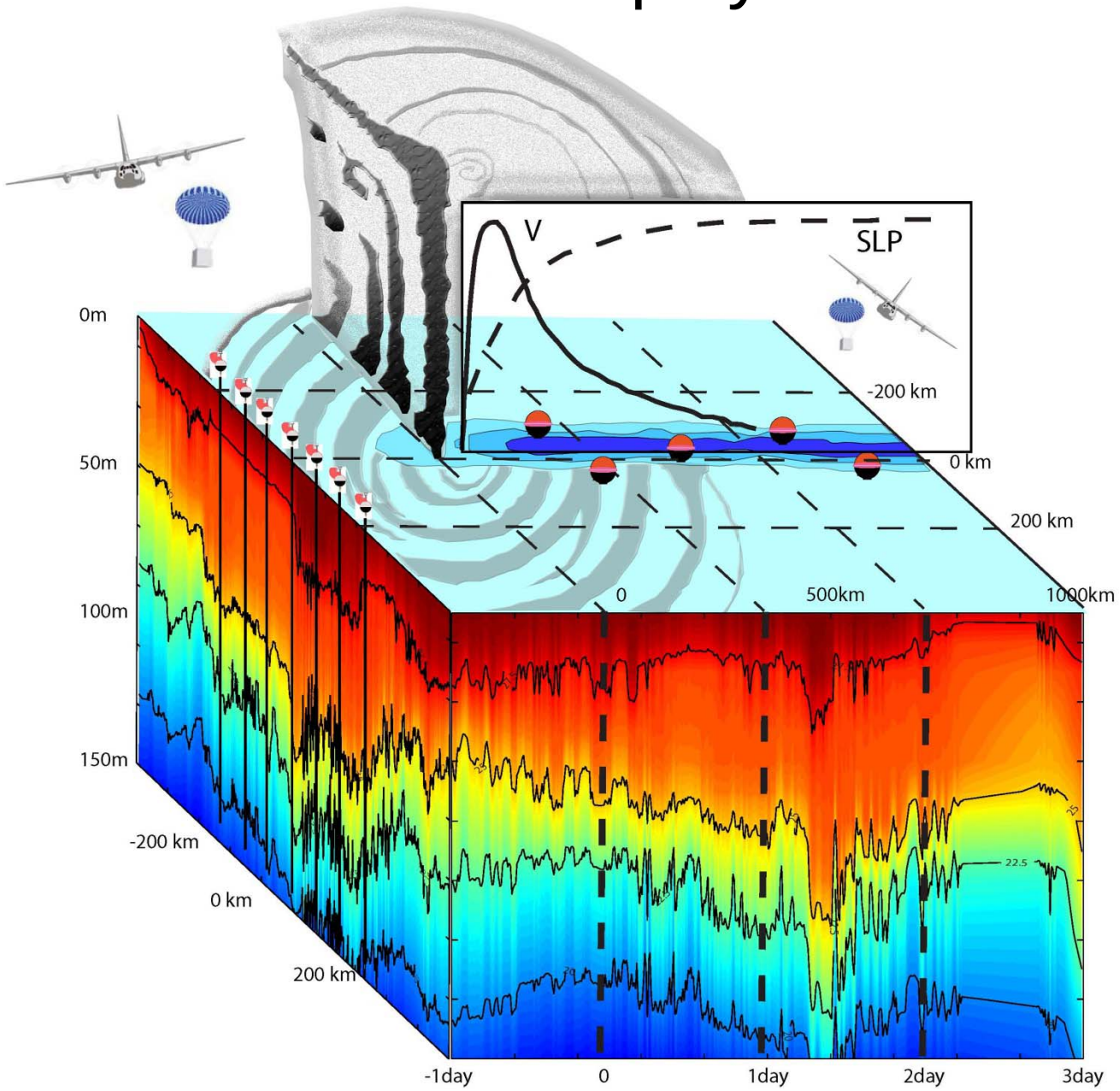
SVPB

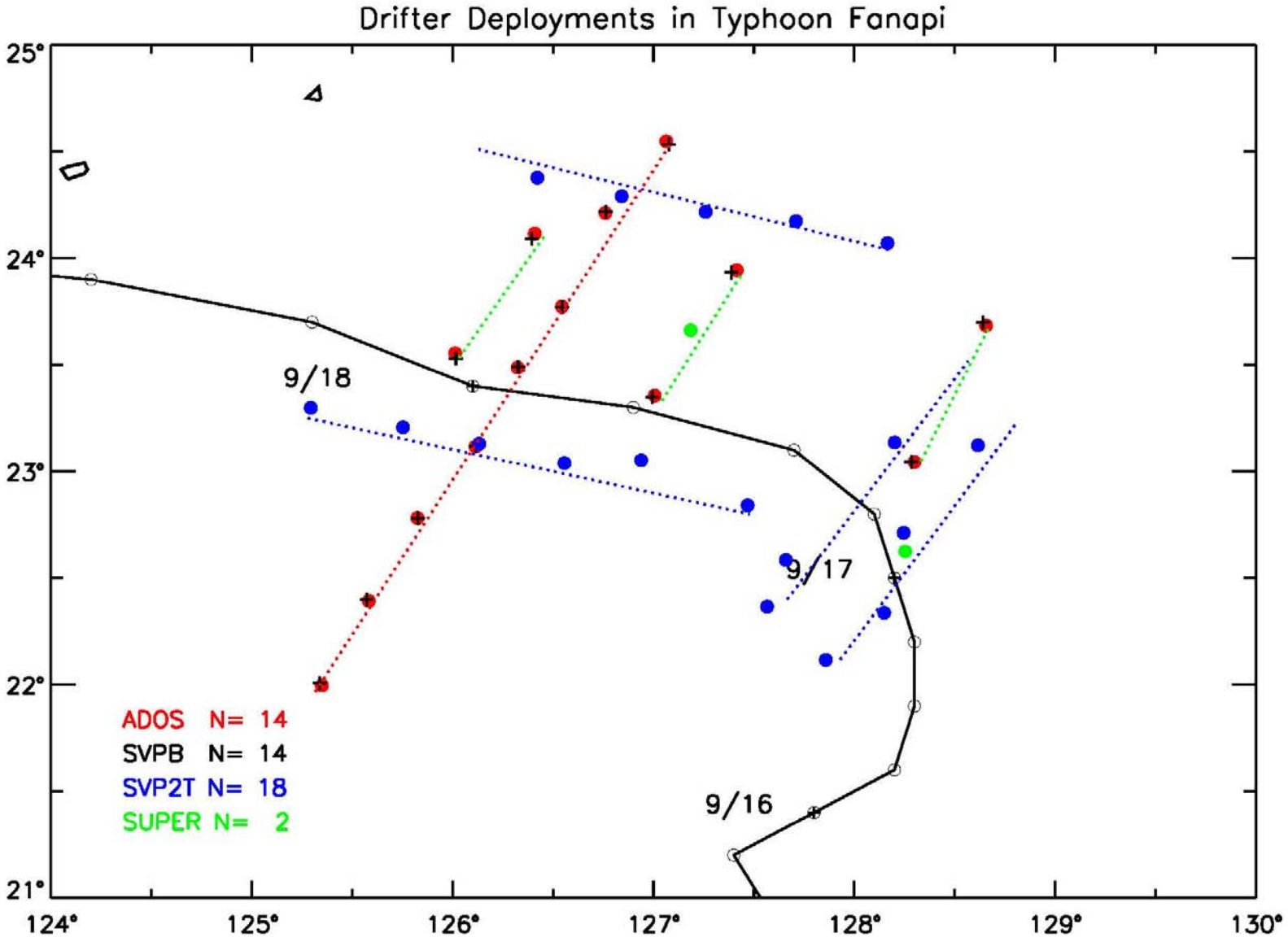

Air Pressure Port +/- 1 mB
35 cm
Sea Surface Temperature
Sensor +/- 0.05 C

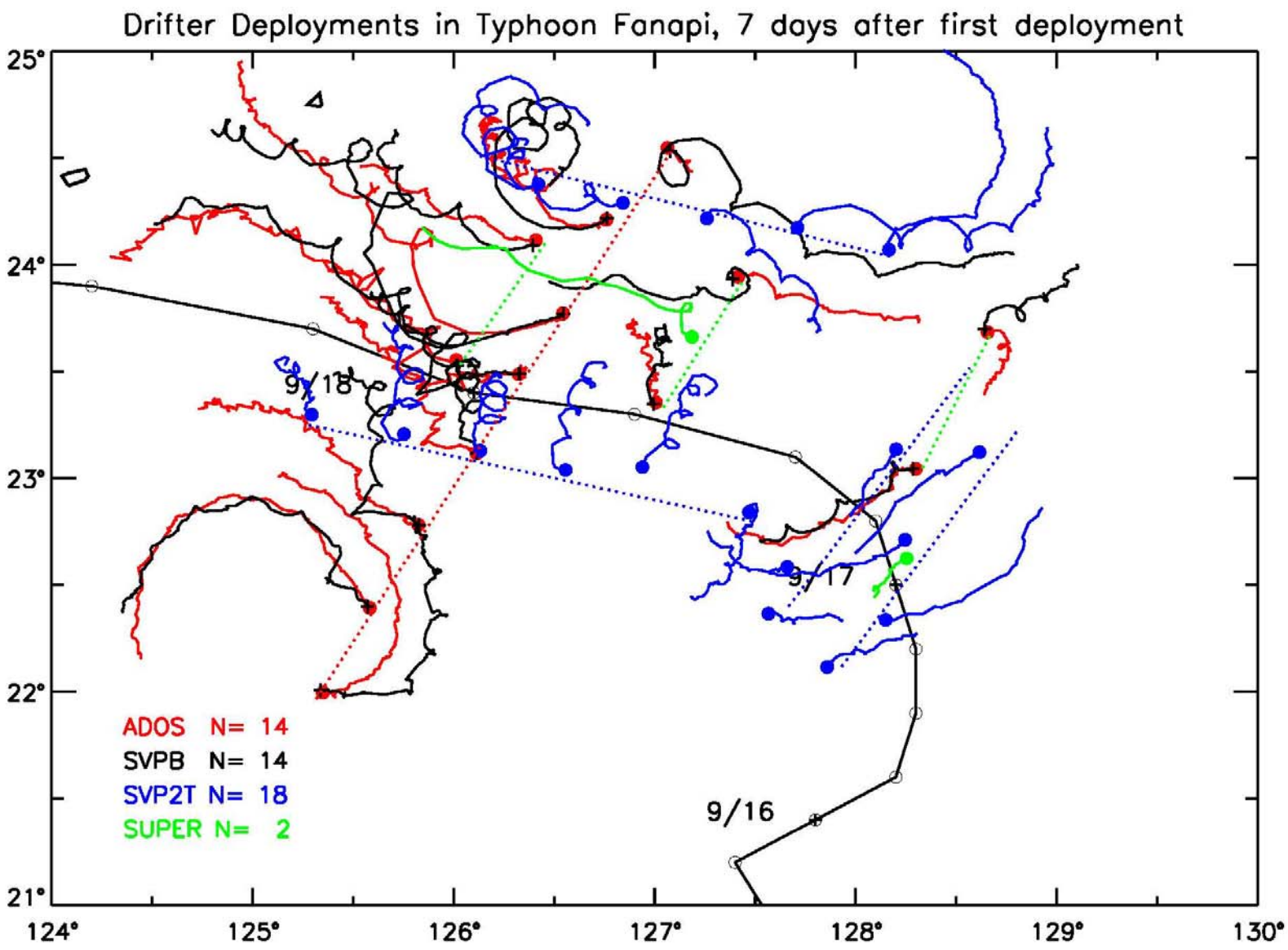

0 m
15 m
5 m
92 cm

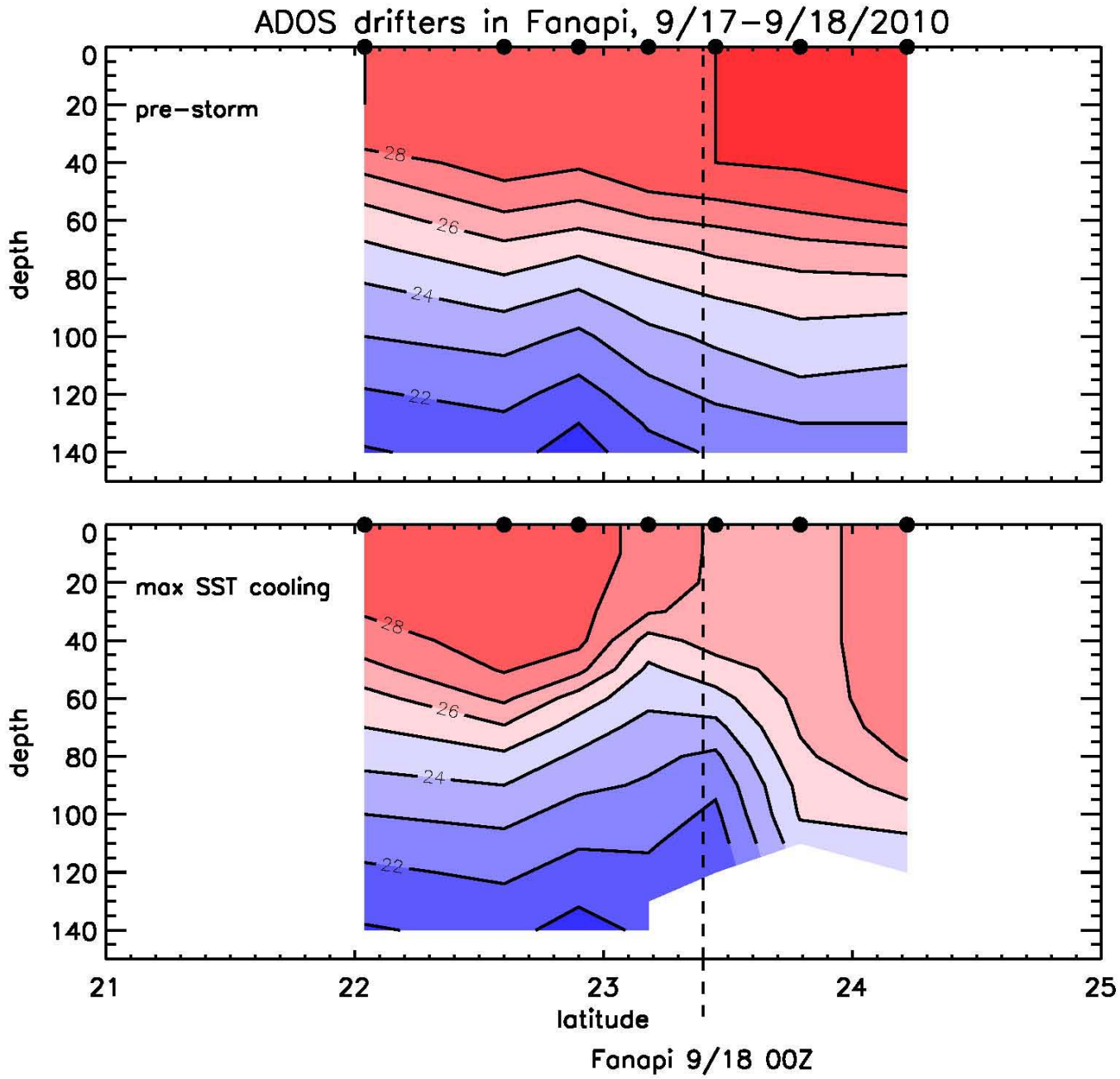
Air-Deployment by 53rd Hurricane Hunter Squadron of Air National Guard

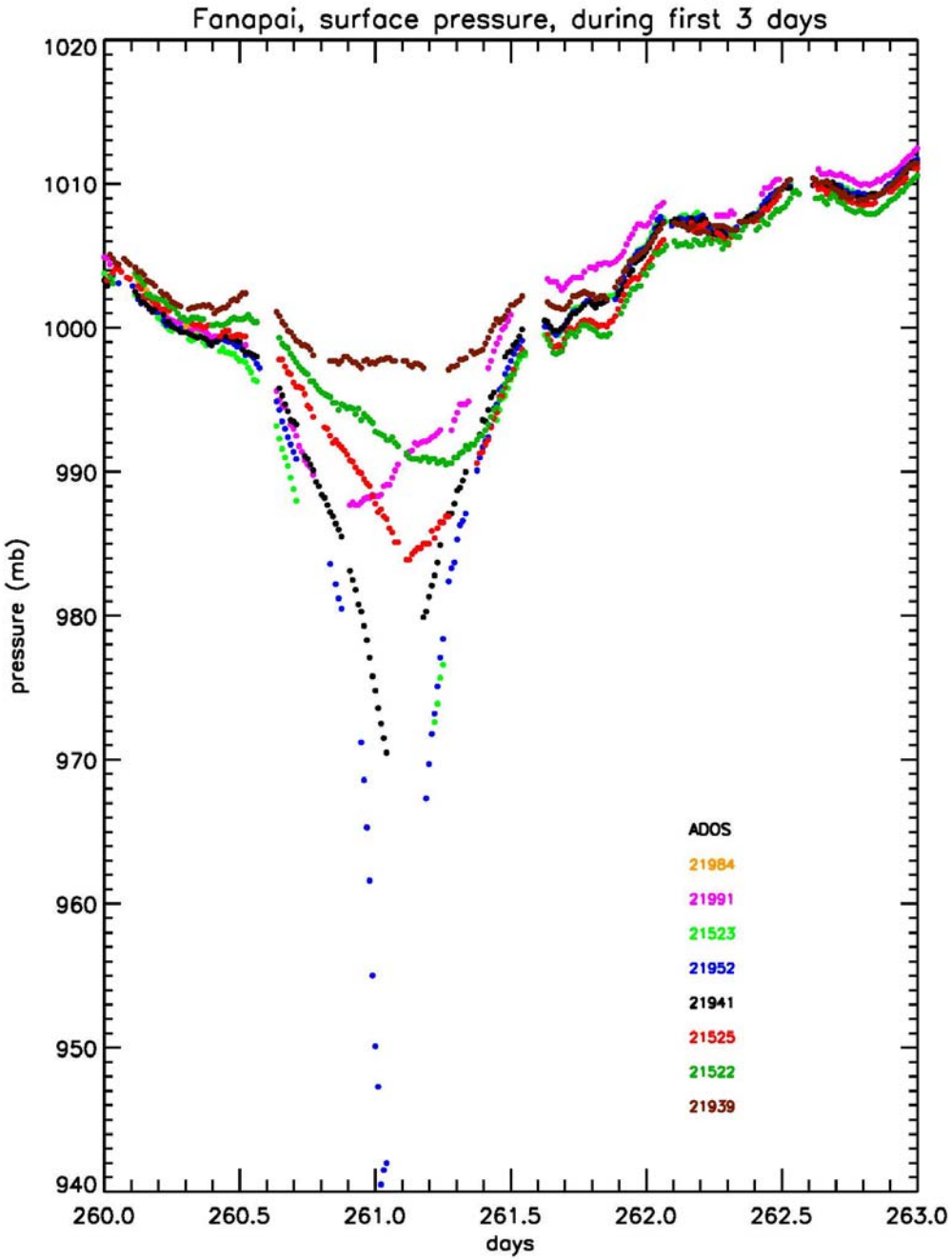
ITOP drifter deployments

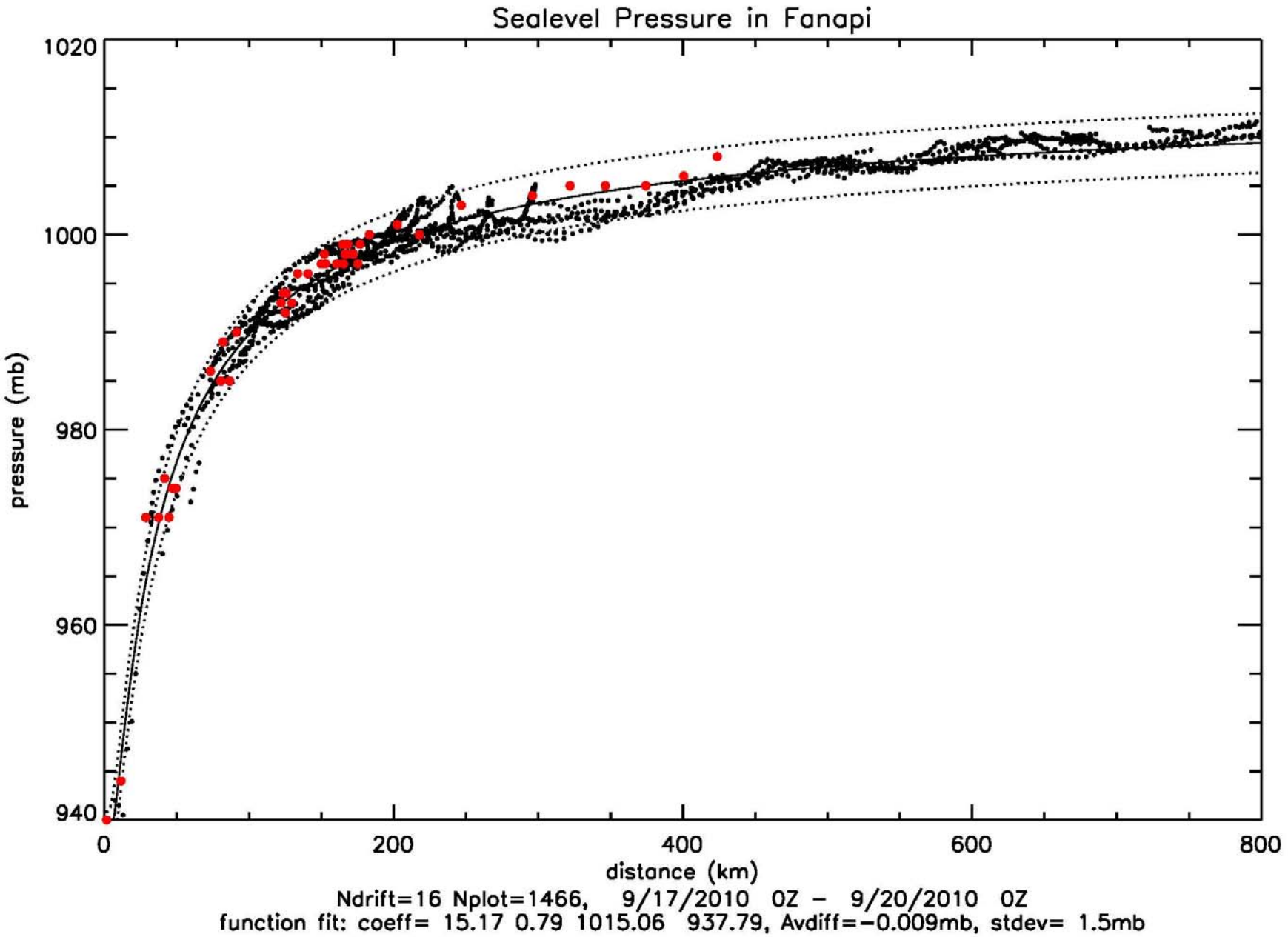


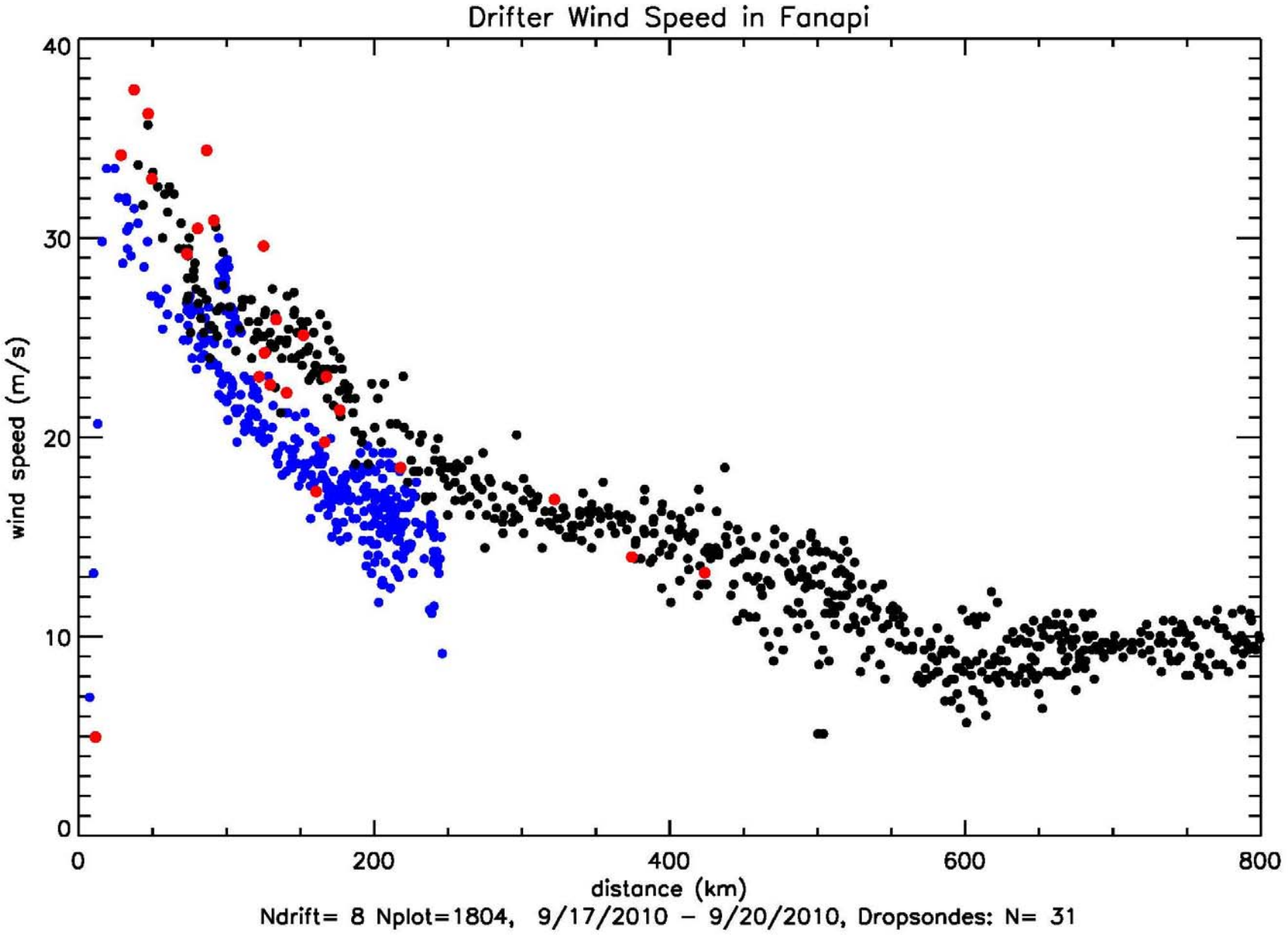

Drifter Deployments in Typhoon Fanapi
25°
24°
23°
22°
21°
124°
125°
126°
127°
128°
129°
130°
9/18
9/17
9/16
ADOS N= 14
SVPB N= 14
SVP2T N= 18
SUPER N= 2

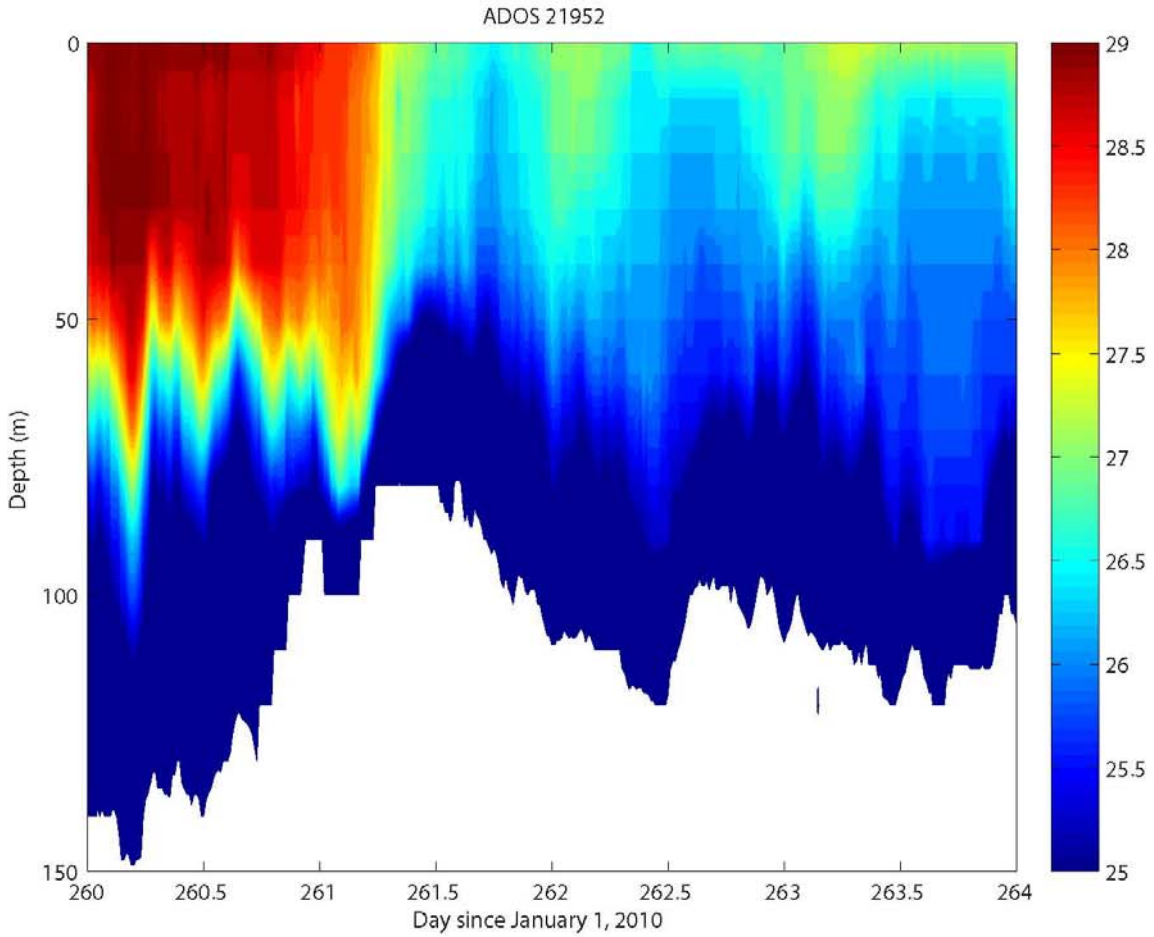

Drifter Deployments in Typhoon Fanapi, 7 days after first deployment
25°
24°
23°
22°
21°
124°
125°
126°
127°
128°
129°
130°
9/18
9/17
9/16
ADOS N= 14
SVPB N= 14
SVP2T N= 18
SUPER N= 2


ADOS drifters in Fanapi, 9/17-9/18/2010
pre-storm
max SST cooling
depth
0
20
40
60
80
100
120
140
28
26
24
22
21
22
23
24
25
latitude
Fanapi 9/18 00Z


Fanapai, surface pressure, during first 3 days
1020
1010
1000
990
980
970
960
950
940
pressure (mb)
260.0
260.5
261.0
261.5
262.0
262.5
263.0
days
ADOS
21984
21991
21523
21952
21941
21525
21522
21939


Sealevel Pressure in Fanapi
1020
1000
980
960
940
pressure (mb)
0
200
400
600
800
distance (km)
Ndrift=16 Nplot=1466, 9/17/2010 0Z - 9/20/2010 0Z
function fit: coeff= 15.17 0.79 1015.06 937.79, Avdiff=-0.009mb, stdev= 1.5mb


Drifter Wind Speed in Fanapi
wind speed (m/s)
0
10
20
30
40
0
200
400
600
800
distance (km)
Ndrift= 8 Nplot=1804, 9/17/2010 – 9/20/2010, Dropsondes: N= 31


ADOS 21952
Depth (m)
0
50
100
150
260
260.5
261
261.5
262
262.5
263
263.5
264
Day since January 1, 2010
29
28.5
28
27.5
27
26.5
26
25.5
25

Conclusions

•“Mean and lean” observing system at interface of ocean/atmosphere, where it’s the most difficult to retrieve reliable measurements
•High quality measurements of Pa, SST, wind and subsurface temperature for assimilation into TC forecast models
•New met-package deployed successfully measured hurricane force winds
•Subsurface T is critically important for ocean heat potential, pre-conditioning of ocean for cooling, and potential for post-storm SST warming in cold wake

Outlook

•Demonstrate improvement in intensity forecast by systematic deployment of subsurface T
•Observing System Simulation Experiments (OSSE) to optimize deployment strategy
•Miniaturization of the ADOS system
•Will ocean drifter measurements become integral part of surveillance of TCs threatening landfall?

Drifter Deployments in Hurricanes (6) and Typhoons (4), 2003-2010

Name	Date	CAT max	CAT drifter	Dist min	N Drifter (deployed)	N Temperature subsurface
Fabian	9/04/2003	4	3	48 km	11 (16)	--
Frances	9/01/2004	4	4	30 km	38 (39) + 29	--
Rita	9/23/2005	5	4	12 km	20 (20)	8
Dean	8/20/2007	5	5	30 km	12 (12)	8
Gustav	9/01/2008	4	2	13 km	12 (12)	6
Ike	9/12/2008	4	2	3 km	8 (9) + 12	5
Hagupit	9/21/2008	4	1	14 km	11 (12)	6
Jangmi	9/27/2008	5	5	18 km	11 (12) + 11	9
Fanapi	9/17/2010	2	1	4 km	48(53)	39
Malakas	9/29/2010	2	-	Wake	12(12)	6

- Wind speed from ambient noise (WOTAN) (2003-2009)
- Wind speed sensor from Gill sonic anemometer (2010-)
- 93% success rate