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Diurnal warming in Lake Vänern

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GHRSST XV, Cape Town, 4th June 2014

Outline

- MET Norway buoy in Lake Vänern, Sweden
- Validation results from OSI SAF SST product in this lake
- Observed cycle of diurnal warming events
- Observed profile of diurnal warming events

Lake Vänern

- Europe's third largest lake
- 5650 km^2
- Altitude 44m
- Latitude 59N

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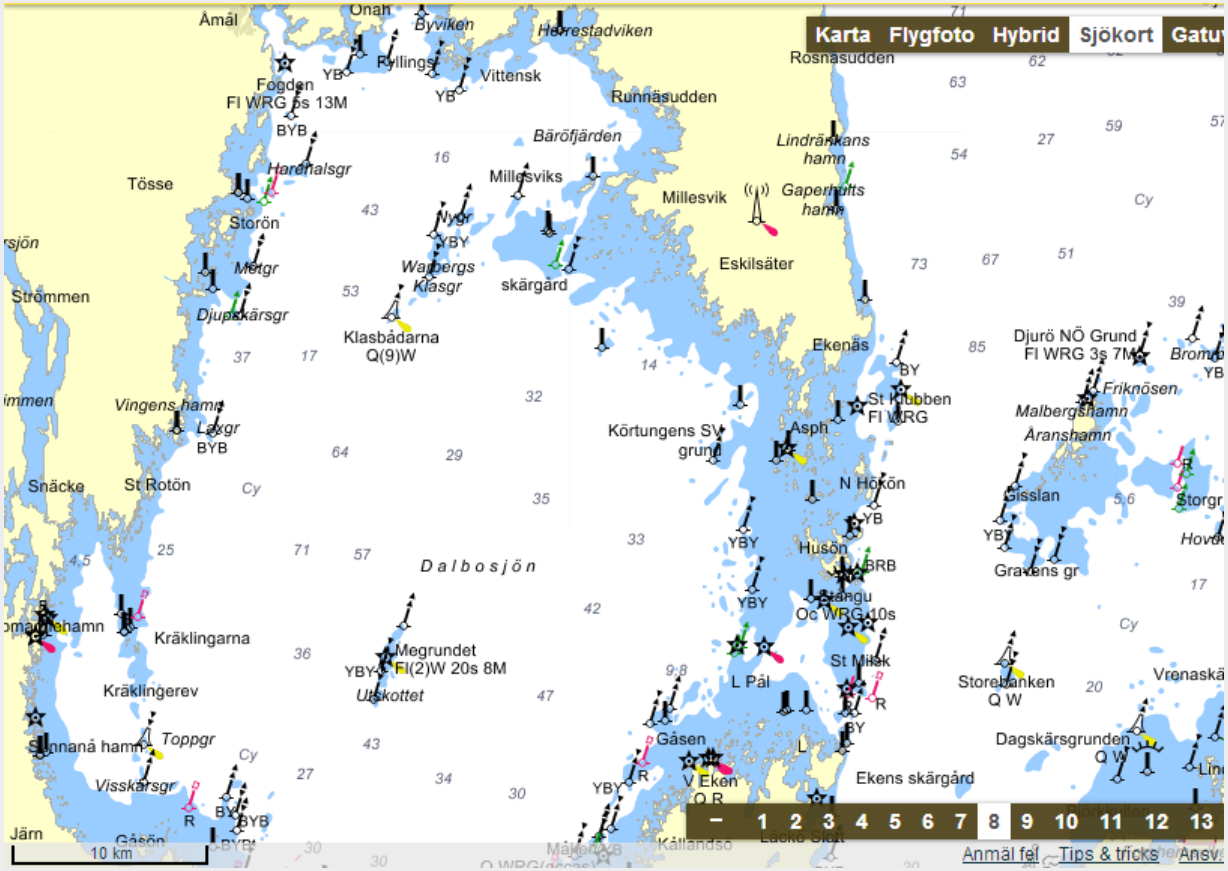
Lake Vänern



- Europe's third largest lake
- 5650 km^2
- Altitude 44m
- Latitude 59N
- Average depth 27m
- Max depth 106 m
- Turbid waters (Secci depth 3-5m)

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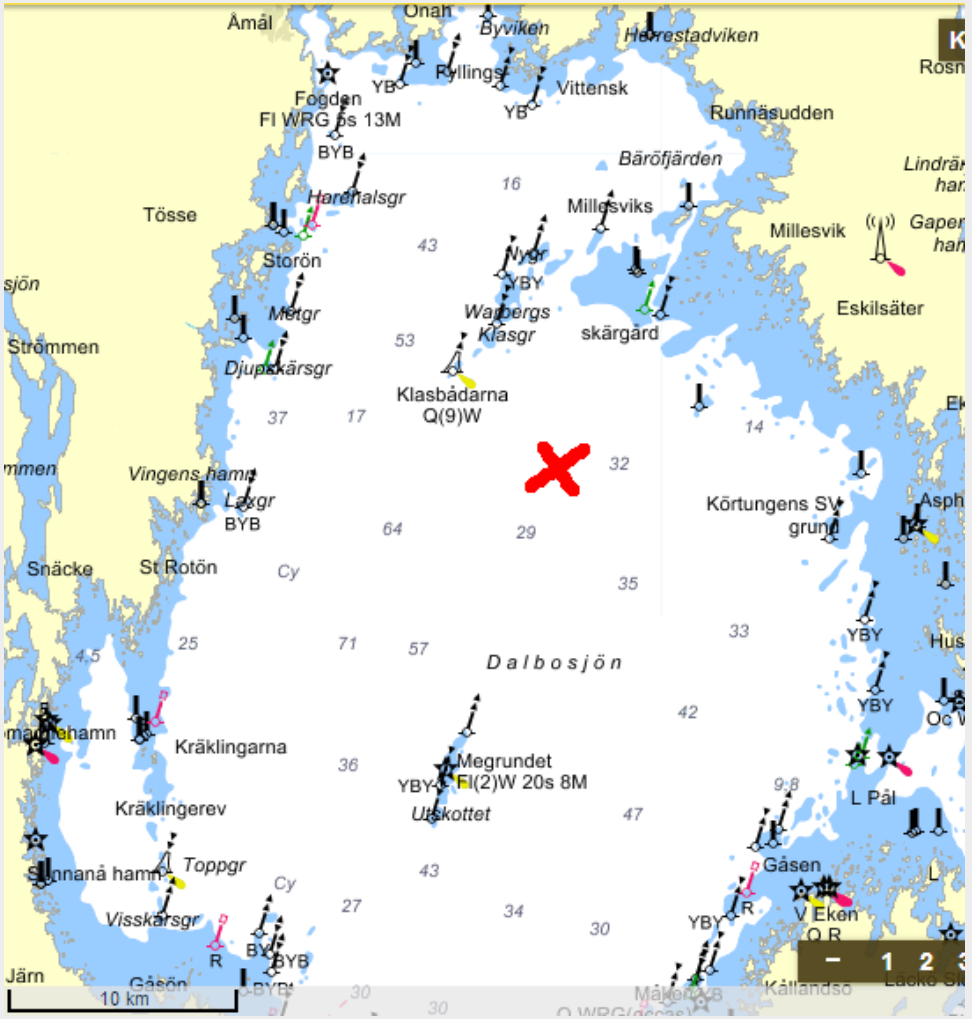
Buoy data

- Buoy moored at 59N, 13E, ~20m depth (MetOcean iSPHERE buoy)
- Observations every 30 minutes
- Buoy termistor placed at ~20cm below surface
- 3rd May to 15th October 2013
- Also temperature loggers at 30cm to 220cm depths and ambient light and air temperature sensor



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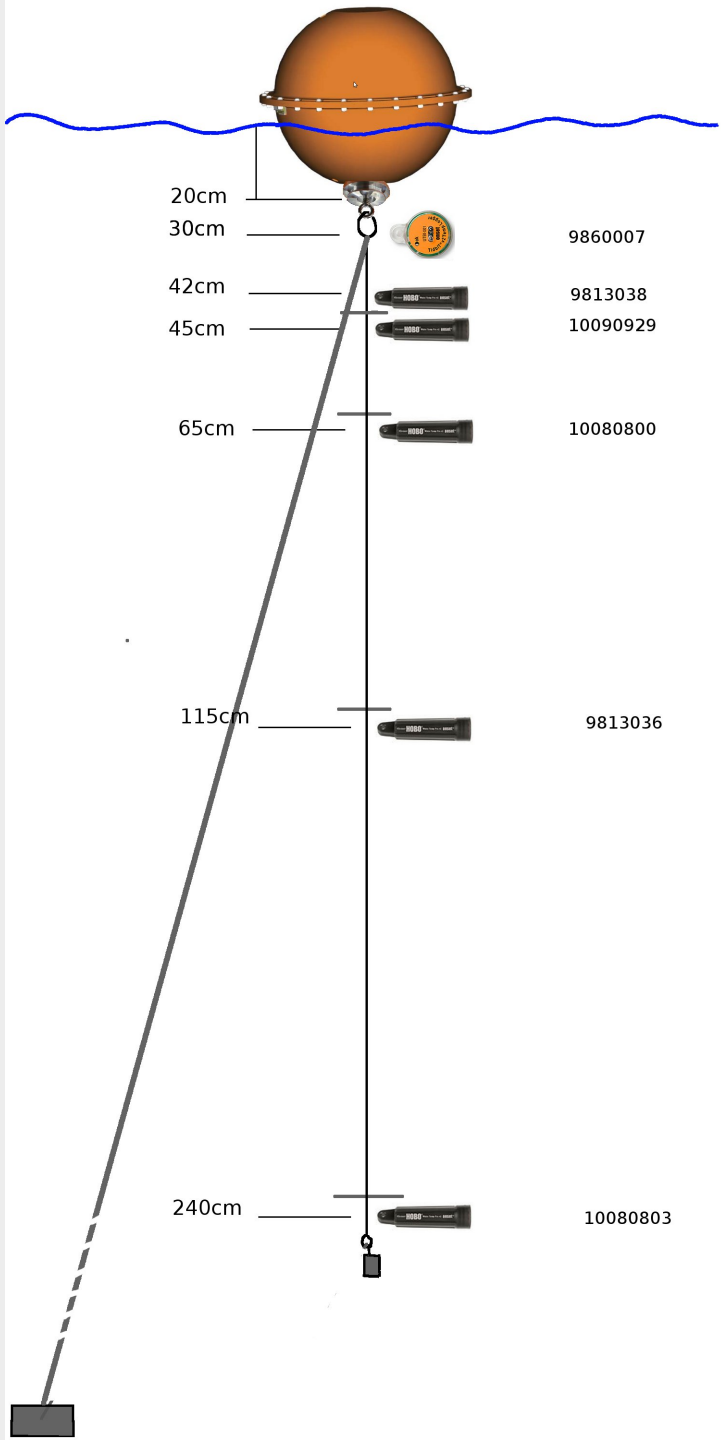
Buoy setup 2013



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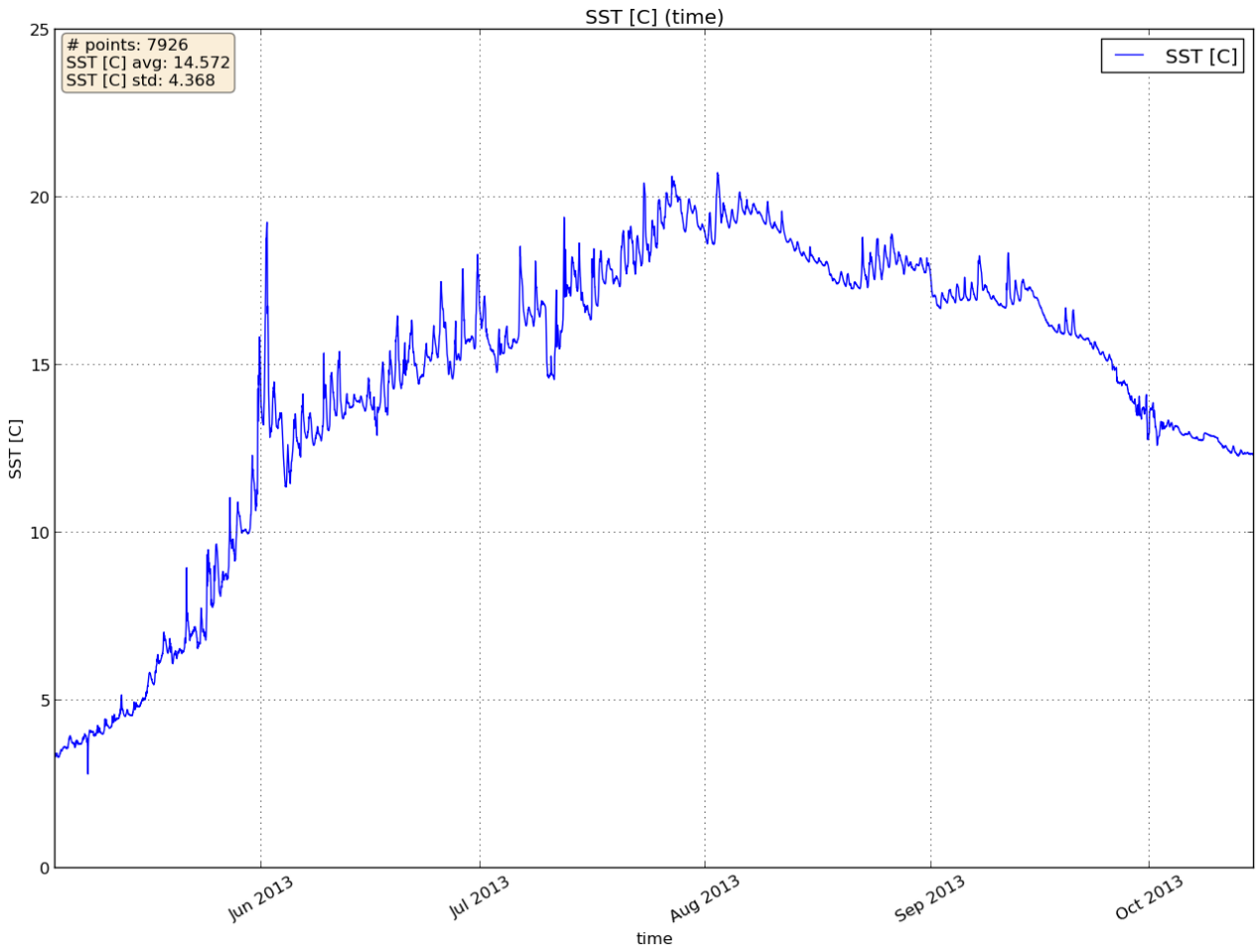
SST data from the buoy



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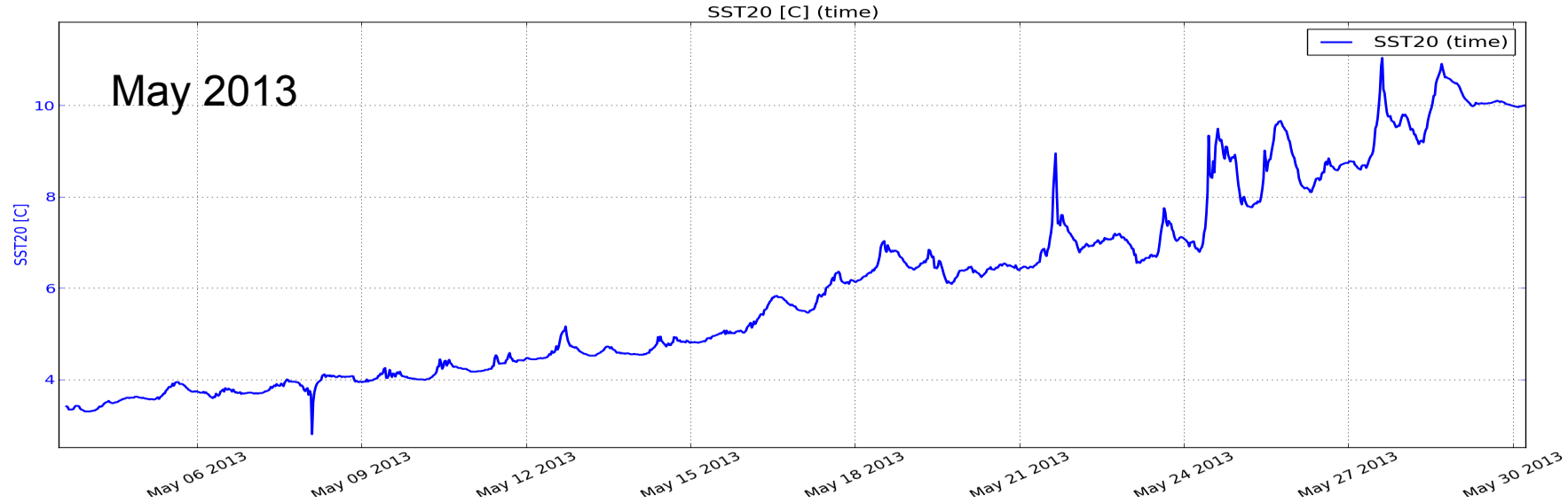
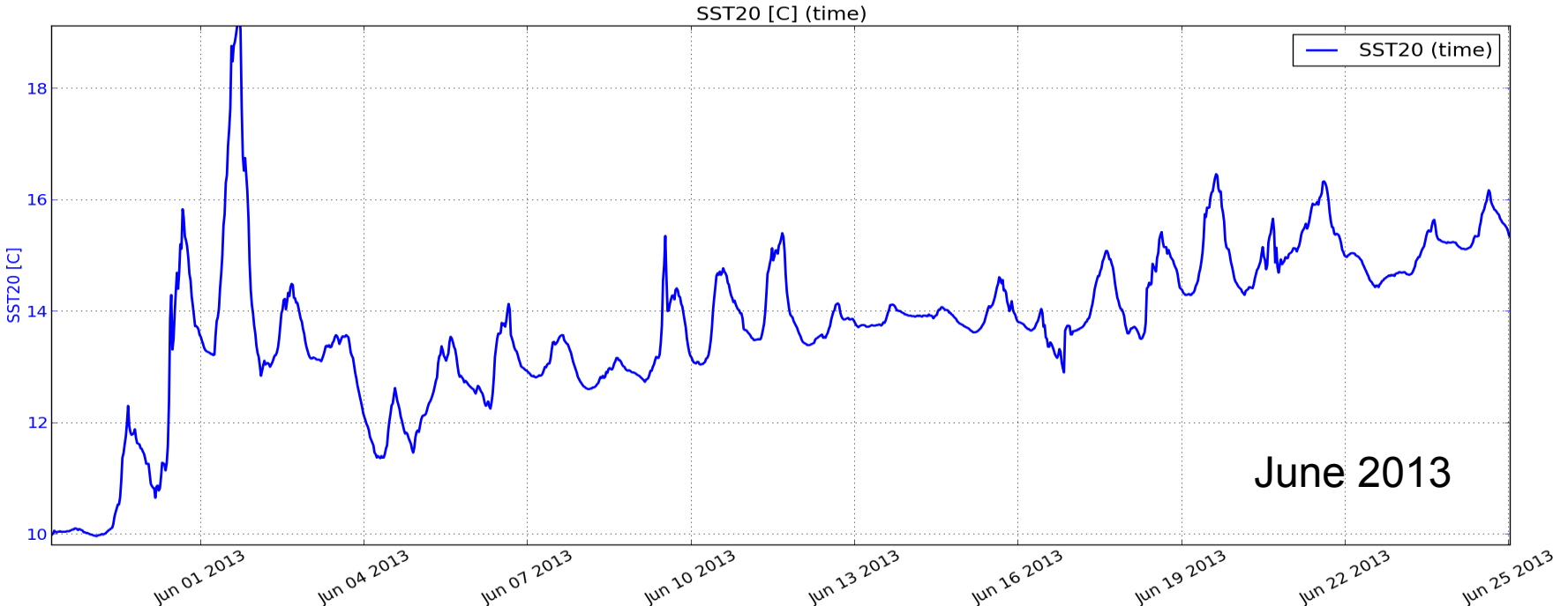
Some validation results

- Comparing OSI SAF products (from CMS, Meteo-France) with this single buoy
- Using confl 3, 4 and 5

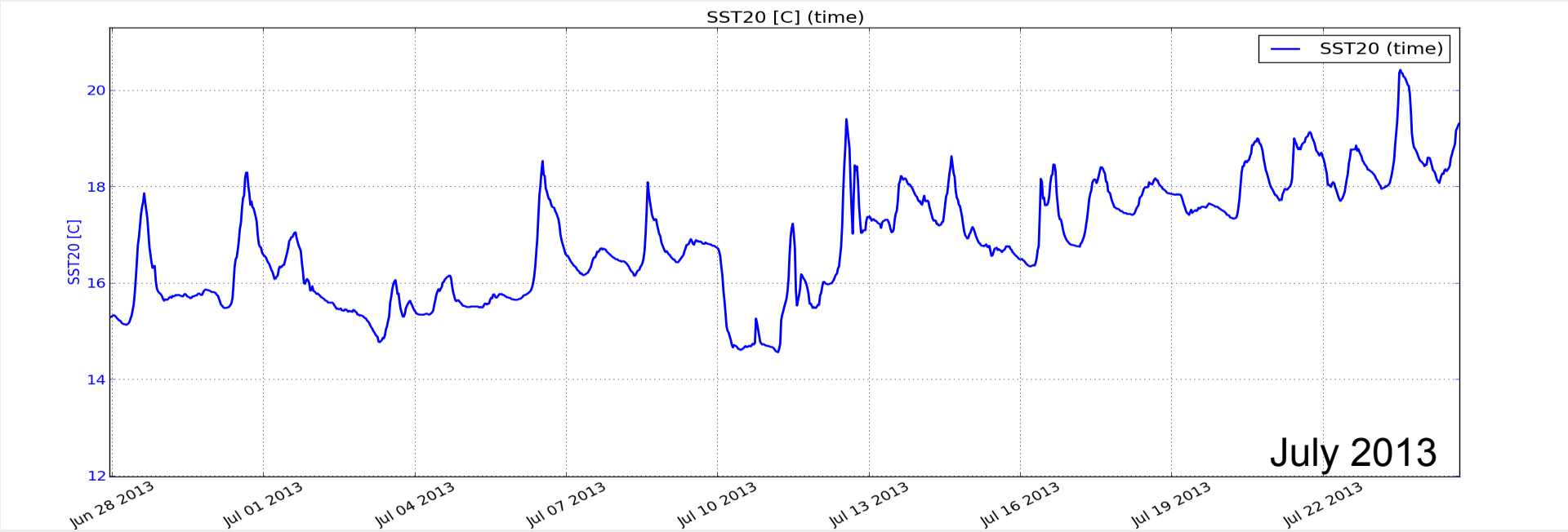
	Night time (> 95)			Daytime (< 85)		
	bias	std	num	bias	std	num
METOP-A	-0.23	0.49	55	0.00	0.67	146
NOAA-19	0.06	0.45	82	0.03	0.68	108
NPP VIIRS	0.04	0.34	68	-0.02	0.53	90

Diurnal cycles





Diurnal cycles



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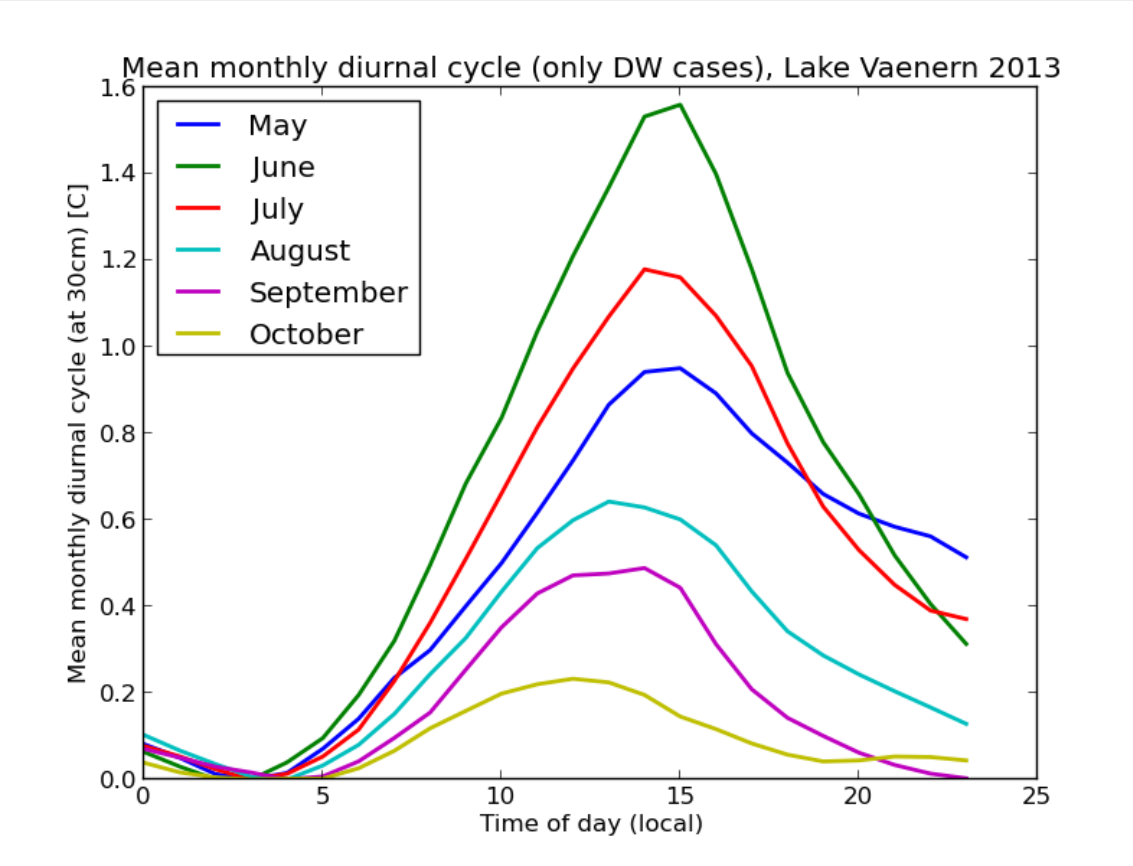
Mean monthly diurnal cycle

- Using all days where SST15 >= SST06 and SST15 >= SST23



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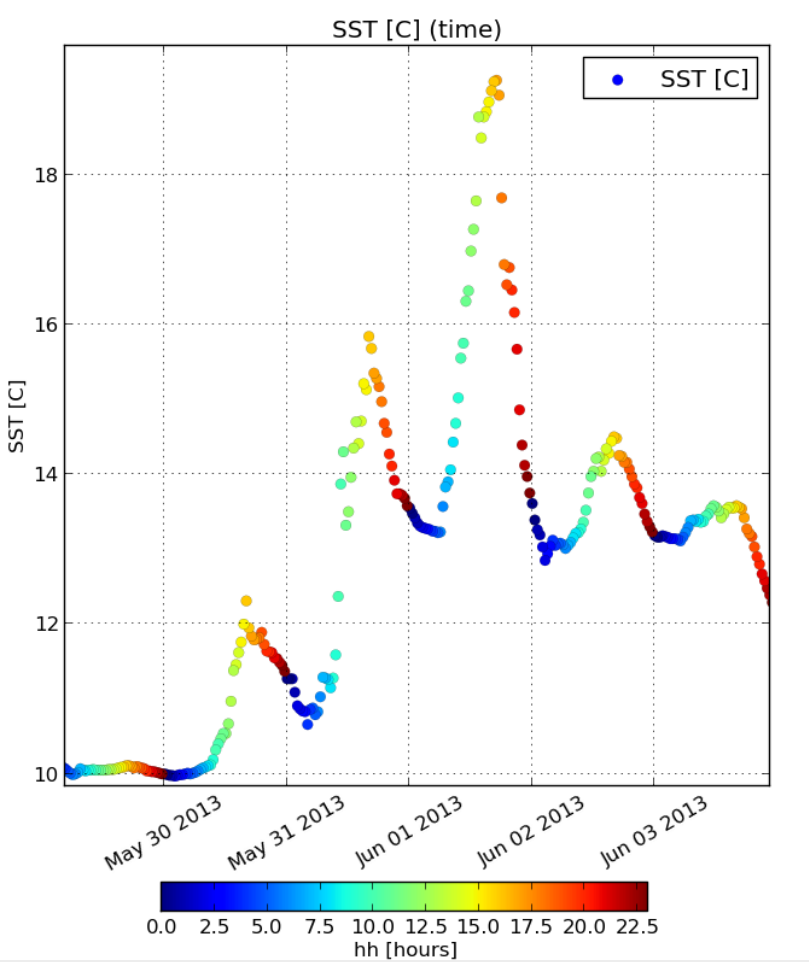
1st June case



- Closer look at 1st June case
- 7 deg C warming case

- First, look at OSI SAF AHL SST 1.5km product

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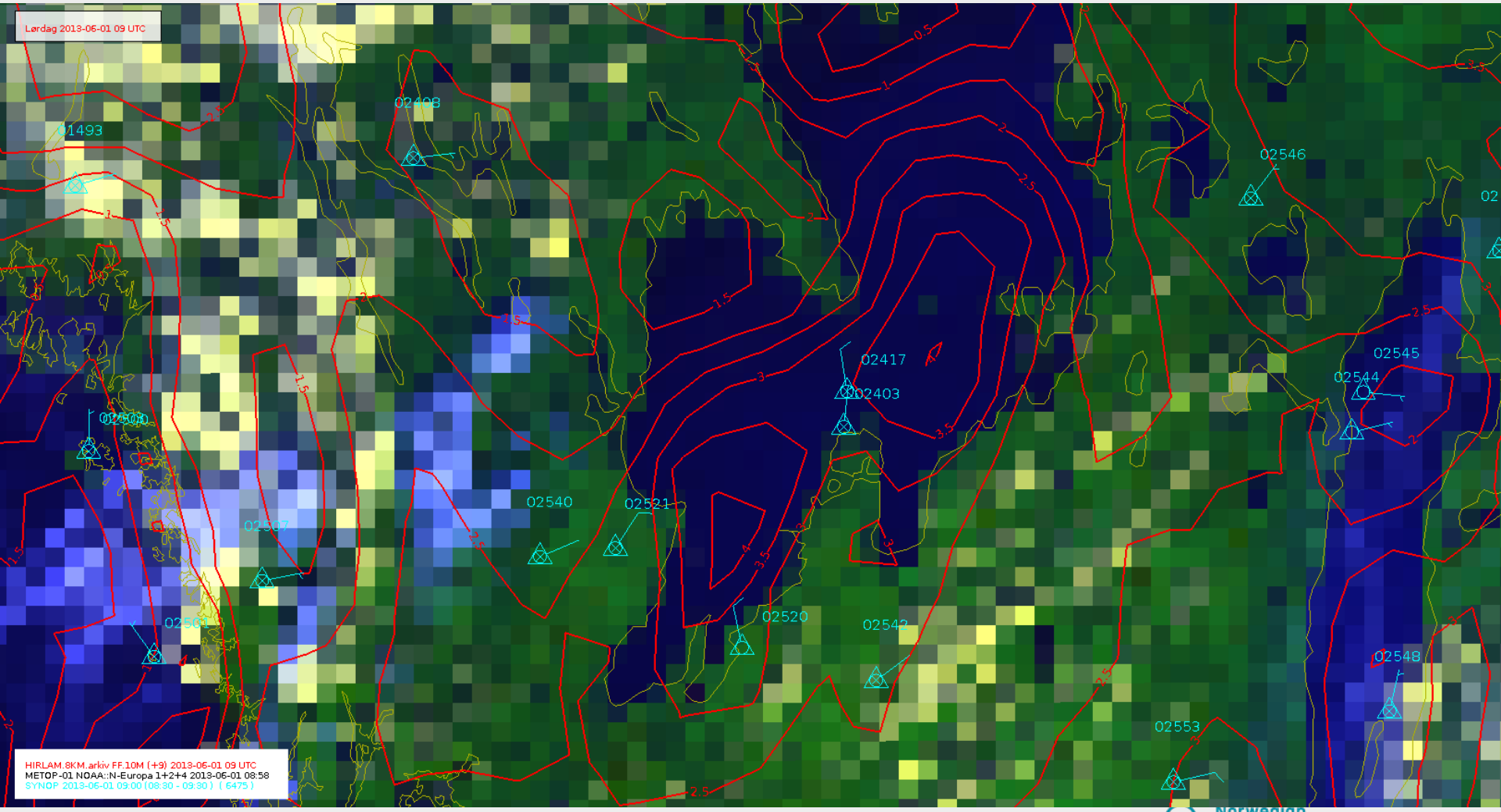
NWP wind at 09UTC (HIRLAM8)



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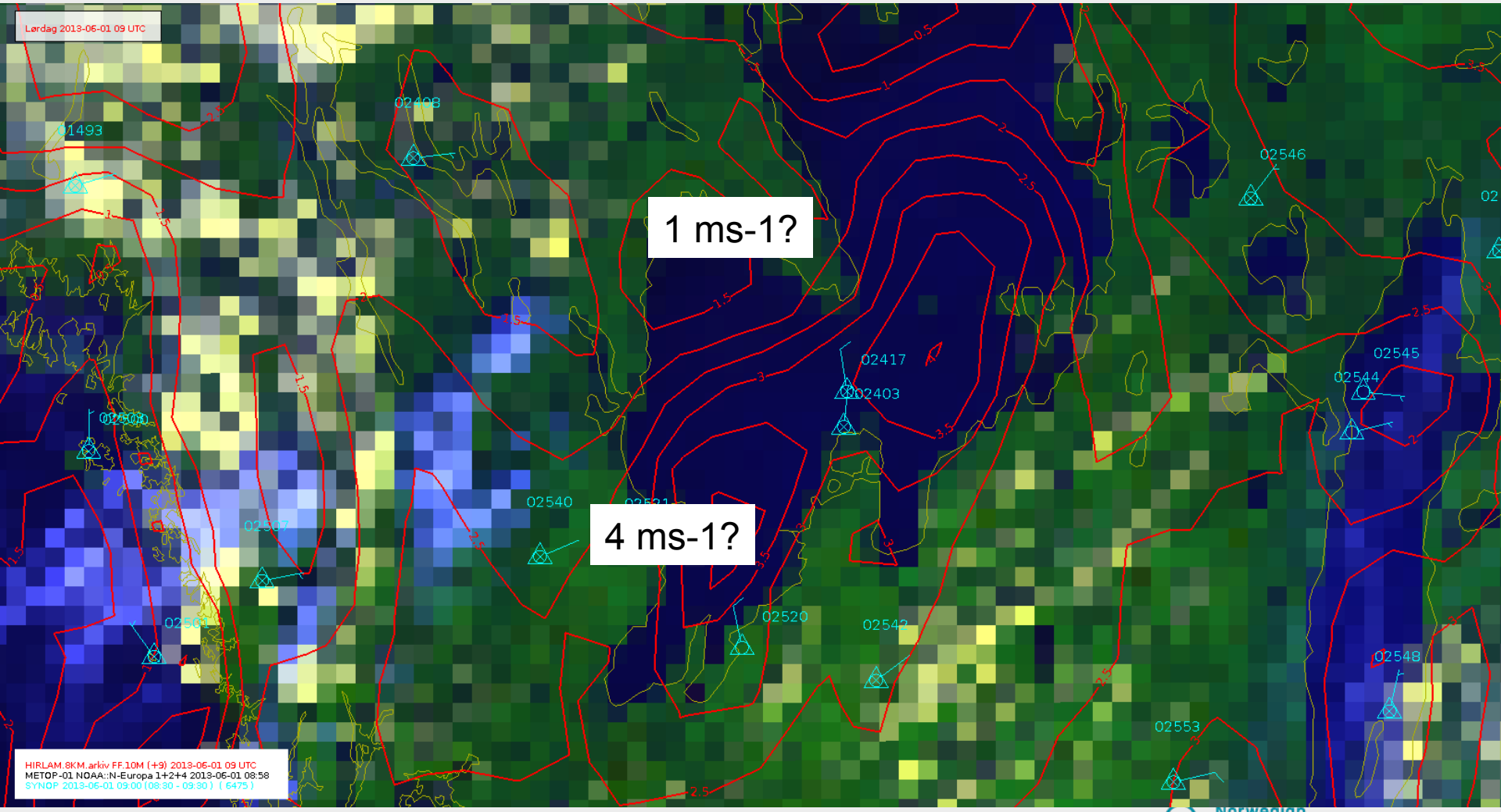
NWP wind at 09UTC (HIRLAM8)



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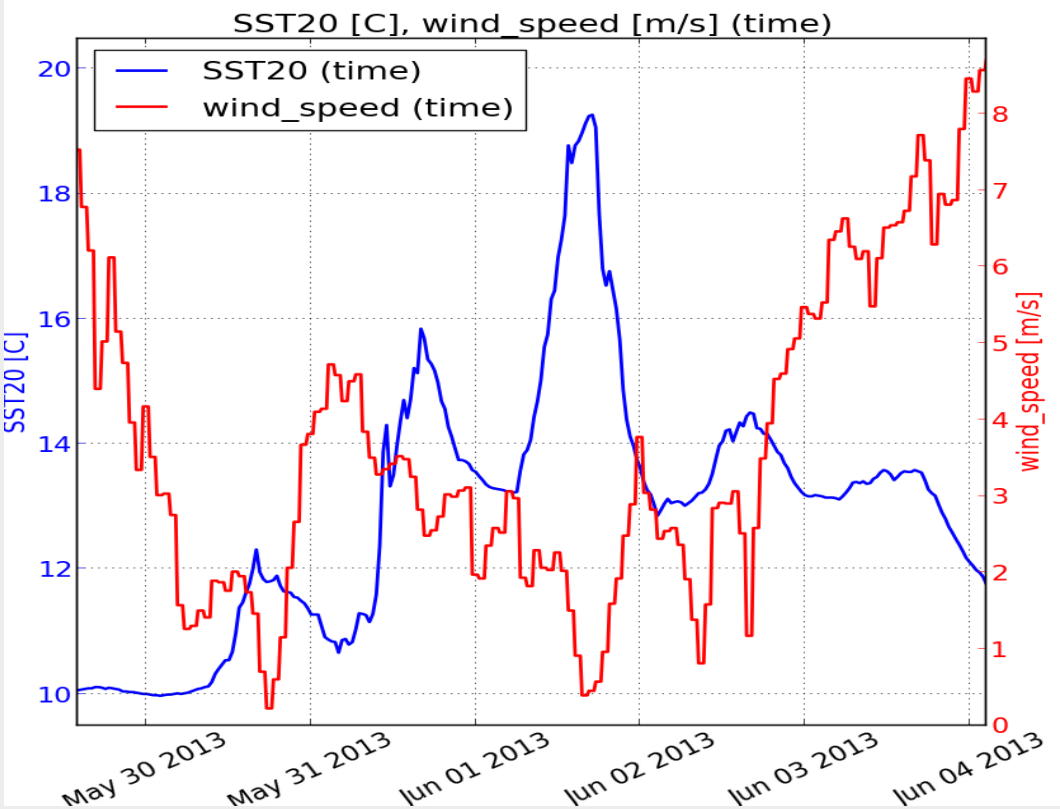

With NWP wind from Hirlam

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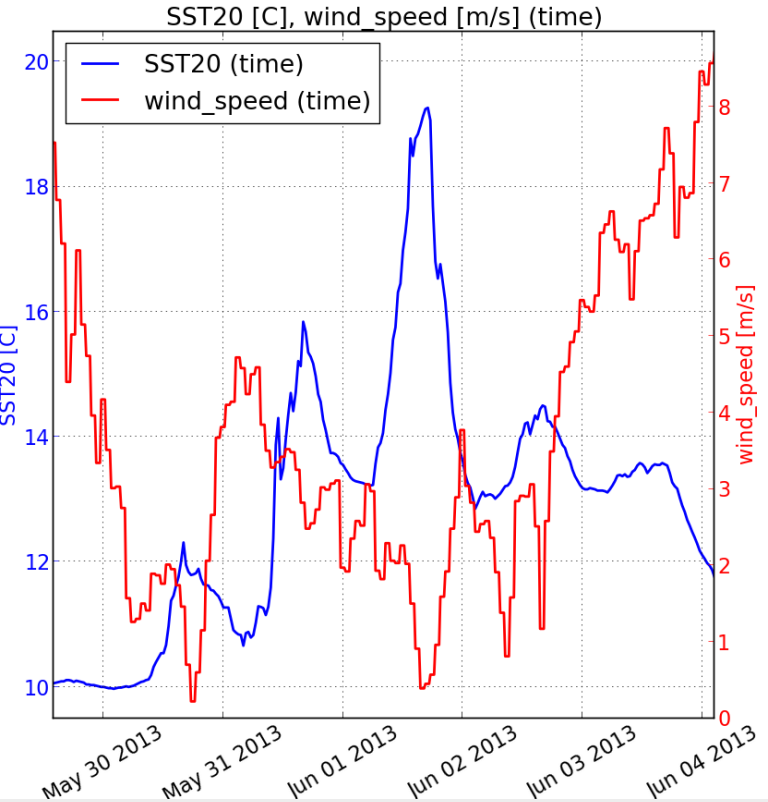
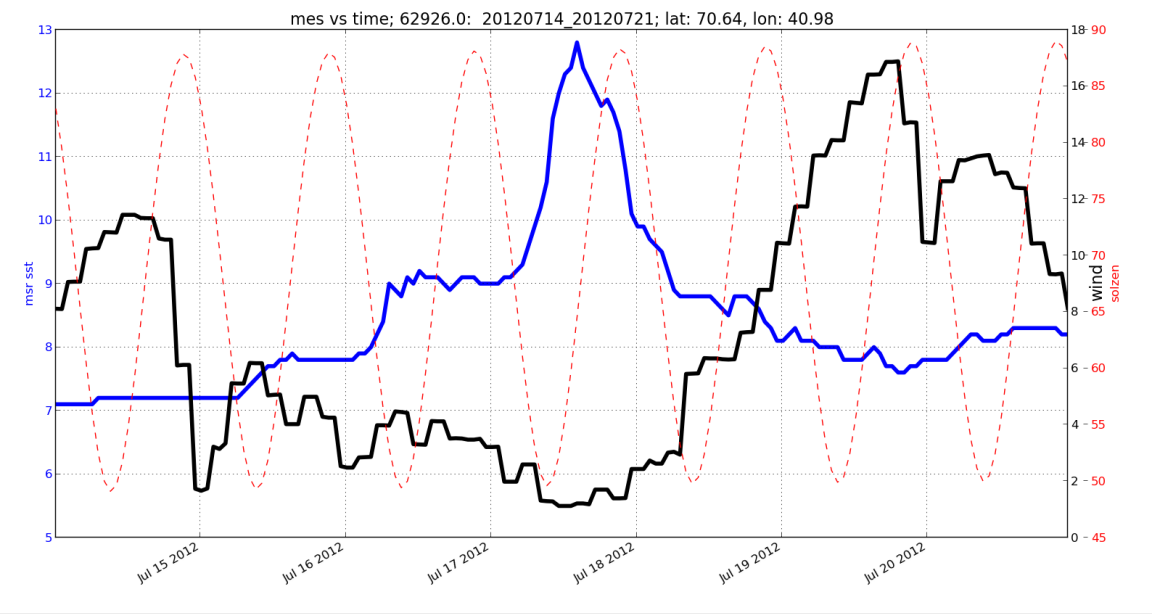
Similar DW cases at High Latitudes

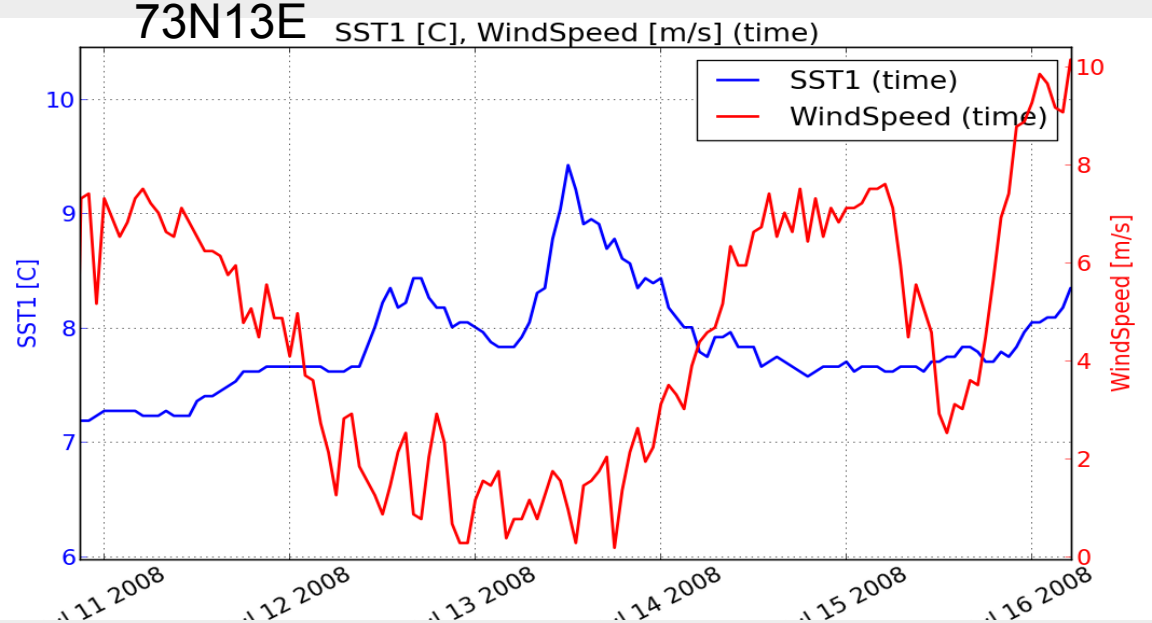


59N 13E

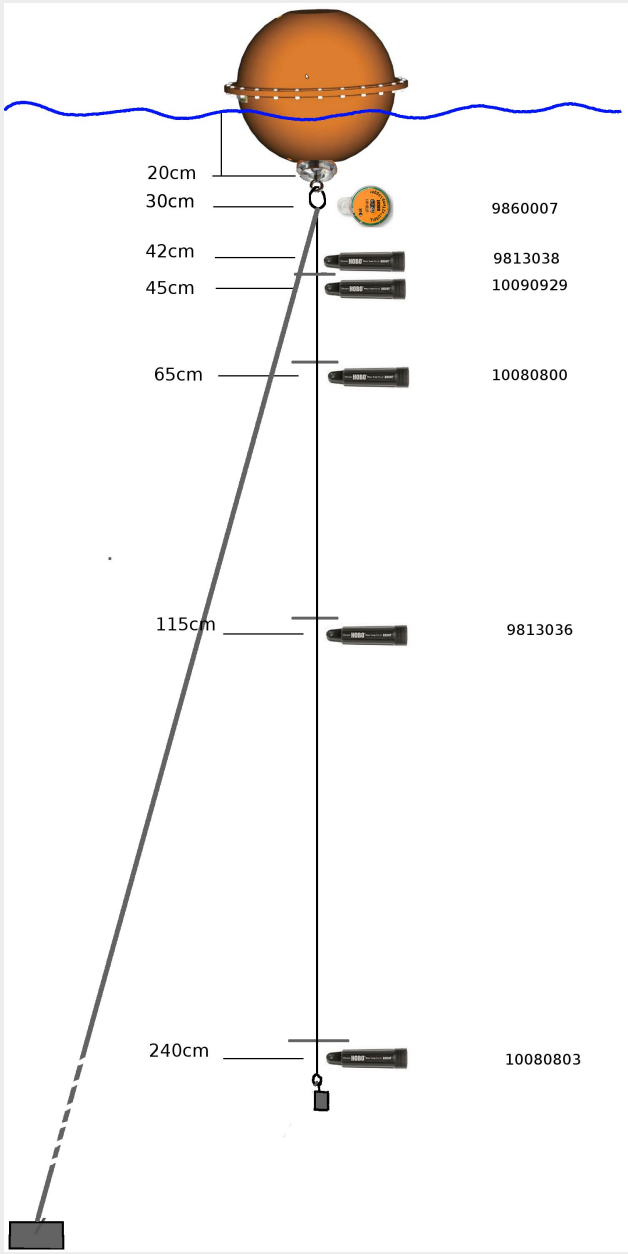


From Sonia Pere, M-F

73N13E



1st June case – SST profile



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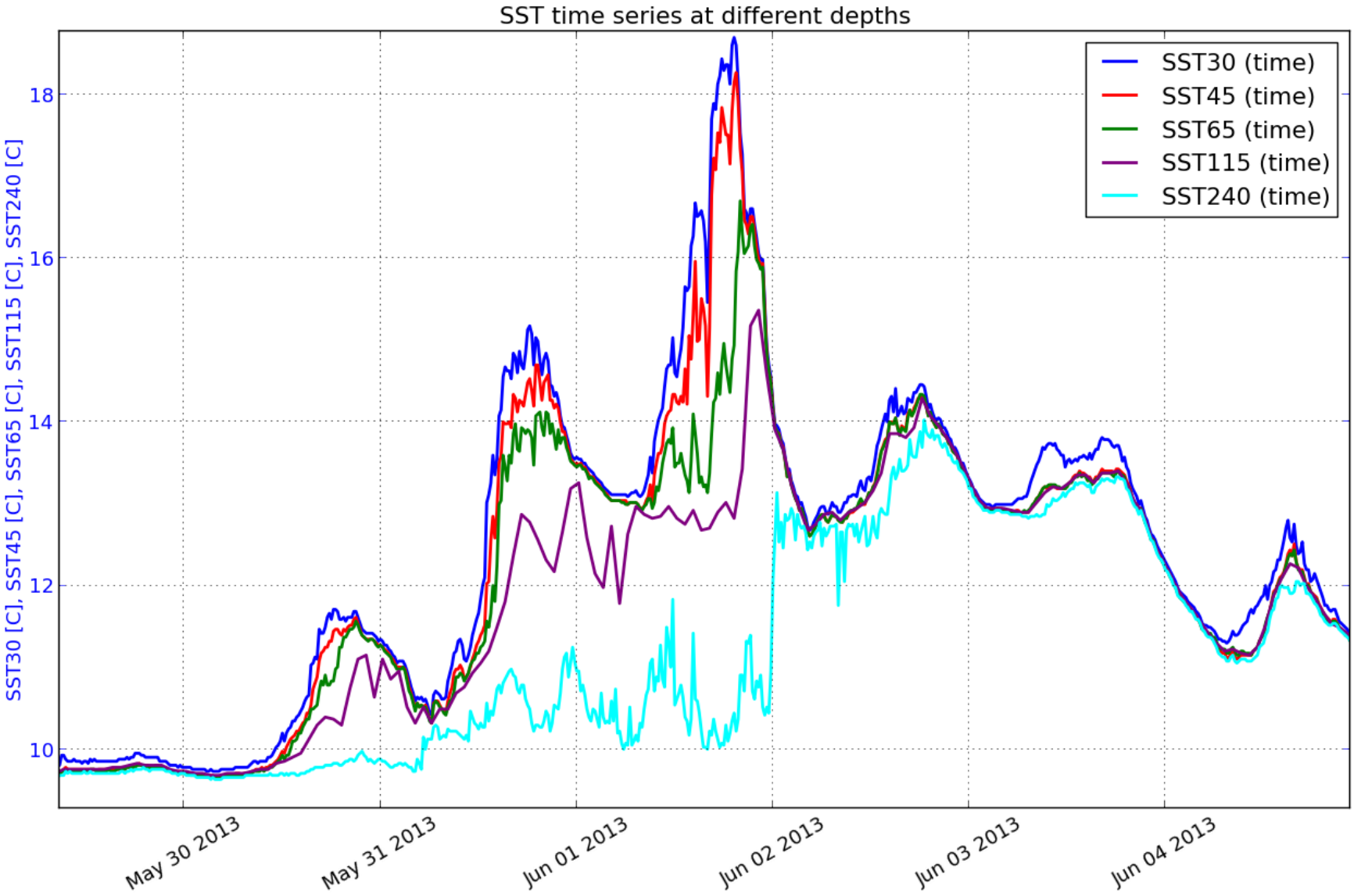
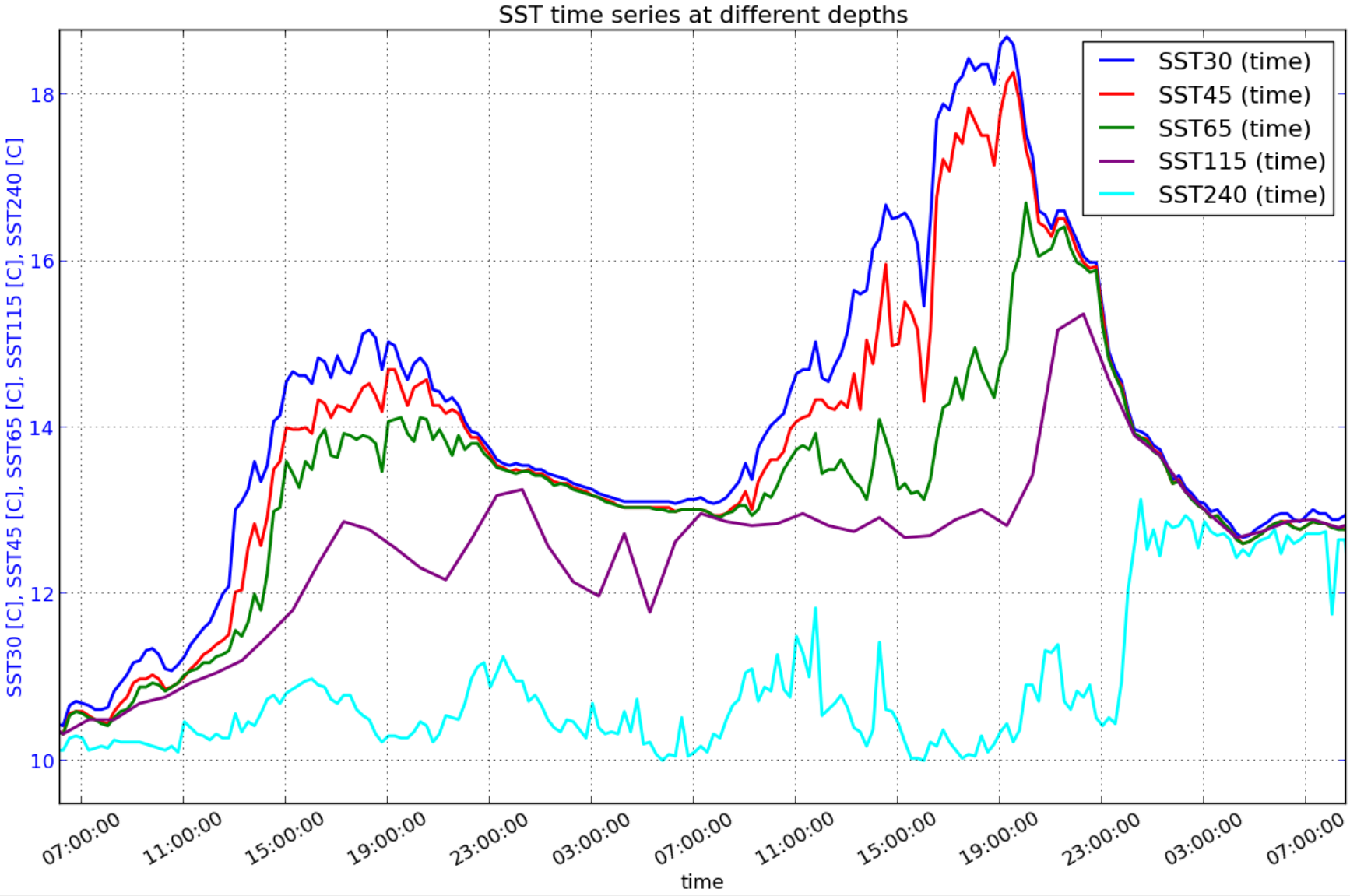
1st June case - SST profile





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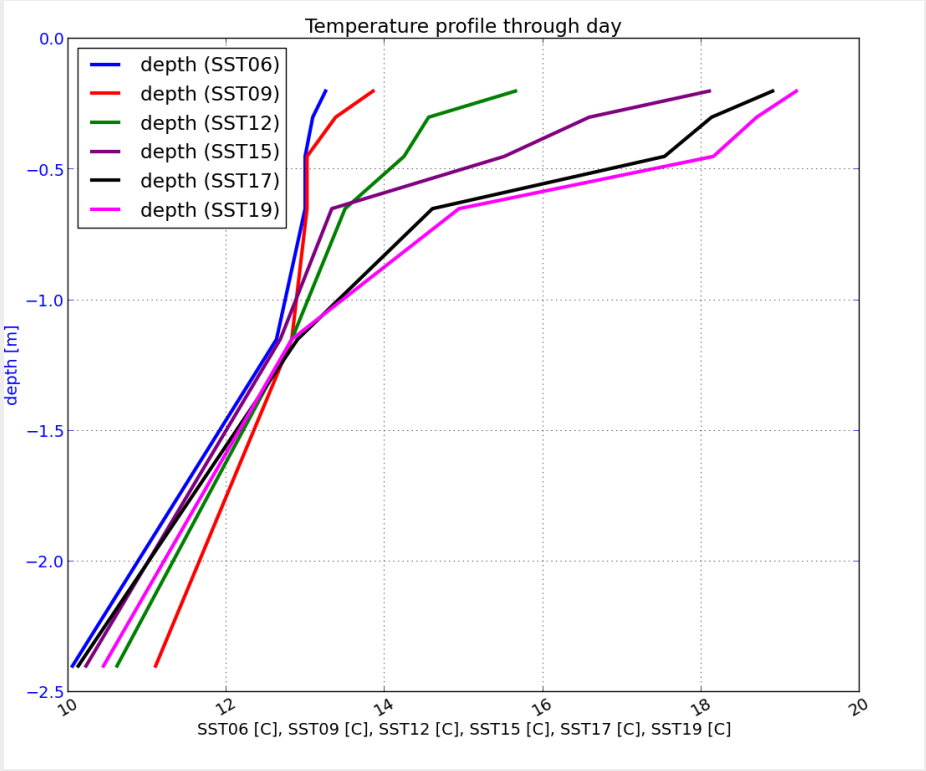
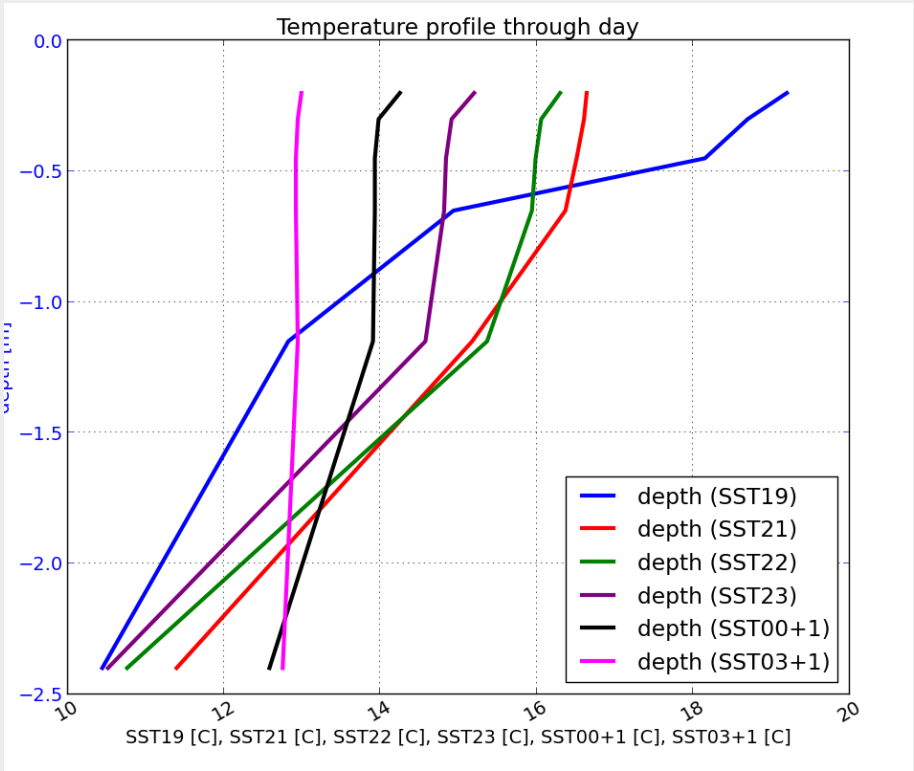
Temperature vs depth





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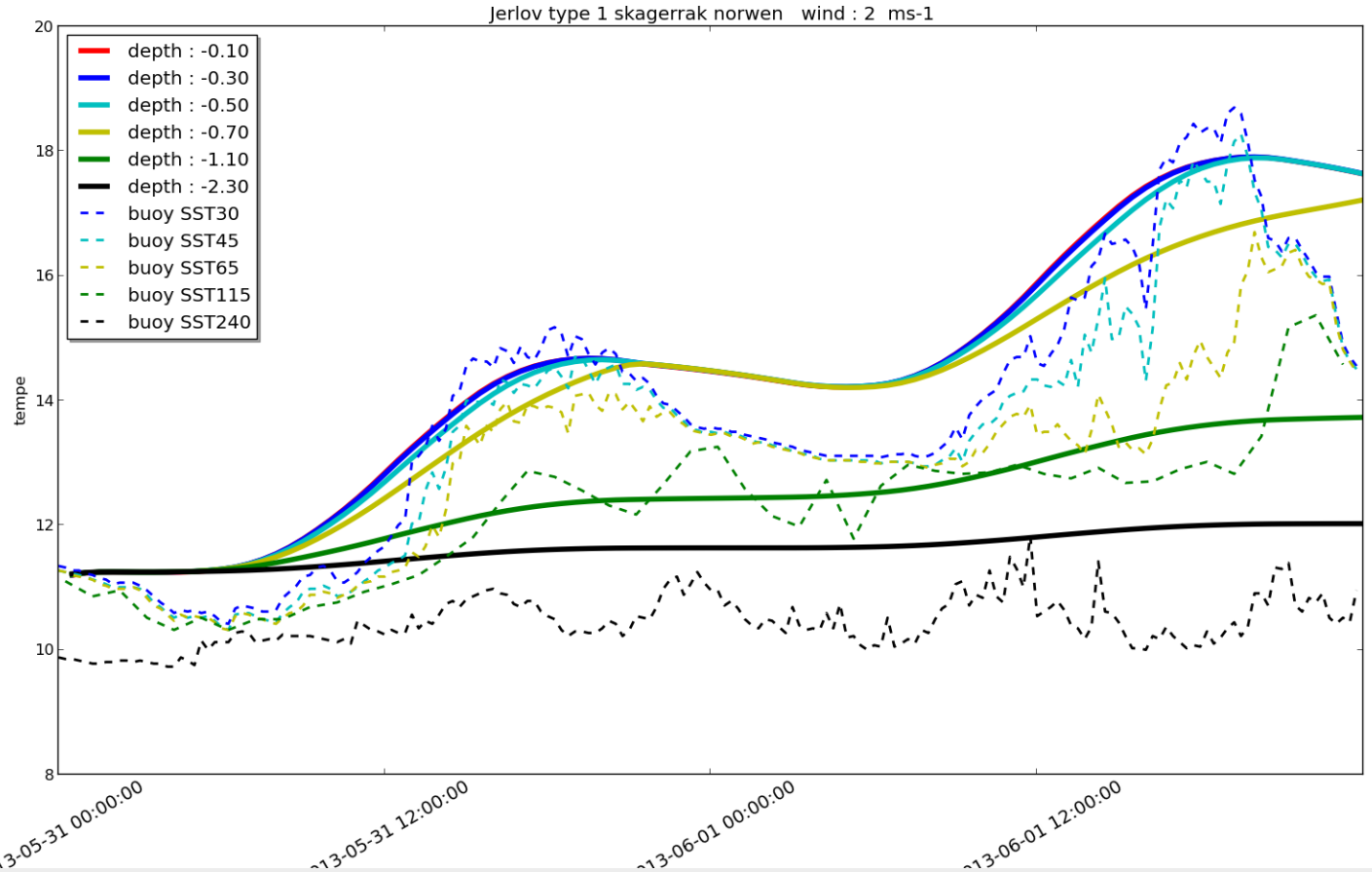
GOTM modelling (wind 2m/s, Jerlov 1)



From Pere and LeBorgne

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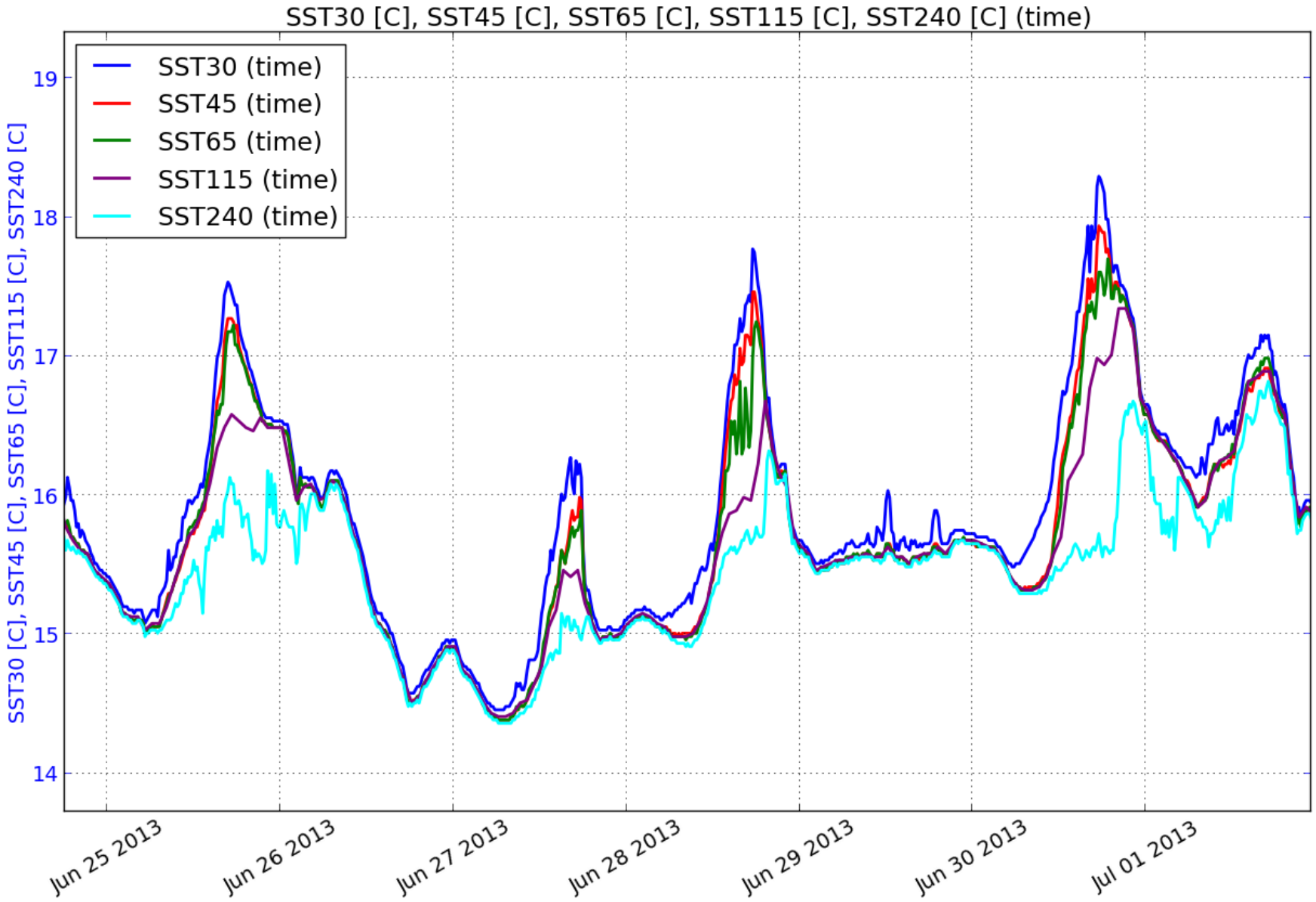
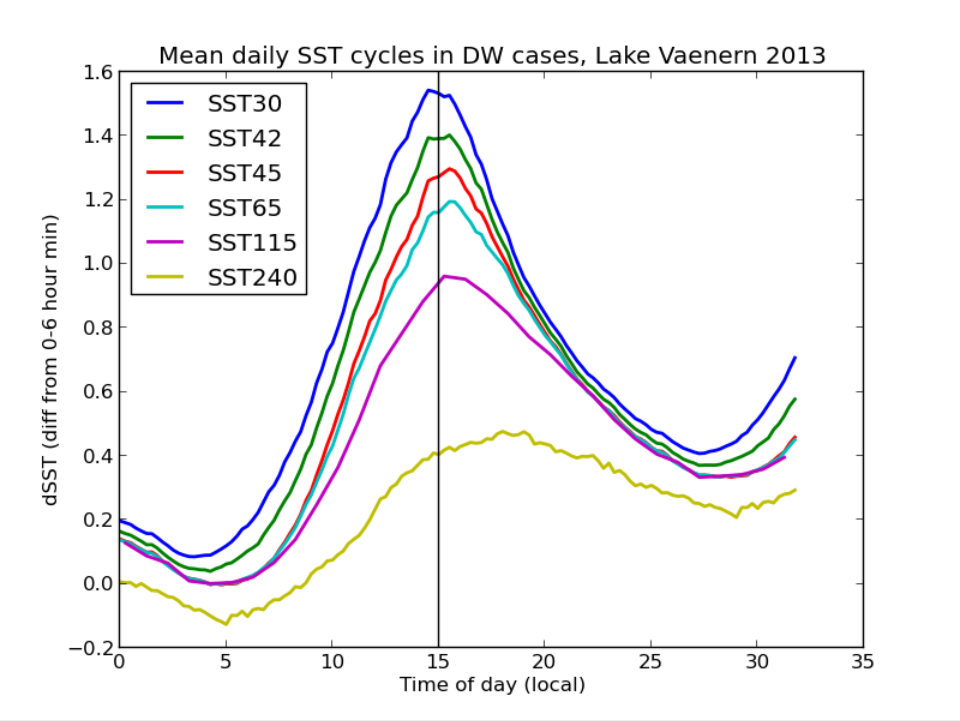
25th June case



Mean diurnal cycle profiles

- Look at all days with diurnal warming > 1.0C
- DW = SSTmax – SSTmin06, where SSTmin06 is minimum between 00 and 06
- Mean profile for May-October data with diurnal warming > 1.0C



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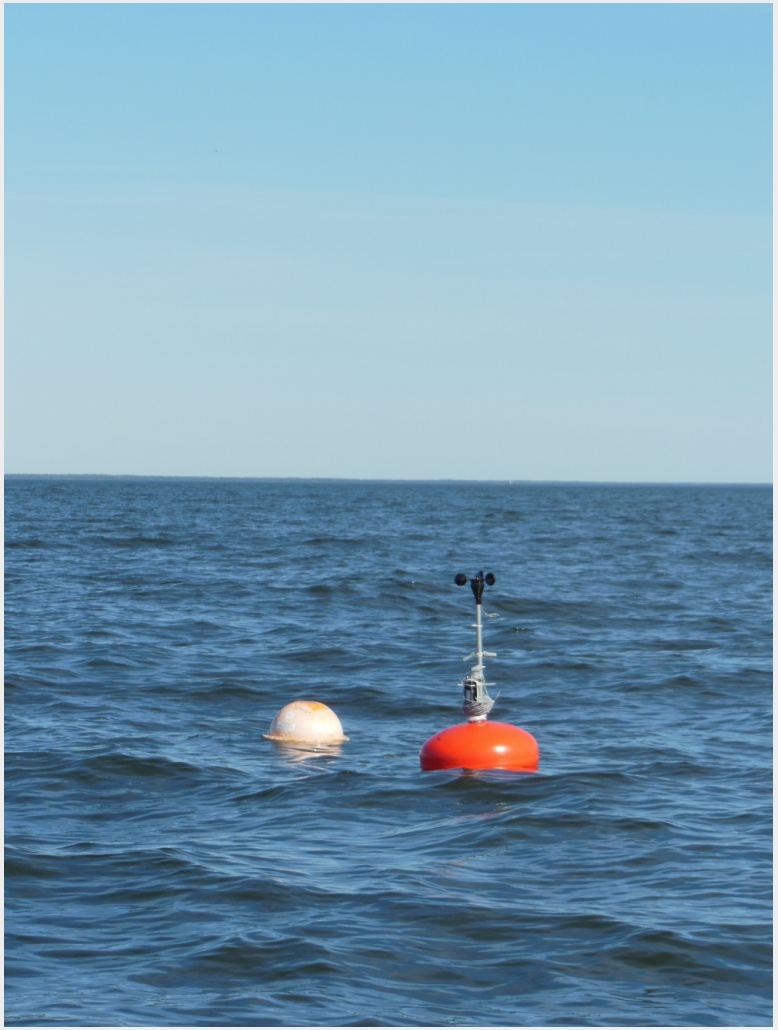
Further work

- New buoy setup was deployed in Lake Vänern in April 2014
- Added wind speed instrument and temperature loggers at 5 and 10 m depths
- Will leave buoy to stay over winter (lake freezes during normal winters)



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Conclusion

- Satellite SST products validate as expected in Lake Vänern
- Diurnal warming is frequent and might be very strong in lakes such as Lake Vänern
- Lake Vänern is a good location for validating satellite lake temperatures, testing measuring equipment and study diurnal warming

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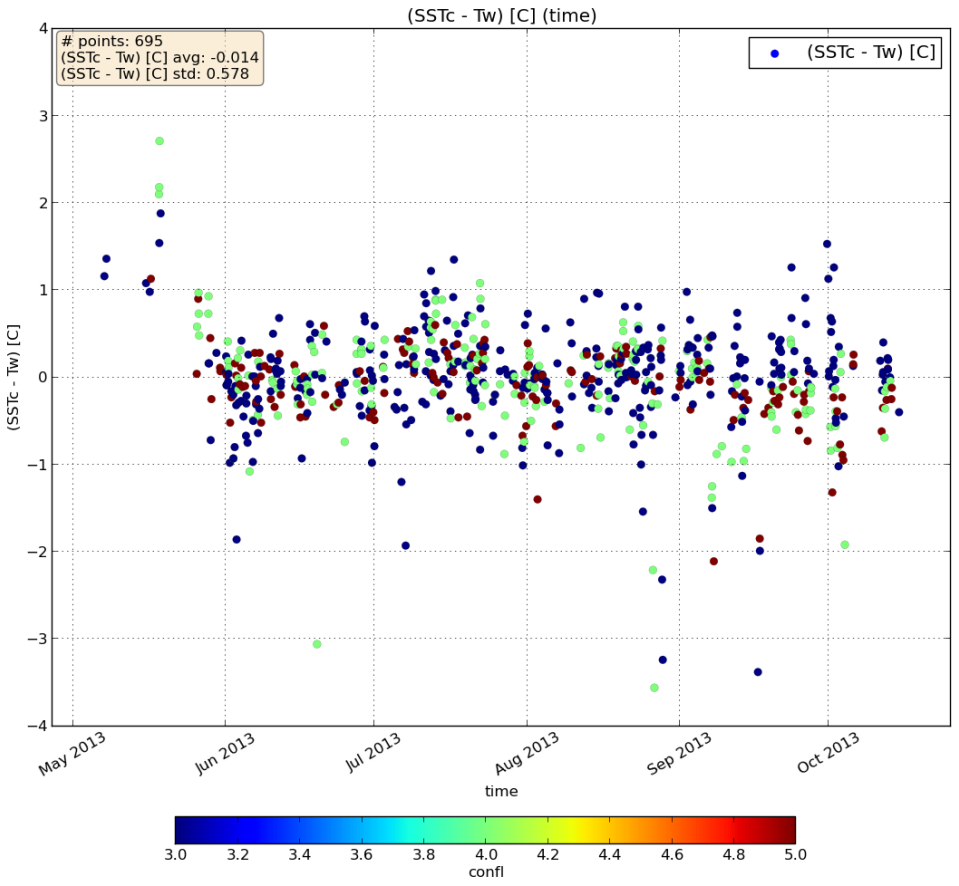
Thank you for your attentio

Validation results CMS products



- All satellites
- Using confl 3, 4 and 5
- Total 780 obs
  - cl 2: 85
  - cl 3: 347
  - cl 4: 194
  - cl 5: 154

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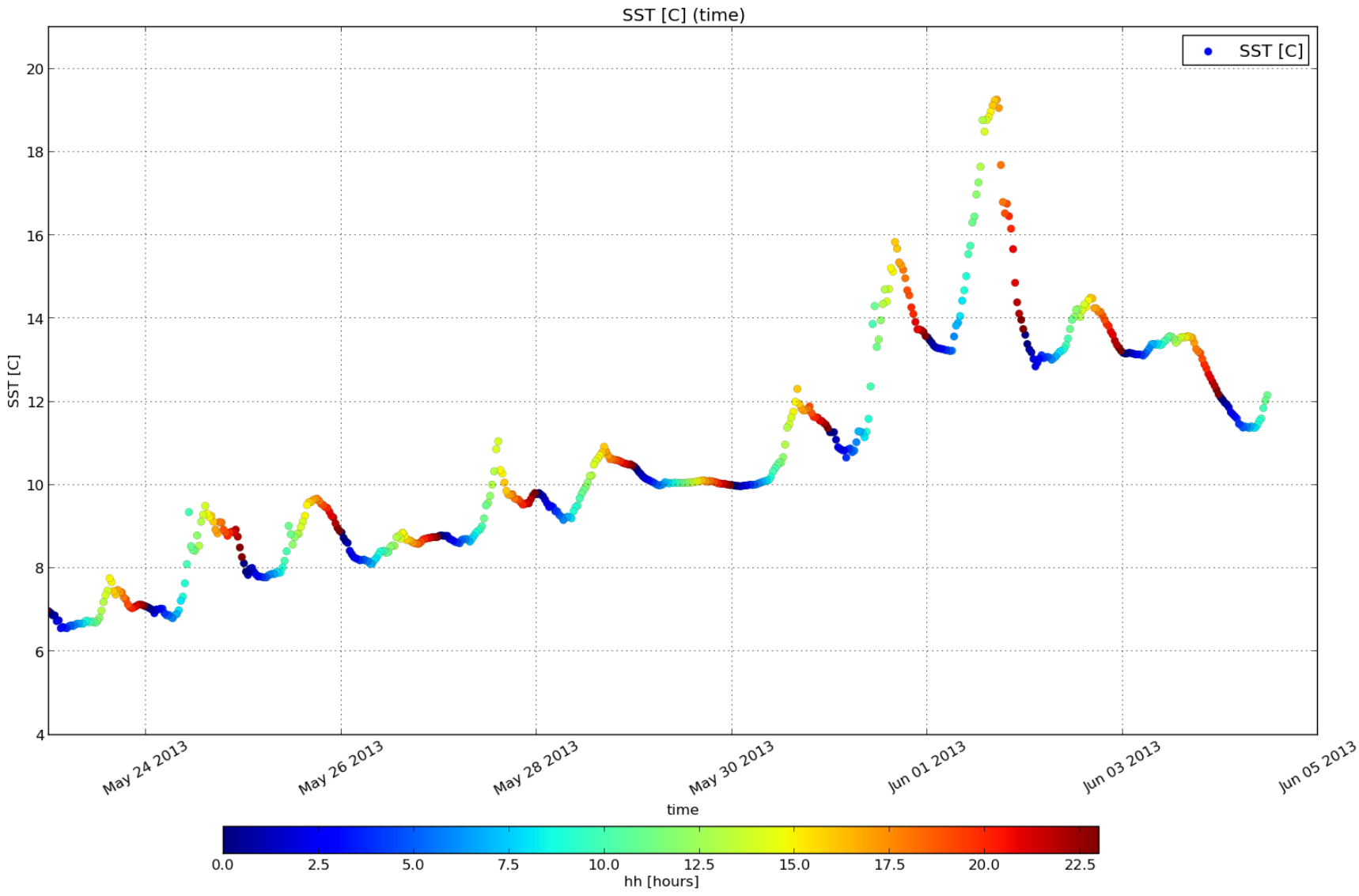
Diurnal variability



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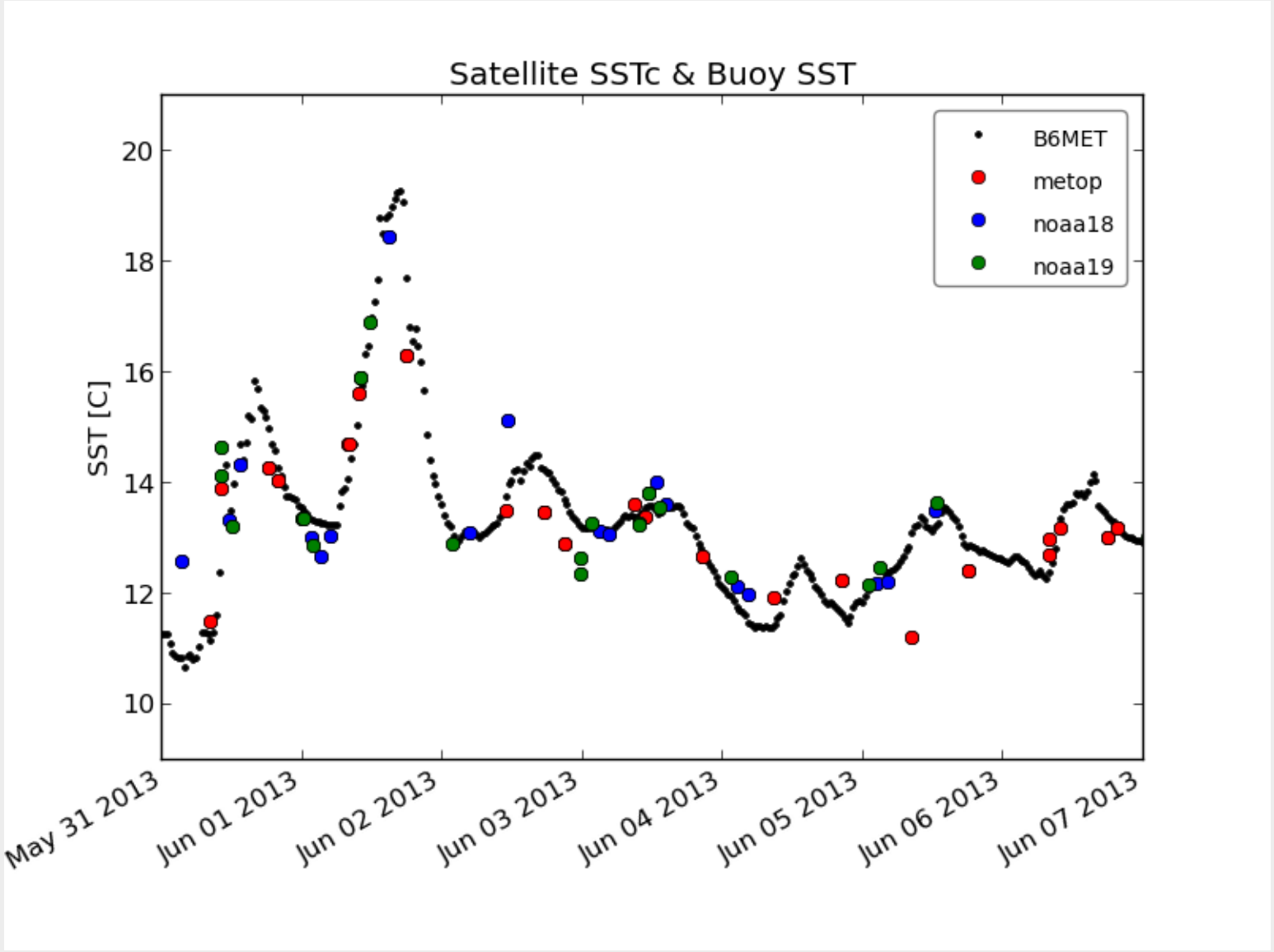

· Comparison with AHL gridded swath SST

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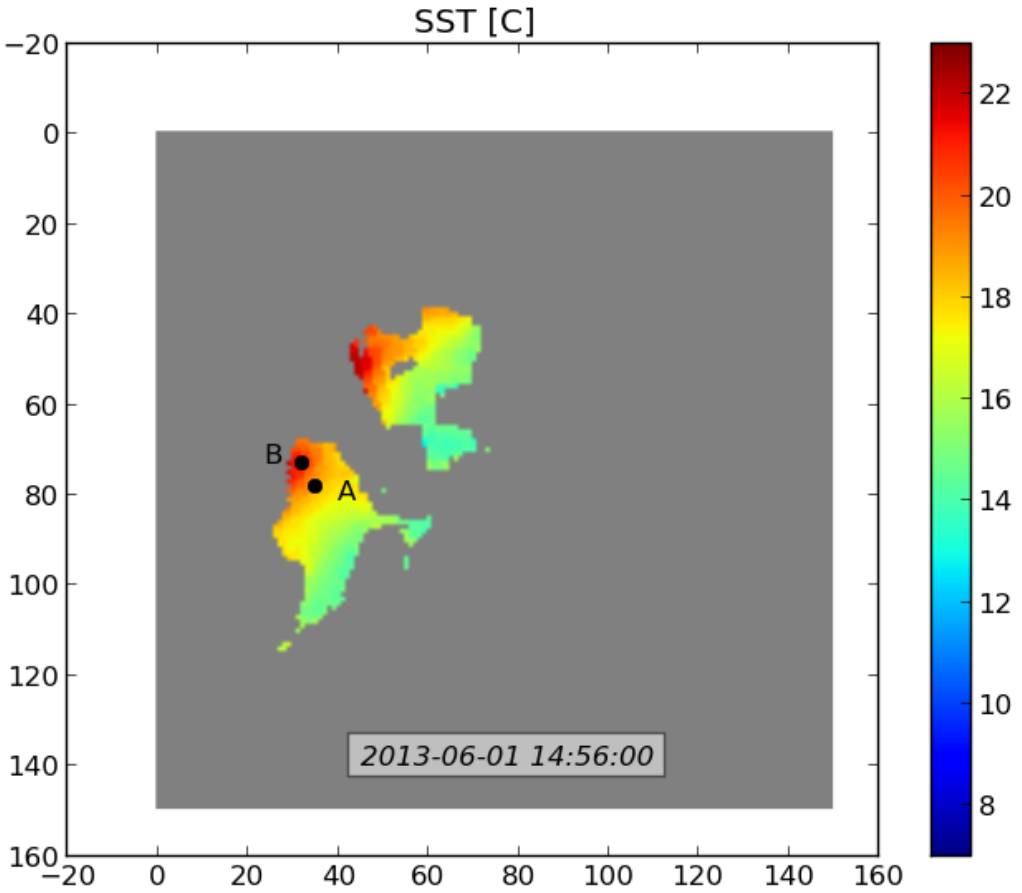
What was the max DW amplitude?



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