Observation of Structure of Marine Atmospheric Boundary Layer by Ceilometer over Kuroshio Current

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[08].[Atmospheric boundary layer processes]

[30-June], [12:00 UTC]

[Thursday_08_P10]

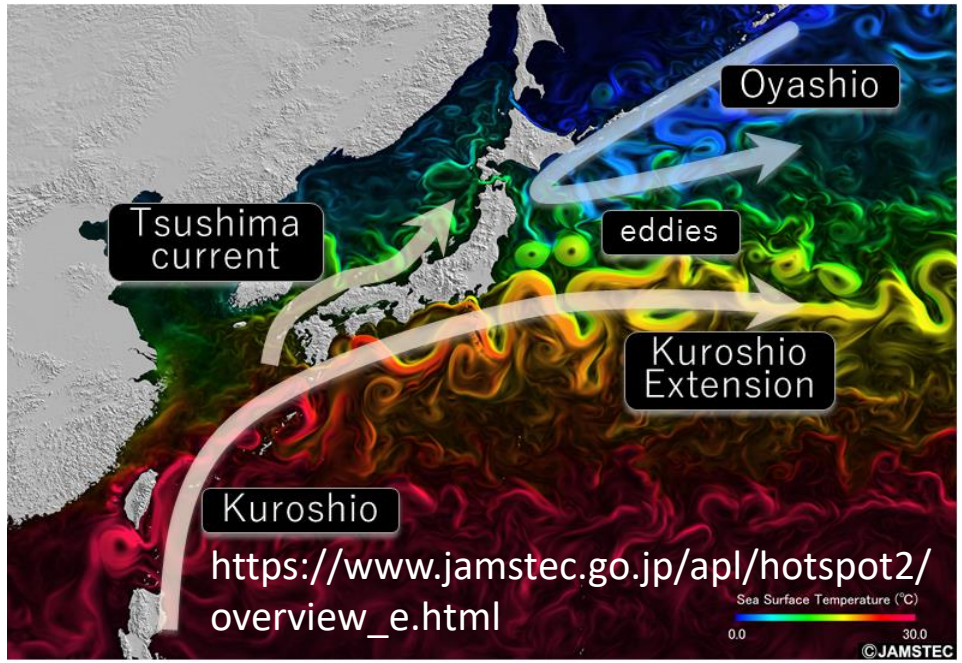
The 30th International Laser Radar Conference (ILRC) virtual conference, June 26th – July 1st, 2022.

Motivation:

- Mid-latitude ocean-atmosphere interaction hotspots under changing climate (“Hotspot2” project; 2019-2023)
- Continuous and high temporal and vertical observation by the Ceilometer
- Vaisala CL31 observation and BL-View (Boundary Layer View) analyses
- R/V Shinsei-maru, KS-21-9 cruise (24-31 May 2021)

R/V Shinsei-maru

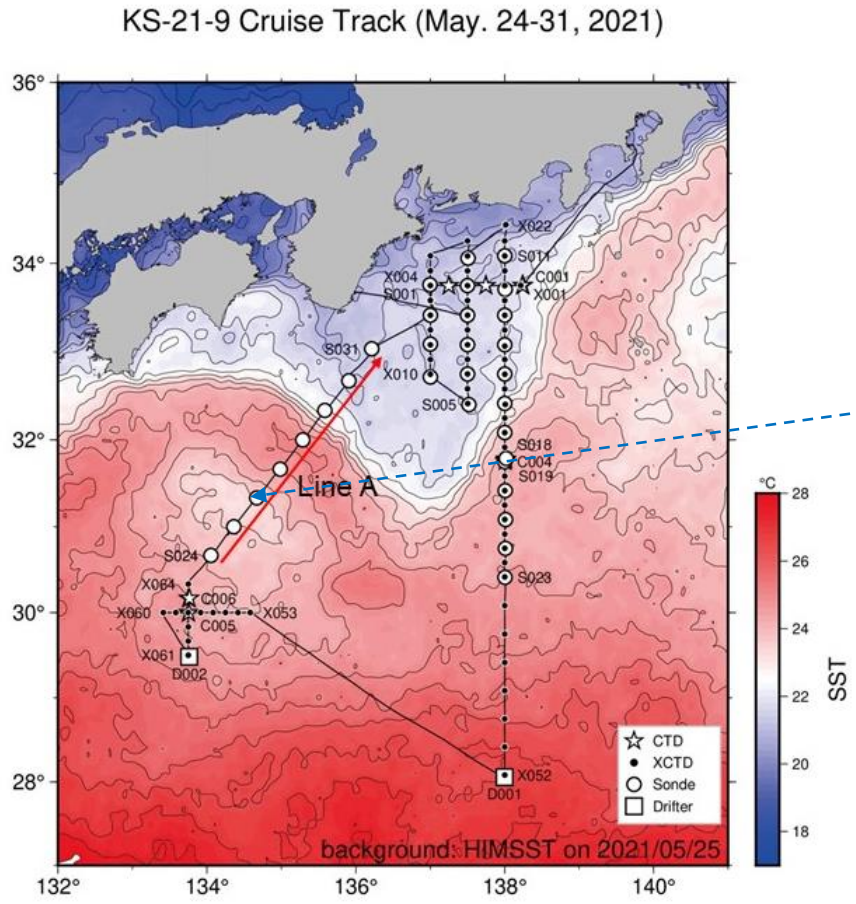
CL31 on the deck



Outline of ocean currents surrounding Japan

Observations:

- Focus on the line-A cruise (Sonde Nos. S024-S031)across the meandering Kuroshio
- GPS radiosonde: iMS-100 & RD-08AC (Meisei Electric Co., Ltd)
- Post-analysis of the BL-View, Gradient method



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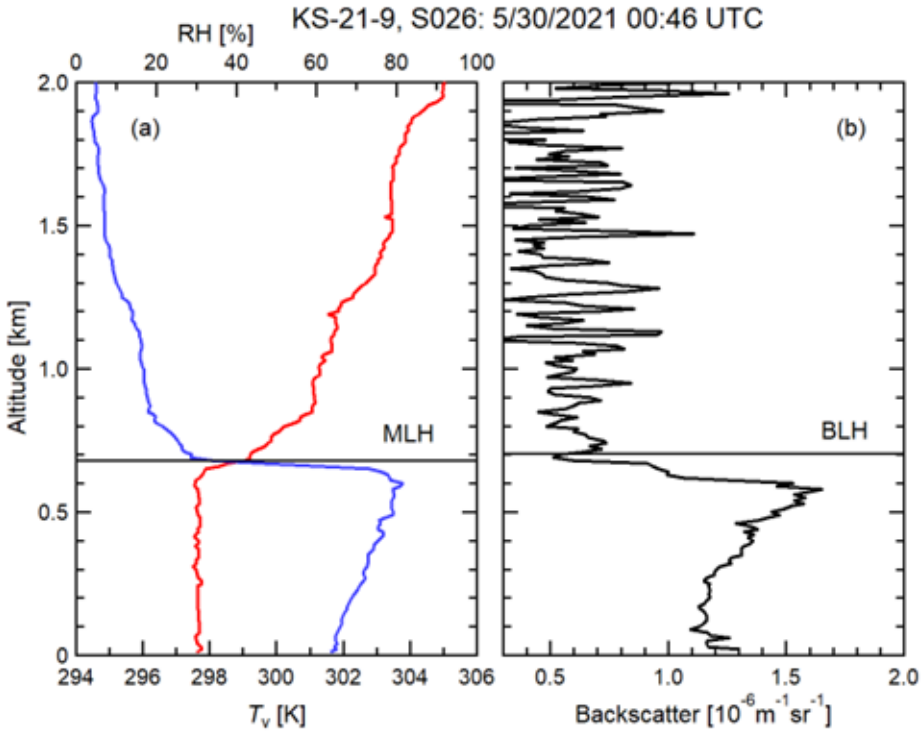


BLH=Boundary Layer Height

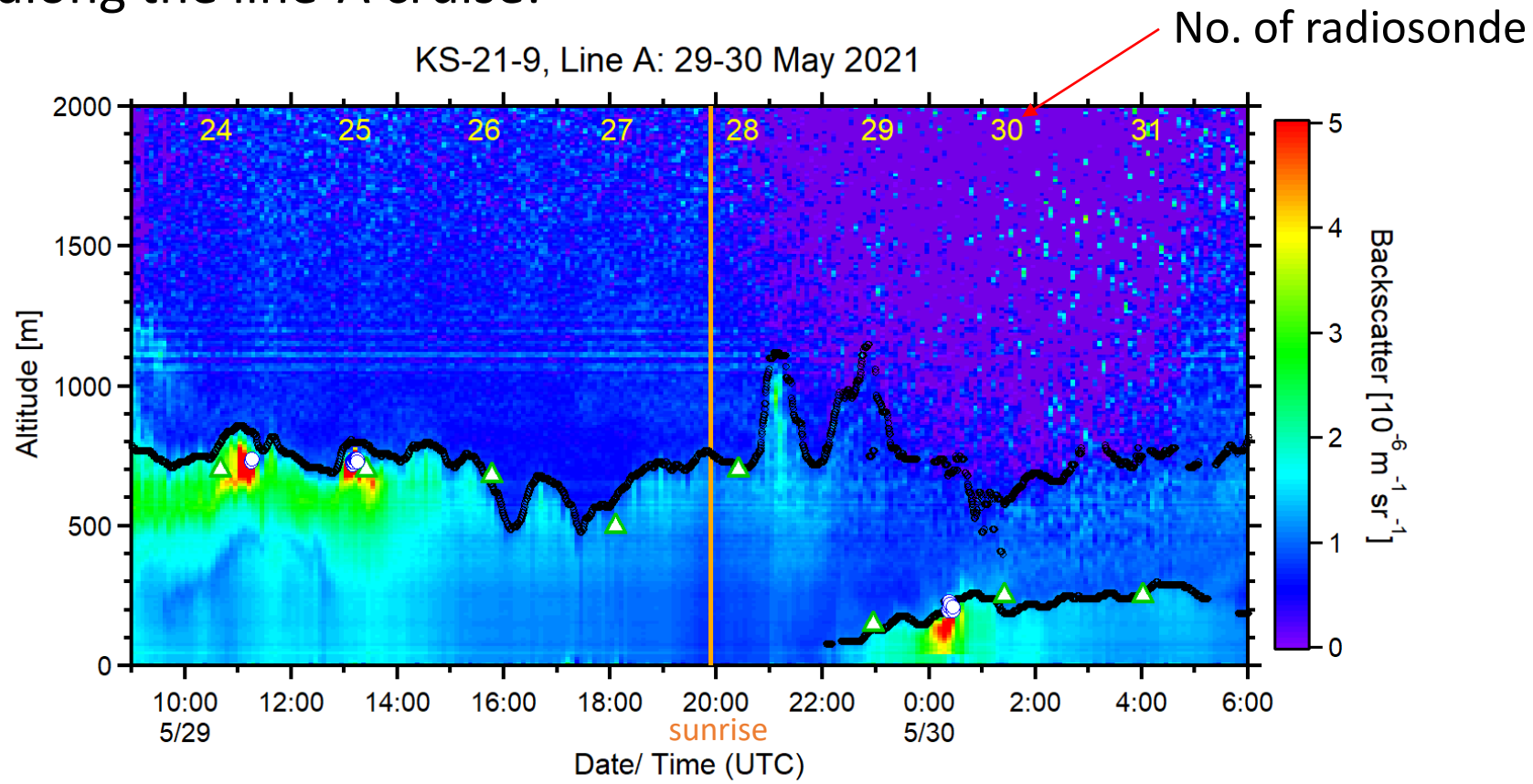
Comparison of the mixing layer height (MLH) determined from the radiosonde observation and the BLH derived from BL-View: A very well-mixed ABL case over the Kuroshio (see left figure).

Observation results along the line-A cruise:

Sonde

Cloud base

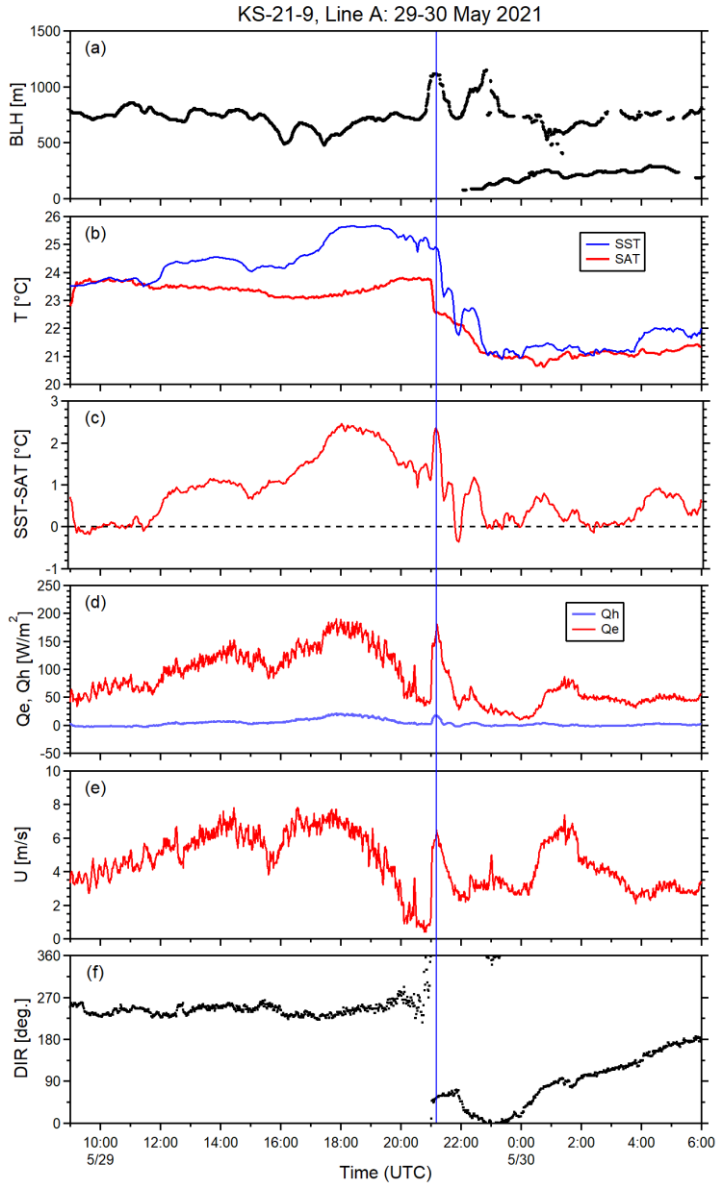
BLH1, 2



- Moderate relatively high MLH over Kuroshio (warm current): 500~800 m
- The MLHs determined by the radiosonde well agree with the BLHs derived from the BL-View.
- Sudden lifts (700 m to 1100 m) of BLH were observed twice between 20:30-23:30 UTC 29 May 2021.
- Shallow BLH newly appears over the cold sea (exited from Kuroshio region) in addition to the elevated BLH (residual layer ?).

Discussions:

- At the first elevation of the ABL (bule vertical line in the right figure); 450 m up with 9 km half width, all the meteorological parameters suddenly changed.
- SST(sea surface temperature)-SAT(surface atmospheric temperature), heat fluxes (sensible and latent), wind speed behave quite similarly.
- However, if we look the Figure (b) carefully, SAT started decreasing ~30 minutes earlier than SST.
- Then the origin of the phenomena must be both the sharp decrease of SST and the passage of the subsynoptic-scale anticyclone travelling in the northern part of the observation site.
- Next surface weather maps show the meteorological condition. The anticyclone changed the wind direction from westerly to north.
- Cold air grown on the cold sea was brought to the warm Kuroshio. Thus, SST-SAT increased.



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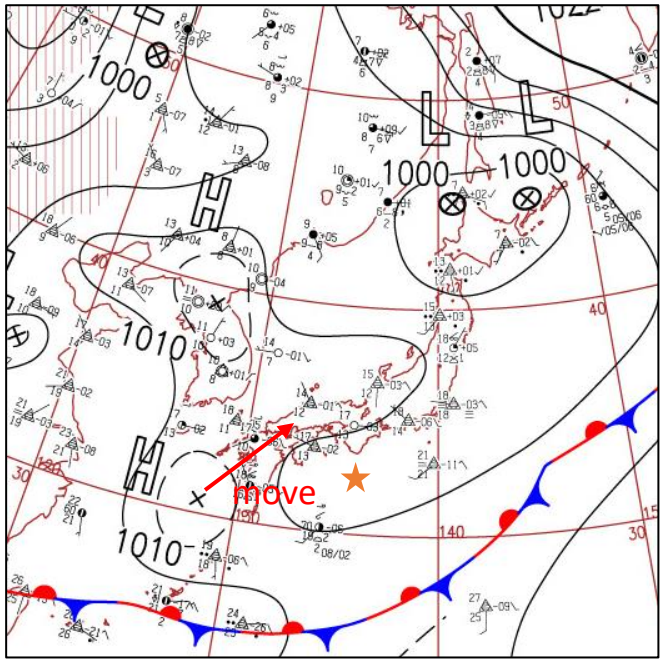
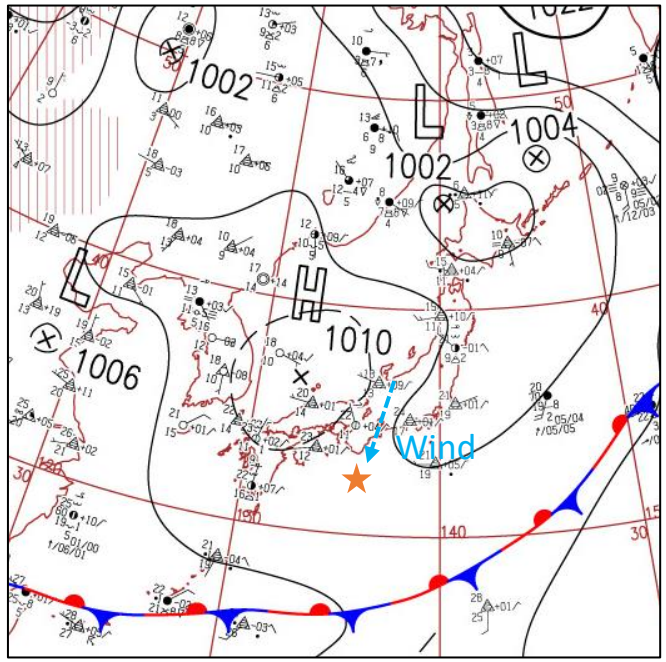


★ ship position

18Z 29 May 2021



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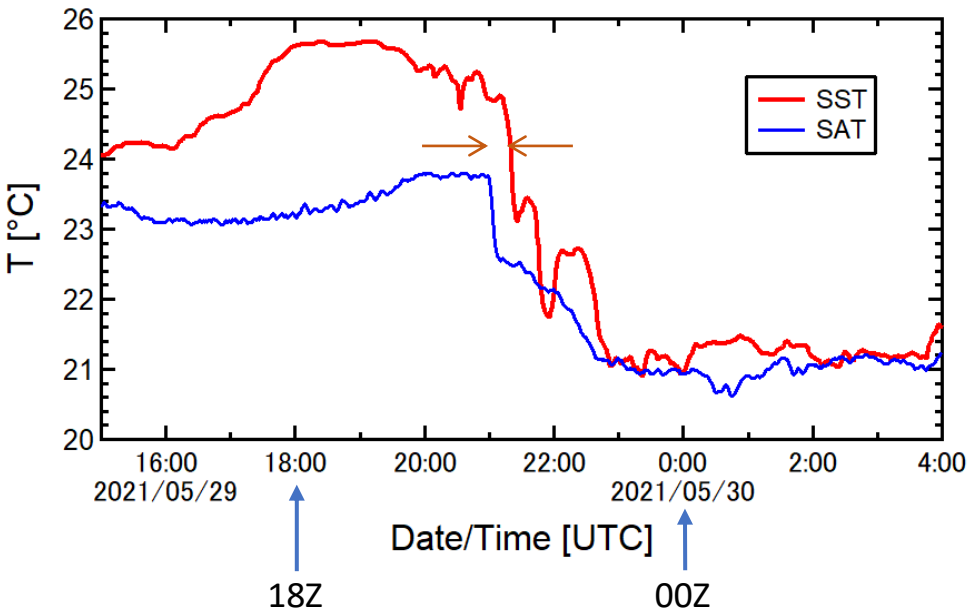

Conclusion:

- Shipborne ceilometer successfully captured the MABL structure with high temporal resolution.
- Sudden increase of the MHL was observed at the edge of Kuroshio.
- The phenomena were understood from the marine and meteorological conditions.
- In the project, we have two cruises in this year: Shinsei-maru KS-22-9 (July 3-12), KS-22-10 (July 15-Aug. 2).