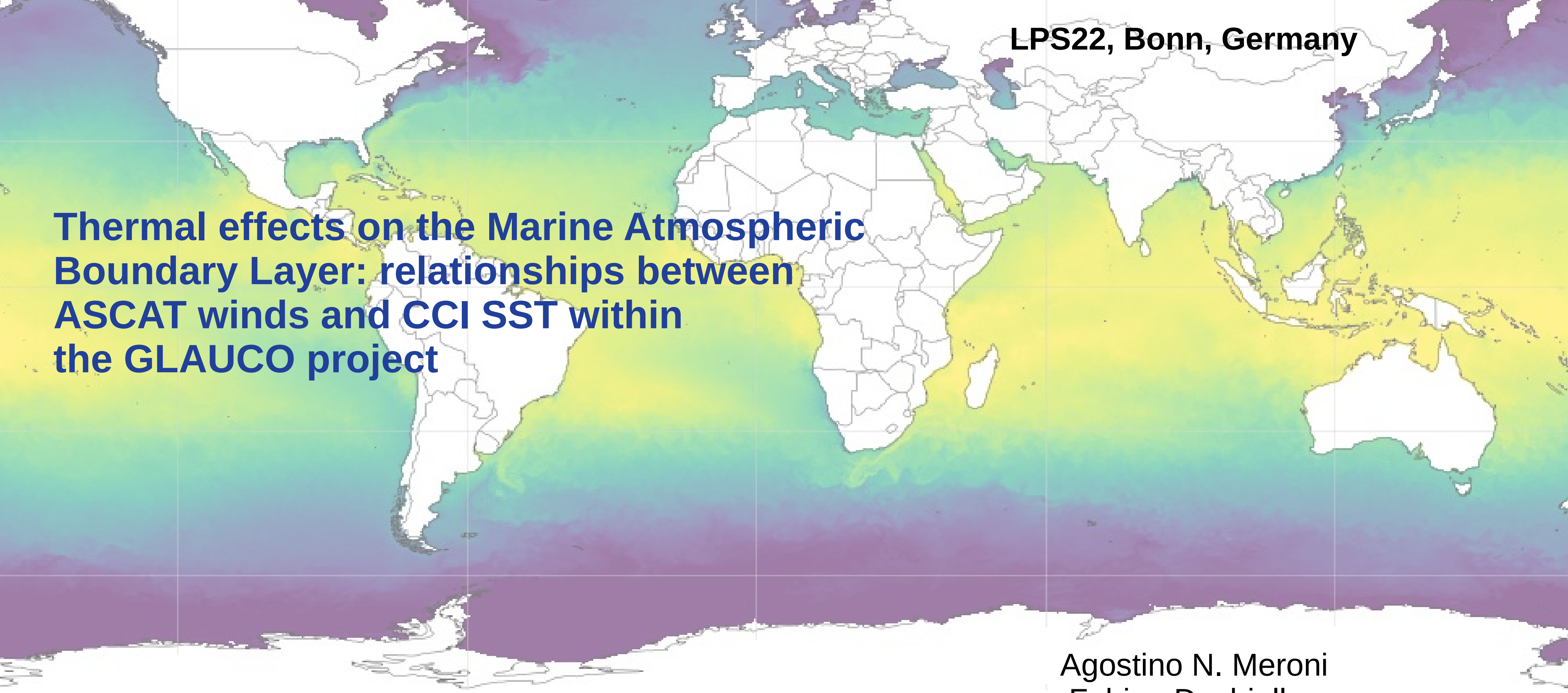
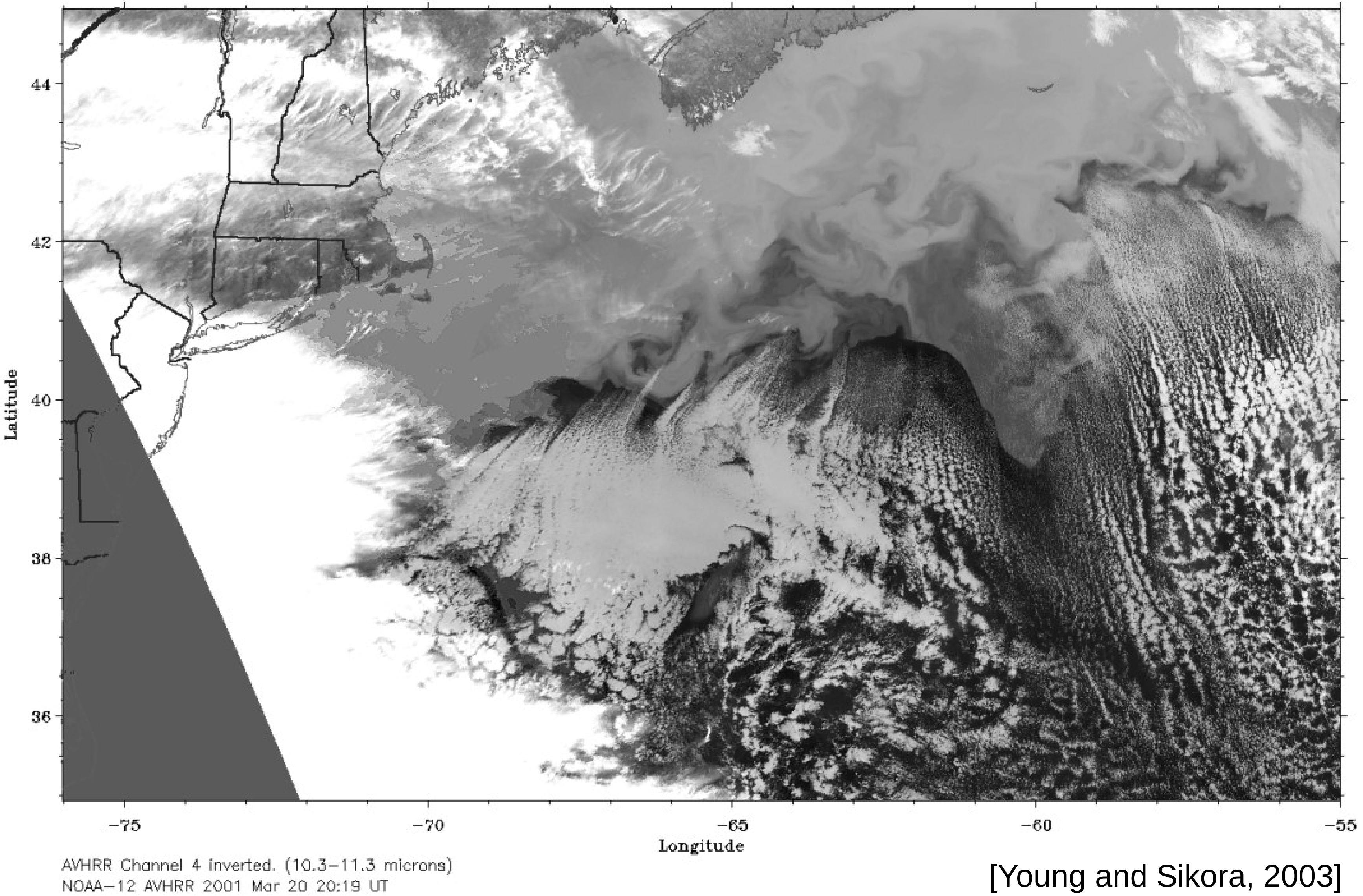


LPS22, Bonn, Germany

Thermal effects on the Marine Atmospheric Boundary Layer: relationships between ASCAT winds and CCI SST within the GLAUCO project

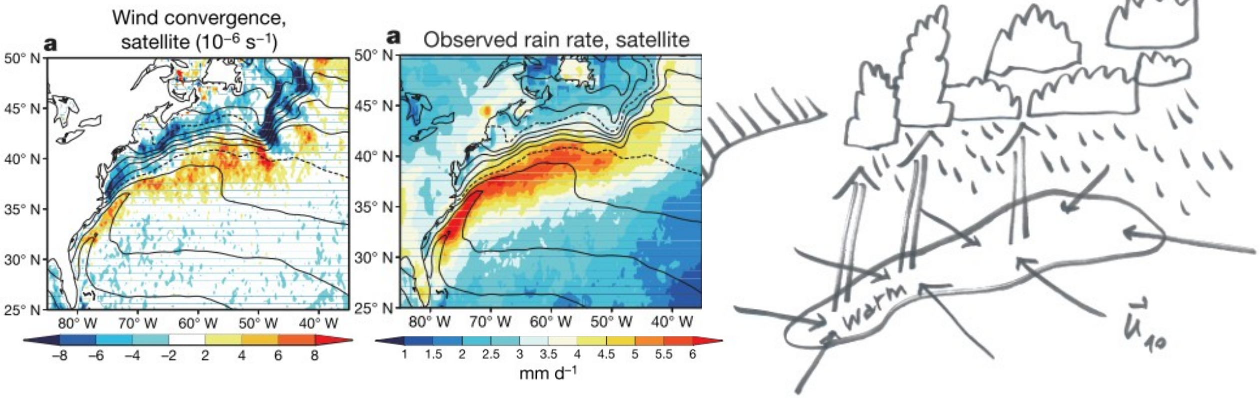
Agostino N. Meroni
Fabien Desbiolles
Claudia Pasquero
Paolo Cipollini

agostino.meroni@unimib.it

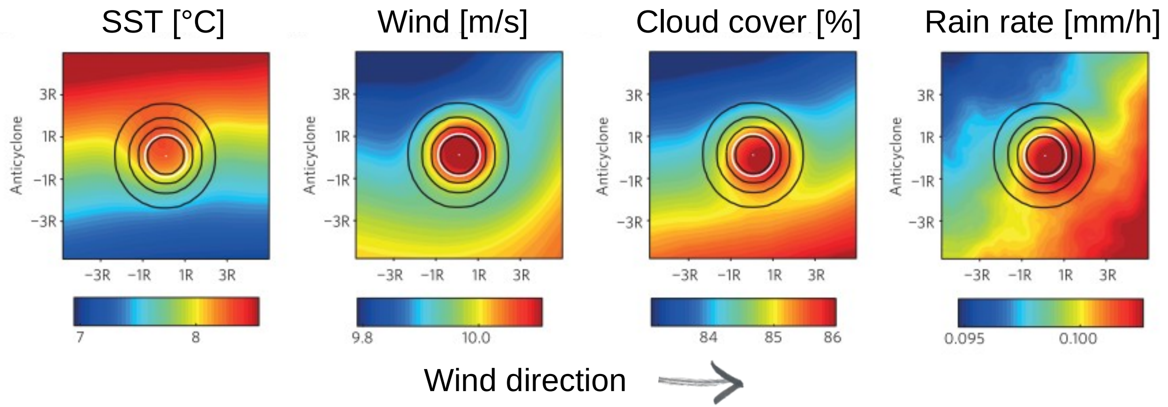


[Young and Sikora, 2003]

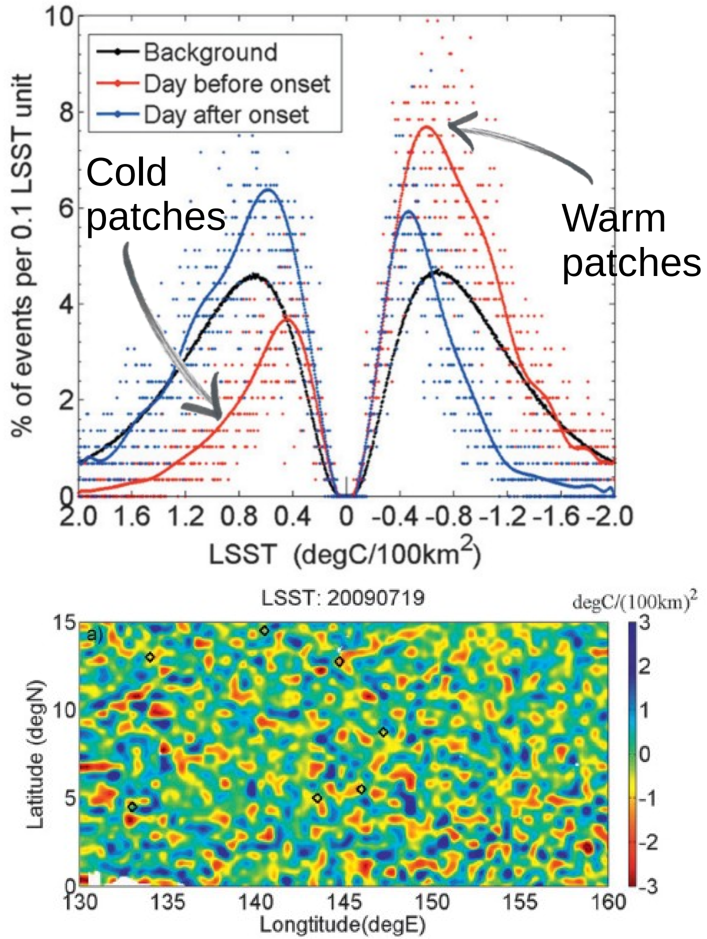
1 The warm Gulf Stream affects the **annual** cloud cover and rainfall [Minobe et al., 2008]



2 Mesoscale eddies in the Southern Ocean affect the **weekly** cloud cover and rainfall [Frenger et al., 2013]



3 Warm patches in the tropical Pacific warm pool trigger **daily** convective rainfall [Li and Carbone, 2012]



Global and Local Atmospheric response to the Underlying Coupled Ocean: GLAUCO

Goals

- Investigate the atmospheric response to the oceanic thermal forcing at **different spatio-temporal scales**;

- Quantify the importance of the **fast** ocean-atmosphere interactions (wind, clouds and rainfall response) on the climate system;

- Assess the control exerted on such mechanisms by the **environmental conditions**;

- Characterize **local** features within the same **global** framework.

ESA-CCI data: high spatio-temporal resolution and long-term consistency.

sea surface temperature

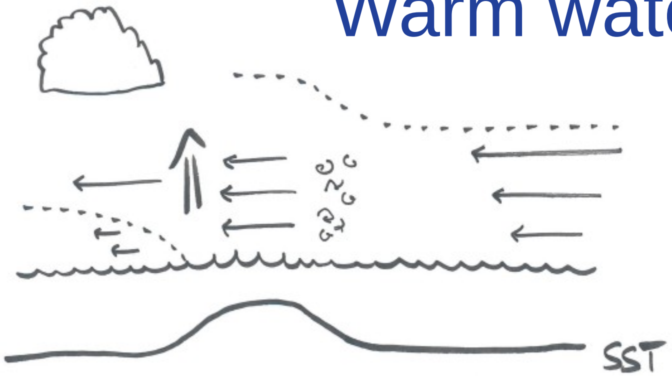
sea surface salinity

cloud

water vapour

sea state

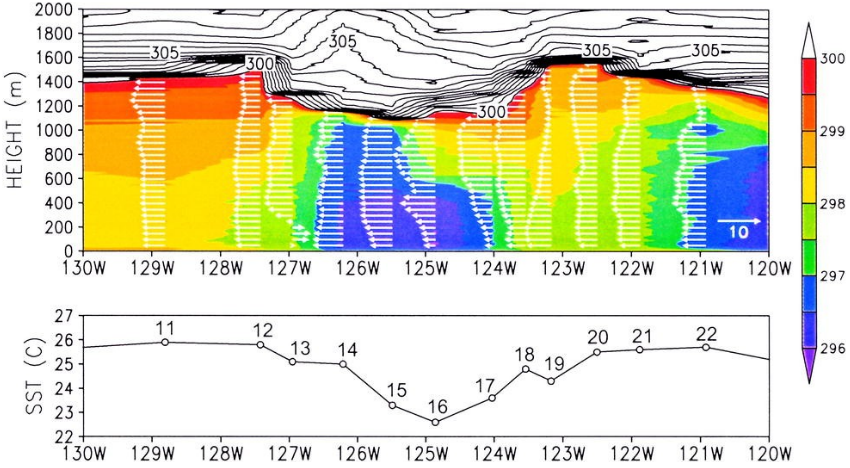
Warm water enhances the atmospheric mixing



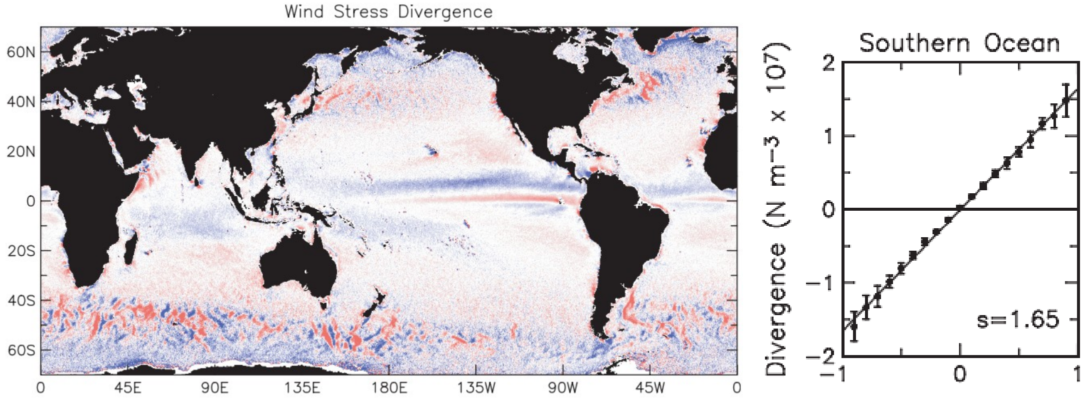
Downward **M**omentum **M**ixing

Wind divergence happens over SST gradients.

Typically, one calculates **correlation coefficients** (in space or time) or the slope of the binned distributions (**coupling coefficients**) of downwind SST gradient and wind divergence.



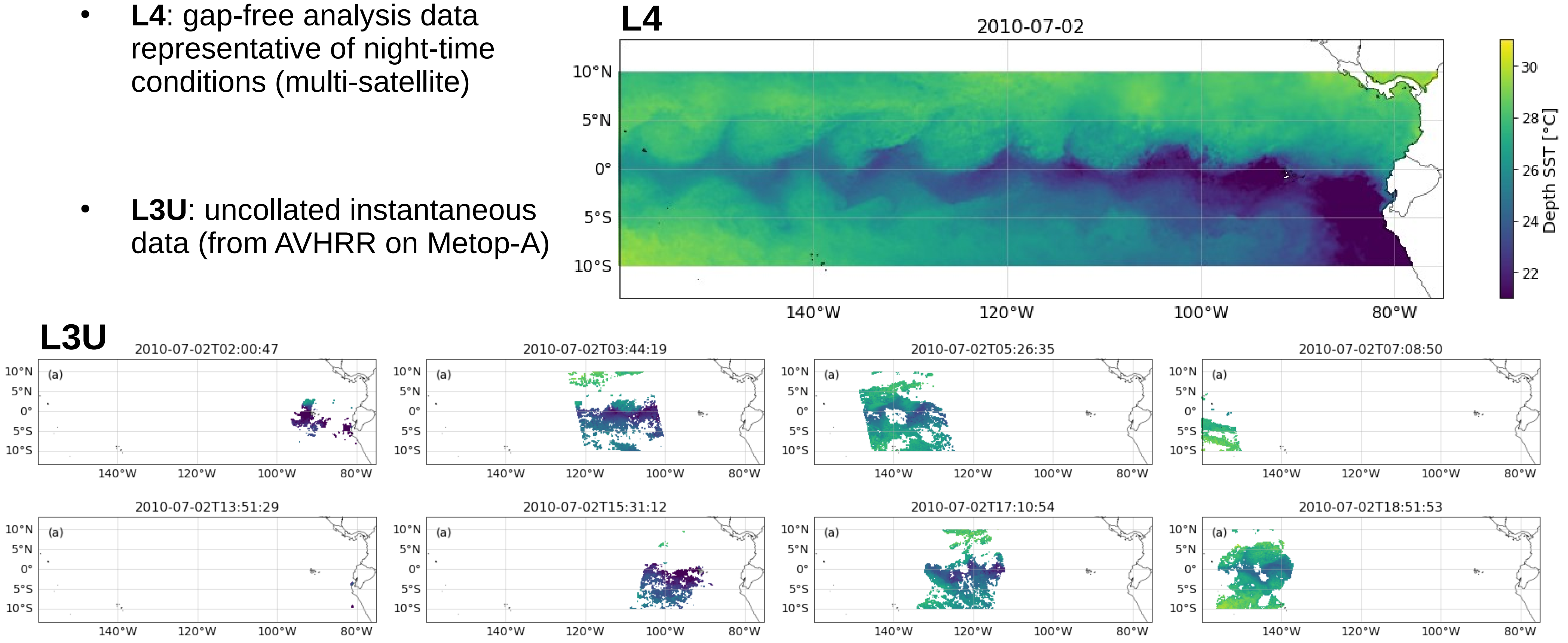
DMM: Longitude-height section of virtual potential temperature (contours and colors) and zonal wind velocity from a radiosonde transect over the TIWs in the eastern Pacific [Hashizume et al., 2002].



[Chelton et al., 2004]

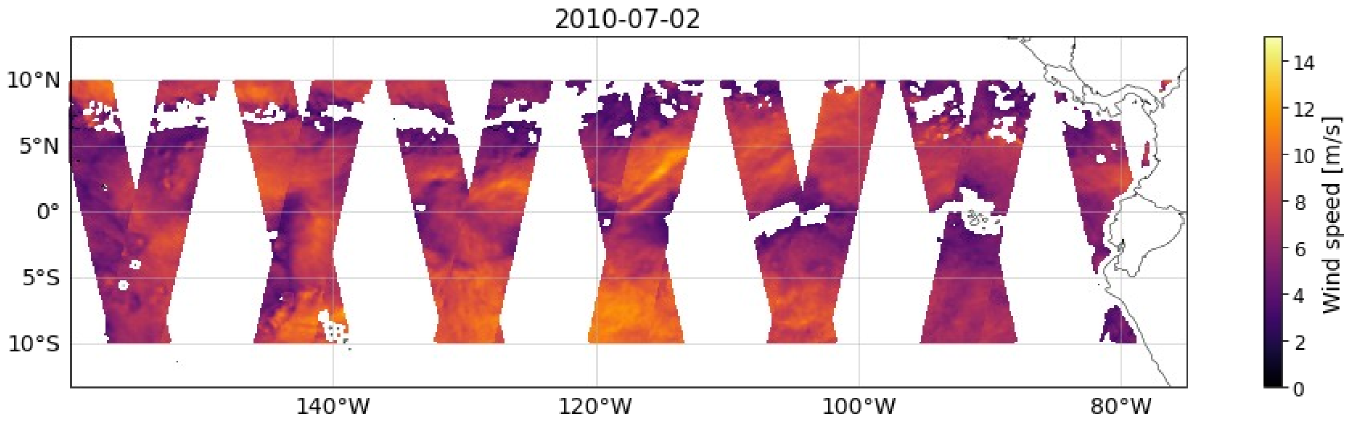
Daily analysis VS instantaneous SST fields

- **L4**: gap-free analysis data representative of night-time conditions (multi-satellite)
- **L3U**: uncollated instantaneous data (from AVHRR on Metop-A)

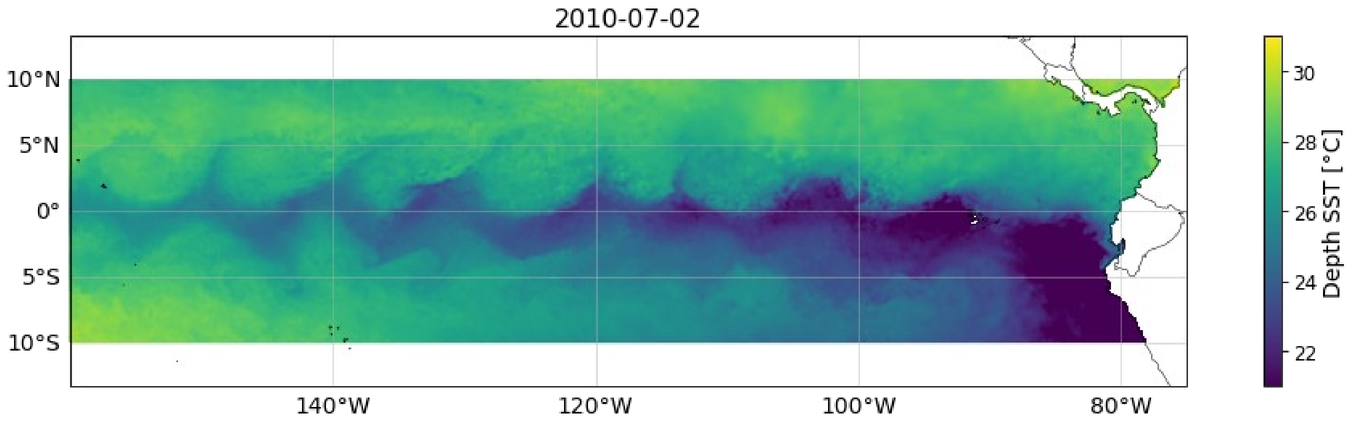


Daily analysis VS instantaneous SST fields

One night-time gap-free **L4 SST** map with **instantaneous wind field** from ASCAT on Metop-A. All the available wind swaths within the area of interest are considered.



For **L3U SST** (next slide), **simultaneous** and **co-located** measurements of SST and wind field are considered, throughout the day, filtered by the appropriate quality flag.



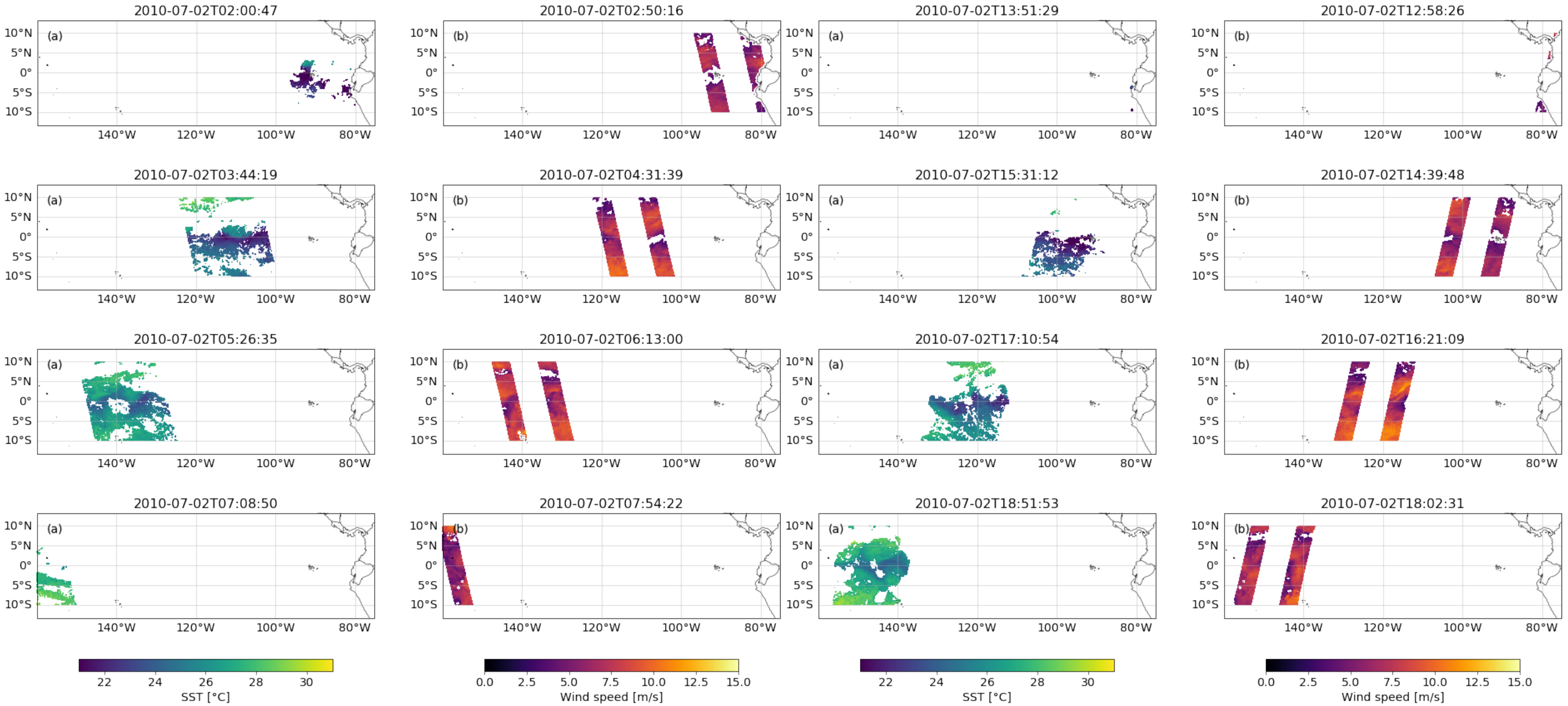
Both sensors (AVHRR and ASCAT are on Metop-A).

Ascending

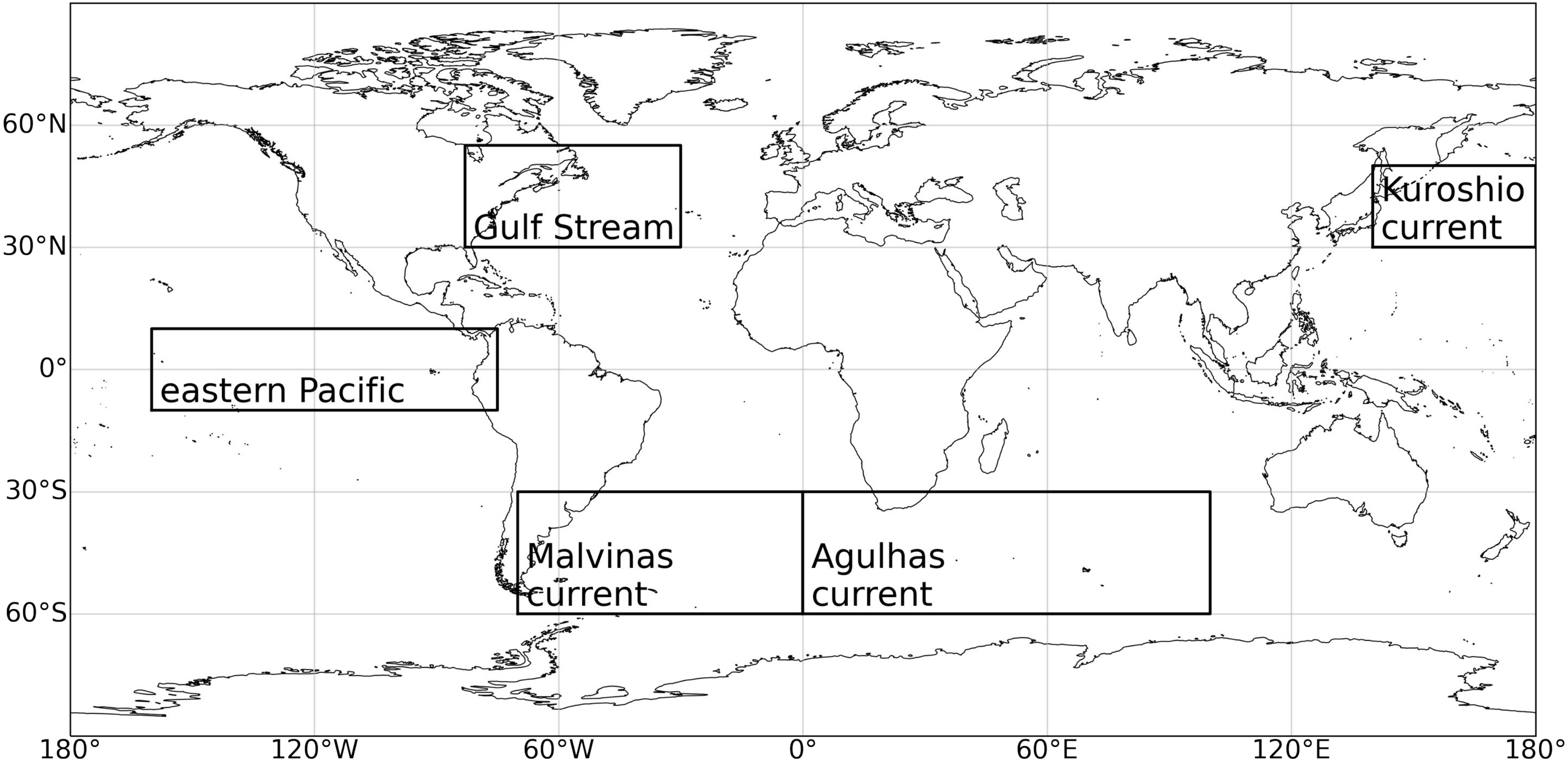
Equator crossing local time: 9:30PM

Descending

Equator crossing local time: 9:30AM

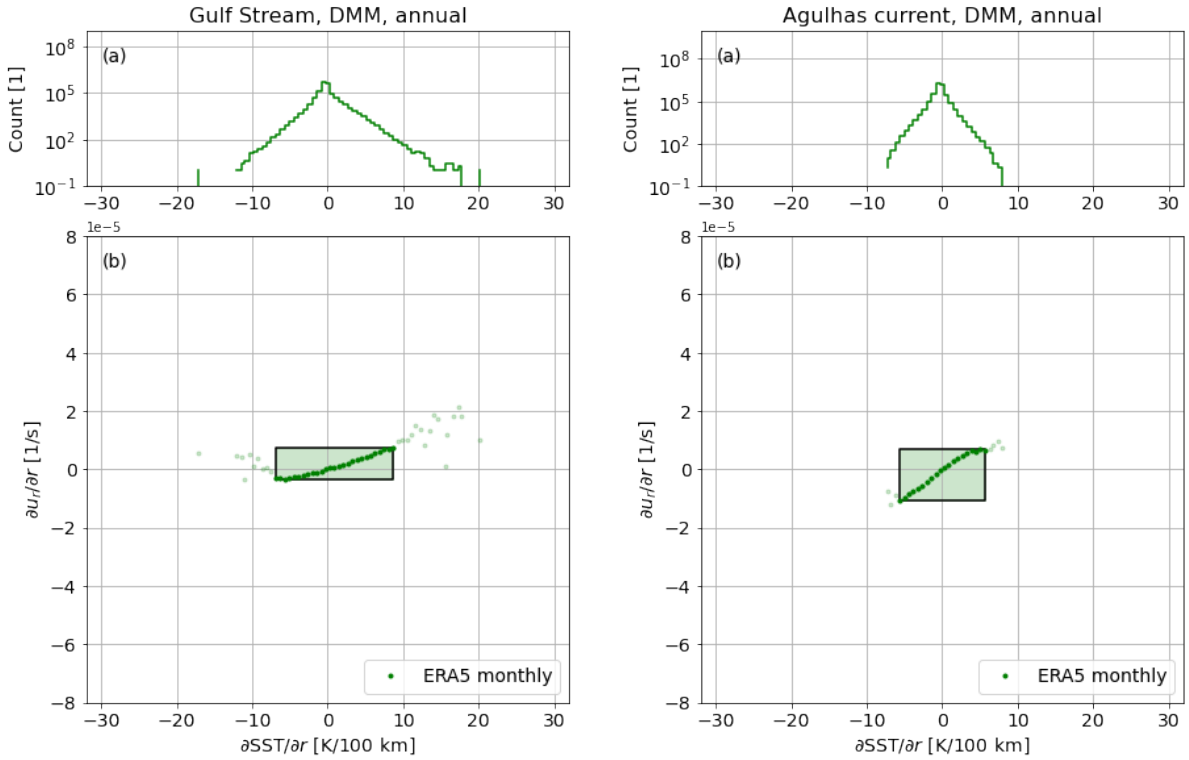


Regions of interest, mainly WBCs here



Monthly data show a mean linear response

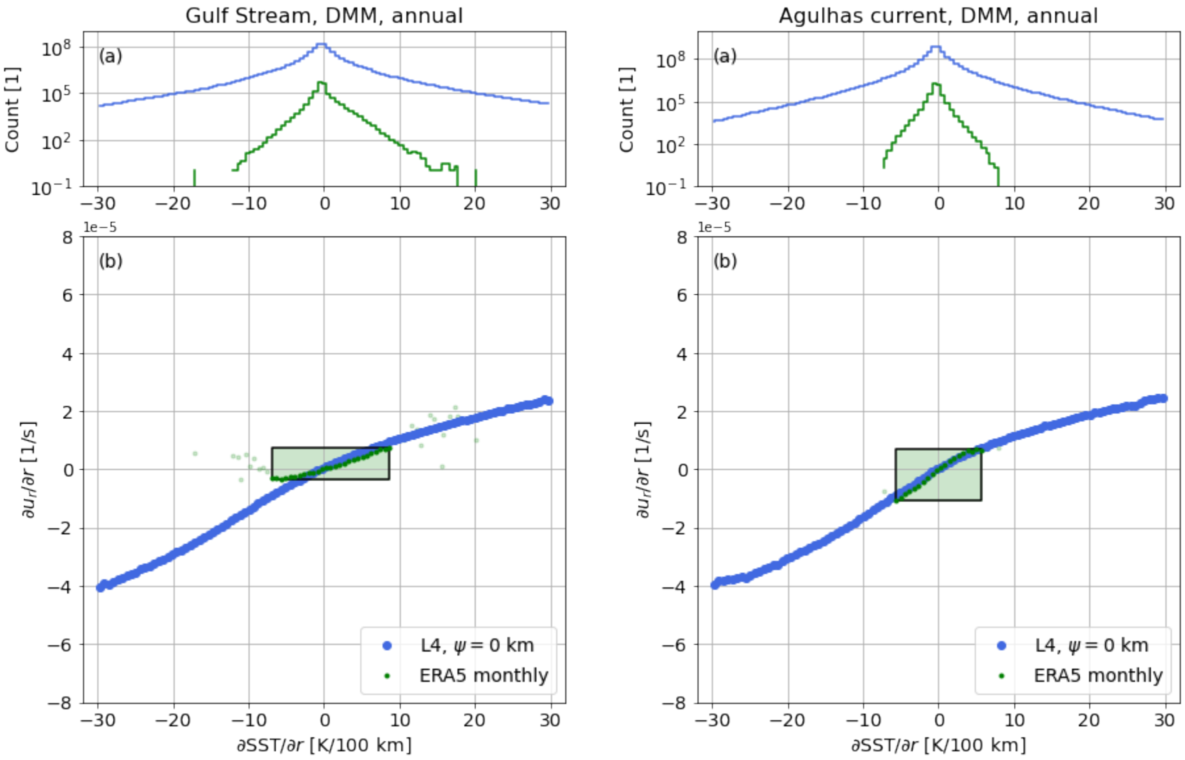
Green: ERA5 monthly mean data: positive slope indicates that the DM is shaping the atmospheric response.



Daily L4 data extend the range and show some nonlinearities

Green: ERA5 monthly mean data: positive slope indicates that the DM is shaping the atmospheric response.

Blue: L4 SST data: both the range of the forcing and of the response widen.



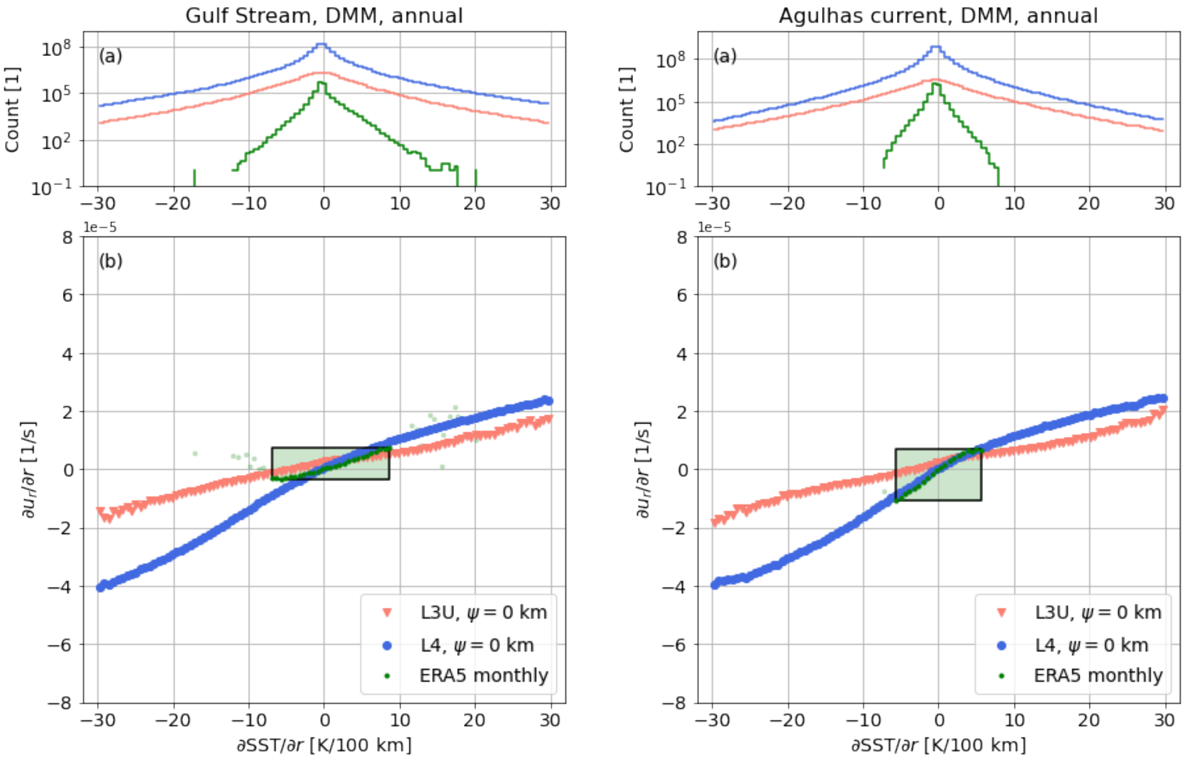
Small-scale SST forcing is noise for scatterometer winds

Green: ERA5 monthly mean data: positive slope indicates that the DM is shaping the atmospheric response.

Blue: L4 SST data: both the range of the forcing and of the response widen.

Red: L3U SST data: the coupling decreases because of the resolution of the wind product (Δx = 12.5 km).

L3U < L4



Simultaneous data reveal a strong coupling

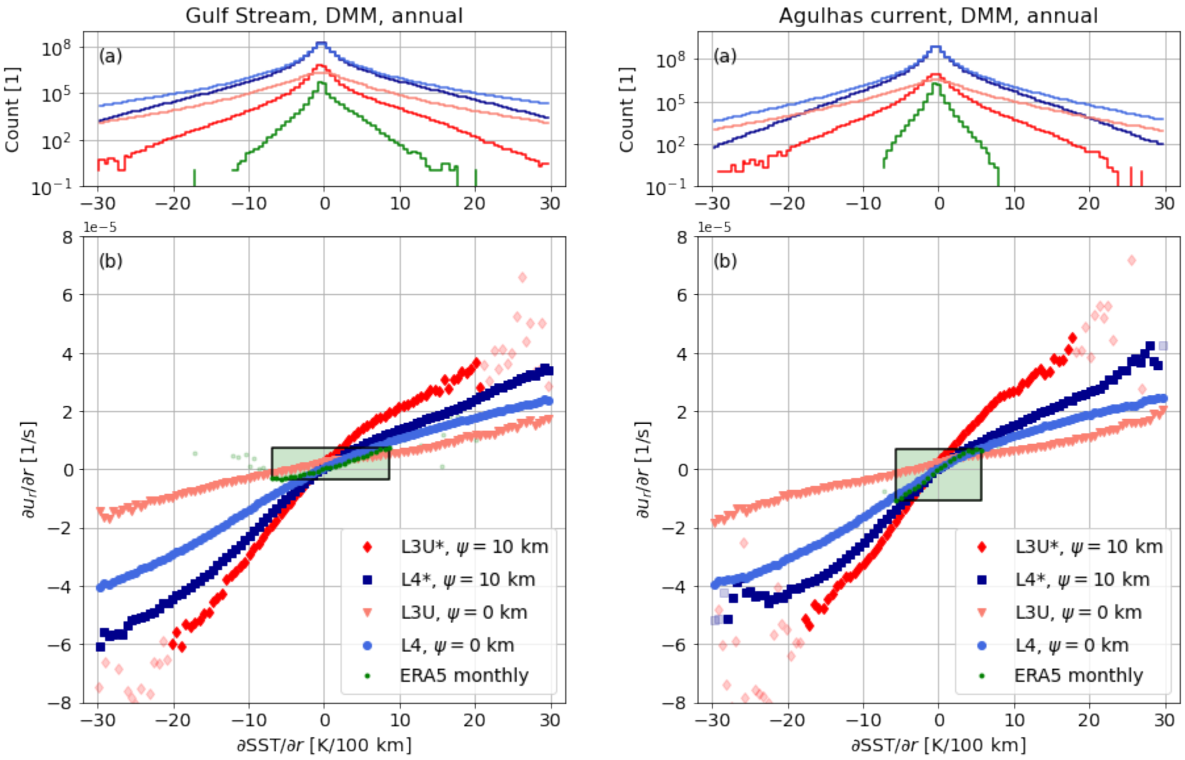
Green: ERA5 monthly mean data: positive slope indicates that the DM is shaping the atmospheric response.

Blue: L4 SST data: both the range of the forcing and of the response widen.

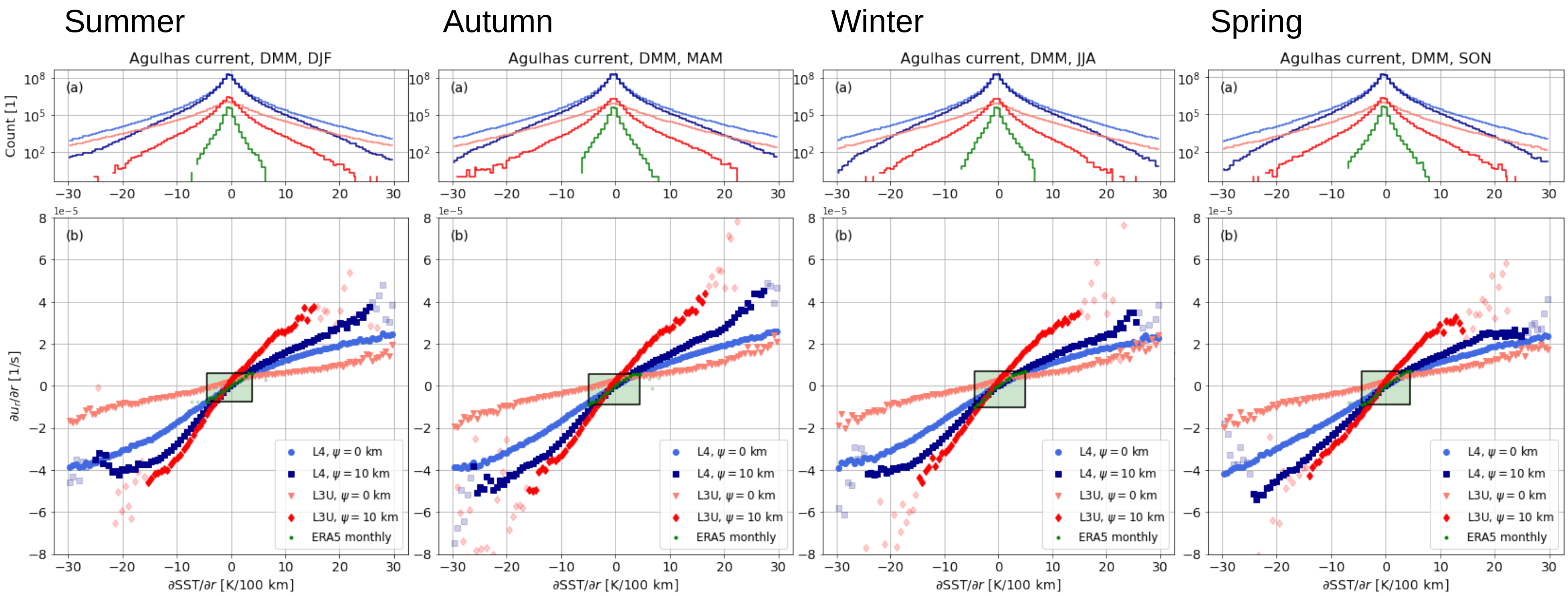
Red: L3U SST data: the coupling decreases because of the resolution of the wind product (Δx = 12.5 km).

By removing the small-scale structures (with a Gaussian filter with standard deviation = 10 km) from the SST forcing, the coupling increases.

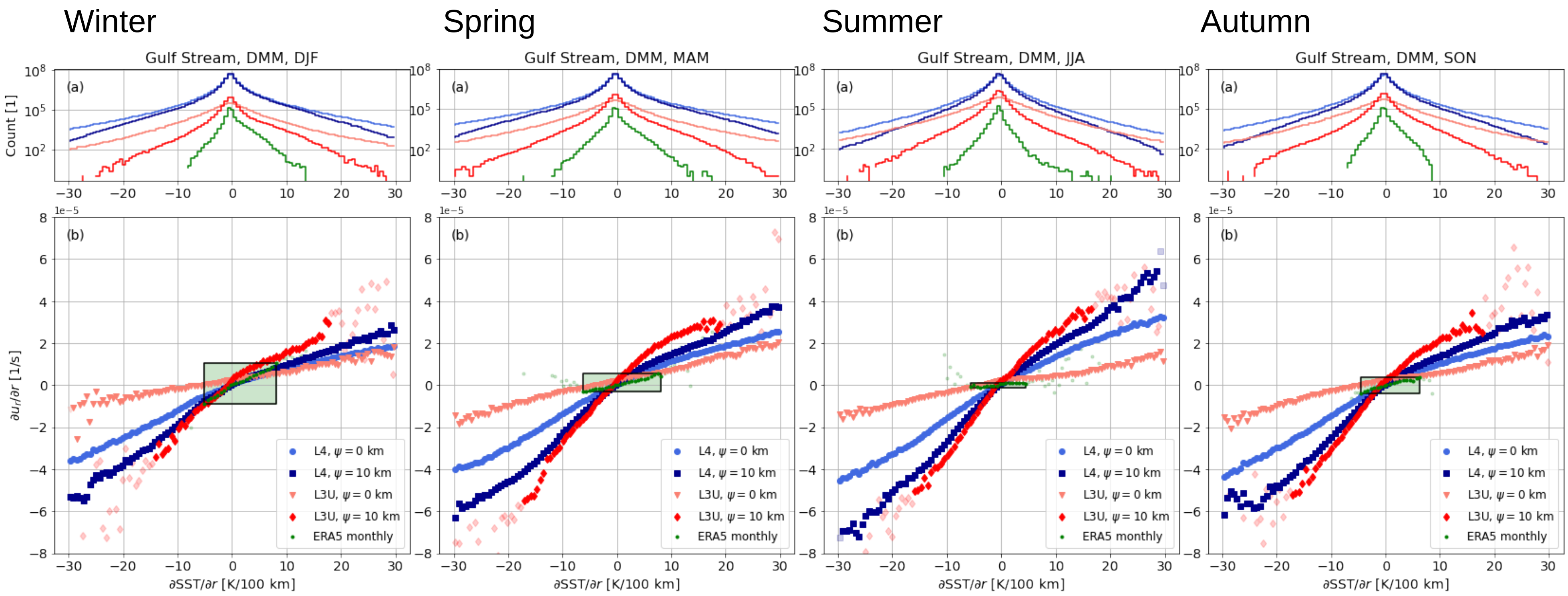
L3U < L4 < L4* < L3U*



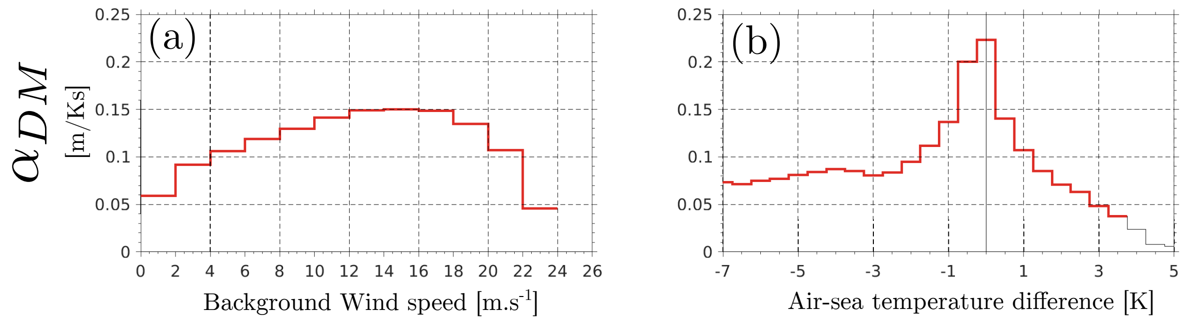
No seasonal cycle is found over the SH WBCs



Over NH WBCs, the strongest coupling is found in JJA



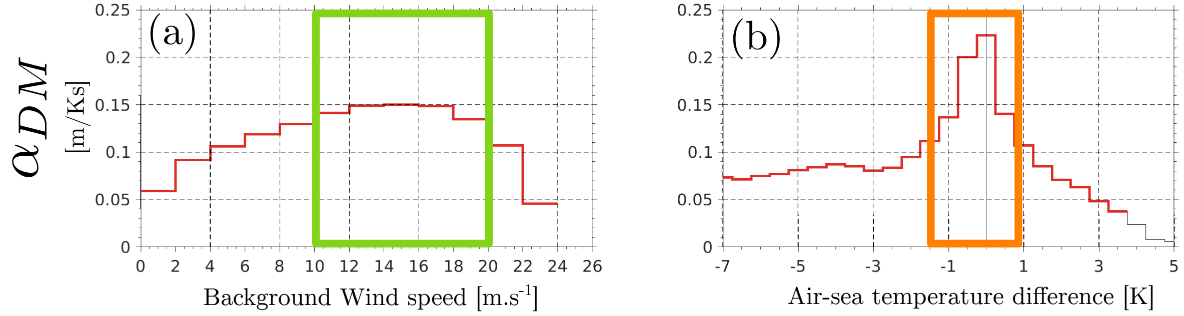
The air stability controls the coupling seasonality



From five years of daily ERA5 data, the coupling coefficients are computed as a function of (a) **background wind speed** and (b) **air-sea temperature difference**.

[Desbiolles et al., submitted]

The air stability controls the coupling seasonality



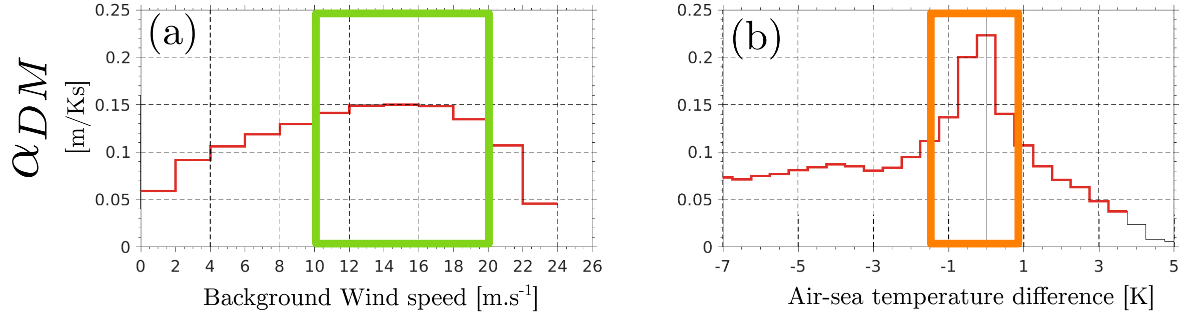
From five years of daily ERA5 data, the coupling coefficients are computed as a function of (a) **background wind speed** and (b) **air-sea temperature difference**.

[Desbiolles et al., submitted]

The coupling is enhanced with
- **moderate to strong background wind** or
- **near-neutral conditions**.

The wind is maximum in **winter** and near-neutral conditions are found in **summer**.

The air stability controls the coupling seasonality



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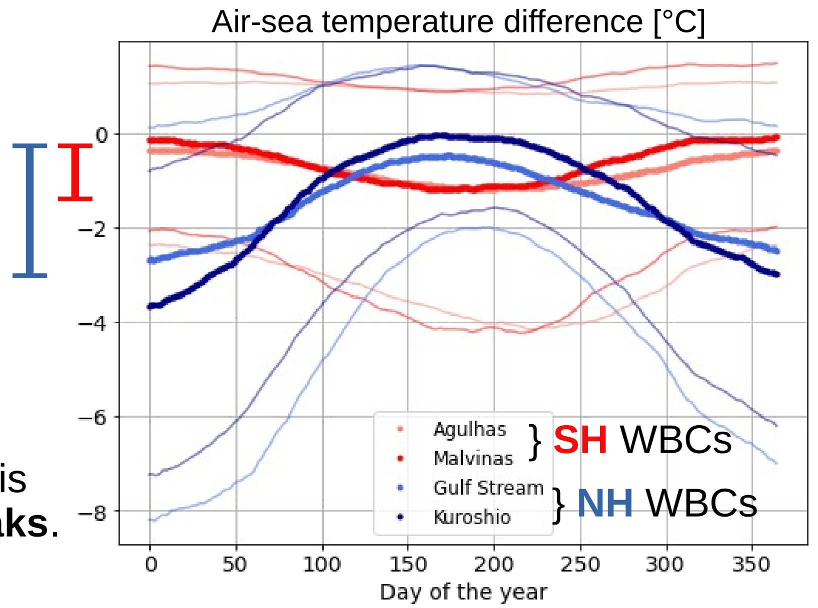

The air-sea temperature difference seasonal cycle over WBCs is stronger in the NH than in the SH, because of **cold air outbreaks**.

Conclusions and next steps

1) **Simultaneous** and **co-located** wind and SST measurements reveal a **stronger coupling** with respect to longer term time averaged data;

2) **Higher resolution wind data** are needed to characterize similar ocean-atmosphere interactions at the **sub-mesoscale**;

3) **Seasonality** in the air-sea temperature difference exerts a control on the seasonality of the fast wind response to the SST gradient forcing.

THANKS FOR YOUR ATTENTION

agostino.meroni@unimib.it