Global identification of atmospheric surface layer stratification states through the imprint of boundary layer coherent structures on the sea-surface roughness

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High-resolution ocean texture provides information about MABL stratification.

$$Ri = \frac{g}{T_{10v}} \frac{z_{10}\left(T_{10v} - SST_v\right)}{U_{10N}^2}$$

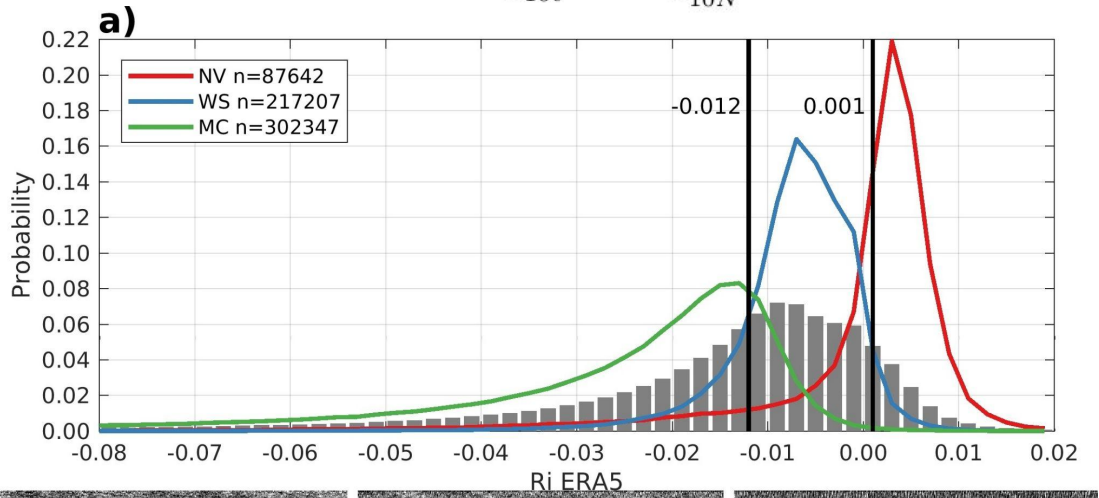
- 607,196 SAR images 2016-2019 S-1A/B
  - ↳CNN classifies each image: WS, MC & cold pools are the most common
  - ↳Use highest-confidence detection of image type

- SAR detection using the sea-surface texture of
  1) Microscale Convection (MC) - unstable (UBL)
  2) Wind Streaks (WS) - near neutral (NNBL)
  3) Negligible Variability (NV) - stable (SBL)

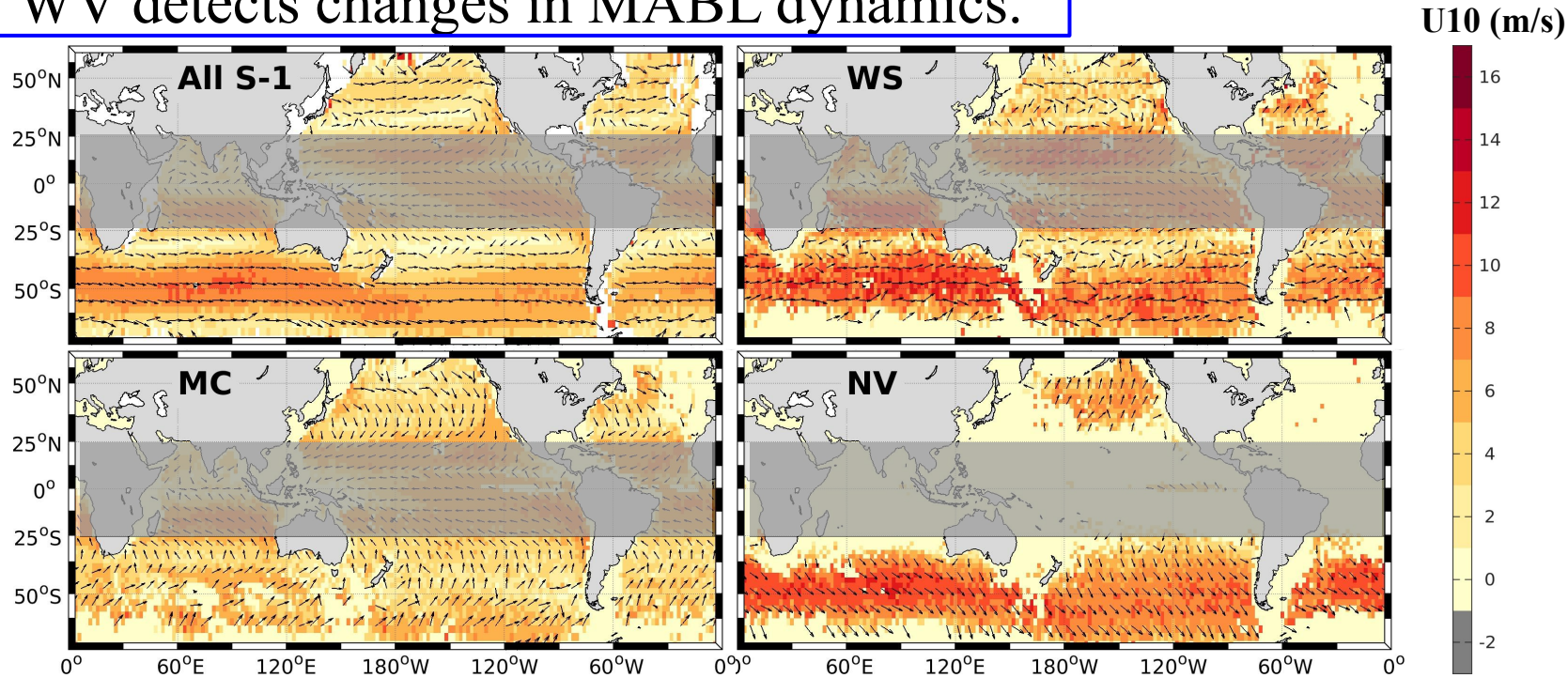
maps to *Ri* from ERA5

- Based on PDFs, implicit coherent structure bands:

1) UBL: Ri<-0.012
2) NNBL: -0.012≤Ri<0.001
3) SBL: Ri ≥0.001



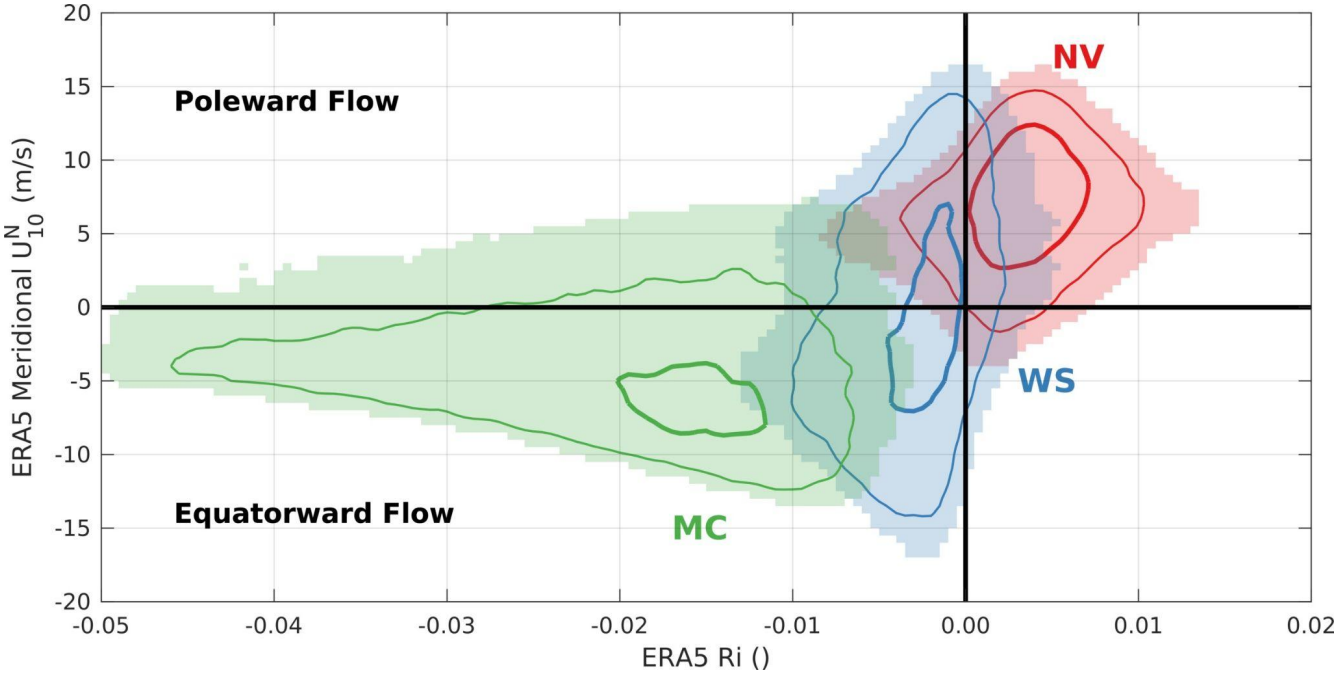
S-1 WV detects changes in MABL dynamics.



ERA5 U10 (m/s) sampled using S-1 3-canonical classes: NV, WS, MC

- WS →no preference b/t warm/cold advection, stronger wind speeds
- MC →cold advection, weaker wind speeds
- NV →warm advection, stronger wind speeds

WV detects changes in MABL Dynamics



Extratropics - NH/SH >25°N/S

- WS has equal split (48%/52%)→no preference between warm/cold advection
  - ↳nearly all the WS with Ri > 0 coincide with mid-latitude warm advection
- MC (79%) →cold advection shifts from NNBL to UBL
- NV (88%) →warm advection shifts toward SBL

Key Points

1) High resolution ocean surface roughness measurements can identify 3 classes of MABL dynamics and their associated stratification regimes.
   a) Unstable - micro-convection
   b) Near-neutral - MABL rolls
   c) Stable - no MABL coherent structures

2) This ancillary information could help to constrain retrievals of near-surface temperature and humidity.

3) This information could help constrain and improve PBL parameterization schemes by identifying the changes in expected mean and coherent structure conditions.

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