Atmospheric Processes Poster Summaries

IOVWST on-line meeting

4 Oct, 2023

Air-sea flux and SST variability associated with atmospheric rivers in the southeast Indian Ocean

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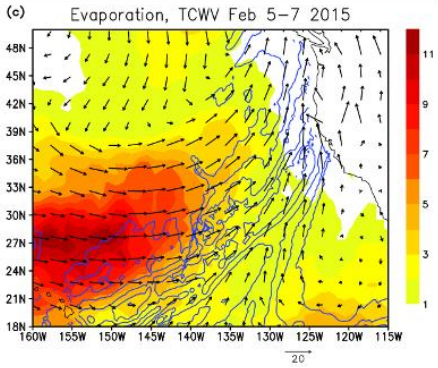
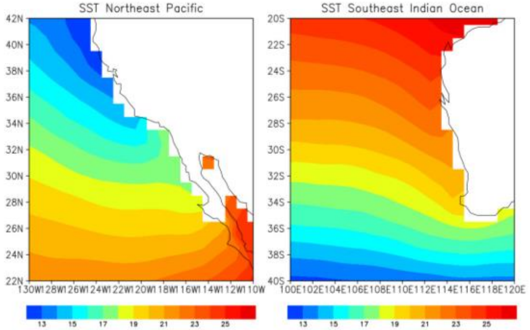
[1]Texas A&M University – Corpus Christi

[2]University of Colorado

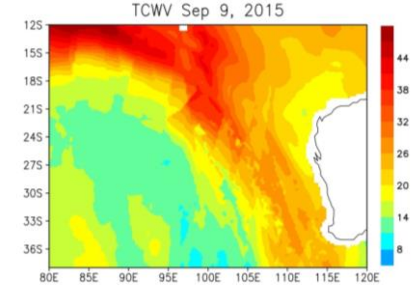
Motivation

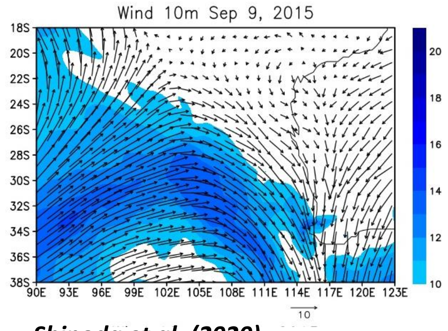




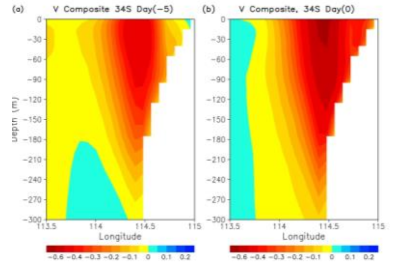
Substantial air-sea fluxes associated with ARs in the northeast Pacific. But the surface evaporation along the west coast of North America is very small because of the cold SSTs. Shinoda et al. (2019).

Southeast Indian Ocean is another AR active area, and the SSTs near the coast are much warmer because of the poleward flowing Leeuwin Current.





Shinoda et al. (2020)

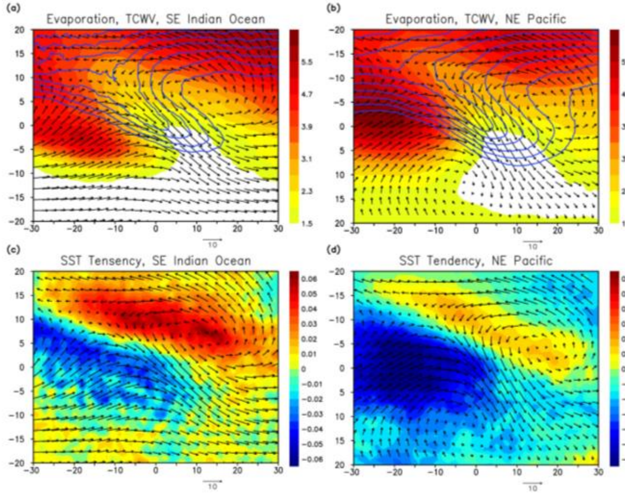


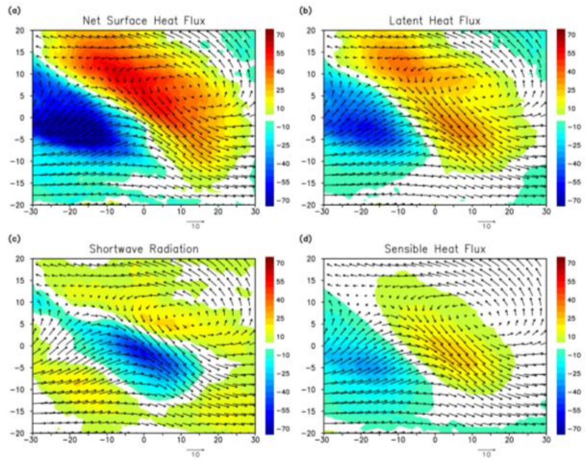
AR-associated surface winds enhance the poleward flowing Leeuwin Current, which causes warming. However, AR-associated winds also enhance surface evaporative cooling.

Warming or cooling during landfalling AR events?

Composite analysis of OAFlux and CCMP data

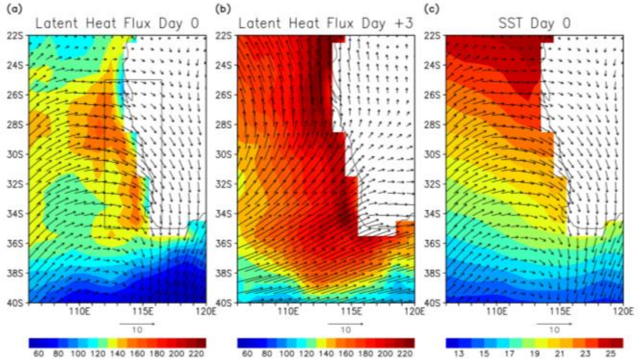
Air-sea flux evolution in the open ocean area

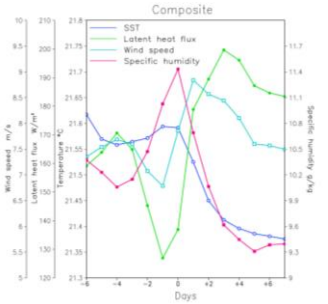




Large surface evaporation and SST cooling are found in the western poleward side of AR upstream areas. The spatial pattern of net surface heat flux anomaly is primarily determined by the latent heat flux. The overall spatial structure of evaporation and SST tendency are similar in the southeast Indian Ocean and the northeast Pacific

Evolution along the coast





A significant latent heat flux induced by ARs is evident along the west coast of Australia due to the relatively warm surface waters maintained by the poleward flowing Leeuwin Current.

The SST cooling of about 0.2℃ for the 5-day period occurs after the AR landfall.

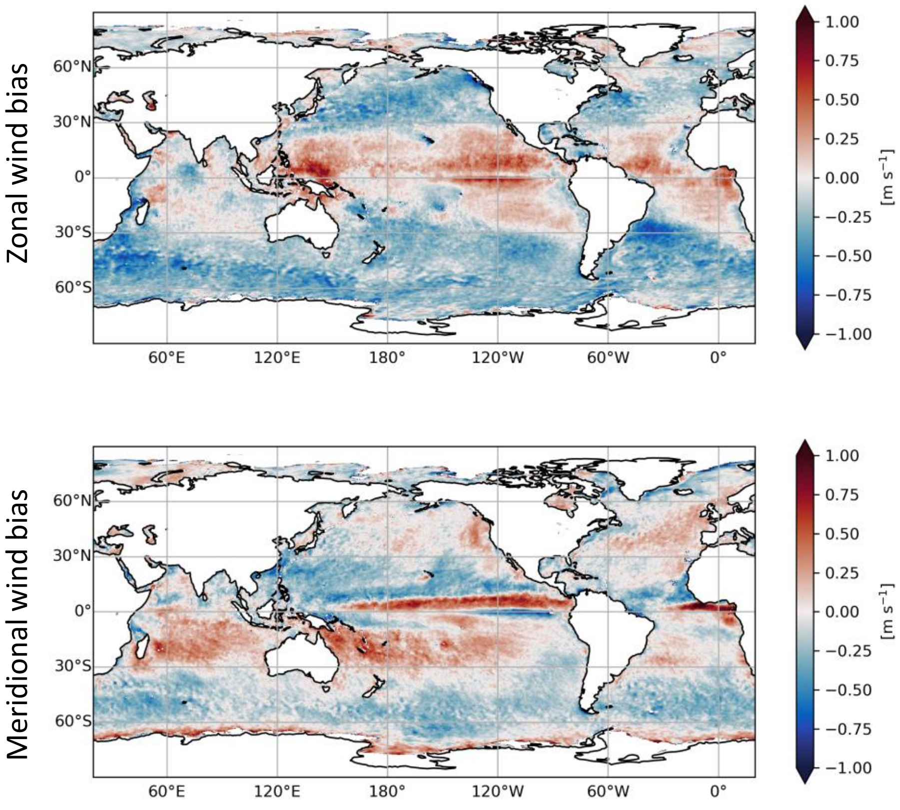
Using scatterometer observations to correct for persistent biases in modelled ocean surface winds

Royal Netherlands Meteorological Institute
Ministry of Infrastructure and Water Management

Copernicus Marine Service

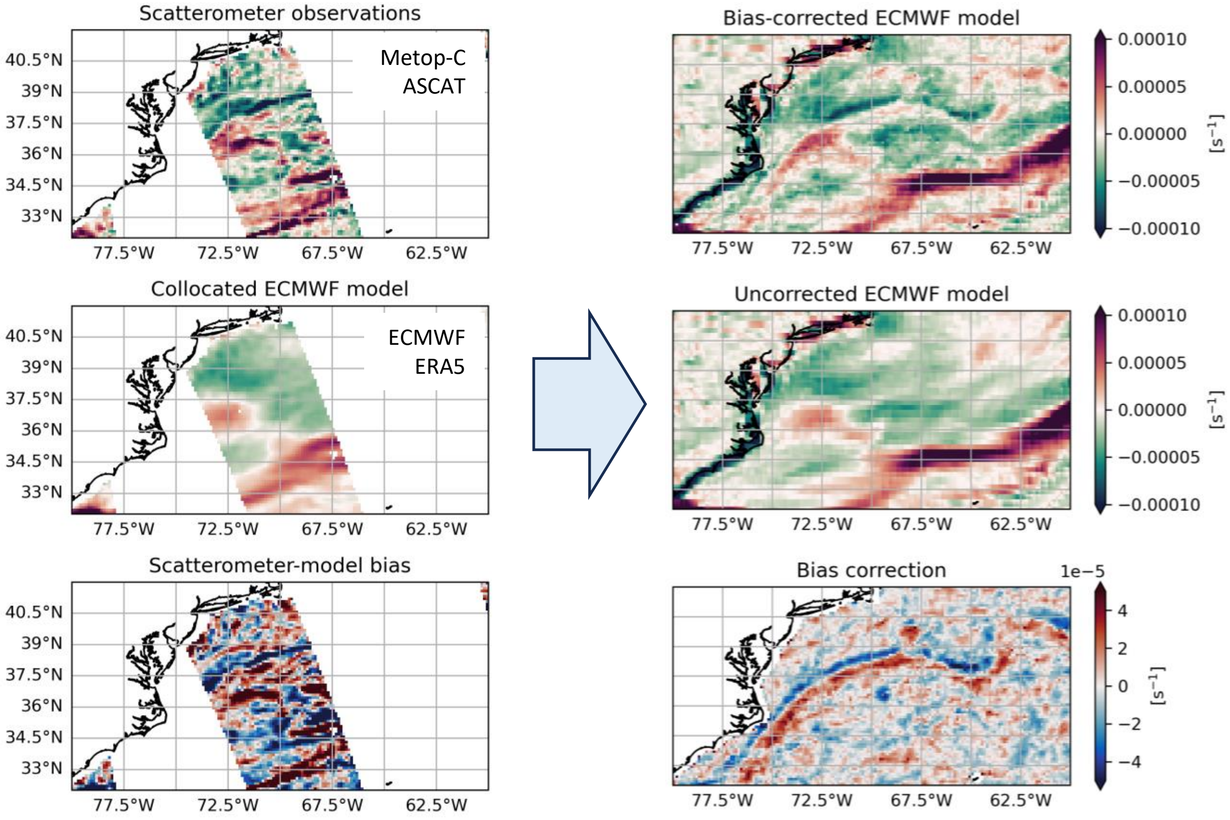
Rianne Giesen, Ad Stoffelen, Jorge Miguel Fernández and Anton Verhoef

Metop-B ASCAT – ECMWF OPS [2022]



Annually averaged scatterometer-model differences display substantial systematic biases

Wind rotation [2 Feb 2023 2 UTC]

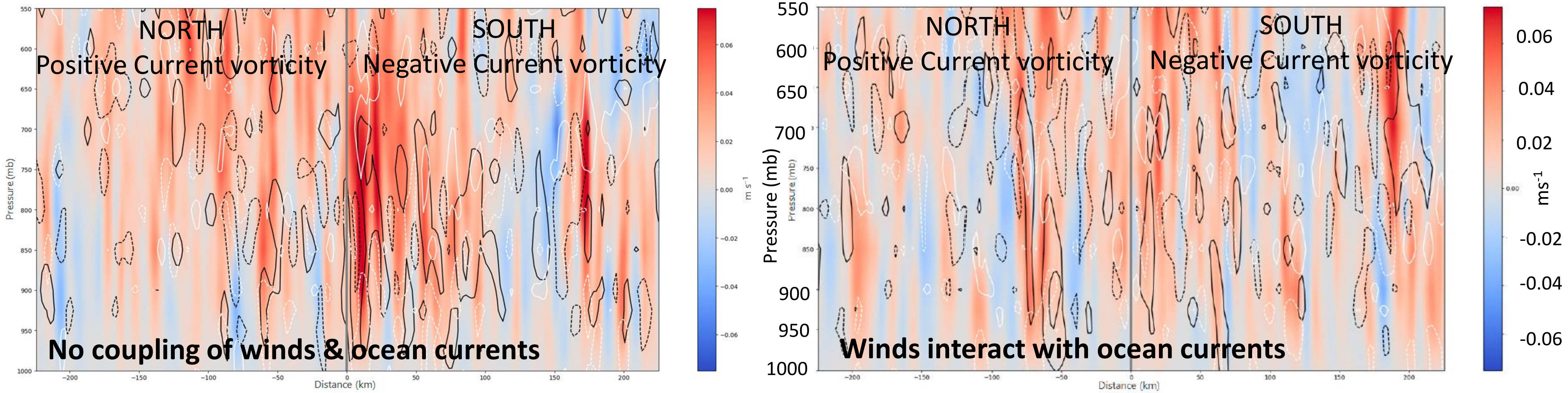


We use 20-day averaged scatterometer-model differences to produce hourly corrected ECMWF model fields

Ocean Surface Currents Influence Winds Well Above the Surface

A key question among climate scientists is whether ocean surface currents modify atmospheric winds well above the sea surface. This is important because the curl and divergence of surface horizontal winds and stress are tied to atmospheric vertical motion through known processes (e.g., Ekman). For example, in the northern hemisphere, horizontal surface winds flowing counterclockwise are associated with convergence and upward motion in the atmosphere. The magnitude and extent of the impacts due to currents are unknown.

In the figures below, blues indicate (downward) motion and and reds indicate (upward) motion. Contours of divergence are white (solid is positive) and curl is black. **Model data indicate that gradients of surface currents *suppress* upward vertical motion to the right of current vector; and they *enhance* upward vertical motion to the left of the current vector.** Atmospheric fronts and cyclones help these impacts penetrate the top of the atmospheric boundary-layer (around 800 to 850 mb). These relatively rare events are high impact, with much stronger current-induced vertical motions than seen in these averages.

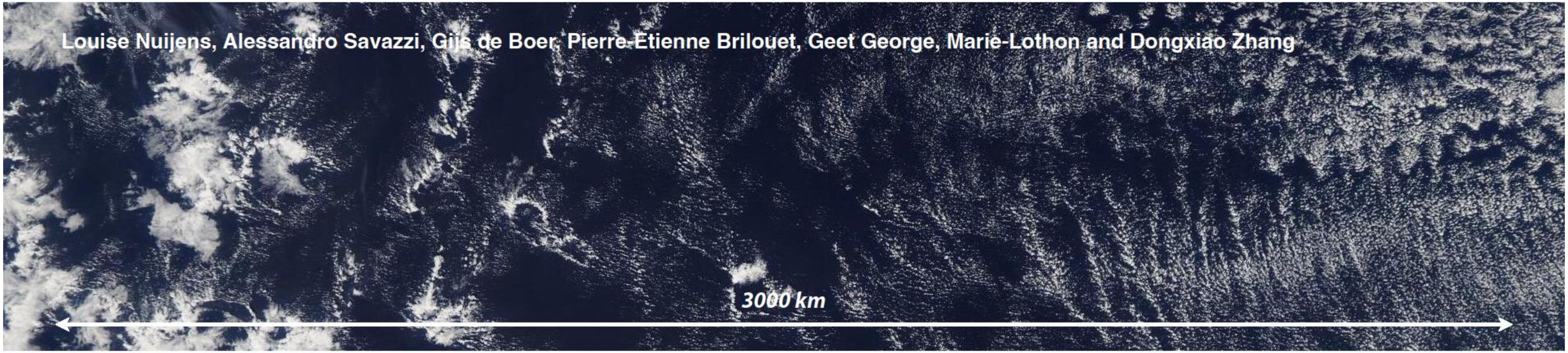


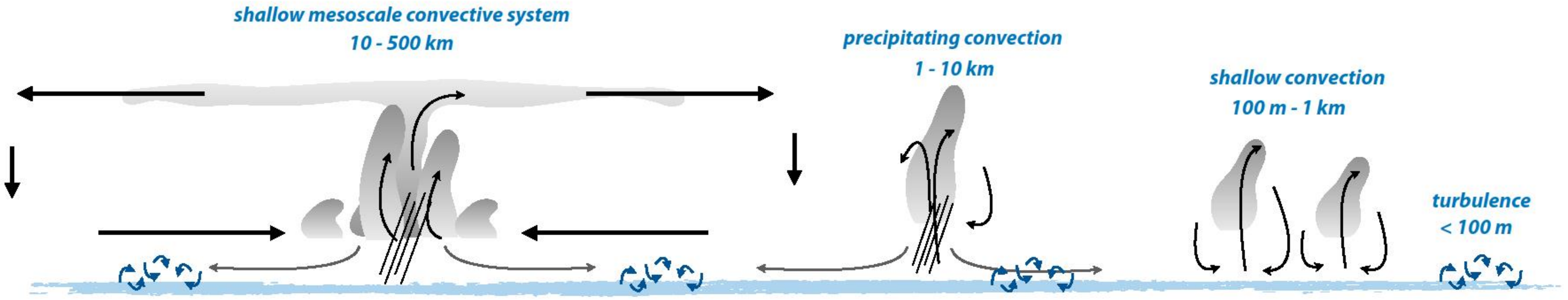
Winter-averaged vertical sections at 70°W, roughly perpendicular the mean current. Data are centered about the strongest surface current (vertical line at distance = 0). The data from 00:00 UTC averaging over December, January and February.

May, J.C., and M. A. Bourassa, 2023: Atmospheric dynamic response to coupling currents to wind stress over the Gulf Stream. Atmosphere, 14(8), DOI: 10.3390/atmos14081216

Funded through NASA OVWST

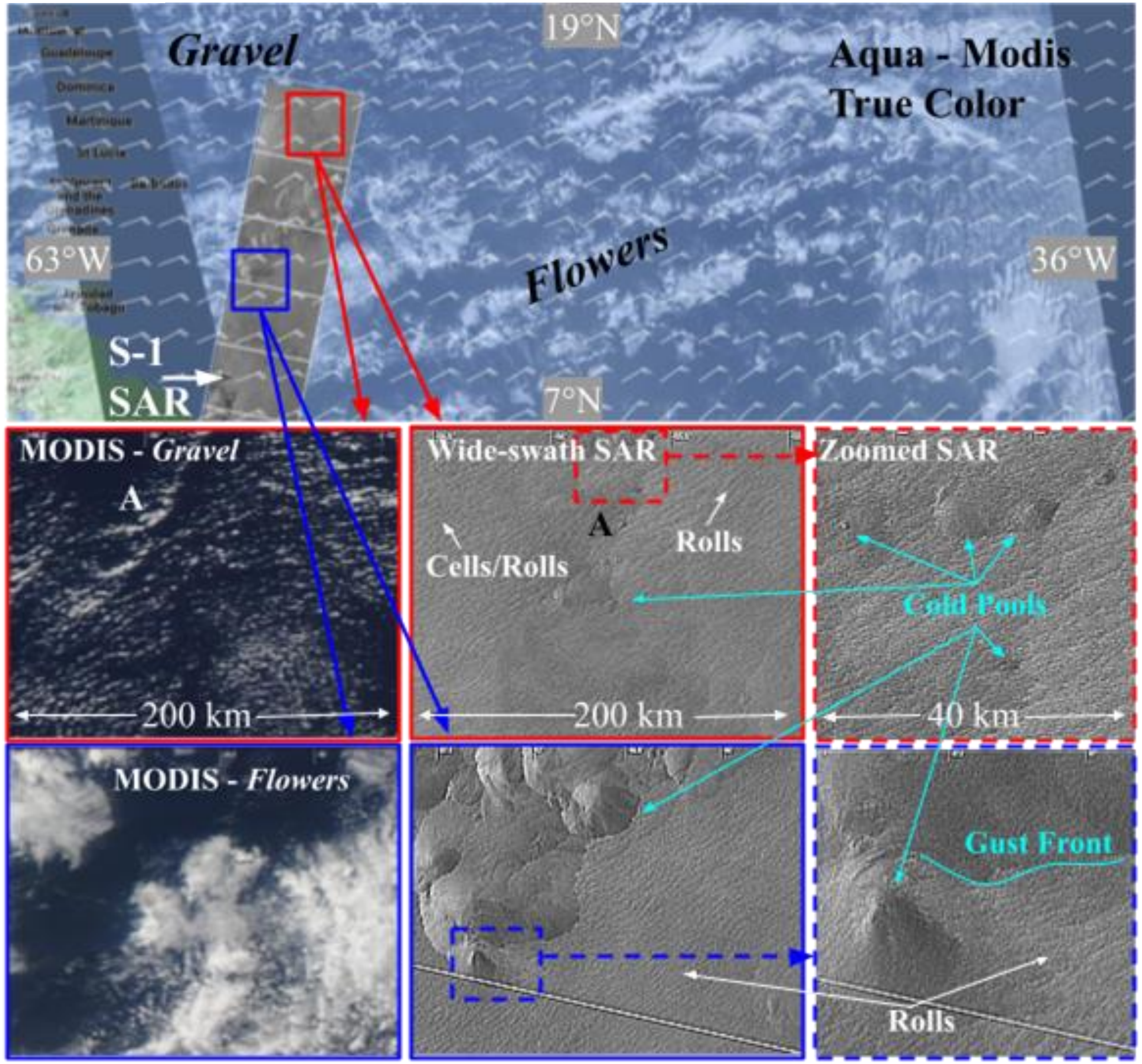
Momentum mixing in convecting atmospheres (in the absence of strong SST gradients)





How does precipitating shallow convection influence near-surface wind speed, directionality and stress?

A Multi-Satellite, Multi-Scale Investigation of Marine Atmospheric Boundary Layer Impacts on Low-Level Cloud Variability



Justin Stopa, Ralph Foster, Doug Vandemark, Ryan Eastman, Hauke Schulz, Betrand Chapron, Alexis Mouche

Synergy between cloud and high-resolution surface satellite imagery: correspondence of boundary layer states in SAR: roll vortices (WS), cellular convection (MC), mixed rolls/cells, gust fronts, and cold pools to cloud features in Modis

<u>Objectives:</u>

●Assess possible relationships between sub-cloud layer trade wind boundary layer coherent structures, the overlying boundary layer cloud field, and the forcing

●Fill an important observational gap by building a new combined database of coincident satellite surface layer vector wind and coherent structure observations over a full range of trade wind cloud conditions

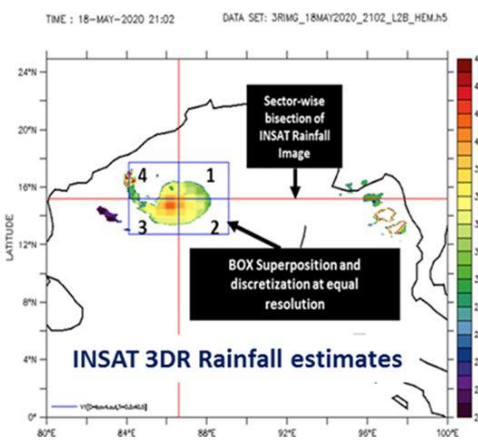
ROLE OF OCEAN PARAMETERS IN MODULATING TROPICAL CYCLONE INTENSITY AND STRUCTURE

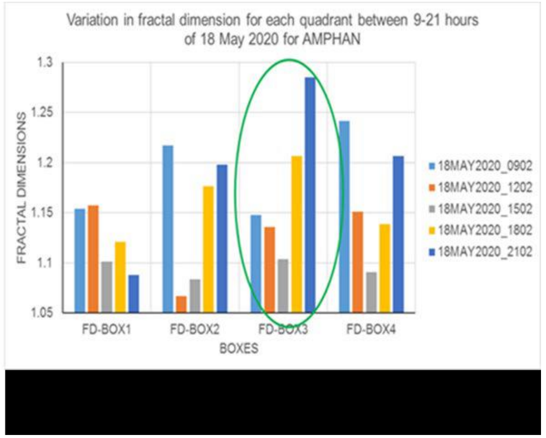
Suchandra Aich Bhowmick[1] , Harikrishnan N[2] , Anup Kumar Mandal[1], Neeru Jaiswal[1], Neeraj Agarwal[1] ,Rashmi Sharma[1] and Raj Kumar[1]

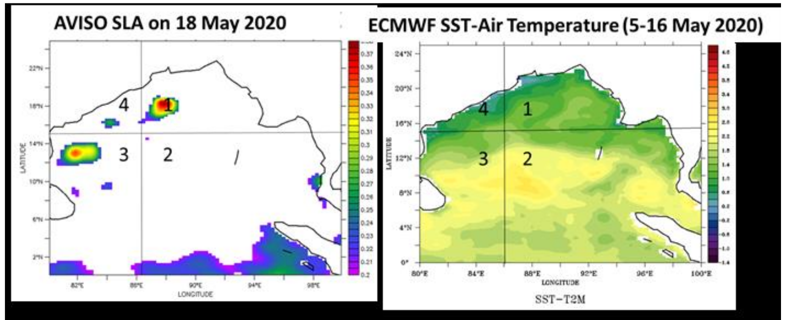
1.SpaceApplications Centre, ISRO, Ahmedabad-380058
2. Department of Physical Oceanography, Cochin University of Science and Technology, Kerala

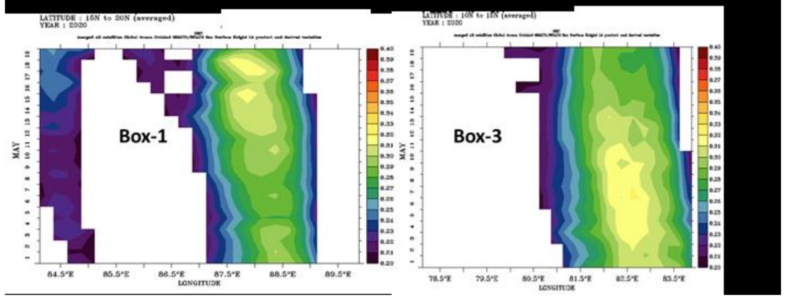
- **Oceanic parameters during cyclogenesis**
  - **Sea Level Anomalies (SLA)**
  - **Sea Surface Temperature (SST) variations**
  - **Wind Speed**
  - **Net Heat Flux (NHF)**
- **Cyclone centre location:**
  - **INSAT-3DR rainfall → cyclone asymmetry (4 sectors)**
  - **Examine parameters in each sector**
  - **Determine typical leading conditions over best track record**

Cyclone Amphan









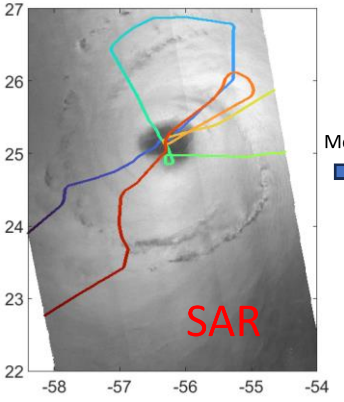
Example: Cyclone Amphan:

- Sector 3 strongest rainfall
- Sectors 1 & 3 have equally strong SLA
- SLA time series: sector 3 warmer for longer period

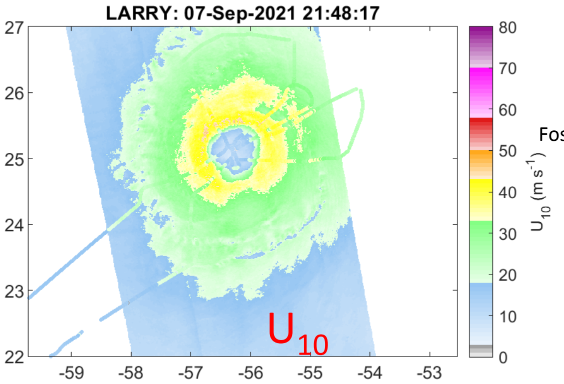
Using SAR Imagery to Diagnose TCBL Structure

Ralph Foster[1], Alexis Mouche[2], Bertrand Chapron[2]
[1]APL, University of Washington, Seattle, WA; [2]Ifremer, Brest FR

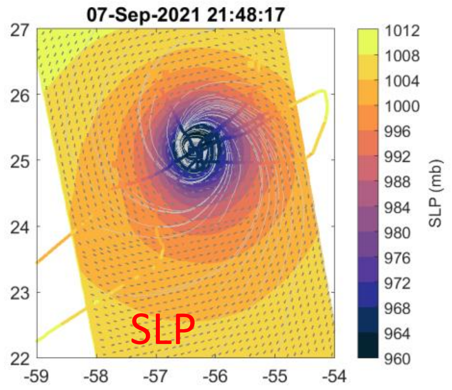
Δt -3 to +2 hours (blue to red)
Adjusted p-3 track



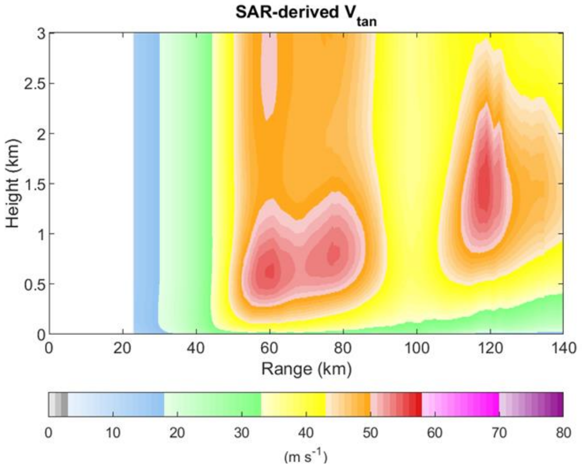
Mouche, 2019



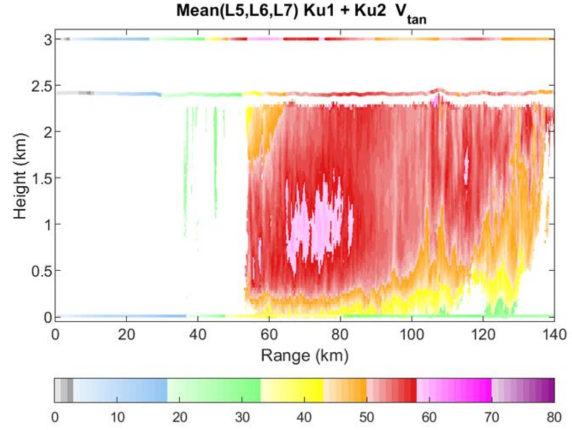
Foster, 2017

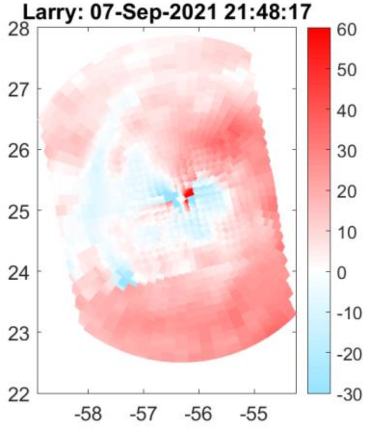


Foster, 2009

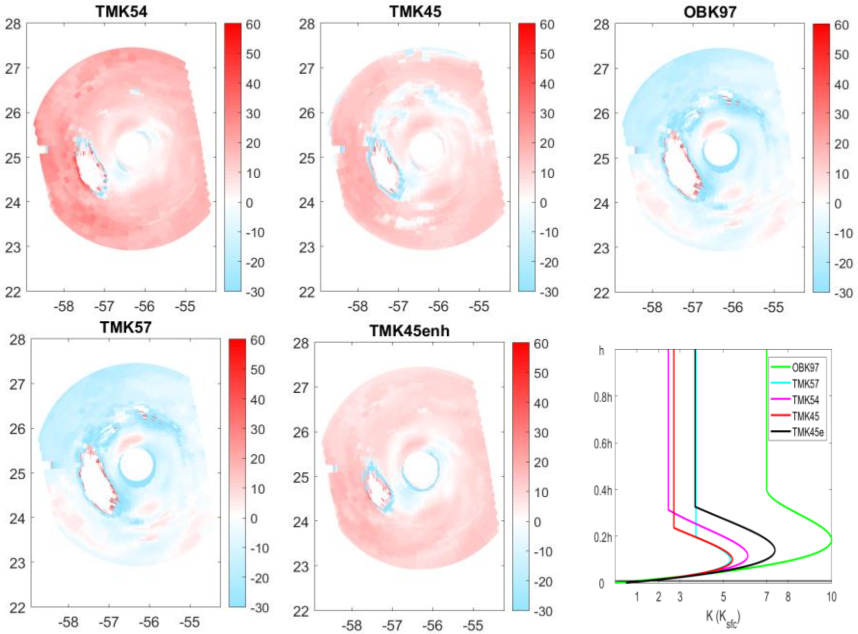


Foster, 2005





SAR-Observed
Roll Orientation



SAR-Predicted Roll Orientation

Comments from John Knaff (NOAA/NESDIS)

Aspirational Tropical Cyclone Wind Information

(no associated poster)

- The tropical cyclone community needs 2-D wind information
  - speed or vector
  - Gale radii (>~ 35 kts or ~18 m/s)
  - Radii of Maximum Wind (RMW)
  - At least 6 hour updates, preferably at synoptic times
- Combine wind speed data across time windows for:
  - Wind radii guidance (gale?); ideally RMW
  - Issues:
    - Inter-instrument calibration
    - calibration to a single standard (at 10 m)
      - US standard is 1-minute sustained
      - WMO standard is 10-minute average
    - downscaling of low resolution wind speed data (AI/ML, physical, statistical)
    - How to combine into a single storm-following wind field.
- Detect RMW and V_{max}
- Real-time access to experimental satellite data
  - small-sat and research missions often do not include real-time capability in budget or hardware.