New evidences of seasonal deep ocean current variability in the north-eastern tropical Pacific Ocean impacted by remote gap winds

K. Purkiani[1], A. Paul[1], A. Vink[2], M. Walter[1], M. Schulz[1]

1- MARUM-Center for Marine Environmental Sciences and Faculty of Geosciences, University of Bremen, Bremen, Germany

2- Federal Institute for Geosciences and Natural Resources (BGR), Hannover, Germany

EGU, 04-May-2020, Wien

marum
Center for Marine Environmental Sciences University of Bremen

BGR

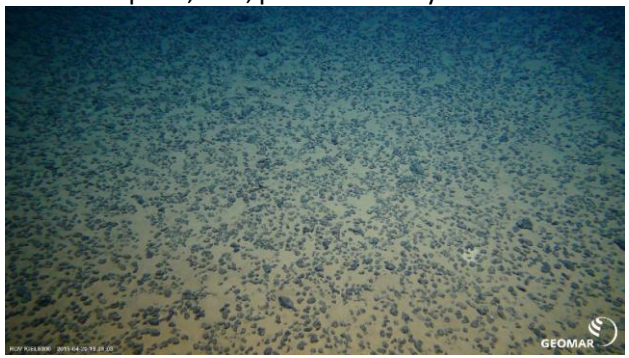
IMPACTS AND RISKS OF DEEP SEA MINING
MiningImpact
FUNDED THROUGH JPI OCEANS

EGU European Geosciences Union

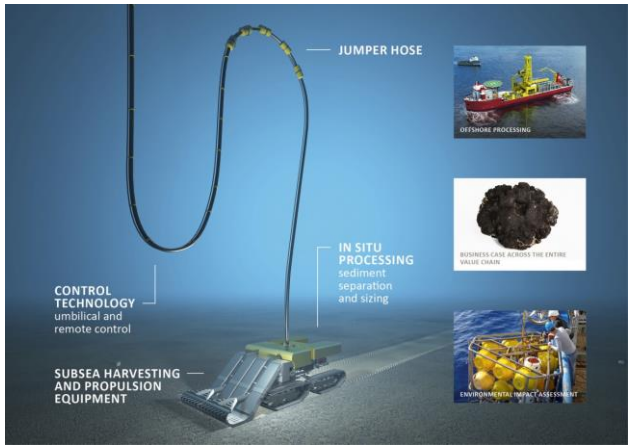
Why are we interest in deep ocean current variability in the Pacific Ocean?

- Trial mining in German license area located in Clarion-Cliperton Fracture Zone (https://www.jpi-oceans.eu/miningimpact)
- Mining activity would potentially produce large sediment plume
- Sediment deposition and distribution likely depend on deep-ocean current properties

Nodules plain, CCZ, photo taken by GEOMAR



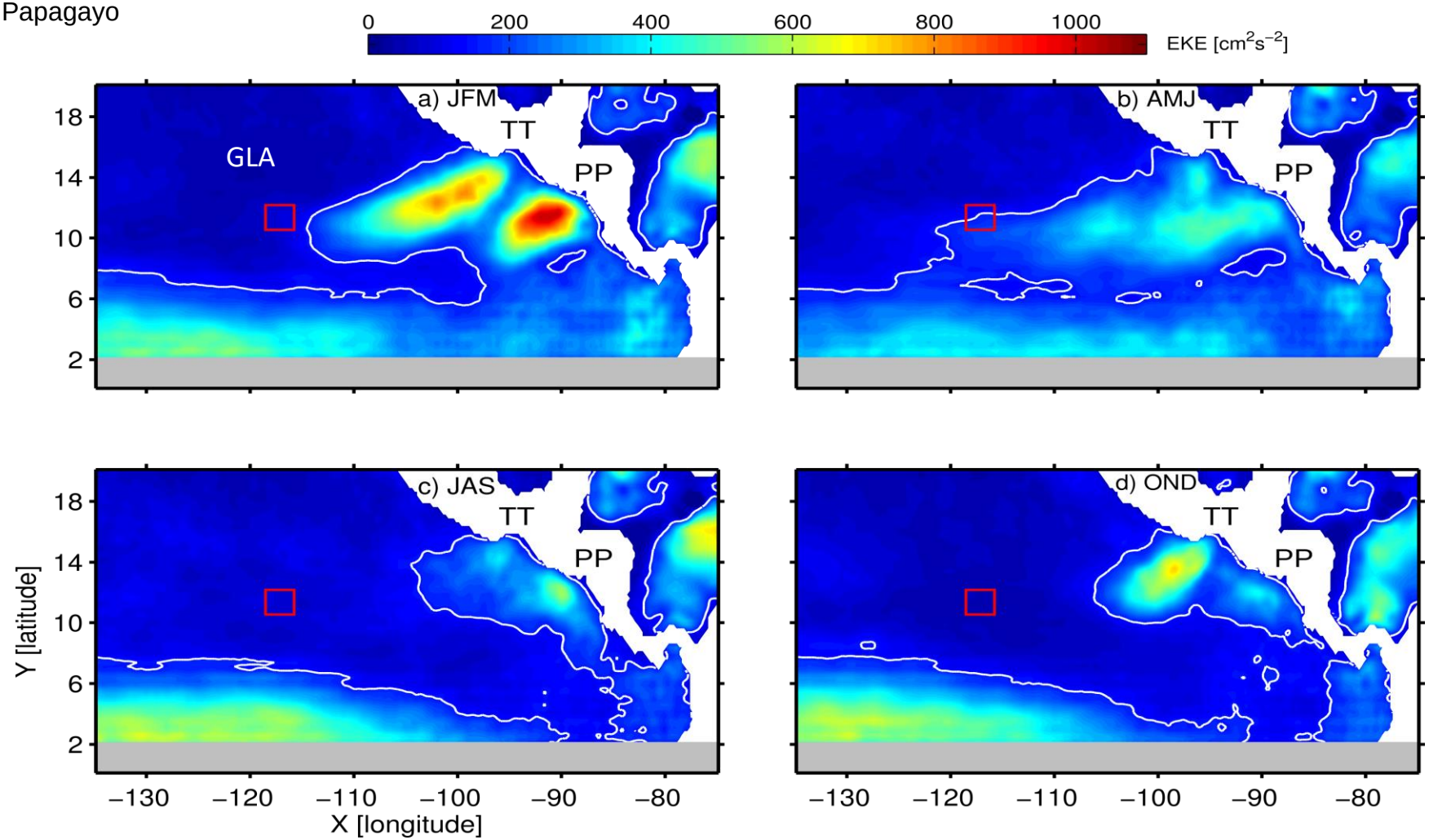
Conceptual strategy of future mining



Mining colector, GSR

Seasonal EKE variation due to strong gap winds in the north-eastern Pacific Ocean

TT: Tehuantepec
PP: Papagayo

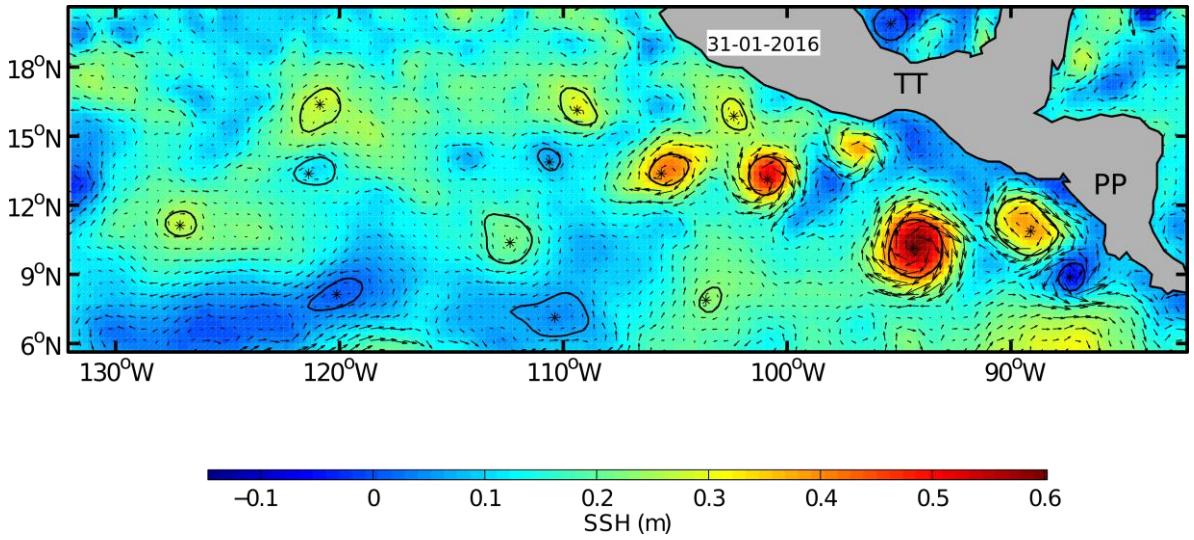


GLA: German license area

Data and methods

- A combination of satellite altimetry data (AVISO), deep ocean current velocity measurements (moored ADCP) and a set of reanalysis model products (HYCOM) were used in this study.
- An automated eddy detection algorithm (ETA) was applied to long-term altimetry data (1993-2016) to quantify mesoscale eddies and their properties (Nencioli et al. 2010).

An example of applying ETA on SSHA at 31-01-2016



Eddy characteristics:

Size,

Number,

Vorticity,

Lifetime,

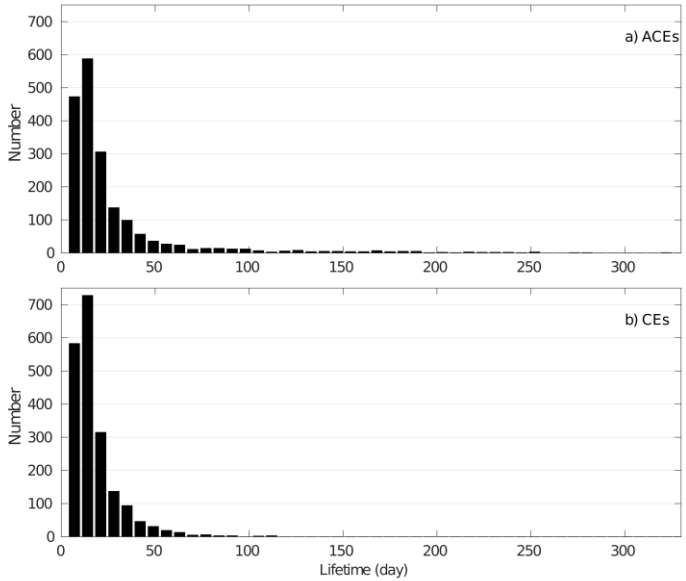
Track

were investigated (1993-2016)

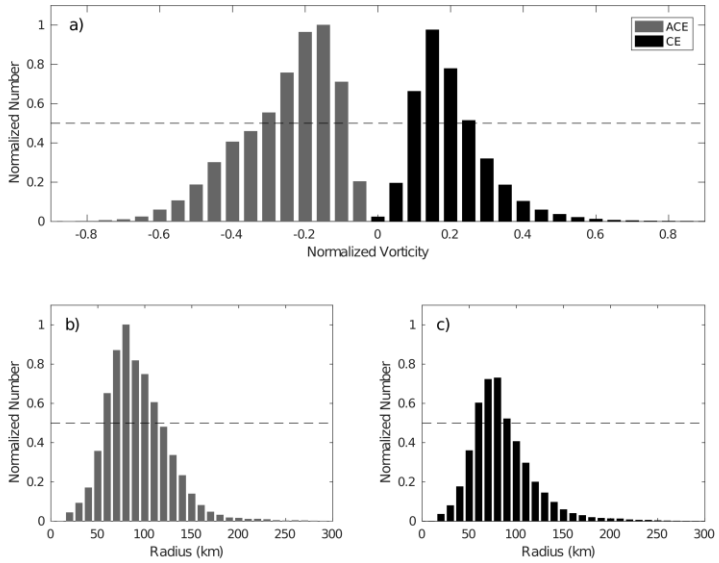
Eddy characteristics

CE: cyclonic eddy
ACE: Anticyclonic eddy

Eddy number



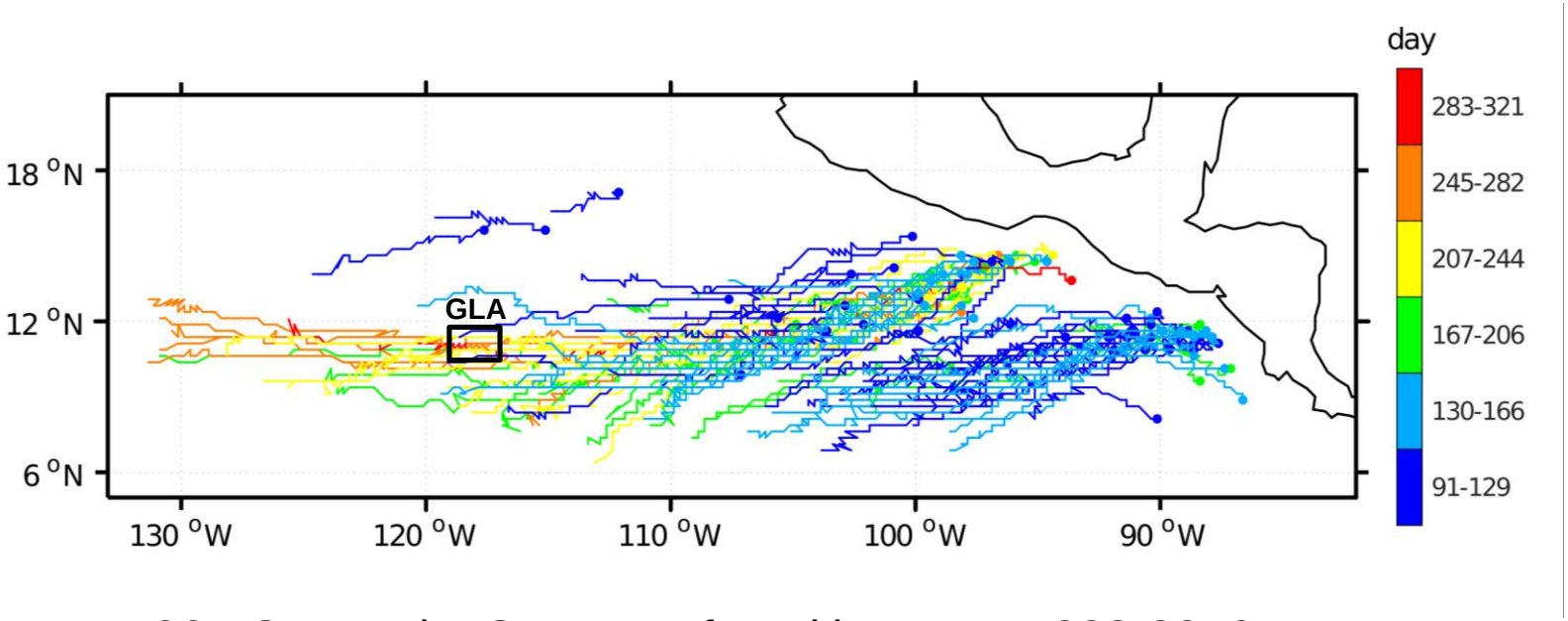
Eddy vorticity and size



- CEs are dominant for short lifetimes < 50 day
- ACEs are dominant in long-lived categories > 50 days

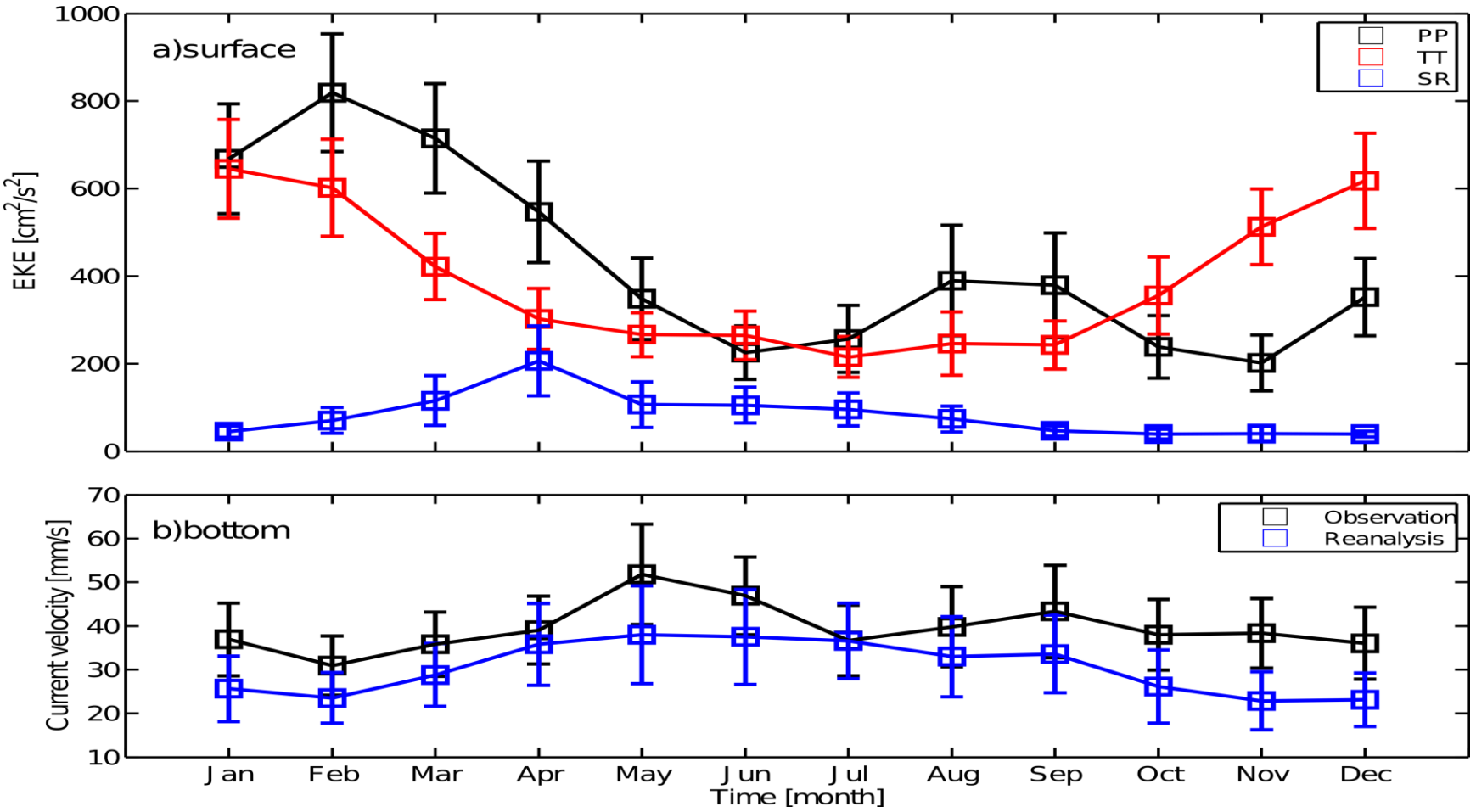
- ACEs have larger vorticity
- ACEs (92 km) are bigger in size than CEs (80 km)

Trajectory of long-lived eddies in the north eastern tropical Pacific Ocean



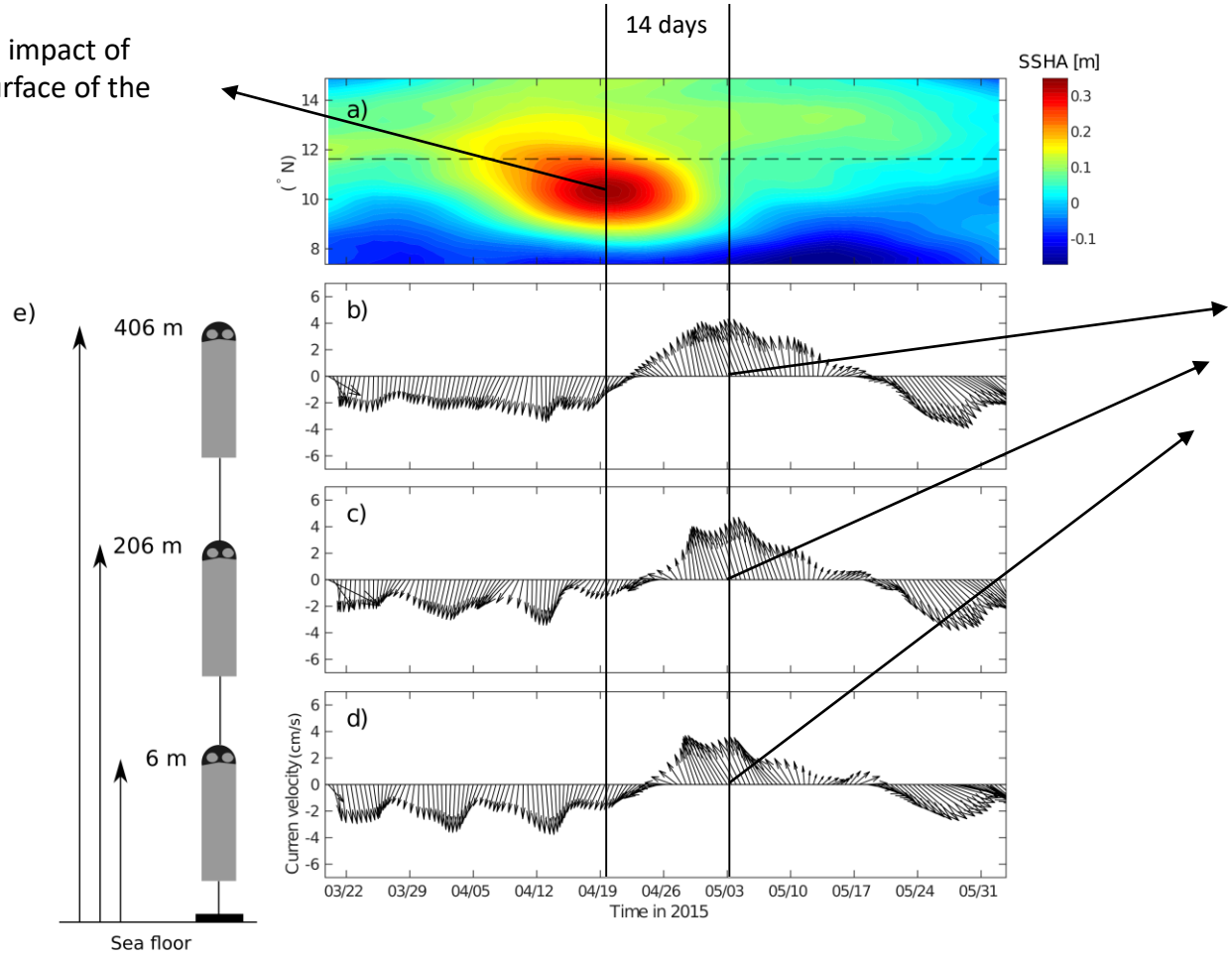
- 106 ACEs and 7 CEs were found between 1993-2016
- Most of the eddies generated in TT gap wind tend to travel long distances in the open ocean and reach the GLA

Long term ocean current variability and its relationship to EKE at the region of gap winds



Lagged response of ocean bottom current properties to an anticyclonic surface mesoscale eddy

Maximum impact of eddy at surface of the ocean



Maximum impact of eddy at deep ocean

A lagging feature of deep ocean current response to the passage of a surface eddy observed in this region (14 days).

Conclusions

- In the north-eastern tropical Pacific Ocean, ACEs are larger in size, velocity and vorticity, but smaller in number than CEs.
- Long-lived ACEs generated in the TT gap wind region tend to travel long distances (1000-4500 km) and most likely impact the GLA.
- A time lag of 5-6 months between high EKE in the vicinity of the TT gap wind region and the GLA is observed.
- Long-lived eddies can reach the deep ocean and increase the bottom current velocity or at least significantly change the dominant bottom current direction.