Evolution of an Atmospheric Kármán Vortex Street from High-resolution Satellite Winds: Guadalupe Island Case Study

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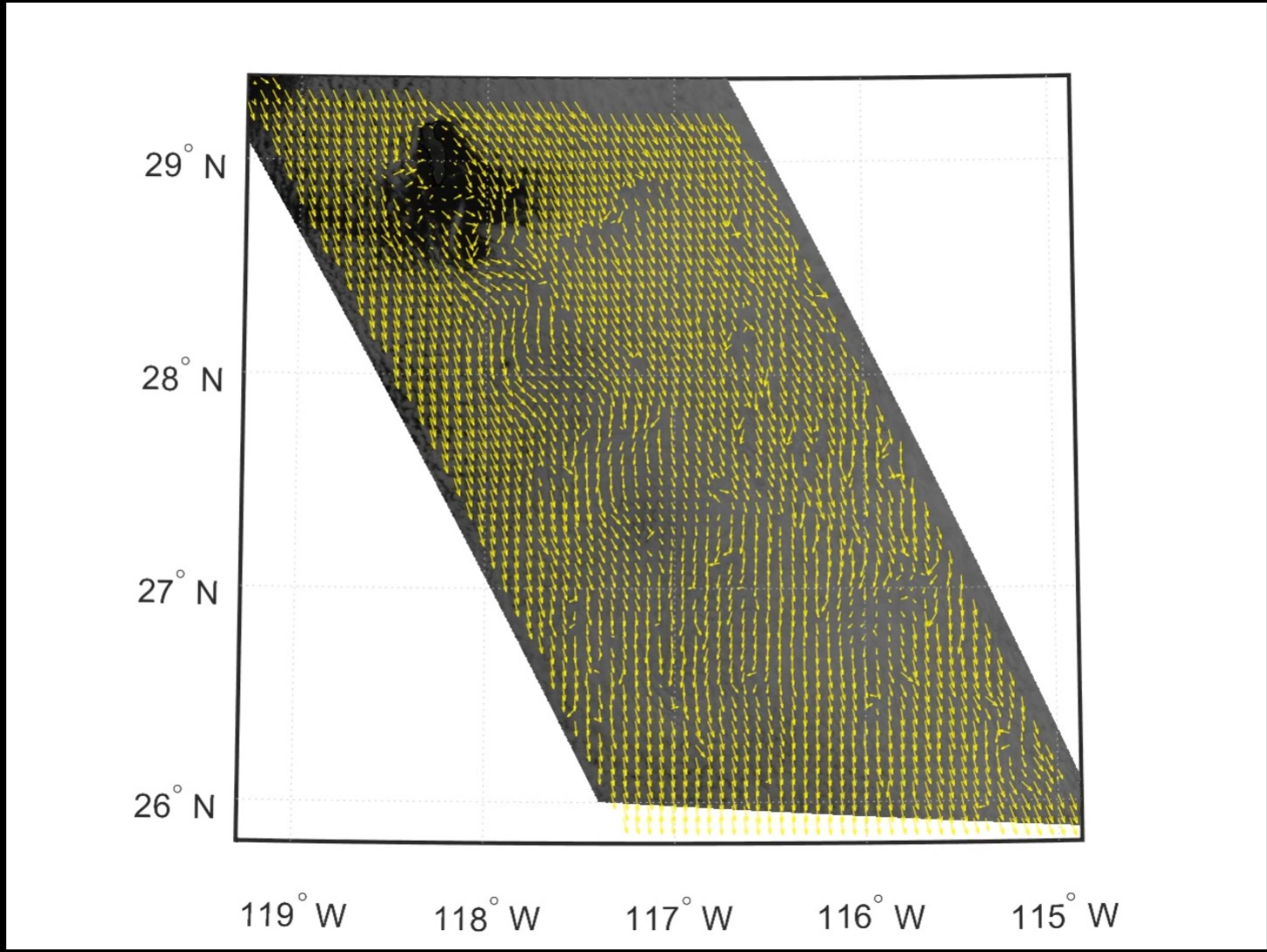
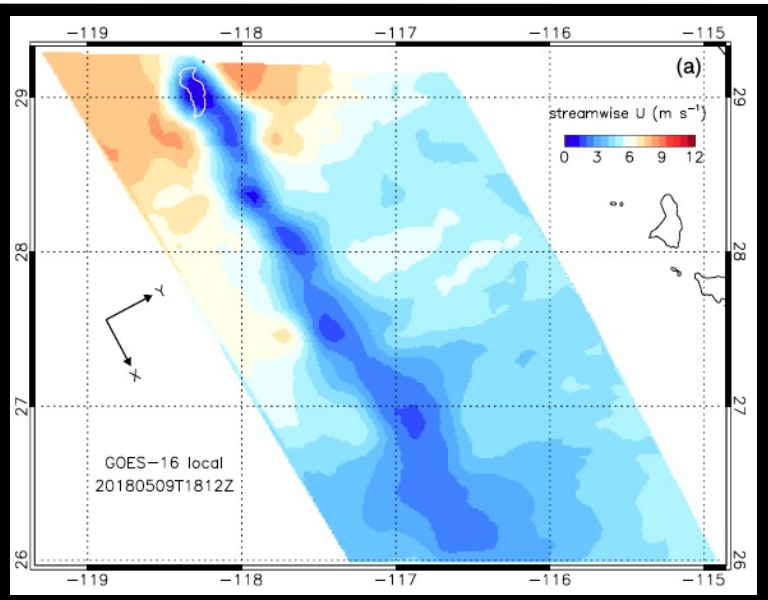
[*Horváth et al. (2020), JGR, 10.1029/2019JD032121*]

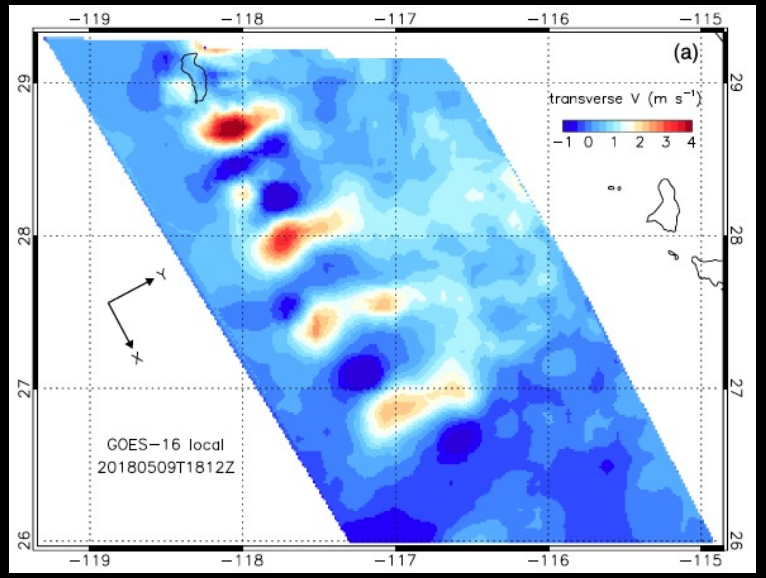
Guadalupe vortex street on 9 May 2018



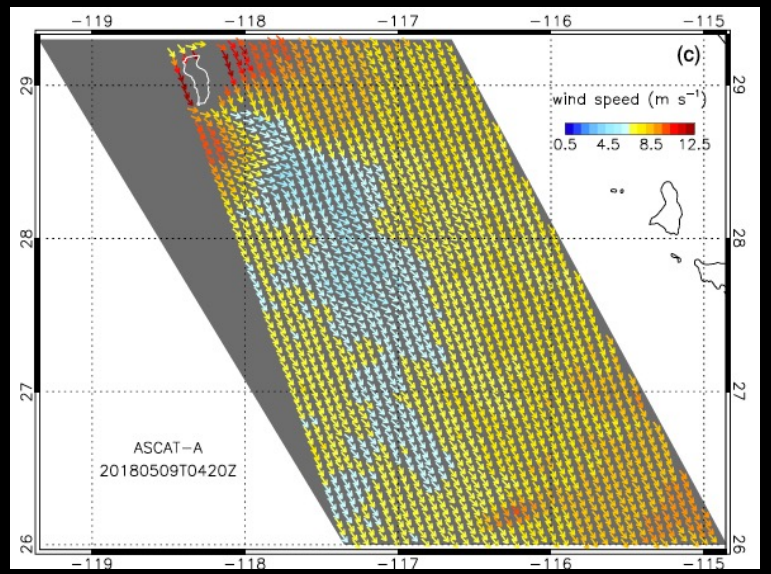
GOES-16 ABI visible winds, 6.3-km and 5-min over an 8-hour period

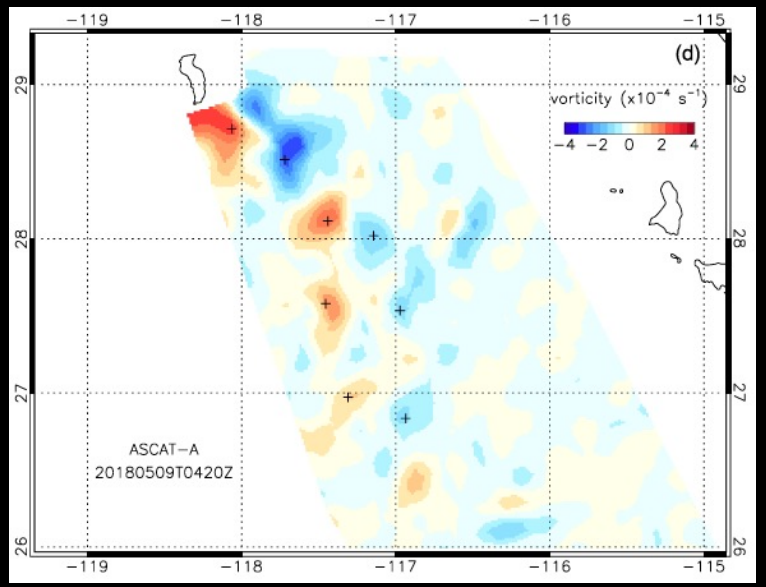
Vortex street wind field features





GOES-16 (cloud top)

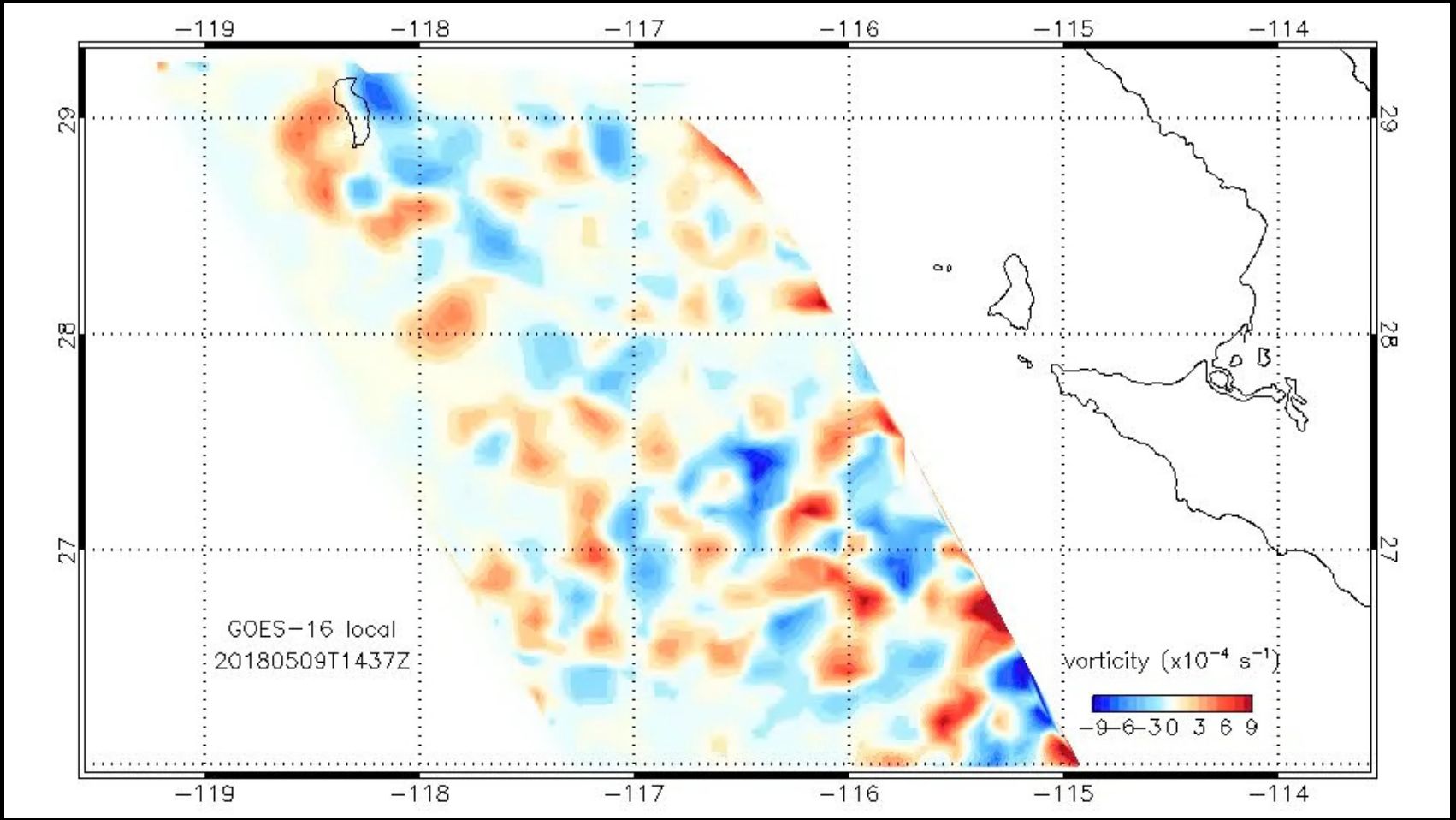




ASCAT-A (surface)

Wind shadow, cross-street jets, vortices

Vortex shedding



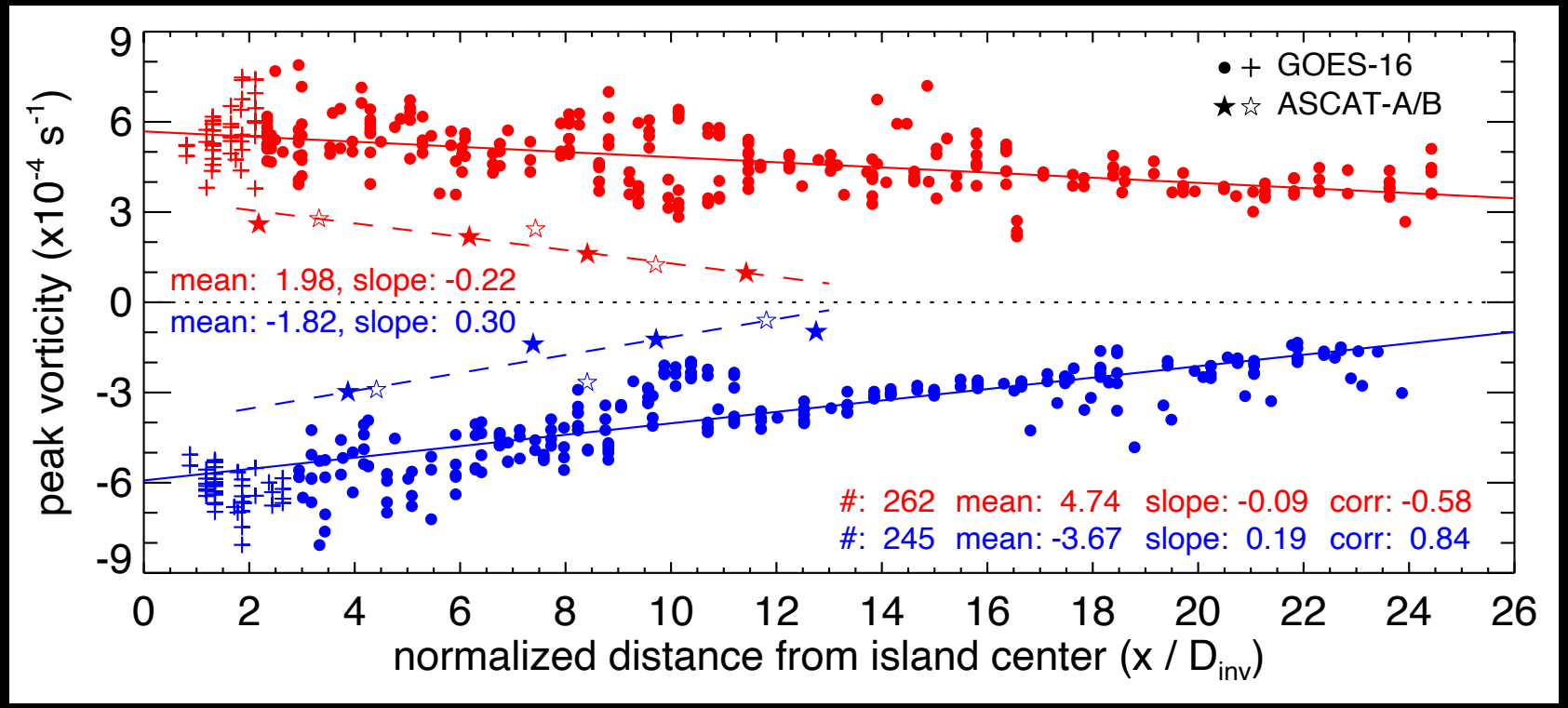
Like-rotating vortices every 2–4 hours

Asymmetric vortex decay

MODIS-Aqua

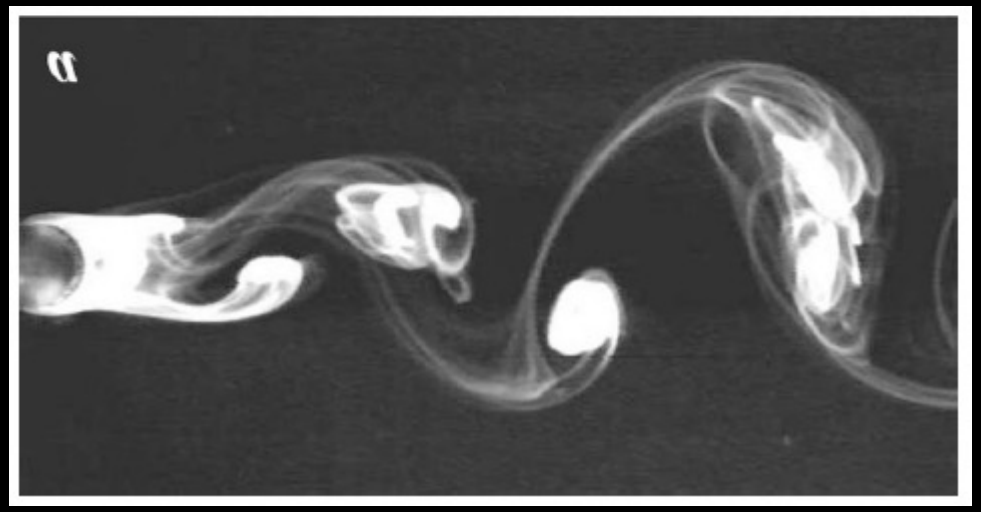
Anticyclones have smaller eyes and less well-preserved spiral patterns

Asymmetric vortex decay quantified

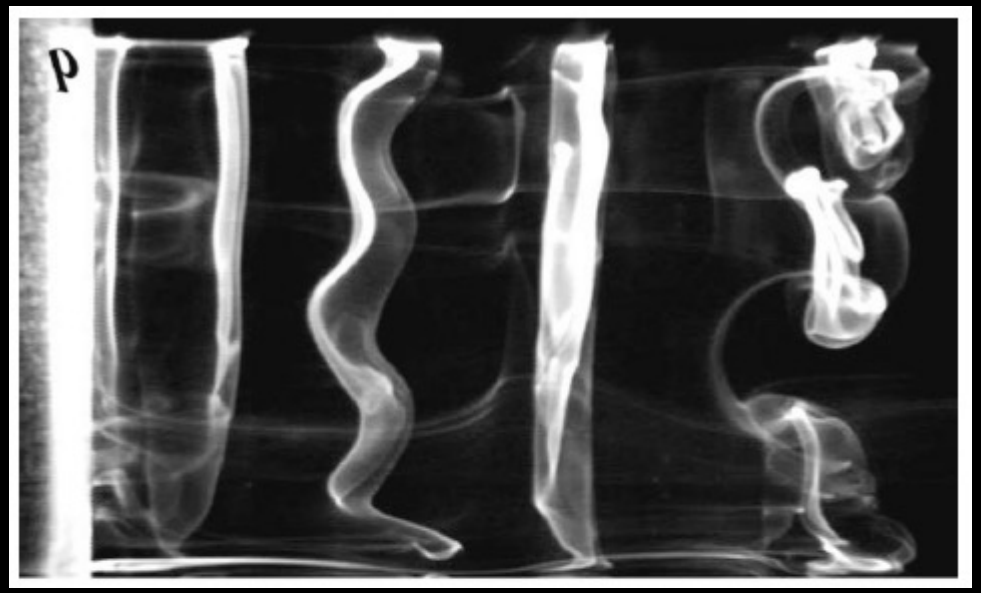


Anticyclonic vorticity decreases faster than cyclonic vorticity

Asymmetric vortex decay: selective 3D destabilization due to rotation



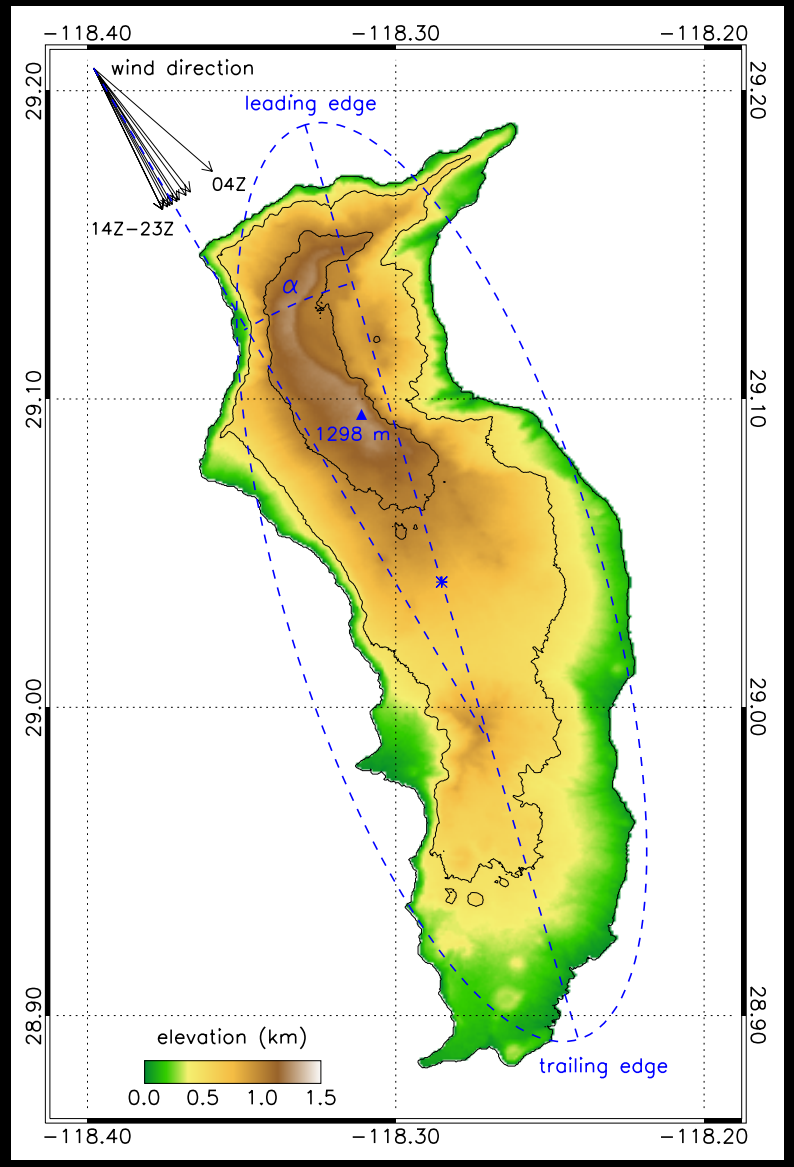
top view



rotating deep-water layer
[Stegner et al., 2005]

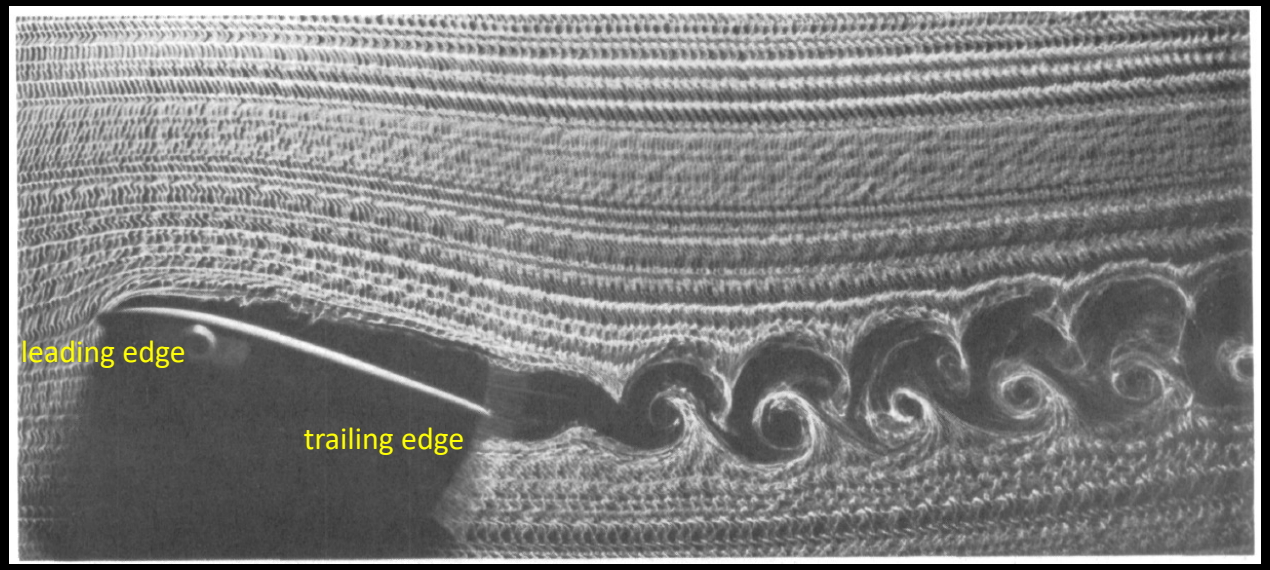
side view

Asymmetric vortex decay: Guadalupe‘s shape

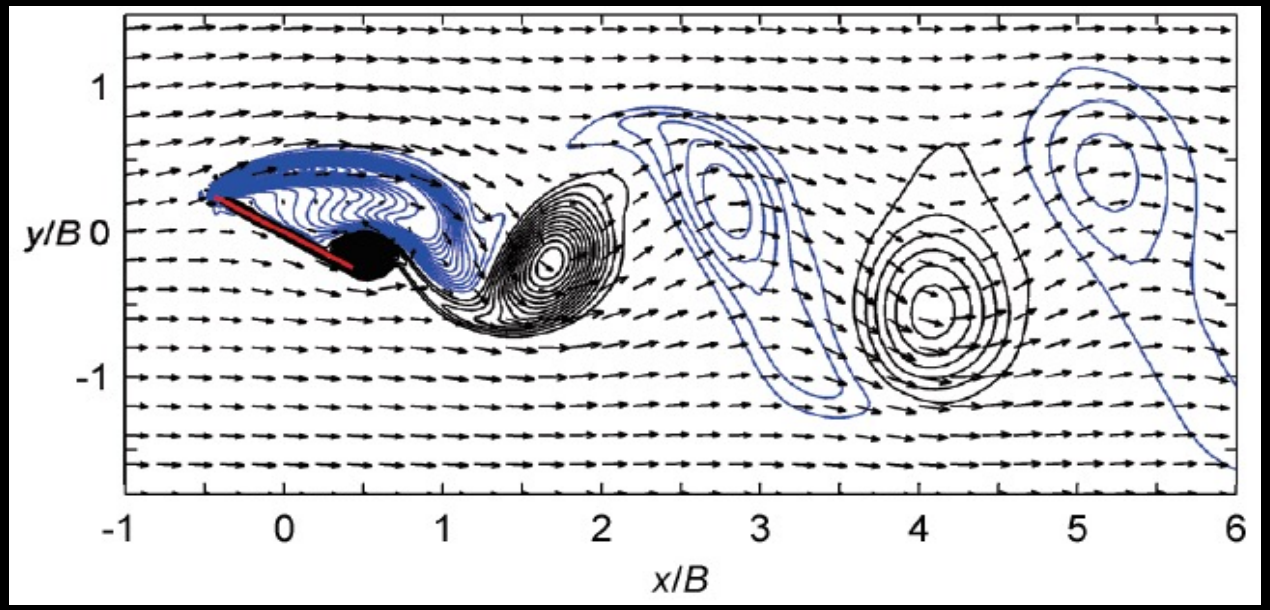


Inclined flat plate at low angle of attack (α = 9° – 32°)

Asymmetric vortex decay: inclined flat plate shape



airfoil in water tunnel at α = 15°
[McAlister and Carr, 1978]



inclined plate simulation at α = 30°
[Lam and Wei, 2010]

Leading edge vortices decay faster than trailing edge vortices

Conclusions

- High spatiotemporal-resolution satellite winds now enable the study of unsteady mesoscale flow *dynamics*
- More Guadalupe examples in the talk of Tobias Günther Thursday, Session 5, 14:40 – 14:50