# Supervisor Meeting - May 30th

Stephan, James, (Jacob) and Hannah

# Discussion Points

- Selection of a direction in which to proceed

1. Detecting Regime Shifts in the Kuroshio Using Machine Learning - A Case Study
2. Multivariate Anomaly Detection in Western Boundary Currents - James' Suggestion
3. Baroclinic Signatures of Surface Anomalies in the Kuroshio Extension or other regions - Markus suggested the DWBC

- Extension of thesis deadline

## 1. Detecting Regime Shifts in the Kuroshio Using Machine Learning - A Case Study

**Core Idea**
Use ML to identify or predict state transitions (e.g., large vs. non-large meander) in the Kuroshio based on ocean model output and/or observations (e.g., SSH, velocity/ vorticity, SST, wind).

**Research Questions**
Can an ML model reliably classify Kuroshio states from SSH and velocity fields?
Are there early-warning features that precede a regime shift?
How do model-based vs. observation-based transitions differ?

--> possibly also applicable to the gulf stream region as second case study
Pro: Model is ready to go, results can be archived pretty much now

## 2. Multivariate Anomaly Detection in Western Boundary Currents - James' Suggestion

**Core Idea**
Use ML to identify anomalies that occur only when multiple variables jointly deviate, rather than single-variable thresholds.

**Research Questions**
Can we distinguish true physical anomalies from model errors using multivariate ML?
Which variables (SSH, velocity/ vorticity, SST, wind) are most informative?
Do anomaly clusters correspond to known physical events (eddies, meanders, boundary separation)?

Con: Requires some work on the model - however Jacob will probably be there on Friday as well and he and James probably know best, how much effort that would take, though going from 2D to nD is usually not thaaaat crazy difficult (at least in theory)

**3. Baroclinic Signatures of Surface Anomalies in the Kuroshio Extension or other regions - Markus suggested the DWBC**

**Core Idea**
Explore whether surface anomalies (e.g., in SSH or vorticity) correspond with deeper structural changes — do surface signals reflect baroclinic shifts?

**Research Questions**
Do SSH anomalies correlate with isopycnal depth changes?
Are transitions between Kuroshio states (e.g., meander onset) reflected below the surface?
Can ML infer deep structure from surface-only variables?

Cons: What Stephan just pointed out - selection of significan isopycnals or depths, outcropping, z- or sigma levels
--> can potentially cost a lot of time and consideration

# Other points to consider

- I personally know nothing about the Kuroshio since all the oceanography lectures were focused on the North and Tropical Atlantic - does someone in the group worked on this before, like Daniel ?
- possible combination of 1&3 to produce some results to write something about and then try to extend the ESN
- extension of thesis deadline