

Final Project Paper for GEOL 1820:  
Geophysical Fluid Dynamics:  
Rotating, Stratified Turbulence Edition  
Due May 14, 2020

Baylor Fox-Kemper

March 5, 2020

## Contacts

The professor for this class is: Baylor Fox-Kemper

baylor@brown.edu

401-863-3979

Office: GeoChem room 133

<http://fox-kemper.com/teaching>, <http://fox-kemper.com/gfd>

## Getting Help!

I am usually available by email. You can make an appointment other times. Just check my calendar at <http://fox-kemper.com/contact> and suggest a time that works for you.

## 1 Review involving 2 or more sources

You will read at least one research paper, likely from the following list. You will then contrast its approach and results against those from another approach, either that of our textbooks (Vallis, 2019; Wyngaard, 2010; Thorpe, 2007) or that of another related research paper.

Note that your goal is *not* to summarize all aspects of the papers. Instead, it is to chose a limited set (2-4) of ideas/hypotheses/conjectures appearing in multiple papers, and then explain and contrast them in a meaningful way. This will require you to convert notation, etc., and you may choose to make your own figures or calculations to support this comparison. This is a review/contrast/comparison paper, however, so you are not required to carry out original research.

The following brief descriptions of paper comparisons of the type I have in mind may help you get started:

- Submesoscales: Bachman *et al.* (2017) is a description of how to parameterize symmetric instability. Contrast it against the (geostrophic) mixed layer instability of (Fox-Kemper *et al.*, 2008).
- Bottom Submesoscales: Wenegrat *et al.* (2018) is a description of bottom boundary layer mixed layer instability. Contrast it against the surface mixed layer instability of (Fox-Kemper *et al.*, 2008).
- Bottom Mixed Layer: Contrast the mixing-restratification balance in the abyssal boundary layers of Callies (2018) versus the surface mixing and restratification discussed in Haney *et al.* (2012).

- KPP vs. K-Epsilon: Contrast any two of the mixing schemes compared in Li *et al.* (2019). Be sure to examine the original papers as well as this review and comparison.
- Submesoscale-Mixing Interface: Choose papers from the many Large Eddy Simulations featuring both submesoscales and boundary layer turbulence and contrast them (Taylor & Ferrari, 2009, 2010; Hamlington *et al.*, 2014; Smith *et al.*, 2016; Haney *et al.*, 2015; Suzuki *et al.*, 2016; Taylor, 2016; Whitt & Taylor, 2017; Skillingstad *et al.*, 2017; Taylor, 2018; Callies & Ferrari, 2018; Sullivan & McWilliams, 2018, 2019; Taylor *et al.*, 2020).
- ABL/OBL: Contrast the atmospheric boundary layer vs. the oceanic boundary layer
- Scalings: Contrast the scalings of Grant & Belcher (2009) vs. the Monin-Obukov theory.
- PV theory: Deep dive into PV in boundary layers (Hoskins *et al.*, 1985; Haynes & McIntyre, 1987; Marshall & Nurser, 1992; Thomas, 2005; Bodner & Fox-Kemper, 2020)
- Coupled Modes: examine some of the recent work on why the atmospheric and oceanic boundary layers are linked (Renault *et al.*, 2018) or <http://iprc.soest.hawaii.edu/users/xie/o-a.pdf>

## 2 The Proposal (Due April 3, 2020)

Due at the same time as HW04 (April 3, 2020), you should prepare a short proposal ( $\leq 1$  page) of your paper topic. For the proposal document, you will outline what plans you have for the final project, including as many details as you have collected by this time. Here are some critical points to make in the plans document, which will help me to better advise you in moving to the paper stage.

- Describe your selected key papers, and region and timeframe of interest if relevant.
- Give a working title.
- Make a list of 1-3 hypotheses or concepts you plan to address.
- Identify additional specific journal articles, figures, or subsections of the book that are relevant. Briefly summarize what they say that is relevant to your planned paper, and what missing hypotheses to test that you will try to test.
- Describe the overarching “science question” that your paper will address.

## 3 The Paper (Due May 14, 2020)

If you are confused about what should go in a scientific paper, these notes from another class are helpful: [http://www.geo.brown.edu/research/Fox-Kemper/classes/GEOL1520\\_19/notes/paperprimer.pdf](http://www.geo.brown.edu/research/Fox-Kemper/classes/GEOL1520_19/notes/paperprimer.pdf). This paper will be *Geophysical Research Letters* length ( $\leq 12$  publication units, with 500 words or 1 figure or table equal to one publication unit).

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