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

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).
• 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 (≤ 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. This paper will be Geophysical Research Letters length (≤ 12 publication units, with 500 words or 1 figure or table equal to one publication unit).

References


Renault, Lionel, McWilliams, James C & Gula, Jonathan 2018 Dampening of submesoscale currents by air-sea stress coupling in the Californian Upwelling System. Scientific reports 8 (1), 13388.


