

# Forcing Mechanisms of the Ross Ice Shelf Airstream

Melissa A. Nigro

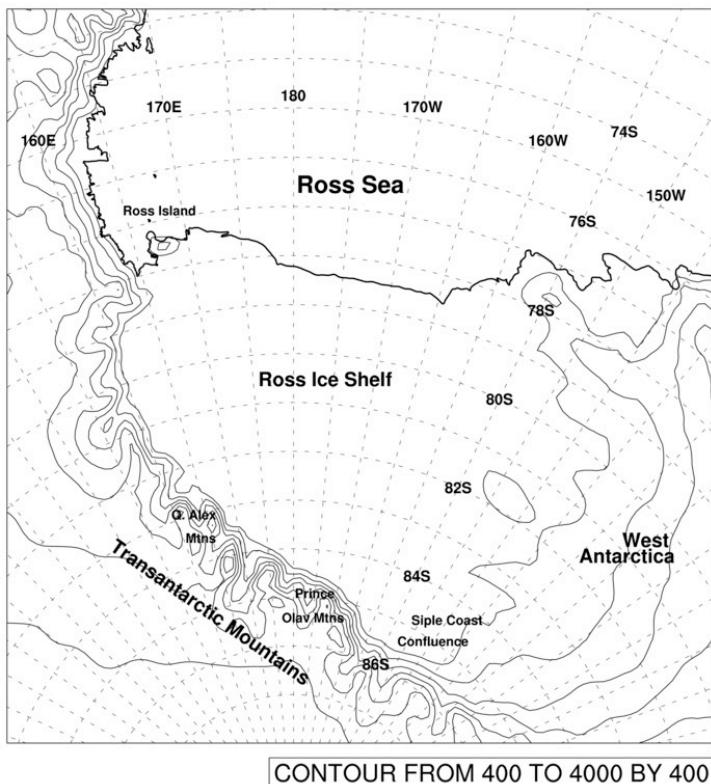
John J. Cassano

University of Colorado and CIRES  
Boulder, Colorado

# Ross Ice Shelf Airstream

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A dominant stream of air flowing northward from the interior of continent across the western to central RIS to the Ross Sea (Seefeldt and Cassano, 2012)

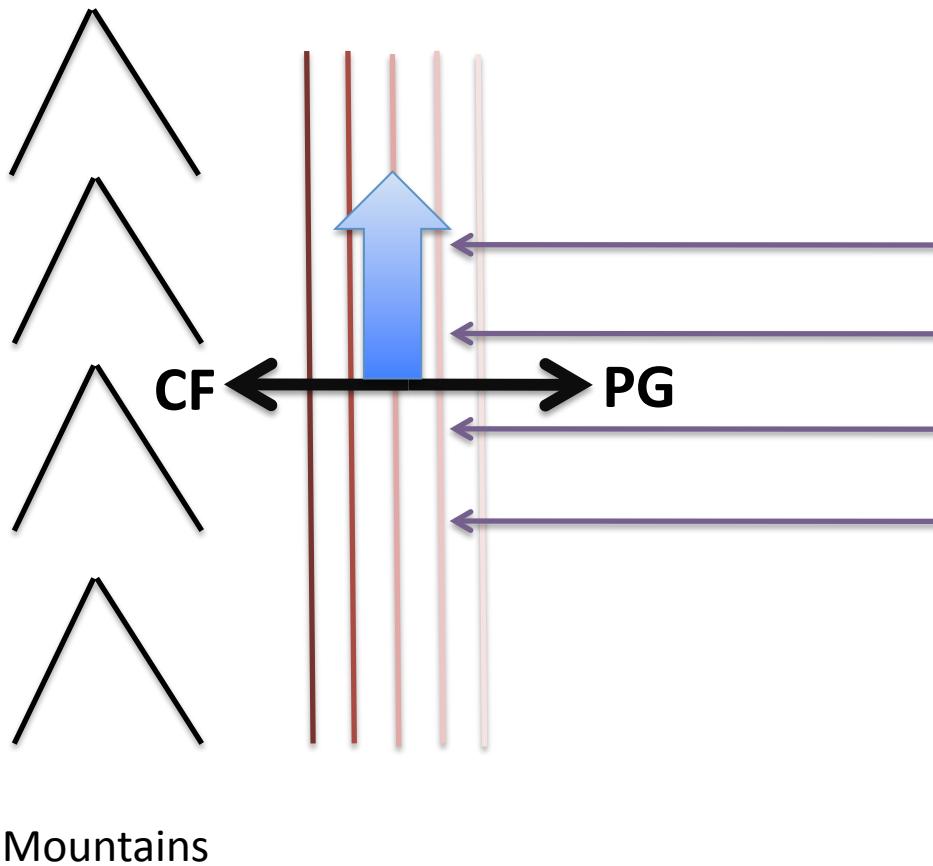


## RAS Forcing:

- Katabatic winds
- Barrier winds
- Synoptic forcing

# Barrier Winds

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O'Connor et al. (1994), Parish et al. (2006), Seefeldt et al. (2007), Steinhoff et al. (2009)

What about other dynamics?

# Agenda

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- Self Organizing Maps (SOM)
- Ross Ice Shelf Airstream Patterns
- Forcing of the Ross Ice Shelf Airstream
- Conclusions and Future Work

# Self Organizing Maps

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## ❑ Technique

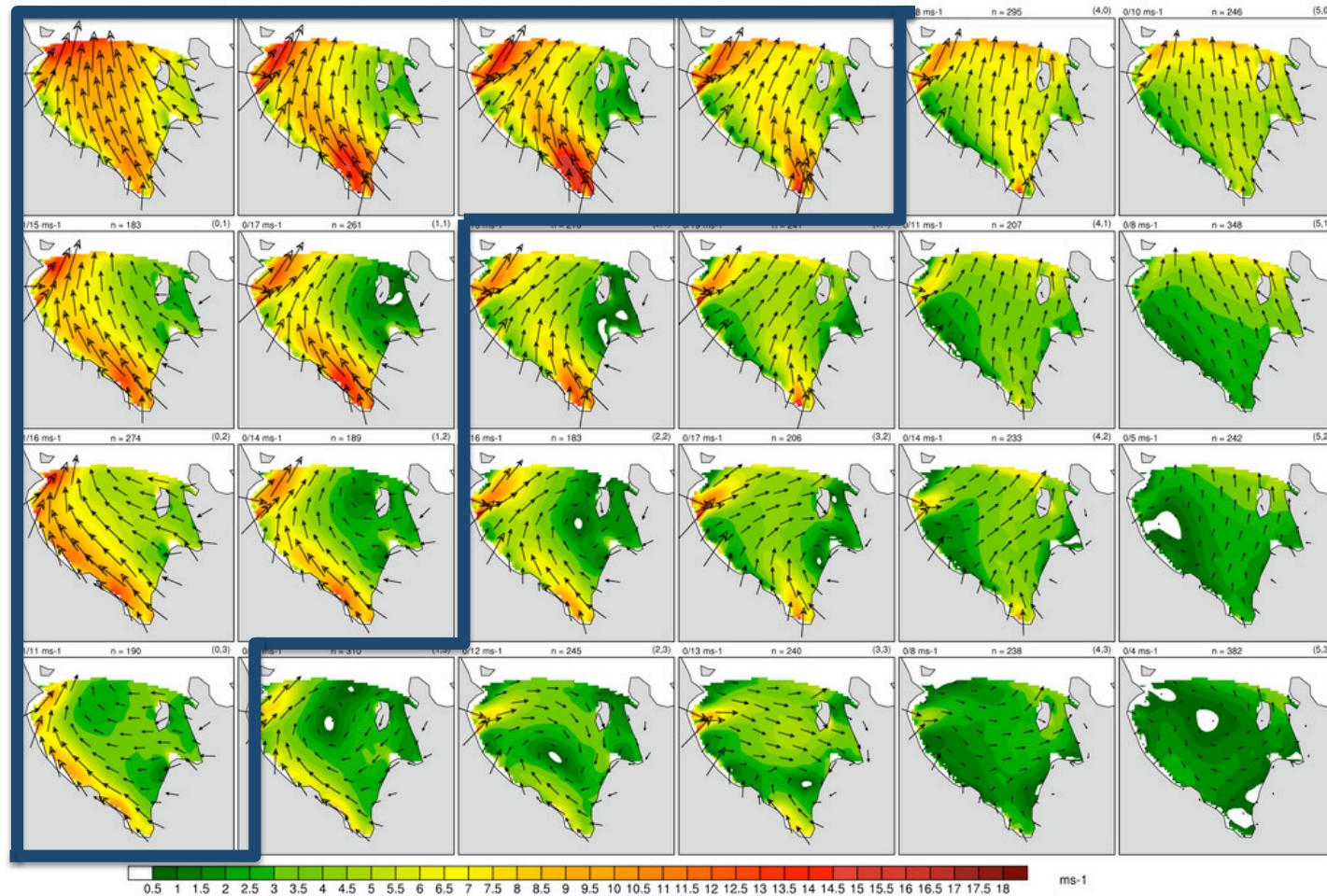
- ❑ Neural network algorithm
- ❑ Unsupervised, iterative learning process
- ❑ Identifies user specified number of patterns within a dataset

## ❑ Training

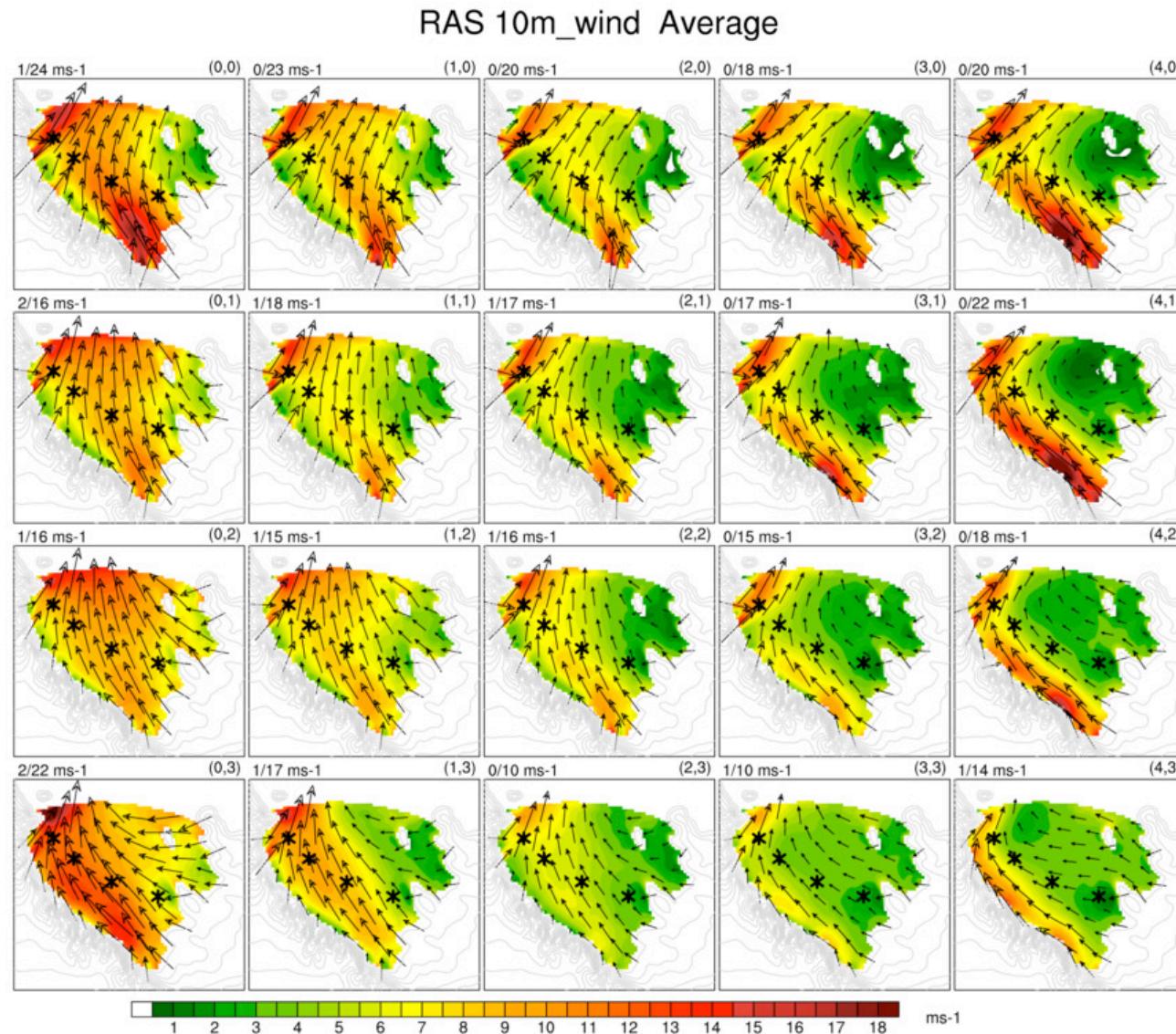
- ❑ AMPS-WRF 15 km
- ❑ 3 hourly output from Oct 2008 – Sept 2010
- ❑ Trained on the u and v component of the 10 m winds
- ❑ Trained with 10 m winds of RAS patterns

# SOM Patterns

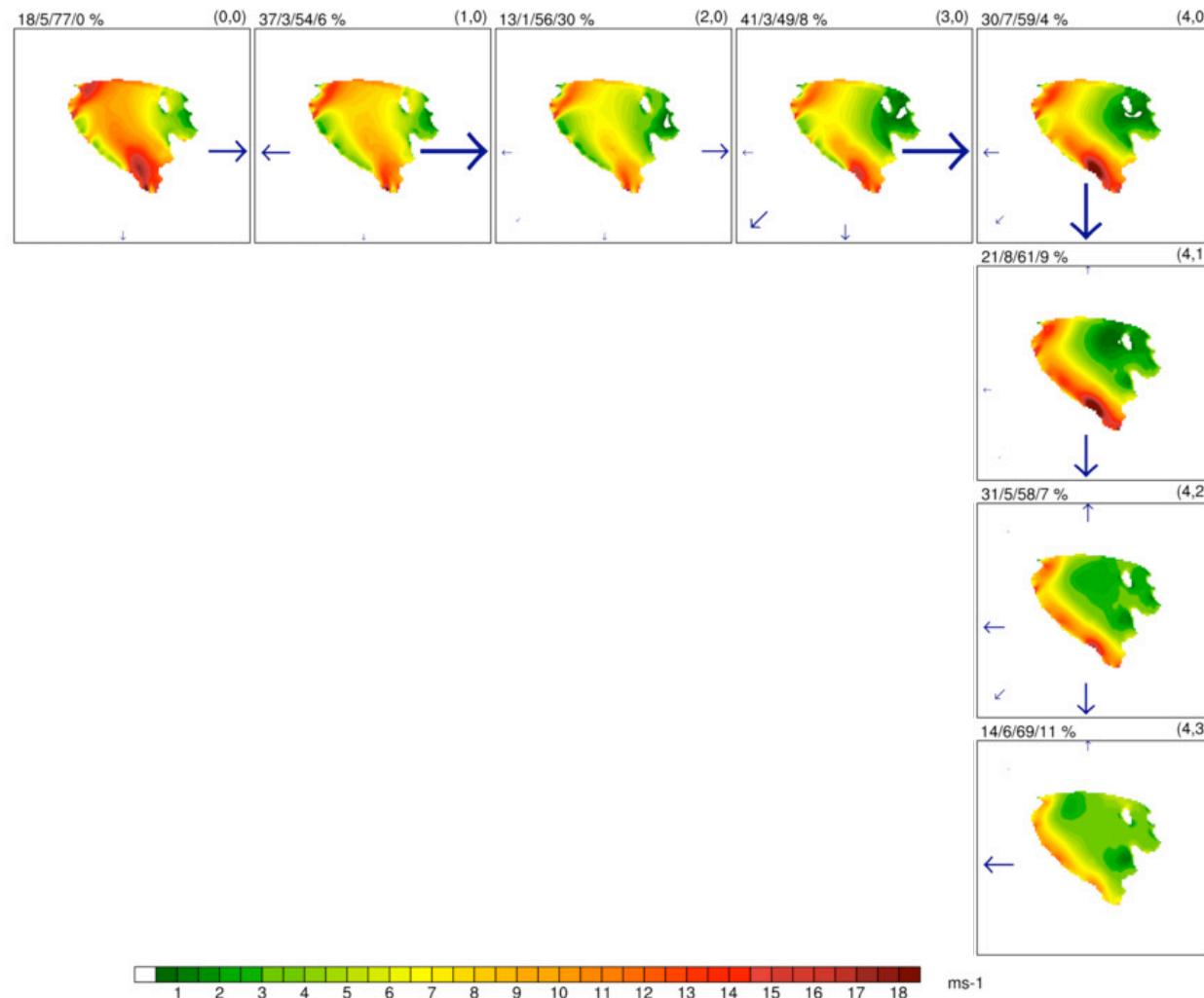
WRF 10m\_wind Average



# SOM of RAS Patterns

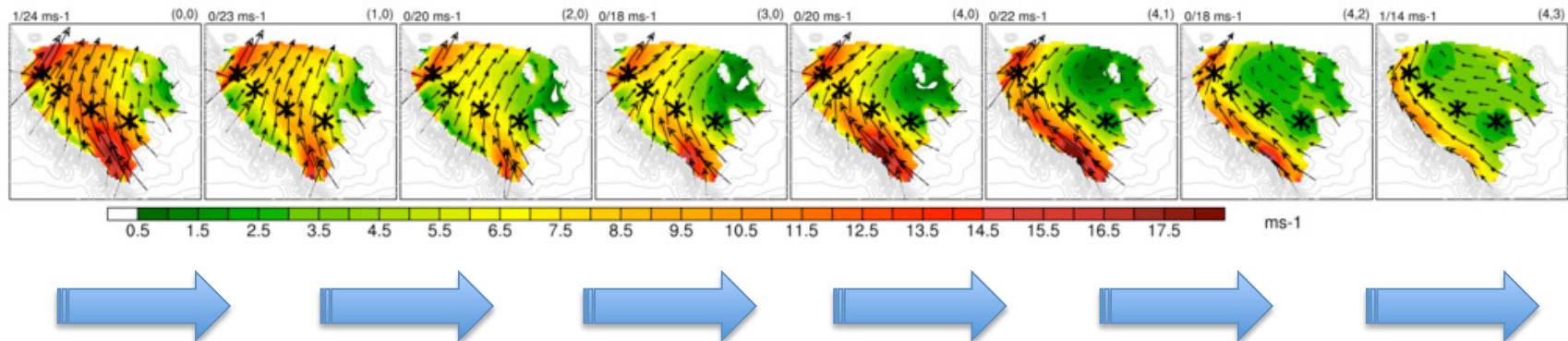


# SOM Transitions

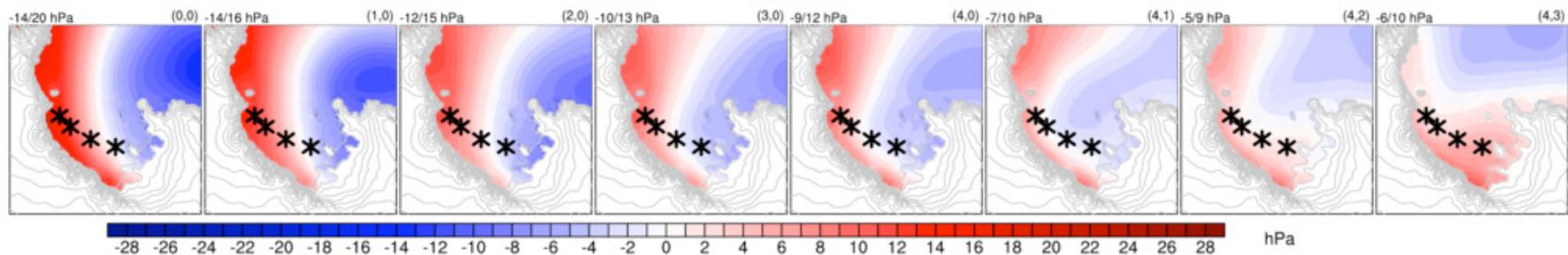


# Weather Patterns

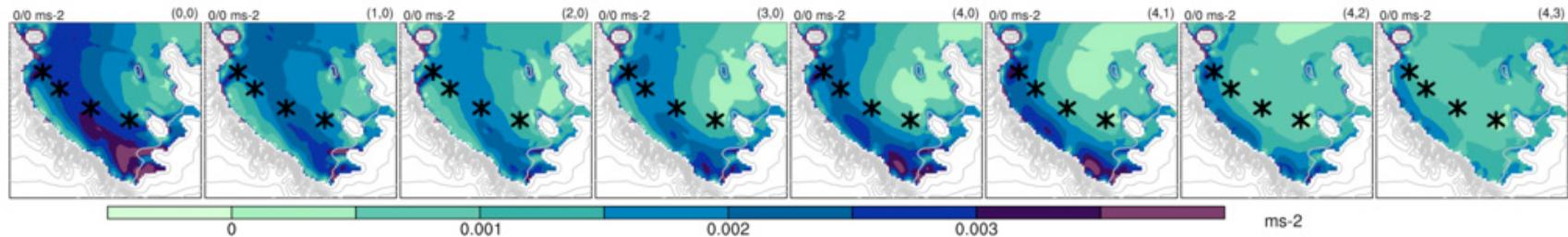
10 m winds:



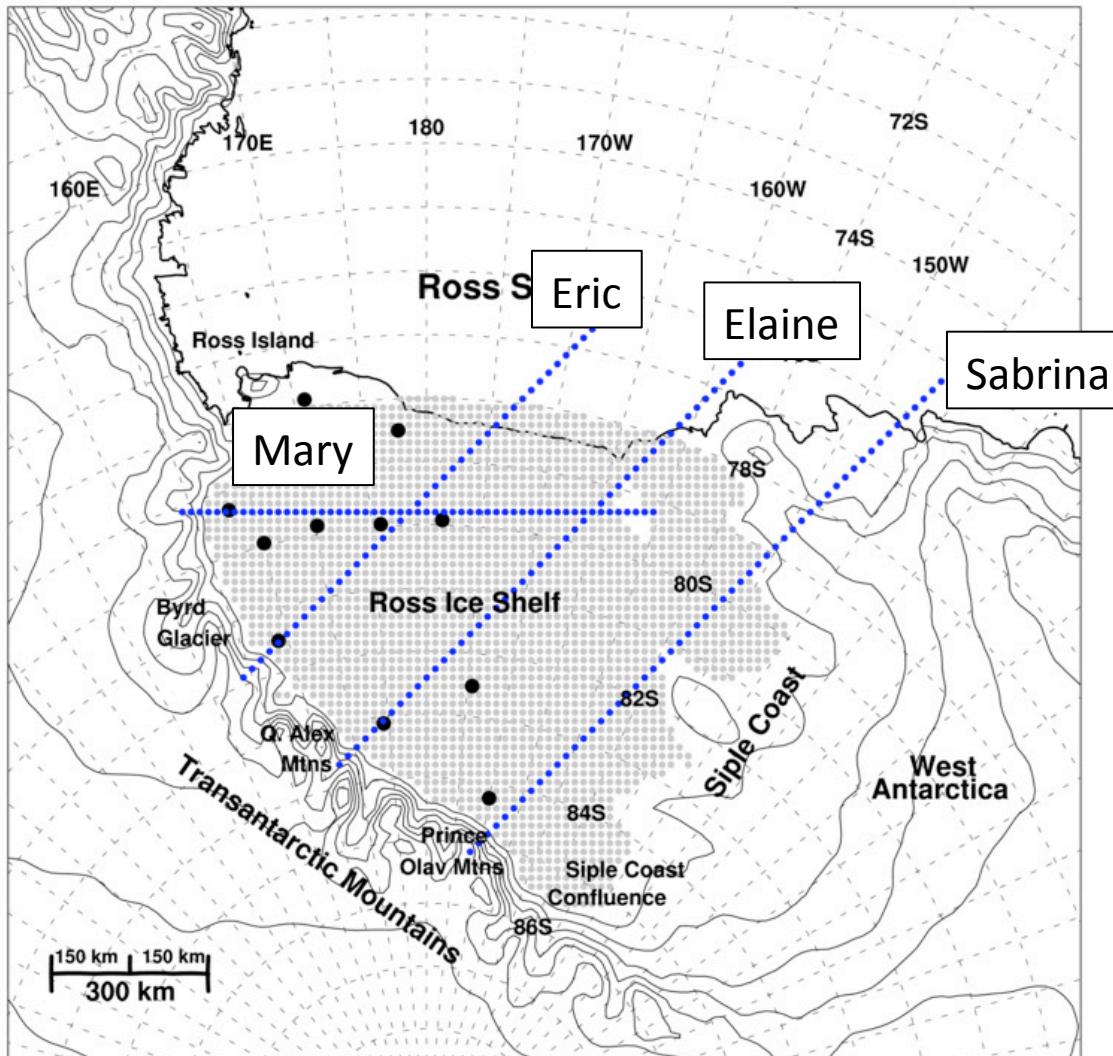
Sea Level Pressure Anomalies:

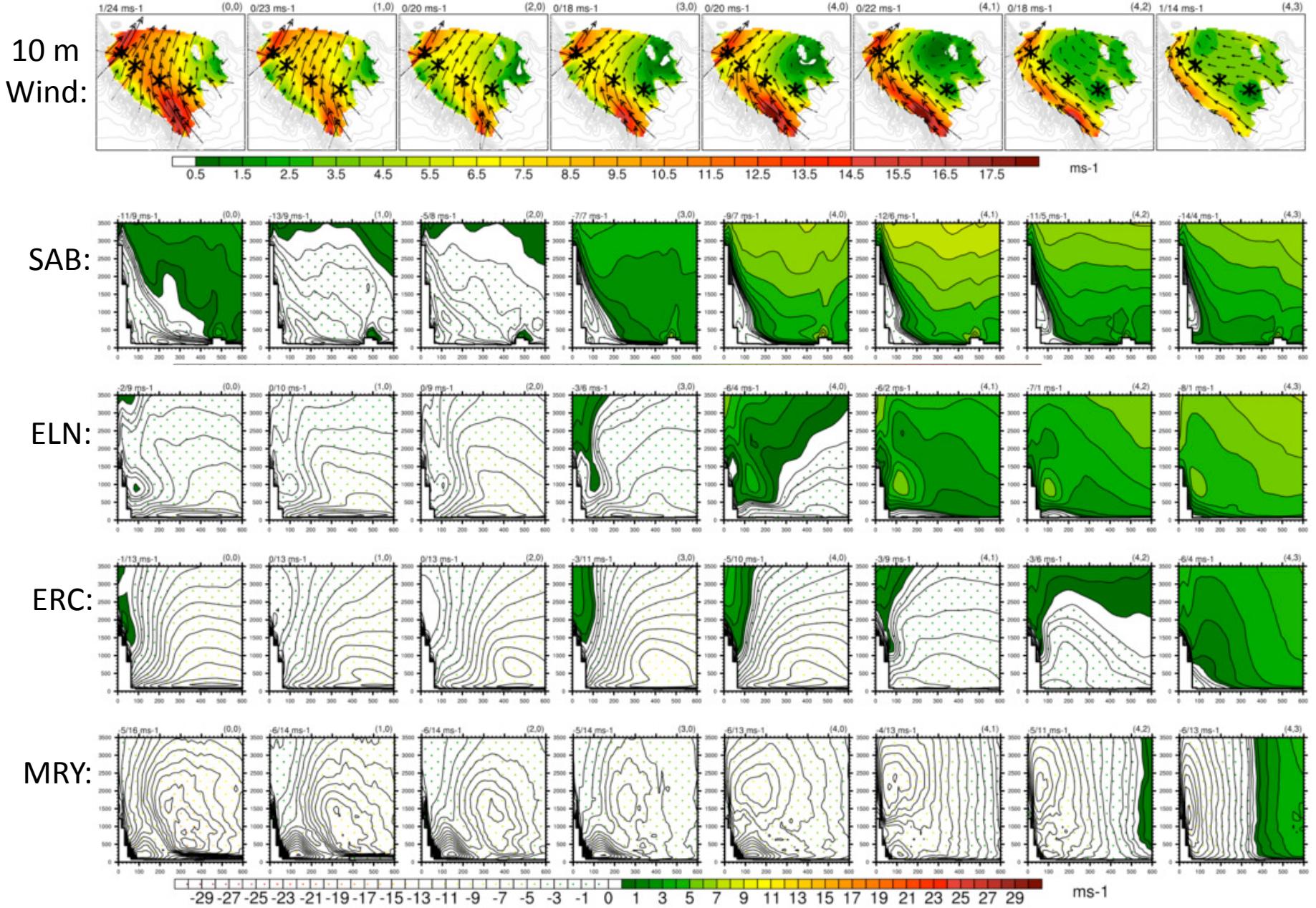


Pressure Gradient Force:



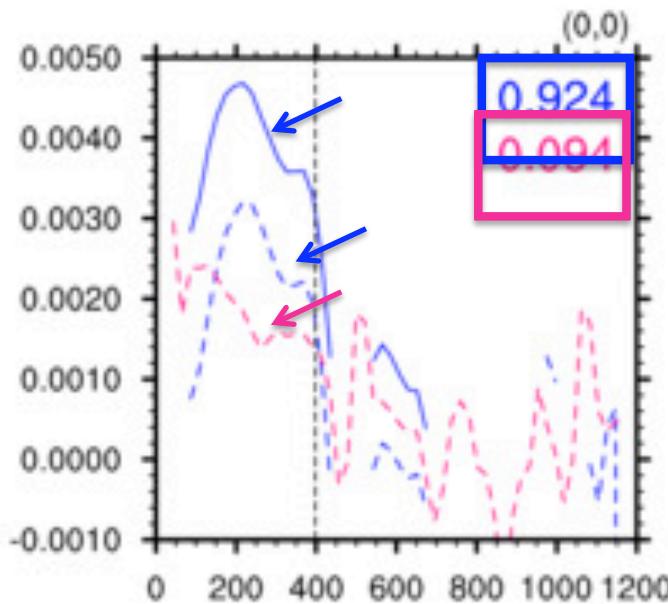
# Cross Sections



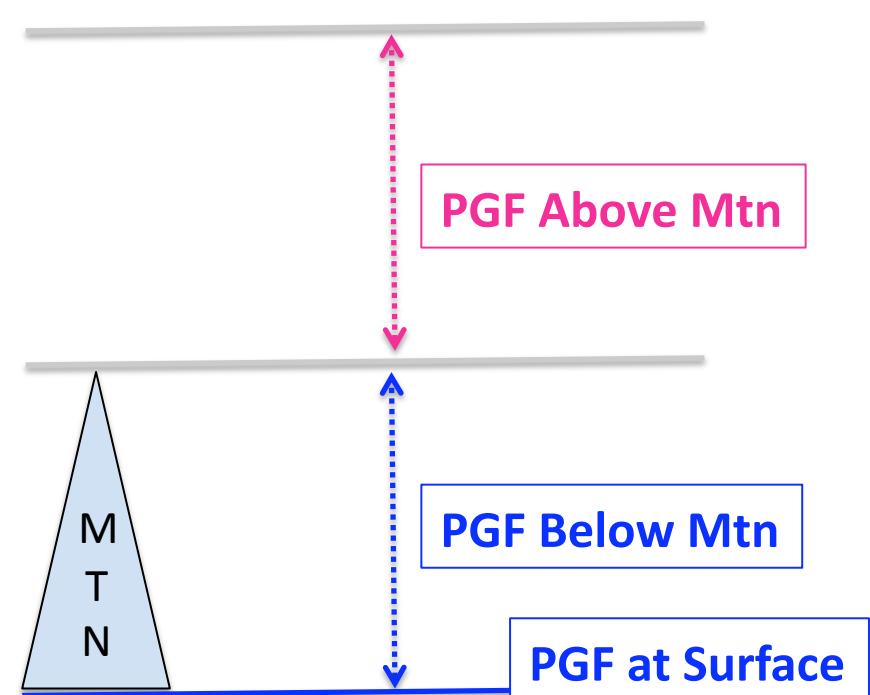
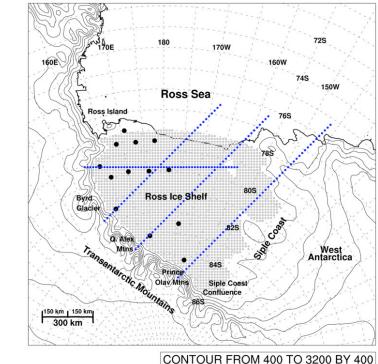


# Pressure Gradient Force

— PGF at the Surface  
 - - - PGF Below Hgt of Mtn  
 - - - PGF Above Hgt of Mtn

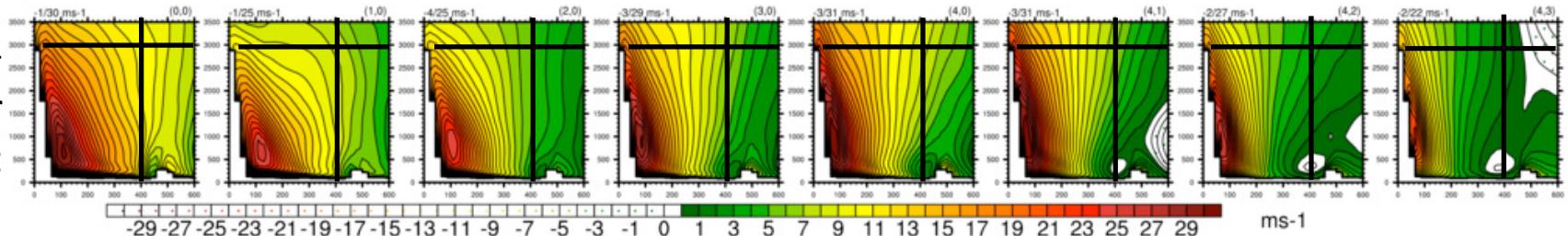


- 1) Dynamics below hgt of mtn
- 2) Dynamics above hgt of mtn
- 3) Atmospherically deep dynamics

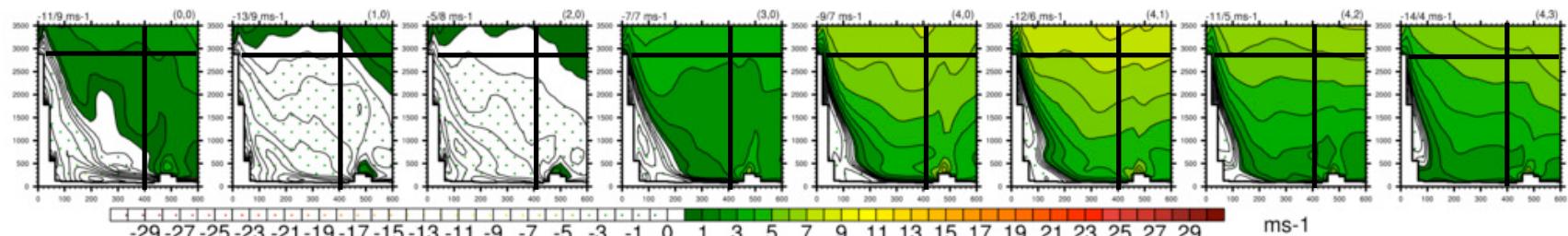


# Pressure Gradient Force at Sabrina

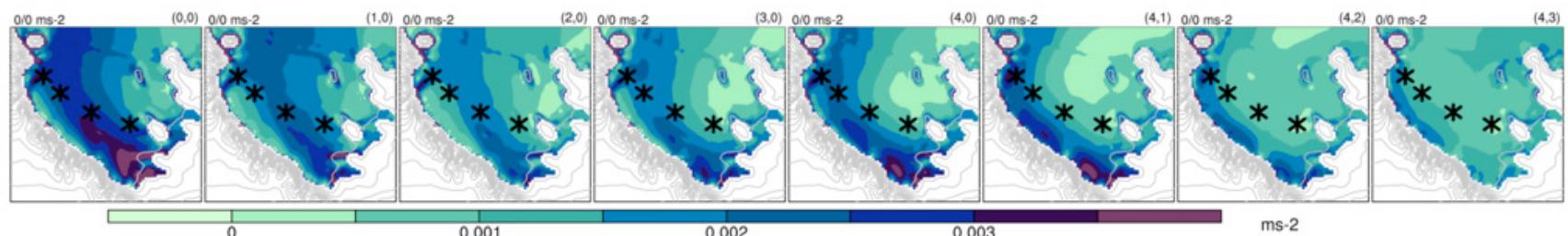
Perpen-  
dicular  
Wind:



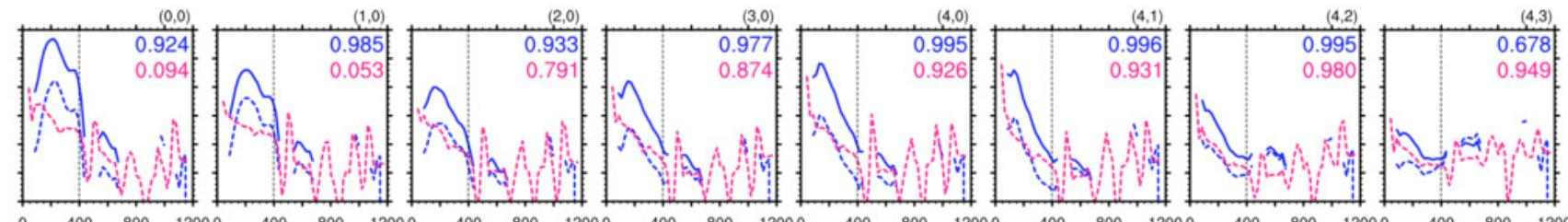
Parallel  
Wind:



PGF:

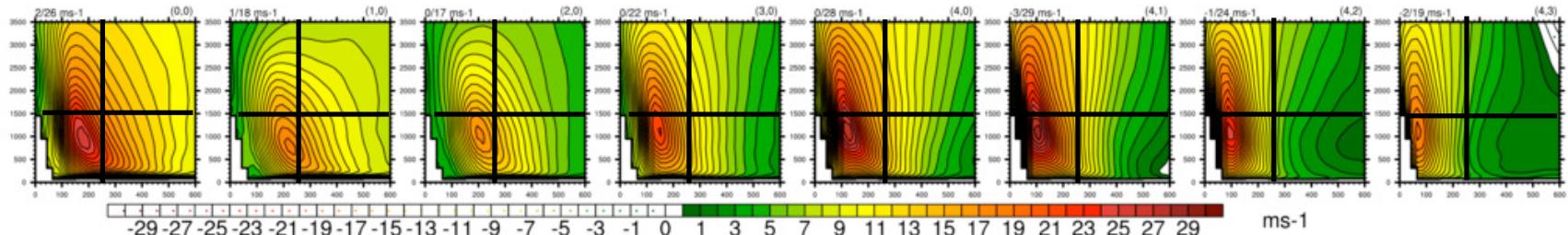


PGF  
RRoD:

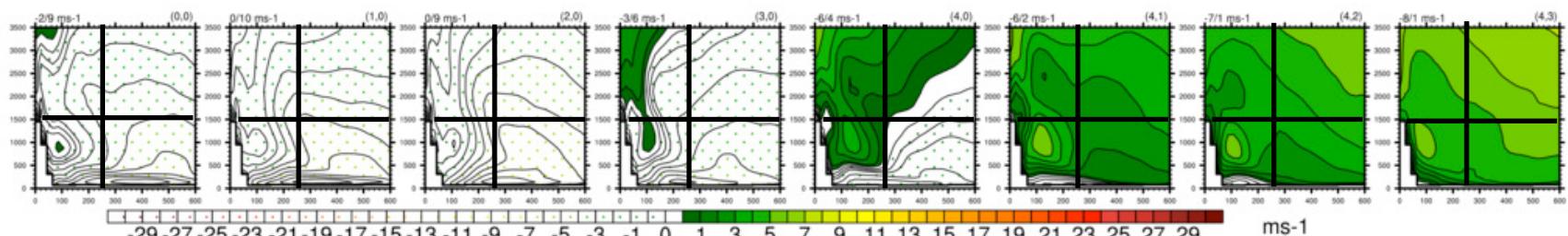


# Pressure Gradient Force at Elaine

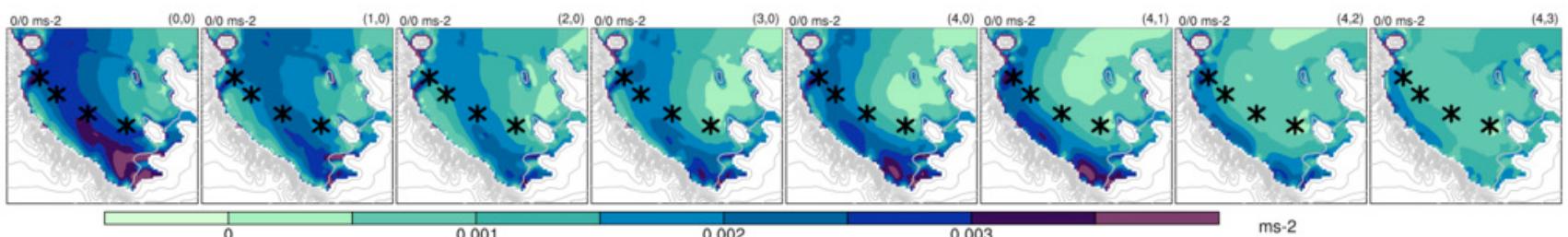
Perpen-  
dicular  
Wind:



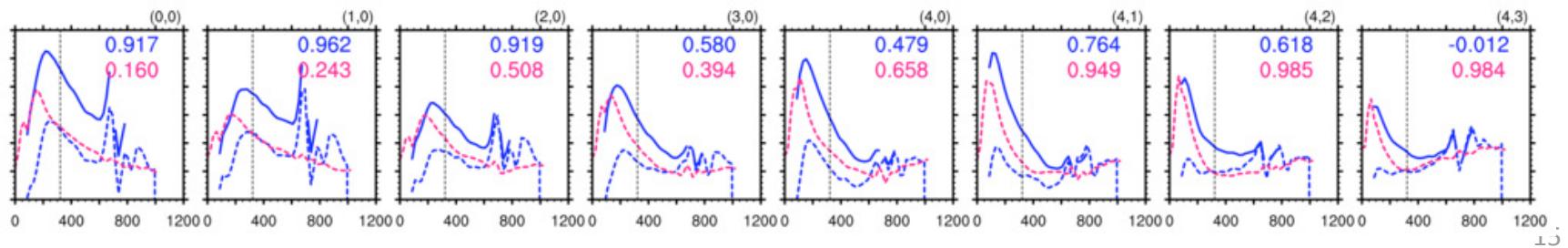
## Parallel Wind:



PGF:

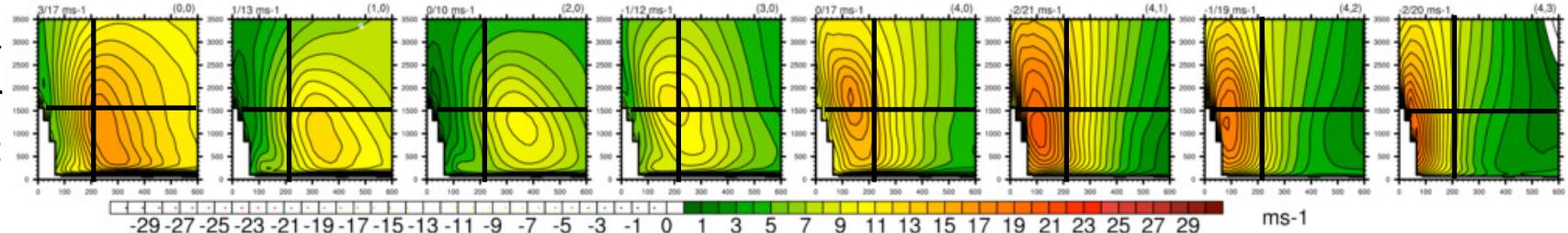


PGF  
RRoD:

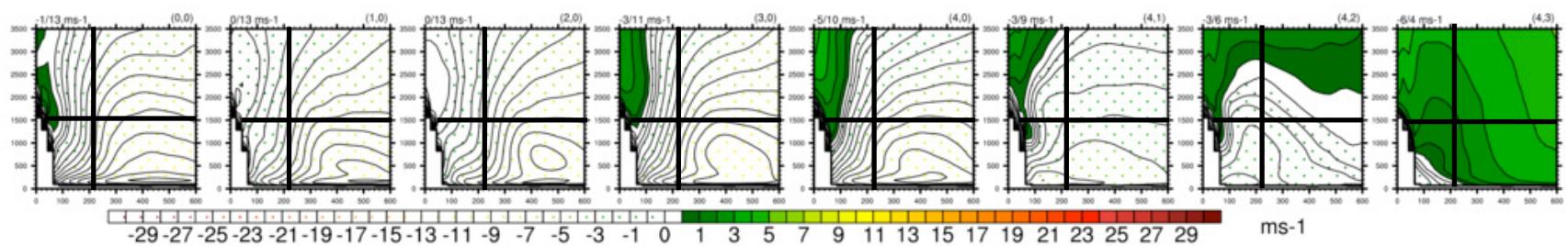


# Pressure Gradient Force at Eric

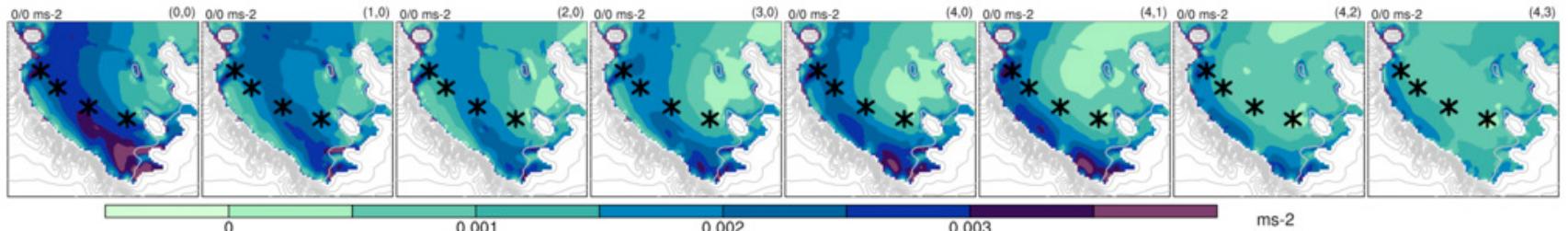
Perpen-  
dicular  
Wind:



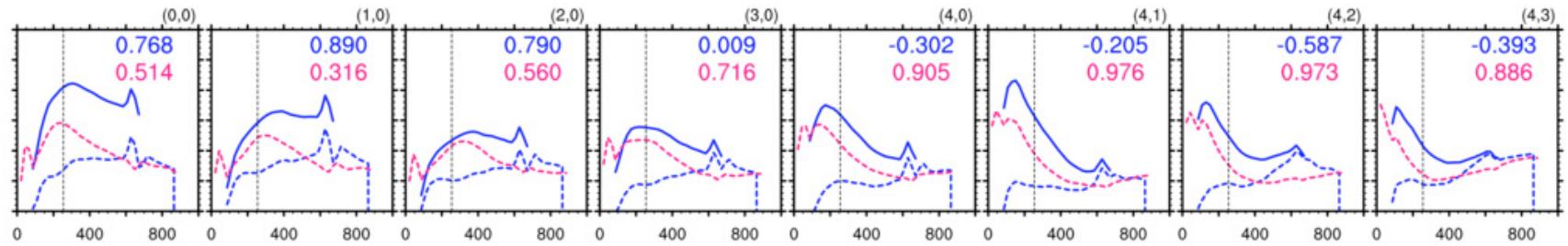
Parallel  
Wind:



PGF:



PGF  
Full:



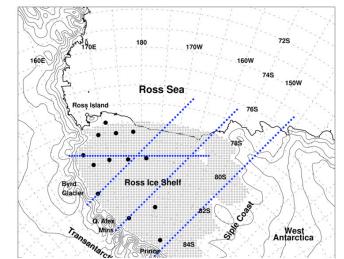
# Conclusions

- Strong, barrier parallel winds within the Rossby radius of deformation are not necessarily barrier winds
- RAS forcing includes: synoptic, katabatic, barrier and **something else** – frontal dynamics?
- This work is in preparation for a two part paper in Monthly Weather Review
  - Nigro, M.A. and J.J. Cassano, 2013. Analysis of high winds over the Ross Ice Shelf, Antarctica Part 1: Wind Pattern Identification using Self Organizing Maps. In preparation for Monthly Weather Review.
  - Nigro, M.A. and J.J. Cassano, 2013. Analysis of high winds over the Ross Ice Shelf, Antarctica Part 2: Forcing Mechanisms of the Ross Ice Shelf, Antarctica. In preparation for Monthly Weather Reivew.

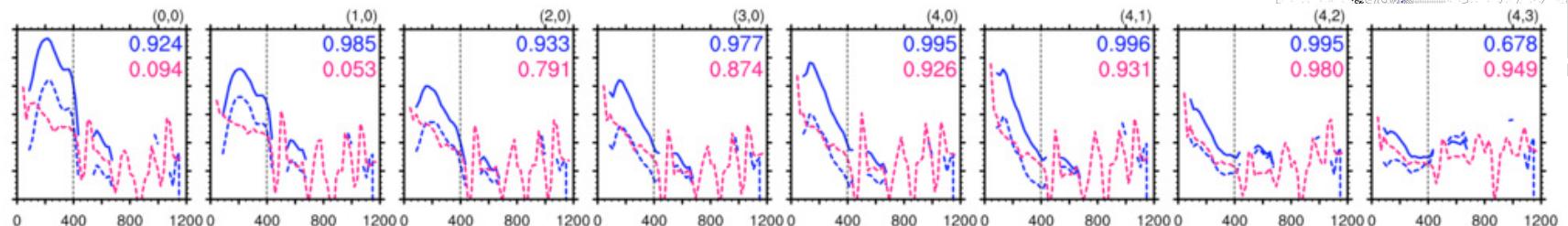


This work is funded by NSF Grant ANT 0943952.

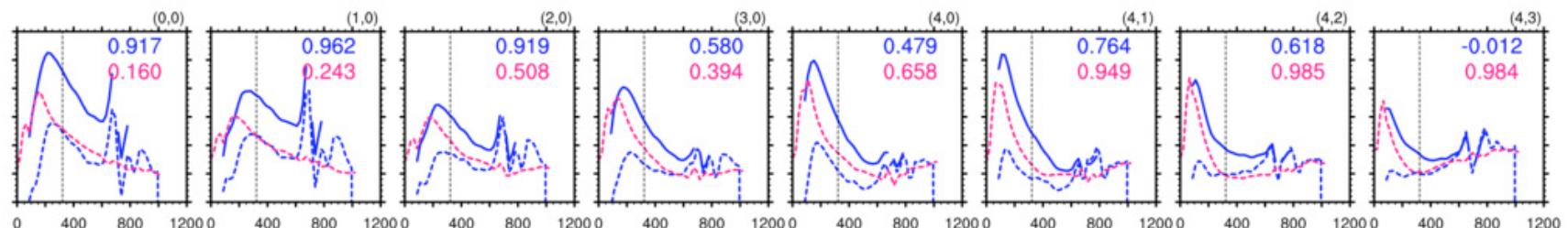
# Pressure Gradient Force



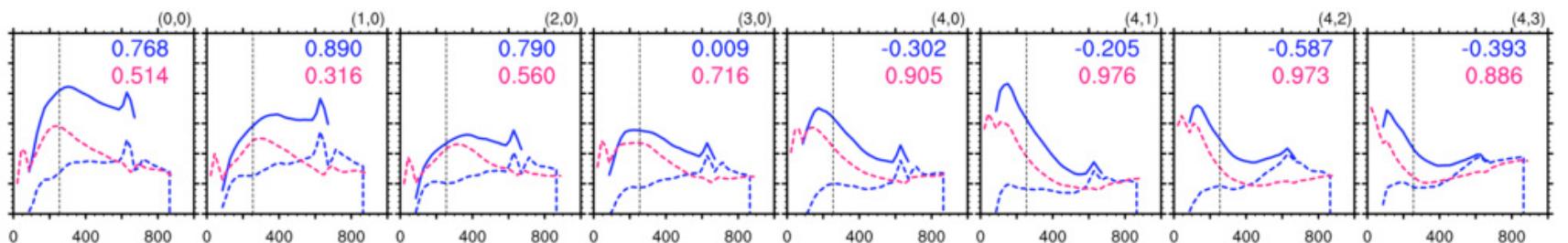
SAB:



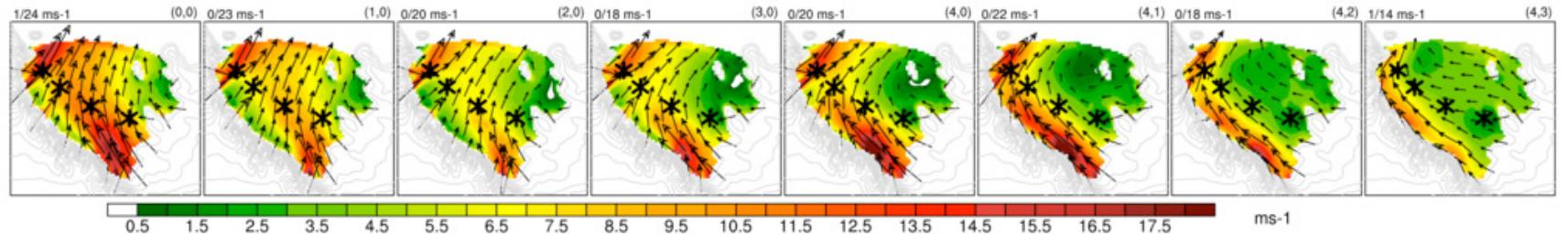
ELN:



ERC:

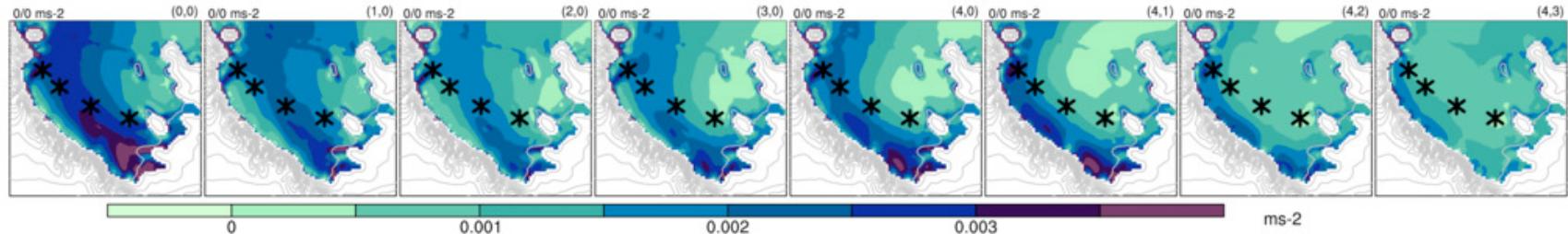


10 m  
Wind:

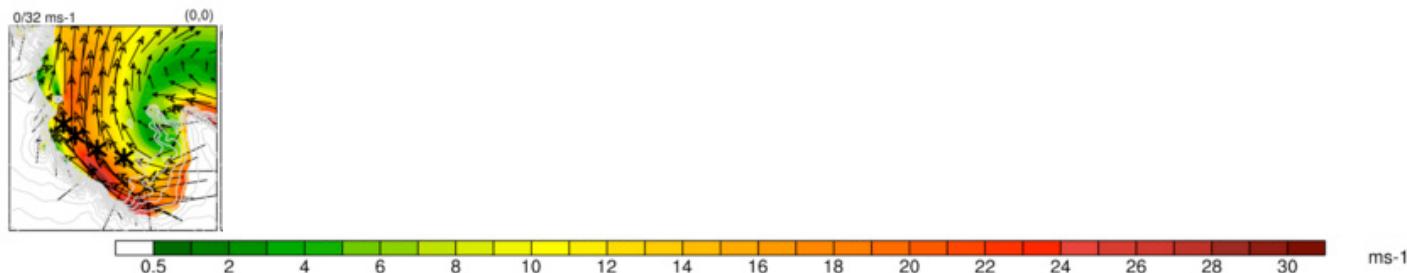


# Weather Patterns

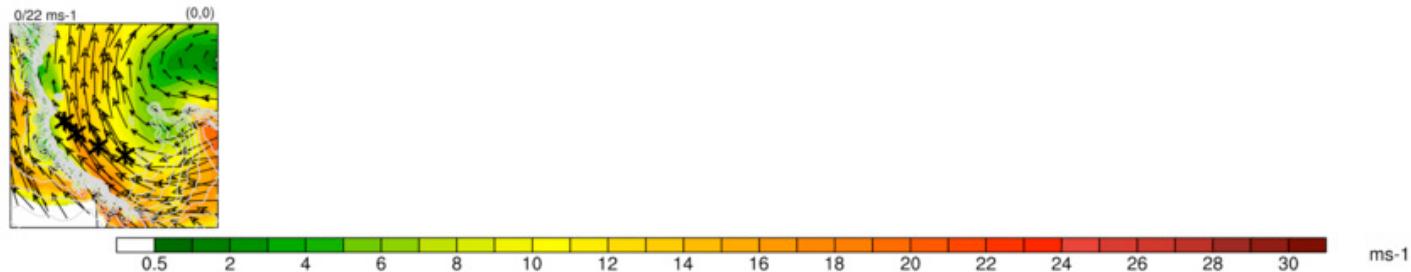
Pressure Gradient Force:



850 mb Winds:

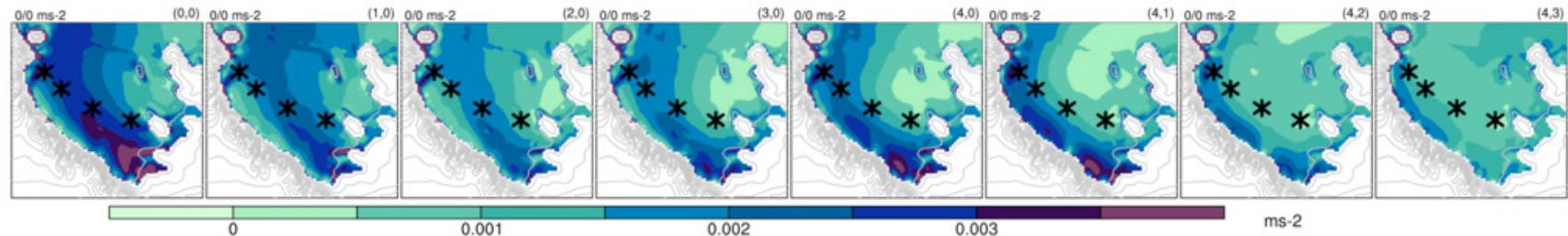


700 mb Winds:

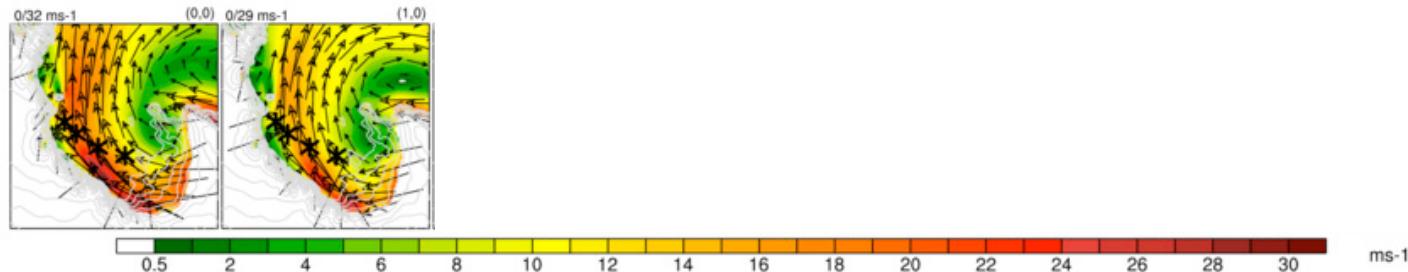


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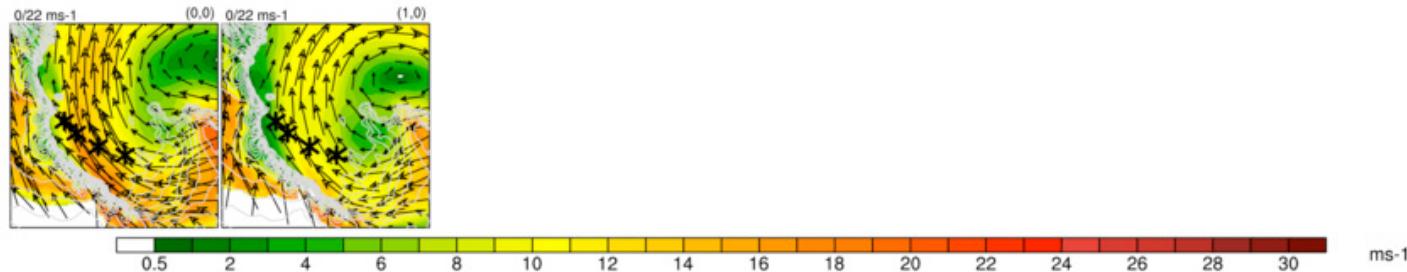
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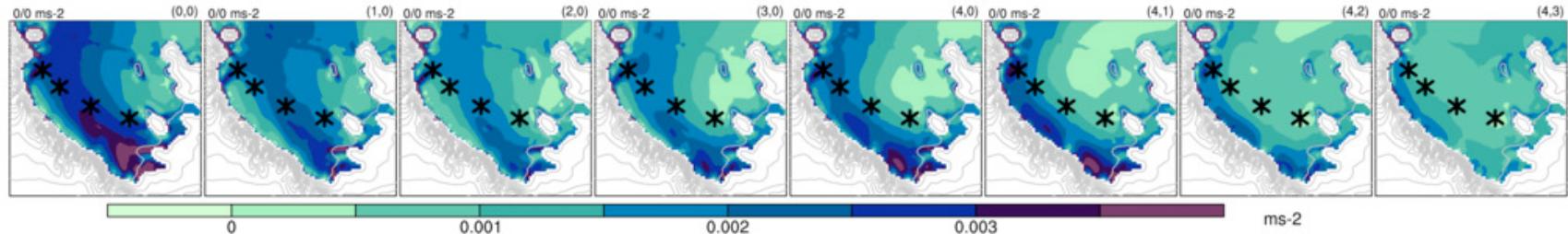


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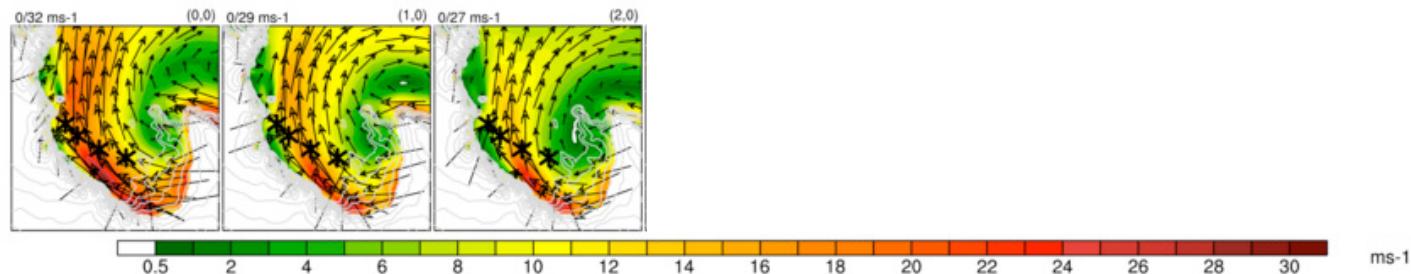


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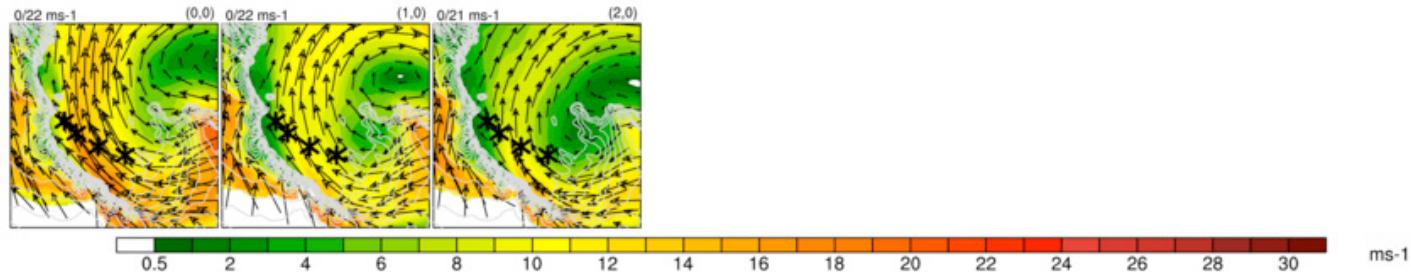
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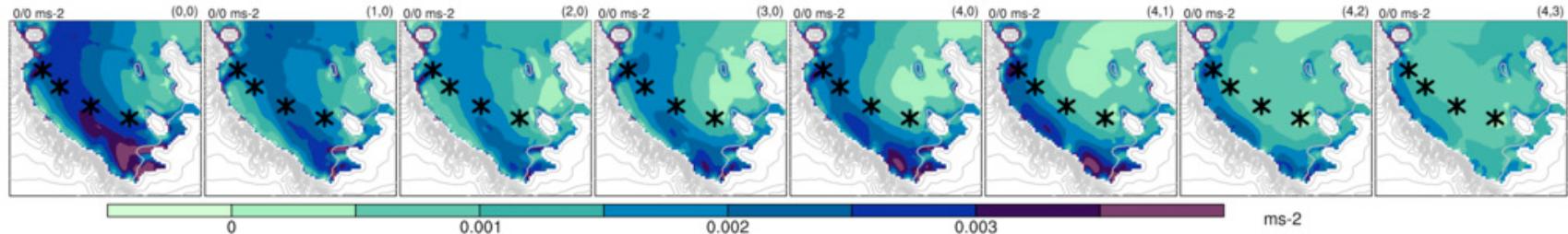


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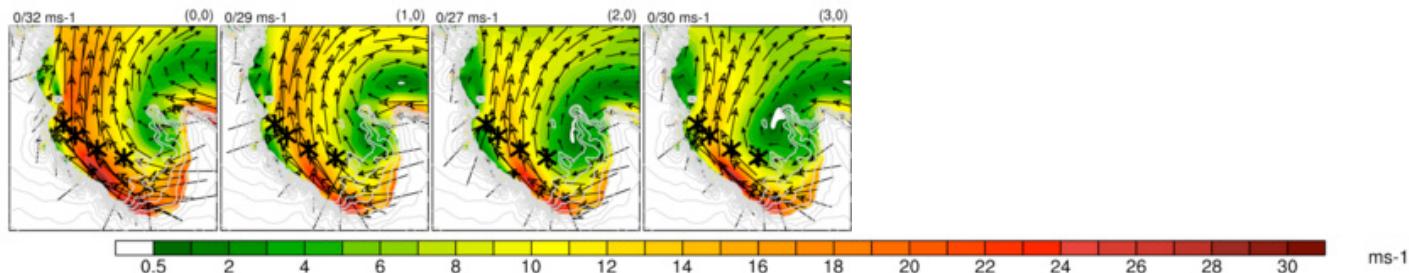


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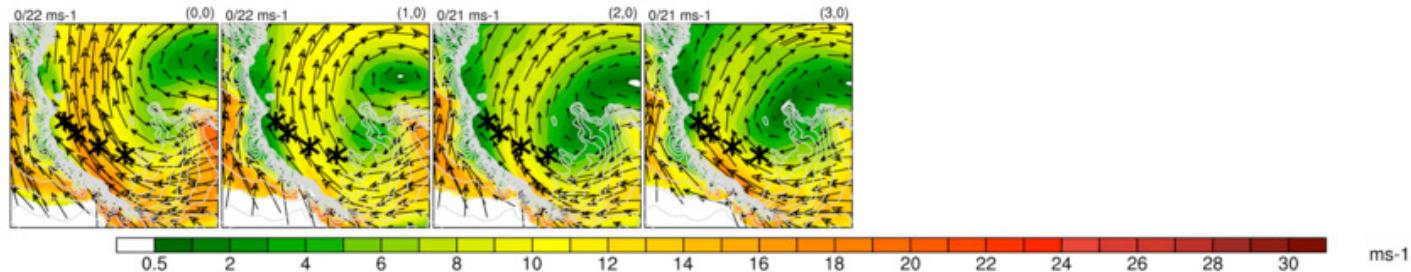
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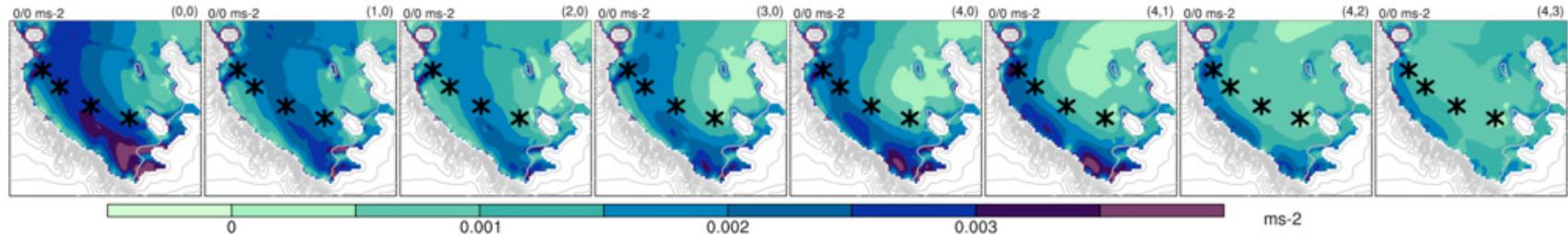


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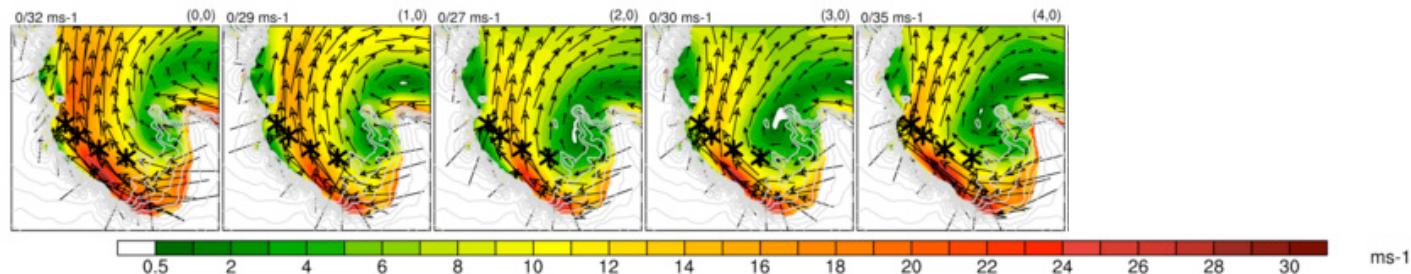


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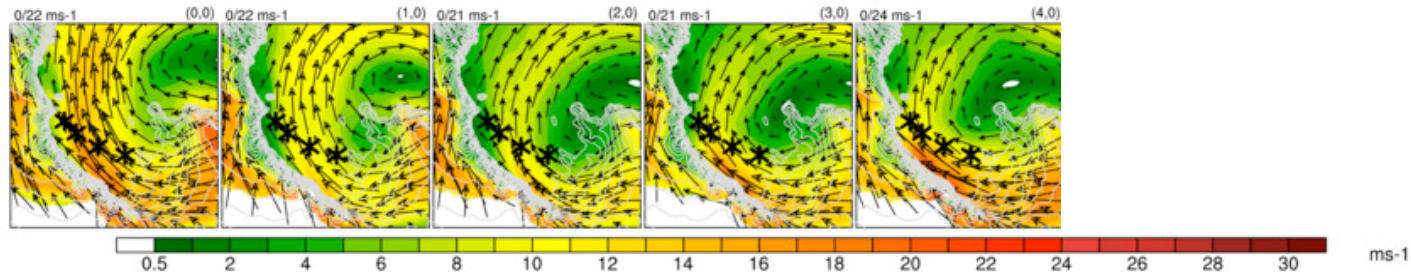
Pressure Gradient Force:



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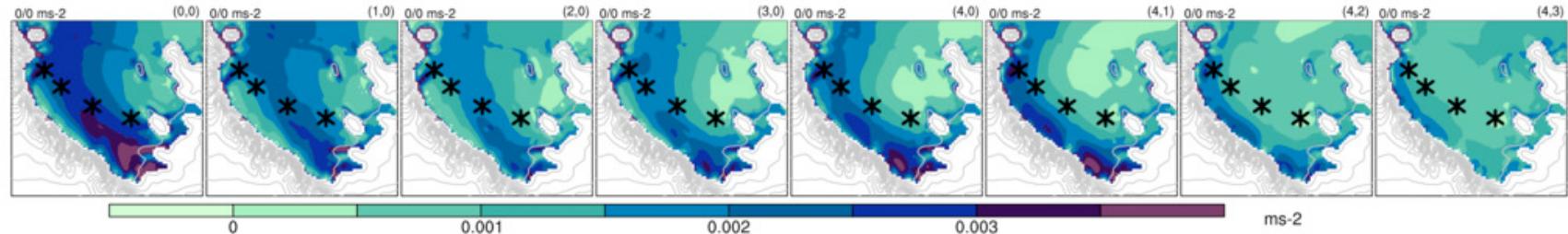


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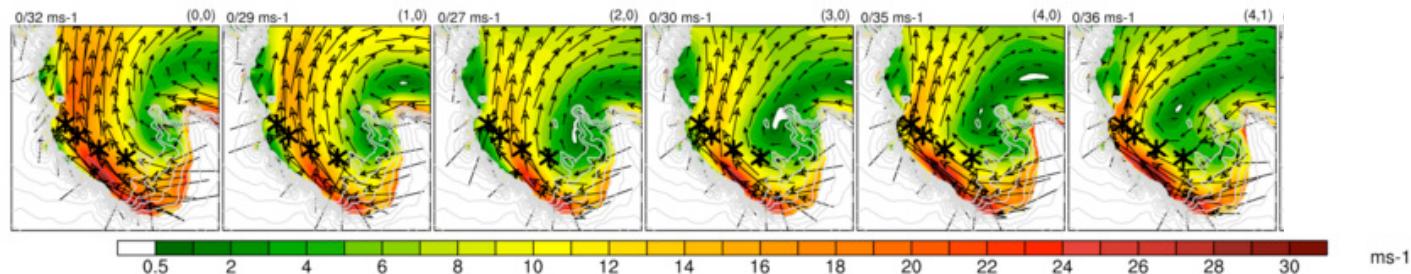


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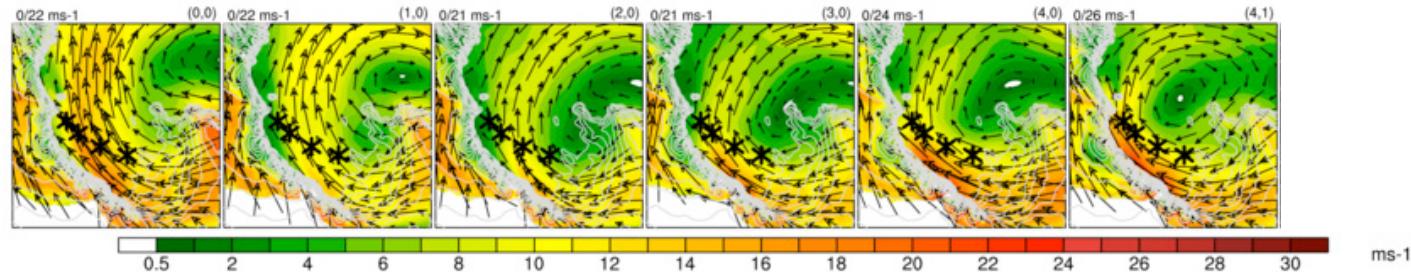
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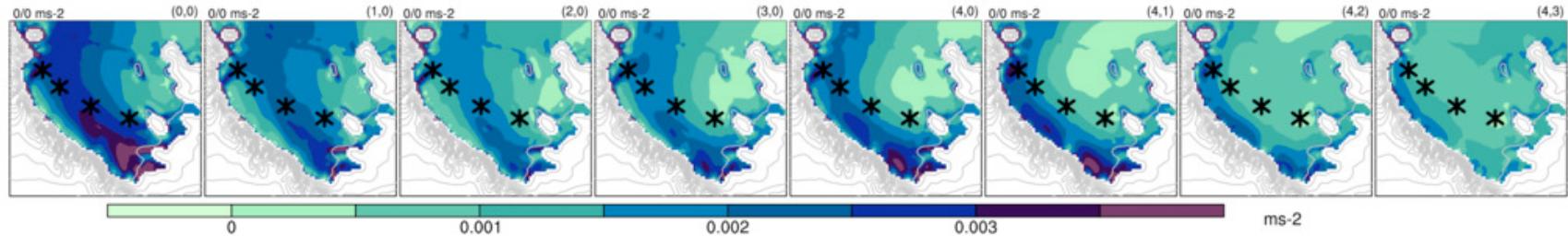


700 mb Winds:

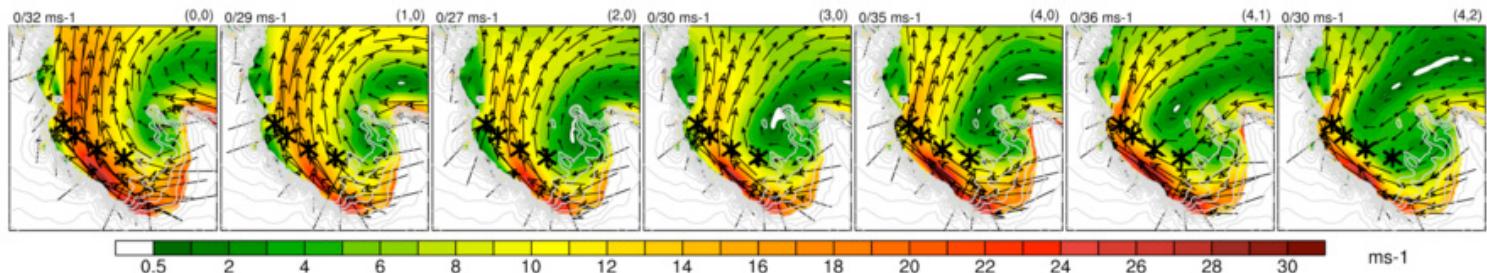


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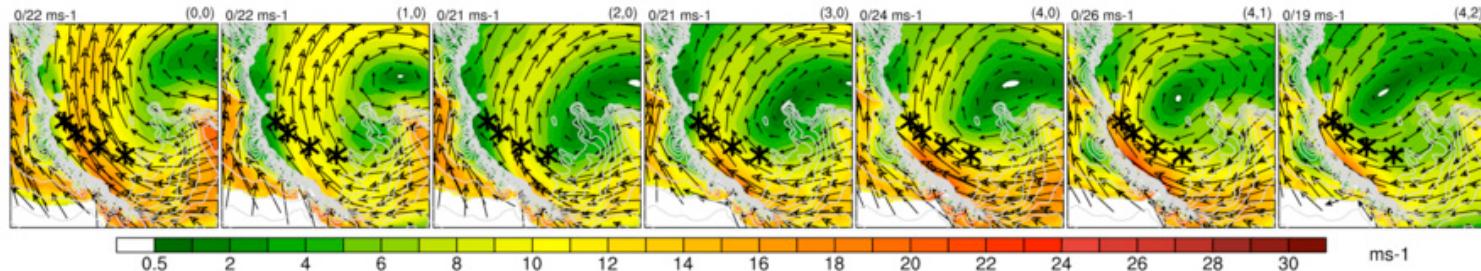
Pressure Gradient Force:



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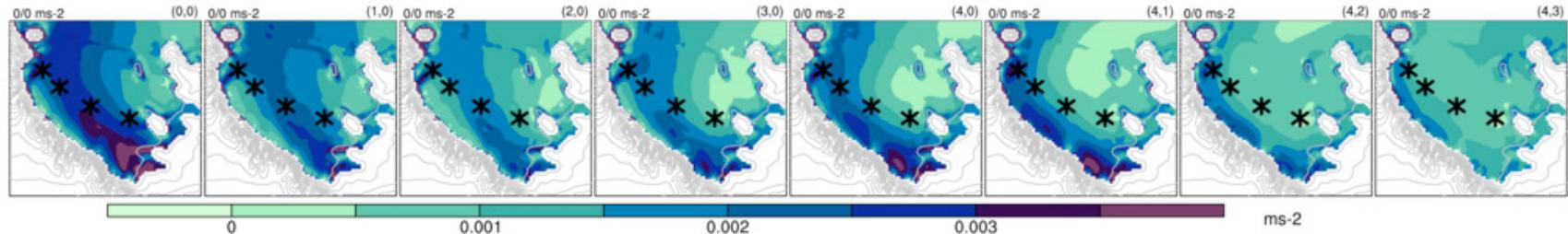


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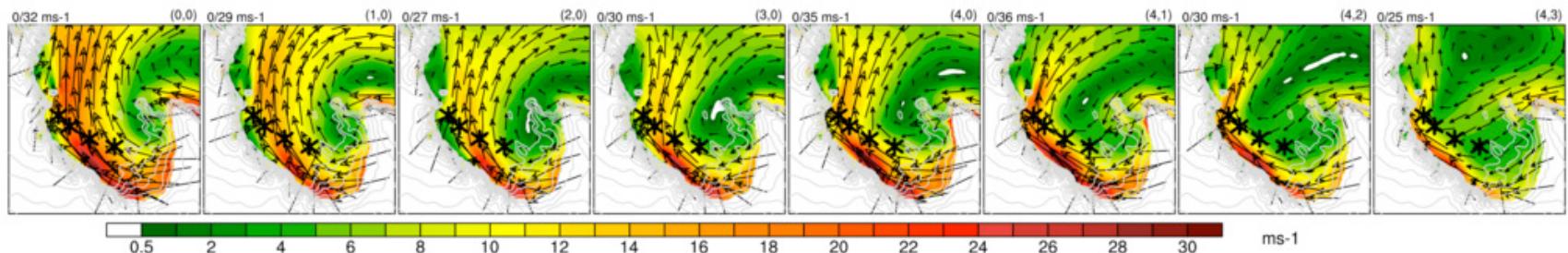


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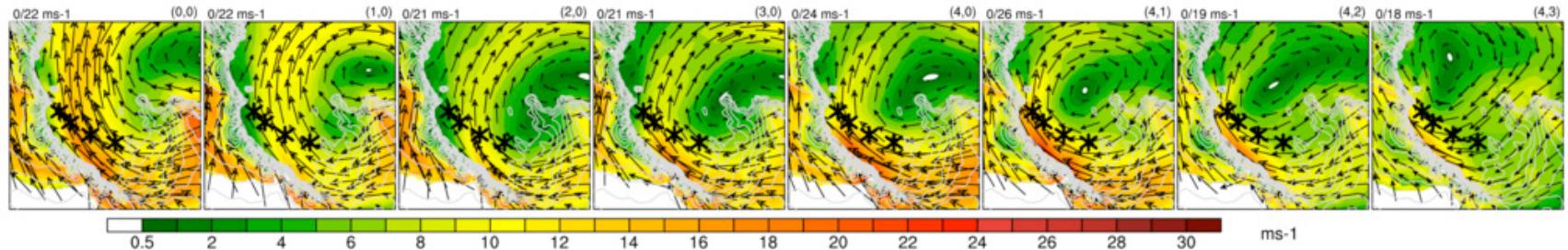
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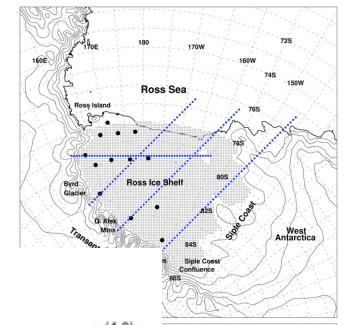
850 mb Winds:



700 mb Winds:



# Pressure Gradient Force at Sabrina



RAS PGF Cross Section at Sabrina Rossby Radius of Def

