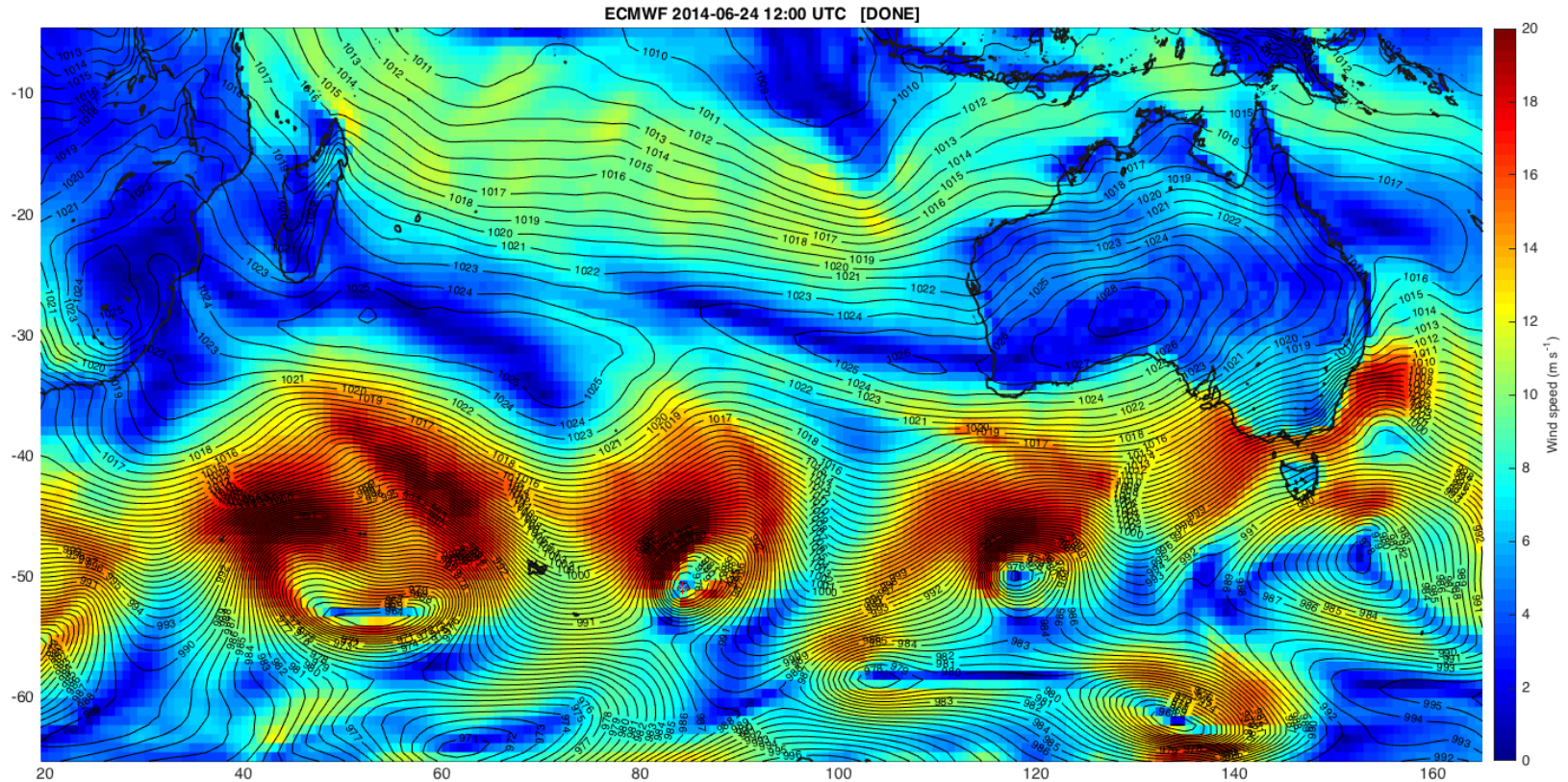


# Storm tracks associated with extreme storm surges, coastal currents and waves in Southern Australia

Yasha Hetzel, Charitha Pattiaratchi, Simone Cosoli, Ivica Janekovic

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Oceans Graduate School  
The UWA Oceans Institute  
The University of Western Australia



# Storm surge

## EXTREME SEA LEVELS IN AUSTRALIA

[HOME](#)[ABOUT](#)[FAQ](#)[CONTACT](#)

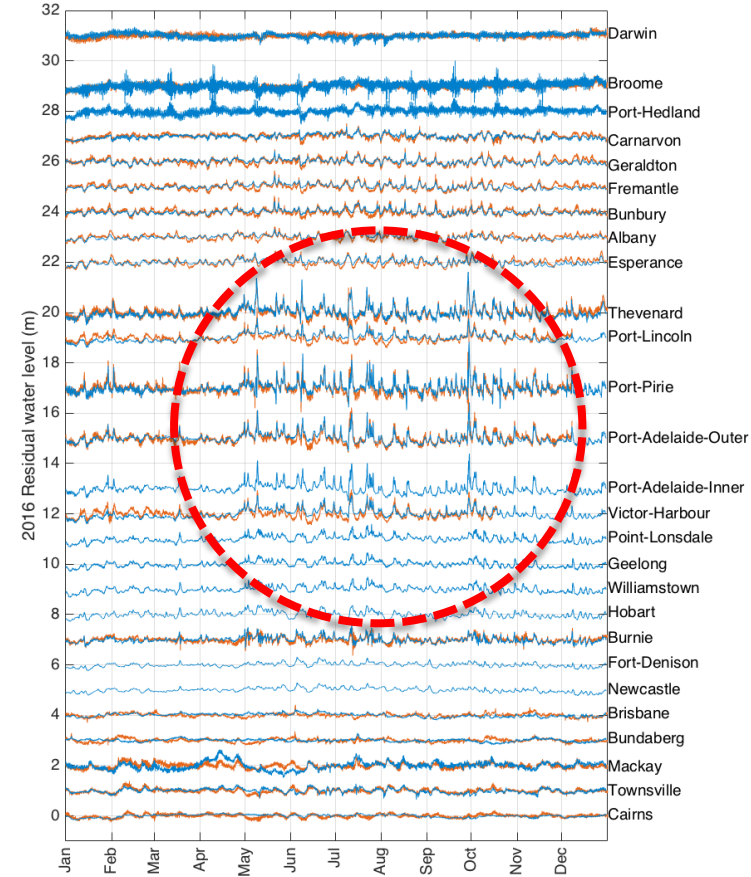
### Predicted extreme sea level statistics around Australia

Click on coastal data points to access the statistics, including present day 100 year Average Recurrence Interval (ARI) levels, historical and seasonal variability derived from the numerical model. Blue markers contain data derived from measurements at 29 tide gauge sites.

Colour scale: 100 year ARI in m above Australian Height Datum (AHD)

[www.Ozsealevelx.org](http://www.Ozsealevelx.org)

<http://sealevelx.ems.uwa.edu.au>





# Southern Ocean winter storms

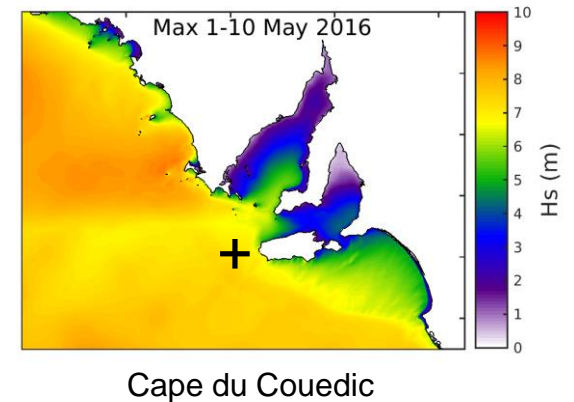
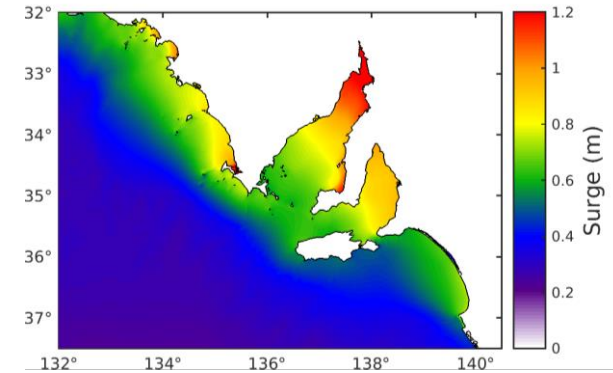
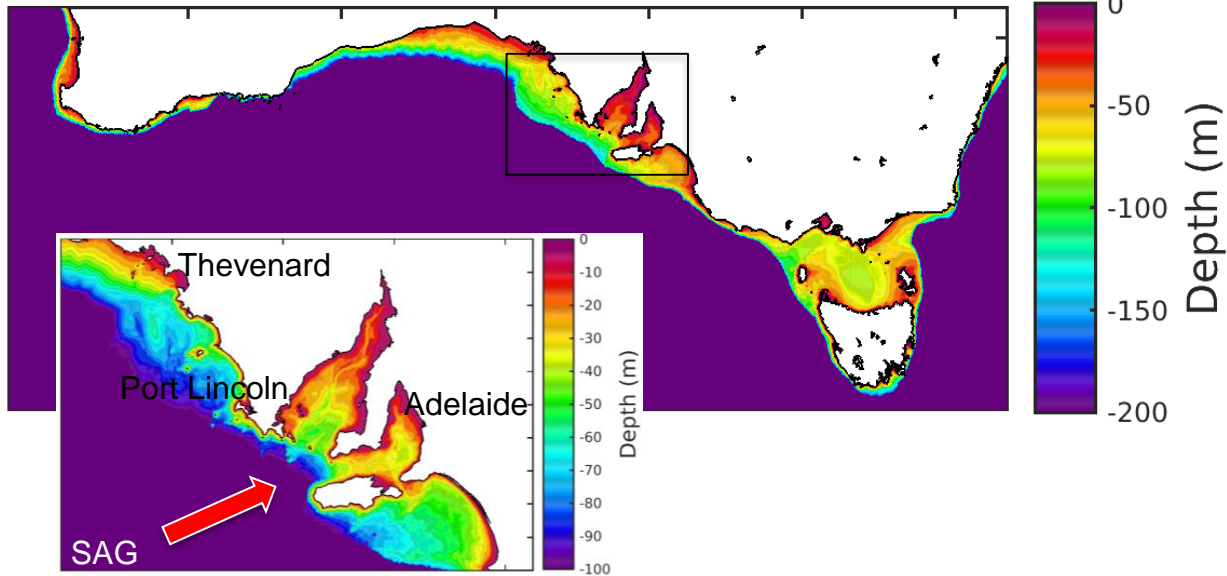
- How does storm track influence the intensity of **coastal currents**, **storm surges**, and **wave heights** in Southern Australia?





# Study site: South Australian Gulfs

- Wide continental shelf across Bight
- Directly exposed to Southern Ocean storms
- Big waves, storm surges, strong shelf currents



# Study site: South Australian Gulfs

- Entrance to Spencer Gulf, fishing, shipping, ports
- Remote! Cape Wiles, Cape Spencer



+Cape Catastrophe, Anxious Bay, Coffin Bay...

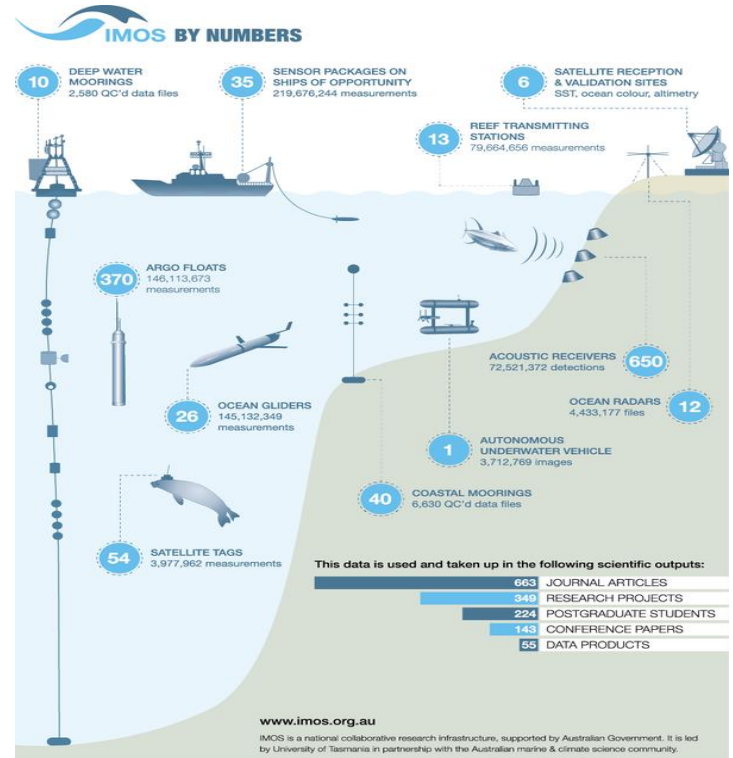


# Study site: South Australian Gulfs

- Entrance to Spencer Gulf, fishing, shipping, ports
- Remote! Cape Wiles, Cape Spencer
- But... data are available!



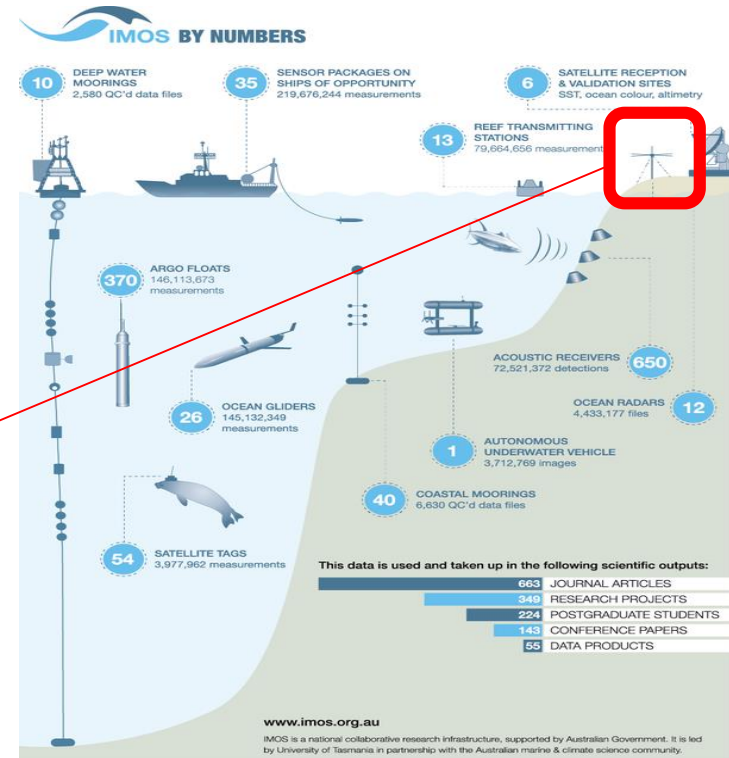
+Cape Catastrophe, Anxious Bay, Coffin Bay...





# Study site: South Australian Gulfs

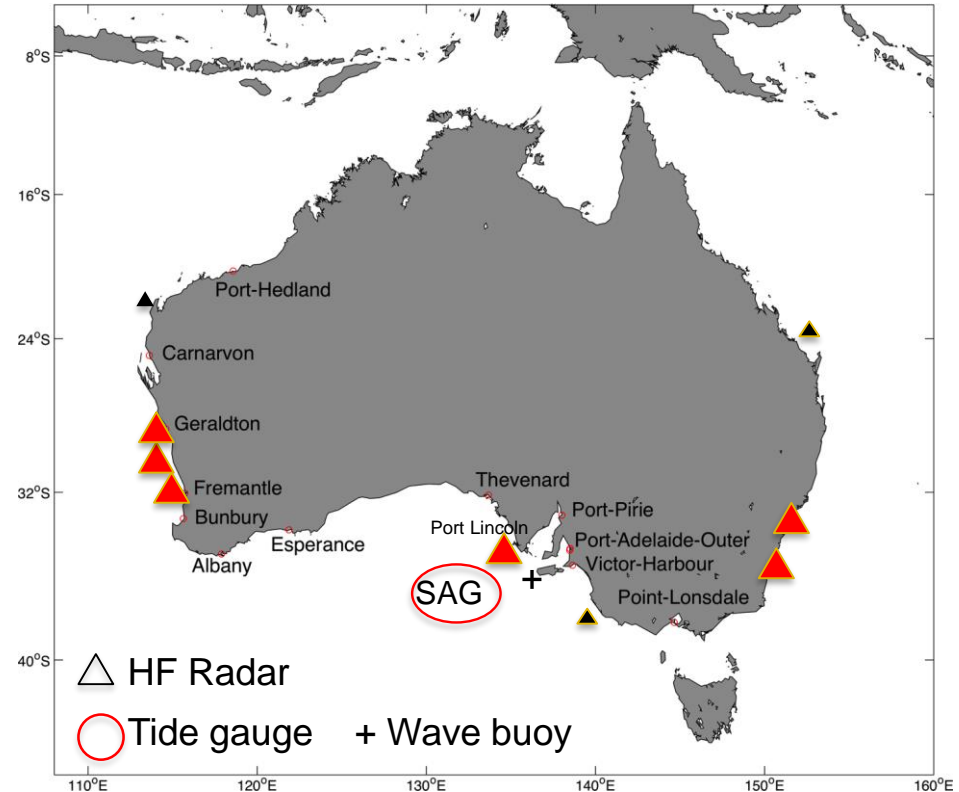
- Entrance to Spencer Gulf, fishing, shipping, ports
- Remote! Cape Wiles, Cape Spencer
- But... data are available!



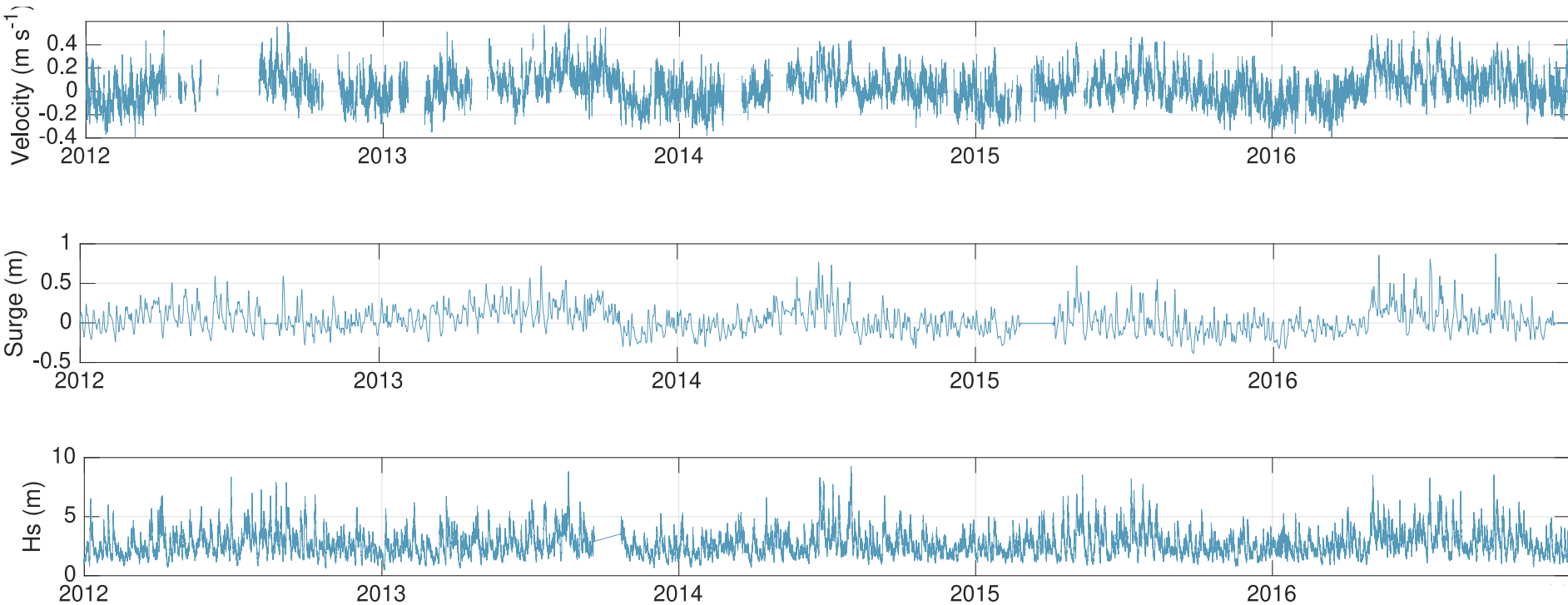
# Data

Focus on 5 years 2012-2016

- HF Radar surface current velocity
- Tide gauge data
- Cape du Couedic wave buoy
- Storm tracks ECMWF ERA-Interim

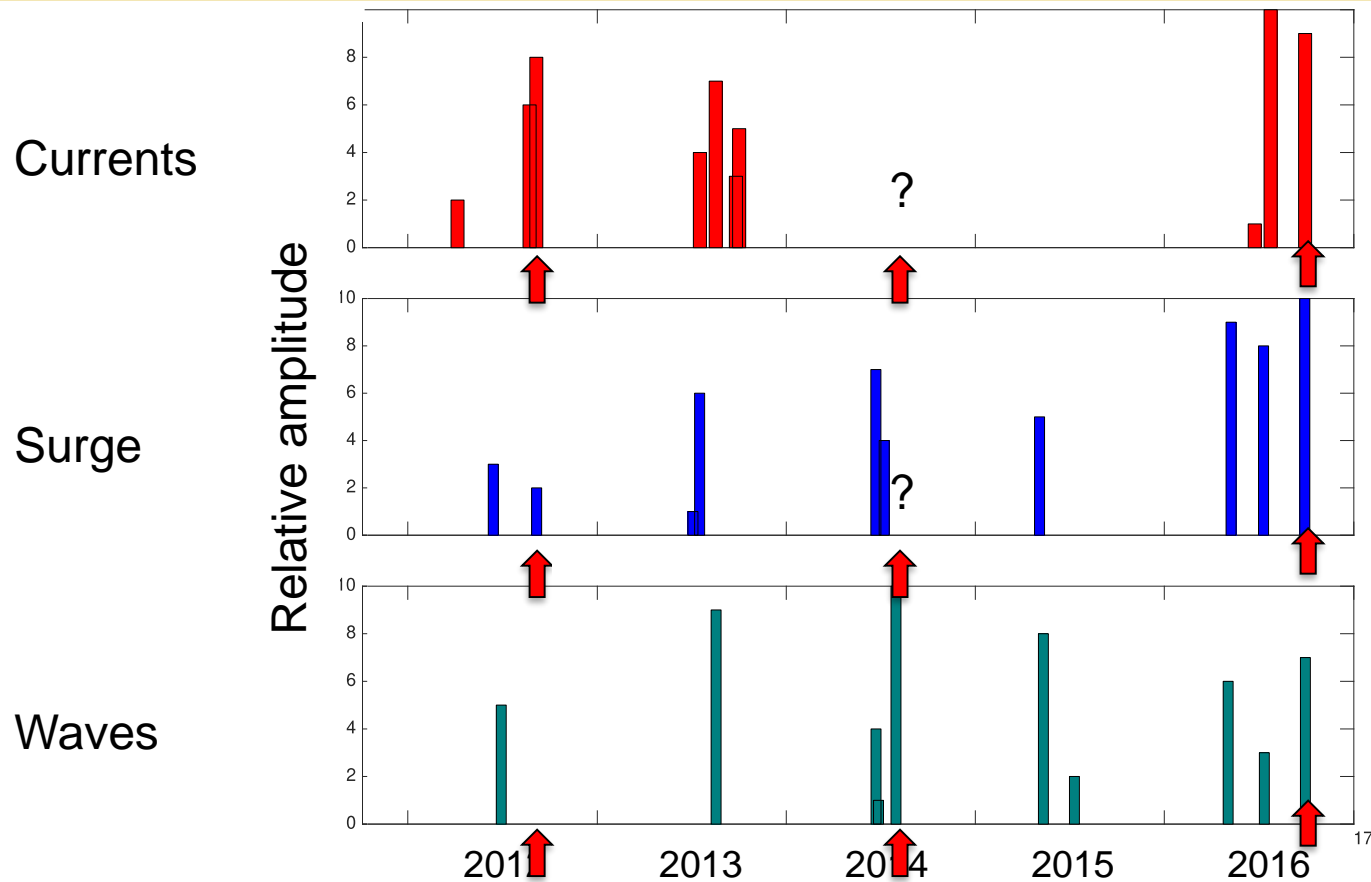


# Currents, storm surges, waves





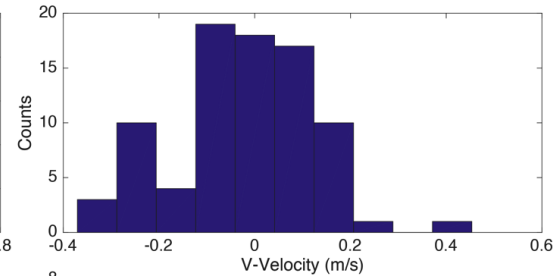
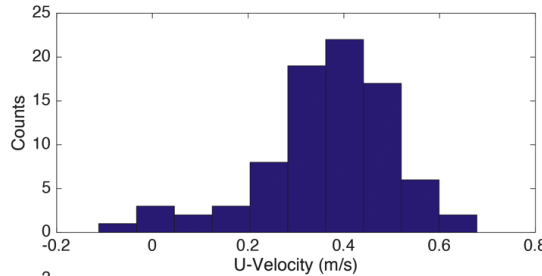
# Top 10 storms (currents, surge, waves)



Extreme events often specific to variable, except for the biggest storms

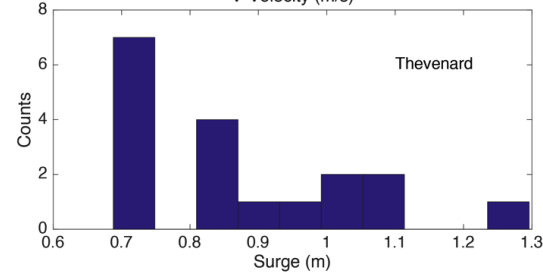
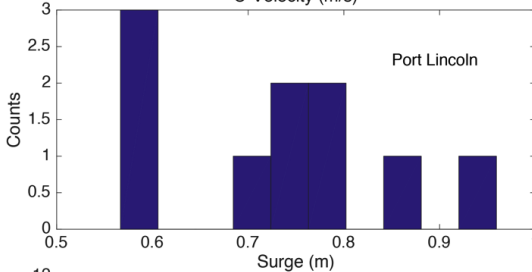
# Amplitudes of extremes

Currents



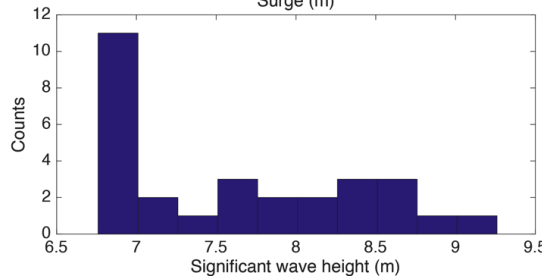
Stronger east velocities

Storm surge



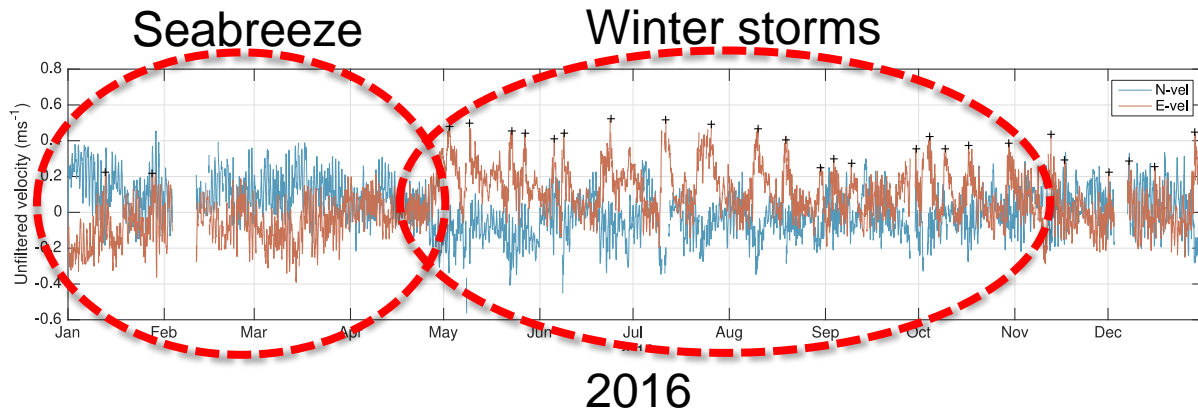
>0.5 m surges, higher at Thevenard

Waves

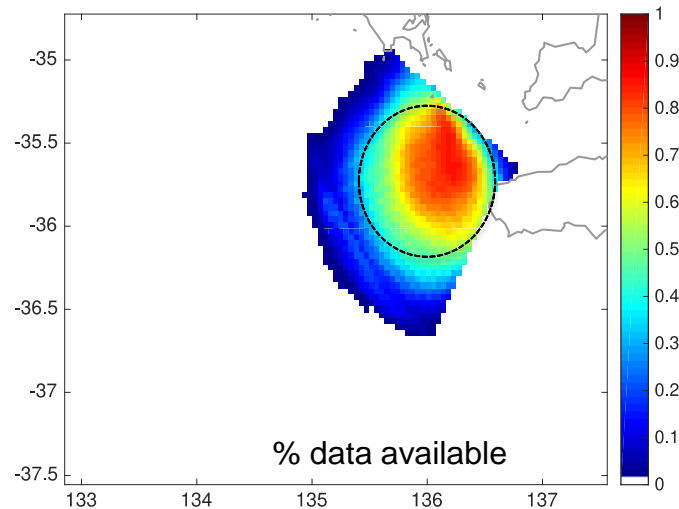


~60% of extreme wave heights > 7m

# Time series - currents



Time series of events  
2012-2016

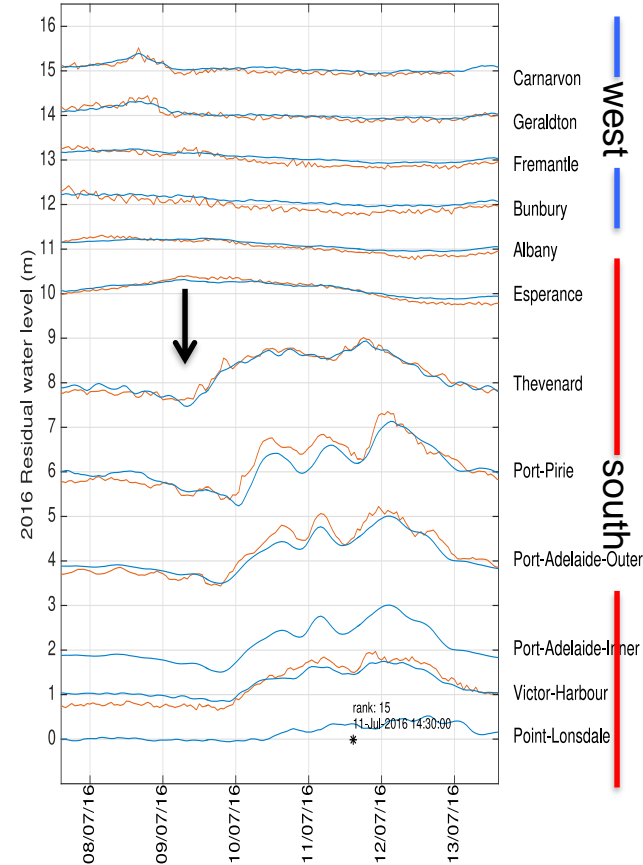
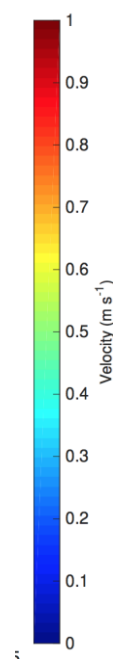
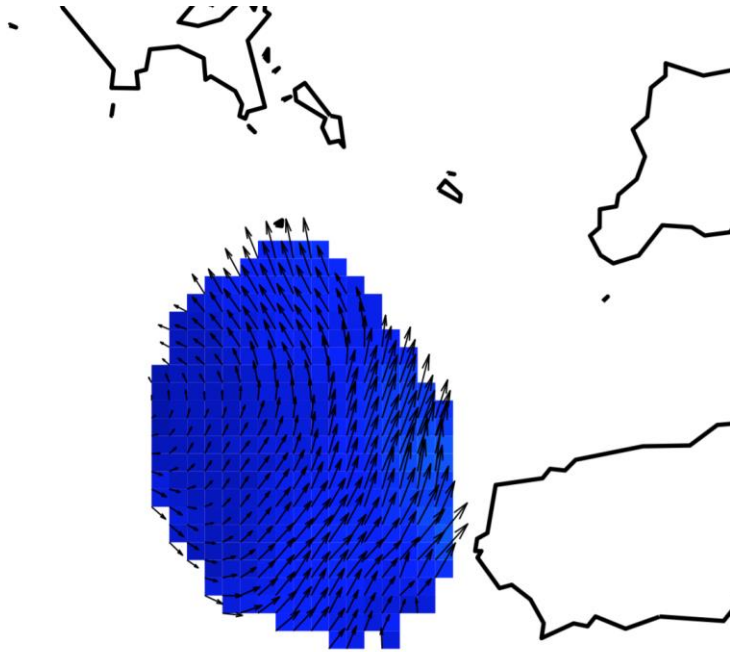


120 ranked events (storms)

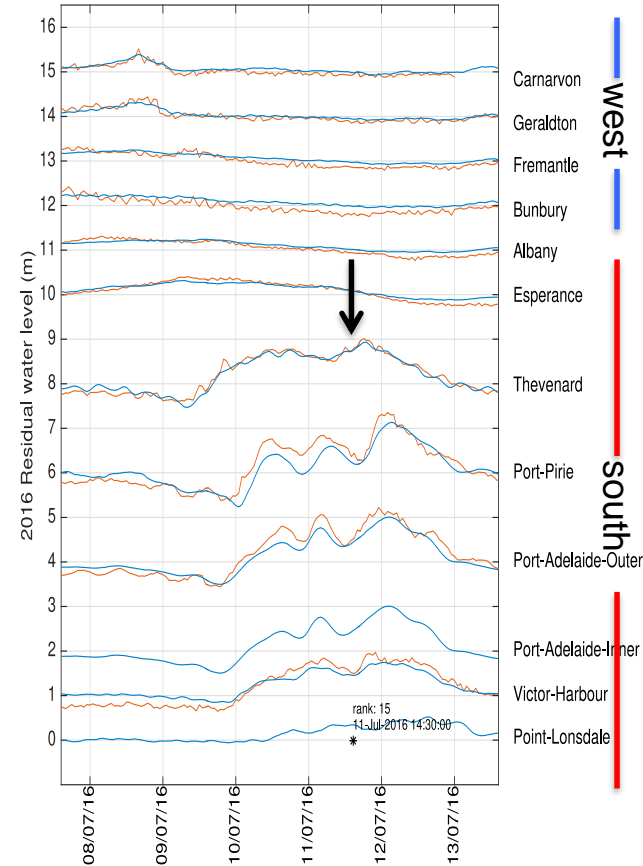
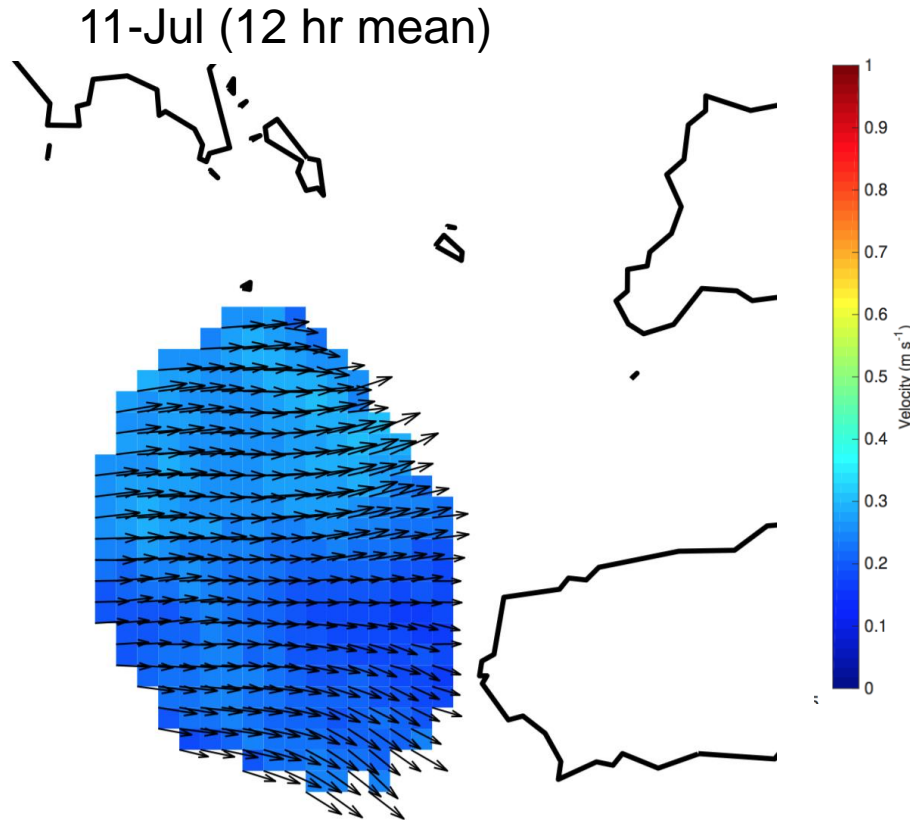


# Current velocities & sea level

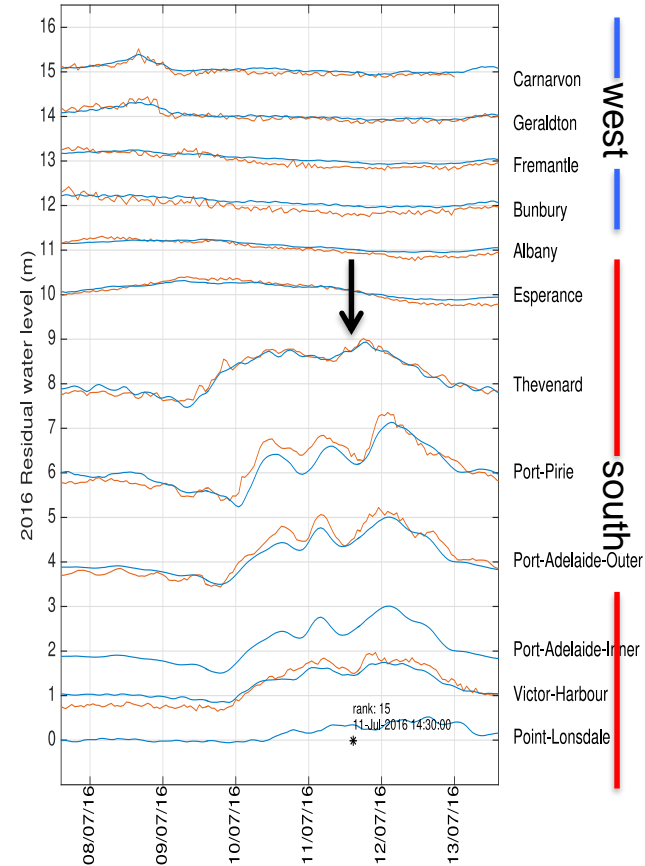
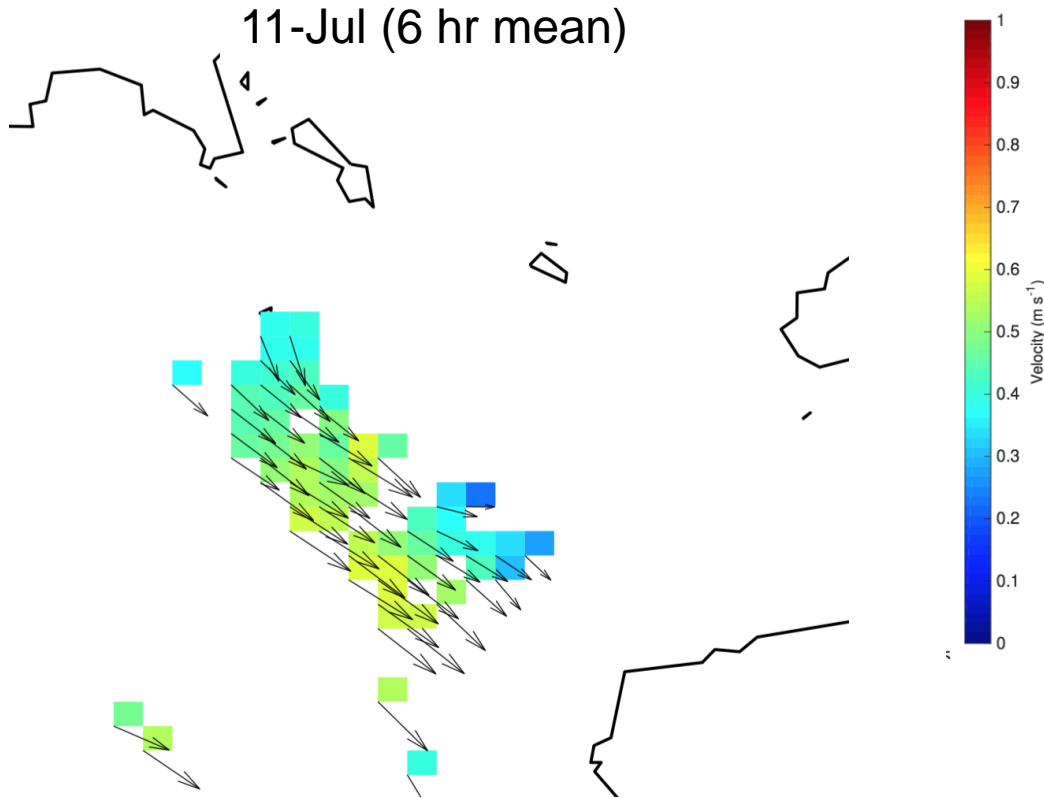
9-Jul (12 hr mean)



# Current velocities & sea level

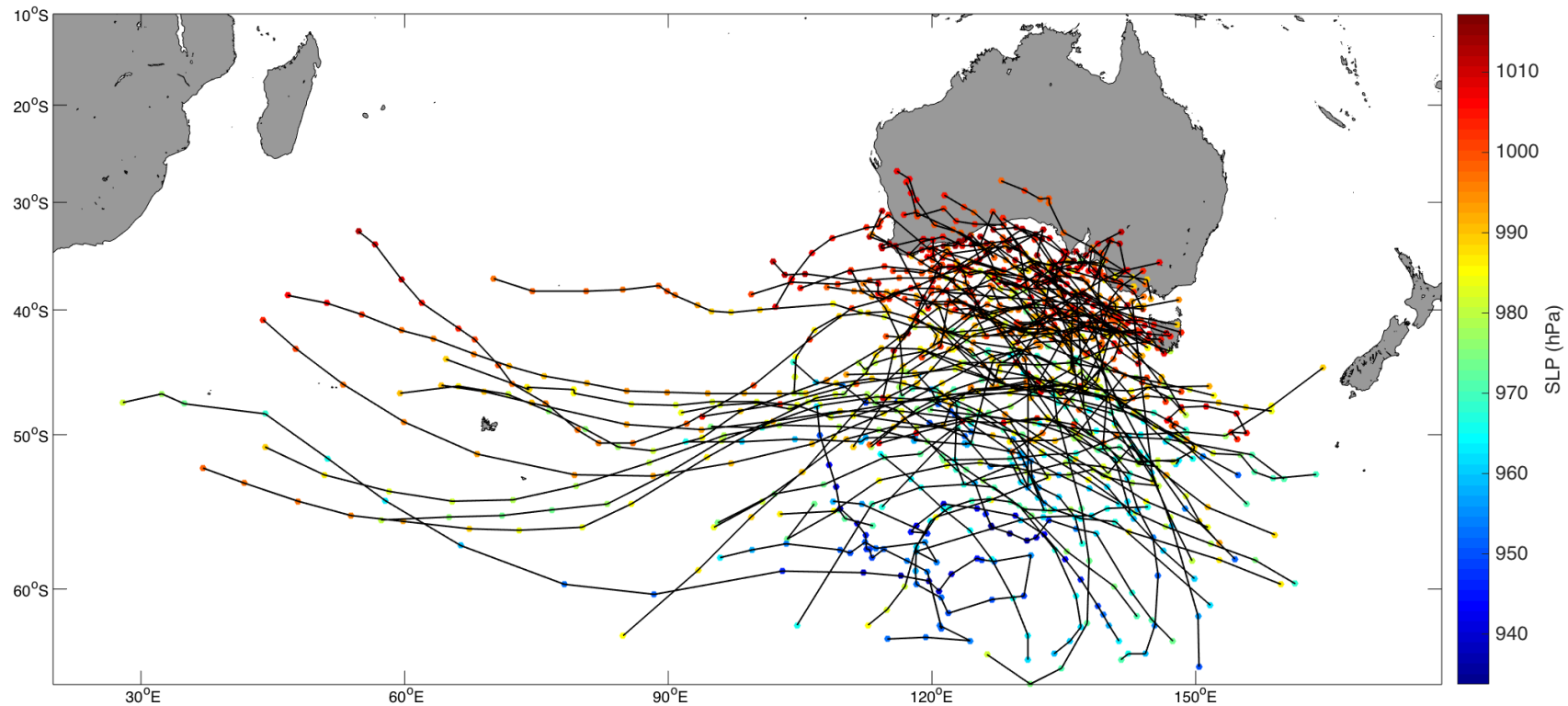


# Current velocities & sea level

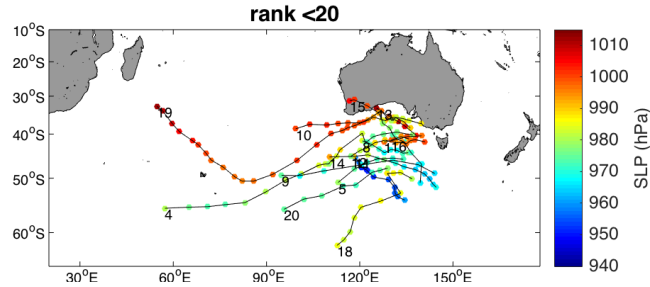




# Storm tracks



# Storm track clusters

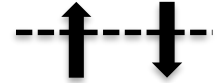


Track along coast

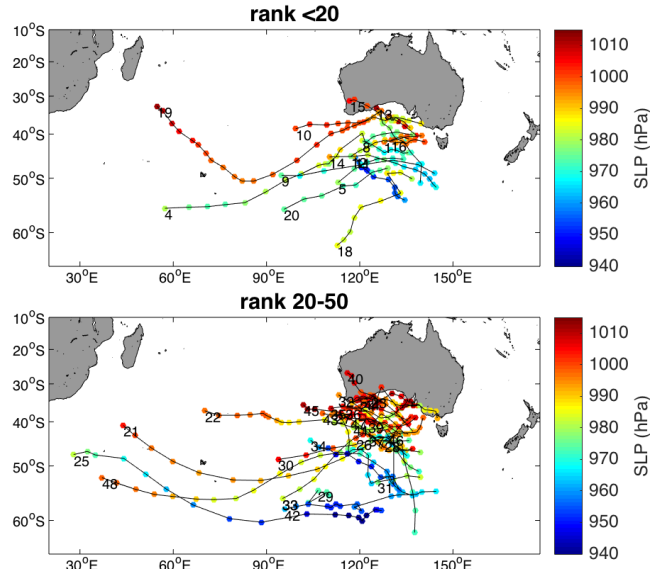
Low pressure

Strong winds

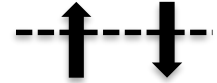
Along coast wind gradients



# Storm track clusters



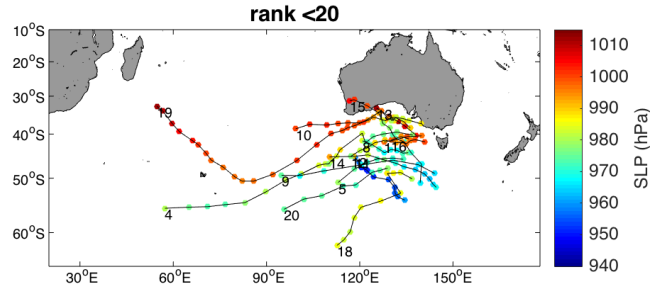
Track along coast  
Low pressure  
Strong winds  
Along coast wind gradients



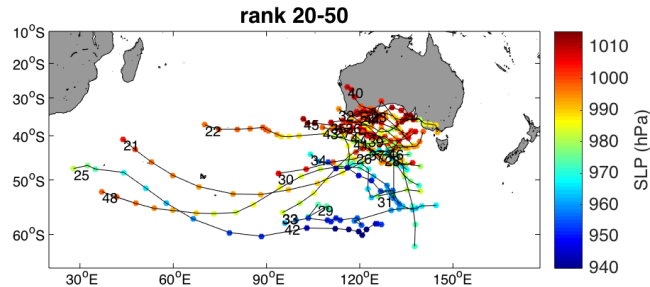
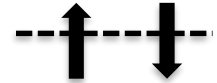
Track along coast  
Less low pressure  
Weak winds  
Uniform winds



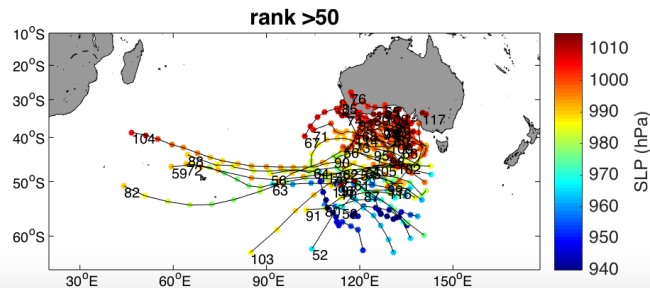
# Storm track clusters



Track along coast  
Low pressure  
Strong winds  
Along coast wind gradients

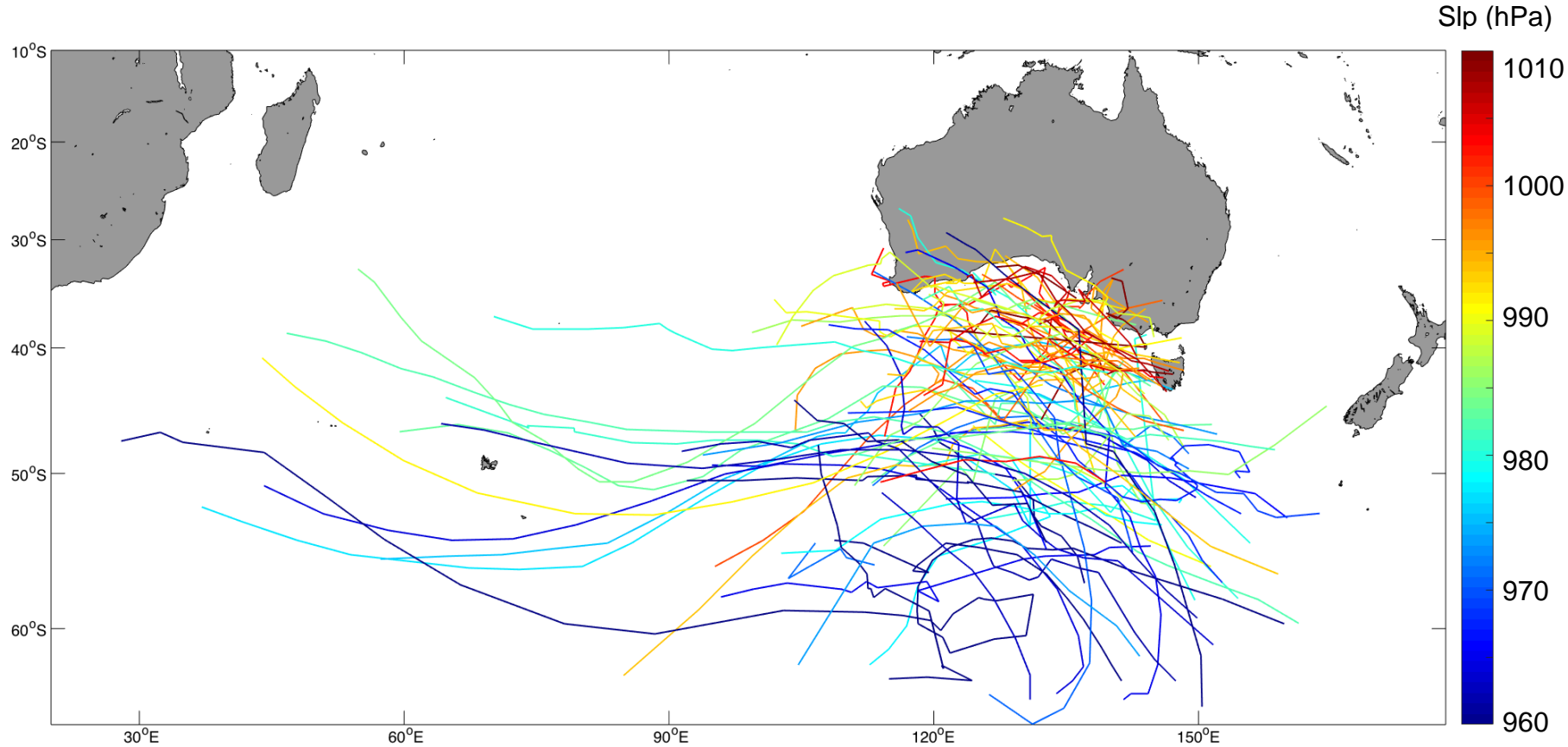


Track along coast  
Less low pressure  
Weak winds  
Uniform winds

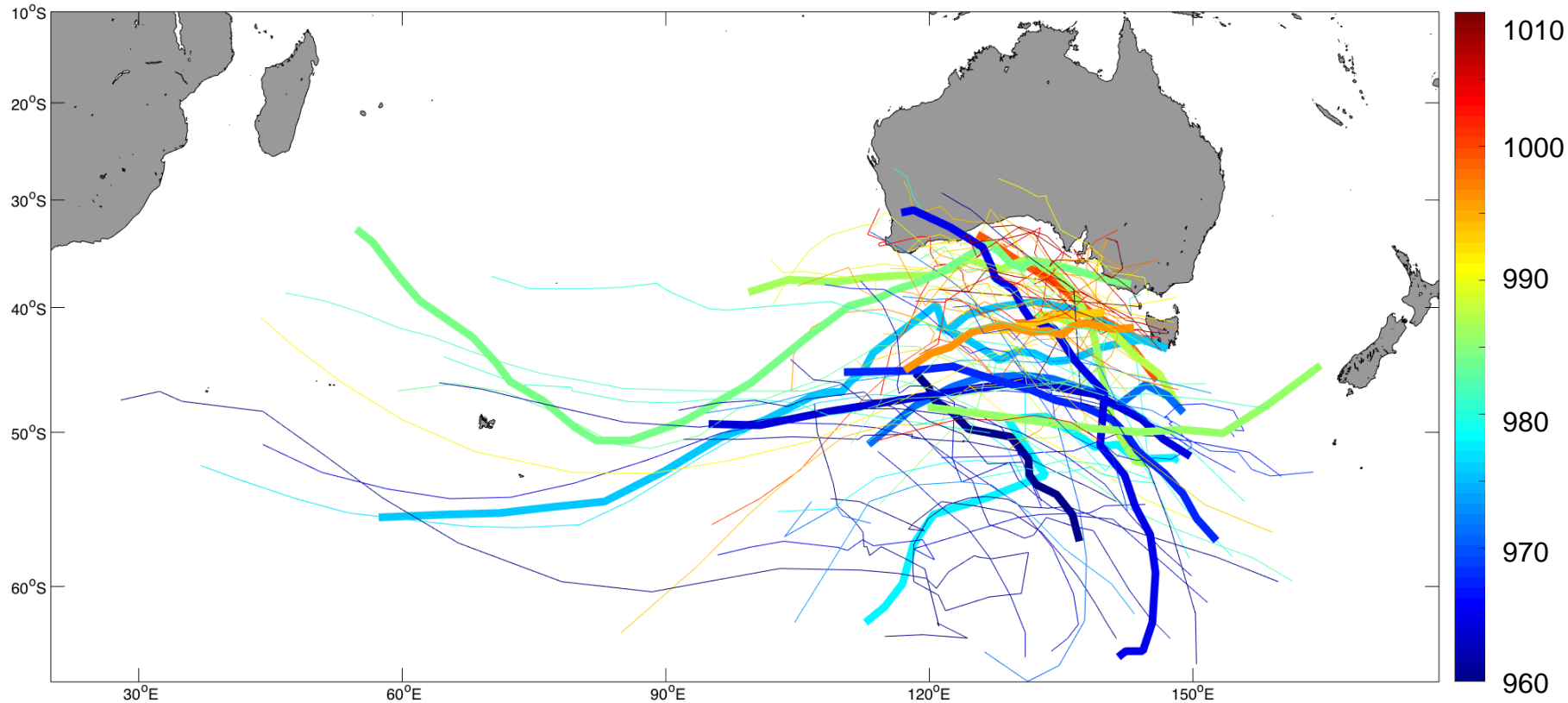


HIGH pressure or  
Far from coast  
Distant storms (often summer)

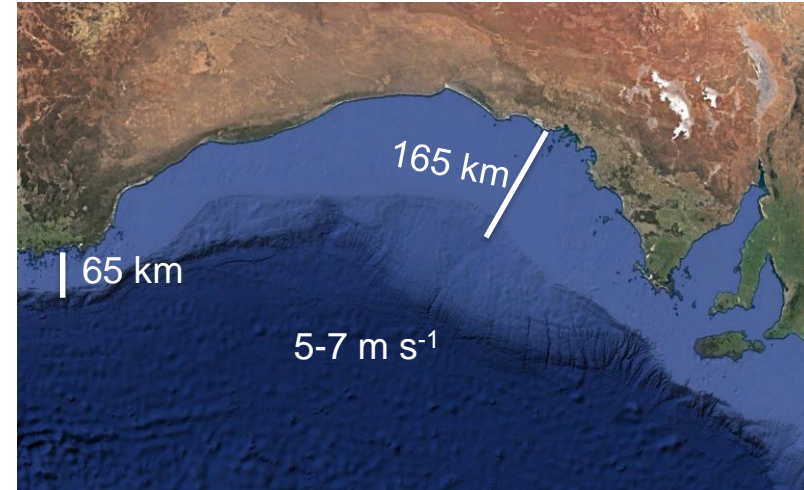
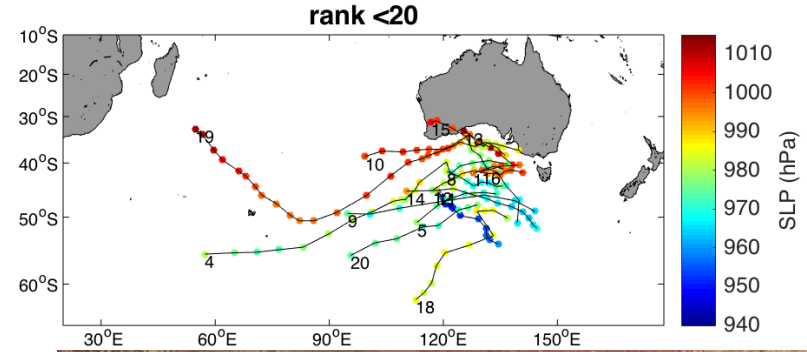
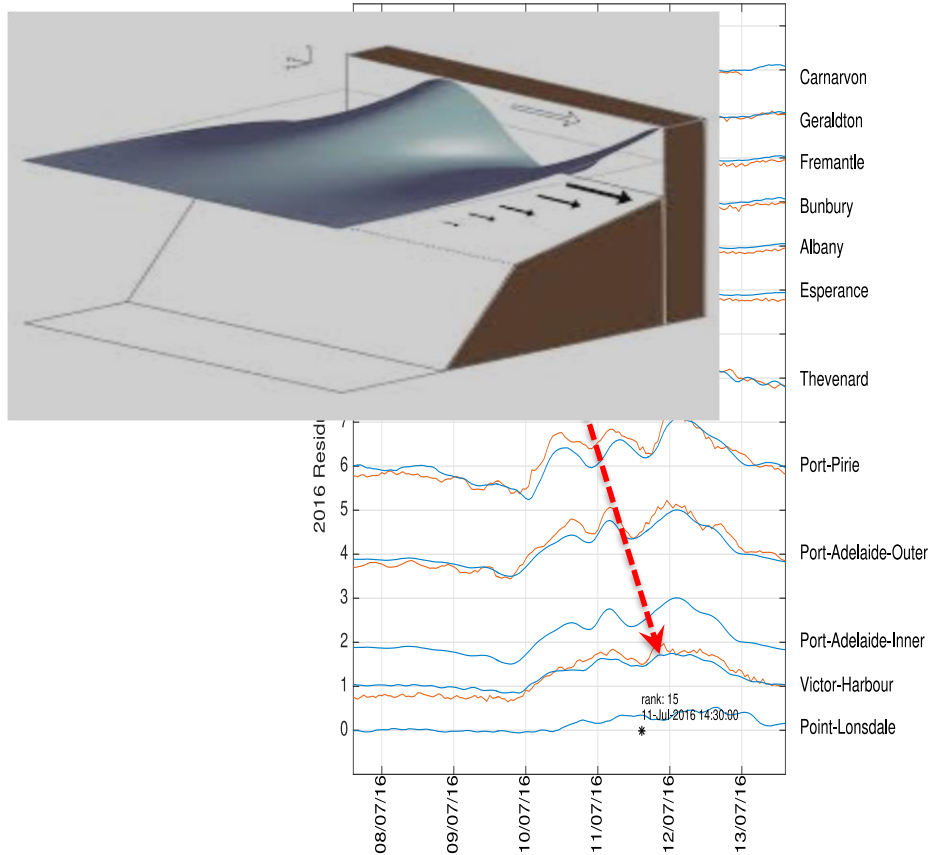
# All storm tracks



# Storms causing strong currents

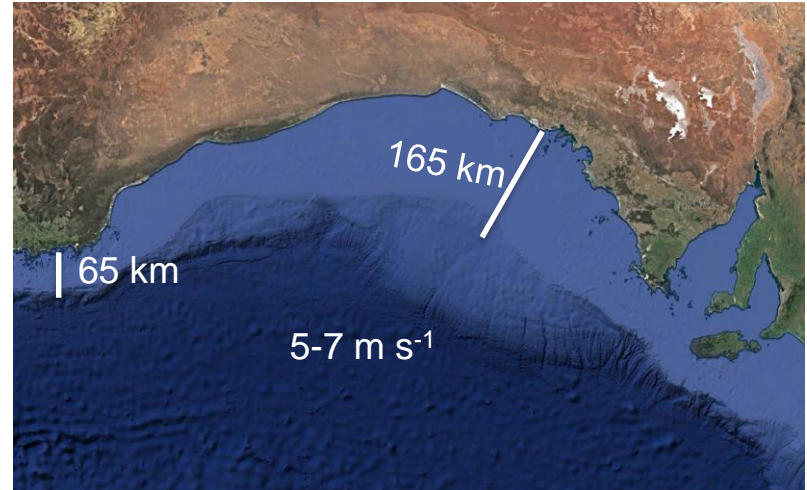
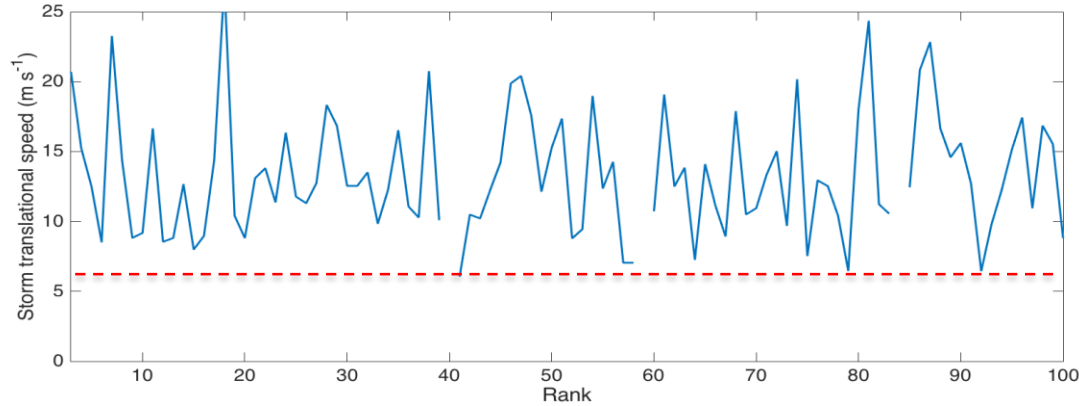
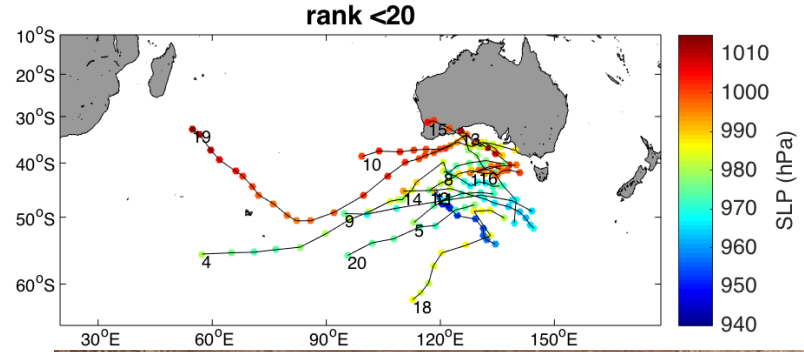
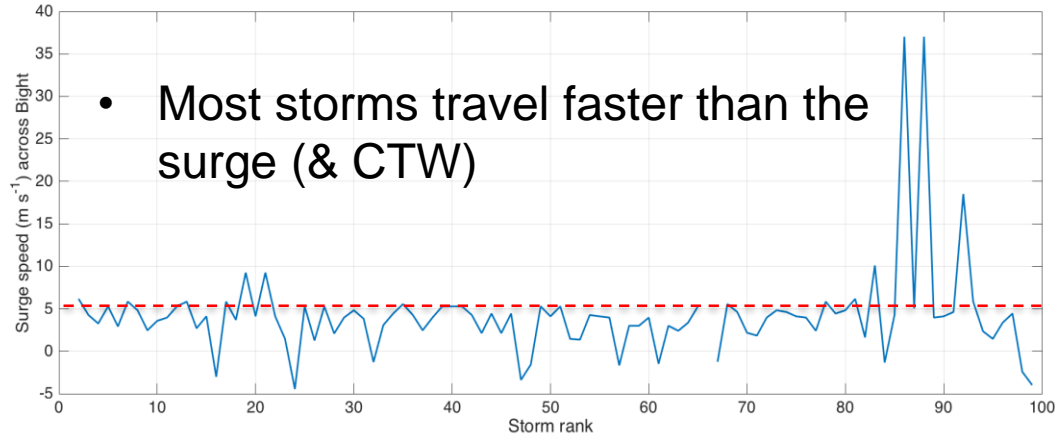


# Are these coastally trapped waves?



# Are these coastally trapped waves?

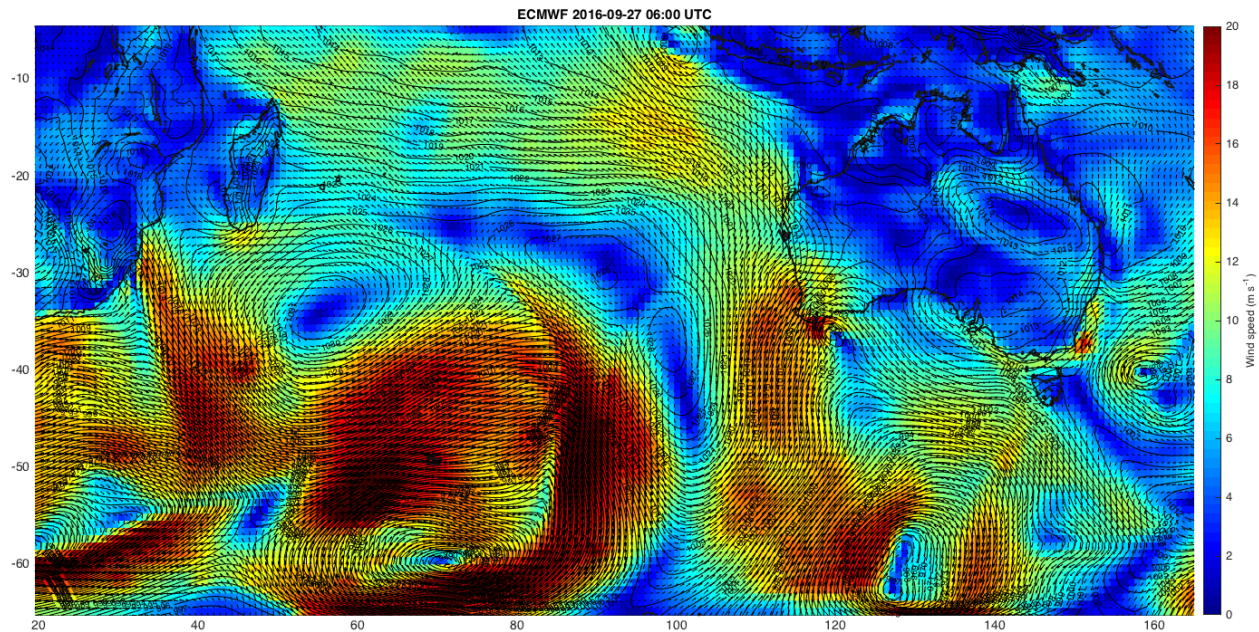
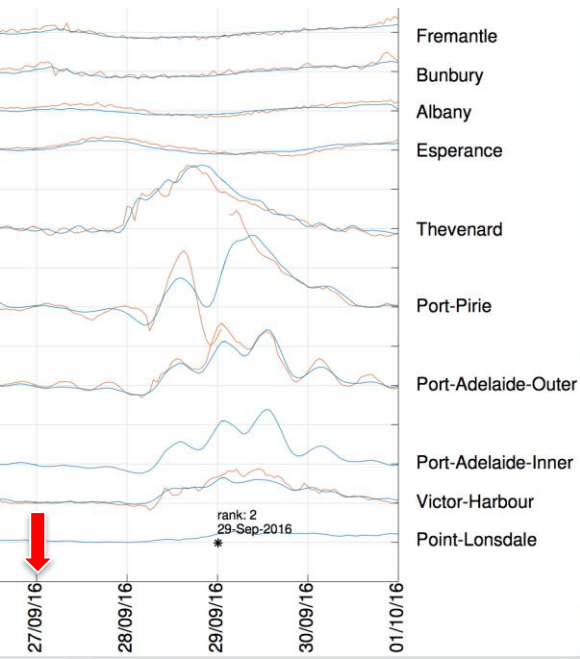
- Most storms travel faster than the surge (& CTW)





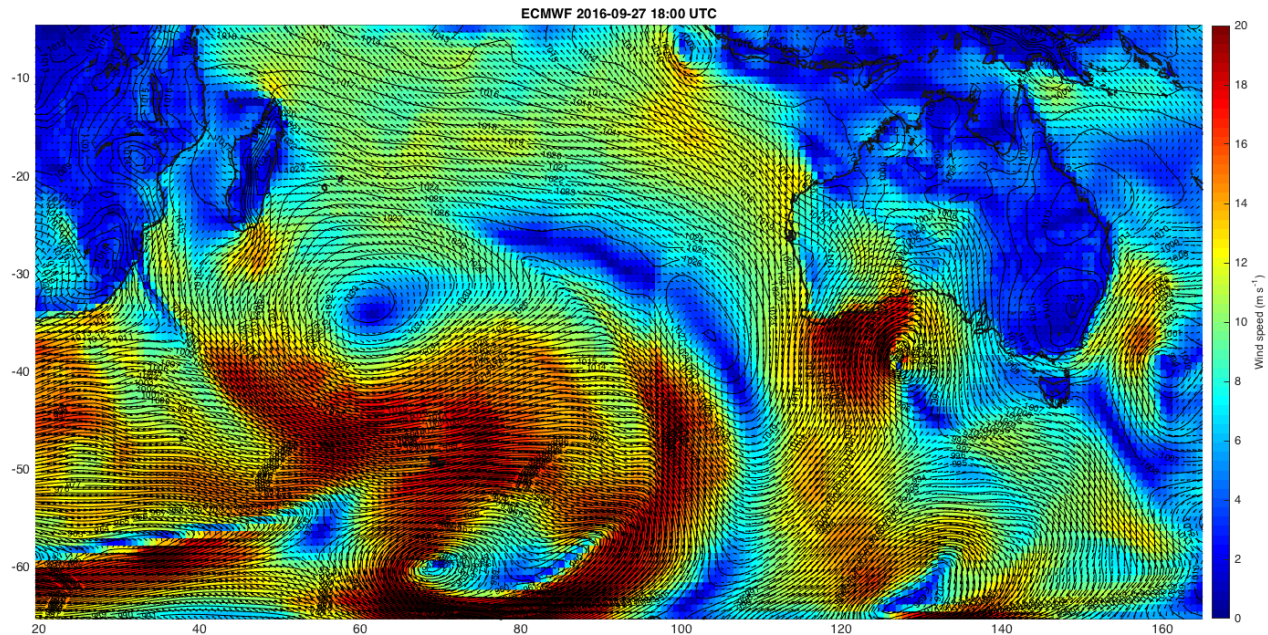
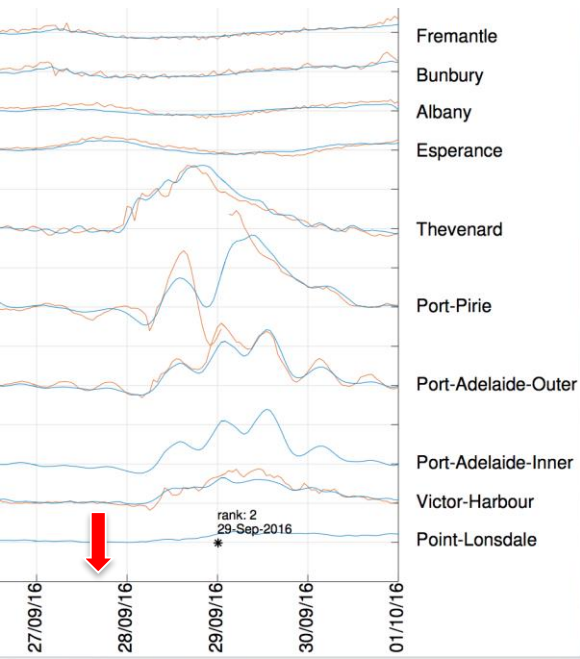
# The Perfect Storm

- Intense storm (Low pressure + strong winds)
- Rotating structure (onshore/offshore flow)
- Track along coast → coastally trapped waves likely
- Slow translational speed
- High pressure to west is favorable



# The Perfect Storm

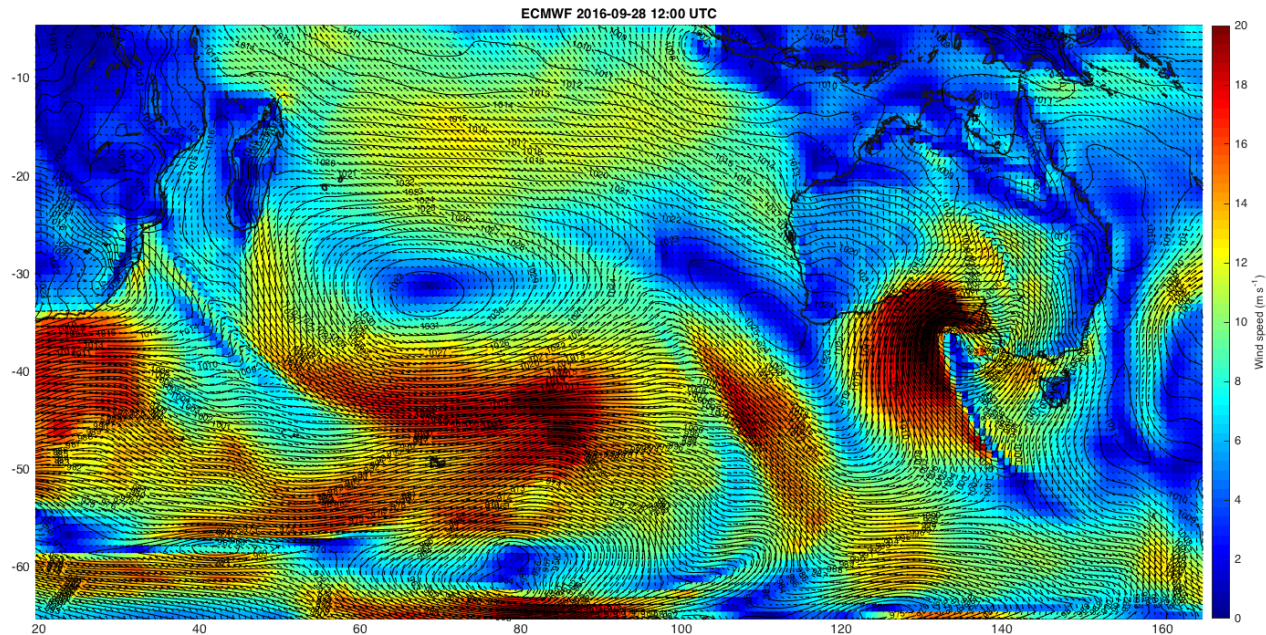
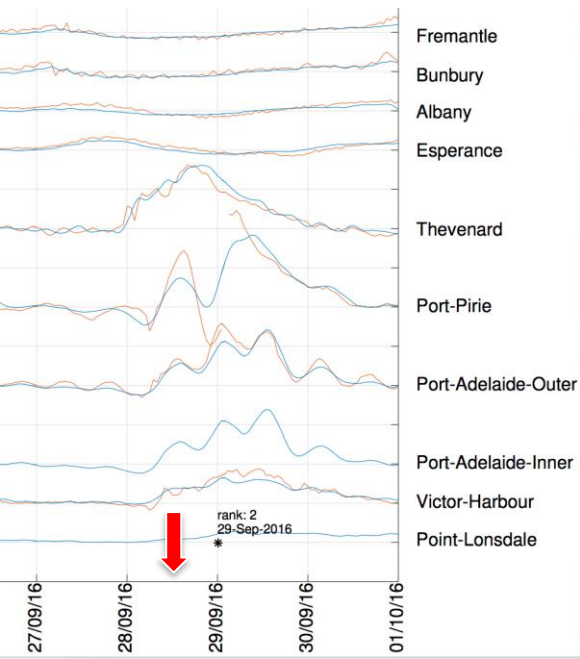
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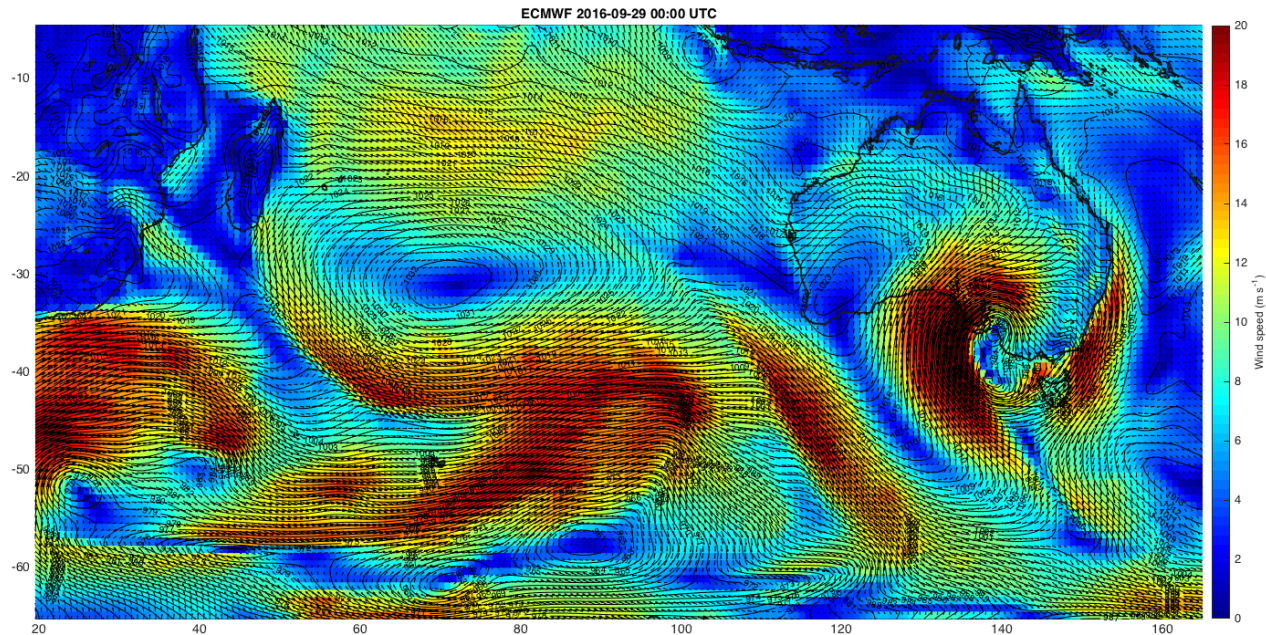
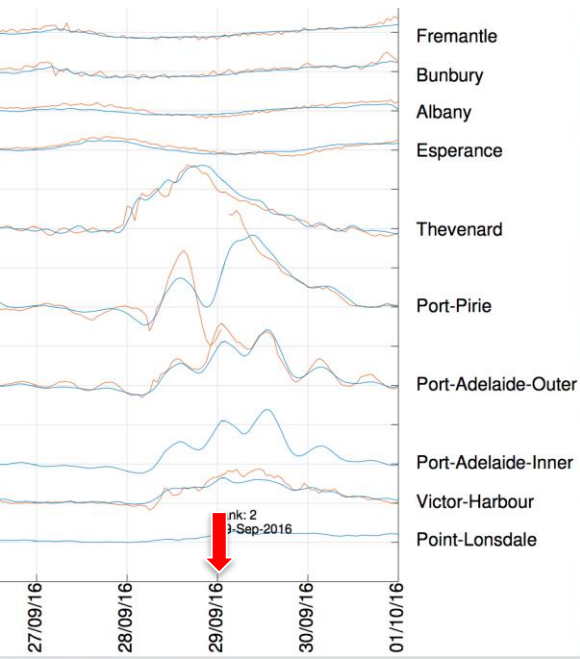
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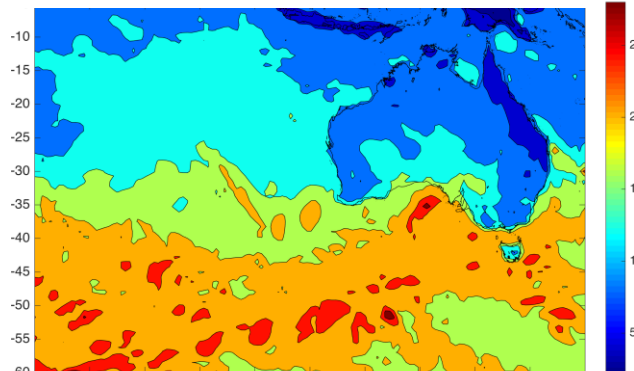
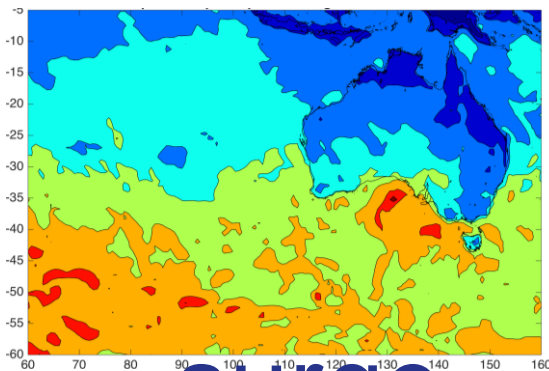
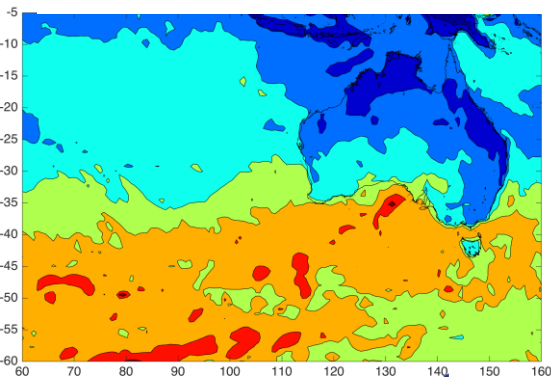
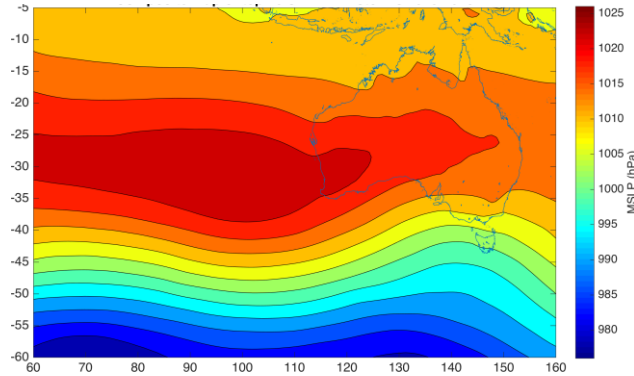
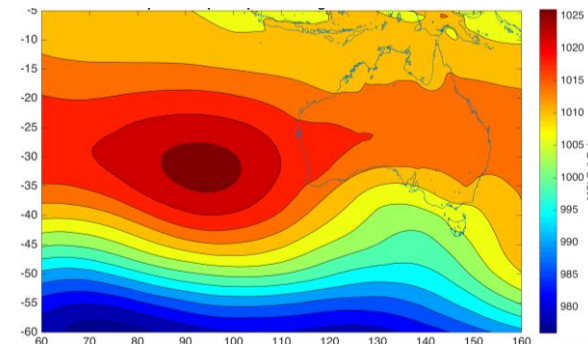
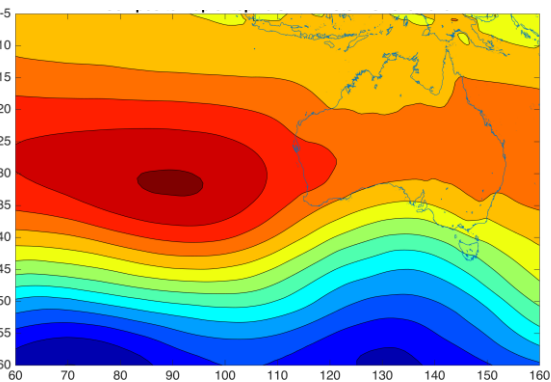
# The Perfect Storm

- Intense storm (Low pressure + strong winds)
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# Composite maps of top 10 events



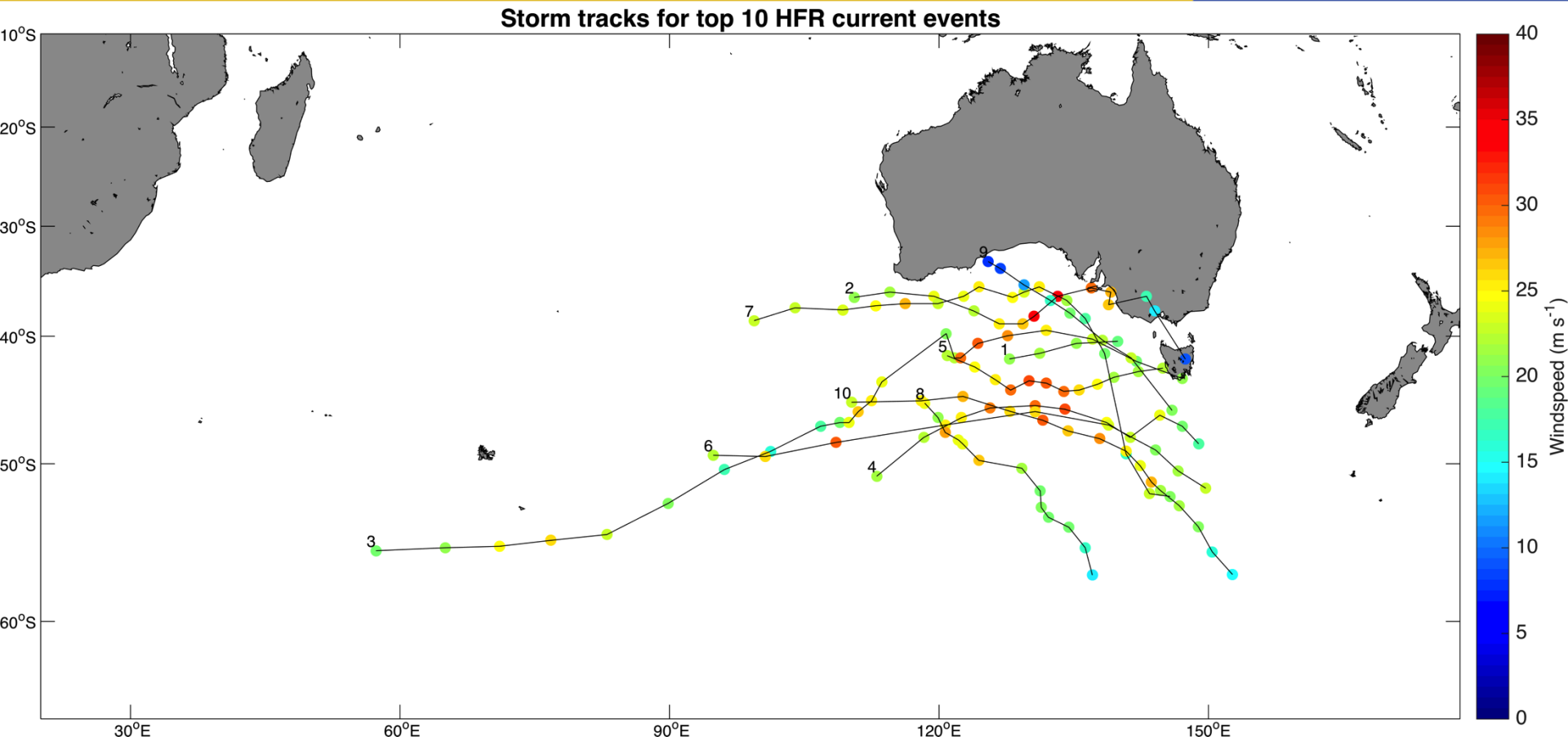
current

surge

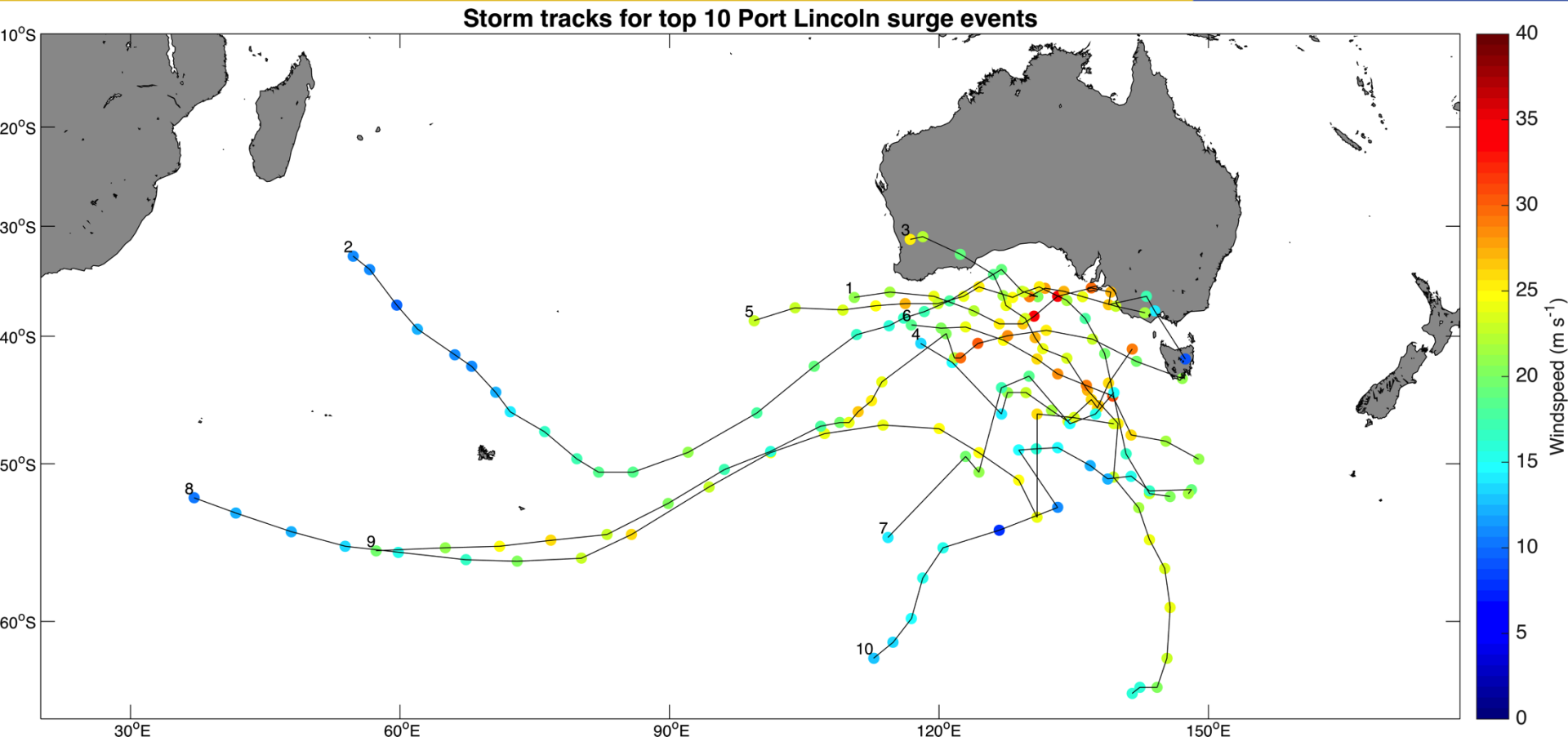
waves



# Currents (top10)

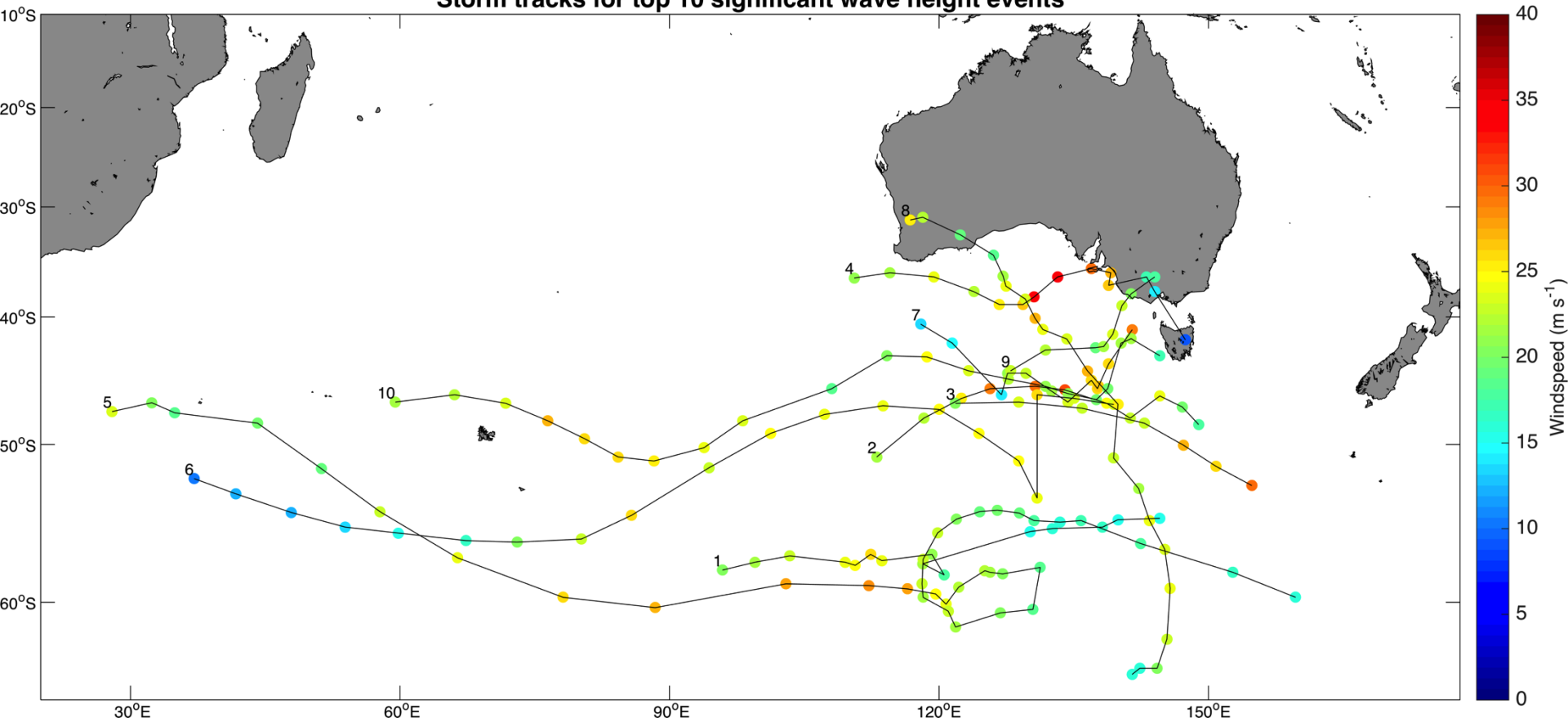


# Storm surge (top10)

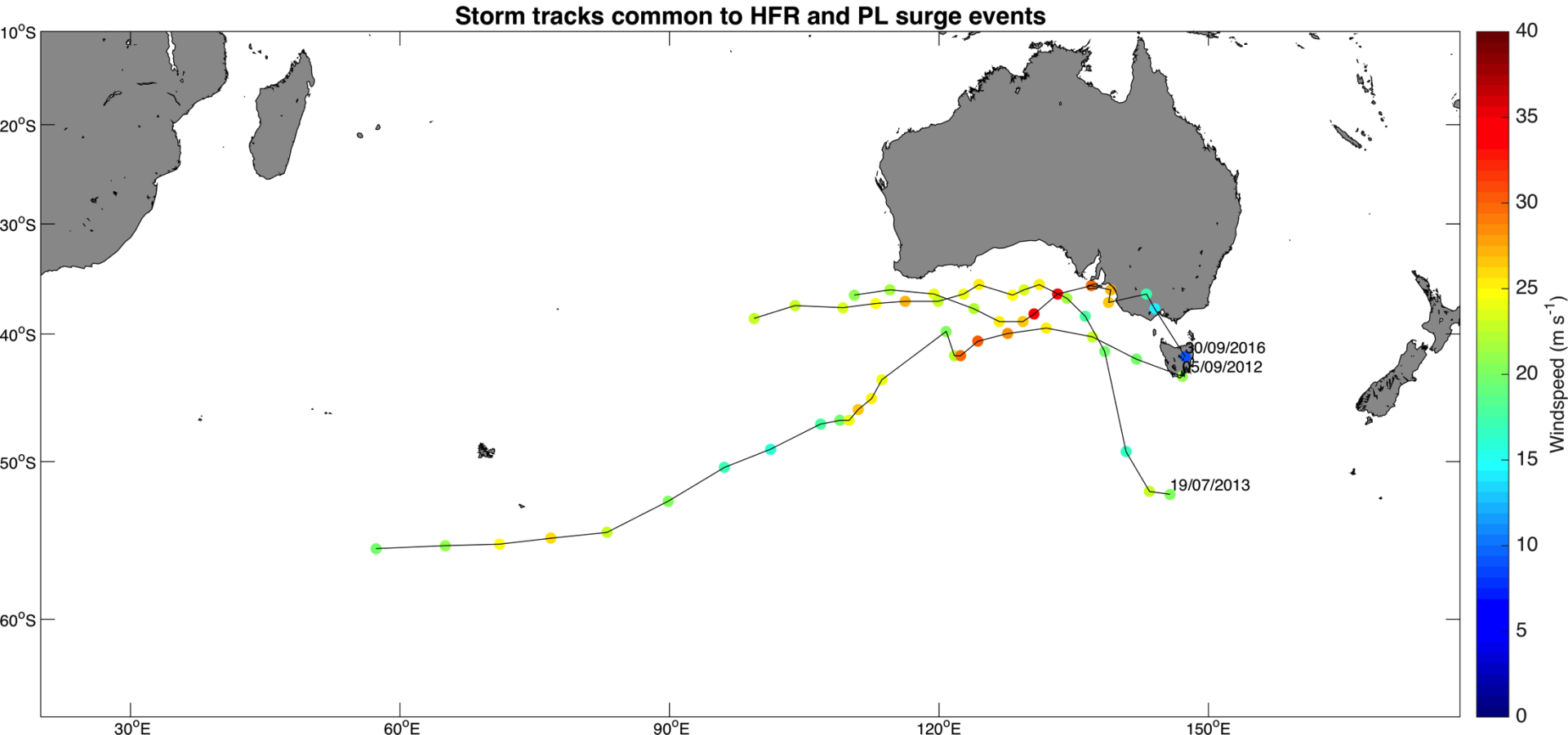


# Waves (top10)

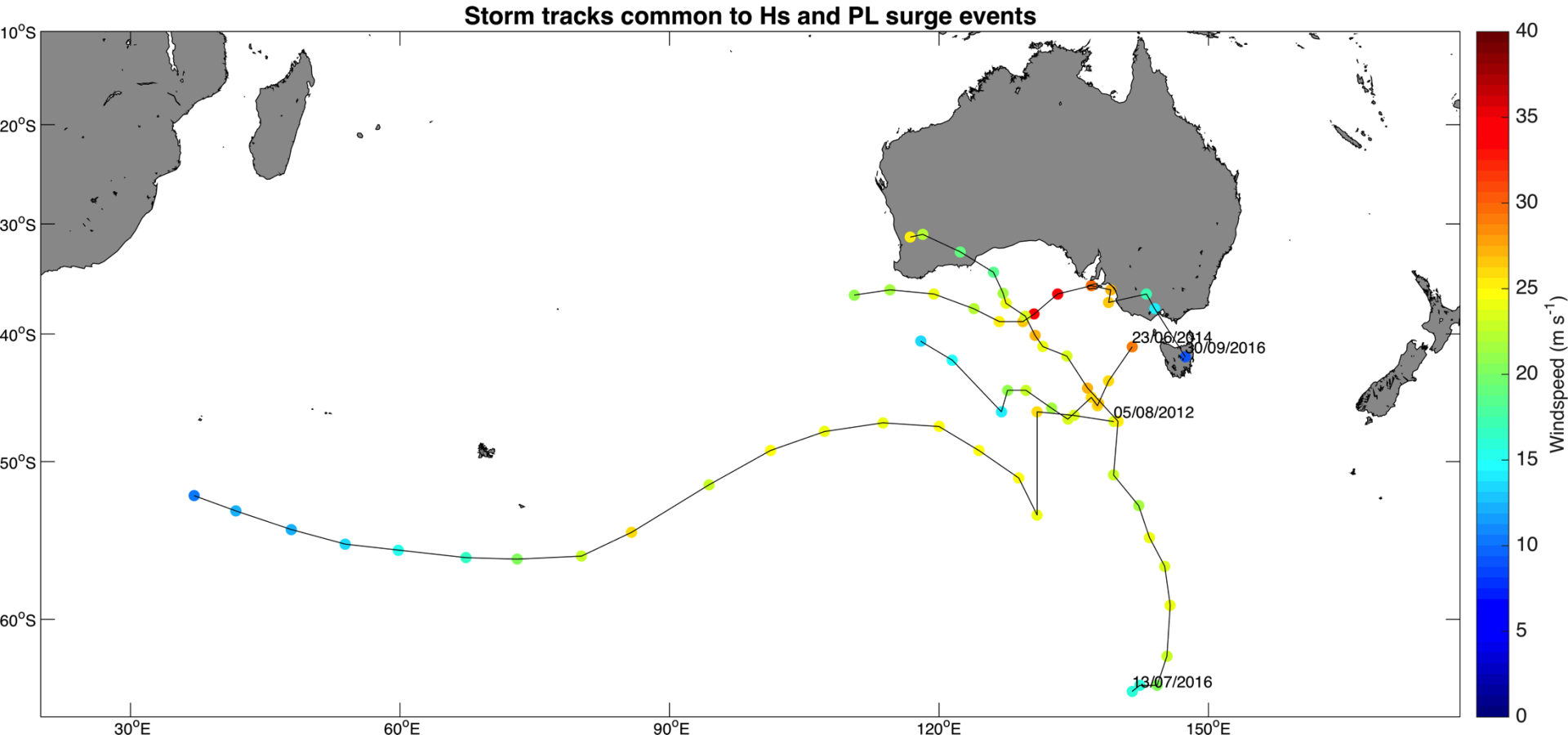
Storm tracks for top 10 significant wave height events



# Common storms – currents & surge

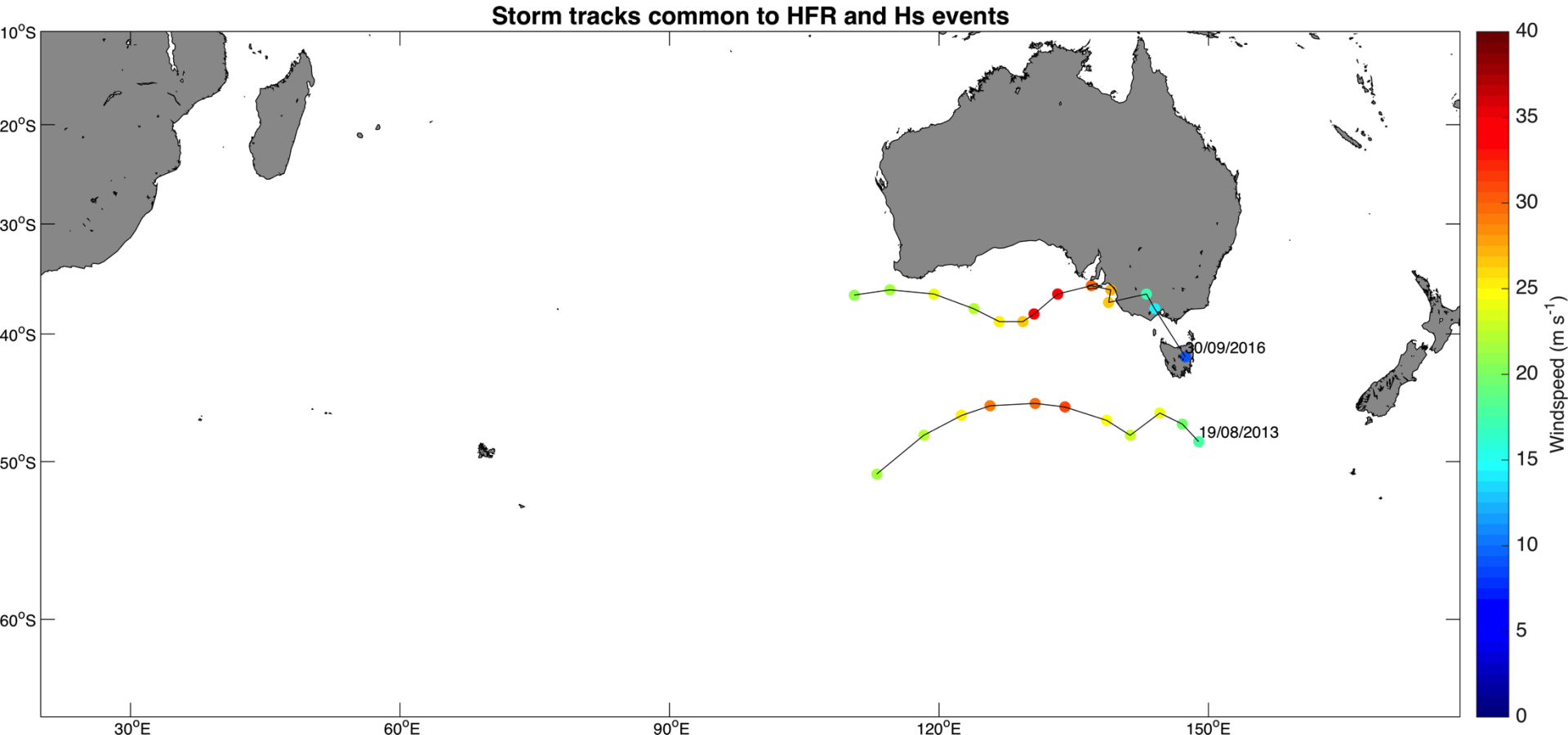


# Common storms – waves & surge

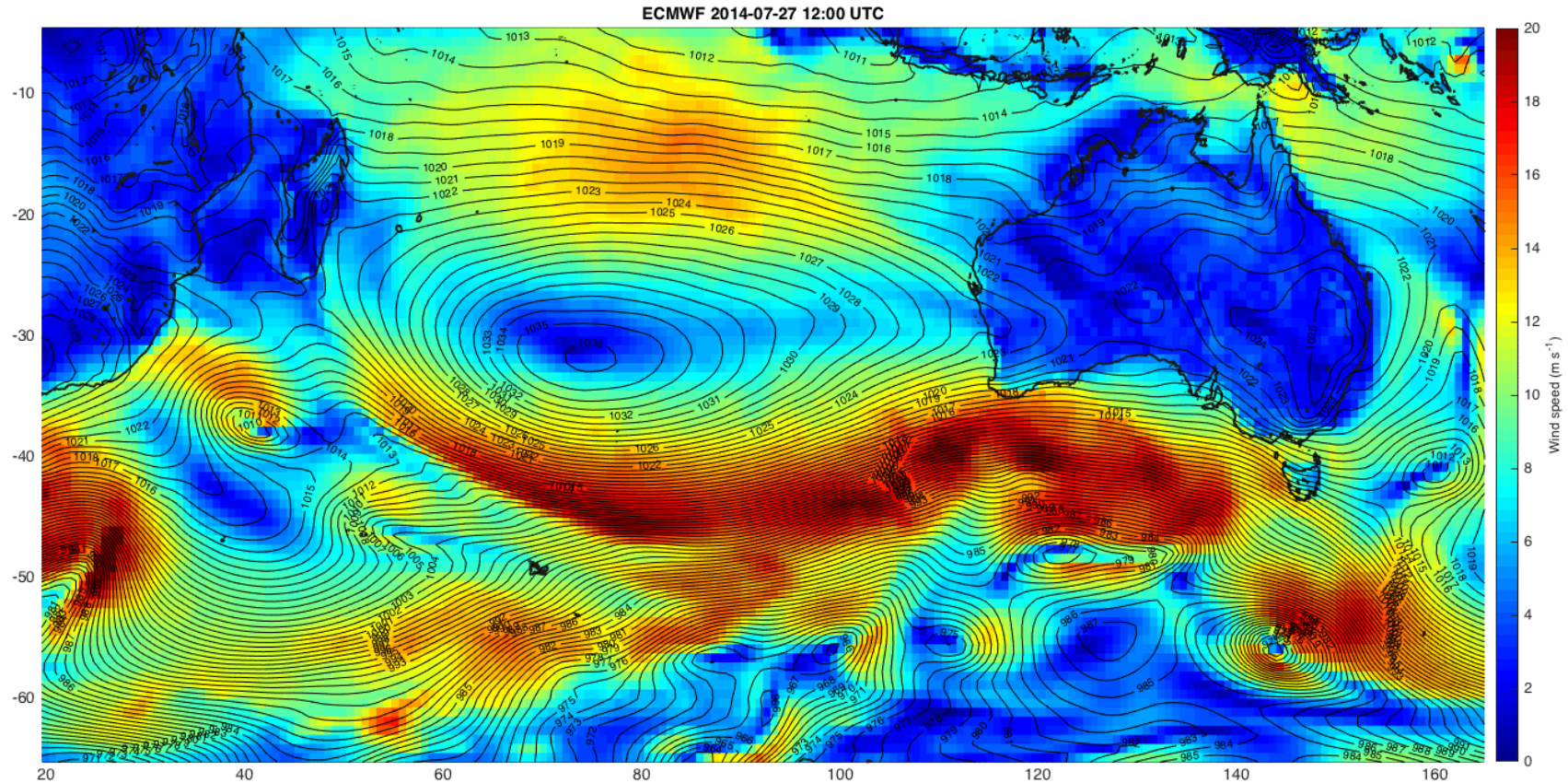




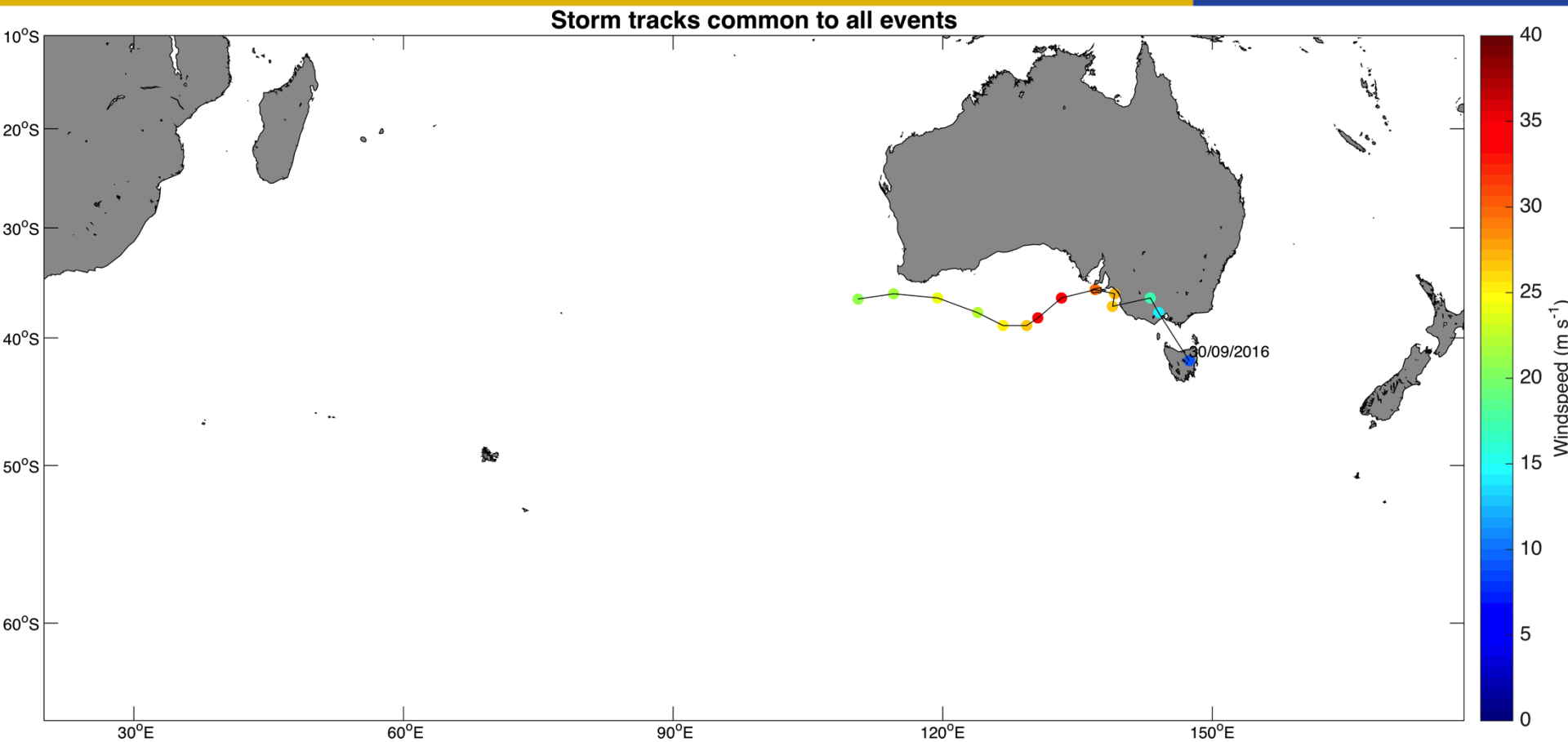
# Common storms – waves & currents



# #1 ranked waves storm



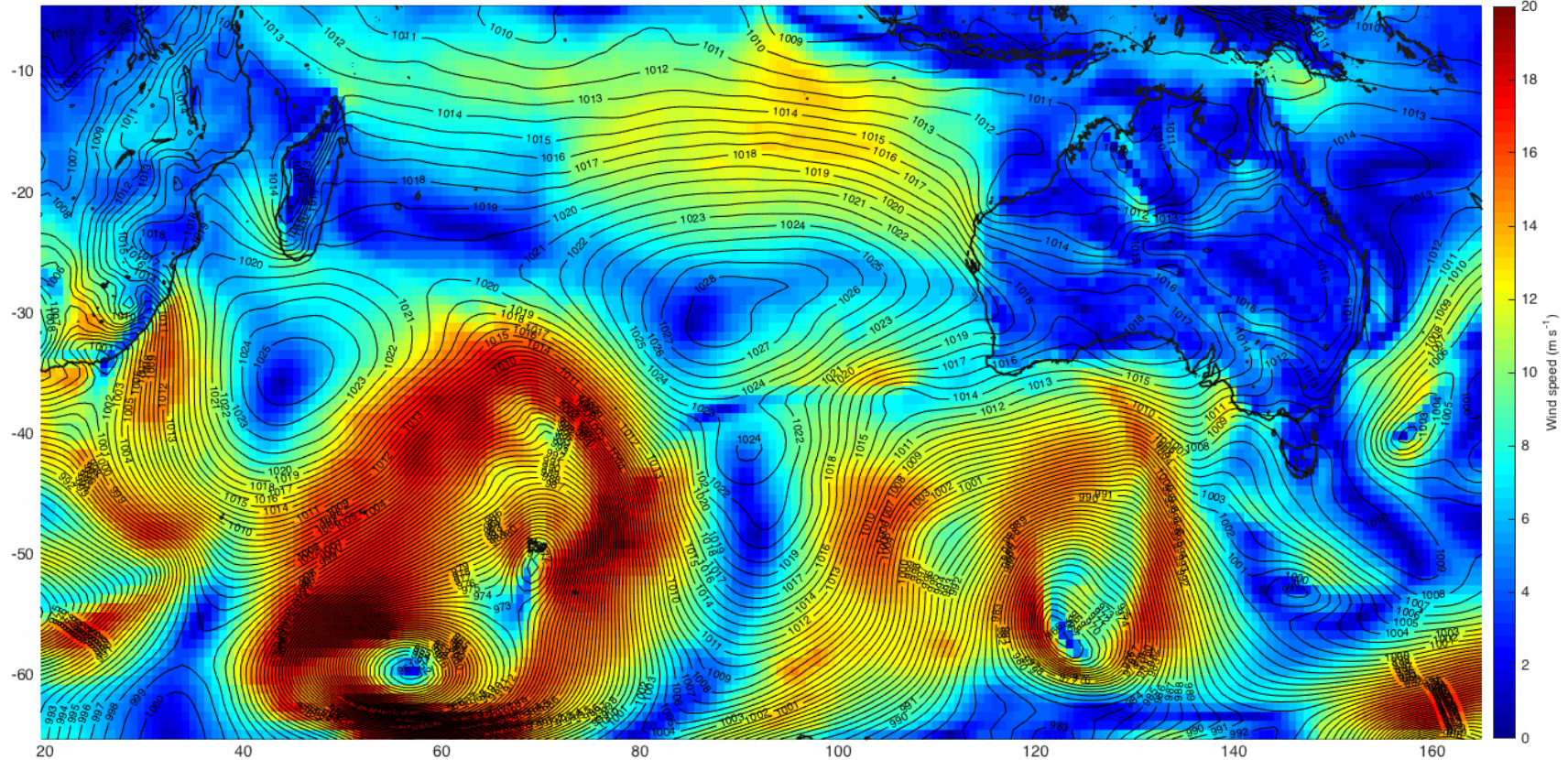
# Common storm (from all top 10)





# ~~Perfect~~ storm (from all top 10)

ECMWF 2016-09-26 12:00 UTC





# Summary



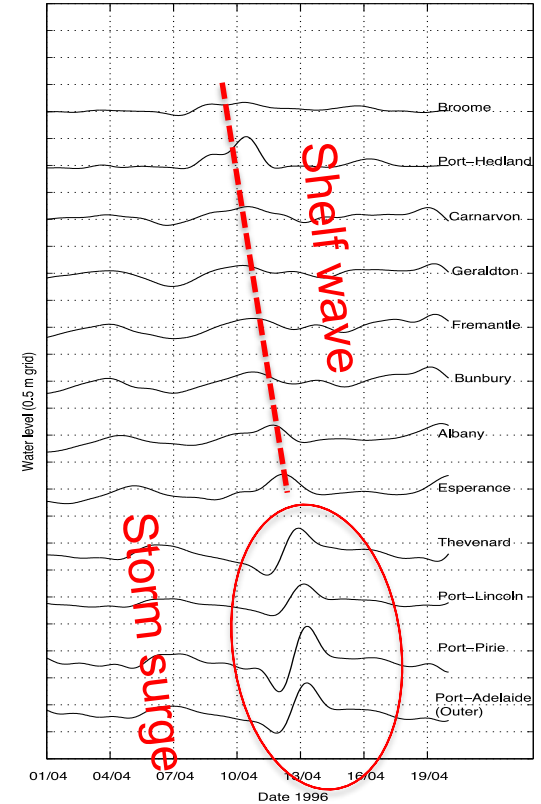
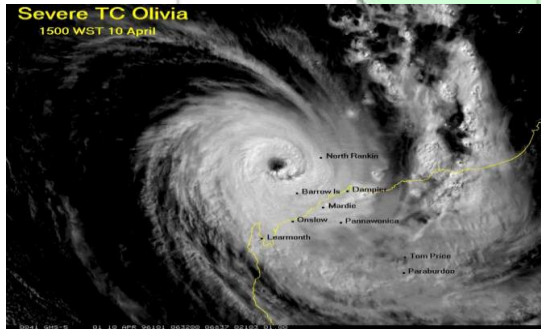
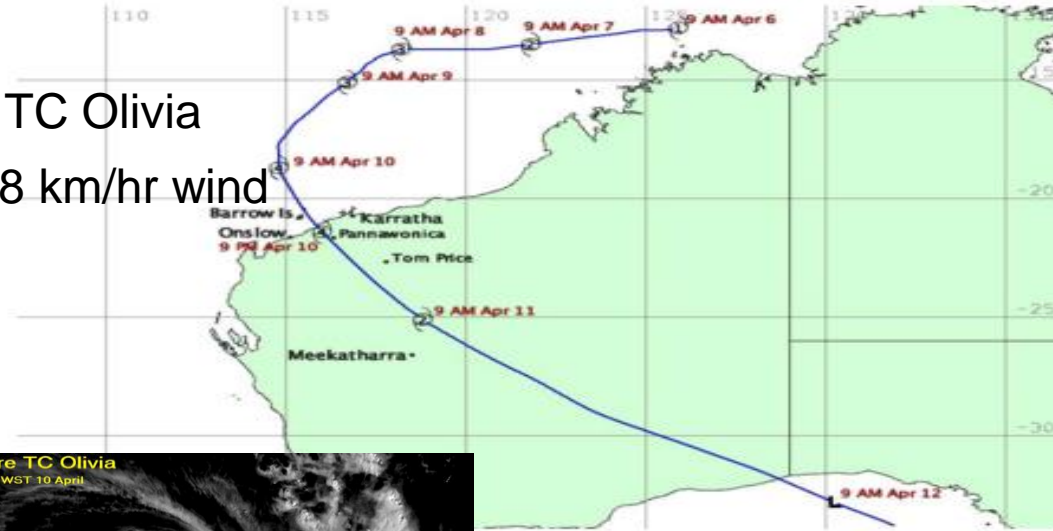
THE UNIVERSITY OF  
**WESTERN**  
**AUSTRALIA**

- S. Australia extreme currents and storm surges sensitive to Southern Ocean storm tracks
- Coastally trapped waves likely important
- Big wave events often have different storm signature
- High pressure to west is common to all extreme events
- **“Perfect Storm”** can still exist
  1. Track along coast
  2. Slow, intense

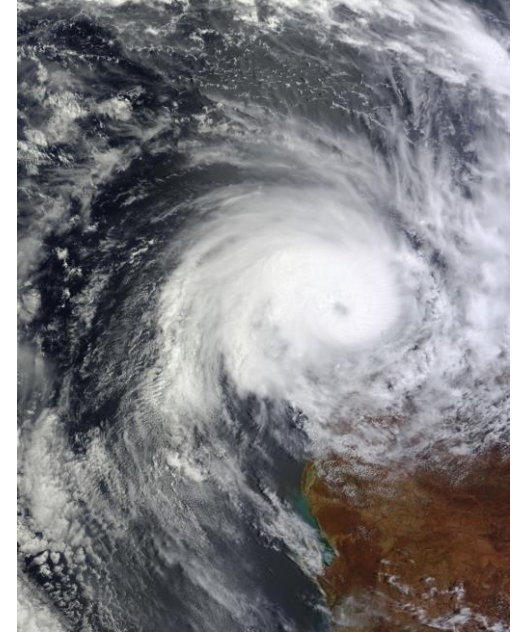
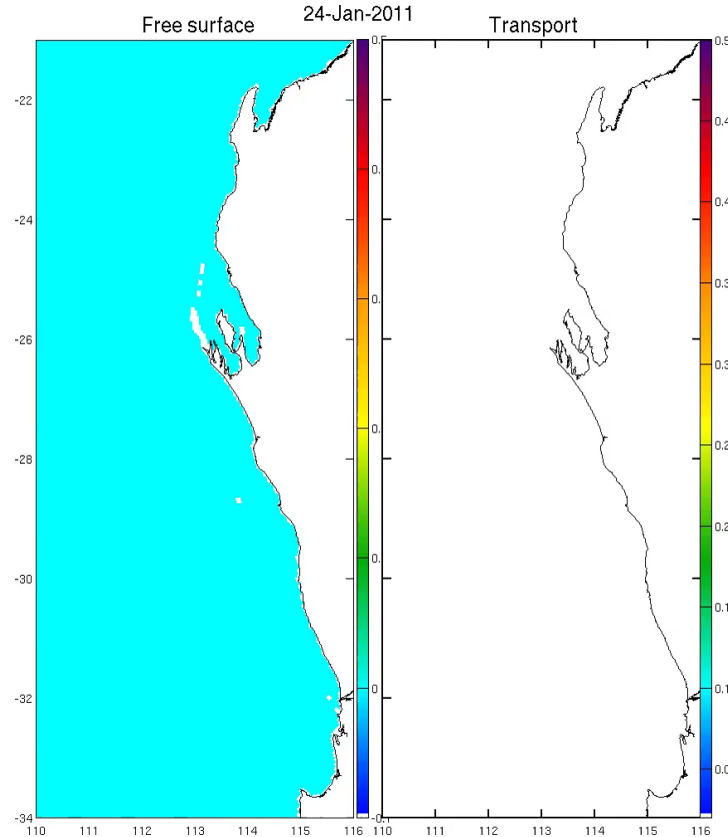


# Tropical vs. extra-tropical

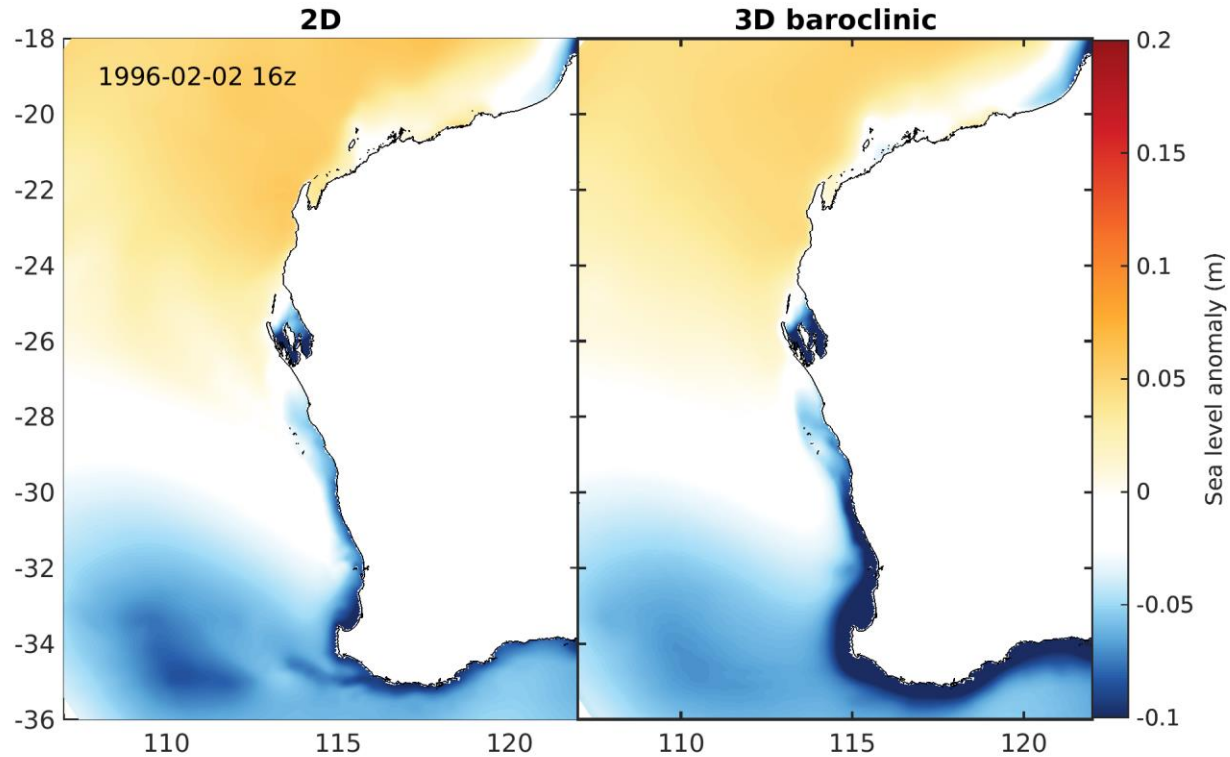
TC Olivia  
408 km/hr wind



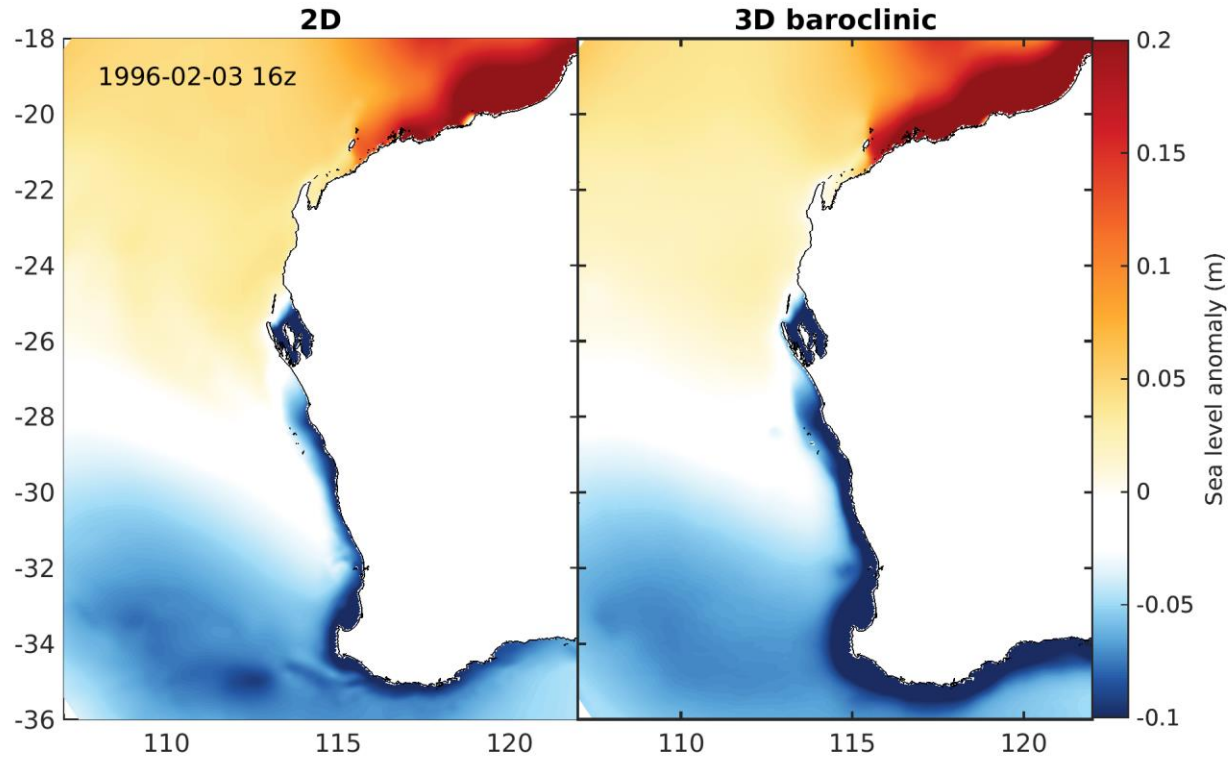
# Tropical Cyclone Bianca



# ROMS 2D vs. 3D

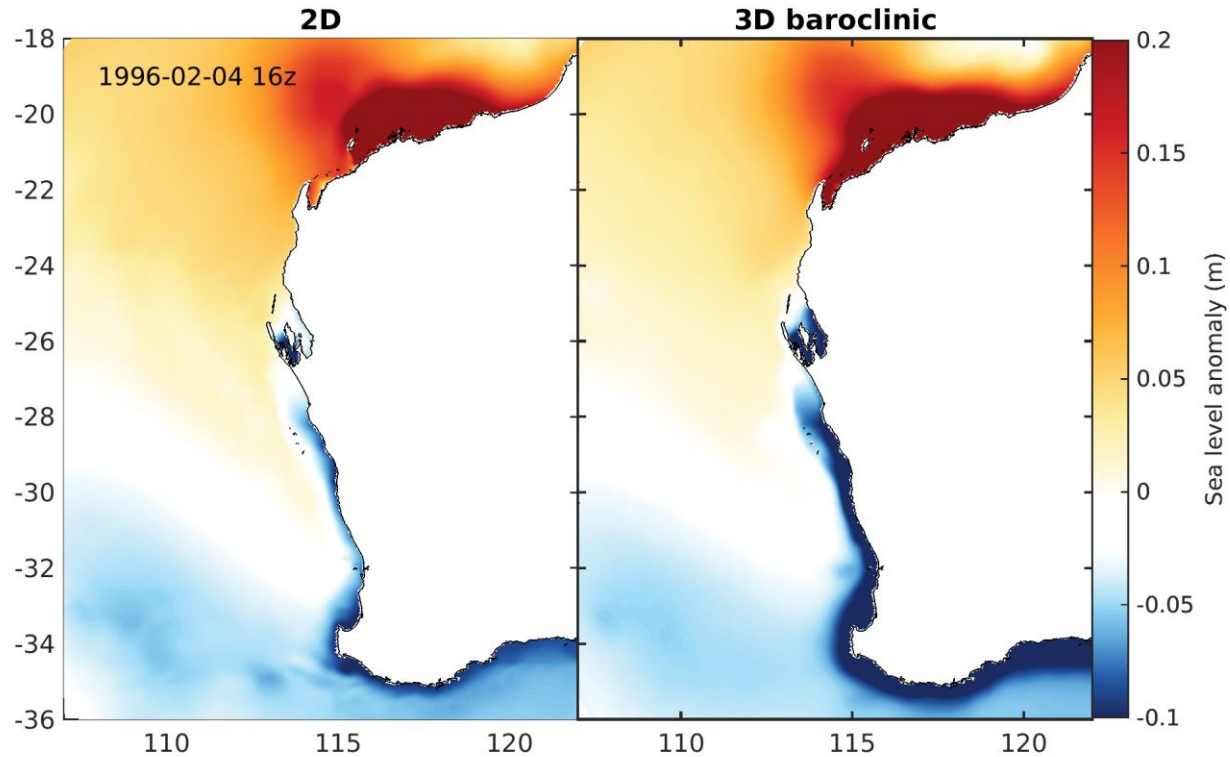


# ROMS 2D vs. 3D

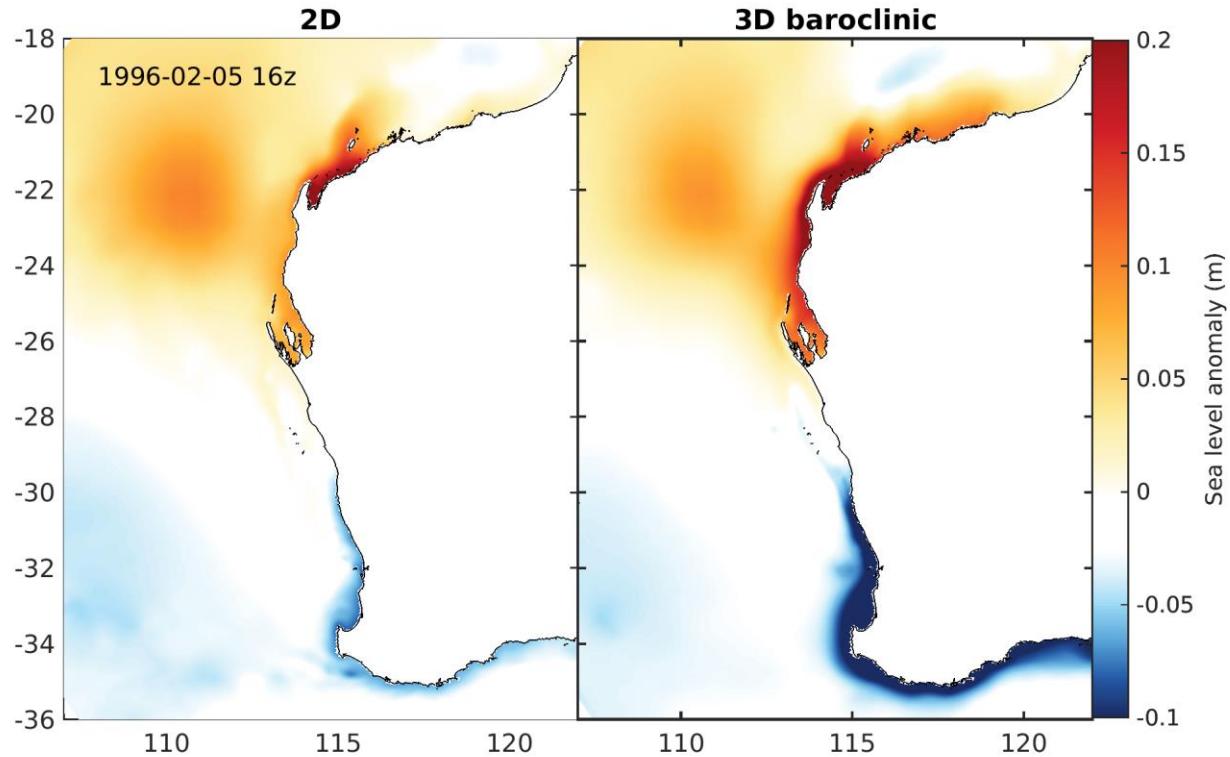




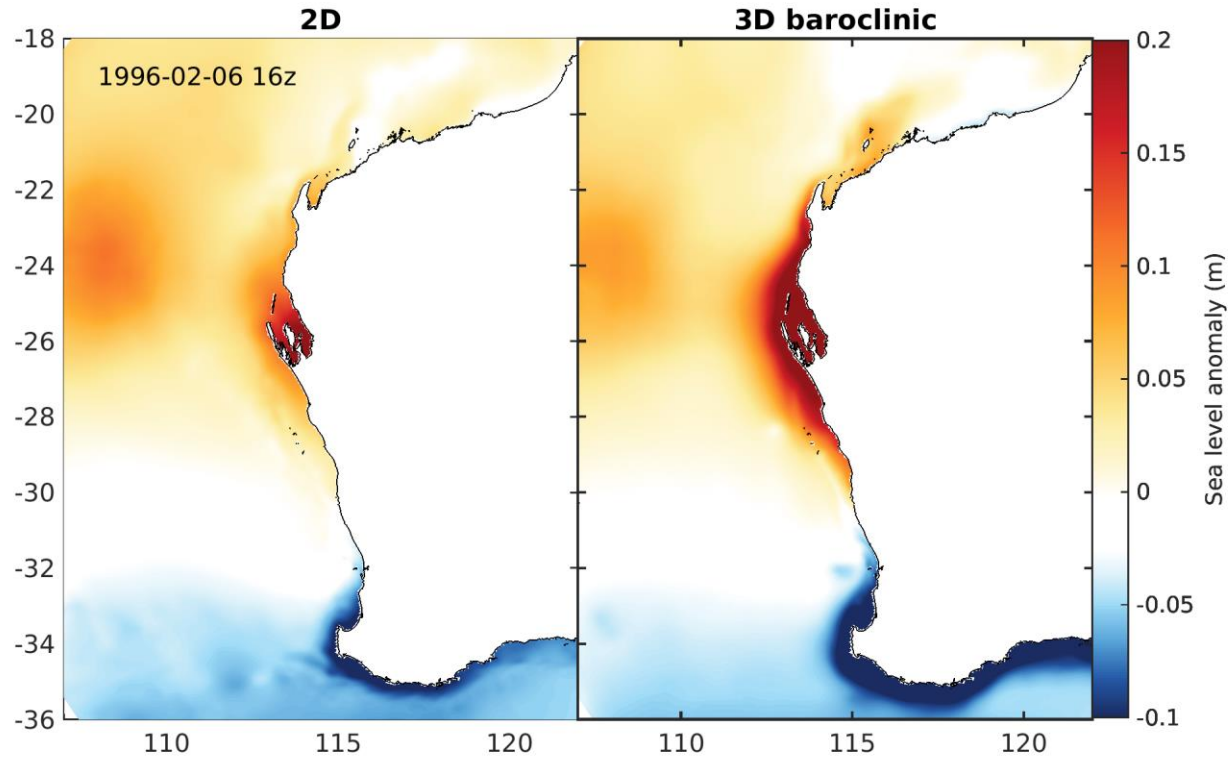
# ROMS 2D vs. 3D



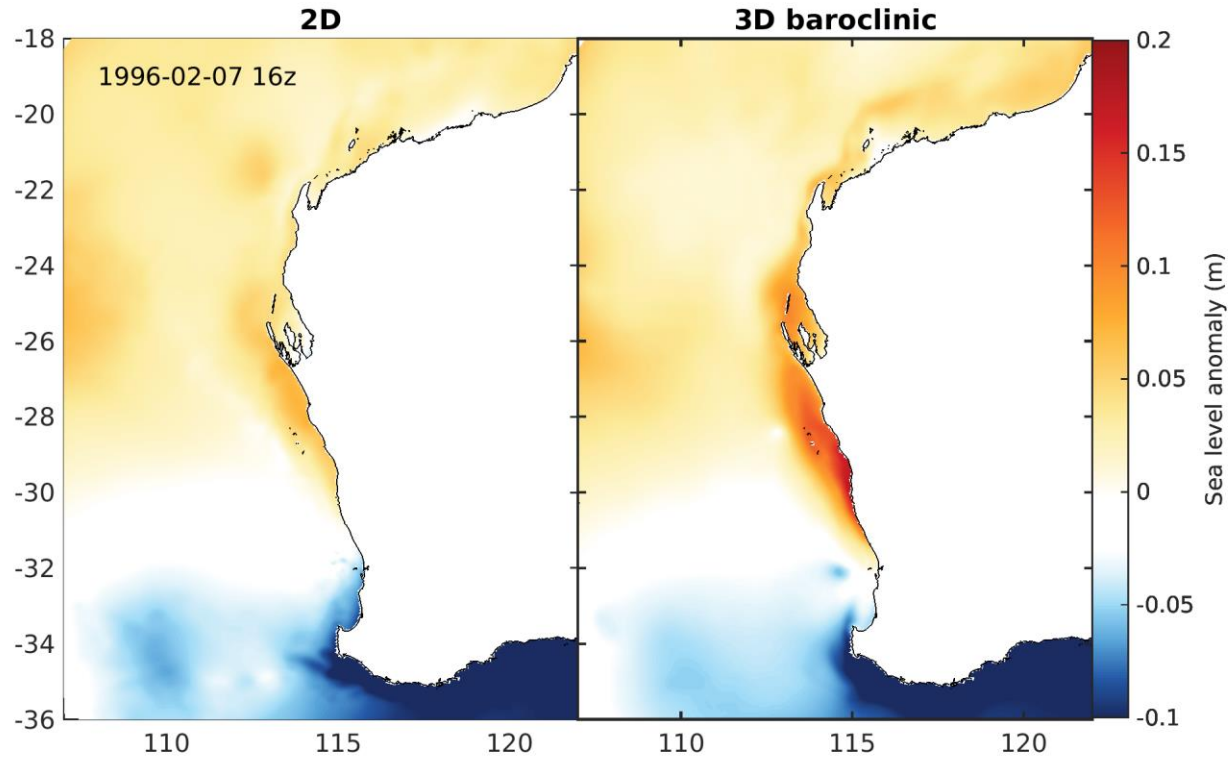
# ROMS 2D vs. 3D



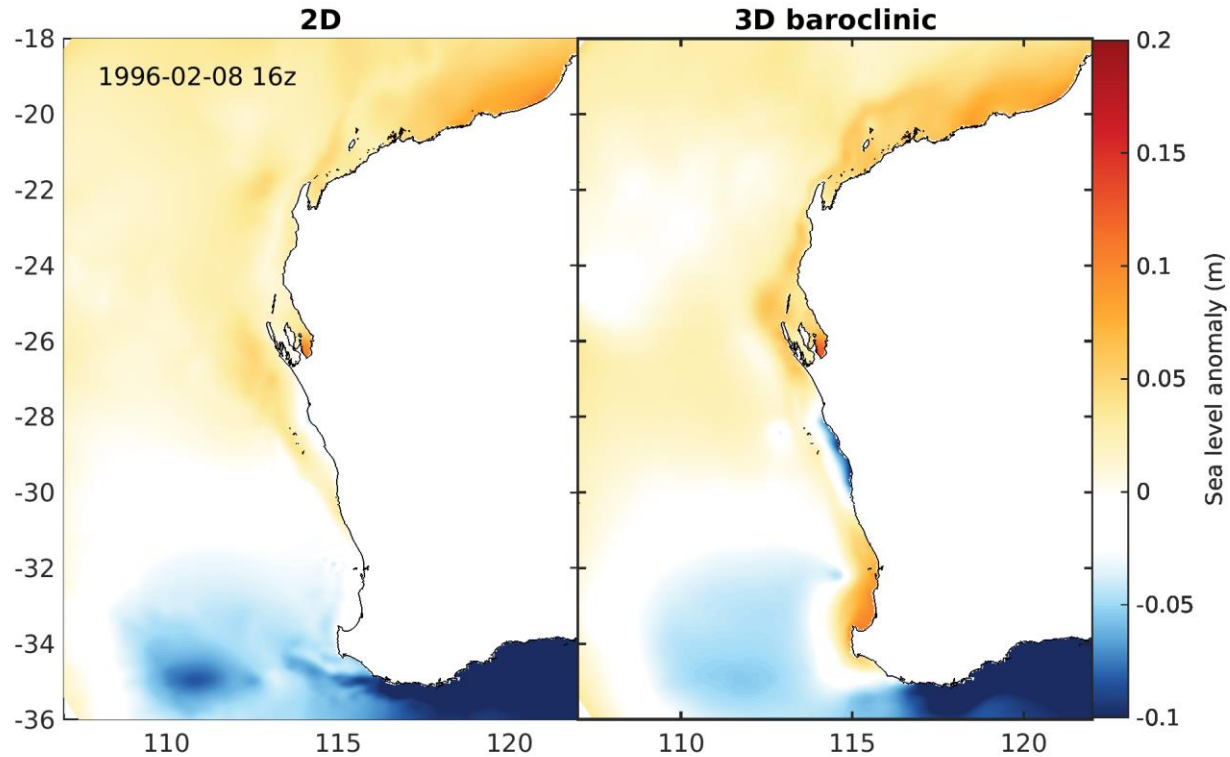
# ROMS 2D vs. 3D



# ROMS 2D vs. 3D

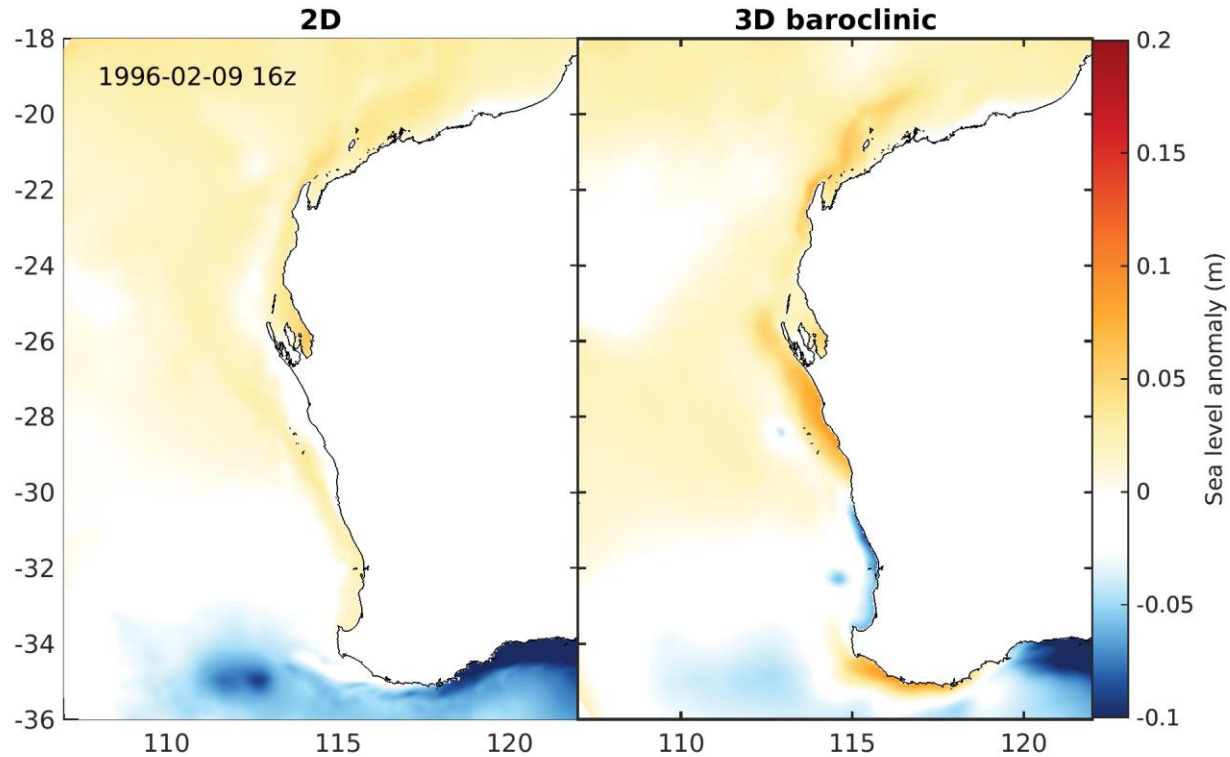


# ROMS 2D vs. 3D

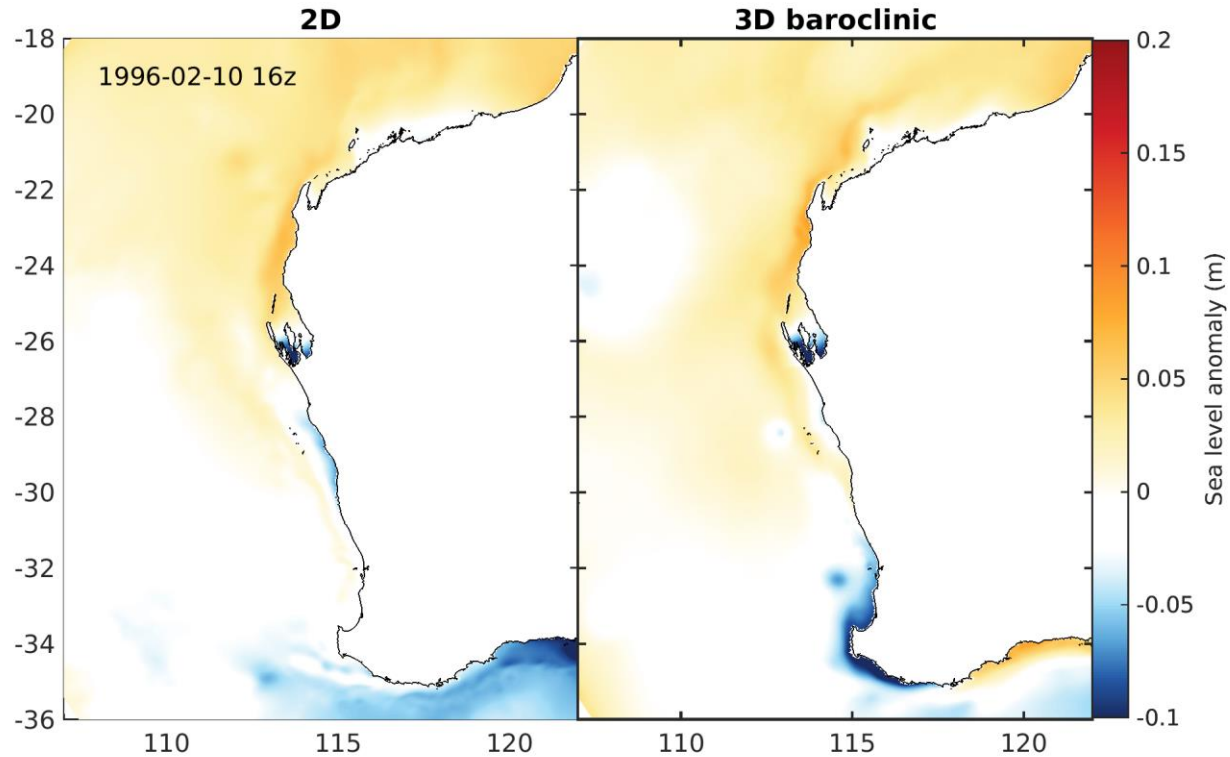




# ROMS 2D vs. 3D



# ROMS 2D vs. 3D



# ROMS 2D vs. 3D

