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# Variability and longer-term changes in the wave climate of the Southern Indian Ocean between 1970 and 2009

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12<sup>th</sup> International Workshop On Wave Hindcasting And Forecasting  
3<sup>rd</sup> Coastal Hazards Symposium

**School of Environmental  
Systems Engineering**

Coastal Oceanography



western australian  
marine science institution

The UWA  
Oceans Institute

Excellence in Marine Science

# Motivation



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To better understand shoreline trend and variability



Perth is one of the fastest growing cities in Australia

Offshore oil and gas industries

Metoccean historical record in WA:

- ~100 years sea level record
- 16 years of wave record

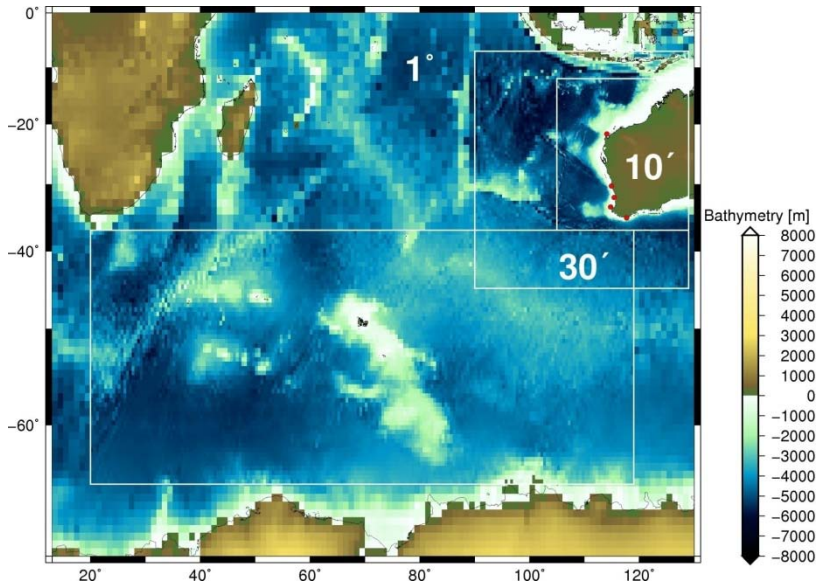
How variable is the wave climate in the Southern Indian Ocean?  
Is the wave climate in the Southern Indian Ocean changing?

# Methods



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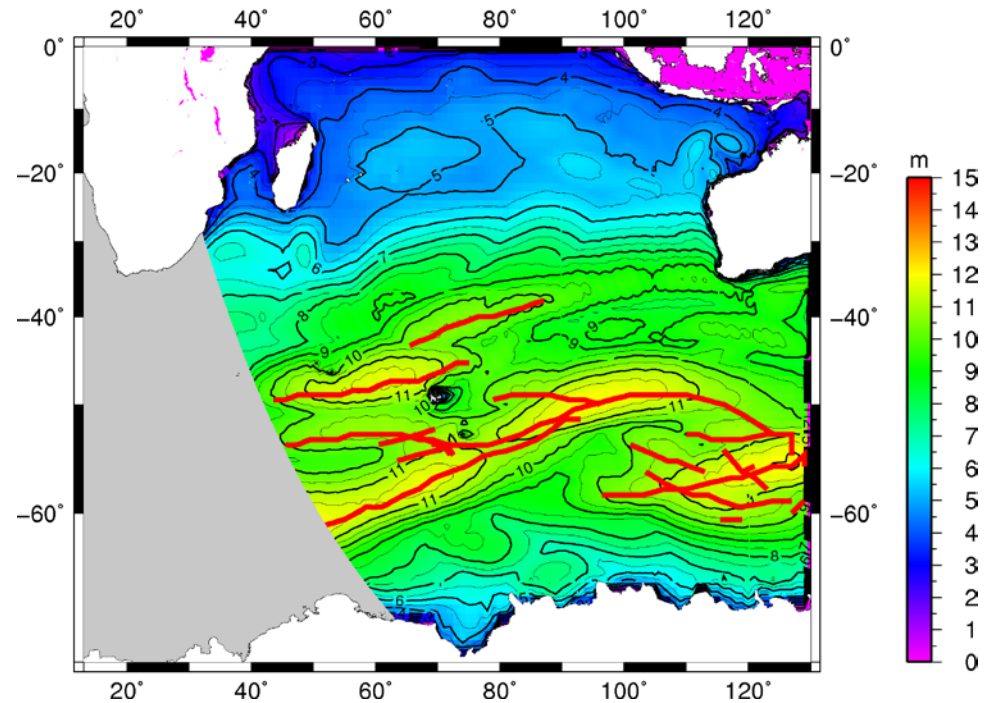
## Model grids



40 years hindcast  
(1970 - 2009)

- WW3
- 4 grids
- NCEP1 winds

## Results: 1999 tracks

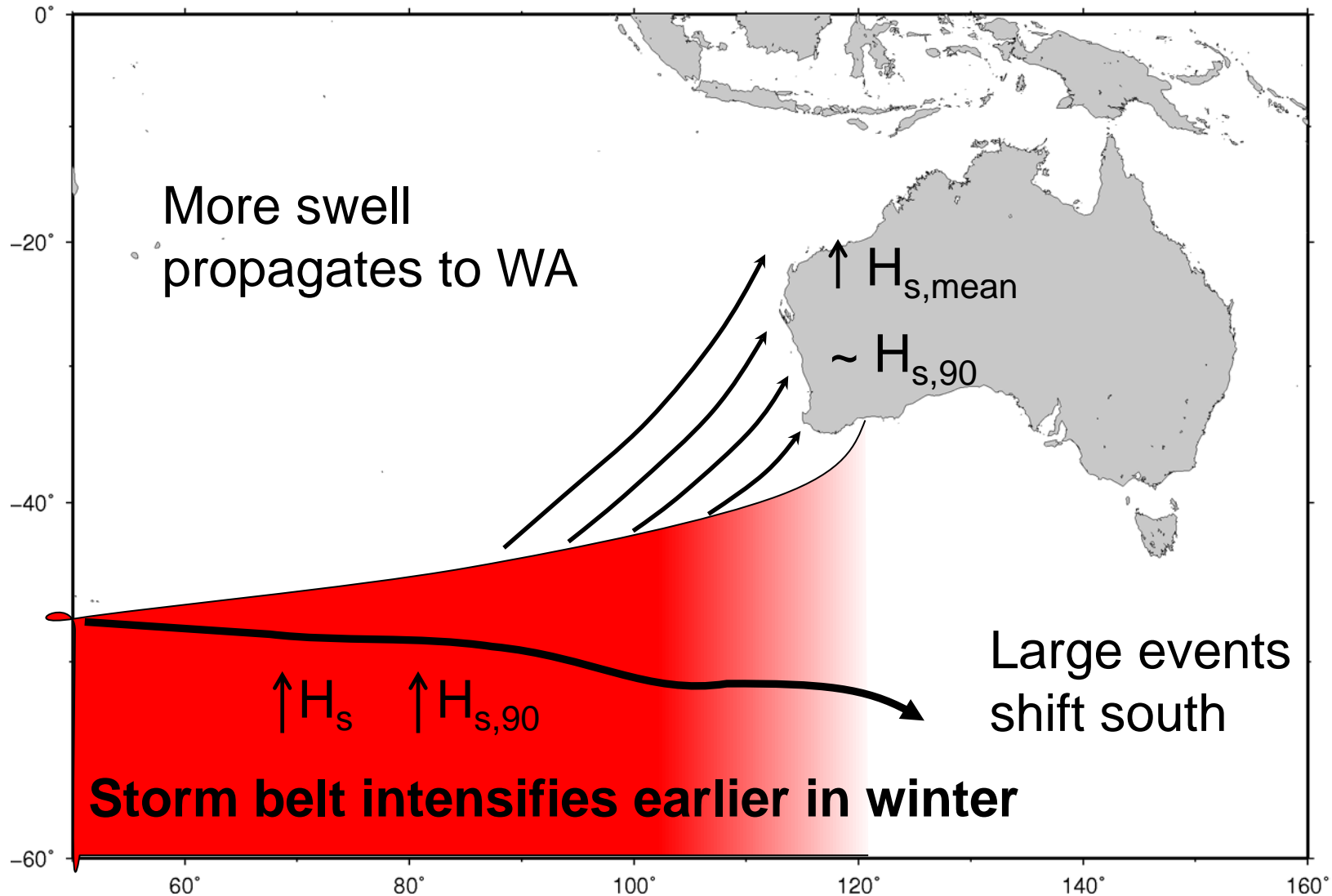


Digitized tracks of large wave events

# Conclusions



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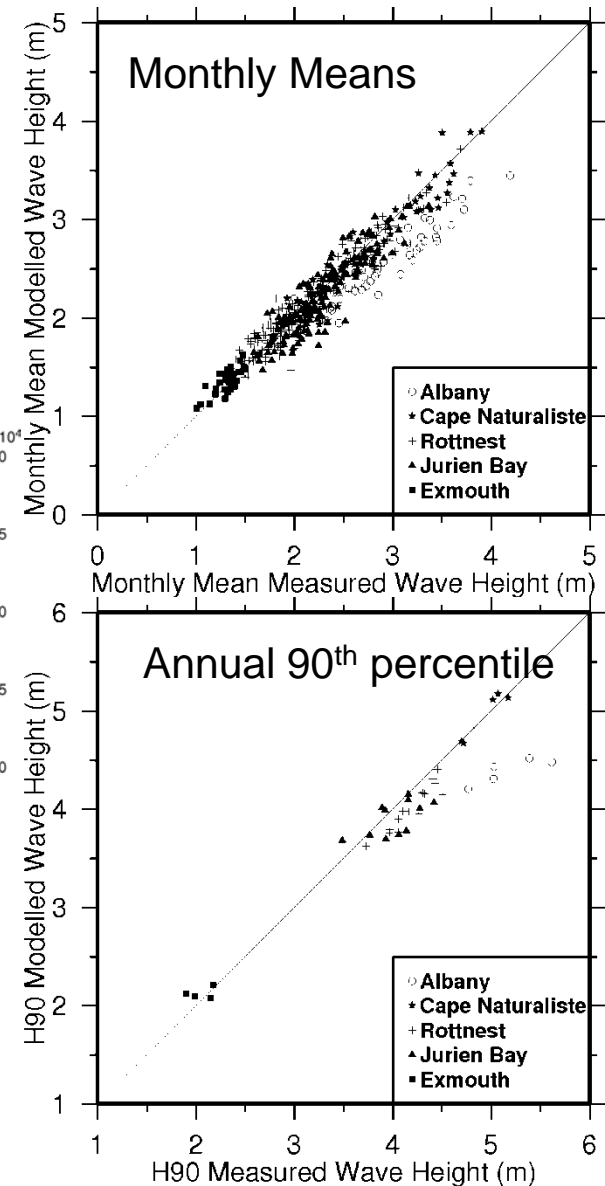
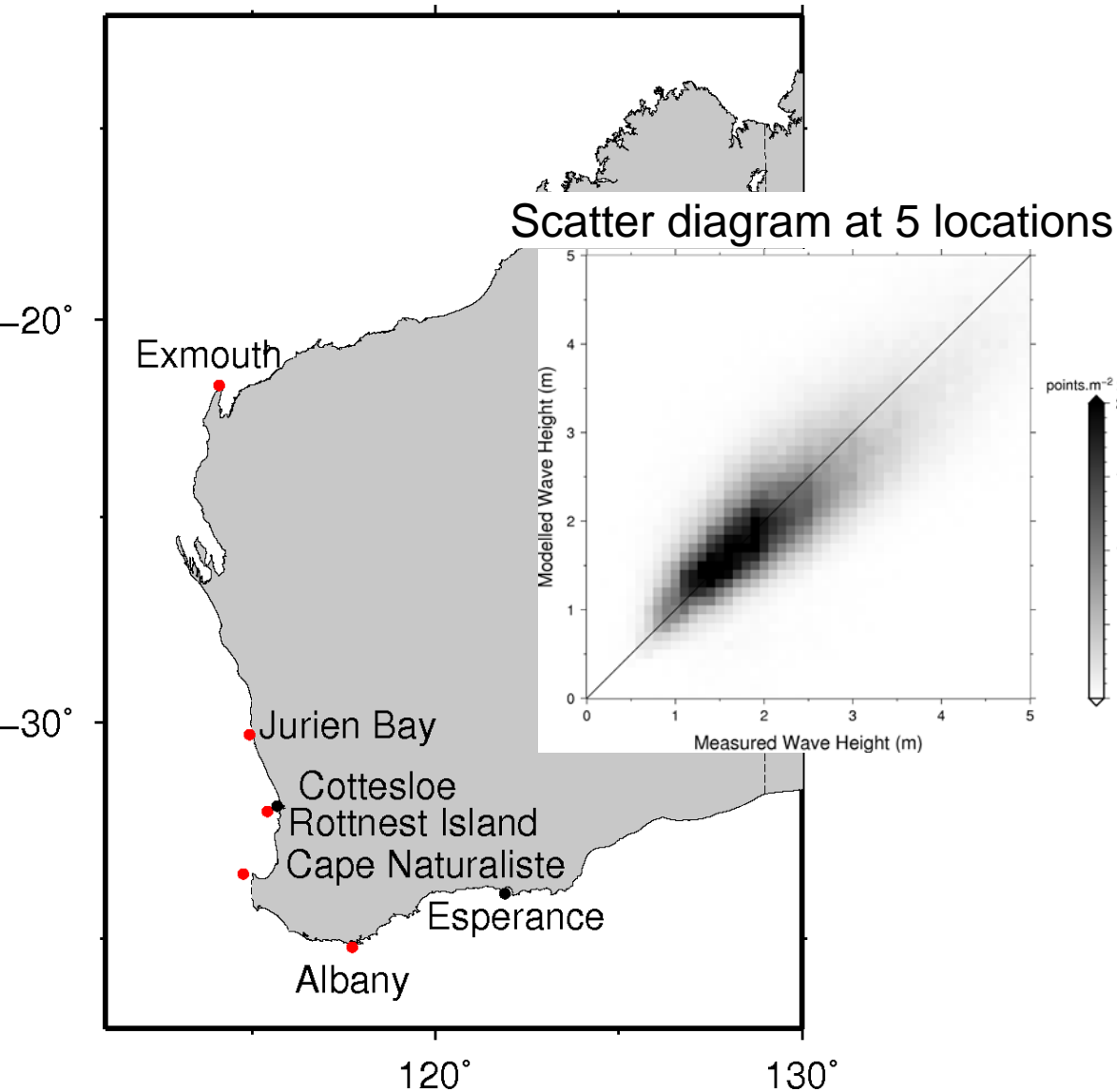


# Hindcast validation



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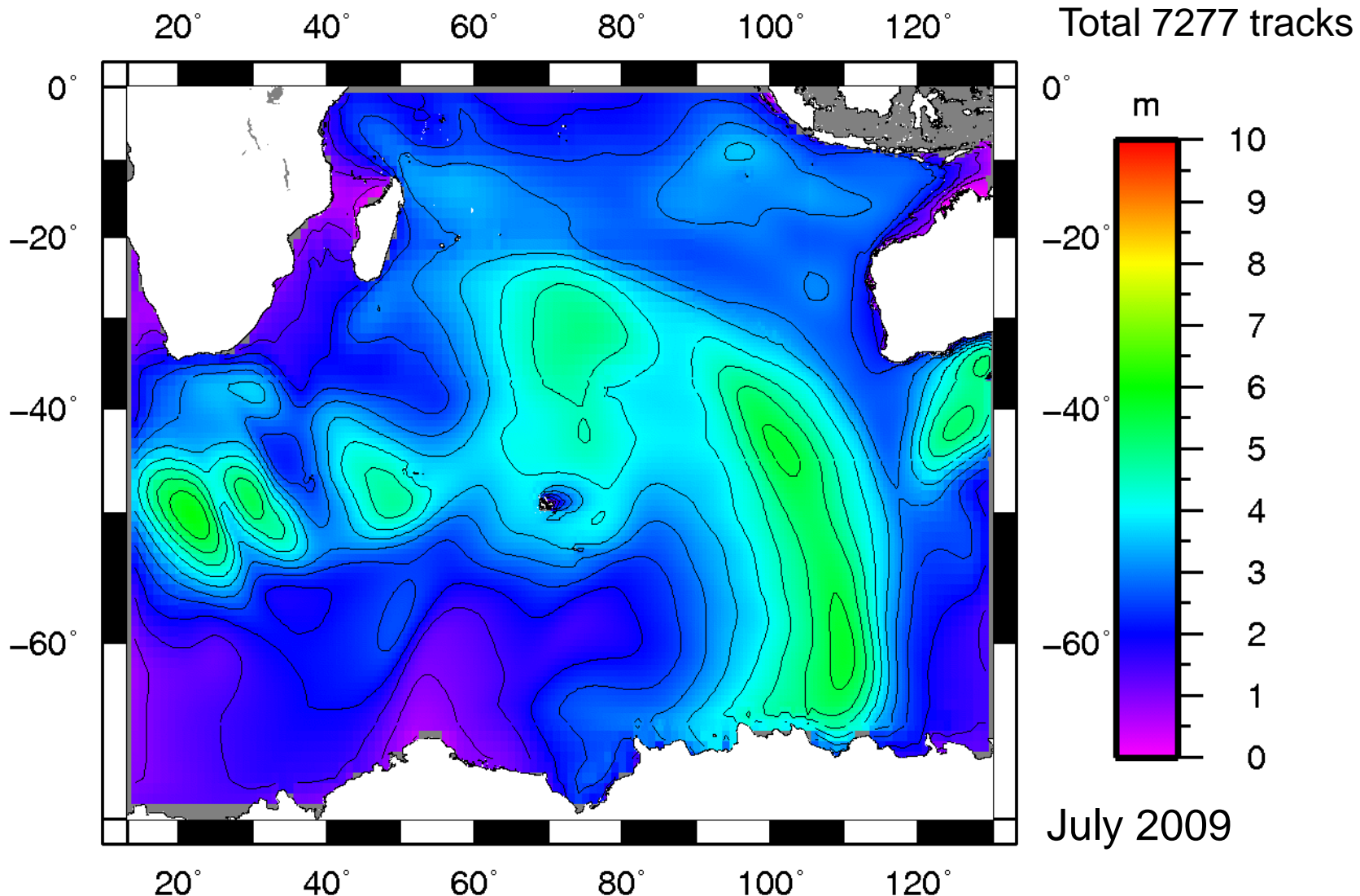


# Tracking large wave events



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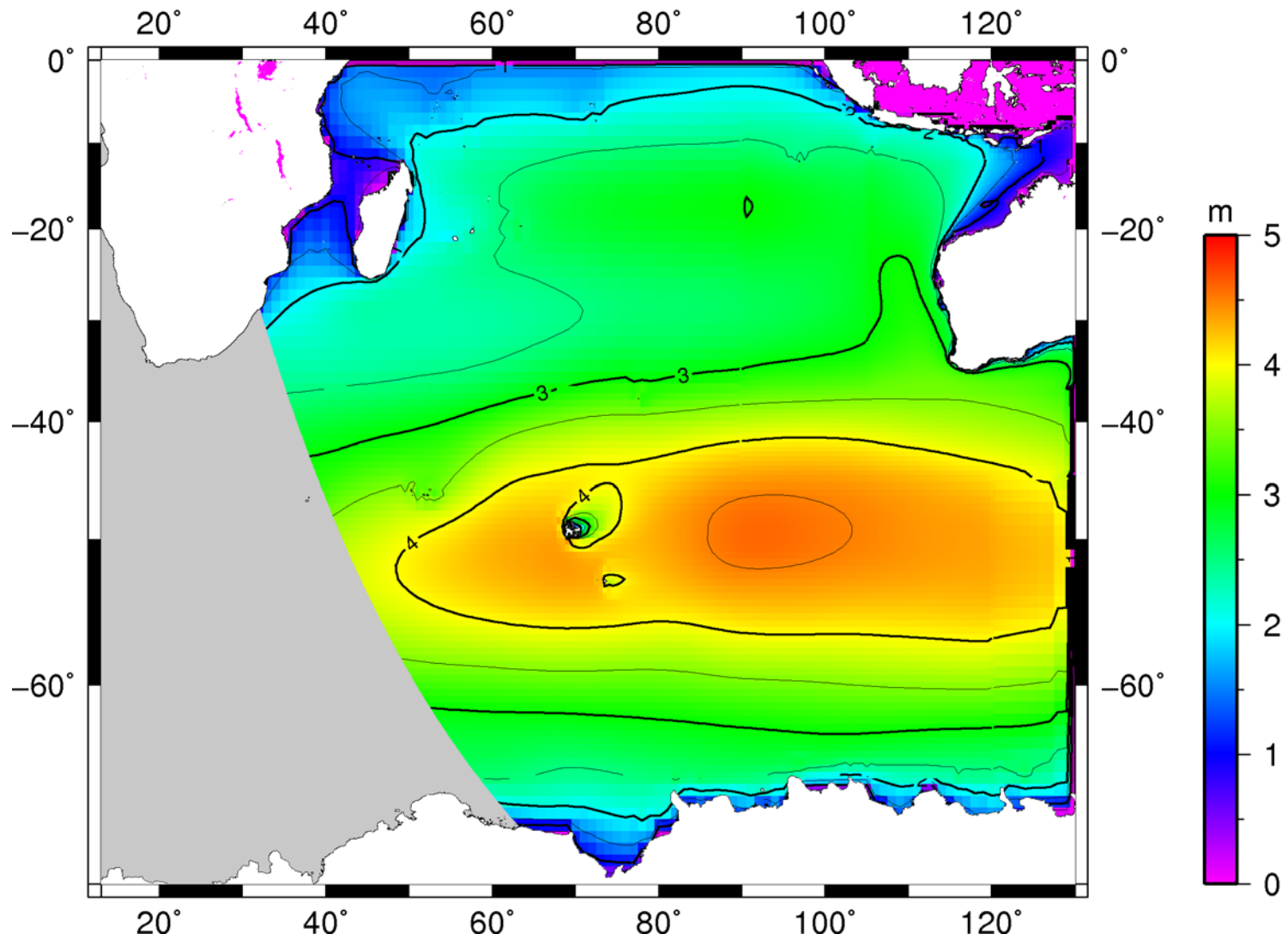
Record lat, long, Hs and time every 3 hours for each event above 7m



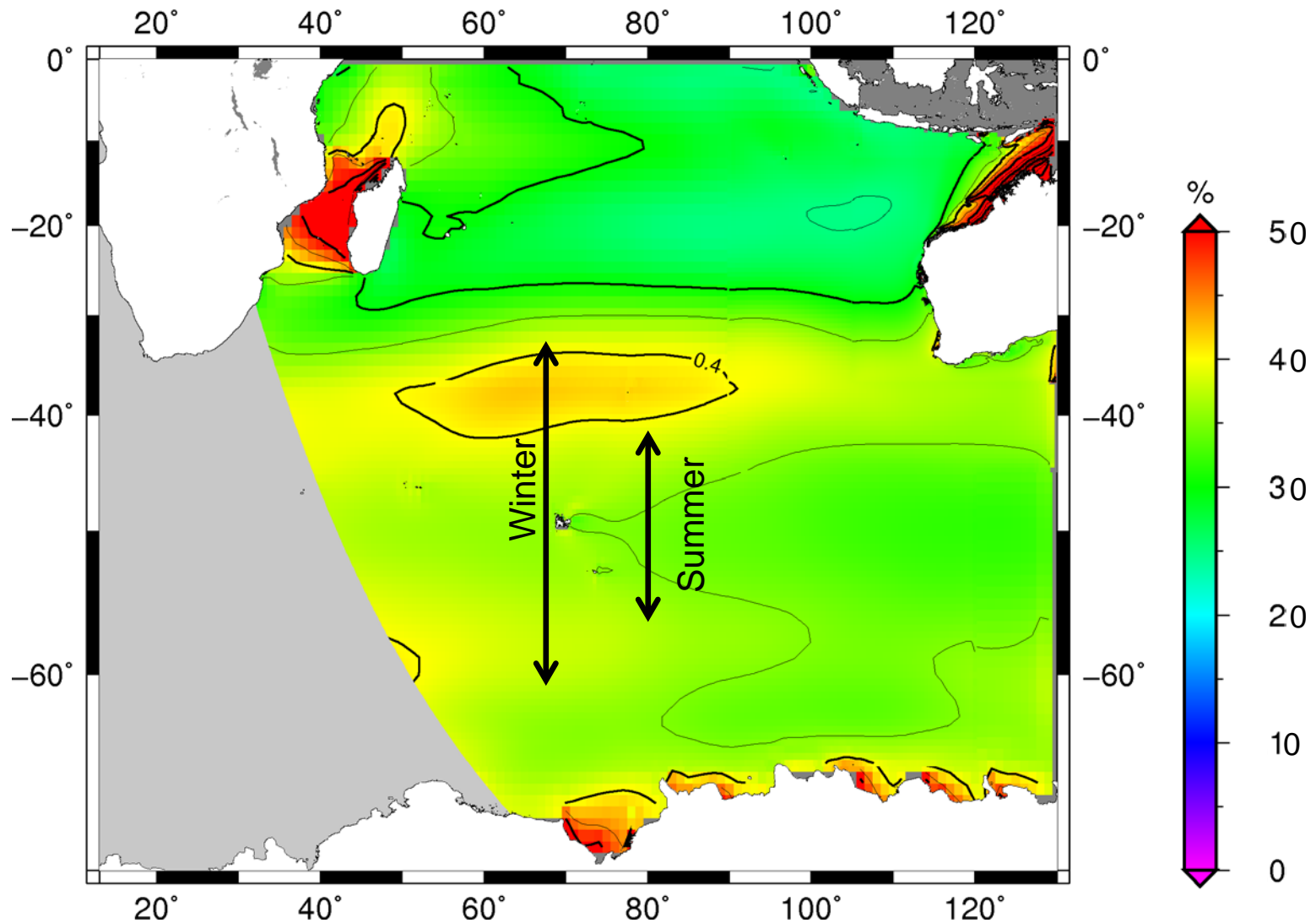
# $H_{s,mean}$



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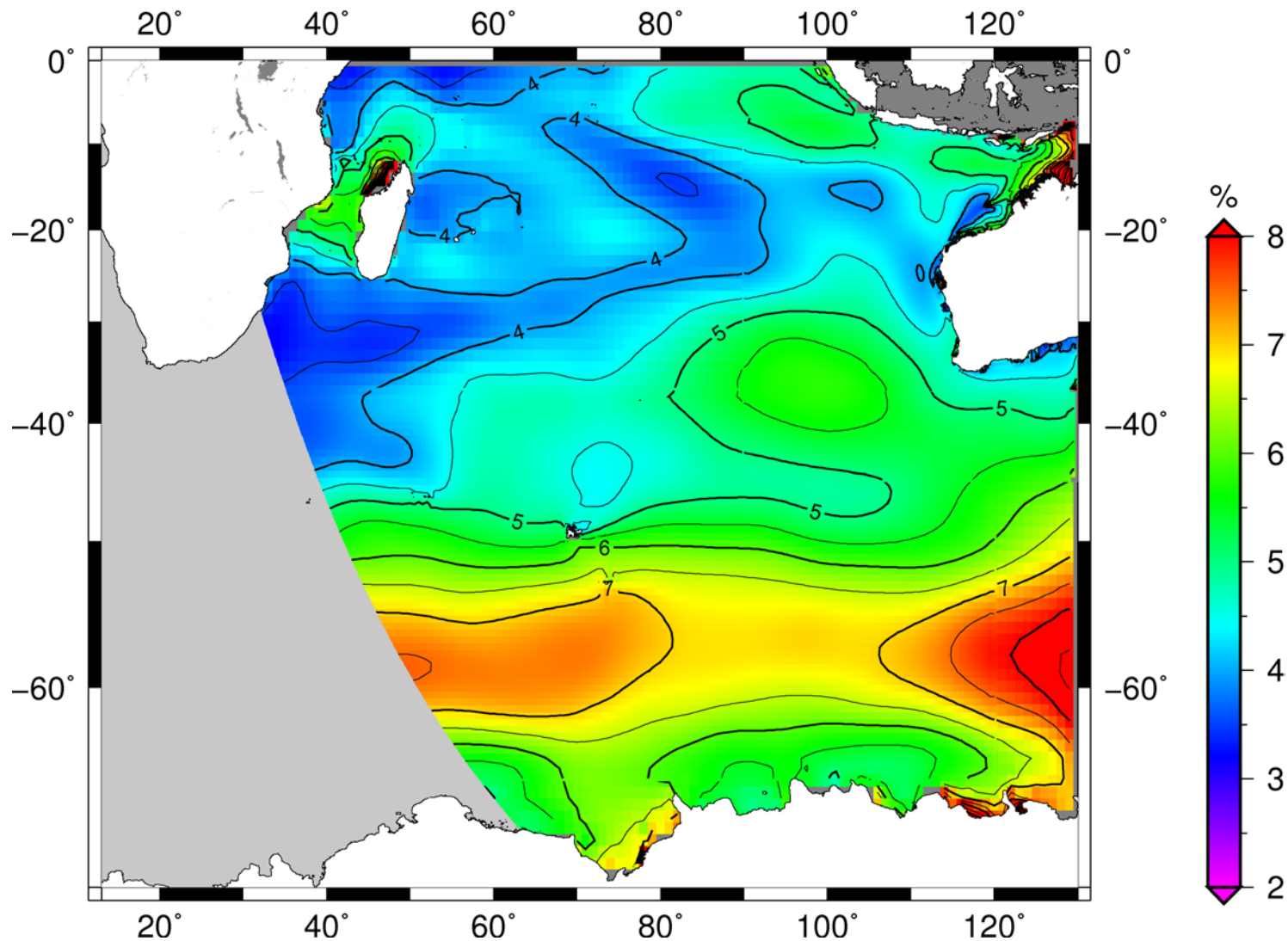


Annual Variability =  $\text{mean}(\text{std}(H_s)) / H_{s,\text{mean}}$



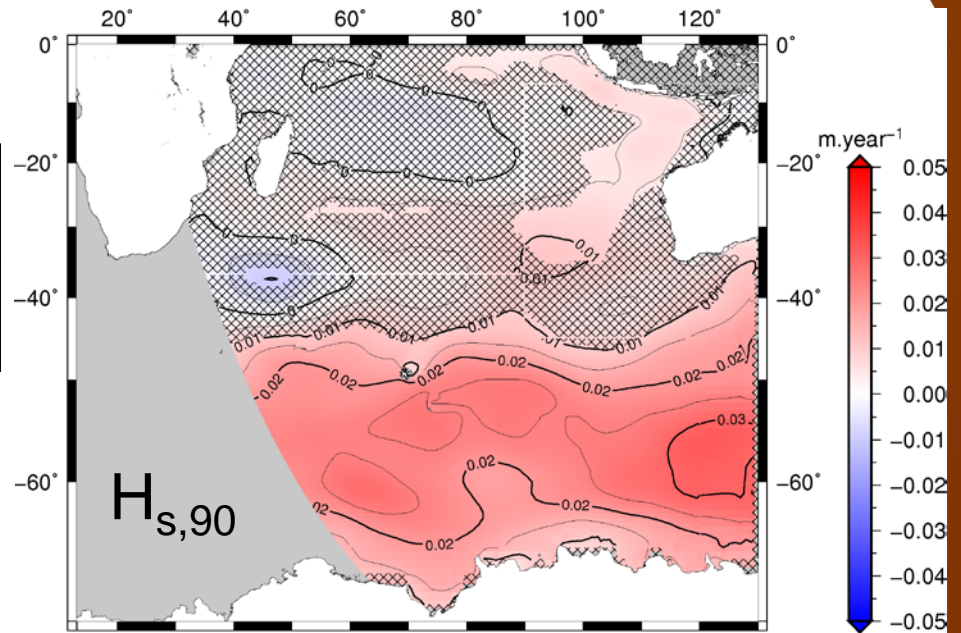


40 year Variability =  $\text{std}(H_{s,\text{mean}}(\text{year})) / H_{s,\text{mean}}$

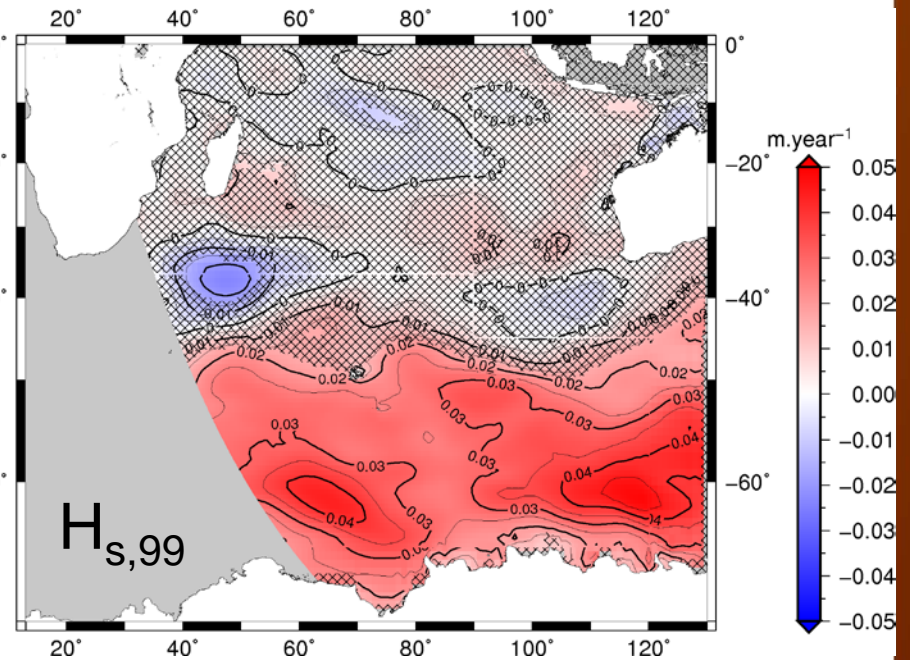
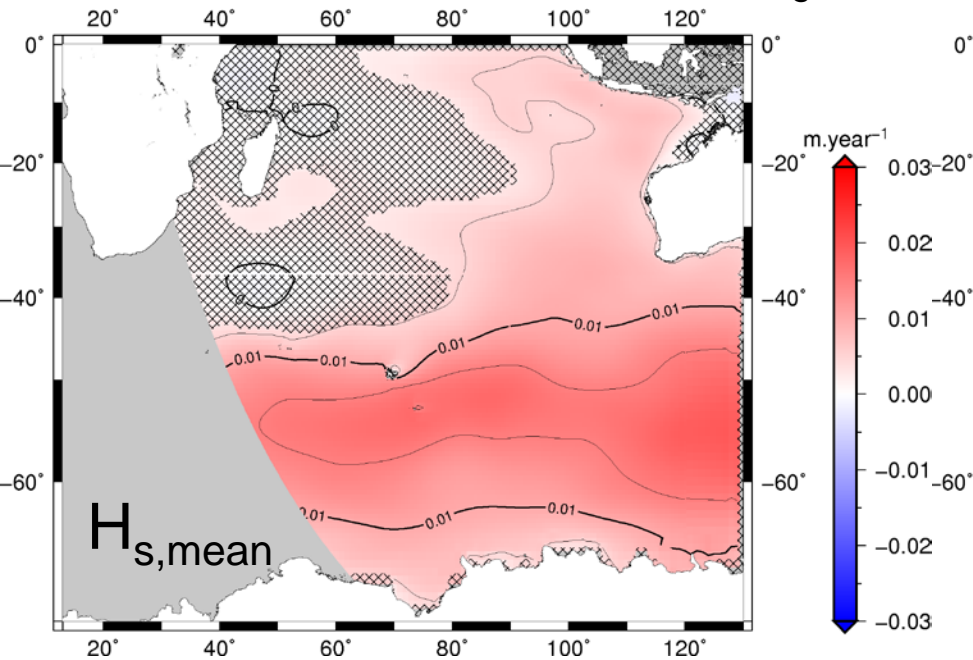


# Trends

over 40 years	WA	SIO
$H_{s,mean}$	+0.2m	+0.6m



Hatched area = Non significant

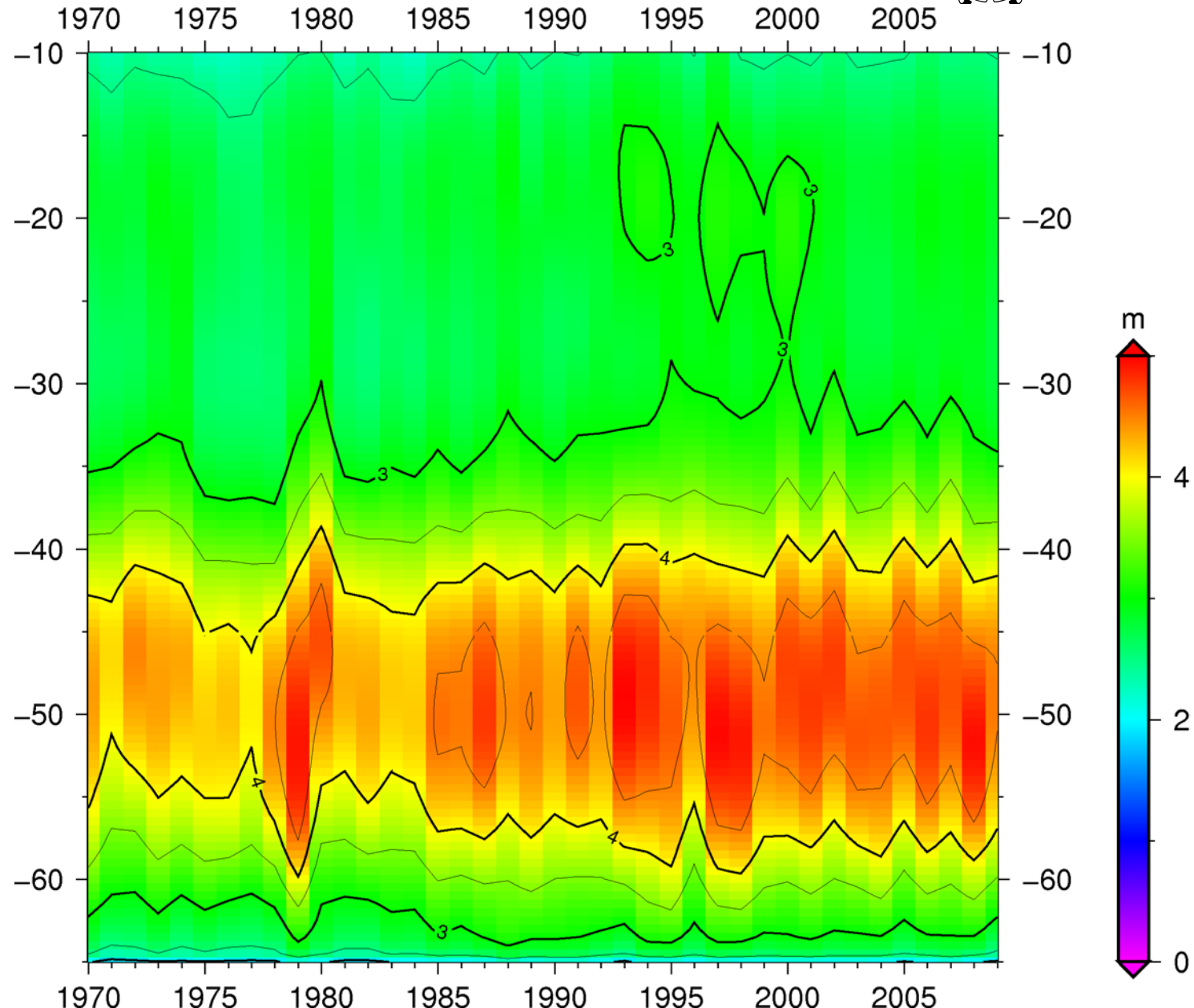


# Time slice of $H_{s,mean}$ at $110^{\circ}$ E



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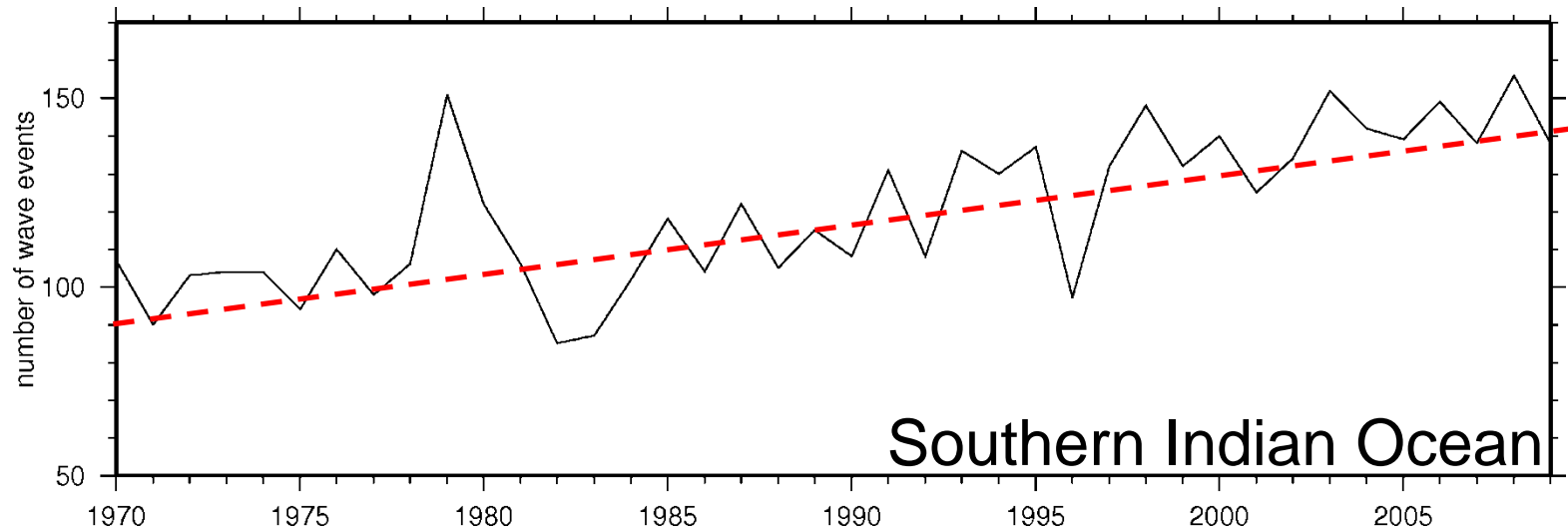
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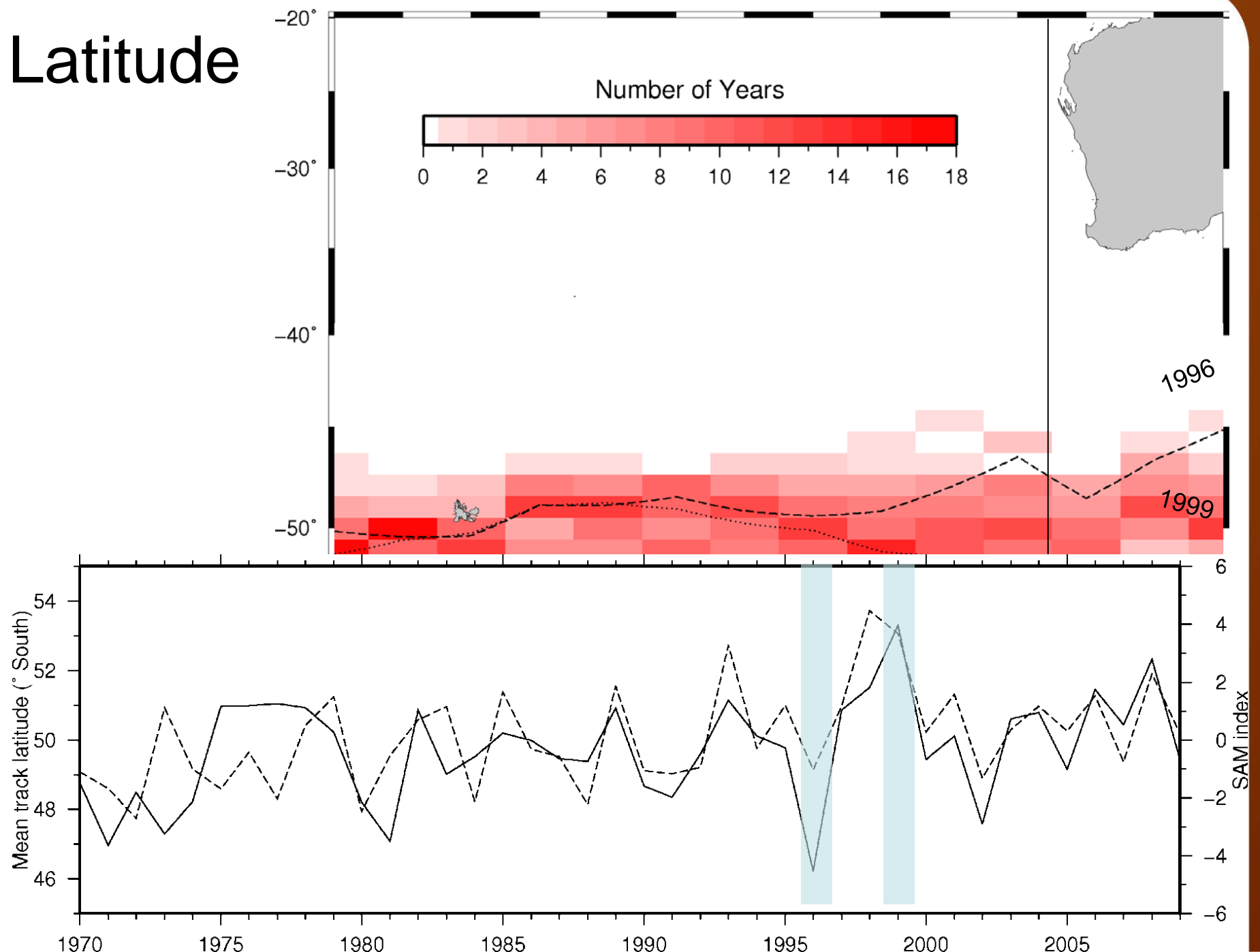
# No. of large wave events



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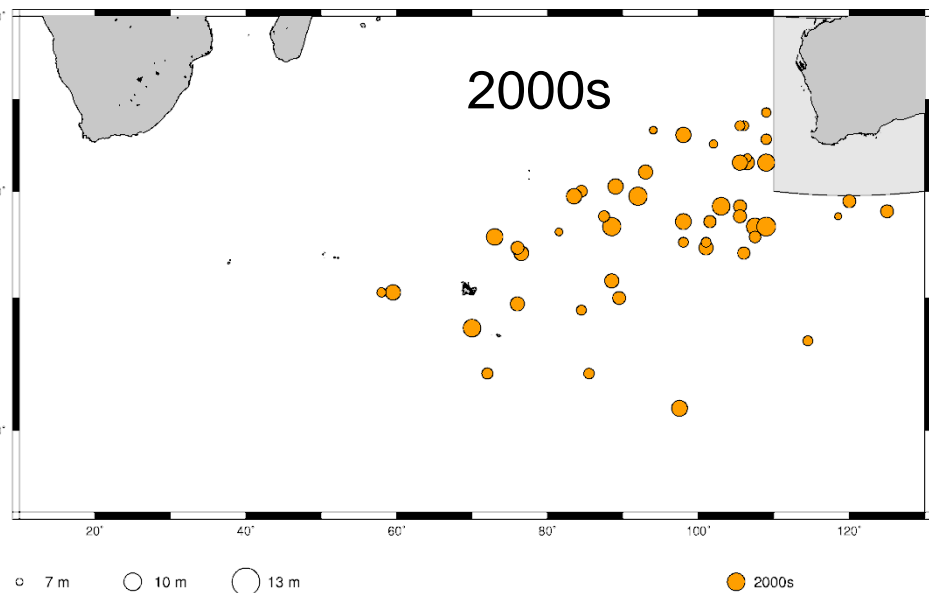
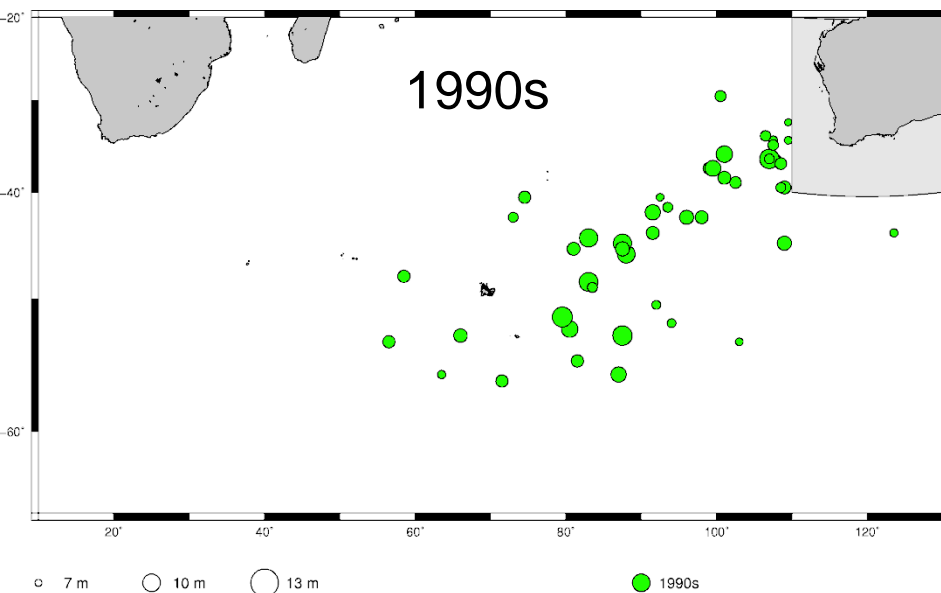
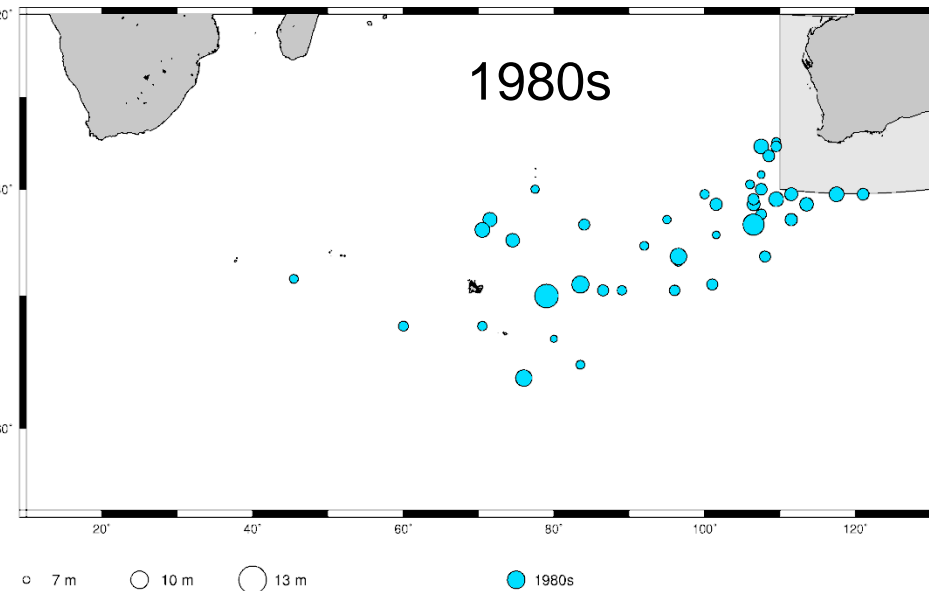
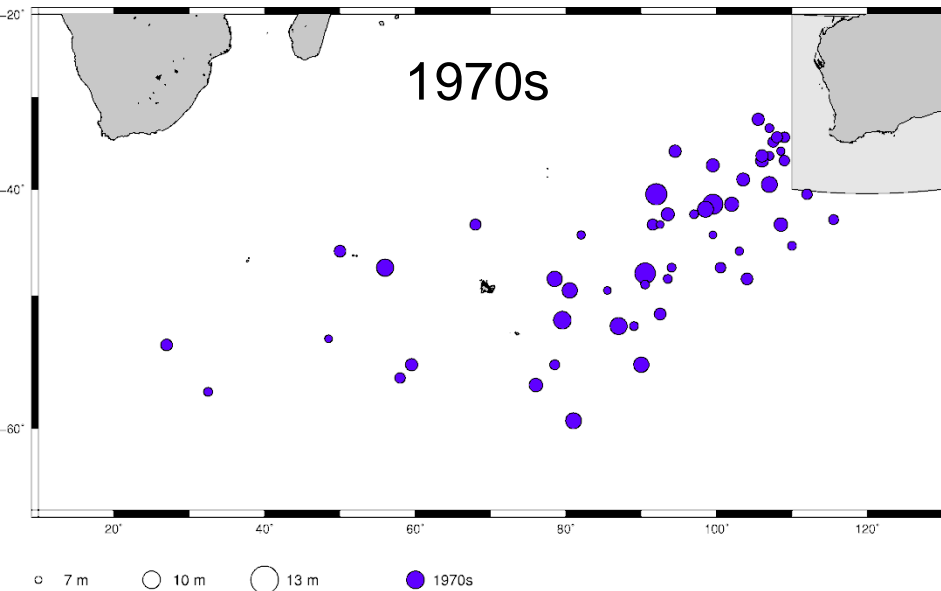
# Latitude



# Origin of large wave events



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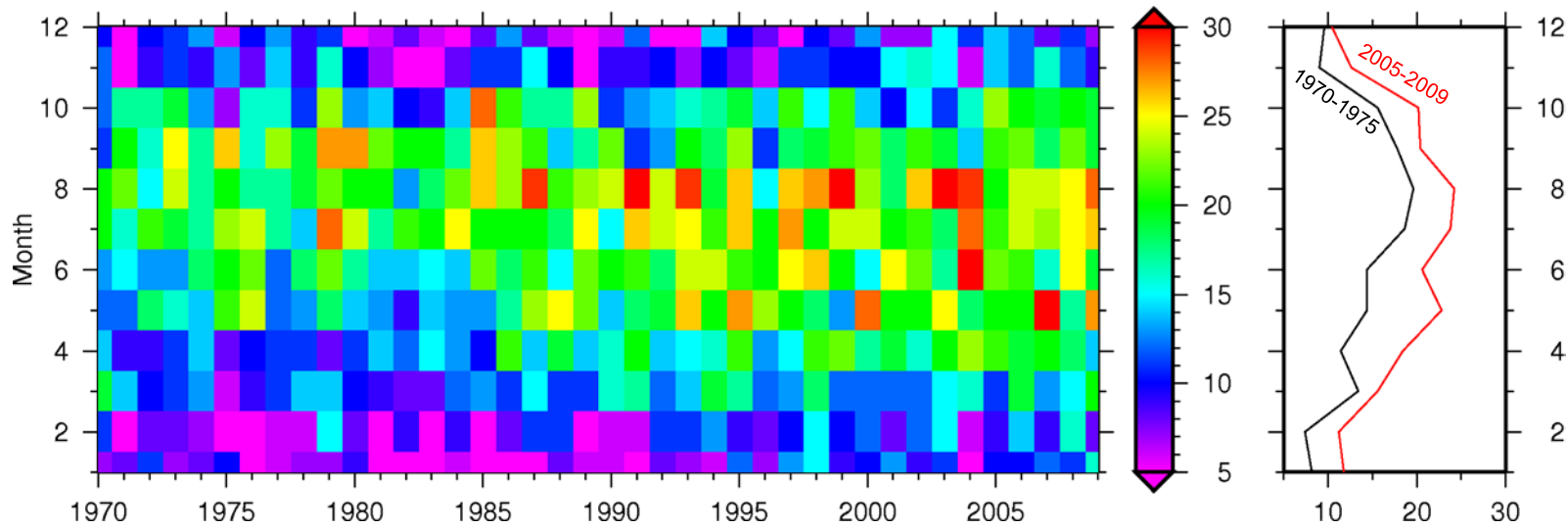




# Seasonal changes



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# Conclusions



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- Storm belt is constantly rough but wave climate is highly variable on both sides
- Increase in  $H_s$  and large wave events south of storm belt
- This resulted in increased swell along the coast of Western Australia
- Large wave events are shifting south
- No increase in large waves in Western Australia because the increase in large waves in the storm belt is balanced by the shift south

# Thanks



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Bosserelle C., Pattiaratchi C. B., Haigh I. D. (In press) Inter-annual variability and longer-term changes in the wave climate of Western Australia between 1970 and 2009. *Ocean Dynamics*.



Photos: Hetzel 2011