



# **On the stratosphere ozone distribution asymmetry possible impact on Antarctic Peninsula regional ecosystem**

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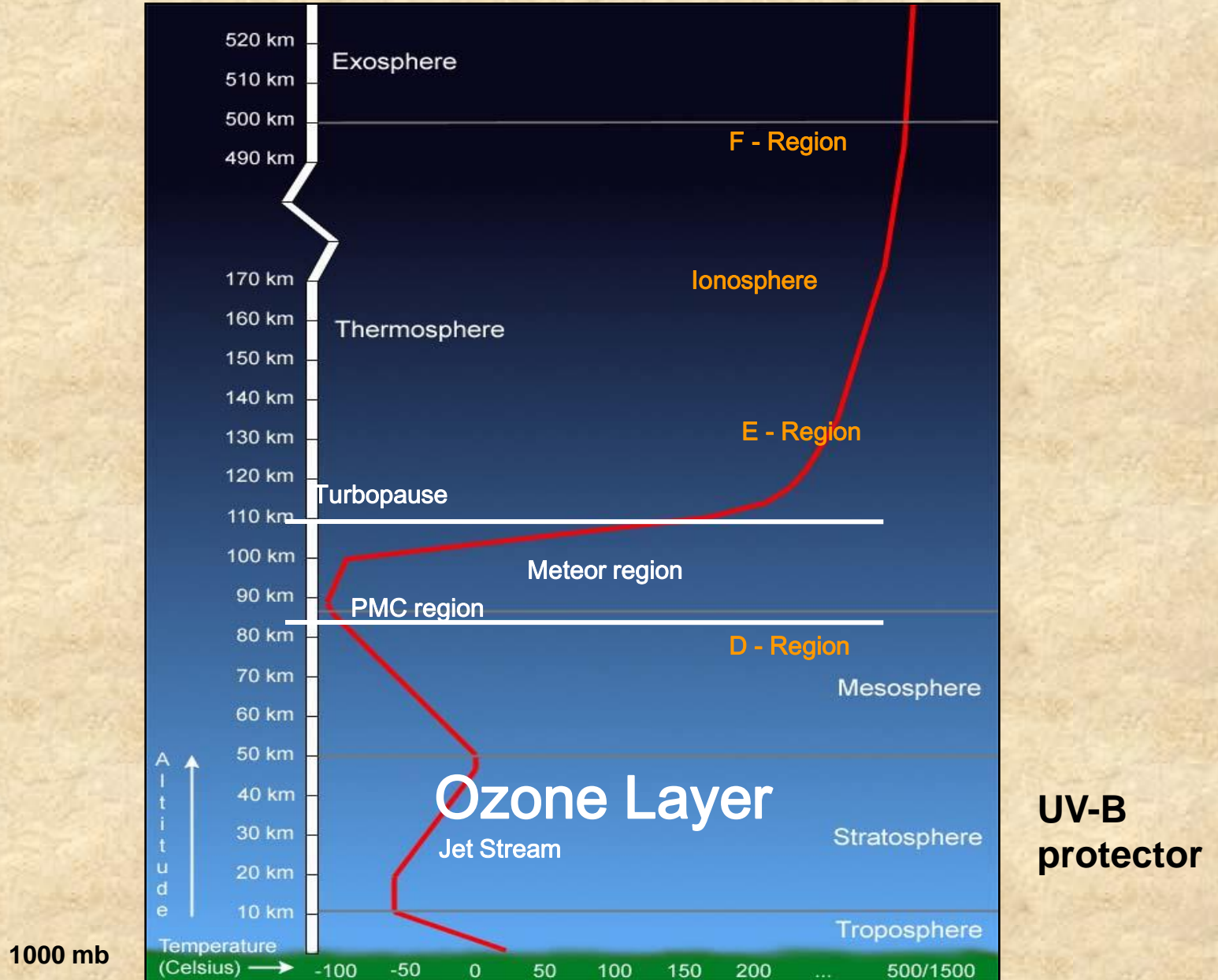
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# Atmosphere structure



# Ozone hole development

Total ozone content  
by Total Ozone  
Mapping  
Spectrometer  
measurements

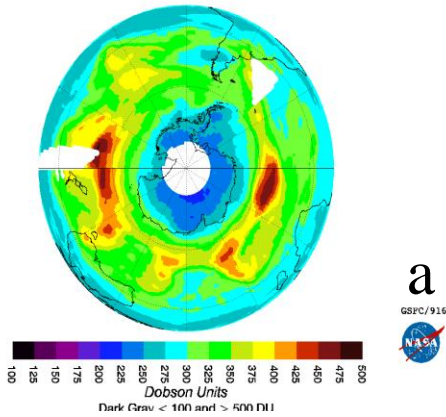
Nimbus-7,

Meteor-3,

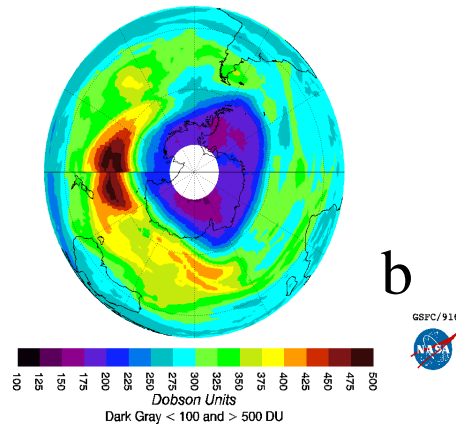
Earth Probe

(Aura, OMI since  
2004)

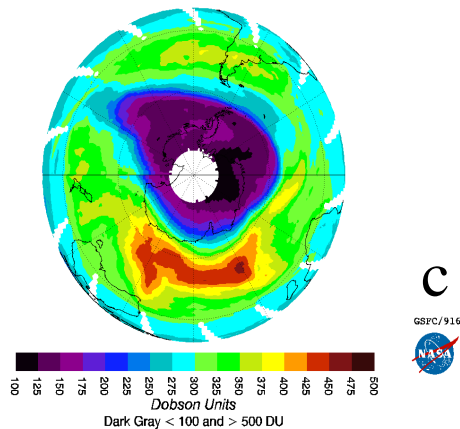
Nimbus-7/TOMS Version 8 Total Ozone for Sep 15, 1980



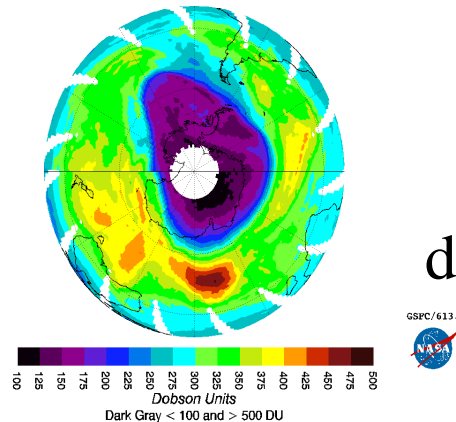
Nimbus-7/TOMS Version 8 Total Ozone for Sep 15, 1990



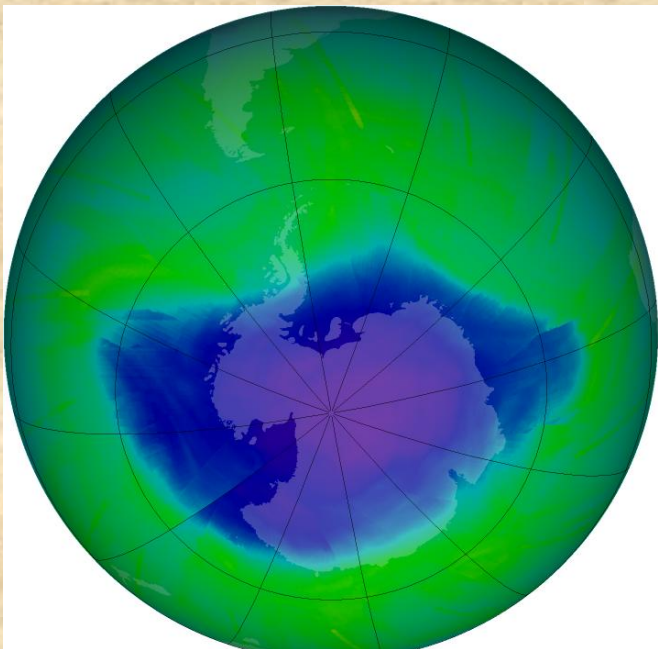
EP/TOMS Version 8 Total Ozone for Sep 15, 2000



EP/TOMS Version 8 Total Ozone for Sep 15, 2005

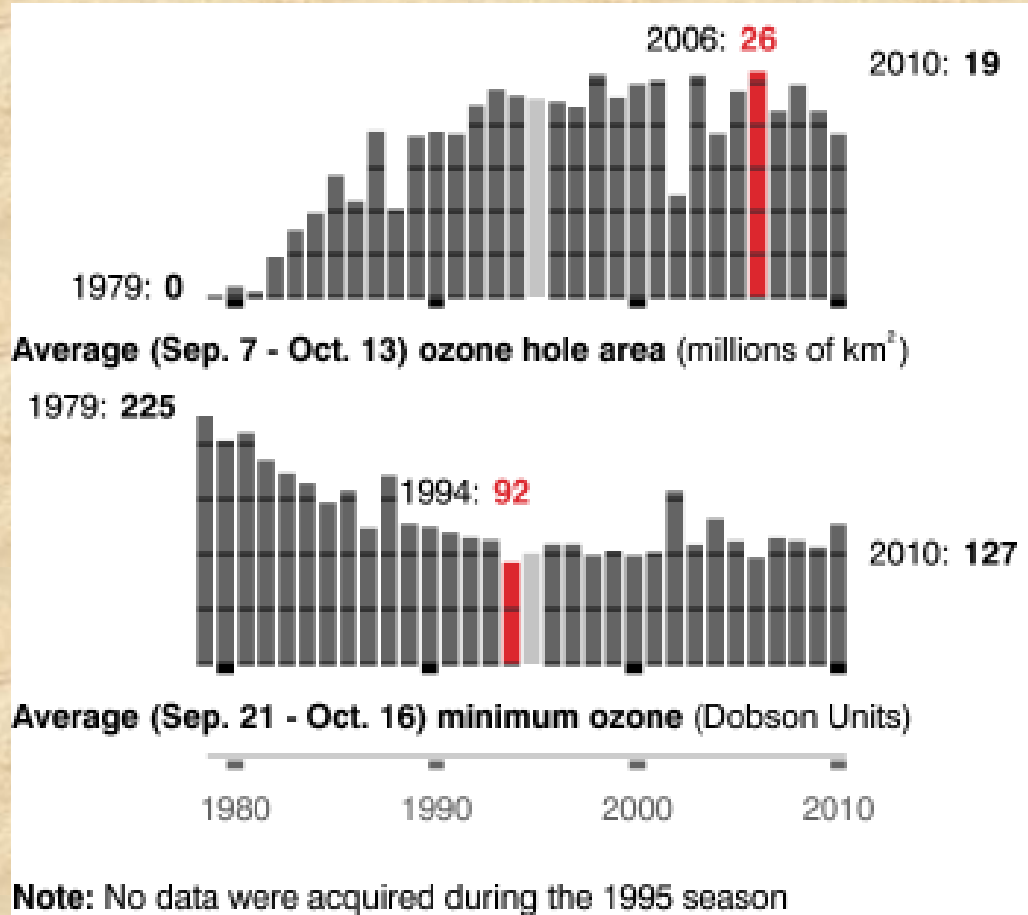
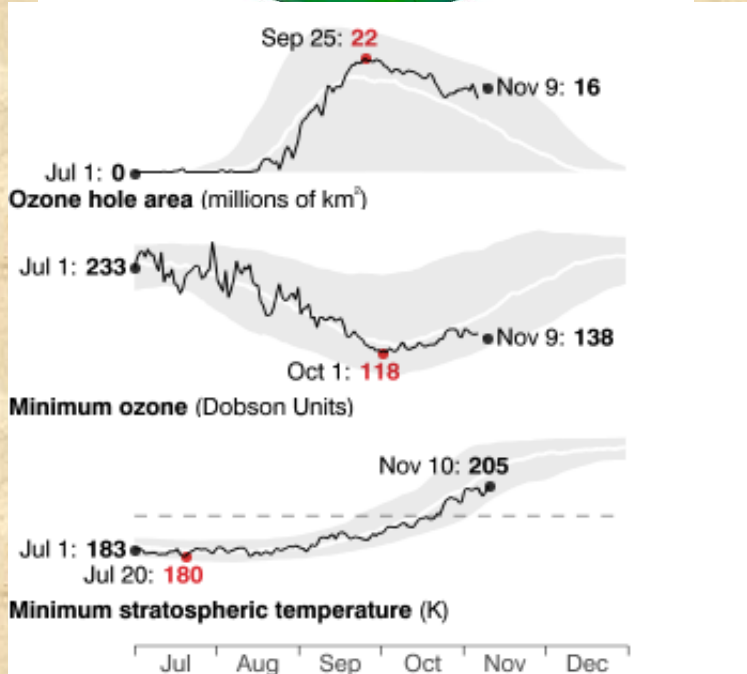


Ozone 15 September: a) 1980; b) 1990; c) 2000; d) 2005.

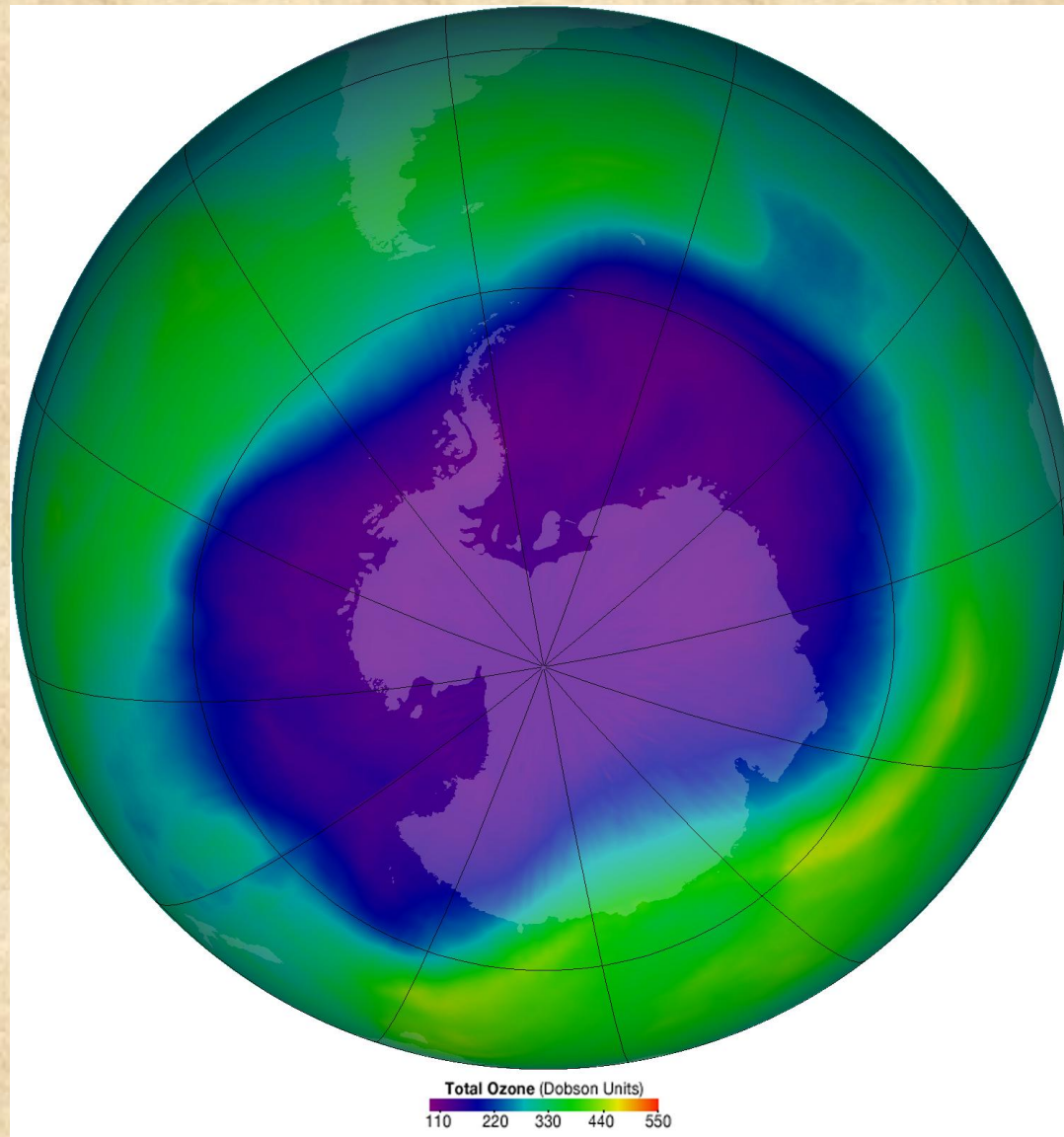


# Ozone hole

## 11 November 2010



# Biggest in area ozone hole 24 Sept 2006



# Antarctic krill – base for South Ocean ecosystem





# Deception Island

Krill

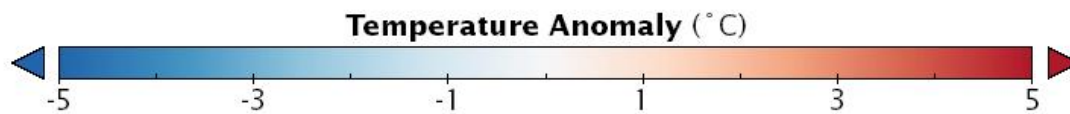
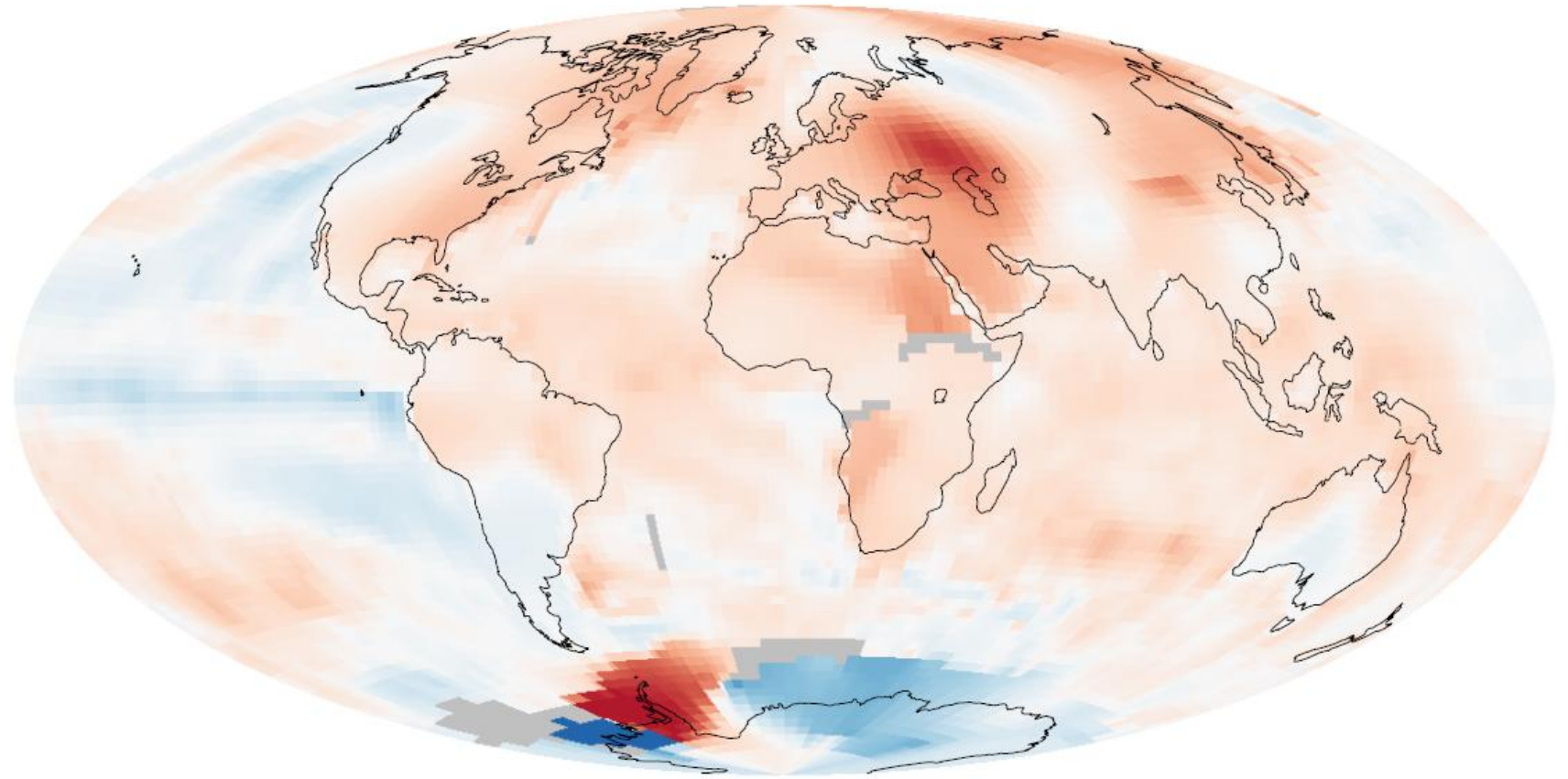






Two salps

# Antarctic Peninsula Climate Warming



August, 2010, GIS, NASA

# Atmosphere warming at AP

More free space  
in sub-Antarctic Islands

Glaciers and ice shelf melting

King penguin  
population grows

More wet snow  
rain in summer

Decrease salinity

Sea water warming

Decrease sea ice

Good for cryptophytes  
and salps

Bad for krill, large algae and  
diatom phytoplankton

Salp population grows  
and compete with krill on  
food + eat krill larvae

Krill population decline

Decrease food availability

Krill based ecosystem changed

Some penguin population decline

Adelie, gentoo  
shifted South





**Adelie suffering from wet snow**





## Idea

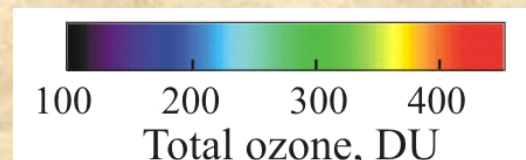
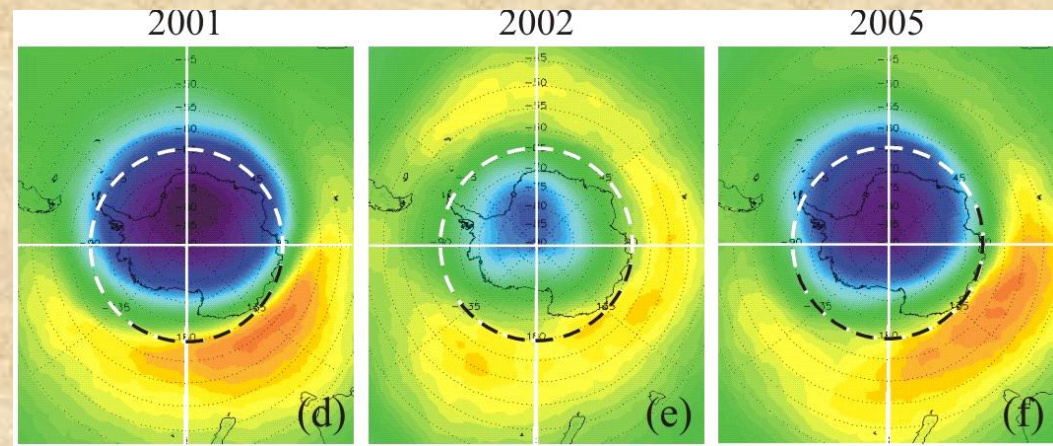
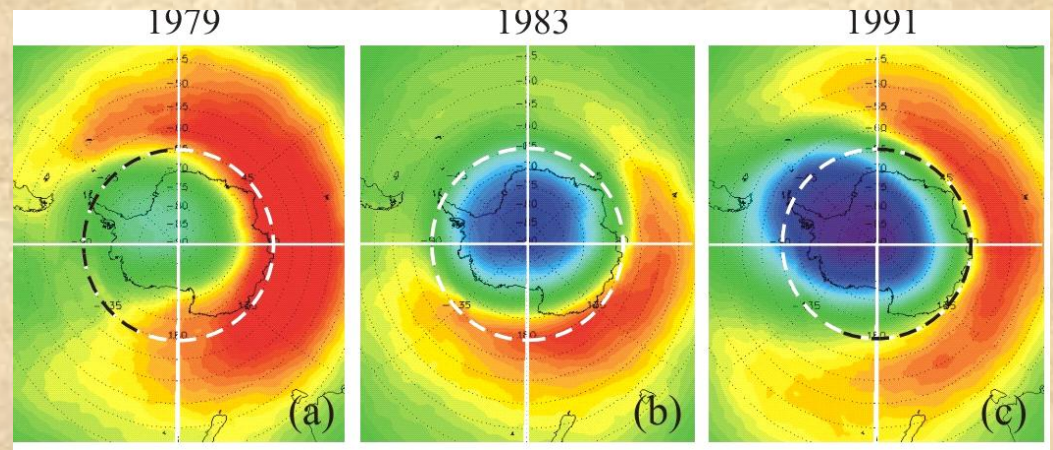
Besides the well known climate change factors (sea ice diminution in Antarctic Peninsula region, acidification, sea temperature increasing, etc.), **the ozone distribution asymmetry** (UVA, UVB asymmetry) can influence on krill based ecosystem.



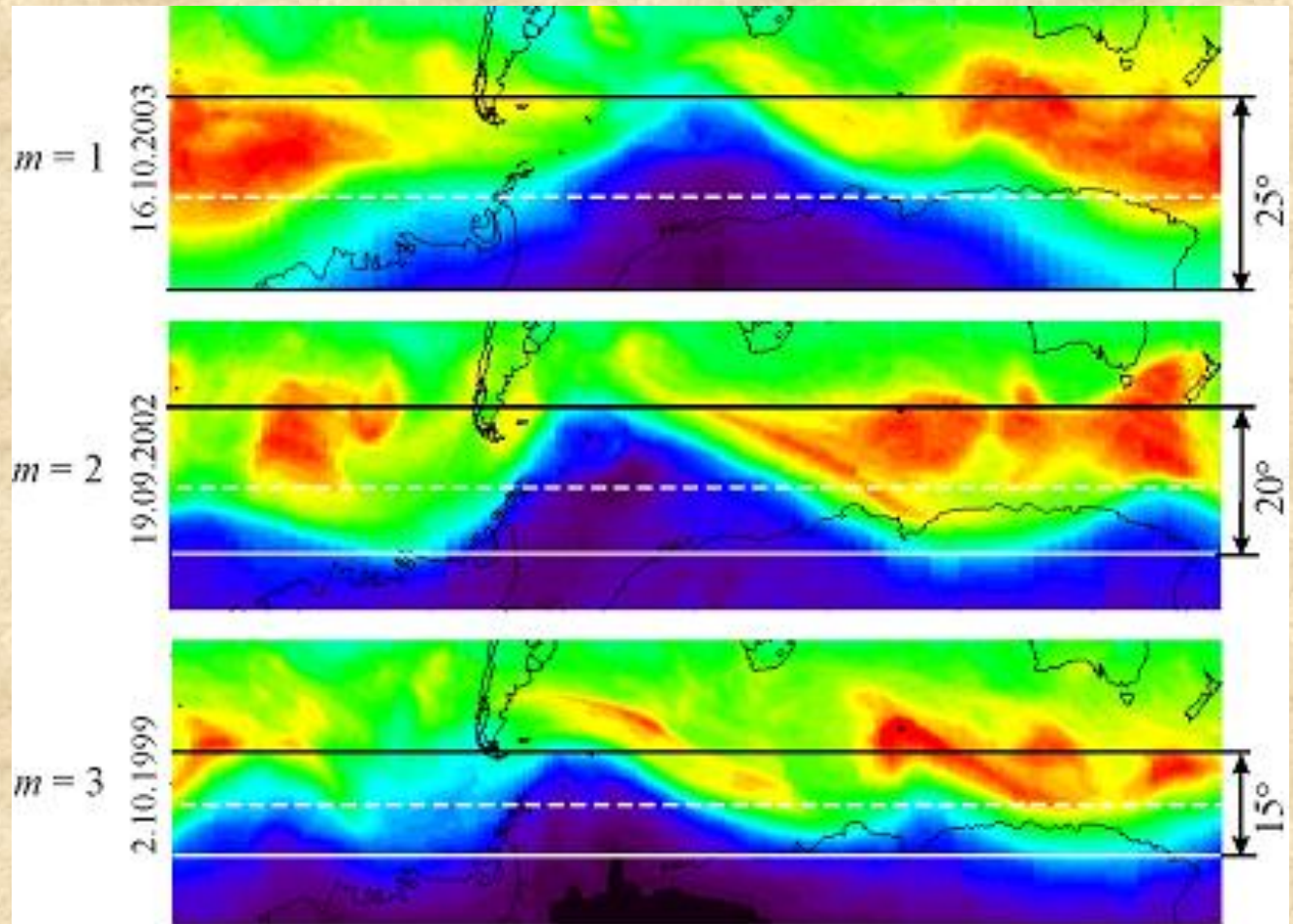
# Ozone hole in the Southern Hemisphere, asymmetry

Ozone hole (blue) and ozone rich collar (red) take typically asymmetric positions relative to the South pole due to quasi-stationary planetary waves influence.

October mean fields of the total ozone,  $45^{\circ}\text{S}$  -  $90^{\circ}\text{S}$ , TOMS data. The dashed circle marks the latitude  $65^{\circ}\text{S}$ .



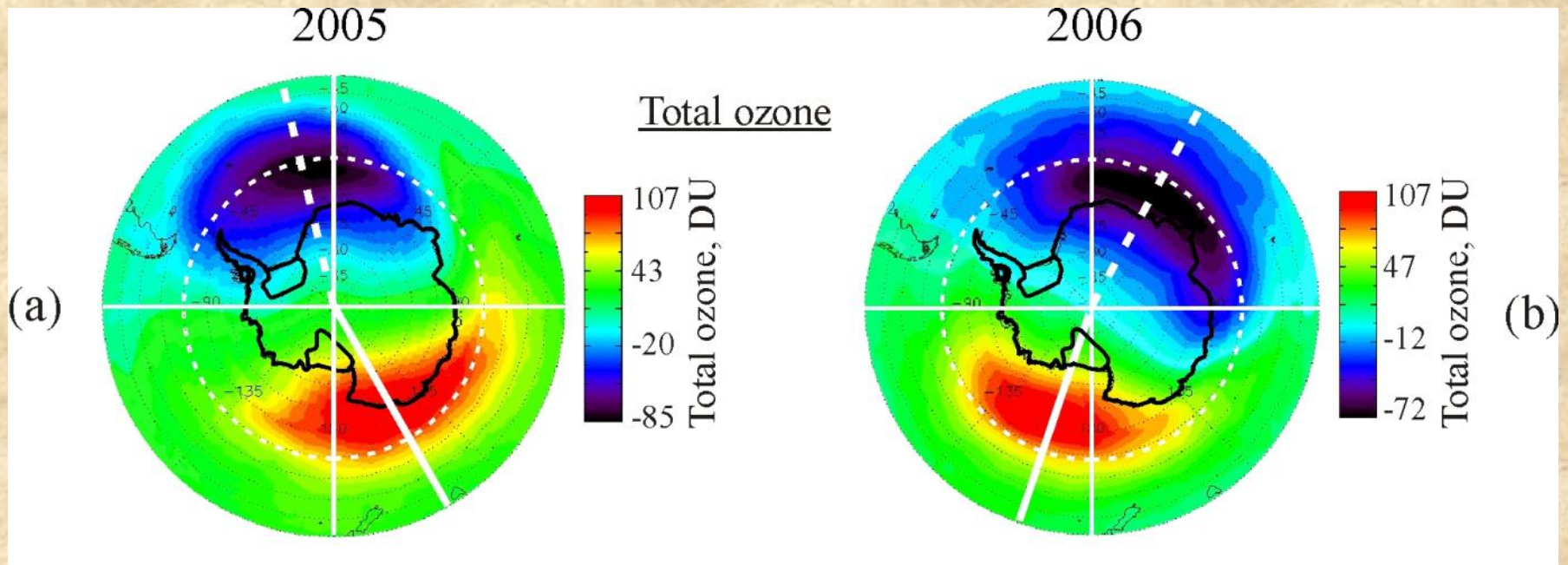
# The asymmetry exist due to planetary waves in total ozone distribution



Planetary waves with zonal wave numbers  $m = 1, 2, 3$

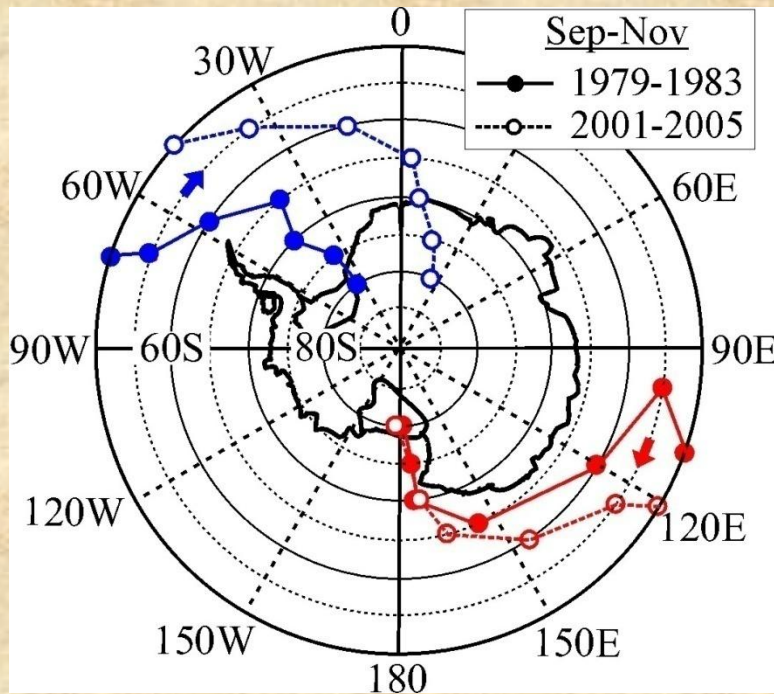
# The stratosphere ozone distribution asymmetry can impact on krill based ecosystem:

- ozone distribution asymmetry - UV impact asymmetry
- comparison to krill abundance, chlorophyll distribution

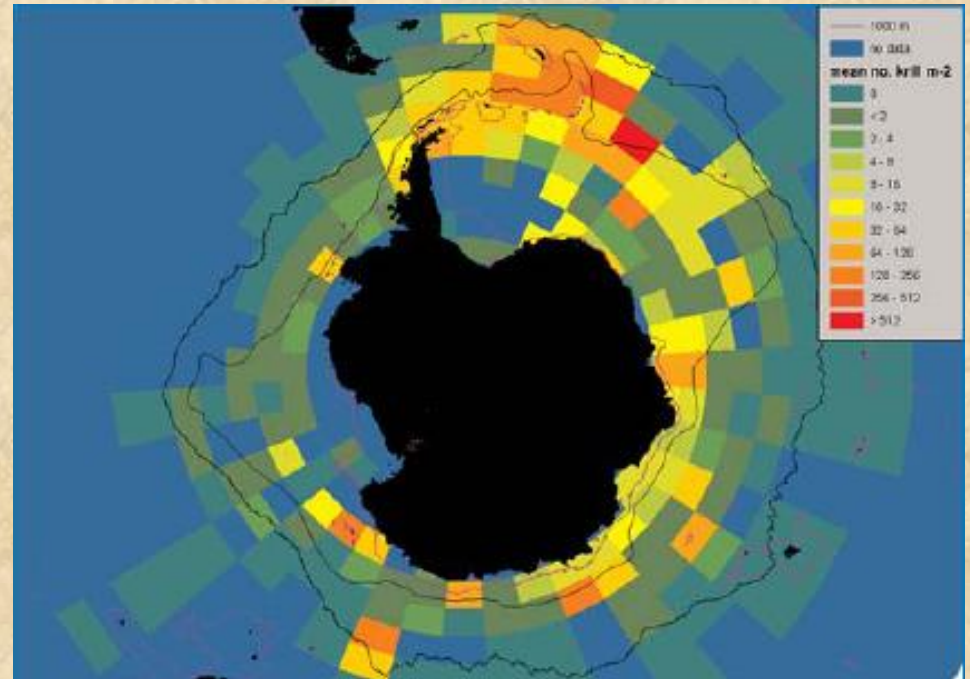


For analysis will be used the CCAMLR FineScale Krill Catch Data

# Zonal asymmetry in total ozone distribution should impact to South Ocean ecosystem food chain, especially in primary level



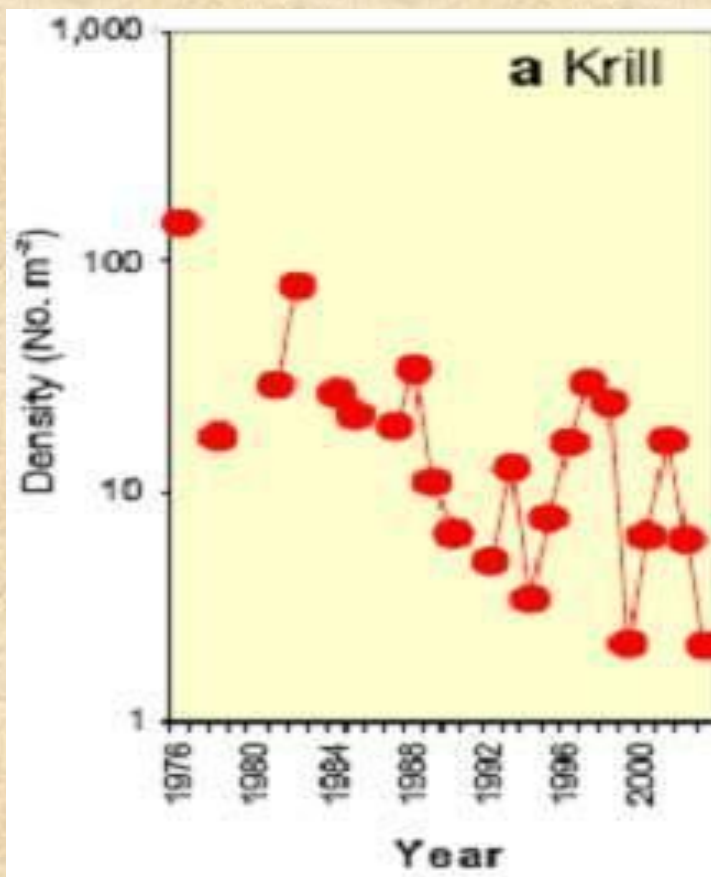
The ozone distribution anomaly



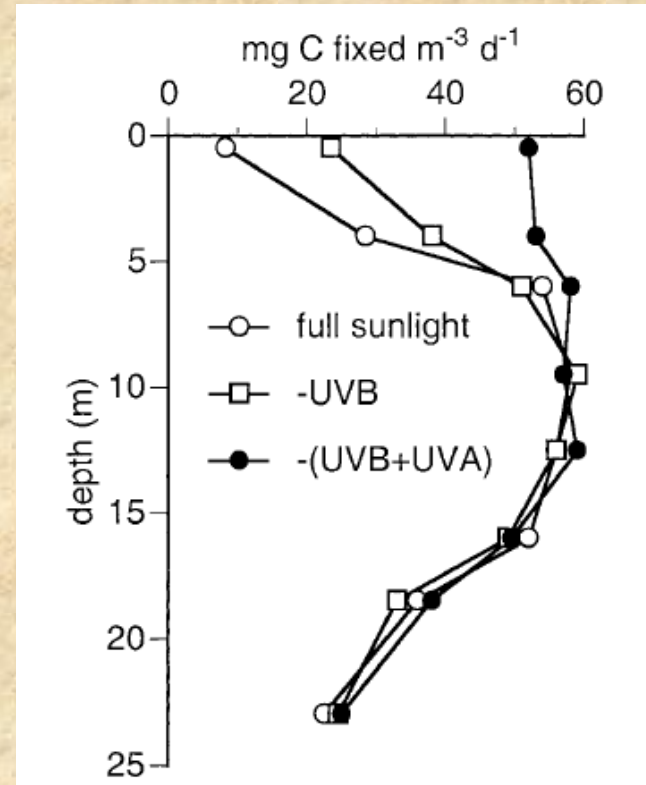
Antarctic krill mean density (1/m<sup>2</sup>) in South Ocean, 1926 – 2003 ( Atkinson et al., 2004)

# Krill density decline and impact of UV irradiation are observed in the region

Long term trend  
of krill density 1976-2004



(Atkinson, 2006)

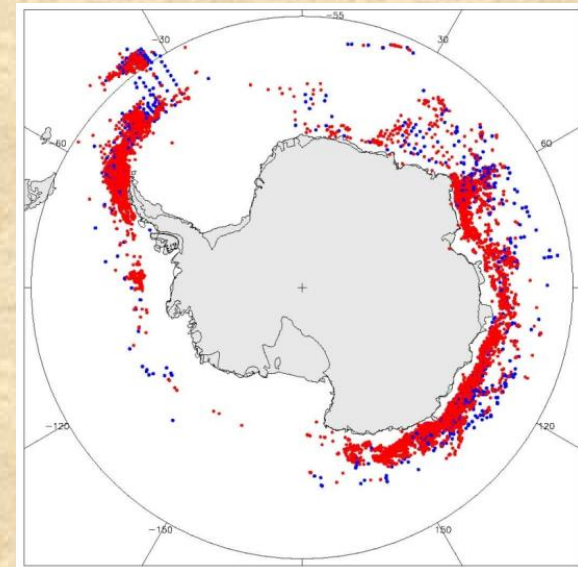


**UV inhibition of primary productivity (Karentz, 2001)**

# CCAMLR Fine Scale Krill Catch Data

For analysis we are developing more or less homogenous parameter or index (or set of parameters - CPUE, CPH?, new index? krill length distribution?), which allows to make comparison the state of krill in different years from 1974 to 2008 with ozone asymmetry distribution.

Create the reanalysis database from the **Fine Scale haul-by-haul data** taking into account and processing as much parameters as possible to receive new corrected catch data: catchability of trawl; krill extrusion through net (mortality) ; gear type, parameters (need list of trawl parameters including all dimensions) ; mesh size; vessel speed; catch amount by haul; types of krill aggregations; stratification by size.



(Naganobu et al, 2008)

# Conclusion

Work still ongoing

We expect to find out the effect of the ozone (UVR) distribution asymmetry in long-term data of krill density, chlorophyll distribution to take that in account in estimation of climate change impact on Antarctic Peninsula ecosystem.