

# **Seeing Estimation from 200 mb wind speed in the ELT campagne in Morocco**

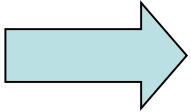
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Laboratory of High Energy Physics and Astronomy  
University Cady Ayyad; Marrakech

## **Presentation plan**

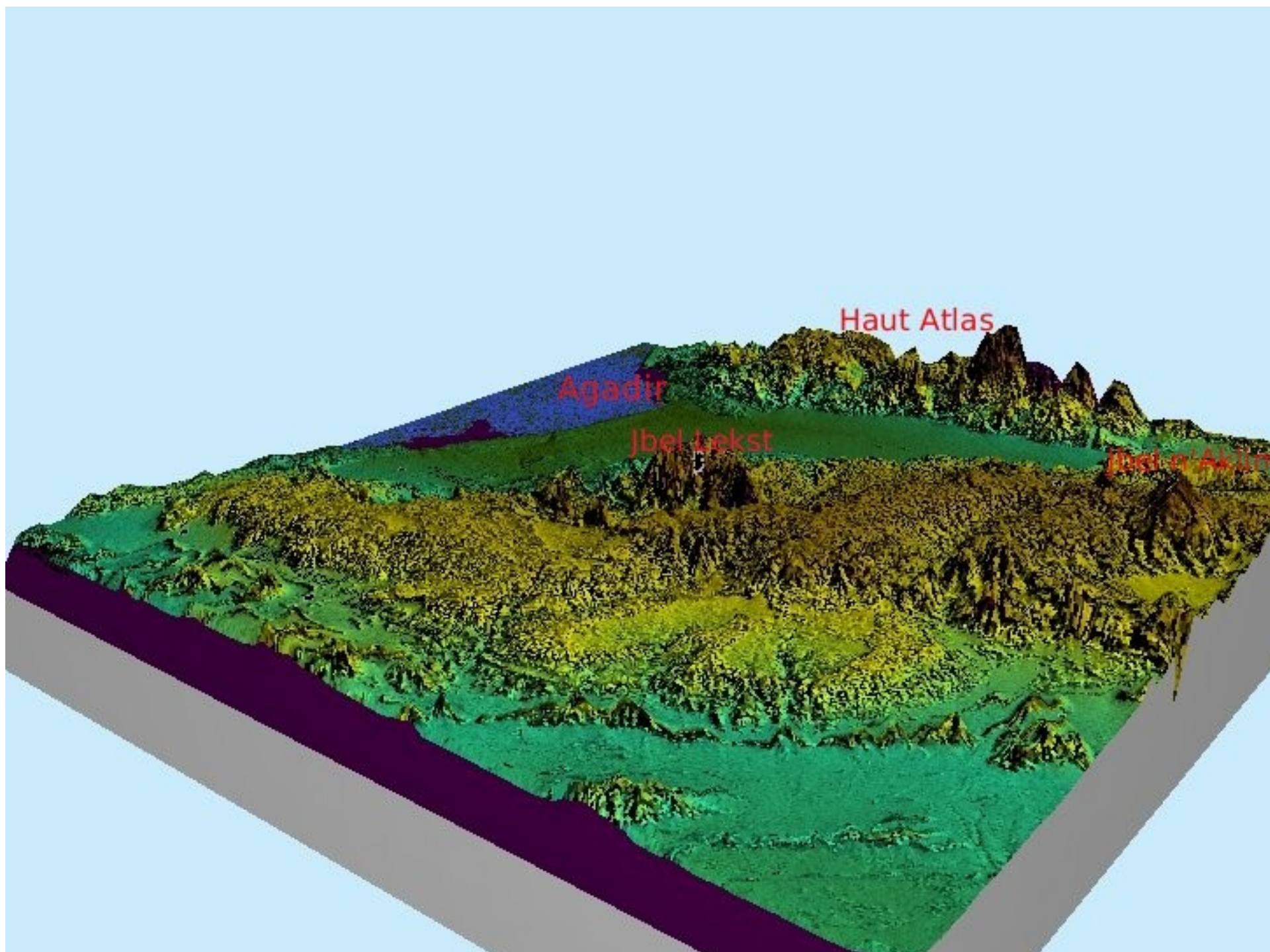
- 1- Introduction
- 2- Seeing and wind properties at Oukaimeden
- 3- Comparision with Paranal and La Silla
- 4- Conclusion and perspectives

# Introduction

- [Vernin et al, 1986], found good correlation between wind speed and seeing values measured at La Silla and Mauna Kea (1983).
- [Sarazin and Tokovinin; 2002] found good correlation between wind speed at 200 mb and the average velocity of the turbulence at Paranal and Cerro Pachon.
- . Wind speed at 200 mb is adopted by the scientific community as a determinant parameter for :
  - good seeing conditions
  - suitability for adaptive optics
- **Statistics of 200 mb wind speed at Oukaimeden**
- **See if there is any correlation with seeing values**
- **Compare with other observatories.**







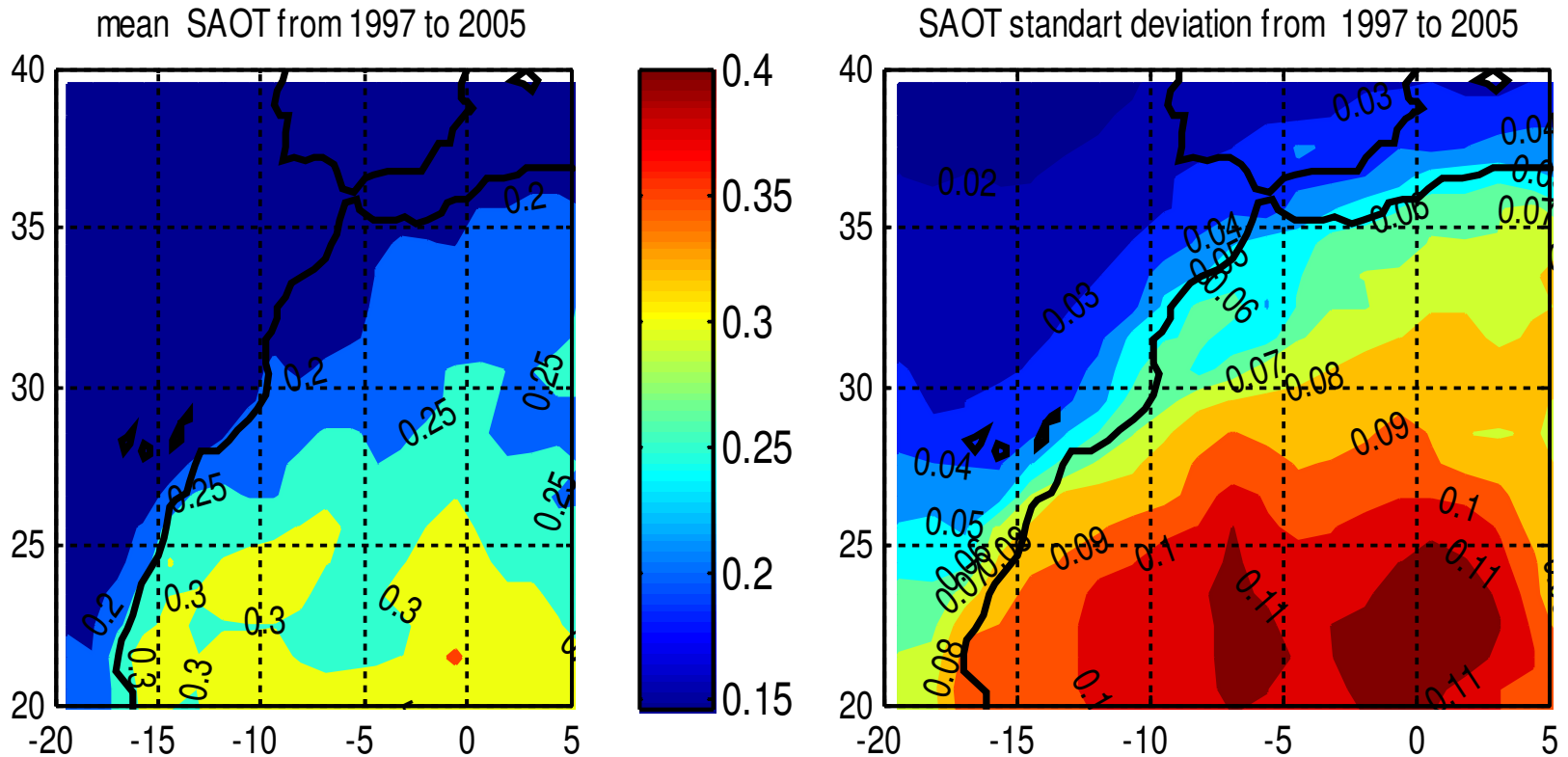
Haut Atlas

Agadir

Jbel Tekt

Jebel Akchouj

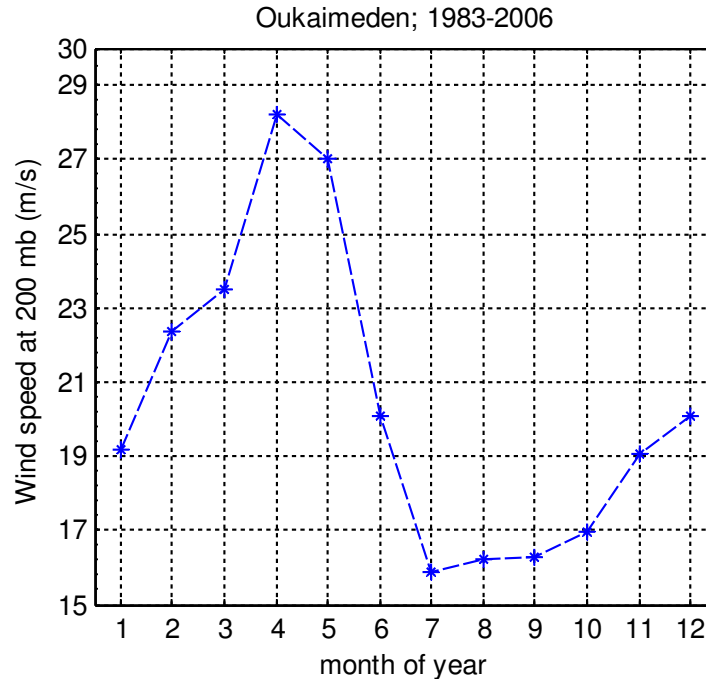
# Aerosol columnar characterization in Morocco: ELT prospect



TOMS EP mean retrieved aerosol optical thickness SAOT from 1997 to 2005 (a) and the inter-annual variability of the SAOT during that period.

# Wind speed at 200 mb averaged from 1983 until 2006

## Seasonal behaviour

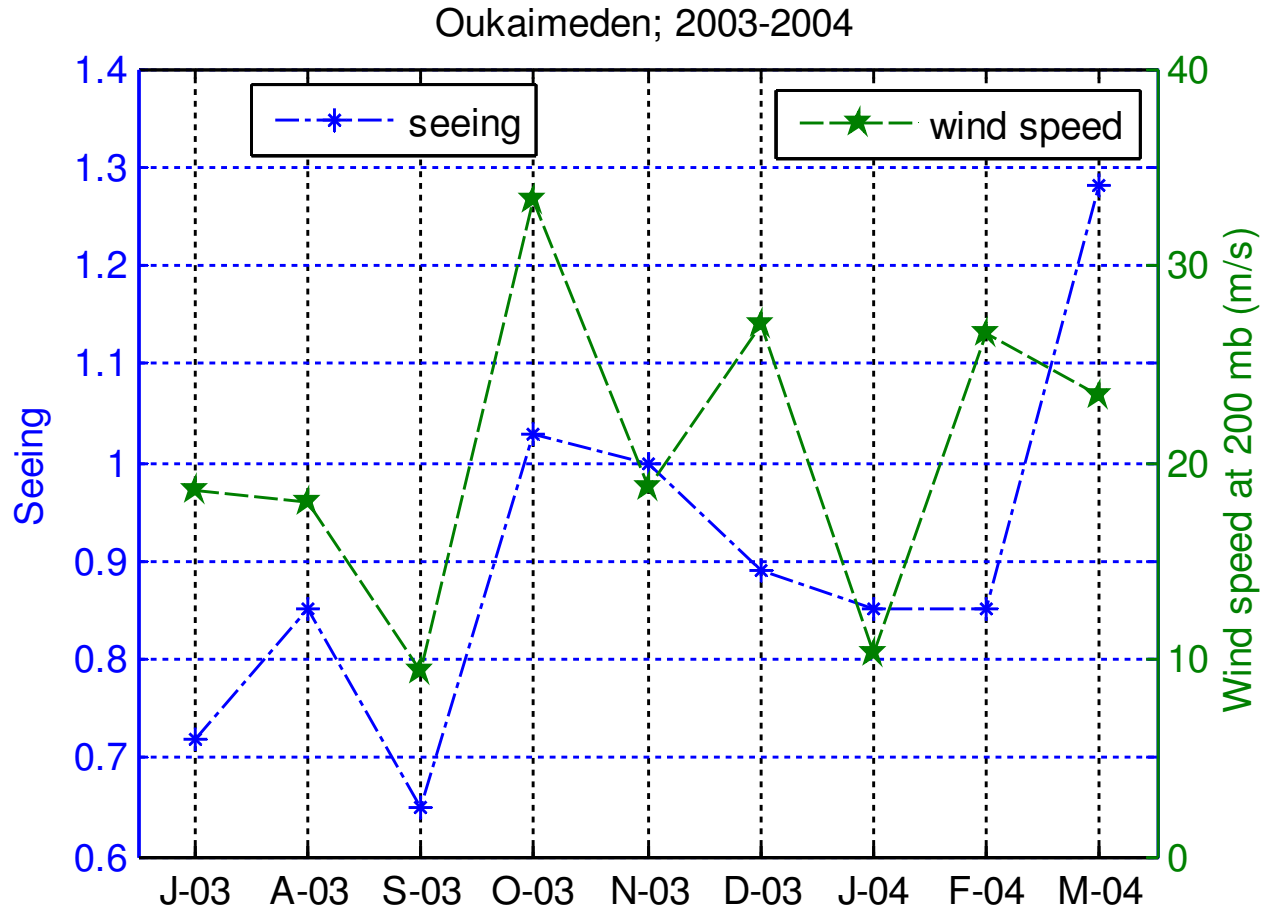


Seasonal pattern like Mauna Kea and La Palma  
Mauna Kea higher values

### Data from:

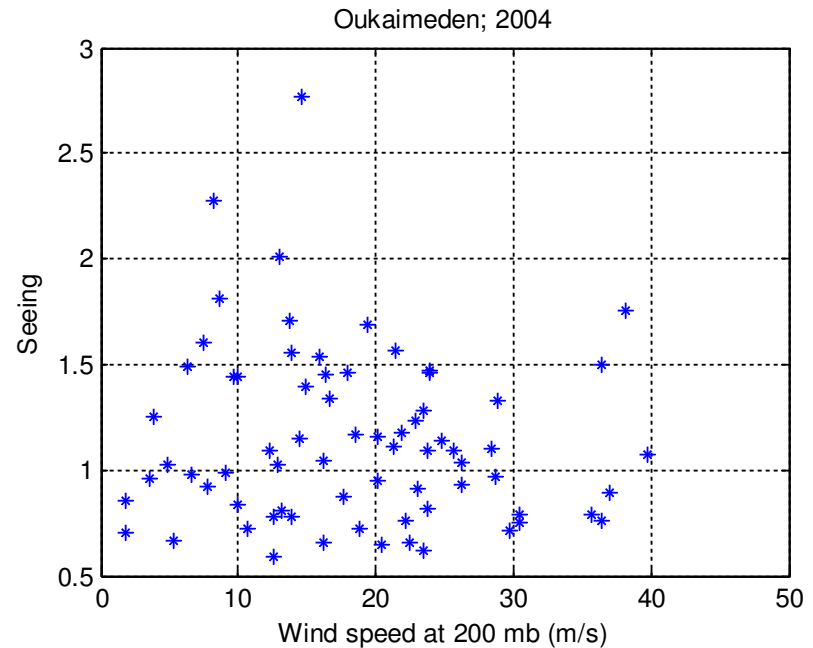
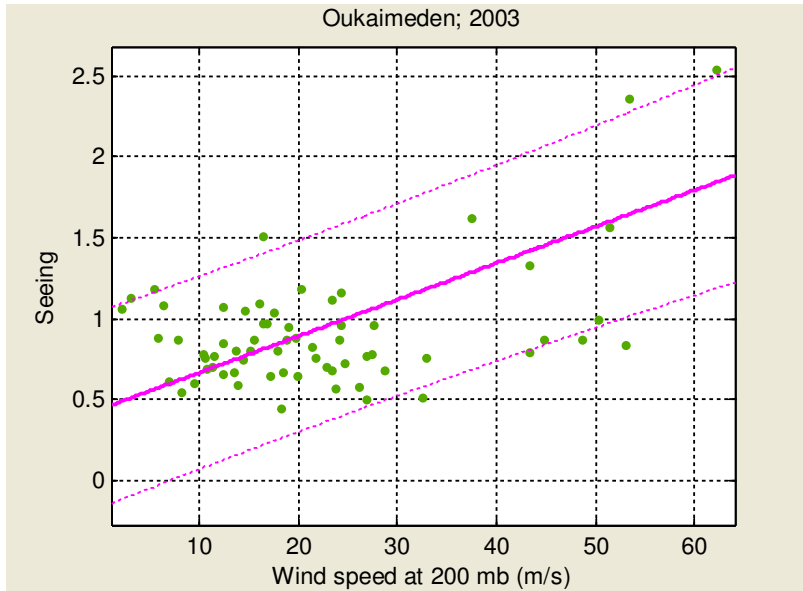
National Center for Environmental Prediction/ National Center for  
Atmospheric Research NCEP/NCAR Reanalysis

# 2003 and 2004 comparison between wind speed at 200 mb and the seeing at Oukaimeden



Seeing Data from: Z. Benkhaldoun at all, A&A 2005.

# Inter-annual variability of the correlation between Daily values of Seeing and wind speed at 200 mb.



2003

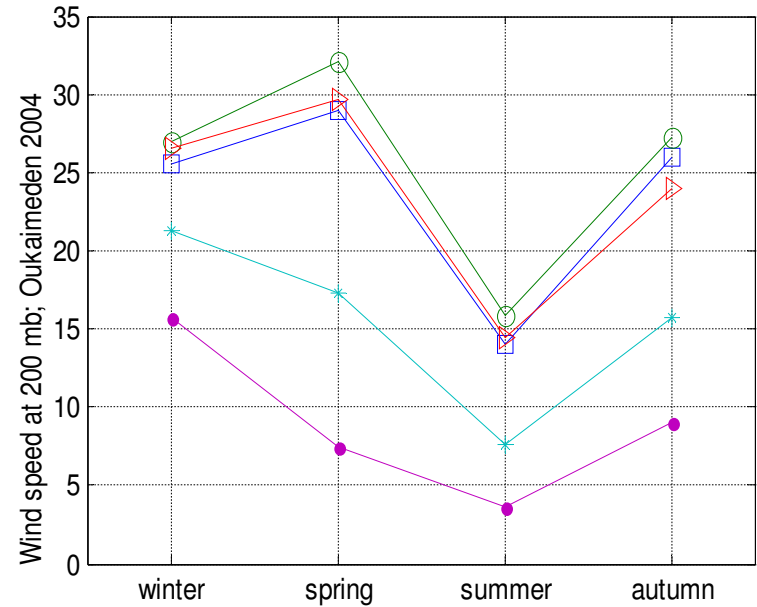
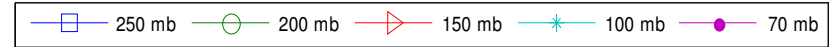
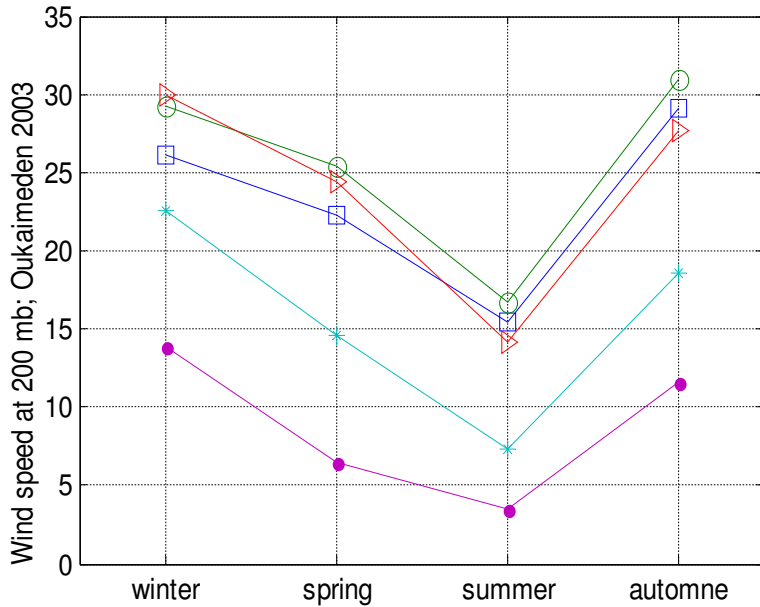
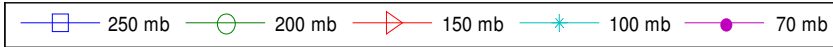
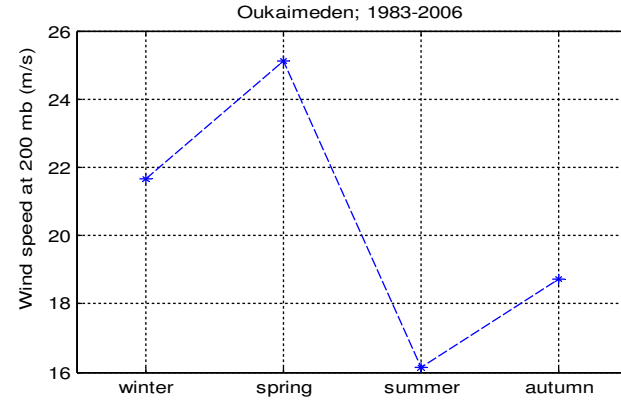
Seeing= $0.023(\pm 0.0068)$ \*Windspeed200mb+ $0.42(\pm 0.32)$  ; **R=0.66**

2004

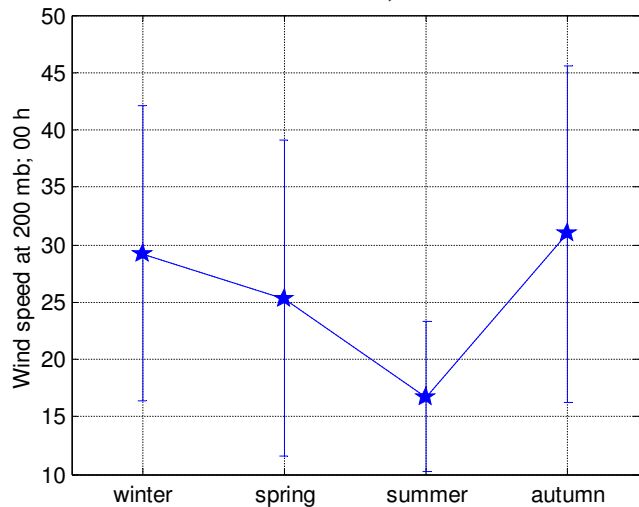
No specific relationship

# Why correlation in 2003 and non-correlation in 2004?

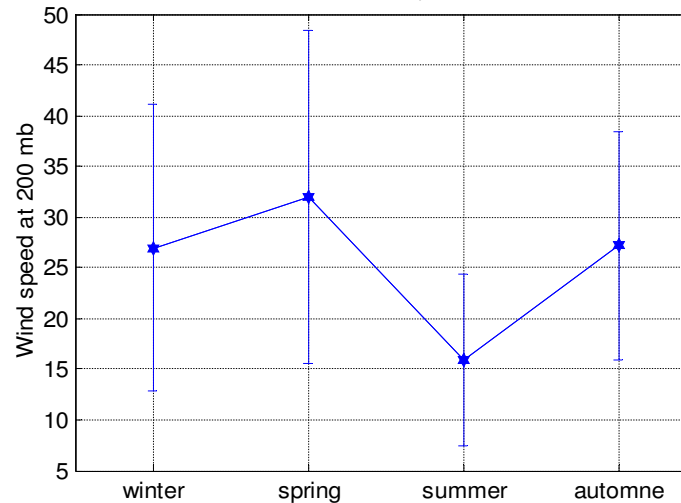
- Is the wind at 200 mb responsible?
- Are there bad data in 2004?
- Other reason



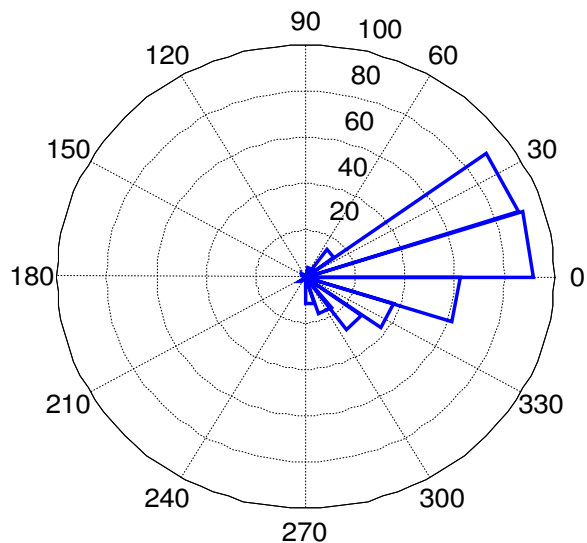
Oukaimeden; 2003



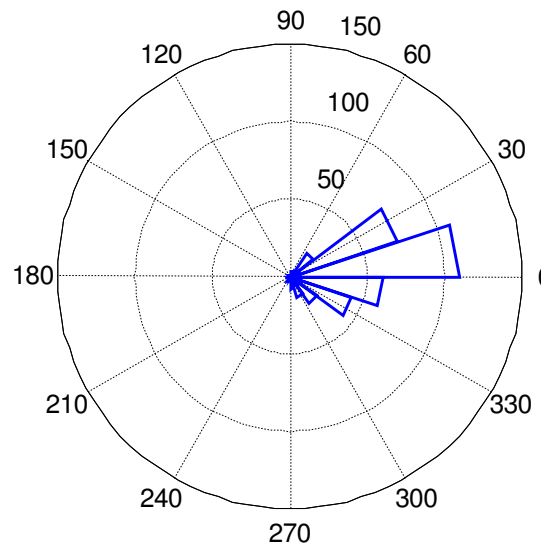
Oukaimeden; 2004



Wind direction 200 mb; Oukaimeden 2003

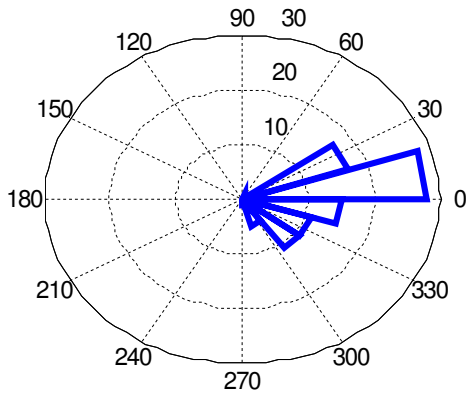


Wind direction; Oukaimeden 2004

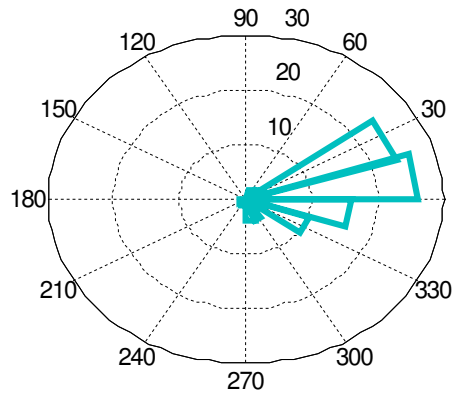


- High day to day variability of wind speed for both years.
- High spring value for 2004.

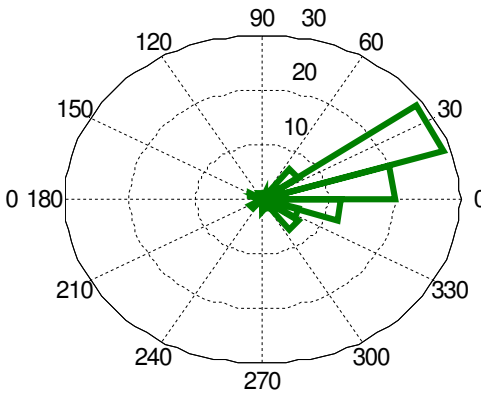
Wind direction, winter; Oukaimeden 2003



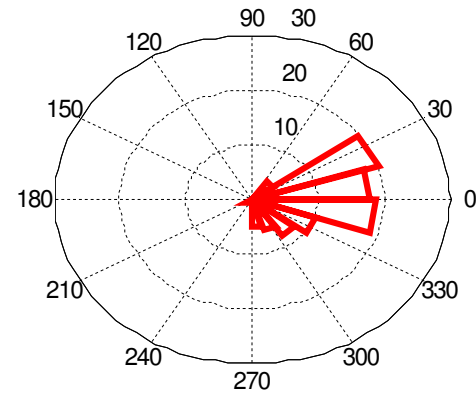
Wind direction, spring; Oukaimeden 2003



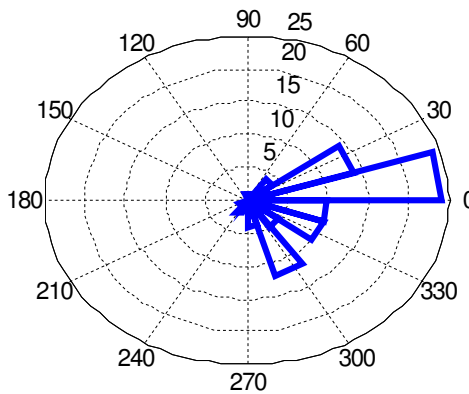
Wind direction; summer; Oukaimeden 2003



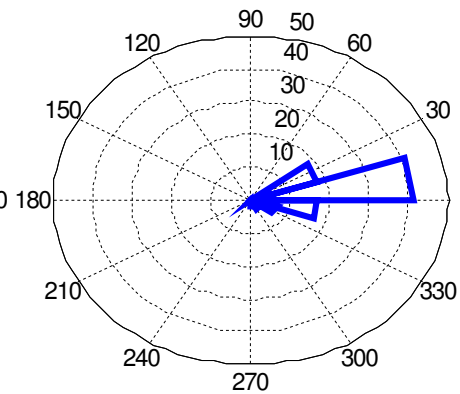
Wind direct; autumn; Oukaimeden 2003



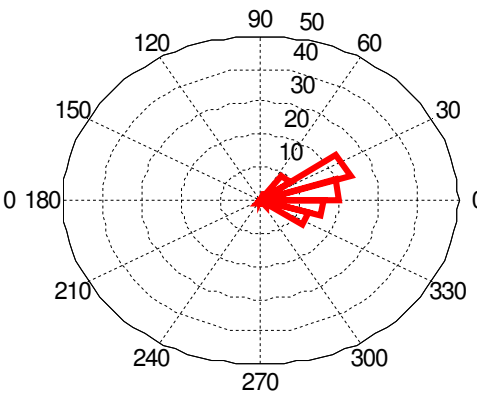
Wind direction, winter; Oukaimeden 2004



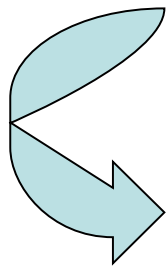
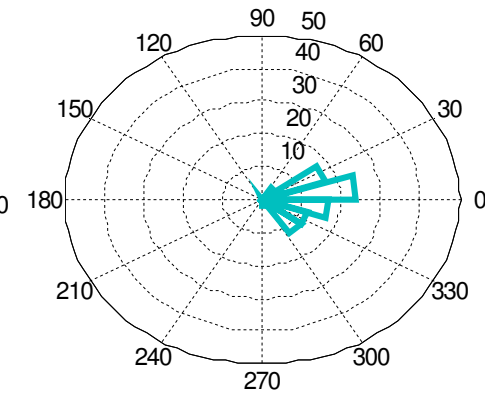
Wind direction, spring; Oukaimeden 2004



Wind direction, summer; Oukaimeden 2004

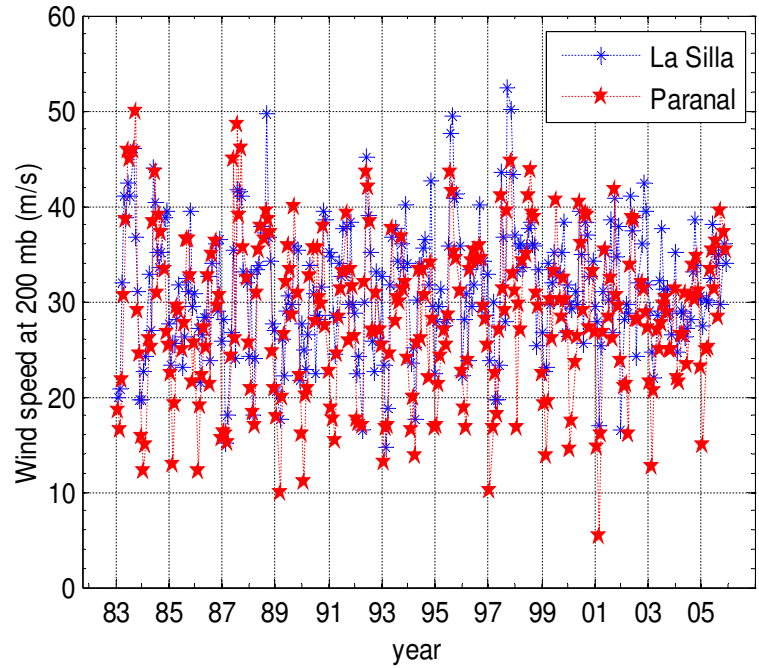
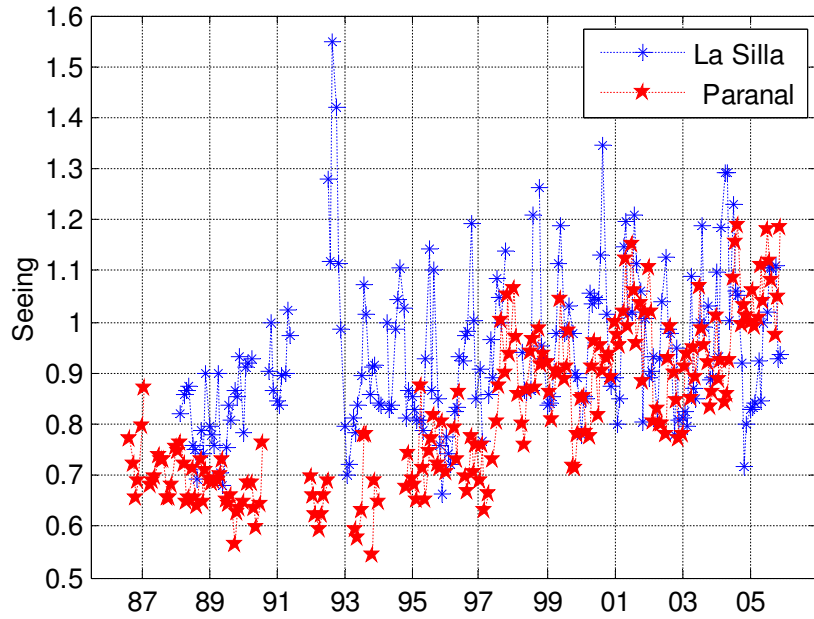


Wind direction, autumn; Oukaimeden 2004

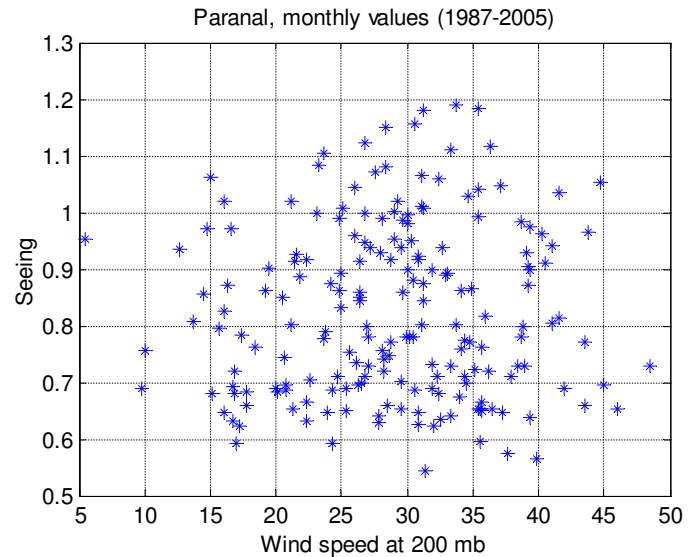
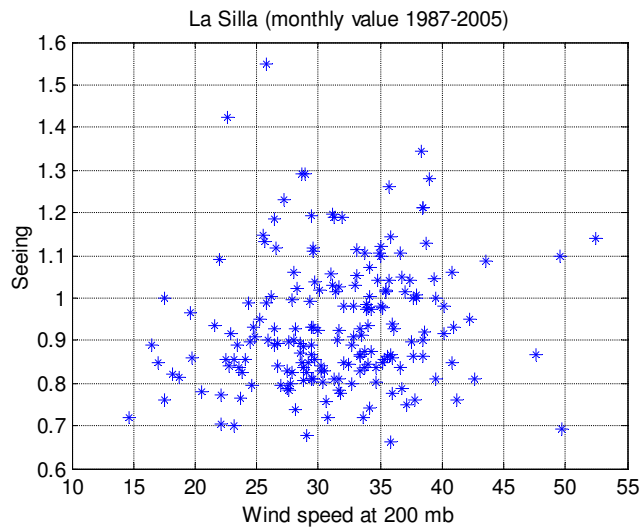
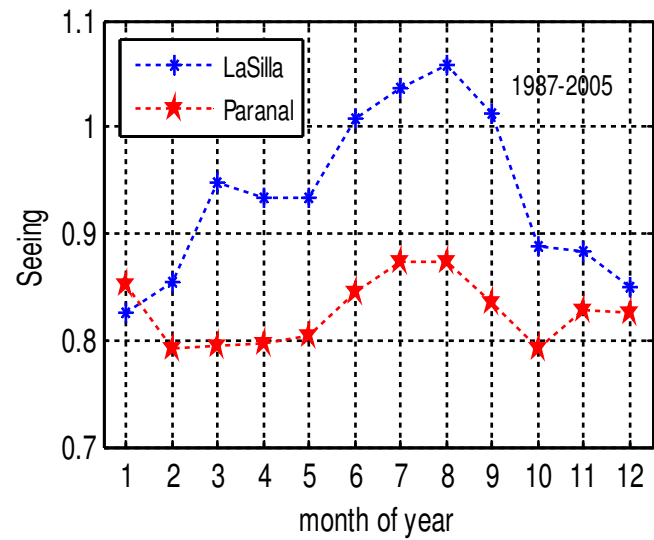
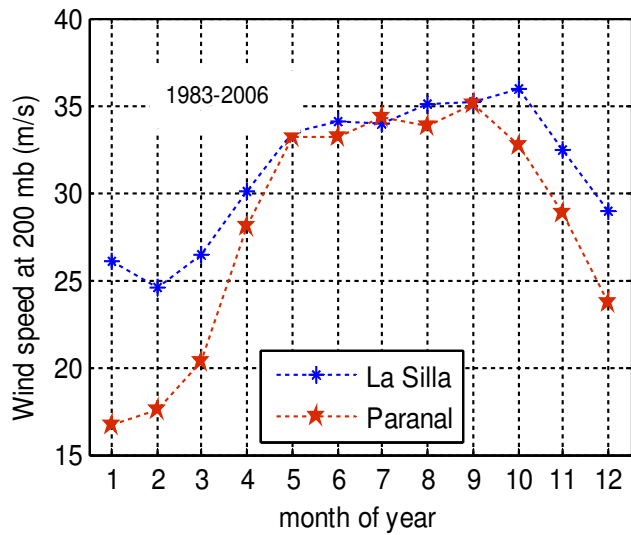


- Need for long term records of seeing values
  - Look for correlation in other observatories
- La Palma and Paranal**

# Monthly Seeing values at La Silla and Paranal

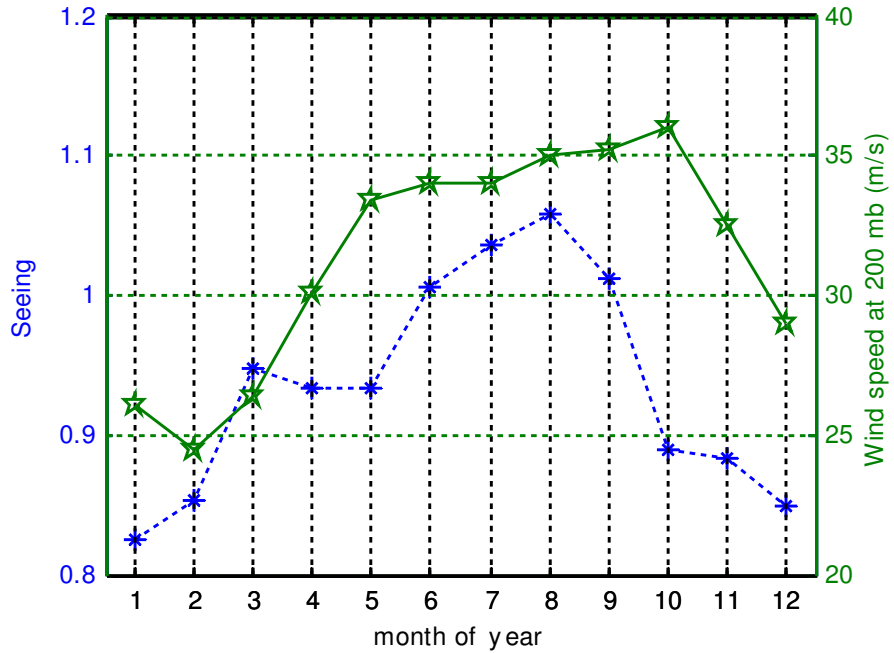


- Trend for increasing seeing.  
No trend for increasing wind speed

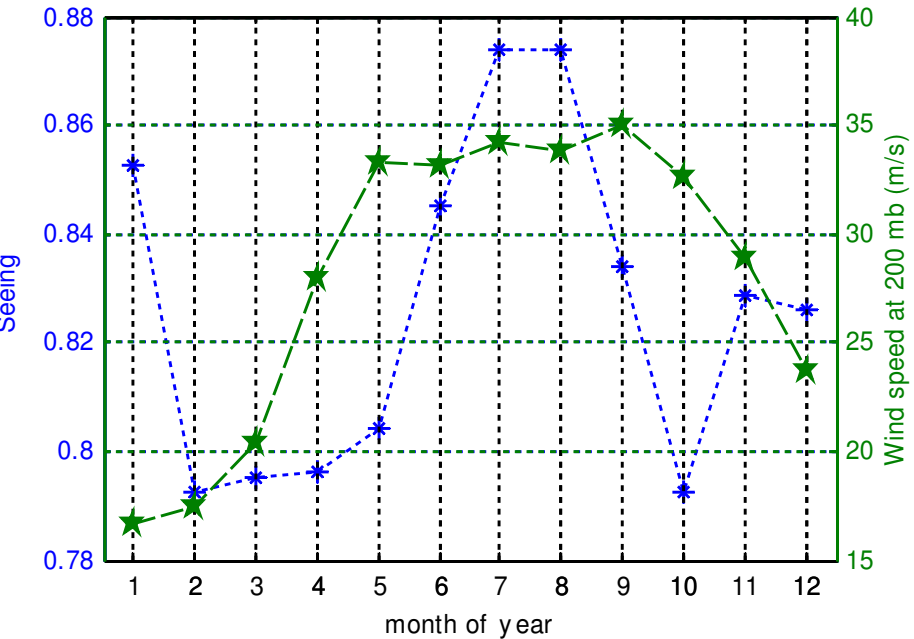


No specific relation between seeing and wind speed at 200 mb at Paranal and La Silla (monthly values from 1987 to 2005)

La Silla; 1987-2005



Paranal (1987-2005)



year	Correlation coefficient Paranal	Correlation coefficient La Silla
1988	<b>0.63</b>	*
1989	0.45	0.18
1990	*	*
1991	*	*
1992	*	*
1993	*	<b>0.58</b>
1994	*	*
1995	0.45	0.37
1996	*	0.31
1997	<b>0.63</b>	*
1998	0.05	*
1999	0.03	0.30
2000	0.42	0.36
2001	0.20	0.37
2002	0.30	0.14
2003	0.40	0.27
2004	<b>0.49</b>	0.41
2005	0.15	0.11
all	0.37 ( <b>0.60</b> without january-)	<b>0.63</b>

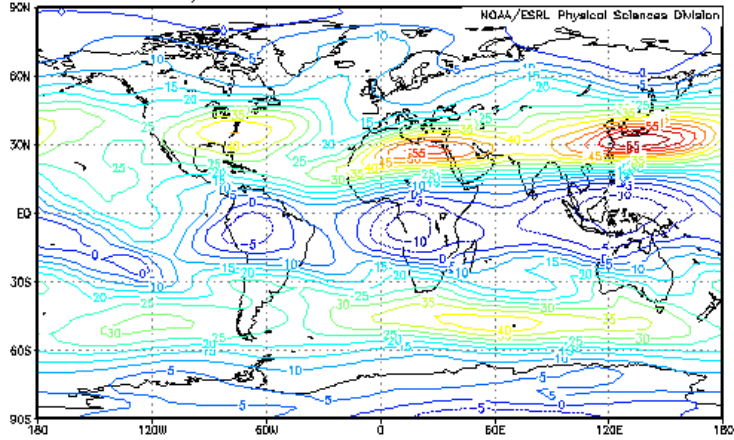
- Same seasonal pattern for seeing and wind speed.
- Low correlation coefficient.

# U-wind; seasonal behaviour;

V-wind is negligible\_

lon: plotted from -180 to 180.00  
lat: plotted from -90 to 90.00  
lev: 200.00  
t: averaged over Jan 2006 to Mar 2006

Mean uwnd m/s

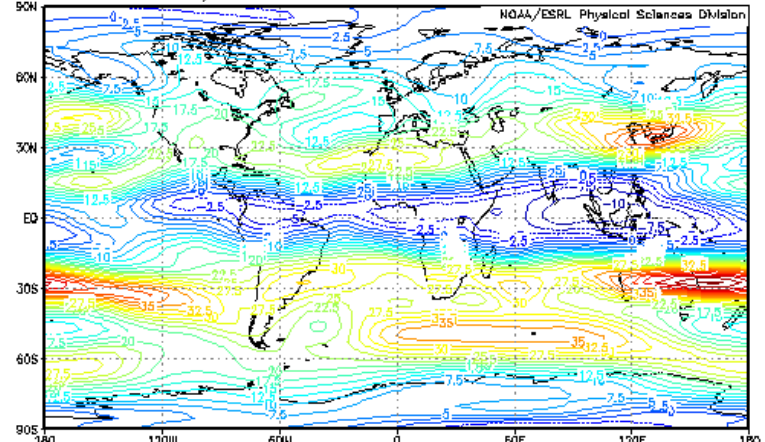


MAX=69.7133  
MIN=-13.8933

GrADS image

lon: plotted from -180 to 180.00  
lat: plotted from -90 to 90.00  
lev: 200.00  
t: averaged over Apr 2006 to Jun 2006

Mean uwnd m/s

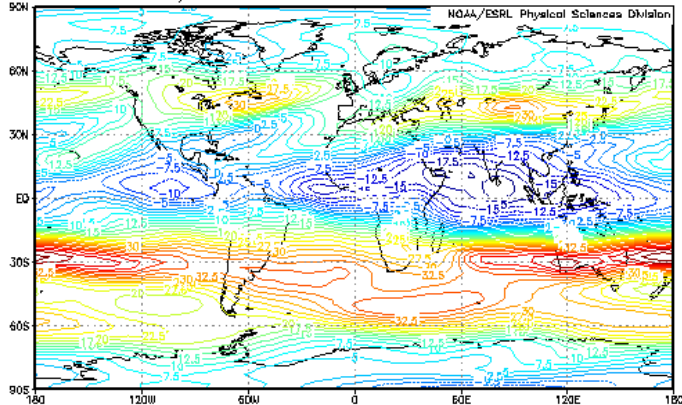


MAX=53  
MIN=-12.38

GrADS image

lon: plotted from -180 to 180.00  
lat: plotted from -90 to 90.00  
lev: 200.00  
t: averaged over Jul 2006 to Sep 2006

Mean uwnd m/s

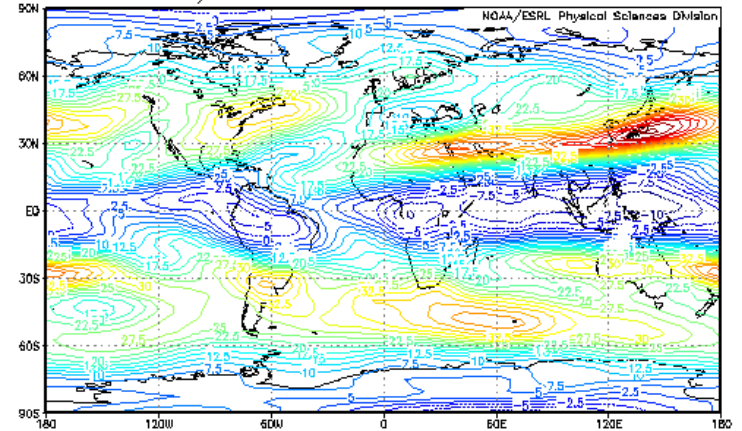


MAX=52.0567  
MIN=-21.6467

GrADS image

lon: plotted from -180 to 180.00  
lat: plotted from -90 to 90.00  
lev: 200.00  
t: averaged over Oct 2006 to Dec 2006

Mean uwnd m/s

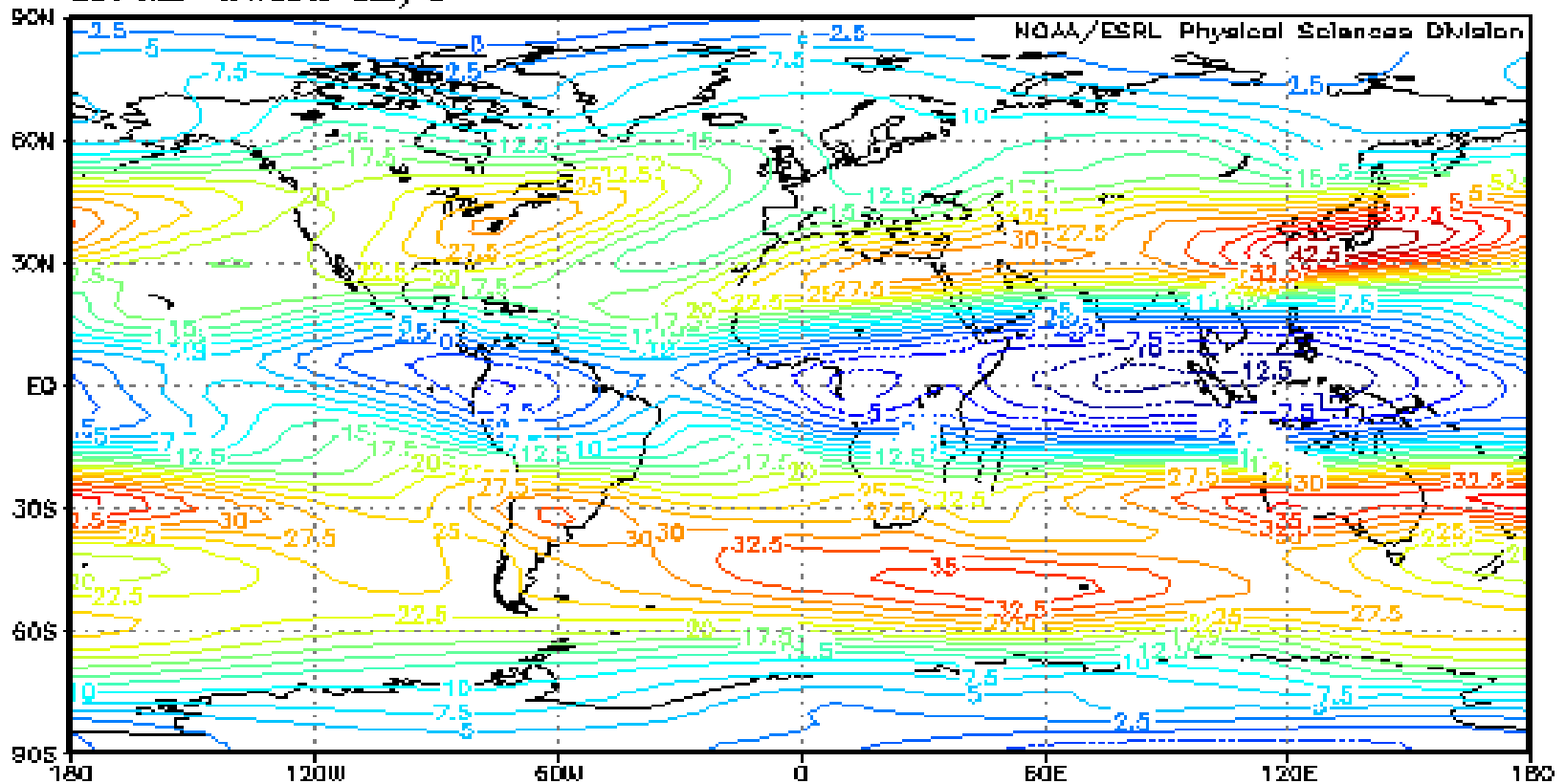


MAX=58.4467  
MIN=-12.0533

GrADS image

# Ten years wind speed (200 mb) values

lon: plotted from -180 to 180.00  
lat: plotted from -90 to 90.00  
lev: 200.00  
t: averaged over Jan 1996 to Dec 2006  
Mean uwind m/s



MAX = 44.9731  
MIN = -13.4554

GrADS image

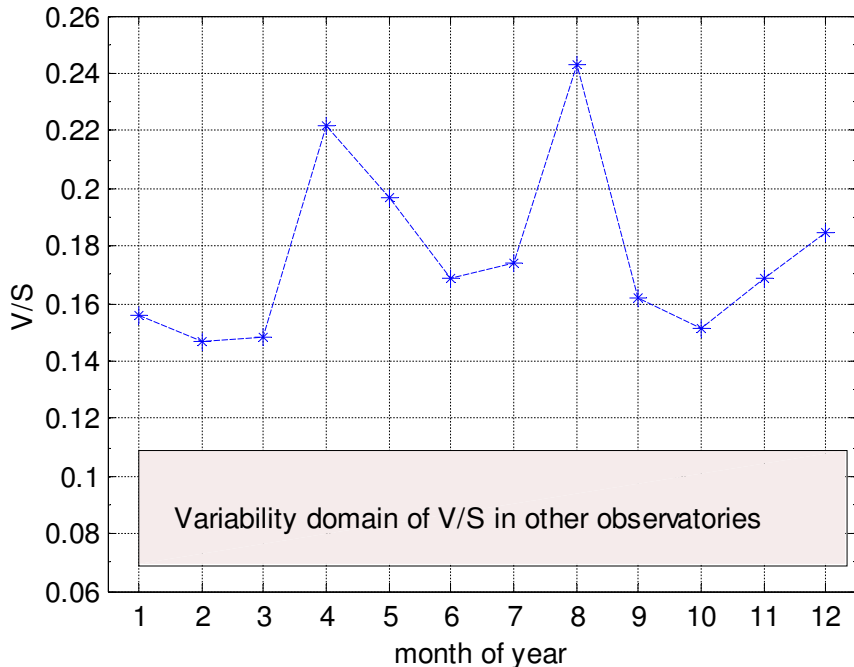
[B. Garcia-Lorenzo et al 2004] defined

$V = (\text{wind speed at 200 mb}) / (\text{global mean of wind speed at 200 mb})$

S=monthly standard deviation

Made inter comparison of wind speed at different observatories

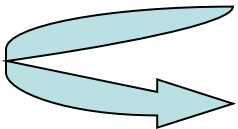
Oukaimeden; 1983-2006



Site	Amplitude (m/s)	Mean (m/s)	Median (m/s)	Standard deviation (m/s)
La Palma	13.69	22.13	20.79	11.67
La Silla	12.46	33.35	32.77	12.94
Mauna Kea	18.00	24.33	22.81	12.30
Paranla	18.47	30.05	28.63	13.01
San Pedro	26.49	26.55	24.57	15.39
<b>Oukaimend</b>	<b>12.32</b>	<b>20.41</b>	<b>19.63</b>	<b>6.99</b>

### Oukaimeden best site in terms of 200 mb wind statistics:

- Smallest standard deviation
- highest V/S ratio; most stable high altitude winds
- smallest mean and median values.



[B. Garcia-Lorenzo et al 2004] inter comparison of wind speed at 200 mb at La Palma, La Silla, Paranal, Mauna Kea and San Pedro.

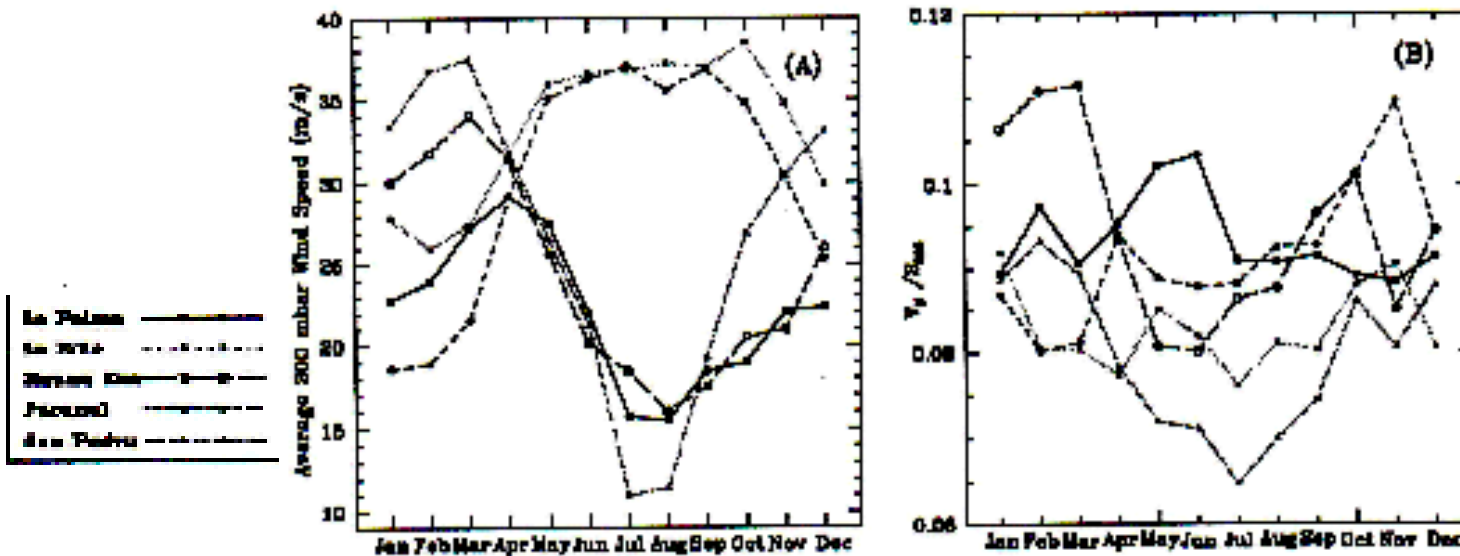
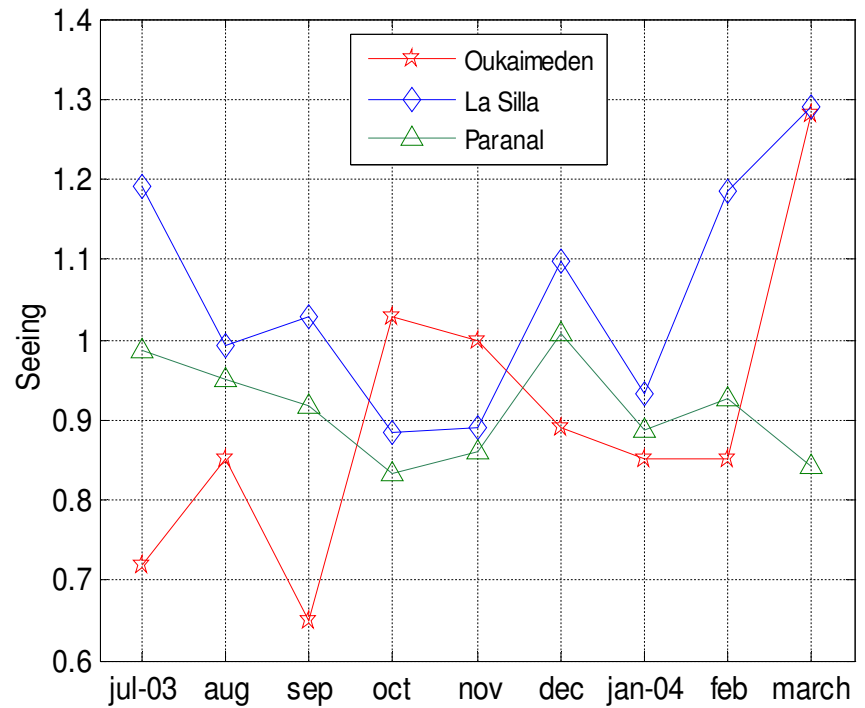
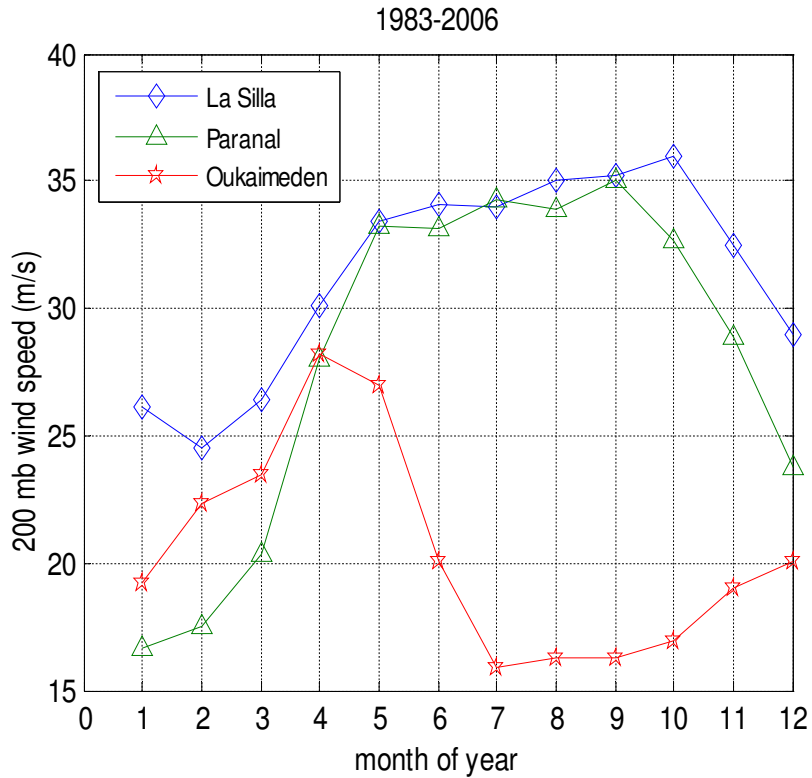


Figure 2. (a) The monthly average wind velocity at the 200-mbar pressure level for the period 1980–2002 for the five selected observing sites. (b) Normalized mean to standard deviation ratio of wind velocity at the 200-mbar pressure level for this period 1980–2002 for the selected observing sites. In panels, lines and symbols indicate sites as in Fig. 1.

At these observatories, the normalized mean to standard deviation ratio ( $V/S$ ) of wind velocity at 200 mb ranges from 0.6 to 0.12 whereas at Oukaimeden The ratio ranges from 0.14 to 0.24.

# Inter comparison between La Silla, Paranal and Oukaimeden



# Conclusion

- 200 mb wind speed at Oukaimeden has a seasonal behaviour with maximum in spring and minimum in summer time.
- Best records in terms of 200 mb wind statistics, compared to La Palma, Paranal Mona Kea, La Silla and San Pedro.
  - lowest mean and median wind speed over 23 years study
  - Best V/S ratio, most stable.
  - lowest standard deviation.
- Correlation between 200 mb wind speed and Seeing in 2003 at Oukaimeden.





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<http://www.ucam.ac.ma/marrakechastro/oisa/>