A sunset over the ocean with a white text box containing the title.

Changes in Wind Structure in Estonia During the Latter Half- century

A sunset over the ocean with a white text box containing the author's name and affiliation.

Sirje Keevallik
Marine Systems Institute at Tallinn
University of Technology

Changes in spring weather conditions and atmospheric circulation in Estonia (1955-1995)

Sirje Keevallik

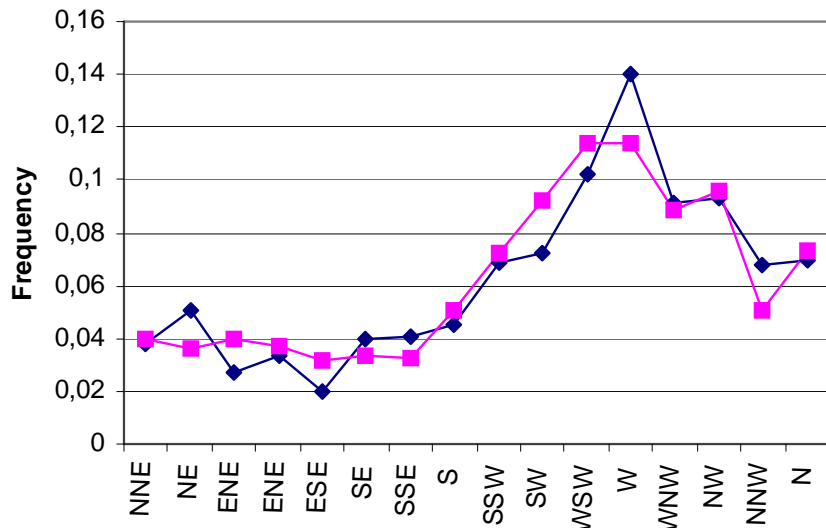
*International Journal of Climatology,
23: 263-270 (2003)*

Aerological data

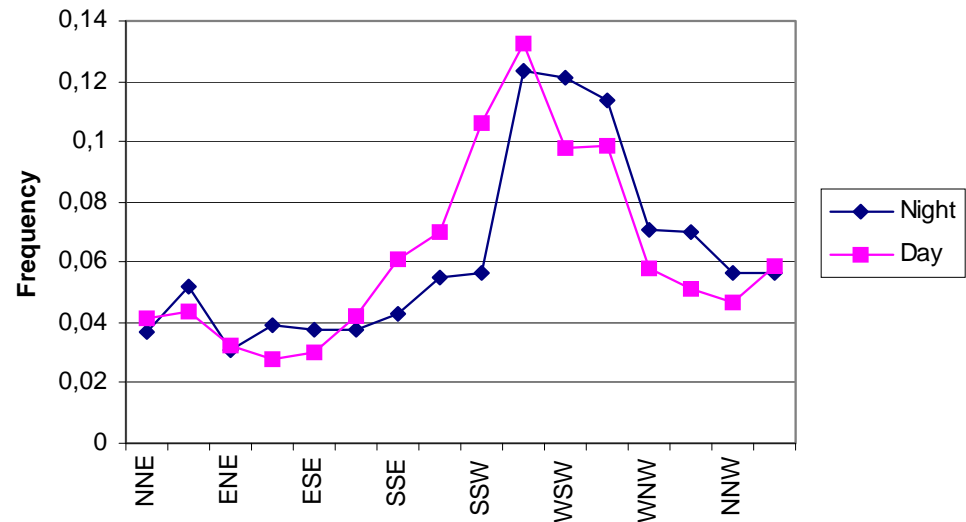
- Wind speed and direction
- Tallinn (Harku) Aerological Station
- 500 and 850 hPa level
- 1955-1995
- 00 GMT

Wind roses at 850 hPa level in Harku at 00 GMT and 12 GMT

850 hPa, January, 1953-1997



850 hPa, July, 1953-1997



Components of wind velocity

$$u = -V \sin \varphi$$

$$v = -V \cos \varphi$$

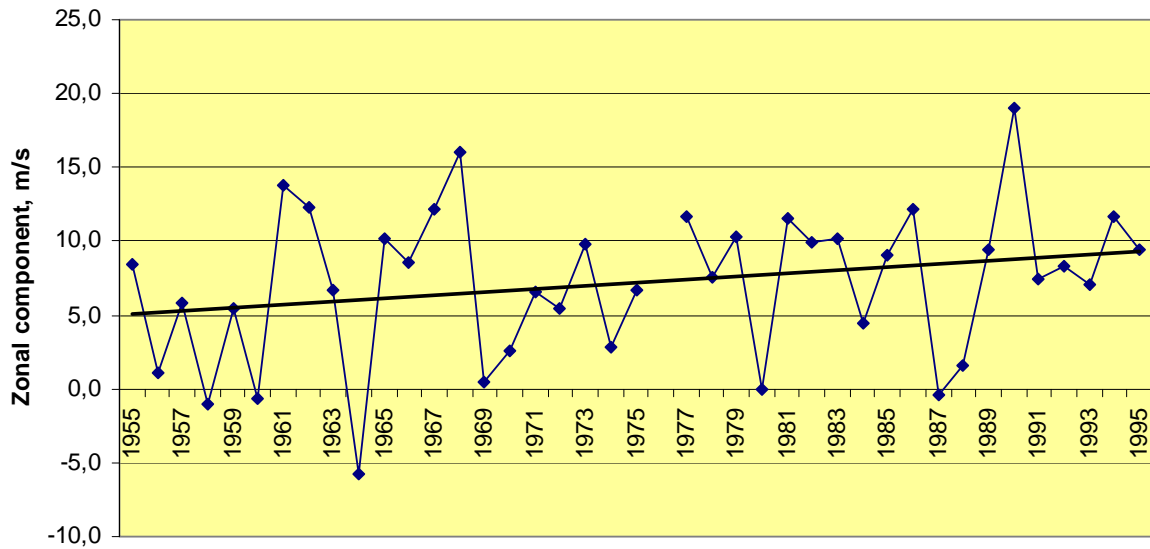
V is wind speed

φ is wind direction

u is zonal component, positive to the East

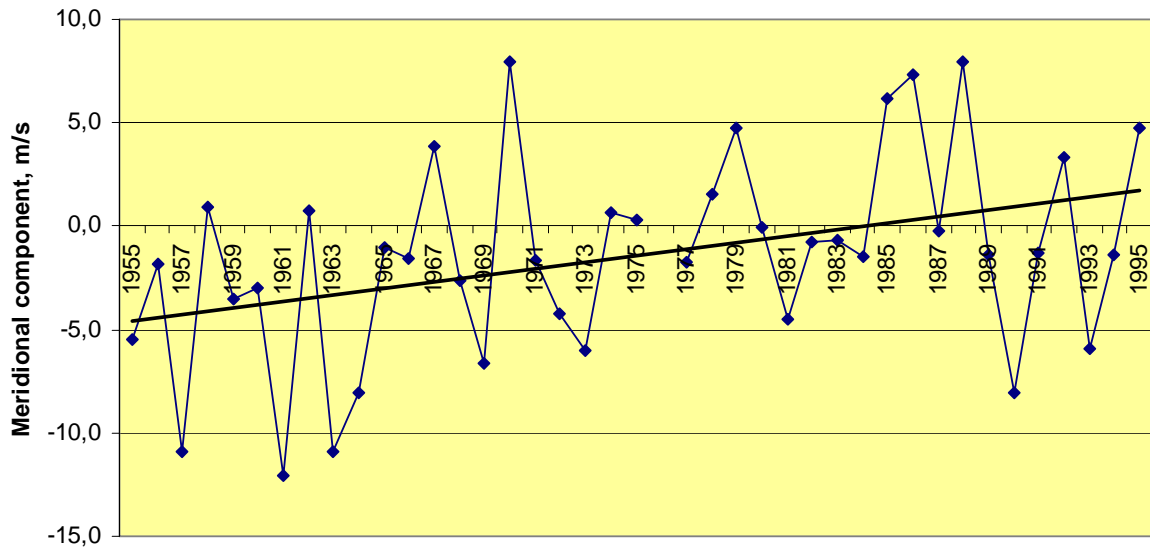
v is meridional component, positive to the North

500 hPa, March



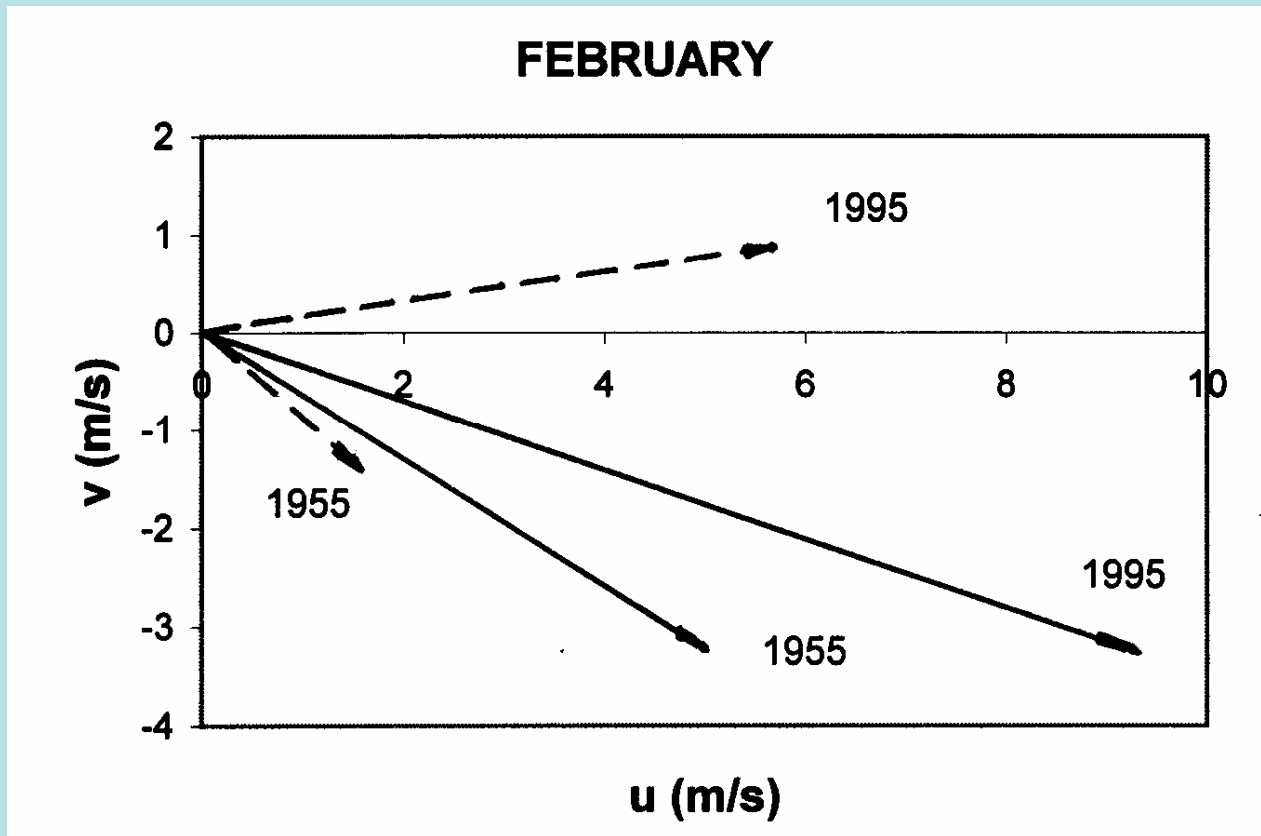
Zonal Component
Change:
0.107 m/s per year
Significance F=0.12

500 hPa, March



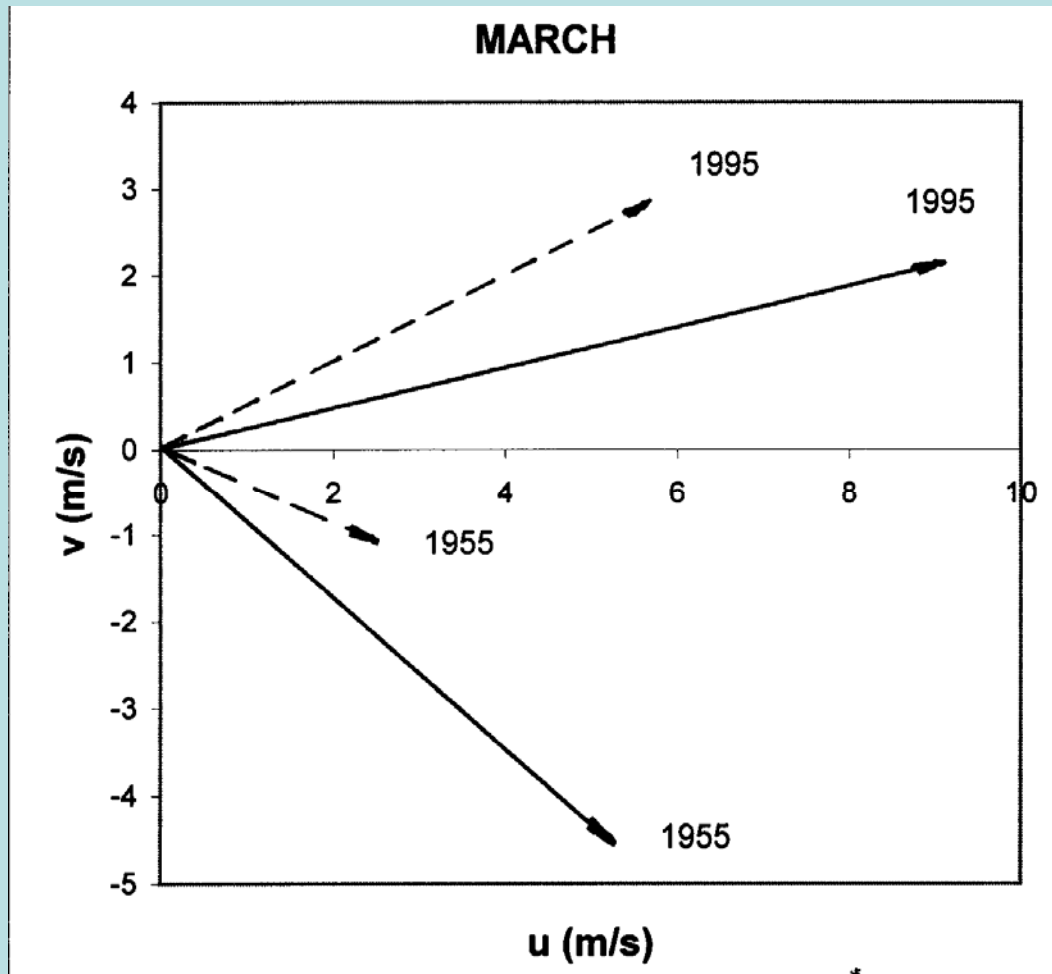
Meridional Component
Change:
0.159 m/s per year
Significance F=0.01

Changes in average airflow over Estonia



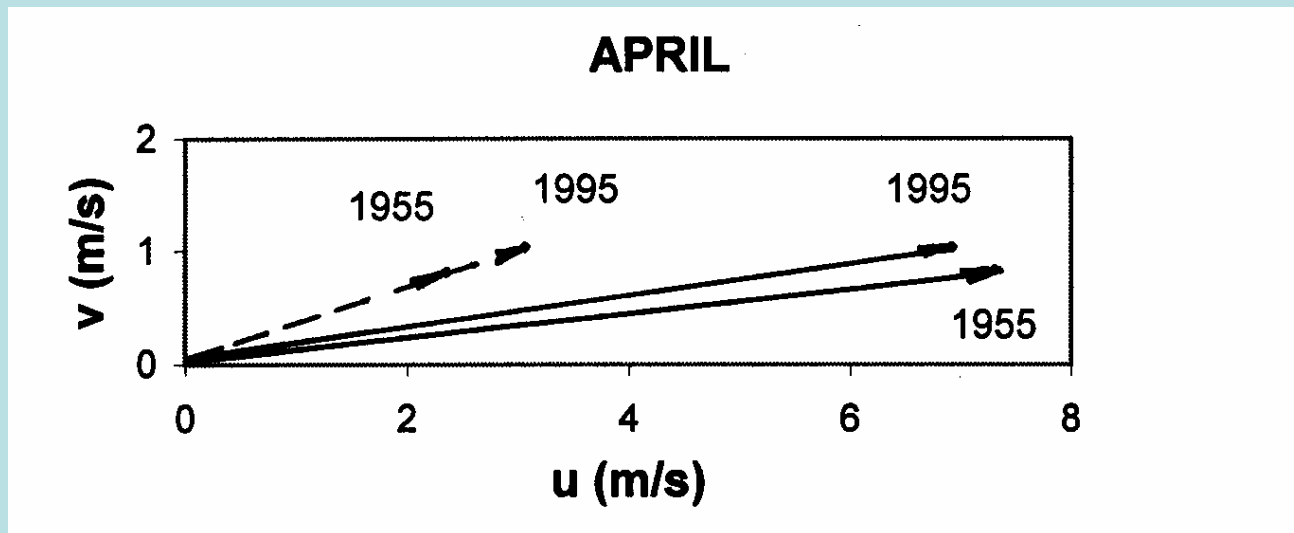
Solid line – 500 hPa, broken line – 850 hPa

Changes in average airflow over Estonia



Solid line – 500 hPa, broken line – 850 hPa

Changes in average airflow over Estonia



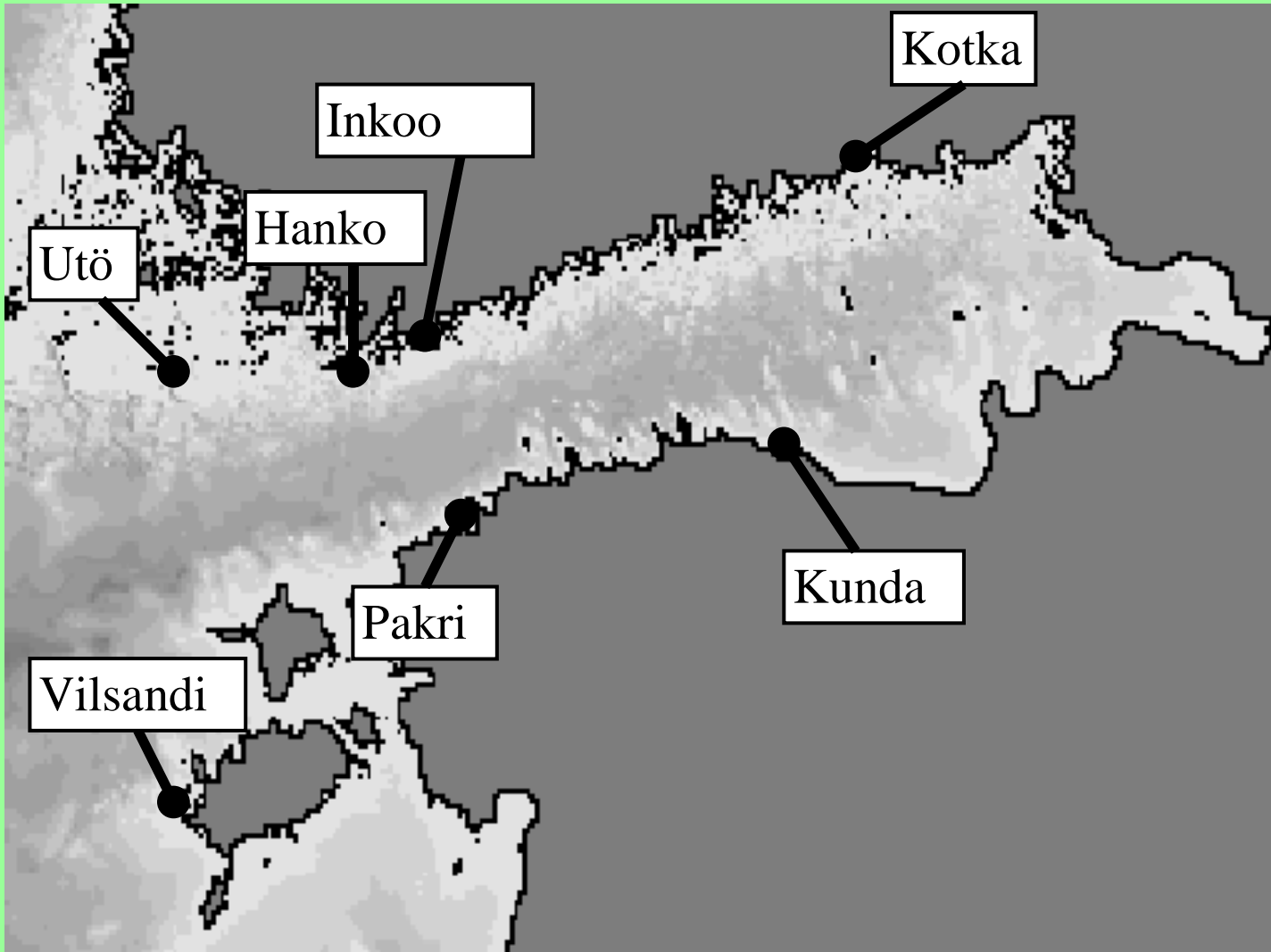
Solid line – 500 hPa, broken line – 850 hPa

Conclusions: March 1955-1995

- The average airflow at 500 and 850 hPa level intensified and turned from WNW (NW) to SW (WSW)
- The cold air masses were in the NE at the beginning of the period and shifted to the north by the end of it
- Changes in the circulation are related to the changes in meteorological parameters

Trends in the wind speed over the Gulf of Finland 1961-2000

Sirje Keevallik and Tarmo Soomere
4th Study Conference on BALTEX, Gudhjem,
Denmark, 24-28 May 2004.



Utö

Hanko

Inkoo

Kotka

Pakri

Kunda

Vilsandi

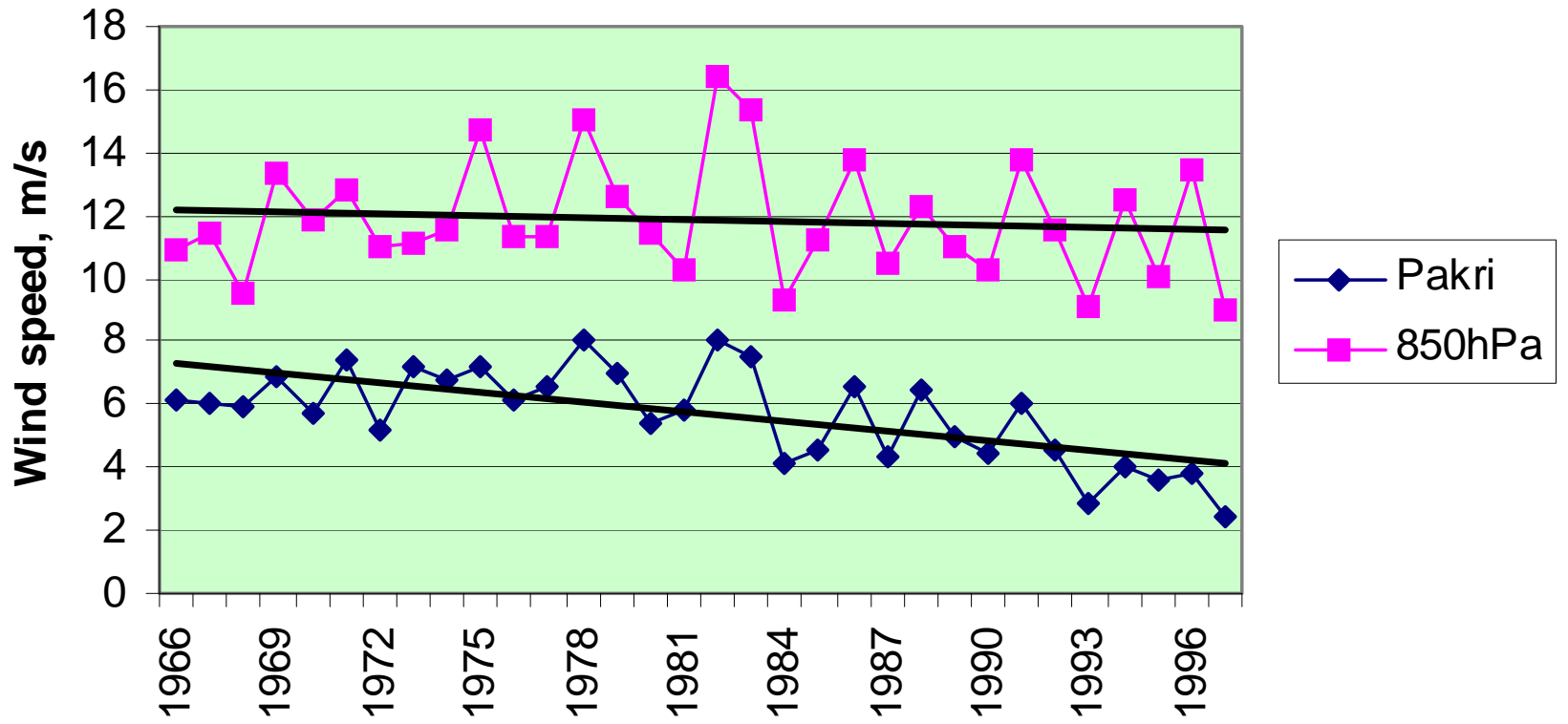
Wind data at meteorological stations

Utö	1961-2000
Hanko	1961-2000
Inkoo	1961-2000
Kotka	1961-2000
Kunda	1966-2000
Pakri	1966-2000
Vilsandi	1969-1999

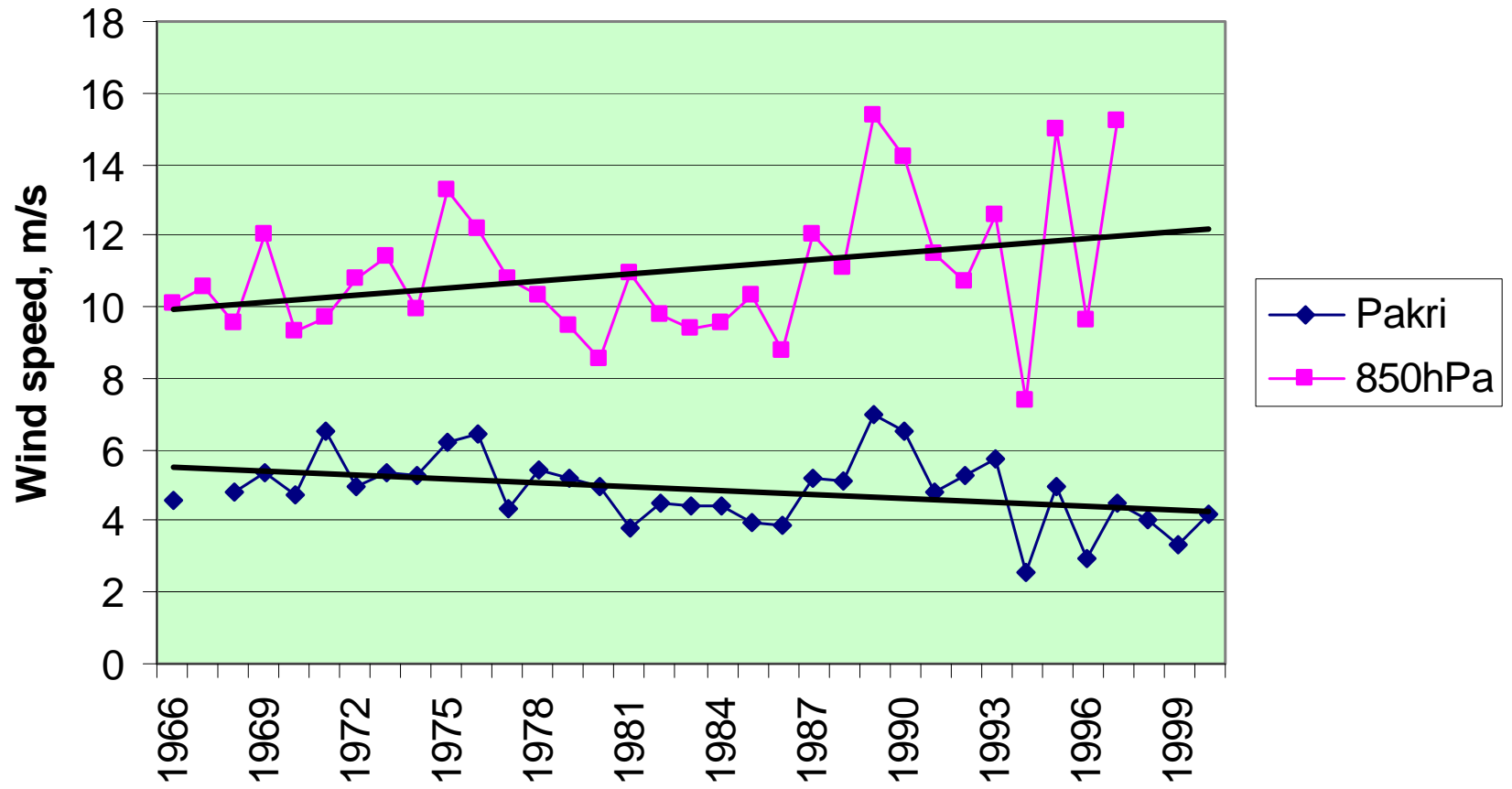
Trends in wind speed 1961-2000, 10⁻² m/s per year

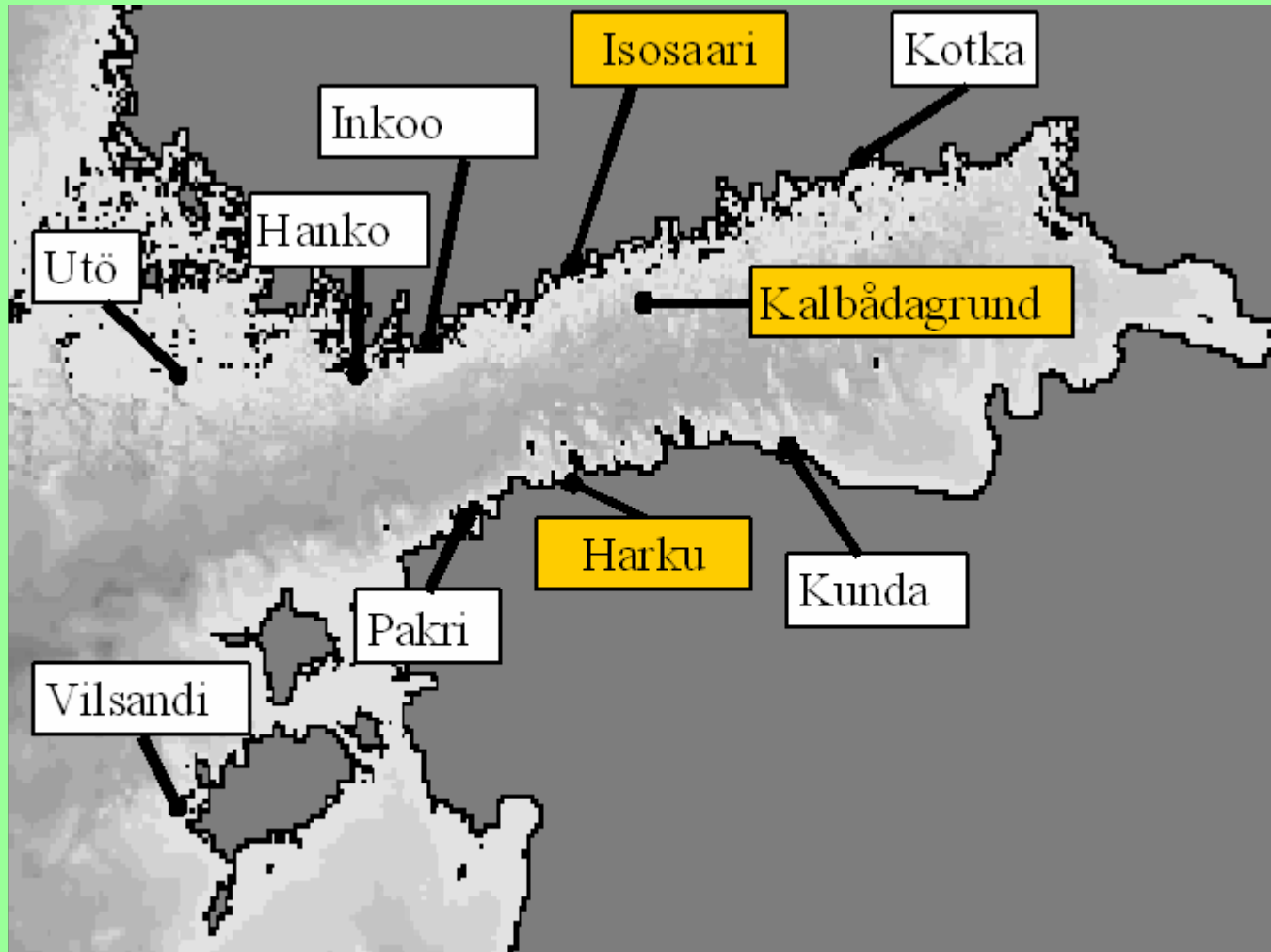
Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utö	4	4	2	2	2	2	2	2	1	2	2	3
Hanko	1	2	0	1	0	-1	0	-1	-1	0	0	0
Inkoo	2	3	1	1	0	1	2	0	-1	1	2	1
Kotka	5	7	5	3	3	3	4	2	2	6	4	4
Kunda	-1	-1	-3	-3	-3	-2	-2	-2	-5	-3	-4	-4
Pakri	-5	-5	-7	-7	-6	-4	-4	-6	-9	-9	-11	-9
Vilsandi	-1	3	0	-3	-1	-1	-3	-1	-6	-1	-7	-2

November



February





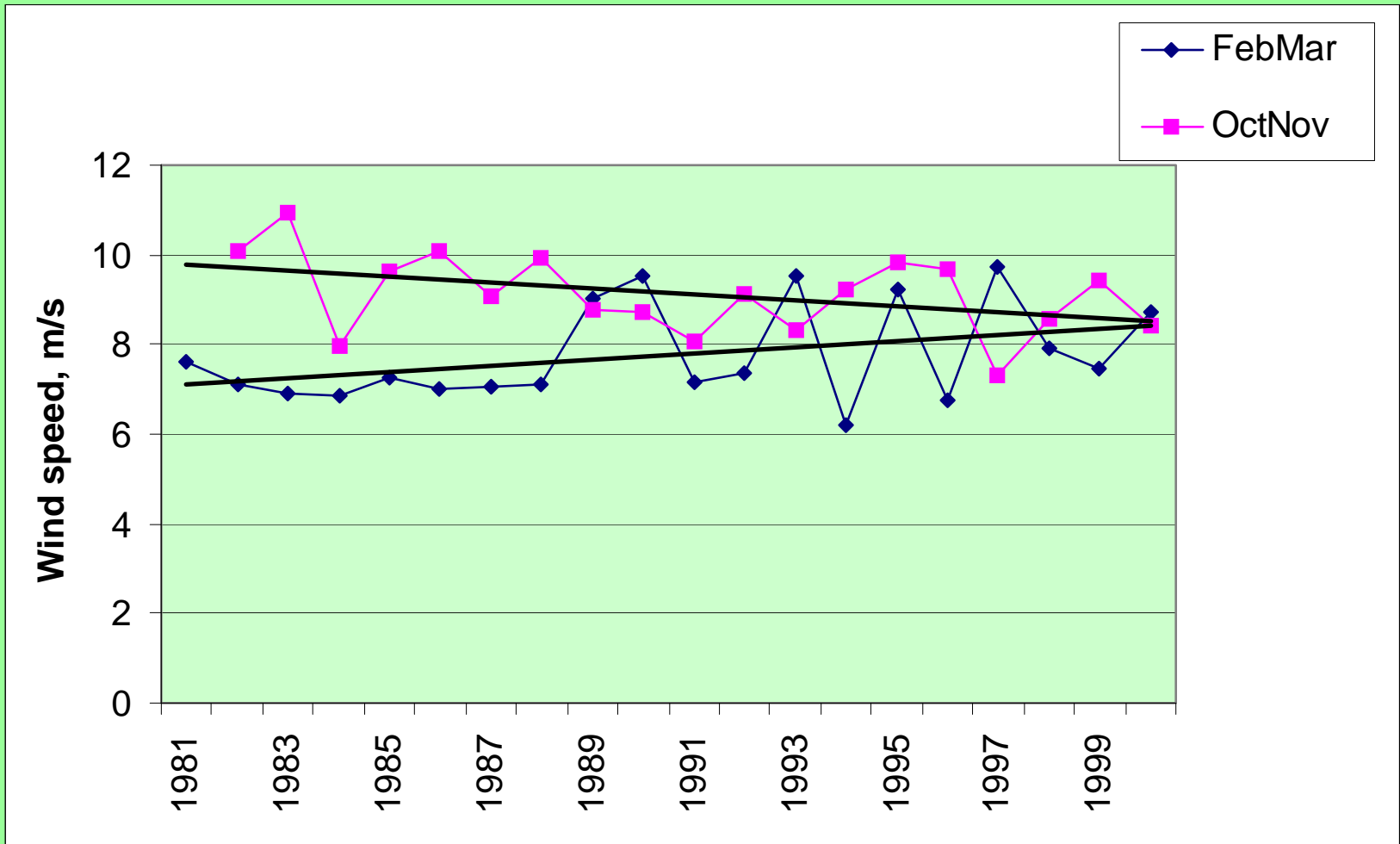
Shorter period wind data in the central part of the gulf

Isosaari	1984-2000
Kalbådagrund	1981-2000
Harku	1980-2000

Trends in wind speed 1980-2000, 10⁻² m/s per year

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Isosaari	-3	5	-1	-4	1	0	3	-4	-1	-2	1	-5
Kalbada- grund	-8	7	7	1	1	1	4	-6	-5	-3	-6	-3
Harku	-5	0	-3	-2	-2	-2	-1	-4	-3	-4	-6	-4

Kalbådagrund



Conclusions

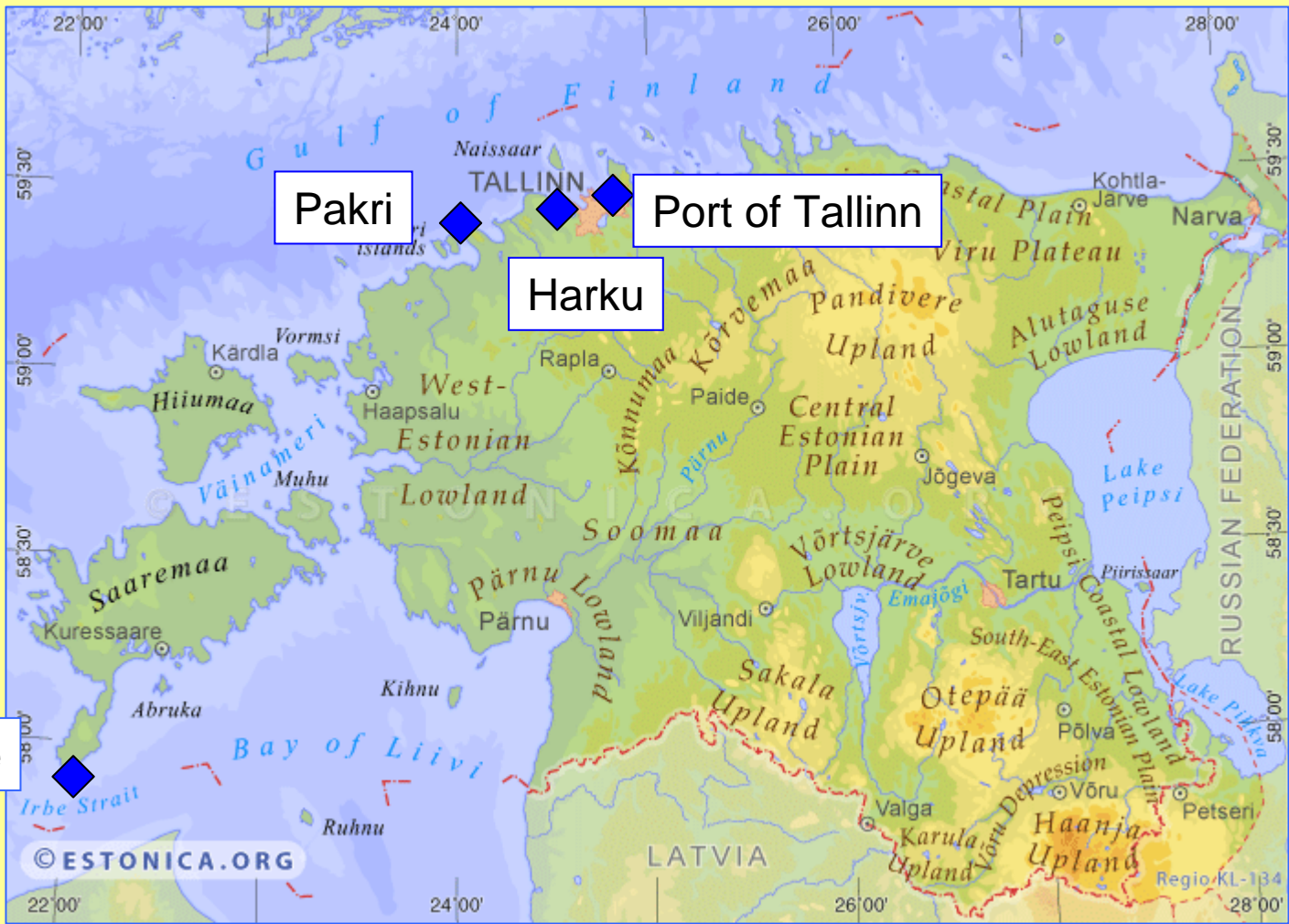
- 1961(1966)-2000: Wind speed increased on the northern coast and decreased on the southern coast of the Gulf of Finland
- 1980 -2000: Wind speed tends to increase in spring and decrease in autumn and winter

Changes in wind velocity in Estonia (1966-1999)

New data

Wind data at 00 GMT

Sõrve 57°55'N, 22°04'E	1969-1999
Pakri 59°24'N, 24°03'E	1966-1992
Port of Tallinn 59°27'N, 24°46'E	1966-1992



Pakri

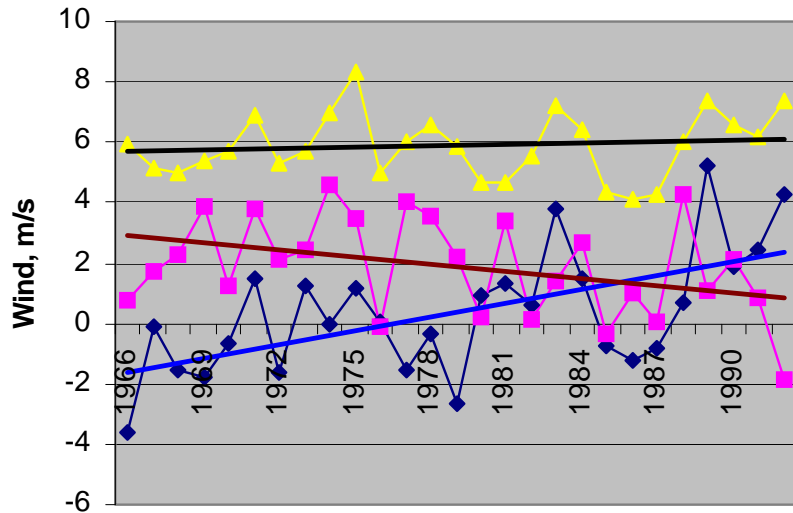
Port of Tallinn

Harku

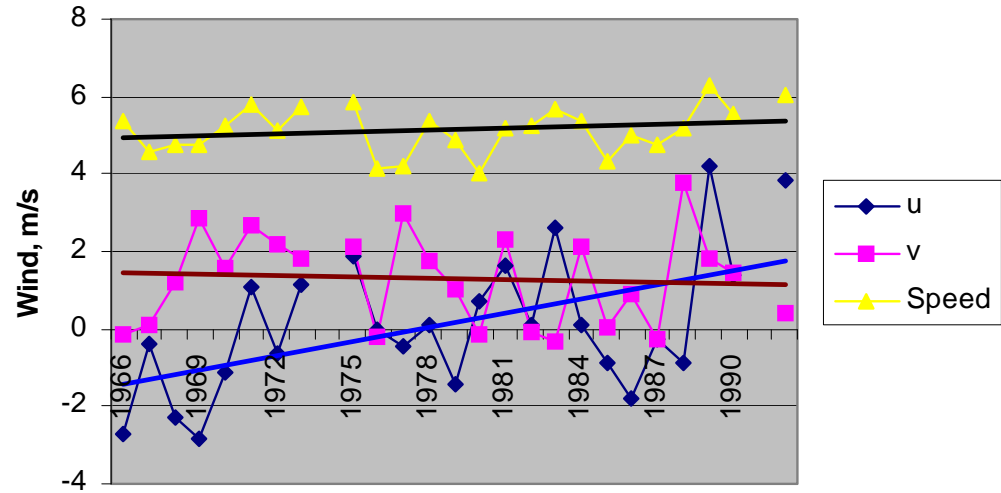
Sõrve

TRENDS IN WINTER

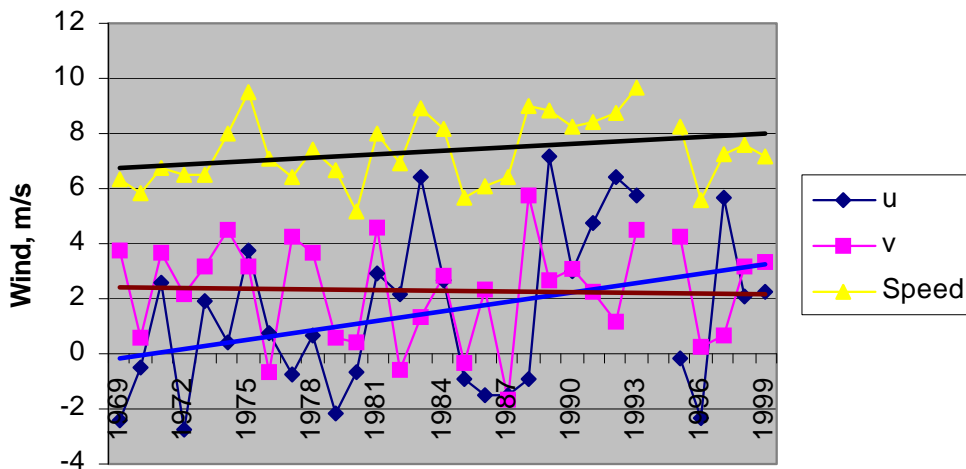
Pakri January 1966-1992, 00GMT



Tallinn Port, January, 1966-1992, 00GMT



Sõrve, January, 1969-1999, 00GMT

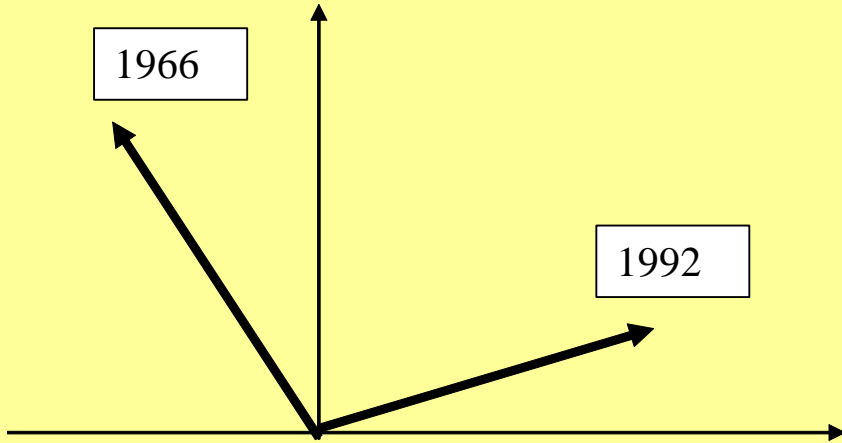


From the point of view of air flow, wind components are more informative than wind speed

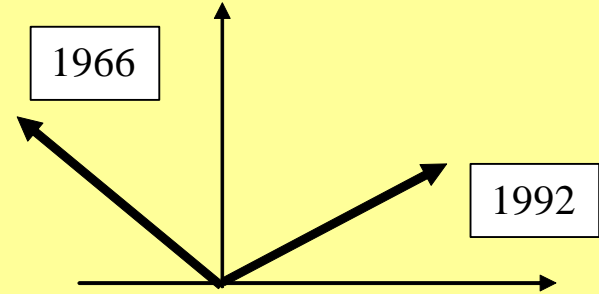
Significant (at least 0.06 level) trends in January, m/s per year

	Zonal component	Meridional component
Sõrve	+0.11	
Pakri	+0.15	-0.08
Port of Tallinn	+0.12	

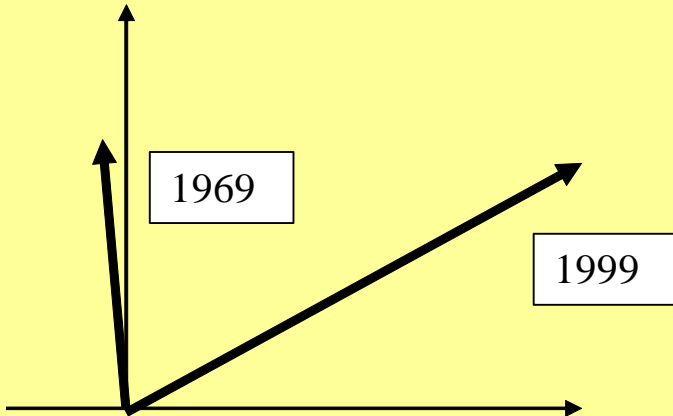
Pakri



Port of Tallinn



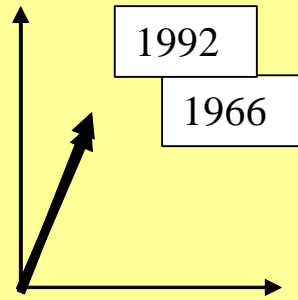
Sõrve



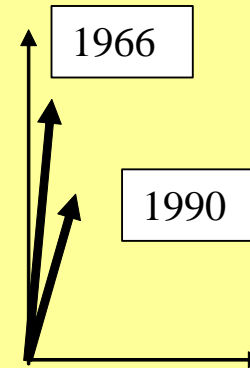
Changes in wind velocity
in January
from midnight data

Changes are similar on the Northern coast

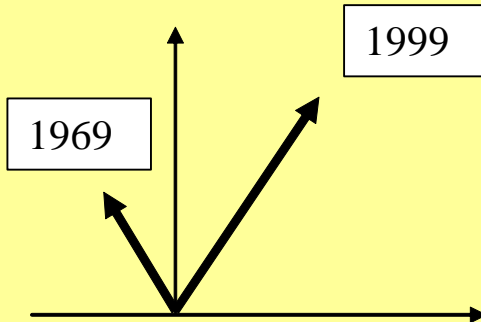
Pakri



Port of Tallinn



Sõrve



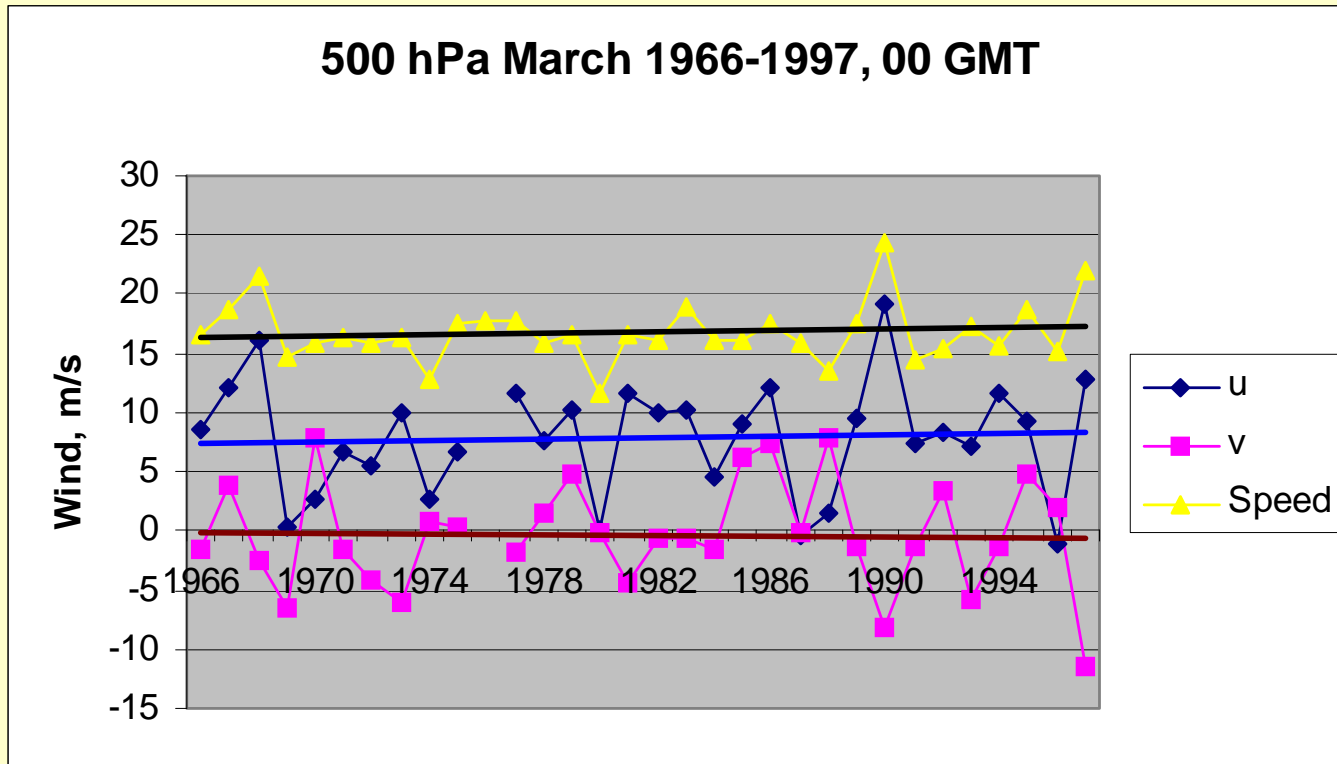
Changes in wind velocity
in March
from midnight data

Changes are different for Western islands and North-Estonia
The meridional component decreases on the Northern coast

Changes in upper-air winds in Estonia (1955-2007)

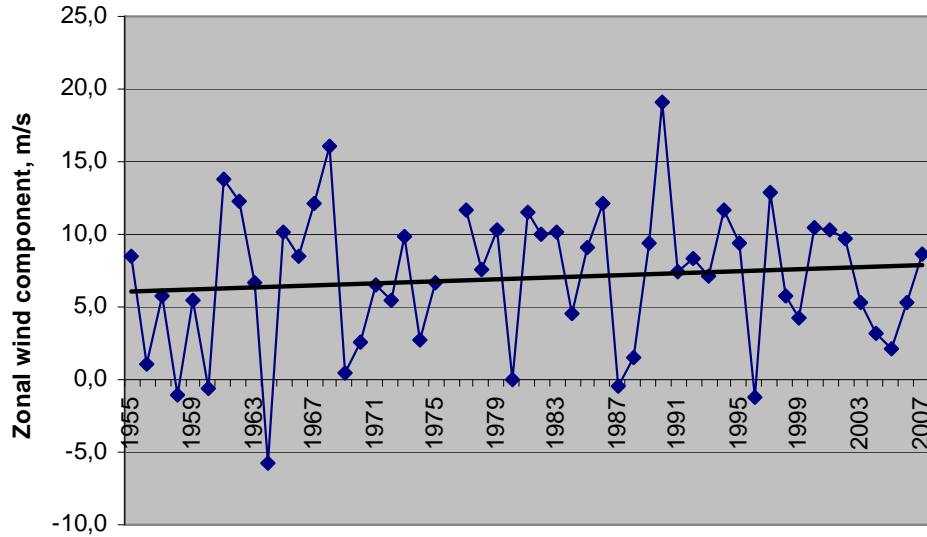
New data

1966-1997



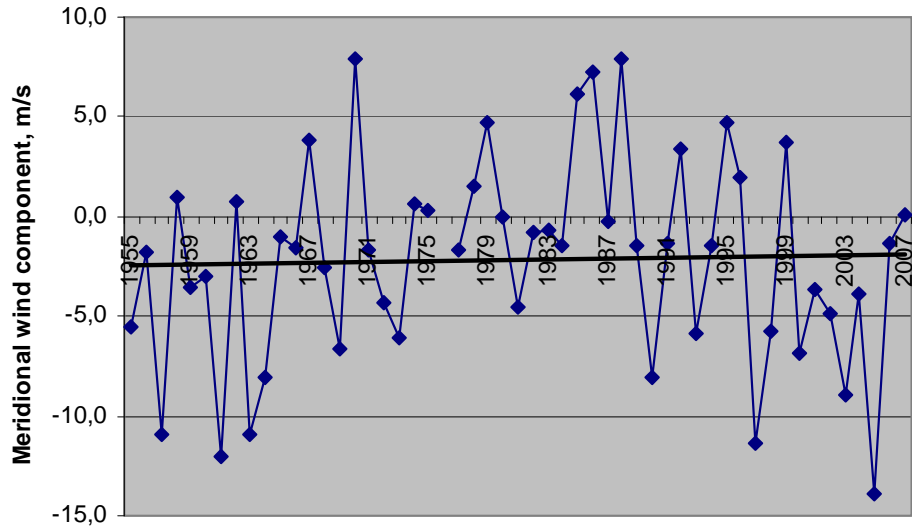
No trend can be seen when the observation period starts later.
Is there an abrupt change in circulation in the middle of the 1960s?

500 hPa March, 1955-2007

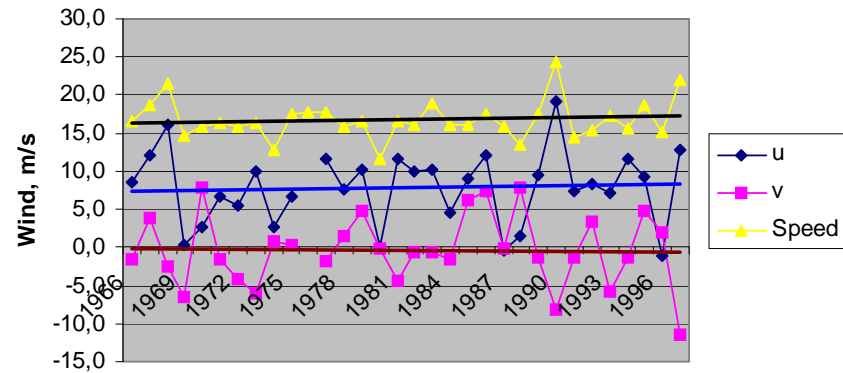


Trends in upper air wind components in March 1955-2007

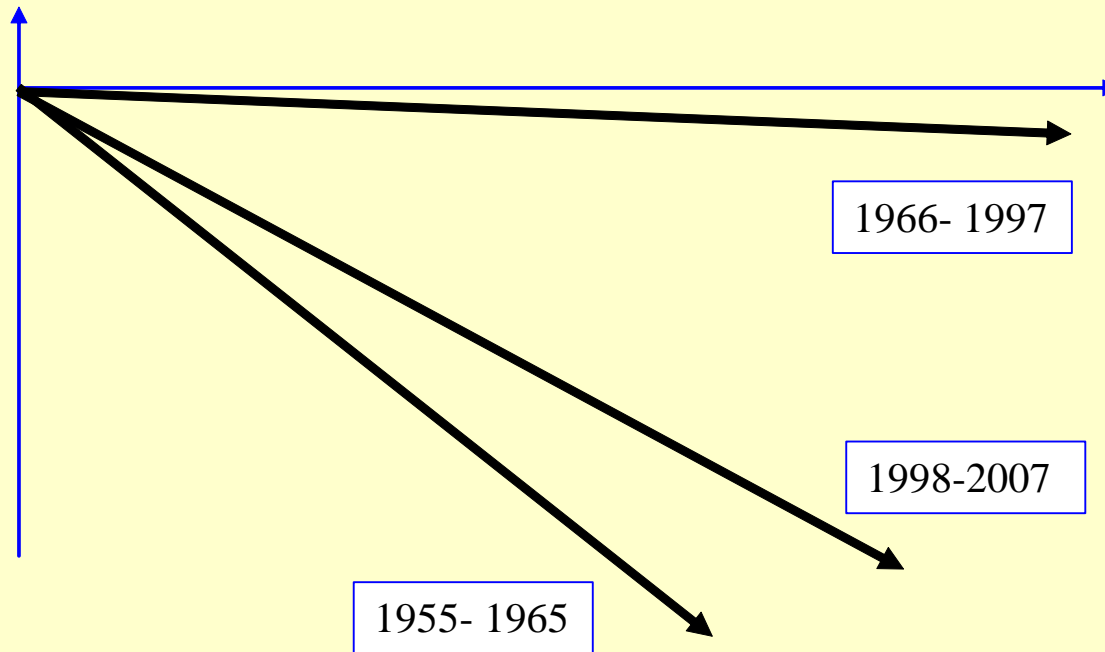
500 hPa March, 1955-2007



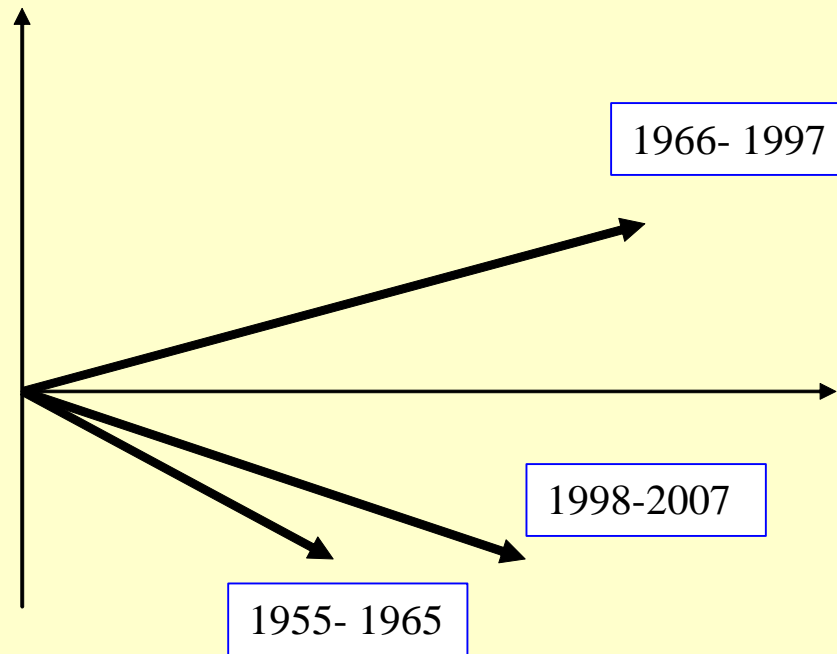
500 hPa March 1966-1997, 00 GMT



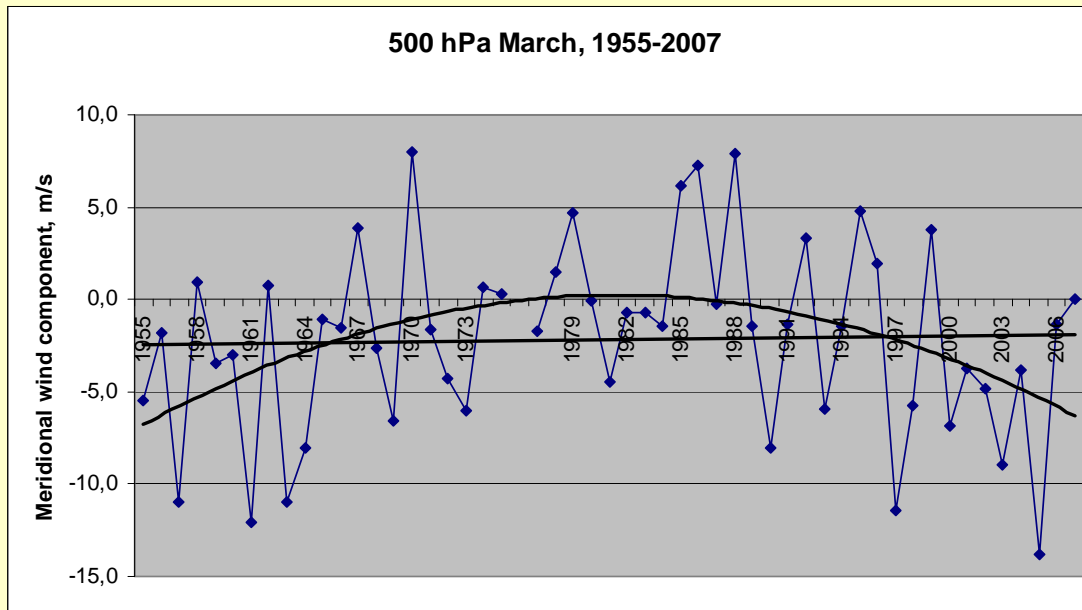
Regime shifts in average air flow on the 500 hPa level in March



Regime shifts in average air flow on the 850 hPa level in March



Or is there an oscillation
in the average air flow in March
with a period of 60 years?





The End