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Maps of the influence of climate change (incl. regime shifts) on ecological patterns

Compiled by

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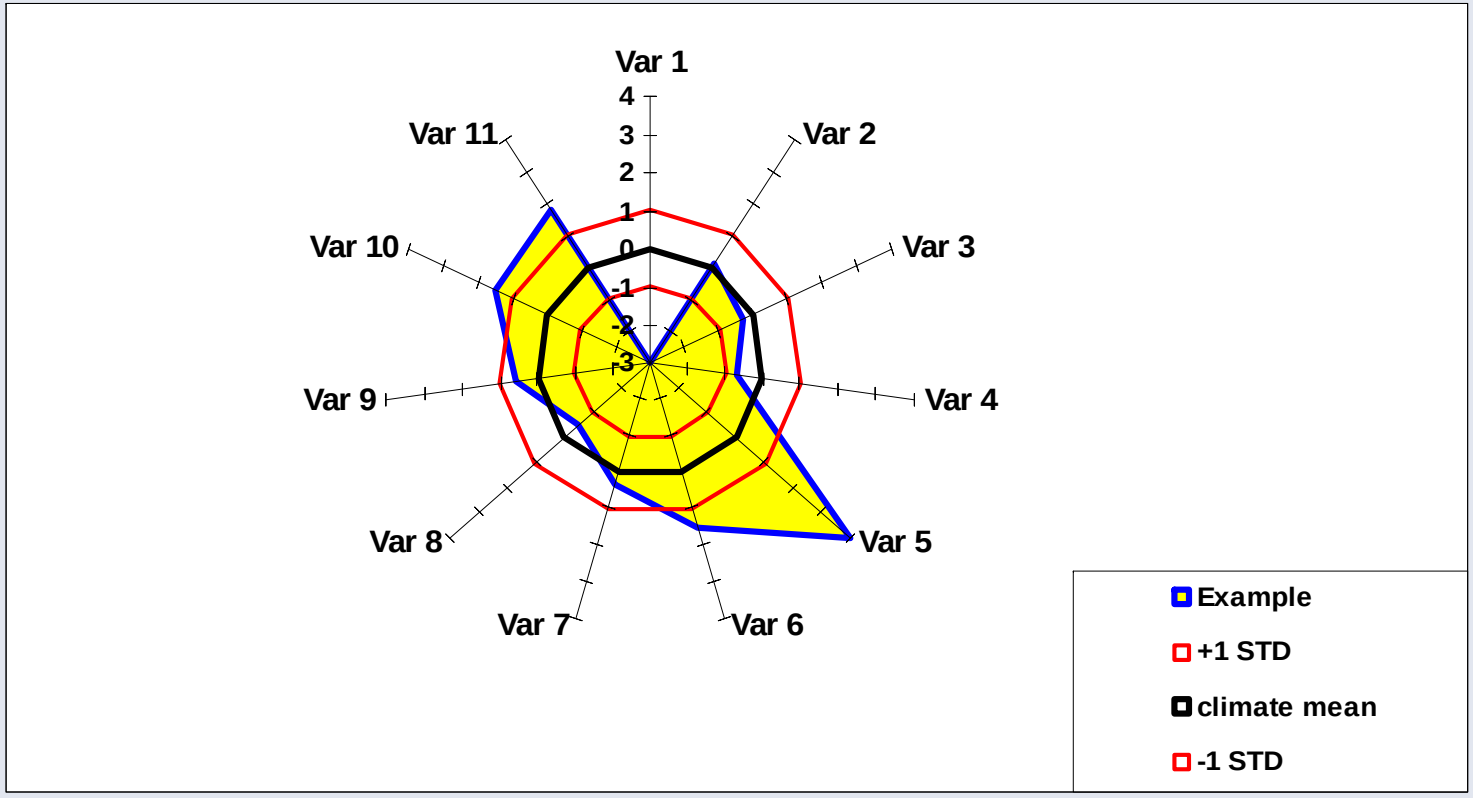
Content

- Description of AMOEBA
- Regime shifts and extreme winters
- Part 1: ICES subdivisions in the Baltic Sea
- Part 2: Zooplankton in the Baltic Sea
- Part 3: LUNG data
- Summary
- Acknowledgment
- References

Description of AMOEBA

- AMOEBA, is a Dutch acronym for “a general method for ecosystem description and assessment” (Ten Brink et al. 1991)
- It has been developed as a quantitative method to present the status of the ecosystem to water managers.
- It is a graphical method in which numerous variables are plotted in a polar diagram and related to an arbitrary reference level.
- Our modification is that the reference level is the climatic mean ± 1 standard deviation.

How to read an AMOEBA?



Variables 2, 3, 4, 7, 8, 9 are inside the ±1 std referred to climate mean.
Variables 1, 5, 6 10, 11 are outside the ±std: action required!

Regime shifts and extreme winters

- Regime shifts (Dippner et al. 2010) occurred:
  - 1975/76
  - 1989/90
  - 2001/02
- Extreme winters occurred:
  - 1978/79
  - 1995/96

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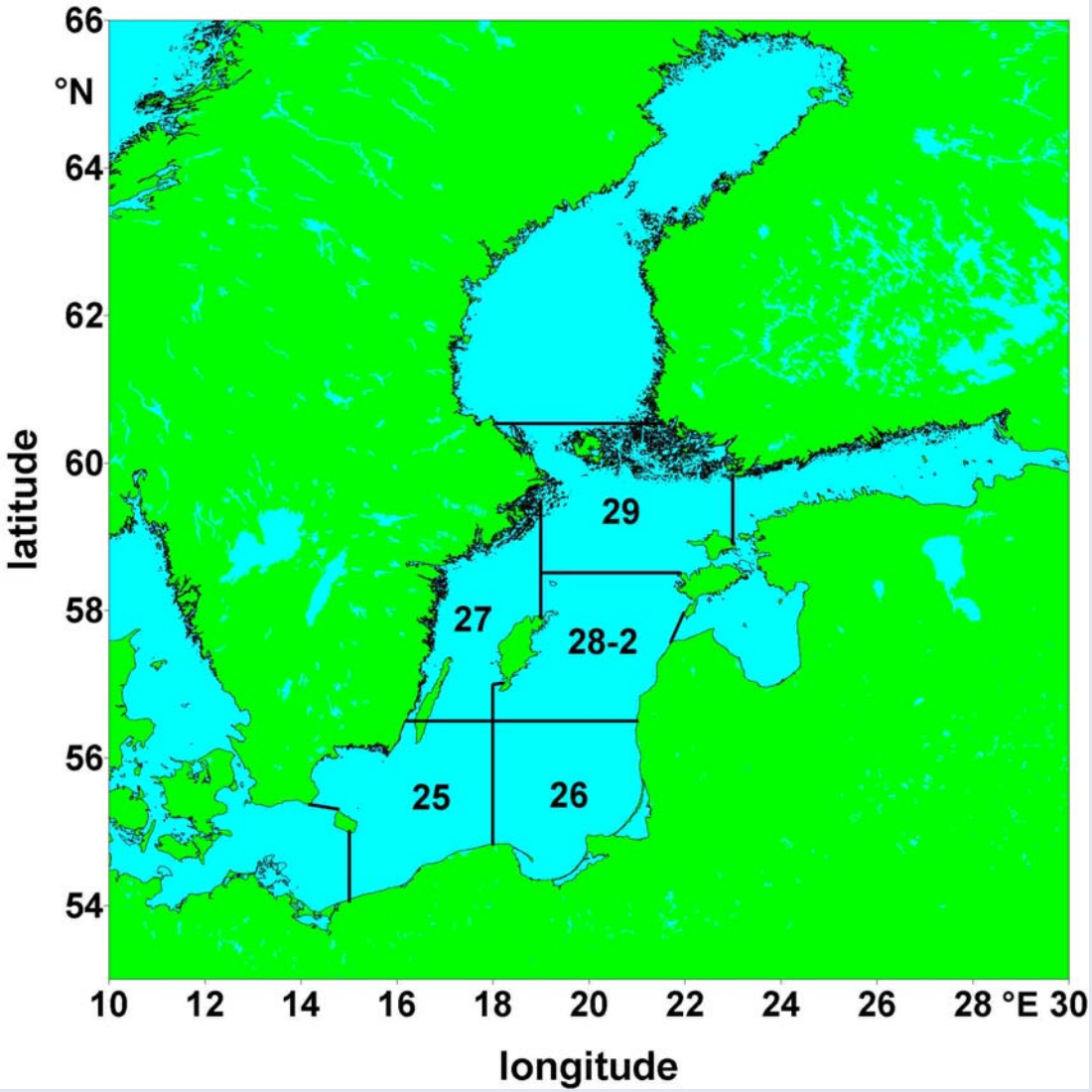
Part 1: ICES subdivisions in the Baltic Sea

Considered ICES Subdivisions



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Variables

- TEMP Temperature
- PSAL Salinity
- ALKY Alkalinity
- AMON Ammonium
- CPHL Chlorophyll a
- DOXY dissolved oxygen
- NTOT total nitrogen
- NTRA Nitrate
- NTRI Nitrite
- PHOS Phosphate
- PHPH hydrgen ion concentration
- SLCA Silicate
- TPHS total phosphorus
- CopeBM Copepods Biomass
- CladBM Cladocerans Biomass
- RotiBM Rotifers Biomass
- PCI Phytoplankton colour index

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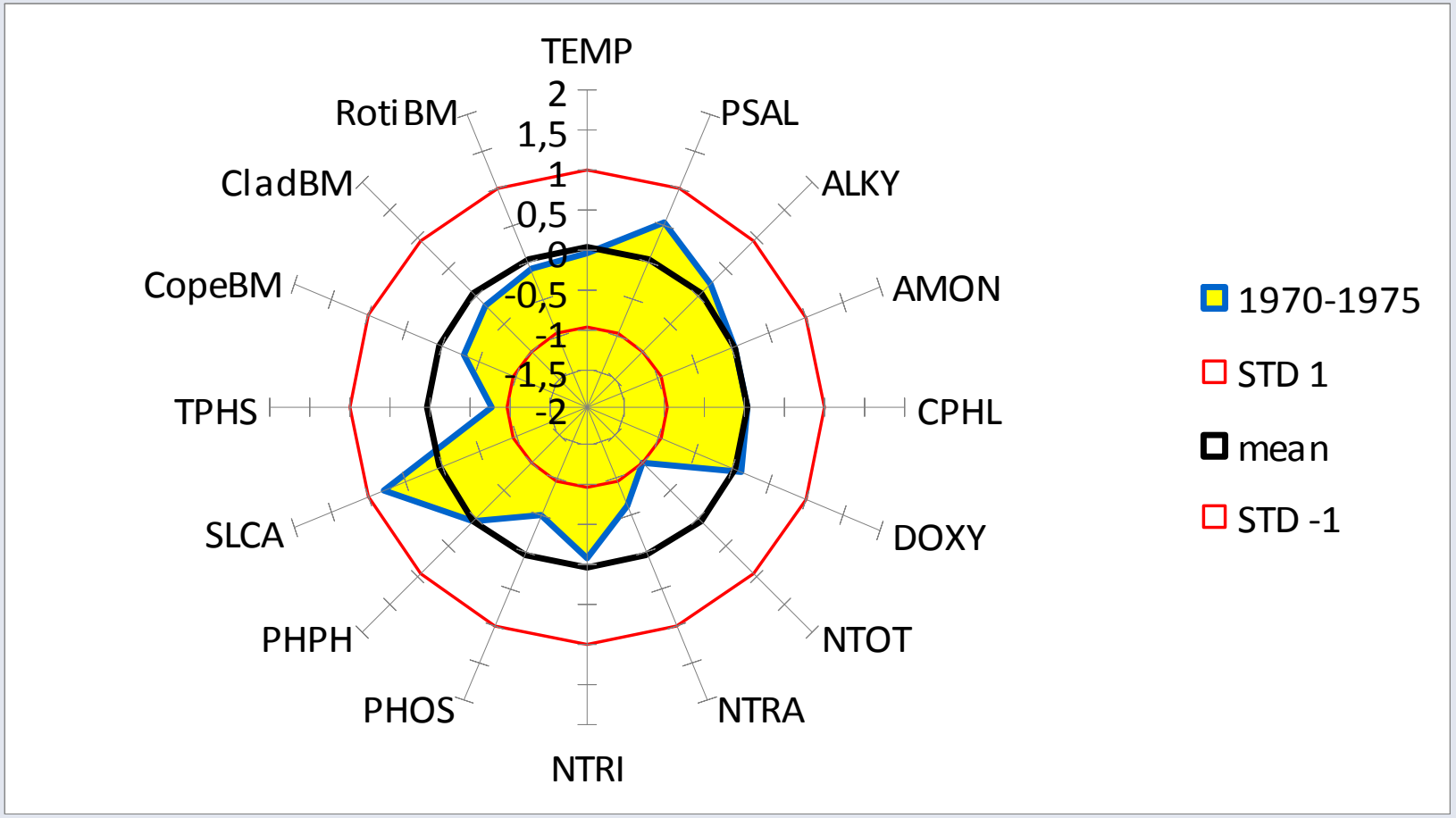
ICES SD 29 (1970-1975)



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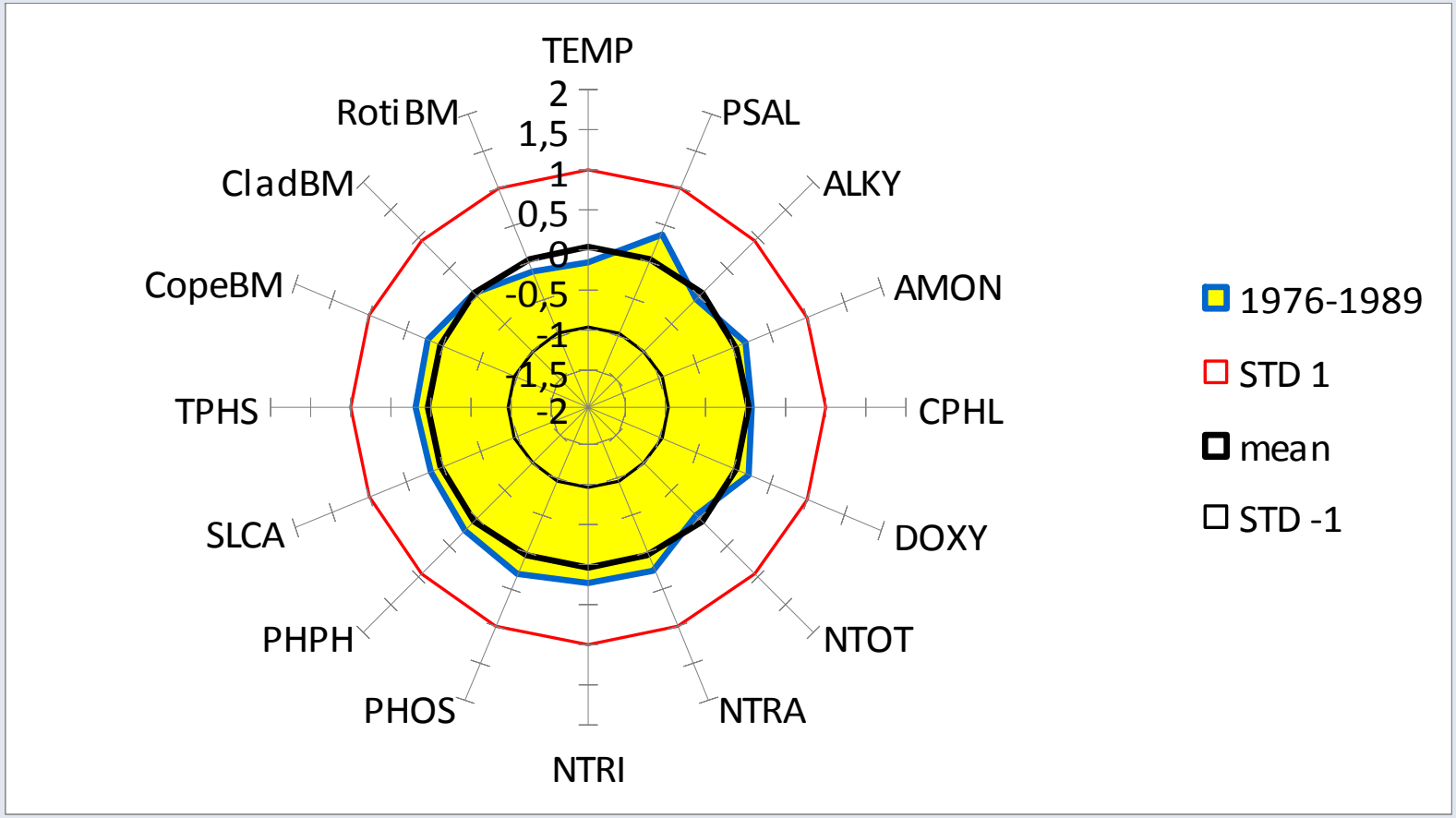
ICES SD 29 (1976-1989)



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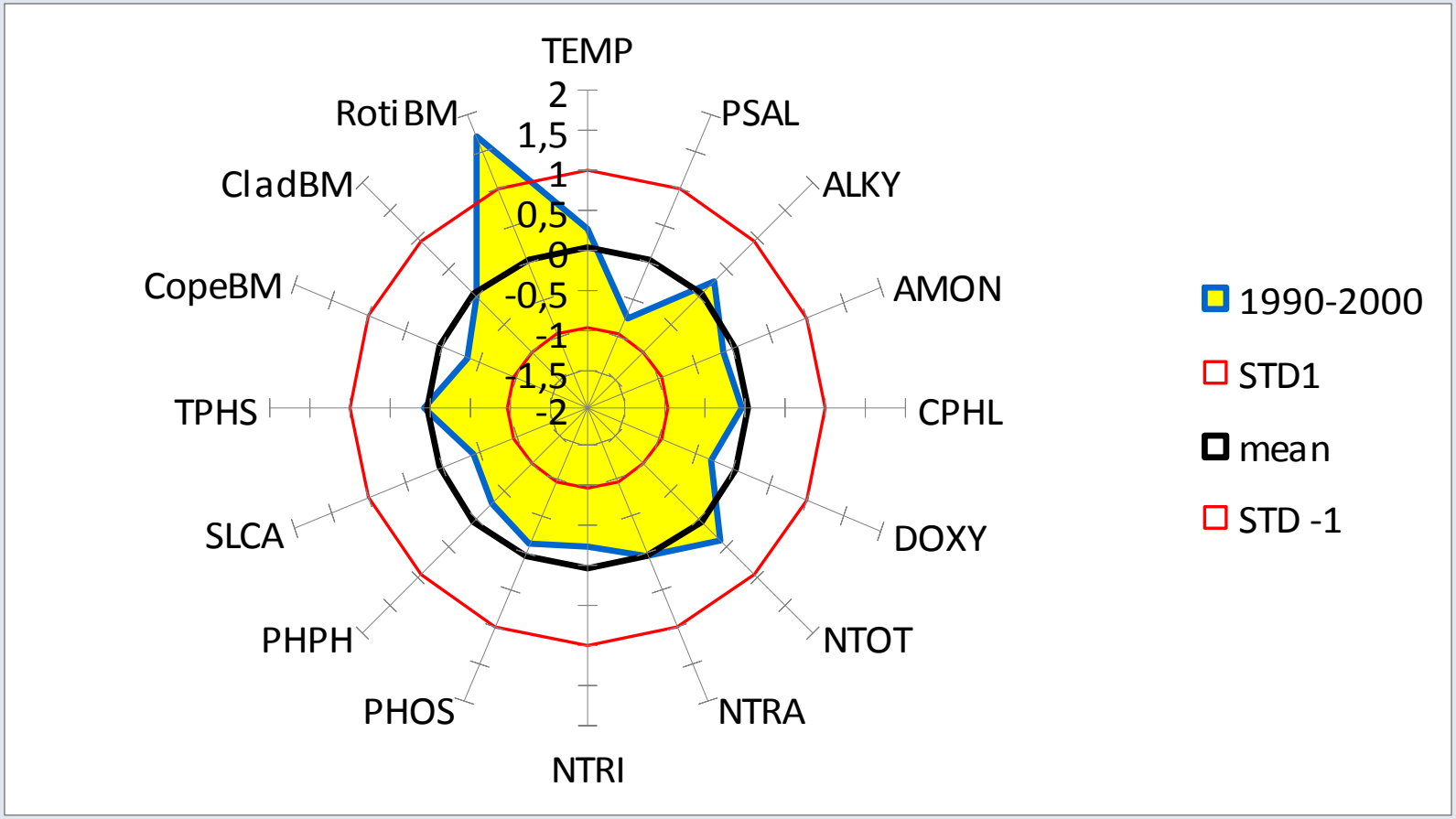
ICES SD 29 (1990-2000)



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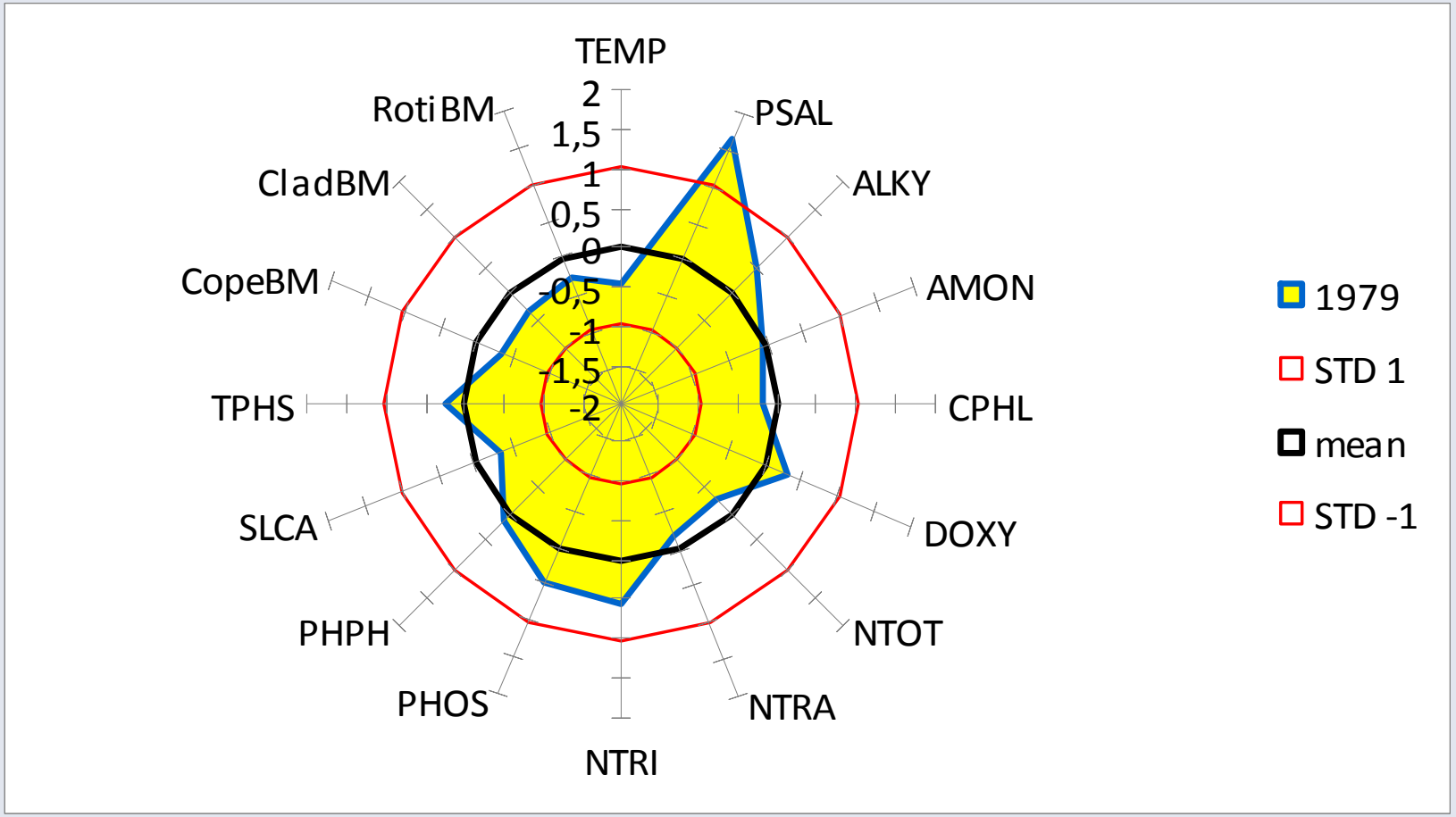
ICES SD 29 (1979)



Structure after the extreme winter 1978/79

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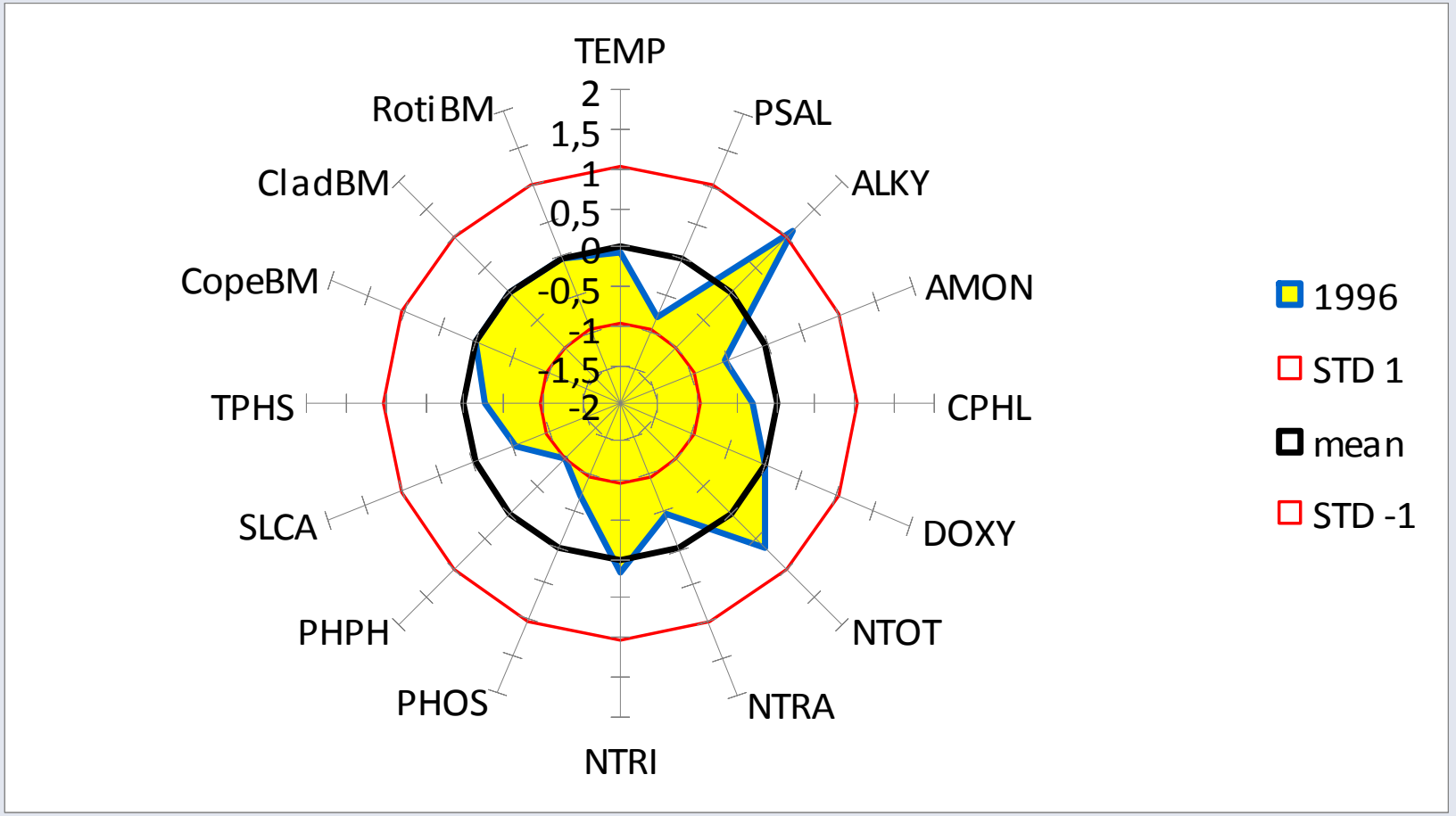
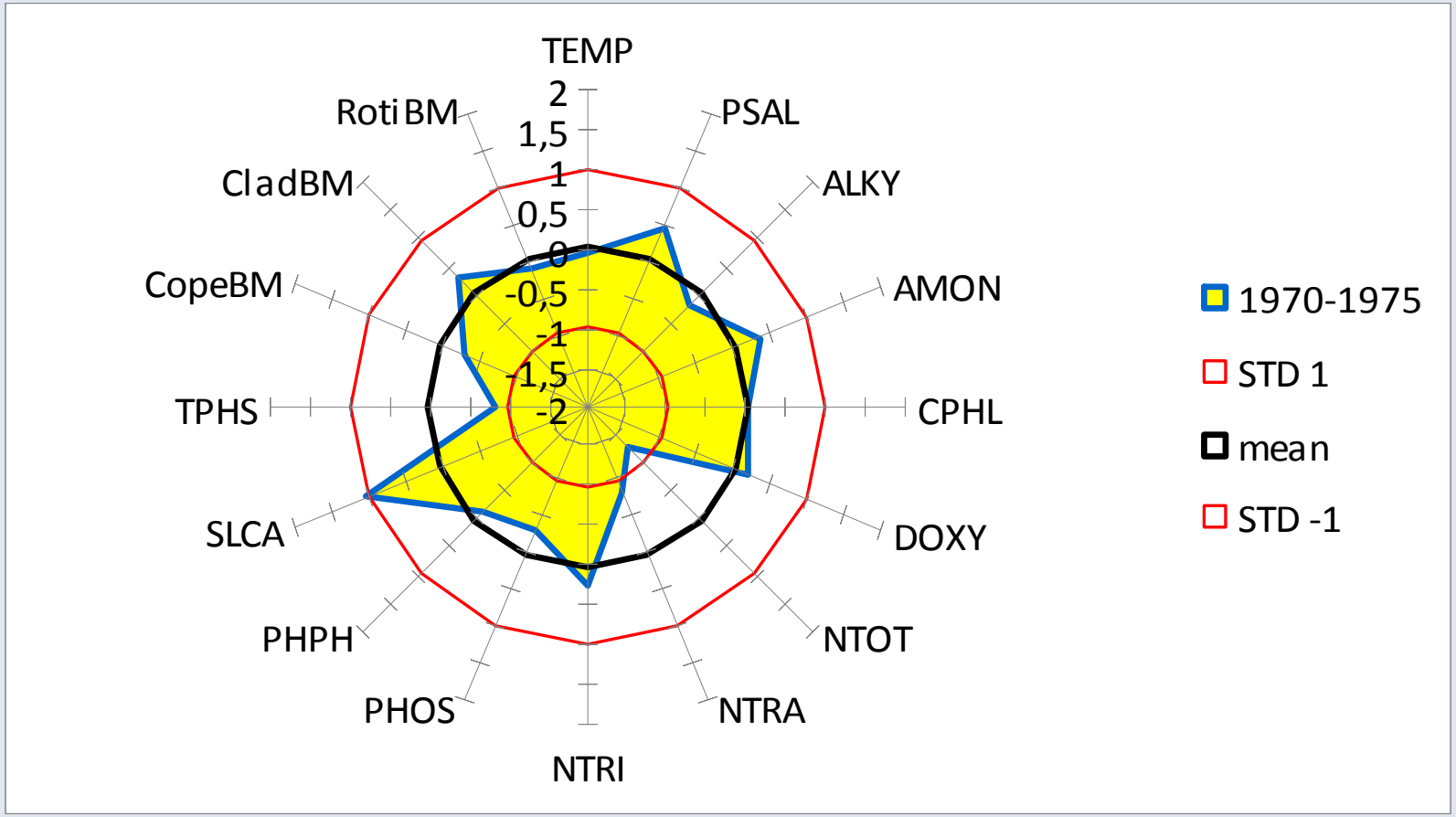
ICES SD 29 (1996)



Structure after the extreme winter 1995/96

Updated version from August 7, 2011

ICES SD 27 / 28-2 (1970-1975)



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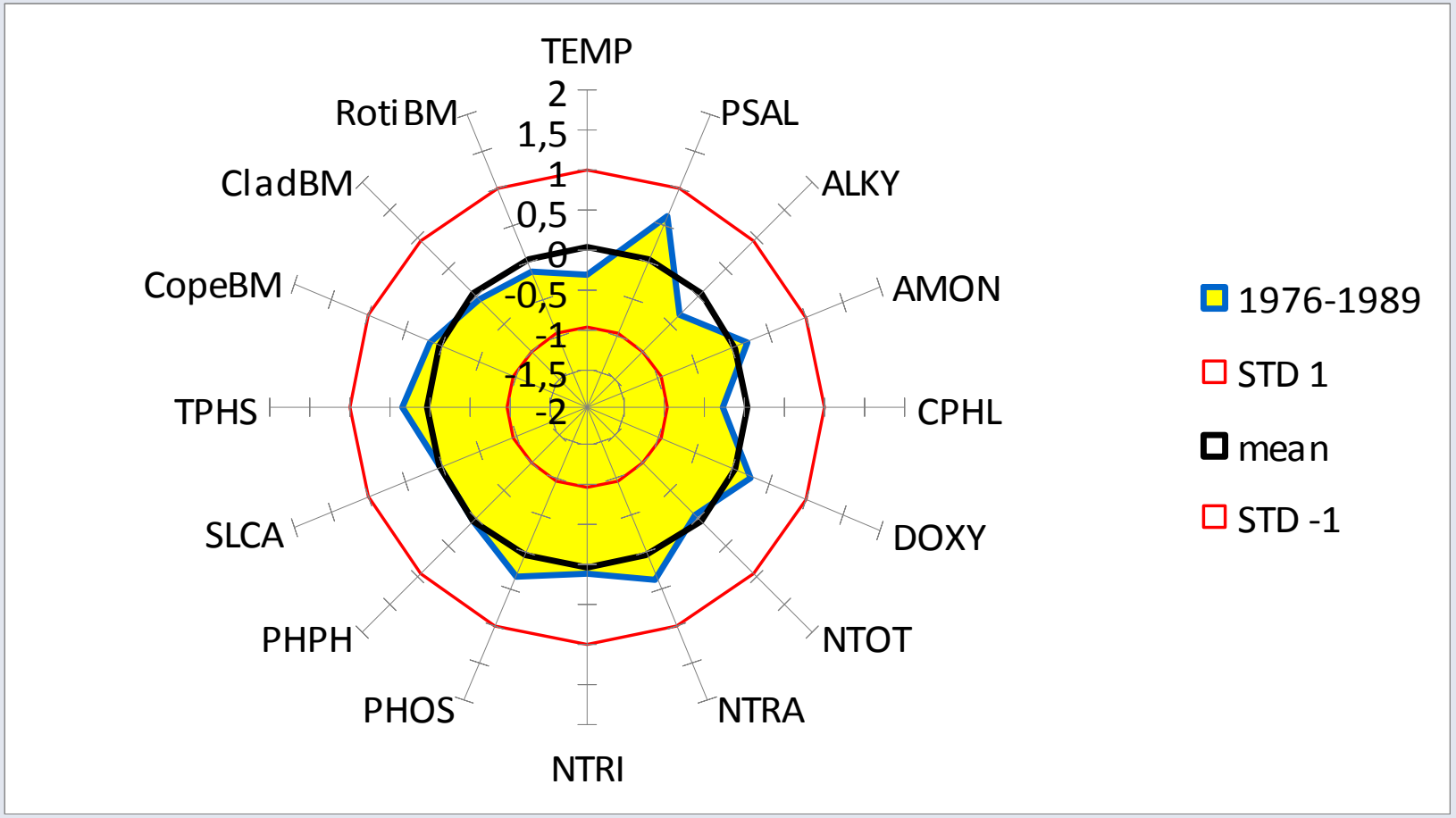

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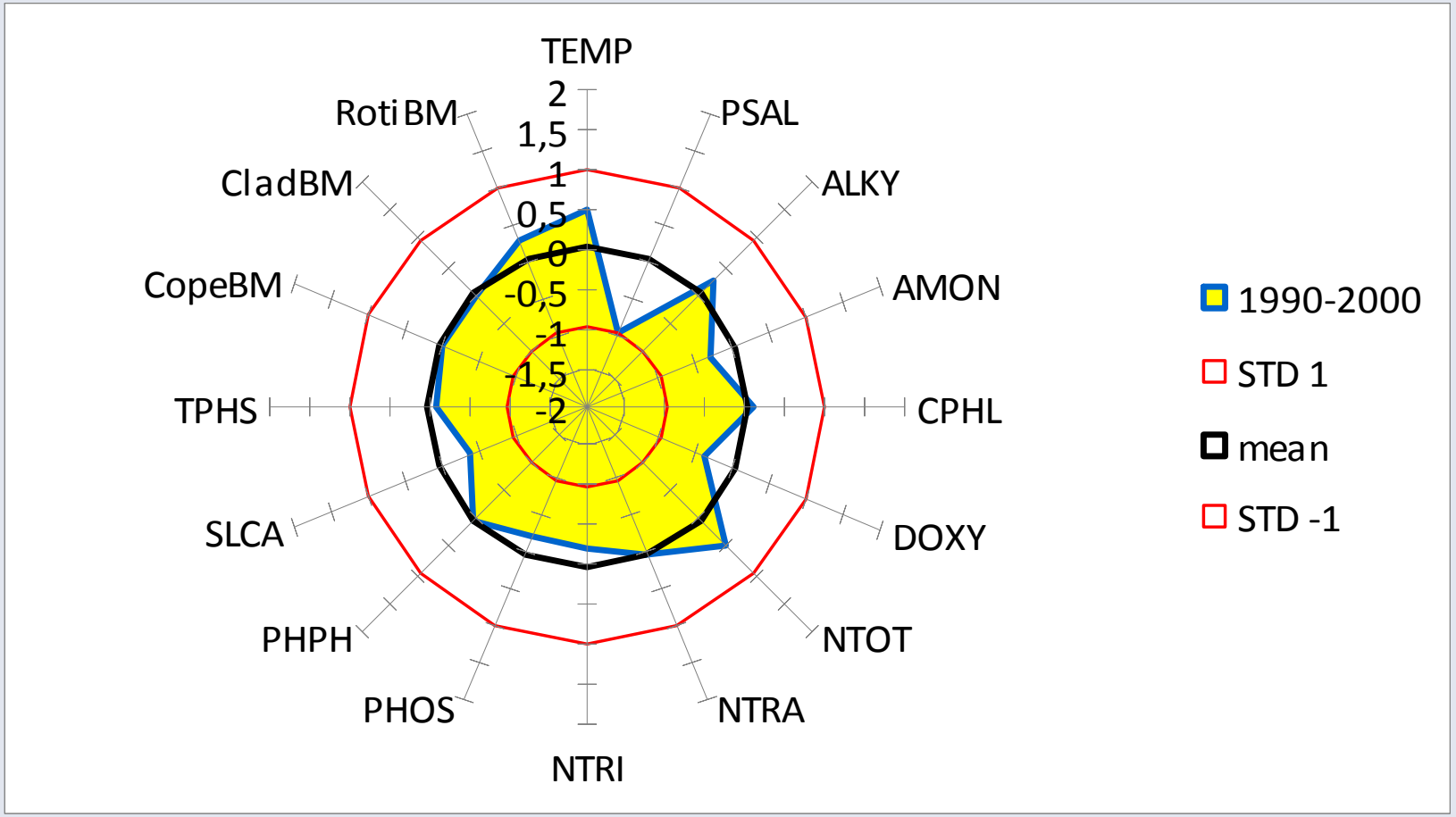
ICES SD 27 / 28-2 (1990-2000)



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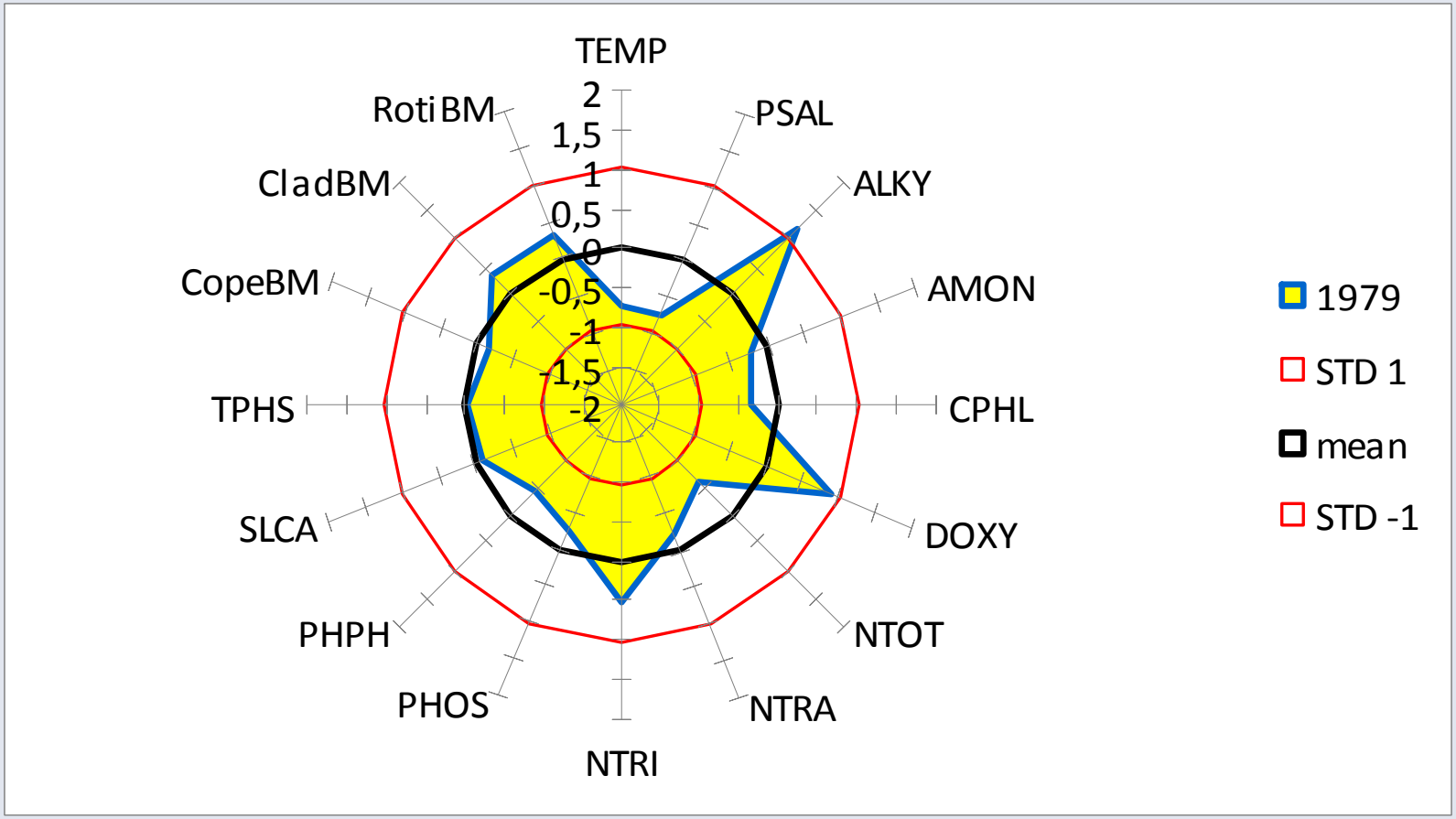
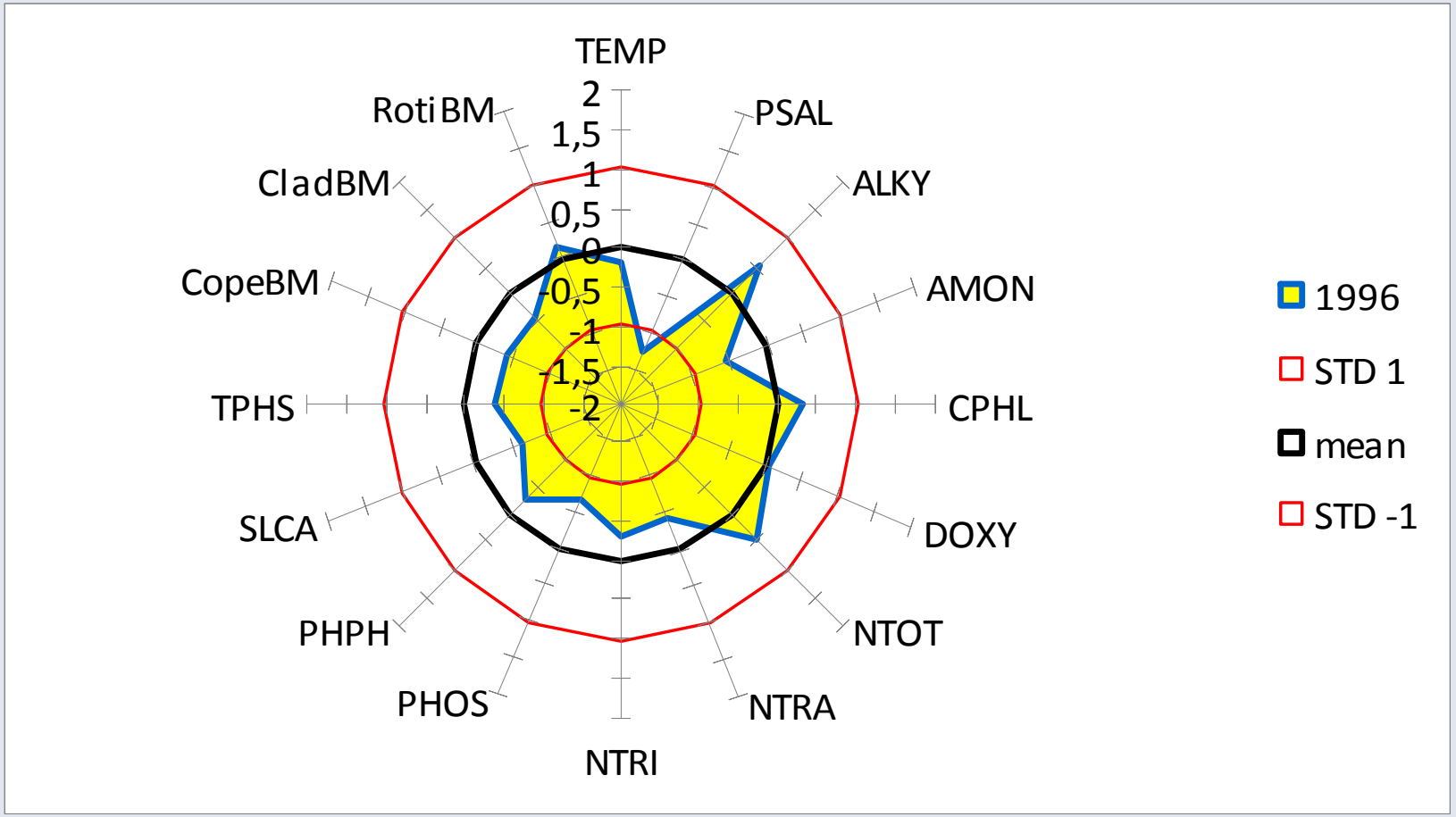


Structure after the extreme winter 1978/79

Updated version from August 7, 2011

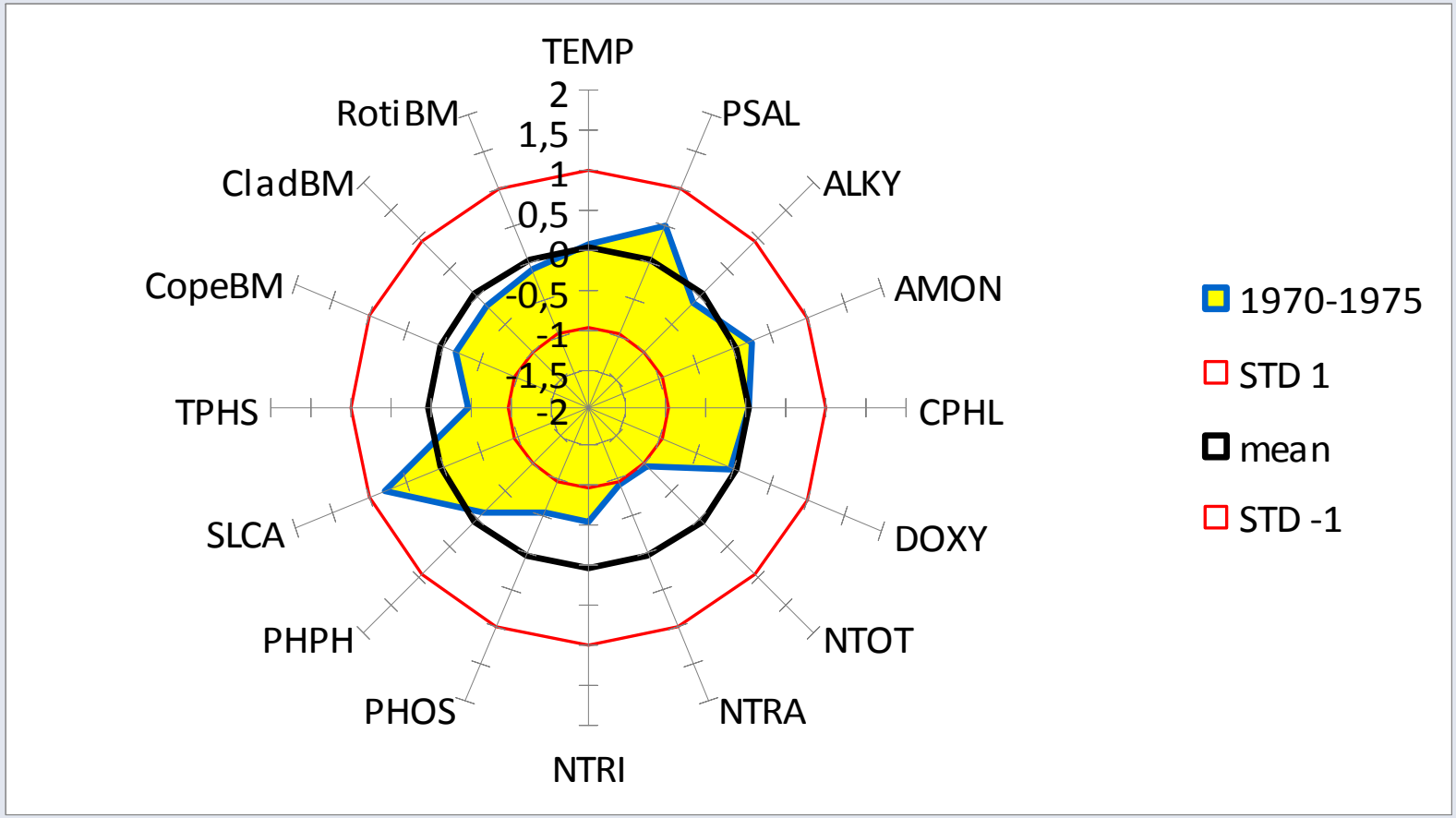
ICES SD 27 / 28-2 (1996)



Structure after the extreme winter 1995/96

Updated version from August 7, 2011

ICES SD 25 / 26 (1970-1975)



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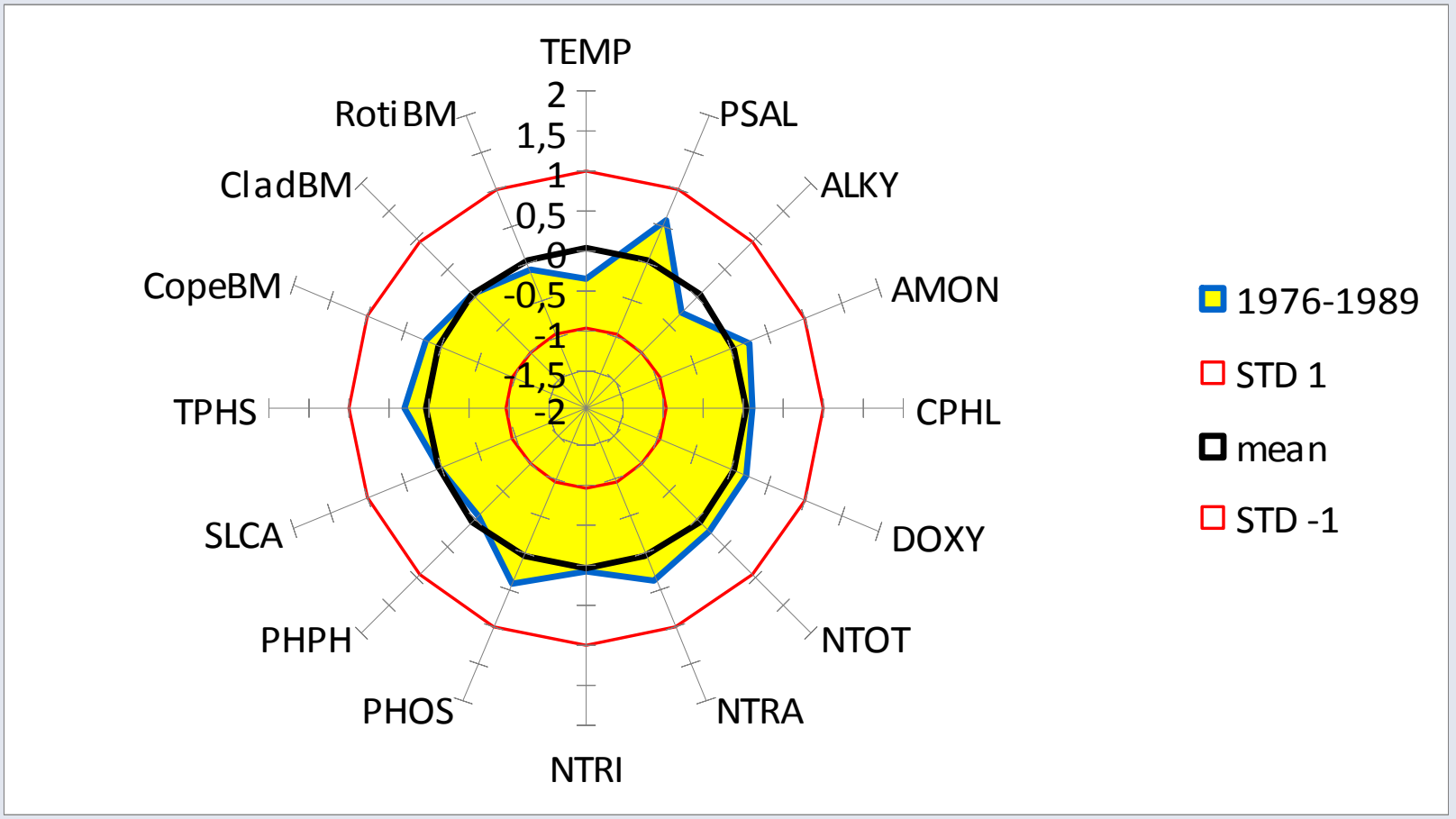

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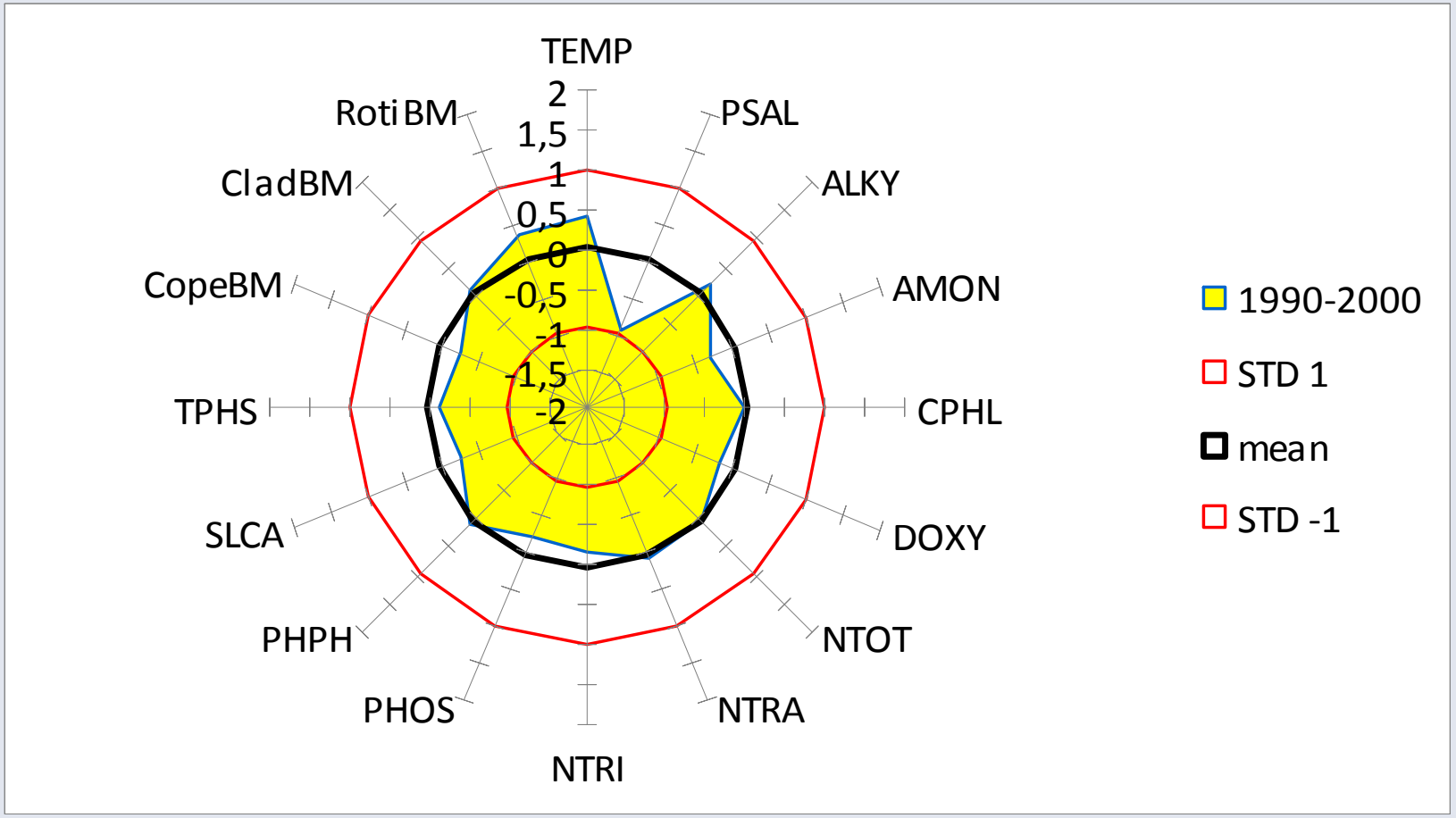
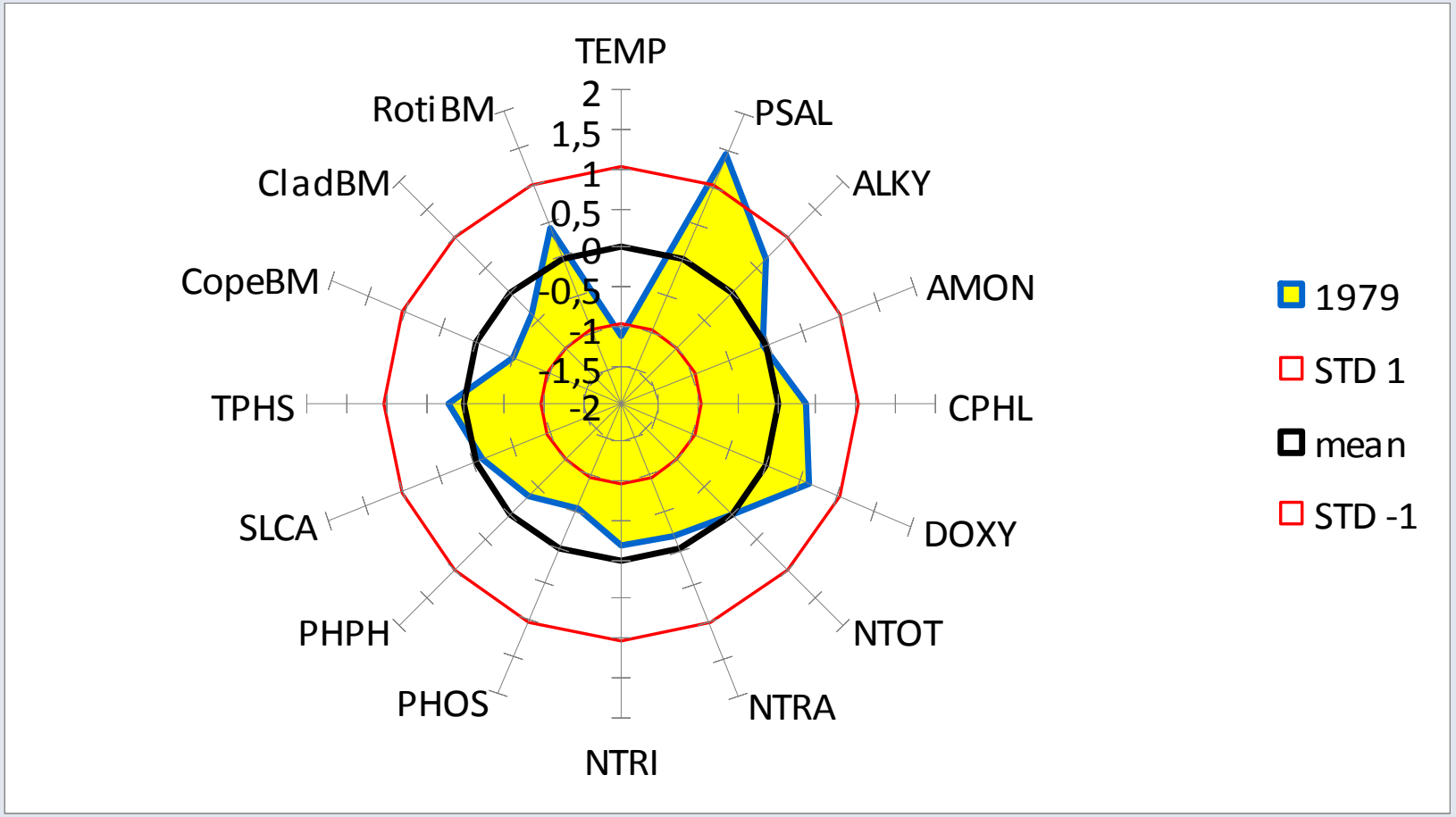


Updated version from August 7, 2011

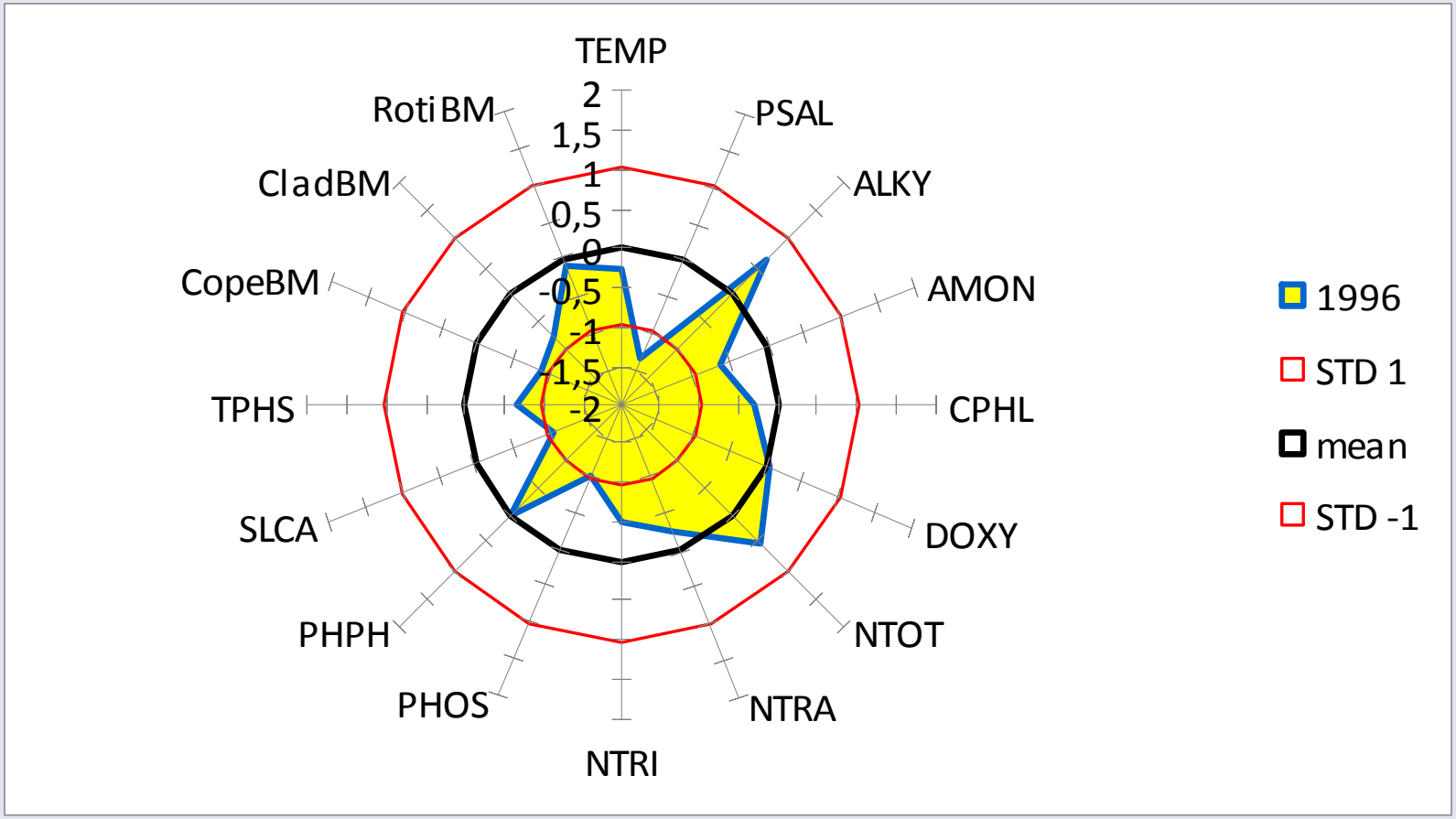
ICES SD 25 / 26 (1979)



Structure after the extreme winter 1978/79

Updated version from August 7, 2011

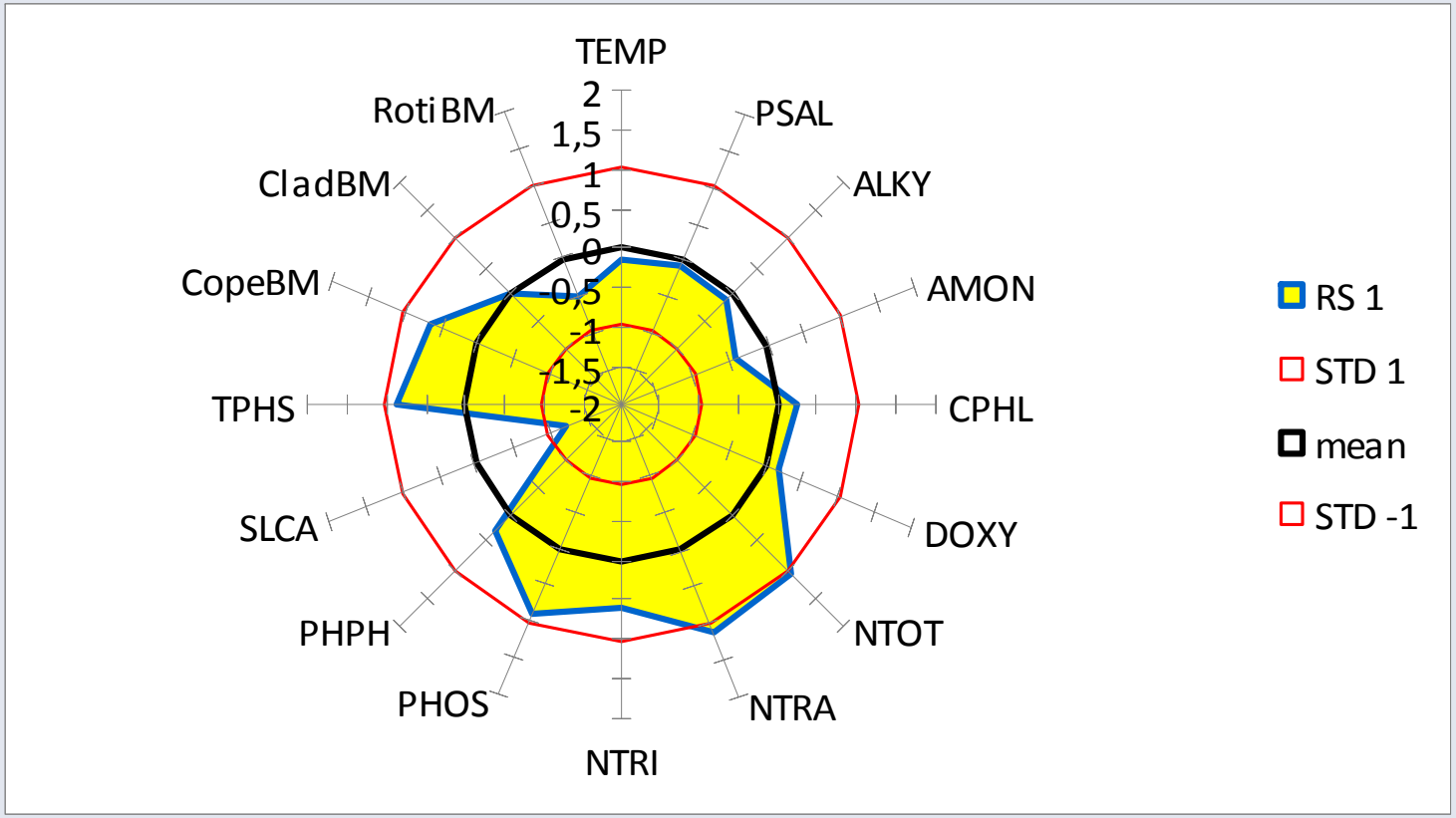
ICES SD 25 / 26 (1996)



Structure after the extreme winter 1995/96

Updated version from August 7, 2011

Regime shift SD 29 (1975/1976)



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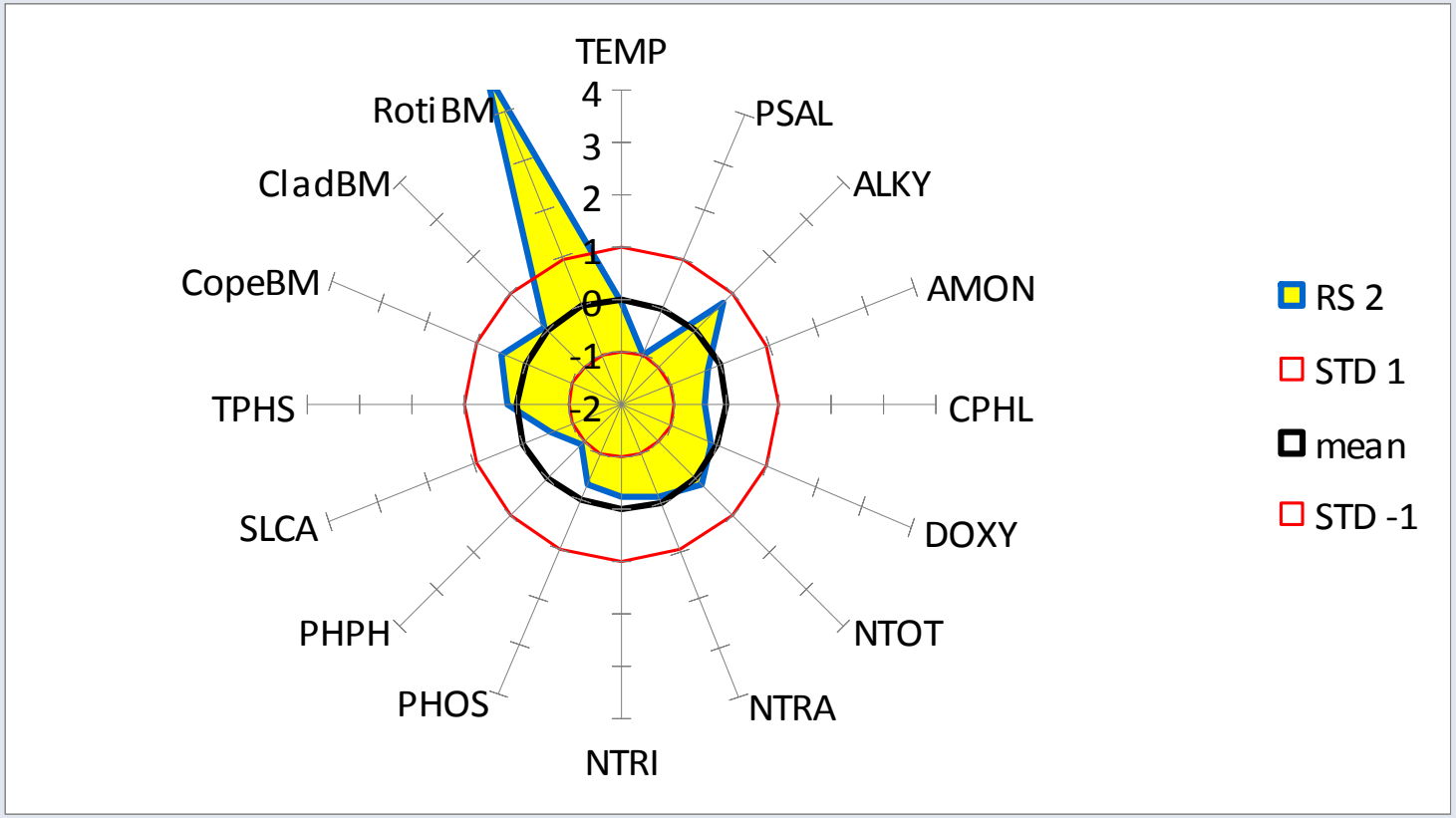
Regime shift SD 29 (1989/1990)



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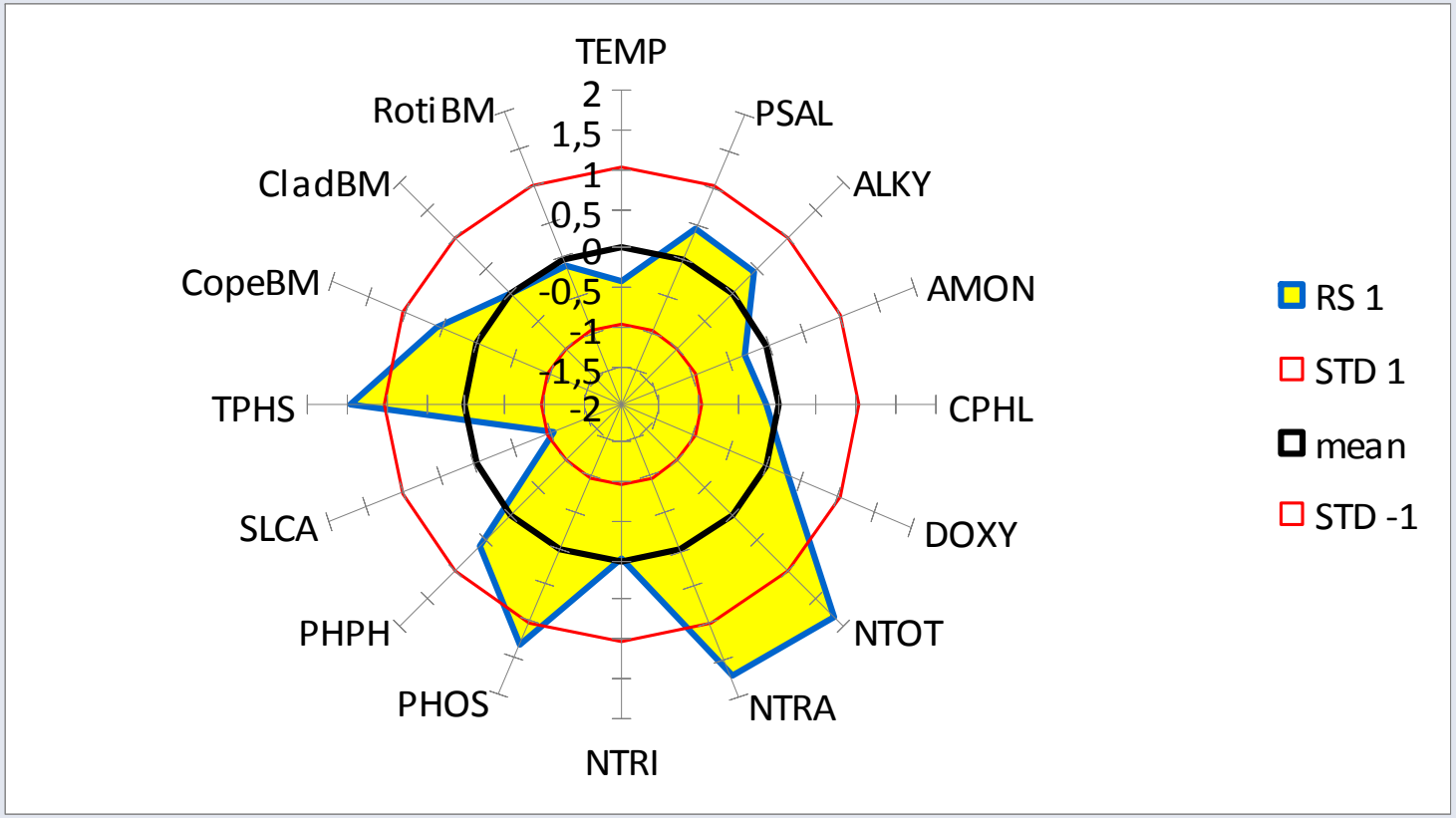
Regime shift SD 27/28 (1975/1976)



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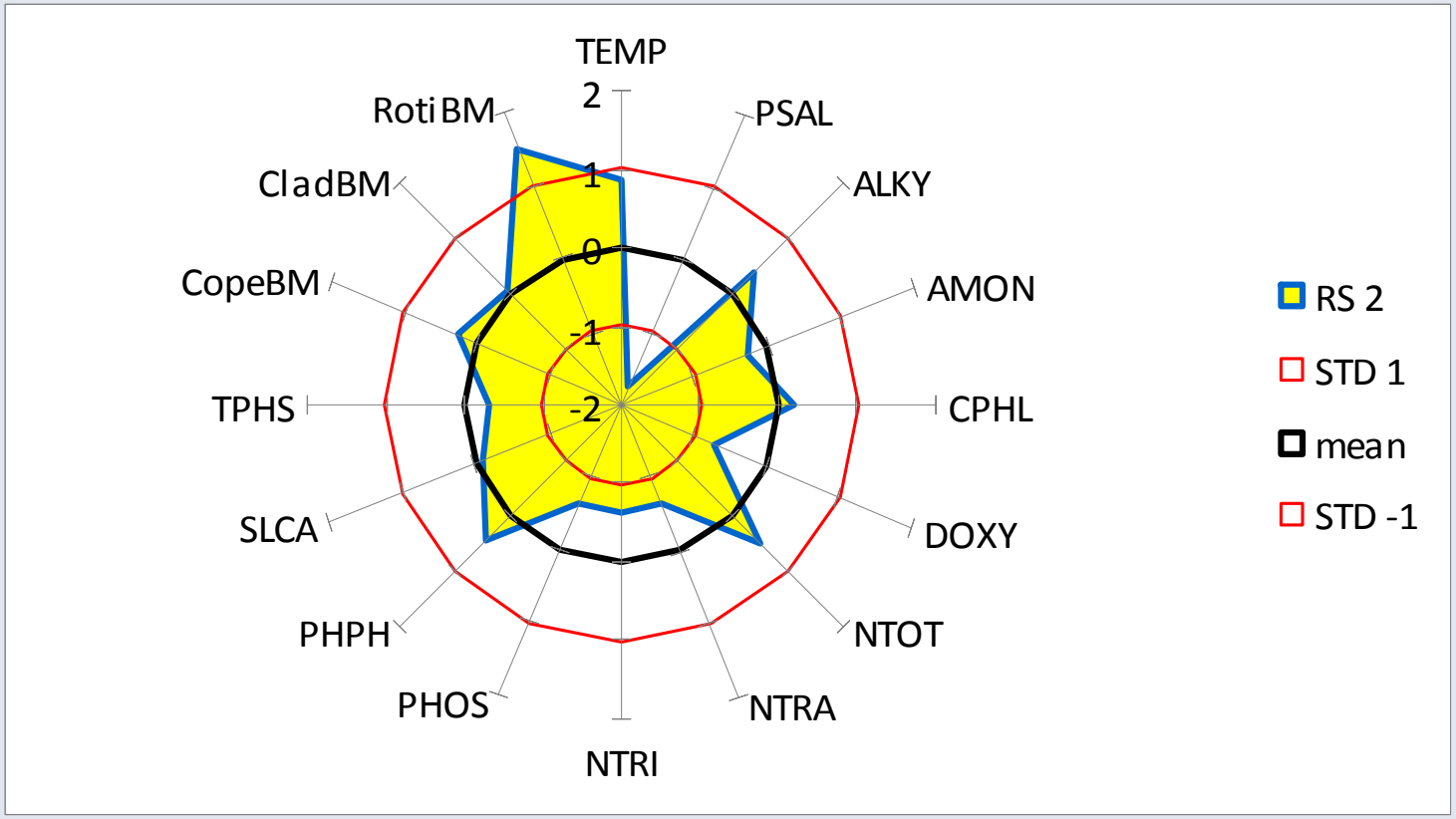
Regime shift SD 27/28 (1989/1990)



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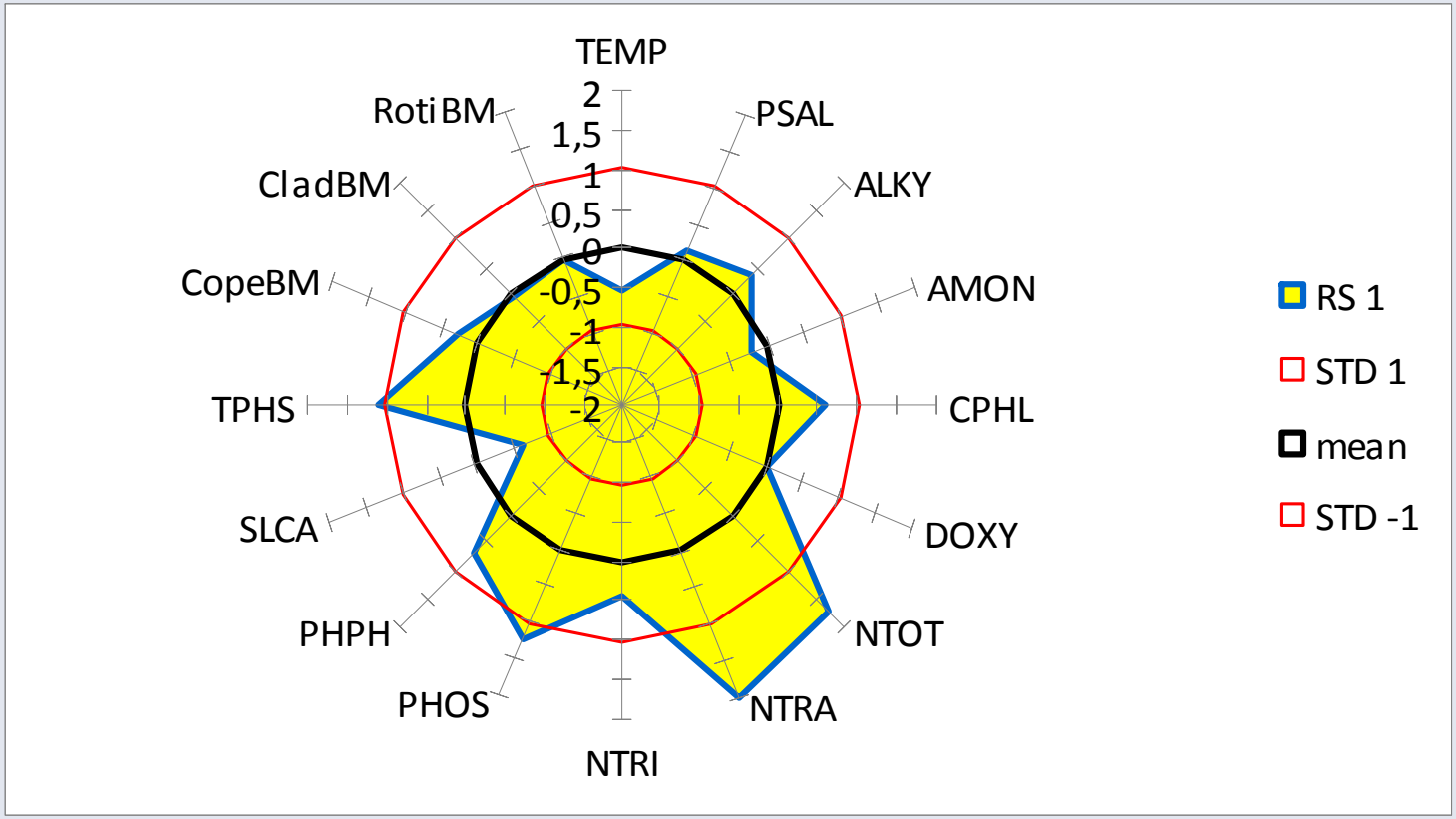
Regime shift SD 25/26 (1975/1976)



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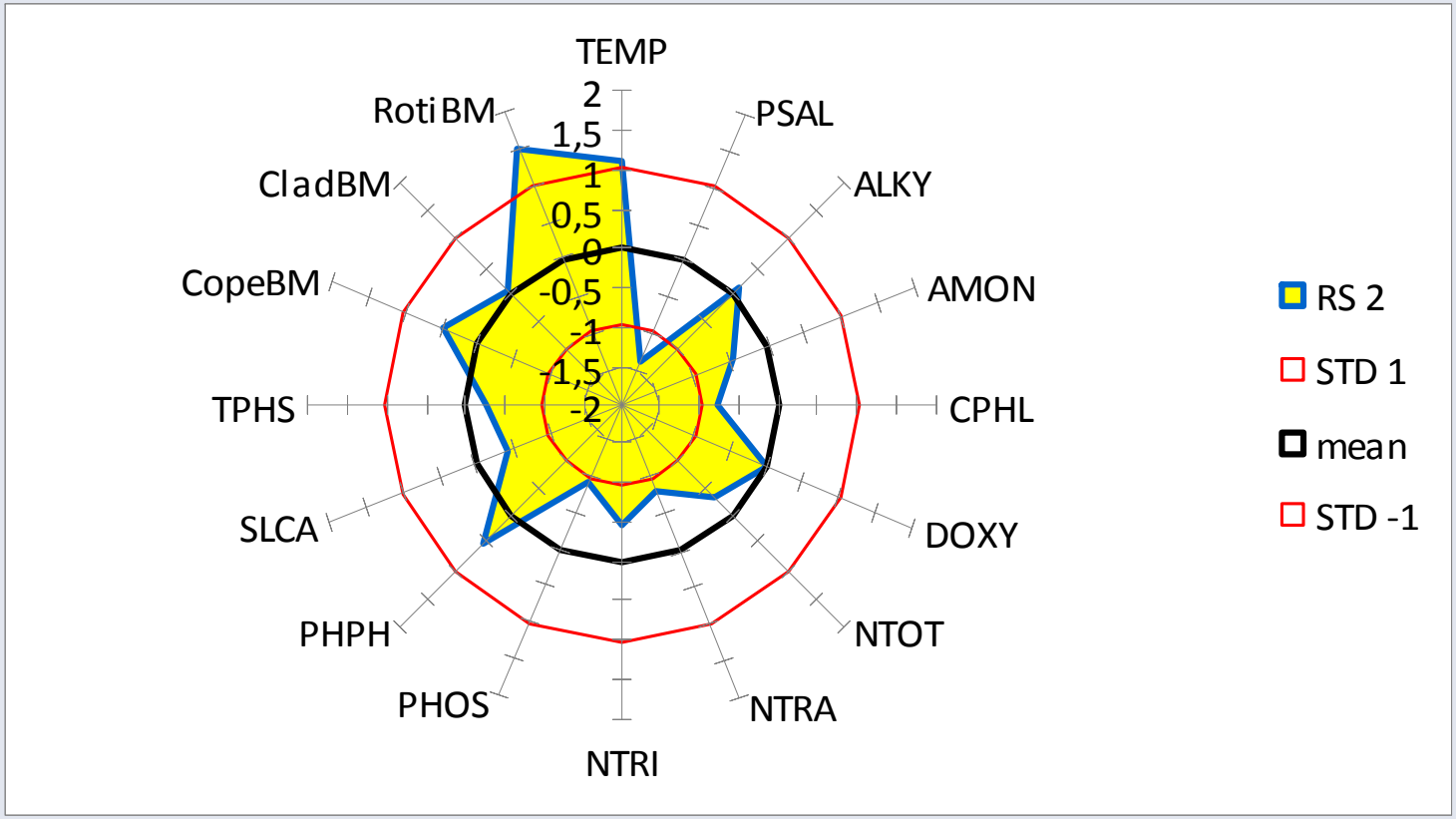

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Part 2: Zooplankton in the Baltic Sea (SD 28-2)

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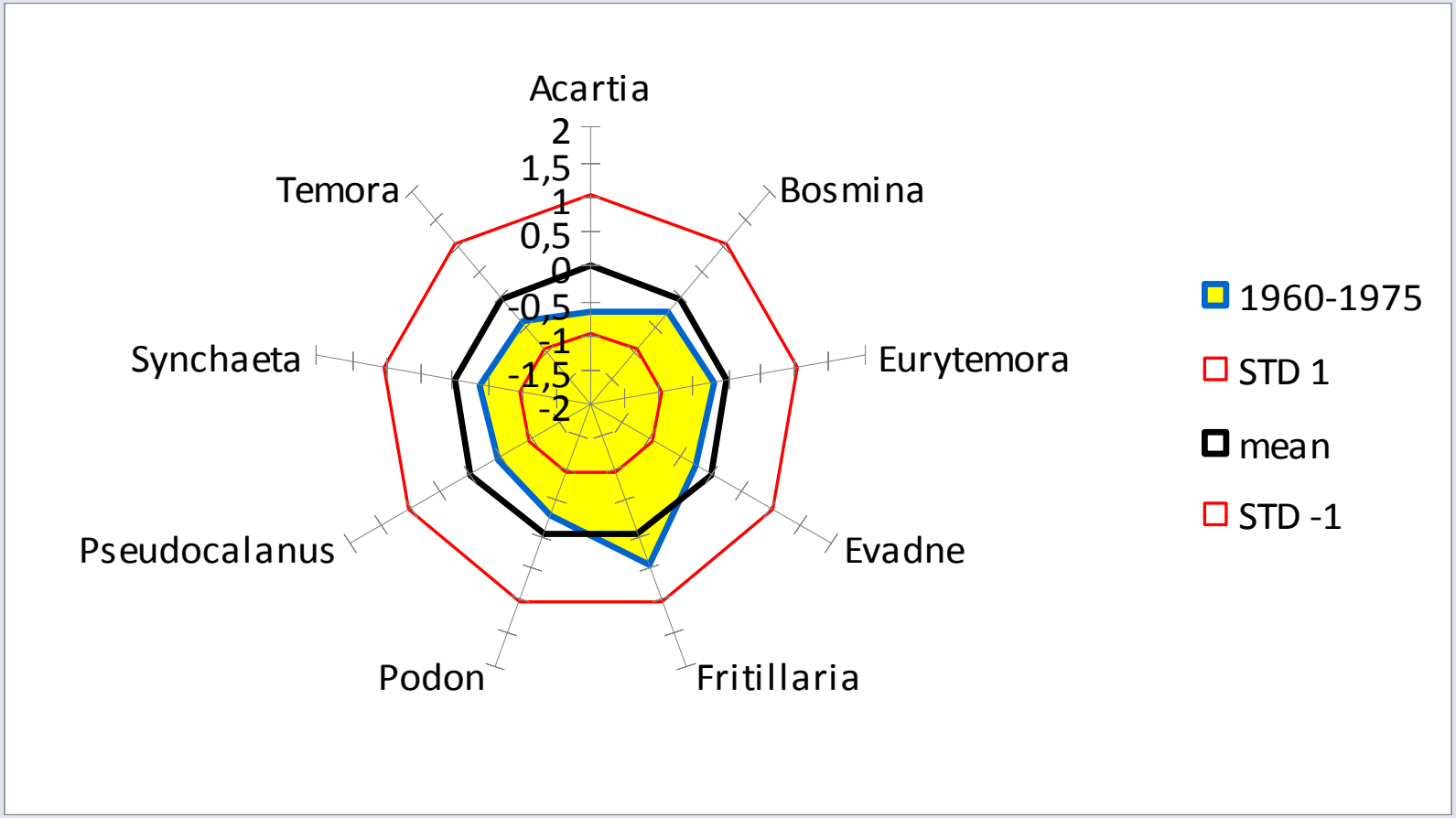
Spring Zooplankton (1960-1975)



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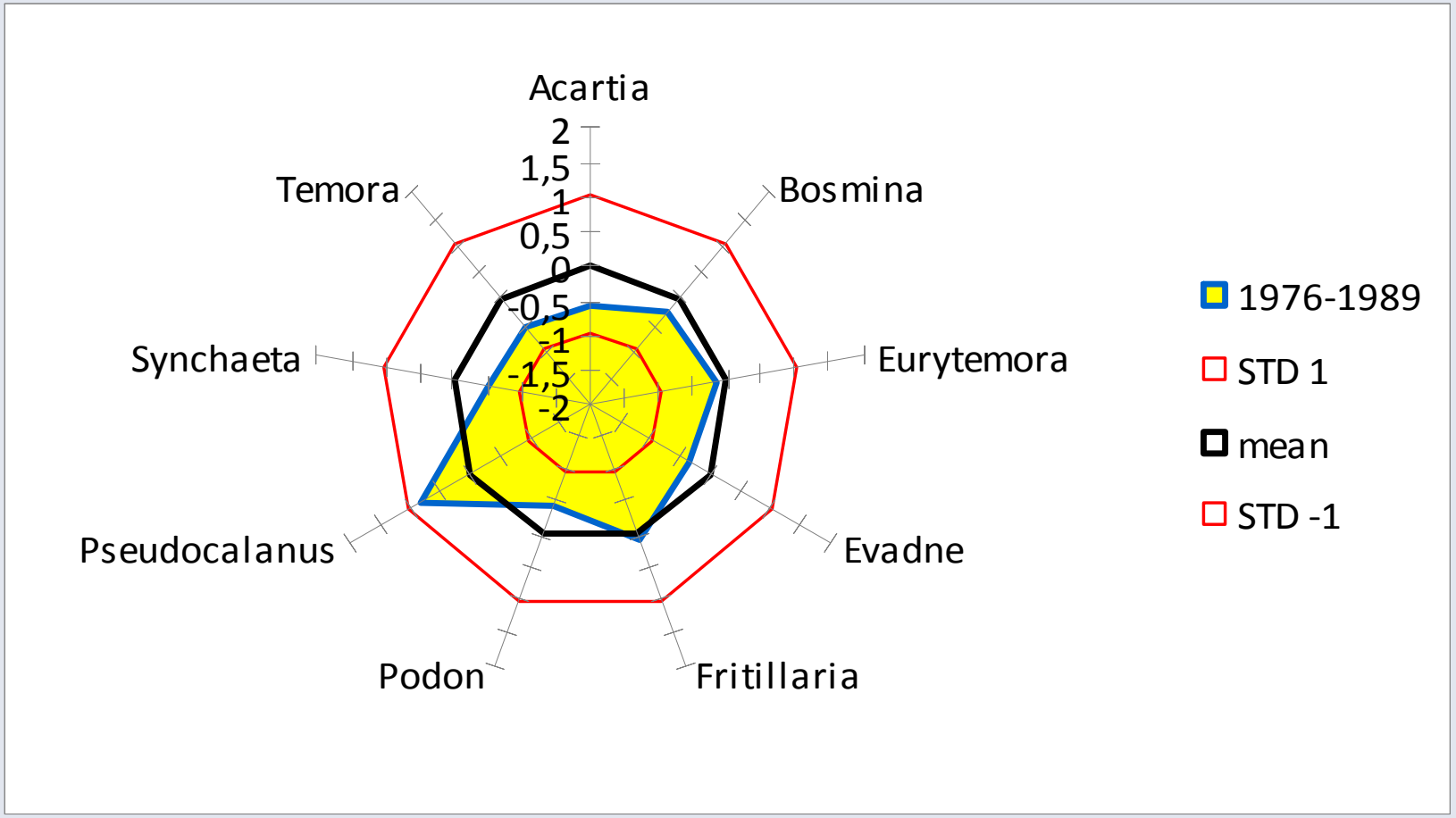
Spring Zooplankton (1976-1989)



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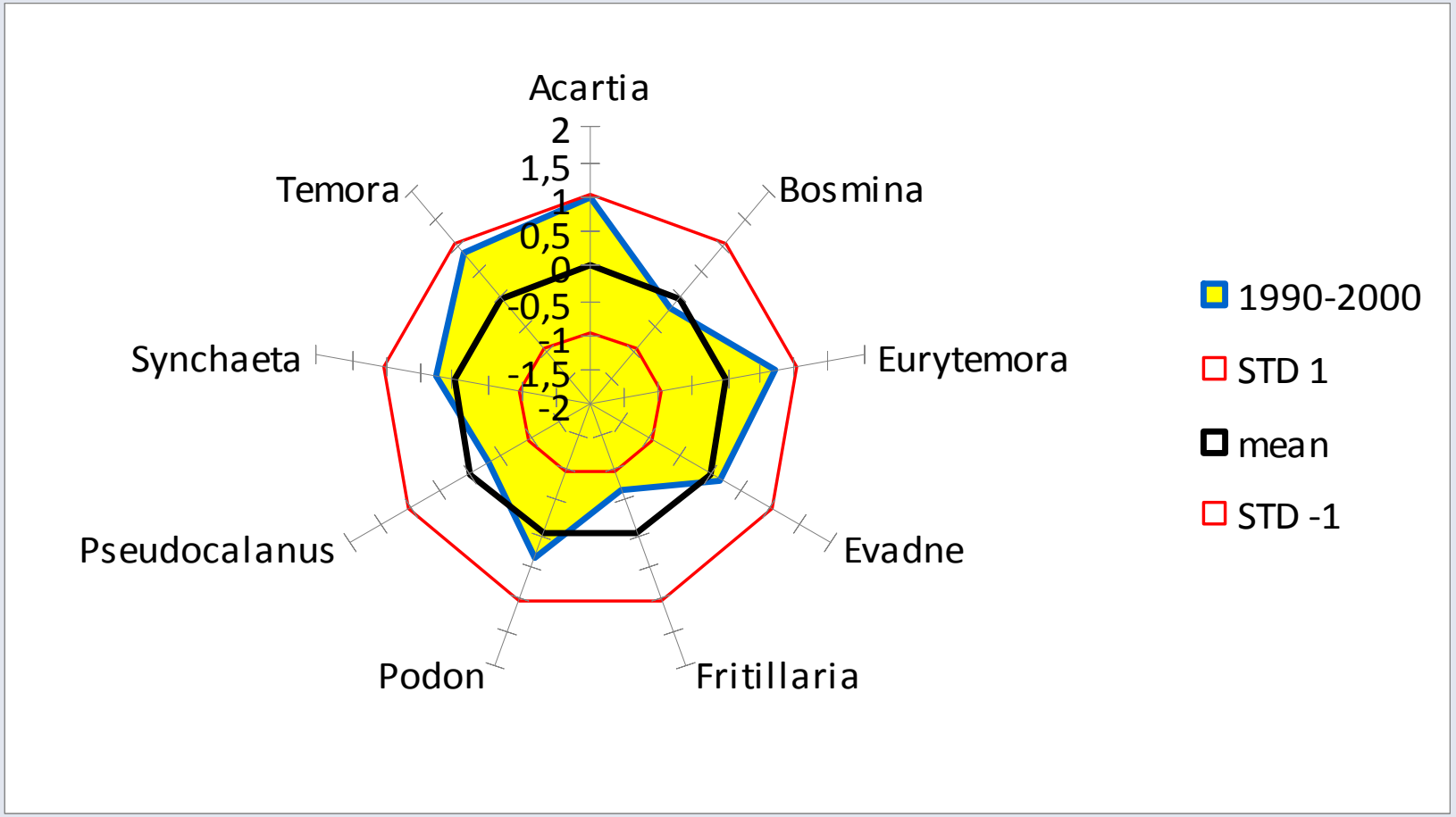
Spring Zooplankton (1990-2000)



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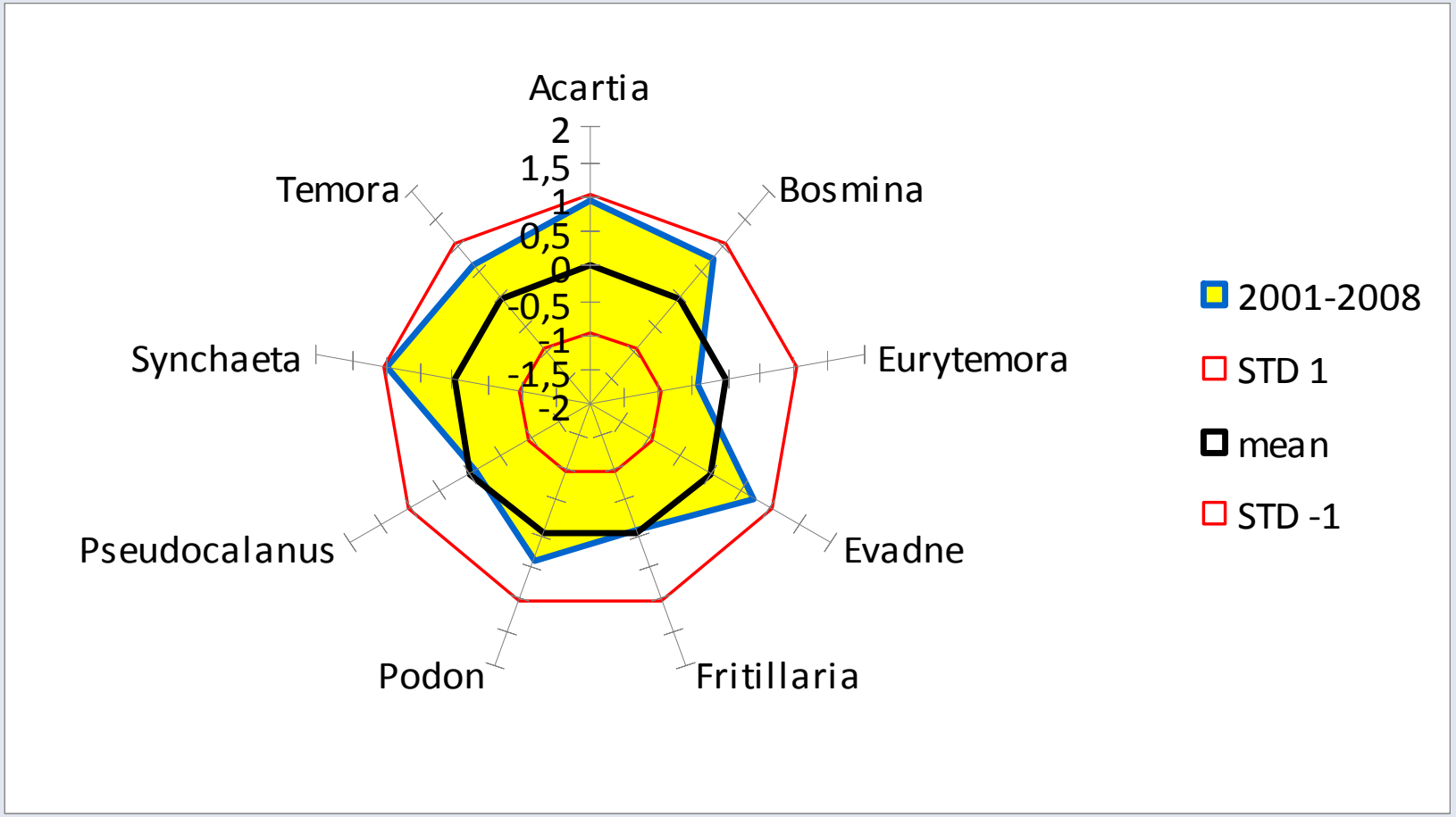
Spring Zooplankton (2001-2008)



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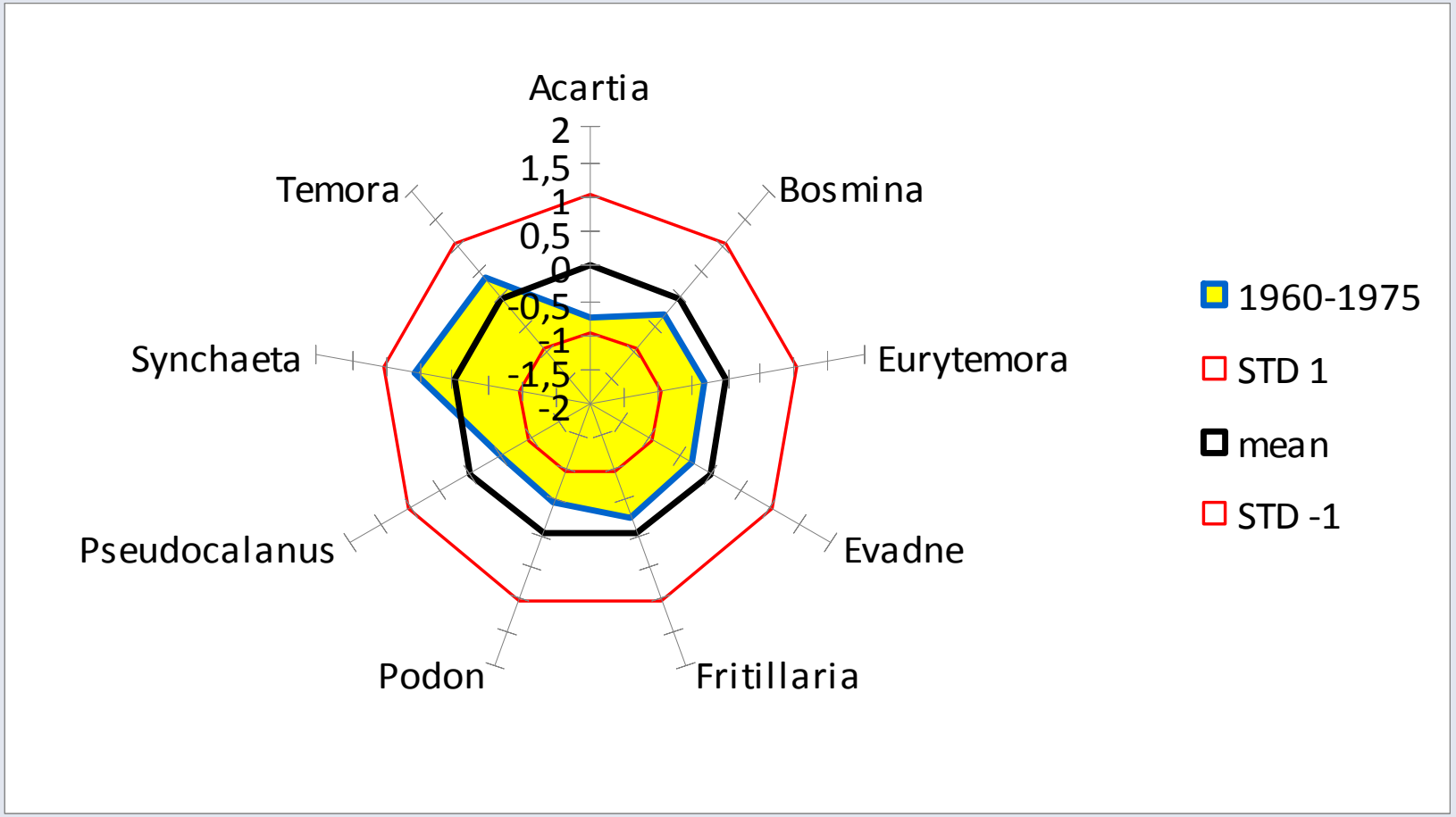
Summer Zooplankton (1969-1975)



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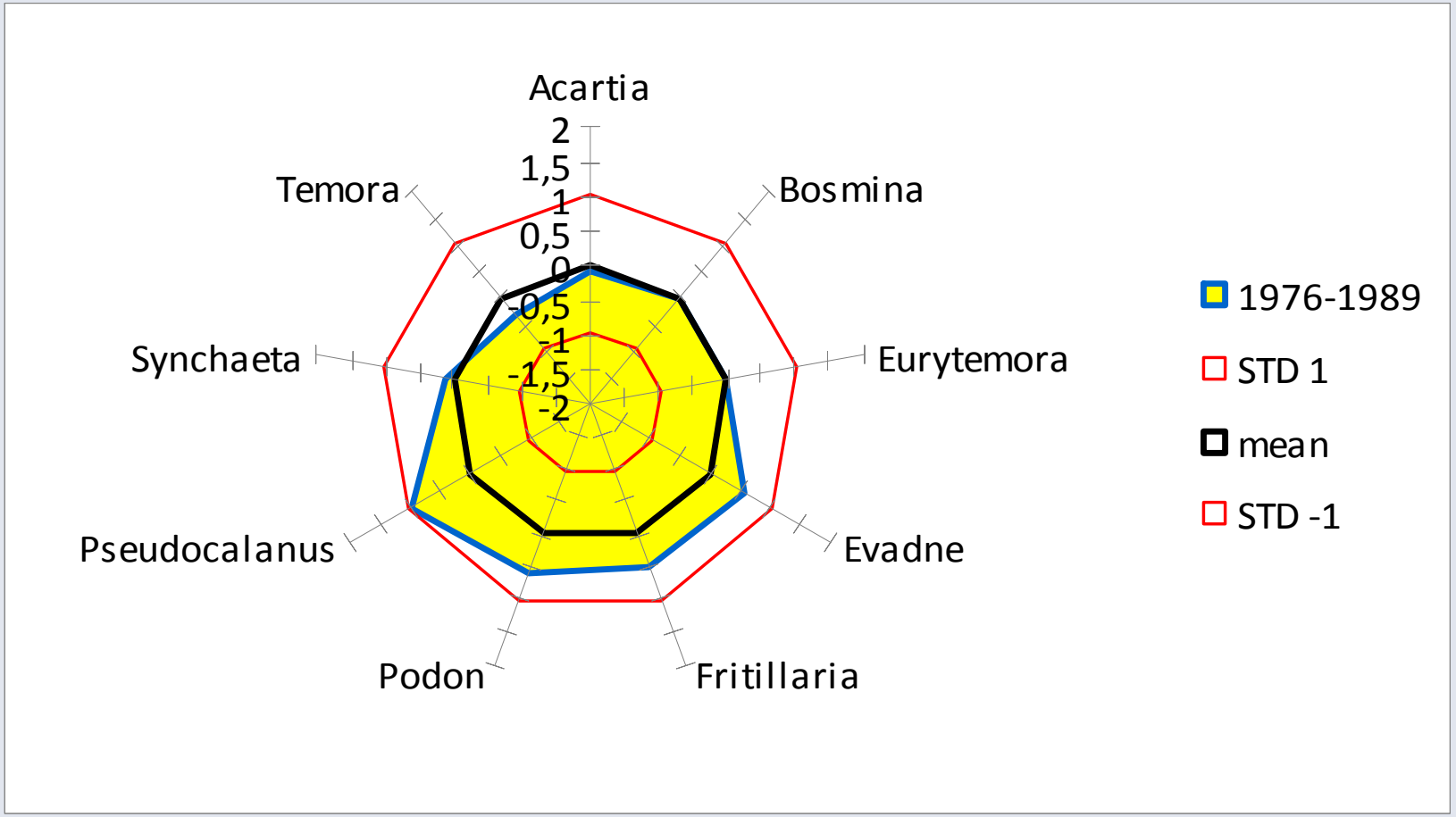
Summer Zooplankton (1976-1989)



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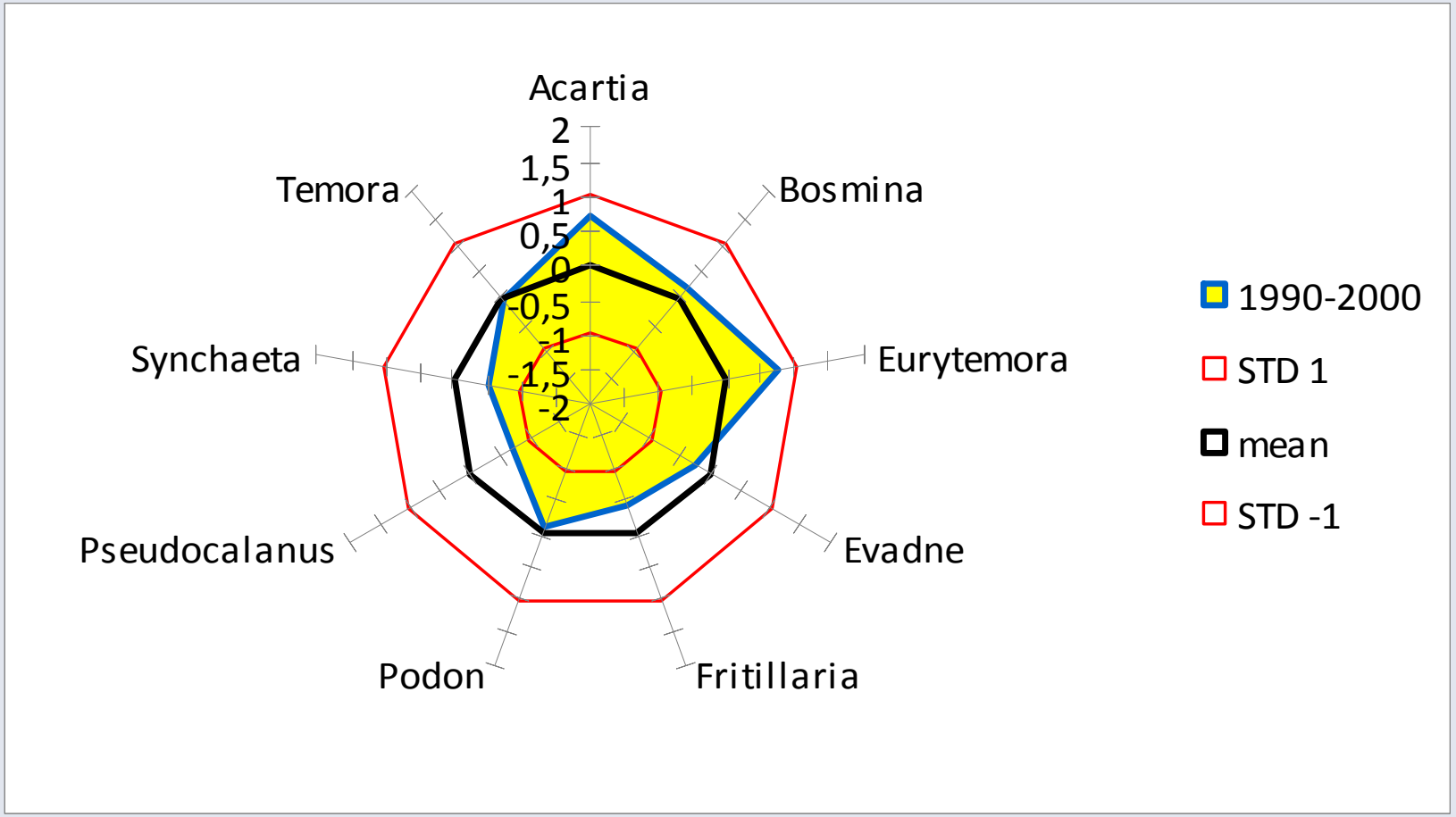
Summer Zooplankton (1990-2000)



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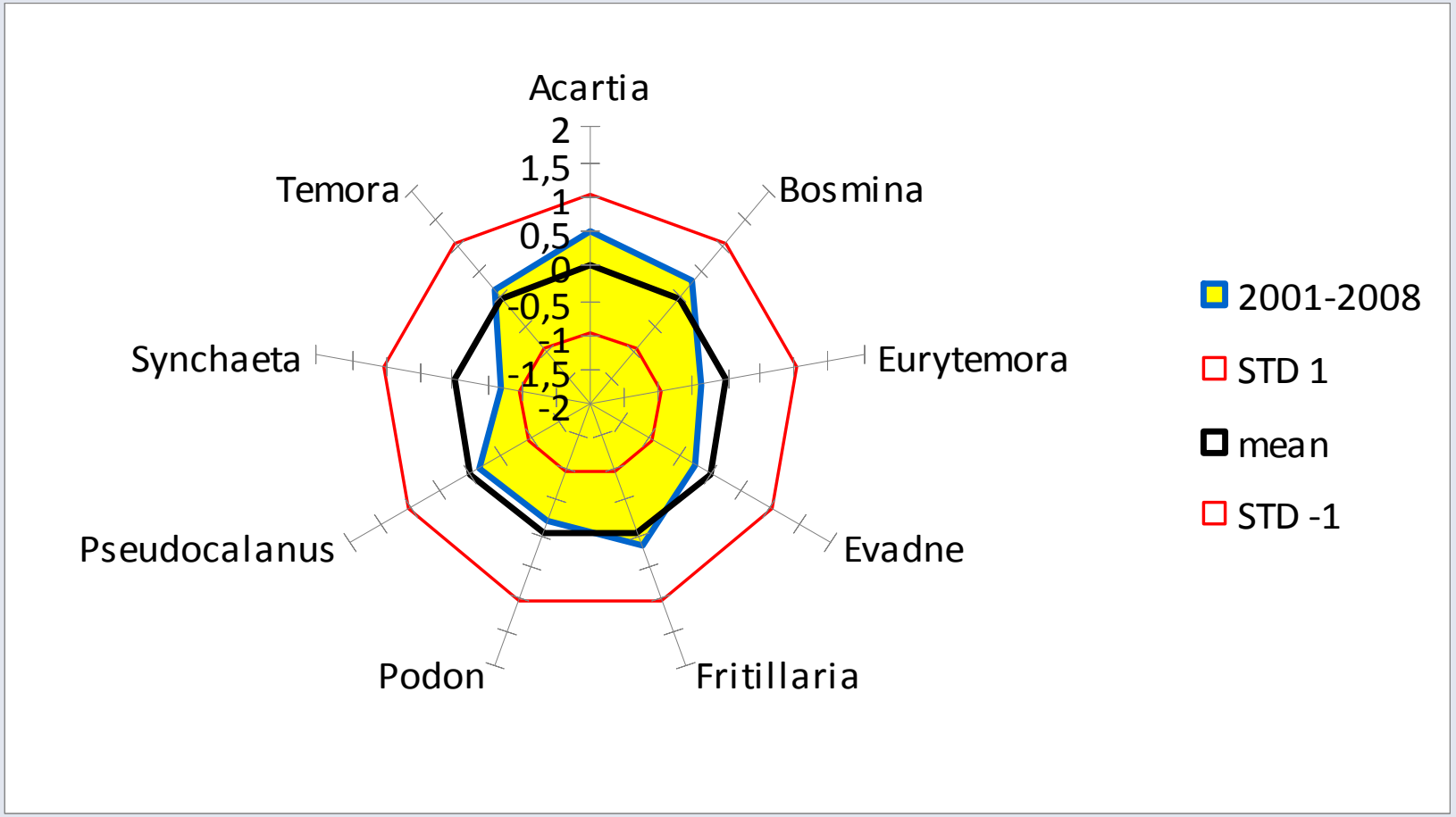
Summer Zooplankton (2001-2008)



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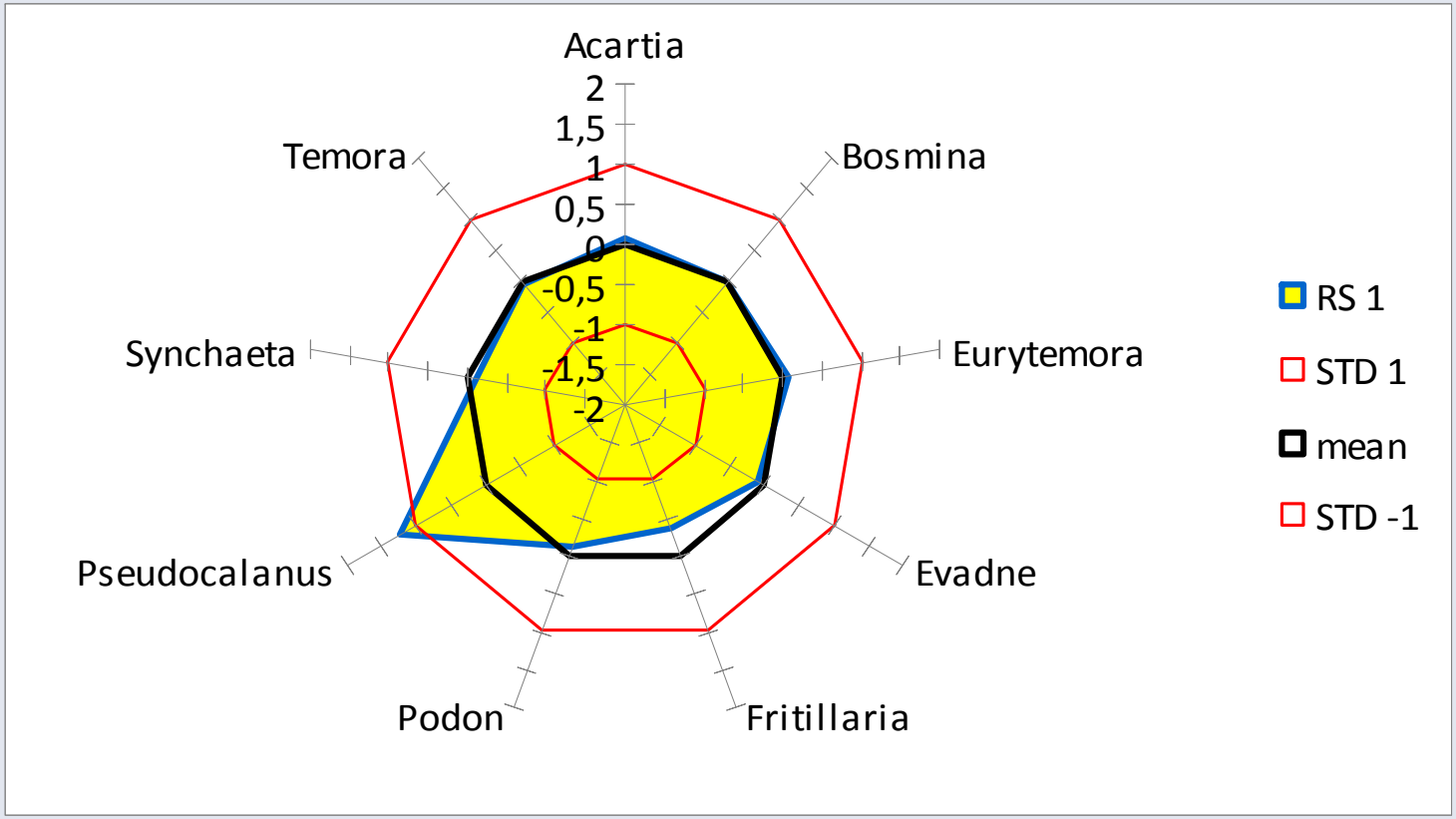
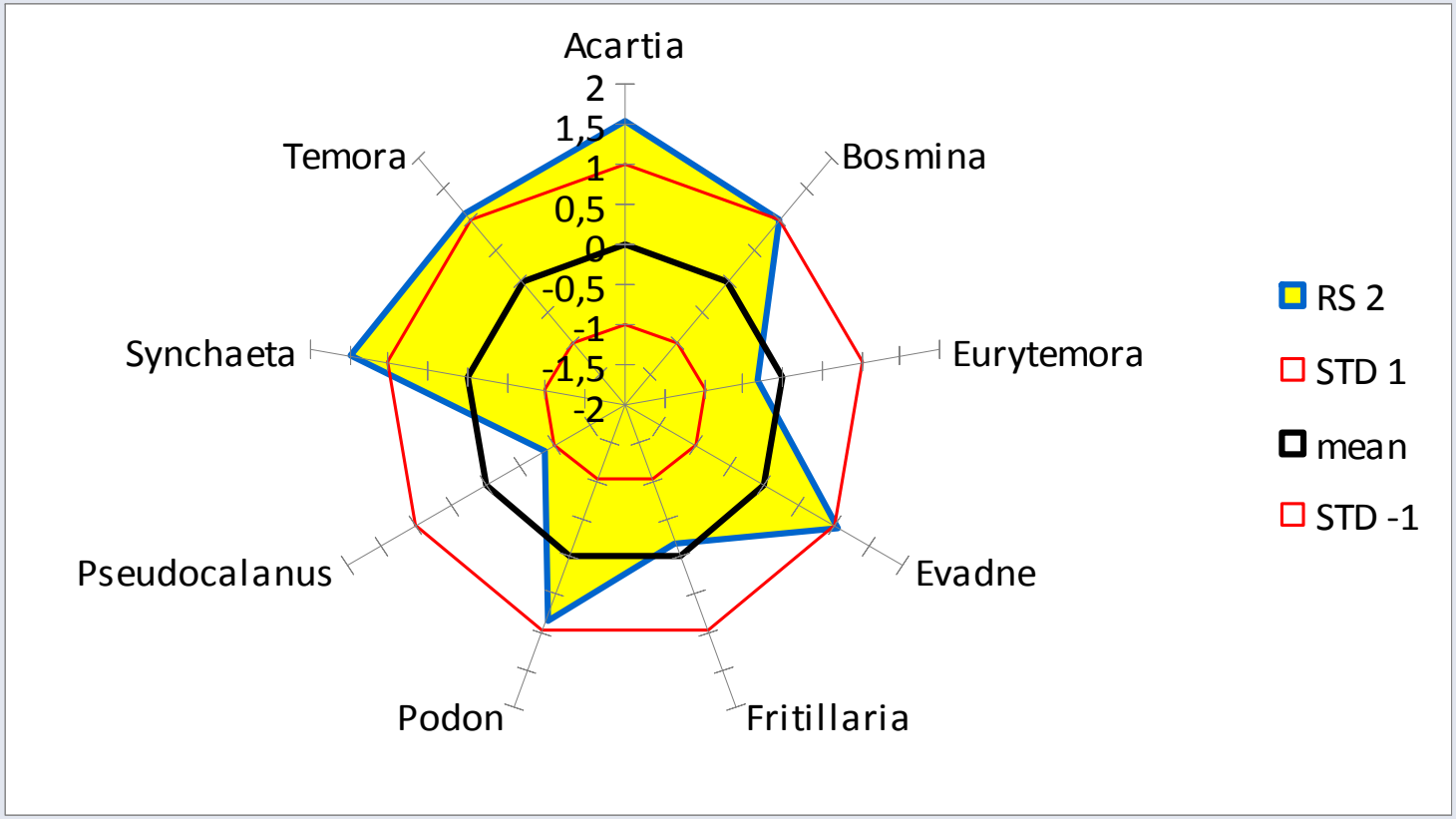
Regime shift (1975/1976)



Spring zooplankton

Updated version from August 7, 2011

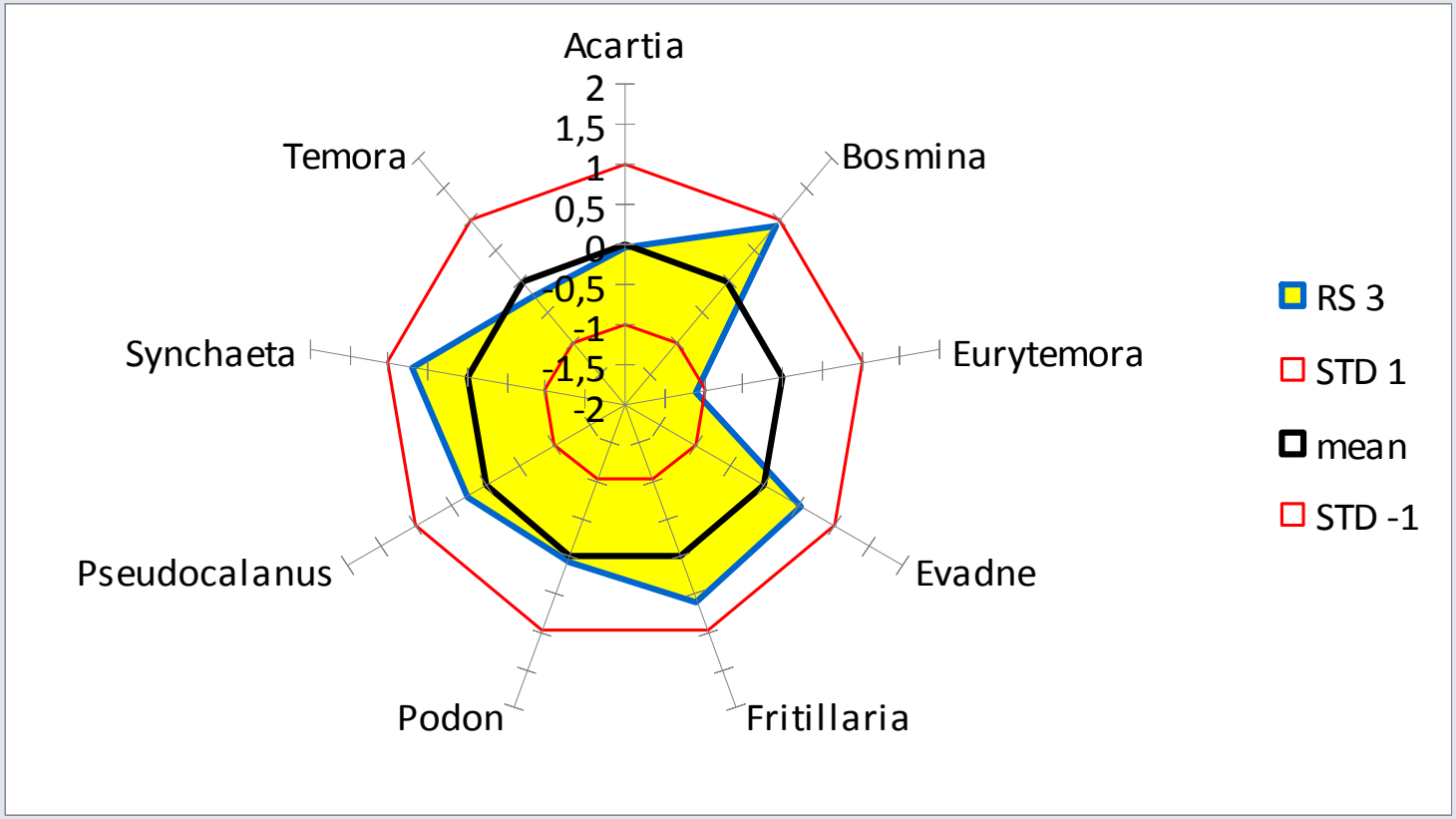
Regime shift (1989/1990)



Spring zooplankton

Updated version from August 7, 2011

Regime shift (2001/2002)



Spring zooplankton

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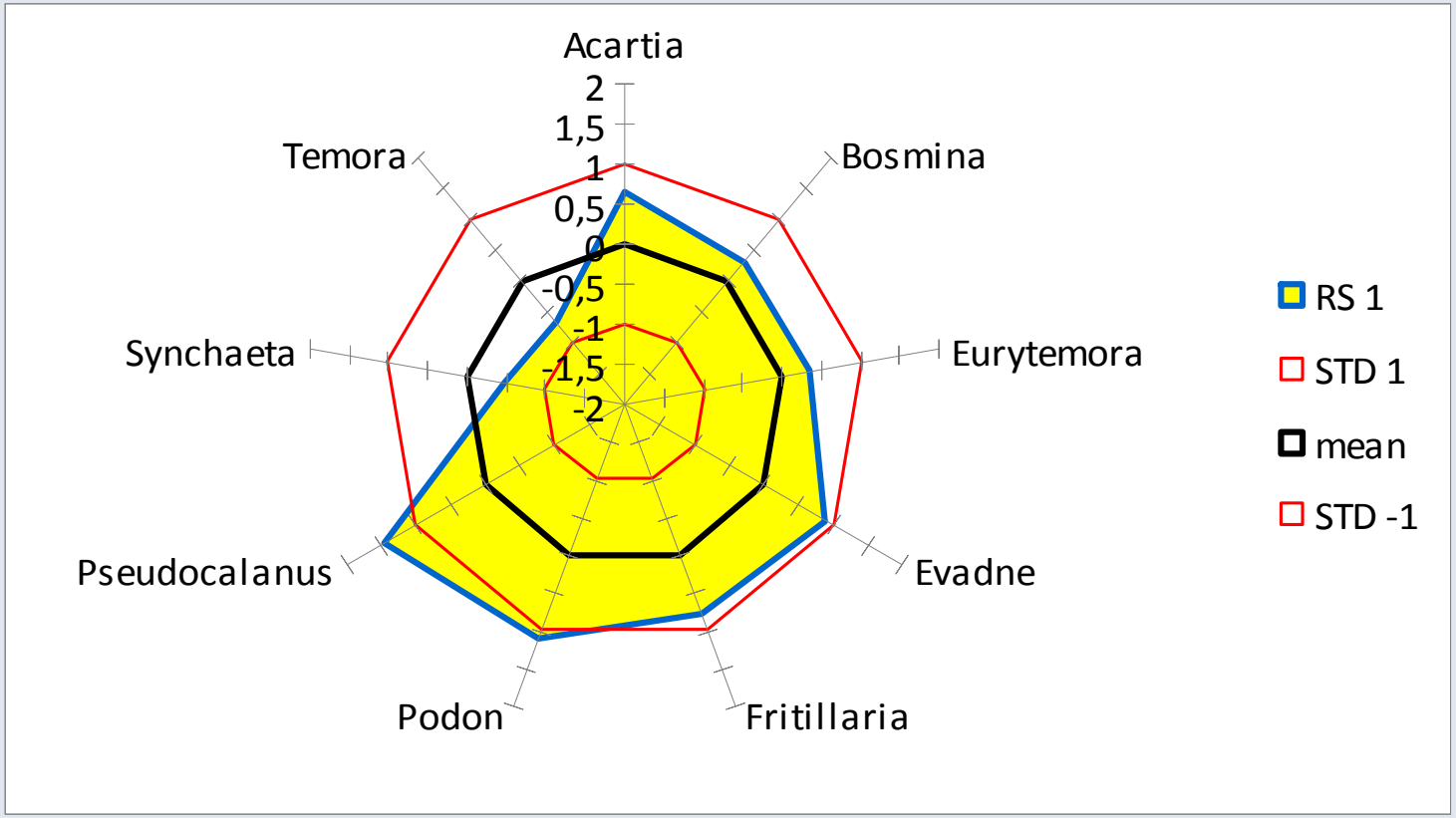
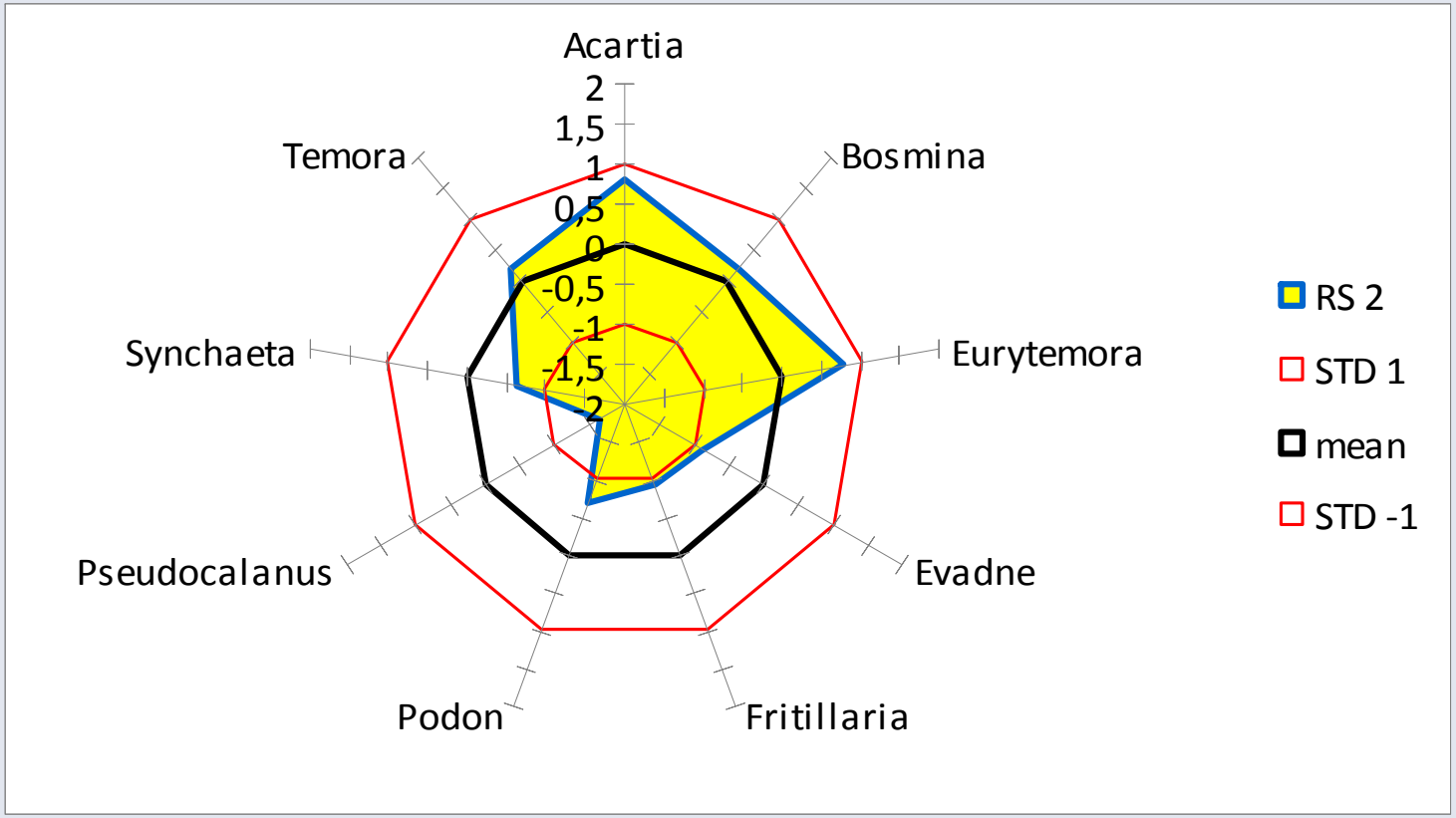
Regime shift (1975/1976)



Summer zooplankton

Updated version from August 7, 2011

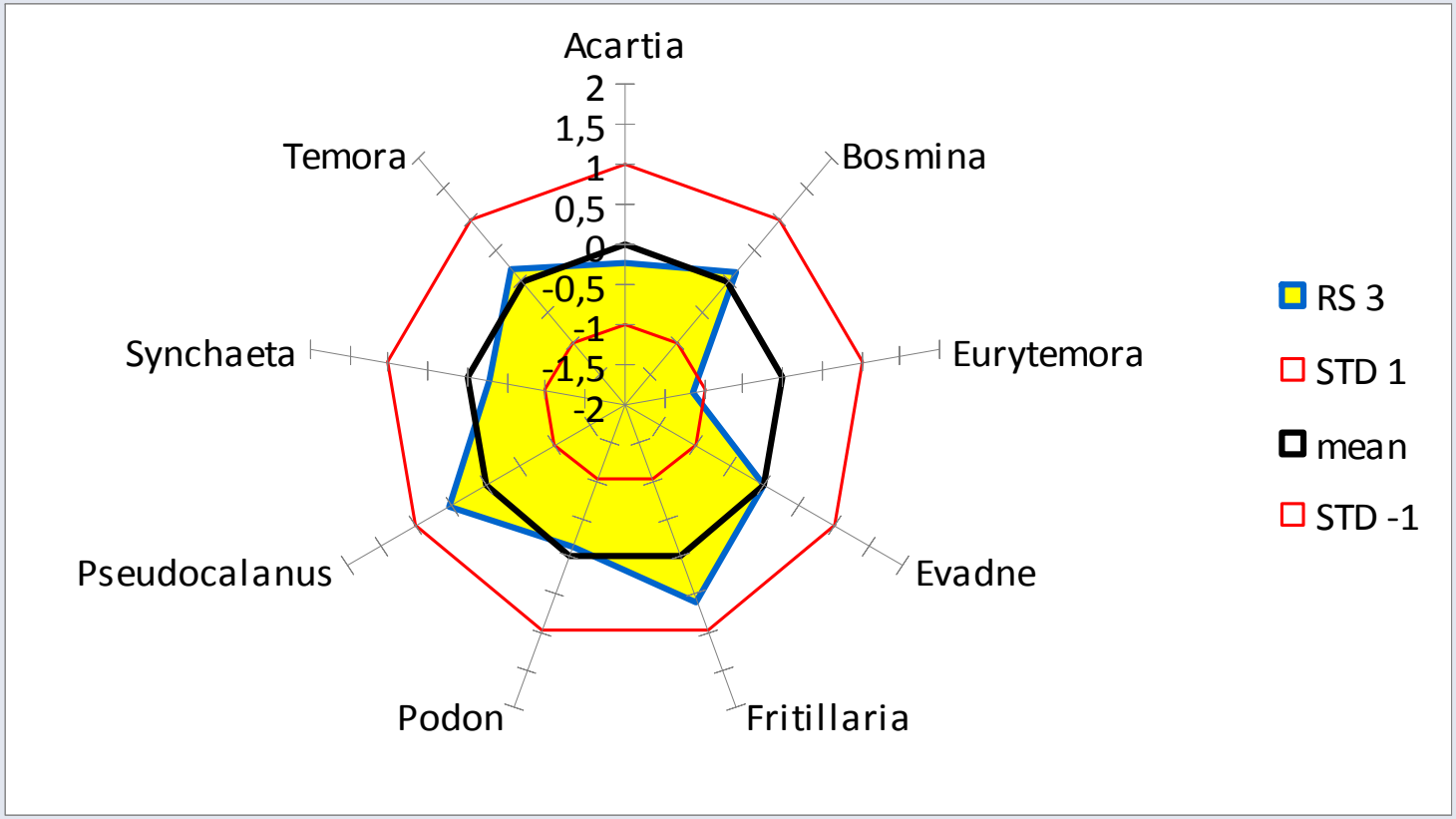
Regime shift (1989/1990)



Summer zooplankton

Updated version from August 7, 2011

Regime shift (2001/2002)



Summer zooplankton

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Part 3: LUNG Data

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Map of LUNG Monitoring Stations

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Abiotic Variables

- TW surface temperature
- PH pH value
- SAL salinity
- O2 oxygen concentration
- O2-sat oxygen saturation
- DOC dissolved organic carbon
- POC particulate organic carbon
- PO4 phosphate
- TP total phosphorus
- NO3 nitrate
- NO2 nitite
- NH4 ammonium
- TN total nitrogen
- SiO4 silicate
- CHL-a chlorophyll-a

Biotic Variables (autotroph)

- Cyan Cyanophyta
- Crypt Cryptophyta
- Dino Dinophyta
- Hapt Haptophyceae
- Crys Crysophyceae
- Eugl Euglenophyta
- Chlo Chlorophyta
- Pras Prasinopyceae
- Cent Centric diatoms
- Penn Pennate diatoms
- Baci Bacillariophyceae (all diatoms)

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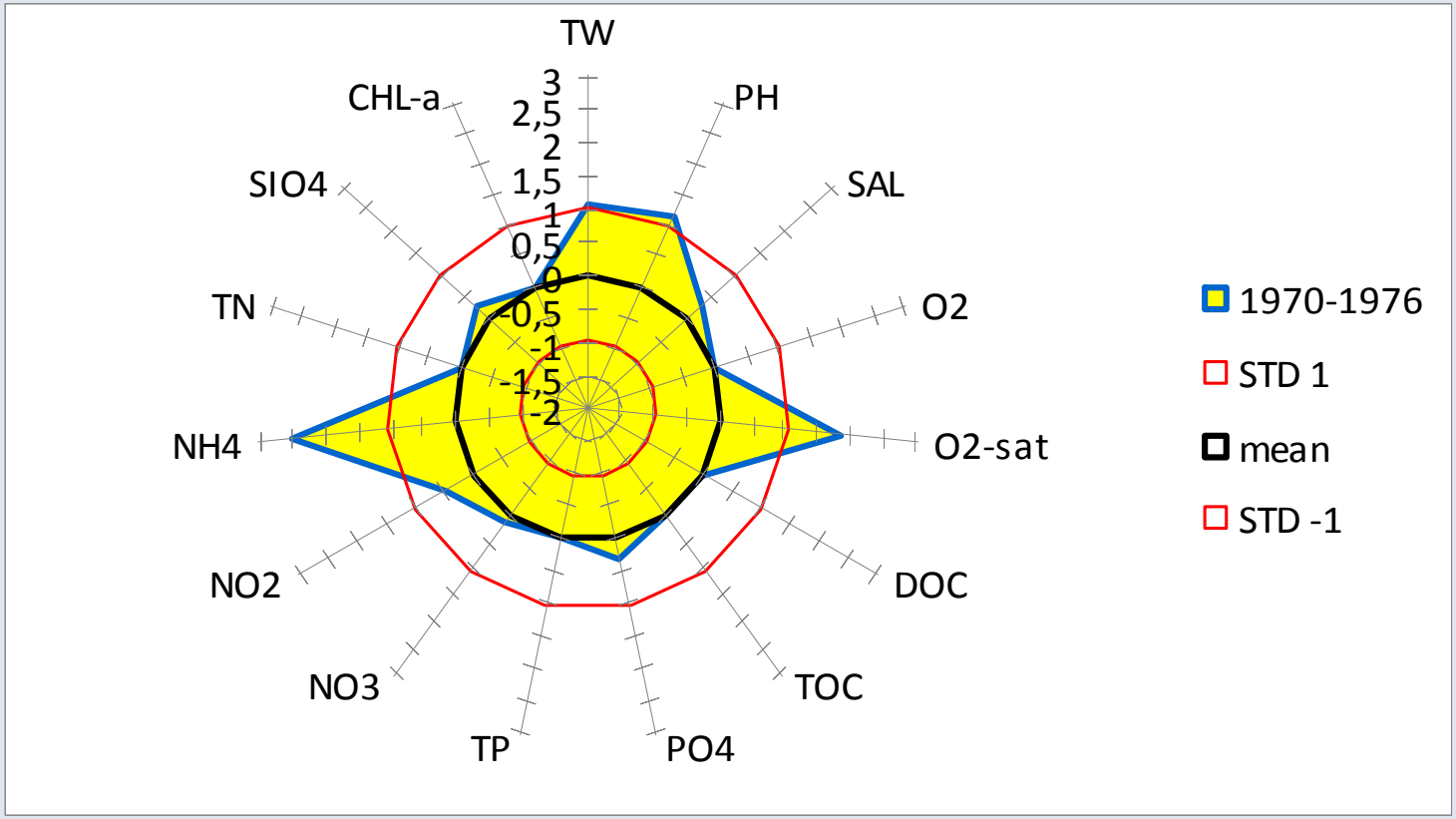
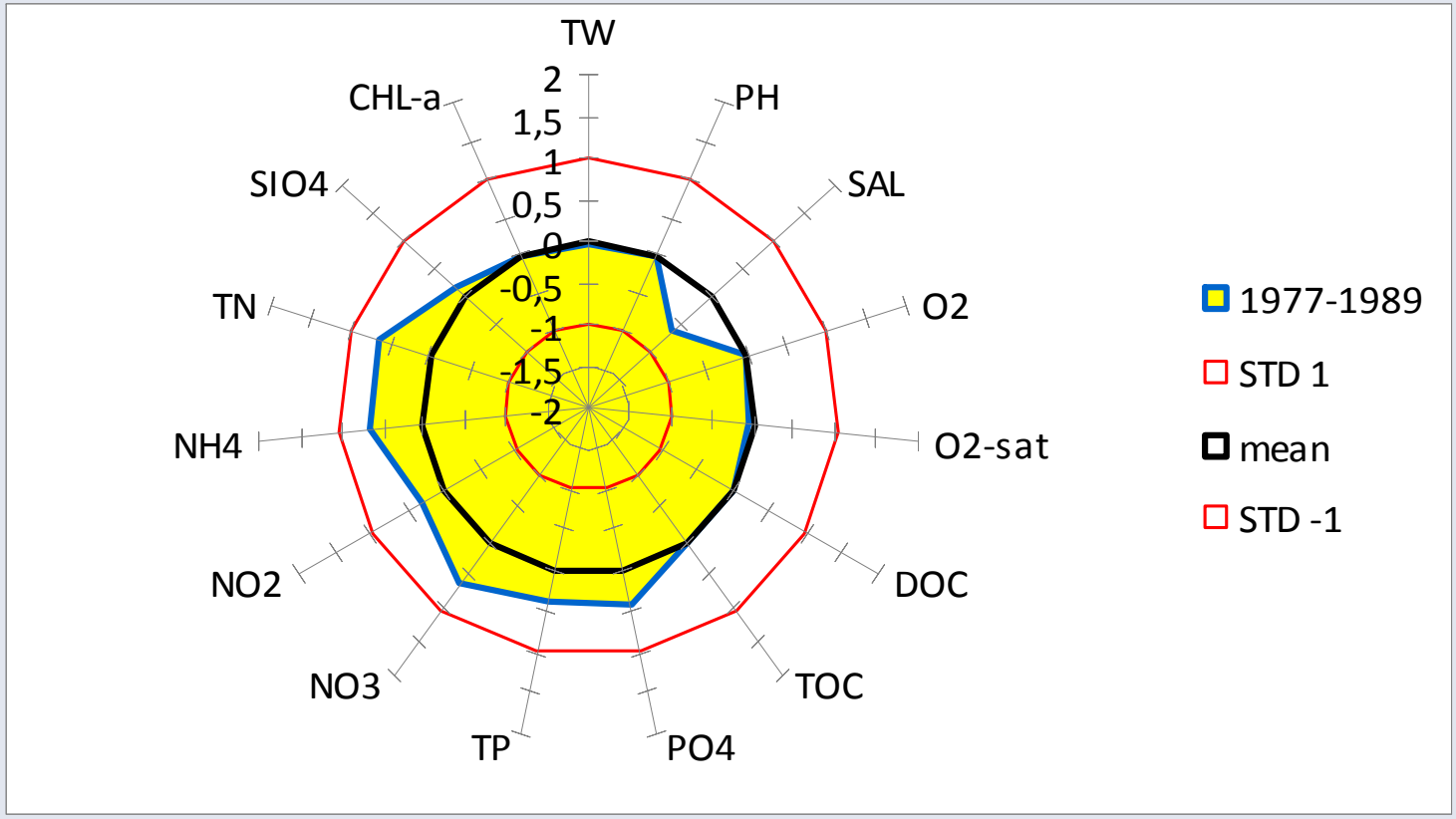
Station OB4 (1970-1976)



Updated version from August 7, 2011

Station OB4 (1977-1989)



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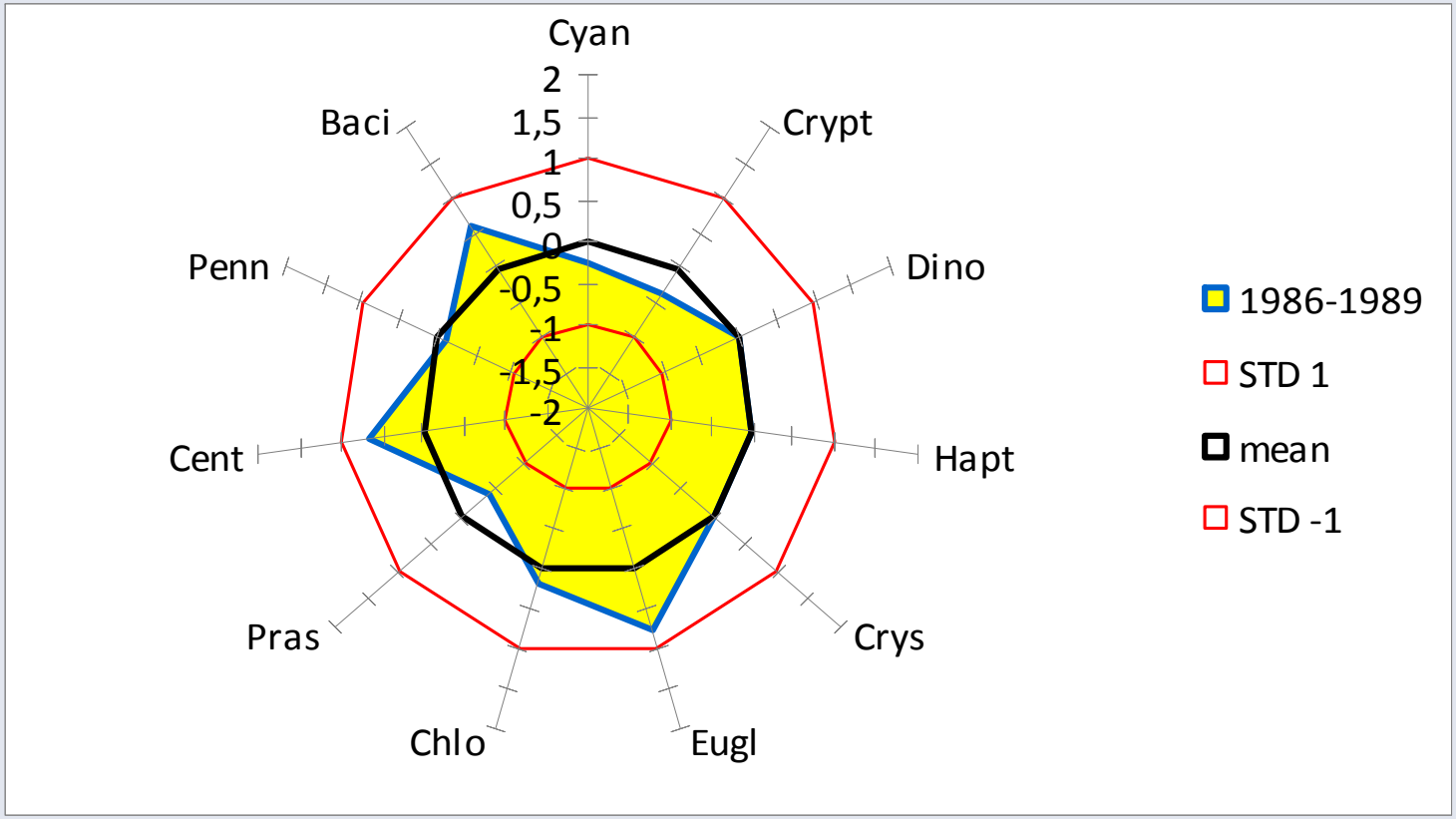
Station OB4 (1986-1989)



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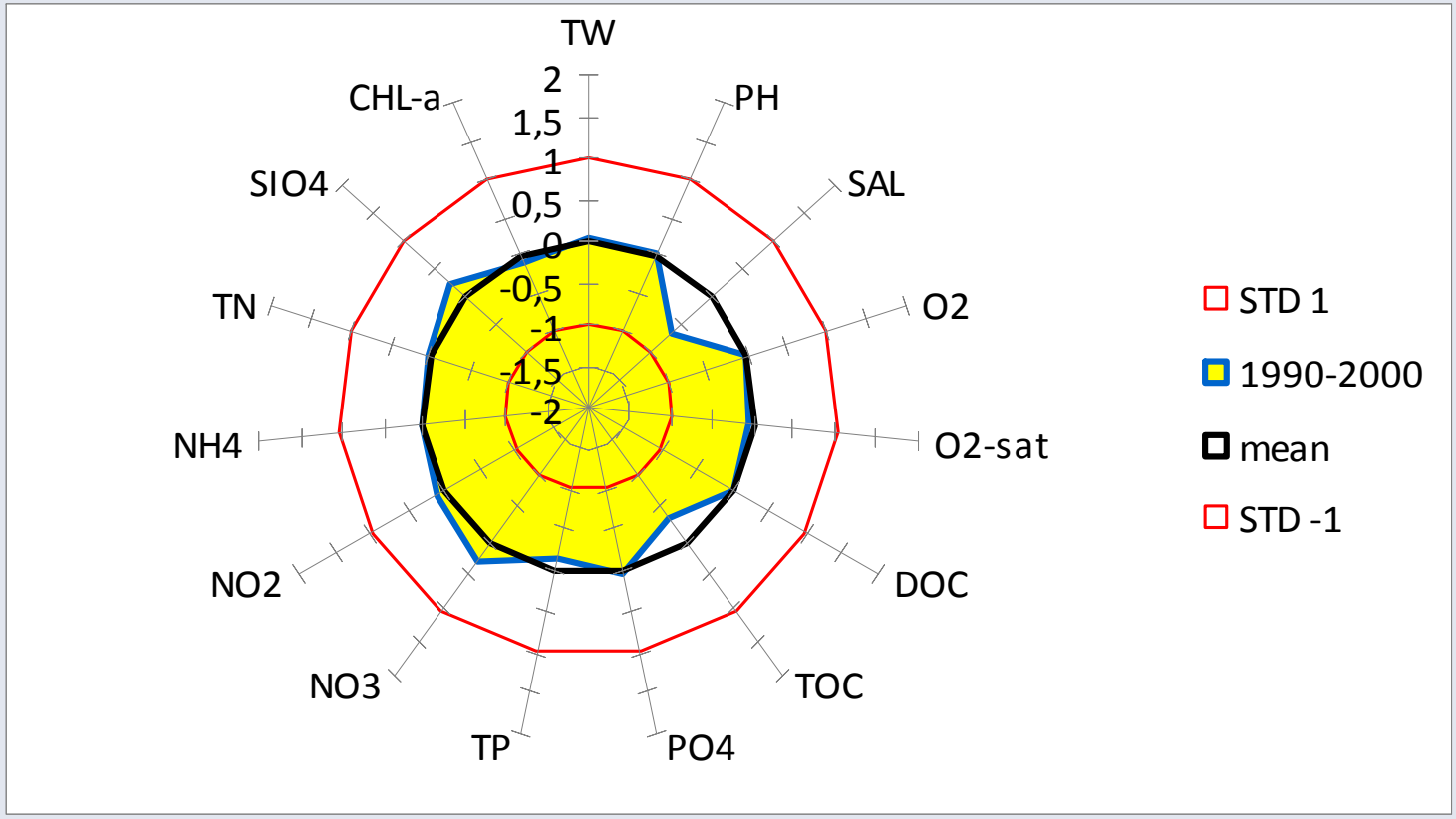
Station OB4 (1990-2000)



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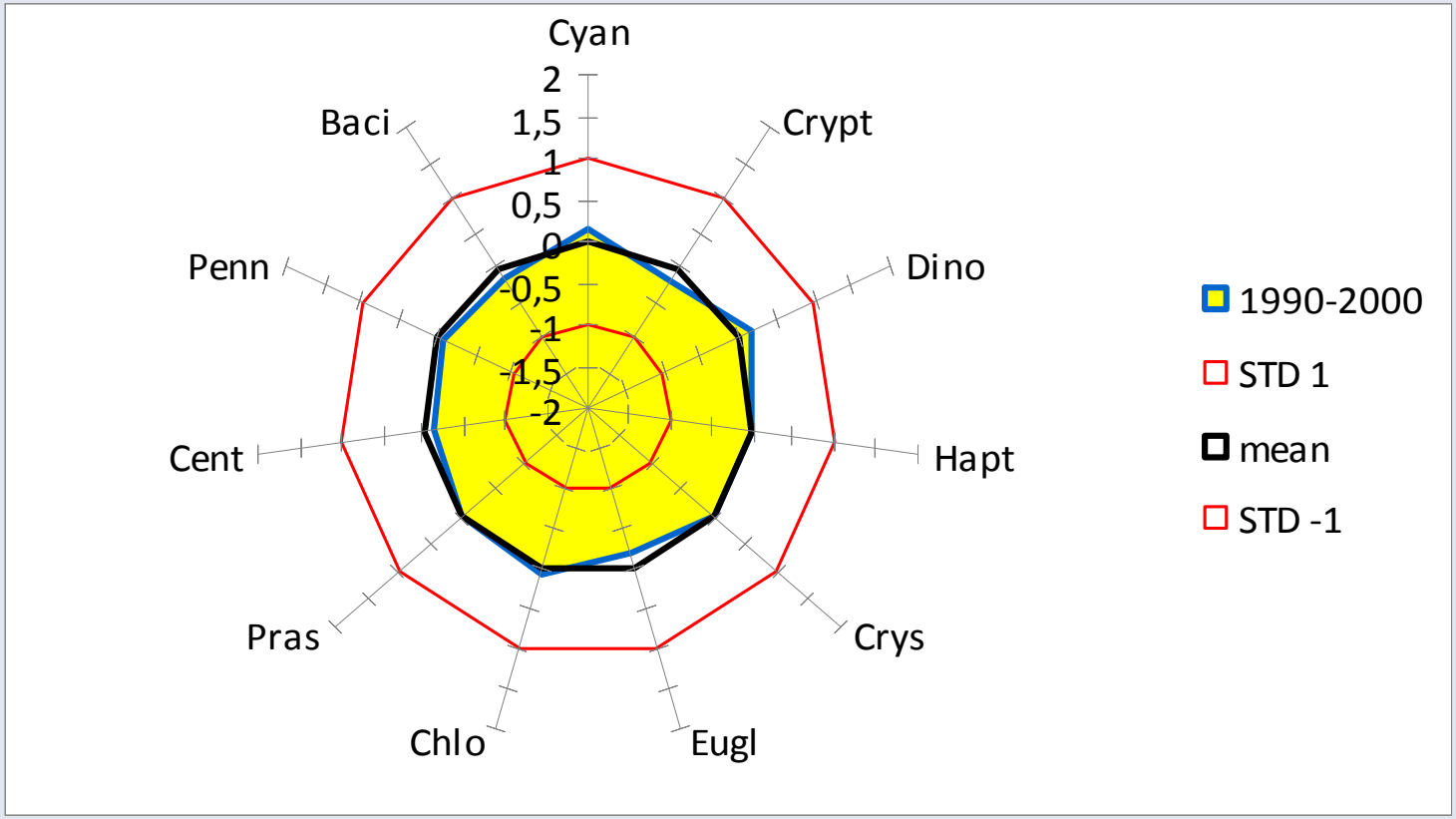
Station OB4 (1990-2000)



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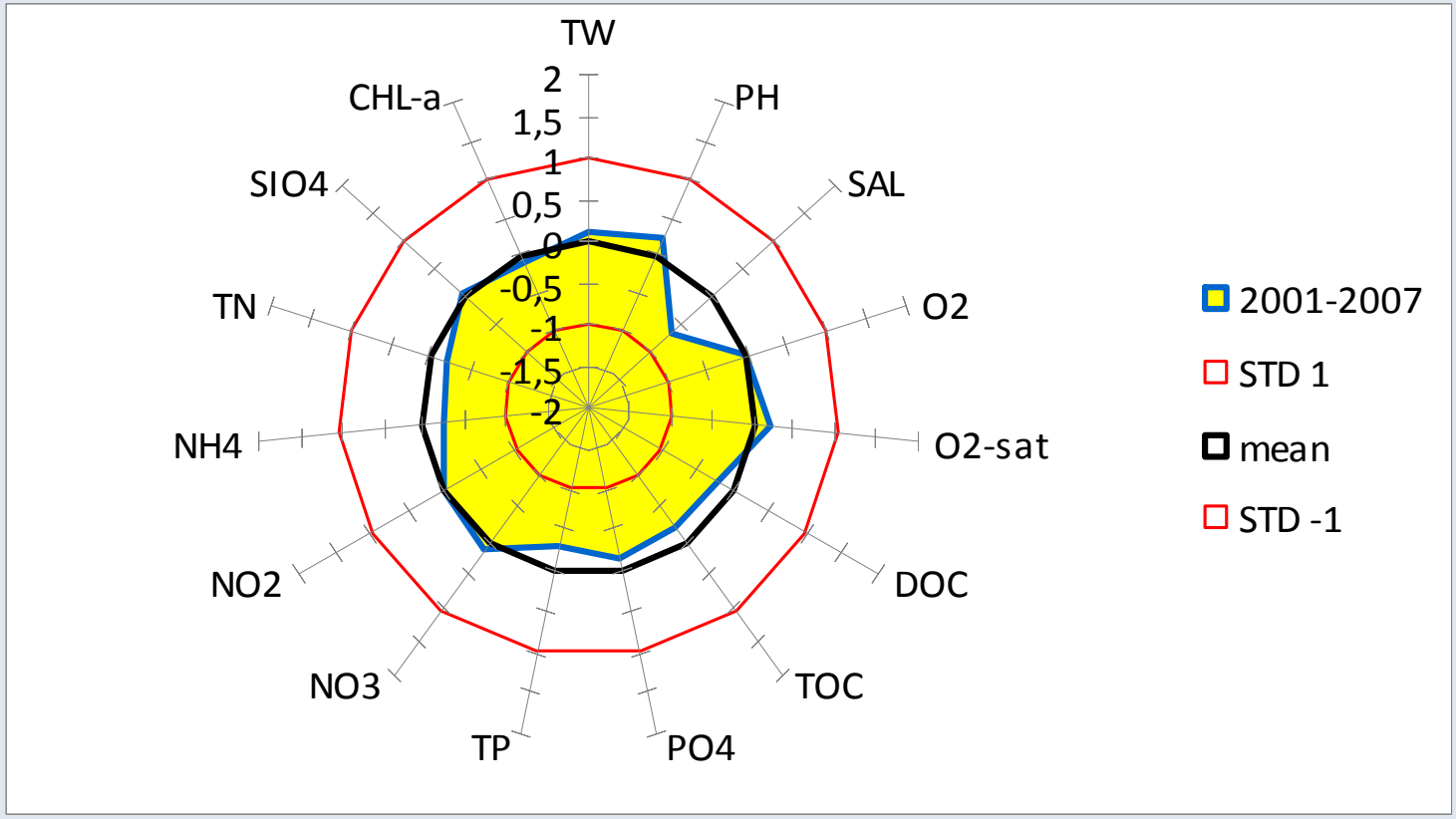
Station OB4 (2001-2007)



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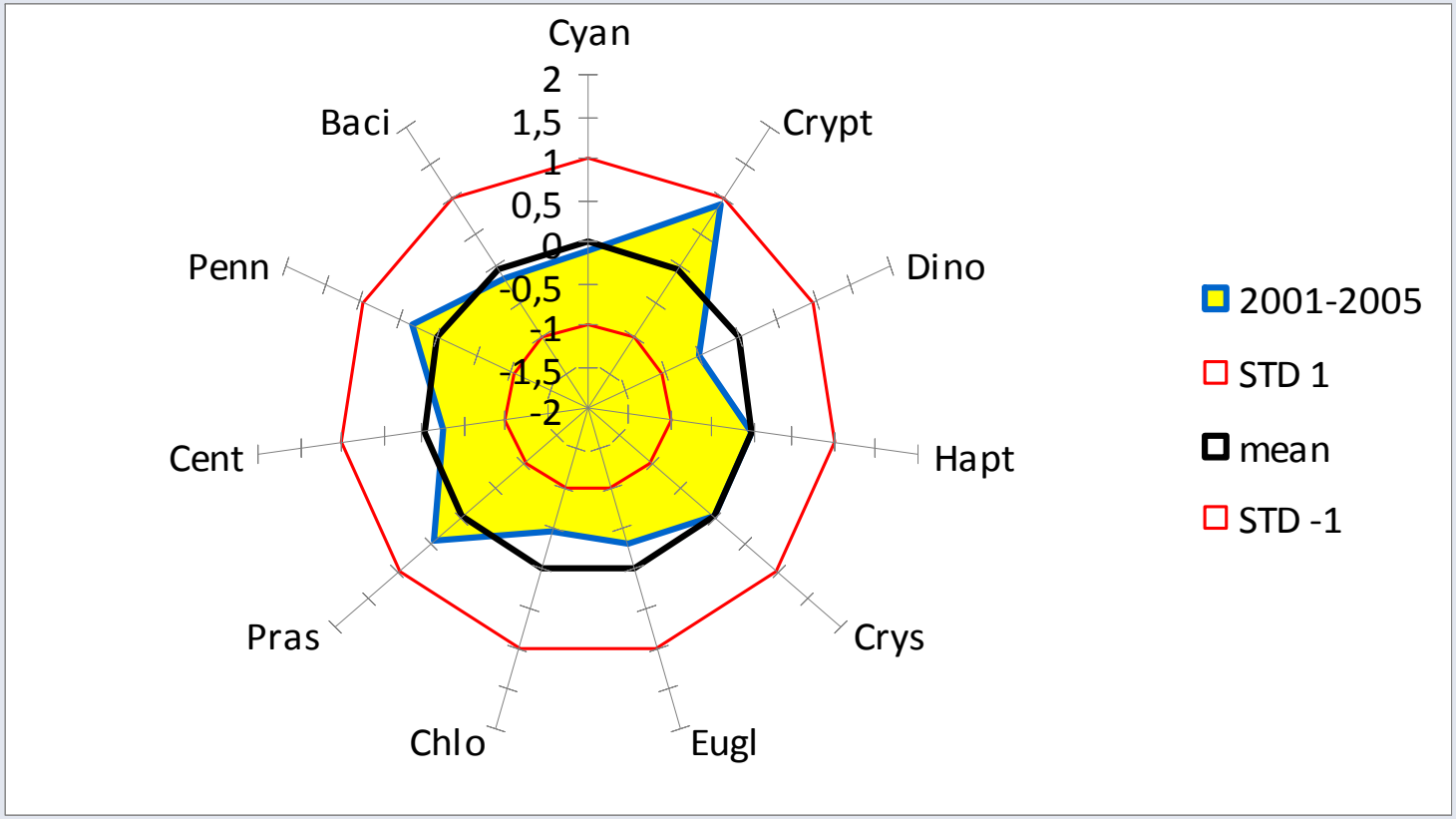
Station OB4 (2001-2005)



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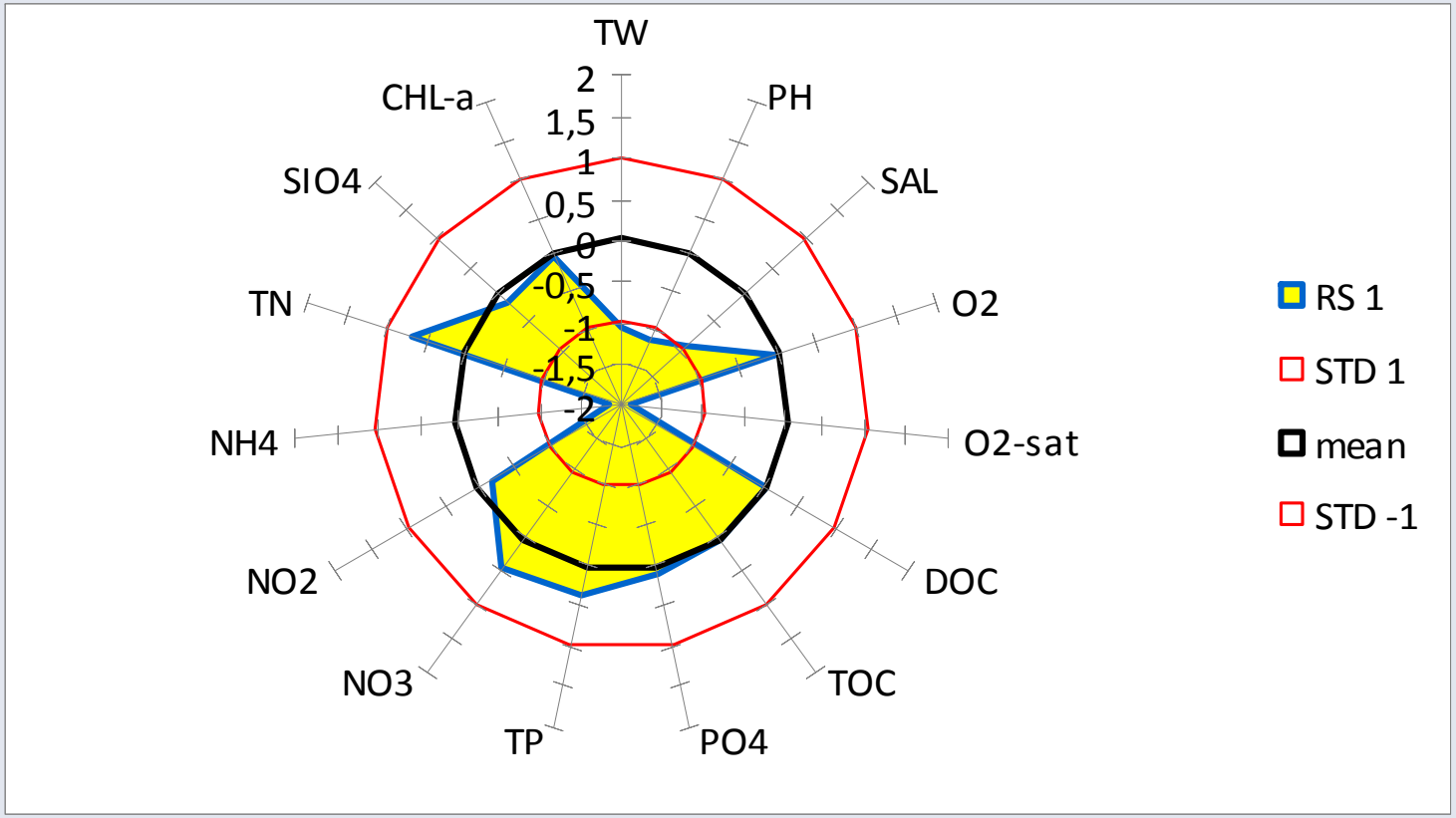
OB4 Regime shift (1975/1976)



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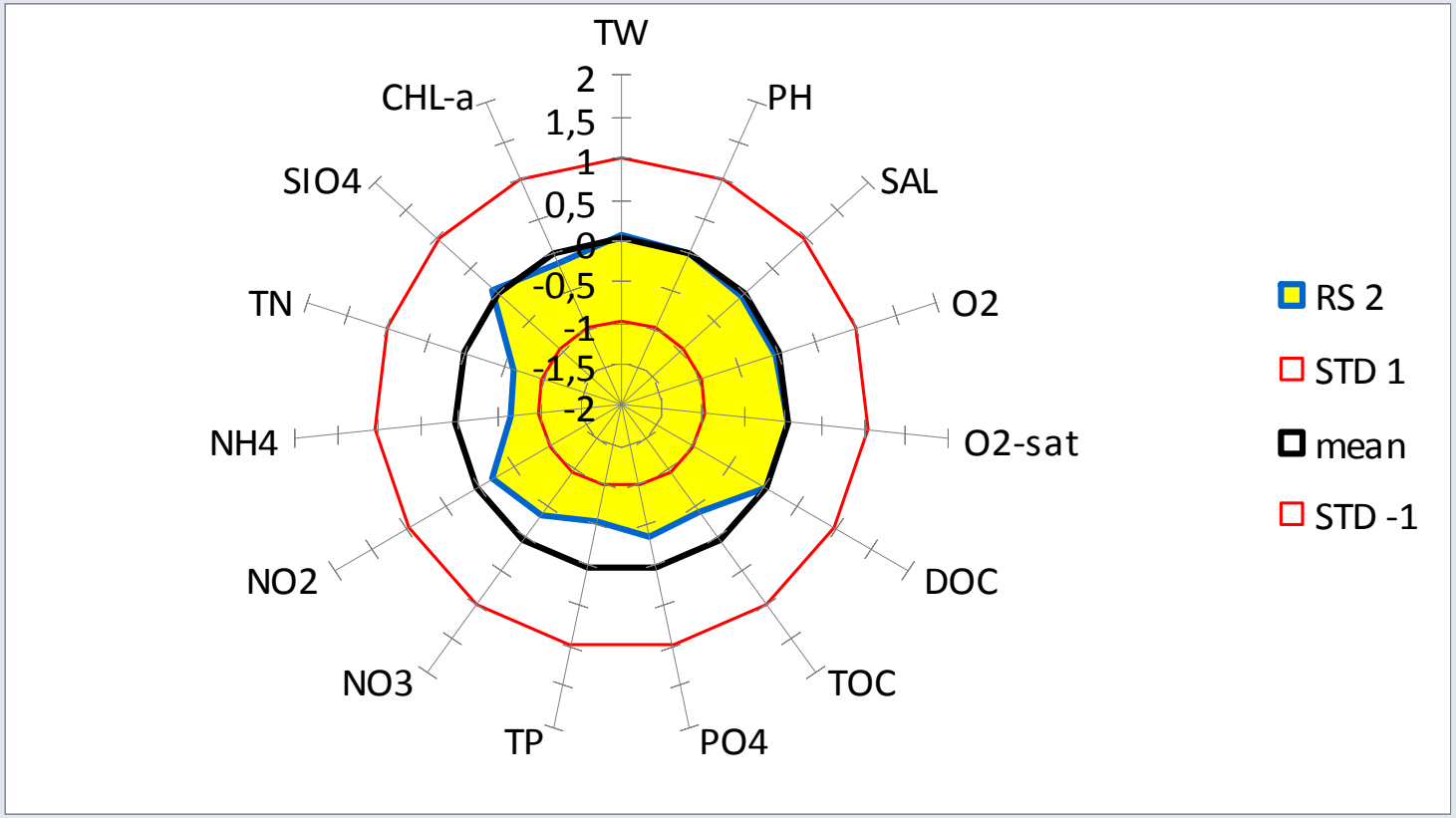
OB4 Regime shift (1989/1990)



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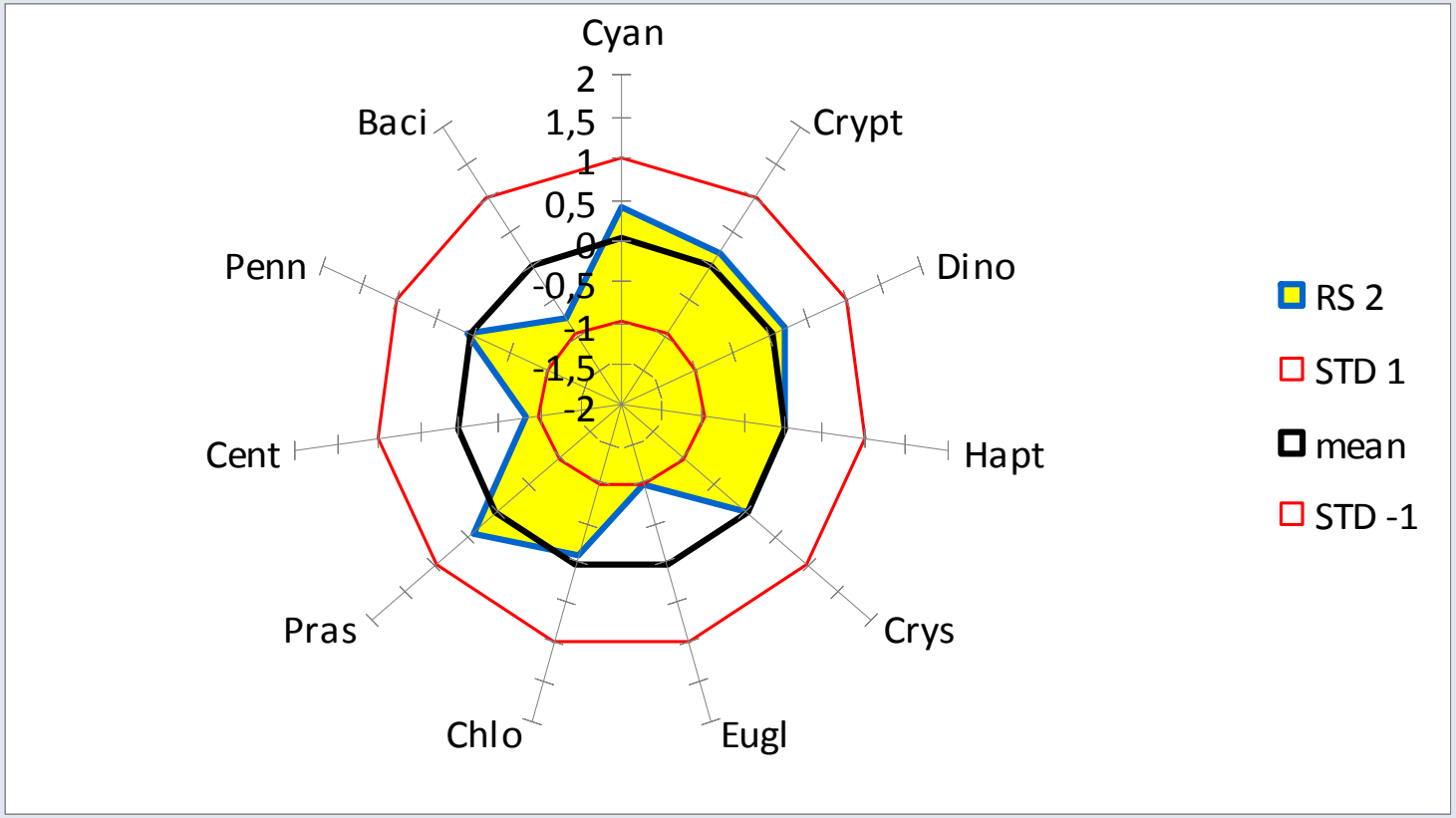
OB4 Regime shift (1989/1990)



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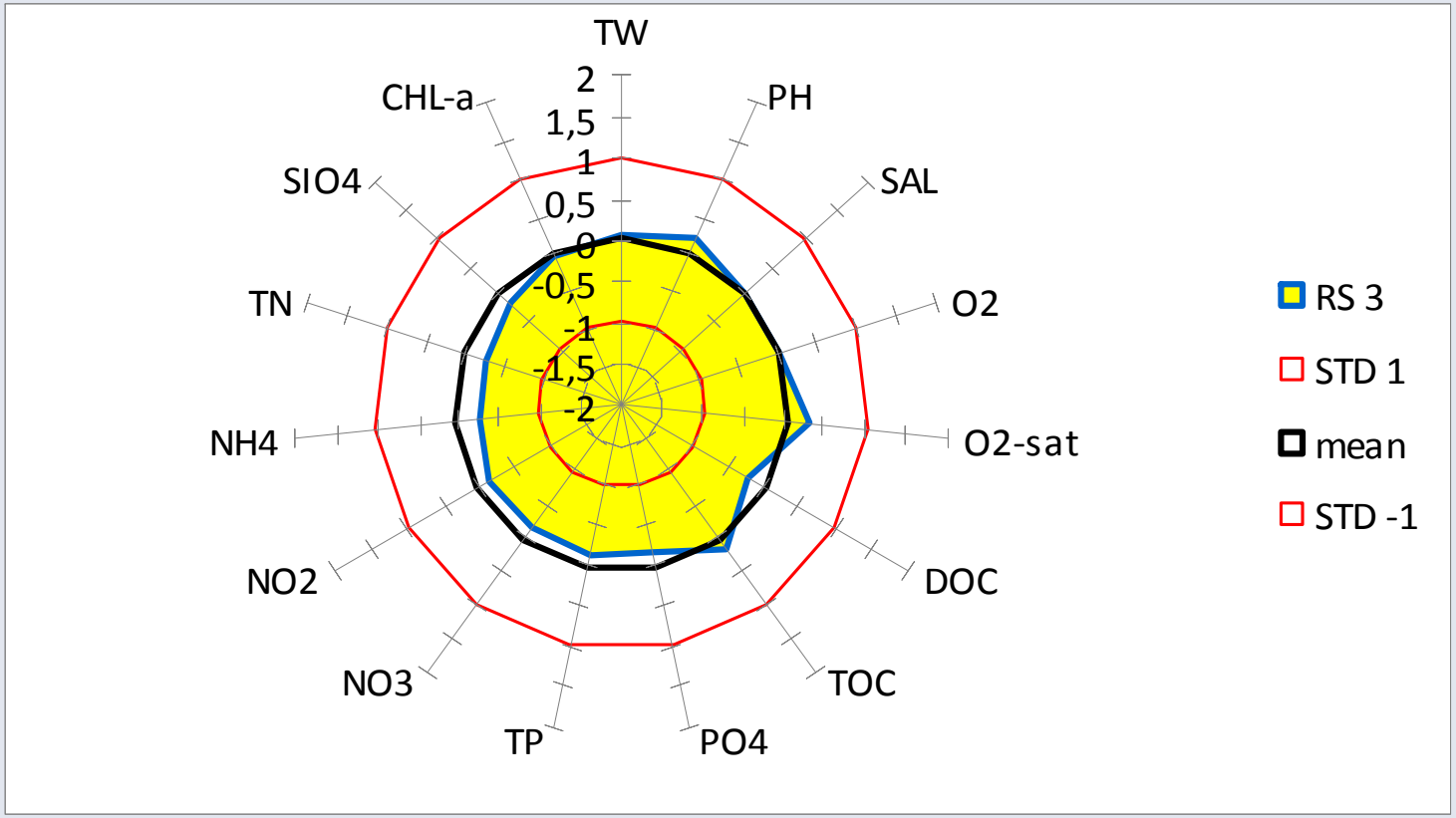
OB4 Regime shift (2000/2001)



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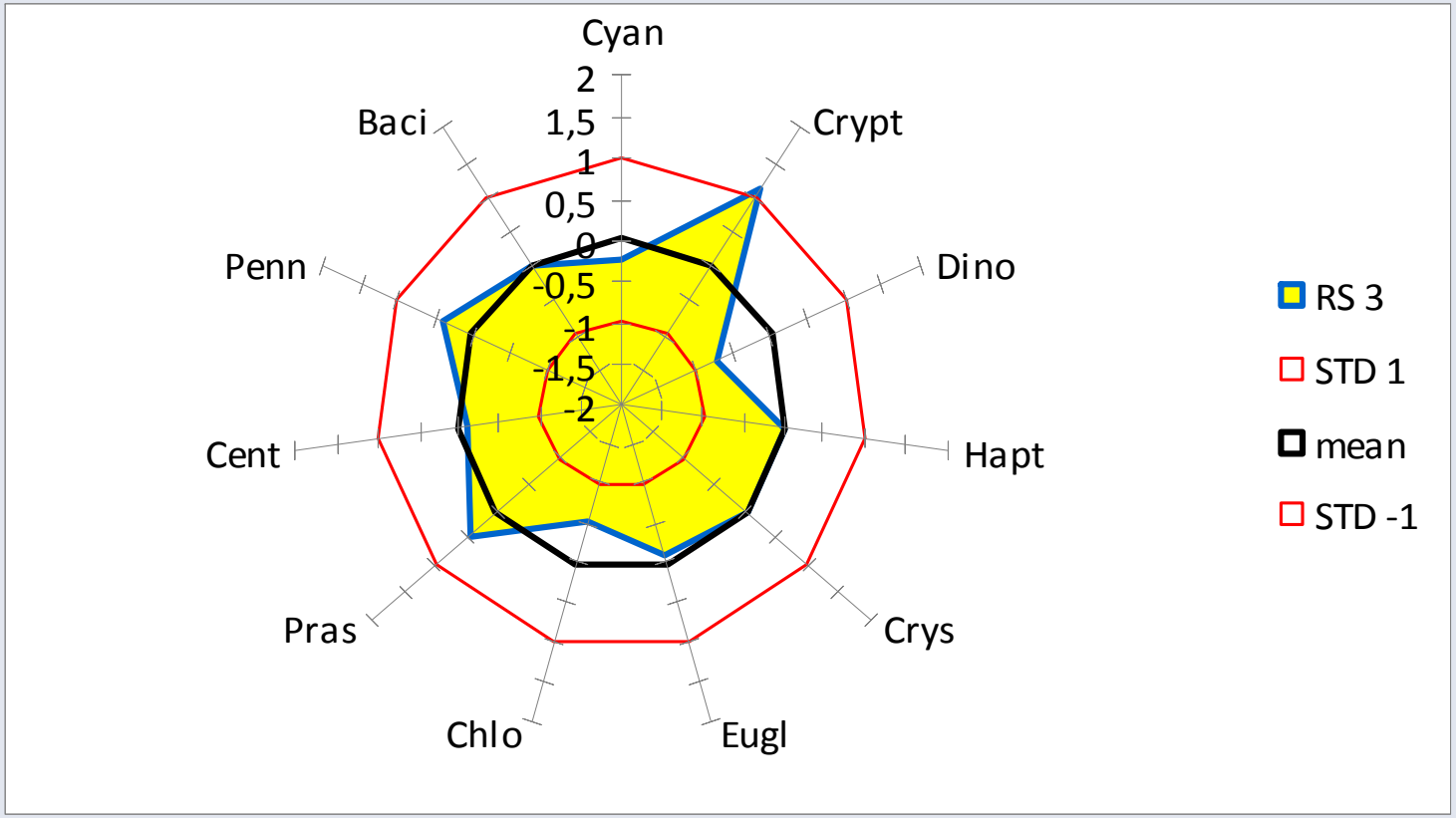
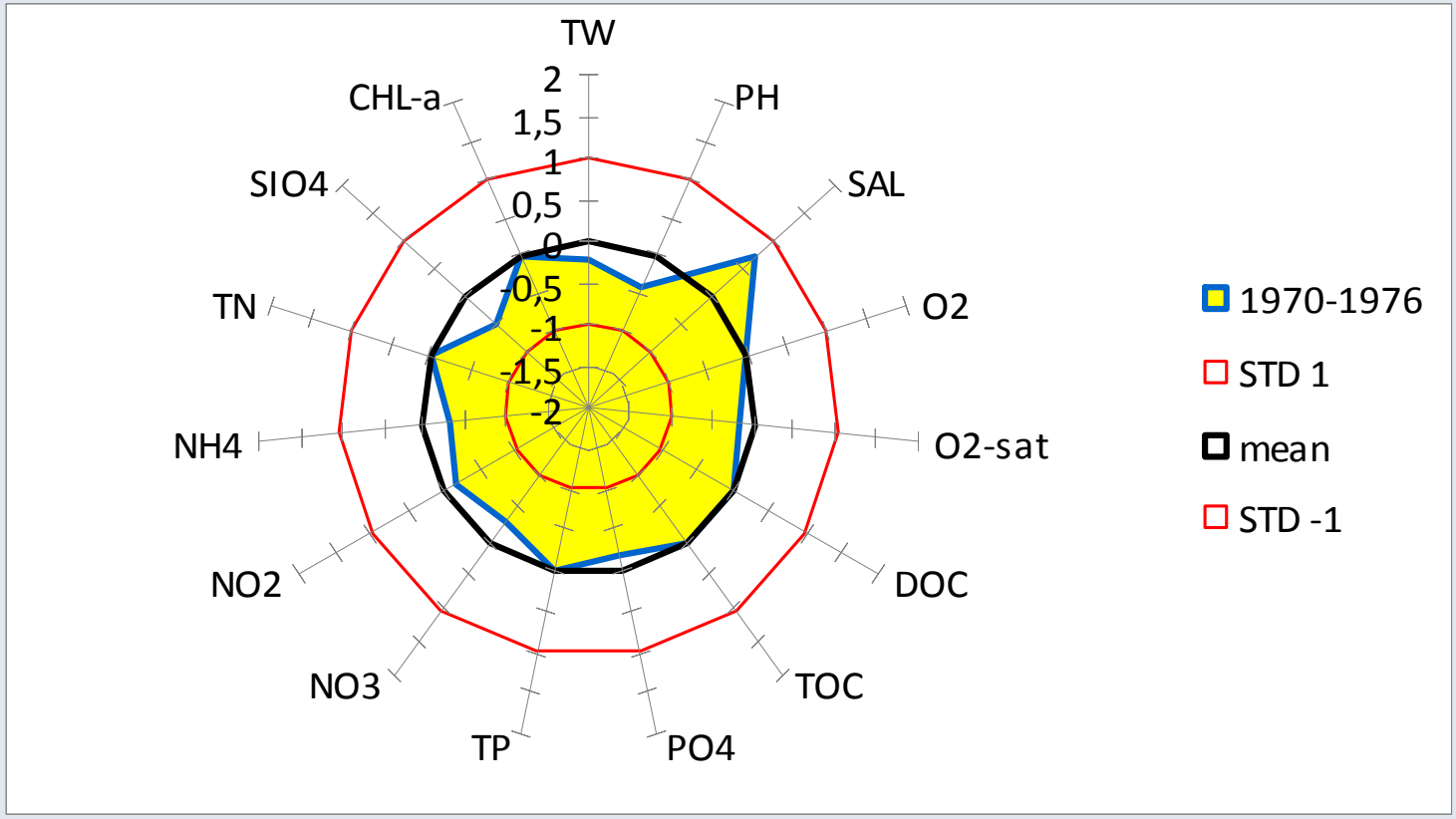
Updated version from August 7, 2011

OB4 Regime shift (2000/2001)



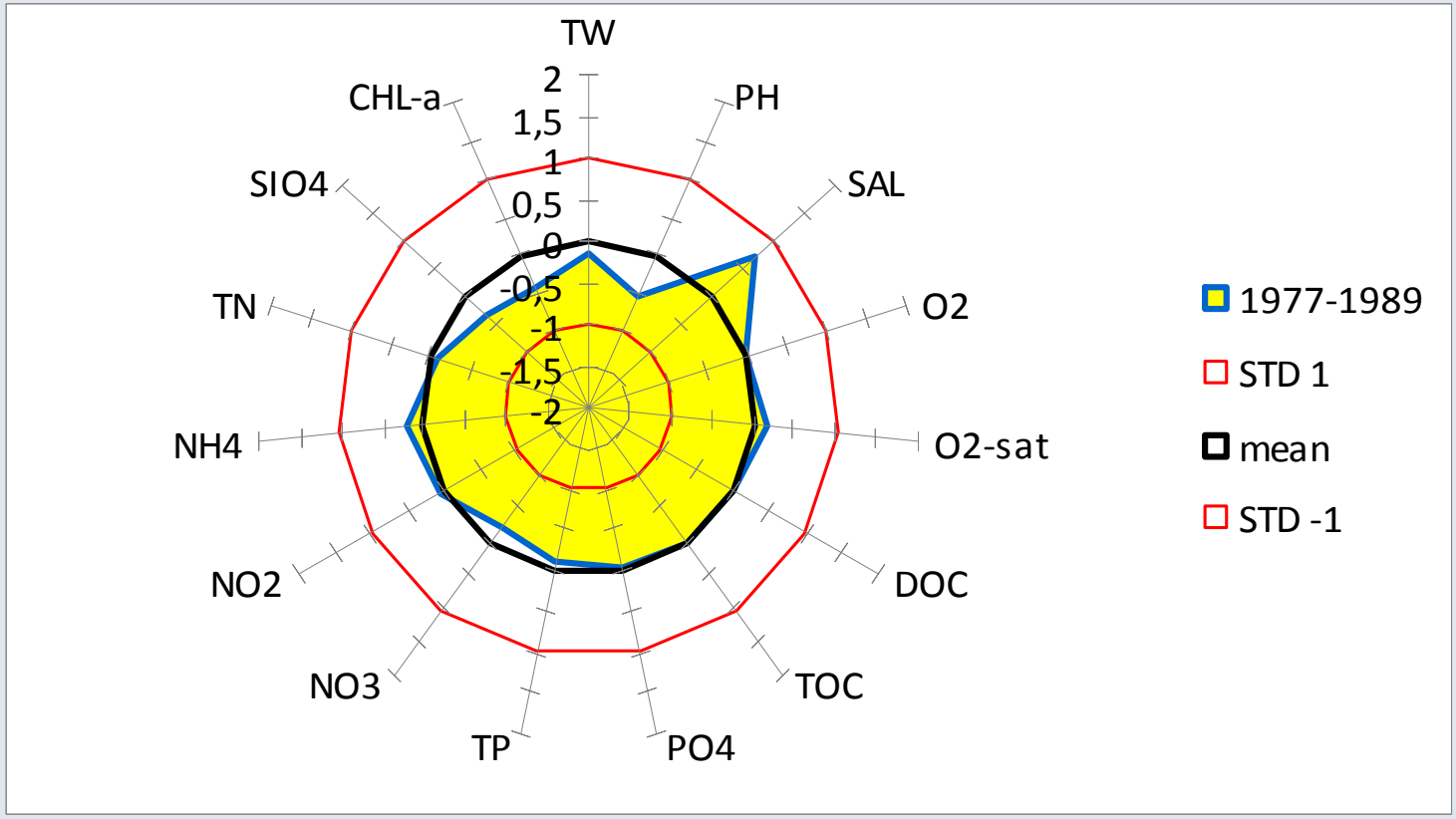
Updated version from August 7, 2011

Station O5 (1970-1976)



Updated version from August 7, 2011

Station O5 (1977-1989)



Updated version from August 7, 2011

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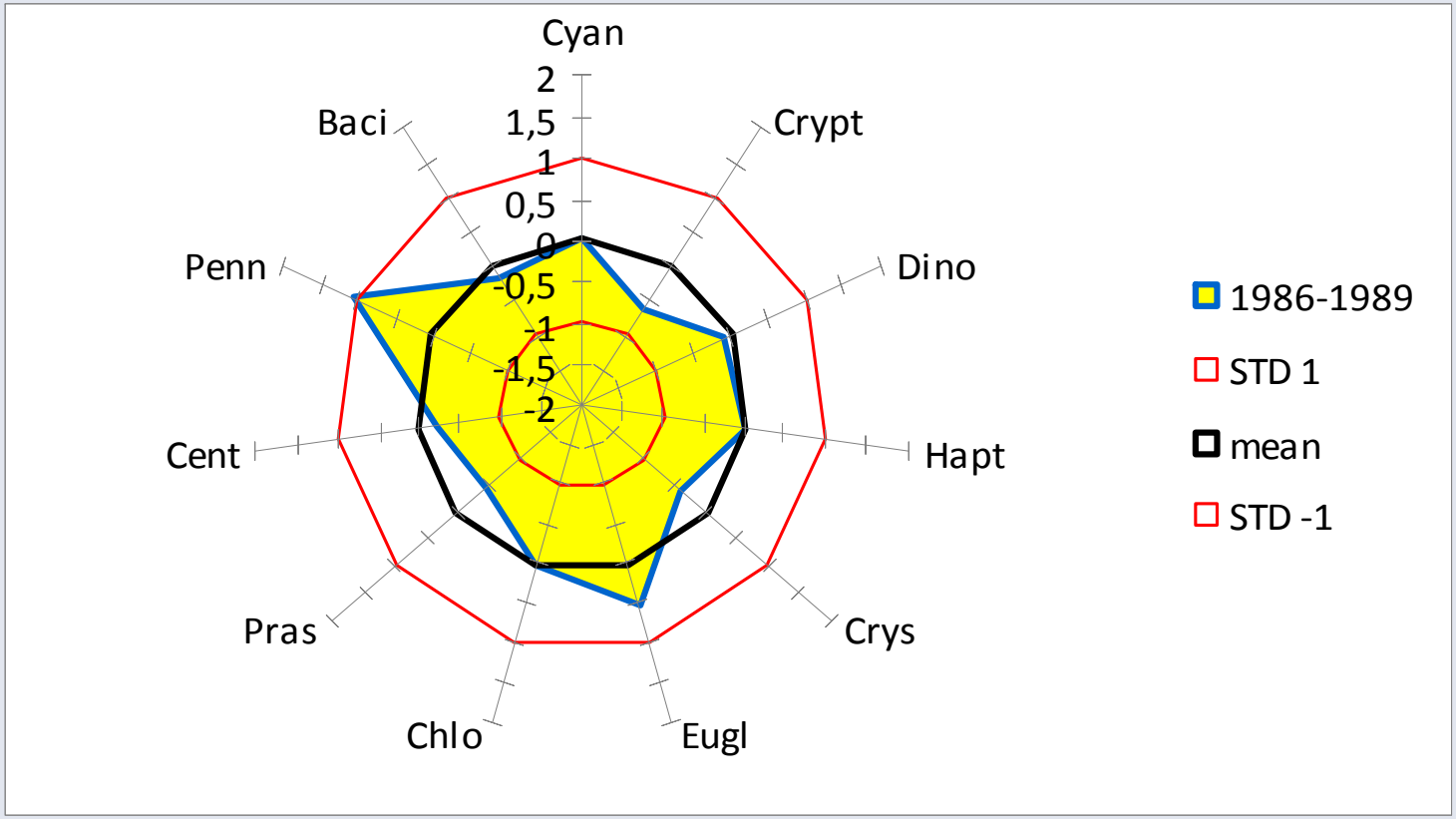

Updated version from August 7, 2011

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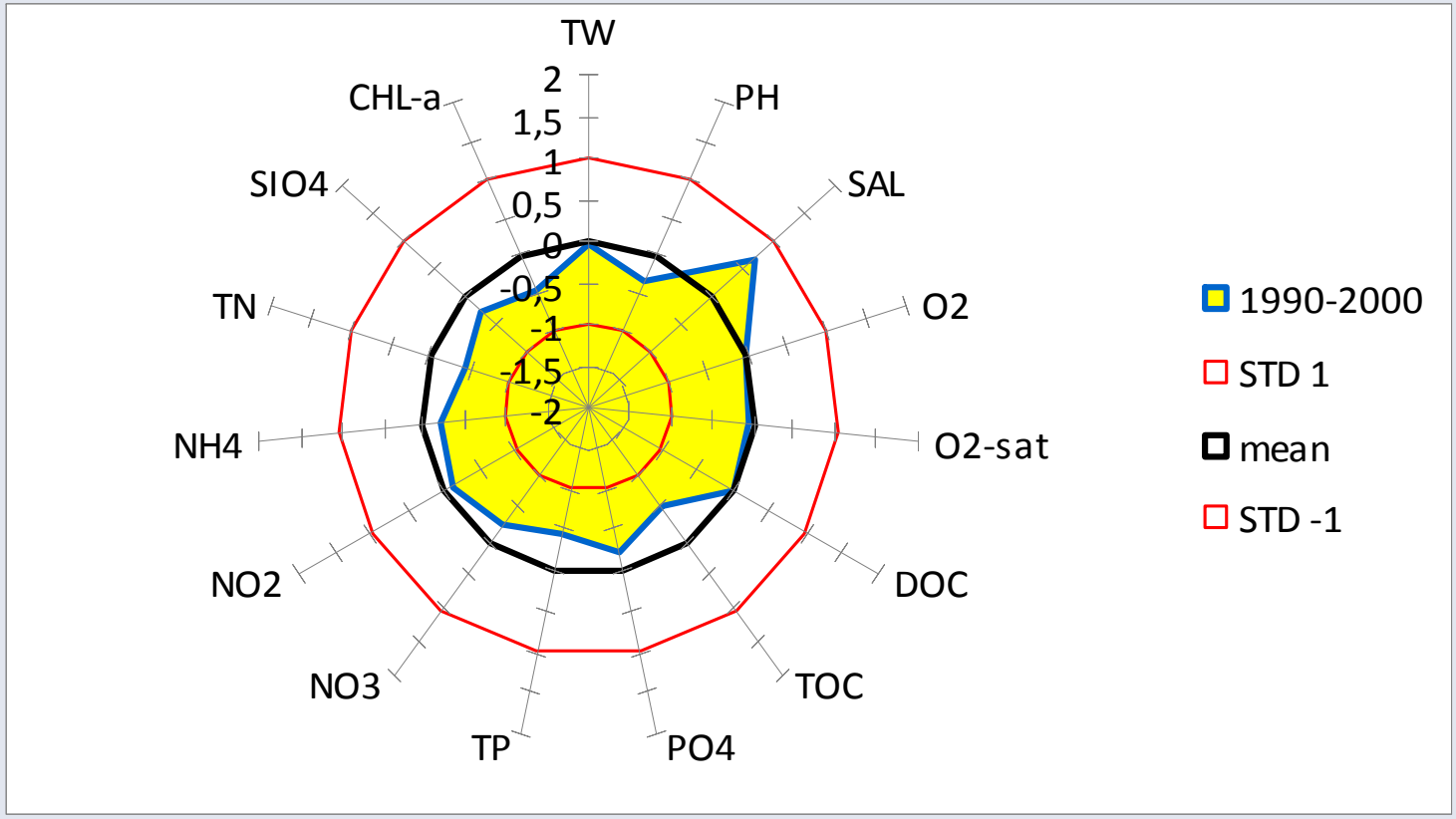

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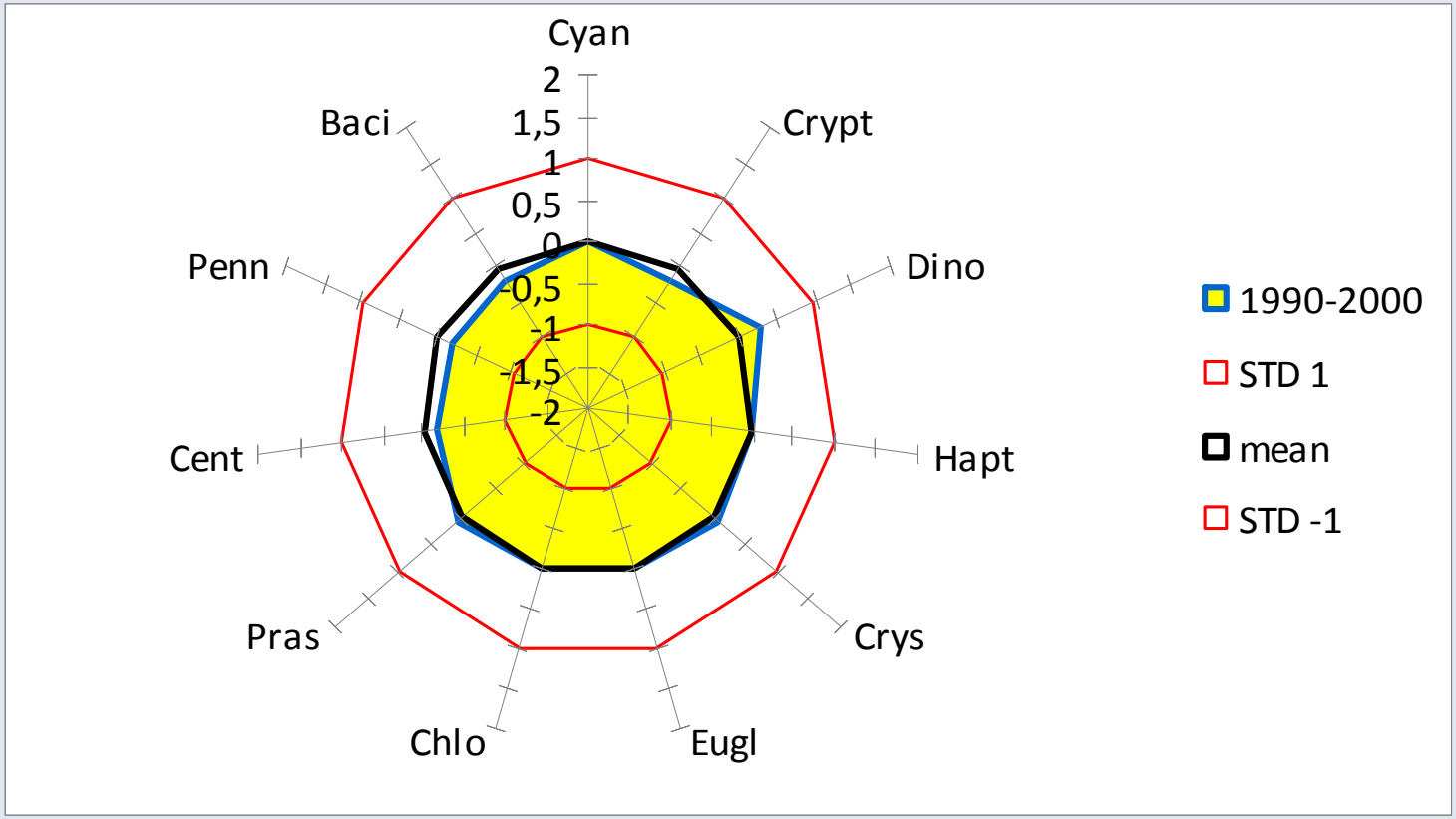

Updated version from August 7, 2011

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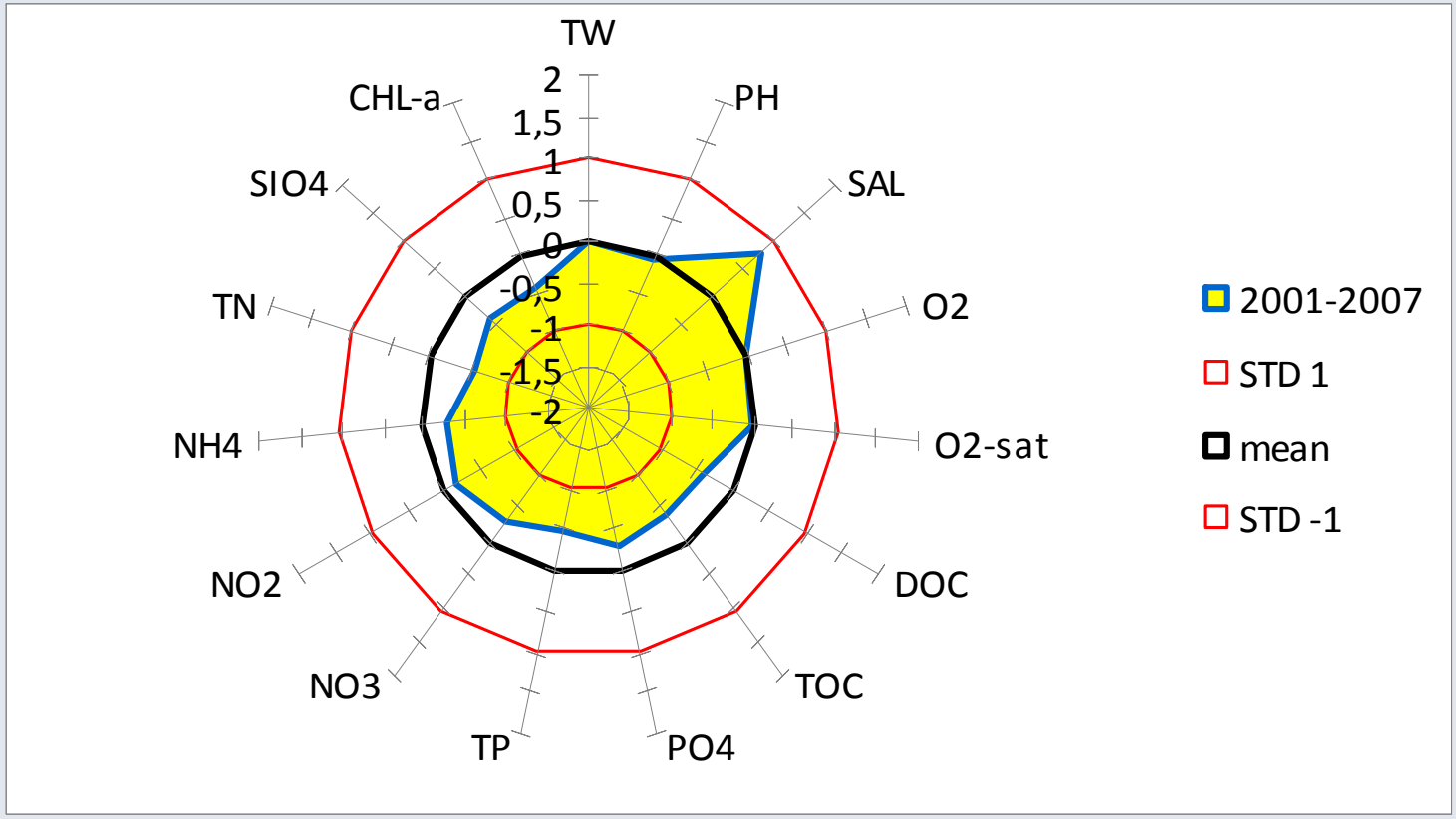

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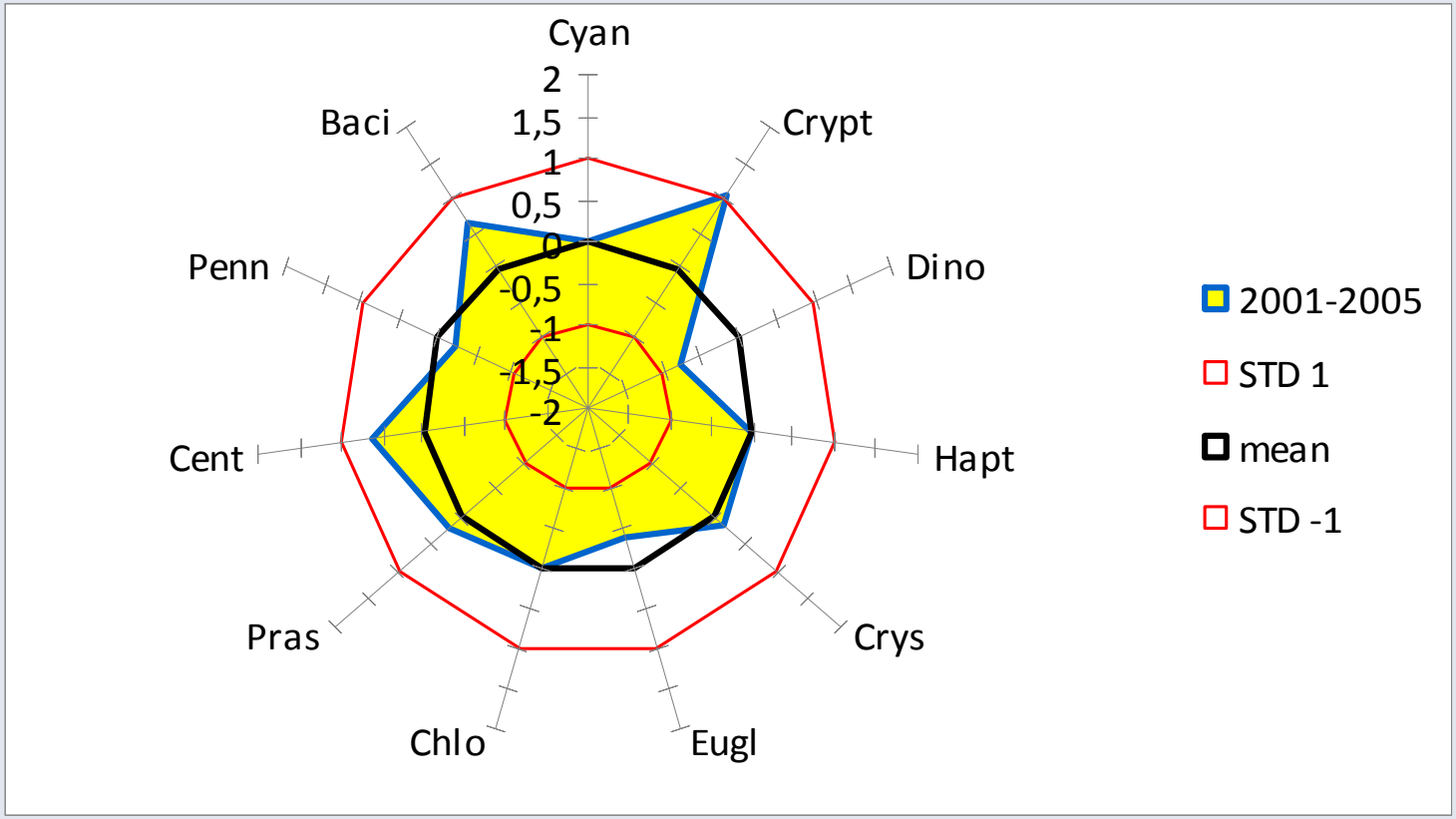
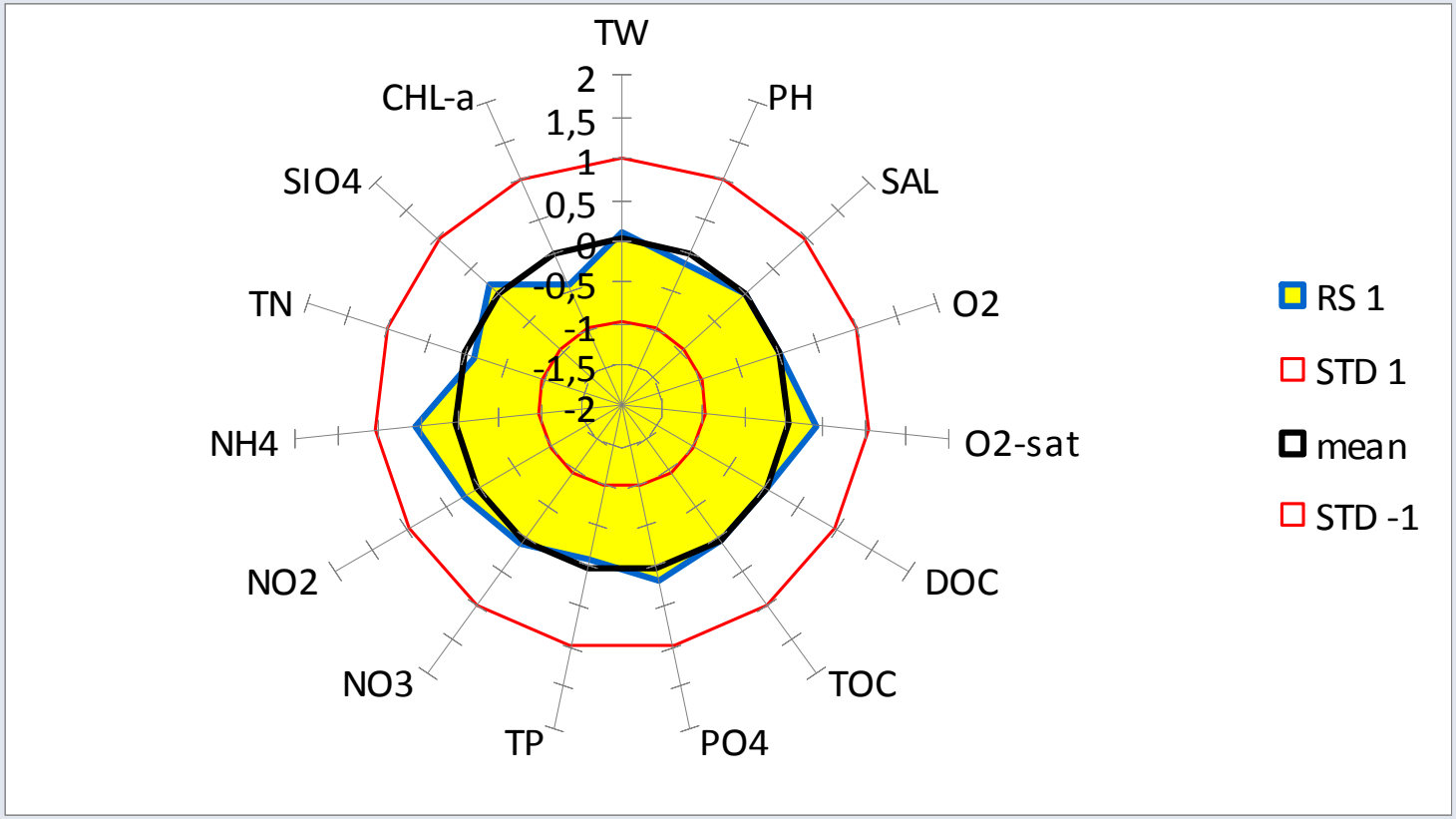


Updated version from August 7, 2011

O5 Regime Shift (1975/1976)



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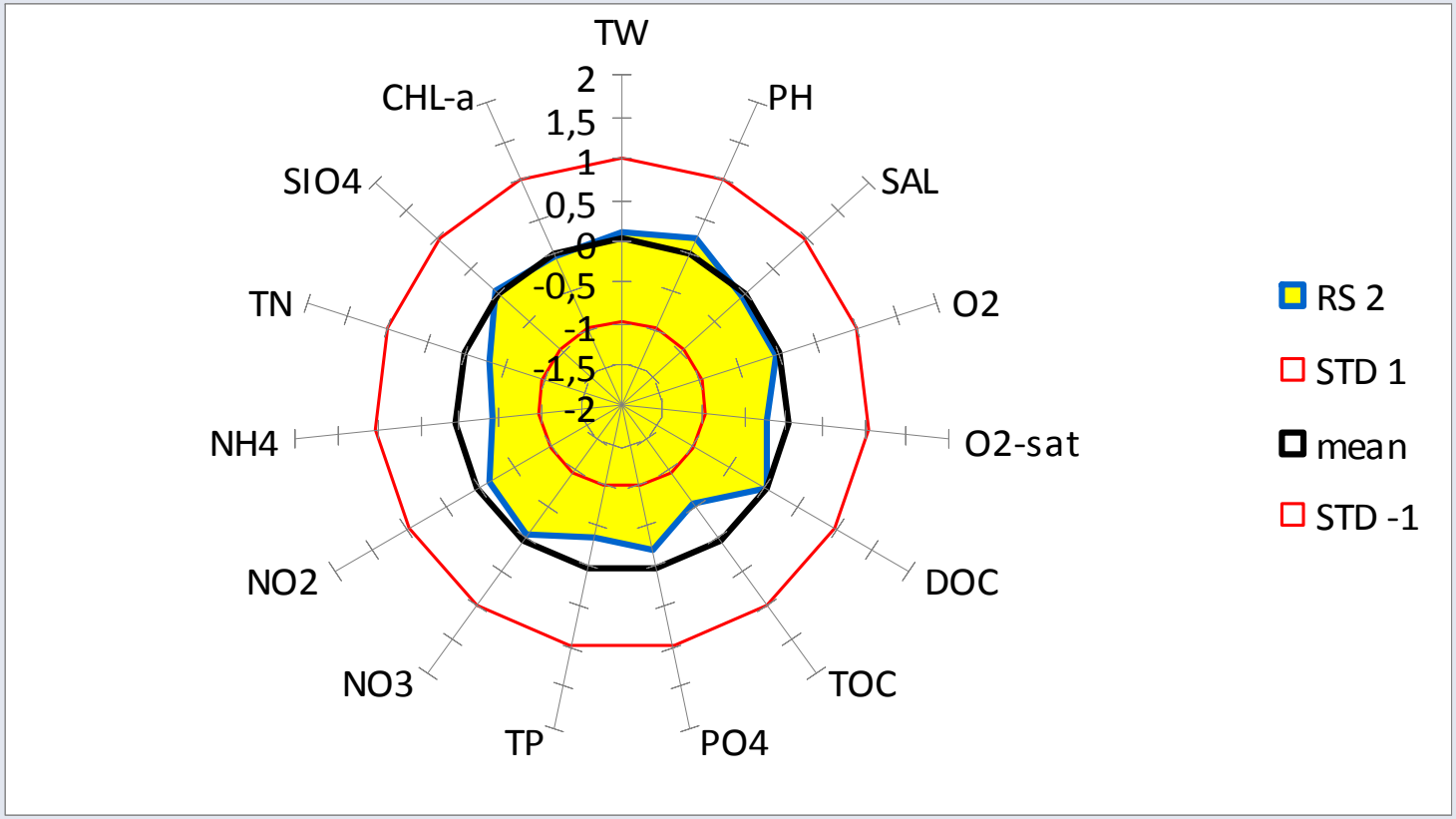
O5 Regime Shift (1989/1990)



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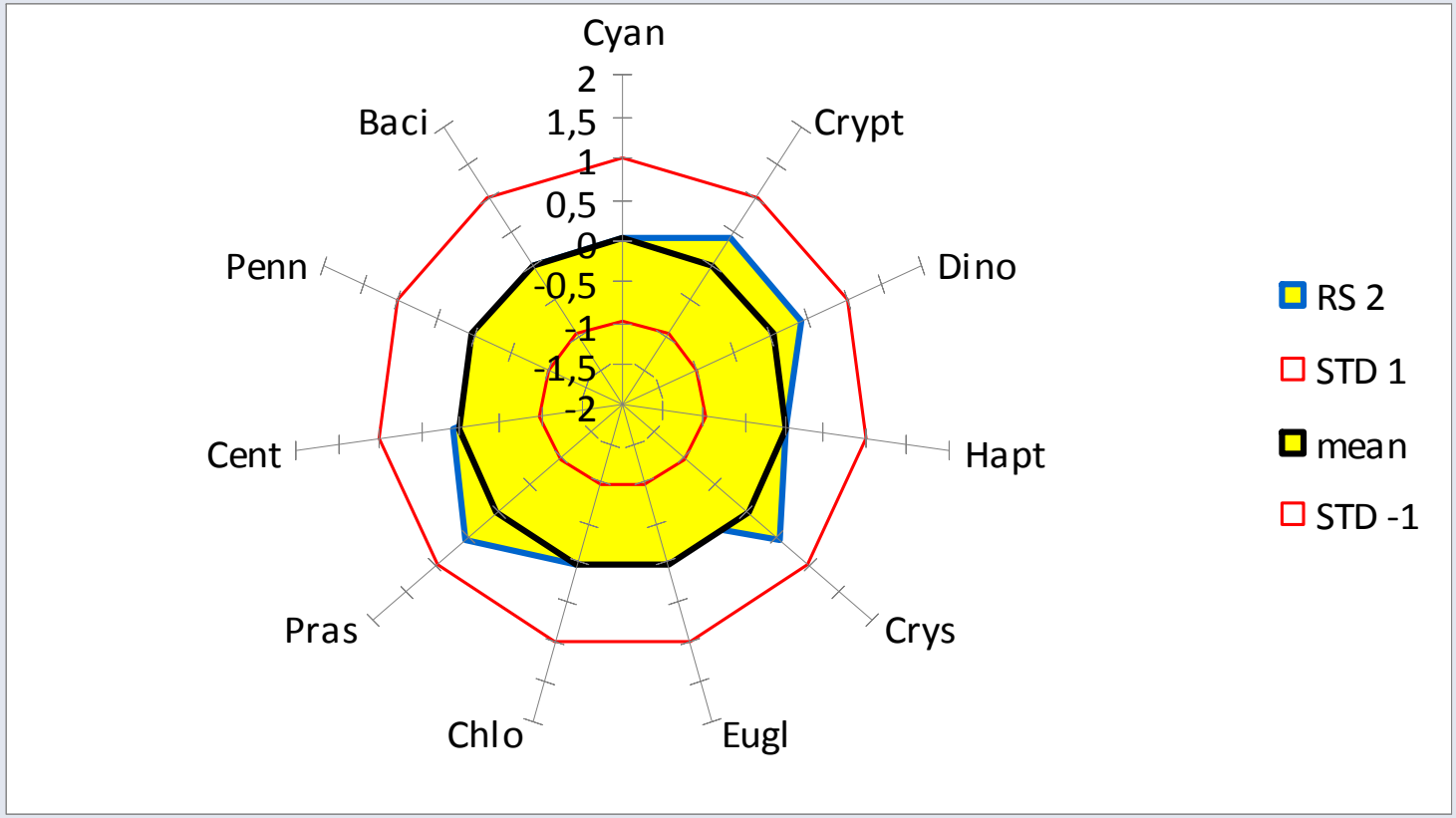

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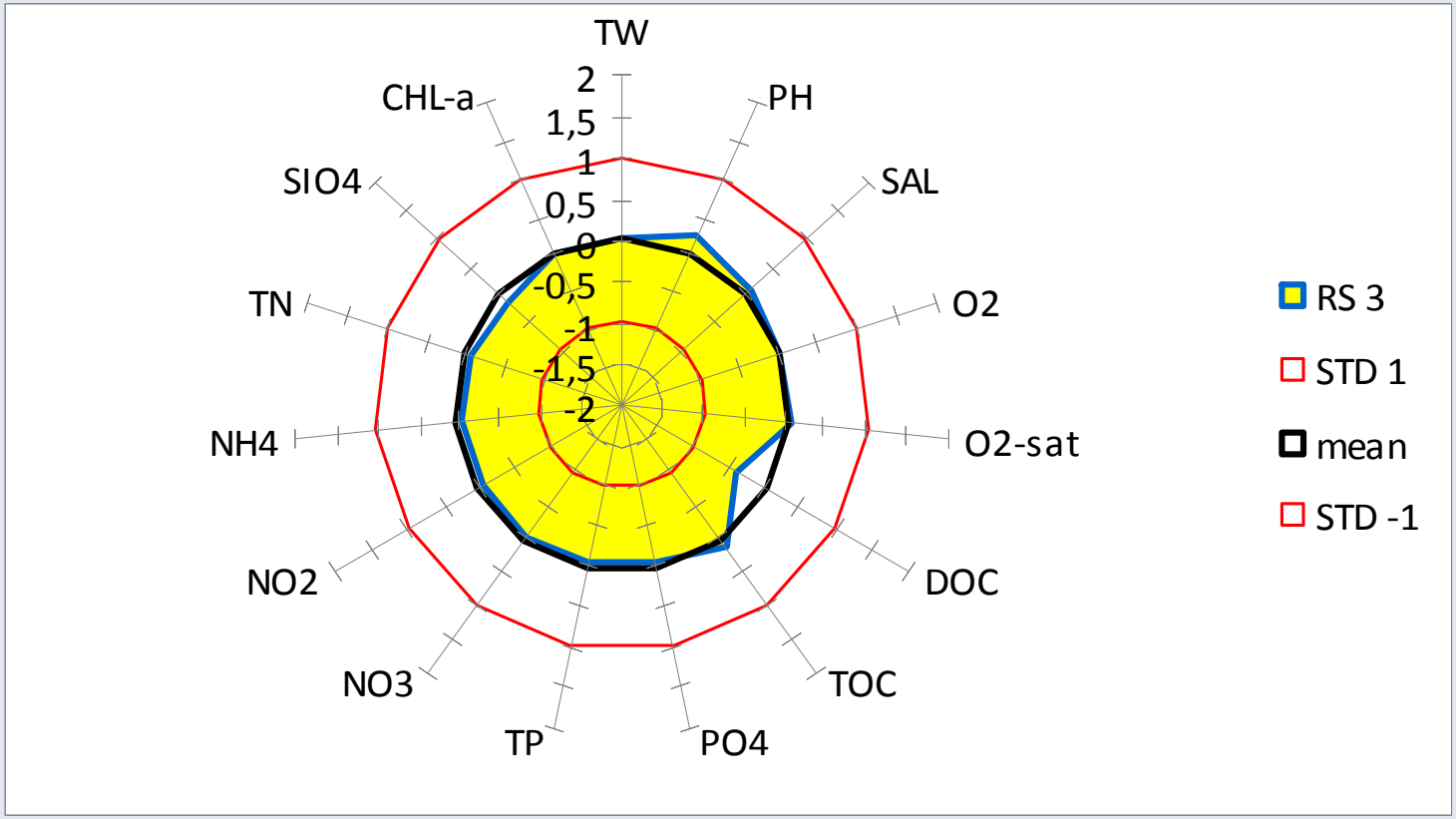
O5 Regime Shift (2000/2001)



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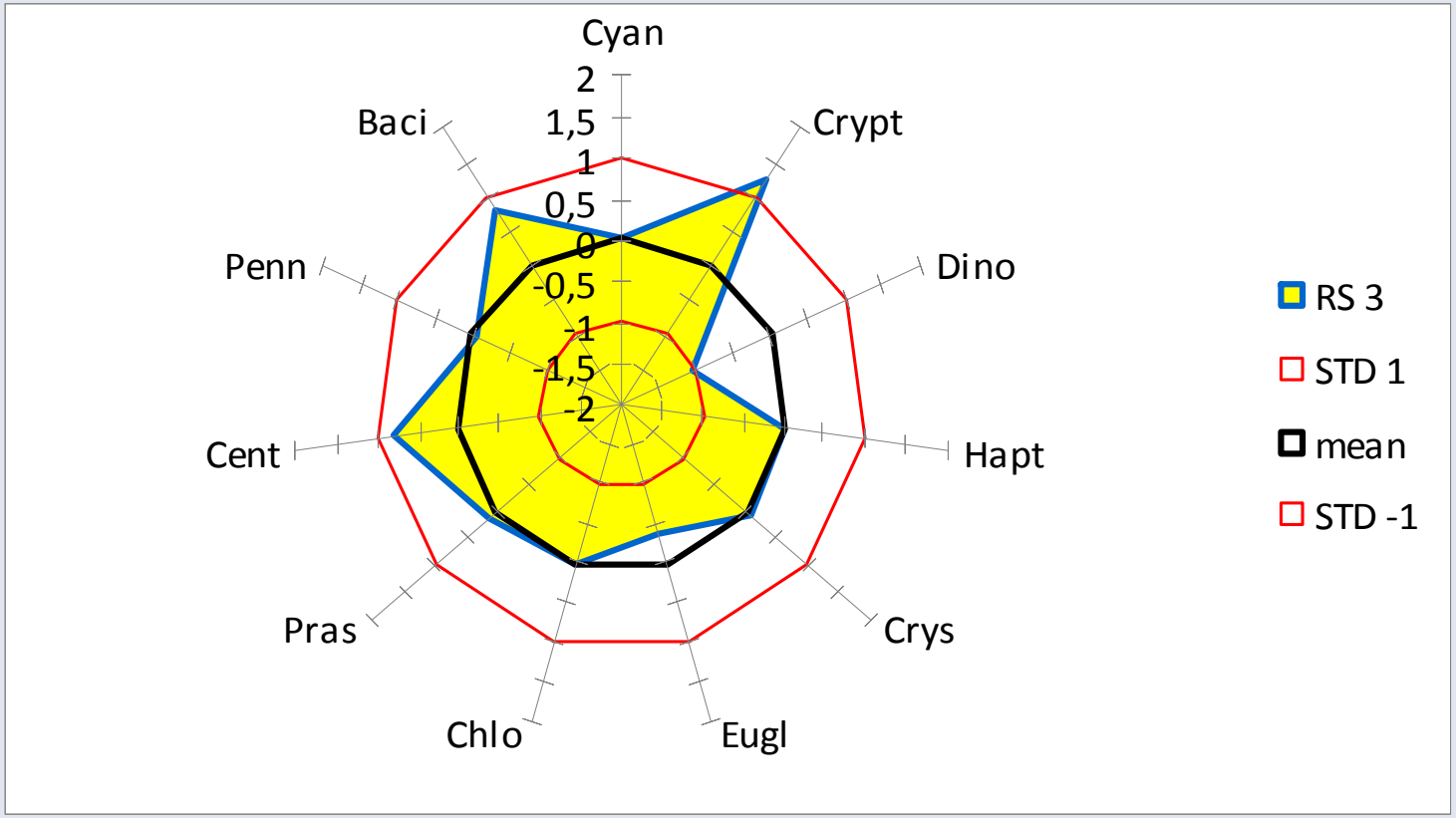
O5 Regime Shift (2000/2001)



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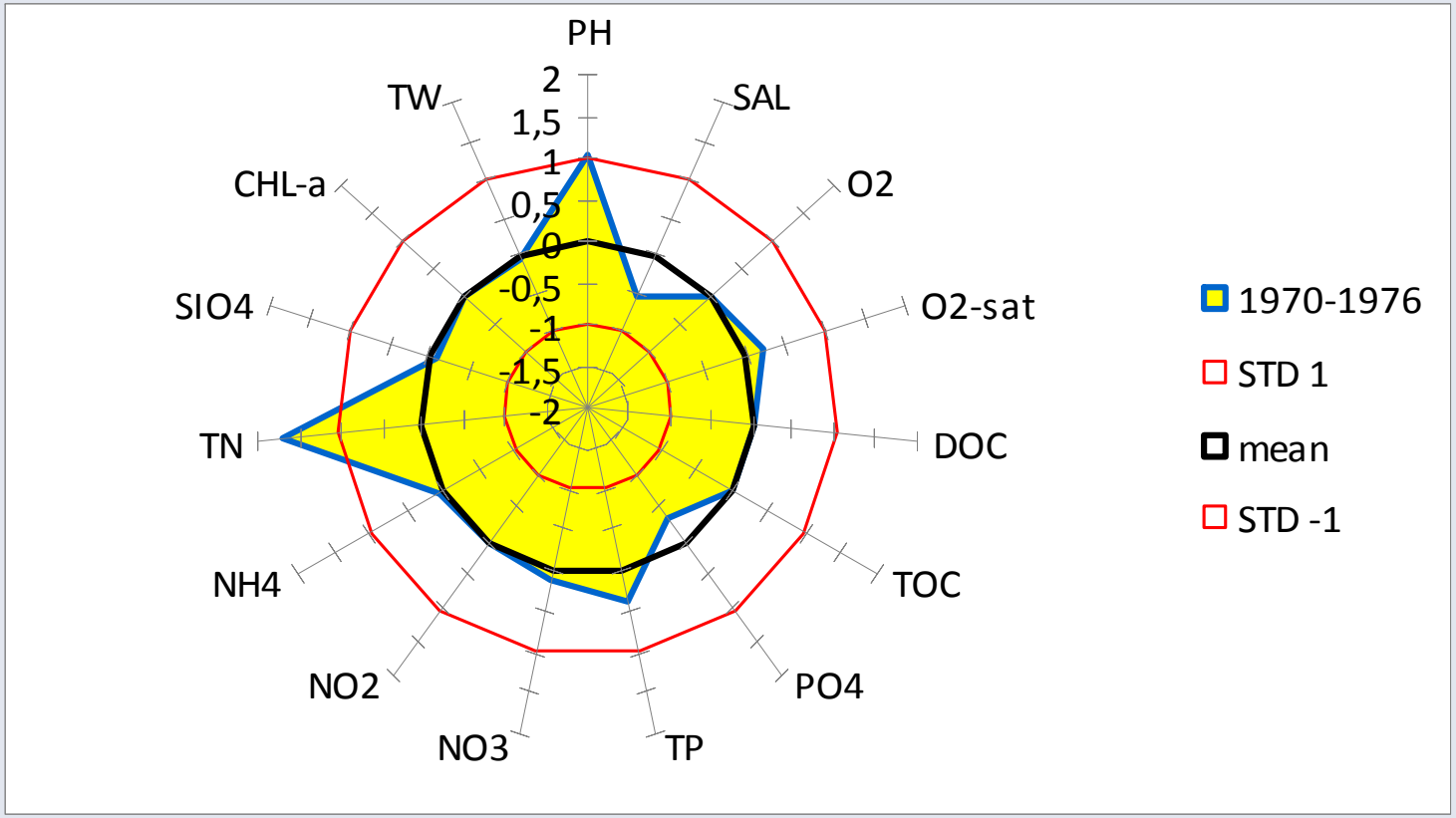

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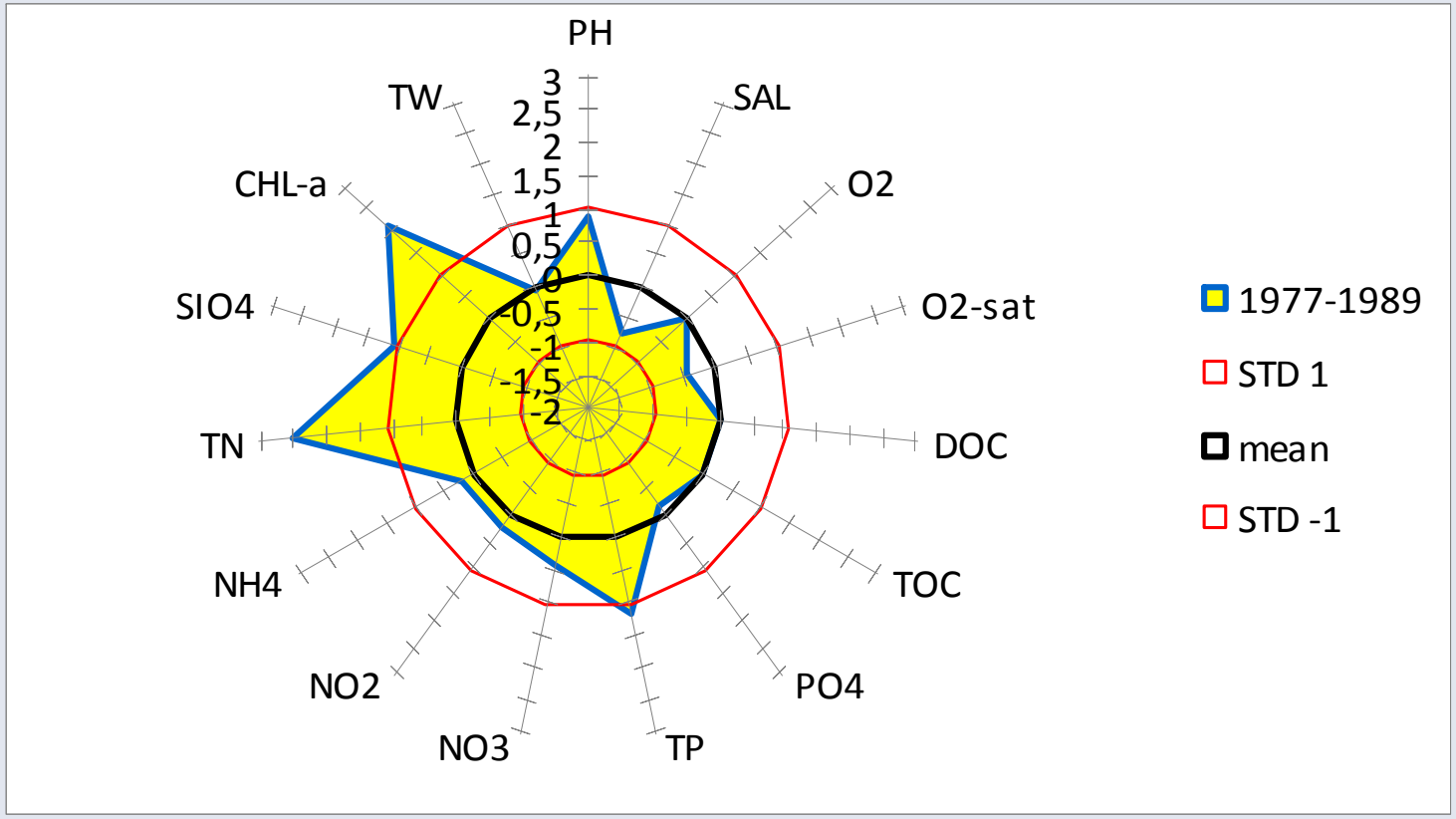

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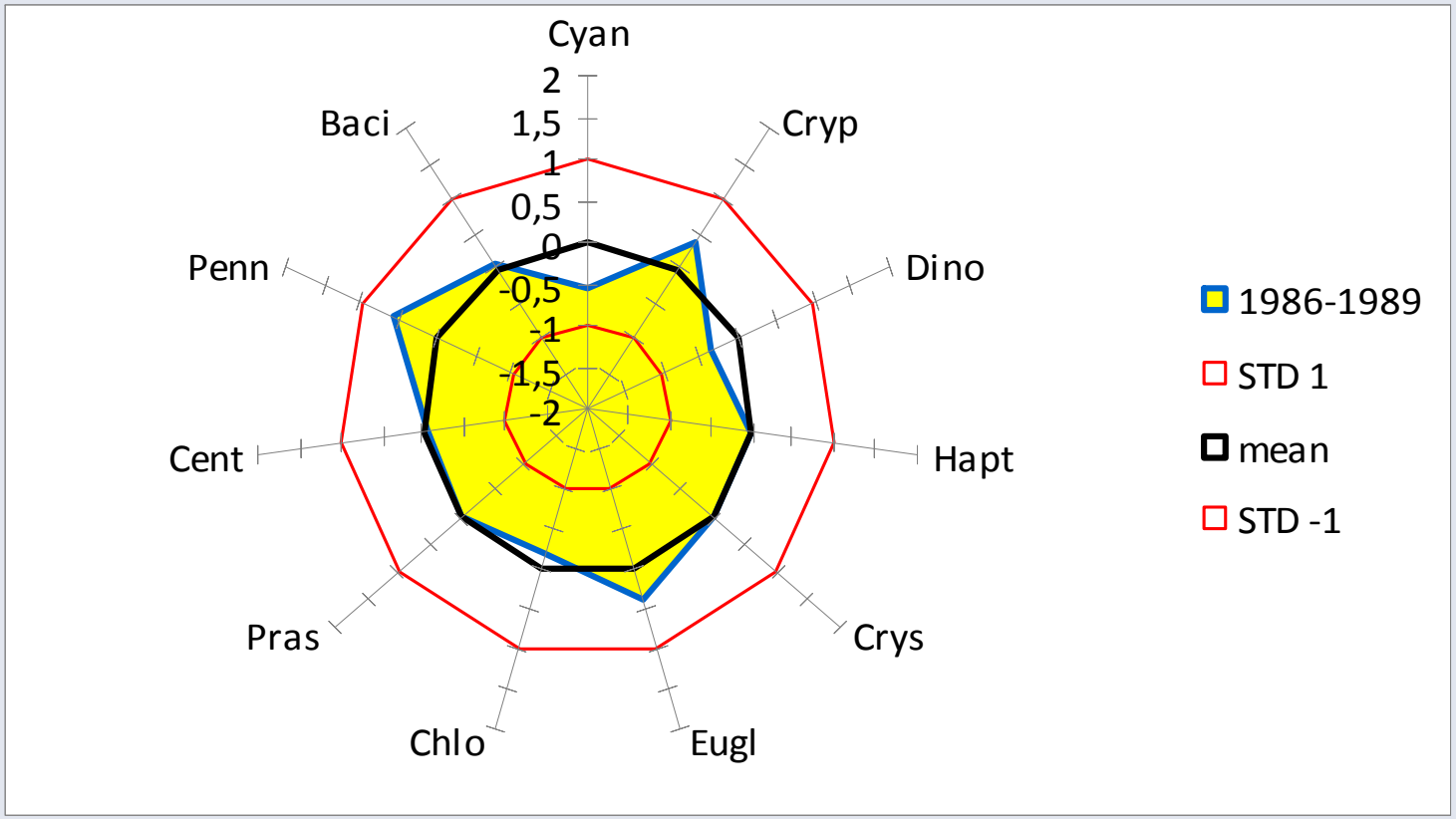
Station DB6 (1986-1989)



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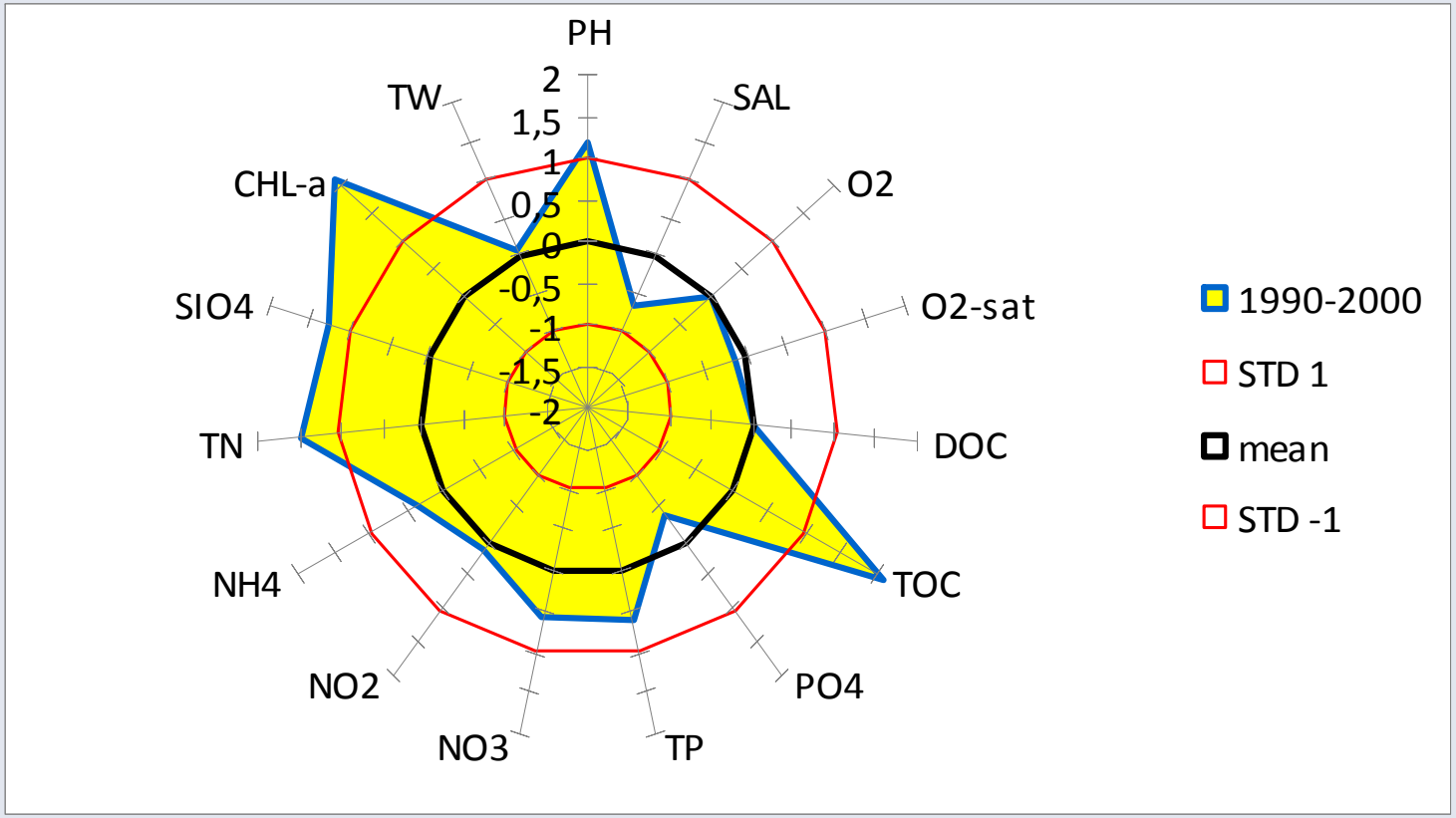

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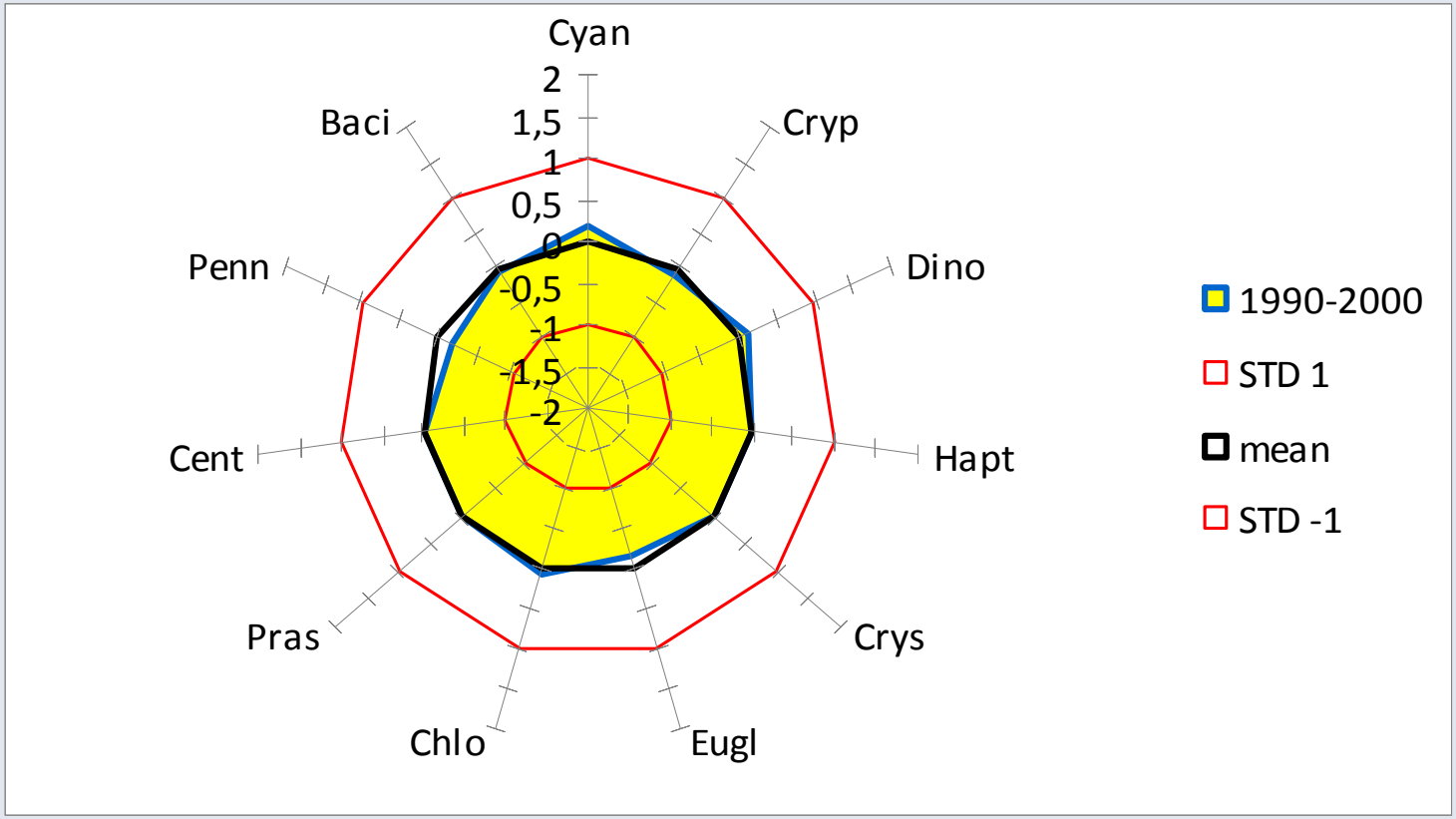

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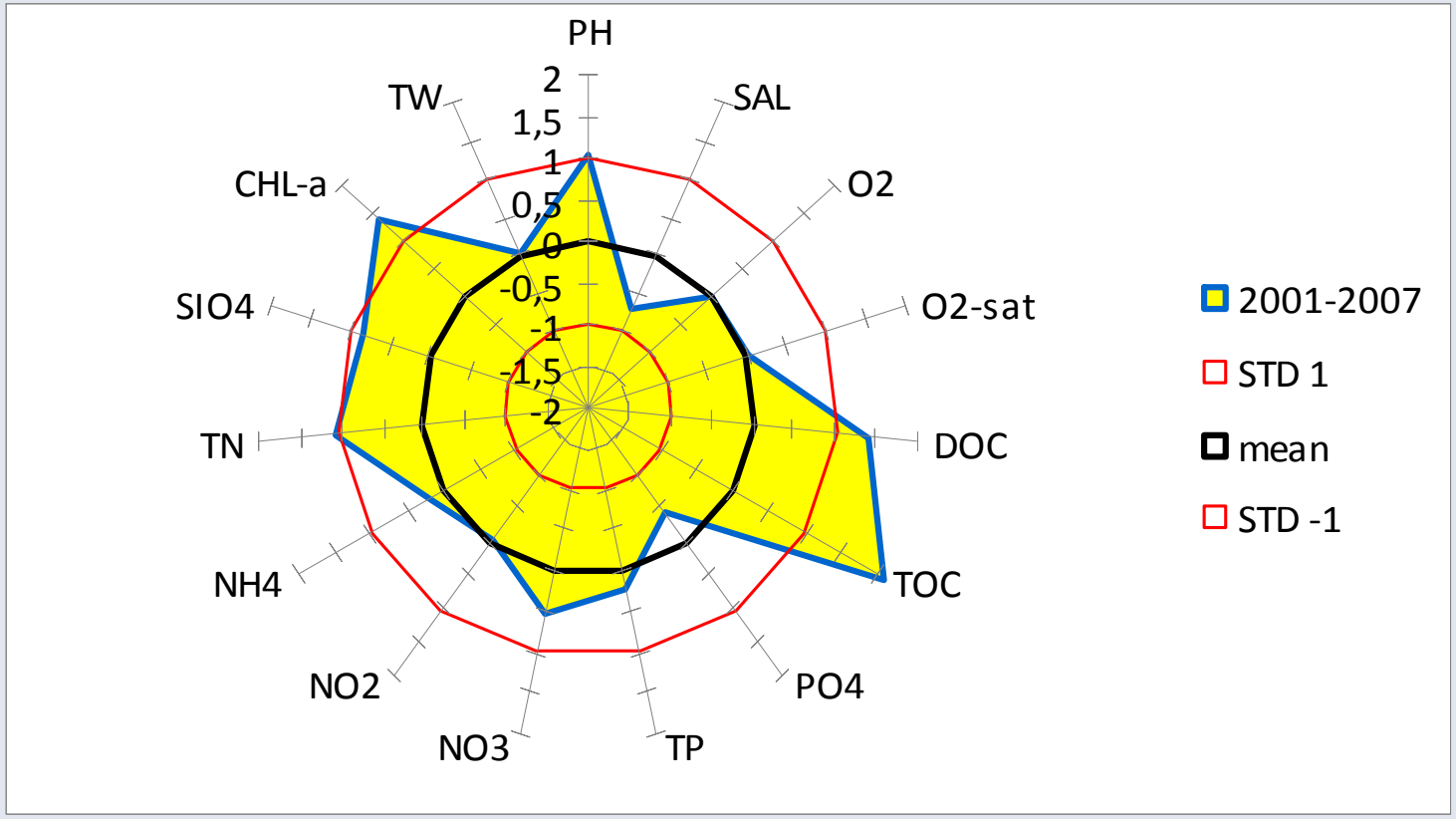

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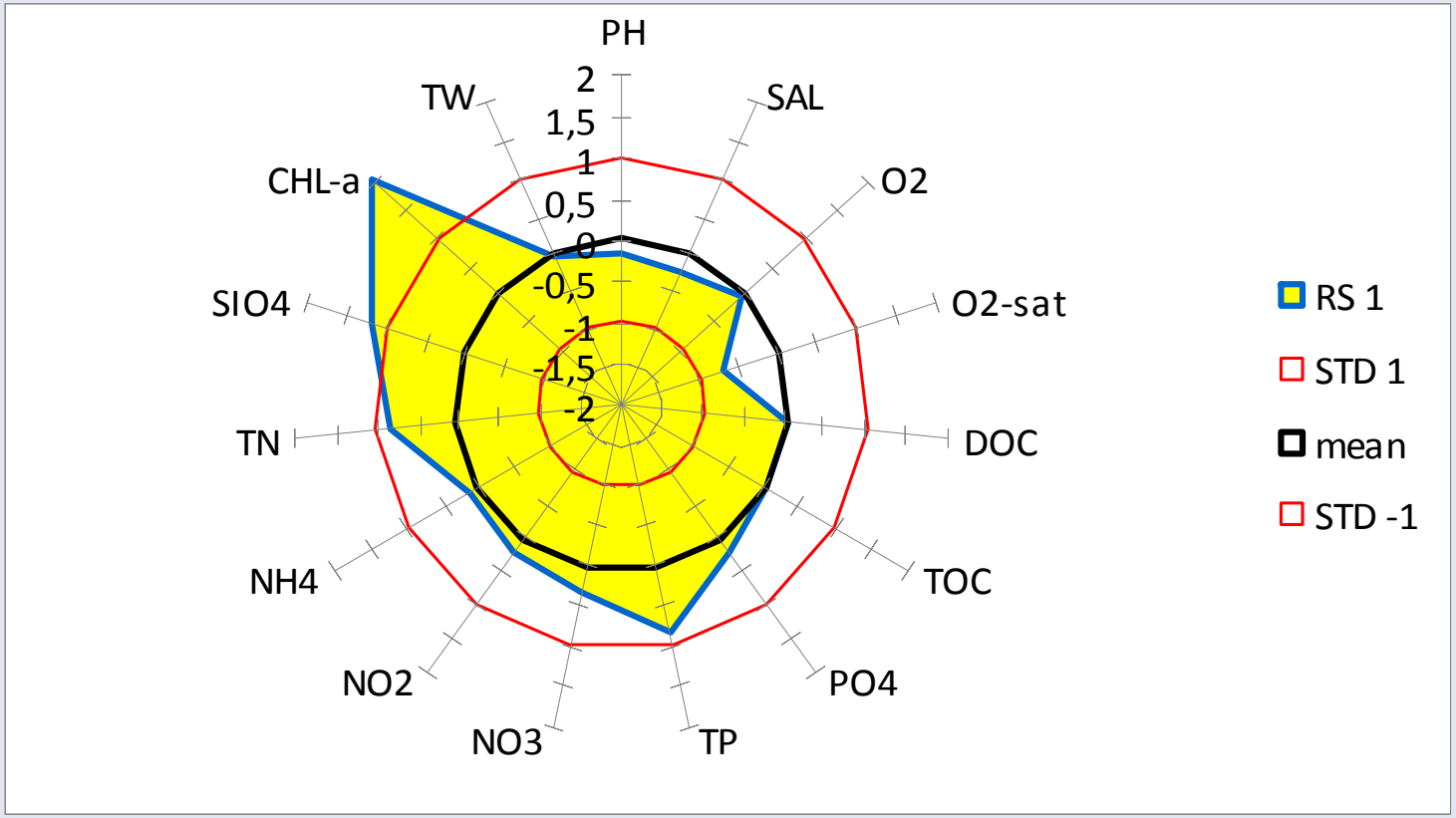

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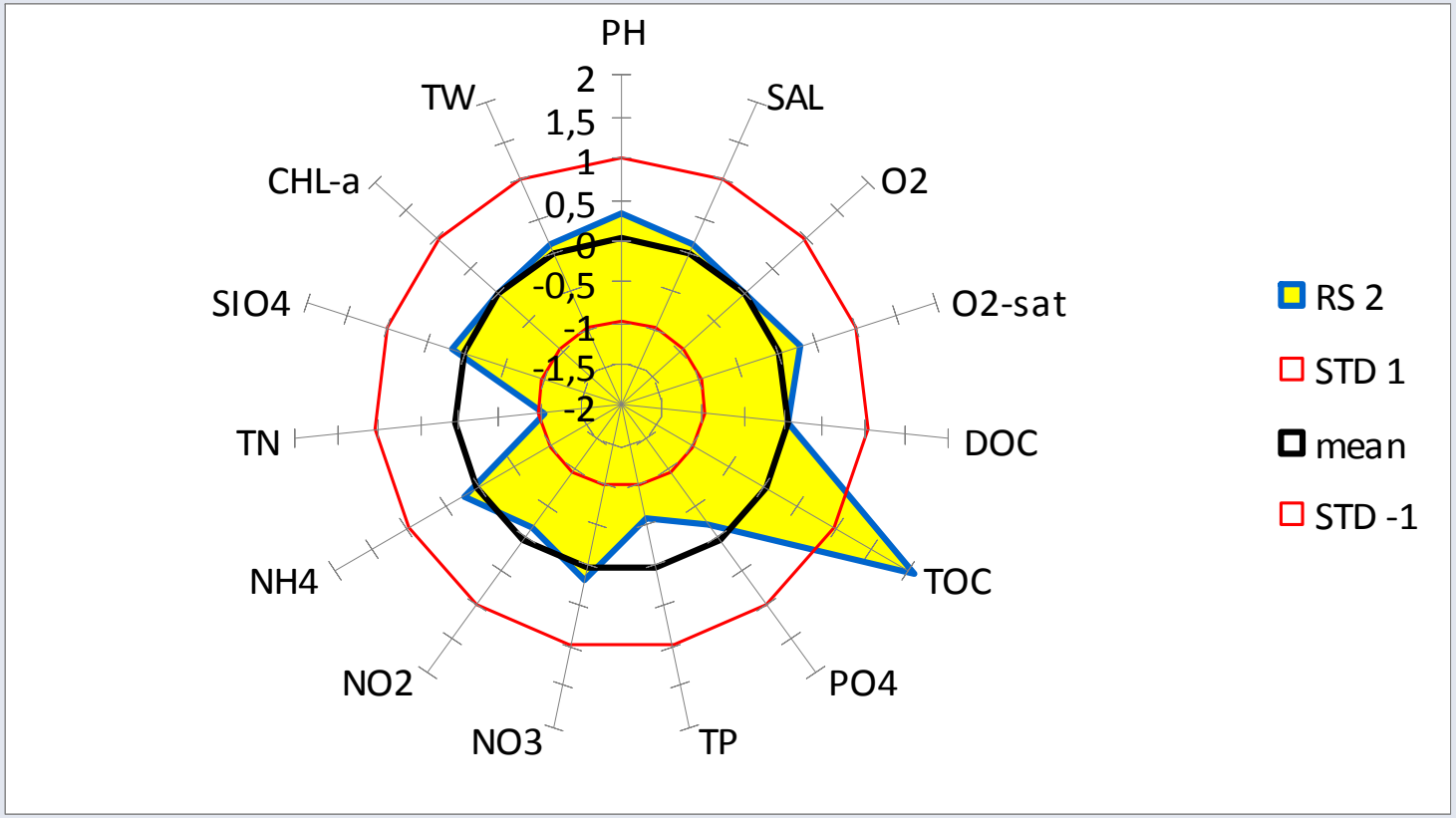

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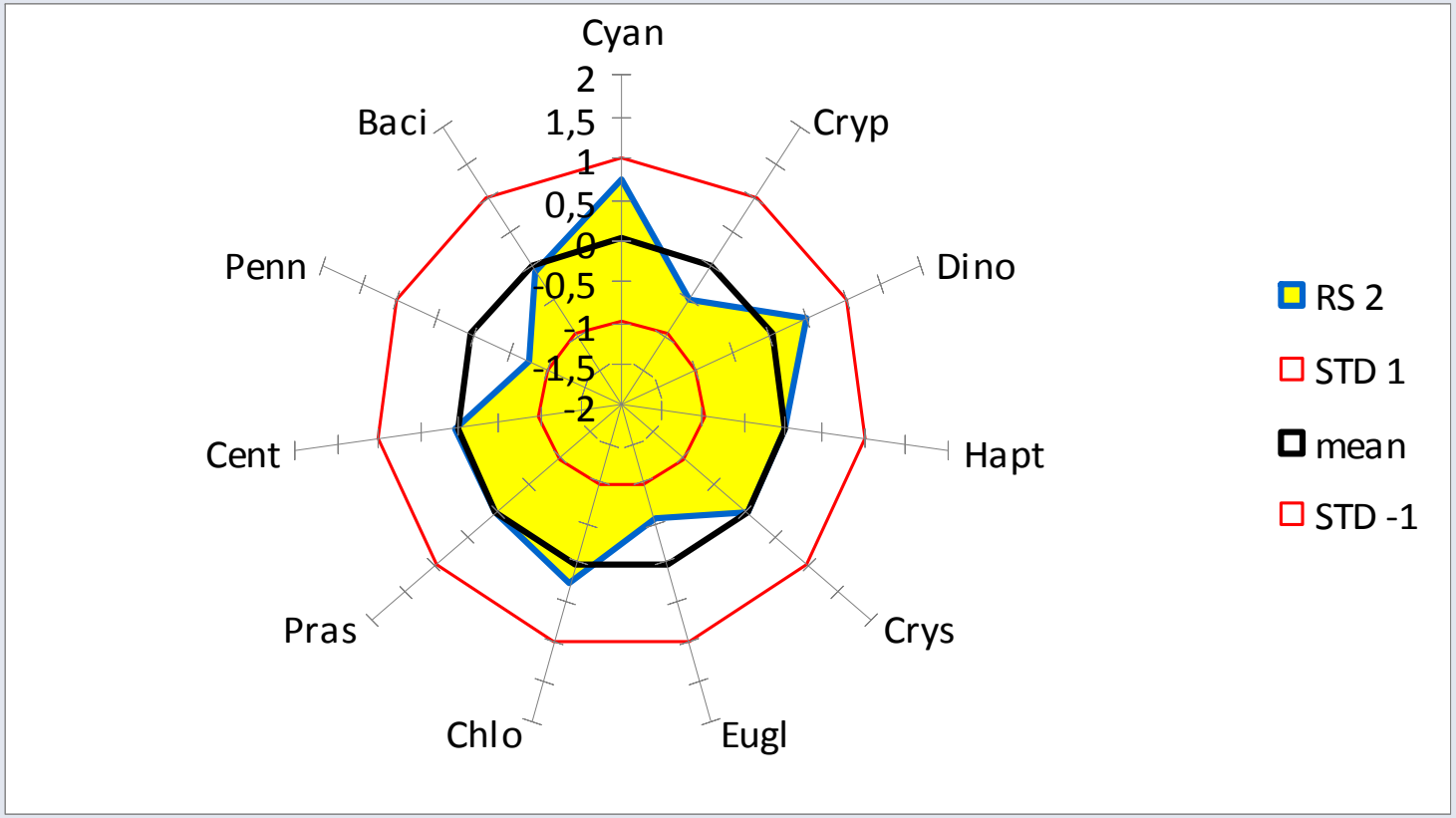

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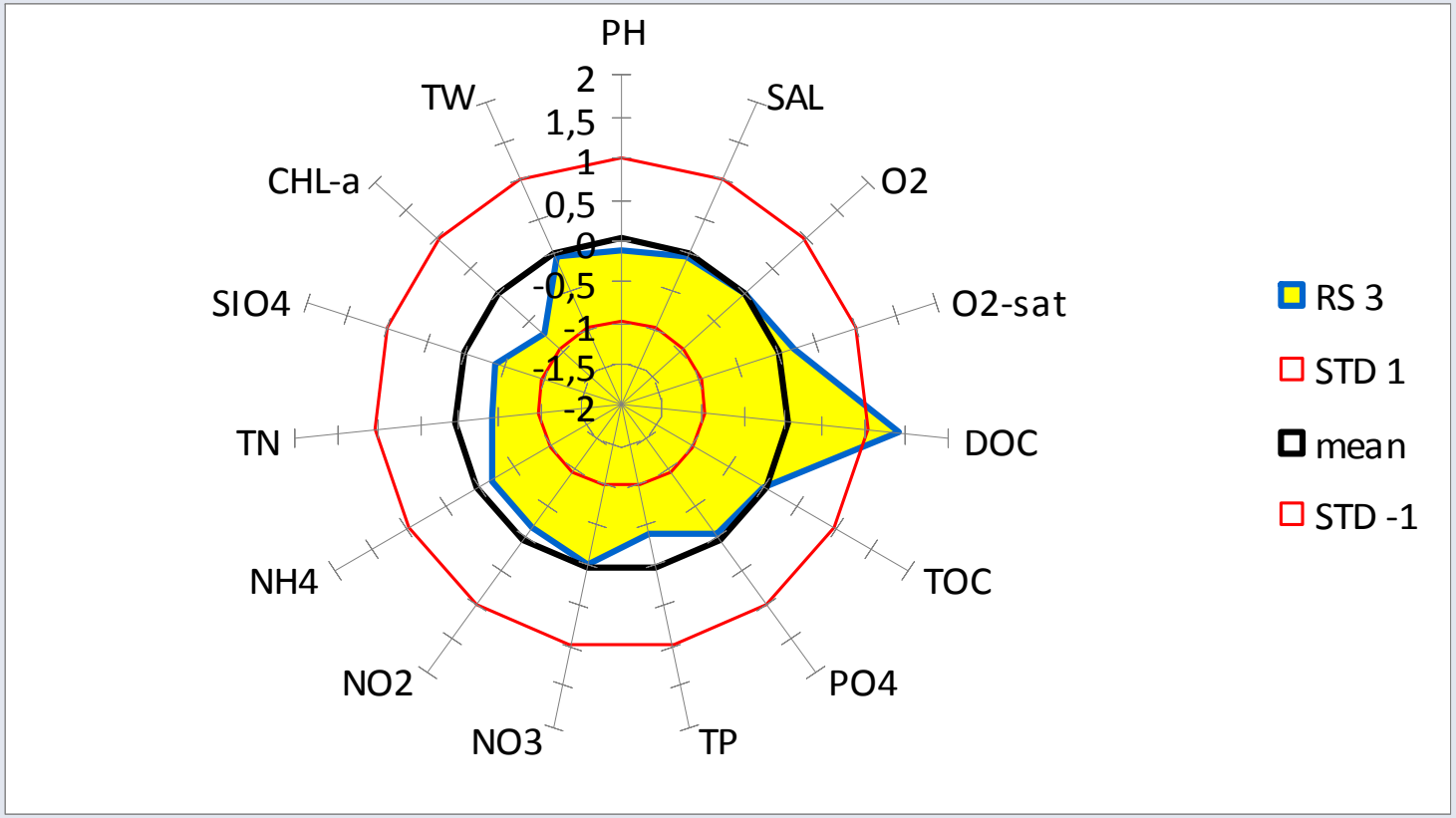

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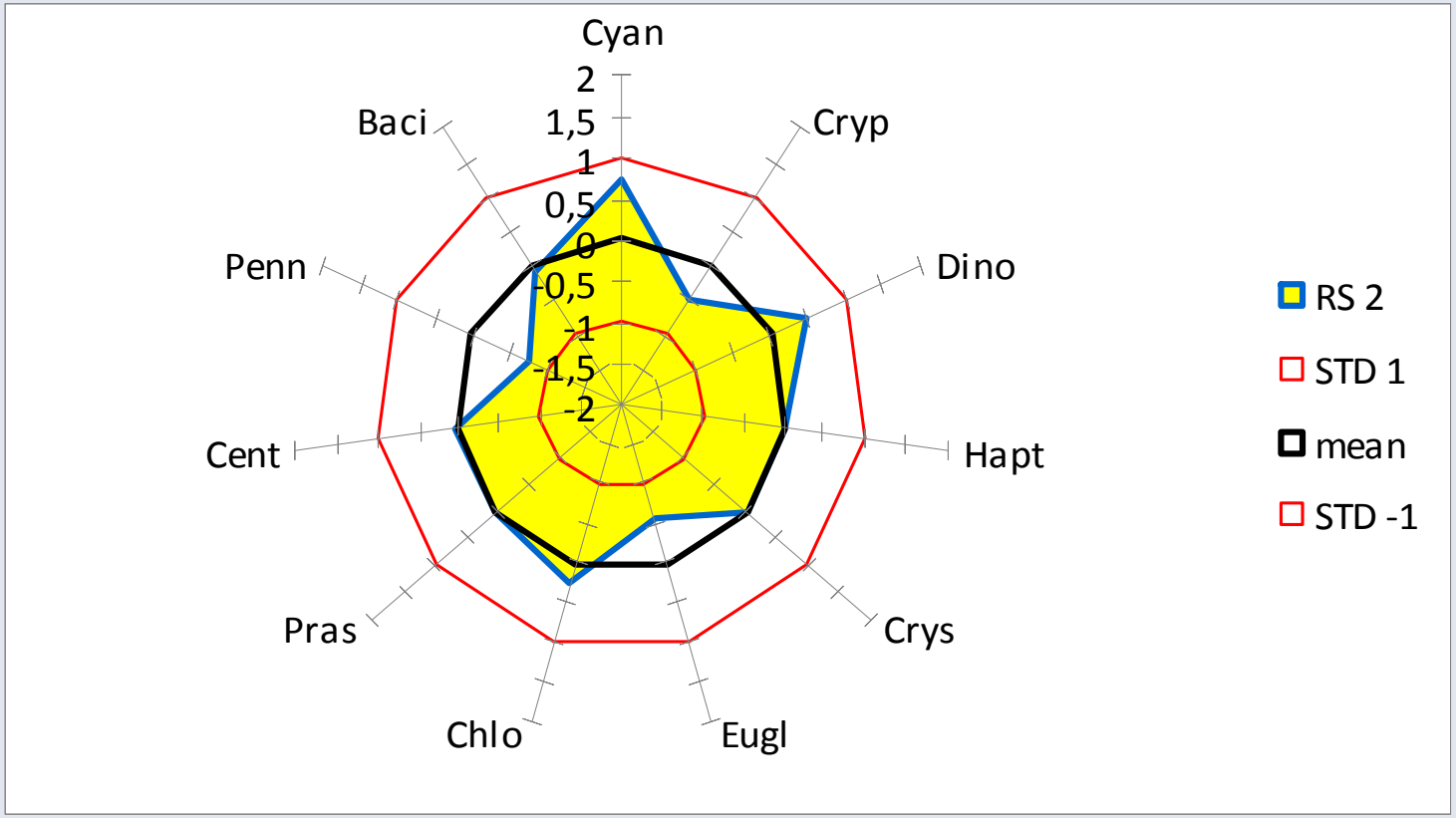

Summary

Various physical and chemical properties and phytoplankton on a species level are routinely monitored in the Baltic Sea (LUNG 2004). These data, monitoring data from ICES for different subregions and Latvian zooplankton data from the central Baltic Sea are investigated with respect to climate change and regime shifts. Biological regime shifts can be identified in different trophic levels which indicates the sensitivity of the system itself. Some of the variables might be used as indicator for identifying regime shifts in the Baltic Sea.

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- Dippner, J.W., K. Junker, and I. Kröncke. 2010. Biological regime shifts and change in predictability. *Geophysical Research Letters* 37: L24701, doi:10.1029/2010GL045696.
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