Research results related to climate prediction

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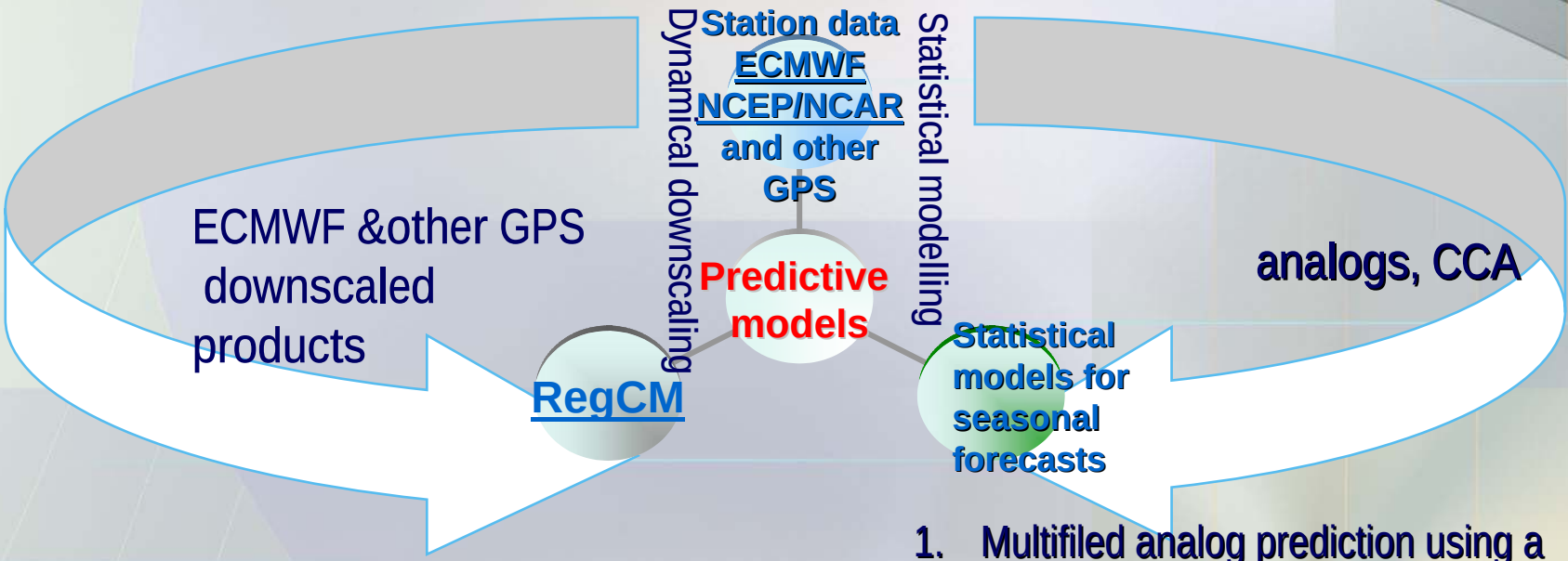
Predictive methodologies



1. Multifiled analog prediction using a climate state vector - adapted for Romania;
2. NAO index prediction using May SSTs
3. NAO index prediction using April-October snow cover

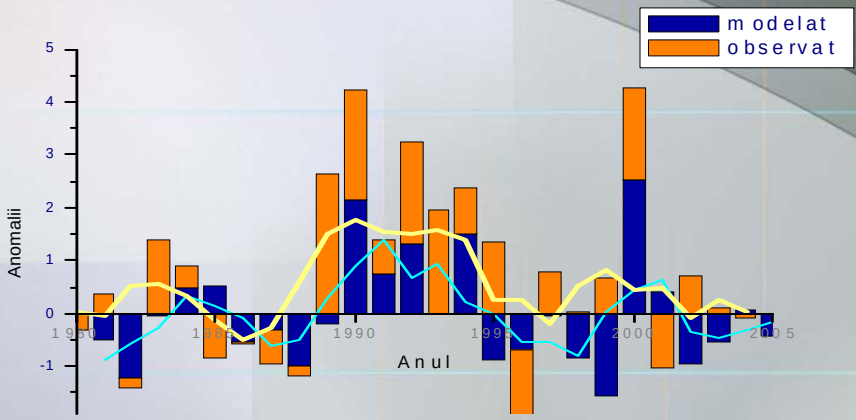
NAO prediction

- Canonical correlation analysis (CCA) based model
- May SST signal
- **Reference:**

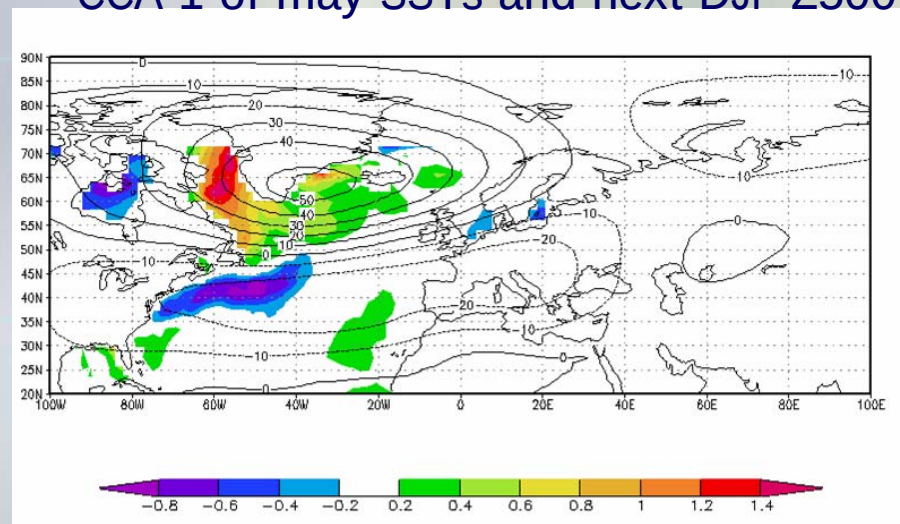
Rodwell, M. J., D. P. Rowell, and C. K. Folland, 1999: Oceanic forcing of the wintertime North Atlantic oscillation and European climate. Nature, 398, 320-323.

Bojariu, R., L.Gimeno, 2003: Predictability and numerical modelling of the North Atlantic Oscillation. Earth Science Reviews, Vol 63/1-2, 145-168.

Observed (orange) and simulated (blue) NAO index anomalies

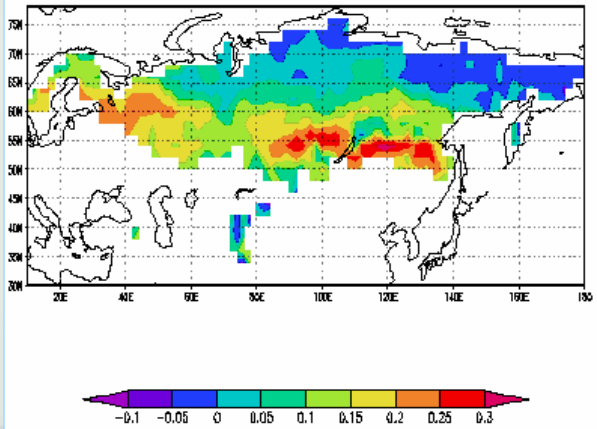


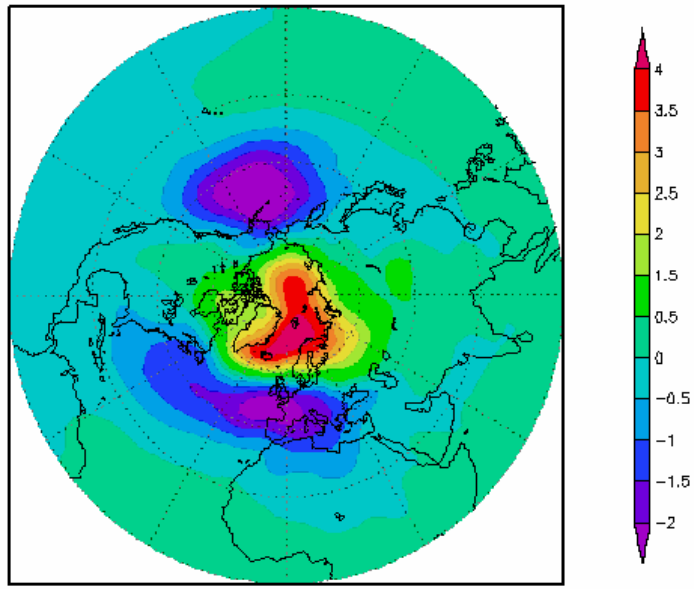
CCA 1 of may SSTs and next DJF Z500



NAO prediction

Canonical correlation analysis (CCA) based model (snow frequency/SLP)





April to October snow signal for December-February

- **References:**

Bojariu, R., L.Gimeno, 2003: The influence of snow cover fluctuations on multiannual NAO persistence. Geophysical Research Letters, 30(4), 1156, doi:10.1029/2002GL015651.

Bojariu, R., R. Garcia-Herrera, L. Gimeno, T. Zhang, and O. W. Frauenfeld. Cryosphere-Atmosphere Interaction Related to Variability and Change of Northern Hemisphere Annular Mode. In L. Gimeno, R. García-Herrera, R. M. Trigo (eds.), Trends and Directions in Climate Research: Ann. N. Y. Acad. Sci. , 1146, pp. 50-59. Wiley-Blackwell, 2008.

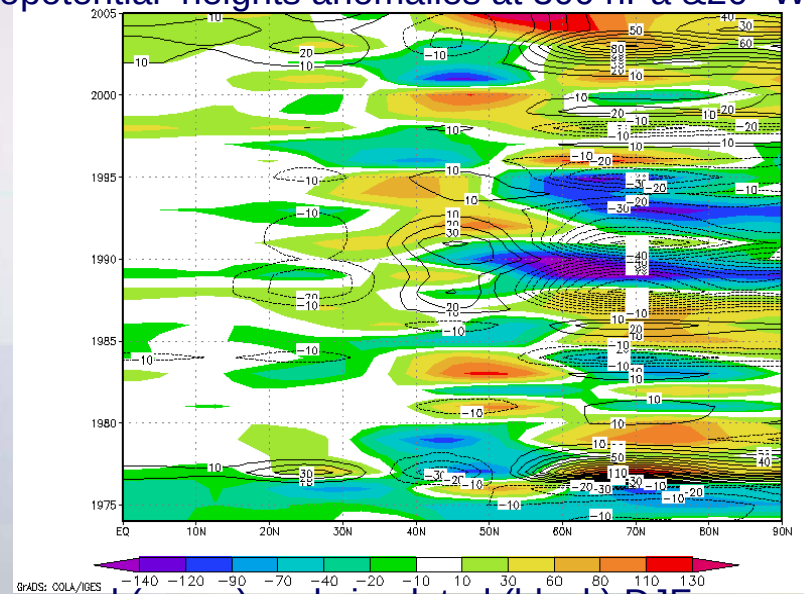
NAO prediction

- Canonical correlation analysis (CCA) based model
- April to October snow signal
- **References:**

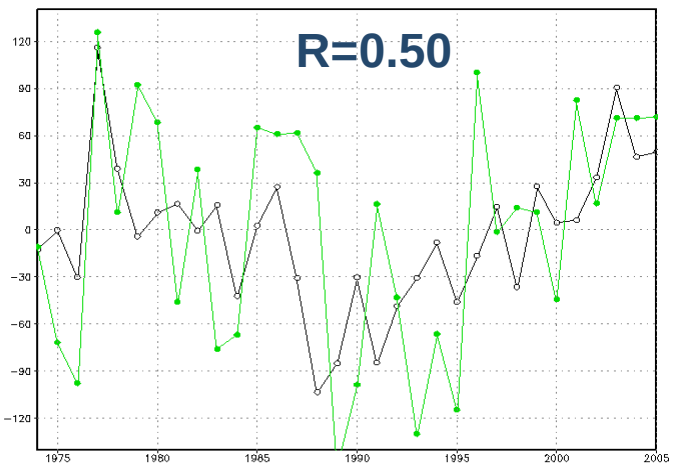
Bojariu, R., L.Gimeno, 2003: The influence of snow cover fluctuations on multiannual NAO persistence. Geophysical Research Letters, 30(4), 1156, doi:10.1029/2002GL015651.

Bojariu, R., R. Garcia-Herrera, L. Gimeno, T. Zhang, and O. W. Frauenfeld. Cryosphere-Atmosphere Interaction Related to Variability and Change of Northern Hemisphere Annular Mode. In L. Gimeno, R. García-Herrera, R. M. Trigo (eds.), Trends and Directions in Climate Research: Ann. N. Y. Acad. Sci. , 1146, pp. 50-59. Wiley-Blackwell, 2008.

Observed (color shaded) and simulated DJF geopotential heights anomalies at 300 hPa &20º W



Observed (green) and simulated (black) DJF geopotential height at 300 hPa (65º N, 20º W)



Multifield analog prediction

- **Climate state vector:**
  - –Local components (50% weight) – seasonal anomalies of precipitationa and air temperature (1951-present)
  - –Large scale components (50% weight) – seasonal anomalies of SSTs from North Atlantic and Black Sea, air temperature at 850 hPa, geopotential heights at 500 hPa, zonal wind at 300 hPa (1951-present, NCAR-NCEP reanalysis)
- **Reference:**

Barnett, T. P. and R. Preisendorfer, 1978. Multifield analog prediction of short-term climate fluctuations using a climate state vector. J. Atmos. Sci., 35, 10, 1771-1787.

$$Y(z,t) = \sum_{l=1}^{54} A_l(t) B_l(z)$$

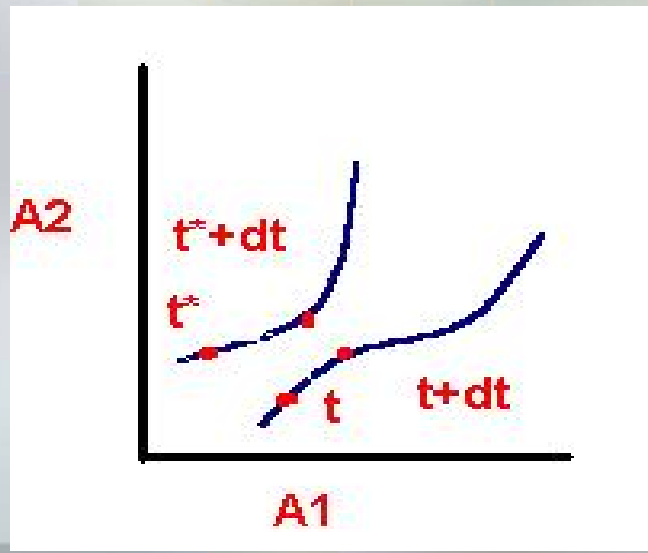
$$Q(z,t) = \sum_{l=1}^{54} C_l(t) D_l(z)$$

$$z = 1,54$$

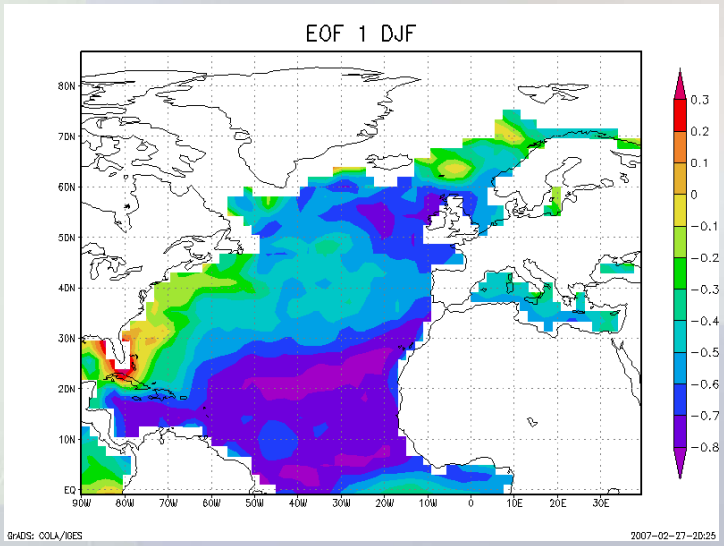
$$t = 1,56$$

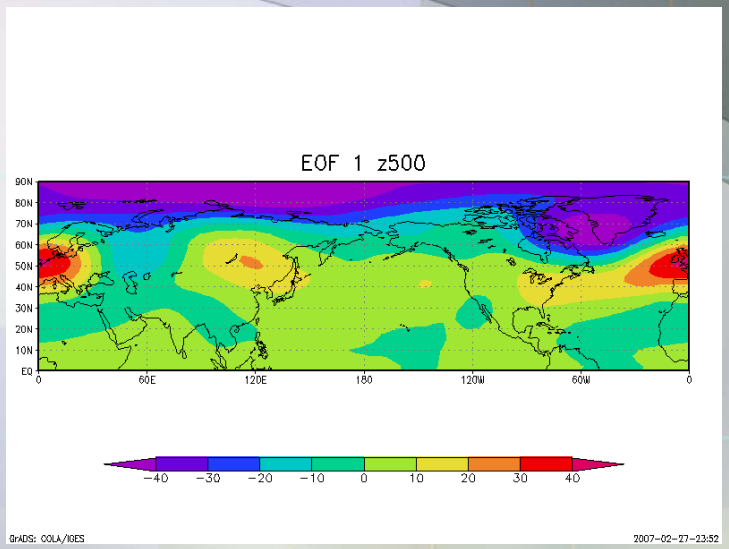
$$d_1^2(t,t') = \sum_{l=1}^{5} [A_l(t) - A_l(t')]^2$$

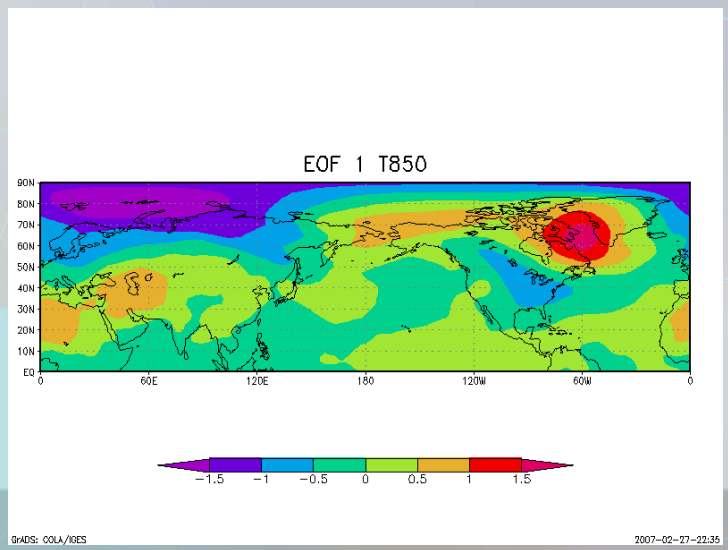
$$d_2^2(t,t') = \sum_{l=1}^{5} [C_l(t) - C_l(t')]^2$$

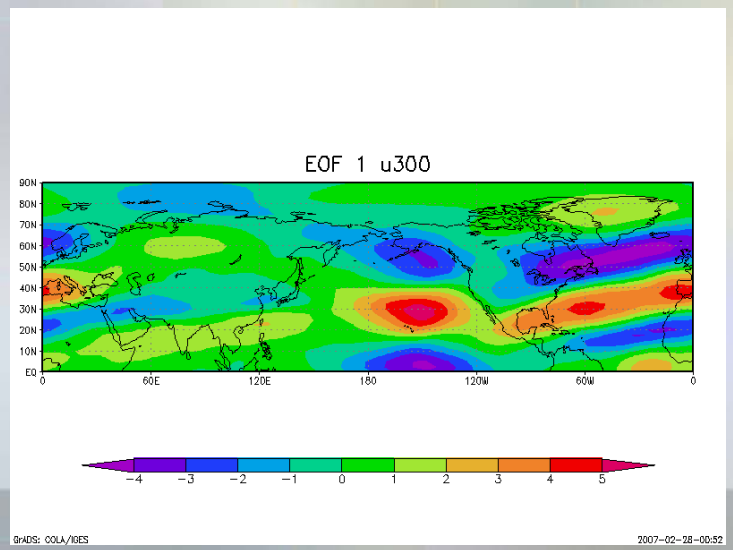


Multifield analog prediction – large scale key regions



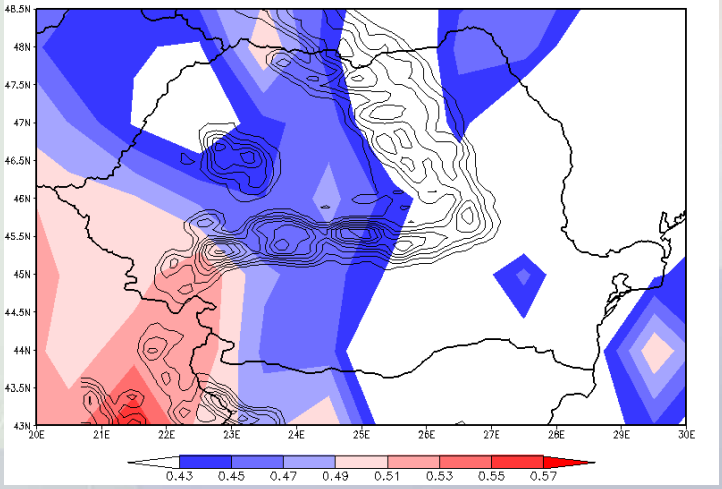




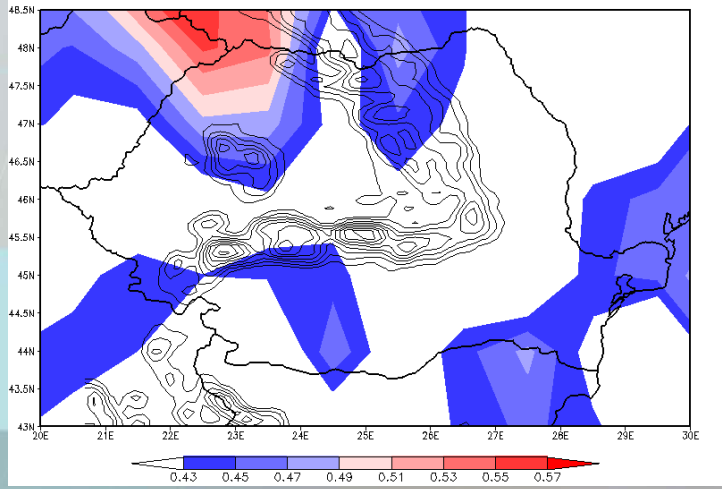


Multifield analog prediction – local skill SL

SL for summer T terciles from winter



SL for fall T terciles from winter



$$p(r) = \frac{m!}{r!(m-r)!}\alpha^r(1-\alpha)^{m-r}$$

$$\bar{r} = \sum_{r=0}^{m} rp(r) = m\alpha$$

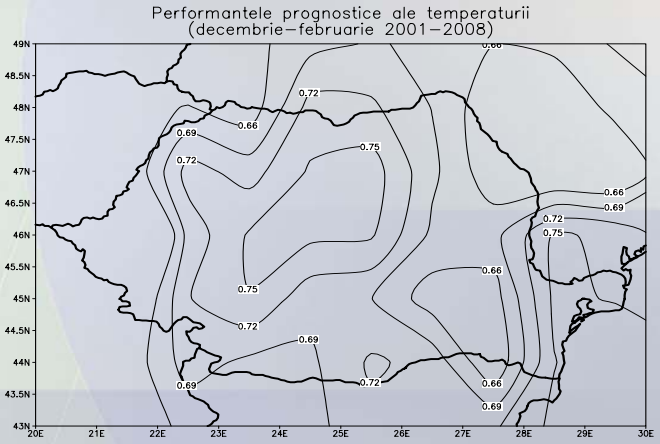
$$q(r) = \sum_{j=1}^{r} p(j), r = 0,1,\ldots m$$

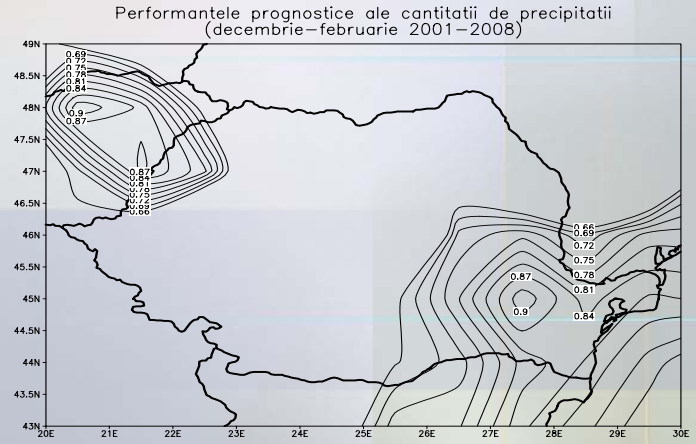
$$S = \frac{C-E}{T-E} X100$$

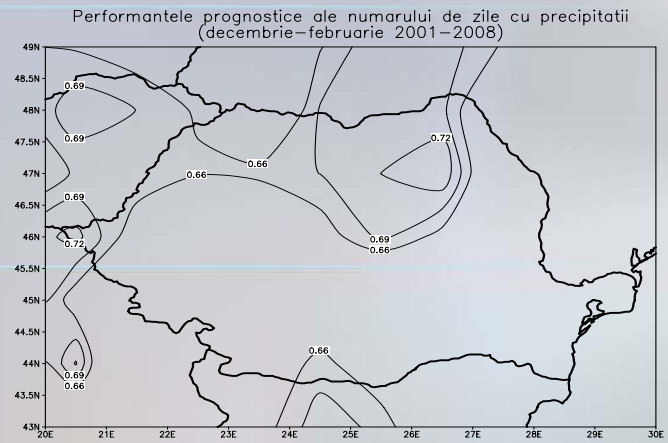
or

$$S_L = \frac{C}{T}$$

Multifield analog prediction – local skill SL







Comments

- Climate predictability is regionally and temporally dependent; climate prediction strategy has to be regionally-orientated;
- Existence of scientific significance of climate prediction results does not guarantee socio-economic; significance (cost/benefit ratio);
- Deontological and ethical implications of climate prediction should be taken into account on regular basis;
- IPCC AR5/CMIP 5 – new opportunities to collaborate in climate prediction.

- http://www.meteoromania.ro
- http://roxana.netfirms.com