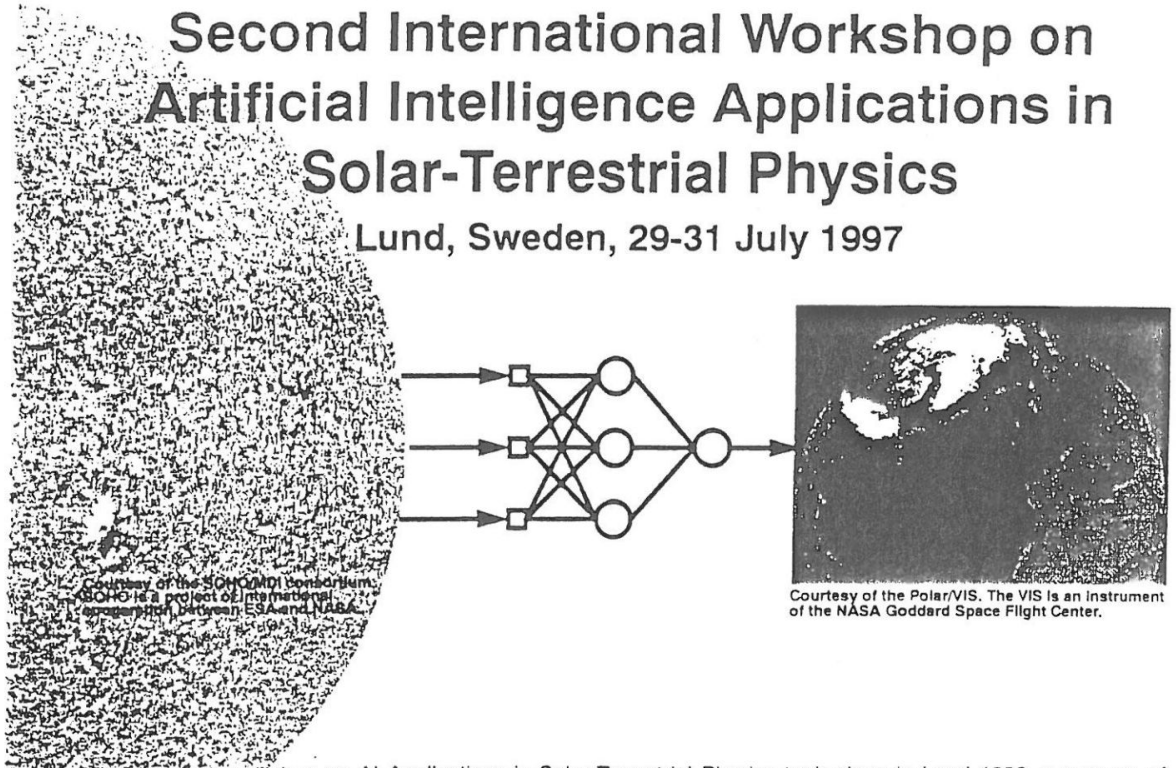
Second International Workshop on Artificial Intelligence Applications in Solar-Terrestrial Physics

Lund, Sweden, 29-31 July 1997



Courtesy of the SOHO/MDI consortium. SOHO is a project of international cooperation between ESA and NASA.

Courtesy of the Polar/VIS. The VIS is an instrument of the NASA Goddard Space Flight Center.

Since our first workshop on AI Applications in Solar-Terrestrial Physics took place in Lund 1993, a new era of solar-terrestrial observations has started. Many discoveries have been made with satellites such as Yohkoh, Ulysses, SOHO, WIND, GEOTAIL and Polar. These satellites are producing an enormous amount of data that require new techniques for data analysis. Artificial Intelligence (AI) methods, including neural networks, expert systems, genetic algorithms, fuzzy logic, fractal analysis and hybrid systems, offer such techniques for automated analysis, data reduction, classification, pattern recognition, function approximation and predictions. Demands for speed and automation have also stimulated development of hardware implementations such as neural chips. For future observations, even clusters of intelligent satellites, are discussed.

FUZZY NEURAL NETWORKS IN THE PREDICTION OF GEOMAGNETIC STORMS

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Artificial Neural Networks in Prediction D_{st} Index

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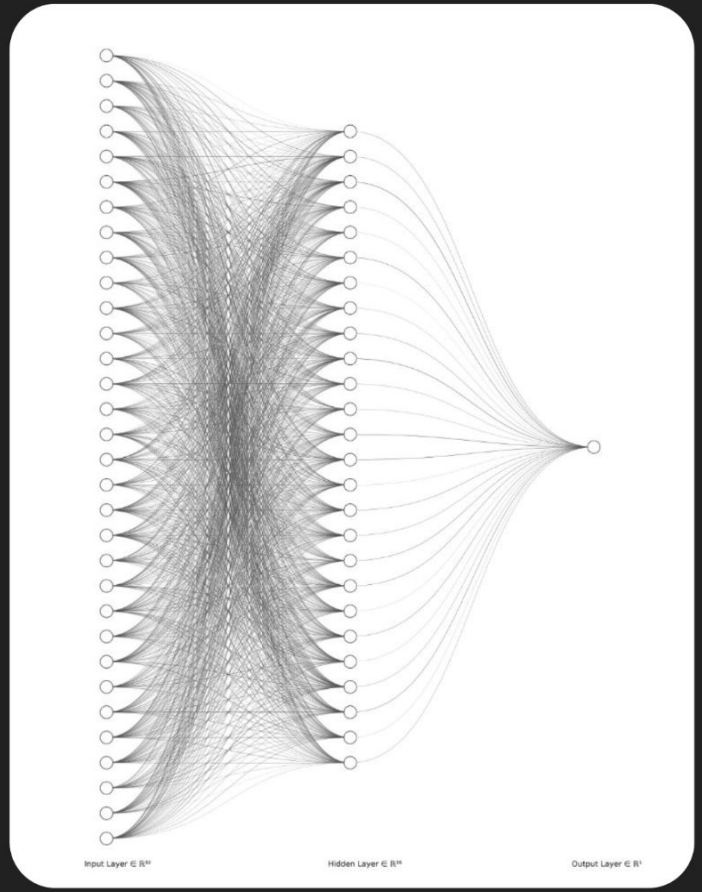
Abstract

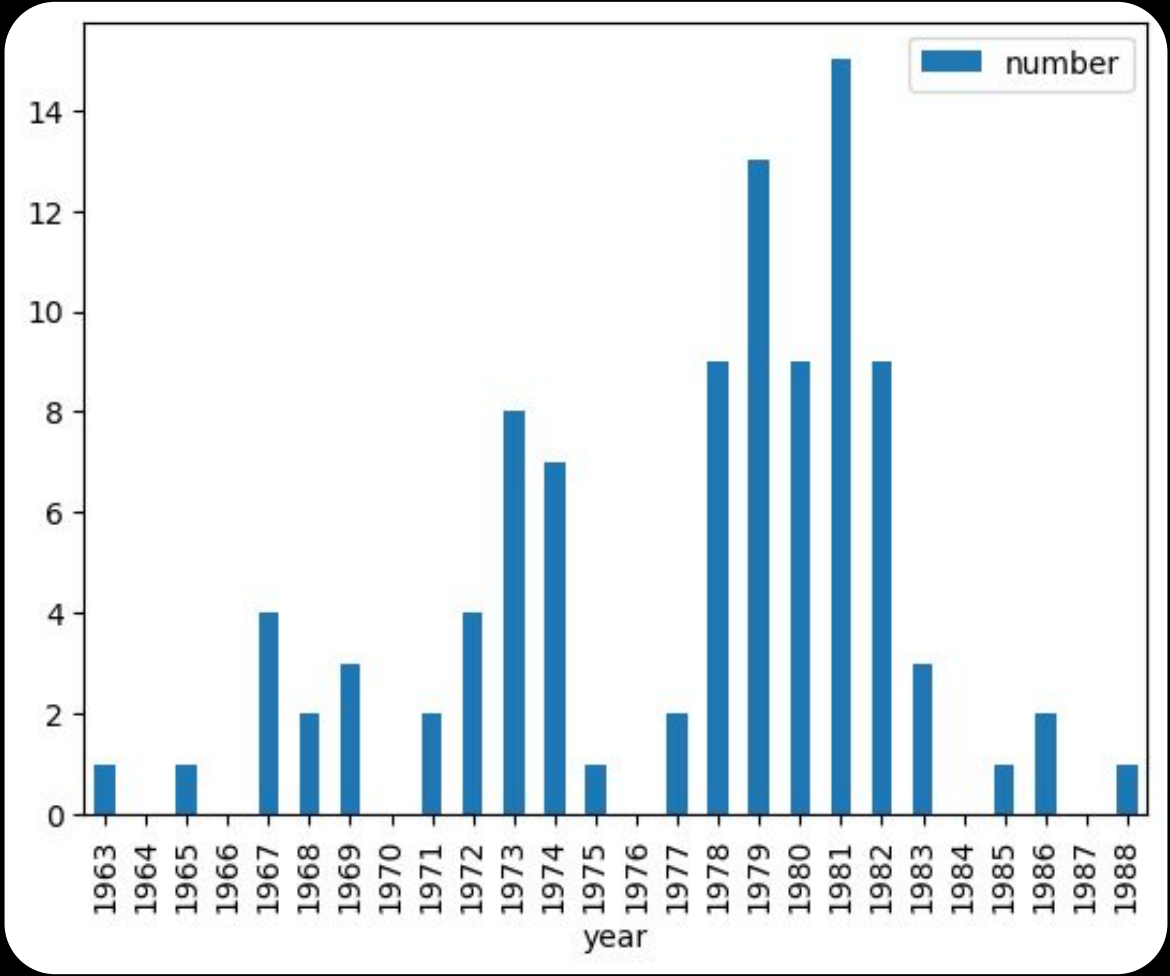
Artificial neural networks (ANN) are used to predict the geomagnetic activity index D_{st} one hour in advance. The B_z-component and σ_{Bz}, the density and velocity of the solar wind are used as input to the network. The results obtained by four ANN models – one feed-forward neural network model (FFNN) and three recurrent network models (RNN) – are compared from computing results point of view. We describe the architectures and learning algorithms of the proposal ANN.



Model A - FFNN

- 32 input neurons
  - 8h x 4 parameters (Bz, σ_{bz}, n, v)
- 26 hidden layer neurons
- 1 output neuron
  - DST_{t+1}

- $\phi(x) = \tanh(x)$
- MSE loss function
- Adam optimizer


number
14
12
10
8
6
4
2
0
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
year

model	1979			1980			1981		
	b=28			b=18			b=51		
	s	p	u=p/b	s	p	u=p/b	s	p	u=p/b
A	27,10	10	0,357	23,32	5	0,277	31,47	31	0,607

Geomagnetic storm forecaster

Task: Develop a model for prediction of Dst index that will be as good as possible

Key features:

- Reproducibility (you need to understand each step)
- Innovation (try to add there something new)
- AI agent needs to be a part of solution

Input: all your knowledge from SLSS 2024

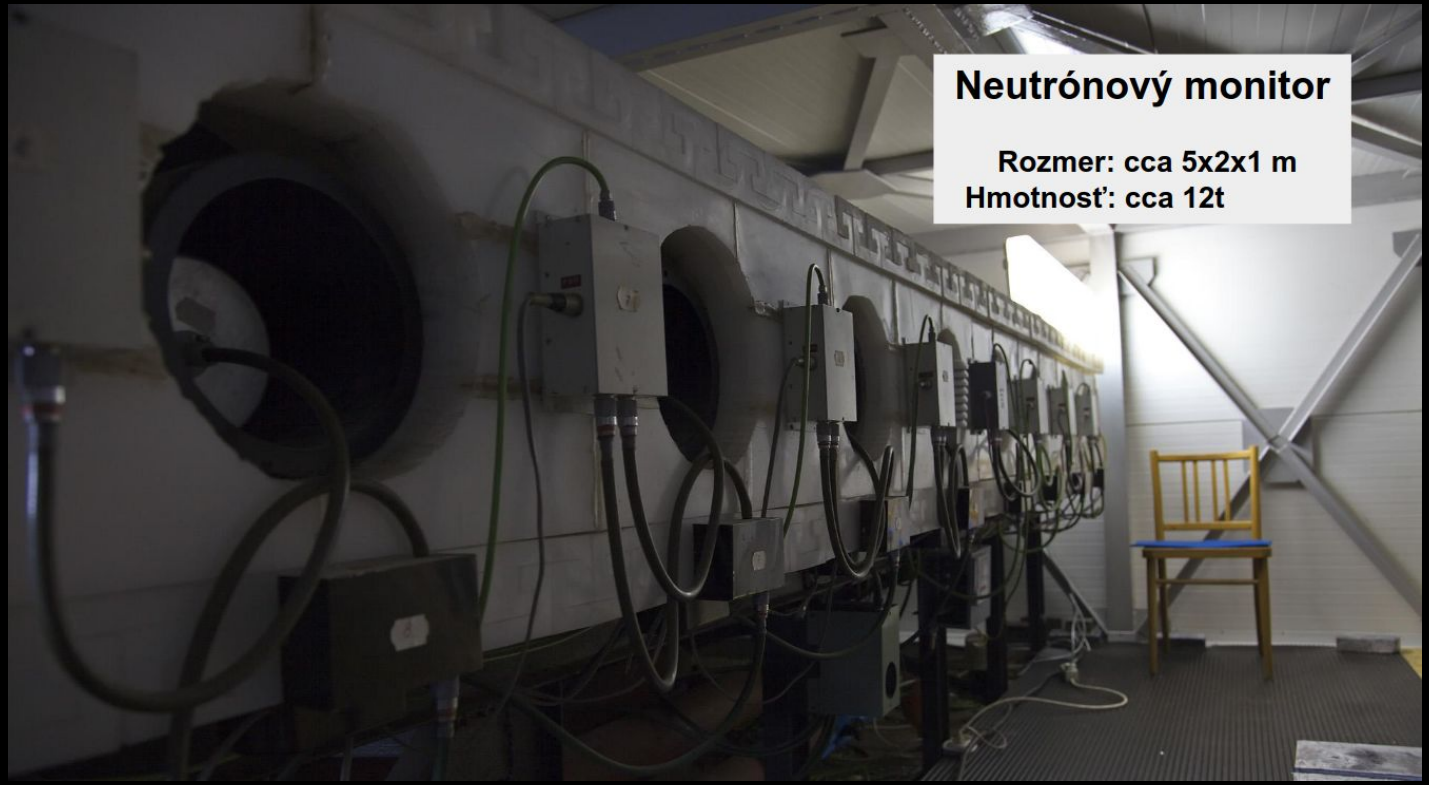
Output: presentation for 5 minutes

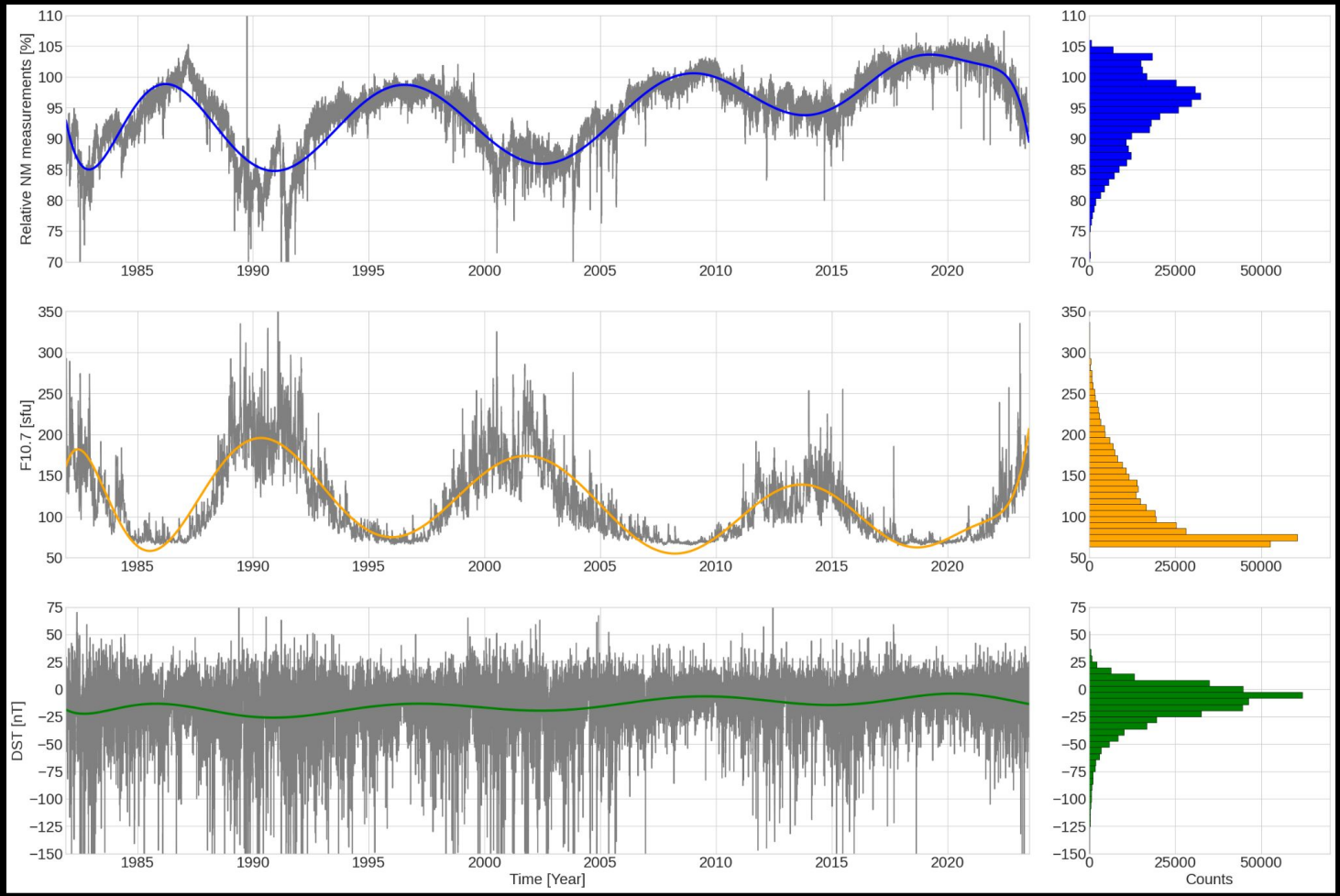
Hints

Ground-based instruments

Lomnický štít Observatory

Image by: S. Mackovjak


Neutrónový monitor
Rozmer: cca 5x2x1 m
Hmotnosť: cca 12t



https://zenodo.org/records/10790916

LiveDst
Geomagnetic storm prediction

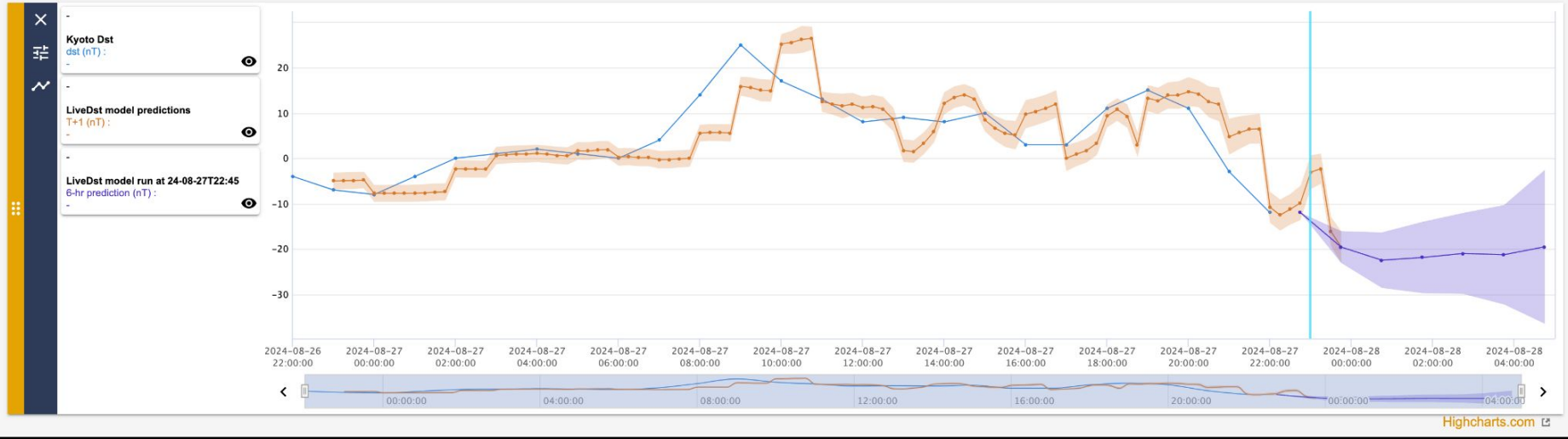
SWx TREC

Dst model | Model description | Data API

Current time (UTC): 2024-08-27 22:59

Selected Date Range **2024-08-26 22:00 to 2024-08-28 05:00**

SET DATE RANGE



https://swx-trec.com/dst/