February/March 2022 - Seminar series at Meteorological Institute of **Hamburg** University; 19 April 2022; 14:15, online

Hans von Storch

Eigenvectors and me

I was invited to join the Theoretical Section of the Meteorological Department of the University of Hamburg, then under the supervision of Professor Günter Fischer, in. 1976. I was tasked by Professor Fischer to design a numerical filter, which would clean the spectrum of spatial variations from the unwanted accumulation of energy at the smallest resolved scales – caused by the spatial truncation when using difference equation in a general circulation model. While Günter Fischer was my formal supervisor, it was more Erich Roeckner, with whom I had my needed daily exchange. My point of departure was a numerical filter suggested in the literature, and the system was tested in a barotropic model of the midlatitude dynamics of the atmosphere.

In 1979, I completed my thesis (Numerische Filter zur Dämpfung meteorologischen Lärms in hemisphärischen Modellen. *Hamburger Geophysikalische Einzelschriften*, Ser. A, 44, 96 pp.; 1980) within 3 years with three achievements:

1. Construction of optimal numerical filters, which we took up after 25 years for separating scales in limited areas (von Storch, H., 1978: Construction of optimal numerical filters fitted for noise damping in numerical simulation models. *Beitr. Phys. Atm.* 51, 189-197
2. Demonstration of the successfully suppression of the accumulation of numerical noise at smallest scales (Roeckner, E. and H. von Storch, 1980: On the efficiency of horizontal diffusion and numerical filtering in an Arakawa-type model. *Atmosphere-Ocean*, 18, 239-25
3. The decomposition of the finite phase space into coordinates using the linearized system's eigenvectors – which allowed to split the dynamics in a "Rossby-regime" and a "gravity-regime"; thus, a PIP model (then not named as such) emerged (only published in the thesis itself). It turned out that the filter was mostly acting on the gravity waves, as was wanted, and less so on the Rossby-waves. This ansatz led later directly to the transformation of data spaces spanned by empirically determined eigenvectors, to the identification of damped oscillatory modes such as the MJO. The concept went under the name of Principal Oscillation Patters (POPs; von Storch, H. T. Bruns, I. Fischer-Bruns and K. Hasselmann, 1988: Principal Oscillation Pattern analysis of the 30-60 day oscillation in a GCM equatorial troposphere. *J. Geoph.Res.* 93, 11022-11036)