



“Group velocity thinking” to understand interaction between extra-tropical cyclones

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70 years ago Carl Gustaf Rossby, while laying on the beach in La Jolla, relaxing from his wartime duties, came to realize that since his famous wave equation was dispersive, i.e. the phase speed was proportional to the wave length, it could be subjected to further mathematical manipulations, yielding the waves' so called “group velocity”. It turned out to be typically 30°/day, around three times faster than the phase speeds.

Five years later, thanks to his collaborator Ernest Hovmöller, Jules Charney, Tu-Cheng Yeh and others Rossby came to realize that this “group velocity” represented the energy transfer downstream from one developing cyclone to the next.

This understanding played a decisive role during the first experiments with NWP in 1950. Other meteorologists explored the use of “group velocity thinking” in operational forecasting. In 1957 after Rossby's death, “group velocity thinking” went “out of fashion”, but resurfaced in 1977 thanks to Brian Hoskins and Adrian Simmons.

At ECMWF great use was made of the “group velocity thinking” not only to trace the origins of forecast failures, but to understand the spread of perturbations in the ensemble forecasts. On a conceptual, synoptic basis it helped us to connect developments of extra-tropical systems to recent upstream developments, in particular hurricanes off the US coast (as in October 1987) and typhoons off the Japanese.

It worked, however, best during zonal regimes. Already in 1985 Sigbjørn Grønaas had shown that the semi-permanent ridge over the Rockies shielded the Atlantic and Europe from Pacific influences. Later investigations at ECMWF confirmed Grønaas's finding.

The presentation will suggest practical means to display the “group velocity” on operational charts and thereby make the forecasters aware of how far away processes rapidly can affect their particular region, in particular during developments of strong extra-tropical cyclone activity.