



## Circulation Type Classifications and their nexus to Van Bebber's storm track Vb

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Circulation Type Classifications (CTCs) are tools to identify repetitive and predominantly stationary patterns of the atmospheric circulation over a certain area, with the purpose to enable the recognition of specific characteristics in surface climate variables. On the other hand storm tracks can be used to identify similar types of synoptic events from a non-stationary, kinematic perspective. Such a storm track classification for Europe has been done in the late 19th century by Van Bebber (1882, 1891), from which the famous type Vb and Vc/d remained up to the present day because of their association with major flooding events like in August 2002 in Europe.

In this work a systematic tracking procedure has been developed, to determine storm track types and their characteristics especially for the Eastern Alpine Region in the period 1961–2002, using ERA40 and ERAinterim reanalysis. The focus thereby is on cyclone tracks of type V as suggested by van Bebber and congeneric types. This new catalogue is used as a reference to verify the hypothesis of a certain coherence of storm track Vb with certain circulation types (e.g. Fricke and Kaminski, 2002). Selected objective and subjective classification schemes from the COST733 action (<http://cost733.met.no/>, Phillip et al. 2010) are used therefore, as well as the manual classification from ZAMG (Lauscher 1972 and 1985), in which storm track Vb has been classified explicitly on a daily base since 1948. The latter scheme should prove itself as a valuable and unique data source in that issue.

Results show that not less than 146 storm tracks are identified as Vb between 1961 and 2002, whereas only three events could be found from literature, pointing to big subjectivity and preconception in the issue of Vb storm tracks. The annual number of Vb storm tracks do not show any significant trend over the last 42 years, but large variations from year to year.

Circulation type classification CAP27 (Cluster Analysis of Principal Components) is the best performing, fully objective scheme tested herein, showing the power to discriminate Vb events. Most of the other fully objective schemes do by far not perform as well. Largest skill in that issue can be seen from the subjective/manual CTCs, proving themselves to enhance relevant synoptic phenomena instead of emphasizing mathematic criteria in the classification.

The hypothesis of Fricke and Kaminsky can definitely be supported by this work: Vb storm tracks are included in one or the other stationary circulation pattern, but to which extent depends on the specific characteristics of the CTC in question.