ANOMALIES IN THE MOISTURE TRANSPORT DURING FLOODS EPISODES IN THE DANUBE RIVER BASIN THROUGH A LAGRANGIAN APPROACH

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RESEARCH OBJECTIVE

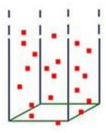
In the last few decades, many significant floods episodes were recorded in Europe, any of the most catastrophic covering the Danube River Basin, a highly diverse region where the total amount of annual precipitation is estimated about 2000 mm/year in the high regions and about 500 mm/year in the plains. In this study, we investigate the anomalies in the moisture transport during floods episodes in Danube River Basin, as the transport of anomalous amounts of water vapor and its associated convergence may trigger extreme precipitation events and cause flooding. The aim of this study is to analyze the moisture sources for the floods episodes and to compute anomalies in the moisture transport during these events over the Danube River Basin (DRB).

I. LAGRANGIAN METHOD

This research is designed on the method developed by Stohl and James [1], which uses the Lagrangian particle dispersion model FLEXPART V9.0 together with ERA-interim reanalysis data available every 6 hours at a 1x1 horizontal resolution. The method is based on dividing the atmosphere into a large number of air particles approximately 2.0 million with constant mass. For each particle changes in specific humidity (q) with time, help us to identify those particles that lose moisture through precipitation (p) or receive it through evaporation (e).

$$e - p = m\frac{dq}{dt}$$

When adding (e-p) for all the particles residing in the atmospheric column over an area, we can obtain (E-P), that is, the surface fresh



$$E - P \approx \frac{\sum_{k=1}^{K}(e-p)}{A}$$

E ⟶ Evaporation
P ⟶ Precipitation
K ⟶ nº particles

The particles were recorded every 6 hours and the tracks were calculated limiting the transport times to 10 days

The analysis covers a temporal period of 35-years from 1980 to 2014. Through this Lagrangian approach, we want to analyze the major moisture source for the flood episodes over the DRB and their anomalous in the moisture transport**.**

II. FLOOD EPISODES

We studied four flood events over the DRB:

- **2002:** 13-August to 02-September [2],
- **2006:** 28-March to 28-April [3],
- **2010:** 15-May to 30-May [4],
- **2014:** 13-May to 20-May [5].

III. METHOD

•We track (E-P) from and to the DRB:

• ***Backward analysis:*** Allows us to identify where the air masses gain humidity along their trajectories toward the DRB (evaporation exceeds precipitation in the atmospheric moisture budget). ➡ **SOURCES OF MOISTURE**

•***Forward analysis:*** Identifies those air masses that left each moisture source region to reach the DRB losing moisture (precipitation exceeds evaporation). ➡ **SINKS OF MOISTURE**

•For every flood episode, anomalies of the moisture sources defined according to the annual climatology (1980-2014) were analyzed, based on the E-P integrated along 10-days trajectories.

IV. MOISTURE SOURCES OVER THE DANUBE RIVER BASIN

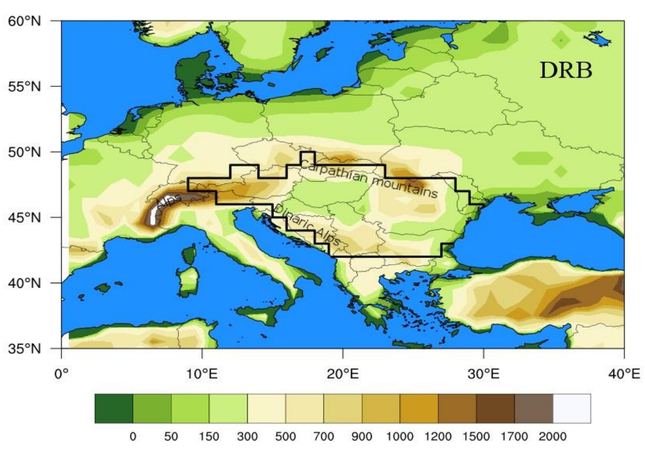


Figure 1. The black contour line indicates the Danube River Basin area. In colours is indicated the elevation of the region (units in meters).

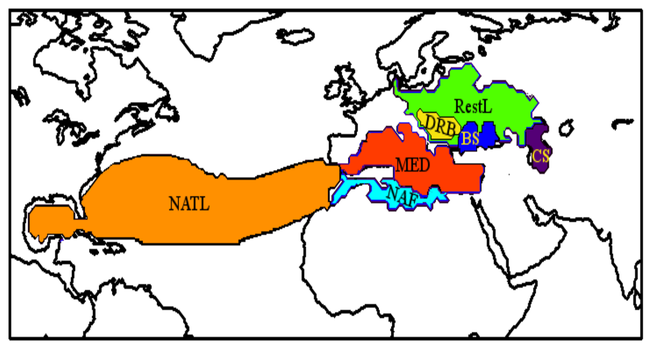
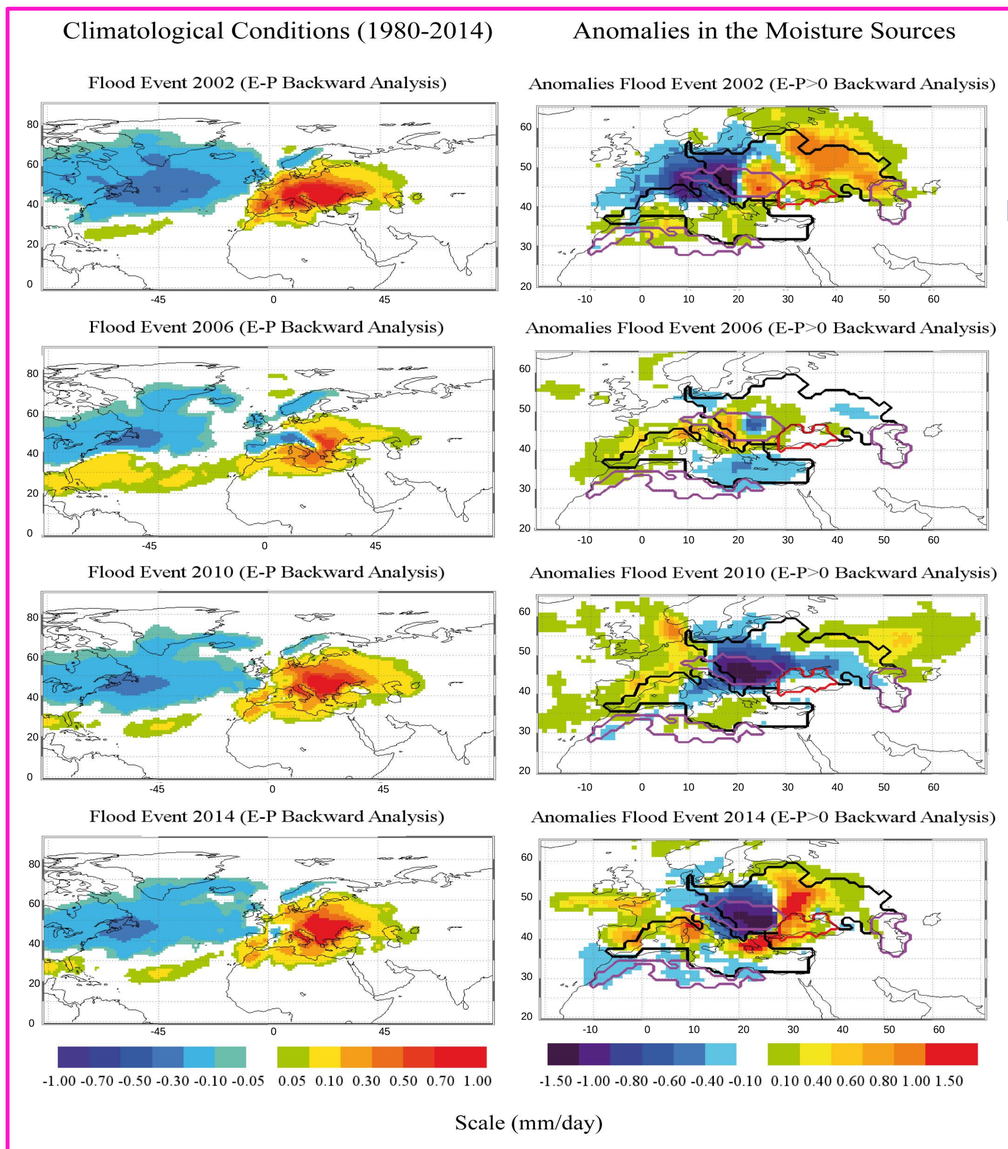


Figure 2. Schematic representation of moisture sources for the Danube River Basin identified from backward experiment for the period 1980-2014. Sources areas were selected using the 90th percentile of the (E-P)>0 values: 0.06 mm/day [6].

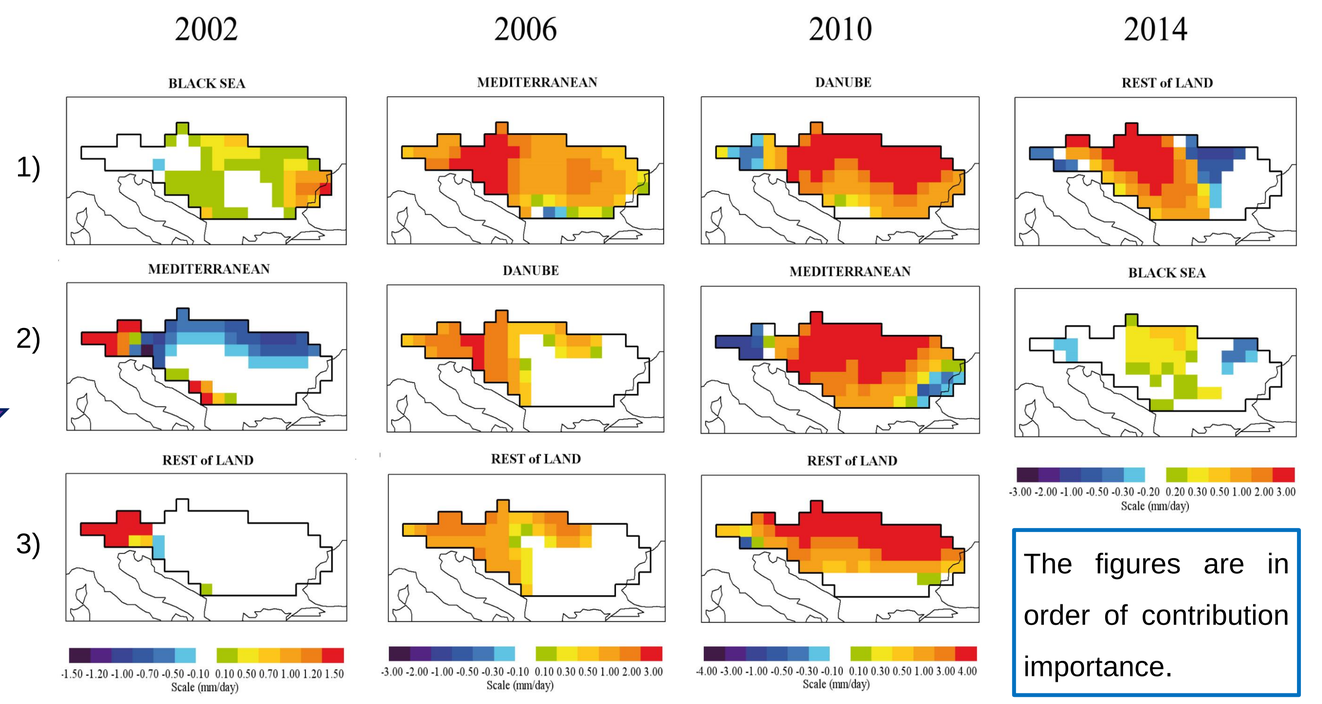
V. RESULTS



Climatology: During the **flood events**, results show that **dominant moisture source** for Danube River Basin is the **Mediterranean Sea** and **European continent** with the exception of the flood event 2006, when the NATL apears as the source of moisture. Also the **Danube** itself is a significant moisture source.

Anomalies: The highest positive values of anomalies in the moisture uptake during the 2002 and 2014 flood events occurs over Rest of Land source (to the eastearn), also BS and MED have a significant impact. For 2006 Flood event the highest anomalies apear in the Danube and for 2010 flood event in the MED source.

Highest Anomalies in Moisture Supply over the DRB



The figures are in order of contribution importance.

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ACKNOWLEDGEMENTS: Danica Ciric is supported by Green-Tech-WB Erasmus Mundus project with coordinator University of Vigo, financed by European Commission. Raquel Nieto acknowledges the support of the Xunta Galicia and FEDER through the THIS (EM2014/043) project. This work was also developed within the framework of the European Project IMDROFLOOD (WaterJPI/0004/2014).