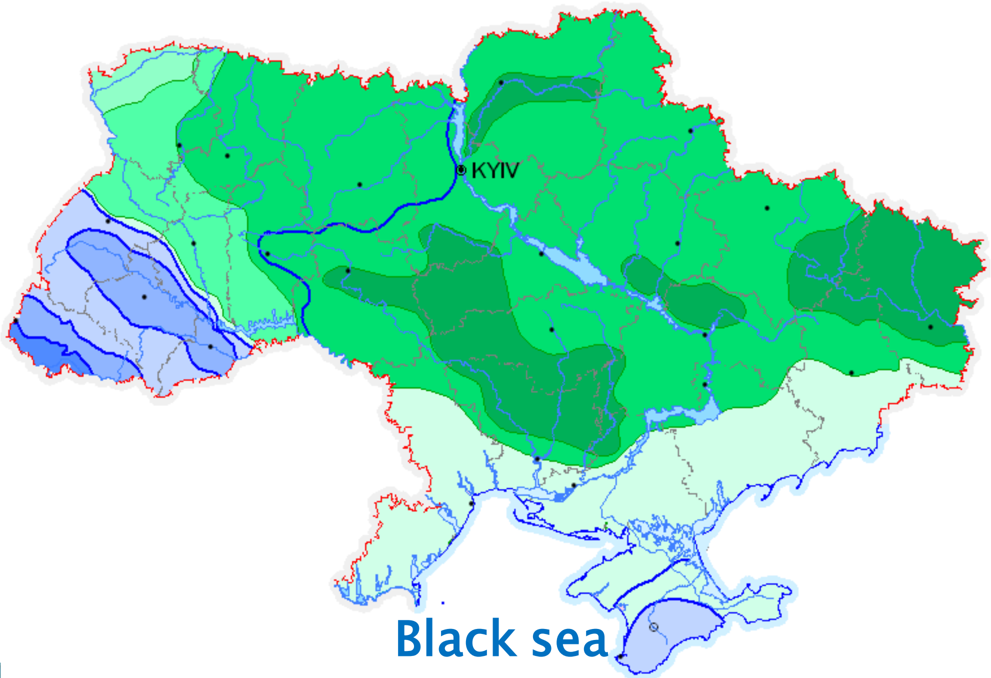
MedCORDEX-Baltic Earth-COST Workshop

Regional Climate System Modelling

for the European Sea Regions

Palma de Mallorca, Spain, 14 to 16 March 2018

# Regional model of forming catastrophic spring runoff in condition climate change on the plain rivers Black sea basin in Ukraine




WATER LEVELS DURING SPRING FLOODS

meters

- 3 to 4
- 4 to 6
- 6 to 10

WATER LEVELS DURING FIELD INUNDATION AND SPRING FLOODS

meters

- high-risk zones for rain and meltwater-rain floods
- 3 highest recorded water increase levels during spring floods compared to summer markers
- 2 highest recorded water increase levels during inundation compared to summer markers

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**The author proposed a new modified version of the operator model [1] for determining the maximum runoff of spring flood, which allows to take into account the possible impact of climate change on the estimated values of the maximum modules 1% probability of exceeding (Fig.1).**

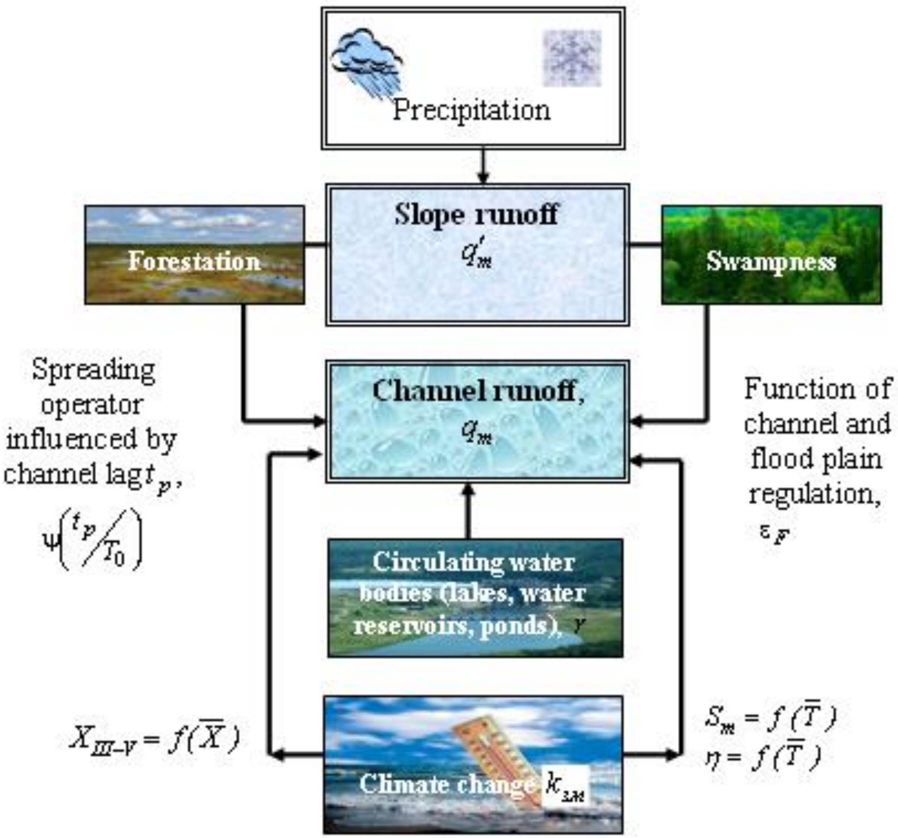
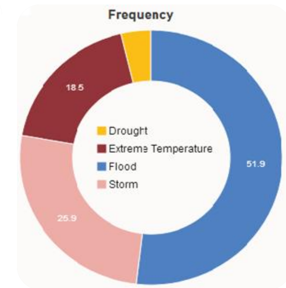


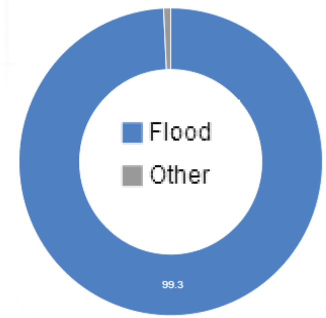

Fig.1–Block diagram of maximum runoff formation

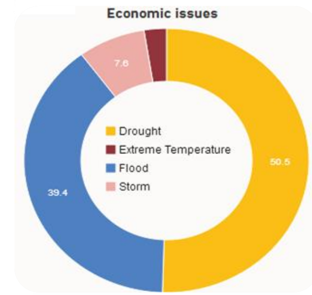
## Probabilistic risk results

Average Annual Loss (AAL) by hazard

| Hazard | Absolute [Million US$] | Capital stock [%] | GFCF [%] | Social exp [%] | Total Reserves [%] | Gross Savings [%] |
|---|---|---|---|---|---|---|
| Earthquake | 8.67 | 0.001 | 0.027 | 0.021 | 0.046 | 0.032 |
| Flood | 1,153.80 | 0.170 | 3.579 | 2.759 | 6.145 | 4.197 |
| Multi-Hazard | 1,162.47 | 0.172 | 3.606 | 2.779 | 6.191 | 4.228 |



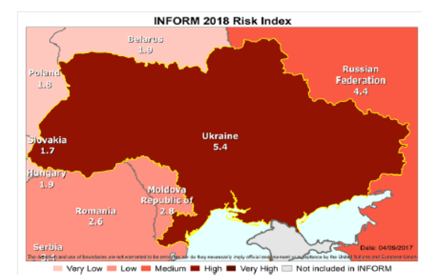

**UKRAINE**

Eastern Europe
Lower middle income

*INFORM Country Risk Profile*

*VERSION 2018*

| | *Value* | *Rank* | *Trend (3 years)* |
|---|---|---|---|
| **INFORM Risk** | **5.4** | **29** | → |
| **Hazard & Exposure** | **7.0** | **19** | → |
| **Vulnerability** | **4.5** | **58** | → |
| **Lack of Coping Capacity** | **5.0** | **76** | → |




**EM-DAT (Feb. 2015) – The OFDA/CRED – International Disaster Database
http://www.emdat.be Université catholique de Louvain Brussels – Belgium
**Source Index for Risk Management 2018 (INFORM 2018) – Inter-Agency Standing Committee Task Team for Preparedness and Resilience and the European Commission
http://www.inform-index.org


1.Gopchenko E.D., Ovcharuk V.A., Romanchuk M.E. A method for calculating characteristics of maximal river runoff in the absence of observational data: Case study of Ukrainian rivers // Water Resources. Pleiades. 2015. Vol. 42. Issue 3. P. 285-291.DOI: 10.1134/S0097807815030057

**To substantiate the main parameters of the proposed method, data from 340 hydrological stations and 229 meteorological stations on plain rivers Black sea basin in Ukraine were used.**

**During the spatial-temporal generalizations of the maximum runoff characteristics, was analyzed the cyclicity of the fluctuations of the maximum runoff of spring flood and done the synchronization zoning of the plain territory of Ukraine on the of spring runoff using factor, cluster and hydro-genetic analysis; was carried out estimate homogeneity of the initial information, statistical processing of the initial time-series of maximum snow supplies, maximum discharges and layers of the spring runoff. For the determination of precipitation in the spring period, proposed the regional calculation formula, the maximum snow supplies and the coefficients of their variation are generalized in the form of a map. The runoff coefficients is determine through the coefficients o RCP8.5 f runoff formation, which are generalized in the form of a map and taking into account the coefficients of the influence of the size of the catchments on the losses of the runoff in the spring flood period.**

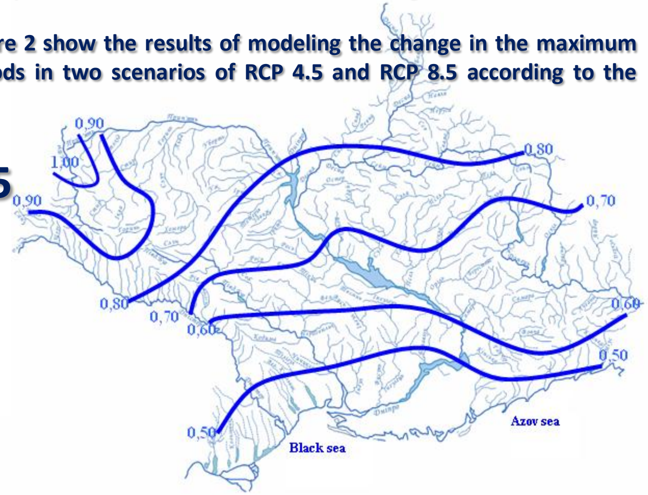
**The characteristics of the slope influx, which are an important component of the calculation scheme, are represented by the maximum slope modulus, which in turn is determined by the coefficient of unevenness of the sloping influx, the duration of the flow into the channel network and the total water supplies to the catchments. All listed parameters are valided for the studied territory, in particular, to determine the influence of intra-zonal factors on the duration of the sloping influx, they was zoning within the limits of physical geographic zones and separate river basins was carried out.**

**The transformation of the maximum slope modulus is represented by functions that take into account the channel time, flood-plain regulation and the impact of flowing lakes and reservoirs. For the determination of the transformation function and the coefficients of flood-plain regulation, the equations of exponential form are derived, with separate parameters in physical geographic zones and for small catchments (with an area up to 100 km2).**

**For the plain rivers of Ukraine the author's modified version of the calculating method for determining the characteristics of spring flood in climate change conditions has implement. The implementation of the proposed calculation option using different models and scenarios has shown that the results differ significantly, but in practically all cases up to 2050 It is forecasted a significant decrease in the runoff of spring flood (from 10-20% in the north of the investigated area and 40-50% in the south).**

**As an example, Figure 2 show the results of modeling the change in the maximum runoff of spring floods in two scenarios of RCP 4.5 and RCP 8.5 according to the model RACMO2.**

**a)RCP4.5**




**b)RCP8.5**

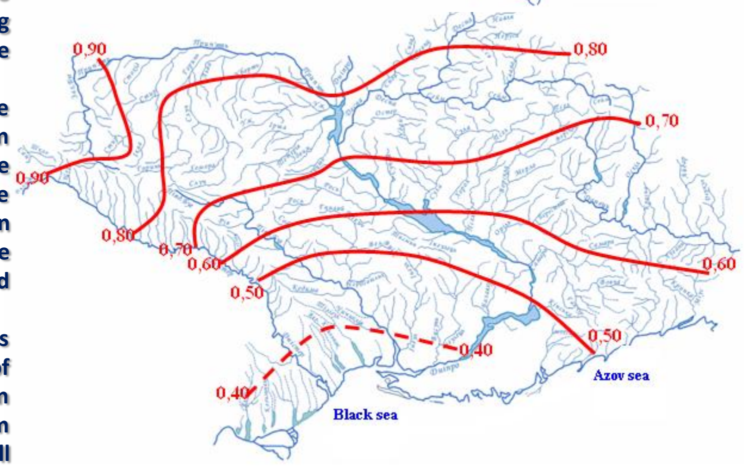



**Figure 2. Distribution of the coefficients of influence of climate change on the maximum runoff of spring flood on the plain territory of Ukraine (model RACMO2, scenario RCP4.5 (a) and RCP8.5 (b) for the period up to 2050, relative to 2010.**