# Flood pulse dynamics and the impact on fish habitat in the Volga-Akhtuba floodplain (Russia)

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Universiteit Utrecht — Faculty of Geosciences

WAGENINGEN UR — For quality of life
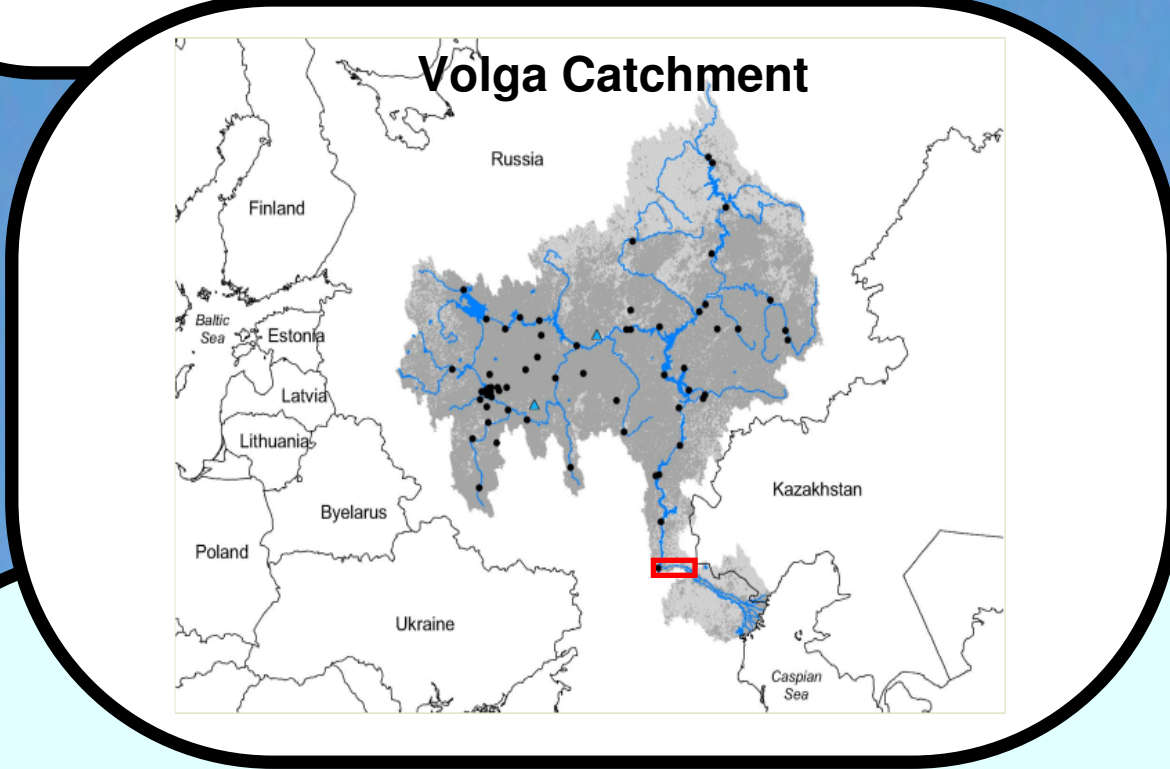
Volga Catchment

Floods & fish habitat

The Volga-Akhtuba floodplain is annually flooded in spring due to **snowmelt** in the catchment and releases by the upstream **hydropower dam**. Then, a complex system of channels and lakes in the floodplain becomes connected, and large areas of land are flooded for several weeks. During this period, many floodplain fish **spawn***.

In Dutch: paaien, kuitschieten

flooded grassland habitat

fry (larvae) of bleak, rudd and goldfish

In compliance with the **Flood Pulse-Concept** the presence of the annual flood is expected to be a dominant factor in the reproduction success of many floodplain fish species (Junk, 1989). In the future the size and timing of floods however may change due to **changes in climate, landuse and reservoir management.**
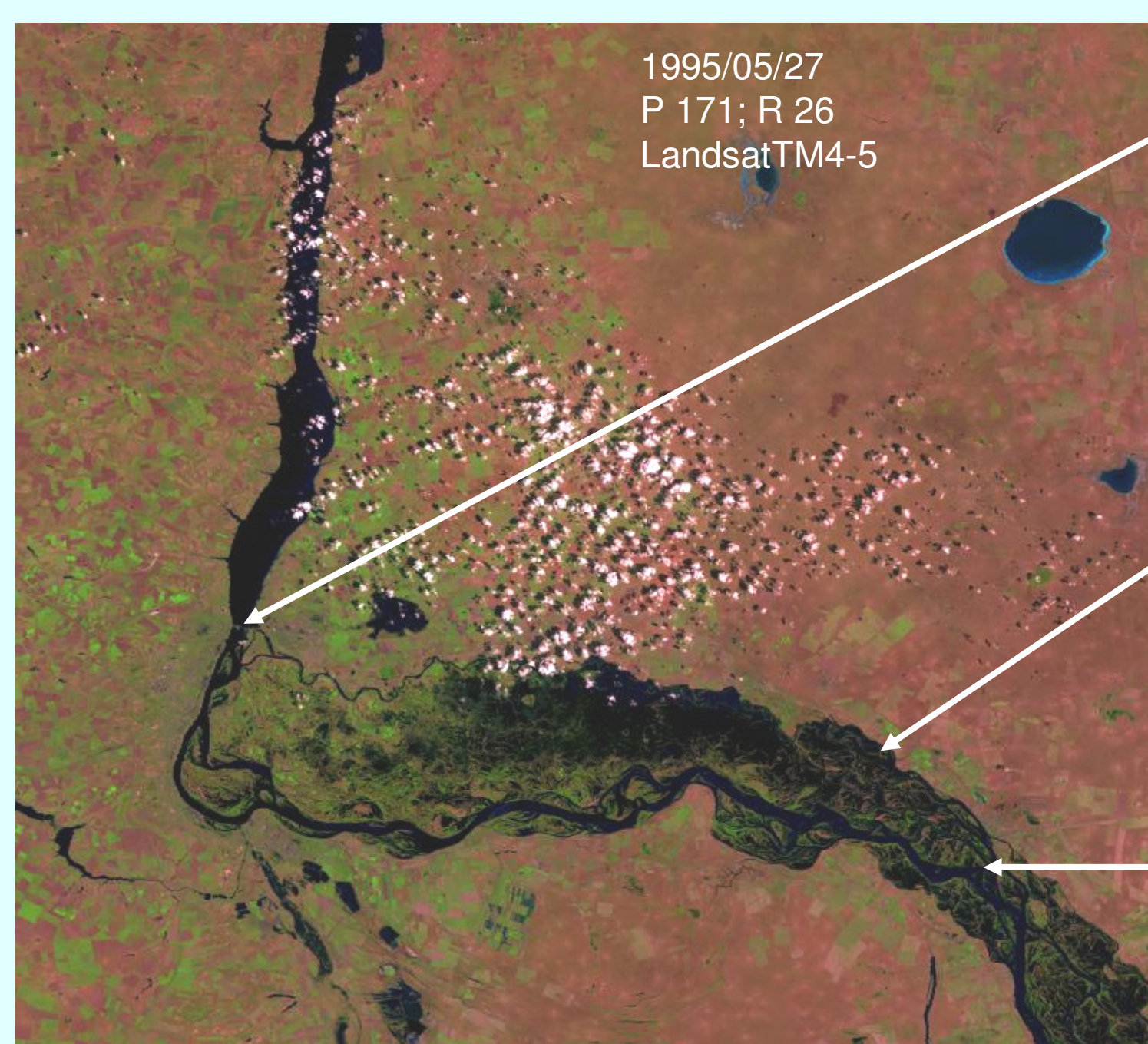
Central Research Question:
How will changes in annual floods affect fish population size and composition of species?

Studying Hydrodynamics

Assumption: Success of spawning is mainly determined by hydrodynamics

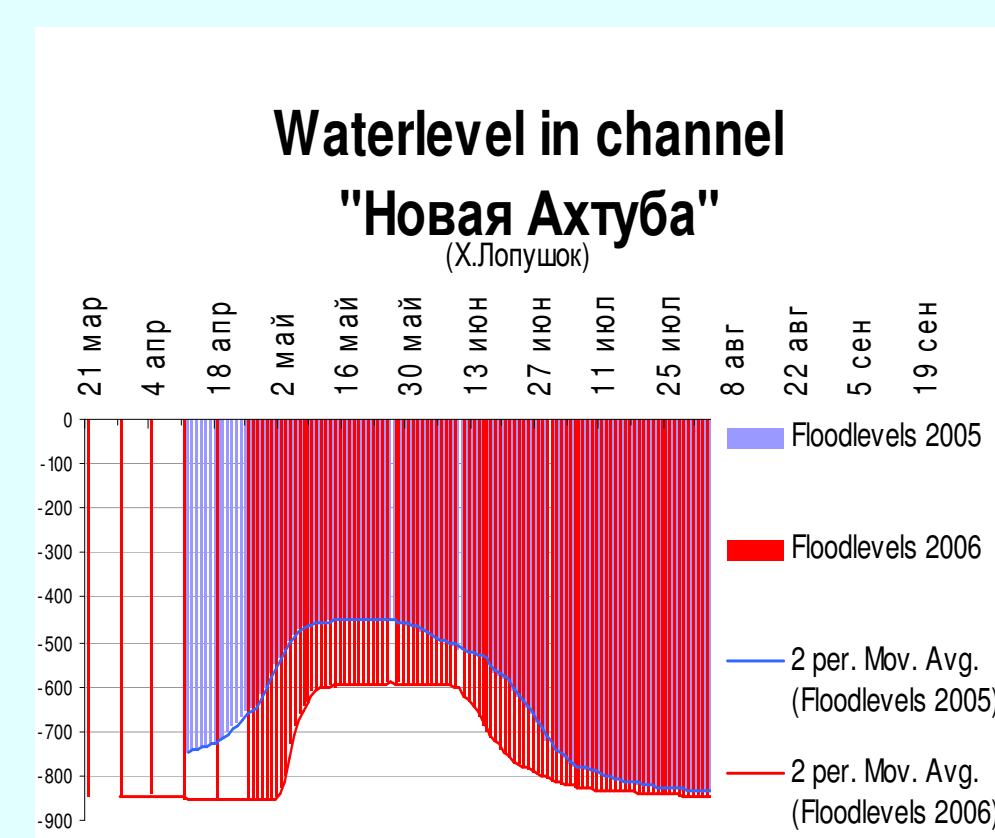### EMPIRICAL STUDY

1995/05/27
P 171; R 26
LandsatTM4-5

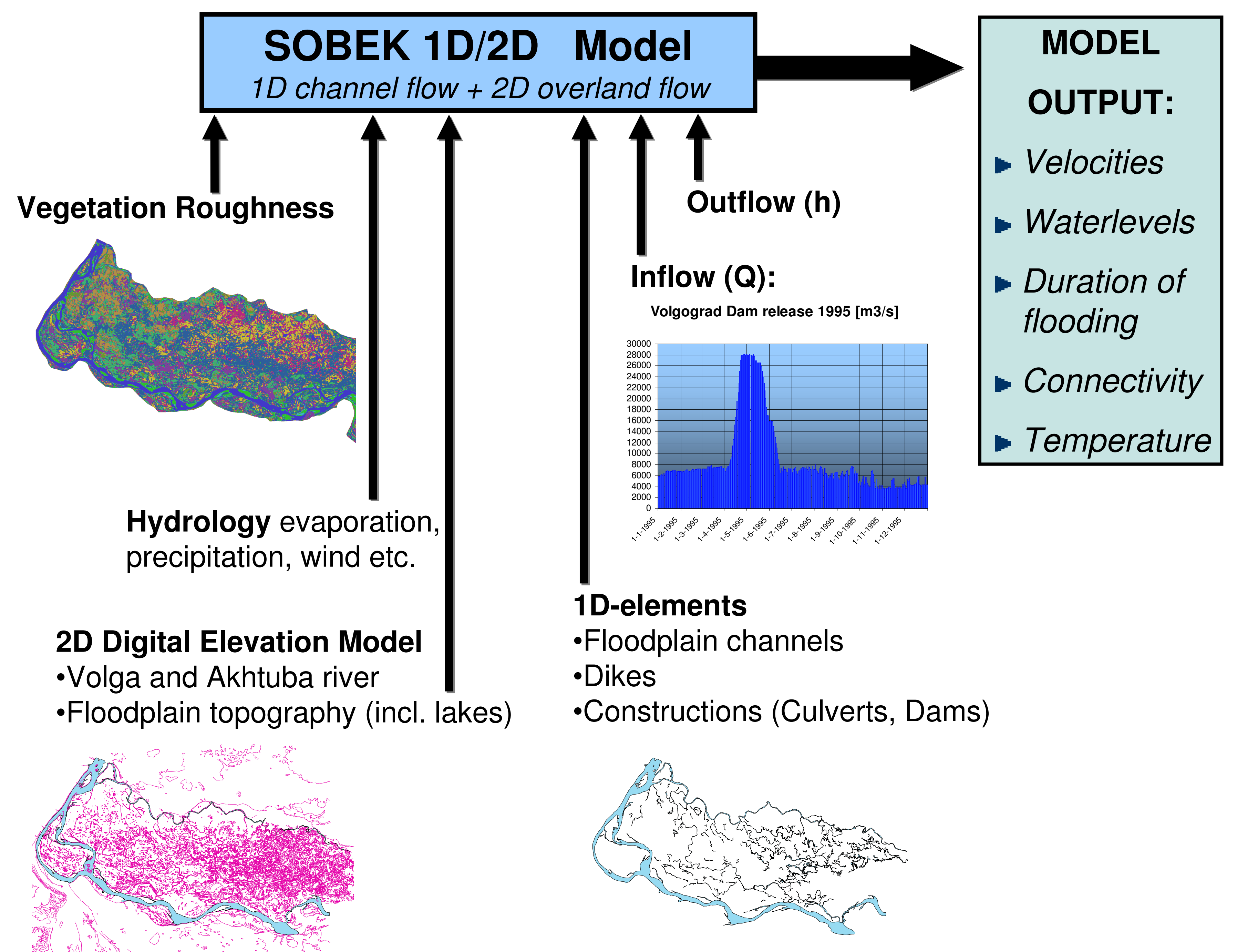Volgograd reservoir dam

Akhtuba River

Volga River

The **flooded area** can be calculated from satellite images (Landsat TM, ASTER) at several stages and related to discharge data.

A **discharge analysis** of the dam releases of the Volgograd reservoir is performed.

Waterlevel in channel "Новая Ахтуба" (Хлопуюк)

Floodlevels 2005
Floodlevels 2006
2 per. Mov. Avg. (Floodlevels 2005)
2 per. Mov. Avg. (Floodlevels 2006)

Floodplain waterlevels have been measured since 2005 by local farmers at at least ten places within the floodplain.

NUMERICAL MODELLING

SOBEK 1D/2D Model
1D channel flow + 2D overland flow

MODEL OUTPUT:
- ► *Velocities*
- ► *Waterlevels*
- ► *Duration of flooding*
- ► *Connectivity*
- ► *Temperature*

Vegetation Roughness

Outflow (h)

Inflow (Q):
Volgograd Dam release 1995 [m3/s]

Hydrology evaporation, precipitation, wind etc.

2D Digital Elevation Model
- •Volga and Akhtuba river
- •Floodplain topography (incl. lakes)

1D-elements
- •Floodplain channels
- •Dikes
- •Constructions (Culverts, Dams)

Spatial habitat prediction

To predict fish habitats, **habitat parameters** must be defined in terms of hydrodynamic model parameters (e.g. flow velocity, depth and water level).

I ♥ floods !
Mother Fish Wish list:
Oxygen for my eggs
Sandy bottom to sleep on
Water temperature around 8°C
Loads of fresh plankton
Turbid waters to mislead predators
Vegetation to shelter my babies
Close to the highway to leave quickly
Min. 10 days for my babies to grow

Other important habitat conditions are spatially combined with the model results in **ArcGIS/PCRaster**, e.g.
- water quality
- soil conditions
- (terrestrial) vegetation

Scenario modelling

Summer 2006: Ecologic catastrophe?

In 2006, many lakes completely **dried up**. Cause: Very low flood levels in spring combined with an extreme long and dry summer.

With the model scenarios such as these can be run and the effect on fish populations predicted.

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