# *THE CONCEPT OF PERMANENT EXISTING MODELS – THE MAIN INSTRUMENT FOR ASSESSMENT OF TRANSBOUNDARY GROUND WATER FLOWS*

Study and prediction of groundwater conditions of the adjacent states demand exact quantitative estimations especially in cases of increasing of technogenic load on groundwater

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It's necessary to consider the goundwater flow as a general which existence and properties are provided by recharge and discharge areas, especially if these areas are located on the territories of different states

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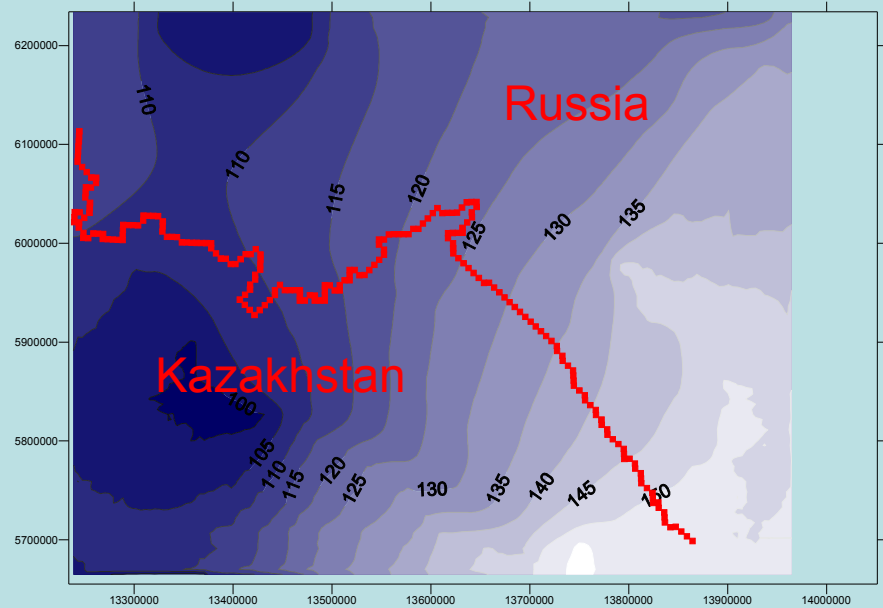
Assessment of ground water flow system

In general case the law of groundwater movement at confined-unconfined geofiltration, can be described by the system of differential equations, which commonly for layer *n* can be written as:

$$\sum_i Q_{xi}^n + \sum_i Q_{yi}^n + \sum_i Q_{zi}^{n-1} + \sum_i Q_{zi}^{n+1} + \sum_i Q_{ai}^n + \sum_i Q_{gi}^n + \sum_i Q_{wi}^n = \sum_i Q_{ci}^n$$

where - $Q_{xi}^n = \dfrac{\partial}{\partial x}\left(T_{xi}^n \dfrac{\partial H_i^n}{\partial x}\right)$ - plan flow along axis X(Y), (m/day),

$\sum Q_{wi}^n$ - infiltration,

$\sum Q_{zi}^{n-1}$ $\sum Q_{zi}^{n+1}$ - vertical flow from adjacent aquifers,

$\sum Q_{ai}^n$ - is the intensity of groundwater extraction,

$\sum Q_{gi}^n = (H_{si}^n - H_i^n)G_i^n$ - water exchange with the surface water:

$\sum Q_{ci}^n = S_i^n \dfrac{\partial H_i^n}{\partial t}$ - changes in the capacity for nonstationary geofiltration

H_{si}^n - surface water level,

G_i^n - the conductivity of river-bed deposits

H_i^n - - function of aquifer head at point *i*.

For the undisturbed filtration regime the right side of equation equals to 0.

The transmissivity of the aquifer at calculated node was determined by absolute marks of top and bottom of aquifer by the following relationship:

$$T_{x,yi}^n = (H_i^n - H_i^b)K_f$$

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The following criteria are suggested for regulation of transboundary water use:

3. to estimate and predict the level of possible groundwater depletion,

4. to estimate and predict the possible damage to underground component of surface water during long-term groundwater exploitation in comparison with undisturbed filtration conditions,

5. prediction of dynamic of contaminated groundwater spreading in accordance with the size of sanitary zones during exploitation of well-fields situated on the territory of adjacent states.

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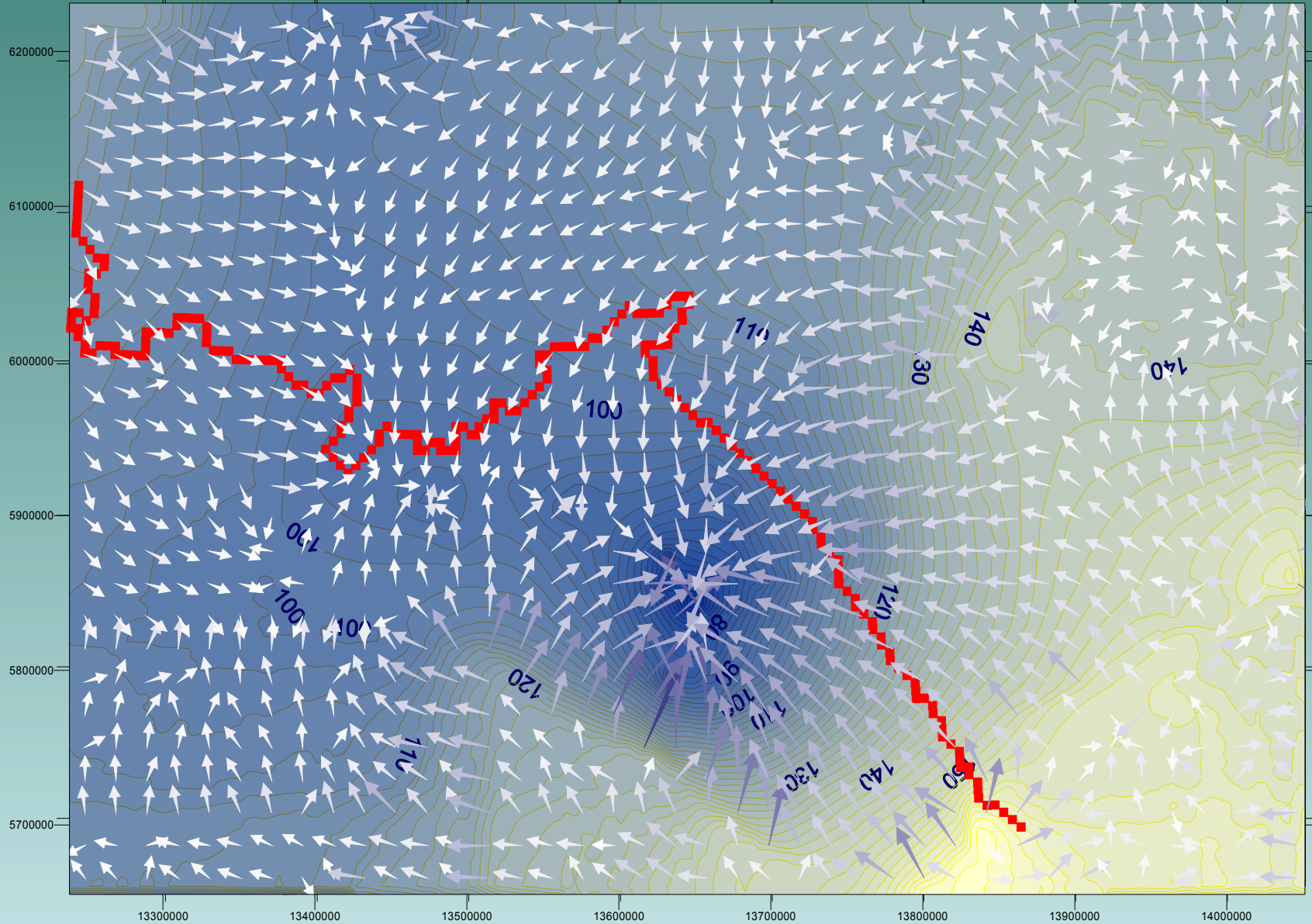
I. By the rate of groundwater depletion

1. the maps of hydroisopiese for each aquifer;
2. the calculation of groundwater level lowering;
3. the calculation of the full amount of the plane groundwater flow
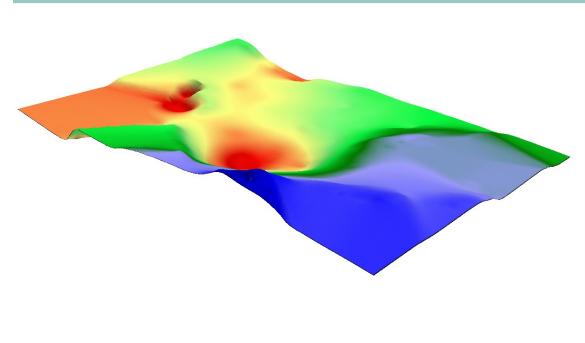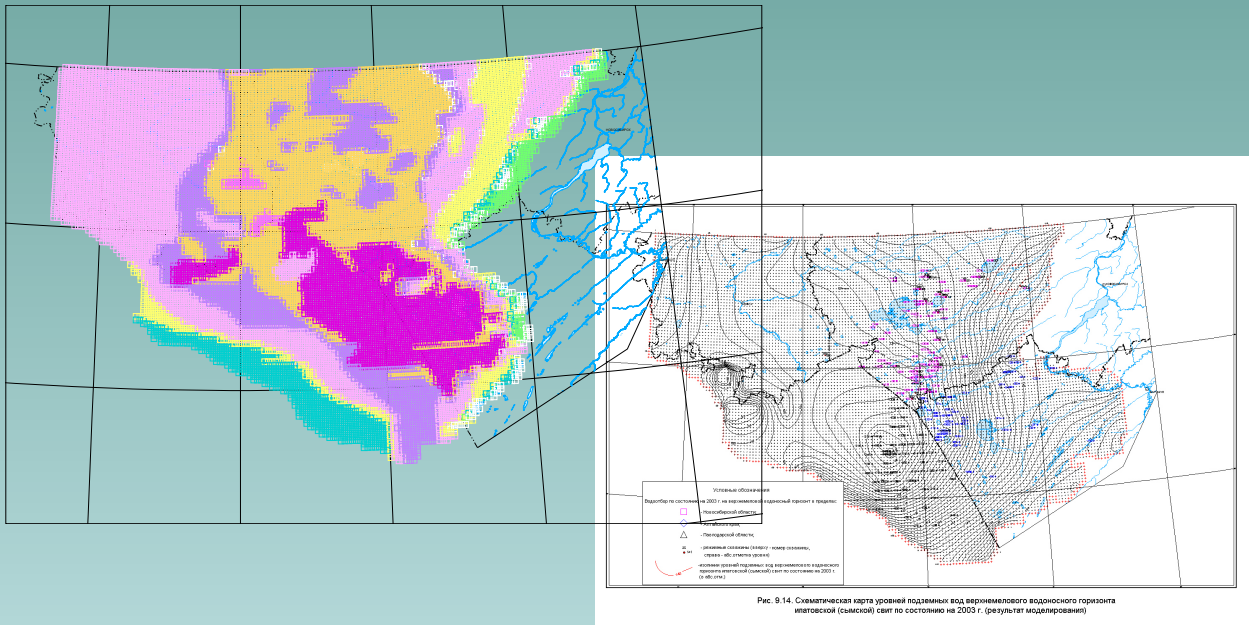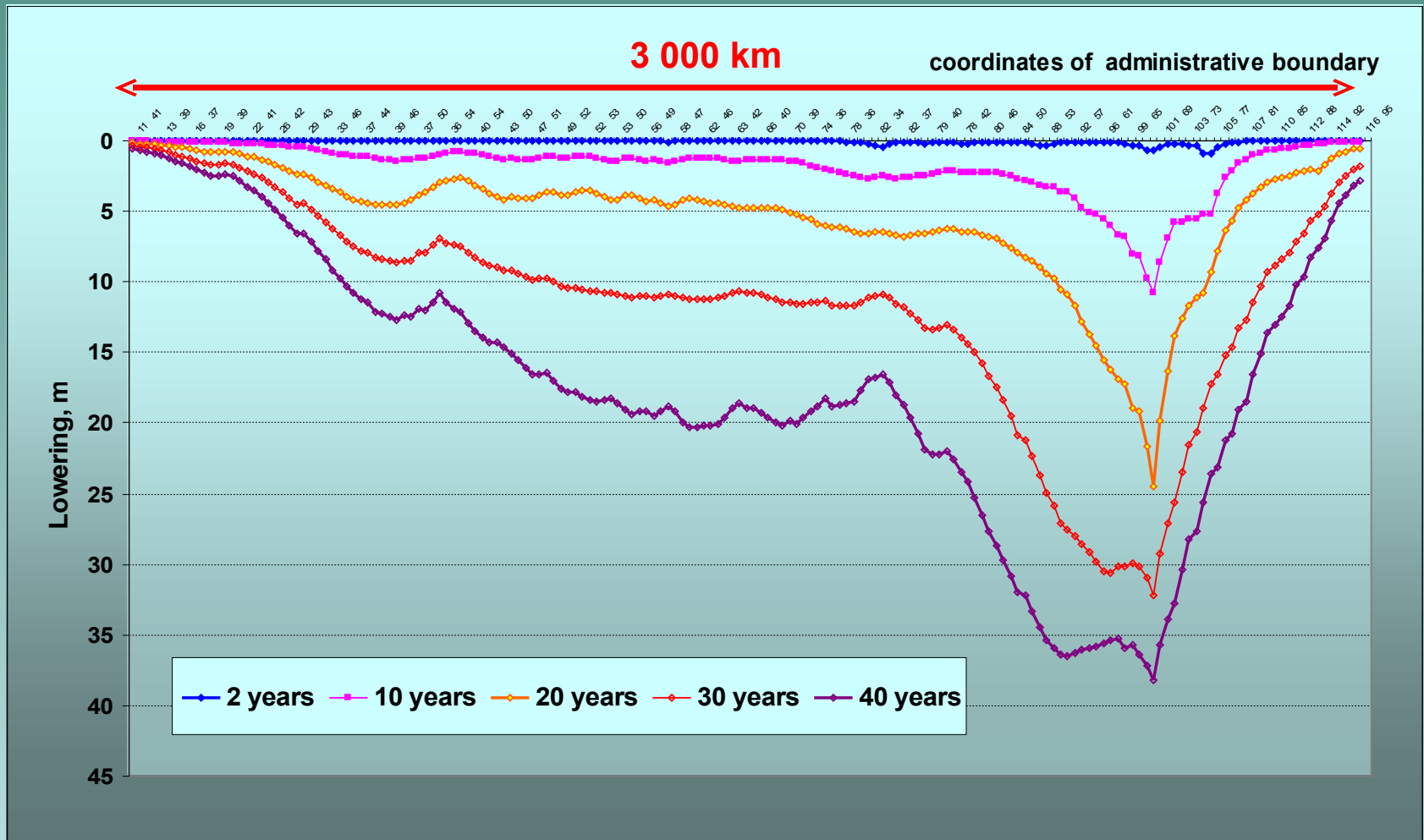
The map of hydroisopiese on a calculated time step allows to receive
the quantitative assessment of direction, velocity and time of depression cones spreading relatively administrative boundaries

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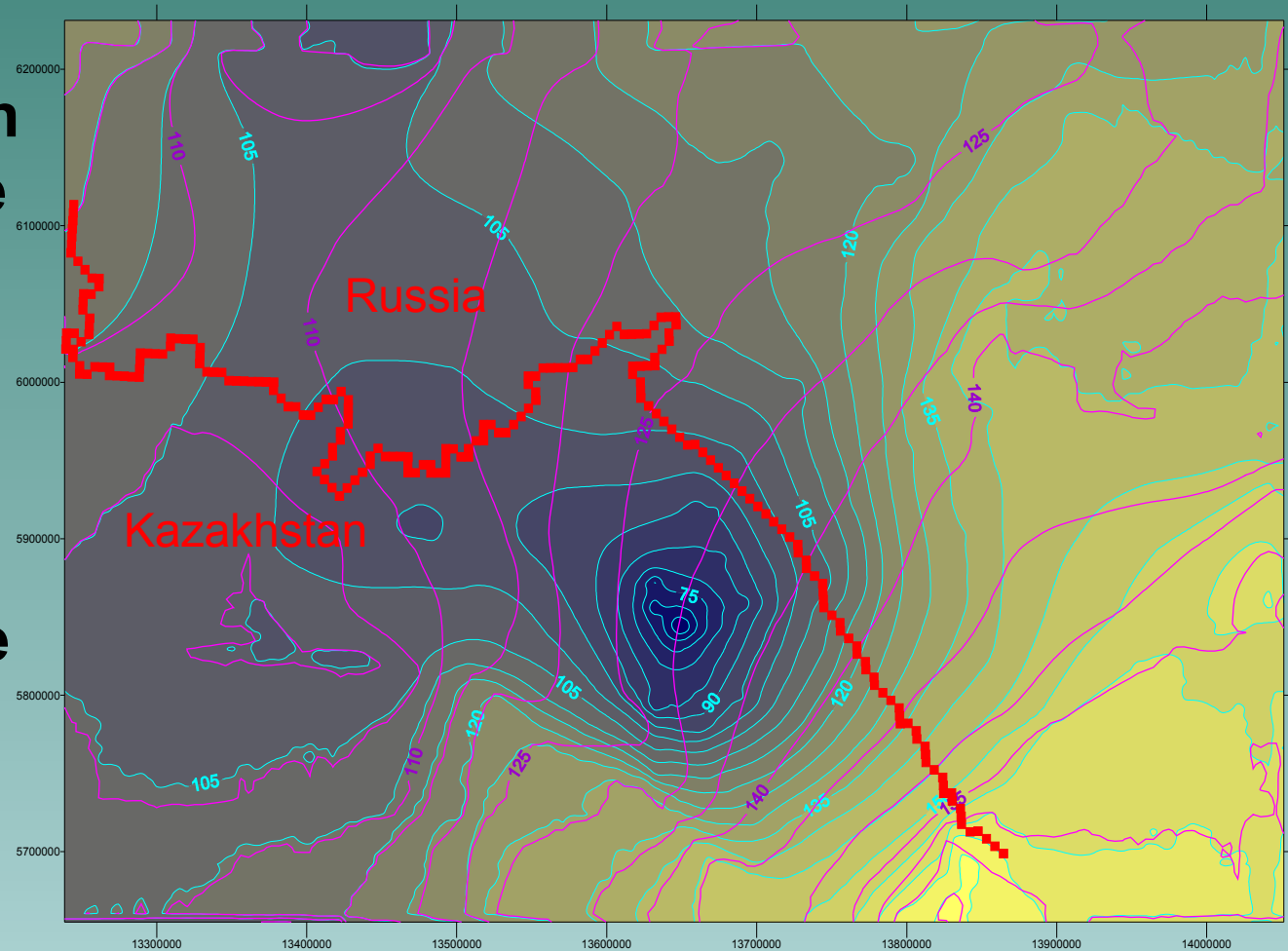
Compatible modification of the flow structure in undisturbed and disturbed geofiltration processions

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Lowering in the points along administrative boundary in west-east direction for different time steps

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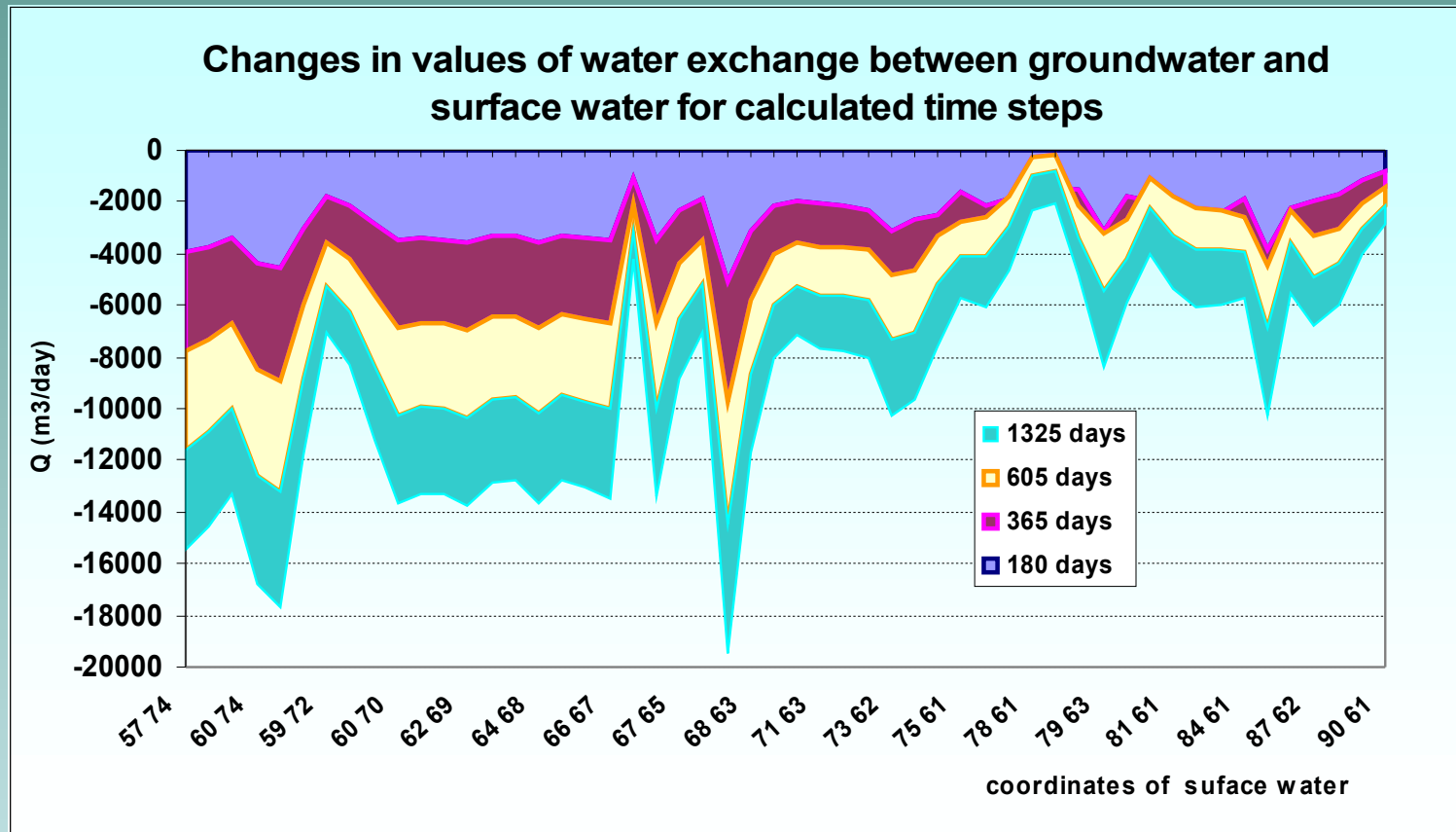
The calculation of the value of foreign plane groundwater flow in the case of depression cone spreading on the territory of the adjacent state as a result of excess of value of possible water withdrawal by one of the states

Plan groundwater flows under depression cones spreading on the territory of adjacent state (m3/sut)

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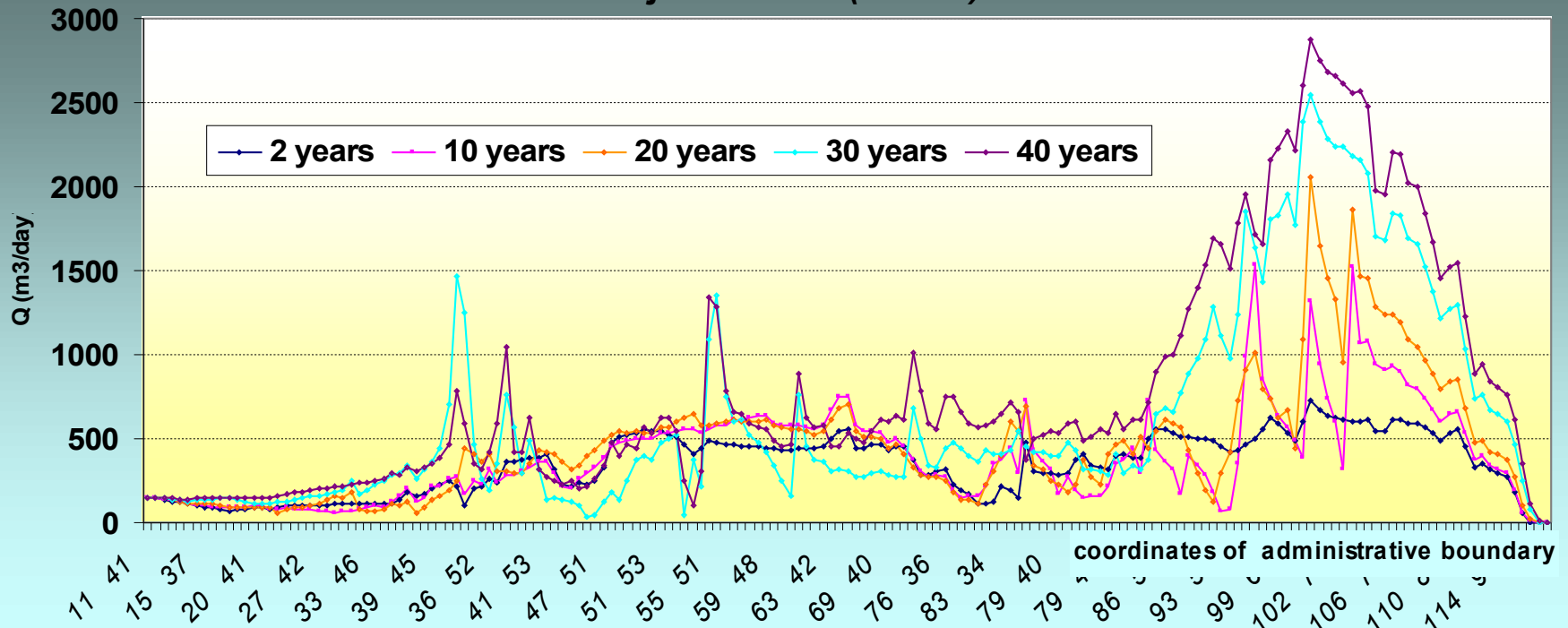
2. By the rate of surface water depletion:

- the graph of changes in water exchange between surface and ground water on different time steps in comparison with undisturbed filtration conditions;

- the quantitative assessment of damage to underground component of river runoff for all surface water sources determined on the model under excess of admissible water withdrawal level by one of state

Changes in values of water exchange between groundwater and surface water for calculated time steps

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3. By the rate of groundwater contamination

Two possibilities of geomigration modeling:

3. Calculation of spreading time from contamination sources.

4. Finding one's position of location probable contamination source by inversing velocity directions.

The times of groundwater contamination

contamination sources

areas of groundwater contamination

exploited well-field
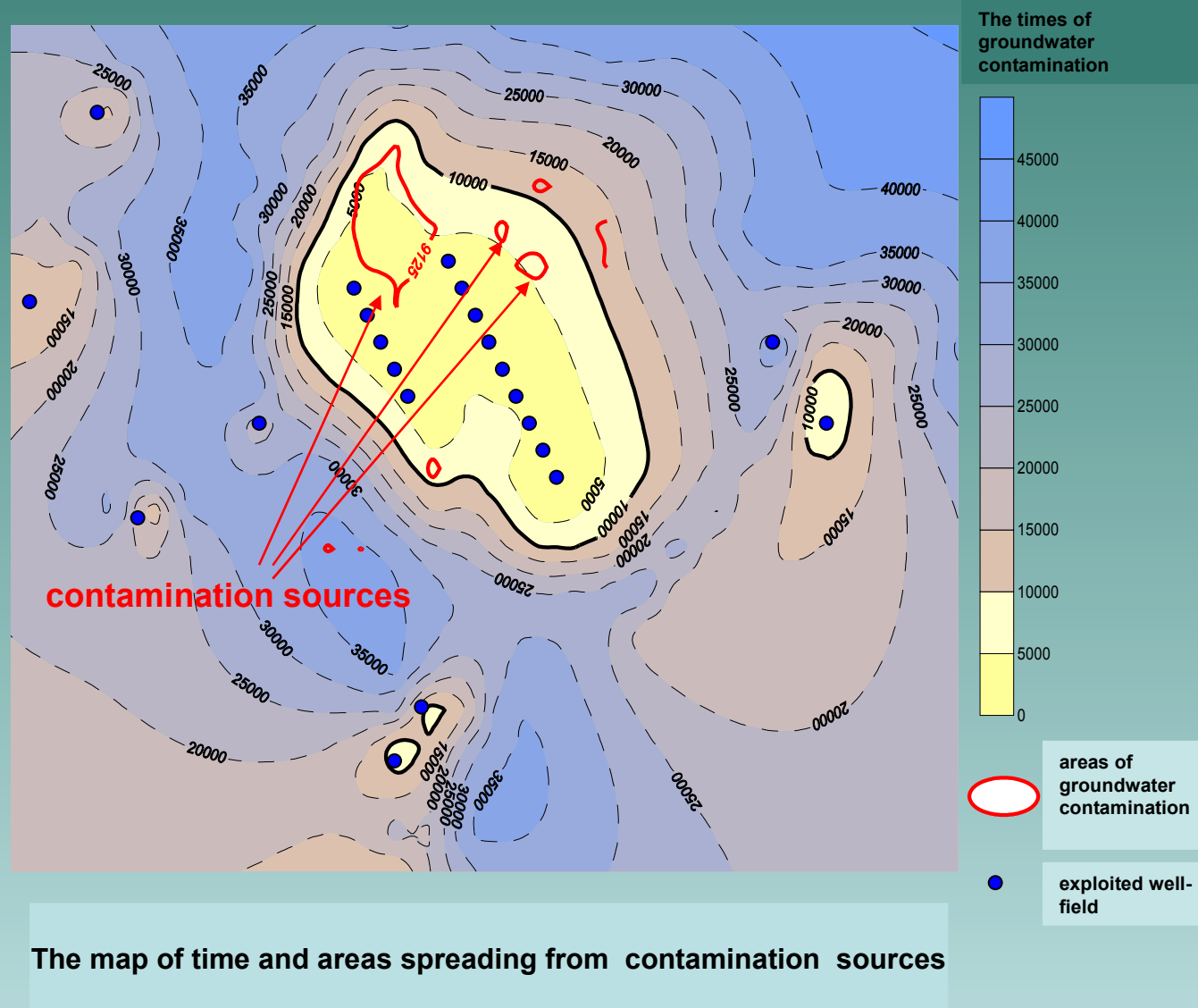
The map of time and areas spreading from contamination sources

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Conclusions

- The constant-working models, as an instrument for hydrogeoecological forecasting, have to be a part of the subsystem of the total interior monitoring.

- Using such approach, both geological service and government authorities meet the real instrument for assessing present-day and prediction conditions of underground hydrosphere and efficient regulating of the anthropogenic load.

- Creation of constant-working models has to be carried out by professional hydrogeologic organizations using all necessary data including archival information. The control of model adequacy to hydrogeologic processes occurred on the territory under investigations have to be realized by special subdivisions being a part of such organizations.

- The use of constant-working models can be realized by several customers according to their purposes (e.g. well-field services or organizations responsible for geoecologic predictions of changes in hydrosphere such as flooding or groundwater quality deterioration).

Thank for your attention!

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