

Management evaluation and optimization of dispatching schedules of Irkutsk reservoir.

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1

Dispatching schedules management

Dispatch schedule – 24 intervals nodal points table

Nodal points

Intervals boundaries

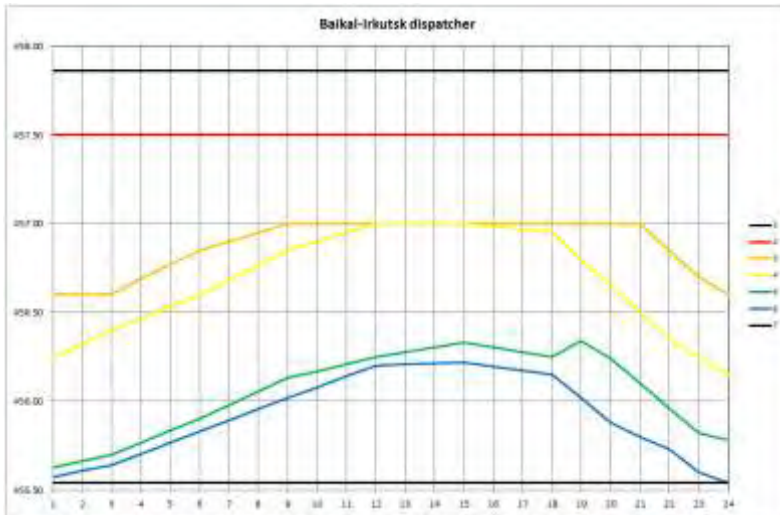
Discharge rates

24 intervals nodal points table																							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
11.65	21.95	01.65	11.66	21.95	01.67	11.67	21.97	01.68	11.68	21.98	01.69	11.69	21.99	01.69	11.69	21.99	01.70	11.70	21.99	01.70	11.70	21.99	01.70
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
7.289	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293	7.293
457.86	457.86	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96
0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933
0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933
457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96	457.96
0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933
4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933	4.933
458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00	458.00
0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933	0.933
2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900	2.900
458.34	458.32	458.40	458.47	458.53	458.60	458.66	458.72	458.77	458.82	458.86	458.90	458.93	458.96	458.99	459.00	459.00	459.00	459.00	459.00	459.00	459.00	459.00	459.00
1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833	1.833
1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533	1.533
458.43	458.44	458.70	458.77	458.83	458.90	458.96	459.02	459.07	459.12	459.17	459.21	459.25	459.28	459.30	459.33	459.34	459.35	459.36	459.37	459.38	459.39	459.40	459.41
1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400
1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400
458.67	458.67	458.68	458.70	458.77	458.82	458.89	458.96	459.00	459.02	459.06	459.10	459.14	459.19	459.21	459.23	459.25	459.28	459.31	459.34	459.36	459.38	459.40	459.41
1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333
1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333
458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54	458.54
1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

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2

Dispatcher – breakout lines



Balance equations
$$W_{end} = W_{beg} + Q - R$$

Bathymetric function
$$H = f(W)$$

H – reservoir level

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3

Water users' requirements number

K

k -th requirement penalty function

$$F_k = V_k \times P_k$$

V_k

number of violation years for the k -th water user

P_k

penalty coefficient for the k -th water user

Total objective function

$$F = \sum_{k=1}^K F_k$$

The compromise dispatch schedule

$$DS \text{ with } F = F_{min}$$

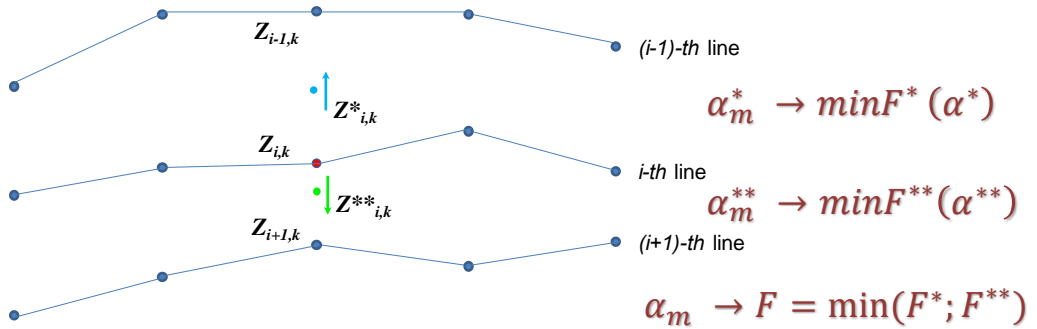
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4

Dispatcher optimization by nodal points shifting

Upward shifting $Z_{i,k}^* = Z_{i-1,k} \cdot \alpha^* + Z_{i,k} \cdot (1 - \alpha^*)$

Downward shifting $Z_{i,k}^{**} = Z_{i+1,k} \cdot \alpha^{**} + Z_{i,k} \cdot (1 - \alpha^{**})$

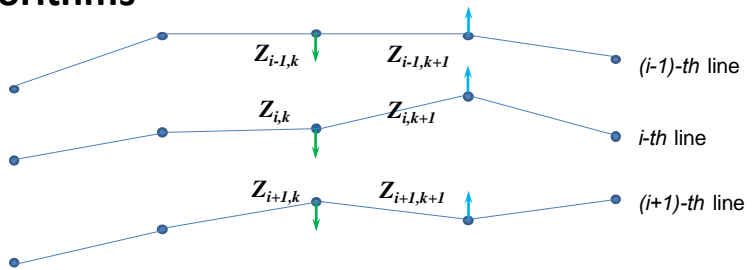


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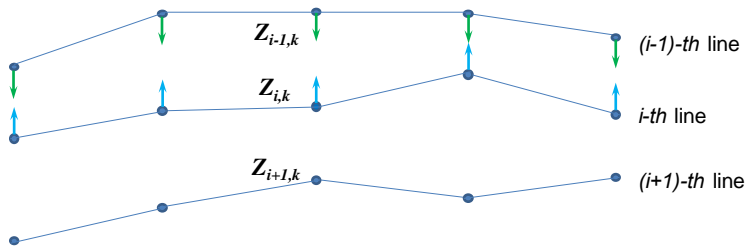
5

V and H optimization algorithms

V - "Vertical"

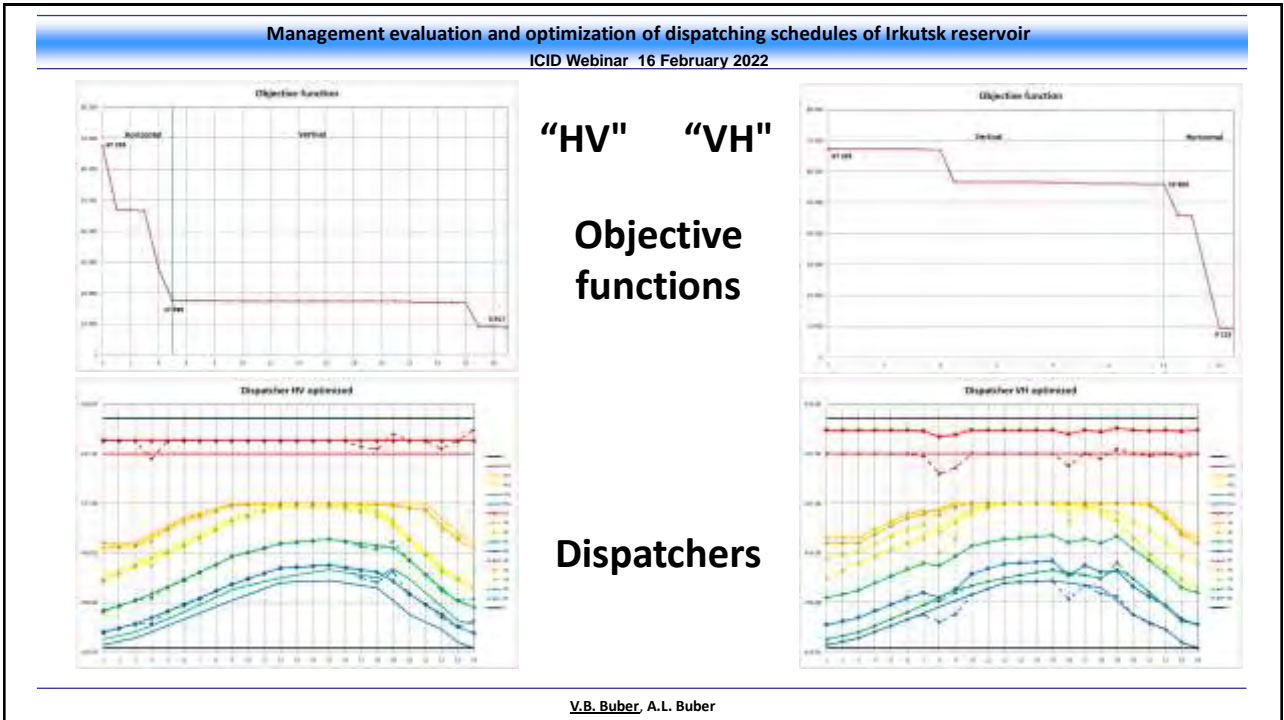


H - "Horizontal"



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6



7

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Violation Years Number and Violations Depth

Table 1. Violations Years Number

Criteria	1	2	3	4	5	6	7	8	9	10	11
Penalty coeff.	1	1	1	100	100	10000	100	100	10000	100	10
Initial dispatcher	3	24	36	10	8	3	38	8	3	5	27
H optimized	0	20	18	10	16	0	36	8	1	4	16
HV optimized	0	20	17	25	15	0	35	8	0	3	28
VH optimized	1	37	8	3	16	0	53	5	0	5	97
HH optimized	1	27	30	4	10	0	40	7	0	2	77
HH $k_4=10\ 000$	1	36	25	1	7	1	52	6	1	5	90
HH $k_4=100\ 000$	1	40	21	1	8	0	57	6	0	4	97
HH $k_4=1\ 000\ 000$	3	38	29	0	7	3	55	6	11	18	90

Table 2. Violations Depth

Criteria	1	2	3	4	5	6	7	8	9	10	11
Initial dispatcher	0.06	0.43	0.52	658	450	250	2 528	87.84	0.96	2.28	0.52
H optimized	0.00	0.45	0.42	1 116	200	0	2 235	31.80	0.52	1.09	0.42
HV optimized	0.00	0.44	0.40	688	200	0	2 198	31.10	0.02	1.04	0.40
HH optimized	0.02	0.52	0.45	1 523	200	0	2 144	32.98	0.00	0.40	0.45
HH $k_4=10\ 000$	0.02	0.50	0.48	1 163	200	250	2 369	86.76	0.13	1.29	0.48
HH $k_4=100\ 000$	0.05	0.55	0.46	1 572	200	0	2 173	33.27	0.00	0.37	0.46
HH $k_4=1\ 000\ 000$	0.07	0.40	0.53	0	450	250	2 800	87.88	1.00	2.46	0.53

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8

Thank you for your
attention!