BASEMENT

BASEchain-Fallbeispiel Thur

Renata Müller

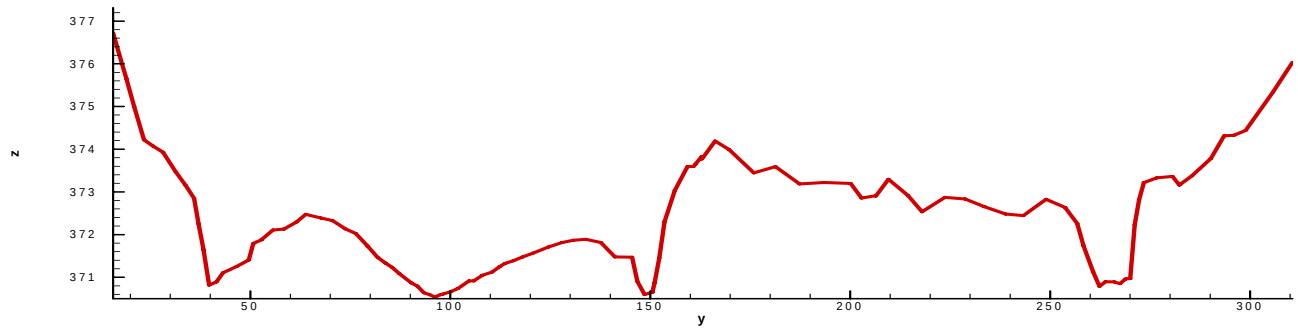
Versuchsanstalt für Wasserbau
Hydrologie und Glaziologie

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Überblick

- Einführung
- Erstellen der Topographie Datei
- Erstellen der Command Datei
- Berechnen des stationären Abflusses
- Berechnen der Hochwasserhydraulik
- Berechnen des Sedimenttransports
- Fazit

Aufweitung – 1D?



Erstellen der Topographie Datei

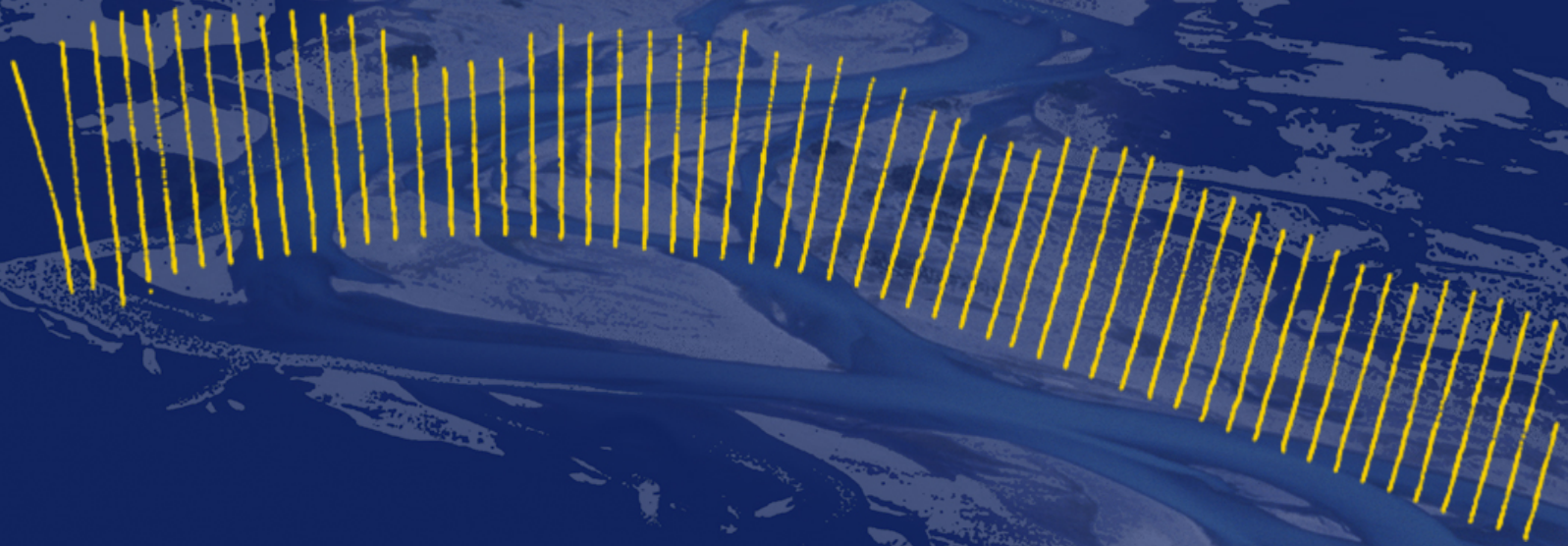
Typ „Floris“

- **Geometrie der Querprofile**
- **Gliederung der Querprofile**
- **Definition der Sohle**
- **Definition der durchströmten Gebiete**
- **Informationen zur Berechnung der hydraulischen Kenngrössen in den Querprofilen**

Erstellen der Topographie Datei

Geometrische Rohdaten

x	y	z
698578.504	272450.223	376.841
698578.494	272446.999	374.991
698578.32	272444.286	373.748
698577.929	272441.889	373.229



Erstellen der Topographie Datei

z(y) Funktion

von links nach rechts

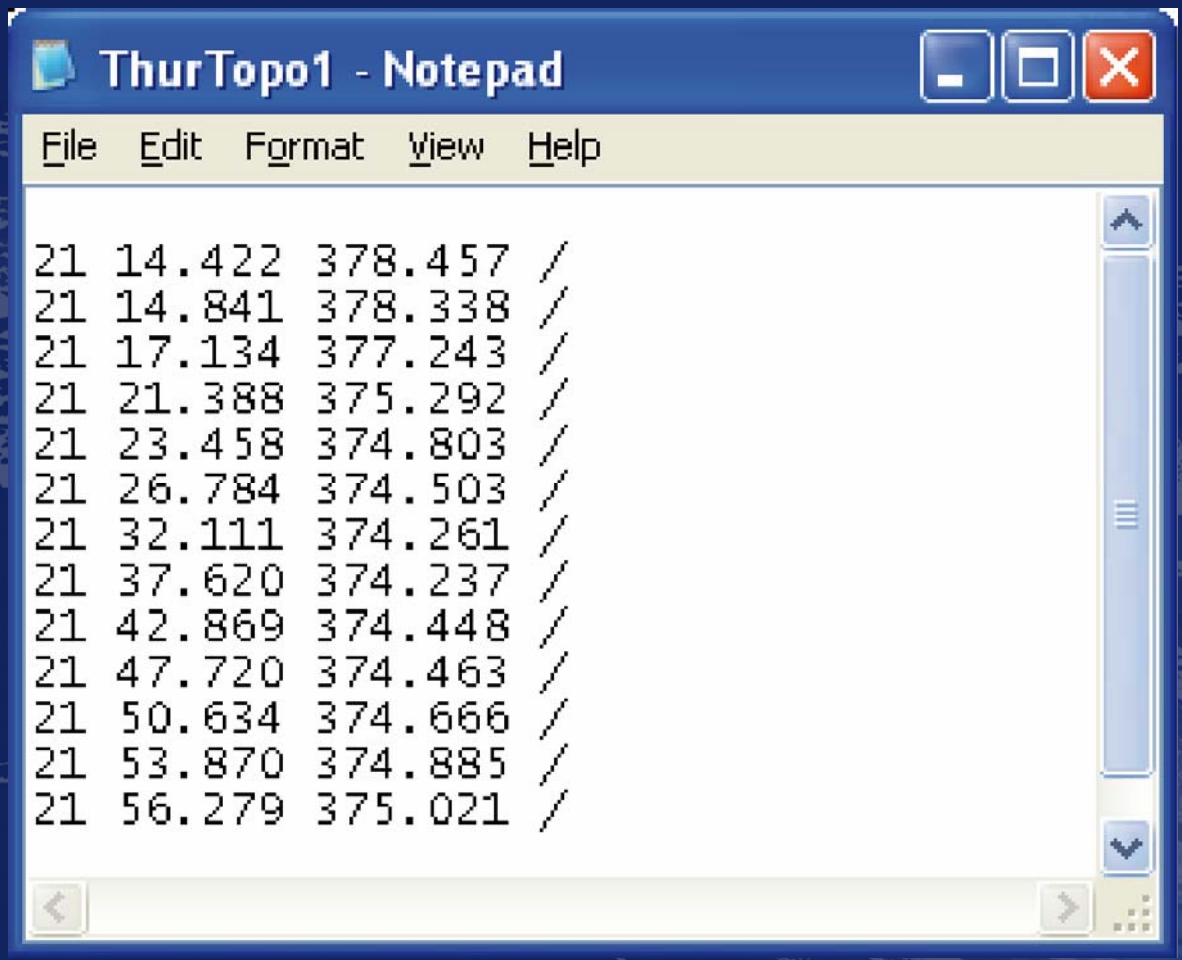
y	z
0	376.264
1.455081097	376.327
4.349044033	377.804
5.134094857	378.133
6.803278107	378.238
8.241452785	378.227
9.123103693	377.965
10.23346129	377.395
11.41786604	376.664
12.57016281	376.221

Distanzen vom oberen Ende

CS1	0
CS2	49.821
CS3	99.218
CS4	149.53
CS5	204.02
CS6	252.34
CS7	302.38
CS8	353.9
CS9	401.01
CS10	452.16
CS11	503.47

...

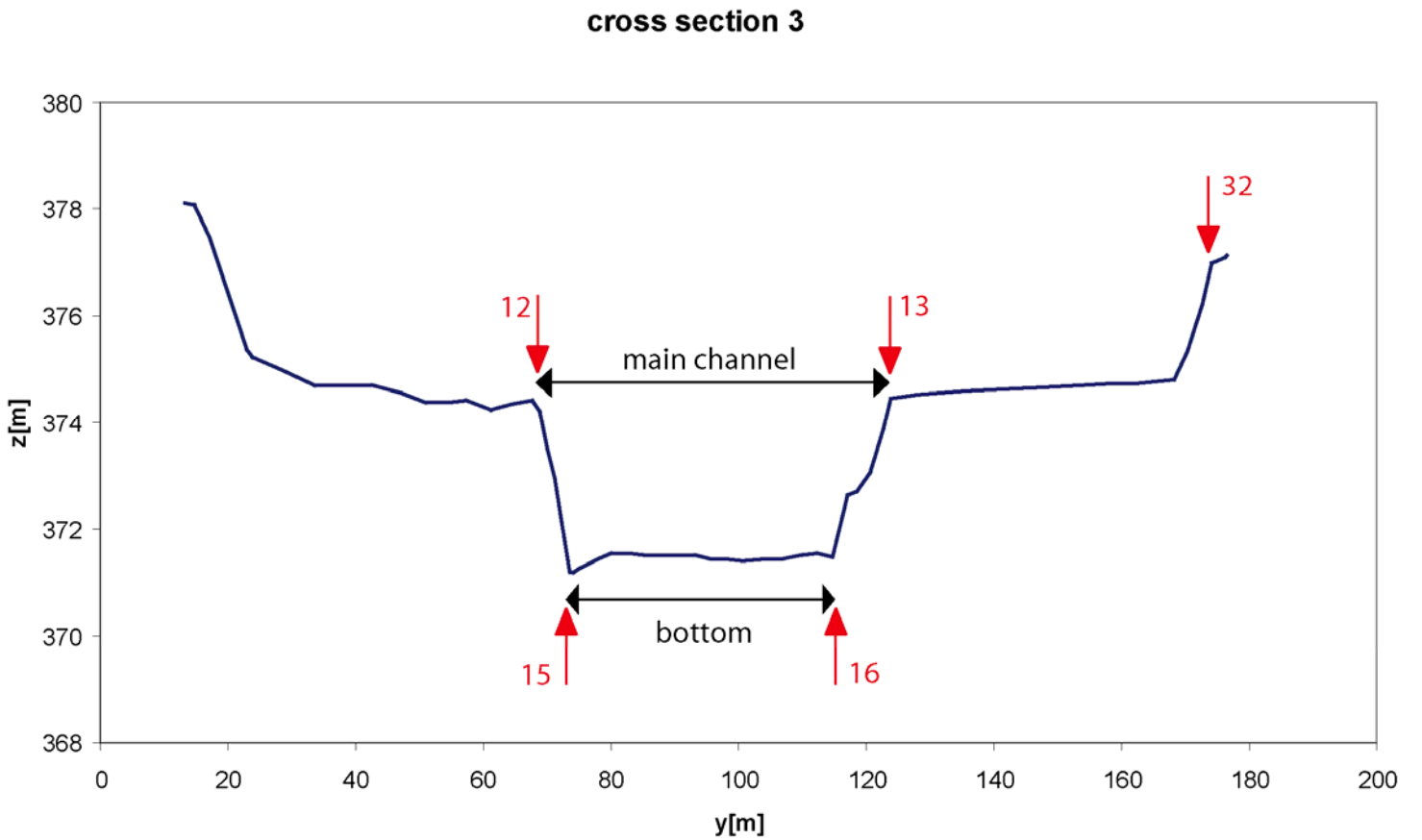
Erstellen der Topographie Datei



Einfügen in Text Datei

Vor jedem Punkt ein „21“

Topographie Datei - Gliederung

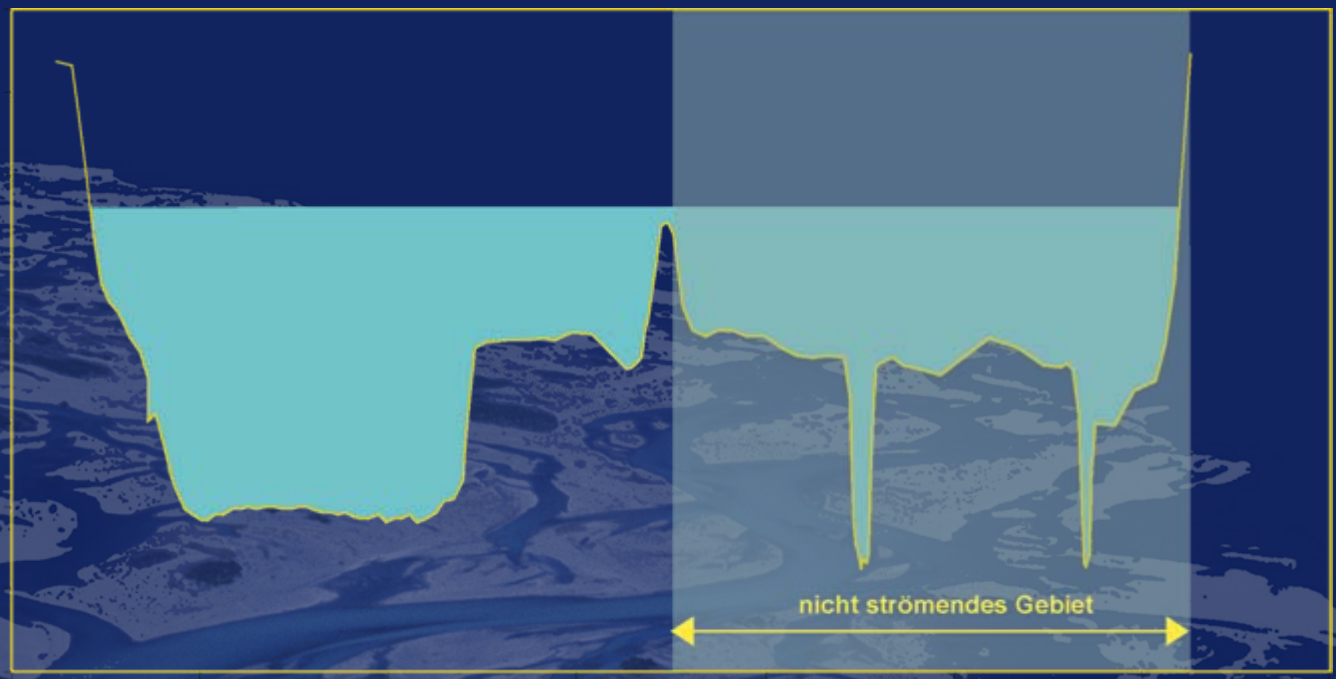


Topographie - Gliederung

21 53.874 375.135 /
21 56.279 375.271 /
21 58.848 375.342 , , 12 /
21 60.685 375.063 /
21 62.707 374.56 /
21 64.438 373.46 /
21 66.320 372.124 /
21 66.615 371.986 , , , , 15 /
21 68.613 371.891 /
21 70.433 371.875 /
21 72.403 371.85 /

21 99.973 371.714 /
21 102.809 371.781 /
21 106.013 371.844 /
21 109.124 371.74 /
21 111.330 371.971 , , , , 16 /
21 112.648 372.694 /
21 113.585 373.837 /
21 115.490 374.895 , , 13 /
21 120.080 374.941 /
21 123.946 374.943 /
21 128.698 374.988 /
21 133.639 375.017 /

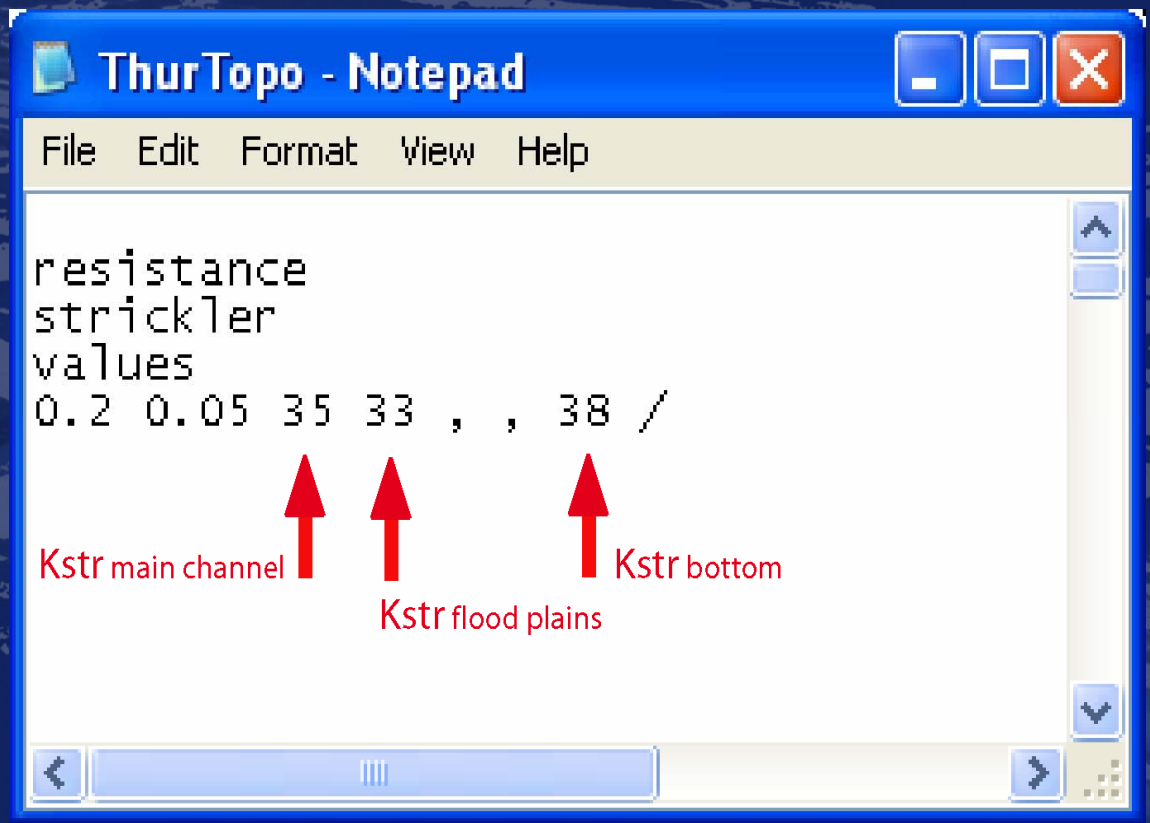
Topographie - Gliederung



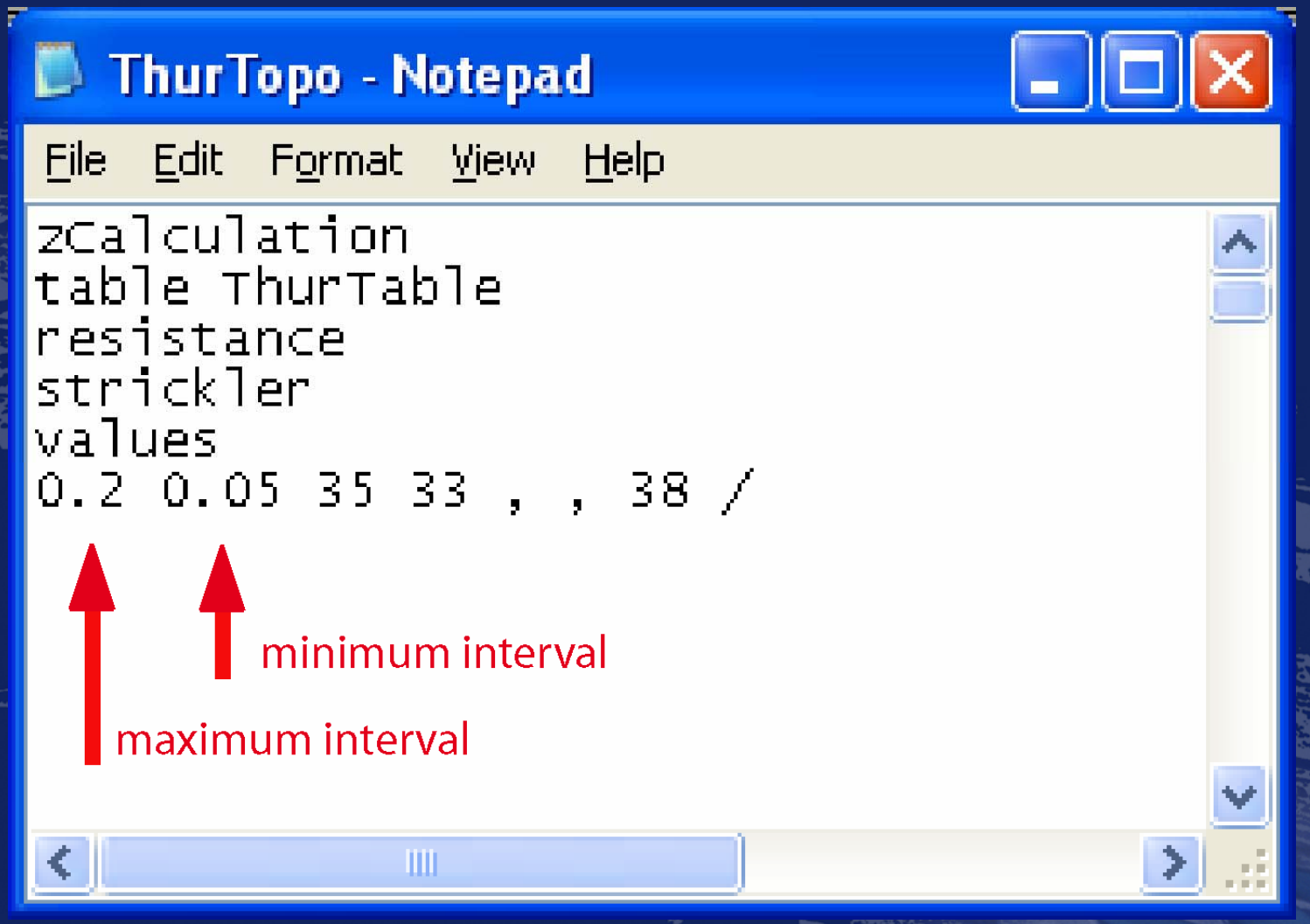

```
21 237.857      370.822  /
21 243.905      370.697  /
21 250.315      370.546  /
21 256.708      370.25   ,,, 1  /
21 262.759      369.993  ,,, 1 /
21 268.701      369.94   ,,, 1 /
```

Reibung

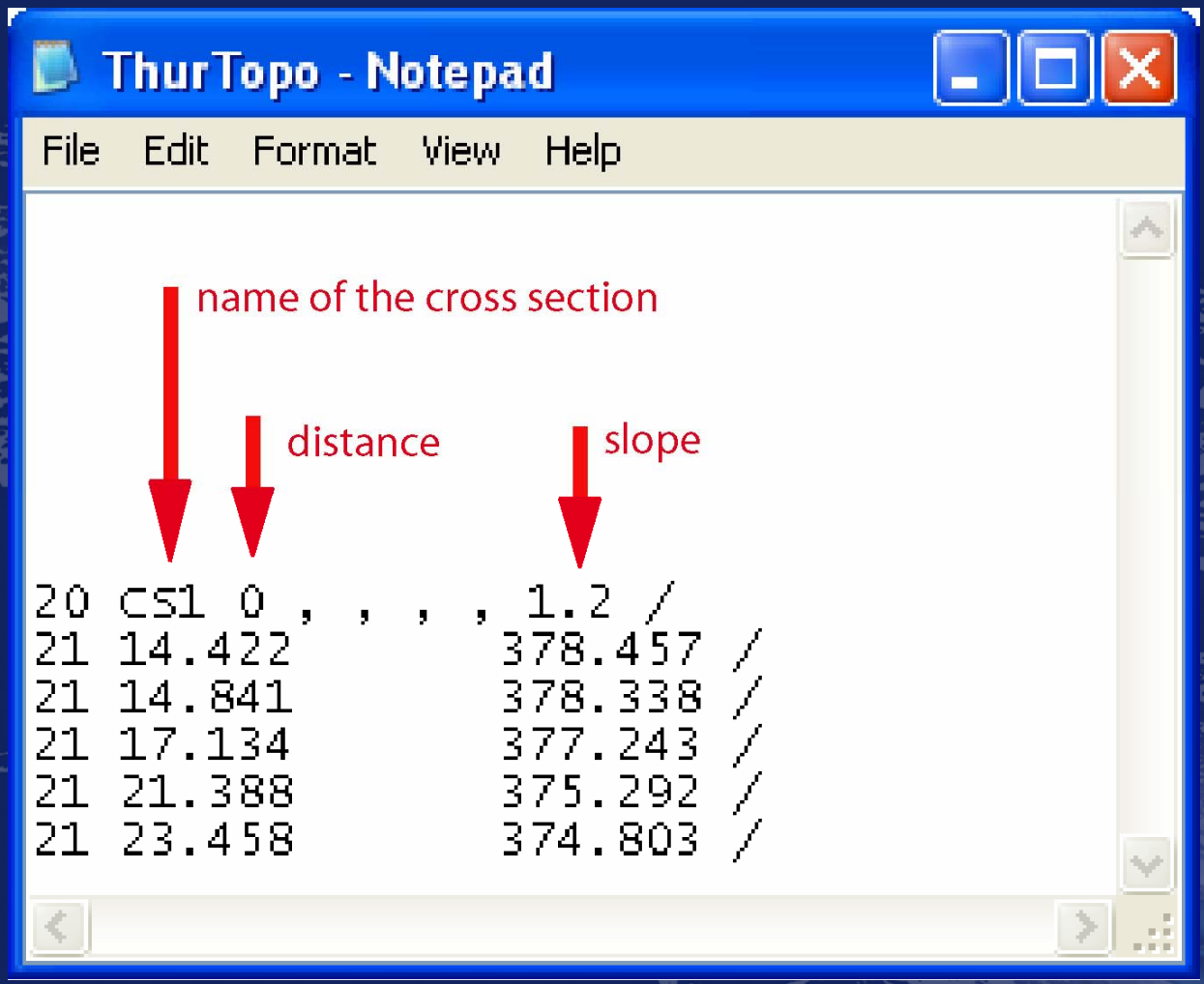
- Hauptgerinne $K_{Str} = 35$ $[m^{1/3}/s]$
- Vorländer: $K_{Str} = 33$ $[m^{1/3}/s]$.
- Sohle: $K_{Str} = 38$ $[m^{1/3}/s]$. aus Korndurchmesser



Berechnung der Wasserspiegellage aus A



Topographie Querprofil Daten



Sediment Charakterisierung

Bodenindex für gesamtes Querprofil

```
20 CS1 0 , , , , 1.2  1 /
21 14.422  378.457 /
21 14.841  378.338 /
21 17.134  377.243 /
21 21.388  375.292 /
21 23.458  374.803 /
```

Bodenindex für einzelne Abschnitte:

```
21 60.684   375.063 /
21 62.707   374.56  /
21 64.438   373.46 /
21 66.320   372.124 /
21 66.615   371.986  , , , , 15 /
21 68.613   371.891  ,,,,,  2 /
21 70.433   371.875  ,,,,,  2 /
21 72.403   371.85  ,,,,, 2 /
21 75.345   371.737  ,,,,,  2 /
21 77.515   371.789  ,,,,,  2 /
```

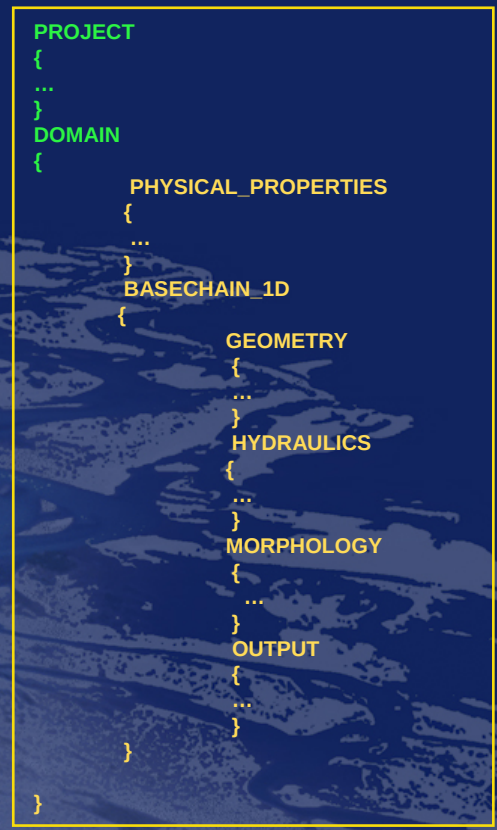
Command Datei erstellen (Hydraulik)

- Projekt
- Physikalische Eigenschaften
- Geometrie
- Hydraulik
- Anfangsbedingungen
- Randbedingungen
- Output

```
PROJECT
{
...
}
DOMAIN
{
        PHYSICAL_PROPERTIES
       {
        ...
        }
        BASECHAIN_1D
        {
                GEOMETRY
                {
                ...
                }
                HYDRAULICS
                {
                ...
                }
                MORPHOLOGY
                {
                ...
                }
                OUTPUT
                {
                ...
                }
        }
}
```

Command Datei Projekt

```
PROJECT
{
   title = Thur
   author = rm
   date = 10.8.2006
}
DOMAIN
{
   multiregion = Thur
```



Command Datei

```
PHYSICAL_PROPERTIES
{
    gravity = 9.81
    viscosity = 0.000001004
    rho_fluid = 1000
}

BASECHAIN1D
{
region_name = Thur_Altikon
```

```
PROJECT
{
...
}
DOMAIN
{
        PHYSICAL_PROPERTIES
        {
         ...
         }
        BASECHAIN_1D
        {
                GEOMETRY
                {
                 ...
                 }
                HYDRAULICS
                {
                 ...
                 }
                MORPHOLOGY
                {
                  ...
                 }
                OUTPUT
                {
                 ...
                 }
        }
}
```

Command Datei geometrie

```
GEOMETRY
{
    geometry_type = floris
    geofile = ThurTopo.txt
    cross_section_order = ( CS1 CS2 CS3
    ….CS54 CS55 )
}
```

→ Alternative hecras

```
BASECHAIN_1D
 {
                    GEOMETRY
                    {
                    ...
                    }
                    HYDRAULICS
                   {
                    ...
                    }
                   MORPHOLOGY
                    {
                      ...
                    }
                    OUTPUT
                    {
                    ...
                    }

}
```

HYDRAULICS

```
{
    BOUNDARY
    {
        boundary_type = qhydrograph
        boundary_string = upstream
        boundary_file =ThurSteadyHydrograph.txt
        precision = 0.001
        number_of_iterations =100
    }
```

```
HYDRAULICS
{
        BOUNDARY
        {
            ...
        }
        INITIAL
        {
            ...
        }
        SOURCE
        {
            ...
        }
        PARAMETER
        {
            ...
        }
}
```

T	Q
0	30
100000	30

Randbedingung und Anfangsbedingung

```
BOUNDARY
{
    boundary_type = hqrelation
    boundary_string = downstream
}

INITIAL
{
    initial_type = dry
}
```

```
HYDRAULICS
{
        BOUNDARY
        {
            ...
        }
        INITIAL
        {
            ...
        }
        SOURCE
        {
            ...
        }
        PARAMETER
        {
            ...
        }
}
```

```
HYDRAULICS
{
        BOUNDARY
        {
            ...
        }
        INITIAL
        {
            ...
        }
        SOURCE
        {
            ...
        }
        PARAMETER
        {
            ...
        }
}
```

Parameter für die Berechnung

```
PARAMETER
{
    total_run_time = 11000
    initial_time_step = 20
    CFL = 0.98
    minimum_water_depth = 0.0001
}
```

```
HYDRAULICS
{
        BOUNDARY
        {
            ...
        }
        INITIAL
        {
            ...
        }
        SOURCE
        {
            ...
        }
        PARAMETER
        {
            ...
        }
}
```

Output

```
OUTPUT
{
    output_time_step = 100
    console_time_step = 100
    SPECIAL_OUTPUT
    {
        type = tecplot_all
        output_time_step = 100
        file_name = ThurTecplot
    }
}
```

```
BASECHAIN_1D
 {
                    GEOMETRY
                    {
                    ...
                    }
                    HYDRAULICS
                   {
                    ...
                    }
                   MORPHOLOGY
                    {
                      ...
                    }
                    OUTPUT
                    {
                    ...
                    }

}
```

Berechnung des Stationären Abflusses

restart.dat

CS41	25.785905	30
CS42	24.429422	30
CS43	22.647555	30
CS44	26.453984	30
CS45	34.367756	30
CS46	35.536409	30
CS47	39.03467	30
CS48	38.658572	30
CS49	38.016649	30
CS50	37.518627	30
CS51	34.37052	30
CS52	47.002793	30
CS53	41.384505	30
CS54	39.940648	30
CS55	31.36507	30

Abspeichern als

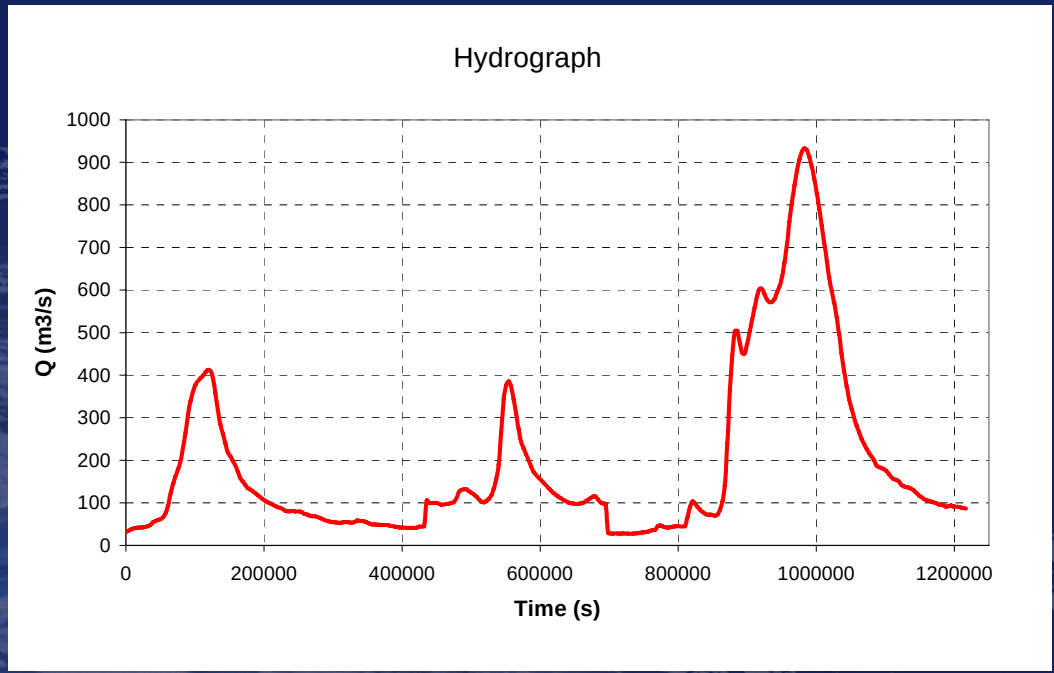
InitalThur.txt

Stationärer Anfangszustand

Hochwasserhydraulik

T	Q
0	30.648
3600	34.05
7200	37.305
10800	39.707
14400	41.18
18000	41.916
21600	42.275

…



Änderungen der Command Datei

```
BOUNDARY
{
    boundary_type = qhydrograph
    boundary_string = upstream
    boundary_file =ThurHydrograph.txt
    precision = 0.001
    number_of_iterations =100
}
INITIAL
{
    initial_type = fileinput
    initial_file = InitialThur.txt
}
```

```
HYDRAULICS
{
        BOUNDARY
        {
            ...
        }
        INITIAL
        {
            ...
        }
        SOURCE
        {
            ...
        }
        PARAMETER
        {
            ...
        }
}
```

```
HYDRAULICS
{
        BOUNDARY
        {
            ...
        }
        INITIAL
        {
            ...
        }
        SOURCE
        {
            ...
        }
        PARAMETER
        {
            ...
        }
}
```

Command Datei anpassen

```
PARAMETER
{
    total_run_time = 1216800   → 338 Std.
    initial_time_step = 20
    CFL = 0.98
    minimum_water_depth = 0.0001
}
 OUTPUT
{
        output_time_step = 1000
        console_time_step = 1000
}
```

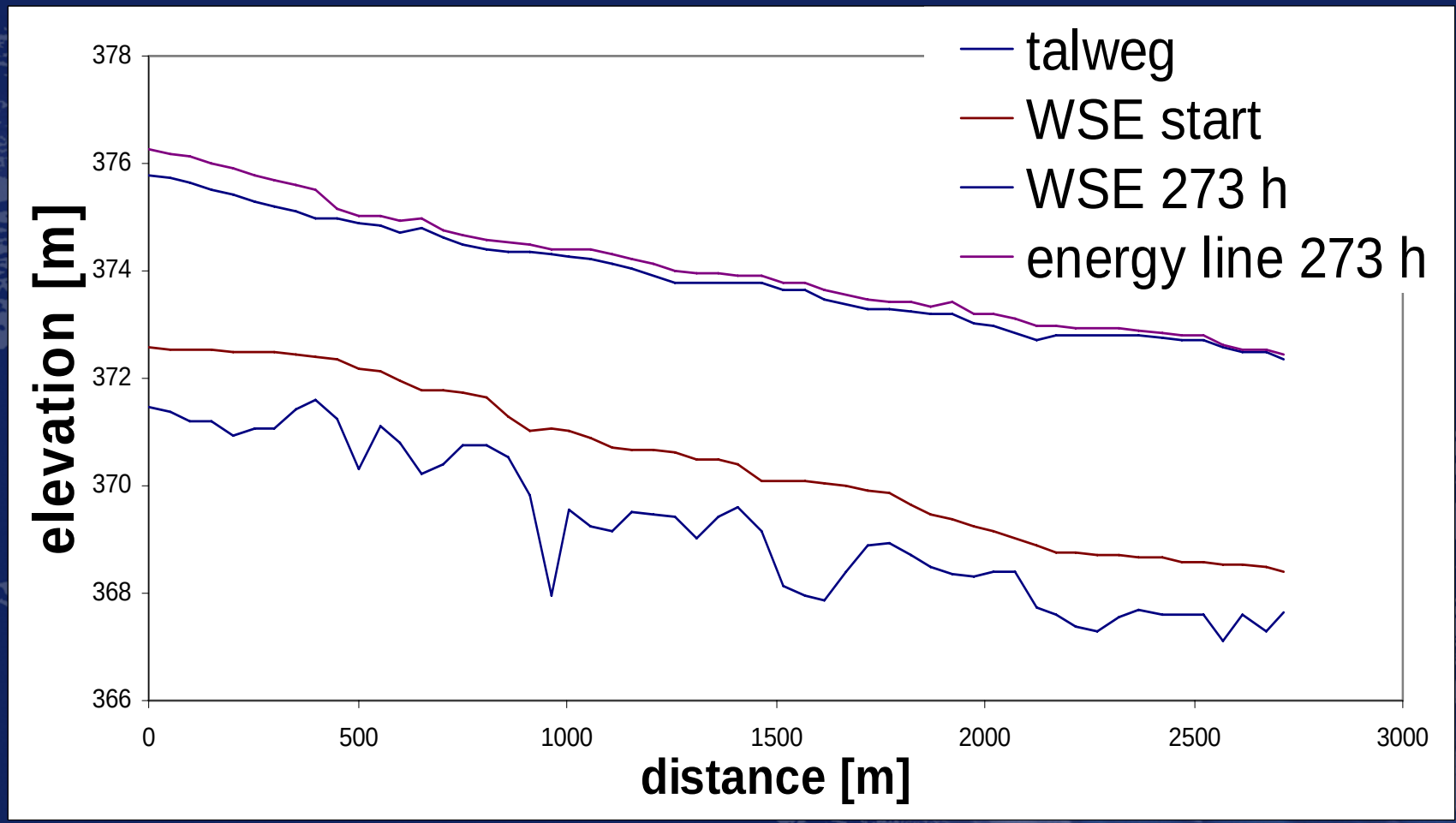
```
HYDRAULICS
{
                BOUNDARY
                {
                   ...
                }
                INITIAL
                {
                   ...
                }
                SOURCE
                {
                   ...
                }
                PARAMETER
                {
                   ...
                }
}
```

```
BASECHAIN_1D
 {
                GEOMETRY
                 {
                ...
                 }

HYDRAULICS
                {
                 ...
                 }
                MORPHOLOG
Y
                 {
                  ...
                 }
                OUTPUT
                {
                ...
                }


}
```

BASEMENT

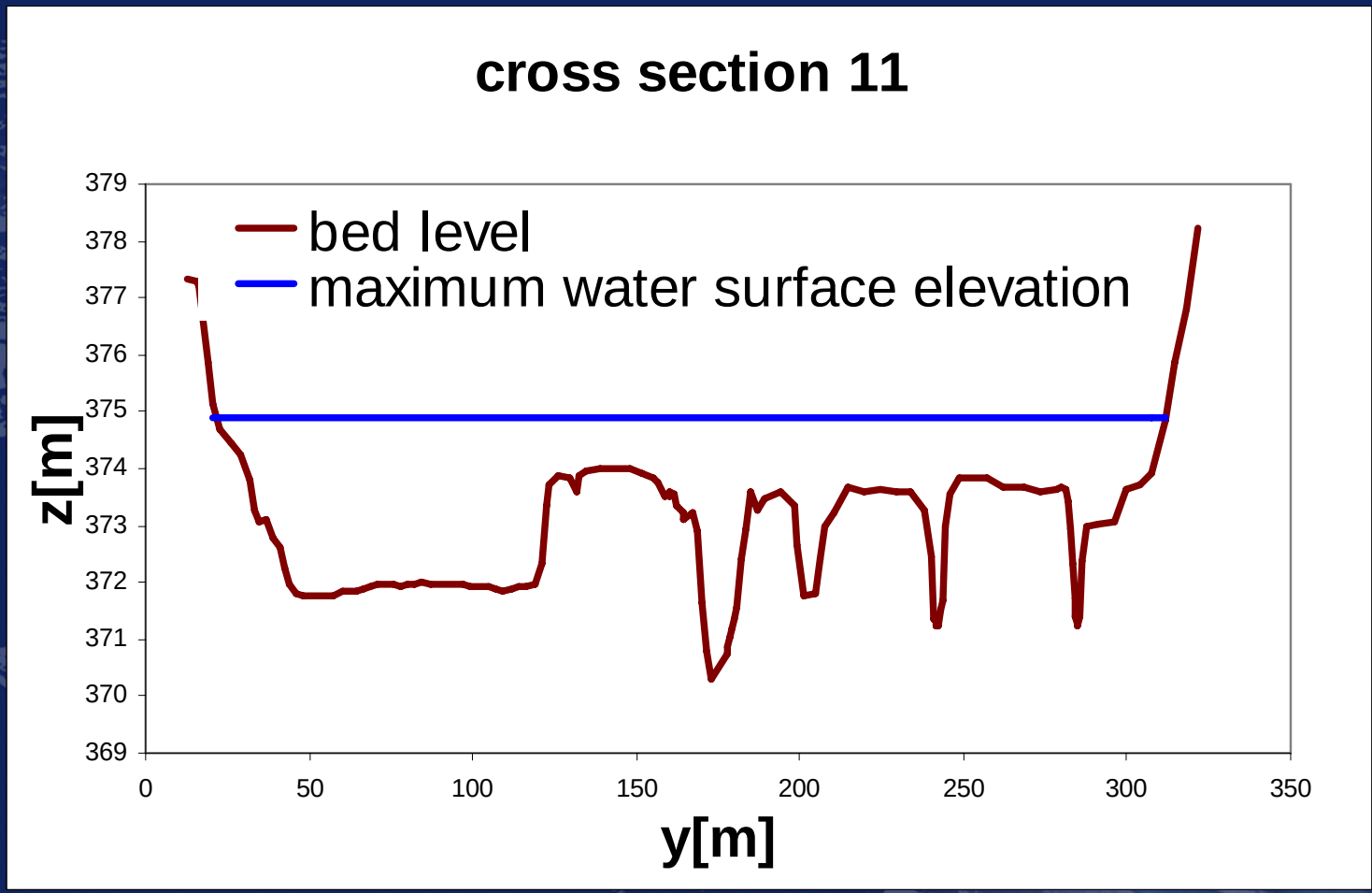
Resultate Hochwassersimulation

Wasserstand beim höchsten Abfluss 950 m³/s



Resultate Hochwassersimulation

Querprofile



Sediment Block erstellen

```
MORPHOLOGY
{


BEDMATERIAL
{
   GRAIN_CLASS
   {
        diameters = ( 0.025 )
   }
```

```
BASECHAIN_1D
{
                GEOMETRY
                {
                ...
                }
                HYDRAULICS
                {
                ...
                }
                MORPHOLOGY
                {
                  ...
                }
                OUTPUT
                {
                ...
                }
}
```

```
MORPHOLOGY
{
                BEDMATERIAL
                {
                  ...
                }
                BOUNDARY
                {
                  ...
                }
                INITIAL
                {
                  ...
                }
                SOURCE
                {
                  ...
                }
                PARAMETER
                {
                  ...
                }
}
```

Bodentypen definieren

```
SOIL_DEF
{
    soil_name = fixed
    active_layer_height = 0
}
SOIL_DEF
{
    soil_name = mobile
    active_layer_height = 0.2
    SUBLAYER
    {
        bottom_elevation = -5.2
    }
}
```

```
MORPHOLOGY
{
                BEDMATERIAL
                {
                   ...
                }
                BOUNDARY
                {
                   ...
                }
                INITIAL
                {
                   ...
                }
                SOURCE
                {
                   ...
                }
                PARAMETER
                {
                   ...
                }
}
```

Bodentypen zuweisen

```
SOIL_ASSIGNMENT
{
   input_type = index_table
   index = ( 1 2 )
   soil = ( fixed mobile )
}
```

```
20 CS1 0 , , , , 1.2  1 /
21 14.422  378.457 /
21 14.841  378.338 /
```

```
21 68.613   371.891  ,,,,,  2 /
21 70.433   371.875  ,,,,,  2 /
21 72.403   371.85  ,,,,,  2 /
```

Randbedingungen für Sediment

```
BOUNDARY
{
    boundary_type = IOUp
    boundary_string = upstream
}

BOUNDARY
{
    boundary_type = IODown
    boundary_string = downstream
}
```

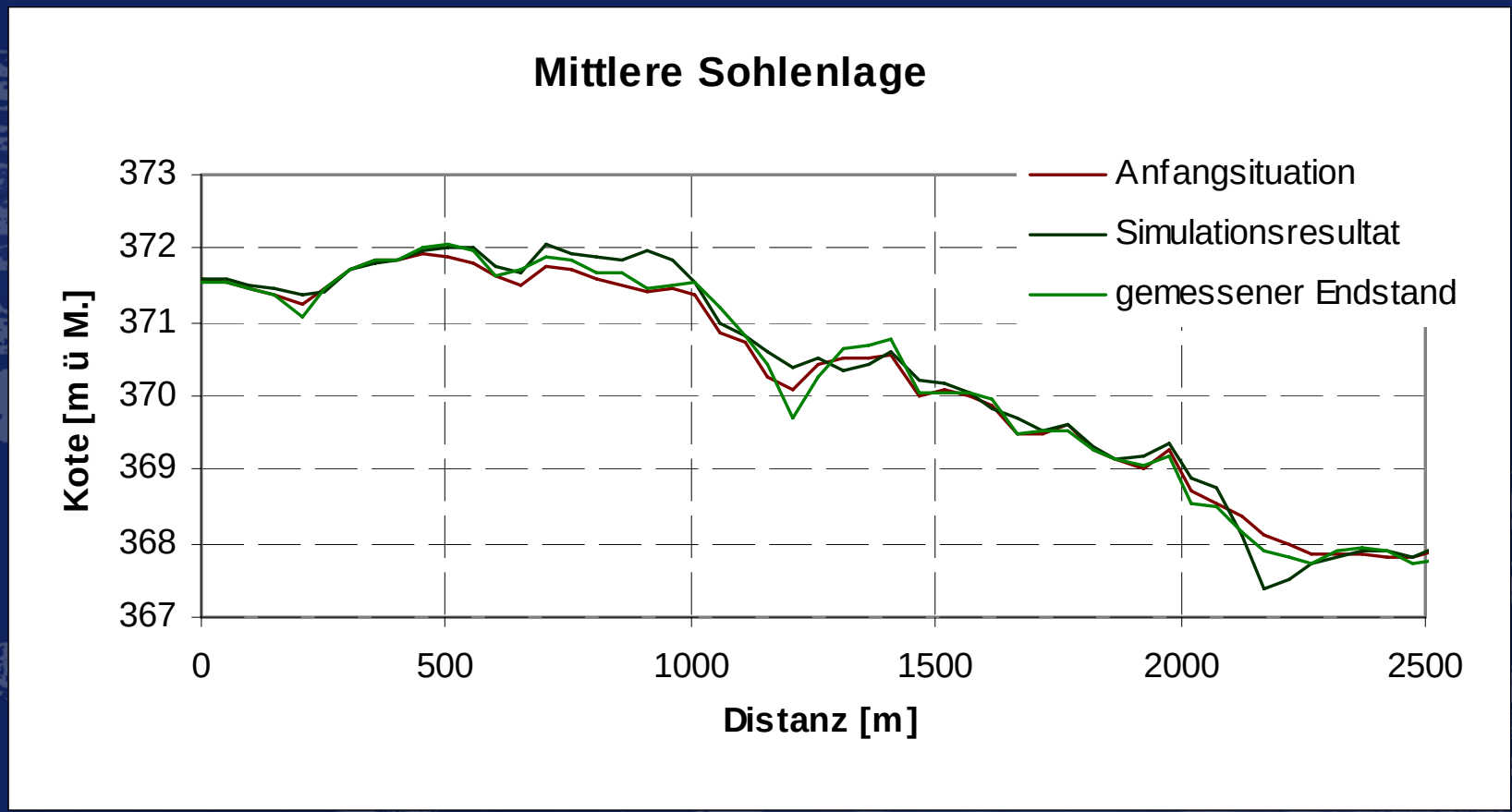
```
MORPHOLOGY
{
        BEDMATERIAL
        {
            ...
        }
        BOUNDARY
        {
            ...
        }
        INITIAL
        {
            ...
        }
        SOURCE
        {
            ...
        }
        PARAMETER
        {
            ...
        }
}
```

Parameter für Geschiebetransport

```
PARAMETER
{
    bedload_transport = MPM
    factor1 = 8
    porosity = 0.37
    upwind = 1
    height_active_layer = 0.2
    critical_angle = 30
    density = 2650
    max_dz_table = 0.05
}
```

```
MORPHOLOGY
{
        BEDMATERIAL
        {
            ...
        }
        BOUNDARY
        {
            ...
        }
        SOURCE
        {
            ...
        }
        PARAMETER
        {
            ...
        }
}
```

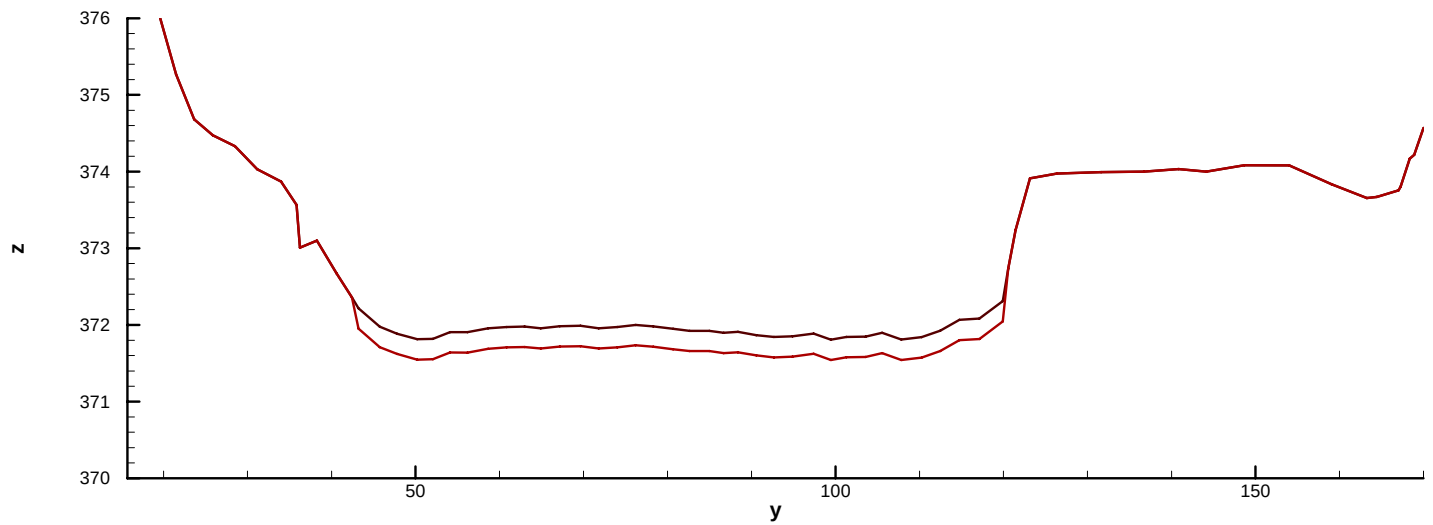
Sediment Berechnung



BASEMENT

Sediment Berechnung

Querprofil-Entwicklung



Fazit

- Hydraulik konnte nicht kalibriert werden. Keine Daten.
- 1D stösst für Geschiebetransport bei solch unregelmässiger Geometrie an Grenzen.
- Kalibrierung für Geschiebetransport unerlässlich und aufwendig.