*Waldemar KOCIUBA*

Effective method for continuous measurement of bedload transport rates by means of RBT in a small glacial High Arctic gravel-bed river

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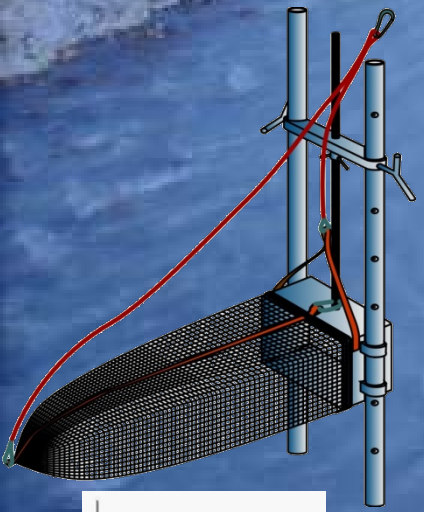

RBT


XXXIV International School of Hydraulics
11 - 14 May · 2015 · Żelechów · Poland

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## *WHY SVALBARD ?*

- 62 000 km$^2$
- small anthropopressure
- 60 % glaciated
- 60 % protected

- national parks
- the reserves of nature
- vegetation reserves
- bird sanctuaries
- free area was shaded


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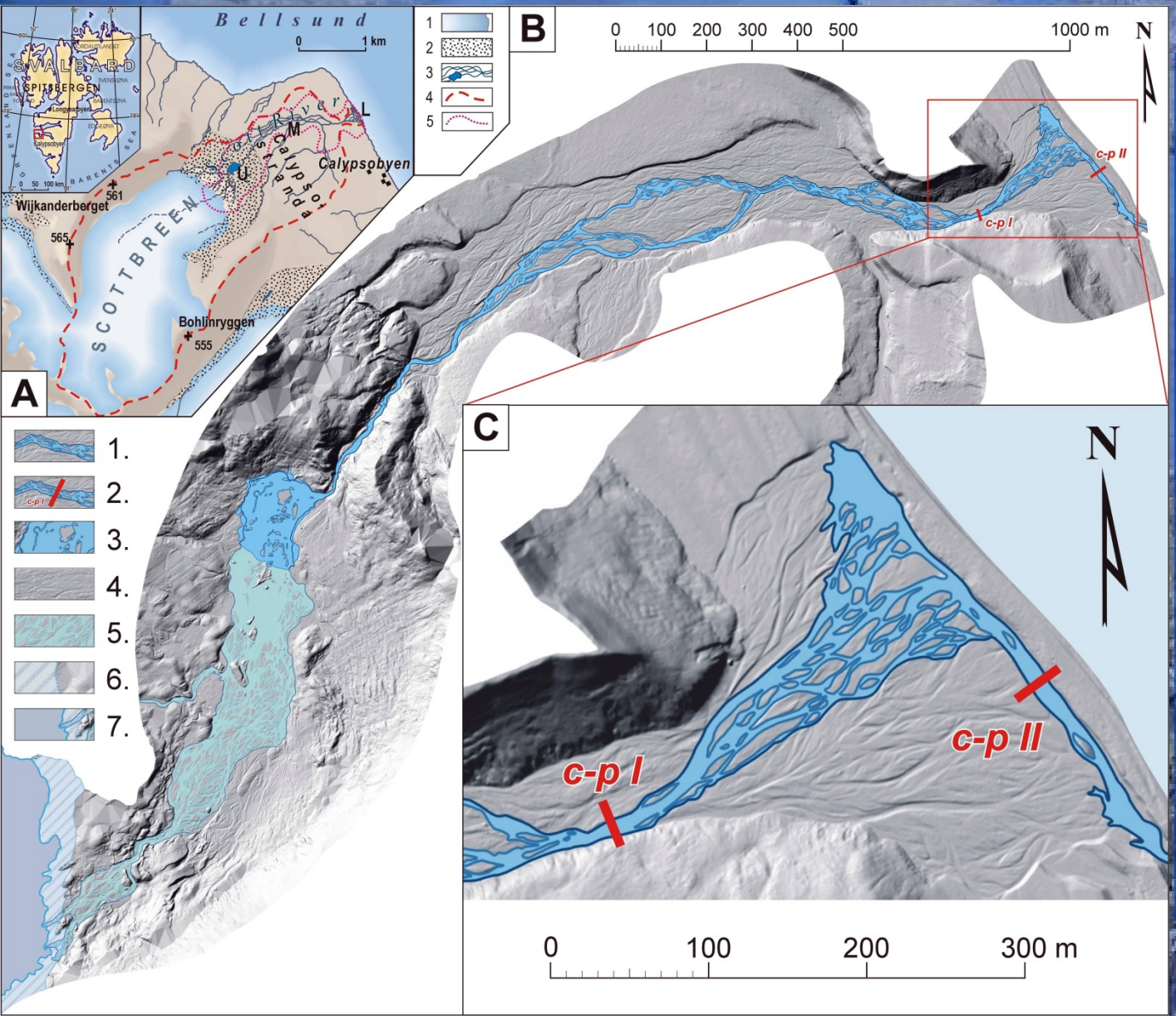


- The hydrometric station and the traps for fluvial transport measurements were located in the place where the braided channels join up into one
- This location was similar to that of hydrographical monitoring in previous years

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| | Continuous measurement, restricted time | | | Point measurement, short term | | | Anchored samplers* continuous measurement, flexible term | |
|---|---|---|---|---|---|---|---|---|
| Sampler features | Vortex sampler | Birkbeck sampler | Unweigh-able pit traps | Basket sampler | H-S pressure-difference sampler | Large pressure-difference sampler | Net-frame sampler | **RBT** |
| facility of operation | +/— | + | +/— | +/— | + | — | — | + |
| portability | — | — | + | +/— | + | + | +/— | +/— |
| anchorage in the river bed | + | + | + | — | — | — | +/— | + |
| manner of anchoring in the river bed** | — | — | — | +/— | + | +/— | +/— | + |
| width of the input opening | + | + | + | + | — | +/— | + | + |
| restriction of measurement term | + | + | + | +/— | — | — | + | + |
| possibility of sampling for GSD analysis | + | — | +/— | + | + | + | + | + |

*continuous measurement possible; ** [—] interference in the shape of the river bed

Source: Bunte, K., Abt, S. R., Potyondy, J. P., Ryan, S. E., 2004, Measurement of coarse gravel and cobble transport using a portable bedload trap: Journal of Hydraulic Engineering 130, 9, 879-893.[*amended by Author*]

## *SAMPLING METHODS* *MODIFIED HELLEY-SMITH BED LOAD SAMPLER*

**ADVANTAGE:**

- ✓ easy sampling
- ✓ small weight
- ✓ mobility

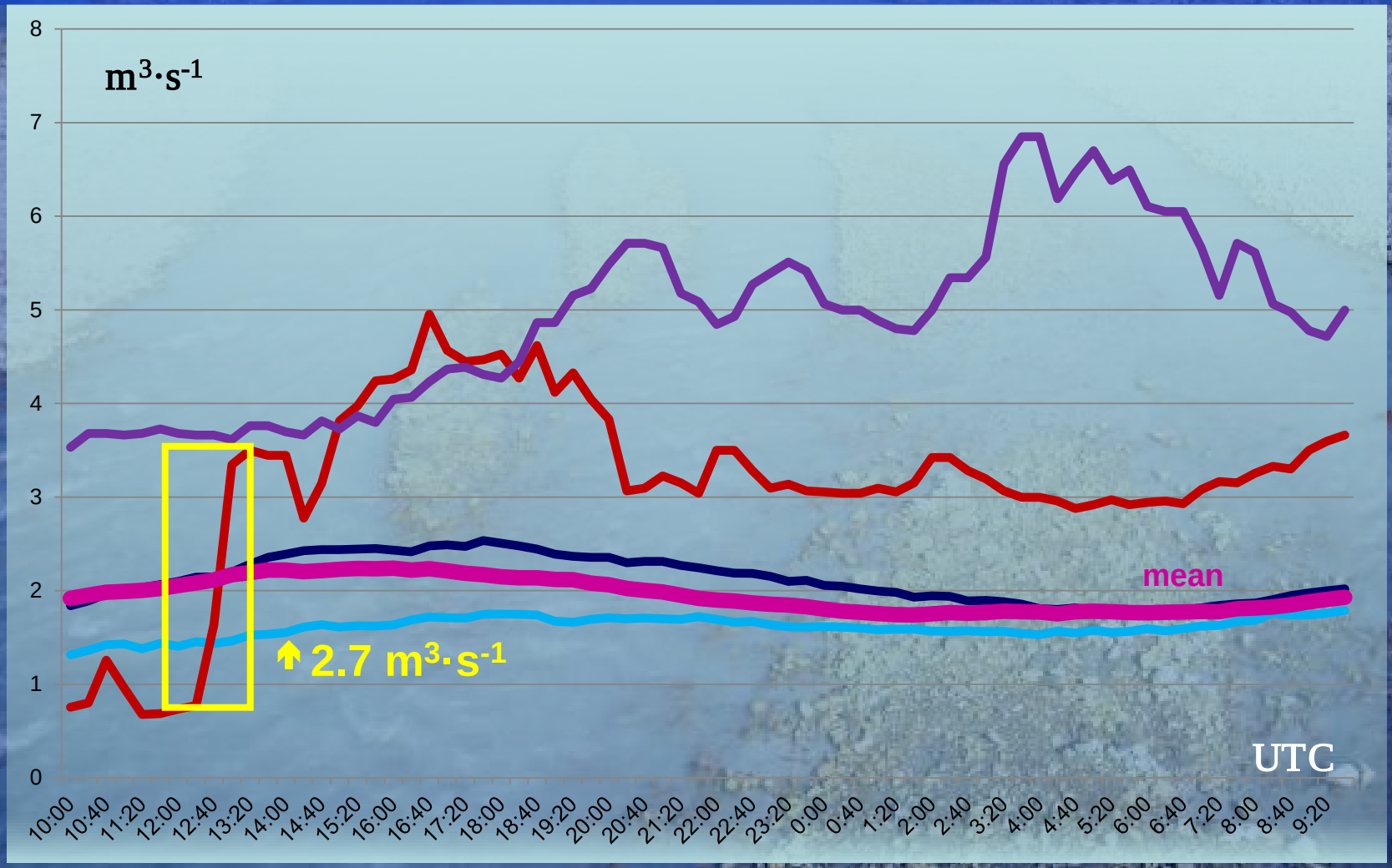
**DISADVANTAGE:**

- ✓ small size
- ✓ short sampling time in sites
- ✓ long sampling time in cross section

*Photograph location:*
*Gipsdalselva, Svalbard*

http://filter.ac.uk/database/getinsite.php

# 24-HOUR CYCLE OF DISCHARGE VARIABILITY IN 20 MINUTE'S PERIODS




daily measurement 10:00 UTC – 12:00 local time

**maximum discharge grows in 60 minutes period: 2.7 m³·s⁻¹**

| | Continuous measurement, restricted time | | | Point measurement, short term | | | Anchored samplers* continuous measurement, flexible term | |
|---|---|---|---|---|---|---|---|---|
| Sampler features | Vortex sampler | Birkbeck sampler | Unweigh-able pit traps | Basket sampler | H-S pressure-difference sampler | Large pressure-difference sampler | Net-frame sampler | **RBT** |
| facility of operation | +/— | + | +/— | +/— | + | — | — | + |
| portability | — | — | + | +/— | + | + | +/— | +/— |
| anchorage in the river bed | + | + | + | — | — | — | +/— | + |
| manner of anchoring in the river bed** | — | — | — | +/— | + | +/— | +/— | + |
| width of the input opening | + | + | + | + | — | +/— | + | + |
| restriction of measurement term | + | + | + | +/— | — | — | + | + |
| possibility of sampling for GSD analysis | + | — | +/— | + | + | + | + | + |

*continuous measurement possible; ** [—] interference in the shape of the river bed
Source: Bunte, K., Abt, S. R., Potyondy, J. P., Ryan, S. E., 2004, Measurement of coarse gravel and cobble transport using a portable bedload trap: Journal of Hydraulic Engineering 130, 9, 879-893.[*amended by Author*]

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## BEDLOAD TRAPS: DESIGN AND OPERATION

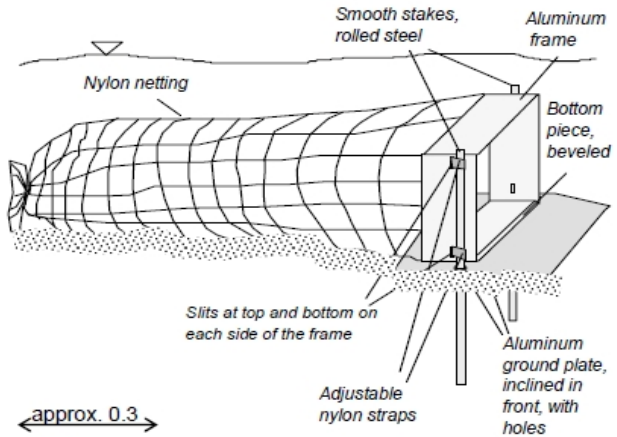


Fig. 1: Schematic Diagram of a Bedload Trap.

- Sturdy aluminum sampler frame,
- Sampling bag made of fishing net,
- Nylon straps with friction buckles,
- Aluminum ground plate, and
- Two smooth iron holding stakes.

*źródło: Bunte, K., Abt, S.R., Potyondy, J.P., Ryan, S.E., 2004, Measurement of coarse gravel and cobble transport using a portable bedload trap: Journal of Hydraulic Engineering 130, 9, 879–893*

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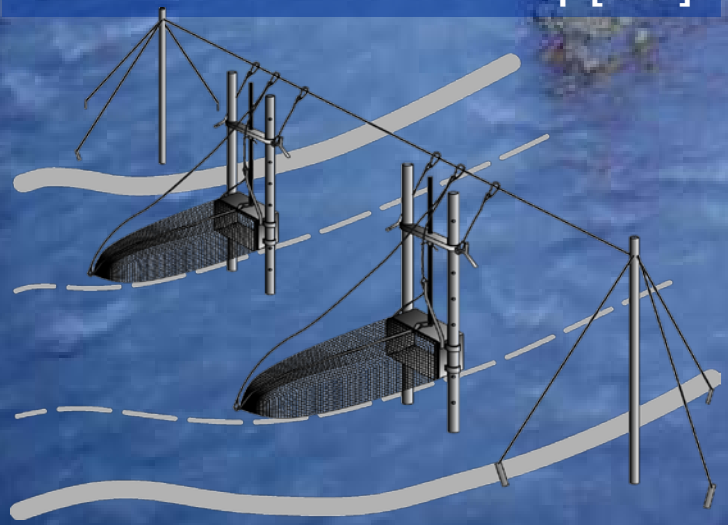
## SAMPLING METHODS

## MY IDEA - RIVER BEDLOAD TRAP - RBT

Scheme of River Bed load Trap [RBT]



Example of arrangement of two RBT sets and systems of protection in cross section.

**RIVER BEDLOAD TRAP (RBT)**

*constructed by W. Kociuba 2009*

*application for patent protection*

*(No. PL 389882; EP 2333161)*

**RIVER BEDLOAD TRAP:**
**samplers system was designed consisting of the following parts:**

- **metal sampler frame**
- **sampling nylon bag**
- ***metal runners***
- ***vertical stabiliser - steel tubes***
- ***horizontal stabiliser with connectors***
- ***pressure element***
- ***system of internal and external protections***

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## *SAMPLING METHODS*

## *MY IDEA - RIVER BEDLOAD TRAP - RBT*

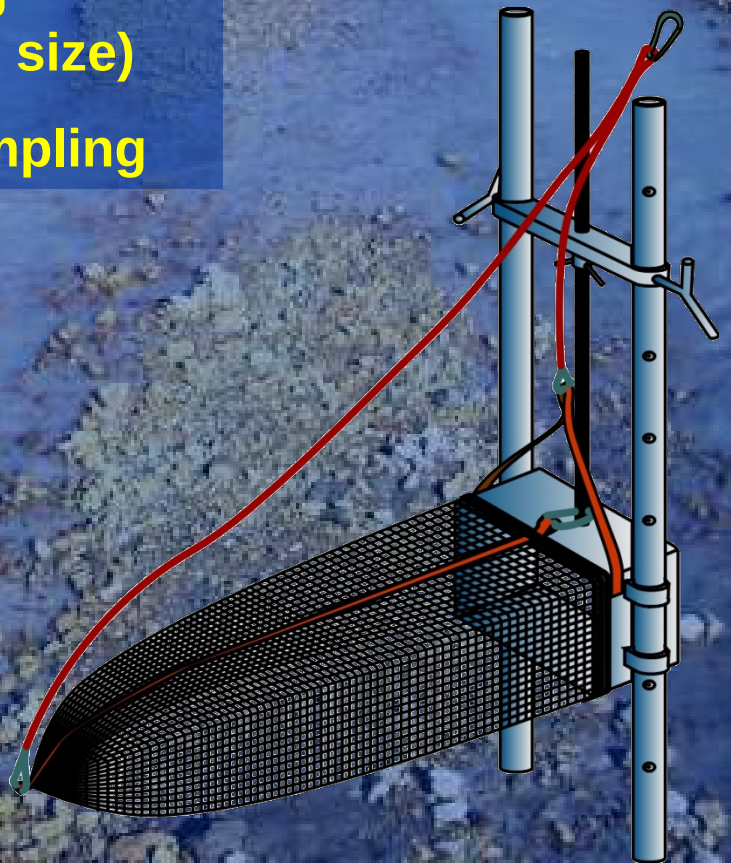
**ADVANTAGE:**

- ✓ easy sampling
- ✓ fast emptying
- ✓ middle size
- ✓ portable
- ✓ the same sampling time in all sites
- ✓ nylon netting (different mesh size)
- ✓ 24 - hour sampling

**DISADVANTAGE:**

- ✓ weight

Two River Bed load Traps installed at Scott River (2009)



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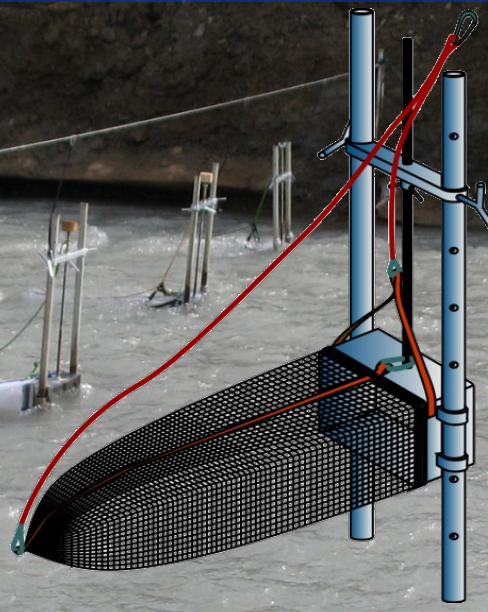
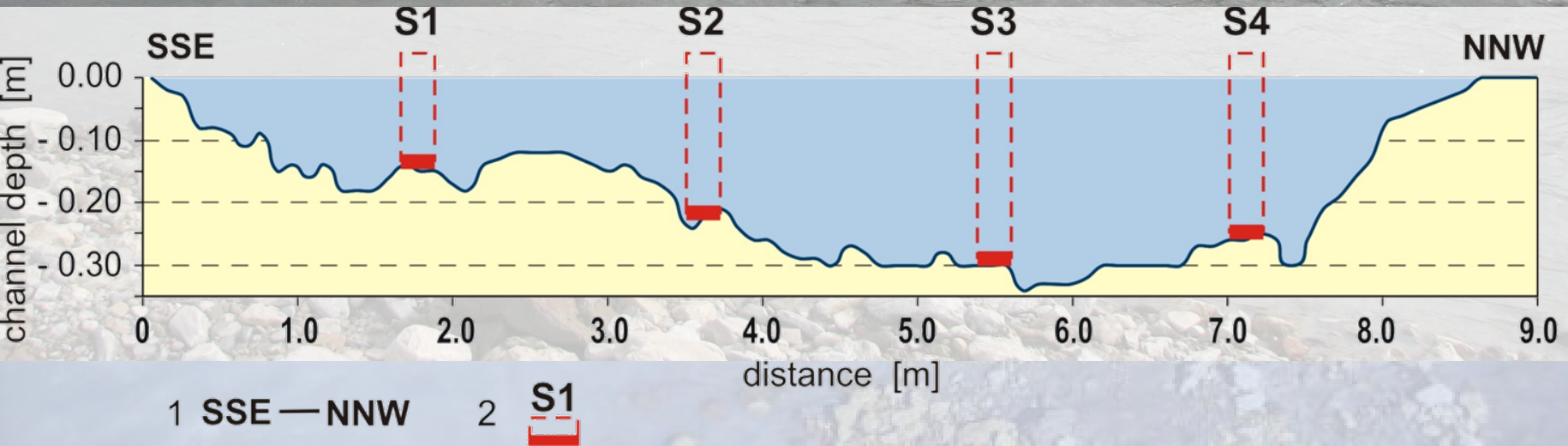
## *SAMPLING METHODS* — *RIVER BEDLOAD TRAP - RBT*

**Hydrological elements (water stages, temperature, water electrolytic conductivity) were recorded automatically (pressure limnigraph) every 10 min., and water flow velocity was measured every 5 days by means of a current meter**



**Continuous measurement of bedload transport was performed with the application of 4 RBT samplers distributed proportionally every 1-2 m in the channel cross-profile, operating in a 24 h cycle.**



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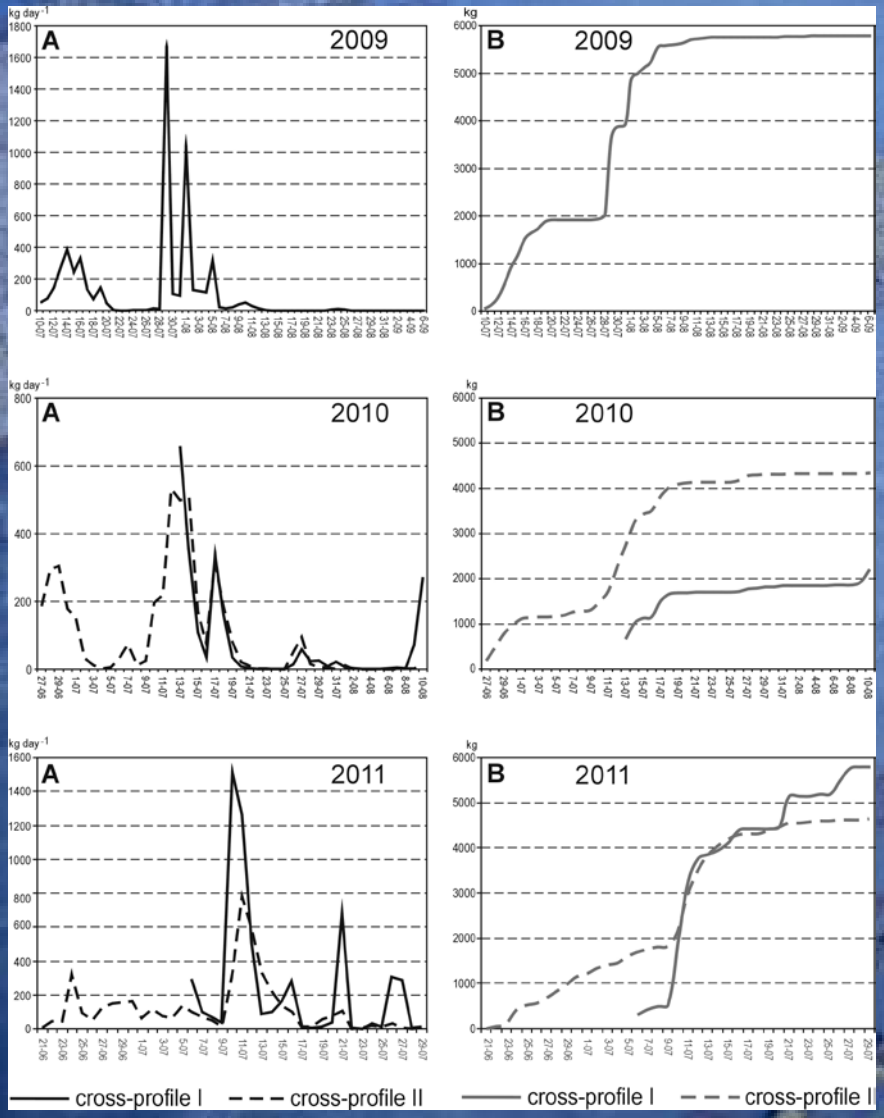
# RESULTS




| year | measurement period | number of: installed RBT | measure-ment day | samples collected | sample size [kg] |
|---|---|---|---|---|---|
| | **cross-profile I** | | | | |
| **2009** | 10 Jul-06 Sep | 4 | 59 | 157 | 758 |
| **2010** | 13 Jul-10 Aug | 4 | 29 | 114 | 267 |
| **2011** | 06 Jul-29 Aug | 4 | 24 | 96 | 594 |
| **2012** | 13 Jul-24 Aug | 4 | 43 | 142 | 282 |
| **2013** | 11 Jul-13 Aug | 4 | 34 | 109 | 180 |
| **total** | | | **189** | **618** | **2080** |
| | **cross-profile II** | | | | |
| **year** | measurement period | number of: installed RBT | measure-ment day | samples collected | sample size [kg] |
| **2009** | - | - | - | - | - |
| **2010** | 27 Jun-10 Aug | 4 | 45 | 177 | 526 |
| **2011** | 21 Jun-29 Jul | 5 | 39 | 193 | 677 |
| **2012** | 13 Jul-24 Aug | 4 | 43 | 126 | 224 |
| **2013** | 11 Jul-13 Aug | 4 | 34 | 110 | 74 |
| **total** | | | **161** | **606** | **1501** |

# CONCLUSIONS

- The RBT device applied in this study has the potential to satisfy the stringent requirements set by fluvial geomorphology
- In comparison to the existing measurement systems, the applied technic based on direct and continuous measurement and anchored RBT set proved to effective determination of quantitative bedload transport parameters
- The application of RBT for continuous monitoring of bedload flux in the conditions of High Arctic gravel-bed rivers was evidenced to permit obtaining high efficiency and credible results
- Due to the considerable values of the RBT, it can be applicable in the calibration of indirect technics e.g. electro-acoustic devices

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Geomorphology 212 (2014) 58–71

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journal homepage: www.elsevier.com/locate/geomorph

## Continuous measurements of bedload transport rates in a small glacial river catchment in the summer season (Spitsbergen)

Waldemar Kociuba *, Grzegorz Janicki

*Faculty of Earth Sciences and Spatial Management, Maria Curie-Skłodowska University in Lublin, Poland*

QUAESTIONES GEOGRAPHICAE 33(1) • 2014

## VARIABILITY OF SEDIMENT TRANSPORT IN THE SCOTT RIVER CATCHMENT (SVALBARD) DURING THE HYDROLOGICALLY ACTIVE SEASON OF 2009

WALDEMAR KOCIUBA, GRZEGORZ JANICKI, KRZYSZTOF SIWEK

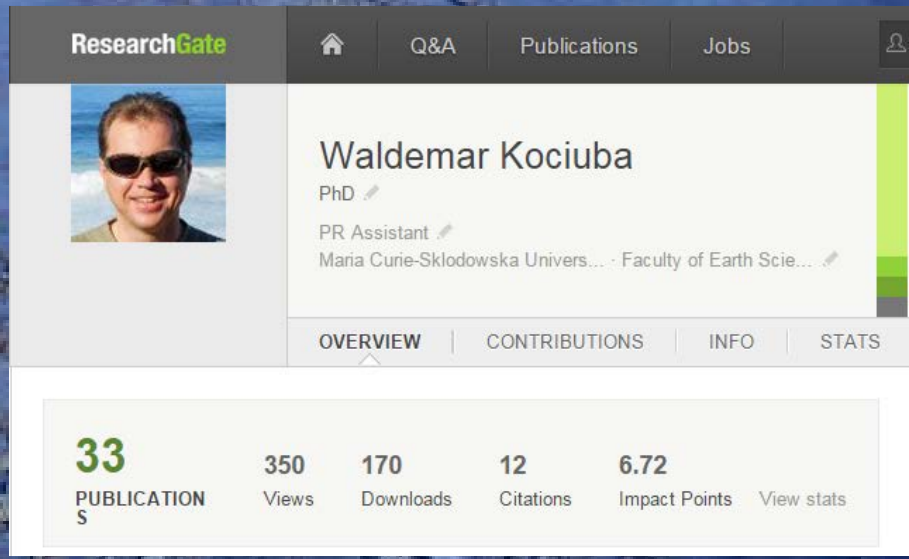
Faculty of Earth Sciences and Spatial Management, Maria Curie-Skłodowska University in Lublin, Poland

GEOGRAFISKA ANNALER SERIES A PHYSICAL GEOGRAPHY

## CHANGEABILITY OF MOVABLE BED-SURFACE PARTICLES IN NATURAL, GRAVEL-BED CHANNELS AND ITS RELATION TO BEDLOAD GRAIN SIZE DISTRIBUTION (SCOTT RIVER, SVALBARD)

WALDEMAR KOCIUBA and GRZEGORZ JANICKI

Faculty of Earth Sciences and Spatial Management, Maria Curie-Sklodowska University in Lublin, Poland



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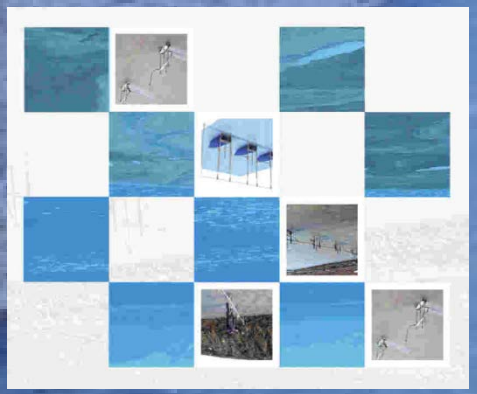
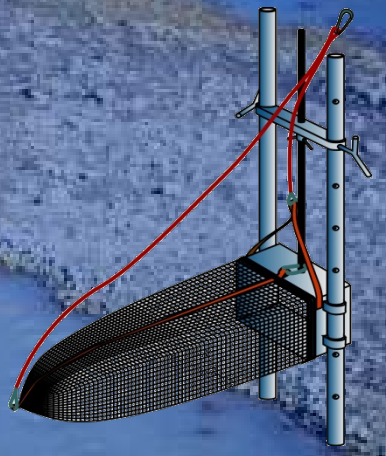
# THANK YOU FOR YOUR ATTENTION !





RBT

# ACKNOWLEDGEMENTS

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