(Over) one hundred years of snow research in Finland

Esko Kuusisto

1.11.2017

Who is this man?

- He served as the President of Finland
- He made snow research abroad

Carl
Gustaf
Emil
Mannerheim
(1867-1951)
Journey to Asia
1906-08
President of Finland
1944-46

Mechelinkatu, Helsinki, FEB. 2011

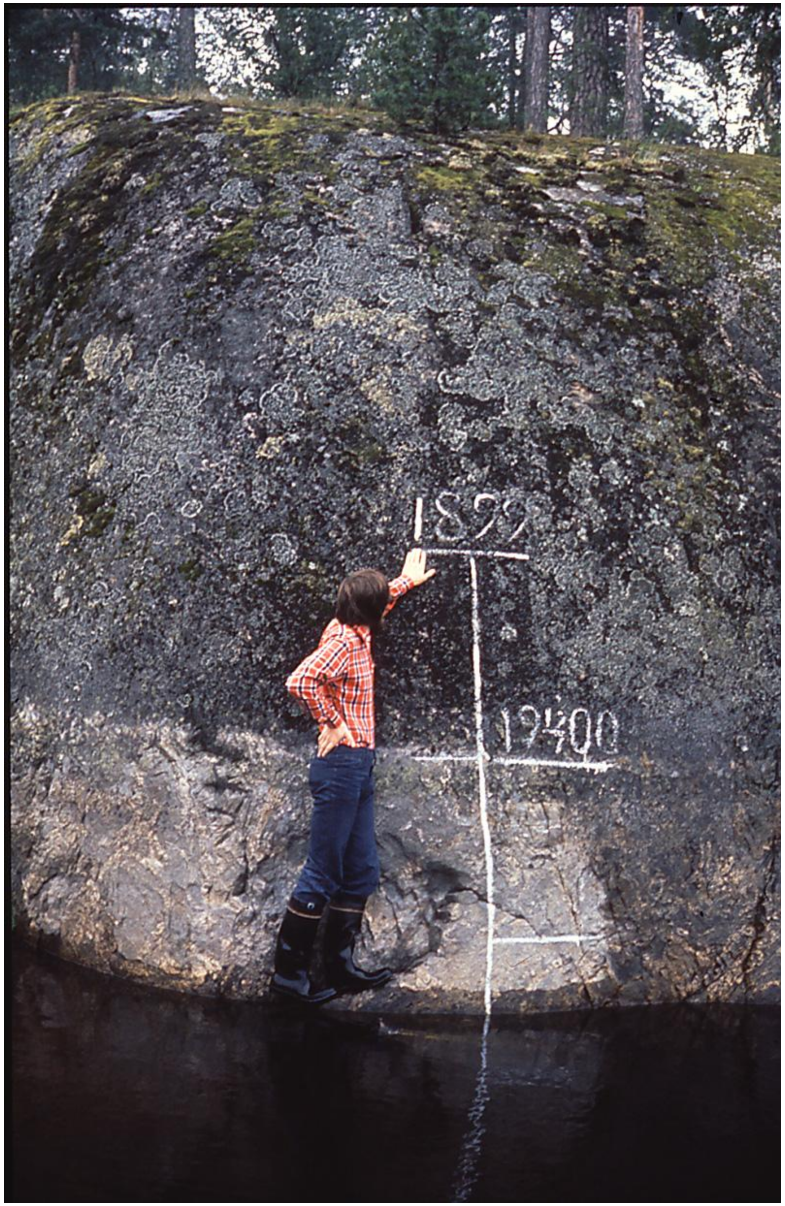
-- In the meeting of the Finnish Geographical Society on 13 December 1890, it was proposed that snow depth should be measured in different parts of the country. (A.F.SUNDELL)

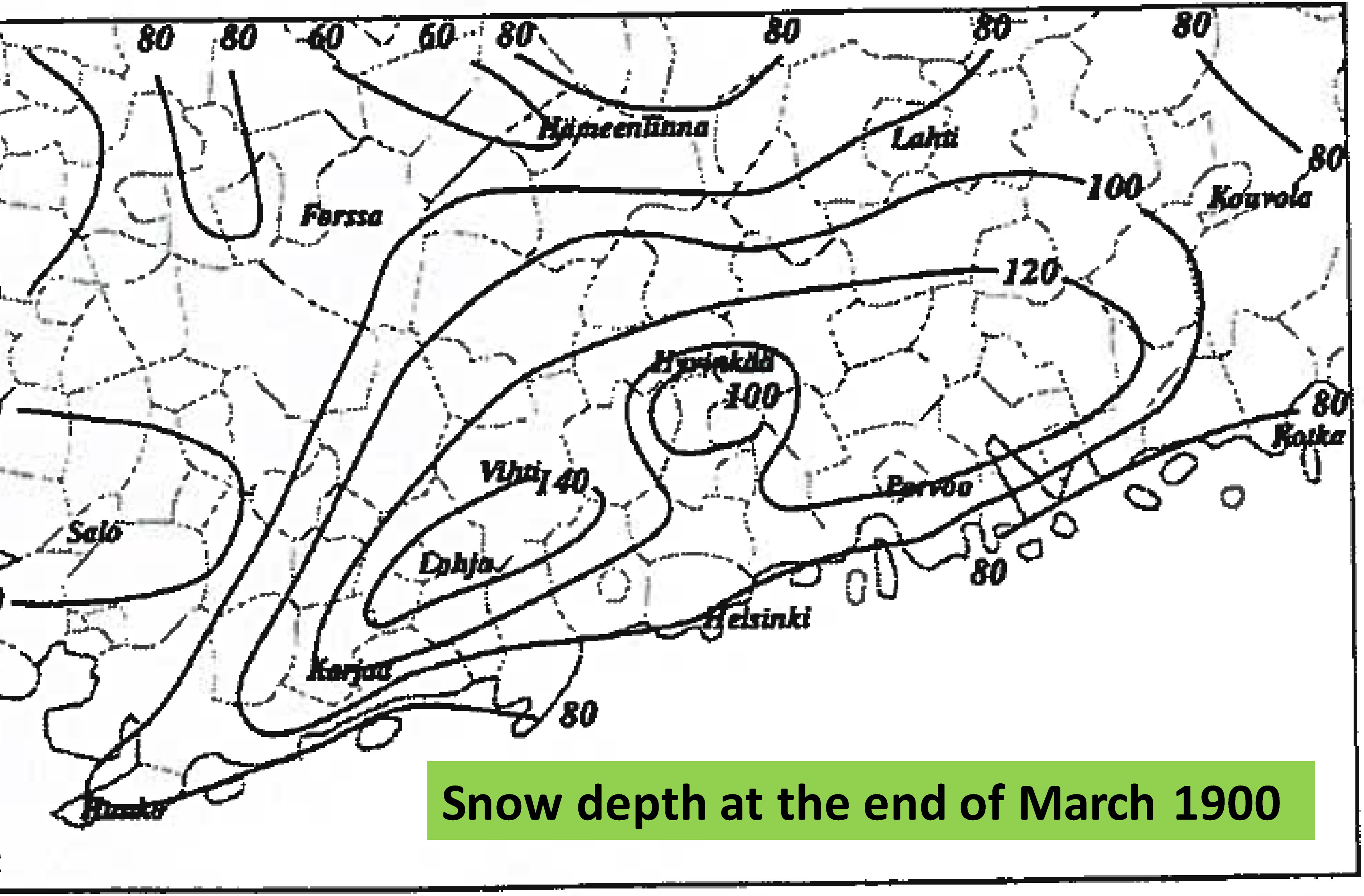
-- In the same winter the Central Meteorological Institute (Meteorologinen Päälaitos) commenced snow observations at 20 sites.
(A.HEINRICHS)

-- These two observation networks were integrated in 1909 under the Central Meteorological Institute, and then the total number of stations exceeded one hundred.

The flood of the Broken Oath, 1899

- **particularly in Vuoksi, Kymijoki and Kokemäenjoki basins**
- **up to two meters of snow in winter; late melting season**
- **high rainfall in May**
- **water level in many lakes 1.5-2.5 metres above normal**

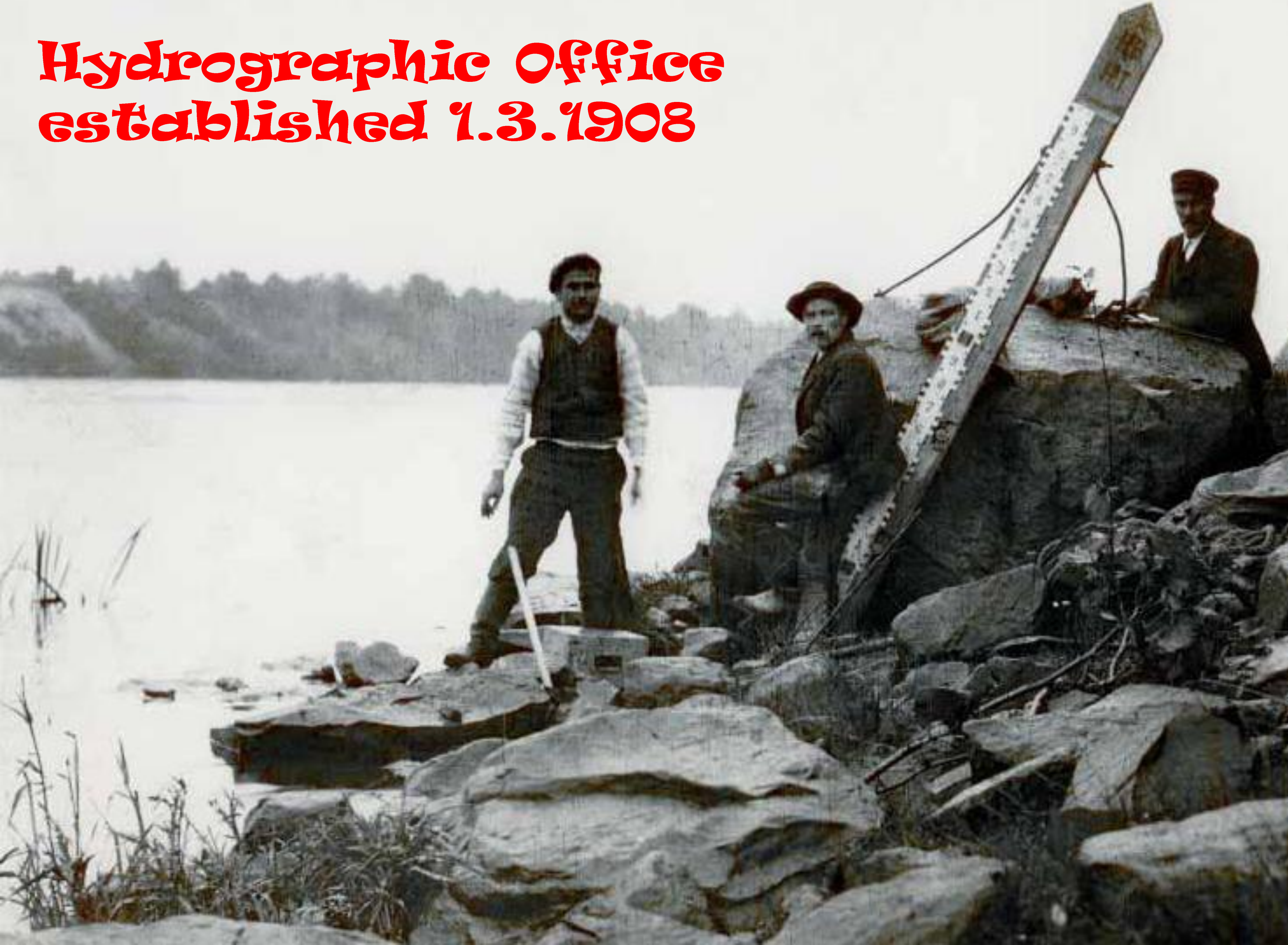




Snow depth at the end of March 1900

Solantie 1999

Hydrographic Office established 1.3.1908

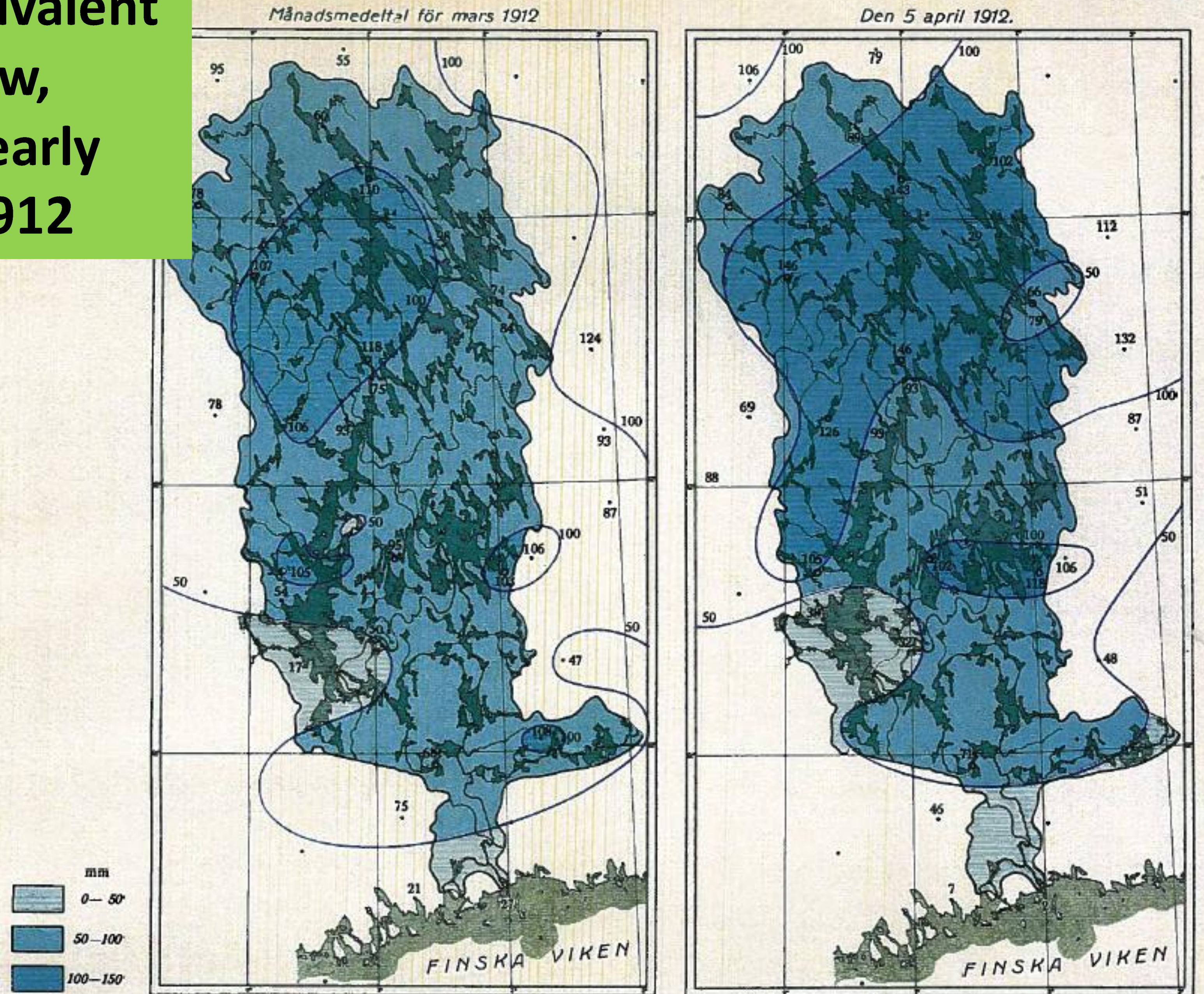


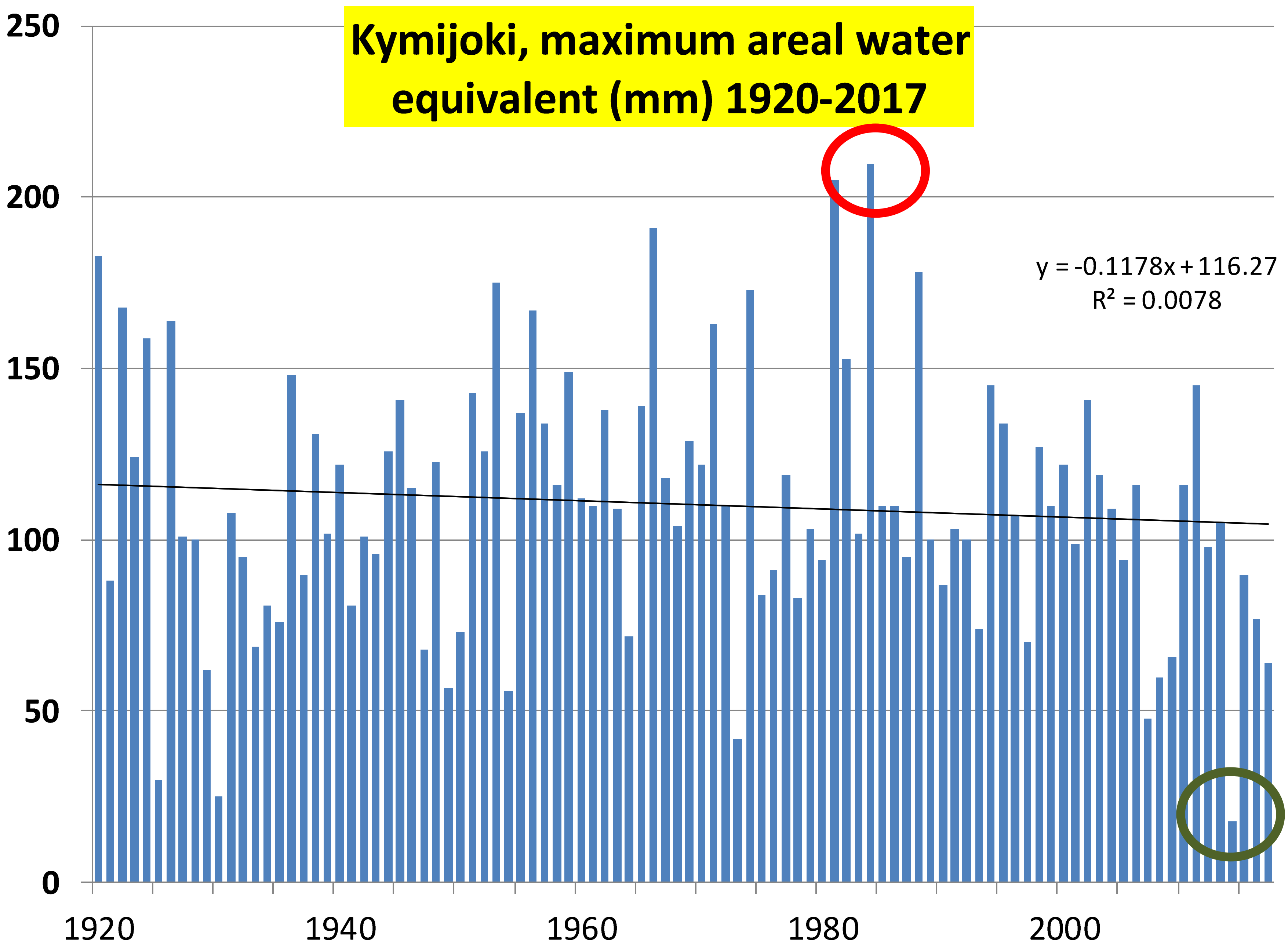
Water equivalent of snow, March-early April 1912

Pl. XVII.

I snötäcket magasinerad vattenmängd.

(mm vatten)




Kymijoki, maximum areal water equivalent (mm) 1920-2017
y = -0.1178x + 116.27
R² = 0.0078
250
200
150
100
50
0
1920
1940
1960
1980
2000

Korhonen – Melander snow sampler in the 1920s

Ville Vihtori Korhonen (1885–1958)

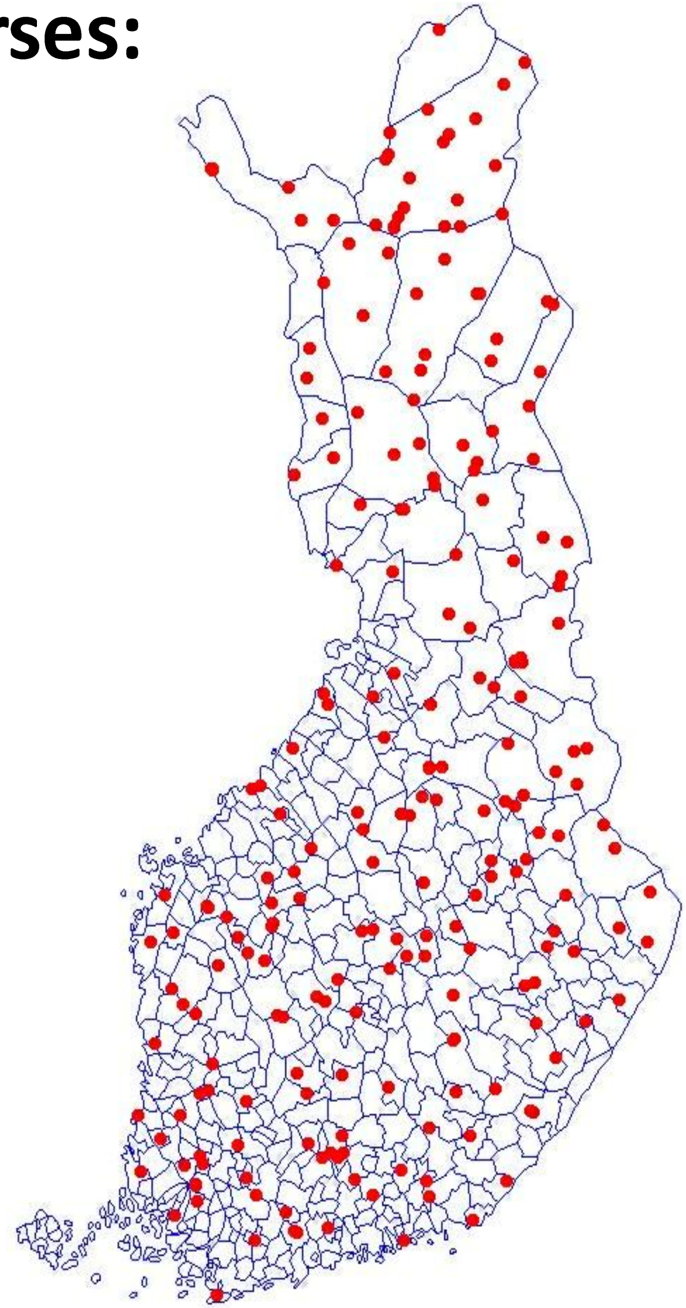
Gustaf Melander (1861 –1938)

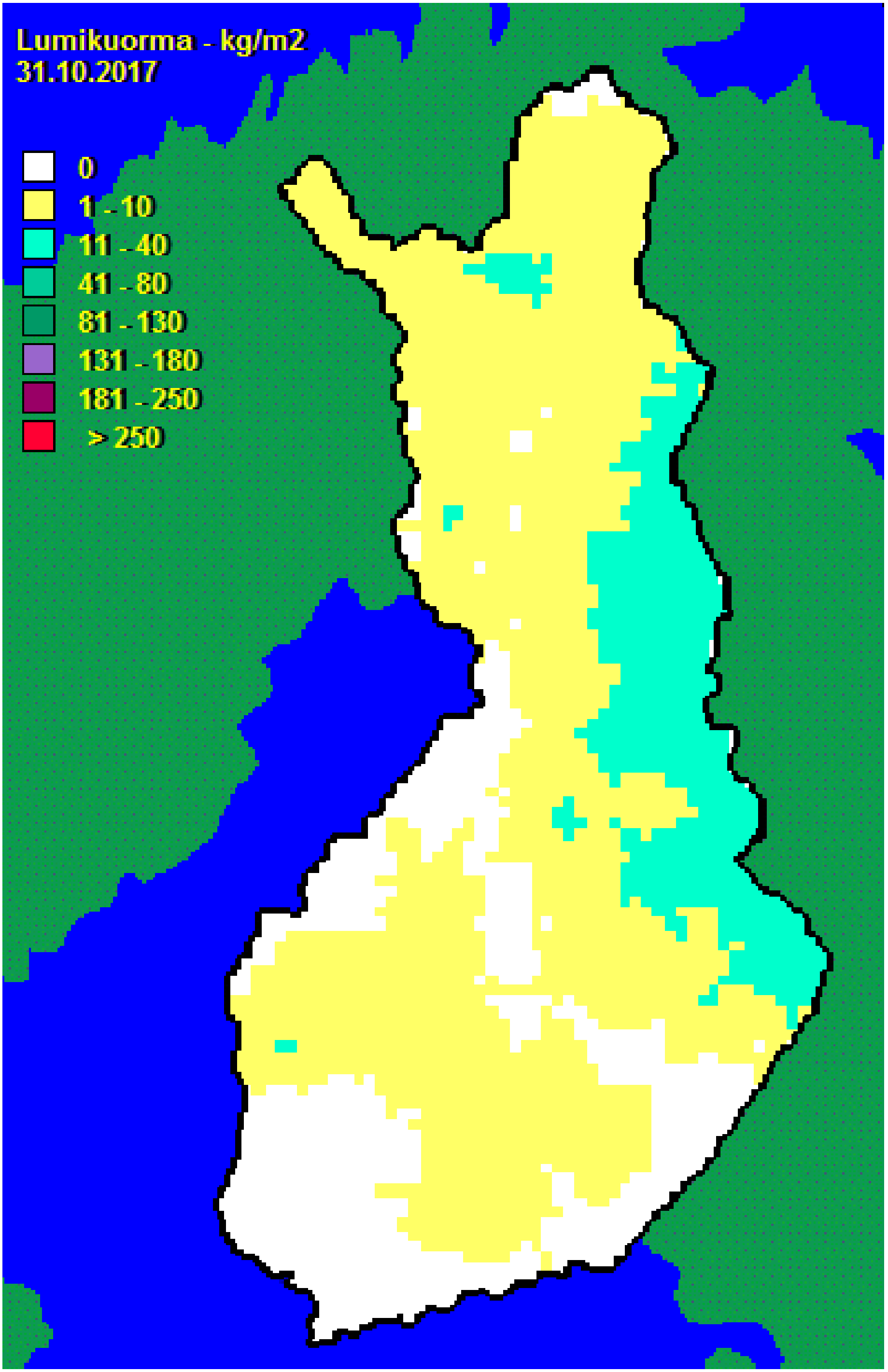

MADSHUS

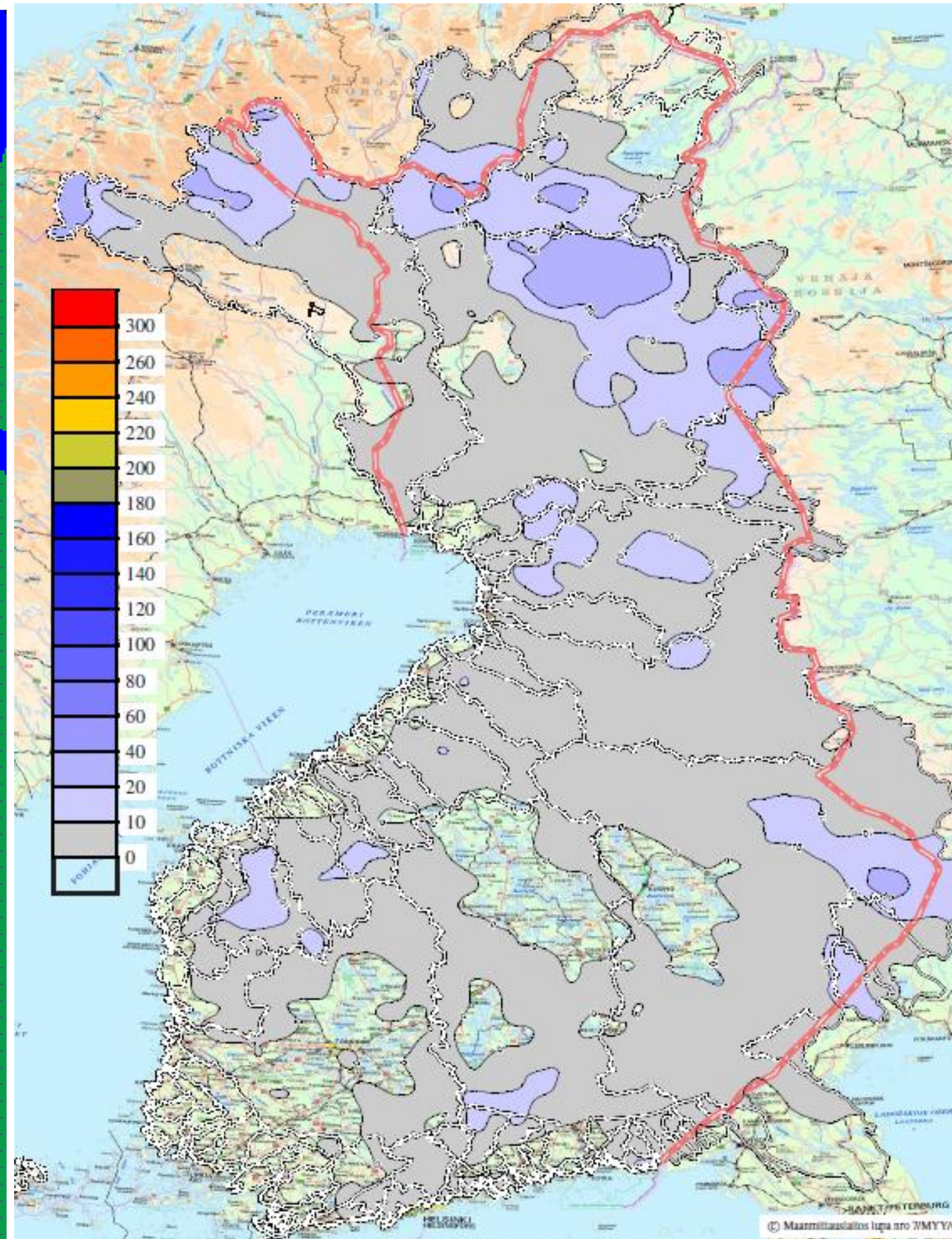
Oiva Urjankangas
The best
snow observer
in the world!

SYKE's network of snow courses:

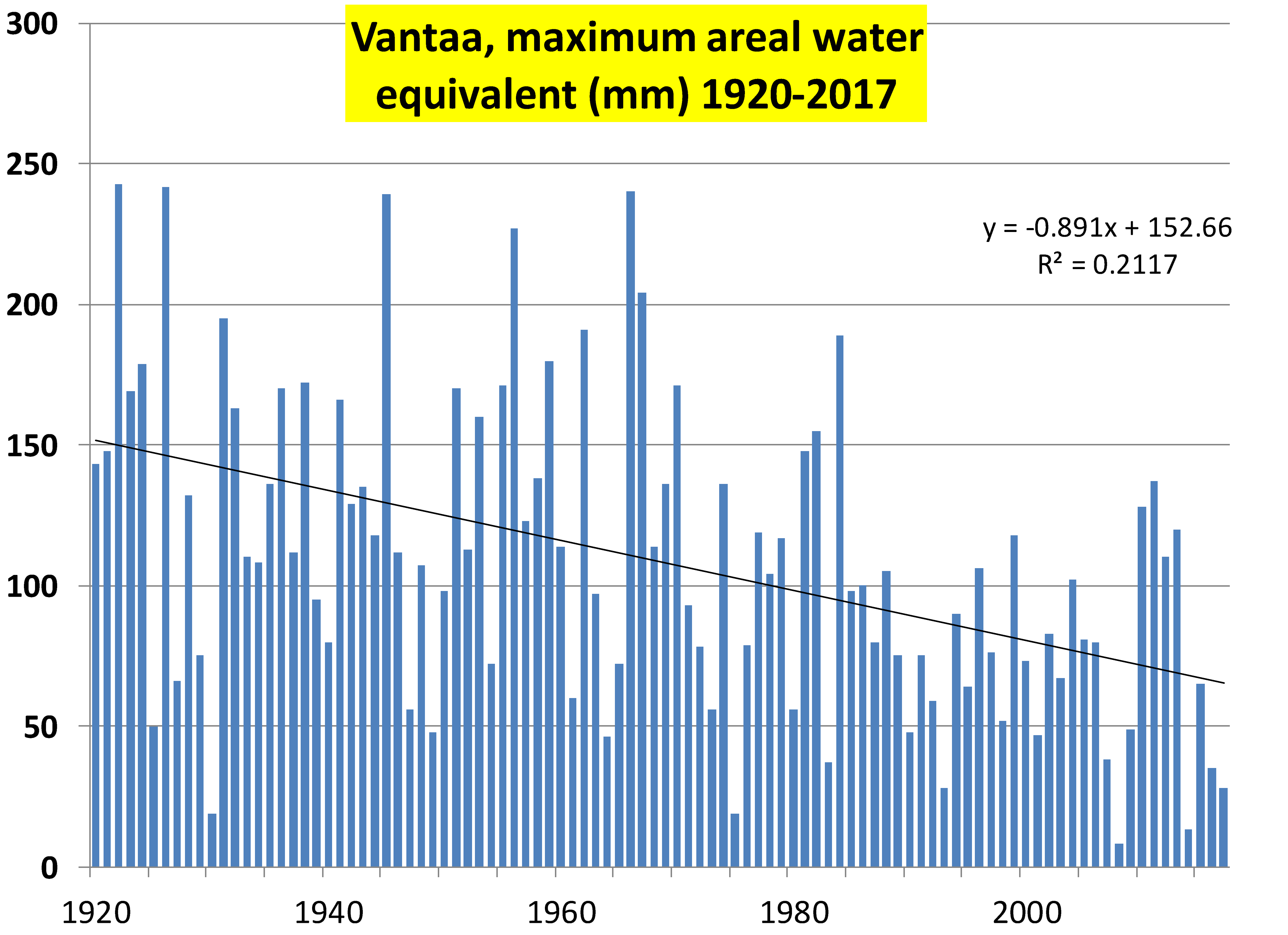
- Today 143 snow courses
- Network established in late 1940s
- 80 snow depths,10 snow densities (length 4 km)
- Land use taken into account
  - Forests, fields, wetlands
- Results used to calculate water equivalents at grid points (10 x 10 km)
- Grid point values used to calculate areal values for river basins

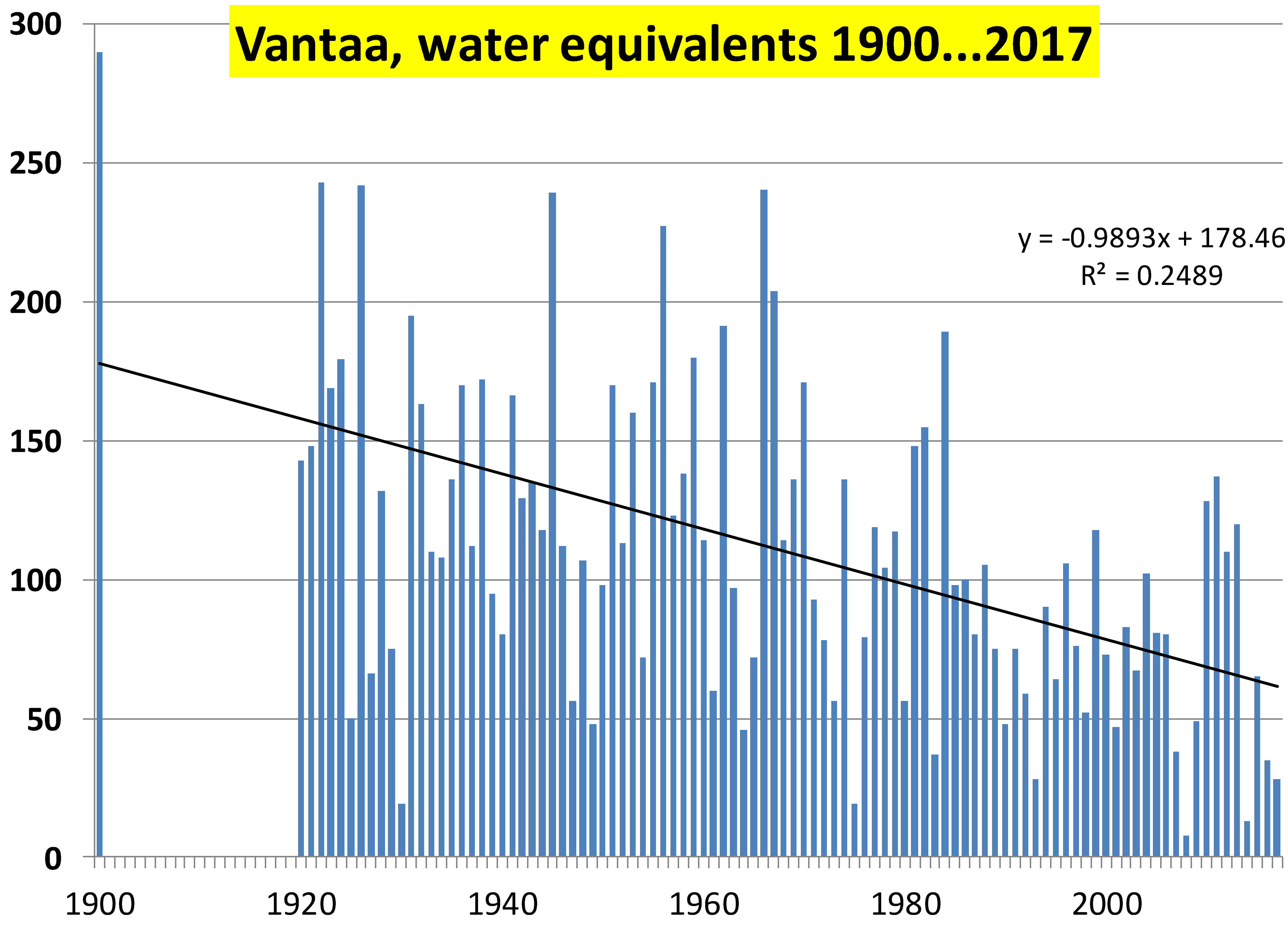






Lumen vesiarvo (mm eli kg/m^2) 31.10.2017
Forecast day 31.10.
Snow water equivalent (mm) 31.10.2017

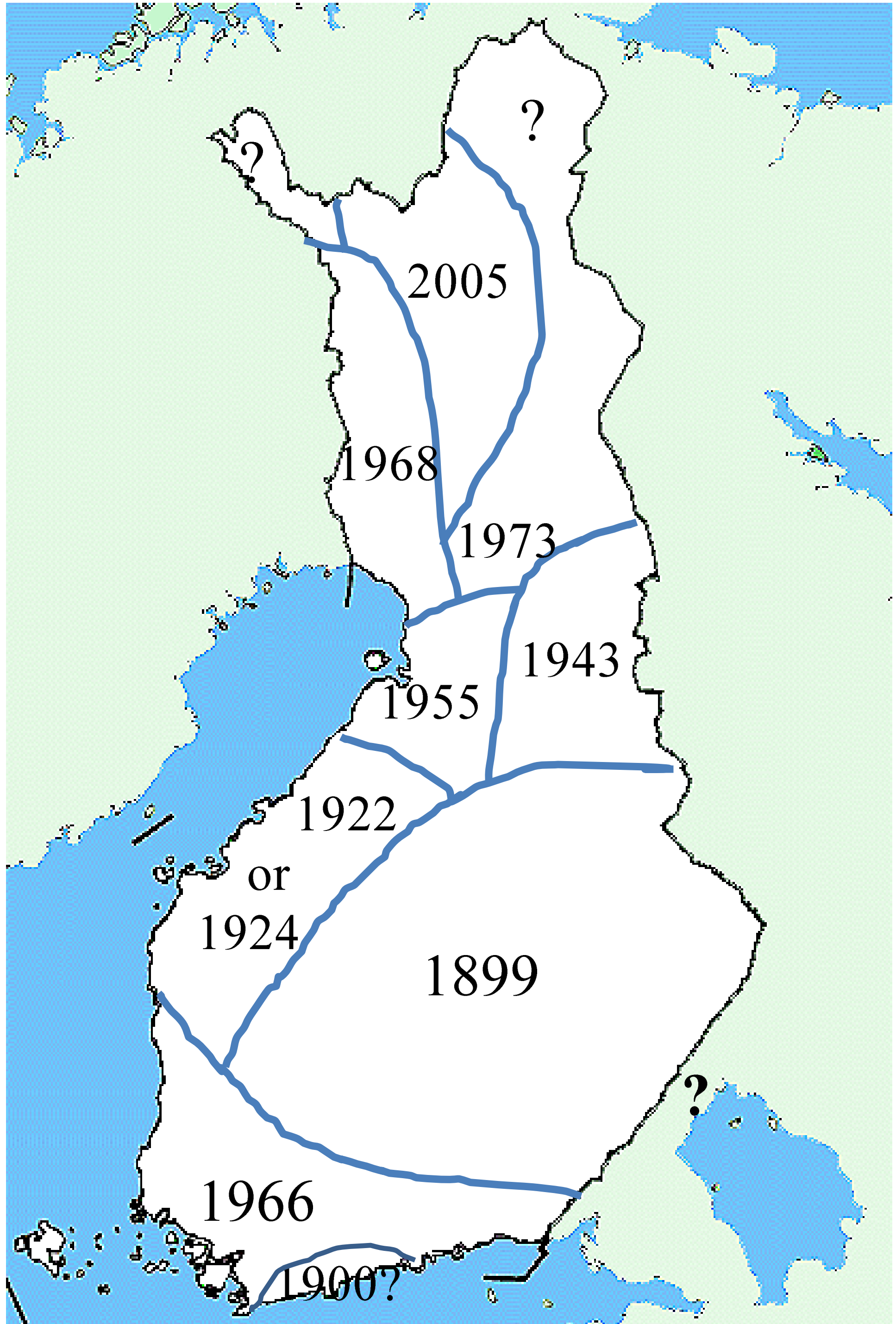

Vantaa, maximum areal water equivalent (mm) 1920-2017
y = -0.891x + 152.66
R² = 0.2117
300
250
200
150
100
50
0
1920
1940
1960
1980
2000



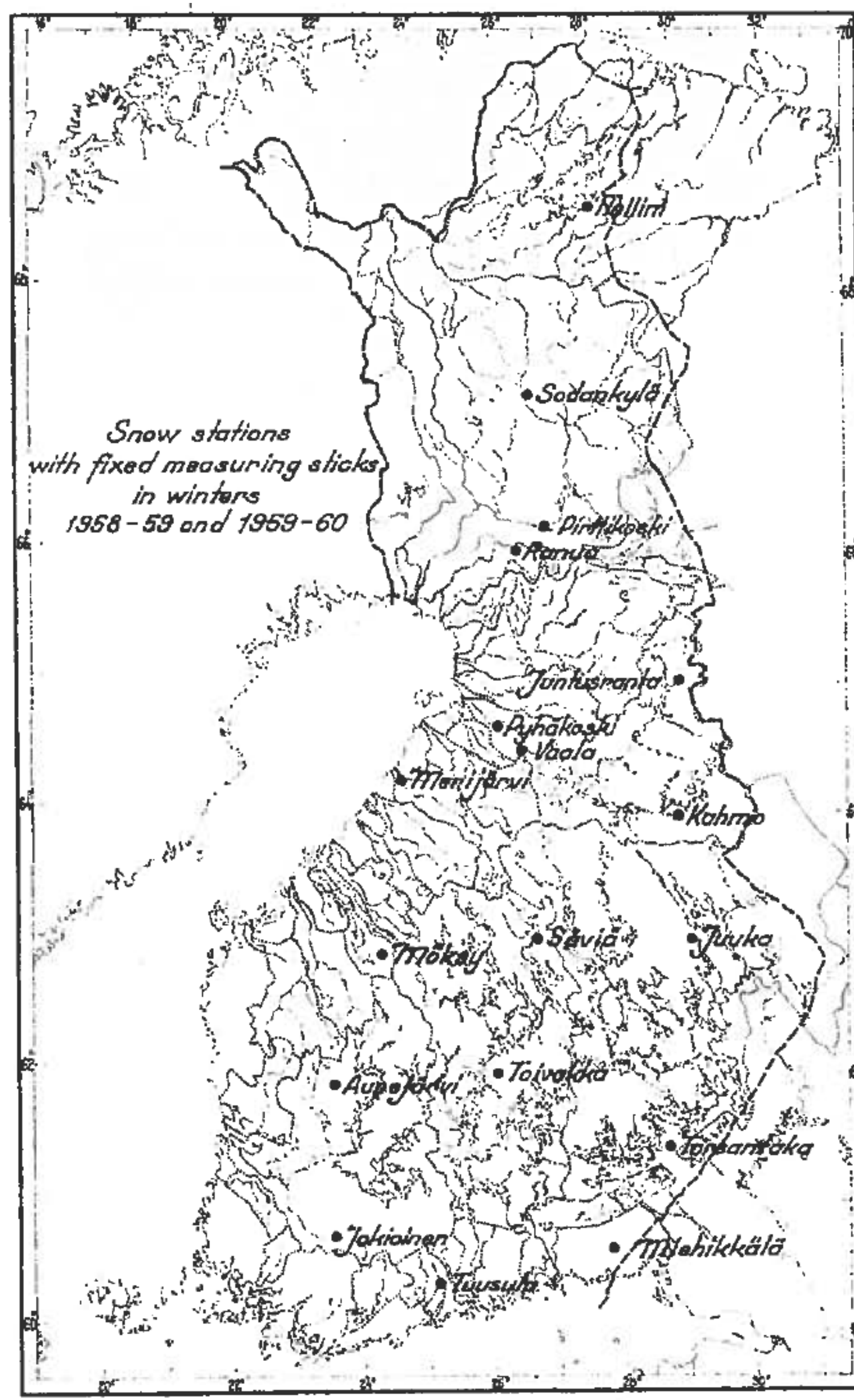
Vantaa, water equivalents 1900...2017
y = -0.9893x + 178.46
R² = 0.2489
300
250
200
150
100
50
0
1900
1920
1940
1960
1980
2000

Largest flood during the last 150 years

- Not valid for small drainage basins (less than 200 km²)
- In Lapland valid since 1910
- All these floods are snowmelt floods



Stake stations of the Hydrological Office operated in 1958-1982



Select language

Svenska

Spara

att du får den bästa upplevelsen.

Jag förstår

1 av 1

Spara sökningen som en Bevakning

annonser

Nyinkommet först

On the accumulation and the decreasing of snow in pine dominated forest in Finland. (Diss.)

av Maunu Seppänen

Helsingfors 1961. (2) + 52 s. + tryckt omslag. [A3870]

Säljare: Dahlia Books Handelsbolag (företag)

130 SEK

Inrikes enhetsfrakt Sverige: 45 SEK

Lumityynyjen rakentamiseen haettiin oppia naapurista. Kenttäsymposiumin osanottajia Filefjällin lumityynyllä Pohjois-Ruotsissa elokuussa 1968.
The experience of neighbouring countries was utilized in the establishment of snow pillows. Participants of a field symposium at the Filefjäll snow pillow site in Sweden in August 1968.

Snow accumulation and snowmelt in Finland

by Esko Kuusisto

Unknown, 149 Pages, Published 1984

ISBN-10: 951-46-7494-4 / 9514674944
ISBN-13: 978-951-46-7494-5 / 9789514674945

New	Used	Rentals	Digital
not available	*not available*	*not available*	*not available*

No copies of this book were found in stock from 712 online book stores and marketplaces.

- Alert me when this book becomes available.

PUBLICATIONS OF WATER AND ENVIRONMENT RESEARCH INSTITUTE

11

1992

Bertel Vehviläinen

Snow cover models in operational watershed forecasting

Yhteenveto: Lumimallit vesistöjen ennustemalleissa


1.3 metres,
about 350 kg/m2,
Areal w.e. only
127 kg/m2
Espoonlahti Hockey Arena, Feb 27, 2010
Photo: Matti Piiroinen

Lumikuorma on romahduttanut ladon katon alas Haminassa.

HS 14.3.2010

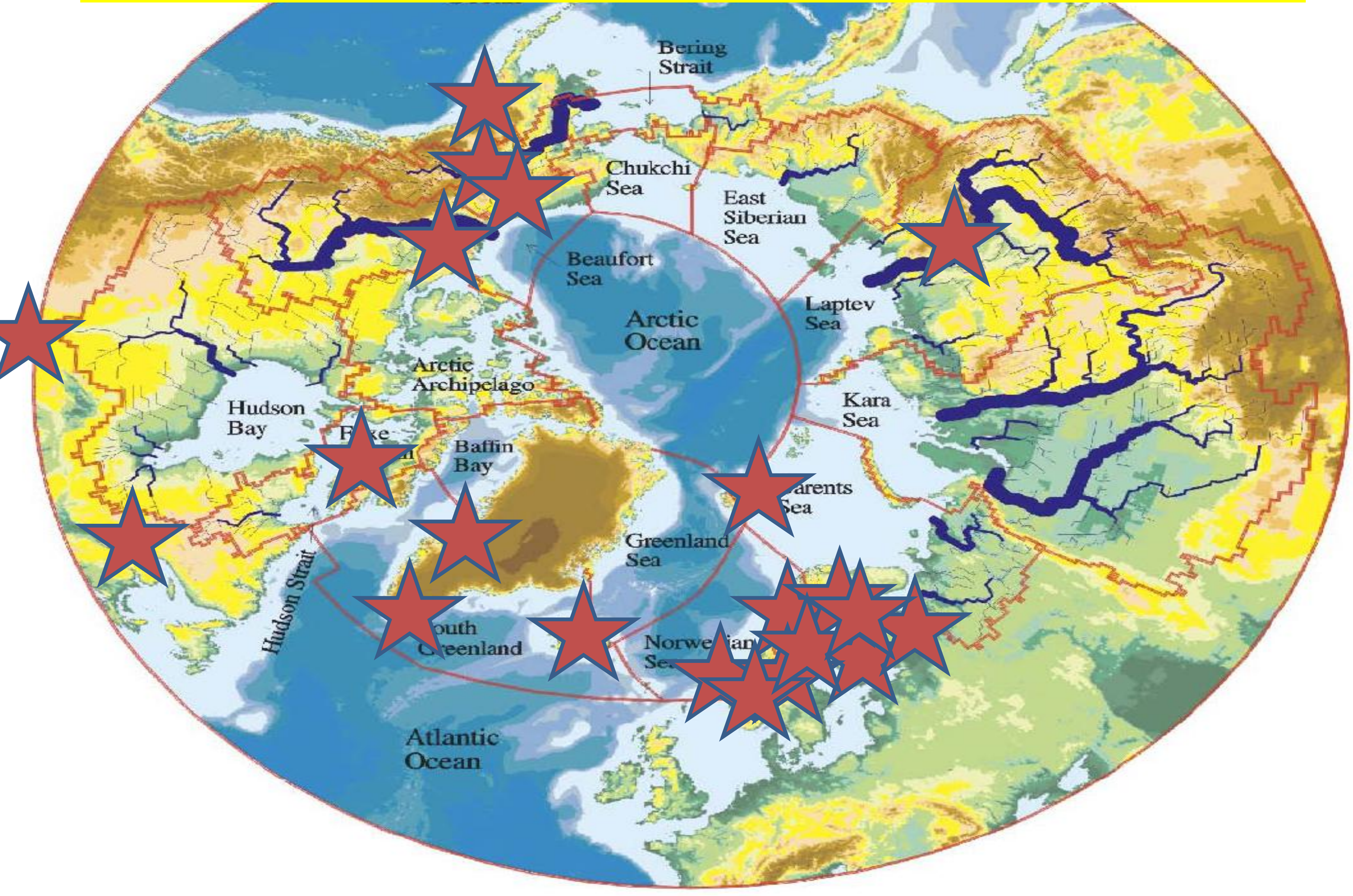
Lumitalvi kuritti pahoin monia maaseudun rakennuksia

Ei ihme, jos katto ei kestänyt, kun lunta

ANTTI JOHANSSON HS

20th International Northern Research Basins Symposium and Workshop
Kuusamo, Finland
August 16–21, 2015

THUS FAR: twentyone NRBs




ULLENSVANG, NORWAY 1982


Toolik Field
Station
Barnes 2007

NY ÅLESUND, SVALBARD 1997

Erkki Palosuo
Svalbard

Päikki Priha’s album

Fig. 5. Nordaustlandet glacier expedition during International Geophysical Year 1957. Professor Erkki Palosuo (in front) loading Vessla vehicle for transportation of equipment.


Matti Leppäranta
Aboa, Antarctica

Eija Kärkäs, Queen Maud Land, Antarctica, 2002

ANNUAL CYCLE OF THE ACTIVE SURFACE LAYER IN WESTERN DRONNING MAUD LAND, ANTARCTICA

Onni Järvinen

ACADEMIC DISSERTATION IN GEOPHYSICS

To be presented, with the permission of the Faculty of Science of the University of Helsinki for public criticism in the Auditorium A110 of Chemicum, A.I Virtasen aukio 1, on September 27th, 2013, at 12 o'clock noon.

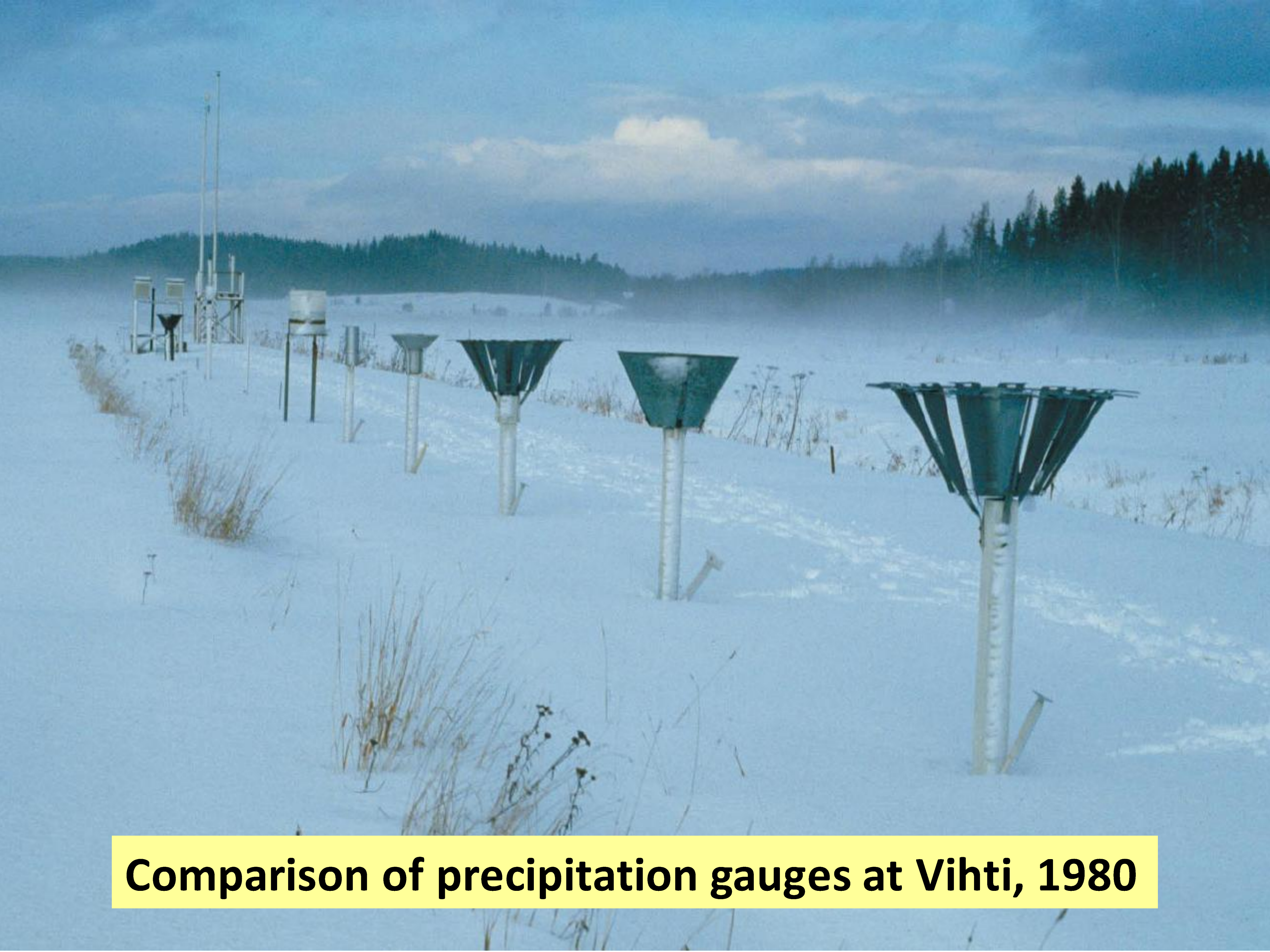
University of Helsinki, Helsinki 2005

Snow pack structure characteristics in Finland - measurements and modelling

Sirpa Rasmus

Academic Dissertation, May 2005.
University of Helsinki, Faculty of Science, Department of Physical Sciences, Division of Geophysics.

1. As a PDF file (ISBN 952-10-2379-1) - 11067 kB



Comparison of precipitation gauges at Vihti, 1980

The first dissertation on snow?

V. V. Korhonen. Die Ausdehnung und Höhe der Schneedecke. Mitteilungen der Meteorologischen Zentralanstalt Nr. 2. Helsinki 1915. — Eine Zusammenstellung der Beobachtungen von den Jahren 1891—1910 über die Zahl der Tage mit Schneedecke und die Höhe der Schneedecke. Kritik des Materials und der Bearbeitungsmethoden. Einwirkung der Beschaffenheit des Beobachtungsplatzes auf die Schneehöhe. Der jährliche Gang. Die Dichte und der Wassergehalt der Schneedecke. Beziehungen zwischen der maximalen Schneehöhe und der Lufttemperatur im Frühjahr samt dem Zeitpunkt des Verschwindens der Schneedecke im Frühjahr. Einwirkung des Waldes auf die Lufttemperatur.

ÜBER DIE TEMPERATUR DES BODENS UND DER SCHNEEDECKE IN SODANKYLÄ

NACH BEOBACHTUNGEN MIT THERMOELEMENTEN

VON

J. KERÄNEN

MIT 8 FIGUREN IM TEXT UND 6 TAFELN

Wird mit Genehmigung der Philosophischen Fakultät der Universität zu Helsingfors am 20. Oktober 1920 um 10 Uhr vormittags im hist.-phil. Auditorium zur öffentlichen Verteidigung vorgelegt

Examiner: Theodor Homén

HELSINGFORS 1920

Suomen Valtion Meteorologisen Keskuslaitoksen toimituksia

Julkaissut sen Johtaja

G. Melander

Mitteilungen der Meteorologischen Zentralanstalt des finnischen Staates

Herausgegeben durch deren Direktor

G. Melander

N:o 18

1926

EIN BEITRAG ZUR KRITIK DER NIEDERSCHLAGSMESSUNGEN

ÜBER DIE DICHTE DES NEUSCHNEES

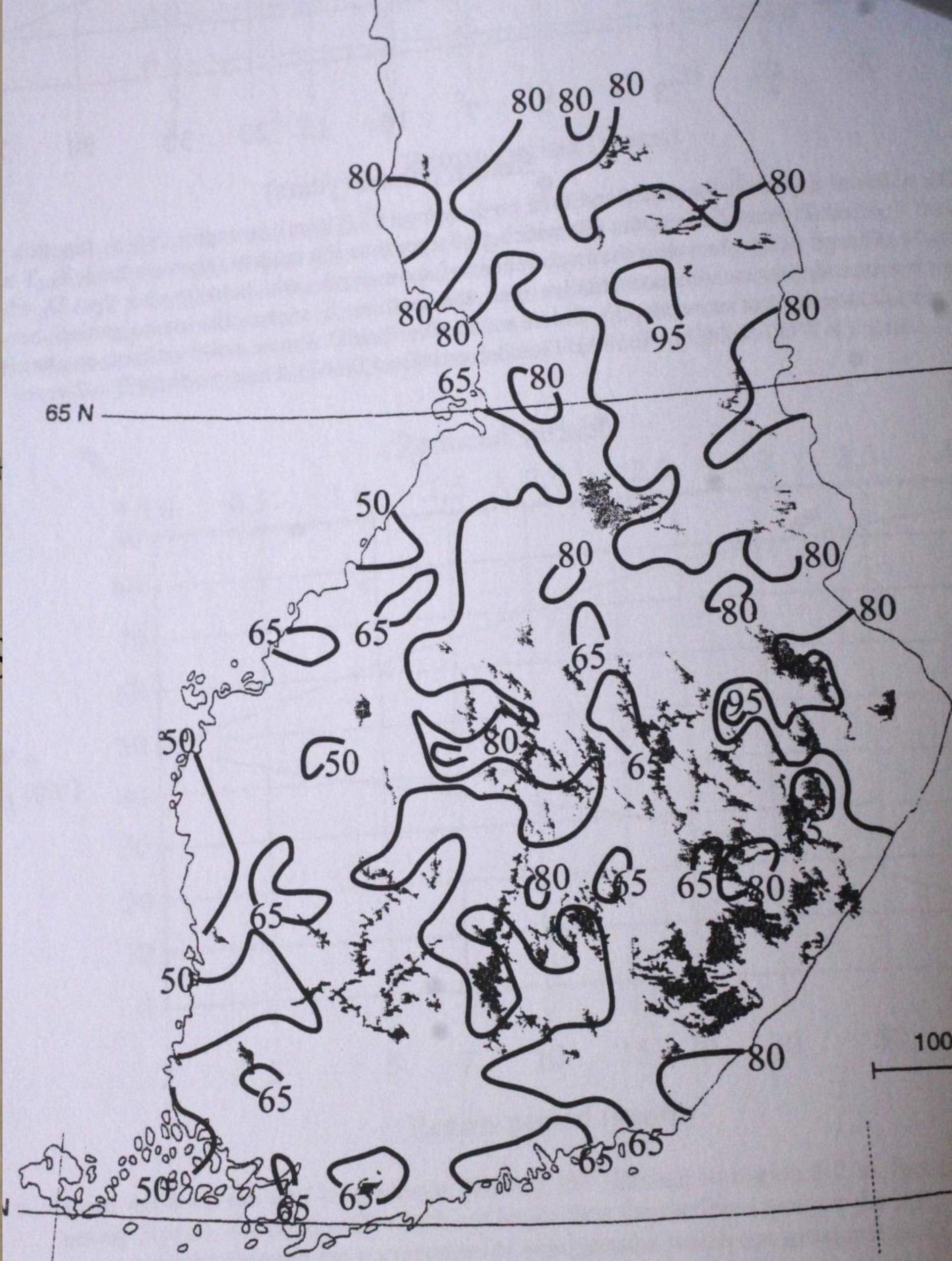
VON

W. W. KORHONEN.

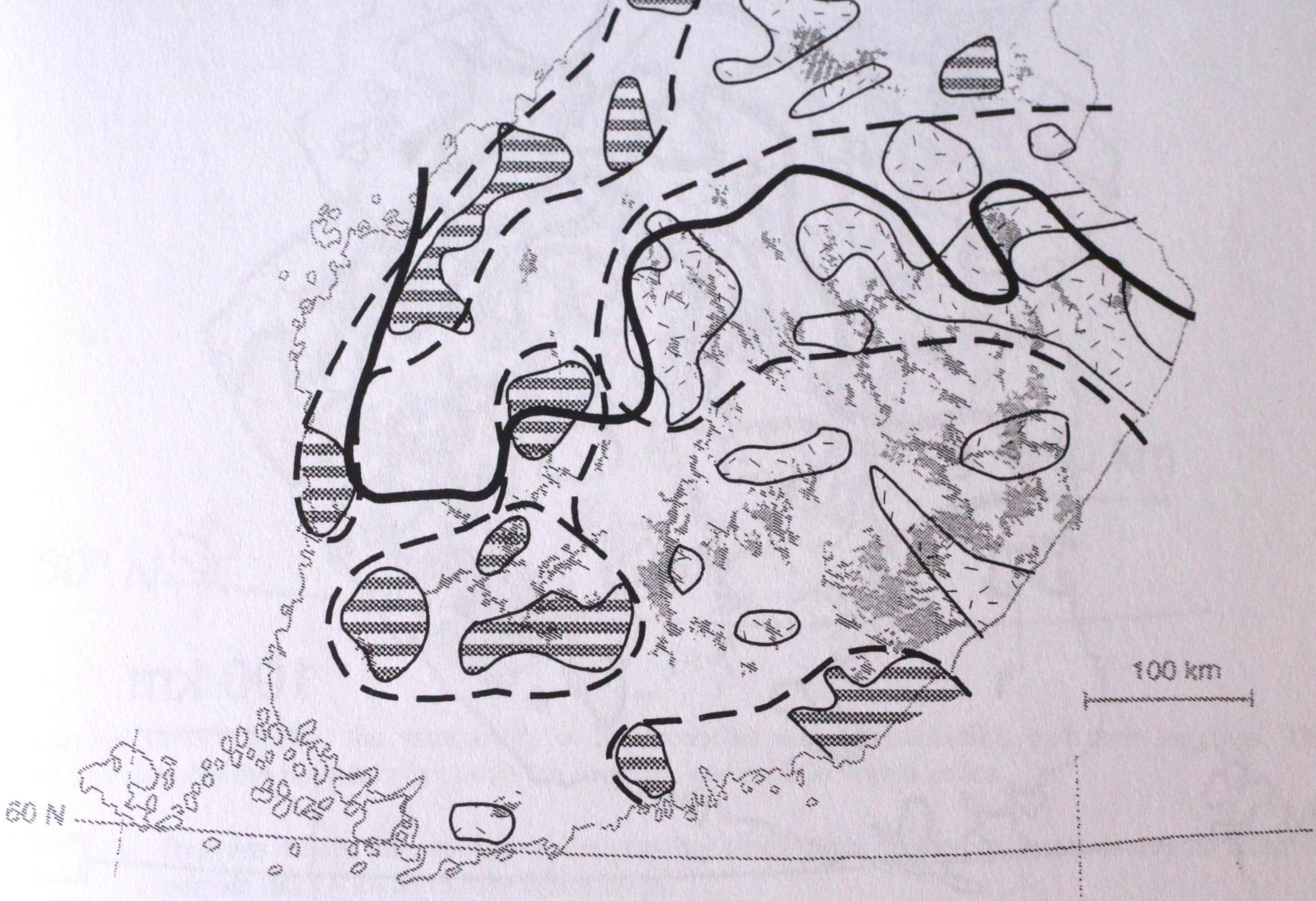
METEOROLOGISIA JULKAISUJA
METEOROLOGISKA PUBLIKATIONER
METEOROLOGICAL PUBLICATIONS

SNOW DEPTH ON JANUARY 15TH AND MARCH 15TH IN FINLAND 1919-98, AND ITS IMPLICATIONS FOR SOIL FROST AND FOREST ECOLOGY

Reijo Solantie



21. The greatest snow depth on the total land area on January 15th 1947—98 (cm)



The areas where the difference of snow depth between forests and open fields on March 15th decreased from the period 1919—39 to 1940—62 by 3 cm or more (ruled), and regions where it increased by 3 cm or more (dotted), in the connection with the boundary between the southern and middle boreal forest vegetational zones (bold line). The clusters of both areas are surrounded by broken lines

Reijo Solantie. Defending his second Doctor’s thesis at Jyväskylä University in Dec. 2012

ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

133
CONTRIBUTIONS

2017

PROJECTED CLIMATE CHANGE IMPACT ON FIRE RISK AND HEAVY SNOW LOADS IN THE FINNISH FORESTS

ILARI LEHTONEN

Nat. Hazards Earth Syst. Sci., 16, 2259–2271, 2016
www.nat-hazards-earth-syst-sci.net/16/2259/2016/
doi:10.5194/nhess-16-2259-2016

Natural Hazards and Earth System Sciences
Open Access

Heavy snow loads in Finnish forests respond regionally asymmetrically to projected climate change

Ilari Lehtonen[1], **Matti Kämäräinen**[1], **Hilppa Gregow**[1], **Ari Venäläinen**[1], **and Heli Peltola**[2]

[1]Finnish Meteorological Institute, 00101 Helsinki, Finland
[2]School of Forest Sciences, University of Eastern Finland, 80101 Joensuu, Finland

Correspondence to: Ilari Lehtonen (ilari.lehtonen@fmi.fi)

Received: 20 May 2016 – Published in Nat. Hazards Earth Syst. Sci. Discuss.: 6 July 2016
Revised: 26 September 2016 – Accepted: 27 September 2016 – Published: 17 October 2016

Abstract. This study examined the impacts of projected climate change on heavy snow loads on Finnish forests, where snow-induced forest damage occurs frequently. For snow-load calculations, we used daily data from five global climate models under representative concentration pathway (RCP) scenarios RCP4.5 and RCP8.5, statistically downscaled onto a high-resolution grid using a quantile-mapping method.

1 Introduction

Forest damage caused by snow loading on trees occurs frequently in boreal environments. On the European level, estimates of the amount of timber damaged by snow during a typical year vary between one and 4 million m^3 (Nykänen et al., 1997; Schelhaas et al., 2003). In addition to the north-

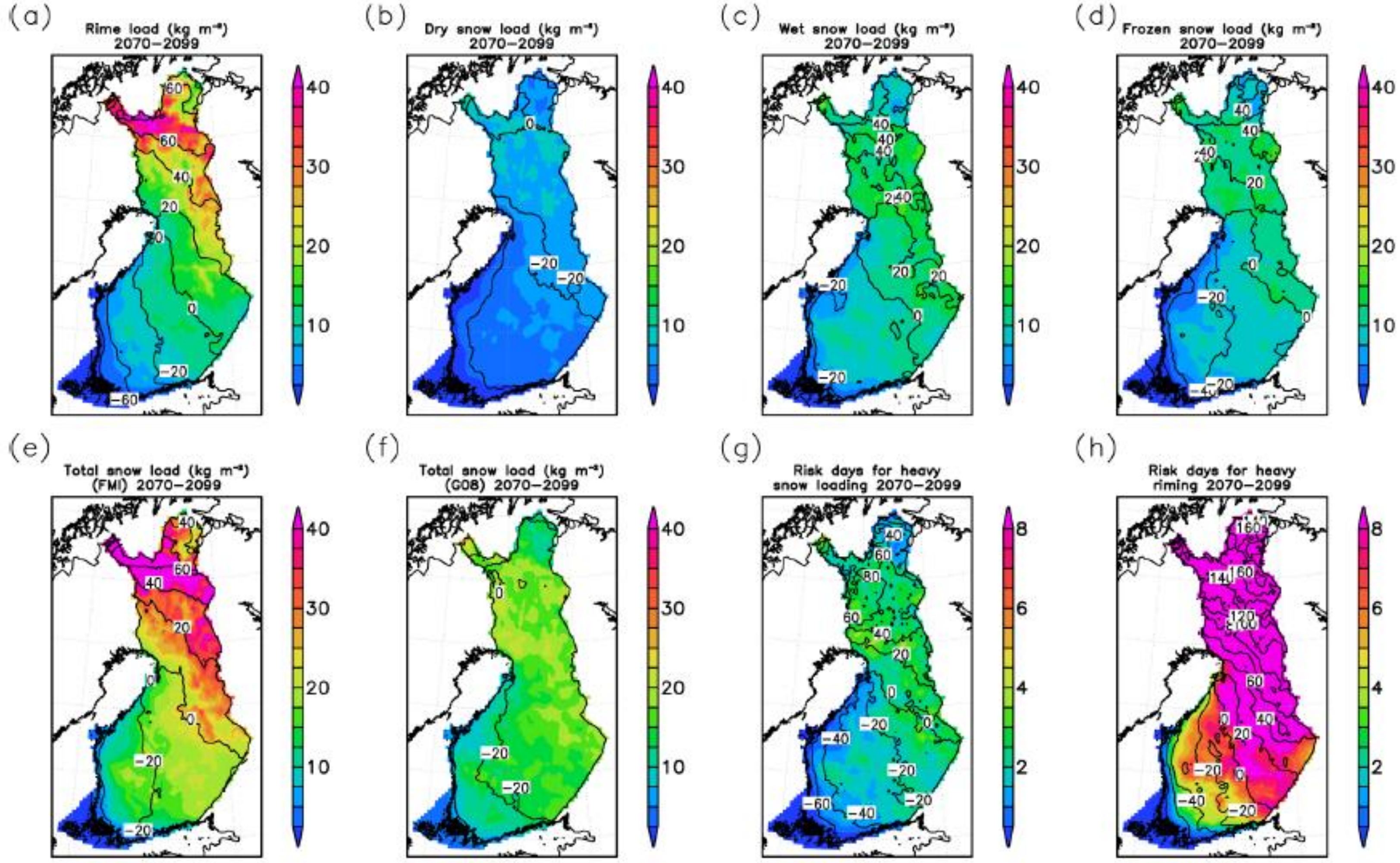


Figure 5. The annual maximum rime loads **(a)**, dry snow loads **(b)**, wet snow loads **(c)**, frozen snow loads **(d)**, total snow loads based on the FMI method **(e)** and total snow loads based on the G08 method **(f)** for the period 2070–2099 under the RCP8.5 scenario as a multi-model mean. Contours show the multi-model mean change from 1980–2009 to 2070–2099.

CURRICULUM VITAE

Jouni_Raisanen_CV_Jan2015.pdf

VIIMEISIMMÄT JULKAISUT

An energy balance perspective on regional CO2-induced tempera

Räisänen, J. toukokuuta 2017 julkaisussa : Climate dynamics : observa
computational research on the climate system. 48, 9-10, s. 3441-3454

Julkaisu: Artikkelijulkaisu › A1 Alkuperäisartikkeli tieteellisessä aikakauslehd

---

OZO v.1.0: software for solving a generalised omega equation anc
tendency equation using WRF model output

Rantanen, M., Räisänen, J., Lento, J., Stepanyuk, O., Räty, O., Sinclai
julkaisussa : Geoscientific Model Development. 10, 2, s. 827-841 15 Si

Julkaisu: Artikkelijulkaisu › A1 Alkuperäisartikkeli tieteellisessä aikakauslehd

---

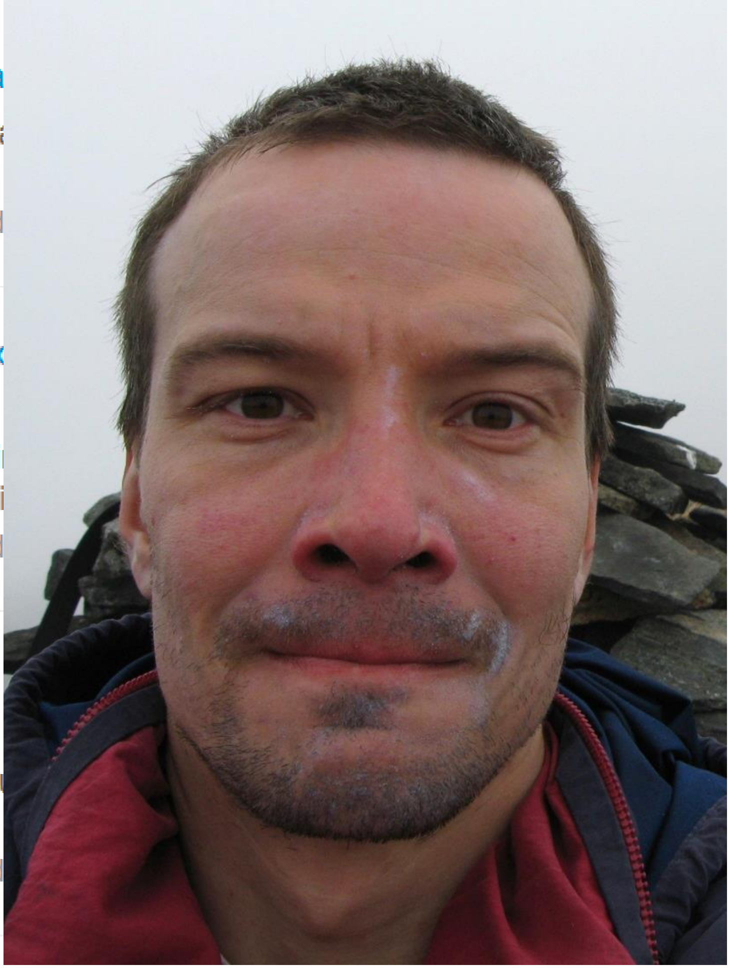
Factors affecting atmospheric vertical motions as analyzed with a
the OpenIFS model

Stepanyuk, O., Räisänen, J., Sinclair, V. A. & Järvinen, H. 2017 julkaisu
and Oceanography. 69, 10 Sivumäärä, 1271563

Julkaisu: Artikkelijulkaisu › A1 Alkuperäisartikkeli tieteellisessä aikakauslehd

---

Näytä kaikki (91) »



Helsinki University of Technology

Pentti Kaitera
1905-1985

Lumen kevätsulamisesta ja sen vaikutuksesta vesistöjen purkautumissuhteisiin Suomessa

Spring snowmelt season and its impacts on discharge conditions in Finland
1939

Gürer I., 1975. Hydrometeorological and water balance studies in Finland. Doctoral thesis. Helsinki University of Technology. Research papers 49.

M. Hallikainen, F. Ulaby, and M. Abdelrazik, "Dielectric Properties of Snow in the 3 to 37 GHz Range", IEEE Trans. Antennas Propagat. vol. 34, no. 11, pp. 1329-1340, 1986.

Martti Hallikainen, Juha Lemmetyinen:
Microwave brightness temperature of snow: Observations and simulations. IGARSS 2016: 7071-7074

Raimo Laurén

Kuva 5. *Risto Kuittisen väitöstilaisuus pidettiin Teknillisellä korkeakoululla 2.12.1988. Vastaväittäjinä toimivat professorit Friedrich Quiel, KTH, ja Pertti Vakkilainen, TKK.*

J. Pulliainen, "Investigation on the backscattering properties of Finnish boreal forests at C- and X-band: A semi-empirical modeling approach," Doctoral dissertation, Laboratory of Space Technology, Helsinki University Technology, Report 19, 1994.

SARI METSÄMÄKI

A fractional snow cover mapping method for optical remote sensing data, applicable to continental scale

Aalto University, School of Engineering,

Department of Real Estate, Planning and Geoinformatics

2013

Aalto University

Process-Oriented Investigation of Snow Accumulation, Snowmelt and Runoff Generation in Forested Sites in Finland

Harri Koivusalo

Dissertation for the degree of Doctor of Science in Technology to be presented with due permission of the Department of Civil and Environmental Engineering for public examination and debate in Auditorium R1 at Helsinki University of Technology (Espoo, Finland) on the 10th of January, 2003, at 12 noon.

Overview in PDF format (ISBN 951-22-6237-1) [862 KB]
Dissertation is also available in print (ISBN 951-22-6214-2)

Abstract

This thesis summarises development and application of a hydrological model for simulating forest canopy processes, snow accumulation and melt, soil and ground water interactions, and streamflow routing. A motivation behind the model development is to outline a methodology for predicting the influence of land use changes on catchment hydrological processes. In addition, the development aims at providing linkages from the hydrological model to atmospheric models through implementation of surface energy balance and to water quality models through quantification of runoff components. The work started with comparison of two existing snow energy balance models using meteorological and snow data from Northern Finland. Based on the comparison the more simple of the tested snow parameterisations was modified to improve its performance in terms of snow heat balance simulation. The modified snow model was then coupled with a canopy scheme to account for the influence of forest on snow processes. The combined model was applied to clear-cut and coniferous forest sites in Southern Finland to identify the differences in snow mass and energy fluxes

Sallanko Jarmo, Kirsi-Marja Haanpää. 2010. Practical melting forecasting of artificial snow made from treated wastewater. Journal of cold region engineering, Vol. 24(3), 87-95.

Water resources and environmental engineering

Ac

Contact

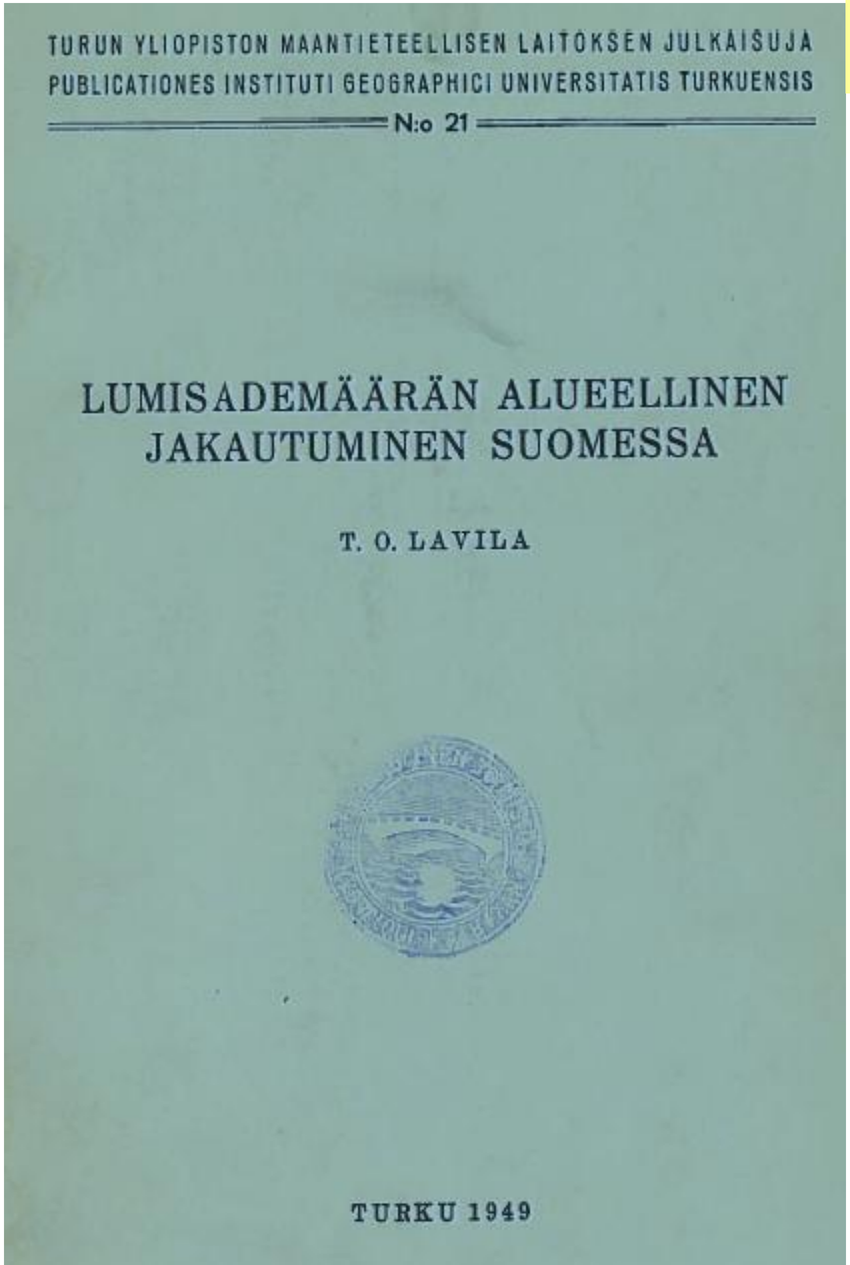
WATER RESOURCES AND ENVIRONMENTAL ENGINEERING

Our mission is to carry out high quality research and education focu
environmental engineering. We produce environmental engineers ar
knowledge in processes, modelling and management. Our internatio
rch rela
asic and
water su
e chang

UNIVERSITY OF OULU

Irannezhad M, Ronkanen A-K, Kløve B. 2015. Wintertime Climate Factors Controlling Snow Resource Decline in Finland? International Journal of Climatology. DOI: 10.1002/joc.4332.

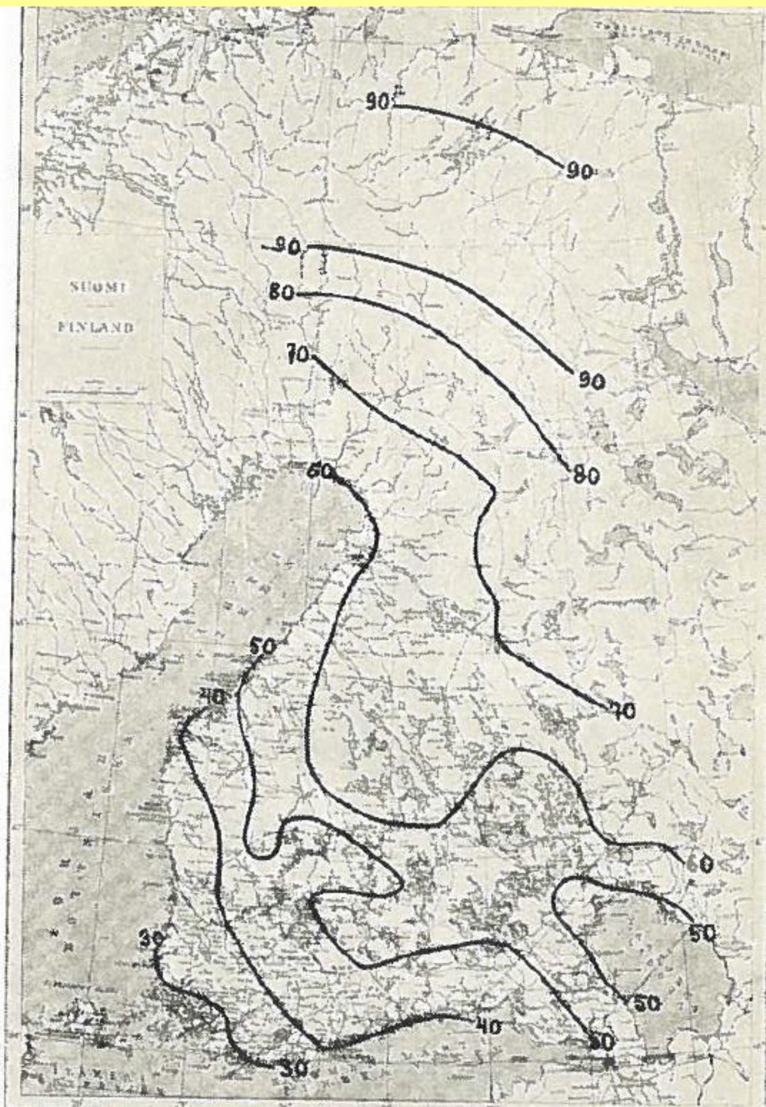
Percentage of snowfall in November


TURUN YLIOPISTON MAANTIETEELLISEN LAITOKSEN JULKAISUJA
PUBLICATIONES INSTITUTI GEOGRAPHICI UNIVERSITATIS TURKUENSIS
N:o 21

LUMISADEMÄÄRÄN ALUEELLINEN JAKAUTUMINEN SUOMESSA

T. O. LAVILA

TURKU 1949



Kartta 4. Lumena tulleen sateen suhteellinen määrä marraskuussa.
Karte 4. Relative Menge der in Schneeform gefallenen Niederschläge im November.

About one million observations in 1911-1935

JULY: only one case; Inari, Thule 1935, 1.5 mm

Included: Viipuri, Uusikirkko, Valkjärvi, Räisälä, Kurkijoki, Sortavala, Suistamo, Värtsilä

Esko Kangas. (1931). Siikakankaan mäntytaimistojen tuhoista. Silva Fennica no. 17 article id 4458.

SILVA FENNICA

Reijo Solantie. (1993). Snow and soil frost in Finnish forests. Silva Fennica vol. 27 no. 4 article id 5523

Eero Kubin. (1990). Lumi-, routa- ja lämpöolot eri tavoin muokatussa metsämaassa Kuusamossa. Silva Fennica vol. 24 no. 1 article id 5407

L. E. T. Borg. (1936). Hankikylvöt Tuomarniemen hoitoalueessa vv. 1913-1930. Silva Fennica no. 38 article id 4479.

Andrea Vajda, Ari Venäläinen, Pekka Hänninen, Raimo Sutinen. (2006). Effect of vegetation on snow cover at the northern timberline: a case study in Finnish Lapland. Silva Fennica vol. 40 no. 2 article id 338.

Juhani Päivänen. (1973). Harvennuksen vaikutus lumi- ja routasuhteisiin nuoressa turvemaan männikössä. Silva Fennica vol. 7 no. 2 article id 4881

Climate Risk Management 11 (2016) 15–36

Contents lists available at ScienceDirect

Climate Risk Management

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

Coping with difficult weather and snow conditions: Reindeer herders' views on climate change impacts and coping strategies

Minna T. Turunen [a,*], Sirpa Rasmus [b,1], Mathias Bavay [c,2], Kimmo Ruosteenoja [d,3], Janne Heiskanen [e,4]

[a] Arctic Centre, University of Lapland, P.O. Box 122, FI-96101 Rovaniemi, Finland
[b] Department of Biological and Environmental Science, University of Jyväskylä, P.O. Box 35, FI-40014 University of Jyväskylä, Finland
[c] WSL Institute for Snow and Avalanche Research SLF, Flüelastrasse 11, CH-7260 Davos Dorf, Switzerland
[d] Finnish Meteorological Institute, P.O. Box 503, FI-00101 Helsinki, Finland
[e] Department of Geosciences and Geography, University of Helsinki, P.O. Box 68, FI-00014 University of Helsinki, Finland

A R T I C L E I N F O

Article history:
Received 2 June 2015

A B S T R A C T

Winter is a critical season for reindeer herding, with the amount and quality of snow being among the most important factors determining the condition of reindeer and the annual


Kilpisjärvi May 27, 2014
Snow depth one meter
Antero Järvinen


Avalanche service in FMI
Alberto Blanco Sequeiros
alberto.blanco@fmi.fi

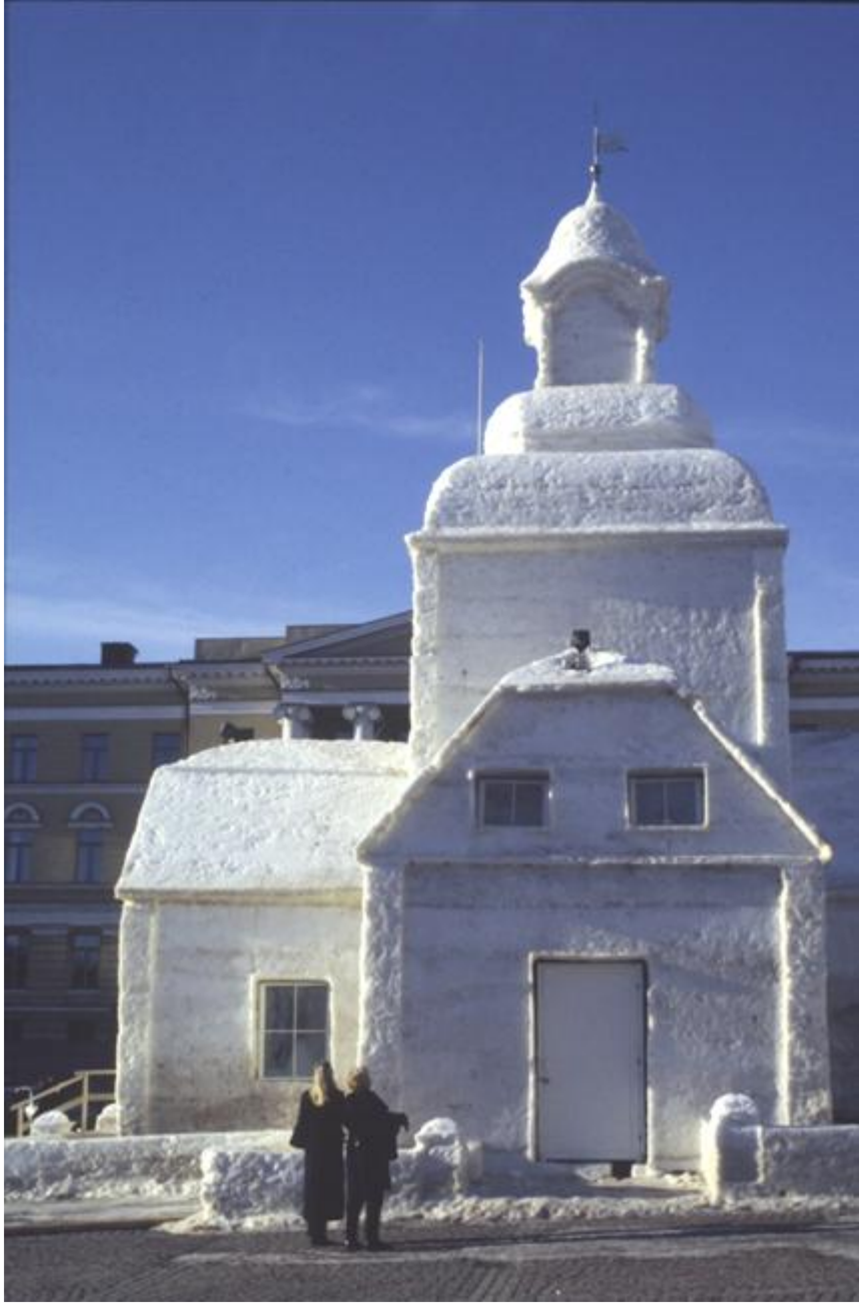

Juhani Lillberg
FINLAND
RAGNARØK

Nordic Ice & Snow Sculpture Competition

Nordic Ice & Snow Sculpture Competition will be held 9-12 March 2017 in Kilpisjärvi.

More information of the event will be published in the beginning of the year 2017.

Further information: Ms Anne Keskitalo-Hohti, anne.keskitalo-hohti@enontekio.fi

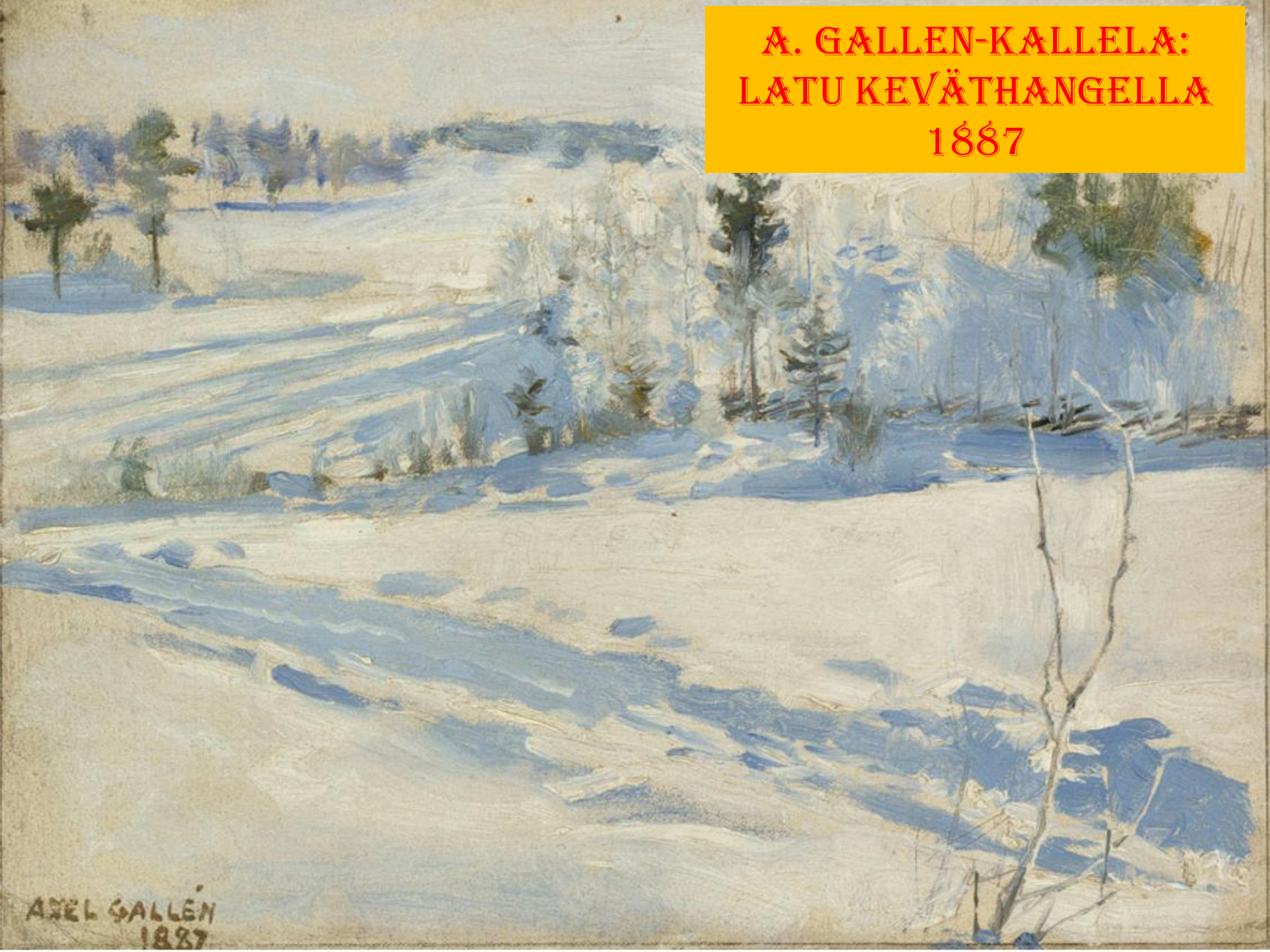


STONE CHURCH
AND
SNOW CHURCH

HELSINKI




A. Gallen-Kallela:
Latu kevähangella
1887



Ruovesi, Jäminkipohja 24.3.2011

Northern Karelia/
Photo: Esko Kuusisto


”SPAGHETTI snow”
Vesa Kaloinen

Pertti Harju

Heinävesi, Tulilahti

HAIR ice (snow?)

Iso-Syöte, Pudasjärvi, Feb. 1994/Esko Kuusisto


KIITOS!