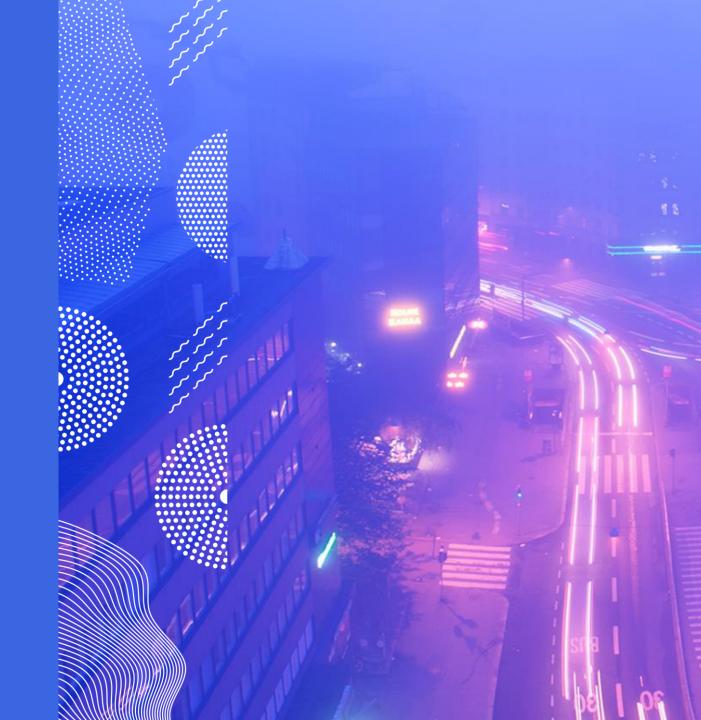


Janne Miettinen



Account Manager Customer Services Finnish Meteorological Institute

- 15 + years at FMI
- Worked at EFHK in the past
- Aviation Meteorologist
- Account Manager since 2013





FMI's collaboration with the Destia winter maintenance management center

EuMeTrain Road Weather Event Week, December 9-13 2019





Content

- ✓ FMI Road Weather Services in Brief
- ✓ Services for Winter Road Maintenance
- ✓ PPP with Destia
- ✓ Research and Development

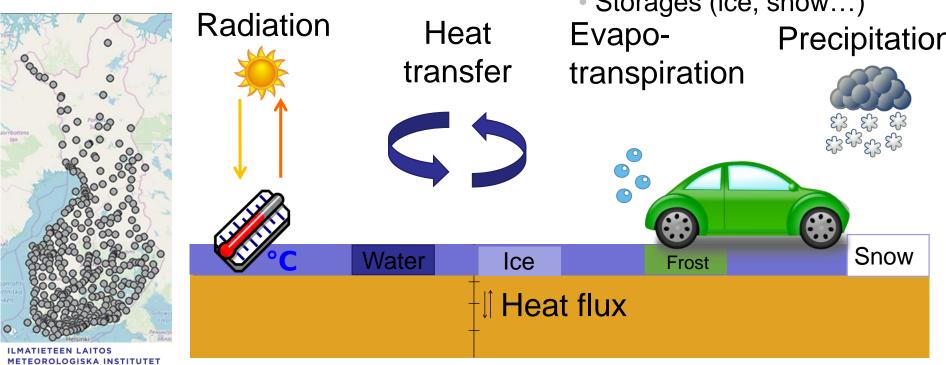


FMI Road Weather Services in Brief



FMI Road Weather Model (RWM)

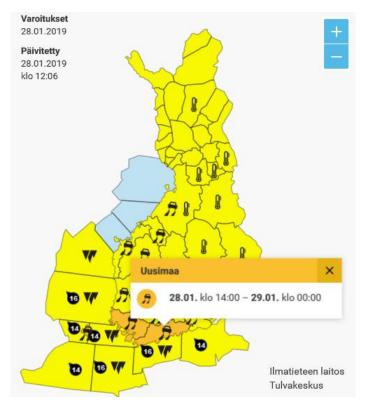
- Input data
 - Observation analysis
 - NWP-model



- Output parametres
 - Surface temperature
 - Surface conditions
 - Storages (ice, snow...)

Precipitation

FMI services for roadsector



Road traffic warnings for public

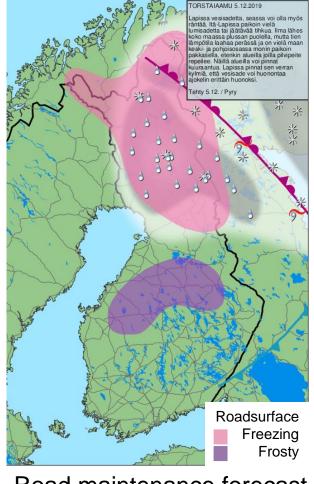


Safety and fluency to cities



Online notifications

SRWC 05.12.2019 5-7



Road maintenance forecast



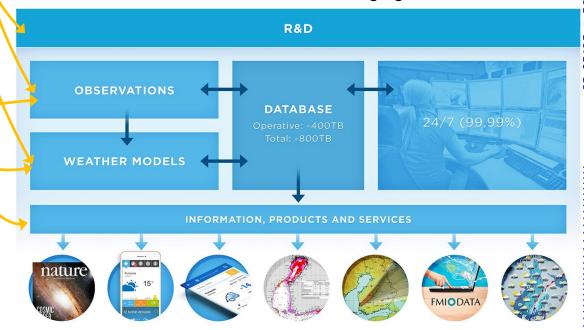
Road weather activities across the FMI

Operational services

- Safety and warnings for all road users
- Traffic authorities' services
- Transportation and road maintenance industries
- Operative road weather models
- Web-pages and machine readable interfaces
- Integration to Intelligent Transport Systems (ITS)
- Observation data

Research

- Road weather model development
- Observations, big data and IoT with mobile and road side technologies
- R&D for publications and new traffic services
- Future road conditions in the changing climate



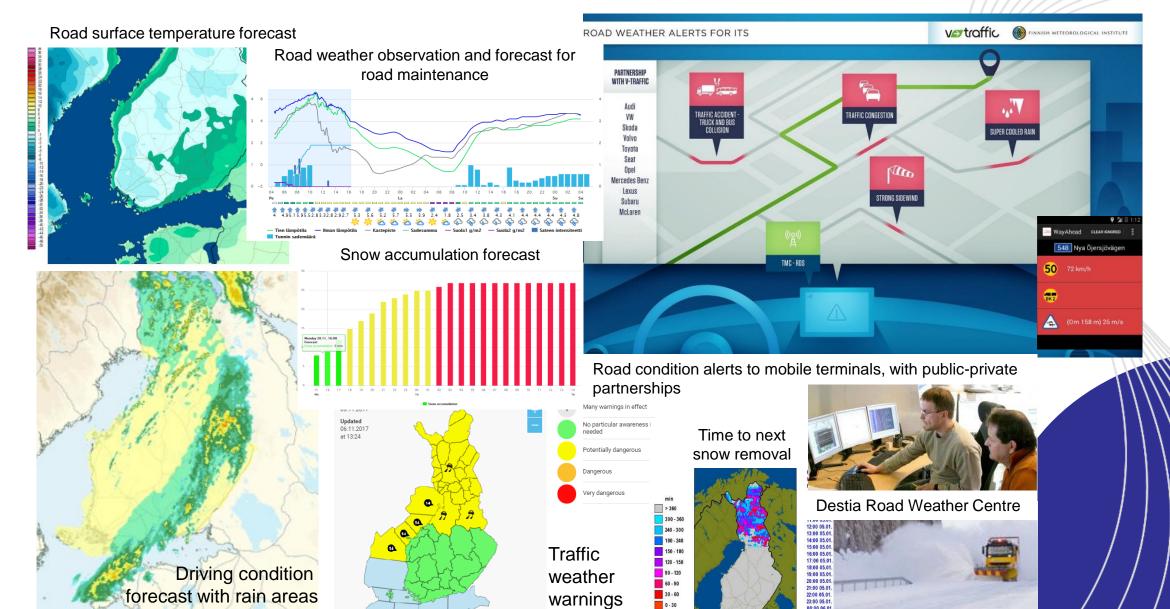


Services for Winter Road Maintenance





Road weather services



Services for Road Maintenance

Intelligent Traffic Management Finland

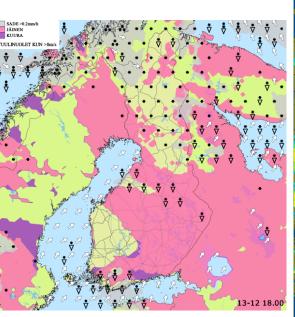
- Regional and point forecasts
- Phone support service
- Training

Finnish Transport Infrastructure Agency

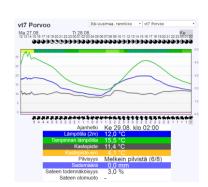
- Radar images
- Satellite images



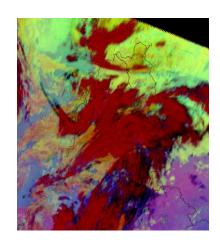
Significant road weather analysis by meteorologist

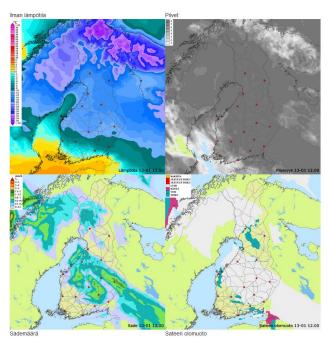


Significant road weather analysis; fully automated product









FMI data on customer's platform



Visualization

- Observations
 - Radar
 - Road observations
- Forecasts
 - Alarms on fast changes in weather
 - Bad driving conditions
 - Situational awareness
 - Maintenance operations
- Warnings
 - Official weather warnings





PPP with Destia





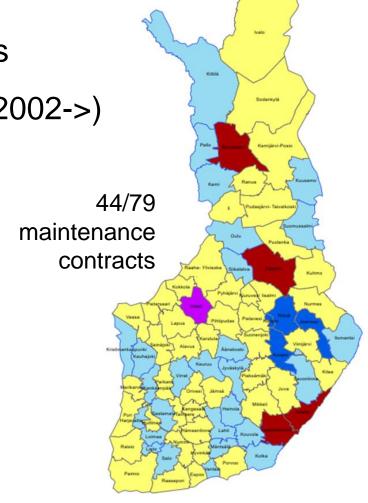
FMI - Destia Partnership

✓ Partnership for over 20 years

✓ Side by side for 17 winters (2002->)

✓ Digital services

✓ Daily consultation



DESTIA Maintenance areas

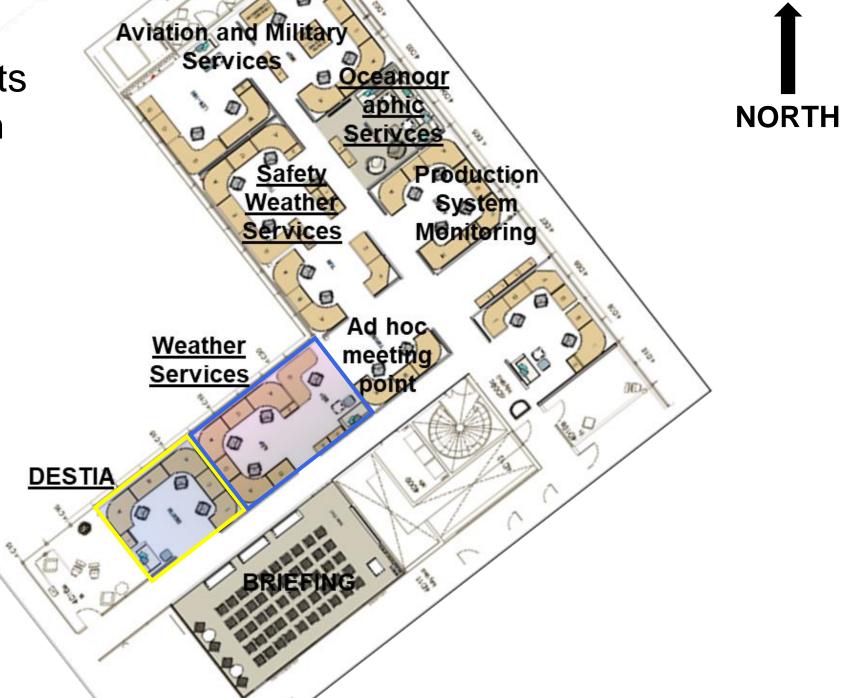
- ✓ Mutual benefits
- ✓ Training sessions
- ✓ Joint development
- ✓ Easy piloting



FMI meteorologists side by side with Destia's road maintenance operators

24/7/212

October - April



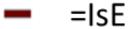


Winter Road Maintenance Policy in Finland

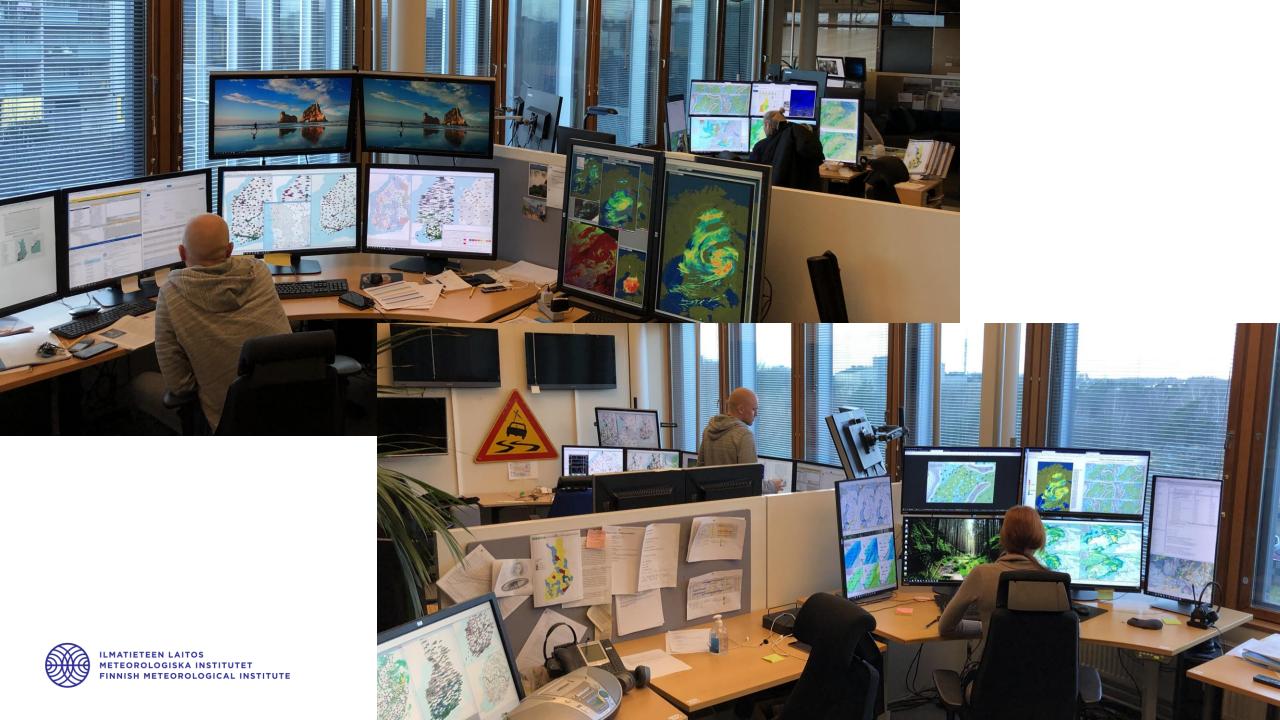
Winter maintenance class	Is	I	Ib and TIb	п	Ш
Maximum depth of snow during snowfall	4cm	4cm	4cm	8cm	10cm
Time to clear after the end of snowfall	2.5h (slush 2h)	3h (slush 2.5 h)	3h	4h	6h

- Ploughing must be started at the latest when half of the maximum depth has accumlated on the ground (so-called 'threshold')
- Maximum snow depth must not be exceeded during snowfall and after that while the measure is being carried out.
- Only half of the snow can be slush.
- The time to carry out the measure starts when the snowfall ends and ends when the traffic lanes have been cleared.





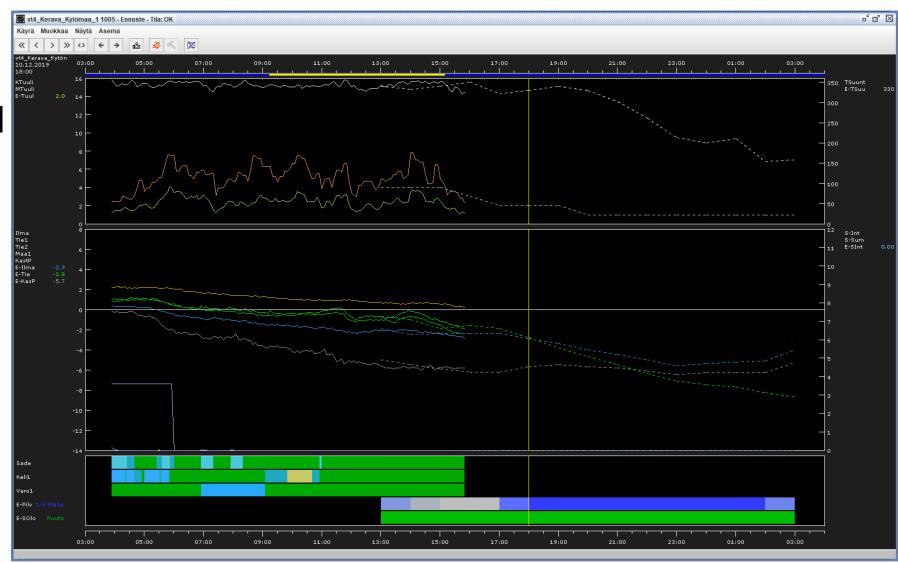


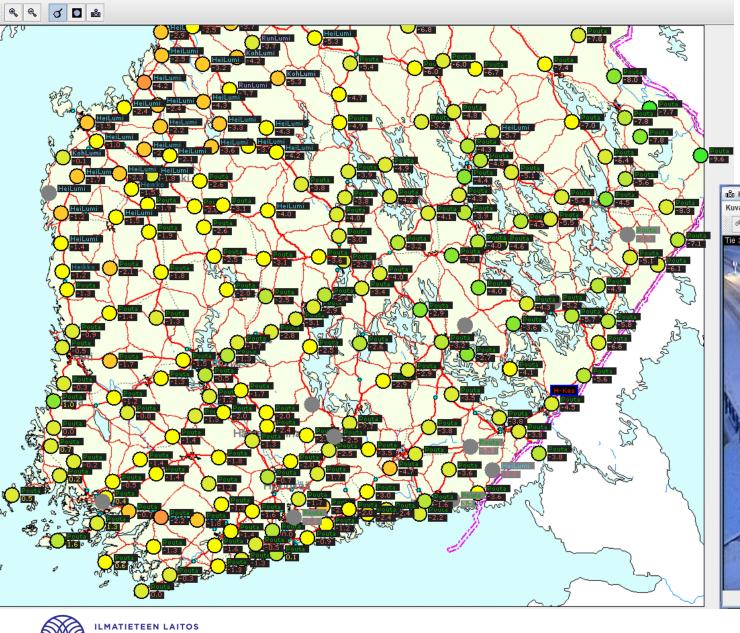


FMI's data on Destia's desision support system

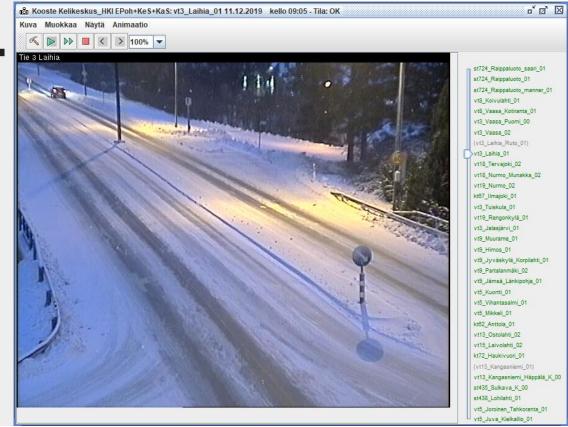
- Observations from ITMF's RWSs
 - Wind speed mx/mean
 - Wind direction
 - Air temperature
 - Road temperature
 - Dewpoint temperature
 - Precipitation
 - Accumulation
 - Form
 - Road condition
 - Cloudiness
- Observations 10-15 min resolution
- Forecasts created hourly







~400 RWS locations ~800 Cameras





E-Suomi - Kp-ero, sade, tie Kartta Muokkaa Näytä

Taulukko Muokkaa Näytä Asema

| « | » | «> | 💸 | «< ASEMA vt1_Espoo_Nupuri_1

Tila Ilma Dilm Tie1 Tie2 DTie1 DTie2 DTie1 DTie2 DTie2 DTie2 Maa1 Maa2 KastP KpEroT JääPit JääPit Koste Sade S-Int S-Sum S-Olom Näky m S-Tila N-Tila Keli1 Keli2 Varo1 Varo2 Tila3 Varo3 Kitka3 DSCpuh DSCsta KTuuli TSuunt MTuuli Aurink JTaaj1 JTaaj2 KostHä1 KosMä2 SuoMä1 SuoMä2 SuoMä1 SuoMä2 SuoWä1 SuoVä2 Turtä1 Turtä2 KVaP1 KV ATKA 11.12.09:01 -0.2 0.2 -0.5 -0.1 0.3 0.2 -1.1 -0.9 -1.0 0.5 0.0 -0.1 94 Pouta 0.00 0.0 Pouta 20000 1.4 Kaakko 4.4 Alhaalla 477 107 0.00 0.00 0.0 0.0 0.0 332.9 0.0 -0.1 0.00 OK OK Kost+Su vt1_Espoo_Nupuri_2 11.12.09:01 -0,2 0,2 -1,5 -0,4 0,4 0,0 -1,8 -1,1 -1,0 -0,5 -0,1 0,0 0,0 1,4 Kaakko 4,4 Alhaalla 112 130 0,06 0,0 0,0 0,10 vt1_Espoo_Nupuri_Opt11 11.12.09:01 ---OK E.Hvvä 0.82 1.4 Kaakko 11.12. 08:59 ------ --- -0,9 --- Kostea OK E.Hyvä 0,82 0.1 94 0.00 0.0 --- Kostea 0.02 vt1 Espoo Nupuri Opt12 -0,2 --- -0,1 --- ------ -1,8 --- -1,0 --- Kostea 11.12.09:01 OK 0.9 94 0.00 0.0 OK Kostea OK E.Hvvä 0.82 1.4 Kaakko 4.4 Alhaalla 0.02 vt1_Espoo_Nupuri_Opt21 20000 /t1_Espoo_Nupuri_Opt22 11.12. 08:59 ------ --- -0.9 0.8 94 0.00 0.0 OK E.Hyvä 0,82 --- Alhaalla 0.01 /t1_Espoo_Kolmiranta_1 11.12, 09:00 OR -0,5 0,3 -1,0 -0,4 0,5 0,3 -1,3 -1,0 -1,2 0.2 0,0 -0,2 95 0,00 0.0 20000 0.6 E-Kaakko 1,7 Alhaalla 110 110 0.00 0,1 0.0 331.9 0.0 -0.2 0,00 0.0 /t1_Espoo_Kolmiranta_2 11.12.09:00 -0,5 0,3 -1,4 -0,9 0,5 0,1 -1,7 -1,5 -1,2 -0,2 0,0 -0,1 95 0,00 0,0 20000 0,6 E-Kaakko 1,7 Alhaalla 107 110 0,01 0,00 0,0 0,0 -0,1 t1 Espoo Kolmiranta Opt11 11.12.09:00 OK -0.5 --- -1.0 ------ -1,3 --- -1,2 0,2 95 Pouta 0,00 0,0 20000 --- Kuiva OK E.Hyvä 0,82 0,6 E-Kaakko 1.7 Alhaalla 0,01 vt1_Espoo_Kolmiranta_Opt12 11.12.09:00 ----0.3 --- -1.0 ---92 0.00 0.0 0.03 --- -1.7 ---0.0 0.6 F-Kaakko 1.7 Albaalla 0.01 vt1 Espoo Kolmiranta Opt21 11.12.09:00 ---0.8 95 0.00 20000 OK F.Hvvä 0.82 vt1_Espoo_Kolmiranta_Opt22 11.12.09:00 ----0,3 --- -0,5 --- --- --- --- -1,4 0,9 0.00 0.0 OK F.Hvvä 0.82 --- Alhaalla 0.00 vt1 Vihti Palojärvi 1 11.12.09:01 OK 0,3 0,4 -0,6 -0,9 0,2 0,3 -0,8 -1,2 -1,0 0,4 0,0 -0,1 0,0 2,9 E-Kaakko 7,0 Alhaalla 107 0,00 0,0 -0,1 0,00 20000 110 0,00 0,0 0,0 330.7 vt1_Vihti_Palojärvi_2 11.12.09:01 OF 0.3 0.4 -1.4 -0.8 0.3 0.2 -1.5 -1.4 -1.0 vt1 Vihti Palojärvi Opt11 11.12.09:01 ------ -0.8 ----1,0 0.4 0.00 0.0 OK E.Hyvä 0,82 2,9 E-Kaakko 7,0 Alhaalla 0.01 0,3 --- -0,8 --- ------ Alhaalla vt1 Vihti Paloiärvi Ont12 11.12. 09:01 OK 91 0.00 0.0 OK F.Hvvä 0.82 0.00 0,3 --- -0,9 ------ -1.5 ----1,0 OK Kostea --- Kostea vt1 Vihti Palojärvi Opt21 11.12.09:01 OK 91 0,00 0,0 20000 OK F.Hvvä 0.82 2,9 E-Kaakko 7,0 Alhaalla 0,02 vt1_Vihti_Palojärvi_Opt22 11.12.09:01 ---0,3 --- -0,6 ----1,1 0,5 91 0,00 0,0 OK E.Hyvä 0.82 --- Alhaalla 0,01 /t1_Lohja_Lehmijärvi_1 0,4 0,1 -0,5 -0,4 0,2 0,1 -0,8 -0,6 -1,0 -0,3 11.12.09:04 0,5 -0,3 0,0 4,7 Alhaalla 0,00 -0,3 vt1_Lohja_Lehmijärvi_2 11.12.09:04 0,4 0,1 -1,0 -1,1 0,2 0,1 -1,2 -1,3 -1,0 -0,2 -0,1 0,00 0,0 1,8 E-Lounas 115 0,03 0,0 -0,2 -0,1 0,0 11.12.09:04 OK 0.4 --- -0.5 ----0,8 -1,0 0,5 90 0,00 0,0 Mäekä OK E.Hyvä 0,82 1,8 E-Lounas 4,7 Alhaalla 0,05 vt1 Lohja Lehmijärvi Opt11 Märkä 0.3 --- -0.5 ------ Albaalla vt1 Lohja Lehmijärvi Opt12 11.12.09:04 ---0.6 90 0.00 0.0 Mäekä --- Märkä OK F.Hvvä 0.81 0.06 vt1_Lohja_Lehmijärvi_Opt21 11.12.09:04 H-K -1.0 0.6 90 0.00 0.0 OK E.Hvvä 0,82 1.8 E-Lounas 4.7 Alhaalla 0.01 vt1_Lohja_Lehmijärvi_Opt22 11.12. 08:59 ----1.1 0.6 0.0 OK E.Hyvä 0,82 --- Albaalla 0.02 0.8 0.3 -0.6 -0.7 0.1 0.2 -0.7 -0.7 -0.6 vt1 Lohia Karnainen R 11.12. 09:02 0.0 -0.2 -0.1 0.0 6.0 Ylhäällä 113 110 0.02 0.0 2.2 -0.1 0.00 11.12.09:02 OK 0,8 0,4 -1,3 -1,5 0,0 0,1 -1,4 -1,4 -0,6 -0.7 -2,4 -0,5 90 0,00 2,5 E-Lounas 113 115 0.2 30.3 6.2 -1.5 -0.3 0.00 vt1 Lohia Karnainen O 0.0 Pouta 0.02 0.03 0.7 11.12.09:00 OK 0.5 0.2 -0.7 -0.4 0.1 0.2 -0.9 -0.6 -0.3 -0.4 -0.1 0.0 94 Pouta 0.00 0.0 3.2 113 0.1 0.0 0.0 vt1 Lohia Pitkämäki R 2000 Etelä 7.8 Ylhäällä 113 0.02 2.32 0.0 1.0 0.0 94 Pouta 0.00 vt1 Lohia Pitkämäki O 11 12 00:00 OK 0.5 0.1 -1.3 -1.1 0.0 0.1 -1.4 -1.4 -0.3 -1.0 -2.6 -2.0 0.0 2000 --- Kost+Su Märk+Su 3,2 Ftolä --- Vihäällä 113 110 0.03 0.05 0.8 0.7 26.0 14.8 -1.4 -0.8 vt2 Karkkila Korpi 1 11.12, 08:58 OK 0.1 0.6 -1.3 -1.3 0.4 0.4 -1.5 -1.5 -1.4 0.1 -0.5 -0.2 00 Pouts 0.00 0.0 20000 OK Kost+Su Kost+Su 2.4 Itä 6.8 Alhaalla 107 115 0.00 0.01 0.1 0.1 329.4 7.7 -0.5 -0.2 /t2_Karkkila_Korpi_Opt 11.12.08:58 --- -1,5 ----1,4 0,1 0,0 2,4 0,01 90 0.00 Itä /t2_Lohja_Salkola_1 11.12.09:04 ---0.3 0.4 --- ----1.3 93 Pouta 0.00 0.0 2.0 t2 Lohia Salkola 1 0.1 vt2 Lohia Salkola Opt2 11.12.09:04 OK -0.3 --- -1.2 --- ------ -1.3 OK E.Hvvä 0.82 2.0 Kaakko 6.7 Alhaalla 0.00 93 Pouta 0.00 0.0 20000 vt2_Humppila_Koenjoki_1 11 12 00:04 OK 0.4 0.4 -1.4 -1.4 0.6 0.5 -1.9 -2.1 -1.2 -0.2 -0.9 -1.6 89 Pouta 0.00 0.0 20000 OK Kost+Su Kost+Su 5.0 E-Kaakko 12.5 Albaalla 110 112 0.10 0.02 0.5 0.7 4 0 32.1 -0.3 -1.6 0.10 vt2_Humppila_Koenjoki_Opt 11.12, 09:04 OK 0.4 --- -1.4 --- --- -1.9 --- -1.2 -0.2 0.0 --- Märkä OK E.Hyvä 0,81 0.07 vt3 Helsinki Pirkkola 1 11.12, 09:01 0.7 0.2 0.3 -0.4 0.4 0.3 -0.6 -1.0 -1.3 1.6 -0.2 -0.9 112 110 vt3_Helsinki_Pirkkola_2 11.12.09:01 OK 0.7 0.2 -0.3 -0.6 0.4 0.4 -0.7 -1.0 -1.3 1.0 -0.8 -0.1 0.0 2.1 Etelä 7.4 Alhaalla 112 110 0.00 0.0 0,7 --- 0,3 --- ----1,3 --- Kostea vt3 Helsinki Pirkkola Opt1 11.12.09:01 OK --- -0.6 ---1.6 86 0.00 0.0 OK Kostea OK E.Hvvä 0.82 2.1 Etelä 7.4 Alhaalla 0.02 0,7 --- -0,4 --- ------ -0.7 --vt3 Helsinki Pirkkola Opt2 -1.3 0.9 OK Kostea 2.1 11.12.09:01 OK 86 0.00 0.0 OK E.Hvvä 0.82 Etelä 7.4 Alhaalla 0.04 vt3_Vantaa_Keimola_1 11.12.09:00 OF 0,3 0,3 0,0 0,5 0,5 0,4 -0,8 -0,6 -1.3 -0.4-0,1 90 0.00 0.0 OK Koet-LSu 3,9 E-Kaakko 7,6 Alhaalla 112 115 0,00 0.00 0.1 0,0 333.0 334.4 -0.4 -0.1 0,3 0,3 -0,8 -0,1 0,5 0,2 -1,4 -0,8 /t3_Vantaa_Keimola_2 11.12.09:00 OF -1.3 0,5 -0,3 -0,1 0.0 115 110 0,00 0.1 0,0 330.8 -0.1 vt3_Vantaa_Keimola_Opt1 11.12.09:00 --- -0.8 3.9 E-Kaakko 0.01 vt3 Vantaa Keimola Opt2 11.12.09:00 OF 0.3 --- 0.5 ------ -1,4 -1,3 1,8 89 0.00 0.0 0.82 3,9 E-Kaakko 0,00 7.6 Alhaalla vt3_Nurmijärvi_Karhunkorpi_1 -0.2 0.3 -1.0 -0.8 0.5 0.4 -1.2 -1.2 -1.7 0.7 -0.2 -0.3 90 0.00 0.0 4.5 7.2 Alhaalla 11.12. 09:01 OK Etelä 115 115 0.00 0.00 0.1 0.1 330.4 330.8 -0.2 -0.3 -0.2 0.3 -1.9 -1.2 0.6 0.3 -2.2 -1.3 -1.7 -0.1 -0.1 vt3_Nurmijärvi_Karhunkorpi_2 11.12, 09:01 OK -0.2 90 0.00 0.0 4.5 Etelä 7.2 Alhaalla 112 110 0.03 0.1 0.02.2 329.7 -0.1 vt3_Nurmijärvi_Karhunkorpi_Opt1 11.12.09:01 ----0,2 --- -1,0 --- --- <u>--- -1,2</u> -1,7 0.7 0.0 OK E.Hyvä 0,82 4,5 0,04 --- -2,2 vt3_Nurmijärvi_Karhunkorpi_Opt2 11.12.09:01 ---4,5 11.12.08:59 OK -0,5 0,8 -0,7 -0,7 0,6 0,4 -1,4 -1,7 -1,9 -0,1 -0,7 0.00 5.2 F-Kaakko 10,7 Alhaalla 110 0.00 0,2 331,3 vt3 Riihimäki Parmala 1 110 0.00 0.0 -0,1 -0.7 0.00 -0,5 --- -0,7 --- ---11.12.08:59 OK --- -1,4 ----1,9 90 0,00 0,0 --- Märkä OK E.Hyvä 0,81 5,2 E-Kaakko 10,7 Alhaalla 0,06 vt3 Riihimäki Parmala Opt1 -1,1 0,4 -1,3 -1,1 0,3 0,4 -1,5 -1,3 -2,2 0,9 -0,1 -0,4 92 Pouta 0,00 0.0 2,5 Kaakko 7.6 Alhaalla 405 112 vt3 Hämeenlinna Miemala 1 11.12.09:00 OK 20000 0.00 0.00 0.0 0.1 0.0 0.0 -0,1 -0.4 0.00 -1,1 --- -1,3 --- --- -1,5 --t3 Hämeenlinna Miemala Opt2 11.12.09:00 OK -2,2 0.9 92 Pouta 0.00 0.0 20000 OK E.Hyvä 0,82 2,5 Kaakko 7,6 Alhaalla 0.00 t4_Helsinki_Jakomäki_1 11.12.09:01 H 0,6 0,3 -0,7 0,3 0,2 0,1 -1,1 -0,2 -1,2 0,5 -0,4 -0,1 88 0,00 0,0 2,8 Etelä 8,2 Alhaalla 110 115 0,00 -0,1 0,0 331,1 334,1 -0.4/t4_Helsinki_Jakomäki_Opt2 11.12.09:01 OK --- -1,1 ----1,2 0,5 0,00 0,0 OK E.Hyvä 0,82 2,8 Etelä 0,05 11.12.06:40 OK 2.4 F-Kaakko t4 Kerava Kytömaa 1 91 Pouta 0.00 0.0 Pouta 328.9 11.12.06:40 OK -1,3 0,2 -2,6 -2,2 0,5 1,0 -2,4 -2,1 -2,6 t4 Keraya Kytömaa 2 91 Pouta 0,00 0,0 Pouta 20000 Kuiva Kostea Kuura Kuura 2,4 E-Kaakko 4,0 Alhaalla OK --- Kuiva OK F.Hvvä 0.82 /t4 Kerava Kytömaa Opt1 11.12.06:40 OK 91 Pouta 0.00 0.0 Pouta 20000 2.4 F-Kaakko 4.0 Albaalla -0,5 0,9 -1,8 -1,7 0,3 0,3 -1,5 -1,6 -1,9 0,1 -0,1 -0,3 91 Pouta /t4_Mäntsälä_Ohkola_1 11.12.09:01 OK 0.00 0.0 20000 3,4 E-Kaakko 7,2 Alhaalla 107 107 0.00 0.00 0.0 0.1 328.2 328.4 -0.1 -0.3 0.00 -0,5 --- -1,8 --- --- -1,5 --- -1,9 0,1 ------ Märkä OK E.Hyvä 0,82 vt4 Mäntsälä Ohkola Opt2 11.12.09:01 OK 7.2 Alhaalla vt4 Mäntsälä Levanto 1 11.12. 08:59 OK -1,3 0,8 -1,9 -1,8 0,9 0,8 -2,2 -2,1 -2,1 0,2 -0,5 0,0 94 Pouta 0,00 0.0 OK OK Kostea Kostea Kuura 2,8 E-Kaakko 6,8 Alhaalla 110 115 0,00 0.00 0.0 327.9 328.2 -0.5 0.0 0.00 0.1 vt4 Mäntsälä Levanto Opt2 --- -2,2 --- -2,1 0,2 ---OK OK Kostea OK --- Kostea OK E.Hyvä 0,82 OK OK 2,8 E-Kaakko 6,8 Alhaalla ---11.12. 08:59 OK 94 Pouta 0.00 0.0 Pouta 20000 0.04

of of X

R'n'D with Destia



















5G-SAFE

5gsafe.fmi.fi/

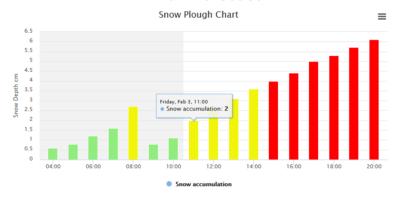


Inkind SUNIT NOKIA

FMI developed services

Snow plough Scheduling service

11 am forecast



- Hard packed snow forecast
- Blowing snow application









SNOW PLOUGH SCHEDULING APPLICATION

06:00

08:00

9 am forecast

Snow Plough Chart

8.5 8.5 7.5 7.6 6.5 6.5 6.5 5.5 5 4.5 4.5 3.3 2.5 2.5 2.5 0.5 0.5 0.5

10:00

Snow accumulation

12:00

14:00

16:00

18:00





02:00

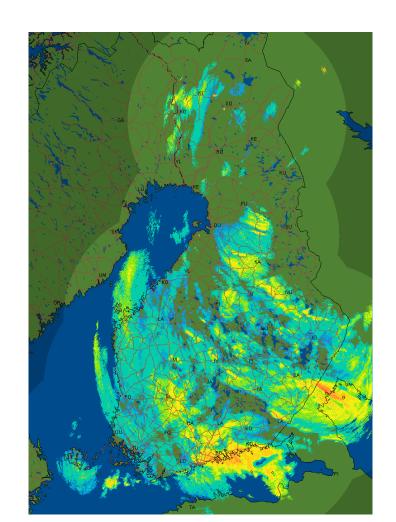


New Digital Input

Residential Mythylatia Mythylatia

ILMATIETEEN LAITOS METEOROLOGISKA INSTITUTET FINNISH METEOROLOGICAL INSTITUTE

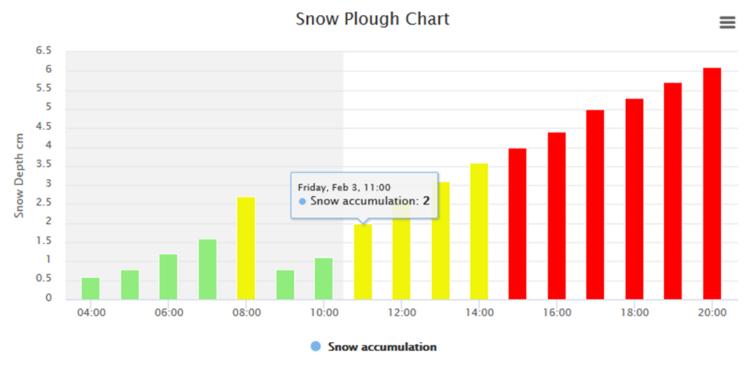
Using Data More Efficiently





SNOW PLOUGH SCHEDULING APPLICATION

11 am forecast





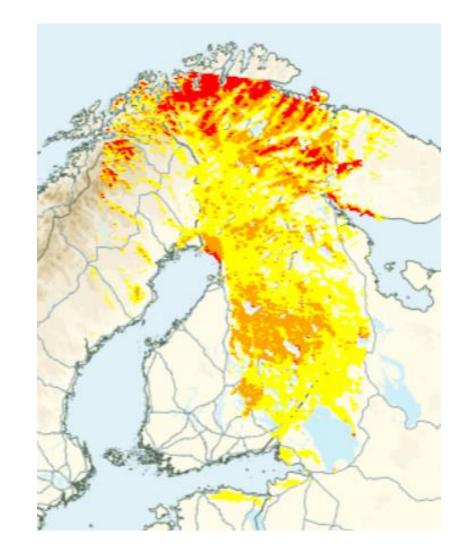
Risk of Blowing Snow

24 Hour animation based on FMI's operative forecast parametres

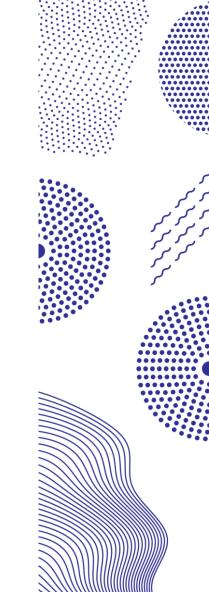




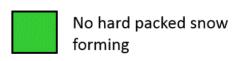
Low Risk

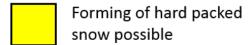


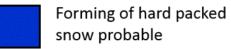


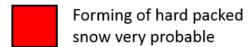


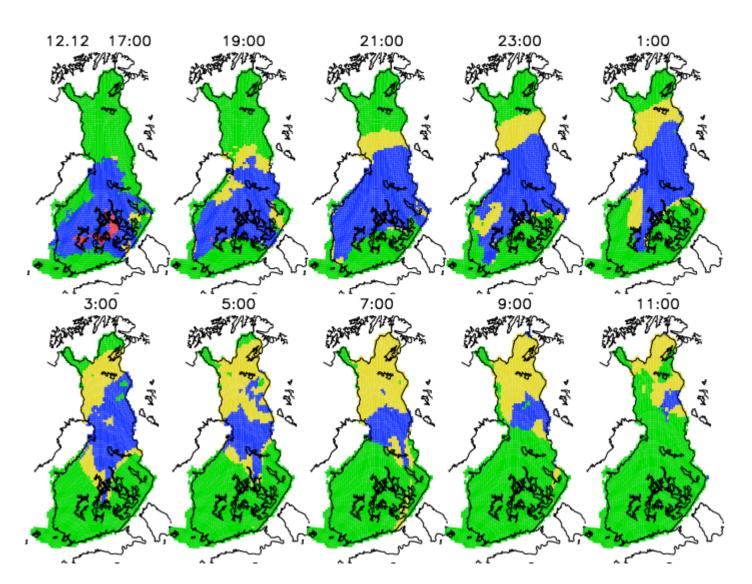
Hard Packed Snow Forecast

















Thank You!

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