

## Finnish Meteorological Institute (FMI): Introduction of Activities and Their Relation to GMES

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## Helsinki University Magnetic-Meteorological Observatory 1838-

 Motivation: theory on connections between magnetic field and weather variations

=> weather services & military advantages

- Academic basis with service function
- Insitute with highest budget of the University



**J.J. Nervander 1805-1848** 





## **SERVICES AND KNOW-HOW OF FMI FOR FINLAND**

#### 1) SAFETY, PROTECTION OF LIFE AND PROPERTY

TRAFFIC			<b>RESCUE &amp; SAFETY</b>		DEFENCE	
• SAFETY: ROAD, AIR, MARITIME & RAIL			• OIL & HAZARDOUS		• AIR FORCE, NAVY AND GROUND	
• WINTER ROAD & AIPORT MAINTENANCE			RELEASES		FORCE SERVICES	
ICEBREAKER SERVICES			• HIGH-IMPACT WEATHER		HEALTH AND LIFE	
TRAFFIC FLUENCY			FOREST FIRES		• NUCLEAR RELEASE DISPERSION	
• EMISSIONS: CLIMATE AND HEALTH IMPACTS				• AIR QI		QUALITY & TEMPERATURE
ZJ PRIVATE SECTOR				3) INTERNATIONAL RESPONSIB		
ENTERPRIZES	FOREST	RY/AGR	RICULTURE	FOREIG	N	ORGANIZATIONS
INSTRUMENTS	CLIMATE AI	DAPTATION		AFFAIRS		
• WIND-SOLAR-WATER	• DISASTER	S AND FLOC	DDING			
ENERGY	DEDICATED SERVICES		S	• DEVELOPIX CO-OP.		EUMETNET
• ENERGY SECURITY	• GREENHO	USE GAS FL	LUXES	CLIMATE POLICY		• ESA PB-EO, EU/GMES,
ARCTIC TECHNOLOGY					)GY	GEO
4) RESEARCH & ENVIRONMENT				TRANSFER		
R&D E		ENVIR	ONMENT			
UNIVERSITY PARTNERSHIPS		• AIR QUAL	LITY			
PROFESSORS & INTRASTRUCTURES		• CLIMATE				



## **AVIATION BIGGEST CUSTOMER**





# WINTER ROAD MAINTENANCE

Earlier products: Temperature & precipitation

Now: Operation of trucks, salt concentrations

Customers at FMI during winter season









## OTHER TRANSPORT

- Roads
- Pedestrians & cycles
- Off-shore activities
- Sailors/boating











## WEATHER SERVICE PRODUCTION SYSTEM





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### 700UTC AS

#### **ECMWF** 17km → 10km (2015)

Thursday 19 May 2011 00UTC @ECMWF Forecast t+048 VT: Saturday 21 May 2011 00UTC Surface: Mean sea level pressure / 850-hPa wind speed



Pmsl and hourly prec. (mm) green:rain blue:snow initial: 00Z19MAY2011 valid: 00Z20MAY2011

HIRLAM







#### HARMONIE 2.5km → ~1km

**16km**  $\rightarrow$  **7.5km** (201 klm) 12AUG2007 00 UTC Forecast. Radar reflectivity 12AUG2007 14:00 UTC (Arome\_bbcase, 2.5km).



Radars:VAN,IK44400,00,KOR,UTA,LUO,VI Antenna=0.3°



## MARINE WEATHER-, WAVE AND ICE SERVICES

- FINLAND IS AN ISLAND
  - ~ 80% of export via sea routes
  - ~ 90% import
- OIL TRANSPORTATION/RUSSIA
- ICE EVERY WINTER
- LARGE SEA LEVEL VARIABILITY
- SHALLOW SEA ROUTES







## **ICE SERVICES**





# NATURAL DISASTER WARNING CENTRE

- Finland-global
- For government, MFA
- General public 2013
- Status, forecasts & warnings
- Impacts (intrests of Finland)
  - Human beings
  - Infrastructures
  - Private sector/businesses







## **Observation Network**

		250 km
<ul> <li>Network design, maintenance and development by</li> </ul>	all	
Automation rate	>97%	
<ul> <li>Operative stations</li> </ul>	~500	LUO
<ul> <li>Sounding stations</li> </ul>	3	
Weather radars	8	and have been a
<ul> <li>Lightning detection antennas</li> </ul>	5+3	A COUTA
<ul> <li>Air quality stations</li> </ul>	30	VIM
AWS stations	200	KUQ
<ul> <li>Tidal gauge/Sea level stations (mareographs)</li> </ul>	13	IKA •
Wave buoy	1	ANJ
<ul> <li>Precipitation stations</li> </ul>	200	KOR
<ul> <li>Special purpose (eg. masts ja radiation)</li> </ul>	50	A DE

C Maanmittausiaitos, lupa nro 30/MYY/00





## SATELLITE PROGRAMMES

#### • ESA, NASA & EUMETSAT

- EUMETSAT Atm. chemistry
- Algorithms
- Sodankylä satellite centre
- Weather, snow, ice, forests, sea
- Global change
- Atmospheric chemistry





# Sodankylä Satellite Data Centre

#### Satellite Data Reception and Processing

- NASA EOS Aura/OMI from 2004
- NASA EOS Terra/MODIS and Aqua/MODIS from 2003
- NOAA/NASA NPP Suomi from 2012

#### Part of ESA ground segment

- FIN-COPAC: Envisat GOMOS ozone data processing for International use
- ESA GlobSnow processing
- EUMETSAT Activities
  - EUMETSAT O3-SAF, H-SAF/Snow products
- The Centre is being developed into a national satellite service centre providing Finnish and international customers with extensive satellite data services







### Sodankylä Satellite Data Centre

- X-band reception systems:
  - 7.3 m antenna, data rate 320 (640) Mbps
  - 2.4 m antenna, data rate 20.8 Mbps
- ESA MMFI Ground Segment in operational use
- 24/7 operations capability:
  - New up-to-date computing facility
  - 10 Gbps data link to outside world
- Current operational NRT-processing lines:
  - MODIS data and products for FMI, SYKE, NOAA
  - EOS-Aura OMI products for FMI, KNMI and NASA
  - NPP/NPOESS (Suomi) data processing
  - ENVISAT GOMOS processing for ESA
- Potential international co-operation including:
  - GMES Sentinels
  - PCW/Canada, CMA-FY/China
  - Radarsat-C/Canada, COSMO-SkyMed/Italy







**Arctic Real-Time Satellite Services** for the Public and Commercial **End-Use** (a Tekes-funded strategic initiative project started 09/2012)





## Cosmo SkyMed X-band SAR constellation

- Reception and product delivery starting by the end of 2012
- Constellation of 4 satellites equipped with X-band SAR
- -> dense coverage at high latitudes (both the North-East and North-West passages can be mapped in less than 20 hours)
- Spatial resolution: 1m 100m
- Applications including sea ice, oil slicks, cryosphere, storm damages, military, ...



Daily acquisition opportunities, with 4 satellites



0

70° N



## 20/3/2012 – COSMO-SkyMed demonstration for the Caspian Sea Ice Charting (by FMI/J. Vainio)





# Demonstration of flood monitoring from NRT CosMo-SkyMed images (Oct. 2012)



ILMATIETEEN LAITOS METEOROLOGISKA INSTITUTET FINNISH METEOROLOGICAL INSTITUTE

# Current cryospheric services





# **EUMETSAT: H-SAF**

- FMI is responsible to the development of real-time snow mapping services for Europe
  - SWE mapping approach is based on the further development of GlobSnow system

# EC: CryoLand

- Multinational EC project carrying partially on with GlobSnow efforts
  - Development of operational satellite-based snow & land ice products

#### **CryoLand** GMES Service Snow and Land Ice



Proposal for a GMES Downstream Service in response to the Call FP7-SPACE-2010-1 Activity 9.1 Space-based applications at the service of European Society 1. Stimulating the development of downstream GMES services.

#### Service Goals

- Develop and validate a pan-European satellitebased snow and land ice service delivering highly needed products to the user society.
- Integrate and operationalise existing snow and land ice services
- Prepare the tools for offering snow and ice services world-wide
- Perform full verification and real time demonstration of the service

- Complement GeoLand Land Cover Products
- Prepare the basis for the Cryosphere Component of a GMES Global Land Monitoring Service
  - Conform to INSPIRE/GEOSS standards
  - Make available products via state-of-the-art online services
- Issue guidelines for stakeholders and for service deployment operations





# 30 year-long Climate Data Record (CDR) on snow conditions of Northern Hemisphere (ESA-GlobSnow)

- First time reliable daily map information on snow:
  - Snow Water Equivalent (SWE)
  - Snow Extent and melt
- Spaceborne passive microwave radiometer data combined with ground-based synoptic snow observations
  - Variational data-assimilation
- Part of "Sodankylä Cryospheric Data Archive"-system
  - 30-year-long time-series
- Continuous real-time hemispehiric processing started on October 2010





LMATIETEEN LAITOS Meteorologiska institutet Innish meteorological institute



EU Life+ Project

Modelling of natural background carbon balance and utilization of results in national and international greenhouse gas conventions and reporting

