ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

SRNWP at FMI

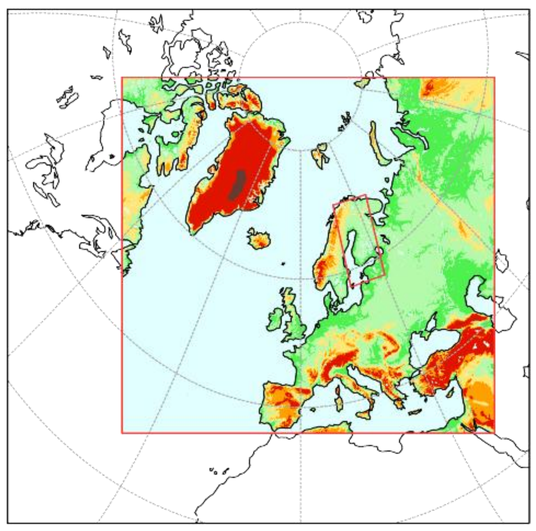
Sami Niemelä, Markku Kangas, Kalle Eerola, Evgeny Kadantsev & Carl Fortelius

OPERATIONAL

SRNWP SUITES	HIRLAM v7.4 "RCR"	HARMONIE Cy36h14 "AROME"
Mesh size	7.5 km	2.5 km
Number of grid points	1036 * 816	300 * 600
Number of levels	65	65
Initial times	00/06/12/18 UTC	00/06/12/18 UTC
Range	+54 h	+36 h
Upper air analysis	4D-var	3D-var
Surface analysis	Optimal interpolation	Optimal interpolation
Nestor forecast	ECMWF IFS, hh - 6 h	ECMWF IFS, hh - 6 h
LBC frequency	3 h	3 h

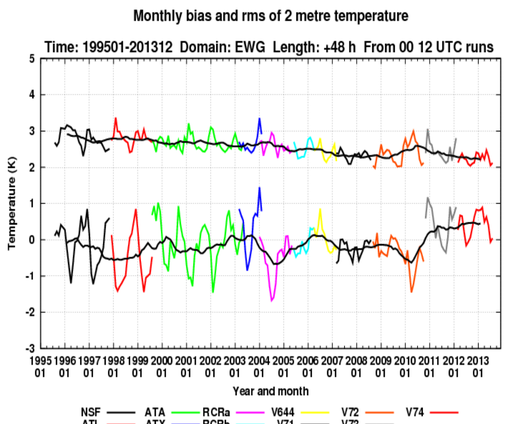
COMPUTING RESOURCES
Cray XT5m: 2 Identical clusters, each with 1996 cores, 2.6 TB shared memory
Peak performance 17.3 TFlop/s for each cluster, ca 35 Tflops/s total
Cray XC30 (2013): 2 identical clusters, each with 3420 cores, 10.7 TB memory
Peak performance ca 70 Tflop/s for each cluster, ca 140 Tflop/s total

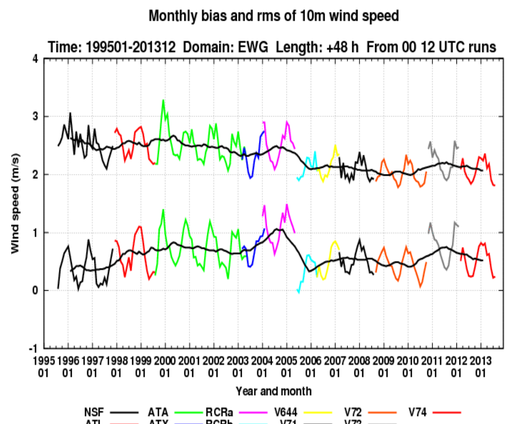
HIRLAM RCR74 –> HARMONIE



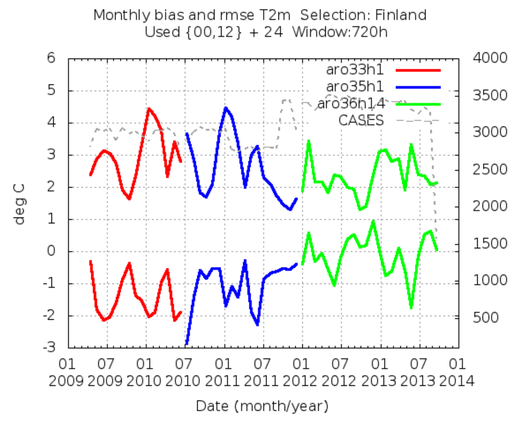
DOWNSTREAM & RELATED APPLICATIONS		
SILAM dispersion and CTM model -POLLEN -FAS -DMAT	Particle dispersion, jointly with the Radiation and Nuclear Safety Authority STUK	Nuclear emergency preparedness Forest fires Volcanic ash Long-range pollen transport
	Chemical transport modelling	SO_2, NO, O_3, CO, PM_{10}, $PM_{2.5}$, concentrations and deposition
HILATAR	Eulerian regional transport	SO_x, NO_x, NH_x, toxic metals, dust
Road model	State of road surfaces and pedestrian pavements Intelligent traffic applications	
Marine models	Baltic wave forecasts	WAM
	Sea level at Finnish coast	Wetehinen, Hansen, OAAS
	Baltic ice models	HIGHTSI, Helmi 2d
	Baltic circulations models	MITgcm, HBM, NEMO
Hydrological models	Managed by Finland's environmental administration SYKE	
LAPS	Analysis & prediction system	In test use with Harmonie

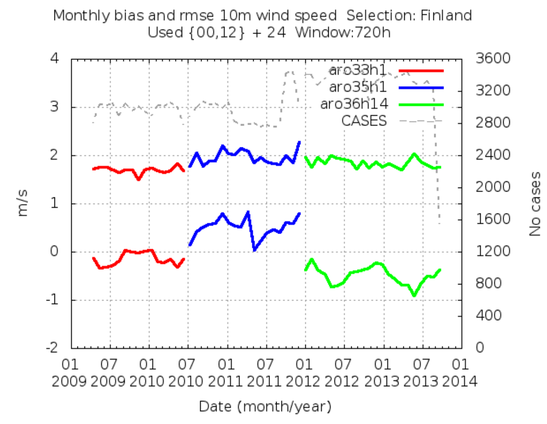
MODEL VERIFICATION





HIRLAM long-term verification for T_{2m} and V_{10m}
years 1995 - 2013





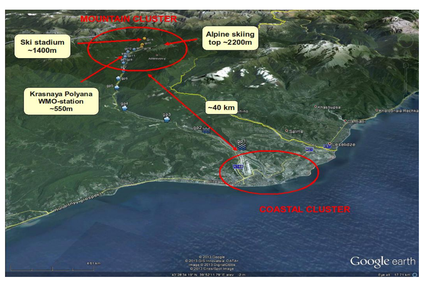
HARMONIE long-term verification for T_{2m} and V_{10m}
03/2009 – 9/2013

HIGHLIGHTS

FROST-2014: Harmonie in Sochi region

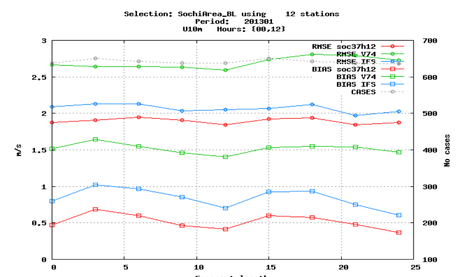
- FMI will run the ***high resolution mesoscale NWP-model Harmonie*** for WMO Forecast Demonstration Project during the next Winter Olympics, in Sochi, Russia, 8-23 Feb 2014

- ***Harmonie cy37h12*****:** winter 2013
  1. mesoscale vs. regional/global
  2. orography: gtopo30 vs. SRTM
  3. 2.5 km vs. 1.5 km vs. 1.0 km



Sochi area

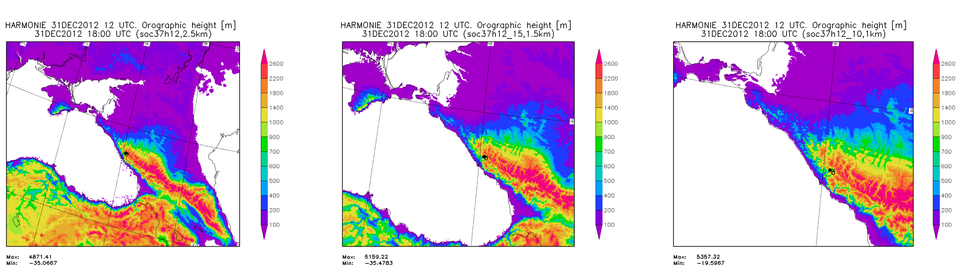
- Harmonie-2.5m outperformed the available operational models (Hirlam-7.5km, ECMWF-16km)
- SRTM orography dataset showed neutral impact compared to gtopo30



T2m bias/rmse: Harmonie/Hirlam/ECMWF

- Harmonie with 1.5 and 1.0 km grid size showed overall improvement compared to Harmonie with 2.5 km
- Improvement was clear in the mountain cluster of the Olympic games

T2m bias/rmse: Harmonie 2.5 / 1.5 / 1.5km

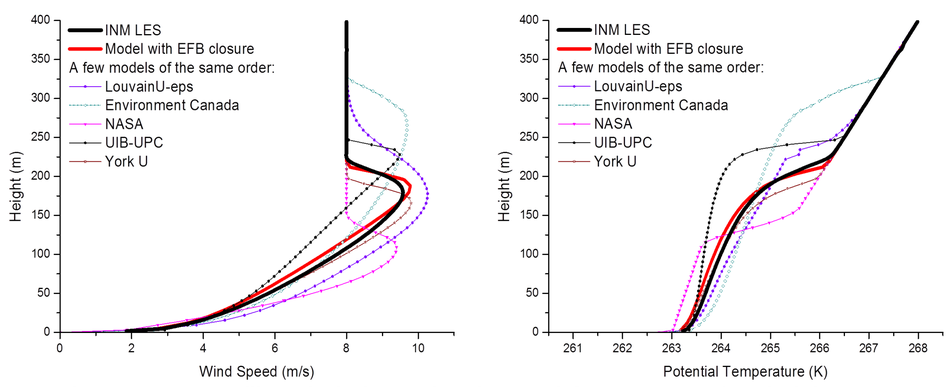


Energy- & flux-budget (EFB) turbulence closure modelling

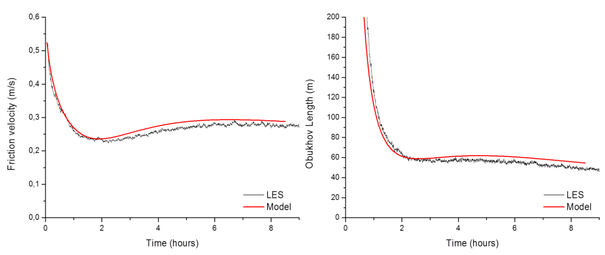
Proposed by Zilitinkevich et al. (2013):

- Budget equations for basic second moments: two energies, turbulent kinetic energy (TKE) and turbulent potential energy (TPE), and vertical turbulent fluxes of momentum and potential temperature
- New prognostic equation for the turbulent dissipation scale

Comparison with GABLS1 (e.g. Holtslag et al, 2003):



EFB closure mean profiles of wind speed and potential temperature for ninth hour compared with LES and pre-GABLS results from other models



Time series for friction velocity and Obukhov length

- No tuning of empirical constants
- Very little sensitivity to spatial resolution
- Works well with only one prognostic equation (TKE)