Recent development of visualisation at Finnish Meteorological Institute

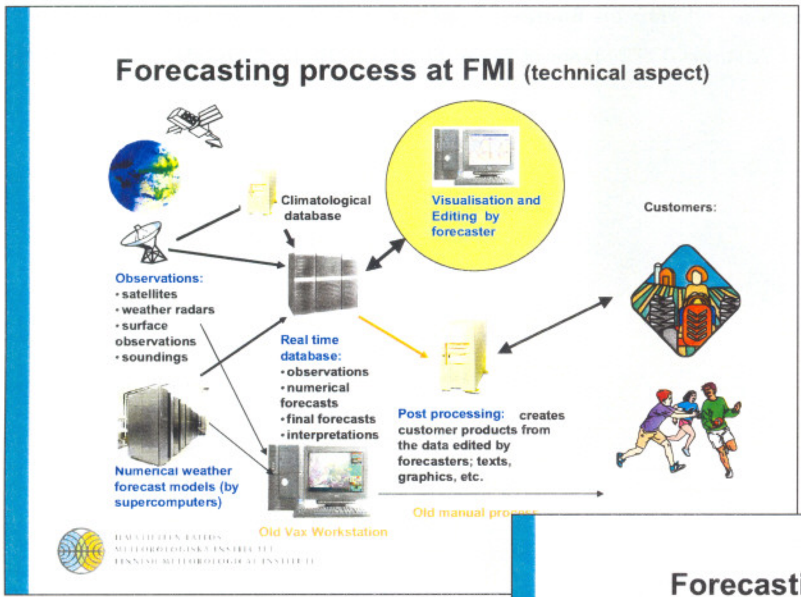
Juha Kilpinen and Annakaisa Sarkanen, Finnish Meteorological Institute (FMI)

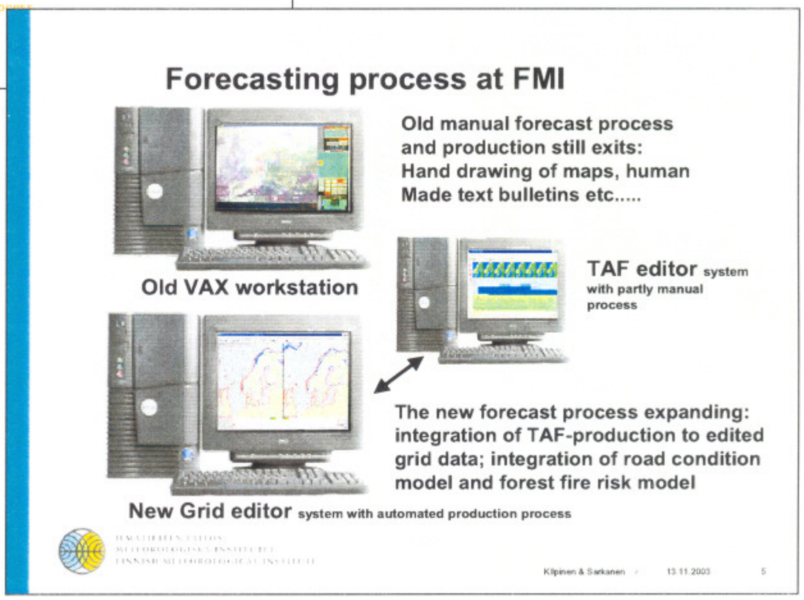
Developments in present production system

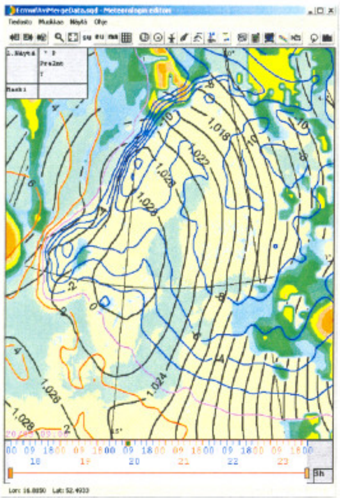
- New features of the grid editor software: SmartTools
- Aviation applications and products
- Some verification results
- Oil spill movement model (customer application)
- Atmospheric dispersion model (customer application)

Background of recent developments at FMI

- To apply latest technology the forecasting and production process has to be changed (re-engineering, typically the most difficult part)
- The migration to new automated production process began at mid 1990's, the work is still continuing;
- The core of the new system is the real time database (grid data, observations etc)
- The forecasters duty is to keep the quality of data in database in best possible level: the grid editor is used to interact withthe data
- Most commercial products for customers are made automatically from this data (the number of products is thousands); still the old manual process also in use







The Grid Editor

- Time series editing using masks
- Paint brush
- Time-shifting and Smoothing
- Control point editing
- Combination of data from different sources
- Integrated visualisation and product generation
- SmartTools

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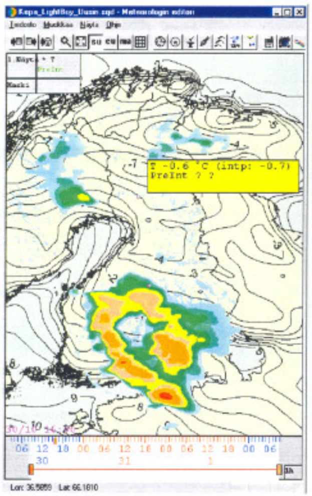
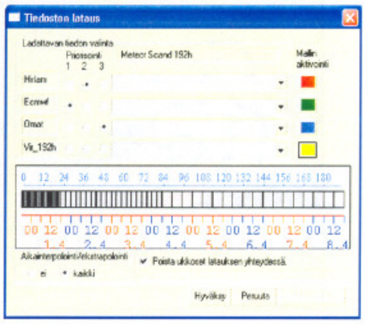


The Grid Editor

Chooce of the initial data/model



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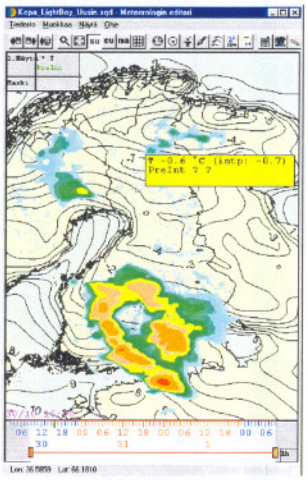
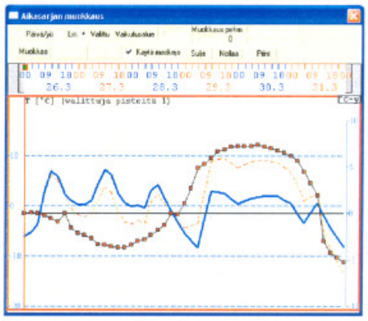


The Grid Editor

Time series editing tool



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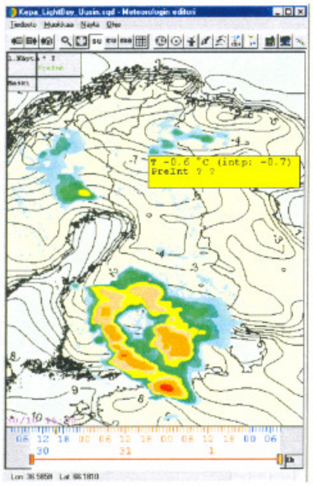
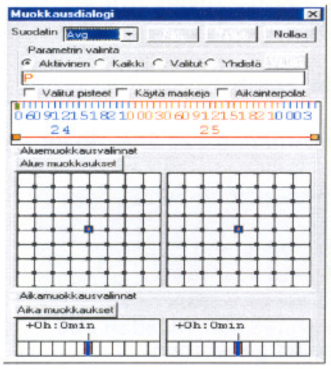
The Grid Editor

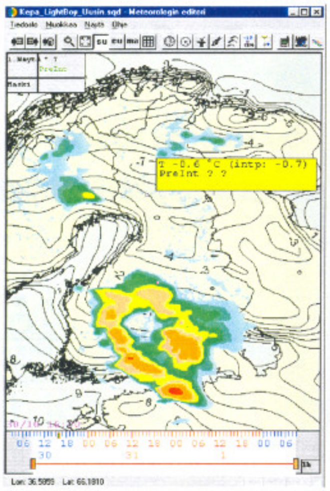
Grid editing windows

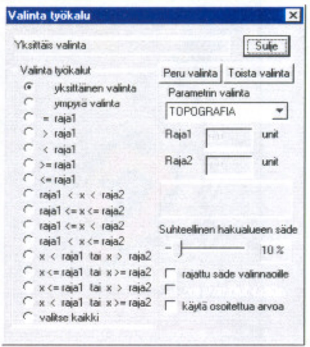




The Grid Editor

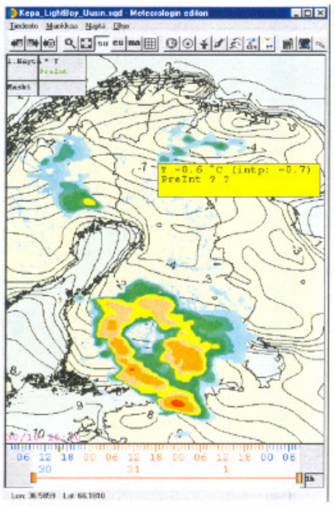
Mask editing windows

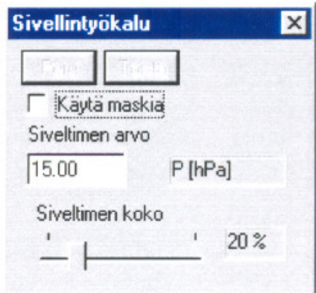




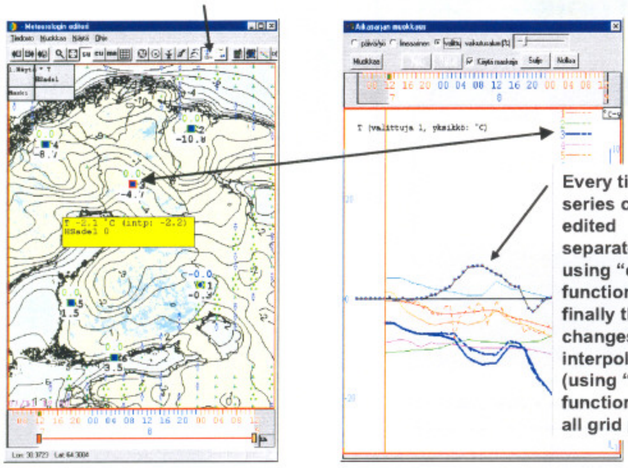
The Grid Editor

Paint brush tool





Control point editing

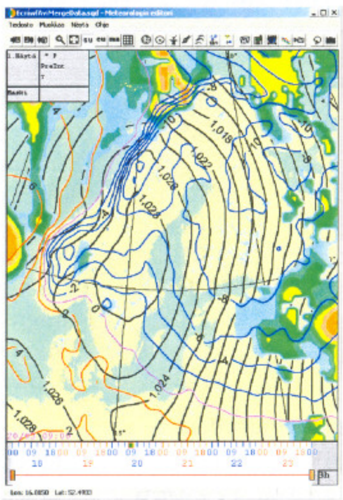


Every time series can be edited separately using "delta functions" and finally the changes are interpolated (using "delta functions") to all grid points

The Grid Editor

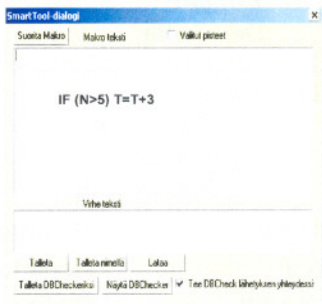
Text generation tool:

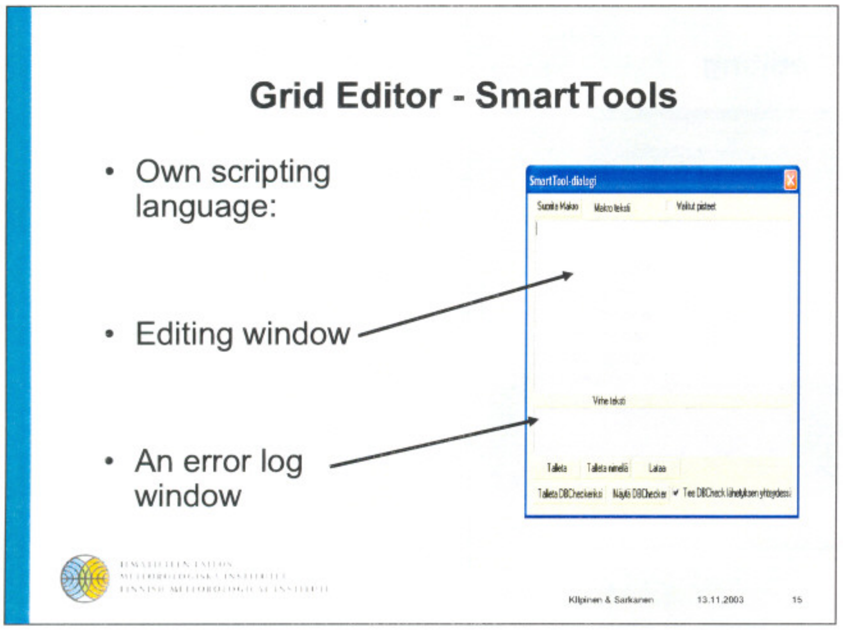
generates automated text forecasts for 1 and 3 days for the location indicated by cursor and time window



The Grid Editor

Smart Tools: ability to make scripts to perform more complicated and often repeated editing actions in a more easy manner





Grid Editor - SmartTools

Operators

```
T = T + P * 0.123 -RH/100 * WS + (T -DP) ^ 2
```

Blocks

```
{
T = T + 1
P = P + 1
RH = RH + 1
}
```

Conditionals

```
IF(T -DP > 2)
T = T + 1
P = P + 1 // both are executed if condition fulfills.
```

More complicated conditionals

```
IF(T -DP > 4)
T = T + 1
P = P + 1
ELSEIF(T -DP > 2) // means actually that (T-DP) is between 2 and 4.
T = T + 2
P = P + 2
ELSE // in all other cases, if T -DP <= 2, then ELSE is executed
T = T + 3
P = P + 3
```

T	Temperature	CL	Amount of low clouds
P	Surface pressure	CM	Amount of medium clouds
RH	Relative humidity	CH	Amount of high clouds
KIND	K-Index	RR	Iintensity of precipitation
DP	Dew point	PREF	Precipitation type (rain, sleet, snow)
LRAD	Long-wave radiation	PRET	Precipitation type (continuous, shower,..)
SRAD	Short-wave radiation	THUND	Probability of thunder
WD	Wind direction	FOG	Iintensity of fog
WS	Wind speed	HSADE	Precipitation symbol (not editable; SYNOP)
N	Total cloud cover	HESSAA	Weather symbol (not editable)

FL1BASE	Flight Level 1 cloud Base	......	
FL1TOP	Flight Level 1 cloud Top	FL8BASE	Flight Level 8 cloud Base
FL1COVER	Flight Level 1 cloud COVER	FL8TOP	Flight Level 8 cloud Top
FL1CLOUDTYPE	Flight Level 1 cloud TYPE	FL8COVER	Flight Level 8 cloud COVER

FL2BASE	Flight Level 2 cloud Base	FL8CLOUDTYPE	Flight Level 8 cloud TYPE
FL2TOP	Flight Level 2 cloud Top	FLCBBASE	Flight Level CB BASE
FL2COVER	Flight Level 2 cloud COVER	FLCBCOVER	Flight Level CB COVER
FL2CLOUDTYPE	Flight Level 2 cloud TYPE	FLMINBASE	Flight Level cloud min. BASE
FL3BASE	Flight Level 3 cloud Base	FLMAXBASE	Flight Level cloud max. BASE
FL3TOP	Flight Level 3 cloud Top	AVIVIS	Aviation Visibility
FL3COVER	Flight Level 3 cloud COVER	VERVIS	Vertical Visibility
FL3CLOUDTYPE	Flight Level 3 cloud TYPE		

Static and non-static functions

TOPO	Topography(static)	DIRLAND	Direction to land
SLOPE	Slope of surface	LANDSEAMASK	Land-sea mask
SLOPEDIR	Direction of deepest slope	RELTOPO	Relative topography
DISTSEA	Shortest distance to sea	LAT	Latitude (non static)
DIRSEA	Direction to sea	LON	Longitude (non static)
DISTLAND	Shortest distance to land	EANGLE	Elevation angle (non static)

Integrating functions

AVG – calculates the arithmetic average
MIN – seeks the minimum value
MAX – seeks the maximim value
SUM – calculates the sum
WAVG – calculates the weighted average (?)

Mathematical functions

SIN, COS, LN, SQRT, LOG, ATAN, EXP, ...

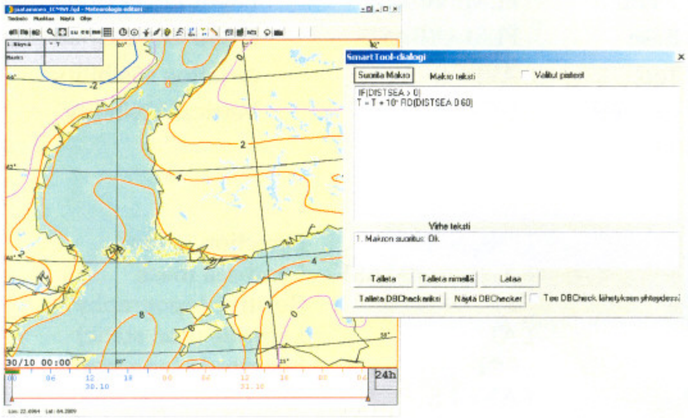
Ramp functions

RU (ramp up)   RD (ramp down)   DD (douple ramp)

Grid Editor – SmartTools

```
// Säteilykorjaus (Radiation correction)
// SN 2002.09.30
// pilvisyys korjataan => säteilyt korjataan
// ECMWF-lyhytaaltosäteily liian pieni selkeissä tilanteissa => 20% lisäys,
// Viitteet: Lauros Johanna, 2001, Tienpinnan talviset liukkausolosuhteet ja niiden mallintaminen,
//      pro gradu, Helsingin yliopiston meteorologian laitos
//      Katso myös gradun kirjallisuusviitteet: Niemelä Sami, Räisänen Petri, Savijärvi Hannu
// SRAD = (1 -0.67 * (N/100) ^ 3.32) / (1 -0.67 * (N_ORIG/100) ^ 3.32) * SRAD_ORIG
// LRAD = (1 + 0.22 * (N/100) ^ 2.75) / (1 + 0.22 * (N_ORIG/100)^ 2.75) * LRAD_ORIG
// SRAD_SELKEA = 1000 * (1 -EXP(-0.06 * EANGLE)) * SIN(EANGLE) + 5 + 96 * (1 -EXP(-0.05 * EANGLE))
// missäEANGLE >= 0
IF (SRAD == SRAD_EC AND (N_ORIG <= 30 OR N <= 30))
{
 SRAD = 1.2 * (1 -0.67 * (N/100) ^ 3.32) / (1 -0.67 * (N_ORIG/100) ^ 3.32) * SRAD_ORIG
 LRAD = (1 + 0.22 * (N/100) ^ 2.75) / (1 + 0.22 * (N_ORIG/100)^ 2.75) * LRAD_ORIG
}
ELSE
{
 SRAD = (1 -0.67 * (N/100) ^ 3.32) / (1 -0.67 * (N_ORIG/100) ^ 3.32) * SRAD_ORIG
 LRAD = (1 + 0.22 * (N/100) ^ 2.75) / (1 + 0.22 * (N_ORIG/100)^ 2.75) * LRAD_ORIG
}
// IF ( SRAD > SRAD_SELKEA)
//    SRAD = SRAD_SELKEA
// missäEANGLE >= 0
IF ( ( SRAD ) -( 1000 * (1 -EXP(-0.06 * EANGLE)) * SIN(EANGLE) + 5 + 96 * (1 -EXP(-0.05 * EANGLE)) ) > 0 AND EANGLE >= 0 )
    SRAD = 1000 * (1 -EXP(-0.06 * EANGLE)) * SIN(EANGLE) + 5 + 96 * (1 -EXP(-0.05 * EANGLE))
ELSEIF ( ( SRAD ) -( 1000 * (1 -EXP(-0.06 * EANGLE)) * SIN(EANGLE) + 5 + 96 * (1 -EXP(-0.05 * EANGLE)) ) > 0 AND EANGLE < 0 )
       SRAD = 1000 * (1 -EXP(-0.06 * 0)) * SIN(0) + 5 + 96 * (1 -EXP(-0.05 * 0))
IF ( SRAD < 0 )
SRAD = 0
```

Grid Editor – SmartTools
Application: Small scale editing



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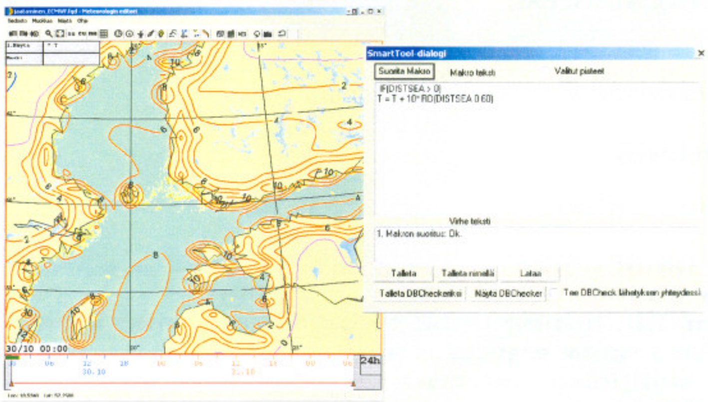
Grid Editor - SmartTools



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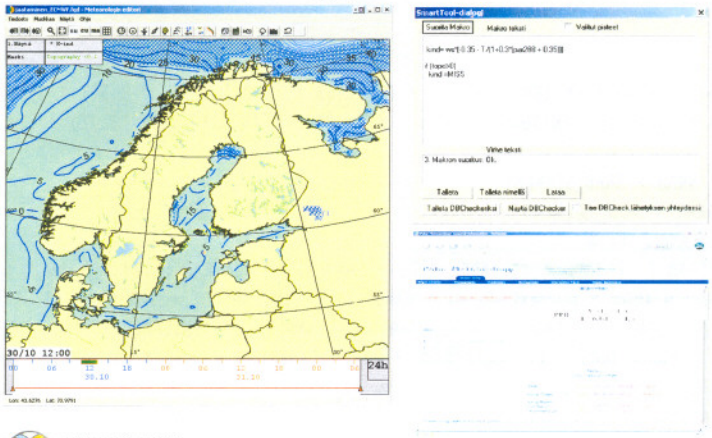
Grid Editor – SmartTools
Application: Icing predictor for Oceans



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Editing of aviation parameters (near future)

Edited parameters:

cloud amount in ICAO layers
intensity of fog (0,1,2)
intensity of precipitation (mm/h)
(edited already elsewhere)

SmartTools scripts are mainly used

Visibility and ceiling height are derived from edited and interpreted parameters

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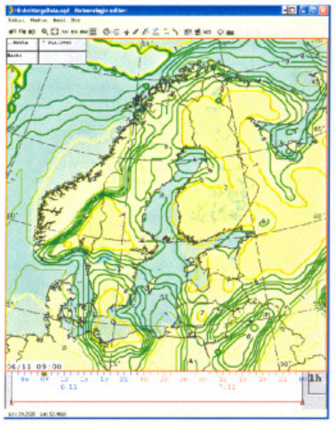
Editing of aviation parameters (cloud base)



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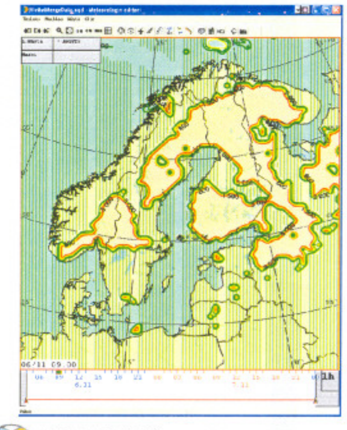
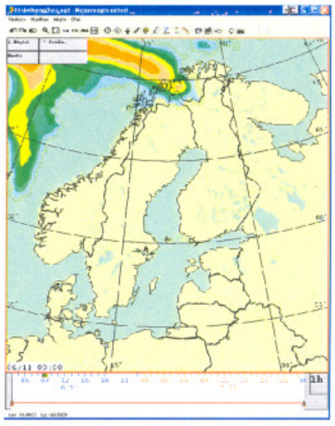
Editing of aviation parameters (visibility/rr)





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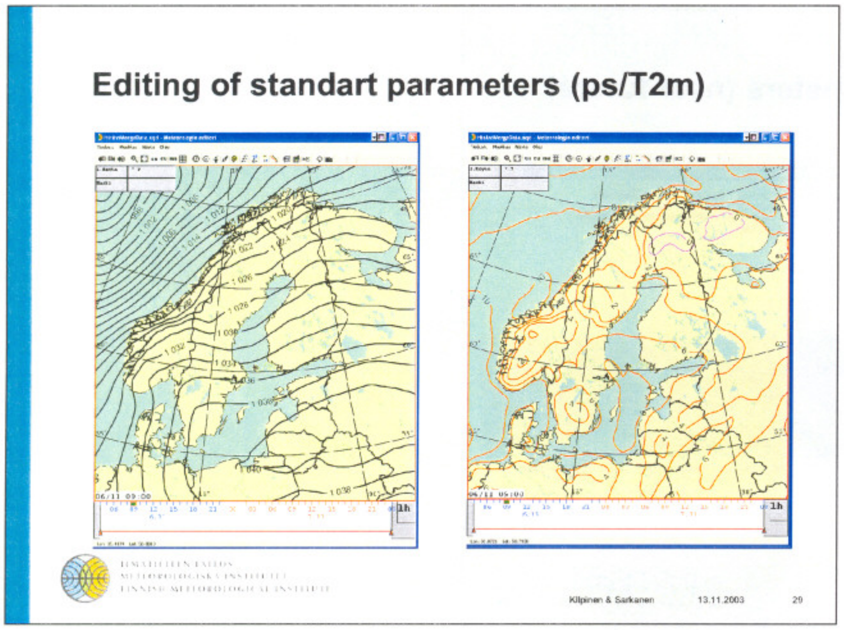
Editing of standart parameters (ps/T2m)
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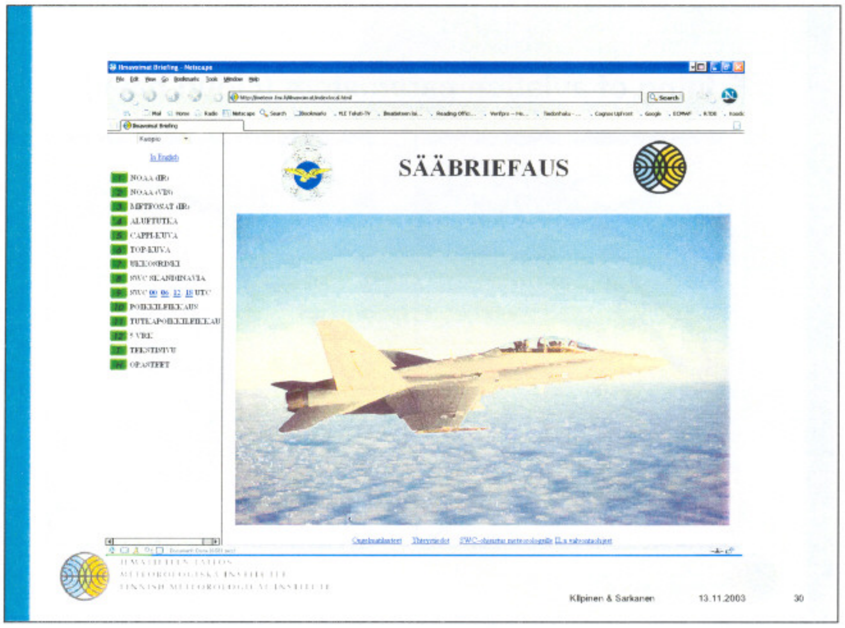
SÄÄBRIEFAUS
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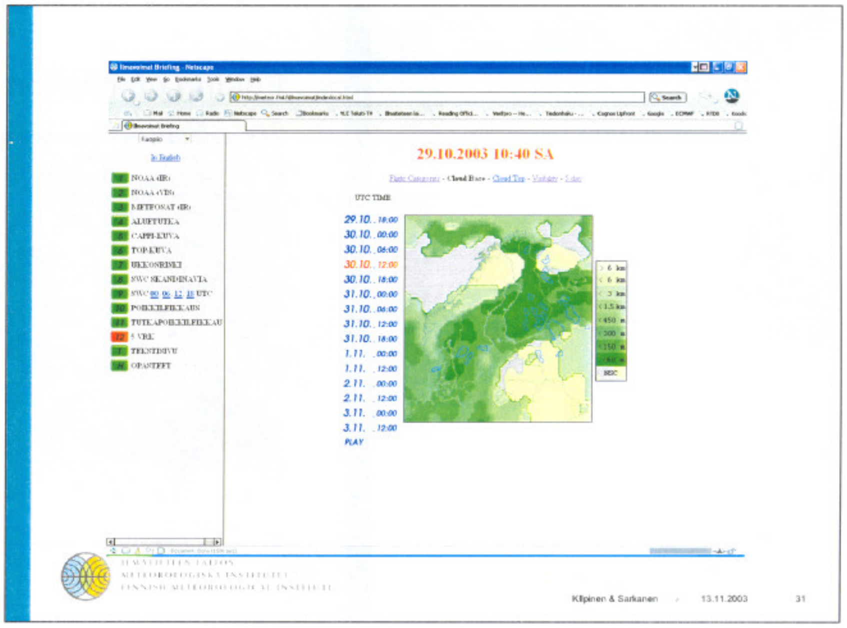
30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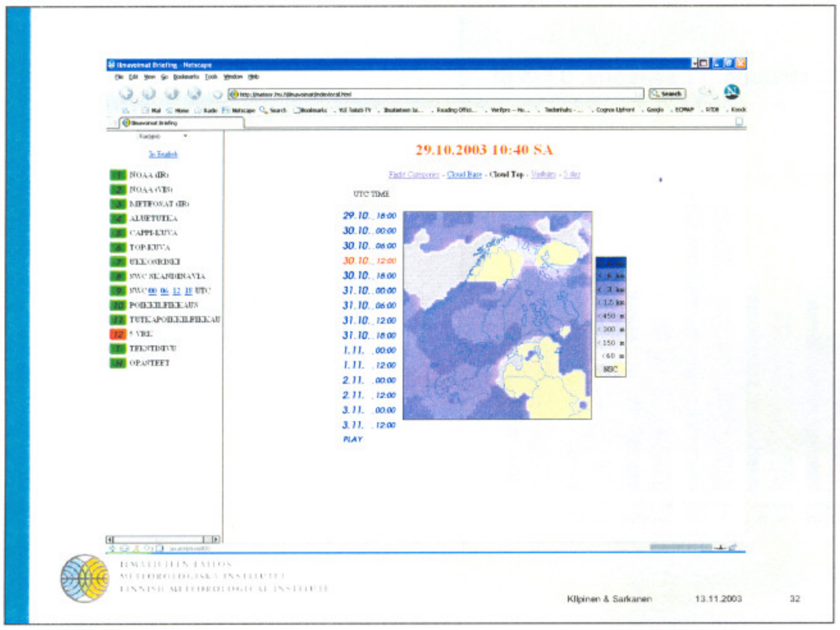
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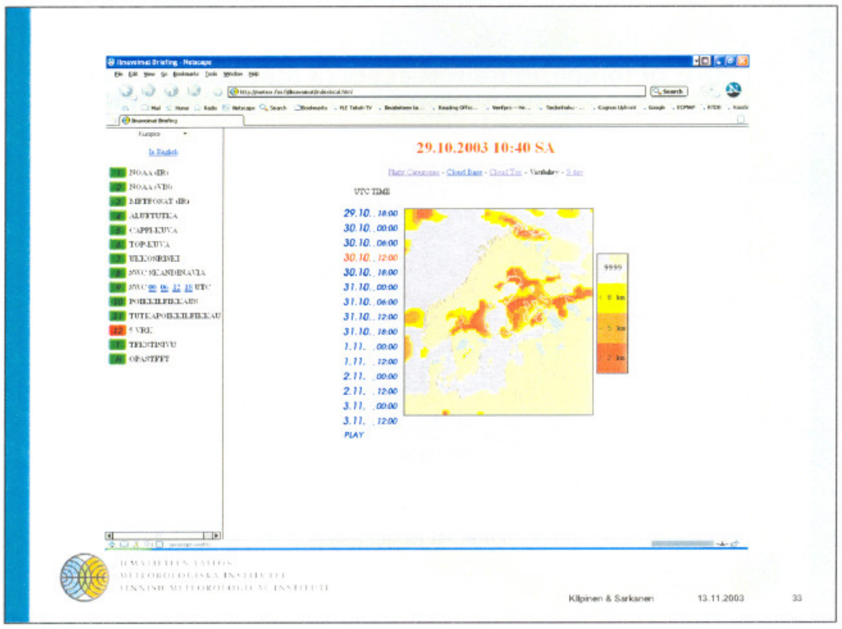
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29.10.2003 10:40 SA
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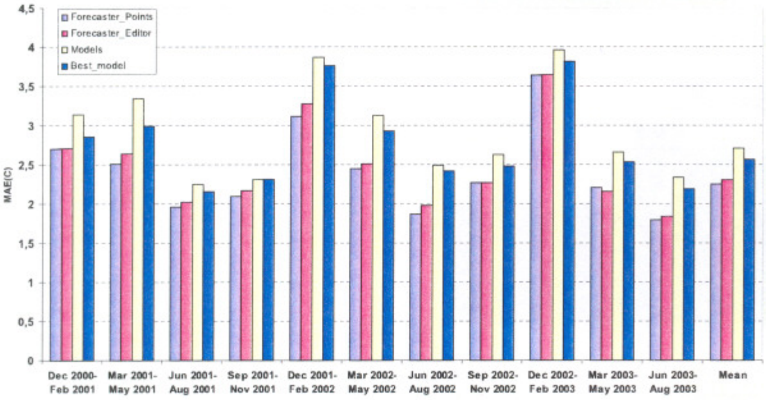
MAE of pooled temperature forecasts (3 stations, 11 seasons, 0.5-5 d)



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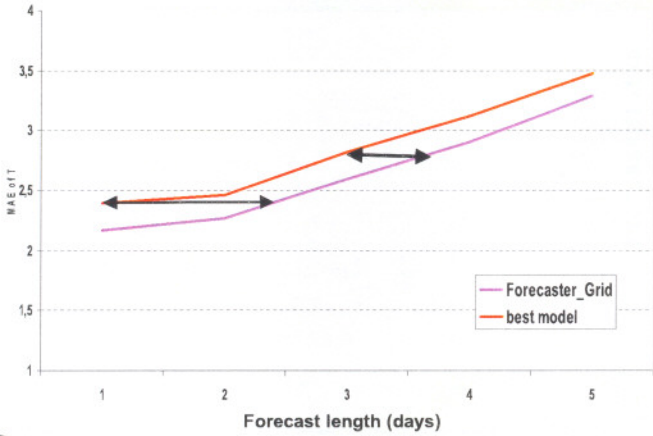
MAE of temperature forecasts (3 stations, 2 years)



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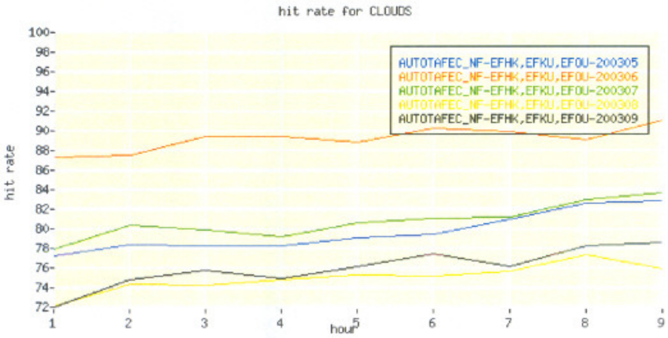
HIT RATE of Ceiling height forecast based on ECMWF data (raw data)



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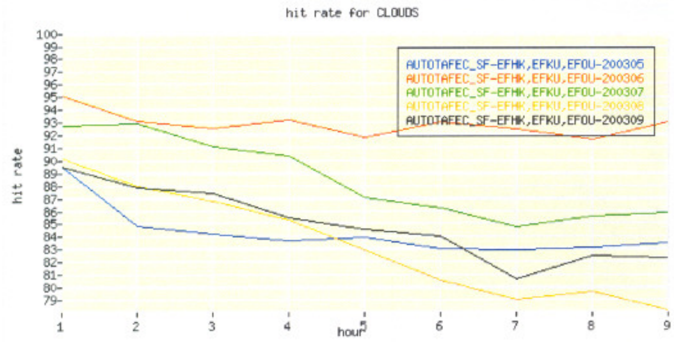
HIT RATE of Ceiling height forecast based on ECMWF data (smart fit with METARs)



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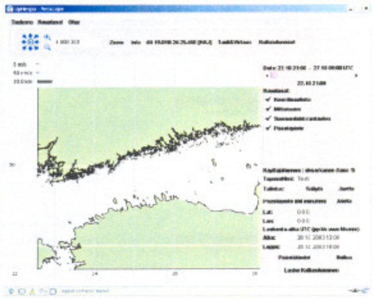
The model for oil spill movement in the Gulf of Finland

- 3D hydrodynamic model
- Wind and current forecasts (ECMWF/HIRLAM data)
- Spill information, start/end time, location etc.
- Duty forecasters and oil combating authorities on duty are main users (also Coast Guard, fire pricades etc. use system)
- User interface with Java
- Co-operation between FMI, Finnish Environment Institute and Finnish Institute of Marine Research



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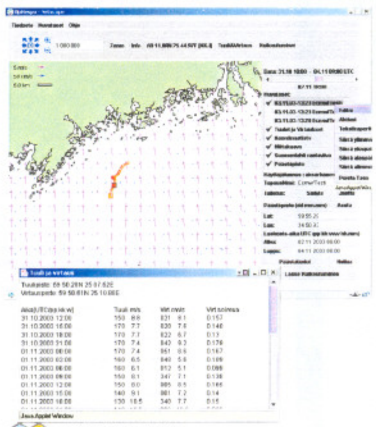
The model for oil spill movement in the Gulf of Finland



- Wind field (vectors)
- Surface current field (vectors)

- Drift trajectories (output)
- time series of wind and current forecasts (output)
- Additional information: SST and ice cover

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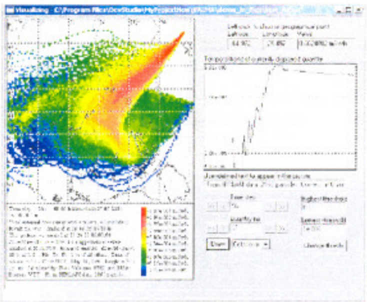
SILAM atmospheric dispersion and dose assessment model

- Trajectory model (based on ECMWF/HIRLAM data)
- Partical distributions and risk area calculations
- Duty forecasters and Radiation safety authorities on duty are main users
- User interface on web (PHP)
- Co-operation between FMI, Radiation and Nuclear Safety Authority of Finland and Technical Research Centre of Finland



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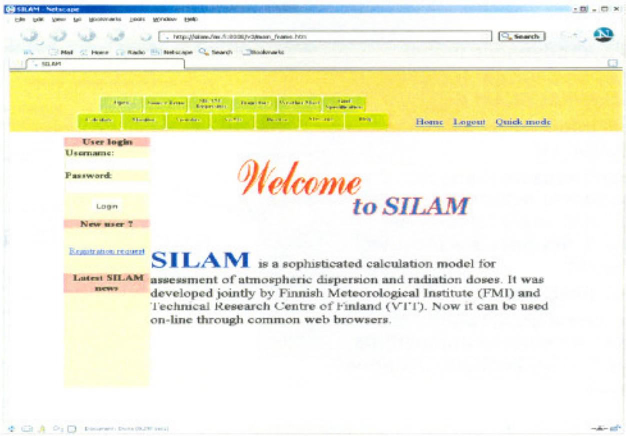
SILAM atmospheric dispersion and dose assessment model



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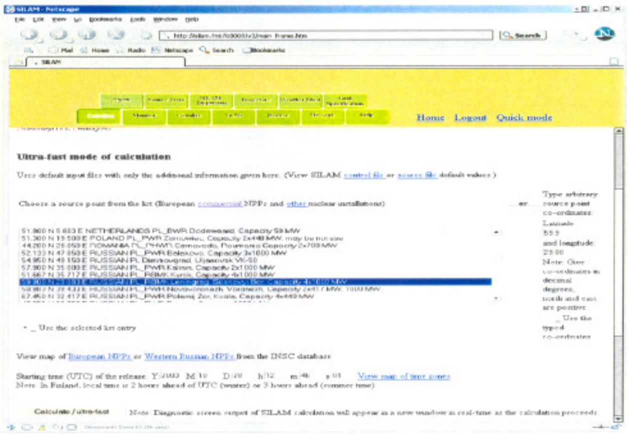
SILAM atmospheric dispersion and dose assessment model



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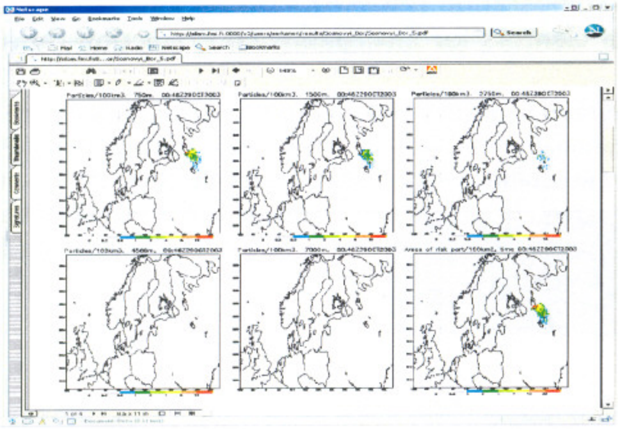
SILAM atmospheric dispersion and dose assessment model



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