



ILMATIETEEN LAITOS  
METEOROLOGISKA INSTITUTET  
FINNISH METEOROLOGICAL INSTITUTE

# Boundary layer challenges for aviation forecaster

## Introduction to the forecasting world

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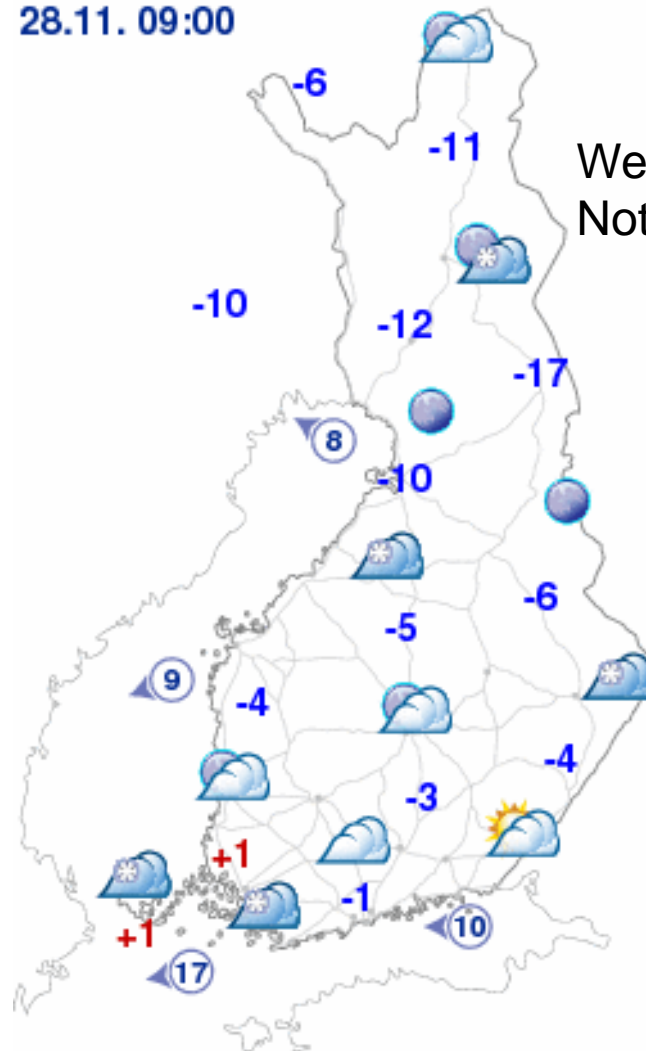
**FMI, Aviation and military WS**





# Forecast for general public

28.11. 09:00



We can live with it - BUT  
Not enough for aviation purposes



# Aviation and weather

Trees are about 200m away.

The tower (air traffic control) is about 1000m away (opposite side of the runway)  
Could be seen **BUT** **visibility < 1km = FOG**



Photo: Heikki Kauppinen



# Aviation forecaster's duty is to serve aviation community

- **Offer Internationally standardized services ( by ICAO)**
  - Terminal Aerodrome Forecast (TAF)
  - Significant Weather Charts to upper atmosphere (SWC)
  - Warnings of hazardous weather phenomena (SIGMET)
    - thunderstorms, turbulens, icing
- **Observations available**
  - from aerodrome – METAR - METeorological Aerodrome Report
  - from aircrafts (AIREP)
  - Others: Satellites, weather radars, different kinds of ground based weather obs stations, soundings



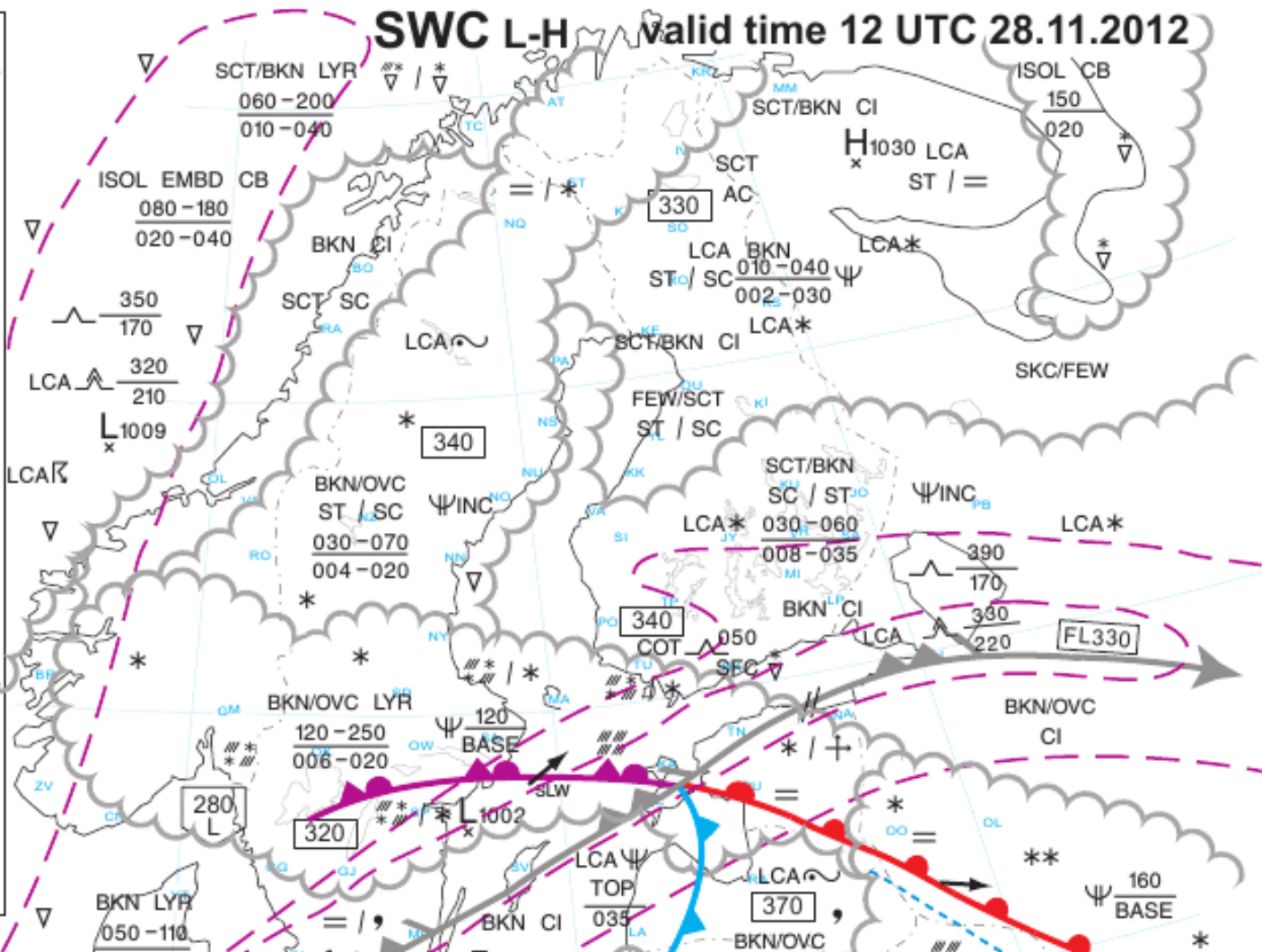
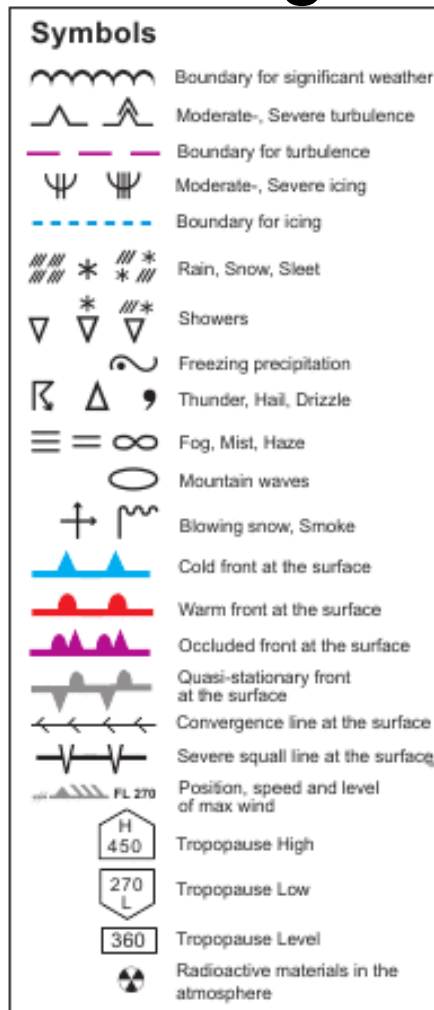
# Use of aviation forecasts and observations

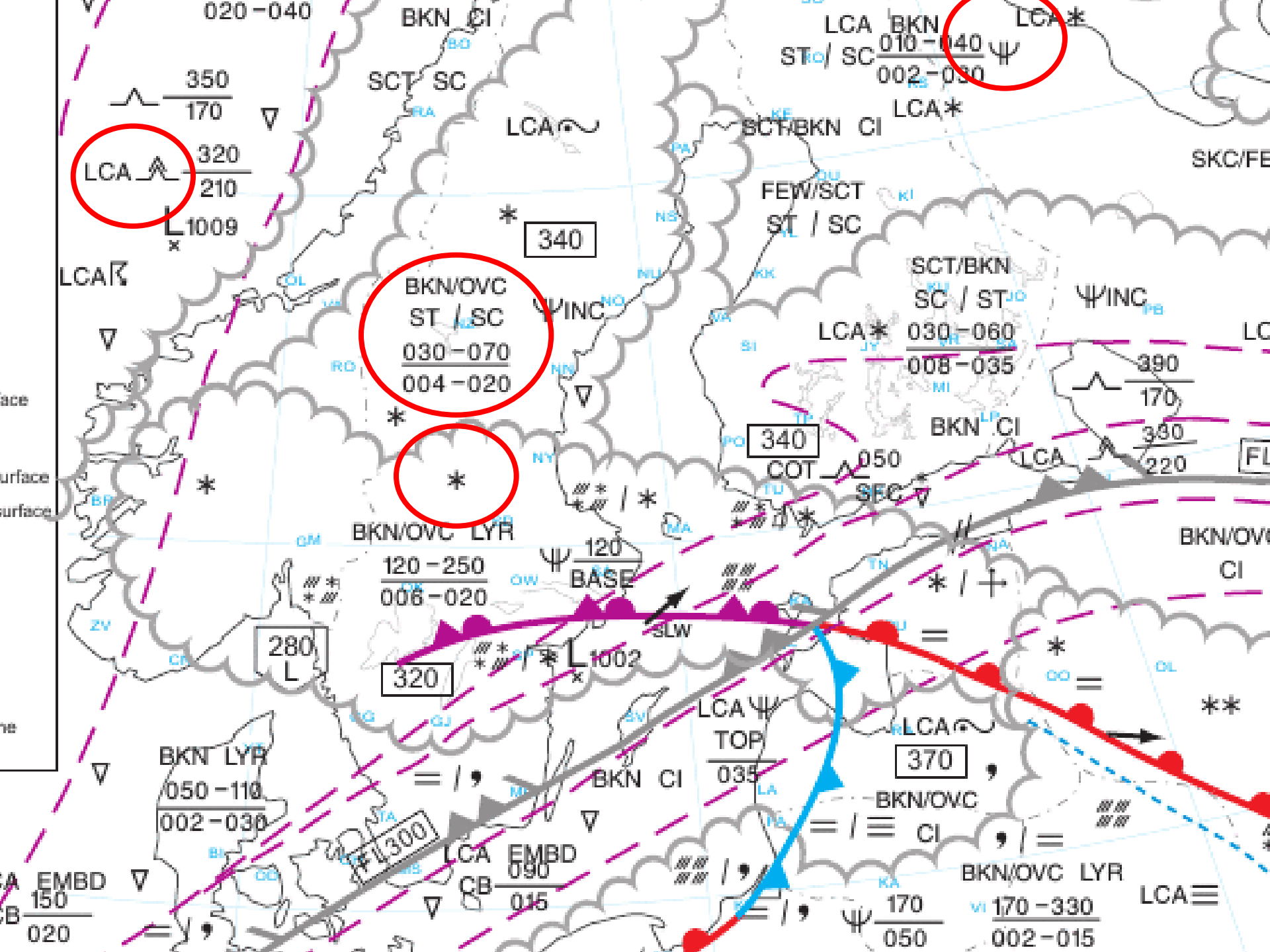
- **Aviation forecasts are used for planning of flight operations - estimations of:**
  - fuel consumption
  - passenger/Gargo relation, safety
  - possibility of getting to the distant airport, keep time tables
- **Observations are mainly for decision making for safe landing and takeoff**
- **Forecasts are made by certified forecaster (ICAO requirement) –**
  - fcst are monitored continuously and amended as necessary



# Weather forecast for aviation community

## 1. Significant weather chart





LCA  $\blacktriangle$   
320  
210  
L1009  
x

BKN/OVC  
ST / SC  
030-070  
004-020

\*

LCA\*  
010-040  
002-030  
 $\Psi$

340  
COT  
050  
SEC

LCA\*  
030-060  
008-035  
BKN CI  
LCA

280  
L

320  
L1002  
x

370  
LCA  
TOP  
035

L300

EMBD  
150  
020

LCA  
EMBD  
090  
CB  
015

$\Psi$   
170  
050

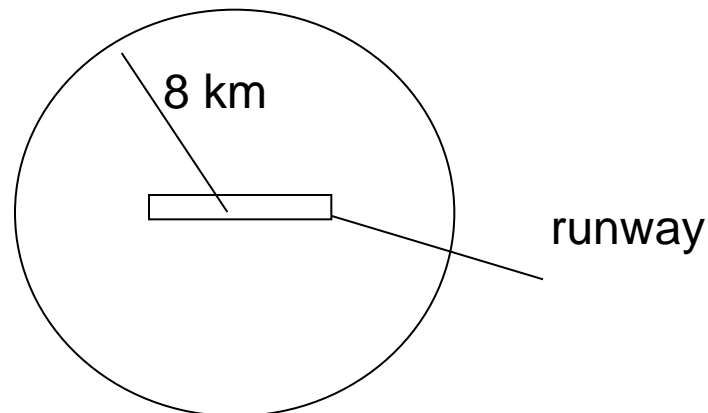
BKN/OVC LVR  
170-330  
002-015

LCA



## 2. TAF (Terminal Aerodrome Forecast) is a "point" forecast

- **Area of 8km circle around the airport**







# TAF Terminal Aerodrome Forecast

- **Made for international and domestic aerodromes**
- **Mandatory for international aviation (civil/military)**
- **Validity 3 to 30 hours, time resolution ~1 hour**
- **Have to:** Continuous monitoring by forecaster against local and other observations available
- **WIND DIRECTION AND SPEED , GUSTs**
- **HORIZONTAL VISIBILITY**
- **WEATHER PHENOMENA (intst + phenomena)**
- **CLOUD COVERAGE (0-8/8) and CEILING**
- **Forecast significant changes of parameters**



# Aviation observations and fcst for airport

**Coded messages – as short as possible and easily interpreted**

## •METAR -observation Helsinki-Vantaa airport

**wind**    **visib**    **weather**    **cloud layers**    **T/Td**    **pressure**

**METAR EFHK 280050Z 05011KT 7000 -SHSN SCT010 BKN025 00/M01 Q1015=**

## TAF - aerodrome forecast Helsinki-Vantaa airport

**TAF EFHK 280238Z 2803/2903 06011KT 9999 -SHSN SCT009 BKN020 TEMPO  
2803/2809 3000 -SHSN BKN009 PROB30 2803/2806 2000 SHSN TEMPO 2809/2903  
3000 -SHSN BKN013=**



# Forecasted parameters and spatial resolution

Trees are about 200m away.

The tower (air traffic control) is about 1000m away, **but where?**





# Examples of required accuracies by ICAO



# Visibility (10m horizontal)

- ICAO requirement of accuracy
- TAF visibility categories :

000m	150m	350m	600m	800m	1500m	3000m	5000m	8000m
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- **Resolution: Categories are very demanding !!**
- **But visibility in one of the most important meteorological parameters for aviation**

Postprocessing (Example [HARMONIE](#))

Climatology [example](#) probability of vis < 1000m (page 21)



# Clouds; ceiling – height of cloud layer measured in the area of airport

## Significant ceiling categories (accuracy of the fcst):

000ft	100ft	200ft	500ft	1000ft	1500ft
	30m	60m	170m	300m	500m

- NOTE: resolution !!
- Ceiling is very important parameter (flight planning and decision making during approach and departure)



# Other important parameters

- Precipitation type
  - Hail, Graupel, freezing rain, freezing drizzle, snow, rain, drizzle – **post-processed in [HARMONIE](#)**
- Icing : light, moderate, heavy
  - Notice: Icing is dependent on a type of an aircraft (velocity, engines, icing protection) – **also postprocessed parameter (use through FMI Met-workstation)**



# Use of NWP

- **Choose the best (locally) NWP-forecast**
  - By subjective analysis and coordination with colleagues

- **f.ex. Meteograms** (Harmonie)

**Stable PBL below 500m in the most important layer for aviation**

**Forecasting:**

**Temperature - Zero-line**

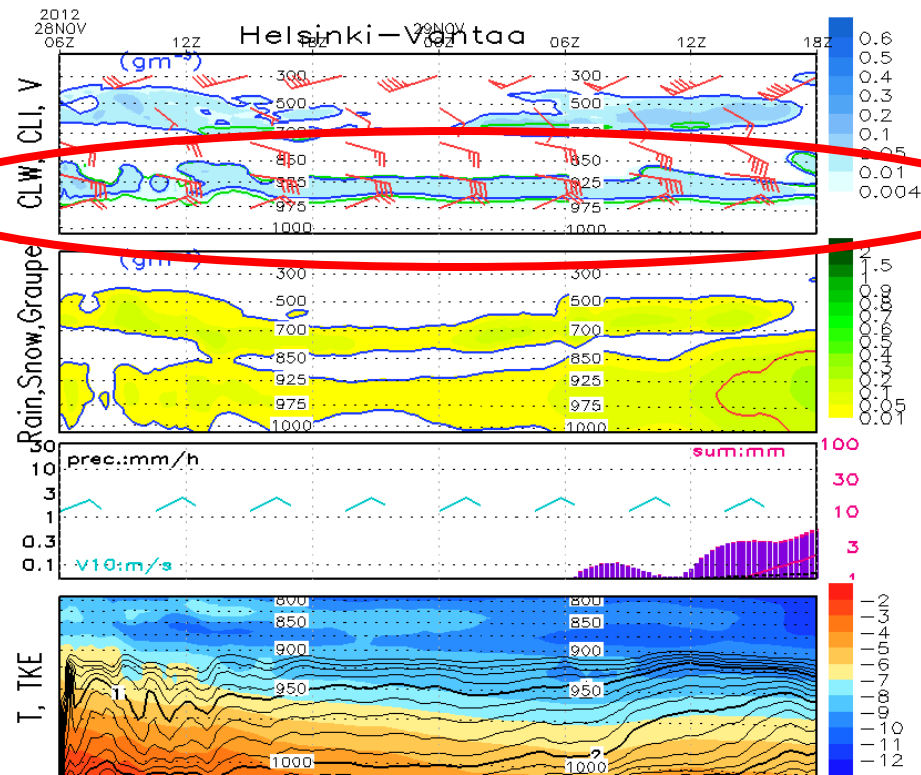
**LWC, Humidity**

**Hydrometeors**

**Aerosols**

**Horiz and vertical resolution**

**Time resolution**







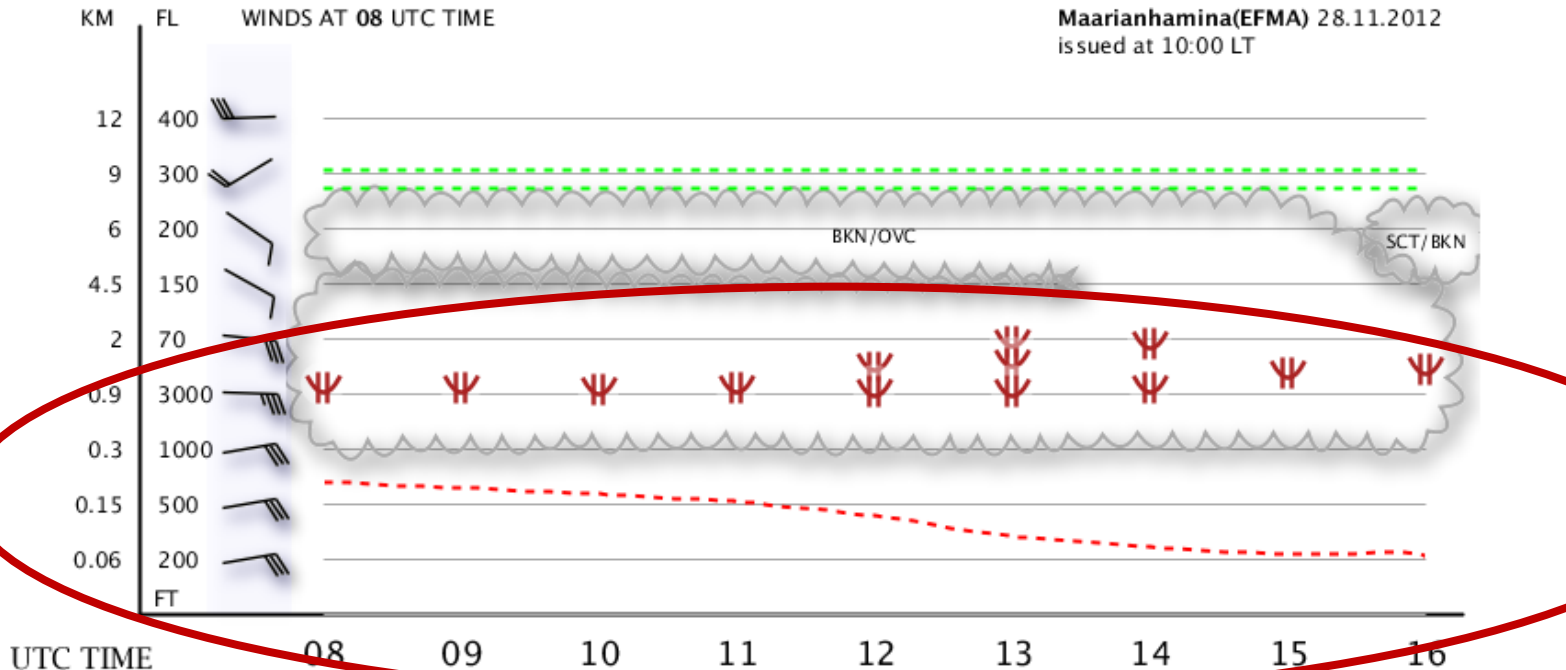
# EU demands and Single European Sky (SES)

- **SESAR development project under SES are working on common Aviation technologies in Europe**
- **One of the main interest is to lower aviation costs and to get European traffic more effective (flexible, f.ex. keeping time tables)**
  - One way in order to reduce the costs is automation
  - The service volume will be so large that manual weather services are practically impossible
    - Solution is to develop atmospheric NWP models
    - Particularly model quality in atmospheric PBL very important on the way to automated aviation service

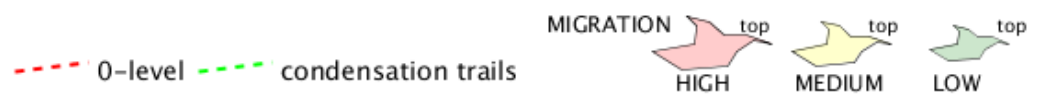


# Time crosssection for aerodrome (made by hand using obs+model (HIRLAM RCR))

**NOTE: "Hyper-logarithmic" vertical (altitude) scale**



WEATHER	08	09	10	11	12	13	14	15	16	
VISIBILITY(KM)					4 1.2	4 1.2	4 1.2	4 1.2	4 1.2	(base) (tempo) (prob)





# We really need your contribution Thank You !



Photo Meteorologist Janne Ylläsjärvi  
at Rovaniemi airport