



# **HARMONIE Reanalysis: overview**

**Martin Ridal**

**Per Undén, Esbjörn Olsson, Jelena Bojarova, Tomas Landelius,  
Klaus Zimmermann, Heiner Körnich**

# SMHI reanalyses in UERRA

**SMHI**  
HARMONIE - ALADIN

1961

2006

2010

2015

SMHI  
HARMONIE- ALARO

2004

2009

SMHI  
MESAN  
Cloud Analysis

1993

2015

**Météo-France**  
MESCAN Surface Analysis

# Outline

HARMONIE

Spinup periods

Observation usage

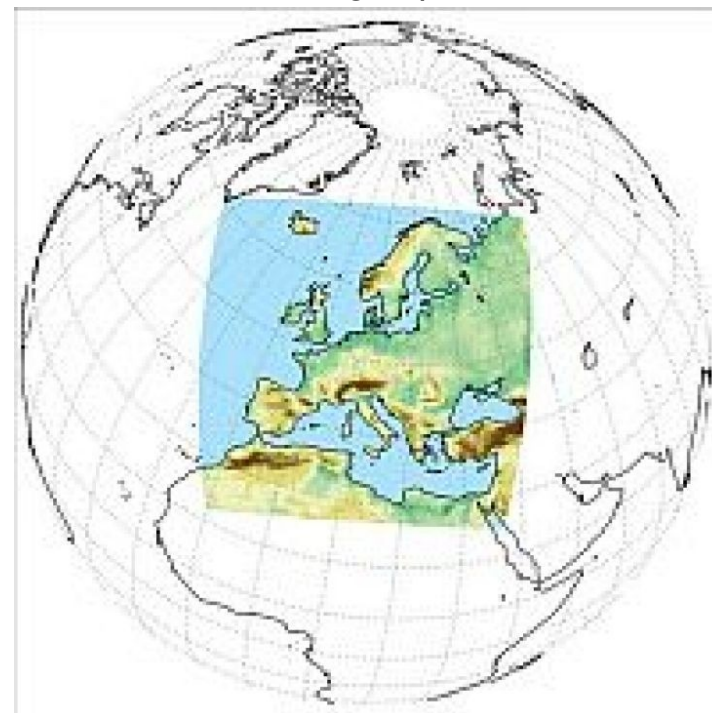
Archiving

Cloud fraction re-analysis

# HARMONIE (HIRLAM ALADIN Regional/Mesoscale Operational NWP In Europe)

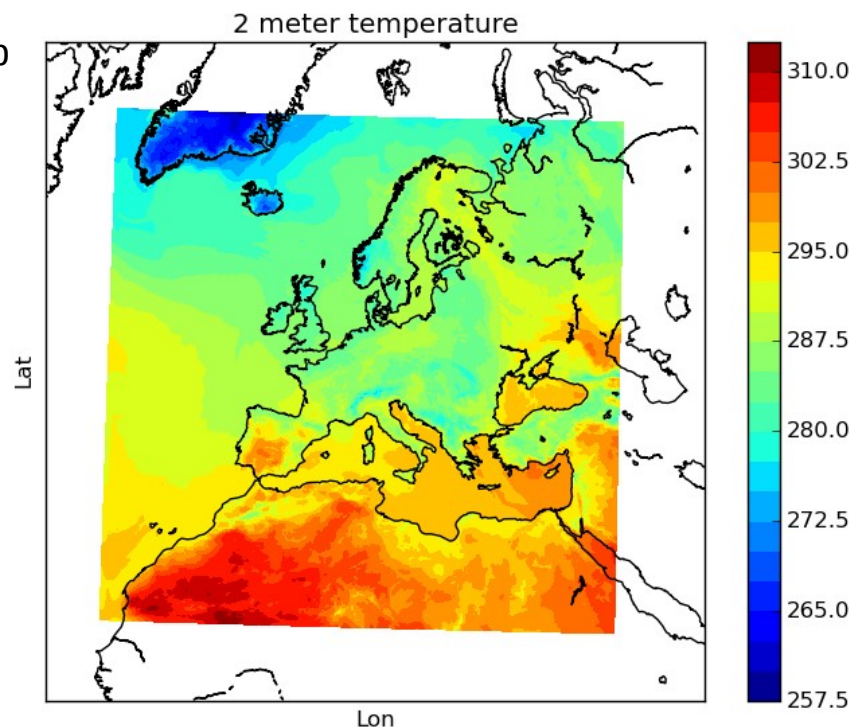
- HARMONIE
  - Cy38h1.1
  - 11 km horizontal resolution, 65 vertical levels
  - Semi implicit, semi Lagrangean, hydrostatic dynamics
  - ALADIN physics
  - SURFEX
  
- Data assimilation
  - 3DVar for upper air – Conventional observations (SYNOP, Ship, Buoys, Radiosondes, Pilot and Aircraft)
  - Large scale constraint – Jk
  - OI for the surface – T2m, RH2m and snow water equivalent
  
- Observations and Boundaries
  - 1961-2001 we used ERA40 observations with addition of Swedish and French observations in the early years. After that operational data
  - 1961-1979 we used ERA40 boundaries. After that ERAinterim

*EURO-CORDEX domain 4  
576x576 grid points*



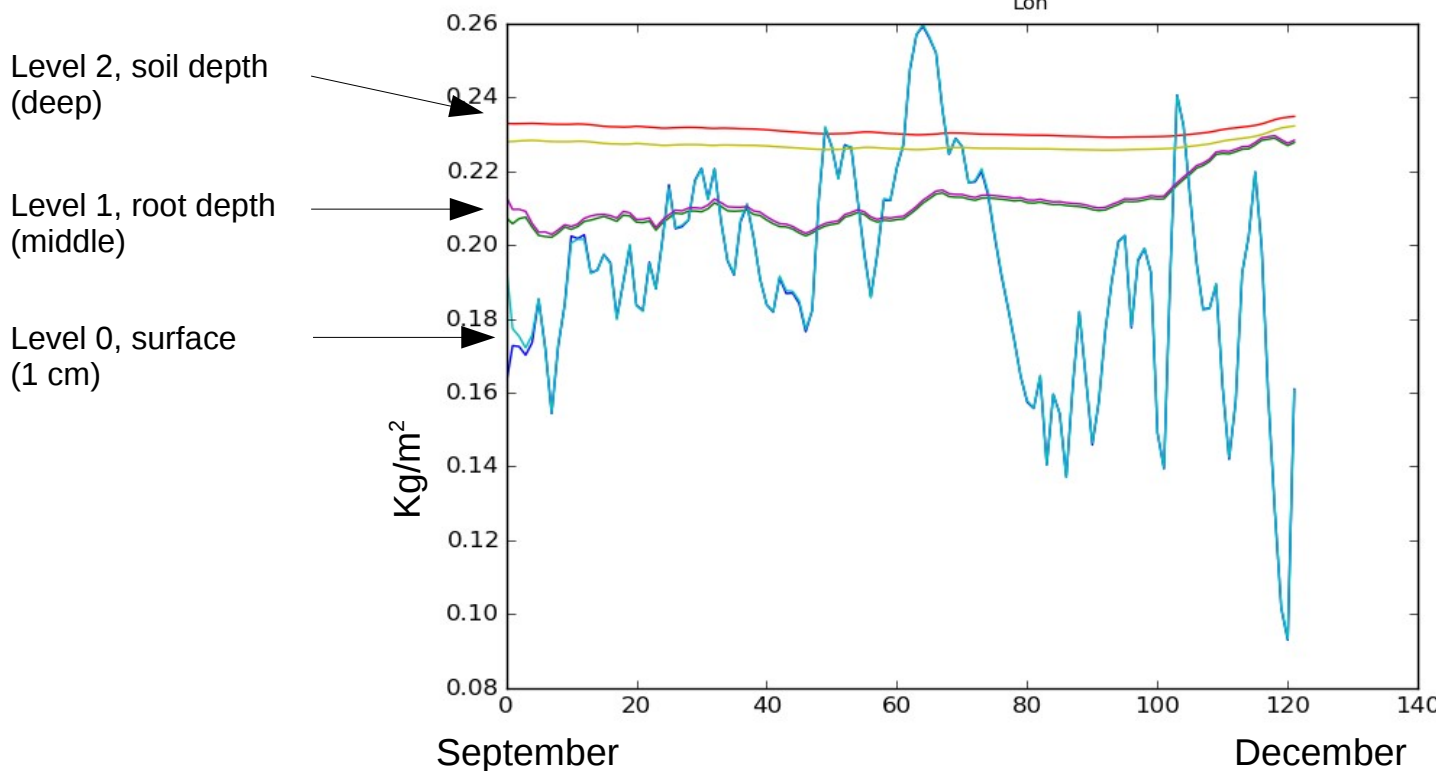
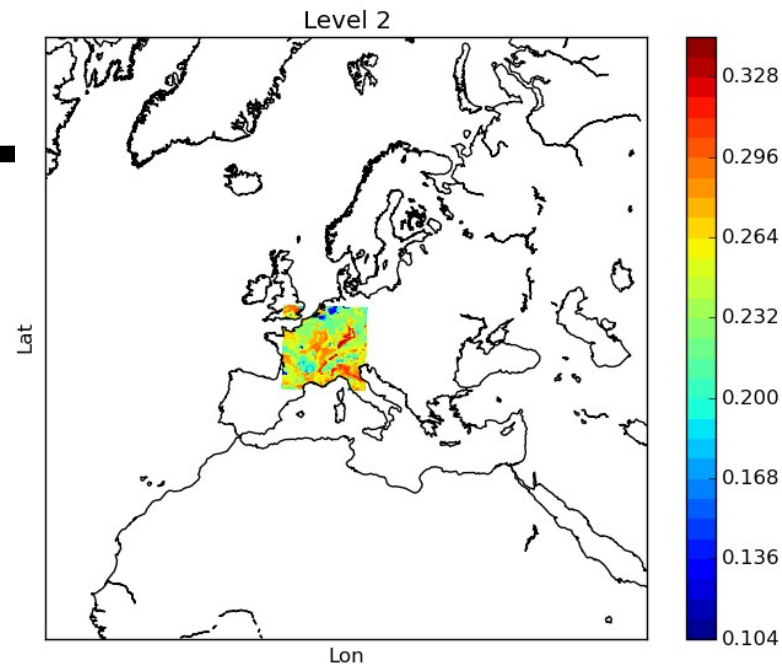
# HARMONIE (HIRLAM ALADIN Regional/Mesoscale Operational NWP In Europe)

- **Forecasts**
  - 30 hour forecasts at 00 and 12
  - 1 hour resolution up to 6 hours, 3 hour resolution up to 30 hours
- **Run at ECMWF**
  - Several streams (5-10 years) with 4 months overlap
  - ~180 milj. SBUs
  - ~1200 Tb data of which ~350 Tb is stored in MARS
- **5 years with HARMONIE-ALARO**
  - 2006-2010
  - Preparation for the longer re-analysis
  - Mini ensemble for uncertainty estimates



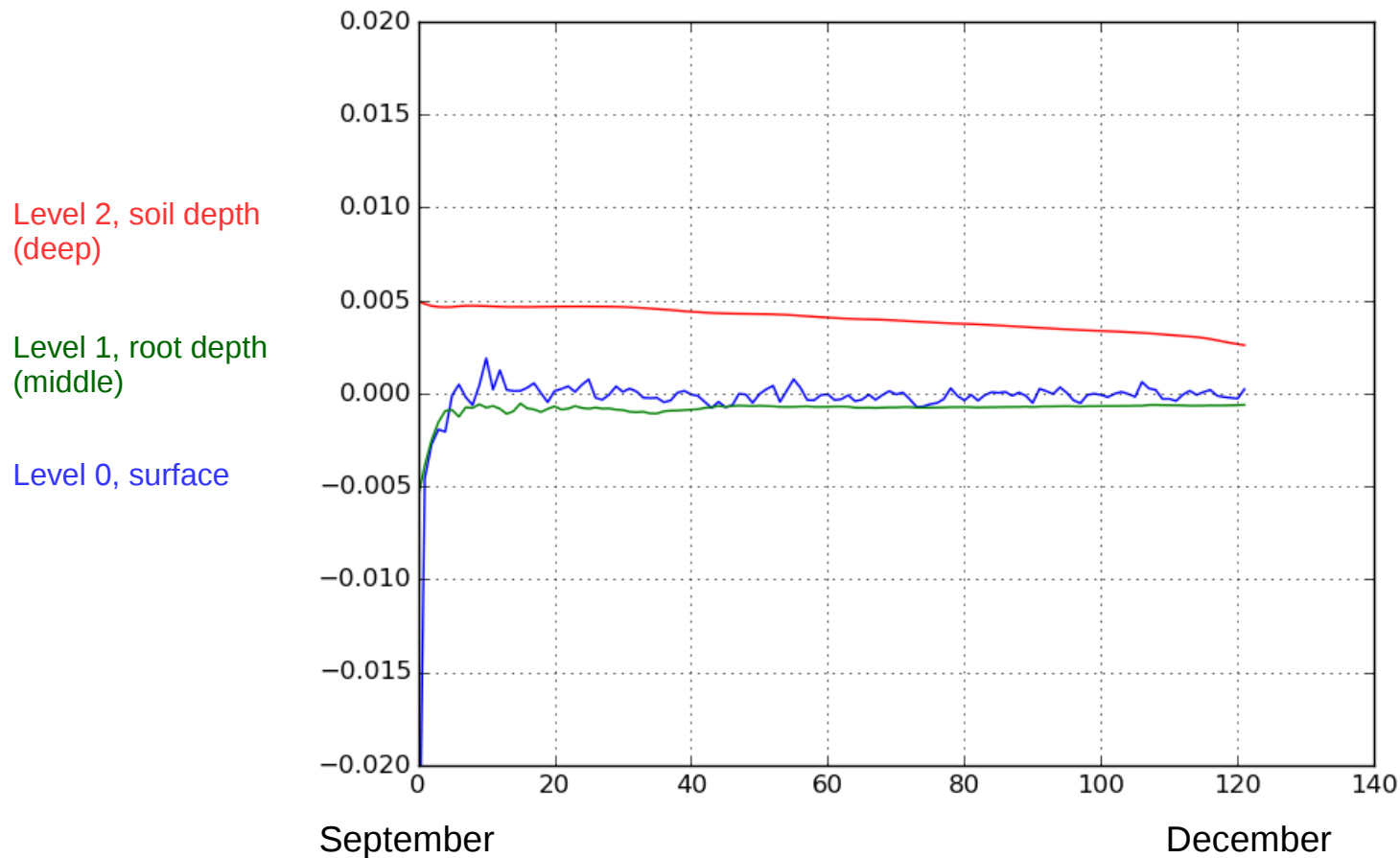
# Spinup of soil moisture

- 4 months spinup was run primarily for the deep soil parameters
  - Daily means for the years 1989, 1999 and 2005
  - For an area in central Europe



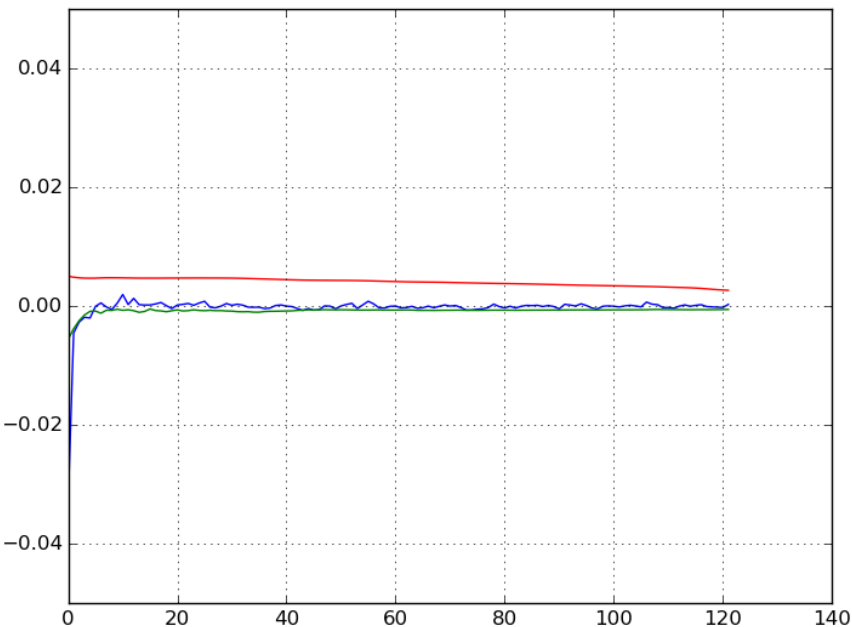
# Spinup of soil moisture

- Difference between production and spinup periods

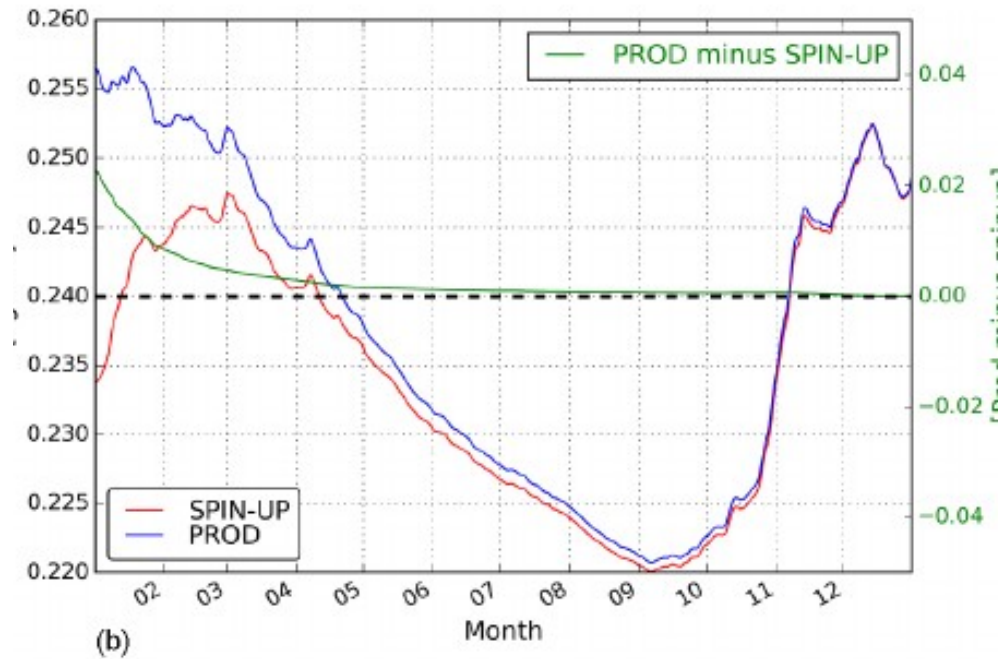


# Spinup of soil moisture

HARMONIE-ALADIN

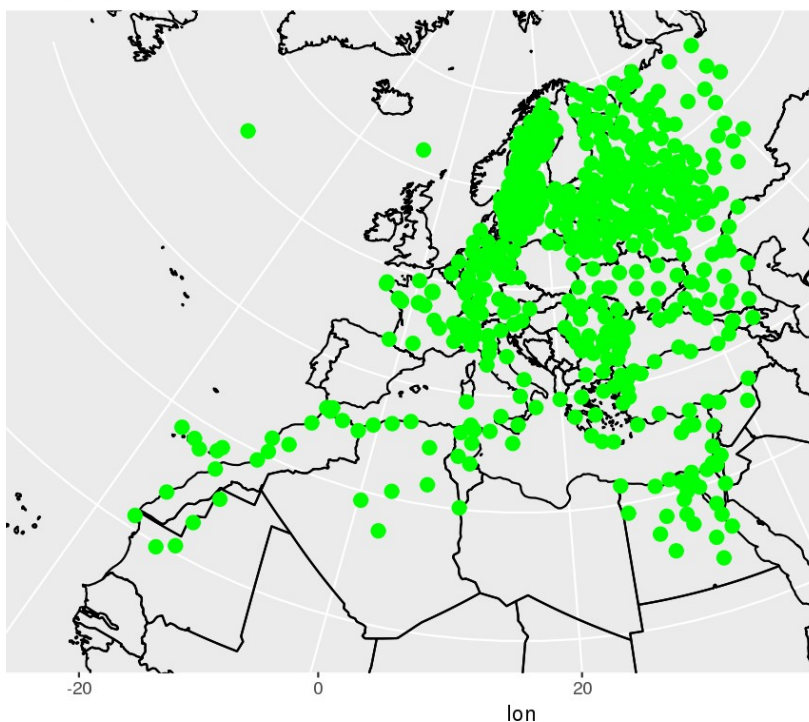


From MÉRA  
For the years 2000, 2005 and 2010  
300 cm below the surface

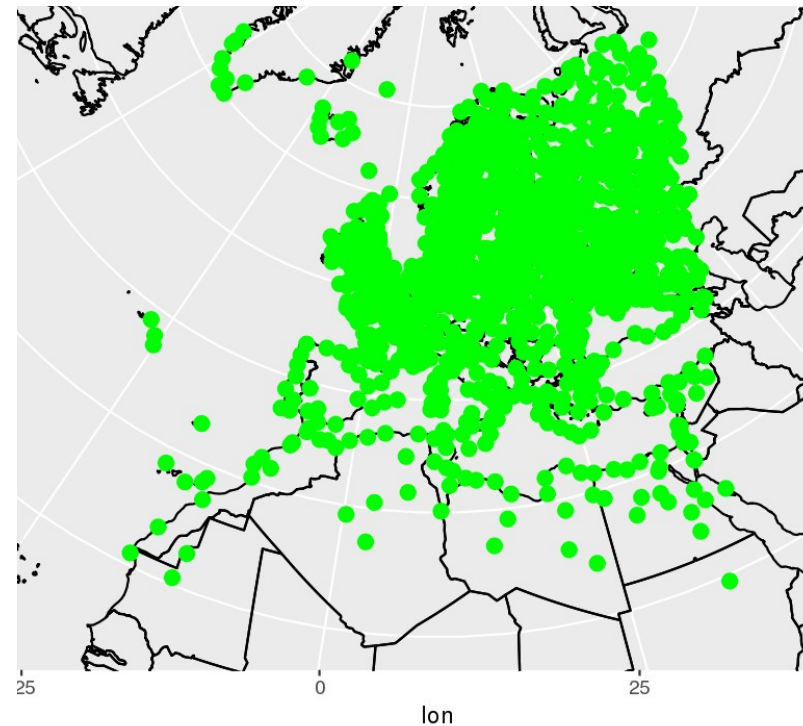


- Upper air
  - Conventional observations from ERA40/ERA-Interim until 2001
  - Additional Swedish and French observations in the early years
  - Operational observations after that
  - Aircraft data available from 1980
  
- Surface
  - T2m, RH2m and Snow water equivalent

*Synop stations July 1965*

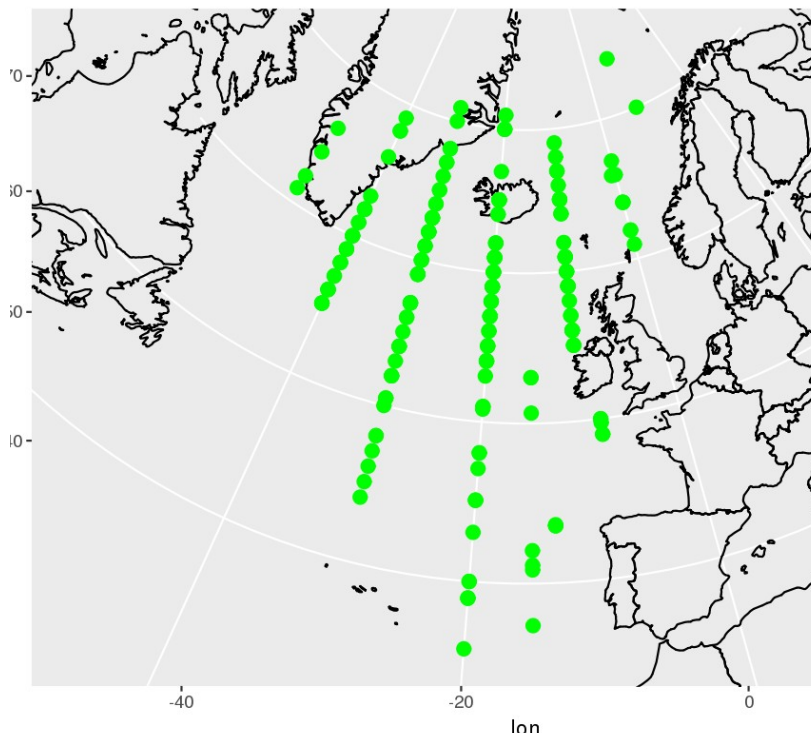


*Synop stations July 1967*

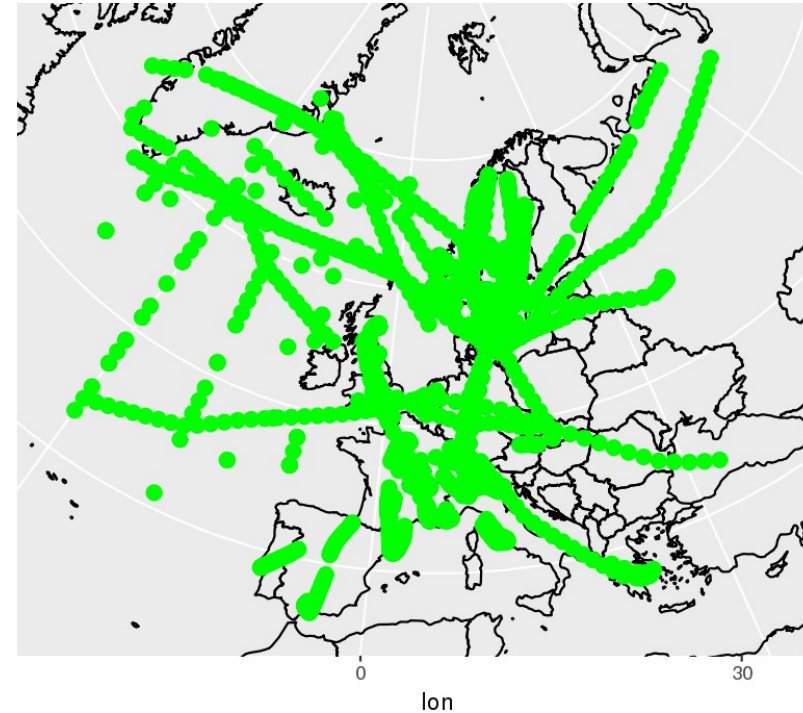


- Aircraft – AIREP
  - Reported manually
  - Certain times and locations
  
- Aircraft – AMDAR
  - Automatic reporting
  - Better distribution and reports during take off and landing
  - More and more aircrafts equipped

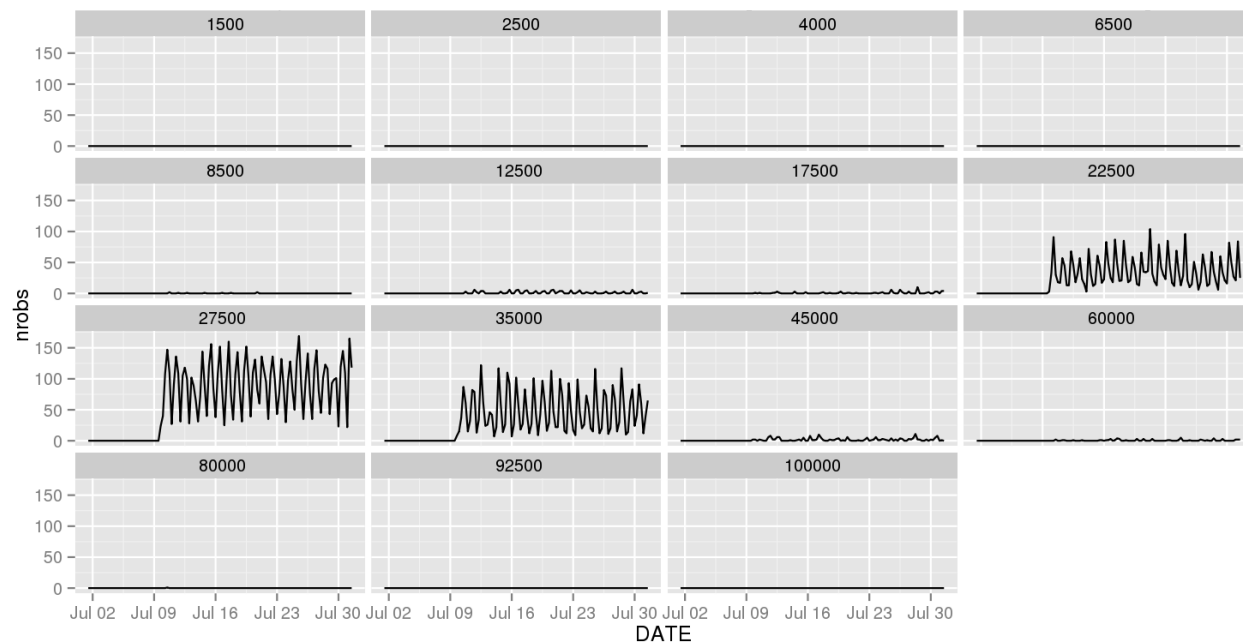
*Aircraft observations 19900731*



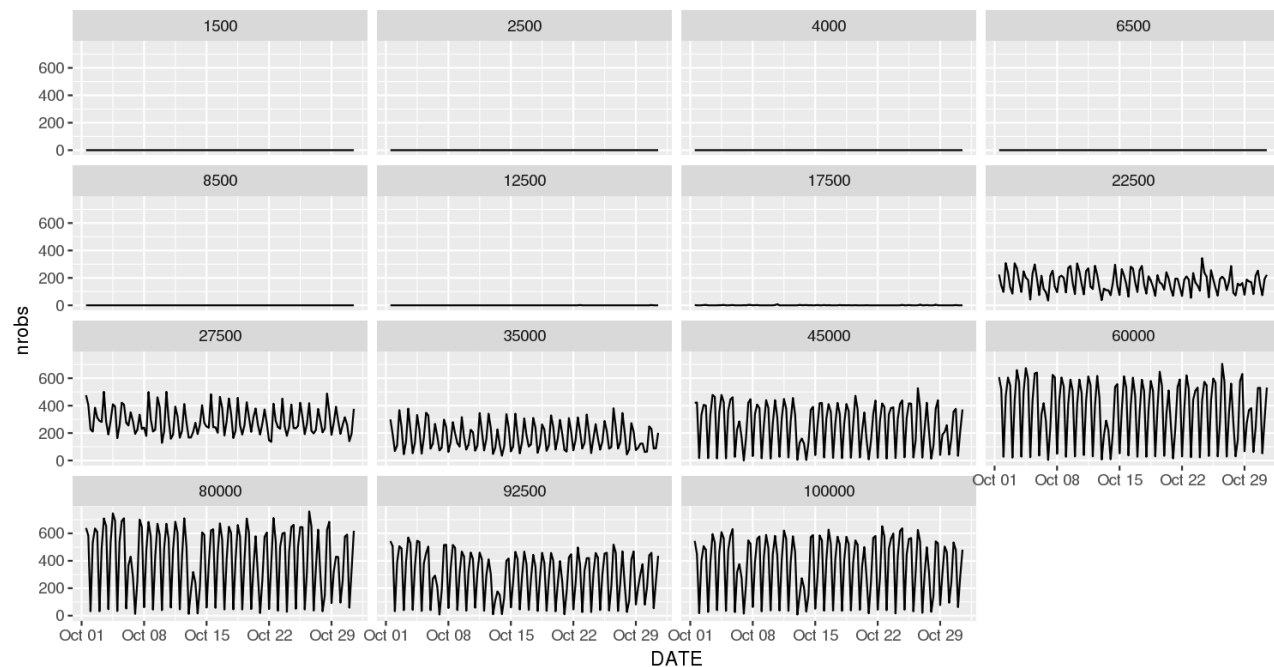
*Aircraft observations 20011031*



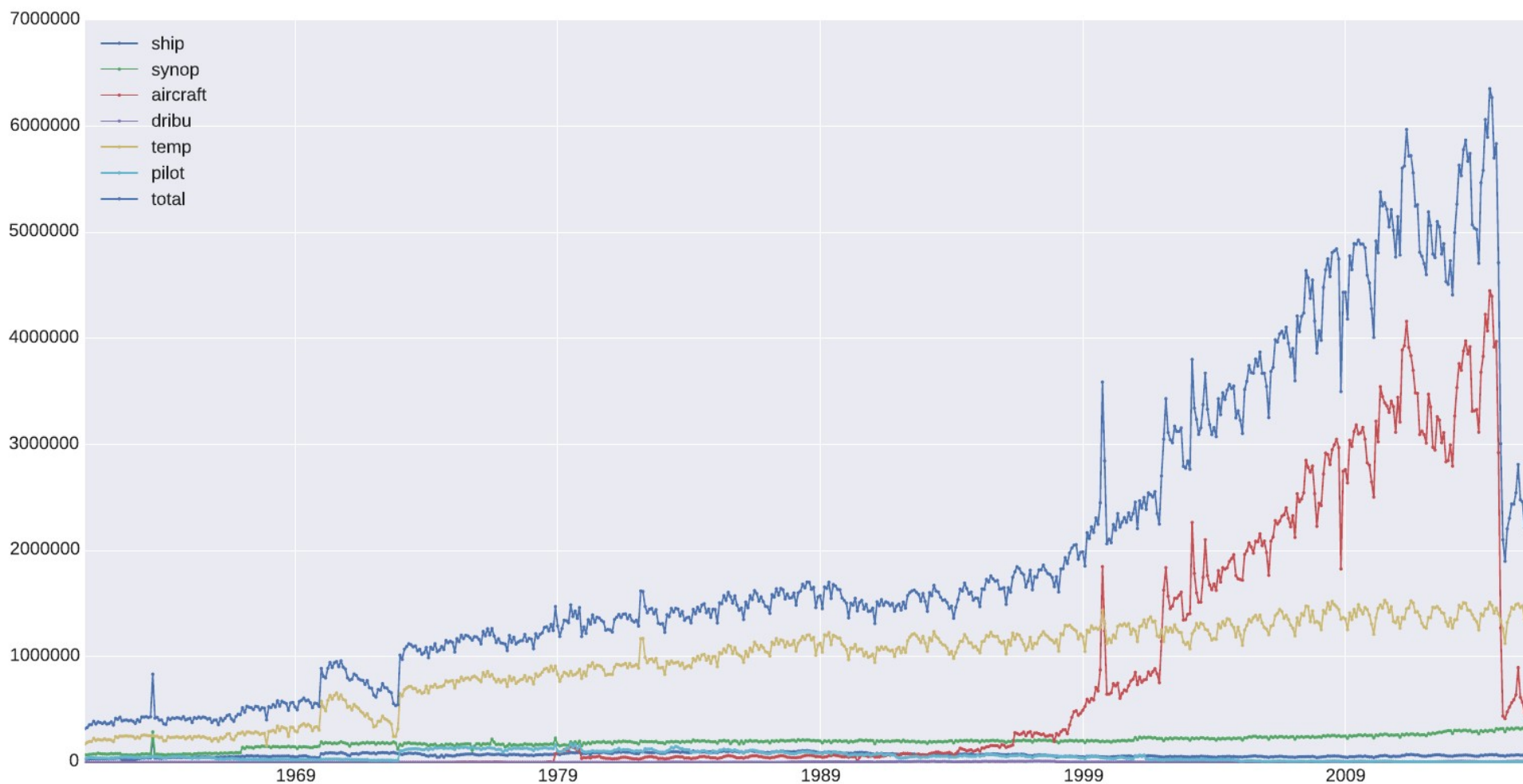
*Aircraft observations, July 1990*

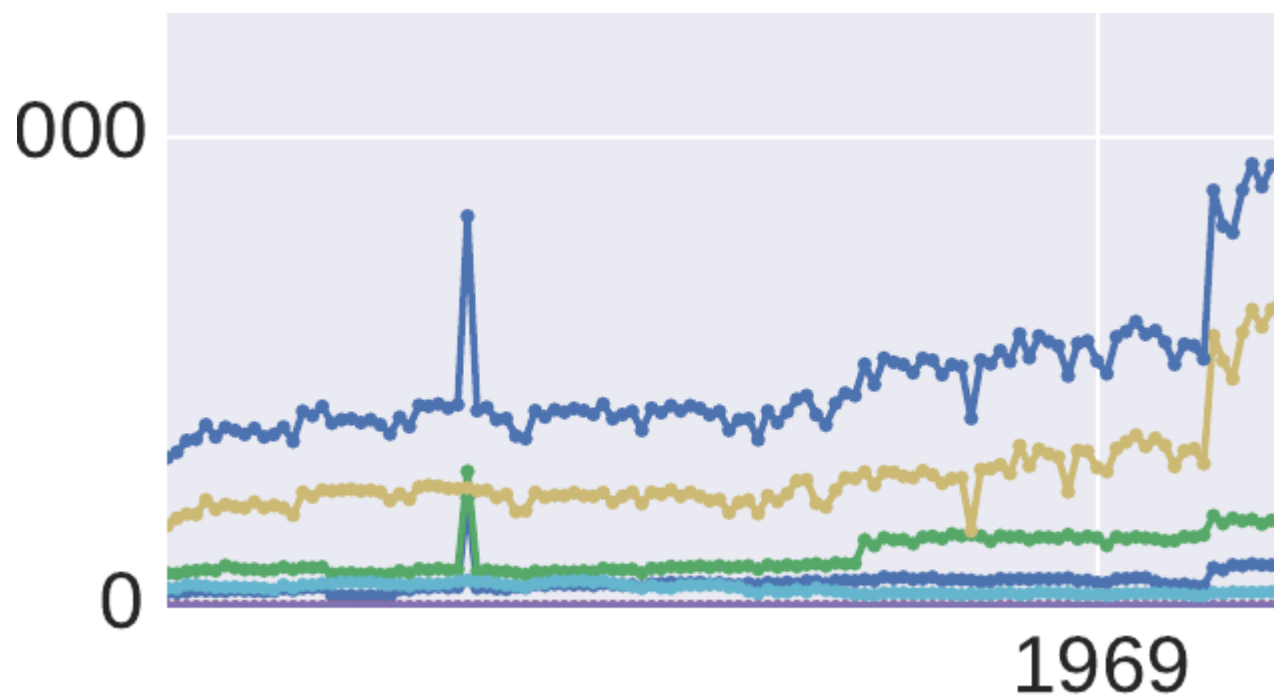


*Aircraft observations, October 2001*

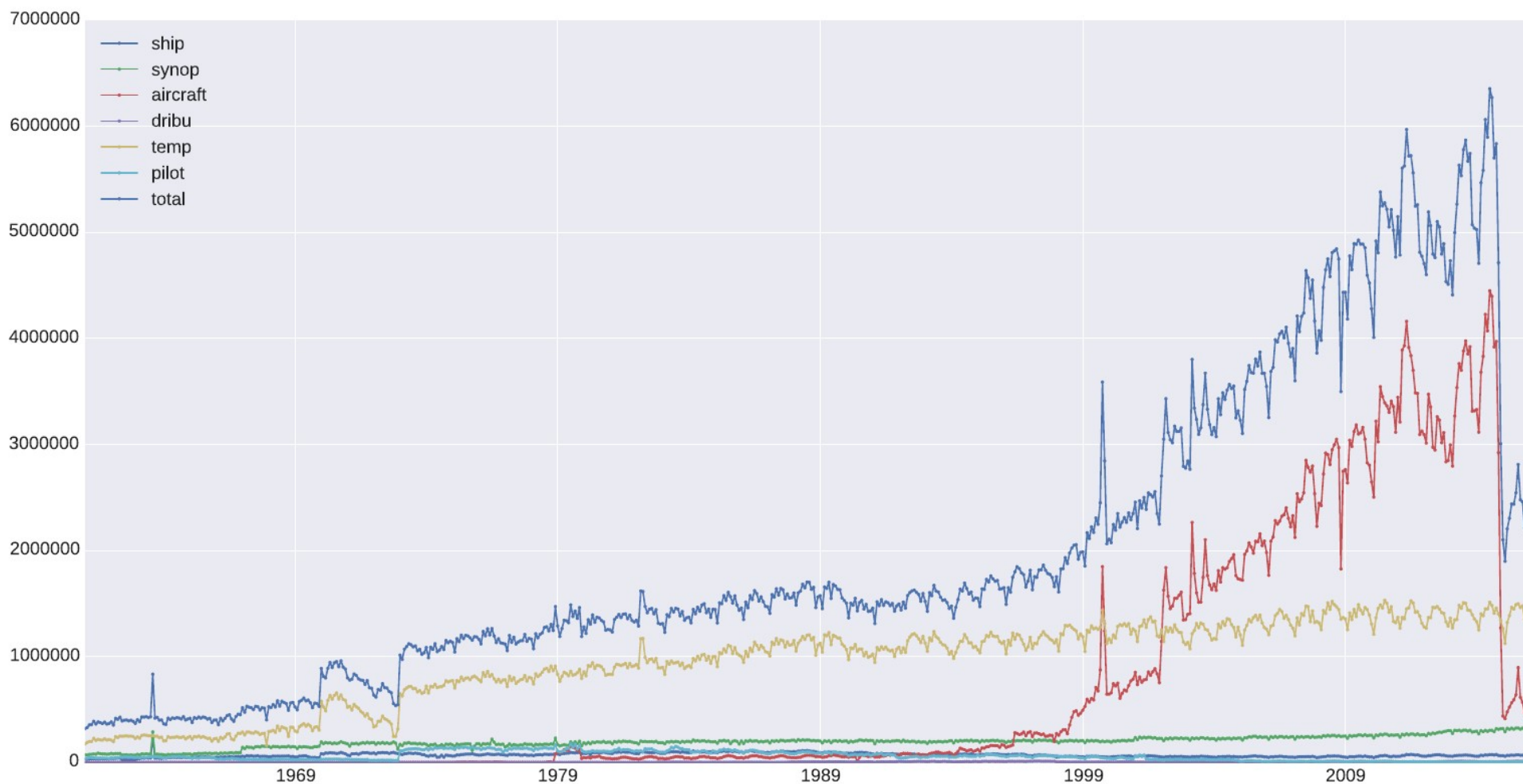


# All observations 1961-2015

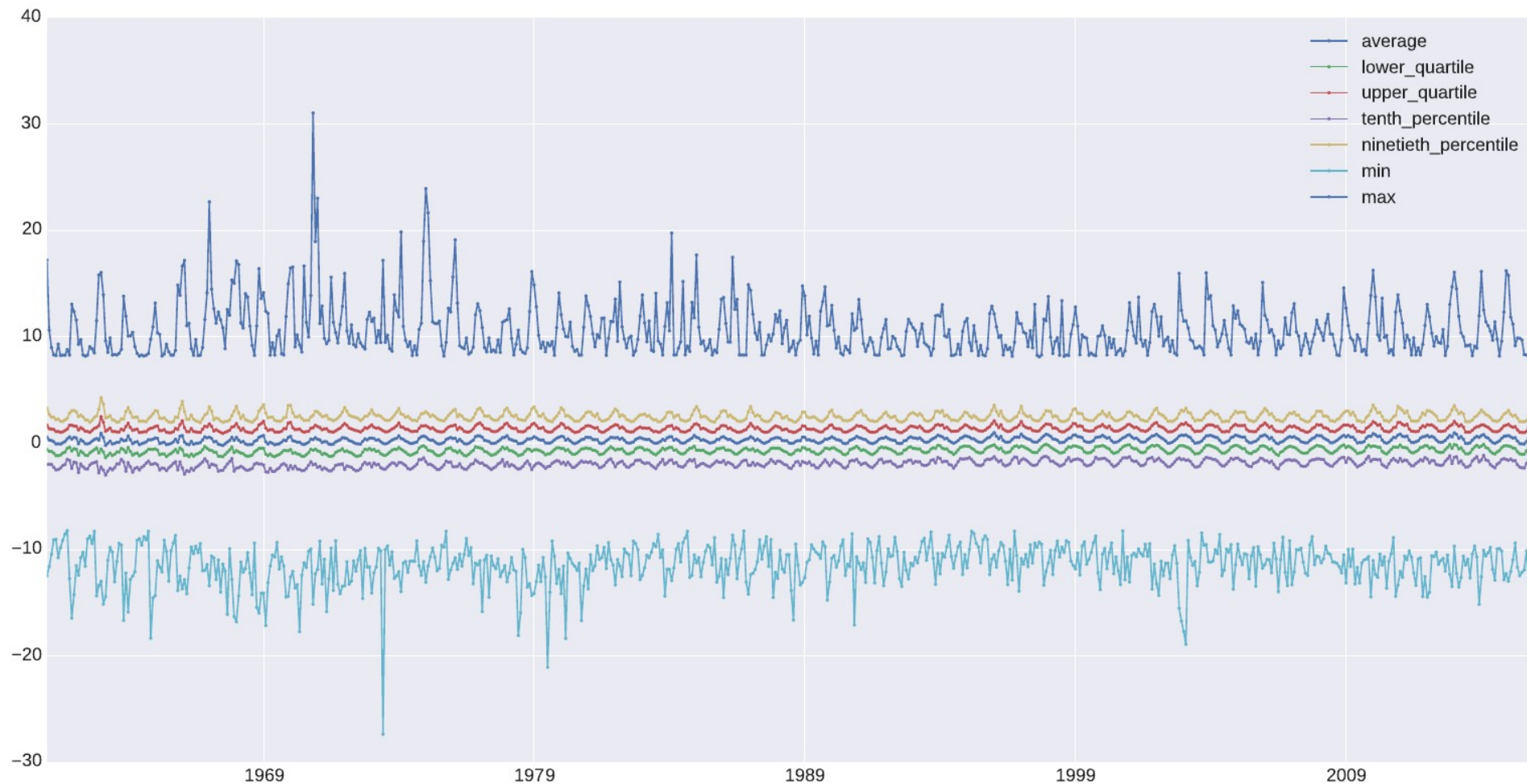




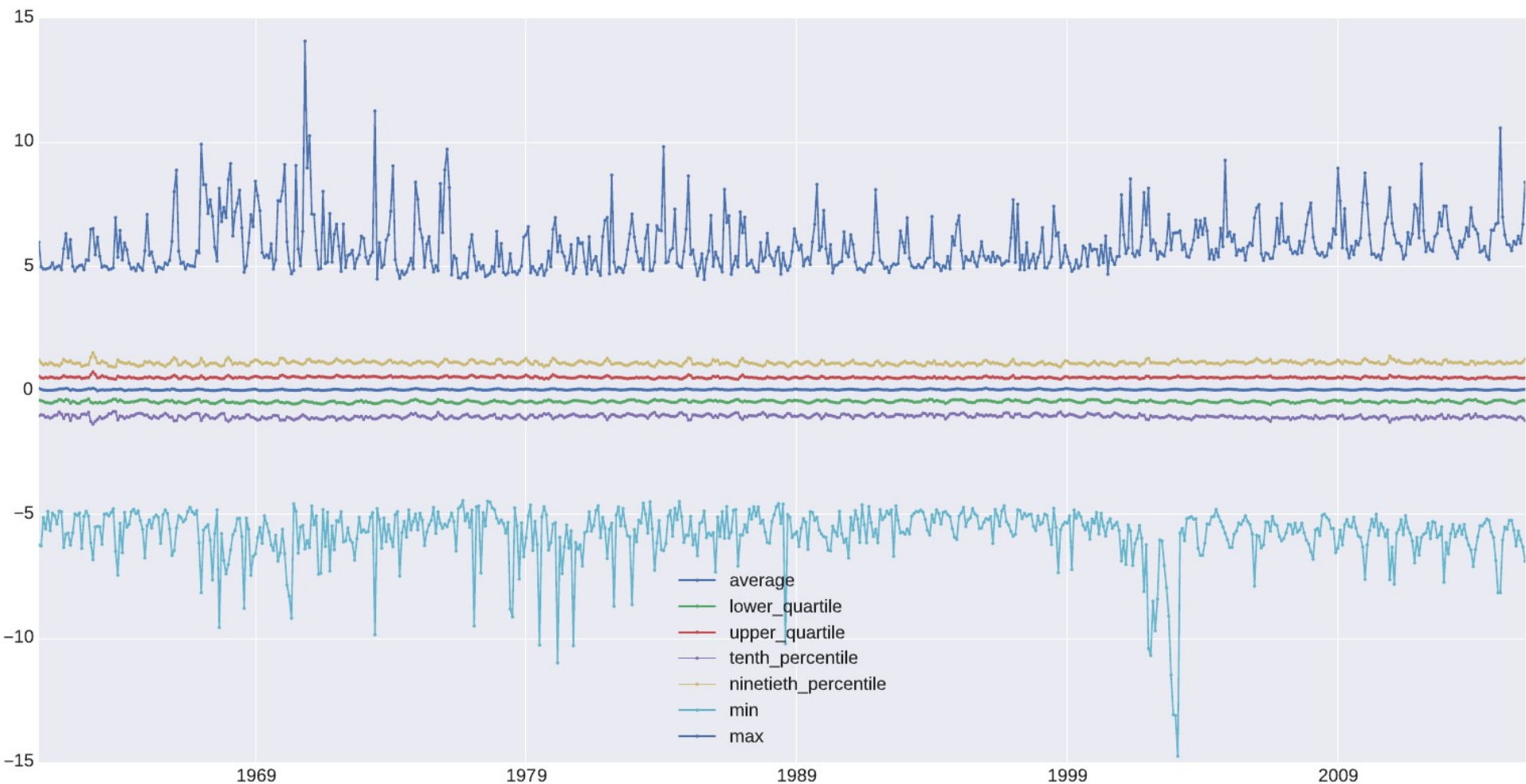
# All observations 1961-2015



# Observation – First guess (6 h forecast) for T2m



# Observation – Analysis for T2m



# Archiving in MARS as GRIB2

## Analysis:

### Model levels

Every six hours at 00, 06, 12, 18 UTC

## Forecasts:

### Height and pressure levels

T+1,2,3,4,5,6,9,12,15,18,21,24,27,30  
started at 00 and 12 UTC

T+1,2,3,4,5,6 started at 06 and 18 UTC

## Surface levels:

Temperature, wind, clouds, fluxes of sensible and latent heat, radiation fluxes, snow, rainfall, albedo...

## Soil levels:

Temperature and soil wetness (3 levels)

Level above ground[m]	Pressure levels [hPa]
	1000
	975
	950
	925
15	900
30	875
50	850
	825
75	800
100	750
150	700
200	600
	500
250	400
300	300
400	250
500	200
	150
	100
	70
	50
	30
	20
	10

# MESAN cloud re-analysis

- Cloud fraction re-analysis
  - Geostationary satellites
  - Polar orbiters
  - EURO4M HIRLAM re-analysis for first guess and gap filling
- 2004-2009 delivered
  - Good quality data from CLAAS-A1 (SEVIRI) and CLARA-A1 (AVHRR)
  - Report written: D2.10 MESAN Cloud Analysis
- 1993-2015 in production
  - New, good quality data is now available from CLARA-A2
  - The method needs some adaption to the new data
  - Possibly also UERRA re-analyses for first guess and gap filling
  - Due to man power problems it has been delayed
  - The goal is to finish before the end of the project

# Summary

- UERRA in general
  - A nice, successful and fun project to work within
- A long deterministic re-analysis has been produced and archived
  - The production in general seems to be ok
  - Most parameters are ok with good results
  - Some problems discovered that can be fixed
  - Some problems discovered that cannot be fixed
- A cloud fraction re-analysis has been produced
  - First version is very short
  - Second version will be much longer