IAGOS related expertise in Hungary

András Horányi Division for Numerical Modelling and Climate Dynamics, Hungarian Meteorological Service

Imre M. Jánosi and **Tamás Tél** von Kármán Laboratory of Environmental Flow, Eötvös Loránd University

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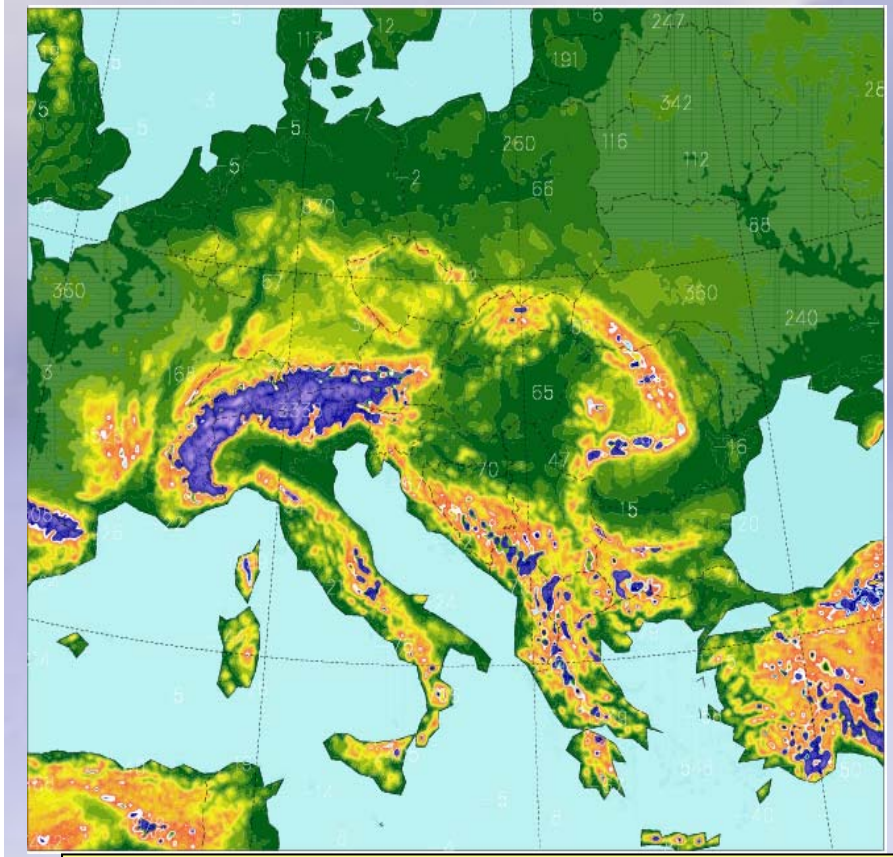
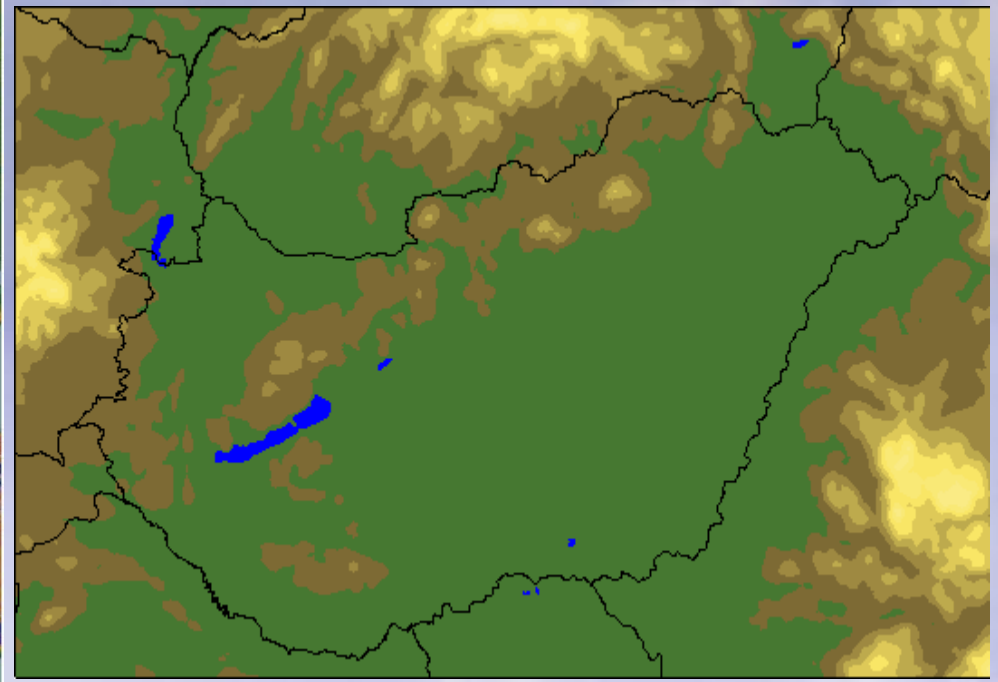
Introduction, previous experience

The Division for Numerical Modelling and Climate Dynamics, Hungarian Meteorological Service has a long term experience in using short range (ALADIN/HU) and ultra-short range (AROME) **numerical weather prediction models.**

Assimilating observational data from aircrafts (AMDAR) was demonstrated to improve the weather forecast.

NWP MODELS AT THE HUNGARIAN METEOROLOGICAL SERVICE





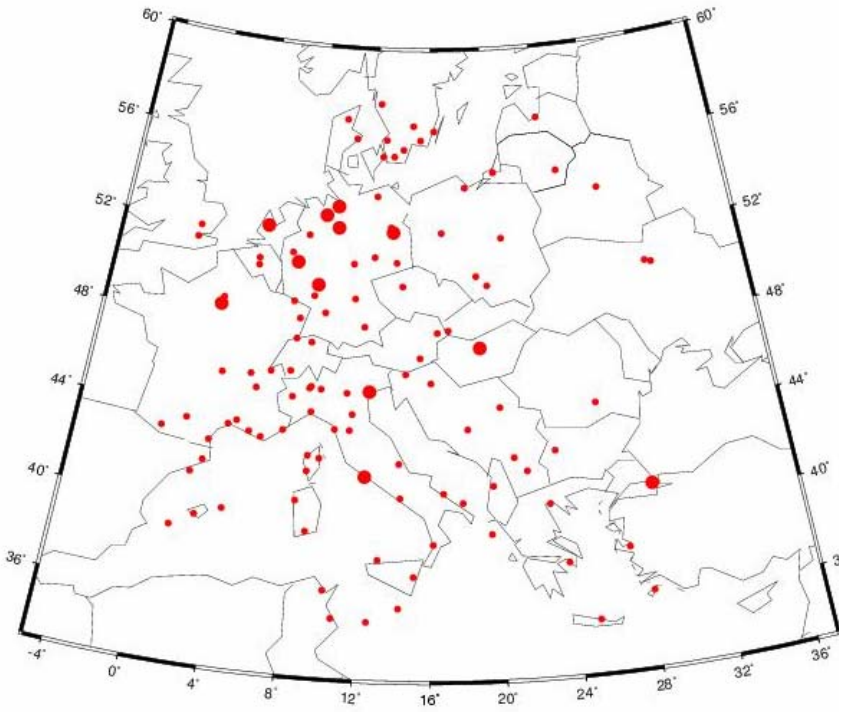
ALADIN/HU **AROME**

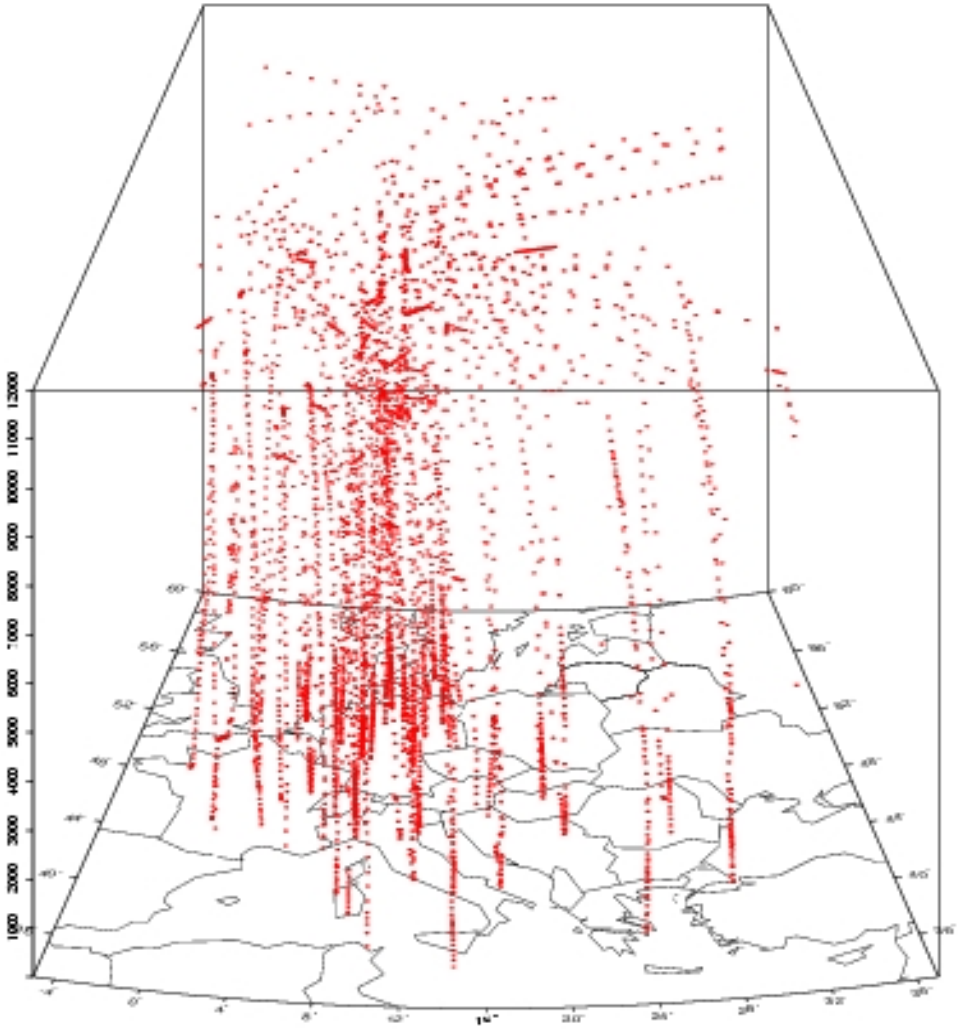
Horizontal resolution: 8 and 2,5 km

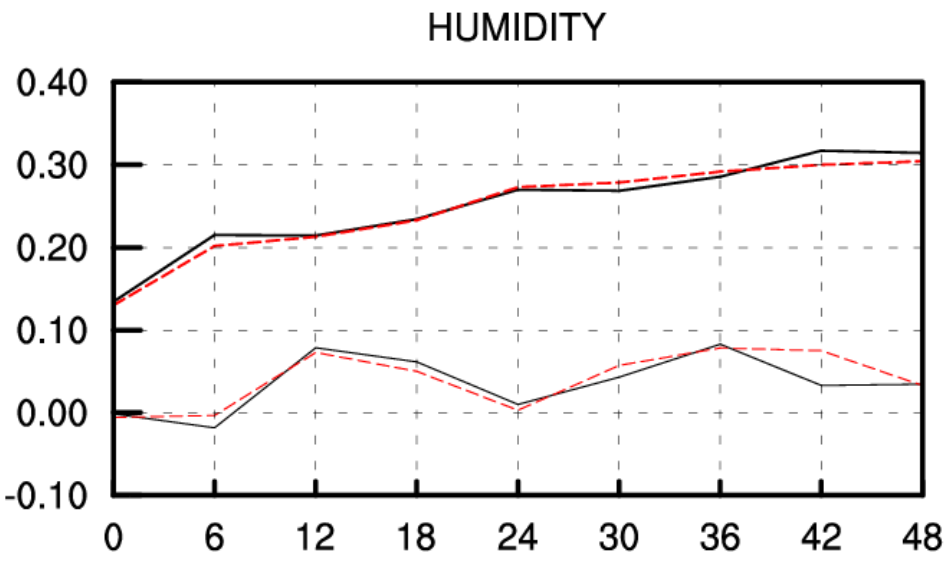
Vertical resolution: 49 and 60 levels

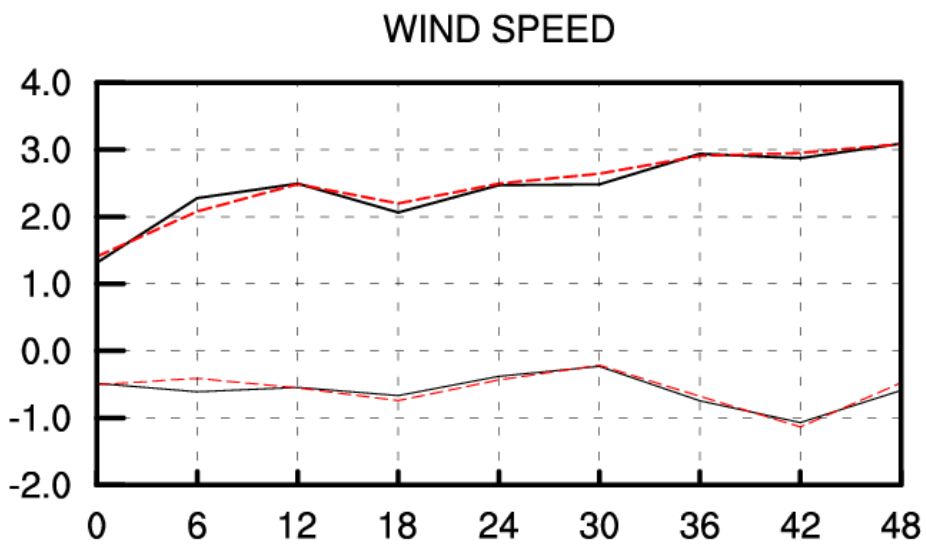
3d-var data assimilation scheme

USE OF AIRCRAFT (AMDAR) DATA: ILLUSTRATION

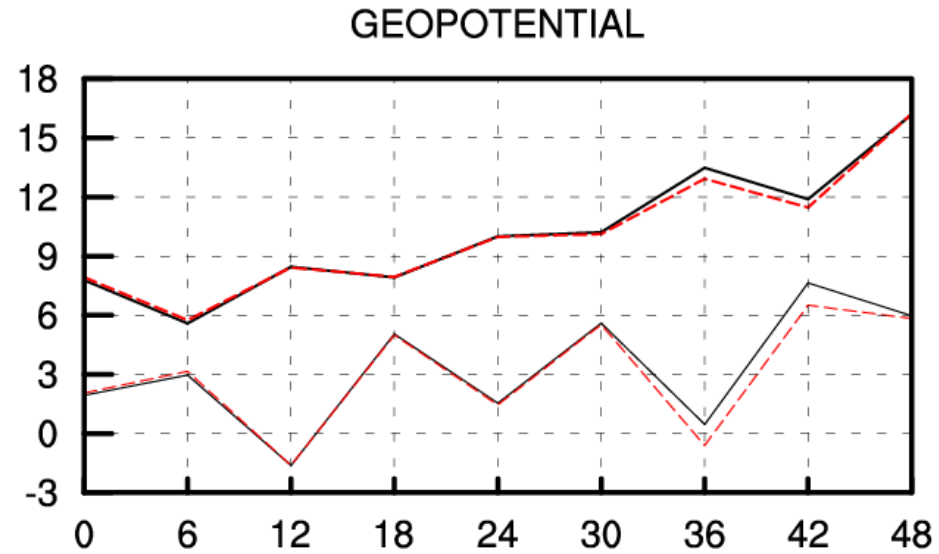


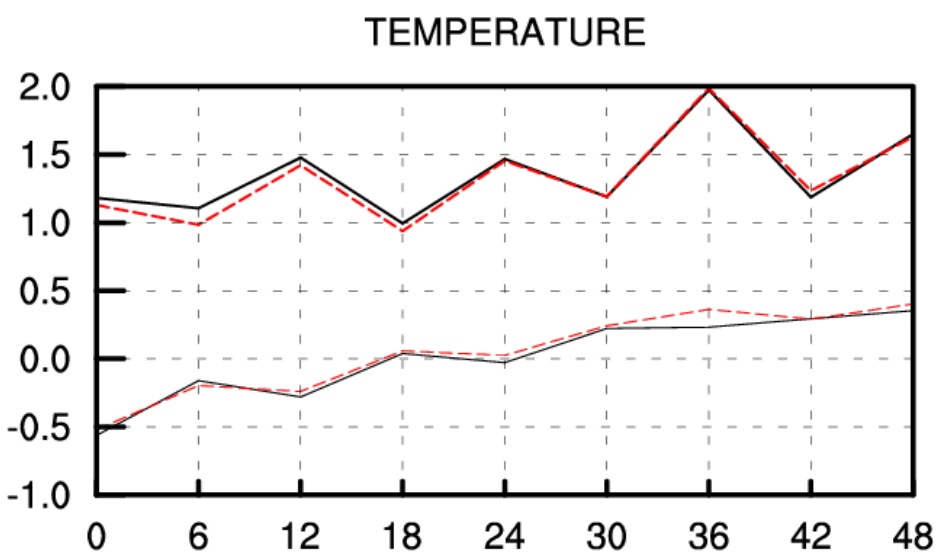






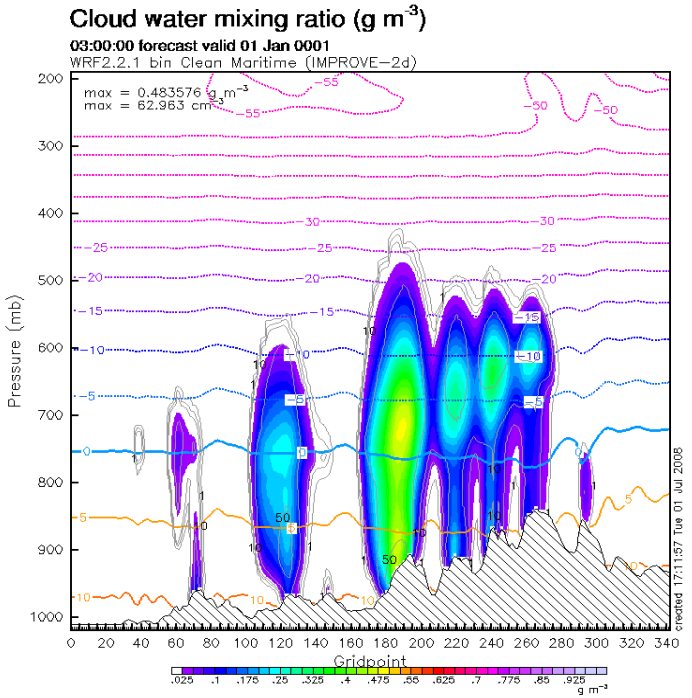
850 hpa (red: AMDAR) systematic (BIAS) and root mean squared errors (RMSE) → the use of aircraft data improves the forecasts!

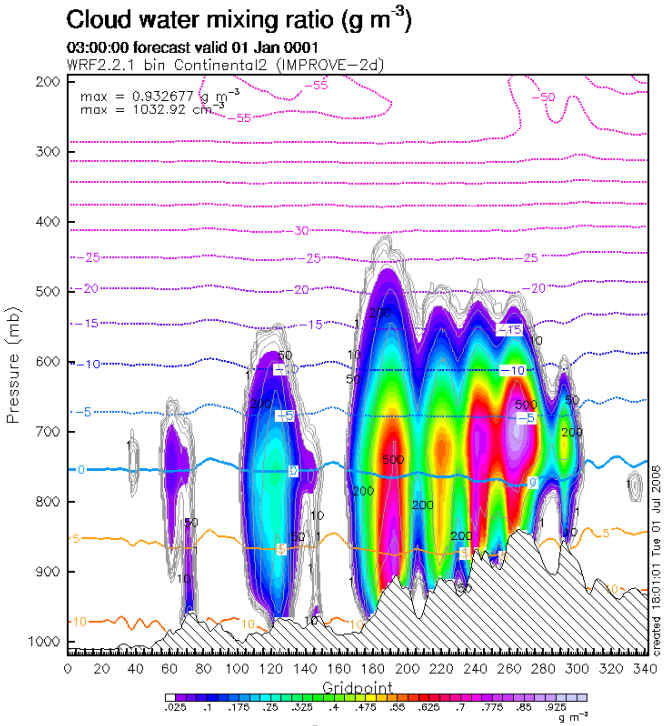


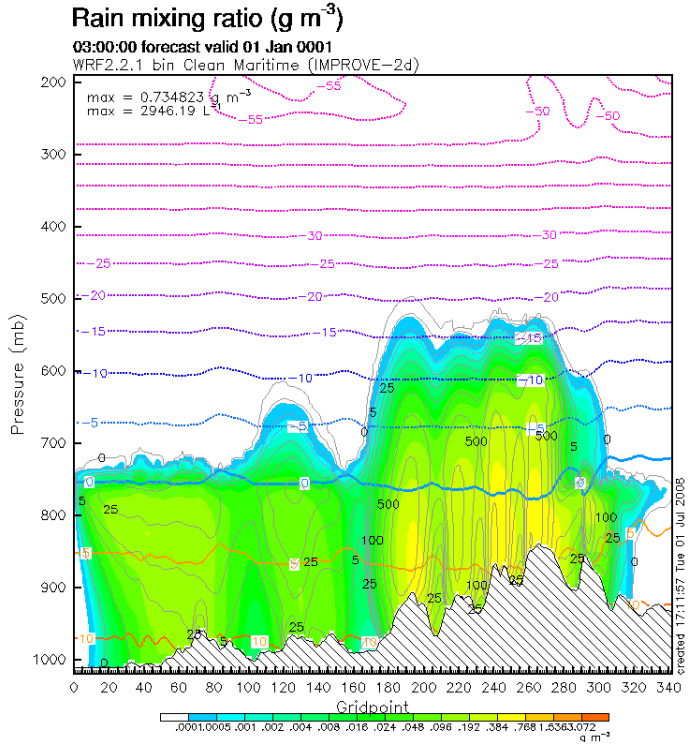


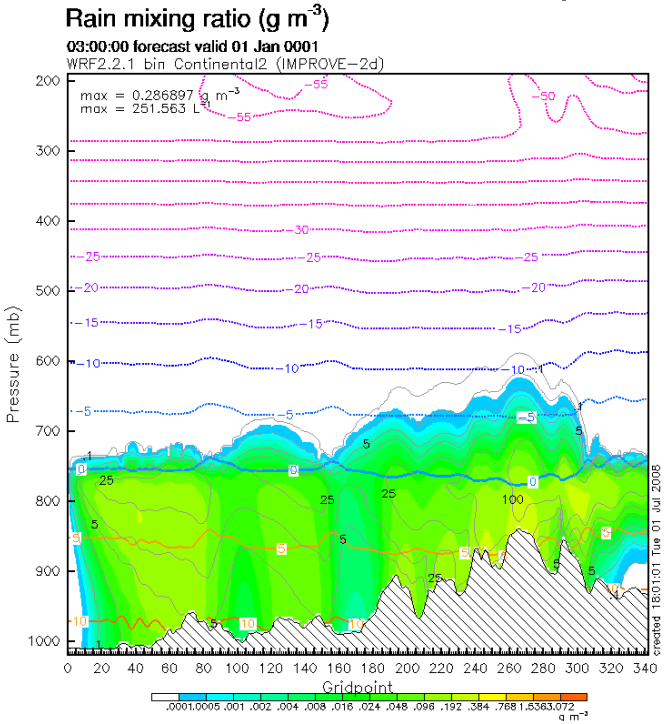
At the Institute of Environmental Sciences, University of Pécs a numerical model was developed to **simulate the formation of the water drops** on the aerosol particles with different sizes and chemical composition. This model allows us to investigate how the change of the characteristics of aerosol particles affect the optical properties of clouds and the efficiency of precipitation formation.

Detailed description of the model can be found in:
Geresdi and Rasmussen, 2005: Freezing drizzle formation in stably stratified layer clouds: Part II. The role of giant nuclei and aerosol particle size distribution
J. Atmos. Sci., 62, 2037-2057


Cloud water mixing ratio (g m-3)
03:00:00 forecast valid 01 Jan 0001
WRF2.2.1 bin Clean Maritime (IMPROVE-2d)
max = 0.483576 g m-3
max = 62.963 cm-3
Pressure (mb)
Gridpoint
created 17:11:57 Tue 01 Jul 2008

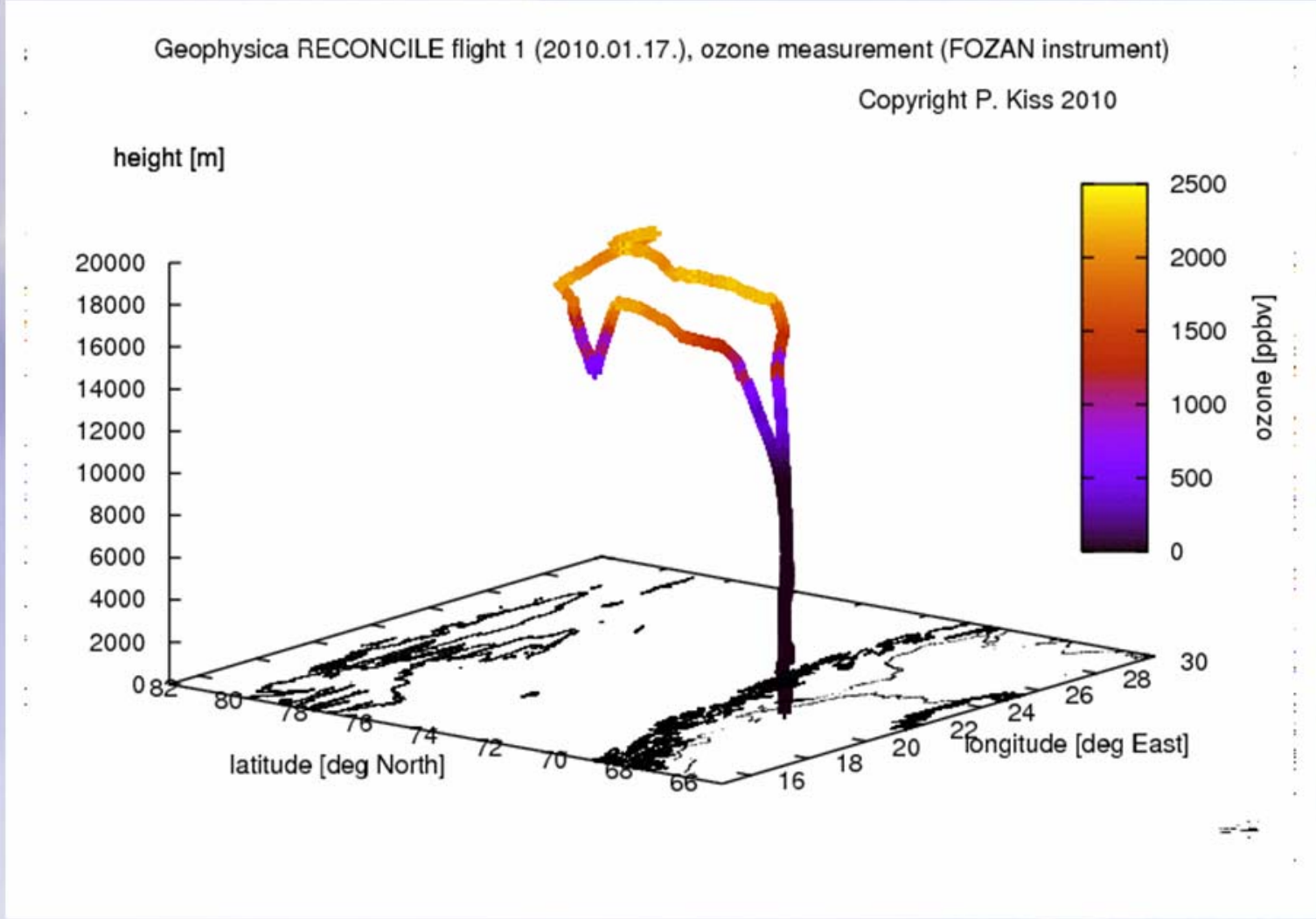

Cloud water mixing ratio (g m-3)
03:00:00 forecast valid 01 Jan 0001
WRF2.2.1 bin Continental2 (IMPROVE-2d)
max = 0.932677 g m-3
max = 1032.92 cm-3
Pressure (mb)
Gridpoint
created 18:01:01 Tue 01 Jul 2008


Rain mixing ratio (g m-3)
03:00:00 forecast valid 01 Jan 0001
WRF2.2.1 bin Clean Maritime (IMPROVE-2d)
max = 0.734823 g m-3
max = 2946.19 L-1
Pressure (mb)
Gridpoint
created 17:11:57 Tue 01 Jul 2008


Rain mixing ratio (g m-3)
03:00:00 forecast valid 01 Jan 0001
WRF2.2.1 bin Continental2 (IMPROVE-2d)
max = 0.286897 g m-3
max = 251.563 L-1
Pressure (mb)
Gridpoint
created 18:01:01 Tue 01 Jul 2008

The von Kármán Laboratory of Environmental Flow, Eötvös Loránd University has a long term experience in **large scale data validation** (i.e. the comparison of direct measurements with reanalysis meteorological fields).

They are also specialised in large scale study of **spreading of pollution** in reanalysis wind fields.

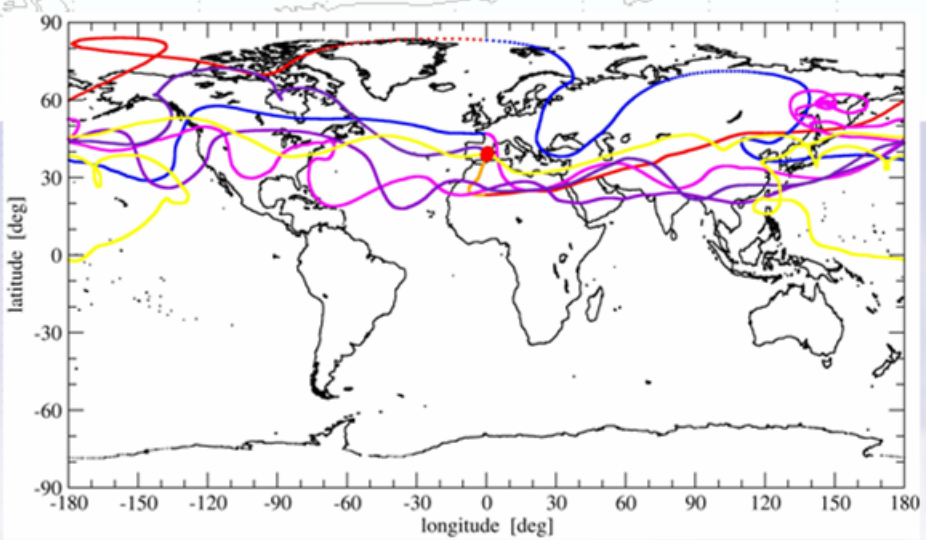

Geophysica RECONCILE flight 1 (2010.01.17.), ozone measurement (FOZAN instrument)
Copyright P. Kiss 2010
height [m]
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
82
80
78
76
74
72
70
68
66
latitude [deg North]
16
18
20
22
24
26
28
30
longitude [deg East]
2500
2000
1500
1000
500
0
ozone [ppbv]

ERA Interim advection, 500 hPa level, year 2000

day 10
hour 21

5000
757
114
17
2
0
pts./gridpt.

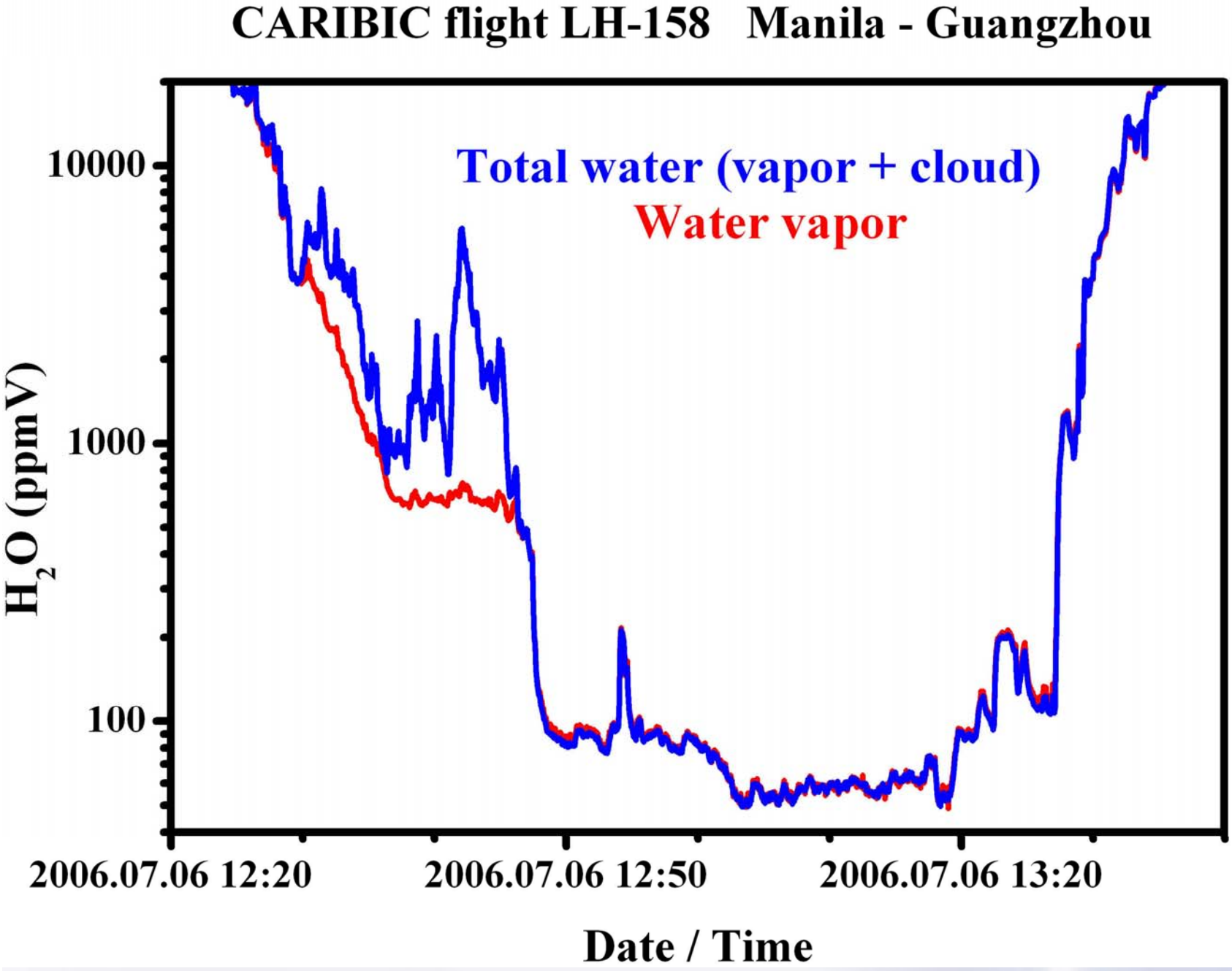
$$\frac{d\mathbf{r}}{dt} = \mathbf{v}[\mathbf{r}(t)]$$

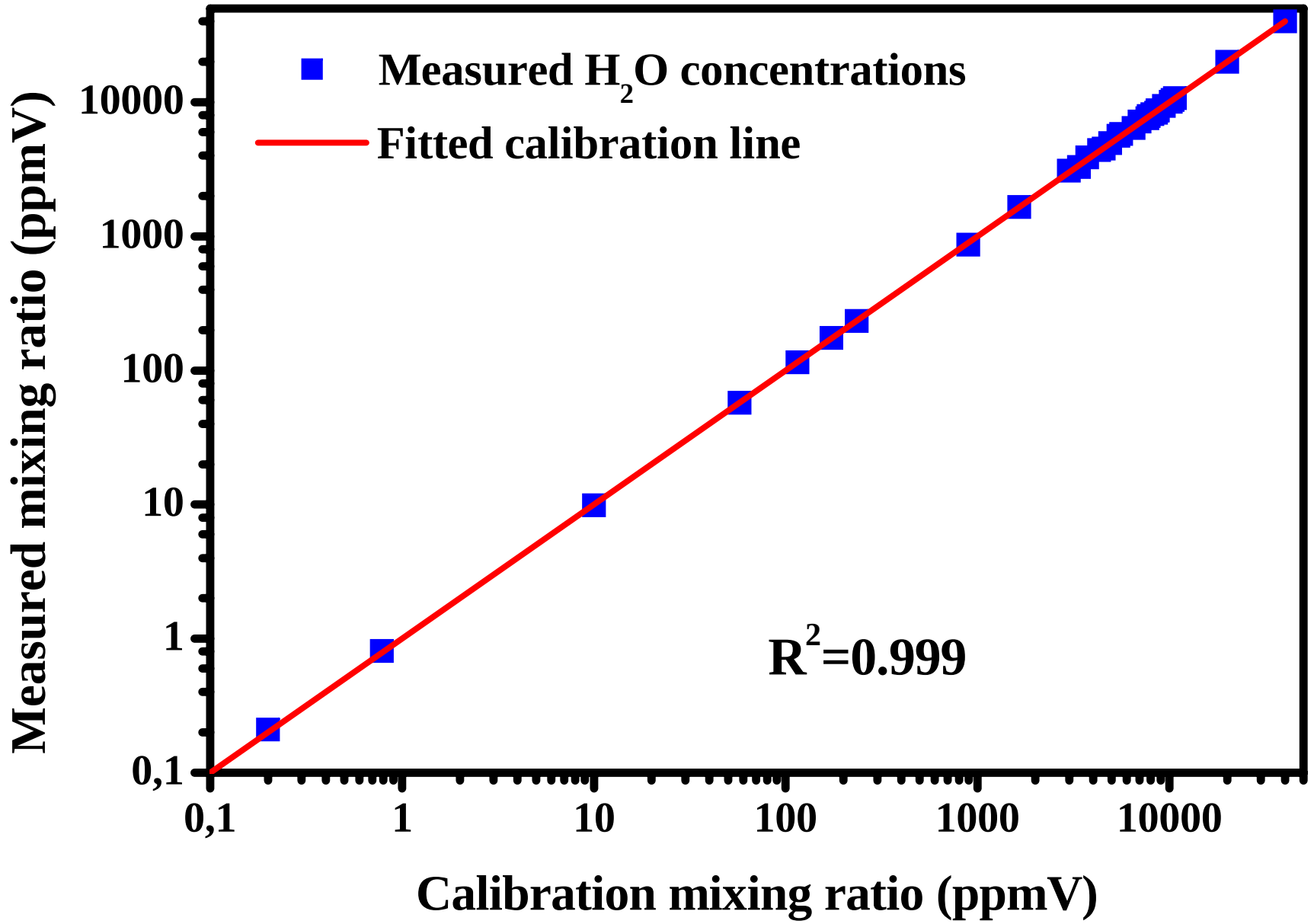


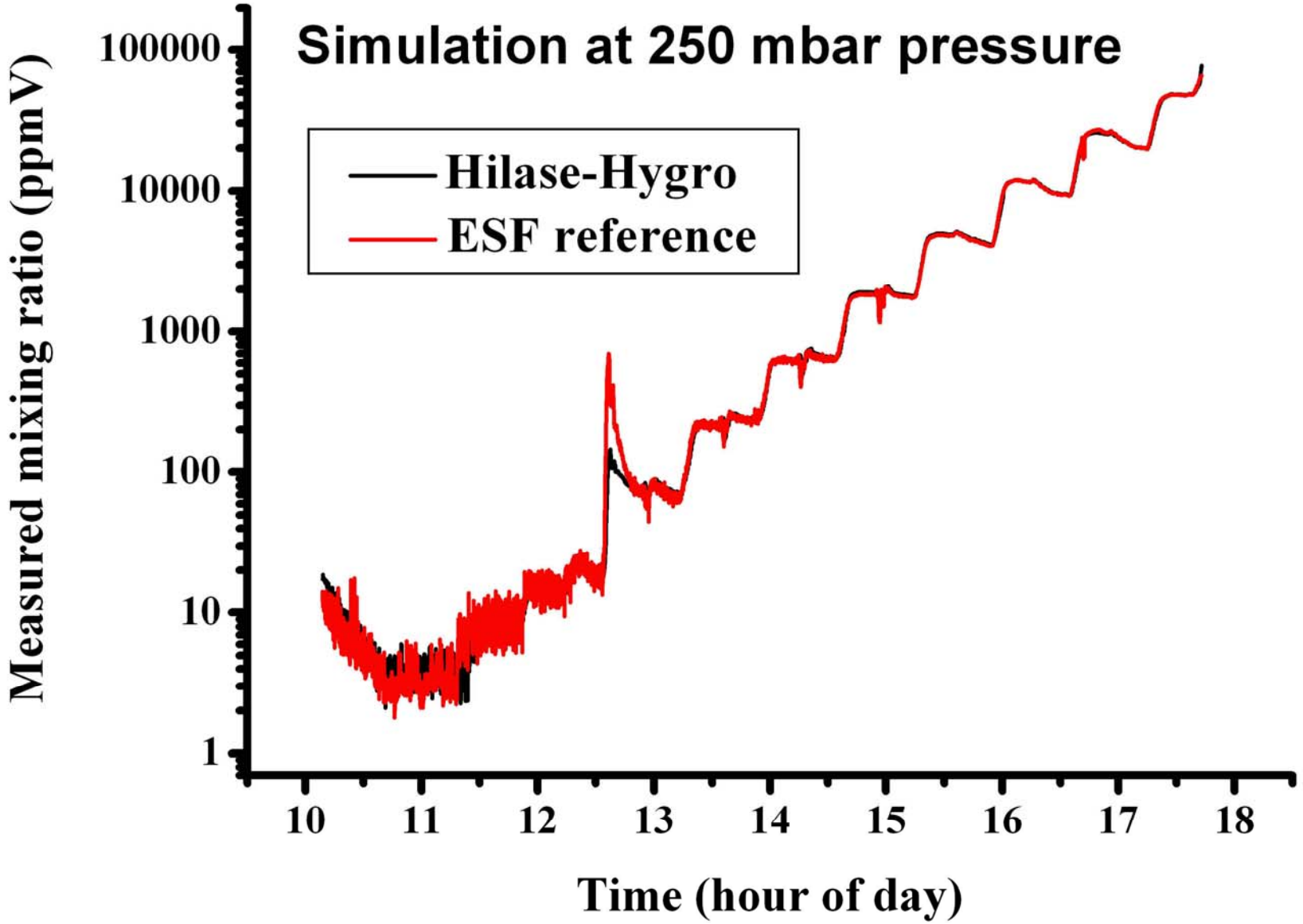
Péter Kiss, 2009

At the Department of Optics and Quantum Electronics, University of Szeged a diode laser based **water vapour and total water concentration measuring** photoacoustic **instrument (Hilase-Hygro)** was developed, which was tested in numerous atmospheric simulation experiments and in airborne applications too.

Measurement results with Hilase-Hygro


CARIBIC flight LH-158 Manila - Guangzhou
Total water (vapor + cloud)
Water vapor
10000
1000
100
H2O (ppmV)
2006.07.06 12:20
2006.07.06 12:50
2006.07.06 13:20
Date / Time


Measured H_2O concentrations
Fitted calibration line
R^2=0.999
Measured mixing ratio (ppmV)
Calibration mixing ratio (ppmV)
0,1
1
10
100
1000
10000


Simulation at 250 mbar pressure
Hilase-Hygro
ESF reference
Measured mixing ratio (ppmV)
100000
10000
1000
100
10
1
10
11
12
13
14
15
16
17
18
Time (hour of day)

Proposed contribution:

Investigating the possibility of improving the reliability of weather forecasts by assimilating water vapour (and total water) concentration data measured airborne by **Hilase-Hygro** diode laser based photoacoustic instruments.

Roles in the proposed work

University of Szeged develops and **operates the airborne photoacoustic instruments** for water vapour (and total water) concentration measurements.

Eötvös Loránd University **validates the measured data**.

Hungarian Meteorological Service **assimilates the measured data** into their numerical weather prediction models.

University of Pécs **improves numerical model** on the formation of the water drops.

Thank you for your attention!