Variability of IN measured with the Fast Ice Nucleus Chamber (FINCH) at the high altitude research station Jungfraujoch during wintertime 2013

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Introduction

Ice nuclei (IN) are an important component of the atmospheric aerosol. Despite their low number concentration in the atmosphere, they have an influence on the formation of ice crystals in mixed-phase clouds and therefore on precipitation. By changing the IN number-concentration, cloud parameters such as lifetime and droplet density may change, which may cause changes in the global radiation budget.

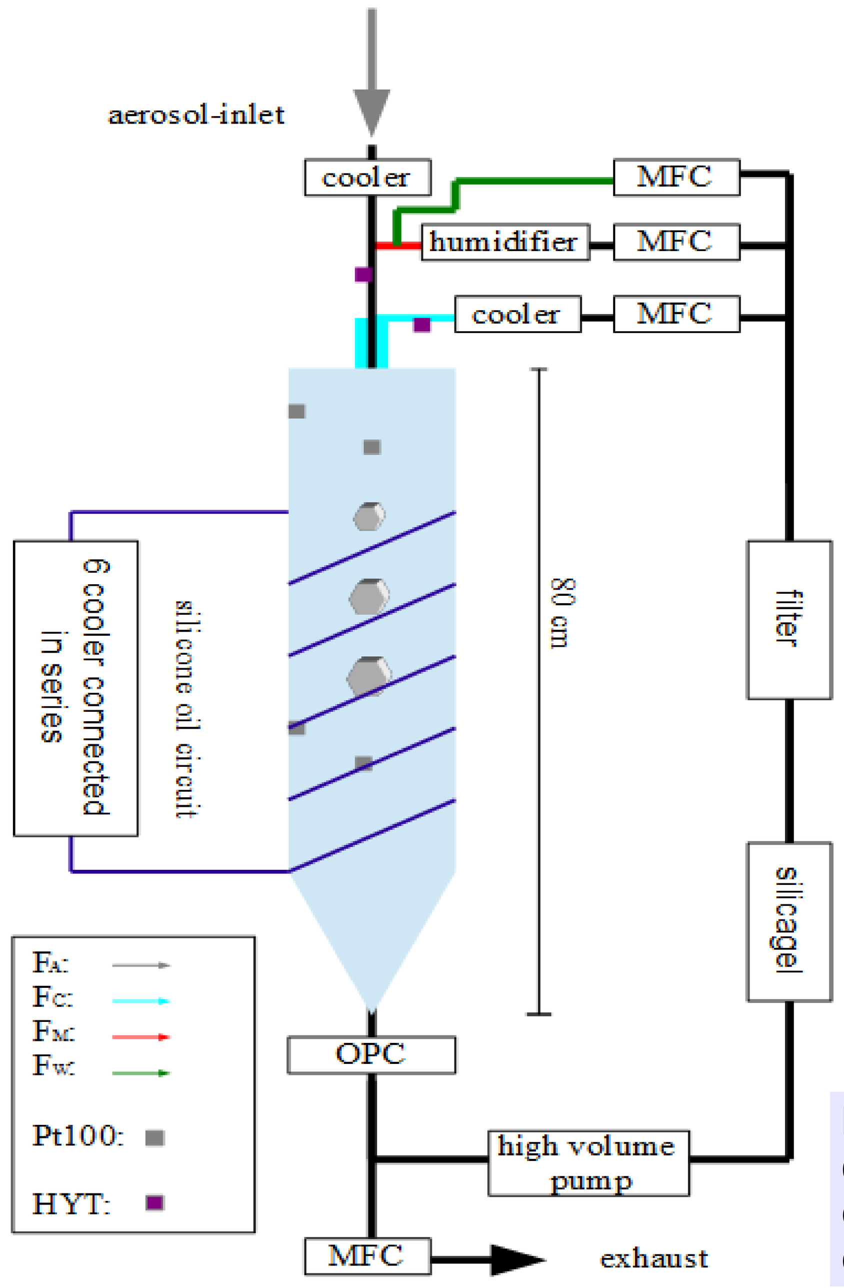


Figure 1: Schematic flow diagram of the FINCH IN-counter (the growth chamber in light blue).

Aim of this work was the determination of the IN number concentration with the IN counter FINCH[1] (Fast Ice Nucleus Chamber) during the measurement campaign INUIT-JFJ 2013. Supersaturation of the sample air and thus activation of the aerosols is achieved by mixing air flows with different temperature and humidity. At the end of a growth chamber the particles are classified and evaluated by an optical detection, the BIO-IN OPC[2], based on scattering properties (Fig. 1). On the basis of fluorescence measurements it is also possible to specify a biological origin of the particles with this device.

Measurements

The presented data were measured during the campaign INUIT-JFJ 2013 (21.01. to 25.02.2013) on the high altitude research station "Jungfraujoch" (3571 m amsl). FINCH was connected to a total aerosol inlet and sampled approx. 2.25 sl min^{-1} aerosol flow. Supersaturation ratio and temperature were varied during the campaign. Most of the time it was measured under water supersaturated conditions to achieve better results in the coupling via ice-CVI with a mass spectrometer (see EGU2014-4967).

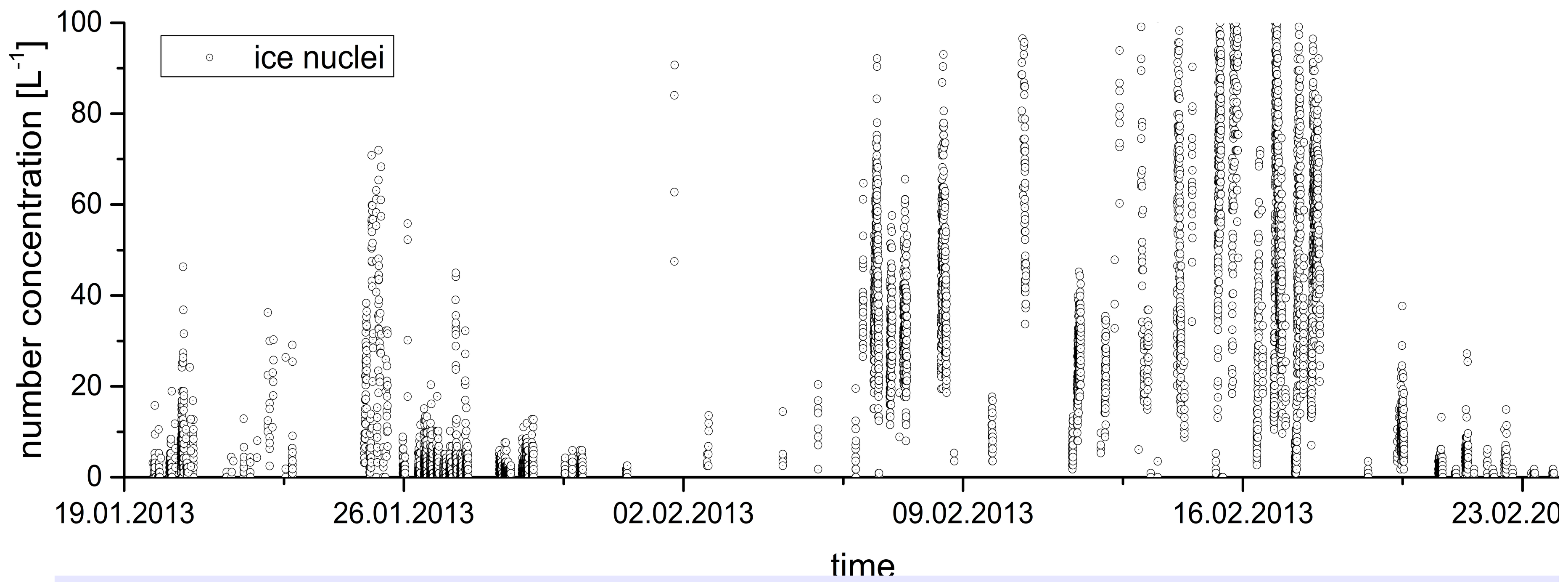


Figure 2: Course of the IN concentration [IN per standard liters] over the entire measurement period of INUIT-JFJ 2013. Shown are filtered data points at which an ice saturation of 1.3 ± 0.1 and a temperature of -23 ± 1 °C were prevailing.

Table 1: Statistical parameters of the IN distribution.

	Total counts	Average [L^{-1}]	Median (Q3 – Q1) [L^{-1}]
IN	270 000	28	8.2 (42 – 0.8)
Bio-IN	1 600	0.2	0 (0 - 0)

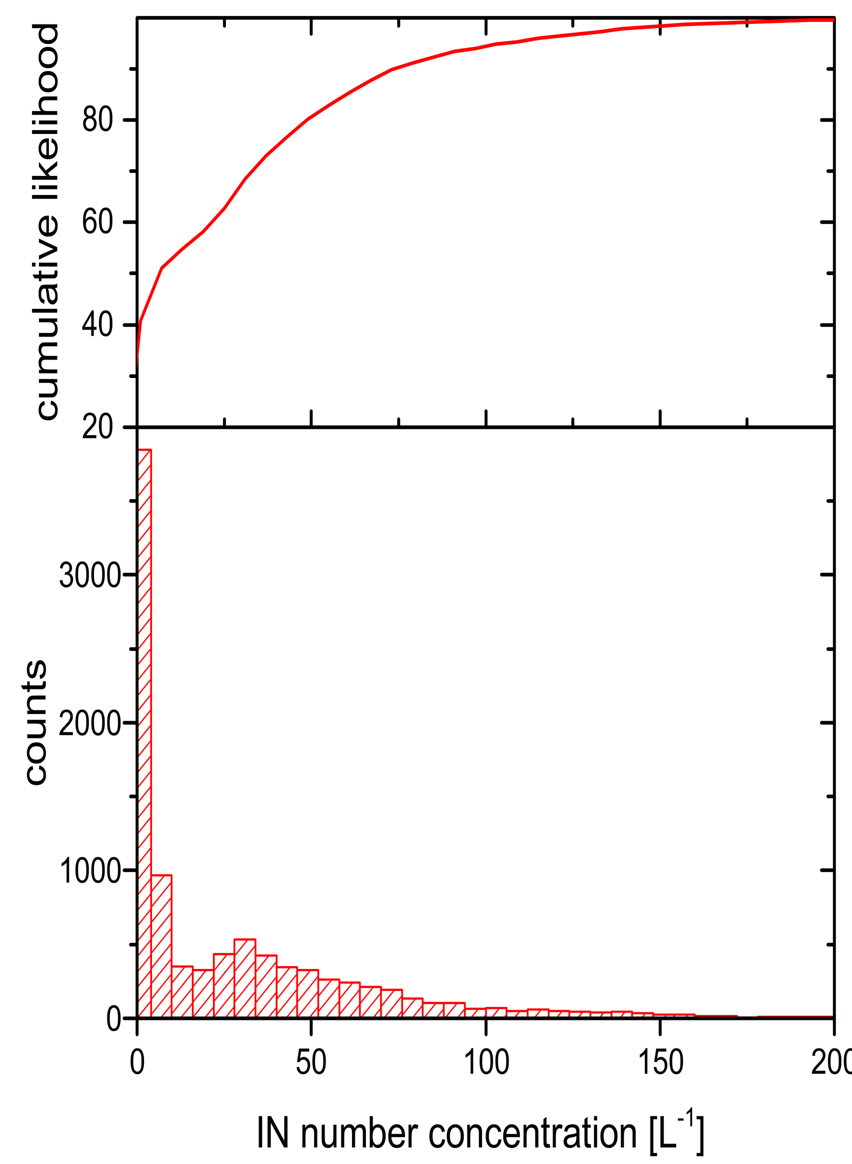
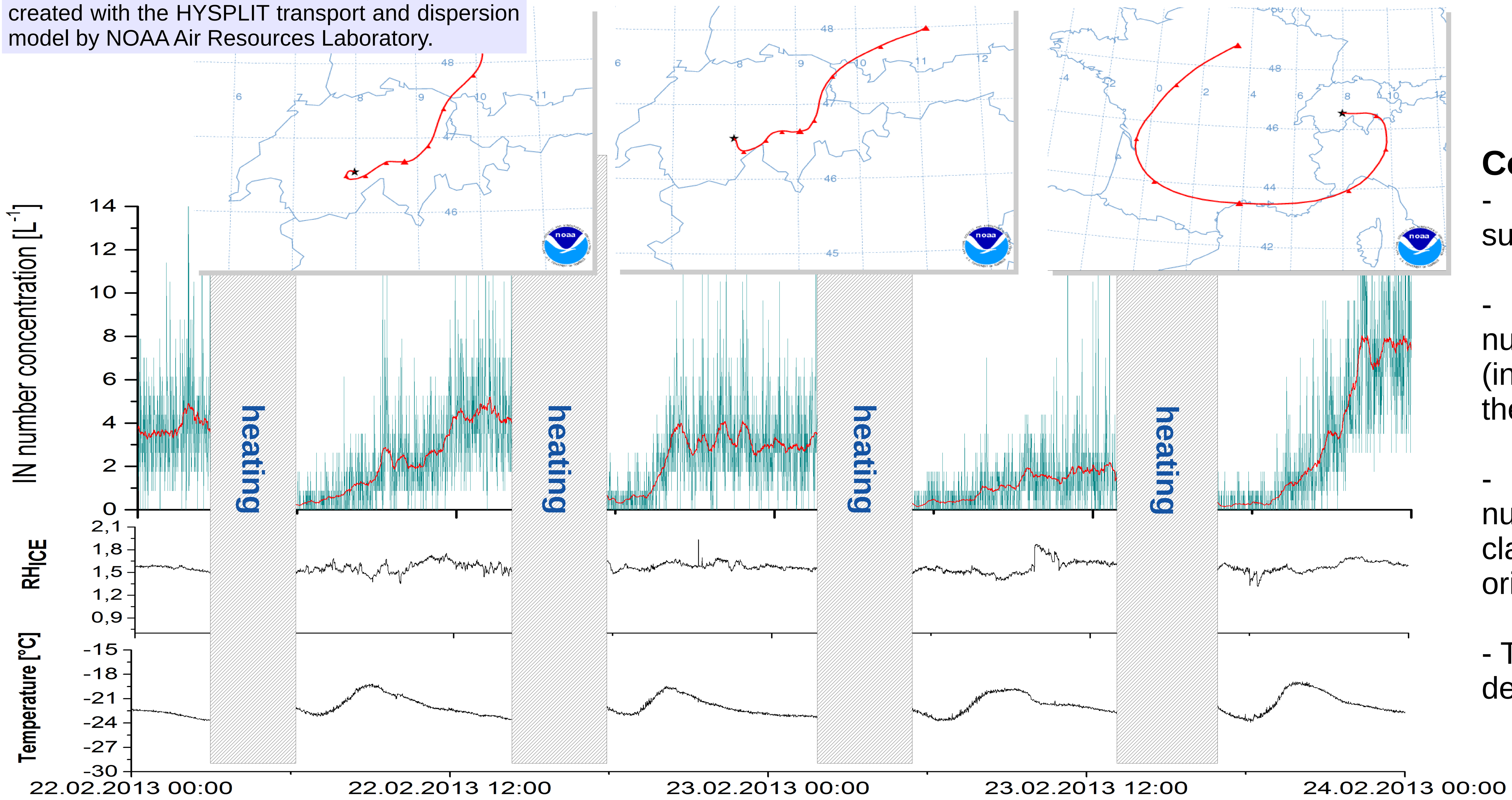


Figure 3: Histogram and cumulative likelihood of the IN number distribution.

Figure 4: Example of the long and continuous measurements with FINCH. Trajectories were created with the HYSPLIT transport and dispersion model by NOAA Air Resources Laboratory.



Conclusions

- up to 10 hours nonstop measurements without heating

- The median value of the IN number concentration was **8.2 L^{-1}** (interquartile distance of 41.2) over the entire campaign (Fig. 2).

- 0.7% of the measured ice nucleating particles could be classified as IN with an biological origin (Table 1).

- The IN number concentration may depend on air mass origin (Fig. 4).

Literature:
[1] - U. Bundke, B. Nillius, R. Jaenicke, T. Wetter, H. Klein, H. Bingemer: *„The fast Ice Nucleus chamber FINCH“ Atmos. Res.*, 90 (2008) 180-186
[2] - U. Bundke, B. Reimann, B. Nillius, R. Jaenicke, H. Bingemer: *„Development of a Bioaerosol single particle detector (BIO-IN) for the Fast Ice Nucleus Chamber FINCH“ Atmos. Meas. Tech.*, 3 (2010) 263-271

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