Ongoing Brazilian research: Rainwater composition

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Introduction

Anthropogenic activities related with occupation and uses of great areas in Amazonia are characterized by the withdrawal of the native forest by logging and burning of the vegetation.

Forest fires are the source of smoke particle concentration in the atmosphere, originating acid rain, so as the increase of dissolved substances in the rain water.
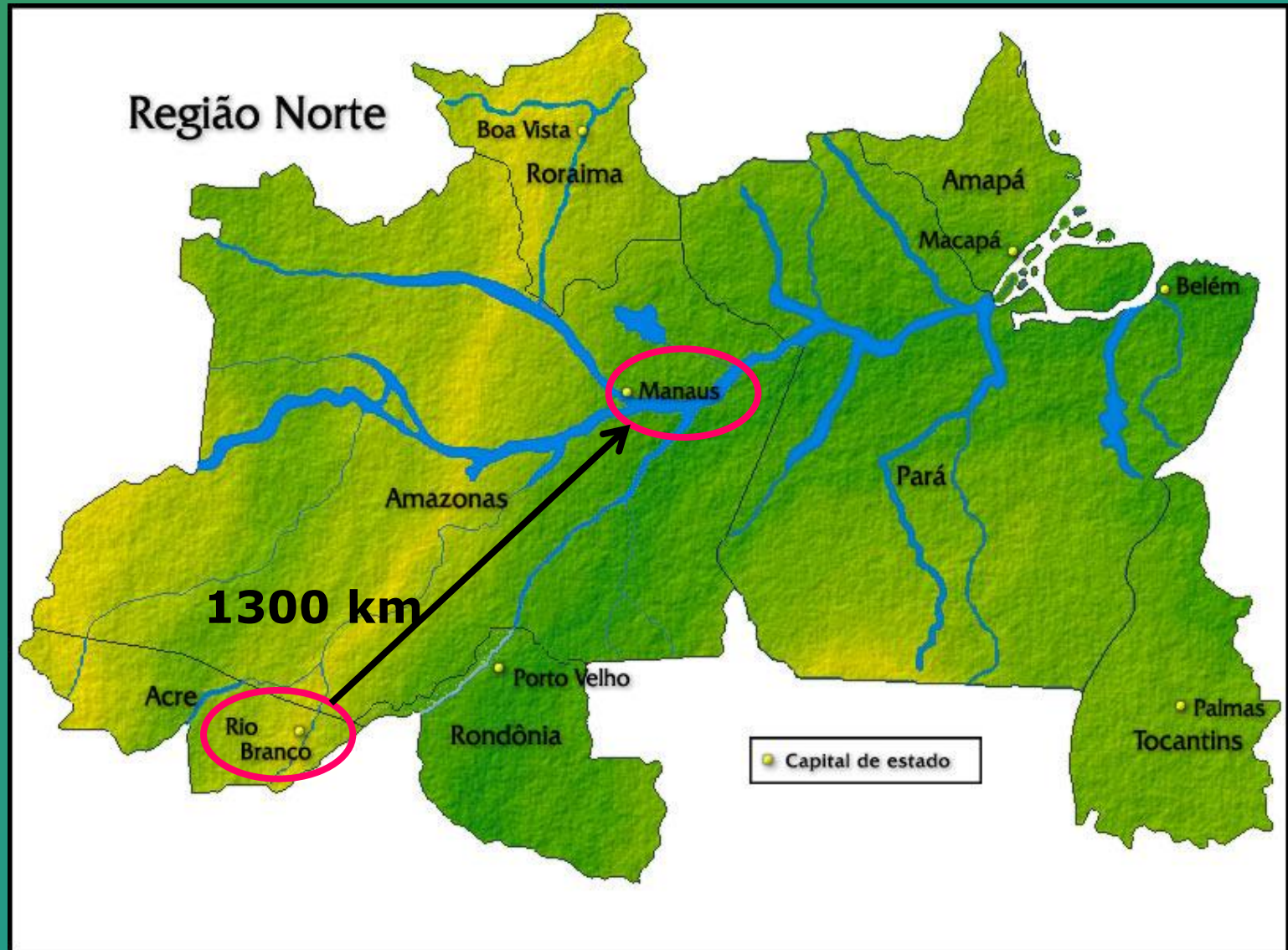
Objectives

◆ To determine the chemical composition of rainwater samples:

  – Total organic carbon (TOC)
  – Water-soluble ions (Ace, For, Cl^-, NO_3^-, SO_4^{2-}, NH_4^+, Ca^{2+}, Mg^{2+}, K^+, Na^+)
  – Trace elements

◆ To identify main sources of the species found

◆ To observe trends and anthropogenic influences

Sampling Sites

Sampling

Rio Branco sampler:
Eigenbrodt NSA 181 / KD
2005-2010
N = 200 samples

Manaus sampler:
AEROCHEM METRICS
2008-2010
N = 160 samples

Analyses

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                          │    Rainwater    │
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│      pH       │ │  Trace metals   │ │      Ions       │ │      TOC        │
│Conductivimetry│ │     (HNO3)      │ │    (Thymol)     │ │     (HgCl2)     │
│               │ │     ICP OES     │ │Ion Chromatography│ │  TOC Shimadzu   │
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Results: Precipitation distribution

Wet season - October to April

Maximum - 109 mm

Mean - 20 ± 19 mm

	Annual (mm)	Mean (mm)
2005 (n=20)	262	12
2006 (n=6)	83	14
2007 (n=40)	974	24
2008 (n=42)	993	23
2009 (n=47)	759	16
2010 (n=31)	661	21

Precipitation - Rio Branco - 2005-2010
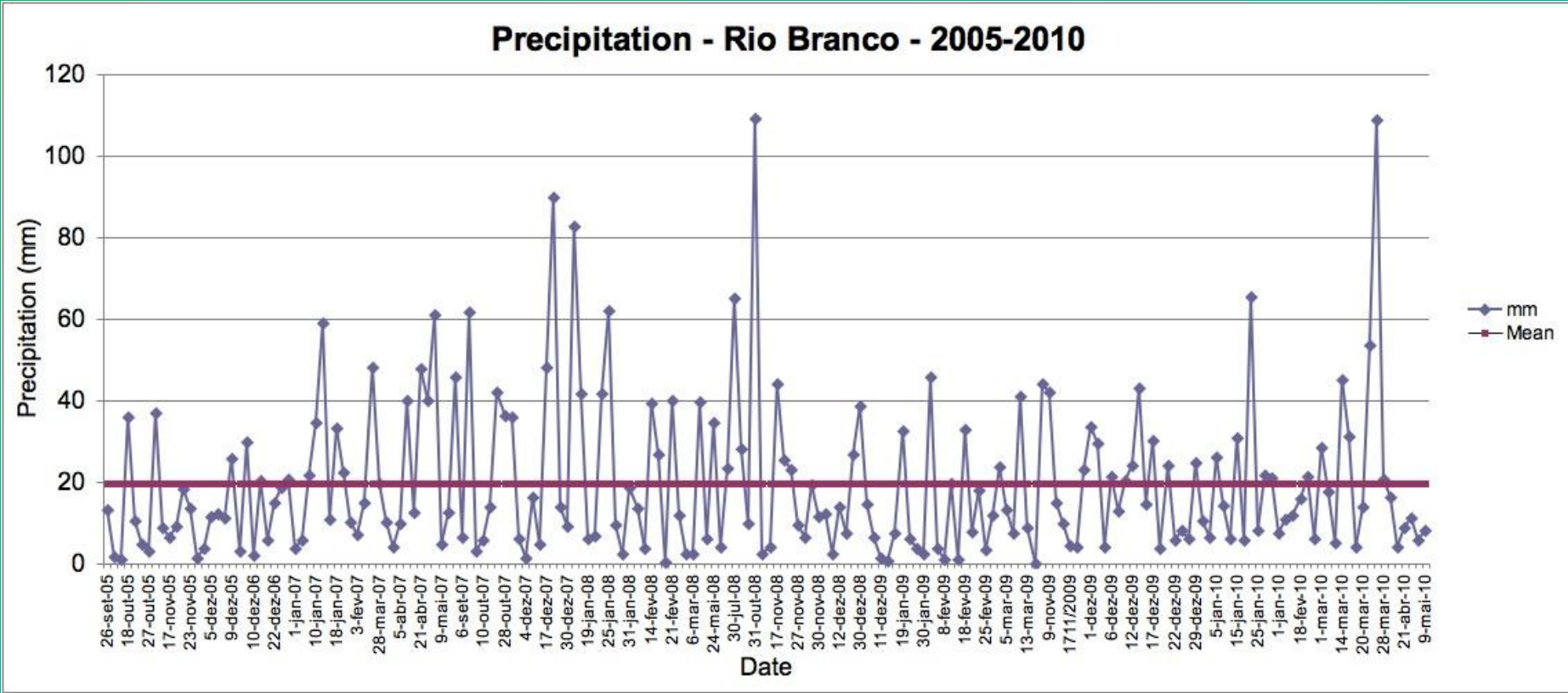
Results: Precipitation distribution

Wet season - October to May

Maximum - 170 mm

Mean - 31 $\pm$ 29 mm

	Annual (mm)	Mean (mm)
2008 (n=61)	1716	28
2009 (n=54)	1853	31
2010 (n=19)	679	31

Precipitation - Manaus - 2008-2010

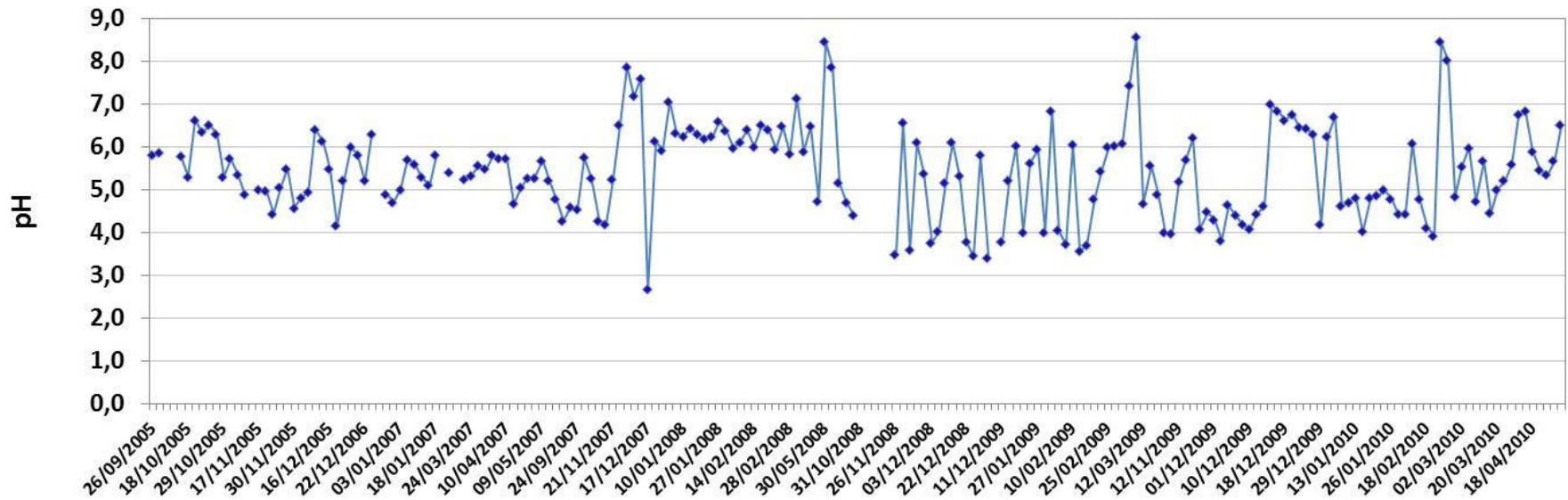# Results: Precipitation distribution
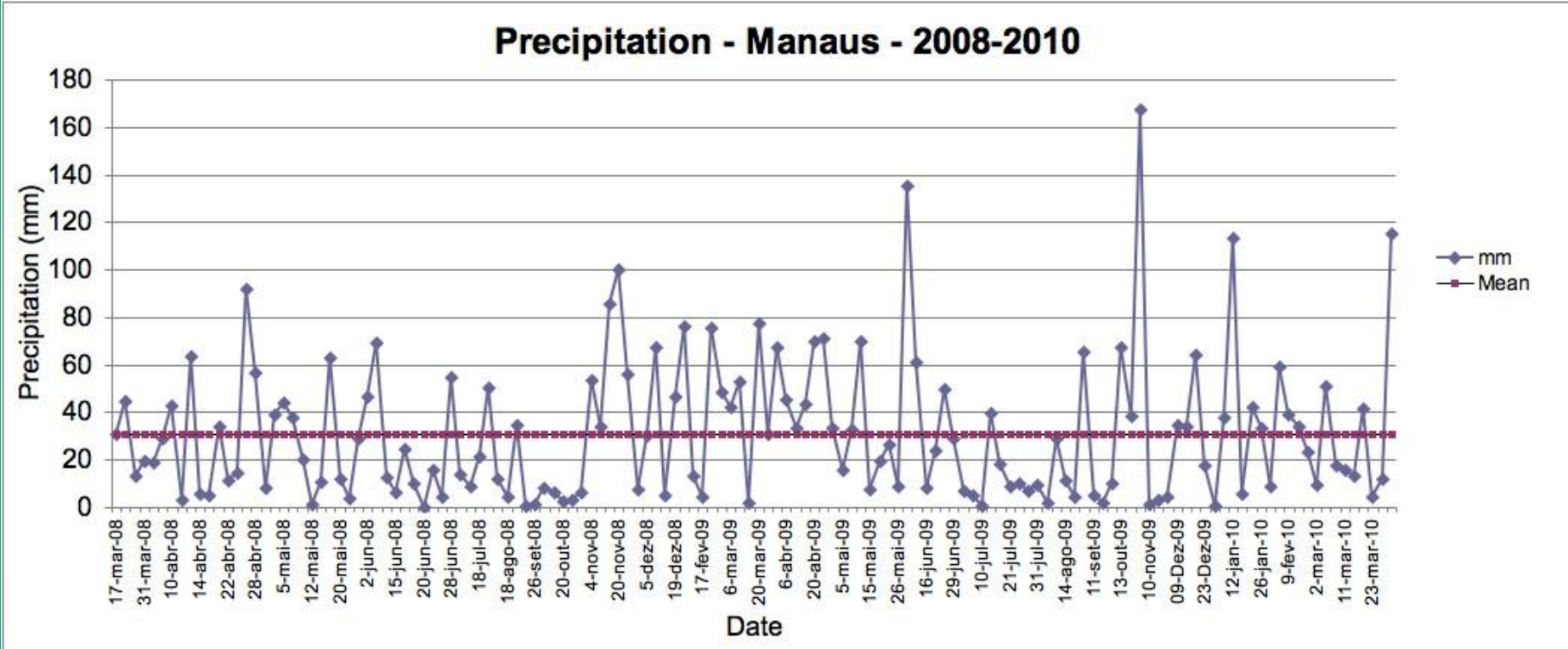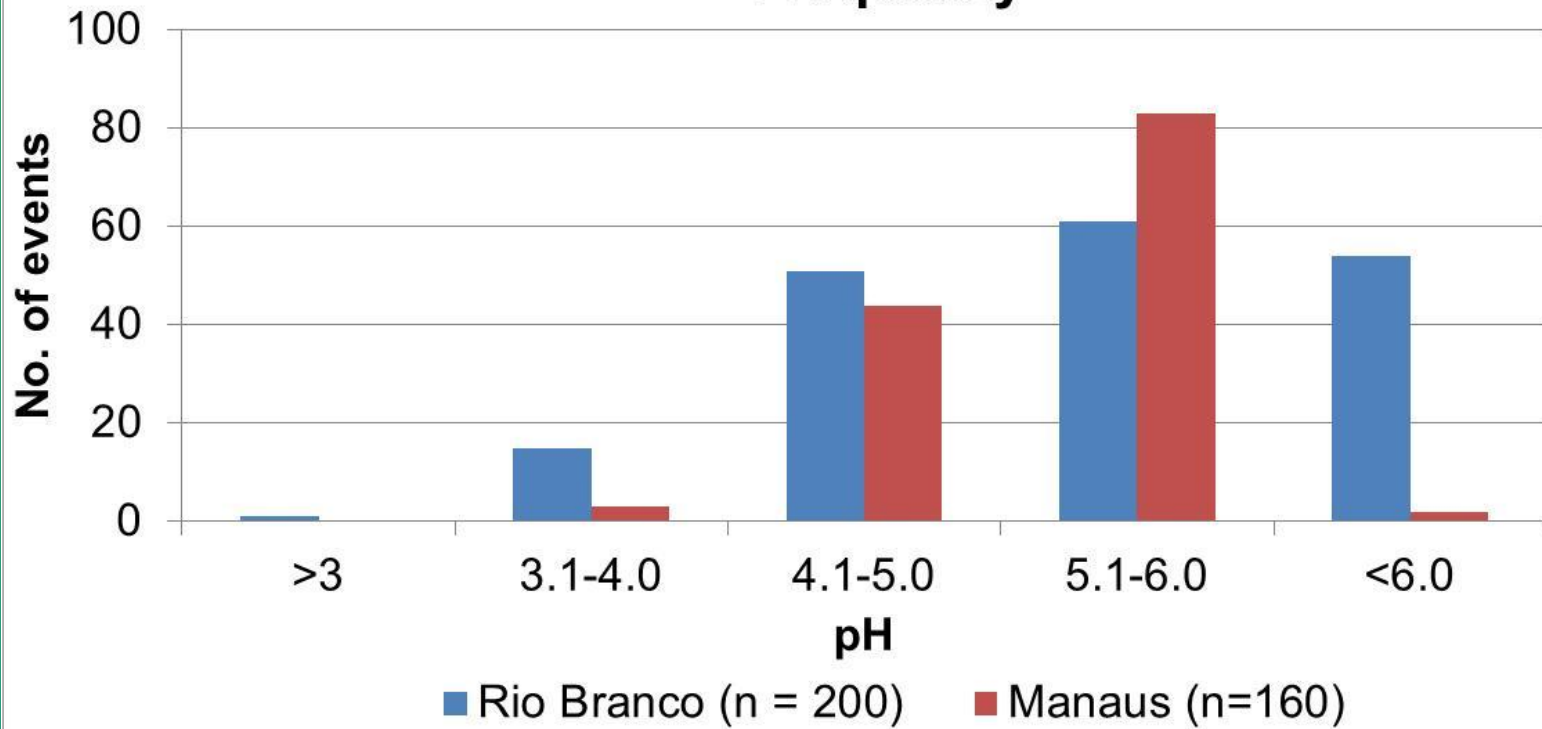

Frequency

Rio Branco (n = 200)   Manaus (n=160)
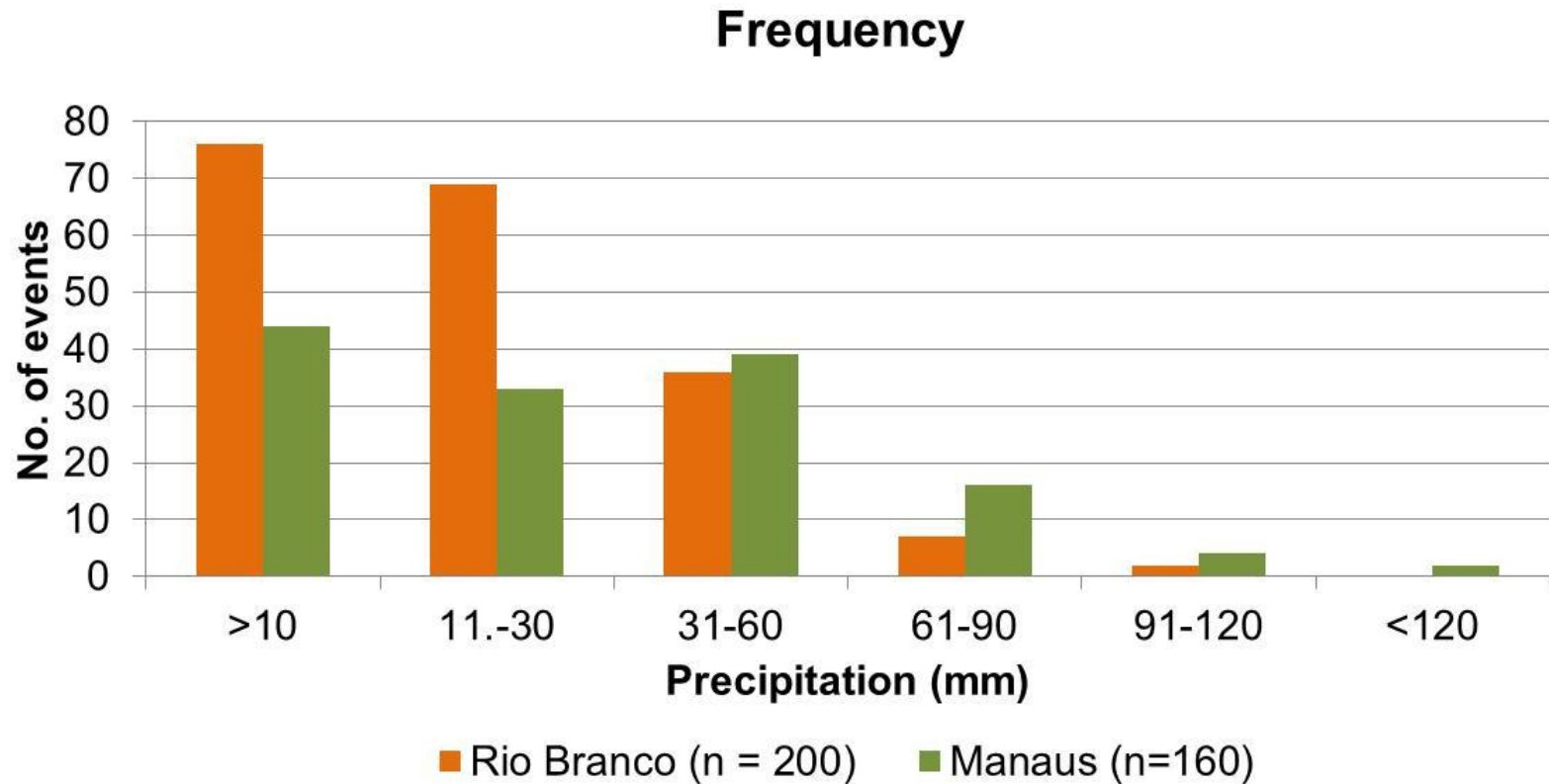
Results: pH

pH - Manaus

pH - Rio Branco

Results: pH

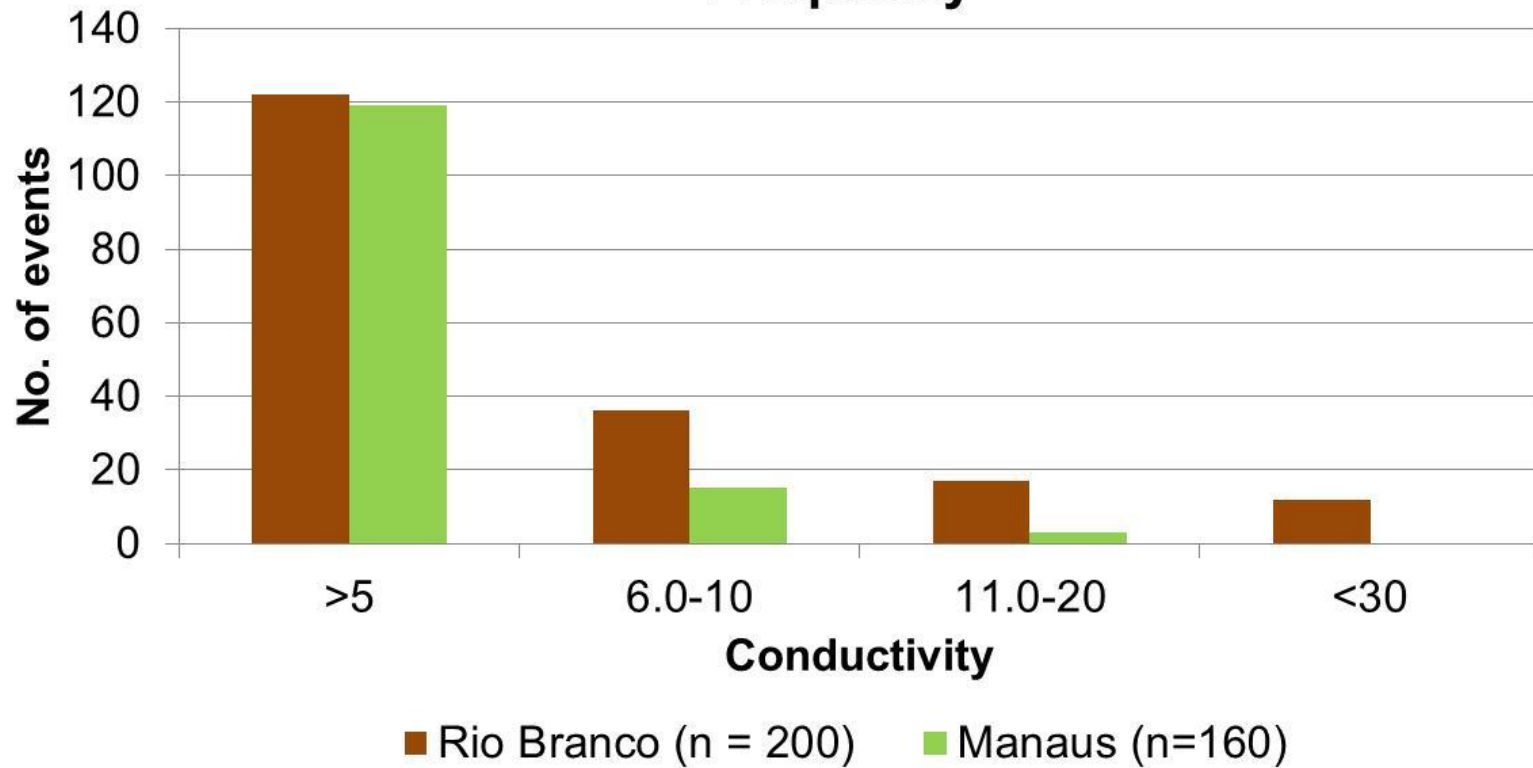# Results: Conductivity

Conductivity - Manaus
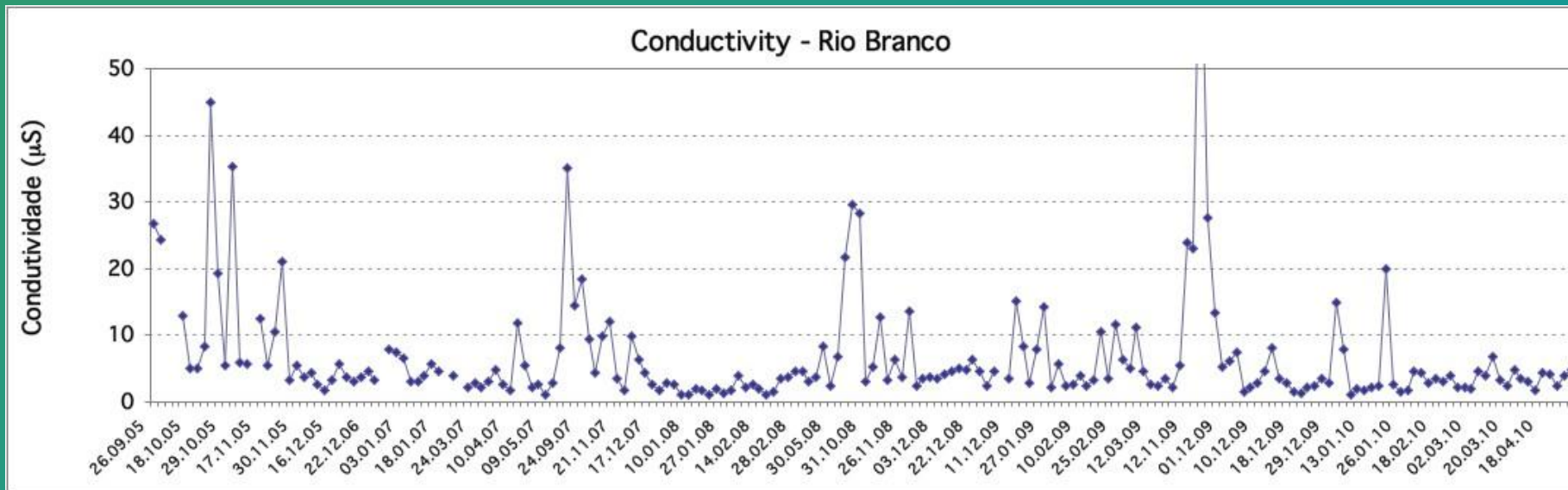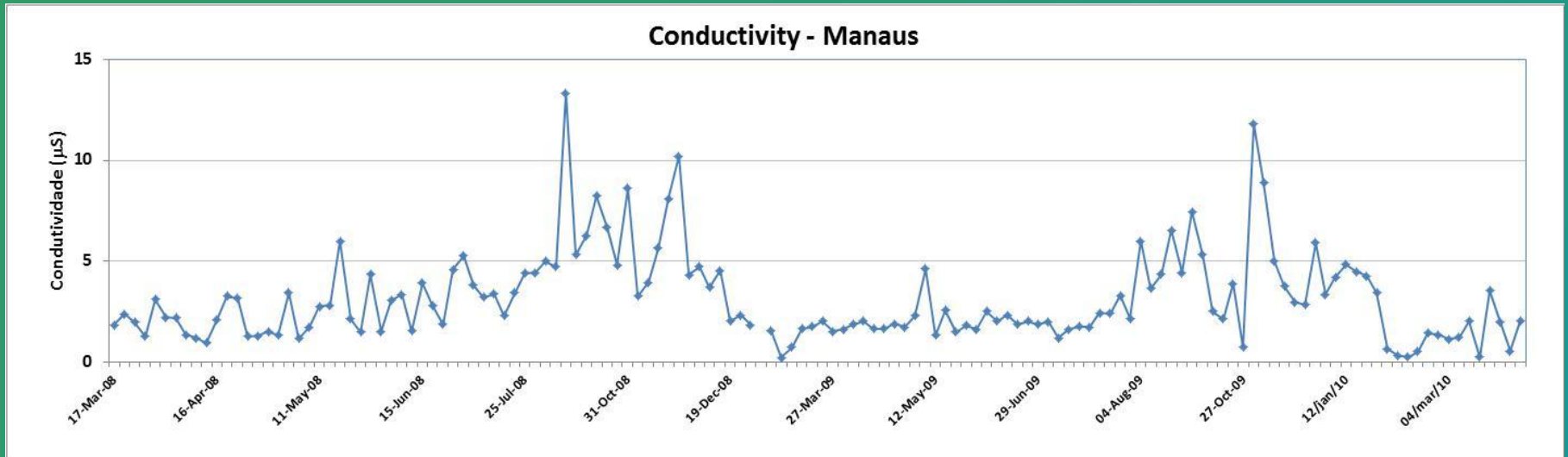
Conductivity - Rio Branco
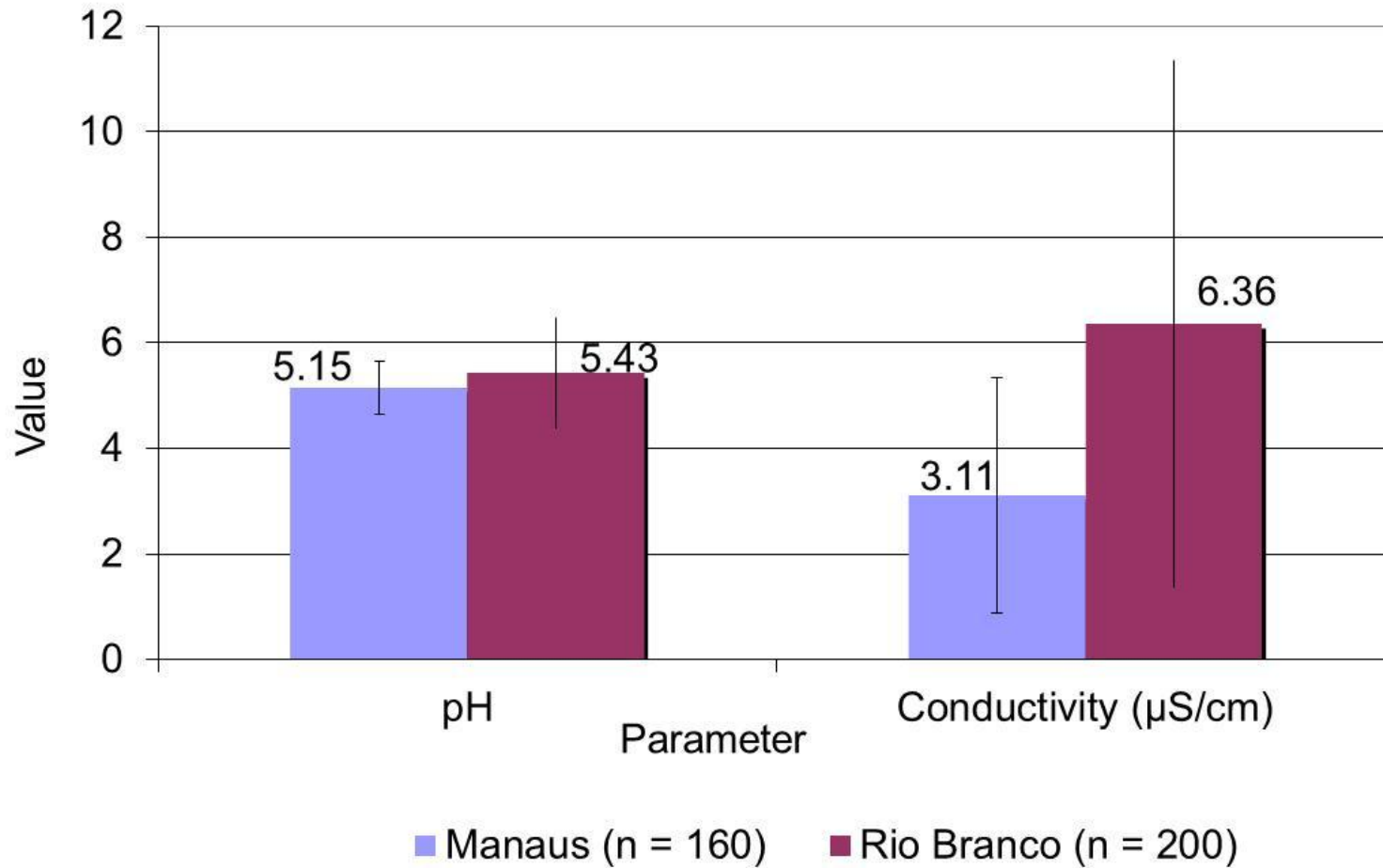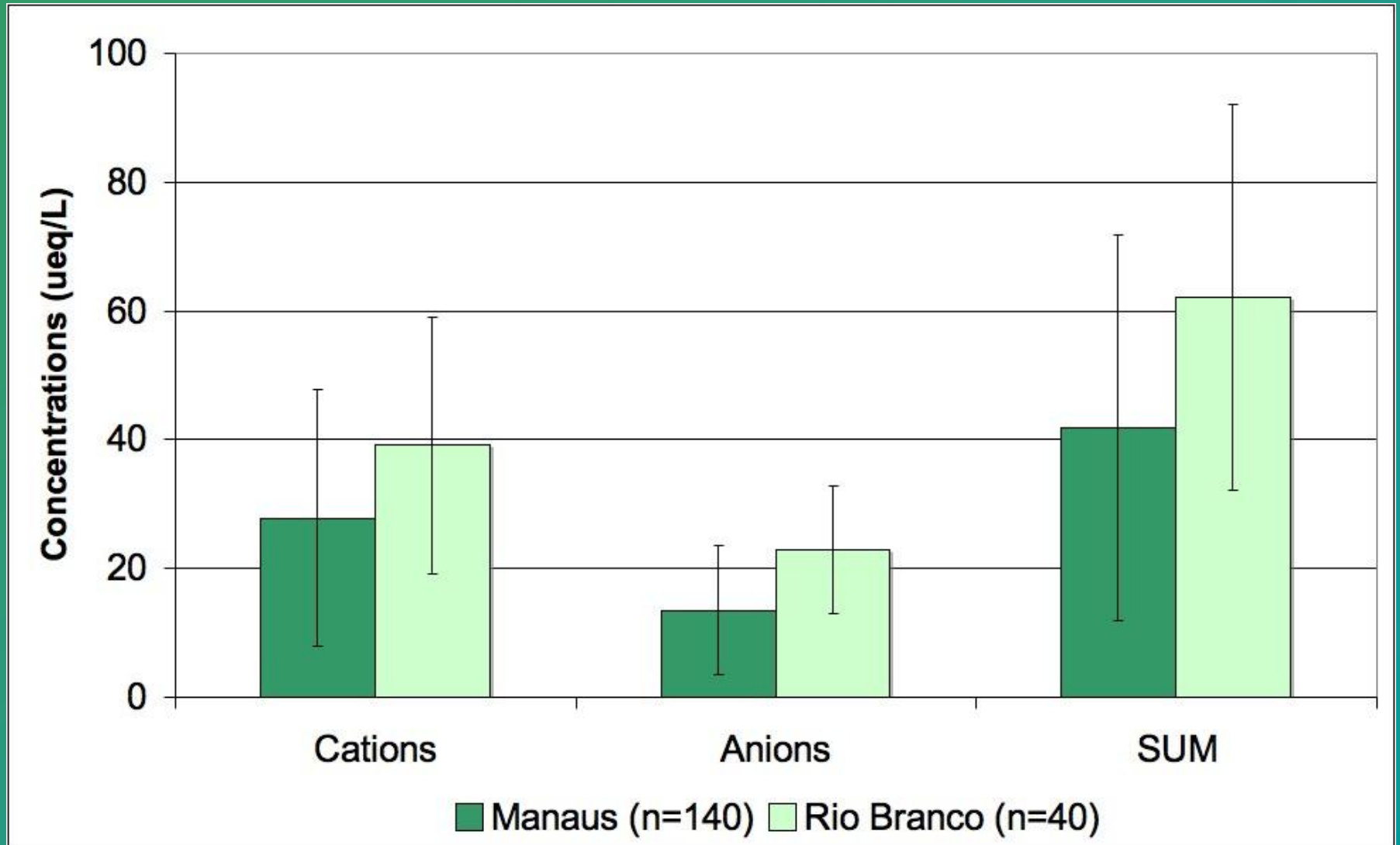
Results: Conductivity

Results: pH and Conductivity

Results: Ionic balance

Results: Ionic composition

Manaus (n=160)
- Na+ 21%
- Mg2+ 4%
- K+ 6%
- Ca2+ 6%
- NH4+ 18%
- CH3COO- 4%
- HCOO- 3%
- Cl- 18%
- NO3- 14%
- SO42- 6%

Rio Branco (n=40)
- SO42- 11%
- NO3- 12%
- Na+ 11%
- Mg2+ 3%
- K+ 6%
- Ca2+ 8%
- NH4+ 26%
- CH3COO- 7%
- HCOO- 10%
- Cl- 6%
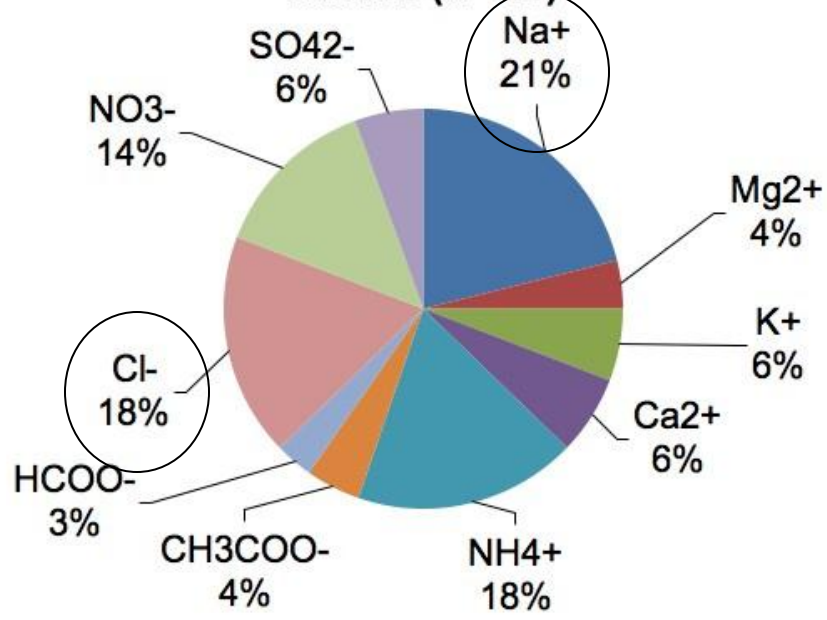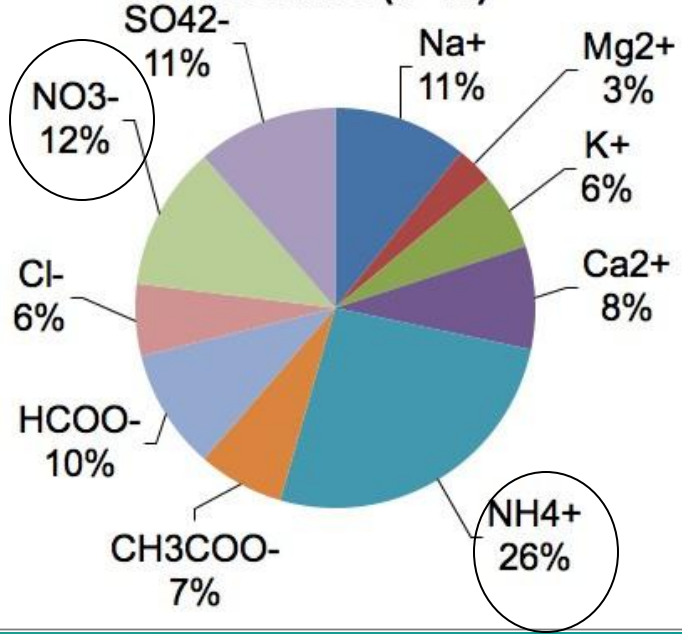
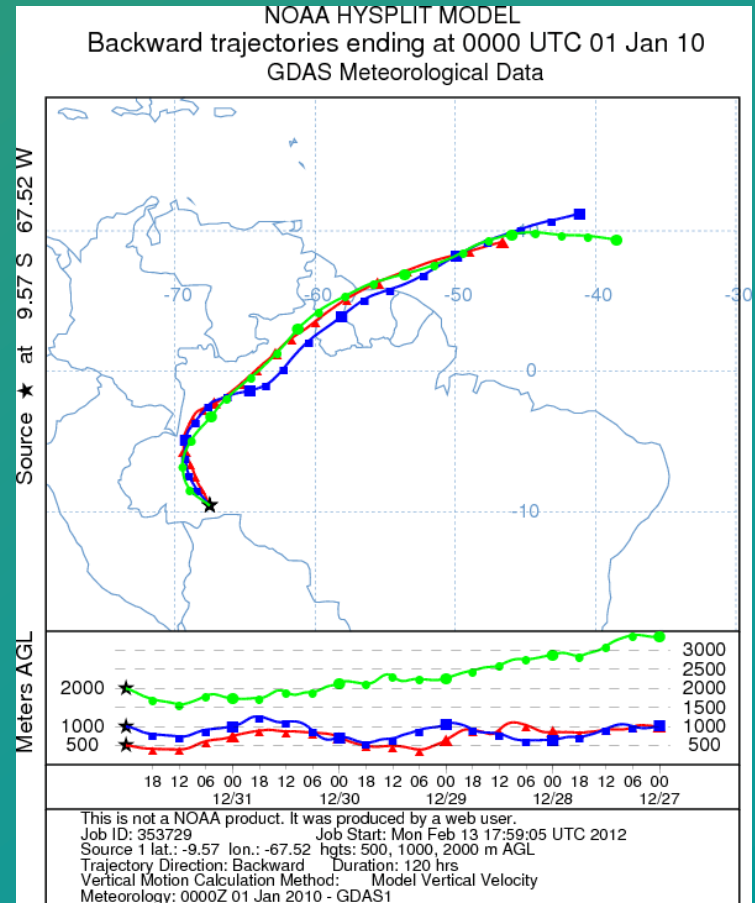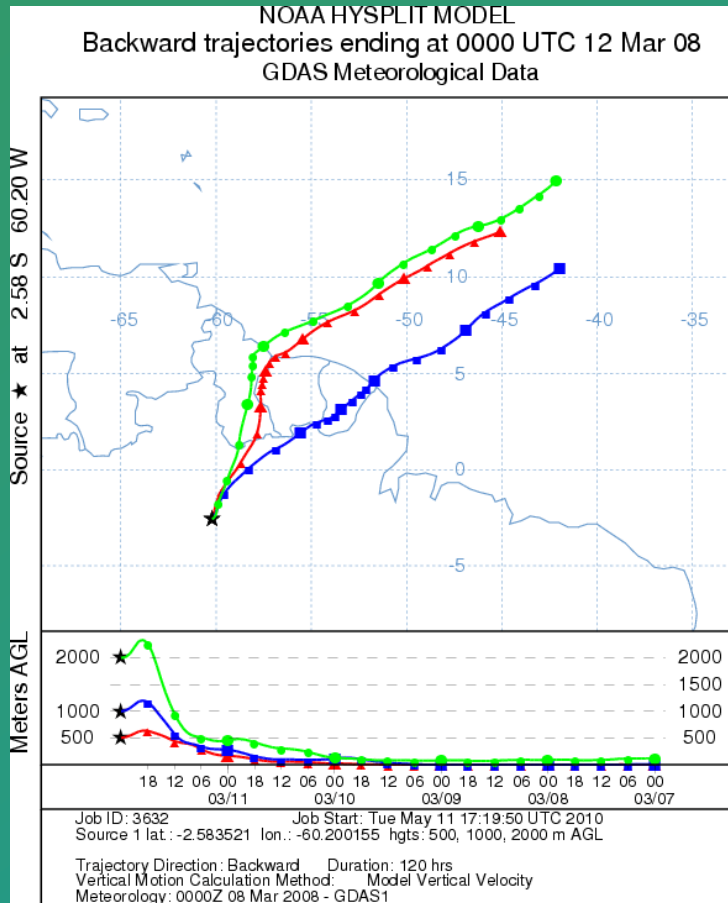# Results: Concentrations of ionic species
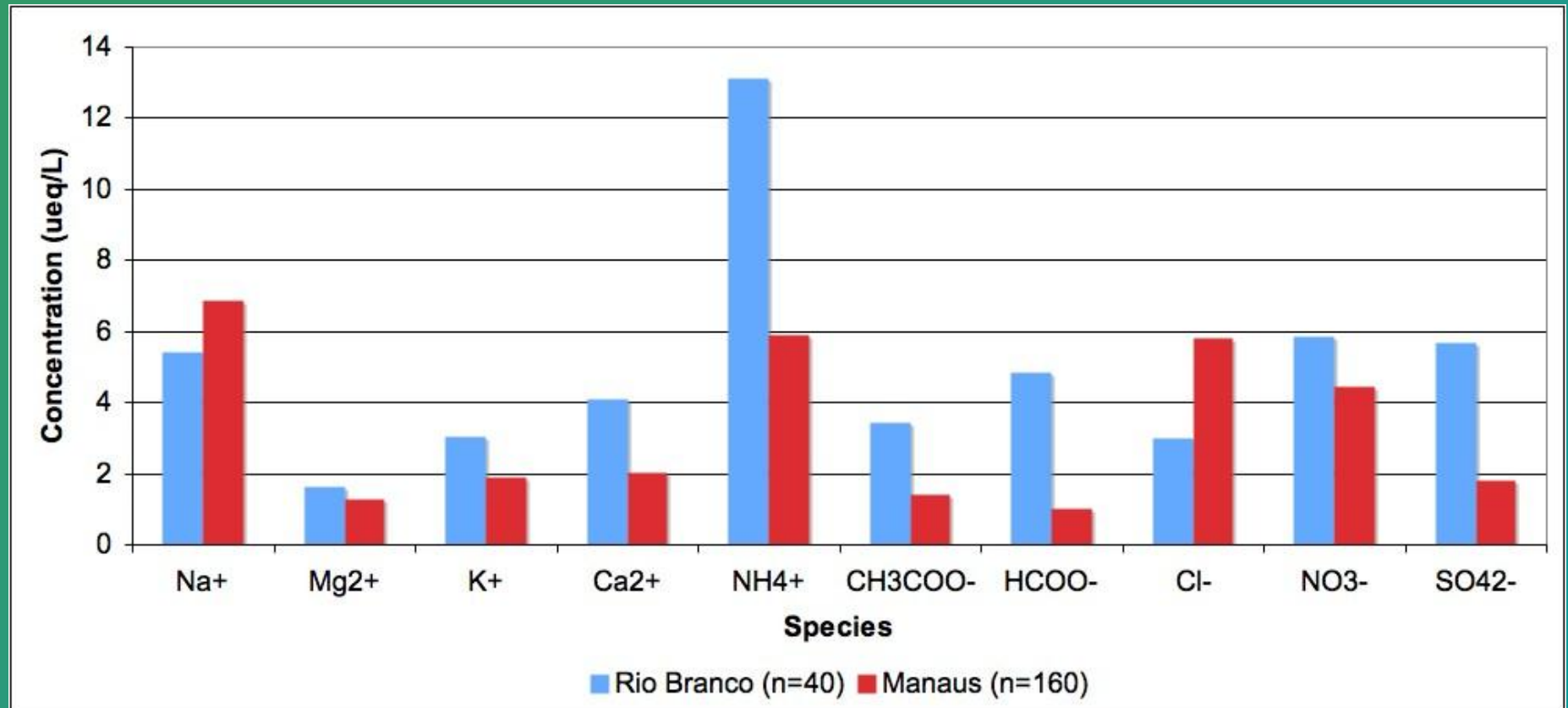
Results: Ionic composition and air masses

Manaus
Sea salt-K+ = 10%
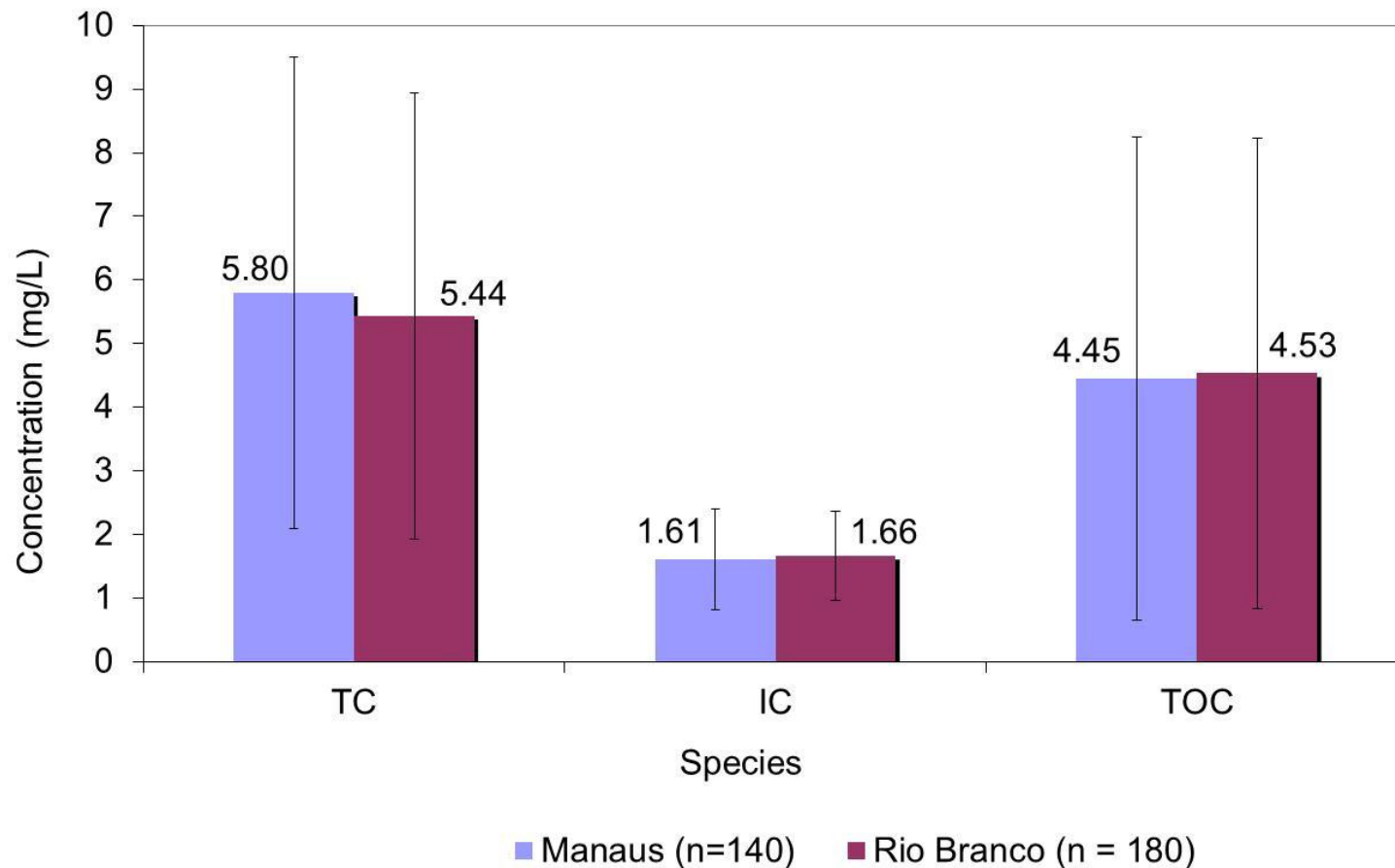Sea salt- SO4 = 51%
Sea salt Ca++ = 23%
Sea salt- Mg++ = 73%

Rio Branco
Sea salt-K+ = 4%
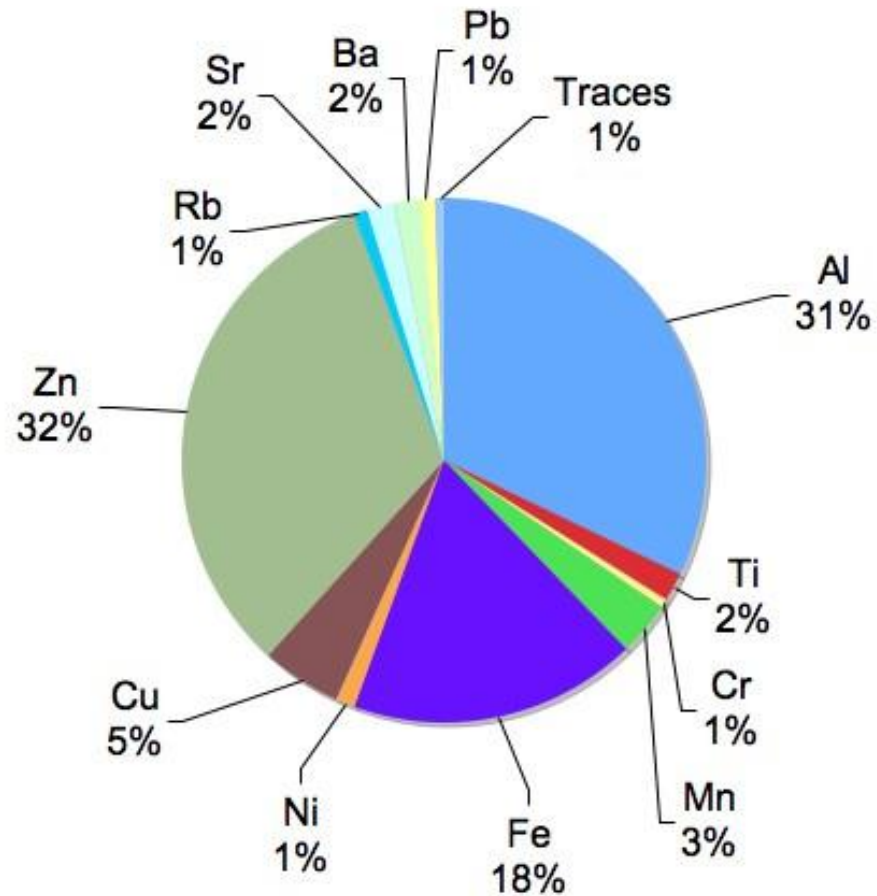Sea salt- SO4 = 6%
Sea salt Ca++ = 6%
Sea salt- Mg++ = 8%

Results: Water-soluble carbon

TOC/TC = 77 to 83%

Results: Trace metals

Trace metals - Manaus

Al 31%
Zn 32%
Fe 18%
Cu 5%
Mn 3%
Sr 2%
Ba 2%
Ti 2%
Pb 1%
Traces 1%
Rb 1%
Cr 1%
Ni 1%

Summary

- No significant trends for rainfall, pH and conductivity was observed.

- Higher volume of precipitation was measured in Manaus.

- Average pH values (5.2-5.4) were similar between sites - similar to remote sites (5.6).

- Conductivity was higher in Rio Branco as well as ionic species concentrations.

- TOC concentrations were similar between sites and representing about 80% of water-soluble species measured.

- The predominant species in Rio Branco were NO_3^- and NH_4^+; in Manaus Cl- and Na^+ as well as Fe, Al and Zn.

Future outlook

◆ Rainwater samples are being collected at both sites.

◆ New analyzes will be performed with samples from 2010.

◆ A scientific paper is being prepared with these data.

Thanks for listening!