

Wetlands of the Brazilian Amazon: extent and recent issues and concerns on their protection

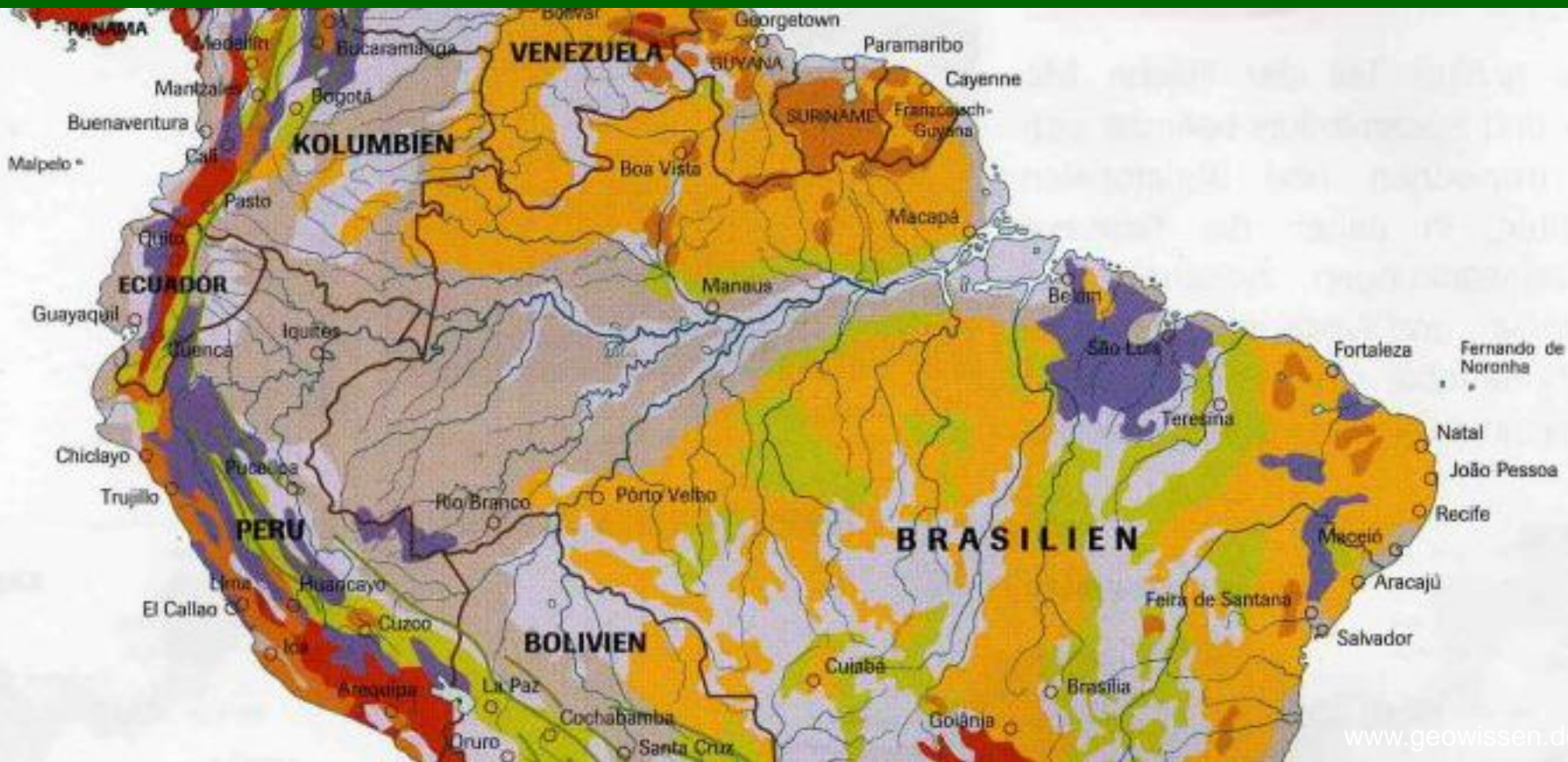
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Pre-cambrian (> 600 M years)



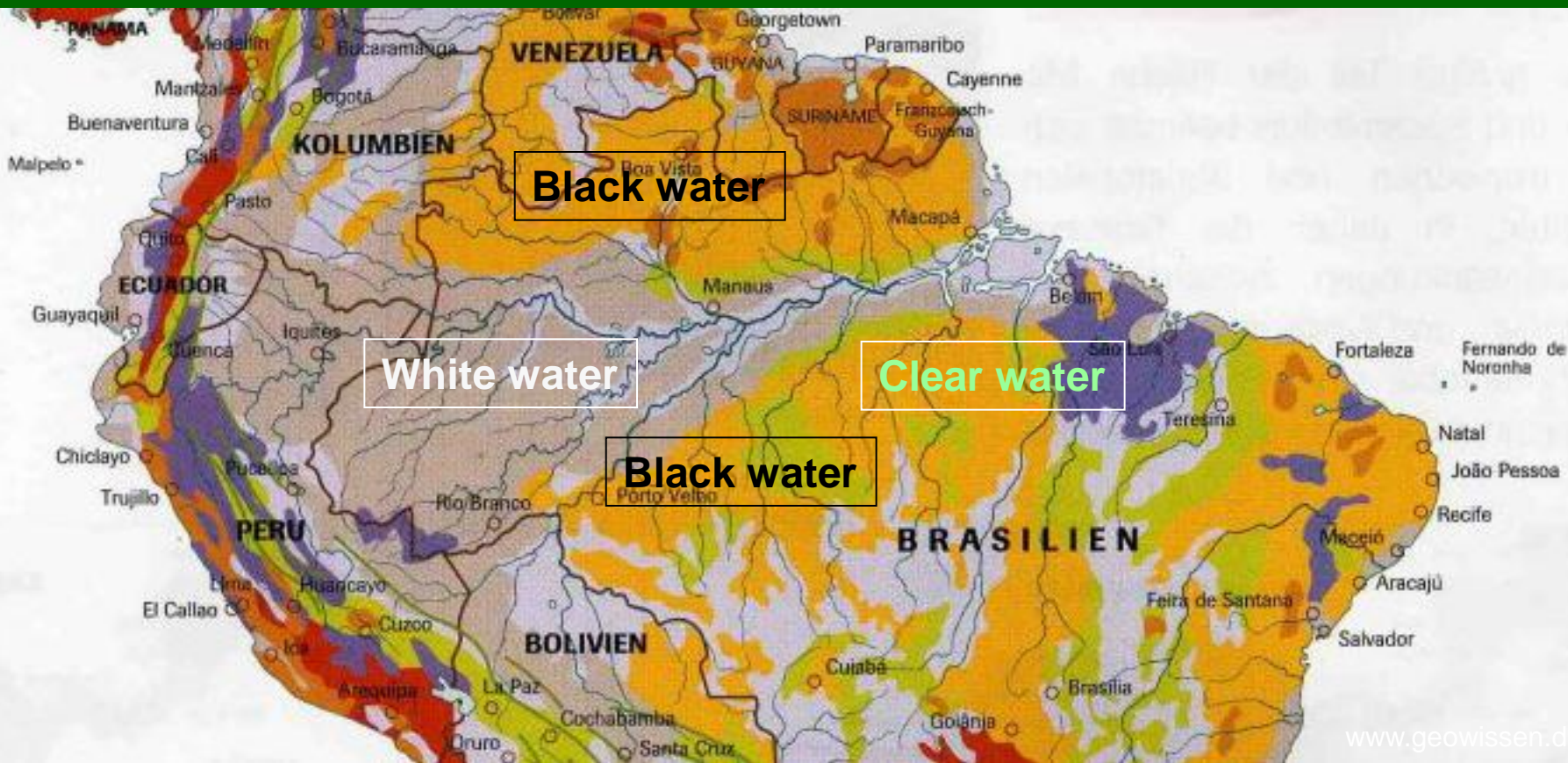
Pliocene (30 M years)



Paleozoic (600-400 M years)



Tertiary and Quaternary (< 30 M years)



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Pre-cambrian (> 600 M years)



Pliocene (30 M years)

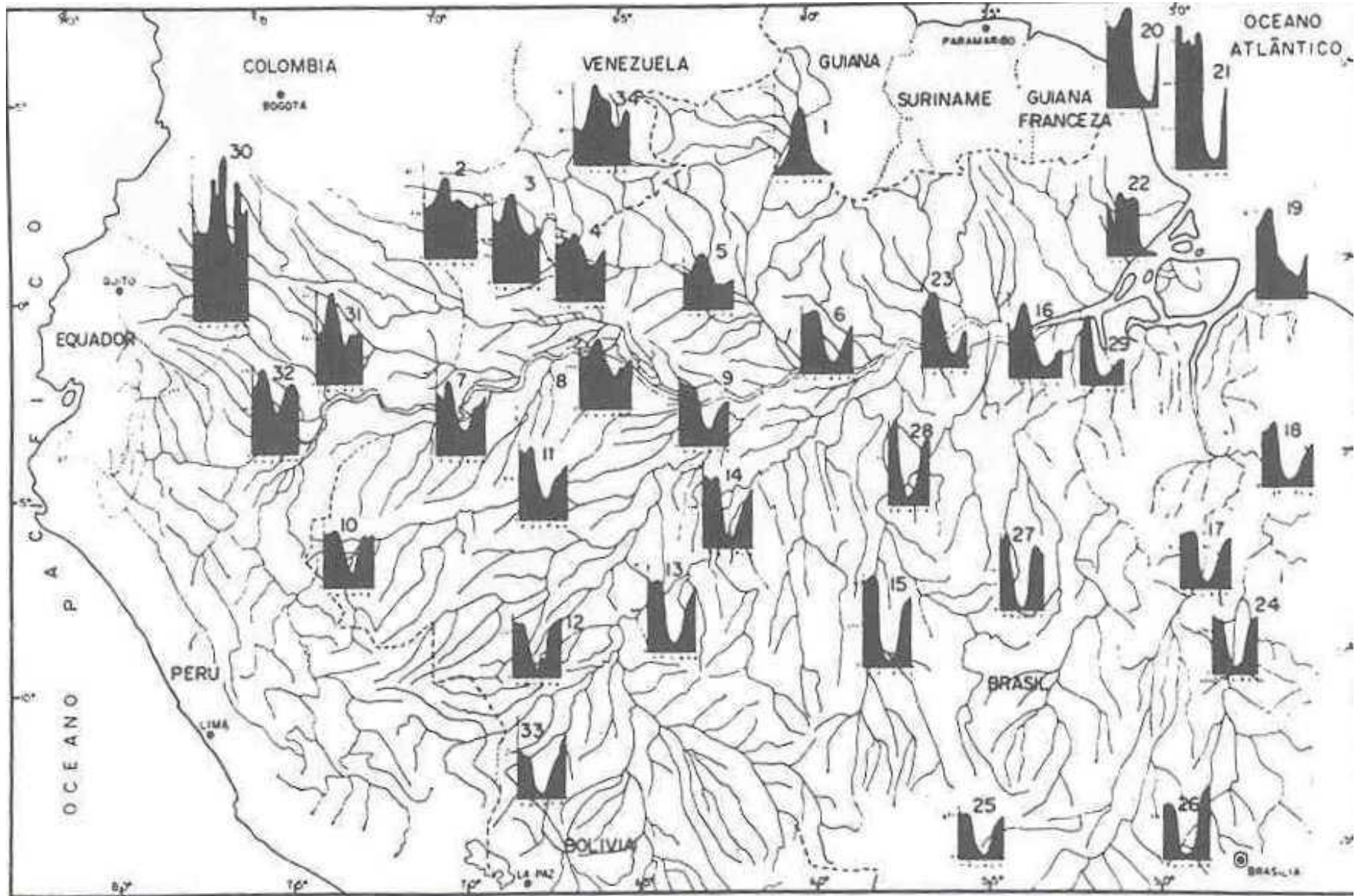


Paleozoic (600-400 M years)

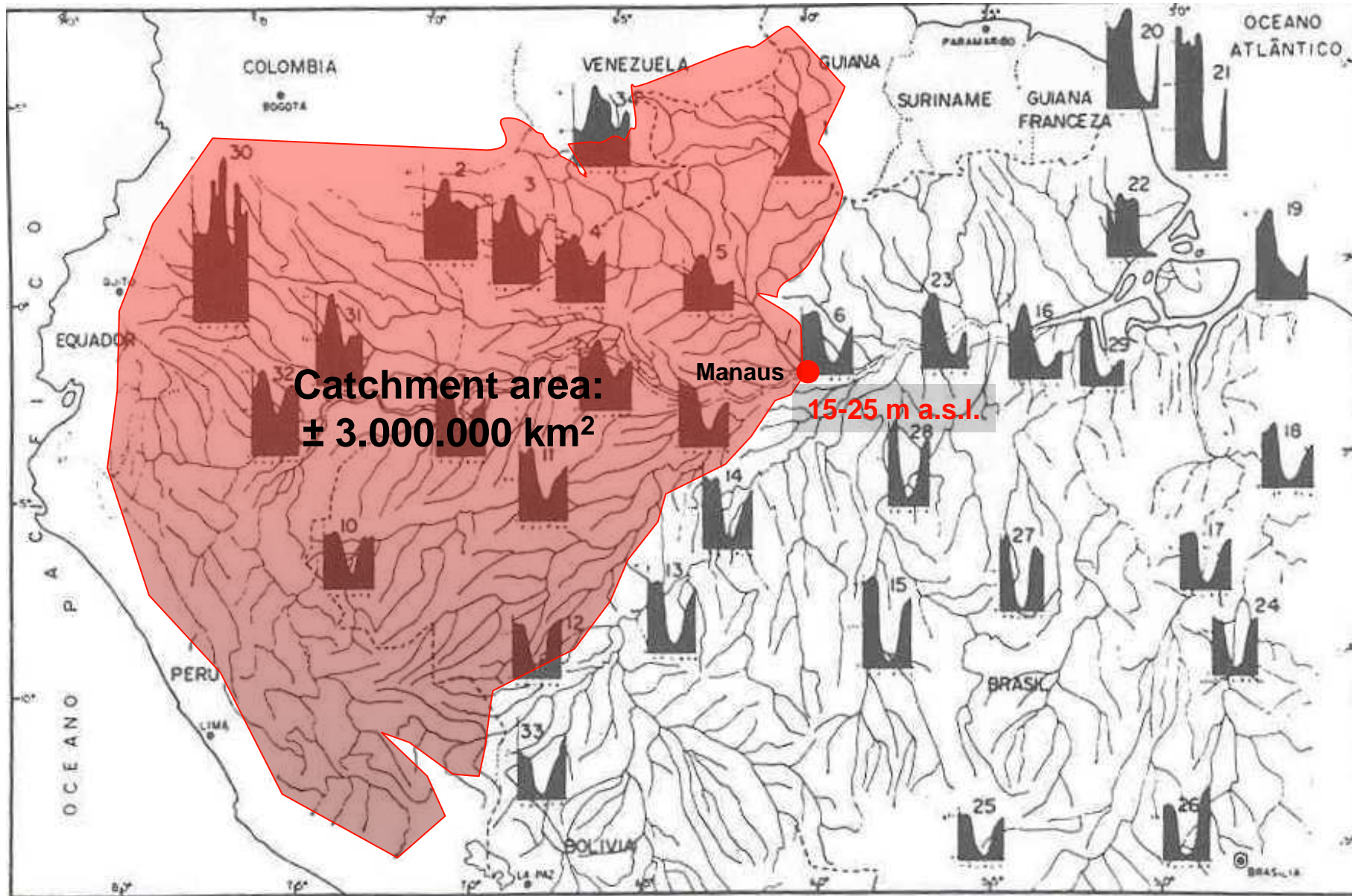


Tertiary and Quaternary (< 30 M years)

Precipitation seasonality

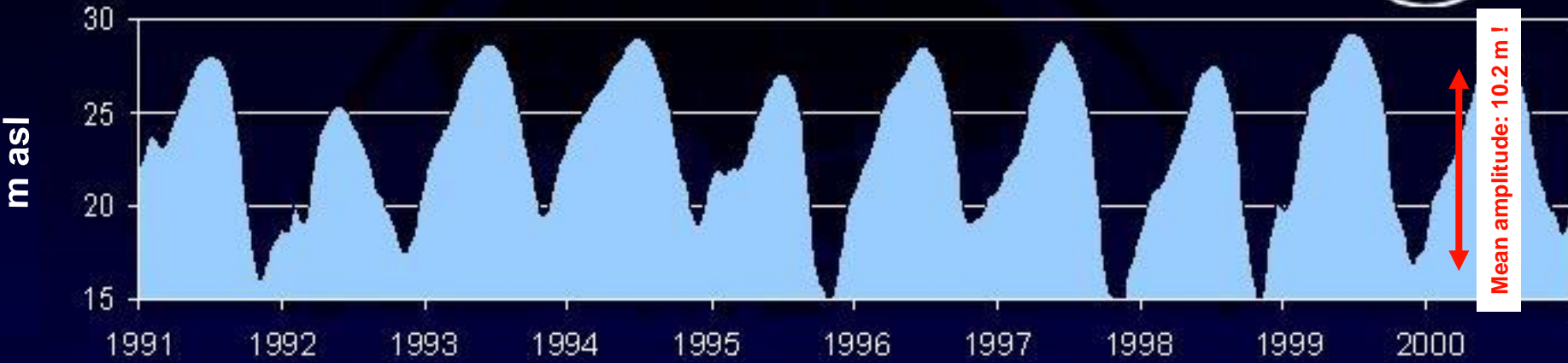


Precipitation seasonality



Monomodal Floodpulse: Regular and Predictable

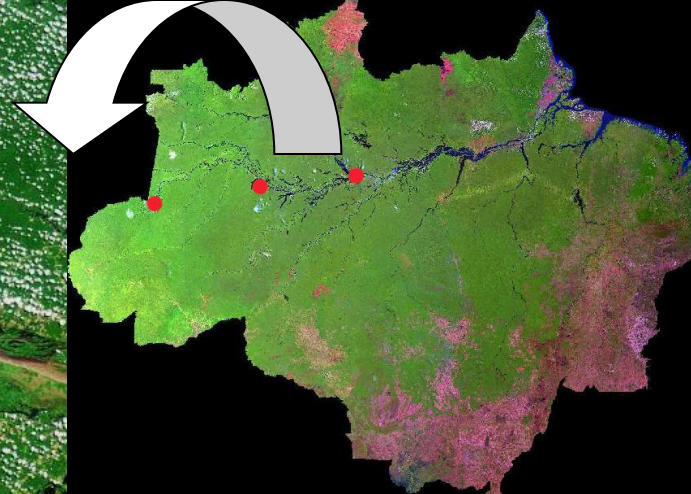
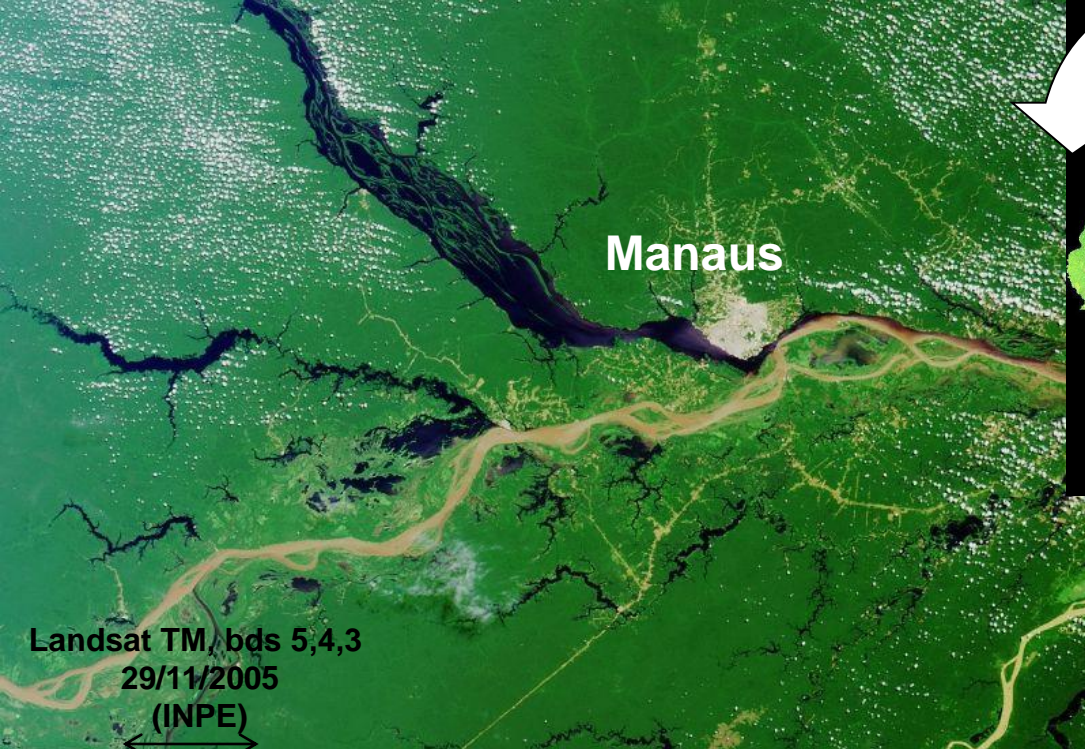
(Junk *et al.* 1989)



Daily water-level records of the Manaus harbour



Floodplains in the terrestrial phase: only 20% of its total area.



Igapó: 100.000 km²

Flooded by nutrient-poor black or clear water rivers;

About 600 tree species.

Várzea: 300.000 km²

Flooded by nutrient-rich white-water rivers;

About 1,000 tree species.



More than 1.500.000 km² – Amazonian Wetlands
Várzeas + Igapós - about 400.000 km²



Estuarine Regions + Small streams and flooded depressions



**Wetlands
25 to 30%
of the Amazon
Basin**

An aerial photograph of a vast Amazonian wetland system. A wide, muddy river flows from the top left towards the bottom left. The river is surrounded by numerous islands and peninsulas of varying sizes. These landmasses are covered in dense, lush green vegetation, likely tropical rainforest. The water in the river and smaller channels is a dark, brownish-grey color, indicating high sediment content. Several small boats or structures are visible on the water. The overall landscape is a complex network of water and forested land.

**The Vegetation of
Amazonian Wetlands**

Adventitious roots



Lenticels



Adaptative Strategies of Floodplain Trees

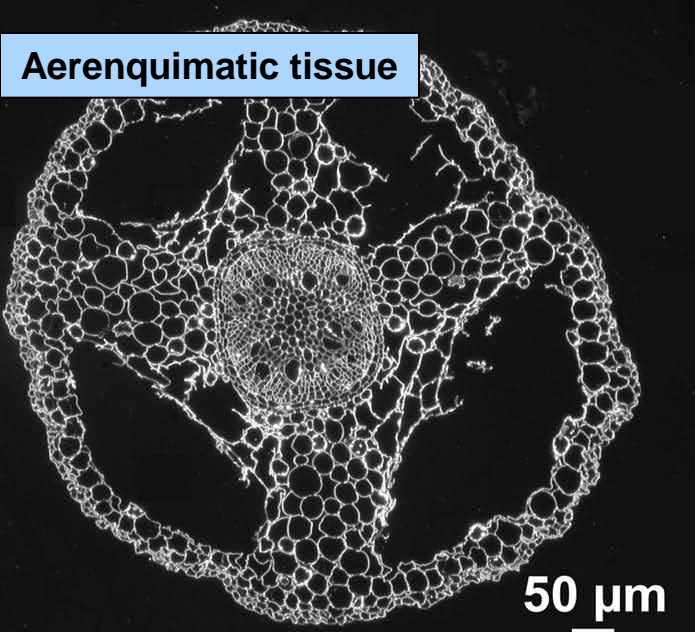
Morpho-anatomical:

- Increase of root surfaces
- Hypertrophic lenticels
- Aerenquimatic tissue;

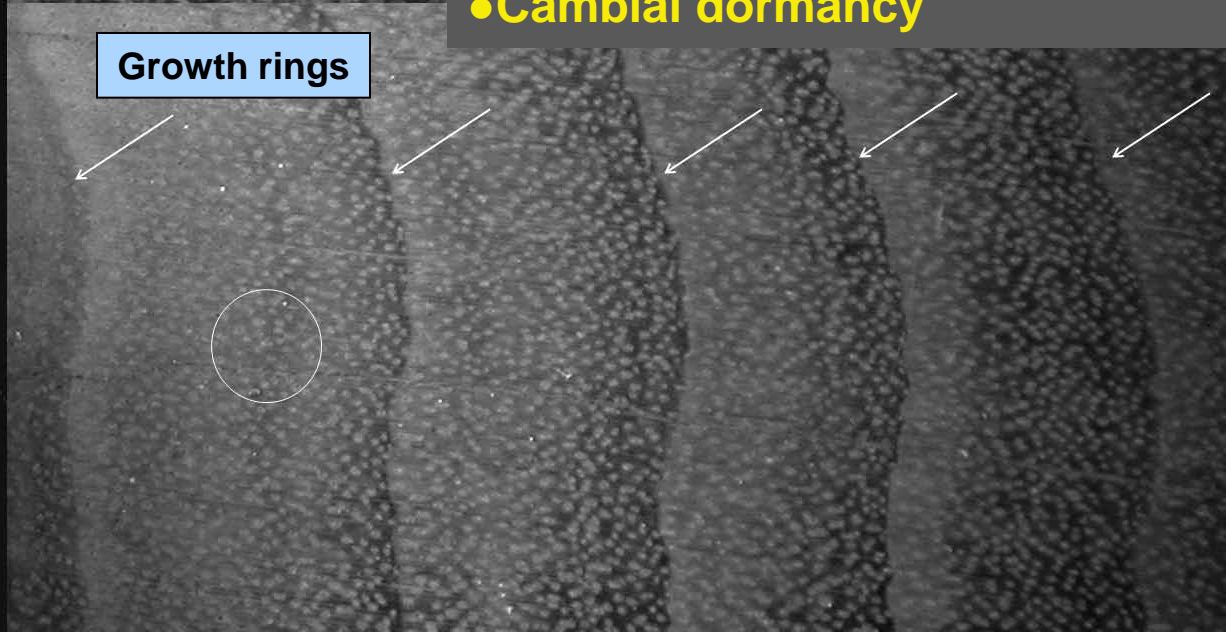
Physiological:

- Leaf shedding - high water
- Reduction of photosynthesis
- Anaerobic respiration
- Cambial dormancy

Aerenquimatic tissue



Growth rings



Phenology – Fruit / seed maturation at high water levels

Fruit / seed dispersal



Anemochory

Hydrochory



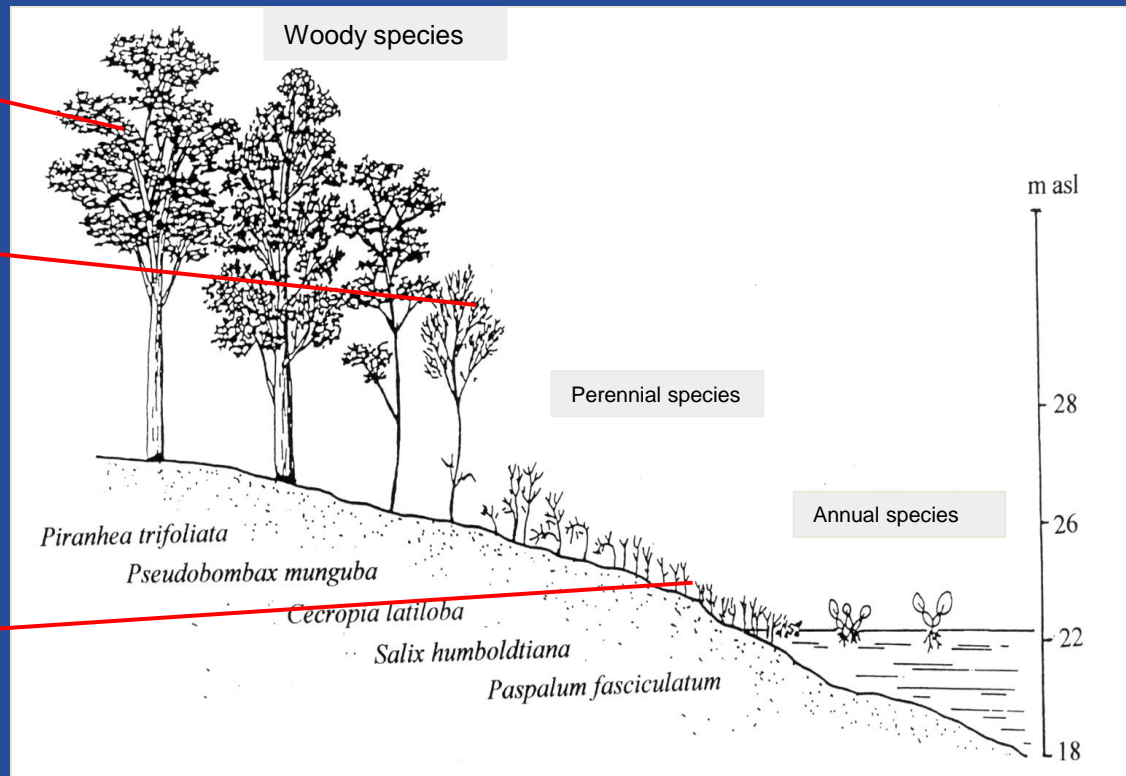
Ichthyochory



Seeds of *Hevea spruceana*



Distribution of plant communities in the Várzea floodplains according to the time of inundation



Above Ground Net Primary Production (AGNPP; Mg C ha⁻¹ yr⁻¹) of different age stages of a várzea floodplain forest

| Age of the stand | AGWBP | Fine Litter | Herbivory | VOCs | AGNPP |
|------------------|-------|-------------|-----------|-------|--------|
| 20 years | 8,5 | 3,9 (*) | (0.5) | (0.3) | (13,5) |
| 50 years | 7,2 | 6,8 (**) | (0,8) | (0.3) | (15,1) |
| 240 years | 2,7 | 3,2 (***) | (0.4) | (0.3) | (6,6) |

Schöngart et al. 2010

Várzea floodplain forests:

accumulate 31% less biomass than the terra firme forest but their annual productivity is about 2 times superior

Percentage of Cover Area – Forests of Mamirauá

Pioneers: 11.70 %
 Late Secondary Stages: 38.48 %
 Climax: 39.43 %



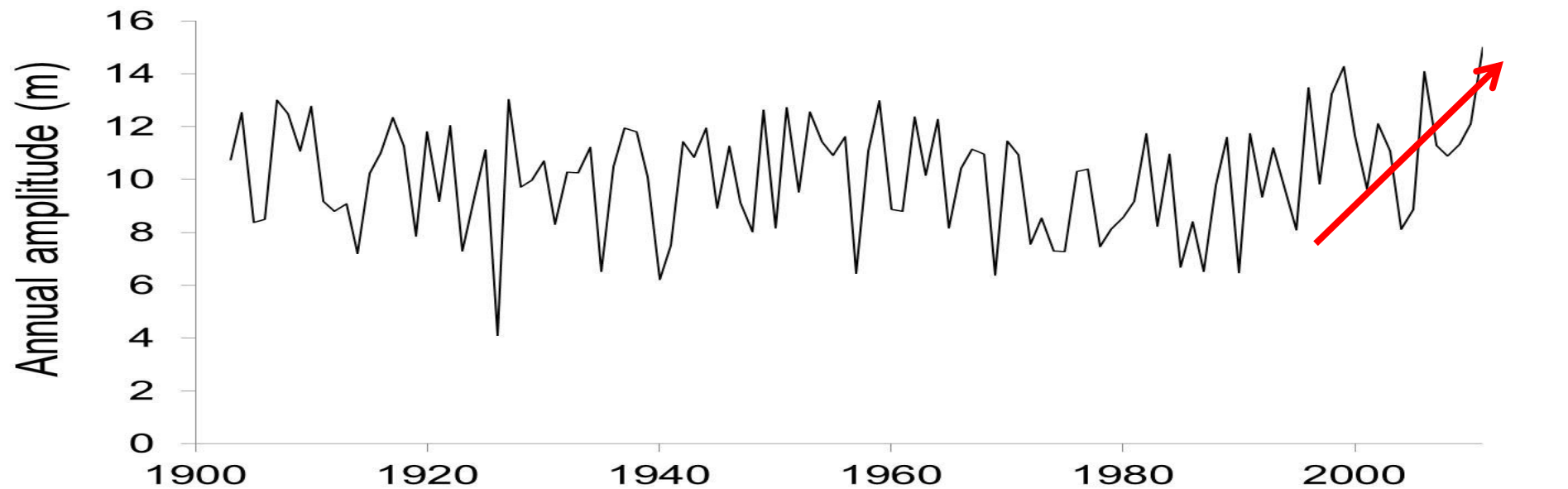
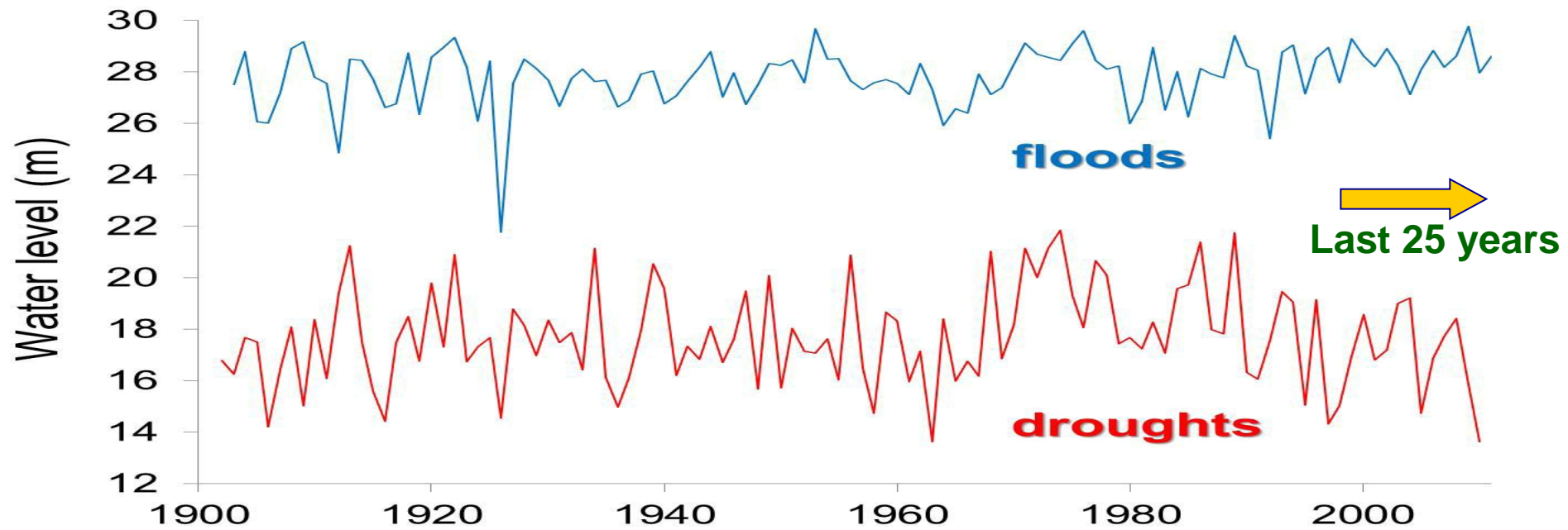
**Recent issues and concerns on the protection of
Amazonian Wetlands**

Drought , October 2005



Flood, June/July 2009

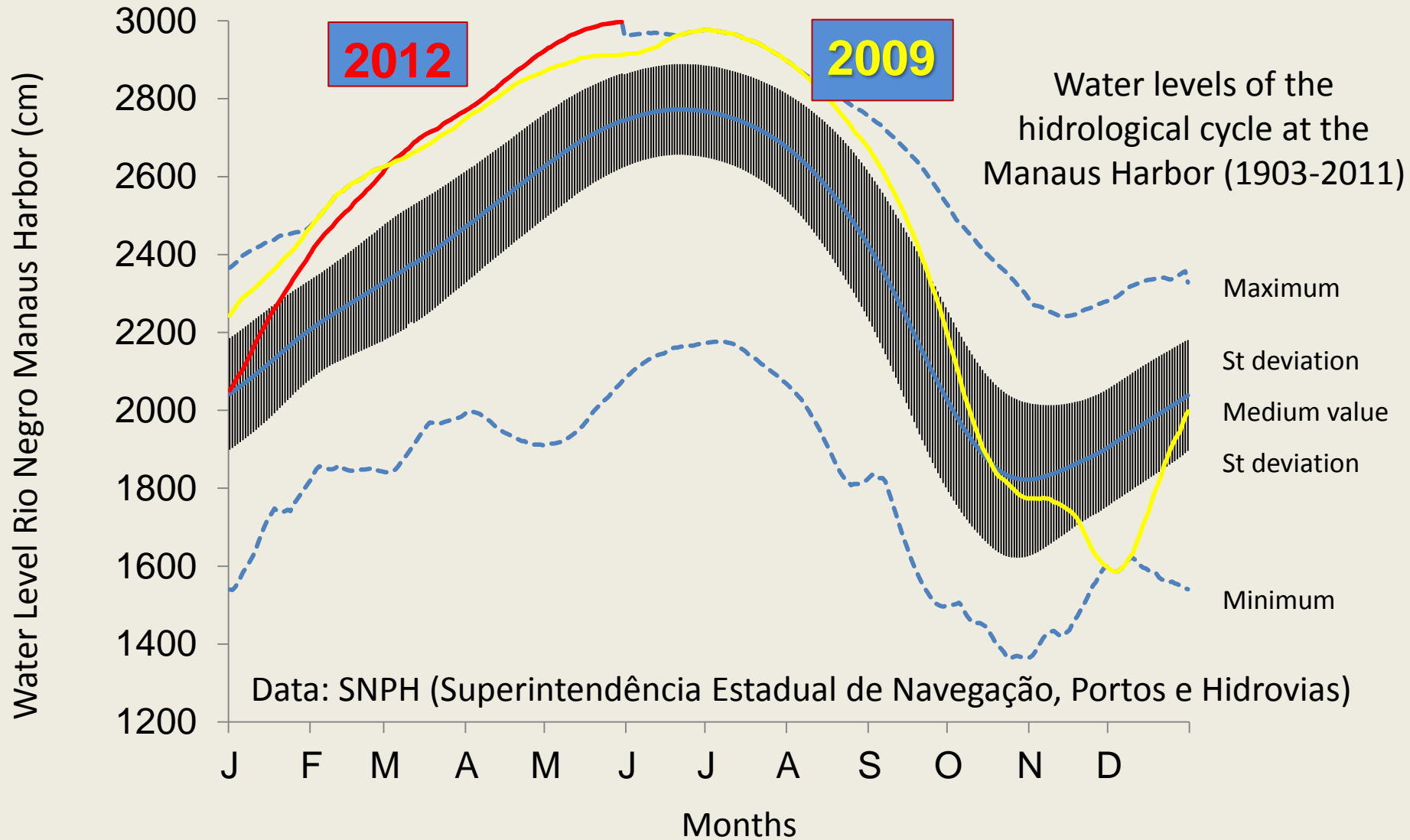




Records at the Manaus Harbor

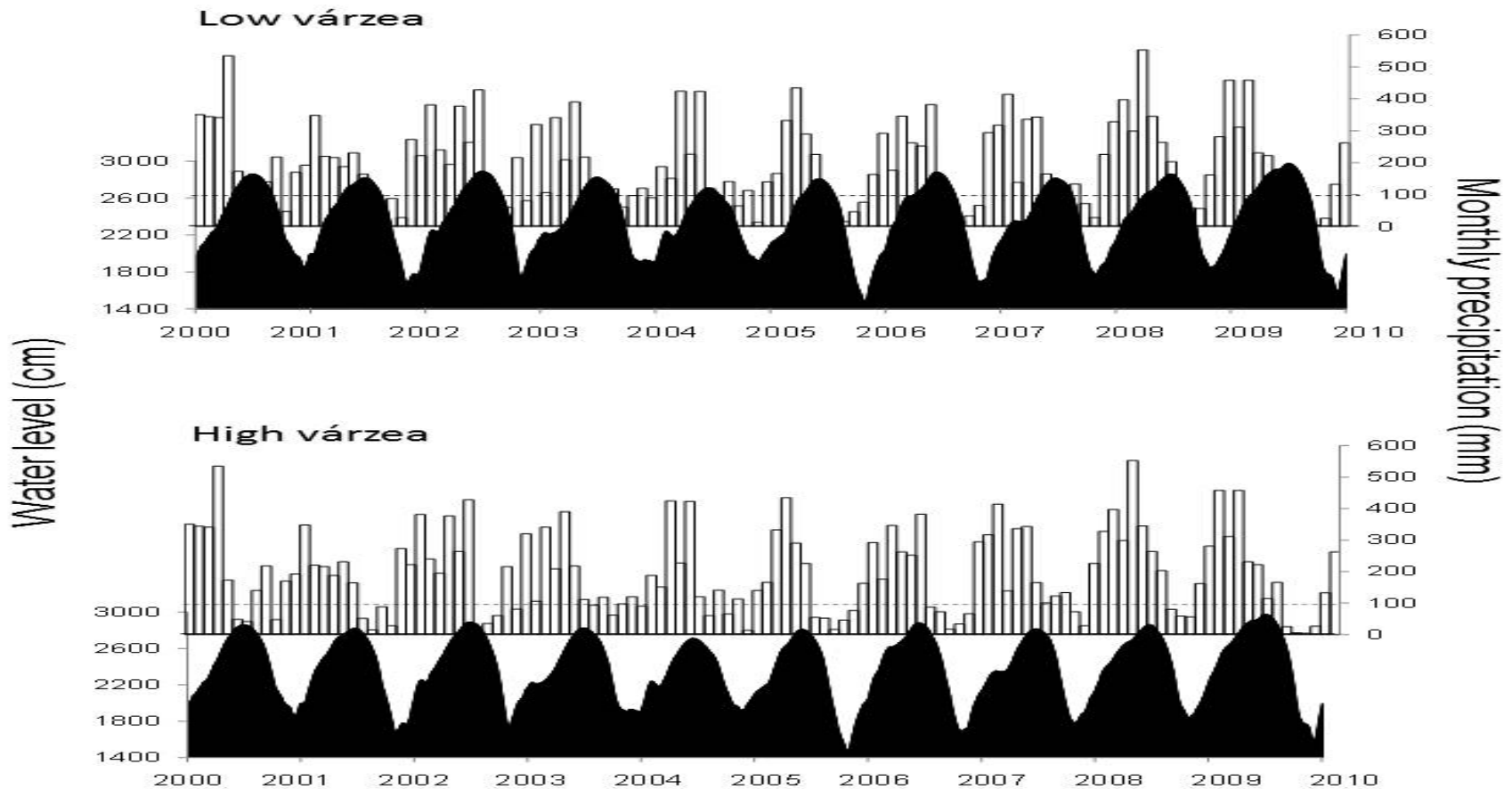
Piedade et al 2012

Flooding of 2012 at the Manaus Harbor: from the beginning of March the medium water levels are the highest ever recorded at this period of the year in the last 110 years.



Data: SNPH (Superintendência Estadual de Navegação, Portos e Hidrovias)

Figure: Jochen Schöngart



Higher topographies - shorter and irregular flooding - more influenced by precipitation. Their vegetation may respond to severe droughts similarly as the upland forests (lower rates of photosynthesis, growth and productivity, and increased mortality).

Forests at lower topographic elevations are more responsive to the flood pulse, and will be less affected.



Climatic changes or natural hydrological regime variability?

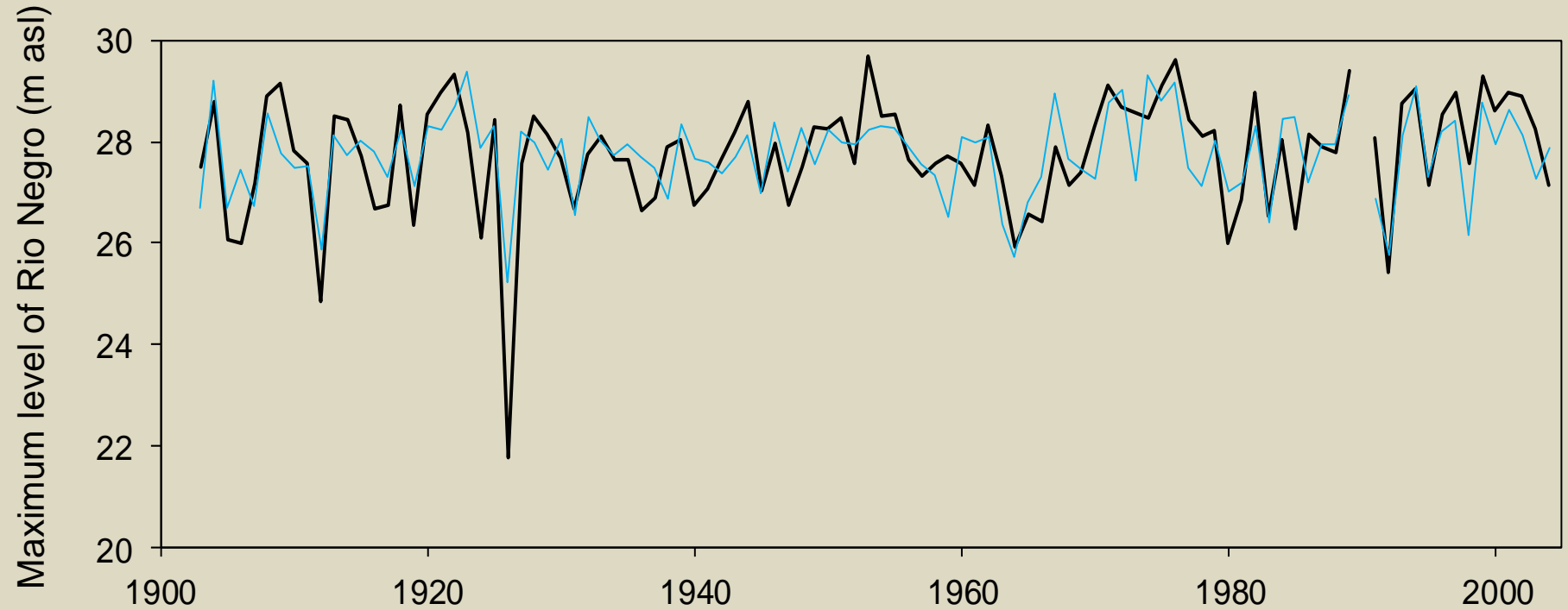


Future increases in the frequency and severity of floods and droughts - Major impacts can be expected on the seedling establishment and tree growth.



Species composition, abundance and forest dynamics along the flood gradient may change, but, owing to the high natural dynamics of river floodplain forests, species extinction at large scale is not expected.

Modeling is possible: comparison between the peak of flooding registered (black) and the predicted values (blue). Medium error of 38 cm.



Amazon floodplain forests (várzea) - historically used by traditional populations – multiple use – low impact

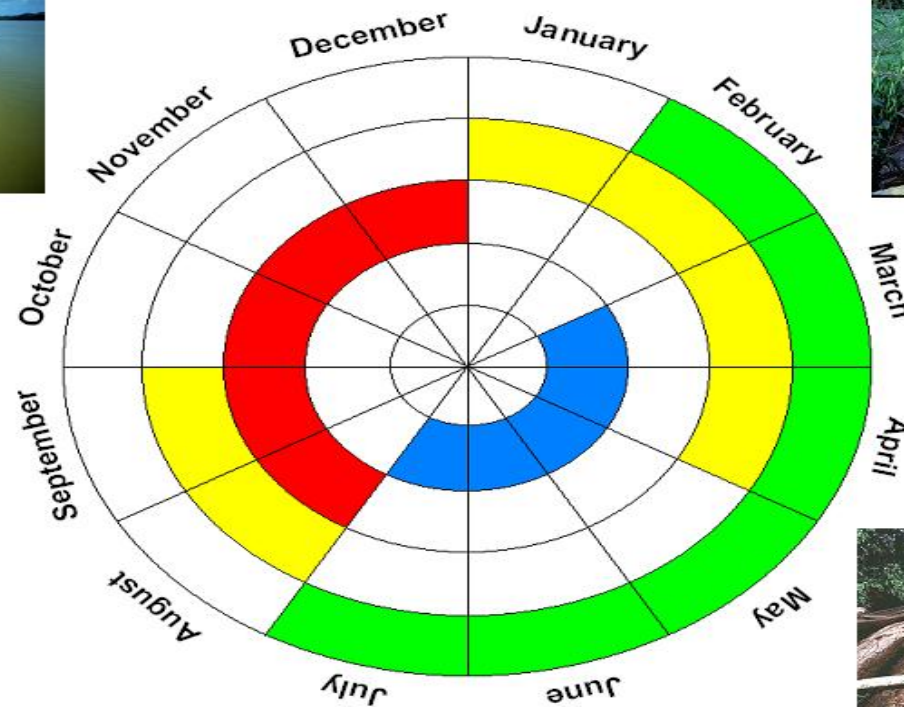


**60 % of the rural population
of Amazon
(Pará and Amazonas - 2
million people)**



Models to predict floods and droughts are important tools to prevent damage and harm to the populations and economy in urban and rural areas of the Amazon region.

Economic activities of the human populations in the floodplains during the year



Albernaz & Ayres (1999)

The reconstruction of the past hydrological regime is crucial to improve predictions of climate and hydrology in the future. A powerful tool in this context: dendroecology.

Final Remarks

The Amazon floodplain forests are the most species-rich floodplain forests worldwide contributing specifically to the regional carbon balance;

A more conclusive scenario on the impacts of a changing hydrological regime and climate is still difficult (tree species respond differently);

However, more than changes in regional climate, deforestation is the major threat for these environments and the traditional human populations living there;

Policies improving the protection and sustainable management of these environments taking into account the scientific knowledge already available are crucial.

Thank you
very much!!!

Grupo MAUA: Ecology, monitoring and sustainable use of wetlands

