Santarém Carbon Cycle Project

Scot Martin, Paulo Artaxo, Steven Wofsy and Kenia Wiedemann

Aerosol Radiation Measurements Climate Research Facility in the Amazon Basin - ACRF

- ***Aerosol life cycle***

1. Manaus pollution plume + VOCs → impact on SOA + new particles.
2. Aging of bb plumes and the subsequent formation of additional SOA.
3. Anthropogenic emissions: Manaus pollution + bb aerosols from the ring of fire:
   - Aerosol microphysical, optical, CCN and ice nuclei;
   - Pristine vs anthropogenical air masses.

- ***Cloud life cycle***

1. Landscape heterogeneity in dynamics of convection and clouds.
2. The evolution of convective intensity from severe storms in the dry season to moderate storms in the wet season, and how changes caused by local deforestation lead to similar transitions;
3. The transition from shallow to deep cumulus convection during the daily cycle (comparison with other ARM sites)

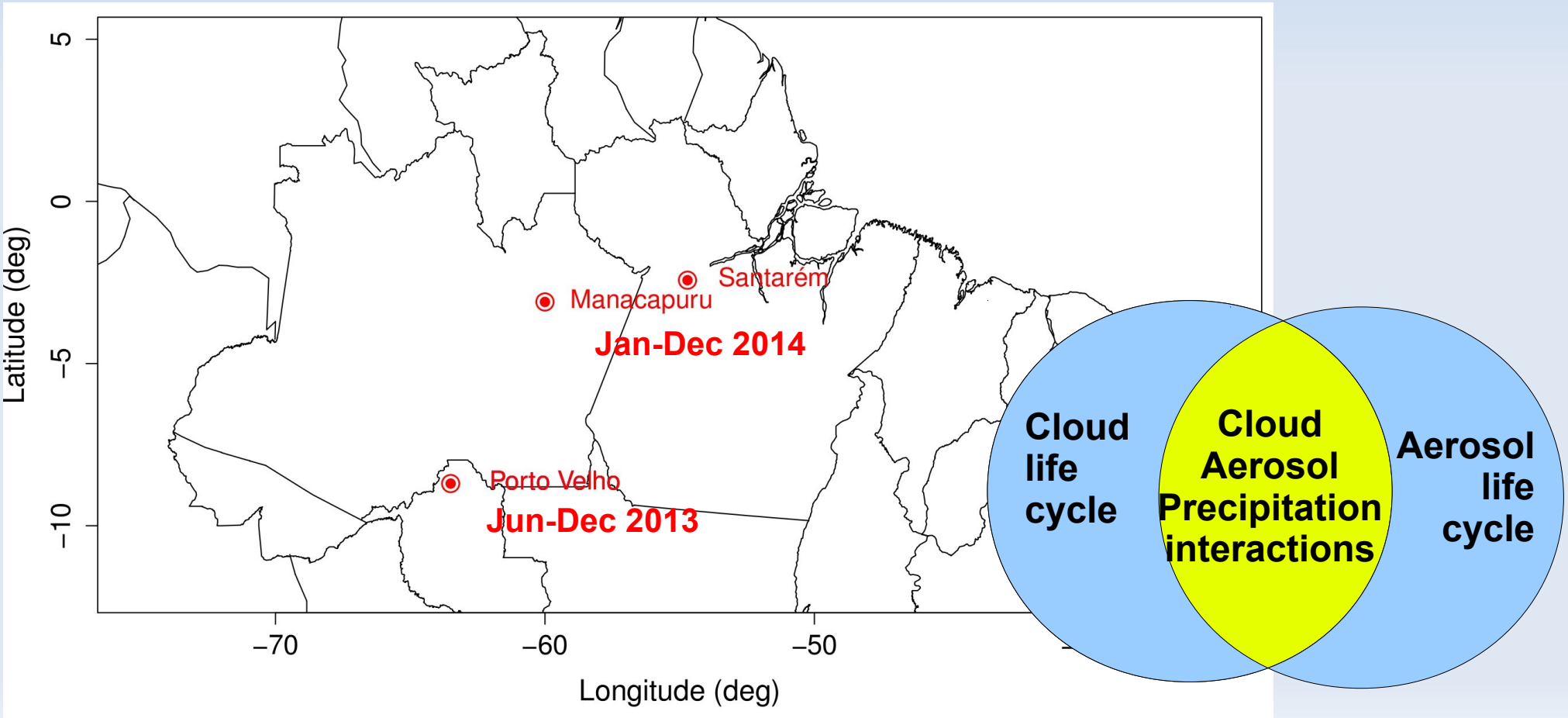
- ***Cloud aerosol precipitation interactions***

1. Aerosol effects on scattered cumulus clouds, aerosol radiative effect, focus on the impact of bb aerosols.
2. Aerosol effects on deep convective clouds, precipitation, and lightning under different aerosol and synoptic regimes, including the roles of aerosols in changing regional climate and atmospheric circulation.
3. Improvement of parameterizations of aerosol-cloud interactions in the climate models

The ARM Climate Research Facility in the Amazon Basin

- Biomass Burning Emissions: Porto Velho, Brazil
- MegaCity Outflow in the Tropics: Manaus, Brazil

" Therefore, in the proposed deployment, we will have the capability to contrast high and low aerosol loadings."



Santarem Forest & Carbon Cycle Project: *Science Questions*

1. **What are the BVOC emissions and what controls them, especially in the scenario of Amazon change**? *Environmental conditions: precipitation, temperature, radiation, soil moisture conditions. (Measurement program linked to LBA, PIRE, ACRF.]*

2. **How does biomass burning influence emissions and BVOC chemistry, including the atmospheric oxidant cycle?**

3. **What is the influence of current and possible future NOx on aerosol formation and properties?**

4. **Aerosol/ozone-forest interactions:** *Influence of increasing diffuse radiation by aerosols on the forests and on the carbon cycle. Impact of ozone and NO_x on plant productivity (forests, agriculture –especially soybeans—considering multiple stressors).*

Santarem Forest & Carbon Cycle Project: *Main Element*

Three year measurement program at the tower in Santarém, Brazil, plus selected measurements at Maxaranguape.

- **BVOC using basic PTRMS, advanced PTRMS**
- **POA and SOA using advanced AMS**
- **High-sensitivity oxidants, pollutants, and tracers NOx, CO, O_3 ; CH_4, CO_2, N_2O, SF_6.** *Some of these at Maxaranguape.*

The site has a long data record of basic hydrological, meteorological, and radiative data, past and ongoing eddy flux measurements of CO_2. These combined data records will place the proposed work in context. The new measurements will complement and enhance the NSF PIRE observations at Santarém, which are focused on forest dynamics and ecophysiology, and to provide an end-member and anchor for the ACRF programs in Manaus and Porto Velho.

Santarem Forest & Carbon Cycle Project: *Science Products*

1. **Primary BVOC emissions and uptake, mapped onto driver variables ("what controls them").**
2. **BVOC reaction chains, products, effects on plants and SOA.**
3. **Analysis of how biomass burning influences emissions and BVOC chemistry, including the atmospheric oxidant cycle and uptake by forest plants.**
4. **Modeling of data to determine what is the influence of current and possible future NOx on aerosol formation and properties.**
5. **Modeling of aerosol/ozone-forest interactions,** *including the influence of diffuse radiation by aerosols on forests and on the carbon cycle, uptake rates of ozone and* No_x*, estimation of effects on plant productivity).*