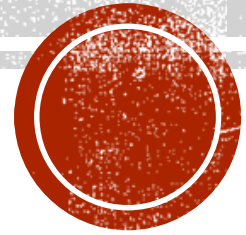
Universität Bremen

CLIMATOLOGICAL BIOMASS BURNING CO – WHERE IT COMES FROM AND WHERE IT GOES

Nikos Daskalakis, Maria Kanakidou, Mihalis Vrekoussis, Laura Gallardo



EGU 2020
6 May 2020

LAMOS

Universidad de Chile

ENVIRONMENTAL CHEMICAL PROCESSES LABORATORY
ECPL

OUTLINE

- Motivation/Aim
  - What do we study and why
- Model Description
  - TM4-ECPL
  - Experiment Setup
- Preliminary Results

MOTIVATION / AIM

- Quantify the biomass burning contribution to CO levels
- Understand patterns based on atmospheric dynamics variability
- Attribute and quantify the CO enhancement by biomass burning to specific source regions.

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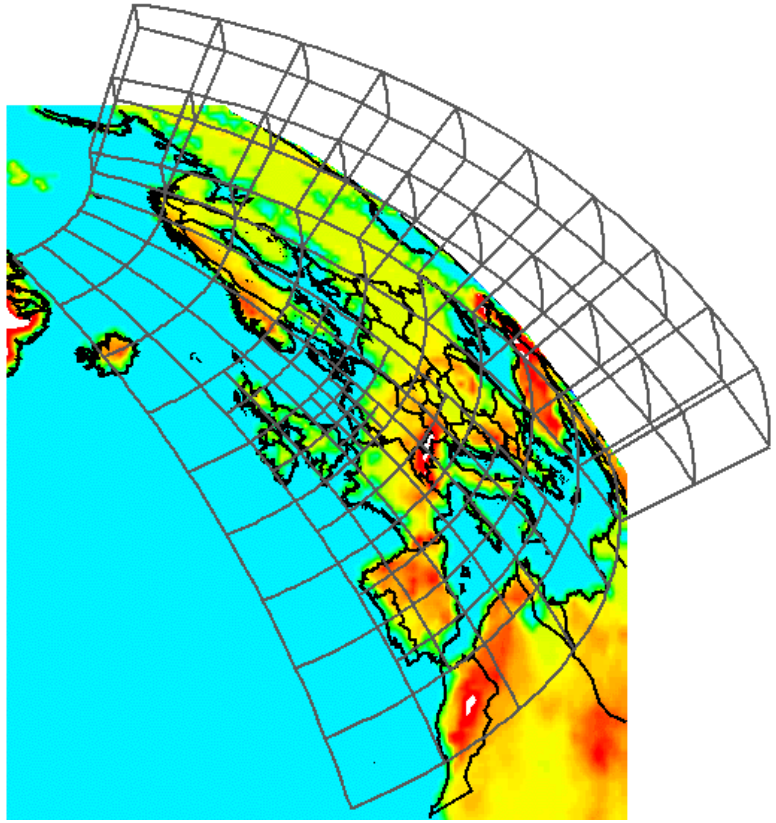
MODEL DESCRIPTION

- Global model (TM4-ECPL)
  - 3° x 2° or 6° x 4° (lon x lat)
  - 34 hybrid layers (up to ~65 km)
- Emissions
  - Anthropogenic
  - Biomass Burning
  - Biogenic
  - Dust
  - On- line sea salt and marine POA
- Chemistry
- Deposition
- ECMWF meteorology
- Validated in AEROCOM OA, Tsigaridis, Daskalakis, Kanakidou et al., ACP, 2014, Daskalakis et al., 2015, Daskalakis et al., 2016
- Detailed description in Daskalakis et al., ACP, 2016



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EXPERIMENT SETUP

- TM4-ECPL simulation of 1980- 2014 with ERA interim meteorology
- Period of study: 1994-2014 (14 years of model stabilization)
- 2°(lat)x3°(lon)x 34 layers (up to ~65km)
- Upper boundary of O_3 from MLS & GOME-2
- Biomass Burning emissions from ACCMIP
  - With Biomass Burning emissions
  - Without Biomass Burning emissions
  - With tagged CO tracers from 13 biomass burning regions

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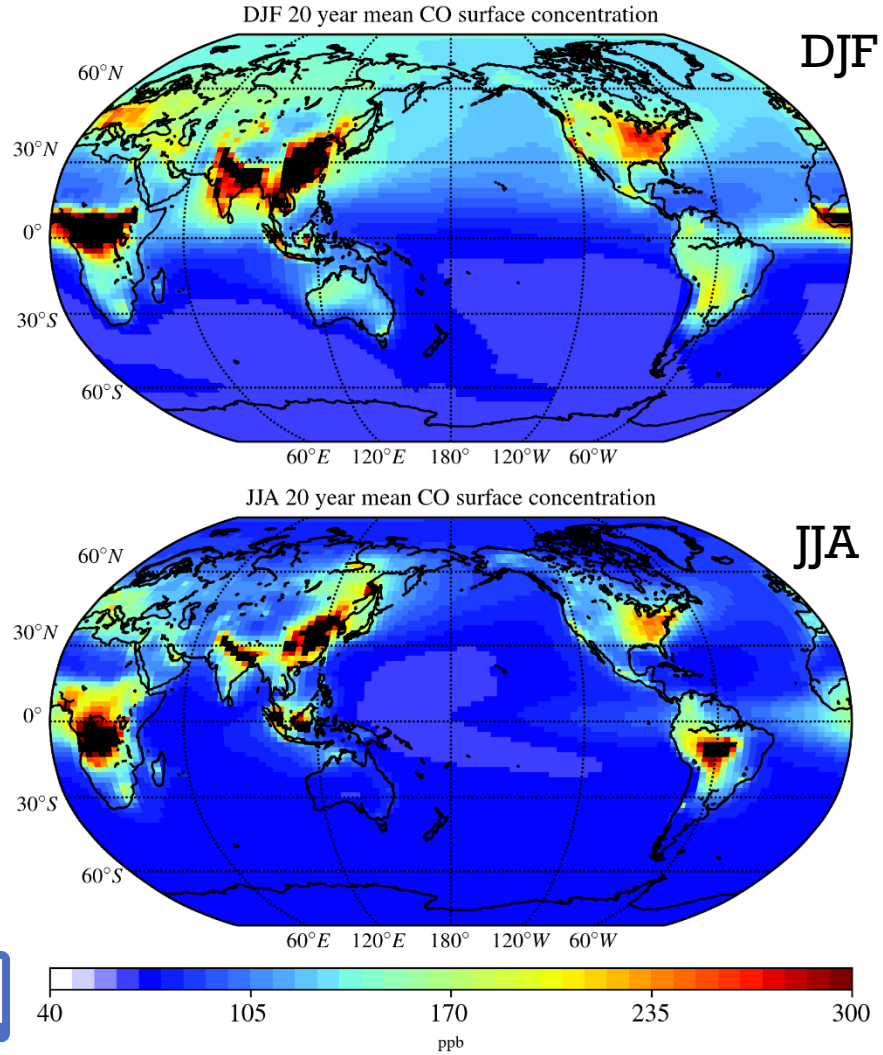
SURFACE CO DISTRIBUTION - SEASONAL



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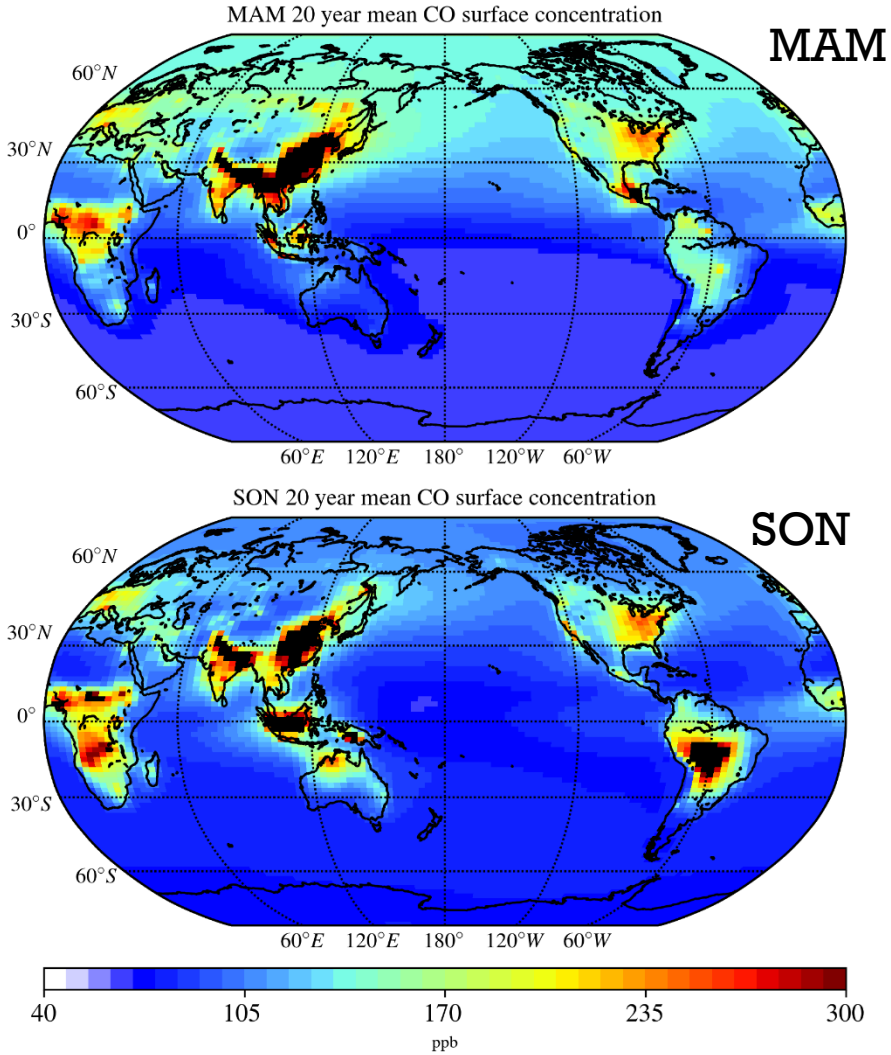
The surface CO distribution shows the high biomass burning regions and the high anthropogenic activity globally and seasonally



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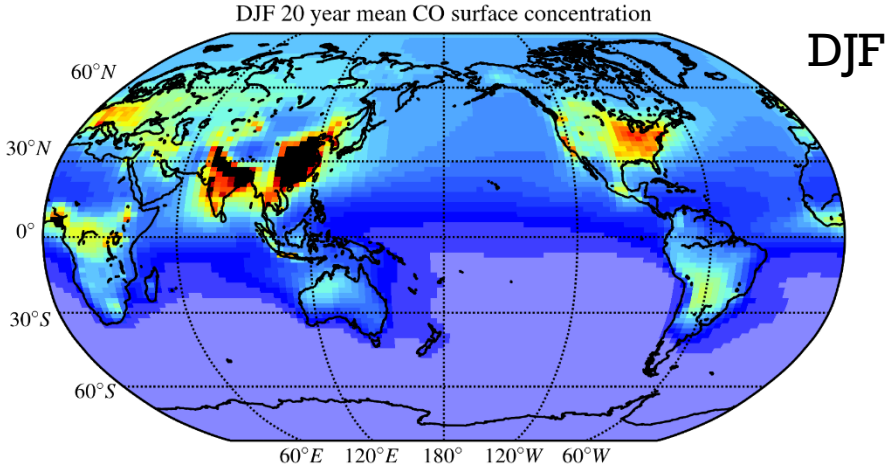
SON

SURFACE CO DISTRIBUTION – NO BB



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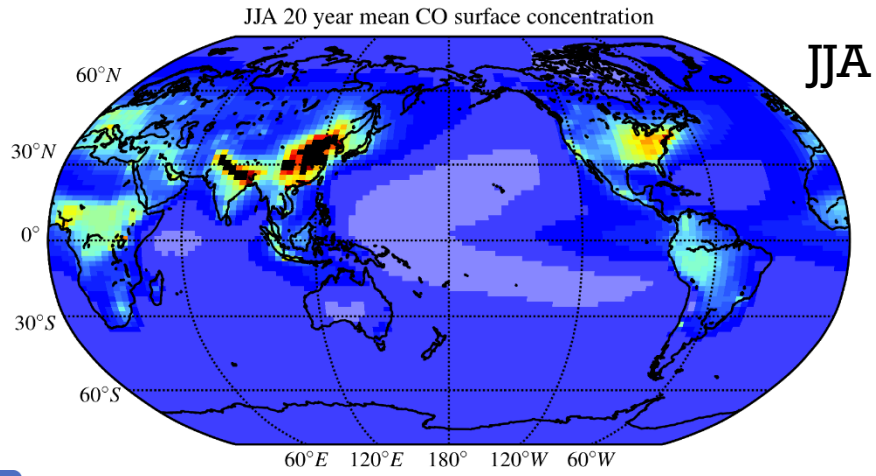

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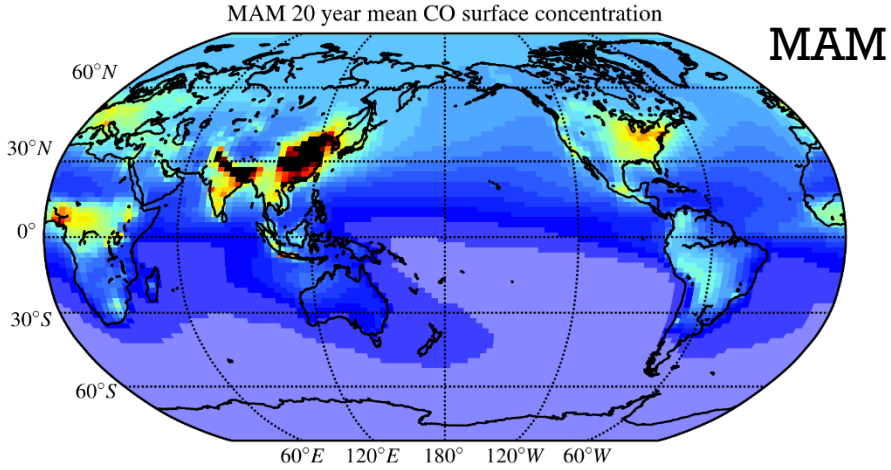
With the absence of biomass burning we can assess if CO comes from forest fires or anthropogenic activities



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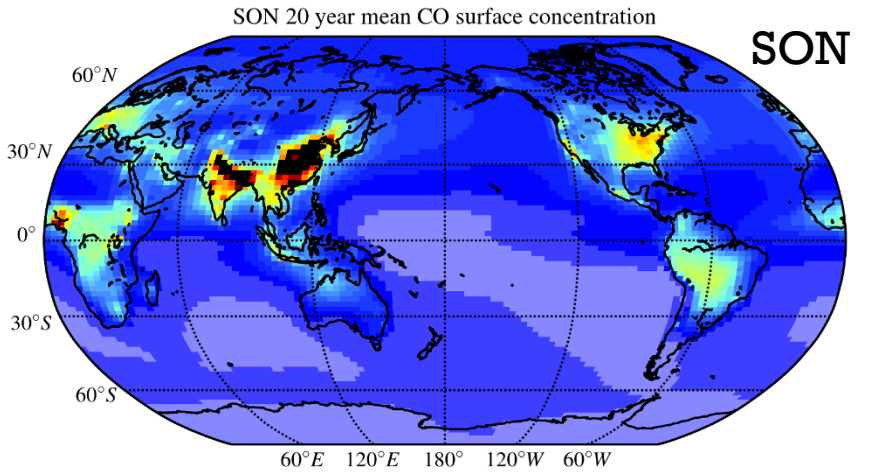

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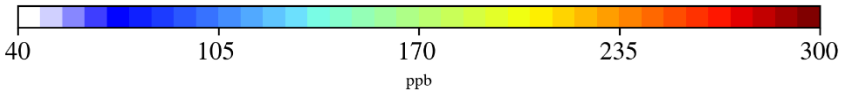
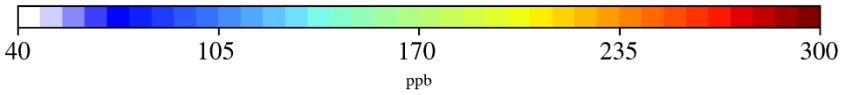
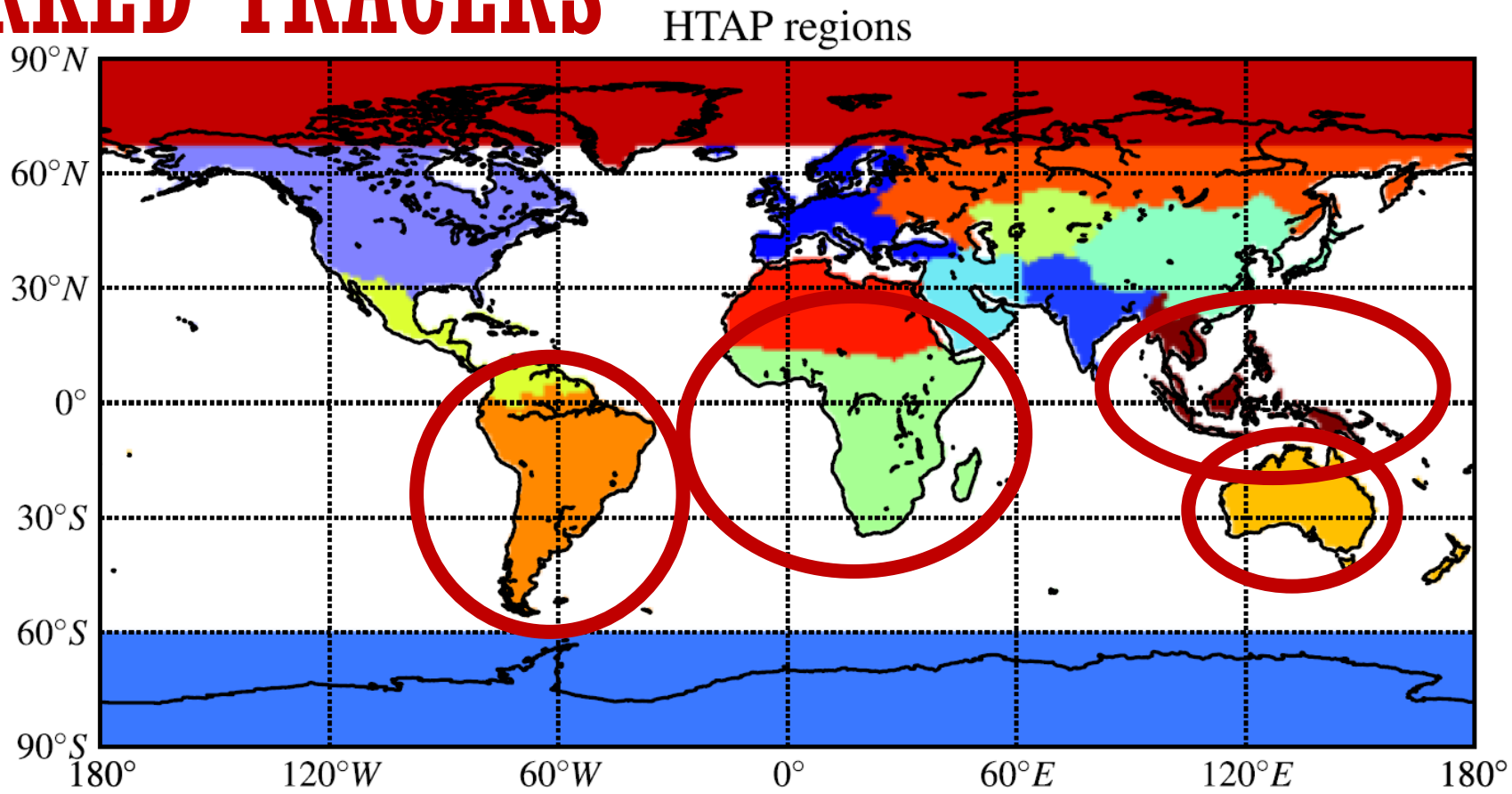


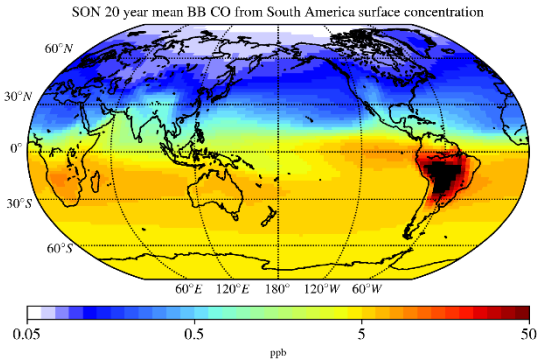


MARKED TRACERS



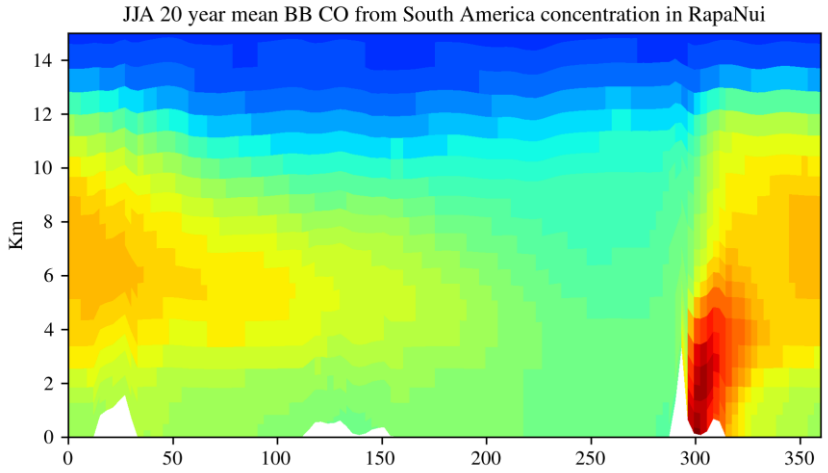
Marked tracers were used in the model following the emitted CO based on the HTAP source regions. CO biomass burning emissions where turned on one source region at a time and the impact was assessed.

IMPACT OF S. AMERICA
(I.E. ONLY EMISSIONS FROM S. AMERICAN BB)



Longitudinal cross section at the latitude of Easter Island

Easter Island



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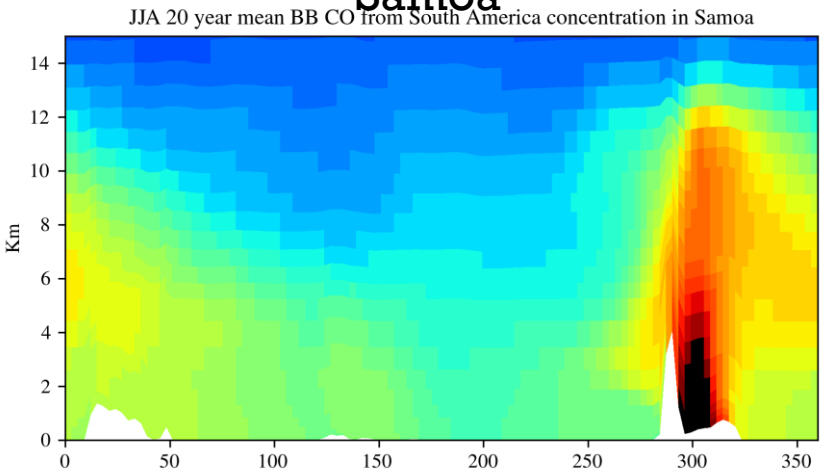
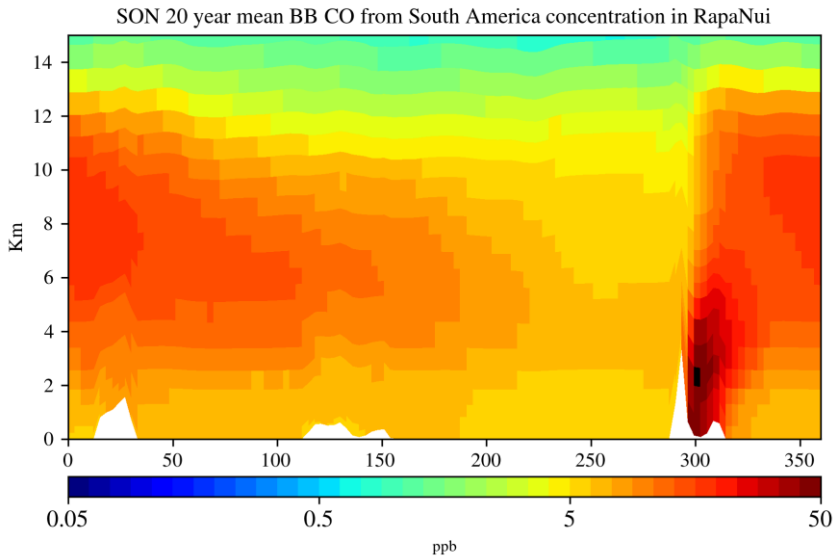
Samoa



Longitudinal cross section at the latitude of Samoa



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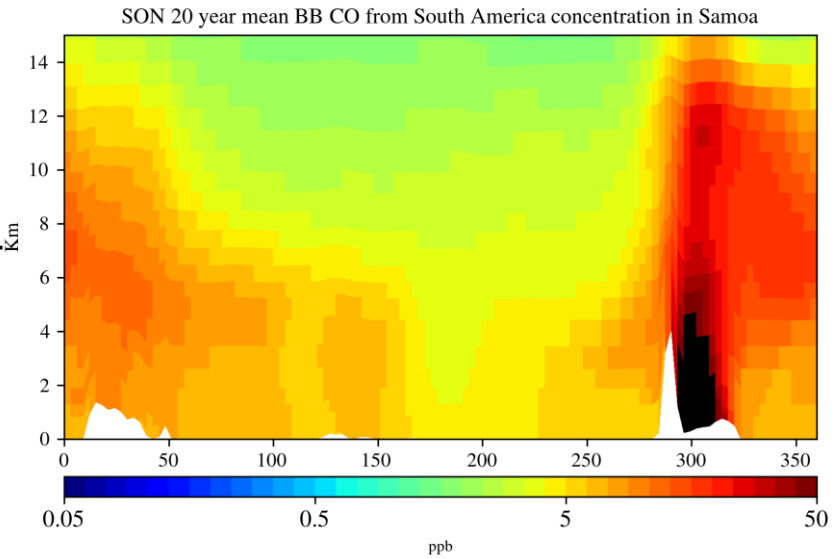
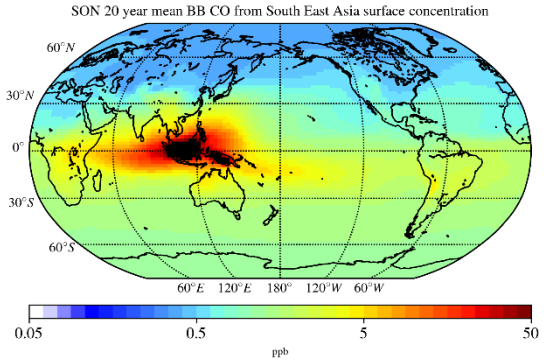


The biomass burning period is evident for South America (SON)

IMPACT OF INDONESIA
(I.E. ONLY EMISSIONS FROM INDONESIAN BB)



Longitudinal cross section at the latitude of Easter Island

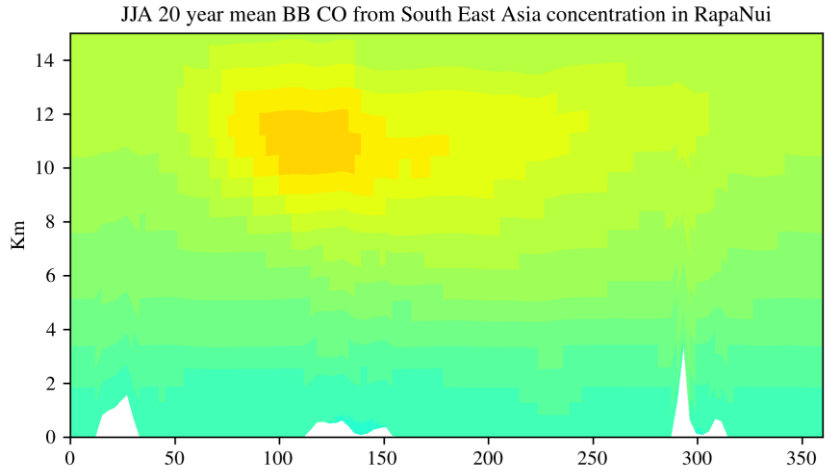
Longitudinal cross section at the latitude of Samoa

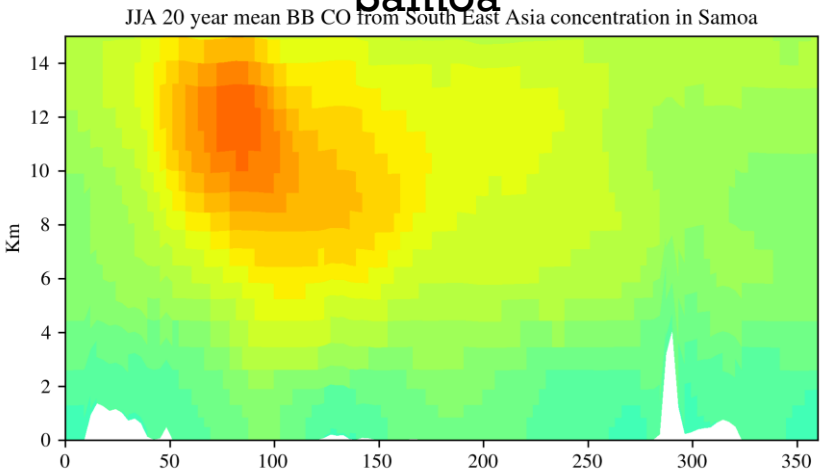
Easter Island

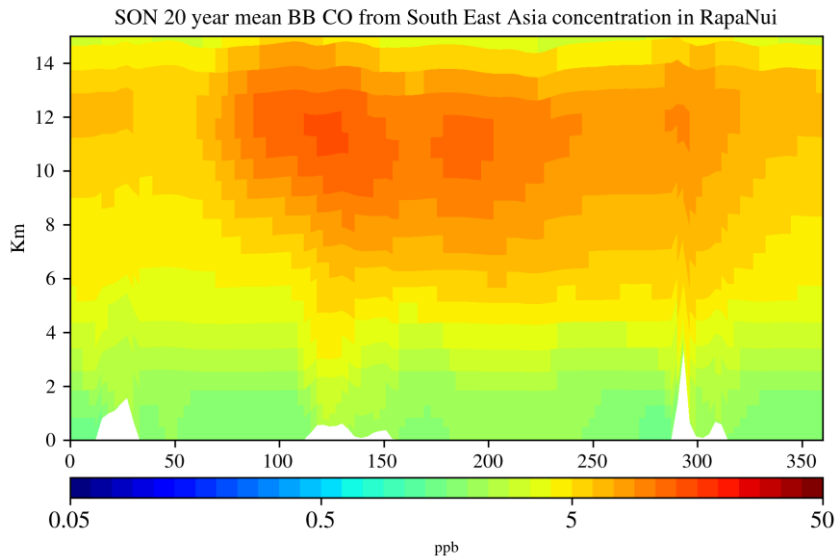
Samoa

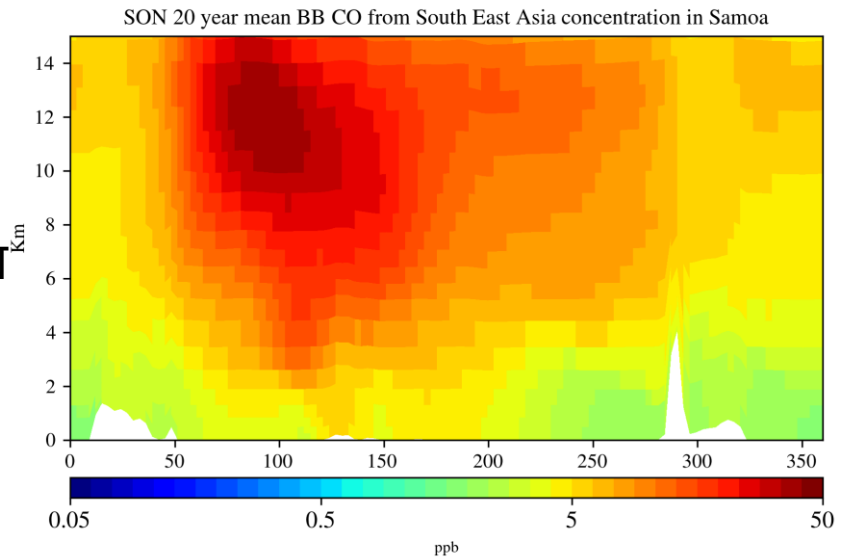
JJA

SON



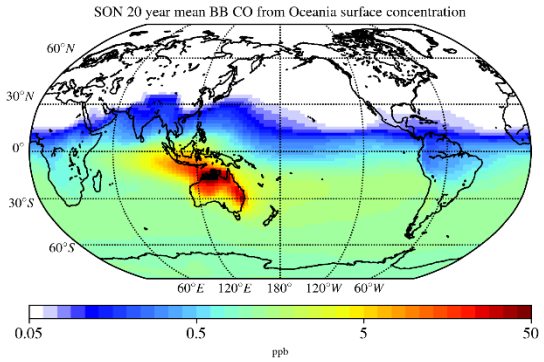






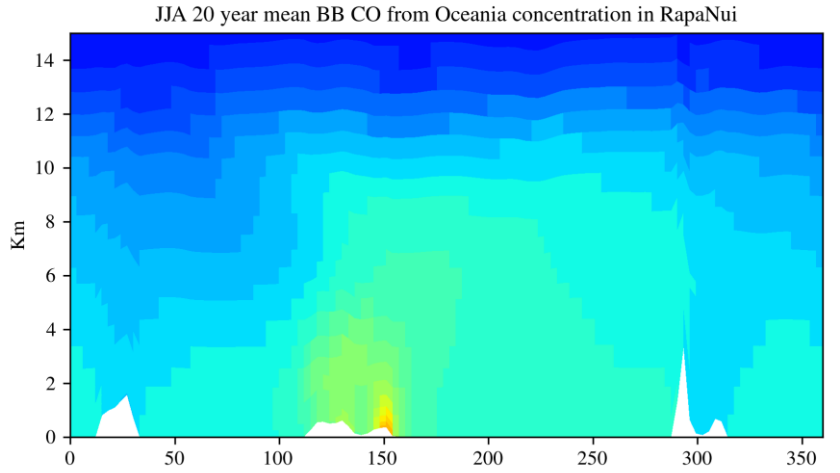
The transported biomass burning is evident in high altitudes

IMPACT OF OCEANIA
(I.E. IMPACT ONLY FROM OCEANEAN BB)



Longitudinal cross section at the latitude of Easter Island

Easter Island



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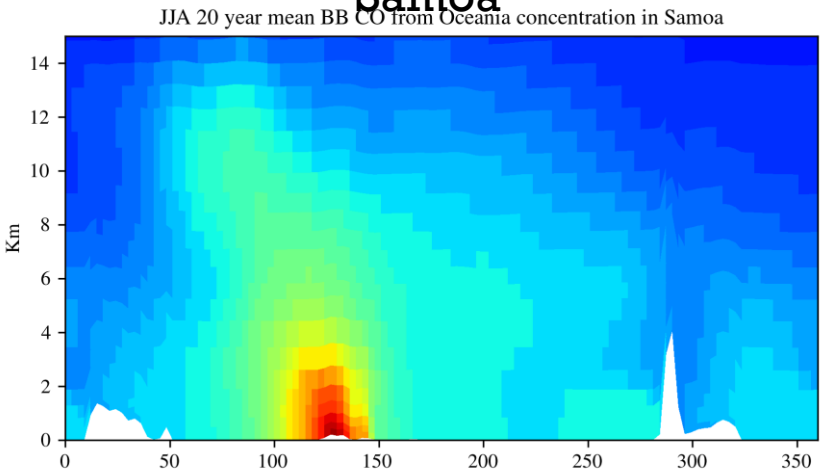
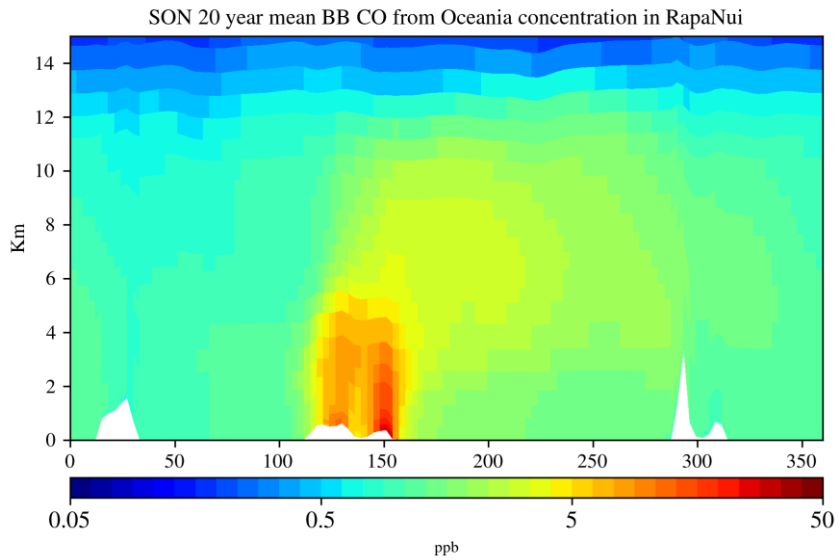
Samoa



Longitudinal cross section at the latitude of Samoa



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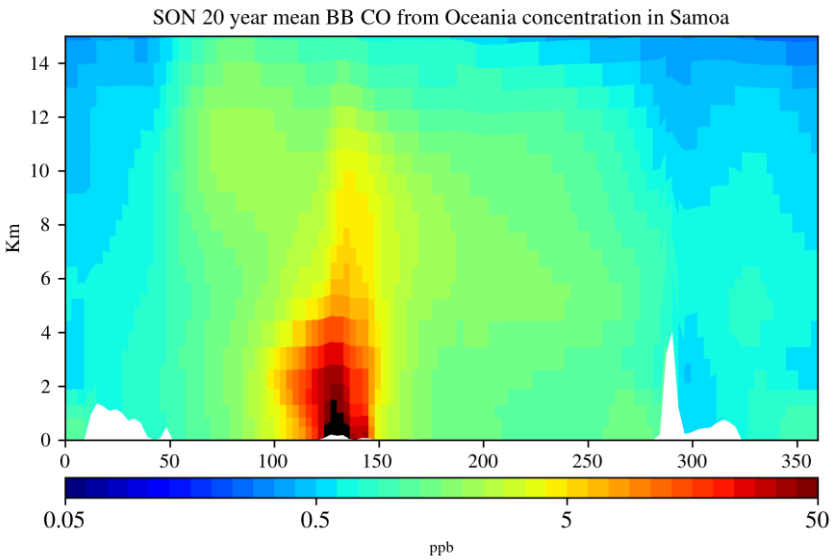
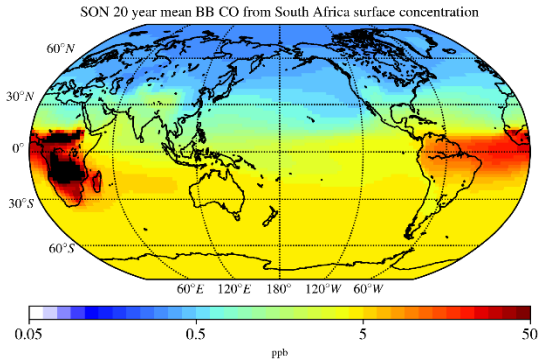


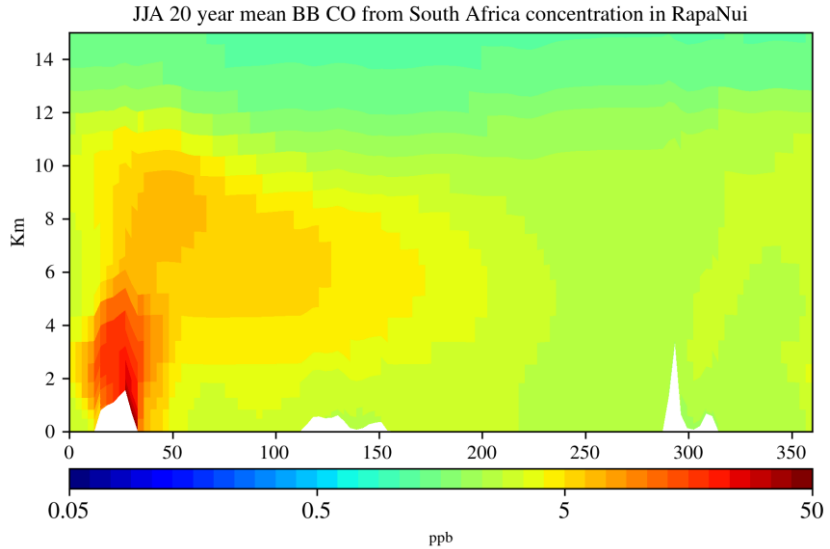
Mostly affecting the atmosphere above Australia

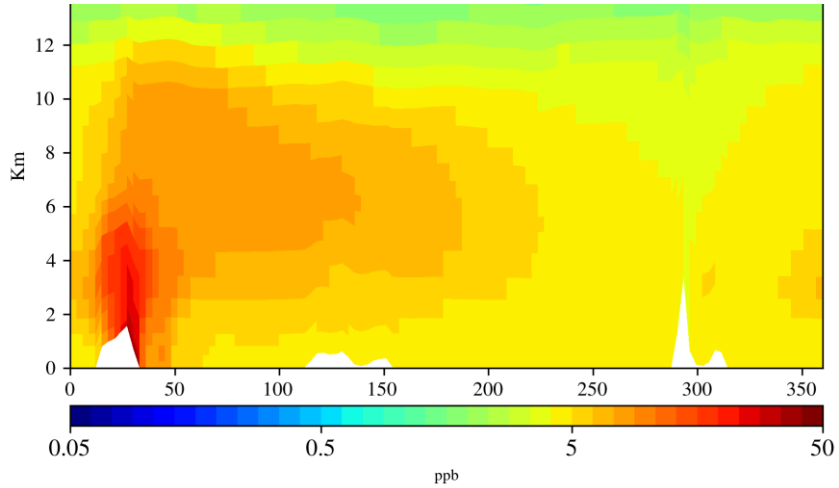
IMPACT OF SOUTH AFRICA
(I.E. ONLY EMISSIONS FROM S. AFRICAN BB)



Longitudinal cross section at the latitude of Easter Island

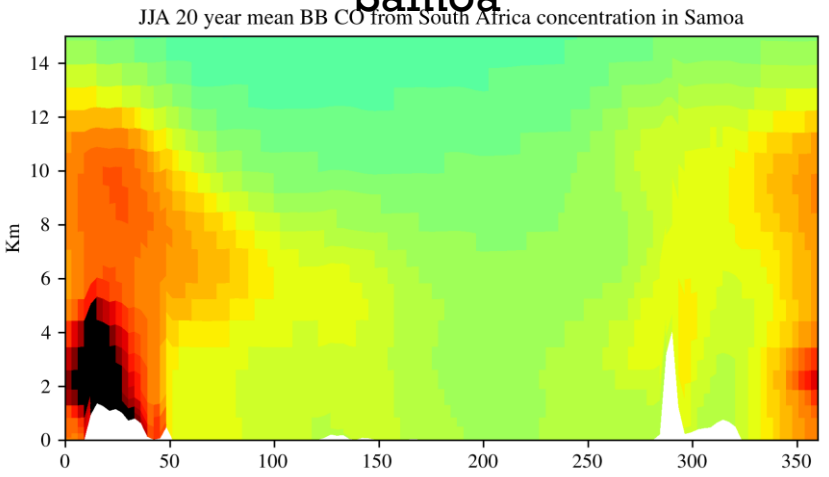
Easter Island





Samoa

JJA



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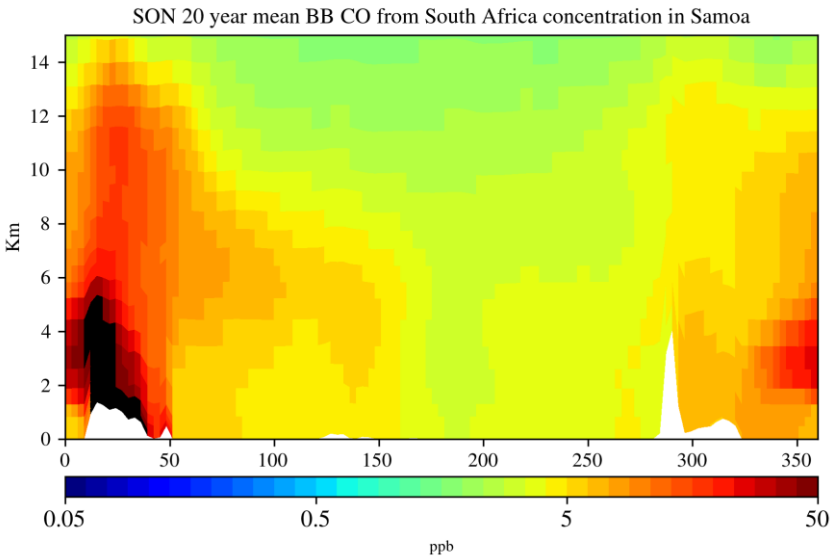
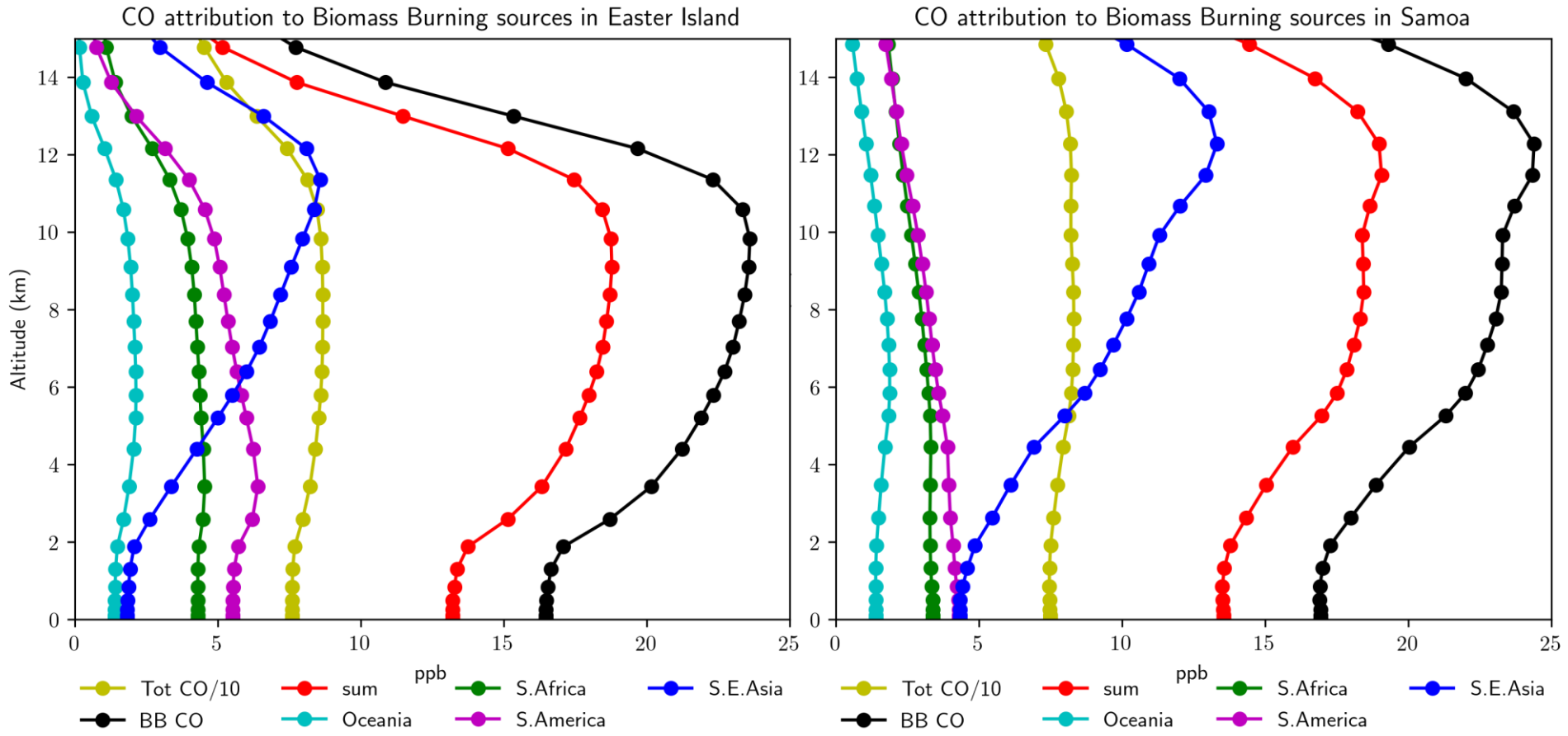


Longitudinal cross section at the latitude of Samoa

Two burning seasons, transported CO westward at Samoa latitude and both eastward and westward at Rapa Nui latitude

CO ATTRIBUTION TO BB SOURCES



CONCLUSIONS

- Biomass Burning affects the most pristine region of the world
- CO from Africa reaches the South Pacific following the westerlies
- CO from Indonesia
  - lifted up in by convection in the warm pool
  - spitted into an eastward and a westward flow
- CO from Oceania is lifted less than that from Indonesia
  - the bulk of the emissions are subject to the lower troposphere winds
- CO from South America in the lower troposphere is separated into two branches.
  - one small part blowing towards the Pacific following the trade winds
  - another drawn into the southward low-level jet

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THANK YOU