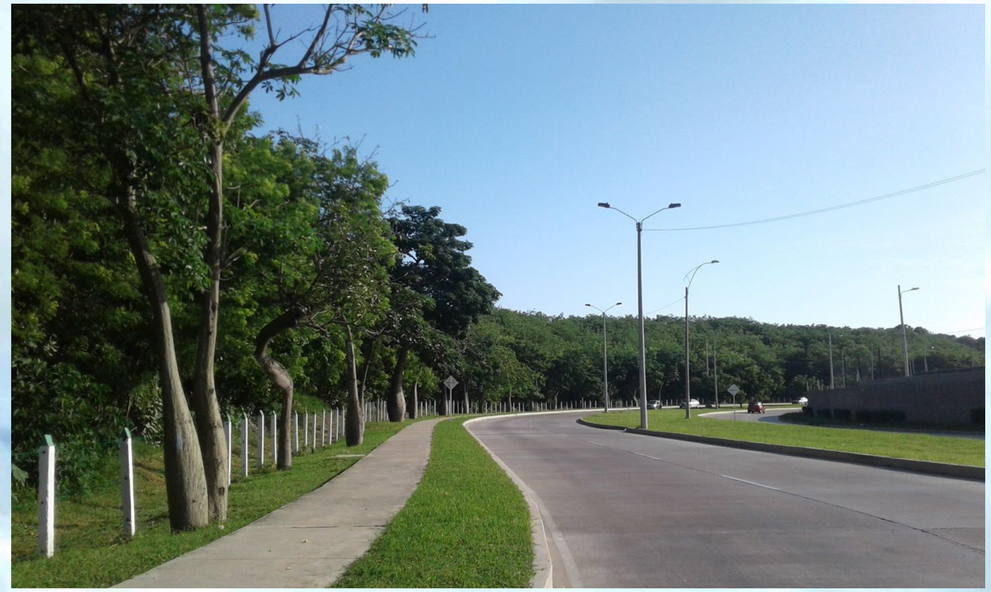
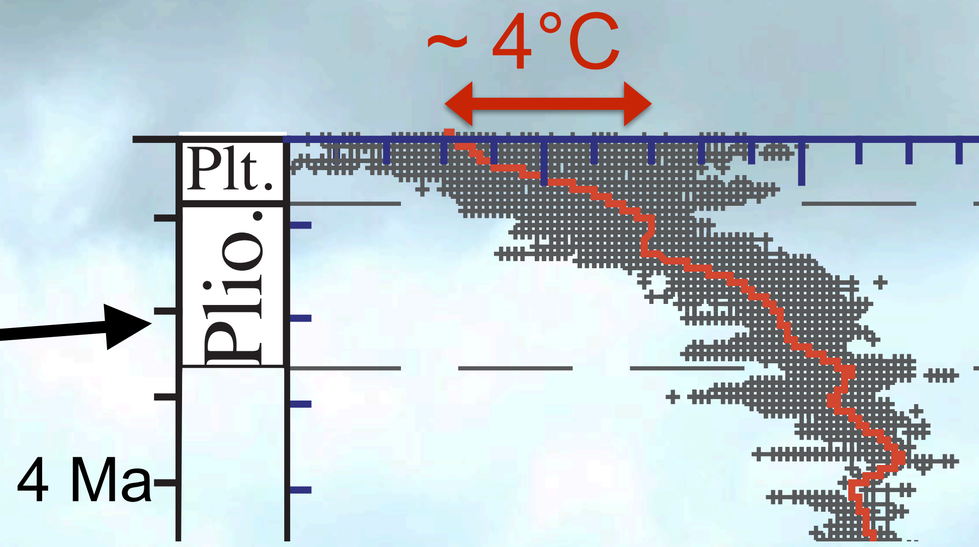


La Arenosa

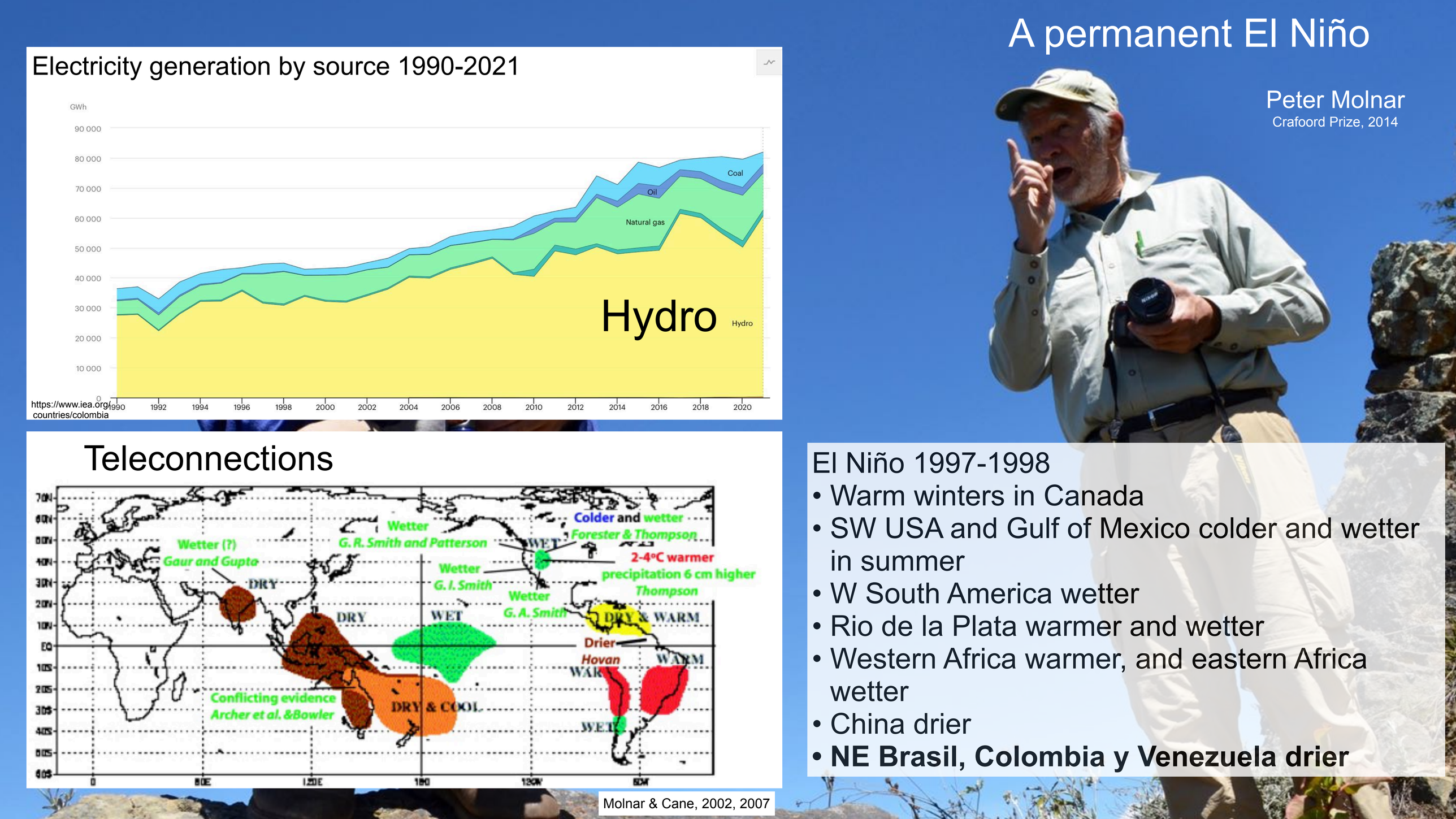
Pliocene,
~5-3 Ma



Dunes

Cra 53

A permanent El Niño



Peter Molnar
Crafoord Prize, 2014

Electricity generation by source 1990-2021

https://www.iea.org/countries/colombia

Teleconnections

Molnar & Cane, 2002, 2007

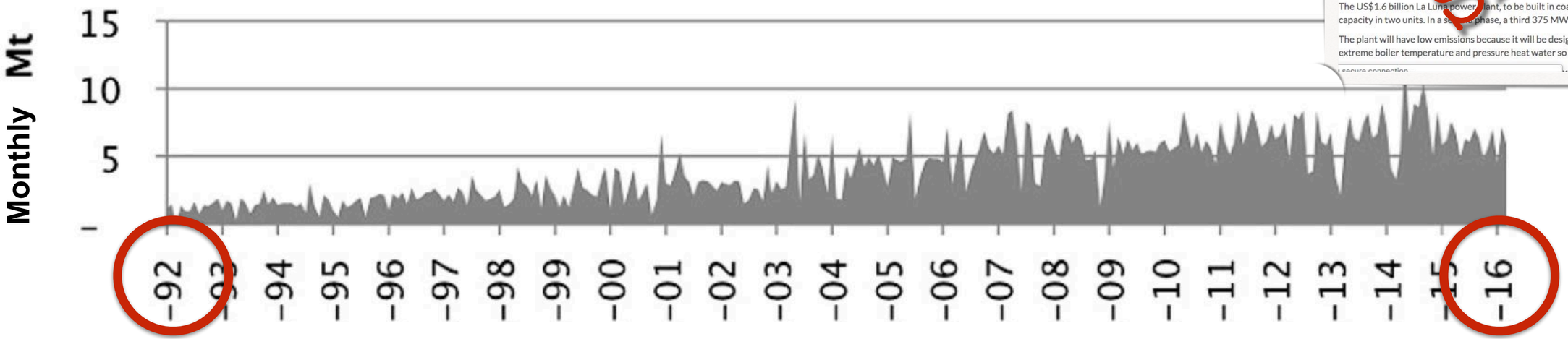
El Niño 1997-1998

- Warm winters in Canada
- SW USA and Gulf of Mexico colder and wetter in summer
- W South America wetter
- Rio de la Plata warmer and wetter
- Western Africa warmer, and eastern Africa wetter
- China drier
- **NE Brasil, Colombia y Venezuela drier**

Colombia Aberrant

- Peak ~ 90 millon t thermal coal a year
  - 2.5 x1018 Jules (2.5 exa-Jules)
- Enough to feed 60 600MW power plants a year
- Colombia is always on the verge of rolling blackouts (1992, 2016), result of El Niño

Shelved

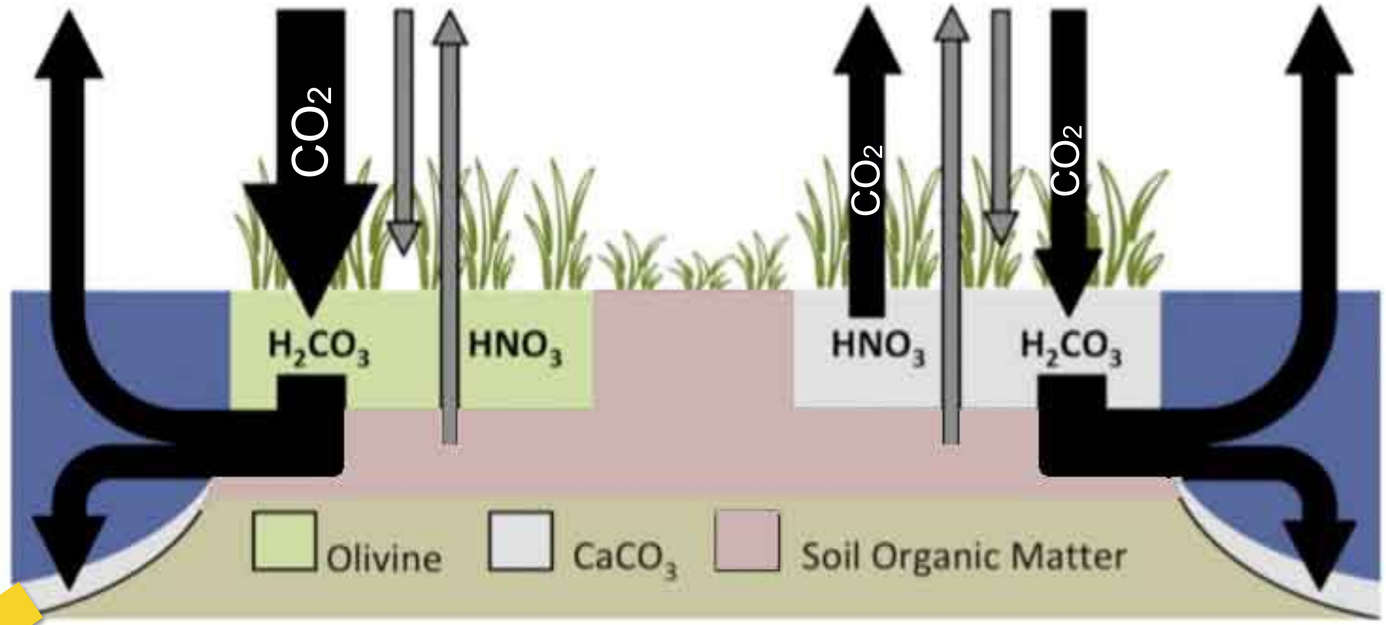


https://www.worldcoal.com/power/10072018/sloane-energy-to-build-la-luna-power-plant-in-colombia/

Oei & Medelevitch, 2016

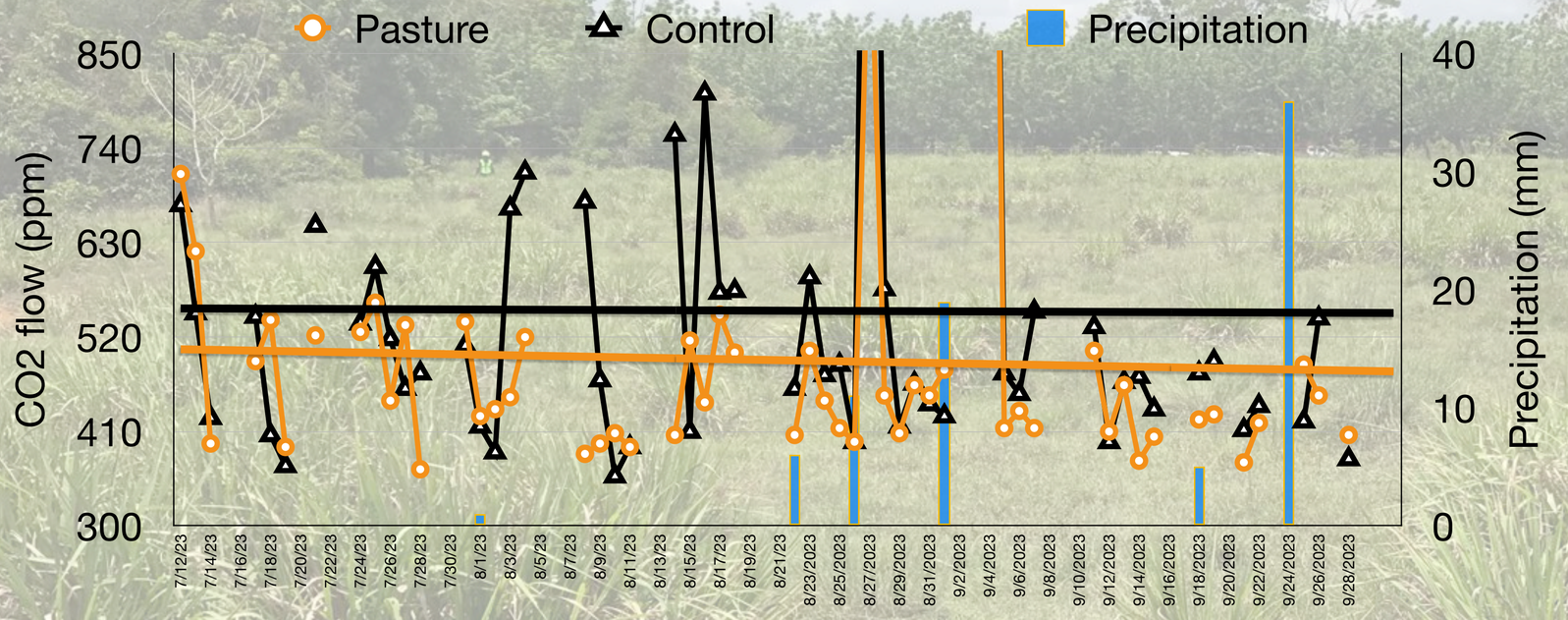
ERW

- Enhanced Rock Weathering
- Natural process, accelerated by grinding
- Low-tech, faster in the tropics
- Modulates soil acidity, preventing emissions
- Coupled to tropical agriculture and mining
- Sold as carbon credit



$$Mg_2SiO_4 + 4\ CO_2 + 4\ H_2O \Rightarrow 2\ Mg_2+ + 4\ HCO_3^- + H_4SiO_4$$

Dietzen, et al., 2019
Moosdorf, et al., 2014


Pasture
Control
Precipitation
CO2 flow (ppm)
850
740
630
520
410
300
40
30
20
10
0
Precipitation (mm)
7/12/23
7/14/23
7/16/23
7/18/23
7/20/23
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7/28/23
7/30/23
8/1/23
8/3/23
8/5/23
8/7/23
8/9/23
8/11/23
8/13/23
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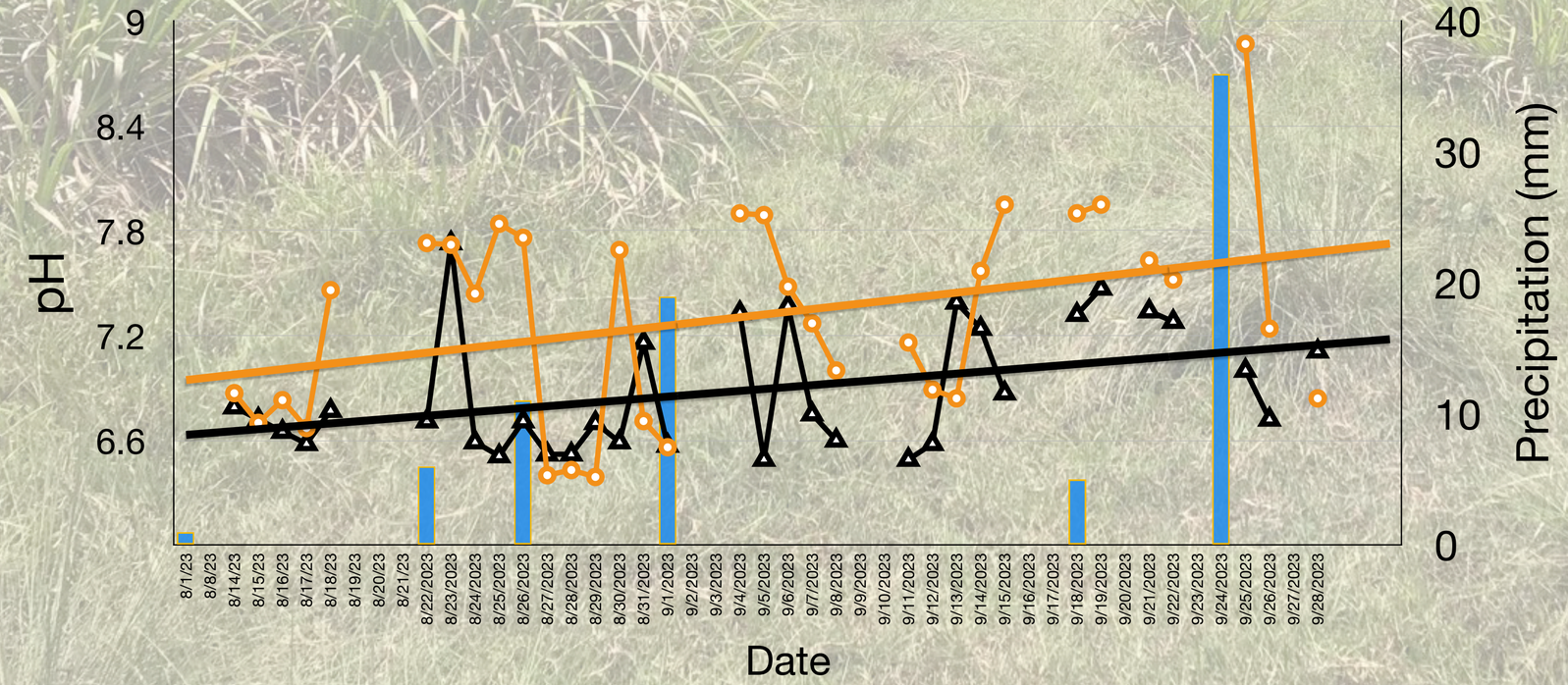
pH
9
8.4
7.8
7.2
6.6
40
30
20
10
0
Precipitation (mm)
8/1/23
8/8/23
8/14/23
8/15/23
8/16/23
8/17/23
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9/28/2023
Date


030553
030552B
Pasture
Control
Gil, (in prep.)

ERW Colombia

- For ~9 million hectares of cropland:
- 0.3 tons of CO_2 captured per ton of basalt, 3 times a year
- ~81 million tons of CO_2 (Colombia's emissions)
- ~67 M m^3 of mafic rocks needed (cube 400 m/yr)
- Emissions related to mining, transport, grinding and application ~0.5 y 3% (Brazil)
- Costs ~ US$50/t of mafic rock (Brazil)
- US$ 140 / ha if carbon credit US$ 180

~ 48 M ha of cropland (81% pastures)

4.8. M ha (~10%) croplands

Routinely use lime to modulate acidity

Beerling, et al., 2020
Moosdorf, 2014
Strefler, 2018

- Gracias

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