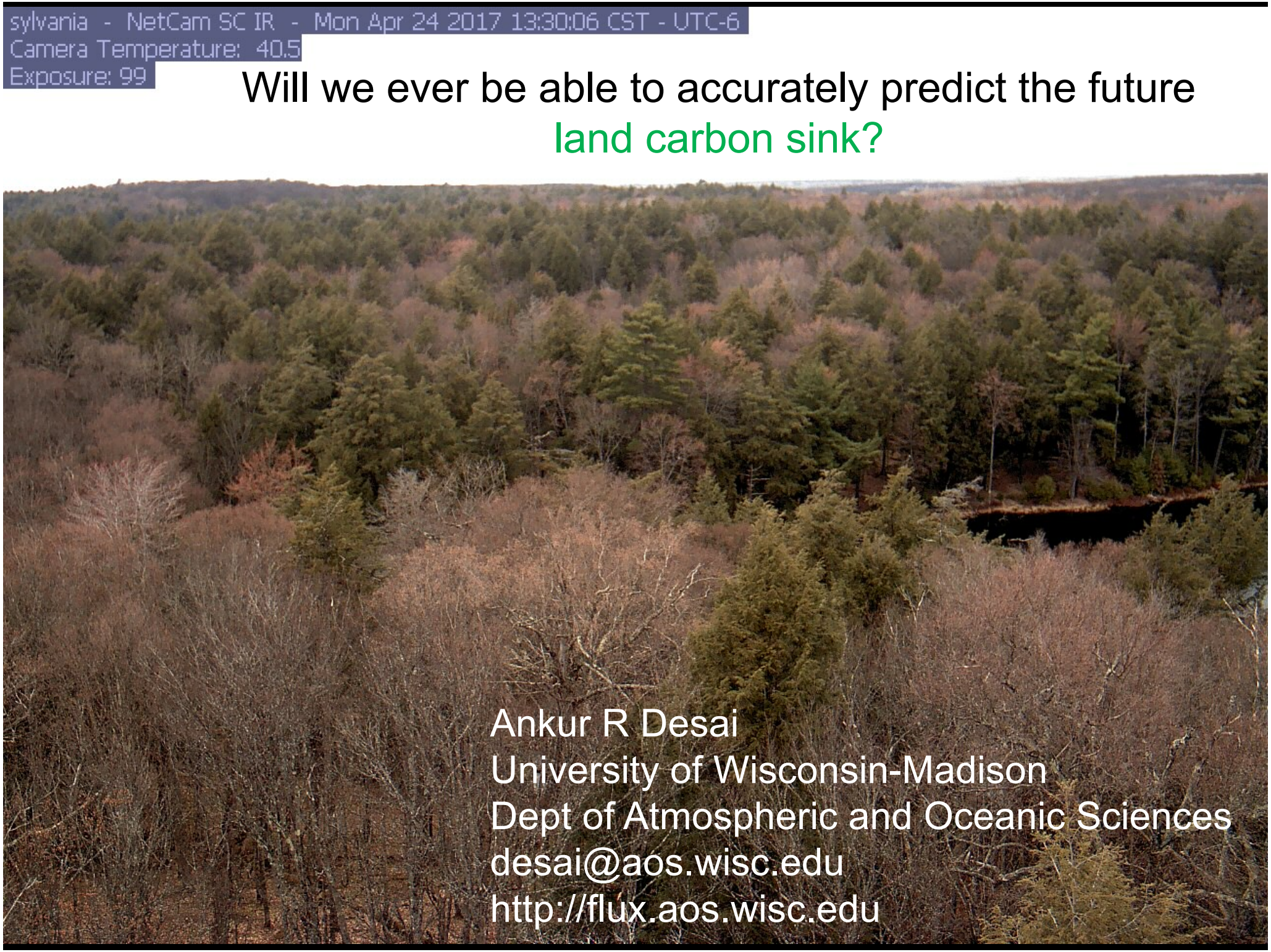

Will we ever be able to accurately predict the future land carbon sink?

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NO

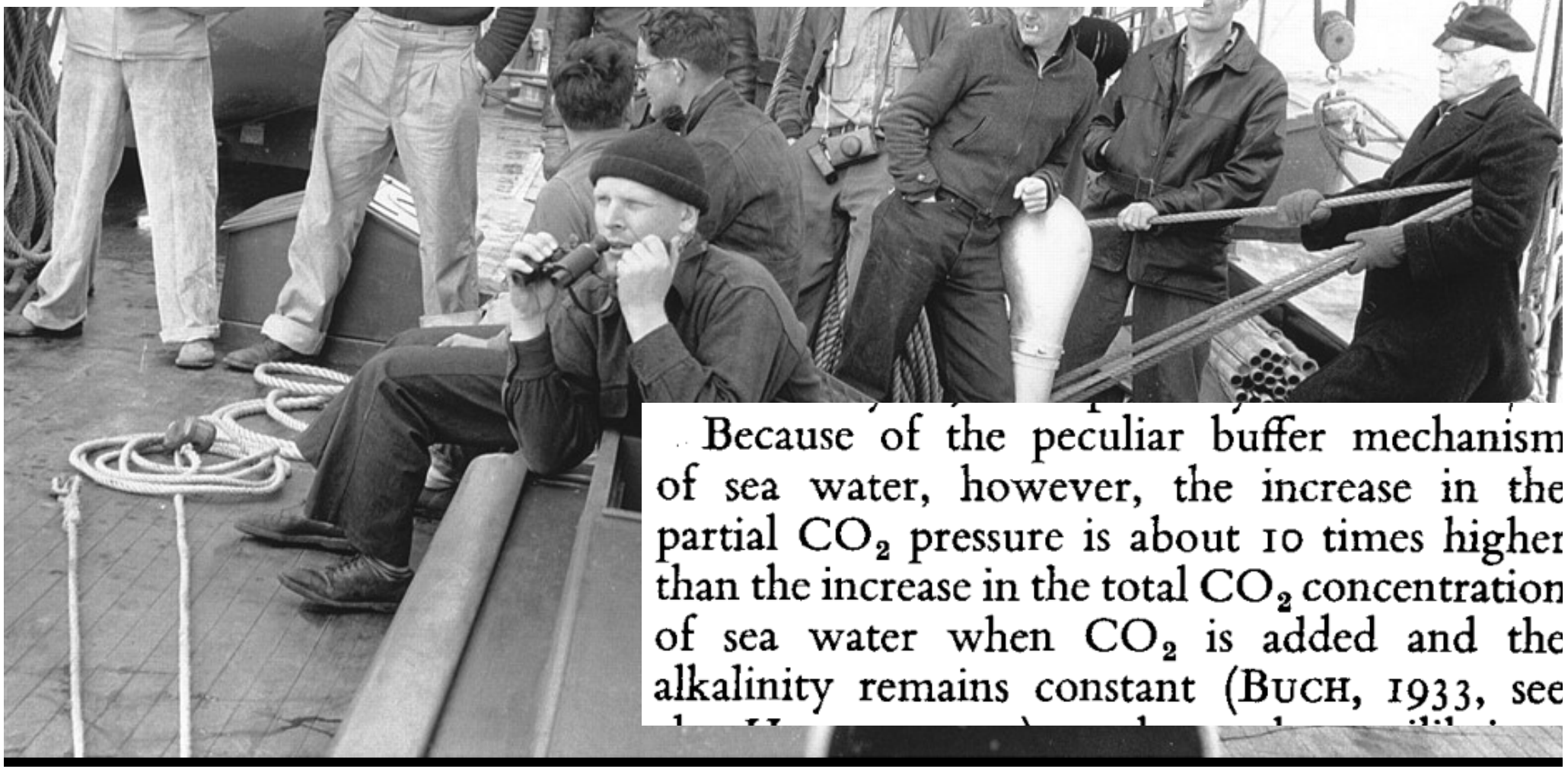
NO

But we can probably figure out what observational constraints are needed to better project its impact on future anthropogenic climate change

Carbon Dioxide Exchange Between Atmosphere and Ocean and the Question of an Increase of Atmospheric CO_2 during the Past Decades

By ROGER REVELLE and HANS E. SUESS, Scripps Institution of Oceanography, University of California, La Jolla, California

(Manuscript received September 4, 1956)

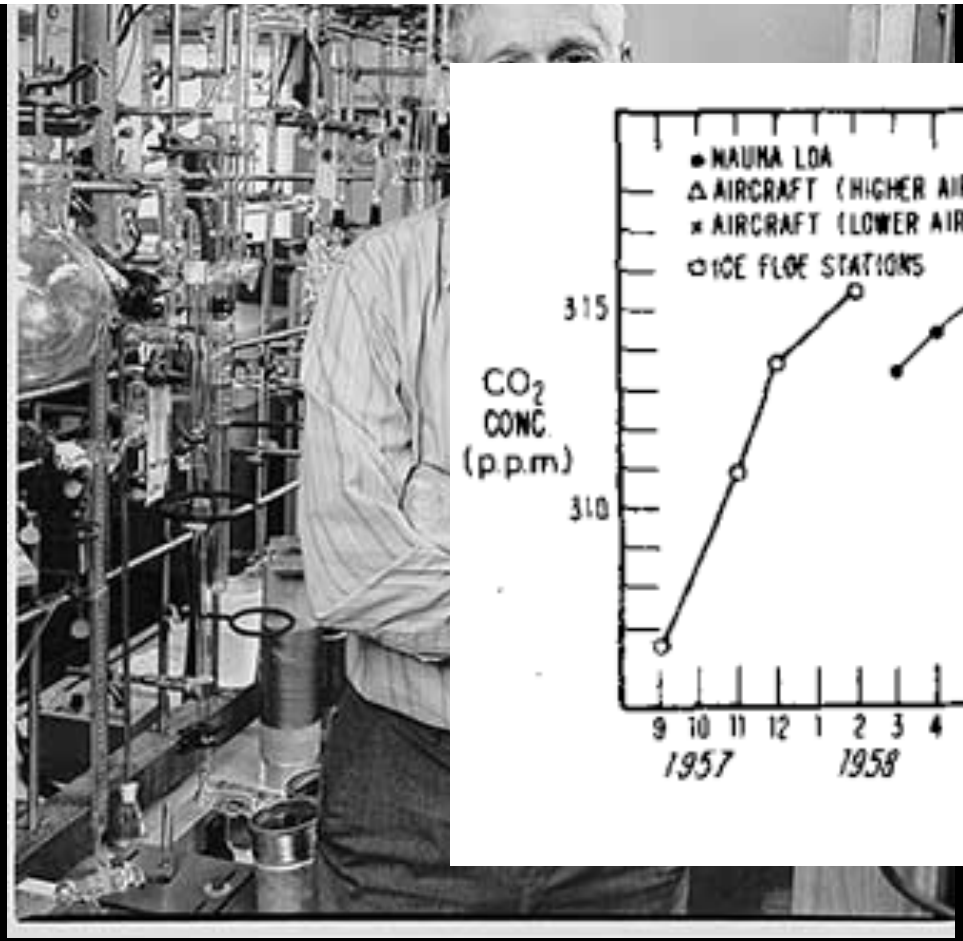


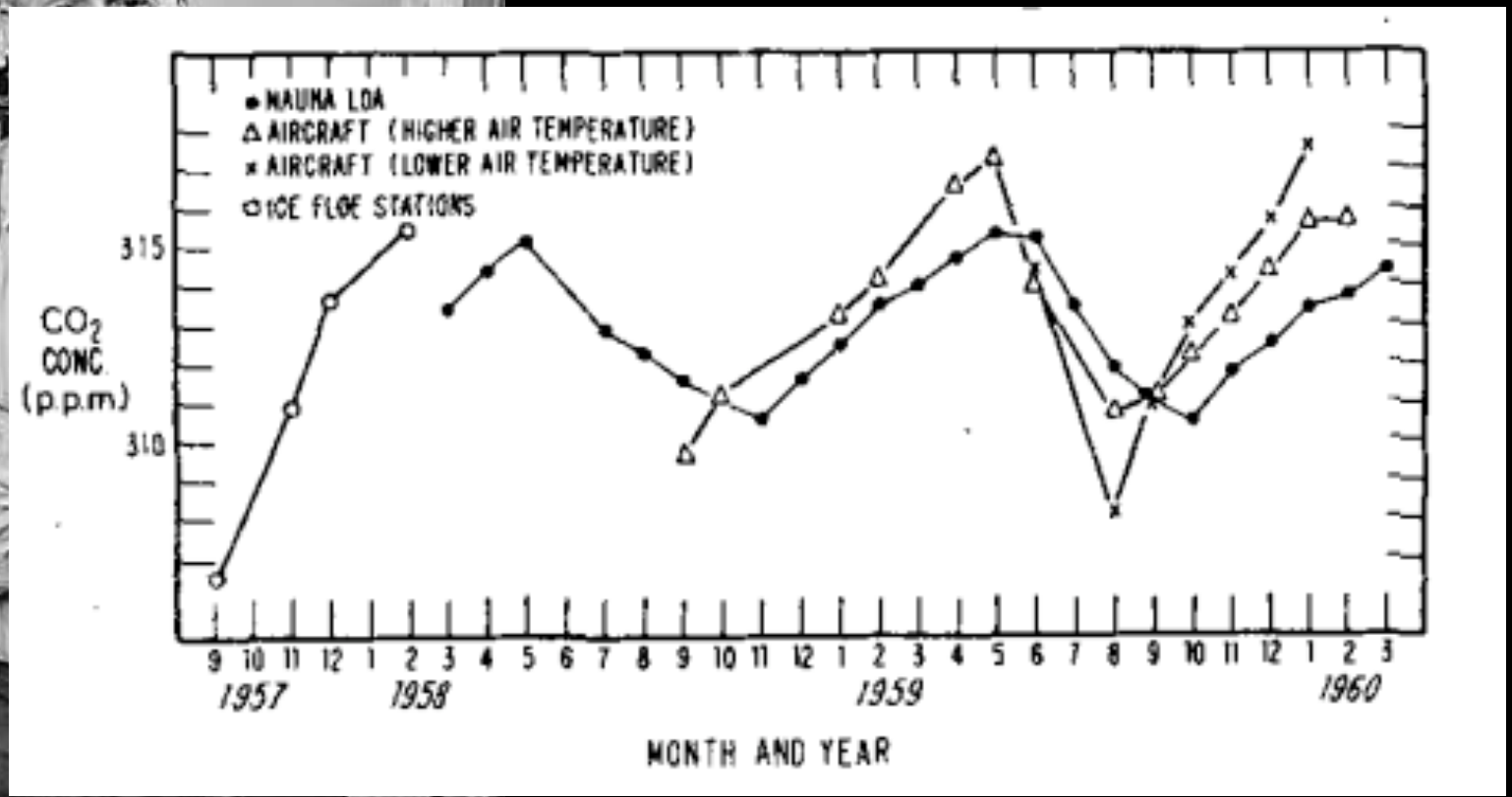
Because of the peculiar buffer mechanism of sea water, however, the increase in the partial CO_2 pressure is about 10 times higher than the increase in the total CO_2 concentration of sea water when CO_2 is added and the alkalinity remains constant (BUCH, 1933, see

The Concentration and Isotopic Abundances of Carbon Dioxide in the Atmosphere

By CHARLES D. KEELING, Scripps Institution of Oceanography, University of California, La Jolla, California

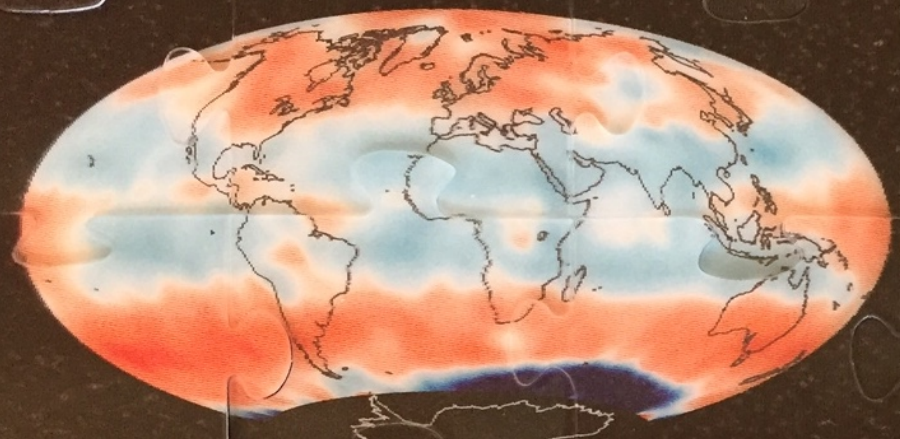
(Manuscript received March 25, 1960)



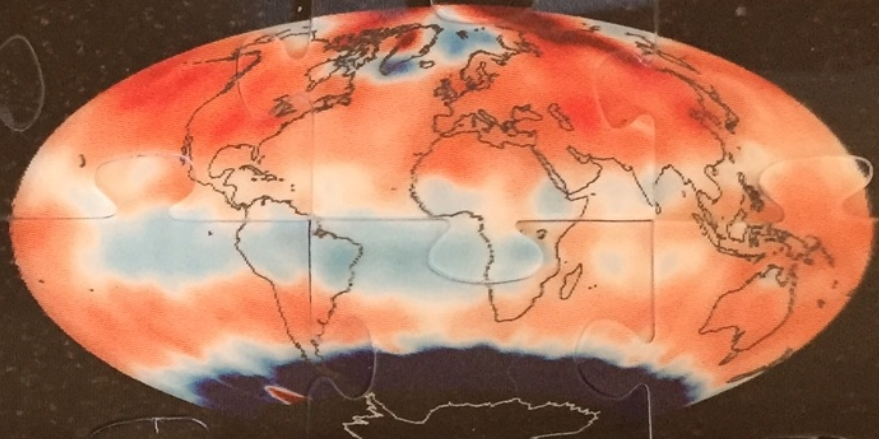


Seasonal Carbon Dioxide
2014 – 2015

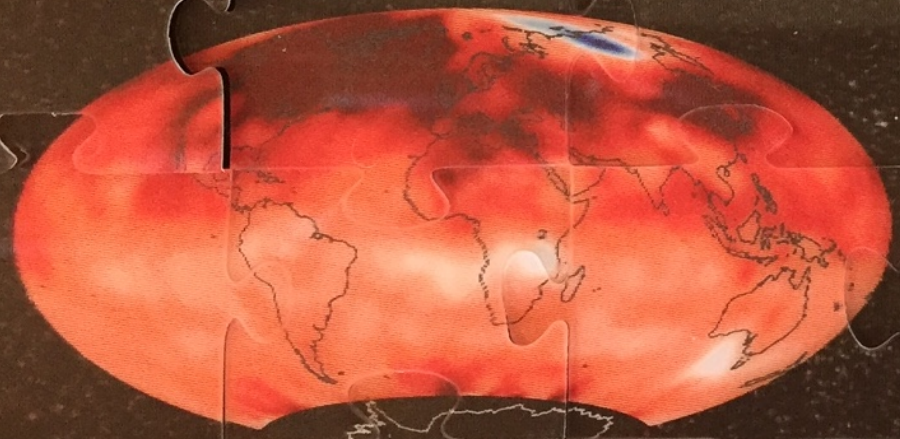
National Aeronautics and Space Administration



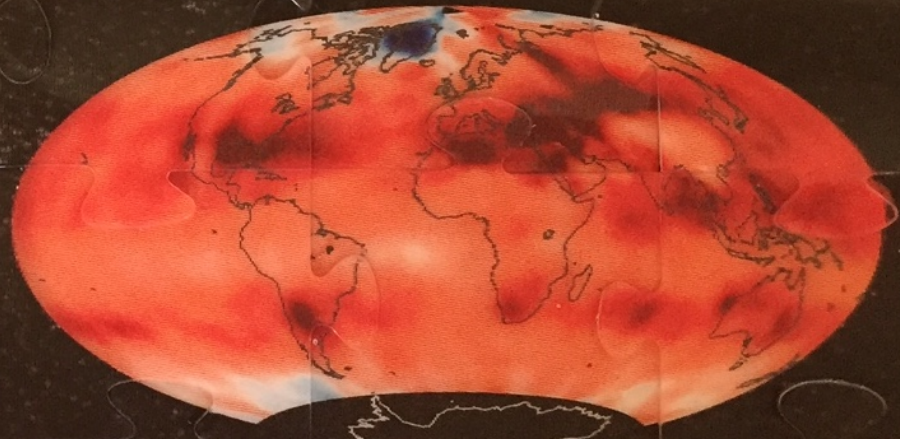
October



January



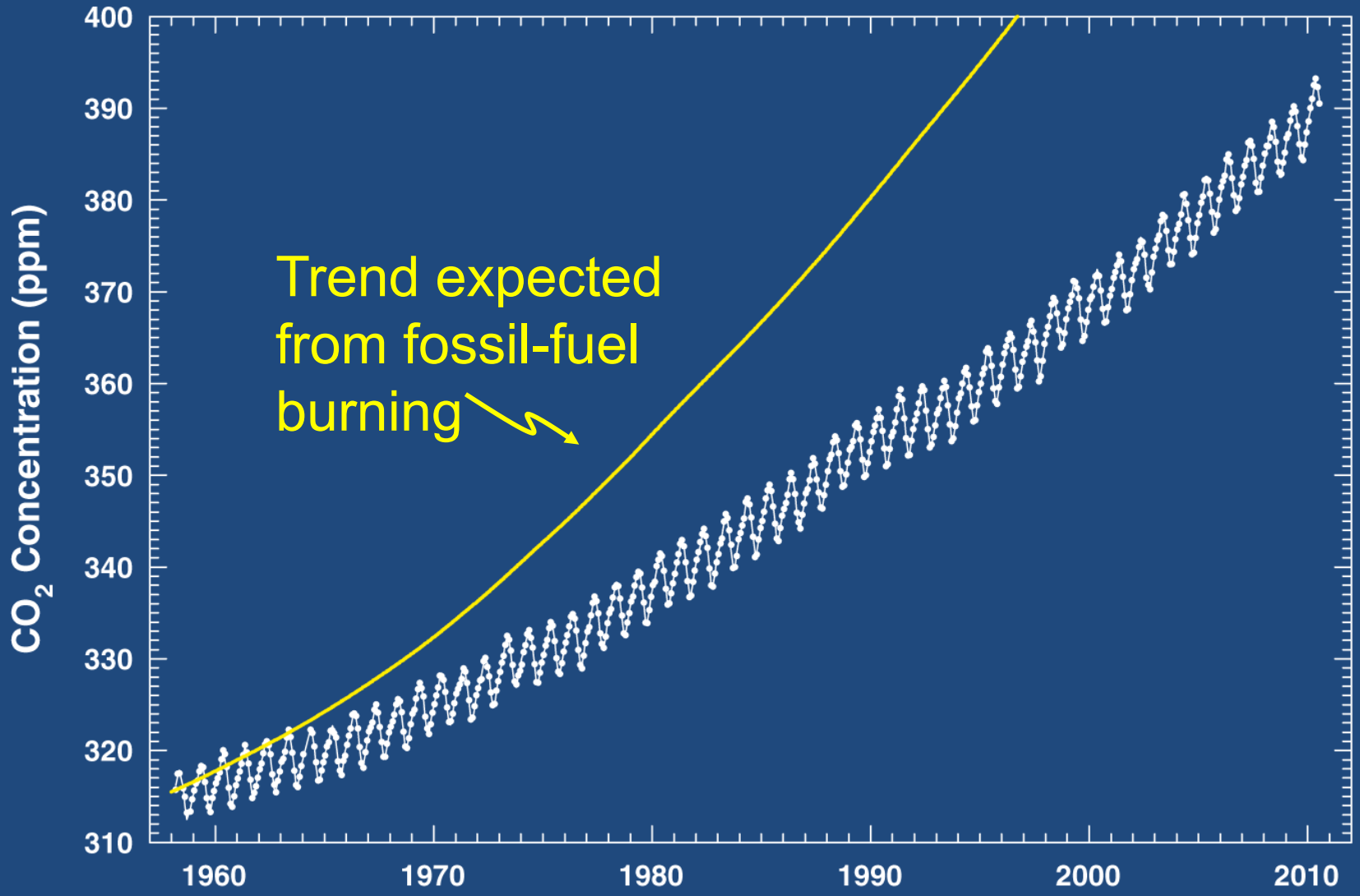
April



July

Carbon Dioxide (ppm)

390 395 400 405


400
390
380
370
360
350
340
330
320
310
CO_2 Concentration (ppm)
1960
1970
1980
1990
2000
2010
Trend expected
from fossil-fuel
burning

Global carbon budget

The cumulative contributions to the global carbon budget from 1870

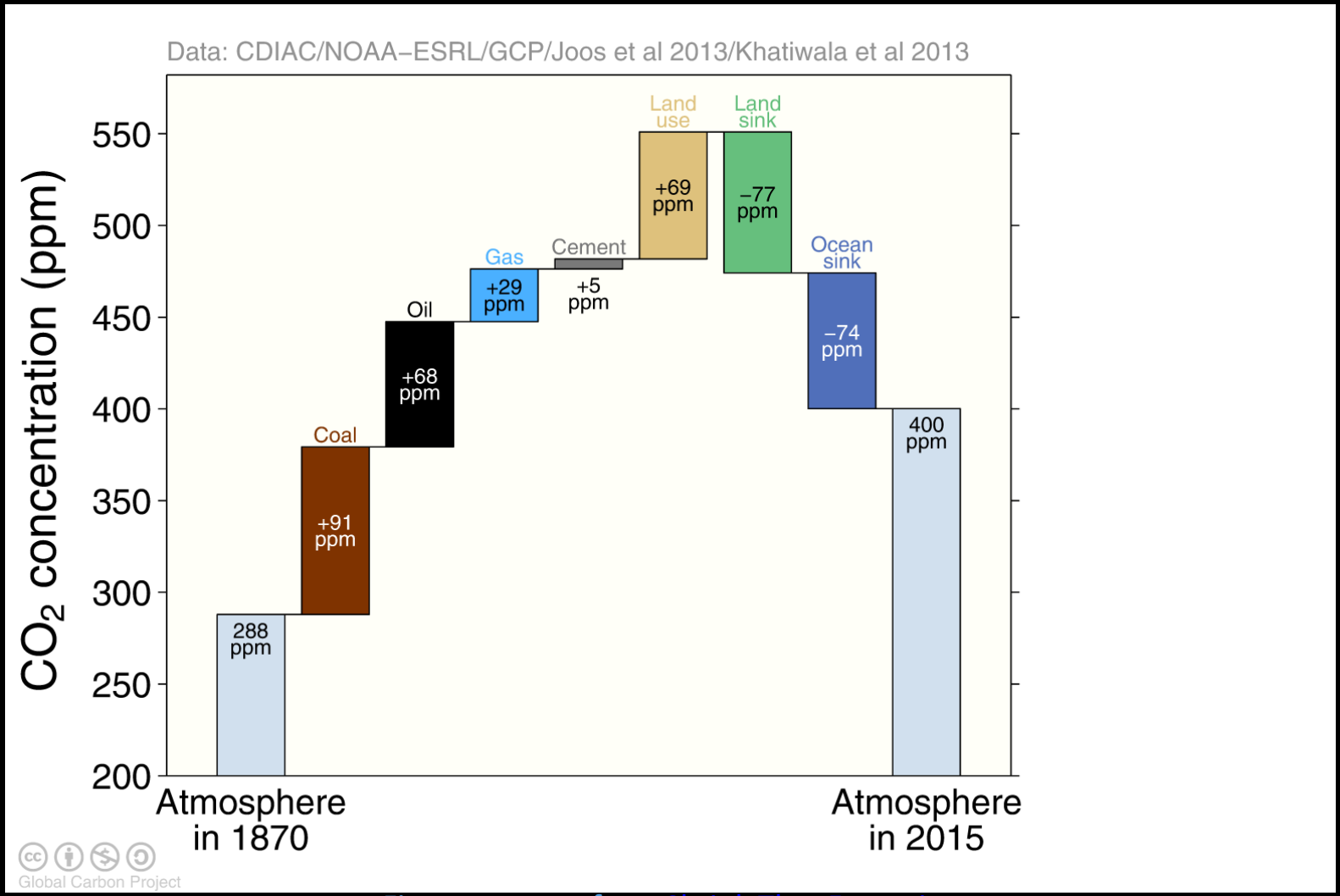


Figure concept from Shrink That Footprint

Source: CDIAC; NOAA-ESRL; Houghton et al 2012; Giglio et al 2013; Joos et al 2013; Khatiwala et al 2013; Le Quéré et al 2016; Global Carbon Budget 2016

Fate of anthropogenic CO_2 emissions (2006-2015)

34.1 $GtCO_2$/yr

91%

9%

3.5 $GtCO_2$/yr

Sources = Sinks

16.4 $GtCO_2$/yr

44%

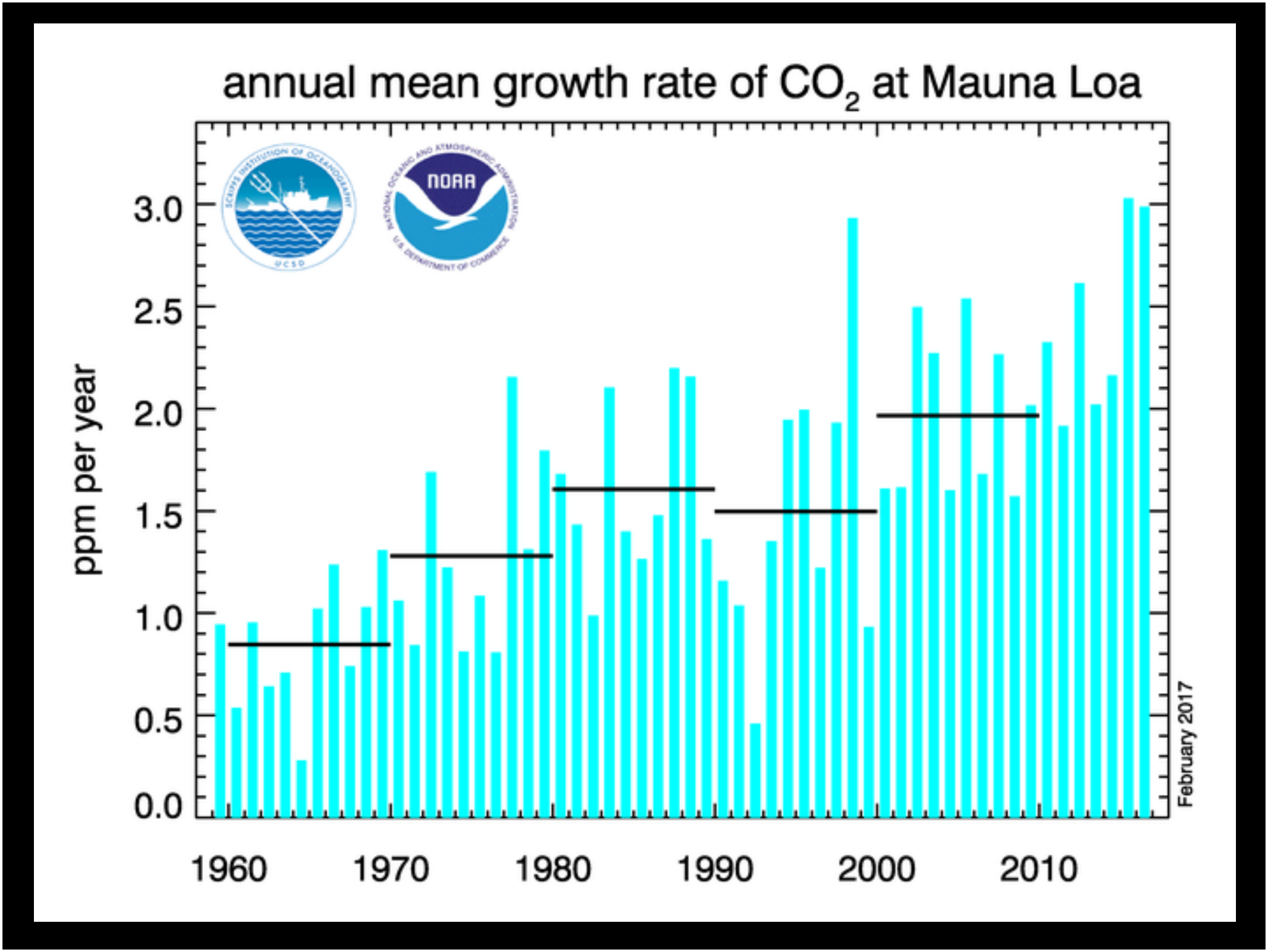
31%

11.6 $GtCO_2$/yr

26%

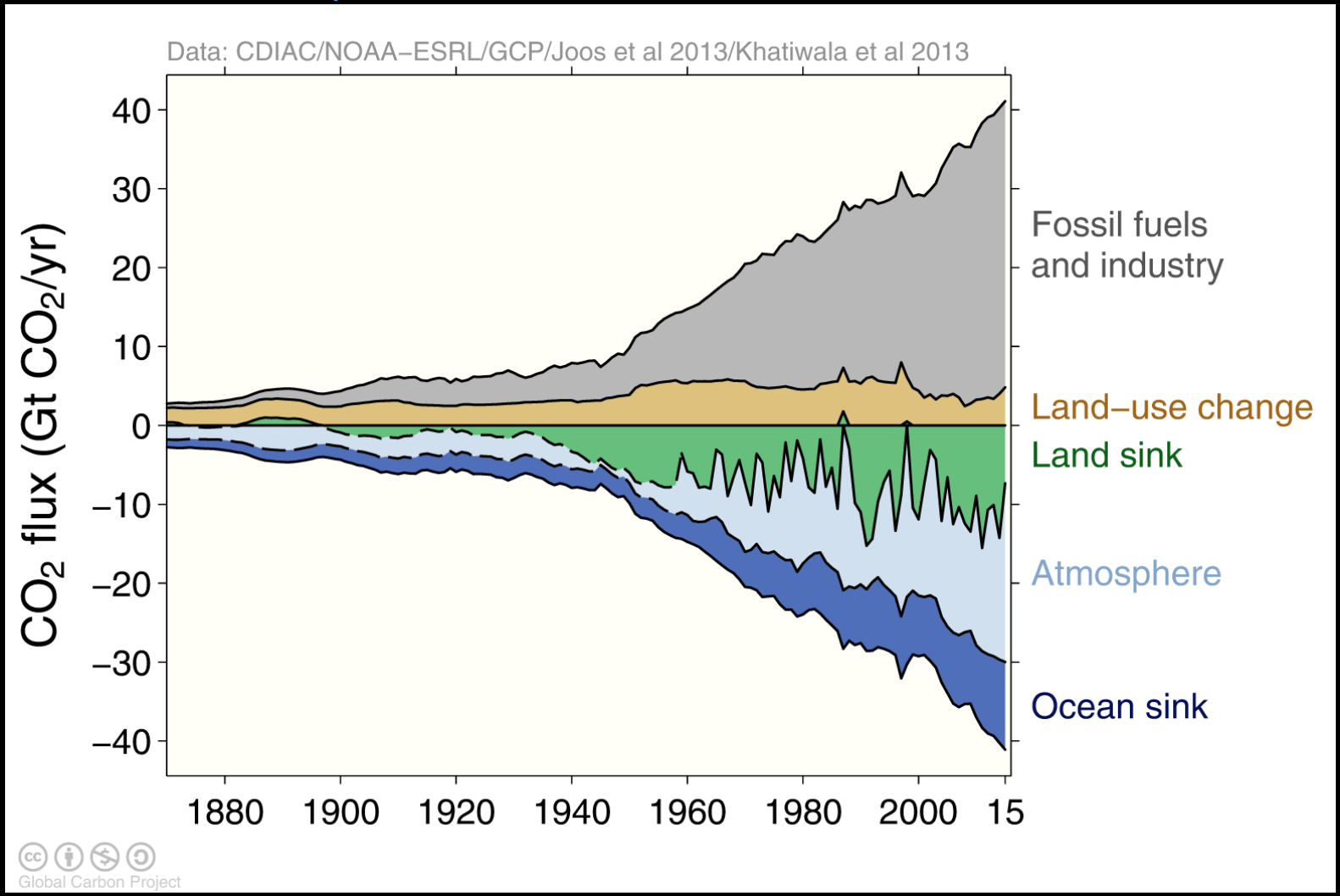
9.7 $GtCO_2$/yr

Source: CDIAC; NOAA-ESRL; Houghton et al 2012; Giglio et al 2013; Le Quéré et al 2016; Global Carbon Budget 2016

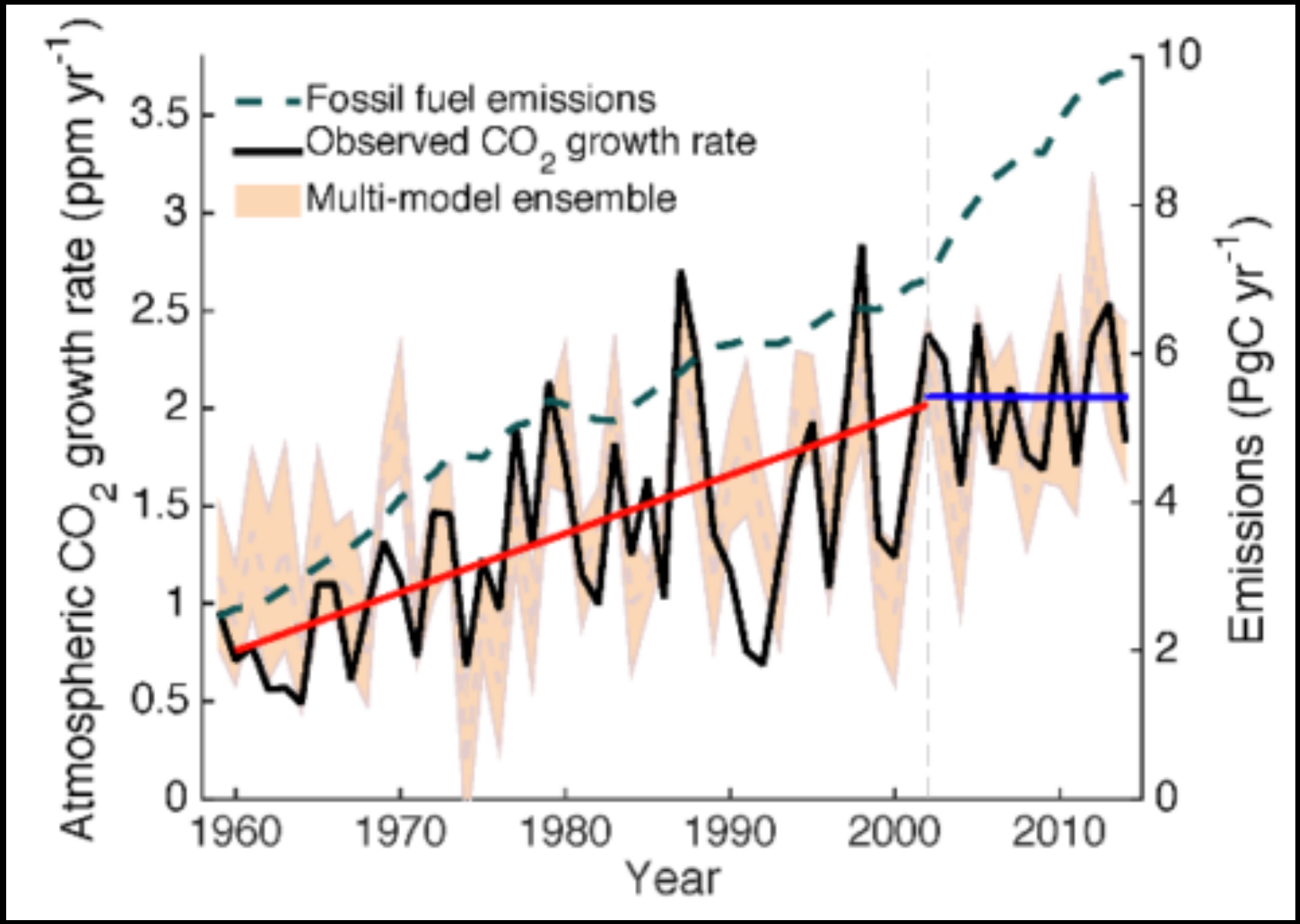

annual mean growth rate of CO_2 at Mauna Loa
ppm per year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1960
1970
1980
1990
2000
2010
February 2017
NOAA

Global carbon budget

The carbon sources from fossil fuels, industry, and land use change emissions are balanced by the atmosphere and carbon sinks on land and in the ocean

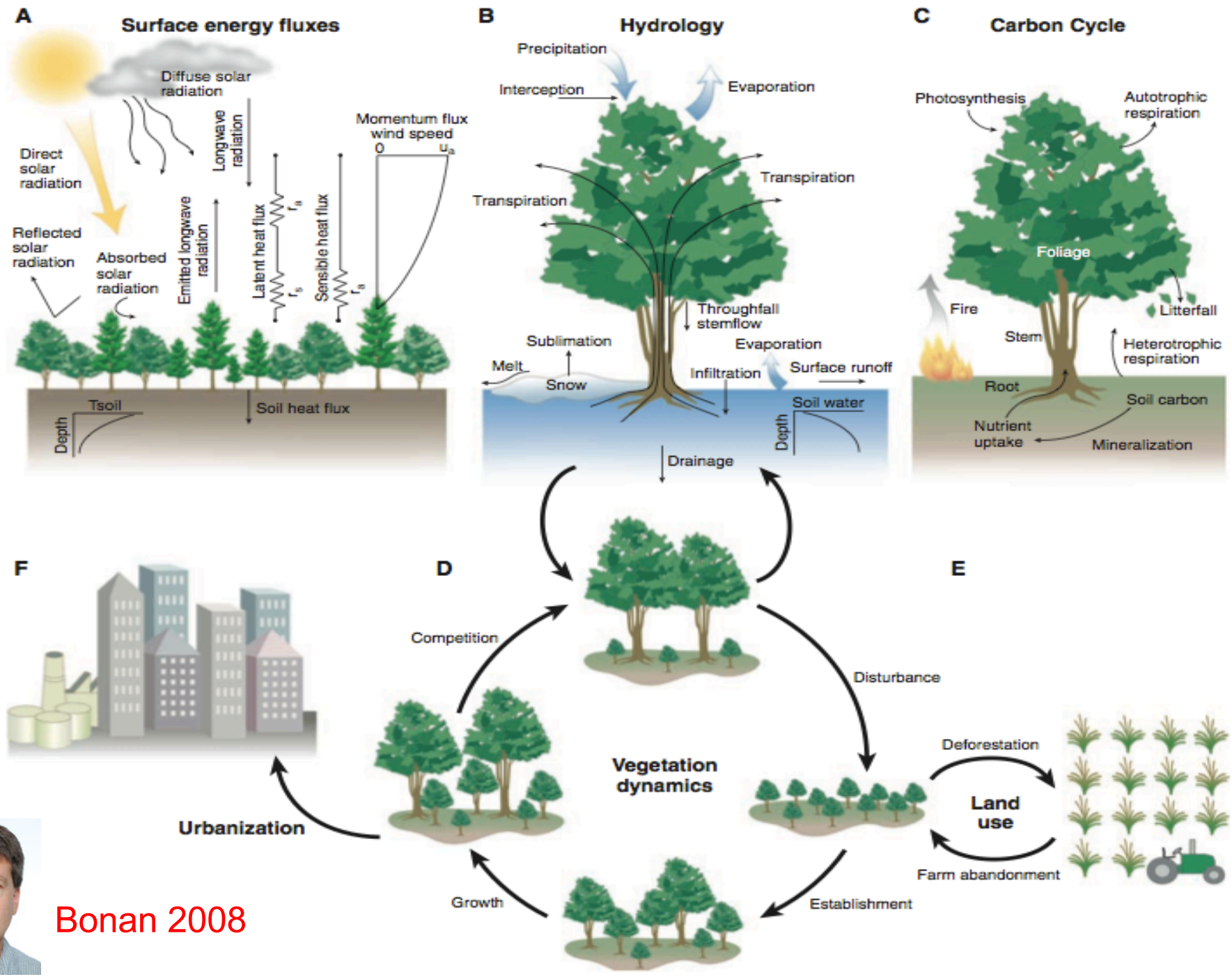


Source: CDIAC; NOAA-ESRL; Houghton et al 2012; Giglio et al 2013; Joos et al 2013; Khatiwala et al 2013; Le Quéré et al 2016; Global Carbon Budget 2016

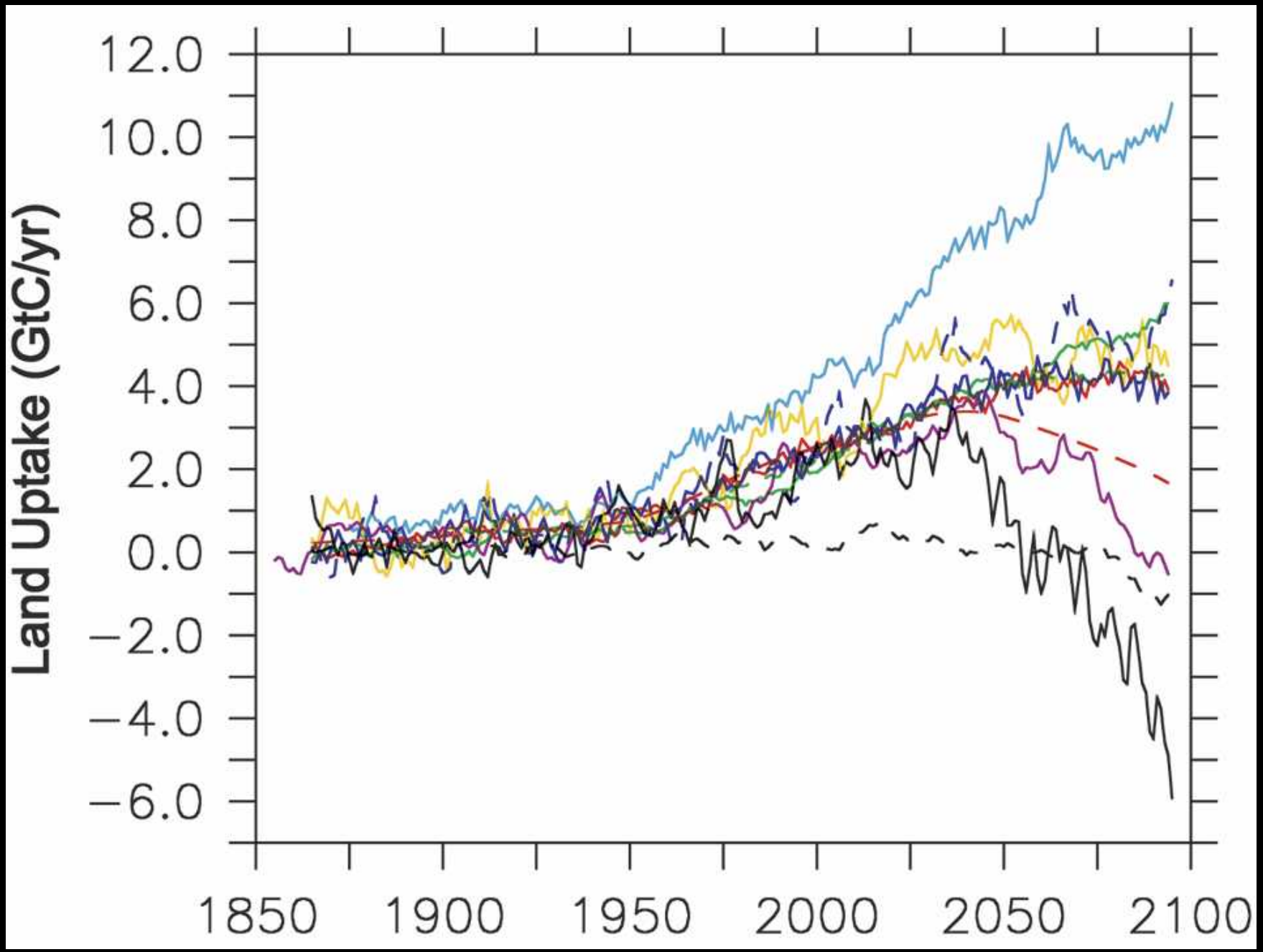


Keenan et al 2016

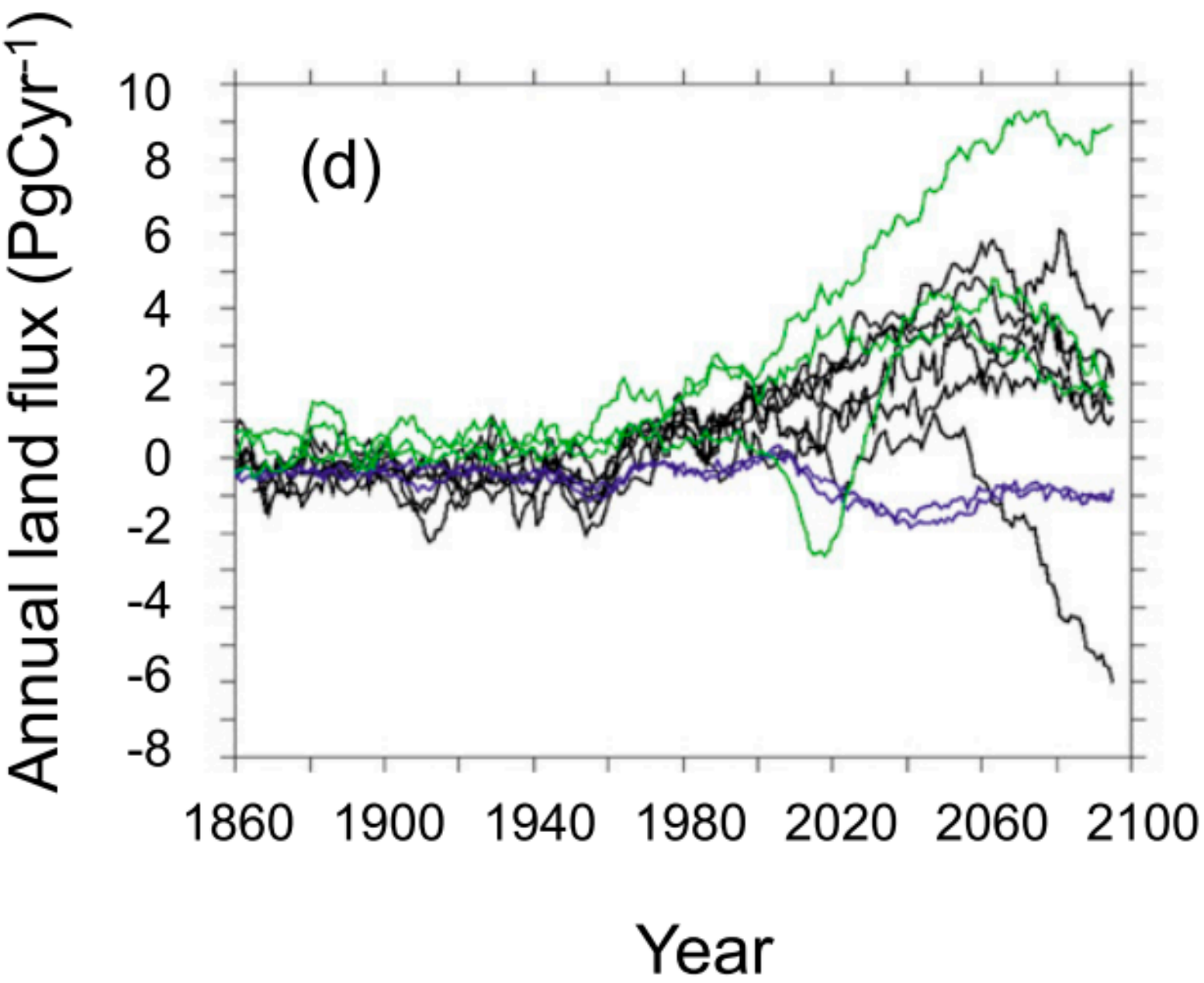
Forests in Flux



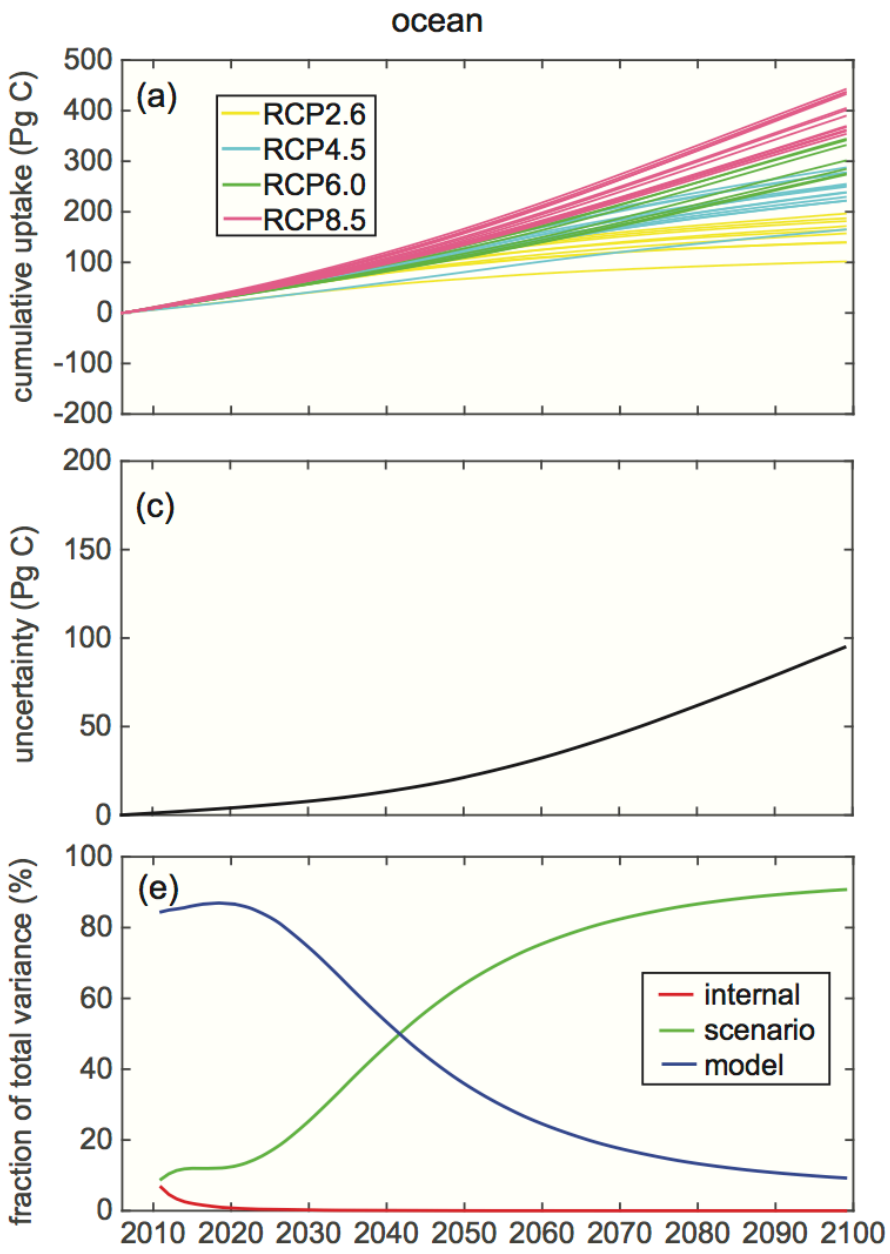
Bonan 2008



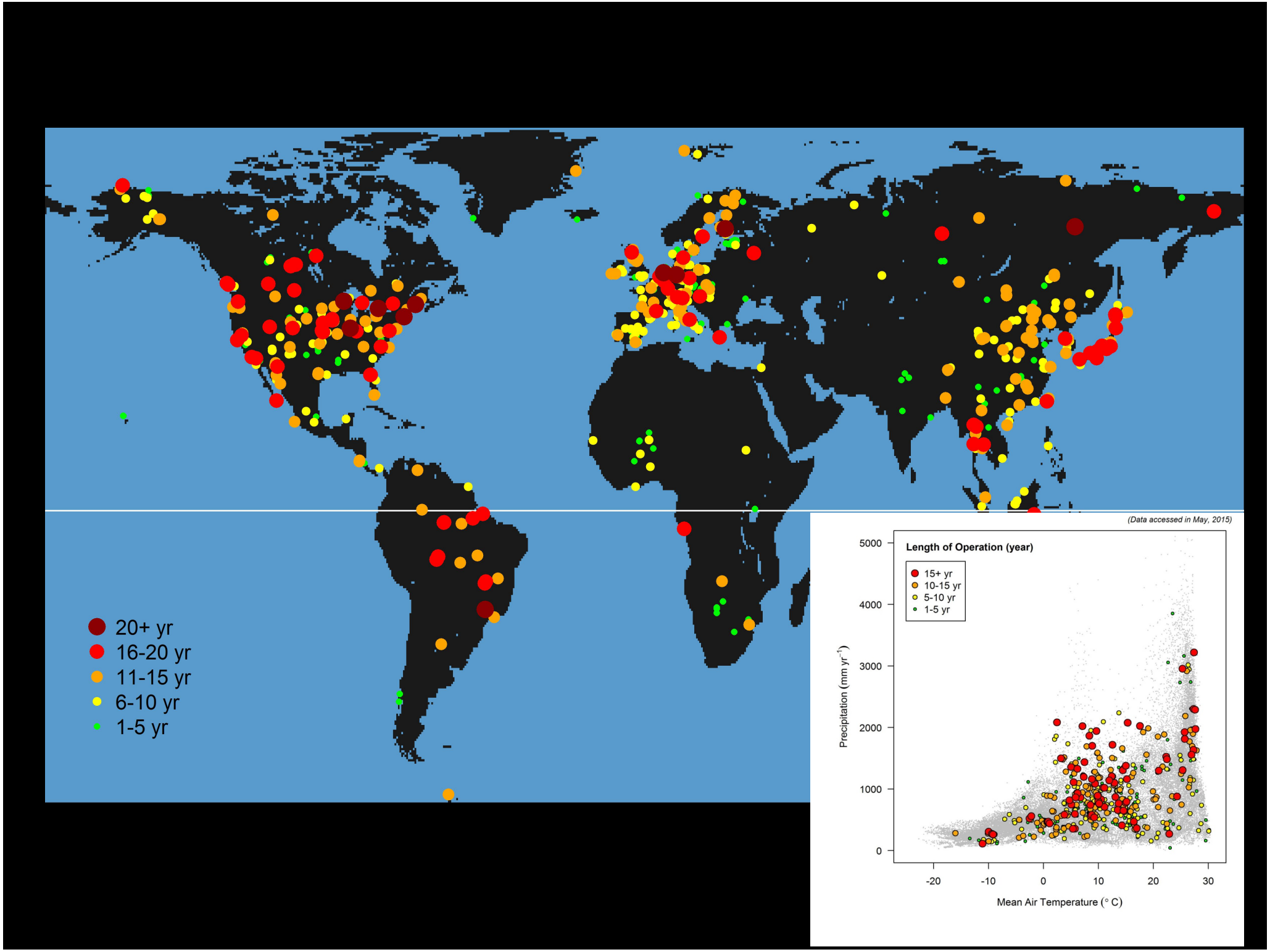
Friedlingstein et al., 2006

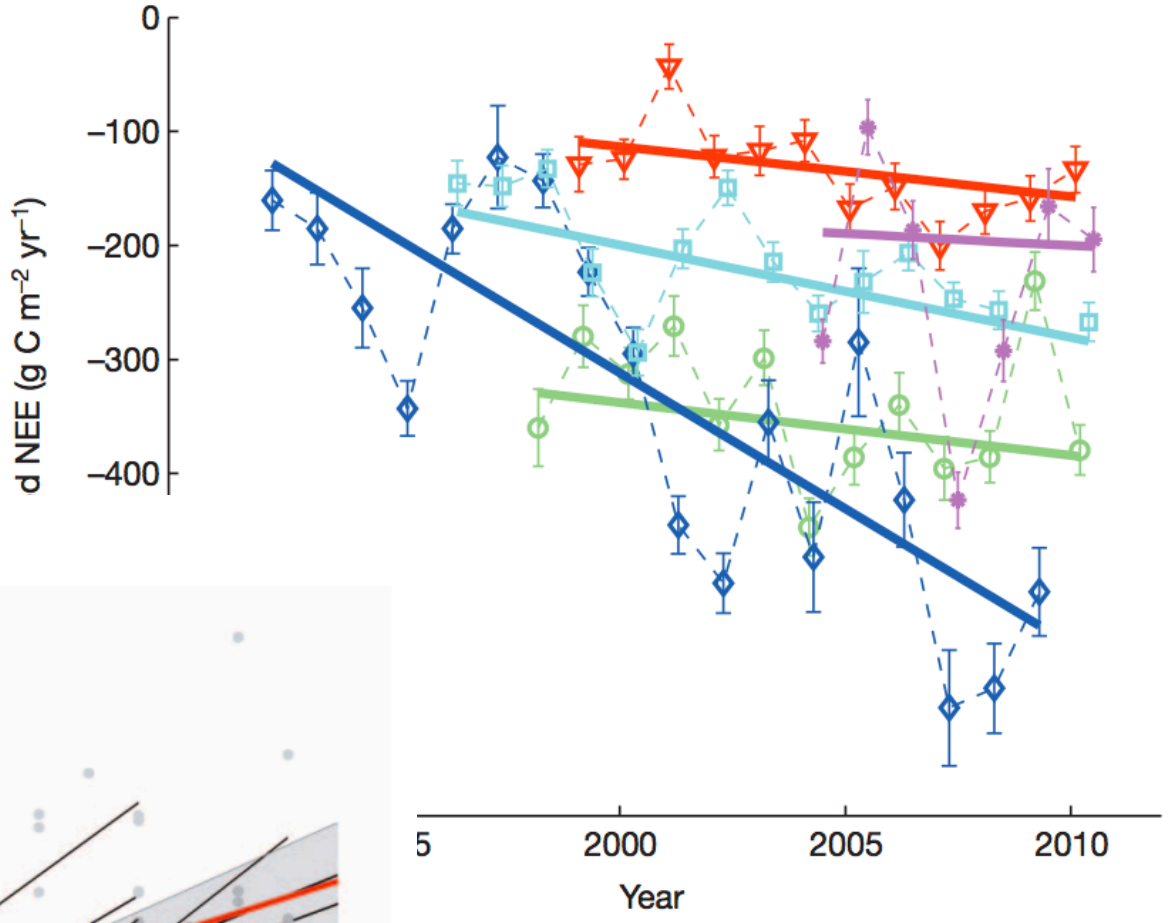


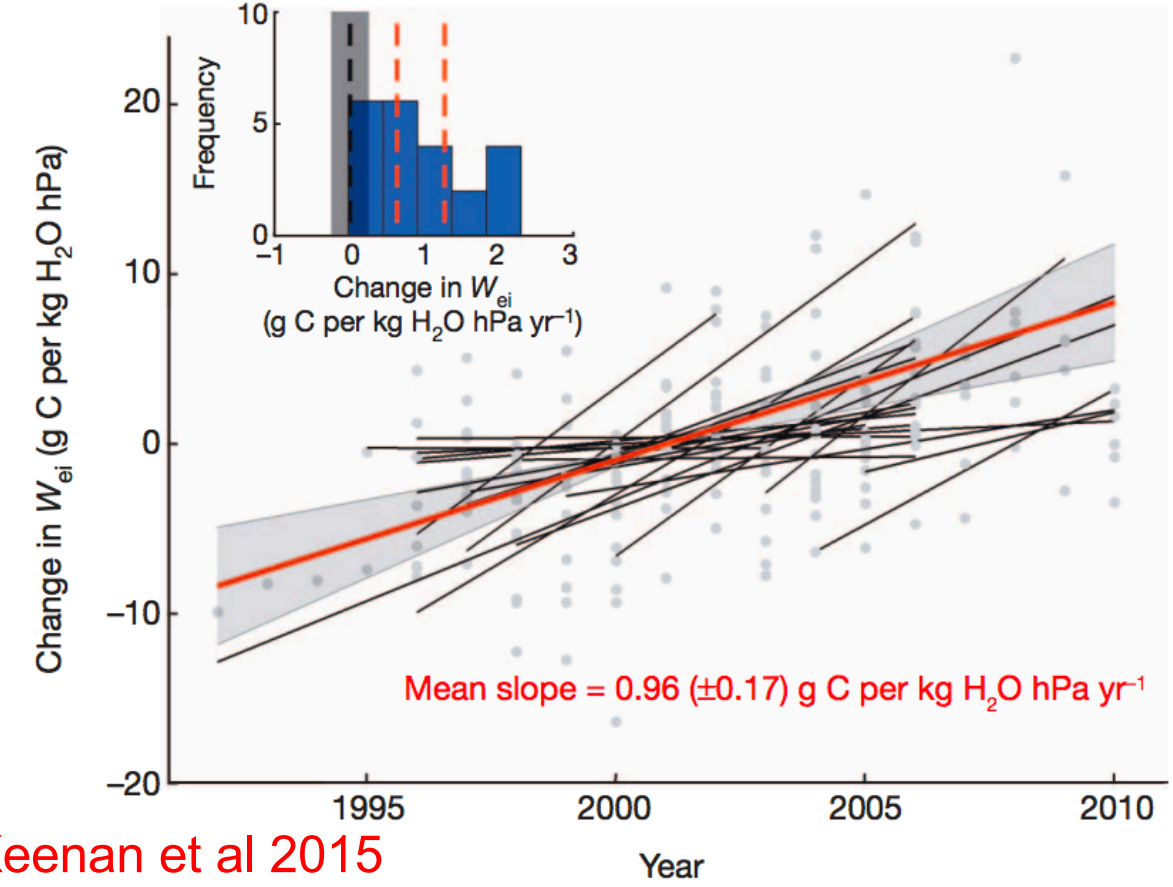
Freidlingstein et al, 2014



Lovenduski et al., 2017

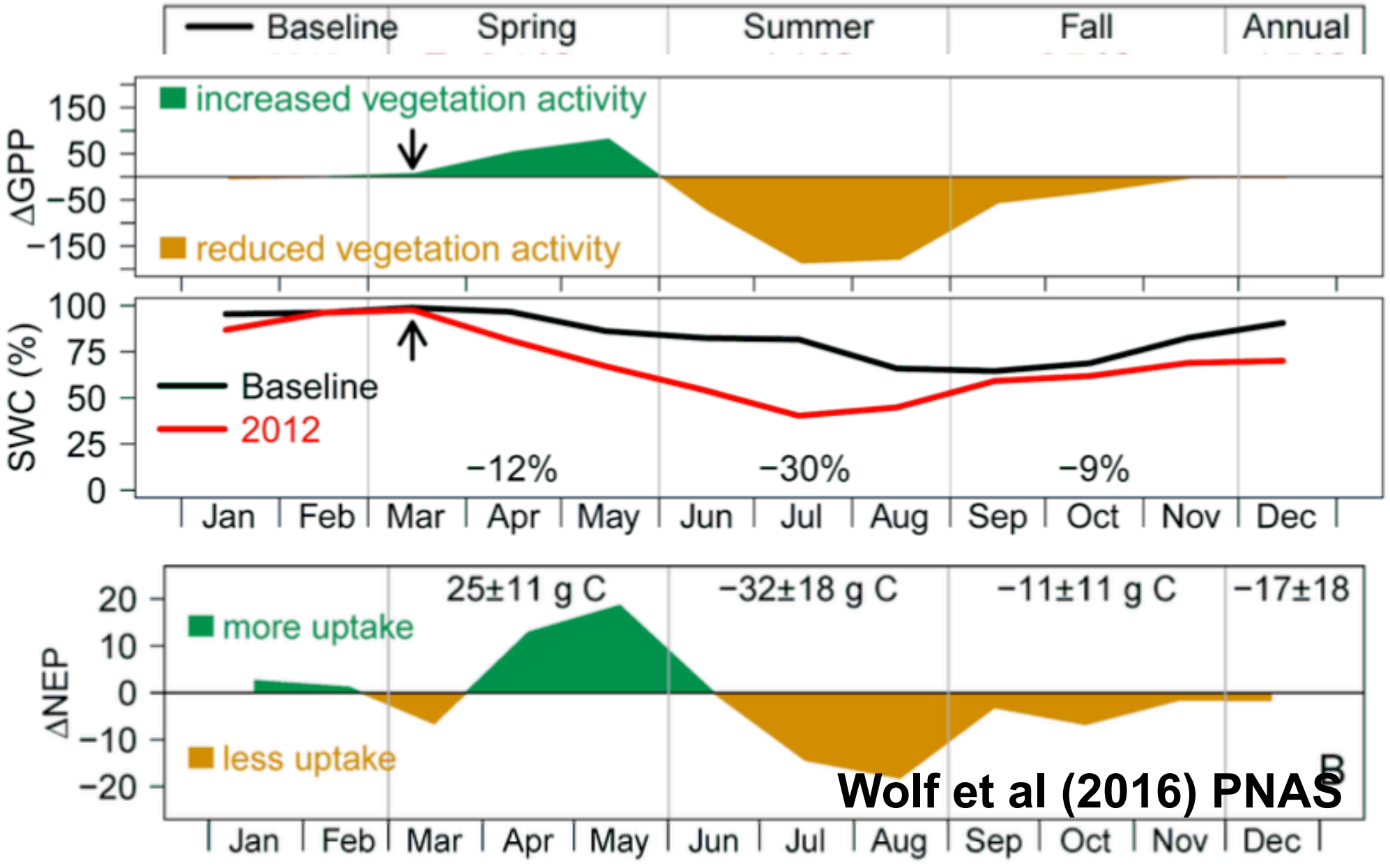

20+ yr
16-20 yr
11-15 yr
6-10 yr
1-5 yr
(Data accessed in May, 2015)
Length of Operation (year)
15+ yr
10-15 yr
5-10 yr
1-5 yr
Precipitation (mm yr⁻¹)
5000
4000
3000
2000
1000
0
-20
-10
0
10
20
30
Mean Air Temperature (° C)



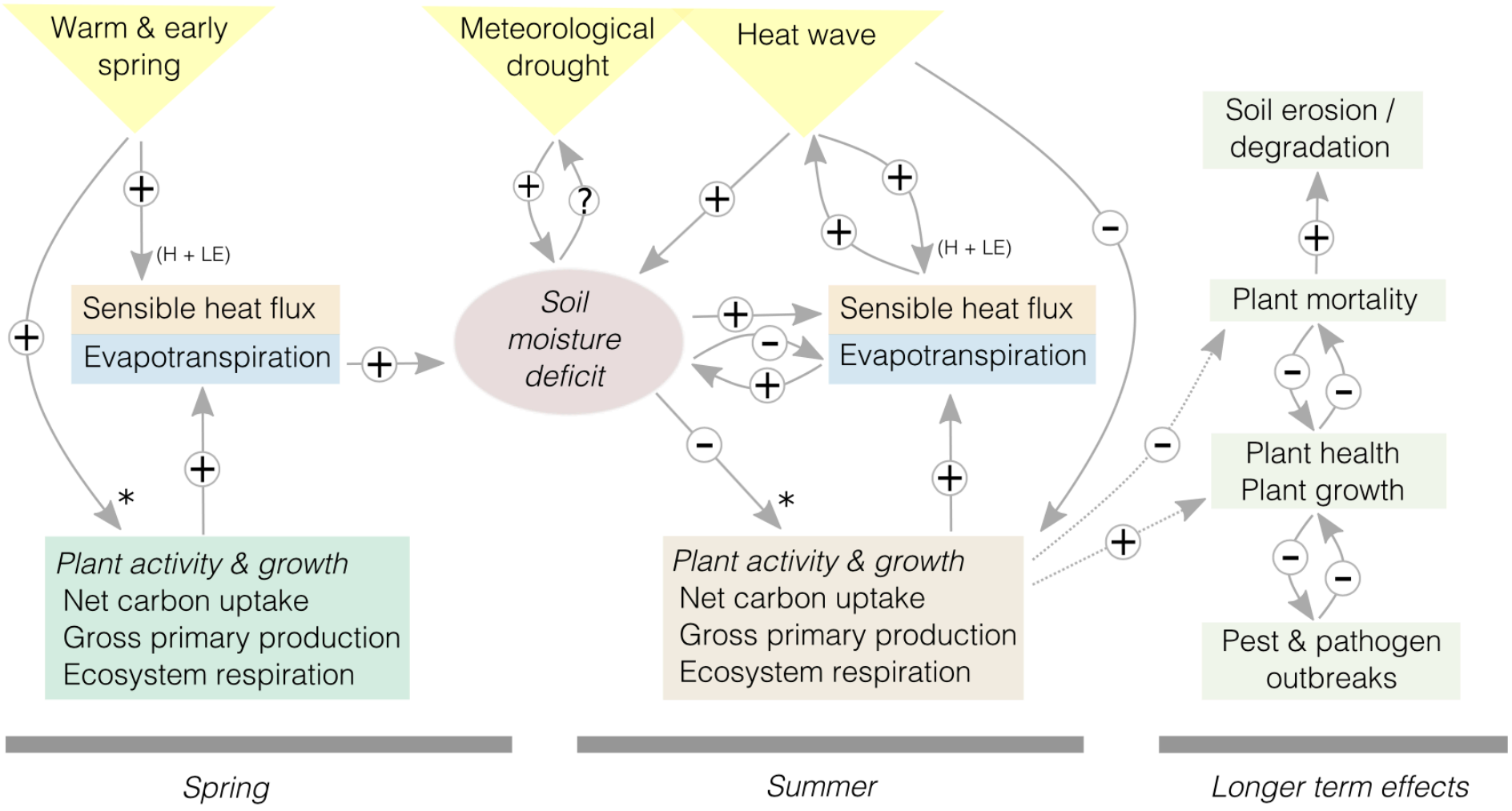


Keenan et al 2015

Net Carbon Uptake Anomaly @ sites (EC)



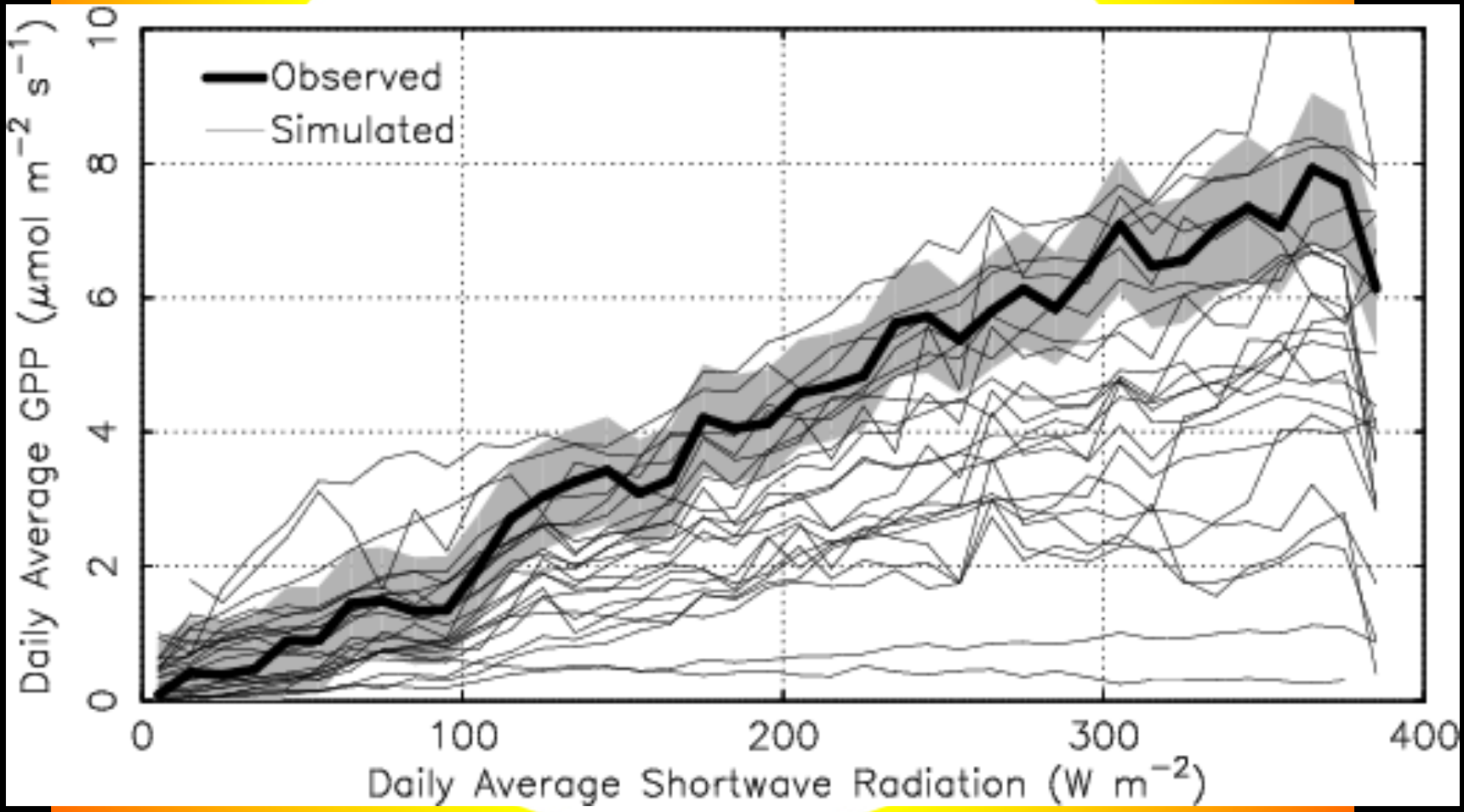
Wolf et al (2016) PNAS



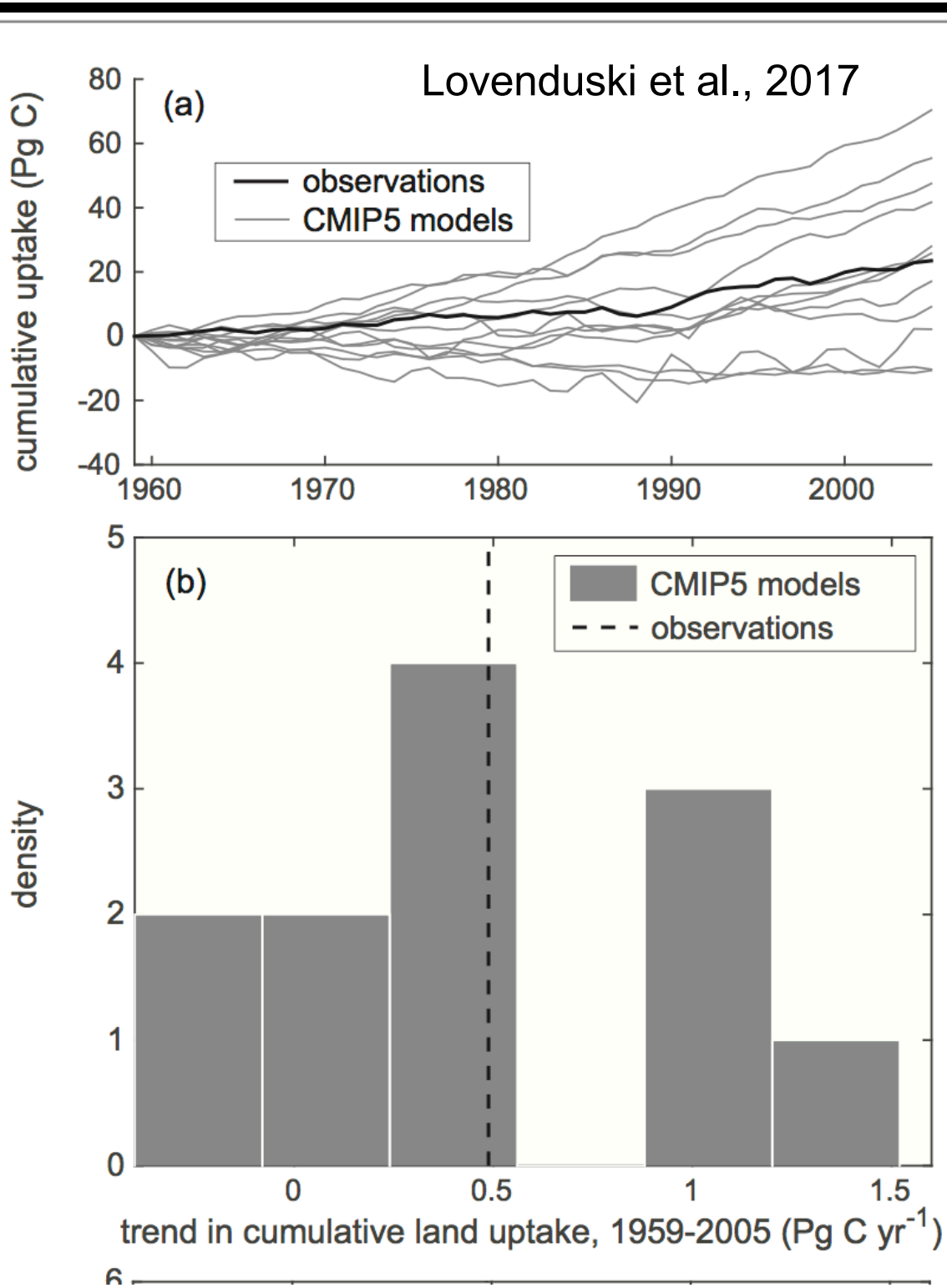
* Climate effects on ecosystem carbon fluxes are shown only in qualitative terms. Individual fluxes might be affected differently by climate extremes (see text).

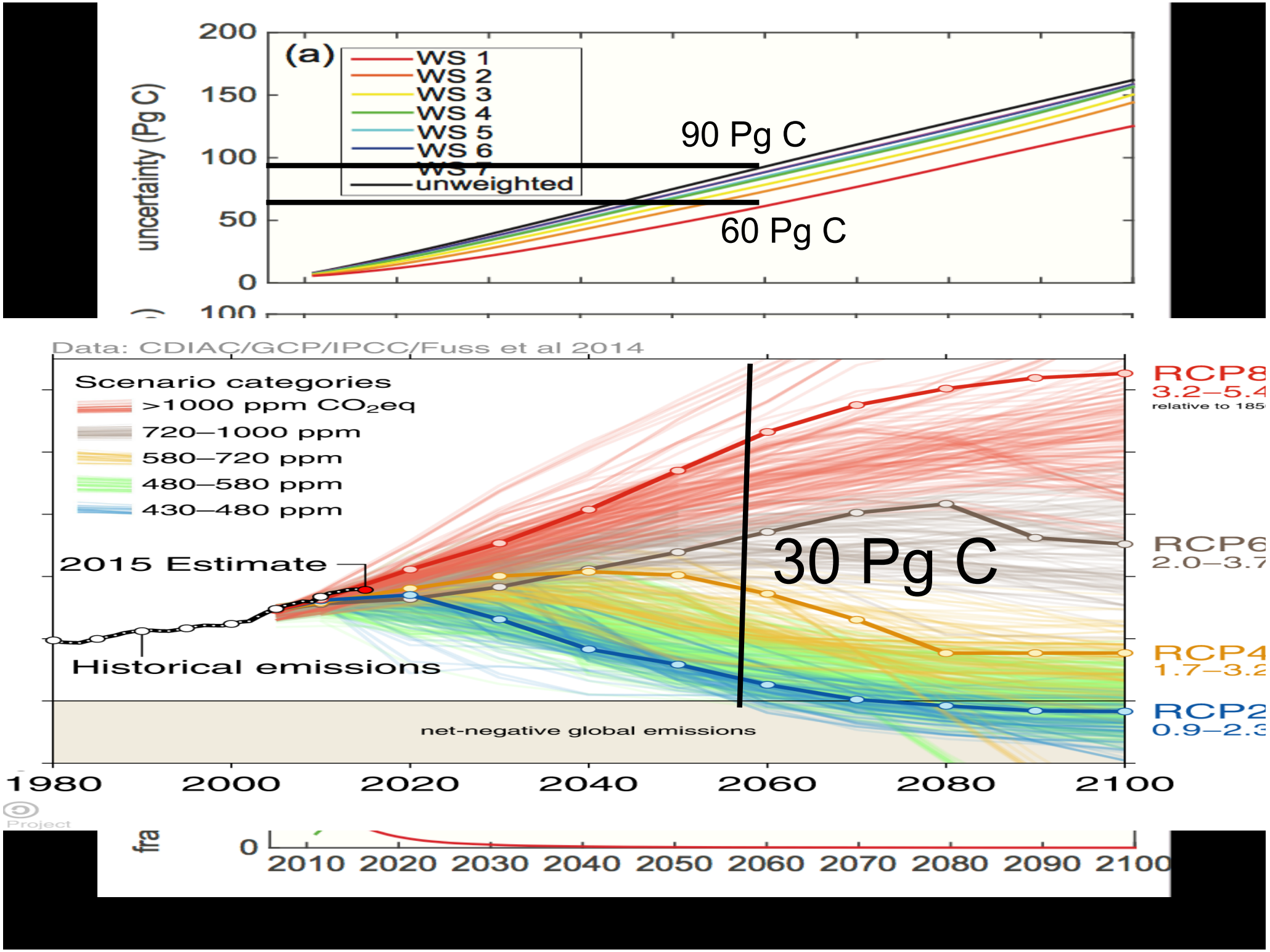
Sippel et al., 2016

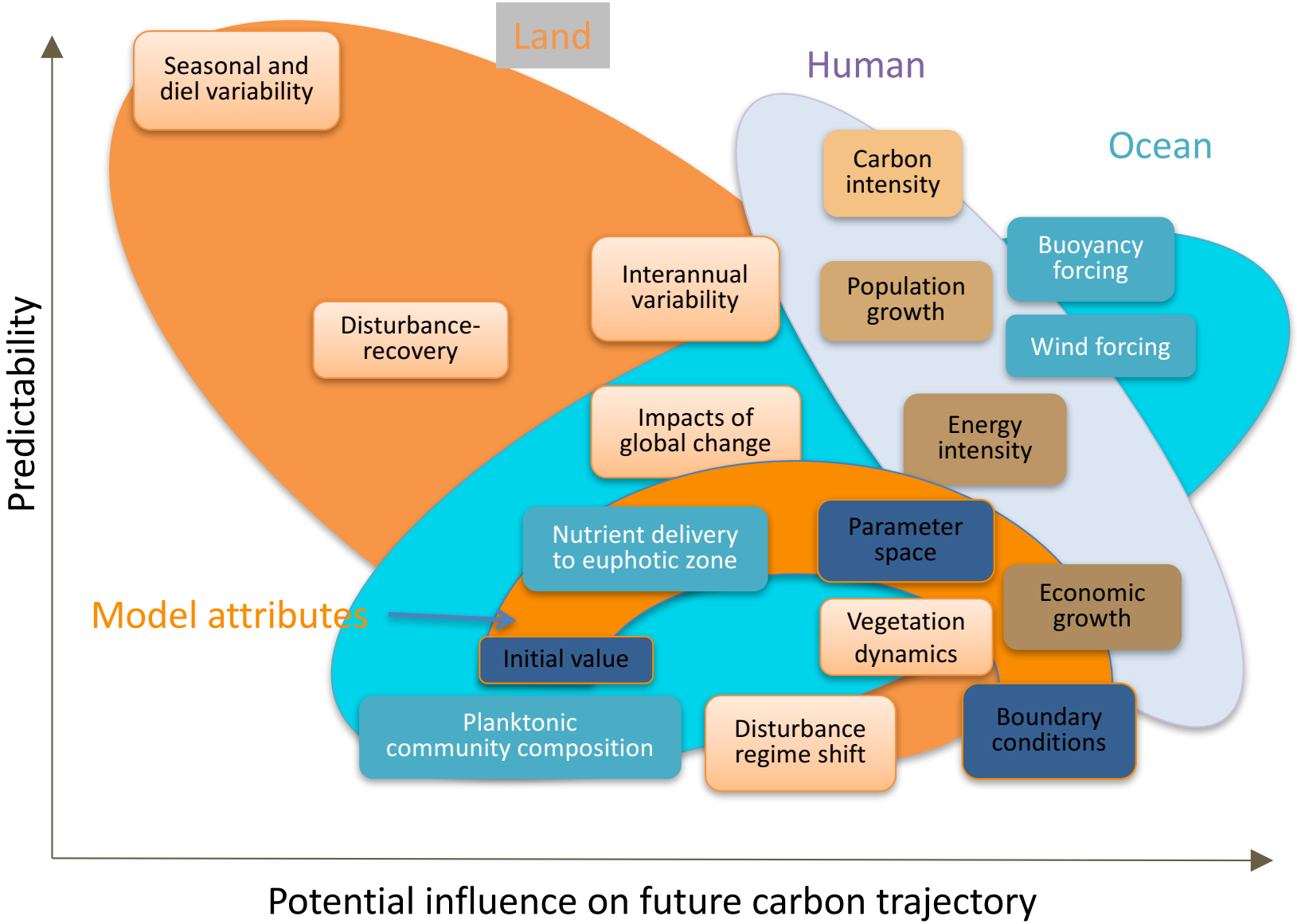
Light



Schaefer et al., 2012


Lovenduski et al., 2017
(a)
observations
CMIP5 models
cumulative uptake (Pg C)
80
60
40
20
0
-20
-40
1960
1970
1980
1990
2000
(b)
CMIP5 models
observations
density
5
4
3
2
1
0
0
0.5
1
1.5
trend in cumulative land uptake, 1959-2005 (Pg C yr^{-1})


(a)
WS 1
WS 2
WS 3
WS 4
WS 5
WS 6
WS 7
unweighted
uncertainty (Pg C)
200
150
100
50
0
90 Pg C
60 Pg C
Data: CDIAC/GCP/IPCC/Fuss et al 2014
Scenario categories
>1000 ppm CO2eq
720–1000 ppm
580–720 ppm
480–580 ppm
430–480 ppm
2015 Estimate
Historical emissions
30 Pg C
net-negative global emissions
RCP8
3.2–5.4
RCP6
2.0–3.7
RCP4
1.7–3.2
RCP2
0.9–2.3
1980
2000
2020
2040
2060
2080
2100
0
2010 2020 2030 2040 2050 2060 2070 2080 2090 2100

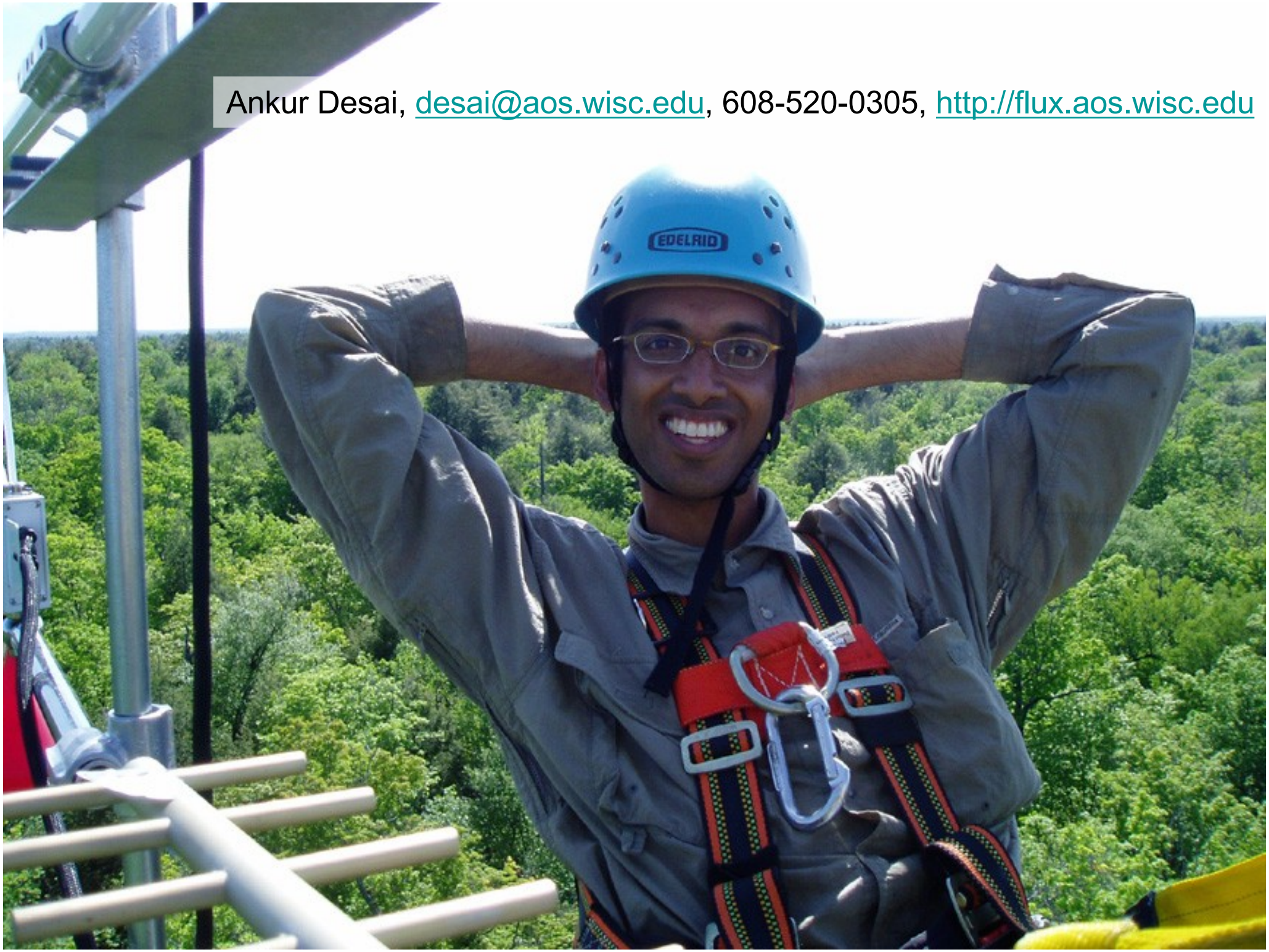


Yiqi Luo et al., NACP meeting

National Ecological Observatory Network

boots on the ground: flux tower sites

D18: Barrow Environmental Observatory - BARR



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