Trends and ENSO/AAO driven variability in productivity and phenology in South America: comparing NDVI-VIP and NDVI3g results

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van Leeuwen, Willem J.D., Kyle Hartfield, Marcelo Miranda, Francisco J. Meza, 2012.Trends and ENSO/AAO driven variability in productivity and phenology alongside the Andes Mountains, Submitted to special issue in "Remote Sensing": Monitoring Global Vegetation with AVHRR NDVI3g Data (1981-2011), In Review

Trends and ENSO/AAO driven variability in productivity and phenology in South America using 30 years of NDVI time series data

Questions:

- **What are the land use and climate impacts on vegetation productivity and phenology?**
- **What trends do we observe in vegetation productivity and phenology during 30 years?**
- **Do the 30-year NDVI time series of VIP and GIMMS-3g show the same results?**

DATA

- **NDVI VIP2 – 1981 thru 2010 (15-day - 5km)**
- **NDVI 3G – July 1981 thru 2011 (15-day - 8km)**
- **Study area - South America between the Latitudes of 9°S - 60°S and the Longitudes of 50°W - 80°W**
- **Land cover classes including Desert, Shrubland, Grassland, Deciduous Forest, Savannah, and Barren (Eva et al, 2004)**

METHODS

- **Simple linear regression analysis ($P<0.05$)**
- **Trends - NDVI=f(time); SOS=f(t); LOS=f(t)**
- **Productivity/phenology=f(MEI); Productivity/phenology=f(AAO)**
- **MEI and AAO – T. and Precip. shifts**

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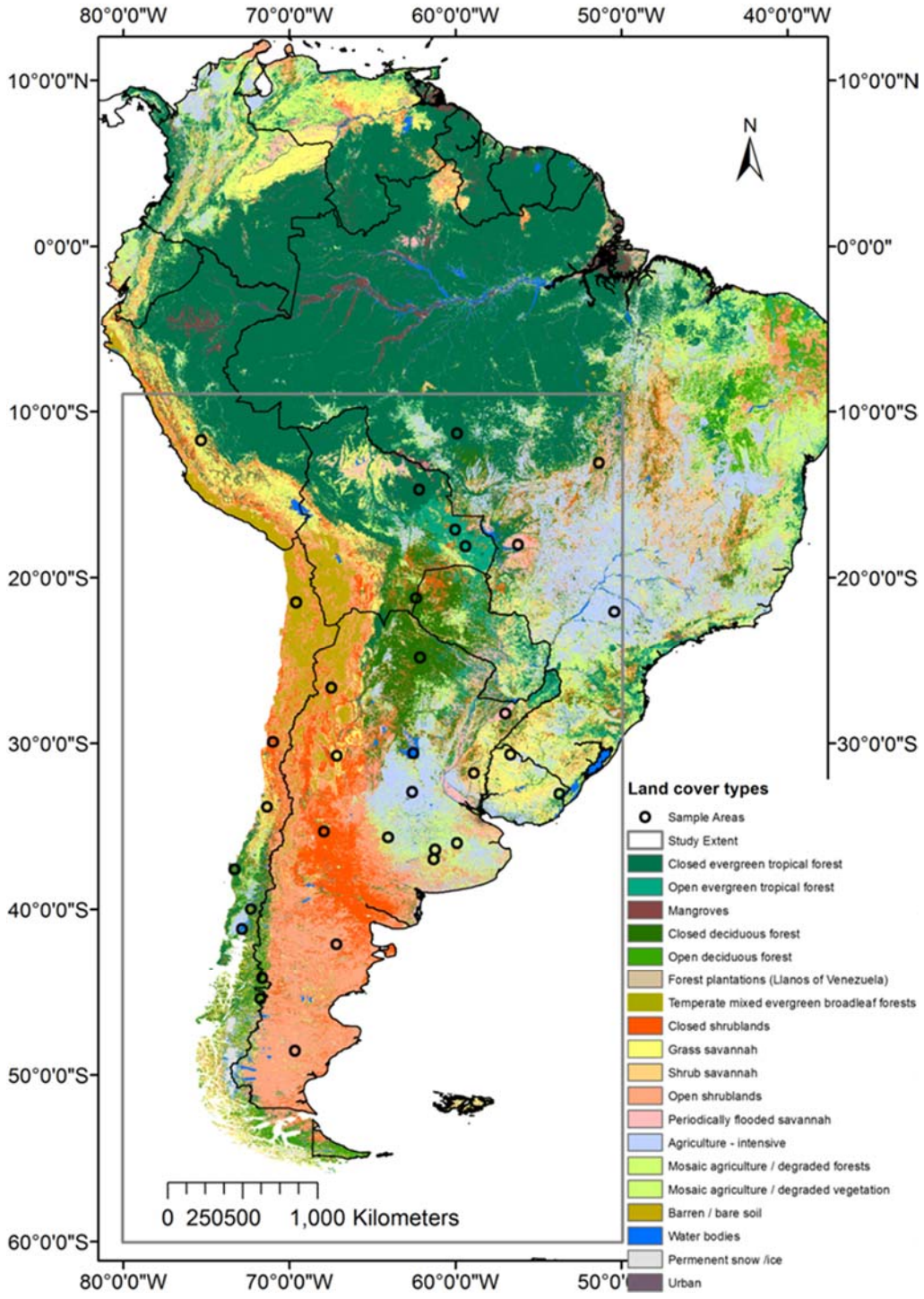
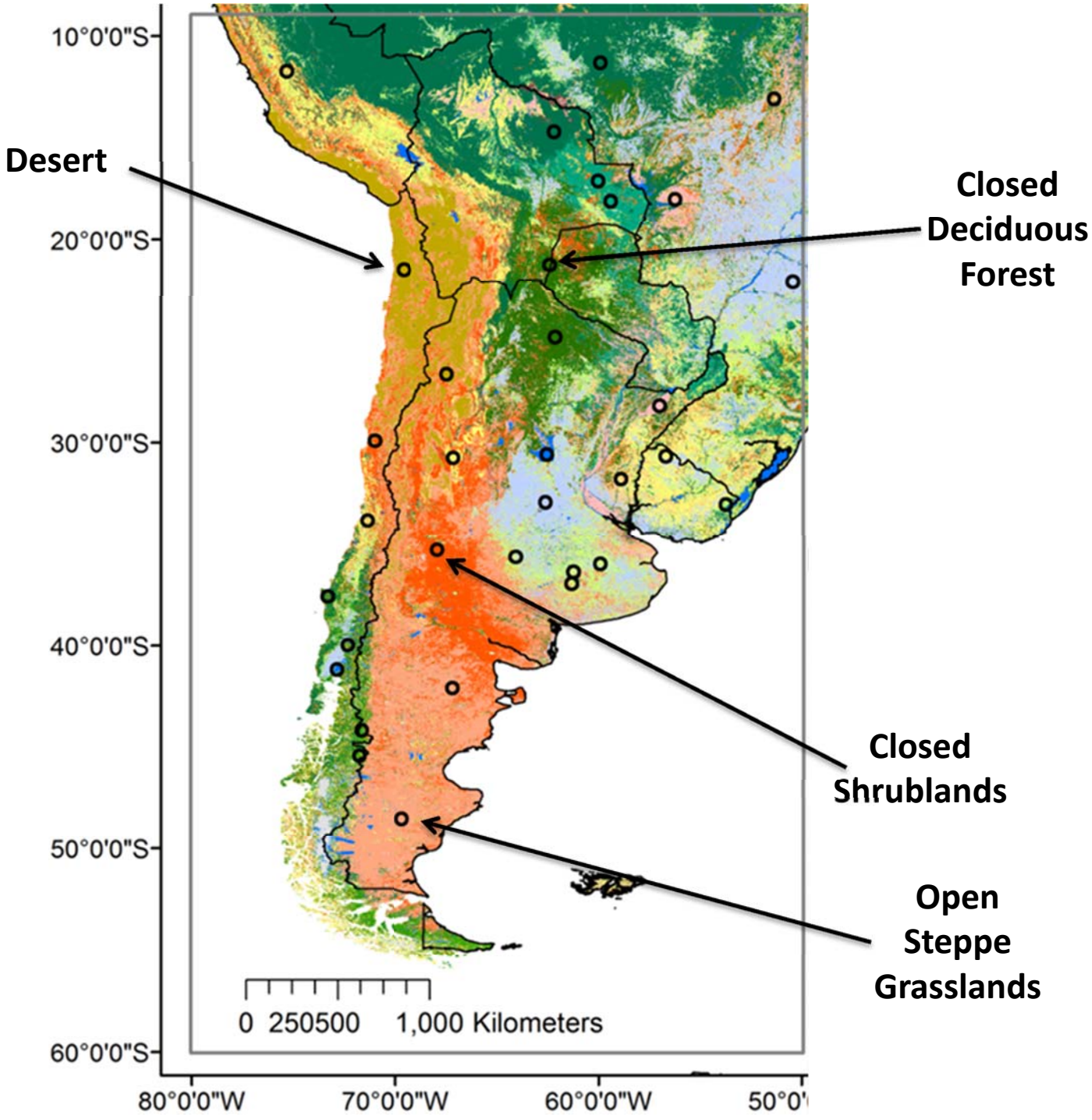
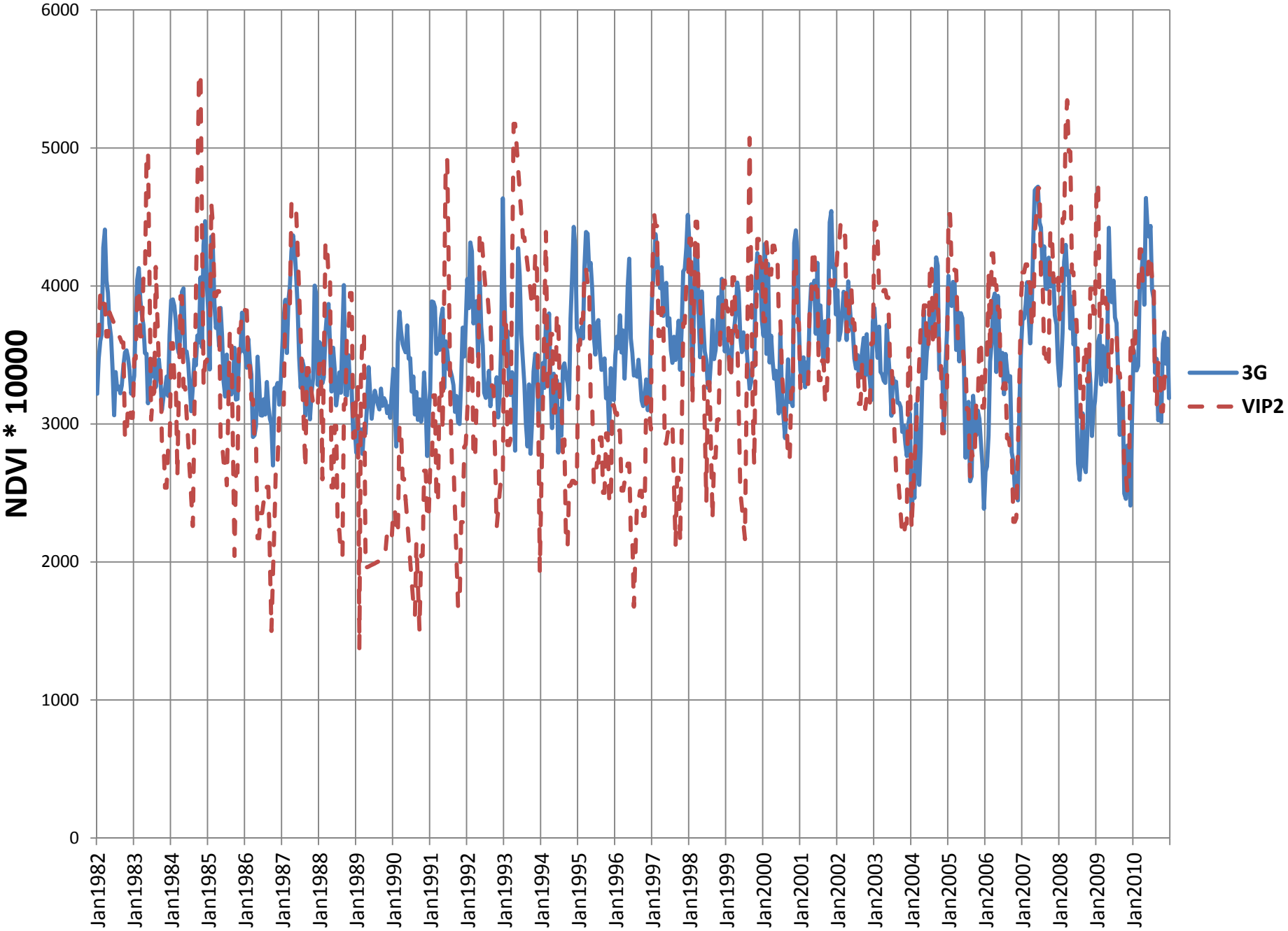
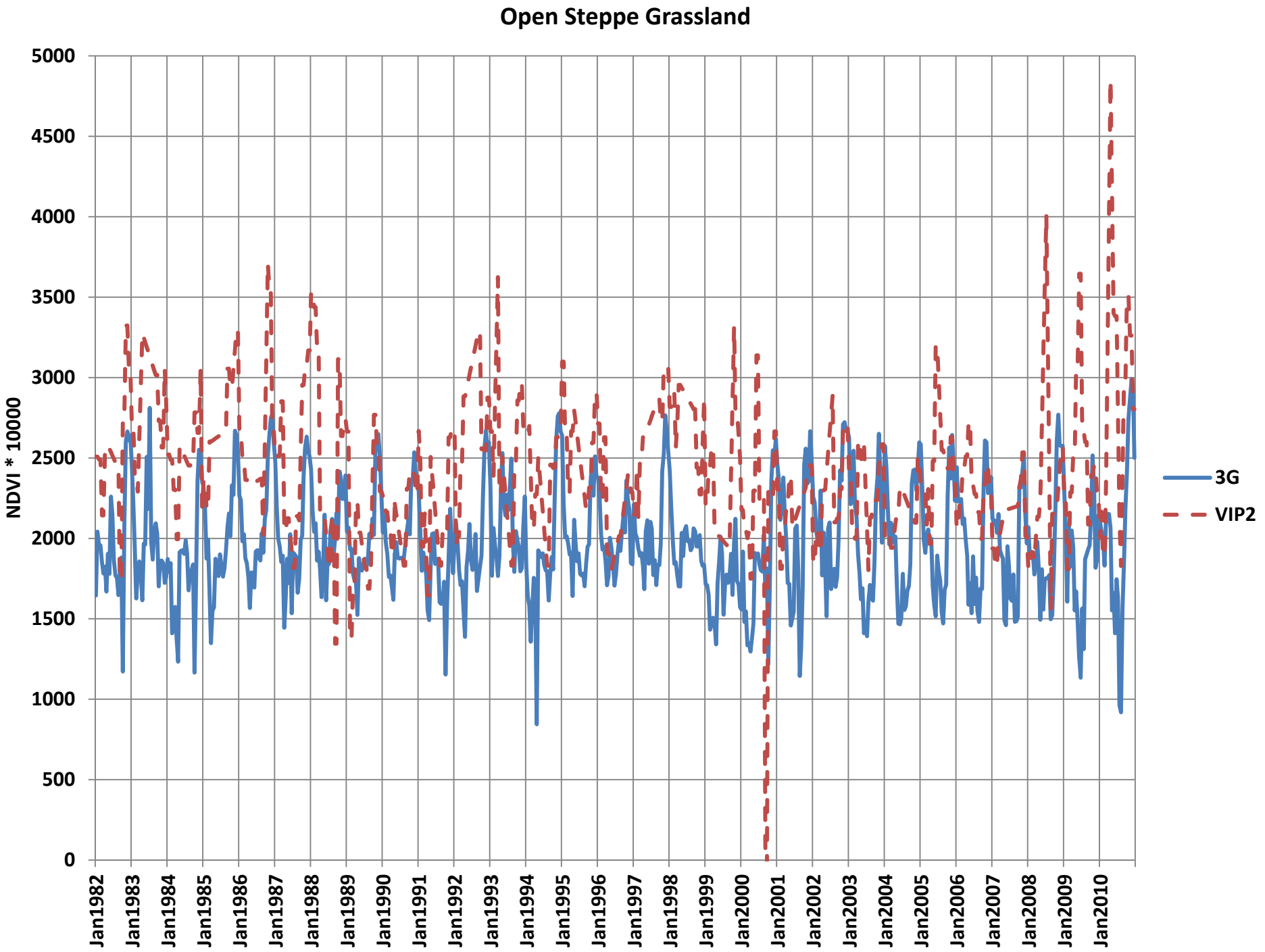
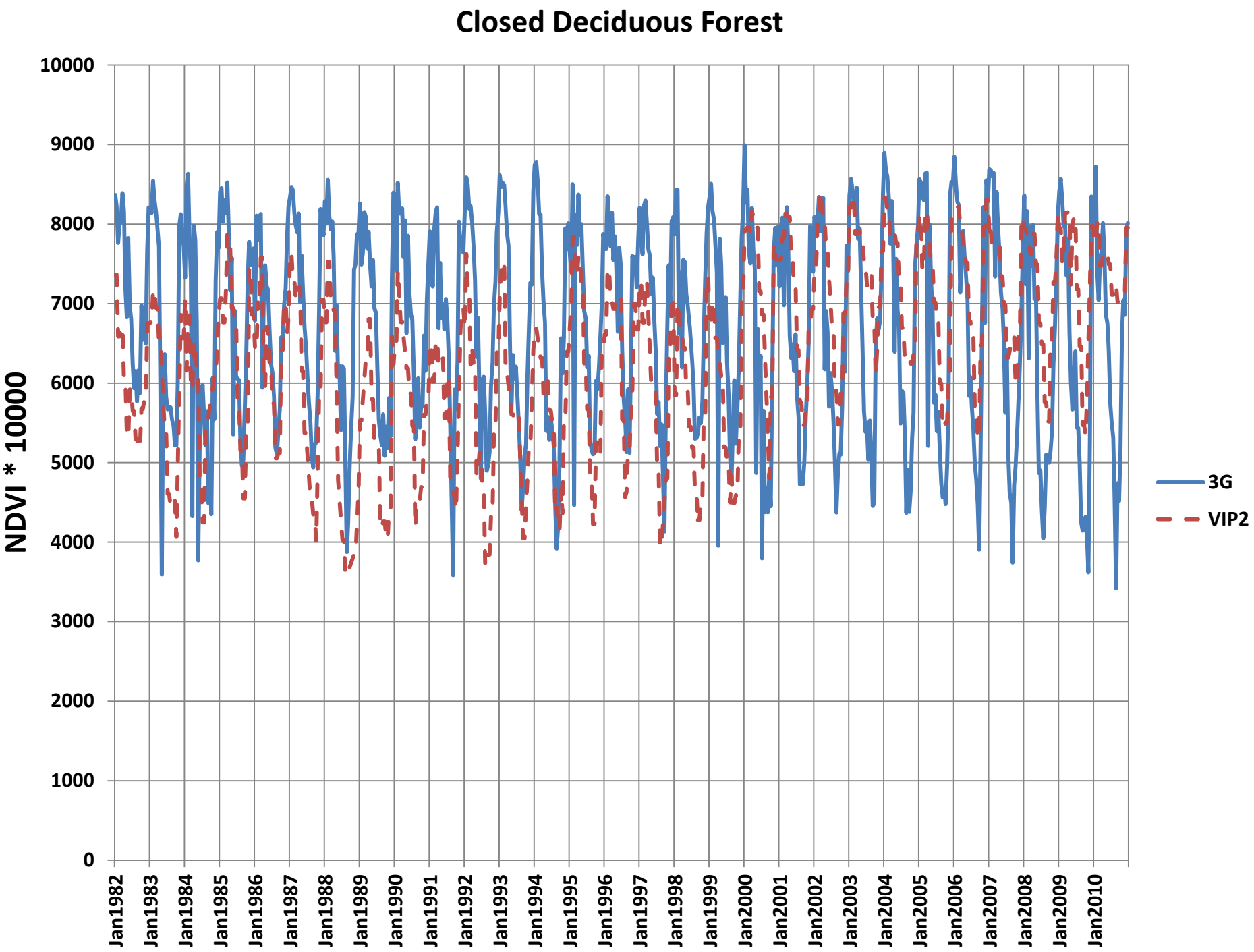
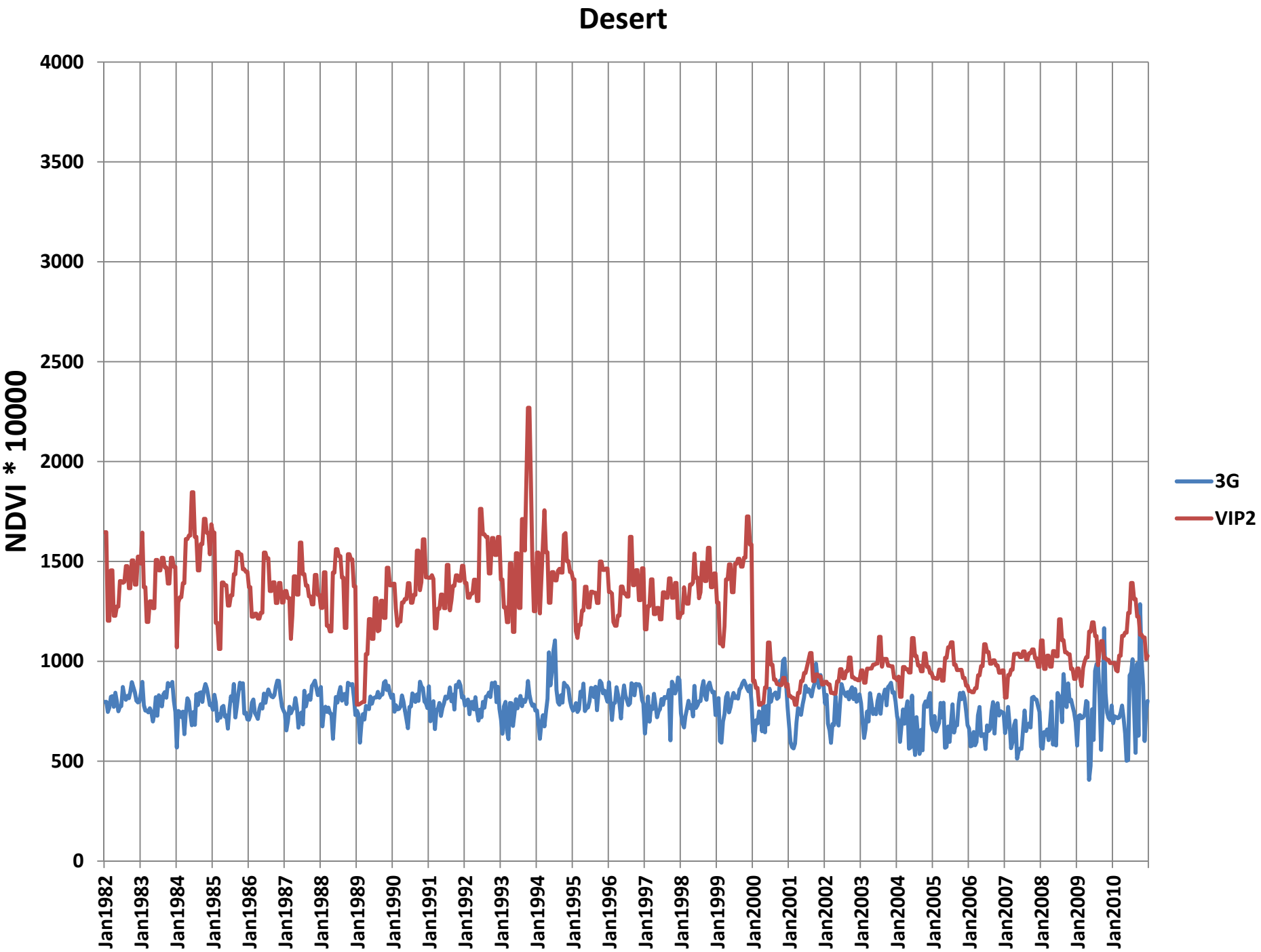



Desert
Closed Deciduous Forest
Closed Shrublands
Open Steppe Grasslands
10°0'0"S
20°0'0"S
30°0'0"S
40°0'0"S
50°0'0"S
60°0'0"S
80°0'0"W
70°0'0"W
60°0'0"W
0 250500 1,000 Kilometers

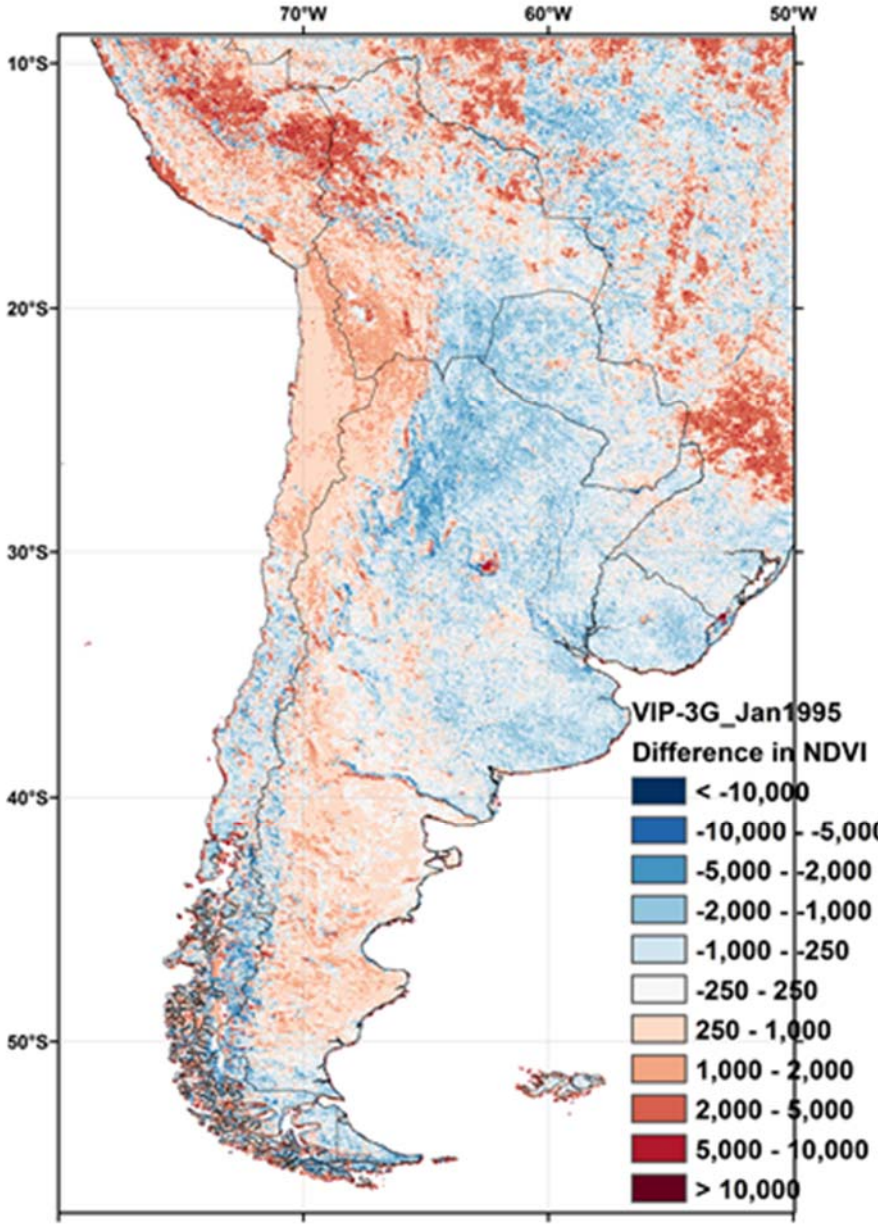

Closed Shrublands
NDVI * 10000
6000
5000
4000
3000
2000
1000
0
Jan1982
Jan1983
Jan1984
Jan1985
Jan1986
Jan1987
Jan1988
Jan1989
Jan1990
Jan1991
Jan1992
Jan1993
Jan1994
Jan1995
Jan1996
Jan1997
Jan1998
Jan1999
Jan2000
Jan2001
Jan2002
Jan2003
Jan2004
Jan2005
Jan2006
Jan2007
Jan2008
Jan2009
Jan2010
3G
VIP2

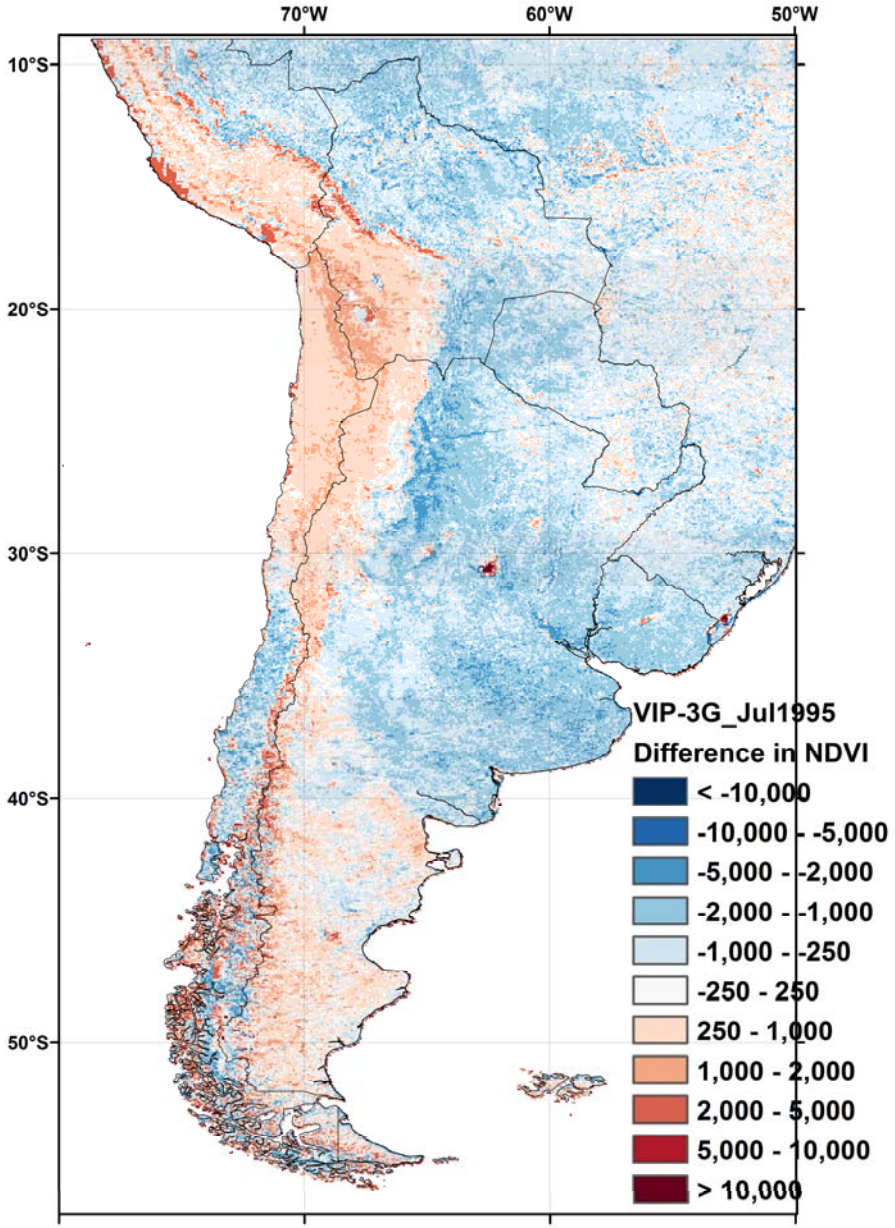

Open Steppe Grassland
NDVI * 10000
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Jan1982
Jan1983
Jan1984
Jan1985
Jan1986
Jan1987
Jan1988
Jan1989
Jan1990
Jan1991
Jan1992
Jan1993
Jan1994
Jan1995
Jan1996
Jan1997
Jan1998
Jan1999
Jan2000
Jan2001
Jan2002
Jan2003
Jan2004
Jan2005
Jan2006
Jan2007
Jan2008
Jan2009
Jan2010
3G
VIP2


Closed Deciduous Forest
NDVI * 10000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Jan1982
Jan1983
Jan1984
Jan1985
Jan1986
Jan1987
Jan1988
Jan1989
Jan1990
Jan1991
Jan1992
Jan1993
Jan1994
Jan1995
Jan1996
Jan1997
Jan1998
Jan1999
Jan2000
Jan2001
Jan2002
Jan2003
Jan2004
Jan2005
Jan2006
Jan2007
Jan2008
Jan2009
Jan2010
3G
VIP2

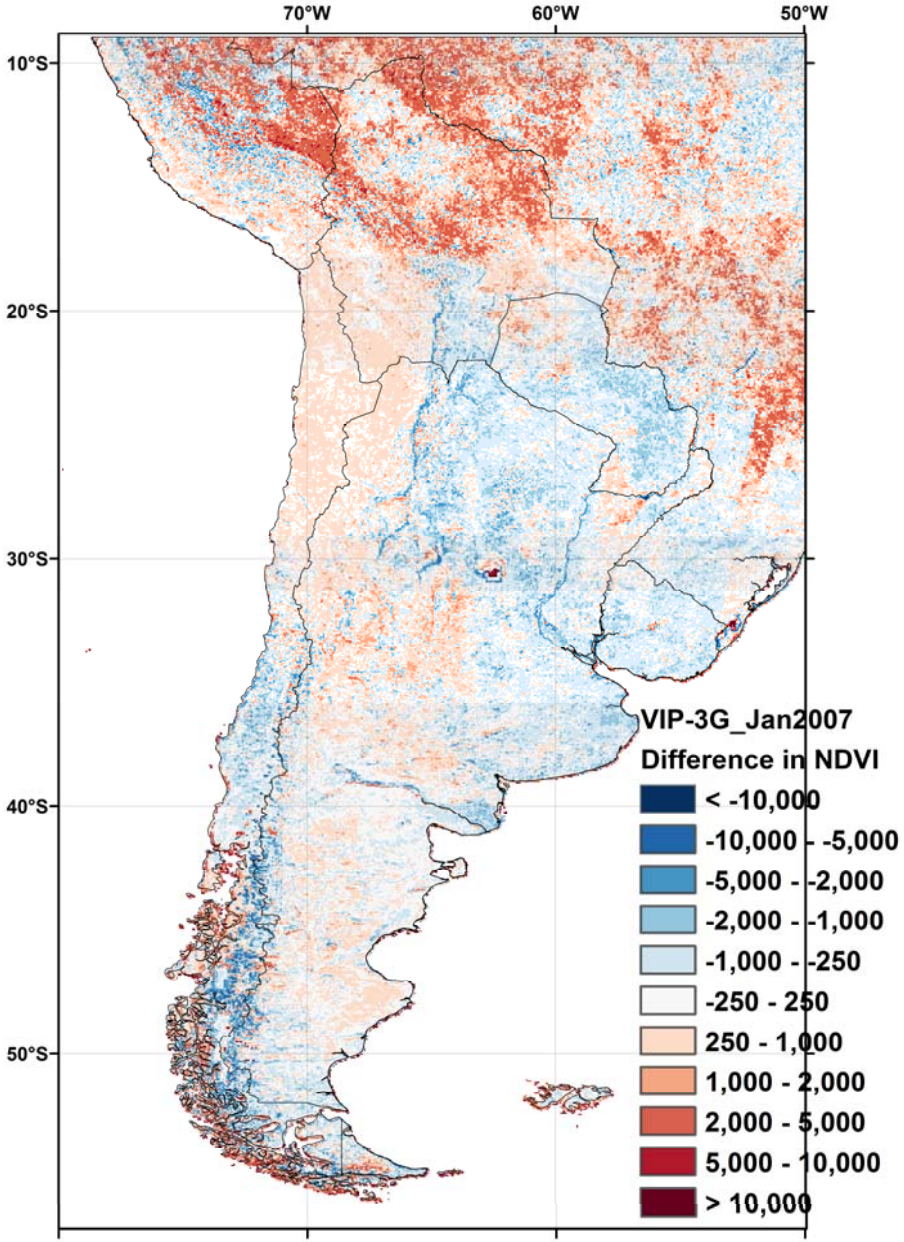

Desert
NDVI * 10000
4000
3500
3000
2500
2000
1500
1000
500
0
Jan1982
Jan1983
Jan1984
Jan1985
Jan1986
Jan1987
Jan1988
Jan1989
Jan1990
Jan1991
Jan1992
Jan1993
Jan1994
Jan1995
Jan1996
Jan1997
Jan1998
Jan1999
Jan2000
Jan2001
Jan2002
Jan2003
Jan2004
Jan2005
Jan2006
Jan2007
Jan2008
Jan2009
Jan2010
3G
VIP2

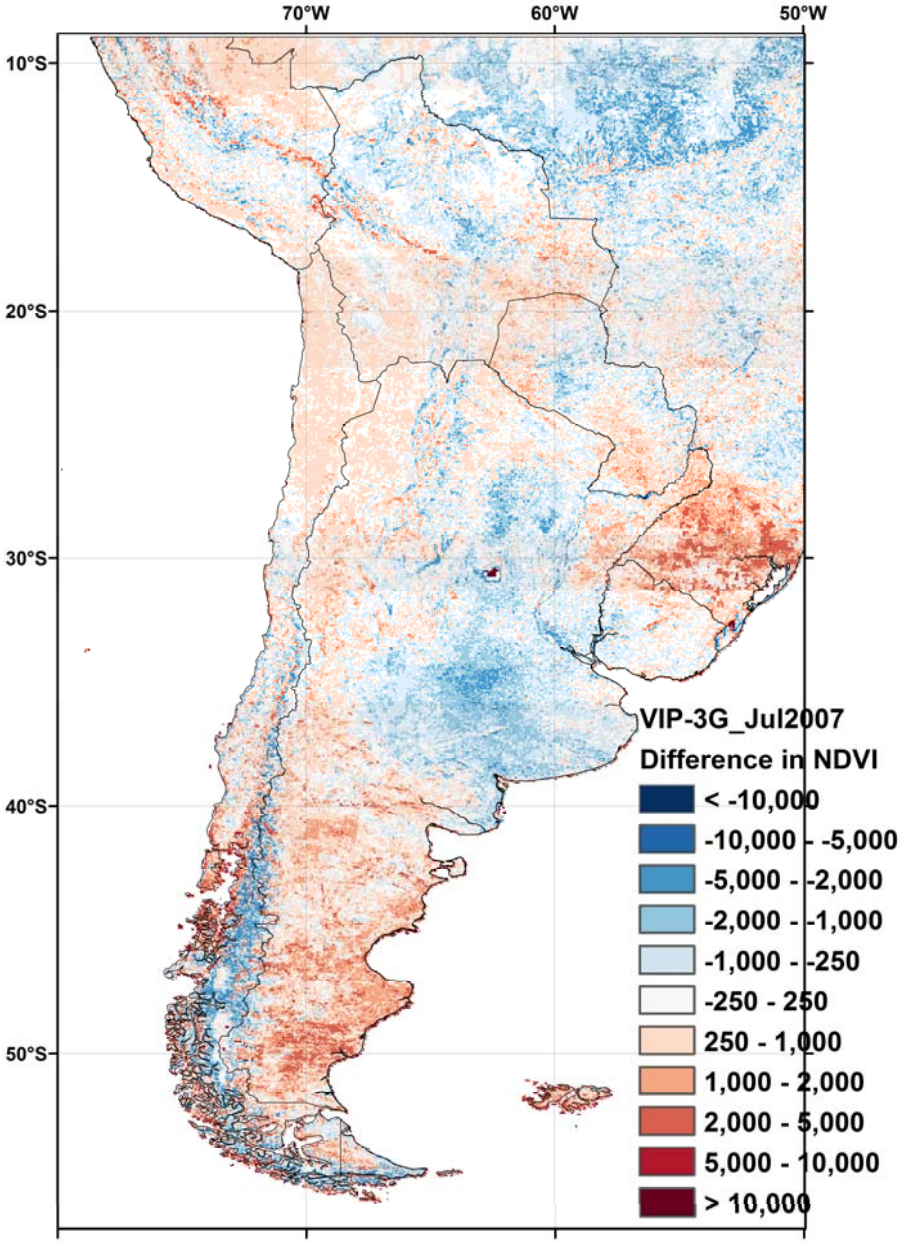
NDVI difference (VIP-3g) for Jan and Jul 1995

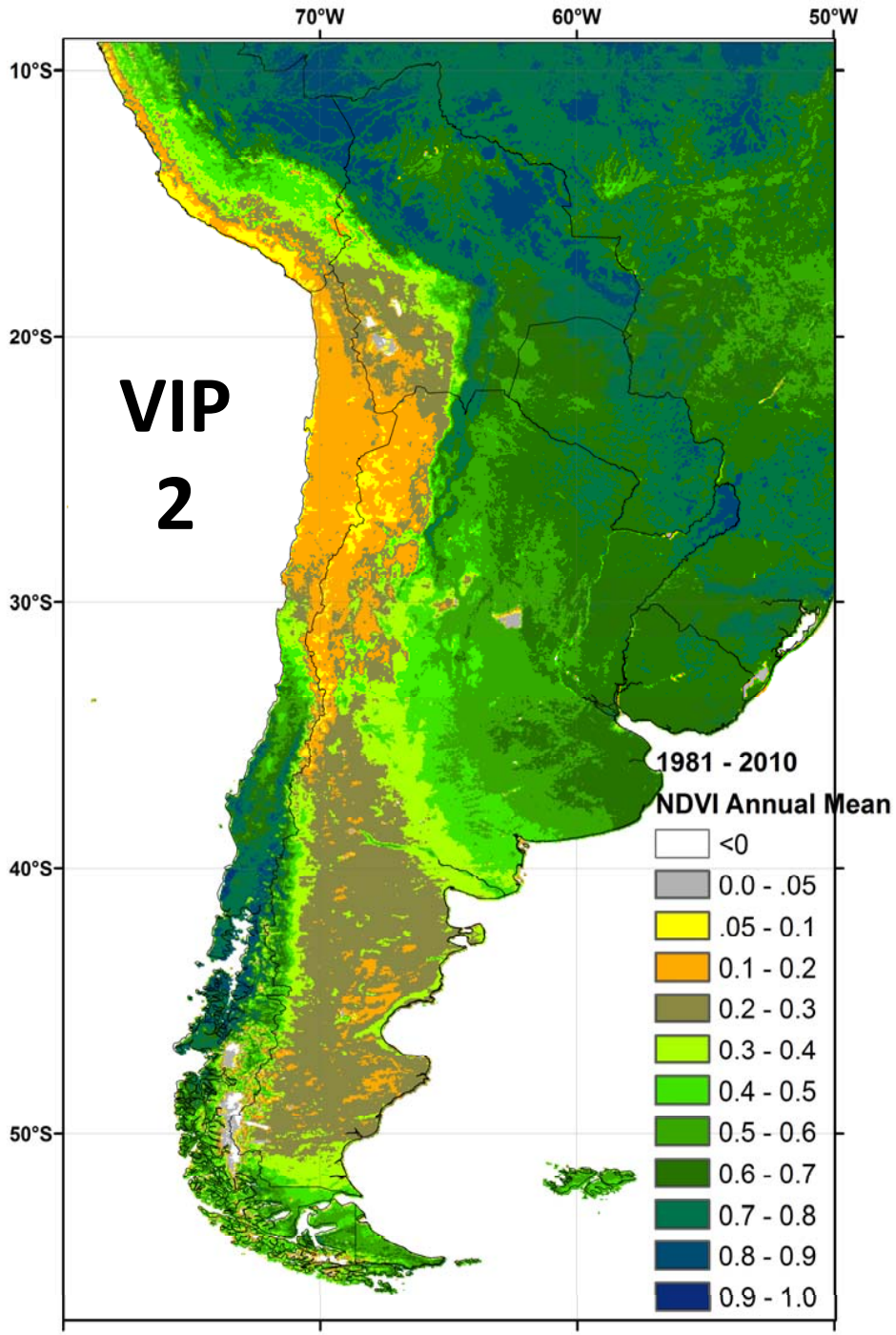


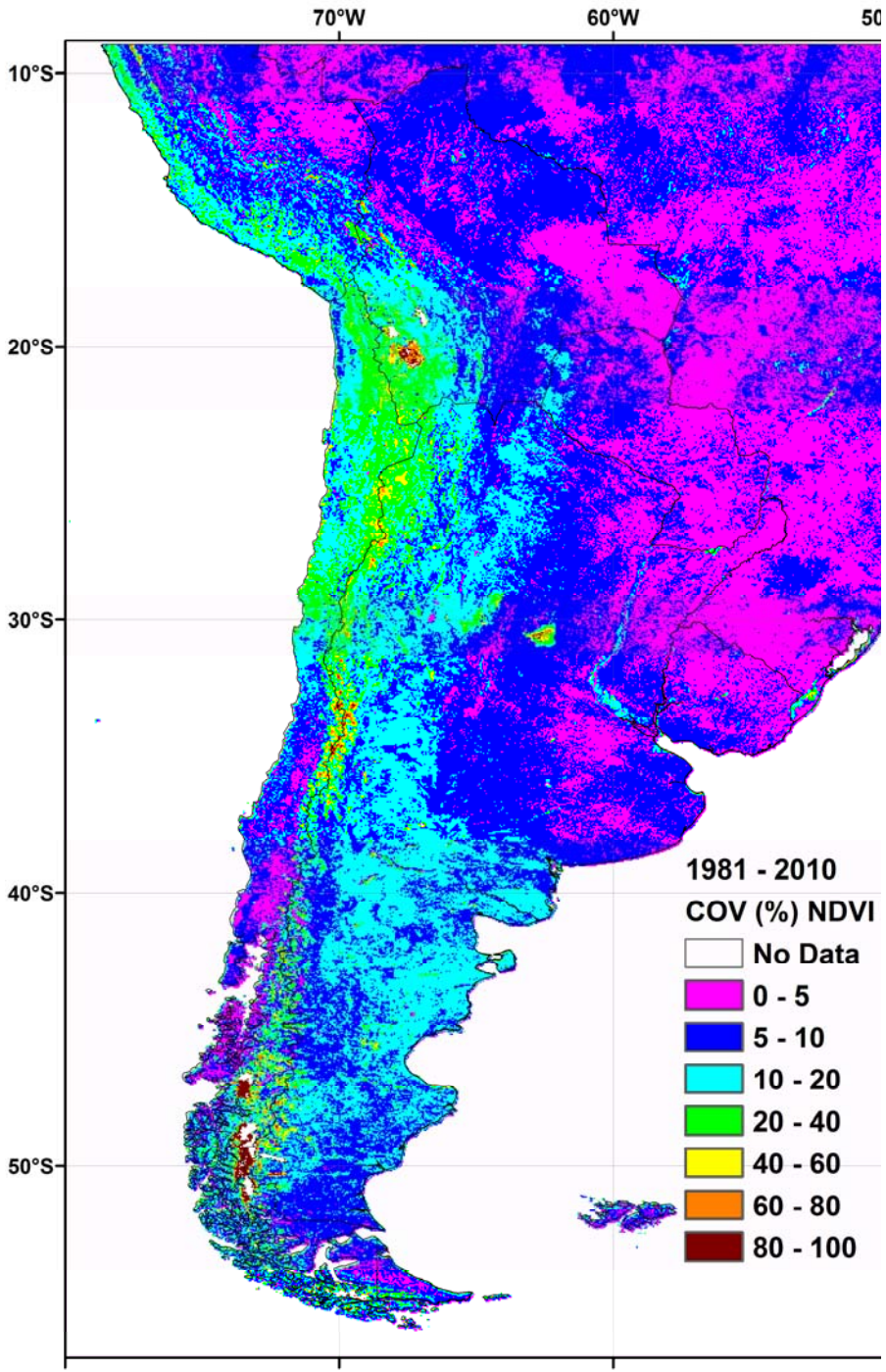


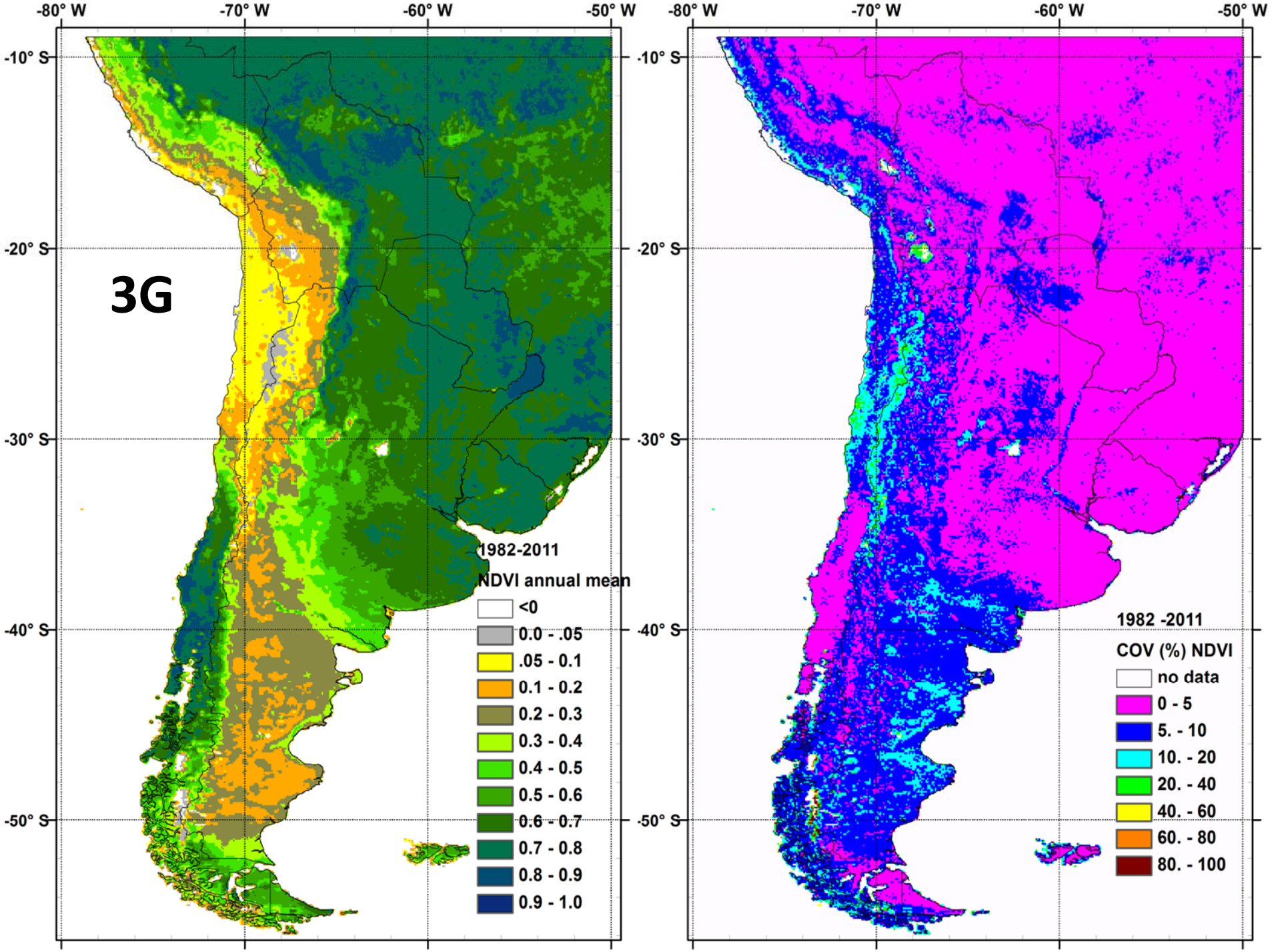
NDVI difference (VIP-3g) for Jan and Jul 2007

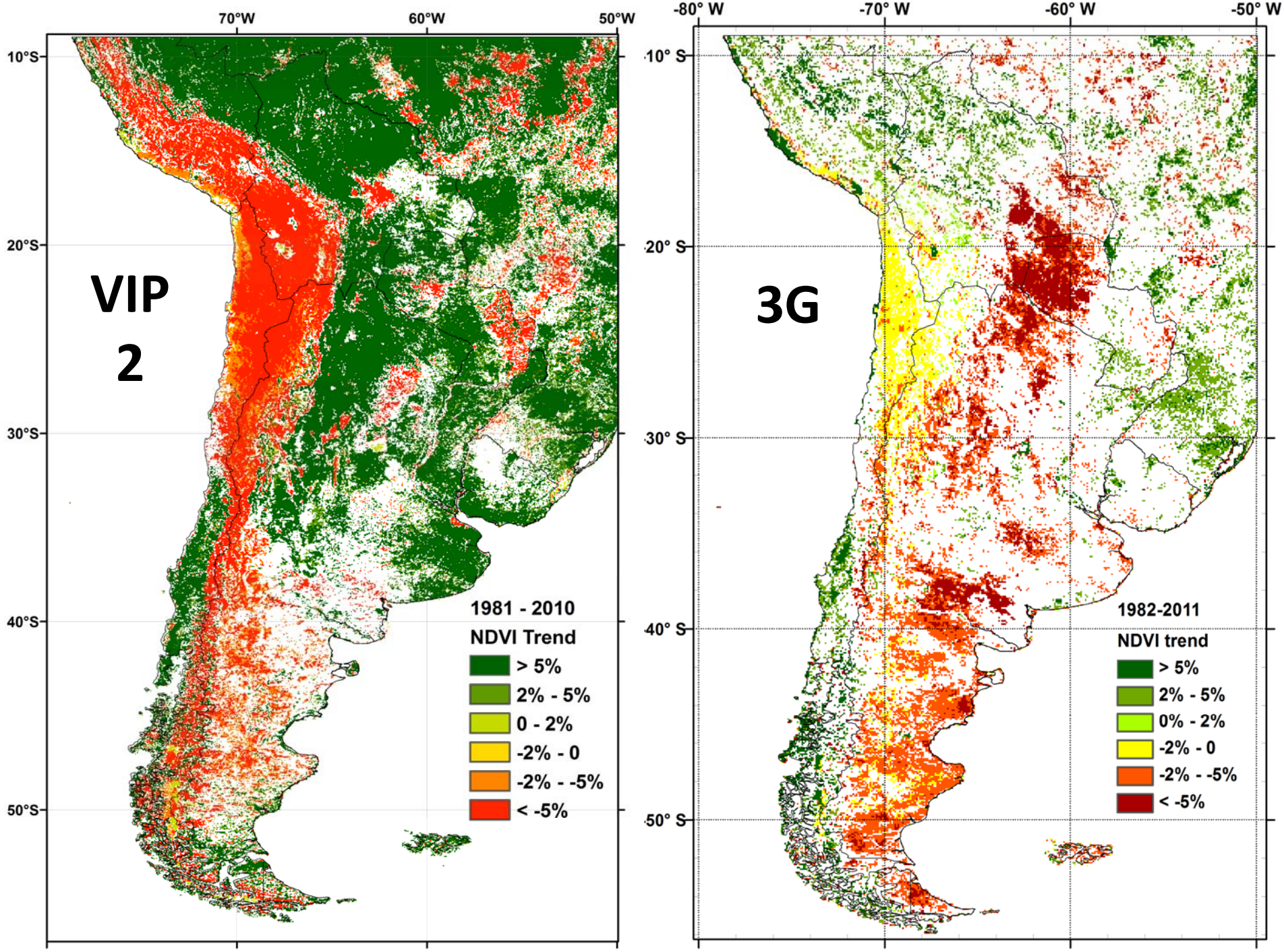


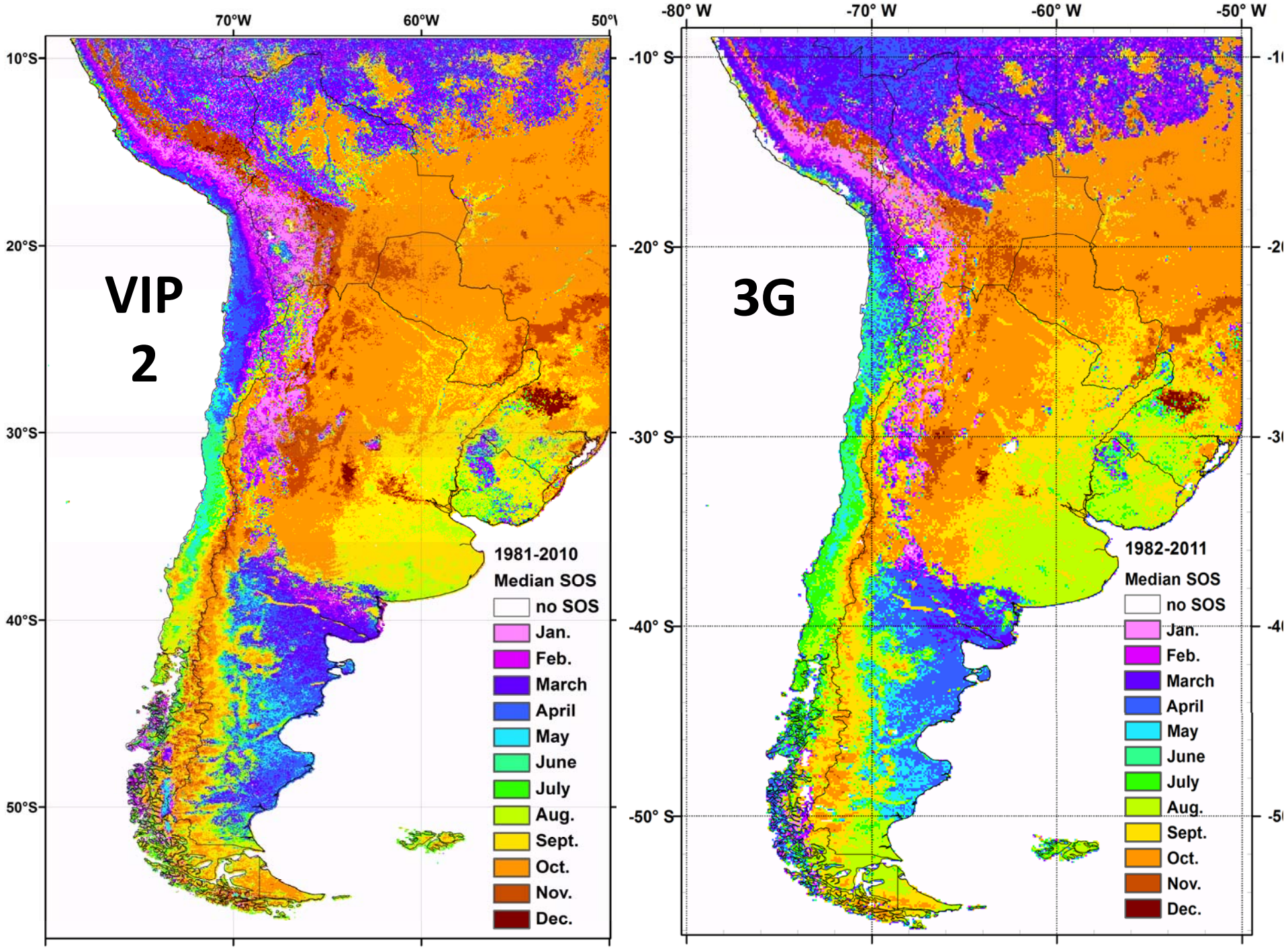


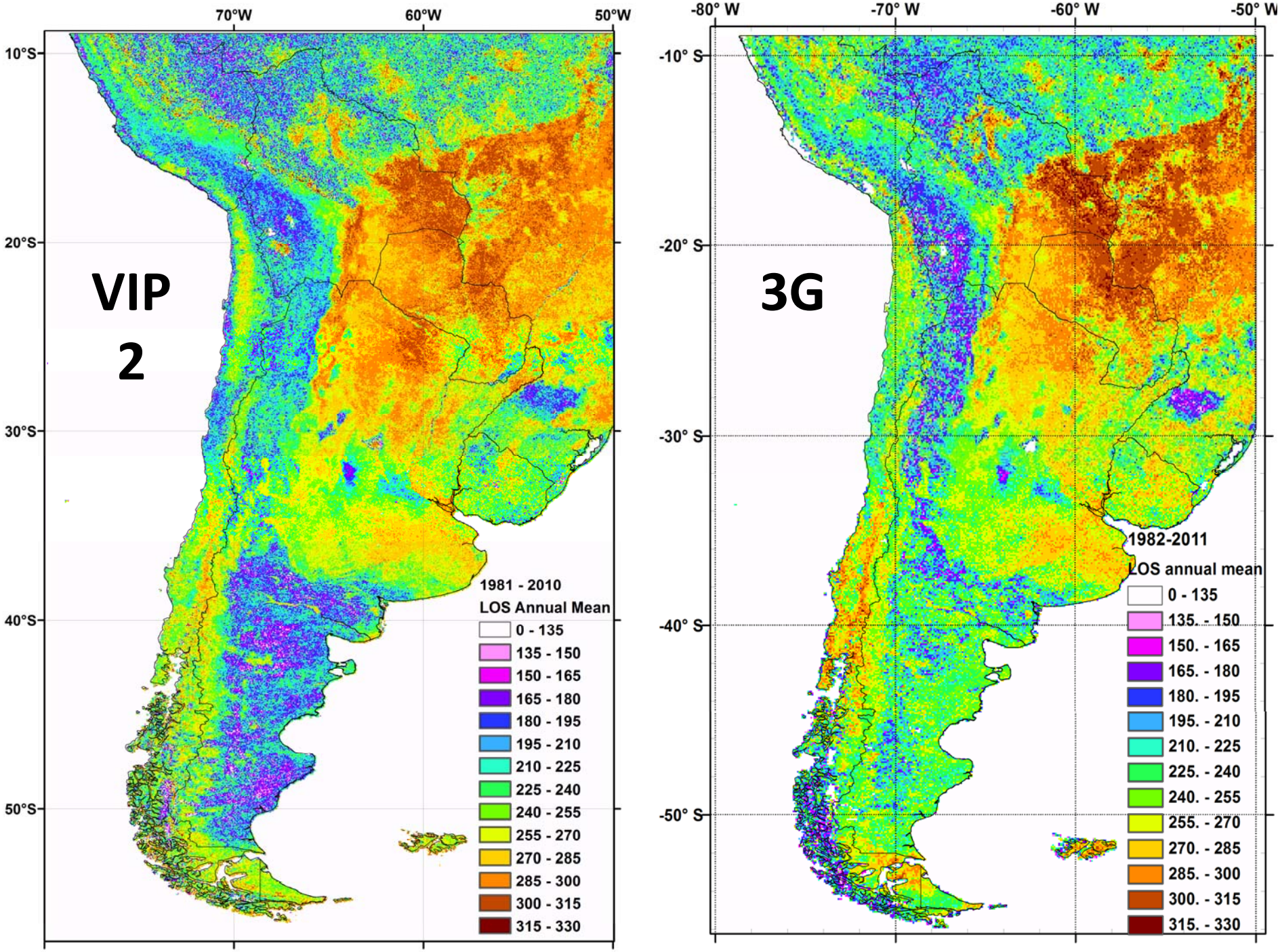

70°W
60°W
50°W
10°S
20°S
30°S
40°S
50°S
VIP
2
1981 - 2010
NDVI Annual Mean
<0
0.0 - .05
.05 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.4
0.4 - 0.5
0.5 - 0.6
0.6 - 0.7
0.7 - 0.8
0.8 - 0.9
0.9 - 1.0

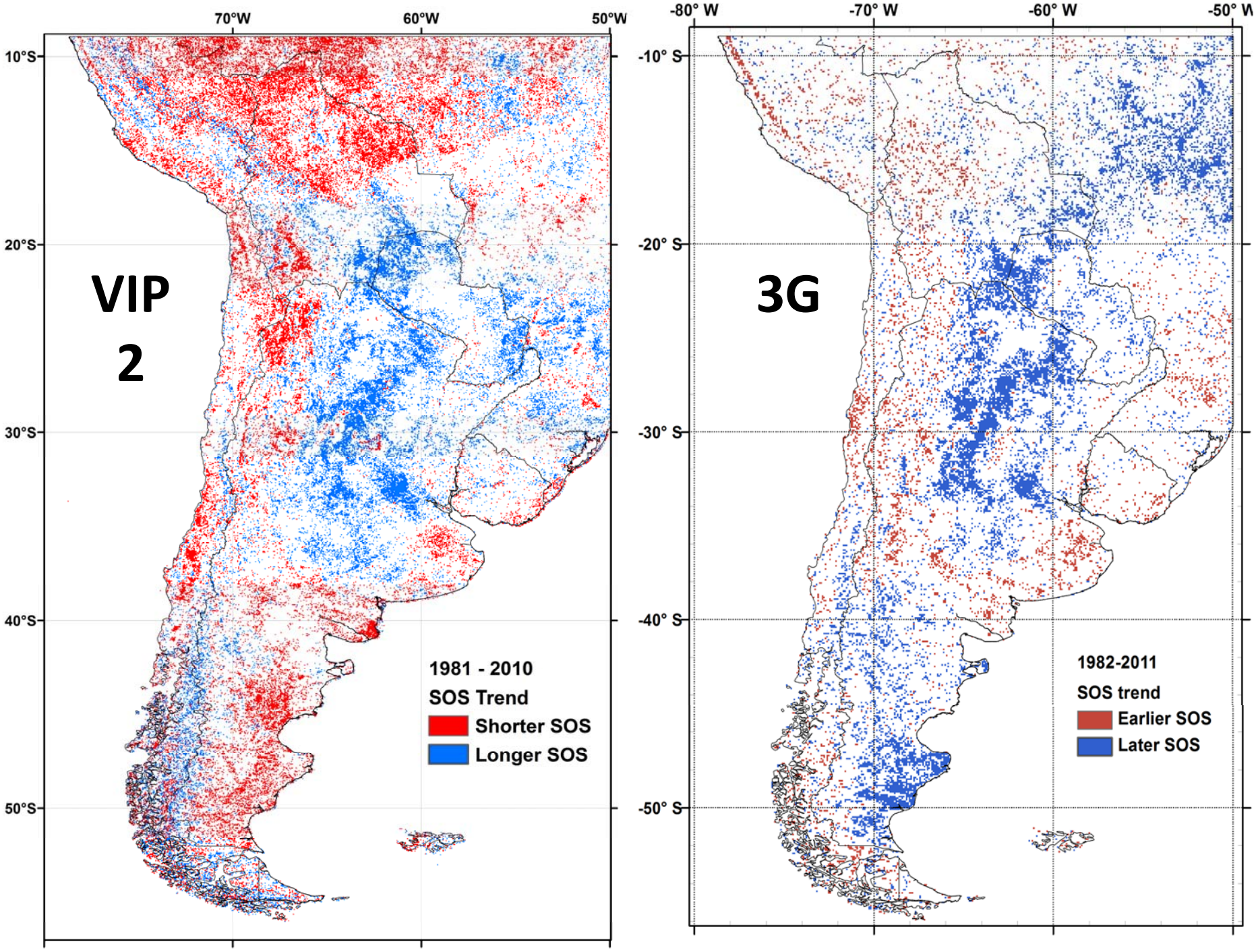

70°W
60°W
10°S
20°S
30°S
40°S
50°S
1981 - 2010
COV (%) NDVI
No Data
0 - 5
5 - 10
10 - 20
20 - 40
40 - 60
60 - 80
80 - 100

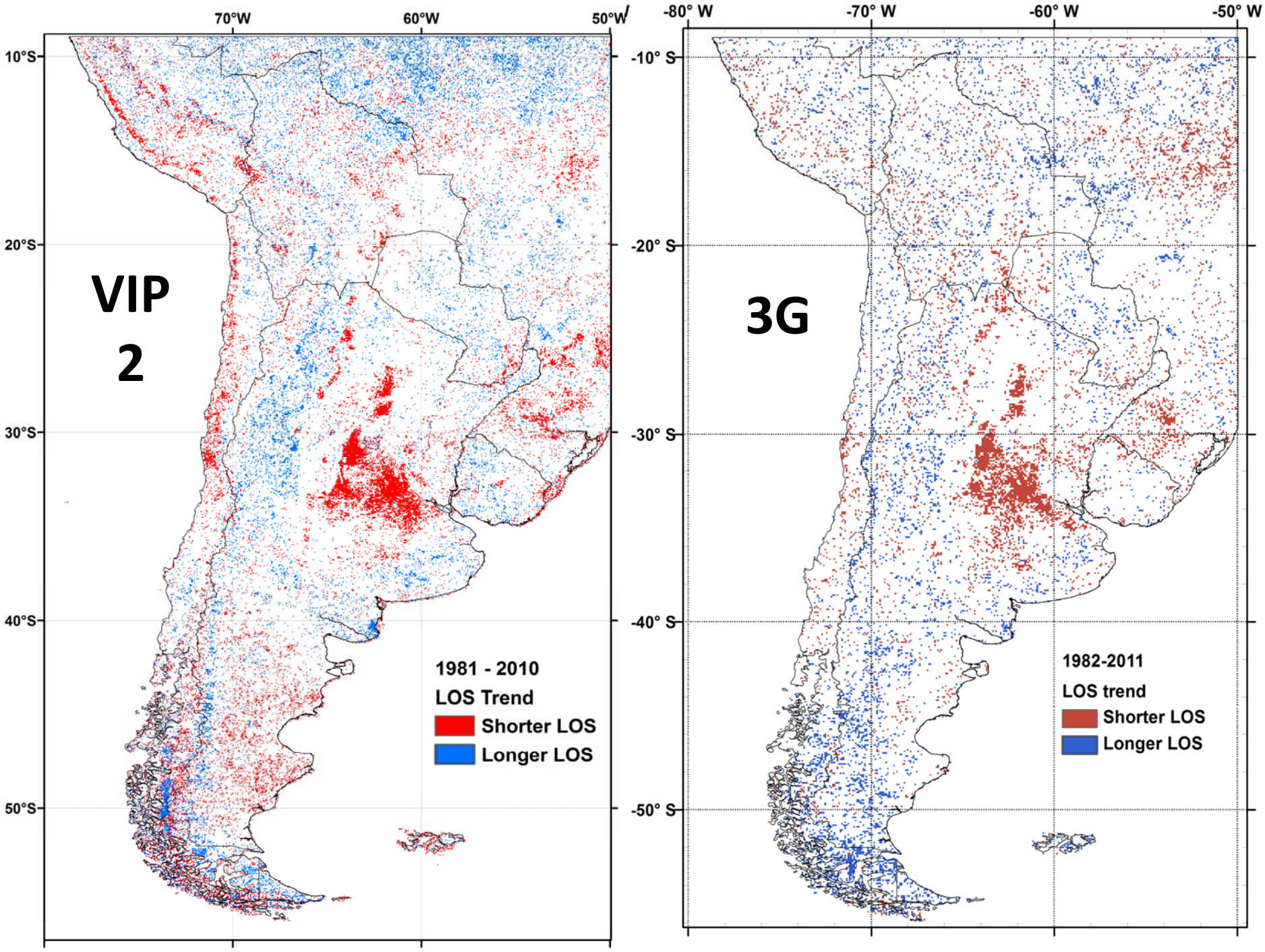

-80° W
-70° W
-60° W
-50° W
-10° S
-20° S
-30° S
-40° S
-50° S
3G
1982-2011
NDVI annual mean
<0
0.0 - .05
.05 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.4
0.4 - 0.5
0.5 - 0.6
0.6 - 0.7
0.7 - 0.8
0.8 - 0.9
0.9 - 1.0
1982 -2011
COV (%) NDVI
no data
0 - 5
5. - 10
10. - 20
20. - 40
40. - 60
60. - 80
80. - 100

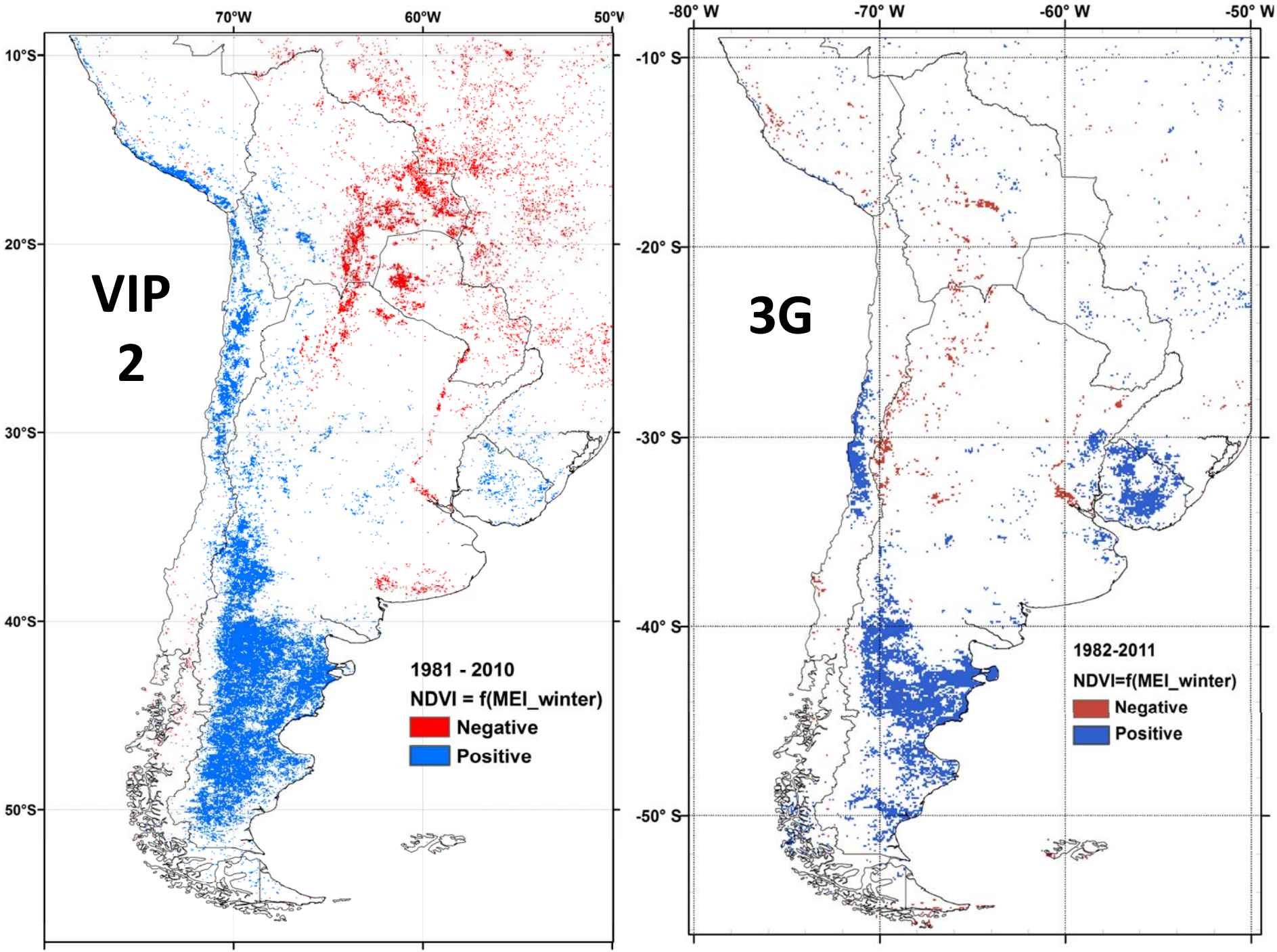

70°W
60°W
50°W
10°S
20°S
30°S
40°S
50°S
VIP
2
1981 - 2010
NDVI Trend
> 5%
2% - 5%
0 - 2%
-2% - 0
-2% - -5%
< -5%
-80° W
-70° W
-60° W
-50° W
10° S
20° S
30° S
40° S
50° S
3G
1982-2011
NDVI trend
> 5%
2% - 5%
0% - 2%
-2% - 0
-2% - -5%
< -5%

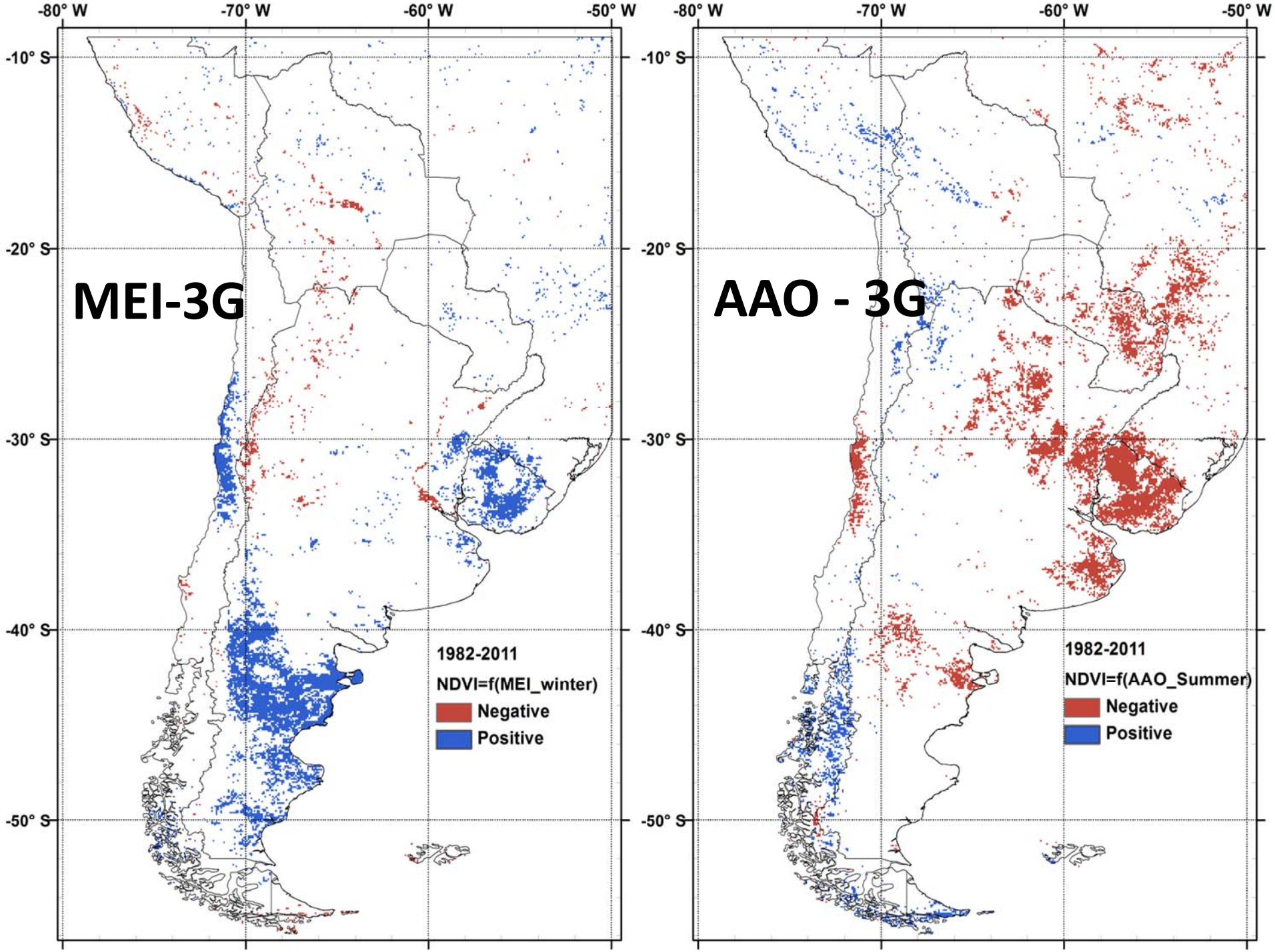

VIP
2
70°W
60°W
10°S
20°S
30°S
40°S
50°S
1981-2010
Median SOS
no SOS
Jan.
Feb.
March
April
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
3G
-80° W
-70° W
-60° W
-50° W
-10° S
-20° S
-30° S
-40° S
-50° S
1982-2011
Median SOS
no SOS
Jan.
Feb.
March
April
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.

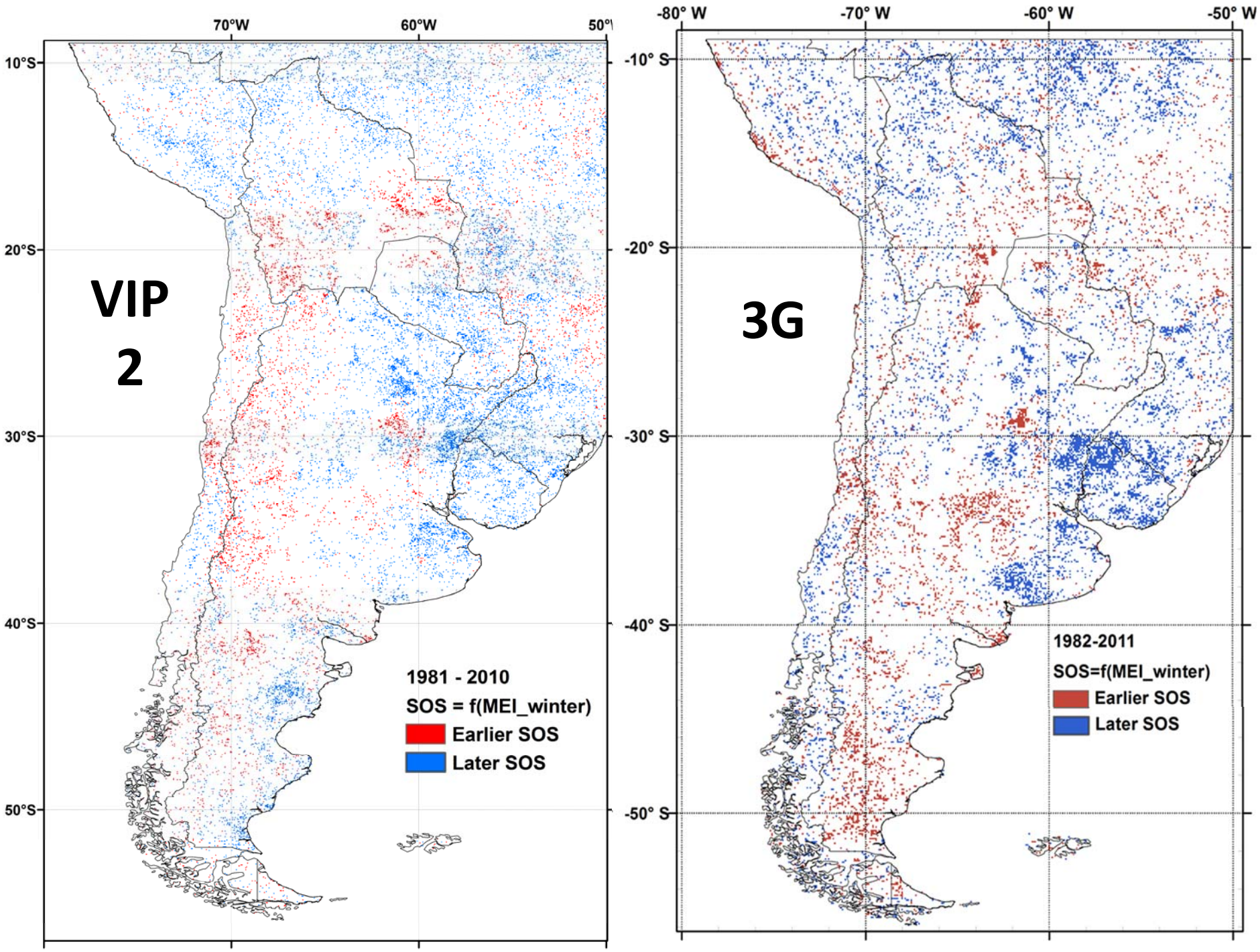

VIP
2
70°W
60°W
50°W
10°S
20°S
30°S
40°S
50°S
1981 - 2010
LOS Annual Mean
0 - 135
135 - 150
150 - 165
165 - 180
180 - 195
195 - 210
210 - 225
225 - 240
240 - 255
255 - 270
270 - 285
285 - 300
300 - 315
315 - 330
3G
-80° W
-70° W
-60° W
-50° W
-10° S
-20° S
-30° S
-40° S
-50° S
1982-2011
LOS annual mean
0 - 135
135. - 150
150. - 165
165. - 180
180. - 195
195. - 210
210. - 225
225. - 240
240. - 255
255. - 270
270. - 285
285. - 300
300. - 315
315. - 330


70°W
60°W
50°W
10°S
20°S
30°S
40°S
50°S
VIP
2
1981 - 2010
SOS Trend
Shorter SOS
Longer SOS
-80° W
-70° W
-60° W
-50° W
-10° S
-20° S
-30° S
-40° S
-50° S
3G
1982-2011
SOS trend
Earlier SOS
Later SOS


VIP
2
70°W
60°W
50°W
10°S
20°S
30°S
40°S
50°S
1981 - 2010
LOS Trend
Shorter LOS
Longer LOS
3G
-80° W
-70° W
-60° W
-50° W
-10° S
-20° S
-30° S
-40° S
-50° S
1982-2011
LOS trend
Shorter LOS
Longer LOS


VIP
2
70°W
60°W
50°W
10°S
20°S
30°S
40°S
50°S
1981 - 2010
NDVI = f(MEI_winter)
Negative
Positive
3G
-80° W
-70° W
-60° W
-50° W
-10° S
-20° S
-30° S
-40° S
-50° S
1982-2011
NDVI=f(MEI_winter)
Negative
Positive


-80° W
-70° W
-60° W
-50° W
-10° S
-20° S
-30° S
-40° S
-50° S
MEI-3G
1982-2011
NDVI=f(MEI_winter)
Negative
Positive
AAO - 3G
1982-2011
NDVI=f(AAO_Summer)
Negative
Positive


VIP
2
70°W
60°W
10°S
20°S
30°S
40°S
50°S
1981 - 2010
SOS = f(MEI_winter)
Earlier SOS
Later SOS
3G
-80° W
-70° W
-60° W
-50° W
-10° S
-20° S
-30° S
-40° S
-50° S
1982-2011
SOS=f(MEI_winter)
Earlier SOS
Later SOS

Preliminary Conclusions

- **Large NDVI differences between VIP and 3g**
- **SOS and LOS patterns from VIP and 3g more similar**
- **Phenology and productivity trends are very different between VIP and 3g**
- **MEI and AAO impacts on productivity and phenology** show different patterns between VIP and 3g