# Snow and Ice Climatology of the Western United States and Alaska

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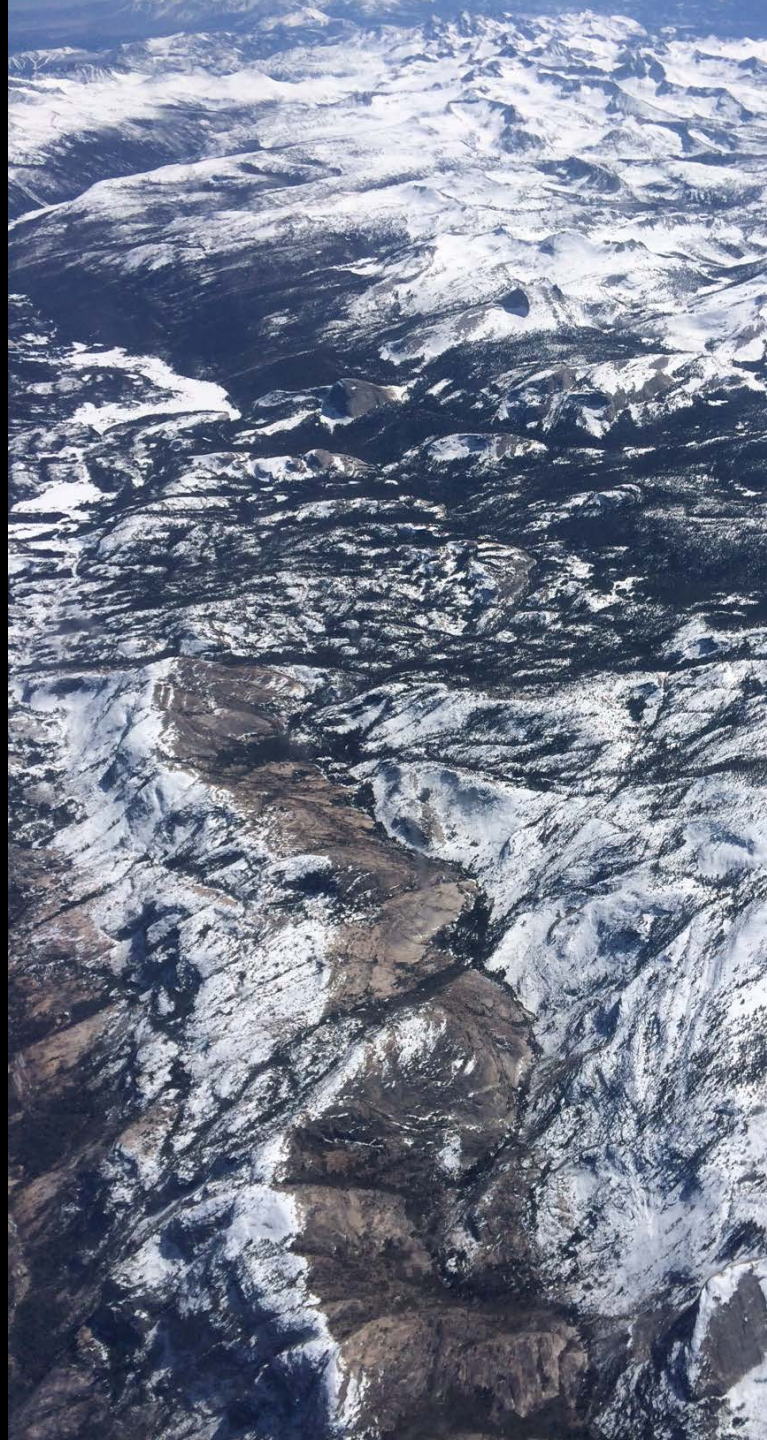
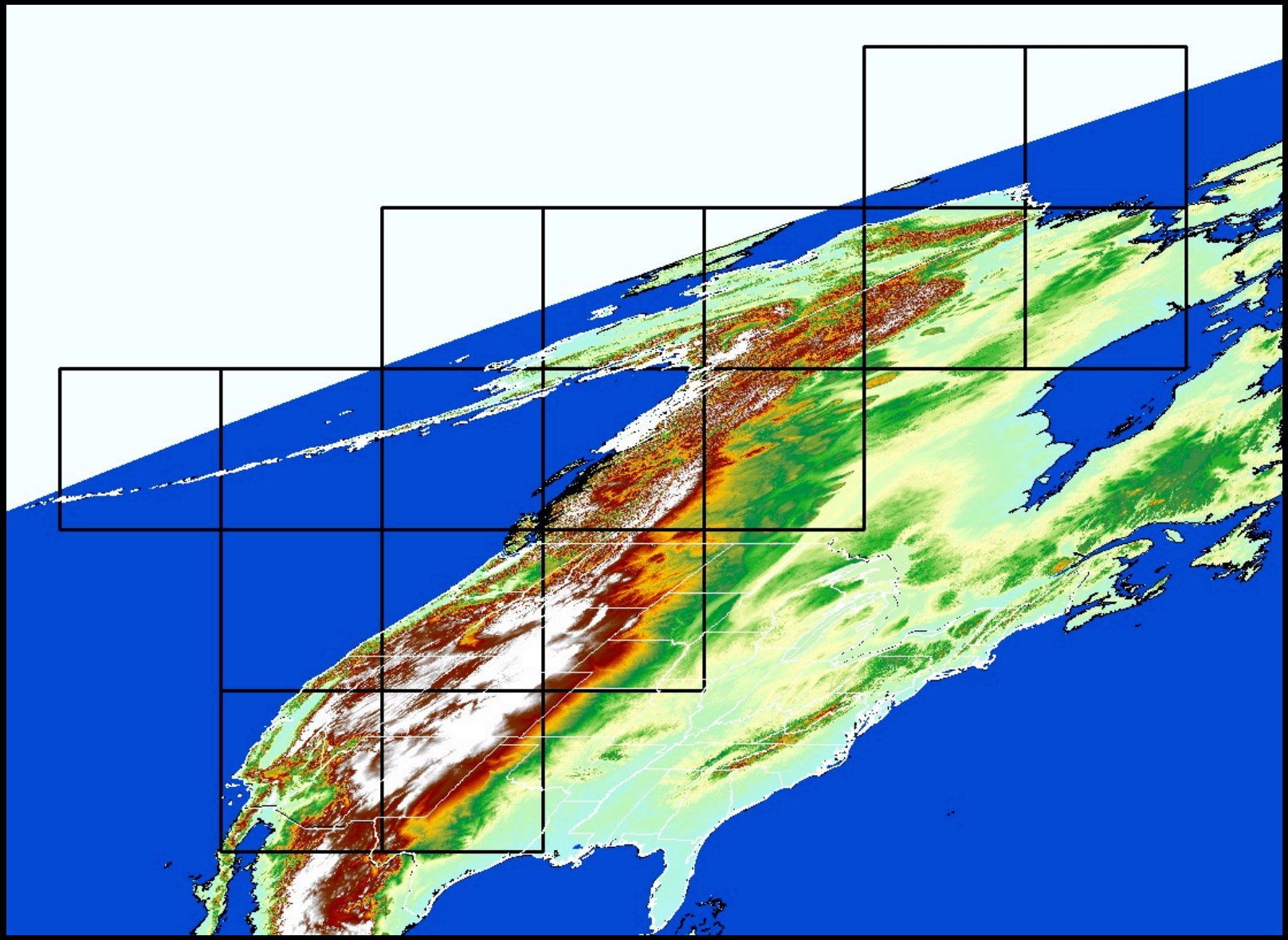


# The Western United States and Alaska

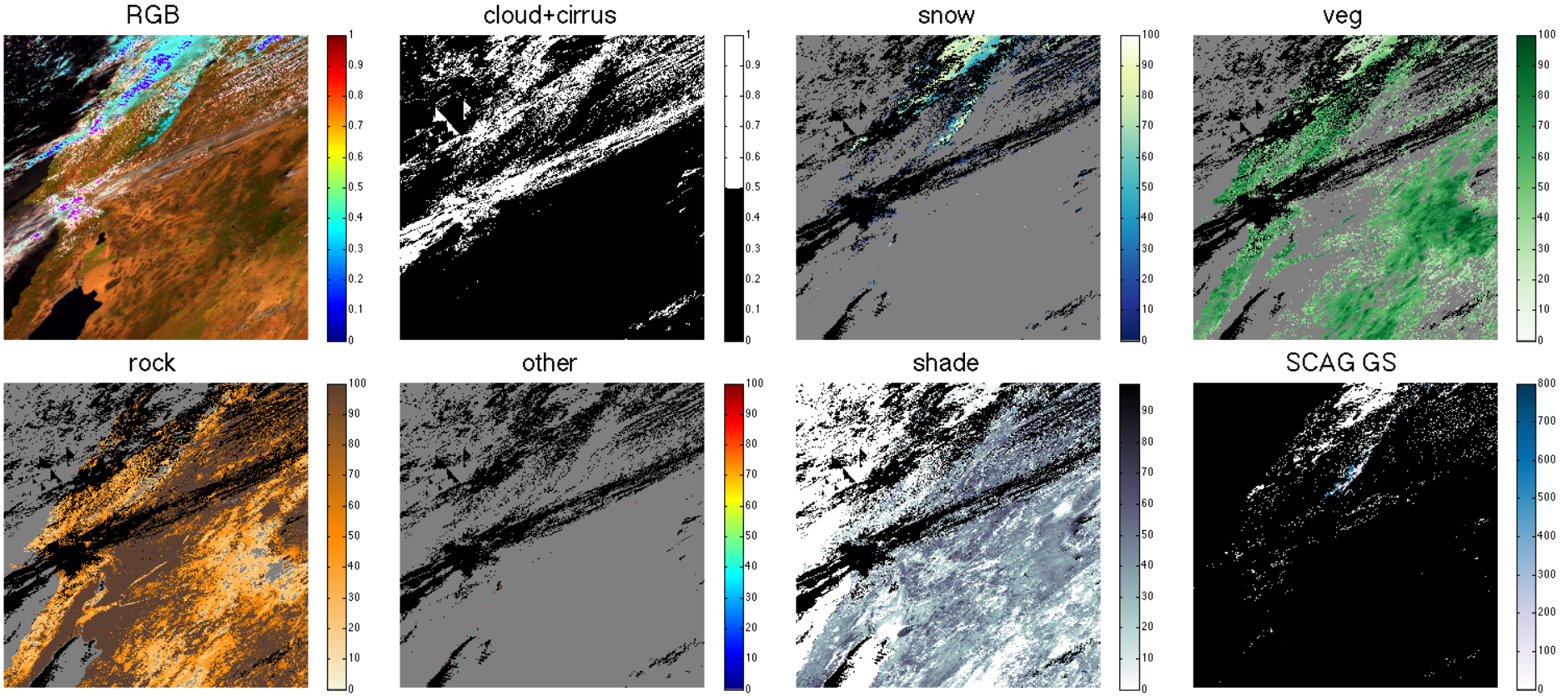


# MODIS Product Overview

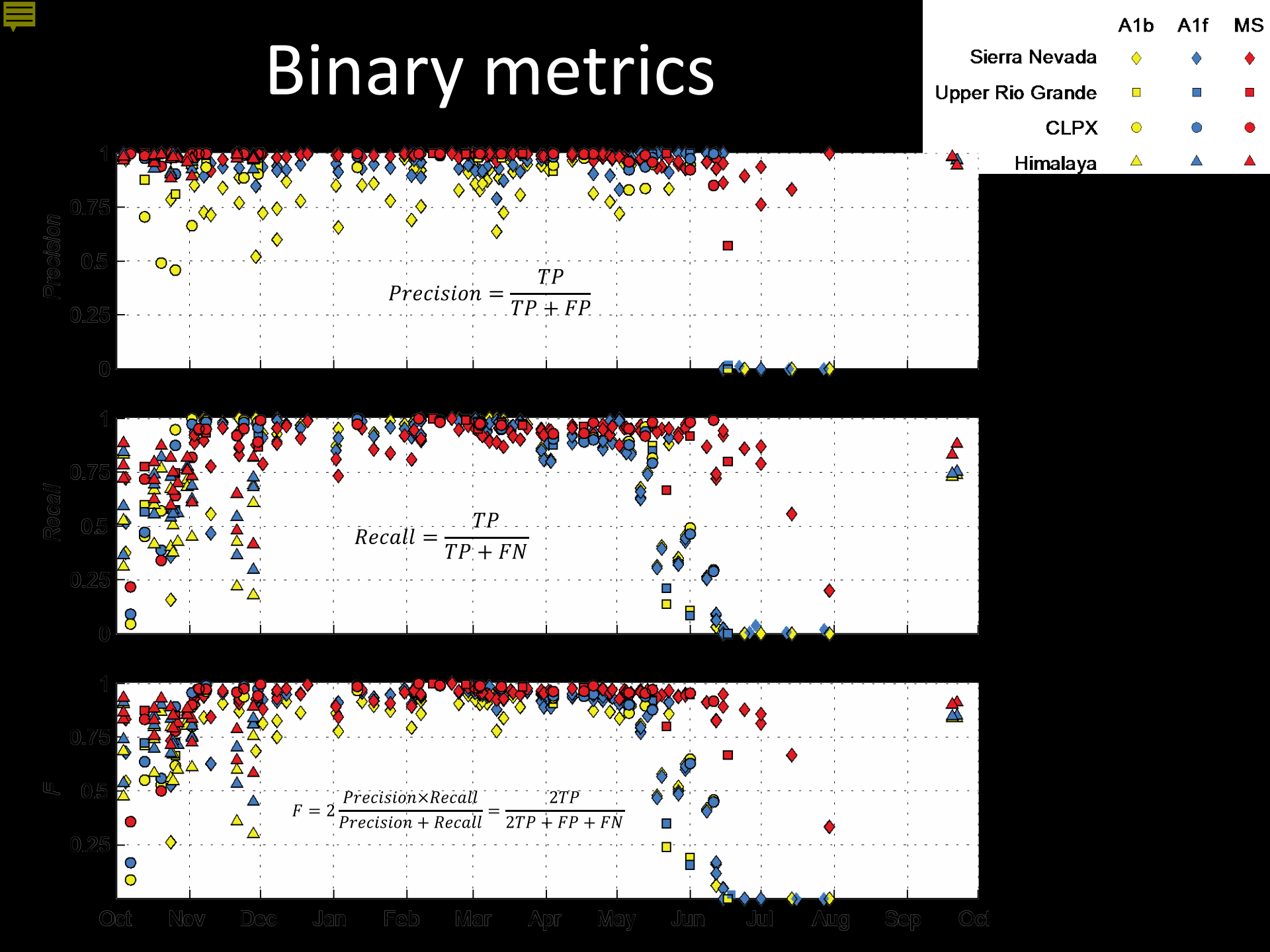
- Level 1
  - MODIS Snow Covered Area and Grain Size
    - MODSCAG (Painter et al., 2009)
  - MODIS Dust Radiative Forcing in Snow
    - MODDRFS (Painter et al., 2012)
- Level 2
  - MODIS Persistent Ice (based on MODSCAG)
    - MODICE (Painter et al., 2012)
  - 8 day composite (based on MODSCAG & MODDRFS)
    - (Rittger et al., In draft)

# MODIS SNOW COVERED AREA AND GRAIN SIZE (MODSCAG)

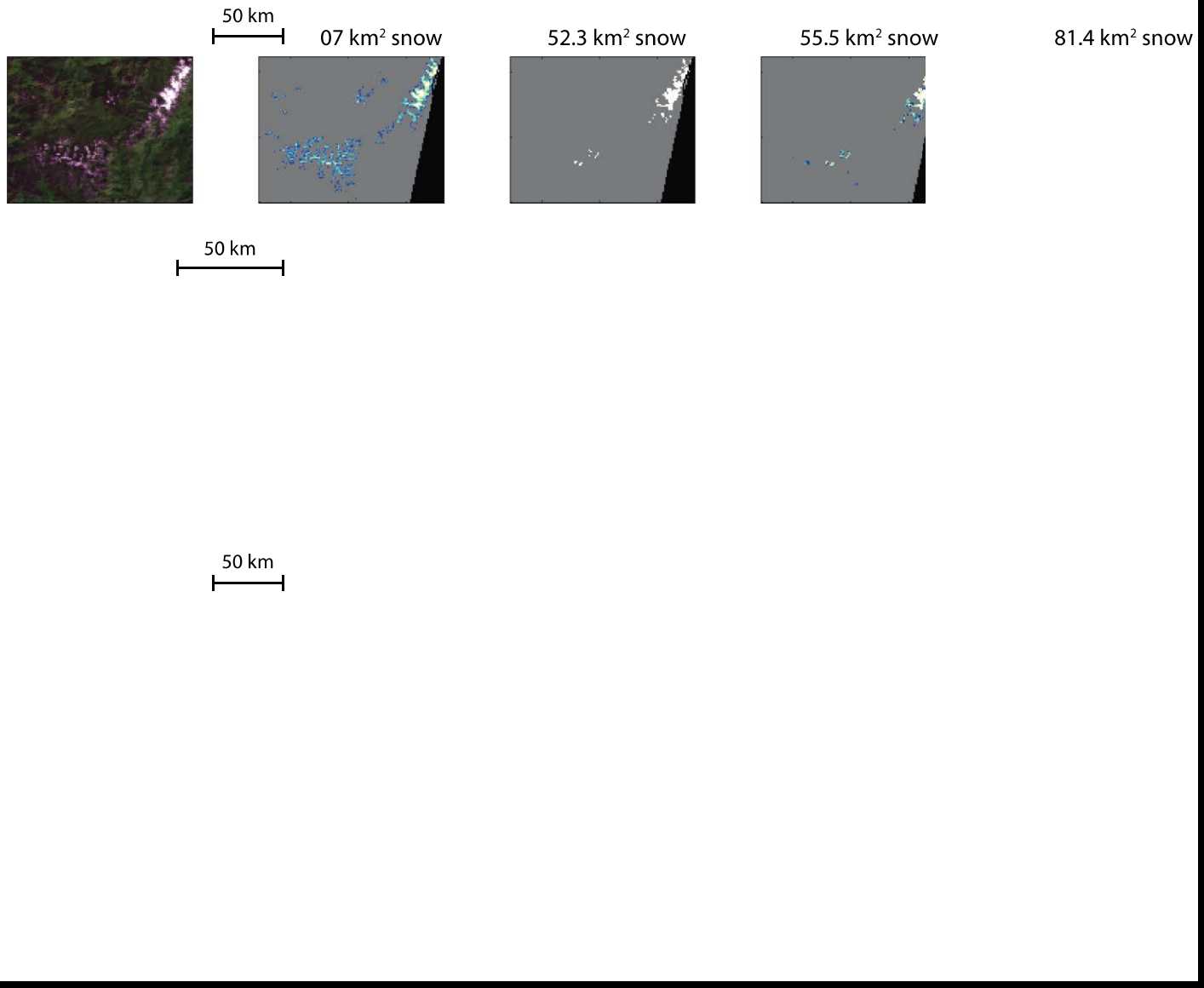
# MODSCAG Products
# Sierra Nevada (2400x2400)

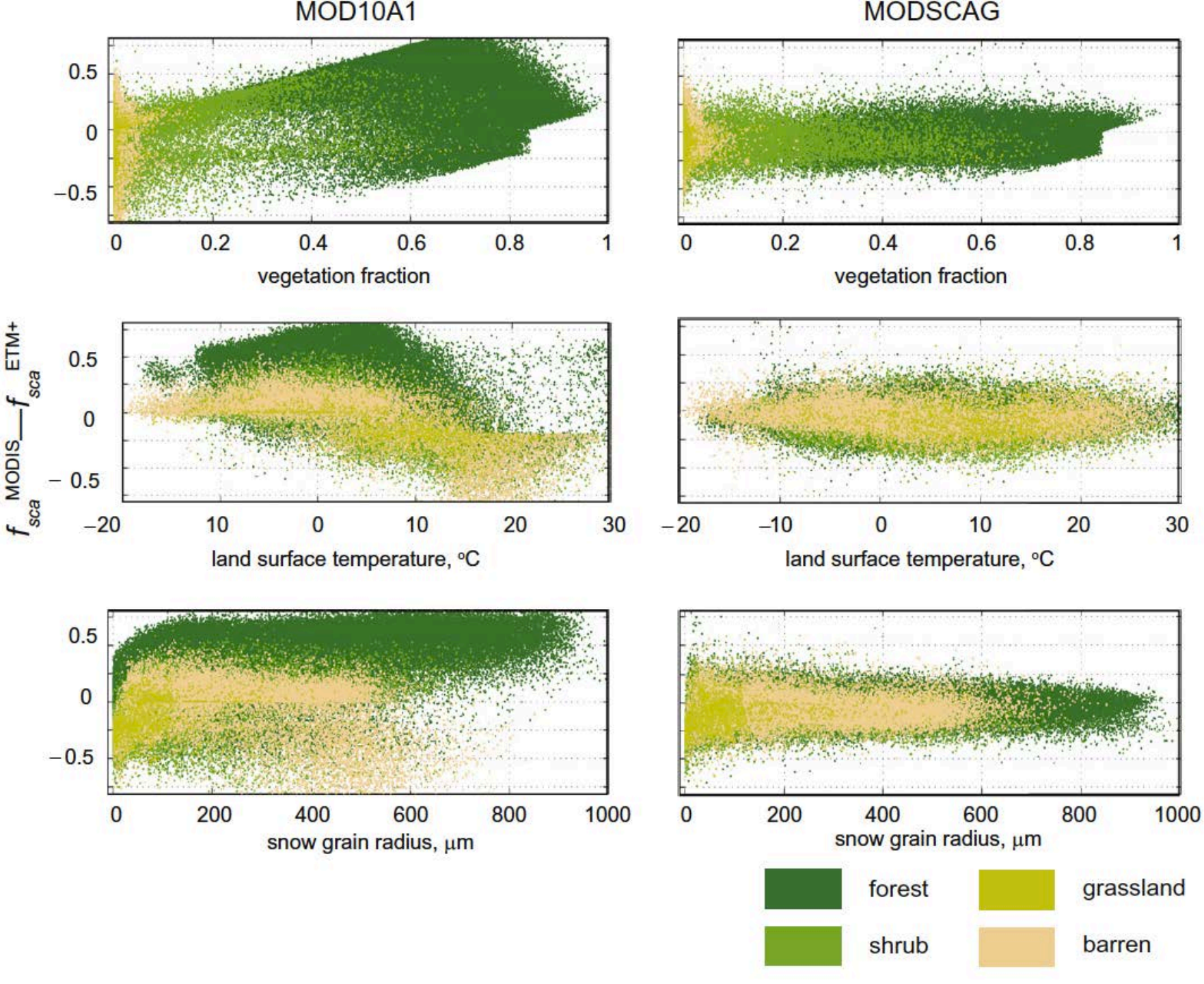


# Binary metrics

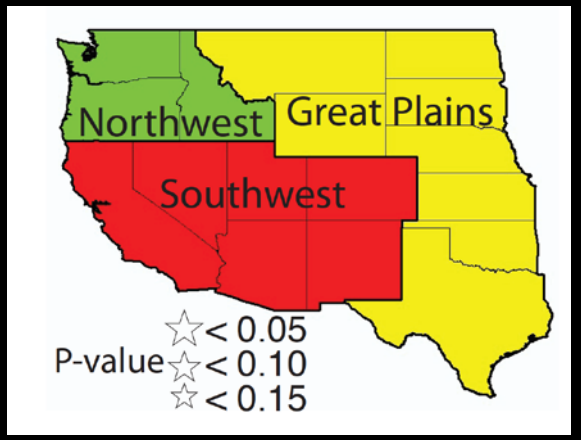


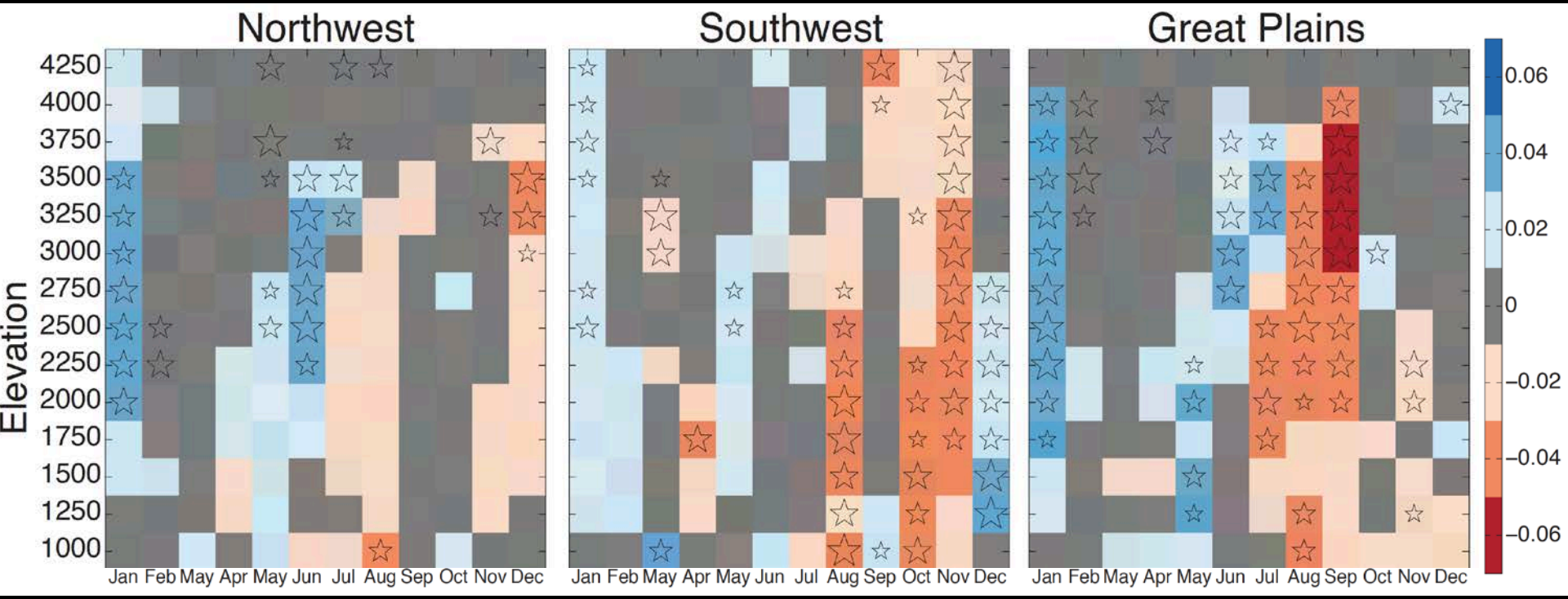
# MODSCAG vs MOD10A1



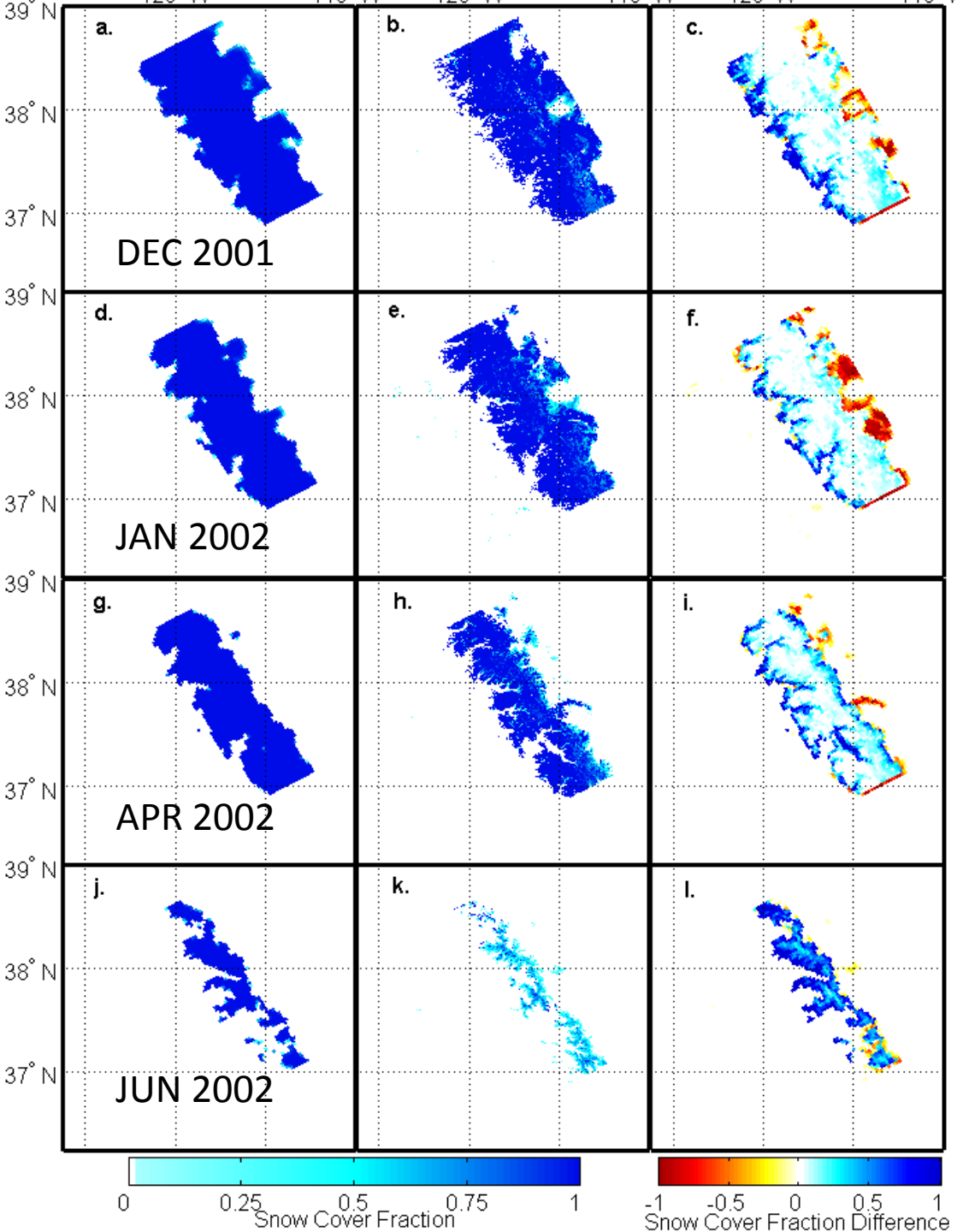

MOD10A1
MODSCAG
0.5
0
−0.5
0
0.2
0.4
0.6
0.8
1
vegetation fraction
$f_{sca}$ MODIS — $f_{sca}$ ETM+
−20
−10
10
20
30
land surface temperature, °C
0
200
400
600
800
1000
snow grain radius, μm
forest
grassland
shrub
barren

# Snow Covered Area trends



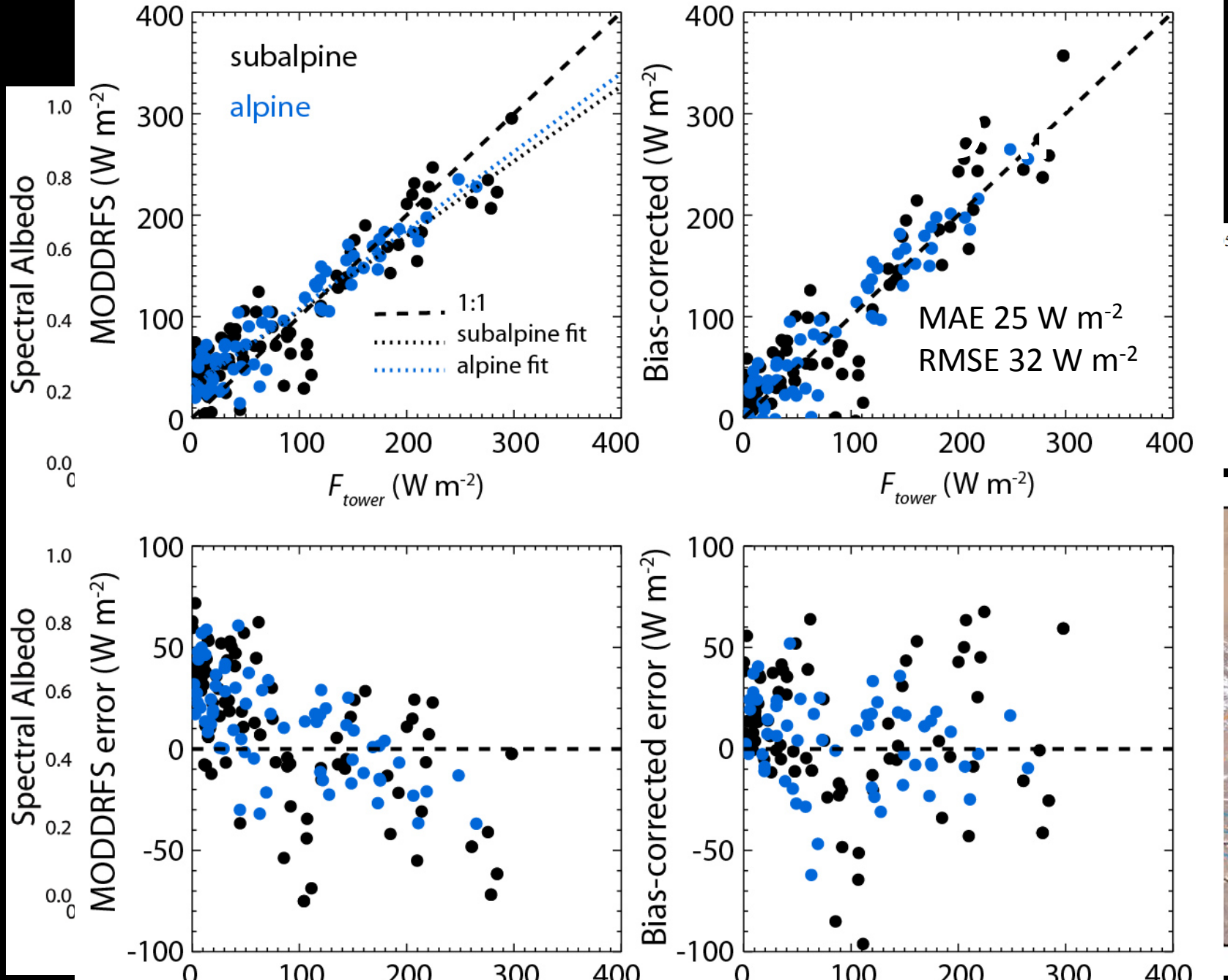



# Comparisons with WRF model

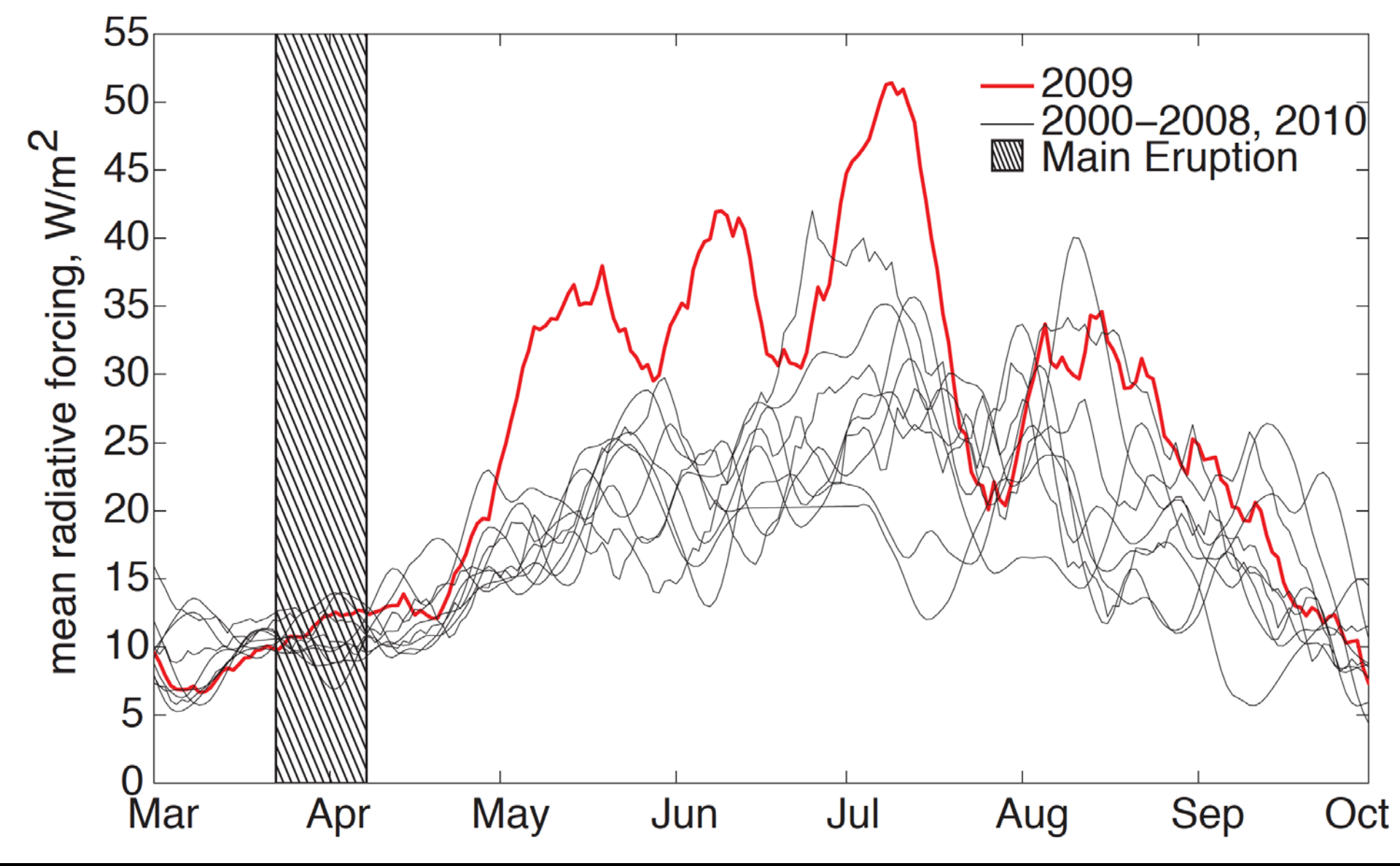



*Wrzesien et al*, in review

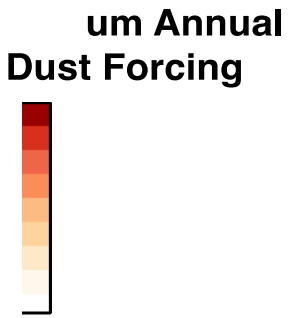
# MODIS DUST RADIATIVE FORCING IN SNOW (MODDRFS)


subalpine
alpine
1:1
subalpine fit
alpine fit
MODDRFS (W m-2)
Bias-corrected (W m-2)
MAE 25 W m-2
RMSE 32 W m-2
F tower (W m-2)
Spectral Albedo
MODDRFS error (W m-2)
Bias-corrected error (W m-2)

52457, 2012

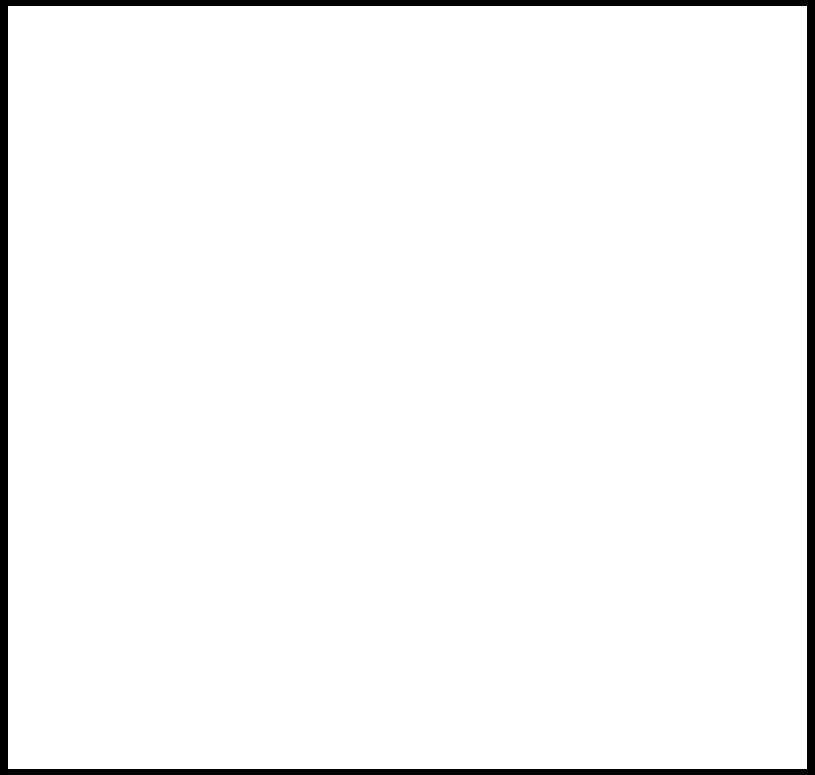

2009
2000–2008, 2010
Main Eruption
mean radiative forcing, W/m2
55
50
45
40
35
30
25
20
15
10
5
0
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct

# Colorado River Basin

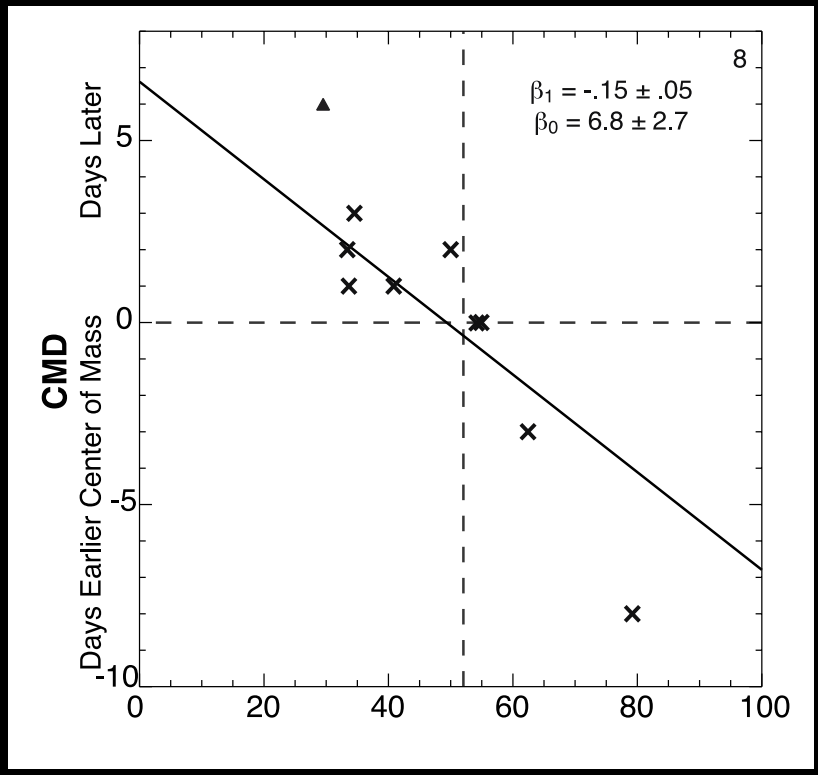



Bryant et al, in prep

# Across the EOS record 2000-2012



Percent bias in forecast




Center of Mass

# MODICE

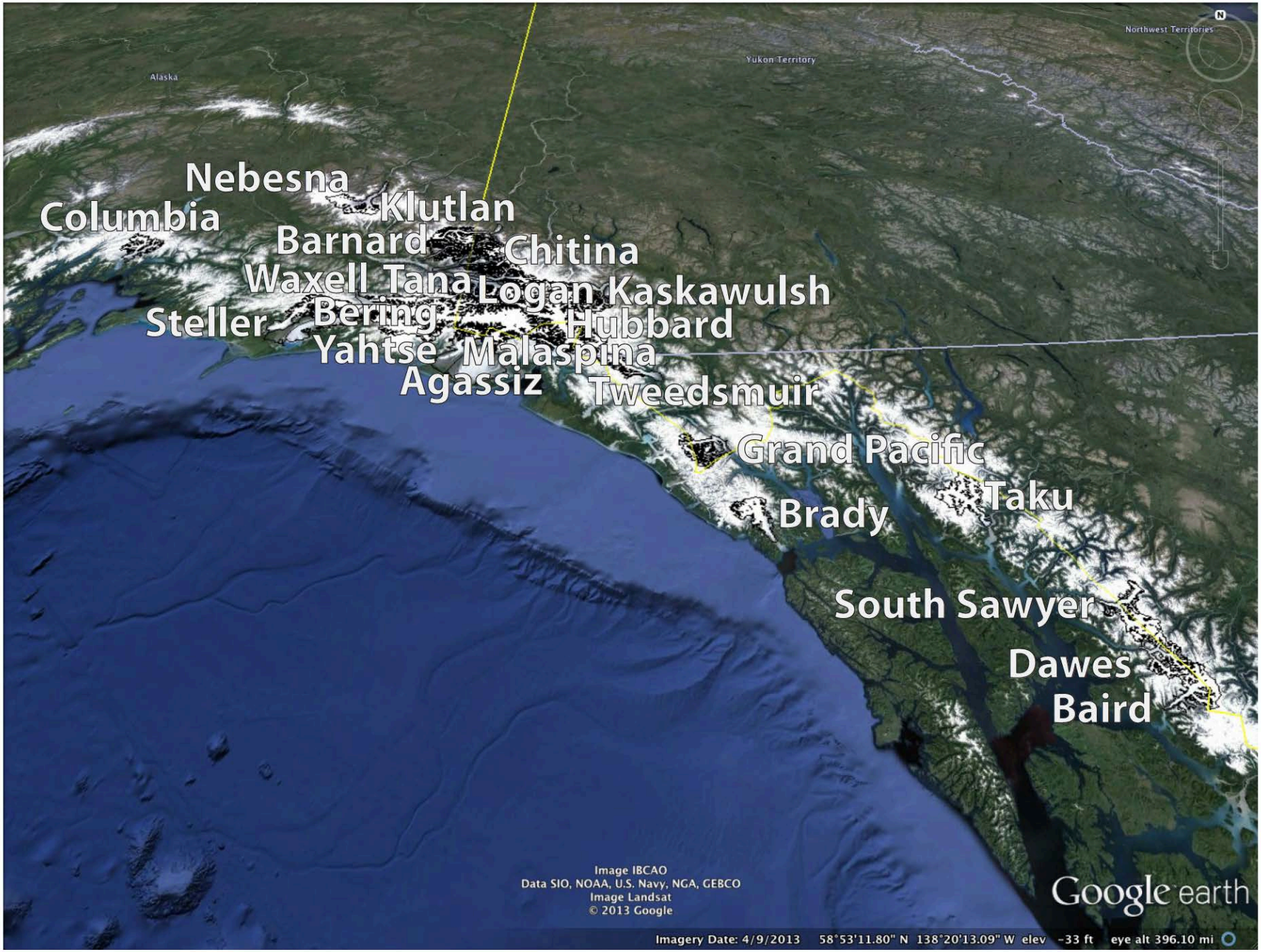
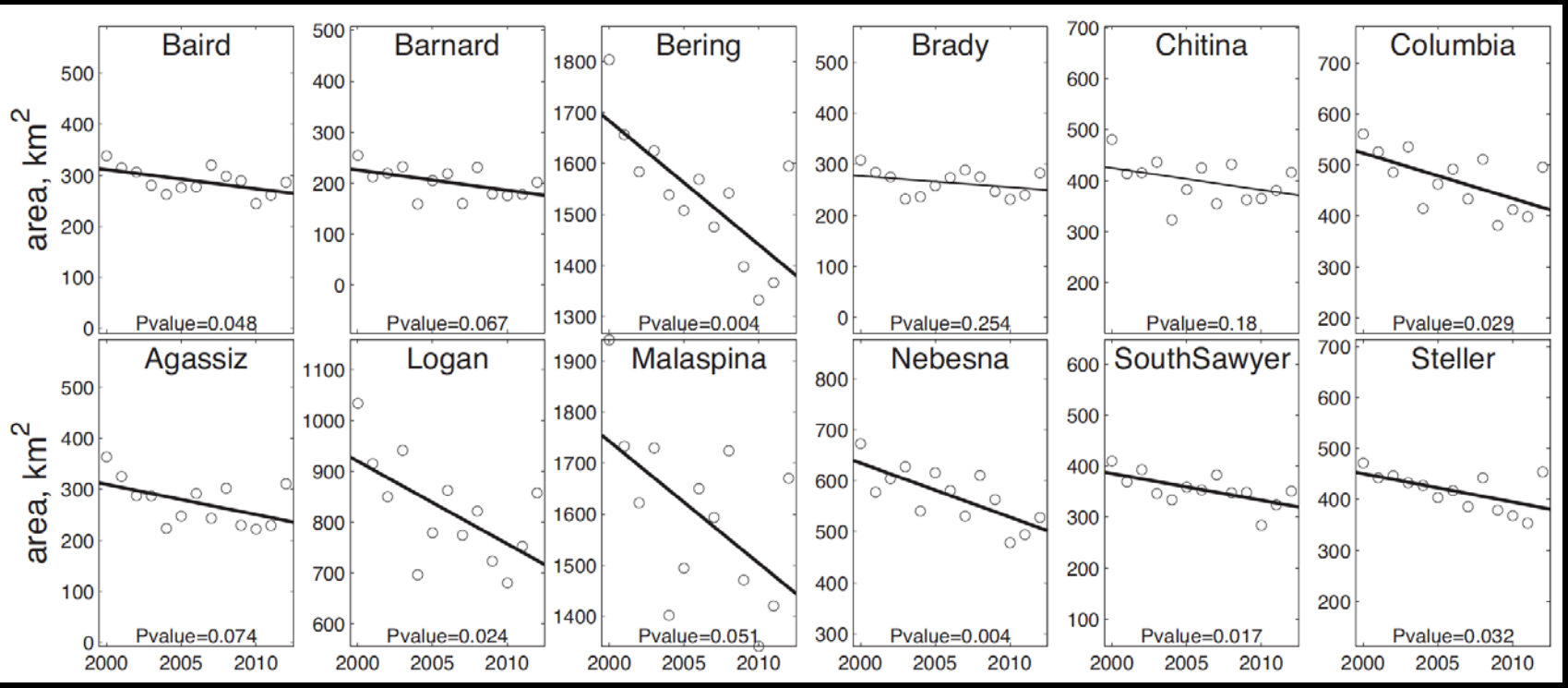
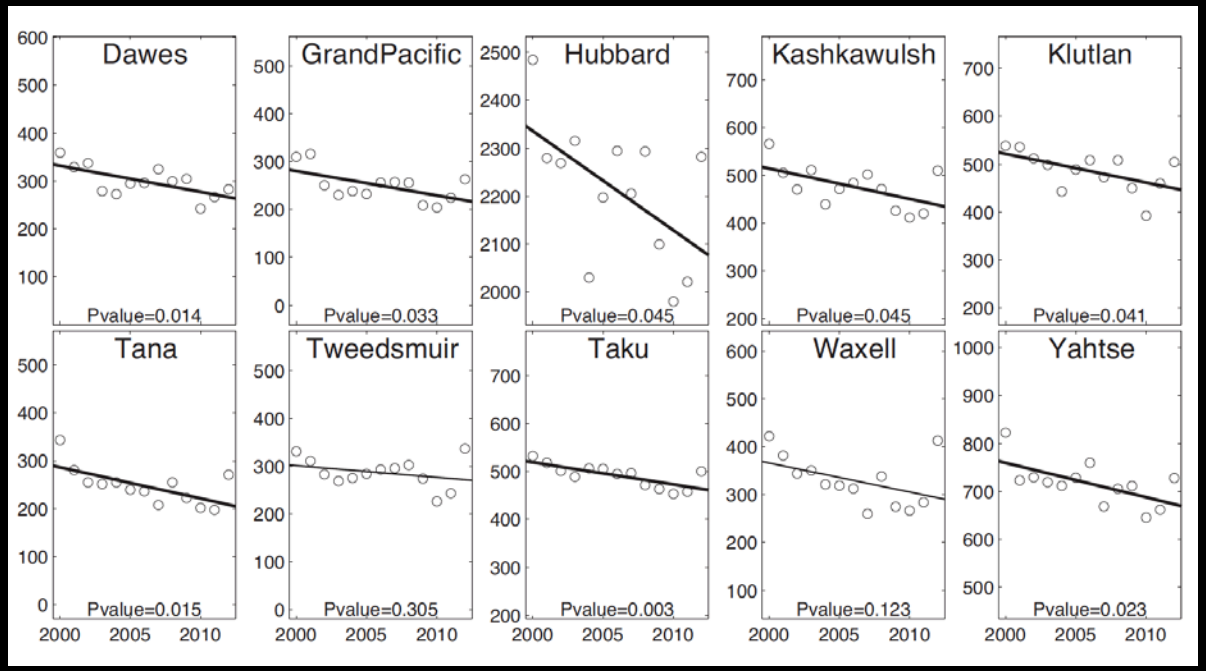


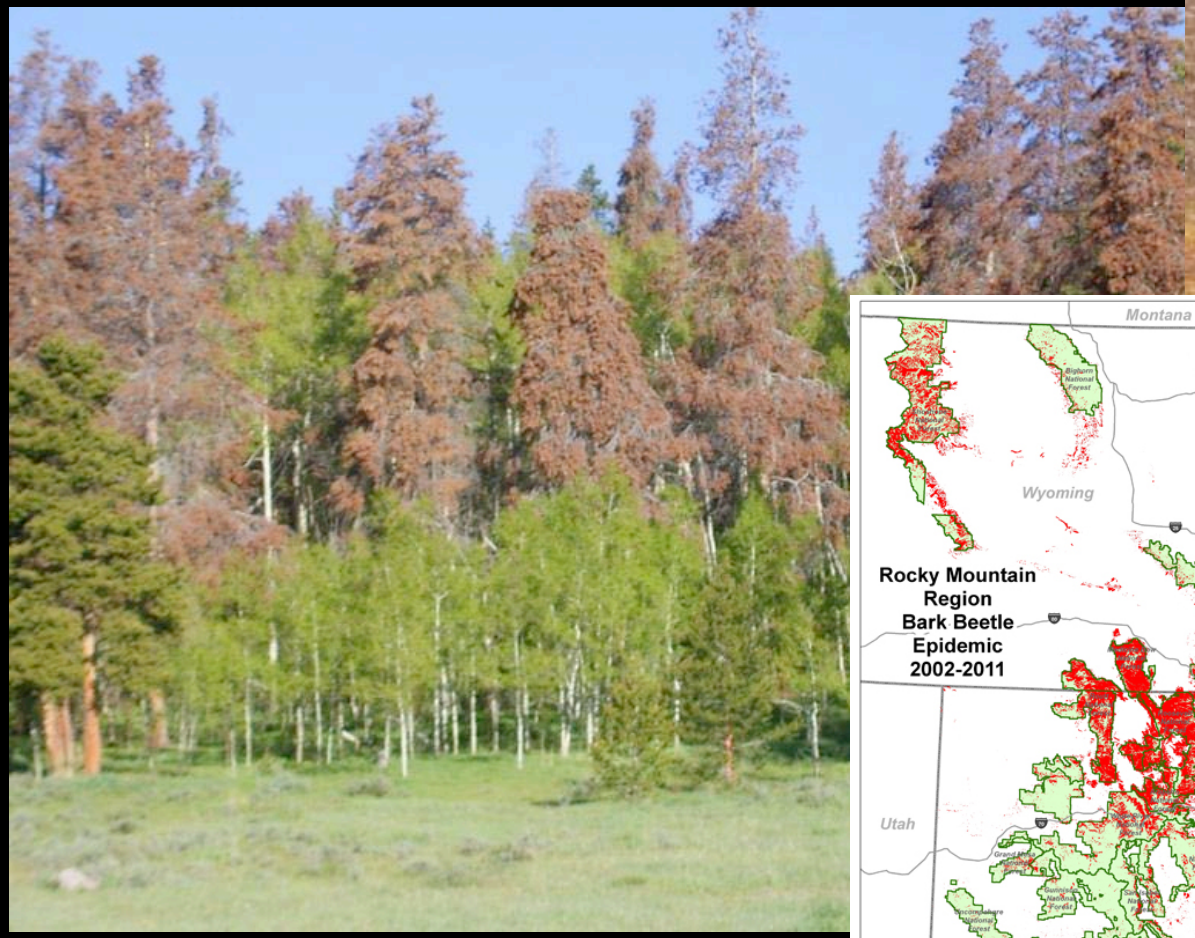

**Fig. 2** Randolf Glacier Inventory (RGI) boundaries and glacier names.

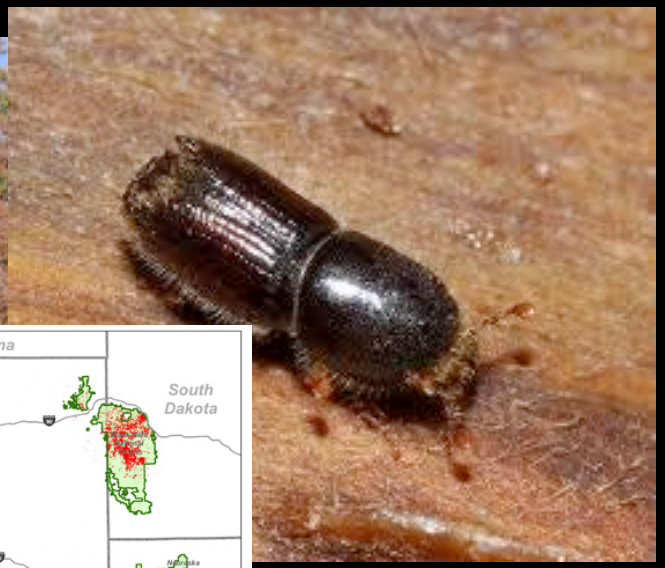

Baird
Pvalue=0.048
Barnard
Pvalue=0.067
Bering
Pvalue=0.004
Brady
Pvalue=0.254
Chitina
Pvalue=0.18
Columbia
Pvalue=0.029
Agassiz
Pvalue=0.074
Logan
Pvalue=0.024
Malaspina
Pvalue=0.051
Nebesna
Pvalue=0.004
SouthSawyer
Pvalue=0.017
Steller
Pvalue=0.032
area, km2
area, km2
2000 2005 2010

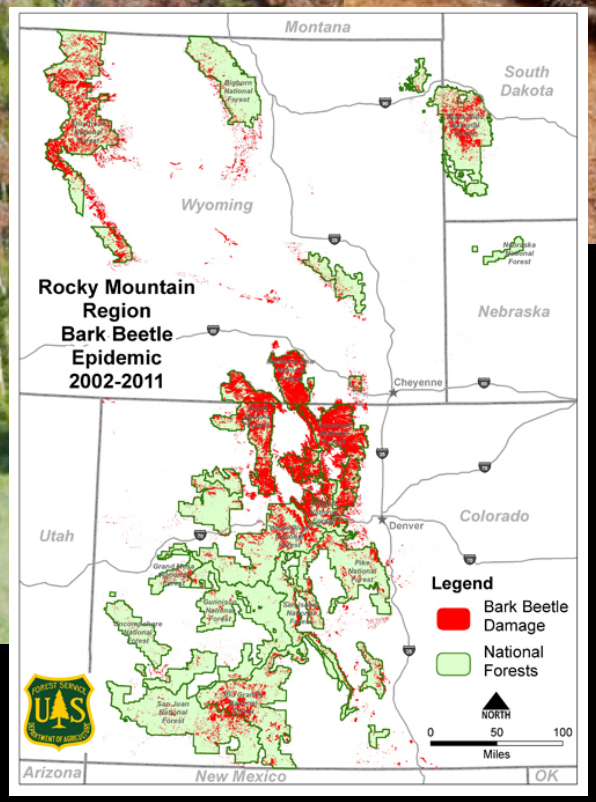

Dawes
Pvalue=0.014
GrandPacific
Pvalue=0.033
Hubbard
Pvalue=0.045
Kashkawulsh
Pvalue=0.045
Klutlan
Pvalue=0.041
Tana
Pvalue=0.015
Tweedsmuir
Pvalue=0.305
Taku
Pvalue=0.003
Waxell
Pvalue=0.123
Yahtse
Pvalue=0.023
2000 2005 2010

# BIOLOGY FROM MODSCAG

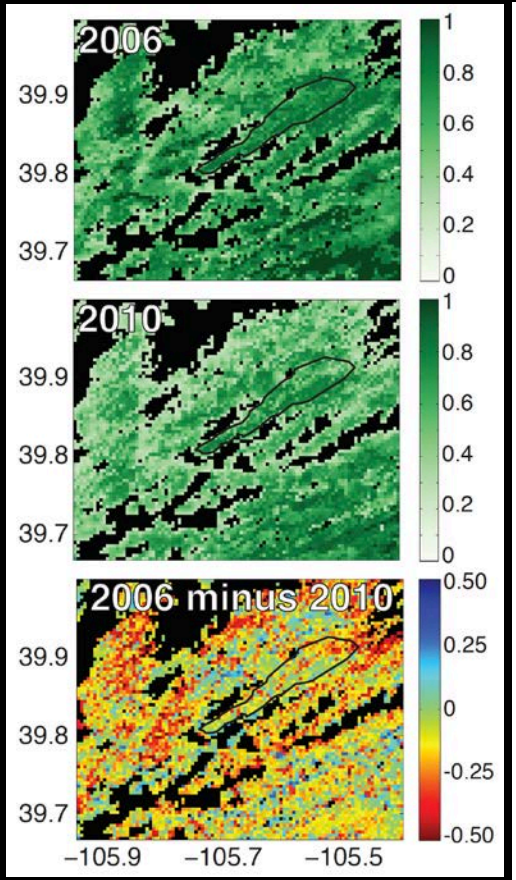
# Biological impacts: the mountain pine beetle







# Vegetation loss from beetles



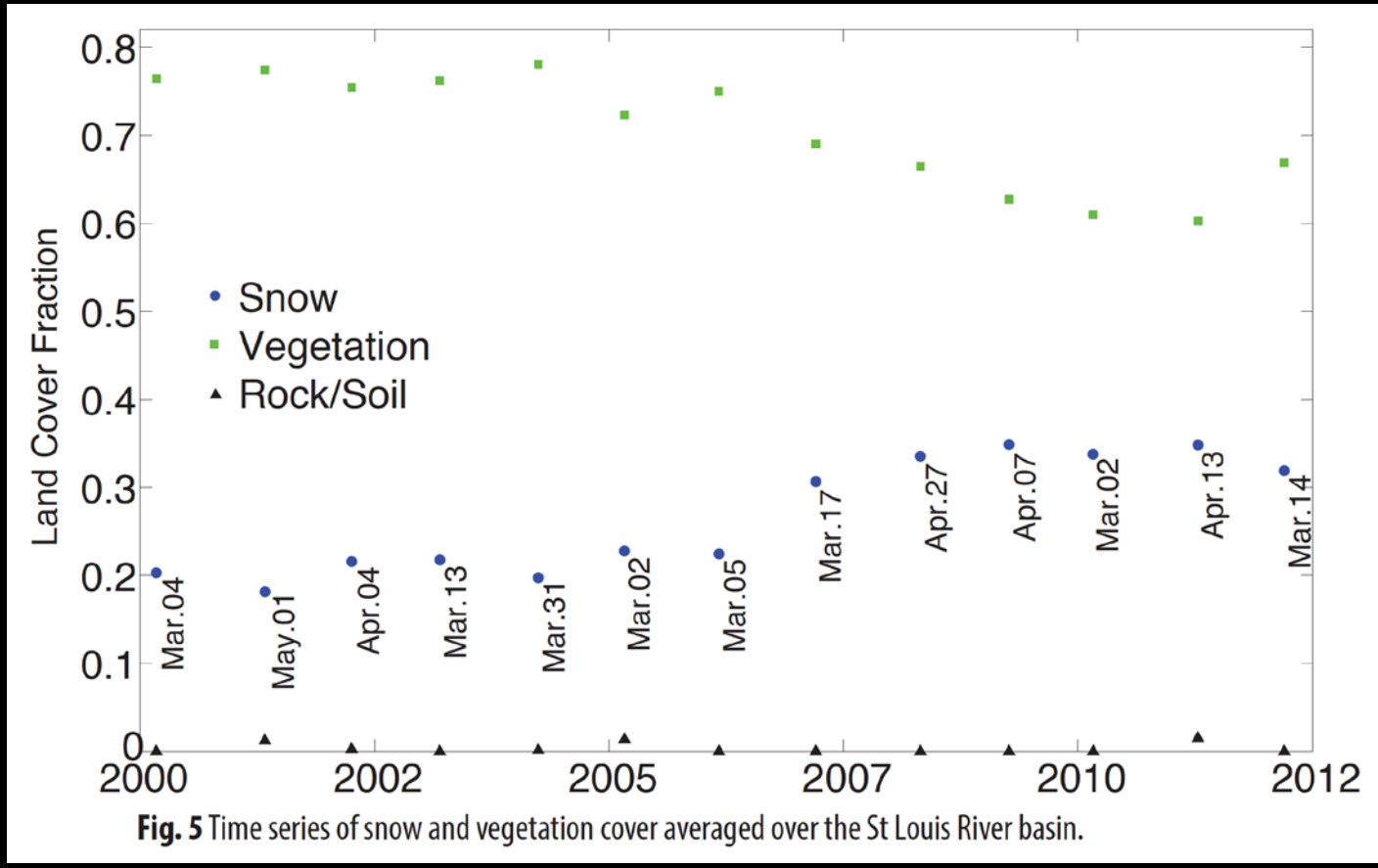
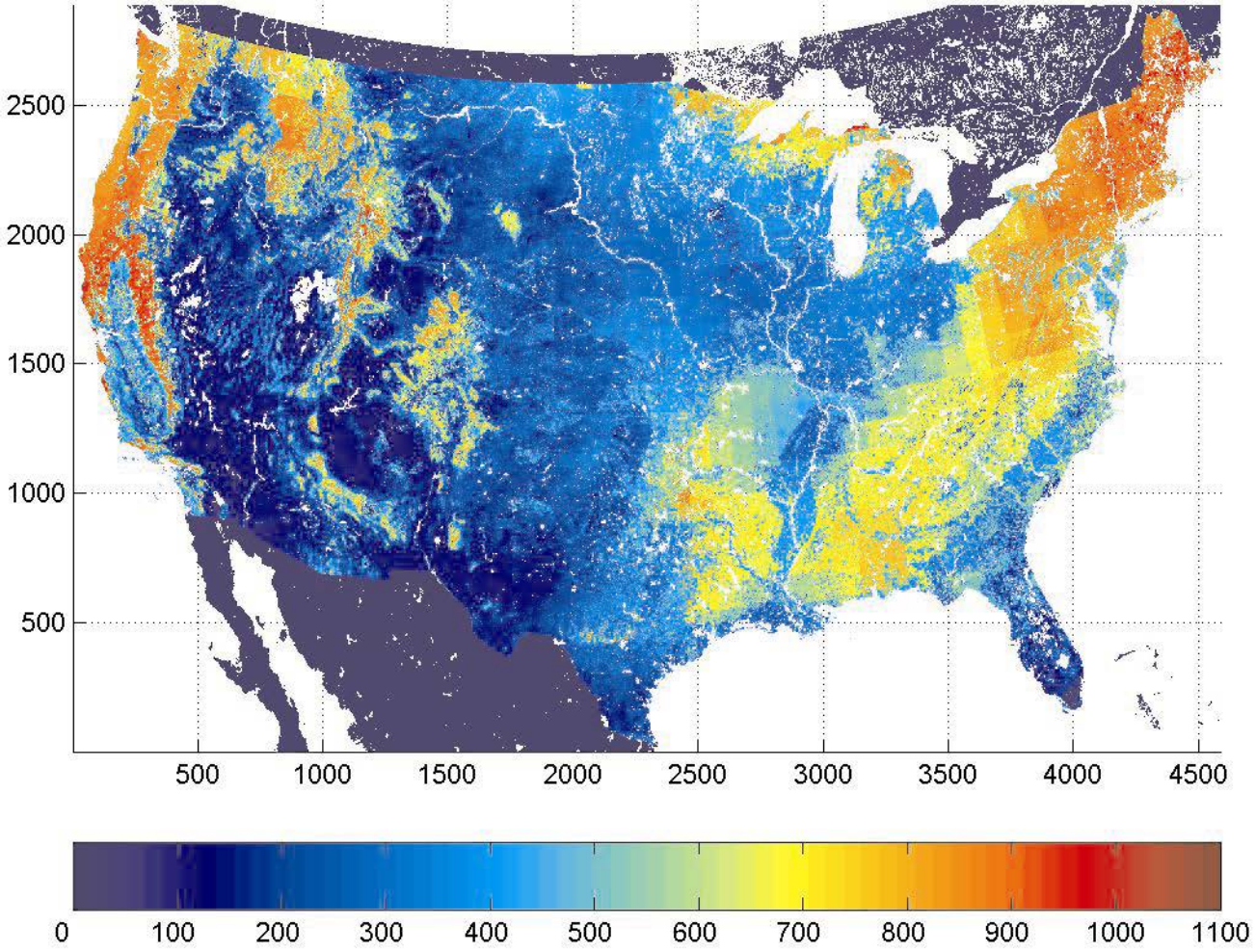
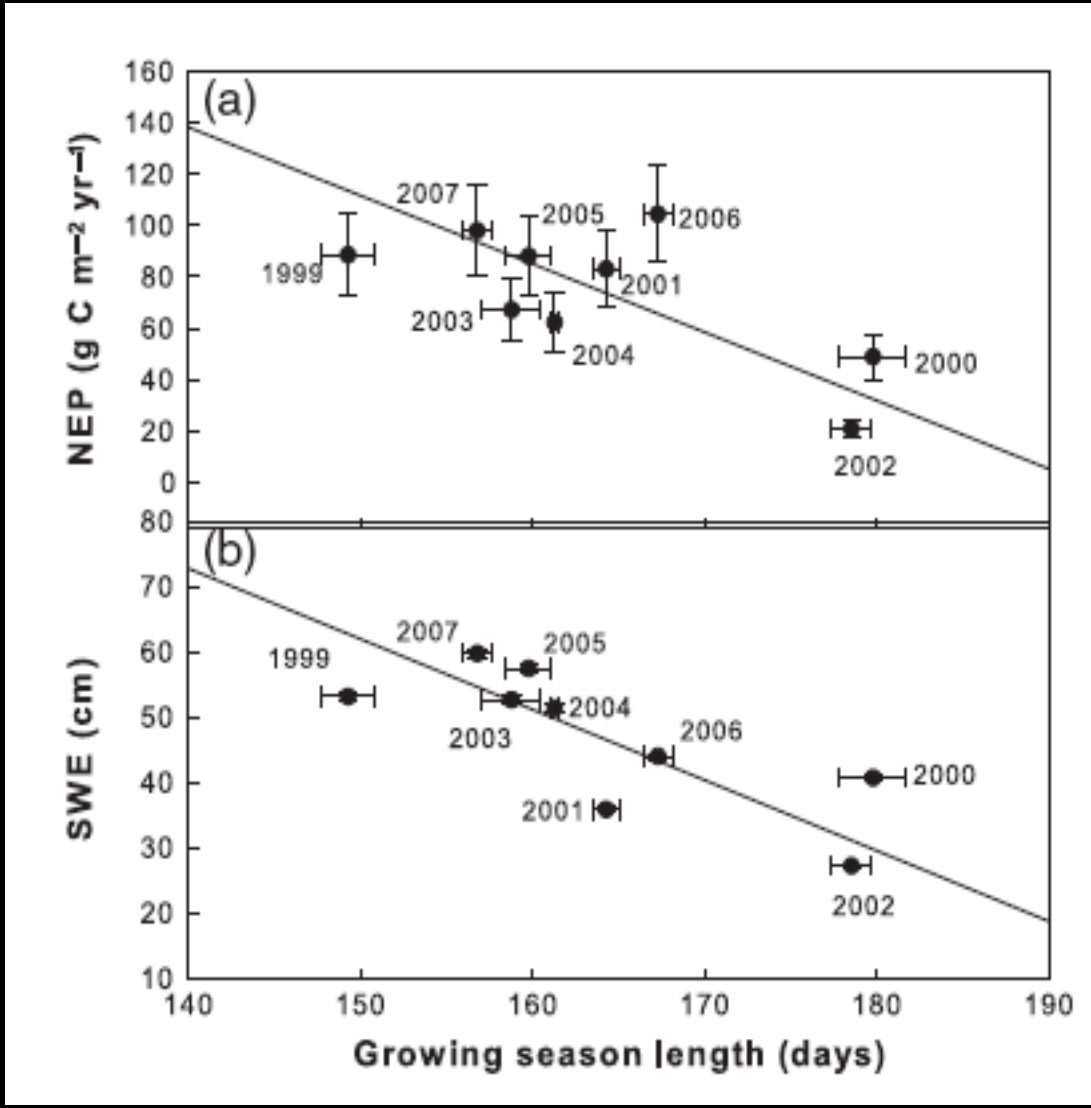




**Fig. 5** Time series of snow and vegetation cover averaged over the St Louis River basin.

# More than half of US GPP is in mountainous regions



# Snowpack dynamics, “growing season” and carbon uptake are all linked




Schimel et al 2003

# Acknowledgements


- Snow DS team
  - Chris Mattmann
  - Paul Ramirez
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  - Annie Bryant
  - Mary Jo Brodzik
  - Kat Bormann