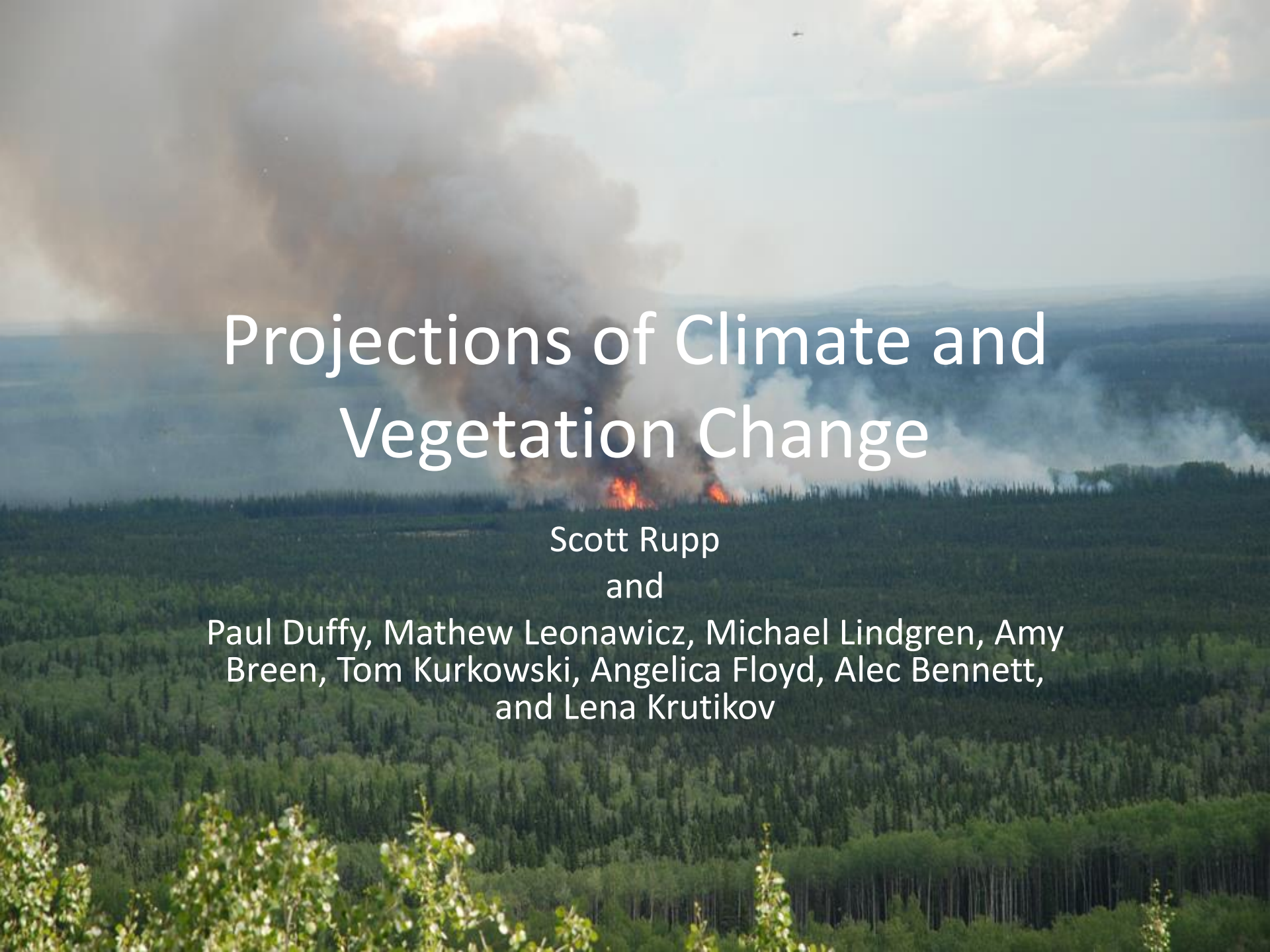


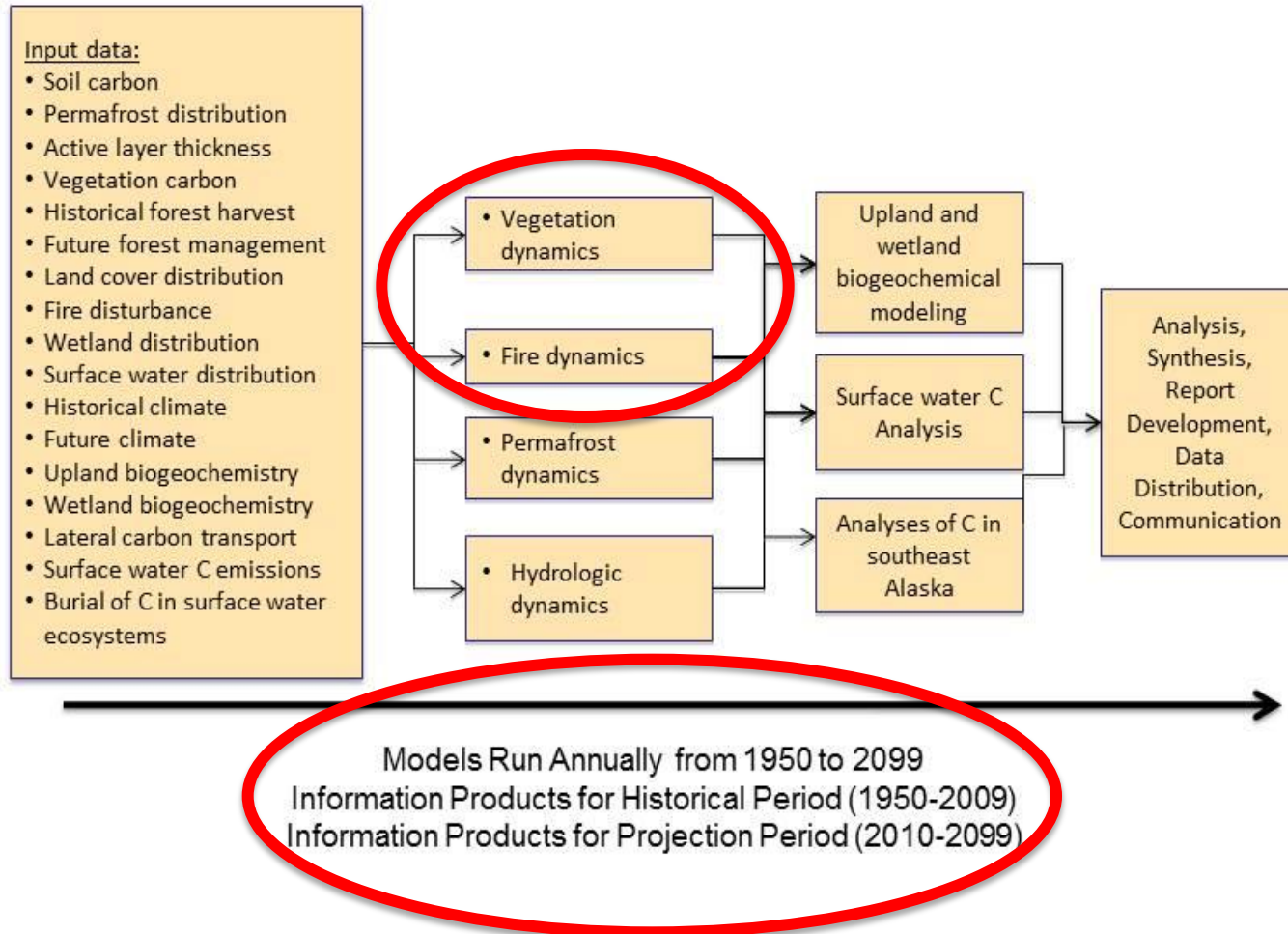


# Projections of Climate and Vegetation Change

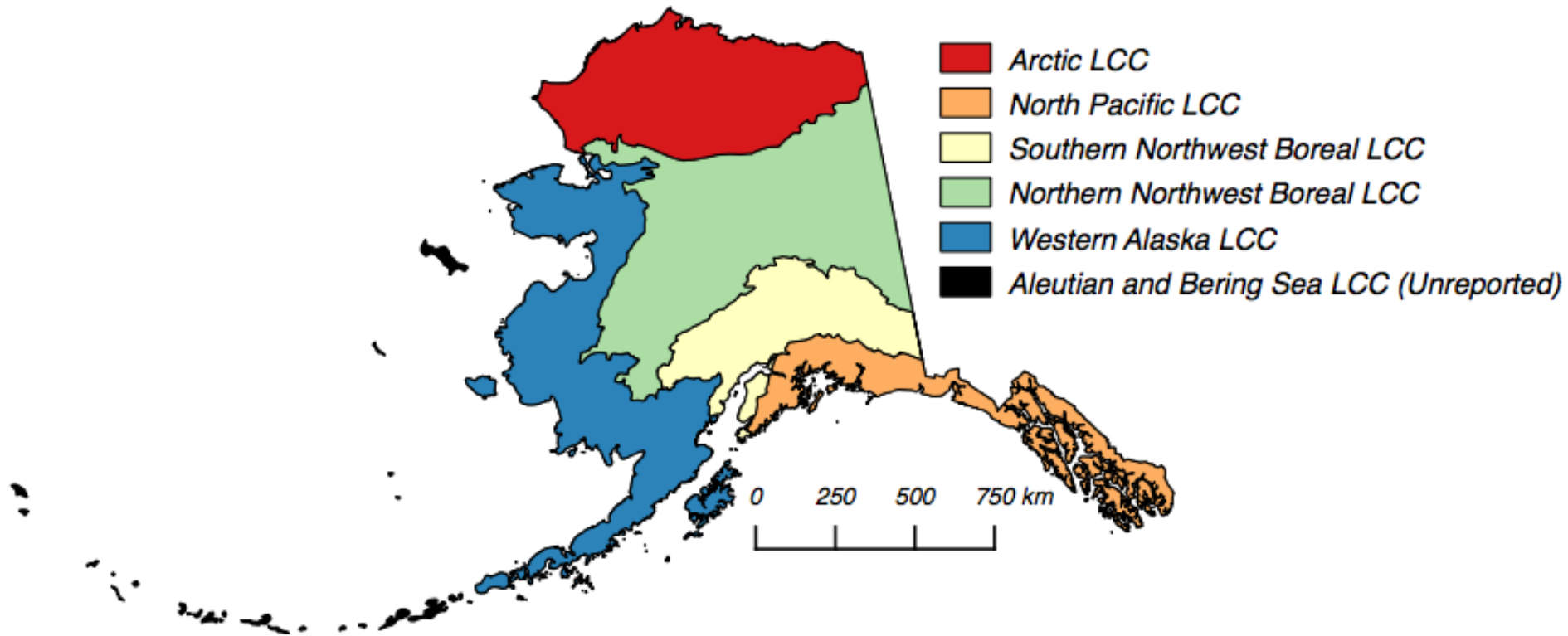
Scott Rupp  
and

Paul Duffy, Mathew Leonawicz, Michael Lindgren, Amy Breen, Tom Kurkowski, Angelica Floyd, Alec Bennett, and Lena Krutikov

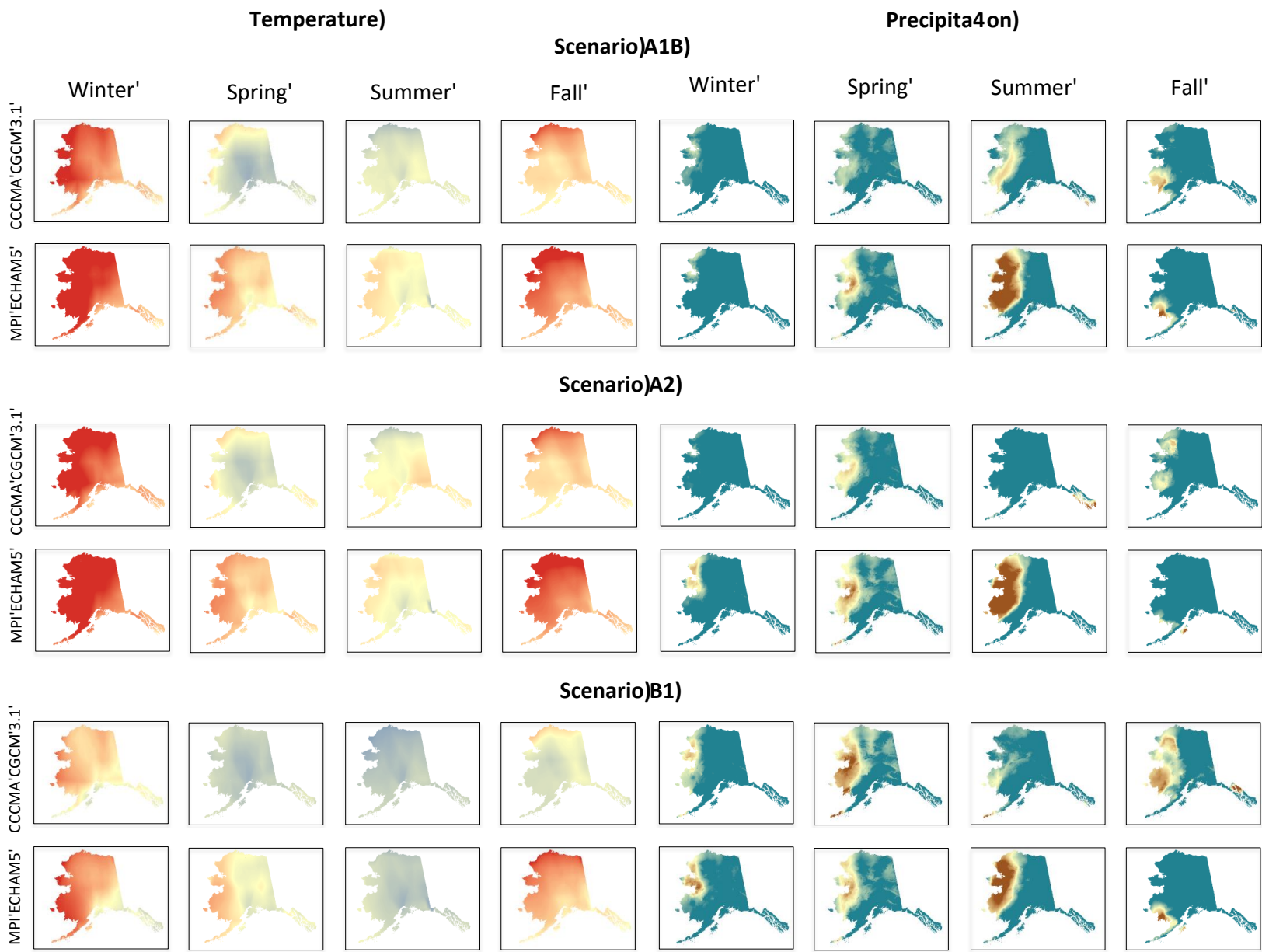
# USGS LandCarbon - National Assessment of Ecosystem Carbon Sequestration and Greenhouse Gas Fluxes



# Assessment Domain and Subregions



# Projected Climate Change – Differences 1980-2009 and 2070-2099



# Projected Climate Change – Differences 1980-2009 and 2070-2099

## Temperature

| CCCMA  | Arctic |      |      | North Pacific |      |      | NW Boreal South |      |      | NW Boreal North |      |      | Western AK |      |      | Alaska |      |      |
|--------|--------|------|------|---------------|------|------|-----------------|------|------|-----------------|------|------|------------|------|------|--------|------|------|
|        | B1     | A1B  | A2   | B1            | A1B  | A2   | B1              | A1B  | A2   | B1              | A1B  | A2   | B1         | A1B  | A2   | B1     | A1B  | A2   |
| Winter | 3.55   | 6.36 | 8.09 | 2.42          | 3.71 | 4.29 | 2.90            | 4.67 | 5.38 | 3.40            | 5.28 | 6.26 | 3.76       | 6.24 | 7.52 | 3.36   | 5.50 | 6.64 |
| Spring | 1.26   | 2.55 | 2.46 | 1.32          | 1.26 | 2.17 | 0.70            | 0.60 | 1.37 | 0.82            | 1.08 | 1.45 | 1.19       | 1.87 | 2.13 | 1.04   | 1.54 | 1.90 |
| Summer | 0.23   | 1.25 | 1.79 | 1.17          | 2.05 | 2.91 | 0.93            | 1.99 | 2.79 | 0.74            | 1.88 | 2.51 | 0.87       | 1.97 | 2.47 | 0.73   | 1.80 | 2.43 |
| Fall   | 2.58   | 4.92 | 5.77 | 1.99          | 3.08 | 3.80 | 1.85            | 3.25 | 3.93 | 1.77            | 3.43 | 4.13 | 1.61       | 3.20 | 3.83 | 1.93   | 3.62 | 4.33 |

| ECHAM  | Arctic |      |      | North Pacific |      |      | NW Boreal South |      |      | NW Boreal North |      |      | Western AK |      |      | Alaska |      |      |
|--------|--------|------|------|---------------|------|------|-----------------|------|------|-----------------|------|------|------------|------|------|--------|------|------|
|        | B1     | A1B  | A2   | B1            | A1B  | A2   | B1              | A1B  | A2   | B1              | A1B  | A2   | B1         | A1B  | A2   | B1     | A1B  | A2   |
| Winter | 4.93   | 8.03 | 8.19 | 2.05          | 3.87 | 4.48 | 3.24            | 5.56 | 6.05 | 4.31            | 6.95 | 7.28 | 5.79       | 8.23 | 8.37 | 4.44   | 7.00 | 7.30 |
| Spring | 2.53   | 3.78 | 3.96 | 2.02          | 2.85 | 3.05 | 2.07            | 2.78 | 3.06 | 2.47            | 3.38 | 3.60 | 3.51       | 4.21 | 4.34 | 2.65   | 3.54 | 3.74 |
| Summer | 1.08   | 2.76 | 2.94 | 1.13          | 2.28 | 2.30 | 0.72            | 2.21 | 2.06 | 0.93            | 2.50 | 2.50 | 1.51       | 3.00 | 2.72 | 1.10   | 2.62 | 2.57 |
| Fall   | 5.56   | 7.21 | 7.51 | 2.94          | 3.77 | 3.97 | 3.26            | 4.17 | 4.59 | 4.07            | 5.12 | 5.58 | 4.20       | 5.38 | 5.65 | 4.19   | 5.36 | 5.70 |

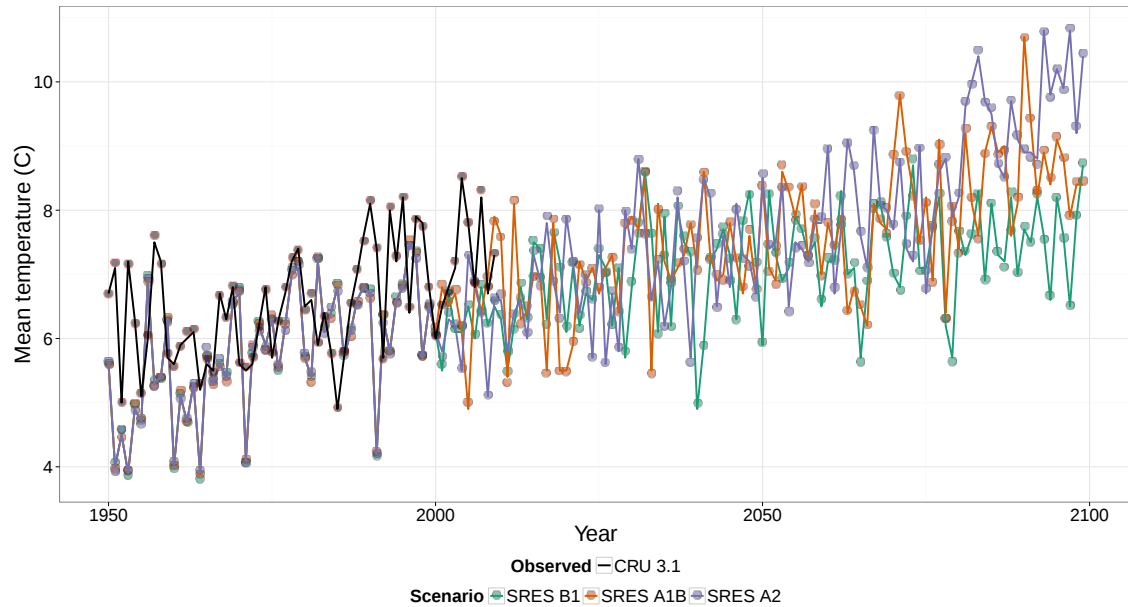
## Precipitation

| CCCMA  | Arctic |      |       | North Pacific |       |       | NW Boreal South |       |       | NW Boreal North |       |       | Western AK |       |       | Alaska |       |       |
|--------|--------|------|-------|---------------|-------|-------|-----------------|-------|-------|-----------------|-------|-------|------------|-------|-------|--------|-------|-------|
|        | B1     | A1B  | A2    | B1            | A1B   | A2    | B1              | A1B   | A2    | B1              | A1B   | A2    | B1         | A1B   | A2    | B1     | A1B   | A2    |
| Winter | 6.81   | 8.42 | 9.55  | 64.82         | 95.77 | 92.63 | 23.01           | 32.39 | 31.99 | 7.61            | 10.38 | 10.75 | 6.50       | 12.06 | 15.47 | 15.06  | 22.06 | 22.89 |
| Spring | 2.45   | 5.30 | 4.82  | 56.37         | 43.99 | 73.92 | 13.85           | 17.92 | 20.22 | 2.44            | 5.17  | 5.54  | 2.45       | 9.68  | 8.71  | 9.49   | 11.98 | 15.15 |
| Summer | 8.04   | 6.75 | 14.73 | 13.87         | 17.10 | 13.14 | 16.08           | 20.94 | 25.35 | 7.53            | 7.69  | 14.84 | 5.32       | 4.89  | 12.39 | 8.82   | 9.44  | 15.35 |
| Fall   | 5.96   | 9.59 | 7.39  | 31.82         | 51.48 | 91.26 | 12.52           | 22.20 | 33.97 | 5.67            | 9.11  | 10.84 | 1.66       | 5.51  | 11.89 | 8.31   | 14.37 | 21.68 |

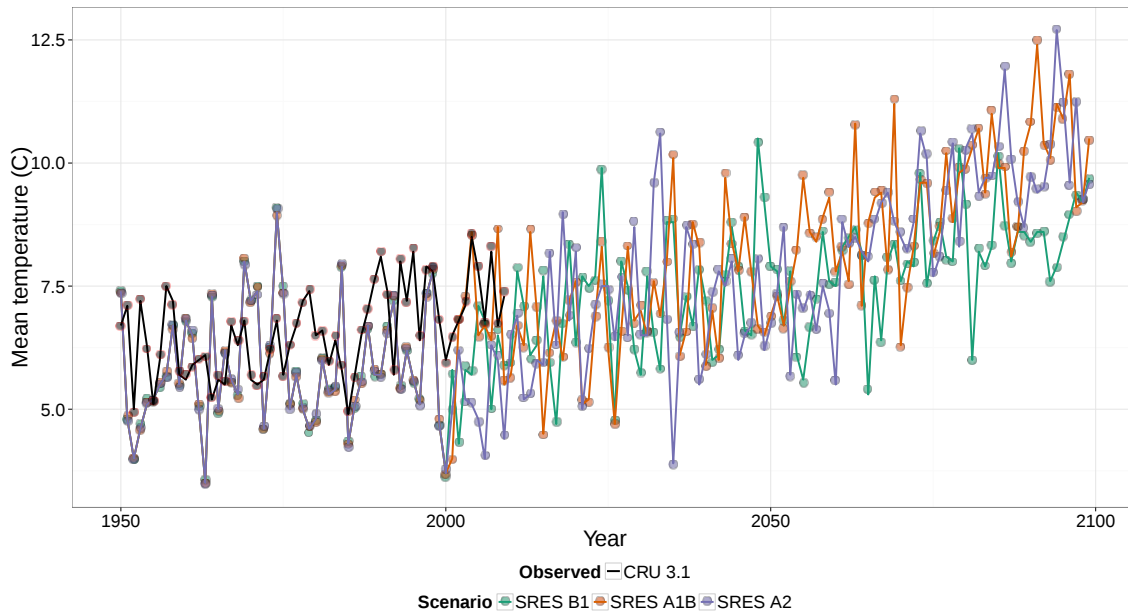
| ECHAM  | Arctic |       |       | North Pacific |       |        | NW Boreal South |       |       | NW Boreal North |       |       | Western AK |       |       | Alaska |       |       |
|--------|--------|-------|-------|---------------|-------|--------|-----------------|-------|-------|-----------------|-------|-------|------------|-------|-------|--------|-------|-------|
|        | B1     | A1B   | A2    | B1            | A1B   | A2     | B1              | A1B   | A2    | B1              | A1B   | A2    | B1         | A1B   | A2    | B1     | A1B   | A2    |
| Winter | 5.25   | 9.94  | 7.08  | 53.70         | 99.84 | 106.87 | 21.17           | 41.83 | 33.07 | 5.97            | 11.62 | 7.94  | 9.09       | 19.67 | 14.53 | 13.49  | 26.29 | 22.88 |
| Spring | 3.99   | 4.33  | 3.72  | 49.64         | 58.04 | 57.77  | 17.24           | 17.32 | 15.45 | 3.63            | 4.08  | 3.14  | 5.36       | 6.34  | 4.91  | 10.64  | 11.98 | 10.94 |
| Summer | 4.03   | 3.73  | 3.10  | 25.60         | 24.40 | 36.90  | 20.33           | 19.50 | 22.23 | 8.53            | 8.19  | 6.28  | 1.91       | 0.21  | 1.11  | 9.20   | 8.37  | 9.52  |
| Fall   | 16.53  | 18.39 | 20.08 | 49.87         | 45.93 | 76.57  | 27.46           | 29.26 | 35.55 | 14.84           | 14.65 | 18.08 | 6.43       | 5.80  | 10.67 | 18.31  | 18.30 | 24.92 |

# Average Growing Season (Apr-Sept) Temperature

CCCMA

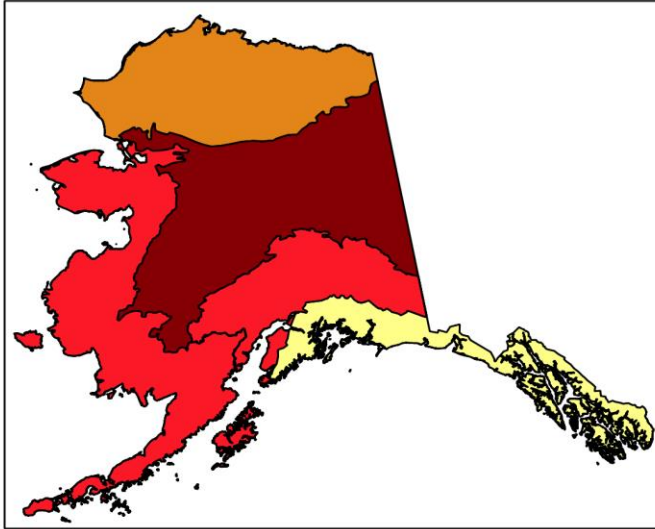


ECHAM

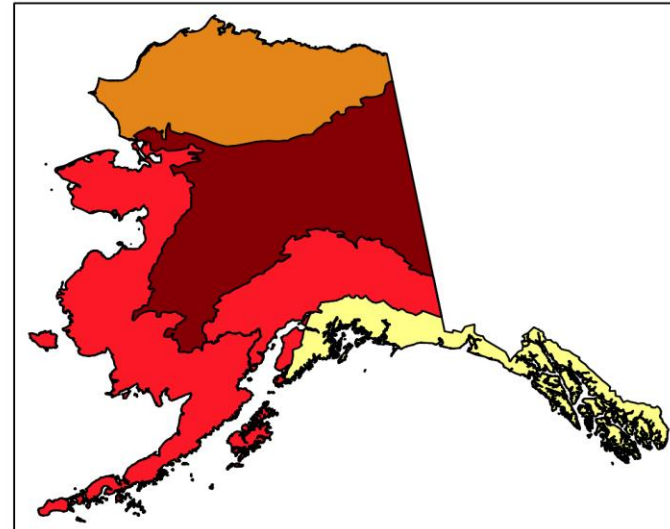


# Projected Vegetation Transitions (%) Footprint

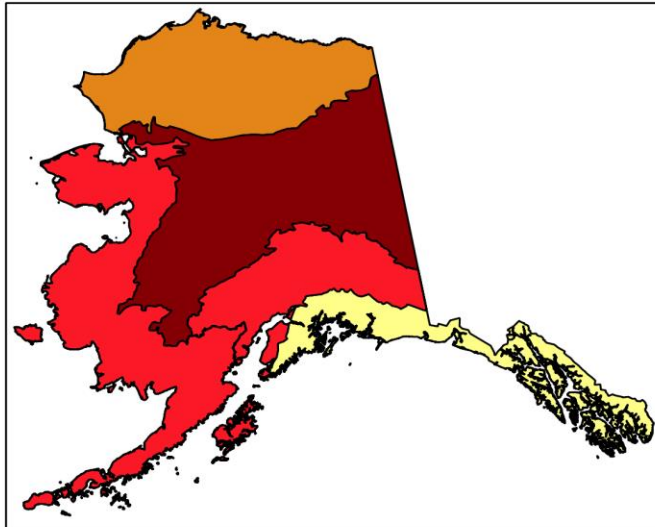
A.) CCCMA-CGCM3.1 - A1B



B.) CCCMA-CGCM3.1 - A2



C.) CCCMA-CGCM3.1 - B1



Percent of LCC area projected to experience at least one shift in vegetation type between 2009 and 2100.

0 to 25

>25 to 50

>50 to 75

>75 to 100

LCC Boundaries

250 0 250 500 750 1000 km



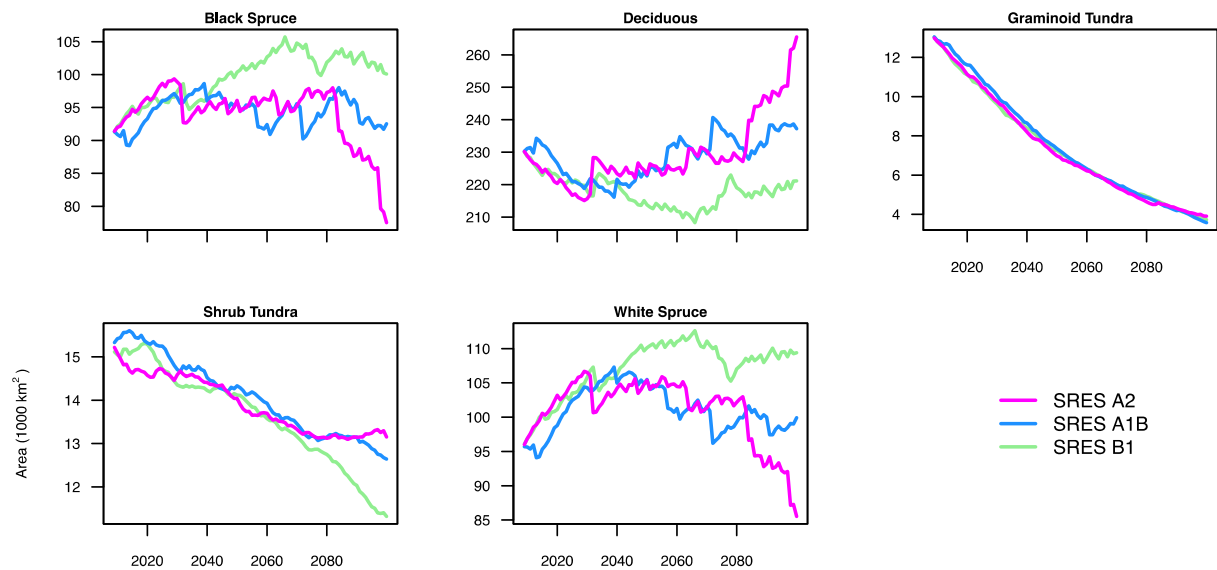
# Projected Vegetation Change (%) by Subregion

|                  |           |            |           |           |            |           |           |            |           | NW Boreal North |            |           | Western AK |            |           | Alaska    |            |           |
|------------------|-----------|------------|-----------|-----------|------------|-----------|-----------|------------|-----------|-----------------|------------|-----------|------------|------------|-----------|-----------|------------|-----------|
| <u>CCCMA</u>     | <u>B1</u> | <u>A1B</u> | <u>A2</u> | <u>B1</u> | <u>A1B</u> | <u>A2</u> | <u>B1</u> | <u>A1B</u> | <u>A2</u> | <u>B1</u>       | <u>A1B</u> | <u>A2</u> | <u>B1</u>  | <u>A1B</u> | <u>A2</u> | <u>B1</u> | <u>A1B</u> | <u>A2</u> |
| Black Spruce     | -8.4%     | -19.7%     | -36.1%    | -1.9%     | -6.4%      | -9.5%     | 9.6%      | 1.3%       | -15.2%    | 3.0%            | -8.0%      | -25.9%    | -12.0%     | -24.9%     | -29.4%    | 1.9%      | -8.3%      | -21.6%    |
| White Spruce     | 66.3%     | 49.8%      | 18.2%     | -1.6%     | -7.2%      | -10.0%    | 13.9%     | 4.4%       | -10.9%    | 3.7%            | -7.9%      | -24.3%    | 6.4%       | -11.6%     | -16.1%    | 12.1%     | -0.2%      | -13.6%    |
| Deciduous        | 129.1%    | 232.5%     | 396.8%    | 20.9%     | 90.0%      | 127.3%    | -3.9%     | 3.0%       | 15.4%     | -5.1%           | 24.5%      | 69.2%     | 34.0%      | 63.1%      | 73.7%     | 2.4%      | 15.2%      | 31.3%     |
| Graminoid Tundra | -8.4%     | -10.2%     | -14.4%    | NA        | NA         | NA        | -71.4%    | -72.6%     | -69.9%    | -46.1%          | -49.7%     | -46.3%    | 6.6%       | 8.2%       | 9.2%      | -13.6%    | -15.2%     | -18.0%    |
| Shrub Tundra     | 2.1%      | 4.2%       | 8.9%      | 0.0%      | 0.0%       | 0.0%      | -25.1%    | -17.5%     | -13.6%    | 1.0%            | 1.8%       | 1.5%      | -11.3%     | -9.5%      | -9.8%     | -5.4%     | -3.2%      | -1.0%     |

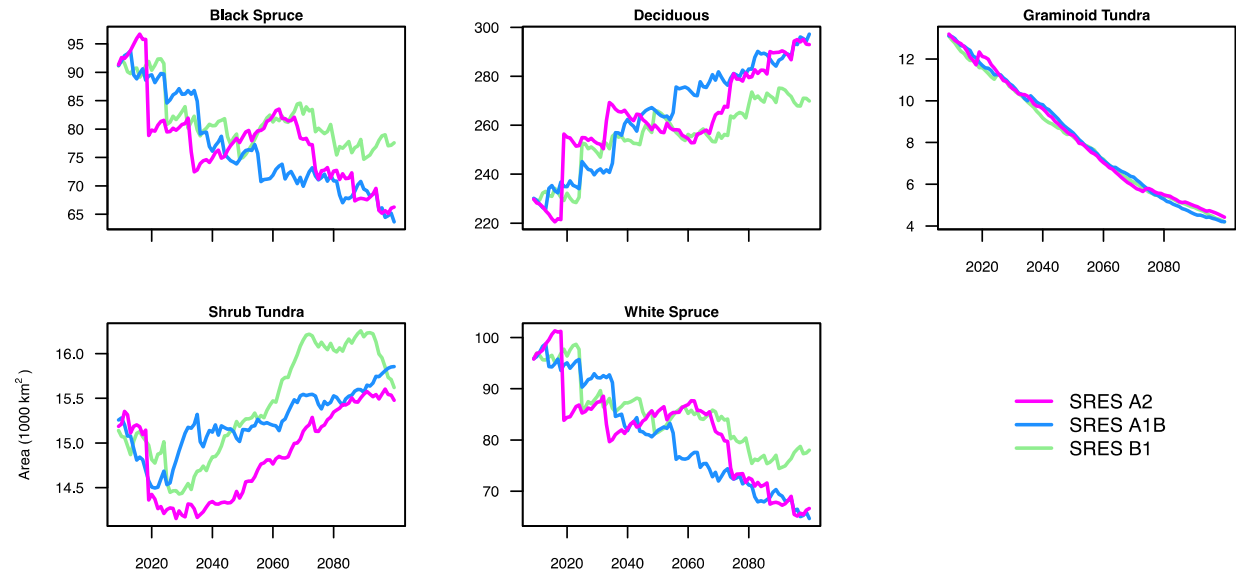
|                  |           |            |           |           |            |           |           |            |           | NW Boreal North |            |           | Western AK |            |           | Alaska    |            |           |
|------------------|-----------|------------|-----------|-----------|------------|-----------|-----------|------------|-----------|-----------------|------------|-----------|------------|------------|-----------|-----------|------------|-----------|
| <u>ECHAM</u>     | <u>B1</u> | <u>A1B</u> | <u>A2</u> | <u>B1</u> | <u>A1B</u> | <u>A2</u> | <u>B1</u> | <u>A1B</u> | <u>A2</u> | <u>B1</u>       | <u>A1B</u> | <u>A2</u> | <u>B1</u>  | <u>A1B</u> | <u>A2</u> | <u>B1</u> | <u>A1B</u> | <u>A2</u> |
| Black Spruce     | -54.7%    | -63.0%     | -63.6%    | -4.3%     | -20.0%     | -13.4%    | -14.9%    | -30.2%     | -27.4%    | -13.6%          | -43.9%     | -34.1%    | -33.6%     | -45.6%     | -43.1%    | -21.1%    | -37.8%     | -34.2%    |
| White Spruce     | -24.9%    | -36.8%     | -46.1%    | -3.6%     | -19.4%     | -14.9%    | -18.7%    | -32.6%     | -30.5%    | -12.2%          | -41.9%     | -33.8%    | -30.6%     | -40.5%     | -40.3%    | -20.7%    | -36.5%     | -34.4%    |
| Deciduous        | 527.0%    | 620.4%     | 598.3%    | 53.2%     | 248.2%     | 174.5%    | 17.4%     | 29.1%      | 27.5%     | 34.8%           | 113.0%     | 91.4%     | 81.4%      | 106.0%     | 102.6%    | 31.6%     | 51.6%      | 47.4%     |
| Graminoid Tundra | -16.4%    | -23.6%     | -22.1%    | NA        | NA         | NA        | -67.9%    | -67.9%     | -66.5%    | -44.0%          | -45.6%     | -44.3%    | 0.4%       | 3.9%       | 3.7%      | -20.2%    | -25.7%     | -24.4%    |
| Shrub Tundra     | 13.8%     | 21.3%      | 20.6%     | 0.0%      | 0.0%       | 0.0%      | 3.2%      | 3.9%       | 1.9%      | 4.7%            | 4.5%       | 5.0%      | -3.6%      | -4.4%      | -3.6%     | 4.8%      | 7.7%       | 7.7%      |

# Projected Vegetation Distribution (km<sup>2</sup>) for NW Boreal North subregion

CCCMA

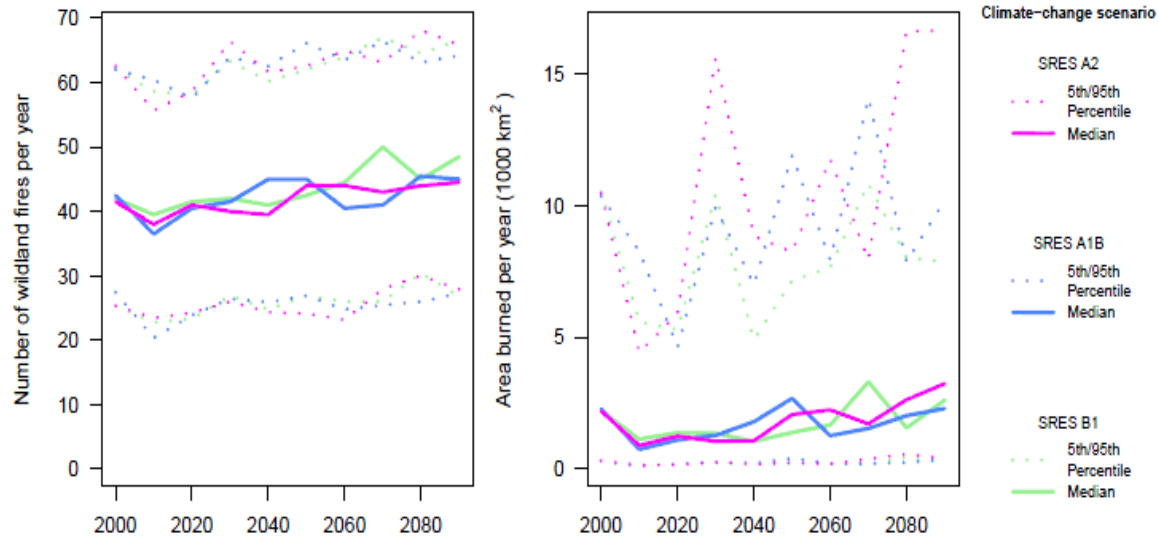


ECHAM

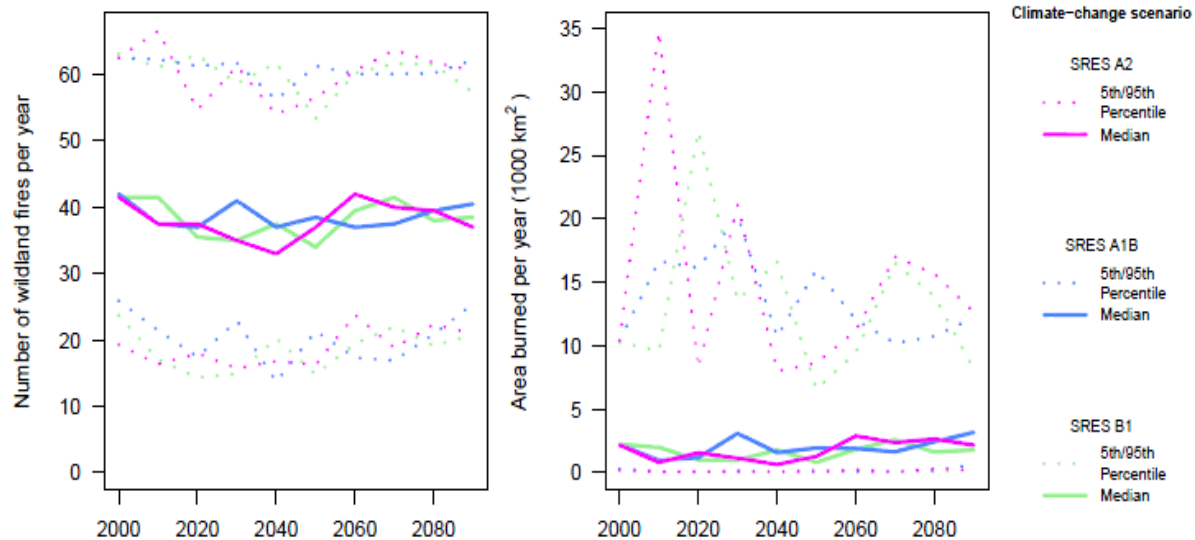


# Projected Fire Dynamics for NW Boreal North subregion

CCCMA



ECHAM



# Projected Fire Dynamics for NW Boreal North subregion

| scenario | Percentile | Historical period Ignitions | Historical period Area burned | Projected Ignitions | Projected Area burned | Percent change Ignitions | Percent change Area burned |
|----------|------------|-----------------------------|-------------------------------|---------------------|-----------------------|--------------------------|----------------------------|
| CCCMA    |            |                             |                               |                     |                       |                          |                            |
| B1       | 50th       | 42                          | 2,216                         | 48                  | 2,622                 | 15.5                     | 18.3                       |
| B1       | 95th       | 62                          | 10,511                        | 67                  | 7,855                 | 7.3                      | -25.3                      |
| A1B      | 50th       | 42                          | 2,274                         | 45                  | 2,295                 | 5.9                      | 0.9                        |
| A1B      | 95th       | 62                          | 10,342                        | 64                  | 10,199                | 3.5                      | -1.4                       |
| A2       | 50th       | 42                          | 2,194                         | 44                  | 3,239                 | 7.2                      | 47.6                       |
| A2       | 95th       | 63                          | 10,459                        | 66                  | 16,626                | 5.3                      | 59                         |
| ECHAM    |            |                             |                               |                     |                       |                          |                            |
| B1       | 50th       | 42                          | 2,230                         | 38                  | 1,798                 | -7.2                     | -19.4                      |
| B1       | 95th       | 63                          | 10,264                        | 57                  | 8,090                 | -9.2                     | -21.2                      |
| A1B      | 50th       | 42                          | 2,200                         | 40                  | 3,174                 | -3.6                     | 44.3                       |
| A1B      | 95th       | 63                          | 10,426                        | 62                  | 12,217                | -0.6                     | 17.2                       |
| A2       | 50th       | 42                          | 2,186                         | 37                  | 2,176                 | -10.8                    | -0.5                       |
| A2       | 95th       | 63                          | 10,422                        | 61                  | 12,642                | -3.1                     | 21.3                       |