

# The Normal Fire Environment

## Modeling Large Wildfire Suitability using Past, Present, and Future Climate Normals

Zhiqiang Yang - Co-Director Lab. For Applications of Remote Sensing in Ecology

Raymond Davis - Monitoring Lead - Older Forests & Spotted Owls. USFS R6

Andrew Yost - Forest Ecologist, Oregon Department of Forestry

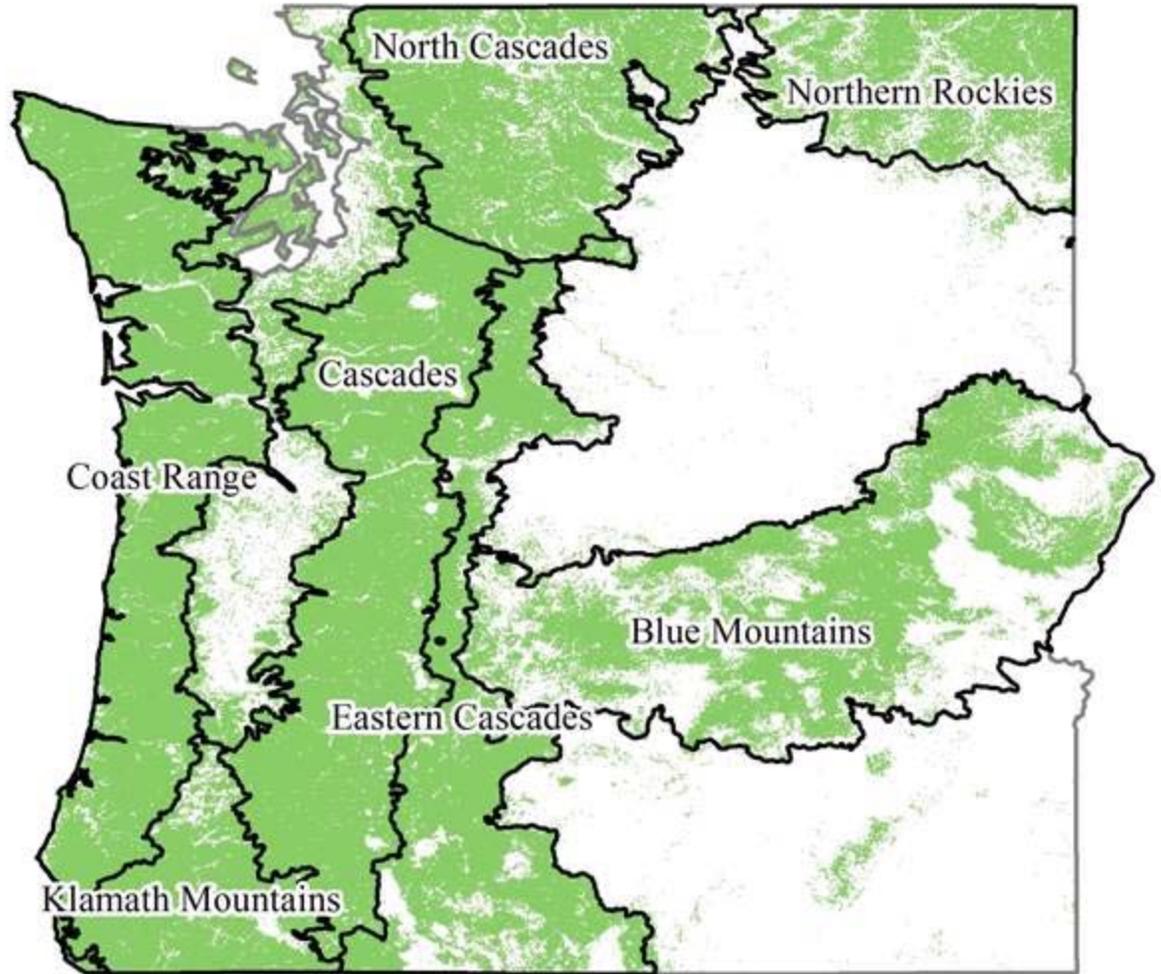
Cole Belongie - GIS Specialist USFS R6

# *Modeling Large Wildfire Suitability*

## Presentation Outline

- Describe process for modeling the probability of large wildfires in Oregon and Washington
- Explain how the baseline models were projected through 2100 using downscaled climate data
- Display preliminary results in graphical and mapped format
- Future possibilities

# EPA Level III Forested Ecoregions

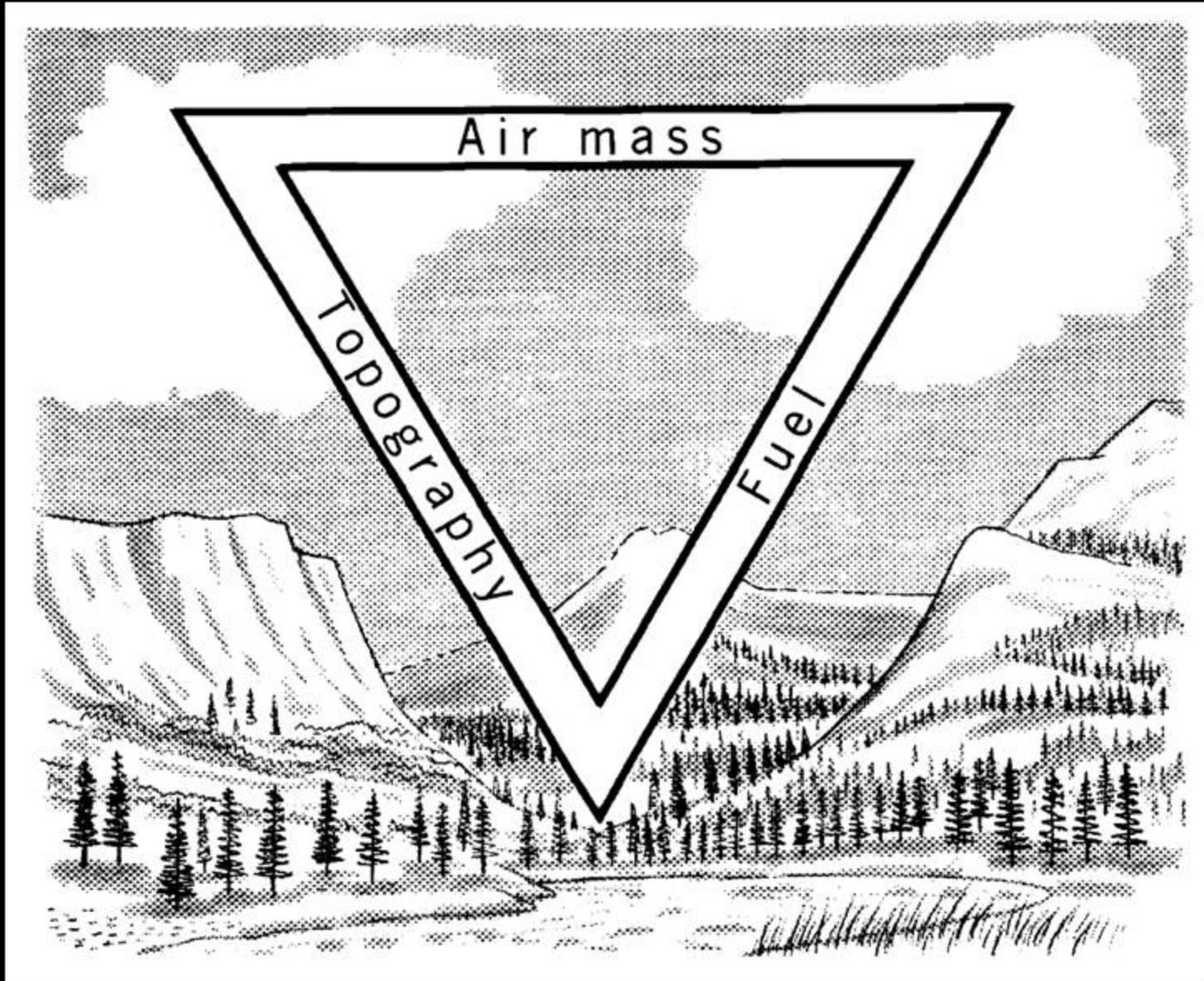


0 50 100 200 300 Kilometers

Ecoregion Boundaries  
 Forested Areas

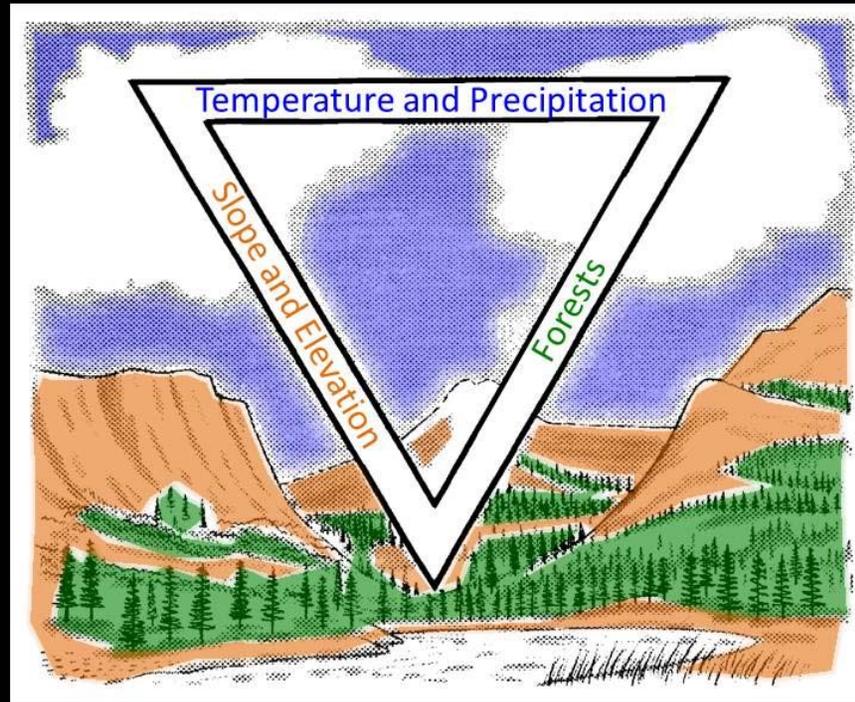
# The Fire Environment

## Countryman 1972 – The Fire Environment Concept



# The Fire Environment

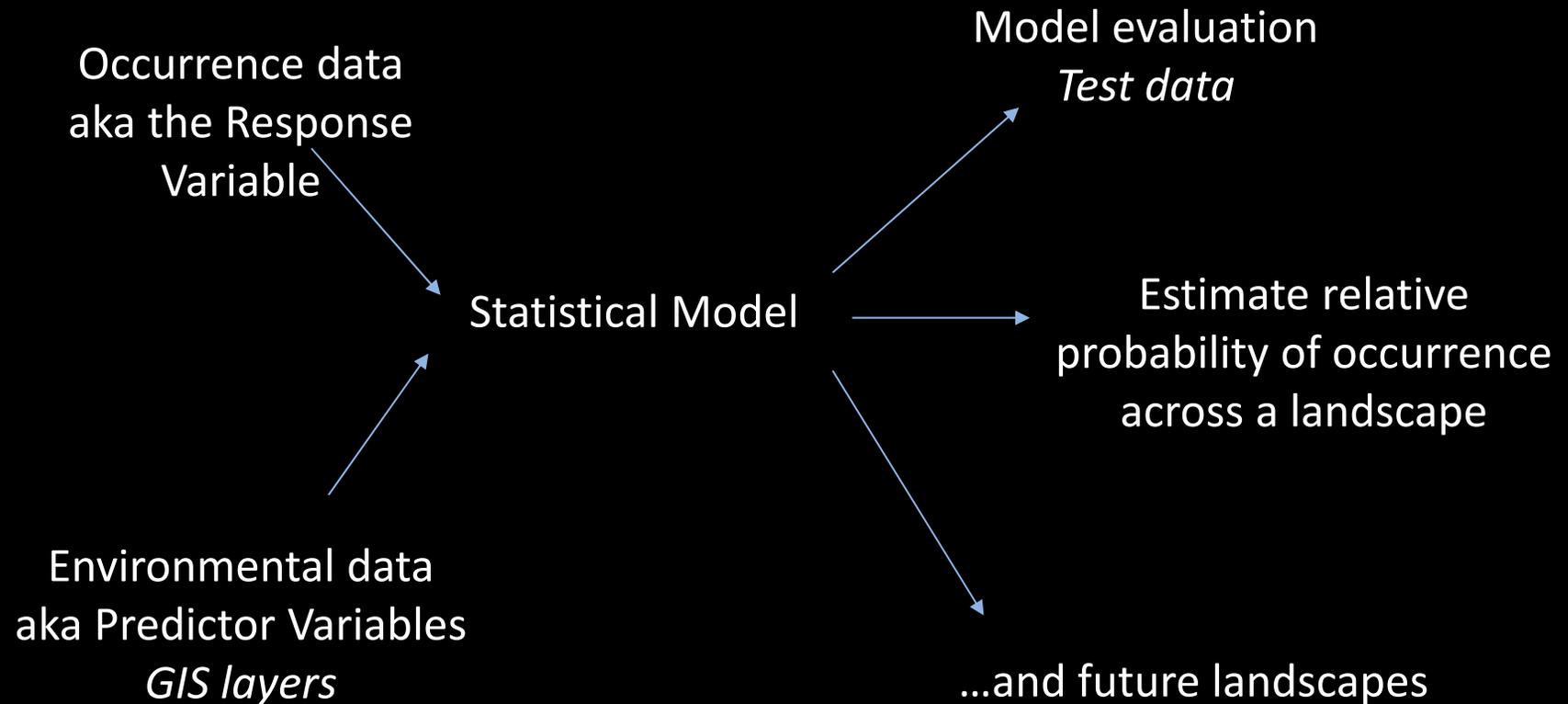
Large ( $\geq 100$  ac) Wildfire Suitability Baseline Model (1971-2000)



The role of models in this context is to help

- Identify plausible future conditions,
- highlight regional vulnerability to large wildfire
- provide insight into the range and variability of potential climate change effects,
- examine general ecological principles rather than predict the behavior of a specific ecosystem,
- inform strategic decision making processes and policy development.

# *Spatial Distribution Modeling*



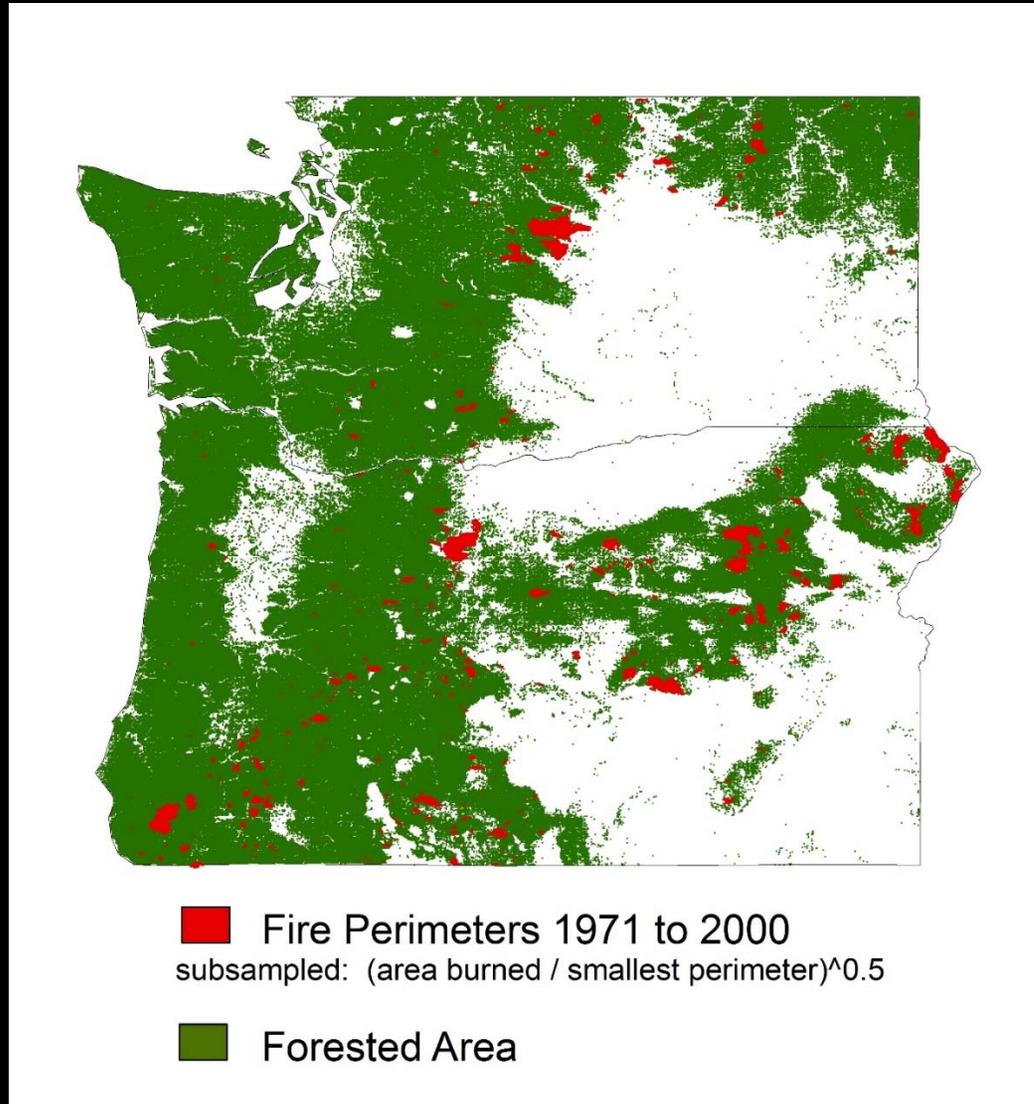
# *Spatial Distribution Modeling*

## Building The Baseline Model

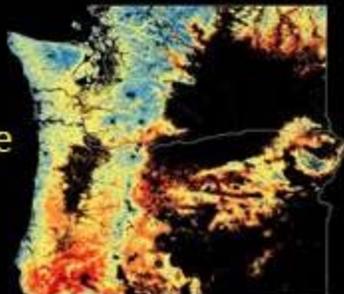
- Maxent modeling algorithm
- Modeling resolution was 800m
- Response variable was sampled from fire perimeters >40 ha (100 acres) (1971-2000)

# *Spatial Distribution Modeling*

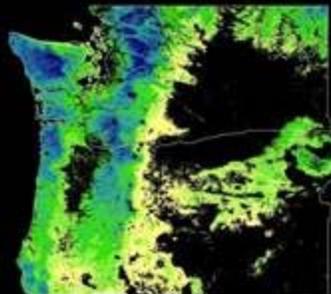
## Response Variable



Max temperature  
(Jul – Aug)



Precipitation  
(May – Sep)



Temperature and Precipitation

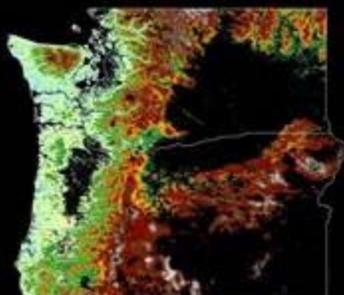
The Fire  
Environment  
Model

Slope and Elevation

Forests



Slope (percent)

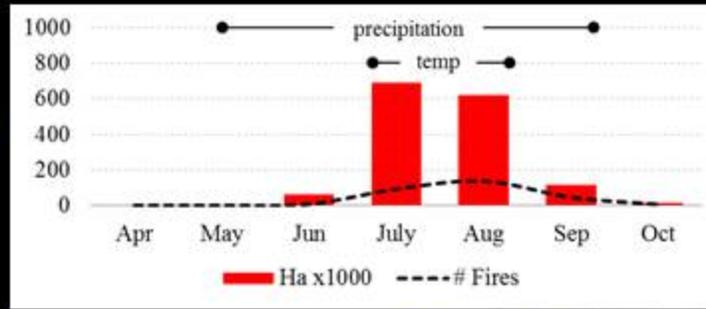


Elevation (m)



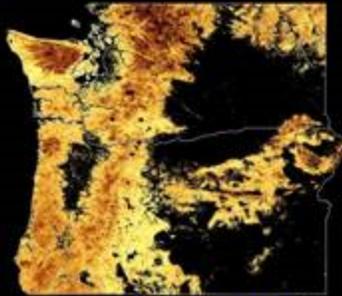
Forested areas

Max temperature  
(Jul – Aug)

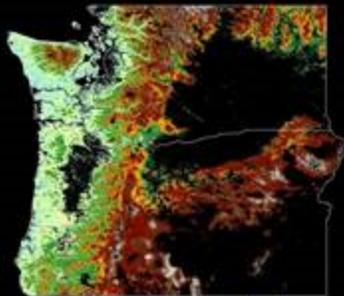


Precipitation  
(May – Sep)

### Temperature and Precipitation



Slope (percent)

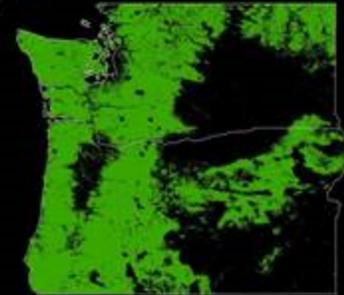


Elevation (m)

### The Fire Environment Model

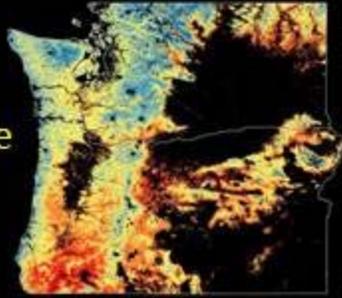
Slope and Elevation

Forests

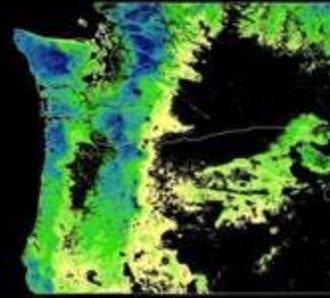


Forested areas

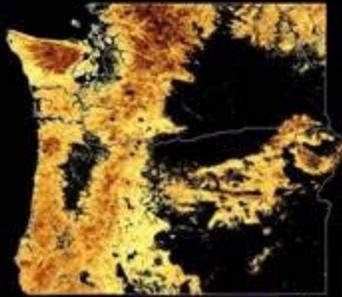
Max temperature  
(Jul – Aug)



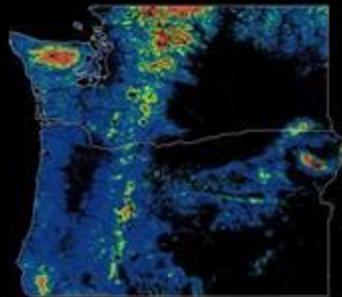
Precipitation  
(May – Sep)



## Temperature and Precipitation



Slope (percent)

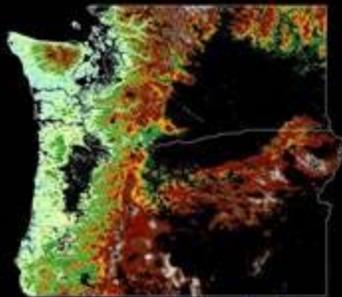


Fire suppression  
(distance to  
roads)

Forests

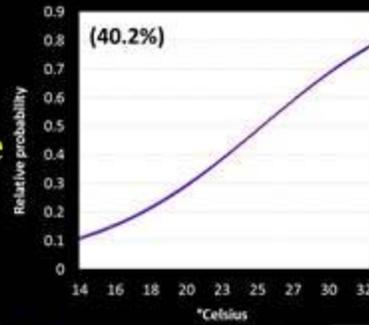


Forested areas

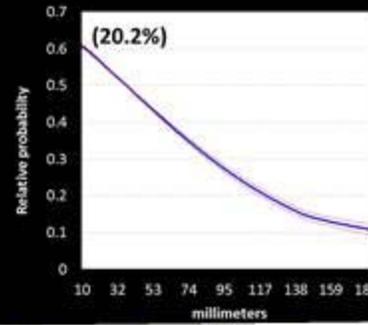


Elevation (m)

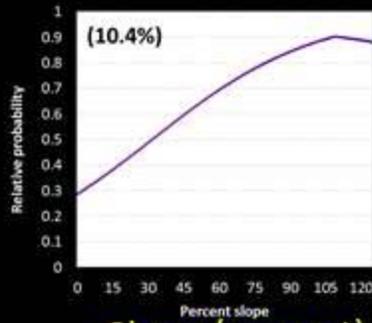
Max temperature  
(Jul – Aug)



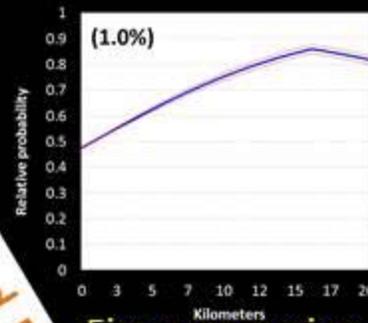
Precipitation  
(May – Sep)



## Temperature and Precipitation

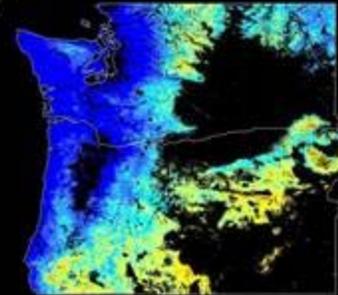


Slope (percent)

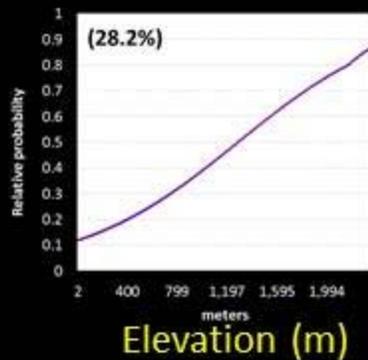


Fire suppression  
(distance to  
roads)

Forests



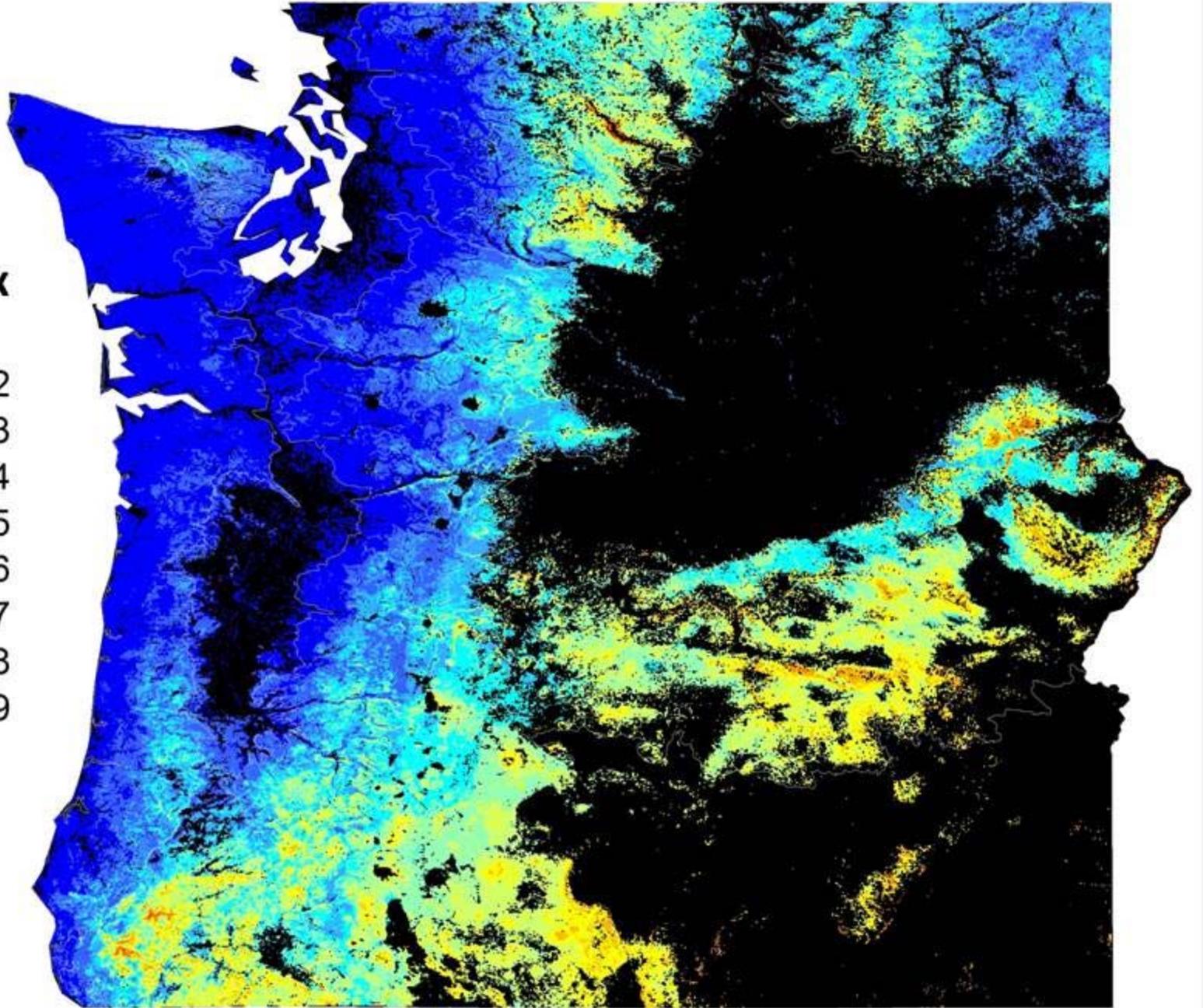
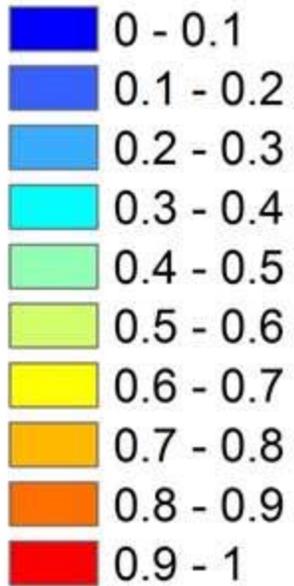
# Baseline LWS Model



Elevation (m)

# 2000

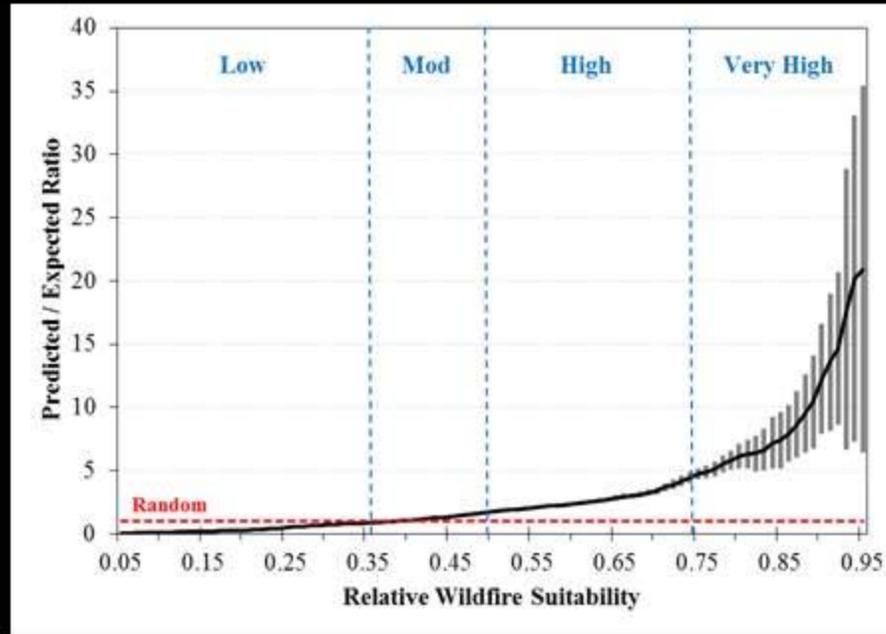
## LWS Index



**Baseline LWS Model (1971-2000)**

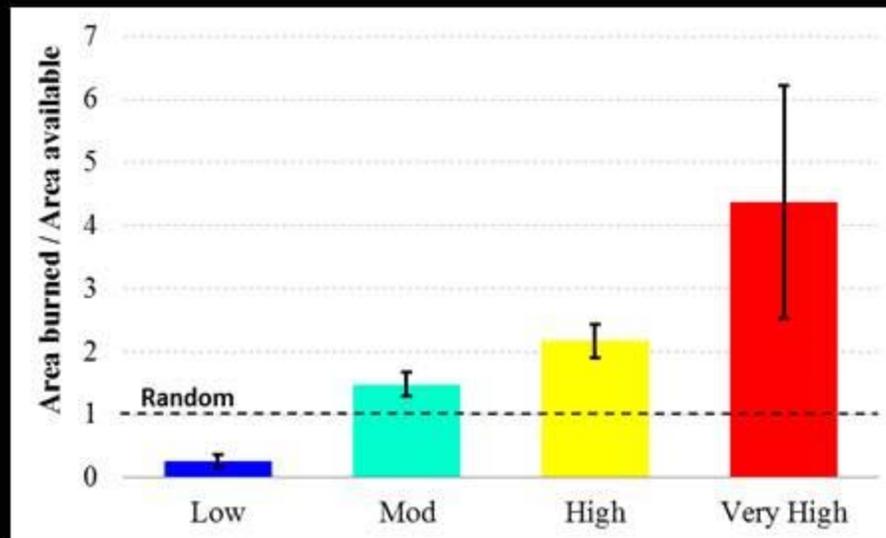
# Model Classification and Evaluation

**Bootstrap Test**  
 Random 50% of large  
 wildfire locations  
 (1971-2000)  
 for 50 replicates



AUC = .77

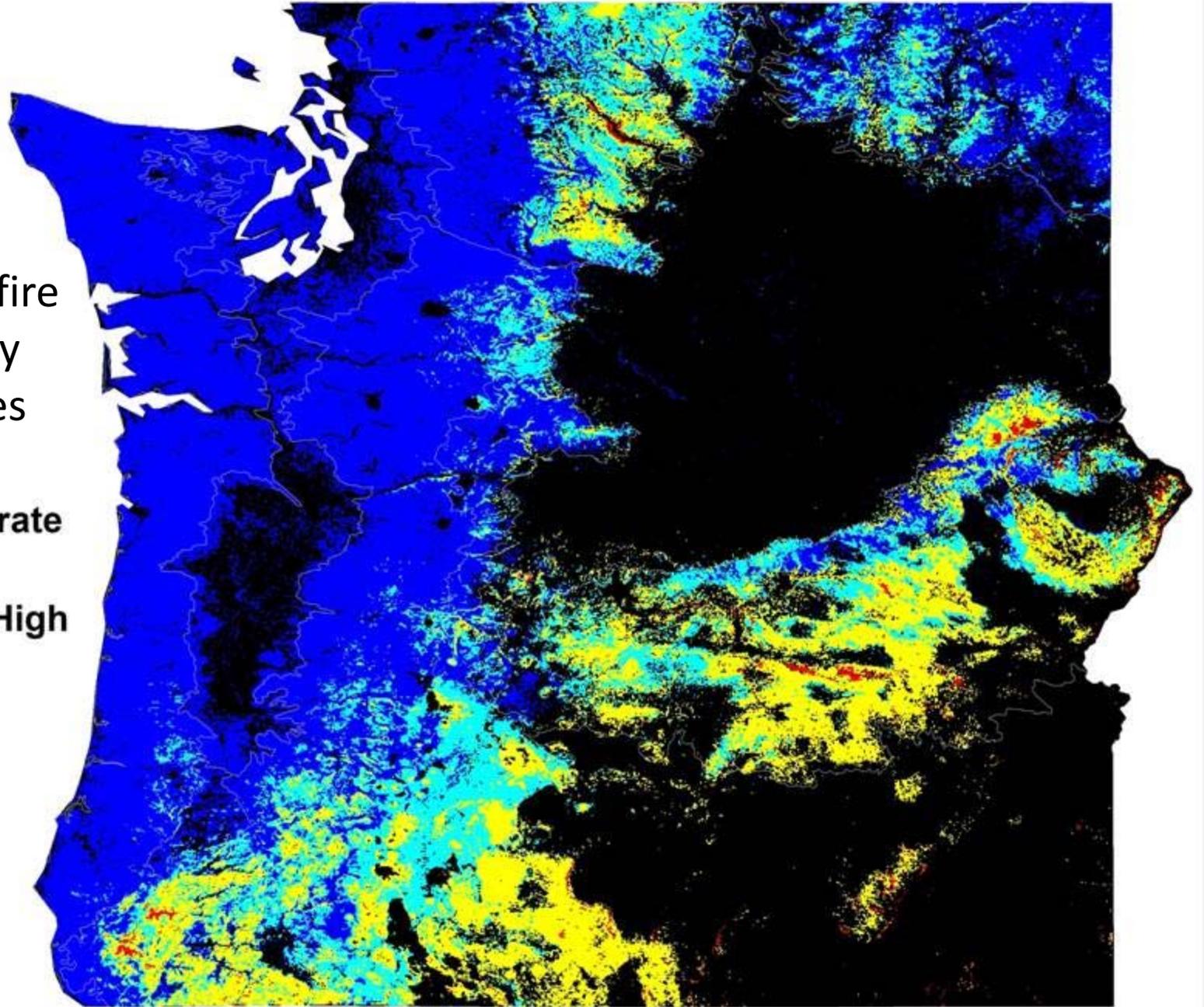
**Independent Test**  
 All large wildfire  
 locations  
 (2001-2013)



# 2000

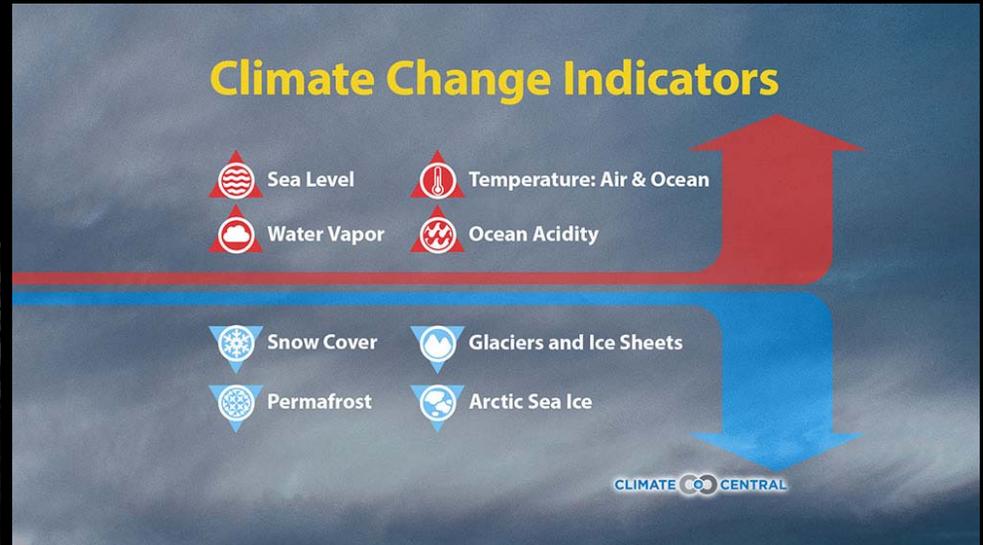
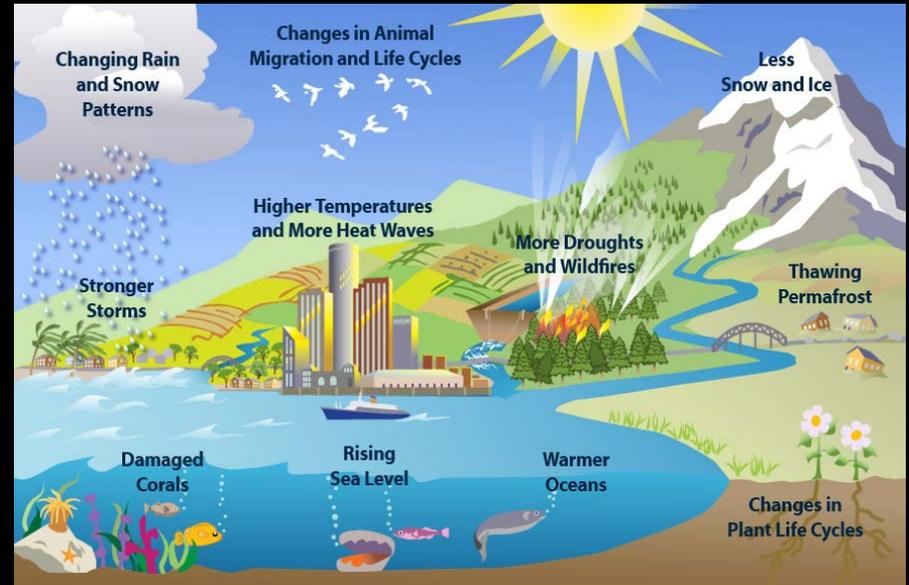
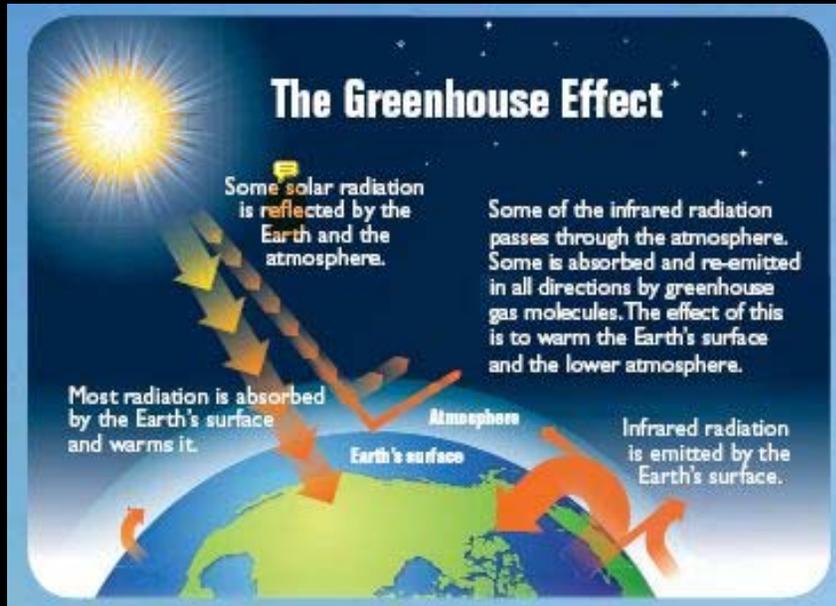
## Large Wildfire Suitability Categories

-  Low
-  Moderate
-  High
-  Very High

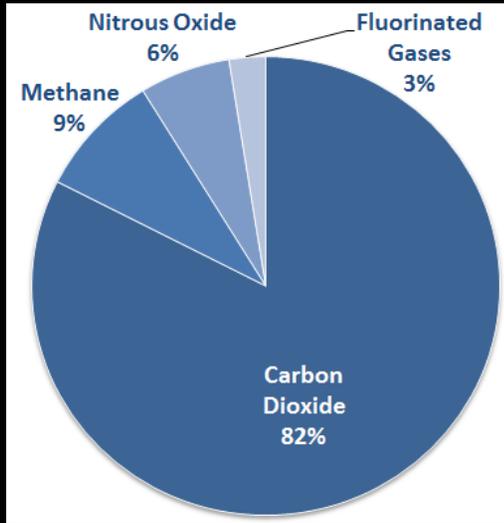


**Baseline LWS Model (1971-2000)**

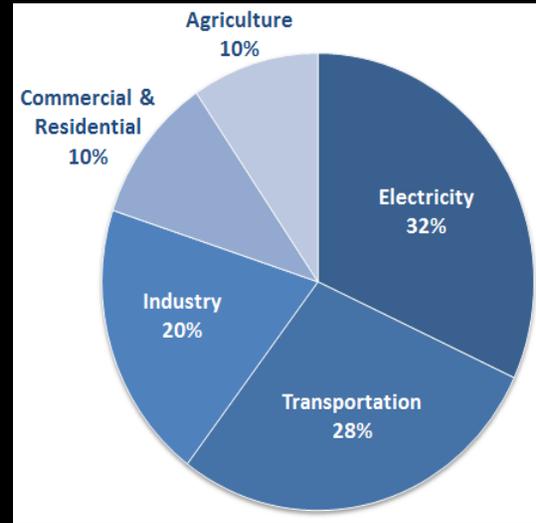
# Future Climate Normals



# Composition of GHG emissions



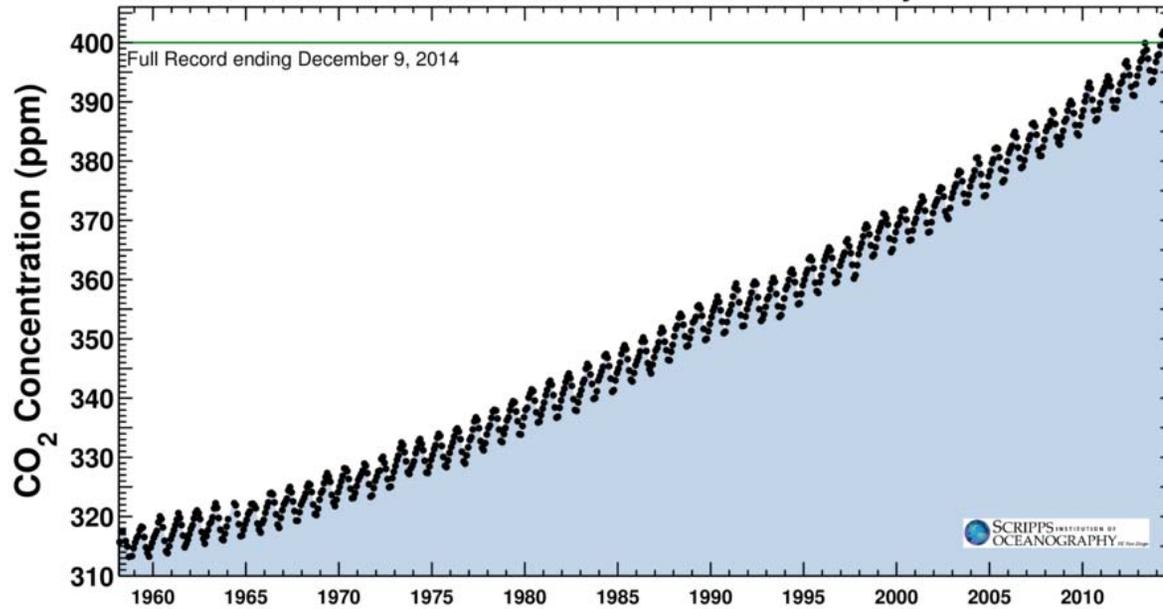
# Sources of GHG emissions



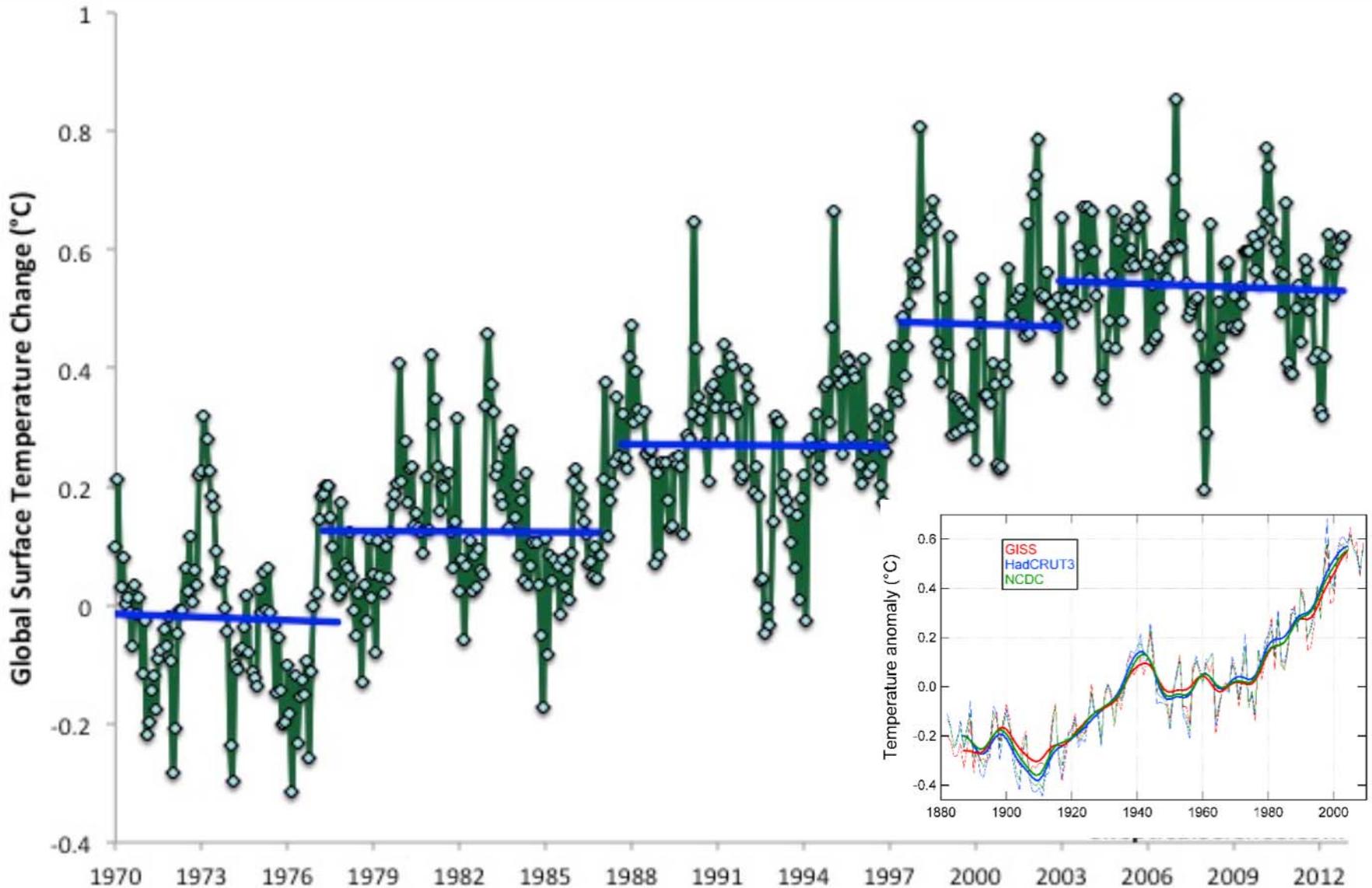
Latest CO<sub>2</sub> reading  
December 09, 2014

# 398.48 ppm

Carbon dioxide concentration at Mauna Loa Observatory

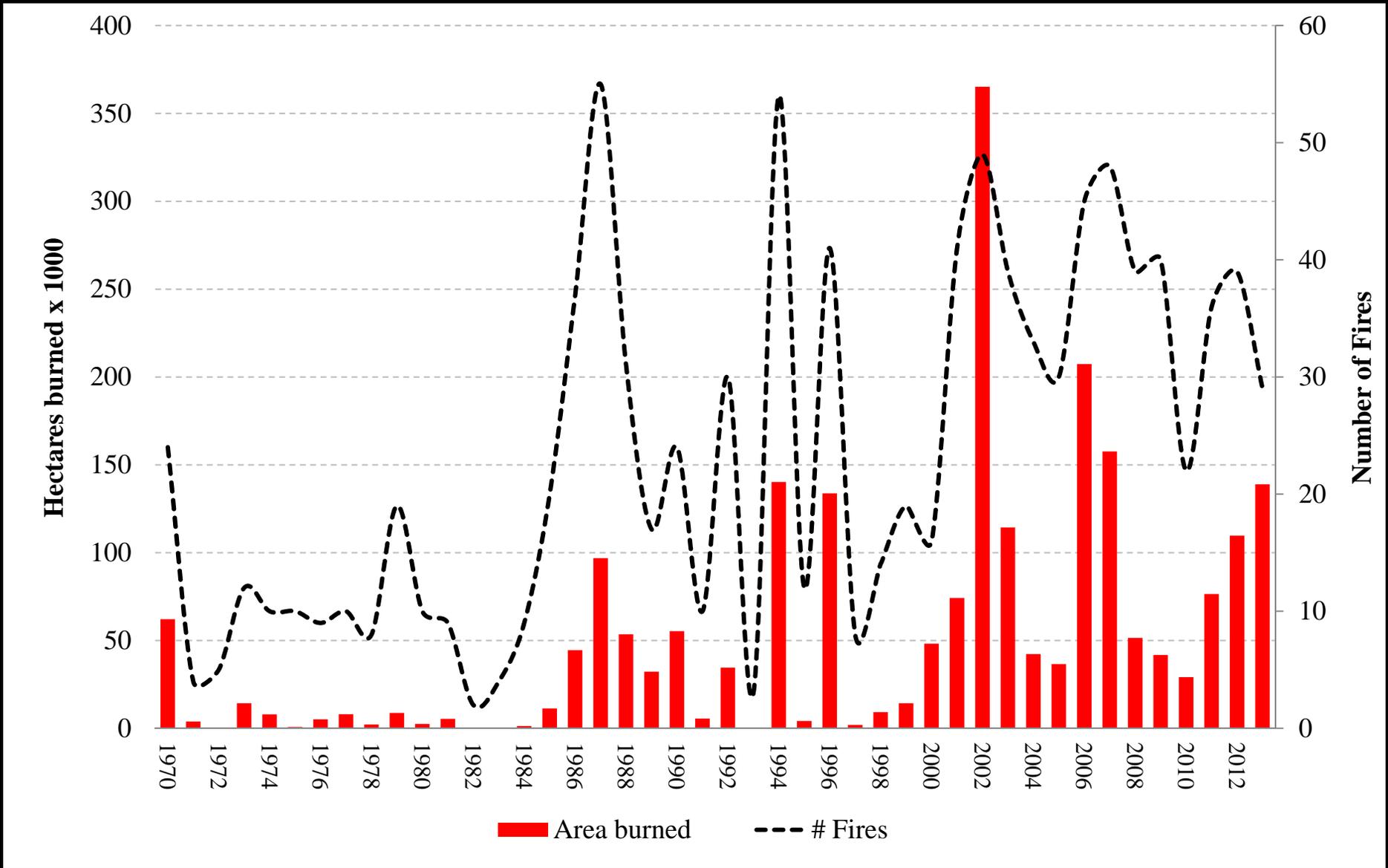


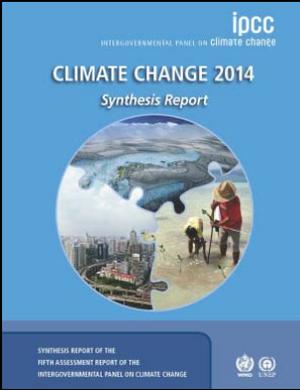
# Average Global Temperature Change



# Climate Change and Large Wildfires

Trend in numbers of large wildfires and total area burned (1970-2013)





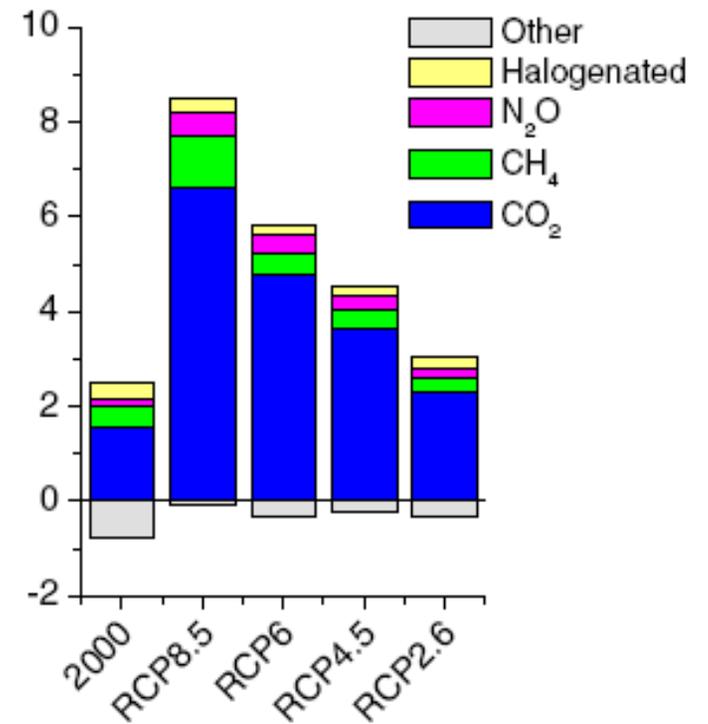
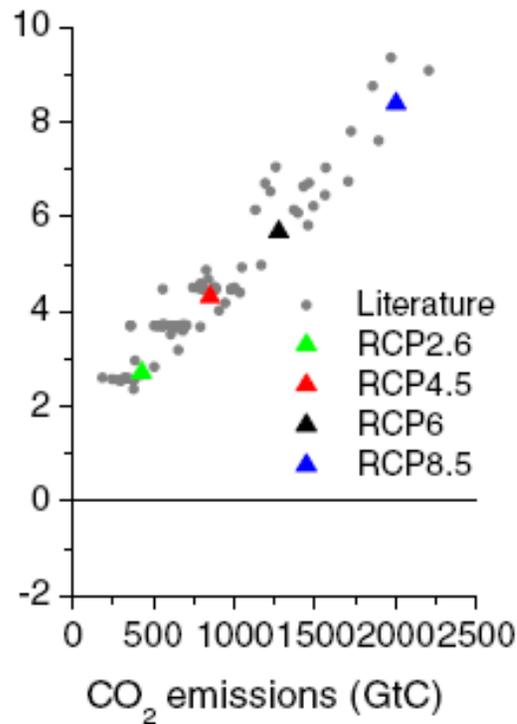
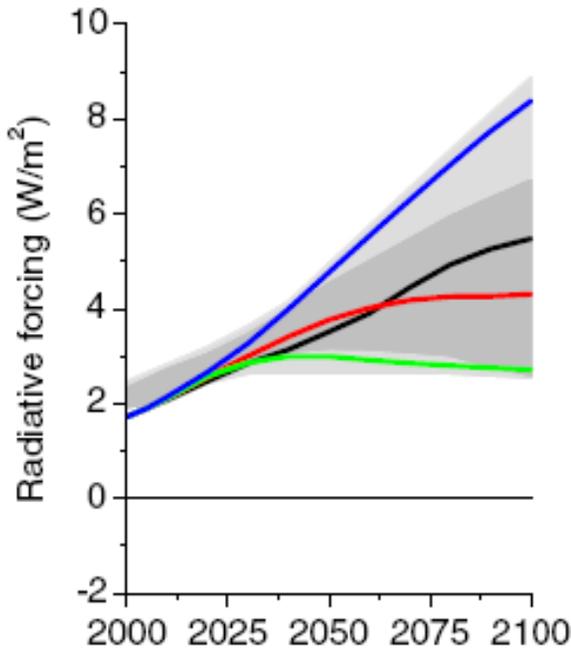
# Representative Concentration Pathway GHG Emissions Scenarios

**RCP 2.6** *Peak and decline*

**RCP 6** *Stabilization*

**RCP 4.5** *Stabilization*

**RCP 8.5** *High Emissions*



# Global Circulation Models and RCP's

	ipsl-cm5a-lr	gfdl-esm1-0	cesm1-bgc	miroc5	hadgem2-chem	inmcm4	cesm1-5b-lr	ipsl-cm5a-mr	bcc-csm1-1-m	csiro-mk3-6-0	giss-e2-r	hadgem2-ao	fiocsm	mri-cgcm3	bnu-esm	giss-e2-h-cc	mpi-esm-lr	bcc-csm1-1	gfdl-cm3	goals-g2	cnrm-cm5	noresm1-m	hadgem2-es	cmcc-cm	miroc-esm	mpi-esm-mr	Counts
RCP26	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	23
RCP45	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	33
RCP60	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	17
RCP85	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	31
Historical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	33

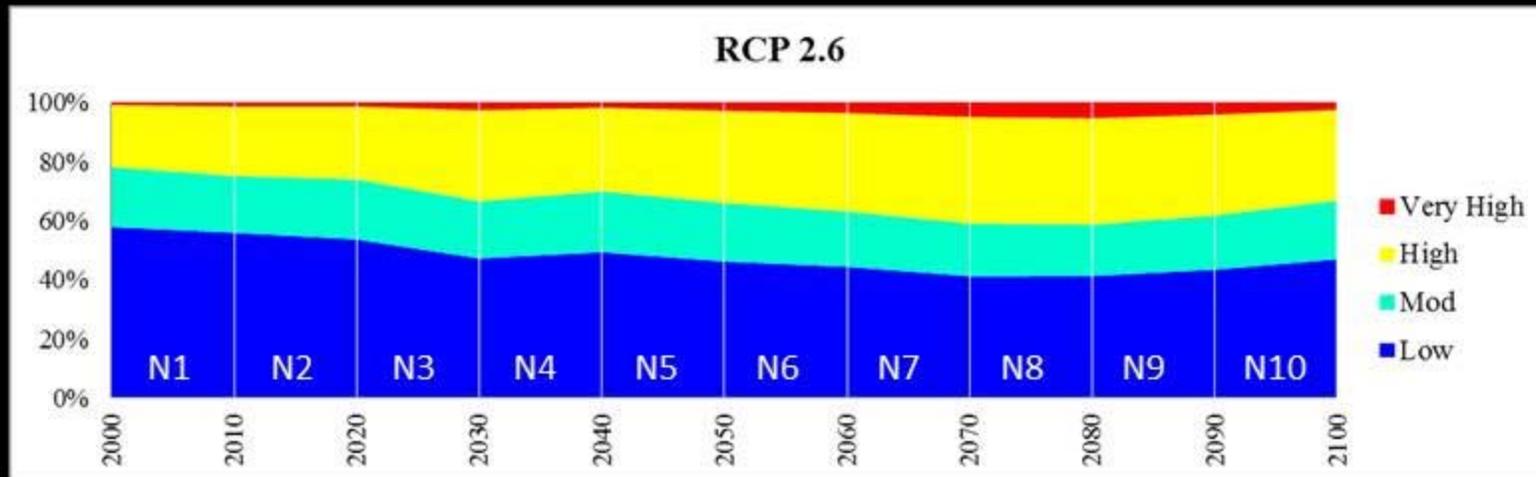
## Variables available NEX-DCP30

- Precipitation,
- Maximum temperature
- Minimum temperature

# Climate Change and LWS Modeling

## Representative Concentration Pathways

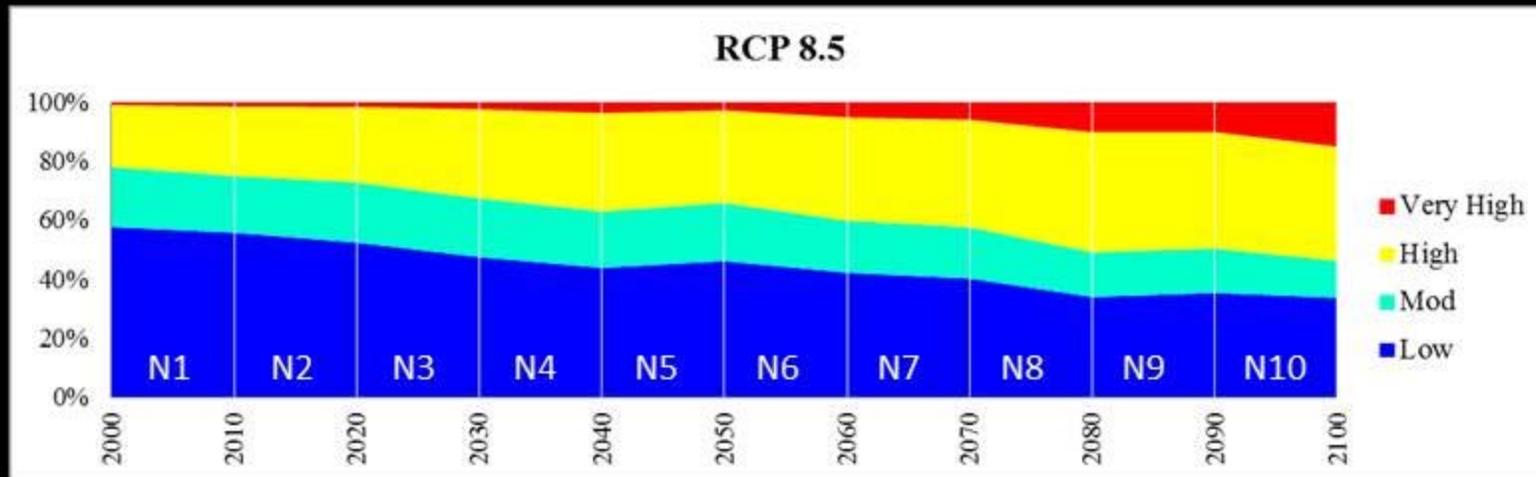
### Forest LWS Class Distribution Trend – RCP 2.6



# Climate Change and LWS Modeling

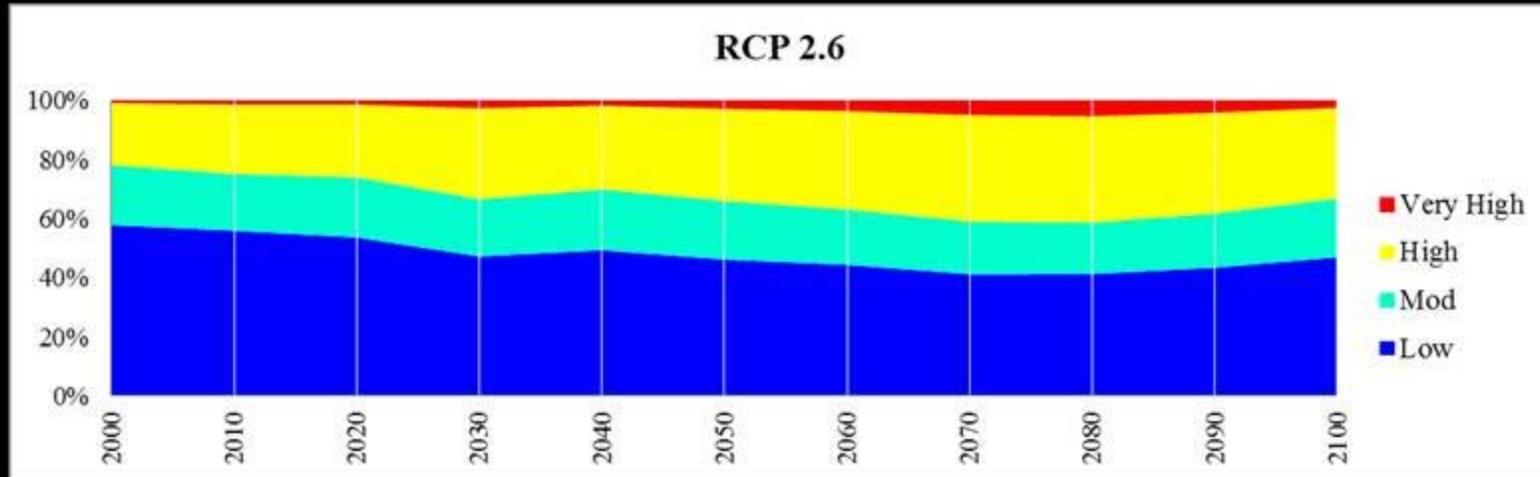
## Representative Concentration Pathways

### Forest LWS Class Distribution Trend – RCP 8.5



# RCP 2.6

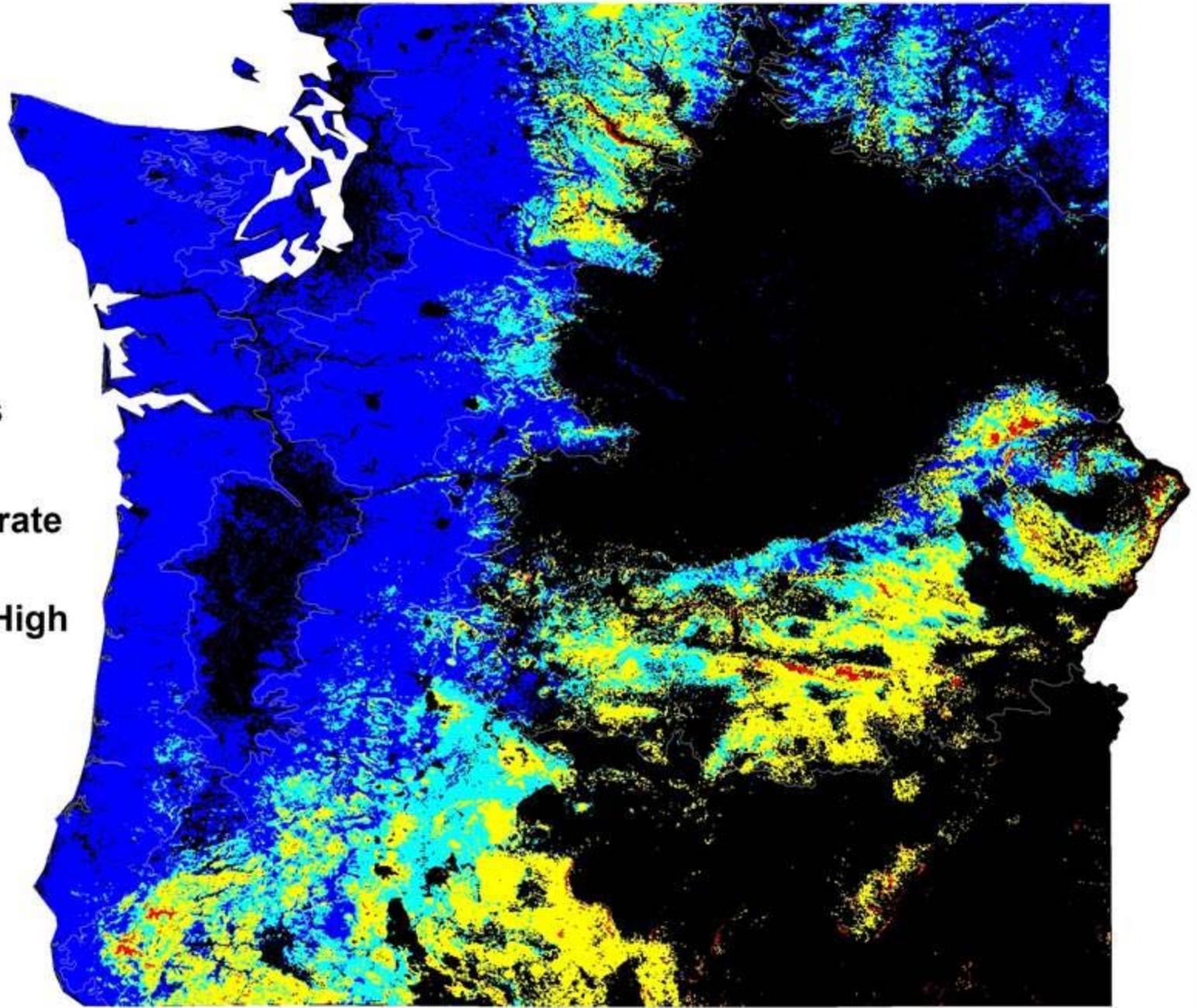
## Map Visualization



# 2000

## WFS Class

-  Low
-  Moderate
-  High
-  Very High

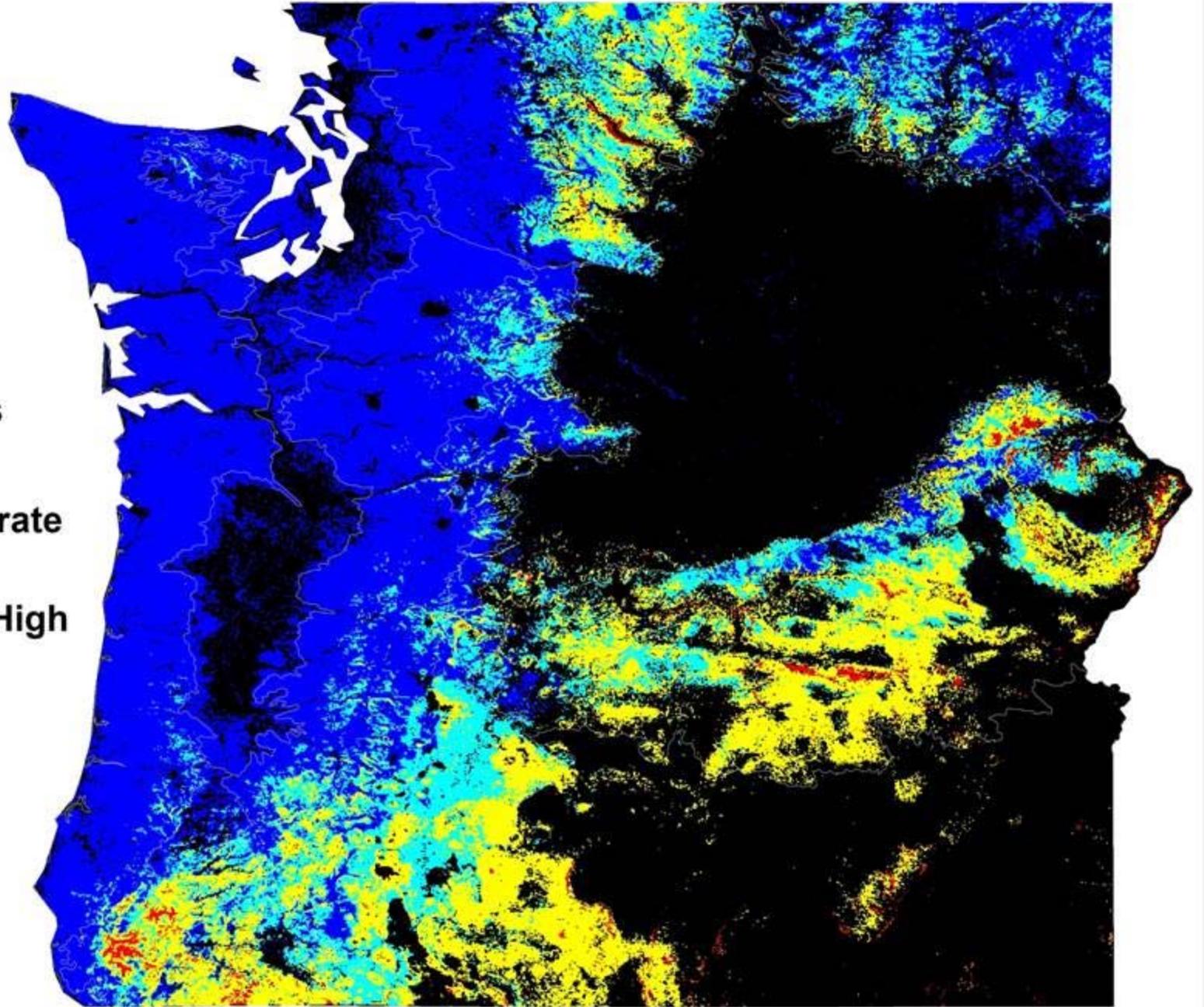


**Baseline Model**

# 2010

## WFS Class

-  Low
-  Moderate
-  High
-  Very High

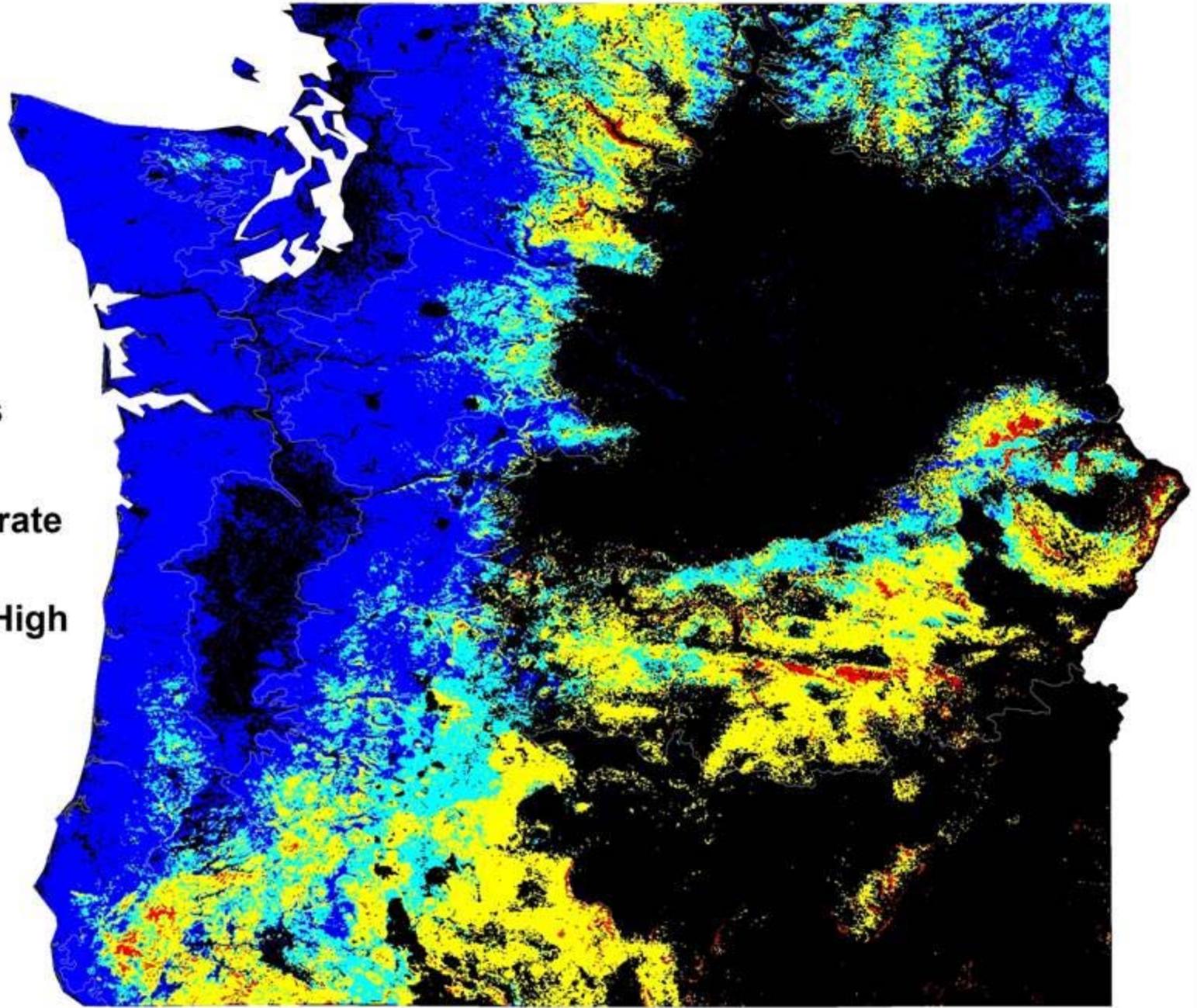


**Current Climate**

# 2040

## WFS Class

-  Low
-  Moderate
-  High
-  Very High

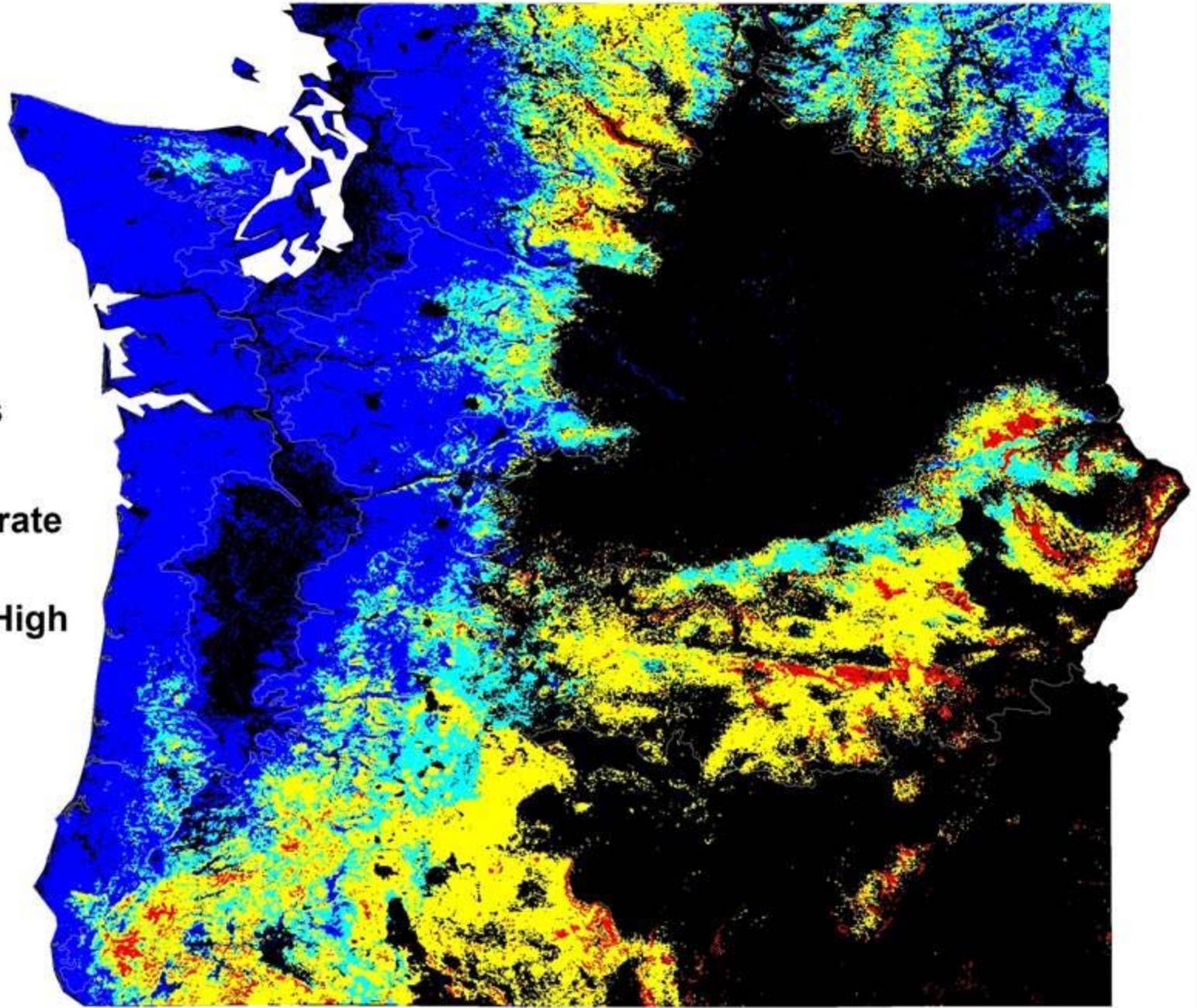


## RCP 2.6

# 2060

## WFS Class

-  Low
-  Moderate
-  High
-  Very High

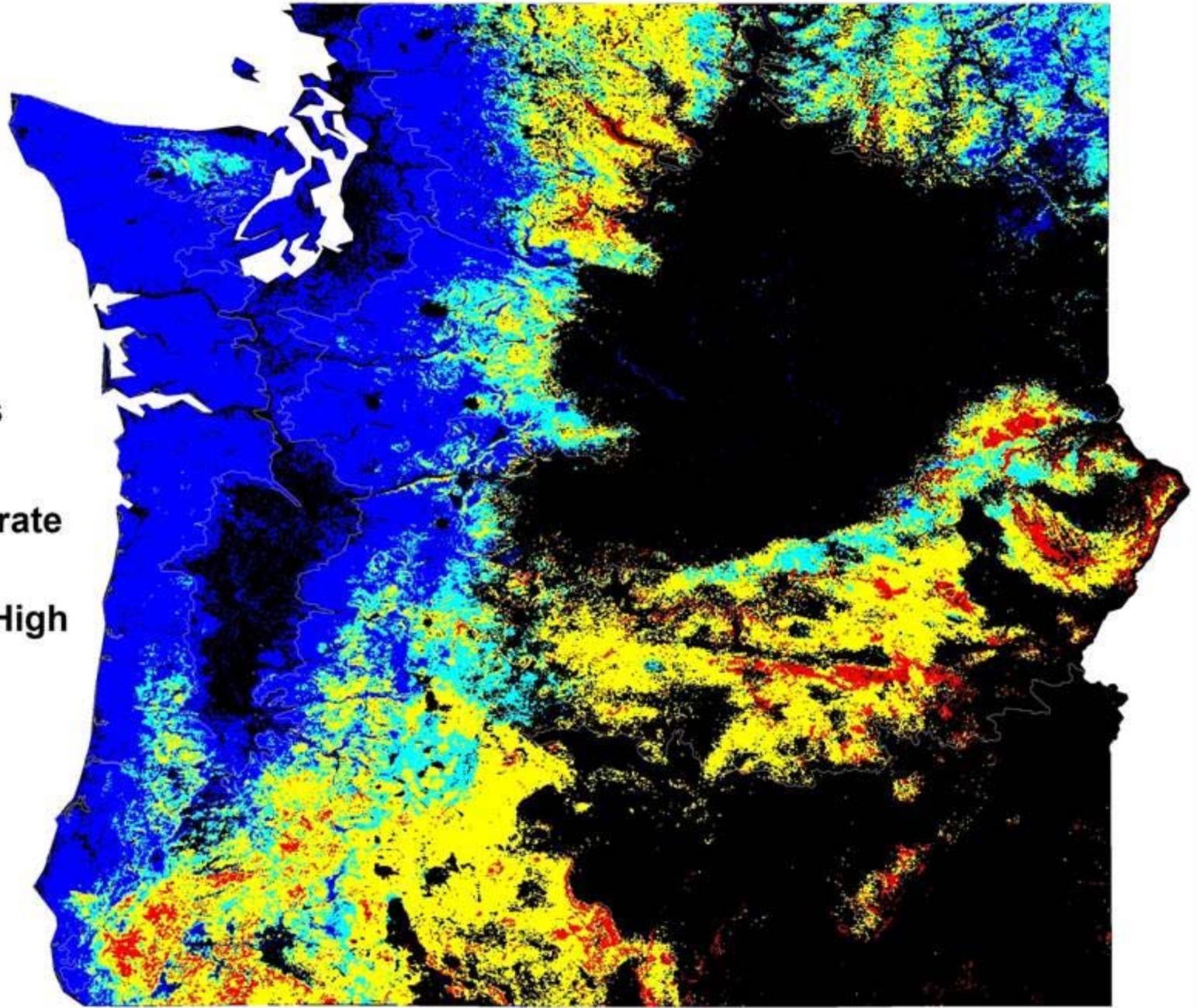


## RCP 2.6

# 2080

## WFS Class

-  Low
-  Moderate
-  High
-  Very High

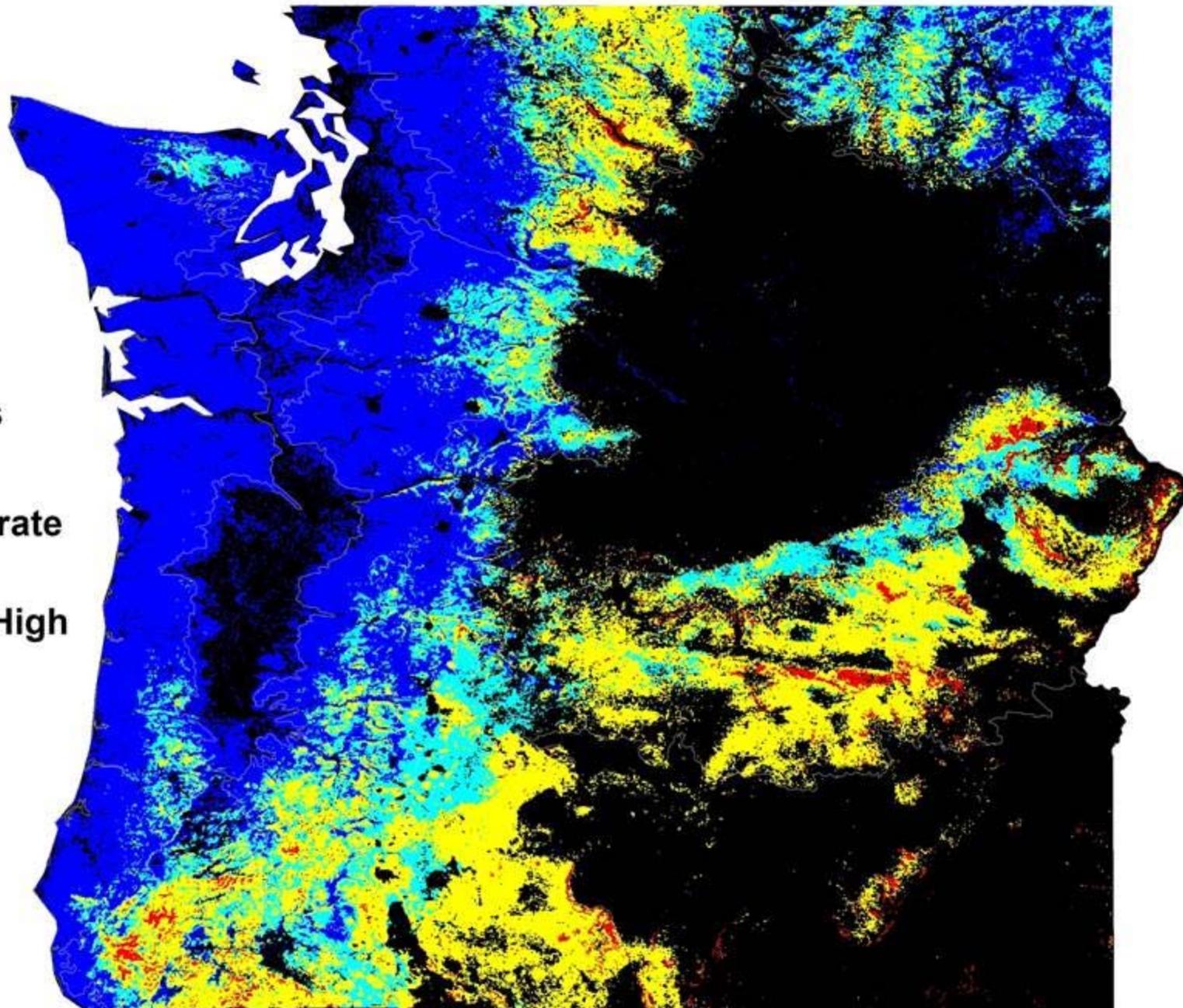


## RCP 2.6

# 2100

## WFS Class

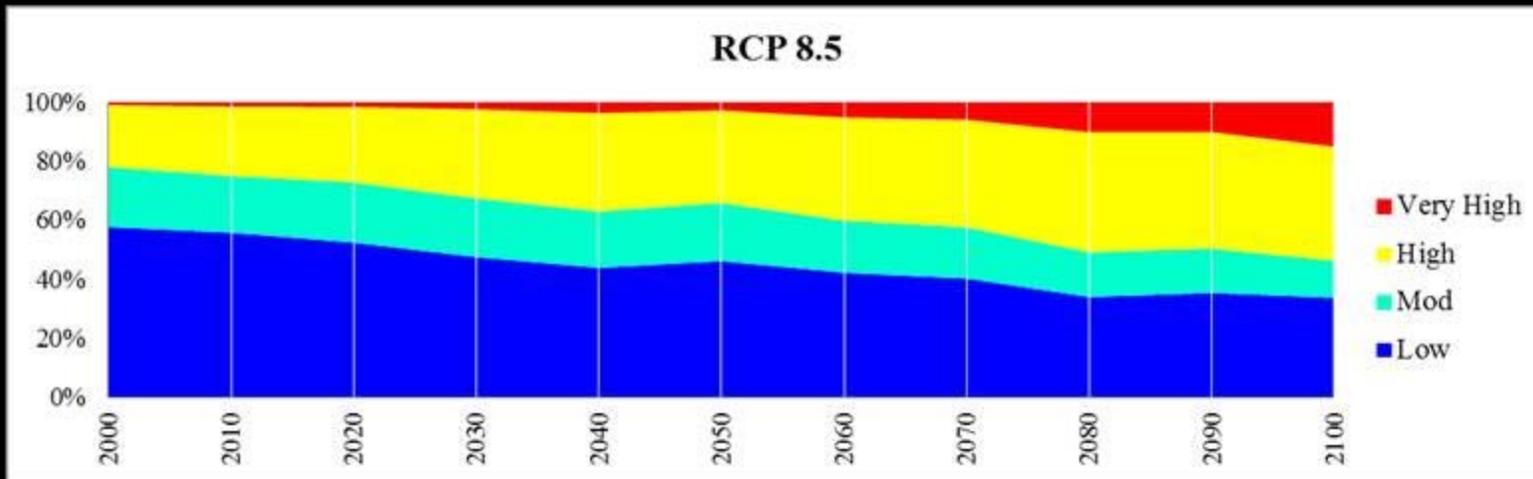
-  Low
-  Moderate
-  High
-  Very High



## RCP 2.6

# RCP 8.5

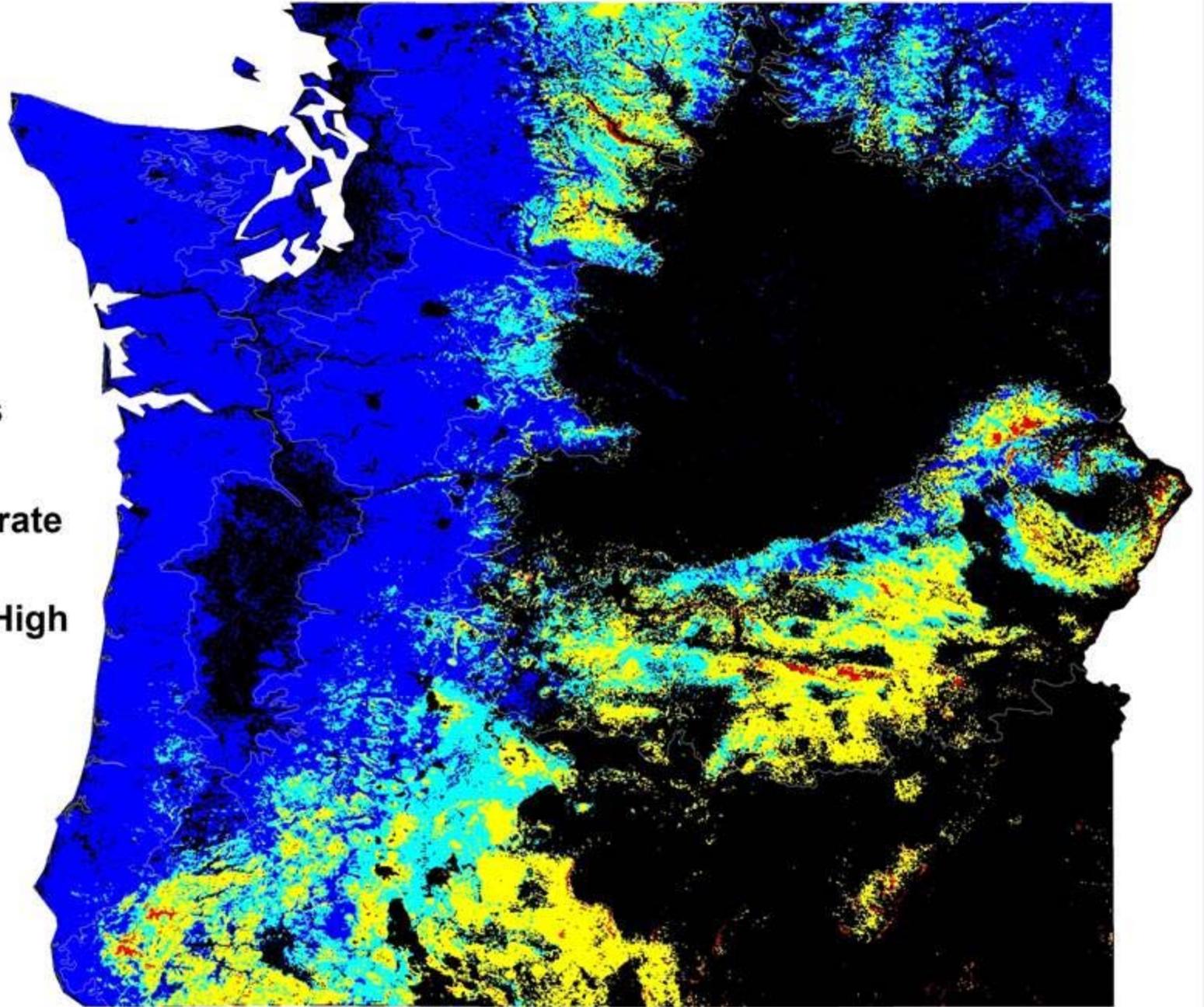
## Map Visualization



# 2000

## WFS Class

-  Low
-  Moderate
-  High
-  Very High

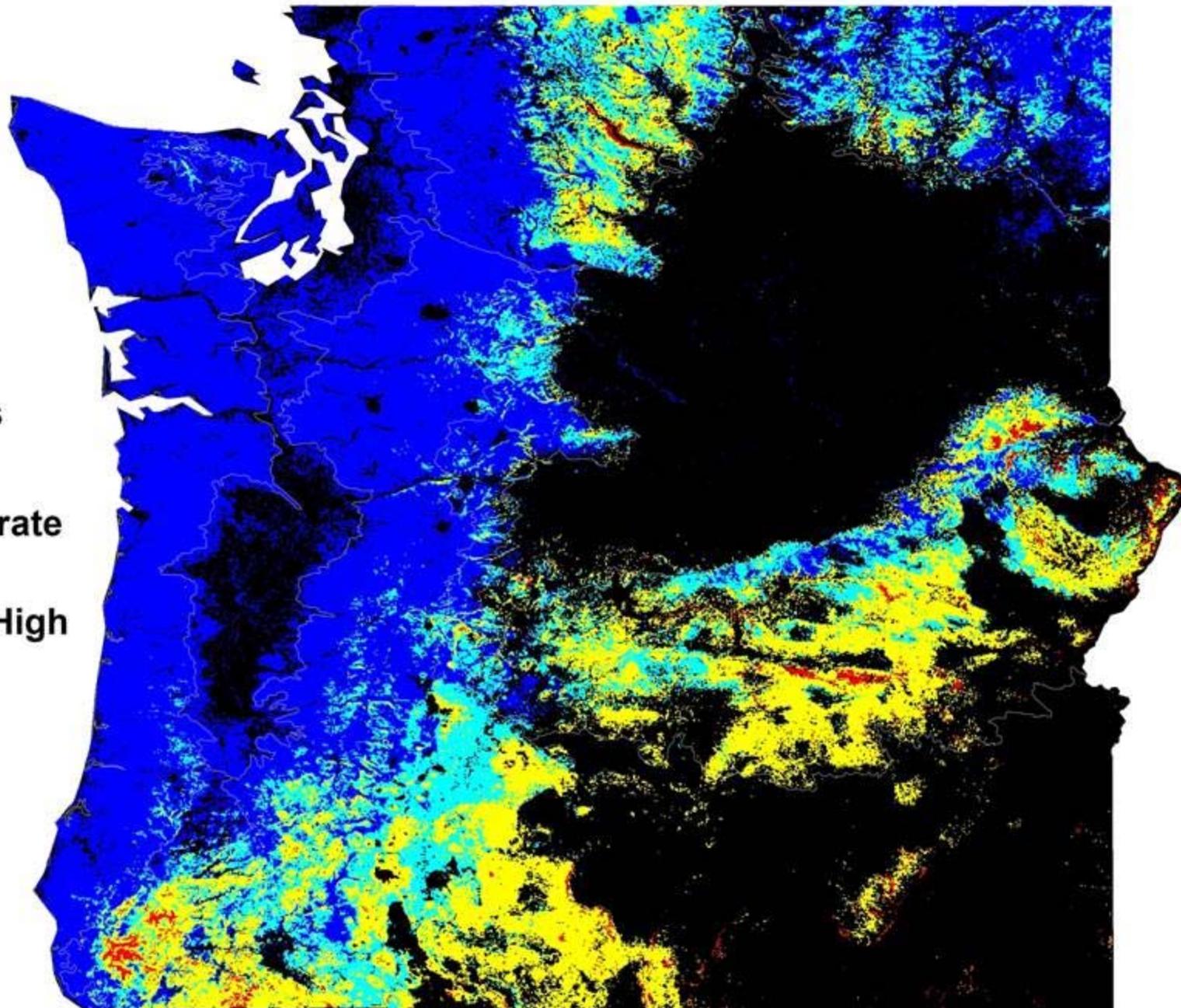


**Baseline Model**

# 2010

## WFS Class

-  Low
-  Moderate
-  High
-  Very High

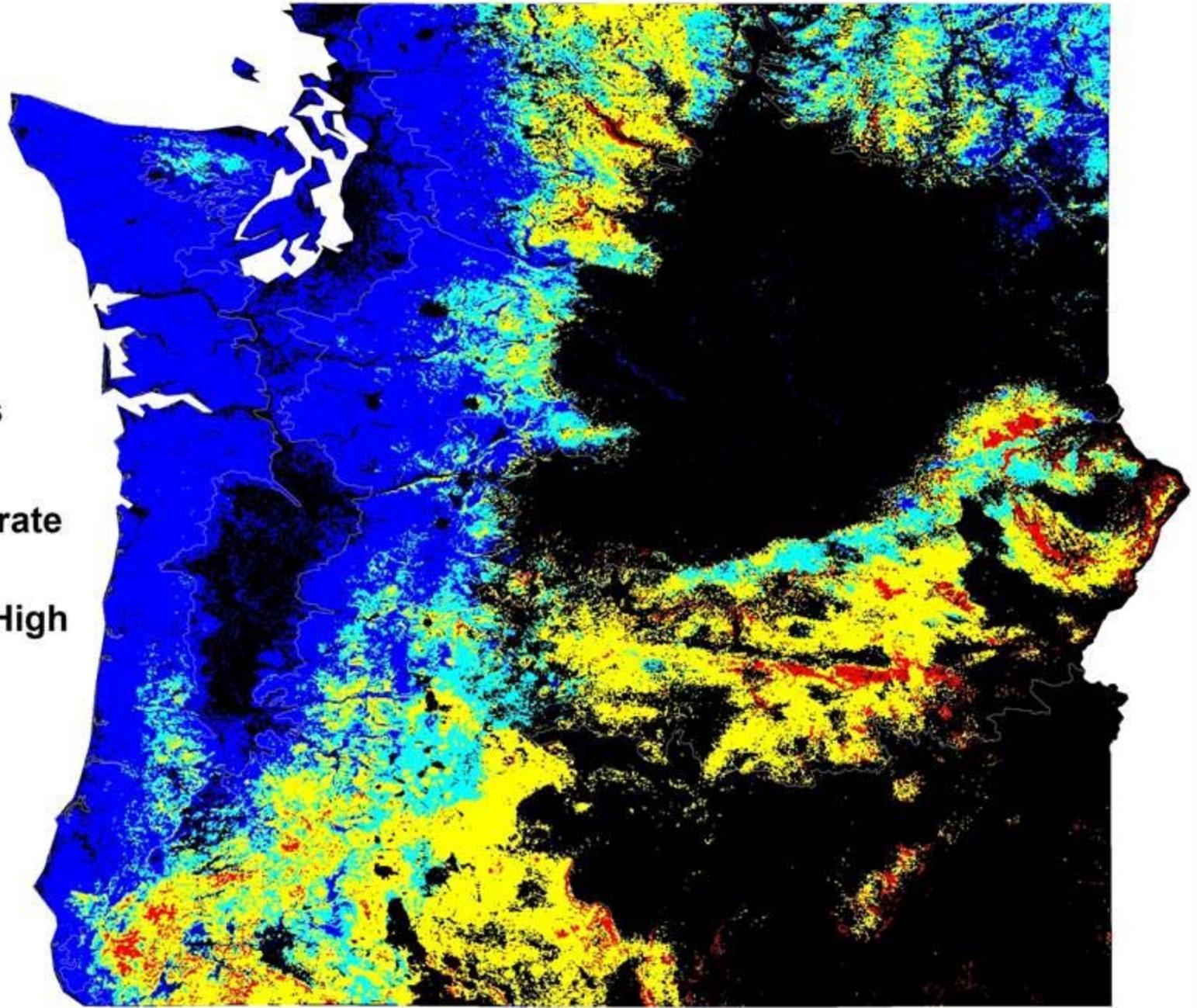


**Current Climate**

# 2040

## WFS Class

-  Low
-  Moderate
-  High
-  Very High

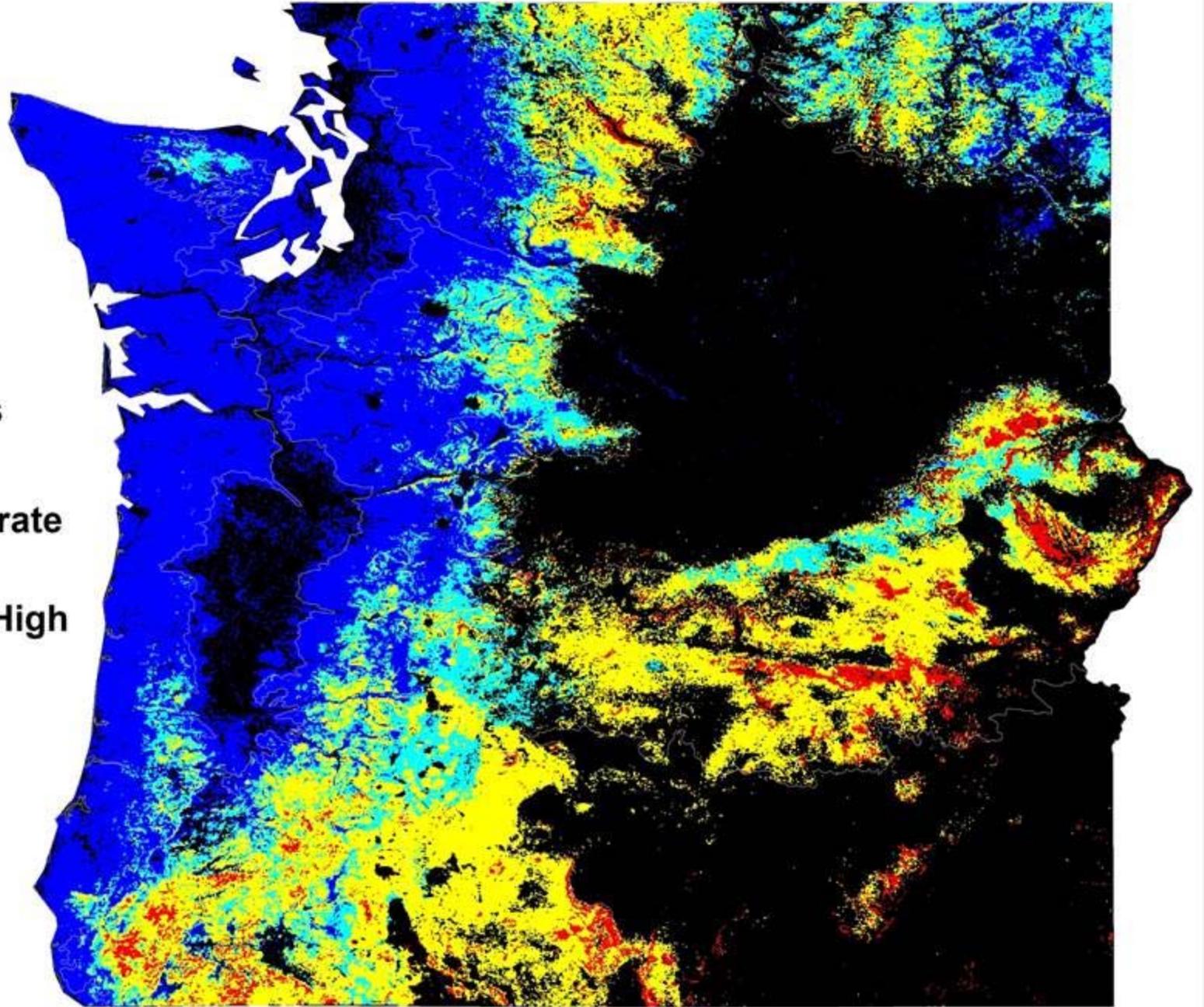


## RCP 4.5

# 2060

## WFS Class

-  Low
-  Moderate
-  High
-  Very High

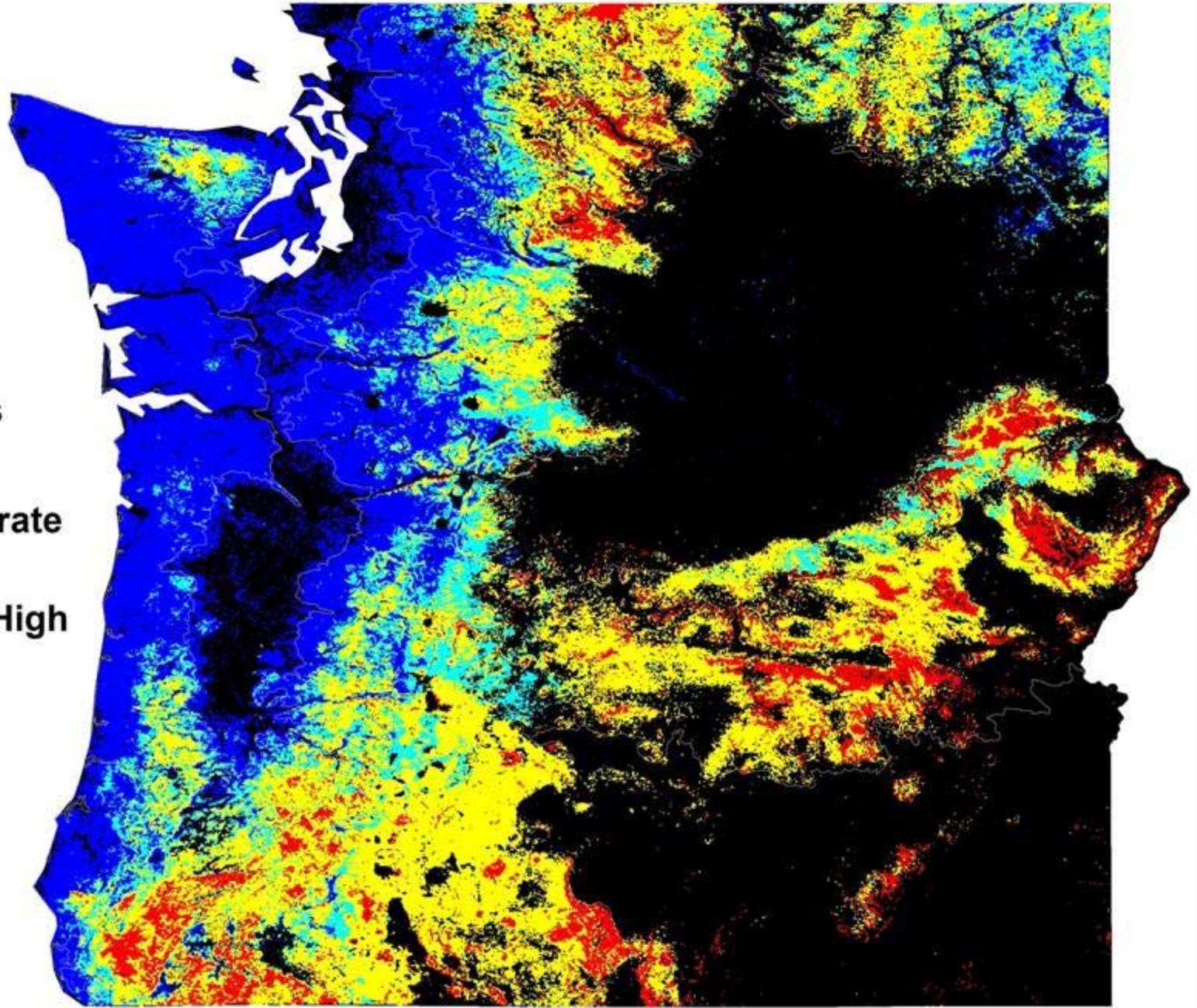


## RCP 8.5

# 2080

## WFS Class

-  Low
-  Moderate
-  High
-  Very High

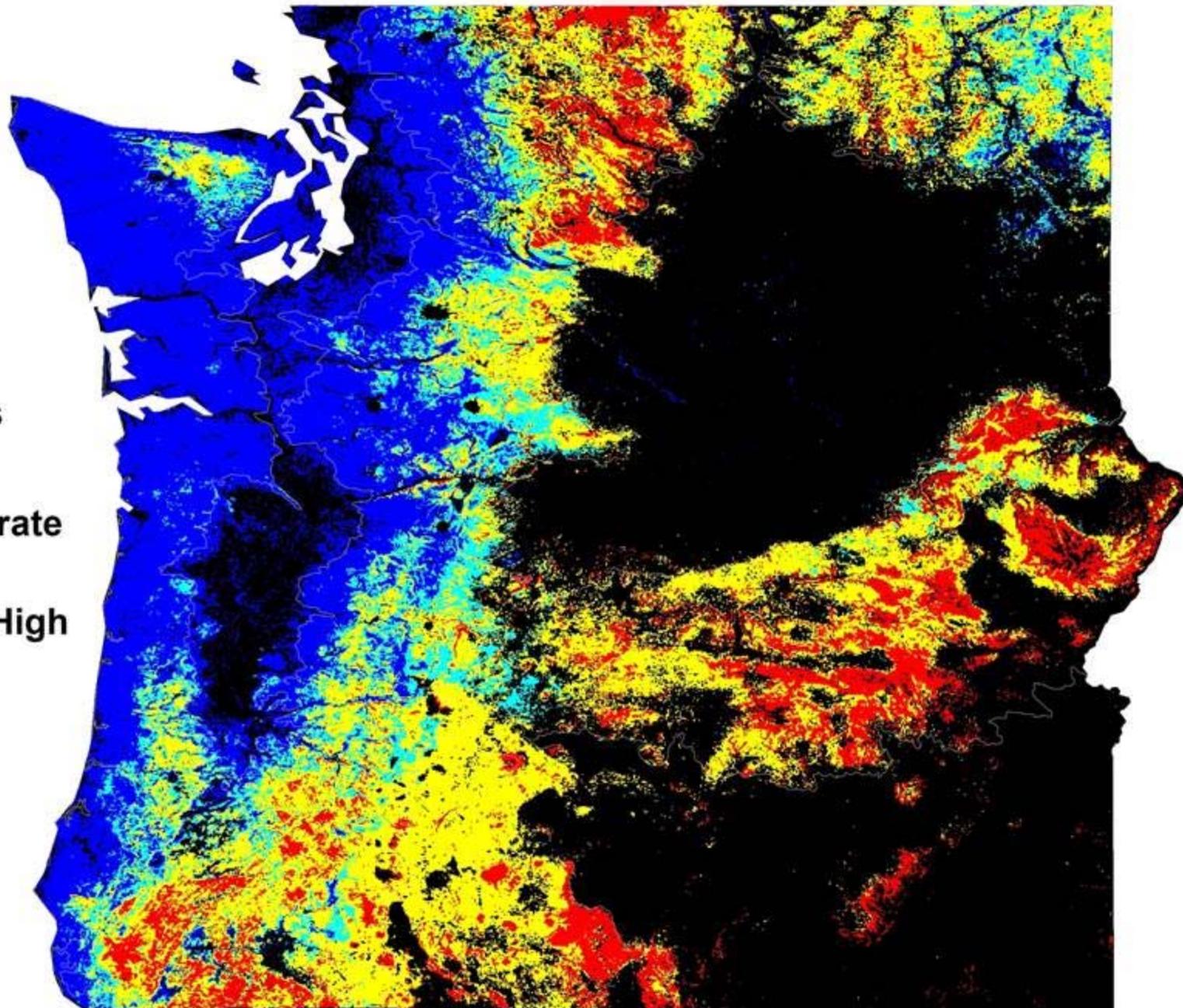


## RCP 8.5

# 2100

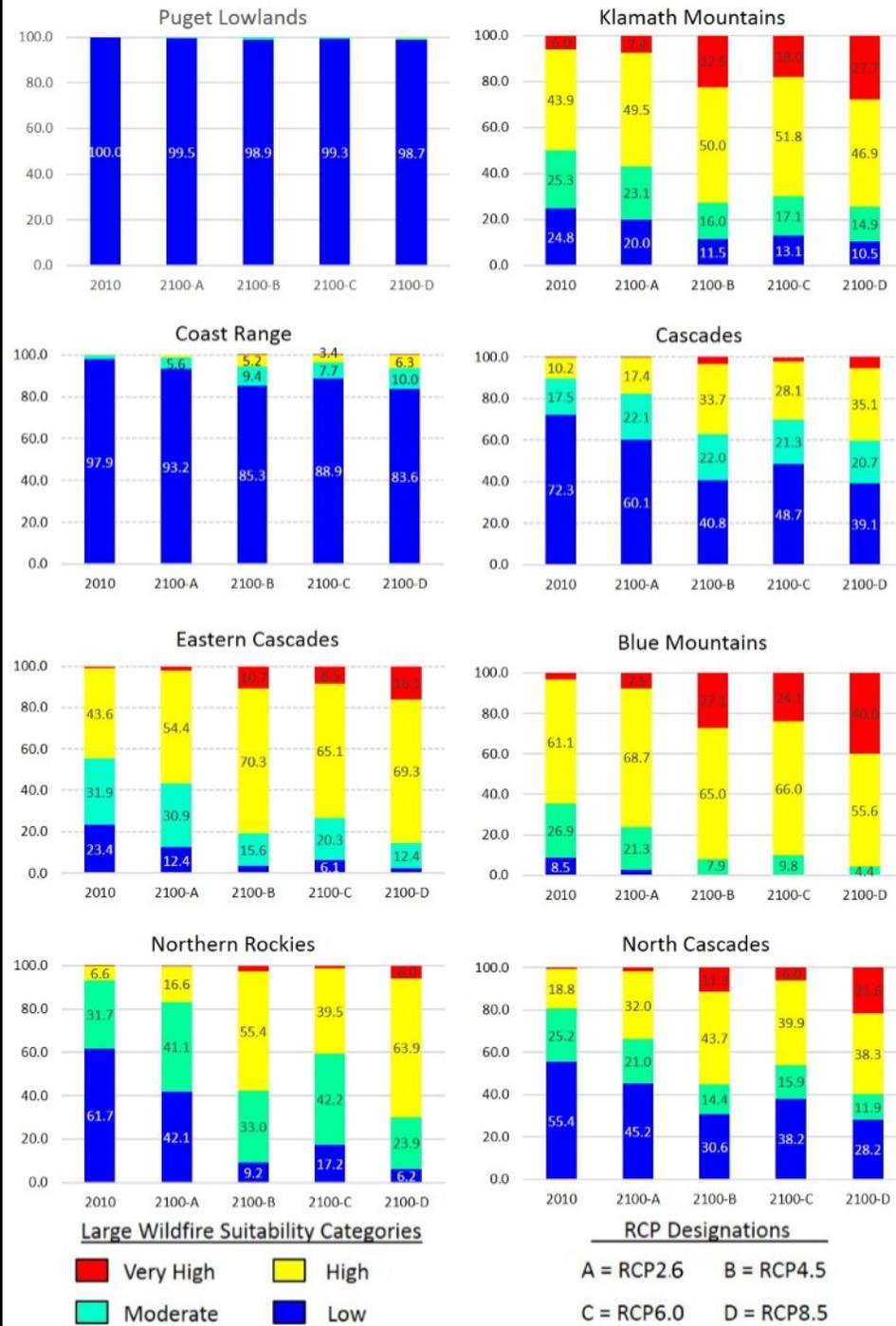
## WFS Class

-  Low
-  Moderate
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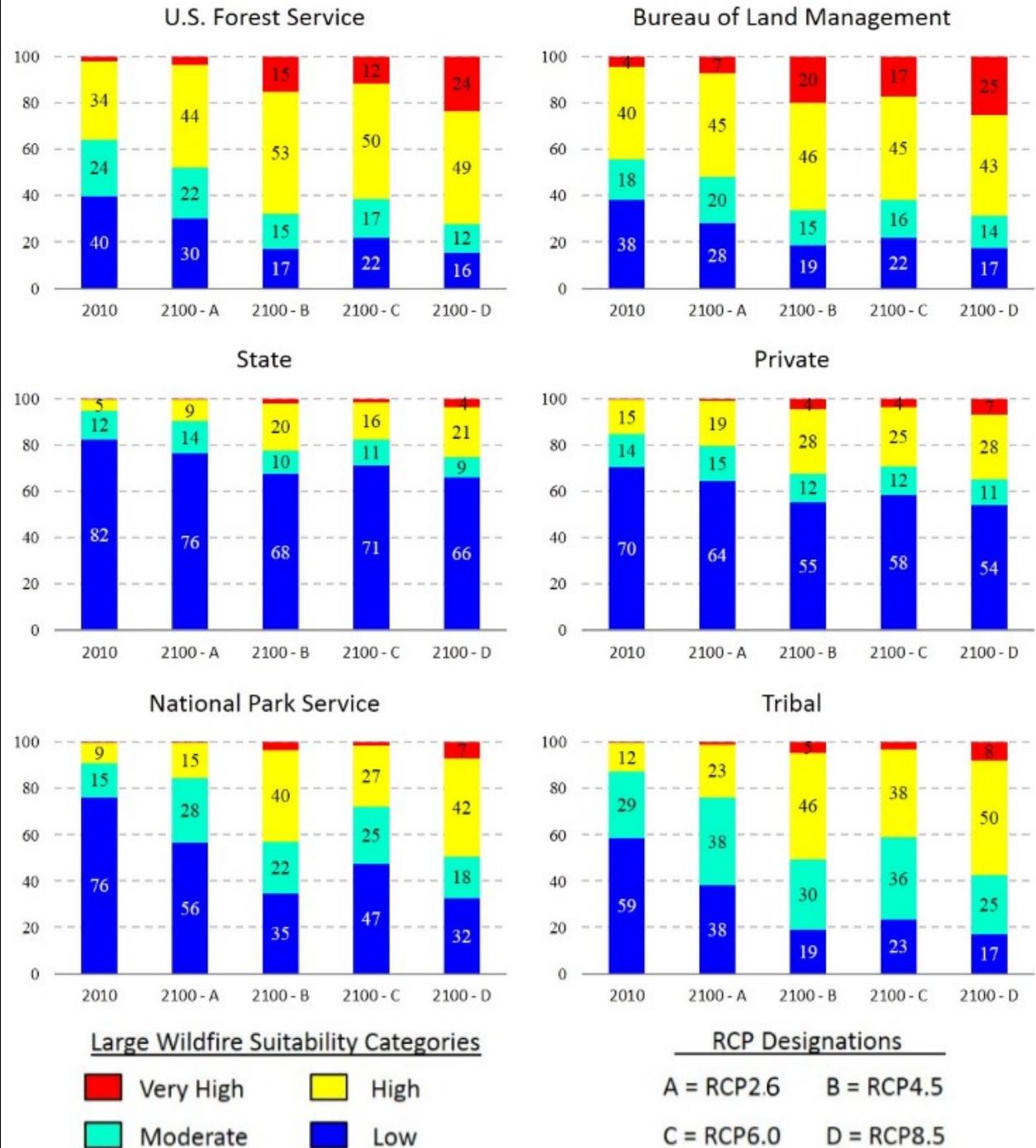


## RCP 8.5

# Ecoregion Summary



# Ownership Summary



# *Modeling Large Wildfire Suitability*

## Next Steps

- Peer review and publication
- Discuss implications of results in terms of the future cost of wildfire protection and the AFMP
- Integrate forest fuel/management covariate
- Explore fire severity as a response variable
- Evaluate potential effects on forest mortality, habitat conservation, and forest dynamics