Quantifying & communicating future wildfire risk across Pakistan under different climate change scenarios

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Coventry University

Research Centre
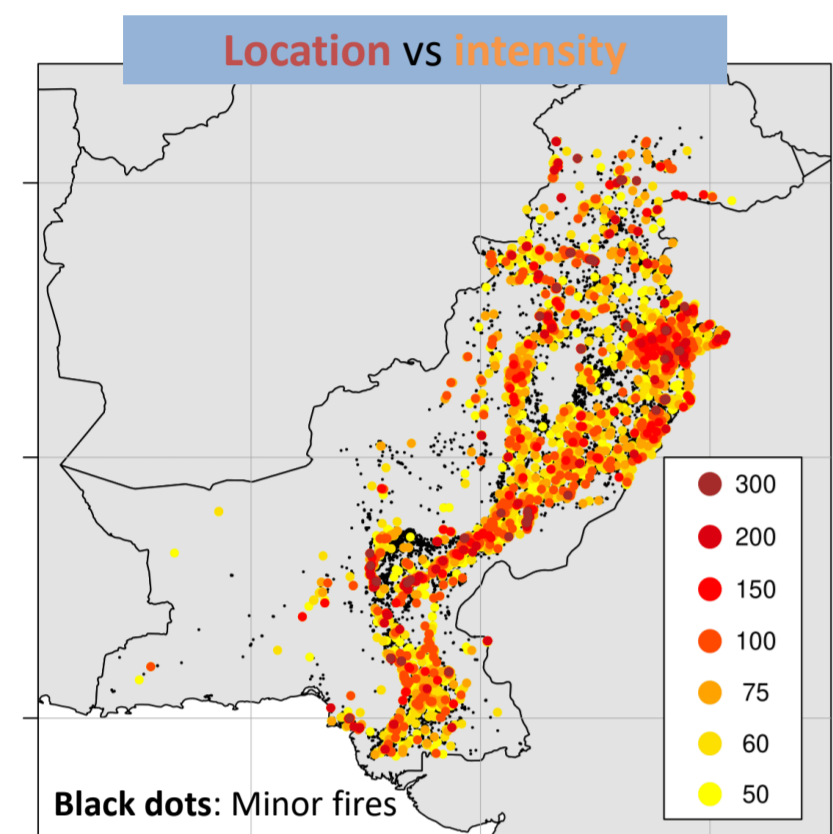Agroecology, Water and Resilience

1. Introduction

Background: Wildfires are becoming more intense and frequent across the world. In Pakistan, wildfire has gradually emerged as a significant environmental and societal threat.

Challenge: Understanding how future fire risk scenarios will unfold in a warmer world is crucial in moving toward better preparedness. It is unclear how such threats will evolve under climate change, and to what extent Pakistan's ongoing afforestation projects, such as the *Ten Billion Tree Tsunami* (shown right), take changes in risk into account.

Aim: The project aims to understand, quantify and communicate how wildfire risk is changing across Pakistan in the face of climate and environmental change.

Ten Billion Tree Tsunami tree planned tree planting
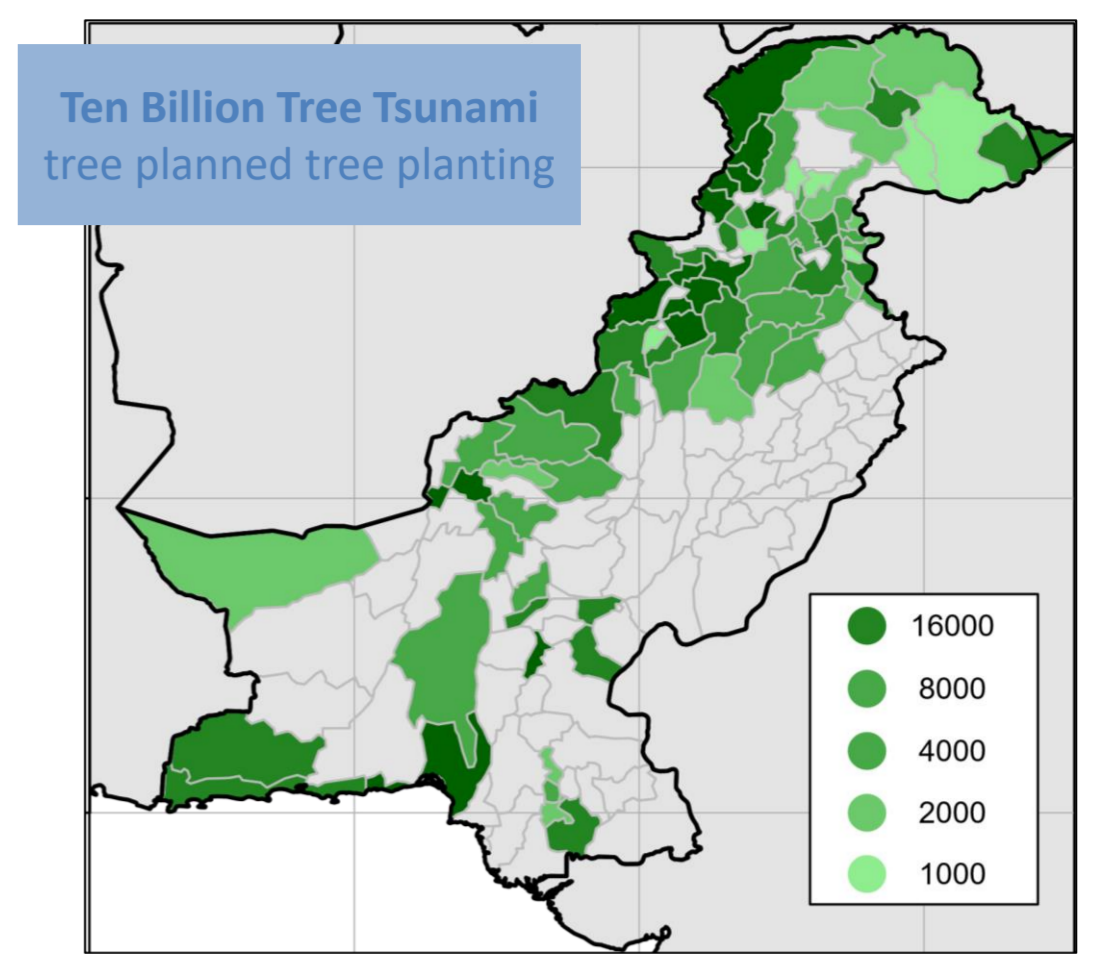
2. Spatiotemporal analysis of wildfires in Pakistan

Location vs intensity
Black dots: Minor fires

Location vs intra-annual timing

- Pakistan fire data taken from NASA for the years 2001-2020.
- The figures shows the **location**, **intra-annual timing** and **intensity** (fire radiative power) of fire occurrence.
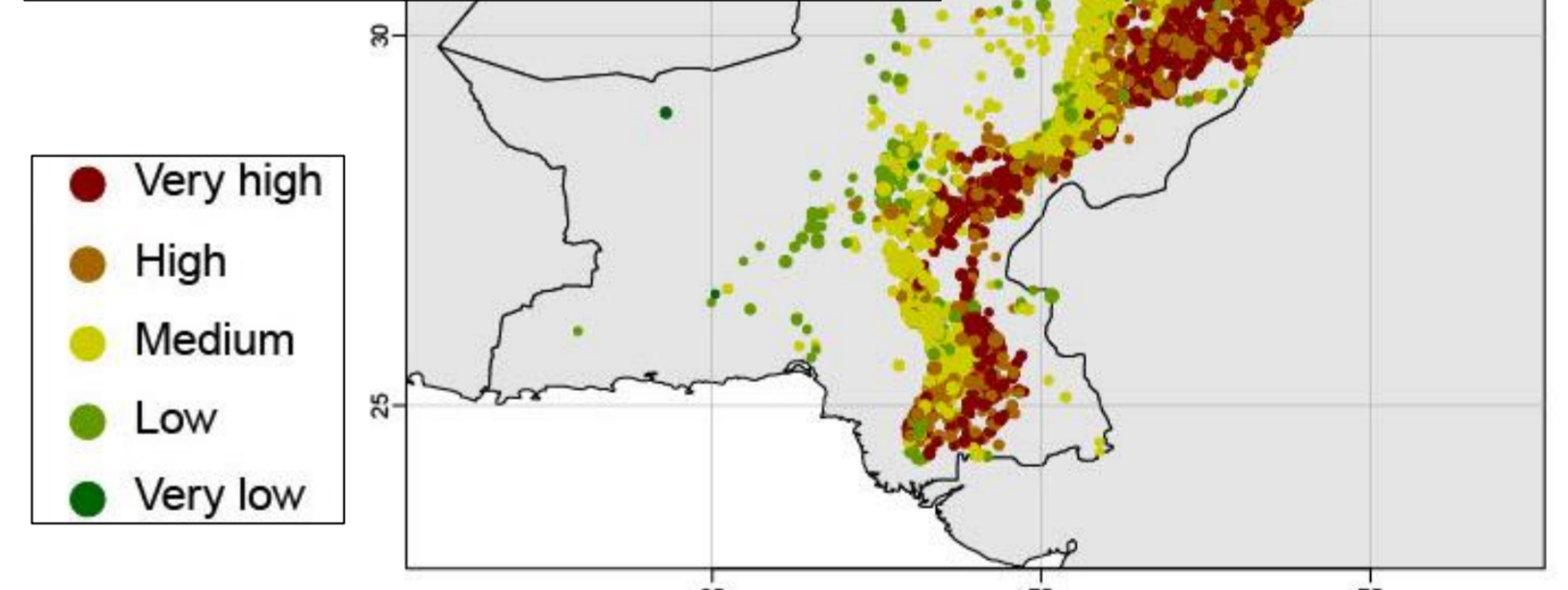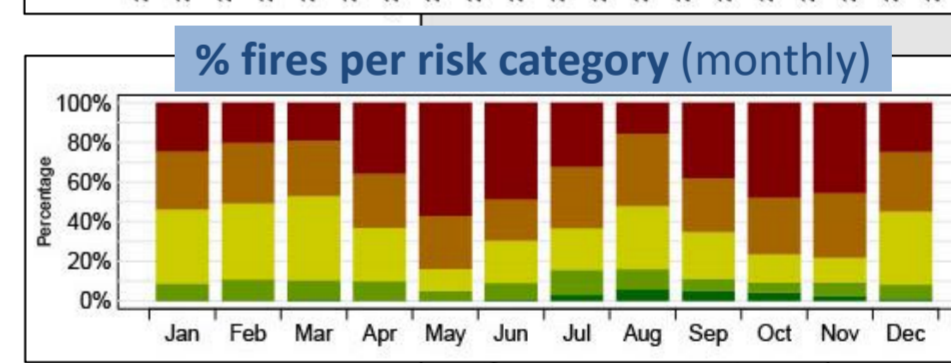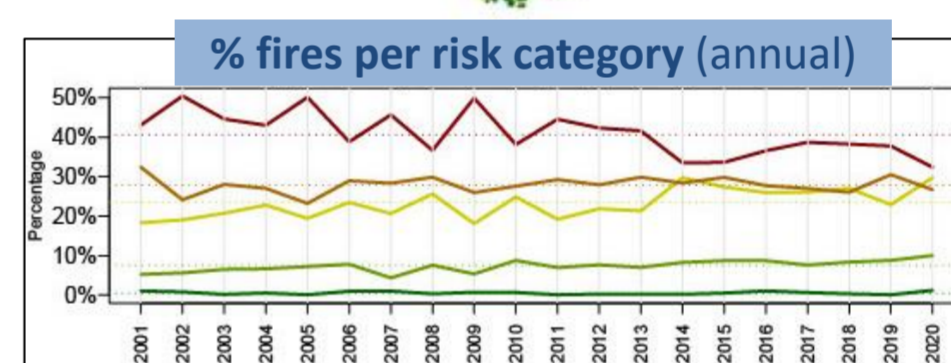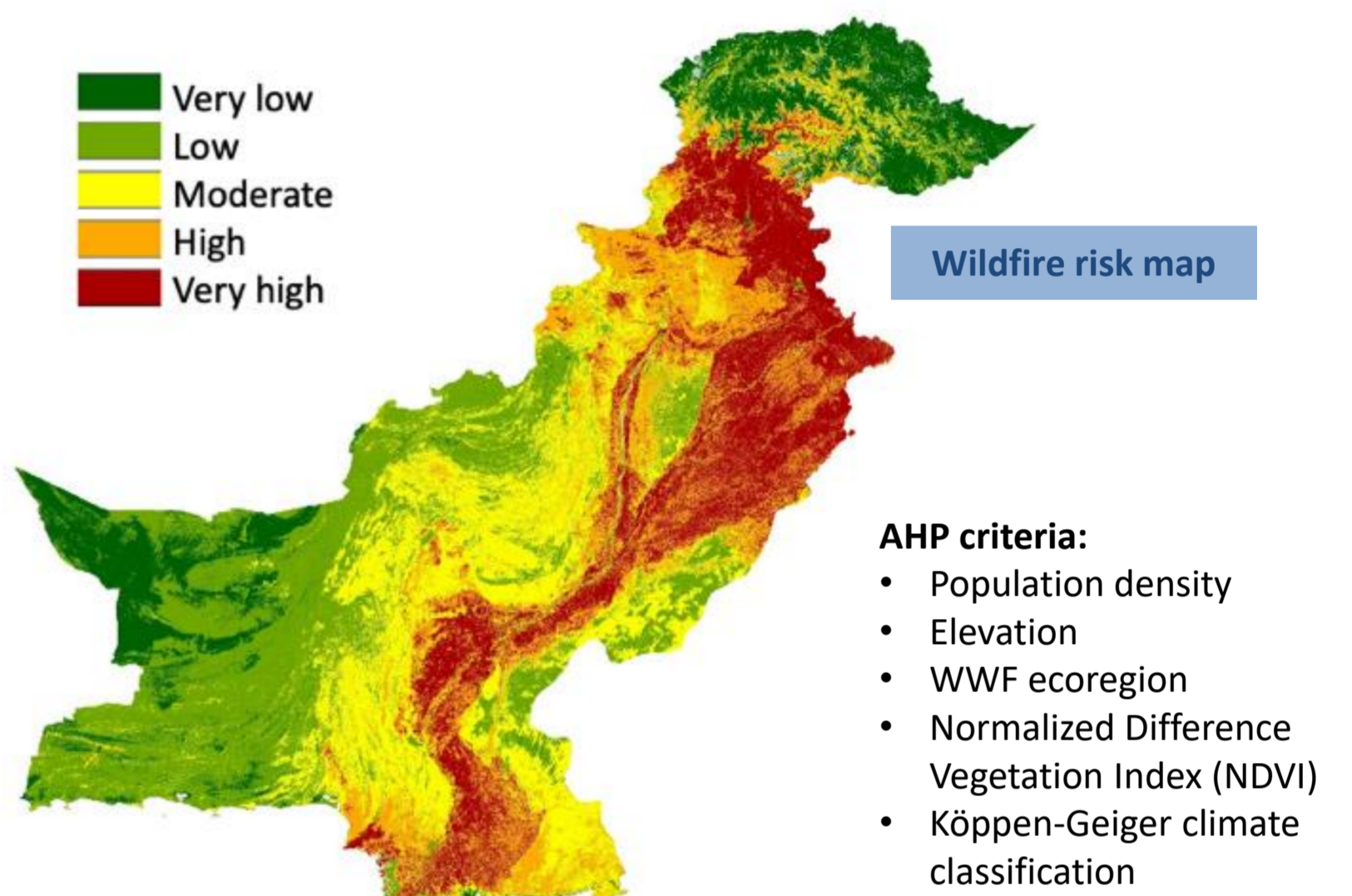

Intra-annual timing vs intensity
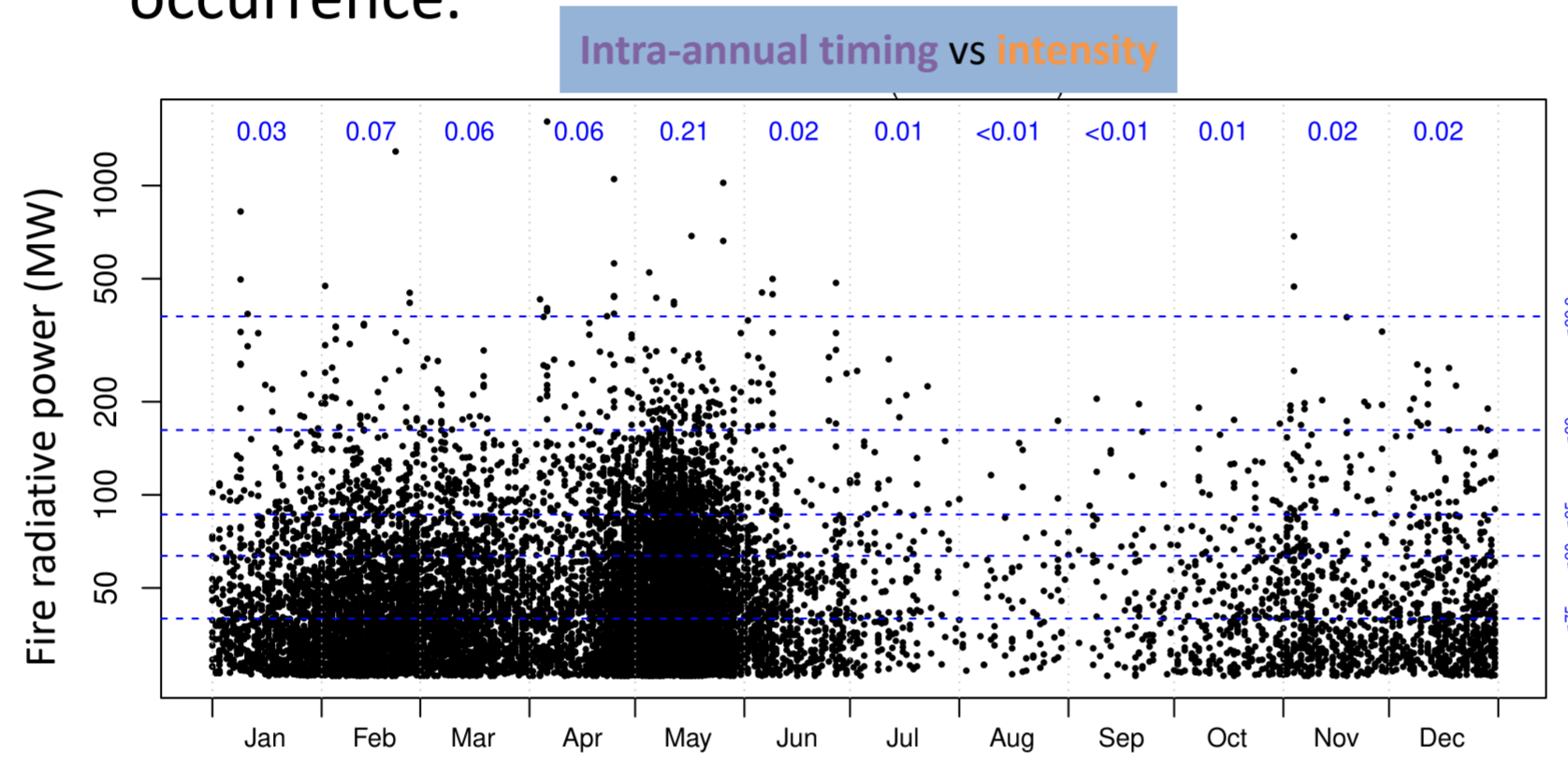
KEY FINDINGS:
- Two distinct fire seasons apparent: Oct to Mar and Apr to Jun; 21% of fires occur during May.
- The provinces of Punjab and Sindh are most affected.
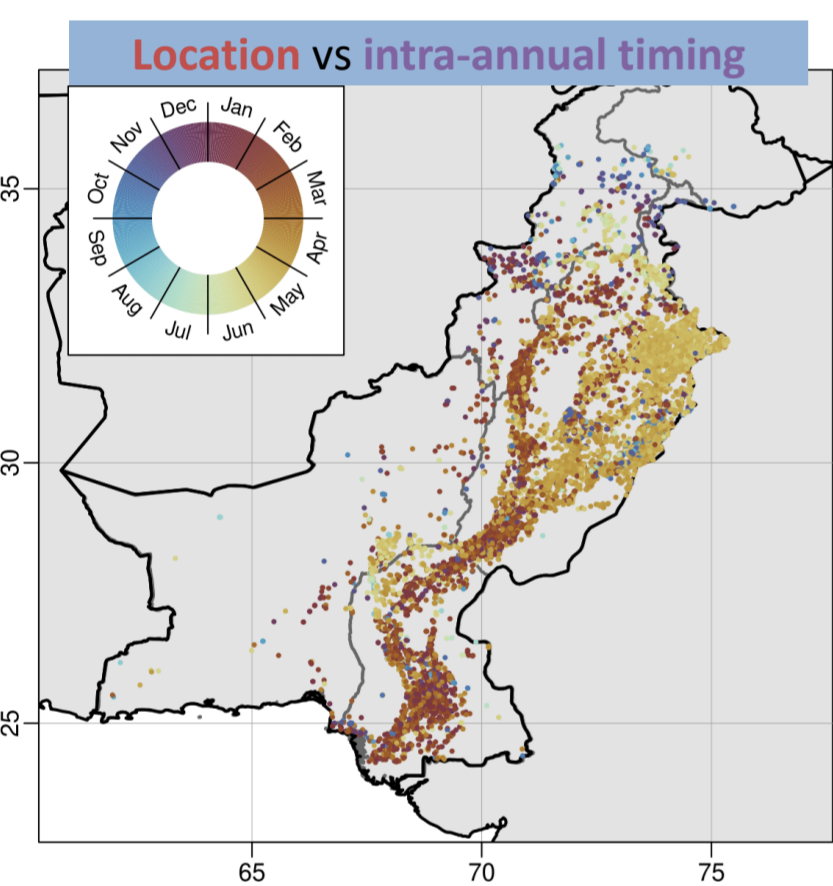
3. Risk Mapping

A **wildfire risk map** developed through Analytical Hierarchy Process (AHP) based on a set of environmental, geographical and societal criteria.
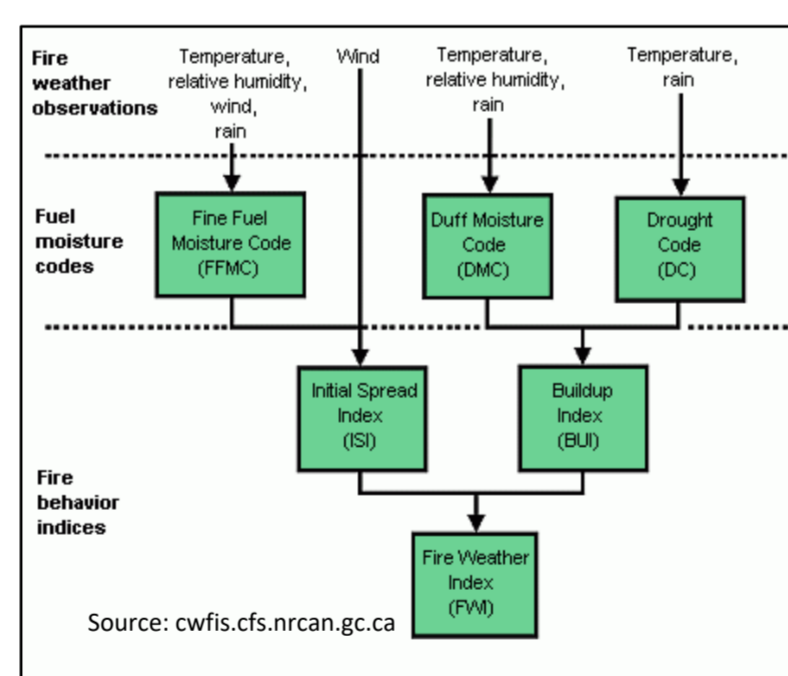

- Very low
- Low
- Moderate
- High
- Very high

Wildfire risk map

AHP criteria:
- Population density
- Elevation
- WWF ecoregion
- Normalized Difference Vegetation Index (NDVI)
- Köppen-Geiger climate classification

% fires per risk category (annual)

% fires per risk category (monthly)

Risk categorisation of fire occurrences
- Very high
- High
- Medium
- Low
- Very low

KEY FINDINGS:
- Up to 84% of satellite-detected fires fell within the high and very high-risk categories.
- In 2002,2005 and 2009, most of the fires occurred were in the very-high risk category.

4. Fire risk under climate change

- Observations of temperature, rainfall, humidity and wind speed combined to generate the seasonal average for the **'Fire Weather Index'** (FWI).
- Near-, medium- and long-term projections under four emission scenarios called Shared Socioeconomic Pathways (SSPs) ranging from *low* (SSP1-2.6) to *very high* (SSP5-8.5).

Source: cwfis.cfs.nrcan.gc.ca

Historical
FWI
FWI % Δ
SSP1–2.6   SSP2–4.5   SSP3–7.0   SSP5–8.5
Near term
Medium term
Long term

Projections made for:
- **seasonal average** FWI (shown left)
- **annual maximum** FWI
- **length** of fire season
- **number of days** with extreme fire weather
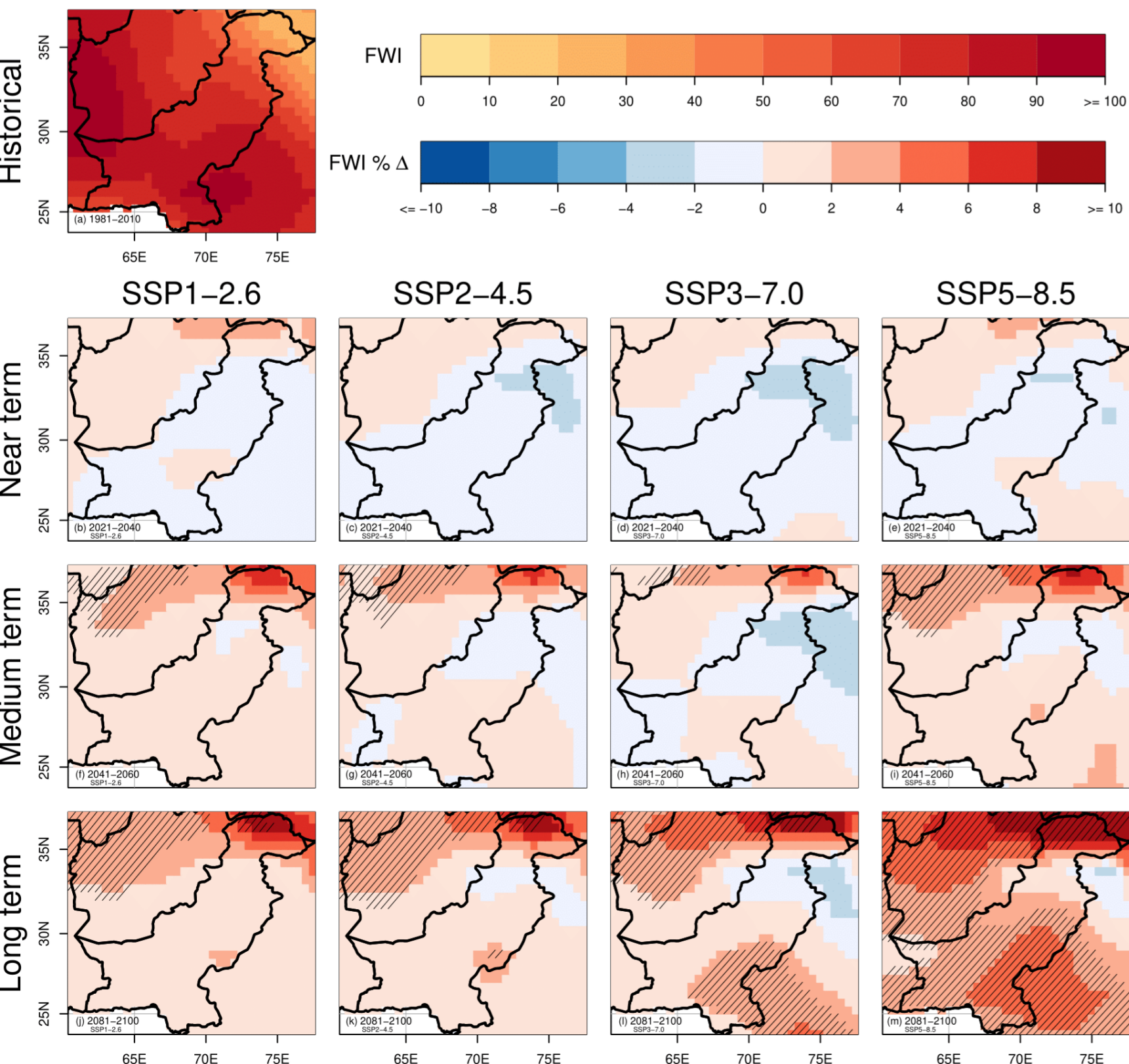
KEY FINDINGS:
- Seasonal mean FWI is projected to increase by 10% at the end of the century.
- Up to 20 additional days of extreme fire weather projected per year.

5. 'Risk portal' & next steps

- A prototype **'risk portal'** platform has been created for online **dissemination** of results and **communication** near-, medium- and long-term wildfire risk under different climate change scenarios.
- Next, focus will be given to the resilience of wildfire forecasting and early warning systems in a changing climate.