Using Global Geo-information for Disaster Risk Reduction Following the UN Sendai Framework: Climate Change and Disruptions to Global Fire Activity

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Why this research?

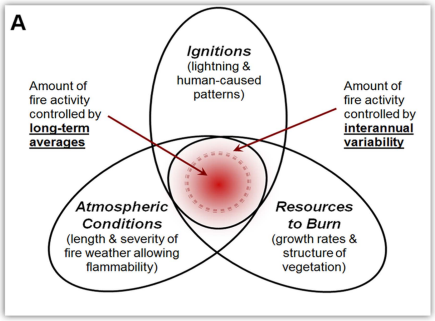
- Future disruptions to fire activity will threaten ecosystems and human well-being throughout the world, yet there are few fire projections at global scales and almost none from a broad range of global climate models (GCMs).

Objectives

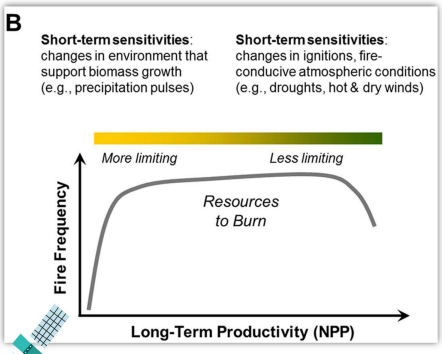
- Examine global disruptions to fire activity using an empirically based statistical framework and a multi-model ensemble of GCM projections, an important step toward assessing fire-related vulnerabilities to humans and the ecosystems upon which they depend.
- Describe how geospatial science will support countries, governments, and the public in Disaster Risk Reduction (DRR) following the UN Sendai Framework

Parameters / Considerations

- For forecasts, focus on variables which capture short-term fluctuations in biomass resources and the conditions affecting their flammability.



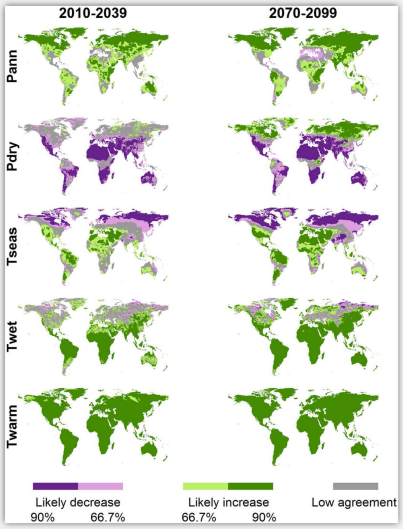
- Long-term fire climate relationships can be overpowered by local cultural practices which take advantage of short-term fluctuations in climate.
- Greater climatic extremes, especially precipitation fluctuations, can promote increased fire activity in chronically wet locations (e.g., drought in tropical rainforests) and chronically dry locations (e.g., precipitation pulses in deserts).

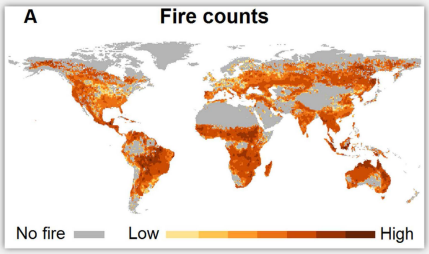


Results

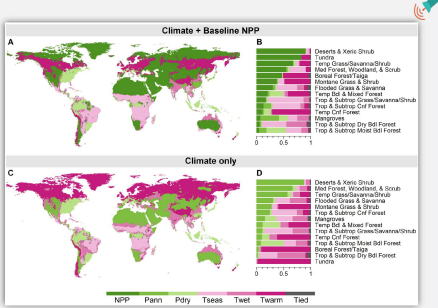
- 16 GCMs of the projected values of five climate variables used for modeling fire probability for the 2010–2039 and 2070–2099 time periods.

Climate metrics capture annual trends, seasonality and extreme environmental conditions that provide meaningful approximations of water and energy balances that determine the amount and dryness of biomass and thus fire occurrence.





Counts of observed fire occurrence readings from combined MODIS and ATSR remote sensing products from 1996 to 2007



NPP metric using the Carnegie-Ames-Stanford Approach (CASA) terrestrial carbon model Measures of NPP represent the amount of solar energy converted to plant organic matter through photosynthesis, quantified as elemental units of carbon per unit time and area. These data were created using climatology, land cover data, solar radiation, soil texture and vegetation data (AVHRR from 1982–1998)

Global Trends

- The majority of the globe (55%) shows low agreement in the direction of projected change. Even so, the ensemble mean change in fire probabilities for many of these areas of low agreement may, in fact, be relatively small.
- By the end of the century there is consensus that the vast majority of the globe (82%) will experience disruptions in fire activity.
- Model agreement is strongest for fire increases in both the near and distant future (37.8% and 61.9% of terrestrial areas, respectively). Most of the predicted increase occurs in the higher northern latitudes.
- Tundra: Our results suggest a striking increase in fire activity for boreal ecosystems in the future, which is consistent with other temperature-driven projections. With warmer temperatures, substantial tundra areas become more conducive to plant growth within this next century, and as a result, fire will rapidly become a novel disturbance there.
- Tropics: Decreases in fire activity are most extensively projected for the tropical and subtropical savannas of the world, which eventually show agreement for higher temperatures in both warmest and wettest months, increasing temperature seasonality, and less precipitation in the driest month, likely causing greater water stress and lower biomass productivity.

Sendai Framework and DRR

- Geospatial data and earth observation data collected by a growing number of satellite-borne instruments and new techniques for robust geospatial analyses contribute significantly to more timely and informed decision making for societal benefits, especially in the context of climate change and increasing exposure to disasters.
- Despite an increase in the amount of data and the frequency of data acquisition, in order for it to be deemed useful, such information and technologies must reach the right people and institutions at the right time and in the right form for a given planning, policy, or other decision making context. Disaster Risk Management (DRM) benefits greatly from the use of geospatial and earth observation technologies because spatial methodologies can be fully explored for serving different purposes from assessment/analysis to application in decision making process. The use of geospatial and earth observation data have become an integral part of the DRM community of practice.
- ADPC has found this integration of geospatial and earth observation data as critical for successful DRM as well as for widely accepted societal applications. These types of data have demonstrated a wide diversity of applications, from addressing the types of hazards to covering all aspects of the risk management spectrum – starting with prevention and mitigation, through preparedness and response, to rehabilitation and reconstruction. Under the Sendai Framework, professionals and policy makers mandated by Government institutions will take on land-use planning and implement sustainable development by developing a harmonized approach to apply hazard and risk knowledge for risk mitigation through integrated spatial planning, especially in a highly risk prone region like the Lower Mekong. This has developed in a number of DRR sub disciplines or fields but more emphasis is needed to apply geospatial and earth observation data when designing multi-hazard resiliency strategies and adopt more holistic and integrated land-use planning.

Limitations/ Future Steps

- Linking fire probabilities to fire intensities and area burned are important next steps.
- Global models are good for trend analysis, downscaling is always recommended for practical end-user adoption.
- Local cultural practices, some of which are traditional, take advantage of short-term fluctuations in climate.
- Detailed scenarios of future change in anthropogenic pressure are needed to assess the human contribution to future fire forecasts