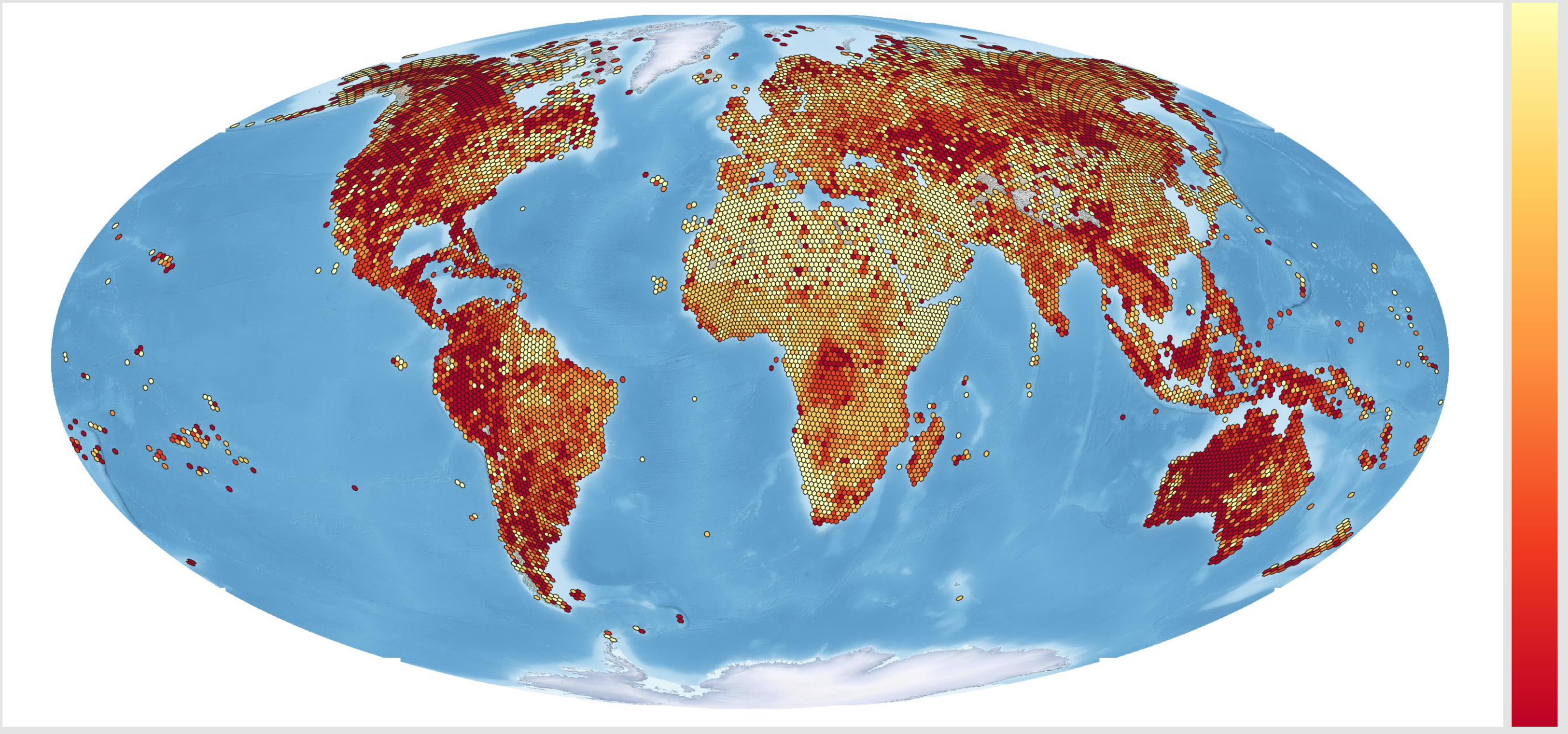
Analyzing trends of changes in fire regimes on a global scale

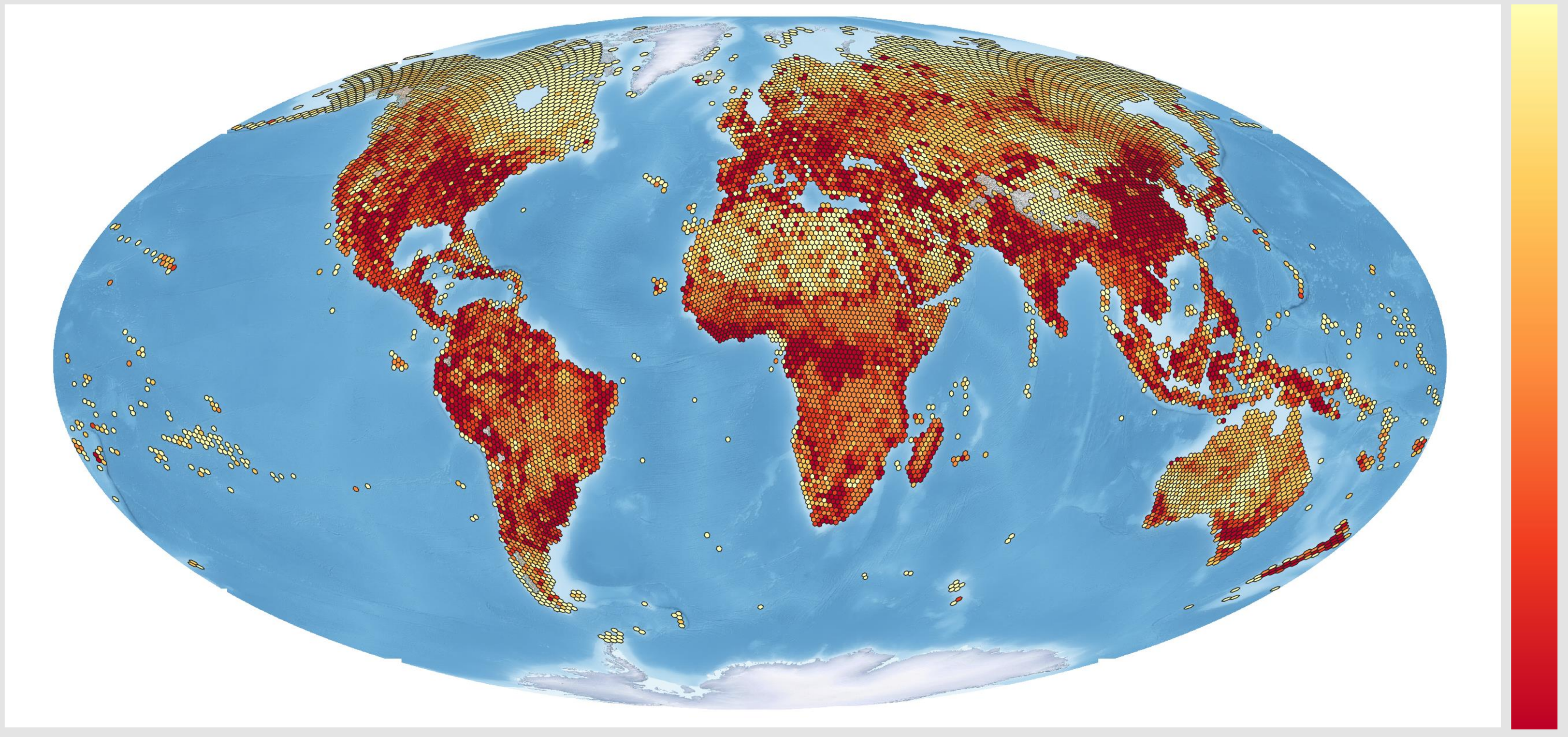
Michael Nolde, Simon Plank, Monika Friedemann, Torsten Riedlinger (German Aerospace Center, DLR)

Intensity: Development in monthly mean Fire Radiative Power (FRP), 2000 - 2019



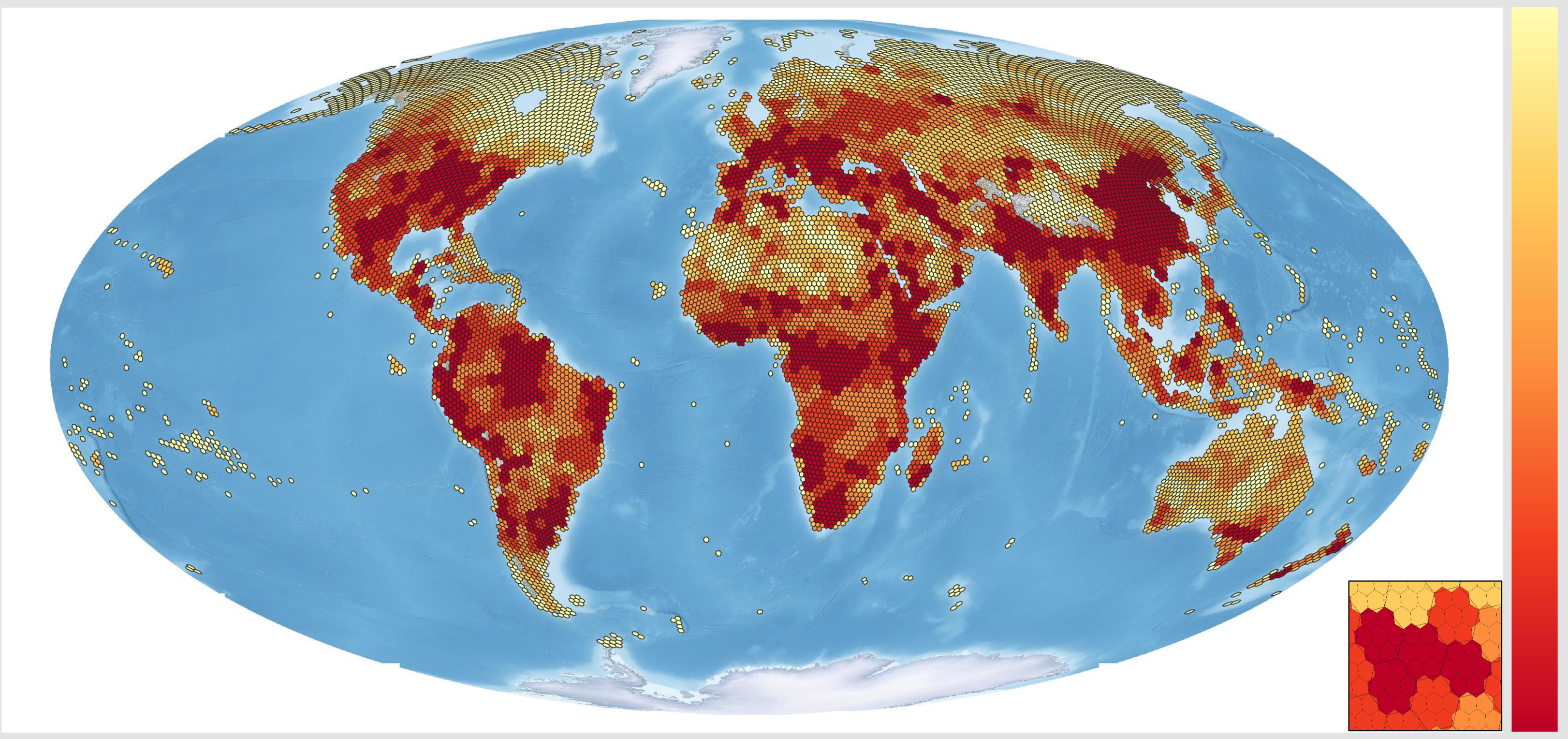
Countries with largest increase	Slope of regression line
Laos	16.55 %
Australia	12.83 %
Colombia	12.24 %
Peru	11.84 %
Kazakhstan	11.71 %
Uruguay	10.79 %
Bolivia	10.22 %
Canada	9.97 %
Argentina	9.81 %
Mexico	9.78 %

Seasonality: Development in length of fire season (months per year), 1995 - 2019



Countries with largest increase	Slope of regression line
Ivory Coast	34.48 %
Cambodia	33.40 %
Uruguay	32.89 %
Romania	32.82 %
Peru	32.37 %
Gabon	32.15 %
DR Congo	32.00 %
Tunisia	31.11 %
Ghana	31.01 %
Bulgaria	30.60 %

Occurrence: Development of number of grid cells featuring fire activity in a reference area for each month, 1995 - 2019



Countries with largest increase	Slope of regression line
Gabon	1.81 %
DR Congo	1.69 %
Bulgaria	1.69 %
Romania	1.69 %
Ivory Coast	1.68 %
Uruguay	1.67 %
Ethiopia	1.67 %
Namibia	1.66 %
Kenya	1.64 %
Germany	1.61 %

Study description

Wildfire is a dominant factor for shaping the landscape ecology in many parts of the world. It also poses an enormous threat to human lives and property. Climate change is expected to influence historical fire patterns, e.g., to intensify the occurrence of fire in already fire-prone ecosystems. This work is an attempt to investigate trends of changes in fire regimes on a global scale, regarding seasonality, intensity, and distribution of fire activity.

Thermal remote sensing allows the monitoring of wildfire activity worldwide. Data from several satellite sensors featuring varying spatial/temporal resolutions and radiometric sensitivities have been used towards that purpose, allowing for a combined temporal resolution of only a few hours between satellite overpasses (in the case of geostationary satellites, such as MSG Seviri or Himawari AHI, data is even gathered every 10 to 15 minutes). The combination of the acquired data therefore allows a fairly seamless monitoring timespan of several decades.

Due to the differences in utilized systems and methodologies, however, these data collections are highly heterogeneous regarding spatial/temporal resolution, utilized data formats, naming conventions, data types and comprised information. In preparation for this work, available datasets have been collected and harmonized, e.g. fire radiative power (FRP) has been corrected to account for the respective spatial resolution. By that, a comprehensive, decade-scale data basis was generated, which is used to derive global, fire related trends.

This study uses data from AQUA/TERRA MODIS, SUOMI-NPP/NOAA-20 VIIRS, MSG SEVIRI (covering Europe, South America and Africa), ENVISAT AATSR as well as ERS-2 ATSR-2. The generated data basis covers the time span from June 1995 to October 2019 and contains a collection of more than 250 million active fire locations, in most cases combined with radiated power information. The data was transferred into a uniform grid (H3 Level 3, ~12,000 km^2 per cell), which was then analyzed regarding temporal developments.

For the intensity and occurrence analysis, monthly mean values have been calculated (regarding FRP and number of affected grid cells, respectively) and utilized to generate a regression line over the complete time range for each grid cell, using a machine learning approach. The same was done for the seasonality analysis with yearly values (number of month featuring fire). The steepness of the slope of this regression line is the feature depicted in the graphics. Yellow color indicates a negative slope, addressing a general decrease in development. Red shades symbolize an increasing trend.

The tables show a ranking of countries for each of the three analyses. Only countries with a minimum size of 100,000 km^2 are considered. Also, at least 10 grid cells featuring fire activity must be present per country. Since sun glint on snow/ice covered surfaces can lead to erroneous detection of thermal anomalies, areas permanently covered by snow have been omitted.

Contact: Michael Nolde (michael.nolde@dlr.de)

Deutsches Zentrum für Luft- und Raumfahrt

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