



Committee on Earth Observation Satellites

WildFire Pilot - Update

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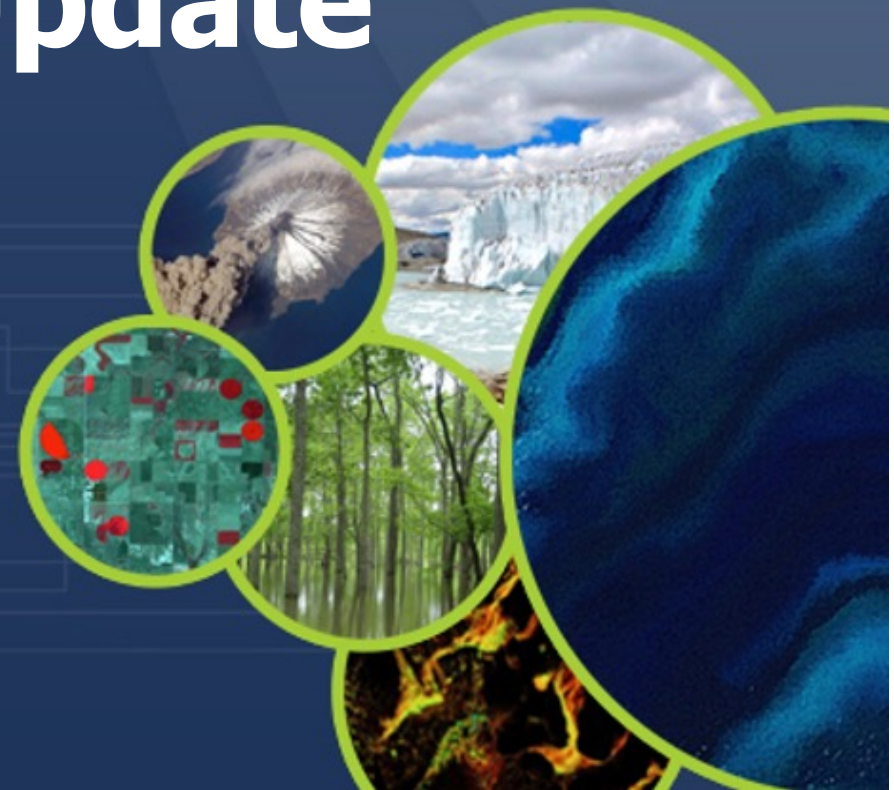
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CEOS WG Disasters Meeting #18

October 4, 2022



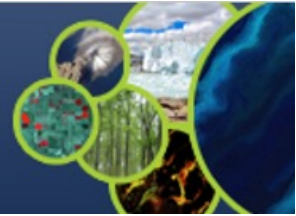


Objective 1: Conduct a detailed inventory and gap analysis of existing and proposed EO systems suitable for global active-fire monitoring, considering climate driven changes in fire

1. How does global future EO AF monitoring capacity change?
2. How will fire regimes (fire weather) change under future climate change?
3. Map existing and future EO coverage & weather projections over 5-10 year intervals, develop metrics for intercomparison



EO AF capabilities



1. How does global future EO AF monitoring capacity change?

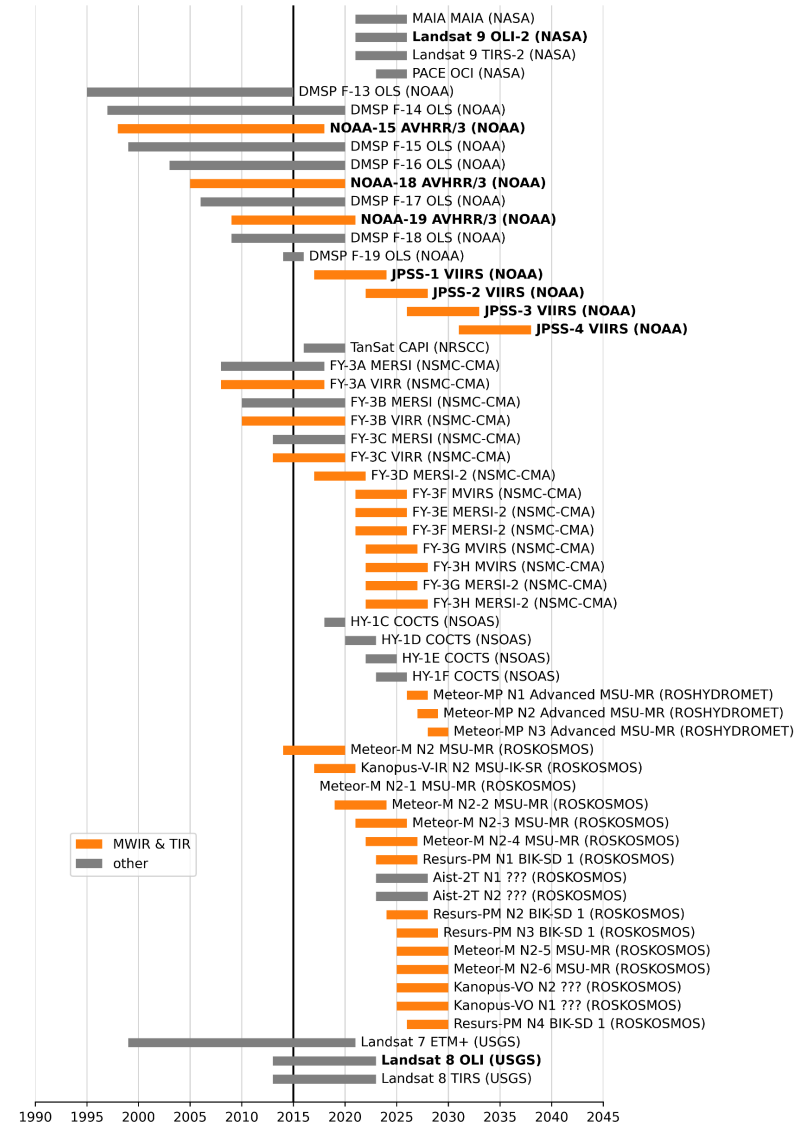
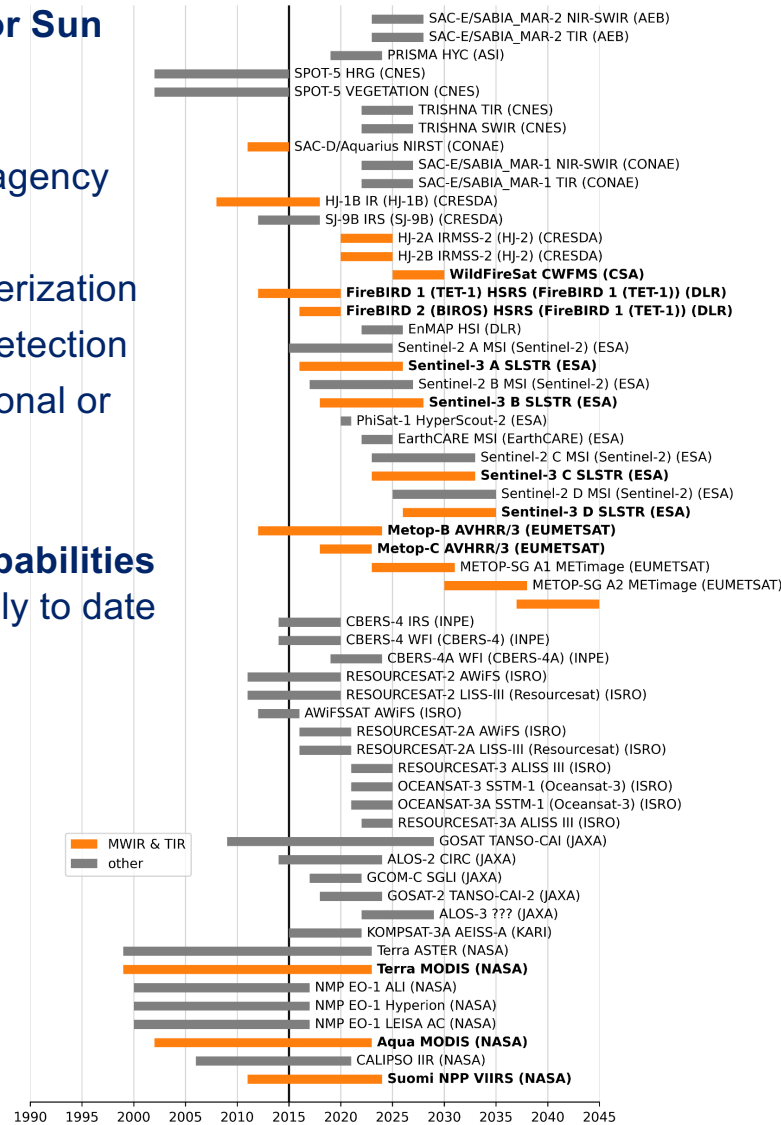
- CEOS database: all historic, current and planned missions for CEOS member space agencies
 - 1970s-2040s
 - >650 missions, ~950 instruments (~450 distinct)
 - Annually updated
- **Liberal** screening of instruments **potentially useful** for fire detection
 - Fire characterisation (FRP, bispectral etc): MWIR & LWIR
 - 'hotspot' mapping: one or more: LWIR, MWIR, NIR, SWIR
- **N=180 unique systems (satellite/instrument combinations)** on orbit between 2015-2045
- Manual cleaning and cross check with e.g. Agency websites, EO Portal, WMO OSCAR database
- **Commercial missions:** important, but **hard to capture** and **questionable data availability. Hard to predict future mission**

The screenshot shows the CEOS Database website. At the top, it features the CEOS and ESA logos, the title 'THE CEOS DATABASE', and a 'Updated for 2022' notice. Below this is a navigation menu with links for Home Database, Agencies, EO Handbook, Missions Activity Table Index, Instruments Table Index, Measurements Overview Timelines, and Datasets Activity. A search bar with 'ENHANCED BY Google' is also present. The main content area is titled 'MISSIONS, INSTRUMENTS, MEASUREMENTS and DATASETS' and contains several sections: 'Agencies' (Agency table with links to agency summary pages), 'Missions' (Activity: View recent satellite launch activity; Table: Searchable mission table with links to mission and instrument summary pages; Index: An alphabetical list with links to mission summary pages), 'Instruments' (Table: Searchable instrument table with links to instrument and mission summary pages; Index: An alphabetical list with links to instrument summary pages), 'Measurements' (Overview: An overview of the measurement categories and detailed measurements indexed in the database; Timelines: Customizable measurement timelines with links to mission summary pages), and 'Datasets' (Activity: Checkout datasets and recent data releases and activity). On the right side, there is a 'Follow us @EOHandbook' section with social media links and a 'CRYO2ICE user update' section with a link to a report.

CEOS MIM database:
<http://database.eohandbook.com/>

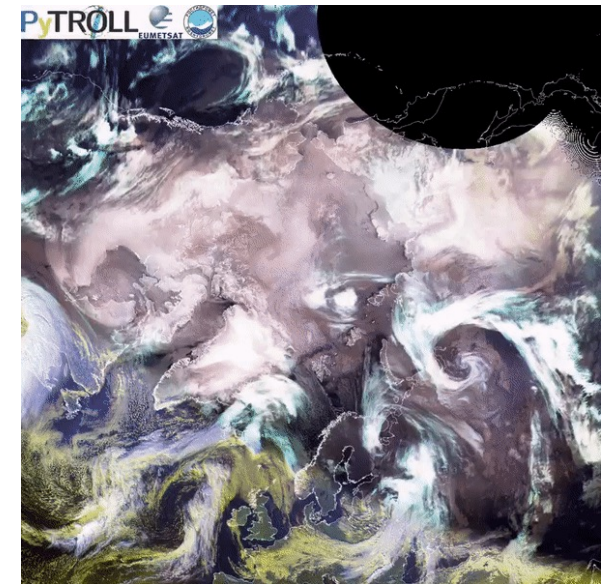
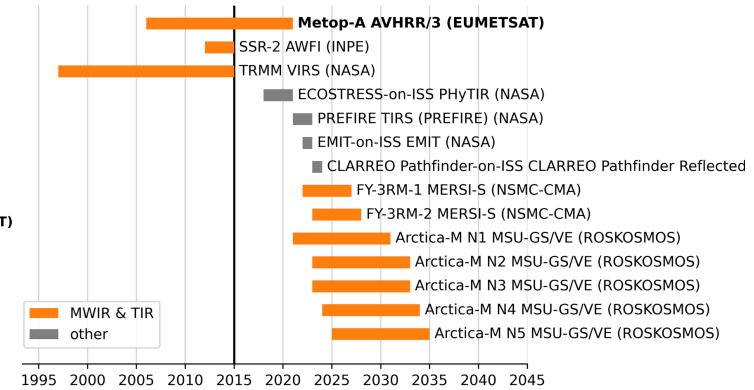
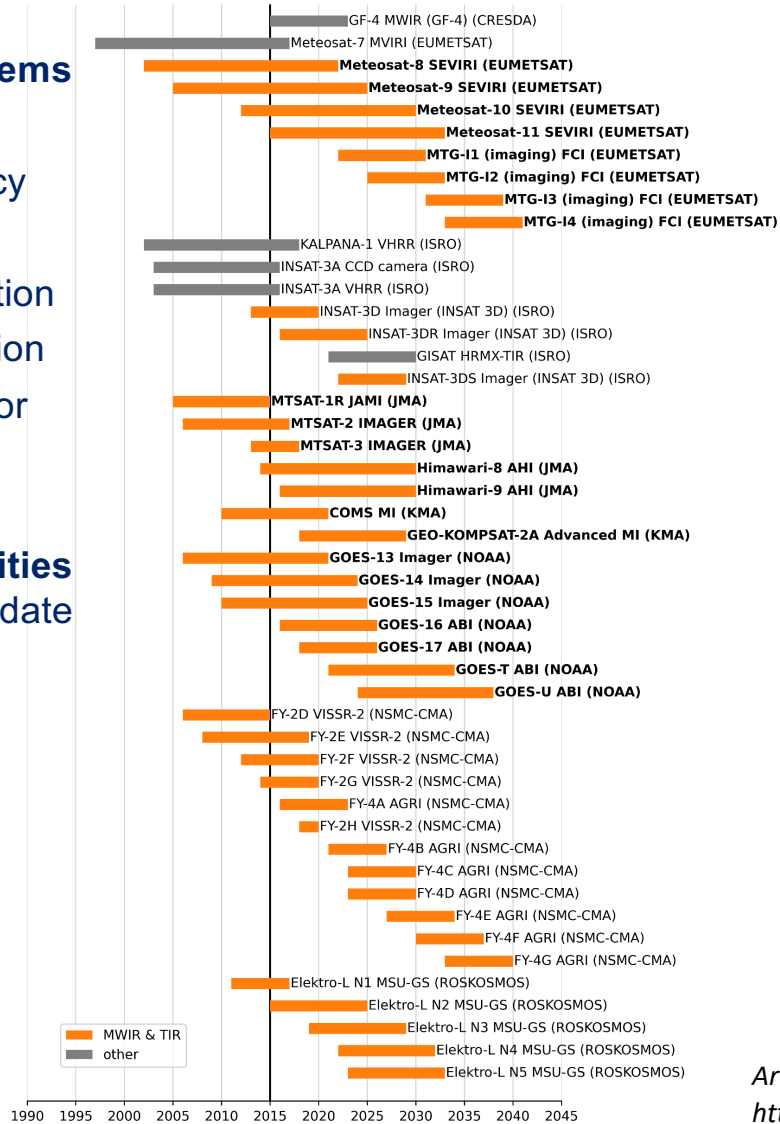
Operational timelines for Sun Synchronous systems

- Listed by lead space agency
- Orange** = fire characterization
- Grey** = fire 'hotspot' detection
- Bold** = known operational or academic use
- many non-US/EU capabilities under exploited globally to date

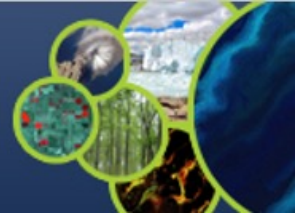


Operational timelines for Geostationary & 'other' systems

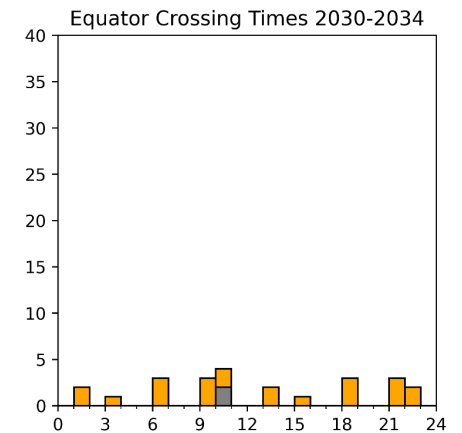
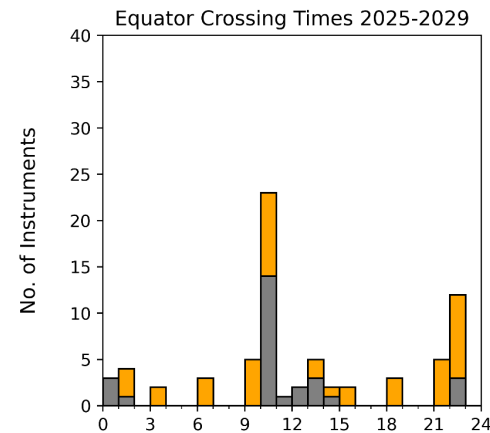
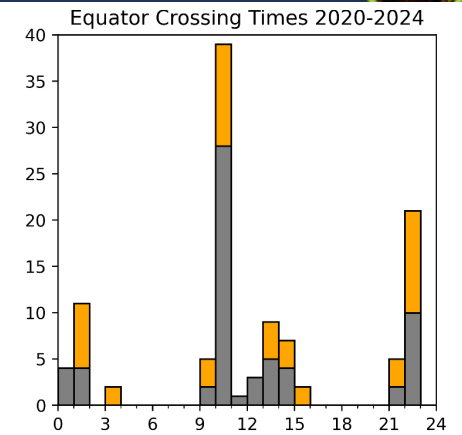
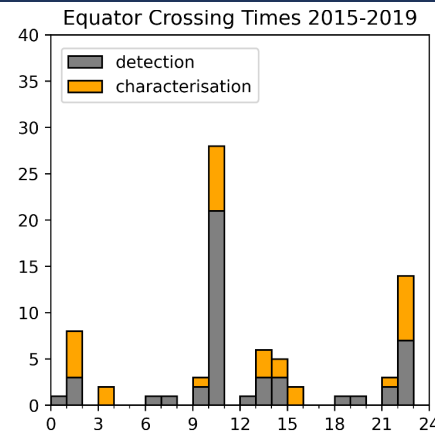
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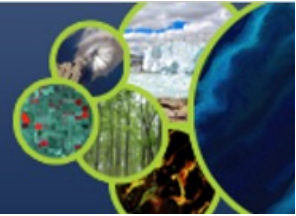


<https://twitter.com/PyTrollOrg/status/1488161544408113160>



- Frequency of different ECTs for all LEO systems, by 5 year time interval
- Good coverage in early afternoon - peak burning in (sub)tropical regions
- Poor coverage in late afternoon – peak burning in temperate to boreal regions
- Few missions planned yet for >2030

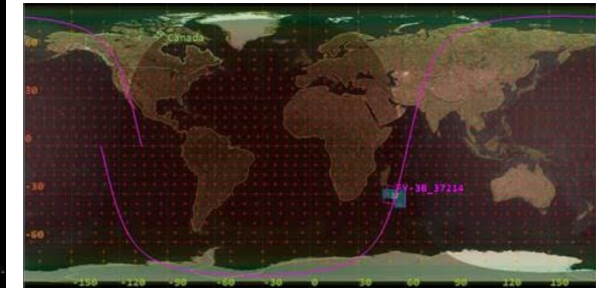
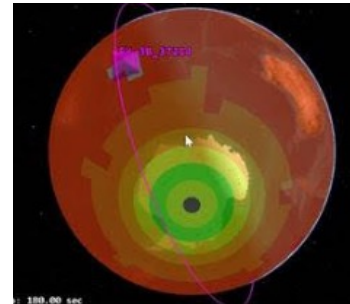




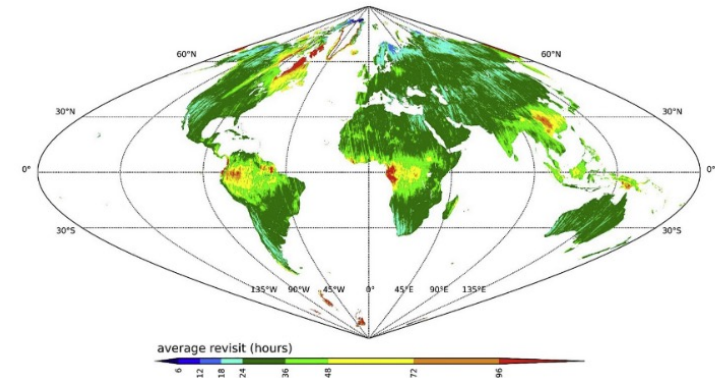
- After manual filtering systems [N=180 -> N=144]:
 - Fire characterization capability [N=87]
 - Fire detection ('Hotspots' only) [N=57]
 - Unlikely suitable [N=36]
- Data availability '*open access*' or '*constrained*' only
- Starting orbit simulation with CSA using Systems Tool Kit
- Will generate global coverage metrics for LEO & GEO by aggregating no. of obs. Per unit time onto a standard grid
- Calculate metrics that reflect fire management needs e.g. minimum revisit time at local hour of peak burn, per global grid cell, on an annual basis between present and ~2040

Questions for CEOS

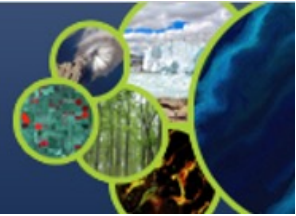
- Other sensible criteria for categorization of instruments/satellites?
- Suggestions for combining coverage information (e.g. GEO &



Initial STK modelling of FY-3B orbital coverage



The average revisit interval (hours) of the PlanetScope-0, -1 and -2 sensors Dec 2019-Nov 2020 (Roy et al. 2021)



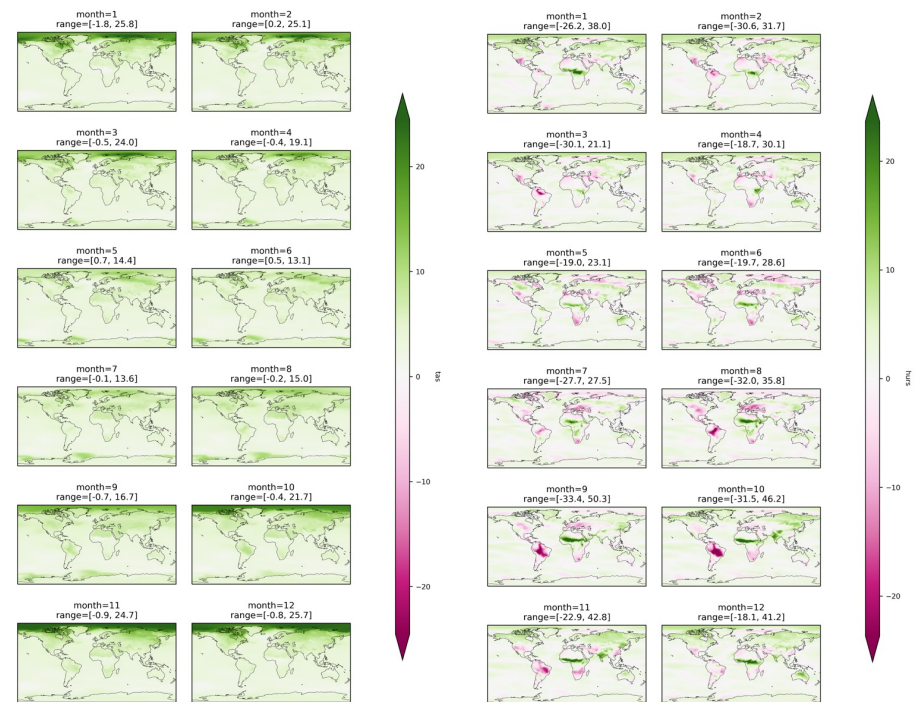
2. How will fire regimes (fire weather) change under future climate change?

Additional contributors: Mike Flannigan, Xianli Wang, Piyush Jain

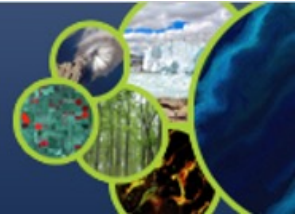
- Ensemble of future fire weather will be used as the indicator of future fire regime changes;

Method:

- delta-change approach with modified precipitation frequency
 - Where $pr \pm > X\%$, adjust pr freq. in addition / instead of magnitude
- Meteorological params \rightarrow FWI using McElhinney et al. (2020) method



Monthly deltas for GCM EC-Earth3-Veg, for SSP5-8.5, 2070-2099 period. Left panel = temperature, right panel = RH



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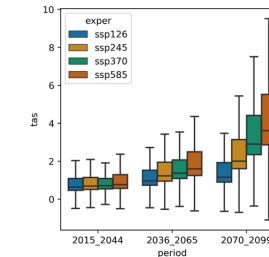
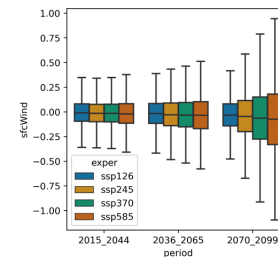
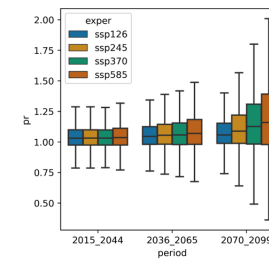
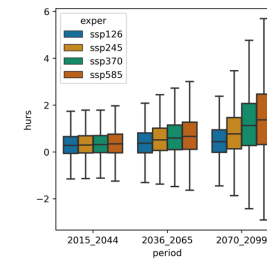
Datasets:

- ERA5 daily reanalysis (1985-2014)
- CMIP6 monthly data for 9 GCMs:
 - historical (1985-2014) & 4 scenarios: SSP1-2.6, SSP2-4.5, SSP3-7.0, SSP5-8.5
- **Alternative dataset to test:** NASA NEX-GDDP-CMIP6 dataset (0.25° , bias corrected)

Contrast *shifts in FWI outputs* in regional fire season over 2015-2045 period to *EO active fire coverage*

CMIP6
GCMs and
their mean
grid cell
resolution

model	group	mean grid res (°)
ACCESS-ESM1-5	CSIRO	1.56
CESM2	NCAR	1.09
CNRM-ESM2-1	CNRM	1.41
EC-Earth3-Veg	EC-Earth	0.70
KACE-1-0-G	NIMS-KMA	1.56
MIROC6	MIROC	1.41
MPI-ESM1-2-LR	MPI-M	1.88
MRI-ESM2-0	MRI	1.13
UKESM1-0-LL	MOHC	1.56

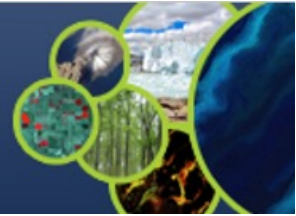


Distributions of all monthly grid cell deltas for GCM EC-Earth3-Veg, by scenario and period.



(Objective 2) “Conduct a detailed analysis of global stakeholders and end-users of near-real-time active-fire EO data”

- Seeking to ensure meaningful input on either use of EO data and products and setting out needs from the fire management perspective
- Implement engagement to ensure that groups not regularly involved can contribute
- The data and information collected will revolve around a core set of questions to source input
- The engagement of stakeholders has been framed up and includes existing groups and consideration of the private sector actors, NGOs and civil society.

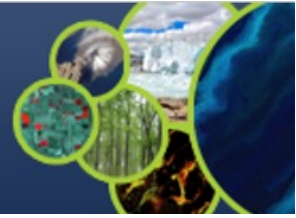


(Objective 2) “Conduct a detailed analysis of global stakeholders and end-users of near-real-time active-fire EO data”

- Outreach to regional networks and partners to identify stakeholders and end-user communities. The potential sources and groups will include:
 - Regional Groups:
 - The Expert Groups on Forest Fires (EGFF) convened by the European Commission (Latin America and the Caribbean & Europe wider than the EU)
 - Association of South East Asian Nations (ASEAN)
 - GOFC-GOLD regional networks
 - Assuring the Future of Forests by Integrated Risk Management (Korea & FAO)
 - FAO country level fire management projects;



Summary



Objective 1

- Initial database of potentially active fire-capable systems compiled
- Database filtered into 'fire characterization' (fire intensity[FRP], subpixel temperature & size) and fire detection ('hotspot') only categories
- Simple timelines and ECT metrics analyzed, now proceeding to do more detailed STK modelling.
- Compiling fire weather data streams under different climate change scenarios (for contrasting against satellite coverage) is on going.

Objective 2

- Identification of stakeholder groups, and surveying them, is currently ongoing
- New staff member joining the team (CFS) who will be helping to share the workload on O2