Evaluating the consistency of different forest disturbance datasets

Laura Häbold[1] and Ana Bastos[1]
Max Planck Institute for Biogeochemistry, Jena

INTRODUCTION

- Understanding the impacts of climate change on forest health and disturbances is crucial to constrain for services forests provide.
- Several datasets on tree mortality and disturbances are available, providing invaluable information. These have different acquisition methods and spatio-temporal scales.
- This study evaluates the consistency of three publicly available tree mortality, loss and disturbance datasets. Comparisons of the reporting time and the disturbance agents for events from 2000 to 2021 were investigated.
- These results are important to assess uncertainty in labels used to train classification algorithms (see Poster EGU23-5651).

Spoiler alert

- An exact overlap is rare;
- There are some similarities, but a clear consistency between the datasets is not detectable.

METHODS

Dataset	Datatype	Data basis	Time period
Hammond et al. (2020) Mortality	Point data, based on literature	1303 plots from literature review collection	1970 to 2018
Hansen et al. (2013) Tree loss	Raster data, based on satellite data	Landsat 7 and Landsat 8 OLI images	2001 to 2021
USDA Forest Service Forest disturbances	Shapefiles, from aerial acquisition	surveys (aerial and ground)	1997 to 2021

- All data include detection years, sometimes additional features and attributes per event (e.g. causing agents, damage type, host)
- Datasets were preprocessed, spatially overlayed and compared with each other in terms of the survey/ mortality year and the lag between the detection years
- If possible, the disturbance causing agents (DCA) and the damage type were examined
- A global comparison was only possible for Hansen et al. (2013) and Hammond et al. (2020), the other analyses focused on the USA

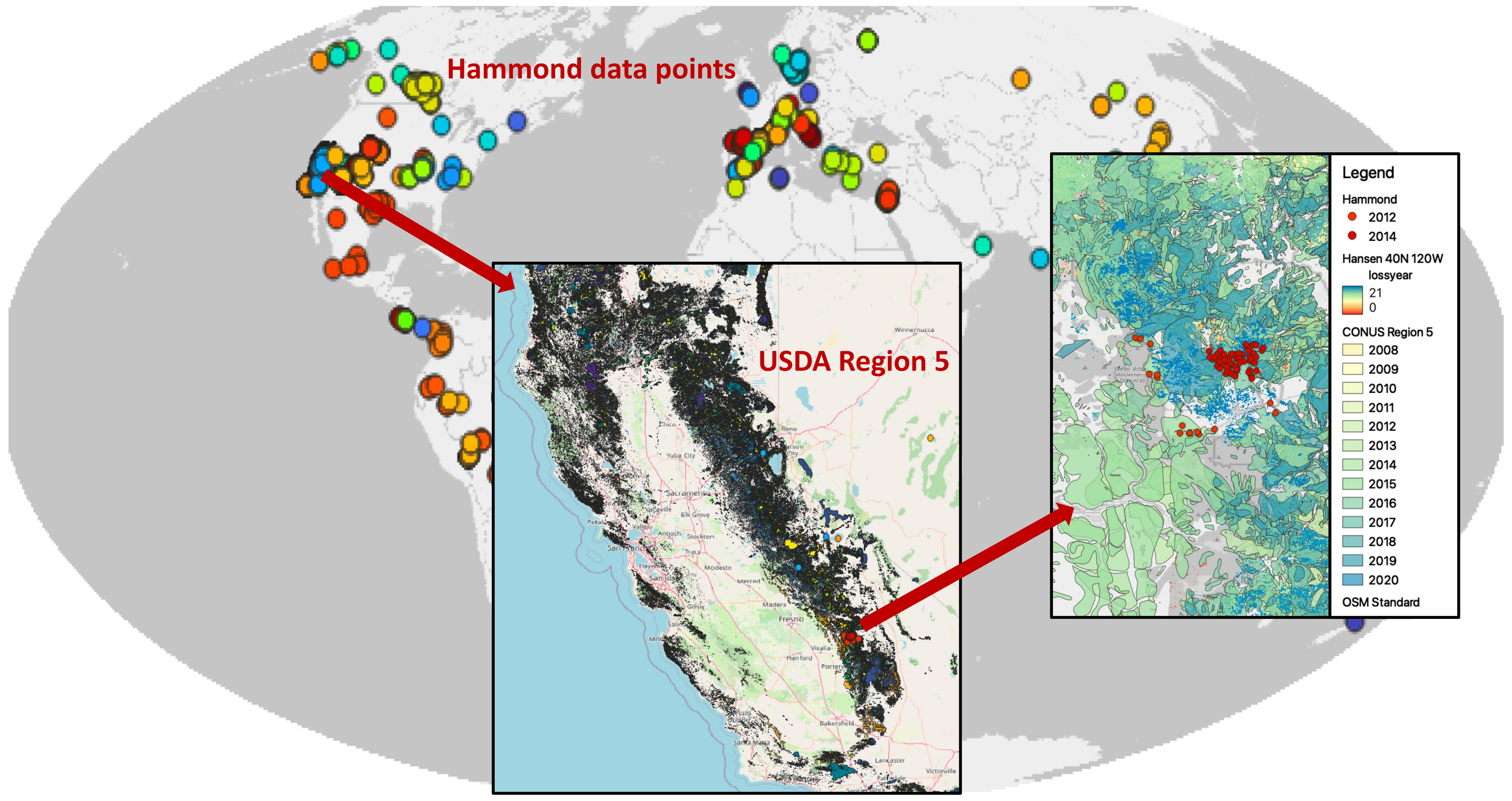

Fig. 1: Map with Hammond et al. (2020) data points, example of USDA Forest Service Region 5 polygons and a Hansen et al. (2013) raster tile.

COMPARISONS of SURVEY YEARS and DISTURBING AGENTS

Hammond and Hansen

Comparison of tree mortality detection year – Fig. 2 shows the number of lag years globally:

- **Negative** values indicate an **earlier** detection of **Hansen** compared to Hammond, **positive** values imply **Hansen** reported tree mortality **later** than Hammond;
- The maximum difference in mortality detection of Hansen was 15 years before and 19 years after Hammond;
- Very low number of events detected in the same year is and the majority of events classified as tree loss by Hansen was reported later than tree mortality by Hammond.

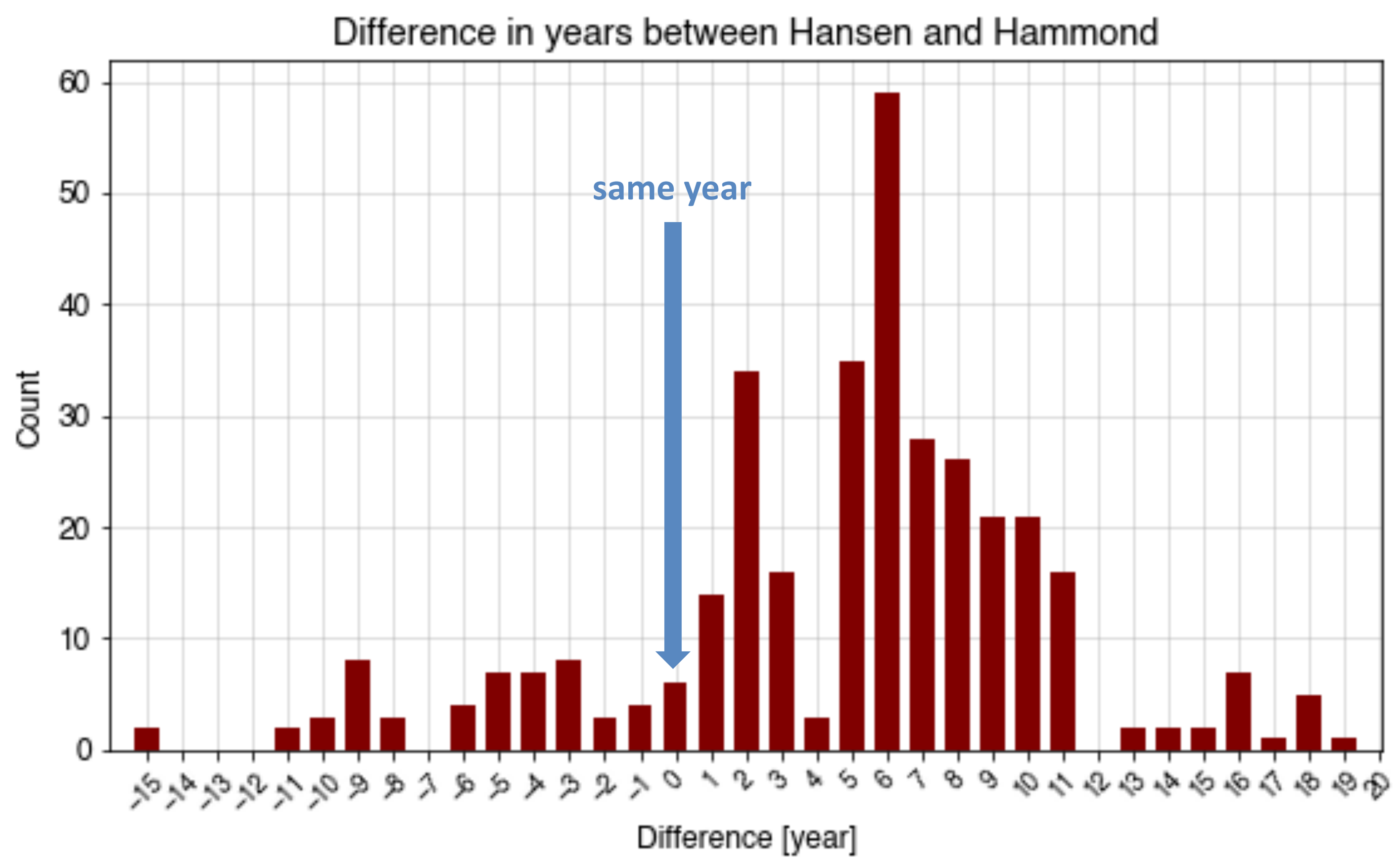

Fig. 2: Difference of detection years between Hammond et al. (2020) and Hansen et al. (2013) globally.

TAKE HOME MESSAGE

- Rare consistency between Hansen and Hammond
- Satellite images detect tree mortality later than ground based data

Hammond and USDA

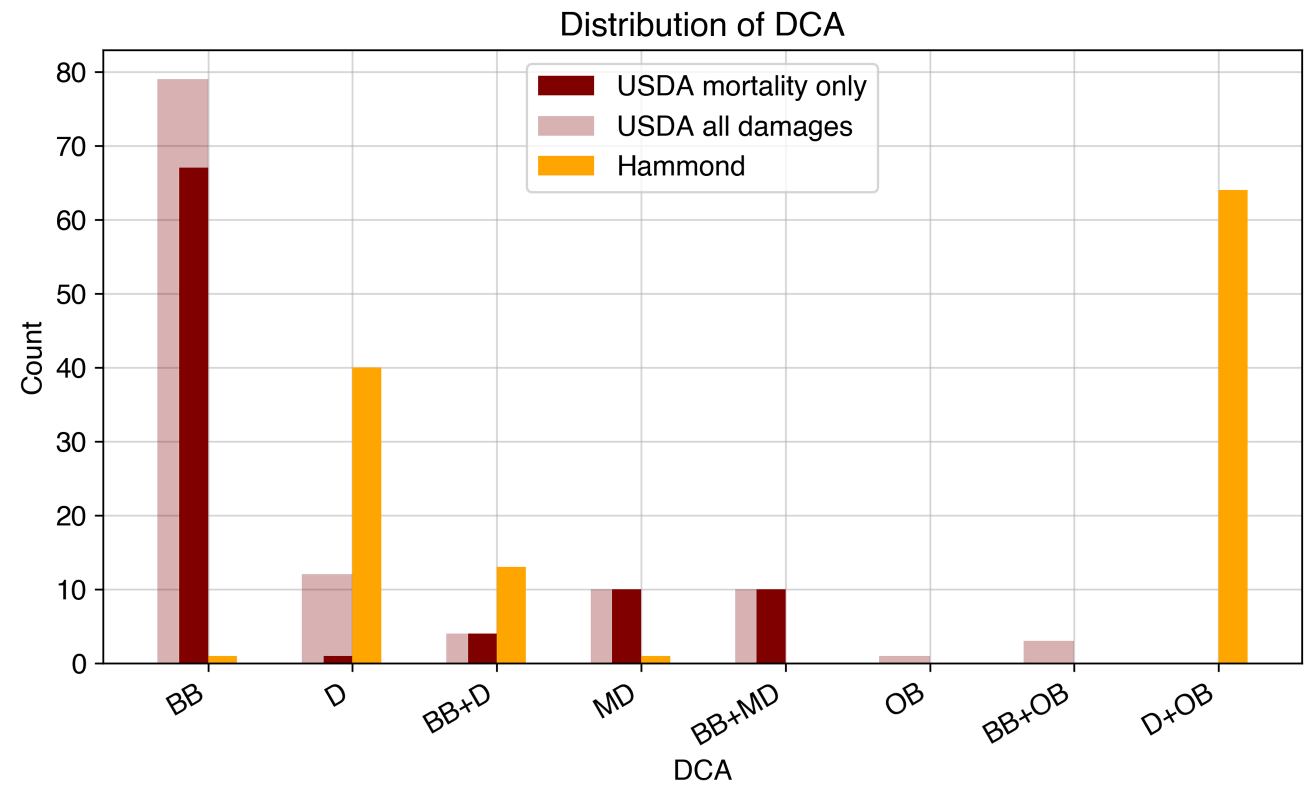

Fig. 3: Number of reported disturbing agents of Hammond et al. (2020) (orange) and USDA (red), whereas events with all damage types are more transparent and mortality only events are dark red. (BB: bark beetle; D: drought; MD: multi damage; OB: other biotic)

Comparison of multiple features, such as disturbing agents (DCA), shown in Fig. 3:

- USDA results were separated in two classes: all damages and mortality only, to compare more easily with Hammond et al. (2020), reporting only tree mortality events;
- Bark beetles are the superior DCA's in the USDA data for all damages and mortality only events, followed by drought and multi damage events;
- Drought and other biotic are the main DCA's in Hammond;
- Poor consistency of the dominant DCA's, however, other biotic can include bark beetles, wherefor the detection of disturbing agents might be similar;
- **Drought events in the USDA data mostly were not associated with mortality.**

TAKE HOME MESSAGE

- Dominant disturbing agents differ, as well as damage effect of drought
- Inconclusive result for other biotic

Hansen and USDA

Comparison of the area overlay and detection years for the USDA regions 1 to 6 and Hansen:

- Fig. 5 shows an excerpt of the result of the percentage of overlaying areas and the lag years;
- **Positive** values: **USDA** detected tree damage **earlier** than Hammond, **negative** values: **USDA** detected **after** Hansen;
- Region 1, 3 and 5 have the highest proportion of overlapping areas;
- In region 2, tree damage was mostly detected in the same year, high proportion also found for region 3 and 5;
- A high portion of areas show difference of 17 to 19, which is not shown in the figure, since these events might not be connected.

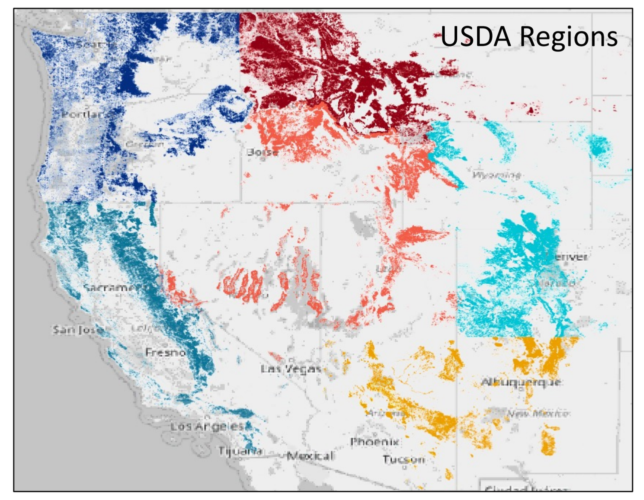

Fig. 4: USDA Regions 1 to 6, colors coded as in Fig. 5.

Fig. 5: Difference in detection years and their percentage of area overlay between USDA Region 1 to 6 and Hansen et al. (2013).

TAKE HOME MESSAGE

- Some areas show same year detection in Region 2, 3 and 5
- Overall low consistency, majority of USDA at least 4 years earlier than Hansen

Contact:
lhaebold@bgc-jena.mpg.de
Master student at University Leipzig

Affiliations:
1 Max Planck Institute for Biogeochemistry, Department of Biogeochemical Integration

ForExD – Forest vulnerability to compound extremes and disturbances in a changing climate

This project is funded by the European Union (ERC StG, ForExD, grant agreement No. 101039567). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Council. Neither the European Union nor the granting authority can be held responsible for them.

References:
Hammond, W. M., et al. (2022). Global field observations of tree die-off reveal hotter-drought fingerprint for Earth's forests. *Nature Communications*, *13*(1), 1761.
Hansen, M. C., et al. (2013). High-resolution global maps of 21st-century forest cover change. *science*, *342*(6160), 850-853.
USDA Forest Service (2018). Insect & Disease Survey Maps and Data. USDA Forest Service. https://data.nal.usda.gov/dataset/insect-disease-survey-maps-and-data.