# TeleViT: Teleconnection-driven Transformers Improve Subseasonal to Seasonal Wildfire Forecasting

AI + HADR

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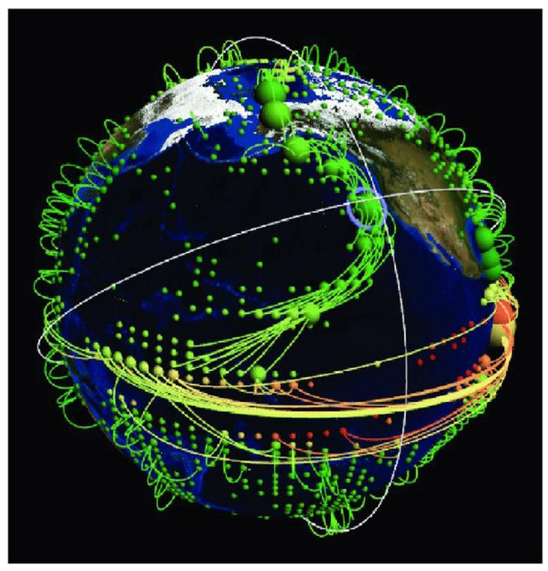
## Motivation

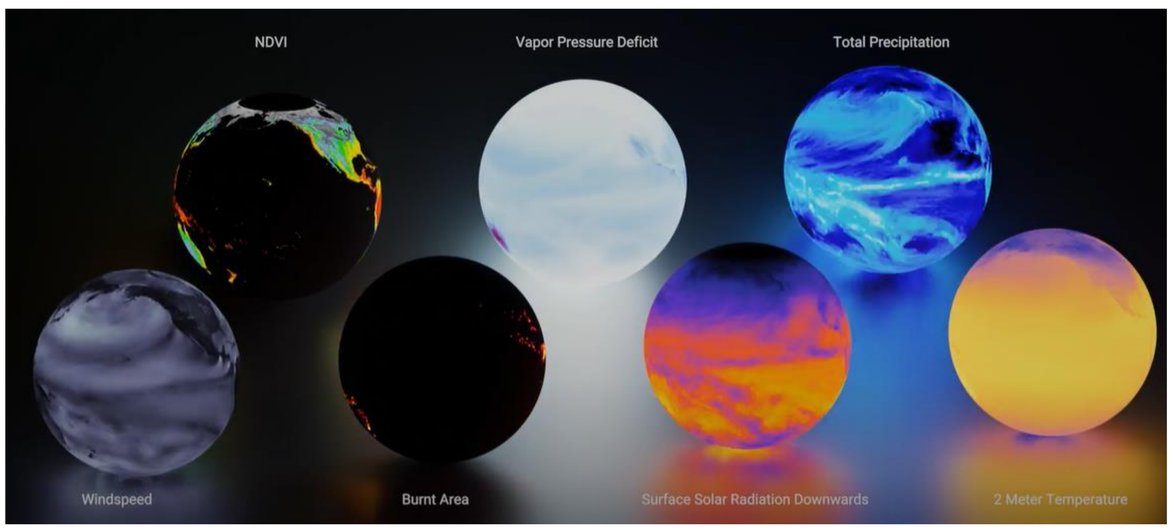
- **Warming climate:** Aggravates fire weather, increasing the *likelihood of extreme wildfires*
- **Subseasonal to Seasonal:** Important to forecast fire weeks to months in advance to improve management + HADR
- **Long-term modeling:** *Teleconnections*, i.e. large scale spatiotemporal interactions, modulate global wildfires [1, 2].

**Figure 1:** Spatiotemporal interactions in the Earth system [3]



## SeasFire DataCube

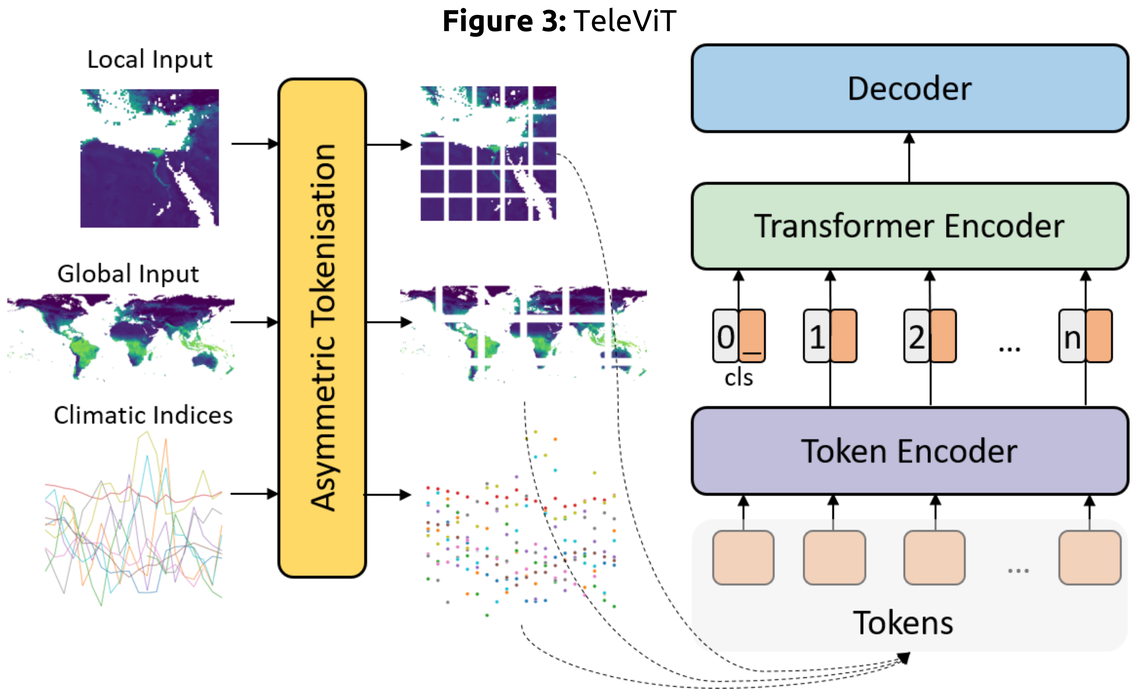
**Figure 2**: Snapshot of variables in the globe. Credits MPI-BGC DataVis.




- An **open-access datacube [4]** for modeling of global wildfires and their impacts.
- Variables containing **burnt areas,** and **fire drivers** such as the **meteorology, vegetation, land cover, population density and oceanic indices**.
- Spatiotemporal grid **0.25° x 0.25 ° x 8-days, (2001 to 2021)**

## TeleViT Architecture

**Figure 3:** TeleViT




TeleViT *combines i)* ***local input****, ii)* ***coarsened global input*** *and iii)* ***time-series of climatic indices***, tokenising each input independently. ***Allows intra/inter-modal interactions.***

## Results

**Figure 4:** Comparison of models for various forecasting windows

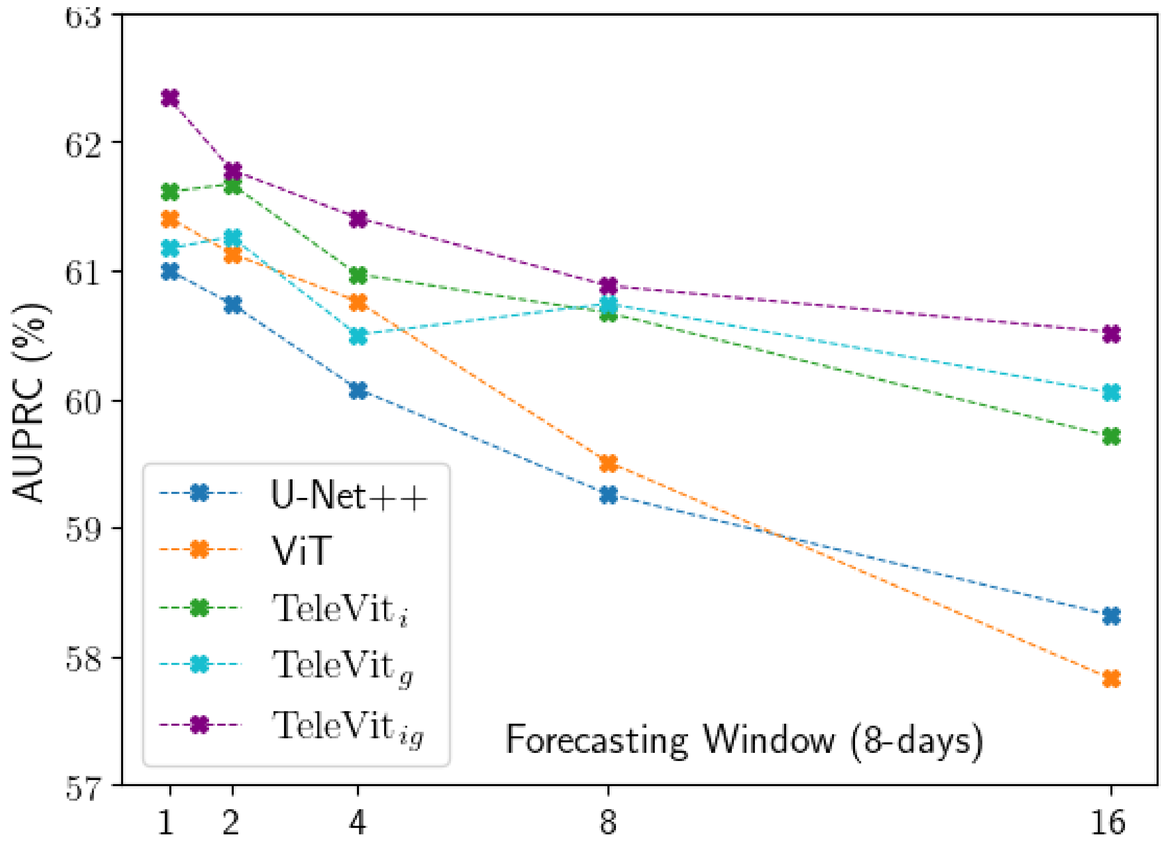
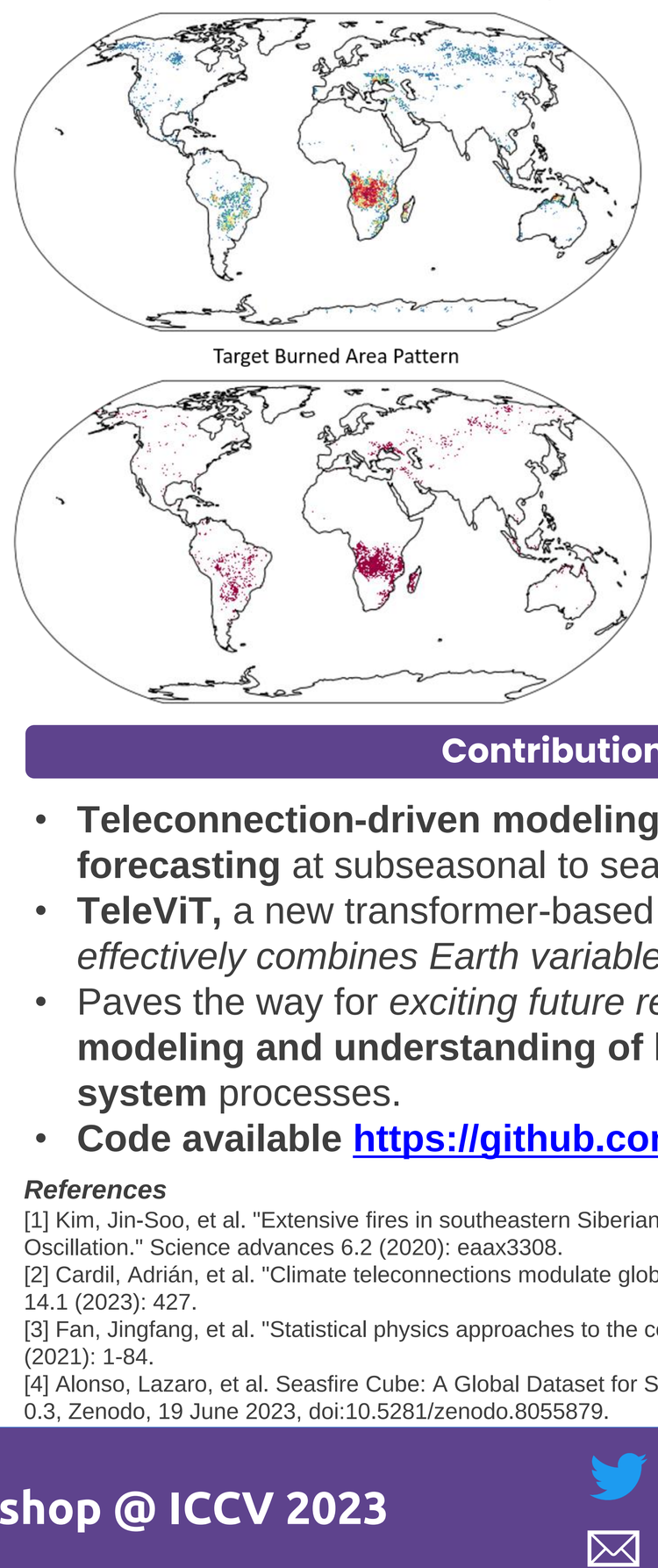



**Figure 5:** Sample prediction versus target




- **Long-term skill improved:** Better performance from TeleViT models, especially for prediction horizon larger than 2 months
- **Input synergy:** Global input and climate indices offer complementary improvement
- **Global forecasts:** Forecasted burned area patterns match very well the target patterns

## Contribution

- **Teleconnection-driven modeling improves long-term forecasting** at subseasonal to seasonal scales
- **TeleViT,** a new transformer-based architecture that *effectively combines Earth variables of different modalities*
- Paves the way for *exciting future research* to **improve the modeling and understanding of large-scale Earth system** processes.
- **Code available https://github.com/Orion-AI-Lab/televit**

***References***

[1] Kim, Jin-Soo, et al. "Extensive fires in southeastern Siberian permafrost linked to preceding Arctic Oscillation." Science advances 6.2 (2020): eaax3308.

[2] Cardil, Adrián, et al. "Climate teleconnections modulate global burned area." Nature Communications 14.1 (2023): 427.

[3] Fan, Jingfang, et al. "Statistical physics approaches to the complex Earth system." Physics reports 896 (2021): 1-84.

[4] Alonso, Lazaro, et al. Seasfire Cube: A Global Dataset for Seasonal Fire Modeling in the Earth System. 0.3, Zenodo, 19 June 2023, doi:10.5281/zenodo.8055879.

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