Observation-based Ionization Rates during the Decade of IBEX Observations (D2828; EGU2020-6167)

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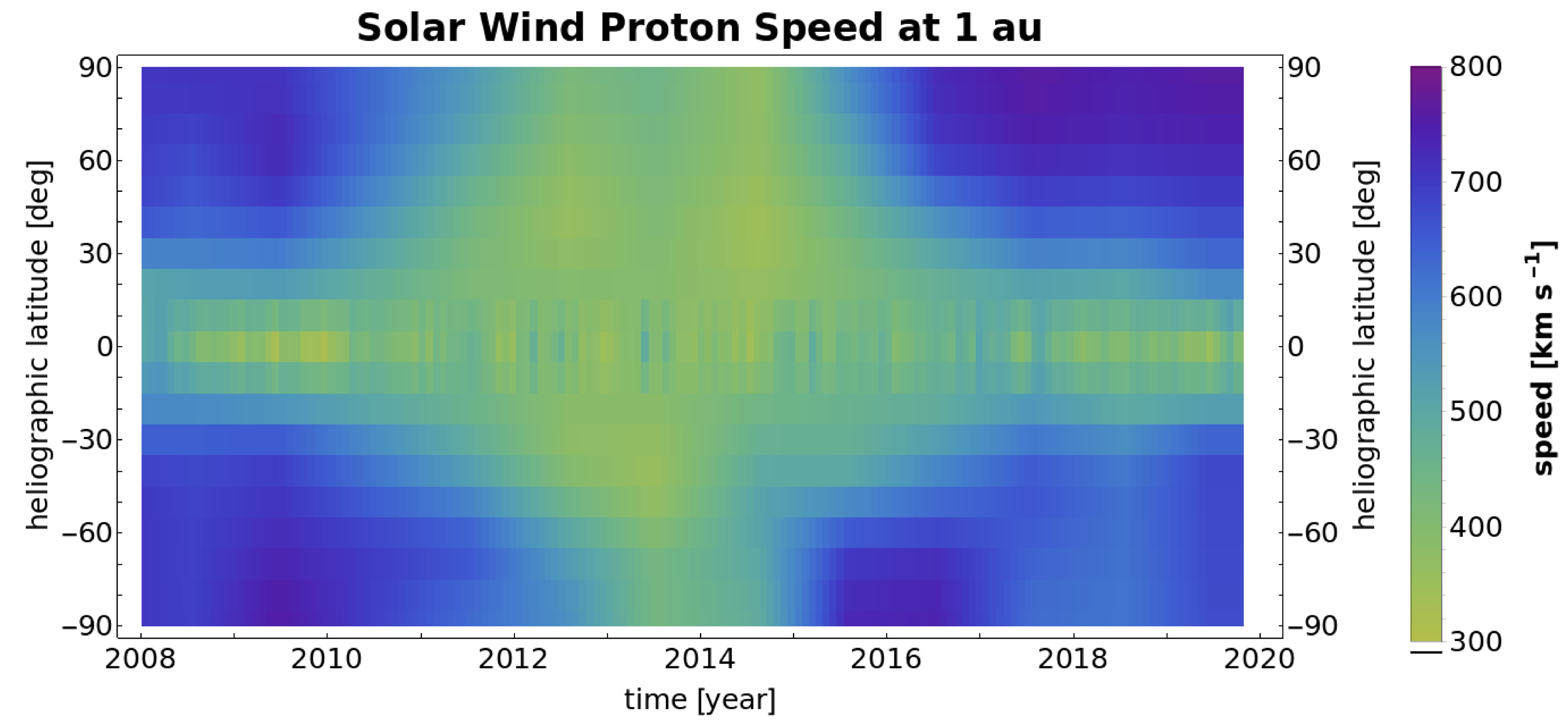
Abstract

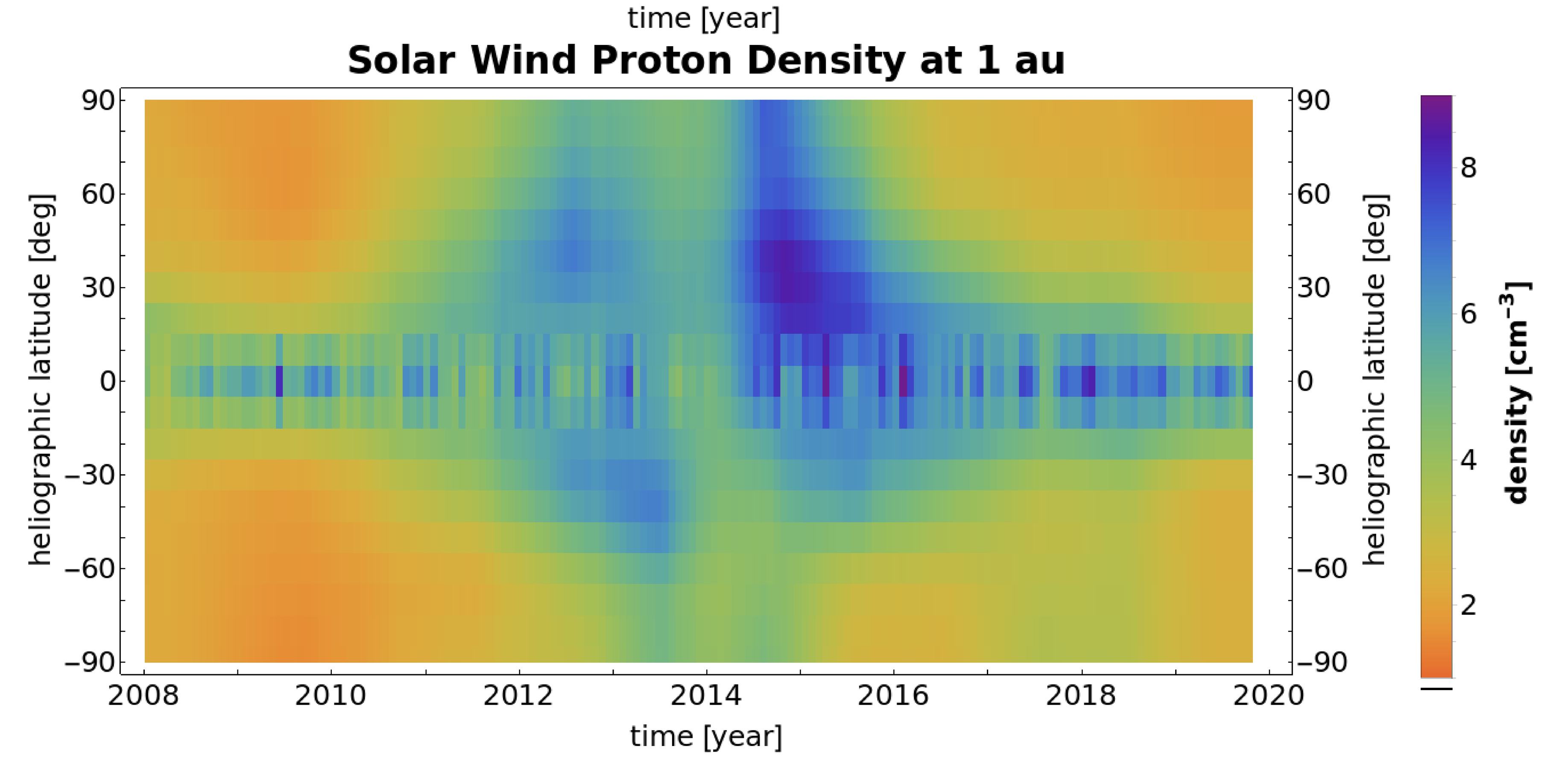
The Interstellar Boundary Explorer (***IBEX***, McComas et al. 2008) operates at ~1 au from the end of 2008. It measures the interstellar neutral (**ISN**) gas entering the heliosphere from the very local interstellar medium (*IBEX-Lo*) and products of interaction of the solar medium with the interstellar medium, energetic neutral atoms (**ENA**) of hydrogen (*IBEX-Hi*). Both ISN and H ENAs are modulated by solar environment on their ways through the heliosphere before detection. Ionization by interaction with **solar wind** and **solar EUV** flux is one of the main factors responsible for the modulation. The dominant ionization reactions are charge exchange with solar wind protons and photoionization (e.g., Sokół et al. 2019).

During solar cycle 24, *IBEX* measured ISN gas of **H, He, Ne,** and **O**, as well as the **H ENAs**. Most of the ISN gas species observed by *IBEX-Lo* are prone to variations in time of the in-ecliptic ionization rates. In the case of H ENAs, variations of the solar wind out-of-ecliptic are significant for data interpretation.

We estimate the ionization rates for IBEX measurements based on available observations of the solar wind and the solar EUV flux following methodology discussed by Sokół et al. 2020, with data revision according to recent data releases. Correction for ionization losses inside the heliosphere during solar cycle 24 is applied, e.g., to scientific interpretation of the full-sky maps of H ENAs observed by *IBEX*, as discussed by McComas et al. 2020.

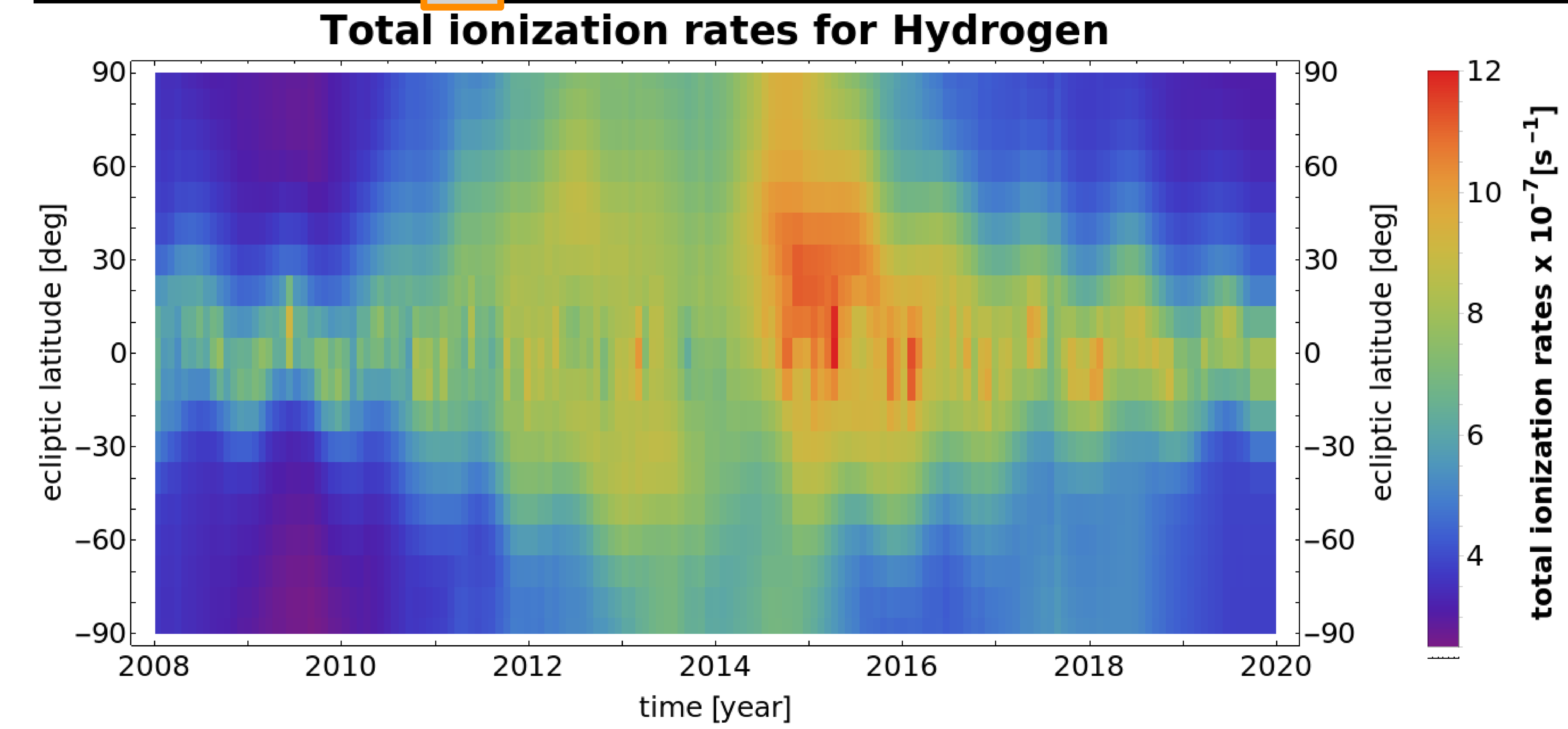
A. Solar Wind Structure at 1 au

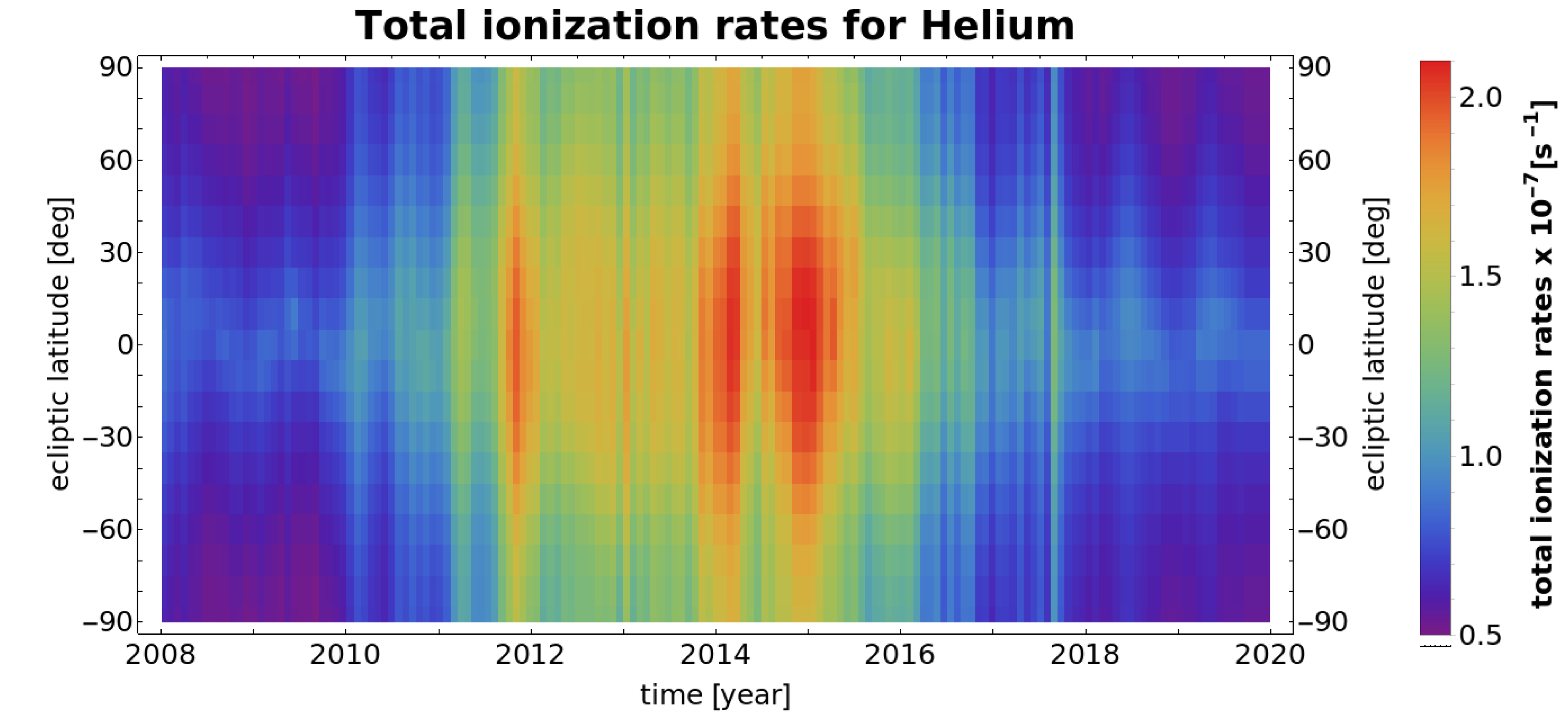




- During the first year of IBEX observations (2009), the solar wind was fast in the high latitudes and with parameters typical for the solar minimum. From 2013 to 2015, the solar wind speed and density were more or less similar in all latitudes as during the solar maximum. In the last years, when solar activity decreased, the solar wind again resembles the solar minimum structure.

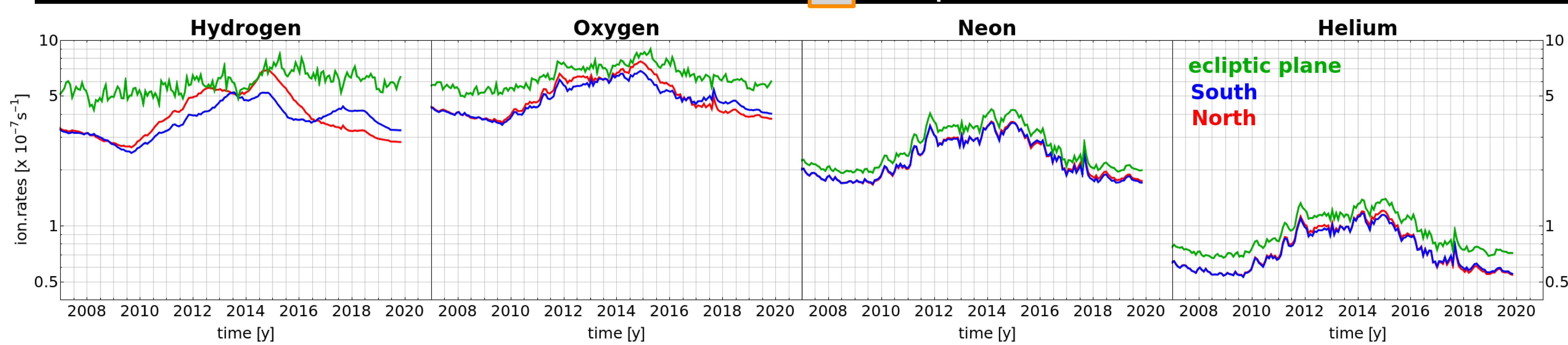
B. Total Ionization Rates at 1 au





- The total ionization rates (sum of charge exchange, photoionization, and electron impact ionization) reflect the solar wind structure variations for H.
- In the case of He, the total ionization rates follow the photoionization rate variations in time. See Sokół et al. 2019, 2020 for more details.

C. In-ecliptic vs Polar Ionization Rates



- In solar cycle 24, at 1 au, the highest ionization rates were for H and O and the lowest for Ne and He. The ionization rates are in general higher in the ecliptic plane and, depending on species and the dominant ionization process, they vary or don't with the cycle of solar activity.

References

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Sokół et al. 2020, *Sun-Heliosphere Observation-based Ionization Rates Model*, arXiv:2003.09292

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