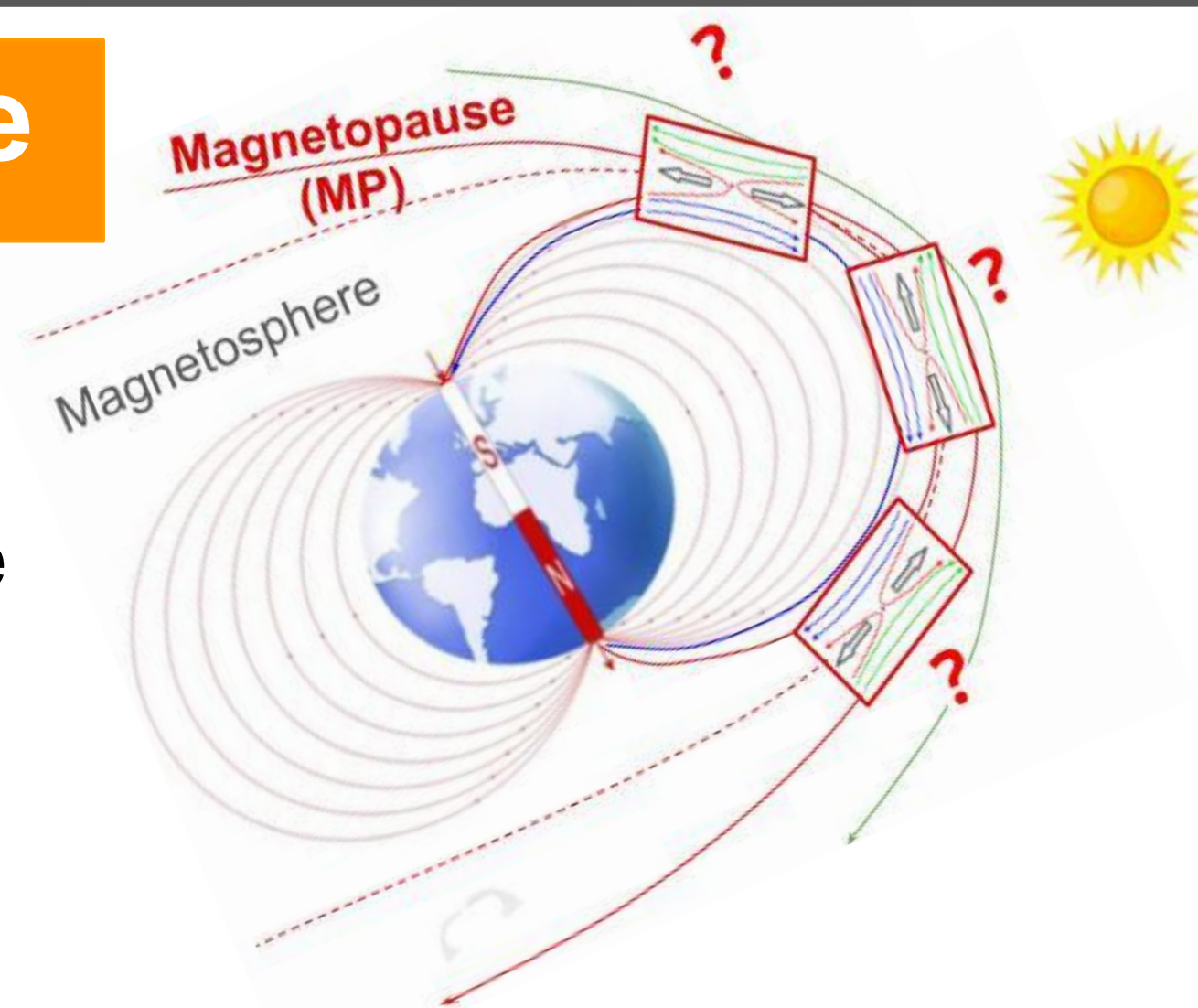


Machine Learning identification of magnetopause Boundary Layer signatures to constrain the location of the global reconnection line

Ambre Ghisalberti, Nicolas Aunai, Benoît Lavraud, Bayane Michotte de Welle, Alexis Jeandet

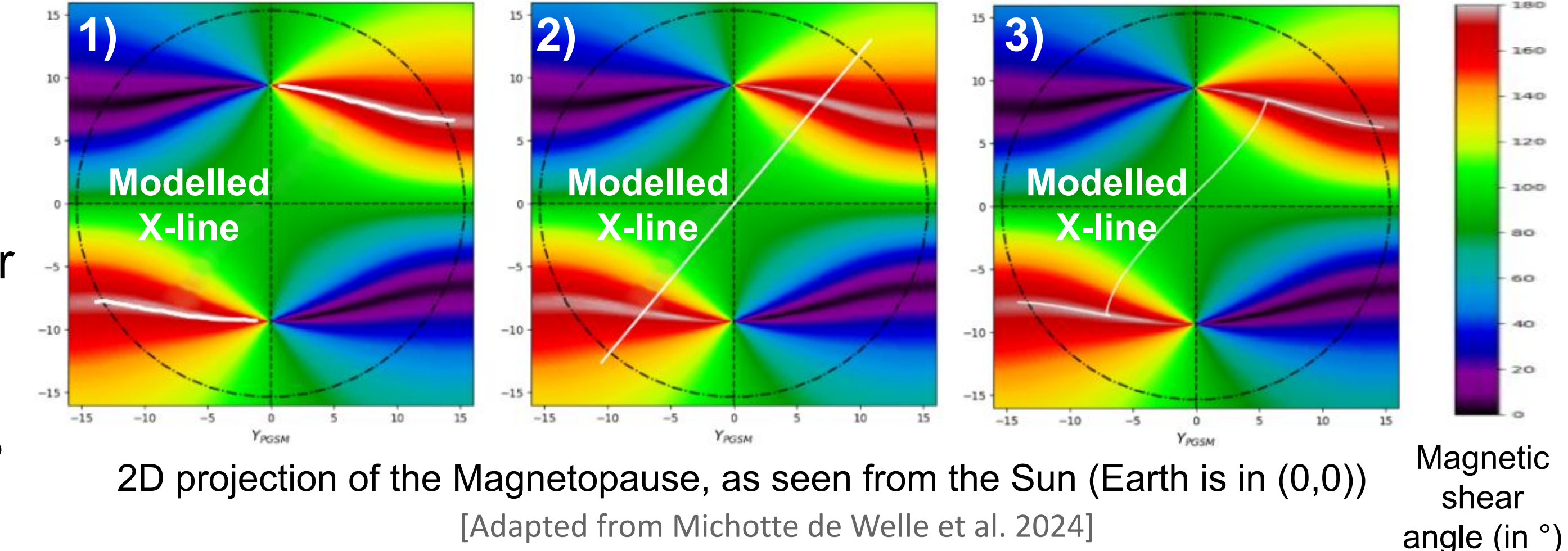
1 - Magnetic reconnection at the magnetopause

- **Magnetic reconnection** : converts magnetic into thermal and kinetic energies
- Transfers matter, momentum, energy from solar wind to magnetosphere
- Signature : accelerated jets in the **boundary layer (BL)** between magnetosphere and magnetosheath
- Its **position** determines the dynamics of magnetosphere.



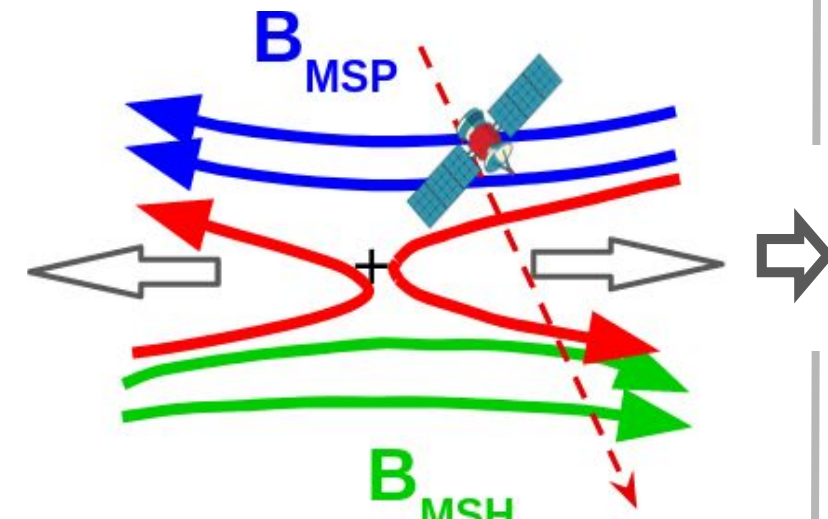
2 - Where is the X-line?

- 1) **Anti-parallel** model?
- 2) **Tilted X-line** going through the subsolar point which orientation depends on the interplanetary magnetic field direction ?
- 3) Along the **Maximum Magnetic Shear** ?



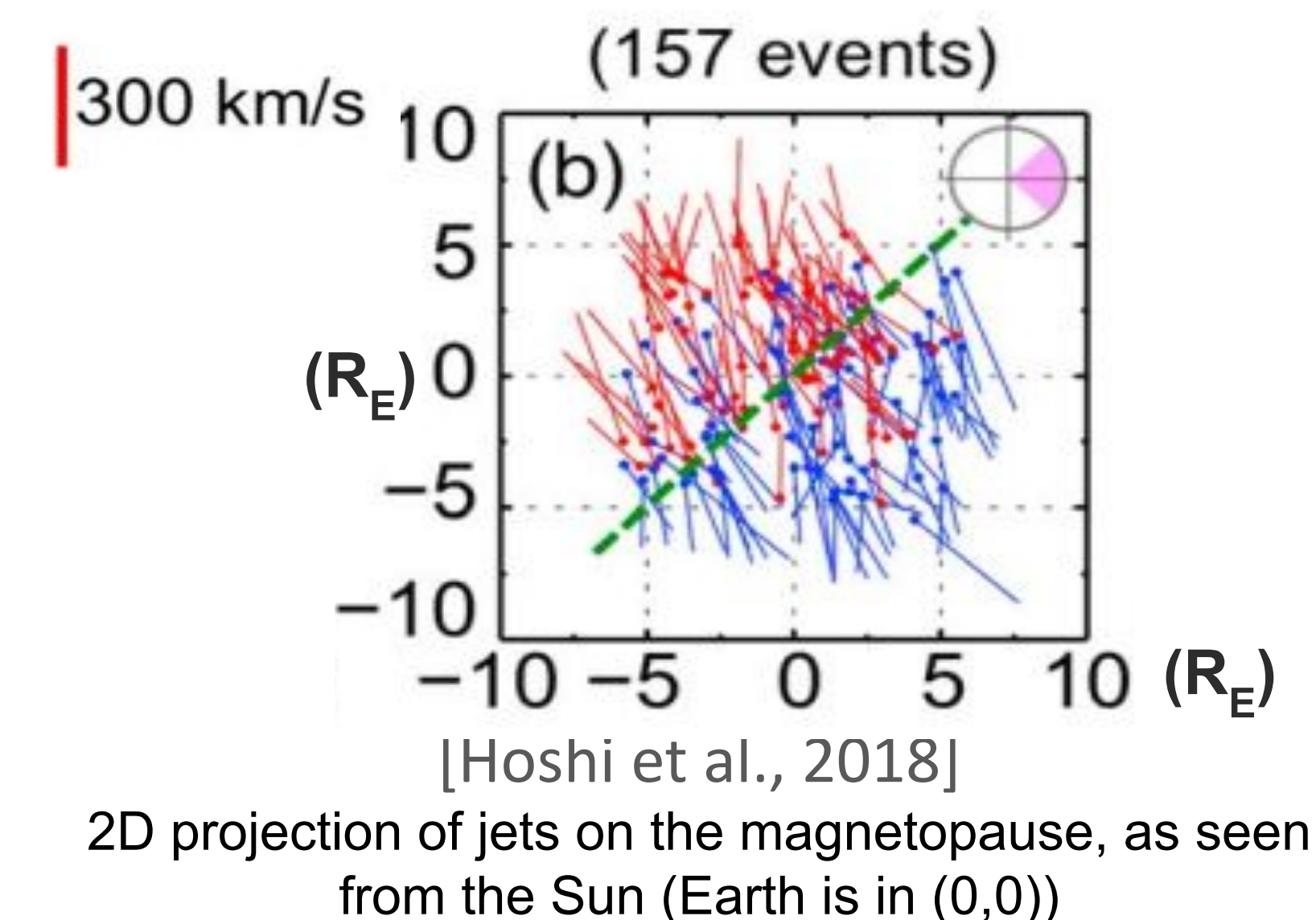
3 - Constraining the X-line with in-situ satellite data

Extraction of ion jets in the boundary layer



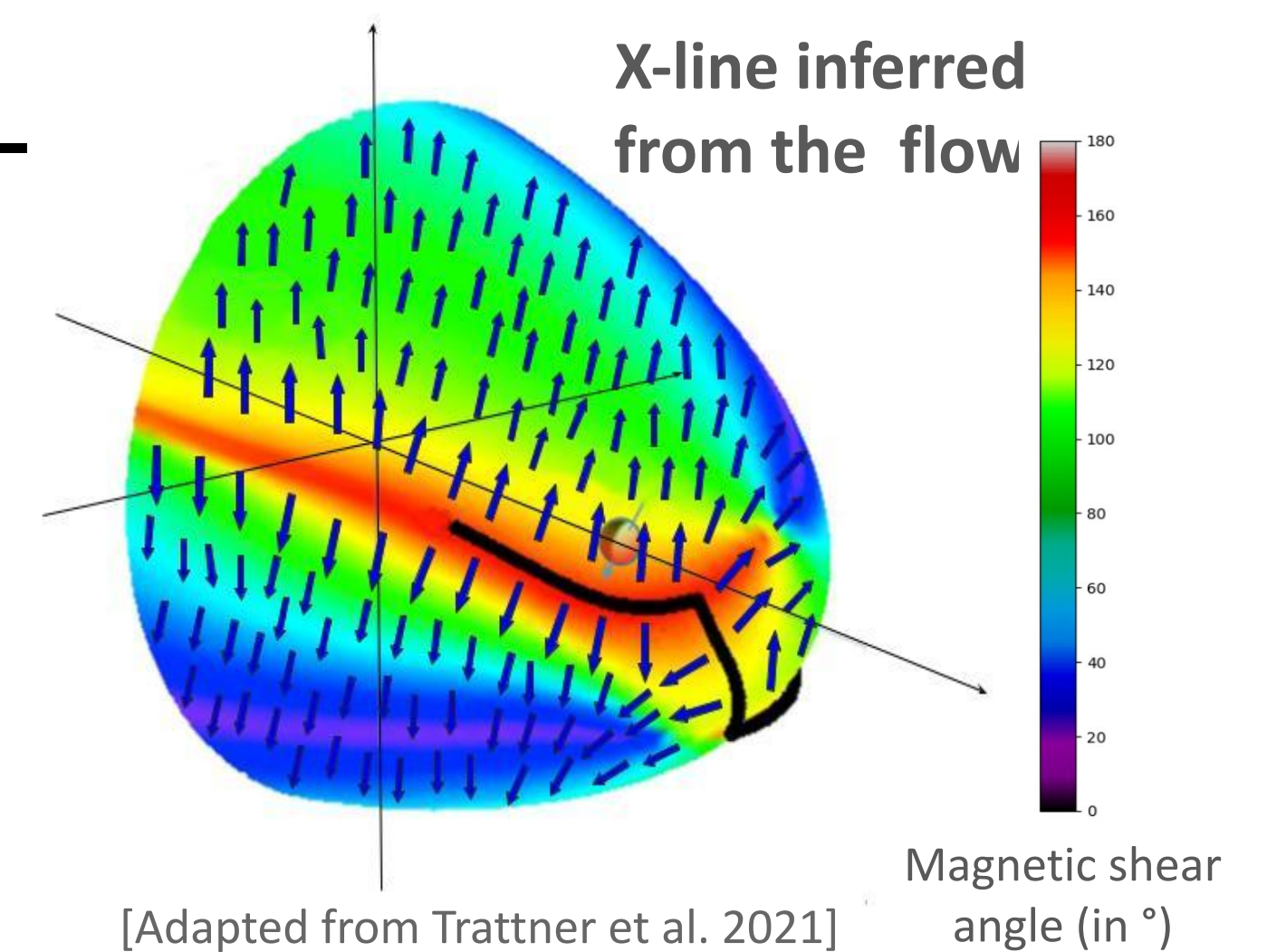
Statistical studies of reconnection position: Hoshi et al. (2018), Trenchi et al. (2008)

- Red jets towards the North and blue jets towards the South constrain the X-line position
- Modelled X-line in green
- Number of jets limiting precision of studies



Precise reconstruction of the ion flow in the BL

- Generalization of Hoshi et al. (2018) : all BL instead of jets, removes a selection bias
- Precise maps require **massive datasets** build with automatic detection of BL allowed by **machine learning**



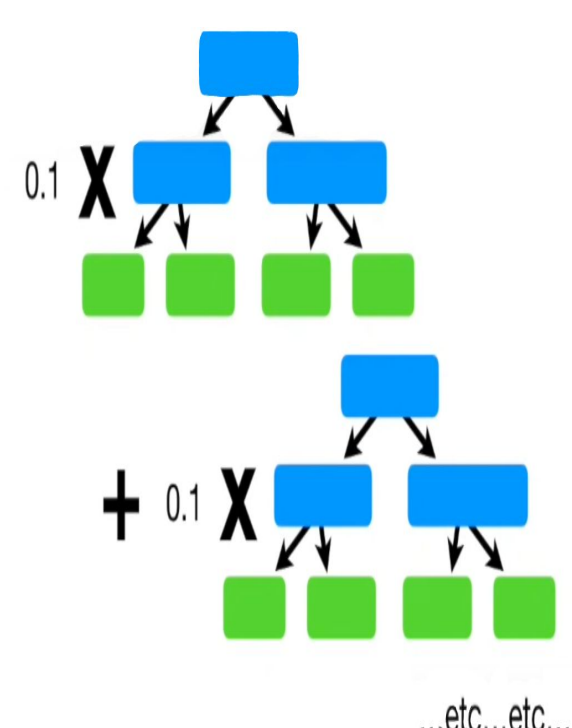
4 - How? Detection of the BL with a machine learning algorithm

BL labelled with **SciQLop** [Jeandet et al. (2023)] : 182 days labelled between 09/2015 and 05/2021

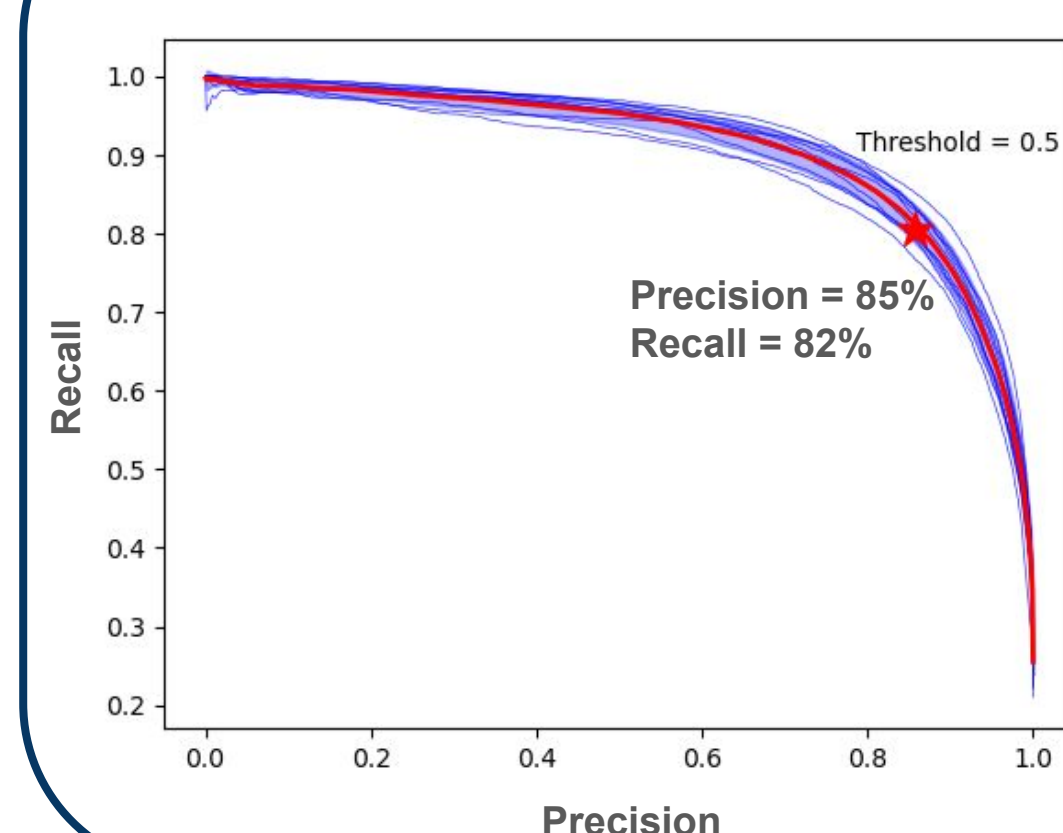
INPUTS: Spectrograph channels & cold ions + Magnetic field (FGM) + Ion moments : speed, N_p , T_p + Neighbour magnetosheath ion moments

GRADIENT BOOSTING

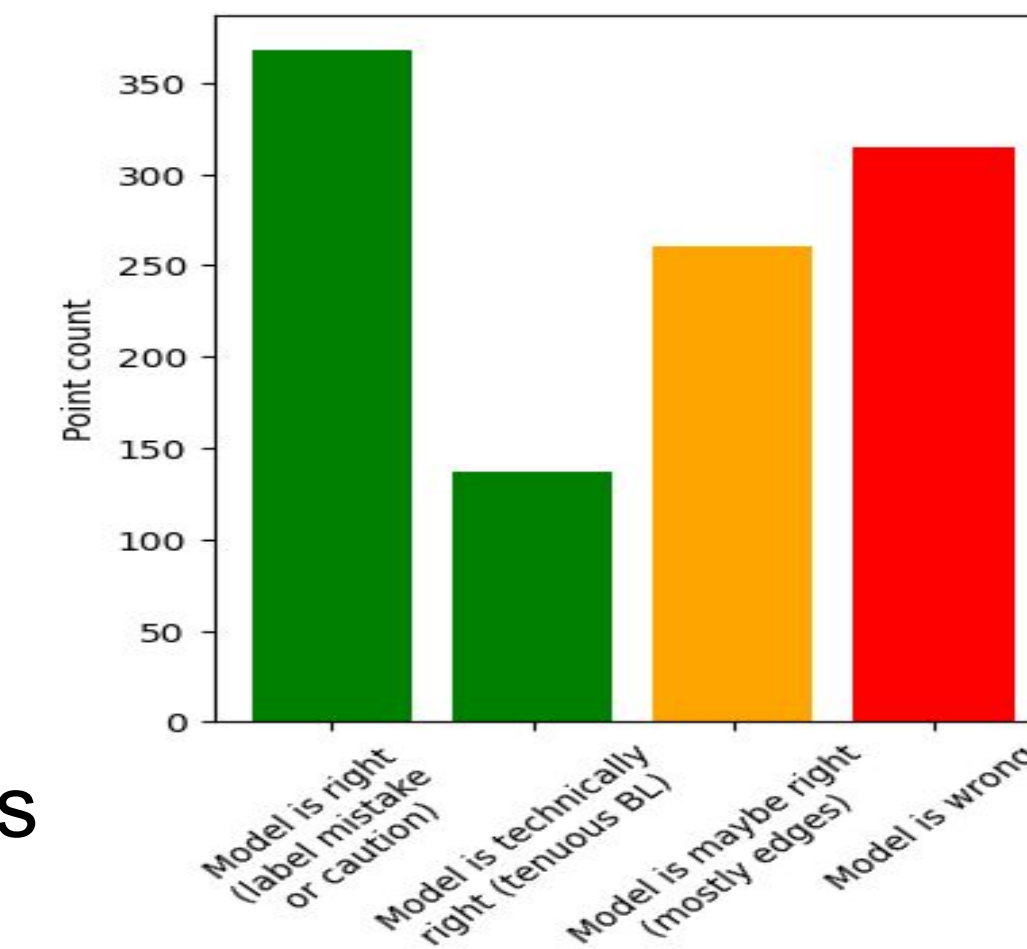
Gradient descent method. Each tree approaches the residuals between dataset and predictions at the previous iteration.



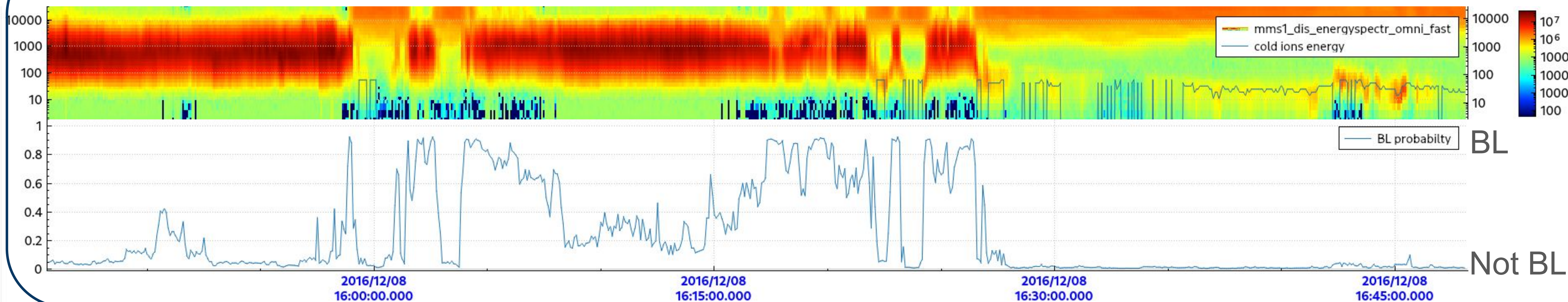
SCORES



Ambiguous data, difficult to label consistently, thus to assess model performance. Characterization of False Positives (15% false BL predictions) → Only 47% are real errors

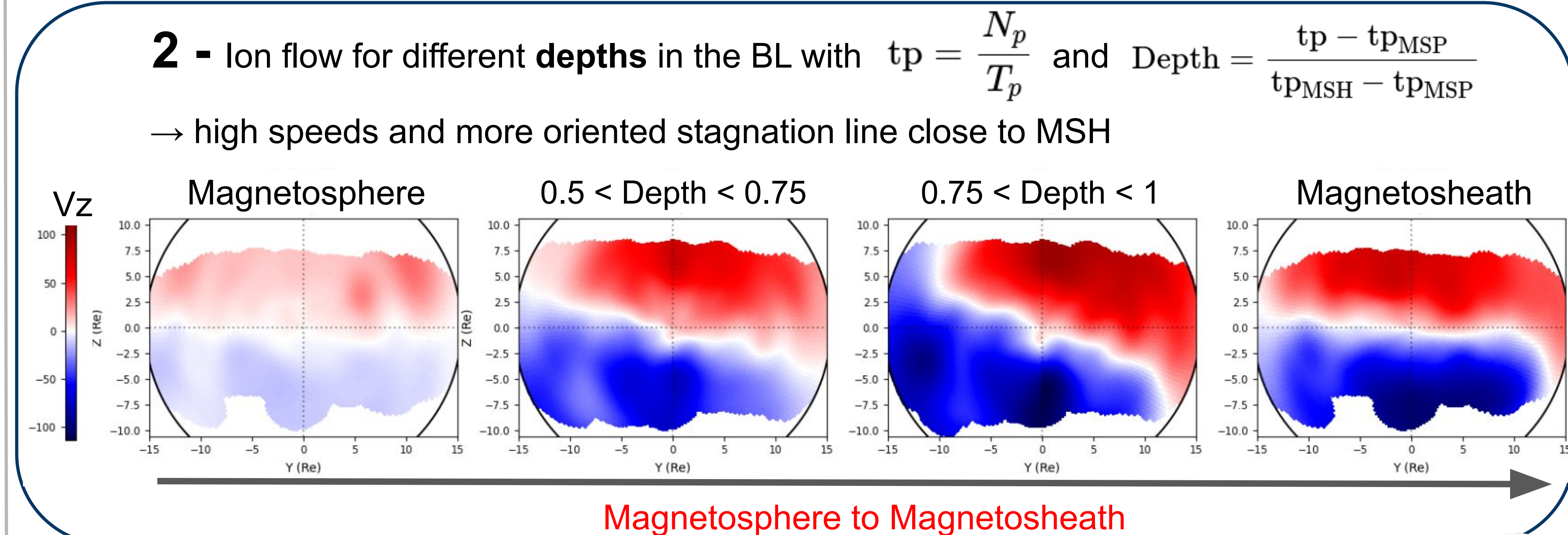
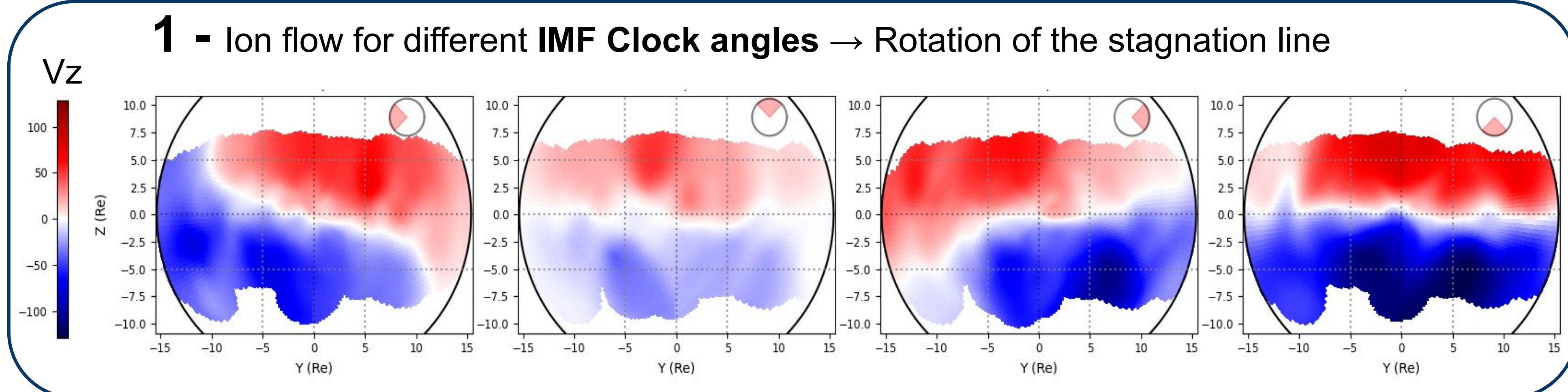
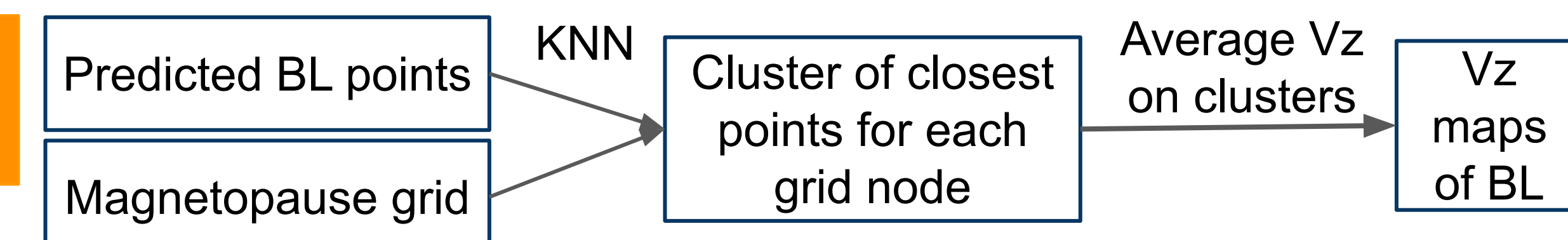


TEMPORAL BL PREDICTION



5 - Scientific results

Ghisalberti et al. in prep



Contact

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