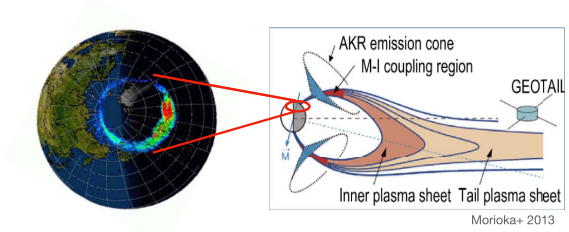
Radio Emissions as a Probe of Planetary Magnetospheres

J. E. Waters & L. Lamy (james.waters@lam.fr)

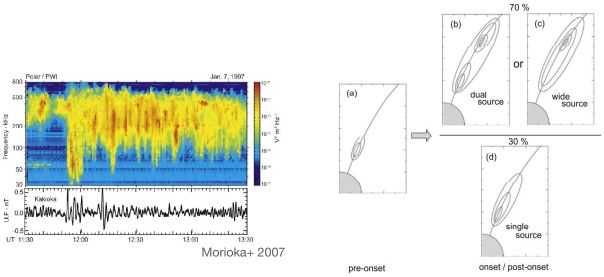
Auroral Kilometric Radiation (AKR)

- **AKR** is a electron cyclotron-maser-instability (ECMI) generated radio emission that has **source regions** in the **auroral acceleration region**, between the ionosphere and inner magnetosphere of Earth



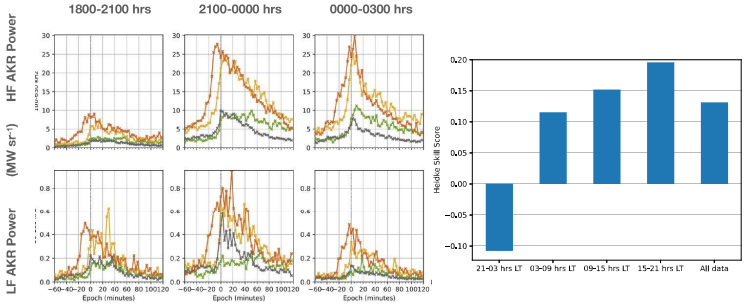
Morioka+ 2013

- The emission frequency is close to the electron gyrofrequency; a **remote observation of AKR** can tell us about the **vertical, spatial distribution of the auroral acceleration region**



Morioka+ 2007

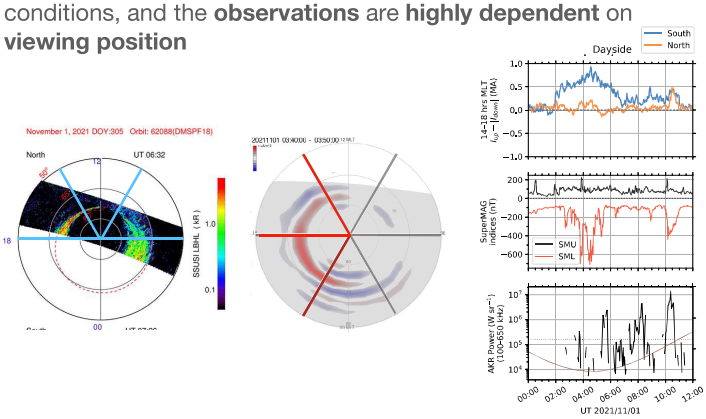
- AKR indicates a **vertical extension of the acceleration region** at substorm onset, an energetic **space weather event**, shown with case studies (Morioka et al. 2007) and on a **statistical, 10 year basis** with the **Wind/WAVES** instrument (Waters et al. 2022)



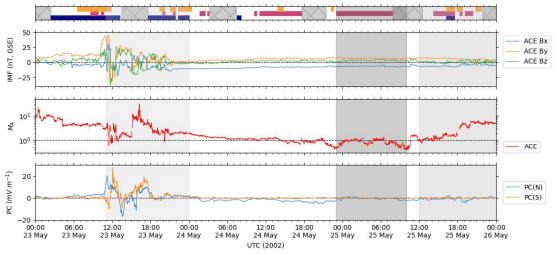
- Further statistical work (Waters et al. 2023, in prep) begins to **utilise AKR observations as a classification tool**, investigating their predictive power.

Magnetospheric Conditions

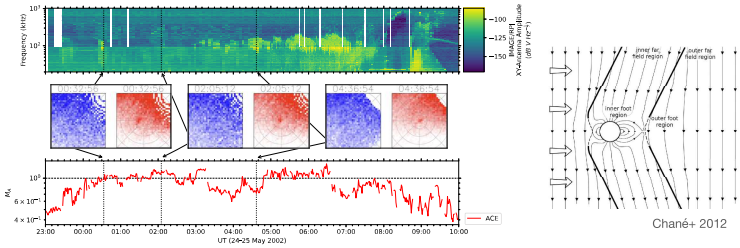
- AKR can be generated in vastly different magnetospheric conditions, and the **observations** are **highly dependent** on **viewing position**



- Waters et al. (2023, accepted) uses **dayside observations** from Wind/WAVES **during a substorm**, in a novel multipoint context - beginning to **exploit the > 20 years data** from this position and **informing the type of acceleration**.



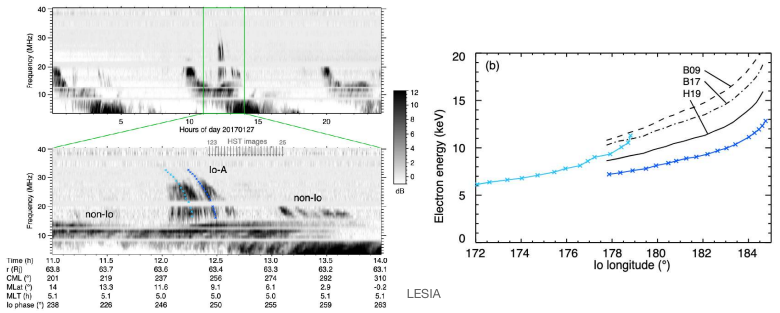
- Waters et al. (2023, in prep) explores acceleration processes while a **double Alfvén wing structure deforms the magnetosphere of Earth**. Observing this new auroral feature with radio and UV instruments improves understanding of the **Earth's response in atypical conditions**. It allows a **comparison** with similar systems, such as that of **Io in the low density plasma of the Jovian magnetosphere**.



Chané+ 2012

Jovian Radio Emission

- Jupiter has a **complex radio spectrum** involving the **Jovian magnetosphere** and its **interaction with particular Galilean moons**.



LESIA

- New opportunities for **statistical multipoint observations** exist, with remote **radio observations from the ground, with Nançay Decametric Array and NenuFAR**, and **from space with Juno/WAVES and Wind/WAVES**. UV observations of the aurora can also be utilised.

Summary

- ECMI **radio emission** gives a proxy for the **altitudinal extent of the auroral acceleration region** and the **primary coupling processes** between the auroral ionosphere and the magnetosphere.
- At Earth, **AKR** can be **used as an indicator for substorms** - space weather events that pose significant risk to modern infrastructure
- At Jupiter, the **complex radio spectrum** can be separated and **examined with multiple observatories** in a similar way to that done at Earth, and to gain an **understanding of the magnetospheric processes** that drive the emission
- A better understanding of the interactions that govern the radio emission, from comparing different planets in the solar system, can provide **insight into the dynamics in exoplanetary systems**.

References

- Waters et al. 2022, doi: 10.1029/2022JA030449
- Waters et al. 2023, in prep
- Waters et al. 2023, accepted
- Waters et al. 2023, in prep
- Morioka et al. 2007, 2013
- Chané et al. 2012