Study of the magnetic structures in full-disk solar Ca II K images and sun-like stars connection

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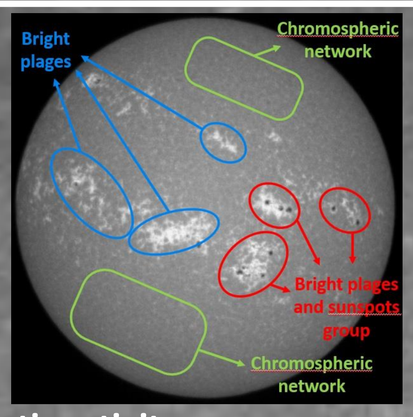
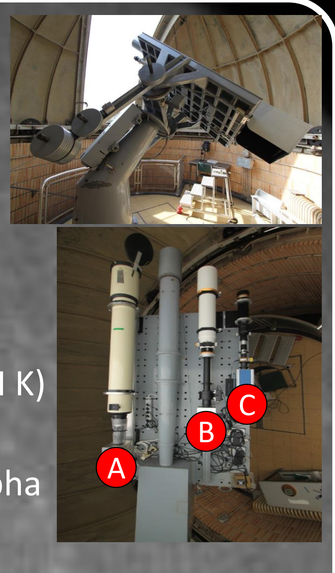
Introduction



- **Aim :** Study the global dynamics and evolution of chromospheric magnetic structures
- **Ca II K emission** = Indicator of **stellar magnetic activity**
  → Can serve as a « **Rosetta stone** » between the Sun and solar-like stars
  → Suspected to be affected by **inclination angle of stellar rotation axis**
- One of our goals is to answer the following question :

« How does the angle between our line of sight relative to the rotation axis of a star change the global irradiance and its variability ? »

Dataset



USET : « **U**ccle **S**olar **E**quatorial **T**able »

- **Ground based** station located in Uccle, Brussel, Belgium
- Observing the Sun's **photosphere** and **chromosphere** simultaneously in 3 wavelenghts : A **White Light** (WL) | B **Calcium II K** (Ca II K) | C **H alpha** (Hα)

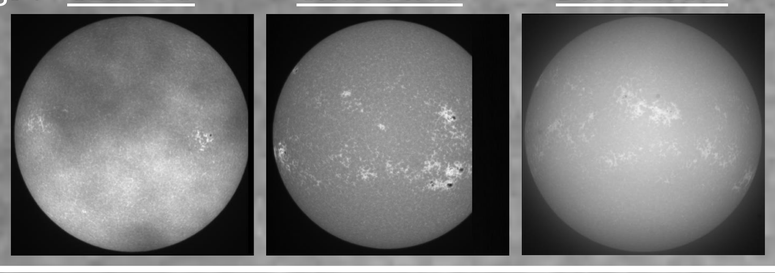
IMAGES :

- From **2012** for Ca II K and **2002** for White light and H-alpha
- Acquired 7 days/week when the weather permits
- CCD images : 12 bit | 2048 x 2048 pixels
- 3 modes: **Manual** | **Synoptic** (every 15 min) | **Continuous** (every 10-20 sec)
- Total of **21.414 Ca II K images** since 2012

Calibration

Selection of **one image per day** →

3 sortings : **CLOUDS** **CROPPING** **DIFFUSION**

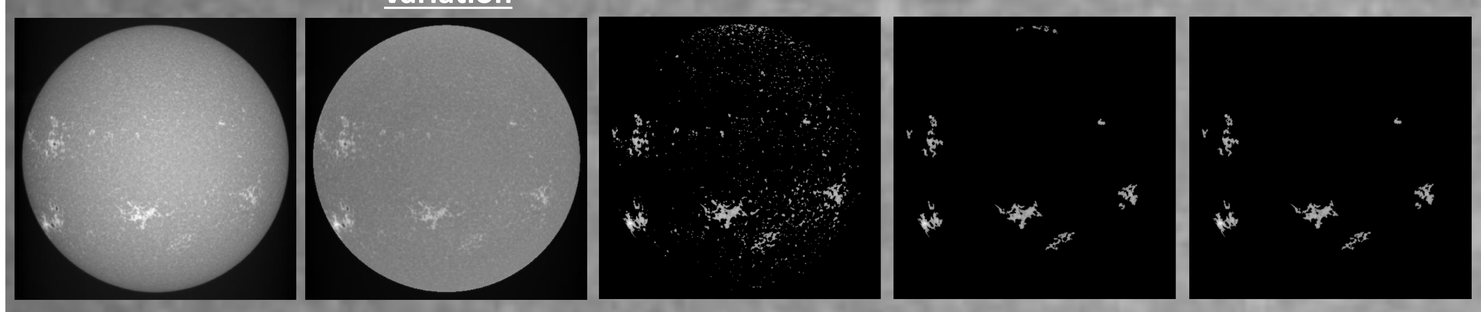


→ For days with multiples images : taking the **earliest** with the **highest quality** (established by the observer while taking the images) →

FINAL DATASET : 2171 IMAGES

Plage-segmentation method

Base image → **Center-to-limb variation** → **Intensity threshold** → **Area threshold** → **Latitude threshold**



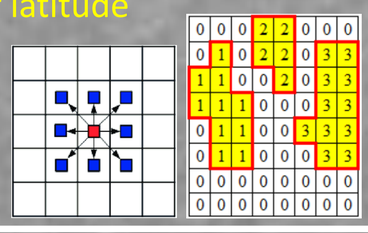
Correction of the intensity for the limb darkening effect

95th percentile of whole-disk intensity distribution

Selection of connected components with area > chromospheric network cell

Selection of connected components > 50° of latitude

Connected components



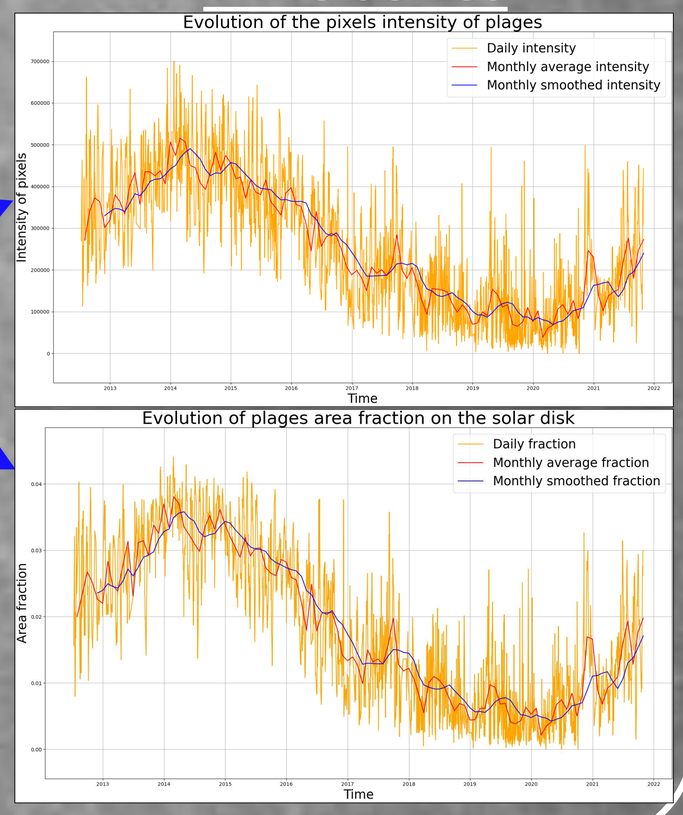
$$I_{tot} = \sum_i I_i$$

where I = Intensity, i = Plages pixel

$$A_{plage} = \frac{N_{plages}}{N_{SD}}$$

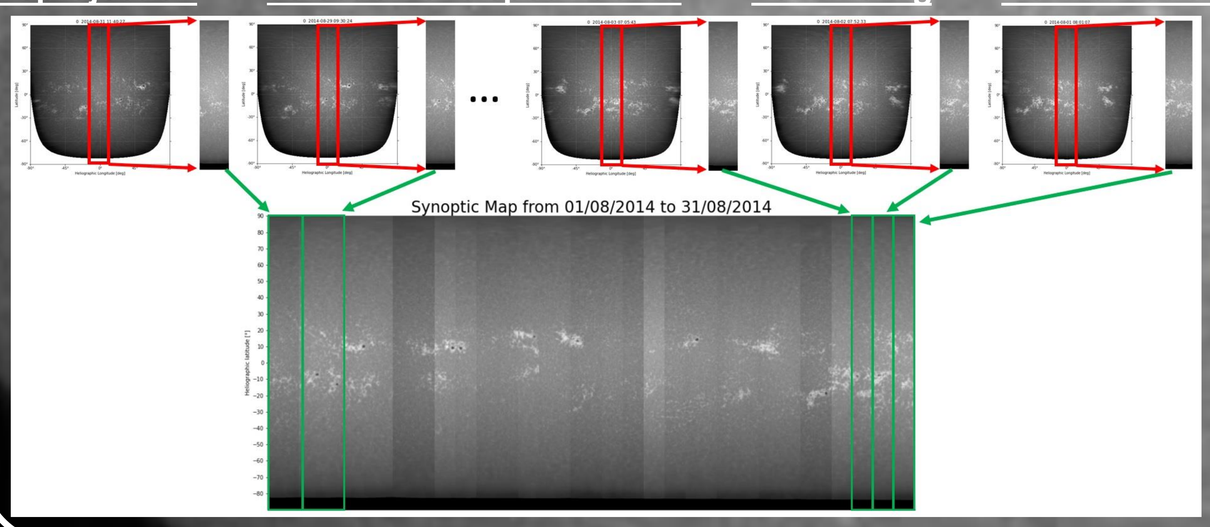
where A = Area fraction, N = Pixels number, SD = Solar disk

Time series

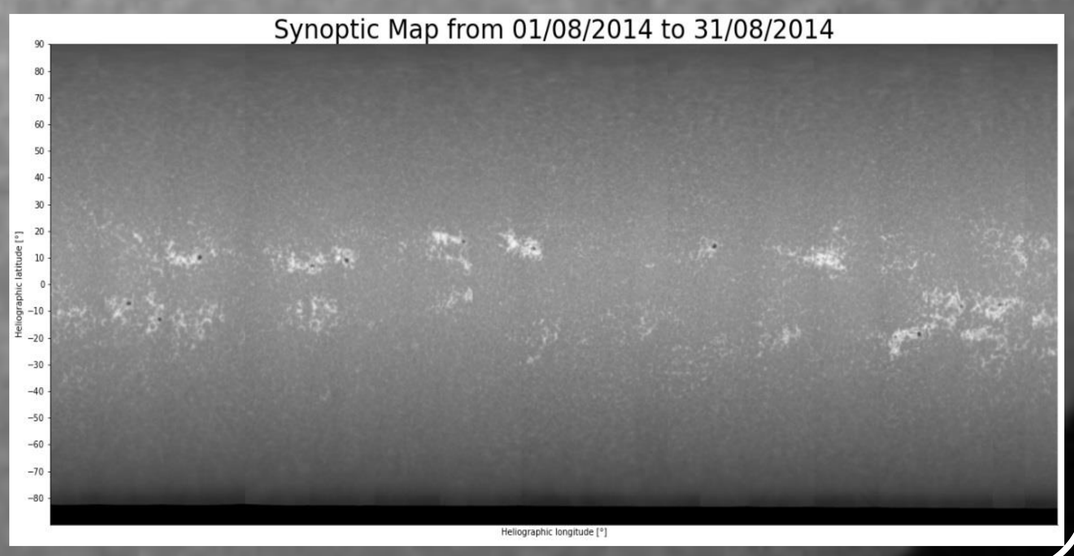


Construction of synoptic maps

Deprojection + **Selection of a specific slice** + **Assembling** + **Normalization**



Synoptic map (Sun's equator view)



Perspectives

- Validation of our **time series** with other solar proxies : Sunspot number, Wolf number, Ca II K Index, F10.7 Index
- Using solar-like stars S-index from TIGRE telescope (Mexico) to find a correlation with our **Ca II K emission time series** (intensity and area fraction)
- **Plages segmentation** of the **synoptic map** to study the brightness variation from any inclination angle

Paper poster **USET website**

SCAN ME !