A Real-Time Plasma Bubble Detection Method Combining Neural Networks and All-Sky Imaging

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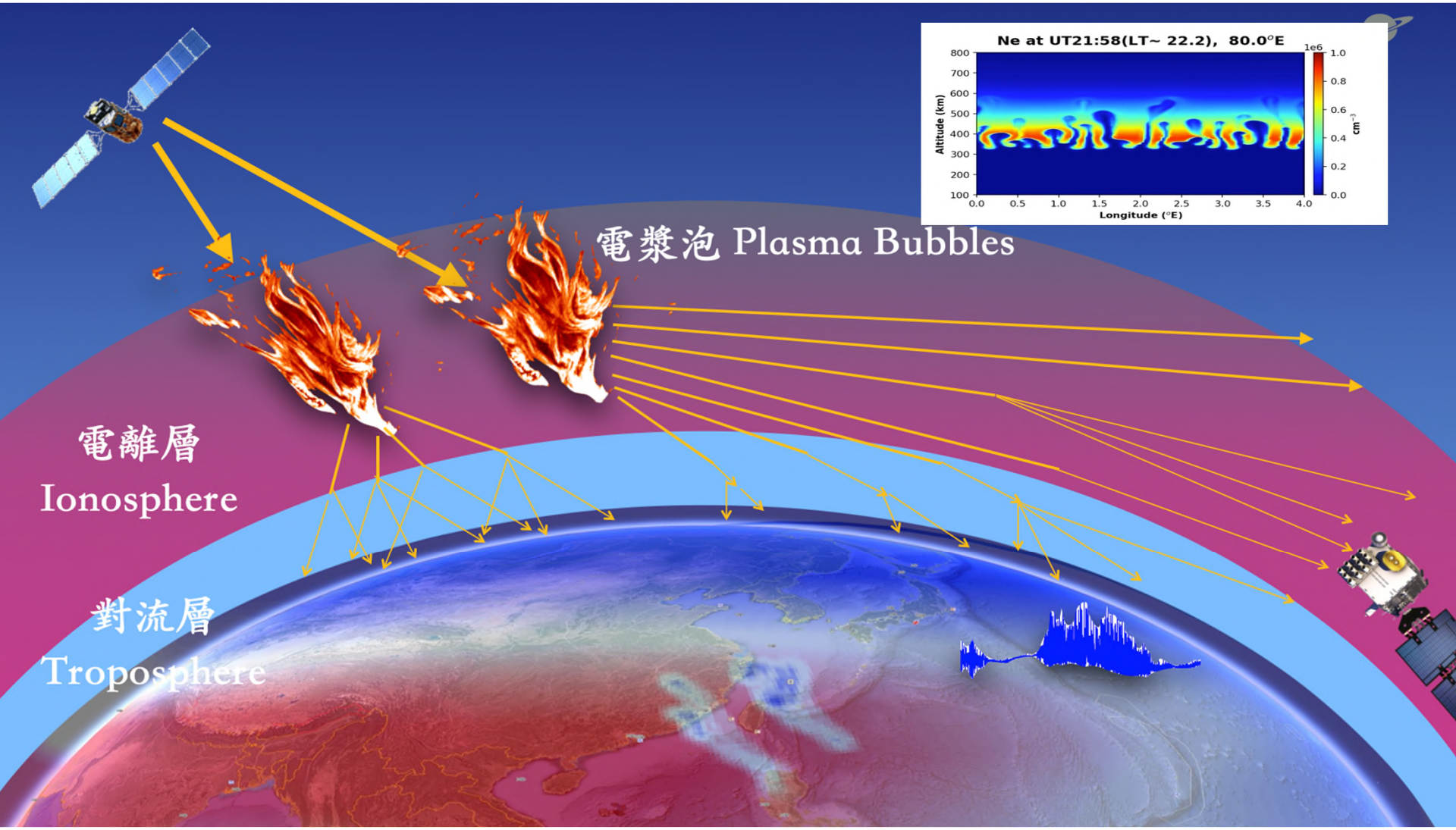
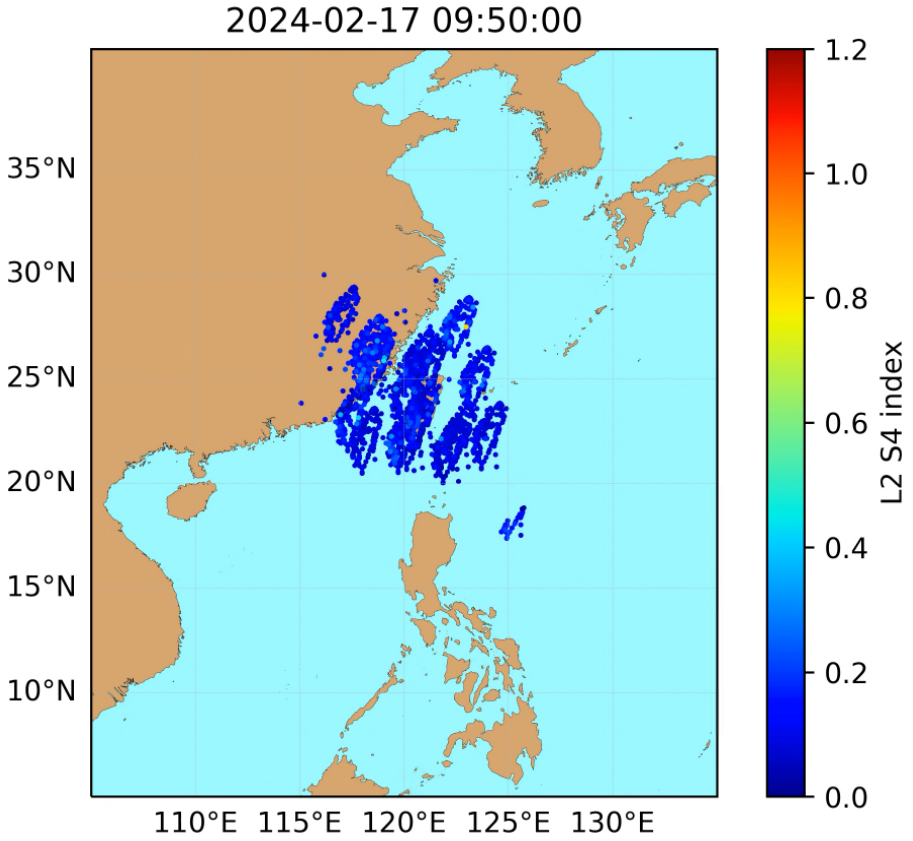
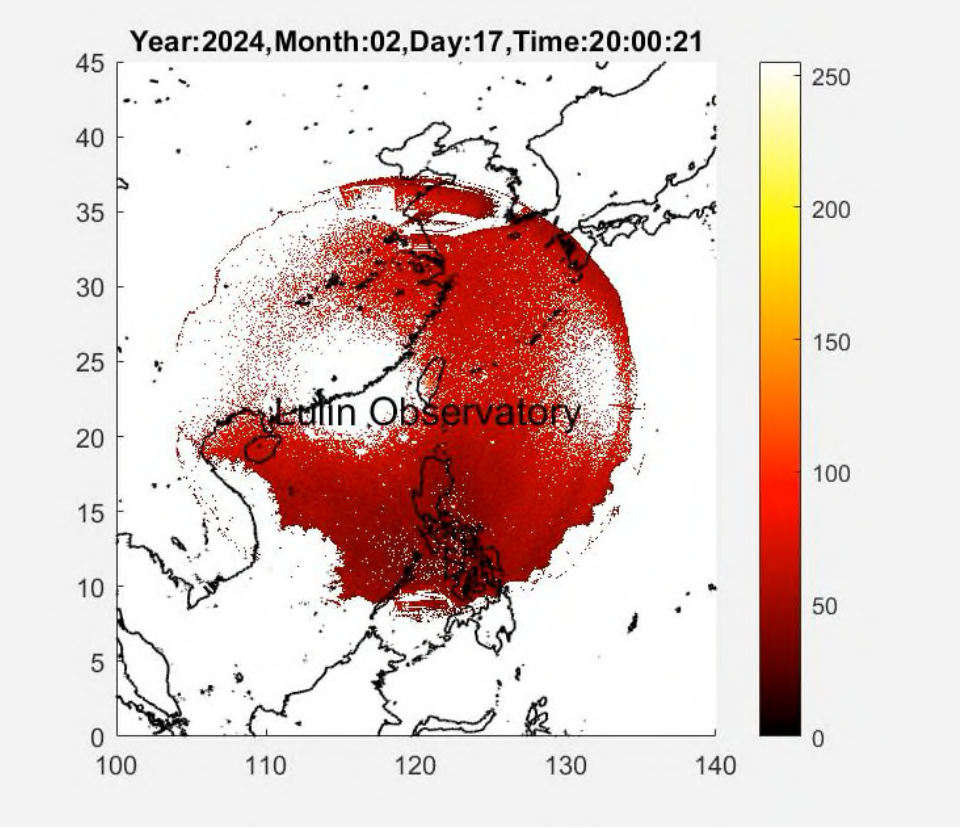
Plasma Bubbles



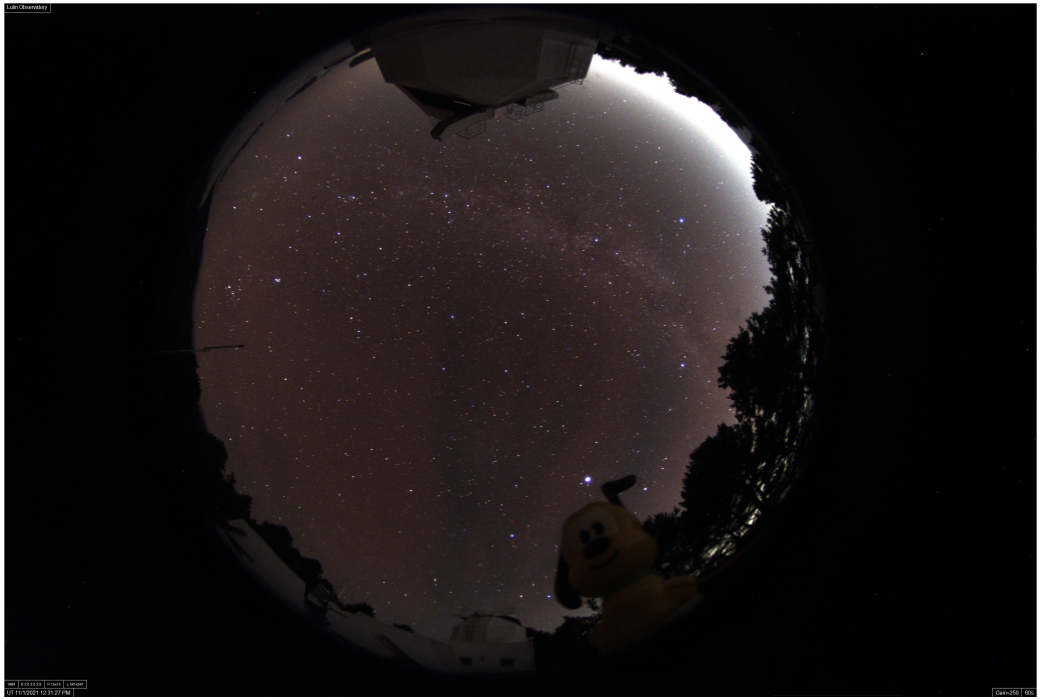
GNSS stations and All sky imager



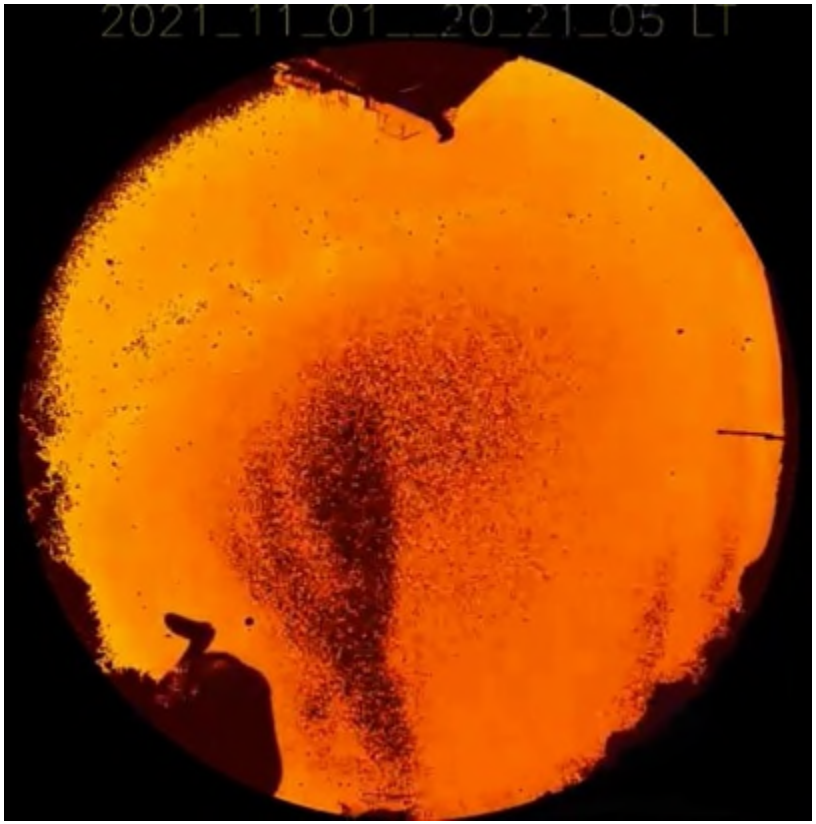


LuLin All Sky Camera

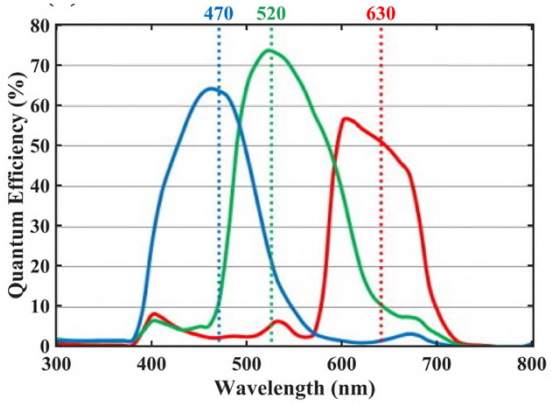
Original



After processong



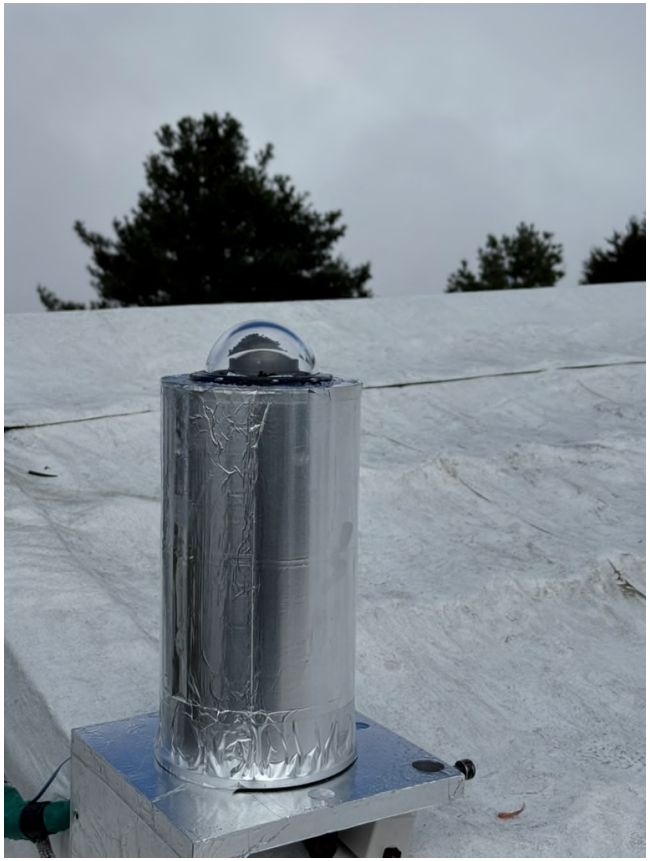
Low-cost allsky(sony cmos sensor)



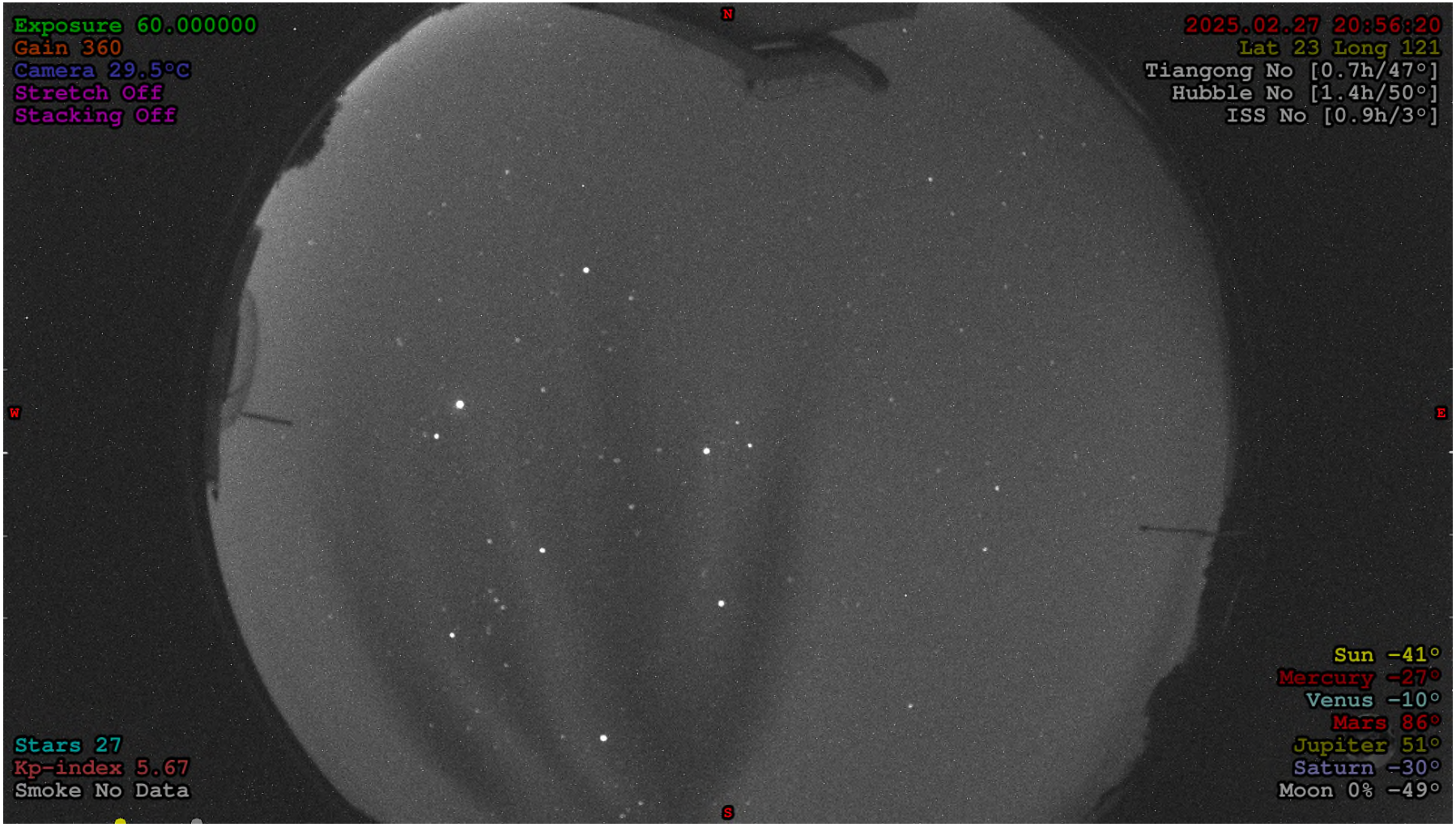
Low-cost allsky(sony cmos sensor) by 3D printer

Low-cost allsky(sony imx462 cmos sensor)

Install at LuLin



(1)All made by the 3D printer
(2)Camera: imx462
(3)Field of view: 180°, the whole sky.
(4)Lens: F/1.4 Fisheye-Fujinon
(5)With Linux Base SBC(raspberry pi) in inside.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Gain 360
Camera 29.5°C
Stretch Off
Stacking Off
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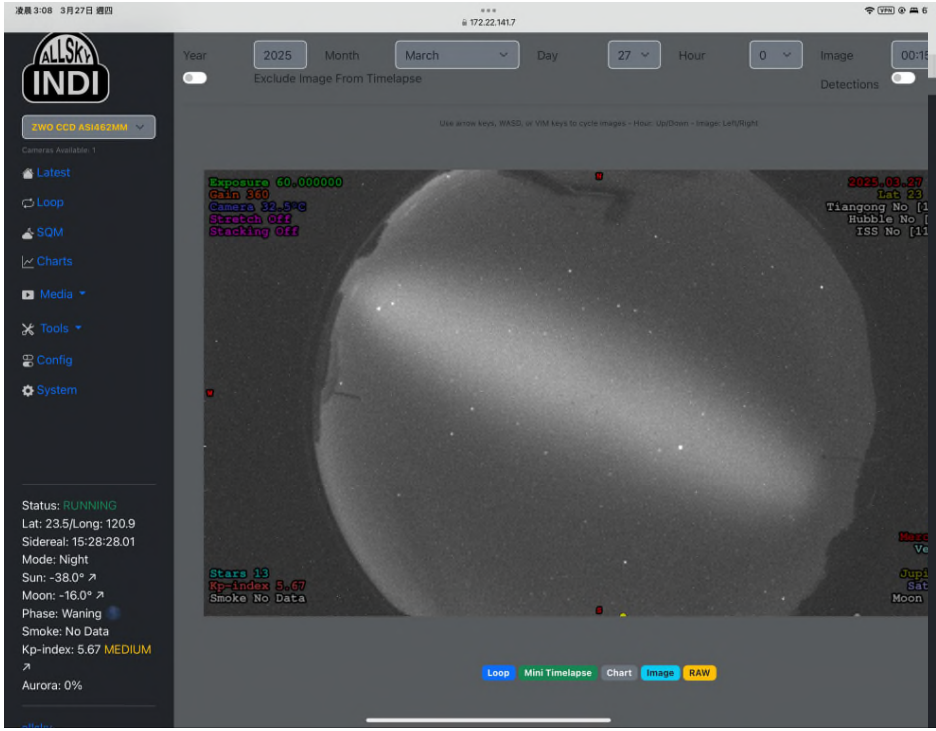
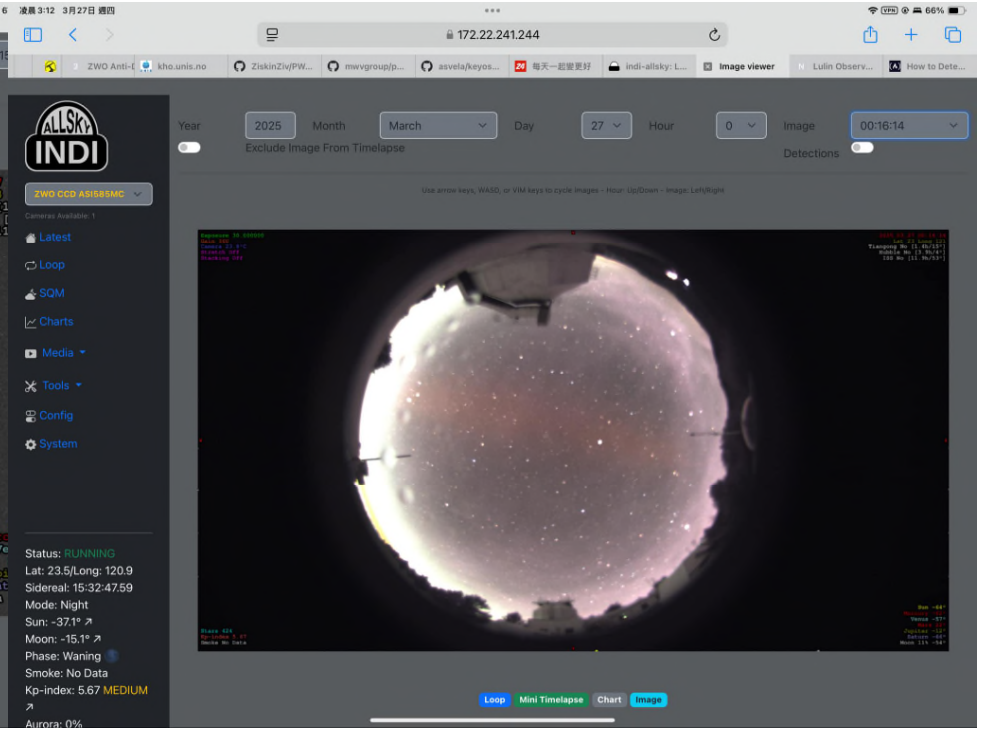
Lat 23 Long 121
Tiangong No [0.7h/47°]
Hubble No [1.4h/50°]
ISS No [0.9h/3°]
W
E
Sun -41°
Mercury -27°
Venus -10°
Mars 86°
Jupiter 51°
Saturn -30°
Moon 0% -49°
Stars 27
Kp-index 5.67
Smoke No Data
S


Exposure 60.000000
Gain 360
Camera 22.0°C
Stretch Off
Stacking Off
2025.02.27 18:23
Tiangong No
Hubble No
ISS No
Sun
Mercury
Venus
Mars
Jupiter
Saturn
Moon 14
Stars 0
Kp-index 3.33
Smoke No Data

Rocket event

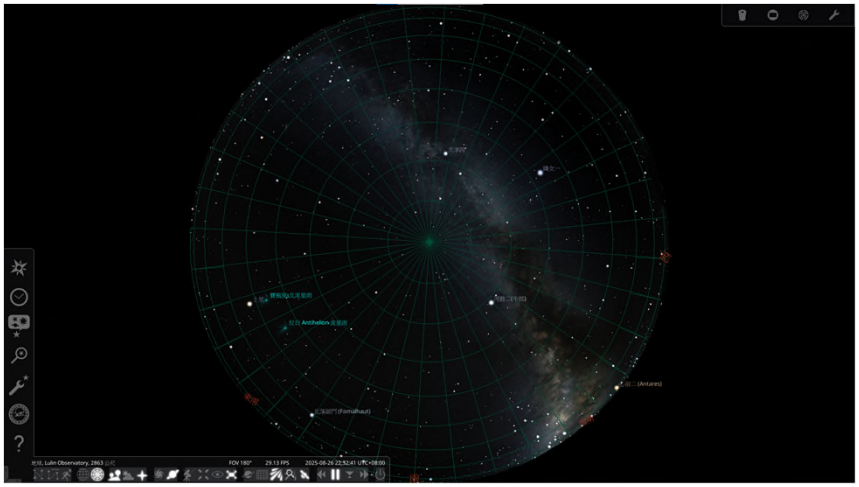


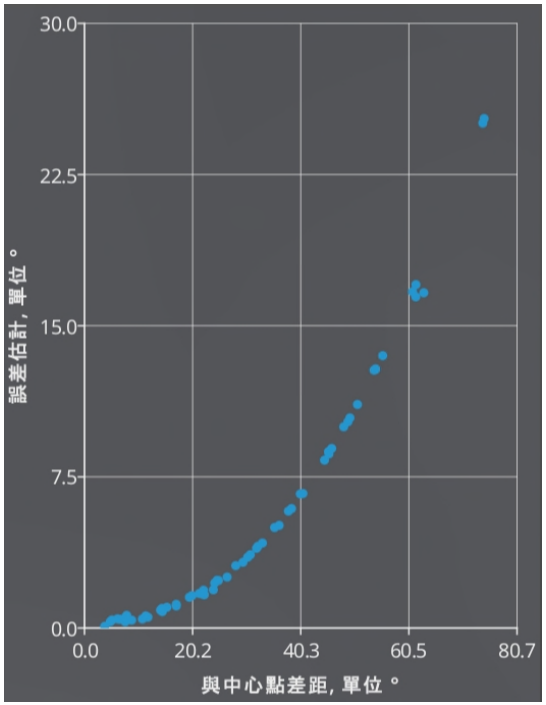


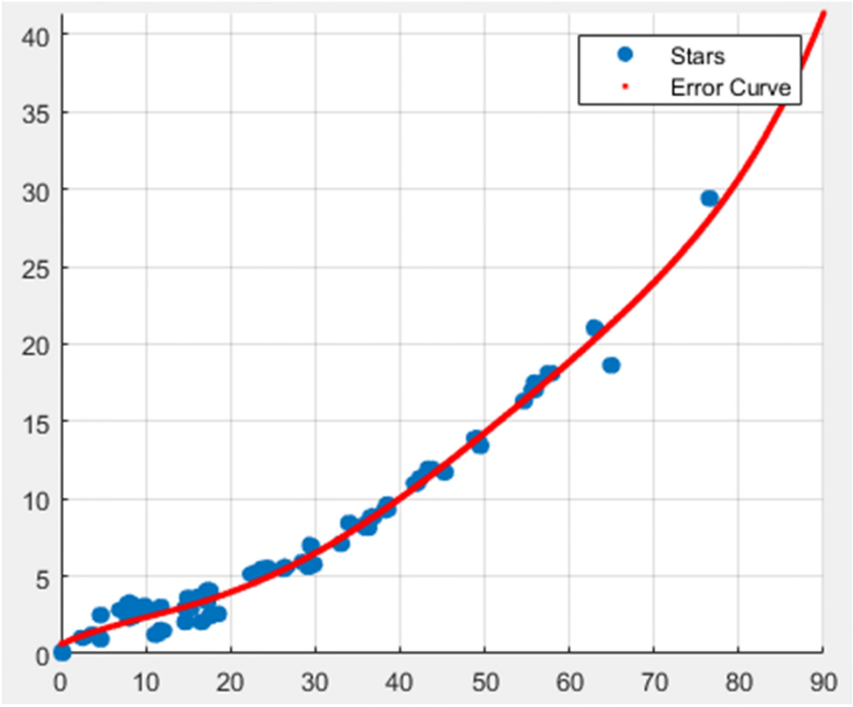
GNSS Septentrio X5 module

(1)GNSS 100 Hz sampling rate receiver。
(2)100Hz 10 and 35 TARI stations(50hz) at Taiwan。
(3)With Linux Base SBC(raspberry pi 4) caculate S4, TEC, ROTI, ZTD, PPP-AR(by Bernese 5.4) etc. on board.

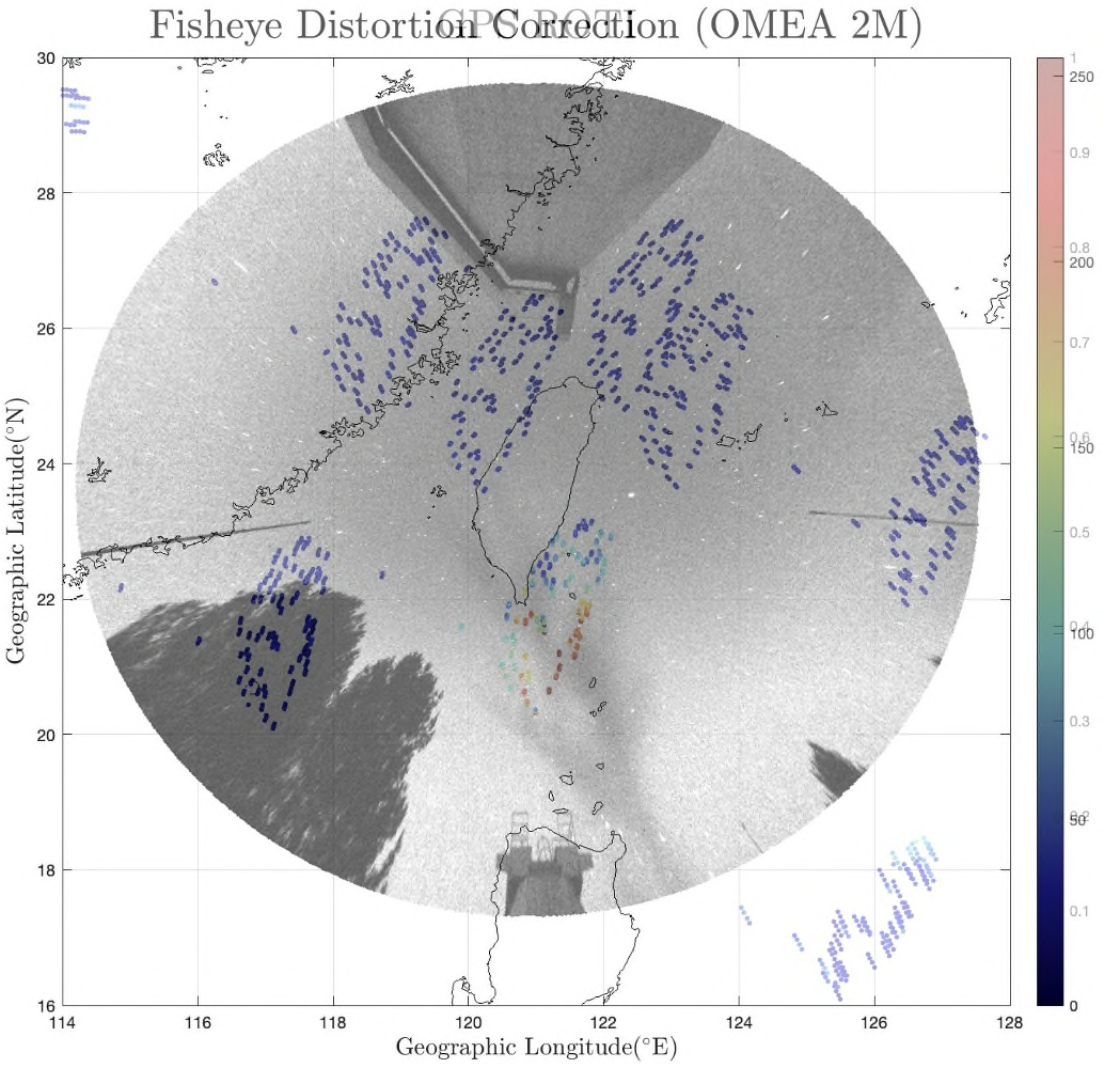
使用stellarium軟體，以天體得到校正曲線

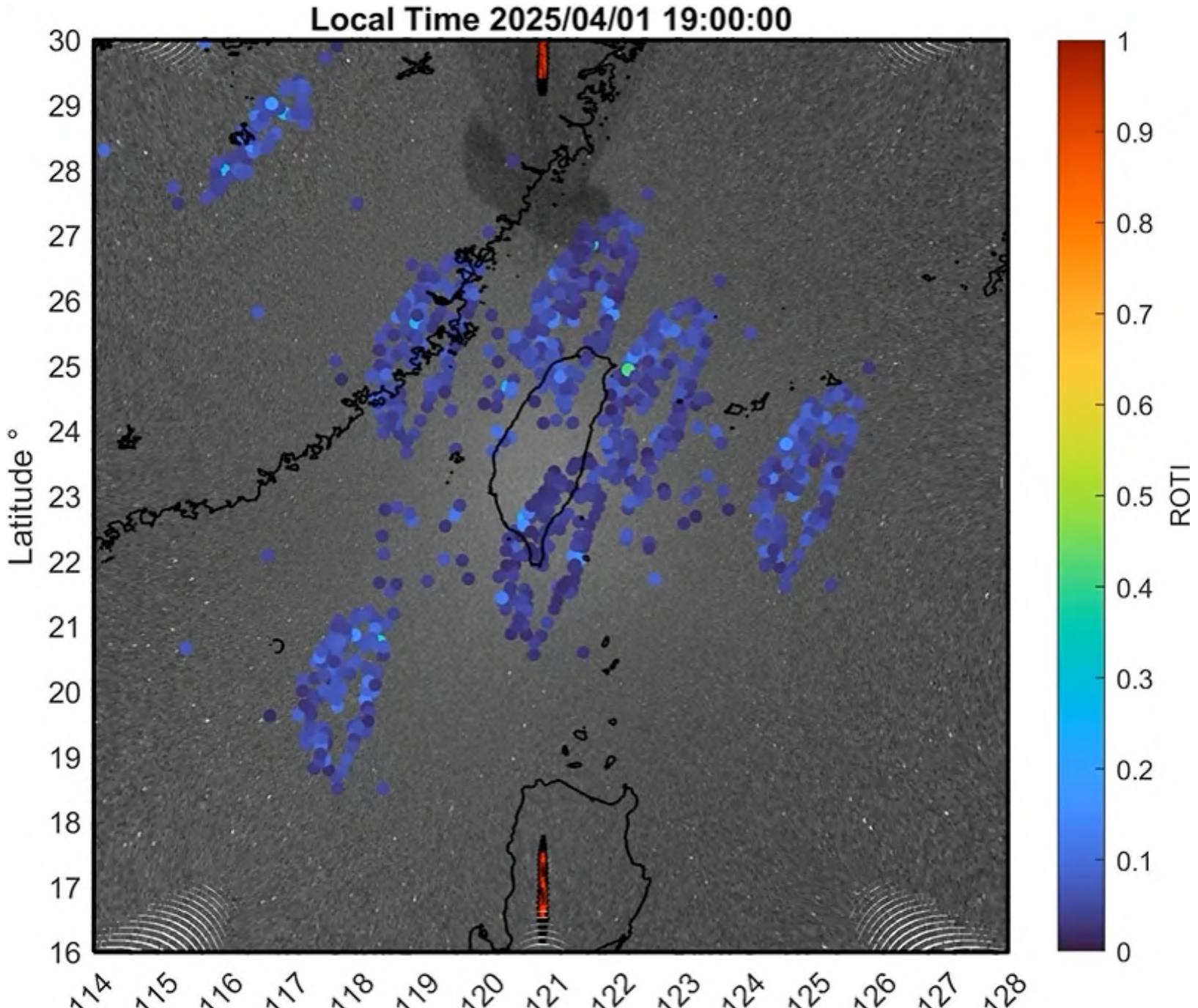






使用stellarium軟體，以天體得到校正曲線，然後調整投影高度與GNSS比對

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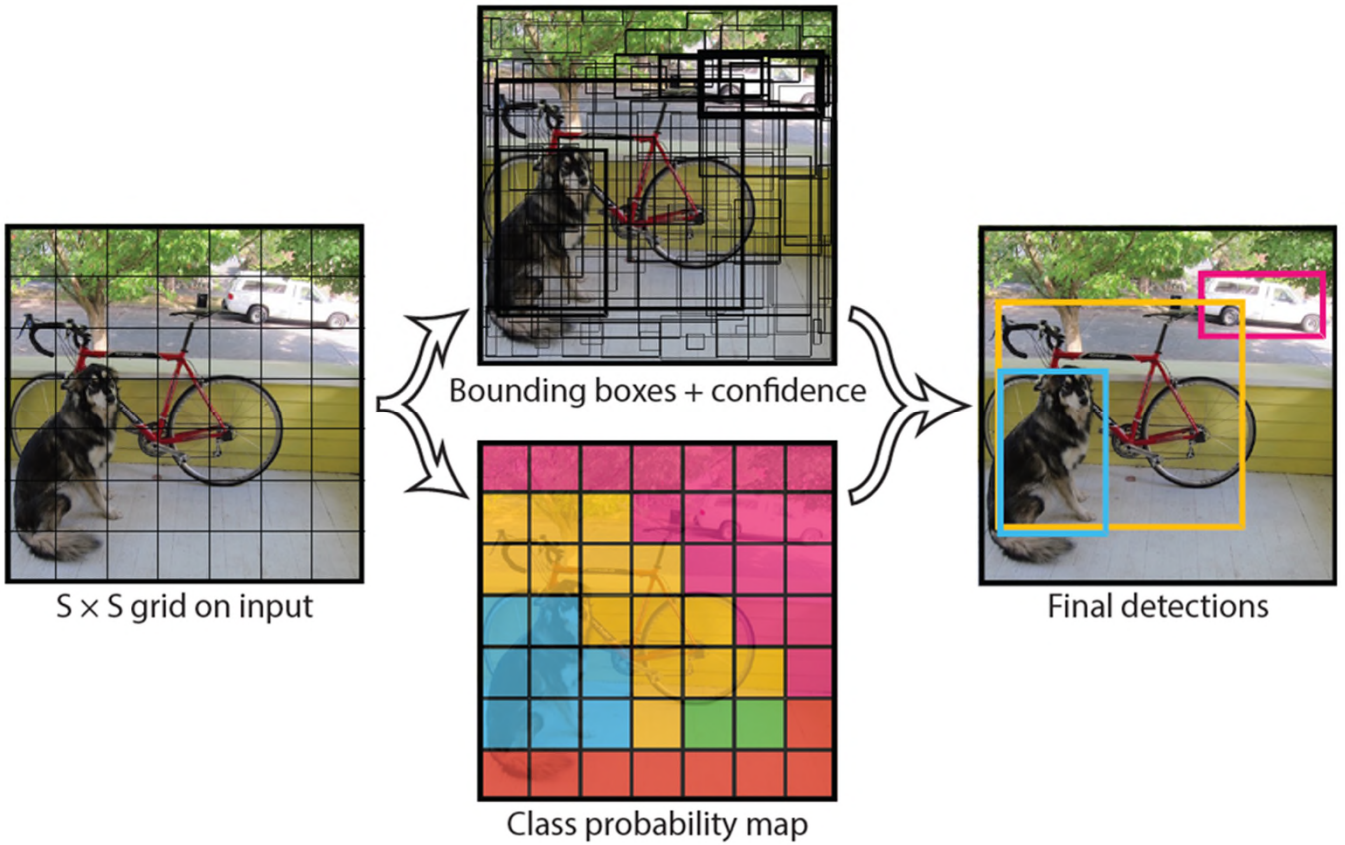
What is YOLO v12?

- YOLO (You Only Look Once) 系列：最廣泛使用的即時物件偵測模型



What is YOLO v12?

Let's look at a simple implementation of YOLO12 using Ultralytics pipeline:

```
!pip install -q ultralytics
from ultralytics import YOLO
```

```
model = YOLO("yolo12m.pt")
result = model(img_path, save = True, conf=0.5)
```

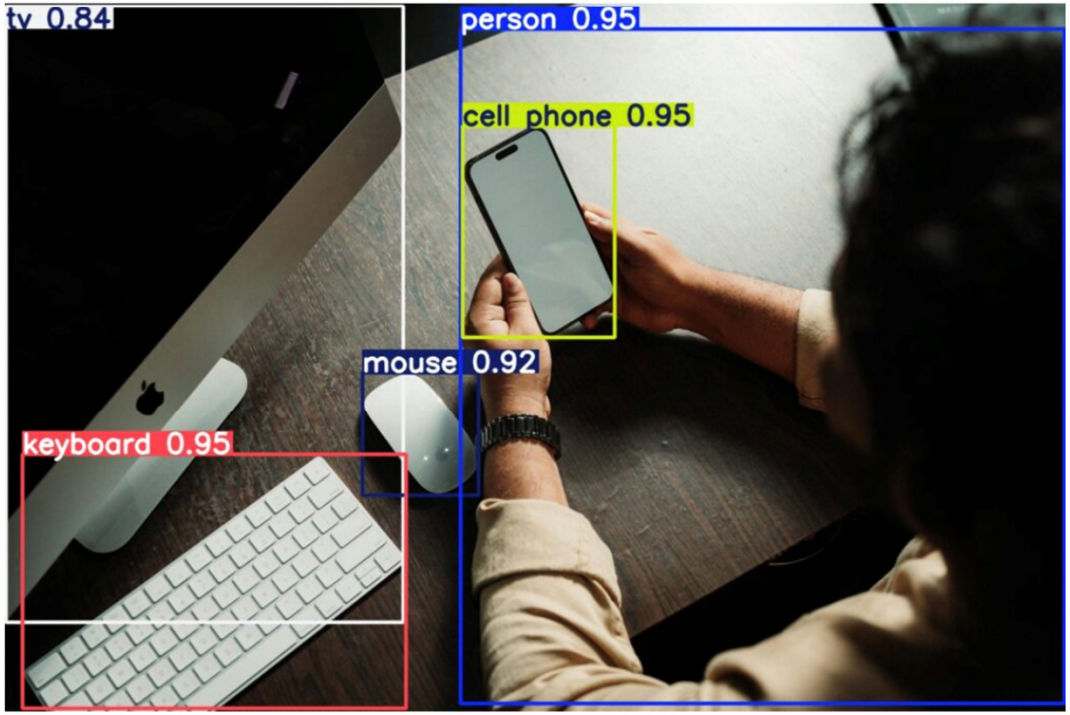
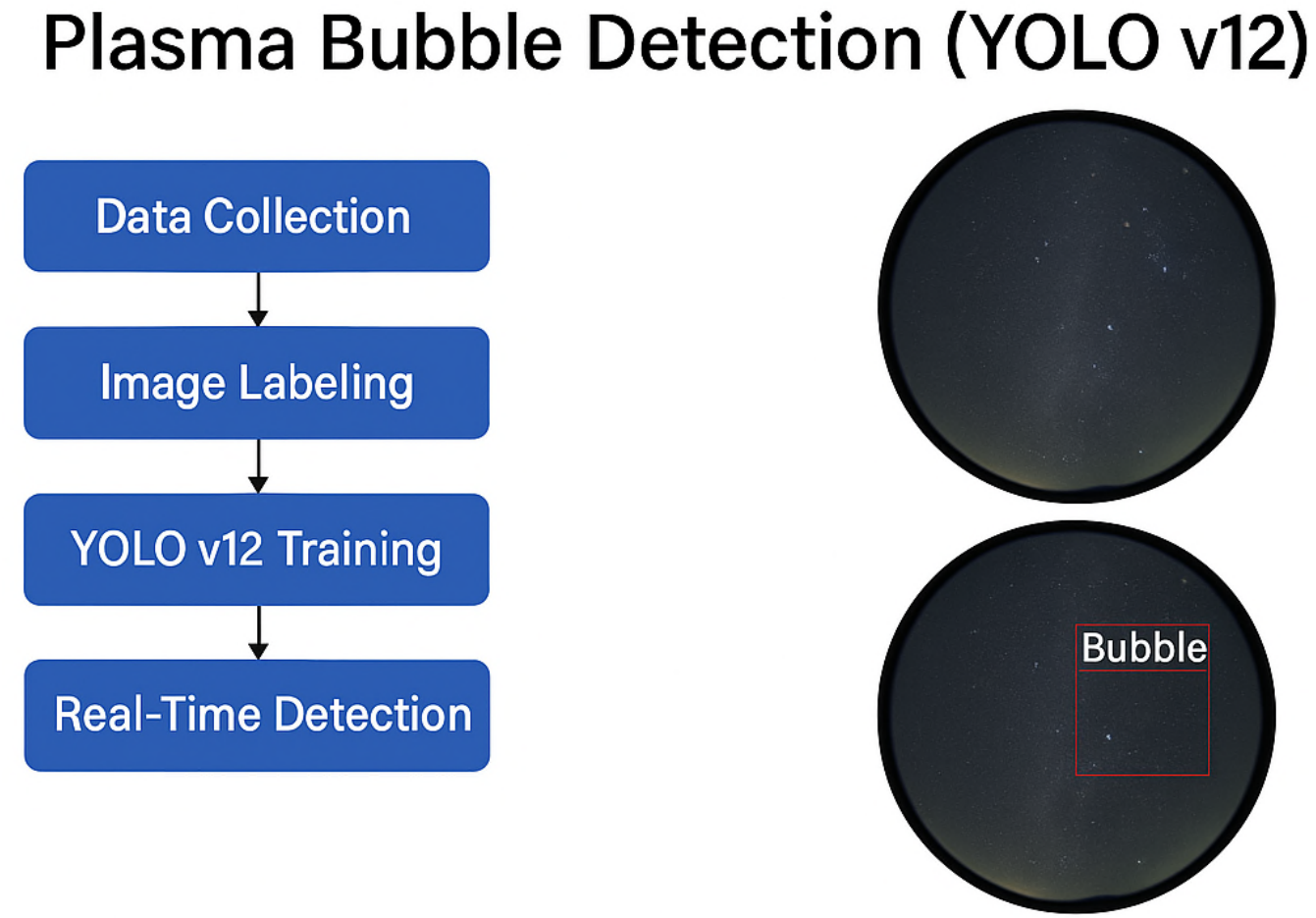


Fig 6: YOLO12 object detection result

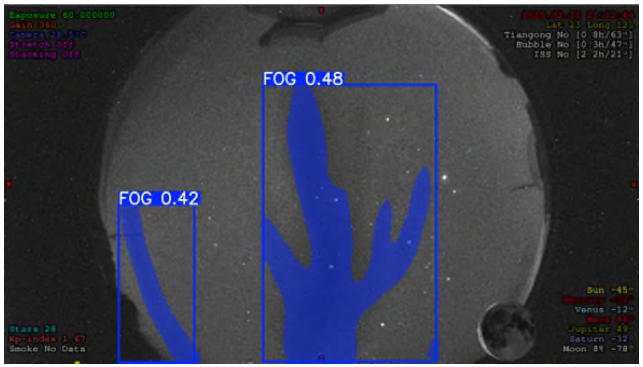
Why we use YOLO v12?

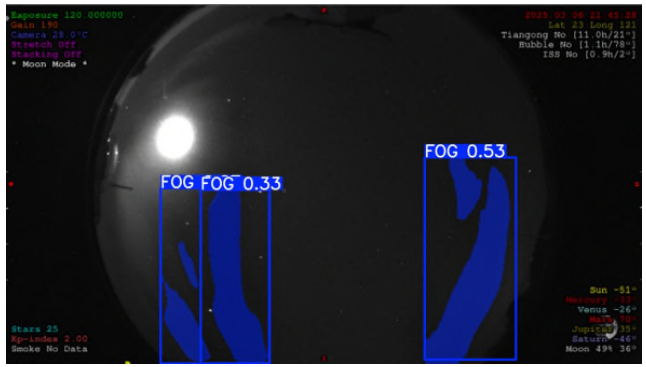
- Plasma bubble 特徵：**暗條狀、延伸、低對比**
- YOLO v12 改進的 **multi-scale feature**
- **extraction** → 能捕捉大範圍與細微結構
- 強化 **low-light image detection** → 適合夜間 All-Sky 影像
- 高速運算 → 可實現 **即時預警系統**

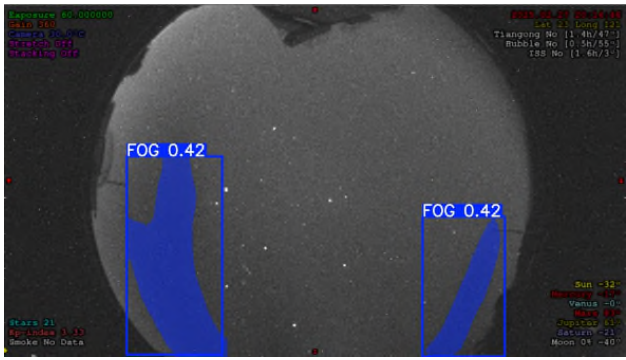
What is YOLO v12?

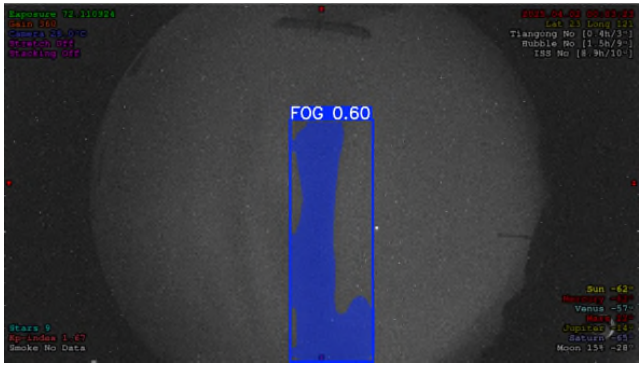


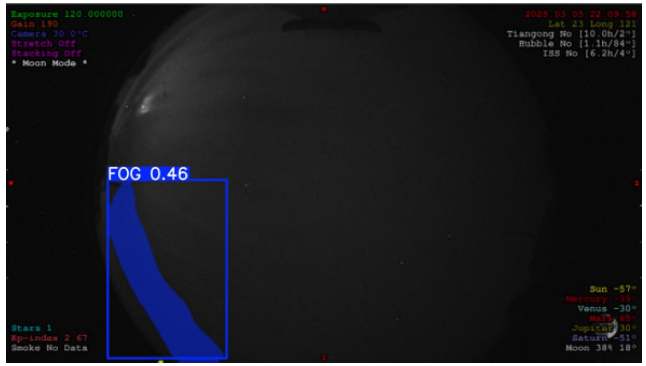
The initial results of Machine Learning

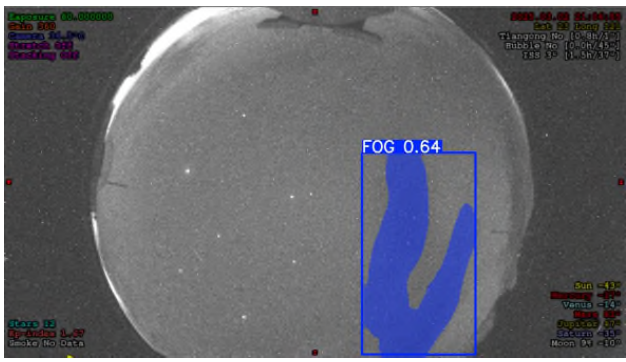












Thanks For Your Attention !!