

# Applications of GNSS for severe weather events in Southeast Europe

A satellite with gold-colored insulation and solar panels is shown in space. The Earth's blue and white clouds are visible in the background, along with a field of stars.

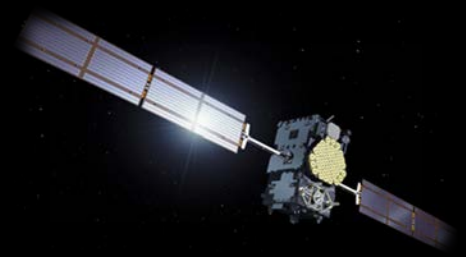
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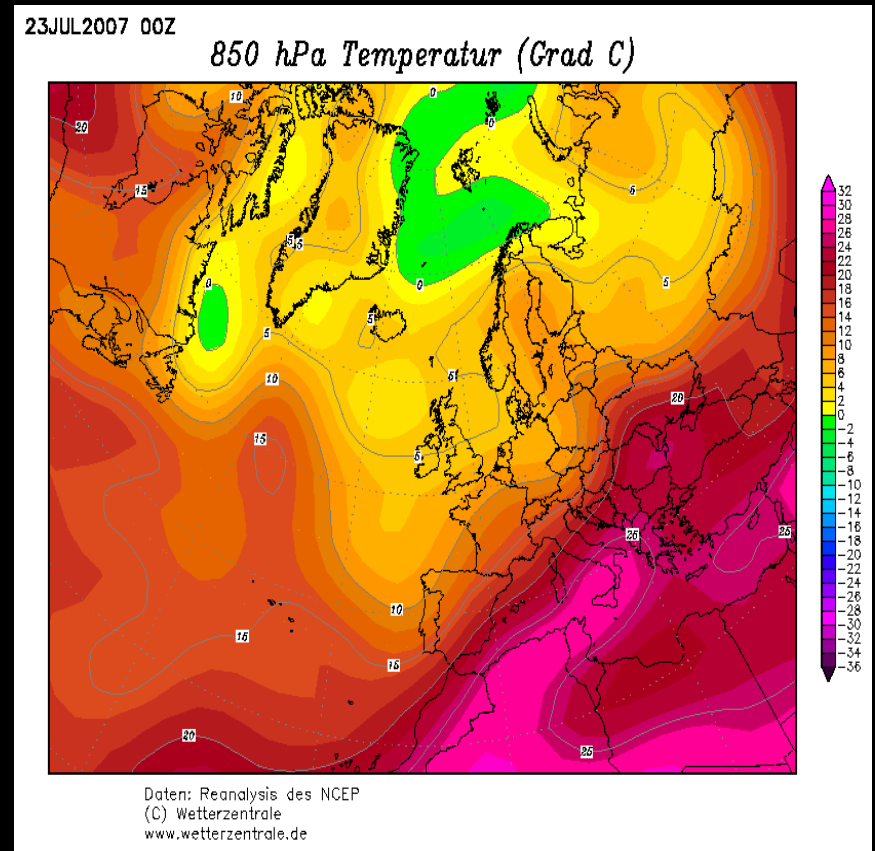
# Introduction



- Heat waves: large social, economic and environmental effects:
  - increasing mortality
  - destruction of forests by fire
  - effects on water systems and glaciers
  - increasing power consumption and power cuts
  - transport restrictions
  - decreasing agricultural production
  - economic losses of 2007 heat wave in Southeast Europe – 2 billion EUR

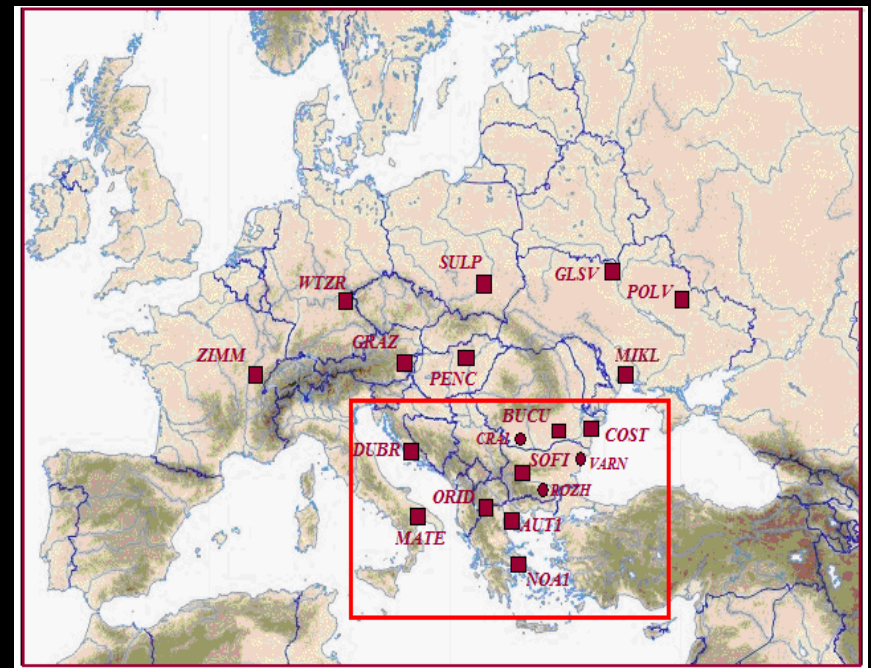
# 19-25 July 2007 heat wave in Southeast Europe

- Heat waves - common summer feature on the Balkan peninsula in the last 20 years
- The July 2007 heat wave - largest geographical extension reaching Bulgaria
- Temperature record in Bulgaria 45.5°
- 32°, 1,5 km ,850hPa

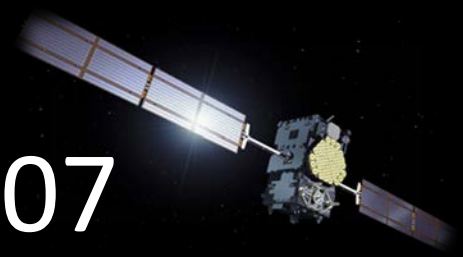


# 19-25 July 2007 heat wave in Southeast Europe

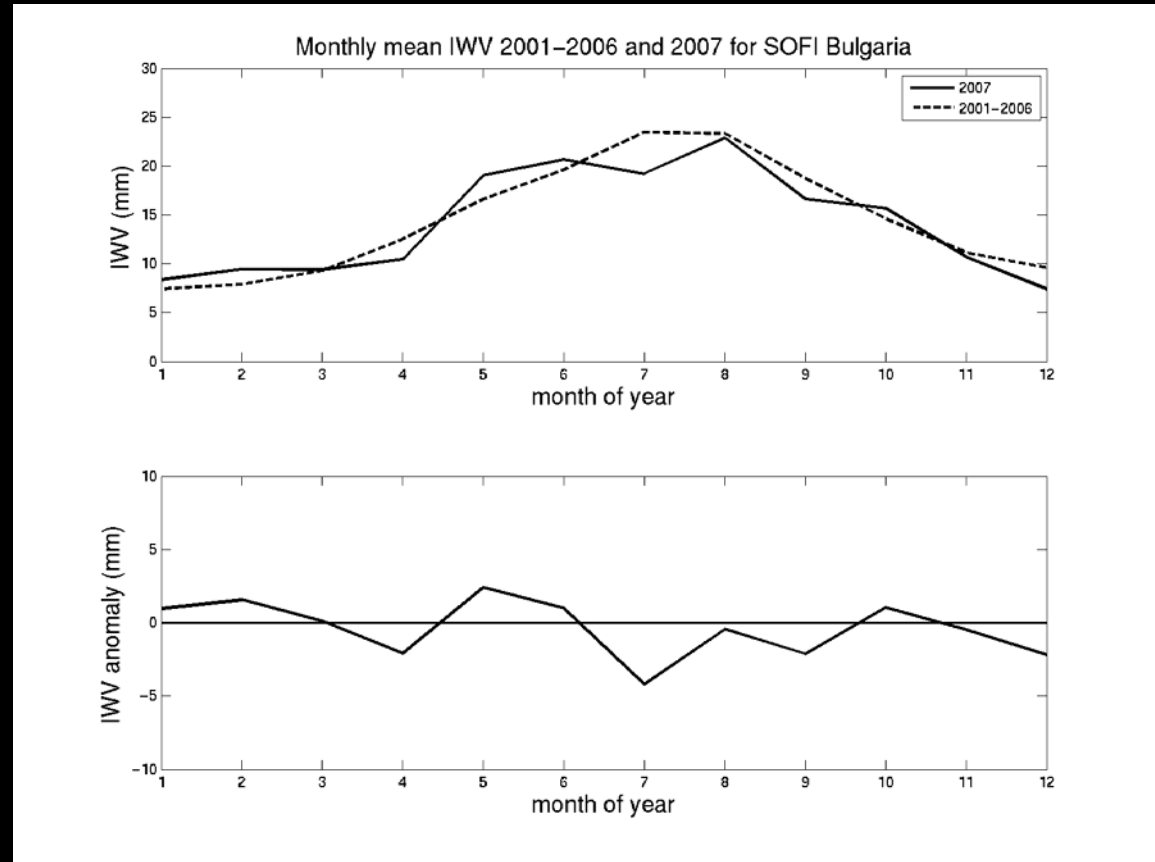
- IWV cycle during the July 2007 heat wave - 8 GNSS stations
- Processed files – thanks to Dr Keranka Vassileva



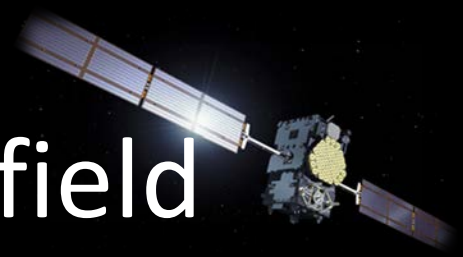
# Monthly mean IWV 2007



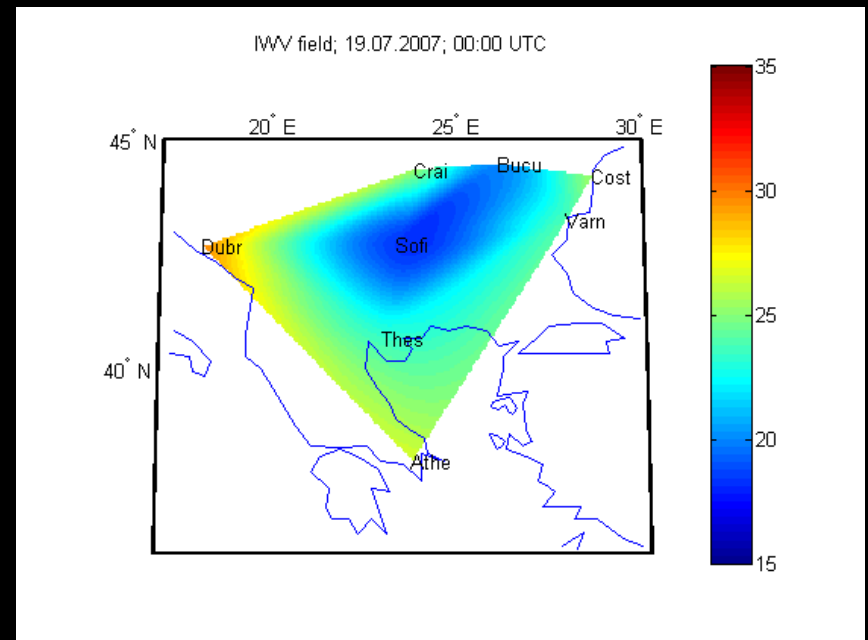
- $\frac{de_s}{dT} = \frac{L_v(T)e_s}{R_v T^2}$
- $T \uparrow$  ; water vapour  $\uparrow$  ; non linear



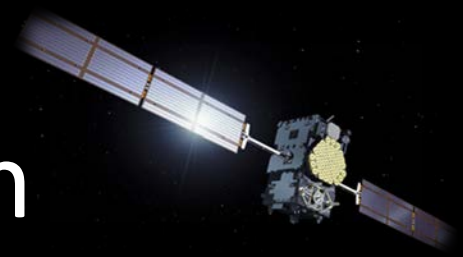
# Integrated water vapour field



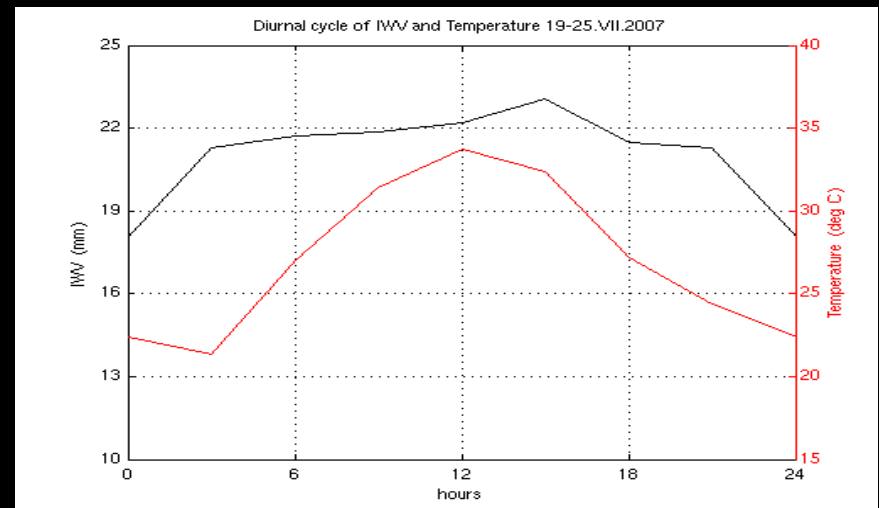
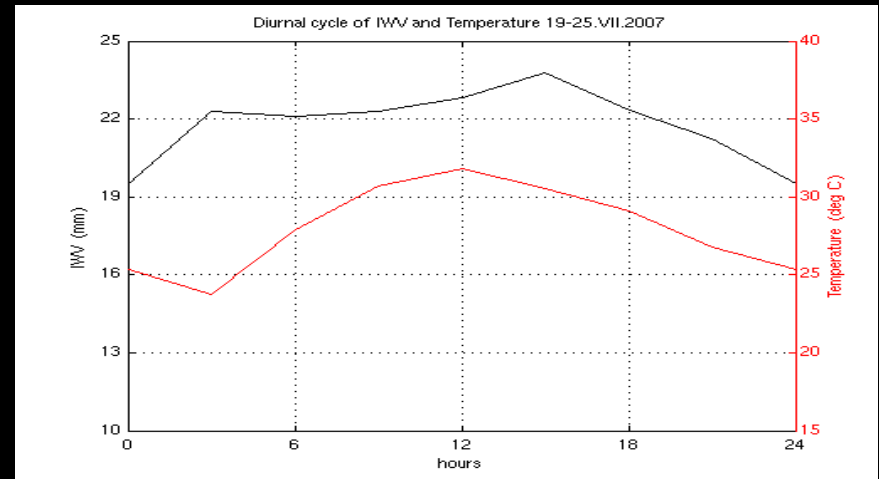
- 2D maps of IWV field during the July 2007 heat wave
- 8 GNSS stations are used
- IWV – Almost double during the day (12 UTC) than during the night (00 UTC)



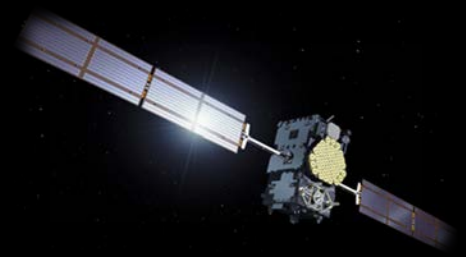
# Sea Breeze Circulation



- Black sea costal stations  
Constanta and Varna:
  - IWV minimum around 00 UTC
  - IWV maximum around 15 UTC - 3 hours after the temperature peak; peak of sea breeze circulation that brings humid sea air inland



# Conclusions

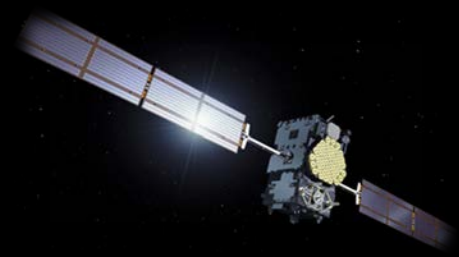
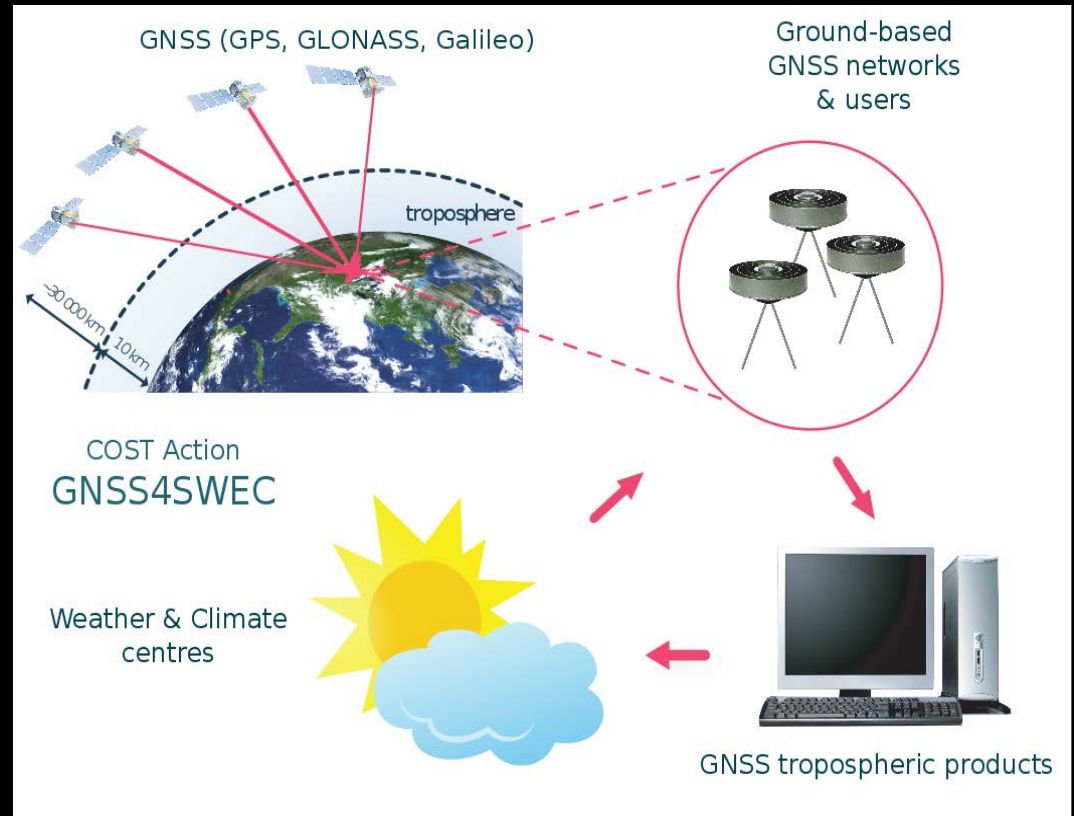


- Monitoring water vapour during the heat waves – critical; combination of high temperature and and water vapour – lethal
- First results of application of ground based GNSS meteorology method in Bulgaria/Southeast Europe
- Coastal stations at Black sea – IWV peak is 3 hours after the temperature peak and co-insides with the peak of sea breezed circulation
- The maximum of IWV - large variations depending on the local enviroment

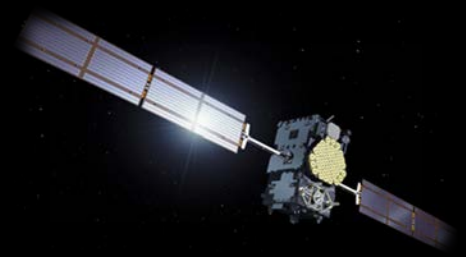


# COST project

- Advanced Global Navigation Satellite Systems tropospheric products for monitoring severe weather events and climate (GNSS4SWEC)
- Advanced GNSS processing (WG1)
- GNSS tropospheric products for monitoring severe weather (WG2)
- GNSS tropospheric products for climate monitoring (WG3)



# I want to thank to :



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- All of you for listening