



Valentia Meteorological and Geophysical Observatory





Valentia Meteorological and Geophysical Observatory



MET ÉIREANN

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KEITH LAMBKIN

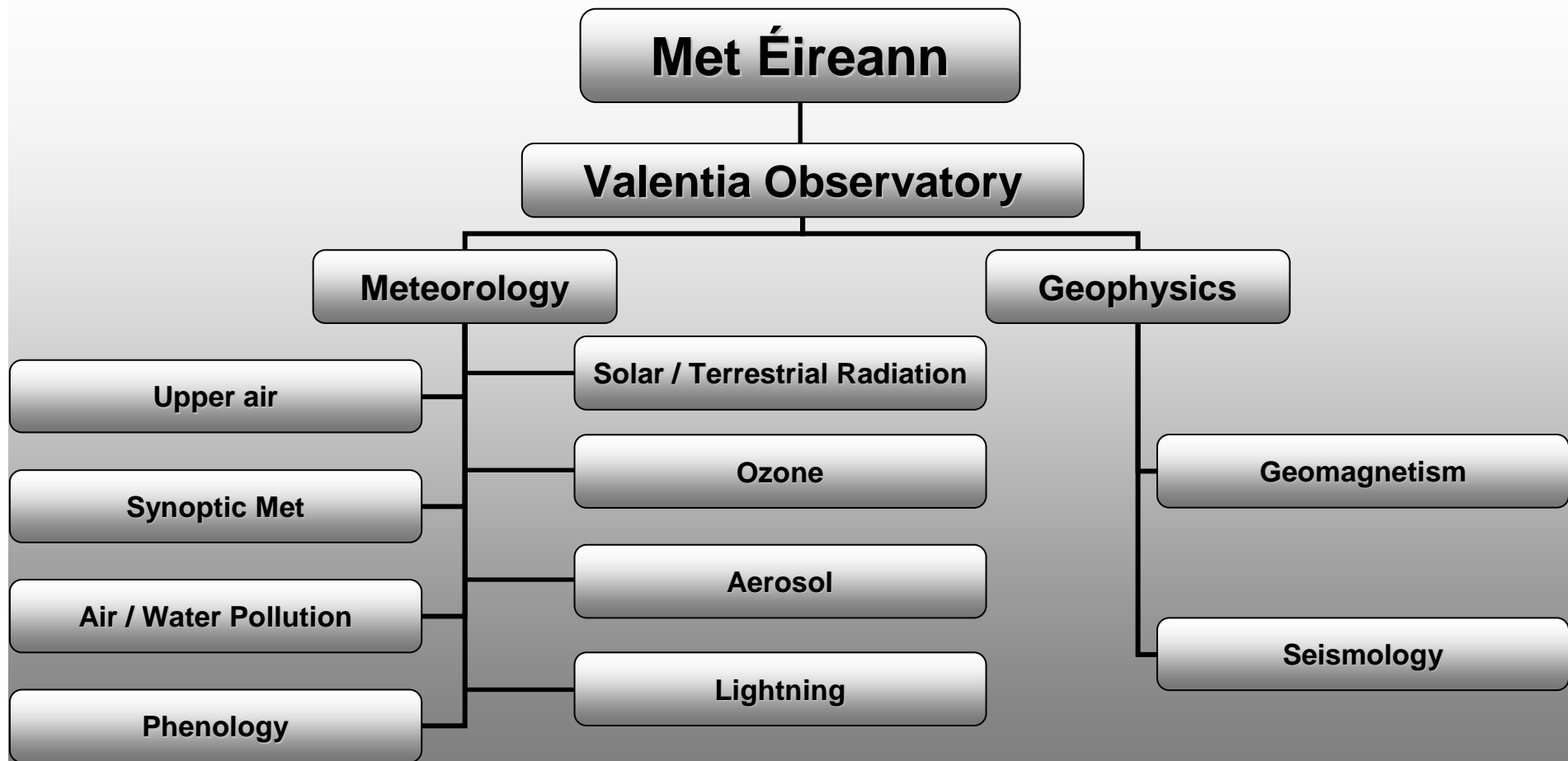
Chief Scientist (Meteorologist)

Instrumentation and Environmental Monitoring Division

Masters in Meteorology Class Field Trip to Valentia Observatory

26th Sep 2008

9:30	Welcome Work done at Valentia Observatory (Talk)	Keith Lambkin
10:30	Atmospheric Chemistry Lab & International Phenological Garden (Tour)	Aoife Ní Bhroin
11:00	Coffee Break	
11:30	Synoptic Observations and Met Enclosure (Tour)	Mike Crean
11:50	Upper Air balloon launch and explanation of balloon launch equipment and tracking (Tour)	Mike Crean
12:30	Lunch	
14:00	History of Valentia Observatory (Talk)	Mike Crean
14:30	Automatic Synoptic Telemetry at Valentia and around Ireland (Talk)	Mike Gill
15:00	Tour of rest of Observatory [Magnetics, Seismology, Solar Radiation and Ozone monitoring] (Tour)	Keith Lambkin
16:00	Close	



Programmes at Valentia

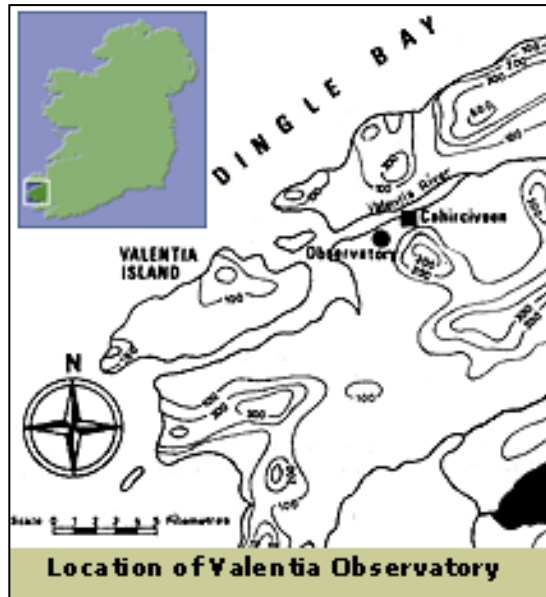




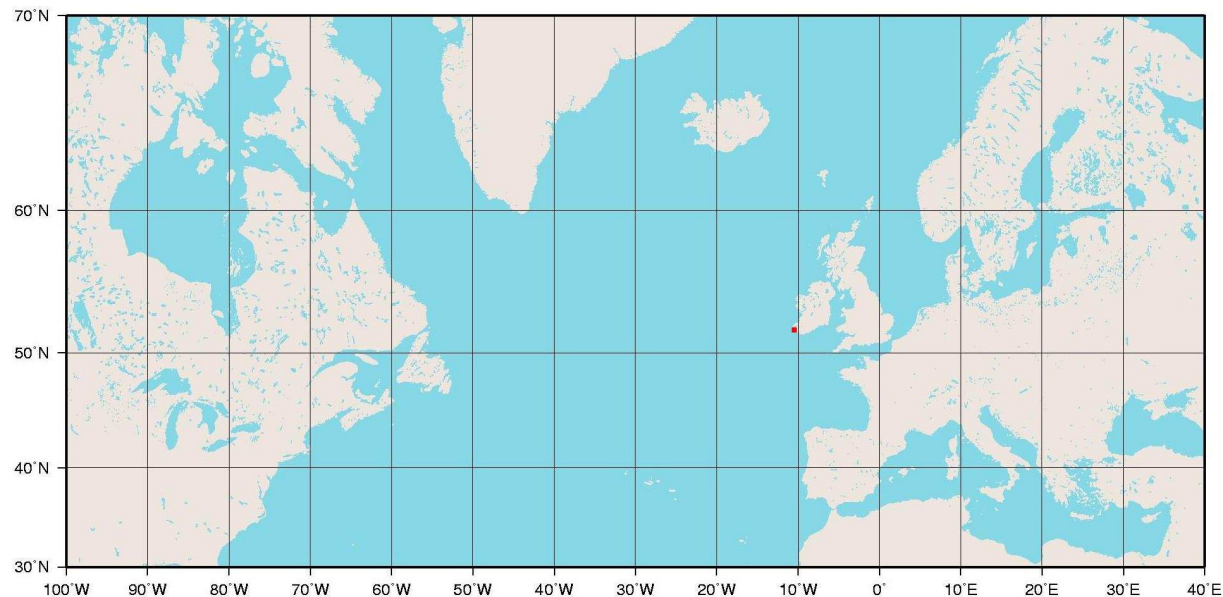
Valentia Meteorological and Geophysical Observatory



Westwood House, Valentia

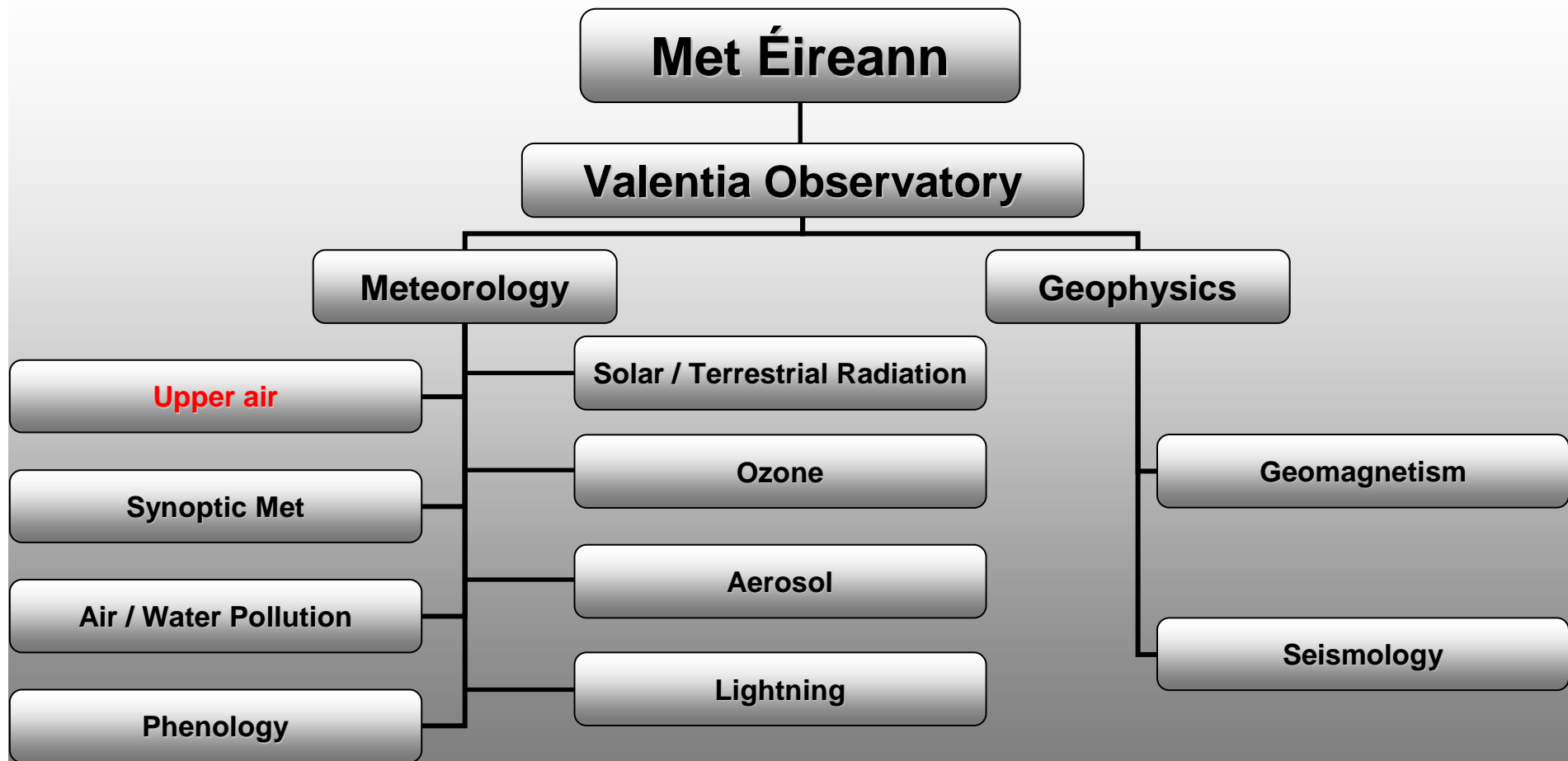


Location of Valentia Observatory



Strategic location nationally, regionally and globally

- Meteorological and Climate Change
- Environmental – Background pollution & Global Atmospheric Watch station
- Geophysical – earthquakes and earth's magnetic field (geomagnetism)



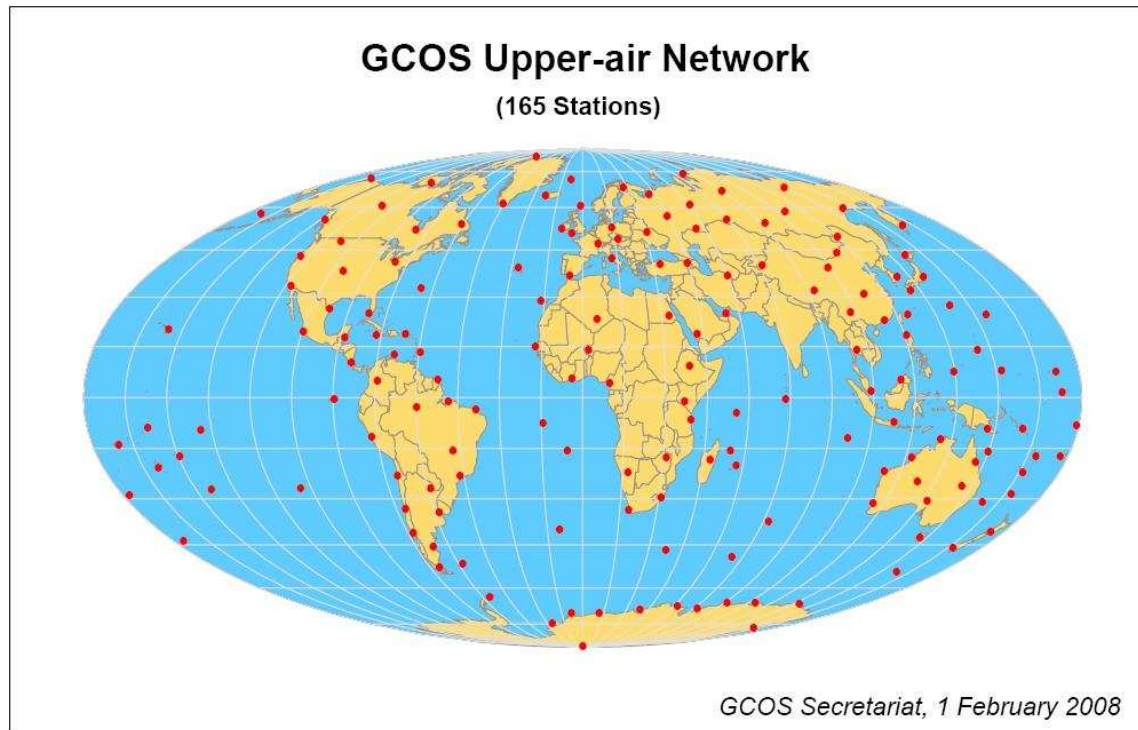
Programmes at Valentia



Upper Air Programme



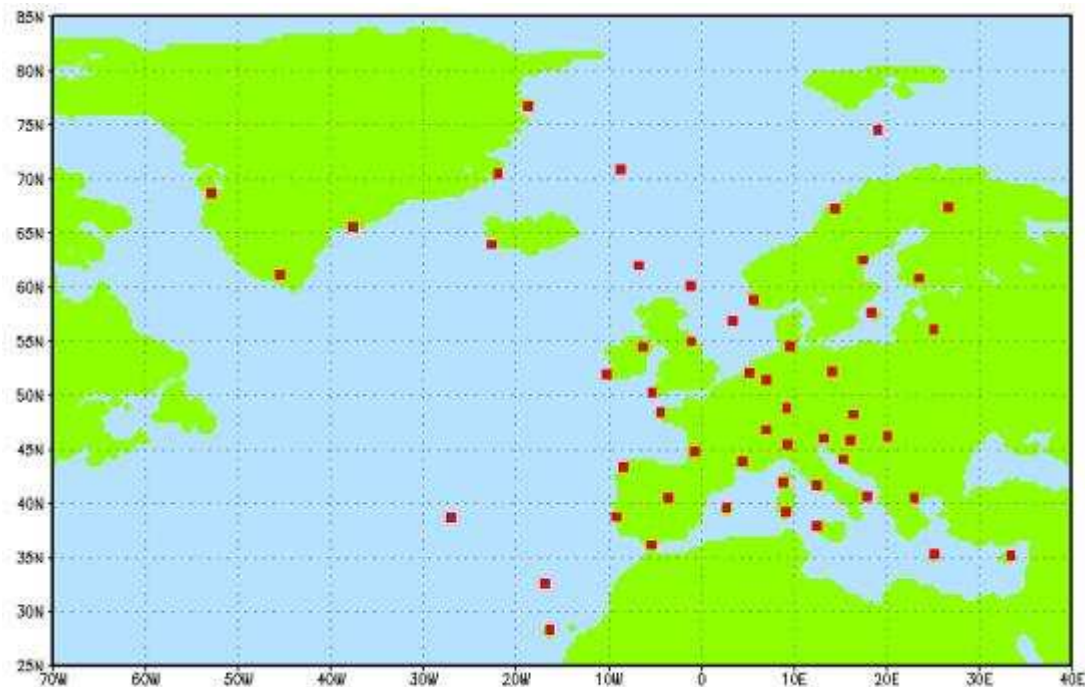
- 4 Ascents per day at 06z, 12z, 18z and 00z
- Measuring Temperature, Humidity, Atmospheric pressure, Wind Speed and direction.
- Member of **GUAN** (GCOS Upper Air Network), **EUCOS** (EUMETNET Composite Observing System)



Upper Air Programme



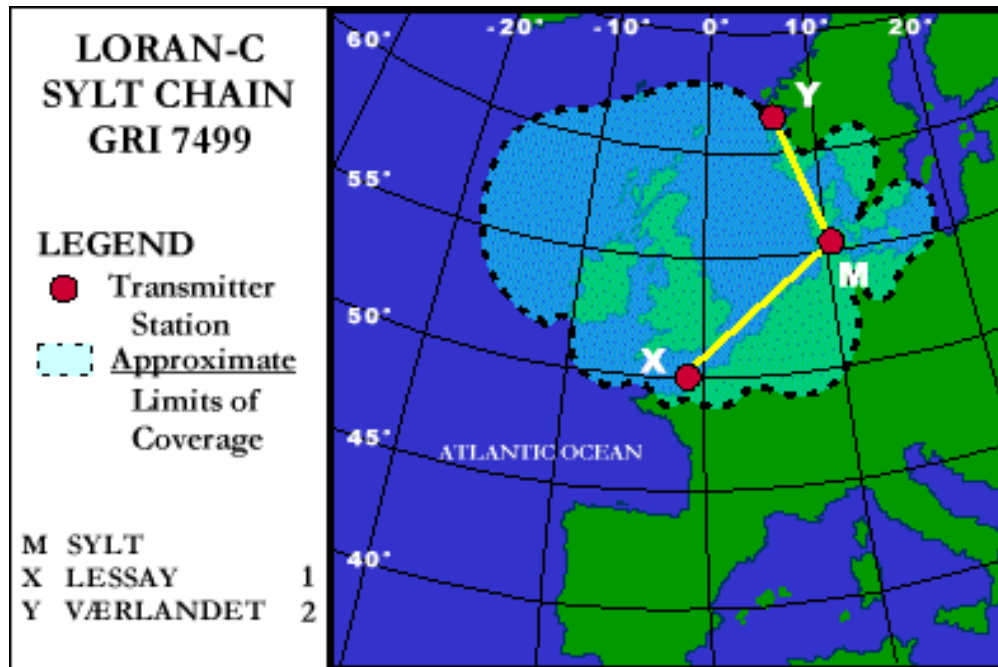
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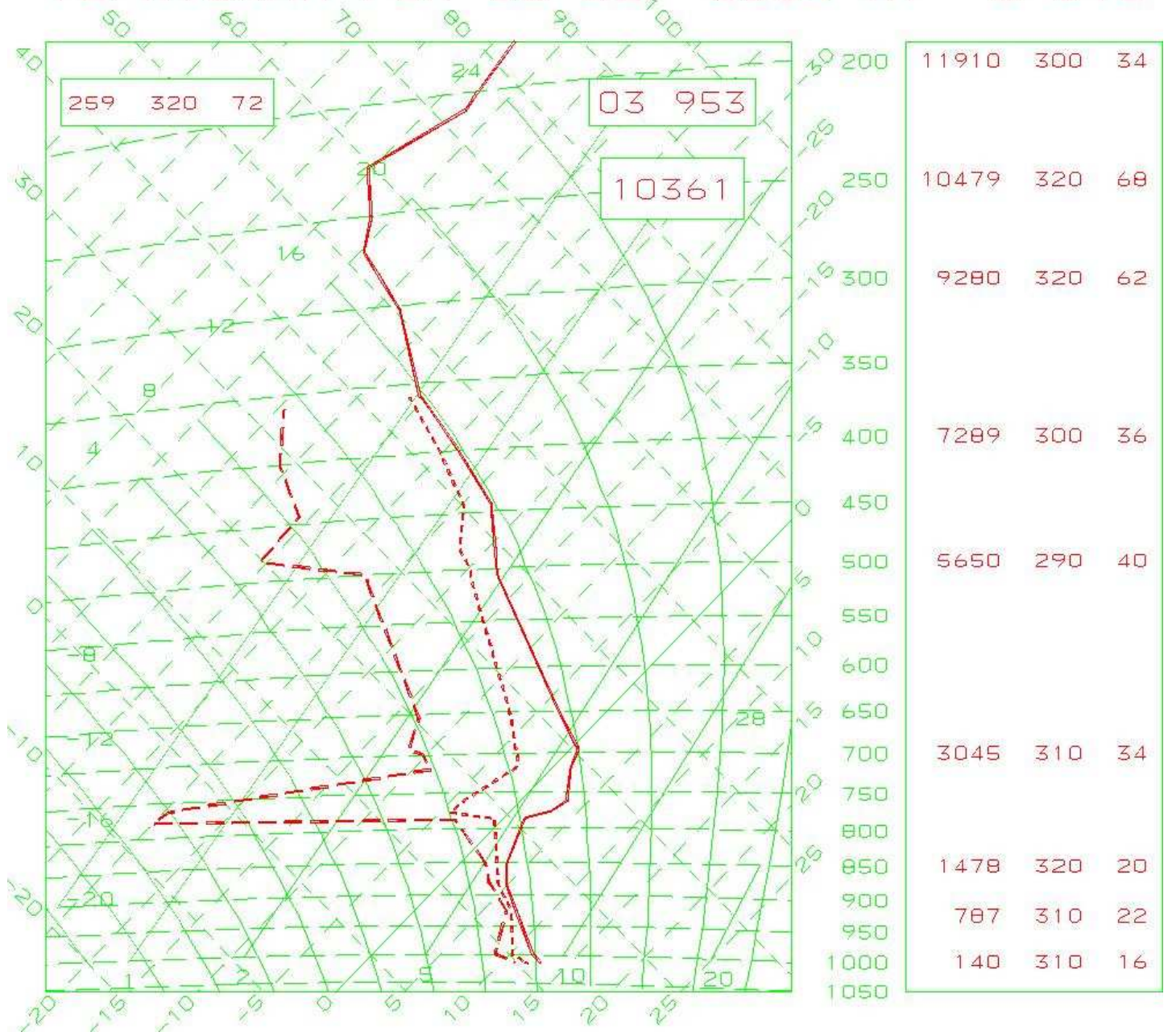
Upper Air Programme



- Navigational reference systems: **LORAN C** (**L**ong **R**ange **N**avigation) and **GPS**
- Measuring Temperature, Humidity, Atmospheric pressure, Wind Speed and direction.



TEPHIGRAM FOR 30 SEP 2004 AT 6 UTC



Upper Air Summary

- ❑ Valentia is the only place in the Republic of Ireland that launches upper air balloons for meteorological purposes
- ❑ 4 ascents a day

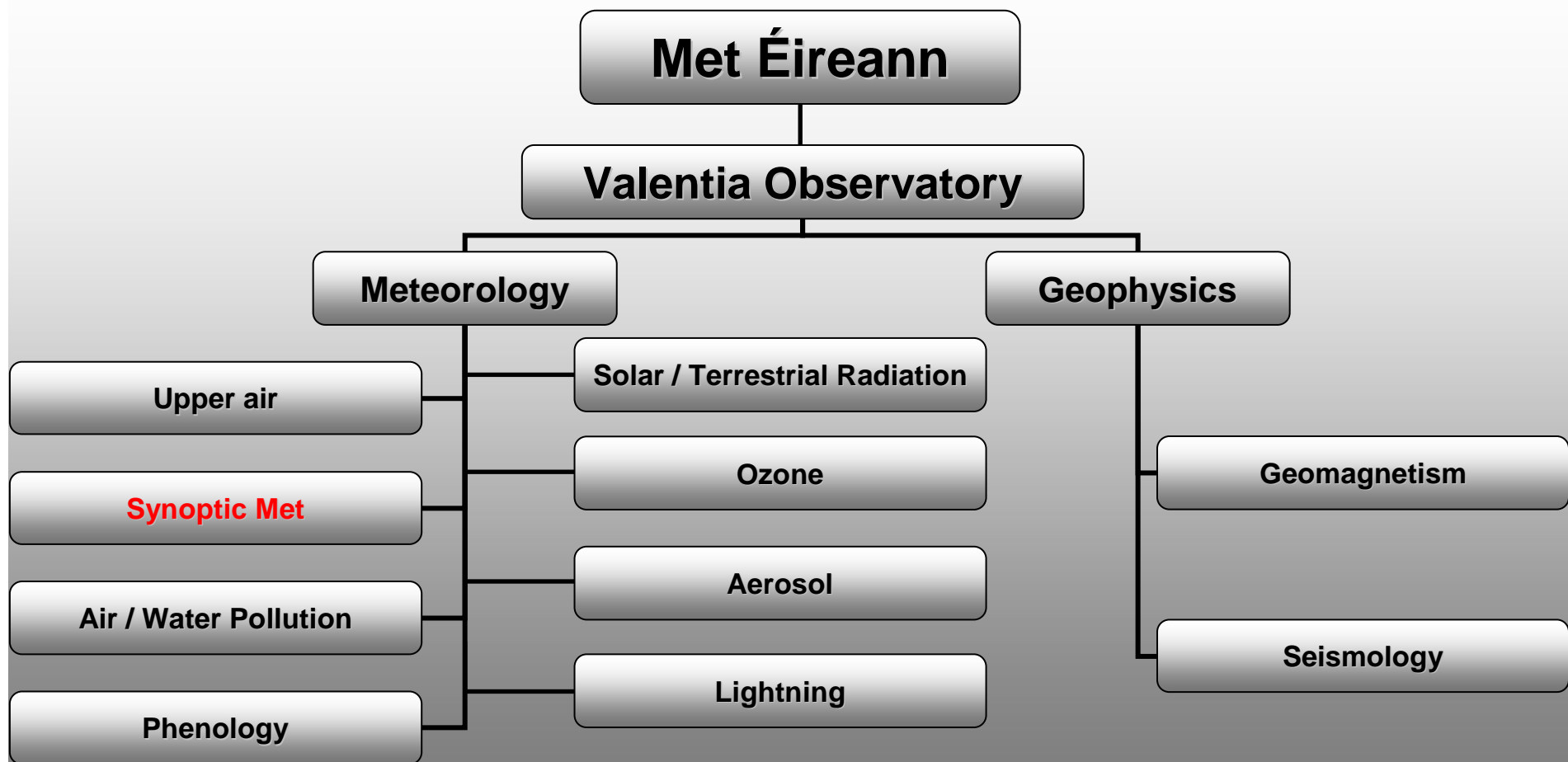
Why?

- ✓ Provide Tephigram chart as a forecast analysis tool
- ✓ To supply vertical profile data to forecast models
- ✓ Used to calibrate satellite sensors



Programmes at Valentia





Programmes at Valentia



Synoptic Weather Station



Surface Met Measurements

- Dry and Wet Bulb Temperature
- Pressure
- Wind Speed and Direction
- Rainfall
- Visibility
- Cloud type and amount
- Gamma dose rate (Radiological Protection Institute of Ireland)



Synoptic Weather Station



Surface Met Measurements

- Dry and Wet Bulb Temperature
- Pressure
- Wind Speed and Direction
- Rainfall
- Visibility
- Cloud type and amount
- Gamma dose rate (Radiological Protection Institute of Ireland)



Synoptic Meteorology Summary

- ❑ Standard meteorology parameters recorded
- ❑ [Dry and Wet Bulb Temperature, Pressure, Wind Speed and Direction, Rainfall, Visibility, Cloud type and amount]

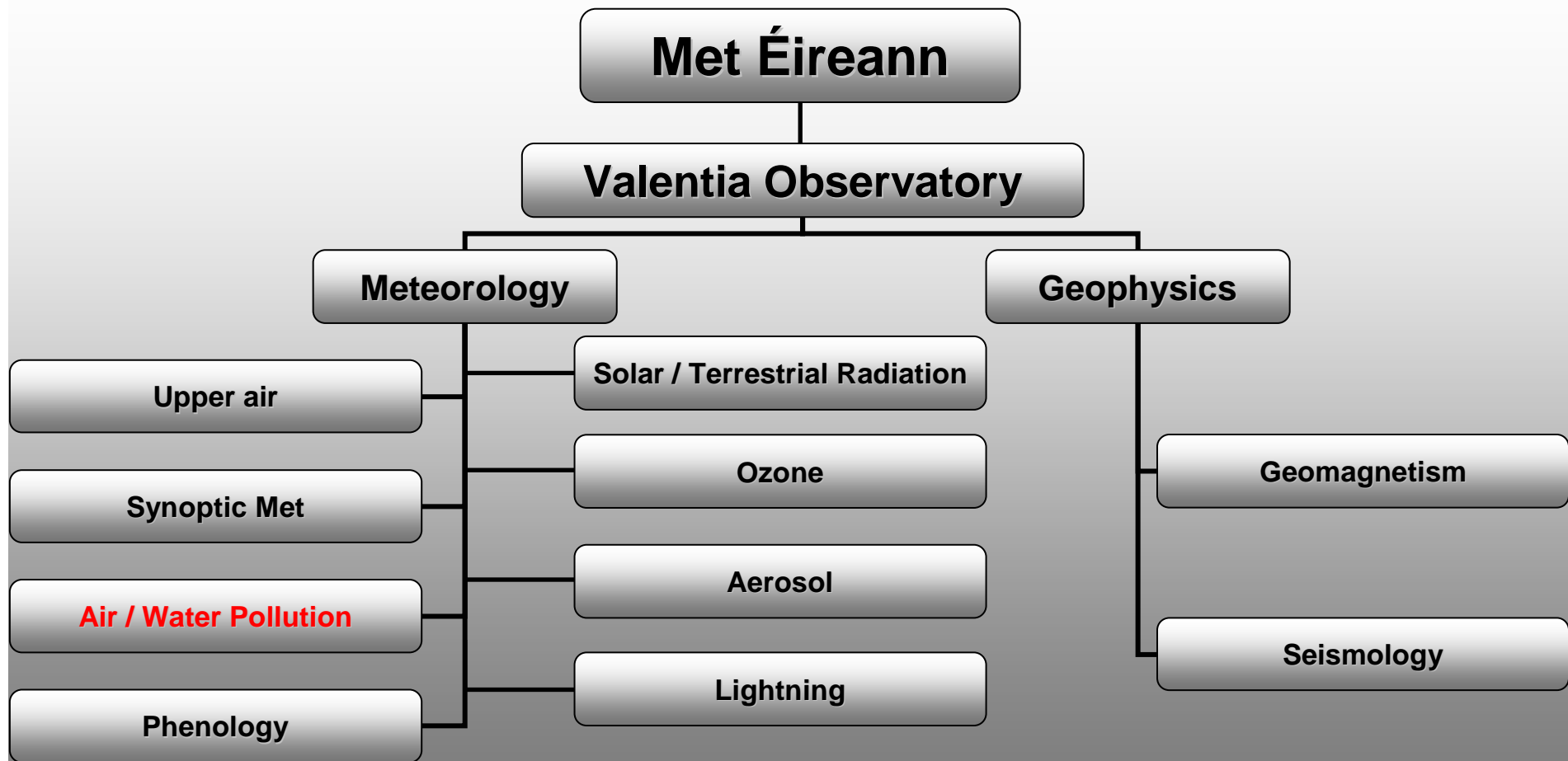
Why?

- ✓ To supply a snapshot of the current weather situation, for forecast purposes
- ✓ Climate record purposes



Programmes at Valentia





Programmes at Valentia





Air and Rainwater Monitoring



1. Air Monitoring:

EMEP: NO_2 - (Nitrogen Dioxide) – daily measurements

EMEP: SO_2 - and SO_4 - (Sulphur Dioxide) – using impregnated filters – daily measurements

EPA: Ground Level Ozone – hourly

2. Rainwater Sampling:

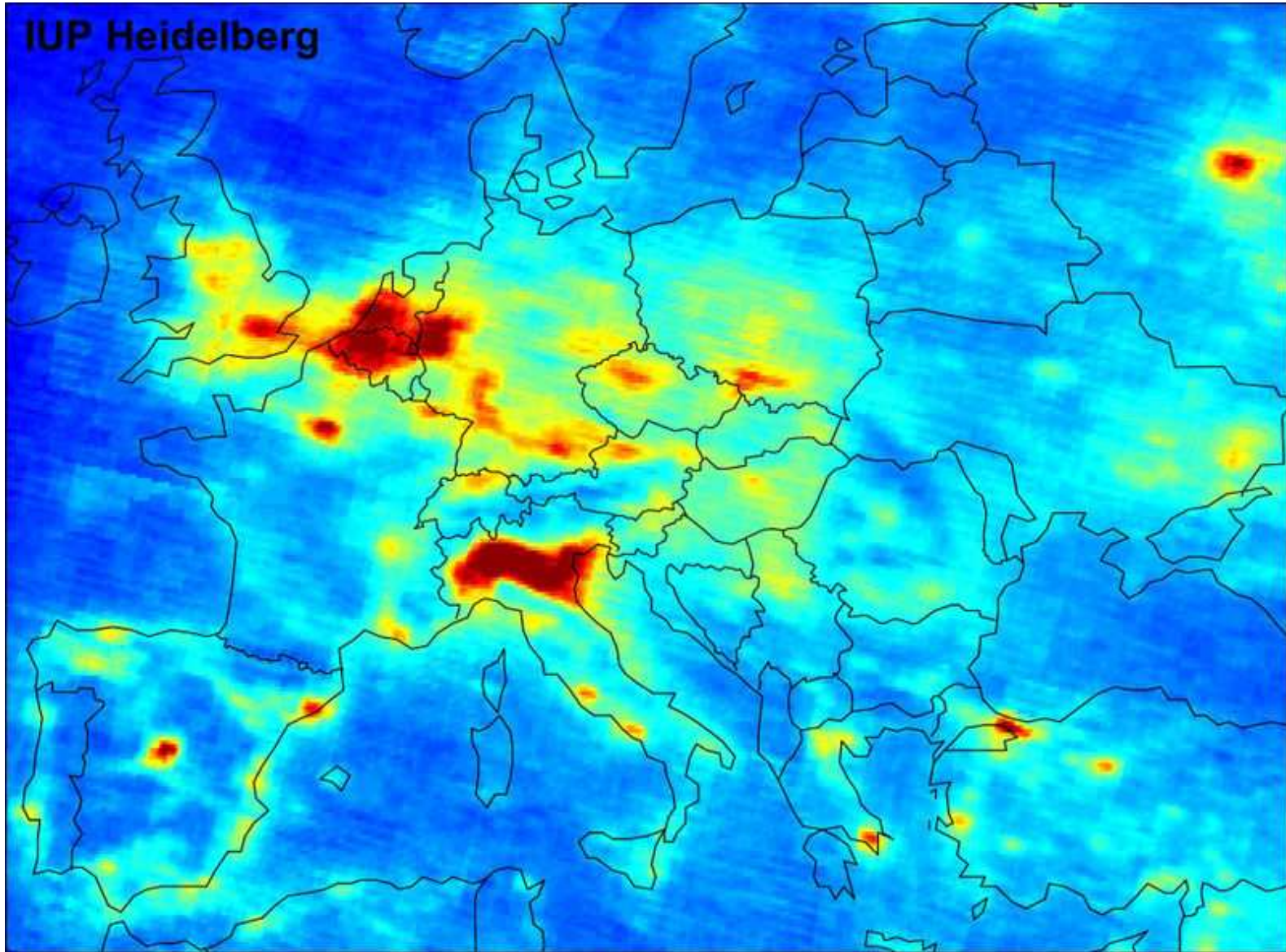
EMEP : Na^+ , Ca^+ , K^+ , Mg^+ , NH_4-N , Cl^- ,
 NO_3-N , SO_4-S , Conductivity – daily

IAEA: Analysis – monthly

EPA: Heavy metals – monthly

pH: Daily





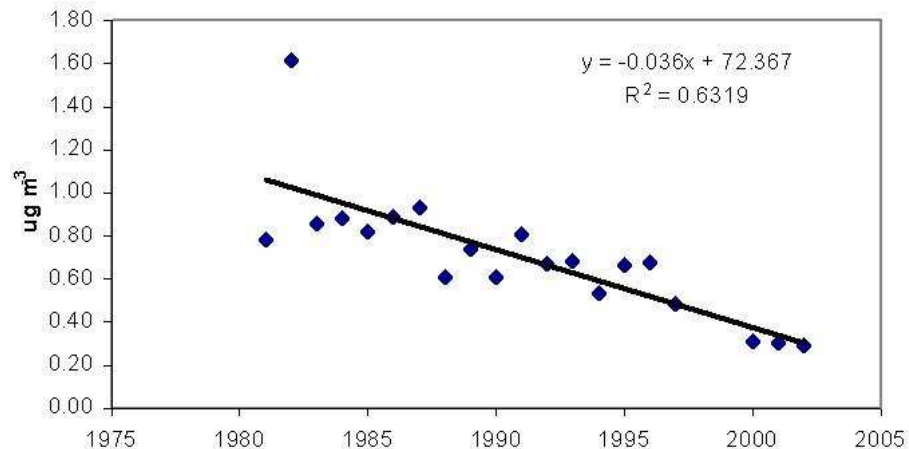
NO₂ Pollution levels in Europe (Jan 03 – Jun 04)



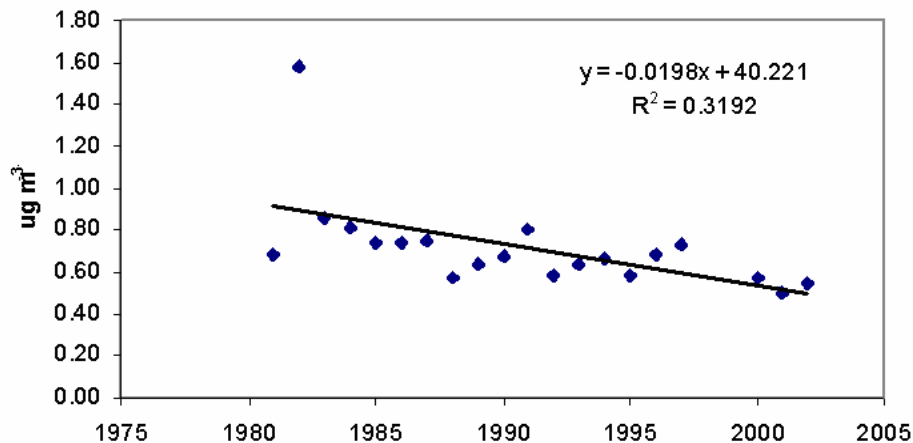
Air and Rainwater Monitoring



Annual average SO₂ levels for the period 1980 to 2002 at Valentia



Annual average SO₄ levels for the period 1980 to 2002 at Valentia



From Bashir and McGovern 2004

- **Convention on Long-range Transboundary Air Pollution (CLRTAP) – 1979**

- **The *Gothenburg Protocol* to abate Acidification, Eutrophication and Ground-level Ozone – 2004**

- **SO₂ and SO₄ since 1981 – most extensive record in Ireland.**

- **NO₂ since 1989 – most extensive in Ireland**

Air & Rainwater Monitoring Summary

- ❑ Valentia's lab (& HQ Dublin lab) measures pollutants in Air and Rainwater

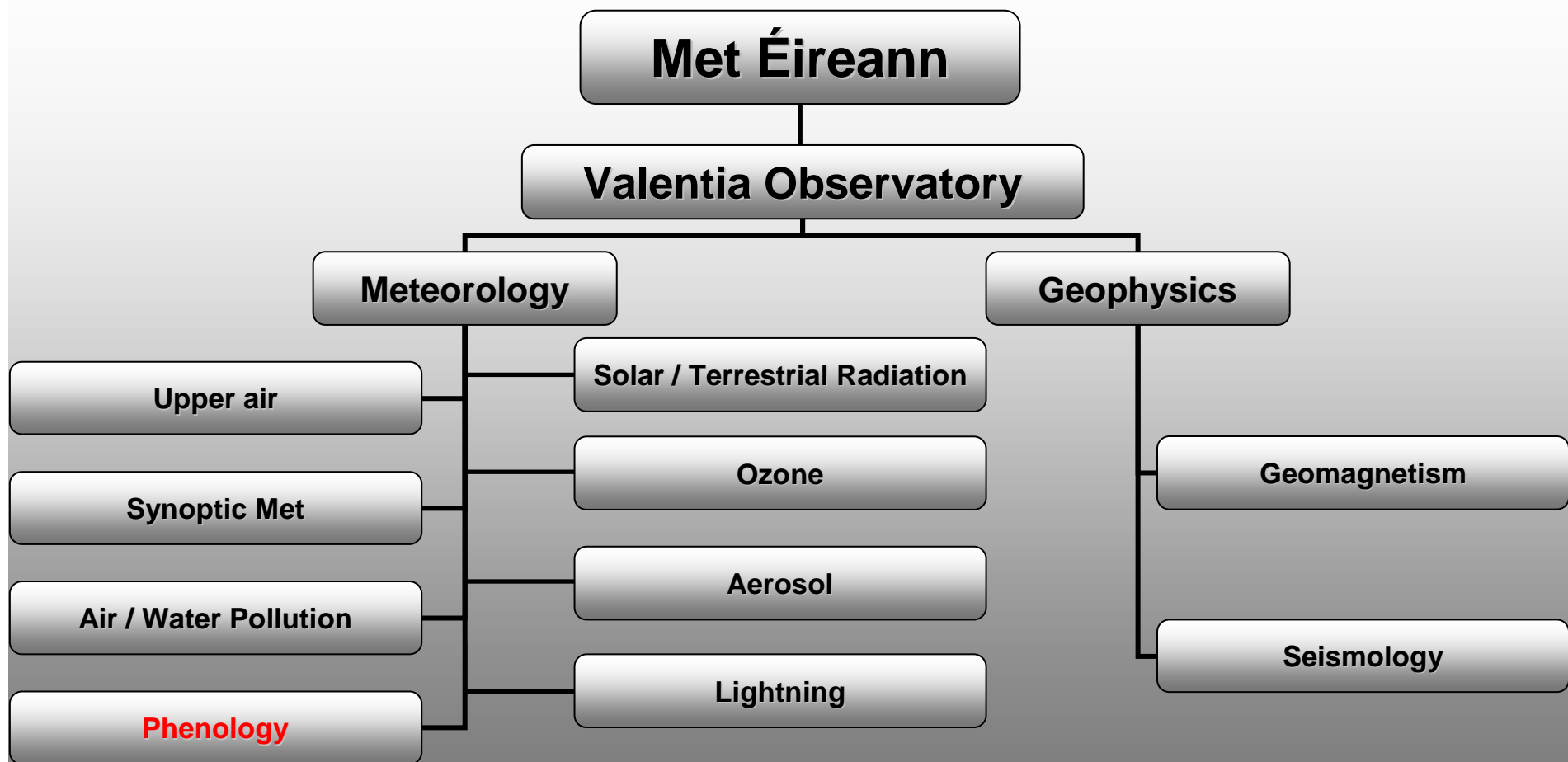
Why?

- ✓ To provide excellent background count values for Europe
- ✓ Monitor changes in pollution levels over Ireland



Programmes at Valentia



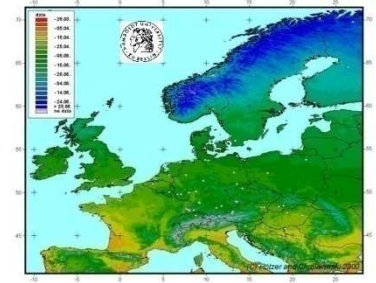


Programmes at Valentia





Valentia IPG



International Phenological Garden programme focussed on possible impacts of climate change on plant ecosystems

Observed Phases:

Beginning of leaf-unfolding

General flowering

First ripe fruits

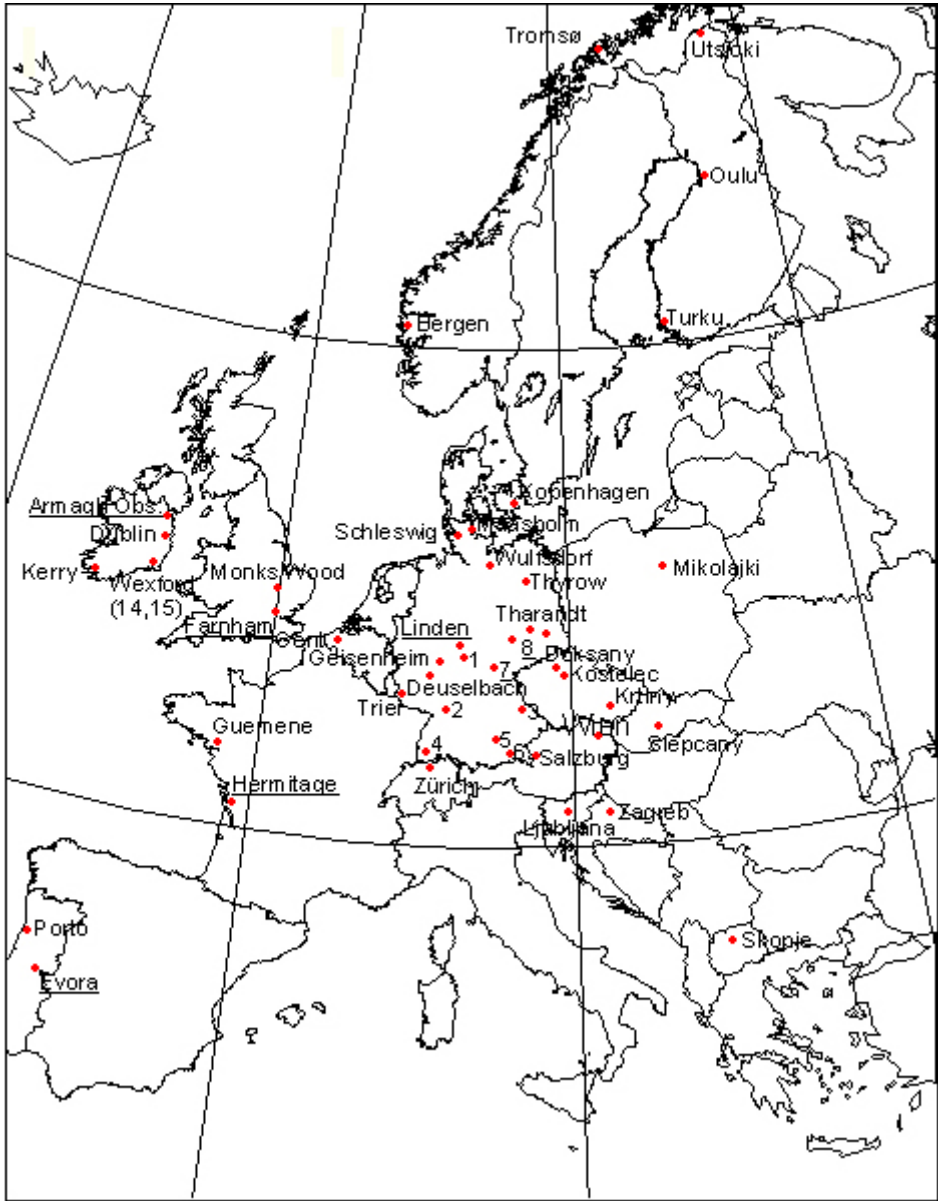
Autumn colouring

Beginning of flowering

Leaf fall

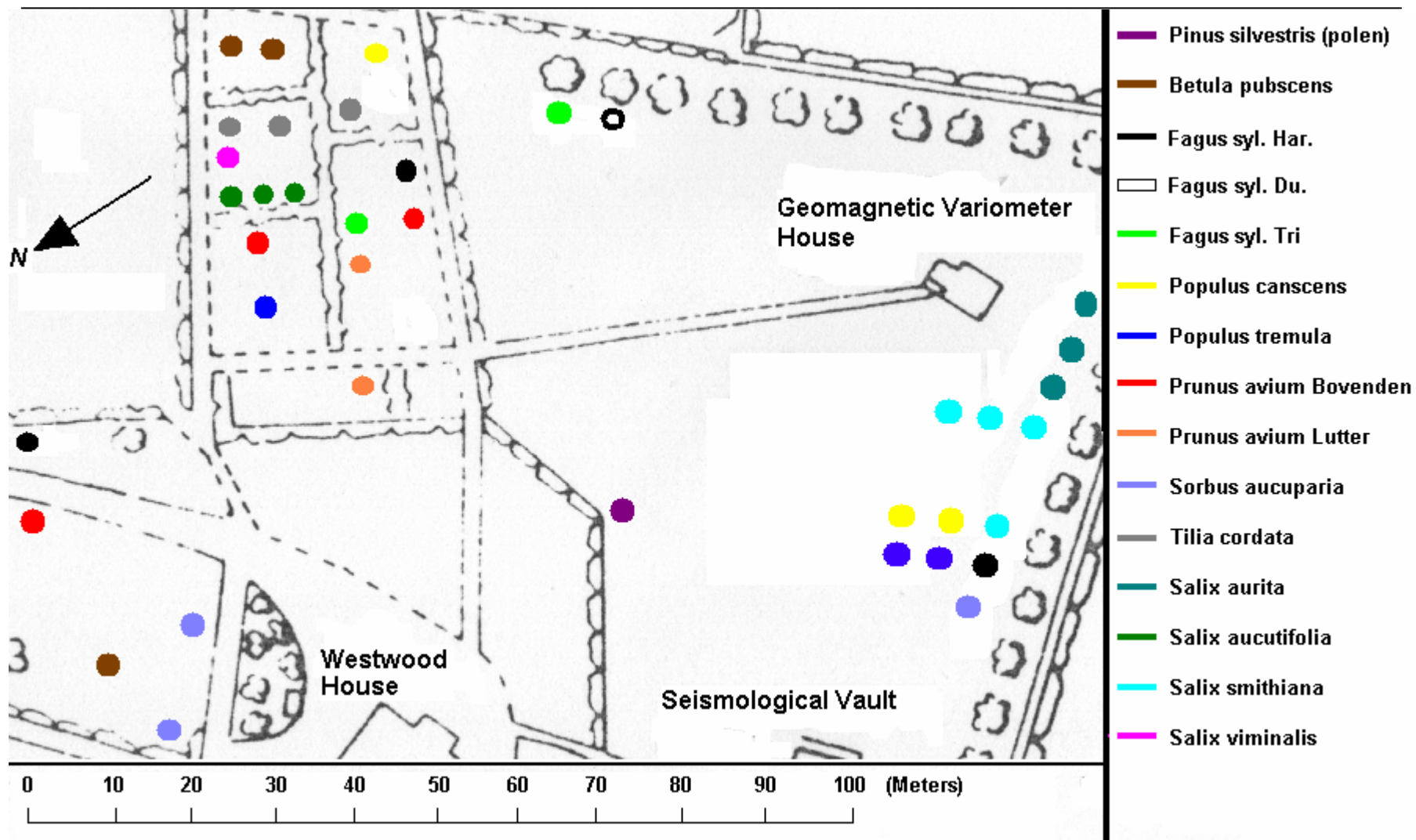


IPG European Network





IPG at Valentia Observatory

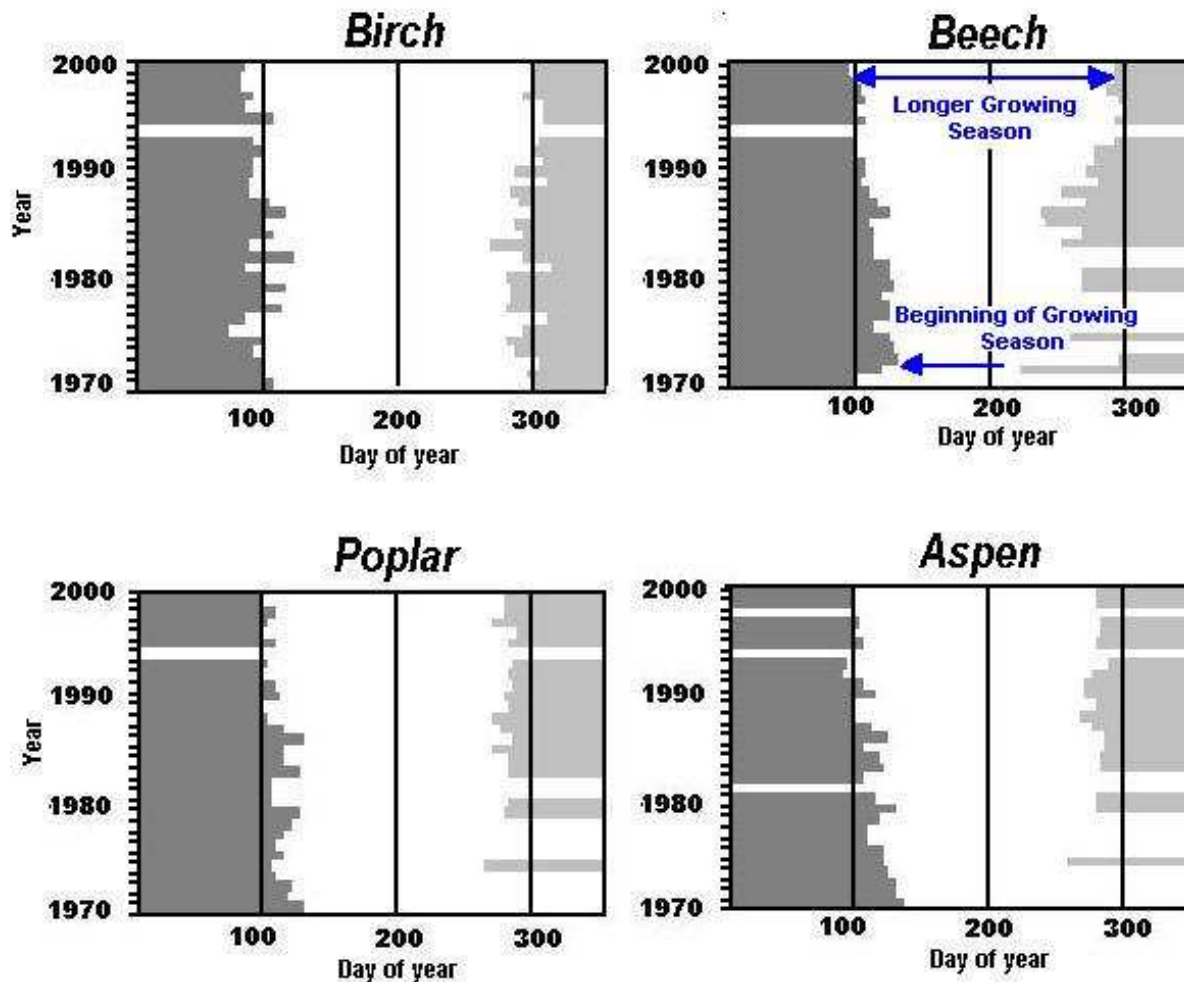




IPG at Valentia Observatory



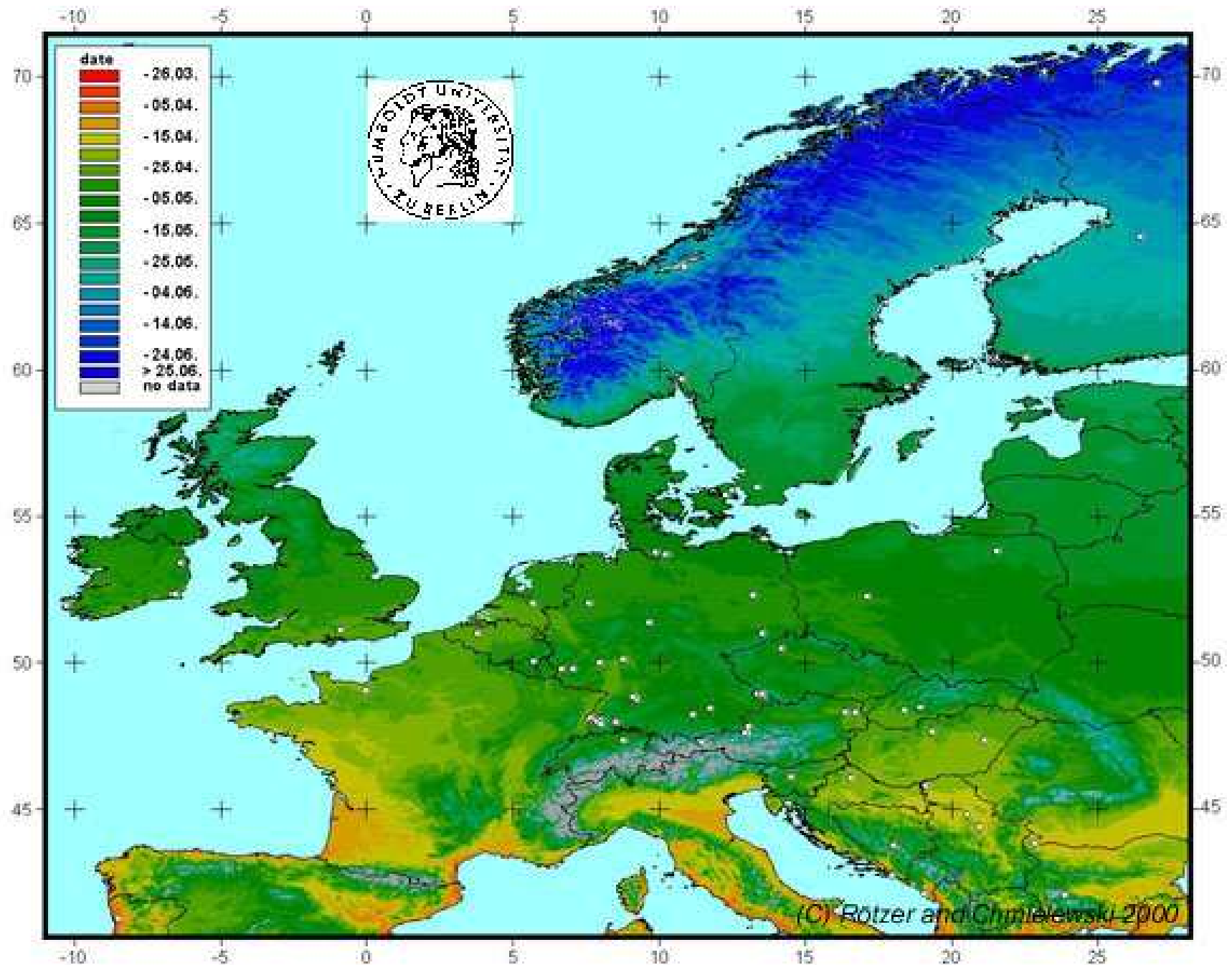
Length of Growing Season at Valentia Observatory



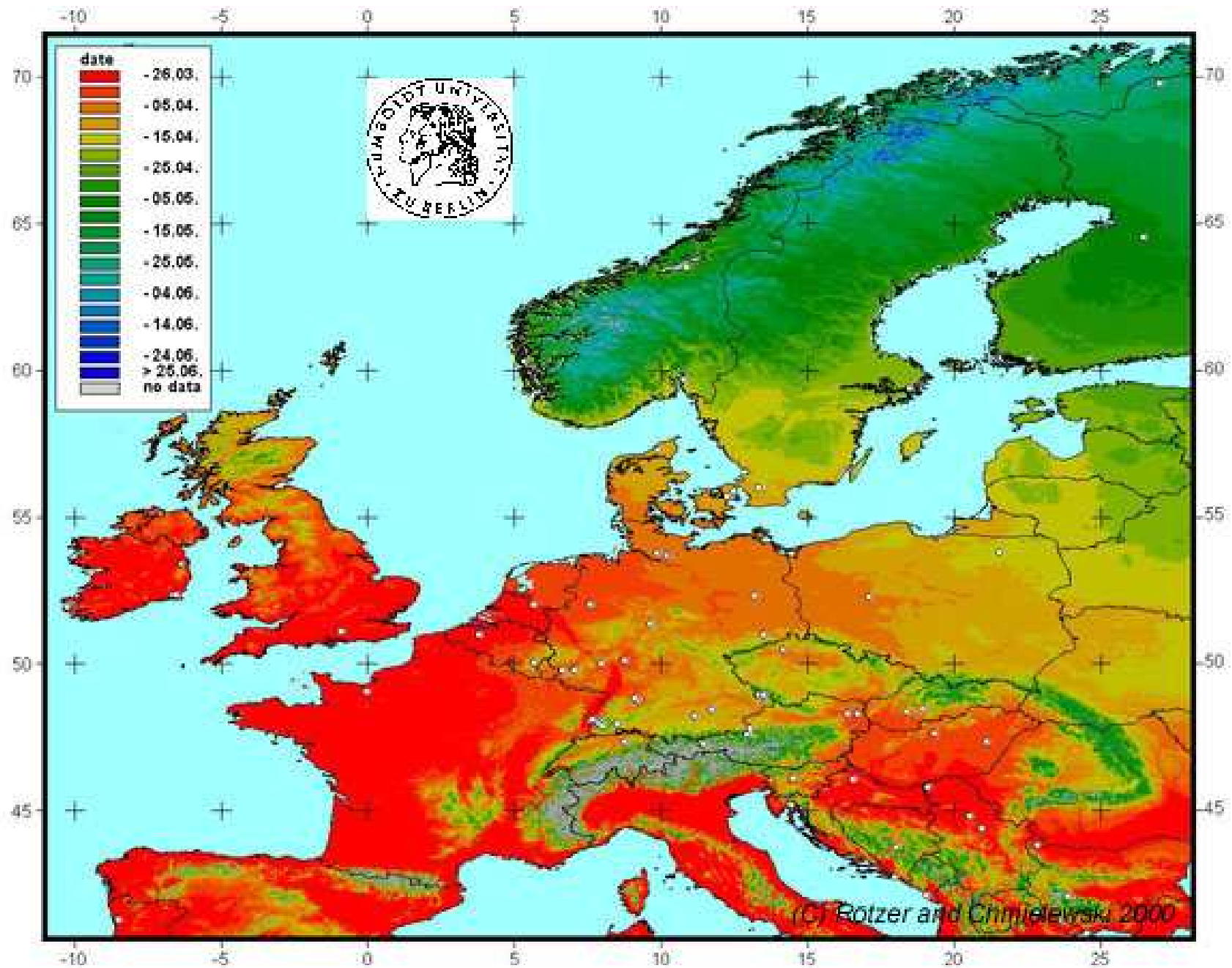
Adapted from Donnelly, Salamin and Jones 2005

- Phenology used as indicator for climate change
- All Species except Birch now leaf earlier than in 1970
- An increase in 1°C average Spring temperature corresponds to an approx 7 day advance of the *beginning of growing season*
- An increase in 1°C annual temperature up to 29 day (Beech) increase in the *length of growing season*

Beginning of Growing Year 1970 (late)



Beginning of Growing Year 1990 (Early)



Phenology Summary

- ❑ Valentia Observatory records phase changes on a number of 'cloned' trees

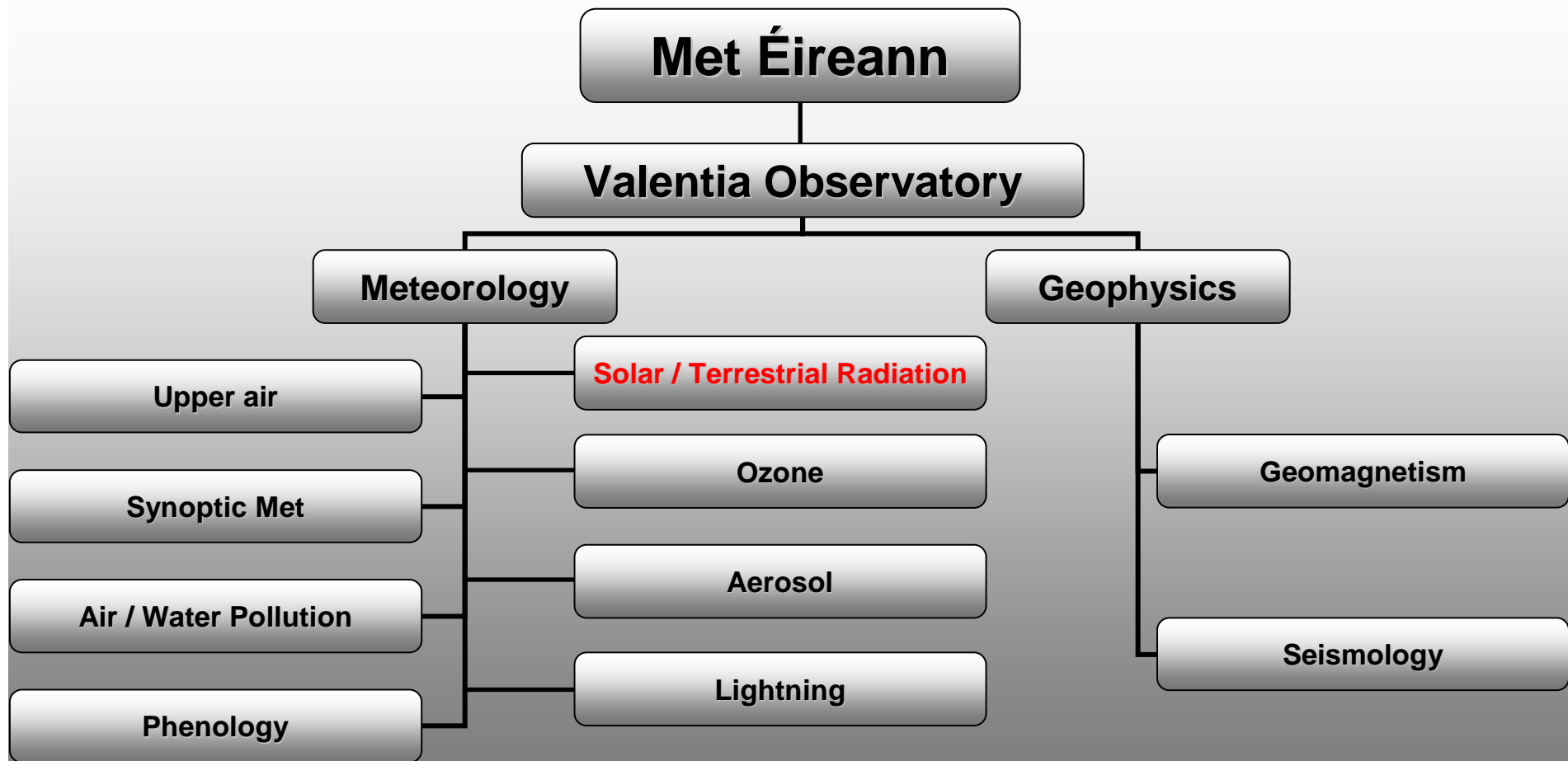
Why?

- ✓ Phenology can be used as a climate change indicator



Programmes at Valentia



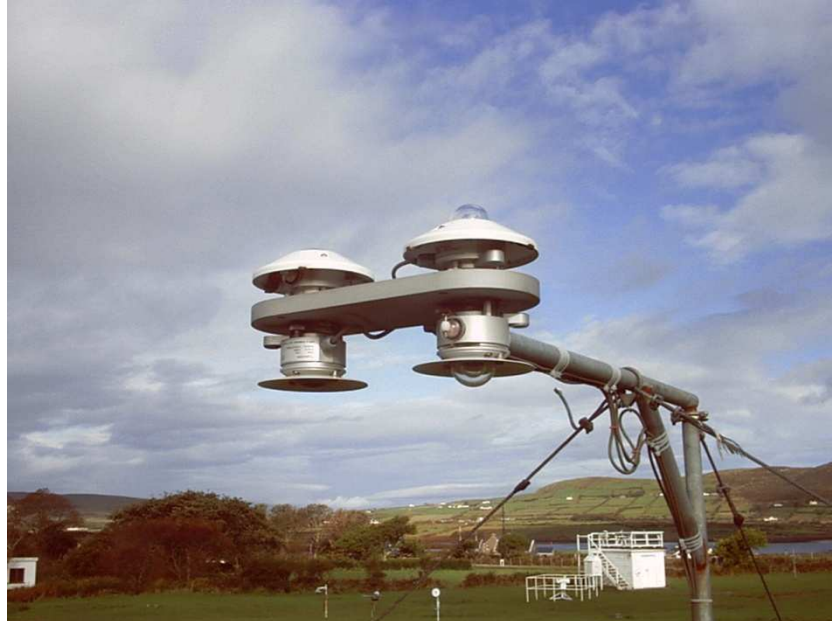


Programmes at Valentia





Valentia Solar and Terrestrial Radiation Measurements



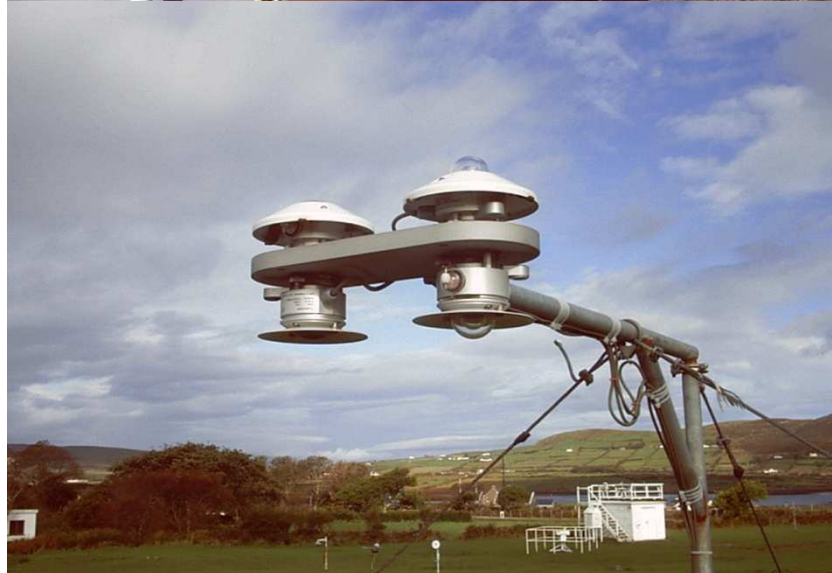


Valentia Solar and Terrestrial Radiation Measurements





Valentia Solar and Terrestrial Radiation Measurements





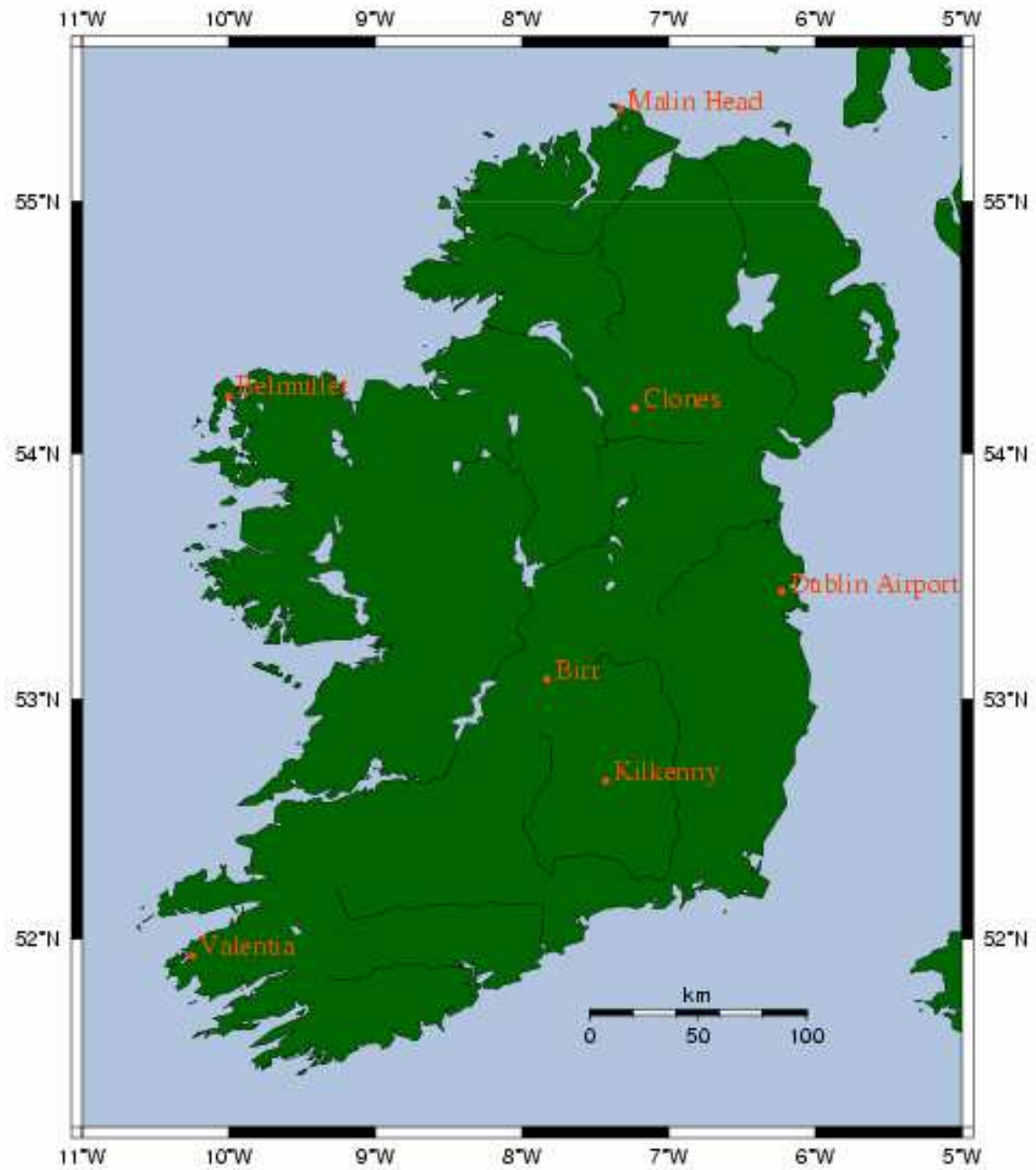
Valentia Solar and Terrestrial Radiation Measurements



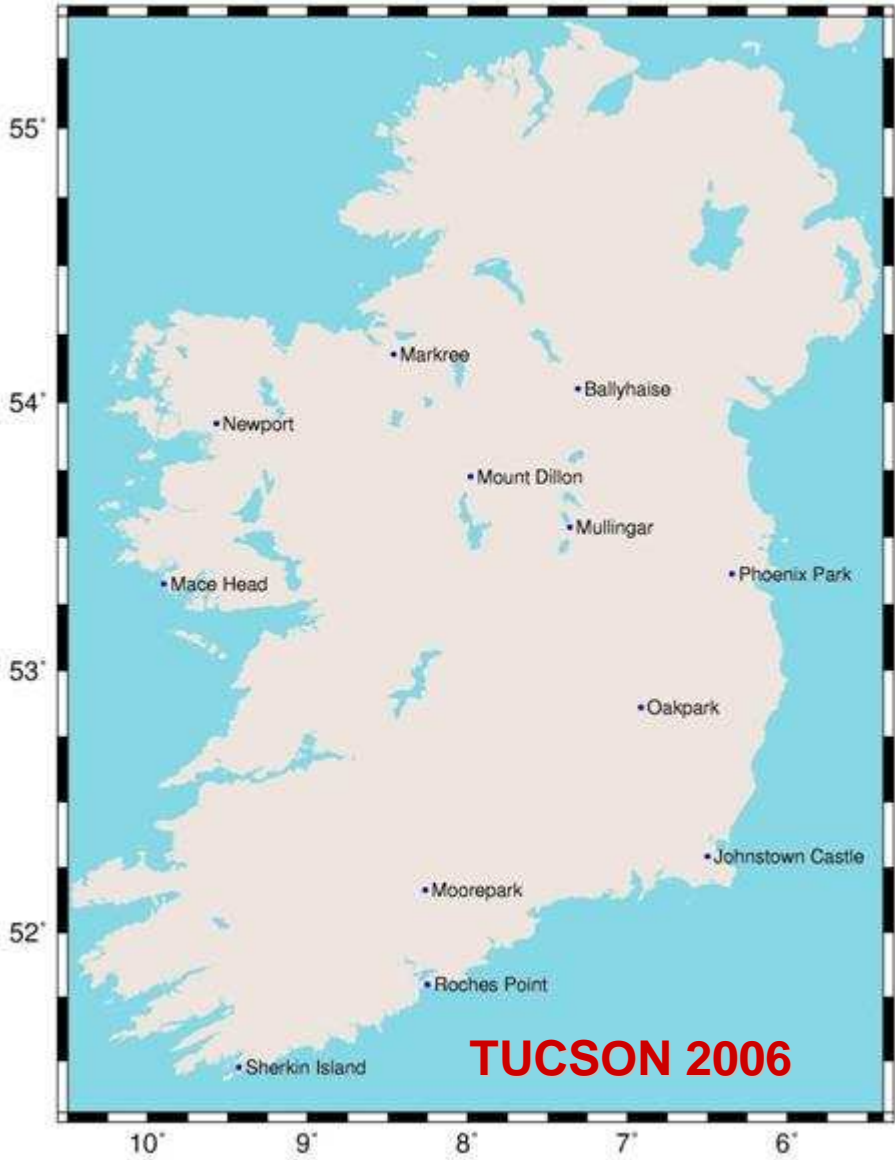
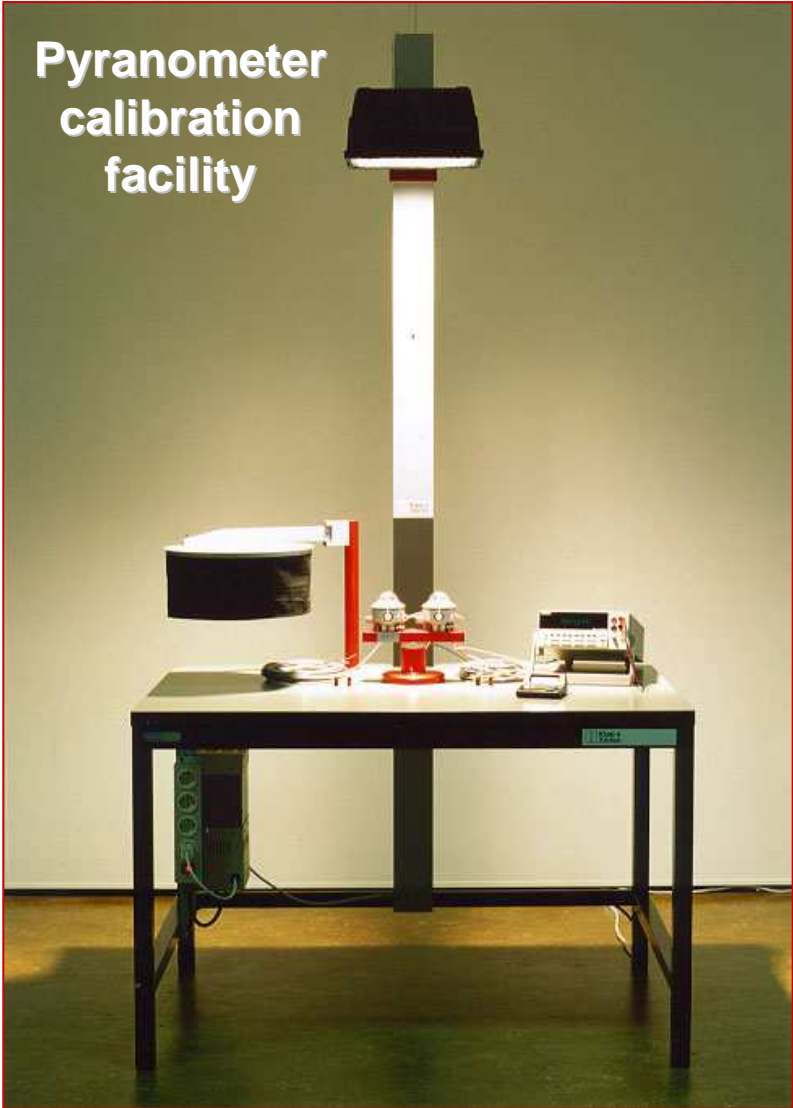
Westwood House, Valentia



Solar Radiation Network



Network Calibration



Solar / Terrestrial Radiation Summary

- ❑ Valentia Observatory records 'Direct' , 'Diffuse' and 'Global' solar radiation
- ❑ Upward and downward LW and SW radiation
- ❑ Calibrate Ireland's Solar radiation network

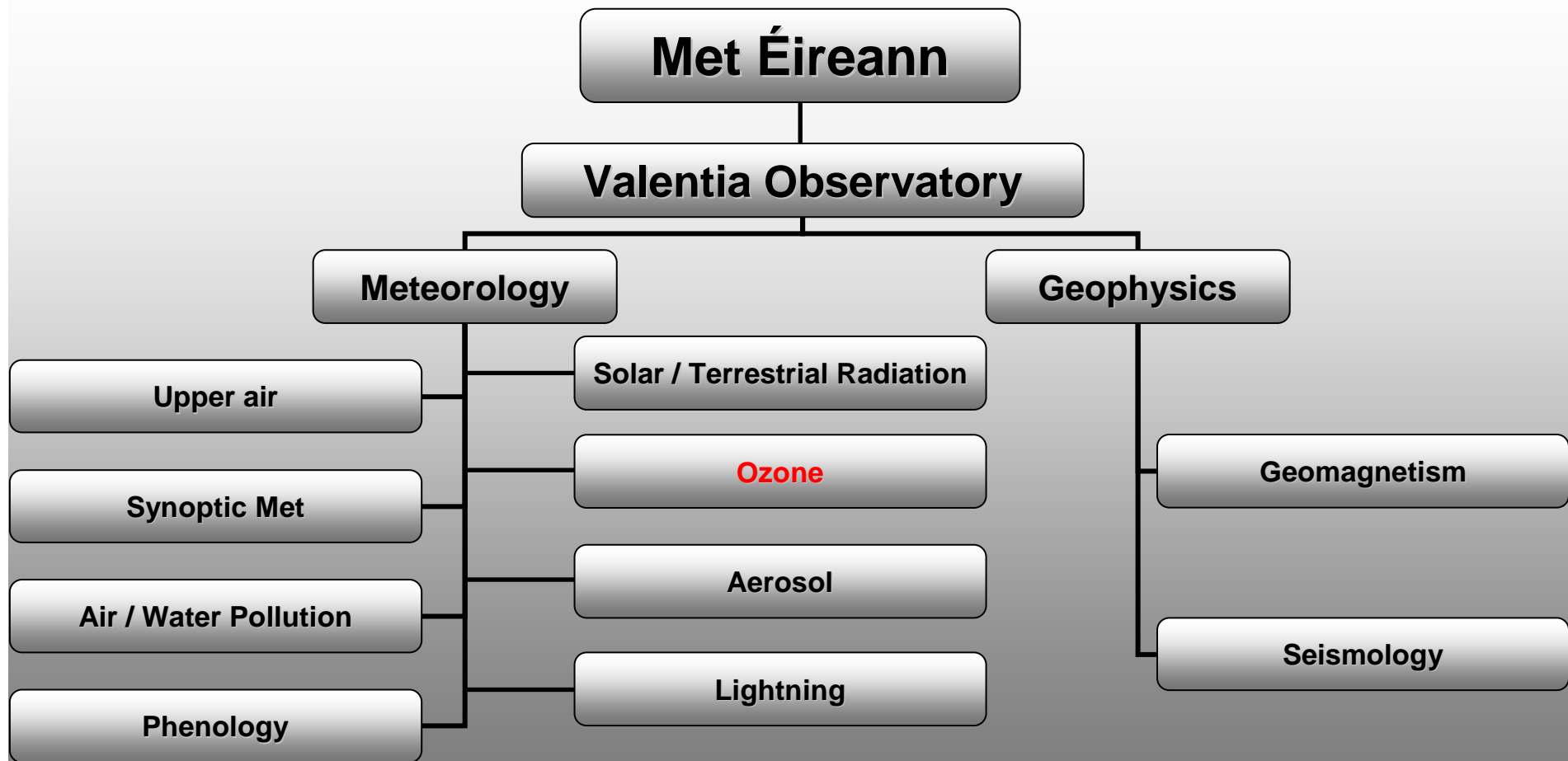
Why?

- ✓ Climate Records
- ✓ Research



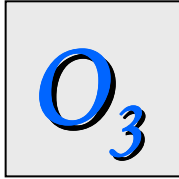
Programmes at Valentia



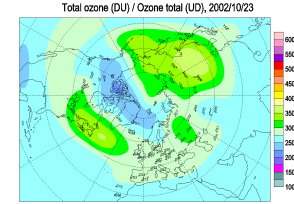


Programmes at Valentia





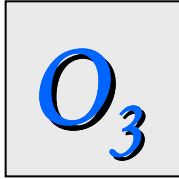
Ozone



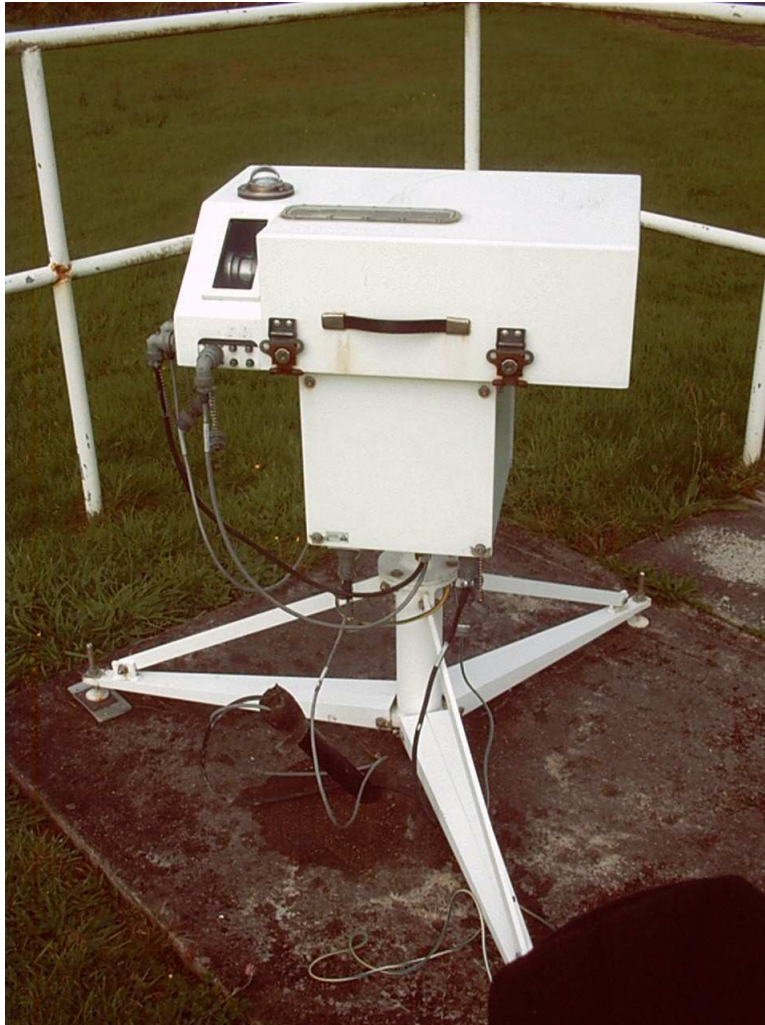
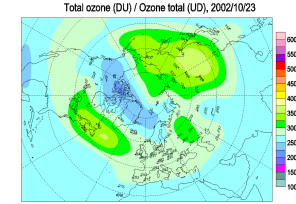
Ground Level Ozone



- 1999 - UV Absorption Ozone Analyzer
- EPA download hourly averages once a day
- Data available 2001-present



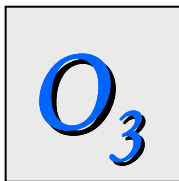
Ozone



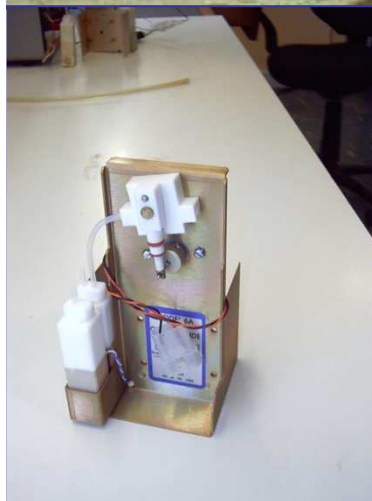
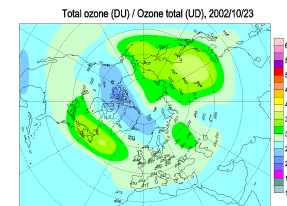
Brewer Spectrophotometer #088

BREWER

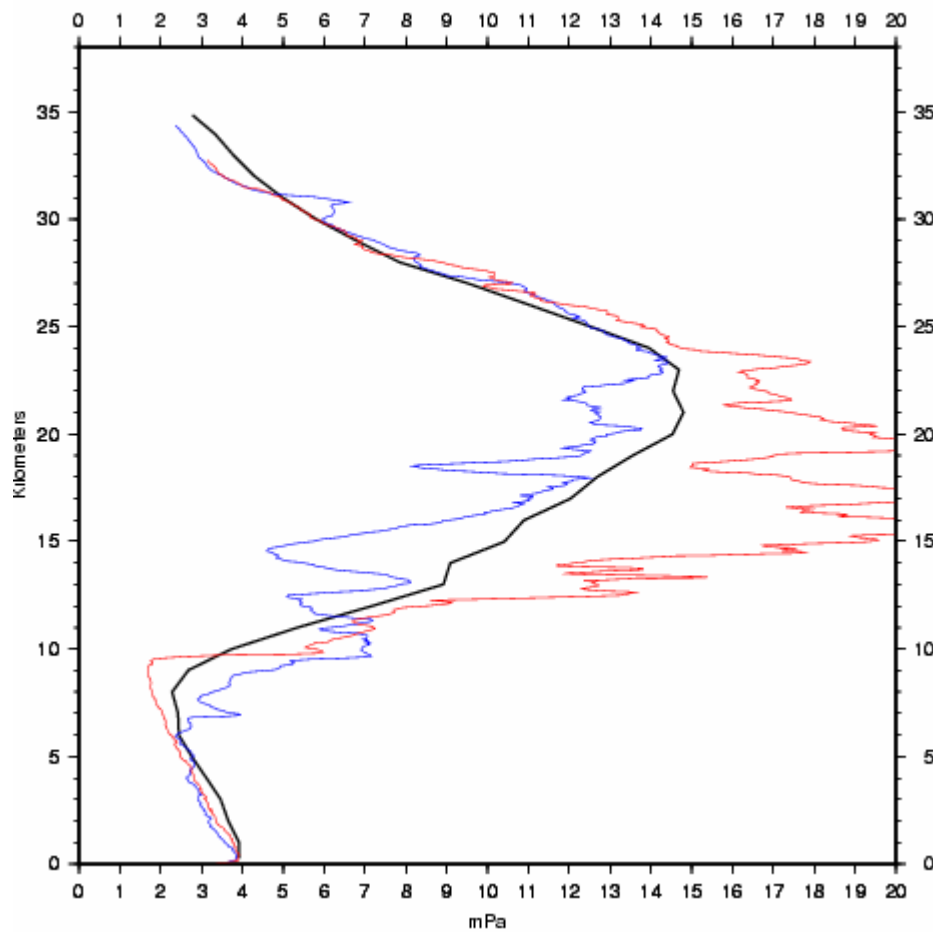
- Measures Total Column Ozone (DU)
- Spectral instrument
- Part of **G**lobal **O**zone **O**bservation **S**ystem
- Automated / continuous measurements
- **W**orld **O**zone & **U**VB **D**ata **C**entre - depletion recovery



Ozonesondes

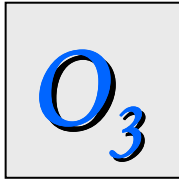


Mean Ozone Profile for Valentia for 2002

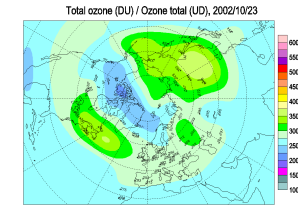


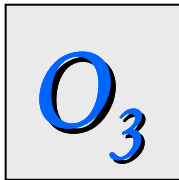
Met Éireann Partners

- DoE & EU STRIDE
- SESAME
- THESOE
- MATCH
- VINTERSOL
- EPA & NUI Galway

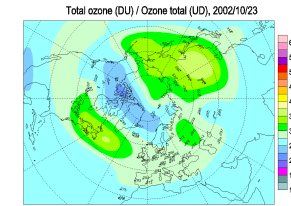


Ozonesondes

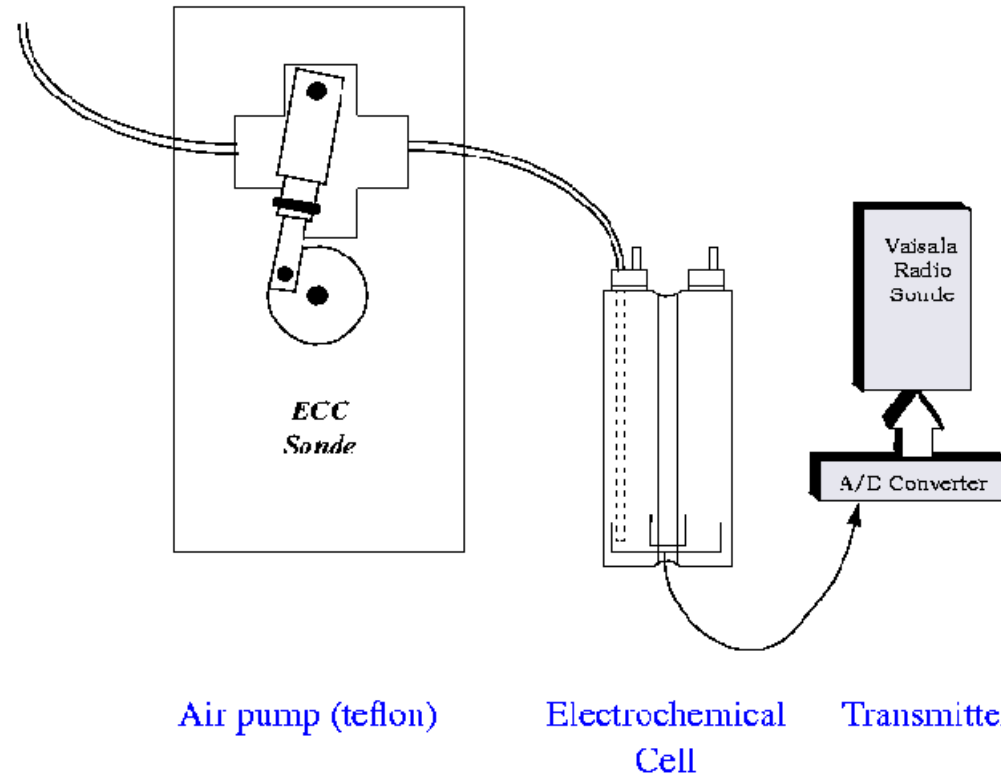
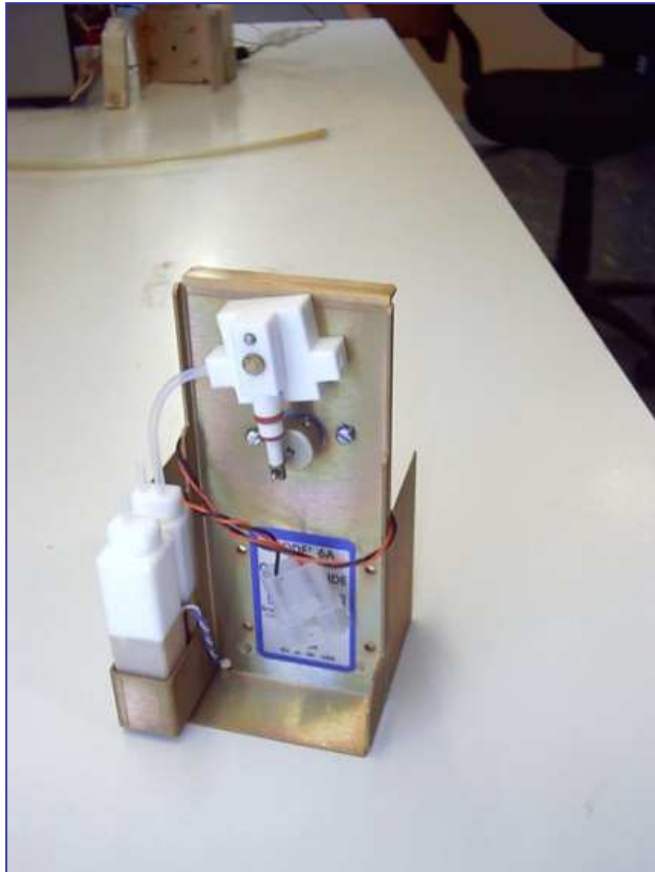




Ozonesondes



Ozone Sonde Schematics



Ozone Summary

- ❑ Ground Level Ozone Network
- ❑ Valentia Observatory records total column ozone
 - Brewer Spectrophotometer
- ❑ Records vertical Ozone profile
 - Ozonesonde

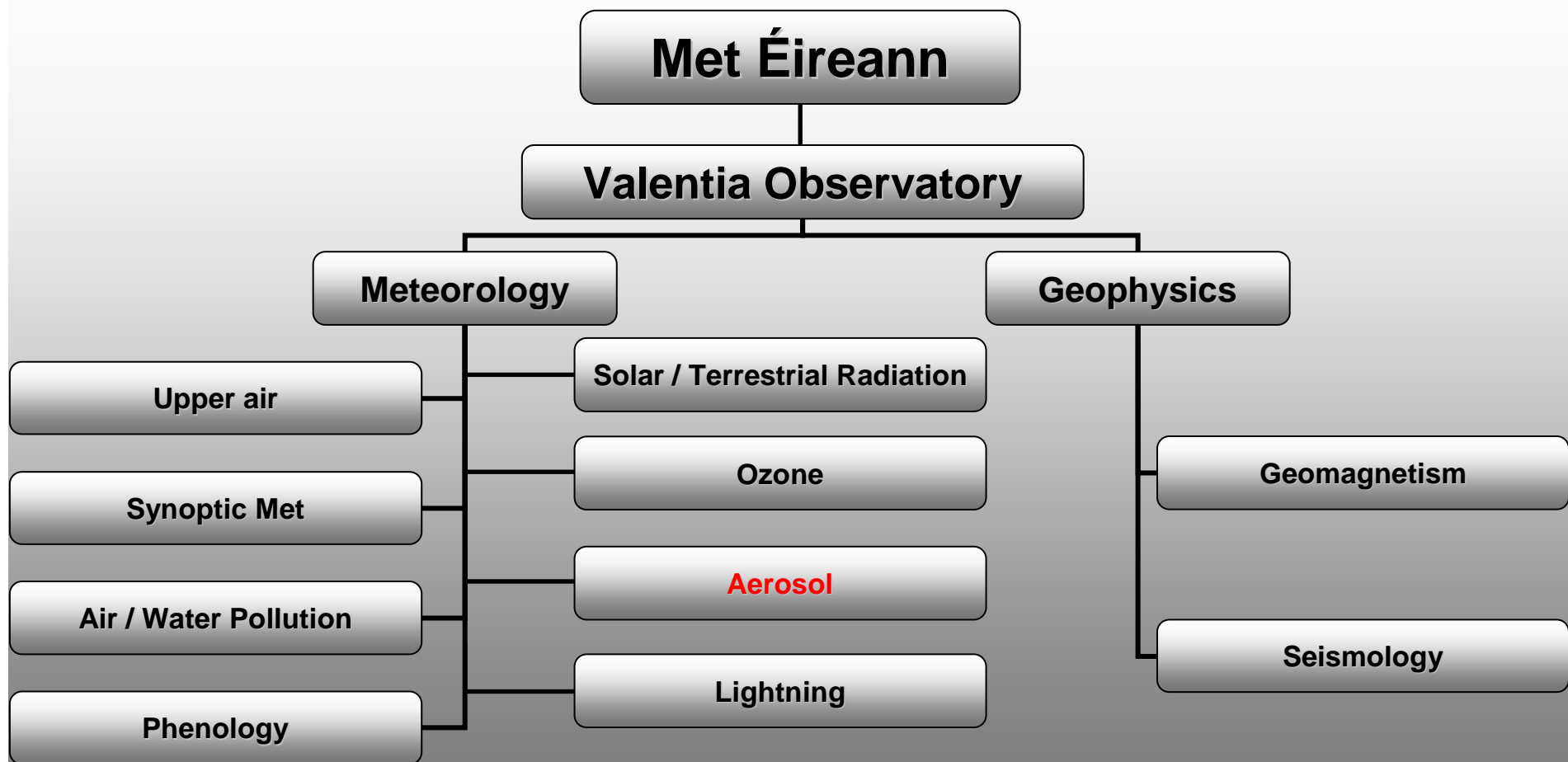
Why?

- ✓ Monitor Ozone depletion
- ✓ UV studies
- ✓ Climate change models



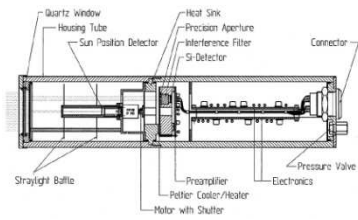
Programmes at Valentia



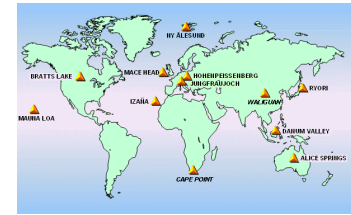


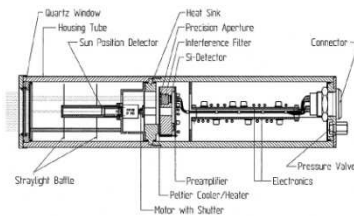
Programmes at Valentia



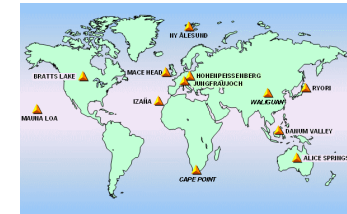


Aerosols





Aerosols

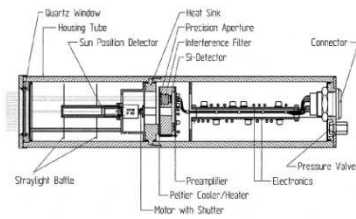


World Meteorological Organisation (WMO) recommended to abandon Aerosol Optical Depth (AOD) measurements under the BAPMoN Program

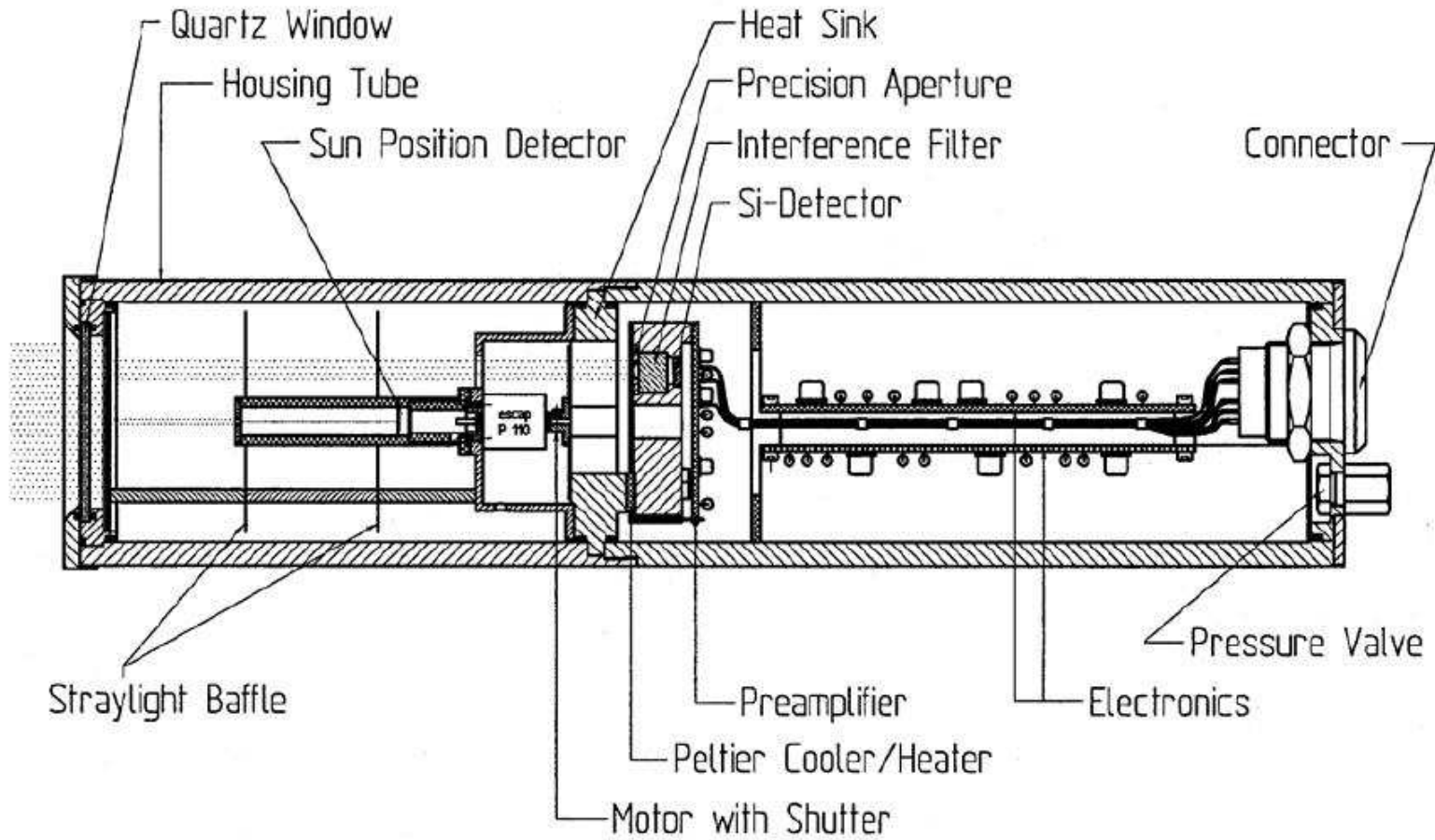
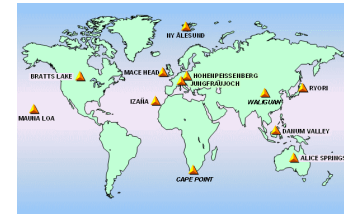
World Optical Depth Research & Calibration Centre (WORCC) 1996

Precision Filter Radiometer (PFR)





Aerosols



Aerosol Summary

- ❑ Valentia Observatory just started to measure & record Aerosol Optical Depth (AOD)
- ❑ Potential for a super site

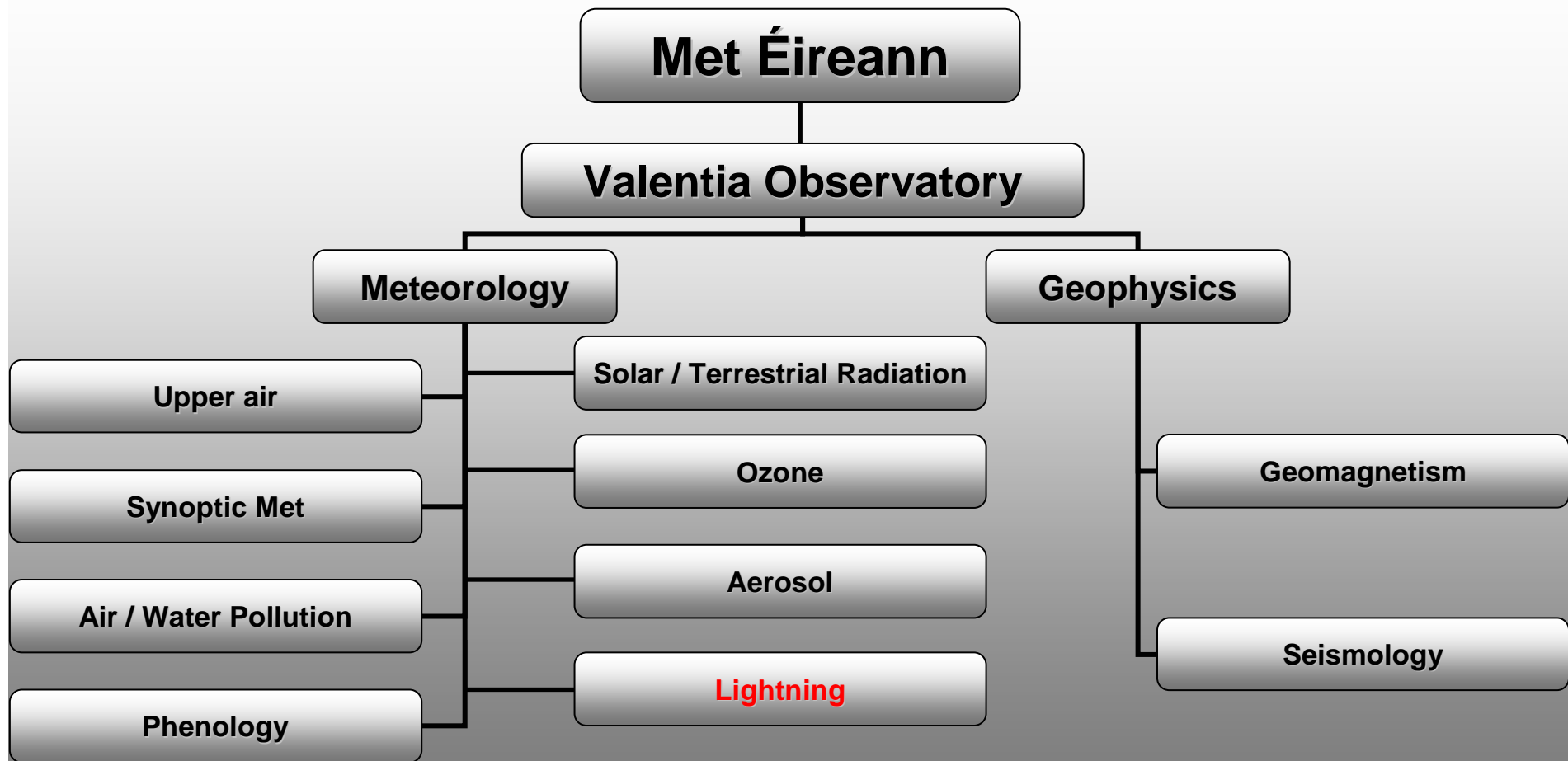
Why?

- ✓ Record Pollution
- ✓ Initiate Climate Models



Programmes at Valentia



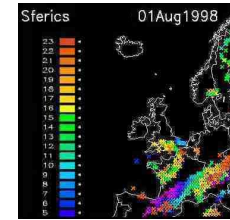


Programmes at Valentia



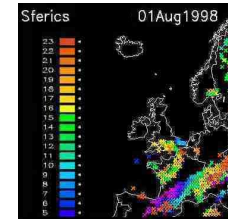


Lightning Detection





Lightning Detection



Lightning:

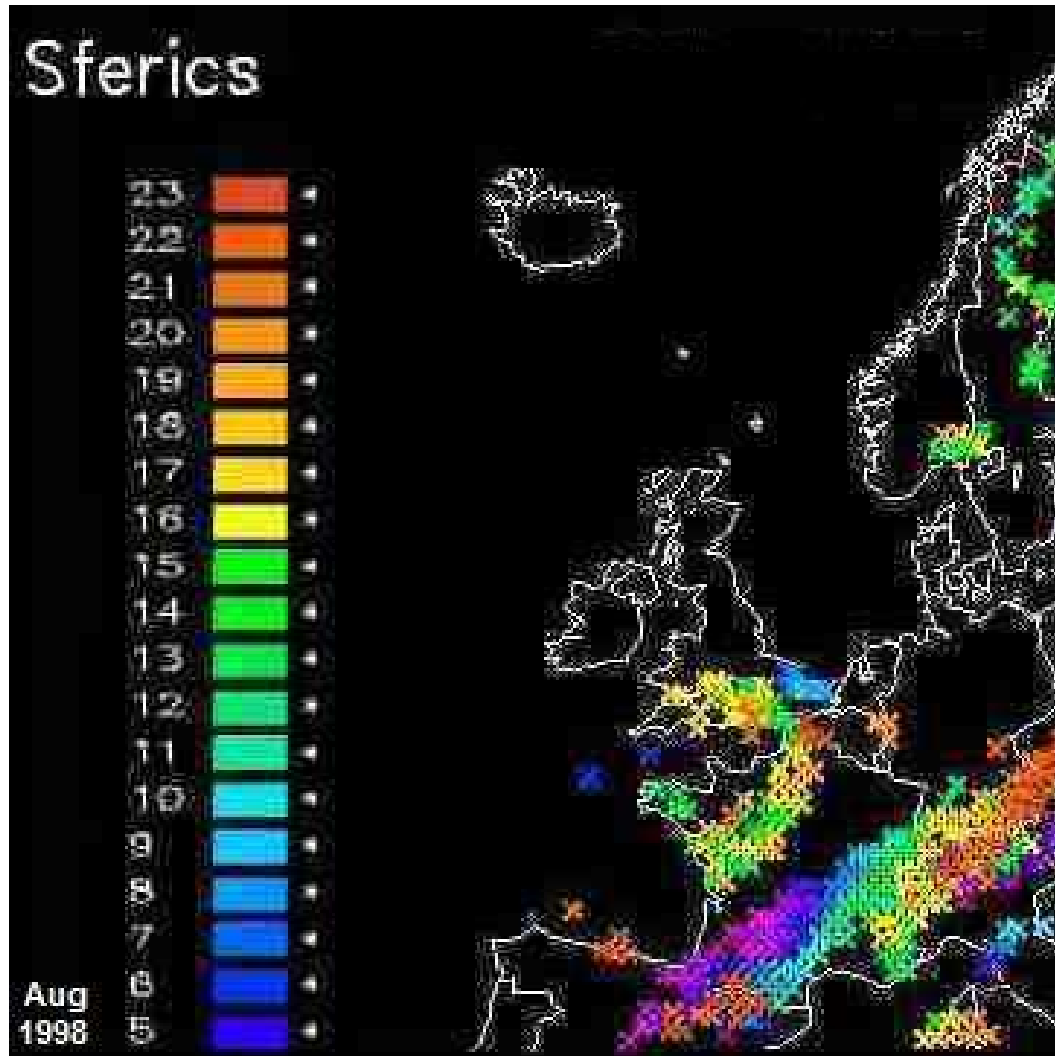
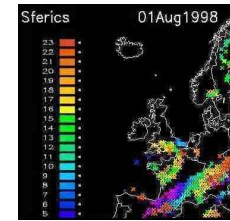
- Passage of a large spark of electricity from cloud to ground or cloud to cloud.

Radio Waves from lightning flashes (sferics):

- Arrival Time Difference (ATD) lightning location
- Range Single Antenna ~ 10,000 km
- Control centre Bracknell
- Tolerance set to only study significant flashes
- Location accuracy ~ 2 km over Europe



Lightning Detection



Lightning Summary

❑ Valentia Observatory has lightning detection antenna which forms part of a international network administrated by the British Met Office.

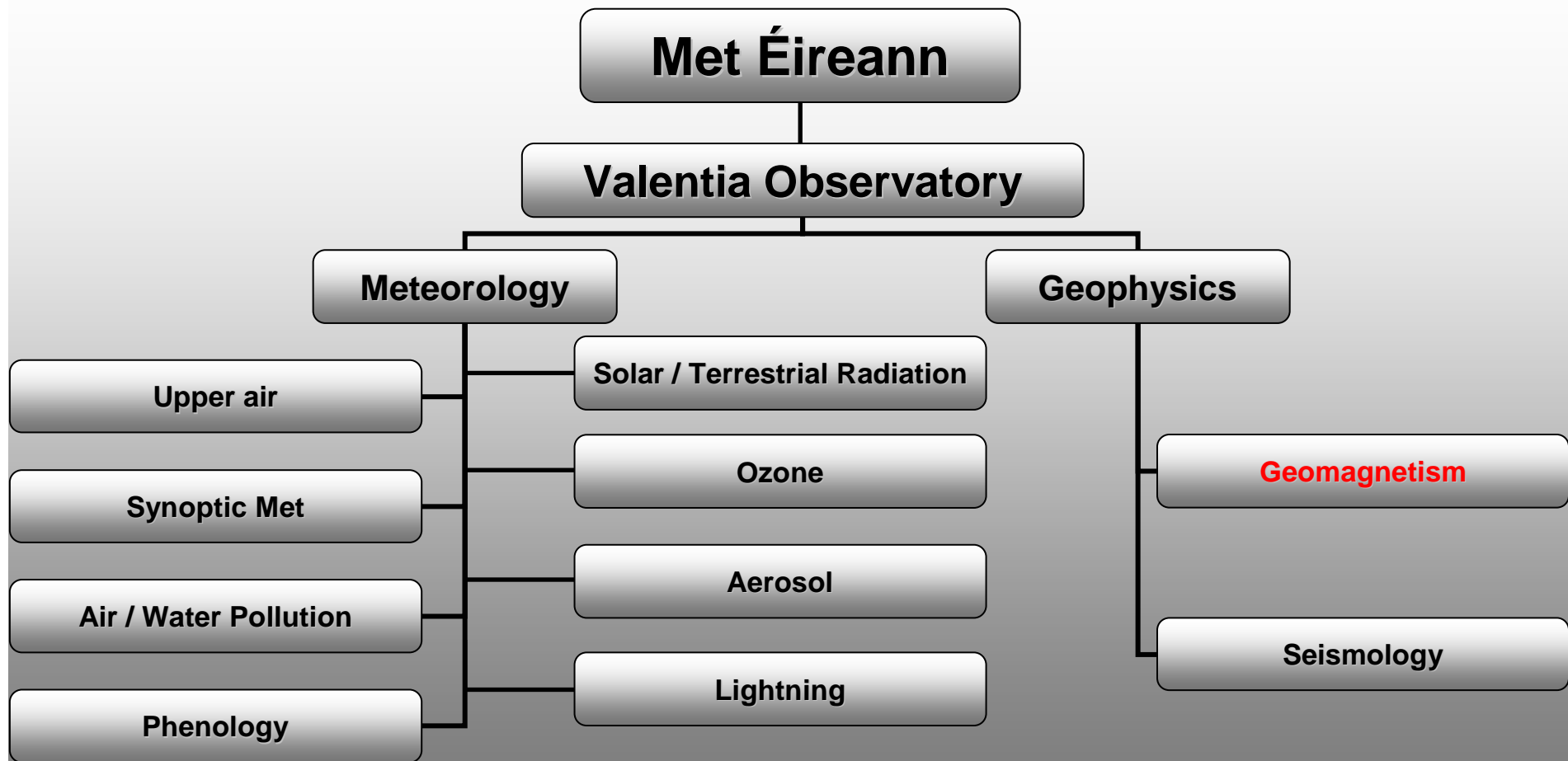
Why?

- ✓ Provide forecasters with information on storm movements
- ✓ Safety – Airports, ESB, Intel



Programmes at Valentia



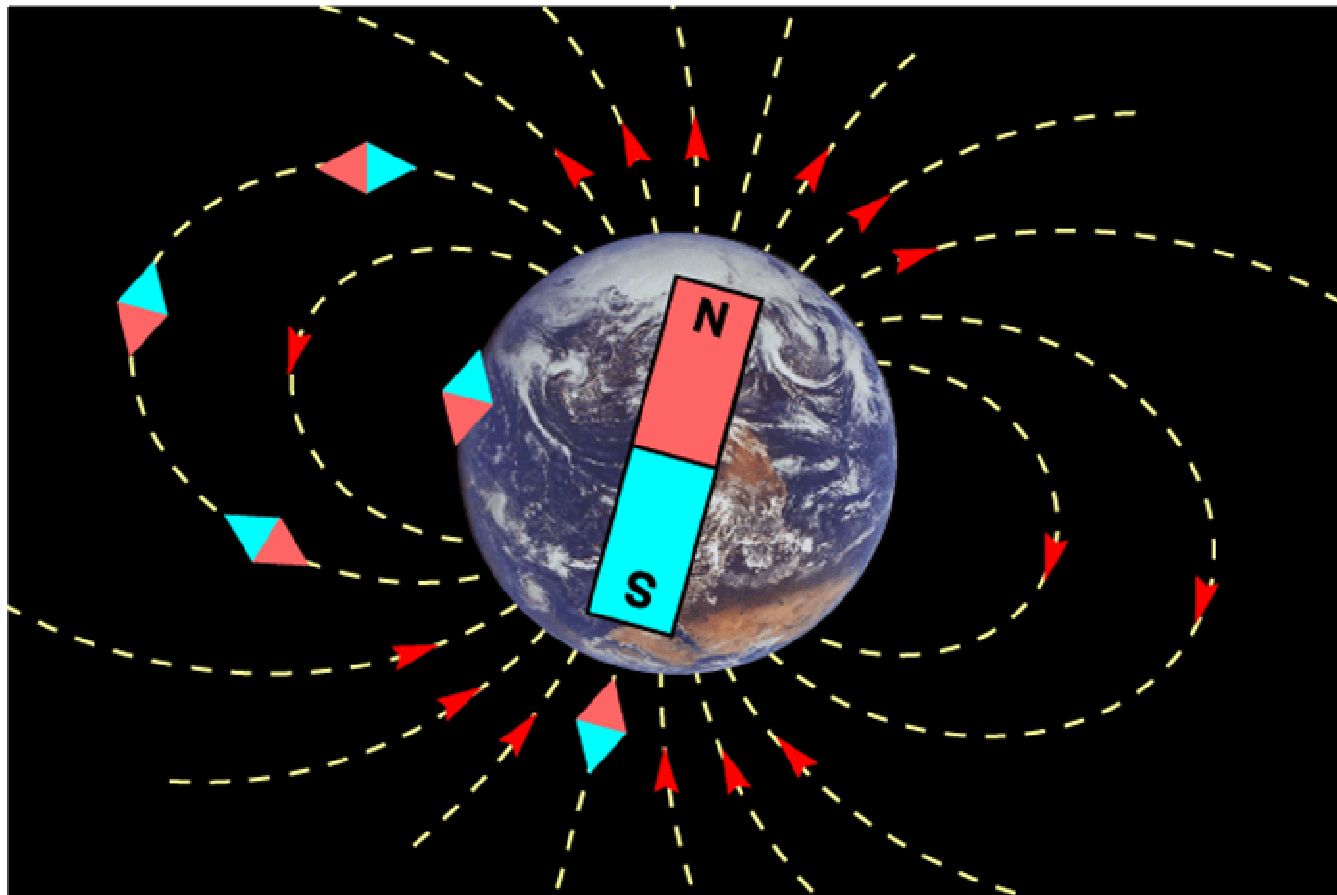
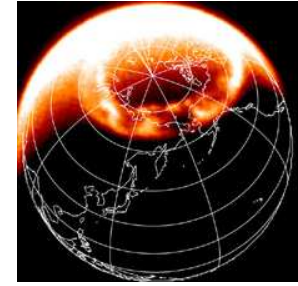


Programmes at Valentia



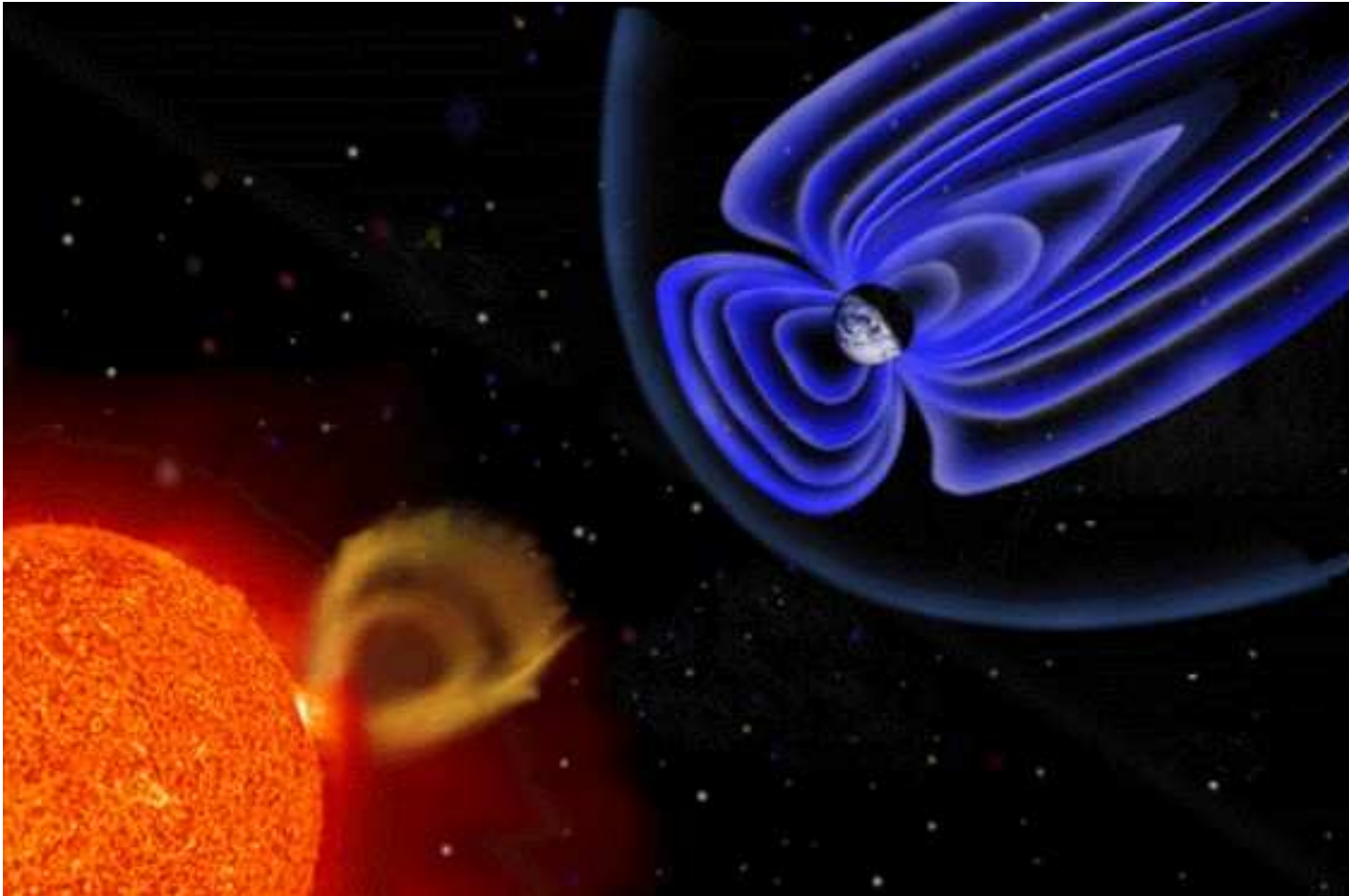
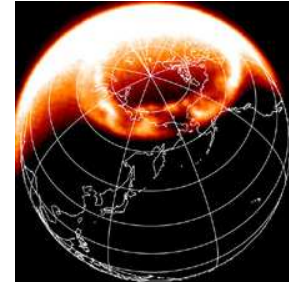


Geomagnetism

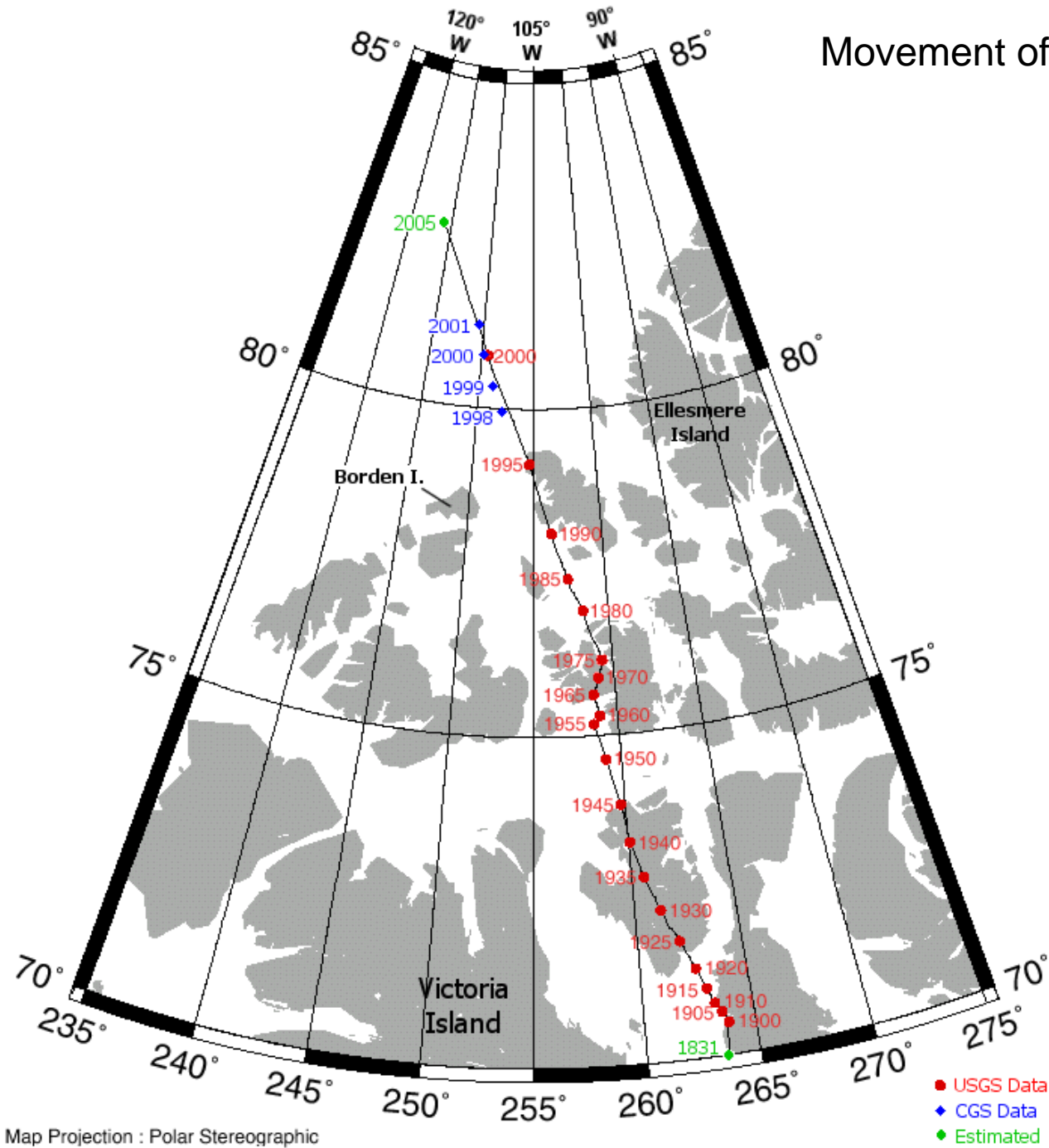




Geomagnetism



Movement of North Pole

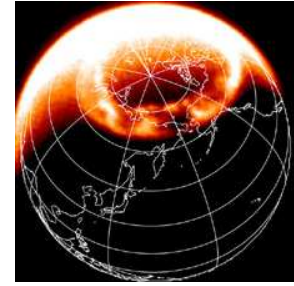


Map Projection : Polar Stereographic

- USGS Data
- ◆ CGS Data
- ◆ Estimated



Geomagnetism

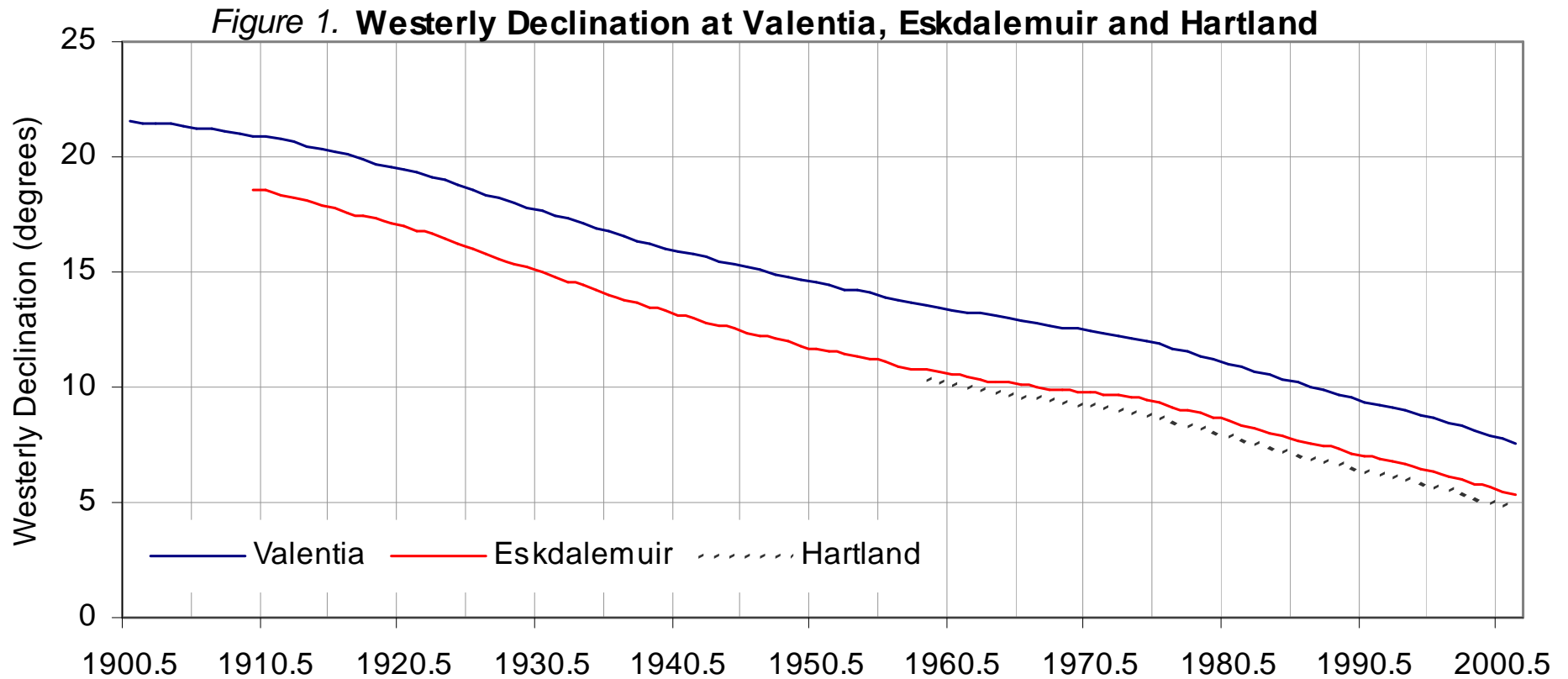


- Started in 1888 – Valentia is one of oldest operational observatories globally.
- Member of ***INTERMAGNET*** – since 2001
- Member of ***MagNetE*** – since 2003

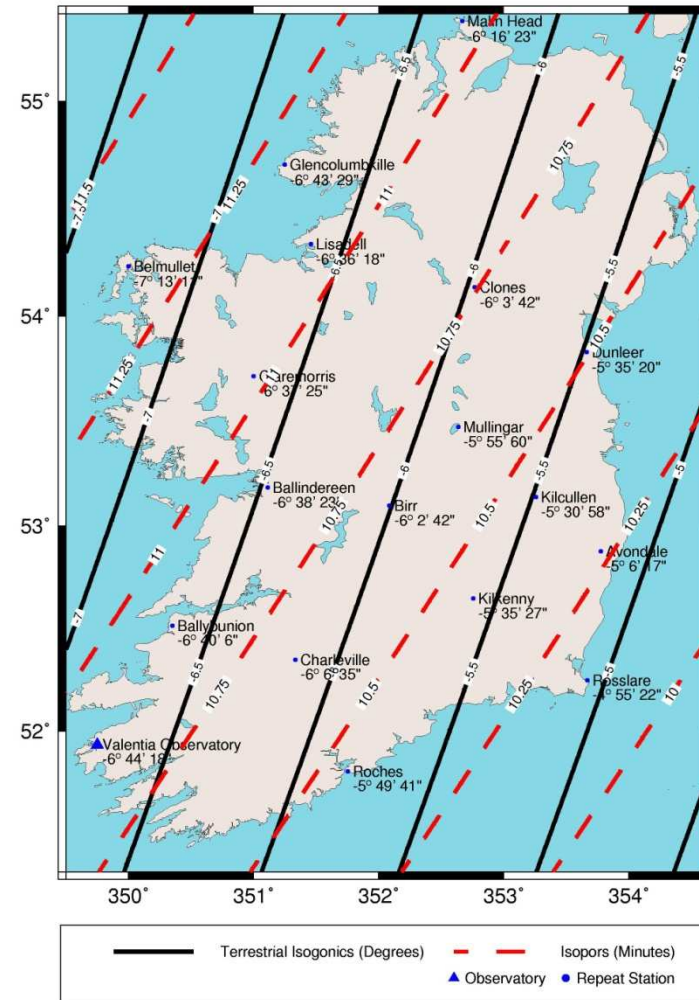




Geomagnetism

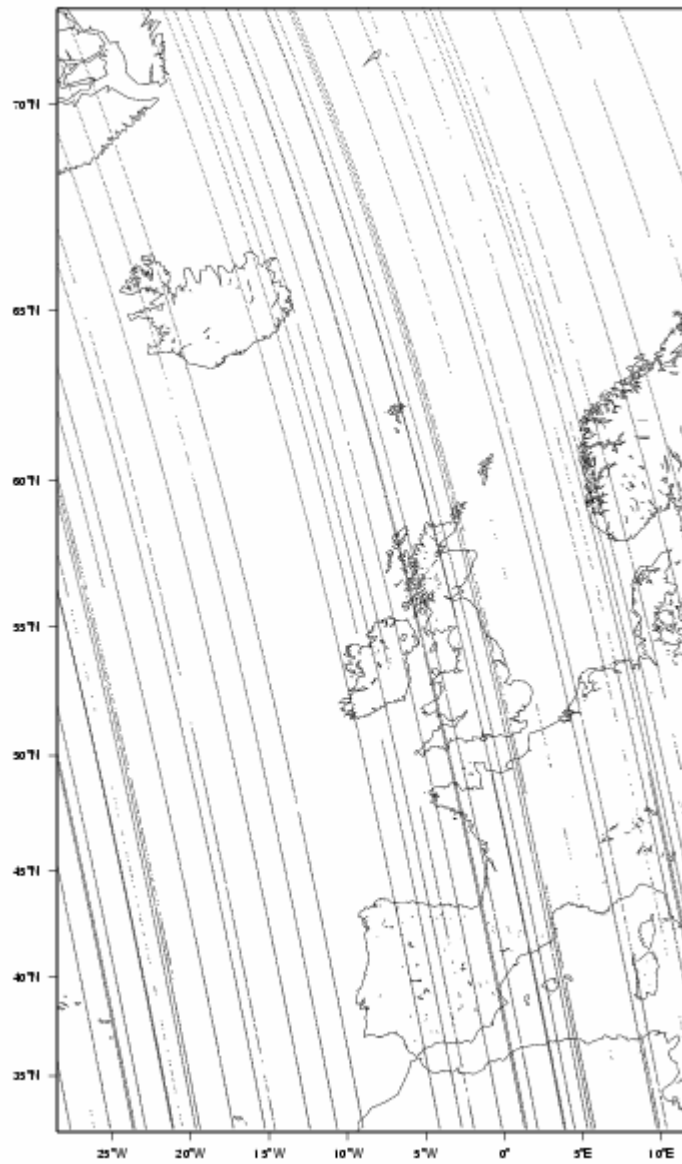


Secular Variation Survey 2005.0



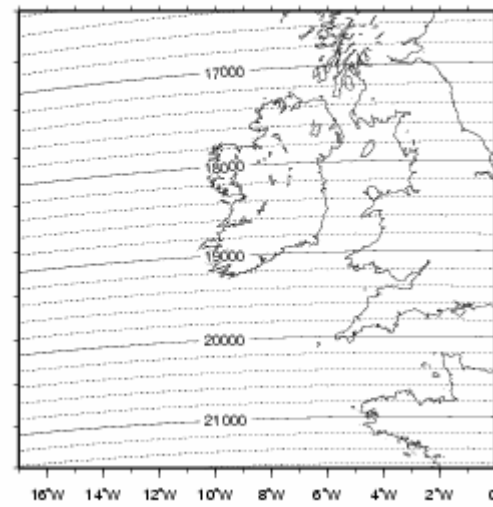
IRELAND Magnetic Declination and Secular Variation

SCHA Geomagnetic Model of IAA System Area

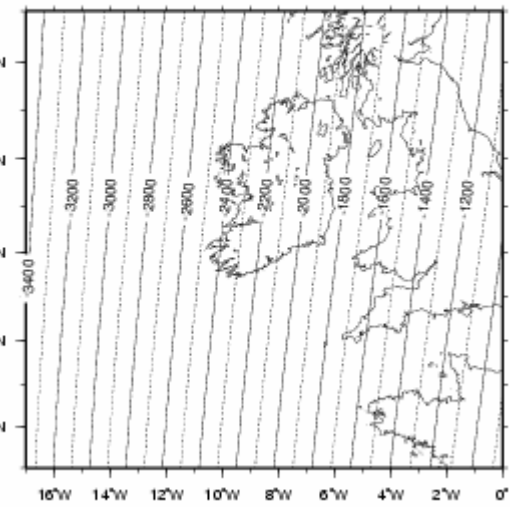


Oersted Satellite Passes

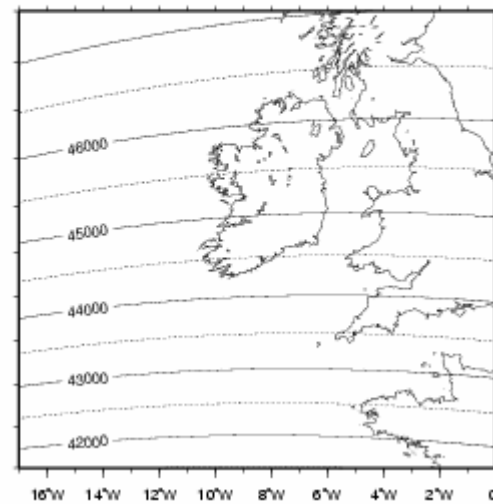
X Component (nT)



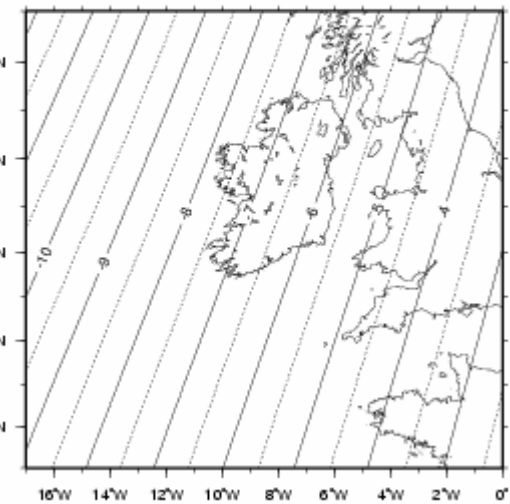
Y Component (nT)



Z Component (nT)



Declination (Degrees)



SCHA Main Field Model



Geomagnetism



- OSI
- Solar Wind Research
- IAA
- Compass Calibration



Geomagnetism Summary

- ❑ Valentia Observatory has one of the oldest magnetic records in the world
- ❑ Monitor the constant movement of the poles (secular variation)

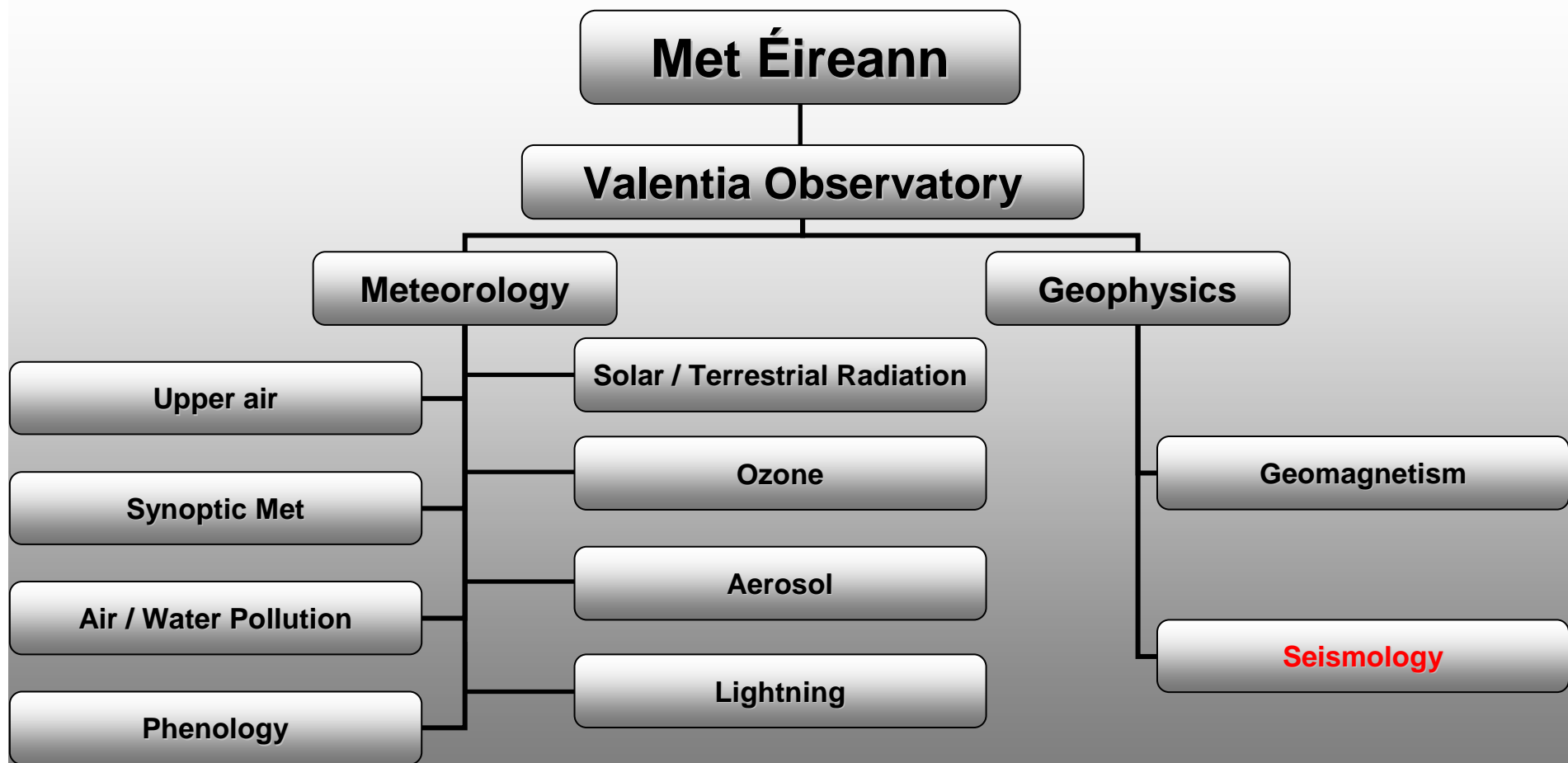
Why?

- ✓ Irish Aviation Authority
- ✓ Ordnance Survey Ireland
- ✓ Research - Solar Wind



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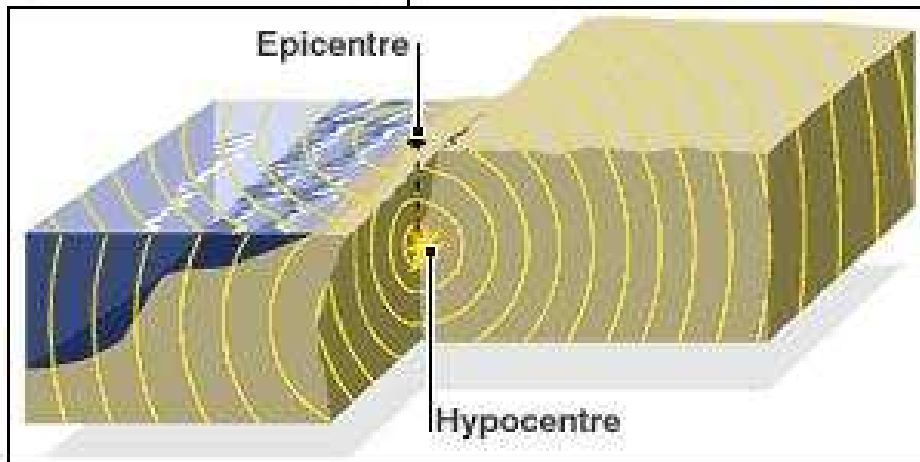
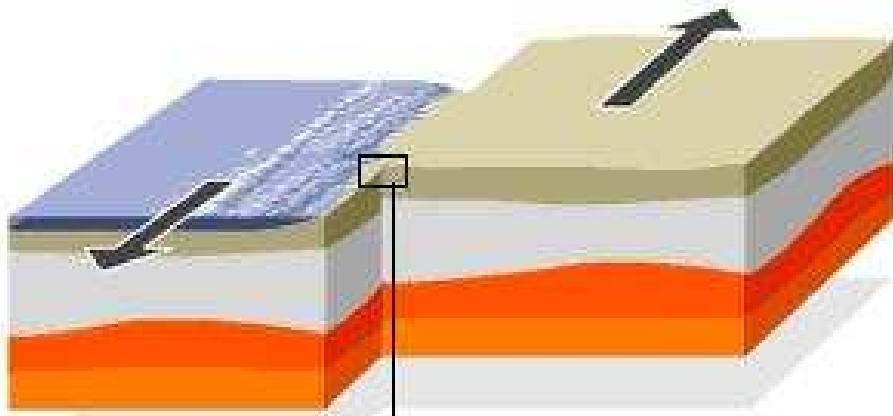
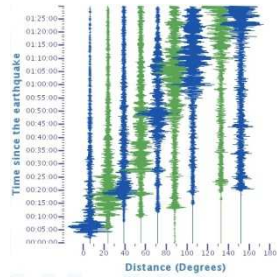




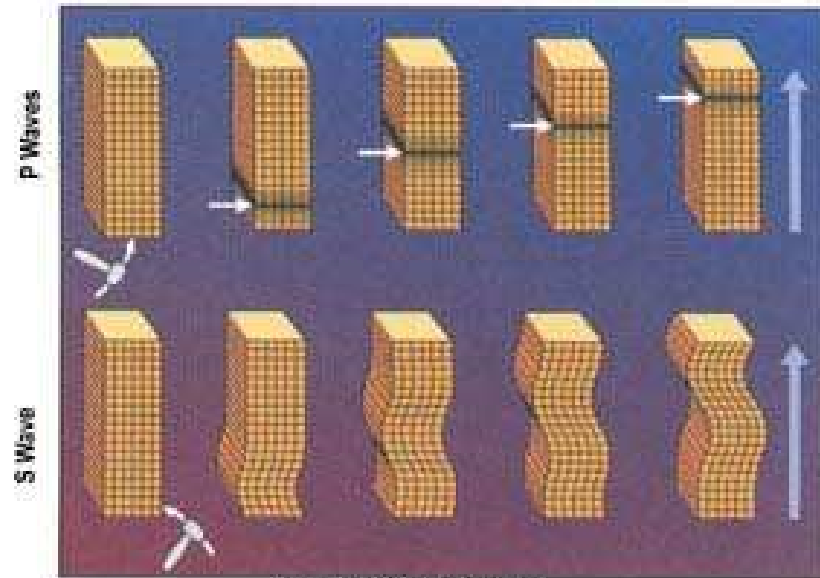
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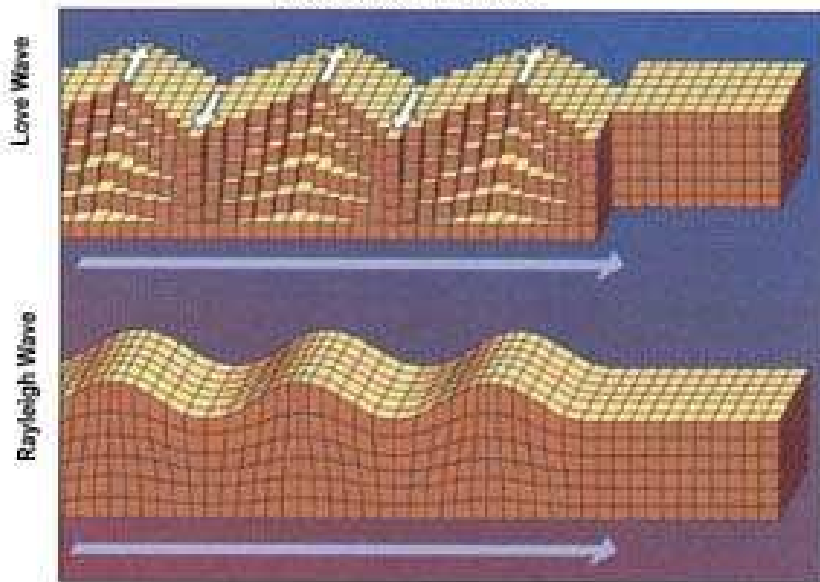
Seismology



Body Waves

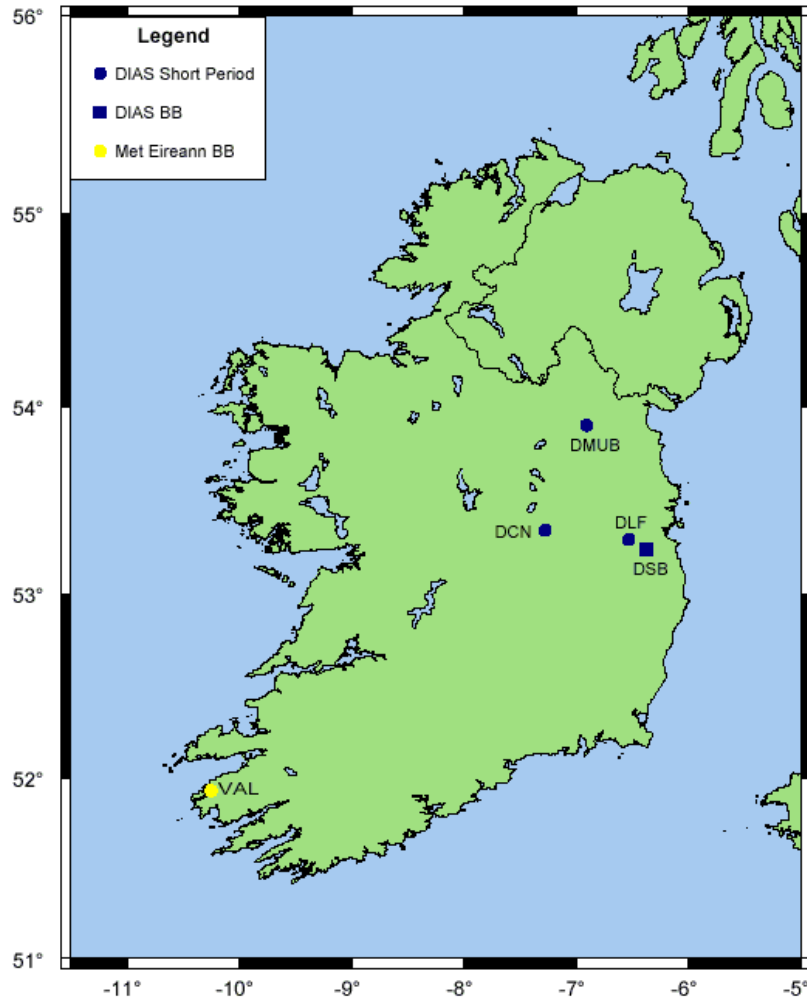


Surface Waves





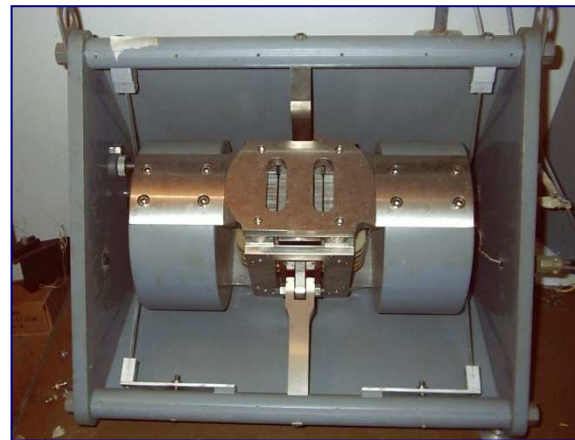
Valentia Seismic Station



Irish Seismic Network

- 1962 – 1999: **World Wide Standardised Seismographic Network** station in conjunction with USGS

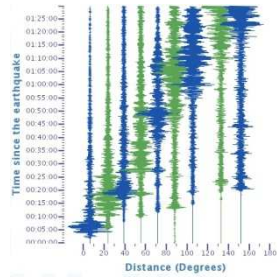
- 1999 to present: Broadband Seismic station in cooperation with DIAS



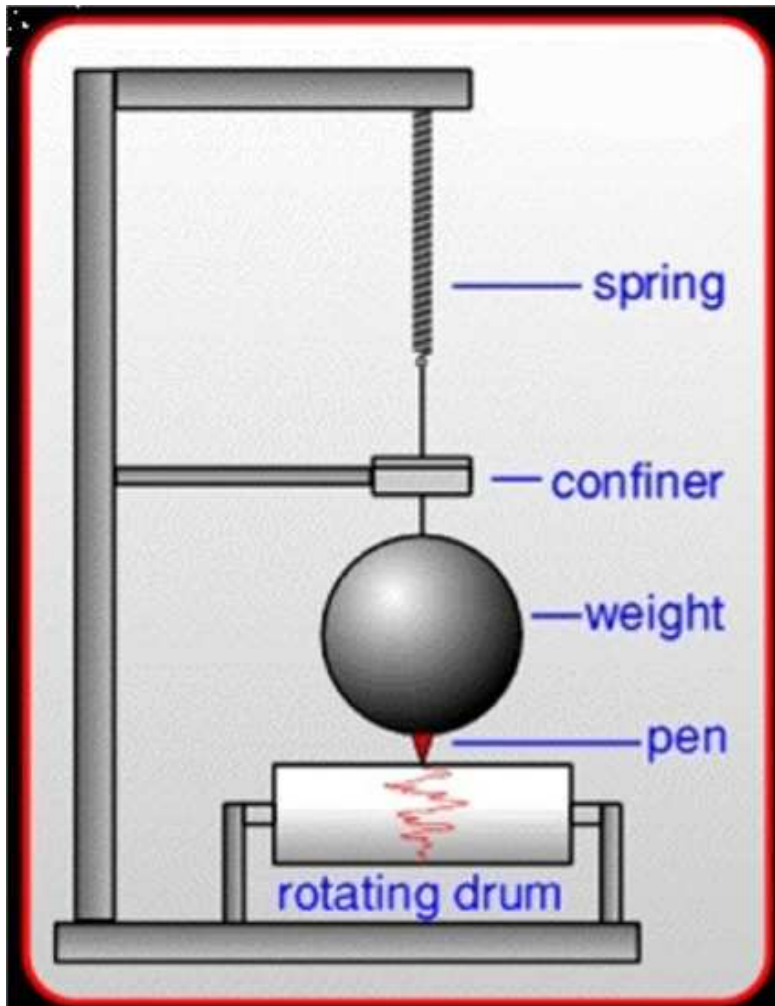
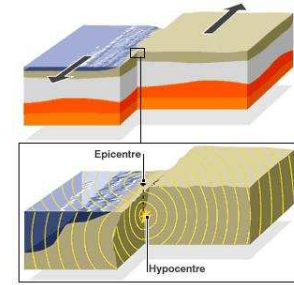
WWSSN



CMG-40T



Seismology



Seismometer

Seismology Summary

- ❑ Valentia Observatory continuously records seismic activity

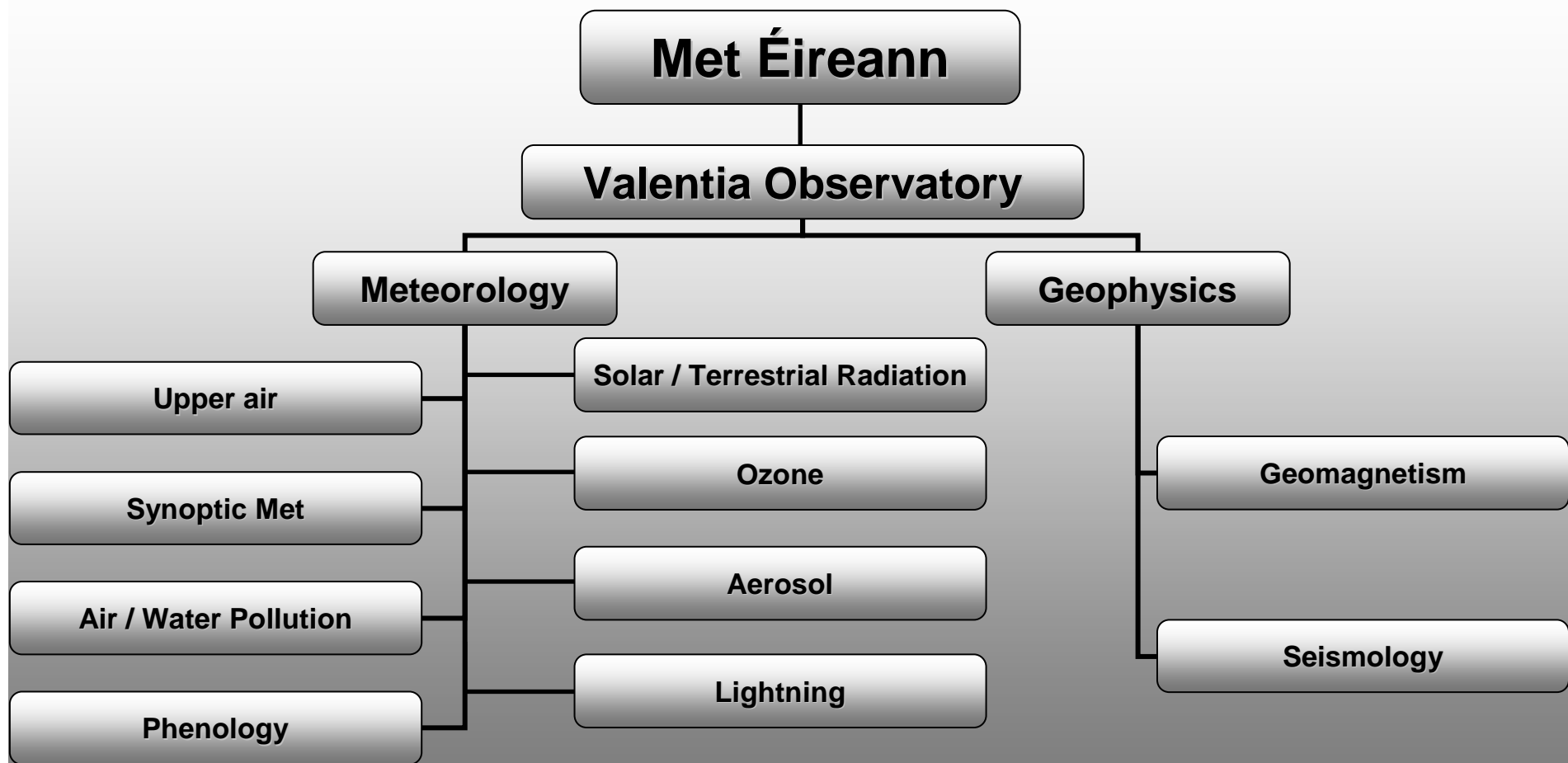
Why?

- ✓ Forms part of a seismic network used to measure location and strength of Earthquakes
- ✓ Watchdog for Nuclear testing
- ✓ Early warning system Earthquake / Tsunami (future)



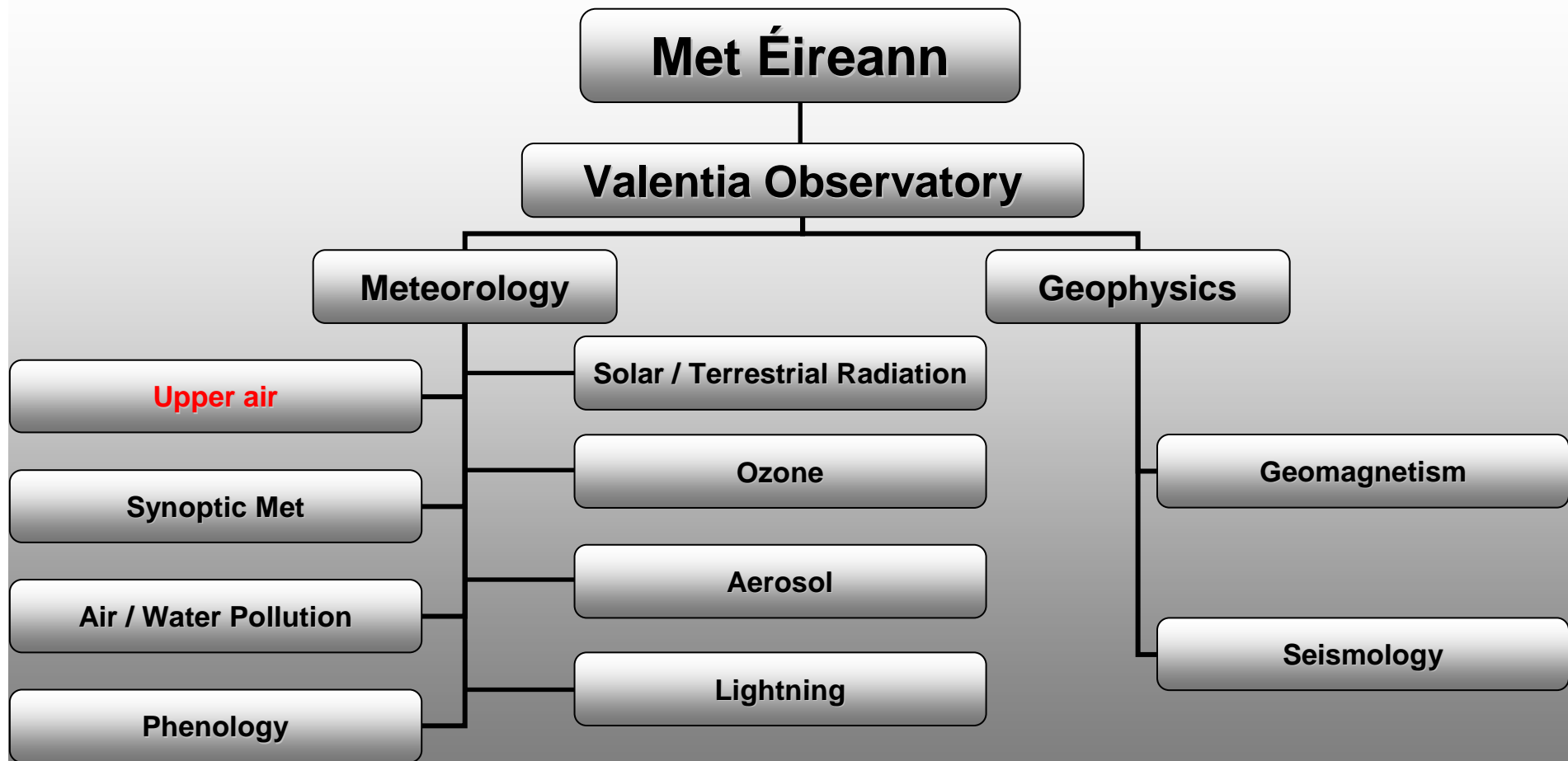
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Upper Air Summary

- ❑ Valentia is the only place in the Republic of Ireland that launches upper air balloons for meteorological purposes
- ❑ 4 ascents a day

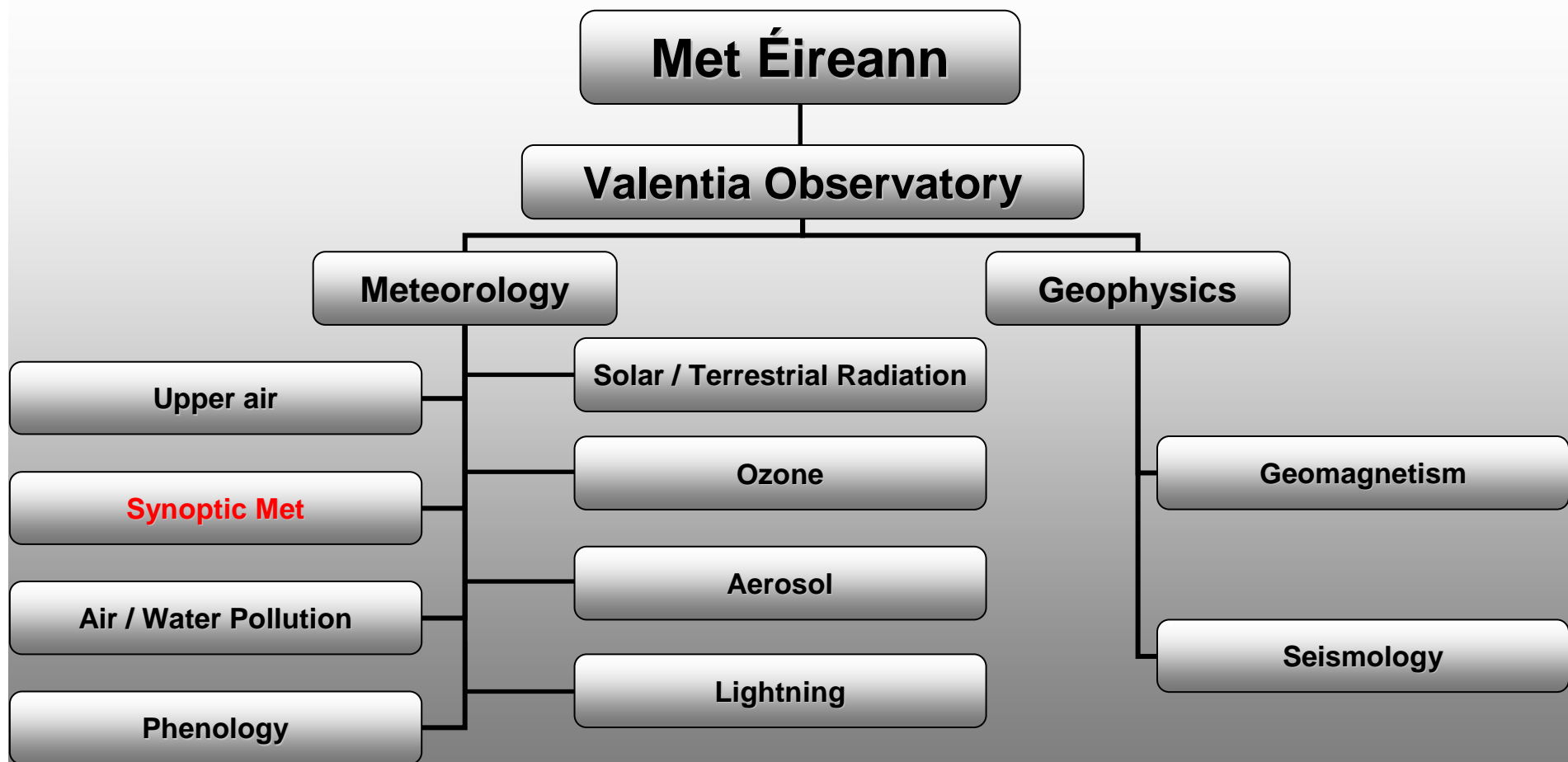
Why?

- ✓ Provide Tephigram chart as a forecast analysis tool
- ✓ To supply vertical profile data to forecast models
- ✓ Used to calibrate satellite sensors



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Synoptic Meteorology Summary

- ❑ Standard meteorology parameters recorded
- ❑ [Dry and Wet Bulb Temperature, Pressure, Wind Speed and Direction, Rainfall, Visibility, Cloud type and amount]

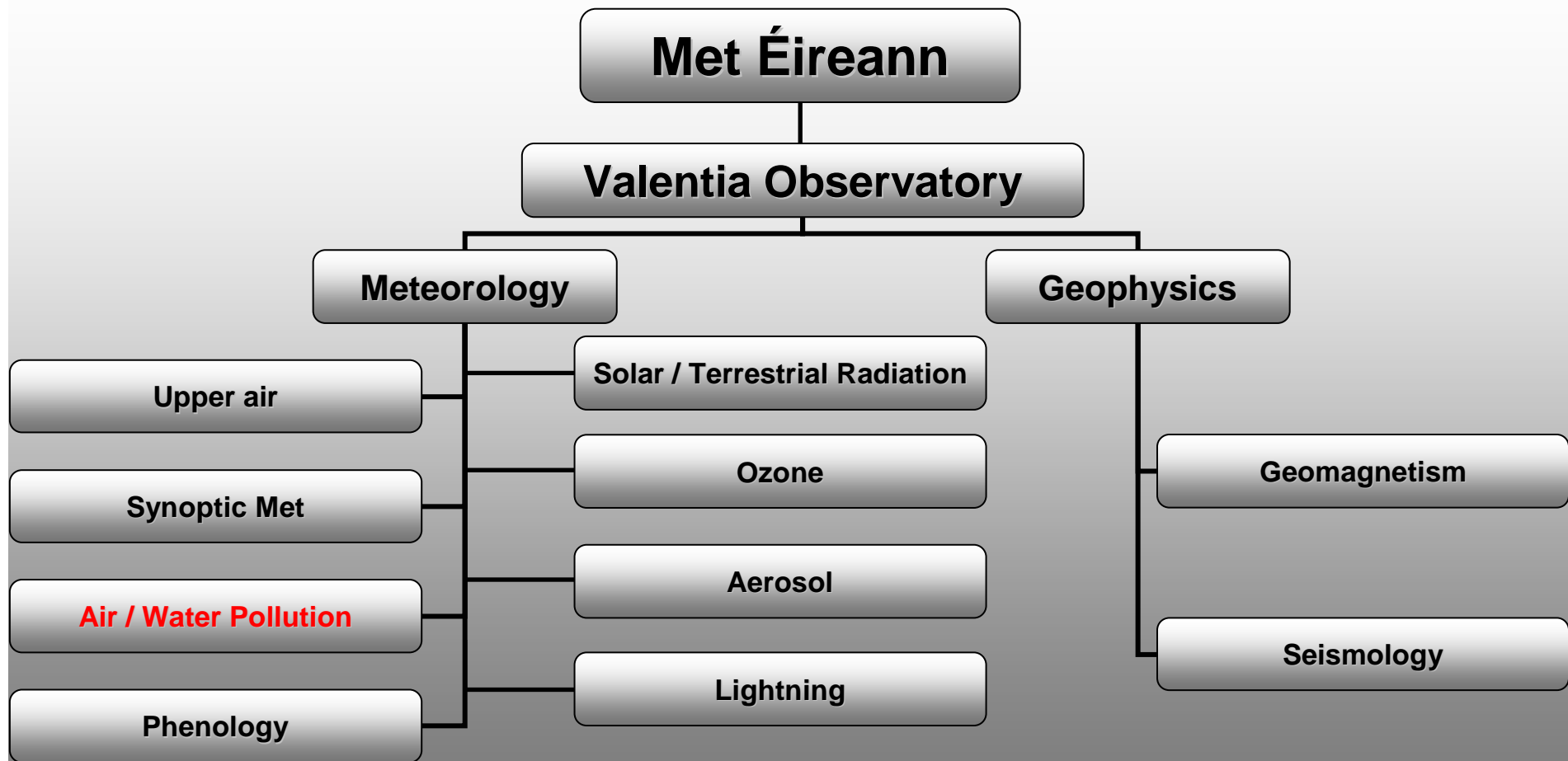
Why?

- ✓ To supply a snapshot of the current weather situation, for forecast purposes
- ✓ Climate record purposes



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Air & Rainwater Monitoring Summary

- ❑ Valentia's lab (& HQ Dublin lab) measures pollutants in Air and Rainwater

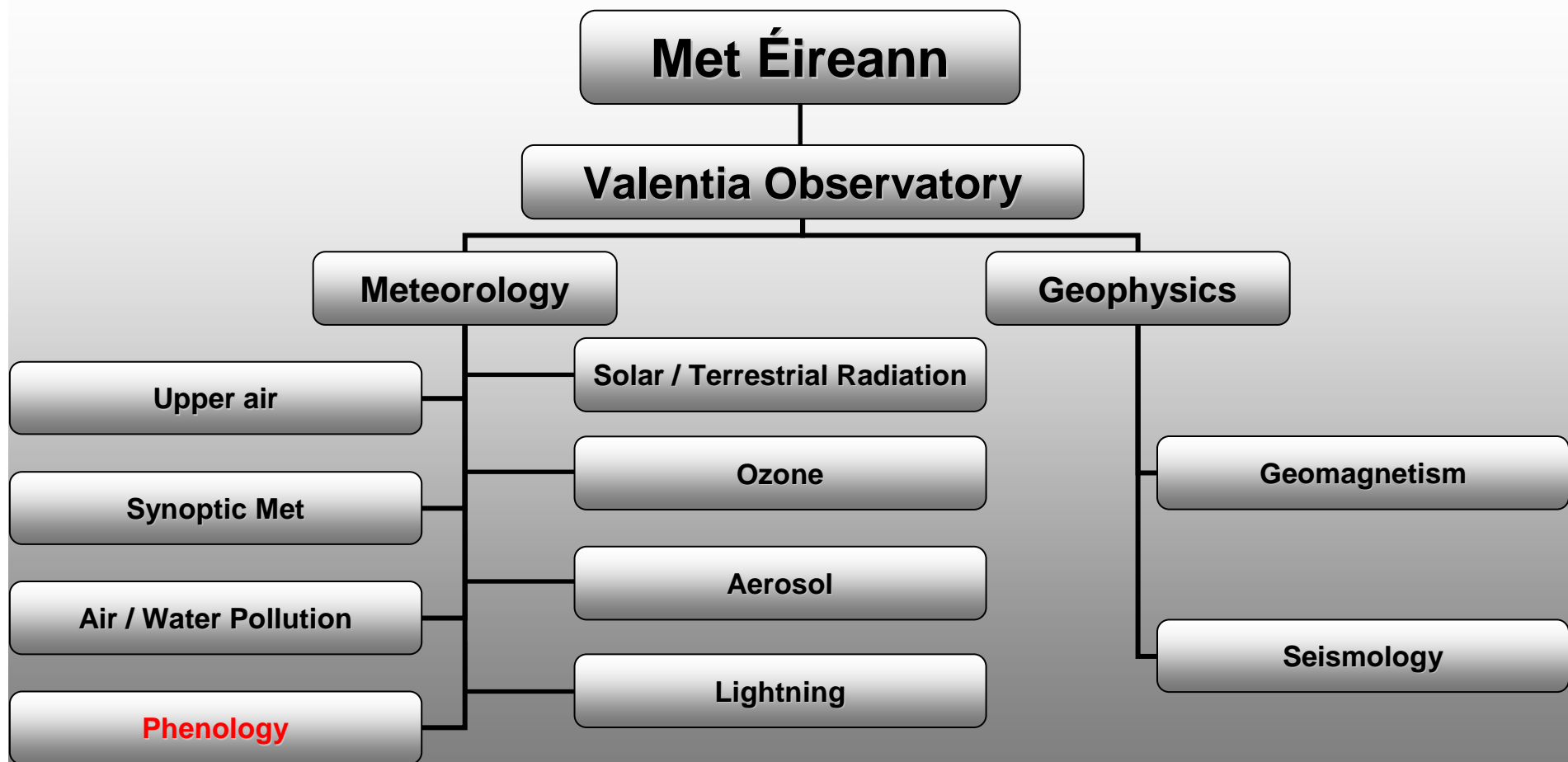
Why?

- ✓ To provide excellent background count values for Europe
- ✓ Monitor changes in pollution levels over Ireland



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Phenology Summary

- ❑ Valentia Observatory records phase changes on a number of 'cloned' trees

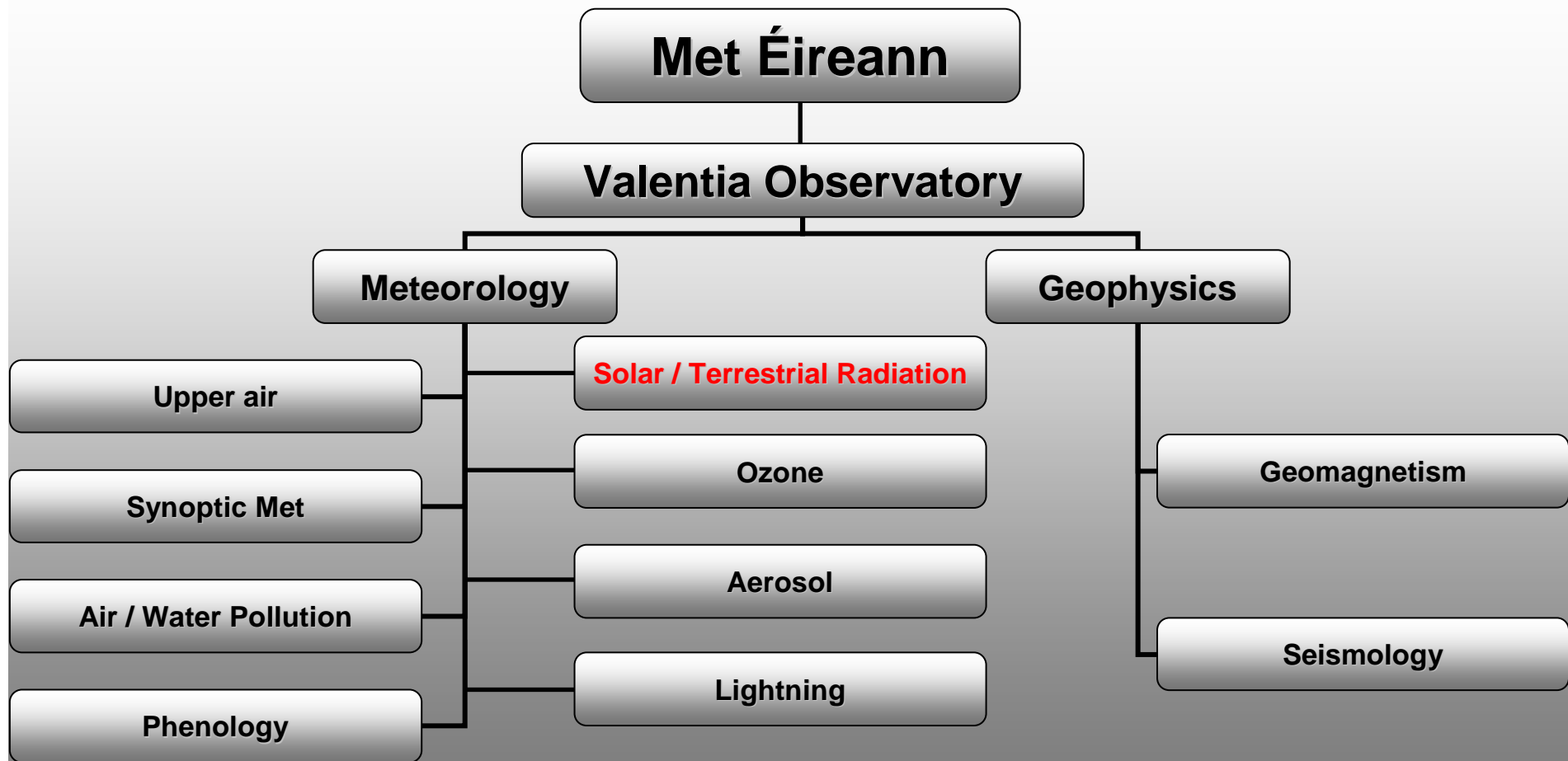
Why?

- ✓ Phenology can be used as a climate change indicator



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Solar / Terrestrial Radiation Summary

- ❑ Valentia Observatory records 'Direct' , 'Diffuse' and 'Global' solar radiation
- ❑ Upward and downward LW and SW radiation
- ❑ Calibrate Ireland's Solar radiation network

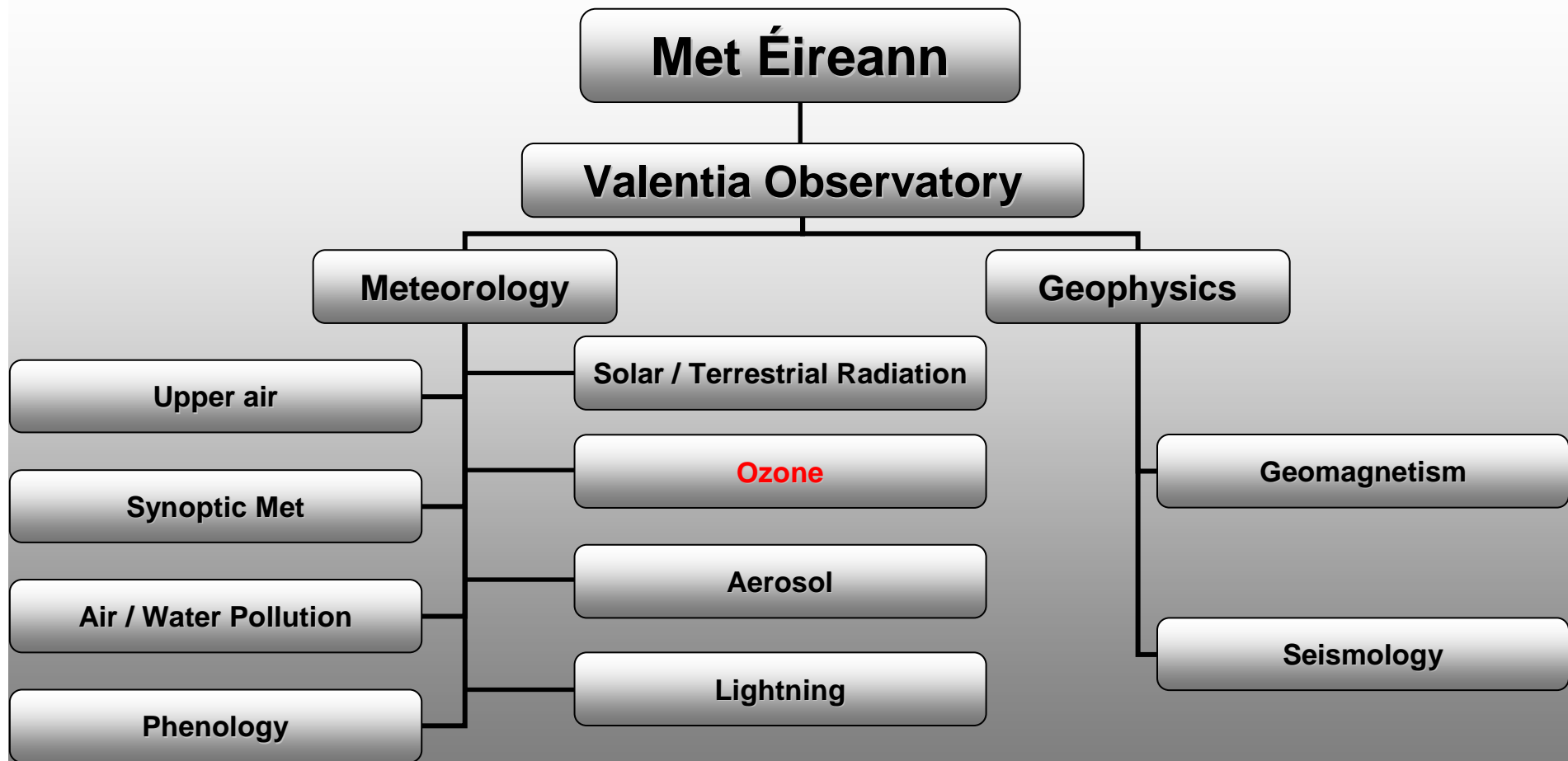
Why?

- ✓ Climate Records
- ✓ Research



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Ozone Summary

- ❑ Ground Level Ozone Network
- ❑ Valentia Observatory records total column ozone
 - Brewer Spectrophotometer
- ❑ Records vertical Ozone profile
 - Ozonesonde

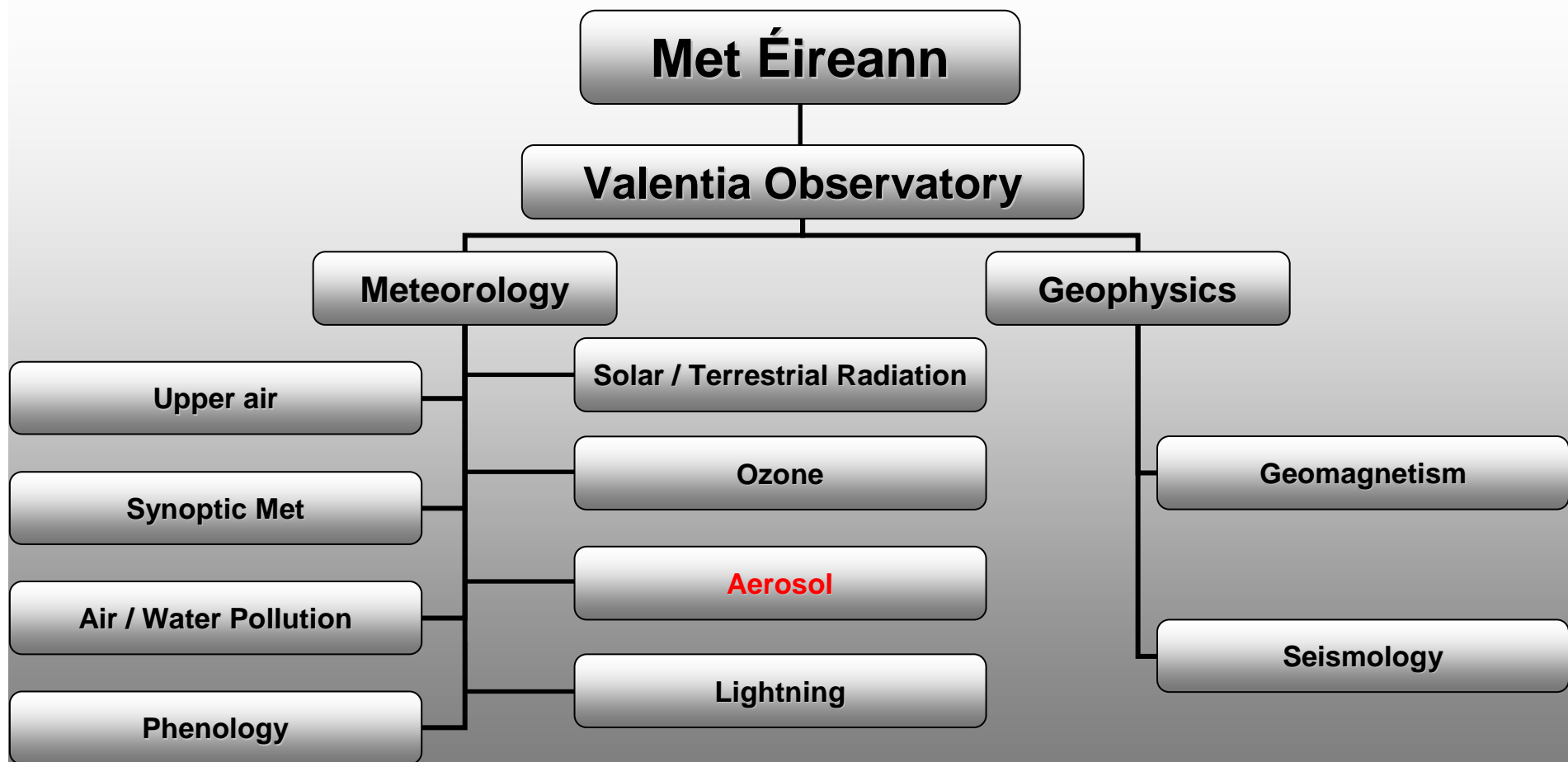
Why?

- ✓ Monitor Ozone depletion
- ✓ UV studies
- ✓ Climate change models



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Aerosol Summary

- ❑ Valentia Observatory just started measure & record Aerosol Optical Depth (AOD)
- ❑ Potential for a super site

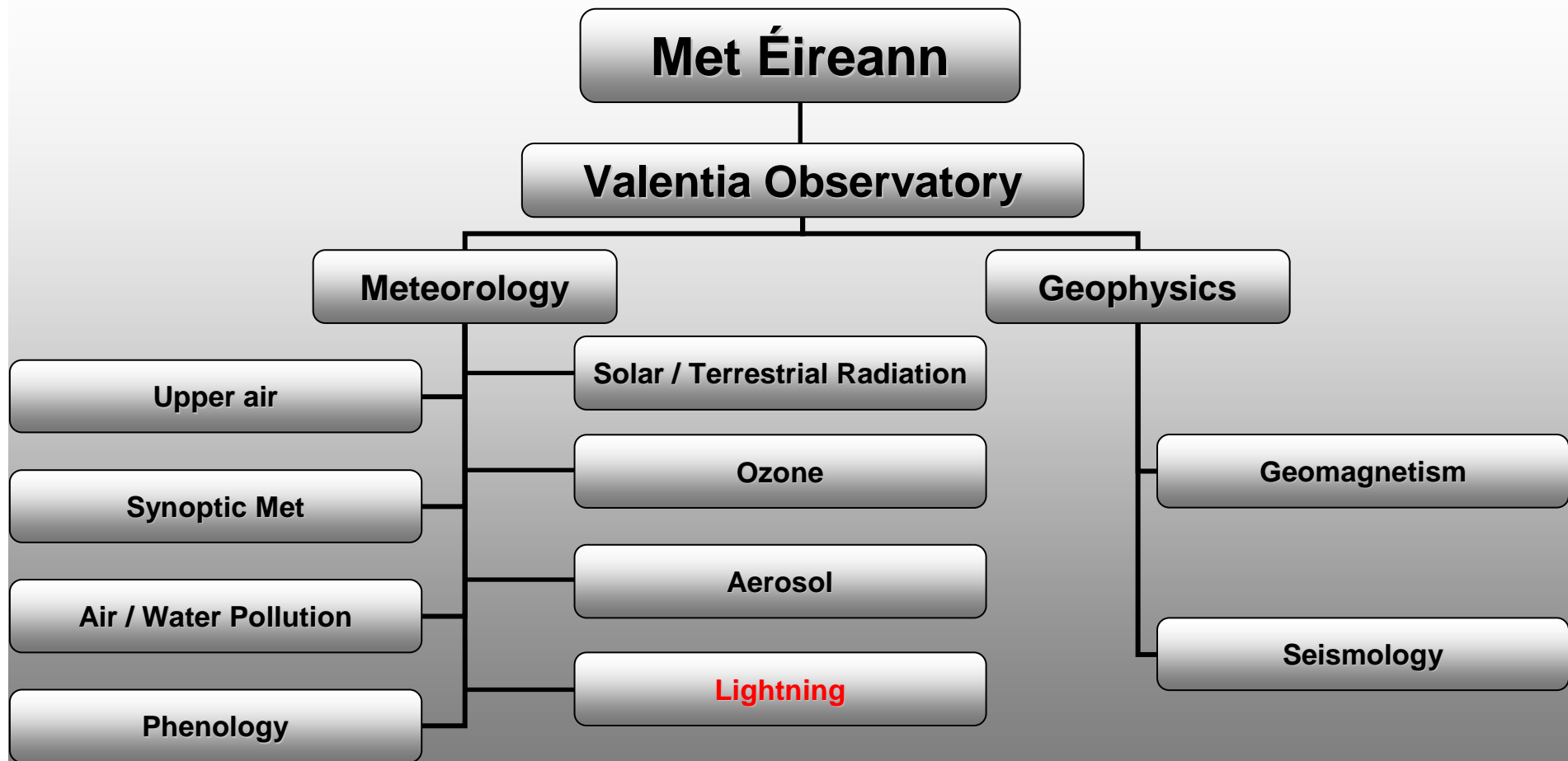
Why?

- ✓ Record Pollution
- ✓ Initiate Climate Models



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Lightning Summary

- ❑ Valentia Observatory has lightning detection antenna which forms part of a international network with BMO.

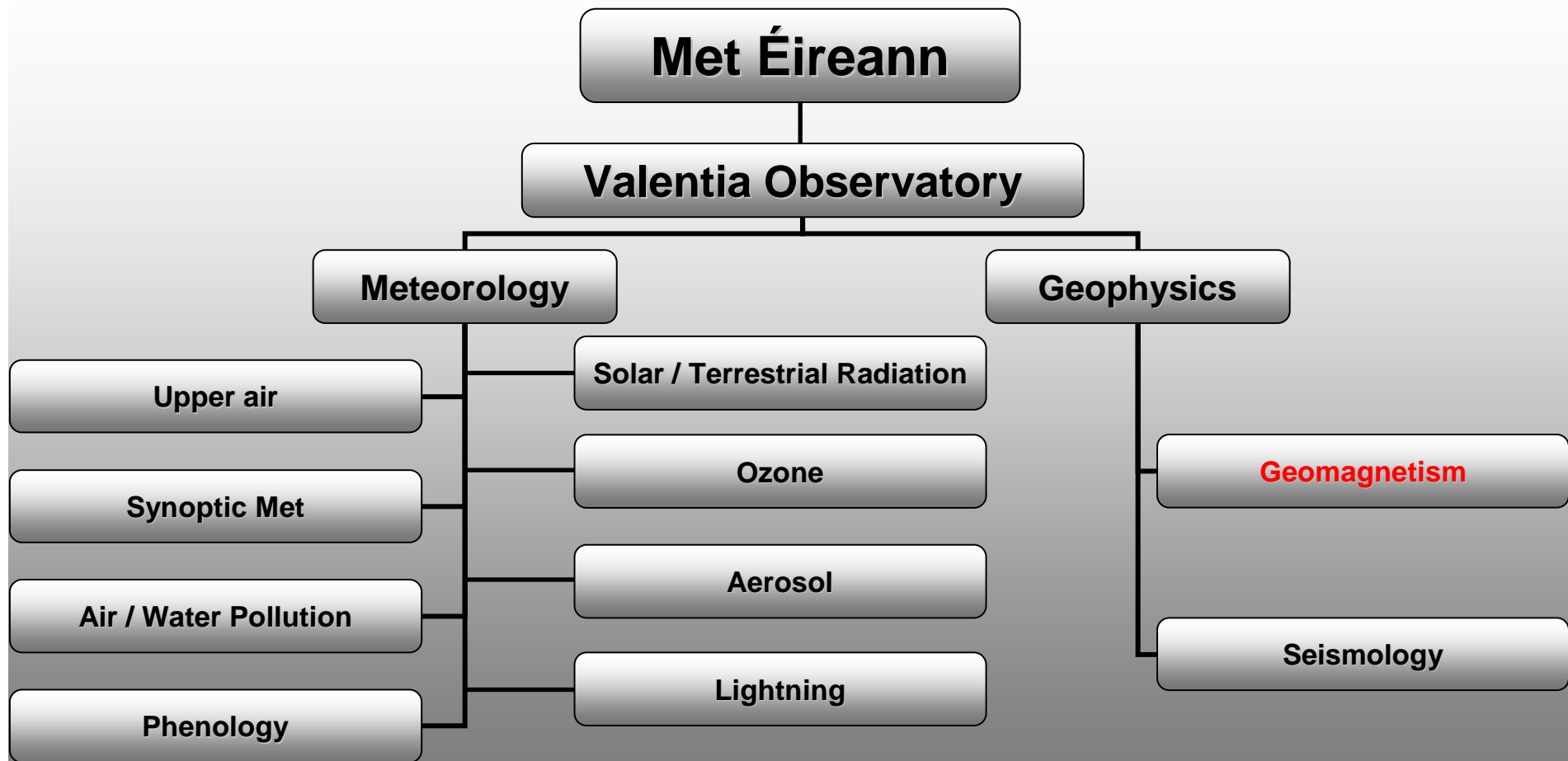
Why?

- ✓ Provide forecasters with information on storm movements
- ✓ Safety – Airports, ESB, Intel



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Geomagnetism Summary

- ❑ Valentia Observatory has one of the oldest magnetic records in the world
- ❑ Monitor the constant movement of the poles (secular variation)

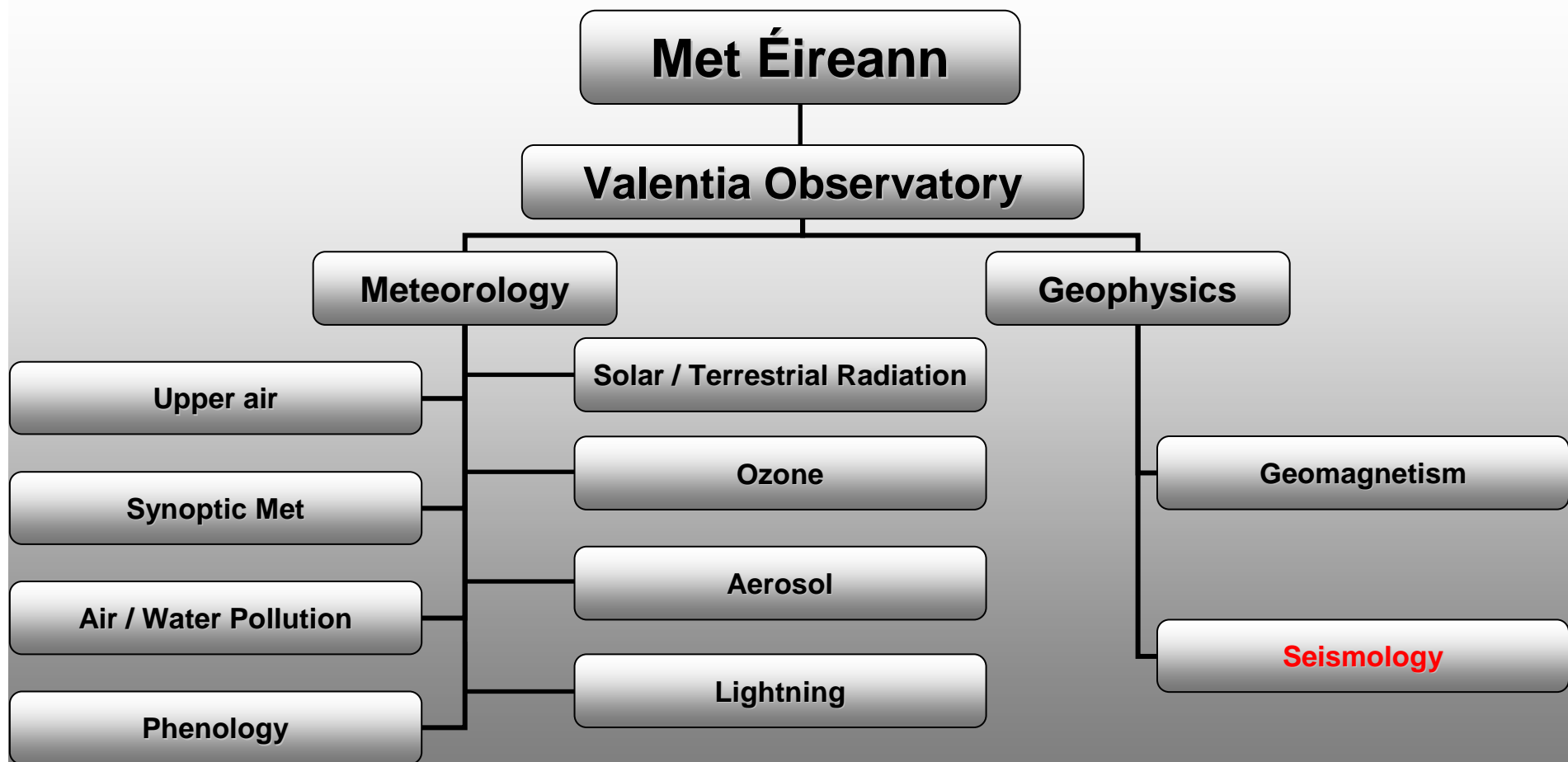
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Seismology Summary

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Why?

- ✓ Forms part of a seismic network used to measure location and strength of Earthquakes
- ✓ Watchdog for Nuclear testing
- ✓ Early warning system Earthquake / Tsunami (future)



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Thank You



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