



Norwegian contributions to SCOSTEP/VarSITI

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University of Oslo (UIO) University of Tromsø (UIT) Tromsø Geophysical Observatory (TGO)

Birkeland Centre for Space Science - Norwegian Centre of Excellence: 2013 – 2022:

University of Bergen (UIB) The University Centre in Svalbard (UNIS) Norges Tekniske Naturvitenskapelige Universitet (NTNU)

University of Oslo



Instabilities and turbulence in polar ionosphere

Rocket programs – ISI –Ca No Rock Cube STAR Instrumentation development



Tromsø



University of Tromsø



Tromsø Geophysical Observatory

Part of European Space Situational Awareness - SSA network

EISCAT 3D New generation of incoherent radar 3D information of ionospheric parameters

Birkeland Centre for Space Science



University of Bergen



ASIM – 2017 450 km

Gamma-rays from thunderstorms





Europe – China ESA - CAS Joint Satellite Mission 2023

Plasma entry to Earth

Birkeland Centre for Space Science



University Centre in Svalbard - UNIS



SuperDARN – plasma convection



Kjell Hensriksen Observatory Auroral Imaging - >20 domes

NTNU – Trondheim

Radar to detect meteor trails -> temperature of mesosphere







Birkeland Centre for Space Science

How Earth is coupled to space

G1: When and why is the aurora in the two hemispheres asymmetric?

G2: How do we get beyond the large scale static picture of the ionosphere?

G3: What are the effects of particle precipitation on the atmospheric system?

G4: What is the role of energetic particles from thunderstorms in geospace?

All targeting SCOSTEP-VarSITI goals



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23 2 0 MLT

22 (c) 19:15 to 19:20

21 22 23 3 (d) 19:45 to 19:50

3 21

22 23 0

(b) 18:45 to 18:50

GPS signals are distorted by irregular electron density

van Der Meeren et al, 2014: How a tongue of ionisation affects **GPS** signal

Important for Space Weather

VarSITI – ROSMIC – effects on technical systems



23 0 1 2

WILEY



Energetic particles affect the mesosphere:

- Temperature
- Chemistry

Nesse Tyssøy et al., 2014:

Combining two telescope + theory -> For the first time: obtain total energy input down to 65 km.

VarSITI – ROSMIC: effects on climate







Laundal and Østgaard, 2009:

The Earth does not respond symmetrically to solar forcing

Auroras are highly asymmetric in the two hemispheres

Followed up with many papers to explain why !

VarSITI – ISEST: complete view on chain of cause-effect from Sun to Earth



Terrestrial gamma-ray flashes – discovered in 1991 by serendipity particles from below through the mesosphere to geospace

Østgaard et al., 2013 - AGU press release: Combined radio, optical and gamma mesuarements:

The flashes are produced just before the leader reaches upper charge region

VarSITI – ROSMIC: coupling within the terrestrial atmosphere









How common are TGFs?

Just exotic?

Gjesteland et al, 2012: Identified 2-3 times more than earlier discovered



Østgaard et al., 2015: Even more

Do all lightning produce gammaray flashes?

VarSITI – ROSMIC





Just a flavor of BCSS science:

From 2013:

150 papers400 presentations70 invited talks

All related to the VarSITI program

Thanks !