IMPACT OF THE 26-30 MAY 2003 EVENTS ON THE EARTH IONOSPHERE AND THERMOSPHERE

C. Hanuise[1], J.C. Cerisier[2], C. Lathuillere[3], M. Menvielle[2], F. Auchere[4], K. Bocchialini[4], S. Bruinsma[5], N. Cornilleau-Wehrlin[6], N. Jakowski[7], J.J. Valette[8], N. Vilmer[9], J. Watermann[10], P. Yaya[8]

1 – LPCE/CNRS ,3A av. de la Recherche Scientifique, 45071 Orléans Cedex, France
hanuise@cnrs-orléans.fr
2 – CETP/CNRS ,4 av. de Neptune, 94107 St Maur des Fossés Cedex, France
3 – LPG, BP 53, 38041 St Martin d'Hères Cedex 9, France
4 – IAS, Bat. 121, Université Paris Sud, 91405 Orsay Cedex, France
5 – CNES, Département de Géodésie Spatiale, 31055 Toulouse Cedex 4, France,
6 – CETP/IPSL, 10-12 av. de l'Europe, 78140 Vélizy-Villacoublay, France
7 – Deutsches Zentrum für Luft und Raumfahrt, 17235 Neustrelitz, Germany
8 – CLS, 8-10 rue Hermès, 31526 Ramonville St Agne Cedex, France
9 – LESIA, Observatoire de Paris, 92195 Meudon Cedex,France
10 – DMI, Lyngbyvej 100, 2100 Copenhagen, Denmark

Extreme solar events and their impact on the terrestrial environment have received a lot of attention in recent years, for example following the October/November 2003 events when some of the strongest solar flares ever recorded were observed. Nevertheless, the relations between the solar source and their effects in the terrestrial environment are far from being quantitatively understood, let it be for the physical mechanisms (solar-terrestrial physics) or for the effects on living bodies and technological systems (space weather). Are successively involved the formation mechanism of solar flares and Coronal Mass Ejections (CME), the propagation within the solar wind, the interaction with the Earth's magnetosphere and the coupling between the magnetosphere, the ionosphere and the neutral atmosphere.

Events of various magnitudes, and not only the most important ones, have to be studied in order to progress in understanding the processes acting in each region, the coupling between the regions and the effects on the terrestrial environment. We focus our attention on a case study for which a moderate solar activity had a strong impact at Earth. On 27-28 May 2003 three halo Coronal Mass Ejections originated from the solar active region AR 10365. On May 29, upon their arrival at the L1 point in front of the earth's magnetosphere, two interplanetary shocks and two additional solar wind pressure pulses were recorded by the ACE spacecraft. The interplanetary magnetic field data showed the clear signature of a magnetic cloud passing ACE. In the wake of the successive increases in solar wind pressure the magnetosphere became strongly compressed and the sub-solar magnetopause moved inside five Earth radii.

The interaction with the Earth's environment caused an intense magnetic storm with numerous manifestations of adverse space weather. At low altitudes a substantial enhancement of region-1 field-aligned currents and ionospheric Hall currents was observed, and the entire high-latitude current system moved equatorward by about 10°. The most notable consequences on geospace were (1) expansion of the auroral oval and aurorae seen at mid latitudes, (2) significant increase of the total electron content in the dark ionosphere, (3) perturbation of radio wave propagation manifested by HF blackouts and increased GPS signal scintillation, and (4) heating of the thermosphere causing increased satellite drag.