Space Weather
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Head of Space Weather
Contents

• Government view
• Met Office status
• Research / Application themes
• Other UK activities
Space Weather in the UK

• UK discussions started early 2010
• Space Environment Impacts Expert Group (SEIEG) formed November 2010
• Emphasis on (peer reviewed) scientific evidence
• Reasonable worst case scenario agreed
• Included as a risk in the National Risk Assessment: 2011 and National Risk Register in 2012
Space weather operations

- UK space weather prediction centre
  - 24x7x365 – April’14
  - Full capability autumn ‘14
- Collaborate with academia not replicate
- Operational collaboration with NOAA SWPC & BGS
  - Daily forecast coordination
- Add UK-centric advice and impacts
Improved solar wind modelling

- Ensemble forecasts to improve forecast advice & identify model deficiencies.
- Ensemble of CME ICs plus different ambient coronal solar wind (e.g., GONG, NSO and WSO data)
- Replace WSA with improved solar magnetic field model (St Andrews, Durham), improved CME tracking (Reading)
- Assimilation of STEREO data into Enlil
- Longer term, use IPS data

(with Francois Bocquet)
• Ionospheric analyses of European sector produced at Met Office using MIDAS (with Bath Uni.). 15 minute update

• Thermosphere DA developed using CHAMP / GOCE / GRACE in situ neutral densities – TIECGM & CMAT2

• Related research shows importance of thermosphere to ionospheric forecast skill

• So coupled thermosphere / ionosphere system important

• Future UM coupling?

20 Nov 2003 (Chartier et al, in review)
Whole atmosphere model plans

- Met Office weather and climate model (UM) extended upwards from ~80 km to exobase (~600 km)
  1. Develop dynamical core to deal with fast waves (e.g., acoustic), new equations for constituents, etc. Extending to Held-Suarez approach to thermosphere.
  2. Develop “intermediate” UM with UB ~140 km to validate tide climatology and add relevant physics & chemistry (e.g., non-LTE)
- Blend 1 and 2 later
FP7 HELCATS: Heliospheric Cataloguing, Analysis and Techniques Service

Start date: 1 May 2014, Duration: 3 years
Total staff effort: 26 staff years over three years

Collaboration between:
- STFC-RAL Space, UK         R. Harrison/J.A. Davies
- University of Graz, Austria C. Möstl
- University Paul Sabatier/CNRS, France A.P. Rouillard
- University of Göttingen, Germany V. Bothmer
- Royal Observatory Belgium, Belgium L. Rodriguez
- Imperial College London, UK   J.P. Eastwood
- University of Helsinki, Finland E.K.J. Kilpua
- Trinity College Dublin, Ireland P. Gallagher
- George Mason University, USA  D. Odstrčil
Aims of HELCATS

- catalogue transient (CMEs) and background (SIRs/CIRs) features imaged by STEREO/HI, including

- kinematic properties estimated using a variety of established & prototype modelling approached
  - geometrical modelling
  - forward and inverse modelling
  - automatic detection

- verify these kinematic properties through comparison with solar source observations and in-situ

- assess the potential for initialising MHD models with both the transient and background solar wind structures observed by HI;

- assess the complementarity of using radio obs (in particular Type II radio bursts and IPS) in combination with HI.
Heliospheric Expert Services Centre
Bid to SSA P2-SWE-I

ENLIL (MHD) Modelling of solar wind propagation (Met Office)

Forecasting based on empirical models (Graz)

In-situ alerts (DTU)
Heliospheric Expert Services Centre
Bid to SSA P2-SWE-I

Proposal Coordinator
• RAL Space, UK (Coordination, scientific QA and service assessment)

Product Service Providers
• UK Met Office, UK (operational forecasting service, MHD modelling)
• University of Graz, Austria (solar wind and CME propagation)
• DTU, Denmark (near-Earth solar wind transient detection)
• IRAP, France (AMDA and propagation validation tools)

Expert Consultants
• KU Leuven, Belgium (European modelling assessment)
• DH Consulting, Belgium (Existing service assessment)
• University of Göttingen, Germany (CME propagation)

Advisory Board
• Representative from each team institute
• Representatives from Solar-ESC and Radiation-ESC
Modelling from Sun to Earth: Current R&D Status

WSA alternative - Magnetic field evolution model (Yeates & Mackay)

Improved methods of tracking solar wind features (Tucker-Hood)

SpaceCast (BAS)

Real time regional TEC (MIDAS)

WSA Enlil Ensembles

Solar wind persistence model for benchmarking / validation (Owens et al, 2013)

M Owens (Reading Uni)

Thermosphere: DA and ionosphere coupling

SEP model (S Dalla, UCLan)

Whole atmosphere model plans
Questions?