Space Weather

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Head of Space Weather

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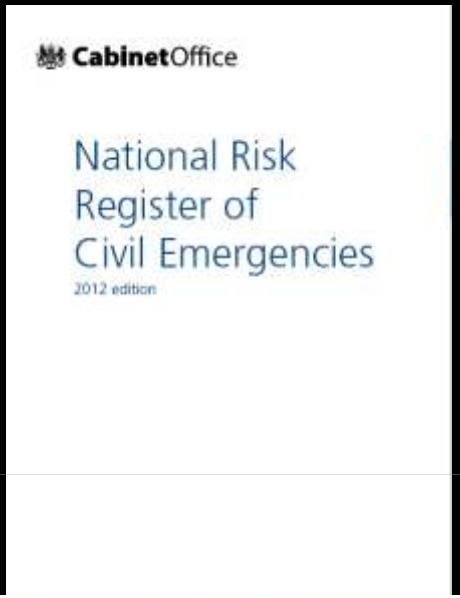
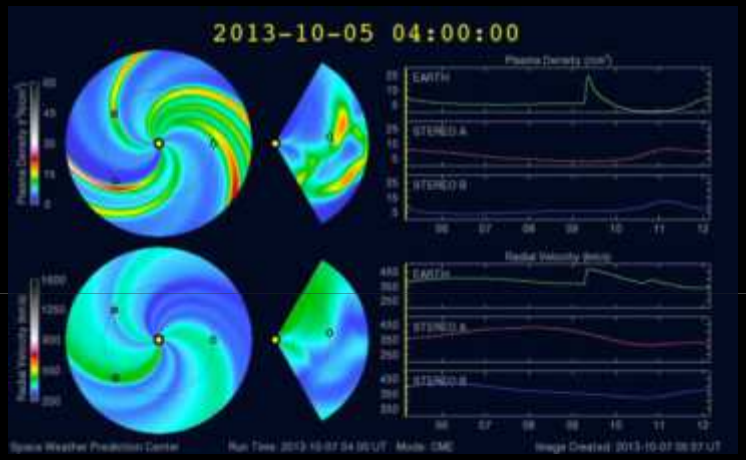
Space Weather in the UK

- 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



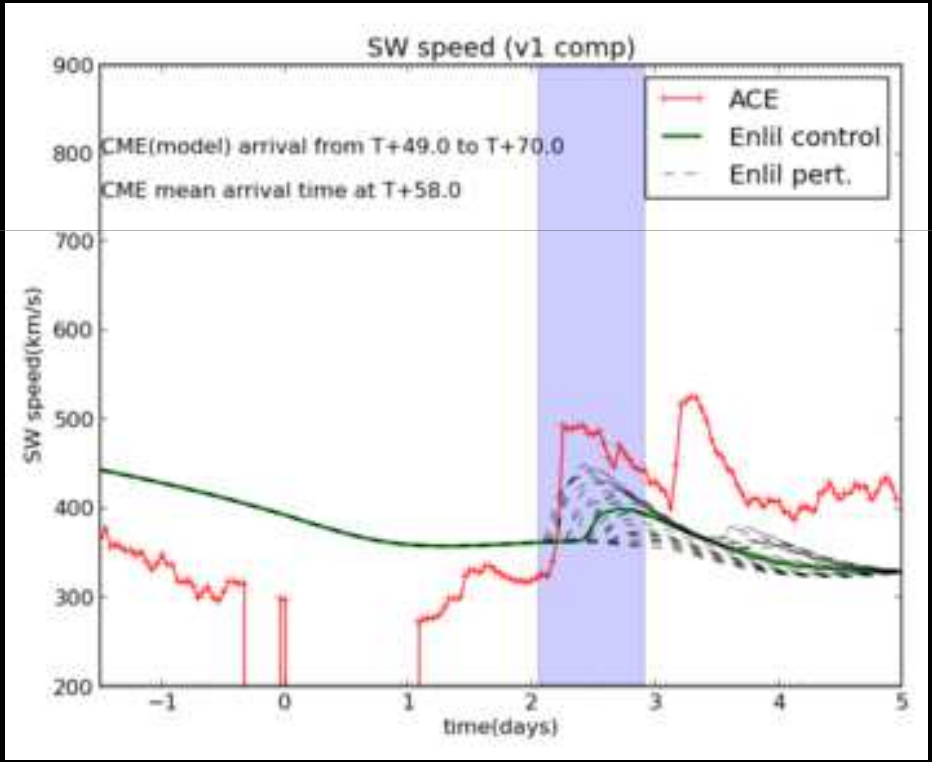
Space weather operations



- 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

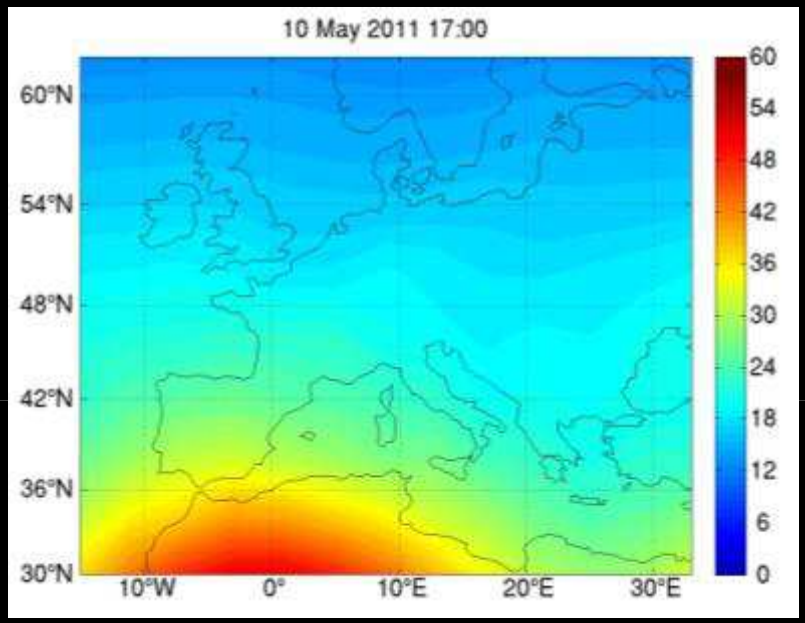
2011-10-22T06 CME (GONG)



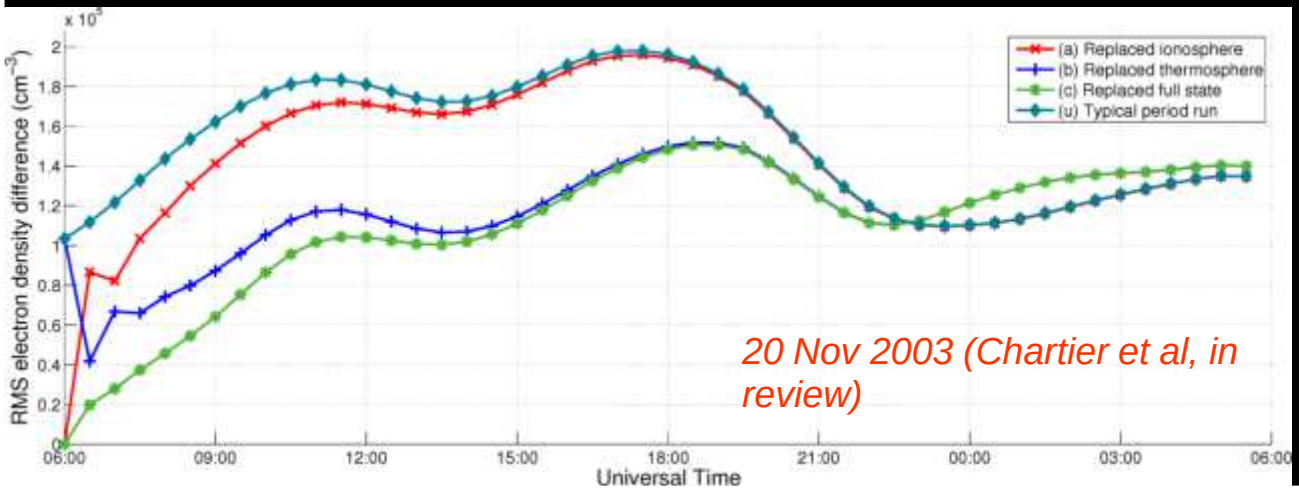
(with Francois Bocquet)

- Ensemble forecasts to improve forecast advice & identify model deficiencies.
- Ensemble of CME ICs plus different ambient coronal solar wind (eg 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

Ionosphere / Thermosphere



- 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 (eg 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 (eg 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:

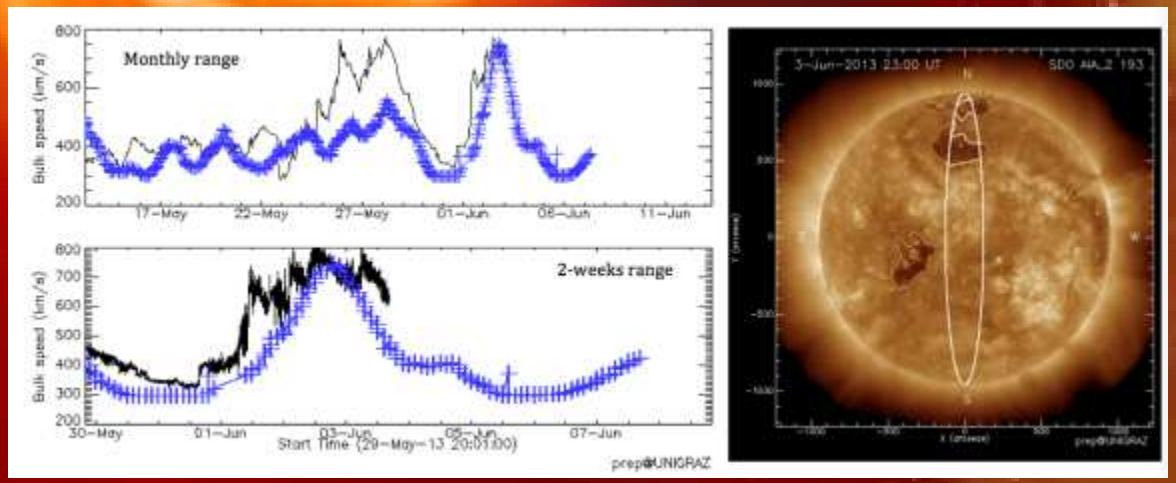
• STFC-RAL Space, UK	R. Harrison/J.A. Davies
• University of Graz, Austria	C. Möstl
• University Paul Sabatier/CNRS, France	A.P. Rouillard
• University of Göttingen, Germany	V. Bothmer
• Royal Observatory Belgium, Belgium	L. Rodriguez
• Imperial College London, UK	J.P. Eastwood
• University of Helsinki,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

Aims of HELCATS

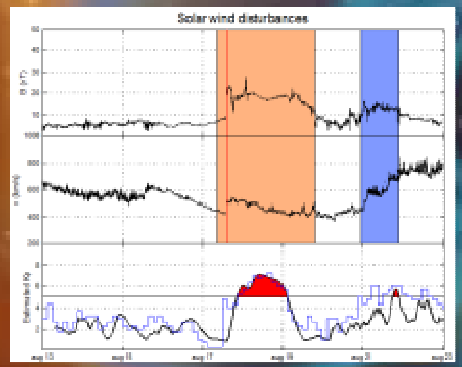
- catalogue transient (CMEs) and background (SIRs/CIRs) features imaged by STEREO/HI, including
- kinematic properties estimated using a variety of established & prototype modelling approached
  - geometrical modelling
  - forward and inverse modelling
  - automatic detection
- verify these kinematic 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

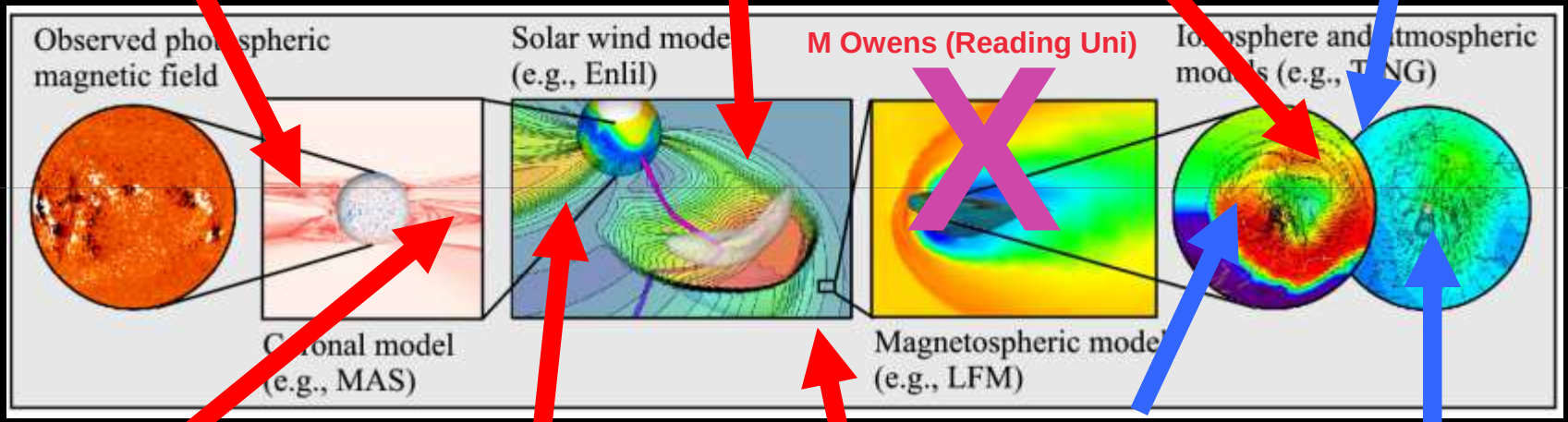
Met Office

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)

SEP model (S Dalla, UCLan)

Thermosphere: DA and ionosphere coupling

Whole atmosphere model plans

Questions?