ABBYNORMAL Model @ CCMC

(**AB**sorption **BY** the D and E Region
of HF Signals with **NORMAL** Incidence)

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Investigation and Development of Data-Driven D-Region Model for HF Systems Impacts

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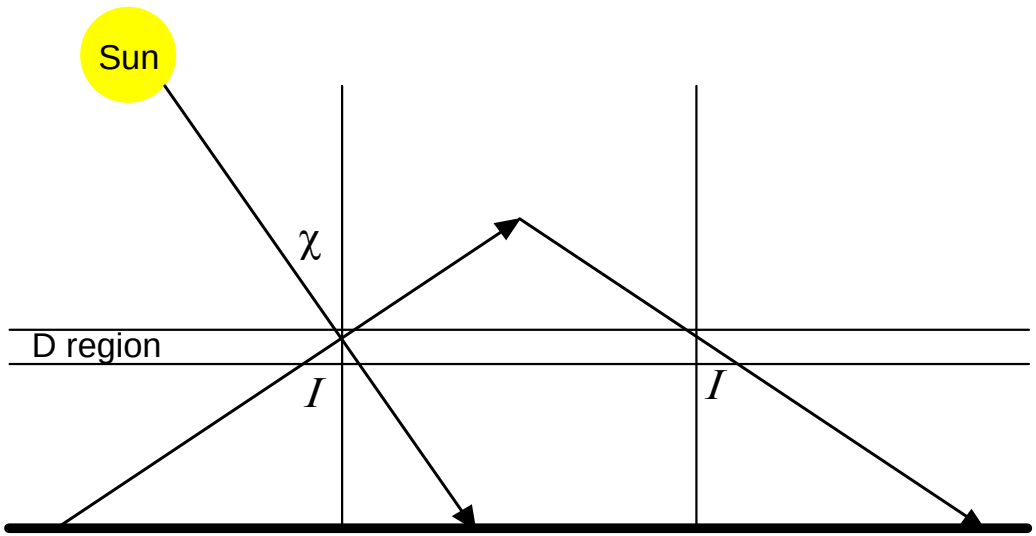
ABsorption **BY** the D and E Region of HF Signals with **NORMAL** Incidence or the ABBYNORMAL Model

- Data-Drive D-region (DDDR) is solves for e from 60 to 130 km.
- ABBYNORMAL uses the DDDR model to calculate global 2D maps of:
  - **Signal loss (absorption) of an HF signal for a single vertical transit (most absorption occurs between 85 to 105 km).**
  - **Vertically integrated Hall and Pedersen Conductivities (because its there).**

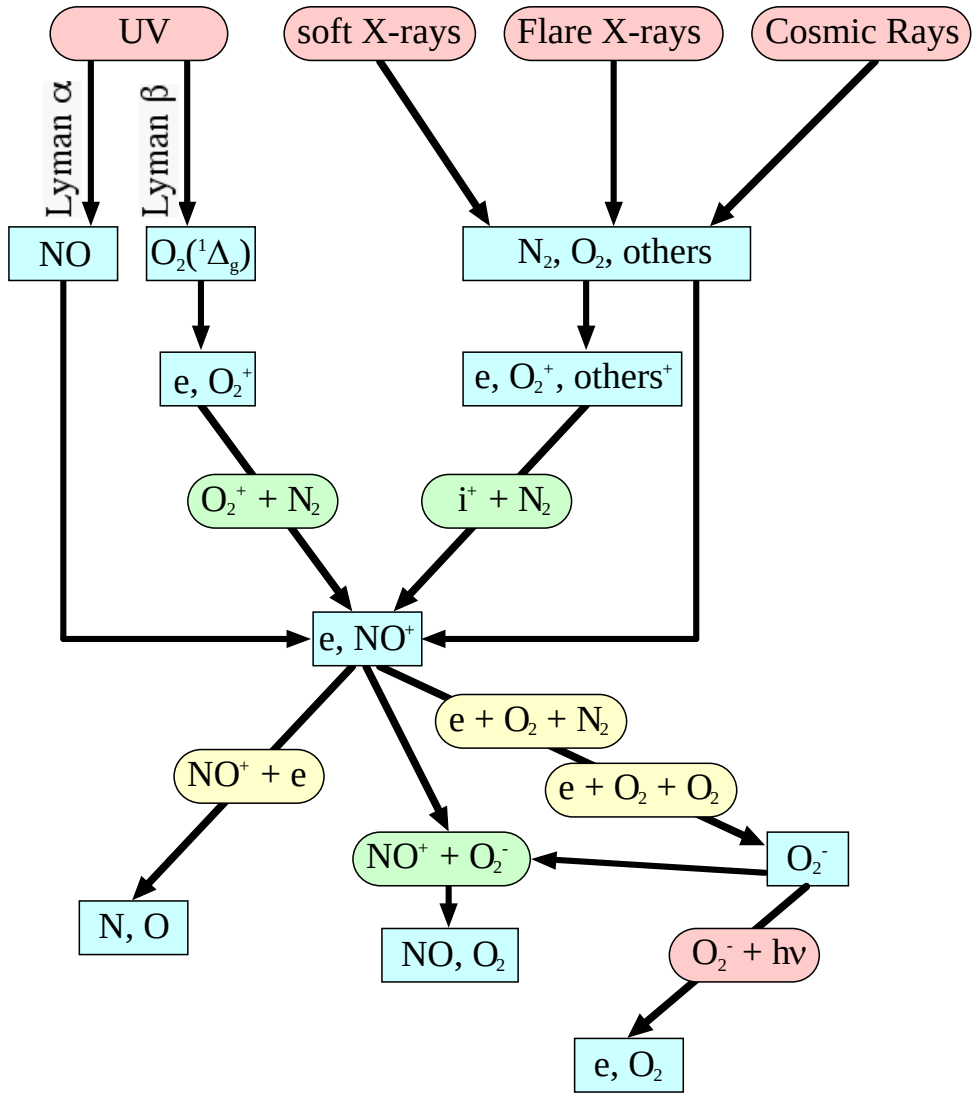


Investigation and Development of Data-Driven D-Region Model for HF Systems Impacts

- **Started with Disturbance D-Region model of *Swider and Foley* [1978] (AFRL). Did not converge for quiet or night time ionization profiles.**
- **Developed new code to provide global D region electron density profiles from 60 to 140 km for all conditions.**
- **It solves for e, i^+, and i^-, with simplified (representative negative ion chemistry.)**
- **D region model is validated by comparing predicted vs measured HF signal absorption calculations.**
- **HF-link monitoring network HIDIVE Experiment**
  http://www.spacenv.com/~rice/hidive

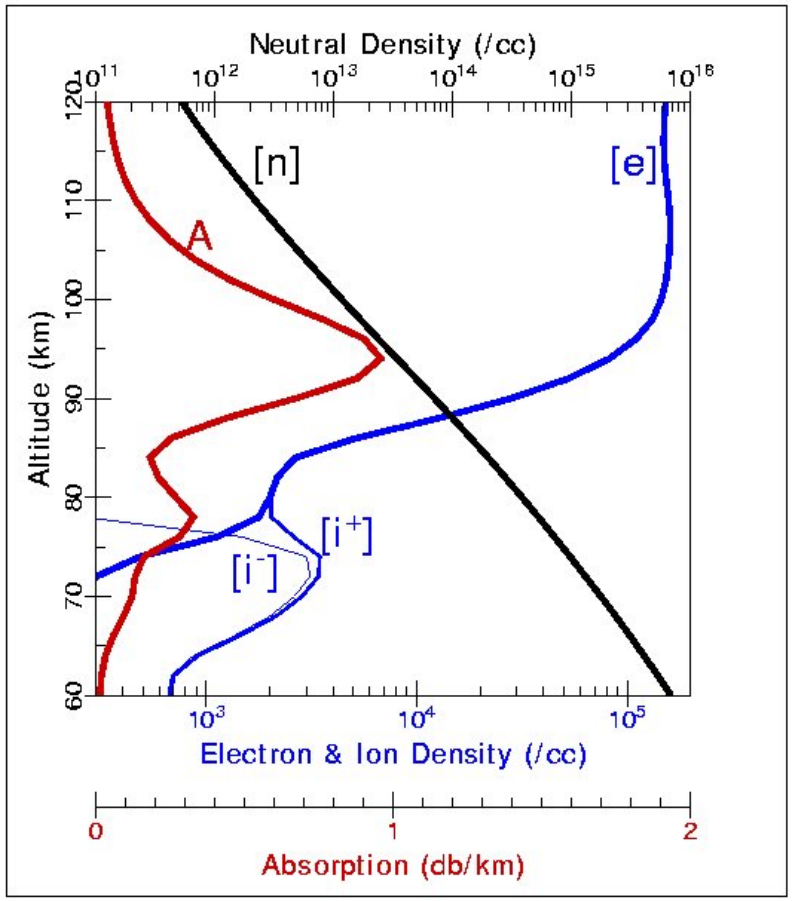
Data-Driven D-Region (DDDR) Model

- Data-Driven D-region model extended and simplified the *Swider and Foley* [1978] model to cover all conditions.
- Ionization sources
  - **UV**
  - **EUV**
  - **X-rays**
  - **Cosmic Rays**
  - **Auroral Precipitation (e-)**
  - **NO SPEs (yet)**
- Chemistry
  - **3-body attachment**
  - **Photo detachment**
  - **Collisional detachment**
  - **e-i and i-i Recombination**
  - **Metastable species.**
  - **NO Metal ion chemistry**



ABBYNORMAL

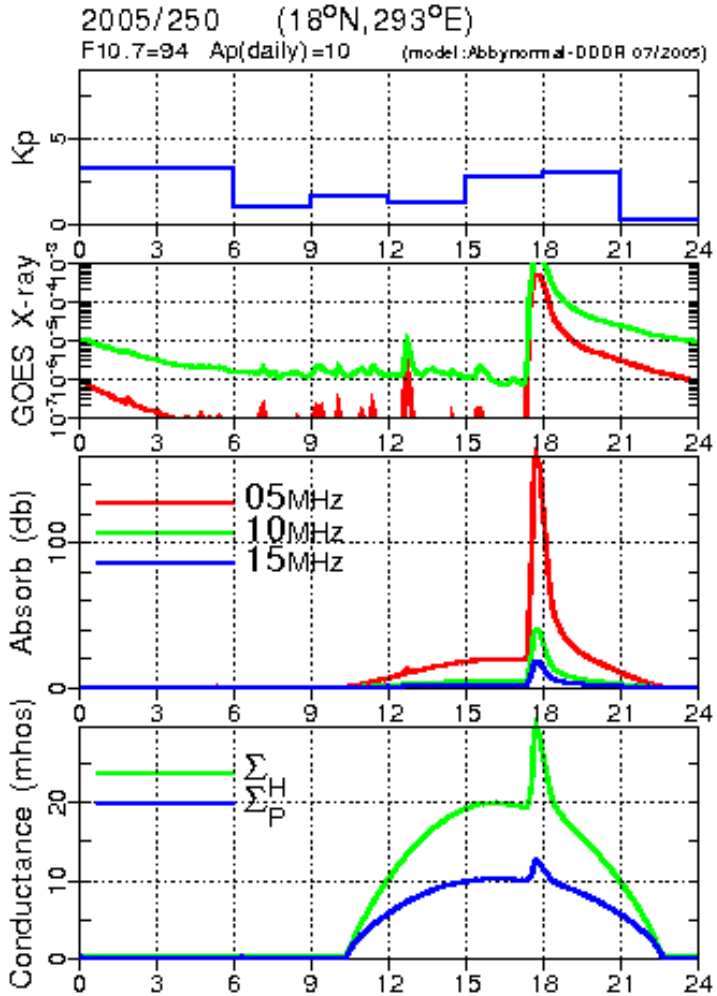
- ABBYNORMAL combines calculations of non-deviative absorption of HF signals with the DDDR electron density profile.
  - Electron density (/cc)
  - E-n collision rate (/s)
  - Absorption (db/km)
- Conductivities are also calculated.
- Give single location time-history.
- Or give global ‘map’ of vertically integrated HF absorption and Conductivities.



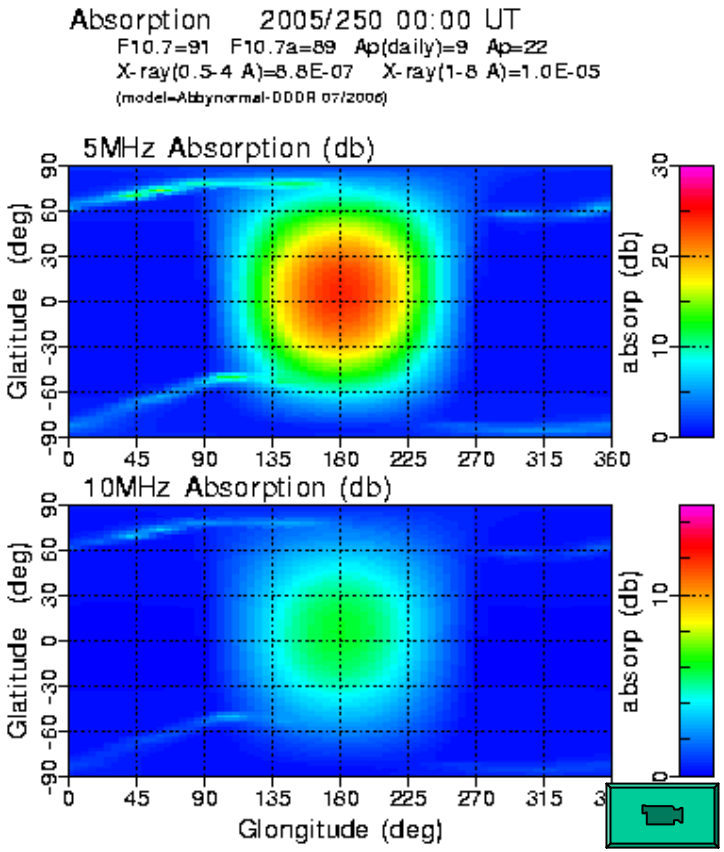
ABBYNORMAL(local) @ CCMC

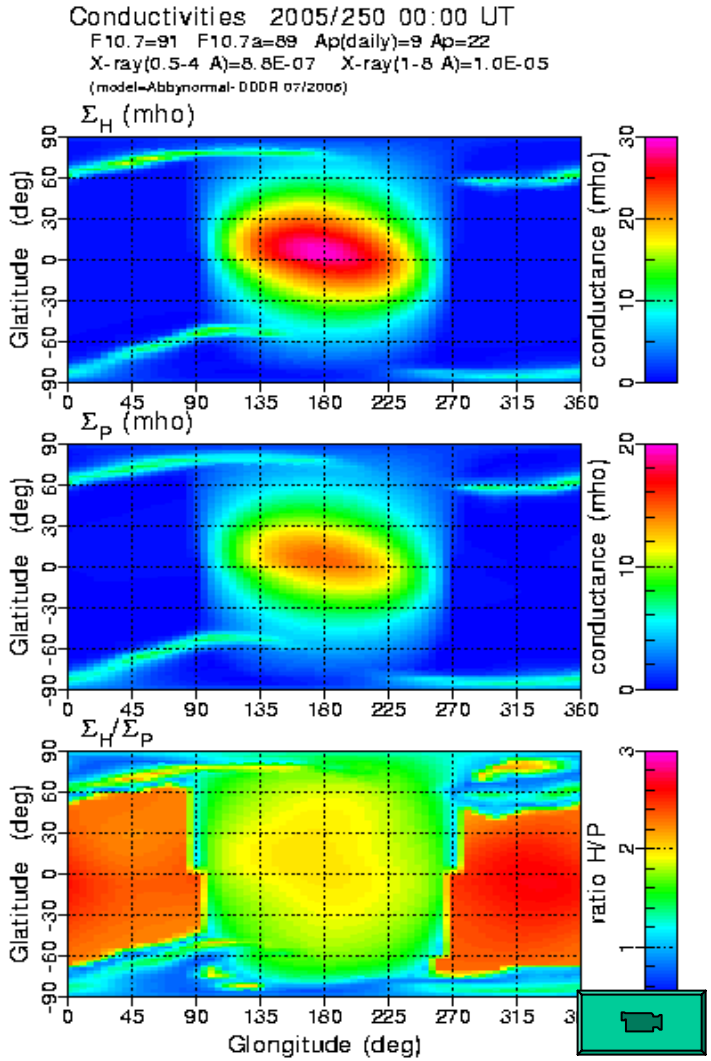
- Select Local Run at Single location from CCMC for a date and location and ABBYNORMAL returns:
  - **Signal absorption calculation of single vertical transit of several HF freq.**
  - **Vertically Integrated Hall & Pedersen Conductivities.**

(5 minute cadence)



ABBYNORMAL @ CCMC (Global)

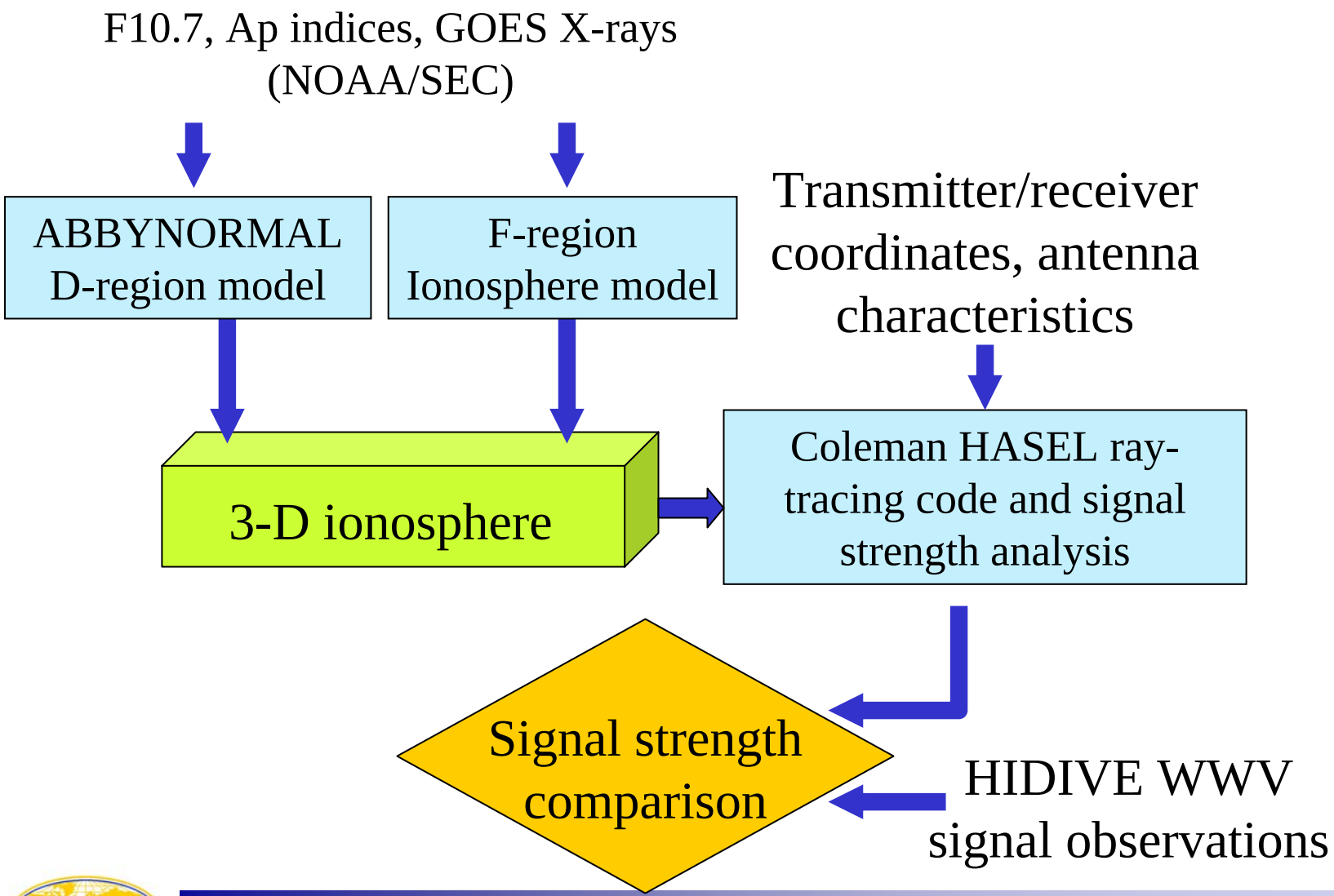


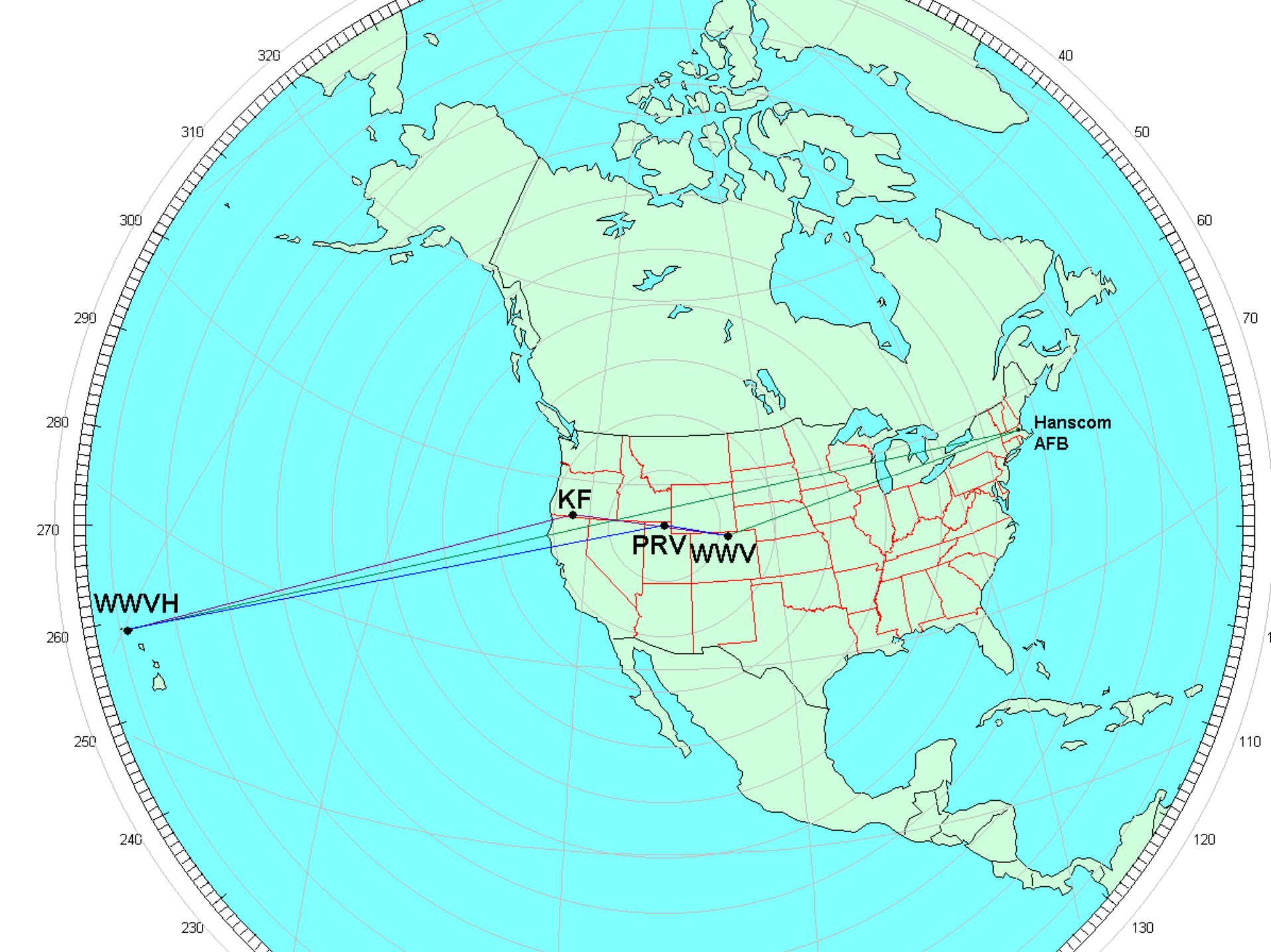


ABBYNORMAL/DDDR Uses

- Combine with ionosphere models and HF Propagation codes
  HF signal propagation and absorption modeling
- Combine with VLF Propagation codes
  VLF signal propagation modeling
- Combine with magnetosphere-precipitation models
  MI coupling

ABBYNORMAL For HF Propagation Tools




320
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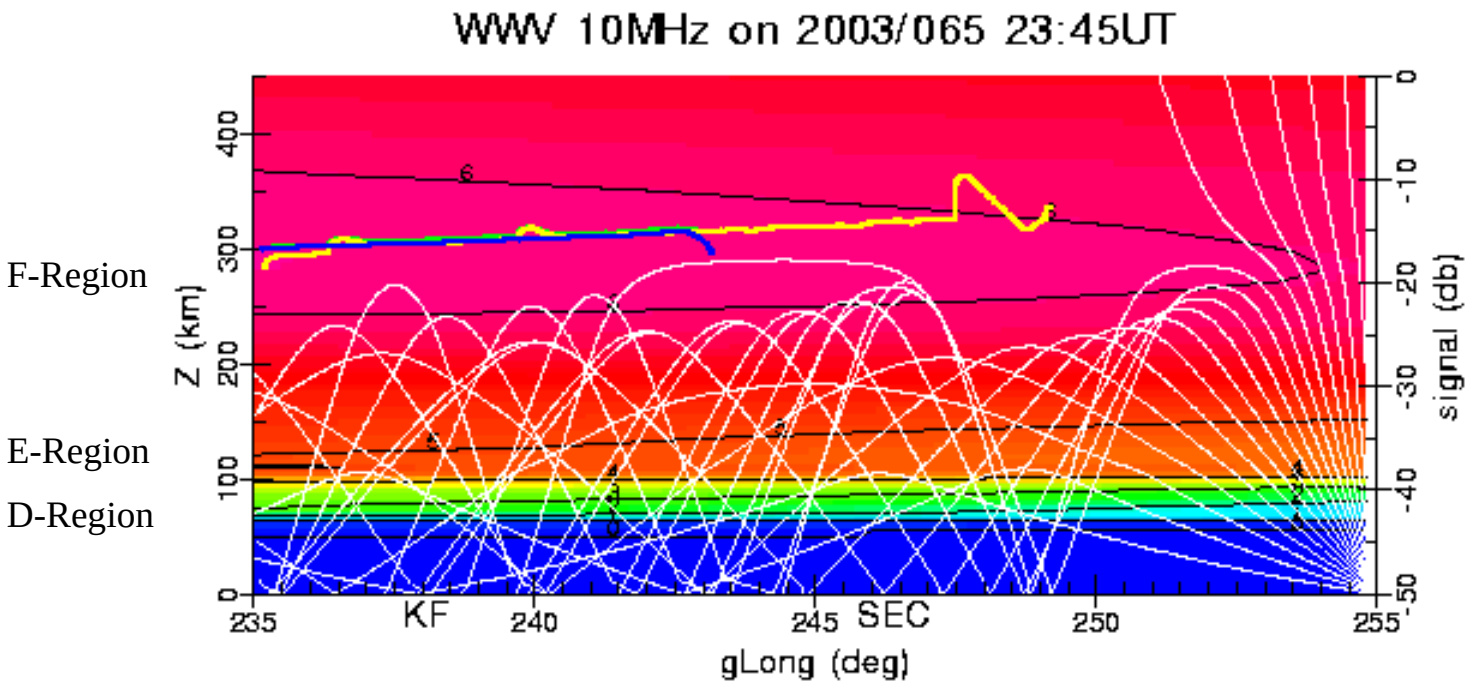
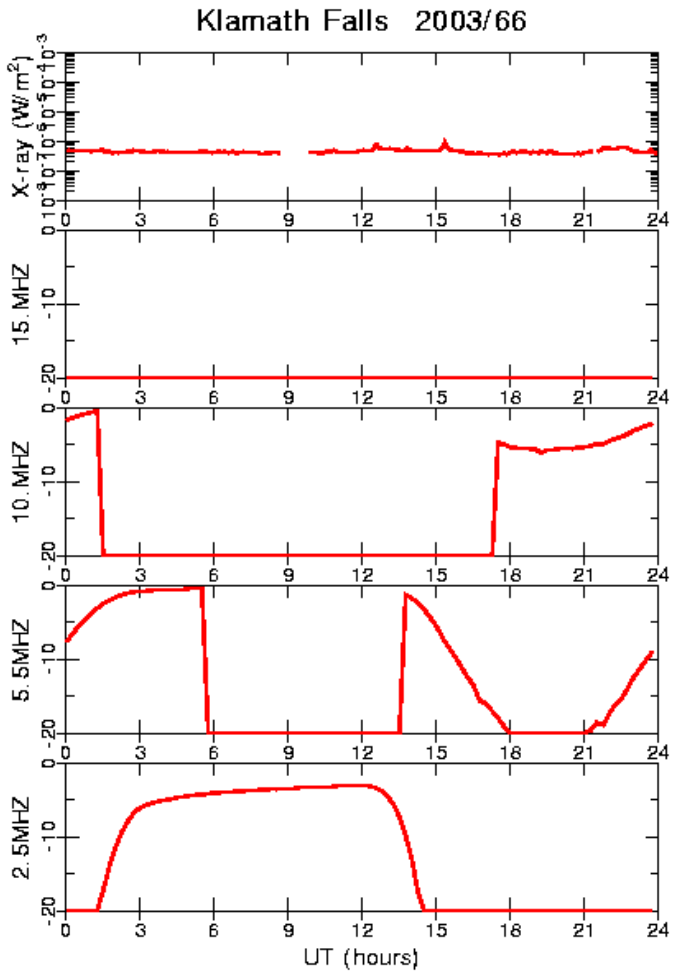
Hanscom
AFB
KF
PRV
WWV
WWVH

High Frequency Radio Propagation



- The ABBYNORMAL model can used to calculate D and E region electron density and non-deviative absorption.
- F Region model ionosphere (IRI, and others) is added to the ABBYNORMAL electron density profiles.
- HF ray-tracing (Coleman Ray Tracing - HASEL).

Quiet Day & Halloween Storm

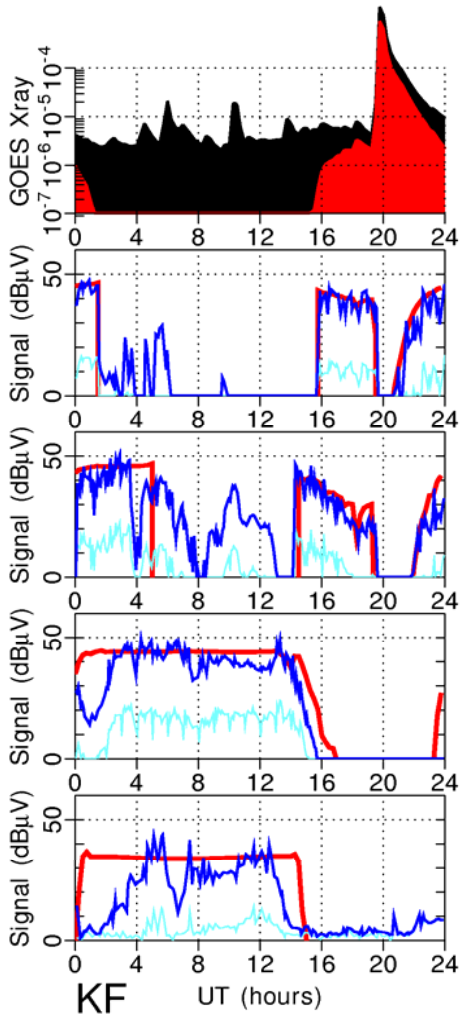


15MHz

10MHz

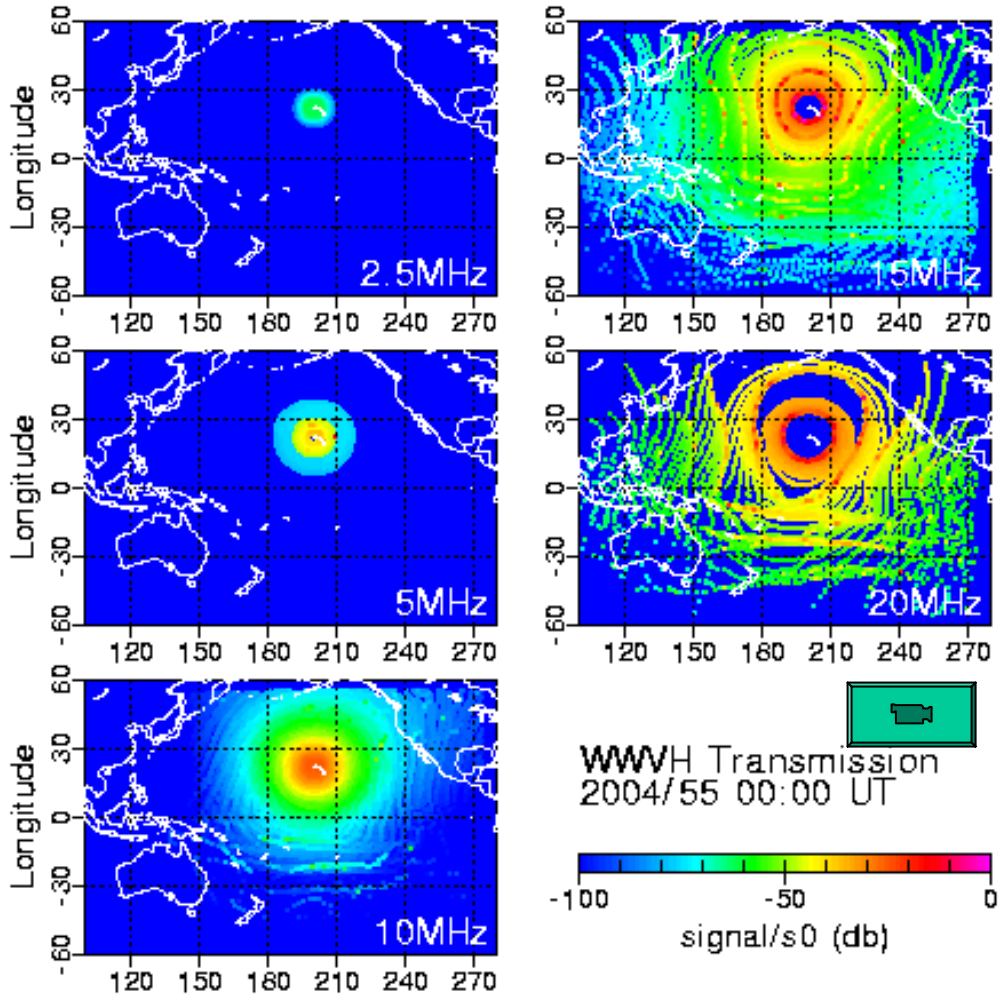
5MHz

2.5MHz



November 4, 2004

Spring, Low F10.7, Quiet Kp



Future Improvements AbbyNormal

- HF specific frequency request.
- HF frequency transmission cutoff.
- Real-Time AbbyNormal.
- Polar Cap Absorption Events.
- Coupling with other models (MI, SEP cutoff models).

- Quiz … What is one of my favorite movies? (hint: Abby Normal)