Jovian Magnetic Field Models: VIP4, VIT4, VIPAL

VIP4:

- First presented in Connerney et al. (1998)
- Fourth order
- Uses Connerney et al. (1981,1982) for the Jovian magnetodisc field
- Solved as a partial solution to a linearized system. See Connerney et al. (1981)
- Uses the following observations:
    - Io flux tube (IFT) footprint
        - Infrared images from the National Science Foundation camera (NSFCAM) at the Infrared Telescope Facility (IRTF)
        - Ultraviolet images with the Hubble Space Telescope (HST)
        - No distinction made between NSFCAM and HST observations because of good agreement between the two for latitude
        - Errors: ±1° latitude and ±2°-15° longitude
            - Poorer longitude errors from northern longitudes 285°-355° λ_{III}
        - Northern longitudes 0°-150° λ_{III} sparsely sampled
        - 112 IFT footprints total
    - Pioneer 11
        - Vector Helium magnetometer 1-min averages
        - Scalar observations from <2.4 R_J
        - Vector observations from 2.4-8.0 R_J
        - Weighted by estimated accuracy of measurement
        - Field magnitude only from closest distances because of potential attitude uncertainties
    - Voyager 1
        - Fluxgate 48-s averages of vector field
        - <10 R_J
        - Weighted with constant magnitude errors

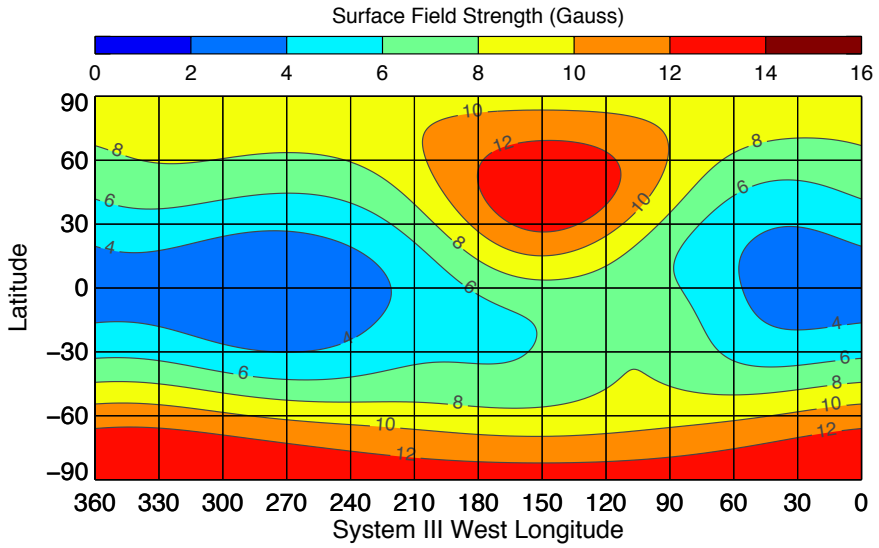
VIT4:

- First presented in Connerney (2007)
- Fourth order
- Uses the same methodology as VIP4
- Uses IFT and a minimum of *in situ* data:
    - Over 500 IFT observations from Connerney et al. (1998)
    - Voyager 1 data least influenced by external fields
        - θ-component only
        - <7 R_J
        - Field strength limited between 1036-3280 nT

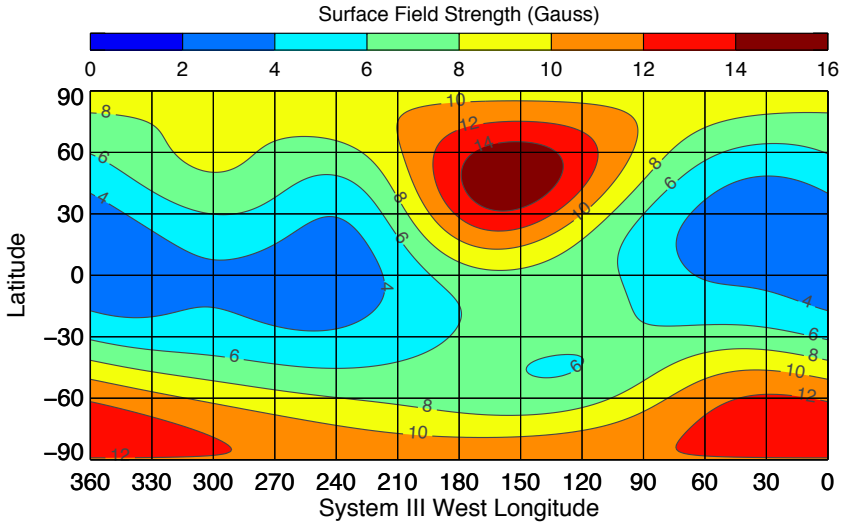
VIPAL:

- First presented in Hess et al. (2011)
- Fifth order
- Began with the VIP4 model and systematically changed Schmidt Coefficients
    - Corrected the longitudinal position based on the location of Io plus a lead angle for Alfvén wave propagation
    - Corrected changes in latitude using a variations method that includes the fits mean error from Voyager 1 and Pioneer 10 and 11 data
    - Minimizes coefficients for uniqueness
- Uses the following observations:
    - IFT footprint
        - Ultraviolet images from the Space Telescope Imaging Spectrograph (STIS) and Advanced Camera for Surveys (ACS) on HST
    - Voyager 1 and Pioneer 10 and 11
        - Used to normalize coefficients and a few further constraints on free parameters
        - Subtracts current sheet magnetic field using Connerney (1981) model
        - <10 R_J

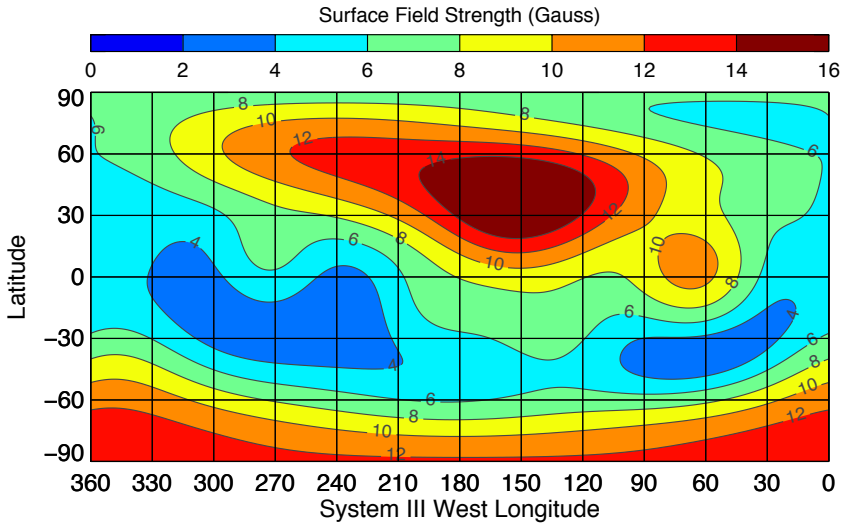
VIT4 Surface Field



VIP4 Surface Field

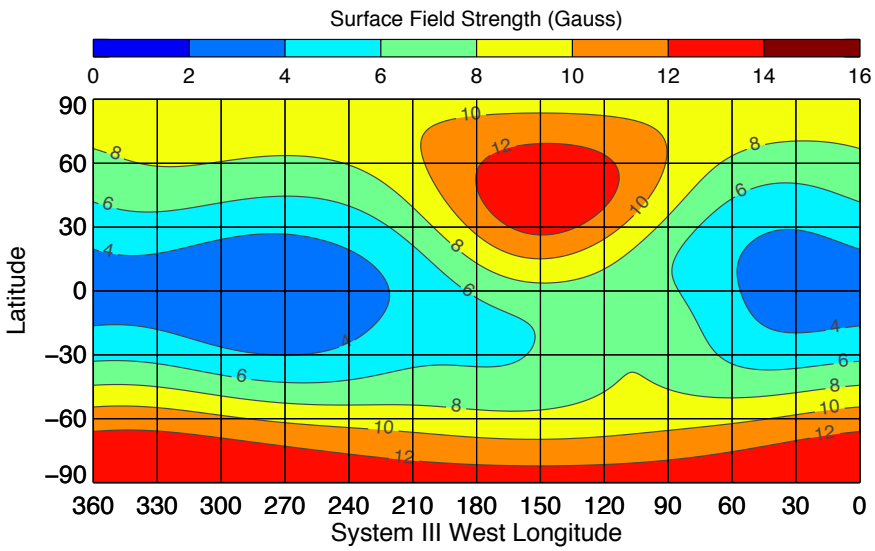


VIPAL Surface Field

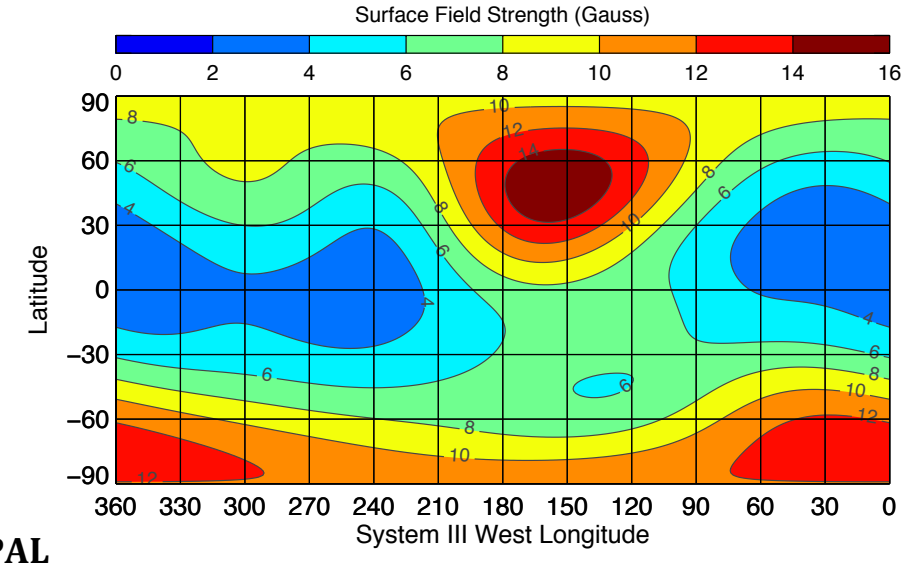


VIP4	VIT4	VIPAL
First in Connerney et al. (1998)	First presented in Connerney (2007)	First presented in Hess et al. (2011)
4th Order	4th Order	5th Order
Uses Connerney et al. (1981,1982) for the Jovian magnetodisc field. Solved as a partial solution to a linearized system-Connerney et al. (1981) **Io flux tube (IFT) footprint** ▪ Infrared images from the NSFCAM at IRTF ▪ Ultraviolet images with the HST ▪ No distinction made between NSFCAM and HST observations because of good agreement between the two for latitude ▪ Errors: ±1° latitude and ±2°-15° longitude • Poorer longitude errors from northern longitudes 285°-355° λ_{III} ▪ Northern longitudes 0°-150° λ_{III} sparsely sampled ▪ 112 IFT footprints total **Pioneer 11** ▪ Vector Helium magnetometer 1-min averages ▪ Scalar observations from <2.4 R_J ▪ Vector observations from 2.4-8.0 R_J ▪ Weighted by estimated accuracy of measurement ▪ Field magnitude only from closest distances because of potential attitude uncertainties **Voyager 1** ▪ Fluxgate 48-s averages of vector field ▪ <10 R_J ▪ Weighted with constant magnitude errors	Uses the same methodology as VIP4 **Uses IFT and a minimum of *in situ* data:** • Over 500 IFT observations from Connerney et al. (1998) **Voyager 1 data** least influenced by external fields ▪ θ-component only ▪ <7 R_J Field strength limited between 1036-3280 nT	• Began with the VIP4 model and systematically changed Schmidt Coefficients • Corrected the longitudinal position based on the location of Io plus a lead angle for Alfvén wave propagation • Corrected changes in latitude using a variations method that includes the fits mean error from Voyager 1 and Pioneer 10 and 11 data • Minimizes coefficients for uniqueness **IFT footprint** • Ultraviolet images from STIS and ACS on HST **Voyager 1 and Pioneer 10 and 11** • Used to normalize coefficients and a few further constraints on free parameters • Subtracts current sheet magnetic field using Connerney (1981) model • <10 R_J

VIT4



VIP4



VIPAL