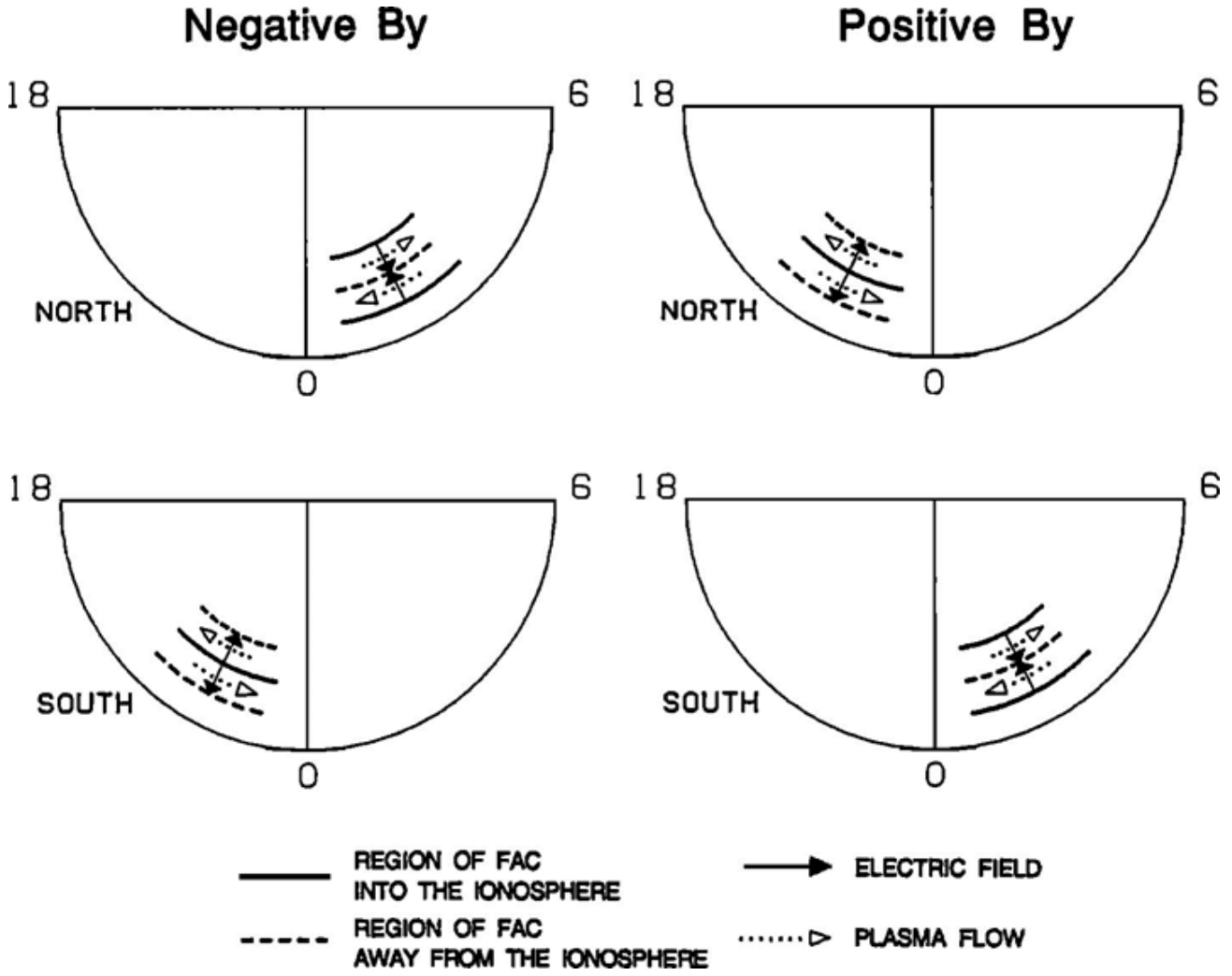
Ionospheric convection during oblique northward IMF periods revisited

M. Watanabe (Kyushu U)

Three research subjects I worked with but have never been successful with

(1) On the formation mechanisms of the transpolar arcs (theta auroras) during steady IMF B_y periods

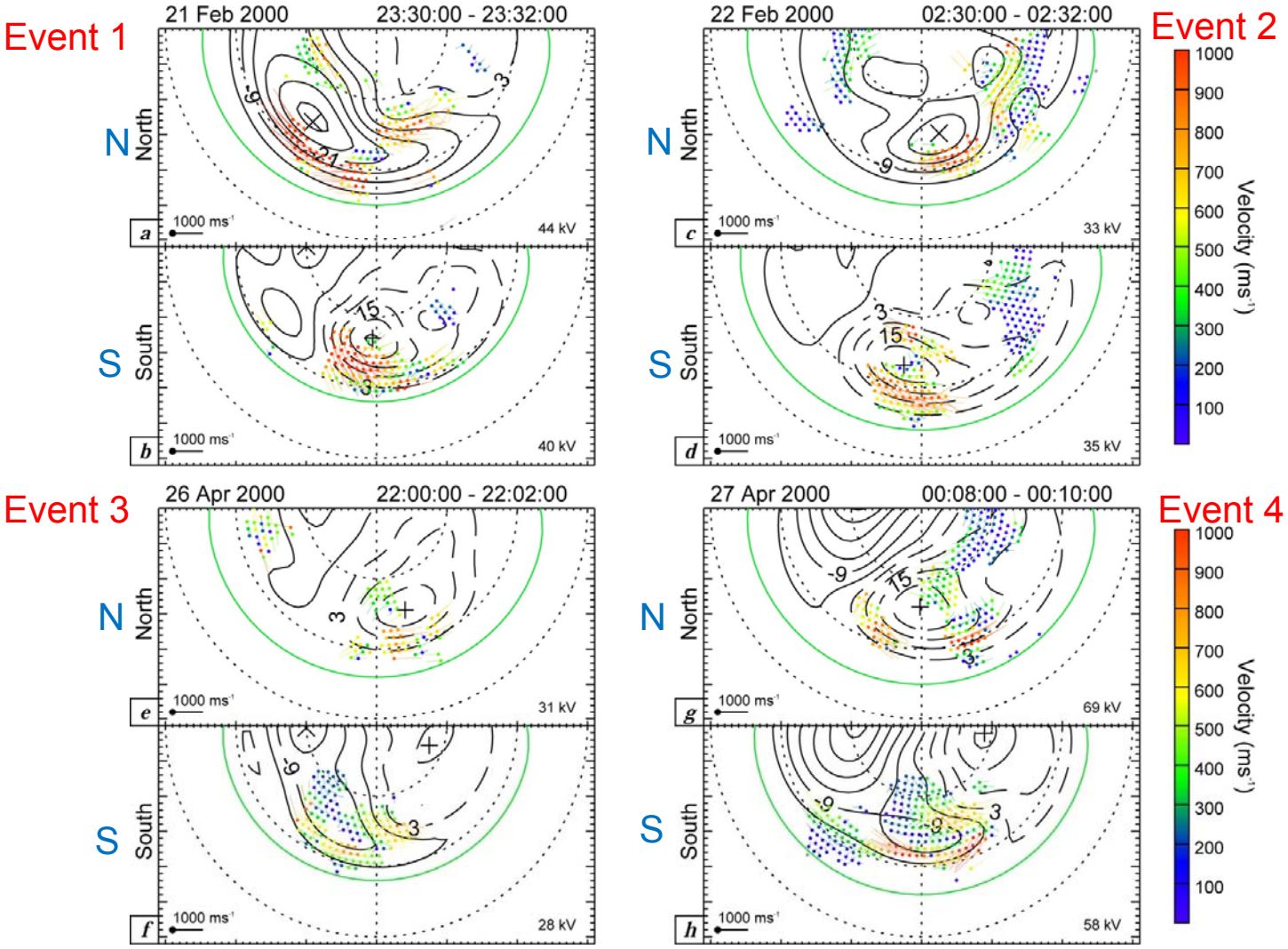
B_y-controlled convection system on the nightside during northward IMF periods (Taguchi, 1992)



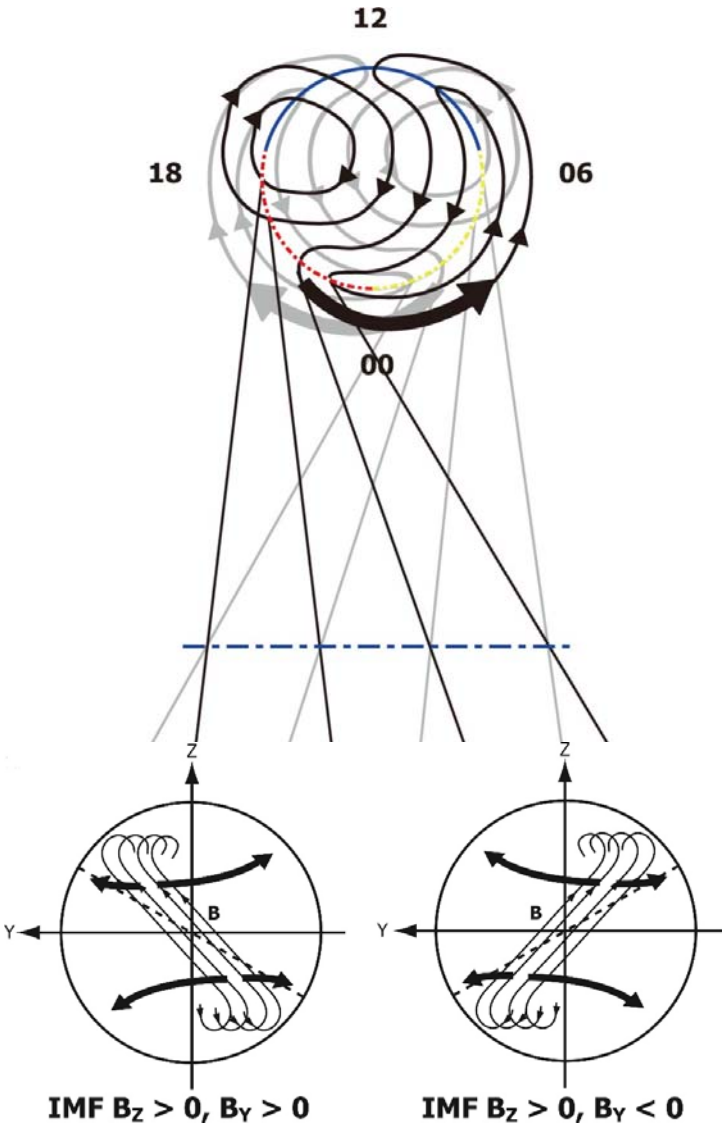
TRINNIs ("tail reconnection during IMF northward non-substorm intervals":
Rediscovery by Grocott et al. (2005)

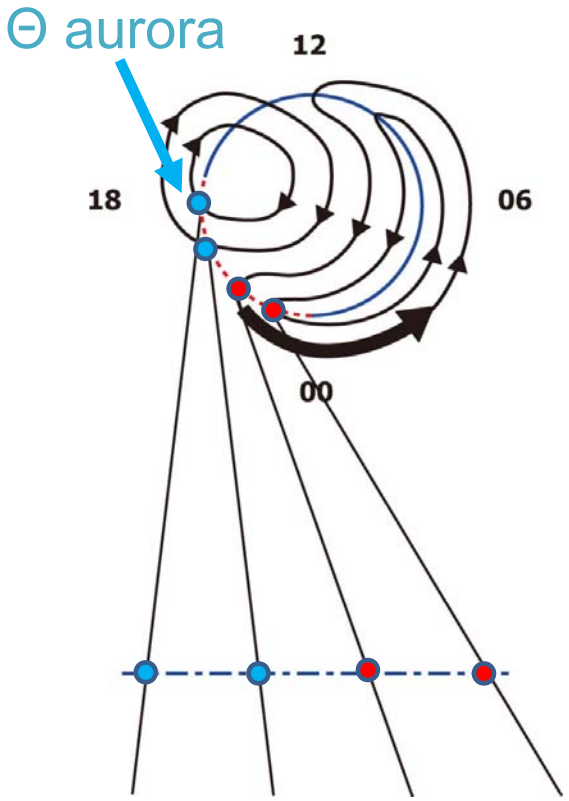
$B_y < 0$

$B_y > 0$

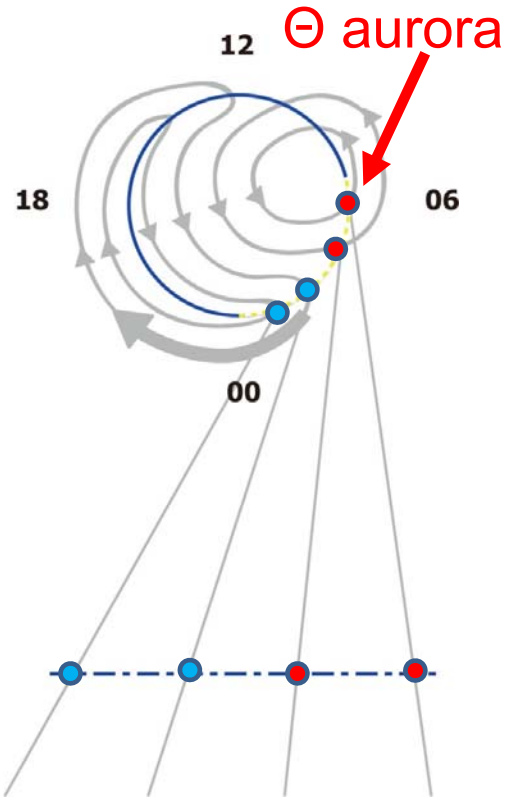


An interpretation in terms of Dungey-type reconnection





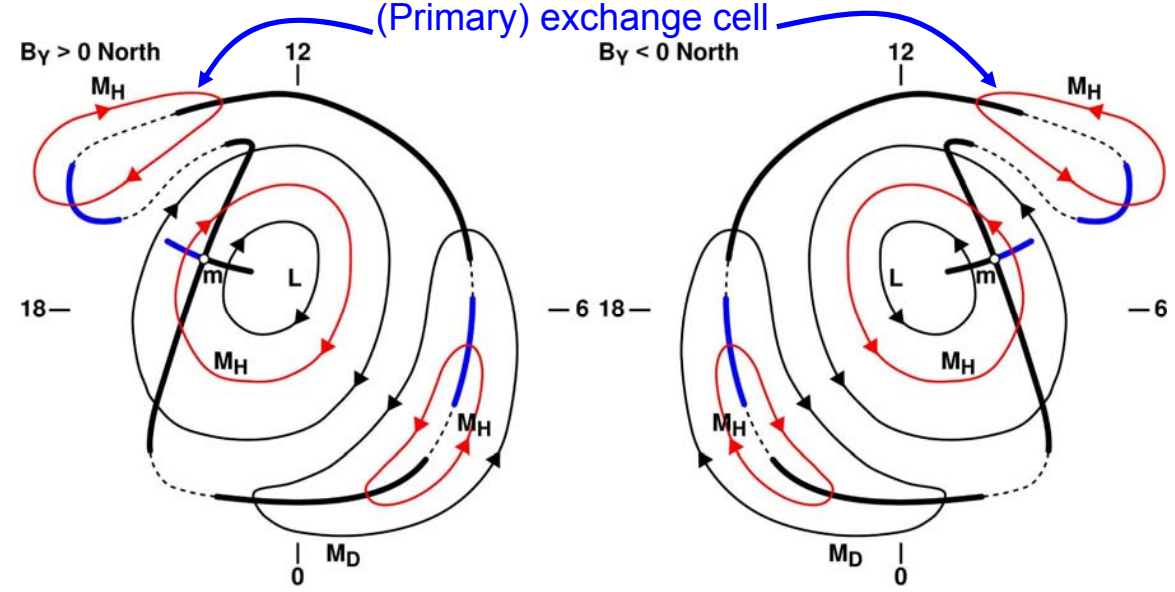
$B_y > 0$, North
$B_y < 0$, South

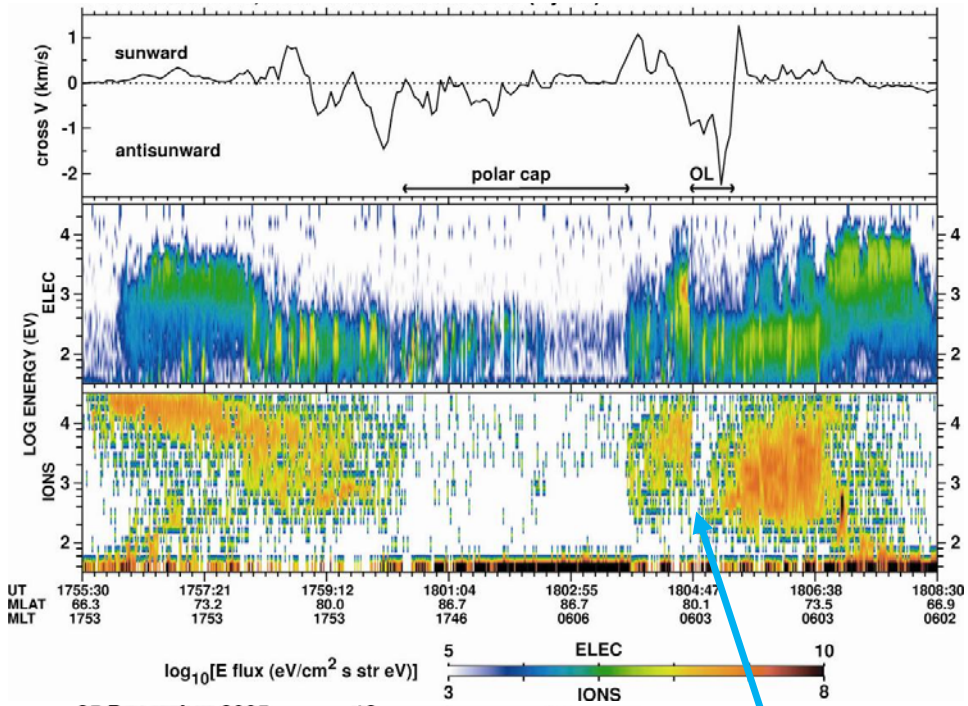


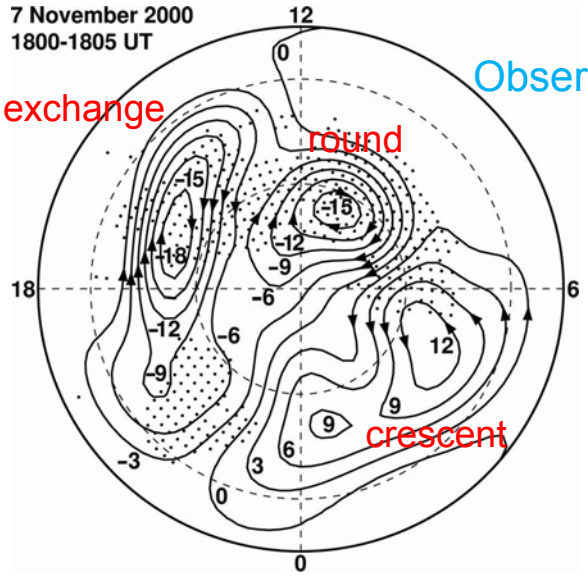
$B_y > 0$, South
$B_y < 0$, North

Grocott et al., 2005; Milan et al., 2005;
Fear and Milan, 2012

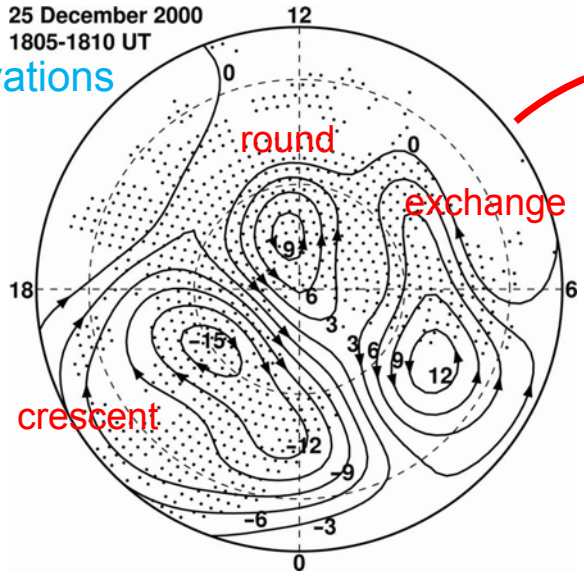
Exchange cells: An alternative

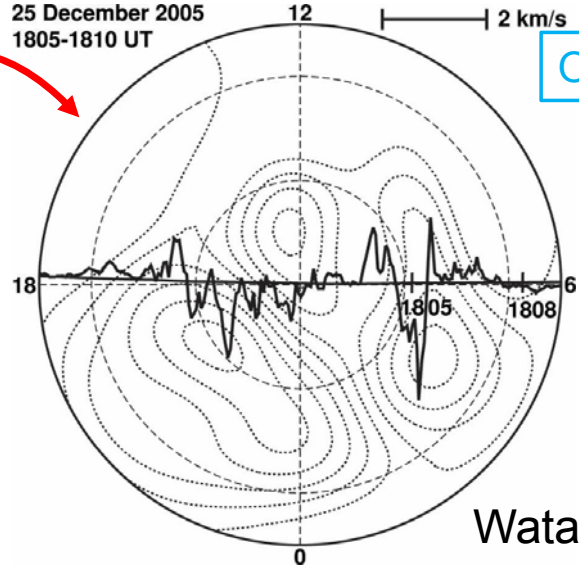






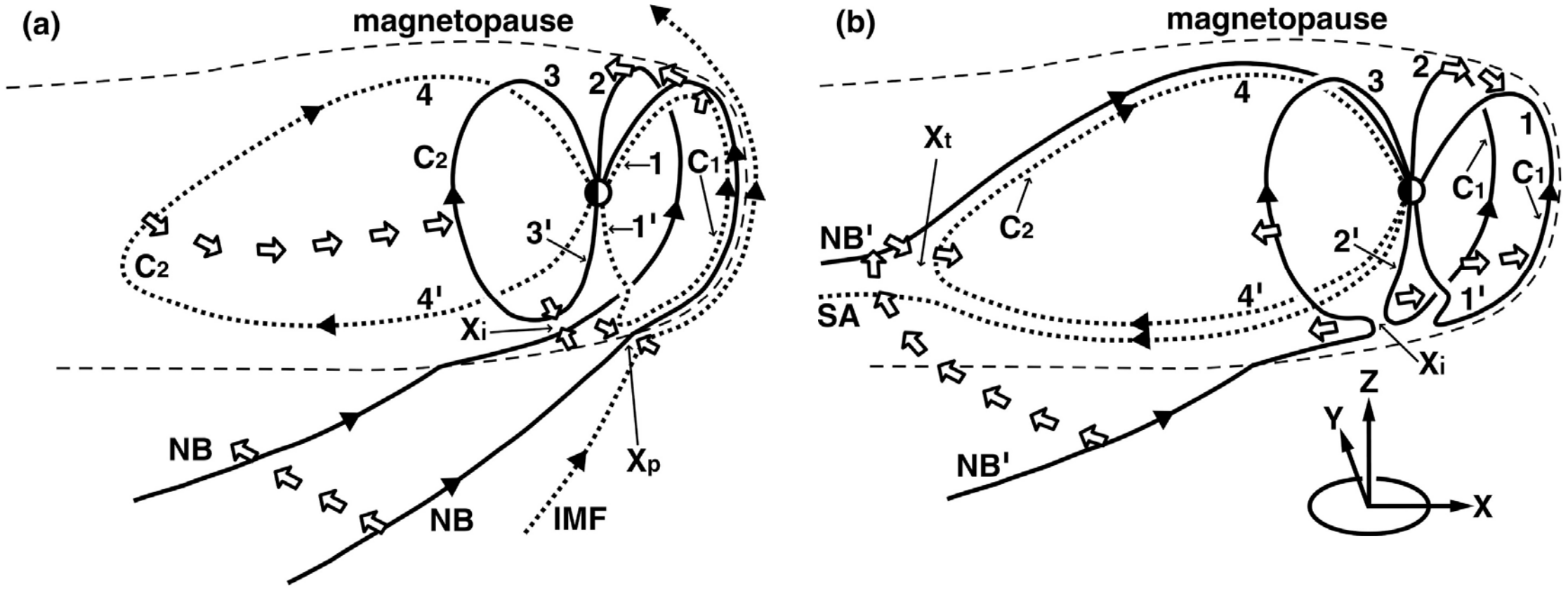
Observations



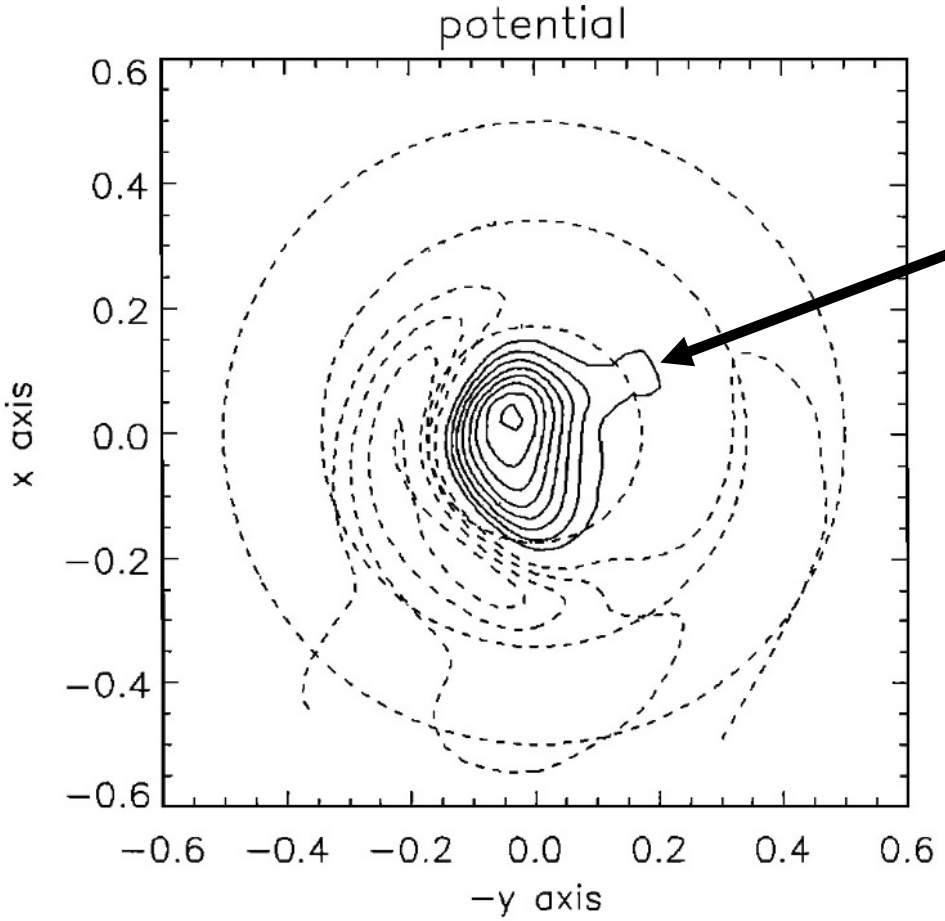


Watanabe et al., 2004

Overdraped lobe formation and subsequent lobe-closed reconnection



Early Tanaka code ($B_z > 0$, $B_y < 0$)



exchange cell

Figure 1. Ionospheric convection potential in the northern polar cap. Solid, dotted, and dashed contours show plus, zero, and minus potentials, and the contour spacing is 4 kV. The three circles show the north latitudes of 60°, 70°, and 80°.

Tanaka, 1999

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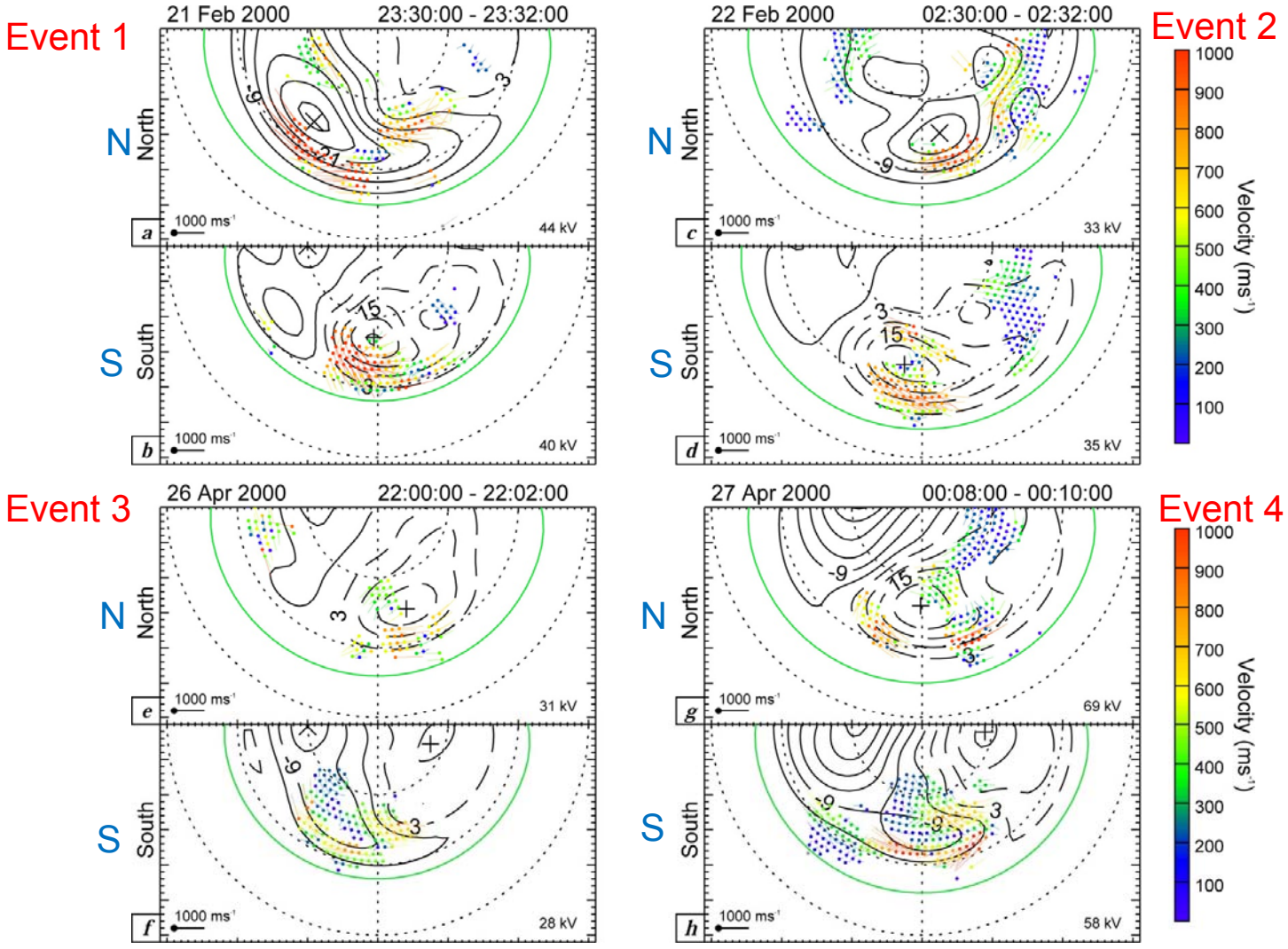
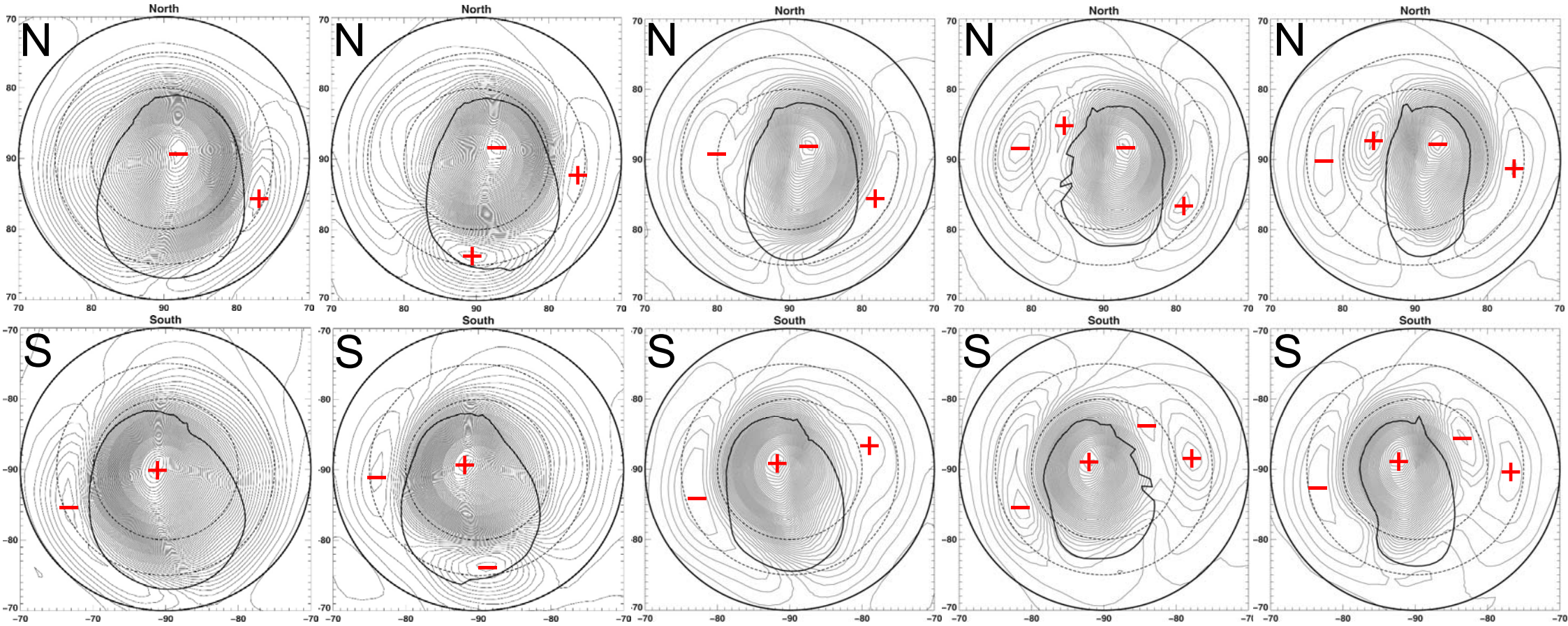


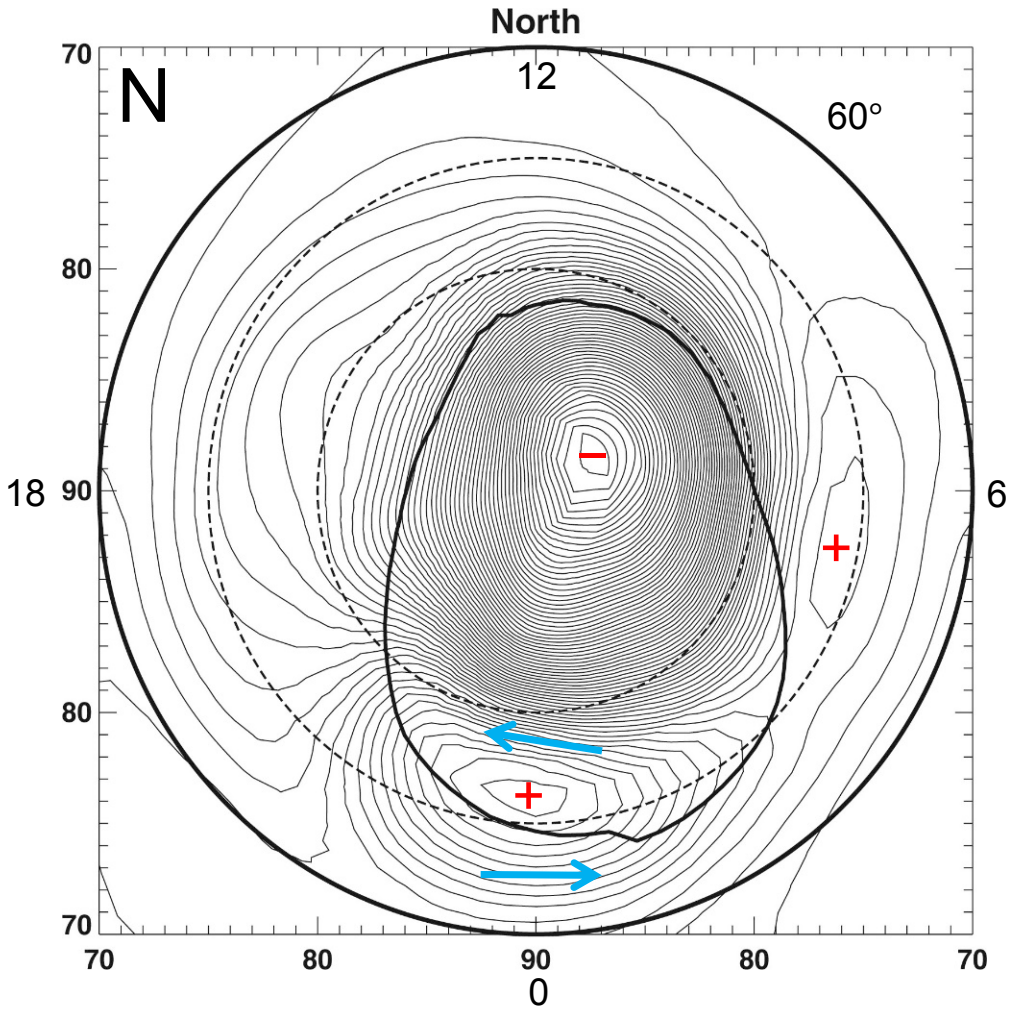
Simulated convection patterns for oblique northward IMF ($B_y > 0$)

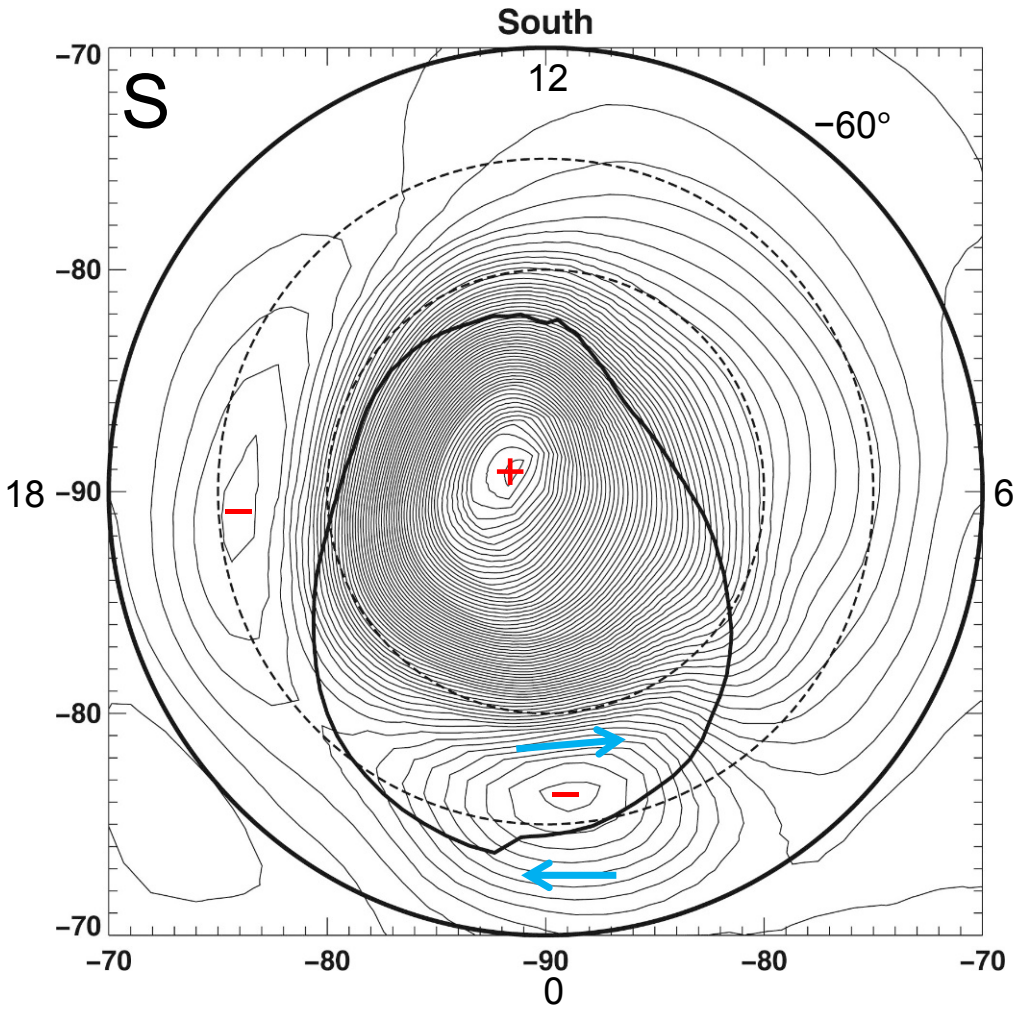
θ=40° θ=35° θ=30° θ=25° θ=20°



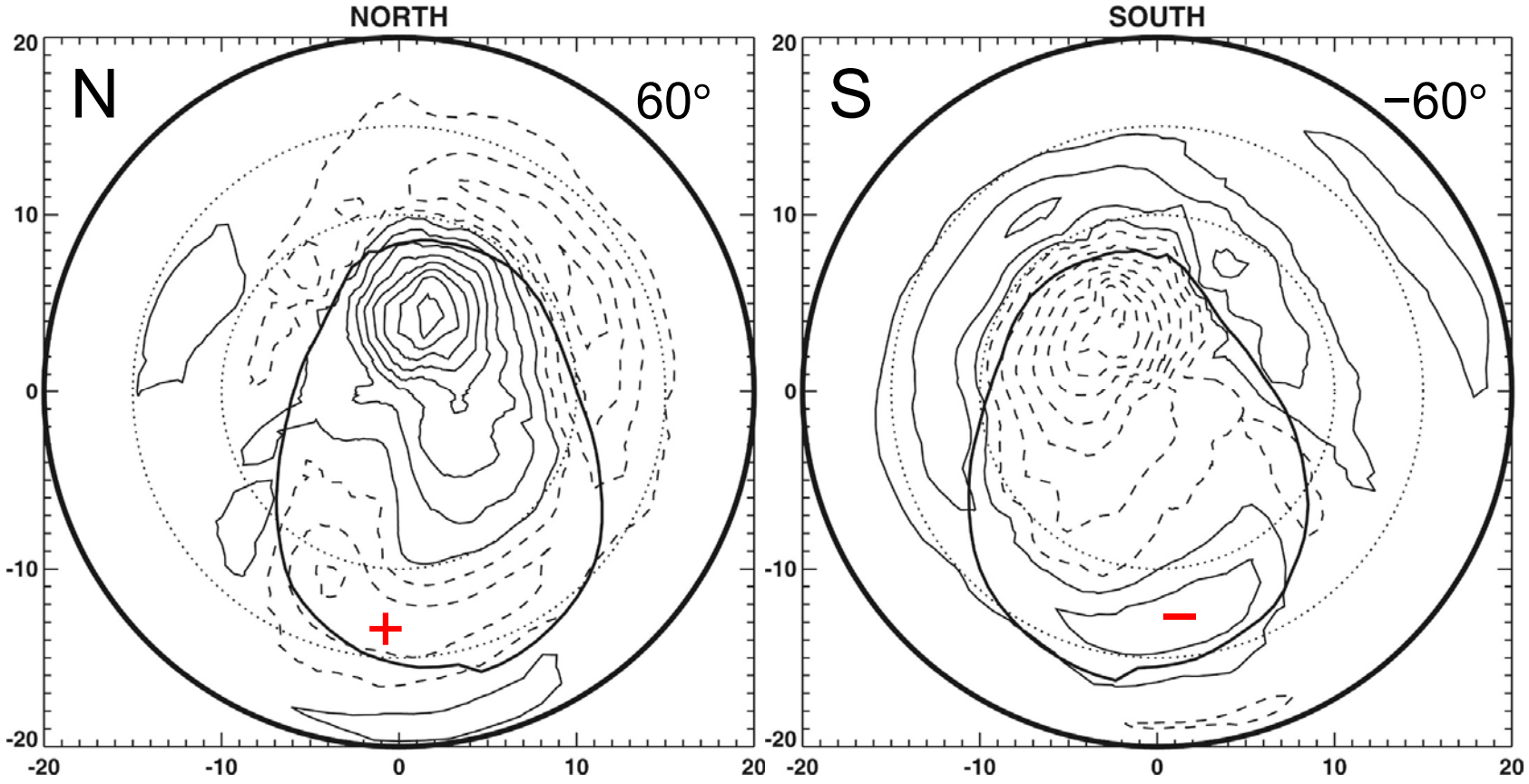
Early Tanaka code; $B_T=\sqrt{B_Y^2+B_Z^2}$=5 nT, V_{SW}=350km/s, N=5#/cc, T=50,000K

Potentials


North
N
12
60°
70
80
90
18
6
0
70
80
90
80
70

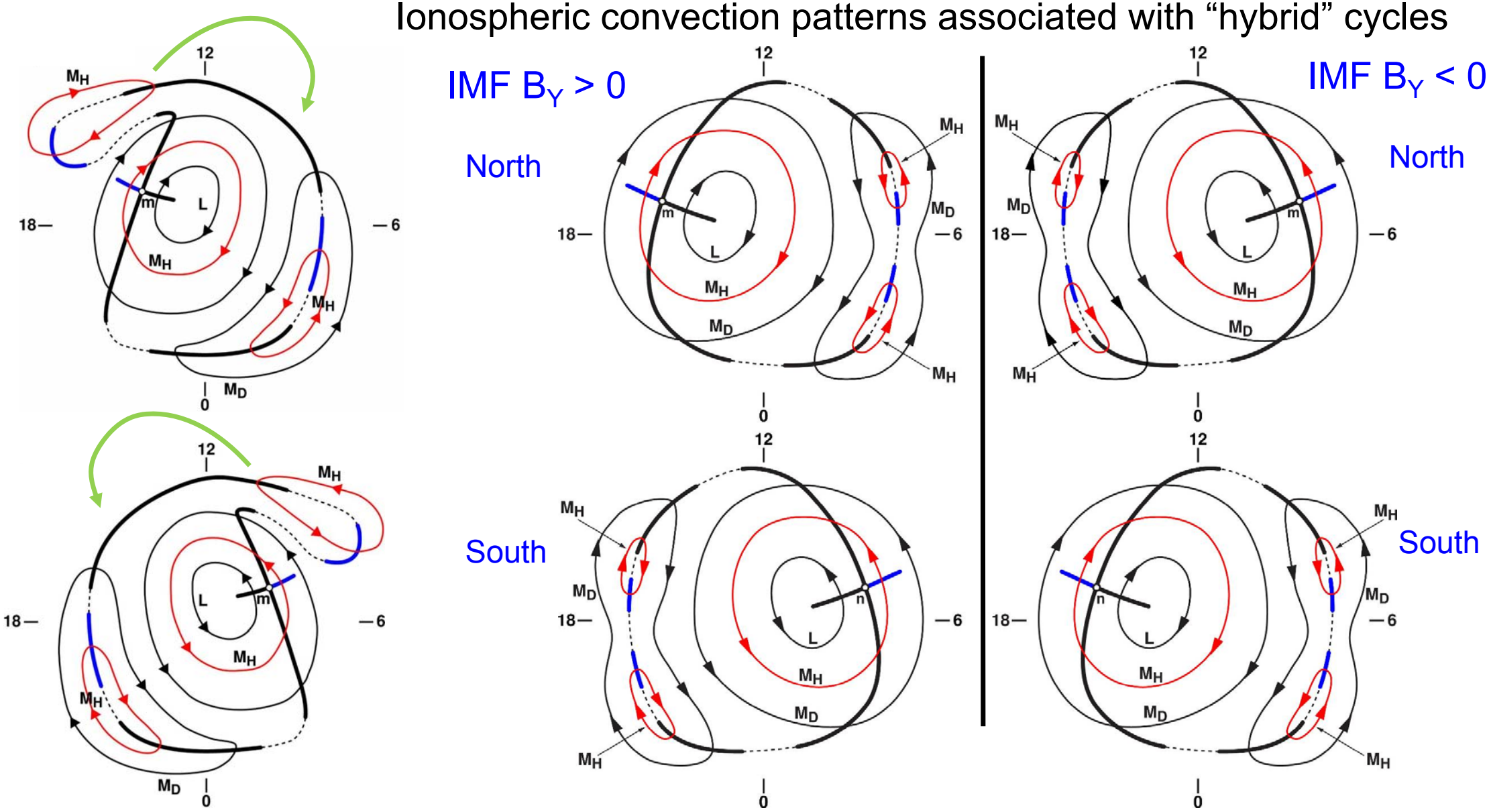

South
S
12
−60°
−70
−80
−90
18
6
0
−70
−80
−90
−80
−70

Field-aligned currents



solid: currents away from ionosphere
dashed: currents into ionosphere

Ionospheric convection patterns associated with “hybrid” cycles



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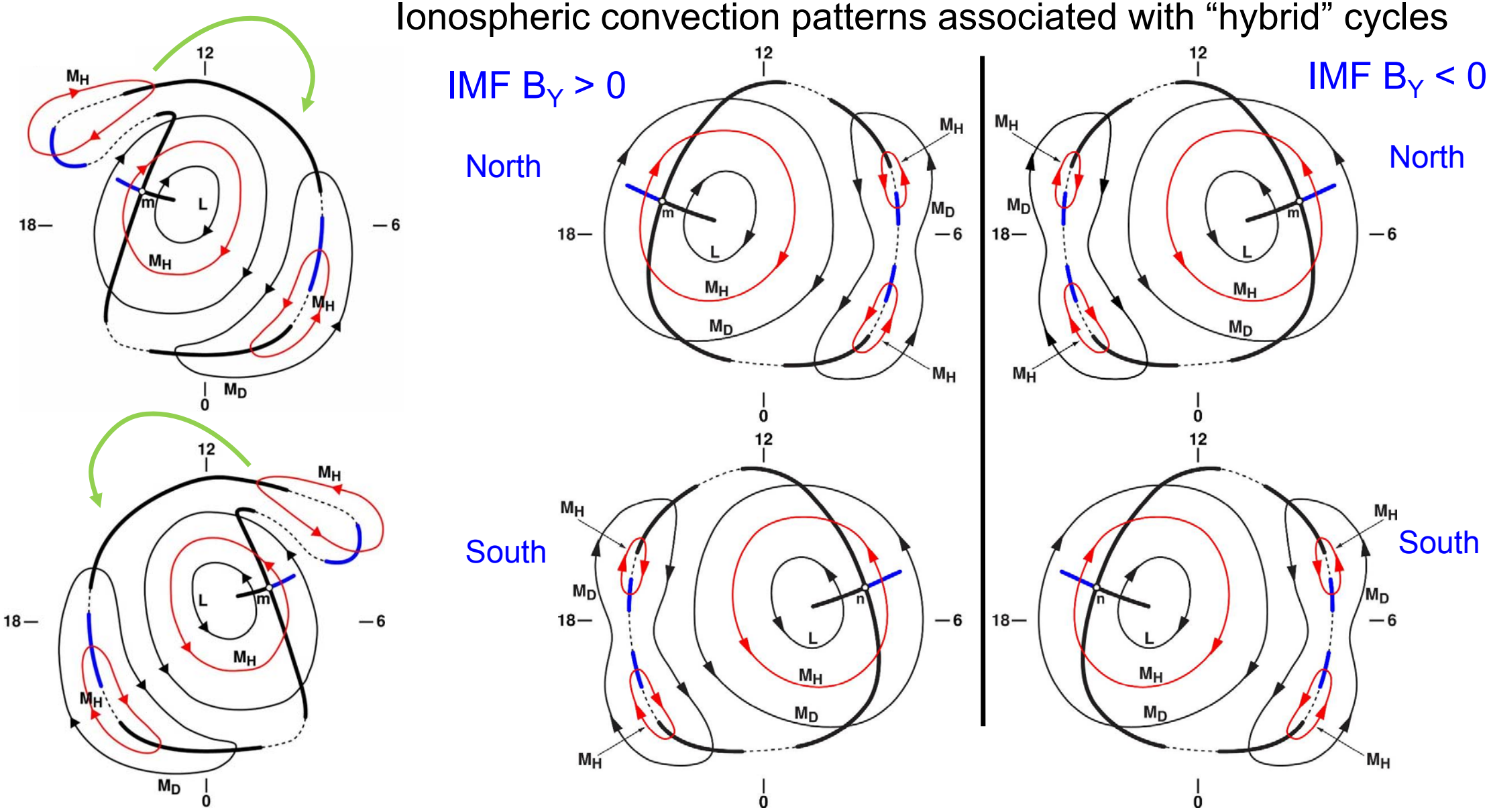
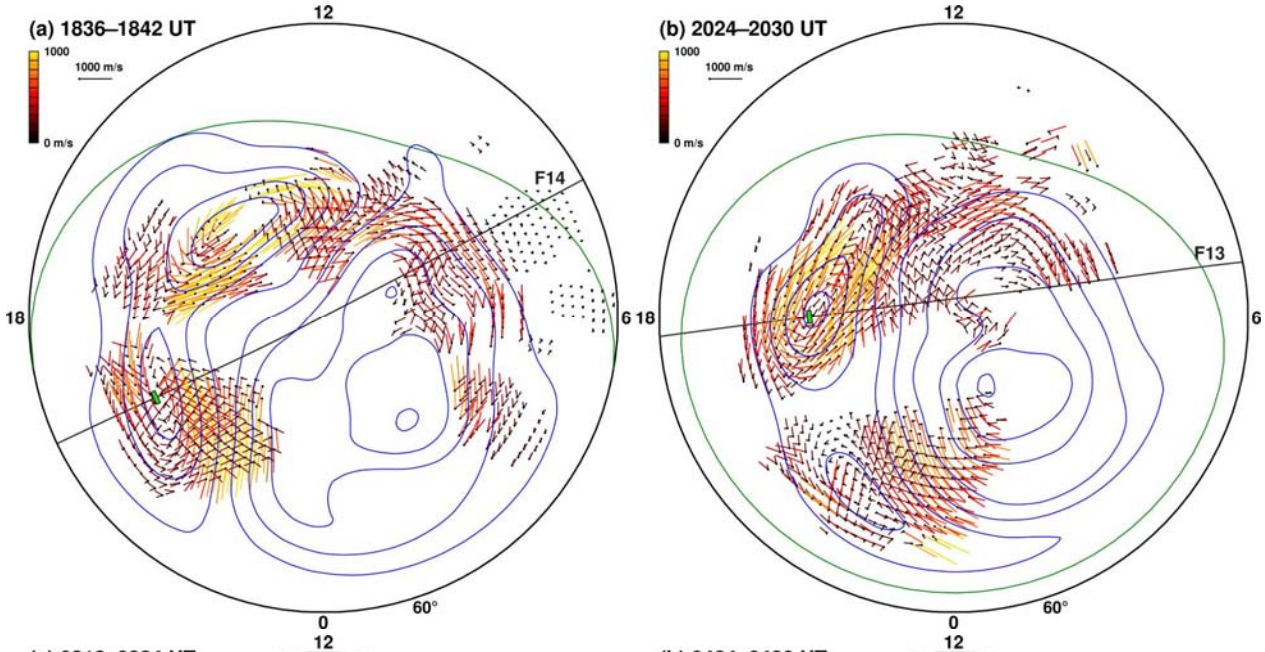


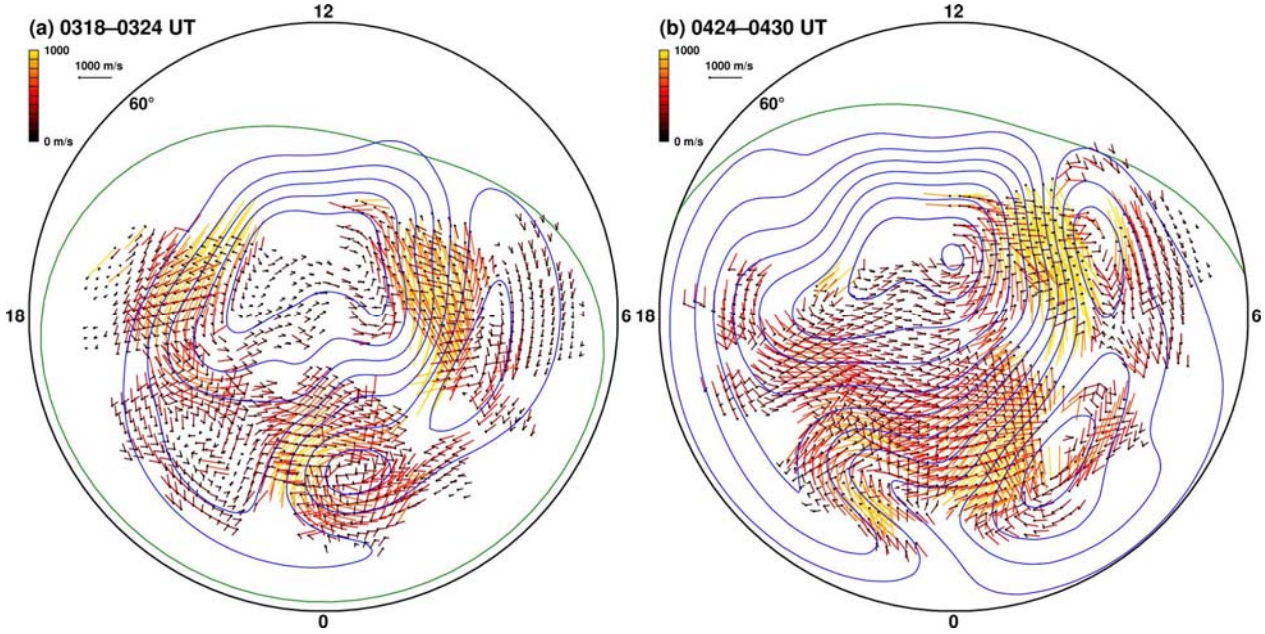
Split crescent cell observations ???

$B_y < 0$, north



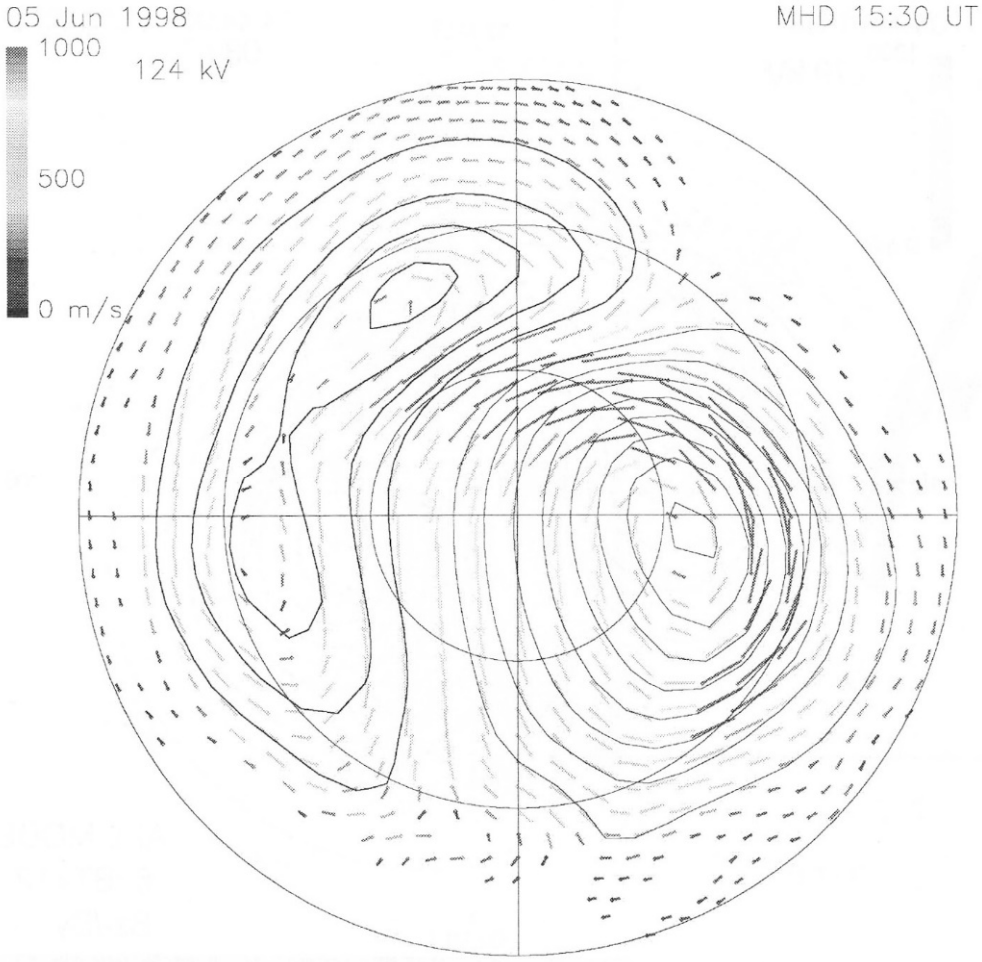
21 December 2002

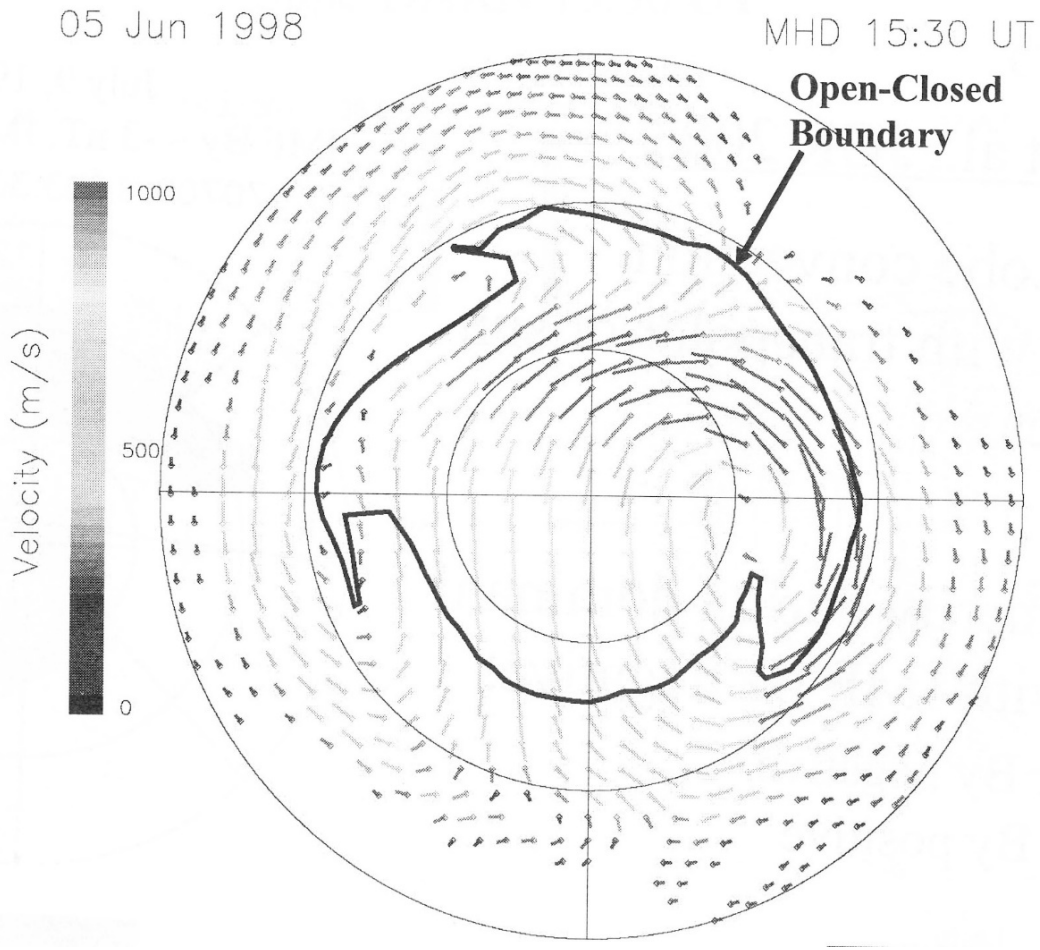
$B_y > 0$, north



16 November 2001

Lyon-Fedder code ($B_z < 0$, $B_y < 0$)





F. R. Fenrich et al., unpublished

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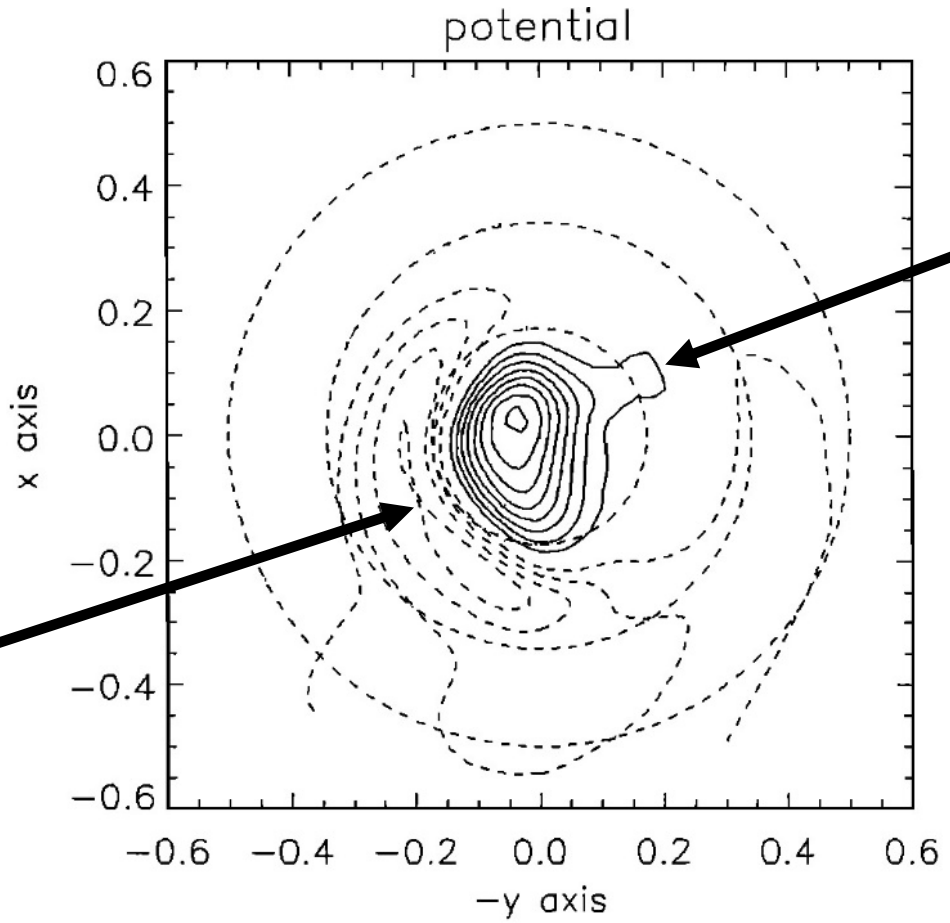

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