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Supplement of

Model representation of the coupling between evapotranspiration and soil water content at different depths

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Table S1  Complete NOAHMP configuration

| Physical Process                  | Available NOAH-MP Options                                                                 | Option Used Here                  |
|----------------------------------|------------------------------------------------------------------------------------------|-----------------------------------|
| Vegetation                       | · Prescribed LAI and shade fraction                                                       | Prescribed LAI and shade fraction |
|                                  | · LAI and shade fraction from dynamic carbon uptake and partitioning                       |                                   |
|                                  | · Shade fraction calculated from prescribed LAI                                           |                                   |
|                                  | · Prescribed LAI and constant shade fraction                                               |                                   |
| Stomatal resistance              | · Ball-Berry (Ball et al., 1987)                                                          | Ball-Berry                        |
|                                  | · Jarvis (Chen et al., 1996)                                                              |                                   |
| Soil moisture factor for stomatal | · Noah-type (based on soil moisture)                                                       | Noah-type                         |
| resistance                       | · CLM-type (based on stomatal resistance) (Oleson et al., 2010)                           |                                   |
|                                  | · SSiB-type (based on stomatal resistance) (Xue et al., 1991)                            |                                   |
| Runoff & groundwater             | · TOPMODEL with groundwater (Niu et al., 2007)                                            | TOPMODEL with groundwater         |
|                                  | · TOPMODEL with equilibrium water table (Niu et al., 2005)                               |                                   |
|                                  | · Infiltration-excess surface runoff and free drainage (Schaake et al., 1996)              |                                   |
|                                  | · BATS runoff and free drainage (Yang and Dickinson, 1996)                               |                                   |
| Surface layer drag coefficient   | · Monin-Obukhov                                                                           | Monin-Obukhov                     |
|                                  | · Noah-type (Chen et al., 1997)                                                           |                                   |
| Super-cooled liquid water        | · No iteration (Niu and Yang, 2006)                                                       | No iteration                      |
|                                  | · With iteration (Koren et al., 1999)                                                     |                                   |
| Frozen soil permeability         | · Linear: Hydraulic Properties from total soil moisture (Niu and Yang, 2006)             | Linear: Total soil moisture       |
|                                  | · Nonlinear: Hydraulic properties from liquid water only (Koren et al., 1999)              |                                   |
| Radiation transfer               | · Two-stream w/ 3D structure                                                               | Two-stream w/ 3D structure        |
|                                  | · Two-stream (Niu and Yang, 2004)                                                         |                                   |
|                                  | · Two-stream with canopy gap equal to 1-(shade fraction)                                   |                                   |
| Snow albedo                      | · BATS (snow age, grain size growth, impurity) (Yang et al., 1997)                        | CLASS                             |
|                                  | · CLASS (only snow age) (Verseghy, 1991)                                                  |                                   |
| Frozen/liquid partitioning       | · Jordan (1991)                                                                           | Jordan (1991)                     |
|                                  | · Offset threshold: \( T_{air} < T_{frz} + 2.2K \)                                      |                                   |
| Bottom soil temperature          | · Prescribed (8m) bottom temp                                                             | Prescribed (8m) bottom temp       |
|                                  | · Zero heat flux                                                                          |                                   |
| Soil temperature solution        | · Semi-implicit                                                                          | Semi-implicit                     |
|                                  | · Full implicit                                                                          |                                   |