# Magnetosphere-Ionosphere-Thermosphere coupling lectures

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| Date | Lecuturer | Topic(s) |
| 03.11.2021 | Claudia | Introduction to the scope of the lecture |
| 14.11.2021 | Claudia | Sun – Properties |
| 18.11.2021 | Dimitry | Basics of magnetohydrodynamics and solar wind / magnetosphere interaction (seminar talk Florian on Russel-McPherron effect) |
| 24.11.2021 | Claudia | Sun – Irradiance and indices |
| 29.11.2021 | Claudia | Sun - Solar Activity: flares, CME, MC, HSS, CIR, SEP |
| 08.12.2021 | Claudia | Thermosphere – Structure and composition, energy sources & sinks, Chapman function, Joule heating, … |
| 15.12.2021 | Claudia | Thermosphere – Dynamics: equations, circulation, waves (seminar talk Florian: Forbes+, 2014, doi: 10.1186/1880-5981-66-122; Helen on mesospause temperature residual circulation etc.), Variability: density, solar activity correlation |
| 05.01.2022 | Dimitry | Basics of plasma physics: characteristic plasma scales, single particle motion, plasma drifts (BT book Ch. 1.1 & Ch. 2) |
| 12.01.2021 | Dimitry | Ionosphere: ionization and recombination, photochemical equilibrium, ionospheric layers (Seminar talk Hanna: Correlation of ionosphere with 27 day solar rotation, Lee et al., 2012, doi:10.1016/j.jastp.2012.01.010) |
| 19.01.2022 | Dimitry | SW-MIT coupling at high latitudes: Dungey cycle, convection electric field, field-aligned currents |
| - | tbd | SW-MIT coupling: polar cap dependence on solar wind conditions, transfer functions, Aurora, Auroral EJ, |
| 26.01.2022 | Dimitry | Ionosphere: Collisions and conductivities (BT book Ch. 4) 🡪 Exercise task description |
| 02.02.2022 | Claudia | Ionosphere: ionization and recombination, photochemical equilibrium, ionospheric layers seminar talk Arthur: Dst, kp/ap, AE index, semiannual effect: Echer+ (2011,<https://doi.org/10.1016/j.jastp.2011.04.021>)) |
| 09.02.2022 | Dimitry | Exercise results discussion |
| 16.02.2022 | Dimitry | Finishing the exercise discussion |
| 23.02.2022 | Dimitry | Ionospheric currents and conductivities, auroral and equatorial electrojets |
| 02.03.2022 | Dimitry | E- and F-region dynamos in the equatorial ionosphere |
| 09.03.2022 | Claudia | Atmosphere-Ionosphere Coupling: Dynamical coupling (waves, chemical/ radiative coupling) |
| 16.03.2022 | Dimitry | Equatorial E-region dynamo, impact of atmospheric tides on the equatorial electrodynamics and plasma density, longitudinal 3-peak structure in the equatorial anomaly. Ref: Immel et al. 2006 article doi:10.1029/2006GL026161. |
| 30.03.2022 | Dimitry | Plasma in the magnetosphere: dipolar magnetic field and drifts, adiabatic invariants, origin of the ring current. B&T book, Ch.3 |
| 06.04.2022 | Claudia | Coupling from below Seminar talk Helen: Goncharenko+, 2010 paper on SSW, doi:10.1029/2010GL043125 |
| 13.04.2022 | Claudia | Geosphere storms – changes of convection and currents (Katja: Gonzalez et al paper review https://doi.org/10.1029/93JA02867) |
| 20.04.2022 | Dimitry | Auroral geomagnetic substorms and the origins of ionospheric particle precipitations, B&T book, Ch. 5 |
| 27.04.2022 | Dimitry | Storm/substorm connections and interplanetary origins of geomagnetic (HSS/CIR/CME-driven) storms. Samira: review of Borovsky and Denton (2006), Differences between CME-driven storms and CIR-driven storms doi:10.1029/2005JA011447 |
| TBD | Claudia | Thermosphere-Ionosphere storms |
| 04.05.2022 | PhDs | Paper presentations on storm conditions |

BT = Baumjohann & Treumann book "Basic Space Plasma Physics"

Textbooks (ionosphere and magentosphere):

* Baumjohann W., R. A. Treumann, Basic Space Plasma Physics, ISBN 978-1860940798
* Kelley, M. C., The Earth's Ionosphere: Plasma Physics and Electrodynamics, ISBN 978-0120884254
* Rishbeth, H., O. K. Garriott, Introduction to Ionospheric Physics, ISBN 978-0125889407

Textbooks (lower / middle atmosphere):

* Holton J. R., G. J. Hakim, An Introduction to Dynamic Meteorology, ISBN 978-0123848666.
* Andrews D. G., J. R. Holton, C. B. Leovy, Middle Atmosphere Dynamics, ISBN 978-0120585762.

Articles on Solar wind flow impact on geomagnetic and ionospheric activity:

1. Shock
   1. [Geomagnetic and ionospheric response to the interplanetary shock on January 24, 2012 | Earth, Planets and Space | Full Text (springeropen.com)](https://earth-planets-space.springeropen.com/articles/10.1186/s40623-017-0696-1)
   2. [Solar wind parameters and geomagnetic indices for four different interplanetary shock/ICME structures - Yue - 2011 - Journal of Geophysical Research: Space Physics - Wiley Online Library](https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2011JA017013)
   3. Jurac S, Kasper JC, Richardson JD, Lazarus AJ. Geomagnetic disturbances and their relationship to Interplanetary shock parameters. *Geophys Res Lett* (2002) 29:1463. doi:10.1029/2001GL014034
2. Sheath
   1. Echer E, Gonzalez WD, Tsurutani BT. Interplanetary conditions leading to superintense geomagnetic storms (Dst <= -250 nT) during solar cycle 23. *Geophys Res Lett* (2008) 35:L06S03. doi:10.1029/2007GL031755,
   2. Zhang J, Richardson IG, Webb DF, Gopalswamy N, Huttunen E, Kasper JC, et al. Solar and interplanetary sources of major geomagnetic storms (Dst <= -100 nT) during 1996-2005. *J Geophys Res Space Phys* (2007) 112:A10102. doi:10.1029/2007JA012321
3. CME
   1. Gonzalez, W. D., B. T. Tsurutani, A. L. Clúa de Gonzalez, Interplanetary origin of geomagnetic storms, *Space Science Reviews* (1999), 88, 529–562, doi: 10.1023/A:1005160129098
   2. Gonzalez, W. D., J. A. Joselyn, Y. Kamide, H. W. Kroehl, G. Rostoker, B. T. Tsurutani, V. M. Vasyliunas, What is a geomagnetic storm? *J Geophys Res Space Phys*(1994), doi:10.1029/93JA02867
4. Magnetic cloud
   1. [The Wind magnetic cloud and events of October 18–20, 1995: Interplanetary properties and as triggers for geomagnetic activity (wiley.com)](https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/97JA00272)
   2. Webb DF, Cliver EW, Crooker NU, Cry OCS, Thompson BJ. Relationship of halo coronal mass ejections, magnetic clouds, and magnetic storms. *J Geophys Res* (2000) 105:7491–508. doi:10.1029/1999JA000275
5. CIR and HSS
   1. Borovsky JE, Denton MH. Differences between CME-driven storms and CIR-driven storms. J Geophys Res Space Phys (2006) 111:A07S08. doi:10.1029/2005JA011447
   2. Tsurutani, B. T., et al. (2006), Corotating solar wind streams and recurrent geomagnetic activity: A review, J. Geophys. Res., 111, A07S01, doi:10.1029/2005JA011273
   3. Zhang J, Richardson IG, Webb DF. Interplanetary origin of multiple-dip geomagnetic storms. J Geophys Res Space Phys (2008) 113:A00A12. doi:10.1029/2008JA013228