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The Earth's ionosphere is becoming more relevant to human society with its reliance on modern technology, since the accuracy of positioning and navigation, and quality of telecommunication are influenced by ionospheric weather conditions from space, Earth's atmosphere, and lithosphere. Recently Taiwan launched 6 micro satellites of FORMOSAT-3/COSMIC (F3/C) in 2006 and is going to place 12 small satellites of FORMOSAT-7/COSMIC-2 (F7/C2) in 2018 and 2019. These for the first time provide a good chance to uniformly, timely, and globally observe the ionospheric three-dimensional (3D) electron density structure from 100 to 800 km altitude. Based on F3/C and F7/C2 radio occultation (RO) observations, and ground-based receiver measurements of International GNSS (global navigation satellite system) Service (IGS), this project shall construct three, monitoring (near real-time), nowcast (few minutes to hours), and forecast (few hours to days), models, as well as a global ionospheric S4 index scintillation model for studying the ionospheric weather, which results from the space weather (solar disturbances, solar winds, magnetic storms, etc.); the atmospheric severe weathers (typhoons, fronts, volcano eruptions, etc.); and the lithosphere weather (earthquakes, tsunami, etc.). The monitoring model is for the first time combining the total electron content (TEC) and the GNSS satellite signal scintillations of F3/C, F7/C2, and IGS observations to construct an advanced GIM (global ionospheric map) to report the ionospheric bias and/or effects on the communication, positioning, and navigation. Since the advanced GIM routinely publishes the global TEC in real time, it can be used to detect seismo-ionospheric precursors at a certain place and also assess possible locations of forthcoming large earthquakes. However, the ionosphere is very dynamic, which can be easily disturbed by solar radiations, magnetic storms, etc. and therefore a nowcast model would be required. The nowcast model is a global 3D ionospheric data assimilation model based on the Gauss-Markov Kalman filter with an existing background model to assimilate the TEC observations from the ground-based IGS receivers and space-based F3/C and/or F7/C2 to output the global electron density for coming few minutes to hours. On the other hand, to carry out a long-term forecast, the neutral compositions in the atmosphere should be taken into consideration. Therefore, to develop a forecast model assimilating the observations of F3/C and F7/C2 as well as IGS ground-based receivers into a neutral-ion coupled model. The developed nowcast and forecast
models shall allow scientists to investigate the 3D electron density structure and related electrodynamics associated with the long-term trends of diurnal, seasonal, solar activity, and geographical location variations, especially in regions of the equatorial ionization anomaly, middle latitude trough, and polar ionosphere, and even the transit signatures of the solar-ionosphere (solar flare, solar wind, corona mass ejection, solar eclipse), magnetosphere-ionosphere (magnetic storm), atmosphere-ionosphere (sudden stratosphere warming, El Nino-Southern Oscillation), lithosphere-atmosphere- ionosphere (volcano eruption, earthquake, tsunami, seismo-ionospheric precursor) couplings. Finally, the space-based F3/C and/or F7/C2 and ground-based IGS observations, and the developed models will be employed to study the ionospheric plasma physics and explore new sciences and findings; evaluate the quality of the communication, positioning, and navigation; as well as assess the hazard of forthcoming large earthquakes and tsunami waves.
OSTS session
Regional and Global CAL/VAL for Assembling a Climate Data Record