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Connections between Mediterranean Storms and Tropical Convective Activity

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The current understanding of the energy-water cycle of the tropical atmosphere has been summed up by Professor William Gray of CSU as "up moist-down-dry", in reference to convective plumes transferring latent heat into the atmosphere in compensation for large scale subsidence which is in turn driven by radiative cooling to space. However, a seminal paper by Johnson (1989) used FIGGE data to demonstrate that the tropical energy – water cycle viewed on isentropic surfaces looks much different revealing a necessary interaction with extra-tropical overturning in order to resolve large accumulations of energy at high altitudes associated with tropical convection. Recent investigations by Tripoli (2011, Cyclone Workshop) have presented empirical evidence supported by modeling studies that reveal a process of internal energetic conversions within tropical cyclones that result in high altitude energy accumulations similar to those discussed by Johnson. Further investigation of the downstream impacts of this process by Tripoli, revealed that in the case of some tropical cyclones (in the Pacific and Caribbean) this accumulation of energy was resolved within days or weeks by the direct interaction of the tropical outflow with extra-tropical overturning, fueled by this energy. These interactions took different extra-tropical forms, but consistently involved the formation of a very deep subtropical tropopause fold that became associated with a "super jet stream". This jet-stream-fold would then drive an anomalously strong quasi-geostrophic response.

A recent study by Tripoli et al. (2005) showed that the 2000 Algerian flood was linked to a strong PV anomaly that moved into Northern Africa and the Southern Mediterranean from the Atlantic. An independent investigation of another anomalously strong storm striking Iceland two days prior (Shapiro, personal communication) was also associated with a strong "Rossby wave train", but one that Shapiro felt seemed to have an origin related to a tropical cyclone several days prior. In light of the recent energetics investigations of Tripoli, we propose a new hypothesis: Both of these extratropical storms, were fueled off of a single plume of energy released by an Atlantic tropical cyclone several days earlier, through a process analogous to the recent investigations of Tripoli in the Pacific basin.

For the oral presentation, new modeling investigations similar to the studies performed recently by Tripoli will be presented that investigate this hypothesis. In a separate Plinius 13 paper, presented by Smith et al., evidence will be presented that many, perhaps a majority of the strong Fall season Mediterranean storms can be linked to tropical cyclones in the Atlantic several days or weeks earlier. Implications of these results will be discussed.